

SECTION 22 13 00 – FACILITY SANITARY AND VENT PIPING**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section pertains to sanitary sewer and vent systems, including piping, equipment and all necessary accessories as designated in this section. Sanitary systems in this section refers to sanitary waste and vent piping, floor drains (including floor drain trap primer tubing on all floor drains except those used as indirect waste receptors in food preparation areas), cleanouts and grease interceptors.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.
- E. Section 07 92 00 Joint Sealants: Sealant products.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturer's Literature and Data:
1. Piping.
 2. Floor Drains.
 4. Cleanouts.
 5. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME): (Copyrighted Society)
- A112.6.3-01 (R 2007)..... Standard for Floor and Trench Drains
- A13.1-07..... Scheme for Identification of Piping Systems
- B16.3-06..... Malleable Iron Threaded Fittings, Classes 150 and 300.
- B16.4-06..... Standard for Grey Iron Threaded Fittings Classes 125 and 250
- B16.12-98 (R 2006)..... Cast Iron Threaded Drainage Fittings
- B16.15-06..... Cast Bronze Threaded Fittings, Classes 125 and 250

- C. American Society for Testing and Materials (ASTM):
- A47/A47M-99 (R 2004) Standard Specification for Steel Sheet, Aluminum Coated, by the Hot Dip Process
 - A53/A53M-07 Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated, Welded and Seamless
 - A74-06..... Standard Specification for Cast Iron Soil Pipe and Fittings
 - A183-03..... Standard Specification for Carbon Steel Track Bolts and Nuts
 - A536-84(R 2004)..... Standard Specification for Ductile Iron Castings
 - B32-08..... Standard Specification for Solder Metal
 - B75-02..... Standard Specification for Seamless Copper Tube
 - B306-02..... *Standard Specification for Copper Drainage Tube (DWV)*
 - B584-06a..... Standard Specification for Copper Alloy Sand Castings for General Applications
 - C564-03a Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
 - D2000-08 Standard Classification System for Rubber Products in Automotive Applications
 - D2564-04E1 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
 - D2665-08 *Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings*
- D. International Code Council:
- IPC-06 International Plumbing Code
- E. Cast Iron Soil Pipe Institute (CISPI):
- 301-05 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
 - 310-04 Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- F. American Society of Sanitary Engineers (ASSE):
- 1018-01 Trap Seal Primer Valves – Potable, Water Supplied
- G. Plumbing and Drainage Institute (PDI):
- PDI WH-201 Water Hammer Arrestor
- H. National Standard Plumbing Code

PART 2 - PRODUCTS**2.1 SANITARY WASTE, DRAIN, AND VENT PIPING**

- A. Cast iron waste, drain, and vent pipe and fittings
 - 1. Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:
 - a. pipe buried in or in contact with earth
 - b. sanitary pipe extensions to a distance of approximately 1500 mm (5 feet) outside of the building.
 - c. interior waste and vent piping above grade.
 - 2. Cast iron Pipe shall be bell and spigot or hubless (plain end or no-hub or hubless).
 - 3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888, or ASTM A-74.
 - 4. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM Standard C-564 or be installed with lead and oakum.
- B. Copper Tube, (DWV):
 - 1. Copper DWV tube sanitary waste, drain and vent pipe may be used for piping above ground, except for urinal drains.
 - 2. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
 - 3. The copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME 16.29.
 - 4. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.

- C. Polyvinyl Chloride (PVC)
1. Polyvinyl chloride (PVC) pipe and fittings are permitted where the waste temperature is below 60°C (140°F).
 2. PVC piping and fittings shall NOT be used for the following applications:
 - a. Waste collected from steam condensate drains
 - b. spaces such as mechanical equipment rooms, kitchens, SPD, and sterilizer areas.
 - b. Vertical waste and soil stacks serving more than two floors
 - c. Exposed in mechanical equipment rooms.
 - d. Exposed inside of ceiling return plenums
 3. Polyvinyl chloride sanitary waste, drain, and vent pipe and fittings shall be schedule 40 solid core sewer piping conforming to ASTM D 1785 and ASTM D2665, sewer and drain series with ends for solvent cemented joints.
 4. Fittings:
 - a. PVC fittings shall be solvent welded socket type using solvent cement conforming to ASTM D2564.

2.2 EXPOSED WASTE PIPING

- A. Full iron pipe size chrome plated brass piping shall be used in finished rooms for exposed waste piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
1. The Pipe shall meet Fed. Spec. WW-P-351, standard weight.
 2. The Fittings shall conform to ANSI B16.15, cast bronze threaded fittings with chrome finish, (125 and 250).
 3. Nipples shall conform to ASTM B 687, Chromium-plated.
 4. Unions shall be brass or bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
- B. In unfinished Rooms such as mechanical Rooms and Kitchens, Chrome-plated brass piping is not required. The pipe materials specified under the paragraph "Sanitary Waste, Drain, and Vent Piping" can be used. The sanitary pipe in unfinished rooms shall be painted as specified in Section 09 91 00, PAINTING.

2.3 SPECIALTY PIPE FITTINGS

- A. Transition pipe couplings shall join piping with small differences in outside diameters or different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear and corrosion resistant metal, tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.

2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F 477 or ASTM D5926.
 3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.
 - C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.
 - D. The di-electric nipples shall be electroplated steel nipple complying with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.4 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); and not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. Minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged sanitary line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings and at every building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty type.
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel-bronze square frame and stainless steel cover with minimum opening of 150 by 150 mm (6 by 6 inches) shall be

furnished at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed pipe, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required.

- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/hubless cast iron ferrule. Plain end (hubless) piping in interstitial space or above ceiling may use plain end (hubless) blind plug and clamp.

2.5 FLOOR DRAINS

- A. Type A (FD-A) floor drain shall comply with ANSI A112.6.3. A caulking flange, inside gasket, or hubless connection shall be provided for connection to cast iron pipe, screwed or no hub outlets for connection to steel pipe. The drain shall have medium duty nickel bronze grate. The drain connection shall be bottom outlet. A membrane clamp and extensions shall be provided, if required, where installed in connection with waterproof membrane. Puncturing membrane other than for drain opening will not be permitted. Double drainage pattern floor drains shall have integral seepage pan for embedding into floor construction, and weep holes to provide adequate drainage from pan to drain pipe. For drains not installed in connection with a waterproof membrane, a 2.2 kg (16-ounce) soft copper membrane, 600 mm (24 inches) square or another approved waterproof membrane shall be provided.
- B. Type B (FD-B) floor drain shall comply with ANSI A112.6.3. The type B floor drain shall be constructed of galvanized cast iron with medium duty nickel bronze grate, double drainage pattern, clamping device, without sediment bucket but with secondary strainer in bottom. The grate shall be 175 mm (7 inches) minimum.
- C. Type C (FD-C) floor drain shall comply with ANSI A112.6.3. The type C floor drain shall have a cast iron body, double drainage pattern, clamping device, light duty square or round nickel bronze adjustable strainer and grate with vandal proof screws. The grate shall be square, 150 mm (6 inches) minimum.
- D. Type D (FD-D) floor drain shall comply with ANSI A112.6.3. The type D floor drain shall have a Cast iron body with flange, integral reversible clamping device, seepage openings and 175 mm (7 inch) diameter or square satin nickel bronze or satin bronze strainer with 100 mm (4 inch) flange.
- E. Type B (FD-B) floor drain shall comply with ANSI A112.6.3. The type B floor drain shall have a heavy, cast iron body, double drainage pattern, heavy-duty non-tilting ductile iron grate not less than 300 mm (12 inches) square, removable sediment bucket. Clearance between body and bucket shall be ample for free flow of waste water. For traffic use, an extra heavy duty load classification ductile iron grate shall be provided.
- F. Type F (FD-F) floor drain shall comply with ANSI A112.6.3. The type F floor drain shall be have a cast iron body with flange, integral reversible clamping device, seepage openings and a 225 mm (9 inch) two-piece satin nickel-bronze or satin bronze strainer for use with seamless vinyl floors.

RFI 04867: FD-C should be flushing drain w/recessed flush valve similar to FD-J in EWP08

- G. Type G (FD-G) floor drain shall comply with ANSI A112.6.3. The type G floor drain shall have a cast iron body, shallow type with double drainage flange and removable, perforated aluminum sediment bucket. The type G drain shall have all interior and exposed exterior surfaces coated with acid resistant porcelain enamel finish. The floor drain shall have a clamping device. The frame and grate shall be nickel bronze. The grate shall be approximately 200 mm (8 inches) in diameter. The space between body of drain and basket shall be sufficient for free flow of waste water.
- F. Type H (FD-H) floor drain shall comply with ANSI A112.6.3. The type H drain shall have a cast iron body, double drainage pattern, without sediment bucket but with loose set nickel bronze grate, secondary strainer, and integral clamping collar. The grate shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square. The drain body shall be 150 mm (6 inches) deep.

I. Type I (FD-I) floor drain shall comply with ANSI A112.6.3. The type I floor drain shall have a cast iron body, wide flange for seamless floor, double drainage pattern, with all interior surfaces and exposed exterior surfaces provided with acid resistant enamel finish. The type I floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket with, perforations with not less than 19 300 square mm (30 square inches) of free area. The sediment basket shall be approximately 100 mm (4 inches) deep, and be provided with grips for easy handling. The floor drain shall be provided with a loose-set, nickel bronze grate approximately 300 mm (12 inches) square and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

M. Type M (FD-M) floor drain shall comply with ANSI A112.6.3. The type M floor drain shall have a cast iron body, nickel bronze adjustable funnel strainer and clamping device. Funnel strainer shall consist of a perforated floor-level square or round grate and funnel extension. Minimum dimensions as follows:

1. Area of strainer and collar – 23 000 square mm (36 square inches).
2. Height of funnel – 95 mm (3-3/4 inches).
3. Diameter of lower portion of funnel – 50 mm (2 inches).
4. Diameter of top portion of funnel – 100 mm (4 inches).
5. Provide paper collars for construction purposes.

N. Type N (FD-N) floor drain shall comply with ANSI A112.6.3. The type N floor drain shall have a cast iron body, wide flange for seamless floors, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish. The type N floor drain shall have a clamping device, secured nickel bronze rim, aluminum enameled finish sediment basket, perforated with not less than 9 000 square mm (14 square inches) of free area and approximately 50 mm (2 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate approximately 200 mm (8 inches) shall be round and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

O. Type O (FD-O) floor drain shall comply with ANSI A112.6.3. The type O floor drain shall have a cast iron body, double drainage pattern, clamping device, less grate and sediment basket but with dome type secondary strainer. The drain shall be 300 mm (12 inches) in diameter or 300 mm (12 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces shall have an acid resisting, enamel finish.

P. Type P (FD-P) floor drain shall comply with ANSI A112.6.3. The type P floor drain shall have a cast iron body, double drainage pattern, with all interior and exposed exterior surfaces provided with acid resistant enamel finish. The type P floor drain shall have a clamping device, secured nickel bronze rim, an aluminum enameled finish sediment basket perforated with not less than .027 square m (42 square inches) of free area and approximately 100 mm (4 inches) deep. The sediment bucket shall be provided with grips for easy handling. The loose-set, nickel bronze grate shall be approximately .0077 square m (12 inches square) and of sufficient strength to support pedestrian traffic. Ample space between body of drain and sediment basket shall be provided for free flow of waste liquids.

Q. Type R (FD-R) floor drain shall comply with ANSI A112.6.3. The type R floor drain shall have a cast iron body, double drainage pattern and clamping device, less grate and sediment basket but with dome type secondary strainer. The drain shall be 200 mm (8 inches) in diameter or 200 mm (8 inches) square and approximately 150 mm (6 inches) deep. The interior and exposed exterior surfaces and rim shall have an acid resisting finish.

R. Type S (FD-S) floor sink shall comply with ANSI A112.6.3. The type S floor sink shall be constructed from type 304 stainless steel and shall be 300 mm (12 inches) square, and 200 mm (8 inches deep). The interior surface shall be polished. The double drainage flange shall be provided with weep holes, internal dome strainer, and heavy duty non-tilting loose set grate. A clamping device shall be provided.

S. Type T (FD-T) floor drain shall comply with ANSI A112.6.3. The type T drain shall be Funnel Type, chemical resistant floor drain with integral p-trap. Double drainage pattern floor drain shall have an integral seepage pan for embedding in floor and weep holes to provide adequate drainage from pan to drain pipe. Floor drain shall be polypropylene, flame retardant, Schedule 40 or 80. An outlet of floor drain shall be suitable for properly jointing perforated or slotted floor-level grate and funnel extension. Minimum dimensions as follows:

1. Height of funnel – 95 mm (3-3/4 inches).
2. Diameter of lower portion of funnel – 50 mm (2 inches).
3. Diameter of top portion of funnel – 100 mm (4 inches).

T. Type V (FD-V) floor drain shall comply with ANSI A112.6.3. The type V floor drain shall have an oval funnel and cast iron body. Funnel strainer shall consist of a slotted cast iron floor-level grate funnel extension. Minimum dimensions as follows:

1. Area of strainer and collar – 23 000 Square mm (36 square inches).
2. Height of funnel – 95 mm (3-7/8 inches).
3. Funnel size - 90 by 225 mm (3-1/2 by 9 inches).

U. Open Sight Drains (OSDs) shall be cast iron, constructed as shown by detail.

2.6 TRAPS

- A. Traps shall be provided on all sanitary branch waste connections from fixtures or equipment not provided with traps. Exposed brass shall be polished brass chromium plated with nipple and set screw escutcheons. Concealed traps may be rough cast brass or same material as pipe connected to. Slip joints are not permitted on sewer side of trap. Traps shall correspond to fittings on cast iron soil pipe or steel pipe respectively, and size shall be as required by connected service or fixture.

2.7 TRAP SEAL PRIMER VALVES AND TRAP SEAL PRIMER SYSTEMS

- A. Trap Primer: The trap seal primer valve shall be hydraulic, supply type with a pressure rating of 5.98 kPa (125 psig) and conforming to standard ASSE 1018.
1. The inlet and outlet connections shall be 15 mm or DN15 (NPS ½ inch)
 2. The trap seal primer valve shall be fully automatic with an all brass or bronze body.
 3. The trap seal primer valve shall be activated by a drop in building water pressure, no adjustment required.
 4. The trap seal primer valve shall include a manifold when serving two, three, or four traps.
 5. The manifold shall be omitted when serving only one trap.

2.9 WATERPROOFING

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2

inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproof caulked joint shall be provided at the top hub.

B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the International Plumbing Code (IPC) and these specifications.
- B. Branch piping shall be installed for waste from the respective piping systems and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings where possible.
- F. The piping shall be installed to permit valve servicing or operation.
- G. Unless specifically indicated on the drawings, the minimum slope shall be 2% slope.
- H. The piping shall be installed free of sags and bends.
- I. Seismic restraint shall be installed where required by code.
- J. Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- K. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- L. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- M. Aboveground copper tubing shall be installed according to CDA's "Copper Tube Handbook".
- N. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless or No-hub, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
 - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.
- F. For PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.3 PIPE HANGERS, SUPPORTS AND ACCESSORIES:

- A. All piping shall be supported according to the International Plumbing Code (IPC), Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications. Where conflicts arise between these the code and Section 22 05 11, the most restrictive or the requirement that specifies supports with highest loading or shortest spacing shall apply.
- B. Hangers, supports, rods, inserts and accessories used for pipe supports shall be shop coated with zinc chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 inch to NPS 2 inch): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 2. 80 mm or DN 80 (NPS 3 inch): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
 3. 100 mm or DN100 to 125 mm or DN125 (NPS 4 to NPS 5): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
 4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 inch to NPS 8 inch): 1500 mm (60 inches) with 19 mm (3/4 inch) rod.
 5. 250 mm or DN250 to 300 mm or DN 300 (NPS 10 inch to NPS 12 inch): 1500 mm (60 inch) with 22 mm (7/8 inch) rod.
- E. The maximum spacing for plastic pipe shall be 1.22 m (4 feet). Maximum Spacing for plastic pipe under slab is 5'-0".
- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet). RFI 5521
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, Hangers shall have the following characteristics:
1. Solid or split unplated cast iron.
 2. All plates shall be provided with set screws.
 3. Height adjustable clevis type pipe hangers.
 4. Adjustable floor rests and base flanges shall be steel.
 5. Hanger rods shall be low carbon steel, fully threaded or threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 7. Riser clamps shall be malleable iron or steel.
 8. Rollers shall be cast iron.
 9. See Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, for requirements on insulated pipe protective shields at hanger supports.
- H. Miscellaneous materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- I. Cast escutcheon with set screw shall be provided at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- J. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.

2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.

K. Piping shall conform to the following:

1. Waste and Vent Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm or DN 80 (3 inches) and smaller	2%
100 mm or DN 100 (4 inches) and larger	1%

2. Exhaust vents shall be extended separately through roof. Sanitary vents shall not connect to exhaust vents.

3.4 TESTS

- A. Sanitary waste and drain systems shall be tested either in its entirety or in sections.
B. Waste System tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.

1. If entire system is tested for a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If the waste system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
2. For an air test, an air pressure of 35 kPa (5 psig) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the air test.
3. After installing all fixtures and equipment, open water supply so that all p-traps can be observed. For 15 minutes of operation, all p-traps shall be inspected for leaks and any leaks found shall be corrected.
4. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce (2 ounces) of peppermint into each line or stack.

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SECTION 22 14 00 – FACILITY STORM DRAINAGE**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. This section describes the requirements for storm drainage systems, including piping and all necessary accessories as designated in this section.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures.
- B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: Pipe Hangers and Supports, Materials Identification.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Piping.
 2. Roof Drains.
 3. Cleanouts.
 4. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI).
- C. American Society of Mechanical Engineers (ASME): (Copyrighted Society)
- A112.21.2m-83.....Roof Drains
- A13.1-07.....Scheme for Identification of Piping Systems
- B16.3-06.....Malleable Iron Threaded Fittings, Classes 150 and 300.
- B16.9-07 Factory-Made Wrought Steel Butt welding
Fittings
- B16.11-05.....Forged Steel Fittings, Socket-Welding and Threaded B16.12-98
(R 2006) Cast Iron Threaded Drainage Fittings
- B16.15-06)Cast Bronze Threaded Fittings, Class 125 and 250
- B16.18-01 (R 2005).....Cast Copper Alloy Solder-Joint Pressure Fittings
- B16.22-01 (R 2005).....Wrought Copper and Copper Alloy Solder Joint Pressure Fittings

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

- A47-99 (R 2004)..... Standard Specification for Steel Sheet, Aluminum Coated, by the Hot-Dip Process
- A53-07..... Standard Specification for Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless
- A74-06..... Standard Specification for Cast Iron Soil Pipe and Fittings
- A183-03) Standard Specification for Carbon Steel Track Bolts and Nuts
- A536-84(R 2004)..... Standard Specification for Ductile Iron Castings
- B32-04..... Standard Specification for Solder Metal
- B61-08..... Standard Specification for Steam or Bronze Castings
- B62-02..... Standard Specification for Composition Bronze or Ounce Metal Castings
- B75-02..... Standard Specification for Seamless Copper Tube
- B88-03..... Standard Specification for Seamless Copper Water Tube
- B306-02..... Standard Specification for Copper Drainage Tube (DWV)
- B584-08..... Standard Specification for Copper Alloy Sand Castings for General Applications
- B687-99..... Standard Specification for Brass, Copper, and Chromium-Plated Pipe Nipples
- C564-06a Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

E. International Code Council (ICC):

- PHCC NSPC 2009..... National Standard Plumbing Code

F. Cast Iron Soil Pipe Institute (CISPI):

- 301-05 Hubless Cast Iron Soil and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- 310-04 Couplings for Use in Connection with Hubless Cast Iron Soil and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

PART 2 - PRODUCTS**2.1 STORM WATER DRAIN PIPING**

A. Cast Iron Storm Pipe and Fittings:

1. Cast iron storm pipe and fittings shall be used for the following applications:
 - a. Pipe buried in or in contact with earth.
 - b. Extension of pipe to a distance of approximately 1500 mm (5 feet) outside of building walls.
 - c. Interior storm piping above grade.

- d. All mechanical equipment rooms or other areas containing mechanical air handling equipment.
 2. The cast iron storm Pipe shall be bell and spigot, or hubless (plain end or no-hub) as required by selected jointing method.
 3. The material for all pipe and fittings shall be cast iron soil pipe and fittings and shall conform to the requirements of CISPI Standard 301, ASTM A-888, or ASTM A-74.
 4. Joints for hubless pipe and fittings shall conform to the manufacturer's installation instructions. Couplings for hubless joints shall conform to CISPI 310. Joints for hub and spigot pipe shall be installed with compression gaskets conforming to the requirements of ASTM Standard C-564 or be installed with lead and oakum.
- B. Copper Tube, (DWV): May be used for piping above ground.
1. The copper DWV tube shall be drainage type, drawn temper conforming to ASTM B306.
 2. The Copper drainage fittings shall be cast copper or wrought copper conforming to ASME B16.23 or ASME 16.29.
 3. The joints shall be lead free, using a water flushable flux, and conforming to ASTM B32.
- C. Roof drain piping in the horizontal position shall be insulated.
- D. Roof drain piping in locations where the outdoor conditions are subject to freezing shall be insulated.

2.2 SPECIALTY PIPE FITTINGS

- A. Transition pipe couplings shall join piping with small differences in outside diameters or be of different materials. End connections shall be of the same size and compatible with the pipes being joined. The transition coupling shall be elastomeric, sleeve type reducing or transition pattern and include shear erring and corrosion resistant metal tension band and tightening mechanism on each end. The transition coupling sleeve coupling shall be of the following material:
1. For cast iron soil pipes, the sleeve material shall be rubber conforming to ASTM C564.
 2. For PVC soil pipes, the sleeve material shall be elastomeric seal or PVC, conforming to ASTM F 477 or ASTM D5926.
 3. For dissimilar pipes, the sleeve material shall be PVC conforming to ASTM D5926, or other material compatible with the pipe materials being joined.
- B. The dielectric fittings shall conform to ASSE 1079 with a pressure rating of 860 kPa (125 psig) at a minimum temperature of 82°C (180°F). The end connection shall be solder joint copper alloy and threaded ferrous.
- C. Dielectric flange insulating kits shall be of non conducting materials for field assembly of companion flanges with a pressure rating of 1035 kPa (150 psig). The gasket shall be neoprene or phenolic. The bolt sleeves shall be phenolic or polyethylene. The washers shall be phenolic with steel backing washers.

- D. The dielectric nipples shall be electroplated steel nipple comply with ASTM F 1545 with a pressure ratings of 2070 kPa (300 psig) at 107°C (225°F). The end connection shall be male threaded. The lining shall be inert and noncorrosive propylene.

2.3 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm (4 inches); not less than 100 mm (4 inches) for larger pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged storm sewer line.
- B. Floor cleanouts shall be gray iron housing with clamping device and round, secured, scoriated, gray iron cover conforming to ASME A112.36.2M. A gray iron ferrule with hubless, socket, inside calk or spigot connection and counter sunk, taper-thread, brass or bronze closure plug shall be included. The frame and cover material and finish shall be nickel-bronze copper alloy with a square shape. The cleanout shall be vertically adjustable for a minimum of 50 mm (2 inches). When a waterproof membrane is used in the floor system, clamping collars shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts where shall be provided where indicated on the drawings and at each building exit. The loading classification for cleanouts in sidewalk areas or subject to vehicular traffic shall be heavy duty.
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. The cleanouts shall be extended to the wall access cover. Cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless steel cover with minimum opening of 150 mm by 150 mm (6 inch by 6 inch) shall be provided at each wall cleanout.
- D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.4 ROOF DRAINS AND CONNECTIONS

- A. Roof Drains: Roof Drains (RD) shall be cast iron with clamping device for making watertight connection. Free openings through strainer shall be twice area of drain outlet. For roof drains not installed in connection with a waterproof membrane, a soft copper membrane shall be provided 300 mm (12 inches) in diameter greater than outside diameter of drain collar. An integral gravel stop shall be provided for drains installed on roofs having built up roofing covered with gravel or slag. Integral no-hub, soil pipe gasket or threaded outlet connection shall be provided.
1. Flat Roofs: The roof drain shall have a beehive or dome shaped strainer with integral flange not less than 300 mm (12 inches) in diameter. For an insulated roof, a roof drain with an

- adjustable drainage collar shall be provided, which can be raised or lowered to meet required insulation heights, sump receiver and deck clamp. The Bottom section shall serve as roof drain during construction before insulation is installed.
2. Canopy Roofs: The roof drain shall have a beehive or dome shaped strainer with the integral flange not larger than 200 mm (8 inches) in diameter. For an insulated roof, the roof drain shall be provided with an adjustable drainage collar, which can be raised or lowered to meet the required insulation heights, sump receiver and deck clamp. Bottom section shall serve as roof drain during construction before insulation is installed.
 3. Promenade Decks: the roof drain shall be the same as for canopy roofs, except decks shall have flat, round, loose, non-slip, bronze grate set in square, non-slip, bronze frame.
 4. Portico Roofs and Gutters: Roof drains shall be horizontal angle type drain with flat bottom and horizontal outlet at the same elevation as the pipe to which it is connected. Strainer shall be removable angle grate type.
 5. Protective Roof Membrane Insulation Assembly: The roof drain shall have a perforated stainless steel extension filter, non puncturing clamp ring, large sump with extra wide roof flange and deck clamp.
 - a. Non pedestrian Roofs: The roof drain shall have large polypropylene or aluminum locking dome.
 - b. Pedestrian Roof: The roof drain shall have a bronze promenade top 350 mm (14 inches) square, set in square secured frame support collar.
 6. Roof Drains, Overflow: Roof Drains identified as overflow drains shall have a 50 mm (2 inch) water dam integral to the drain body.
 7. Roof drains in areas subject to freezing shall have heat tape and shall be insulated.
- B. Expansion Joints: Expansions joints shall be heavy cast iron with cast brass or copper expansion sleeve having smooth bearing surface working freely against a packing ring held in place and under pressure of a bolted gland ring, forming a water and air tight flexible joint. Asbestos packing is prohibited.
- C. Interior Downspouts: An expansion joint shall be provided, specified above, at top of run on straight, vertical runs of downspout piping 12 m (40 feet) long or more.
- D. Downspout Nozzle: The downspout nozzle fitting shall be of brass, unfinished, with internal pipe thread for connection to downspout.

2.5 WATERPROOFING

- A. A sleeve flashing device shall be provided at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2

inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.

B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the International code and these specifications.
- B. Branch piping shall be installed from the piping system and connect to all drains and outlets.
- C. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe shall be reamed to full size after cutting.
- D. All pipe runs shall be laid out to avoid interference with other work.
- E. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.
- F. Unless otherwise stated on the documents, minimum horizontal slope shall be one inch for every 8 feet of pipe length.
- G. The piping shall be installed free of sags and bends.
- H. Seismic restraint shall be installed where required by code.
- I. Changes in direction for storm drainage piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep $\frac{1}{4}$ bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and $\frac{1}{8}$ bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
- J. Buried storm drainage piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- K. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- L. Aboveground copper tubing shall be installed according to CDA's "Copper Tube Handbook".

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.

- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. Copper tube and fittings with soldered joints shall be joined according to ASTM B828. A water flushable, lead free flux conforming to ASTM B813 and a lead free alloy solder conforming to ASTM B32 shall be used.
- F. for PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS AND ACCESSORIES:

- A. All piping shall be supported according to the International plumbing code, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications.
- B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
1. NPS 1-1/2 to NPS 2 (DN 40 to DN 50): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 2. NPS 3 (DN 80): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
 3. NPS 4 to NPS 5 (DN 100 to DN 125): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
 4. NPS 6 to NPS 8 (DN 150 to DN 200): 1500 mm (60 inches) with 19 mm (3/4 inch) rod.
 5. NPS 10 to NPS 12 (DN 250 to DN 300): 1500 mm (60 inches) with 22 mm (7/8 inch) rod.
- E. The maximum support spacing for horizontal plastic shall be 1.22 m (4 feet). Maximum Spacing for plastic pipe under slab is 5'-0" (RFI 5521)
- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 m (15 feet).
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates shall have the following characteristics:

1. Solid or split unplated cast iron.
 2. All plates shall be provided with set screws.
 3. Height adjustable clevis type pipe hangers.
 4. Adjustable Floor Rests and Base Flanges shall be steel.
 5. Hanger Rods shall be low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 6. Riser Clamps shall be malleable iron or steel.
 7. Roller shall be cast iron.
 8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gage steel. The shield shall be sized for the insulation.
- H. Miscellaneous Materials shall be provided as specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. All necessary auxiliary steel shall be provided to provide that support.
- I. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- J. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, a fire stop shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 2. Water proofing: At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- K. Piping shall conform to the following:
1. Storm Water Drain to main stacks:

Pipe Size	Minimum Pitch
80 mm (3 inches) and smaller	2%
100 mm (4 inches) (4 inches) and larger	1%

3.5 TESTS

- A. Storm sewer system shall be tested either in its entirety or in sections.
- B. Storm Water Drain tests shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted, as directed.
 1. If entire system is tested with water, tightly close all openings in pipes except the highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly

plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in the system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.

2. For an air test, an air pressure of 35 kPa (5 psi) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the test.
3. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce .06 liters (2 ounces) of peppermint into each line or stack.

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RFI 07576 - Confirmation of required smoke/peppermint test on storm drain piping.

SECTION 22 35 00 – DOMESTIC WATER HEAT EXCHANGERS**PART 1 - GENERAL****1.1 DESCRIPTION:**

This section describes the requirements for domestic hot water heat exchangers including thermometers and all necessary accessories, connections and equipment.

1.2 RELATED WORK:

- A. Section 09 91 00, PAINTING: Preparation and finish painting.
- B. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- C. Section 22 11 23, DOMESTIC WATER PUMPS: Circulating Pump.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Heater Insulation.
- E. Section 22 05 19, METERS AND GAGES FOR PLUMBING PIPING, 22 05 23, GENERAL-DUTY VALVES FOR PLUMBING PIPING, and 22 11 00, FACILITY WATER DISTRIBUTION: Piping, Fittings, Valves and Gages.

1.3 SUBMITTALS:

- A. Submit manufacturer's literature and data pertaining to the water heater in properly bound package, in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES. Include the following as a minimum:
 - 1. Heat Exchangers.
 - 2. Pressure and Temperature Relief Valves.
 - 3. Steam Control Valves.
 - 4. Thermometers.
 - 5. Pressure Gages.
 - 6. Vacuum Breakers.
- B. Equipment components in contact with potable water shall meet NSF compliance requirements in document NSF 61, "Drinking Water System Components – Health Effects.
- C. A form U-1 or other documentation stating compliance with the ASME Boiler and Pressure Vessel code.

1.4.APPLICABLE PUBLICATIONS:

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
 - Z21.22-00/4.4A-00 Relief Valves for Hot Water Supply systems
- C. American Society of Mechanical Engineers (ASME):
 - B1.20.1-01 Pipe Threads, General Purpose
 - B16.5-03 Pipe Flanges and Flanged Fittings, NPS ½ through NPS 24

B16.24-06.....	Cast Copper Alloy Pipe Flanges, Class 150, 300,600, 900, 1500, 2500
PTC 25.3-02.....	Pressure Relief Devices
Section IV-07.....	Heating Boilers
Section VIII-07.....	Pressure Vessels Division 1

1.5 AS-BUILT DOCUMENTATION

- A. The electronic documentation and copies of the Operations and Maintenance Manual, approved submittals, shop drawings, and other closeout documentation shall be prepared by a computer software program complying with Section 508 of the Rehabilitation Act of 1973, as amended (29 U.S.C 794d). The manufacturer or vendor of the software used to prepare the electronic documentation shall have a Voluntary Product Accessibility Template made available for review and included as part of the Operations and Maintenance Manual or closeout documentation. All available accessibility functions listed in the Voluntary Accessibility Template shall be enabled in the prepared electronic files. As Adobe Acrobat is a common industry format for such documentation, following the document, "Creating Accessible Adobe PDF files, A Guide for Document Authors" that is maintained and made available by Adobe free of charge is recommended."
- B. Four sets of manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- C. Four sets of operation and maintenance data updated to include submittal review comments shall be inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

PART 2 - PRODUCTS

2.1 CIRCULATING DOMESTIC WATER HEAT EXCHANGERS

- A. A packaged small capacity with hot water storage tank shall be provided with circulator, heat exchanger coil, controls, and specialties. The domestic water heat exchanger with circulator shall be based upon a standard flow arrangement with water from bottom of storage tank circulated across the heat exchanger coil and returned to tank.
- B. A hot water outlet shall be included at the top of the tank.

- C. A temperature sensor shall be located inside the storage tank.
- D. A circulating pump complying with UL 778, all bronze construction, overhung impeller, and separately coupled inline pump shall be included. The pump shall have mechanical seals. The working pressure shall be rated at 860 kPa (125 psig).
- E. The stand shall be factory fabricated for floor mounting.
- F. The tappings shall be factory fabricated of materials compatible with heat exchanger shell. For sizes 50 millimeters or DN50 (NPS 2) and smaller, the tappings shall be threaded ends fabricated in accordance to ASME B1.20.1. For sizes 65 millimeters or DN65 (NPS 2-1/2) and larger, the tappings shall be flanged according to ASME B16.5 for steel and stainless steel flanges and ASME 16.24 for copper and copper alloy flanges.
- G. Shell insulation shall comply with ASHRAE 890.1 and suitable for operating temperature. The entire shell and nozzles shall be completely surrounded except connections and controls.
- H. The heat exchanger coils shall be constructed from copper and fabricated in a helix wound for steam heating medium. The pressure rating shall be equal to or greater than the steam supply pressure plus 50%.
- I. The temperature controls shall be based upon an adjustable temperature transmitter that operates a control valve and is capable of maintaining outlet water temperature within 2°C (4°F) of setting.
- J. Safety control shall be automatic, high temperature limit shutoff device.
- K. The relief valves shall be ASME rated and stamped for combination temperature and pressure relief valves. One or more relief valves with total relieving capacity at least as great as heat input shall be included. The pressure setting shall be less than the working pressure rating of the heat exchanger minus 10 percent.

2.3 THERMOMETERS:

- A. Thermometers shall be rigid stem or remote sensing, dial type with an aluminum, black metal, stainless steel, or chromium plated brass case. The thermometer shall be back connected, mercury, vapor, BI-metal or gas actuated, with circular dial 90 mm (3 1/2 inches) in diameter graduated from 4 to 100°C (40 to 210°F), with two-degree graduations guaranteed accurate within one scale division. The socket shall be separable, double-seat, micrometer-fittings, with extension neck not less than 65 mm (2 1/2 inches) to clear tank or pipe covering. The thermometer shall be suitable for 20 mm (3/4 inch) pipe threads. Thermometers may be consoles mounted with sensor installed in separate thermometer well.

2.4 SAFETY VALVES FOR SHELL AND STEAM HEATERS:

- A. Separate temperature relief valve and pressure relief valve or combination pressure/temperature relief valves shall be provided on each water heater. The safety valve discharge shall be routed to nearest floor drain.

- B. Temperature Relief Valves shall be constructed from all brass or bronze material. The temperature relief valves shall be automatic, self-closing reseating type valve, equipped with a noncorrosive metal thermostat with bulb extending into tank that can be manually displaced from its seat for test purposes. The temperature relief valve shall be tested and approved as to its BTU capacity by ASME or an independent laboratory satisfactory to the Contracting Officer. In no case shall total rated BTU relieving capacity of temperature relief valve, or valves, be less than BTU input into water heater. Temperature relief valve shall be completely open before temperature reaches 98°C (210°F) and shall close when temperature goes below 93°C (200°F).
- C. Pressure relief valves shall conform to requirements of ASME, Section IV. BTU relieving capacity of pressure relief valve, or valves, shall be not less than BTU input of the water heater. The pressure relief shall be set at 690 kPa (100 psig) pressure.
- D. A double solenoid safety system shall be provided for each shell and steam coil heater to function as a safety over temperature prevention system. System shall consist of aquastat, pilot light, solenoid steam safety valve and solenoid water safety valve located in the control circuit. The aquastat shall be set at 60°C (140°F).

2.5 DOMESTIC HOT WATER COMPRESSION TANKS

- A. A steel pressure rated tank constructed with welded joints and factory installed butyl rubber diaphragm shall be installed as scheduled. The air pre-charge shall be set to minimum system operating pressure at tank.
- B. The tappings shall be factory fabricated steel, welded to the tank and include ASME B1.20.1 pipe thread.
- C. The interior finish shall comply with NSF 61 barrier materials for potable water tank linings and the liner shall extend into and through the tank fittings and outlets.
- D. The air charging valve shall be factory installed.

2.6 HEAT TRAPS

- A. Heat traps shall be installed in accordance with ASHRAE 90.1, latest edition.

2.7 COMBINATION TEMPERATURE AND PRESSURE RELIEF VALVES

- A. The combination temperature and pressure relief valves shall be ASME rated and stamped and include a relieving capacity at least as great as the heat input and include a pressure setting less than the water heater's working pressure rating.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. The water heaters shall be installed on concrete bases. Refer to Specification Section 03 30 00, CAST-IN-PLACE CONCRETE and Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING
- B. The water heaters shall be installed level and plumb.

- C. Water heaters shall be installed and connected in accordance with manufacturer's written instructions.
- D. All pressure and temperature relief valves discharge shall be pipe to nearby floor drains.
- E. Thermometers shall be installed on water heater inlet and outlet piping.
- F. The control thermostats shall be set for a maximum setting of 54°C (130°F).

3.2 LEAKAGE TEST:

- A. Before piping connections are made, the water heaters shall be tested at a hydrostatic pressure of 1375 kPa (200 psi) for water heaters rated at less than 1103 kPa (160 psig) and 1654 kPa (240 psig) for units with an maximum working pressure of 1103 kPa (160 psig) or over. Any failed test shall be corrected and the water heater shall be retested at no additional cost to the VA.

3.3 PERFORMANCE TEST:

- A. Ensure that all of the remote water outlets will have a minimum of 49°C (120°F) and a maximum of 54°C (130°F) water flow at all times. If necessary, make all correction to balance the return water system or reset the thermostat to make the system comply with design requirements.

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SECTION 22 40 00
PLUMBING FIXTURES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Plumbing fixtures, associated trim and fittings necessary to make a complete installation from wall or floor connections to rough piping, and certain accessories.

1.2 RELATED WORK

- A. Sealing between fixtures and other finish surfaces: Section 07 92 00, JOINT SEALANTS.
- B. Flush panel access doors: Section 08 31 13, ACCESS DOORS AND FRAMES.
- C. Through bolts: Section 10 21 13, TOILET COMPARTMENTS.
- D. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- E. SECTION 01 91 13, COMMISSIONING OF SYSTEMS. Requirements for commissioning, systems readiness checklist, and training.
- F. Section 01 03 42 ALTERNATES: Alternate 8.40. Eliminate the emergency showers at the service bays and provide emergency eyewashes only. Provide mixing valve and supply piping sized for the eyewash only.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Submit plumbing fixture information in an assembled brochure, showing cuts and full detailed description of each fixture.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standard Institute (ANSI):
The American Society of Mechanical Engineers (ASME):
A112.6.1M-02 (R2008) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
A112.19.1M-08 Enameled Cast Iron Plumbing Fixtures
A112.19.2M-03 Vitreous China Plumbing Fixtures
A112.19.3-2001(R2008) Stainless Steel Plumbing Fixtures (Designed for Residential Use)

- C. American Society for Testing and Materials (ASTM):
A276-2010Stainless and Heat-Resisting Steel Bars and Shapes
WW-P-541-E/GENPlumbing Fixtures with Amendment 1
- D. National Association of Architectural Metal Manufacturers (NAAMM): NAAMM AMP 500-505
Metal Finishes Manual (1988)
- E. American Society of Sanitary Engineers (ASSE):
1016-05Performance Requirements for Individual Thermostatic, Pressure
Balancing and Combination Pressure Balancing and
Thermostatic Control Valves for Individual Fixture Fittings
- F. National Sanitation Foundation (NSF)/American National Standards Institute (ANSI):
61-2009Drinking Water System Components-Health Effects
- G. American with Disabilities Act (A.D.A) Section 4-19.4 Exposed Pipes and Surfaces
- H. Environmental Protection Agency EPA PL 93-523 1974; A 1999) Safe Drinking Water Act.
- I. International Building Code, ICC IPBC 2009.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL

- A. Corrosion-resistant Steel (CRS):
 - 1. Plate, Sheet and Strip: CRS flat products shall conform to chemical composition requirements of any 300 series steel specified in ASTM A276.
 - 2. Finish: Exposed surfaces shall have standard polish (ground and polished) equal to NAAMM finish Number 4.
- B. Die-cast zinc alloy products are prohibited.

2.2 STOPS

- A. Provide lock-shield loose key or screw driver pattern angle stops, straight stops or stops integral with faucet, with each compression type faucet whether specifically called for or not, including sinks in wood and metal casework, laboratory furniture and pharmacy furniture. Locate stops centrally above or below fixture in accessible location.
- B. Furnish keys for lock shield stops to Resident Engineer.
- C. Supply from stops not integral with faucet shall be chrome plated copper flexible tubing or flexible stainless steel with inner core of non-toxic polymer.
- D. Supply pipe from wall to valve stop shall be rigid threaded IPS copper alloy pipe, i.e. red brass pipe nipple, chrome plated where exposed.
- E. Psychiatric Area: Provide stainless steel drain guard for all lavatories not installed in casework.

2.3 ESCUTCHEONS

- A. Heavy type, chrome plated, with set screws. Provide for piping serving plumbing fixtures and at each wall, ceiling and floor penetrations in exposed finished locations and within cabinets and millwork.

2.4 LAMINAR FLOW CONTROL DEVICE

- A. Smooth, bright stainless steel or satin finish, chrome plated metal laminar flow device shall provide non-aeration, clear, coherent laminar flow that will not splash in basin. Device shall also have a flow control restrictor and have vandal resistant housing.
- B. Flow Control Restrictor:
 - 1. Capable of restricting flow from 95 ml/s to 110 ml/s (1.5 gpm to 1.7 gpm) for lavatories; 125 ml/s to 140 ml/s (2.0 gpm to 2.2 gpm) for sinks P-505 through P-520, P-524 and P-528; and 170 ml/s to 190 ml/s (2.75 gpm to 3.0 gpm) for dietary food preparation and rinse sinks or as specified.
 - 2. Compensates for pressure fluctuation maintaining flow rate specified above within 10 percent between 170 kPa and 550 kPa (25 psi and 80 psi).
 - 3. Operates by expansion and contraction, eliminates mineral/sediment build-up with self-cleaning action, and is capable of easy manual cleaning.

2.5 CARRIERS

- A. ASME/ANSI A112.6.1M, with adjustable gasket faceplate chair carriers for wall hung closets with auxiliary anchor foot assembly, hanger rod support feet, and rear anchor tie down.
- B. ASME/ANSI A112.6.1M, lavatory, steel plate as detailed on drawing. All lavatory chair carriers shall be capable of supporting the lavatory with a 500 pound vertical load applied at the front of the fixture.
- C. Where water closets, lavatories or sinks are installed back-to-back and carriers are specified, provide one carrier to serve both fixtures in lieu of individual carriers. The drainage fitting of the back to back carrier shall be so constructed that it prevents the discharge from one fixture from flowing into the opposite fixture.

2.6 WATER CLOSETS

- A. (P-101) Water Closet (Floor Mounted) - elongated bowl, siphon jet 6 L (1.6 gallons) per flush, floor outlet. Top of rim shall be (16 ½ inches) above finished floor.
 - 1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 - 2. Fittings and Accessories: Floor flange fittings-cast iron; Gasket-wax; bolts with chromium plated cap nuts and washers.

3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, hard wired/battery powered active infra-red sensor for automatic operation with courtesy flush button for manual operation, water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance, top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker, and sweat solder adapter with cover tube and cast set screw wall flange. Set centerline of inlet 292 mm (11 1/2 inches) above rim. Seat bumpers shall be integral part of flush valve. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass.
- B. (P-101A) Water Closet (Floor Mounted) Same fixture as P-101 above less electronic valve except with manual flush valve.
1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Floor Flange fittings - cast iron; gaskets - wax; bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold-open, ADA approved side oscillating handle, offset top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, sweat solder adapter with cover tube and cast set screw wall flange, and high back pressure vacuum breaker. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass. Set centerline of inlet 673 mm (26 1/2 inches) above rim. Seat bumpers shall be set in wall behind fixture at proper contact height.
- C. (P-102) Water Closet (Floor Mounted with Bedpan Washer ASME/ANSI A112.19.2M) floor outlet, with bed pan lugs – bedpan washer, flush valve operated, 6 L (1.6 gallons) per flush. Top of rim shall be (16 1/2 inches) above finished floor. Provide standoff bracket support between studs for bedpan washer at height as recommended by manufacturer.
1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Floor Flange fittings - cast iron; gaskets - wax; bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, non-hold-open, ADA approved side oscillating handle, offset top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, sweat solder adapter with cover tube and cast set screw wall flange, and high back pressure vacuum breaker. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass. Set centerline of inlet 673 mm (26 1/2 inches) above rim. Seat bumpers shall be set in wall behind fixture at proper contact height.
- D. (P-103) Water Closet (Floor mounted with Bedpan Washer) as P-102 above except shall be wall outlet.
- E. (P-104) Water Closet (Floor mounted, ANSI 12.19.2M). Office and industrial, elongated bowl, siphon jet 6 L (1.6 gallons) per flush, back outlet. Top of rim shall be (16 1/2 inches) above finished floor.

1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Floor flange fittings-cast iron; Gasket-wax; bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, exposed chrome plated, hard wired/battery powered active infra-red sensor for automatic operation with courtesy flush button for manual operation, water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance, top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker, and sweat solder adapter with cover tube and cast set screw wall flange. Set centerline of inlet 292 mm (11 1/2 inches) above rim. Seat bumpers shall be integral part of flush valve. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM Alloy classification for semi-red brass.
- F. (P-104A) Water Closet (Floor Mounted, back outlet) Same fixture as P-104 above except and with manual flush valve.
- G. (P-105) Water Closet (Floor Mounted, Floor Outlet ANSI 112.19.2M) elongated bowl with siphon jet 6 L (1.6 gallons) per flush, floor outlet Type 304 stainless steel, back supply. Top of rim shall be 17 inches above finished floor above finished floor.
1. Seat: Institutional/Industrial, extra heavy duty, chemical resistant, solid plastic, open front less cover for elongated bowls, integrally molded bumpers, concealed check hinge with stainless steel post. Seat shall be posture contoured body design. Color shall be white.
 2. Fittings and Accessories: Floor flange fittings-cast iron; Gasket-neoprene; bolts with chromium plated cap nuts and washers.
 3. Flush valve: Large chloramines resistant diaphragm, semi-red brass valve body, fully concealed, hydraulic push button metal type actuator, water saver design 6 L (1.6 gallons) per flush with maximum 10 percent variance, top spud connection, adjustable tailpiece, one-inch IPS screwdriver back check angle stop with vandal resistant cap, high back pressure vacuum breaker, and sweat solder adapter with cover tube and cast set screw wall flange.

2.7 URINALS

- A. (P-201) Urinal (Wall Hung, ANSI A112.19.2M) bowl with integral flush distribution, wall to front of flare 356 mm (14 inches). Wall hung with integral trap, washout flushing action (0.125 gallon) per flush with 50 mm (2 inches) back outlet and 19 mm (3/4 inch) top inlet spud.
1. Support urinal with chair carrier and install with rim 600 mm (24 inches) above finished floor.
 2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, exposed flush valve electronic sensor operated, hardwired/battery powered, active infrared sensor for automatic operation, water saver design, 19 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11 1/2 inches) above urinal. Valve body, cover, tailpiece, and control stop shall be in conformance with ASTM alloy classification for semi-red brass.

- B. (P-202) Urinal (Wheelchair, Wall Hung, ANSI A112.19.2M) bowl with integral flush distribution, wall to front of flare 356 mm (14 inches). Wall hung with integral trap, washout flushing action (0.125 gallon per flush) with 51 mm (2 inches) back outlet and 19 mm (3/4 inch) top inlet spud.
1. Support urinal with chair carrier and install with rim 381 mm (15 inches) above finished floor.
 2. Flushing Device: Large chloramines resistant diaphragm, semi-red brass body, exposed flush valve, electronic sensor operated, hard-wired/battery-powered active infrared sensor for automatic operation, water saver design, 19 mm (3/4 inch) capped screwdriver angle stop valve. Set centerline of inlet 292 mm (11 1/2 inches) above urinal. Valve body, cover, tailpiece and control stop shall be in conformance with ASTM alloy classification for semi-red brass.
- C. (P-203) Urinal (Wall hung ASME/ANSI A112.19.2M) same fixture as P-201 above except with manual flush valve.
- D. (P-204) Urinal (Wall hung ASME/ANSI A112.19.2M) same fixture as P-202 above except with manual flush valve.

2.8 LAVATORIES

- A. Dimensions for lavatories are specified, Length by width (distance from wall) and depth.
- B. Brass components in contact with water shall contain no more than 3 percent lead content by dry weight.
- C. (P-413) Lavatory (Counter Mounted ASME/ANSI A112.19.2M) vitreous china, self-rimming, approximately (20³/₄" X 17¹/₂" oval) with punching for faucet on (4 inches) centers. Mount unit in countertop.
1. Faucet: Solid cast brass construction with washerless Quatum cartridge type, 5" rigid gooseneck spout with outlet (9⁵/₈ inches) above slab with 102 mm (4 inches) wrist blade handles. Provide 0.5gpm laminar flow control device. Faucet, wall and floor escutcheons shall be either copper alloy or CRS. Exposed metal parts shall be chrome plated with a smooth bright finish.
 2. Drain: cast or wrought brass with flat grid strainer, offset tailpiece, brass, chrome plated.
 3. Stops: Angle type. See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap, adjustable with connected elbow and 1.4mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to the wall.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- D. (P-414) Lavatory (Wrist Control, ASME/ANSI A112.19.2M) straight back, approximately (20 inches by 18¹/₄ inches) first quality vitreous china. Punching for faucet shall be on (4 inches) centers.
1. Faucet: Solid cast brass construction with washerless Quantum cartridge type and centrally exposed 5" rigid gooseneck spout with outlet (9⁵/₈ inches) above rim. Provide 0.5 gpm laminar flow control device. One hundred two millimeter (4-inch) wrist blade type, handles on faucets shall be cast, formed or drop forged copper alloy. Faucet, wall and floor escutcheons shall be either copper alloy or CRS.

- Exposed metal parts, including exposed part under valve handle when in open position, shall be chrome plated with a smooth bright finish.
2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, chrome plated.
 3. Stops: Angle type. See paragraph 2.2.Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap. Adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Exposed metal trap surface, and connection hardware shall be chrome plated with a smooth bright finish. Set trap parallel to the wall.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- E. (P-417) Lavatory (Semi-Countertop Mounted ASME/ANSI A112.19.2M) vitreous china, self-rimming, approximately (19 inches x 21½inches) with punching for faucet on 102 mm (4 inches) centers. Mount unit in countertop.
1. Faucet: Solid cast brass construction, Single handle deck type, (4 inches) maximum center, gooseneck spout with outlet (9-5/8 inches) above rim, (4 inch) wristblade handles. Control shall be washerless Quatern disc mixing cartridge type. Provide 0.5 gpm laminar flow control device, high temperature limit stop and vandal proof screws.
 2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, chrome plated.
 3. Stops: Angle type. See paragraph 2.2. Stops
 4. Trap: Cast copper alloy, 38 mm by 32 mm (1 1/2 inches by 1 1/4 inches)P-trap, adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Set trap parallel to the wall. Exposed metal trap surface and connection hardware shall be chrome plated with a smooth bright finish.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- F. (P-418) Lavatory Anti-ligature (Sensor Control, Wall Mounted ASME/ANSI A112.19.2M) (21¼ x 21½ inches) single station fixture designed to minimize ligature points. Fixture is constructed of vandal-resistant Terreon. Support with ASME/ANSI A112.19.1M, in wall, chair carrier.
1. Faucet: Electronic sensor operated, 120/24 volt solenoid, plug in transformer. Provide 0.5 gplaminar flow control device. Breaking the light beam shall activate the water flow. Flow shall stop when user moves away from light beam. All connecting wiring between transformer, solenoid valve and sensor shall be cut to length with no excess hanging or wrapped up wiring allowed.
 2. Drain: Cast or wrought brass with flat grid strainer, offset tailpiece, chrome plated. Set trap parallel to wall.
 3. Stops: Angle type. See paragraph 2.2.Stops
 4. Trap: Cast copper alloy, (1 1/2 inches by 1 1/4 inches)P-trap, adjustable with connected elbow and 1.4 mm thick (17 gauge) tubing extension to wall. Set trap parallel to the wall. Provide stainless steel trap cover.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.

2.9 SINKS

- A. Dimensions for sinks and laundry tubs are specified, length by width (distance from wall) and depth.

- B. (P-501) Service Sink single bowl, acid resistant enameled cast iron, approximately 610 mm by 508 mm (24 inches by 20 inches) with 229 to 305 mm (9 to 12 inches) raised back without faucet holes. Equip sink with CRS rim guard. Mount sink on trap standard.
1. Faucet: Solid brass connection, horizontal swing spout with escutcheon mounted on wall above sink. Solid brass construction, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, integral stops, mounted on wall above sink. Spout shall have a pail hook, 19 mm (3/4 inch) hose coupling threads, vacuum breaker, and top or bottom brace to wall. Lever handles on faucets shall be cast, formed, or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish. Provide 914 mm (36 inches) hose with wall hook. Centerline of rough in is 1219 mm (48 inches) above finished floor. See Architectural drawings for faucet mounting height.
 2. Drain: Seventy six millimeter (3 inches) cast brass with nickel bronze strainer.
 3. Trap: Trap standard, painted outside and enameled inside with acid-resistant enamel, drain through adjoining wall.
- C. (P-504) Service Sink (Corner, Floor Mounted) stain resistant molded stone, (36 inches by 24 inches by 10 inches) Provide extruded aluminum cap on front side.
1. Faucet: Solid brass construction, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, integral stops, mounted on wall above sink. Spout shall have a pail hook, 19 mm (3/4 inch) hose coupling threads, vacuum breaker, and top or bottom brace to wall. Lever handles on faucets shall be cast, formed, or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish. Provide 914 mm (36 inches) hose with wall hook. Centerline of rough in is 1219 mm (48 inches) above finished floor. See Architectural drawings for faucet mounting height.
 2. Drain: Seventy six millimeter (3 inches) cast brass drain with nickel bronze strainer.
 3. Trap: P-trap, drain through floor.
- D. (P-505) Clinic Service Sink (Flushing Rim, Wall Hung) approximately 508 mm by 635 mm (20 inches by 25 inches) by 203 mm (8 inches) deep. Support with ASME/ANSI A112. 6.1M chair carrier and secure with 10 mm (3/8 inch) bracket studs and nuts. Set sink with rim 762 mm (30 inches) above finished floor.
1. Faucet: Elbow control, wall hung, integral stops, single spout with 19 mm (3/4 inch) hose threaded outlet and pail hook, vacuum breaker and brace to wall. Outlet 356 mm to 381 mm (14 inches to 15 inches) from wall. Exposed metal parts shall be chromium plated with a smooth bright finish. Provide laminar flow control device.
 2. Flush valve: Large diaphragm, semi-red brass body, exposed chromium plated flush valve with screwdriver back check straight stop with cap, union outlet, street ells, elevated high pressure vacuum breaker, casing cover, 32 mm (1 1/4 inches) elbow flush connection from finished wall to 38 mm (1 1/2 inches) top spud. Spud coupling, wall and spud flanges.
 3. Bed Pan Washer: Mechanical pedal mixing valve, wall hung, with double self-closing pedal valve with loose key stops, renewable seats and supply from valve to nozzle with wall hook hose connection; 1219 mm (48 inches) of heavy duty rubber hose, with extended spray outlet elevated vacuum breaker, indexed lift up pedals having clearance of not more than 13 mm (1/2 inch) above the floor and not less than 356 mm (14 inches) from wall when in operation. Supply pipe from wall to valve stop shall be rigid, threaded, IPS copper alloy pipe.

- Exposed metal parts shall be chromium plated with a smooth bright finish. Provide valve plate for foot control. Provide inline laminar flow control device.
4. See Architectural drawings for sink and faucet mounting heights.
- E. (P-507) Plaster Sink, vitreous glazed earthenware, single compartment with 152 mm to 203 mm (6 inches to 8 inches) integral back and approximately 762 mm by 559 mm (30 inches by 22 inches) with 229 mm (9 inches) apron. Support sink with cast aluminum or enameled iron brackets on ASME/ANSI A112.6.1M, Type I, chair carrier. Set sink rim 914 mm (36 inches) above finished floor.
1. Faucet: Solid brass construction, combination faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, mounted on wall above sink back, 13 mm (1/2 inch) female union inlets, integral screw-driven stops in shank, and rigid gooseneck spout. Provide laminar control device. 152 mm (6 inches) blade handles on faucets shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a smooth bright finish.
 2. Drain: Open waste strainer with 51 mm (2 inches) outside diameter waste connection and clean out between strainer and plaster trap. Provide 51 mm (2 inches) outside diameter connection to wall with escutcheon.
 3. Plaster Trap: Heavy cast iron or steel body with removable gasket cover, porcelain enamel exterior and two female, threaded, side inlet and outlet. Provide removable perforated stainless steel sediment bucket. Minimum overall dimensions shall be 216 mm (8 1/2 inches) diameter by 318 mm (12 1/2 inches) high. Trap shall be non-siphoning and easily accessible for cleaning.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4
- F. (P-519) Sink (Surgeons Scrub-up, Sensor Control) single unit, approximately (32 inches by 27-9/32 inches) and (51½ inches) deep.
1. Construction: Provide a minimum of 16 gage, Type 302/304 stainless steel, with exposed welds grounded and polished to blend with adjacent surfaces. Sound deadened front and back, front access panel, splash-retarding angle design. Exterior surfaces shall have a uniformed NAAMM Number 4 finish. Mount sink with wall hanger and stainless steel support brackets and ASME/ANSI A112.6.1M, Type III, heavy duty chair carriers and secure fixture with minimum 3/8-inch bracket studs and nuts. Carrier shall be secured to the floor. Cove corners with 6 mm (1/4 inch) radius.
 2. Equip each scrub bay with an infrared photocell sensor to control water flow automatically, solenoid valve and thermostatic valve. Breaking the light beam shall activate the water flow. Flow shall stop when the user moves away from light beam. Sensor may be wall mounted, deck mounted or integral with faucet.
 3. Valve: Type T/P combination thermostatic and pressure balancing with chrome plated metal lever type operating handle and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be IPS. Provide external screwdriver check stops, and temperature limit stops. Set stops for a maximum temperature of 43 degrees C (110 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of 380 ml/s at 310 kPa (6 gpm at 45 psi) pressure drop.
 4. Gooseneck Spout: For each scrub bay, provide gooseneck spout with laminar flow device. Spout and trim shall be cast or wrought copper alloy and be chrome plated with smooth bright finish.
 5. Grid Drain: Stainless steel stamped drain fitting, 114 mm (4 1/2 inches) top with 76 mm (3 inches) grid and 38 mm (1 1/2 inches) tailpiece.

RFI 7960 confirmed that sink should be provided by specification 12 36 00.

6. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap, adjustable with connected elbow and nipple to the wall. Exposed metal trap surfaces and connection hardware shall be chrome plated with smooth bright finish.
 7. Shelf: Surface mounted of Type 304 stainless steel with exposed surface in satin finish and stainless steel support brackets. Shelf shall be 203 mm (8 inches) wide and length as shown on the drawings.
- G. (P-519A) Sink (Surgeon's Scrub-Up, Sensor Control) approximately (64 inches by 27-9/32 inches) by (51½ inches) deep, Sink shall be same as P-519 above except shall be a two station sink.
- H. (P-524) Sink, (CRS, Double Compartment, Counter Top, ASME/ANSI A112.19.3M, Kitchen Sinks) self-rimming, approximately 838 mm by 559 mm (33 inches by 22 inches) with two compartments inside dimensions approximately 343 mm by 406 mm by 191 mm (13 1/2 inches by 16 inches by 11 inches), minimum 20 gage CRS. Corners and edges shall be well rounded.
1. Faucet: Solid brass construction, 8" fixed centers, with 8" rigid/swing spout with vacuum breaker, chrome plated copper alloy with 4" wristblade handles and 2.2 Laminar flow outlet.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy, 38 mm (1 1/2 inches) P-trap with cleanout plug, continuous drain with wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- I. (P-524A) Sink, same fixture as 524 but with 2.0 laminar flow outlet less vacuum breaker.
- J. (P-528) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks) self rimming, back faucet ledge, approximately (22 inches by 22 inches) with single compartment inside dimensions approximately 406 mm by 483 mm by 191 mm (16 inches by 19 inches by 7 1/2 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, 8" fixed centers deck mounted combination faucet with quatern compression operating cartridge, removable replacement unit containing all parts subject to ware, swivel gooseneck spout with approximately 203 mm (8 inches) reach (4 inches) wrist blades and 0.5 gpm laminar flow outlet.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- K. (S-1) Sink by others (one piece counter with integral sink)
1. Faucet: Solid brass construction, deck mounted combination faucet with quatern cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with approximately (5¼ inches) reach with spout outlet 11¼ inches above deck and (4 inches) wrist blades with 0.5 laminar flow outlet. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.

- L. (S-2A) Stainless steel **single bowl** with sink cleanup counter)
1. Faucet: Provide faucet, back mounted solid brass construction, mounted combination faucet with slow compression operating cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with approximately (6 inches) reach with spout outlet (9-7/8 inches) above deck and cross handles with laminar flow outlet. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- M. (S-3) Sink by others (**Epoxy sink in lab furniture**):
1. Faucet: Unit shall be solid brass construction, deck mounted combination mixing faucet. Faucet shall be polished chrome plated. Faucet shall be equal to Fisher Hamilton Product No. 32L406SG
 2. Provide compressed air cleaning pistol and Tyson tubing similar to Storz piped from point of use compressor.
 3. Drain: Drain plug with strainer, stainless steel.
 4. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 5. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- N. (S-4) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks) self rimming, back faucet ledge, approximately (22 inches by 22 inches) with single compartment inside dimensions approximately 406 mm by 483 mm by 191 mm (16 inches by 19 inches by 10 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, 8" fixed centers deck mounted combination faucet with quatern compression cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with vacuum breaker with approximately 203 mm (8 inches) reach with spout outlet, 11-3/8 inches above deck and 102 mm (4 inches) wrist blades. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- O. (S-6) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks) self rimming, back faucet ledge, approximately (22 inches by 19½ inches) with single compartment inside dimensions approximately (16 inches by 19 inches by 10 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, deck mounted combination faucet with quatern compression cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck with vacuum breaker spout with approximately (6½ inches) reach with spout outlet 11-3/8 inches above deck and (4 inches) wrist blades.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.

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S-3 WITH NO
COMPRESSED AIR.

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5. Provide solids interceptor with removable sediment basket.
- P. (S-7) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks) self rimming, back faucet ledge, approximately (19½ inches by 17 inches) with single compartment inside dimensions approximately 406 mm by 483 mm by 191 mm (16 inches by 13½ inches by 10⅞ inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, 8" fixed centers deck mounted combination faucet with quatern compression operating cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with approximately (5¼ inches) reach with spout outlet, 11⅞ inches above deck and (4 inches) wrist blades. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
 5. Provide solids interceptor with removable sediment basket.
- Q. (S-8) Sink (CRS, Single Compartment, Undermount ASME/ANSI A112.19.2M, Kitchen Sinks) approximately (18½ inches by 18½ inches) with single compartment inside dimensions approximately (16 inches by 16 inches by 7-7/8 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, deck mounted combination faucet with quatern compression cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with approximately (5¼ inches) reach with spout outlet 11 ⅞ inches above deck and (4 inches) wrist blades. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- R. (CS-1) Sink (CRS, oval cup sink) self rimming, (7½ inches by 4½ inches) with single compartment inside dimensions approximately(6 inches by 3 inches by 5 inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, 8" fixed centers deck mounted combination faucet with slow compression opening cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with vacuum breaker (6 inches) reach spout outlet 7¾ inches above deck and cross handle. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.

- S. (LS-1) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks) self rimming, back faucet ledge, approximately (19½ inches by 19 inches) with single compartment inside dimensions approximately (16 inches by 13½ inches by 10⅞ inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, 8" fixed centers deck mounted combination faucet with quatern cartridge, removable replacement unit containing all parts subject to ware, rigid gooseneck spout with approximately (8 inches) reach with spout outlet 11-5/8 inches above deck and (4 inches) wrist blades and third water inlet, Provide hot and cold water pedal box with short pedals. Faucet shall be polished chrome plated.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.
- T. (LS-2) Sink (CRS, Single Compartment, Counter Top ASME/ANSI A112.19.2M, Kitchen Sinks) self rimming, back faucet ledge, approximately (22 inches by 19½ inches) with single compartment inside dimensions approximately (16 inches by 16 inches by 10⅞ inches) deep. Shall be minimum of 1.3 mm thick (18 gauge) CRS. Corners and edges shall be well rounded:
1. Faucet: Solid brass construction, 8" fixed centers deck mounted combination faucet with quatern compression operating cartridge, removable replacement unit containing all parts subject to ware, rigid/swivel gooseneck spout with vacuum breaker approximately (8 inches) reach with spout outlet, 11⅜ inches above deck and (4 inches) wrist blades.
 2. Drain: Drain plug with cup strainer, stainless steel.
 3. Trap: Cast copper alloy 38 mm (1 1/2 inches) P-trap with cleanout plug. Provide wall connection and escutcheon.
 4. Provide cover for drain, stops and trap per A.D.A 4-19.4.

2.10 DISPENSER, DRINKING WATER

- A. Standard rating conditions: 10 degrees C (50 degrees F) water with 27 degrees C (80 degrees F) inlet water temperature and 32 degrees C (90 degrees F) ambient air temperature.
- B. (P-609) Electric Water Cooler: Mechanically cooled, self contained, wheel chair, bubbler style fully exposed dual height stainless steel fountain, recessed in wall refrigeration system, stainless steel grille, stainless steel support arm, wall mounting box, energy efficient cooling system consisting of a hermetically sealed reciprocating type compressor, 115v, 60 Hz, single phase, fan cooled condenser, permanently lubricated fan motor. Set highest bubbler 1016 mm (40 inches) above finished floor.

2.11 SHOWER BATH FIXTURE

- A. (P-701) Shower Bath Fixture (Detachable, Wall Mounted, Concealed Supplies, Type T/P Combination Valve):
1. Shower Installation: Wall mounted detachable spray assembly and fixed shower head, two (2) heads total, (30 inch) wall bar, elevated vacuum breaker, supply elbow and flange and valve. All external trim, chrome plated metal.
 2. Shower Head Assembly: Plastic shower head with flow control to limit discharge to (2.0 gpm), 1524 mm (60 inches) length of rubber lined CRS, chrome plated metal flexible, or

- white vinyl reinforced hose and supply wall elbow. Design showerhead to fit in palm of hand. Provide CRS or chrome plated metal wall bar with an adjustable swivel hanger for showerhead. Fasten wall bar securely to wall for hand support.
3. Valves: Type T/P combination thermostatic and pressure balancing, with chrome plated metal lever type operating handle adjustable for rough-in variations and chrome plated metal or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver check stops, vacuum breaker and temperature limit stops. Set stops for a maximum temperature of 40 degrees C (105 degrees F). All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of (2.0 gpm at 45 psi) pressure drop.
- B. (P-702) Shower Bath Fixture (Wall Mounted, Concealed Supplies, Type T/P Combination Valve):
1. Shower Installation: Wall mounted, shower head connected to shower arm. All external trim shall be chrome plated metal.
 2. Shower Heads: Chrome plated metal head, adjustable ball joint, self cleaning with automatic flow control device to limit discharge to not more than (2.0 gpm). Body, internal parts of shower head and flow control fittings shall be copper alloy or CRS. Install showerhead 1829 mm (72 inches) above finished floor. See Architectural drawings for mounting height.
 3. Valves: Type T/P combination thermostatic and pressure balancing, with chrome plated metal lever with adjustment for rough-in variations, type operating handle and chrome plated brass or CRS face plate. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external screwdriver check stops, and temperature limit stops. Set stops for a maximum temperature of 40 degrees C (105 degrees F). Install valve 1372 mm (54 inches) from bottom of shower receptor. All exposed fasteners shall be vandal resistant. Valve shall provide a minimum of (2.0 gpm at 45 psi) pressure drop.
- C. (P-703) Shower Bath Fixture (Anti- Ligature, Wall Mounted, Concealed Supplies, Type T/P combination Valve):
1. Shower Installation: Wall mounted, Anti- Ligature showerhead with integral back secured to wall.
 2. Shower Heads: Chrome plated metal head, Anti- Ligature, institutional type, automatic flow control device to limit discharge to not more than (2.0 gpm). Provide mounting and vandal-proof screws. Body, internal parts of showerhead, and flow control fittings shall be copper alloy or CRS. Install showerhead 1829 mm (72 inches) above finished floor. See Architectural drawings for mounting height. See Architectural drawings for mounting height.
 3. Valves: Anti- Ligature Type T/P combination thermostatic and pressure balancing. Valve body shall be any suitable copper alloy. Internal parts shall be copper, nickel alloy, CRS or thermoplastic material. Valve inlet and outlet shall be 13 mm (1/2 inch) IPS. Provide external combination screwdriver check stops, and temperature limit stops. Set stops for a maximum temperature of 40 degrees C (105 degrees F). One piece chrome plated brass or CRS faceplate, with chrome plated metal lever handle with adjustment for rough-in variation. Exposed fasteners shall be vandal resistant. Valve shall provide minimum of 160 ml/s at 310 kPa (3 gpm at 45 psi) pressure drop.

2.12 EMERGENCY FIXTURES

- A. (P-706) Emergency Shower: Recessed, stainless steel with stainless steel cabinet.
1. Shower Head: Polished chrome plated, 203 mm (10 inches) in diameter.
 2. Installation: Head shall be 2134 mm (84 inches) above floor.
 3. Valves: Stay-open ball type, chrome plated, operated by a stainless steel panic bar with black vinyl foam grip located in stainless steel cabinet. Pull-down opens valve push-up closes valve.
- B. (P-707) Emergency Shower and Eye and Face Wash recessed with drain pan, exposed shower head:
1. Shower Head: Polished chrome plated, 203 mm (10 inches) in diameter, install head 2134 mm (84 inches) above floor. Equip with stay-open ball valve. Operate valve with heavy duty stainless steel panic bar with black vinyl foam grip. Pull-down opens valve; push-up closes valve. CORROSION RESISTANT STEEL
 2. Emergency Eye and Face Wash: CRS receptor. Equipment with a 13 mm (1/2 inch) stay open ball valve operated when opened. Mount eye and face wash spray heads according to Architectural elevations. CORROSION RESISTANT STEEL
- C. (P-713) Emergency Eye and Face Wash (Deck Mounted): CRS, deck mounted, 316SS pull down control unit shall have two GS-plus spray heads with flip top dust cover. Mount eye and face wash spray heads adjacent to lab sink. Shall be deck mounted to countertop.
- D. (P-712) Emergency Shower and Eye Wash: Hand and foot control, stainless steel bowl. Combination eye/face wash and safety shower. Eyewash is activated by the flag handles or foot pedal. Two large FS-plus spray type outlet heads and a 10" diameter ABS plastic shower head.
- E. Provide shutoff bvalve with chain and lock in locked open position on all emergency fixtures.

2.13 HYDRANT, HOSE BIBB AND MISCELLANEOUS DEVICES

- A. (P-801) Wall Hydrant: Cast bronze non-freeze hydrant with detachable T-handle. Brass operating rod within casing of bronze pipe of sufficient length to extend through wall and place valve inside building. Brass valve with coupling and union elbow having metal-to-metal seat. Valve rod and seat washer removable through face of hydrant; 19 mm (3/4 inch) hose thread on spout; 19 mm (3/4 inch) pipe thread on inlet. Finish may be rough; exposed surfaces shall be rough bronze. Set not less than 457 mm (18 inches) nor more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker which automatically drains when shut off.
- B. (P-804) Hose Bibb (Single Faucet, Wall Mounted to Concealed Supply Pipe): Cast or wrought copper alloy, single faucet with replaceable monel seat, removable replacement unit containing all parts subject to wear, mounted on wall 914 mm (36 inches), above floor (U.N.O.) to concealed supply pipe. Provide faucet with 19 mm (3/4 inch) hose coupling thread on spout and vacuum breaker. Tee handle on faucet shall be cast, formed or drop forged copper alloy. Escutcheons shall be either forged copper alloy or CRS. Exposed metal parts, including exposed part under valve handle when in open position, shall have a bright finish.

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- C. (P-806) Lawn Faucet: Shall be rough bronze with detachable T-handle, non-freeze, straight or angle body, and be of compression type 19 mm (3/4 inch) hose threaded on spout; 19 mm (3/4 inch) pipe threaded on inlet. Finish may be rough; exposed surfaces shall be rough bronze. Set not less than 457 mm (18 inches) or more than 914 mm (36 inches) above grade. On porches and platforms, set approximately 762 mm (30 inches) above finished floor. Provide integral vacuum breaker.
- D. (P-807) Wall Hydrant: Hot and cold water, shall be rough bronze with detachable T-handle, non-freeze compression type 3/4 inch hose threaded on spout; finish shall be rough bronze set not less than 18 inches or more than 36 inches above ground.
- E. (P-808) Washing Machine Supply and Drain Units: Fabricate of 16-gage steel with highly corrosion resistant epoxy finish. Unit to have 51 mm (2 inches) drain connection, 13 mm (1/2 inch) combination MPT brass sweat connection, ball type shut-off valve, 51 mm (2 inches) cast brass P-trap, duplex electric grounding receptacle and dryer outlet. Size 229 mm by 375 mm (9 inches by 14 3/4 inches) rough wall opening 203 mm by 330 mm by 92 mm (8 inches by 13 inches by 3 5/8 inches). Centerline of box shall be 1118 mm (44 inches) above finished floor.
- F. (P-809) Dialysis Box: Recessed wall box with continuously welded 18 gage CRS, Type 316, with satin finish. Wall flange and hinged door shall be 16 gage CRS, Type 304, with satin finish. Provide polypropylene ball valve, 19 mm (3/4 inch) male supply outlet and two discharge hose brackets above 38 mm (1 1/2 inches) chemical resisting waste. Furnish each valve with flushing nipple.
- G. (P-809A) Dialysis Box: Same fixture as 809 above except with two polypropylene ball valves.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fixture Setting: Opening between fixture and floor and wall finish shall be sealed as specified under Section 07 92 00, JOINT SEALANTS.
- B. Supports and Fastening: Secure all fixtures, equipment and trimmings to partitions, walls and related finish surfaces. Exposed heads of bolts and nuts in finished rooms shall be hexagonal, polished chrome plated brass with rounded tops.
- C. Through Bolts: For free standing marble and metal stud partitions refer to Section 10 21 13, TOILET COMPARTMENTS.
- D. Toggle Bolts: For hollow masonry units, finished or unfinished.
- E. Expansion Bolts: For brick or concrete or other solid masonry. Shall be 6 mm (1/4 inch) diameter bolts, and to extend at least 76 mm (3 inches) into masonry and be fitted with loose tubing or sleeves extending into masonry. Wood plugs, fiber plugs, lead or other soft metal shields are prohibited.
- F. Power Set Fasteners: May be used for concrete walls, shall be 6 mm (1/4 inch) threaded studs, and shall extend at least 32 mm (1 1/4 inches) into wall.
- G. Tightly cover and protect fixtures and equipment against dirt, water and chemical or mechanical injury.

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- H. Where water closet waste pipe has to be offset due to beam interference, provide correct and additional piping necessary to eliminate relocation of water closet.
 - I. Do not use aerators on lavatories and sinks.

3.2 CLEANING

- A. At completion of all work, fixtures, exposed materials and equipment shall be thoroughly cleaned.

3.3 WATERLESS URINAL

- A. Manufacturer shall provide an operating manual and onsite training for the proper care and maintenance of the urinals.

3.4 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 01 91 13 – COMMISSIONING OF SYSTEMS for all inspection, startup, and contractor testing required above and required by the Pre-Functional Checklist provided by the Commissioning Agent.
- B. Components provided under this section of the specification will be tested as part of a larger system. Refer to Section 01 91 13 – COMMISSIONING OF SYSTEMS and related sections for Contractor responsibilities for system commissioning.

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SECTION 22 62 00
VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Central Laboratory and Healthcare Vacuum Systems: This section describes the labor, equipment, and services necessary for and incidental to the installation of piped medical vacuum systems and medical vacuum and waste anesthesia gas disposal systems (WAGD). Medical vacuum and WAGD systems shall be installed started, tested, and ready for use. The scope of work shall include all necessary piping, fittings, valves, cabinets, station outlets and inlets, rough ins, ceiling services, gages, alarms including low voltage wiring, vacuum pumps, electric motors and starters, receivers, and all necessary parts, accessories, connections and equipment.
- B. The Contractor shall provide all elements and accessories required for a complete system according to the most recent edition of NFPA 99, Gas and Vacuum Systems.
- C. All necessary connections to owner furnished equipment shall be made as indicated on the documents.
- D. Electrical power and control wiring for vacuum pump(s), ceiling columns, alarms wiring from equipment to alarm panels, and modular accessories associated with the system(s) shall be included.
- E. Pressure testing, cross connection testing and final testing per NFPA 99 most recent edition and using procedures shall be performed.
- F. The Contractor shall retain a qualified third party medical vacuum verifier acceptable to the Engineer and VA to perform and attest to final verification of the systems. The Contractor shall make all corrections as determined by this third party verifier, including additional testing if necessary to attain full and unqualified certification.
- G. Coordinate with owner retained verifier for final verification of the systems. Make corrections as required, including additional testing if necessary to attain full and unqualified certification.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Sealing around pipe penetrations to maintain the integrity of time rated construction.
- B. Section 07 92 00, JOINT SEALANTS: Sealing around pipe penetrations through the floor to prevent moisture migration.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING: General requirements and items common to more than one section of Division 22.
- D. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC: Alarm interface with ECC.

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- E. Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS: Conduit.
 - F. Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW): Control wiring.
 - G. Section 26 27 26, WIRING DEVICES: Electrical wiring and accessories.
 - H. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT: Electric motors.
 - I. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS: Motor starters.
 - J. Section 10 25 13, PATIENT BED SERVICE WALLS: Prefabricated bedside patient units.
 - K. Section 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Laboratory and Healthcare Gases and Vacuum Alarms.
 - L. SECTION 22 63 00, GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES: Laboratory and Healthcare Gas Piping and Equipment:

1.3 QUALITY ASSURANCE

- A. Installation and Start-up: The manufacturer will provide factory authorized representatives to review installation and perform initial start up of system.
- B. Contractor shall include with submittals an affidavit attesting to compliance with all relevant paragraphs of NFPA 99 most recent edition. Personnel assembling medical vacuum and WAGD system shall meet NFPA 99 5.1.10.10.11 "Qualification of Installers" and hold medical gas endorsements as under ASSE 6010. The Contractor shall furnish documentation attesting that all installed piping materials were purchased cleaned and complied with the requirements of NFPA 99 5.1.10.1 and 5.1.10.2. Electrical Control systems and Medical vacuum Alarms are to be UL listed as assemblies with label affixed. Medical vacuum and WAGD controls are to be wired in accordance with NEC.
- C. Equipment Installer: The equipment installer shall show documentation proving that the personnel installing the equipment meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Installers. Show technical qualifications and previous experience in installing medical gas equipment on three similar projects. Submit names and addresses of referenced projects. The equipment install shall perform the following coordination functions:
 - 1. Coordinate with other trades to ensure timely installations and avoid conflicts and interferences.
 - 2. Work with the metal stud partition installer and/or mason to ensure anchors, sleeves and similar items are provided in sufficient time to avoid delays; chases and openings are properly sized and prepared.
 - 3. Coordinate with VA to ensure medical vacuum inlets, whether owner supplied or contractor supplied, in walls, ceiling and all equipment is provided by the same Medical Vacuum Equipment Manufacturer satisfactory to the owner.
 - 4. The Contractor shall coordinate with the Medical Vacuum System Verifier to deliver a complete, tested medical gas installation ready for owner's use.

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- D. Equipment Supplier: The Equipment supplier shall demonstrate evidence of installing equivalent product at three installations similar to this project that has been in satisfactory and efficient operation for three years. Names and addresses where the product is installed shall be submitted for verification.
- E. Medical Gas System Testing Organization: The Medical vacuum verifier shall show documentation proving that the medical gas verifier meet the standards set by the American Society of Sanitary Engineers (ASSE) 6010 Professional Qualification Standards for Medical Gas System Verifiers. The testing shall be conducted by a party technically competent and experienced in the field of medical gas pipeline testing. Such testing shall be performed by a party other than the installing contractor.
- F. Names of three projects where testing of vacuum systems has been performed by the testing agency shall be provided. The name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification shall be included in the documentation.
- G. The testing agency's detailed procedure which will be followed in the testing of this project shall be submitted. In the testing agency's procedure documentation, include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, data on test methods, types of equipment to be used, calibration sources and method references shall be submitted.
- H. Installation and Start-up: The manufacturer shall provide factory authorized representatives to review the installation and perform the initial startup of the system. The factory authorized representatives shall submit a report to the construction administrator and to the Contractor. The Contractor shall make all corrections identified by the factory authorized representative.
- I. Certification: The Final inspection documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- J. The installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided, and a copy of them on Auto-CAD version (R-14 or later) provided on compact disk.
- K. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 019113, Commissioning, for detailed commissioning requirements.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

B. Manufacturer's Literature and Data:

1. Complete specifications for the product intended to be installed, dimensional drawings, and wiring schematics.
2. Package drawing indicating package style, dimensions when complete, method of disassembly and sizes of subsections for rigging and installation.
3. Piping.
4. Valves.
5. Inlet and outlet cocks
6. Valve cabinets.
7. Gages.
8. Station inlets, and rough in assemblies.
9. Ceiling services.
10. Alarm controls and panels.
11. Vacuum switches.
12. Vacuum bottle brackets.
13. Vacuum pump systems (Provide certified pump test data at start up):
 - a. Pumps: Manufacturer and model.
 - b. Pump performance curves.
 - c. Pump operating speed (RPM).
 - d. Capacity: Free air exhaust from 65 and 80 kPa (19 and 24 inches Hg.) gage vacuum (L/s) (SCFM).
 - e. Capacity: Expanded air capacity at 65 and 80 kPa (19 and 24 inches Hg.) gage vacuum (L/s) (SCFM).
 - f. Type of bearing in pump.
 - g. Type of lubrication.
 - h. Type and adjustment of drive.
 - i. Electric motors: Manufacturer, frame and type.
 - j. Speed of motors (RPM).
 - k. Current characteristics and horsepower of motors.
 - l. Receiver capacity and rating.
 - m. Silencers: Manufacturer, type and model.

C. Station Inlets: A letter from manufacturer shall be submitted stating that inlets are designed and manufactured to comply with NFPA 99. Inlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.

D. Certification: The completed systems have been installed, tested, purged and analyzed in accordance with the requirements of this specification.

E. A notarized affidavit from the verifier stating that the verifier undertakes to verify this project and thus agrees to disqualify themselves from supplying any equipment which will be included in the scope of their verification. No verifier who supplies equipment shall be permitted to verify that equipment. Statement declaring that the vacuum system manufacturer has no fiduciary interest in the verifier and that the verifier is not an agent or representative of the vacuum system manufacturer. Statement declaring that the contractor has no fiduciary interest in the third party verifier and that the third party verifier has no fiduciary interest in the contractor.

1.5 TRAINING

- A. The services of a competent instructor shall be provided for not less than two four-hour periods for instructing personnel in the operation and maintenance of the vacuum systems, on the dates requested by COTR.
- B. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory-authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 017900, Demonstration and Testing, and Section 019113, Commissioning, for Contractor training requirements.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
- B. American National Standards Institute (ANSI):
 - A13.1-2007 Scheme for Identification of Piping Systems
 - B16.22-01 (R2005) Wrought Copper and Bronze Solder-Joint Pressure Fittings
 - B40.1- (2006) Pressure Gauges and Gauge Attachments
- C. American Society for Testing and Materials (ASTM):
 - B819-00 Standard Specification for Seamless Copper Tube for Medical Gas Systems
- D. American Society of Mechanical Engineers (ASME):
 - Section IX-04 Welding and Brazing Qualifications
- E. American Welding Society (AWS):
 - AWS A5.8/A5.8M-2004 Brazing Filler Metal
 - AWS B2.2-91 Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)
- F. Compressed Gas Association (CGA):
 - P-9-92 Inert Gases Argon, Nitrogen and Helium
- G. National Electrical Manufacturers Association (NEMA):
 - ICS-6- (1993, R 2006) Industrial Controls and Systems Enclosures
- H. National Fire Protection Association (NFPA):
 - 70(2007) National Electric Code
 - 99-2005 Health Care Facilities with 2005 errata
- I. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)
- J. Manufacturing Standardization Society (MSS):
 - MSS-SP-72-99 Ball Valves With Flanged or Butt Welding For General Purpose
 - MSS-SP-110-96 Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends
 - MSS-SP-73-03 Brazing Joints for Copper and Copper Alloy Solder Pressure Fittings

1.7 WARRANTY

- A. Warranty will be expressly complete, include all components of the system and be the responsibility of the vacuum system manufacturer of record only. Warranties limiting the responsibility of the vacuum system for any system component or which pass through to another manufacturer are not acceptable.
- B. Warranties shall include on site repairs including travel, labor and parts. Warranties requiring return of equipment for adjustment are not acceptable.

1.8 MAINTENANCE SUPPORT

- A. The medical vacuum equipment manufacturer shall demonstrate a national factory direct service capability able to perform major overhauls. The medical vacuum equipment manufacturer shall offer factory direct preventative maintenance contract for the owner's consideration. The medical vacuum equipment manufacturer shall offer formal maintenance training courses.

PART 2 - PRODUCTS

2.1 GENERAL PRODUCT REQUIREMENTS

- A. One Medical Vacuum Equipment Manufacturer shall supply the medical vacuum system(s) and equipment to include outlets, valves and gauges, valve boxes, alarm panels, manifolds, medical air, instrument air, vacuum and WAGD sources.

2.2 PIPING

- A. Copper Tubing: Copper tubing shall be type "K" or "L", ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ANSI B16.22 or brazing fittings complying with MSS SP-73. The copper tubing size designated reflects nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".
- B. Brazing Alloy: The brazing alloy shall comply with AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux shall be strictly prohibited for copper to copper connections.
- C. Screw Joints: Screw joints shall use polytetrafluoroethylene (teflon) tape.
- D. Galvanized Steel: Galvanized steel shall only be used for the discharge from the vacuum producer. The galvanized steel vacuum discharge pipe and fittings shall comply with the following:
 - 1. Pipe: The galvanized steel pipe shall comply with ASTM A53, standard weight.
 - 2. Fittings: The fittings shall comply with the following
 - a. Flexible groove, malleable iron, ASTM A47, or ductile iron, ASTM A536.

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- b. Malleable iron screwed, ANSI B16.3.
 - E. Memory metal couplings shall have temperature and pressure ratings not less than that of a brazed joint.
 - F. Piping identification labels shall be applied at time of installation in accordance with current NFPA Standards. Supplementary color identification shall be in accordance with CGA Pamphlet C-9.
 - G. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:
 - 1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
 - 2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
 - 3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
 - 4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.3 EXPOSED LABORATORY AND HEALTHCARE VACUUM PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping shall be used for exposed laboratory and healthcare vacuum piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
 - 1. Pipe: Fed. Spec. WW-P-351, standard weight.
 - 2. Fittings: Fittings shall comply with ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
 - 3. Nipples: Nipples shall comply with ASTM B 687, Chromium-plated.
 - 4. Unions: Unions shall comply with Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
 - 5. Valves: Valves shall comply with Mss SP-72, SP-110, Brass or bronze with chrome finish.

2.4 VALVES

- A. Ball: Ball valves shall be in line, other than zone valves in cabinets.
 - 1. Sixty five millimeter or DN65 (2 1/2 inches) and smaller: Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full ported, three piece or double union end connections, Teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle. 2. Eighty millimeter or DN80 to 100 millimeter or DN100 (3" to 4" inches): Ball valves shall be bronze/ brass body, Fed. Spec. MSS SP72 & SP 110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full ported, three piece, double seal, Teflon seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle.

B. Check:

1. Check valves eighty millimeters (DN80) (3 inches) and smaller: brass and Bronze body, straight through design for minimum pressure drop, spring loaded, self aligning with teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, 2750 kPa (400 psi) WOG minimum working pressure.
2. One hundred millimeter or DN100 (4 inches) and larger check valves shall be iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, 1025 kPa (150 psi) WSP.

- C. Zone valve in cabinet shall be ball valve with bronze/ brass body, double seal, three piece or double union end connections, replaceable Teflon seat seals, Teflon stem seal, 4125 kPa (600 psi) WOG, cold, non shock gas working pressure or vacuum service to 29 inch Hg, blowout proof stem, one quarter turn of handle to completely open or close. Tubing extensions, factory brazed, pressure tested, cleaned for oxygen service shall be provided. A 3 mm (1/8 inch) NPT gauge port shall be provided for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick on labels. Valves shall be in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
MEDICAL VACUUM	Black letters on white background	WHITE
Evacuation (Waste Gas)	White letters on purple background	PURPLE

2.5 VALVE CABINETS

- A. Valve cabinets shall be flush mounted, commercially available item for use with medical gas services, constructed from steel not lighter than 1.3 mm (18 gage) steel or extruded aluminum not lighter than 1.9 mm (14 gage). The valve cabinets shall be rigidly assembled, of adequate size to accommodate all valve(s) and fittings indicated. Holes shall be predrilled to receive pipe connections. These pipe connections shall be made outside of the valve box. Anchors shall be provided to secure cabinet to wall construction. Openings in cabinet shall be sealed to be dust tight. Bottom of cabinet shall be located 1375 mm (4 foot 6 inches) above finished floor.
- B. Engraved rigid plastic identification plate shall be mounted on the wall above or adjacent to the cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate shall be clearly visible at all times. Inscriptions shall be provided on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS." The final wording must be approved by the VA project manager.
- C. Cover plate: The cover plate shall be fabricated from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. A cover window shall be provided of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal.

The following shall be permanently painted or stenciled on window: "FOR EMERGENCY SHUT-OFF VALVES ONLY, SHUT OFF VALVES FOR PIPED GASES", or equivalent wording. The valve cabinet shall be configured such that it is not possible to install window with any valve in the closed position. Each valve shall have a pressure gauge upstream of valve and this pressure gauge shall be inside valve box.

- D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. Each cabinet shall serve no more than one smoke compartment.

2.6 GAGES

A. Vacuum Gages

1. For vacuum line adjacent to source equipment the vacuum gages shall comply with ANSI B40.1, vacuum gage type, size 115 mm (4-1/2 inches), gage listed for vacuum, accurate to within 2-1/2 percent, with metal case. The vacuum gage range shall be 0 to-100 kPa (0-30 inches Hg). Dial graduations and figures shall be black on a white background, or white on a black background. Label shall be for vacuum service. A gage cock shall be installed. Compound gages shall be installed for Vacuum system.
2. For vacuum service upstream of main shutoff valve: A 40 mm (1-1/2 inch) diameter gage shall be provided with steel case, bourdon tube and brass movement, dial range 0 to -100 kPa (0-30 inches Hg). Compound gages shall be provided for Vacuum system.

2.7 STATION INLETS

A. Vacuum Station inlets:

1. Station inlets shall be for designated service, consisting of a quick coupler, quick disconnect type with inlet supply tube.
2. The outlet station shall be made, cleaned, and packaged to NFPA 99 standards and shall be UL listed and CSA certified.
3. A coupler shall be provided that is non-interchangeable with other services, and leak proof under three times normal working pressure.
4. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.
5. Each inlet shall be securely fastened to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for appropriate service. Rough in shall be indexed and gas specified latch vale with non-interchangeable safety keying with color coded gas service identification.
6. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) shall be furnished under this specification but installed by manufacturer of PBPU's before initial test specified herein.
7. Completion kits (valve body and face plate) shall be installed for the remainder of required tests.

B. For Ceiling Hose Drops:

1. Brass, stainless steel or chromed metal non interchangeable DISS connections for appropriate service to conform with CGA V-5.
2. Hose assemblies shall be furnished for all ceiling stations for the finished ceiling height as indicated on the drawings. Each hose shall be provided with a heavy chain type dual retractor for vacuum. Retractors made of stainless steel are not acceptable. An extra 450 millimeters (18 inches) of hose length shall be provided for retractors.
3. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing.
4. Each inlet shall be securely to rough-in to prevent floating, and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for appropriate service so the installation shall be adjusted. Compensate for variations in plaster or cover thickness.

2.8 STATION INLETS

A. Vacuum Station inlets:

1. Station inlets shall be brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5.
2. The outlet station shall be made, cleaned, and packaged to NFPA 99 standards and shall be UL listed and CSA certified.
3. A coupler shall be provided that is non-interchangeable with other services, and leak proof under three times normal working pressure. Threaded DISS connector shall be per CGA standards
4. Each station inlet shall be equipped with an automatic valve to conform with NFPA 99. Valves shall be placed in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.
5. Each inlet shall be securely fastened to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) 10 mm outside diameter (3/8-inch outside diameter) tubing for connection to supply tubing. Stub tubing shall be labeled for appropriate service. Rough in shall be indexed and gas specified latch vale with non-interchangeable safety keying with color coded gas service identification.
6. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPU) shall be furnished under this specification but installed by manufacturer of PBPUs before initial test specified herein.
7. Completion kits (valve body and face plate) shall be installed for the remainder of required tests.

2.9 STATION INLET ROUGH-IN

- A. Station inlet rough in shall be Flush mounted, and protected against corrosion. Rough in shall be anchored securely to unit or wall construction.
- B. The modular cover plate shall be constructed from die cast plate, two piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, secured to rough in with stainless steel or chromium plated countersunk screws. The latch mechanism shall be designed for one handed, singe thrust mounting and one handed fingertip release of secondary equipment.
- C. Cover Plate for Prefabricated Bedside Patient Units (PBPU) shall be One piece with construction and material as indicated for modular cover plate.

- D. Permanent, metal or plastic, identification plates shall be provided securely fastened at each inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
MEDICAL VACUUM	Black letters on white background
EVACUATION (Waste Gas)	White letters on purple background

2.10 CEILING SERVICES

- A. Column accessories: Each utility column shall be equipped with flush type quick coupler vacuum service station inlets as specified under Article, STATION INLETS.
- B. Ceiling Mounted Station Inlets shall be equipped as specified under Article, STATION INLETS. The station inlets shall be flush mount on ceiling and provide with hose tubing drops and retractors. Male thread DISS connection shall be extended through ceiling plate.
1. Hoses: Conductive, neoprene tubing hoses, color coded for appropriate service shall be capable of, dropping to within 1425 mm (4 feet 6 inches) from floor, with upper end of hose having female DISS connection with nut, easily finger tightened to ceiling inlet, and lower end of hose having DISS connection quick. Color coding for hoses is as follows:

SERVICE	HOSE COLOR
VACUUM	White
EVACUATION (Waste Gas)	Purple

2. Rough-in shall be standard metal single gang, interchangeable, sectional or one piece, securely anchored to ceiling runner channels. Ceiling plate shall be die cast plate, .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal. Identification plate shall be attached as specified in Article, STATION INLET ROUGH-IN, to ceiling plate and attached adjacent to each inlet.
3. Hose retractor kit: The hose retractor kits shall be chrome plated, spring loaded assembly. Hose clamps shall have stainless steel sash chain; to automatically withdraw hose assembly a minimum of 508 mm (20 inches) from fully extended position of 1425 mm (4 feet 8 inches) to 1930 mm (6 feet 4 inches) above finished floor.

2.11 VACUUM SWITCHES

- A. Vacuum switches shall be general purpose, contact or mercury type, allowing both high and low set points, with contact type provided with a protective dust cover. The vacuum switch shall have an adjustable range set by inside or outside adjustment. Vacuum switches shall activate when indicated by alarm requirements. One orifice nipple (or DISS demand check valve) shall be used for each sensor switch.

2.12 VACUUM BOTTLE BRACKET

- A. Vacuum bottle bracket shall be single plate of one piece, .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal or aluminum, finish matching cover of adjoining vacuum inlet. All components shall be of same material as plate and assembly anchored securely. The bracket shall be provided and plastic vacuum bottle holder for each vacuum wall inlet.

2.13 LAB VACUUM PUMP SYSTEM

- A. Furnish and install per plans and specifications one (1) BeaconMedaes Model VHV04D-060H-D duplex oil-less claw medical vacuum system. The package is to consist of two (2) 4 HP oil-less rotary claw vacuum pumps, each rated for 29 SCFM @ 19" HgV, an integral pre-wired duplex control panel, and horizontally mounted 60 gallon air receiver tank with full size three-valve bypass all mounted on a common vertically configured base. Package to have a single point of connection for the electrical panel, intake and discharge. The common base is sized to fit through standard 34.5" doorway. Package is to be designed and manufactured with ISO 13485 processes and completely tested before shipment..
- B. Each pump and receiver is to be connected to a common intake manifold. Each pump to be connected to a common discharge manifold with integral flex connector, isolation valve, and drip leg with ball valve and condensate drain. Interconnecting exhaust piping to consist of powder-coated steel tubing and flanges. An exhaust muffler is to be shipped loose.
- C. Each pump is to be direct driven by a 4 HP motor and feature a non-contacting claw capable of operating down to 28.4" HgV continuous duty at sea level. The pumping chamber is to be oil-free. The pump must be completely air-cooled with no water requirements. Each pump is to have a 5 micron inlet air filter, and be equipped with a vacuum relief valve, check valve to prevent backflow through off-cycle units, flexible connector, isolation valve, high discharge temperature switch, oil drain valve and oil sight glass.
- D. The motors are to be continuous duty, NEMA rated, C-face, TEFC, 3450 RPM with a 1.15 service factor suitable for 208V or 230/460V-3PH-60HZ, 3-phase electrical service.
- E. Each vacuum pump is to have a factory piped intake with integral flex connector, isolation valve, and check valve. The vacuum receiver tank is to be a 60 gallon ASME code stamped and rated for a minimum of 150 psig design pressure.
- F. The duplex mounted and wired control system is to be Beacon TotalAlert embedded control system and U.L. labeled. The control system is to provide automatic lead/lag sequencing and automatic alternation of vacuum pumps based on first-on/first-off principle with provision for simultaneous operation if required. Automatic activation of reserve unit, if required, will activate an audible alarm as well as a visual alarm on the display screen. Additional components to include:
- Circuit Breaker Disconnects for each vacuum pump with external operators
 - full voltage motor starters with overload protection
 - 24V control circuit

The touch screen controls feature one 5.7" master screen and a 3.5" operating screen for each vacuum pump. Screen displays and functions include:

- Service alerts, runtime hourmeters for each pump, system status, system vacuum level

- Visual/audible alarm indications with isolated contacts for all standard remote alarms
- Event log recording alarms and system activity
- Event log recording service warnings and service history
- Trend graphs for vacuum level, pump operations, and ambient temperature
- Ethernet connectivity and embedded web page for remote monitoring
- Electronic notifications of alarms and warnings
- Integral connectivity to the Total Alert medical gas network via Ethernet.

- G. System should be warranted to be free of defects in material and workmanship under normal use for a period not to exceed thirty (30) months from date of shipment, or twenty-four (24) months from date of start-up.
- H. When the vacuum system has been completely installed, wired and ready for operation, the contractor shall contact the supplier's representative who shall visit the job and place the equipment in operation, making such adjustments as may be necessary to provide satisfactory performance. Before the equipment is accepted, the contractor shall furnish the engineer with a written statement from the manufacturer's representative indicating that the equipment performed in accordance with the specified requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All installation shall be performed in strict accordance with NFPA 99 5.1.10. Brazing procedures shall be as detailed in NFPA 99 5.1.10.5. Brazing shall be performed only by brazers qualified under NFPA 99 5.1.10.11. Where piping runs underground, the installation shall be made in accordance with NFPA 99 5.1.10.10.5.
- B. Contractor shall furnish 4 inch high concrete housekeeping pads. The contractor shall furnish inertia bases in lieu of housekeeping pads where the equipment installed is not factory isolated by the manufacturer. Anchor bolts shall be cast into bases
- C. Cast escutcheon shall be installed with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- D. Open ends of tube shall be capped or plugged at all times or otherwise sealed until final assembly.
- E. Piping shall be cut square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. The tubing shall be reamed to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. The tubing shall be worked into place without springing or forcing. The tubing shall be bottomed in socket so there are no gaps between tube and fitting. Care shall be exercised in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease from being introduced into the tubing. Where contamination has occurred, material shall be no longer suitable for vacuum service and new, sealed tube sections used.
- F. Piping shall be supported with pipe trays or hangers at intervals as shown on the drawings or as defined in NFPA 99 Table 5.1.10.10.4.5. Piping shall not be supported by other piping. Isolation

of copper piping from dissimilar metals shall be of a firm, positive nature. Duct tape is not acceptable as an isolation material.

- G. Valves and other equipment shall be rigidly supported to prevent strain on tube or joints.
- H. Piping exposed to physical damage shall be protected.
- I. During any brazing operation, the interior of the pipe shall be purged continuously with oil free, dry nitrogen NF, following the procedure in NFPA 99 5.1.10.5.5. At the completion of any section, all open pipe ends shall be capped using an EXTERNAL cap. The flow of purged gas shall be maintained until joint is cool to touch. The use of flux is prohibited when making of joints between copper to copper pipes and fittings.
- J. Threaded joints in piping systems shall be avoided whenever possible. Where unavoidable, make up the male threads with polytetrafluorofethylene (such as Teflon) tape. Liquid sealants shall not be used.
- K. Tubing shall not be bent. Fittings shall be used in all change of direction or angle.
- L. After installation of the piping, but before installation of the outlet valves, blow lines clear using nitrogen NF.
- M. Ceiling column assembly shall be supported from heavy sub-mounting castings and furnished with the unit as part of rough in. Ceiling columns shall be anchored with 15 mm (1/2-inch) diameter bolts attached to angle iron frame supported from structural ceiling.
- N. Two 25 mm (1 inch) minimum conduits shall be provided from ceiling column assembly to the adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, and for connection to signal cabling network.
- O. Pressure and vacuum switches, transmitter and gauges shall be installed to be easily accessed, and provide access panel where installed above plaster ceiling. Pressure switch and sensors shall be installed with orifice nipple between the pipe line and switches/sensors.
- P. Pipe labeling shall be applied during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- Q. After initial leakage testing is completed, the piping shall be allowed to remain pressurized with testing gas until testing agency performs final tests.
- R. Penetrations:
 - 1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, fire stopping shall be installed that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, Clearances between raceways and openings with the fire stopping material shall be completely filled and sealed..
 - 2. Water proofing: At floor penetrations, clearances shall be completely sealed around the pipe and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- S. A vacuum gage 40mm (1 1/2 inch) diameter line shall be installed downstream of each zone valve in cabinets.

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- T. Zone valves shall be provided in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlets.
 - U. Piping shall be labeled with name of service, identification color and direction of flow. Where non-standard pressures are piped, pressure shall be labeled. Labels shall be placed at least once every 20 feet of linear run or once in each story (whichever is more frequent). A label shall additionally be placed immediately on each side of all wall or floor penetrations. Pipe labels shall be self adhesive vinyl type or other water resistant material with permanent adhesive colored in accordance with NFPA 99 Table 5.1.11 and shall be visible on all sides of the pipe. Each master alarm signal shall be labeled for function after ring out. Each zone valve shall be labeled and each area alarm labeled for the area of control or surveillance after test. Labels shall be permanent and of a type approved by the VAMC.
 - V. Alarms and valves shall be labeled for service and areas monitored or controlled. Coordinate with the VAMC for final room or area designations. Valves shall be labeled with name and identification color of the gas and direction of flow

3.2 INSTALLER TESTING

- A. Prior to declaring the lines ready for final verification, the installing contractor shall strictly follow the procedures for verification as described in NFPA 99 5.1.12.2 and attest in writing over the notarized signature of an officer of the installing company the following;
 - 1. That all brazing was conducted by brazers qualified to ASSE 6010 and holding current medical gas endorsements.
 - 2. That all brazing was conducted with nitrogen purging. (Procedure per NFPA 99 5.1.10.5.5).
 - 3. That the lines have been blown clear of any construction debris using oil free dry nitrogen or air is clean and ready for use. (Procedure per NFPA 99 5.1.12.2.2).
 - 4. That the assembled piping, prior to the installation of any devices, maintained a test pressure 1 1/2 times the standard pressures listed in NFPA 99 Table 5.1.11 without leaks. (Procedure per NFPA 99 5.1.12.2.3).
 - 5. That after installation of all devices, the pipeline was proven leak free for 24hours at a pressure 20% above the standard pressures listed in NFPA 99 Table 5.1.11. (Procedure per NFPA 99 5.1.12.2.2.6)
 - 6. That the systems have been checked for cross connections and none were found. (Procedure per NFPA 99 5.1.12.2.4)
 - 7. That the manufacturer has started up all medical air compressors, medical vacuum pumps and manifolds, and that they are in operating order.
- B. Four originals of the affidavit, shall be distributed; (1) to the engineer, (1) to the owners representative, (1) to the general contractor and (1) to the verifier.

3.3 VERIFIER TESTING

- A. Prior to handing over the systems to VAMC, the contractor shall retain a Verifier acceptable to the engineer and owner who shall follow strictly the procedures for verification as described in NFPA 99 5.1.12.3 and provide a written report and certificate bearing the notarized signature of an officer of the verification company which contains at least the following:
 - 1. A current ACORD insurance certificate indicating professional liability coverage in the minimum amount of \$1 Million per occurrence, and general aggregate liability in the

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- minimum amount of \$1 Million, valid and in force when the project is to be verified. General liability insurance is not alone acceptable.
2. An affidavit bearing the notarized signature of an officer of the verification company stating that the verification company is not the supplier of any equipment used on this project or tested in this report and that the verification contractor has no relationship to, or pecuniary interest in, the manufacturer, seller, or installer of any equipment used on this project or tested in this report
 3. A listing of all tests performed, listing each source, outlet, valve and alarm included in the testing.
 4. An assertion that all tests were performed by a Medical Vacuum System Certified Medical Gas or vacuum Verifier or by individuals qualified to perform the work and holding valid qualifications to ASSE 6030 and under the immediate supervision a Verifier. Include the names, credential numbers and expiration dates for all individuals working on the project.
 5. A statement that equipment used was calibrated at least within the last six months by a method traceable to a National Bureau of Standard Reference and enclosing certificates or other evidence of such calibration(s). Where outside laboratories are used in lieu of on site equipment, those laboratories shall be named and their original reports enclosed.
 6. A statement that where and when needed, equipment was re calibrated during the verification process and describing the method(s) used.
 7. A statement that the systems were tested and found to be free of debris to a procedure per NFPA 99 5.1.12.3.7.
 8. The flow from each outlet when tested to a procedure per NFPA 99-5.1.12.3.10.
 9. A statement that the systems were tested and found to have no cross-connections to a procedure per NFPA 99 5.1.12.3.3.
 10. A statement that the systems were tested and found to be free of contaminants to a procedure per NFPA 99 5.1.12.3.8 except that the purity standard shall be 2 ppm difference for halogenated hydrocarbons and 1 ppm total hydrocarbons (as methane).
 11. Statement that all local signals function as required under NFPA 99 5.1.3.4.7 and as per the relevant NFPA 99 sections relating to the sources.
 12. A listing of local alarms, their function and activation per NFPA 99 5.1.12.3.14.
 13. A listing of master alarms, their function and activation, including pressures for high and low alarms per NFPA 99 5.1.12.3.5.2.
 14. A listing of area alarms, their function and activation pressures per NFPA 99 5.1.12.3.5.3.
 15. A statement that the sources include all alarms required by NFPA 99 Table A.5.1.9.5.
 16. The concentration of each component of NFPA 99 Table 5.1.12.3.12 in the medical air after 24hours of operation of the medical air source.
 17. The concentration of each gas at each outlet as specified in NFPA 99 5.1.12.3.11.
 18. A statement that all valves and alarms are accurately labeled as to zone of control.
 19. Provide four originals of this affidavit, and report, distributed; (1) to the engineer, (1) to the Owner's representative, (1) to the General Contractor and (1) to the installing contractor.
- B. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
- C. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
- D. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.

E. Inlet flow test:

1. Test all inlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
2. Needle valve vacuum inlets must draw no less than 1.0 scfm with adjacent inlet flowing, at a dynamic inlet pressure of 12-inches Hg, and a static vacuum of 15-inches Hg.
3. Vacuum inlets must draw no less than 85 Lpm (3.0 scfm) with adjacent inlet flowing, at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).
4. Anesthesia evacuation inlets must draw no less than 1 L/mm (1.0 scfm) at a dynamic inlet pressure of 40 kPa (12-inches Hg), and a static vacuum of 50 kPa (15-inches Hg).

3.4 FUNCTIONAL PERFORMANCE AND INTEGRATED SYSTEMS TESTING

- A. Functional Performance and Integrated Systems Testing is part of the Commissioning Process. Functional Performance and Integrated Systems Testing shall be performed by the Contractor and witnessed and documented by the Commissioning Authority. Refer to Section 019113, Commissioning, for functional performance and integrated systems testing and commissioning requirements.

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SECTION 22 63 00
GAS SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Central Laboratory and Healthcare Gas Systems: Consisting of laboratory compressed air services, medical compressed air (cylinder system), Oxygen (cylinder system); complete, ready for operation, including all necessary piping, fittings, valves, cabinets, station outlets, rough-ins, ceiling services, gages, alarms including low voltage wiring, nitrogen control panels, cylinder manifolds, air compressors, electric motors and starters, air dryers, filters, pressure regulators, dew point, carbon monoxide monitors and all necessary parts, accessories, connections and equipment.
- B. Oxygen and medical compressed air: Ready for connection to cylinders, but not including cylinders.
- C. Laboratory and healthcare gas system alarm wiring from equipment to alarm panels.

1.2 RELATED WORK

- A. Sealing around pipe penetrations to maintain the integrity of time rated construction: Section 07 84 00, FIRESTOPPING.
- B. Sealing around pipe penetrations through the floor to prevent moisture migration: Section 07 92 00, JOINT SEALANTS.
- C. General requirements and items common to more than one section of Division 22. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Alarm interface with ECC. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- E. Conduit: Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- F. Control wiring: Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER
- G. CONDUCTORS AND CABLES (600 VOLTS AND BELOW).
- H. Electrical wiring and accessories: Section 26 27 26, WIRING DEVICES.
- I. Electric motors: Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- J. Motor starters: Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.
- K. Prefabricated bedside patient units: Section 10 25 13, PATIENT BED SERVICE WALLS.

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- L. Vacuum Piping and Equipment: SECTION 22 62 00, VACUUM SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES
 - M. Section 01 91 13, COMMISSIONING OF SYSTEMS. Requirements for commissioning, pre-functional checklist, and training.
 - N. Section 01 03 42, ALTERNATES: Alternate 8.41. Allow Type L copper tubing for medical gas piping.

1.3 QUALITY ASSURANCE

- A. Materials and Installation: In accordance with NFPA 99, (2005) and as specified.
- B. Equipment Installer: Show technical qualifications and previous experience in installing laboratory and healthcare equipment on three similar projects. Submit names and addresses of referenced projects. Installers shall meet the qualifications of ANSI/ASSE Standard 6010.
- C. Equipment Supplier: Show evidence of equivalent product installed at three installations similar to this project that has been in satisfactory and efficient operation for three years. Submit names and addresses where the product is installed.
- D. Laboratory and healthcare System Testing Organization: The testing shall be conducted by a party technically competent and experienced in the field of laboratory and healthcare pipeline testing. Testing and systems verification shall be performed by personnel meeting the qualifications of ANSI/ASSE Standard 6030. Such testing shall be performed by a party other than the installing contractor.
- E. Provide names of three projects where testing of medical or laboratory gases systems has been performed by the testing agency. Include the name of the project, names of such persons at that project who supervised the work for the project owner, or who accepted the report for the project owner, and a written statement that the projects listed required work of similar scope to that set forth in this specification.
- F. Submit the testing agency's detailed procedure which will be followed in the testing of this project. Include details of the testing sequence, procedures for cross connection tests, outlet function tests, alarm tests, purity tests, etc., as required by this specification. For purity test procedures, include data on test methods, types of equipment to be used, calibration sources and method references.
- G. Certification: Provide documentation prior to submitting request for final inspection to include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and a certification that all results of tests were within limits allowed by this specification.
- H. Installing contractor shall maintain as-built drawings of each completed phases for verification; and, shall provide the complete set at the time of final systems certification testing, for certification by the Third Party Testing Company. As-built drawings shall be provided on prints and in digital format. The digital format shall be in the native CAD system required for the project design. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.

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- I. Commissioning of a system or systems specified in this section is part of the construction process. Documentation and testing of these systems, as well as training of the Owner's operation and maintenance personnel, is required in cooperation with the Owner's Representative and the Commissioning Authority. Project Closeout is dependent on successful completion of all commissioning procedures, documentation, and issue closure. Refer to Section 019113, Commissioning, for detailed commissioning requirements.

1.4 SUBMITTALS

- A. Submit as one package in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
1. Piping.
 2. Valves.
 3. Inlet and outlet cocks
 4. Valve cabinets.
 5. Gages.
 6. Station outlets and rough-in assemblies.
 7. Ceiling services.
 8. Alarm controls and panels.
 9. Pressure Switches.
 10. Nitrogen control panels.
 11. Manifolds.
 12. Air compressor systems (Provide certified compressor test data at start-up.):
 - a. Compressors: Manufacturer and model.
 - b. Characteristic performance curves.
 - c. Compressor operating speed (RPM).
 - d. Capacity: Free air delivered at indicated pressure (L/s) (SCFM).
 - e. Type of bearing in compressor.
 - f. Type of lubrication.
 - g. Type and adjustment of drive.
 - h. Electric motors: Manufacturer, frame and type.
 - i. Speed of motors (RPM).
 - j. Current characteristics and horsepower of motors.
 - k. Receiver capacity and rating.
 - l. Air silencer: Manufacturer, type and model.
 - m. Air filters: Manufacturer, type, model and capacity.
 - n. Pressure regulators: Manufacturer and capacity.
 - o. Dew point monitor: Manufacturer, type and model.
 - p. Air dryers: Manufacturer, type, model and capacity (L/s) (SCFM).
 - q. Carbon monoxide monitor manufacturer, type and model.
 - r. Aftercoolers.
- C. Station Outlets: Submit letter from manufacturer stating that outlets are designed and manufactured to comply with NFPA 99. Outlet shall bear label of approval as an assembly, of Underwriters Laboratories, Inc., or Associated Factory Mutual Research Corporation. In lieu of above labels, certificate may be submitted by a nationally recognized independent testing laboratory, satisfactory to the Contracting Officer, certifying that materials, appliances and assemblies conform to published standards, including methods of tests, of above organizations.

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- D. Certification: The completed systems have been installed, tested, purged, analyzed and verified in accordance with the requirements of this specification.
 - E. Completed Pre-Functional Checklist provided by the Commissioning Agent and completed by the contractor, signed by a qualified technician and dated on the date of completion, in accordance with the requirements of Section 01 91 13, COMMISSIONING OF SYSTEMS.

1.5 TRAINING

- A. Furnish the services of a competent instructor for not less than two four-hour periods for instructing personnel in the operation and maintenance of the laboratory and healthcare gas systems, on the dates requested by COTR.
- B. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative. Provide competent, factory-authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Owner's Representative after submission and approval of formal training plans. Refer to Section 017900, Demonstration and Testing, and Section 019113, Commissioning, for Contractor training requirements.

1.6 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the test by the basic designation only.
- B. American Society for Testing and Materials (ASTM):
B819-(R2006) Seamless Copper Tube for Medical Gas Systems
- C. American Society of Mechanical Engineers (ASME):
A13.1-07 Scheme for Identification of Piping Systems
B16.22-01(R2005) Wrought Copper and Bronze Solder-Joint Pressure Fittings
B40.100 (2005) Pressure Gauges and Gauge Attachments Boiler and Pressure Vessel Code -
Section VIII-07 Pressure Vessels, Division I
Section IX-07 Welding and Brazing Qualifications
- D. American Welding Society (AWS):
AWS A5.8-04 Brazing Filler Metal
AWS B2.2-91 Standard for Brazing Procedure and Performance Qualification (Modified per NFPA 99)
- E. Compressed Gas Association (CGA):
C-9-04 Standard Color Marking of Compressed Gas Cylinders
G-4.1 (2009) Cleaning Equipment for Oxygen Service
G-10.1(2008) Nitrogen, Commodity
P-9-01 Inert Gases Argon, Nitrogen and Helium
V-1-05 Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections
- F. National Electrical Manufacturers Association (NEMA):
ICS-6-93(R2006) Industrial Controls and Systems Enclosures

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- G. National Fire Protection Association (NFPA):
99-05.....Health Care Facilities
 - H. United States Pharmacopoeia XXI/National Formulary XVI (USP/NF)
 - I. Manufacturing Standardization Society (MSS):
MSS-SP-72-99Ball Valves With Flanged or Butt Welding For General Purpose
MSS-SP-110-96Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and
Flared Ends
MSS-SP-73-03Braze Joints for Copper and Copper Alloy Solder Pressure
Fittings

PART 2 - PRODUCTS

2.1 PIPING AND FITTINGS

- A. Copper Tubing: Type "L" ASTM B819, seamless copper tube, hard drawn temper, with wrought copper fittings conforming to ASME B16.22 or brazing fittings complying with MSS SP-73. Size designated reflecting nominal inside diameter. All tubing and fittings shall be labeled "ACR/OXY", "OXY", "OXY/MED", "ACR/MED", or "MED".
- B. Brazing Alloy: AWS A5.8, Classification BCuP, greater than 537 °C (1000 °F) melting temperature. Flux is strictly prohibited for copper-to-copper connections.
- C. Screw Joints: Polytetrafluoroethylene (Teflon) tape.
- D. Underground Protective Pipe: Polyvinyl Chloride (PVC), ASTM D1785, Schedule 80.
- E. Memory metal couplings: Temperature and pressure rating shall not be less than that of a brazed joint.
- F. Apply piping identification labels at the time of installation in accordance with current NFPA. Apply supplementary color identification in accordance with CGA Pamphlet C-9.
- G. Special Fittings: The following special fittings shall be permitted to be used in lieu of brazed joints:
 1. Memory-metal couplings having temperature and pressure ratings joints not less than that of a brazed joint.
 2. Listed or approved metallic gas tube fittings that, when made up, provide a permanent joint having the mechanical, thermal, and sealing integrity of a brazed joint.
 3. Dielectric fittings where required by the manufacturer of special medical equipment to electrically isolate the equipment from the piping distribution system.
 4. Axially swaged, elastic strain preload fittings providing metal to metal seal having pressure and temperature ratings not less than that of a brazed joint and when complete are permanent and non-separable.

2.2 EXPOSED LABORATORY AND HEALTHCARE GASES PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed laboratory and healthcare gas piping connecting fixtures, casework, cabinets, equipment and reagent racks

when not concealed by apron including those furnished by the Government or specified in other sections.

1. Pipe: Fed. Spec. WW-P-351, standard weight.
2. Fittings: ASME B16.15 cast bronze threaded fittings with chrome finish, (125 and 250 PS1 Classes).
3. Nipples: ASTM B 687, Chromium-plated.
4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.

2.3 VALVES

A. Ball: In-line, other than zone valves in cabinets:

1. Seventy five millimeter (2 1/2 inches) and smaller: Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110 , Type II, Class 150, Style 1, with tubing extensions for brazed connections, full port, three-piece or double union end connections, Teflon seat seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service.
2. Eighty to one hundred millimeter (3-4 inches): Bronze/ brass body, Fed. Spec. MSS SP72 & SP 110, Type II, Class 150, Style 1 with tubing extensions brazed to flanges, full port, three piece, double seal, Teflon seals, full flow, 4125 kPa (600 psi) WOG minimum working pressure, with locking type handle, cleaned for oxygen use and labeled for intended service.

B. Check:

1. Eighty millimeter (3 inches) and smaller: Bronze/brass body, straight through design for minimum pressure drop, spring loaded, self aligning with Teflon cone seat, vibration free, silent operation, supplied NPT female threads at each end with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 2750 kPa (400 psi) WOG minimum working pressure.
2. One hundred millimeter (4 inches) and larger: Iron body, bronze trim, swing type, vertical or horizontal installation, flange connection, with flow direction arrow permanently cast into, cleaned for oxygen use and labeled for intended service, 1025 kPa (150 psi) WSP.

- #### C. Zone Valve in Cabinet: Ball valve, bronze/ brass body, double seal, three piece or double union end connections, replaceable teflon seat seals, teflon stem seal, 4125 kPa (600 psi) WOG, cold, non-shock gas working pressure service to 100 kPa (29 inch Hg), cleaned for oxygen use and labeled for intended service, blowout proof stem, one quarter turn of handle to completely open or close. Provide tubing extensions factory brazed, and pressure tested. Provide 3 mm (1/8 inch) NPT gauge port for a 50mm (2 inch) diameter monitoring gauge downstream of the shut off valve. Zone valves shall be securely attached to the cabinet and provided with type-K copper tube extensions for making connection to system piping outside the cabinet. Zone valves shall be products of one manufacturer, and uniform throughout in pattern, overall size and appearance. Trim with color coded plastic inserts or color coded stick-on labels. Install valves in cabinets such that cover window cannot be in place when any valve is in the closed position. Color coding for identification plates and labels is as follows:

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
OXYGEN	White letters on green background	GREEN

SERVICE LABEL	IDENTIFICATION COLORS	MFG. STD. CLR.
NITROUS OXIDE	White letters on blue background	BLUE
NITROGEN	White letters on black background	BLACK
MEDICAL AIR	Black or white letters on yellow background	YELLOW
CARBON DIOXIDE	Black or white letters on gray background	GRAY
INSTURMENT AIR		

2.4 VALVE CABINETS

- A. Flush mounted commercially available item for use with laboratory and healthcare services, not lighter than 1.3 mm (18 gage) steel or 1.9 mm (14 gage) extruded aluminum, rigidly assembled, of adequate size to accommodate valve(s) and fittings. Punch or drill sides to receive tubing. Provide anchors to secure cabinet to wall construction. Seal openings in cabinet to be dust tight. Locate bottom of cabinet 1375 mm (4 foot 6 inches) above floor.
- B. Mount engraved rigid plastic identification plate on wall above or adjacent to cabinet. Color code identification plate to match gas identification colors as indicated above. Identification plate must be clearly visible at all times. Provide inscriptions on plate to read in substance: "VALVE CONTROL SUPPLY TO ROOMS."
- C. Cover plate: Fabricate from 1.3 mm (18 gage) sheet metal with satin chromed finish, extruded anodized aluminum, or .85 mm (22 gage) stainless steel. Provide cover window of replaceable plastic, with a corrosion resistant device or lever secured to window for emergency window removal. Permanently paint or stencil on window: CAUTION-CLOSE ONLY IN EMERGENCY, SHUT-OFF VALVES FOR PIPED GASES", or equivalent wording. Configure such that it is not possible to install window with any valve in the closed position. Each valve shall have gauge upstream of valve inside valve box.
- D. Cabinets and isolation valves shall be located and piped as shown, and at a minimum, so as to allow the isolation of each smoke compartment separately. No cabinet shall serve more than one smoke compartment.

2.5 GAGES

- A. Pressure Gages: Includes gages temporarily supplied for testing purposes.
 1. For line pressure use adjacent to source equipment: ASME B40.1, pressure gage, single, size 115 mm (4-1/2 inches), for compressed air, nitrogen and oxygen, accurate to within two percent, with metal case. Range shall be two times operating pressure. Dial graduations and figures shall be black on a white background, or white on a black background. Gage shall be cleaned for oxygen use, labeled for appropriate service, and marked "USE NO OIL". Install with gage cock.
 2. For all services downstream of main shutoff valve: Manufactured for oxygen use, labeled for the appropriate service and marked "USE NO OIL", 40 mm (1-1/2 inch) diameter gage with dial range 1-690 kPa (1-100 psi) for air service and 1-2050 kPa (1-300 psi) for Nitrogen or instrument air service.

2.6 STATION OUTLETS

- A. For all services except ceiling hose drops and nitrogen system: For designated service, consisting of a quick coupler and inlet supply tube. Provide coupler that is non-interchangeable with other services, and leak proof under three times the normal working pressure. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation for servicing and replacement, and to facilitate line blow-out, purging, and testing.

Fasten each outlet and inlet securely to rough-in to prevent floating and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm outside diameter) (3/8-inch outside diameter) tubing for connection to supply. Identification of each gas service shall be permanently cast into the back plate and shall be visible through a transparent plastic guard. Label stub tubing for appropriate service. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPUs) are furnished under this specification but installed by manufacturer of PBPUs before initial test specified herein. Install completion kits (valve body and face plate) for the remainder of required tests.

- B. For Ceiling Hose Drops and Nitrogen Service: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet and inlet securely to rough-in to prevent floating, and provide each with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Adjust to compensate for variations in plaster or cover thickness.

2.7 STATION OUTLETS

- A. For all services: Brass, stainless steel or chromed metal non-interchangeable DISS connections for appropriate service to conform with CGA V-5. Equip each station outlet with an automatic valve and a secondary check valve to conform with NFPA 99. Equip each station inlet with an automatic valve to conform with NFPA 99. Place valves in the assembly to provide easy access after installation, for servicing and replacement, and to facilitate line blow-out, purging, and testing. Fasten each outlet securely to outlet rough-in to prevent floating, and provide each outlet with a capped stub length of 6 mm (1/4-inch) (10 mm (3/8-inch) outside diameter) tubing for connection to supply. Label stub tubing for appropriate service. Adjustable to compensate for variations in plaster or cover thickness. Rough-in kits and test plugs for Prefabricated Bedside Patient Units (PBPUs) are furnished under this specification but installed by manufacturer of PBPUs before initial tests specified herein. Install outlet completion kits (valve body and face plate) for the remainder of required tests.

2.8 RECESSED SECURITY CONSOLE

- A. The Recessed Security Console for the Fifth Floor Mental Health Patient Rooms shall be a medical gas service assembly which allows services to be secured behind a locked cover to limit access to the devices. The transparent polycarbonate cover hinges down to allow access to components for use. Unit shall be 23" W x 22.5" H and house two (2) medical gas outlets and electrical outlets. The exact quantity of outlets shall be confirmed with the Architect prior to purchasing.
- B. Units are UL listed and NFPA 99 compliant and include sound dampening material on the back of the recessed compartment. Unit shall be similar to Modular Services Company RSC-108.

2.9 WATERPROOF SURFACE-MOUNTED SECURITY MEDICAL GAS CABINET

- A. The Security Medical Gas Cabinet for the decontamination room shall provide waterproof protection for medical gas outlets. The unit shall be surface-mounted, all steel construction,

powder-coated, waterproof, with full EDPM door seal and pipe seals, dust-resistant, dual locks and house three (3) medical gas outlets. The cabinet shall be similar to Hospital Systems Inc.

2.10 STATION OUTLET ROUGH-IN

- A. Flush mounted, protected against corrosion. Anchor rough-in securely to unit or wall construction.
- B. Modular Cover Plate: Die cast back plate, two-piece .85 mm (22 gage) stainless steel or 1.6 mm (16 gage) chromium plated metal, with mounting flanges on all four sides, secured to rough-in with stainless steel or chromium plated countersunk screws.
- C. Cover Plate for Prefabricated Bedside Patient Units (PBPU): One-piece with construction and material as indicated for modular cover plate.
- D. Provide permanent, metal or plastic, identification plates securely fastened at each outlet and inlet opening, with inscription for appropriate service using color coded letters and background. Metal plates shall have letters embossed on baked-on enamel background. Color coding for identification plates is as follows:

SERVICE LABEL	IDENTIFICATION PLATE COLORS
OXYGEN	White letters on green background
NITROUS OXIDE	White letters on blue background
NITROGEN	White letters on black background
MEDICAL AIR	Black or white letters on yellow
CARBON DIOXIDE	White letters on gray background
INSTRUMENT AIR	

2.11 ALARMS

- A. Provide all low voltage control wiring, except for wiring from alarm relay interface control cabinet to ECC, required for complete, proper functioning system, in conformance with Section 26 05 21, LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES (600 VOLTS AND BELOW). Run wiring in conduit, in conformance with Section 26 05 33, RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS.
- B. Local Alarm Functions: Provide individual local air compressor malfunction alarms at each compressor system main control panel.
 - 1. Compressor Malfunction Alarm: Each compressor system receiving any of the following individual signals and sends a single combined "compressor malfunction alarm" signal to master alarm panel.
 - a. Thermal Malfunction Alarm: Functions when discharge air temperature exceeds 177 °C (350 °F), shutting down affected compressor.
 - b. Lead Compressor Fails to Start: Functions when lead compressor fails to start when actuated, causing lag pump to start.
 - c. Lag Compressor in Use: Functions when the primary or lead compressor is incapable of satisfying the demand. When three or more compressors are part of the system, the lag compressor in use alarm shall energize when the last compressor has been signaled to start.
 - d. High Water Level in Receiver. (Liquid ring or water-cooled units)

- e. High Water Level in Separator (if so required). (Liquid ring unit)

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2. Desiccant Air Dryer Malfunction Alarm: Dryer receives the following individual signals and sends a single consolidated dryer malfunction alarm signal to master alarm panel.
 - a. Dew Point Alarm: Functions when line pressure dew point rises above 4 °C (39 °F) at 380 kPa (55 psi).
 3. Vacuum Pump Malfunction Alarm: Pump system receives the following individual signals and sends a single consolidated pump malfunction alarm signal to master alarm.
 - a. High Temperature Shut down Alarm: Functions when exhaust air temperature exceeds 104 °C (220 °F), shutting down affected pump.
 - b. Lead Pump Fails to Start Alarm: Functions when lead pump fails to start when actuated causing lag pump to start.
 - c. Lag Pump In Use Alarm: Functions when the primary or lead vacuum pump is incapable of satisfying the demand. When three or more vacuum pumps are part of the system, the lag pump in use alarm shall energize when the last vacuum pump has been signaled to start.
 4. Instrument Air Dew Point High: Functions when the line pressure dew point is greater than -30 °C (-22 °F).
- C. Master Alarm Functions: Provide the following individual alarms at the master alarm panel.
1. Oxygen Alarms:
 - a. Liquid oxygen low level alarm: Functions when stored liquid oxygen reaches a predetermined minimum level.
 - b. Reserve switchover alarm: Functions when, or just before, reserve oxygen supply goes in operation.
 - c. Reserve low supply alarm: Functions when contents of cylinder reserve oxygen supply are reduced to one day's average supply; switch and contacts at the bulk tank control panel.
 - d. Reserve low pressure alarm: Functions when the gas pressure available in the liquid reserve oxygen supply is reduced below the pressure required to function properly.
 - e. Low pressure alarm: Functions when system pressure downstream of the main shutoff valve drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi); operated by pressure switch or transmitters.
 - f. High pressure alarm: functions when system pressure downstream of main shutoff valve increases above 415 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
 - g. Cylinder reserve pressure low: Functions when the content of a cylinder reserve header is reduced below one day's average supply.
 2. Nitrous Oxide Alarms:
 - a. Reserve switchover alarm: Functions when, or just before, secondary or reserve nitrous oxide supply goes in operation.
 - b. Pressure alarms: Functions when system pressure downstream of main shutoff valve drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi) or increases above 415 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.

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- c. Cylinder reserve pressure low: Functions when the content of a cylinder reserve header is reduced below one day's average supply.
 3. Nitrogen Alarms:
 - a. Reserve switchover alarm: Functions when, or just before, secondary or reserve nitrogen supply goes in operation.
 - b. Pressure alarms: Functions when system pressure downstream of main shutoff valve drops below 1310 kPa (190 psi), plus/minus 14 kPa (2 psi) or increases above 1510 kPa (220 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
 - c. Cylinder reserve pressure low: Functions when the content of a cylinder reserve header is reduced below one day's average supply.
 4. Carbon Dioxide Alarms:
 - a. Reserve Switchover Alarm: Functions when, or just before, secondary or reserve carbon dioxide supply goes in operation.
 - b. Pressure Alarms: Functions when system pressure downstream of main shutoff valve drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi) or increases above 415 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
 - c. Cylinder reserve pressure low: Functions when the content of a cylinder reserve header is reduced below one day's average supply.
 5. Compressed Air Alarms:
 - a. Medical air dew point high alarm: Functions when the line pressure dew point rises above 2 °C (35 °F) at 380 kPa (55 psi).
 - b. Carbon Monoxide Alarm: Functions when the carbon monoxide levels rise above 10 parts per million; receives signal from the carbon monoxide monitor.
 - c. Main Bank Filter Set Alarm: Functions when the pressure drop across filter set increases more than 14 kPa (2 psi) over that when filters are clean and new; operates by differential pressure switch or transmitters.
 - d. Desiccant Prefilter Alarm: Functions when pressure across the filter increases more than 21 kPa (3 psi) over that when filters are clean and new; operates by pressure differential switch.
 - e. Desiccant Post Filter Alarm: Functions when pressure drop across filter increases more than 21 kPa (3 psi) over that when filters are clean and new; operates by pressure differential switch.
 - f. Desiccant Dryer Malfunction Alarm: Functions on any combination of failure of tower cycling and/or pressure dew point rise above 60 ° C at 690 kPa (140 ° F at 100 psi).
 - g. Aftercooler High temperature Alarm: Functions when aftercooler discharge air temperature exceeds 38 ° C (100 ° F).
 - h. Pressure Abnormal Alarm: Functions when system pressure downstream of main shutoff valve drops below 550 kPa (80 psi) (plus/minus gage or increases above 830 kPa (120 psi) (plus/minus 14 kPa (2 psi) set points; operated by pressure switch.
 - i. Compressor Malfunction Alarm: Functions when compressor system control panel signals compressor thermal malfunction alarm, lead compressor fails to start alarm or high water level in receiver or separator (if so required) receives signal from system control panel.

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- j. Low Lubricant Shutdown: For rotary screw compressors. Functions when lubricant level drops to a low point. Receives signal from compressor control panel.
 - k. Instrument air dew point high alarm: Functions when the line pressure dew point rises above -30 °C (-22 °F) at 380 kPa (55 psi).
6. Instrument air alarms.
- D. Alarm Functions:
- 1. Oxygen, nitrous oxide, carbon dioxide and compressed air alarms: Pressure alarms: Functions when pressure in branch drops below 275 kPa (40 psi), plus/minus 14 kPa (2 psi) or increases above 414 kPa (60 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
 - 2. Nitrogen alarms: Pressure alarms: Functions when pressure in branch drops below 1310 kPa (190 psi), plus/minus 14 kPa (2 psi) or increases above 1500 kPa (220 psi), plus/minus 14 kPa (2 psi) set points; operated by pressure switches or transmitters.
 - 3. Vacuum alarms: Low vacuum alarm: Functions when vacuum in branch drops below 40 kPa (12-inches Hg); operated by vacuum switch.
 - a. Reserve switchover alarm: Functions when secondary or reserve manifold supply goes in operation.
 - b. Pressure alarms: Function when system pressure downstream of main shutoff valve drops or increases above or below set points; operated by pressure switches or transmitters.
 - 4. Vacuum alarms:
 - a. Low vacuum alarm: Function when system vacuum upstream of main shutoff valve drops below 40 kPa (12 inches Hg); operated by vacuum switch.
 - b. Filter differential pressure/back pressure alarm: Functions when discharge oil filter differential rises to set level, or when back pressure is sensed; receives signal from pump control panel.
 - c. Laboratory vacuum pump malfunction.
- E. Alarm Panels:
- 1. General: Modular design, easily serviced and maintained; alarms operate on alternative current low voltage control circuit; provide required number of transformers for efficient functioning of complete system. Alarm panels shall be integral units, reporting compressed air and vacuum services, as required.
 - 2. Box: Flush-mounted, sectional or one piece, corrosion protected. Size to accommodate required number of service functions for each location, and for one audible signal in each box. Anchor box securely. Provide spare capacity to accommodate 50% of the number of provided alarm points.
 - 3. Cover plate: Designed to accommodate required number of signals, visual and audible, for each location, and containing adequate operating instructions within the operator's view. Bezel shall be extruded aluminum, chromium plated metal, or plastic. Secure to the box with chromium plated or stainless steel countersunk screws.
 - 4. Service indicator lights: Red translucent plastic or LED with proper service identification inscribed thereon. Number of lights and service instruction shall be as required for each location. Provide each panel with a green test button of the same material, inscribed with "PUSH TO TEST" or similar message.
 - 5. Audible signal: Provide one in each alarm panel and connect electrically with all service indicator light functions.

6. Controls:

- a. Visual signal: When the condition occurs which any individual service indicator light is to report, button for particular service shall give a lighted visual signal which cannot be canceled until such condition is corrected.
- b. Audible signal: Alarm shall give an audible signal upon circuit energization of any visual signal. Audible signal shall be continuous until silenced by pushing a button. This shall cancel and reset audible only, and not affect the visual signal. After silencing, subsequent alarms shall reactivate the audible alarm.
- c. Signal tester: Test button or separate normal light shall be continuously lighted to indicate electrical circuit serving each individual alarm is energized. Pushing test button shall temporarily activate all visual signals and sound audible signal, thereby providing desired indications of status of system.

F. Alarm Relay Interface Control Cabinet: Design cabinet to transfer the closed circuit alarm signals through relays to a set of terminals for monitoring signals at the ECC without interrupting the closed circuit system. Construct of 1.9 mm (14 gage) steel, conforming with NEMA ICS-6, Type 1, enclosures. Provide both normally open and normally closed contacts for output signals, with number of circuits required for full alarm capability at the ECC. Refer to Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC for compatibility.

G. Alarm Network Communication: Network communications board shall be installed in local alarm and connected to the facility's Ethernet. Local alarm modules shall send information to the master alarm and the data can be downloaded thru the computer connected to the facility's Ethernet. Master alarm displays the message, sounds its alarm and saves the information in an event log. This event log shall be downloaded to a computer file for tracking data and troubleshooting.

2.12 PRESSURE SWITCHES

- A. General purpose, contact or mercury type, allowing both high and low pressure set points, with contact type provided with a protective dust cover; adjustable range set by inside or outside adjustment; switches activate when indicated by alarm requirements. Use one orifice nipple (or DISS demand check valve) for each sensor or pressure switch.

2.13 CYLINDER GAS SUPPLY MANIFOLDS

- A. Non-ferrous metal manifold and fittings, valves, parts and connections, suitable for a regular working pressure of 21 MPa (3000 psi). Gas cylinders at manifold shall be individually chained to wall or floor with adequate support.
- B. Duplex arrangement, each bank having number of cylinder connections as required, Nitrogen, 14 cylinders per bank, Nitrous Oxide, 11 cylinders per bank, Carbon Dioxide, 3 cylinders per bank, high pressure copper cylinder connection pigtailed with brazed fittings. Shutting of either bank shall not interrupt supply to system.
- C. Provide manifold with two (one for each bank) two-stage pressure regulators with gages and built-in safety valves, manifold header valves and check valves, service line connection valves, relief valves, tank connecting coils and handles, and all required equipment for a complete assembly. Enclose manifold controls in sheet metal cabinet.
- D. Supply pressure for Nitrogen is 185 PSI, Nitrous Oxide is 55 PSI and Carbon Dioxide is 55 PSI.

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- E. Switch-over to full reserve bank shall be automatic when one cylinder bank becomes exhausted, with no fluctuation in pressure, and not require resetting of regulators. After replacement of empty tank, resetting of controls shall be automatic or by single lever. Reserve switch-over shall be actuated by pressure switch; alarm shall be part of manifold control. After replacement of the depleted cylinders, the manifold automatically indicates the cylinder bank recently replaced as the secondary supply. Manual resetting of the control panel is NOT necessary. The manifold includes a line pressure gauge, two cylinder bank pressure gauges (left-bank and right-bank), and color-coded indicator LED visual indicators for "IN USE" (green), "READY" (yellow), and "EMPTY" (red) for each cylinder bank. The manifold has intermediate and line pressure relief valves that are internally connected to a common vent port, terminating into a 1/2" FNPT O-ring sealed "zero clearance" union.
- F. A separate power supply is furnished with the manifold to convert 120 VAC to 24 VAC output power and includes dry contacts for (2) separate, electrically isolated, remote alarm connections. The power supply is housed in a NEMA 3R enclosure with electrical requirements of (1) amp at 120 VAC, 60 HZ, single phase. The manifold is supplied with a 3/4" FNPT O-Ring sealed "zero clearance" union outlet. The system also includes a 3/4" full port, three piece, ball-type source shut-off valve with a 1/8" FNPT port. The source valve has a 3/4" NPT attachment to the union outlet and a 3/4" nominal copper (type K) tube for brazing to main supply line. Manifolds are to be installed in accordance with requirements stated by NFPA 99 and CGA.

2.14 AIR COMPRESSOR SYSTEMS

- A. Furnish and install per plans and specifications one (1) BeaconMedaes System Model # SAS15T-240V-T-SPL Triplex Laboratory Compressed Air System, complete with a triplex control panel. System to be comprised of three (3) 15 HP scroll compressor modules, each driven by a 15 HP motor, each rated for 50.4 SCFM @ 50 psig. The system shall be of a single point connection, base mounted design consisting of two (2) stack mounted compressor modules. Piped fittings to be flanged in lieu of threaded and use of anodized aluminum drilled blocks wherever possible to be incorporated throughout air stream design to reduce leak points. Package to be designed and manufactured with ISO 13485 processes and be completely tested prior to shipment.
- B. The compressors shall be a continuous duty rated scroll type, single-stage and air-cooled. Each compressor shall have one fixed and one orbiting scroll sealed with PTFE tip seals between the scroll halves. The compressor module must have field replaceable tip seals, dust and contamination protection from two part face seal, grease filled orbiting bearing and pin crank bearings that are grease filled with a maintenance interval of 10,000 hours for 10 HP and 8,000 hours for 15 HP, integral cooling fan, totally enclosed belt guard to protect V-Belt Drive and fully adjustable motor mounting base to achieve belt tensioning.
- C. The motor shall be a NEMA rated, ODP, 3600 RPM, with a 1.15 service factory suitable for 208V or 230/460V electrical service. Each compressor shall have a piped intake manifold with one inline inlet air filter with isolation valve and a high inlet vacuum switch to protect the compressor. Each compressor shall be equipped with an integral air-cooled aftercooler designed for a maximum approach temperature of 15 deg. F, complete with integrated drain trap with automatic solenoid drain valve. Each compressor discharge line must include a heat-shielded flex connector, safety relief valve, isolation valve and check valve. The discharge piping of each compressor shall incorporate an integral valve to provide load-less starting and rapid air evacuation between the check valve and scroll discharge at shutdown. Each compressor must be equipped with a wired high discharge air temperature shutdown switch.
- D. The compressor module shall be fully isolated from the system base by means of a four-point, heavy duty isolation system for a minimum of 95% isolation efficiency. Where required by local or state regulation, seismically restrained isolators shall be provided.
- E. The vertical air receiver shall be corrosion resistant, ASME Coded, National Board Certified, rated for a minimum 150 PSIG design pressure and must include a liquid level gauge glass, safety relief valve, manual drain valve, and a zero loss electronic drain valve.
- F. The Duplex Dryer System shall be comprised of two (2) twin tower desiccant dryers, pre-filters, afterfilters, regulators, safety relief valves, and integral purge saving control system within a four-valve bypass arrangement. This dryer/filter package shall be sized to handle the flow of one compressor. Each dryer shall be capable of producing a - 12 deg. C (10 deg. F) pressure dew point at 100 psig. Dryer purge flow shall be minimized through an integral demand based purge saving control system that shall include a 441 transfer valve utilizing 2 ceramic slide plates that is covered by a 5-year factory warranty. The inlet to each dryer shall include a mounted pre-filter rated for 0.01 micron with automatic drain and element change indicator. Fully duplexed final line filters rated for 0.01 micron with element change indicators and duplexed final line regulators with duplexed safety relief valves shall be factory mounted and piped.

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- G. The Duplex mounted and wired TotalAlert Embedded control system is to be UL labeled. This control system shall provide automatic lead/lag sequencing and automatic lead/lag sequencing and alternation of all compressors based on first-on/first-off principle with provision for simultaneous operation if required. Control panel to include:

- Circuit breaker disconnects for each compressor module with external operators (including controls for future pump)
- full voltage motor starters with overload protection
- 24V control circuit for safety

The touch screen controls feature one 5.7" master screen and a 3.5" operating screen for each compressor. Screen displays and functions are to be as follows:

- Service alerts, runtime hour meters, system status, system pressure level, and dew point level.
- Visual/audible alarm indications with isolated contacts for all standard remote alarms
- Event log recording alarms and system activity
- Event log recording service warnings and service history
- Trend graphs for outlet pressure, Dew Point and ambient temperature
- Ethernet connectivity and embedded web page for remote monitoring
- Integral connectivity to the TotalAlert medical gas network via Ethernet

- H. Example of an acceptable product and manufacturer:

1. Beacon Medical Lifeline Air Systems.

2.17 PRESSURE REGULATORS:

- A. For 690 kPa (100 psi) regulator, provide duplex in parallel, valve for maintenance shut-down without service interruption. For additional pressures, locate regulators remote from compressor near point of use, and provide with isolation valves and valve bypass.
 - 1. For systems 5 L/s (10 scfm) and below: Brass or bronze body and trim, reduced pressure range 170 – 850 kPa (25 – 125 psi) adjustable, spring type, diaphragm operated diaphragm operated, relieving. Delivered pressure shall vary not more than one kPa (0.15psi) for each 10 kPa (1.5psi) variation in inlet pressure.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. In accordance with current NFPA. Run buried oxygen piping in PVC protective pipe for entire length including enclosure of fittings and changes of direction.
- B. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- C. Keep open ends of tube capped or plugged at all times or otherwise sealed until final assembly.

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- D. Cut piping square and accurately with a tube cutter (sawing not permitted) to measurements determined at place of installation. Ream tube to remove burrs, being careful not to expand tube, and so no chips of copper remain in the tube. Work into place without springing or forcing. Bottom tube in socket so there are no gaps between tube and fitting. Exercise care in handling equipment and tools used in cutting or reaming of tube to prevent oil or grease being introduced into tubing. Where contamination has occurred, material is no longer suitable for oxygen service.
- E. Spacing of hangers: Current NFPA.
- F. Rigidly support valves and other equipment to prevent strain on tube or joints.
- G. While being brazed, joints shall be continuously purged with *oil* free nitrogen. The flow of purged gas shall be maintained until joint is cool to touch.
- H. Do not bend tubing. Use fittings.
- I. Support ceiling column assembly from heavy sub-mounting castings furnished with the unit as part of roughing-in. Anchor with 15 mm (1/2-inch) diameter bolts attached to angle iron frame supported from structural ceiling, unless otherwise indicated.
- J. Provide two 25 mm (1 inch) minimum conduits from ceiling column assembly to adjacent corridor, one for mass spectrometer tubing and wiring and one for monitor wiring, for connection to signal cabling network.
- K. Install pressure switches, transmitter and gauges to be easily accessed, and provide access panel where installed above plaster ceiling. Install pressure switch and sensors with orifice nipple between the pipe line and switches/sensors.
- L. Apply pipe labeling during installation process and not after installation is completed. Size of legend letters shall be in accordance with ANSI A13.1.
- M. Pipe compressor intake to a source of clean ambient air as indicated in current NFPA.
- N. After initial leakage testing is completed, allow piping to remain pressurized with testing gas until testing agency performs final tests.
- O. Penetrations:
1. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoked partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING, with intumescent materials only. Completely fill and seal clearances between raceways and openings with the fire stopping material.
 2. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- P. Provide 40mm (1 1/2 inch) diameter line pressure gage downstream of zone valve in cabinets.
- Q. Provide zone valves in cabinets where indicated and outside each Operating Room and a minimum one zone valve assembly for each 18 outlet set.

3.2 TESTS

- A. Initial Tests: Blow down, and high and low pressure leakage tests as required by current NFPA with documentation.
- B. Laboratory and healthcare testing agency shall perform the following:
1. Perform and document all cross connection tests, labeling verification, supply system operation, and valve and alarm operation tests as required by, and in accordance with, current NFPA and the procedures set forth in pre-qualification documentation.
 2. Verify that the systems, as installed, meet or exceed the requirements of current NFPA, this specification, and that the systems operate as required.
 3. Piping purge test: For each positive pressure gas system, verify cleanliness of piping system. Filter a minimum of 35 cubic feet (1000 liters) of gas through a clean white 0.45 micron filter at a minimum velocity of 3.5 scfm (100 Lpm). Filter shall show no discoloration, and shall accrue no more than 0.1 mg of matter. Test each zone at the outlet most remote from the source. Perform test with the use of an inert gas as described in CGA P-9.
 4. Piping purity test: For each positive pressure system, verify purity of piping system. Test each zone at the most remote outlet for dew point, carbon monoxide, total hydrocarbons (as methane), and halogenated hydrocarbons, and compare with source gas. The two tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Perform test with the use of an inert gas as described in CGA P-9.
 5. Outlet and inlet flow test:
 - a. Test all outlets for flow. Perform test with the use of an inert gas as described in CGA P-9.
 - b. Oxygen, nitrous oxide and air outlets must deliver 100 Lpm (3.5 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 350 kPa (50 psi).
 - c. Nitrogen outlets must deliver 565 Lpm (20 scfm) with a pressure drop of no more than 35 kPa (5 psi), and static pressure of 1445 kPa (210 psi).
 - d. Needle valve air outlets must deliver 1.5 scfm with a pressure drop of no more than five psi, and static pressure of 350 kPa (50 psi).
 6. Source Contamination Test: Analyze each pressure gas source for concentration of contaminants, by volume. Take samples for air system test at the intake and at a point immediately downstream of the final filter outlet. The compared tests must in no case exceed variation as specified in Paragraph, Maximum Allowable Variation. Allowable concentrations are below the following:

Dew point, air	4 degrees C (39 degrees F) pressure dew point at 690 kPa (100 psi)
Carbon monoxide, air	10 mg/L (ppm)
Carbon dioxide, air	500 mg/L (ppm)
Gaseous hydrocarbons as methane, air	25 mg/L (ppm)
Halogenated hydrocarbons, air	2 mg/L (ppm)

7. Analysis Test:
 - a. Analyze each pressure gas source and outlet for concentration of gas, by volume.
 - b. Make analysis with instruments designed to measure the specific gas dispensed.

c. Allowable concentrations are within the following:

1) Laboratory air 19.5 percent to 23.5 percent oxygen.

Oxygen	>=97 plus percent oxygen
Nitrous oxide	>=99 plus percent nitrous oxide
Nitrogen	>=99 plus percent nitrogen
Medical air	19.5 percent to 23.5 percent oxygen
Carbon Dioxide	99 plus percent carbon dioxide

2) [add name of special gas and analysis test criteria here] //

8. Maximum Allowable Variation: Between comparative test results required are as follows:

Dew point	2 degrees C (36 degrees F)
Carbon monoxide	2 mg/L (ppm)
Total hydrocarbons as methane	1 mg/L (ppm)
Halogenated hydrocarbons	2 mg/L (ppm)

C. Functional Performance and Integrated Systems Testing is part of the Commissioning Process. Functional Performance and Integrated Systems Testing shall be performed by the Contractor and witnessed and documented by the Commissioning Authority. Refer to Section 019113, Commissioning, for functional performance and integrated systems testing and commissioning requirements.

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SECTION 22 66 00 - CHEMICAL-WASTE SYSTEMS FOR LABORATORY AND HEALTHCARE FACILITIES**PART 1 - GENERAL****1.1 DESCRIPTION**

This section describes the requirements for chemical waste systems, including piping, equipment and all necessary accessories as designated in this section.

1.2 RELATED WORK

- A. Section 07 84 00, FIRESTOPPING: Penetrations in rated enclosures:
- B. Section 09 91 00, PAINTING: Preparation and finish painting and identification of piping systems.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION: Pipe Insulation.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. Floor Drains.
 - 3. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American National Standards Institute (ANSI):
 - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - A13.1-07..... Scheme for Identification of Piping Systems
 - B16.11-01..... Forged Steel Fittings, Socket-Welding and Threaded
 - B16.12-98 (R 2006)..... Cast Iron Threaded Drainage Fittings ANSI/ASME
 - B16.15-06(R 2006)..... Cast Bronze Threaded Fittings ANSI/ASME
- C. American Society for Testing and Materials (ASTM):
 - A74-06..... Standard Specification for Cast Iron Soil Pipe and Fittings
 - A183-03) Standard Specification for Carbon Steel Track Bolts and Nuts
 - A312-08..... Standard Specification for Seamless and Welded Austenitic
Stainless Steel Pipe

- A733-03..... Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
- C564-03a Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
- D401-07 Standard Specification for Propylene Plastic Injection and Extrusion Materials
- D2447-03 Standard Specification for Polyethylene (PE) Plastic Pipe, Schedule 40 and 80, Based on Outside Diameter
- D2564-04e1 Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
- D2665-07 Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
- D4101-07 Standard Specification for Propylene Plastic Injection and Extrusion Materials
- D. International Code Council:
IPC-06 International Plumbing Code
- E. Cast Iron Soil Pipe Institute (CISPI):
301-05 Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
310-04 Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
- F. PHCC (Plumbing, Heating, Cooling Contractors Association)
2009 National Standard Plumbing Code

PART 2 - PRODUCTS

2.1 CHEMICAL RESISTANT WASTE AND VENT PIPING

- A. The material shall include connecting fittings in stacks or mains.
- B. The chemical resistant waste and vent piping shall be high silicon iron pipe and drainage pattern fittings conforming to ASTM A861. The cast iron pipe shall be close grained, containing not less than 14.25 percent silicon content.
1. The joints shall be mechanical joint type with stainless steel clamps with TFE inner sleeve and CR outer sleeve.
 2. The joints shall be bell and Spigot Joint type joint using acid resistant packing and lead calking materials.
- C. The chemical resistant waste and vent pipe material shall be extruded polypropylene plastic pipe and drainage pattern fittings conforming to ASTM F1412. The polypropylene pipe and fittings

shall be schedule 40 and made from a polypropylene resin with a fire retardant additive complying with ASTM D4101 with mechanical joints for sizes under 3 inches (DN 75) and fusion and mechanical joints for sizes 3 inches (DN 75) and over.

2.2 PIPING SPECIALTIES

- A. Plastic dilution traps shall be corrosion resistant polypropylene with removable base and mechanical joint connections. The dilution tanks shall have a 3.8 liter (one gallon) capacity with a clear base. The dilution tank shall have two 40 mm or DN40 (NPS 1-1/2) top inlets and one 40 mm or DN40 (NPS 1-1/2) side outlet.
- B. High silicon iron dilution traps shall have 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 or NPS 2) as required for fixture and waste with mechanical joints, and conforming to ASTM A861.
- C. Glass drain line interceptor drum traps shall have 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 or NPS 2) as required for fixture and waste and conforming to ASTM C 1053.
- D. Corrosion resistant P-trap or drum trap shall have 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 or NPS 2) as required for fixture and waste and conform to ASTM A 861 for high silicon iron pipe with hubless joints, ASTM D4101 for polypropylene pipe with mechanical joints.

2.3 NEUTRALIZATION TANKS

- A. Plastic neutralization tanks shall have a capacity of 19 liters (5 gallons) and be constructed from corrosion resistant plastic materials with removable, gastight cover. The tank shall be filled with limestone 25 to 75 mm (1 to 3 inch) chips or lumps with a calcium carbonate content exceeding 90 percent. The traffic cover shall be //medium duty pedestrian traffic// //light duty vehicular with steel plate cover//.

2.4 CLEANOUTS

- A. Cleanouts shall be the same size as the pipe, up to 100 mm or DN100 (4 inches); not less than 100 mm or DN100 (4 inches) for larger pipe. Cleanouts for chemical waste drain pipe shall be of same material as the pipe. Cleanouts shall be easily accessible and shall be gastight and watertight. A minimum clearance of 600 mm (24 inches) shall be provided for clearing a clogged chemical waste drain.
- B. Floor cleanouts shall have cast iron body and frame with square adjustable scoriated secured nickel bronze top. The cleanout shall be vertically adjustable for a minimum of 50 mm or DN50 (2 inches). When a waterproof membrane is used in the floor system, a clamping collar shall be provided on the cleanouts. Cleanouts shall consist of wye fittings and eighth bends with brass or bronze screw plugs. Cleanouts in the resilient tile floors, quarry tile and ceramic tile floors shall be provided with square top covers recessed for tile insertion. In the carpeted areas, carpet cleanout markers shall be provided. Two way cleanouts shall be provided where indicated on drawings.
- C. Cleanouts shall be provided at or near the base of the vertical stacks with the cleanout plug located approximately 600 mm (24 inches) above the floor. If there are no fixtures installed on the lowest floor, the cleanout shall be installed at the base of the stack. The cleanouts shall be

extended to the wall access cover. The vertical cleanout shall consist of sanitary tees. Nickel bronze square frame and stainless steel cover shall be furnished with a minimum opening of 150 by 150 mm (6 by 6 inches) at each wall cleanout. Where the piping is concealed, a fixture trap or a fixture with integral trap, readily removable without disturbing concealed roughing work, shall be accepted as a cleanout equivalent providing the opening to be used as a cleanout opening is the size required. D. In horizontal runs above grade, cleanouts shall consist of cast brass tapered screw plug in fitting or caulked/no hub cast iron ferrule. Plain end (no-hub) piping in interstitial space or above ceiling may use plain end (no-hub) blind plug and clamp.

2.5 WATERPROOFING

- A. A sleeve flashing device shall be provide at points where pipes pass through membrane waterproofed floors or walls. The sleeve flashing device shall be manufactured, cast iron fitting with clamping device that forms a sleeve for the pipe floor penetration of the floor membrane. A galvanized steel pipe extension shall be included in the top of the fitting that will extend 50 mm (2 inches) above finished floor and galvanized steel pipe extension in the bottom of the fitting that will extend through the floor slab. A waterproofed caulked joint shall be provided at the top hub.
- B. Walls: See detail shown on drawings.

PART 3 - EXECUTION

3.1 PIPE INSTALLATION

- A. The pipe installation shall comply with the requirements of the National Standard Plumbing Code, International plumbing code and these specifications.
- B. Branch piping for chemical waste piping system shall be installed and connected to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
- C. Piping shall be installed for reagent racks. The piping shall be arranged neatly and located as required by the equipment.
- D. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
- E. All pipe runs shall be laid out to avoid interference with other work.
- F. The piping shall be installed above accessible ceilings to allow for ceiling panel removal.
- G. The piping shall be installed to permit valve servicing or operation.
- H. The piping shall be installed at the indicated slopes or according to the National Standard Plumbing Code, and International plumbing code.
- I. The piping shall be installed free of sags and bends.
- J. Seismic restraint shall be installed where required by code.
- K. Changes in direction for chemical waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.

Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected.

Reducing size of drainage piping in direction of flow is prohibited.

- L. Buried soil and waste drainage and vent piping shall be laid beginning at the low point of each system. Piping shall be installed true to grades and alignment indicated with unbroken continuity of invert. Hub ends shall be placed upstream. Required gaskets shall be installed according to manufacturer's written instruction for use of lubricants, cements, and other installation requirements.
- M. Cast iron piping shall be installed according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings"
- N. Aboveground PVC piping shall be installed according to ASTM D2665. Underground PVC piping shall be installed according to ASTM D2321.

3.2 JOINT CONSTRUCTION

- A. Hub and spigot, cast iron piping with gasket joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub and spigot, cast iron piping with calked joints shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.
- C. Hubless, cast iron piping shall be joined in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless piping coupling joints.
- D. For threaded joints, thread pipe with tapered pipe threads according to ASME B1.20.1. The threads shall be cut full and clean using sharp disc cutters. Threaded pipe ends shall be reamed to remove burrs and restored to full pipe inside diameter. Pipe fittings and valves shall be joined as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is required by the pipe service
 - 2. Pipe sections with damaged threads shall be replaced with new sections of pipe.
- E. for PVC piping, solvent cement joints shall be used for joints. All surfaces shall be cleaned and dry prior to applying the primer and solvent cement. Installation practices shall comply with ASTM F402. The joint shall conform to ASTM D2855 and ASTM D2665 appendixes.

3.3 SPECIALTY PIPE FITTINGS

- A. Transition coupling shall be installed at pipe joints with small differences in pipe outside diameters.
- B. Dielectric fittings shall be installed at connections of dissimilar metal piping and tubing.

3.4 PIPE HANGERS, SUPPORTS, AND ACCESSORIES

- A. All piping shall be supported according to the International plumbing code, Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, and these specifications.
- B. Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with zinc Chromate primer paint.
- C. Horizontal piping and tubing shall be supported within 300 mm (12 inches) of each fitting or coupling.
- D. Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:
 - 1. 40 mm or DN40 to 50 mm or DN50 (NPS 1-1/2 to NPS 2): 1500 mm (60 inches) with 10 mm (3/8 inch) rod.
 - 2. 80 mm or DN 80 (NPS 3): 1500 mm (60 inches) with 13 mm (1/2 inch) rod.
 - 3. 100 mm or DN 100 to 125 mm or DN125 (NPS 4 to NPS 5): 1500 mm (60 inches) with 16 mm (5/8 inch) rod.
 - 4. 150 mm or DN150 to 200 mm or DN200 (NPS 6 to NPS 8): 1500 mm (60 inches) with 19 mm (3/4 inch) rod.
 - 5. 250 mm or DN250 to 300 mm or DN300 (NPS 10 to NPS 12): 1500 mm (60 inches) with 22 mm (7/8 inch) rod.
- E. Vinyl coated hangers shall be installed for glass piping. The maximum horizontal spacing and minimum rod diameters shall be:
 - 1. For 25 mm or DN25 to 32 mm DN32 (NPS 1 and NPS 1-1/4), the maximum spacing shall be 1.22 meters (48 inches) with 10 mm (3/8 inch).
 - 2. For 40 mm or DN40 and 50 mm or DN50 (NPS 1-1/2 and NPS 2), the maximum spacing shall be 1.83 meters (72 inches) with 10 mm (3/8 inch).
 - 3. For 80 mm or DN80 (NPS 3 inch), the maximum spacing shall be 1.83 meters (72 inches) with 13 mm (1/2 inch).
 - 4. For 100 mm (DN100) (NPS 4 inch), the maximum spacing shall be 1.83 meters (72 inches) with 16 mm (5/8 inch).
- F. Vertical piping and tubing shall be supported at the base, at each floor, and at intervals no greater than 4.57 meters (15 feet). In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING,
- G. In addition to the requirements in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING, floor, Wall and Ceiling Plates, Supports, and Hangers shall have the following characteristics:
 - 1. Solid or split unplated cast iron.
 - 2. All plates shall be provided with set screws.
 - 3. Height adjustable clevis type pipe hangers.

4. Adjustable Floor Rests and Base Flanges shall be steel.
 5. Hanger Rods shall be carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 6. Riser Clamps shall be malleable iron or steel.
 7. Rollers shall be Cast iron.
 8. Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 100 mm (4 inches) in length and be 16 gauge steel. The shield shall be sized for the insulation.
- H. Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
- I. Cast escutcheon with set screw shall be installed at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
- J. Penetrations:
1. Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop system that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Clearances between raceways and openings shall be completely filled and sealed with the fire stopping materials.
 2. At floor penetrations, Clearances around the pipe shall be completely sealed and made watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
- K. Chemical waste and vent piping shall conform to the following:
1. Where waste lines from fixtures are shown on plans to be chemical resistant, vents from those fixtures shall also be chemical resistant.
 2. Storage and installation for PVC chemical resistant pipe shall comply with ASTM D2665.
 3. Glass Pipe installation shall be as recommended by the manufacturer. Glass pipe pitch shall be 1 : 50 (1/4 inch per foot), minimum.
 4. Silver recovery pipe pitch shall be 1 : 200 (0.5 percent), minimum.
 5. Mechanically Joined Polypropylene Pipe requires a pre-grooved pipe or cutting of a groove in each pipe section using a rotation cutting tool. Polypropylene chemical resistant pipe pitch shall be 6 mm minimum (1/4 inch per foot) minimum. Mechanically joined pipe shall not be installed below grade.
 6. Plastic chemical waste pipe shall not be installed within 23 m (75 feet) of hot water appliances (autoclaves, dishwashers, sterilizers) and similar equipment.
 7. High silicon content cast iron pipe with bell and spigot joints and heat fusion plastic pipe may be used below grade under building.

8. Stainless steel, mechanical joints shall not be installed below grade.
9. Stainless Steel Piping system shall be Joined and supported per manufacturer's recommendations.

3.5 TESTS

- A. The chemical resistant pipe system shall be tested either in its entirety or in sections.
- B. Tests for Chemical Resistant Waste, vent, and Silver Recovery Systems shall be conducted before trenches are backfilled or fixtures are connected. A water test or air test shall be conducted as directed.
 1. If entire system is tested using a water test, tightly close all openings in pipes except highest opening, and fill system with water to point of overflow. If system is tested in sections, tightly plug each opening except highest opening of section under test, fill each section with water and test with at least a 3 m (10 foot) head of water. In testing successive sections, test at least upper 3 m (10 feet) of next preceding section so that each joint or pipe except upper most 3 m (10 feet) of system has been submitted to a test of at least a 3 m (10 foot) head of water. Water shall be kept in system, or in portion under test, for at least 15 minutes before inspection starts. System shall then be tight at all joints.
 2. Air pressure test of 35 kPa (5 psi) gage shall be maintained for at least 15 minutes without leakage. A force pump and mercury column gage shall be used for the test.
 3. Final Tests: Either one of the following tests may be used.
 - a. Smoke Test: After fixtures are permanently connected and traps are filled with water, fill entire drainage and vent systems with smoke under pressure of 1.3 kPa (1 inch of water) with a smoke machine. Chemical smoke is prohibited.
 - b. Peppermint Test: Introduce (two ounces) of peppermint into each line or stack.

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SECTION 22 77 00 - FACILITY NATURAL-GAS PIPING**PART 1 - GENERAL****1.1 DESCRIPTION**

- A. Fuel gas systems, including piping, equipment and all necessary accessories as designated in this section. Fuel gas piping for central boiler plants is not included.

1.2 RELATED WORK

- A. Penetrations in rated enclosures: Section 07 84 00, FIRESTOPPING.
- B. Preparation and finish painting and identification of piping systems: Section 09 91 00, PAINTING.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Pipe Insulation: Section 23 07 11, HVAC, PLUMBING, AND BOILER PLANT INSULATION.
- E. Fuel Gas Piping For Boiler Plants: Section 23 21 11, BOILER PLANT PIPING SYSTEMS.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- B. Manufacturer's Literature and Data:
 - 1. Piping.
 - 2. Strainers.
 - 3. All items listed in Part 2 - Products.
- C. Detailed shop drawing of clamping device and extensions when required in connection with the waterproofing membrane or the floor drain.

1.4 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Federal Specifications (Fed. Spec.):
 - A-A-59617 Unions, Brass or Bronze Threaded, Pipe Connections and Solder-Joint Tube Connections
- C. American National Standards Institute (ANSI):
 - American Society of Mechanical Engineers (ASME): (Copyrighted Society)
 - A13.1-96..... Scheme for Identification of Piping Systems
 - B16.3-98..... Malleable Iron Threaded Fittings ANSI/ASME
 - B16.9-01..... Factory-Made Wrought Steel Buttwelding Fittings ANSI/ASME
 - B16.11-01..... Forged Steel Fittings, Socket-Welding and Threaded ANSI/ASME
 - B16.15-85(R 1994)..... Cast Bronze Threaded Fittings ANSI/ASME
 - B31.8-01..... Gas Transmission and Distribution Piping Systems ANSI/ASME

- D. American Society for Testing and Materials (ASTM):
- A47-99..... Ferritic Malleable Iron Castings Revision 1989
 - A53-02..... Pipe, Steel, Black And Hot-Dipped, Zinc-coated Welded and Seamless
 - A183-83(R1998)..... Carbon Steel Track Bolts and Nuts
 - A536-84(R1999) E1 Ductile Iron Castings
 - A733-03..... Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
 - B687-99..... Brass, Copper, and Chromium-Plated Pipe Nipples
- E. National Fire Protection Association (NFPA):
- 54-92 National Fuel Gas Code
- F. National Association of Plumbing - Heating - Cooling Contractors (PHCC):
- National Standard Plumbing Code - 1996
- G. International Association of Plumbing and Mechanical Officials (IAPMO):
- Uniform Plumbing Code - 2000
 - IS6-93..... Installation Standard
- H. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS):
- SP-72-99 Ball Valves With Flanged or Butt Welding For General Purpose
 - SP-110-96 Ball Valve Threaded, Socket Welding, Solder Joint, Grooved and Flared Ends

PART 2 - PRODUCTS

2.1 FUEL GAS SERVICE CONNECTIONS TO BUILDING

- A. From inside face of exterior wall to a distance of approximately 1500 mm (5 feet) outside of building, use coated piping.
- B. Pipe: Black steel, ASTM A53, Schedule 40. Shop-applied pipe coating shall be one of the following types:
1. Coal Tar Enamel Coating: Exterior of pipe and fittings shall be cleaned, primed with Type B primer and coated with hot-applied coal tar enamel with bonded layer of felt wrap in accordance with AWWA C203. Asbestos felt shall not be used; felt material shall be fibrous glass mat as specified in Appendix Section A2.1 of AWWA C203.
 2. Adhesive-thermoplastic Resin Coating: Fed. Spec. L-C-530, Type I.
 3. Thermosetting Epoxy Coating: Fed. Spec. L-C-530, Type II.
 4. Field-applied plastic tape material used on pipe joints and for repairing damaged areas of shop-applied coatings, Fed. Spec. L-T-1512, Type I, 10 mils nominal thickness for pipe joints, and Type II, 20 mils nominal thickness for coating repairs.
- C. Fittings:
1. Butt weld fittings, wrought steel, ANSI B16.9.

2. Socket weld and threaded fittings forged steel, ANSI B16.11.
 3. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47, Grade 32510), or steel (ASTM A53, Type F or Type E or S, Grade B).
- D. Joints: Welded, ANSI B31.8.
- E. Earthquake Valve:
1. Valve: Cast from aluminum, ANSI Z21.70.
 2. Valve actuator: Actuated by one stainless steel ball, incorporated with a bubble level, vertically mounted and have a single step manual reset level.
 3. Operating ambient temperature range: minus 40°C (minus 40°F) to 65.5°C (150°F)
 4. Maximum allowable pressure: 414 Kpa (60 psi).

2.2 FUEL GAS PIPING

- A. Pipe: Black steel, ASTM A53, Schedule 40.
- B. Nipples: Steel, ASTM A733, Schedule 40.
- C. Fittings:
1. Steel Welded: Schedule 40
 - a. Up to 100 mm (4 inch), ANSI B16.11, Socket welded.
 - b. Over 100 mm (4 inch), ANSI B16.9, Butt welded.
 2. Malleable Iron, Threaded: ANSI B16.3.
 3. Grooved End: Ductile iron (ASTM A536, Grade 65-45-12), malleable iron (ASTM A47, Grade 32510), or steel (ASTM A53, Type F or Type E or S, Grade B).
- D. Joints: Provide welded or threaded joints.
- E. Procedure for holiday inspection: Procedure for holiday inspection: Holiday Inspection shall be conducted on all coatings to determine the presence and number of discontinuities in those coatings referenced in 2.6 / B - 1, 2, 3, and 4 using a Tinker & Razor model AP/W Holiday Detector. Holiday inspection shall be performed in a manner spelled out in the Tinker & Razor operating instructions and at a voltage level recommended by the coating manufacturer or applicable NACE International Standard such as RPO 274-93 or RPO 490-90 in the case thermosetting epoxy coating. Holiday Detectors shall be calibrated and supplied with a certificate of calibration from the factory. A calibration of the Holiday Detector shall be performed once every 6 months to verify output voltages are true and correct.

2.3 EXPOSED FUEL GAS PIPING

- A. Finished Room: Use full iron pipe size chrome plated brass piping for exposed fuel gas piping connecting fixtures, casework, cabinets, equipment and reagent racks when not concealed by apron including those furnished by the Government or specified in other sections.
1. Pipe: Fed. Spec. WW-P-351, standard weight.
 2. Fittings: ANSI B16.15 cast bronze threaded fittings with chrome finish, (125 and 250).
 3. Nipples: ASTM B 687, Chromium-plated.

4. Unions: Mss SP-72, SP-110, Brass or Bronze with chrome finish. Unions 65 mm (2-1/2 inches) and larger shall be flange type with approved gaskets.
 5. Valves: Mss SP-72, SP-110, Brass or bronze with chrome finish.
- B. Unfinished Rooms, Mechanical Rooms and Kitchens: Chrome-plated brass piping is not required. Paint piping systems as specified in Section 09 91 00, PAINTING.

2.4 WATERPROOFING

- A. Provide at points where pipes pass through membrane waterproofed floors or walls in contact with earth.
- B. Floors: Provide cast iron stack sleeve with flashing device and a underdeck clamp. After stack is passed through sleeve, provide a waterproofed caulked joint at top hub.
- C. Walls: See detail shown on drawings.

2.5 STRAINERS

- A. Provide on high pressure side of pressure reducing valves, on suction side of pumps, on inlet side of indicating and control instruments and equipment subject to sediment damage and where shown on drawings. Strainer element shall be removable without disconnection of piping.
- B. Gas Lines: "Y" type with removable mesh lined brass strainer sleeve.
- C. Body: Smaller than 80 mm (3 inches), brass or bronze; 80 mm (3 inches) and larger, cast iron or semi-steel.

2.6 DIELECTRIC FITTINGS

- A. Provide dielectric couplings or unions between ferrous and non-ferrous pipe.

2.7 GAS EQUIPMENT CONNECTORS

- A. Flexible connectors with teflon core, interlocked galvanized steel protective casing, AGA certified design.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Comply with the PHCC National Standard Plumbing Code and the following:
 1. Install branch piping for fuel gas and connect to all fixtures, valves, cocks, outlets, casework, cabinets and equipment, including those furnished by the Government or specified in other sections.
 2. Pipe shall be round and straight. Cutting shall be done with proper tools. Pipe, except for plastic and glass, shall be reamed to full size after cutting.
 3. All pipe runs shall be laid out to avoid interference with other work.
 4. Install valves with stem in horizontal position whenever possible. All valves shall be easily accessible.
 5. Install union and shut-off valve on pressure piping at connections to equipment.
 6. Pipe Hangers, Supports And Accessories:
 - a. All piping shall be supported per of the National Standard Plumbing Code, Chapter No. 8.

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- b. Shop Painting and Plating: Hangers, supports, rods, inserts and accessories used for Pipe supports shall be shop coated with red lead or zinc Chromate primer paint. Electroplated copper hanger rods, hangers and accessories may be used with copper tubing.
 - c. Floor, Wall and Ceiling Plates, Supports, Hangers:
 - 1) Solid or split unplated cast iron.
 - 2) All plates shall be provided with set screws.
 - 3) Pipe Hangers: Height adjustable clevis type.
 - 4) Adjustable Floor Rests and Base Flanges: Steel.
 - 5) Concrete Inserts: "Universal" or continuous slotted type.
 - 6) Hanger Rods: Mild, low carbon steel, fully threaded or Threaded at each end with two removable nuts at each end for positioning rod and hanger and locking each in place.
 - 7) Riser Clamps: Malleable iron or steel.
 - 8) Rollers: Cast iron.
 - 9) Self-drilling type expansion shields shall be "Phillips" type, with case hardened steel expander plugs.
 - 10) Hangers and supports utilized with insulated pipe and tubing shall have 180 degree (min.) metal protection shield Centered on and welded to the hanger and support. The shield shall be 4 inches in length and be 16 gauge steel. The shield shall be sized for the insulation.
 - 11) Miscellaneous Materials: As specified, required, directed or as noted on the drawings for proper installation of hangers, supports and accessories. If the vertical distance exceeds 6 m (20 feet) for cast iron pipe additional support shall be provided in the center of that span. Provide all necessary auxiliary steel to provide that support.
 - 7. Install cast escutcheon with set screw at each wall, floor and ceiling penetration in exposed finished locations and within cabinets and millwork.
 - 8. Penetrations:
 - a. Fire Stopping: Where pipes pass through fire partitions, fire walls, smoke partitions, or floors, install a fire stop that provides an effective barrier against the spread of fire, smoke and gases as specified in Section 07 84 00, FIRESTOPPING. Completely fill and seal clearances between raceways and openings with the fire stopping materials.
 - b. Waterproofing: At floor penetrations, completely seal clearances around the pipe and make watertight with sealant as specified in Section 07 92 00, JOINT SEALANTS.
 - B. Piping shall conform to the following:
 - 1. Fuel Gas:
 - a. Entire fuel gas piping installation shall be in accordance with requirements of NFPA 54.

- b. Install fuel gas piping with plugged drip pockets at low points.
- c. Install automatic shutoff valve (earthquake valve) on medical center side of meter. Valve shall positively shut off supply of gas in case of pressure failure, remain shut off until manually reopened, and be provided with outside adjustment for reset.

3.2 TESTS

- A. General: Test system either in its entirety or in sections.
- B. Fuel Gas System: NFPA 54.

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See RFI 04487.1:
Earthquake valve
should not be installed

