SECTION 220000

BASIC PLUMBING SYSTEM REQUIREMENTS

PART 1 - GENERAL

1.00 Refer to Section 23 00 00 - Basic Mechanical Requirements. Comply with that Section, written for the intent of governing all of Division 22 work also, as applicable.
SECTION 221123
PLUMBING EQUIPMENT

PART 1 GENERAL

1.00 The following sections are to be included as if written herein:

   A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.

   B. Section 23 00 00 - Basic Mechanical Requirements

   C. Section 23 05 29 - Sleeves, Flashings, Supports and Anchors

   D. Section 23 05 53 - Mechanical Identification

1.01 SECTION INCLUDES

   A. Water Heaters

   B. Packaged Water Heating Systems

   C. Not Used

   D. Not Used

   E. Domestic Hot Water Circulating Pumps

   F. Thermostatic Mixing Valve

   G. Domestic Water Pressure Booster System

1.02 Not Used

1.03 Not Used

1.04 RELATED SECTIONS

   A. Section 23 05 48 - Vibration Isolation

   B. Section 26 05 19 - Cable, Wire and Connectors, 600 Volt: Electrical characteristics, cable, wire, materials

   C. Section 26 27 26 - Wiring Devices and Floor Boxes: Wiring connections

1.05 REFERENCES

   A. ANSI/ASHRAE 90A - Energy Conservation in New Building Design

   B. ASME Section VIIIID - Pressure Vessels; Boiler and Pressure Vessel Codes
C. ANSI/NFPA 30 - Flammable and Combustible Liquids Code
D. ANSI/NFPA 54 - National Fuel Gas Code
E. ANSI/NFPA 58 - Storage and Handling of Liquefied Petroleum Gases
F. ANSI/NFPA 70 - National Electrical Code
G. ANSI/UL 1453 - Electric Booster and Commercial Storage Tank Water Heaters
H. ANSI/UL 174 - Household Electric Storage Tank Water Heaters
I. ANSI/NEMA 250 - Enclosure for Electrical Equipment (1000 Volts Maximum)

1.06 SUBMITTALS

A. Submit under provisions of Section 23 00 00.
B. Not Used.
C. Product Data:
   1. Include dimension drawings of all equipment including water heaters, water pressure booster package, pumps, mixing valves, etc. indicating components and connections to other equipment and piping.
   2. Indicate pump type, capacity, power requirements, and affected adjacent construction.
   3. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
   4. Provide electrical characteristics and connection requirements.
D. Manufacturer's Installation Instructions.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 00 00.
B. Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.

1.08 QUALITY ASSURANCE

A. Perform Work in accordance with Department of State Health Services standards.
B. Provide pumps with manufacturer's name, model number, and rating/capacity identified.
C. Ensure products and installation of specified products are in conformance with recommendations and requirements of the following organizations:
   1. American Gas Association (AGA).
2. National Sanitation Foundation (NSF).
3. American Society of Mechanical Engineers (ASME).
4. National Board of Boiler and Pressure Vessel Inspectors (NBBPVI).
6. Underwriters Laboratories (UL).

D. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 10 percent of midpoint of published maximum efficiency curve.

1.09 REGULATORY REQUIREMENTS
A. Conform to AGA, NSF, ANSI/NFPA 54, ANSI/NFPA 58, ANSI/NFPA 70, ANSI/UL 174, and ANSI/UL 1453, as appropriate, requirements for water heaters.
B. Conform to ASME Section VIIID for manufacture of pressure vessels for heat exchangers.
C. Conform to ASME Section VIIID, ANSI/NFPA 30, or ANSI/NFPA 31 for tanks.

1.10 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
B. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.11 WARRANTY
A. Provide five-year warranty under provisions of Section 23 00 00.
B. Warranty: Include coverage of domestic water heaters, in-line circulator, domestic water pressure booster system, thermostatic mixing valve.

PART 2 - PRODUCTS

2.03 DOMESTIC HOT WATER CIRCULATING PUMPS:
A. These pumps shall be Grundfos (magnetic coupled), Bell and Gossett, or approved equal, having a circulating capacity as shown on the Drawings. Pumps shall be all bronze construction. Furnish for the control of each pump an Allen Bradley Bulletin 600 Toggle Switch with thermal overload protection and pilot light.

2.05. CENTRAL DOMESTIC WATER HEATERS: GAS-FIRED POWER BURNER - CONDENSING
A. Domestic water heater(s) shall be similar and equal to that scheduled on the drawings. The heating section of the water heater shall be a single module gas heat exchanger capable of the scheduled recovery capacity with natural gas fuel. Heater shall be U.L. listed.

B. Heating Section: The entire heating section and all heating surfaces shall be completely surrounded by water shall have continuous spiral fire tube, shall have a ceramic coating or glass-lined on the water side and an acid resistant glass liner on the flue side or shall be constructed of 90/10 cupronickel and shall have a guaranteed start-up thermal efficiency of 94%. Start-up shall be performed by an authorized start-up agency of the manufacturer. Maximum flue gas temperature shall be 140 degrees F.

C. Tank: Shall be constructed in accordance with ASME Code Section IV and stamped with the appropriate symbol for 125 psi working pressure. The tank shall be completely lined with a nonferrous, corrosion-resistant protective barrier or shall be constructed of 316L stainless steel.

D. Controls: Microprocessor based electronic flame monitoring system with electrically operated thermostat, automatic reset temperature limiting device, electrically operated main gas valve, pressure regulator, manual gas shutoff valve, automatic pilot ignition, monitoring of both pilot and main burner flame, with shutdown of pilot and main burner gas supply within 2-4 seconds if loss of pilot should occur. Digital display panel shall show operating mode, all user settings and any failure modes. Controls shall be capable of maintaining supply temperature to within +/- 5 degrees F of setpoint.

1. Provide 140°F setpoint
2. Not used.

E. Other equipment: The tank shall be insulated with thick foam insulation and trimmed with a baked enamel steel or plastic jacket. The water heater shall also be installed with: ASME rated temperature and pressure relief valve; all brass drain valve; temperature and pressure gauges; and temperature controls.

F. Heater shall be provided with mufflers (if required) to provide a maximum of 58 dbA at a point 10 feet from exhaust terminal and intake terminal. Noise levels shall be indicated on submittal.

G. The heater shall be listed by SCAQMD rule 1146.2 Low NOx.

H. Warranty: Refer to Paragraph 1.11.

I. Water heater flue and combustion air duct shall be Schedule 40 CPVC unless otherwise noted. Provide separate flue, and combustion air duct through roof for each heater or to manufacturer's concentric terminal units (intake and exhaust). Flue and duct shall include appropriate fittings, roof penetration, flashing and drip ring, termination as recommended by manufacturer.

J. The entire water heater equipment package shall be the responsibility of the manufacturer.

2.06 THERMOSTATIC MIXING VALVE

A. Approved Manufacturers

1. Armstrong International “RADA”

2. Substitutions: Under provisions of Section 230000 - General Requirements for Mechanical Work

B. Valve Construction and Operation

1. Master water mixing valve for tempered water control shall be of the thermostatic type with dual thermostatic elements. It shall have bronze body construction with replaceable non-corrosive components. Valve shall be hydrostatically tested to 300 p.s.i. (150 p.s.i. maximum operating pressure).

2. The thermostatic mixing valve shall include a thermostatically controlled return temperature limiter that eliminates temperature creep during both peak and zero demand operation.

3. The thermostatic mixing valves shall come equipped with union end stop and check inlets with removable stainless steel strainers. The valve shall control temperature from a low flow of 0 gpm up to a maximum as indicated in “Thermostatic Mixing Valve Schedule” on plans.

4. The valve shall provide three-way protection from scalding upon:

   a. failure of the thermostat,

   b. shut off of hot water, or

   c. shut off of cold water.

   The valve must meet ASSE 1017 requirements.

C. Manufacturer shall review the project and approve application, sizing, and piping schematic. **Submit statement from manufacturer stating such, or, if applicable, revised sizing and/or piping schematic for review by Architect/Engineer.** (In that latter case, proposals shall be based on the selected valve and piping as scheduled/specified in the Construction Documents.)

2.07 DOMESTIC WATER BOOSTER PUMP

A. General: Provide and install a packaged triplex booster pump system with capacity and head as shown on the drawings. System shall be complete with pumps, ODP non-overloading high efficiency, variable speed (Gould E+ or equal) motors, combination pressure regulating/non-slam check valves, isolation valves, controls, safeties, piping, etc. Entire system shall be factory tested for complete and proper operation prior to shipment. Test report shall be submitted to the Contractor and/or Architect/Engineer to document testing was performed and results were satisfactory.
B. Pumps: Pumps shall be centrifugal single stage, all bronze, with mechanical seal. Pumps shall be end suction close coupled. Pumps shall be selected for operation near the midpoint of their respective performance curves with efficiency not less than 55%. Each pump shall be selected for 50% of total system capacity. The system shall have 150% of total capacity (N+1) configuration.

C. Sequence of Operation: Lead pump capacity shall be selected for 50% of total system capacity, the Lag pump shall be sized for 50% of total system capacity. As demand exceeds 50% demand, one of the other pumps shall come online to help satisfy the demand. Both pumps shall operate together to supply 50-100% system flow. The third pump shall be on stand-by. If one of the Lead -Lag pumps fail during the above sequence then stand-by pump shall became the Lag pump and come online to help satisfy the system demand. The system controls shall alternate pumps to be Lead, Lag and Standby Designation.

D. All piping and manifolds shall be 304L Series stainless steel.

E. Controls: Pump sequencing shall be controlled by a single direct flow sensing device in a common housing, including sequencing switches. Submittals shall describe the cycling control and set points. The system shall include a U.L. labeled control panel in a NEMA 1 enclosure, and including the following:

1. No flow shutdown with alarm light and manual reset.
2. Lead, Lag or Stand-by pump failure alarm and protection.
3. Low suction pressure alarm with light and manual reset. 60 psig set point (adjustable).
4. High suction pressure shutdown to allow pump to shut down when City pressure is sufficient without boosting. Provide with indicator light and manual reset. Set point 150 psig (adjustable).
5. High discharge pressure shut down with alarm light and manual reset.
6. 24 hour auto alternation of (3) equal size pumps.
7. Externally operable disconnect switches, circuit breakers, control transformer, HOA switches and run lights, magnetic starters with externally resettable overload relays, common audible alarm with silence button.
8. All necessary safeties, including but not limited to: pressure/temperature relief to protect against no flow conditions with pump(s) running; pressure relief of discharge manifold to protect against excessive delivery pressures (160 psig, adjustable), with flow switch in relief valve discharge which shuts pump(s) down.
9. Contacts for remote connections to Building Automation/Control System for the following conditions: common alarm (single contact that annunciates any alarm condition); common shutdown (single contact that annunciates any shutdown condition).
F. Variable Frequency drives: Similar to ABB ACH550, NEMA 1, mounted and wired on skid.

G. Provide one 132 gallon bladder type hydropneumatic pressure tanks (ASME rated at 150 PSI).

H. Provide Control Panel with Individual fused disconnect with external Handle, Programmable logic controller and Pump Minimum run timers.

I. Approved Manufacturers

1. Canariis
2. Paco
3. Armstrong

PART 3 - EXECUTION

3.01 NOT USED

3.02 NOT USED

3.03 NOT USED

3.04 NOT USED

3.05 FACTORY START-UP (Performed by manufacturer authorized vendor)

A. Water Heater

1. Include performance tests of thermal efficiency and flue gas analysis. Provide written report to Architect/Engineer/Commissioning agent and include in Records for Owner.

B. Domestic Water Booster

1. Manufacturers start up procedure, including pressure deferential check, lead lag operation. Provide written report to Architect/Engineer/Commissioning agent and include in Records for Owner.
SECTION 221316
PLUMBING PIPING

PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:
   A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.
   B. Section 23 00 00 - Basic Mechanical Requirements
   C. Section 23 05 29 - Sleeves, Flashings, Supports and Anchors
   D. Section 23 05 53 - Mechanical Identification

1.01 SECTION INCLUDES
   A. Pipe and Pipe Fittings
   B. Valves

1.02 RELATED SECTIONS
   A. Section 31 00 00 - Earthwork
   B. Section 31 21 00 - Earthwork Beneath Building
   C. Section 31 23 00.0020 - Excavation and Fill
   D. Section 08 31 13 - Access Doors
   E. Section 09 91 13 - Exterior Painting
   F. Section 09 91 23 - Interior Painting
   G. Section 23 20 00.A - Piping, Valves and Fittings
   H. Section 23 05 16 - Expansion Compensation
   I. Section 23 05 48 - Vibration Isolation
   J. Section 23 07 19 - Piping Insulation
   K. Section 22 13 16.A - Plumbing Specialties
   L. Section 22 40 00 - Plumbing Fixtures
   M. Section 22 11 23 - Plumbing Equipment
1.03 REFERENCES
A. See Section 23 20 00

1.04 SUBMITTALS
A. Submit under provisions of Section 23 00 00.
B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.05 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 23 00 00.
B. Record actual locations of valves, etc., and prepare valve charts.

1.06 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 23 00 00.
B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.07 QUALITY ASSURANCE
A. See Section 23 20 00.A

1.08 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing the work of this section with minimum of three years documented experience.

1.09 REGULATORY REQUIREMENTS
A. Perform Work in accordance with International Plumbing Code, 2006 edition the City of San Antonio, Texas water system (SAWS) and the Texas Commission on Environmental Quality (TCEQ).
B. Conform to applicable codes for installation of backflow prevention devices.

1.10 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
B. Accept valves on site in shipping containers with labeling in place. Inspect for damage.
C. Provide temporary protective coating on cast iron and steel valves.
D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.11 ENVIRONMENTAL REQUIREMENTS
A. Do not install underground piping when bedding is wet or frozen.

1.12 EXTRA MATERIALS
A. Furnish under provisions of Section 23 00 00.
B. Provide two repacking kits for each size valve.

PART 2 - PRODUCTS

2.01 WALL, FLOOR AND CEILING PLATES:
See Section 23 05 29.

2.02 SLEEVES, INSERTS, AND FASTENINGS:
See Section 23 05 29.

2.03 VALVES:
A. See Section 23 20 00.A

2.04 UNIONS:
A. See Section 23 20 00.A.
B. Unions connecting ferrous pipe to copper or brass pipe shall be dielectric type equal to Epco.
C. In all domestic water lines where the material of the pipe is changed from ferrous to copper or brass, a dielectric coupling shall be used at the transition.

2.05 FLANGES:
A. See Section 23 20 00.A.

2.06 Not Used

2.08 SANITARY DRAINAGE SYSTEM:
A. The sanitary drainage system shall be installed as indicated on the Drawings complete with all fixtures, drains, traps and required connections. All fixtures and drains shall be properly vented and trapped. The Contractor shall complete the installation of the sanitary drainage system by making approved connections as indicated on the Drawings.

B. Materials and installation of the system shall be as specified in the following paragraphs and Section 23 20 00.A.
C. PIPE AND FITTINGS:

1. All pipe used for interior, above ground sewer and drainage purposes, unless specifically shown to the contrary, shall be service weight cast iron soil pipe.

2. Galvanized or black steel pipe shall not be used in any waste connection to a fixture or in any section of the soil or waste piping system.

3. All underground sanitary waste piping, of all sizes, shall be cast iron hub and spigot type, with Tyseal (or approved equal) neoprene gaskets. Hubless piping systems shall not be used in a directly buried, underground application.

D. INSTALLATION OF PIPING:

1. All piping shall be run in the most direct manner. Horizontal pipes less than 3” shall have a grade of one-quarter inch (1/4”) per foot. Horizontal pipes 3” and larger shall have a grade of one-eighth inch (1/8”) per foot, unless otherwise noted on Drawings.

2. Cleanouts shall be provided at the bottom of each riser, at each change of direction exceeding 45° and at intervals not exceeding 95 feet in horizontal runs. Interior cleanouts shall be brass caulked into the lines, and where they occur in walls or floors of finished areas, shall be provided with nickel-bronze tops or access plates. All interior cleanouts shall be of the same size as the pipe served up to four inch (4”) size and four inches (4”) for all larger lines.

3. Exterior cleanouts shall consist of a concrete encased wye in the line with sewer pipe extending upward therefrom and terminating in a concrete slab below grade. A standard cast iron cleanout casting shall be set on this slab in such manner as to be flush with finished grade and to provide access through its cover to the cleanout.

E. FLASHINGS:

1. All vent pipes passing through the roof shall be provided with roof flashings per Section 23 05 29.

F. TESTING:

1. After the vertical lines of soil pipe, waste, and other parts of the sanitary system have been set from the basement to the top of the building, all outlets shall be temporarily "plugged up", except as are required for testing as described herein. One floor level of the building shall be tested at a time. Each floor shall be tested from a level below the structure of the floor, or the outlet of the building in the case of the lowest level, to a level of 12 inches above the floor immediately above the floor being tested, or the top of the highest vent in the case of the highest building level. The pipes for the level being tested shall be filled with water to a verifiable and visible level as described above and be allowed to remain so for 24 hours. If after 24 hours the level of the water has been lowered by leakage, the leaks must be found and stopped, and the water level shall again be raised to the level described, and the test repeated until, after a 24 hour retention period, there shall be no perceptible lowering of the water level in the system being tested.
2. A final test shall be conducted after all vertical and horizontal pipes and "rough-ins" have been complete but before the sewer connection is made. The test procedure shall be identical with that described above except that the entire plumbing system, i.e., the vertical and horizontal pipe and "rough-in", shall be subjected to water under the head imposed by filling the system to the top of the building. After all testing operations have been completed, all waste lines shall be cleaned.

3. Should the completion of these tests leave any reasonable question of a doubt relative to the integrity of the installation, additional tests or measures shall be performed to demonstrate the reliability of these systems to the complete satisfaction of the Owner's duly authorized representative. Such tests shall be conducted and completed before any joints in plumbing are concealed or made inaccessible.

G. FABRICATION METHODS FOR SEWAGE AND DRAINAGE PIPE LINES:

1. Install promptly all sewers, drains and piping after excavating, chasing or cutting for them has been done to keep the openings for such piping open as short a time as possible. No piping shall, however, be permanently closed up, furred in or covered before the examination of same by the authorities having jurisdiction.

2. Waste pipes shall be sized to conform to the sizes indicated on the Drawings. Under no circumstances shall any drain line be smaller than two inches. The waste pipes from water closets shall not be smaller than four inches.

3. The drilling and tapping of soil or waste lines or the use of saddle joints or the welding or brazing of hubs or pipe to any soil, waste or vent lines is prohibited.

4. Wastes must be brought up directly in back of each fixture. Horizontal branch arms of lead or brass will not be allowed.

5. No waste or soil lines shall enter the vertical part or heel of a lead or cast iron closet bend. Waste lines may enter the horizontal part of the lead or cast iron closet bend. No sink or lavatory waste line shall enter any other waste line of two inch (2") size.

6. All waste connections shall be made of heavy brass threaded nipples or with copper tube with appropriate screw to sweat adapters for connecting to sanitary tee. All fixtures used in connection with the conveying of any waste substance to the sanitary sewer, shall be connected by means of a trap, waste and overflow. Slip joints will be permitted only on the house side of the trap, waste and overflow, or appliance which has such slip joints embodied in their original manufacture. Fixtures which have waste opening connected to the soil or waste lines by the use of bolts or screws shall have such connections made by the use of the exact number of bolts or screws as provided for in their original manufacture.

7. Where waste and vents are exposed at fixtures, pipes shall be chrome plated brass or brass W.C.P. cover (iron pipe size) and shall have chrome plated escutcheons where they pass through floors, walls, or ceilings.

H. VENTS:

1. Vent pipes shall be carried up adjoining soil and waste pipes, and they shall be connected into the main stack at top and bottom as indicated on the plumbing riser diagrams on the Drawings.
2. Vent pipes shall be of hubless service weight cast iron pipe.

3. All vent lines shall be so constructed that they cannot be used for waste or soil lines. No fixture shall be double trapped.

I. Not Used.

2.09 WATER SUPPLY SYSTEM:

A. A complete system of hot and cold water supply to all plumbing fixtures and mechanical equipment shall be supplied and installed as shown on the Drawings. The water supply system shall be installed using the materials and methods as specified in the following paragraphs.

B. UNDERGROUND WATER PIPING SYSTEMS:

1. Pipe: All pipe used for underground water piping mains shall be Class 52 centrifugally cast, close grained cast iron pipe or Class 50 DUCTILE iron pipe arranged with bell and spigot mechanical joints.

2. Fittings: See Section 23 20 00.A.

3. Valves: See Section 23 20 00.A.

4. Valve Boxes:

   a. For each underground valve installed by the Contractor, the Contractor shall provide and install a two-piece, screw adjustable type valve box. These valve boxes shall be designed for heavy roadway service and they shall have a deep socket type of cover which prevents their being accidentally knocked out of position.

   b. The word "WATER" shall appear on each cover. The installation of these members shall be such that by the use of the adjustable screw type bodies the tops are just flush with the finished grade. These valve boxes shall be Tyler Pipe Industries #6850, or approved equal.

5. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then ALL of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and reinstalled using ALL NEW MATERIALS.

C. Not Used.

D. Not Used.

E. BUILDING ENTRANCE:

1. A metallic sleeve shall be inserted in the forms of the building wall through which the water service enters the building. The interior diameter of such sleeve shall be four inches (4") greater than the exterior diameter of the water service.
2. The water service pipe from within the building shall be extended to a point three feet outside the building wall through this sleeve. The position of the water service in this sleeve shall be concentric and the intervening space shall be packed in a flexible manner to avert the flow of water from outside of the building into the basement.

3. The interior pipe extended outside the building shall be provided with a protective wrapping of "Tape Coat" SP warmed with hand torch. This protective tape shall be applied with "half-lap" coverage in strict accordance with the manufacturer's published instructions. The cast iron pipe connected to the pipe extending from the building wall shall contain two caulked joints within four feet of the union of the cast iron pipe and the interior pipe from the building.

2.10 INTERIOR DOMESTIC WATER PIPING SYSTEMS:

A. ALL piping within confines of building walls shall be a part of the interior water piping system. Interior domestic water piping material and installation shall be as specified in the following paragraphs.

B. PIPE:

1. Not Used.

2. Unless otherwise shown on the Drawings, all interior domestic water piping four inches (4") and smaller shall be fabricated of Type L, hard drawn, copper pipe made of deoxidized copper (99.9% pure). See Section 23 20 00.A. No pipe smaller than three-fourths inches (3/4") shall be used in this project except at local connections or as detailed for laboratory areas.

C. FITTINGS:

1. See Section 23 20 00.A.

D. HEADERS: Not Used

E. CONTROL VALVES:

1. Control valves shall be installed where indicated on Drawings and/or wherever necessary for controlling the several sections of the domestic water system. Valves shall be provided on all inlet (and outlet where applicable) connections to all kinds of apparatuses, all risers and all groups of fixtures. Groups of fixtures shall be arranged to have their group valves in one location. Access shall be provided to all concealed valves by means of an access door. Coordinate the location of valves with the architectural features of the building in order that the access doors will be located symmetrically with other features.

2. The hot and/or cold water supply lines to each and every fixture hereinafter specified shall be equipped with stop valves which shall be chromium plated where exposed chrome plated pipe is used.
F. CROSS CONNECTIONS:

1. Care shall be exercised in fabricating plumbing lines to avoid all cross connections and to construct the piping systems in a manner which eliminates the possibility of water contamination.

2. The piping systems have been designed in every case to avoid the possibility of reverse flow or back siphoning. Care shall be exercised in constructing plumbing lines to make certain that not only the letter, but the spirit, of these safety precautions is carried out to the fullest possible extent.

G. REQUIREMENTS OF INTERIOR WATER PIPING SYSTEMS:

1. All piping shall have reducing fittings used for reducing or increasing where any change in the pipe sizes occurs. No bushing of any nature shall be allowed in piping.

2. All exposed chrome plated, polished or enameled connections from fixtures shall be put up with special care, showing no tool marks or threads at fittings, and supported by neat racks or hangers with round head screws of same material and finish.

3. Wade Shokstop, or approved equal, water hammer arrestors shall be provided in all water branches to fixtures, sized in accordance with manufacturer's recommendations, concealed, accessible, and located so as to protect each group of plumbing fixtures.

4. The fabrication of copper pipe and fittings shall in every detail conform to the recommendations and instructions of the fitting manufacturer. The tools used shall be the tools adapted to that specific purpose.

5. Refer to other parts of this Section and Section 23 00 00 and 23 20 00.A for other information concerning installation of piping.

H. TESTING AND STERILIZATION:

1. All water piping systems shall be properly tested to assure their being absolutely tight. In the case of pipes which are to be insulated, these tests shall be completed and the piping system proven to be absolutely tight before any insulation is applied. Wherever pipes are placed so that they will ultimately be concealed, these tests shall be conducted and the absolute tightness of each piping system shall be demonstrated before the system is concealed.

2. The procedure of these tests shall consist of subjecting a piping system to a hydrostatic pressure per Section 23 00 00. During the test period, all pipe, fittings and accessories in the particular piping system which is being tested shall be carefully inspected. If leaks are detected, such leaks shall be stopped by means designated by the Owner's duly authorized representative and the hydrostatic test shall again be applied. This procedure shall be repeated until, for an entire twenty-four hour period, no leaks can be found while the system being tested is subjected to the pressure mentioned above.

3. Wherever conditions permit, each piping system shall thereafter be subjected to its normal operating pressure and temperature for a period of no less than five (5)
days. During that period, it shall be kept under the most careful observation. The piping systems must demonstrate the propriety of their installation by remaining absolutely tight during this period. Even though the completion of these tests is satisfactory, there is a continuing responsibility for the ultimate, proper, and satisfactory operation of such piping systems and their accessories.

4. After completion of the testing, the entire cold and hot water piping systems, with attached equipment, shall be thoroughly sterilized with a solution containing not less than 50 parts per million of available chlorine. The chlorinating materials shall be either liquid chlorine conforming to U. S. Army Specification No. 4-1 or calcium hypochlorite or chlorinated lime conforming to the requirements of Federal Specification O-C-114. The sterilizing solution shall be allowed to remain in the system for a period of eight (8) hours during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chlorine content is not greater than 0.2 parts per million.

5. The sterilization process shall be conducted as required by the Health Department of the City of San Antonio, and the specifications above, and upon completion of the process, the Health Department shall test and certify the cleanliness of the water piping system. The Mechanical Subcontractor shall pay all costs and charges incidental to this test and certification.

2.11 NATURAL GAS DISTRIBUTION SYSTEM:

A. The gas distribution system shall be installed as indicated on the Drawings, complete with all valves, regulators, meters and other required items.

B. Not Used

C. Verify and coordinate, with the actual various users on the site, all the times and timing involved with modification, additions to, or alterations thereof, of gas piping serving these users.

D. The natural gas system shall be installed using the materials and methods as specified herein and in the following paragraphs.

E. VALVES:

1. The gas regulator bypass globe valve shall be sized to pass only a slightly larger maximum flow rate than the gas regulator. It shall include provision for locking shut with a large padlock.

F. GAS CUTOFFS:

1. On the inlet and discharge side of the meter and pressure regulators and at building entrance, install a wrench operated plug cock valve. The flanges of this stop valve shall be dimensioned, drilled, faced and spot faced to conform to the Class 125 American Standard for Cast Iron Flanges (B16.1-1948).

G. PIPING:

1. All pipe used for the fabrication of above grade gas piping systems shall be Schedule 40 black steel pipe. See Section 23 20 00.A.
2. Unless otherwise specifically required, all steel pipe provided for gas piping systems shall be provided with plain ends and assembled with weld fittings on all pipe 1-1/4" and larger. No pipe smaller than 3/4", shall be used.

3. All gas piping within the building shall be installed exposed to view.

4. Below grade piping within 6' from the building and the final riser to meter or building entrance point shall be wrapped steel.

5. Below grade and outside of six (6) ft. building line shall be:

   a) Unless otherwise indicated, below grade gas piping shall be PE2406 polyethylene pipe and shall comply with ASTM D2513. Tracer wire shall be spirally wrapped around the pipe (minimum of 1 revolution for every 3 feet of pipe). All sizes shall be IPS, NIPAC, Driscopipe 6500, or equal approved by Architect/Engineer.

   b) Fittings shall be butt fusion complying with ASTM-D3261, or socket fusion complying with ASTM-D2683. All branch connections shall be made using tees. Branch saddle or service saddle with tapping tee shall be allowed only at taps on existing mains.

   c) Technicians performing fusion process shall be currently certified by the Texas Railroad Commission and shall submit a resume showing experience on comparable fusion procedures within the last twelve (12) months.

   d) Transitions from polyethylene to steel pipe shall be by factory fabricated transition fitting (i.e., Central Double “0” Seal) or transition riser (Central Plastics Part No. 600 Series). Minimum horizontal dimension for transition riser shall be 30 inches. Anodeless service riser may be used when interior carrier pipe complies with the specifications for the location of the pipe.

H. FITTINGS:

1. Unless otherwise specifically shown or called for, gas piping systems installed throughout the building shall be fabricated by a fusion welding process making use of welding fittings. These fittings shall be fittings as specified in other Sections. In no case shall the wall thickness of a fitting incorporated in a gas piping system be less than that of the pipe to which it is joined.

I. FLANGES:

1. In all instances in which flanges are required for the installation of flanged fittings for gas lines, the Contractor shall provide Crane or Walworth weld neck pattern, Class 150 forged steel flanges. See Section 23 20 00.A for additional requirements for flanges.

J. Not Used

K. Not Used
L. **DRIP PIPES:**

1. 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 piping to which they are connected in each instance.

2. 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 shall be provided in the event that the water forming the seal evaporates.

M. **FABRICATION METHODS:**

1. All interior gas piping shall, wherever possible, be installed so as to grade back toward a dripleg. 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 with 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 house piping must be securely fastened in place in such a manner as to maintain its grading. Under no circumstances shall extension bars be used for supporting gas piping. Under no circumstances shall any gas piping be used to support any weight other than its own weight.

3. 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.

4. 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.

5. Refer to Section 23 00 00 for other information concerning installation of piping.

N. **PROTECTIVE COATING:**

1. 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, dated June 4, 1970. This coating shall be applied by A&A Coating Company, Lone Star, Texas.

2. 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. Flanged joints will not be allowed under ground.

3. Under no circumstances shall any backfilling operations be begun until these pipe protection operations have been completed.

O. TESTING:

1. All gas piping systems shall be completely tested by the Contractor. These piping systems shall first be subjected to a pneumatic test pressure per Section 23 00 00. All hydro and pneumatic tests shall be dead weighted, recorded, and countersigned by the project inspector. While the systems are subjected to this air pressure, all welded joints shall have a soapy water solution applied for the purpose of detecting minute, as well as larger leaks, and shall be witnessed by Owner. A final test shall be performed after casework and lab hook up are completed at 15 psi for a minimum of 4 hours. If leaks are found, they shall be repaired by chipping and re-welding operations. Alternate testing and re-welding operations shall be repeated until gas piping systems are absolutely tight at the pneumatic test pressure indicated above. If leaks occur in the case of threaded joints, such leaks shall be eliminated by legitimate means, i.e., either by replacing leaking fittings or by tightening them properly. Leaking flanged joints shall have flange bolts appropriately tightened or have gaskets causing leaks replaced.

2. Then the entire gas piping systems shall be re-subjected to a pneumatic test pressure per Section 23 00 00. Such gas piping systems must be demonstrated to be absolutely tight when subjected to this pressure for a period of twenty-four hours. In all instances in which leaks are then found, they shall be eliminated in the manner designated by the Owner's duly authorized representative. A one-half inch (1/2") test connection and cap shall be provided in each branch of the gas piping system.

3. 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. The Contractor shall then bleed gas from every riser and every runout until the odor is present in the proper quantity at every gas outlet.

4. Contractor is to connect to an existing 20 psi gas main that belongs to Owner's site distribution system and extend 20 psi line to new regulated meter stations as indicated on drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify excavations under provisions of Section 23 00 00.

B. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.
C. Prepare piping connections to equipment with flanges or unions.

3.03 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.
B. Route piping in orderly manner and maintain gradient.
C. Install piping to conserve building space and not interfere with use of space.
D. Group piping whenever practical at common elevations.
E. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
F. Provide clearance for installation of insulation and access to valves and fittings.
G. Provide access where valves and fittings are not exposed. Coordinate access door location with architectural features.
H. Establish elevations of buried piping outside the building to ensure a minimum of cover. Refer to Section 23 00 00.
I. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
J. Provide support for utility meters in accordance with requirements of utility companies.
K. Prepare pipe, fittings, supports, and accessories not prefinished, ready for finish painting. Refer to Division 09.
L. Excavate in accordance with Section 23 00 00 for work of this Section.
M. Backfill in accordance with Section 23 00 00 for work of this Section.
N. Install bell and spigot pipe with bell end upstream.
O. Install valves with stems upright or horizontal, not inverted.
P. Provide one plug valve wrench for every ten plug valves sized 2 inches and smaller, minimum of one. Provide each plug valve sized 2-1/2 inches and larger with a wrench with set screw.
Q. Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

3.04 APPLICATION

A. Install unions downstream of valves and at equipment or apparatus connections.
B. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.
C. Install ball or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

D. Install globe or plug valves for throttling, bypass, or manual flow control services.

E. Provide spring loaded check valves on discharge of water pumps.

F. Provide plug valves in Natural gas systems for shut-off service.

G. Provide flow controls in water recirculating systems where indicated.

3.05 ERECTION TOLERANCES

A. Establish invert elevations, slopes for drainage to 1/8 inch per foot (one percent) minimum. Maintain gradients through each joint of pipe and throughout system.

B. Slope water piping and arrange to drain at low points.

3.06 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

A. Prior to starting work, verify system is complete, flushed and clean.

B. Ensure PH of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

C. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

D. Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15 percent of outlets.

E. Maintain disinfectant in system for 24 hours.

F. If final disinfectant residual tests less than 25 mg/L, repeat treatment.

G. Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

H. Take samples no sooner than 24 hours after flushing, from 10 percent of outlets and from water entry, and analyze in accordance with AWWA C651.

3.07 EQUIPMENT CONNECTIONS:

A. Under this section, water lines shall be run to and connected to the pumps, quick fills, and other items of equipment as indicated. Provide suitable shutoff valves, check valves, and, if required by the drawings, bypass valves at each and every such point of connection.

3.08 CONNECTIONS FOR GENERAL CONTRACTOR FURNISHED EQUIPMENT:

A. Route lines as indicated on the Drawings to serve various items of equipment specified elsewhere. Rough-in accordance with detailed drawings furnished by the equipment supplier, and make final connections to the equipment when it is installed. Rough-in shall terminate where noted on Drawings. All pressure lines shall be provided with shutoff valves or cocks. Drain lines shall be provided where required. It shall be assumed that the
equipment supplier will provide and install valves and pipe specialties, etc. only as specified herein or called for on the Drawings.

B. Laboratory and/or other special equipment and trim are specified in another section under which the equipment shall be furnished and installed. Trim, sink strainers and tail pieces shall be furnished only as indicated to the contractor who shall receive, store and install them. In addition, furnish the sink P-traps and all materials and labor to rough-in and make final connections.

3.09 CONNECTIONS FOR OWNER FURNISHED EQUIPMENT:

A. The Owner will be furnishing various pieces of equipment. The Contractor shall provide the rough-in indicated on the Drawings. Final connections are also included as part of this contract.

END OF SECTION

- o 0 o -
PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:

A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.
B. Section 230000 - Basic Mechanical Requirements
C. Section 230529 - Sleeves, Flashings, Supports and Anchors
D. Section 230553 - Mechanical Identification

1.01 SECTION INCLUDES

A. Not Used
B. Floor Drains
C. Cleanouts
D. Strainers
E. Backflow preventers
F. Not Used.
G. Not Used
H. Water hammer arrestors
I. Natural Gas Regulators
J. Natural Gas Meters
K. Water Meter.
L. Pre-fabricated heated enclosure
M. Equipment Furnished by Others

1.02 Not Used

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Not Used
B. Not Used
C. Section 11 53 13 - Fume Hoods and Other Containment Units
D. Section 11 53 19 - Laboratory Equipment
E. Section 11 53 43 - Laboratory Service Fittings and Fixtures: Laboratory casework, for connection of sinks, fixtures, and drains.
F. Section 13 21 29 - Controlled Environmental Rooms: Supply of environmental rooms, for connection of sinks, fixtures, and drains by this Section.

1.04 RELATED SECTIONS
A. Section 011100 - Summary of Work
B. Not Used
C. Not Used
D. Section 221316. - Plumbing Piping
E. Section 224000 - Plumbing Fixtures
F. Section 221123 - Plumbing Equipment

1.05 REFERENCES
A. ANSI/ASSE 1011 - Hose Connection Vacuum Breakers
B. ANSI/ASSE 1012 - Backflow Preventers with Immediate Atmospheric Vent
C. ANSI/ASSE 1013 - Backflow Preventers, Reduced Pressure Principle
D. ANSI/ASSE 1019 - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types
E. ANSI A112.21.1 - Floor Drains
F. Not Used
G. ANSI A112.26.1 - Water Hammer Arrestors
H. Not Used
I. AWWA C506 - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types
J. PDI WH-201 Water Hammer Arresters

1.06 SUBMITTALS
A. Submit under provisions of Section 230000.
B. Shop Drawings: Indicate dimensions, weights, and placement of openings and holes.
C. Product Data: Provide component sizes, rough-in requirements, service sizes, and finishes.
D. Manufacturer's Installation Instructions: Indicate assembly and support requirements.

1.07 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 230000.
B. Record actual locations of equipment, cleanouts, backflow preventers, etc.

1.08 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 230000.
B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.09 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section 230000.
B. Accept specialties on site in original factory packaging. Inspect for damage.

1.10 EXTRA MATERIALS
A. Furnish under provisions of Section 230000.
B. Not used.

PART 2 - PRODUCTS

2.01 Not Used
2.02 Not Used
2.03 Not Used.

2.04 FLOOR DRAINS:
A. Floor drains (F.D.) shall be sized to conform to the information indicated on the Drawings or contained elsewhere in these Specifications. Extreme care shall be used to set the elevation of the drain to meet the low point elevation of the finished floor. Each floor drain shall be provided with a P-trap unless noted otherwise. Note that a deep seal type trap may be required under other Sections of these Specifications.

B. All floor drains will be furnished and installed with all accessories required for the particular construction in which they are to be mounted; and shall be as manufactured by Wade, Josam, Zurn, or approved equal.

C. Not Used.
D. Not Used.
E. Not Used.
F. Not Used.
G. Not Used.
H. Not Used.
I. Refer to “Plumbing Equipment Schedule” on drawings for schedules.

2.05 Not Used.

2.06 CLEANOUTS:

A. At each change in direction, at the end of each continuous waste line, at the foot of each riser in the building and at 50' intervals in long horizontal runs, of lines of four inch (4") size and smaller, and not more than 95' intervals for larger lines, cleanouts shall be placed in soil and waste lines. The size of the cleanouts shall be identical with the size of the soil or waste line in which they are placed for four inch (4") and smaller lines. The size of cleanouts in lines larger than four inches (4") shall be six inches (6") in all cases. All cleanouts shall be placed to be easily accessible for servicing. Where they occur in pipe chases, they shall be placed above the floor in such a location so they will be easily accessible through access doors, or they shall be brought through the walls and be provided with covers. All horizontal soil and waste lines shall have a cleanout placed in the end of the line by the use of a wye and a 1/8 bend, or by a combination tee-wye and made easily accessible by extending the cleanout through the wall and be covered as described above. The screw plug of all cleanouts shall be of cast brass.

B. The bodies of floor cleanouts shall be tapped for iron pipe threads. The brass tap screws shall have flange caps with raised nuts. Wherever such cleanouts occur in finished floor slabs or terminate in finished walls, they shall be provided with scoriated nickel bronze cleanout covers of such a size as to make the plugs over which they are installed readily accessible. These cleanouts shall be cast iron floor cleanout with cut-off ferrule, tapered brass plug with eight inch (8") round screwed brass access cover with three-eighths inches (3/8") diameter Allen Head Screw.

C. Finished Floors and Concrete Floors, Round Top. Primer coated cast iron floor cleanout with SV hub outlet, taper thread bronze plug, threaded adjustable housing and ferrule, membrane flange, secured/vandal proof, round-heavy duty satin finished nickel bronze scoriated top that adjusts to finished floor after concrete has set. For cleanouts located under carpet floors provide an integral carpet marker to indicate location after floor carpeting is installed. Reference Architectural drawings for areas with carpet floors. Jay R. Smith No. 4033L (service weight Speedi-Set hub outlet)-F-C-U (-Y, where applicable), Josam 5600-15-22-41-MODIFIED for Heavy Duty Top (-14, where applicable)-Y, Wade W-6030-D-X-5-26-75-Threaded/Machined for Clamp Device (-72, where applicable) or Zurn ZN-1400 (Neo-Loc)-BP-HD-KC-VP (-CM, where applicable). Set top of floor cleanouts such that top is flush with finished floor.

D. Outside Areas, Round Top. Primer coated cast iron, extra heavy traffic duty floor cleanout with taper thread bronze plug, threaded adjustable housing with flanged ferrule, secured/vandal proof, round, extra heavy duty, gasketed satin finished nickel bronze scoriated top that adjusts to finished grade in field after installation. Cast cleanouts flush in a 16" by 16" by 6" thick concrete pad. Concrete pad and cleanout shall be installed such that the top of pad and cleanout top are both set with top flush with finished grade. Jay R. Smith No.4113L~U (service weight Speedi-Set hub outlet), Josam 56040-1-15-22-Y, Wade W-6O30-Z-XS-1-5-75 or Zum ZN-1400 (Neo-Loc)-BP-MODIFIED for Extra Heavy Duty Top-VP. Set top of exterior floor cleanouts such that top is flush with finished grade.


G. Lab Waste Floor Cleanouts, Finished Floors, Outside Graded Areas and Exterior Cleanouts. 10 inch diameter, secured/vandal proof, round, heavy duty, satin finished nickel bronze scoriaed top type cleanout access frame and cover. Jay R. Smith No. 4810-08-U, Josam 58610-MODIFIED for 10-inch diameter covcr-10-15, Wade W-8300-C10-5 or Zurn ZNAB-1463-11-inch diameter cover-VP. Set top of floor cover such that top is flush with finished floor (including tile). Installation shall be exact, top of cleanout cover shall be set to the exact finished floor level, No tolerance will be allowed on this item. Extend lab waste cleanout to bottom of cleanout top, caulk annular space between cleanout and concrete floor watertight with sleeve, insulation, tape and Linkseal per Section 22 66 00. Secure cover to concrete floor with expansion bolts and - top flush with finished floor. Cleanout shall be same material as piping.

H. Lab Waste Wall Cleanouts, Finished Walls. 8-inch square, secured/vandal proof, satin finished nickel bronze scoriaed face-of-wall cover type access frame and cover. Jay R. Smith No. 4730-08X08-NB-U, Josam 58631-15, Wade W-8480-ST8-5 or Zurn ZNAB-1462 (7-1/2 inch cover)-VP. Set on wall such that cover is flush with finished wall. Extend lab waste cleanout to within 3-inches (in depth) from access door and center in respect to access door opening for easy access. Installation shall be exact, cleanout cover shall be set exact, and no tolerance will be allowed on this item. Adequately secure frame and cover to wall studs or CMU block. Provide additional blocking in wall to ensure a rigid and permanent installation Cleanout shall be same material as piping.

2.07 STRAINERS:

A. Strainers, 2" and smaller, bronze body, screwed ends, No. 10 mesh strainer, screwed cap with bronze blow-off valve (size to be determined by standard tap size in cap). Cast iron body, 2 1/2" and larger, isolating type flanged ends where installed in copper lines, No. 7 perforated monel strainer, flanged cap with bronze ball blow-off valve (size of blow-off valve shall be determined by standard tap size in cap).

B. Not Used.

2.08 BACKFLOW PREVENTERS:

A. Backflow preventers (BFP) shall be reduced pressure type, Febco 825, or approved equal. A BFP shall be installed to isolate all non-potable water requirements from the building domestic water system. Refer also to drawings.

B. Installation

1. Backflow prevention devices and assemblies shall be installed in compliance with American Water Works Association Manual M-14 “Backflow Prevention”, and the following:

   a. Devices and assemblies shall be located as shown on plans.
b. The highest part of any device or assembly shall not be installed over 5 feet above the finish floor. There shall be a minimum of 12" clearance above the device/assembly.

c. The lowest part of any double check or reduced pressure zone backflow preventer assembly (excluding air gap) shall be installed a minimum of 12 inches above finish floor.

d. The service side of any device/assembly shall have a minimum clearance of 24” from the outermost dimension.

2.09 WATER HAMMER ARRESTORS

A. Provide water hammer arrestors as shown on the plans and as necessary to prevent water hammer from occurring. As a minimum, provide as follows.

1. A minimum of one arrestor shall be installed for each fixture header serving up to three fixtures. A minimum of two arrestors shall be installed for each fixture header serving four to seven fixtures. A minimum of three shall be installed for each fixture header serving eight or more fixtures.

   Note: “Header” refers to horizontal pipe from which adjacent fixtures are directly connected without intervening horizontal or vertical runs or offsets.

2. Provide an arrestor for each single fixture with a quick closing valve (e.g single lever handles; wrist blades, push/pull faucets, self-closing faucets, flush valves, solenoid valves, etc.).

3. NOTE: Washing machines and other solenoid operated equipment shall have arrestor (not air chamber) provided for each piece of equipment/fixture.

B. Water hammer arrestor shall be similar and equal to Wade “Shockstop”, Precision Plumbing Products SC Series, Sioux Chief “Hyd rarester” or Josam “Absorbatron”.

C. Where indicated on drawings, provide air chambers. Air chambers shall be a minimum of one size larger than the drop/line being served and a minimum of 18” long. Air chamber shall be located so that it can be drained by opening the faucet of the fixture served.

2.10 Not Used

2.11 Not Used

2.12 NATURAL GAS PRESSURE REGULATOR

A. Service: Where required, provide a “pounds to inches” pressure regulator to reduce gas pressure as required by plans for each specific application. Regulator assembly shall be approved by UTSA and local Building officials and shall include isolation valve on inlet side and dirt leg assembly for maintenance.

2.13 NATURAL GAS PRESSURE METER

B. Meters shall be suitable for accurately measuring and handling gas at pressures, temperatures, and flow rates indicated. Meters shall have a pulse switch initiator capable of operating up to speeds of 500 pulses per minute with optional high frequency pulse signal for integration with a remote meter reading device.

C. Meters shall be protected from any damage. Meters must be shipped or sealed to keep moisture or dust from entering under shipping and handling conditions.

D. Meters shall be pedestal mounted. Meters shall be provided tamper-proof protection.

2.14 WATER METER

A. Turbine meter conforming to the AWWA C-701 class II. All turbine meters are to have a bronze case or as specified on plans with flanged connection, obtain approval from UTSA of the type of meter and accessories prior to purchasing.

1. Register shall allow electronic reading of the meter with a portable data acquisition unit.

B. Install meter with 5 pipe diameters of straight pipe on the inlet and 3 pipe diameters of straight pipe on the outlet of the meter. Verify with manufacturer installation instruction.

C. Provide isolation valves on both sides of the meter with bypass. Provide valve in bypass line. Install strainer on the inlet of the meter.

D. Provide all meter, valves and bypass with adjustable pipe stands, where required. Brick, concrete or wood blocking is not acceptable.

2.15 PRE-FABRICATED HEATED ENCLOSURE

A. The enclosure shall be constructed of 5052-H32 marine grade aluminum (.050/18 gauge), mill finish, ASTM B209 with polyisocyanurate insulation in the walls having a minimum thermal resistance of (10.0 °R value). The enclosure shall be certified by ASSE to Class I of ASSE Standard #1060.

B. The complete equipment assembly, including valve stems and hand wheels, shall be inside the enclosure. Access panels shall be completely removable and shall be provided with built-in locks keyed alike with two keys furnished to UTSA. The drain panel(s) shall have a stainless steel hinge and a stainless steel spring as a positive means of closure to prevent activation by wind. The drain panel shall be fabricated of the same materials as the enclosure and integrated into the access panel(s). All mounting hardware and threaded fasteners shall be furnished and shall be 300 series stainless steel or T6 aluminum. All masonry fasteners shall be metal wedge anchors.

C. The enclosure shall be assembled and mounted to a concrete pad in such a way that it will remain locked and secured to pad even if outside screws are removed. The concrete pad shall be constructed above final grade to prevent eroded soil from obstructing the enclosure drain. The concrete pad shall be a minimum of 10" longer and wider than the inside dimensions of the enclosure.
D. Heating Equipment, ASSE 1060 Class I-Required, shall be furnished and the size verified by the manufacturer of the enclosure to maintain an interior temperature of +40°F with a worst case outside temperature of +20°F, electrical resistance elements completely enclosed within a solid aluminum cast platen base designed for attachment to the concrete base pad with mounting hardware provided. The platen heater shall be suitable for installation underneath a reduced pressure zone backflow prevention assembly and designed to sustain occasional water discharge without damage to or impeding the performance of the heater. The heater shall be provided with a thermostat adjustable from +40°F to +60°F. The thermostat, all conduits and wiring fittings provided shall be suitable for wet environment installation.

E. The enclosure shall be provided for all above ground backflow preventers and water meters. Refer to the drawings for specific locations.

F. The enclosure shall be manufactured as specified on the drawings, by Safe-T-Cover or an approved equal

2.16 EQUIPMENT FURNISHED BY OTHERS

A. Provide all rough-ins, installation, and final connections for equipment provided by others. Equipment shall include, but not necessarily be limited to: laboratory equipment; refrigerators; ice machines; etc.

B. Rough-ins shall include domestic hot and cold water, sanitary waste and vent, laboratory waste and vent, purified water, laboratory air, vacuum as required.

C. Prior to rough-in, determine exact locations of equipment through coordination with the General Contractor, Owner, and/or Architect. For laboratory equipment, refer to approved "LF" drawings.

D. Make all final connections to equipment so that equipment is properly isolated (valved) and properly operational. Also provide for: gas regulating valves (provided by this contractor) for gas-fired equipment where more than two pieces of equipment are served from the same manifold, and where regulators are not included with the equipment; drains (piped to nearest approved indirect waste receptor) as required for laboratory equipment (i.e. autoclave).

PART 3 - EXECUTION

3.01 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

C. Encase exterior cleanouts in concrete flush with grade.
D. Pipe relief from back flow preventer to nearest drain (if located indoors).

E. Install water hammer arrestors complete with accessible isolation valve on hot and cold water supply piping to all fixtures and equipment.

F. Lead: It is forbidden that lead in any form be used in any water system other than waste. If lead is used in the fabrication or installation of any water system other than waste, then all of the installed equipment and material, which may have come in contact with the lead, shall be marked with bright red or orange spray paint, and shall be removed from the project site. The system(s) shall then be restored and re-installed using all new materials.

G. Backflow and back siphonage assemblies/devices:

1. All backflow and/or back siphonage assemblies/devices shall be tested in accordance with the rules and regulations of Texas Commission on Environmental Quality and the utility supplying the domestic water before substantial completion inspection is requested.

2. Final reports shall be submitted to local code / inspection authorities and to Architect / Engineer and utility prior to scheduling Substantial Completion reviews by the Architect / Engineer.

3. Persons performing the test on backflow and/or back siphonage assemblies/devices shall meet the following requirement:
   a. Licensed by the Texas Commission on Environmental Quality as a Backflow Prevention Assembly Technician, and

END OF SECTION
PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:

A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.

B. Section 230000 - Basic Mechanical Requirements

C. Section 230529 - Sleeves, Flashings, Supports and Anchors

D. Section 230553 - Mechanical Identification

E. Section 22660 - Lab Waste system

F. Section 226713 - Process Water Piping

1.01 SECTION INCLUDES:

A. Lavatories

B. Sinks

C. Service Sinks

D. Water Closets

E. Urinals

F. Faucets

G. Not Used.

H. Not Used.

I. Electric Water Coolers

J. Hose Bibbs

K. Not Used

L. Vacuum Breakers

M. Laboratory Fittings

N. Combination Emergency Shower and Eyewash (Mechanical Room Areas)
O. Combination Emergency Shower and Eyewash (Laboratory Areas)

P. Not Used.

1.02 Not Used.

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Section 011100 - Summary of Work: Owner furnished fixtures including ice machines.

B. Not Used.

C. Not Used.

D. Division 11 - equipment

1.04 RELATED SECTIONS

A. Section 06410 - Custom Casework: Preparation of Counters for Sinks

B. Section 06410 - Custom Casework: Lavatory Tops

C. Section 079200 - Joint Sealers: Seal Fixtures to Walls and Floors

D. Not Used.

E. Section 230529 - Supports and Anchors

F. Section 221316 - Plumbing Piping

G. Section 221316.A - Plumbing Specialties

H. Section 221123 - Plumbing Equipment

I. Section 115813 - Fume Hoods

J. Section 115343 – Laboratory Service Fittings and Fixtures.

1.05 ALLOWANCES - Not Used.

1.06 REFERENCES

A. ANSI/ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

B. ASME A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.


D. ANSI/ASME A112.19.2 - Vitreous China Plumbing Fixtures.

E. ANSI/ASME A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).

F. ANSI/ASME A112.19.4 - Porcelain Enameled Formed Steel Plumbing Fixtures.
G. ANSI/ASME A112.19.5 - Trim for Water-Closet Bowls, Tanks, and Urinals (Dimensional Standards).

H. Not Used.

I. Not Used.


K. ANSI/ARI 1010 - Drinking-Fountains and Self-Contained, Mechanically-Refrigerated Drinking-Water Coolers.

1.07 SUBMITTALS

A. Submit under provisions of Section 230000.

B. Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Installation Instructions.

1.08 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 230000.

B. Maintenance Data: Include fixture trim exploded view and replacement parts lists.

1.09 Not Used.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 230000.

B. Accept fixtures on site in factory packaging. Inspect for damage.

C. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

1.11 FIELD MEASUREMENTS

A. Verify that field measurements are either as indicated on shop drawings or as instructed by the manufacturer, and designate in the submittal both that it has been verified, and which measurements are the basis for construction.

B. Confirm that millwork is constructed with adequate provision for the installation of countertop lavatories and sinks.

1.12 WARRANTY

A. Provide five-year warranty under provisions of Section 230000.

B. Warranty: Include coverage of electric water cooler compressor.
1.13 EXTRA MATERIALS

A. Furnish under provisions of Section 230000.

B. Not Used.

PART 2 - PRODUCTS

2.01 GENERAL

A. The Contractor shall provide plumbing fixtures where indicated on the Drawings. These plumbing fixtures shall be standard products as manufactured by Kohler, Crane, American Standard or Eljer. The fixtures shall be free from mars or chips and shall be new, first quality and shall be furnished with sufficient supports in order to adequately hang each and every unit. The space between fixtures and masonry walls shall be grouted with White General Electric Silicone flexible grout. The space between fixtures and sheetrock or wood panel walls shall not be grouted but the fixture shall fit flat against the wall surface with no more than 1/16" gap.

B. All faucets, fittings, supply stops and similar devices shall be of one manufacturer unless otherwise specified. All water faucets and valve bodies shall be cast brass with a minimum copper content of 85%. They shall contain standardized interchangeable operating units constructed of a removable and replaceable unit containing all parts subject to wear. All water faucets shall contain an adjustable internal volume control unit. All exposed parts shall be chromium plated.

C. All fixtures shall meet the requirements of ADA, ANSI A117.1, ANSI Z124.2 and the State of Texas Accessibility Standards (TAS).

D. See drawings for schedule of fixtures.

2.02 FITTINGS AND PIPES:

A. Fittings and piping shall be brass and, wherever exposed, shall be polished chrome-plated. Provide tight fitting wall or floor escutcheons of chrome-plated brass wherever pipes pass through floors, walls or ceilings.

B. Furnish and install all required water, waste, soil and vent connections to all plumbing fixtures, together with all fittings, supports, fastening devices, cocks, valves, traps, etc., leaving all in complete working order.

C. Supplies for all lavatories, sinks, tank type water closets and drinking fountains shall be loose key angle stops with 1/2" I.P.S. female inlets and shall include wall flanges, and 1/2" O.D. flexible risers with bull-nose or flared end outlets. All components to be chrome plated. In all cases, all piping, tubing, fittings, and faucets shall be installed using a mechanical non-slip connection, such as bull-nose, flared, flanged, ferrule, or threaded fittings. Fittings requiring a friction fit using slip-on or gasketed connections are not acceptable.

2.03 Not Used.

2.04 Not Used.
2.05 Not Used.
2.06 Not Used.
2.07 Not Used.
2.08 Not Used.
2.09 Not Used.
2.10 Not Used.
2.11 Not Used.
2.12 Not Used.
2.13 Not Used.
2.14 Not Used.
2.15 Not Used.
2.16 WATER CLOSETS - General Toilet Rooms (Note: All water closets shall be installed 16 1/2" to 17 1/2" from finished floor to the top of the china rim.)
   A. Not Used.
   B. Not Used.
   C. Not Used.
   D. Not Used.
2.17 URINALS - General Toilet Rooms
   A. All urinals shall be mounted with rim at 16" above finished floor. Submittal data shall show height of basin opening and rough-in height. Fixture size, design and mounting height shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS). Fixture-to-wall sealing rings shall be resilient rubber. Wax sealing rings will not be acceptable.
2.18 Not Used.
2.19 Not Used.
2.20 Not Used.
2.21 Not Used.
2.22 Not Used.
2.23 Not Used.
2.24 Not Used.

2.25 VACUUM BREAKERS

A. All outlets with hose threads shall be provided with vacuum breakers. Where vacuum breakers have not been specified with fixture trim and on all hose faucets not associated with plumbing fixtures both inside and outside of buildings, contractor shall furnish and install 3/4" hose thread vacuum breakers attached to the hose outlet threads with tamper proof set screw. Vacuum breaker shall be as manufactured by Chicago Faucet (E-27 or E-22), or by Watts.

2.26 LABORATORY FITTINGS:

A. All laboratory fittings specified under Laboratory Furniture and Casework, shall contain standardized operating valve units which are interchangeable with plumbing faucets and fittings specified under Plumbing Fixtures and Equipment and shall be T&S, Water Saver or Chicago Faucet ONLY. Contractor shall furnish and install threaded and/or flared ferrule fittings for all faucets and fixtures specified for this project. Fittings requiring a friction fit using a slip on gasketed fitting are not acceptable.

B. Not Used.

C. Not Used.

2.27 COMBINATION EMERGENCY SHOWER AND EYEWASH UNITS (MECHANICAL ROOM AREAS) – Provided by Division 22.

A. Refer to drawings.

2.28 COMBINATION EMERGENCY EYEWASH AND SHOWER (LAB AREAS) – Provided by Division 11. Installed by Division 22

A. Not Used.

B. Not Used.

C. Not Used.

2.29 Not Used.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify that electric power is available and of the correct characteristics.

3.02 PREPARATION
A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.03 INSTALLATION
A. Furnish and install all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation of complete plumbing fixtures, as indicated on the Drawings, reasonably implied therefrom, or as specified herein, unless specifically excluded.

B. Plumbing fixtures shall be supplied, set and connected as listed herein and as shown on the Drawings. Fixtures shall be protected from damage during construction, and shall be thoroughly cleaned of all tape and adhesives prior to final acceptance.

C. Coordinate special mounting heights of plumbing fixtures with architectural details of each toilet area.

D. Install in accordance with manufacturer's instructions.

E. Install each fixture with trap, easily removable for servicing and cleaning.

F. Install components level and plumb.

G. Install and secure all fixtures in place with specified wall carriers and bolts.

H. Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.04 INTERFACE WITH OTHER PRODUCTS
A. Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.05 ADJUSTING
A. Adjust work under provisions of Section 230000.

B. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.06 CLEANING
A. Clean work under provisions of 230000.

B. At completion clean plumbing fixtures and equipment.

3.07 PROTECTION OF FINISHED WORK
A. Protect finished Work under provisions of Section 230000.

B. Do not permit use of fixtures during construction, until after Substantial Completion has been announced by Owner.

3.08 FIXTURE HEIGHTS
Fixture size, design and mounting height shall meet the requirements of ADA, ANSI A117.1 and the State of Texas Accessibility Standards (TAS).

A. Install fixtures to heights above finished floor as indicated.

B. Water Closet
   1. Standard 17 inches to top of bowl rim.

C. Urinal
   1. Standard 24 inches to top of bowl rim.
   2. Handicapped 17 inches to top of bowl rim (one and only one urinal shall be installed at this height in each location where urinals are installed).

D. Lavatory (wall hung)
   1. Standard 32 inches to top of basin rim.

E. Drinking Fountain
   1. Standard 36 inches to top of basin rim.

F. Water Closet Flush Valves
   1. Standard 10 inches min. above bowl rim.

G. Not Used.

H. Emergency Eye Wash
   1. Standard 38 inches to receptor rim.

I. Emergency Shower
   1. Standard 84 inches to bottom of head.

3.09 FIXTURE ROUGH-IN SCHEDULE: Refer to plans.

END OF SECTION
SECTION 226313
LABORATORY GAS SYSTEMS

PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:

A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.

B. Section 23 00 00 - Basic Mechanical Requirements

C. Section 23 05 29 - Sleeves, Flashings, Supports and Anchors

D. Section 23 05 53 - Mechanical Identification

1.01 SECTION INCLUDES

A. Not Used.

B. Laboratory Compressed Air System

C. Laboratory Vacuum System

D. Not Used.

E. Not Used.

1.02 Not Used.

1.03 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

A. Not Used.

B. Not Used.

1.04 RELATED SECTIONS

A. Section 31 00 00 - Earthwork

B. Section 31 21 00 - Earthwork Beneath Building

C. Section 31 23 00.0020 - Excavation and Fill

D. Section 23 05 48 - Vibration Isolation

E. Section 23 07 19 - Piping Insulation

F. Section 22 13 16 - Plumbing Piping

G. Section 26 27 26 - Wiring Devices
H. Section 260500 - Basis Electrical Materials and Methods.

1.05 Not Used.

1.06 REFERENCES

A. ANSI B16.18 - Cast Copper Alloy Solder-Joint Pressure Fittings
B. ANSI B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
C. ANSI B40.1 - Gauges, Pressure and Vacuum, Indicating Dial Type-Elastic Element
D. ASME Boiler and Pressure Vessel Code
E. ASTM A167 - Stainless and Heat-Resisting Chromium - Nickel Steel Plate
F. ASTM A269 - Stainless and Welded Austentic Stainless Steel Tubing for General Service
G. ASTM A403 - Wrought Austentic Stainless Steel Piping Fittings
H. ASTM B32 - Solder Metal
I. ASTM B88 - Seamless Copper Water Tube
J. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration field Service
K. Not Used.
L. Not Used.
M. Not Used.
N. AWS A5.8 - Brazing Filler Metal
O. Not Used.
P. Not Used.
Q. Not Used.
R. FM - Factory Mutual System - Approval Guide
S. FS TT-P-645 - Primer, Paint, Zinc Chromate, Alkyd Type
T. FS W-C-596 - Electrical Power Connector, Plug, Receptacle, and Cable Outlet
U. FS WW-V-35 - Valve Ball
V. FS WW-V-54 - Valve, Gate, Bronze (125, 150 and 200 Pound, Screwed, Flanged, Solder End, For Land Use)
W. Not Used.
X. MIL-V-82026 - Valves, Diaphragm, Stop
Y. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacture
Z. MSS SP-69 - Pipe Hangers and Supports - Selection and Application
AA. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)
BB. Not Used.
CC. NFPA 99 - Standard for Health Care Facilities

1.07 SUBMITTALS
A. Submit under provisions of Section 23 00 00.
B. Shop Drawings: Indicate general assembly of components, mounting and installation details, and general layout of laboratory gas system.
C. Product Data: Provide manufacturers literature and illustrations for all components indicating size, dimensions and configuration.
D. Not Used.
E. Not Used.
F. Manufacturer's Installation Instruction: Indicate requirements for equipment and systems.

1.08 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 23 00 00.
B. Record actual locations of piping, valving, and outlets.

1.09 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 23 00 00.
B. Operation Data: Include installation instructions, assembly views, lubrication instructions, and assembly views.
C. Maintenance Data: Include maintenance and inspection data, replacement part numbers and availability, and service depot location and telephone.

1.10 QUALITY ASSURANCE
A. Perform Work in accordance with NFPA 99 and these specifications.
B. Maintain one copy of each document on site.

1.11 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum three years documented experience.
B. Installer: Company specializing in performing the work of this Section with minimum three years documented experience. All installing mechanics shall hold current (within six months) certification for laboratory gas as issued by the State Board of Plumbing Examiners. Evidence of certification shall be presented to the OFPC RCM prior to any work on the laboratory gas systems.

C. Testing Laboratory: Company specializing in performing the testing of this Section with minimum three years documented experience.

1.12 REGULATORY REQUIREMENTS
A. Conform with applicable codes for medical gas systems.

1.13 Not Used.

1.14 DELIVERY, STORAGE, AND HANDLING
A. Delivery, store, protect and handle products to site under provisions of Section 23 00 00.

B. Accept material on site in factory containers and packing. Inspect for damage.

C. Protect from damage and contamination by maintaining factory packaging and caps in place until installation.

1.15 SCHEDULING
A. Schedule work under the provisions of Section 23 00 00.

B. Schedule Work to ensure equipment is installed and systems tested and certified prior to substantial completion.

1.16 EXTRA MATERIALS
A. Furnish under provisions of Section 23 00 00.

B. Not Used.

1.17 SCOPE:
A. Provide all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation and testing of, compressed air and vacuum piping systems including fittings, valves, outlets, air compressors, vacuum pumps, alarms, etc. for complete operable systems.

B. Not Used.

C. Provide all labor, materials, equipment, tools and services and perform all operations required in connection with or properly incidental to the installation and testing of compressed air, vacuum, and nitrogen piping systems including fittings, valves, gas outlets, compressed air source and vacuum source, for complete operable systems. Systems shall be provided with materials and installed, tested, and cleaned in accordance with industry standards and “best practice” for “General Purpose” (GP),
For clarity and coordination for this project, the following shall apply:

1. General Purpose (GP) is defined as the same as “Medical Grade” within the medical/hospital industries.

PART 2 - PRODUCTS

2.01 PIPING:

A. All piping for vacuum and gases of every character shall be ASTM Specification B-88, Type L, hard drawn, seamless copper tubing with wrought copper solder fittings. No ferrous piping will be permitted in the system. Where threaded nipples are required these shall be I.P.S. brass. All vacuum and oxygen piping shall be purged with dry nitrogen while being soldered.

B. All piping shall be pitched back so as to drain to the point shown on the Drawings. All branch takeoffs shall be made from the top of the mains.

C. Not Used.

D. Fittings for copper tube shall be wrought copper fittings and attached with silver solder alloy containing not less than 50% silver. All joining operations shall be done with pure dry nitrogen flowing through the pipe to prevent oxidation and scale information. During joining operations, nitrogen flow shall be verified by an oxygen sensor at the free end of the piping and by a pressure alarm on the nitrogen supply. When there are no active joining operations being performed, the system shall be securely sealed and maintained with a nitrogen charge in the sealed system.

E. Not Used.

F. Where screwed connections are required at equipment, suitable adapters shall be provided with threaded connections. A thin paste of litharge and glycerin shall be applied to the external threads only.

G. After erection of pipe and tubing, but prior to installation of the laboratory outlet valves, each system shall be blown clear of moisture and foreign matter by means of dry nitrogen or oil free air.

H. After installing laboratory outlet valves, each system shall be subjected to a test pressure of 150 psig by means of water-pumped (oil free) nitrogen or air. This test pressure shall be maintained until each joint has been thoroughly examined for leaks by means of soapy water. A soap solution mixed in the following proportions should be used: one ounce of Castile or palm oil soap, eight ounces of water, and four ounces of glycerin. Dissolve the soap in the water, add the glycerin and mix thoroughly. Wipe joints clean after test. All leaks shall be properly repaired and the system retested.

I. A final test shall be 24 hours standing pressure test with water pumped (oil free) air or dry nitrogen at 150 psig to check the completeness of prior joint pressure tests. If water pumped nitrogen is used, particular care must be exercised to assure that it is all flushed out with oxygen before placing the system in service.

J. Air systems shall be finally cleaned using the high-pressure pulse-purge procedure described in NFPA 99. During this procedure, sufficient volume of dry nitrogen shall
be provided to insure a minimum velocity of 2000 fpm in the largest section of pipe being cleaned. Note: It is not required that the entire system be tested at one time. The system can be divided into convenient sections. Upon the successful completion of the operation on a section, it shall be sealed and left with a holding charge of dry nitrogen.

K. All piping, fittings, valves, etc. shall be cleaned for oxygen service by the manufacturer. Cleaning on site is prohibited.

2.02 Not Used.

2.03 VALVES:

A. Valves shall be NCG bronze bodied, double seal, full flow ball type, with Teflon seat seals and 0-ring packing designed for working pressures up to 300 psi with a chrome plated brass ball which seals in both directions. The valves shall be so designed that only a quarter turn of the lever type handle is necessary between the open and closed positions. Valves shall be supplied and properly washed for oxygen service. Gas service labels shall be provided for each service as required.

B. Not Used.

2.04 Not Used.

2.05 Not Used.

2.06 Not Used.

2.07 VACUUM PUMP AND ACCESSORIES:

A. Provide vacuum pumping units for laboratory service as scheduled on the drawings. Each unit shall be arranged for triplex operation and shall be complete with driving motors, tanks, automatic controls including alternators and accessories as hereinafter specified.

B. Not Used.

C. Tank shall be welded steel, hot dipped galvanized after fabrication, inside and out; size as scheduled with gauge and necessary taps for pipe connections.

D. Not Used.

E. Not Used.

F. Not Used.

G. A vacuum exhaust line shall be installed to exhaust vapors and odors to outside of building to point approved by Architect/Engineer. The exhaust line shall terminate adjacent to pumps in a drip leg of minimum 10" length with cock valve drain, for purpose of trapping condensates. Flexible hose connections and in-line exhaust mufflers shall be installed as shown on Drawings.
H. Vacuum Source

1. Provide a complete laboratory vacuum source, complying with NFPA 99 5.1.3.6 in all respects, as specified and scheduled on the drawings and as manufactured by BeaconMedæs or pre approved equal.

2. All components shall be at least triplexed and valved (or check valved as provided in NFPA-99) to permit service to any component without interrupting vacuum supply to the facility during any maintenance operation or any condition of single fault failure. Each pump exhaust shall be isolated by a union fitting permitting capping for service removal.

3. Furnish complete plant consisting of pumps, receiver and controls capable of providing the scheduled capacity with one pump out of service. All capacities will be indicated in SCFM at 24 inches HG.

4. System shall be completely factory assembled, requiring only interconnection between modules on site. Systems requiring on site assembly other than interconnection are not acceptable (replacement of components removed for shipping is permitted).

5. Each pump will be direct or close coupled to a NEMA rated High Efficiency TEFC motor with a service factor of 1.15.

6. Each pump will include inlet and outlet flex connectors supplied by the source manufacturer.

7. Programmable Logic Controllers (PLC) will be used to implement operating logic. PLC has integral memory and EPROM backup. PLC shall control the automatic alternation of the vacuum pumps with provisions for simultaneous operation if required, and automatic activation of reserve unit if required. A lag alarm on control cabinet and contacts for the connection to the BAS will be provided.

8. The complete control system and all electrical components shall be NEMA 12 and UL labeled. The control system shall provide:
   a. Automatic lead/lag sequencing including self adjusting minimum run timers which adaptively optimize the number of pump starts based on demand.
   b. Circuit breaker disconnects for each vacuum pump with external operators. Units with fuses instead of circuit breakers in motor circuit are not acceptable. The control system shall include an automatic minimum run time adjustment to automatically adjust run time based on demand.
   c. Full voltage motor starters with overload protection.
   d. Redundant 120 volt control circuit transformers.
   e. Visual and audible reserve unit alarm with isolated contacts for remote alarms and audio cancel.
   f. Control cabinet shall have lighted HOA selector switches
   g. Panel mounted vacuum gauge.
   h. Runtime hour-meter for each pump.

9. Provide non contacting claw style rotary pumps. Internal construction is to be friction free and rotors non-contacting. Air end shall be oil free and requires no sealants. Each pump to be air cooled and continuous duty rated. Pump is to be provided with a single lubricated gearbox requiring
oil change not more often than 5,000 operating hours. Pump to be provided with exhaust silencer. Pumps to be equipped with high vacuum shutdown, high temperature shutdown and alarm. Lubricant supplied shall be inert with oxygen. Provide BeaconMedaes OxyAssured pump or pre approved equal.

10. The complete vacuum system and all electrical components shall be factory pretested prior to shipment by the manufacturer.

2.08 AIR COMPRESSOR AND ACCESSORIES:

A. Not Used.

B. Not Used.

C. Provide welded steel control tank hot dipped galvanized after fabrication, inside and out, for each unit. Provide vertical tank, size as scheduled; with gauge and necessary taps for pipe connections, equipment with gauge glass, pressure gauge and constant pressure valve.

D. Not Used.

E. Not Used.

F. Laboratory Air Compressor System

1. Provide a complete laboratory air source, complying with all relevant requirements of NFPA 99 5.1.3.5 and supplying laboratory air continuously for the life of the equipment. The unit shall be manufactured by BeaconMedæs or pre approved equal.

2. All components are at least duplexed and valved to permit service to any component without interrupting air supply to the facility.

3. Furnish a complete plant consisting of compressors, receiver, air treatment system and controls capable of providing scheduled capacity with one compressor out of service.

4. System is modular or field separable, allowing for ease of shipment and handling on site. All sections fit through a standard 36 inch door frame on a standard pallet jack. System is completely factory assembled, requiring only interconnection between modules on site. Systems requiring site assembly other than interconnection are not acceptable (remounting of components removed for shipping is permitted).

5. The control system is NEMA 12 and UL labeled. Provide in the control system:

a. Automatic lead/lag sequencing and alternation.

b. A separate circuit breaker disconnect for each compressor internal to the main control cabinet and protected by the safety interlock of that cabinet.

c. Full voltage motor starters with overload protection.

d. Redundant 120 Volt control circuit transformers
e. Visual and audible reserve unit alarm with isolated contacts for remote alarm and cancelable audio.

f. HOA lighted selector switches

g. Panel mounted pressure gauge

h. Runtime hour-meters for each compressor.

i. When HOA switches are in Hand mode, system will operate on pressure switch and compressors will not run if lead switch is satisfied.

j. Provide visual and audible alarm indication for high discharge air temperature shutdown with isolated contacts for remote alarm.

k. A temperature sensor at the outlet of each compressor cylinder or air-end to provide hi-temp alarm and shutdown that compressor. Systems employing a single switch for multiple cylinders are not acceptable.

l. Dryers are controlled from main control panel with selector switches mounted on control panel.

6. Compressor motors shall be a NEMA rated, open drip proof unit with 1.15 service factor suitable for 208 or 230/460 volt, three phase, 60hz.

7. All moving parts (fans, pulleys and belts) shall be fully protected by an OSHA approved enclosure.

8. All support structures shall be minimum of 10 Gauge Steel.

9. The compressor modules and motors shall be fully isolated from the main compressor base by means of a four point, heavy-duty isolation system for a minimum of 95% isolation efficiency. Engineering data shall be provided supporting isolation efficacy and equal weight distribution between supports. Pumps not having this feature shall have an inertia base sized for that system installed at this contractor’s expense.

10. Provide redundant laboratory air treatment systems including desiccant dryers, filters, and purifiers sized for peak calculated demand. Include dew point and carbon monoxide monitoring laboratory air treatment shall include:

a. Desiccant dryers producing a 10°F (-12°C) pressure dew point. Refrigerant dryers are not acceptable.

b. Dryer purge flow control through an integral dew point based purge control system. Purge controllers using desiccant temperature are not acceptable.

c. 441 transfer valve utilizing two ceramic slide plates. Units utilizing multiple solenoids or diaphragm type switching are not acceptable. Valve shall require no periodic service and be covered by a 10 year factory warranty.

d. Mounted pre-filter rated for 0.01 micron with automatic drain and element change indicator at the inlet to each dryer.

e. Final line filters rated for 0.01 micron with element change indicators, dupplexed final line regulators, and dupplexed safety
relief valves shall be factory mounted and piped at the outlet of each dryer.

11. System piping shall be brazed except where unions are required for service. Vibration flexes shall be all metal and of sufficient length to achieve full isolation. Systems using rubber tubing flex connectors with hose clamps are not acceptable. Systems with short flex connections providing only nominal isolation are not acceptable.

12. Provide corrosion resistant, ASME Coded, National Board Certified receiver rated for a minimum 150 PSIG design pressure. Include a liquid level glass, safety relief valve, manual drain valve, and a screened automatic solenoid valve. During normal operation the flow of air will travel through the tank to allow water vapor to condense in tank.

13. The complete medical air package shall be pre-wired, pre-piped and assembled on one common base with single point connections for electrical, intake air, discharge air, and condensate drains. All elements shall be factory installed including source valve. All piping shall be factory complete including all valves per NFPA 99 Fig. A-5.1.3.5.11.6.

14. The compressors shall be a continuous duty rated scroll type with sealed bearings. The design shall be single stage, air-cooled, consisting of one fixed and one orbiting scroll sealed with PTFE tip seals between the scroll halves and rated for 828kPa (120 PSIG) discharge pressure. Orbiting bearings shall be grease filled and permanently sealed type requiring no lubrication at any time. Units requiring re-lubrication are not acceptable. Noise level shall not exceed 75dB(A) for duplex system, 78dB(A) for triplex system, and 80 dB(A) for quad system with pumps running at peak demand. Belt tensioning shall be achieved with a pivoting motor mounting base adjustable with one tensioning screw. Each compressor shall be equipped with an integral air-cooled after cooler designed for a maximum approach temperature of 7°C (15°F) at 37.8°C (100°F) ambient and complete with electronic drain valve. The discharge of piping of each compressor shall incorporate an integral valve to prevent more than 1/4 revolution of reverse rotation of the scroll at shutdown. The MGEM shall include in their price all labor and parts required for normal maintenance of the actual scroll compressor(s) (i.e. not including service for the package and accessories) for the life of the compressor.

15. The complete medical air system and all electrical components shall be factory pretested prior to shipment by the MGEM.

2.09 AIR AND VACUUM VALVES:

A. Stop valves at compressors, tanks, vacuum pumps, and in air and vacuum piping shall be Jenkins 32A bronze ball valves with screwed connections and Teflon seats.

2.10 FINAL CHECKING AND OPERATING INSTRUCTIONS:

A. A representative of the equipment manufacturer shall periodically check with the Contractor during initial installation of the pipeline systems equipment. He shall assist the Contractor in final check to make certain that all systems are in perfect operating condition. The equipment manufacturer's representative shall provide 8 hours of instruction to the personnel in the use of the piping systems and the related equipment which is operated from those systems.
2.11 LABORATORY FITTINGS:
A. Laboratory fittings will be furnished to the job site by the laboratory equipment supplier, with necessary holes cut in the laboratory equipment. The Mechanical Contractor shall receive, store and install the fittings and make all necessary connections thereto.

2.12 STANDARDS AND CODES:
A. The recommendations of the National Fire Protection Association (NFPA) as set forth in Pamphlet No. 56, 565 and 566, and the "Standard for Medical/Surgical Vacuum Systems in Hospitals" as set forth in Compressed Gas Association (CGA) Pamphlet No. P-2.1, Second Edition 1967, shall apply to this installation and shall be adhered to in all respects.

2.13 Not Used.

PART 3- EXECUTION

3.01 Install in complete compliance with governing Codes and manufacturers instructions.

3.02 Except for piping and pipe fittings, all components shall be supplied by a single manufacturer and shall be fully compatible with Owner's existing system and service devices.

3.03 Tests to include procedures described in NFPA 99, Sections 4-3 through 4-10 and the procedures contained elsewhere in these specifications. See 2.01 G-J. Provide to Owner a notarized letter of certification from equipment manufacturer certifying the following:

A. No cross connections exist.
B. Alarm system is adjusted and performing to manufacturer's design.
C. All components have been installed, adjusted and are functioning in accordance with manufacturer's recommendations.

3.04 Verify compatibility of all new components with existing system and services.

END OF SECTION
PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:

A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.

B. Section 23 00 00 - Basic Mechanical Requirements

C. Section 23 05 29 - Sleeves, Flashings, Supports and Anchors

D. Section 23 05 53 - Mechanical Identification

1.01 SECTION INCLUDES

A. Acid Waste Piping System

1.02 Not Used

1.03 RELATED SECTIONS

A. Section 31 00 00 - Earthwork

B. Section 31 21 00 - Earthwork Beneath Building

C. Section 31 23 00.0020 - Excavation and Fill

D. Section 08 31 13 - Access Doors and Frames

1.04 REFERENCES

Not Used

1.05 SUBMITTALS

A. Submit under provisions of Section 23 00 00.

B. Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalog information. Indicate valve data and ratings.

1.06 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Section 23 00 00.

1.07 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Section 23 00 00.
B. Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.08 QUALITY ASSURANCE
A. Maintain one copy of each document on site.

1.09 QUALIFICATIONS
A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
B. Installer: Company specializing in performing the work of this section with minimum three years documented experience.

1.10 REGULATORY REQUIREMENTS
A. Perform Work in accordance with Uniform Pluming Code.
B. Conform with applicable code for installation of piping.

1.11 DELIVERY, STORAGE, AND HANDLING
A. Deliver, store, protect and handle products to site under provisions of Section 23 00 00.
B. Accept materials on site in shipping containers with labeling in place. Inspect for damage.
C. Provide temporary protection for all materials from the elements and corrosive nature of the environment.
D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.12 ENVIRONMENTAL REQUIREMENTS
A. Do not install underground piping when bedding is wet or frozen.

1.13 EXTRA MATERIALS
A. Furnish under provisions of Section 23 00 00.

PART 2 - PRODUCTS

2.01 WALL, FLOOR AND CEILING PLATES:
A. Except as otherwise noted, provide C.P (Chrome plated) brass floor and ceiling plates around all pipes, conduits, etc., passing exposed through walls, floors, or ceilings, in any spaces except underfloor and above ceiling spaces. Plates shall be sized to fit snugly against the outside of the pipe or against the insulation on lines which are insulated and positively secured to such pipe or insulations. Plates will not be required for piping where
pipe sleeves extend ¾" above finished floor. All equipment rooms are classified as finished areas.

2.02 SLEEVES, INSERTS, AND FASTENINGS:

A. General: All openings through all floors, and roofs, etc., regardless of material for the passage of piping, etc., shall be sleeved. All penetrations must pass through sleeves except waste pipe installed under concrete slabs on fill. Sleeves shall be set in new construction before concrete is poured, as cutting holes through any part of the concrete will not be permitted unless acceptable to the Architect/Engineer. If a penetration is cored into an existing concrete, masonry or stone structure, then the installation of a sleeve will not be necessary.

B. The minimum clearance between horizontal penetrations and sleeve shall be ¼", except that the minimum clearance shall accommodate a Thunderline Link seal closure where piping exits the building, or penetrates a wall below ground level. Contractor shall be responsible for the accurate location of penetrations in the slab for his pipe, duct, etc. All penetrations shall be of ample size to accommodate the pipe, duct, etc. plus any specified insulation. Sleeve materials shall be rigid metal of adequate strength. Void between sleeve and pipe shall be filled with Nelson Flameseal Firestop or approved equal caulk or putty.

C. Installation of sleeves in walls shall be the same as for floors.

D. Sleeves for penetrations passing through walls or floors on or below grade shall be removed, if practical, and after the pipes have been installed, the void space around the pipe shall be caulked with a suitable material to effect a waterproof penetration. Note that the practicality of the removal of the sleeve shall be the decision of the Construction Inspector. The decision of the Inspector shall be final.

E. Inserts: In new construction, suitable concrete inserts for pipe and equipment hangers shall be set and properly located for all pipe and equipment to be suspended from concrete construction. If the inserts are later found not to be in the proper location for the placement of hangers, then drilled anchors shall be installed. Drilled anchors in concrete or masonry shall be submitted for the approval by the Owner.

F. Fastening of pipes, conduits, etc., in the building shall be as follows: To wood members – by wood screws; to masonry – by threaded metal inserts, metal expansion screws, or toggle bolts, whichever is appropriate for the particular type of masonry; to steel – machine screws or welding (when specifically permitted or directed), or bolts, and to concrete by suitable inserts anchored to reinforcing steel, and poured in place unless other means are indicated on the plans. Power-actuated fasteners (shooting) will not be acceptable under any circumstances. If it is necessary to install a method of fastening a hanger after the structure has been installed, then only clamps or drilled anchors shall be used.

Note: Under no circumstances will the use of plastic anchors or plastic expansion shields be permitted for any purpose whatsoever.

G. Rat Proofing: The open space around all ductwork, piping, etc., passing through the ground floor and/or exterior walls shall be rat-proofed in a manner acceptable to the Architect/Engineer.

H. Weatherproofing: The annular space between a pipe and its sleeve in exterior walls or through floor to below grade shall be filled with polyurethane foam rods 50 percent greater in
diameter than the space as backing and fill material and made watertight with a permanent elastic polysulfide compound. Seal both surfaces of wall or floor.

I. Air Plenums: The space around piping, etc. passing through air plenums shall be made airtight in a manner acceptable to the Architect/Engineer.

J. Fireproofing: Each subcontractor shall seal all pipe, etc. penetrations through roof, fire rated walls and floors with a foam or sealant as described below, that will form a watertight, vermin-tight barrier that is capable of containing smoke and fire up to 2000 degrees F for two hours. For wet locations, the foam material shall be a silicone RTV foam or an approved equal. For dry locations, a premixed putty equal to Nelson Flameseal Firestop putty may be used.

2.03 HANGERS:

A. Entire system shall be installed free of stress. Horizontal lines shall allow for lateral movement of pipe and shall be supported by a padded hanger every 4’ to 6’. Vertical lines shall be supported by a padded riser clamp under bottom most coupling in the stack. This riser clamp shall restrict sideward as well as downward movement. Three-inch and larger diameter stacks shall be supported at each floor by a riser clamp on the pipe O.D., smaller diameter stacks shall be supported at every other floor. All riser clamps shall be padded with 1/4" thick solid neoprene or buna-N rubber.

2.04 LABORATORY WASTE AND VENT PIPING:

A. Contractor shall provide a complete corrosion resistant non-pressure drain, waste, and vent system made of following materials:

1. Buried Piping: Pipe and fittings shall be Schedule 40 non-flame retardant polypropylene (PPRO). Fittings to be DWV pattern. Joints to be by electrical fusion coils made of conductive metal wide coated with polypropylene. Acceptable manufacturer: George Fischer Sloane “Fuseal II”


3. Accessible locations at fixture equipment connections: Pipe and fittings shall be Schedule 40 flame retardant polypropylene with mechanical joint fittings. Acceptable manufacturer: George Fischer Sloane Mechanical Joint System.

B. NOT USED

C. NOT USED

D. The joining of the cup sink tailpieces and other sink outlets and strainers to the laboratory waste piping system shall be the responsibility of the Plumbing Contractor. Sink traps shall be flame retardant polypropylene p-trap with mechanical joints.

2.05 TESTING:

A. Refer to Section 221316 for testing requirements. The acid waste system shall be tested as specified for sanitary drainage system.
PART 3 - EXECUTION

3.01 EXAMINATION
   A. Verify excavations under provisions of Section 23 00 00.
   B. Verify that excavations are to required grade, dry, and not over-excavated.

3.02 INSTALLATION
   A. 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.
   B. Piping shall follow as closely as possible the routes shown on Drawings which take into consideration conditions to be met at the site.
   C. Should any unforeseen conditions arise, lines shall be changed or rerouted as required after proper approval has been obtained.
   D. 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.
   E. All piping shall be clean when it is installed. Before installation it shall be checked, upended, swabbed, if necessary, and all dirt from storage or from lying on the ground shall be removed.
   F. Procedure for Assembling Other Joints: For the assembly of the materials included in this section, consult the manufacturers for the recommended procedures.
   G. A manufacturer's representative, who has been certified as a training instructor, shall be at the site prior to the day the piping system installation is to commence. Manufacturer's rep. shall perform a complete training session on the proper method of installation for the piping systems. Upon completion of the training, the installers will be given test on the items covered in the session. Persons successfully completing the test shall be given laminated card which certifies them for one year as installers of the Fuseal piping system.
SECTION 226713
PROCESSED WATER PIPING

PART 1 - GENERAL

1.00 The following sections are to be included as if written herein:
   A. The conditions of the Contract, including the Uniform General Conditions, Supplementary
      General Conditions, Owner's Special Conditions, and Division 01 - General
      Requirements of the Specifications apply to the work specified in this Section.
   B. Section 230000 - Basic Mechanical Requirements
   C. Section 230529 - Sleeves, Flashings, Supports and Anchors
   D. Section 230553 - Mechanical Identification

1.01 SECTION INCLUDES
   A. Pipe, Pipe Fittings, and Valves
   B. Refer to Section 226719 - Processed Water Equipment for additional requirements.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION
   A. Section 011100 - Summary of Work: Owner furnished purified water polishers.

1.03 RELATED SECTIONS
   A. Section 033000 - Cast-in-Place Concrete.
   B. Section 221316 - Plumbing Piping.
   C. Section 230000 - Basic Mechanical Requirements.
   D. Section 230529 - Sleeves, Flashing, Supports and Anchors.
   E. Section 230548 - Vibration Isolation.
   F. Section 230553 - Mechanical Identification: Identification of piping system.
   G. Section 260519 - Cable, Wire and Connectors, 600 Volt: Electrical characteristics, cable,
      wire, materials.
   H. Section 262726 - Wiring Devices and Floor Boxes: Wiring connections.
   I. Section 019100 - Project Commissioning

1.04 REFERENCES
   A. ASME - Boiler and Pressure Vessel Code.
   B. NOT USED
C. NOT USED
D. NOT USED
E. NOT USED
F. NOT USED
G. NOT USED
H. NOT USED
I. NOT USED
J. NOT USED
K. NOT USED
L. NOT USED
M. NFPA 70 - National Electrical Code.
N. SEMI F61-0301 - Guide for Ultra Pure Water System used in semiconductor processing

1.05 SUBMITTALS
A. Submit under provisions of Section 230000.
B. Shop Drawings: Indicate piping system schematic with electrical characteristics and connection requirements.
C. Product Data: Provide manufacturers catalog literature with capacity, weight, and electrical characteristics and connection requirements.
D. Test Reports: Submit piping system pressure test, sterilization test, and water quality test reports as indicated in Part 3.
E. Manufacturer's Installation Instructions: Indicate hoisting and setting requirements, and starting procedures for all equipment. Indicate pipe joining and support methods.

1.06 PROJECT RECORD DOCUMENTS
A. Submit under provisions of Section 230000.
B. Record actual locations of equipment and components. Modify shop drawings to indicate final locations.

1.07 OPERATION AND MAINTENANCE DATA
A. Submit under provisions of Section 230000.
B. Operation Data: Refer to Section 226719 – Processed Water Equipment.
C. Maintenance Data: Refer to Section 226719 – Processed Water Equipment.

1.08 REGULATORY REQUIREMENTS
A. Conform with applicable ASME codes for installation of pressure vessels.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters' Laboratories, Inc., as suitable for the purpose specified and indicated.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect and handle products to site under provisions of Section 230000.

B. Accept delivery of packaged water equipment, storage vessels, etc. on site in factory fabricated containers with shipping skids and pipe end protectors in place. Inspect for damage.

C. Protect piping and equipment from weather and construction traffic.

1.10 WARRANTY

A. Provide warranty under provisions of Section 230000.

1.11 MAINTENANCE MATERIALS

A. Provide maintenance materials under provisions of 230000.

1.12 WORK BY OWNER AFFECTING WORK OF CONTRACTOR

A. The Owner has awarded a contract for project commissioning. Refer to Sections 019100 for requirements.

B. Division 22 Contractors shall perform all work required of it by the Commissioning specifications and as reasonably inferred by them.

C. Division 22 Contractors shall coordinate with the Construction Manager, with all affected trades, and with the Commissioning Agent and shall support the commissioning process as required to accomplish the commissioning scope.

PART 2 - PRODUCTS

2.01 NOT USED

2.02 NOT USED

2.03 The Contractor's work shall include furnishing and installing the following items:

- Valves
- Piping and supports

Refer to Section 226719 – Processed Water Equipment for additional requirements

2.04 NOT USED

2.05 PIPING, VALVES AND FITTINGS (Polypropylene):

A. Where indicated, pipe valves and fittings for purified water service shall be Schedule 40, virgin, un-pigmented polypropylene. Refer to paragraph 3.03 system piping application.
B. Installation practices, including support spacing and joint fusion, shall be in compliance with manufacturer's printed recommendations.

C. Materials from which pipe, fittings and valves are manufactured shall have been tested and approved for conveying potable water by the National Sanitation Foundation (NSF). All pipe, fittings and valves shall bear the NSF hallmark indicating that the material has been tested and approved for conveying deionized water by the National Sanitation Foundation, and shall be as manufactured by Enfield Industrial Corporation, GSR R&G Sloane Manufacturing Company ("PPRO-SEAL") or approved equal.

D. To ensure installation uniformity, all system piping components shall be the products of one manufacturer.

E. All piping shall be thoroughly rinsed and flushed to remove all dirt and debris before installation. After installation the Contractor shall flush the entire piping system with deionized water to the satisfaction of the Owner.

F. NOT USED.

G. Valves shall be ball valve type and shall be manufactured of the same virgin, un-pigmented molding compound as the fittings to assure compatibility.

H. All ball valves shall have Viton seals, and PTFE seats. Ball valves shall carry a pressure rating of 150 psi at a minimum of 68F, and shall be of True Union design as manufactured by Enfield Industrial Corporation, GSR R&G Sloane Manufacturing Company ("PPRO-SEAL") or approved equal.

I. The contractor shall supply a fusion welding machine to the owner prior to completion of the project. The contractor shall also furnish training for a minimum of two of the owner's personnel on the operation of the fusion machine, installation of the piping and fittings, and the maintenance required for the machine and piping systems. The training shall consist of a minimum of 4 hours at a location convenient to the owner, preferably on the owner's premises at the Physical Plant of the institution where this project is constructed. The training shall consist of actual course material designed for the training of maintenance and installation personnel, where actual hands-on training is involved. This training shall not be a sales session consisting of only sales literature and without hands-on training.

2.06 PIPING, VALVES AND FITTINGS (PVC):

A. Where indicated, pipe and fittings shall be polyvinyl chloride (PVC) Schedule 80, Type 1. Refer to paragraph 3.03 for system piping application.

B. Pipe, fittings and valves shall be manufactured from a PVC compound which meets the requirements of Type 1, Grade 1 polyvinyl chloride as outlined in ASTM D-1784. A Type 1, Grade 1 compound is characterized as having the highest requirements for mechanical properties and chemical resistance.

C. Compound from which pipe is produced shall have a design stress rating of 2000 psi at 73 degrees F., listed by the Plastics Pipe Institute (PPI).

D. Materials from which pipe, fittings and valves are manufactured shall have been tested and approved for conveying potable water by the National Sanitation Foundation (NSF).

E. Pipe shall conform to the requirements of ASTM D-1785, as manufactured by Cabot Piping Systems, Louisville, Kentucky, or approved equal.
F. Fittings shall conform to the requirements of ASTM D-2464 for solvent type, as manufactured by Cabot Piping Systems, Louisville, Kentucky, or approved equal.

G. Manual valves shall be stainless steel ball type with Teflon seats, packing and gasket, Jenkins Figure 1336 or approved equal.

H. Solenoid valve is to be especially designed for pure water service. Body is stainless steel with ethylene propylene elastomers. ASCO No. 8210C87E or approved equal.

I. Installation practices, including support spacing and joint threading, shall comply with manufacturer's printed recommendations. In general, socket weld joints are preferred over threaded joints.

J. To insure installation uniformity, all system piping components shall be the products of one manufacturer.

K. NOT USED.

2.07 NOT USED

2.08 NOT USED

2.09 NOT USED

2.10 FLOW CONTROL VALVES:

A. The Mechanical Contractor shall furnish and install a 3/8" PVC flow control valve in each and every purified water outlet that limits the flow to 1/2 GPM.

B. 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.

C. The flow control valves shall be Series "FC," as manufactured by Plastomatic Valves, Inc., or approved equal.

2.11 NOT USED

2.12 PRESSURE GAUGES

A. Pressure gauges shall be 2-1/2" diameter, dual calibrated for 0 to 100 psi and SI units, having 316 stainless steel internals and plastomatic ultra pure gauge guards. The gauges supplied and/or installed for the service specified shall be manufactured by Ashcroft, Fig. No. 1079-S or approved equal.

2.13 NOT USED

2.14 NOT USED

2.15 NOT USED

2.16 PIPING VALVES AND FITTINGS (PVDF)

A. General
All system components (piping, valves, etc.) shall be products of a single manufacturer. The system shall be PVDF piping system as manufactured by George Fischer, Inc. (SYGEF (PVDF)). Substitutions under provisions of Section 230000. Service temperatures are not to exceed 284ºF.

B. PVDF Material

Pipe, valves, and fittings shall be manufactured from a natural, unpigmented, virgin polyvinylidene fluoride (PVDF) homopolymer conforming to the standards of ASTM D-3222. This PVDF material shall have a tensile strength of 6815 psi/470 bar and a flexural strength of 11165 psi/770 bar when tested at 73ºF according to ASTM D-638 and ASTM D-790.

All system components shall meet the requirements of ASTM E84 and NFPA 255 with a flame spread/smoke developed rating not exceeding 25/50.

C. PVDF Pipe

Pipe shall have a Standard Dimension Ratio (SDR) of 21. The pressure rating for all pipe sizes through 4" (110 m) diameter shall be 232 psi (16 bar) when measured at 68ºF. All PVDF pipe shall be ink embossed to denote production lot pipe diameter and wall thickness. Immediately after production the PVDF pipe shall be fitted with protective polyethylene end caps and bagged in a polyethylene liner.

D. PVDF Fittings

All PVDF fittings in sizes through 4" (110mm) diameter shall be butt fusion type suitable for heat fusion.

All PVDF butt fusion fittings shall also be the type as outlined in ASTM D-2657 and have laying lengths designed for use with piping system manufacturer's fusion machines.

All PVDF fittings shall be molded with identification to allow traceability to production lot and resin batch. All flanged connections shall have bolt patterns to accommodate both ASA and ISO (DIN) bolt circles. All threaded connections shall have NPT tapered pipe threads in accordance with the requirements of ANSI B-2.1.

E. PVDF Valves

All PVDF valves in sizes through 2" (63mm) shall be ball valves with either EPDM or RPM/Viton seals.

All PVDF valves in diameters 2-1/2" (75mm) through 4" (110mm) shall be diaphragm valves with flanged connections. The diaphragm valve shall be weir style with either EPDM or PTFE/Viton (backed with EPDM) diaphragm seals.

All PVDF valves with flange connections shall have bolt patterns to accommodate both ASA and ISO(DIN) bolt circles. All PVDF valves with threaded connections shall have NPT tapered pipe threads in accordance with the requirements of ANSI B-2.1.

F. Fusion Equipment

All butt fusion type PVDF pipe, valves and fittings shall be joined in accordance with ASTM D-2657 using fusion joint equipment as manufactured by the piping system manufacturer.

All PVDF butt fusion pipe and fittings shall be joined by use of the Infrared (IR) Butt Fusion Process. The Infrared Equipment to be utilized shall be per the manufacturer's
recommendation. The infrared fusion equipment shall automatically control the fusion temperature, joining pressure, alignment and fusion time. The infrared fusion equipment shall allow for repeatable, uniform fusion welds of minimal size without operator dependency.

G. Fusion Training, Installation and Certification

PVDF piping installation shall only be performed by factory trained and certified installers in accordance with the manufacturer's written procedures. Each installer shall complete the manufacturer's certification course including written test examinations and submittal of fusion test welds to the manufacturer for evaluation and file. All PVDF pipe, valves and fittings shall be properly prepared in accordance with the manufacturer's written instructions. Installation practices, including support spacing and expansion considerations, shall be in compliance with the manufacturer's certification course and written recommendations.

2.17 PROCESSED WATER EQUIPMENT

A. Refer to Section 226719 - Processed Water Equipment

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's instructions.
B. NOT USED.
C. NOT USED.
D. Install valved bypass around purification equipment.
E. Install manual air vent valves at all high points of piping system, including piping direction changes from horizontal to vertical drops (ells only).
F. Install take offs to outlets with shut off valve after take off. Slope take off piping to outlets.
G. Identify piping system and components. Refer to Section 230553.

3.02 FIELD QUALITY CONTROL

A. Field inspection and testing will be performed under provisions of Section 230000.
B. Repair or replace piping as required to eliminate leaks, and retest to demonstrate compliance.
C. Cap (seal) ends of piping when not connected to mechanical equipment.

3.03 SYSTEM PIPING APPLICATIONS

A. Piping within Physical Science Lab (PSL) and Life Science Lab (LSL) shall be PVDF.
B. Piping outside of Physical Science Lab (PSL) and Life Science Lab (LSL) shall be polypropylene. Piping within Reverse Osmosis units (RO) may be PVC.
3.04  SYSTEM STERILIZATION

A. Upon completion of installation, pressure testing, and system flush provide the services of a TCEQ Class III Certified water Specialist to perform system sterilization of lab water and ultra pure water systems.

B. The Sterilant shall incorporate a formulation of peroxacetic acid and hydrogen peroxide catalyst to provide a 6-log reduction of bacteria population at a 1% dilution within a 36-minute soak time.

C. The Sterilant shall be applied in accordance with manufacturer's instructions.

D. Technician shall first fill the system with a 1% solution of the Sterilant with DI water verified by testing as each faucet with manufacturer supplied test strips.

E. Technician shall let the dilution soak for a minimum of 1 hour before rinsing.

F. Technician shall rinse system with DI water until a residual of 0 ppm is verified at each faucet by manufacturer supplied test strips.

G. Following sterilization the technician shall take a sample of water from the furthermost tap and test for total bacteria.

H. If test comes back positive then technician shall repeat process until a test result of non-detected bacteria is provided.

END OF SECTION
SECTION 226719
PROCESSED WATER EQUIPMENT

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 - General Requirements of the Specifications apply to the work specified in this Section.

B. Work in this Section includes, but is not limited to, all labor; materials, equipment, appliances and incidentals necessary to provide the water softening equipment, laboratory reverse osmosis and mixed bed deionization water equipment as shown on the drawings and as specified herein. Systems shall be complete in all respects and shall include all interconnecting piping, valves, fittings, instrumentation, well, ports, controls, control wiring, electrical wiring, etc.

2. Carbon filtration system to serve all reverse osmosis (RO) and purified water systems.
3. Purified water treatment system to serve PSL/LSL. System generally consists of RO pretreatment, storage tank, distribution/polishing skid.
4. Reverse osmosis system with hydro pneumatic tank to provide boiler make-up water.
5. Packaged reverse osmosis system to serve SAL.

1.2 CODES AND STANDARDS

A. All designs and installations shall be in accordance with the most current enforced editions of the following codes, standards, and references adopted by the agencies having jurisdiction. Should discrepancies occur between the specification and the following codes, standards and local agency policies, the most stringent shall prevail:

1. ANSI - American National Standards Institute
2. ASME - American Society of Mechanical Engineers
3. ASTM – American Society for Testing and Materials
4. AWS - America Welding Society
5. IEC – International Electrotechnical Commission
6. NFPA 79 - National Fire Protection Association
7. SSPC – Steel Structures Painting Council
8. UL 508a - Underwriter's Laboratories, Inc.
9. NEC - National Electric Code
10. Equipment is built to Seismic Zone 2 unless otherwise stated.

B. Conform to applicable EPA, Texas Department of Health, Texas Commission on Environmental Quality (TCEQ) and other applicable regulations and codes for addition of chemicals to potable water systems, and for delivery to public sewage systems.

1.3 QUALITY ASSURANCE

A. Products: All materials, equipment, and appliances shall be new and free of defect, and the most current design by the manufacturer(s).

B. Manufacturer: The manufacturer shall have produced the specified product(s) for a period of at least five (5) years prior to beginning the work of this section, and shall have the capability to produce the products to meet the delivery and quantity criteria of the project.

C. Not used.

D. The water treatment systems shall be provided by a single contractor or subcontractor specializing in water treatment systems of the type required. Contractor/subcontractor shall have minimum of five years experience and shall have a local representative with water analysis laboratories and full service personnel.

1.4 SUBMITTALS

A. The following mechanical and electrical drawings are included with the system.

1. General Arrangement Drawing - Shows the overall general arrangement for the system with dimensions to locate equipment.

2. Piping and Instrumentation Diagram(s) - Provides a flow schematic illustrating the treatment equipment. Equipment is shown with the instrumentation, valves, pipe sizes and materials of construction.

3. Equipment Arrangement Drawings for the System Modules - Each equipment arrangement drawing will show overall equipment dimensions, access and maintenance clearance requirements, shipping and operating weights, equipment coatings or lining specifications, anchoring details, piping connections and utility requirements.

4. Control Panel Enclosure Layout - A dimensioned front elevation of the Electrical Control Panel, which details door-mounted component locations and identification. This document also includes part number references for component identification. Depending on system size and complexity, the Nameplate Schedule or Sub-Panel Layout may also be included on this drawing in lieu of a separate drawing.

5. Electrical Schematic Diagrams - This drawing provides a schematic representation of all circuitry contained within the Electrical Control Panel.
including internal and field termination points, PLC I/O wiring, and wire numbering.

6. **Nameplate Schedule** - Lists individual nameplates for control panel devices. This includes nameplate text, material type, size and mounting methods. Depending on system size, this information may be incorporated into one of the Control Panel Layout drawings.

7. **Electrical Bill of Materials** - A spreadsheet listing of all components contained in the Control Panel design. Each component is assigned a bill of material number allowing its reference to the Control Panel Layout drawings.

8. **Operating and Maintenance Manuals** - Include installation instructions for utilities and piping connections to the system. It includes operating procedures, maintenance instructions and vendor manuals for the equipment furnished.

B. Submit product data. Include chemical treatment materials, chemicals, equipment, and manufacturer's installation requirements.

C. Submit field reports including indication that start-up of treatment systems is completed and systems are operating properly. Include analysis of system water before and after cleaning and before and after treatment.

D. Submit operation and maintenance data as part of submittals and Records for Owner. Provide data on chemical feed equipment including spare parts lists, procedures, and treatment programs.

1. Include manufacturer's operation instructions, start-up data, trouble-shooting check lists.

2. Include system components manufacturer's literature, servicing requirements, Record Documents, installation instructions, exploded assembly views, replacement part numbers and availability.

3. Include cleaning procedures, preventive maintenance schedule, preventive maintenance recommendations and procedures.

4. Identify place of purchase, location and contact numbers of service depot and technical support for each product installed.

E. Include step-by-step instructions on test procedures including target concentrations.

F. Submit contractor qualifications including qualifications of personnel working on this project and a list of related projects with points of contacts.

1.5 **RELATED SECTION**
A. The conditions of the Contract, including the Uniform General Conditions, Supplementary General Conditions, Owner's Special Conditions, and Division 01 – General Requirements of the Specifications apply to the work specified in this Section.

B. Section 23 00 00 – Basic Mechanical Requirements

C. Section 23 05 53 - Mechanical Identification

1.6 DELIVERY, STORAGE AND HANDLING

A. Accept delivery of packaged high purity water equipment, storage vessel, etc. on Site in factory fabricated containers with shipping skids and pipe end protectors in place. Inspect for damage. Comply with manufacturers rigging and installation instructions.

B. All components and materials shall be new, undamaged, and free of rust.

C. Provide temporary protective coating and end plugs on valves not packaged within containers. Maintain in place until installation.

D. Provide temporary end caps and closures on openings, connections, pipe and fittings. Maintain in place until installation.

E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work and isolating parts of completed system.

F. Protect all components and materials that are to be installed within this project from exposure to rain, freezing temperatures and direct sunlight. EXCEPTION: Materials manufactured for exterior locations.

1.7 WARRANTY

A. Warranty: Include, but not limited to, coverage for the RO water systems, storage tank, pumps, softener system, all associated instrumentation, controls, accessories and labor.

PART 2 - PRODUCTS

2.1 APPROVED VENDORS

A. General:

1. The manufacturers listed set a standard for reviewed equivalents.

2. Water Softeners and Carbon filters shall be furnished by one manufacturer to ensure component compatibility.

3. Reverse osmosis equipment and mixed bed resin tanks shall be furnished by one manufacturer to ensure component compatibility.

4. All controls and instrumentation shall be furnished by one manufacturer to ensure component compatibility.

5. All equipment shall meet the standard of quality and performance for components specified herein.

B. Valves:
Georg Fisher or equal

C. Pressure Gauges:
   Ashcroft Amer. Gauge Co. or equal

D. Pumps:
   Grundfos or equal

E. Filters:
   Ametek, Pall Corporation, Siemens or equal

F. UV Lights:
   Aquafine or equal

G. Controls:
   Allen Bradley or equal

H. Instrumentation:
   Thornton, Signet, Blue White or equal

I. Softeners Equipment and Controllers
   Siemens, Fleck, Alamo or equal

J. Carbon Filters
   Siemens, Fleck, Alamo, or equal

2.2 PIPE AND FITTINGS

A. Refer to Section 226713 – Processed Water Piping

2.3 VALVES

A. Shutoff Valves

1. Reverse Osmosis Water Shutoff Valves: Hayward “Safe Block”, Georg Fischer Type 346 or equal, true union, full port, PVC ball valve with EPDM seals and PTFE Teflon seats.

2. Distribution Skid Shutoff Valves: Enpure VM, Georg Fischer Type 5282 or equal, manual diaphragm valve with polypropylene body, EPDM diaphragm, and union ends.

3. Check Valves for Purified Water Piping:
   a. Ball Checks: Thermoplastic polypropylene body and ball, true union design. Viton seat and O-ring seal; 150 psig at 75 degrees F; thread or heat fusion weld ends. Georg Fischer type 360, Asahi or equal.
   
   b. Swing Checks: Thermoplastic Polypropylene body and disc; Viton seat and seal, removable, bolted top; flanked ends; 150 psig at 70 degrees F up to 3-inch; 100 psig at 70 degrees F for 4-inch and larger; Asahi Swing Check, or equal (no known equal).
4. Back Pressure Valve (1/2" – 3"): Fischer, Type V, polypropylene, flanged end, 150 psi rated, “PTFE” seal and diaphragm.

2.4 Not Used

PART 3 - EQUIPMENT

3.1 GENERAL

A. Provide all equipment and interconnecting piping and wiring between equipment, including, but not limited to, vessels, storage tanks, media, filter media, electrical controls, pipe fittings, valves, pumps, motors, gauges, sensors, labor, tools, etc., to provide water softening and treatment/purification systems as specified herein.

B. System Description: The overall water system consists of five distinct systems:

1. Duplex water softening system, skid mounted plus brine tank. Dimensions of Assembly (not including brine tank) shall not exceed 133"Lx66"Dx104"H.

2. Duplex carbon filtration system, skid mounted. Dimensions of assembly shall not exceed 97"Lx51"Wx96"H.

3. Purified water treatment system to serve PSL/LSL. System to include four sub-assemblies:
   a. RO pretreatment skid/assembly. Dimensions shall not exceed 34"Wx42"Dx73"H
   b. 500 Gallon storage tank. Dimensions not to exceed 52" diameter x 96"H (including stand)
   c. Circulation and polishing skid. Dimensions of skid shall not exceed 62"Wx32"x74"H (not including mixed bed resin tanks).
   d. Mixed bed resin tanks (six), three trains (lead/lag operation).

4. RO skid/assembly for boiler feed water. Dimensions shall not exceed 34"Wx42"Dx73"H. System also included 119 gallon hydropneumatic tank (23"x63"H).

5. Packaged RO system for SAL. Dimensions shall not exceed 29"Wx35"Dx72"H.

C. The skids/assemblies shall be completely plumbed, wired, valve, and instrumented by the vendor. Control panels shall be provided for the separate systems. Contractor installation shall consist of setting the skids, connecting piping skid both feed water and inter-skid, connecting main electrical to power points and point-to-point wiring of terminal strips on each skid.

3.2 BUILDING WATER SOFTENER: (WS-1)

A. DUPLEX WATER SOFTENER:
Configuration: Duplex with volumetric meter regeneration. Tanks operate in alternating fashion. Water technician shall obtain water chemistry analysis for water system servicing this building/system. Submit water chemistry analysis for review.

Softener system shall be capable of delivering product with maximum Total Hardness as CaCO$_3$ of 100 mg/L (5.8 grains per gallon) at peak flows and continuous flow as described herein. Regeneration shall be based on usage, volumetric flow, not time and shall not be required to regenerate more than once daily. Pressure drop through system at peak flow shall not exceed 15 psig.

1. Mineral Tanks:
   a. Carbon steel construction. Each mineral tank to be 42" diameter by 60" in height. Total resin capacity to be 35 cubic feet each. The amount of resin shall be such that the peak flow rate through either softener does not exceed 5 gpm per cubic foot. Self-supporting tanks shall be of: electric welded pressure vessel quality rated for (150) psig working pressure and hydrostatically tested at 50% in excess of the working pressure.
   b. Paint: 4-6 mils DFT epoxy
   c. Liner: 12-16 mils DFT epoxy (NSF-61 approved)
   d. Face Piping & Laterals: Sch 80 PVC
   e. Skid Materials: Structural Steel I beam
   f. Exchange Mineral: Virgin High capacity cation exchange resin capable of 30,000 grains capacity per cubic foot with 15 lbs. of salt dosage.
   g. Access opening for tanks 20" through 30" diameter shall include two 4" diameter or 4" x 6" elliptical handholes (one in top head and one in lower side shell). Tanks 36" diameter and larger shall include on 11" x 15" manhole in top head.
   h. Tank support(s) shall be structural steel strap leg type welded to lower tank head.
   i. Upper distributor system shall be of the single point baffle type, constructed of Schedule 40 galvanized steel and fittings.
   j. Lower distribution system shall be the hub and radial arm type, PVC constructed with individual fine slotted non-clogging polyethylene strainers arranged for even flow distribution through the resin bed. Slotted lateral arms are unacceptable. The distribution system shall be embedded in a single layer subfill of washed 1/8" x 1/16" gravel to support the resin bed.

2. Automatic Control Valve:
   a. General: Aquamatic 958 Stager with 952 Controller.
   b. Enclosure: Nema 4X fiberglass
c. **Flow Regulators:** Integrate a fixed orifice control valve to regulate backwash flow, brine flow, etc.

d. The skid shall be pre-piped with block and bypass valves with 4” city water connection and a 3” drain connection.

e. The main operating valve shall be an Industrial Automatic Multiport diaphragm type, slow opening and closing, free of water hammer. The diaphragm assembly shall be fully guided on its perimeter when pressure actuated 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.

f. 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 30 to 150 PSI. Valve shall have a soft water sampling cock.

3. **Brine Tank:**

a. The water softener system shall be provided with a salt storage tank capable of storing at least three consecutive regenerations of the softener before requiring any addition of salt. A loose fitting cover shall be supplied with brine tank.

b. The brine tank shall be equipped with an automatic air eliminator safety valve attached to the brine line and housed in a chamber within the brine tank. The brine system shall automatically open to educt the brine into the softener tank, close to prevent eduction of air, and refill the brine tank with the proper amount of water regardless of the salt level in the tank.

c. Tank shall be constructed of rigid 3/8” thick rotationally molded polyethylene with cover. The brine tank shall be equipped with a float operated plastic, fitted field serviceable brine valve for automatic control of brine withdrawal and fresh water refill. The brine valve shall provide positive shut-off to prevent air from entering the system. High purity pellet type or solar salt is required.

d. Provide supply of salt not less than 1000 lbs. (20 sacks) set on pallet in location directed by Architect/Engineer.

4. **Pipe and Fittings**

a. The main operating valve and manifold piping shall be factory assembled and shipped attached to the resin tank for ease of installation and start-up. Piping system shall be rated for 150 psig continuous service. At a minimum, piping shall be: Schedule 40 galvanized steel with galvanized class 150 threaded malleable iron; Type L hard copper with wrought copper fittings; or Schedule 80 PVC with solvent cemented fittings, except threaded fittings or unions shall be provided for all valves, instrumentation ports, and as required for disassembly or service.

5. **Control**
a. An automatic flow controller shall be provided to maintain proper backwash and flush rates over wide variations in operating pressures and require no field adjustment.

b. A factory-mounted and wired cycle controller shall incorporate an adjustable time switch with multiported pilot valve to control all steps of automatic regeneration. Provision for push-button initiated regeneration shall be included.

c. The multiported pilot control valve shall be factory pre-tubed to automatically pressure activate the main operating control valve through the steps of regeneration and return to service. A pointer on the pilot valve indicates the cycle of operation at all times. In the event of power failure, a complete regeneration can be performed by manual operation of the pilot control valve.

d. Electrical lockouts for multiple units shall be provided to prevent more than one unit from regenerating at the same time when regeneration is initiated from an external signal. Regeneration initiation shall be an electrical signaling device as described in "6" below.

6. Automatic Regeneration

a. Provide a "Parallel Twin" control system including an electronic, automatic resetting water meter controller to initiate a regeneration/backwash to the tank on stream having the least amount of remaining capacity. Initiation shall be due to one of the following operating conditions:

1) Immediately upon reaching a pre-set volume.

2) By determination to insure that no tank will become exhausted during the two hour regeneration period of another tank. The controller shall keep track of the remaining volume in each tank. The controller shall then compare the volume remaining to the highest two hour usage period in the previous 8 days. Any tank calculated as not lasting through the regeneration period of the other tank shall be regenerated prematurely.

b. A 120V signal to a selected Regeneration Sequence Controller shall occur upon reaching either condition or manually at any time. Simultaneous regeneration/backwash initiation shall not be possible.

c. The Water Meter Controller package for a Parallel Twin System shall consist of two full flow turbines or paddlewheel each fitted with a solid state sensor for direct installation into the treated water line of each tank and an electronic device which collects, interprets and displays the water flow and status data housed in a Nema 1 enclosure.

d. The electronic programmable controller shall have a rechargeable battery to sustain time, volume and memory functions during power outages up to three hours. A six digit numeric L.E.D. display provides visual
indication of tank status, flow rate and programming values. A lockout shall provide protection against unauthorized tampering.

e. The meter shall be a self-contained, full flow, in-line turbine design utilizing a rotating vane with magnet and Hall Effect sensor. The plastomeric housing incorporates a union connector for easy installation/removal. Flow measurement accuracy shall be ±1.5% over entire operating range. Maximum operating temperature shall be 120 degrees F, and maximum operating pressure shall be 150 psig.

7. Electrical Requirements: 120 VAC, 1 phase, 60 Hz, 10 watts.

8. Basis for design is Siemens Vantage PTI series duplex water softeners or approved equal.

3.3 DUPEX CARBON FILTER: (CF-1)

Configuration: Duplex with timed backwash. Tanks operate in alternating fashion. Activated carbon filter shall reduce chlorine from the water to a level not to exceed <0.1 ppm (0.1 mg/l) as determined by an accepted water analysis of the treated water when the unit is operated at design flow and in accordance with operating instructions

A. DUPEX CARBON FILTER SYSTEM

1. Mineral Tanks:

a. Carbon steel Construction. Each mineral tank to be 30” diameter by 60” in height. Total carbon capacity to be 12 cubic feet each. The amount of carbon shall be such that the peak flow rate through either carbon filter does not exceed 2 gpm per cubic foot. Tank shall be of electric welded pressure vessel quality rated for 150 psig, working pressure and hydrostatically tested at 50% in excess of the working pressure. Tank shall have threaded NPT connections on the service inlet and outlet.

b. Paint: 4-6 mils DFT epoxy
c. Liner: 12-16 mils DFT epoxy (NSF-61 approved)
d. Face Piping & Laterals: Sch 80 PVC
e. Skid Materials: Structural Steel I beam
f. Exchange Mineral: Acid Washed Granular Activated Carbon (Coconut Shell) 12 x 40 mesh.
g. Access opening for the tank shall include two 4” diameter or 4” x 6” elliptical handholes; one in tophead and one in lower side shell.
h. Upper distribution system shall be of the baffle type to evenly distribute the water over the entire tank area. Lower distribution the water over the entire tank area. Lower distribution system shall be of a proven design constructed with individual fine slotted non-clogging polyethylene strainers arranged for even flow distribution through the media bed. Slotted lateral arms are unacceptable. The distribution system shall be
embedded in a single layer subfill of washed 1/8” x 1/16” gravel to support the media bed.

2. Automatic Control Valve:
   a. The main operating valve shall be an industrial automatic multiport diaphragm type, slow opening and closing, free of water hammer. The diaphragm assembly shall be fully guided on its perimeter when pressure actuated 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. The main operating valve shall be manufactured by the manufacturer of the filter. Valve shall have a treated water sampling cock. An automatic flow controller shall be provided to maintain proper backwash and flush rates over wide variation in operating pressures and require no field adjustment.
      
      1) Aquamatic V52 Controller or equal

   b. Enclosure: Nema 4X fiberglass

   c. Flow Regulators: Integrate a fixed orifice control valve to regulate backwash flow. The valve shall be operated by an electric time clock control with a 7 or 14 day calendar time clock control capable of backwashing the filter at a preset time every day. It shall include a manual override to permit manual initiation of backwashing and then return to automatic operation. The valve shall have a 1-year parts warranty and vendor shall provide 1 year of service warranty (labor).

   d. The skid shall be pre-piped with block and bypass valves and a 2” city water connection and a 2.5” drain connection. Electric requirements: 120VAC, 1 phase, 60Hz, 10 Watts

   e. Basis for design is Siemens Vantage PTI series duplex carbon filters or approved equal.

   f. Tanks shall be set to regenerate during night or at unoccupied times.

3.4 PURIFIED WATER SYSTEM FOR SAL/PSL

A. REVERSE OSMOSIS UNIT (RO-1)

1. GENERAL: Reverse Osmosis unit shall be provided with pressure booster pump, microprocessor control panel, piping, valves, and a structural steel frame. All process equipment shall be affixed to and mounted on a structural steel skid. All fasteners are composed of stainless steel or PVC. Skids shall be painted with two zinc enriched primer coats and two acrylic enamel finishing coats. Both membrane housings and pump shall be mounted vertically.

2. High Pressure Water Booster Pump: Vertical Centrifugal multi-stage pump, with 5 HP motor attached. Motor to be TEFC design, close coupled at 3500 RPM. Pump shall be Grundfos CRX series in 316 stainless steel material or approved equal.
3. Reverse Osmosis membrane filters:
   a. Pressure Vessels: 316SS shell with glass filled polypropylene end caps. Each pressure vessel shall be rated for a minimum of 300 psi, non-ASME code vessel. Process connections to be side-entry for feed and concentrate.

   b. Membrane Filters: Thin film composite, spiral-wound membranes within FRP or stainless steel pressure vessels. Each vessel shall have a working pressure rating of 300 psig at 100 degrees F. Each of the RO membranes shall be 4” in diameter and 40” in length. Filmtec or approved equal.

4. Low Pressure piping shall be schedule 80 PVC and PE tubing. High pressure piping shall be threaded brass and braided hose.

5. Controls: Programmable microprocessor controls to provide fully automatic operation of RO system. Controls shall monitor system pressure, feed, permeate and reject flow rates, and conductivity of the permeate stream. A centralized console shall be provided which shall control the operation of:
   a. Automatic interface with level or pressure controls.
   b. Pretreatment and post-treatment interlocks.
   c. Reverse osmosis system controls: All motor controls, starters and disconnect switches shall be furnished and shall be housed in a NEMA 12 steel enclosure. All local controls shall be rated NEMA 4X.

6. Capacity: The RO shall be capable of producing up to 5760 gallons of purified water every 24 hours, with membrane flux of 16-18 gallons per day per square foot. Unit shall be sized for at least 75% recovery of feed water (as permeate) at the coldest specified operating temperature.

7. A prefilter system with 5 micron pleated cartridge filters shall be included. Prefilter sizing shall be based on 1.0 gallon per minute per square foot of filter surface area. The filter housing shall be constructed of polypropylene.

8. All low pressure piping shall be Schedule 80 PVC or specially qualified thermoplastic tubing. The high pressure piping shall be 316L stainless steel or special high pressure thermoplastic tubing. All welded pipe shall be passivated.

9. All low pressure valves shall be PVC ball, ball check, or butterfly design. All high pressure (over 125 psi) valves shall be 316 stainless steel ball, butterfly, glove or needle valves. The system shall include a motorized inlet shut-off valve for systems isolation during shutdown. Cleaning valves and fittings shall be provided for membrane cleaning system connection.

10. Glycerin filled pressure gauges shall be provided to measure filter pressure drops, pump discharge, membrane feed and reject. Process control gauges shall be panel mounted.
11. Analog paddle wheel type flow meters shall be used to indicate the flow of the reject and product water in order to monitor the unit operations. These meters shall be panel mounted.

12. The following process monitoring devices shall be provided:
   a. A low pressure shut off switch on the suction side of the pump.
   b. A total dissolved solids monitor for both product and feed water quality.
   c. A high discharge pressure switch located on the discharge side of the pump.

13. The following automatic features shall be provided on this system:
   a. Automatic shutdown relays, time delays and other devices necessary for automatic operation.
   b. The system shall start and stop either by manual or automatic control.
   c. All auxiliary process equipment shall be automatically switched “on” with plant start-up. All safety devices as previously described shall be operable in the manual mode.
   d. All automatic shutdown shall be indicated after shutdown.

14. Refer to "INSTRUMENTATION" for controls and monitoring equipment parameters.

15. Basis for design is Siemens Vantage™ M41 GP series RO or approved equal.

B. HIGH PURITY WATER STORAGE TANK:(T-1)

1. FDA approved High Density Polyethylene tank, conical bottom, gasket lid and painted steel stand. Complete manway with air vent filter, spray ball, all required tank fittings and ultra sonic liquid level controls to start and stop the RO and stop the loop pump in case of low water level. Capacity to be 500 gallons. Tank designed for initial fill from makeup in less than 2 hours and for 10 minutes minimum residence time in normal operation. Basis of design is Terrapure or approved equal.

2. Ultra sonic liquid level controls shall be integrated into the control panel for the loop system and the RO unit serving this tank to:
   a. Start and stop the RO unit
   b. Low Level alarm to stop the loop pump in case of low water level and provide a trouble alarm light.
   c. High Level alarm to stop the RO unit and provide a trouble alarm.
   d. Provide capability to connect to the BAS system to monitor remotely.

3. A return line assembly shall be included to handle loop return flows ranging from 33-100% of the loop supply flow rate.

4. Storage Tanks Vent Filters and Housings:
a. Vent filters shall be Osmonics “Ventrex-PN” No. VPN922, Dominick Hunter or equal, 20”, 0.2 micron, polypropylene hydrophobic media vent filter. The filter shall be integrity testable with a minimum bubble point of 14 psig in 60:40 IPA and shall be capable of venting 4.0 scfm at 2” w.c. pressure drop.

b. Vent filter housing shall be Ametek 150160 all natural, unpigmented, non-reinforced polypropylene with 3/4” NPT inlet and outlet connections. Housing to accept single open end double 222 O-ring cartridge.

C. LOOP DISTRIBUTION PUMP SKID WITH UV AND FINAL FILTER. (PS-1)

1. Provide a loop distribution pump skid capable of providing a minimum of 30 GPM at a minimum pressure of 60-70 PSI. The system is part of a tanked recirculation with RO pretreatment.

2. Pump shall be multistage centrifugal design, 316SS construction with flanged connections, Grundfos CRN series or approved equal. Provide an option to supply a shelf-spare pump/motor of the same size.

3. Pump to shut off automatically upon substantial loss of downstream pressure, to safeguard against possible piping failures in building distribution loop.

4. Sch 80 PVC pipe materials and valves shall be provided on recirculation skid.

5. Provide the loop pump skid with a pump motor control panel with starter, resistivity/conductivity controller and step down transformer for the UV sterilizer. Panel to be UL listed. Control panel shall be capable of integrating tank level controls and shall provide additional dry contracts for the connection to a BAS for remote monitoring.

6. Provide the loop pump skid with a 254 nm UV sterilizer capable of treating the entire flow rate of the loop at a minimum dosage of 30,000 microwatt-s per square cm. UV to be 316SS electro polished material with light traps for inlet and outlet connections.

7. Final Filter Housing shall be mounted and pre-plumbed to this skid.

8. Refer to “INSTRUMENTATION” for controls and monitoring equipment parameters

9. Basis for design Siemens DIRS System Distribution Skid or approved equal.

D. FILTERS AND HOUSINGS:

1. System RO Pre-Filter and makeup Post-Filter shall each have a Polypropylene housing and a spun polypropylene filter rated for 5-micron filtration.

2. Final Filters shall be pleated polysulfone cartridges rated for 0.2 micron absolute, and sized to handle the entire loop flow rate with no more than 2.5 GPM per 10” equivalent. Filter housings shall be 316SS material, with flanged connections and designed to accept (6) Code O cartridges.
E. MIXED BED RESIN TANKS:

1. The Purified Water System vendor shall provide Mixed Bed Resin Tanks in portable form. 2 sets will be used for loop polish.

2. Loop polish to utilize mixed beds in a lead-lag arrangement, with each unit nominally sized to hold 3.6 cubic feet of resin. Design shall include 3 lead-lag pair such that flow rate does not exceed 10 gpm per in-service train with one pair is disconnected for exchange. Provide quality lights to indicate exhaustion of the primary unit in each pair, and a common resistivity meter for the storage tank feed. The System shall be capable of sending a signal to the BAS system.

3. The resin in the mixed beds shall be mixed in a 40% cation/60% anion ratio and be capable of making a minimum of 10 meg-ohm quality at the start of the system.

4. Each mixed bed tank to be of fiberglass construction with an ABS base. The tank top closure to be supplied with a XTA top with a double-stacked screen and 1" riser pipe of PVC material.

5. Refer to "INSTRUMENTATION" for controls and monitoring equipment parameters

F. ULTRAVIOLET STERILIZERS

1. Provide ultraviolet sterilizer that shall be rated at a minimum of 30 GPM with 1-1/2-inch outlet and inlet stainless steel flanged connections. Lamps shall have manual wipers and use 115 VAC, 60 Hz power. Pressure drop at maximum recommended flow must be 5 psi or less. The bulbs shall be 254 nanometers wave length type. UV sterilizer is to be mounted just after the repressurization pumps. The treatment chamber and all wetted parts shall be of 316 stainless steel. The sterilizers shall include elapsed running time meter and ultraviolet dosage monitor with alarms for low intensity light. Provide light traps on the inlet and outlet of the UV sterilizer. The equipment shall meet US Department of Health regulations. Acceptable manufacturer: Aquafine or approved substitution.

3.5 RO SYSTEM FOR BOILER FEED: (RO-2)

A. Reverse Osmosis Unit

1. GENERAL: Reverse Osmosis unit shall be provided with pressure booster pump, microprocessor control panel, piping, valves, and a structural steel frame. This system incorporates a hydro pneumatic tank in the permeate (product) discharge side of the RO unit. This will result in a back pressure of 40 psi on the RO unit before the unit is shut down, refer to drawings for control sequence. The manufacturer and supplier of the RO unit shall be aware of this and shall provide a unit that will continue to maintain product flow rate as specified in these documents.

2. High Pressure Water Booster Pump: Vertical Centrifugal multi-stage pump, with 5 HP motor attached. Motor to be TEFC design, close coupled at 3500 RPM. Pump shall be Grundfos CRX series in 304 stainless steel material or approved equal.

3. Reverse Osmosis membrane filters:
a. Pressure Vessels: 316SS shell with glass filled polypropylene end caps. Each pressure vessel shall be rated for a minimum of 300 psi, non-ASME code vessel. Process connections to be side-entry for feed and concentrate.

b. Membrane Filters: Each of the RO membranes shall be 4" in diameter and 40" in length. The RO membranes shall be thin-Film composite style, Filmtec or approved equal.

4. Low Pressure piping shall be schedule 80 PVC and PE tubing. High pressure piping shall be threaded brass and braided hose.

5. Controls: Programmable microprocessor controls to provide fully automatic operation of RO system. Controls shall monitor system pressure, flows, and conductivity of the permeate stream.

6. Capacity: The RO shall be capable of producing up to 5760 gallons of purified water every 24 hours, with membrane flux of 16-18 gallons per day per square foot. Unit shall be sized for at least 75% recovery of feed water (as permeate) at the coldest specified operating temperature.

7. Refer to "INSTRUMENTATION" for controls and monitoring equipment parameters

8. Basis for design is Siemens Vantage™ M41 GP series RO (Part Number M41RGP004) or approved equal.

3.6 INSTRUMENTATION

A. Resistivity Monitor: The conductivity analyzer shall be capable of measuring from two cells simultaneously with the range of 0.055 us/cm to 20,000 us/cm. The analyzer shall include three field-selectable high purity temperature compensation algorithms. All algorithms shall converge for absolutely pure water, following the accepted values of T.S. Light published in the Journal of Analytical Chemistry. Algorithms shall be individually selectable for each measurement point. The analyzer display, two alarms and output signal shall each be individually field selectable to represent either conductivity measurement. The temperature measurement shall imply a precision thermistor, providing +/-0.15C accuracy up to 500 feet separation of cell and analyzer. The analyzer shall be housed in a corrosion-resistant plastic NEMA 4X (IP 65) case with an inside conductive coating to provide EMI/RFI shielding from external electrical signals and noise. Isolated output signals of 0-1V, 0-10V and 4-20 ma dc shall be provided for interface with grounded or ungrounded devices. Output scaling shall be adjustable to any range within the display range by front panel keypad. Two SPDT relays, assignable to alarms or diagnostics, shall be provided. The conductivity cell shall imply titanium coaxial electrodes with 0.1 cm constant for all measurements below 20 U=us/cm. It shall have the temperature sensor located in the tip of the center electrode to sense temperature at the same location the conductivity is being measured.

1. Acceptable manufacturer: Leeds, Northrup or accepted substitution.
B. Level Switches: Provide a liquid level system to include fiber optic level sensors mounted into the side of the storage tank for high level, low level and low level cut off for the circulating pump. The sensors will come with a panel mounted controller with relays for the operation of the reverse osmosis unit and the repressure pumps. Components of the level system in contact with the liquid are to be made from PVDF. The controller shall be capable of producing 4-20 milliamp output.

C. Flow Monitor: Provide a panel mounted flow monitor and inline transmitter. The flow monitor will come with a read out for flow rate and totalized flow volume. The unit will come with a 7 digit non-resettable counter for continuous totalizing. The flow transmitter will come with a PVDF paddle wheel sensor and will be provided with a 4-20 milliamp output signal. The unit shall measure from 0-300 GPM.

E. Back Pressure Regulator: Provide an electric actuated ball valve with controller to preset the back pressure on the return line to the storage tank. The valve is designed to maintain a constant back pressure in the building loop system during peak usage. The ball valve shall be made from PVDF with Viton O rings.

F. Pressure Gauges: The pressure gauge is to come with a single scale dial of 0-200 psi. The tube and socket material will be made from 316 SS. The gauges will be liquid filled with glycerin and have a lower connection size of 1/4-inch NPT. The gauges are to be mounted in an Ultrapure Gauge Guard manufactured by Plast-O-Matic or accepted substitution on the product side of the RO unit and chemical gauge guards on the RO pretreatment to the storage tank.

G. Control Panel: The control panel will be NEMA 4X rated and be supplied with a Programmable Logic Controller. The power supply to the panel will be 460V/3pH/60Hz 60 amp service and a 120V/1pH/60Hz 30 amp service. All control wiring and electrical wiring from the equipment will terminate at the control panel and be run in rigid conduit. Disconnects for the service shall be provided. The control panel will contain: disconnect switches and motor starters, instrumentation for water quality, flow and pressures, run lights, on/off switches and alarms. The panel will contain 4-20 milliamp analog outputs for low tank level, low water quality, contacts for pump on/off status, low RO return line pressure and RO low pressure status. Provide two sets of dry form “C” contacts for remote indication of LOW RO RETURN LINE PRESSURE AND RO SYSTEM TROUBLE (to monitor all other indicated alarm status).

H. Pressure Transmitter: A pressure transmitter shall be provided on the return line before the storage tank for and as shown on the drawings. The transmitter shall be manufactured by Signet or accepted substitution.

3.7 PACKAGED REVERSE OSMOSIS SYSTEM FOR SAL: (RO-3)

A. The reverse osmosis unit and module shall be a single integrated fully contain unit complete with internal prefilter cartridge and break tank, reverse osmosis unit, 350 liter storage reservoir, ultraviolet lamp, booster and recirculation pumps (Siemens WT Centra R 200 part #CN200RDM1115 or equivalent).

B. Provide the reverse osmosis unit with one (1) spiral wound thin film composite polyamide reverse osmosis cartridges, 4.0” dia. X 40” long, capable of producing up to 200 liters per hour at 24 degrees C and 160psi.

C. Design the reverse osmosis system to have an optimum recovery of 75 percent (product flow: feed flow) and not to exceed 75 percent (product flow: feed flow) for effective
operation of the system and extended membrane life. This recovery is based on softened feed water with a silt density index of less than 5.0.

D. Design the reverse osmosis system to deliver product water to the integral RO module 92 gallon storage tank on demand from a tank mounted level control switch.

E. Provide the reverse osmosis system with a stainless steel rotary vane pump capable of producing 53 gph at 160 psi.

F. Control the system by means of a microprocessor-based controller housed in the control panel. The RO should also include:
   1. Auto Rinse Capability upon startup with 3-way divert valve recycling water back to the break tank
   2. Integral prefilter and break (feed) tank
   3. Tank (Reservoir) Level Switch
   4. Audio/visual alarms with adjustable settings
   5. Feed and product water conductivity monitoring
   6. RO permeate temperature

G. The RO system module (Centra) shall have the following features:
   1. Internal leak detection system and distribution loop detection system.
   2. Adjustable purity readout setting (resistivity or conductivity) and quality alarm set points.
   3. Multilevel passkey to prevent changes in system settings.
   4. Night service setting to extend component lifespan.
   5. Scrolling display of return loop pressure, product water quality, and quantity of water in reservoir.
   6. Real time clock
   7. Manually initiated automatic sanitization regime for RO and distribution loop.
   8. RS232 and RS458 interface connections.
   10. Auto restart after power supply failure.

H. Input voltage: 110 volts AC, 1 phase. Output voltage: 24 volt DC for safety. Equip the controller with a conductivity meter capable of monitoring input conductivity from 0-1000 micromhos, product conductivity from 1-100 micromhos and percent rejection with alarm output on percent rejection.
I. Reverse Osmosis Water Storage Reservoir

1. Provide on storage reservoir integral to the RO module.

2. Reservoir design should be conical bottom and constructed of smooth linear polyethylene which is chemically resistant. A spray ball shall be integral to the tank.


4. Provide the tank with the following accessories, placed as directed:
   a. Composite vent filter rated at 0.2 micron.
   b. Level switches for low level, RO on/off.

J. RECIRCULATION PUMP – internal to Centra RO module

1. Provide one (1) rotary vane stainless steel recirculation pump.

2. Construct pump housing of type 316 stainless steel, precision machined to ensure absolute alignment of the rotating assembly.

3. Pump Capacity: 4.5G.P.M. @ 45 psi, 110V, 1 PH

K. ULTRAVIOLET STERILIZER – Internal to the Centra RO Module System

1. Provide the ultraviolet sterilizer to function to provide a 99.9 percent bacteria reduction in the water flow stream. Design the system to enable ultraviolet rays to strike bacteria, virus, yeast, molds, and algae, and break through the outer membrane wall, reaching the deoxyribonucleic acid of the organism and destroying it.

2. Provide the ultraviolet sterilizer complete with on basic ultraviolet device capable of a flow rate of 5.0 G.P.M.

3. The maximum operating pressure rating: 120 psi with a test pressure of 180 psi. Design the units to be capable of operating within a water temperature range of 35 to 100 degrees F and an ambient air temperature range of 25 to 120 degrees

L. POSTFILTER MEMBRANE CARTRIDGE FILTER (0.2 MICRON) AND HOUSING (Internal to the Centra RO Module System)

1. Provide a membrane cartridge filter system to filter deionized water to a level of 0.2 micron. The cartridge filter water flow: 5.0 G.P.M.

2. Provide polyethersulphone membrane filter cartridge with a micron rating of 0.2 micron and a maximum flux rate of 5.0 gpm per 10-inch cartridge length.

3.7 EXECUTION

A. GENERAL
1. Furnish and install equipment, piping, and accessories specified herein and as shown on contract drawings, and in accordance with the equipment manufacturer’s recommendations.

B. INSTALLATION

1. Provide all required site supervision during the placement of the equipment, and during the interconnecting plumbing and wiring of the system.

2. Cut all pipe square and remove rough edges. Make changes in direction only by use of proper pipe fittings.

3. Install plastic pipe and fittings as recommended by pipe manufacturer. Make socket fusion joints using equipment supplied by pipe manufacturer according to manufacturer’s instructions. Provide adequate support to prevent distortion of piping system in accordance with pipe manufacturer’s recommendations. Install plastic pipe with adequate offsets to allow for expansion of the piping system.

4. Pipe hangers in contact with plastic piping shall be plastic coated. Provide continuous support of PVC and polypropylene piping in accordance with pipe manufacturer’s recommendations.

5. Install plugs and caps on all openings and during the construction phase to prevent intrusion of construction debris.

6. Provide flexible connections at pump pipe connections, compatible with polypropylene piping. Include all miscellaneous adapters, fittings, etc., required for installation.

7. Provide fused disconnect and across-the-line starter for each pump in a NEMA 4 control panel. Complete with run and stop lights, pressure indicator and run-time hour indicator. Provide all accessories specified.

C. LEAK TESTING

1. Hydrostatically test the completed high purity water piping system with product water at 150 psi for a period of four hours with no loss of pressure or leakage allowed. Defective joints shall be cut out and the piping repaired and retested. Do not conceal any piping until satisfactorily tested. The piping shall not be tested with air. The piping system may be tested in whole or in sections. After successful leak and pressure test, the piping system shall be drained and purged with dry nitrogen to maintain a pure environment until such time that disinfection and start-up process is initiated, just prior to acceptance by Owner.

D. DISINFECTION

1. Disinfection process shall be conducted after the ultrapure water equipment is operational and the polypropylene building piping loop has been pressure and leak-tested. At the completion of pressure and leak testing, the polypropylene piping loop shall be drained using 0.2 micron absolute filtered nitrogen with a maximum 50 psig pressure. The Contractor shall place a pressure relief valve set at 50 psig downstream of the nitrogen filter.
2. Contractor shall consult with Owner to schedule disinfection date.

3. Technical grade 30% unstabilized hydrogen peroxide diluted to 10% with medical grade purified water Type III shall be used as the disinfection agent. Sodium hypochlorite is not acceptable.

4. Hydrogen peroxide disinfection solution shall be placed in storage tanks, pumped through 0.2 micron absolute nylon membrane filters and into high purity polypropylene piping system. All valves and sample ports shall be opened to purge distribution lines of gases. (Note: Deionization equipment shall be taken off-line during disinfection process.) Prior to any operations, be sure that protective equipment and safety shower and/or hose stream is available for personnel protection.

5. Hydrogen peroxide solution shall re-circulate for four hours.

6. Outlets and sample ports shall be opened and closed each hour for one minute.

7. At end of 4-hour recirculation period, valves and sample ports shall be opened and system shall be drained using nitrogen filtered to 0.2 micron absolute to purge system.

8. Nitrogen purge will continue until all outlets and sample ports are closed to the atmosphere.

9. With the high purity storage tank full, the Contractor shall re-circulate the mains which returns back to storage for a minimum of 30 minutes. Recirculation is done with circulation pumps, deionization units, ultraviolet purifier, and final filters on-line.

10. At the end of the 30 minute recirculation period the Contractor shall open each outlet and sample port starting from a point closest to the DI equipment. Each outlet shall be opened for a period not less than one minute to remove nitrogen and flush branch clean.

11. At the completion of disinfection process, the purified water shall be on-line with process equipment ready for operation and distribution piping system in recirculation mode.

12. Contractor shall submit his detailed disinfection/cleaning process for approval by Owner prior to performing the work.

13. Contractor shall provide all chemicals, filters, nitrogen, and other accessories and appurtenances specified herein and necessary to affect the disinfection process.

14. Contractor shall perform a resistivity monitor test at selected lab outlets to verify presence and purity level of high purity water. Test shall be submitted to Owner for approval listing lab room number, purified water outlet location, and water purity level achieved in megohms. All outlets shall be approved for use prior to acceptance by Owner.
E. BACTERIOLOGICAL TESTING

1. Take three representative water samples from pure water loop on each floor. The samples shall show zero organisms/liter. Tests shall be performed by an independent certified testing lab in accordance with ASTM D 1125 and ASTM F60.

F. START-UP

1. Equipment start-up shall be performed by the equipment manufacturer's representative. Monitors and alarms shall be inspected for proper connections and tested for function and signal transmission to Building Automation System. The system shall be filled with product water and flushed until product water is verified at all outlet locations. Test results shall be submitted to Owner. Systems shall not be considered in-service until satisfactory test results are obtained.

2. Verify proper signal transmission for each condition specified to Building Automation System.

3. Manufacturer's representative shall furnish a maintenance logbook with listed scheduled maintenance and normal system operating conditions.

G. COMMISSIONING

1. The supplier of the water treating system shall be fully responsible for final checkout of the installed system, shall start the system into operation, and verify performance. All pieces of equipment shall be fully filled or loaded with consumables (salt, membranes, filter cartridges, batteries, bulbs, fuses, etc.).

2. Prior to start up and testing of the systems. Provide Start-up and testing documentation to the Commissioning Agent for approval of procedures.

3. Provide all initial and final documentation, including but not limited to, water analysis, system start-up documentation, system testing documentation and training verification.

H. OPERATOR TRAINING

1. Manufacturer's representative shall perform 4 hours of on-site operator training for each system (LSL/PSL, Boiler Feed and SAL) instructing personnel on installation, care, maintenance, testing, and operation of water treatment system.

END OF SECTION