
USACE / NAVFAC / AFCEA / NASA UFGS-22 04 00.00 10 (January 2008)

Preparing Activity: USACE Superseding
UFGS-22 04 00.00 10 (October 2007)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMLR dated October 2008

SECTION TABLE OF CONTENTS

DIVISION 22 - PLUMBING

SECTION 22 04 00.00 10

PLUMBING, HOSPITAL

01/08

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SYSTEM DESCRIPTION
 - 1.2.1 Electrical Work
 - 1.2.2 Cathodic Protection and Pipe Joint Bonding
 - 1.2.3 Medical Gas and Vacuum System Work
- 1.3 SUBMITTALS
- 1.4 QUALITY ASSURANCE
 - 1.4.1 Welding
 - 1.4.2 General Requirements

PART 2 PRODUCTS

- 2.1 MATERIALS AND EQUIPMENT
- 2.2 MATERIALS
 - 2.2.1 Pipe Joint Materials
 - 2.2.2 Copper Tubing and Fittings
 - 2.2.3 Miscellaneous Materials
 - 2.2.4 Pipe Insulation Material
- 2.3 PIPE HANGERS, INSERTS, AND SUPPORTS
- 2.4 VALVES
 - 2.4.1 Backwater Valves
 - 2.4.2 Wall Faucets
 - 2.4.3 Wall Hydrants
 - 2.4.4 Lawn Faucets
 - 2.4.5 Yard Hydrants
 - 2.4.6 Relief Valves
 - 2.4.7 Thermostatic Mixing Valves and Cabinets
 - 2.4.7.1 Mixing Valves
 - 2.4.7.2 Cabinets
 - 2.4.7.3 Hardware for Mixing-Valve Cabinets
 - 2.4.8 Laboratory Service Fittings
 - 2.4.9 Water Heater Drain Valve
- 2.5 FIXTURES
 - 2.5.1 Flushometer Valves

- 2.5.2 Automatic Flushing System
- 2.5.3 Shower Bath Outfits
- 2.5.4 Joint Schedule Fixtures
- 2.6 BACKFLOW PREVENTERS
- 2.7 DRAINS
 - 2.7.1 Floor and Shower Drains
 - 2.7.1.1 Metallic Shower Pan Drains
 - 2.7.1.2 Drains and Backwater Valves
 - 2.7.2 Area Drains
 - 2.7.3 Floor Sinks
 - 2.7.4 Floor Drains for Acid Waste Piping System (X-Ray Film Processors)
 - 2.7.5 Boiler Room Drains
 - 2.7.6 Pit Drains
 - 2.7.7 Sight Drains
 - 2.7.8 Roof Drains and Expansion Joints
- 2.8 WATER COOLERS
- 2.9 SHOWER PAN
 - 2.9.1 Sheet Copper
 - 2.9.2 Plasticized Chlorinated Polyvinyl Chloride Shower Pan Material
 - 2.9.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material
- 2.10 TRAPS
- 2.11 GREASE INTERCEPTORS
- 2.12 GARBAGE CAN WASHER
- 2.13 DISHWASHING MACHINES
- 2.14 WATER HEATERS
 - 2.14.1 Automatic Storage Type
 - 2.14.1.1 Oil Fired Type
 - 2.14.1.2 Gas Fired Type
 - 2.14.1.3 Electric Type
 - 2.14.1.4 Indirect Heater Type
 - 2.14.2 Instantaneous Water Heater
 - 2.14.3 Phenolic Resin Coating
 - 2.14.3.1 Coating Coil Interiors
 - 2.14.3.2 Coating Coil Exteriors
 - 2.14.3.3 Coating Components
- 2.15 HOT WATER STORAGE TANKS
- 2.16 PUMPS
 - 2.16.1 Sump Pumps
 - 2.16.2 Circulating Pumps
 - 2.16.3 Booster Pumps
 - 2.16.3.1 Testing
 - 2.16.3.2 Controls
 - 2.16.4 Flexible Connectors
- 2.17 WATER PRESSURE BOOSTER SYSTEM
 - 2.17.1 Constant Speed Pumping System
 - 2.17.2 Hydro-Pneumatic Water Pressure System
 - 2.17.3 Variable Speed Pumping System
- 2.18 COMPRESSED AIR SYSTEM
 - 2.18.1 Air Compressors
 - 2.18.2 Medical Compressed Air (Oil-Free Type) Compressors
 - 2.18.3 Oil-Free Type Compressors
 - 2.18.4 Air Receivers
 - 2.18.5 Air Dryers
 - 2.18.6 Intake Air Supply Filter
 - 2.18.7 Discharge Air Supply Filter
 - 2.18.8 Pressure Regulators
 - 2.18.9 Dewpoint Meter
 - 2.18.10 Carbon Monoxide Sensor

- 2.19 VACUUM PUMPS AND RECEIVER
- 2.20 MEDICAL GAS SYSTEMS
 - 2.20.1 Valves
 - 2.20.2 Manifold
- 2.21 ALARM PANELS FOR MEDICAL GAS AND VACUUM SYSTEMS
 - 2.21.1 Central and Local, Medical Gas and Vacuum Alarm Panels
 - 2.21.2 Life Support System, Medical Gas and Vacuum Alarm Panels
- 2.22 SURGICAL DISPENSERS FOR MEDICAL GAS AND VACUUM SYSTEMS
 - 2.22.1 Station Outlets
 - 2.22.1.1 Couplers
 - 2.22.1.2 Cover Plates
 - 2.22.2 Operating and Delivery Room Outlets and Wall Outlets
 - 2.22.3 Service-Control Valve Cabinets
- 2.23 ORAL EVACUATION SYSTEM FOR DENTAL OPERATORIES
 - 2.23.1 High-Volume Oral Evacuation System (HVE)
 - 2.23.1.1 Vacuum Turbines
 - 2.23.1.2 Pipe Isolators
 - 2.23.1.3 Valves
 - 2.23.1.4 Exhaust Silencer
 - 2.23.1.5 Controls
 - 2.23.1.6 Central Wet Separators
 - 2.23.1.7 Piping
 - 2.23.1.8 Vacuum Relief Valve
 - 2.23.1.9 Spare Parts
 - 2.23.2 High-Volume Evacuation System (HVEL)
 - 2.23.2.1 Vacuum Producer
 - 2.23.2.2 Motor
 - 2.23.2.3 Isolation Pads
 - 2.23.2.4 Pipe Isolators
 - 2.23.2.5 Volume Control Device
 - 2.23.2.6 Exhaust Silencer
 - 2.23.2.7 Controls
 - 2.23.2.8 Central Separator
 - 2.23.2.9 Primary Separator
 - 2.23.2.10 Piping
 - 2.23.2.11 Air Volume Relief Valve
 - 2.23.2.12 Vacuum Inlets
 - 2.23.2.13 Vacuum Producer Spare Parts
 - 2.23.3 Environmental-Janitorial Vacuum System (EJVS)
 - 2.23.3.1 Vacuum Source
 - 2.23.3.2 Central Dry Separator
 - 2.23.3.3 Piping
 - 2.23.3.4 Vacuum Inlets
 - 2.23.3.5 Mobile Wet-Pickup Caddy
 - 2.23.3.6 Accessories
- 2.24 REVERSE OSMOSIS WATER TREATMENT SYSTEM
 - 2.24.1 Water Analysis
 - 2.24.2 System Requirements
 - 2.24.3 Booster Pumps
- 2.25 WATER SOFTENING WATER TREATMENT SYSTEM
 - 2.25.1 Water Analysis
 - 2.25.2 System Requirements
 - 2.25.3 Automatic Operation and Controls
 - 2.25.3.1 Multiple-Port Valve
 - 2.25.3.2 Package-Type Valve Nest
 - 2.25.3.3 Backwash and Brine-Rinse Control
 - 2.25.4 Accessories
 - 2.25.4.1 Pressure Gauges and Sampling Cocks
 - 2.25.4.2 Automatic Hardness Tester

- 2.25.4.3 Water Meters
- 2.25.4.4 Water-Testing Equipment

PART 3 EXECUTION

- 3.1 EXAMINATION
- 3.2 GENERAL INSTALLATION REQUIREMENTS
- 3.3 WATER PIPE, FITTINGS, AND CONNECTIONS
 - 3.3.1 Utilities
 - 3.3.2 Cutting and Repairing
 - 3.3.3 Protection to Fixtures, Materials, and Equipment
 - 3.3.4 Mains, Branches, and Runouts
 - 3.3.5 Pipe Drains
 - 3.3.6 Expansion and Contraction of Piping
 - 3.3.7 Thrust Restraint
 - 3.3.8 Commercial-Type Water Hammer Arresters
- 3.4 DISTILLED AND DE-IONIZED HIGH-PURITY WATER PIPING
 - 3.4.1 Fittings
 - 3.4.2 Valves
- 3.5 NONMEDICAL (NON-OIL-FREE) COMPRESSED AIR PIPING
- 3.6 MEDICAL (OIL-FREE) COMPRESSED AIR AND VACUUM PIPING
- 3.7 NITROUS OXIDE, OXYGEN, AND NITROGEN SYSTEMS
- 3.8 JOINTS
 - 3.8.1 Threaded
 - 3.8.2 Mechanical Couplings
 - 3.8.3 Unions and Flanges
 - 3.8.4 Grooved Mechanical Joint
 - 3.8.5 Cast Iron Pipe
 - 3.8.6 Copper Tube and Pipe
 - 3.8.7 Plastic Pipe
 - 3.8.8 Glass Pipe
 - 3.8.9 Corrosive Waste Plastic Pipe
 - 3.8.10 High Purity Water Pipe
 - 3.8.11 Dissimilar Pipe Materials
- 3.9 CORROSION PROTECTION FOR PIPE AND FITTINGS
- 3.10 PIPE SLEEVES AND FLASHING
 - 3.10.1 Sleeve Requirements
 - 3.10.2 Flashing Requirements
 - 3.10.3 Waterproofing
 - 3.10.4 Optional Counterflashing
- 3.11 FIRE SEAL
- 3.12 SUPPORTS
 - 3.12.1 Pipe Supports and Structural Bracing, Seismic Requirements
 - 3.12.2 Pipe Hangers, Inserts, and Supports
- 3.13 WELDED INSTALLATION
- 3.14 PIPE CLEANOUTS
- 3.15 VALVES, OUTLETS, AND DISPENSERS
 - 3.15.1 Thermostatic Mixing Valve and Cabinet
 - 3.15.2 Medical Gas and Vacuum Station Outlets
 - 3.15.3 Nitrous Oxide, Oxygen, and Nitrogen Systems
 - 3.15.4 Surgical Dispensers for Medical Gas and Vacuum Systems
 - 3.15.4.1 Automatic Valves
 - 3.15.4.2 Wall Outlets
 - 3.15.4.3 DISS Connections
 - 3.15.4.4 Connector Height of Outlets
 - 3.15.4.5 Room Outlets
 - 3.15.4.6 Service-Control Valve Cabinets
- 3.16 ORAL EVACUATION VACUUM SYSTEM INSTALLATION
 - 3.16.1 Installation and Startup

- 3.16.2 Vacuum Turbine Units
- 3.16.3 Central Separator
- 3.16.4 Field Instructions
- 3.17 FIXTURES AND FIXTURE TRIMMINGS
 - 3.17.1 Fixture Connections
 - 3.17.2 Flushometer Valves
 - 3.17.3 Height of Fixture Rims Above Floor
 - 3.17.4 Shower Bath Outfits
 - 3.17.5 Fixture Supports
 - 3.17.5.1 Concrete or Solid Masonry Construction
 - 3.17.5.2 Cellular-Masonry Wall Construction
 - 3.17.5.3 Steel Stud Frame Partitions
 - 3.17.5.4 Wood Stud Construction
 - 3.17.5.5 Wall-Mounted Water Closet Gaskets
 - 3.17.6 Backflow Prevention Devices
 - 3.17.7 Access Panels
 - 3.17.8 Sight Drains
 - 3.17.9 Traps
 - 3.17.10 Shower Pans
 - 3.17.10.1 Metal Shower Pans
 - 3.17.10.2 Nonplasticized Chlorinated Polyethylene Shower Pans
 - 3.17.10.3 Plasticized Polyvinyl Chloride (PVC) Shower Pans
- 3.18 VIBRATION-ABSORBING FEATURES
 - 3.18.1 Tank or Skid Mounted Compressors
 - 3.18.2 Foundation Mounted Compressors
- 3.19 WATER HEATERS AND HOT WATER STORAGE TANKS
 - 3.19.1 Relief Valves
 - 3.19.2 Gas and Oil Fired Water Heaters
 - 3.19.3 Storage Water Heaters
 - 3.19.4 Heat Traps
 - 3.19.5 Connections to Water Heaters
 - 3.19.6 Expansion Tank
- 3.20 IDENTIFICATION SYSTEMS
 - 3.20.1 Identification Tags
 - 3.20.2 Color Coding
 - 3.20.3 Color Coding Scheme for Locating Hidden Utility Components
- 3.21 ESCUTCHEONS
- 3.22 PAINTING
- 3.23 FRAMED INSTRUCTIONS
- 3.24 TESTS, FLUSHING AND DISINFECTION
 - 3.24.1 Plumbing System
 - 3.24.1.1 Test of Backflow Prevention Assemblies
 - 3.24.1.2 Shower Pans
 - 3.24.1.3 Compressed Air Piping (Non-Oil-Free)
 - 3.24.1.4 Compressed Air Piping (Oil-Free)
 - 3.24.2 Medical Gas and Vacuum Piping
 - 3.24.3 High-Purity Water (De-ionized or Distilled) System
 - 3.24.4 Oral Evacuation Vacuum System for Dental Operatories
 - 3.24.4.1 Testing of Piping for Leaks
 - 3.24.4.2 Air Flow and Vacuum Tests
 - 3.24.4.3 Recorded Test Data
 - 3.24.4.4 General Operating Tests
 - 3.24.5 Phenolic Resin Coatings
 - 3.24.5.1 Test Panels
 - 3.24.5.2 Heat Test
 - 3.24.5.3 Abrasion Test
 - 3.24.5.4 Corrosion Test
 - 3.24.6 Defective Work
 - 3.24.7 System Flushing

- 3.24.7.1 During Flushing
- 3.24.7.2 After Flushing
- 3.24.8 Operational Test
- 3.24.9 Disinfection
- 3.24.10 Flushing of Potable Water System
- 3.25 TABLES

-- End of Section Table of Contents --

and title.

Use the Reference Wizard's Check Reference feature when you add a RID outside of the Section's Reference Article to automatically place the reference in the Reference Article. Also use the Reference Wizard's Check Reference feature to update the issue dates.

References not used in the text will automatically be deleted from this section of the project specification when you choose to reconcile references in the publish print process.

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

AHRI 1010 (2002) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers

AMERICAN SOCIETY OF HEATING, REFRIGERATING AND AIR-CONDITIONING ENGINEERS (ASHRAE)

ASHRAE 146 (2006) Method of Testing and Rating Pool Heaters

ASHRAE 90.1 - IP (2007; Errata 2008; Errata 2008; Errata 2008) Energy Standard for Buildings Except Low-Rise Residential Buildings, I-P Edition

ASHRAE 90.1 - SI (2004; Addendas a,b,c,d,e,f,g,h,i,j,k,l,m,n,o,p,r,s,t,u,v,x,ak 2006; Supp to Addendas 2006; Errata 2007; Interpretations 8 - 15:2007; Errata 2008; INT 16-21 2008; Errata 2008) Energy Standard for Buildings Except Low-Rise Residential Buildings, SI Edition

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001 (2008) Atmospheric Type Vacuum Breakers

ASSE 1003 (2001; Errata, 2003) Performance Requirements for Water Pressure Reducing Valves

ASSE 1006 (1986) Residential Use Dishwashers

ASSE 1011 (2004; Errata 2004) Hose Connection Vacuum Breakers

ASSE 1012 (2002) Backflow Preventer with Intermediate Atmospheric Vent

ASSE 1013 (2005) Reduced Pressure Principle Backflow

Preventers and Reduced Pressure Fire
Protection Principle Backflow Preventers

ASSE 1018	(2001) Trap Seal Primer Valves - Potable, Water Supplied
ASSE 1020	(2004; Errata 2004; Errata 2004) Pressure Vacuum Breaker Assembly
ASSE 1037	(1990) Performance Requirements for Pressurized Flushing Devices (Flushometer) for Plumbing Fixtures
ASSE Series 6000	(2006) WARNING: Text in tags exceeds the maximum length of 300 characters

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA 10084	(2005) Standard Methods for the Examination of Water and Wastewater
AWWA B300	(2004) Hypochlorites
AWWA B301	(2004) Liquid Chlorine
AWWA C105/A21.5	(2005) Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C203	(2002) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(2006) Grooved and Shouldered Joints
AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities
AWWA D100	(2005; Errata 2007) Welded Steel Tanks for Water Storage

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(2004; Errata 2004) Specification for Filler Metals for Brazing and Braze Welding
----------------	--

ASME INTERNATIONAL (ASME)

ASME A112.1.2	(2004) Standard for Air Gaps in Plumbing Systems (For Plumbing Fixtures and Water-Connected Receptors)
ASME A112.14.1	(2003; R 2008) Backwater Valves
ASME A112.18.1	(2005) Standard for Plumbing Fixture Fittings

ASME A112.19.1	(2008) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2	(2008) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.19.3	(2008) Stainless Steel Plumbing Fixtures (Designed for Residential Use)
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991; R 2008) Cleanouts
ASME A112.6.1M	(1997; R 2008) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001; R 2007) Standard for Floor and Trench Drains
ASME B1.20.1	(1983; R 2006) Pipe Threads, General Purpose (Inch)
ASME B1.20.7	(1991; R 2008) Standard for Hose Coupling Screw Threads (Inch)
ASME B16.12	(1998; R 2006) Cast Iron Threaded Drainage Fittings
ASME B16.15	(2006) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2001; R 2005) Standard for Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2002; Errata 2003; R 2006) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2006) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.29	(2007) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2004) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998; R 2006) Standard for Malleable Iron

	Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.4	(2006) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24
ASME B19.3	(1991; Addenda A 1994; Addenda B 1995) Safety Standard for Compressors for Process Industries
ASME B31.1	(2007; Addenda 2008) Power Piping
ASME B31.5	(2006) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2005) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IV	(2007; Addenda 2008) Boiler and Pressure Vessel Code; Section IV, Recommended Rules for the Care and Operation of Heating Boilers
ASME BPVC SEC IX	(2007; Addenda 2008) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2007; Addenda 2008) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME CSD-1	(2006) Control and Safety Devices for Automatically Fired Boilers
ASSOCIATION FOR IRON AND STEEL TECHNOLOGY (AIST)	
AIST PB-224	(1999) Stainless Steels
ASTM INTERNATIONAL (ASTM)	
ASTM A 105/A 105M	(2005) Standard Specification for Carbon Steel Forgings for Piping Applications
ASTM A 183	(2003) Standard Specification for Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2008b) Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 47/A 47M	(1999; R 2004) Standard Specification for Steel Sheet, Aluminum-Coated, by the Hot-Dip Process
ASTM A 515/A 515M	(2003; R 2007) Standard Specification for Pressure Vessel Plates, Carbon Steel, for

	Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2006) Standard Specification for Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999; R 2003) Standard Specification for Corrosion-Resistant High-Silicon Iron Castings
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 733	(2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(2008) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM A 888	(2008) Standard Specification for Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 111/B 111M	(2008) Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 117	(2007a) Standing Practice for Operating Salt Spray (Fog) Apparatus
ASTM B 152/B 152M	(2006ae1) Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 280	(2008) Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service
ASTM B 306	(2002) Standard Specification for Copper Drainage Tube (DWV)
ASTM B 32	(2008) Standard Specification for Solder Metal
ASTM B 339	(2000; R 2005) Standard Specification for Pig Tin
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 42	(2002e1) Standard Specification for Seamless Copper Pipe, Standard Sizes

ASTM B 43	(1998; R 2004) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B 584	(2008) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B 75	(2002) Standard Specification for Seamless Copper Tube
ASTM B 75M	(1999; R 2005) Standard Specification for Seamless Copper Tube (Metric)
ASTM B 813	(2000e1) Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 819	(2000; R 2006) Standard Specification for Seamless Copper Tube for Medical Gas Systems
ASTM B 828	(2002) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 1053	(2000; R 2005) Standard Specification for Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2008) Standard Specification for Elastomeric Joint Sealants
ASTM D 1004	(2007) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1193	(2006) Reagent Water
ASTM D 1248	(2005) Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1527	(1999; R 2005) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80
ASTM D 1784	(2007) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds

ASTM D 1785	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2008) Standard Classification System for Rubber Products in Automotive Applications
ASTM D 2235	(2004) Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2241	(2005) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(2003) Standard Specification for Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(2006) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2006) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991; R 2007) Evaluating Coatings for High Temperature Service
ASTM D 2564	(2004e1) Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2661	(2008) Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40, Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(2008a) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a; R 2003) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(2004) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2822	(2005) Asphalt Roof Cement
ASTM D 2846/D 2846M	(2006) Chlorinated Poly(Vinyl Chloride)

	(CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996; R 2002) Standard Practice for Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(2001; R 2007e1) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(2008) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D 3122	(1995; R 2002) Solvent Cements for Styrene-Rubber (SR) Plastic Pipe and Fittings
ASTM D 3138	(2004) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1998; R 2005) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(2007) Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(2003) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(2006) PTFE Resin Skived Tape
ASTM D 4060	(2007) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(2008) Standard Specification for Polypropylene Injection and Extrusion Materials
ASTM D 4551	(1996e1; R 2008) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM D 609	(2000; R 2006) Preparation of Cold-Rolled Steel Panels for Testing Paint, Varnish, Conversion Coatings, and Related Coating Products
ASTM D 638	(2008) Standard Test Method for Tensile Properties of Plastics

ASTM E 1	(2007) Standard Specification for ASTM Liquid-in-Glass Thermometers
ASTM E 96/E 96M	(2005) Standard Test Methods for Water Vapor Transmission of Materials
ASTM F 1866	(2007) Poly(Vinyl Chloride) (PVC) Plastic Schedule 40 Drainage and DWV Fabricated Fittings
ASTM F 409	(2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(2006) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(2004) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(2006) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(2002) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1999; R 2005e1) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(2008) Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(2004) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 876	(2008) Crosslinked Polyethylene (PEX) Tubing
ASTM F 877	(2007) Crosslinked Polyethylene (PEX) Plastic Hot- and Cold- Water Distribution Systems
ASTM F 913	(2002e1) Thermoplastic Elastomeric Seals (Gaskets) for Joining Plastic Pipe

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301	(2004) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
-----------	---

CISPI 310 (2004) Coupling for Use in Connection with Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications

COMPRESSED GAS ASSOCIATION (CGA)

CGA V-5 (2005) Diameter-Index Safety System (Non-Interchangeable Low Pressure Connections for Medical Gas Applications)

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (1994; R 1995) Copper Tube Handbook

CSA AMERICA, INC. (CSA/AM)

CSA/AM Z21.10.1 (2004; Errata 2005; Addenda A 2006, Addenda B 2006; Errata 2007) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less

CSA/AM Z21.10.3 (2004; Addenda A 2007; Addenda B 2008) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous

CSA/AM Z21.22 (1999; Addenda A 2000, Addenda B 2001; R 2004) Relief Valves for Hot Water Supply Systems

FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual (1988e9) Manual of Cross-Connection Control

INTERNATIONAL ASSOCIATION OF PLUMBING AND MECHANICAL OFFICIALS (IAPMO)

IAPMO PS 117 (2005) Press Type Or Plain End Rub Gsktd W/ Nail CU & CU Alloy Fittings for Install On CU Tubing

IAPMO Z124.1.2 (2005) Plastic Bathtub and Shower Units

IAPMO Z124.5 (1997) Plastic Toilet (Water Closet) Seats

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 (2003; R 2004) Standard for Accessible and Usable Buildings and Facilities

ICC IPC (2006; Supplement 2007) International Plumbing Code

INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)

ISEA Z358.1 (2004) Emergency Eyewash and Shower

Equipment

MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS INDUSTRY (MSS)

MSS SP-110	(1996) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends
MSS SP-25	(1998) Standard Marking System for Valves, Fittings, Flanges and Unions
MSS SP-44	(2006) Steel Pipeline Flanges
MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-67	(2002a; R 2004) Standard for Butterfly Valves
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-70	(2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends
MSS SP-71	(2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) Standard for Ball Valves with Flanged or Butt-Welding Ends for General Service
MSS SP-73	(2003) Brazing Joints for Copper and Copper Alloy Pressure Fittings
MSS SP-78	(2005a) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2006) Standard for Class 3000 Steel Pipe Unions Socket Welding and Threaded
MSS SP-85	(2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
NEMA MG 1	(2007) Standard for Motors and Generators

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2006; Errata 2006; Errata 2007)
---------	----------------------------------

	Installation of Oil Burning Equipment
NFPA 54	(2008) National Fuel Gas Code
NFPA 90A	(2008) Standard for the Installation of Air Conditioning and Ventilating Systems
NFPA 99	(2005; Errata 2005) Health Care Facilities
NSF INTERNATIONAL (NSF)	
NSF 14	(2007; Addenda 2007) Plastics Piping System Components and Related Materials
NSF 3	(2007) Commercial Warewashing Equipment
NSF 5	(2007) Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
NSF 61	(2007a; Addendum 2007) Drinking Water System Components - Health Effects
PLUMBING AND DRAINAGE INSTITUTE (PDI)	
PDI G 101	(1996) Testing and Rating Procedure for Grease Interceptors with Appendix of Sizing and Installation Data
PDI WH 201	(2006) Water Hammer Arresters Standard
SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)	
SAE J1508	(1997) Hose Clamp Specifications
THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)	
SSPC SP 5	(2007) White Metal Blast Cleaning
U.S. DEPARTMENT OF DEFENSE (DOD)	
MIL-STD-1691	(Rev F) Construction and Material Schedule for Military Medical and Dental Facilities
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
PL 93-523	(1974; A 1999) Safe Drinking Water Act
U.S. GENERAL SERVICES ADMINISTRATION (GSA)	
CID A-A-50012	(Basic) Garbage Disposal Machine, Commercial
U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)	
10 CFR 430	Energy Conservation Program for Consumer Products
21 CFR 175	Indirect Food Additives: Adhesives and Components of Coatings

UNDERWRITERS LABORATORIES (UL)

UL 174	(2004; Rev thru Sep 2008) Household Electric Storage Tank Water Heaters
UL 732	(1995; Rev thru Feb 2005) Oil-Fired Storage Tank Water Heaters
UL 749	(2008) Household Dishwashers
UL 921	(2006) Commercial Electric Dishwashers

1.2 SYSTEM DESCRIPTION

1.2.1 Electrical Work

Motors, motor controllers and motor efficiencies shall conform to the applicable requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Electric motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Motors shall be open, drip-proof type unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller shall be provided with the mechanical equipment. Electrical characteristics shall be as indicated. Motor controllers shall be provided complete with properly sized thermal-overload protection in each ungrounded conductor, auxiliary contact, and other equipment at the specified capacity including an allowable service factor, and other appurtenances necessary for the motor control specified. Manual or automatic control and protective or signal devices required for operation herein specified and any wiring required to such devices not shown on the electrical drawings shall be provided under this section. Complete electrical schematic lineless or full line interconnection and connection diagram for each piece of mechanical equipment having more than one automatic or manual electrical control device shall be submitted for approval. Manual or automatic control and protective or signal devices required for operation herein specified and any wiring required to such devices not shown on the electrical drawings shall be provided under this section.

1.2.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)].

1.2.3 Medical Gas and Vacuum System Work

All work on medical gas and vacuum systems shall be in accordance with NFPA 99.

1.3 SUBMITTALS

NOTE: Review submittal description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit

the following list to reflect only the submittals required for the project. Submittals should be kept to the minimum required for adequate quality control.

A "G" following a submittal item indicates that the submittal requires Government approval. Some submittals are already marked with a "G". Only delete an existing "G" if the submittal item is not complex and can be reviewed through the Contractor's Quality Control system. Only add a "G" if the submittal is sufficiently important or complex in context of the project.

For submittals requiring Government approval on Army projects, a code of up to three characters within the submittal tags may be used following the "G" designation to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes following the "G" typically are not used for Navy, Air Force, and NASA projects.

Choose the first bracketed item for Navy, Air Force and NASA projects, or choose the second bracketed item for Army projects.

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for [Contractor Quality Control approval.] [information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] The following shall be submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Control Diagrams[; G][; G, [_____]]

Complete electrical schematic lineless or full line interconnection and connection diagrams for each piece of mechanical equipment having more than one automatic or manual electrical control device.

Plumbing System[; G][; G, [_____]]

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operation of each system. Detail drawings for the complete plumbing system including piping layout and location of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams; and wiring diagrams or connection and interconnection diagrams. Indicate in the Detail drawings clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, include in the details loadings

and proposed support method. All mechanical drawing plans, elevations, views, and details, shall be drawn to scale.

SD-03 Product Data

Welding

A copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.

Fixtures

Fixtures and Fixture Trimmings

Plumbing Fixture Schedule with catalog cuts of [specified plumbing fixtures] [valves] [related piping] system and system location where installed.

Vibration-Absorbing Features[; G][; G, [_____]]

Details of vibration-absorbing features, including arrangement, foundation plan, dimensions and specifications.

Framed Instructions[; G][; G, [_____]]

Diagrams, instructions, and other sheets, prior to posting. Manufacturer's recommendations for the installation of bell and spigot and hubless joints for cast iron soil pipe.

SD-06 Test Reports

Tests, Flushing and Disinfection

Test reports in booklet form showing all field tests performed to adjust each component and field tests performed to prove compliance with the specified performance criteria, upon completion and testing of the installed system. Indicate in each test report the final position of controls.

Test of Backflow Prevention Assemblies

Certification of proper operation shall be accomplished with requirements in accordance with state regulations by an individual certified by the state to perform such test. If no state requirement exists, have the manufacturer's representative test the device, to ensure the unit is properly installed and performing as intended. Provide written documentation of the tests performed and signed by the individual performing the tests.

SD-07 Certificates

Station Outlets

Proof that outlets as an assembly conform to the requirements of Underwriters Laboratories, Inc.

Materials and Equipment

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF include proof of such

compliance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, a written certificate may be submitted from an approved, nationally recognized testing organization equipped to perform such services, stating that the items have been tested and conform to the requirements and testing methods of the specified agency. Where equipment is specified to conform to ASME requirements, the design, fabrication, and installation shall conform to the code.

Bolts

Written certification from the bolt manufacturer that the bolts furnished comply with specified requirements. Include in the certification illustrations of product-required markings, date of manufacture, and number of each type of bolt to be furnished based on this certification.

Medical Gas and Vacuum System Work

Written certificate of installer certification in accordance with **ASSE Series 6000** and written certificate of verifier certification in accordance with **ASSE Series 6000**.

SD-10 Operation and Maintenance Data

Plumbing System[; G][; G, [____]]

[Six] [____] copies of the operation manual outlining the step-by-step procedures required for system startup, operation and shutdown. Include in the manual the manufacturer's name, model number, service manual, parts list, and brief description of all equipment and their basic operating features. [Six] [____] copies of the maintenance manual listing routine maintenance procedures, possible breakdowns and repairs. Include in the manual piping and equipment layout and simplified wiring and control diagrams of the system as installed.

1.4 QUALITY ASSURANCE

1.4.1 Welding

NOTE: The designer will indicate welding requirements on the project drawings. Normally, delete the second bracketed statement. If the need exists for more stringent requirements for weldments, delete the first bracketed statement and the welding submittal.

[Piping shall be welded in accordance with qualified procedures using performance-qualified welders and welding operators. Procedures and welders shall be qualified in accordance with **ASME BPVC SEC IX**. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by **ASME B31.1**. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in

accordance with Section 05 05 23 WELDING, STRUCTURAL.] [Welding and nondestructive testing procedures are specified in Section 43 02 00 WELDING PRESSURE PIPING.]

1.4.2 General Requirements

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC. Water flow and consumption rates shall, at a minimum, comply with requirements in PL 109-58 and Executive Order 13423 dated January 26, 2007. Equipment energy efficiencies shall meet or exceed requirements of ASHRAE 90.1 - SI ASHRAE 90.1 - IP.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

Provide materials and equipment which are standard items of a manufacturer regularly engaged in the manufacture of such products and that essentially duplicate equipment that has performed satisfactorily at least 2 years prior to bid opening.

2.2 MATERIALS

NOTE: Some materials listed are superior to others for specific requirements. Therefore, information should be obtained from the using service for any special requirements before selection of material is made. The type of tubing or pipe required will be as determined by local experience. This specification allows drainage systems up to 425.0 mm (15 inches) diameter only: designer will assure the availability of materials when drainage line exceeds 425.0 mm (15 inches) diameter.

Provide materials for various services in accordance with TABLES I and II. Pipe fittings shall be compatible with the applicable pipe materials. Plastic pipe, fittings, and solvent cement shall meet NSF 14 and shall be NSF listed for the service intended. Plastic pipe, fittings, and solvent cement used for potable hot and cold water service shall bear the NSF seal "NSF-PW." Polypropylene pipe and fittings shall conform to dimensional requirements of Schedule 40, Iron Pipe size. Pipe threads (except dry seal) shall conform to ASME B1.20.1. Grooved pipe couplings and fittings shall be from the same manufacturer. Material or equipment containing lead shall not be used in any potable water system. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with PL 93-523 and NSF 61, section 8. End point devices such as drinking water fountains, lavatory faucets, kitchen and bar faucets, residential ice makers, supply stops and end point control valves used to dispense water for drinking shall meet the requirements of NSF 61, section 9. Hubless cast-iron soil pipe shall not be installed underground, under concrete floor slabs or in crawl spaces below kitchen floors. Plastic pipe shall not be installed in air plenums. Plastic pipe shall not be installed in a pressure piping system in buildings greater than three stories including any basement levels.

2.2.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used under ground. Joint and gasket materials shall conform to the following:

- a. Coupling for Hubless Cast-Iron Pipe: For hub and spigot type [ASTM A 74](#), [AWWA C606](#). For hubless type: [CISPI 310](#)
- b. Coupling for Steel Pipe: [AWWA C606](#).
- c. Couplings for Grooved Pipe: [Ductile Iron [ASTM A 536](#) (Grade 65-45-12)] [Malleable Iron [ASTM A 47/A 47M](#), Grade 32510] [Copper [ASTM A 536](#)].
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with [ASME B16.21](#). Gaskets shall be flat, [1.6 mm 1/16 inch](#) thick, and contain aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- e. Brazing Material: Brazing material shall conform to [AWS A5.8/A5.8M](#), BCup-5.
- f. Brazing Flux: Flux shall be in paste or liquid form, be appropriate for use with brazing material, be lead free, have a 100 percent flushable residue, contain slightly acidic reagents, contain potassium bromides, and contain fluorides.
- g. Solder Material: Solder metal shall conform to [ASTM B 32](#).
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and shall conform to [ASTM B 813](#), Standard Test 1.
- i. Polytetrafluoroethylene Tape, for use with Threaded Metal or Plastic Pipe, and Distilled Water-Piping: [ASTM D 3308](#).
- j. Rubber Gaskets for Cast-Iron Soil Pipe and Fittings (hub and spigot type and hubless type): [ASTM C 564](#).
- k. Rubber Gaskets for Grooved Pipe: [ASTM D 2000](#), maximum temperature [110 degrees C 230 degrees F](#).
- l. Flexible Elastomeric Seals: [ASTM D 3139](#), [ASTM D 3212](#) or [ASTM F 477](#).
- m. Bolts and Nuts for Grooved Pipe Couplings: Heat treated carbon steel, [ASTM A 183](#).
- n. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: [ASTM D 3138](#).
- o. Plastic Solvent Cement for ABS Plastic Pipe: [ASTM D 2235](#).
- p. Plastic Solvent Cement for PVC Plastic Pipe: [ASTM D 2564](#) and [ASTM D 2855](#).
- q. Plastic Solvent Cement for CPVC Plastic Pipe: [ASTM F 493](#).
- r. Flanged Fittings: Flanged fittings including flanges, bolts, nuts,

bolt patterns, etc. shall be in accordance with [ASME B16.5](#) Class 150 and shall have the manufacturers trademark affixed in accordance with [MSS SP-25](#). Flange material shall conform to [ASTM A 105/A 105M](#). Blind flange material shall conform to [ASTM A 516/A 516M](#) cold service and [ASTM A 515/A 515M](#) for hot service. Bolts shall be high strength or intermediate strength with material conforming to [ASTM A 193/A 193M](#).

s. Elastomeric Seals: Elastomeric seals (gaskets) for joining plastic pipe [ASTM F 477](#); thermoplastic elastomeric seals (gaskets) for joining plastic pipe [ASTM F 913](#).

t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: [ASTM D 3122](#).

u. Press Fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of [ASME B16.18](#) or [ASME B16.22](#). Sealing elements for copper press fittings shall be EPDM, FKM or HNBR. Sealing elements shall be factory installed or an alternative supplied by fitting manufacturer. Sealing element shall be selected based on manufacturers' approved application guide.

2.2.2 Copper Tubing and Fittings

a. Copper Tube: Copper tubing shall conform to [ASTM B 88M](#), Type K, L or M.

b. Press Fittings: Copper and bronze press fittings shall conform to material requirements of [ASME B16.18](#) or [ASME B16.22](#) and performance criteria of [IAPMO PS 117](#). Sealing elements shall be of EPDM and be factory installed or an alternative supplied by fitting manufacturer.

2.2.3 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

a. Water Hammer Arresters: [PDI WH 201](#).

b. Copper, Sheet and Strip for Building Construction: [ASTM B 370](#).

c. Asphalt Roof Cement: [ASTM D 2822](#).

d. Hose Clamps: [SAE J1508](#).

e. Supports for Off-The-Floor Plumbing Fixtures: [ASME A112.6.1M](#).

f. Metallic Cleanouts: [ASME A112.36.2M](#).

g. Plumbing Fixture Setting Compound: A preformed flexible ring seal molded from hydrocarbon wax material. The seal material shall be nonvolatile, nonasphaltic and contain germicide and provide watertight, gastight, odorproof and verminproof properties.

h. Coal-Tar Protective Coating and Linings for Steel Water Pipelines: [AWWA C203](#).

i. Hypochlorites: [AWWA B300](#).

j. Liquid Chlorine: [AWWA B301](#).

k. Polyethylene Encasement for Ductile Iron Piping: [AWWA C105/A21.5](#).

1. Gauges - Pressure and Vacuum Indicating Dial Type-Elastic Element:
ASME B40.100.

m. Thermometers: ASTM E 1. Mercury shall not be used in thermometers

2.2.4 Pipe Insulation Material

Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.3 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69.

2.4 VALVES

NOTE: Drawings will indicate equipment isolation, branch, and sectionalizing valves for water systems. Valves will be provided so that system maintenance can be performed without complete system shutdown. In general, valves should be provided in the following locations:

- a. Each branch serving a group of fixtures.
- b. Each riser serving a group of fixtures.
- c. Isolation valves will be provided on the supply and discharge of booster and circulating pumps and on all water heaters.
- d. In nonfreezing climates, wall faucets will be installed on outside walls and lawn faucets in parking, garden, and lawn areas. In freezing climates, freezeproof wall hydrants will be installed on outside walls and yard hydrants in parking, garden, and lawn areas. Indicate on the drawings height of hydrants and faucets above finished grade.

Provide valves on supplies to equipment and fixtures. Valves shall be gate valves, unless otherwise specified or indicated. Valves 65 mm 2-1/2 inches and smaller shall be bronze, with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm 3 inches and larger shall have flanged iron bodies and bronze trim. Pressure ratings shall be based upon the application. Grooved end valves may be provided if the manufacturer certifies that the valves meet the performance requirements of applicable MSS standard. Valves shall conform to the following standards:

Description	Standard
Butterfly Valves	MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70

Description	Standard
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged or Butt-Welding Ends for General Service	MSS SP-72
Ball Valves Threaded, Socket- Welding, Solder Joint, Grooved and Flared Ends	MSS SP-110
Cast-Iron Plug Valves, Flanged and Threaded Ends	MSS SP-78
Bronze Gate, Globe, Angle, and Check Valves	MSS SP-80
Steel Valves-Socket Welding and Threaded Ends	ASME B16.34
Faucets For High-Purity Water (De-ionized or Distilled) Either of the Following:	
Polyvinyl Chloride Composition Class 1245-B of Valves	ASTM D 1784,
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	CSA/AM Z21.22
Water Pressure Reducing Valves	ASSE 1003
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	CSA/AM Z21.22, and ASME BPVC SEC IV
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1, Part CW, Article 5

2.4.1 Backwater Valves

Backwater valves shall be either separate from the floor drain or a combination floor drain, "P" trap, and backwater valve, as shown. Valves shall have cast-iron bodies with cleanouts large enough to permit removal of interior parts. Valves shall be of the flap type, hinged or pivoted, with revolving disks. Hinge pivots, disks, and seats shall be nonferrous metal. Disks shall be slightly open in a no-flow, no-backwater condition. Cleanouts shall extend to finished floor and be fitted with threaded

countersunk plugs.

2.4.2 Wall Faucets

Wall faucets with vacuum breaker backflow preventer shall be brass with 19 mm 3/4 inch male inlet threads, hexagon shoulder, and 19 mm 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

2.4.3 Wall Hydrants

Wall hydrants with vacuum breaker backflow preventer shall have a nickel-brass or nickel-bronze wall plate or flange with nozzle and detachable key handle. A brass or bronze operating rod shall be provided within a galvanized iron casing of sufficient length to extend through wall so that the valve is inside the building, and the portion of the hydrant between the outlet and valve is self-draining. A brass or bronze valve with coupling and union elbow having metal-to-metal seat shall be provided. Valve rod and seat washer shall be removeable through the face of the hydrant. The hydrant shall have 19 mm 3/4 inch exposed hose thread on spout and 19 mm 3/4 inch male pipe thread on inlet.

2.4.4 Lawn Faucets

Lawn faucets shall be brass, with either straight or angle bodies, and shall be of the compression type. Body flange shall be provided with internal pipe thread to suit 19 mm 3/4 inch pipe. Body shall be suitable for wrench grip. Faucet spout shall have 19 mm 3/4 inch exposed hose threads. Faucet handle shall be securely attached to stem.

2.4.5 Yard Hydrants

Yard box or post hydrants shall have valve housings located below frost lines. Water from the casing shall be drained after valve is shut off. Hydrant shall be bronze with cast-iron box or casing guard. "T" handle key shall be provided.

2.4.6 Relief Valves

NOTE: The routing of the discharge piping should be shown on the drawings.

Water heaters and hot water storage tanks shall have a combination pressure and temperature (P&T) relief valve. The pressure relief element of a P&T relief valve shall have adequate capacity to prevent excessive pressure buildup in the system when the system is operating at the maximum rate of heat input. The temperature element of a P&T relief valve shall have a relieving capacity which is at least equal to the total input of the heaters when operating at their maximum capacity. Relief valves shall be rated according to CSA/AM Z21.22, have 19 mm 3/4 inch minimum inlets, and 19 mm 3/4 inch outlets for systems where the maximum rate of heat input is less than 59 kW 200,000 Btuh. Relief valves rated according to ASME BPVC SEC IV, or ASME CSD-1, shall have 25 mm 1 inch minimum inlets, and 25 mm 1 inch outlets for systems where the maximum rate of heat input is greater than 59 kW 200,000 Btuh. The discharge pipe from the (P&T) valve shall be the size of the valve outlet.

2.4.7 Thermostatic Mixing Valves and Cabinets

2.4.7.1 Mixing Valves

NOTE: Require thermostatic mixing valves on hot water systems where storage temperature is above 43 degrees C (110 degrees F).

Mixing valves, thermostatic type, pressure-balanced or combination thermostatic and pressure-balanced shall be line size and shall be constructed with rough or finish bodies either with or without plating. Each valve shall be constructed to control the mixing of hot and cold water and to deliver water at a desired temperature regardless of pressure or input temperature changes. The control element shall be of an approved type. The body shall be of heavy cast bronze, and interior parts shall be brass, bronze, corrosion-resisting steel or copper. The valve shall be equipped with necessary stops, check valves, unions, and sediment strainers on the inlets. Mixing valves shall maintain water temperature within 2 degrees C 5 degrees F of any setting.

2.4.7.2 Cabinets

Cabinets for mixing valves shall be constructed of 1.519 mm 16 gauge minimum thickness sheet metal of a size to accommodate the equipment to be installed therein, shall be rigidly assembled with joints welded, and shall be punched or drilled for the passage of required pipes and services. Cabinets shall be designed for recessed mounting in wall construction, with front flush with tile or plaster finish, and shall have flush-fitting continuously hinged doors. Keyed locks on cabinets located in neuropsychiatric wards shall be provided. Other cabinets shall be equipped with friction catch and pull. Doors and trim shall be flush with front of cabinet and shall be constructed of 1.519 mm 16 gauge minimum thickness sheet metal. Doors shall open through 180 degrees. The interior of the cabinets shall be cleaned, filled and primed, and factory finished with two coats of gray semigloss baked-on enamel. The exterior of the cabinets shall be cleaned and filled and factory primed with one coat baked-on enamel primer.

2.4.7.3 Hardware for Mixing-Valve Cabinets

Each door of cabinets in neuropsychiatric wards shall have a chromium-plated brass continuous hinge, and shall have a utility lock. Locks shall be keyed alike and not master keyed in the Attendants (AT) set. Each inactive door of two-door cabinets shall have two 102 mm 4 inch surface bolts mounted on the inside, one at the top and one at the bottom. Each door of cabinets in wards other than the neuropsychiatric wards shall have an approved friction catch and chromium-plated knob pull in lieu of a utility lock. Hinges shall be of the type specified for neuropsychiatric ward cabinets.

2.4.8 Laboratory Service Fittings

Laboratory service fittings shall be the products of one service fixture manufacturer. The location, service, and number of valves, goosenecks, panel flanges, hose cocks, needle valves, and laboratory back flow preventers shall be as shown. Fume hood remote control valves for 45 degree angular front mounting shall be front panel mounted brass forgings

of a type that facilitates servicing from the front of the fume hood exterior and shall have stems mounted parallel to the fume hood side wall. Laboratory service fittings shall have an acid- and solvent-resistant baked plastic coating.

2.4.9 Water Heater Drain Valve

Bronze or brass construction, neoprene seal disc, 19 mm^{3/4} inch hose threaded outlet with plated steel canopy handle. Pipe threads shall comply with ASME B1.20.1. Hose threads shall comply with ASME B1.20.7.

2.5 FIXTURES

NOTE: These paragraphs cover fixtures most often specified. The selection of fixture requirements is based on MIL-STD-1691 to the most practicable extent. The fixture listing will be revised for each project by deleting inapplicable items. The various types of fixtures will be identified by corresponding "P" numbers shown on the drawings. A maximum of acceptable fixture and trim options should be allowed for materials in this specification, unless life cycle analysis or local experience indicates that one type of material is better suited than others. Use separate hot and cold water valves. For fixture mounting heights see paragraph FIXTURES AND FIXTURE TRIMMINGS. When wall-mounted water closets are specified, chair carriers will be provided. Designer will specify wash fountains in industrial type washrooms where economically justified. Also, designer should consider the use of wash fountains designed to meet all needs including those of the handicapped.

Adjustable spray shower heads have been shown to be more satisfying to the user.

Fixtures shall be water conservation type, in accordance with ICC IPC. Fixtures for use by the physically handicapped shall be in accordance with ICC A117.1. Vitreous china, nonabsorbent, hard-burned, and vitrified throughout the body shall be provided. Porcelain enameled ware shall have specially selected, clear white, acid-resisting enamel coating evenly applied on surfaces. No fixture will be accepted that shows cracks, crazes, blisters, thin spots, or other flaws. Fixtures shall be equipped with appurtenances such as traps (or approved equal), faucets, stop valves, and drain fittings. Each fixture and piece of equipment requiring connections to the drainage system, except grease interceptors, shall be equipped with a trap (or approved equal). Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports. Pipe, valves, and fittings exposed to view shall be chromium plated. Fixtures and trim not covered by MIL-STD-1691 shall be considered special, but shall be of equal quality and material. Fixtures with the supply discharge below the rim shall be equipped with backflow preventers. Internal parts of flush and/or flushometer valves, shower mixing valves, shower head face plates, pop-up stoppers of lavatory waste drains, and pop-up stoppers and overflow tees and shoes of bathtub waste drains may contain acetal resin, fluorocarbon, nylon, acrylonitrile-butadiene-styrene (ABS) or other plastic material, if

the material has provided satisfactory service under actual commercial or industrial operating conditions for not less than 2 years. Plastic in contact with hot water shall be suitable for 82 degree C 180 degree F water temperature. Plumbing fixtures shall be as listed below. Shower heads, ASME A112.18.1 other than emergency showers, shall be [adjustable] [nonadjustable] spray type and shall include a non-removable, tamperproof flow control device which shall limit water flow to 0.16 L/second 2.5 gpm when tested in accordance with ASME A112.18.1.

2.5.1 Flushometer Valves

Flushometer valves shall have a non-hold-open feature with backcheck angle control stop and a vacuum breaker. Flushometer valves shall be large diaphragm type, having a minimum upper chamber inside diameter of not less than 66.7 mm 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. Flushometer valves shall conform to ASSE 1037.

2.5.2 Automatic Flushing System

NOTE: Include this paragraph only if automatic flushing system is a project requirement. Automatic sensor operated flush valves would be provided only on handicapped designated water closets. Designer should confirm use of automatic valve with Contracting Officer.

Flushing system shall consist of a solenoid-activated flush valve with light beam sensor. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.5.3 Shower Bath Outfits

Shower bath with outfits, shall be provided.

2.5.4 Joint Schedule Fixtures

The following Joint Schedule Numbers (JSN) for plumbing fixture items are as shown in MIL-STD-1691. Description of the fixture may vary from that in MIL-STD-1691.

a. Item P0300. Bath perineal, pedestal mounted, armchair design; vitreous china, removable molded vinyl overflow; 690.0 mm 27-1/8 inches wide by 610 mm 24 inches with height of rim 368 mm 14-1/2 inches above floor; pedestal bell supply; 13 mm 1/2 inch pipe to wall escutcheon, adjustable "P" trap 40 x 40 mm 1-1/2 x 1-1/2 inches: 40 mm 1-1/2 inch threaded trap nipple, additional removable vinyl overflow, and thermostatic supply assembly with thermometer.

b. Item P0320. Bath, sitz, vitreous-glazed earthenware or acid-resisting enameled cast iron shall be designed to be built into wall at back; shall have nominal overall dimensions of 762 x 965 mm 30 x 38 inches with height of back 533 mm 21 inches, height of rim 356 to 406 mm 14 to 16 inches above floor; and shall have water supply assembly, exposed thermostatic mixing valve with thermometer backflow preventer, 1524 mm 5 feet of rubber hose, and wall hook. Waste fitting

shall consist of 40 mm 1-1/2 inch pop-up waste and overflow with operating mechanism at the top of fixture.

c. Item P0330. Bath, sitz, vitreous china vitreous-glazed earthenware shall be designed to be built into the wall at back; shall have nominal overall dimensions 762 x 711 mm 30 x 28 inches with height of back 533 mm 21 inches and height of rim 356 to 406 mm 14 to 16 inches above floor; and shall have water supply assembly, exposed thermostatic mixing valve with thermometer, backflow preventer, 1524 mm 5 feet of rubber hose and wall hook. Waste fitting shall consist of 40 mm 1-1/2 inch pop-up waste and overflow with operating mechanism at the top of fixture.

d. Item P0500. Bathtub, corner, shall conform to ASME A112.19.1 with pop-up drain, and with shower fixture. Shower shall be complete with thermostatic or pressure balancing mixing valve. Bathtub shall be enameled cast iron.

e. Item P0700. Bathtub, recessed, 1524 mm 60 inches long, shall conform to ASME A112.19.1, Part A, Type I, Style A; with pop-up drain, and with shower fixture. Shower shall be complete with thermostatic or pressure balancing mixing valve. Bathtub shall be enameled cast iron.

f. Item P0750. Bathtub, recessed, shall conform to ASME A112.19.1 with pop-up drain, and with shower fixture. Shower shall be complete with thermostatic or pressure balancing mixing valve. Bathtub shall be enameled cast iron.

g. Item P1000. Bathtub, NP type, about 761 mm 30 inches wide, 1676 mm 66 inches long, 457 mm 18 inches high shall be installed with the rim 610 mm 24 inches above the floor; shall be cast-iron roll rim fixture, enameled inside and outside with acid-resisting porcelain enamel or a vitreous glazed earthenware; shall be designed for installation on a masonry or terrazzo base and for tiling in at the waste end. Thermostatic mixing valve shall be designed to deliver water at a rate of 37.8 L/min 10 gpm based on a water pressure of 310 kPa 45 psi at a maximum temperature of 41 degrees C 105 degrees F.

h. Item P1050. Bathtub, pier type for mounting on masonry base, 762 mm 30 inches wide, 1676 mm 66 inches long, 4572 mm 18 inches deep, with the rim 610 mm 24 inches, including base, above floor. Each fixture shall be provided with a built-in at the end fitting, a spray fitting, a backflow preventer, and a pop-up waste.

i. Item P1100. Rinse valve, bedpan, for mounting on water closet having exposed flush valve; provided with wall support bracket; and brass valve body having a taper machined type leakproof, raise and lower spray arm; and using one-third of flush water volume to rinse pan, balance to flush waste.

j. Item P1150. Rinse valve, bedpan, same as P1100, plus deodorant disinfectant plastic disposal jar injection of approximately 30 mL 1 ounce solution with each flush.

k. Item P1175. Bedpan cleanser, shall be hand operated type, single compression valve with handle supply to wall and vacuum breaker, loose key stop, 1200 mm 4 foot hose, self-closing valve handle and nozzle with spray and wall hook.

l. Item P1600. Drinking fountain, wall-mount, with push-button, and splash back shall be [vitreous china, ASME A112.19.2] [stainless steel] bowl having rounded corners and edges. Each fixture shall be provided with a guarded angle stream nozzle head, self-closing control valve, automatic volume regulator, and loose key stop valve and strainers. The trap and bodies of regulating and control valves shall be concealed. Drinking fountains shall meet the requirements of NSF 61, section 9.

m. Item P1650. Drinking fountain, wall-mount, semi-recessed, with push-button shall be [vitreous china, ASME A112.19.2] [stainless steel] of one-piece with bowl having rounded corners and edges. Each fixture shall be provided with a guarded angle-stream nozzle head, self-closing valve, automatic volume regulator, loose key stop valve, and strainer. The trap and bodies of regulator and control valves shall be concealed. Drinking fountains shall meet the requirements of NSF 61, section 9.

n. Item P1800. Drinking fountain, pedestal, [vitreous china, SPN D0835] [stainless steel, SPN D0935b]. Drinking fountains shall meet the requirements of NSF 61, section 9.

o. Item P2000. Fountain, ISEA Z358.1, eye wash, wall-mounted self-cleaning, non-clogging eye and face wash with quick opening, full-flow valves, corrosion-resisting steel eye and face wash receptor. Unit shall deliver 0.19 L/s 3 gpm of aerated water at 207 kPa 30 psig flow pressure, with eye and face wash nozzles 838 to 1143 mm 33 to 45 inches above finished floor. Copper alloy control valves shall be provided. An air-gap shall be provided with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the ICC IPC minimum in accordance with IPC Table 608.15.1. Provide [packaged, U.L. listed, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow switch, assembled and prewired for NEMA 3 waterproof [and NEMA 4 explosion proof] service,] [a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 16 to 35 degrees C 60 to 95 degrees F,] complete with 13 mm 1/2 inch pipe connection and 32 mm 1-1/4 inch standard chrome drain fitting.

p. Item P2050. Fountain, ISEA Z358.1, eye wash/shower; hand spray unit, floor mounted; complete with hose guide bracket, deck flange and 152 mm 6 inch hose.

q. Item P2100. Disposal unit, garbage, 1.5 kW 2 horsepower, 45 kg 100 pounds; without prerinse assembly; Type I, Class 2, CID A-A-50012; with [_____] pole, [_____] volts, [_____] phase, manual reversing switch.

r. Item P2150. Disposal unit, garbage, 1.5 kW 2 horsepower, [115/230] [200] volts, 45 kg 100 pounds; with prerinse assembly; Type I, Class 1, CID A-A-50012; with [_____] pole, [_____] volts, [_____] phase, manual reversing switch.

s. Item P2200. Disposal unit, garbage, 2.2 kW 3 horsepower, [200] [230] volts, 90.7 kg 200 pounds; without prerinse assembly; Type I, Class 2, CID A-A-50012; with [_____] pole, [_____] volts, [_____] phase, manual reversing switch.

t. Item P2250. Disposal unit, garbage, 2.2 kW 3 horsepower, [200]

[230] volts, 90.7 kg 200 pounds; with prerinse assembly; Type I, Class 1, CID A-A-50012; with [_____] pole, [_____] volts, [_____] phase, manual reversing switch.

u. Item P2300. Disposal unit, garbage, 3.7 kW 5 horsepower, [200] [230] volts, 182.4 kg 400 pounds; without prerinse assembly; Type I, Class 2, CID A-A-50012; with [_____] pole, [_____] volts, [_____] phase, manual reversing switch.

v. Item P2350. Disposal unit, garbage, 3.7 kW 5 horsepower, [200] [230] volts, 181.4 kg 400 pounds, with prerinse assembly; Type I, Class 1, CID A-A-50012; with [_____] pole, [_____] volts, [_____] phase, manual reversing switch.

w. Item P2400. Irrigator, perineal, CRS cabinet, surface or panel (recessed) unit shall contain a chemical tank with pump; control and regulating equipment; a thermostatically controlled water heater with tank; and hose connected applicator; 115 volt, 9 ampere; cold water connection required.

x. Item P3000. Ledge-Back Lavatory, 508 x 457 mm 20 x 18 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with combination faucet, finger lift drain fitting, "P" trap, and angle or straight stop valves.

y. Item P3070. Rectangular self-rimming Lavatory, 483 x 406 mm 19 x 16 inches, for use in patient toilet room, shall conform to ASME A112.19.2, suitable for recessed installation in counter top. Fixture shall be equipped with combination faucet, elevated gooseneck spout, wrist action handles, pop-up drain fitting, "P" trap, and angle or straight stop valves.

z. Item P3100 Sub Type. Lavatory, clinic, 508 x 457 mm 20 x 18 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with wrist action handle combination faucet, pop-up drain fitting, "P" trap, and angle or straight stop valves.

aa. Item P3150. Ledge-Back Lavatory, 610 x 508 mm 24 x 20 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with combination faucet, drain fitting with strainer, "P" trap, and angle or straight stop valves. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

bb. Item P3200. Shelf-back Lavatory, 508 x 457 mm 20 x 18 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with combination faucet, pop-up drain fitting, "P" trap, and angle or straight stop valves. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

cc. Item P3250. Lavatory with back, 610 x 508 mm 24 x 20 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with

combination faucet, elevated gooseneck spout, wrist action handles, drain stopper with chain stay, "P" trap, and angle or straight stop valves. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

dd. Item P3300. Lavatory with back, 508 x 610 mm 20 x 18 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with cold water faucet only. In lieu of hot water faucet, cock hole blank shall be provided. Drain stopper with chain stay, continuous waste for groups of two and three lavatories, "P" trap, and angle or straight stop valve shall be provided. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

ee. Item P3440. Lavatory, surgeons, vitreous china, 711 X 533 mm 28 x 21 inches nominal dimensions; with bowl 356 x 279 mm 14 x 11 inches; and with two integral instrument trays, 356 x 114 mm 14 x 4-1/2 inches, designed to permit draining into the bowl; gooseneck supply with knee control mixing valve. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

ff. Item P3450. Lavatory with back, 508 x 610 mm 20 x 18 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with combination faucet, elevated gooseneck spout, wrist action handles, drain fitting with strainer, "P" trap, and angle or straight stop valves. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

gg. Item P3451. Lavatory, exam room, vitreous china, front overflow, 508 x 457 mm 20 x 18 inches, with soap depression, gooseneck faucet, aerator, 102 mm 4 inch wrist handles; plus open drain with perforated grid; and with necessary accessory fittings. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

hh. Item P3490. Sink scrub, automatic, three station, wall-mounted, electronically timed with long (10 minute) and short (3, 4, 5 minute) cycles. Constant temperature control and regulated volume shall be provided. Plastic splash shield shall be provided between scrub stations. Control shall be watertight and top mounted. Timing devices shall be internal to reduce tampering. Construction shall be of welded

stainless steel. A foot-controlled soap dispenser shall be provided. Requires hot and cold water lines, each 13 mm 1/2 inch NPT, 138-345 kPa 20-50 psi. Drain shall be 40 mm 1-1/2 inch NPT. Sink shall include 120 volt, 2 ampere power to an internal junction box.

ii. Item P3500. Lavatory, surgeons, faucet holes 203 mm 8 inches on centers; vitreous china-front overflow; gooseneck faucet, spray 102 mm 4 inch wrist handles; cast grid drain 32 mm 1-1/4 inch tailpiece; cast-brass "P" trap; 508 mm 20 inches wide, 711 mm 28 inches long, 92 mm 3-5/8 inches deep.

jj. Item P3510. Sink, surgeon's scrub-up, center faucet hole, vitreous china, wall hanger; gooseneck with 51 mm 2 inch spray outlet 203 mm 8 inches above slab; straight tailpieces; knee action mixing valve 508 mm 20 inches long; with screwdriver stops-wall support; supply pipe assembly; grid drain 40.0 mm 1-1/2 inch tailpieces; 40 mm 1-1/2 inch cast-brass "P" trap; 559 mm 22 inches wide, 711 mm 28 inches long, 305 mm 12 inches deep.

kk. Item P3520. Sink, plaster, 610 x 1016 x 241 mm 24 x 40 x 9-1/2 inches; integral right-hand tray; vitreous china; faucet with 51 mm 2 inch spray, 152 mm 6 inch handles, screwdriver stops, grid drain 40 mm 1-1/2 inch tailpieces, 51 mm 2 inch O.D. drain connection to trap and wall; plaster-interceptor trap, space shall be left above for removal of screens; 610 mm 24 inches wide, 1016 mm 40 inches long, 241 mm 9-1/2 inches deep.

ll. Item P3530. Sink, bowl, single, stainless steel, 559 mm 22 inches wide by 635 mm 25 inches long. Faucet with 102 mm 4 inch wrist handles and rigid connection to 10 mm 3/8 inch gooseneck spout with aerator, outlet 127 mm 5 inches above slab, and grid drain with 32 mm 1-1/4 inch tailpiece.

mm. Item P3540. Sink, bowl, double, stainless steel, 559 mm 22 inches wide, by 838 mm 33 inches long. Faucet with 127 mm 4 inch wrist handles and rigid connection to 10 mm 3/8 inch gooseneck spout with 51 mm 2 inch spray outlet 152 mm 5 inches above slab.

nn. Item P3550. Lavatory with back, 610 x 457 mm 24 x 18 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with self-closing pedal valve, drain fitting with strainer "P" trap and angle or straight stop valves. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

oo. Item P3560. Lavatory, handwash, gooseneck faucet with aerator and four arm handles; vitreous china; front overflow; soap depressions; wall hanger; 356 mm 14 inches wide by 508 mm 20 inches long. Supply pipes with loose key stops; flexible risers; cast escutcheon; cast grid drain 32 mm 1-1/4 inch tailpiece; 32 mm 1-1/4 inch cast-brass "P" trap; 32 mm 1-1/4 inch threaded trap nipple. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

pp. Item P3570. Sink, pack, 559 mm 22 inches wide, 610 mm 24 inches long, 343 mm 13-1/2 inches deep; vitreous china; wall hung; gooseneck faucet-aerator; 152 mm 6 inch handles; 40 mm 1-1/2 inch cast-brass "P" trap.

qq. Item P3600. Lavatory with back, 610 x 508 mm 24 x 20 inches, shall conform to ASME A112.19.2. Fixture shall be equipped with knee action valve and gooseneck spout, open waste strainer, 40 mm 1-1/2 inch cast brass trap with clean-out, and angle or straight stop valves. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

rr. Item P3640. Sink, surgeon's scrub-up, electronic infra-red control; vitreous china, wall mounted, gooseneck water pipe, curved bottom. Automatic water flow starts electronically by proximity of individual. To include grid drain with 40 mm 1-1/2 inch tailpiece; 40 mm 1-1/2 inch cast brass "P" trap; thermostatic control water; and wall bracket; 120 volt ac primary, 24 volt ac secondary, 914 mm 36 inches wide by 419 mm 16-1/2 inches high by 600 mm 23-5/8 inches deep.

ss. Item P3850. Lavatory, surgeons, shall be vitreous china; 711 x 533 mm 28 x 21 inches nominal dimensions with bowl 356 x 279 mm 14 x 11 inches and with two integral instrument trays 356 x 114 mm 14 x 4-1/2 inches, designed to permit draining into the bowl; gooseneck supply with knee-central mixing valve. Perforated grid strainer, p-trap with nipple to wall as required. Lavatory shall conform to ASME A112.19.1 as applicable. Flow shall be limited to 1 liter 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

tt. Item P4040. Sink, bowl, single, all service; wrist control, gooseneck supply, countertop, nickel stainless steel satin finish, polished rim, sound dampener, 635 x 559 mm 25 x 22 inches, three faucet holes. Sink faucet shall be provided with 102 mm 4 inch wrist handles, and with crumb cup stopper drain with 40 mm 1-1/2 inch brass tailpiece.

uu. Item P4100. Sink, drainboard, single, two-door cabinet base with 610 mm 24 inch long, 457 mm 18 inch wide, 203 mm 8 inch high O.D. duratherm gray glazed vitrified chemical porcelain sink with waste disposal chute, to include combination hot-and-cold water fixture and non-lead sink strainer. Counter top, drainboard, splashback and curb shall be constructed of 32 mm 1-1/4 inch charcoal gray colorlith, 936 mm 37 inches long, 686 mm 27 inches wide, 540 mm 37 inches high.

vv. Item P4220. Sink, deep, double, with drainboard, to be constructed of CRS.

ww. Item P4240. Sink, double bowl, stainless steel, all service; wrist control faucet; countertop nickel stainless steel satin finish; polished rim, sound dampener; 838 mm 33 inches long by 558 mm 22 inches deep; three faucet holes, to include: gooseneck faucet with aerator,

102 mm 4 inch handles, and crumb cup stopper drain with brass body and 40 mm 1-1/2 inch tailpiece.

xx. Item P4260. Sink, double drainboard assembly, laboratory stone, and four-door cabinet base with 610 mm 24 inch long, by 457 mm 18 inch wide, by 203 mm 8 inch high sink well, to include: combination hot-and-cold water fixtures and non-lead sink strainer. Countertop, drainboards, splashbacks and curbs shall be constructed of 32 mm 1-1/4 inch stone 2019 mm 79-1/2 inches long, 762 mm 30 inches deep, 940 mm 37 inches high.

yy. Item P4400. Sink, all service, wrist control; vitreous glazed laboratory sink with rectangular basin and 229 mm 9 inch high back, raised integral ledge and [left] [right] hand drain shelf; concealed hangers and stainless steel brackets; gooseneck swing spout supply fittings with aerator and indexed wrist action blade handles; 10 mm 3/8 inch angle supplies with loose key stops and reducers; 40 mm 1-1/2 inch cast-brass perforated open strainer; 40 mm 1-1/2 inch cast-brass "P" trap with cleanout; basin 330 x 381 mm 13 x 15 inches by 152 mm 6 inches deep inside; and shelf 508 x 330 mm 20 x 23 inches.

zz. Item P4700. Basin, mop service; molded polyester/fiberglass product, 914 x 610 x 254 mm 36 x 24 x 10 inches, built under heat and pressure, resulting in a one-piece, homogeneous product. Service faucet, hose, hose racket, and mop hanger shall be provided.

aaa. Item P5040. Shower, single.

bbb. Item P5100. Shower, concealed type with thermostatic or pressure balancing valve.

ccc. Item P5150. Shower, cabinet, shall be 914 mm 36 inches wide, 914 mm 36 inches deep, and 1890 mm 74 inches high. Cabinet shall be fiberglass-reinforced plastic conforming to IAPMO Z124.1.2 and complete with receptor.

ddd. Item P5200. Shower, emergency, shall be a cast-brass ceiling shower, rough chromium plated with flange and 200 mm 8 inch self-cleaning head ASME A112.18.1 and shall be provided with a 25 mm 1 inch slow-closing, self-closing valve operated by a heavy chain attached to the floor; the shower head shall deliver not less than 94.6 L/min 25 gpm at 207 kPa 30 psi of pressure. Fixture shall conform to ISEA Z358.1.

eee. Item P5210. Shower, ISEA Z358.1, deluge, safety, shall be a complete, maximum protection safety station consisting of a free-standing emergency shower and an aerated eye-face wash fixture.

fff. Item P5300. Shower, litter, with floor drain, to include one 1524 mm 5 foot flexible spray hose, one thermostatic water regulating valve, one floor drain, and two valve stops. Flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

ggg. Item P5350. Shower, NP patient, shall be vandal-resistant with thermostatic valve in cabinet; shower head shall be designed for prison use. Fixture shall have smooth surfaces with no projection that can be used as a catch or hook; shall have flat back arranged for bolting directly to the wall; shall be tapped for 13 mm 1/2 inch pipe connection to tempered water line; the head shall have a tamperproof

removable face not less than 90 mm 3-1/2 inch diameter; and the shower head shall be installed not less than 1.8 meters 6 feet above the floor and shall deliver the spray within a 900 mm 3 foot circle. Flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

hhh. Item P5950. Sink, all-service, knee control, shall be vitreous china or vitreous-glazed earthenware, with right-hand instrument shelf and 203 mm 8 inch integral back drilled to receive gooseneck spout; nominal dimensions shall be 559 mm 22 inches wide, 914 mm 36 inches long, 229 mm 9 inches deep, with sink compartment 813 x 444 mm 32 x 17-1/2 inches.

iii. Item P6000. Sink, all-service, knee control, shall be vitreous china or vitreous-glazed earthenware, with right-hand instrument shelf and 203 mm 8 inch integral back drilled to receive gooseneck spout; nominal dimensions shall be 559 mm 22 inches wide by 762 mm 30 inches long by 229 mm 9 inches deep, with sink compartment 483 x 444 mm 19 x 17-1/2 inches.

jjj. Item P6040. Trap, overflow, safety, surgical suction; 473 mL 1 pint capacity; positive shutoff float; lip seal cap.

kkk. Item P6050. Sink, all-service, pedal control, shall be vitreous china or vitreous glazed earthenware, with right-hand instrument shelf and 203 mm 8 inch integral back drilled to receive gooseneck spout; nominal dimensions shall be 559 mm 22 inches wide by 762 mm 30 inches long by 229 mm 9 inches deep with sink compartment 483 x 444 mm 19 x 17-1/2 inches.

lll. Item P6060. Sink, all-service, wrist control, vitreous china, 762 mm 30 inches long by 813 mm 22 inches wide by 241 mm 9-1/2 inches deep; back to spout outlet 190 mm 7-1/2 inches with integral right-hand drain shelf and 203 mm 8 inches integral back drilled to receive gooseneck spout. Includes 102 mm 4 inch wrist control and gooseneck spout with 50 mm 2 inch spray.

mmm. Item P6100. Sink, all-service, wrist control, shall be vitreous china or vitreous glazed earthenware, with right-hand instrument shelf and 203 mm 8 inch integral back drilled to receive combination hot-and-cold water faucet; the dimensions shall be 559 mm 22 inches wide by 762 mm 30 inches long by 229 mm 9 inches deep with sink compartment 381 x 432 mm 15 x 17 inches.

nnn. Item P6150. Sink, cage washing, 1.897 mm 14 gauge thick CRS, 610 mm 24 inches wide by 660 mm 26 inches long, 406 mm 16 inches deep, with back on chair carrier.

ooo. Item P6230. Sink, instrument washing, 584 mm 23 inches wide by 1067 mm 42 inches long of stainless steel, with two compartments and drainboard.

ppp. Item P6300. Sink, service, disposal, 508 mm 20 inches wide by 508 mm 20 inches long shall be vitreous-glazed earthenware, with flushing rim, siphon jet, of the pedestal disposal type, with 40 mm 1-1/2 inch top inlet spud, and rim to floor 457 mm 18 inches minimum.

qqq. Item P6340. Sink, clinical service, 610 x 559 x 305 mm 24 x 22 x 12 inches, with 102 mm 4 inch drain.

rrr. Item P6350. Sink, service disposal, flushing rim (deep sink); 559 mm 22 inches wide by 660 mm 26 inches long by 267 mm 10-1/2 inches deep; vitreous china with an integral flushing rim and an integral back 121 mm 4-3/4 inches high; to include faucet with fork brace, 152 mm 6 inch handles, 260 mm 10-1/4 inches wall to spout outlet, and plain end spout with bucket hood; stainless steel, spring type front; rim guard; and grid drain with 50 mm 2 inch tailpiece.

sss. Item P6380. Sink, service, floor type, corner mounted; 711 x 711 x 203 mm 28 x 28 x 8 inches; precast material or cast iron; complete with polished chrome plated combination hot-and-cold water faucet with integral stops; back flow preventer; and 1.5 meters 5 feet of 10 mm 3/8 inch cloth-reinforced rubber hose.

ttt. Item P6400. Sink, utility, double bowl, one bowl 187 mm 7-3/8 inches deep, one bowl 305 mm 12 inches deep; wrist control; counter top, nickel stainless steel satin finish, polished rim, sound damper, 838 mm 33 inches long by 559 mm 22 inches deep and three faucet holes; to include gooseneck faucet, aerator, crumb cup stopper drain, and brass body.

uuu. Item P6450. Sink, all-service, doublebowl 187 mm 7-3/8 inches deep; wrist control; counter top, type 302 nickel bearing stainless steel, polished exposed surfaces, sound dampener, 838 mm 33 inches long by 559 mm 22 inches deep, and three faucet holes. Includes gooseneck faucet, aerator, crumb cup stopper drain, and brass body.

vvv. Item P6480. Sink, all-service, wrist control, earthenware, vitreous glazed, laboratory sink with rectangular basin and 203 mm 8 inch high back, raised integral ledge and [left] [right]-hand drain shelf; gooseneck swing spout supply fitting with aerator and indexed wrist action blade handles; S.P.S. 10 mm 3/8 inch coupler with loose key stops and reducers; 40 mm 1-1/2 inch cast-brass perforated open strainer; 40 mm 1-1/2 inch cast-brass "P" trap with cleanout; basin 330 x 381 mm 13 x 15 inches by 152 mm 6 inches deep; and shelf 508 x 584 mm 20 x 23 inches.

www. Item P6500. Sink, service, shall conform to ASME A112.19.1 with rim guard, modified without faucet holes or drillings; provided with a polished chromium-plated combination hot-and-cold water faucet with integral stops and extended spout. Spout shall have pail hook, 19 mm 3/4 inch hose coupling thread and shall include a backflow preventer. Faucet shall be provided with top brace to wall and wall fittings for mounting on wall above service sink and sink shall be approximately 610 mm 24 inches wide by 508 mm 20 inches long by 305 to 355 mm 12 to 14 inches deep. Sink shall have drain stopper. Service sink shall include a minimum 75 mm 3 inch diameter cast-iron trap.

xxx. Item P6550. Sink, drainboard, assembly, laboratory; two-door cabinet base 940 mm 37 inches long by 686 mm 27 inches wide by 940 mm 37 inches high; and 610 mm 24 inches long by 457 mm 18 inches high O.D. [glazed vitrified chemical porcelain] [stainless steel] sink and waste disposal chute. Includes combination hot-and-cold water fixtures, non-lead sink strainer, counter top, drainboard, and splashback and curb constructed of 32 mm 1-1/4 inch colorlith.

yyy. Item P656p. Sink, double drainboard assembly, laboratory; four-door cabinet base 2019 mm 79-1/2 inches long by 762 mm 30 inches

deep by 940 mm 37 inches high; with 610 mm 24 inch long by 457 mm 18 inch wide, 203 mm 8 inch high O.D. alberene stone sink. Includes combination hot-and-cold water fixtures; non-lead sink strainer, countertop, drainboard, splashbacks constructed of 32 mm 1-1/4 inch alberene stone.

zzz. Item P6570. Sink, double drainboard assembly, laboratory; open table type base 1829 mm 72 inches long by 762 mm 30 inches wide by 940 mm 37 inches high; with 610 mm 24 inch long by 457 mm 18 inch deep by 203 mm 8 inch high O.D. [glazed vitrified chemical porcelain] [stainless steel] sink. Includes combination hot-and-cold water fixtures; non-lead sink strainer, counter top, drainboards, splashback and curbs, constructed of 82 mm 1-1/4 inch colorlith.

aaaa. Item P6580. Sink, bowl, all-service; with wrist control gooseneck supply; countertop, nickel stainless steel satin finish, polished rim, sound dampener, 635 x 559 mm 25 x 22 inches; three faucet holes. Sink faucet shall have 102 mm 4 inch wrist handles and crumb cup stopper drain-brass body with 40 mm 1-1/2 inch tailpiece.

bbbb. Item P6600. Sink, laundry tray combination, shall be rim ledge sink and laundry tray combination with a concealed chair carrier and painted white enamel brackets; right-hand sink shall be provided unless otherwise shown; each compartment shall be equipped with 40 mm 1-1/2 inch cast-brass "P"-trap with threaded cleanout pulp fixture (not less than 152 mm 6 inches deep) and tray shall be not less than 305 mm 12 inches deep. Fixture shall be approximately 1067 mm 42 inches long by 610 or 635 mm 24 or 25 inches wide. Fixture shall conform to ASME A112.19.1, with sink and tub combination faucet, drain with strainer, and angle or straight stop valves.

cccc. Item P6700. Sink, pack, 559 mm 22 inches wide by 711 mm 28 inches long by 356 mm 14 inches deep; shall be acid-resisting enameled iron in addition to supporting brackets, vitreous china, or vitreous-glazed earthenware; with concealed type chair carrier, steam valve, two single faucets, 1.897 mm 14 gauge thick CRS drainboard, and wringer.

dddd. Item P6750. Sink, plaster, 559 mm 22 inches wide by 762 mm 30 inches long by 241 mm 9-1/2 inches deep, and integral back 152 mm 6 inches high; vitreous china; with gooseneck faucet aerator; 102 mm 4 inch handles; screwdriver stops grid drain; 40 mm 1-1/2 inch tailpipe; 50 mm 2 inch O.D. drainconnection to trap and wall; and porcelain plastic-interceptor trap.

eeee. Item P6800. Sink, plaster, 610 x 914 mm 24 x 36 inches by 203 mm 8 inches deep and integral back 203 mm 8 inches high; shall be vitreous china or vitreous glazed earthenware; concealed-typed chair shall be furnished in addition to adjustable enamel painted brackets; drainboard, 1219 x 610 mm 48 x 24 inches, 1.519 mm 16 gauge thick CRS, shall have fixed spout 229 mm 9 inches long with 50 mm 2 inch spray and wrist action handles, open drain with perforated grid, and plaster interceptor.

ffff. Item P6850. Sink, plaster, 457 x 610 x 254 mm 18 x 24 x 10 inches; flat rim shall be acid-resisting cast iron, 457 mm 18 inches wide by 610 mm 24 inches long by 254 mm 10 inches deep; with ledge-type faucet and plaster interceptor.

gggg. Item P6900. Sink, surgeon's scrub-up, 559 mm 22 inches wide by 762 mm 30 inches long by 254 mm 10 inches deep, back 152 mm 6 inches in height; shall be vitreous china or vitreous-glazed earthenware; with integral back designed for wall mounting on brackets or a flat bar anchored to the brackets; gooseneck supply with knee-action mixing valve; 50 mm 2 inch spray 254 mm 10 inches above sink rim; strainer type waste and cast-brass strap with thread cleanout plug. Sink shall conform to ASME A112.19.2.

hhhh. Item P6905. Sink, surgeon's scrub-up; 559 mm 22 inches wide by 762 mm 30 inches long by 254 mm 10 inches deep; back 152 mm 6 inches high; vitreous china or vitreous-glazed earthenware; with integral back designed for wall mounting on brackets or a flat bar anchored to the brackets; gooseneck supply with knee-action mixing valve; 50 mm 2 inch spray 254 mm 10 inches above sink rim; type 85 waste, and type 106 trap.

iiii. Item P6910. Sink, surgeon's scrub-up, same as P6900 except with wall-mounted, foot pedal valve.

jjjj. Item P6920. Sink, surgeon's scrub-up, same as P6900, except with wrist control valve.

kkkk. Item P6950. Sink, surgeon's scrub-up, with knee action valve and gooseneck supply; 482 mm 19 inches wide by 559 mm 22 inches long by 350 mm 13-1/2 inches deep. Sink shall conform to ASME A112.19.2 as applicable.

llll. Item P6960. Sink, surgeon's scrub-up, with foot pedal valve and gooseneck supply; 482 mm 19 inches wide by 559 mm 22 inches long by 350 mm 13-1/2 inches deep. Sink shall conform to ASME A112.19.2 as applicable.

mmmm. Item P6970. Sink, surgeon's scrub-up with wrist control valve and gooseneck supply; 482 mm 19 inches wide by 559 mm 22 inches long by 350 mm 13-1/2 inches deep. Sink shall conform to ASME A112.19.2 as applicable.

nnnn. Item P6980. Sink, scrub station, surgeons, stainless steel, No. 4 finish; 1.5875 mm 16 gauge thick minimum; hydro-mechanical knee operation water control valves; knee-operated surgical soap dispenser. One, two, or three bay models, as indicated.

oooo. Item P6990. Scrub station, surgical, automatic; double length (two-station); thermostat control water temperature selector; solid state timer, automatically timed scrub period; automatic water shutoff; full arm wash/rinse spray; built-in detergent dispenser, foot controlled; 3251 mm 128 inches long by 692 mm 27-1/4 inches deep by 616 mm 24-1/4 inches high; 138 to 552 kPa 20 to 80 psi water pressure. Requires cold water and hot water, 13 mm 1/2 inch NPT, 138 to 345 kPa 20 to 50 psi; drain, 40 mm 1-1/2 inch NPT; and 120 volt, 2 ampere power to an internal junction box. Sink shall conform to ASME A112.19.3 with sink and tub combination faucet, drain with strainer, "P" trap, and angle or straight stop valves.

pppp. Item P7500. Trap, interceptor, plaster, cast-iron sediment interceptor with side inlet, sealed side outlet. Bolted removable gasketed watertight cover; removable heavy galvanized basket having lift bars; cast iron removable inlet baffle; and removable bronze screens and cleanout at bottom for installation in floor, either

recessed in pit or flush with floor shall be provided

qqqq. Item P7600. Trap, plaster, large, 406 mm 16 inches high by 356 mm 14 inches wide by 356 mm 14 inches long; shall have heavy gray cast-iron body, white porcelain-enamel inside and outside; clamps, cage of heavy galvanized material, and brass screens; with 50 mm 2 inch long inlet and 50 mm 2 inch high outlet fitted with hood seal.

rrrr. Item P7650. Trap, plaster, small, 254 mm 10 inches high by 152 mm 6 inches wide by 152 mm 6 inches long; shall be cast aluminum, rectangular with solid top and hinged bottom having integral baffles and 6 mm 1/4 inch drain plug; bolted bottom shall provide easy access for removal of screens for cleaning and recovery of items in sediment bucket.

ssss. Item P8100. Urinal wall-hanging, [siphon-jet] [or] [wash-out] with extended shields shall conform to ASME A112.19.2. Fixture shall be equipped with flushometer valve conforming to ASSE 1037, SPN 1a1.5. Flow shall be limited to 3.8 L 1 gallon per flush at a flowing water pressure of 549 kPa 80 psi.

tttt. Item P8350. Urinal wall-hanging, [siphon-jet] [or] [wash-out] with extended shields, shall conform to ASME A112.19.2. Fixture shall be equipped with flushometer valve conforming to ASSE 1037, SPN 2c1.5. Flow shall be limited to 3.8 L 1 gallon per flush at a flowing water pressure of 549 kPa 80 psi.

uuuu. Item P8500. Urinal non-water using, ASME A112.19.2, [white] [_____] vitreous china, wall-mounted, wall outlet, integrall drain line connection. The trap design shall comply with the IPC. Sealed replaceable cartridge or integral liquid seal trap shall use a biodegradable liquid to provide the seal and maintain a sanitary and odor-free environment. Install with urinal rim 432 mm 17 inch above the floor. Provide ASME A112.6.1M concealed chair carriers. Installation, maintenance and testing shall be in accordance with the manufacturer's recommendations. Slope the sanitary sewer branch line for non-water use urinals a minimum of 6 mm/300 mm 1/4 inch/foot. Drain lines that connect to the urinal outlet shall not be made of copper tube or pipe. For urinals that use a replaceable cartridge, provide four additional cartridges for each urinal installed along with any tools needed to remove/install the cartridge. Provide an additional quart of biodegradable liquid for each urinal installed. Manufacturer shall provide manuals and on-site training for the proper care and maintenance of the urinal.

vvvv. Item P8700. Washer, tubing with individually controlled connectors for tubing 3 to 13 mm 1/8 to 1/2 inch inside diameter and number of outlets as indicated. Tubing washers shall consist of four serrated nozzles, each equipped with backflow preventers and individual volume control valves with 13 mm 1/2 inch hot and cold water valved controls to the assembly. Washer shall be constructed of brass chromium plated. Hose nozzles shall be suitable for hoses ranging in size from 3 mm 1/8 inch and shall have a 10-serration hose end. Backflow preventers shall be of the moving part and air vent type. Control valve for nozzles shall be not less than 152 mm 6 inches on center.

www. Item P9000. Water closet wall-hanging, siphon-jet, elongated bowl for direct flushometer valve, shall conform to ASME A112.19.2.

Seat shall conform to IAPMO Z124.5, SPN CEWX. Flushometer valve shall conform to ASSE 1037, SPN 1a3.5. The maximum water use allowed shall be 6 L 1.6 gallons per flush. Floor flange shall be [cast iron] [copper] [or] [copper alloy], with wax seal unless otherwise specified.

xxxx. Item P9050. Water closet floor mounted, siphon-jet, elongated bowl shall conform to ASME A112.19.2. Seat shall conform to IAPMO Z124.5, SPN CEWX. Flushometer valve shall conform to ASSE 1037, SPN 1a3.5. The maximum water use allowed shall be 6 L 1.6 gallons per flush. Floor flange shall be [cast iron] [copper] [or] [copper alloy], with wax seal unless otherwise specified.

yyyy. Item P9150. Cabinet, toilet/lavatory cabinet. Lavatory/toilet combination unit shall have 304 stainless steel cabinet frame, elongated siphon jet toilet and lavatory. Cabinet doors shall support 1.1 kN 250 pound static load and floor-supported toilet shall support 11 kN 2500 pound static load. Cabinet and countertop shall be melamine plastic laminate. Valves shall be wrist handle or foot control as required.

zzzz. Item P9160. Lavatory, disturbed patient, shall consist of vitreous china, with integral faucet and soap dish, and self-closing pushbutton valves. Flow shall be limited to 1 L 0.25 gallon per cycle at a flowing water pressure of 549 kPa 80 psi if a metering device or fitting is used that limits the period of water discharge such as a foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 L/second 2.5 gpm at a flowing water pressure of 549 kPa 80 psi.

aaaaa. Item P9180. Lavatory, wheelchair, 508 x 686 mm 20 x 27 inches with appropriate carrier for installation.

bbbbb. Item P9200. Water closet floor mounted, regular bowl, wash-down, shall conform to ASME A112.19.2. Seat shall conform to IAPMO Z124.5, SPN CRWX. Flushometer valve shall conform to ASSE 1037, SPN 1a3.5. The maximum water use allowed shall be 6 L 1.6 gallons per flush. Floor flange shall be [cast iron] [copper] [or] [copper alloy], with wax seal unless otherwise specified.

cccc. Item P9320. Floor drain attachment, used in hydrotherapy rooms shall have automatic trap primer.

dddd. Item P9400. Water closet, NP Patient, shall conform to ASME A112.19.2, SPN SJEB203. Seat shall conform to IAPMO Z124.5, SPN CEWX. Flushometer valve shall conform to ASSE 1037, SPN 2c3.5. The maximum water use allowed shall be 6 L 1.6 gallons per flush. Floor flange shall be [cast iron], [copper] [or] [copper alloy], with wax seal unless otherwise specified.

eeee. Item P9450. Water closet, bedpan cleaning, shall conform to ASME A112.19.2 as applicable. Water closet shall be vitreous china siphon jet elongated bowl with lugs or slots for holding bedpan. Water closet bowls shall have siphon trapway at the rear of the bowl and an integral flushing rim and jet. Bedpan cleaner shall be [foot valve,] [flush valve,] [or] [hand valve] operated. Seat shall be white color, open front without cover, with check hinge.

ffff. Item P9510. Mixing valve, 170 L/minute 45 gpm thermostatic.

ggggg. Item P9520. Water closet siphon-jet, elongated bowl, specimen, shall conform to [ASME A112.19.2](#), except that the bowl shall be capable of receiving a full size standard bedpan. Seat shall conform to [IAPMO Z124.5](#), SPN CEWX. Flushometer valve shall conform to [ASSE 1037](#), SPN 1a3.5. Floor flange shall be [cast iron] [copper] [or] [copper alloy], with wax seal unless otherwise specified.

hhhhh. Item P9550. Water closet, specimen, shall conform to [ASME A112.19.2](#) as applicable. Water closet shall be vitreous china siphon jet elongated bowl capable of receiving a full size standard bedpan. Bedpan cleaning shall not be provided. Seat shall be white color, open front without cover, with check hinge.

iiii. Item P9560. Cleaner, whirlpool, exposed; wall mounted with stationary hose rack and vacuum breaker; 737 mm 29 inches high by 406 mm 16 inches wide; standard hot-and-cold water supply system.

jjjjj. Item P9570. Toilet, specimen; vitreous china. Includes vacuum breaker, 10 mm 3/8 inch piping; nozzle with hood; heat-resistant handle; horse-shoe with spray; double pedal valve; and supply pipe assembly with loose key stop (for pedal valve).

2.6 BACKFLOW PREVENTERS

NOTE: Indicate on the drawings all locations where backflow preventers are required (and type of device) to protect water supply and distribution system against backflow and backsiphonage in accordance with the International Plumbing Code. If a drain is required, ensure it is shown. Backflow prevention device requirements for connection to nongovernment potable water systems will be coordinated with the local jurisdiction and/or water service agency.

Backflow preventers shall be approved and listed by the Foundation For Cross-Connection Control & Hydraulic Research. Reduced-pressure principle assemblies, double check valve assemblies, atmospheric (nonpressure) type vacuum breakers, and pressure type vacuum breakers shall be tested, approved, and listed in accordance with [FCCCHR Manual](#). Backflow preventers with intermediate atmospheric vent shall conform to [ASSE 1012](#). Reduced pressure principle backflow preventers shall conform to [ASSE 1013](#). Hose connection vacuum breakers shall conform to [ASSE 1011](#). Pipe applied atmospheric type vacuum breakers shall conform to [ASSE 1001](#). Pressure vacuum breaker assembly shall conform to [ASSE 1020](#). Air gaps in plumbing systems shall conform to [ASME A112.1.2](#).

2.7 DRAINS

2.7.1 Floor and Shower Drains

Floor and shower drains shall consist of a galvanized body, integral seepage pan, and adjustable perforated or slotted chromium-plated bronze, nickel-bronze, or nickel-brass strainer, consisting of grate and threaded collar. Floor drains shall be cast iron, except where metallic waterproofing membrane is installed. Drains shall be of double drainage pattern for embedding in the floor construction. The seepage pan shall

have weep holes or channels for drainage to the drain pipe. The strainer shall be adjustable to floor thickness. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or waterproofing membrane shall be provided when required. Drains shall be provided with threaded connection. Between the drain outlet and waste pipe, a neoprene rubber gasket conforming to [ASTM C 564](#) may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to [ASME A112.6.3](#).

2.7.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws for securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain-to-waste piping. Polyethylene floor drains shall be constructed of polyethylene conforming to [ASTM D 1248](#). Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and chrome-plated strainer, unless otherwise indicated.

2.7.1.2 Drains and Backwater Valves

Drains and backwater valves installed in connection with waterproofed floors or shower pans shall be equipped with bolted-type device to securely clamp flashing.

2.7.2 Area Drains

Area drains shall be plain pattern with polished stainless steel perforated or slotted grate and bottom outlet. The drain shall be circular or square, with a [300 mm 12 inch](#) nominal overall width or diameter and [250 mm 10 inch](#) nominal overall depth. Drains shall be cast iron with manufacturer's standard coating. Grate shall be easily lifted out for cleaning. Outlet shall be suitable for inside caulked connection to drainpipe. Drains shall conform to [ASME A112.6.3](#).

2.7.3 Floor Sinks

Floor sinks shall be circular or square, with [300 mm 12 inch](#) nominal overall width or diameter and [250 mm 10 inch](#) nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body and aluminum sediment bucket, and perforated grate of cast iron in industrial areas and stainless steel in finished areas. The outlet pipe size shall be as indicated or of the same size as the connective pipe.

2.7.4 Floor Drains for Acid Waste Piping System (X-Ray Film Processors)

Floor drains for polypropylene piping systems shall be of flame-retardant polypropylene conforming to [ASTM D 4101](#). Floor drains for high-silicon content cast-iron piping systems shall be of cast-iron composition compatible with the cast-iron pipe specified. Details of floor drains shall be as shown.

2.7.5 Boiler Room Drains

NOTE: Boiler room drains will be used where coal is
the heating fuel.

Boiler room drains shall have combined drain and trap, hinged grate, removable bucket, and threaded brass cleanout with brass backwater valve. The removable galvanized cast-iron sediment bucket shall have rounded corners to eliminate fouling and shall be equipped with handgrips. Drain shall have a minimum water seal of 100 mm 4 inches. The grate area shall be not less than 0.064 square meters 100 square inches.

2.7.6 Pit Drains

Pit drains shall consist of a body, integral seepage pan, and nontilting perforated or slotted grate. Drains shall be of double drainage pattern suitable for embedding in the floor construction. The seepage pan shall have weep holes or channels for drainage to the drain pipe. Membrane or flashing clamping device shall be provided when required. Drains shall be cast iron with manufacturer's standard coating. Drains shall be circular and provided with bottom outlet suitable for inside caulked connection, unless otherwise indicated. Drains shall be provided with separate cast-iron "P" traps, unless otherwise indicated.

2.7.7 Sight Drains

Sight drains shall consist of body, integral seepage pan, and adjustable strainer with perforated or slotted grate and funnel extension. The strainer shall have a threaded collar to permit adjustment to floor thickness. Drains shall be of double drainage pattern suitable for embedding in the floor construction. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided for other than concrete construction. Drains shall have a galvanized heavy cast-iron body and seepage pan and chromium-plated bronze, nickel-bronze or nickel-brass strainer and funnel combination. Drains shall be provided with threaded connection and with a separate cast-iron "P" trap, unless otherwise indicated. Drains shall be circular unless otherwise indicated. The funnel shall be securely mounted over an opening in the center of the strainer. Minimum dimensions shall be as follows:

- a. Area of strainer and collar: 0.0235 square m 36 square inches
- b. Height of funnel: 95 mm 3-3/4 inches
- c. Diameter of lower portion of funnel: 50 mm 2 inches
- d. Diameter of upper portion of funnel: 102 mm 4 inches

2.7.8 Roof Drains and Expansion Joints

Roof drains shall conform to ASME A112.21.2M with dome and integral flange, and shall have a device for making a watertight connection between roofing and flashing; the whole assembly shall be galvanized heavy pattern cast iron. For aggregate surface roofing, the drain shall be provided with a gravel stop. On roofs other than concrete construction, roof drains shall be complete with underdeck clamp, sump receiver, and an extension for the insulation thickness where applicable. A clamping device for attaching flashing or waterproofing membrane to the seepage pan without damaging the flashing or membrane shall be provided when required to suit the building construction. Strainer openings shall have a combined area equal to twice that of the drain outlet. The outlet shall be equipped to make a proper connection to threaded pipe of the same size as the downspout. An

expansion joint of proper size to receive the conductor pipe shall be provided. The expansion joint shall consist of a heavy cast-iron housing, brass or bronze sleeve, brass or bronze fastening bolts and nuts, and gaskets or packing. The sleeve shall have a nominal thickness of not less than 3.4 mm 0.134 inch. Gaskets and packing shall be close-cell neoprene; O-ring packing shall be close-cell neoprene of 70 durometer. Packing shall be held in place by a packing gland secured with bolts.

2.8 WATER COOLERS

NOTE: Designer will indicate location, type, and capacity of the water cooler and water heaters on the drawings. All requirements will be indicated. Designer will add to the specification required data on construction, supports, and insulation.

Self-contained, wall hung, mechanically refrigerated drinking water coolers shall conform to AHRI 1010, shall use one of the halogenated hydrocarbons as a refrigerant, and shall have a capacity to deliver a minimum of 30.2 L/hour 8 gph of 10 degree C 50 degree F water when supplied with 27 degree C 80 degree F inlet water and a 32 degree C 90 degree F room temperature.

2.9 SHOWER PAN

NOTE: Shower pans will be shown on the architectural details. Shower pans may be omitted for showers located on floors with slab-on-grade construction, unless special local conditions necessitate waterproofing. Pans will be omitted in toilet facilities of patient rooms.

Shower pan may be copper or nonmetallic material.

2.9.1 Sheet Copper

Sheet copper shall be 4.9 kg 16 ounce weight.

2.9.2 Plasticized Chlorinated Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 1.016 mm 0.040 inch minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and be in accordance with ASTM D 4551.

2.9.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material

Material shall consist of a plastic waterproofing membrane in sheet form. The material shall be 1.016 mm 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. ASTM D 638:

- 1) Ultimate Tensile Strength: 17.9 MPa 2600 psi
- 2) Ultimate Elongation: 398 percent

- 3) 100 Percent Modulus: 3.07 MPa 445 psi
- b. ASTM D 1004: Tear Strength: 53 kN/meter 300 lbs./inch
- c. ASTM E 96/E 96M: Permeance: 0.46 nanograms per pascal-second-sq. meter 0.008 Perms
- d. Other Properties:
 - 1) Specific Gravity: 1.29
 - 2) PVC Solvent: Weldable
 - 3) Cold Crack: minus 47 degrees C minus 53 degrees F
 - 4) Dimensional stability, (100 degrees C 212 degrees F): 2.5 percent
 - 5) Hardness, Shore A: 89

2.10 TRAPS

Unless otherwise specified, traps shall be plastic in accordance with ASTM F 409 or copper alloy adjustable tube type with slip joint inlet and swivel. Traps shall be without a cleanout. Tubes shall be copper alloy with walls not less than 0.81 mm 0.032 inch thick within commercial tolerances, except on the outside of bends where the thickness may be reduced slightly in manufacture by usual commercial methods. Inlets shall have rubber washer and copper alloy nuts for slip joints above the discharge level. Swivel joints shall be below the discharge level and shall be of metal-to-metal or metal-to-plastic type as required for the application. Nuts shall have flats for wrench grip. Outlets shall have internal pipe thread, except that when required for the application, the outlets shall have sockets for solder-joint connections. The depth of the water seal shall be not less than 50 mm 2 inches. The interior diameter shall be not more than 3 mm 1/8 inch over or under the nominal size, and interior surfaces shall be reasonably smooth throughout. A plastic or copper-alloy "P" trap assembly consisting of an adjustable "P" trap and threaded trap wall nipple with cast-brass wall flange, shall be provided for lavatories. The assembly shall be a standard manufactured unit and may have a rubber-gasketed swivel joint.

2.11 GREASE INTERCEPTORS

 NOTE: Concrete pit must be detailed on structural drawings.

[Grease interceptors of the sizes indicated shall be constructed of reinforced concrete, [or of precast concrete construction] [or equivalent capacity commercially available steel grease interceptor] with removable three-section, 10 mm 3/8 inch checker-plate cover, and shall be installed outside the building.] [Steel grease interceptor shall be installed in a concrete pit and shall be epoxy-coated to resist corrosion as recommended by the manufacturer.] Interceptors shall be tested and rated in accordance with PDI G 101. Concrete shall have 21 MPa 3000 psi minimum compressive strength at 28 days.

2.12 GARBAGE CAN WASHER

Garbage can washer shall be capable of cleaning cans up to 635 mm 25 inches in outside diameter. Garbage can washer basin shall be fabricated of corrosion resisting steel, and the basin supports shall be of [galvanized] [malleable iron] [carbon steel].

2.13 DISHWASHING MACHINES

[Commercial dishwashing machines shall conform to NSF 3, NSF 5, and UL 921.]
[Household dishwashing machines shall conform to UL 749 and ASSE 1006, sized as indicated.]

2.14 WATER HEATERS

NOTE: Coordinate with the HVAC engineer the availability of heating source and control air in order to make proper selection of bracketed choices.

The option for phenolic resin coating for heaters with service water in the shell and steam or hot water in the coil should be used only at locations where scaling on coil surfaces due to water hardness is severe or where corrosion-induced leaks are a severe problem.

Location of water heaters should be shown on the drawings.

Also, the type, capacity, etc. of each unit should be scheduled on the drawings.

Except for gas-fired water heaters, water temperatures in excess of 60 degrees C (140 degrees F) should be obtained by using a booster heater in series with a primary heater. Hot water systems utilizing recirculation systems should be tied into building off-hour controls. When using a gas-fired water heater, provide thermostatic, pressure-balanced, or combination thermostatic and pressure-balanced type mixing valves to obtain water temperatures below 60 degrees C (140 degrees F).

Ensure that values for efficiencies in Table III are equal to or greater than the latest "recommended" values currently released by the Department of Energy Federal Energy Management Program (FEMP). The latest values can be found on FEMP's Internet site: <http://www.eren.doe.gov/femp/>.

Select expansion tank based on incoming water pressure, water heater volume and temperature rise of water. Consult expansion tank manufacturer for sizing recommendations. Show the expansion tank size and acceptance volume on the drawings.

Water heater types and capacities shall be as indicated. Each water heater shall have replaceable anodes. Each primary water heater shall have controls with an adjustable range that includes 32 to 71 degrees C 90 to 160 degrees F. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 49 to 82 degrees C 120 to 180 degrees F. Hot water systems utilizing recirculation systems shall be tied into building off-hour controls. The thermal efficiencies and standby heat losses shall conform to Table III, for each type of water heater specified. The only exception is that storage water heaters and hot water storage tanks having more than 2000 L 500 gallon storage capacity need not meet the standby loss requirements if the tank surface area is insulated to R-12.5 and if a standing pilot light is not used. Plastic materials polyetherimide (PEI) and polyethersulfone (PES) are forbidden to be used for vent piping of combustion gases. A factory pre-charged expansion tank shall be installed on the cold water supply to each water heater. Expansion tanks shall be specifically designed for use on potable water systems and shall be rated for 93 degrees C 200 degrees F water temperature and 1034 kPa 150 psi working pressure. The expansion tank size and acceptance volume shall be [_____] [as indicated].

2.14.1 Automatic Storage Type

Heaters shall be complete with control system, [temperature gauge,] [and] [pressure gauge,] and shall have ASME rated combination pressure and temperature relief valve. [A phenolic resin coating shall be provided.]

2.14.1.1 Oil Fired Type

Oil fired type water heaters shall conform to UL 732. [A phenolic resin coating shall be provided.]

2.14.1.2 Gas Fired Type

NOTE: To the maximum extent possible, gas-fired
type water heaters with the new Flame-Guard safety
system should be used. Since Flame-Guard is a new
technology, limited models are available.

Gas fired water heaters shall conform to CSA/AM Z21.10.1 when input is 22 kW 75,000 Btu/hour or less or CSA/AM Z21.10.3 for heaters with input greater than 22 kW 75,000 Btu/hour. [A phenolic resin coating shall be provided.]

2.14.1.3 Electric Type

Electric type water heaters shall conform to UL 174 and have dual heating elements. Each element shall be 4.5 kW 3,000 Btu/hour. The elements shall be wired so that only one element can operate at a time. [A phenolic resin coating shall be provided.]

2.14.1.4 Indirect Heater Type

NOTE: The title of the sections covering the
applicable systems will be inserted in the blanks.

Cast-iron heads will be used in steam-to-steam or
nonfired boiler application. Bronze heads will be

used in steam-to-water application. Carbon steel heads will be used in water-to-water applications. For most applications, copper coils will be acceptable. Copper-nickel coils will be used with high pressure steam, 1.034 MPa (150 psi) or above, high temperature water, or salty water conditions.

Single wall type exchangers may be allowed if the requirements in the plumbing code are satisfied (one requirement is that the heat transfer medium is potable or recognized as safe).

Steam and high temperature hot water (HTHW) heaters with storage system shall be the assembled product of one manufacturer, and be ASME tested and "U" stamped to code requirements under ASME BPVC SEC VIII D1. The storage tank shall be as specified in paragraph HOT-WATER STORAGE TANKS. The heat exchanger shall be [double wall] [single wall] type that separates the potable water from the heat transfer medium with a space vented to the atmosphere in accordance with ICC IPC. [The coil shall be coated as specified in paragraph Water Heater, Phenolic Resin Coatings.]

a. HTHW Energy Source: The heater element shall have a working pressure of 2758 kPa 400 psig with water at a temperature of 204 degrees C 400 degrees F. The heating surface (see 6.2 and 6.8) shall be based on 0.093 square meter 1 square foot of heating surface to heat 76 L 20 gallons or more of water in 1 hour from 4 to 82 degrees C 40 to 180 degrees F using hot water at a temperature of 178 degrees C 350 degrees F. Carbon steel heads shall be used. Tubing shall conform to ASTM B 111/B 111M, Copper Alloy No. 706 (90-10 copper-nickel). Heating elements shall withstand an internal hydrostatic pressure of 4137 kPa 600 psig for not less than 15 seconds without leaking or any evidence of damage.

b. Steam Energy Source: The heater element shall have a working pressure of 1034 kPa/square meter 150 psi gauge (psig) with steam at a temperature of 185 degrees C 365 degrees F. The heating surface (see 6.2 and 6.8) shall be based on 0.093 square meter 1 square foot of heating surface to heat 76 L 20 gallons or more of water in 1 hour from 4 to 82 degrees C 40 to 180 degrees F using steam at atmospheric pressure. [Cast-iron] [bronze] heads shall be used. Tubing shall be light-drawn copper tubing conforming to ASTM B 75M ASTM B 75. Heating elements shall withstand an internal hydrostatic pressure of 1551 kPa 225 psig for not less than 15 seconds without leaking or any evidence of damage.

2.14.2 Instantaneous Water Heater

Heater shall be crossflow design with service water in the coil and [steam] [hot water] in the shell. An integral internal controller shall be provided, anticipating a change in demand so that the final temperature can be maintained under normal load conditions when used in conjunction with a [pneumatic control system] [pilot-operated temperature control system]. Normal load conditions shall be as specified by the manufacturer for the heater. Unit shall be manufactured in accordance with ASME BPVC SEC VIII D1, and shall be certified for 1034 kPa 150 psi working pressure in the shell and 1034 kPa 150 psi working pressure in the coils. Shell shall be carbon steel with copper lining. Heads shall be [cast iron] [bronze] [carbon steel plate with copper lining]. Coils shall be [copper] [copper-nickel].

Shell shall have metal sheathed fiberglass insulation, combination pressure and temperature relief valve, and thermometer. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.14.3 Phenolic Resin Coating

NOTE: If interior erosion of the tubes at or near the tube sheet is expected to be a severe problem, change the wording of this paragraph and its subparagraphs to require the coating to be applied to the first 125 to 200 mm (5 to 8 inches) inside the tubes by brushing.

The phenolic resin coating shall be applied at either the coil or coating manufacturer's factory. The coil shall be chemically cleaned to remove any scale if present and to etch the metal surface. The exposed exterior surface of the coil shall be abrasively cleaned to white metal blast in accordance with SSPC SP 5. The coating shall be a product specifically intended for use on the material the water heating coils are made of and shall be acceptable for use in potable water systems. The coating components shall be capable of withstanding temperatures up to 204 degrees C 400 degrees F dry bulb and shall meet the requirements of 21 CFR 175. The entire exterior surface and the first 125 to 200 mm 5 to 8 inches inside the tubes of each coil shall be coated with the three-component phenolic resin coating system. The system shall consist of the following: the wash primer, the pigmented base coat, and the clear top coat. Immediate and final cure times and temperatures shall be as recommended by the coating manufacturer.

2.14.3.1 Coating Coil Interiors

One coat of the wash primer component shall be applied by brushing or flooding. Two coats of the pigmented base component shall be applied by brushing, immersion, or flooding. Two coats of the clear top (non-pigmented) component shall be applied by brushing, immersion, or flooding, with exception of the final coat which may be applied by spraying.

2.14.3.2 Coating Coil Exteriors

One coat of the wash primer component shall be applied by flooding. Two coats of the pigmented base component shall be applied by immersion or flooding. Two coats of the clear top (non-pigmented) component shall be applied by immersion or flooding, with exception of the final coat which may be applied by spraying.

2.14.3.3 Coating Components

a. Wash Primer. The wash primer component shall be composed of a combination of a polyvinyl butyral and a heat hardening phenolic resin. The weight per L gallon shall be between 0.84 kg/L 7.0 lbs/gallon minimum and 0.89 kg/L 7.4 lbs/gallon maximum.

b. Pigmented Base. The pigmented base component shall be applied to a dry film thickness of 0.102 to 0.152 mm 0.004 to 0.006 inch. The pigmented base shall consist of heat hardening phenolic resins, suitable pigments of the earth type, and softening agents and shall not contain drying oils or cellulose material. The weight shall be between

1.2 kg/L 10.3 lbs/gallon minimum and 1.3 kg/L 10.7 lbs/gallon maximum. The non-volatile solids content shall be between 60 percent minimum and 64 percent maximum by weight.

c. Clear Top. The clear top (non-pigmented) component shall be applied until the dry film thickness of the total coating system is between 0.127 and 0.178 mm 0.005 and 0.007 inch. The clear non-pigmented top coat shall have a weight of between 1.0 kg/L 8.65 lbs/gallon minimum and 1.1 kg/L 8.95 lbs/gallon maximum. The non-volatile solids content shall be between 48 percent minimum and 52 percent maximum by weight.

2.15 HOT WATER STORAGE TANKS

Hot water storage tanks shall be the construction of one manufacturer, ASME stamped for the working pressure, and shall have the National Board (ASME) registration. The tank shall be cement-lined or glass-lined steel type in accordance with AWWA D100. The heat loss shall conform to Table III, as determined by the requirements of ASHRAE 90.1 - SI ASHRAE 90.1 - IP. Storage tank capacity shall be as shown. Tanks shall be equipped with a pressure gauge 155 mm 6 inch minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.16 PUMPS

NOTE: Designer will indicate location, sizes, horsepower, and capacities of equipment on drawings. Provide duplex pumps if discharge capacity is greater than 94.6 liters per min. (25 gpm) and total head is at least 6 meters (20 feet).

2.16.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. Each pump shall be directly connected by an approved flexible coupling to a vertical electric motor having a continuous oiling device or packed bearings sealed against dirt and moisture. Motors shall be totally enclosed, fan-cooled of sizes as indicated and each shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type [1] [4] enclosure. Each pump shall be fitted with a high grade thrust bearing mounted above the floor. Each shaft shall have an alignment bearing at each end, and the suction inlet shall be between 75 and 150 mm 3 and 6 inches above the sump bottom. The suction side of each pump shall have a strainer of ample capacity. A float switch assembly, with the switch completely enclosed in a NEMA 250, Type [1] [4] enclosure, shall start and stop each motor at predetermined water levels. Duplex pumps shall be equipped with an automatic alternator to change the lead operation from one pump to the other, and for starting the second pump if the flow exceeds the capacity of the first pump. The discharge line from each pump shall be provided with a union or flange, a nonclog swing check valve, and a stop valve in an accessible location near the pump.

2.16.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single

stage, centrifugal, mechanical seals, suitable for the intended service. Pump capacities, efficiencies, motor sizes, speeds, and impeller types shall be as shown. Pump and motor shall be [integrally mounted on a cast-iron or steel subbase,] [close-coupled with an overhung impeller,] [or] [supported by the piping on which it is installed]. The shaft shall be one piece, heat-treated, corrosion-resisting steel with impeller and smooth surfaced housing of bronze. Motor shall be totally enclosed, fan-cooled and shall have sufficient wattage horsepower for the service required. Pump shall be hydraulically balanced. Each pump motor shall be provided with enclosed, across-the-line type, magnetic controller complete in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than 746 W Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

2.16.3 Booster Pumps

Horizontal split-case centrifugal-type booster pumps shall be furnished. The capacities shall be as shown, and the speed shall not exceed 1800 rpm. Pumps shall have a casing of close-grained iron or steel with smooth water passages. A gasket shall be provided between the upper and lower halves of the casing. Suction and discharge connections shall be flanged. Impellers shall be nonoverloading, bronze, balanced to eliminate vibration, and shall be keyed to corrosion-resisting steel shafts. The casings shall be fitted with bronze bearing or sealing rings. Bearings shall be cartridge type, enabling the entire rotating element to be removed without disturbing alignment or exposing the bearings to dirt, water, and other foreign matter. Pumps shall be provided with mechanical seals. Seal boxes shall be machined in the pump casing and at both sides of the pump, and shall be of sufficient depth to include a conventional bronze seal ring and rows of shaft packing. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole. Bedplates shall be close-grain cast iron or steel with ribs and lugs, complete with foundation bolts, and shall have a drip lip with drain hole.

2.16.3.1 Testing

Each pump shall be tested at the manufacturer's plant for operating characteristics at the rated capacity and under specified operating conditions. Test curves shall be furnished showing capacity in L/second gpm, head in meters feet, efficiency, brake wattage horsepower, and operation in parallel with similar pumps. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. The electric motor shall be of a size that will not be overloaded when operating at any point along the characteristic curve of the pump. Guards shall shield exposed moving parts.

2.16.3.2 Controls

Each pump motor shall be provided with enclosed across-the-line type, magnetic controller complete in a NEMA 250, Type 1 enclosure with three-position, "HAND-OFF-AUTOMATIC," selector switch in cover. Pumps shall be automatically started and stopped by float or pressure switches, as indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously, with a third pump being standby.

2.16.4 Flexible Connectors

NOTE: Flexible connectors shall be provided for the suction and discharge of each centrifugal pump only as a solution to alignment problems to accommodate retrofits and/or for fluid media temperatures in excess of 82 degrees C (180 degrees F).

Flexible connectors shall be provided at the suction and discharge of each pump that is 0.75 kW 1 hp or larger. Connectors shall be constructed of neoprene, rubber, or braided bronze, with class 150 standard flanges. Flexible connectors shall be line size and suitable for the pressure and temperature of the intended service.

2.17 WATER PRESSURE BOOSTER SYSTEM

NOTE: Designer will indicate location, sizes, wattage (horsepower), and capacities of equipment on drawings. Provide duplex pumps, if discharge capacity is greater than 94.6 L/minute (25 gpm) and total head is at least 6 meters (20 feet).

One of the following systems shall be used to boost the water pressure service to the building to a value required for service within the building.

2.17.1 Constant Speed Pumping System

NOTE: In the design of buildings which experience periods of low water flow or no water flow, do not install constant speed water pressure booster systems, since this is a waste of electrical energy.

Constant speed pumping system with pressure regulating valves shall employ one lead pump for low flows, and one or more lag pumps for higher flows. Pressure regulating valves shall be provided with nonslam check feature. The factory prepiped and prewired assembly shall be mounted on a steel frame complete with pumps, motors and automatic controls. The system capacity and capacity of individual pumps shall be as indicated. Current sensing relays shall provide staging of the pumps. The pumps shall be protected from thermal buildup, when running at no-flow, by a common thermal relief valve. Pressure gauges shall be mounted on the suction and discharge headers. The control panel shall bear the UL listing label for industrial control panels and shall be in a NEMA 250, Type 1 enclosure. The control panel shall include the following: No-flow shutdown; 7-day time clock; audio-visual alarm; external resets; manual alternation; magnetic motor controllers; time delays; transformer; current relays; "HAND-OFF-AUTOMATIC" switches for each pump; minimum run timers; low suction pressure cutout; and indicating lights for power on, individual motor overload, and low suction pressure. The control circuit shall be interlocked so that failure of any controller shall energize the succeeding controller.

2.17.2 Hydro-Pneumatic Water Pressure System

In addition to constant speed pumping system described above, an ASME code constructed tank stamped for 862 kPa 125 psig water working pressure shall be provided. Tank shall have a flexible diaphragm made of material conforming to the Food and Drug Administration requirements for use with potable water. Tank shall be factory precharged to meet required system pressure.

2.17.3 Variable Speed Pumping System

Variable speed pumping system shall provide system pressure by varying speed and number of operating pumps. The factory prepiped and prewired assembly shall be mounted on a steel frame complete with pumps, variable speed drives, motors, and controls. The variable speed drives shall be the variable frequency type capable of power transmission throughout their complete speed range without vibration, noise, or shock loading. Each variable speed drive shall be run-tested by the manufacturer for rated performance, and the manufacturer shall furnish written performance certification. System shall have suppressors to prevent noise transmission over electric feed lines. Required electrical control circuitry and system function sensors shall be supplied by the variable speed manufacturer. The primary power controls and magnetic motor controllers shall be installed in [the controls supplied by the drive manufacturer] [the motor control center]. The sensors shall be located in the system to control drive speed as a function of [constant pump discharge pressure] [constant system pressure at location indicated]. Connection between the sensors and the variable speed drive controls shall be accomplished with [hydraulic sensing lines] [copper wiring] [telemetry]. Controls shall be in NEMA 250, Type 1 enclosures.

2.18 COMPRESSED AIR SYSTEM

2.18.1 Air Compressors

Air compressors shall conform to ASME B19.3. Medical (oil-free air) compressor installation shall conform to NFPA 99. Air compressor unit shall be a factory packaged assembly, including [_____] -phase, [_____] volts motor controls, switches, wiring, accessories, and motor controllers, in a UL listed NEMA 250, Type [1] [4] enclosure. Tank-mounted air compressors shall be manufactured to comply with UL listing requirements. Air compressors shall have manufacturer's name and address, together with trade name and catalog number, on a nameplate securely attached to the equipment. Each compressor shall [start and stop automatically at upper and lower pressure limits of the system] [regulate pressure by constant speed compressor loading and unloading] [have a "manual-off-automatic" switch that, when in the manual position, the compressor loads and unloads to meet the demand and, in the automatic position, a time delay relay allows the compressor to operate for an adjustable length of time unloaded, then stops the unit]. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with [automatic alternation system] [manual alternation system]. Each compressor motor shall be provided with an across-the-line type magnetic controller, complete with low-voltage release. An intake air filter and silencer shall be provided with each compressor. Aftercooler and moisture separator shall be installed between compressors and air receivers, to remove moisture and oil condensate before the air enters the receiver. Aftercoolers shall be either air or water cooled, as indicated. The air shall pass through a sufficient number of tubes to affect cooling. Tubes shall be sized to give

maximum heat transfer. Water to unit shall be controlled by a solenoid or pneumatic valve, which opens when the compressors start and closes when the compressors shut down. Cooling capacity of the aftercooler shall be sized for the total capacity of the compressors. Means shall be provided for draining condensed moisture from the receiver by an automatic float type trap. Capacities of air compressors and receivers shall be as indicated.

2.18.2 Medical Compressed Air (Oil-Free Type) Compressors

NOTE: Oil-free air is required for dental operatories and operating, delivery, and recovery rooms. Multiple compressors of the 6 to 7.5 kW (7-1/2 to 10 horsepower) range are suggested, in lieu of the larger power range of 15 kW (20 horsepower) or greater to provide more flexibility. Generally, the pressures required at the installed equipment or point of usage are as follows: Dental operatories, 552 kPa (80 psig); operating, delivery, and recovery rooms, 345 kPa (50 psig); laboratory deck or counter-mounted service fixtures, 207 kPa (30 psig). Reciprocating type air compressors should be avoided, except in foreign or desert applications. Delete references to this type of compressor where not utilized. Refer to ETL 1110-3-379 dated 30 November 1987 for requirements for compressed air and vacuum systems for dental facilities.

Compressors shall have the capacity indicated. Compressor shall be [centrifugal] [or] [liquid-sealed rotary type] [or] [reciprocating teflon-ring type designed so that no oil is administered to the air cylinder, the portion of the piston rod that travels in the crankcase section does not travel in any portion of the air-cylinder section, and with provision to prevent the flow of lubrication oil along the piston rod into the air-cylinder section]. A pressure gauge calibrated to 2068 kPa 300 psi, and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to the pressure switch. The motor and compressors shall be directly connected or operated by V-belt drive. Compressors shall be sequenced to start automatically when the pressure drops to a preset point. Compressors shall be [air] [water] cooled.

2.18.3 Oil-Free Type Compressors

NOTE: Where a suitable compressing station is shown for delivering air to laundries, prosthetic laboratories, and linen-repair rooms; in addition to the shops, a duplicate compressor will be required for compressing and delivering air. Non-oil-free type compressors are required for delivery of air to prosthetic laboratories and laundry, at 586 kPa (85 psig), linen repair at 552 kPa (80 psig), and general laboratories and shops at 207 kPa (30 psig).

Compressors shall be two-stage, V-belt drive, capable of operating continuously against their designed discharge pressure, and shall operate

at a speed not in excess of 1800 rpm. Compressors shall have the capacity and discharge pressure indicated. Compressors shall be assembled complete on a common subbase. The compressor main bearings shall be either roller or ball. The discharge passage of the high pressure air shall be piped to the air receiver with a copper pipe or tubing. A pressure gauge calibrated to 1034 kPa 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

2.18.4 Air Receivers

Separate air receivers delivering air to dental operatories, operating, delivery, and recovery rooms shall be designed for 862 kPa 125 psi working pressure. All other receivers shall be designed for 1378 kPa 200 psi working pressure. Receivers shall be factory air tested to 1.5 times the working pressure. Receivers shall be equipped with safety relief valves and accessories, including pressure gauges and automatic and manual drains. The outside of air receivers may be galvanized or supplied with commercial enamel finish. Receivers shall be designed and constructed in accordance with ASME BPVC SEC VIII D1, and shall have the design working pressures specified. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.18.5 Air Dryers

NOTE: Designer will check TM 5-810-4 for air dryer
specification information.

An air dryer shall be provided in the air supply system to medical and dental functions. The dryers shall be installed on the downstream side of the receiver. The dryer shall be designed to provide air at a maximum dewpoint that is below 0 degrees C 32 degrees F at any level of demand with entering air at 38 degrees C 100 degrees F saturated. The compressed air dryer shall be of the refrigerated type.

2.18.6 Intake Air Supply Filter

NOTE: Designer will indicate location and
capacities of the air filters on the drawings.
Specially filtered air should be provided for all
locations, except laundries and garages, unless
otherwise designated by the Office of the Surgeon
General.

Dry type air filter shall be provided having a collection efficiency of 99 percent of particles larger than 10 micrometers. Filter body and media shall withstand a maximum 862 kPa 125 psi capacity as indicated.

2.18.7 Discharge Air Supply Filter

A high-efficiency type micro-coalescer filter shall be provided on the discharge air line of medical-compressed-air compressors to limit particle size to a maximum of 2 micrometers.

2.18.8 Pressure Regulators

The air system shall be provided with the necessary regulator valves to maintain the desired pressure for the installed equipment. Regulators shall be designed for a maximum inlet pressure of 862 kPa 125 psi and a maximum temperature of 93 degrees C 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim, and threaded connections. The regulator valve shall include a pressure gauge and shall be provided with an adjustment screw for adjusting the pressure differential from 0 to 862 kPa 0 to 125 psig. Regulator shall be sized as indicated.

2.18.9 Dewpoint Meter

A dewpoint meter shall be provided to continuously monitor the dewpoint of the medical air. Meter shall meet requirements of NFPA 99.

2.18.10 Carbon Monoxide Sensor

A carbon monoxide sensor shall be provided to continuously monitor the medical air for carbon monoxide, and shall actuate a local alarm if the carbon monoxide level is 10 ppm or higher.

2.19 VACUUM PUMPS AND RECEIVER

Vacuum pumps in duplicate and one receiver shall be provided. The capacities of the pumps and receiver shall be as indicated. The pumps shall be single-stage, positive displacement, nonpulsating, liquid-sealed or oil-lubricated sliding vane rotary type, designed for vacuum service. Fluids shall be capable of passing directly through each pump to waste. Each pump shall be provided with a motor, discharge separator-silencer, seal water line strainers, flow control valves, and antisiphon fittings. A control panel to contain the vacuum gauge, vacuum "LEAD" and "LAG" switches, manual transfer switch to alternate the lead vacuum pump, and magnetic motor controllers and wiring shall be provided. Gauges and manual operation switches shall be mounted through the panel door. The receiver shall be designed to operate at 64 to 85 kPa 19 to 25 inches of mercury vacuum, but shall be tested at 95 kPa 28 inches of mercury vacuum. Interior of the receiver shall be galvanized and the exterior may be galvanized or supplied with commercial standard enamel. Guards shall shield exposed moving parts. A three position "hand-off-automatic" selector switch shall be provided for each motor. Cooling water shall be served from a partial water recirculating system containing a water recirculation reservoir with liquid level gauge, water metering valve, manual fill valve, strainers and solenoid valve, air gap, aquastats, and isolation valves. System shall conform to NFPA 99.

2.20 MEDICAL GAS SYSTEMS

NOTE: References to nitrous oxide will be deleted, if use of nitrous oxide is not required. Bulk storage of oxygen and nitrous oxide will be specified for hospitals of 200 beds or more, or where consumption is estimated to exceed 1,000 cu. meters (35,000 cubic feet) per month in areas where bulk-storage service is available. Bulk oxygen systems will conform to the requirements of both NFPA 55 and NFPA 99. If bulk storage systems are

required, the paragraphs will be revised accordingly. A paved and fenced area should be provided with sufficient space for easy entrance of trailers and trucks and having the following dimensions: For hospitals with less than 500 bed capacity, 5 x 5 meters (16 x 16 feet); for 500 bed capacity, 5 x 7 meters (16 x 22 feet); for 750 and 1,000 bed capacity, 6 by 9 meters (20 by 30 feet). Storage area should be located near a good road and should be surfaced with a concrete mat. Precautions should be taken in selecting a site away from oil tanks; sources of intense heat, such as furnaces and boilers; and away from areas under medium-voltage electric wires. The storage area should be enclosed by chain-link fence 2 meters (6 feet) in height, with double gates of suitable dimensions provided with stop and lock. Manifold regulating and control equipment should be provided by the medical gas supplier. Piping should be underground and conform to TABLE II. Piping should terminate with capped ends suitably protected and easily accessible at a corner of the paved bulk-storage area. Wiring for the alarm system should be installed underground and extended to the corner where the medical gas piping terminates. Floodlights should be provided for the storage area.

Medical gas systems comprising medical and dental compressed air, nitrous oxide, oxygen and nitrogen systems shall conform to NFPA 99. The systems shall not be used for the distribution of combustible anesthetic gases. Higher-than-use pressures as indicated shall be used in hospitals for distribution of medical gas systems, with reduction valves contained in shutoff valve boxes after the zone shutoff valves. Systems shall be of the bulk primary source type with cylinder primary systems utilized only as indicated.

2.20.1 Valves

Valves shall be brass-bodied, packless, diaphragm type with renewable seats and discs, or ball type capable of being disassembled in line for servicing the O-ring and seating surface. The valves shall be suitable for cold nonshock gas working pressure of not less than 2757 kPa 400 psi. Service control shutoff valves shall be installed in recessed satin finished stainless steel wall cabinets and shall have color-coded service indication on valves and valve handles. Cabinets shall be identified by means of engraved plastic nameplates.

2.20.2 Manifold

Manifolds shall conform to requirements of NFPA 99 as to design features and pressure requirements. The manifold shall be designed so that when the switchover from the primary service to the reserve supply occurs, there will be no drop or fluctuation in the line pressure. The control cabinet shall have a visual signal to indicate switchover from the primary service to the reserve supply. Resetting of the control unit shall be accomplished automatically. The manifold shall be provided with a bronze-bodied poppet-type pressure-relief adjusted to relieve at 50 percent above maximum working pressure. The manifold shall be equipped with an approved pressure

switch for actuating a warning signal when, or before, the reserve bank goes into operation. For cylinder supply systems, manifold capacity shall be as indicated and control valve shall be contained within a cabinet designed to prevent tampering by unauthorized personnel. One bank of cylinders shall be in service while the other bank is in reserve. Each bank shall be equipped with a master manifold regulator and a gauge for 28 MPa 4,000 psi or greater cylinder-contents pressure. The manifold shall be completely automatic in switching from the empty bank of cylinders to the reserve, or full bank of cylinders, and shall not require resetting of the regulators.

2.21 ALARM PANELS FOR MEDICAL GAS AND VACUUM SYSTEMS

NOTE: For Air Force facilities the emergency room area (nurses station or control desk) will have a central alarm panel. Other appropriate locations, when approved by the Air Force, are the plant manager's office and the office/work station of the inhouse engineer. Local alarm panels for Air Force facilities will be located at each nursing ward nurses station, major clinical control desks, nurseries, and other areas when specifically designated. Where central supervisory control panels exist on Air Force facilities, central alarm systems will be connected to the panel.

Alarm panels for medical gas and vacuum systems shall be located as specified and indicated. Each signal and gauge shall be appropriately labeled "OPERATING" and "EMERGENCY." Each gauge and device shall be clearly identified by means of engraved plastic nameplates. Alarms and pressure gauges shall be installed for each medical gas system in accordance with NFPA 99 and as specified. Alarms and gauges shall be provided as specified for vacuum, anesthesia, and oral evacuation systems. Alarm system shall be in a NEMA 250, Type [1] [4] [12] enclosure. Signal systems shall be energized by the normal and emergency power systems.

2.21.1 Central and Local, Medical Gas and Vacuum Alarm Panels

Central and local recessed mounted wall panel stations shall be provided for the medical gas and vacuum services specified. The central panels shall be located as indicated. Supplemental central panels shall be located in the Control Room of the Heating Plant and Telephone Switchboard Room or as indicated. Local panels shall be located adjacent to nurses stations, control stations, or as indicated. Each panel shall contain signal lights, buzzer, silencing push button, test push button, and gauges, suitably identified. Signal lights shall be red and shall be wired to indicate the following:

Oxygen Liquid Low	Notify A&D
Oxygen Reserve in Use	Notify A&D
Oxygen Reserve Low	Notify A&D
Oxygen Line Pressure	High/Low
Nitrous Oxide Reserve in Use	Notify A&D

Nitrous Oxide Reserve Low	Notify A&D
Nitrous Oxide Line Pressure	High/Low
HP Nitrogen Reserve in Use	Notify A&D
HP Nitrogen Reserve Low	Notify A&D
HP Nitrogen Line Pressure	High/Low
Medical Air Dew Point	High
Instrument Air Dew Point	High
Medical Air Line Pressure	High/Low
Dental Air Line Pressure	High/Low
Medical Vacuum Line	Low Vacuum
Anesthesia and Oral Evacuation Vacuum Line	Low Vacuum

One green light per panel shall be provided to indicate that all medical gas systems are normal. Medical vacuum alarm shall be actuated when the vacuum drops to 51 kPa 15 inches of mercury vacuum. Anesthesia and oral evacuation vacuum system alarms shall be actuated when the vacuum drops below 27 kPa 8 inches of mercury vacuum. Anesthesia evacuation active type systems utilizing vacuum pumps shall be provided with an alarm system; passive type systems that utilize room heating, ventilating, and air conditioning exhaust systems do not require an alarm system. Medical gas high/low pressure alarms shall be actuated when the line pressure reaches approximately 20 percent above or below normal operating pressure. Medical air dew point alarm shall be actuated by each compressor site to indicate when the line pressure dew point is greater than 4 degrees C 39 degrees F. Instrument air dew point alarm shall be actuated from each compressor site to indicate when the line pressure dew point is greater than -30 degrees C -22 degrees F. Alarms shall be activated by the pressure of the line being monitored. A buzzer shall sound upon actuation of any alarm signal. The buzzer shall be provided with a reset relay that shall shut off only the buzzer and not affect the signal light, until the condition is corrected. The buzzer shall sound again upon actuation of any additional alarm.

2.21.2 Life Support System, Medical Gas and Vacuum Alarm Panels

Recessed wall panel stations, located at Operating Rooms, Delivery Rooms, Intensive Care Units, Coronary Care units, and nurse/central stations shall be provided for all life support medical gas services in each area as indicated. Each panel shall contain signal lights, buzzer, silencing pushbutton, and pressure indicating gauges. Signal lights shall be red and shall be wired indicating the following:

Oxygen Line Pressure	High/Low
Nitrous Oxide Line Pressure	High/Low
Nitrogen Line Pressure	High/Low

Medical Air Line Pressure	Low
Medical Vacuum Line	Low Vacuum
Anesthesia and Oral Evacuation	Low Vacuum

One green light per panel shall be provided to indicate that all medical gas systems are normal. Medical vacuum alarm shall be actuated when the vacuum drops to **34 kPa 10 inches of mercury** vacuum line. Anesthesia and oral evacuation vacuum alarms shall be actuated when the line pressure drops below **27 kPa 8 inches of mercury** vacuum. Medical gas high/low pressure alarms shall be actuated when the line pressure reaches approximately 20 percent above or below normal operating pressure. Alarms shall be activated by the pressure in the line being monitored. A buzzer shall sound upon actuation of any alarm signal. The buzzer shall be provided with a reset relay that shall shut off only the buzzer and not affect the signal light, until the condition is corrected. The buzzer shall sound again upon actuation of any additional alarm. The buzzer shall be capable of being silenced only at the station. Alarm panels shall be provided in each nursing unit on a wing/ward basis as indicated, but these panels shall not include nitrous oxide, nitrogen, nor anesthesia and oral evacuation vacuum alarms, unless specifically indicated.

2.22 SURGICAL DISPENSERS FOR MEDICAL GAS AND VACUUM SYSTEMS

2.22.1 Station Outlets

NOTE: The type of connectors at station outlets will be as specified by the using service. This is required to ensure that the connectors provided are compatible with those on Government-furnished mobile apparatus.

Station outlets for concealed piping shall be made of brass and shall have an adjustable valve mechanism to compensate for variation in plaster thickness. Each unit shall be securely mounted and self-sealing, and shall conform to **NFPA 99** for medical gas and vacuum outlets. Outlets as an assembly shall conform to the requirements of the Underwriters Laboratories Inc., and the Contractor shall submit proof of such conformance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, the Contractor may submit a written certificate from any approved nationally recognized testing organization adequately equipped and competent to perform such services, including the follow-up service, stating that the item has been tested and conforms to the requirements, including method of testing, of the specified agency. Station outlets shall be equipped with noninterchangeable quick disconnect coupler, except for nitrogen which shall be equipped with DISS connections as assigned for medical gas and vacuum systems in **CGA V-5**, except that inlets for the anesthesia evacuation system shall be **22 mm 7/8 inch** nonthreaded connections.

2.22.1.1 Couplers

Where quick-type couplers are furnished they shall be of the noninterchangeable type. Connector shall lock firmly into position and shall have a finger-type quick release.

2.22.1.2 Cover Plates

Cover plates shall be 1.5875 mm 16 gauge polished chromium-plated metal or 0.7950 mm 22 gauge satin-finish stainless steel secured with chromium-plated countersunk screws.

2.22.2 Operating and Delivery Room Outlets and Wall Outlets

Station outlets shall be of the [overhead] [pedestal] [recessed hose-reel] [flush ceiling with hose drop with check valve assembly] [ceiling flush mounted track] [recessed wall] type. Exposed brass flange, pedestal, and couplers shall be polished chromium-plated brass or combination of brass and approved plastic. Details for mounting shall be submitted for approval. [The recessed hose-reel type shall be installed in a cadmium- or zinc-plated steel housing and shall be provided with a stainless steel faceplate. The reel shall be capable of retracting a minimum of 4 meters 12 feet of conductive, color-coded type hose. The entire assembly, except for the stainless steel faceplate, shall not project below the furred-down ceiling. The faceplate shall have a No. 4 finish and shall be provided with polytetrafluoroethylene grommets to reduce hose wear. Connections feeding the reel shall be fail-safe, swivel joints, leakproof and frictionless. Reel springs shall be of a first quality spring steel. Hoses shall terminate in a male threaded or female quick-connect coupler with automatic shutoff or disconnect.] [The flush ceiling type hose drop shall consist of a flush ceiling outlet equipped with a male connection. The conductive, color-coded hose shall be 1.2 meters 4 feet in length, shall attach to the outlet coupler with a female threaded connection and shall end in a male threaded or female quick connect coupler with automatic shutoff.] [The recessed wall type shall be as previously specified, installed within a cadmium-plated or zinc-plated steel housing, and provided with a satin finish stainless steel faceplate. The female member of a quick-coupler shall be accessible through the faceplate for connection of the male coupler adapter.]

2.22.3 Service-Control Valve Cabinets

Service-control valve cabinets shall be constructed of corrosion-resisting steel having a minimum nominal 1.214 mm 18 gauge thickness. Cover shall be continuously hinged with magnetic or snap locks, and shall have a satin finish. Laminated plastic nameplates shall be provided. Cabinets shall house zone-control valves, pressure reducing valves, service control valves, and alarm system sensors.

2.23 ORAL EVACUATION SYSTEM FOR DENTAL OPERATORIES

NOTE: Type of system to be used as described in paragraphs "High-Volume Oral Evacuation System (HVE)," "High Vacuum Oral Evacuation System (HIVAC)," "High Volume Evacuation System (HVEL)," and "Environmental-Janitorial Vacuum System (EJVS)" will be determined by users; inapplicable type will be deleted. Also, delete reference to nonused system in Part 3. For equipment intended specifically for installations outside of the Continental United States (overseas bases), the vacuum-source drive-motor frequency and voltage requirements of this specification should be changed to ensure compatibility with onsite electrical

supply configurations. Such modifications will not detract from equipment longevity or performance.

2.23.1 High-Volume Oral Evacuation System (HVE)

The central HVE system shall be composed of standard manufactured products, complete with devices normally furnished and devices required herein. The central HVE system shall be supplied by an established manufacturer of commercially available, industrial quality vacuum system, as a complete system. The HVE shall be essentially a wet system, composed of two vacuum turbines, each of which shall be sized to support the full HVE requirement. The turbines shall be connected in parallel to the central wet separator tanks.

2.23.1.1 Vacuum Turbines

NOTE: Vacuum turbine units should be specified for dental operatories or clinics having six or more chairs. For operatories and small dental clinics having only three to five chairs, water ring type vacuum pump may be specified.

Turbines shall be self-governing, multistage, centrifugal type, of overhung or outboard design. The vacuum producer shall operate at a speed not to exceed 3,600 rpm and shall be connected to its driving motor by a flexible coupling. Bearings may be sealed or of the lubricatable type. A fan shall be connected directly to the vacuum producer shaft adjacent to vacuum producer shaft bearings to create a flow of ambient air over the bearing carrier while the unit is operating. A steel coupling guard encompassing the flexible coupling shall be installed between the motor and vacuum producer. Cases shall be cylindrical in design. Cases and end plates (inlet and exhaust heads included) shall be constructed of either heavy-gauge sheet steel rigidly welded at seams and sections, or of cast grey iron. Sheet steel end plates shall be either concave or convex. Inlet and exhaust connections shall be tangential to the vacuum producer except the inlet connection can be axial to vacuum producer and sized to allow free air movement through the vacuum producer, without flow restriction and shall have class 150 flanges. The vacuum producer input shall have an adjustable volume control valve, a directional flow valve and antisurge valve. The vacuum producer output shall have an exhaust silencer. Plumbing shall be connected to the vacuum producer through flexible sleeve connectors. Internal moving parts shall be constructed with not less than 3.2 mm 0.125 inch clearance throughout to prevent damage by transient particulates. Impellers shall be constructed of fabricated sheet metal or high-tensile aluminum alloy, smooth on all surfaces to prevent imbalance by uneven dust deposits. Impellers shall be of the backward curved or radial design to provide optimal performance over a wide range of volume requirements. Impellers shall be securely attached to the vacuum producer shaft by set screws or clamps of high-tensile material. Each impeller shall be individually balanced. The complete assembly, with motor, shall not exceed 0.038 mm 1.5 mils of vibration when given a running test. Power to operate the vacuum producer shall be in direct proportion to the volume of air exhausted and shall not exceed the normal motor rating. The vacuum produced shall be substantially constant throughout the operating range of the vacuum producer. Each vacuum producer shall have a minimum capacity, rated in scfm at standard conditions: 101 kPa 14.7 psig

and 21 degrees C 70 degrees F of [_____] standard cu. m per sec scfm exhaust at [_____] kPa inch Hg vacuum. The vacuum producer shall be sized to produce the above designated performance standards at the above-sea-level elevation of the proposed installation site, and shall be so certified by the manufacturer by equipment tag or plate, or by letter of certification identifying the vacuum producer by serial number. The motor for the vacuum producer shall be of a standard NEMA MG 1, 3450 rpm, T-frame, dripproof design [_____] Vac, 60 Hz, [_____] phase with either sealed or lubricatable bearings. Operating temperature rise of the motor shall not exceed 22 degrees C 72 degrees F. Each vacuum producer assembly shall be mounted on resilient isolator pads as recommended by the manufacturer. The pads shall not be fastened to the facility floor. Vibration transmission shall be limited to less than 5 percent of the lowest frequency of vibration.

2.23.1.2 Pipe Isolators

Flexible, resilient band-sealed (clamped) sleeves shall be furnished to isolate the vacuum producer from associated piping. Sleeve couplings shall be sized in accordance with the exhauster intake and output connections. Pipe isolators shall be provided with steel coupling guards.

2.23.1.3 Valves

a. Volume Control Valve: The input of each vacuum producer shall have an adjustable air volume control valve to prevent accidental vacuum producer overload and to provide a means of adjusting the upper design capacity limit. The volume control valve shall be built in or immediately adjacent to the first or input stage of the vacuum producer and shall be preset by the manufacturer during certification procedure. The valve shall be a butterfly type with cast iron body with corrosive resistant internals.

b. Antisurge Valve: The input of each vacuum producer shall have an antisurge valve that will operate proportionally and automatically throughout the vacuum producer's designed range. This valve shall continually sense the motor current and maintain a predetermined operational level of volume by proportionally bleeding air into the system. The valve shall be equipped with a silencer to attenuate air noise to 85 dB or below. The valve shall be installed in, on, or near the first stage of the vacuum producer and can be mounted in conjunction with the directional flow valve.

c. Directional Flow Valve: The input of each vacuum producer shall have a directional flow valve to prevent back flow of air through the shutdown. The directional flow valve shall be cast iron with corrosive resistant internals.

2.23.1.4 Exhaust Silencer

Each vacuum producer shall exhaust to a separate air discharge silencer of the open-bore expansion type. No interior baffling or shrouding will be permitted. The silencer shall satisfactorily attenuate air noise to a level below 85 dB.

2.23.1.5 Controls

The main electric control panel for the system shall consist of the following: combination across-the-line magnetic starters with time-delay

fused disconnects, running-hour meters to indicate the number of hours each vacuum producer has been in operation, a manual and automatic alternator to control starting sequence of the vacuum producers on-off-auto selector switch for each vacuum producer, automatic start of standby vacuum producer on system demand, a certified vacuum gauge (kPa inch Hg), red or amber warning lights with audible alarm to indicate shutdown due to fuse failure, and separator tank washdown system timers. Controls shall include a complete low-voltage (24 volts ac) control function with a low-voltage control panel for remote operation and monitoring of the vacuum producers. The remote panel location shall be as shown. The low voltage remote control panel shall contain on-off switch for operation of the vacuum producers, pilot lights to indicate operation, and a certified vacuum gauge (kPa inch Hg) to indicate the vacuum within the system at all times.

2.23.1.6 Central Wet Separators

The HVE system shall utilize a central wet separator. Separator tanks shall be constructed of a nonmetallic, noncorrosive, inert material or composite such as glass-reinforced plastic (GRP). Tanks shall be of one-piece construction, with smooth, interior walls. Tanks shall be freestanding. [One tank] [Two tanks] shall be provided with each tank having a capacity of [_____] liters gallons. Tanks shall be high-pressure vessels able to withstand a constant negative pressure of 51 kPa 5 inch Hg. The tops of the tanks may be convex or concave. The bottom of the tanks shall be convex with drain at the apex of convexity. The inlet shall be tangential to effect a cyclonic separation of air, water and waste. Separator tanks shall be equipped with mechanical overflow protection, which shall be preplumbed with a 360 degree nozzle internal washdown system with timer. The washdown system shall include a 115 volt ac automatic-flush clock-controlled mechanism which shall effect a complete washdown of the interior of the separator at any predetermined time of day or night. Washdown time shall be adjustable for up to at least 3 minutes. The timers shall be in the main electric control panel. The cold water supply to the automatic tank flush unit shall be equipped with an in-line filter with 40-mesh stainless steel screens. Filter shall be supplied as part of the HVE system. Each separator tank shall be equipped with an electronic high-low liquid level sensor which shall perform as the primary overflow protector. In multiple-tank installations, one tank shall be adjusted to sense 90 percent of its capacity and the other tank 100 percent of its capacity via the liquid-level sensing devices. Each sensor shall control a 115 volt ac electrically operated output air solenoid valve located to control the outgoing air from the tank to the vacuum producer. Each tank shall be equipped with a gate and swing type check valve at the bottom drain. With negative pressure in the tank, the check valve shall remain closed to maintain vacuum. When negative pressure ceases, either by vacuum producer shutdown or by closure of the outgoing air solenoid control by the liquid level sensor, the check valve shall open and the tank shall undergo gravity drain.

2.23.1.7 Piping

Vacuum pipes shall be of corrosion-resistant material, shall have a smooth internal surface, and shall not collapse when installed in an HVE system evacuated to 41 kPa 12 inch Hg gauge. Piping shall be cut square, with burrs removed, and installed with minimum obstruction to airflow. Vacuum pipe shall be acrylonitrile-butadiene-styrene (ABS) conforming to ASTM D 1527 or polyvinyl chloride (PVC) conforming to ASTM D 1785. Solvent cement for ABS plastic pipe fittings shall conform to ASTM D 2235. PVC plastic pipe fittings shall conform to ASTM D 2466, and solvent cement

shall conform to ASTM D 2564 (DWV fittings for vacuum piping shall conform to ASTM F 1866). Fittings, supports, and joint assembly shall comply with ICC IPC. The assembled piping system shall be suitable for [] kPa inch Hg vacuum service. Fittings shall be the long-radius type for turns and the wye type for branches. Vacuum piping shall slope not less than 10.0 mm per meter 0.12 inch/foot to the separator tanks. The most distant end of each trunk line from the separators shall terminate with a vacuum relief valve. Couplings, unions, and other disconnecting couplings shall be readily accessible at all times. Discharge piping from the vacuum producers shall be galvanized steel tubing with a minimum wall thickness of 1.994 mm 14 gauge.

2.23.1.8 Vacuum Relief Valve

The vacuum relief valve shall be mechanically operated. The valve shall operate automatically at [] kPa inch Hg vacuum and shall be adjustable between [] and [] kPa [] and [] inch Hg vacuum. The vacuum relief valve connector shall be 15 mm 0.5 inch NPT. The valve shall be equipped with a silencer to attenuate air noise to 85 dB.

2.23.1.9 Spare Parts

Furnish a turbo-exhauster bearing and coupling kit with the delivered system consisting of one set of exhauster bearings and one complete motor/exhauster flexible coupling, all of the same size and design as those supplied with the turbo-exhauster. Include with the kit complete installation instructions for repair kit items.

2.23.2 High-Volume Evacuation System (HVEL)

The central HVEL system shall be composed of standard manufactured products, complete with devices normally furnished and devices required herein. The central HVEL system shall be supplied by an established manufacturer of commercially available industrial quality vacuum. The HVEL shall be a dry system for collection of dust and grinding particulates. The system shall consist of one vacuum turbine, except for area laboratory (ADL) application, and a dry, cyclonic, filtered separator.

2.23.2.1 Vacuum Producer

Vacuum producer shall be self-governing multistage, centrifugal type and may be of overhung or outboard design. The vacuum producer shall operate at a speed not to exceed 2600 rpm. The vacuum producer shall be connected to its drive motor by multiple V-belts. The vacuum producer shaft shall have a minimum of two radial bearings and at least one support bracket. Bearings may be permanently-lubricated sealed or lubricatable type. The vacuum producer/connector/drive motor assembly shall be fastened to a plate or frame structure. Power to operate the exhauster at the calculated design load shall not exceed the normal motor rating. Power required shall be in direct proportion to the volume of air exhausted. The vacuum produced shall be substantially constant throughout the design operating range of the exhauster. Vacuum producer cases shall be cylindrical in design. Cases and end plates may be constructed of either heavy-gauge sheet steel rigidly welded at seams or sections, or of cast grey iron. Sheet steel end plates shall be either concave or convex for flex resistance. Inlet connections may be axially or tangentially placed. Exhaust connections may be tangential to the casing. Inlet and outlet connections shall be sized to allow free air movement through the vacuum producer, without flow restrictions. The vacuum producer shall have an

adjustable volume control device in, on, or adjacent to the first stage of the input and an exhaust silencer on the output. The silencer and all plumbing shall be connected to the vacuum producer flexible sleeve connectors. Internal moving parts of the vacuum producer shall be constructed with not less than 3.2 mm 0.125 inch clearance throughout to prevent damage by transient particulates. Impellers shall be constructed of built-up sheet or high tensile composites. Impellers shall be of the backward curved design. Impellers shall be securely attached to the exhauster shaft by set screws or clamps of high-tensile material. Each impeller shall be individually balanced. The complete assembly with motor, shall not exceed 0.038 mm 1-1/2 mils of vibration when given a running test. Power to operate the vacuum producer shall be in direct proportion to the volume of air exhausted and shall not exceed the normal motor rating. The vacuum produced shall be substantially constant throughout the operating range of the vacuum producer. Each vacuum producer shall have a minimum capacity of [_____] standard cu. m per sec scfm at [_____] kPa inch Hg vacuum at standard conditions. The vacuum producer shall be sized to produce the above designated performance standards at the above-sea-level elevation of the proposed installation site, and shall be so certified by the manufacturer by equipment tag or plate, or by letter of certification identifying the turbo-exhauster by serial number.

2.23.2.2 Motor

The motor for the vacuum producer shall be a standard NEMA MG 1, 3450 rpm, T-frame, dripproof design; [_____] volts ac, 60 Hz, [_____] phase, with either sealed or lubricatable bearings. Operating temperature rise of the motor shall not exceed 22 degrees C 72 degrees F.

2.23.2.3 Isolation Pads

The vacuum producer assembly shall be mounted on resilient isolator pads as recommended by the manufacturer. The pads shall not be fastened to the facility floor. Vibration transmission shall be limited to less than 5 percent of the lowest frequency of vibration.

2.23.2.4 Pipe Isolators

Flexible, resilient clamped sleeves shall be furnished to isolate the vacuum producer from associated plumbing. Sleeve couplings shall be sized in accordance with the exhauster intake and output connections. Pipe isolators shall be provided with steel coupling guards.

2.23.2.5 Volume Control Device

The input of the vacuum producer shall have an adjustable air volume control device to prevent accidental overload and to provide a means of adjusting the upper design capacity limit. The volume control device may be built-in or immediately adjacent to the first or input stage of the exhauster and shall be preset by the manufacturer during certification procedure.

2.23.2.6 Exhaust Silencer

The vacuum producer shall output to an air discharge silencer of the open-bore expansion type. No interior baffling or shrouding will be permitted. The silencer shall satisfactorily attenuate air noise to a level below 85 dB.

2.23.2.7 Controls

Electrical controls for the vacuum producer shall consist of a combination across-the-line magnetic starter with time-delay-fused disconnects, a running-hour meter to total the number of hours of operation, stop-start button, and a red or amber warning light and an audible alarm to indicate shutdown due to fuse failure. The controls shall include a complete low-voltage (24 volts ac) remote control function with a control panel for remote operation of the exhauster. The low-voltage remote control panel shall contain an on-off switch for the vacuum producer, a pilot light to indicate operation, and a certified vacuum gauge reading in **kPa inches of water** to indicate the vacuum within the system at all times.

2.23.2.8 Central Separator

The central separator shall be a freestanding unit of heavy-gauge steel and all-welded construction. The separator chamber shall be of the cyclonic type and shall effectively separate and trap all particulate matter contained in the vacuum input. The internal configuration of the separator shall be such that air leaving the cyclonic chamber shall be directed upward through filter bags to effect final cleaning of the air before its entry into the vacuum producer. The lower part of the separator enclosure shall contain an easily accessible and serviceable debris container. The container shall lock into operating position to form a positive seal between the removable container and the separator enclosure. The debris container shall be removable and reinstallable without the use of tools. The container shall be equipped with casters to facilitate moving for emptying and reinstallation alignment and shall have a pivoting handle to facilitate handling. The separator shall be equipped with a filter-shaker mechanism actuated by an electric motor operating through mechanical linkage to the shaker mechanism. An electrical switch to control the shaker motor shall be on or adjacent to the separator. The separator shall be equipped with an easily removed screw- or bolt-fastened access panel to provide easy access for filter inspection and service.

2.23.2.9 Primary Separator

When necessary to satisfy specific design requirements, a primary separator shall be used in addition to, and ahead of, the central separator. The primary separator shall be of the cyclonic type and shall effect initial separation of abrasive particulates before vacuum air and debris enter the central separator. The primary separator shall be of heavy-gauge steel, all welded-seam construction, and may be freestanding or wall-mounted.

2.23.2.10 Piping

Pipes shall be of corrosion-resistant material, and have a smooth internal surface. Plastic pipe shall be acrylonitrile-butadiene-styrene (ABS) conforming to **ASTM D 1527** or polyvinyl chloride (PVC) conforming to **ASTM D 1785**. Solvent cement for ABS plastic pipe fittings shall conform to **ASTM D 2235**. PVC plastic pipe fittings shall conform to **ASTM D 2466**, and solvent cement shall conform to **ASTM D 2564**. Fittings, supports and joint assembly shall be of approved type. The assembled piping system shall be suitable for **17 kPa 5 inch Hg** vacuum. Fittings shall be of DWV long-radius type. Coupling, union, and other disconnecting fittings shall be readily accessible at all times. The most distant end of the main trunk line from the central filter-separator shall terminate with an air volume relief valve.

2.23.2.11 Air Volume Relief Valve

The air volume relief valve shall be mechanically operated, requiring no electrical power. The valve shall operate automatically, sensing negative pressure in the system and opening and closing proportionately to maintain designed air capacity to the vacuum producer regardless of the number of inlets on-line. Valve shall be equipped with silencer to attenuate air noise to 85 dB or less.

2.23.2.12 Vacuum Inlets

User inlets for technicians' benches shall be 32 mm 1-1/4 inches ID and for fixed-equipment locations, 40 mm 1-1/2 inches ID, with removable friction fit adapters sized to receive 80 mm 3 inch ID flexible hose. Adapters shall provide an airtight seal when inserted into the vacuum inlet. Inlets shall have attached pivot or hinge-mounted doors. When closed, the doors shall provide an airtight seal to close off the vacuum inlet; when open, they shall not interfere with insertion of the adapters with 80 mm 3 inch ID hose attached.

2.23.2.13 Vacuum Producer Spare Parts

Deliver a vacuum producer bearing and belt kit with the system. Include with the kit one set each of exhaustor bearings and replacement drive belts, all the same size and design as those supplied with the turbo-exhauster. Include with the repair kit complete installation instructions for all its items.

2.23.3 Environmental-Janitorial Vacuum System (EJVS)

2.23.3.1 Vacuum Source

The vacuum producers furnished for the HVE system shall serve as the vacuum source for the EJVS.

2.23.3.2 Central Dry Separator

The central separator shall be a freestanding dry unit of heavy-gauge steel and all-welded construction. The separator chamber shall be the cyclonic type and shall effectively separate and trap all particulate matter contained in the vacuum input. The internal configuration of the separator shall be such that air leaving the cyclonic chamber shall be directed upward through a filter bag to effect final cleaning of the air before its entry into the vacuum producer. The lower part of the separator enclosure shall contain an easily accessible and serviceable debris container. The container shall lock into operating position to form a positive seal between the removable container and the separator enclosure, to prevent leakage of the vacuum system. The debris container shall be removable and reinstallable without use of tools. The container shall be equipped with casters to facilitate moving for emptying and reinstallation alignment, and shall have a pivoting handle to facilitate handling. The separator shall be equipped with a filter-shaker mechanism actuated by an electric motor operating through mechanical linkage to the shaker mechanism. An electrical switch to control the shaker motor shall be on or adjacent to the separator and shall conform to appropriate electrical code. The separator shall be equipped with an easily removed, screw- or bolt-fastened access panel to provide easy access for filter inspection and service.

2.23.3.3 Piping

Pipes shall be of corrosion-resistant material with a smooth internal surface, and shall not collapse when installed in an evacuation system evaluated to 27 kPa 8 inch Hg gauge. Plastic pipe shall be acrylonitrile-butadiene-styrene (ABS) conforming to ASTM D 1527 or polyvinyl chloride (PVC) conforming to ASTM D 1785. Solvent cement for ABS plastic pipe fittings shall conform to ASTM D 2235. PVC plastic pipe fittings shall conform to ASTM D 2466, and solvent cement shall conform to ASTM D 2564. Fittings, supports, and joint assembly shall be of approved type. The assembled piping system shall be suitable to support 27 kPa 8 inch Hg vacuum gauge requirement. Fittings shall be of DWV long-radius type. Coupling, union, and other disconnecting fittings shall be readily accessible at all times.

2.23.3.4 Vacuum Inlets

User inlets shall be wall-mounted not more than 600 mm 24 inches nor less than 300 mm 12 inches from inlet center to finished floor top and shall project no more than 13 mm 1/2 inch from the wall. The inlet shall be of heavy-duty construction with heavy-gauge stainless steel valve body and door assembly. The external surfaces shall be a satin finish, with edges and corners beveled. The cover door shall be self-closing and shall have a neoprene or similar gasket on its inner surface that will provide a vacuum-tight seal when closed. The valve shall be sized to 40 mm 1-1/2 inch ID and shall receive a 40 mm 1-1/2 inch OD commercial hose cuff with sufficient accuracy of fit to prevent vacuum leakage.

2.23.3.5 Mobile Wet-Pickup Caddy

The wet-pickup caddy shall be a cylindrical tank of 45 L 12 gallon minimum capacity, mounted horizontally on wheels. The tank shall be constructed of 3.416 mm 10 gauge minimum thickness steel with welded joints. Nominal tank dimensions shall be 300 mm 12 inch diameter and 675 mm 27 inches long. The tank shall be designed with convex ends to prevent collapse under vacuum. A 350 mm 14 inch nominal length axle shall be attached under one end of, and perpendicular to, the long axis of the tank and shall be equipped with 175 mm 7 inch nominal diameter wheels. The opposite end of the tank shall have a support leg or caster set under it to stabilize the tank in the horizontal position while in use, and a push-handle on the top for easy mobility. The top of the tank shall be equipped with inlet and outlet ports. The inlet port shall be a swiveling, removable 90-degree elbow, sized and equipped to receive a 40 mm 1-1/2 inch ID commercial vacuum hose cuff. The outlet port shall be a fixed 90-degree elbow attached to an automatic-float-valve assembly sized and equipped to receive a 40 mm 1-1/2 inch ID commercial hose cuff. One end of the tank shall have a drain hole at the lower edge, equipped with an expansion plug with safety chain to prevent loss. A jumper hose shall be provided with each wet caddy, to connect the caddy to the wall vacuum inlets. The jumper hose shall be 1.5 meter 5 foot nominal length, 40 mm 1-1/2 inch ID, and cuffed at each end for proper connections.

2.23.3.6 Accessories

Hoses for the central vacuum system shall be 40 mm 1-1/2 inch ID commercial-grade corrugated vacuum hose, fabricated of PVC or polyurethane, and without wire reinforcement. Hose ends shall be equipped with vacuum hose cuffs compatible with wall vacuum inlets, wet-caddy inlet and outlet, and vacuum tools. Tool sets shall include a 1.5 meter 5 foot S-wand of

aluminum construction; a master shoeholder with carpet, nylon floor brush, and squeezed shoes; and a 300 mm 12 inch long steel crevice tool, hoses and [] tool set shall be supplied.

2.24 REVERSE OSMOSIS WATER TREATMENT SYSTEM

NOTE: Consult with various equipment manufacturers to determine suitable equipment components for the specific application. There are several categories of reverse osmosis treatment facilities ranging from roughing units used for water softening to units providing high-purity water. Units process water ranging from domestic water to sea water. Design depends entirely upon an adequate water analysis for selection of proper components, since units are designed for a specific type of water to be treated, with not much flexibility in application. The reverse osmosis membrane selection is critical and the operating pressure depends on the membrane selected. The reverse osmosis unit is only part of the required treatment system, which may include pretreatment facilities and additional organic filters.

Reverse osmosis water treatment system shall be a complete operable system to produce water with an output that complies with ASTM D 1193, Type IV. The reverse osmosis unit shall be capable of providing total dissolved solids removal in excess of 90 percent, through a [replaceable] [renewable] membrane cartridge. Cartridge shall be capable of accepting a pH range of 3 to 11 at a temperature range of 0.556 to 54.4 degrees C 33 to 130 degrees F. Unit shall be provided complete with cartridge, feed solenoid valve, low feed pressure cutoff and liquid filled pressure gauges. A granulated activated carbon filter shall be installed on the feed water line to remove chlorine prior to entering unit.

2.24.1 Water Analysis

The water analysis of the water to be treated is as follows:

----- Cations as CaCO ₃		----- Anions as CaCO ₃	
Constituent	mg/L	Constituent	mg/L
-----	-----	-----	-----
Ca++	[]	HCO ₃ -	[]
Mg++	[]	CO ₃ =	[]
Na+	[]	Cl =	[]
K+	[]	SO ₄ =	[]
	[]	NO ₃ =	[]
		PO ₄ -	[]

Cations as CaCO ₃		Anions as CaCO ₃	
Constituent	mg/L	Constituent	mg/L
Total Cations	[_____]	Total Anions	[_____]

Constituent	mg/L	Miscellaneous	Values
CO(2) as CO(2)	[_____]	Turbidity	[_____] ppm
Fe as Fe	[_____]	Color	[_____] Color units
Mn as Mn	[_____]	Cl(2) (residual). [_____]	pH
SiO(2) as SiO(2) . . .	[_____]	Fouling index	
Suspended Solids	[_____]	(5 minutes 207 kPa (30 psig)	
		100 mL sample). [_____]	

Water temperature

Max [_____] degrees C ([_____] degrees F)

Min [_____] degrees C ([_____] degrees F)

Avg [_____] degrees C ([_____] degrees F)

Ambient temperature

Max [_____] degrees C ([_____] degrees F)

Min [_____] degrees C ([_____] degrees F)

Avg [_____] degrees C ([_____] degrees F)

Minimum inlet
water pressure [_____] kPa ([_____] psig)

Constituent	mg/L	Miscellaneous	Values
CO(2) as CO(2)	[_____]	Turbidity	[_____] ppm
Fe as Fe	[_____]	Color	[_____] Color units
Mn as Mn	[_____]	Cl(2) (residual). [_____]	pH
SiO(2) as SiO(2) . . .	[_____]	Fouling index	
Suspended Solids	[_____]	(5 minutes 30 psig	
		100 mL sample). [_____]	

Water temperature

Maximum [_____] degrees F

Minimum [_____] degrees F

Average [_____] degrees F

Ambient temperature

Maximum [_____] degrees F

Constituent	mg/L	Miscellaneous	Values
		Minimum	[] degrees F
		Average	[] degrees F
		Minimum inlet water pressure.	[] psig

2.24.2 System Requirements

A storage tank, a pressure distribution pump, a control panel, and necessary pressure vessels shall be provided. Minimum service output shall be the indicated continuous water flow capacity at the indicated design and operating temperature. A continuous Cl₂ residual of 0.2-1.0 ppm shall be maintained in the influent stream to the system. Operating pressure shall be as required for the type of membranes necessary to suit the indicated water quality. Pumps, chlorinator, any required organic filters, pretreatment equipment, and control valves, shall be provided as part of the operable system to produce the quality of water specified. The control panel shall bear UL listing label for industrial control panels and shall be in a NEMA 250, Type 1, enclosure. The control panel shall include the following: audio-visual alarm, external resets, motor controllers, time-delay transformers, relays, timers, and selector switches. Pressure vessels shall be factory air tested to 1-1/2 times the working pressure. Pressure vessels shall be equipped with valves and accessories, including pressure gauges and automatic and manual drains. Pressure vessels shall be supplied with the manufacturer's standard protective coating. Pressure vessels shall be designed and constructed in accordance with ASME BPVC SEC VIII D1, and shall have the design working pressures required. A display of the ASME seal on the receiver or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided. Process pumps shall be the manufacturer's standard.

2.24.3 Booster Pumps

NOTE: Designer will indicate location, sizes, wattage (horsepower), and capacities of equipment on drawings. Provide duplex pumps, if discharge capacity is greater than 94.6 liters per minute (25 gpm) and total head is at least 6 meters (20 feet).

Booster pumps shall be provided where it is necessary to boost the output pressure of the reverse osmosis water treatment system to meet the indicated de-ionized water system pressure requirement. Pumps shall be of all-bronze construction or all-stainless steel construction in accordance with AIST PB-224, Type 316. Head and capacity shall be as shown. Pumps shall be 1800 rpm, end suction, frame mounted, centrifugal type, with mechanical seals. Pumps shall be direct connected to the electric-motor drive through a flexible coupling, and each mounted on a separate cast iron or fabricated steel base. Bases shall have a drip lip and drain tapping. Test curves shall be furnished showing capacity in L/minute gpm, head in meters feet, efficiency, and brake wattage horsepower. Multiple pump installations shall have pump characteristics compatible for operation in parallel with similar pumps. Guards shall shield exposed moving parts. Pump controls shall be provided to maintain pressure on the distribution system as indicated.

2.25 WATER SOFTENING WATER TREATMENT SYSTEM

NOTE: For hospital use, water with a hardness expressed as CaCO₃ exceeding 171 mg per liter (10 grains per gallon) or 171 ppm will require

softening. Degree of softening required will depend upon the end use of the water. Degree of hardness can be controlled by blending softened water and raw water. Normally, softening to a requirement for no more than 0.189 liters per second (3 gpm) at 51 ppm hardness will be acceptable. Usually, the water system supplying a hospital will have both a hydrogen sulfide ppm and a turbidity content of less than 5 ppm. However, if the water analysis indicated that either or both exceed 5 ppm, suitable water treatment will be specified in addition to a water softener system.

Water softening water treatment system shall be provided for the indicated continuous water flow capacity and for the indicated grains hardness to which water shall be softened.

2.25.1 Water Analysis

The water analysis of the water to be softened is as follows:

Constituent	ppm	Constituent	ppm
<hr/>			
Total solids	[_____]	Nitrates as NO(3).	[_____]
Calcium as Ca	[_____]	Alkalinity as CaCO(3):	
Magnesium as Mg	[_____]	(Methyl Orange)	
		(Phenolphthalein)	[_____]
Sodium and potassium		Total hardness	
as Na	[_____]	as CaCO(3)	[_____]
Iron as Fe	[_____]	Carbonate hardness	
Silica as SiO(2)	[_____]	as CaCO(3)	[_____]
Sulphate as SO(4).	[_____]	Noncarbonate hardness	
Chlorides as Cl	[_____]	as CaCO(3)	[_____]
Hydrogen Sulfide		Free carbon dioxide	
as H(2)S	[_____]	as CO(2)	[_____]
<hr/>			
Miscellaneous		Values	
<hr/>			
Turbidity	[_____]	ppm	
Color	[_____]		
pH	[_____]		

2.25.2 System Requirements

The water softener assembly shall consist of two softener units, with each

unit designed for the full-flow capacity indicated, and a brine-solution tank for regeneration of the softener exchanger material. Each unit shall be a fully automatic, downflow pressure type water softener. The assembly shall be provided with the alarm and controls necessary to provide a complete operable system. The softener tank shells shall be of electric welded, heavy gauge, low carbon steel hot-dipped galvanized construction and the brine-solution tank shall be of polyethylene construction. The exchange material shall not require dosing or the adding of any chemical mixture or solution, either to the water to be treated or the water used for backwashing or regeneration, other than common salt (NaCl). The brine-solution tank shall be provided with indicators for measuring the correct volume of brine for regeneration and shall be of adequate size to provide for necessary salt storage. A hydraulic ejector or motor-driven all-bronze pump with valves, piping, and connections shall be provided for delivering brine to the softeners. The softeners shall be designed for 100 psi working pressure, and shall be designed and constructed in accordance with ASME BPVC SEC VIII D1. A display of the ASME seal on the softeners or a certified test report from an approved independent testing laboratory indicating conformance to the ASME Code shall be provided.

2.25.3 Automatic Operation and Controls

Operation shall be initiated automatically and regeneration of the unit shall continue automatically. Operational power shall be from a 120 volt, 60 Hz, single-phase ac motor or self-contained hydraulic system. Electrically operated units shall be provided with a 5 meter 15 foot electrical cord and plug cap matching the electrical receptacle provided for service. Electrical control shall be designed to be operated manually in the event of failure of the electrical equipment. The necessary washing, brining, and rinsing operations shall be timed by suitable timing device and carried out without manual attention or supervision other than to keep the salt-storage tank filled. Following complete regeneration, the softening run shall start automatically. Each function of softener operation shall be controlled mechanically or electrically, or by both methods in combination to assure the highest degree of efficiency; and the controls shall be capable of convenient and accurate manual adjustment. An interlocking system shall be provided that prevents the regeneration of more than one unit at a time. The transfer of water and brine solution to and from the water softener shall be accomplished by a single-unit multiple-port valve or by a package-type valve nest for automatic operation.

2.25.3.1 Multiple-Port Valve

The multiple-port valve shall consist of an assembly of nonsticking, nonleaking, water-lubricated valve ports that connect to the hard-water inlet, soft-water outlet, backwash inlet and outlet, and brine inlet, all enclosed in a single casing. The design shall permit the various steps of operation service, backwash, brine flow, and rinse to be accomplished by the rotation of a shaft that drives the mechanism causing the opening and closing of ports in correct sequence. The design of the valve mechanism shall be such that gradually increasing flows will be attained as ports are opened and initial surges and sudden inrushes of water or brine solutions are avoided. A dial pointer shall indicate each step of the operation.

2.25.3.2 Package-Type Valve Nest

The package-type valve nest shall consist of a pilot valve connected with fittings as may be required to each one of a nest of valves hydraulically or electrically operated. The nest of valves shall have connections to

hard-water inlet, soft-water outlet, backwash inlet and outlet, and brine inlet. A dial pointer shall indicate each step of the operation.

2.25.3.3 Backwash and Brine-Rinse Control

Adequate means shall be provided for automatically controlling the rate of backwashing and brine rinsing. Wash and rinse water shall discharge into an open sump or other suitable drain. The controls shall be entirely automatic in operation and shall accurately regulate the rate of backwash and brine rinse as recommended by the softener manufacturer.

2.25.4 Accessories

2.25.4.1 Pressure Gauges and Sampling Cocks

Each softener unit shall be provided with a duplex pressure gauge, or two single pressure gauges, connected to the hard-water inlet and the soft-water outlet, to indicate pressure loss through softener when in operation. The pressure loss through the softener, plus its pipe, valve, and fitting assembly when delivering the indicated amount of water per softener unit, shall not exceed 69 kPa 10 psi. Sampling cocks shall be furnished for both the hard and soft water.

2.25.4.2 Automatic Hardness Tester

A device for automatically testing the hardness of the water shall be installed in the soft-water line leading from each softener unit. The automatic hardness tester shall be suitable for wall mounting and shall be capable of carrying out intermittent tests on the softener water and of giving visual warning that the residual hardness present exceeds a predetermined limit. The tester shall be equipped with necessary wiring and electrical controls to initiate automatic regeneration.

2.25.4.3 Water Meters

Each softener shall be provided with displacement-type water meter reading in liters and U.S. gallons U.S. gallons. The meter shall be equipped with necessary wiring and electrical controls to initiate automatic regeneration when the softener unit has delivered the indicated amount of water. The meter contacts shall be adjustable to permit setting to suit actual hardness of the water being tested. The meter shall be installed in the soft-water line from the softener unit and shall be located so as to be readily accessible for reading and setting.

2.25.4.4 Water-Testing Equipment

A complete water-testing set furnished by the manufacturer shall be provided with the water softener assembly, with complete instructions for conducting either the American Public Health Association test or other suitable test for hardness. Two Baume hydrometers, calibrated for the range necessary for testing saturated brine solution, and three glass cylinders of heat-resistant glass to hold sufficient brine for testing shall be provided.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify dimensions in

the field, and advise the Contracting Officer of any discrepancy before performing any work.

3.2 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A requirements. Plastic pipe shall not be installed in air plenums. Piping located in shafts that constitute air ducts or that enclose air ducts shall be noncombustible in accordance with NFPA 90A. Installation of plastic pipe shall be in compliance with NFPA. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 meters 5 feet outside the building, unless otherwise indicated. A [gate] [or] [full port ball] [ball] valve and drain on the water service line shall be installed inside the building approximately 150 mm 6 inches above the floor from point of entry. Piping shall be connected to the exterior service lines or capped or plugged, if the exterior service is not in place. Sewer and water pipes shall be laid in separate trenches, except when otherwise shown. Exterior underground utilities shall be at least 300 mm 12 inches below the [average local frost depth] [finish grade] or as indicated on the drawings. If trenches are closed or the pipes are otherwise covered before being connected to the service lines, the location of the end of each plumbing utility shall be marked with a stake or other acceptable means. Valves shall be installed with handle horizontal to or above the valve body.

3.3 WATER PIPE, FITTINGS, AND CONNECTIONS

3.3.1 Utilities

The piping shall be extended to fixtures, outlets, and equipment. The hot water and cold water piping system shall be arranged and installed to permit draining. The supply line to each item of equipment or fixture, except faucets, flushing devices, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the time for repair and maintenance without interfering with operation of other equipment or fixtures. Supply piping to fixtures, faucets, hydrants, shower heads, and flushing devices shall be anchored to prevent movement.

3.3.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting through construction shall be avoided. Damage to building, piping, wiring, or equipment as a result of cutting shall be repaired by mechanics skilled in the trade involved.

3.3.3 Protection to Fixtures, Materials, and Equipment

Pipe openings shall be closed with caps or plugs during installation. Fixtures and equipment shall be tightly covered and protected against dirt, water, chemicals, and mechanical injury. Upon completion of the work, the fixtures, materials, and equipment shall be thoroughly cleaned, adjusted, and operated. Safety guards shall be provided for exposed rotating equipment.

3.3.4 Mains, Branches, and Runouts

Piping shall be installed as indicated. Pipe shall be accurately cut and worked into place without springing or forcing. Structural portions of the

building shall not be weakened. Aboveground piping shall run parallel with the lines of the building, unless otherwise indicated. Branch pipes from service lines may be taken from top, bottom, or side of main, using crossover fittings required by structural or installation conditions. Supply pipes, valves, and fittings shall be kept a sufficient distance from other work and other services to permit not less than 13 mm 1/2 inch between finished covering on the different services. Bare and insulated water lines shall not bear directly against building structural elements so as to transmit sound to the structure or prevent flexible movement of the lines. Water pipe shall not be buried in or buried under floors unless specifically indicated or approved. Buried pipe shall be inspected, tested, and approved before backfilling. Changes in pipe sizes shall be made with reducing fittings. Use of bushings will not be permitted except for use in situations in which standard factory fabricated components are furnished to accommodate specific accepted installation practice. Change in direction shall be made with fittings, except that bending of pipe 100 mm 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The center-line radius of bends shall be not less than six diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be acceptable.

3.3.5 Pipe Drains

NOTE: Designer will indicate location of pipe drains on the drawings.

Pipe drains indicated shall consist of 19 mm 3/4 inch hose bibb with renewable seat and [gate] [or] [full port ball] valve ahead of hose bibb. At other low points, 19 mm 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

3.3.6 Expansion and Contraction of Piping

Allowance shall be made throughout for expansion and contraction of water pipe. Each hot water and hot water circulation riser shall have expansion loops where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 meters 50 feet in length shall be anchored to the wall or the supporting construction about midway on the run to force expansion, evenly divided, toward the ends. Sufficient flexibility shall be provided on branch runouts from mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining. If mechanical grooved pipe coupling systems are provided, the deviation from design requirements for expansion and contraction may be allowed pending approval of Contracting Officer.

3.3.7 Thrust Restraint

Plugs, caps, tees, valves and bends deflecting 11.25 degrees or more, either vertically or horizontally, in waterlines 100 mm 4 inches in diameter or larger shall be provided with thrust blocks to prevent movement. Thrust blocking shall be concrete of a mix not leaner than: 1 cement, 2-1/2 sand, 5 gravel; and having a compressive strength of not less than 14 MPa 2000 psi after 28 days. Blocking shall be placed between solid

ground and the fitting to be anchored. Unless otherwise indicated or directed, the base and thrust bearing sides of the thrust block shall be poured against undisturbed earth. The side of the thrust block not subject to thrust shall be poured against forms. The area of bearing shall be as shown or directed. Blocking shall be placed so that the joints of the fittings are accessible for repair. Steel rods and clamps, protected by galvanizing or by coating with bituminous paint, shall be used to anchor vertical down bends into gravity thrust blocks.

3.3.8 Commercial-Type Water Hammer Arresters

NOTE: Designer will indicate location, quantity and size of commercial type water hammer arresters on the drawings. Commercial type water hammer arresters shall be sized and located in accordance with PDI-WH 201. Piping serving equipment having quick-closing valves shall have suitably sized arresters. For pressure of 448 kPa (65 psi) or less, commercial water hammer arresters may be reduced by the designer in number and size, if the system does not contain quick-acting valves. Water pressure regulating or reducing valves may be provided in lieu of commercial type water hammer arresters, if local use has provided satisfactory performance. When required, install arresters as close as possible to quick-acting valves, ends of long pipe runs, and near batteries of fixtures.

Commercial-type water hammer arresters, conforming to PDI WH 201, shall be provided on hot and cold water supplies and shall be located as generally indicated, with precise location and sizing in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Vertical capped pipe columns will not be permitted.

3.4 DISTILLED AND DE-IONIZED HIGH-PURITY WATER PIPING

Metallic piping shall be tin-lined with tin-lined valves, or Type 316 stainless steel. Pipe, fittings, and valves shall be thoroughly cleaned at the factory and fitted with plastic caps or inserts to keep out dirt and prevent thread damage. Tin-lined pipe shall be regular class brass pipe conforming to ASTM B 43, lined with tin that conforms to ASTM B 339. Ends of pipe shall be tin-beaded, and terminal threads shall be tin-designed to make up with tin threads in the fittings or valves. Outer threads shall be brass. Tin thickness shall be a minimum of 1.6 mm 1/16 inch for pipe valves and fittings. Nonmetallic piping shall be polyvinylidene fluoride (PVDF), acrylonitrile-butadiene-styrene (ABS), chlorinated polyvinyl chloride (PVC), and cross-linked polyethylene (PEX). Nonmetallic pipe shall be installed in accordance with manufacturer's instructions.

3.4.1 Fittings

Fittings for brass pipe shall be bronze cast type, designed especially for tin lining. Fittings for polyvinyl chloride (PVC) shall be socket type. Polyethylene fittings shall be butt-fusion or socket-fusion type. Fittings for stainless steel pipe shall be Type 316 stainless steel.

3.4.2 Valves

Line or shut-off valves shall be of the diaphragm type, with a polytetrafluoroethylene (PTFE) diaphragm. Valves installed in tin-lined pipe shall be of bronze body and tin lined. Valves installed in nonmetallic pipe shall be nonmetallic body. Valves installed on stainless steel pipe shall be stainless steel.

3.5 NONMEDICAL (NON-OIL-FREE) COMPRESSED AIR PIPING

Nonmedical (non-oil-free) compressed air piping shall be installed as specified for water piping and shall be suitable for 862 kPa 125 psig working pressure. Air piping shall have supply lines and discharge terminals legibly and permanently marked at both ends with the name of the system and the direction of flow.

3.6 MEDICAL (OIL-FREE) COMPRESSED AIR AND VACUUM PIPING

Medical (oil-free) compressed air and vacuum piping shall be installed as follows. Medical compressed air and vacuum piping shall be cleaned, tested, and installed as specified in NFPA 99. Piping shall be connected near the top of the receiver. Vacuum pump exhaust pipe shall be extended to the outside of the building and its end turned down and screened against insects. A dry nitrogen gas or other approved inert gas purge may be provided to prevent oxide formation inside the copper tubing when silver brazing joints. Compressed air and vacuum system alarms shall be located as specified in paragraph ALARM PANELS FOR MEDICAL GAS AND VACUUM SYSTEMS. Joints shall be made with silver brazing alloy, except at valves or equipment requiring threaded pipe connections. Pipe threads on shutoff valves shall be installed by tinning the male threads with soft solder. The medical compressed air piping and vacuum system piping shall be suitable for 862 kPa 125 psig working pressure. Where oil-free air is required in laboratories, the piping system shall be separate from the medical surgical system. Vacuum at 51 kPa 15 inches of mercury shall be provided at operating rooms, delivery rooms, and patient's clinics. Pipelines shall be readily identified by appropriate system labeling at intervals of not more than 6 meters 20 feet and with at least one such identification in each room. Antivibration couplings shall be installed between the vacuum pump and the pipeline and between the vacuum pump and the exhaust pipe. Initial startup of the oil-free compressed air system shall be under the supervision of system's manufacturer.

3.7 NITROUS OXIDE, OXYGEN, AND NITROGEN SYSTEMS

A dry nitrogen gas or other approved inert gas purge shall be provided to prevent oxide formation inside the copper tubing when joints are silver brazed. Piping inside of building and aboveground shall be hard-drawn copper tubing and piping underground shall be annealed. Underground piping shall be adequately protected against frost, corrosion, and physical damage by nonmetallic ducts or casings. Fittings used for joining copper tubing shall be wrought copper or bronze, made especially for soldered or brazed connection. Joints, except those at valves or equipment requiring screw connections, shall be made with silver brazing alloy or a similar high melting point alloy of not lower than 538 degrees C 1000 degrees F. Screw joints used in shutoff valves, excluding station-outlet valves, shall be installed by tinning the male thread with soft solder.

3.8 JOINTS

NOTE: Where environmental conditions do not warrant
the use of dielectric unions or flanges the
requirement for such unions and flanges will be
deleted.

Installation of pipe and fittings shall be made in accordance with the manufacturer's recommendations. Mitering of joints for elbows and notching of straight runs of pipe for tees will not be permitted. Joints shall be made up with fittings of compatible material and made for the specific purpose intended.

3.8.1 Threaded

Threaded joints shall have American Standard taper pipe threads conforming to ASME B1.20.1. Only male pipe threads shall be coated with graphite or with an approved graphite compound, or with an inert filler and oil, or shall have a polytetrafluoroethylene tape applied.

3.8.2 Mechanical Couplings

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints. Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted. Rigid grooved pipe couplings shall be for use with grooved end pipes, fittings, valves and strainers. Rigid couplings shall be designed for not less than 862 kPa 125 psi service and appropriate for static head plus the pumping head, and shall provide a watertight joint. Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at a site agreed upon. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the pipe, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.8.3 Unions and Flanges

Unions and flanges and mechanical couplings shall not be concealed in walls, ceilings, or partitions. Unions shall be used on pipe sizes 65 mm 2-1/2 inches and smaller; flanges shall be used on pipe sizes 80 mm 3 inches and larger.

3.8.4 Grooved Mechanical Joint

Grooves shall be prepared according to the coupling manufacturer's instructions. Grooved fittings, couplings, and grooving tools shall be products of the same manufacturer. Pipe and groove dimensions shall comply with the tolerances specified by the coupling manufacturer. The diameter of grooves made in the field shall be measured using a "go/no go" gauge, vernier or dial caliper, narrow-land micrometer, or other method specifically approved by the coupling manufacturer for the intended application. Groove width and dimension of groove from end of pipe shall be measured and recorded for each change in grooving tool setup to verify compliance with coupling manufacturer's tolerances. Grooved joints shall not be used in concealed locations.

3.8.5 Cast Iron Pipe

Cast iron soil, waste and vent pipe joints shall be bell and spigot compression and hubless gasketed clamped joints installed in accordance with the manufacturer's recommendations.

3.8.6 Copper Tube and Pipe

Joints shall be made up with fittings of compatible material and made for the purpose intended.

- a. Brazed. Brazed joints shall conform to [MSS SP-73](#) and [CDA A4015](#), made with flux, and are acceptable for all pipe sizes.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping [50 mm 2 inches](#) and smaller. Soldered joints shall conform to [ASME B31.5](#) and [CDA A4015](#). Soldered joints shall not be used in compressed air piping between the air compressor and the receiver.
- c. Copper Tube Extracted Joint. Mechanically extracted joints shall be made in accordance with [ICC IPC](#).
- d. Press Connection. Copper press connections shall be made in **strict** accordance with the manufacturers' installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.
- e. Mechanical couplings may be used in conjunction with grooved tube for aboveground, nonferrous, domestic hot and cold water systems in lieu of unions, brazed, soldered, or threaded joints. Mechanical couplings are permitted only in accessible locations, including behind access plates. Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted. Rigid grooved tube couplings shall be used with grooved end tubes, fittings, and valves. Rigid couplings shall be designed for not less than [862 kPa 125 psi](#) service appropriate for static head plus the pumping head, and shall provide a watertight joint. Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally brazed or soldered elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators

having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations. The Contracting Officer shall be notified 24 hours in advance of test to demonstrate operator's capability, and the test shall be performed at the work site, if practical, or at an agreed upon site. The operator shall demonstrate the ability to properly adjust the grooving tool, groove the tube, and to verify the groove dimensions in accordance with the coupling manufacturer's specifications.

3.8.7 Plastic Pipe

NOTE: Some materials listed are superior to others for specific requirements. Therefore, information should be obtained from the using service for any special requirements before selection of material is made. The type of tubing or pipe required will be as determined by local experience. In the absence of actual experience with water characteristics, the selection of materials for pipe, tubing, and tanks will be made by reference to the classification of water into categories as listed in TM 5-810-5/AFM 32-1070, Chap. 4. This specification allows drainage systems up to 15 inch diameter only; designer will ensure the availability of materials when drainage line exceeds 15 inch diameter.

Designer will add desired working pressure ratings for any plastic pipe, after the pipe material description in TABLE II.

ABS pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, or mated flanged. Threading of Schedule 80 pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 pipe is not allowed. Joints for plastic pipe materials shall be made in the following manner:

Pipe Material	Joint Method
Pipe Jointing Method for PE Plastic Pipe	Socket and Butt Fusion
Pipe Jointing Method for Chemically Resistant Glass Pipe	Manufacturer's Recommendation
Pipe Jointing Method for Filament-Wound Reinforced Thermosetting Resin Pipe (RTRP)	Manufacturer's Recommendation
ABS	Solvent Cement
PVC AND CPVC	Solvent Cement Elastomeric (Threading of Schedule 80 Pipe is allowed, only where required for disconnection and inspection)

Pipe Material

Joint Method

(Threading of Schedule 40 Pipe is not allowed) Flanged, Grooved Joint to Joint Methods

3.8.8 Glass Pipe

Joints for corrosive waste glass pipe and fittings shall be made with corrosion-resisting steel compression-type couplings with acrylonitrile rubber gaskets lined with polytetrafluoroethylene.

3.8.9 Corrosive Waste Plastic Pipe

Joints for polypropylene pipe and fittings shall be made by mechanical joints or electrical fusion coil method. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions shall be used where required for disconnection and inspection.

3.8.10 High Purity Water Pipe

Joints for metal pipe shall be made up with a polytetrafluoroethylene tape as recommended by the pipe manufacturer. Joints for polyethylene shall be made with heat fusion or heat socket fusion. Joints for PVC pipe shall be socket type made up using PVC cement. All plastic joints shall be in accordance with manufacturer's instructions.

3.8.11 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous pipe shall be made with dielectric unions, flanges or dielectric waterways. Dielectric waterways shall have temperature and pressure rating equal to or greater than that specified for the connecting piping. Waterways shall have metal connections on both ends suited to match connecting piping. Dielectric waterways shall be internally lined with an insulator specifically designed to prevent current flow between dissimilar metals. Dielectric flanges shall meet the performance requirements described herein for dielectric waterways. Connecting joints between plastic and metallic pipe shall be made with transition fittings for this specific purpose.

3.9 CORROSION PROTECTION FOR PIPE AND FITTINGS

NOTE: Specify polyethylene coating for cast iron piping if installed at locations where soil corrosion has been a problem and where electrical resistivity of soil is less than 2,000 ohm-cm. For additional guidance on cathodic protection for underground ferrous piping, refer to NACE SP0169. Designer shall indicate slopes of horizontal waste lines on the drawings.

Buried cast-iron soil piping shall be completely encased in polyethylene tube or sheet in accordance with AWWA C105/A21.5. Exterior surfaces of steel pipe and fittings installed underground shall be coated with primer and wrapped with tape during installation. Tape shall conform to AWWA C203 and primer shall be as recommended by the tape manufacturer. After

thoroughly cleaning piping of foreign matter, the pipe shall be primed and immediately wrapped with tape, applied with a 50 percent overlap. Joints and fittings shall be coated and wrapped with the same primer and tape after piping has been tested in accordance with ICC IPC.

3.10 PIPE SLEEVES AND FLASHING

Pipe sleeves shall be furnished and set in their proper and permanent location.

3.10.1 Sleeve Requirements

NOTE: The designer will coordinate requirements for clearances around sleeves with UFC 3-310-04 and Section 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

Pipes passing through concrete or masonry wall or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves will not be required for supply, drainage, waste and vent pipe passing through concrete slab on grade, except where penetrating a membrane waterproof floor. A modular mechanical type sealing assembly with sleeves of proper diameter may be installed in lieu of a waterproofing clamping flange and caulking and sealing of annular space between pipe and sleeve. The seals shall consist of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and sleeve using galvanized steel bolts, nuts, and pressure plates. The links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and each nut. After the seal assembly is properly positioned in the sleeve, tightening of the bolt shall cause the rubber sealing elements to expand and provide a watertight seal between the pipe and the sleeve. Each seal assembly shall be sized as recommended by the manufacturer to fit the pipe and sleeve involved. Sleeves shall not be installed in structural members, except where indicated or approved. Rectangular and square openings shall be as detailed. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface, except for special circumstances. Pipe sleeves passing through floors in wet areas such as mechanical equipment rooms, lavatories, kitchens, and other plumbing fixture areas shall extend a minimum of 100 mm 4 inches above the finished floor. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 6 mm 1/4 inch clearances between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeves. Sleeves in bearing walls and concrete slab on grade floors shall be steel pipe or cast-iron pipe. Sleeves in nonbearing walls or ceilings may be steel pipe, cast-iron pipe, galvanized sheet metal with lock-type longitudinal seam or plastic. Except as otherwise specified, the annular space between pipe and sleeve, or between jacket over insulation and sleeve, shall be sealed as indicated with sealants conforming to ASTM C 920 and with primer backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated. Pipe sleeves in fire-rated walls shall conform to the requirements of Section 07 84 00 FIRESTOPPING.

3.10.2 Flashing Requirements

NOTE: The applicable detail plates will be completed and included in the contract drawings. Sleeve thickness and square and rectangular opening details will be determined and indicated on the drawings. Indicate pipe chase areas on the drawings.

Coordinate with paragraph WATER HEATERS.

Pipes passing through roof shall be installed through a lead flashing or a 4.9 kg/sq meter 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed; the skirt or flange shall extend not less than 200 mm 8 inches from the pipe, and shall be set over the roof or floor membrane in a solid coating of bituminous cement. The flashing shall extend up the pipe a minimum of 250 mm 10 inches. For cleanouts, the flashing shall be turned down into the hub and caulked after placing the ferrule. Pipes passing through pitched roofs shall be flashed, using copper flashing, with an adjustable integral flange of adequate size to extend not less than 200 mm 8 inches from the pipe in all directions and lapped into the roofing to provide a watertight seal. The annular space between flashing and bare pipe or between flashing and metal-jacket covered insulation shall be sealed as indicated. Flashing for dry vents shall be turned down into the pipe to form a waterproof joint. Pipes, up to and including 250 mm 10 inches in diameter, passing through roof or floor waterproofing membrane may be installed through a cast iron sleeve with caulking recess, anchor lugs, flashing-clamp device, and pressure ring with brass bolts. Flashing shield shall be fitted into the sleeve clamping device. Pipes passing through wall waterproofing membrane shall be sleeved as described above. A waterproofing clamping flange shall be installed.

3.10.3 Waterproofing

NOTE: Drawings will detail method of attaching waterproofing membranes to sleeves passing through walls or floors that are subject to a static head of water.

Waterproofing at floor-mounted water closets shall be accomplished by forming a flashing guard from soft-tempered sheet copper. The center of the sheet shall be perforated and turned down approximately 40 mm 1-1/2 inches to fit between the outside diameter of the drainpipe and the inside diameter of the cast-iron or steel pipe sleeve. The turned down portion of the flashing guard shall be embedded in sealant to a depth of approximately 40 mm 1-1/2 inches; then the sealant shall be finished off flush to floor level between the flashing guard and drainpipe. The flashing guard of sheet copper shall extend not less than 200 mm 8 inches from the drainpipe and shall be lapped between the floor membrane in a solid coating of bituminous cement. If cast-iron water closet floor flanges are used, the space between the pipe sleeve and drainpipe shall be sealed with sealant and the flashing guard shall be upturned approximately 40 mm 1-1/2 inches to fit the outside diameter of the drainpipe and the inside diameter of the water closet floor flange. The upturned portion of the sheet fitted into the floor flange shall be caulked to form a seal.

3.10.4 Optional Counterflashing

Instead of turning the flashing down into a dry vent pipe, or caulking and sealing the annular space between the pipe and flashing or metal-jacket covered insulation and flashing, counterflashing may be accomplished by utilizing the following:

- a. A standard roof coupling for threaded pipe up to 150 mm 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

3.11 FIRE SEAL

NOTE: Normally, fire walls and fire partitions will be designated on the architectural drawings.

Where pipes pass through fire walls, fire partitions, fire rated pipe chase walls or floors above grade, a fire seal shall be provided as specified in Section 07 84 00 FIRESTOPPING.

3.12 SUPPORTS

Hangers used to support piping 50 mm 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement when operating temperatures exceed ambient temperatures shall be supported by variable spring hangers and supports or by constant support hangers. In the support of multiple pipe runs on a common base member, a clip or clamp shall be used where each pipe crosses the base support member. Spacing of the base support members shall not exceed the hanger and support spacing required for an individual pipe in the multiple pipe run.

3.12.1 Pipe Supports and Structural Bracing, Seismic Requirements

NOTE: Provide seismic requirements for piping and related equipment supports and show on the drawings.

Piping and attached valves shall be supported and braced to resist seismic loads as [specified in UFC 3-310-04 and Sections 13 48 00 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 13 48 00.00 10 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT] [shown on the drawings]. Structural steel required for reinforcement to properly support piping, headers, and equipment but not shown shall be provided. Material used for supports shall be as specified in Section 05 12 00 STRUCTURAL STEEL.

3.12.2 Pipe Hangers, Inserts, and Supports

NOTE: Mechanical and electrical layout drawings and specifications for ceiling suspensions should contain notes indicating that hanger loads between

panel points in excess of 222 Newtons (50 pounds)
shall have the excess hanger loads suspended from
panel points.

Pipe hanger, insert and support installation shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

- a. Types 5, 12, and 26 shall not be used.
- b. Type 3 shall not be used on insulated pipe.
- c. Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for type 18 inserts.
- d. Types 19 and 23 C-clamps shall be torqued in accordance with MSS SP-69 and have both locknuts and retaining devices, furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.
- e. Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.
- f. Type 24 may be used only on trapeze hanger systems or on fabricated frames.
- g. Type 39 saddles shall be used on insulated pipe 100 mm 4 inches and larger when the temperature of the medium is 16 degrees C 60 degrees F or higher. Type 39 saddles shall be welded to the pipe.
- h. Type 40 shields shall:
 - (1) Be used on insulated pipe less than 100 mm 4 inches
 - (2) Be used on insulated pipe 100 mm 4 inches and larger when the temperature of the medium is 16 degrees C 60 degrees F or less.
 - (3) Have a high density insert for all pipe sizes. High-density inserts shall have a density of 144 kg per cu. meter 9 pcf or greater.
- i. Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 300 mm 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 meters 5 feet apart at valves. Operating temperatures of 49 degrees C 120 degrees F for PVC pipe and 82 degrees C 180 degrees F for CPVC shall be used in determining hanger spacing for PVC or CPVC pipe. Horizontal pipe runs shall include allowances for expansion and contraction.
- j. Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 5 meters 15 feet, nor more than 2 meters 8 feet from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and contraction.
- k. Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided to allow longitudinal pipe

movement. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered. Lateral restraints shall be provided as needed. Where steel slides do not require provisions for lateral restraint, the following may be used:

- (1) On pipe 100 mm 4 inches and larger when the temperature of the medium is 16 degrees C 60 degrees F or higher, a Type 39 saddle, welded to the pipe, may freely rest on a steel plate.
- (2) On pipe less than 100 mm 4 inches, a Type 40 shield, attached to the pipe or insulation, may freely rest on a steel plate.
- (3) On pipe 100 mm 4 inches and larger carrying medium less than 16 degrees C 60 degrees F, a Type 40 shield, attached to the pipe or insulation, may freely rest on steel plate.

l. Pipe hangers on horizontal insulated pipe shall be the size of the outside diameter of the insulation. The insulation shall be continuous through the hanger on all pipe sizes and applications.

m. Where there are high system temperatures and welding to piping is not desirable, the type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 100 mm 4 inches, or by an amount adequate for the insulation, whichever is greater.

3.13 WELDED INSTALLATION

Plumbing pipe weldments shall be as indicated. Changes in direction of piping shall be made with welding fittings only; mitering or notching pipe to form elbows and tees or other similar type construction will not be permitted. Branch connection may be made with either welding tees or forged branch outlet fittings. Branch outlet fittings shall be forged, flared, flared for improvement of flow where attached to the run, and reinforced against external strains. Beveling, alignment, heat treatment, and inspection of weld shall conform to ASME B31.1. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded. After filler metal has been removed from its original package it shall be protected or stored so that its characteristics or welding properties are not affected. Electrodes that have been wetted or that have lost any of their coating shall not be used. Threaded sections of rods shall not be formed or bent.

3.14 PIPE CLEANOUTS

NOTE: Specify cast-iron adjustable heads where heads are subject to loads, cleaning agents, and chemicals which will destroy heads made of plastic materials.

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm 4 inches will not be required. A cleanout installed in connection with cast-iron soil pipe shall consist of a long-sweep 1/4 bend or one or two 1/8 bends extended to the place shown. An extra heavy cast-brass or cast-iron ferrule with countersunk cast-brass head screw plug shall be caulked into the hub of the fitting and shall be flush with the floor. Cleanouts in connection with other pipe, where

indicated, shall be T-pattern, 90-degree branch drainage fittings with cast brass screw plugs, except plastic plugs shall be installed in plastic pipe. Plugs shall be the same size as the pipe up to and including 100 mm 4 inches. Cleanout tee branches with screw plug shall be installed at the foot of soil and waste stacks, at the foot of interior downspouts, on each connection to building storm drain where interior downspouts are indicated, and on each building drain outside the building. Cleanout tee branches may be omitted on stacks in single story buildings with slab-on-grade construction or where less than 450 mm 18 inches of crawl space is provided under the floor. Pipe cleanouts concealed in partitions shall be provided with chromium-plated bronze, nickel bronze, nickel brass or stainless steel flush type access cover plates. Round access covers shall be provided and secured to plugs with securing screw. Square access covers may be provided with matching frames, anchoring lugs and cover screws. Cleanouts in finished walls shall have access covers and frames installed flush with the finished wall. Cleanouts installed in finished floors subject to foot traffic shall be provided with a chrome-plated cast brass, nickel brass, or nickel bronze cover secured to plug or cover frame and set flush with the finished floor. Heads of fastening screws shall not project above the cover surface. Where cleanouts are provided with adjustable heads, the head cleanouts shall be provided with adjustable cast iron or plastic heads.

3.15 VALVES, OUTLETS, AND DISPENSERS

3.15.1 Thermostatic Mixing Valve and Cabinet

The assembly, when not installed in a cabinet, shall be mounted 1.372 meters 4 feet 6 inches above the floor. When a cabinet is used, bottom of cabinet shall be set approximately 1.2 meters 4 feet above finished floor. Cabinet doors shall not offer any obstruction when opened. Anchors shall be provided for fastening cabinet in place. Valves located in pipe corridors for tempering water for neuropsychiatric patient showers shall have a maximum outlet temperature of 48 degrees C 118 degrees F, and valves for neuropsychiatric patient lavatories shall have a maximum outlet temperature of 41 degrees C 105 degrees F.

3.15.2 Medical Gas and Vacuum Station Outlets

Medical gas and vacuum outlets shall be as specified for surgical dispensers for medical gas and vacuum systems. Valves shall be as recommended for the intended service by the valve manufacturer. Bracket shall be designed to accommodate a 1.91 liter 2 quart capacity bottle equipped with float cutoff. The bracket shall be installed at the left of each station outlet. Vacuum station outlets not capable of supporting a 1.91 liter 2 quart capacity bottle equipped with float cutoff shall have a slide bracket installed adjacent to each station outlet. Brackets shall be made of aluminum in accordance with AIST PB-224, Series 300 polished corrosion-resisting steel.

3.15.3 Nitrous Oxide, Oxygen, and Nitrogen Systems

Manifold shall be overhead type mounted on an I-beam or bolted to the wall. A check valve shall be provided between each cylinder head and the manifold header. Each header shall be connected to the manifold controls with shutoff valves. The relief valve shall be vented to the outside atmosphere if the total capacity of the system is more than 57 cubic meters 2,000 cubic feet of gas. Venting shall be accomplished by piping the relief valve to the outside atmosphere or by approved ductwork having a minimum opening of 0.047 square meters 72 square inches. The manifold

shall be installed according to the manufacturer's recommendation and as required by NFPA 99.

3.15.4 Surgical Dispensers for Medical Gas and Vacuum Systems

3.15.4.1 Automatic Valves

Automatic valves shall be easily accessible for servicing and replacement, and locations shall facilitate line blowout, purging, and testing. Test the systems to assure that proper flows and purity of gases or vacuums can be obtained at each outlet. Unit shall be provided with a capped stub length of 6 or 10 mm 1/4 or 3/8 inch OD tubing, at least 150 mm 6 inches long, for connection to supply.

3.15.4.2 Wall Outlets

Wall outlets shall be located 1.5 meters 60 inches from finished floor or as indicated. Where wall-type oxygen outlet is installed adjacent to other service outlets, 125 mm 5 inches minimum center-to-center spacing shall be maintained for attaching and detaching equipment. Station outlet back boxes shall be permanently stamped with the gas or vacuum service identification and shall be safety-keyed to accept only the appropriate gas or vacuum faceplate.

3.15.4.3 DISS Connections

Where threaded connections are furnished, DISS connections as described in CGA V-5 shall be used to provide noninterchangeable connections. In order to facilitate connection making, the threads of the connection shall engage before the check valve is depressed and pressure is allowed to enter the attached fitting. No leakage shall occur when threads are fingertight.

3.15.4.4 Connector Height of Outlets

Connector height of operating and delivery room outlets and wall outlets shall terminate 2 meters 6 feet 8 inches above the finished floor or, in the case of the hose-reel type, a pull-down chain shall be attached to the hose and shall terminate 2 meters 6 feet 8 inches above the floor. Recessed-wall type hose reels shall be located 1.5 meters 5 feet above finished floor.

3.15.4.5 Room Outlets

Rooms other than operating and delivery rooms shall have recessed wall type outlets installed, unless specified otherwise under special equipment covered in other sections of these specifications.

3.15.4.6 Service-Control Valve Cabinets

Service-control valve cabinets shall be installed in partitions separating operating and delivery rooms from the corridor. The cabinets shall be recess mounted on the corridor side of the partition. Cabinets shall house alarm system sensors, zone control valves, pressure reducing valves, and service control valves. The valves shall be installed in the cabinet 1.5 meters 5 feet above the floor at the center line of the box and shall provide complete shutoff of each of the medical gas and vacuum service outlets in the operating and delivery rooms. Valves and exposed piping connecting the valves shall be enameled or identified in an approved manner with colors as follows:

System	Color
Compressed Air	Yellow
Oxygen	Green
Nitrogen	Black
Nitrous Oxide.....	Blue
Vacuum	White

Each valve shall be securely mounted in a fixed position by means of brackets. Position of each valve shall allow for a firm grip to facilitate easy closing and opening. Each valve or valve box shall be labeled in substance as follows:

"Caution - (Name of applicable system) Valves. Do not close except in emergency. This valve controls (Name of applicable system) to [____]."

3.16 ORAL EVACUATION VACUUM SYSTEM INSTALLATION

3.16.1 Installation and Startup

HVE, HIVAC, and HVEL system installation shall be approved by factory trained personnel. System startup shall be performed by factory trained personnel.

3.16.2 Vacuum Turbine Units

Shutoff valve shall be installed on the suction and discharge of each turbine. Check valve shall be installed on each turbine discharge. Piping connections shall be made with flexible fittings.

3.16.3 Central Separator

The separator shall be located so that the lower canister can be removed easily and cleaned. The separator shall be equipped with a cut-off valve to permit shutdown when the system is not in use. Piping shall be of corrosion-resistant material, with a smooth internal surface, and shall not collapse when installed in a vacuum system evacuated to 27 kPa 8 inches of mercury. Piping shall be cut square, with burrs removed and installed with minimum of obstructions to air flow. Fittings, supports, and joint assembly shall be of approved type. The assembled piping system shall be suitable for the vacuum requirement specified above. Fittings shall be long radius type, except wye type shall be utilized for branches. Piping shall slope not less than 9 mm per meter 1/8 inch per foot to separators. Coupling, unions, and other disconnecting couplings shall be readily accessible.

3.16.4 Field Instructions

Upon completion of the work, and at a time designated by the Contracting Officer, provide the services of one or more competent engineers for [1 day] [[____] days] to instruct a representative of the Government in the operation and maintenance of the oral evacuation system. These field instructions shall cover the items contained in the bound instructions.

3.17 FIXTURES AND FIXTURE TRIMMINGS

Polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. Angle stops, straight stops, stops integral with the faucets, or concealed type of lock-shield, and loose-key pattern stops for supplies with threaded, or sweat inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beaded tool shall be used to mechanically deform the tubing above the compression fittings. Exposed traps and supply pipes for fixtures and equipment shall be connected to the rough piping systems at the wall, unless otherwise specified under the item. Floor and wall escutcheons shall be as specified. Drain lines and hot water lines of fixtures for handicapped personnel shall be insulated and do not require polished chrome finish. Plumbing fixtures and accessories shall be installed within the space shown. Stops for water closet seats shall be installed on the wall.

3.17.1 Fixture Connections

Where space limitations prohibit standard fittings in conjunction with the cast-iron floor flange, special short-radius fittings shall be provided. Connections between earthenware fixtures and flanges on soil pipe shall be made gastight and watertight with a closet-setting compound or neoprene gasket and seal. Use of natural-rubber gaskets or putty will not be permitted. Fixtures with outlet flanges shall be set the proper distance from floor or wall to make a first-class joint with the closet-setting compound or gasket and fixture used.

3.17.2 Flushometer Valves

NOTE: Delete sentence describing location of flush valve handle when an automatic flushing system is provided.

Flushometer valves shall be secured to prevent movement by anchoring the long finish connection to top spud adjacent to valve, to the wall with approved metal bracket. [Flushometer valves for water closets shall be installed 1 m 39 inches above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 762 mm 30 inches above the floor and arranged to avoid interference with grab bars. In addition, for water closets intended for handicap use, the flush valve handle shall be installed on the wide side of the enclosure.]

3.17.3 Height of Fixture Rims Above Floor

Lavatories shall be mounted with rim 775 mm 31 inches above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1.05 meters 42 inches above floor. Wall-hung service sinks shall be mounted with rim 700 mm 28 inches above the floor. Installation of fixtures for use by the physically handicapped shall conform to ICC A117.1.

3.17.4 Shower Bath Outfits

The area around the water supply piping to the mixing valves and behind the escutcheon plate shall be made watertight by caulking or gasketing.

3.17.5 Fixture Supports

NOTE: Project drawings will detail methods of hanging lavatories and wall-hung urinals. Normally, these fixtures will be supported by one of the methods described.

Fixture supports for off-the-floor lavatories, urinals, water closets, and other fixtures of similar size, design, and use, shall be of the chair carrier type. The carrier shall provide the necessary means of mounting the fixture, with a foot or feet to anchor the assembly to the floor slab. Adjustability shall be provided to locate the fixture at the desired height and in proper relation to the wall. Support plates, in lieu of chair carrier, shall be fastened to the wall structure only where it is not possible to anchor a floor-mounted chair carrier to the floor slab.

3.17.5.1 Concrete or Solid Masonry Construction

Chair carrier shall be anchored to the floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be imbedded in the masonry wall.

3.17.5.2 Cellular-Masonry Wall Construction

Chair carrier shall be anchored to floor slab. Where a floor-anchored chair carrier cannot be used, a suitable wall plate shall be fastened to the cellular wall using through bolts and a back-up plate.

3.17.5.3 Steel Stud Frame Partitions

Chair carriers shall be used. The anchor feet and tubular uprights shall be of the heavy duty design. Feet (bases) shall be steel and welded to a square or rectangular steel tube upright. Wall plates, in lieu of floor-anchored chair carriers, may be used only if adjoining steel partition studs are suitably reinforced to support a wall plate bolted to these studs.

3.17.5.4 Wood Stud Construction

Where entire construction is wood, wood crosspieces shall be installed. Fixture hanger plates, supports, brackets, or mounting lugs shall be fastened with not less than No. 10 wood screws, 6 mm 1/4 inch thick minimum steel hanger, or toggle bolts with nut. The wood crosspieces shall extend the full width of the fixture and shall be securely supported.

3.17.5.5 Wall-Mounted Water Closet Gaskets

When wall-mounted water closets are provided, reinforced wax, treated felt, or neoprene gaskets shall be provided. The type of gasket furnished shall be as recommended by the chair carrier manufacturer.

3.17.6 Backflow Prevention Devices

Plumbing fixtures, equipment, and pipe connections shall not cross connect or interconnect between a potable water supply and any source of nonpotable water. Backflow preventers shall be installed where indicated and in accordance with ICC IPC at all other locations necessary to preclude a

cross-connect or interconnect between a potable water supply and any nonpotable substance. In addition backflow preventers shall be installed at all locations where the potable water outlet is below the flood level of the equipment, or where the potable water outlet will be located below the level of the nonpotable substance. Backflow preventers shall be located so that no part of the device will be submerged. Backflow preventers shall be of sufficient size to allow unrestricted flow of water to the equipment, and preclude the backflow of any nonpotable substance into the potable water system. Bypass piping shall not be provided around backflow preventers. Access shall be provided for maintenance and testing. Each device shall be a standard commercial unit.

3.17.7 Access Panels

Access panels shall be provided for concealed valves and controls or any item requiring inspection or maintenance. Access panels shall be of sufficient size and located so that the concealed items may be serviced, maintained, or replaced. Access panels shall be as specified in Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS.

3.17.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm 2 inches above the flood rim of the funnel to provide an acceptable air gap.

3.17.9 Traps

Each trap shall be placed as near the fixture as possible, and no fixture shall be double-trapped. Traps installed on cast iron soil pipe shall be cast iron. Traps installed on steel pipe or copper tubing shall be recess-drainage pattern, or brass-tube type. Traps for acid-resisting waste shall be of the same material as the pipe.

3.17.10 Shower Pans

NOTE: Shower pans will be shown on the architectural details. Shower pans may be omitted for showers located on floors with slab-on-grade construction, unless special local conditions necessitate waterproofing. Pans will be omitted in toilet facilities of patient rooms.

Before installing shower pan, subfloor shall be free of projections such as nail heads or rough edges of aggregate. Drain shall be a bolt-down, clamping-ring type with weepholes, installed so the lip of the subdrain is flush with subfloor. The floor of each individual shower, the shower area portion of combination shower and drying room, and the entire shower and drying room where the two are not separated by curbing or partition shall be made watertight with a shower pan fabricated in place. The shower pan material shall be cut to size and shape of the area indicated, in one piece to the maximum extent practicable, allowing a minimum of 150 mm 6 inches for turnup on walls or partitions, and shall be folded over the curb with an approximate return of 1/4 of curb height. The upstands shall be placed behind any wall or partition finish. Subflooring shall be smooth and clean, with nail heads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drain with the drain clamping ring.

3.17.10.1 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flat-lock seam and soldered or burned. The corners shall be folded, not cut, and the corner seam shall be soldered or burned. Pans, including upstands, shall be coated on all surfaces with one brush coat of asphalt. Asphalt shall be applied evenly at not less than **1 liter per square meter 1 gallon per 50 square feet**. A layer of felt covered with building paper shall be placed between shower pans and wood floors. The joining surfaces of metal pan and drain shall be given a brush coat of asphalt after the pan is connected to the drain.

3.17.10.2 Nonplasticized Chlorinated Polyethylene Shower Pans

Corners of nonplasticized chlorinated polyethylene shower pans shall be folded against the upstand by making a pig-ear fold. Hot-air gun or heat lamp shall be used in making corner folds. Each pig-ear corner fold shall be nailed or stapled **15 mm 1/2 inch** from the upper edge to hold it in place. Nails shall be galvanized large-head roofing nails. On metal framing or studs, approved duct tape shall be used to secure pig-ear fold and membrane. Where no backing is provided between the studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding **13 mm 1/2 inch** from upper edge. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Surfaces to be solvent-welded shall be clean. Surfaces to be joined with xylene shall be initially sprayed and vigorously cleaned with a cotton cloth, followed by final coating of xylene and the joining of the surfaces by roller or equivalent means. If ambient or membrane temperatures are below **4 degrees C 40 degrees F**, the membrane and the joint shall be heated prior to application of xylene. Heat may be applied with hot-air gun or heat lamp, taking precautions not to scorch the membrane. Adequate ventilation and wearing of gloves are required when working with xylene. Membrane shall be pressed into position on the drain body, and shall be cut and fit to match so that membrane can be properly clamped and an effective gasket-type seal provided. On wood subflooring, two layers of **0.73 kg per sq. meter 15 lb. per 100 sq. feet** dry felt shall be installed prior to installation of shower pans to assure a smooth surface for installation.

3.17.10.3 Plasticized Polyvinyl Chloride (PVC) Shower Pans

Plasticized PVC shall be turned up behind walls or wall surfaces a distance of not less than **150 mm 6 inches** in room areas and **75 mm 3 inches** above curb level in curbed spaces with sufficient material to fold over and fasten to outside face of curb. Corners shall be pig-ear type and folded between pan and studs. Only top **25 mm 1 inch** of upstand shall be nailed to hold in place. Nails shall be galvanized large-head roofing type. Approved duct tape shall be used on metal framing or studs to secure pig-ear fold and membrane. Where no backing is provided between studs, the membrane slack shall be taken up by pleating and stapling or nailing to studding at top inch of upstand. To adhere the membrane to vertical surfaces, the back of the membrane and the surface to which it will be applied shall be coated with adhesive that becomes dry to the touch in 5 to 10 minutes, after which the membrane shall be pressed into place. Trim for drain shall be exactly the size of drain opening. Bolt holes shall be pierced to accommodate bolts with a tight fit. Adhesive shall be used between pan and subdrain. Clamping ring shall be bolted firmly. A small

amount of gravel or porous material shall be placed at weepholes so that holes remain clear when setting bed is poured. Membrane shall be solvent welded with PVC solvent cement. Surfaces to be solvent welded shall be cleaned free of grease and grime. Sheets shall be laid on a flat surface with an overlap of about 50 mm 2 inches. Top edge shall be folded back and surface primed with a PVC primer. PVC cement shall be applied and surfaces placed together at once, while still wet. Joint shall be lightly rolled with a paint roller, then as the joint sets shall be rolled firmly but not so hard as to distort the material. On long lengths, about 600 or 900 mm 2 or 3 feet at a time shall be welded. On wood subflooring, two layers of 0.73 kg per sq. meter 15 psf felt shall be installed prior to installation of shower pan to assure a smooth surface installation.

3.18 VIBRATION-ABSORBING FEATURES

NOTE: Designer will indicate on the drawings where equipment should be mounted resiliently. Details for proper mounting of equipment will be indicated on the drawings. Designer will insert required isolation efficiency in the blank space for installations where specific values for reduction of noise and vibration transmission are necessary; otherwise the sentence will be deleted. For areas where the maximum tolerable transmissibility in percent is considered necessary, the isolation efficiency will be given. Recommended transmissibility in percentages is as follows: 10 percent for equipment mounted in very critical areas, 10 to 20 percent for critical areas, and 20 to 40 percent for noncritical areas. The drawings should be checked to ensure that all structural and equipment connection factors or conditions surrounding the equipment, which are to be provided with vibration isolation units, favorably influence the effectiveness of the isolators. Where many items of equipment require different transmission values because of different equipment locations, the specification may be revised to indicate the appropriate values on the drawings.

Delete submittal of vibration-absorption features when not required.

Mechanical equipment, including compressors and pumps, shall be isolated from the building structure by approved vibration-absorbing features unless otherwise shown. Each foundation shall include standard isolation units as indicated. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed loading rating. Piping connected to mechanical equipment shall be provided with flexible connectors. Isolation unit installation shall limit vibration to [_____] percent of the lowest equipment rpm.

3.18.1 Tank or Skid Mounted Compressors

Floor attachment shall be as recommended by compressor manufacturer. Compressors shall be mounted to resist seismic loads as specified in UFC

3.18.2 Foundation Mounted Compressors

[Foundation attachment shall be as recommended by the compressor manufacturer.] [Foundation shall be as recommended by the compressor manufacturer, except the foundation shall weigh not less than three times the weight of the moving parts.] Compressors shall be mounted to resist seismic loads as specified above.

3.19 WATER HEATERS AND HOT WATER STORAGE TANKS

3.19.1 Relief Valves

NOTE: A discharge pipe the full size of the relief valve outlet will be shown connected to the outlet and shown on the drawings terminated at a safe location. The discharge pipe should not be directly connected to the drainage system and will conform to the requirements of the International Plumbing Code (for commercial and industrial hot water heaters ASME BPVC SEC IV also applies).

Valves shall not be installed between a relief valve and its water heater or storage tank. The relief valves shall be installed where the valve actuator comes in contact with the hottest water in the heater or tank. Whenever possible, the valve shall be installed directly in a tapping in the tank or heater. When heaters are not provided with a relief valve tapping, the valve shall be installed in the hot water outlet piping. A vacuum relief valve shall be provided on the cold water supply line to the hot water storage tank or water heater and mounted above and within 150 mm 6 inches of the tank or water heater.

3.19.2 Gas and Oil Fired Water Heaters

Installation shall conform to NFPA 54 for gas fired and NFPA 31 for oil fired. [A phenolic resin coating shall be provided.]

3.19.3 Storage Water Heaters

Storage water heaters that are not equipped with integral heat traps and having vertical pipe risers shall be installed with heat traps directly on both the inlet and outlets. Circulating systems need not have heat traps installed. An acceptable heat trap may be a piping arrangement such as elbows connected so that the inlet and outlet piping make vertically upward runs of not less than 600 mm 24 inches just before turning downward or directly horizontal into the water heater's inlet and outlet fittings. Commercially available heat traps, specifically designed by the manufacturer for the purpose of effectively restricting the natural tendency of hot water to rise through vertical inlet and outlet piping during standby periods, may also be approved. [A phenolic resin coating shall be provided.]

3.19.4 Heat Traps

NOTE: Piping arrangement for the heat trap should be shown on the drawings.

Piping to and from each water heater and hot water storage tank shall be routed horizontally or downward a minimum of 600 mm 2 feet before turning in an upward direction.

3.19.5 Connections to Water Heaters

Connections to water heaters and metallic pipe shall be made with dielectric unions or flanges.

3.19.6 Expansion Tank

A precharged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. Adjust the expansion tank air pressure as recommended by the tank manufacturer to match incoming water pressure.

3.20 IDENTIFICATION SYSTEMS

3.20.1 Identification Tags

NOTE: Delete when identification tags are not considered necessary on small projects.

Identification tags made of brass, engraved laminated plastic, or engraved anodized aluminum, indicating service and valve number, shall be installed on valves, except those valves installed on supplies at plumbing fixtures. Tags shall be 35 mm 1-3/8 inch minimum diameter, and marking shall be stamped or engraved. Indentations shall be black, for reading clarity. Tags shall be attached to valves with No. 12 AWG, copper wire, chrome-plated beaded chain, or plastic straps designed for that purpose.

3.20.2 Color Coding

NOTE: Designer will coordinate color code marking with Section 09 90 00 PAINTS AND COATINGS. Color code marking for piping not listed in Table I of Section 09 90 00, will be added to the table.

Color coding for piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.20.3 Color Coding Scheme for Locating Hidden Utility Components

NOTE: The Color Code Table will be developed to suit the installation. The colors of metal disks used in Army projects will be as directed by the Facilities Engineer. Identification plate specified in Section 09 51 00 ACOUSTICAL CEILINGS will be deleted if color coding scheme is specified.

Scheme shall be provided in buildings having suspended grid ceilings. The color coding scheme shall identify points of access for maintenance and operation of operable components which are not visible from the finished space and installed in the space directly above the suspended grid ceiling. The operable components shall include valves, dampers, switches, linkages and thermostats. The color coding scheme shall consist of a color code board and colored metal disks. Each colored metal disk shall be approximately 9.5 mm 3/8 inch in diameter and secured to removable ceiling panels with fasteners. The fasteners shall be inserted into the ceiling panels so that the fasteners will be concealed from view. The fasteners shall be manually removable without tools and shall not separate from the ceiling panels when panels are dropped from ceiling height. Installation of colored metal disks shall follow completion of the finished surface on which the disks are to be fastened. The color code board shall have the approximate dimensions of 1 meter 3 foot width, 750 mm 2 foot 6 inch height, and 13 mm 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 19 mm 3/4 inch in diameter and the related lettering in 13 mm 1/2 inch high capital letters. The color code board shall be mounted and located in the mechanical or equipment room. The color code system shall be as indicated below:

Color	System	Item	Location
[_____]	[_____]	[_____]	[_____]

3.21 ESCUTCHEONS

Escutcheons shall be provided to finished surfaces where bare or insulated piping exposed to view passes through floors, walls, or ceilings, except in boiler, utility, or equipment rooms. Escutcheons shall be fastened securely to pipe or pipe covering and shall be satin finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one piece or split-pattern, held in place by internal spring tension or setscrew.

3.22 PAINTING

Painting of pipes, hangers, supports, and other iron work, in concealed spaces or exposed, is specified in Section 09 90 00 PAINTS AND COATINGS.

3.23 FRAMED INSTRUCTIONS

Framed instructions under glass or in laminated plastic, including wiring and control diagrams showing the complete layout of the entire system, shall be posted where directed. Condensed operating instructions explaining preventive maintenance procedures, methods of checking the system for normal safe operation, and procedures for safely starting and stopping the system shall be prepared in typed form, framed as specified above for the wiring and control diagrams and posted beside the diagrams. The framed instructions shall be posted before acceptance testing of the systems.

3.24 TESTS, FLUSHING AND DISINFECTION

NOTE: Some facilities may require a

conditioning/flushing of water fountains and faucets that are listed as end point devices by NSF 61, Section 9. This is to meet possible customer expectations that these devices produce drinking water that meets the lead leaching requirements of NSF 61 immediately upon beneficial occupancy. If the customer is not willing to allow the end point devices to "self-condition" after project turn-over, then the designer should edit the paragraph titled System Flushing, requiring the Contractor to flush the drinking water fountains and faucets.

3.24.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with ICC IPC, except that the drainage and vent system final test shall include the smoke test. The Contractor has the option to perform a peppermint test in lieu of the smoke test. If a peppermint test is chosen, submit a testing procedure to the Contracting Officer for approval.

- a. Drainage and Vent Systems Tests.
- b. Building Sewers Tests.
- c. Water Supply Systems Tests.

3.24.1.1 Test of Backflow Prevention Assemblies

Backflow prevention assembly shall be tested using gauges specifically designed for the testing of backflow prevention assemblies. Gauges shall be tested annually for accuracy in accordance with the University of Southern California's Foundation of Cross Connection Control and Hydraulic Research of the American Water Works Association Manual of Cross Connection Control (Manual M-14). Report form for each assembly shall include, as a minimum, the following:

Data on Device	Data on testing Firm
Type of Assembly	Name
Manufacturer	Address
Model Number	Certified Tester
Serial Number	Certified Tester No.
Size	Date of Test
Location	
Test Pressure Readings	Serial Number and Test Date of
Gauges	

If the unit fails to meet specified requirements, the unit shall be repaired and retested.

3.24.1.2 Shower Pans

After installation of the pan and finished floor, the drain shall be temporarily plugged below the weep holes. The floor area shall be flooded with water to a minimum depth of 25 mm 1 inch for a period of 24 hours. Any drop in the water level during test, except for evaporation, shall be reason for rejection, repair, and retest.

3.24.1.3 Compressed Air Piping (Non-Oil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 1.034 MPa 150 psig and pressure maintained for 2 hours with no drop in pressure.

3.24.1.4 Compressed Air Piping (Oil-Free)

Piping systems shall be filled with gaseous nitrogen to 1.034 MPa 150 psig and pressure maintained for a minimum of 2 hours without requiring additional nitrogen. In lieu of gaseous nitrogen, oil-free dry air specially filtered may be utilized. At point of introduction into piping system, the oil-free dry air shall be injected through a three-stage filtering assembly consisting of a 5 micrometer prefilter, and a two-stage combination microcoalescer and filtration unit utilizing activated charcoal granules for capture of oil vapors. The filtering assembly shall be rated to remove 99.99998 percent of any oil, water, and solid particles 0.03 micrometers or larger present in the air.

3.24.2 Medical Gas and Vacuum Piping

Medical gas and vacuum piping systems shall be cleaned, pressure tested, cross-connection tested, purged, and final tested in accordance with NFPA 99.

3.24.3 High-Purity Water (De-ionized or Distilled) System

The high-purity water systems shall be flushed and tested as specified, except that high-purity water [obtained from the operational testing of the reverse osmosis water treatment system] [provided by the Contractor] shall be utilized for flushing, pressure testing, and disinfection. Piping systems shall be disinfected by chlorination as specified. Final flushing shall also utilize high-purity water. Testing connections to special medical equipment shall be as indicated, as specified, and in accordance with equipment manufacturer's instructions.

3.24.4 Oral Evacuation Vacuum System for Dental Operatories

Perform tests under the supervision of a competent engineer who has had at least 5 years experience installing and testing central high-volume evacuation systems for dental operatories. Prepare and submit a test schedule and a testing procedure to the Contracting Officer for approval. Furnish test materials, piping or tubing, equipment, and instruments. Calibrate test instruments at a qualified independent laboratory. Test shall be witnessed by the Contracting Officer.

3.24.4.1 Testing of Piping for Leaks

The completed piping system between turbine suction connection and operating separator connections shall be exhausted down to a vacuum of not less than 27 kPa 8 inches of mercury after initial drying out of pipeline. The pressure shall not increase by more than 1.4 kPa 0.4 inches of mercury in 1 hour. In the event vacuum does not hold, leaks shall be located and repaired, and testing redone until the required vacuum holds.

3.24.4.2 Air Flow and Vacuum Tests

Air flow and vacuum tests shall be performed to confirm that the system can meet vacuum and air flow requirements at aspirator tips and that vacuum turbines can produce the required capacity. Testing shall be performed

after equipment is properly installed, and piping cleaned and proved tight. A nominal 10 mm 3/8 inch internal diameter tube of 1.5 meters 5 feet minimum length shall be installed temporarily at each dental operatory water-air separator inlet connection. In the event water-air separator is not installed or available for connection, an 8 mm 5/16 inch internal diameter tube of 1.5 meters 5 feet minimum length shall be connected temporarily to each water-air separator discharge connection point. Tubes shall have smooth internal bore and shall be suitable for maximum system vacuum. Required fittings and valves for connection of air flow gauges, vacuum gauges, and air flow adjustment and shut off devices shall be provided with tubes. Each tube shall handle a minimum of [_____] standard L/second standard cfm of air flow and a suitable vacuum gauge shall be installed temporarily on the suction of each vacuum turbine. Tests shall start after the system has been operated and dried out. Tests shall be conducted for a period of not less than 2 hours. Testing shall be done with one turbine operating and then with both turbines operating. When one turbine operates, testing shall be done at [_____] tubes and the other tubes shall be closed or blanked. On testing with two turbines, testing shall be done at [_____] tubes and other tubes shall be closed or blanked.

3.24.4.3 Recorded Test Data

Air flow, vacuum readings of each tube, and vacuum of the turbine suctions shall be recorded in 10-minute intervals. Three copies of recorded test data shall be furnished to the Contracting Officer.

3.24.4.4 General Operating Tests

General operating tests shall be conducted during or after air flow and vacuum tests to ensure that the turbines start up and cycle properly. In addition, each operatory tube shall be tested with at least 1 liter 1 quart of water to assure proper separation after the water is pulled into the evacuation system.

3.24.5 Phenolic Resin Coatings

A certificate of compliance shall be submitted by the coating manufacturer that documents successful use of coating system under service conditions indicated on the drawings for a minimum of 2 years at three different locations and that certifies that the coating material and application comply with the testing procedures outlined in this specification.

3.24.5.1 Test Panels

Test panels shall be prepared in accordance with ASTM D 609. If steel test panels are utilized, the steel substrate shall be 0.607 mm 24 gauge in thickness. The panels shall be coated with one coat wash primer, then pigmented baking phenolic to a dry film thickness of 0.1016 to 0.1524 mm 0.004 to 0.006 inch, then clear baking phenolic to a total dry film thickness of 0.1270 to 0.1778 mm 0.005 to 0.007 inch. The panels shall then be subjected to the tests specified in the following paragraphs.

3.24.5.2 Heat Test

A coated test panel shall show no cracking, flaking, or other failure after the panel has been tested in accordance with ASTM D 2485, with a furnace temperature of 204 degrees C 400 degrees F.

3.24.5.3 Abrasion Test

A coated test panel shall show no more than a 40 milligram loss when tested in accordance with [ASTM D 4060](#), utilizing a Tabor Abraser CS-17F wheel with a 1000 g. weight for 1000 cycles.

3.24.5.4 Corrosion Test

A coated test panel shall show no corrosion after being subjected to a 500 hour salt spray test in accordance with [ASTM B 117](#).

3.24.6 Defective Work

If inspection or test shows defects, such defective work or material shall be replaced or repaired as necessary and inspection and tests shall be repeated. Repairs to piping shall be made with new material. Caulking of screwed joints or holes will not be acceptable.

3.24.7 System Flushing

3.24.7.1 During Flushing

Before operational tests or disinfection, potable water piping shall be flushed. Sufficient water shall be used to produce water velocity that is capable of entraining and removing debris in all portions of the piping system. This requires simultaneous operation of all fixtures on a common branch or main in order to produce a flushing velocity of approximately [1.2 m/sec](#) [4 fps](#) through all portions of the piping system. In the event that this is impossible due to the size of the system, the Contracting Officer (or designated representative) shall specify the number of fixtures to be operated during flushing. Provide adequate personnel to monitor the flushing operation and to ensure that drain lines are unobstructed in order to prevent flooding of the facility. Contractor shall be responsible for any flood damage resulting from flushing of the system. Flushing shall be continued until entrained dirt and other foreign materials have been removed and until discharge water shows no discoloration.

3.24.7.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, system shall be prepared for testing by immediately filling water piping with clean, fresh potable or high-purity water as applicable to the system being flushed. Any stoppage, discoloration, or other damage to the finish, furnishings, or parts of the building, due to the Contractor's failure to properly clean the piping system, shall be repaired. When the system flushing is complete, the hot-water system shall be adjusted for uniform circulation. Flushing devices and automatic control systems shall be adjusted for proper operation. [All faucets and drinking water fountains, to include any device considered as an end point device by [NSF 61](#), Section 9, shall be flushed a minimum of [1 L 0.25 gallons](#) per 24 hour period, ten times over a 14 day period. Proof of compliance shall be submitted in triplicate to the Contracting Officer.]

3.24.8 Operational Test

Upon completion of flushing and prior to disinfection procedures, subject the plumbing system to operating tests to demonstrate satisfactory functional and operational efficiency. Such operating tests shall cover a

period of not less than 8 hours for each system and shall include the following information in a report with conclusion as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Water pressures at the most remote and the highest fixtures.
- c. Operation of each fixture and fixture trim.
- d. Operation of each valve, hydrant, and faucet.
- e. Pump suction and discharge pressures.
- f. Temperature of domestic hot water supply.
- g. Operation of each floor and roof drain by flooding with water.
- h. Operation of each vacuum breaker and backflow preventer.
- i. Complete operation of each water pressure booster system, including pump start pressure and stop pressure.
- j. Compressed air readings at each compressor and at each outlet. Each indicating instrument shall be read at 1/2 hour intervals. The report of the test shall be submitted in quadruplicate. Furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.
- k. Operational test and verification of purity of medical gas systems. Each outlet shall be tested and installation certified as to correctness of installation. The tests shall be performed by an independent testing company and a certification document provided stating that the entire medical gas system, for each individual gas, has been tested, found correctly installed, and the purity of the delivered gas has been verified.

3.24.9 Disinfection

NOTE: The option of having the Contracting Officer perform the sampling and testing shall be selected only if Government laboratory facilities are available and with concurrence from appropriate laboratory personnel. At some locations, either disinfection or installation health officers inspect the disinfection process. If this is required, add a notification requirement and give the office to notified including phone number. For modification of existing systems, provide specific procedures for disinfection of equipment

After operational tests are complete, the entire domestic hot-and-cold water distribution system to be disinfected shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be either liquid chlorine or hypochlorite. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be constantly fed into the

water piping system at a concentration of at least 50 parts per million (ppm). A properly adjusted hypochlorite solution injected into the main with a hypochlorinator, or liquid chlorine injected into the main through a solution-feed chlorinator and booster pump, shall be used. The chlorine residual shall be checked at intervals to ensure that the proper level is maintained. Chlorine application shall continue until the entire main is filled. The water shall remain in the system for a minimum of 24 hours. Each valve in the system being disinfected shall be opened and closed several times during the contact period to ensure its proper disinfection. Following the 24 hour period, no less than 25 ppm chlorine residual shall remain in the system. Water tanks shall be disinfected by the addition of chlorine directly to the filling water. Following a 6 hour period, no less than 50 ppm chlorine residual shall remain in the tank. If after the 24 hour and 6 hour holding periods, the residual solution contains less than 25 ppm and 50 ppm chlorine respectively, flush the piping and tank with potable water, and repeat the above procedures until the required residual chlorine levels are satisfied. The system, including the tanks, shall then be flushed with clean water until the residual chlorine level is reduced to less than 1 ppm. During the flushing period each valve and faucet shall be opened and closed several times. Samples of water in disinfected containers shall be obtained from several locations selected by the Contracting Officer. The samples of water shall be tested for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with AWWA 10084. The testing method used shall be either the multiple-tube fermentation technique or the membrane-filter technique. Disinfection shall be repeated until tests indicate the absence of coliform organisms (zero-mean coliform density per 100 milliliters) in the samples for at least 2 full days. The system will not be accepted until satisfactory bacteriological results have been obtained.

3.24.10 Flushing of Potable Water System

As an option to the system flushing specified above, the potable water system shall be flushed and conditioned until the residual level of lead is less than that specified by the base industrial hygienist. The water supply to the building shall be tested separately to ensure that any lead contamination found during potable water system testing is due to work being performed inside the building.

3.25 TABLES

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item No.	Pipe and Fitting Material	A	B	C	D	E	F
1	Cast-iron soil pipe and fittings, hub and spigot, ASTM A 74 . Pipe and fittings shall be marked with the CISPI trademark.	X	X	X	X	X	
2	Cast-iron soil pipe and fittings, hubless, CISPI 301 and ASTM A 888 . Pipe and fittings shall be marked with the CISPI trademark.		X	X	X		
3	Cast-iron drainage fittings, threaded, ASME B16.12 for use with Item 6		X		X	X	
4	Cast-iron screwed fittings, threaded, ASME B16.4 for use with Item 6		X		X	X	
5	Grooved pipe couplings, ferrous pipe, ASTM A 536 and ASTM A 47/A 47M ; non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M		X			X	
6	Ductile iron grooved joint fittings for ferrous pipe, ASTM A 536 and ASTM A 47/A 47M for use with Item 5		X		X		
7	Malleable-iron threaded fittings, galvanized, ASME B16.3 for use with Item 6				X	X	
8	Steel pipe, seamless galvanized, ASTM A 53/A 53M , Type S, Grade B	X		X	X	X	
9	Seamless red brass pipe, ASTM B 43				X	X	
10	Bronze flanged fittings, ASME B16.24 for use with Item 9				X	X	
11	Cast-copper alloy solder joint				X	X	

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

						SERVICE	
Item							
No.	Pipe and Fitting Material	A	B	C	D	E	F
	pressure fittings.						
12	Bronze and sand castings, grooved joint pressure fittings for Non-Ferrous Pipe, ASTM B 584 for Use with Item 5			X		X	
13	Wrought copper grooved joint pressure fittings for non-ferrous Pipe, ASTM B 75 , ASTM B 75M , C12200, ASTM B 152/B 152M , C11000, ASME B16.22 for Use with Item 5					X	
14	Seamless copper pipe, ASTM B 42					X	
15	Cast-bronze threaded fittings, ASME B16.15 for use with Item 9				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
17	Wrought copper and wrought copper alloy solder-joint drainage fittings, ASME B16.29 for use with Item 12	X	X	X	X	X	
18	Cast-copper alloy solder joint drainage fittings, (DWV), ASME B16.23 for use with Item 12	X	X	X	X	X	
19	Process glass pipe and fittings, ASTM C 1053					X	X
20	High silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M				X	X	X
21	Polypropylene (PP) waste pipe and fittings, ASTM D 4101					X	X
22	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996					X	X

TABLE I
PIPE AND FITTING MATERIALS FOR
DRAINAGE, WASTE, AND VENT PIPING SYSTEMS

		SERVICE					
Item							
No.	Pipe and Fitting Material	A	B	C	D	E	F
23	Acrylonitrile-butadiene-styrene (ABS) plastic drain, waste, and vent pipe and fittings, ASTM D 2661	X	X	X	X		X
24	Polyvinyl chloride plastic drain, waste and vent pipe and fittings, ASTM D 2665	X	X	X	X		X
A - Underground Building Soil, Waste and Storm Drain							
B - Aboveground Soil, Waste, Drain In Buildings							
C - Underground Vent							
D - Aboveground Vent							
E - Interior Rainwater Conductors Aboveground							
F - Corrosive Waste And Vent Above And Belowground							
* - Hard Temper							

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE							
Item									
No.	Pipe and Fitting Material	A	B	C	D	E	F	G	H
1	a. Malleable-iron threaded fittings, galvanized, ASME B16.3 for use with Item 4a	X	X	X					
	b. Malleable-iron threaded fittings, ASME B16.3 for use with Item 4b			X					
2	Grooved pipe couplings, ferrous pipe, ASTM A 536 and ASTM A 47/A 47M; non-ferrous pipe, ASTM A 536 and ASTM A 47/A 47M		X	X		X	X		X
3	Ductile iron grooved joint fittings for ferrous pipe, ASTM A 536 and ASTM A 47/A 47M for Use with Item 2		X	X			X	X	X
4	Steel pipe: seamless galvanized,	X	X	X					

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE							
Item	No. Pipe and Fitting Material	A	B	C	D	E	F	G	H
	ASTM A 53/A 53M, Type S, Grade B								
5	Ductile iron grooved joint fittings for ferrous pipe, ASTM A 536 and ASTM A 47/A 47M for use with Item 2		X	X			X		X
6	Seamless red brass pipe, ASTM B 43	X	X						
7	Bronze flanged fittings, ASME B16.24 for use with Items 6 and 8	X	X						
8	Seamless copper pipe, ASTM B 42	X	X						
9	Seamless copper water tube, ASTM B 88 ASTM B 88M	X**	X*	X*		X*			
10	Seamless and welded copper distribution tube (Type D), As approved.	X	X	X					
11	Seamless copper water tube, ASTM B 819				X*	X*			
12	Seamless copper ASTM B 280 ACR tube			X*		X			
13	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe, ASTM B 584 for Use with Item 2		X	X			X		X
14	Wrought copper grooved joint pressure fittings for non-ferrous pipe, ASTM B 75, ASTM B 75M, C12200; ASTM B 152/B 152M, C11000, ASME B16.22 for Use with Items 6,8, and 9	X	X	X	X				X
15	Cast-bronze threaded fittings, ASME B16.15 for use with Items 6 and 8	X	X						
16	Wrought copper and bronze solder-joint pressure fittings,	X	X	X	X	X			

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE							
Item		A	B	C	D	E	F	G	H
No.	Pipe and Fitting Material								
	ASME B16.22 for use with Items 6, 8, 9, 11 and 12								
17	Cast-copper alloy solder-joint pressure fittings, ASME B16.18 for use with Items 9 and 10	X	X	X					
18	Wrought copper and bronze mechanical-joint 50 mm 2 in to 100 mm 4 in pressure fittings, ASTM B 75, ASTM B 75M C12200; ASME B16.22 for use with Item 3	X	X						
19	Bronze and sand castings mechanical-joint 127 mm 5 in to 152 mm 6 in pressure fittings, ASTM B 584, for use with Item 2	X	X	X					
20	Polyethylene (PE) plastic pipe, Schedule 40 and 80, based on outside diameter, ASTM D 2447	X					X	X	
21	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X					X	X	
22	Polyvinyl chloride (PVC) pressure rated pipe (SDR Series), ASTM D 2241	X					X	X	
23	Polyvinyl chloride (PVC) plastic pipe Schedule 40, 80, and 120, ASTM D 1785	X					X	X	
24	Butt heat fusion polyethylene (PE) plastic fittings for polyethylene (PE) plastic pipe and tubing, ASTM D 3261 for use with Items 20 and 21	X					X	X	
25	Socket-type polyethylene (PE) fittings for outside diameter controlled polyethylene, ASTM D 2683	X					X	X	

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE							
Item		A	B	C	D	E	F	G	H
No.	Pipe and Fitting Material for use with Item 21								
26	Polyvinyl chloride (PVC) plastic pipe fittings Schedule 40, ASTM D 2466						X	X	
27	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, Schedule 80, ASTM D 2467 for use with Items 22 and 23						X	X	
28	Flanges, pipe line, steel, MSS SP-44	X	X						
29	Unions, ASME B16.39; brass or bronze, fittings: ASME B16.15, ASME B16.18 and ASTM B 828, Composition B; carbon steel pipe unions socket welding and threaded, MSS SP-83; malleable-iron threaded union, ASME B16.39	X	X						
30	Nipples, pipe, threaded, ASTM A 733	X	X						
31	Gaskets, flange, fiber plastic or other synthetic material ASTM D 3139	X	X						
32	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X	X				X	X	
33	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M	X	X				X	X	
34	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR), ASTM F 442/F 442M	X	X				X	X	
35	Threaded chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 80, ASTM F 437 for use with Items 32, 33, and 34	X	X				X	X	
36	Socket-type chlorinated polyvinyl	X	X				X	X	

TABLE II
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

		SERVICE							
Item		A	B	C	D	E	F	G	H
No.	Pipe and Fitting Material chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 32, 33, and 34								
37	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 32, 33, and 34	X	X				X	X	
38	Threaded polyvinyl chloride (PVC) plastic pipe fittings, Schedule 80, ASTM D 2464						X	X	
39	Bell-end polyvinyl chloride (PVC) pipe, ASTM D 2672							X	
40	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X	X	
41	Crosslinked Polyethylene (PEX) Tubing, ASTM F 876						X	X	
42	Crosslinked Polyethylene (PEX) Plastic Hot and Cold Water Distribution Systems, ASTM F 877; Tubing, ASTM F 876	X					X	X	
43	Press Fittings		X						X

A - Cold Water Service Aboveground or Belowground

B - Hot and Cold Water Distribution 82 degrees C 180 degrees F Maximum
Aboveground

C - Compressed Air Non-Oil-Free

D - Compressed Medical (Oil-Free), Nitrogen & Oxygen (Gaseous), Nitrous
Oxide

E - Vacuum

F - Distilled Water

G - De-ionized Water

H - Aboveground only

Indicated types are minimum wall thicknesses.

* - Type L Hard

** - Type K Hard

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
RATINGS FOR WATER HEATING EQUIPMENT (SI)

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect	227 max		10 CFR 430	EF = 0.93
Elect	227 min		10 CFR 430	EF = 0.91
Elect.	75.7 min	12 kW max	10 CFR 430	EF = 0.93-0.00132V minimum
Elect.	75.7 min	12 kW min	CSA/AM Z21.10.3	SL = 20 m+35x(V ^{1/2}) maximum
Elect	Heat Pump 24 Amps or less And 250 Volts or les		10 CFR 430	EF = 0.93-0.00132V
Gas	189 max		10 CFR 430	EF = 0.62
Gas	75.7 min	22 kW max	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	309.75 W/L max	22 kW min	CSA/AM Z21.10.3	ET = 80 percent; SL = (Q/800+110x(V ^{1/2})) maximum
Oil	75.7 min	30.8 kW max	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	309.75 W/L max	30.8 kW min	CSA/AM Z21.10.3	ET = 78 percent; SL = (Q/800+110x(V ^{1/2})) max.

B. UNFIRED HOT WATER STORAGE, R = 2.2 minimum

C. INSTANTANEOUS WATER HEATER

Gas	309.75 W/L min And 7.57 L max	44.66 kW min 58.62 kW max	10 CFR 430 58.62 kW max	EF = 0.62-0.0019V
Gas	309.75 W/L min And 37.85 L max.	58.62 kW min	CSA/AM Z21.10.3	ET = 80 percent
Gas	309.75 W/L min And 37.85 L min	58.62 kW min	CSA/AM Z21.10.3	ET = 80 percent SL = (Q/800+110x(V ^{1/2}))
Oil	309.75 W/L min And 7.57 L max	61.55 kW max	10 CFR 430	EF = 0.59-0.0019V
Oil	309.75 W/L min And 37.85 L max	61.55 kW min	CSA/AM Z21.10.3	ET = 80 percent
Oil	309.75 W/L min And 37.85 L min	61.55 kW min	CSA/AM Z21.10.3	ET = 78 percent SL = (Q/800+110x(V ^{1/2}))

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
RATINGS FOR WATER HEATING EQUIPMENT (SI)

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
------	-------------------------------	-----------------	----------------	----------------------

D. POOL HEATER

Gas or percent Oil	All	ALL	ASHRAE 146	ET = 78
Heat Pump	All	ALL	ASHRAE 146	COP = 4.0

TERMS:

EF = Energy factor, minimum overall efficiency.

ET = Minimum Thermal efficiency.

SL = Standby loss is maximum Watts based on a 38.9 degrees C temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in Watts

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
RATINGS FOR WATER HEATING EQUIPMENT (I-P)

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
------	--------------------------------	-----------------	----------------	----------------------

Elect.	60 max		10 CFR 430	EF = 0.93
Elect.	60 min		10 CFR 430	EF = 0.91
Elect.	20 min	12 kW max	10 CFR 430	EF = 0.93-0.00132V minimum
Elect.	20 min	12 kW min	CSA/AM Z21.10.3	SL = 20+35x(V ^{1/2}) maximum
Elect.	Heat Pump	24 Amps or less And 250 Volts or less	10 CFR 430	EF = 0.93-0.00132V
Gas	50 max		10 CFR 430	EF = 0.62
Gas	20 min	75,000 Btu/h max	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	4,000 (Btu/h)gal min	75,000 Btu/h min	CSA/AM Z21.10.3	ET = 80 percent; SL = (Q/800+110x(V ^{1/2})) max

TABLE III
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE
RATINGS FOR WATER HEATING EQUIPMENT (I-P)

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Oil	20 min	105,000 Btu/h max	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	4,000 (Btu/h)gal max	105,000 Btu/h min	10 CFR 430	ET = 78 percent; SL = $(Q/800+110x(V^{1/2}))$ max

B. UNFIRED HOT WATER STORAGE R-12.5 minimum.

C. INSTANTANEOUS WATER HEATER

Gas	4,000 (Btu/h)/gal min And 2 gal max	50,000 Btu/h min	10 CFR 430	EF = 0.62-0.0019V 200,000 Btu/h max
Gas	4,000 (Btu/h) gal min percent And 10 gal max.	200,000 Btu/h min	CSA/AM Z21.10.3	ET = 80
Gas	4,000 (Btu/h) gal min percent And 10 gal min	200,000 Btu/h min	CSA/AM Z21.10.3	ET = 80 SL = $(Q/800+110x(V^{1/2}))$ max
Oil	4,000 (Btu/h) gal min And 2 gal max.	50,000 Btu/h min	10 CFR 430	EF = 0.59-0.0019V 210,000 Btu/h max.
Oil	4,000 (Btu/h)/gal min percent	210,000 Btu/h min And 10 gal max.	CSA/AM Z21.10.3	ET = 80
Oil	4,000 (Btu/h)/gal min percent And 10 gal.min	210,000 Btu/h min	CSA/AM Z21.10.3	ET = 78. SL = $(Q/800+110x(V^{1/2}))$ max.

D. POOL HEATER

Gas or	All	ALL	ASHRAE 146	ET = 78 percent
Oil				
Heat Pump	All	All	ASHRAE 146	COP = 4.0

TERMS:

EF = Energy factor, minimum overall efficiency.
ET = Minimum Thermal efficiency.
SL = Standby loss is maximum Btu/h based on a 70 degree F temperature difference between stored water and ambient requirements.
V = Rated volume in gallons.
Q = Nameplate input rate in Btu/h

-- End of Section --