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USACE / NAVFAC / AFCEA UFGS-15400A (April 2004)  
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Preparing Activity: USACE Superseding  
UFGS-15400A (January 2004)

UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 25 June 2004

Latest change indicated by CHG tags

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SECTION TABLE OF CONTENTS

DIVISION 15 - MECHANICAL

SECTION 15400A

PLUMBING, GENERAL PURPOSE

04/04

PART 1 GENERAL

- 1.1 REFERENCES
- 1.2 SUBMITTALS
- 1.3 STANDARD PRODUCTS
- 1.4 ELECTRICAL WORK
- 1.5 PERFORMANCE REQUIREMENTS
  - 1.5.1 Welding
  - 1.5.2 Cathodic Protection and Pipe Joint Bonding
- 1.6 REGULATORY REQUIREMENTS
- 1.7 PROJECT/SITE CONDITIONS

PART 2 PRODUCTS

- 2.1 MATERIALS
  - 2.1.1 Pipe Joint Materials
  - 2.1.2 Miscellaneous Materials
  - 2.1.3 Pipe Insulation Material
- 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS
- 2.3 VALVES
  - 2.3.1 Backwater Valves
  - 2.3.2 Wall Faucets
  - 2.3.3 Wall Hydrants
  - 2.3.4 Lawn Faucets
  - 2.3.5 Yard Hydrants
  - 2.3.6 Relief Valves
  - 2.3.7 Thermostatic Mixing Valves
- 2.4 FIXTURES
  - 2.4.1 Lavatories
  - 2.4.2 Automatic Flushing System
- 2.5 BACKFLOW PREVENTERS
- 2.6 DRAINS
  - 2.6.1 Floor and Shower Drains
    - 2.6.1.1 Metallic Shower Pan Drains

- 2.6.1.2 Drains and Backwater Valves
- 2.6.2 Area Drains
- 2.6.3 Floor Sinks
- 2.6.4 Boiler Room Drains
- 2.6.5 Pit Drains
- 2.6.6 Sight Drains
- 2.6.7 Roof Drains and Expansion Joints
- 2.7 SHOWER PAN
  - 2.7.1 Sheet Copper
  - 2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material
  - 2.7.3 Nonplasticized Polyvinyl Chloride (PVC) Shower Pan Material
- 2.8 TRAPS
- 2.9 GREASE INTERCEPTOR
- 2.10 WATER HEATERS
  - 2.10.1 Automatic Storage Type
    - 2.10.1.1 Oil-Fired Type
    - 2.10.1.2 Gas-Fired Type
    - 2.10.1.3 Electric Type
    - 2.10.1.4 Indirect Heater Type
  - 2.10.2 Instantaneous Water Heater
  - 2.10.3 Phenolic Resin Coatings
    - 2.10.3.1 Wash Primer
    - 2.10.3.2 Pigmented Base Coat
    - 2.10.3.3 Clear Top Coat
    - 2.10.3.4 Certificate of Compliance
    - 2.10.3.5 Test Panels
- 2.11 HOT-WATER STORAGE TANKS
- 2.12 PUMPS
  - 2.12.1 Sump Pumps
  - 2.12.2 Circulating Pumps
  - 2.12.3 Booster Pumps
    - 2.12.3.1 Centrifugal Pumps
    - 2.12.3.2 Controls
  - 2.12.4 Flexible Connectors
- 2.13 WATER PRESSURE BOOSTER SYSTEM
  - 2.13.1 Constant Speed Pumping System
  - 2.13.2 Hydro-Pneumatic Water Pressure System
  - 2.13.3 Variable Speed Pumping System
- 2.14 COMPRESSED AIR SYSTEM
  - 2.14.1 Air Compressors
  - 2.14.2 Lubricated Compressors
  - 2.14.3 Air Receivers
  - 2.14.4 Intake Air Supply Filter
  - 2.14.5 Pressure Regulators
- 2.15 DOMESTIC WATER SERVICE METER

### PART 3 EXECUTION

- 3.1 GENERAL INSTALLATION REQUIREMENTS
  - 3.1.1 Water Pipe, Fittings, and Connections
    - 3.1.1.1 Utilities
    - 3.1.1.2 Cutting and Repairing
    - 3.1.1.3 Protection of Fixtures, Materials, and Equipment
    - 3.1.1.4 Mains, Branches, and Runouts
    - 3.1.1.5 Pipe Drains
    - 3.1.1.6 Expansion and Contraction of Piping
    - 3.1.1.7 Thrust Restraint
    - 3.1.1.8 Commercial-Type Water Hammer Arresters
  - 3.1.2 Compressed Air Piping (Non-Oil Free)

- 3.1.3 Joints
  - 3.1.3.1 Threaded
  - 3.1.3.2 Mechanical Couplings
  - 3.1.3.3 Unions and Flanges
  - 3.1.3.4 Grooved Mechanical Joints
  - 3.1.3.5 Cast Iron Soil, Waste and Vent Pipe
  - 3.1.3.6 Copper Tube and Pipe
  - 3.1.3.7 Plastic Pipe
  - 3.1.3.8 Glass Pipe
  - 3.1.3.9 Corrosive Waste Plastic Pipe
  - 3.1.3.10 Other Joint Methods
- 3.1.4 Dissimilar Pipe Materials
- 3.1.5 Corrosion Protection for Buried Pipe and Fittings
- 3.1.6 Pipe Sleeves and Flashing
  - 3.1.6.1 Sleeve Requirements
  - 3.1.6.2 Flashing Requirements
  - 3.1.6.3 Waterproofing
  - 3.1.6.4 Optional Counterflashing
  - 3.1.6.5 Pipe Penetrations of Slab on Grade Floors
- 3.1.7 Fire Seal
- 3.1.8 Supports
  - 3.1.8.1 General
  - 3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements
  - 3.1.8.3 Pipe Hangers, Inserts, and Supports
  - 3.1.8.4 Structural Attachments
- 3.1.9 Welded Installation
- 3.1.10 Pipe Cleanouts
- 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS
  - 3.2.1 Relief Valves
  - 3.2.2 Installation of Gas- and Oil-Fired Water Heater
  - 3.2.3 Phenolic Resin Application Process
  - 3.2.4 Heat Traps
  - 3.2.5 Connections to Water Heaters
  - 3.2.6 Expansion Tank
- 3.3 FIXTURES AND FIXTURE TRIMMINGS
  - 3.3.1 Fixture Connections
  - 3.3.2 Flushometer Valves
  - 3.3.3 Height of Fixture Rims Above Floor
  - 3.3.4 Shower Bath Outfits
  - 3.3.5 Fixture Supports
    - 3.3.5.1 Support for Solid Masonry Construction
    - 3.3.5.2 Support for Concrete-Masonry Wall Construction
    - 3.3.5.3 Support for Steel Stud Frame Partitions
    - 3.3.5.4 Support for Wood Stud Construction
    - 3.3.5.5 Wall-Mounted Water Closet Gaskets
  - 3.3.6 Backflow Prevention Devices
  - 3.3.7 Access Panels
  - 3.3.8 Sight Drains
  - 3.3.9 Traps
  - 3.3.10 Shower Pans
    - 3.3.10.1 General
    - 3.3.10.2 Metal Shower Pans
    - 3.3.10.3 Nonplasticized Chlorinated Polyethylene Shower Pans
    - 3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans
- 3.4 VIBRATION-ABSORBING FEATURES
  - 3.4.1 Tank- or Skid-Mounted Compressors
  - 3.4.2 Foundation-Mounted Compressors
- 3.5 WATER METER REMOTE READOUT REGISTER
- 3.6 IDENTIFICATION SYSTEMS

- 3.6.1 Identification Tags
- 3.6.2 Pipe Color Code Marking
- 3.6.3 Color Coding Scheme for Locating Hidden Utility Components
- 3.7 ESCUTCHEONS
- 3.8 PAINTING
- 3.9 TESTS, FLUSHING AND DISINFECTION
  - 3.9.1 Plumbing System
    - 3.9.1.1 Test of Backflow Prevention Assemblies
    - 3.9.1.2 Shower Pans
    - 3.9.1.3 Compressed Air Piping (Nonoil-Free)
  - 3.9.2 Defective Work
  - 3.9.3 System Flushing
    - 3.9.3.1 During Flushing
    - 3.9.3.2 After Flushing
  - 3.9.4 Operational Test
  - 3.9.5 Disinfection
- 3.10 PLUMBING FIXTURE SCHEDULE
- 3.11 POSTED INSTRUCTIONS
- 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT
  - 3.12.1 Storage Water Heaters
    - 3.12.1.1 Electric
    - 3.12.1.2 Gas
    - 3.12.1.3 Oil
  - 3.12.2 Unfired Hot Water Storage
  - 3.12.3 Instantaneous Water Heater
    - 3.12.3.1 Gas
    - 3.12.3.2 Oil
  - 3.12.4 Pool Heaters
- 3.13 TABLES

-- End of Section Table of Contents --

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-----  
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### SECTION 15400A

#### PLUMBING, GENERAL PURPOSE 04/04

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NOTE: This guide specification covers the requirements for general purpose plumbing systems.

Comments and suggestions on this guide specification are welcome and should be directed to the technical proponent of the specification. A listing of technical proponents, including their organization designation and telephone number, is on the Internet.

Recommended changes to a UFGS should be submitted as a Criteria Change Request (CCR).

Use of electronic communication is encouraged.

This guide specification includes tailoring options for piping, fixtures, water heaters, pumps, compressed air system, and pressure piping. Selection or deselection of a tailoring option will include or exclude that option in the section, but editing the resulting section to fit the project is still required.

Brackets are used in the text to indicate designer choices or locations where text must be supplied by the designer.

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## PART 1 GENERAL

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NOTE: This guide specification covers general purpose type plumbing systems. This specification essentially implements the requirements of the International Plumbing Code (IPC). Equipment supports and connections, for either equipment on the ground or in the building, will conform to these requirements.

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## 1.1 REFERENCES

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NOTE: Issue (date) of references included in  
project specifications need not be more current than  
provided by the latest guide specification. Use of  
SpecsIntact automated reference checking is  
recommended for projects based on older guide  
specifications.  
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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 AND REFRIGERATION INSTITUTE (ARI)

ARI 1010	(2002 ) Self-Contained, Mechanically Refrigerated Drinking-Water Coolers
ARI 700	(1999 with Appendix C) Specifications for Fluorocarbon Refrigerants

### AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI A117.1	(1998) Guidelines for Accessible and Usable Buildings and Facilities -- Providing Accessibility and Usability for Physically Handicapped People
ANSI Z124.1	(1995) Plastic Bathtub Units
ANSI Z124.3	(1995) Plastic Lavatories
ANSI Z124.5	(1997) Plastic Toilet (Water Closet) Seats
ANSI Z124.9	(1994) Plastic Urinal Fixtures
ANSI Z21.10.1	(2001; R 2002) Gas Water Heaters Vol. I, Storage Water Heaters with Input Ratings of 75,000 Btu Per Hour or Less
ANSI Z21.10.3	(2001) Gas Water Heaters Vol.III, Storage Water Heaters With Input Ratings Above 75,000 Btu Per Hour, Circulating and Instantaneous
ANSI Z21.22	(1999; A 2001) Relief Valves for Hot Water Supply Systems
ANSI Z21.56	(2001) Gas-Fired Pool Heaters
ANSI Z358.1	(1998) Emergency Eyewash and Shower Equipment

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

ASHRAE 34	(2001; Errata 2002) Designation and Safety Classification of Refrigerants
ASHRAE 90.1	(2001; various Errata) Energy Standard for Buildings Except Low-Rise Residential Buildings

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2002) Atmospheric Type Vacuum Breakers
ASSE 1002	(1999) Anti-siphon Fill Valves (Ballcocks) for Gravity Water Closet Flush Tanks
ASSE 1003	(2001) Water Pressure Reducing Valves
ASSE 1005	(1999) Water Heater Drain Valves
ASSE 1006	(1986) Residential Use Dishwashers
ASSE 1010	(1996) Water Hammer Arresters
ASSE 1011	(1993) Hose Connection Vacuum Breakers
ASSE 1012	(2002) Backflow Preventer with Intermediate Atmospheric Vent
ASSE 1013	(1999) 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	(1998) Pressure Vacuum Breaker Assembly
ASSE 1037	(1990) Pressurized Flushing Devices (Flushometers) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

AWWA B300	(1999) Hypochlorites
AWWA B301	(1999) Liquid Chlorine
AWWA C203	(2002; A C203a-99) Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot-Applied
AWWA C606	(1997) Grooved and Shouldered Joints
AWWA C651	(1999) Disinfecting Water Mains
AWWA C652	(2002) Disinfection of Water-Storage Facilities

AWWA C700	(2002) Cold-Water Meters - Displacement Type, Bronze Main Case
AWWA C701	(2002) Cold-Water Meters - Turbine Type, for Customer Service
AWWA D100	(1996) Welded Steel Tanks for Water Storage
AWWA EWW	(1998) Standard Methods for the Examination of Water and Wastewater

#### AMERICAN WELDING SOCIETY (AWS)

AWS A5.8	(1992) Filler Metals for Brazing and Braze Welding
AWS B2.2	(1991) Brazing Procedure and Performance Qualification

#### ASME INTERNATIONAL (ASME)

ASME A112.1.2	(1991; R 2002) Air Gaps in Plumbing Systems
ASME A112.14.1	(1975; R 1998) Backwater Valves
ASME A112.18.1	(2003) Plumbing Fixture Fittings
ASME A112.19.1M	(1994; R 1999) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2M	(1998) Vitreous China Plumbing Fixtures
ASME A112.19.3	(2001) Stainless Steel Fixtures (Designed for Residential Use)
ASME A112.19.4M	(1994; R 1999) Porcelain Enameled Formed Steel Plumbing Fixtures
ASME A112.21.2M	(1983) Roof Drains
ASME A112.36.2M	(1991; R 2002) Cleanouts
ASME A112.6.1M	(1997; R 2002) Floor Affixed Supports for Off-the-Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001) Floor and French Drains
ASME B1.20.1	(1983; R 2001) Pipe Threads, General Purpose, Inch
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.15	(1985; R 1994) Cast Bronze Threaded Fittings Classes 125 and 250
ASME B16.18	(2002) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.21	(1992) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.22	(2002) Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
ASME B16.23	(2002) Cast Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.24	(2002) Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 400, 600, 900, 1500, and 2500
ASME B16.29	(2002) Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV
ASME B16.3	(1998) Malleable Iron Threaded Fittings
ASME B16.34	(1996) Valves Flanged, Threaded, and Welding End
ASME B16.39	(1998) Malleable Iron Threaded Pipe Unions
ASME B16.4	(1998) Gray Iron Threaded Fittings
ASME B16.5	(1996) Pipe Flanges and Flanged Fittings
ASME B31.1	(2001) Power Piping
ASME B31.5	(2001) Refrigeration Piping and Heat Transfer Components
ASME B40.100	(2000) Pressure Gauges and Gauge Attachments
ASME BPVC SEC IX	(2001) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications
ASME BPVC SEC VIII D1	(2001) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASME CSD-1	(2002) Control and Safety Devices for Automatically Fired Boilers

#### ASTM INTERNATIONAL (ASTM)

ASTM A 105/A 105M	(2002) Carbon Steel Forgings for Piping Applications
ASTM A 183	(2003) Carbon Steel Track Bolts and Nuts
ASTM A 193/A 193M	(2003) Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service
ASTM A 47/A 47M	(1999) Ferritic Malleable Iron Castings

ASTM A 515/A 515M	(2003) Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service
ASTM A 516/A 516M	(2003) Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
ASTM A 518/A 518M	(1999) Corrosion-Resistant High-Silicon Iron Castings
ASTM A 53/A 53M	(2002) Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 1999e1) Ductile Iron Castings
ASTM A 733	(2003) Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM A 74	(2003b) Cast Iron Soil Pipe and Fittings
ASTM A 888	(2003) Hubless Cast Iron Soil Pipe and Fittings for Sanitary and Storm Drain, Waste, and Vent Piping Applications
ASTM B 111	(1998e1) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock
ASTM B 111M	(1998e1) Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock (Metric)
ASTM B 117	(2002) Operating Salt Spray (Fog) Apparatus
ASTM B 152/B 152M	(2000) Copper Sheet, Strip, Plate, and Rolled Bar
ASTM B 306	(2002) Copper Drainage Tube (DWV)
ASTM B 32	(2003) Solder Metal
ASTM B 370	(1998) Copper Sheet and Strip for Building Construction
ASTM B 42	(2002) Seamless Copper Pipe, Standard Sizes
ASTM B 43	(1998) Seamless Red Brass Pipe, Standard Sizes
ASTM B 584	(2000) Copper Alloy Sand Castings for General Applications
ASTM B 75	(2002) Seamless Copper Tube
ASTM B 75M	(1999) Seamless Copper Tube (Metric)
ASTM B 813	(2000e1) Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube
ASTM B 828	(2002) Making Capillary Joints by

Soldering of Copper and Copper Alloy Tube and Fittings

ASTM B 88	(2002) Seamless Copper Water Tube
ASTM B 88M	(1999) Seamless Copper Water Tube (Metric)
ASTM C 1053	(2000) Borosilicate Glass Pipe and Fittings for Drain, Waste, and Vent (DWV) Applications
ASTM C 564	(2003) Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 920	(2002) Elastomeric Joint Sealants
ASTM D 1004	(2003) Initial Tear Resistance of Plastic Film and Sheeting
ASTM D 1248	(2002) Polyethylene Plastics Extrusion Materials for Wire and Cable
ASTM D 1785	(1999) Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120
ASTM D 2000	(2001) Rubber Products in Automotive Applications
ASTM D 2235	(2001) Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings
ASTM D 2239	(2003) Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D 2241	(2000) Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 2447	(2003) Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter
ASTM D 2464	(1999) Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2466	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D 2467	(2002) Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D 2485	(1991; R 2000) Evaluating Coatings for High Temperature Service
ASTM D 2564	(2002) Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
ASTM D 2657	(1997) Heat Fusion Joining Polyolefin Pipe

and Fittings

ASTM D 2661	(2002) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2665	(2002ae1) Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM D 2672	(1996a) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D 2683	(1998) Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D 2737	(2003) Polyethylene (PE) Plastic Tubing
ASTM D 2822	(1991; R 1997e1) Asphalt Roof Cement
ASTM D 2846/D 2846M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems
ASTM D 2855	(1996; R 2002) Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings
ASTM D 2996	(2001) Filament-Wound "Fiberglass" (Glass-Fiber-Reinforced Thermosetting-Resin) Pipe
ASTM D 3035	(2001) 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	(2002) Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly(Vinyl Chloride) (PVC) Non-Pressure Piping Components
ASTM D 3139	(1998) Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals
ASTM D 3212	(1996a; R 2003) Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals
ASTM D 3261	(2003) Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D 3308	(2001) PTFE Resin Skived Tape

ASTM D 3311	(2002) Drain, Waste, and Vent (DWV) Plastic Fittings Patterns
ASTM D 4060	(2001) Abrasion Resistance of Organic Coatings by the Taber Abraser
ASTM D 4101	(2003) Polypropylene Injection and Extrusion Materials
ASTM D 4551	(1996; R 2001) Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
ASTM D 638	(2002a) Tensile Properties of Plastics
ASTM E 1	(2003) ASTM Thermometers
ASTM E 96	(2000e1) Water Vapor Transmission of Materials
ASTM F 1290	(1998a) Electrofusion Joining Polyolefin Pipe and Fittings
ASTM F 1760	(2001) Coextruded Poly(Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content
ASTM F 409	(2002) Thermoplastic Accessible and Replaceable Plastic Tube and Tubular Fittings
ASTM F 437	(1999) Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 438	(2002e1) Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F 439	(2002e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F 441/F 441M	(1999e1) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F 442/F 442M	(1999) Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F 477	(2002e1) Elastomeric Seals (Gaskets) for Joining Plastic Pipe
ASTM F 493	(1997) Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings
ASTM F 628	(2001) Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe with a Cellular Core

ASTM F 877 (2002a) Crosslinked Polyethylene (PEX)  
Plastic Hot- and Cold- Water Distribution  
Systems

ASTM F 891 (2000e1) Coextruded Poly (Vinyl Chloride)  
(PVC) Plastic Pipe with a Cellular Core

CAST IRON SOIL PIPE INSTITUTE (CISPI)

CISPI 301 (2000) Hubless Cast Iron Soil Pipe and  
Fittings for Sanitary and Storm Drain,  
Waste, and Vent Piping Applications

CISPI 310 (1997) Coupling for Use in Connection with  
Hubless Cast Iron Soil Pipe and Fittings  
for Sanitary and Storm Drain, Waste, and  
Vent Piping Applications

COPPER DEVELOPMENT ASSOCIATION (CDA)

CDA A4015 (1994; R 1995) Copper Tube Handbook

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

FCCCHR Manual (9th Edition) Manual of Cross-Connection  
Control

INTERNATIONAL CODE COUNCIL (ICC)

ICC A117.1 (1998) Accessible and Usable Buildings and  
Facilities

ICC IPC (2003) International Plumbing Code

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 (1996; R 2001) Steel Pipeline Flanges

MSS SP-58 (2002) Pipe Hangers and Supports -  
Materials, Design and Manufacture

MSS SP-67 (2002) Butterfly Valves

MSS SP-69 (2002) Pipe Hangers and Supports -  
Selection and Application

MSS SP-70 (1998) Cast Iron Gate Valves, Flanged and  
Threaded Ends

MSS SP-71	(1997) Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-72	(1999) 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	(1998) Cast Iron Plug Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-83	(2001) Class 3000 Steel Pipe Unions, Socket-Welding and Threaded
MSS SP-85	(2002) Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

NACE INTERNATIONAL (NACE)

NACE RP0169	(2002) Control of External Corrosion on Underground or Submerged Metallic Piping Systems
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NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA 250	(2003) Enclosures for Electrical Equipment (1000 Volts Maximum)
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NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 31	(2001) Installation of Oil Burning Equipment
NFPA 54	(2002) National Fuel Gas Code
NFPA 90A	(2002) Installation of Air Conditioning and Ventilating Systems

NSF INTERNATIONAL (NSF)

NSF 14	(2003) Plastics Piping System Components and Related Materials
NSF 3	(2003) Commercial Warewashing Equipment
NSF 5	(2000e) Water Heaters, Hot Water Supply Boilers, and Heat Recovery Equipment
NSF 61	(2003e) Drinking Water System Components - Health Effects

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA-01	(1998) Plastic Pipe in Fire Resistive Construction
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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 (1992) Water Hammer Arresters

SOCIETY OF AUTOMOTIVE ENGINEERS INTERNATIONAL (SAE)

SAE J1508 (1997) Hose Clamp Specifications

THE SOCIETY FOR PROTECTIVE COATINGS (SSPC)

SSPC SP 5 (2000) White Metal Blast Cleaning

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

40 CFR 50.12 National Primary and Secondary Ambient Air Quality Standards for Lead

PL 93-523 (1974; A 1999) Safe Drinking Water Act

UNDERWRITERS LABORATORIES (UL)

UL 174 (1996; Rev thru Oct 1999) Household Electric Storage Tank Water Heaters

UL 430 (1994; Rev thru Mar 2001) Waste Disposers

UL 732 (1995; Rev thru Jan 1999) Oil-Fired Storage Tank Water Heaters

UL 749 (1997; Rev thru Mar 2003) Household Dishwashers

UL 921 (1996; Rev thru Mar 2000) Commercial Electric Dishwashers

1.2 SUBMITTALS

\*\*\*\*\*

**NOTE: Submittals must be limited to those necessary for adequate quality control. The importance of an item in the project should be one of the primary factors in determining if a submittal for the item should be required.**

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 projects.

Submittal items not designated with a "G" are considered as being for information only for Army projects and for Contractor Quality Control approval for Navy projects.

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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 01330 SUBMITTAL PROCEDURES:

#### SD-02 Shop Drawings

Plumbing System[; G][; G, [\_\_\_\_]]

Detail drawings consisting of illustrations, schedules, performance charts, instructions, brochures, diagrams, and other information to illustrate the requirements and operations of each system. Detail drawings for the complete plumbing system including piping layouts and locations of connections; dimensions for roughing-in, foundation, and support points; schematic diagrams and wiring diagrams or connection and interconnection diagrams. Detail drawings shall indicate clearances required for maintenance and operation. Where piping and equipment are to be supported other than as indicated, details shall include loadings and proposed support methods. Mechanical drawing plans, elevations, views, and details, shall be drawn to scale. Provide the manufacturer's written installation instructions and recommendations for all fixtures and equipment to be installed.

Electrical Work[; G][; G, [\_\_\_\_]]

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.

#### SD-03 Product Data

##### Welding

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

##### Plumbing Fixture Schedule

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.

##### Plumbing System

Diagrams, instructions, and other sheets proposed for 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 all field tests performed to prove compliance with the specified performance criteria, completion and testing of the installed system. Each test report shall indicate the final position of controls.

##### Test of Backflow Prevention Assemblies[; G][; G, [\_\_\_\_\_]].

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

#### SD-07 Certificates

##### Materials and Equipment

Where materials or equipment are specified to comply with requirements of AGA, ASME, or NSF proof of such compliance shall be included. 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 requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, and installation shall conform to the code.

#### Bolts

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

#### 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. The manual shall include 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. The manual shall include piping and equipment layout and simplified wiring and control diagrams of the system as installed.

### 1.3 STANDARD PRODUCTS

Specified materials and equipment shall be standard products of a manufacturer regularly engaged in the manufacture of such products. Specified equipment shall essentially duplicate equipment that has performed satisfactorily at least two years prior to bid opening.

### 1.4 ELECTRICAL WORK

Motors, motor controllers and motor efficiencies shall conform to the requirements of Section 16402 INTERIOR DISTRIBUTION SYSTEM. Electrical motor-driven equipment specified herein shall be provided complete with motors. Equipment shall be rated at 60 Hz, single phase, ac unless otherwise indicated. Where a motor controller is not provided in a motor-control center on the electrical drawings, a motor controller 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, and including an allowable service factor.

### 1.5 PERFORMANCE REQUIREMENTS

#### 1.5.1 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 05090A WELDING, STRUCTURAL.] [Welding and nondestructive testing procedures are specified in Section 05093 WELDING PRESSURE PIPING.]

#### 1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with [Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 13112A CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)].

#### 1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with ICC IPC.

#### 1.7 PROJECT/SITE CONDITIONS

The Contractor shall become familiar with details of the work, verify dimensions in the field, and advise the Contracting Officer of any discrepancy before performing any work.

### PART 2 PRODUCTS

#### 2.1 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. 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 UFC 3-420.01. Chap 4.

This specification allows drainage systems up to 375 mm (15 inch) diameter only; designer will ensure the availability of materials when drainage line exceeds 375 mm (15 inch) diameter.

Add working pressure ratings for plastic pipe after material description in Table I.

Plastic traps used in DWV plumbing should be same material as the plumbing.

\*\*\*\*\*

Materials for various services shall be in accordance with TABLES I and II.

Pipe schedules shall be selected based on service requirements. 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 must 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.

#### 2.1.1.1 Pipe Joint Materials

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

- a. Coupling for 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) 1/16 inch thick, and contain Aramid fibers bonded with Styrene Butadiene Rubber (SBR) or Nitro Butadiene Rubber (NBR). Gaskets shall be the full face or self centering flat ring type. Gaskets used for hydrocarbon service shall be bonded with NBR.
- f. Brazing Material: Brazing material shall conform to AWS A5.8, BCuP-5.
- g. Brazing Flux: Flux shall be in paste or liquid form appropriate for use with brazing material. Flux shall be as follows: lead-free; have a 100 percent flushable residue; contain slightly acidic reagents; contain potassium borides; and contain fluorides.
- h. Solder Material: Solder metal shall conform to ASTM B 32.
- i. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to ASTM B 813, Standard Test 1.
- j. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe, ASTM D 3308.

- k. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): ASTM C 564.
- l. Rubber Gaskets for Grooved Pipe: ASTM D 2000, maximum temperature 110 degrees C (230 degrees F). 230 degrees F.
- m. Flexible Elastomeric Seals: ASTM D 3139, ASTM D 3212 or ASTM F 477.
- n. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, ASTM A 183.
- o. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: ASTM D 3138.
- p. Plastic Solvent Cement for ABS Plastic Pipe: ASTM D 2235.
- q. Plastic Solvent Cement for PVC Plastic Pipe: ASTM D 2564 and ASTM D 2855.
- r. Plastic Solvent Cement for CPVC Plastic Pipe: ASTM F 493.
- s. Flanged fittings including flanges, bolts, nuts, bolt patterns, etc., shall be in accordance with ASME B16.5 class 150 and shall have the manufacturer's 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.
- t. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: ASTM D 3122.

#### 2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: 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 Coatings and Linings for Steel Water Pipelines:

AWWA C203.

- i. Hypochlorites: AWWA B300.

- j. Liquid Chlorine: AWWA B301.
- k. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: ASME B40.100.
- l. Thermometers: ASTM E 1. Mercury shall not be used in thermometers.

#### 2.1.3 Pipe Insulation Material

Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

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

#### 2.3 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.

\*\*\*\*\*

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm (2-1/2 inches) 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) 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

Description	Standard
Cast-Iron Gate Valves, Flanged and Threaded Ends	MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends	MSS SP-71
Ball Valves with Flanged 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
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends	MSS SP-85
Backwater Valves	ASME A112.14.1
Vacuum Relief Valves	ANSI Z21.22
Water Pressure Reducing Valves	ASSE 1003
Water Heater Drain Valves	ASSE 1005
Trap Seal Primer Valves	ASSE 1018
Temperature and Pressure Relief Valves for Hot Water Supply Systems	ANSI Z21.22
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	ASME CSD-1 Safety Code No., Part CW, Article 5

#### 2.3.1 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.

#### 2.3.2 Wall Faucets

Wall faucets with vacuum-breaker backflow preventer shall be brass with 20 mm (3/4 inch) 3/4 inch male inlet threads, hexagon shoulder, and 20 mm (3/4 inch) 3/4 inch hose connection. Faucet handle shall be securely attached to stem.

### 2.3.3 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 the 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 removable through the face of the hydrant. The hydrant shall have 20 mm (3/4 inch) 3/4 inch exposed hose thread on spout and 20 mm (3/4 inch) 3/4 inch male pipe thread on inlet.

### 2.3.4 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 20 mm (3/4 inch) 3/4 inch pipe. Body shall be suitable for wrench grip. Faucet spout shall have 20 mm (3/4 inch) 3/4 inch exposed hose threads. Faucet handle shall be securely attached to stem.

### 2.3.5 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.

### 2.3.6 Relief Valves

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 ANSI Z21.22. Relief valves for systems where the maximum rate of heat input is less than 59 kW (200,000 Btuh) 200,000 Btuh shall have 20 mm (3/4 inch) 3/4 inch minimum inlets, and 20 mm (3/4 inch) 3/4 inch outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW (200,000 Btuh) 200,000 Btuh shall have 25 mm (1 inch) 1 inch minimum inlets, and 25 mm (1 inch) 1 inch outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

### 2.3.7 Thermostatic Mixing Valves

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 FIXTURES

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, 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. Brass expansion or toggle bolts capped with acorn nuts shall be provided for supports, and polished chromium-plated pipe, valves, and fittings shall be provided where exposed to view. 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 degrees C (180 degrees F) 180 degrees F water temperature. Plumbing fixtures shall be as indicated in paragraph PLUMBING FIXTURE SCHEDULE.

### 2.4.1 Lavatories

\*\*\*\*\*  
**NOTE: Lavatories installed in male barracks or dormitories and in male gang toilets (three or more water closets) or other types of buildings should be provided with brackets to prevent uplifting. In central toilets allow only enameled cast-iron lavatories.**  
\*\*\*\*\*

[Enameled cast-iron lavatories shall be provided with two cast-iron or steel brackets secured to the underside of the apron and drilled for bolting to the wall in a manner similar to the hanger plate. Exposed brackets shall be porcelain enameled.] [Vitreous china lavatories shall be provided with two integral molded lugs on the back-underside of the fixture and drilled for bolting to the wall in a manner similar to the hanger plate.]

### 2.4.2 Automatic Flushing System

\*\*\*\*\*  
**NOTE: Include this paragraph only if automatic flushing system is a project requirement. Automatic flushing systems provide enhanced hygiene and improved water conservation but cost more and may require more maintenance than lever-operated valves. This should be discussed with the user and an automatic flushing system specified if requested by the user.**  
\*\*\*\*\*

Flushing system shall consist of 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 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 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.

## 2.6 DRAINS

### 2.6.1 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 drainpipe. 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.

#### 2.6.1.1 Metallic Shower Pan Drains

Where metallic shower pan membrane is installed, polyethylene drain with corrosion-resistant screws securing the clamping device shall be provided. Polyethylene drains shall have fittings to adapt drain to waste piping. Polyethylene for floor drains shall conform to ASTM D 1248. Drains shall have separate cast-iron "P" trap, circular body, seepage pan, and strainer,

unless otherwise indicated.

#### 2.6.1.2 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.

#### 2.6.2 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) 12 inch nominal overall width or diameter and 250 mm (10 inch) 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 drain pipe. Drains shall conform to ASME A112.6.3.

#### 2.6.3 Floor Sinks

Floor sinks shall be [circular] [square], with 300 mm (12 inch) 12 inch nominal overall width or diameter and 250 mm (10 inch) 10 inch nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, 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 connecting pipe.

#### 2.6.4 Boiler Room Drains

\*\*\*\*\*  
**NOTE: Boiler room drain 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 hand grips. Drain shall have a minimum water seal of 100 mm (4 inches). 4 inches. The grate area shall be not less than 0.065 square meters (100 square inches). 100 square inches.

#### 2.6.5 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.

#### 2.6.6 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:

Area of strainer and collar    0.023 square meters (36 square inches) 36 square inches

Height of funnel    95 mm (3-3/4 inches)    3-3/4 inches

Diameter of lower portion    50 mm (2 inches)    2 inches  
of funnel

Diameter of upper portion    100 mm (4 inches) 4 inches  
of funnel

#### 2.6.7 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 3.416 mm (0.134 inch). 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.

#### 2.7 SHOWER PAN

\*\*\*\*\*  
NOTE: Show shower pans on the architectural detail.  
Shower pans may be omitted for showers located on  
floors with slab-on-grade construction, unless  
special local conditions necessitate waterproofing.  
\*\*\*\*\*

Shower pan may be copper, or nonmetallic material.

### 2.7.1 Sheet Copper

Sheet copper shall be 4.9 kg per square meter (16 ounce) 16 ounce weight.

### 2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

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

### 2.7.3 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) 0.040 inch minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. or ASTM D 638:

Ultimate Tensile Strength:	1.79 MPa (2600 psi) 2600 psi
Ultimate Elongation:	398 percent
100 Percent Modulus:	3.07 MPa (445 psi) 445 psi

b. ASTM D 1004:

Tear Strength:	53 kilonewtons per meter (300 pounds per inch) 300 pounds per inch
----------------	--

c. ASTM E 96:

Permeance:	0.46 ng per Pa per second per square meter (0.008 perms) 0.008 perms
------------	--

d. Other Properties:

Specific Gravity:	1.29
PVC Solvent:	Weldable
Cold Crack:	minus 47 degrees C (-53 degrees F)
-53 degrees F	
Dimensional stability,	
100 degrees C (212 minus 2.5 percent degrees F)	212 degrees F
minus 2.5 percent	
Hardness, Shore A:	89

## 2.8 TRAPS

Unless otherwise specified, traps shall be plastic per 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 0.813 mm (0.032 inch) 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). 2 inches. The interior diameter shall be not more than 3.2 mm (1/8 inch) 1/8 inch over or under

the nominal size, and interior surfaces shall be reasonably smooth throughout. A 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.

## 2.9 GREASE INTERCEPTOR

\*\*\*\*\*  
NOTE: Concrete pit must be detailed on structural drawings.  
\*\*\*\*\*

Grease interceptor of the size indicated shall be of reinforced concrete, [or precast concrete construction] [or equivalent capacity commercially available steel grease interceptor] with removable three-section, 9.5 mm (3/8 inch) 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 3,000 psi minimum compressive strength at 28 days.

## 2.10 WATER HEATERS

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

Show locations of water heaters on the drawings. Also show the type, capacity, etc. of each water heater 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). 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). 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 liters 500 gallons storage capacity need not meet the standard loss requirement if the tank surface area is insulated to R-12.5 and if a standing 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].

#### 2.10.1 Automatic Storage Type

Heaters shall be complete with [control system,] [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.]

##### 2.10.1.1 Oil-Fired Type

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

##### 2.10.1.2 Gas-Fired Type

Gas-fired water heaters shall conform to ANSI Z21.10.1 when input is 22 KW (75,000 BTU per hour) 75,000 BTU per hour or less or ANSI Z21.10.3 for heaters with input greater than 22 KW (75,000 BTU per hour). 75,000 BTU per hour. [A phenolic resin coating shall be provided.]

##### 2.10.1.3 Electric Type

Electric type water heaters shall conform to UL 174 with dual heating elements. Each element shall be 4.5 KW. The elements shall be wired so that only one element can operate at a time. [A phenolic resin coating shall be provided.]

##### 2.10.1.4 Indirect Heater Type

\*\*\*\*\*

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

**Cast-iron heads will be used in steam-to-steam or non fired 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). 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.

\*\*\*\*\*

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 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 111M ASTM B 111, 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 per square meter 150 pounds per square inch gauge (psig) with steam at a temperature of 185 degrees C. 365 degrees F. The heating surface 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.

#### 2.10.2 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 all normal load conditions when used in conjunction with [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 1.03 MPa (150 psi) 150 psi working pressure in the shell and 1.03 MPa (150 psi) 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 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS.

#### 2.10.3 Phenolic Resin Coatings

\*\*\*\*\*

**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. Steel, copper, copper alloy, or stainless steel coatings shall be capable of withstanding temperatures up to 204 degrees C (400 degrees F) 400 degrees F dry bulb; and meet the requirements of 21 CFR 175. [The entire exterior surface] [and] [the first 125 mm (5 inches) to 200 mm (8 inches) 5 to 8 inches inside the tubes] of each coil shall be coated with three component phenolic resin coating system. The system shall consist of the following: wash primer, pigmented base coat, and the clear top coat. Immediate and final cure times and temperatures shall be as recommended by the coating manufacturer.

##### 2.10.3.1 Wash Primer

The wash primer shall be composed of a combination of polyvinyl butyral and a heat hardening phenolic resin. The weight per liter (gallon) gallon shall be between 0.8388 kg per liter (7.0 lbs. per gallon) 7.0 lbs per gallon minimum and 0.8867 kg per liter (7.4 lbs. per gallon) 7.4 lbs. per gallon maximum.

##### 2.10.3.2 Pigmented Base Coat

The pigmented baking phenolic base coat 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 per liter (gallon) gallon shall be between 1.2 kg per liter (10.3 lbs per gallon) 10.3 lbs per gallon minimum and 1.3 kg per liter (10.7 lbs per gallon) 10.7 lbs per gallon maximum. The non-volatile solids content shall be between 60 percent minimum and 64 percent maximum by weight.

##### 2.10.3.3 Clear Top Coat

The clear non-pigmented baking phenolic top coat shall have a weight per liter (gallon) gallon of between 1.0 kg per liter (8.65 lbs per gallon) 8.65 lbs per gallon minimum and 1.1 kg per liter (8.95 lbs per gallon) 8.95 lbs per gallon maximum. The non-volatile solids content shall be between

48 percent minimum and 52 percent maximum by weight.

#### 2.10.3.4 Certificate of Compliance

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 the coating material and application comply with the testing procedures outlined.

#### 2.10.3.5 Test Panels

Steel test panel substrate shall be 0.607 mm (24 gauge) 24 gauge in thickness. The panels shall be coated with one coat wash primer, then pigmented baking phenolic to a dry film thickness of 0.10 to 0.15 mm, 4 to 6 mil, then clear baking phenolic to a total dry film thickness of 0.13 to 0.18 mm. 5 to 7 mil. The panels shall then be subjected to the tests specified below:

- a. Heat Test: Test panel shall be minimum 70 x 150 mm 2-3/4 x 5-7/8 inches in size. 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). 400 degrees F.
- b. 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.
- c. 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.

#### 2.11 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by 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. Each tank shall be equipped with a thermometer, conforming to ASTM E 1, Type I, Class 3, Range C, style and form as required for the installation, and with 175 mm (7 inch) 7 inch scale. Thermometer shall have a separable socket suitable for a 20 mm (3/4 inch) 3/4 inch tapped opening. Tanks shall be equipped with a pressure gauge 155 mm (6 inch) 6 inch minimum diameter face. Insulation shall be as specified in Section 15080A THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

#### 2.12 PUMPS

##### 2.12.1 Sump Pumps

\*\*\*\*\*

**NOTE: Designer will indicate location, sizes, horsepower, and capacities of equipment on drawings. Provide duplex pumps, if discharge capacity is greater than 1.6 liters per second (25 gpm) and total head is at least 6 m (20 feet). Delete**

**"totally enclosed and fan cooled" when not required.**

\*\*\*\*\*

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. The pumps shall be direct-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 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.

#### 2.12.2 Circulating Pumps

Domestic hot water circulating pumps shall be electrically driven, single-stage, centrifugal, with 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) horsepower for the service required. Each pump motor shall be equipped with an across-the-line magnetic controller in a NEMA 250, Type 1 enclosure with "START-STOP" switch in cover. Pump motors smaller than 746 W (Fractional horsepower pump motors) Fractional horsepower pump motors shall have integral thermal overload protection in accordance with Section 16402 INTERIOR DISTRIBUTION SYSTEM. Guards shall shield exposed moving parts.

#### 2.12.3 Booster Pumps

##### 2.12.3.1 Centrifugal 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 wearing 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. 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 liters per second (gpm), gpm, head in meters (feet), feet, efficiency, brake wattage (horsepower), 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 sized for non-overload when operating at any point along the characteristic curve of the pump. Guards shall shield exposed belts and moving parts.

#### 2.12.3.2 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. The pumps shall start and stop at the levels and pressures indicated. A multiposition sequence selector switch shall be provided so that any two pumps may be operated simultaneously keeping a third pump as a standby.

#### 2.12.4 Flexible Connectors

\*\*\*\*\*  
**NOTE: Flexible connectors should 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 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.

#### 2.13 WATER PRESSURE BOOSTER SYSTEM

\*\*\*\*\*  
**NOTE: One of the following systems will be used to boost the water pressure to the value required for service within the building. Indicate location, sizes, horsepower, and capacities of equipment on drawings. Provide duplex pumps, if discharge capacity is greater than 1.6 liter per second (25 gpm) and total head is at least 59.78 kPa (20 feet).**  
\*\*\*\*\*

##### 2.13.1 Constant Speed Pumping System

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; audiovisual 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 the failure of any controller shall energize the succeeding controller.

#### 2.13.2 Hydro-Pneumatic Water Pressure System

An ASME code constructed tank stamped for 862 kPa (125 psig) 125 psig water working pressure shall be provided. The tank shall have a flexible diaphragm made of material conforming to FDA requirements for use with potable water and shall be factory precharged to meet required system pressure.

#### 2.13.3 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 oil-filled 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 drive 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.

### 2.14 COMPRESSED AIR SYSTEM

#### 2.14.1 Air Compressors

Air compressor unit shall be a factory-packaged assembly, including [\_\_\_\_\_] phase, [\_\_\_\_\_] volt motor controls, switches, wiring, accessories, and motor controllers, in a 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 shall allow the compressor to operate for an adjustable length of time unloaded, then stop the unit]. Guards shall shield exposed moving parts. Each duplex compressor system shall be provided with [automatic] [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 receiver 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.

#### 2.14.2 Lubricated Compressors

\*\*\*\*\*  
NOTE: Where a suitable compressing station is shown for delivering air to laundries and linen-repair rooms, in addition to the shops, a duplicate compressor will be required for compressing and delivering air. Lubricated type compressors are required for delivery of air to linen repair at 552 kPa (80 psig), laundry at 586 kPa (85 psig), and general laboratories and shops at 345 kPa (50 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 1.03 MPa (150 psi) 150 psi and equipped with a gauge cock and pulsation dampener shall be furnished for installation adjacent to pressure switches.

#### 2.14.3 Air Receivers

Receivers shall be designed for 1.38 MPa (200 psi) 200 psi working pressure. Receivers shall be factory air tested to 1-1/2 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 herein. 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.

#### 2.14.4 Intake Air Supply Filter

\*\*\*\*\*

**NOTE: Indicate location and capacities of the air filters on the drawings. Specially filtered air should be provided for all locations, except laundries and garages.**

\*\*\*\*\*

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

#### 2.14.5 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) 125 psi and a maximum temperature of 93 degrees C (200 degrees F). 200 degrees F. Regulators shall be single-seated, pilot-operated with valve plug, bronze body and trim or equal, 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 kPa to 862 kPa (0 to 125 psi). 0 to 125 psi. Regulator shall be sized as indicated.

#### 2.15 DOMESTIC WATER SERVICE METER

Cold water meters 50 mm 2 inches and smaller shall be positive displacement type conforming to AWWA C700. Cold water meters 64 mm 2-1/2 inches and larger shall be turbine type conforming to AWWA C701. Meter register may be round or straight reading type, [indicating [\_\_\_\_]] [as provided by the local utility]. Meter shall be provided with a pulse generator, remote readout register and all necessary wiring and accessories.

### PART 3 EXECUTION

#### 3.1 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 where in compliance with NFPA may be installed in accordance with PPFA-01. The plumbing system shall be installed complete with necessary fixtures, fittings, traps, valves, and accessories. Water and drainage piping shall be extended 1.5 m 5 feet outside the building, unless otherwise indicated. A [gate valve] [full port ball valve] [ball valve] and drain shall be installed on the water service line 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 control no lower than the valve body.

### 3.1.1 Water Pipe, Fittings, and Connections

#### 3.1.1.1 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, flush valves, or other control valves which are supplied with integral stops, shall be equipped with a shutoff valve to enable isolation of the item 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.

#### 3.1.1.2 Cutting and Repairing

The work shall be carefully laid out in advance, and unnecessary cutting of 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.

#### 3.1.1.3 Protection of 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.

#### 3.1.1.4 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 12 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 to prevent flexible movement of the lines. Water pipe shall not be buried in or under floors unless specifically indicated or approved. 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) 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.

#### 3.1.1.5 Pipe Drains

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

\*\*\*\*\*

Pipe drains indicated shall consist of 20 mm (3/4 inch) 3/4 inch hose bibb with renewable seat and [gate] [full port ball] [ball] valve ahead of hose bibb. At other low points, 20 mm (3/4 inch) 3/4 inch brass plugs or caps shall be provided. Disconnection of the supply piping at the fixture is an acceptable drain.

#### 3.1.1.6 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 or other provisions such as offsets, changes in direction, etc., where indicated and/or 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 m 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.

#### 3.1.1.7 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, where indicated, 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 will be as shown. Blocking shall be placed so that the joints of the fitting 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.

#### 3.1.1.8 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 will be sized and located in accordance with PDI WH 201. Piping serving equipment having quick-closing valves shall have suitably sized arresters. The ICC International Plumbing Code defines a quick-closing valve and the Codes 1997 Commentary provides examples of what are and are not considered quick-closing valves. PDI-WH 201 also defines quick valve closure. Review of these documents will help the designer provide the proper

number of arresters.

For pressures of 450 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 shall be provided on hot- and cold-water supplies and shall be located as generally indicated, with precise location and sizing to be in accordance with PDI WH 201. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to ASSE 1010. Vertical capped pipe columns will not be permitted.

### 3.1.2 Compressed Air Piping (Non-Oil Free)

Compressed air piping shall be installed as specified for water piping and suitable for 862 kPa (125 psig) 125 psig working pressure. Compressed 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.

### 3.1.3 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.

#### 3.1.3.1 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.

#### 3.1.3.2 Mechanical Couplings

Grooved mechanical joints shall be prepared according to the coupling manufacturer's instructions. 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, or narrow-land micrometer. Groove width and dimension of groove from end of the 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, such as behind solid walls or ceilings, unless an access panel is shown on the drawings for servicing or adjusting the joint.

#### 3.1.3.3 Unions and Flanges

Unions, 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) 2-1/2 inches and smaller; flanges shall be used on pipe sizes 80 mm (3 inches) 3 inches and larger.

#### 3.1.3.4 Grooved Mechanical Joints

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.

#### 3.1.3.5 Cast Iron Soil, Waste and Vent Pipe

Bell and spigot compression and hubless gasketed clamp joints for soil, waste and vent piping shall be installed per the manufacturer's recommendations.

#### 3.1.3.6 Copper Tube and Pipe

- a. Brazed. Brazed joints shall be made in conformance with AWS B2.2, MSS SP-73, and CDA A4015 with flux and are acceptable for all pipe sizes. Copper to copper joints shall include the use of copper-phosphorus or copper-phosphorus-silver brazing metal without flux. Brazing of dissimilar metals (copper to bronze or brass) shall include the use of flux with either a copper-phosphorus, copper-phosphorus-silver or a silver brazing filler metal.
- b. Soldered. Soldered joints shall be made with flux and are only acceptable for piping 50 mm (2 inches) 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.

#### 3.1.3.7 Plastic Pipe

Acrylonitrile-Butadiene-Styrene (ABS) pipe shall have joints made with solvent cement. PVC and CPVC pipe shall have joints made with solvent cement elastomeric, threading, (threading of Schedule 80 Pipe is allowed only where required for disconnection and inspection; threading of Schedule 40 Pipe is not allowed), or mated flanged.

#### 3.1.3.8 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.

#### 3.1.3.9 Corrosive Waste Plastic Pipe

Joints for polyolefin pipe and fittings shall be made by mechanical joint or electrical fusion coil method in accordance with ASTM D 2657 and ASTM F 1290. Joints for filament-wound reinforced thermosetting resin pipe shall be made in accordance with manufacturer's instructions. Unions or flanges shall be used where required for disconnection and inspection.

#### 3.1.3.10 Other Joint Methods

\*\*\*\*\*  
**NOTE: Coordinate with paragraph MATERIALS.**  
\*\*\*\*\*

#### 3.1.4 Dissimilar Pipe Materials

Connections between ferrous and non-ferrous copper water pipe shall be made with dielectric unions or flange 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 fitting for the specific purpose.

#### 3.1.5 Corrosion Protection for Buried Pipe and Fittings

\*\*\*\*\*  
**NOTE: Both cathodic protection and protective coatings, regardless of soil resistivity, are to be provided for steel, ductile iron, and cast iron pressurized piping under floor (slab on grade) in soil. The results of an economic analysis and recommendations by a "corrosion expert" will govern the application of CP and protective coatings on gravity sewer lines, regardless of soil resistivity, and for potable water lines in resistivities above 10000 ohm-centimeters. For a large majority of new facilities, a sacrificial type of cathodic protection system, as specified in Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE), would be the applicable section to reference; however, the plumbing designer must coordinate with the cathodic protection designer for selection of one or both of the CP specification options.**  
\*\*\*\*\*

Ductile iron, cast iron, and steel pipe, fittings, and joints shall have a protective coating. Additionally, ductile iron, cast iron, and steel pressure pipe shall have a cathodic protection system and joint bonding.

The cathodic protection system, protective coating system, and joint bonding for cathodically protected pipe shall be in accordance with [Section 13110A CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 13112A CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)]. Coatings shall be selected, applied, and inspected in accordance with NACE RP0169 and as otherwise specified. The pipe shall be cleaned and the coating system applied prior to pipe tightness testing. Joints and fittings shall be cleaned and the coating system applied after pipe tightness testing. For tape coating systems, the tape shall conform to AWWA C203 and shall be applied with a 50 percent overlap. Primer utilized with tape type coating systems shall be as recommended by the tape manufacturer.

### 3.1.6 Pipe Sleeves and Flashing

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

#### 3.1.6.1 Sleeve Requirements

\*\*\*\*\*  
**NOTE: The designer will detail type of pipe sleeves on the drawings, illustrating method of sealing annular space between pipe and sleeve. The designer will coordinate requirements for clearances around sleeves with Section 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.**  
\*\*\*\*\*

Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves are not 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 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 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) 1/4 inch clearance between bare pipe or insulation and inside of sleeve or between insulation and inside of sleeve. 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 a primer, backstop material and surface preparation as specified in Section 07920 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. Sleeves through below-grade walls in contact with earth shall be recessed 12 mm (1/2 inch) 1/2 inch from wall surfaces on both sides. Annular space between pipe and sleeve shall be filled with backing material and sealants in the joint between the pipe and [concrete] [masonry] wall as specified above. Sealant selected for the earth side of the wall shall be compatible with dampproofing/waterproofing materials that are to be applied over the joint sealant. Pipe sleeves in fire-rated walls shall conform to the requirements in Section 07840 FIRESTOPPING.

### 3.1.6.2 Flashing Requirements

\*\*\*\*\*  
**NOTE: The applicable detail plates will be completed and included on 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.**  
\*\*\*\*\*

Pipes passing through roof shall be installed through a 4.9 kg per square meter (16 ounce) 16 ounce copper flashing, each within an integral skirt or flange. Flashing shall be suitably formed, and 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 lead or 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 the flashing and the bare pipe or between the flashing and the 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) 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.

### 3.1.6.3 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 sealed.

#### 3.1.6.4 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) 6 inches in diameter.
- b. A tack-welded or banded-metal rain shield around the pipe.

#### 3.1.6.5 Pipe Penetrations of Slab on Grade Floors

Where pipes, fixture drains, floor drains, cleanouts or similar items penetrate slab on grade floors, except at penetrations of floors with waterproofing membrane as specified in paragraphs Flashing Requirements and Waterproofing, a groove 6 to 13 mm 1/4 to 1/2 inch wide by 6 to 10 mm 1/4 to 3/8 inch deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07920 JOINT SEALANTS.

#### 3.1.7 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 07840 FIRESTOPPING.

#### 3.1.8 Supports

##### 3.1.8.1 General

Hangers used to support piping 50 mm (2 inches) 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. Threaded sections of rods shall not be formed or bent.

### 3.1.8.2 Pipe Supports and Structural Bracing, Seismic Requirements

\*\*\*\*\*  
**NOTE: Provide seismic requirements or 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 Sections 13080 SEISMIC PROTECTION FOR MISCELLANEOUS EQUIPMENT and 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT [as shown]. 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 05120 STRUCTURAL STEEL.

### 3.1.8.3 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 22.7 kg (50 pounds) shall  
have the excess hanger loads suspended from panel  
points.**  
\*\*\*\*\*

Installation of pipe hangers, inserts and supports 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. Type 19 and 23 C-clamps shall be torqued per MSS SP-69 and shall 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) 4 inches and larger when the temperature of the medium is 15 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). 4

inches.

(2) Be used on insulated pipe 100 mm (4 inches) 4 inches and larger when the temperature of the medium is 15 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 128 kg per cubic meter (8 pcf) 8 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 m 5 feet apart at valves. Operating temperatures in determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C 120 degrees F for PVC and 82 degrees C 180 degrees F for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

j. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m 15 feet nor more than 2 m 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) 4 inches and larger when the temperature of the medium is 15 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) 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) 4 inches and larger carrying medium less than 15 degrees C 60 degrees F a Type 40 shield, attached to the pipe or insulation, may freely rest on a 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.

n. Hangers and supports for plastic pipe shall not compress, distort,

cut or abrade the piping, and shall allow free movement of pipe except where otherwise required in the control of expansion/contraction.

#### 3.1.8.4 Structural Attachments

Attachment to building structure concrete and masonry shall be by cast-in concrete inserts, built-in anchors, or masonry anchor devices. Inserts and anchors shall be applied with a safety factor not less than 5. Supports shall not be attached to metal decking. Supports shall not be attached to the underside of concrete filled floor or concrete roof decks unless approved by the Contracting Officer. Masonry anchors for overhead applications shall be constructed of ferrous materials only.

#### 3.1.9 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 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.

#### 3.1.10 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) 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). 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. Cleanouts on pipe 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 the 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 heads shall be [cast iron] [or] [plastic].

### 3.2 WATER HEATERS AND HOT WATER STORAGE TANKS

#### 3.2.1 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).**  
\*\*\*\*\*

No valves shall be installed between a relief valve and its water heater or storage tank. The P&T relief valve shall be installed where the valve actuator comes in contact with the hottest water in the heater. Whenever possible, the relief valve shall be installed directly in a tapping in the tank or heater; otherwise, the P&T 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 above the top of the tank or water heater.

#### 3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to NFPA 54 for gas fired and NFPA 31 for oil fired. 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 outlet. 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.]

#### 3.2.3 Phenolic Resin Application Process

\*\*\*\*\*  
**NOTE: Where interior erosion of the tubes at or near the tube sheet is a severe problem, the coating may 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 [steam] [hot water] 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 exterior surface shall be coated with the three-component coating system in the following sequence and manner. For immediate and final cure times and temperature, the recommendations of the coating manufacturer shall be followed.

- a. Wash Primer. One coat of wash primer shall be applied by flooding.
- b. Pigmented Base Coat. Pigmented baking phenolic coating shall be applied in several coats by immersion or flooding to a dry film thickness of 0.10 to 0.15 mm. 4 to 6 mils.
- c. Clear Top Coat. Clear non-pigmented baking phenolic top coat shall be applied in several coats by immersion or flooding. The final coat may be applied by spraying. The dry film thickness of the total coating system shall be between 0.13 and 0.18 mm. 5 and 7 mils.

#### 3.2.4 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 and downward a minimum of 600 mm 2 feet before turning in an upward direction.

#### 3.2.5 Connections to Water Heaters

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

#### 3.2.6 Expansion Tank

A pre-charged expansion tank shall be installed on the cold water supply between the water heater inlet and the cold water supply shut-off valve. The Contractor shall adjust the expansion tank air pressure, as recommended by the tank manufacturer, to match incoming water pressure.

#### 3.3 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, sweat or solvent weld inlets shall be furnished and installed with fixtures. Where connections between copper tubing and faucets are made by rubber compression fittings, a beading tool shall be used to mechanically deform the tubing above the compression fitting. 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.

#### 3.3.1 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.

#### 3.3.2 Flushometer Valves

\*\*\*\*\*  
**NOTE: Include bracketed requirement for water closets in male barracks and dormitories. Bumpers for water closet seat on flushometer spud work only with closed front seat. 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 finished top spud connecting tube to wall adjacent to valve 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 760 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.] [Bumpers for water closet seats shall be installed on the [wall] [flushometer stop] [flushometer spud].]

#### 3.3.3 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 1020 mm 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 be in accordance with ICC A117.1.

#### 3.3.4 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.

#### 3.3.5 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.

#### 3.3.5.1 Support for 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.

#### 3.3.5.2 Support for Concrete-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 concrete wall using through bolts and a back-up plate.

#### 3.3.5.3 Support for Steel Stud Frame Partitions

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

#### 3.3.5.4 Support for Wood Stud Construction

Where floor is a concrete slab, a floor-anchored chair carrier shall be used. 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) 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.

#### 3.3.5.5 Wall-Mounted Water Closet Gaskets

Where 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.

#### 3.3.6 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.

#### 3.3.7 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 05500A MISCELLANEOUS METAL.

#### 3.3.8 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.

#### 3.3.9 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 installed on plastic pipe may be plastic conforming to ASTM D 3311. Traps for acid-resisting waste shall be of the same material as the pipe.

#### 3.3.10 Shower Pans

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.

##### 3.3.10.1 General

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 curb 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 nailheads driven flush with surface, and shall be sloped to drain. Shower pans shall be clamped to drains with the drain clamping ring.

##### 3.3.10.2 Metal Shower Pans

When a shower pan of required size cannot be furnished in one piece, metal pieces shall be joined with a flatlock 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.

#### 3.3.10.3 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 12 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 12 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 square meter (15 pound) 15 pound dry felt shall be installed prior to installation of shower pan to ensure a smooth surface for installation.

#### 3.3.10.4 Nonplasticized Polyvinyl Chloride (PVC) Shower Pans

Nonplasticized 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 is to 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 materials 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 clean (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 immediately placed together, 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. In 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 square meter (15 pound) 15 pound felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

### 3.4 VIBRATION-ABSORBING FEATURES

\*\*\*\*\*

Indicate on the drawings where equipment should be mounted resiliently. Details for proper mounting of equipment will be indicated on the drawings. 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 is 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 paragraph 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 an adequate number of standard isolation units. Each unit shall consist of machine and floor or foundation fastening, together with intermediate isolation material, and shall be a standard product with printed load 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.

#### 3.4.1 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 Section 15070A SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

#### 3.4.2 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 in Section 15070 SEISMIC PROTECTION FOR MECHANICAL EQUIPMENT.

### 3.5 WATER METER REMOTE READOUT REGISTER

The remote readout register shall be mounted at the location indicated or as directed by the Contracting Officer.

### 3.6 IDENTIFICATION SYSTEMS

#### 3.6.1 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) 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.

#### 3.6.2 Pipe Color Code Marking

\*\*\*\*\*  
**NOTE: Designer will coordinate color code marking  
with Section 09900. Color code marking for piping  
not listed in Table I of Section 09900, will be  
added to the table.**  
\*\*\*\*\*

Color code marking of piping shall be as specified in Section 09900 PAINTS AND COATINGS.

#### 3.6.3 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 09900 PAINTS AND COATINGS 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 12 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 m 3 foot width, 750 mm 30 inches height, and 12 mm 1/2 inch thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm (1/16 inch) 1/16 inch transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm (3/4 inch) 3/4 inch in diameter and the related lettering in 12 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
[_____]	[_____]	[_____]	[_____]

### 3.7 ESCUTCHEONS

Escutcheons shall be provided at 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.

### 3.8 PAINTING

Painting of pipes, hangers, supports, and other iron work, either in concealed spaces or exposed spaces, is specified in Section 09900 PAINTS AND COATINGS.

### 3.9 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.  
 \*\*\*\*\*

#### 3.9.1 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, the Contractor must submit a testing procedure to the Contracting Officer for approval.

- a. Drainage and Vent Systems Test. The final test shall include a smoke test.
- b. Building Sewers Tests.

c. Water Supply Systems Tests.

3.9.1.1 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 or the American Water Works Association Manual of Cross Connection (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 Data of
Gauges	

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

3.9.1.2 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, will be reason for rejection, repair, and retest.

3.9.1.3 Compressed Air Piping (Nonoil-Free)

Piping systems shall be filled with oil-free dry air or gaseous nitrogen to 1.03 MPa 150 psig and hold this pressure for 2 hours with no drop in pressure.

3.9.2 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 materials. Caulking of screwed joints or holes will not be acceptable.

3.9.3 System Flushing

3.9.3.1 During Flushing

Before operational tests or disinfection, potable water piping system shall be flushed with potable water. Sufficient water shall be used to produce a 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 meters per second (4 fps) 4 fps through all portions of the piping system. In the event that this is impossible due to size of system, the Contracting Officer (or the designated representative) shall

specify the number of fixtures to be operated during flushing. Contractor shall 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. [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.]

#### 3.9.3.2 After Flushing

System shall be drained at low points. Strainer screens shall be removed, cleaned, and replaced. After flushing and cleaning, systems shall be prepared for testing by immediately filling water piping with clean, fresh potable water. 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 by the Contractor. 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. [ Unless more stringent local requirements exist, lead levels shall not exceed limits established by 40 CFR 50.12 Part 141.80(c)(1). 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.]

#### 3.9.4 Operational Test

Upon completion of flushing and prior to disinfection procedures, the Contractor shall 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 each 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. The

Contractor shall furnish instruments, equipment, and personnel required for the tests; the Government will furnish the necessary water and electricity.

### 3.9.5 Disinfection

\*\*\*\*\*

**NOTE:** If government laboratory facilities are available to conduct the bacterial examination of the test samples, revise this paragraph accordingly.

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

\*\*\*\*\*

After operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. System shall be flushed as specified, before introducing chlorinating material. The chlorinating material shall be hypochlorites or liquid chlorine. Except as herein specified, water chlorination procedure shall be in accordance with AWWA C651 and AWWA C652. The chlorinating material shall be fed into the water piping system at a constant rate 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 one part per million. 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 EWW. 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.

### 3.10 PLUMBING FIXTURE SCHEDULE

\*\*\*\*\*

NOTE: For P-3 Urinal, in order to maintain sanitary conditions, waterless/waterfree urinal trap inserts should be replaced two to four times a year. The waterless urinal's immiscible barrier liquid needs to be replenished according to the urinal's use; approximately once a month. The waterfree urinal maintains its seal between trap changes. The designer must insure that responsible installation representatives are aware of these maintenance requirements and approve the use of waterless urinals.

For P-5 Lavatory, pop-up drain shall be used in lieu of strainer for BOQ, BEQ, UOPH, and UEPH.

For P-10 Laboratory Sink, vitreous china sinks shall have a stainless steel drain. Plastic sinks shall have an acid-resisting plastic drain and trap. Enameled cast iron sinks shall have a stainless steel drain.

For P-13 Shower, for EM Barracks and dormitories, vandal-resistant shower heads will be specified. Designer should ensure the facility has adequate water pressure (345-552 kPa (50-80 psi)) for shower head to function properly. At lower pressure (138-345 kPa (20-50 psi)) the shower head's flow may be inadequate. The designer has the option to select an adjustable or nonadjustable spray shower head. Adjustable spray shower heads have been shown to be more satisfying to the user.

For P-14 Water Fountains will be located outside the hazardous area whenever possible. The designer will add to the specifications required data on construction, supports and insulation.

\*\*\*\*\*

#### P-1 WATER CLOSET:

Siphon-jet, elongated bowl, top supply spud, ASME A112.19.2M, [floor mounted] [wall mounted]. Floor flange shall be copper alloy, cast iron, or plastic.

Gasket shall be wax type.

Seat - ANSI Z124.5, [black] [white] [\_\_\_\_\_] plastic, elongated, open front.

Flushometer Valve - ASSE 1037, large diaphragm type with non-hold-open feature, backcheck angle control stop, and vacuum breaker. Minimum upper chamber inside diameter of not less than 66.7 mm (2-5/8 inches) 2-5/8 inches at the point where the diaphragm is sealed between the upper and lower chambers. The maximum water use shall be 6 liters 1.6 gallons per flush. [Automatic flush valves shall be as indicated in paragraph Automatic Flushing System.]

Flush Tank - An adequate quantity of water shall be provided to flush and clean the fixture served. The water supply to flush tanks equipped for manual flushing shall be controlled by a float valve or other automatic device designed to refill the tank after each discharge, and to completely shut off the water flow to the tank when the tank is filled to operational capacity. Water closets having their flush valve seat located below the flood level rim of the closet bowl shall have a ballcock installed within a sheath or in a separate and isolated compartment of the tank, both to have visible discharge onto the floor in case of failure. Provision shall be made to automatically supply water to the fixture so as to refill the trap seal after each flushing. The water supply to flush tanks equipped for automatic flushing shall be controlled by a suitable timing device. Ballcocks shall meet ASSE 1002.

Flush Valve in Flush Tank - Flush valve seats in tanks for flushing water closets shall be at least 25 mm (1 inch) 1 inch above the flood level rim of the bowl connected thereto, except in approved water closet and flush tank combinations designed so that when the tank is flushed and the fixture is clogged or partially clogged, the flush valve shall close tightly so that water will not spill continuously over the rim of the bowl or back flow from the bowl to the tank.

P-2 WATER CLOSET HANDICAPPED:

Height of top rim of bowl shall be in accordance with ICC A117.1; other features are the same as P-1.

P-3 URINAL:

[Wall hanging, with integral trap and extended shields, ASME A112.19.2M [siphon jet] [washout]. Top supply connection, back outlet.]

Flushometer Valve - Similar to Flushometer Valve for P-1. The maximum water use shall be 3.8 liters 1 gallon per flush.]

[Plastic wall hanging urinal shall be in accordance with ANSI Z124.9. Vitreous china urinal shall be in accordance with ASME A112.19.2M and ANSI A117.1. Fixture shall be a waterless/waterfree, non-flushing type, with replaceable trap insert. The replaceable trap insert shall contain a low specific gravity immiscible barrier liquid. The liquid shall be biodegradable. The urinal and trap assembly shall maintain a sufficient barrier of immiscible liquid necessary to inhibit backflow of sewer gases.]

P-4 BATHTUB:

\*\*\*\*\*  
NOTE: When cast iron will be the selected choice,  
the designer should check to ensure that a cast iron  
bathtub is available meeting the Buy American Act.  
\*\*\*\*\*

Recessed bathtub, 1.524 m 60 in in length, manufacturer's standard width and depth, [enameled cast iron, ASME A112.19.1M] [porcelain enameled formed steel with bonded structural composite reinforcement ASME A112.19.4M. Structural reinforcement shall be in accordance with ANSI Z124.1] [gel-coated fiberglass reinforced plastic (FRP), ANSI Z124.1 with slip resistant bottom and without wall] [gel-coated fiberglass reinforced plastic (FRP), ANSI Z124.1 with slip resistant bottom and with high wall].

Drain Assembly - Plug, cup strainer, overflow assembly, washers, couplings, pop-up lever, trip lever, stopper, fittings, etc., shall be brass, cast copper alloy, or wrought copper alloy. See paragraph FIXTURES for optional plastic accessories.

P-5 LAVATORY:

Manufacturer's standard sink depth, [enameled cast iron ASME A112.19.1M] [vitreous china ASME A112.19.2M], [straight back] [ledge back] [shelf back] [countertop, rectangular].

Faucet - Faucets shall meet the requirements of NSF 61, Section 9. Faucets shall be [single] [center set] [combination] [single control, mixing] type. [Faucets shall have replaceable seats and washers.] [Faucets shall have metal replaceable cartridge control unit or metal cartridge units with diaphragm which can be replaced without special tools.] Valves and handles shall be copper alloy. Connection between valve and spout for center-set faucet shall be of rigid metal tubing. 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 liters per second 2.5 gpm at a flowing pressure of 549 kPa. 80 psi.

Handles - [Index turn] [Lever] [Four arm] [Crown] type. Cast, formed, or drop forged copper alloy.

Drain - [Strainer shall be copper alloy or stainless steel] [Pop-up drain shall include stopper, lift rods, jam nut, washer, and tail piece]. See paragraph FIXTURES for optional plastic accessories.

P-6 WHEELCHAIR LAVATORY:

Vitreous china, ASME A112.19.2M, wheelchair lavatory with wrist or elbow controls 508.0 mm wide x 685.8 mm deep (20 inches wide x 27 inches deep) 20 inches wide x 27 inches deep with gooseneck spout. 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 foot switch or fixture occupancy sensor. If a metering device is not used, the flow shall be limited to 0.16 liters per second 2.5 gpm at a flowing water pressure of 549 kPa. 80 psi.

Drain - Strainer shall be copper alloy or stainless steel.

P-7 KITCHEN SINK:

Ledge back with holes for faucet and spout [single bowl [609.6 x 533.4 mm (24 x 21 inches) 24 x 21 inches] [609.6 x 762.0 mm (24 x 30 inches) 24 x 30 inches]] [double bowl [812.8 x 533.4 mm (32 x 21 inches) 32 x 21 inches] [1067.0 x 533.4 mm (42 x 21 inches) 42 x 21 inches]] [enameled cast iron ASME A112.19.1M] [porcelain enameled steel ASME A112.19.4M] [stainless steel ASME A112.19.3].

Faucet and Spout - Faucets shall meet the requirements of NSF 61, Section 9. Cast or wrought copper alloy. Aerator shall have internal threads. 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 liters per second 2.5 gpm at a flowing water pressure of 549 kPa. 80 psi.

Handle - Cast copper alloy, wrought copper alloy, or stainless steel. Single lever type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

#### P-8 SERVICE SINK:

Enameled cast iron ASME A112.19.1M, copper alloy or stainless steel ASME A112.19.3 [trap standard 609.6 mm wide x 508.0 mm deep (24 inches wide x 20 inches deep), 24 inches wide x 20 inches deep, splashback 228.6 mm (9 inches) 9 inches high] [wall mounted 609.6 mm wide x 508.0 mm deep (24 inches wide x 20 inches deep), 24 inches wide x 20 inches deep, splashback 228.6 mm (9 inches) 9 inches high] [corner, floor mounted 711.2 mm (28 inches) 28 inches square, 171.5 mm (6-3/4 inches) 6-3/4 inches deep].

Faucet and Spout - Cast or wrought copper alloy, [with] [without] top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Handles shall be [lever] [four arm] type. Strainers shall have internal threads.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

Trap - Cast iron, minimum 7.5 cm 3 inch diameter.

#### P-9 COMBINATION SINK AND LAUNDRY TRAY:

[ledge back 1067 x 635.0 mm (42 x 25 inch, 42 x 25 inch), 101.6 mm (4 inch) 4 inch splash back, sink 203.2 mm (8 inches) 8 inches deep, tray 304.8 mm (12 inches) 12 inches deep]] [counter top 1067 x 533.4 mm (42 x 21 inch, 42 x 21 inch, 101.6 mm (4 inch) 4 inch splash back, sink 190.5 mm (7-1/2 inches) 7-1/2 inches deep, tray 254 mm (10 inches) 10 inches deep)], [left hand] [right hand], [enameled cast iron ASME A112.19.1M] [porcelain enameled steel ASME A112.19.4M].

Faucet and Spout - Cast or wrought copper alloy, [with] [without] top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast or wrought copper alloy. [Indexed turn] [Lever] [Four arm] type.

#### P-10 LABORATORY SINK:

[ledge back [584.2 mm wide x 381.0 mm deep (23 inches wide x 15 inches deep) 23 inches wide x 15 inches deep] [762.0 mm wide x 508.0 mm deep (30 inches wide x 20 inches deep) 30 inches wide x 20 inches deep]] [countertop [508.0 mm wide x 381.0 mm deep (20 inches wide x 15 inches deep) 20 inches wide x 15 inches deep] [762.0 mm wide x 508.0 mm deep (30 inches wide x 20 inches deep) 30 inches wide x 20 inches deep]], [vitreous china ASME A112.19.2M] [acid-resistant enameled cast iron ASME A112.19.1M] [acid-resistant plastic ANSI Z124.3] [corrosion-resisting steel ASME A112.19.3]. Thickness of sinks shall be manufacturer's standard. [Drain] [drain and trap] shall be

[stainless steel] [\_\_\_\_\_].

Faucet and Spout - Cast or wrought copper alloy, [with] [without] top or bottom brace, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

#### P-11 SCULLERY SINK:

Stainless steel ASME A112.19.3 with drainboard, 914.4 x 609.6 mm (36 x 24 inch) 36 x 24 inch compartments, 685.8 mm (27 inch) 27 inch deep, 381.0 mm (15 inch) 15 inch splashback, [single compartment - 1549 mm (61 inches) 61 inches wide] [double compartment - 2743 mm (108 inches) 108 inches wide] [triple compartment - 3505.2 mm (138 inches) 138 inches wide]. Drain shall have quick opening valve. Support on stainless steel legs.

Faucet and Spout - Cast or wrought copper alloy, with backflow preventer. Faucets shall have replaceable seat and the washer shall rotate onto the seat. Strainers shall have internal threads. Combination faucets with two valves and spouts shall be provided.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, four arm type.

Drain Assembly - Plug, cup strainer, crossbars, jam nuts, washers, couplings, stopper, etc., shall be copper alloy or stainless steel.

#### P-12 LAUNDRY SINK:

Double bowl, [countertop 1067 x 533.4 mm (42 x 21 inches) 42 x 21 inches] [ledge back 1067 x 609.6 mm (42 x 24 inches) 42 x 24 inches] [pedestal 1219 x 508.0 mm (48 x 20 inches) 48 x 20 inches] [leg support 1219 x 508.0 mm (48 x 20 inches), 48 x 20 inches,] [enameled cast iron ASME A112.19.1M] [stainless steel ASME A112.19.3].

Faucet and Spout - Cast copper alloy, wrought copper alloy, cast iron, or stainless steel, with backflow preventer. Faucets shall have replaceable seat and the stem shall rotate onto the seat. Strainers shall have internal threads. Combination faucets shall be mounted on the tub back. Spouts shall be externally threaded for hose connection.

Handles - Cast copper alloy, wrought copper alloy, or stainless steel, lever type.

Traps - Copper alloy, or cast iron.

P-13 Shower: Shower heads, ASME A112.18.1 other than emergency showers, shall be [adjustable] [nonadjustable] spray type and shall include a non-removable, tamperproof device to limit water flow to 0.16 liters per second (2.5 gpm) 2.5 gpm when tested in accordance with ASME A112.18.1.

Wall Mounted: Shower head shall be [adjustable] [nonadjustable] spray, stainless steel or chromium plated brass with ball joint. Handles shall be [chrome-plated die cast zinc alloy] [manufacturer's option]. Control valves shall be copper alloy and have metal integral parts of copper alloy, nickel alloy, or stainless steel. Valves shall be [thermostatic mixing]

[pressure balancing] [mechanical mixing, single lever] [separate hot and cold water] type [with integral stops]. Shower head shall be vandalproof with integral back.

Column Showers: Column showers shall have a 1.8 m (6 foot) 6 foot column height measured from floor to shower head, 12 mm (1/2 inch) 1/2 inch IPS threads.

Bath Showers: Bath showers shall include bathtub spout, shower head, valves, and diverters. A shower head mounting [with ball joint] [without ball joint] [with ball joint and head integral with a formed wall plate] [with shower head integral with formed wall plate] shall be provided. Diverter shall be integral with single mixing valves or mounted hot and cold water valves. Tub spout shall be copper alloy.

Cabinet Showers: Free standing cabinet, single unit with receptor; 863.6 mm (34 inches) 34 inches wide by 863.6 mm (34 inches) 34 inches deep, fiberglass reinforced plastic with terrazzo or plastic receptor. Cabinet shall include curtain rod, trim, and concealed fittings.

Emergency Showers: Head for Emergency and Emergency Eye and Face Wash. Shower control shall be 25 mm (1 inch) 1 inch or 40 mm (1-1/2 inch) 1-1/2 inch stay-open type control valve. Unit shall be corrosion-resisting steel and shall be [wall mounted] [pedestal mounted]. Emergency showers shall comply with ANSI Z358.1.

Emergency Eye Wash: Fountain, ANSI 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 (gage) 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 per IPC Table 608.15.1. The Contractor shall 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 15 mm (1/2 inch) 1/2 inch pipe connection and 32 mm (1-1/4 inch) 1-1/4 inch standard chrome drain fitting.

P-14 Not Used

P-15 [WATER COOLER] [BUBBLER] DRINKING FOUNTAINS:

[Water cooler drinking fountains shall meet the requirements of NSF 61, Section 9, shall be self contained, conform to ARI 1010, and use one of the fluorocarbon gases conforming to ARI 700 and ASHRAE 34 which has an Ozone Depletion Potential of less than or equal to 0.05. Shall deliver not less than 30.2 L/hour 8 gph of water at 10 degrees C 50 degrees F with an inlet water temperature of 27 degrees C 80 degrees F and ambient air temperature of 32 degrees C 90 degrees F.] [Bubbler drinking fountains shall meet the requirements of NSF 61, Section 9.] Drinking fountains shall have a self-closing valve with automatic stream regulator, flow control capability, an in-line inlet strainer, and have push-button or bar actuation. Exposed surfaces of stainless steel shall have a satin finish. Waste strainers shall be made of chrome plated brass or stainless steel.

[Surface wall-mounted] [Semi-Recessed Wall-Mounted] [Recessed wall-mounted] units shall have a bowl and splash back made of stainless steel. The unit shall have concealed fasteners and be for [interior] [exterior] installation. [Interior free standing units shall have a bowl made of stainless steel and shall be for interior installation.] [Exterior free standing units shall have a bowl made of stainless steel and shall be for exterior installation.]

Handicapped units shall be surface wall-mounted. The unit shall clear the floor or ground by at least 200 mm 8 inches. A clear knee space shall exist between the bottom of the bowl and the floor or ground of at least 685 mm 27 inches and between the front edge of the bowl and the body of the unit of at least 200 mm 8 inches. A 200 mm 8 inch wide clear space shall exist on both sides of the unit. The spout height shall be no more than 1 m 36 inches above the floor or ground. The spout shall be at the front of the unit and direct the water flow in a trajectory that is parallel or nearly parallel to the front of the unit. The bowl and splash back shall be made of stainless steel and be for [interior] [exterior] installation.

Interior Free Standing - Free standing units shall be 1016 to 1054 mm 40 to 41-1/2 inches high, 305 to 457 mm 12 to 18 inches wide, and 305 to 356 mm 12 to 14 inches deep. The bowl shall be made of stainless steel and be for interior installation.

#### P-16 FOOD WASTE DISPOSER:

Food waste disposers shall be in accordance with UL 430.

#### P-17 GARBAGE DISPOSAL MACHINES:

Garbage disposals machines shall be in accordance with CID A-A-50012.

#### P-18 WASH FOUNTAIN:

[Circular - 6 or 8 station] [Semicircular - 3, 4, 5 station] [Corner, 2 or 3 station], [1.9837 mm (14 gauge) 14 gauge stainless steel] [galvanized steel] [masonry] bowl.

#### P-19 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.]

### 3.11 POSTED 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.

### 3.12 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 21 degrees C 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0 (trace is permitted).

SL = Standby loss in W/0.093 sq. m. W/sq. ft. based on 27 degrees C 80 degrees F delta T, or in percent per hour based on nominal 38 degrees C 90 degrees F delta T.

HL = Heat loss of tank surface area.

V = Storage volume in liters

#### 3.12.1 Storage Water Heaters

##### 3.12.1.1 Electric

- a. Storage capacity of 454 liters 120 gallons or less, and input rating of 12 kW or less: minimum energy factor (EF) shall be 0.95-0.00132V per 10 CFR 430.
- b. Storage capacity of more than 454 liters 120 gallons or input rating more than 12 kW: maximum SL shall be 1.9 w/0.093 sq. m. 1.9 W/sq. ft. per ASHRAE 90.1, Addenda B.

##### 3.12.1.2 Gas

- a. Storage capacity of 379 liters 100 gallons or less, and input rating of 21980 W 75,000 Btu/h or less: minimum EF shall be 0.62-0.0019V per 10 CFR 430.
- b. Storage capacity of more than 379 liters 100 gallons - or input rating more than 21980 W: 75,000 Btu/h: Et shall be 77 percent; maximum SL shall be 1.3+38/V, per ANSI Z21.10.3.

##### 3.12.1.3 Oil

- a. Storage capacity of 189 liters 50 gallons or less and input rating of 30773 W 105,000 Btu/h or less: minimum EF shall be 0.59-0.0019V per 10 CFR 430.
- b. Storage capacity of more than 189 liters 50 gallons or input rating more than 30773 W: 105,000 Btu/h: EC shall be 83 percent; maximum SL shall be 1.3+38/V, per 10 CFR 430.

#### 3.12.2 Unfired Hot Water Storage

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter. 6.5 Btu/h/sq. ft.

### 3.12.3 Instantaneous Water Heater

#### 3.12.3.1 Gas

Volumes and inputs: ET shall be 80 percent per ANSI Z21.10.3.

#### 3.12.3.2 Oil

Capacities and inputs: EC shall be 83 percent per ANSI Z21.10.3.

### 3.12.4 Pool Heaters

Gas/oil fuel, capacities and inputs: ET shall be 78 percent per ANSI Z21.56.

### 3.13 TABLES

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NOTE: Corrosive waste, indicated in column F of Table I below, is a broad category; how well a pipe material will respond to a specific application will depend on the type of waste and its concentration. Column F was developed based on corrosive waste typically found at military or civil works facilities, e.g., battery acid at normal concentration levels. The designer should consider each specific application and research which type of pipe would work best. To help, The Plastic Pipe Institute published a report titled "TR-19/2000 Thermoplastics Piping for the Transport of Chemicals" that contains a data table listing the chemical resistance of thermoplastics piping located at web site:  
<http://www.plasticpipe.org/pubs/download/reports/tr19-00.pdf>.

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

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
1	Cast iron soil pipe and fittings, hub and spigot, ASTM A 74 with compression gaskets. 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	X	
3	Cast iron drainage fittings, threaded, ASME B16.12 for use with Item 10	X		X	X		
4	Cast iron screwed fittings (threaded) ASME B16.4 for use with Item 10				X	X	
5	Grooved pipe couplings, ferrous and non-ferrous pipe ASTM A 536 and ASTM A 47/A 47M	X	X		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		X	X	

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

Item #	Pipe and Fitting Materials	SERVICE					
		A	B	C	D	E	F
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 5	X	X		X	X	
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe ASTM B 75M ASTM B 75 C12200, ASTM B 152/B 152M, C11000, ASME B16.22 ASME B16.22 for use with Item 5	X	X				
9	Malleable-iron threaded fittings, galvanized ASME B16.3 for use with Item 10				X	X	
10	Steel pipe, seamless galvanized, ASTM A 53/A 53M, Type S, Grade B	X			X	X	
11	Seamless red brass pipe, ASTM B 43		X	X			
12	Bronzed flanged fittings, ASME B16.24 for use with Items 11 and 14				X	X	
13	Cast copper alloy solder joint pressure fittings, ASME B16.18 for use with Item 14				X	X	
14	Seamless copper pipe, ASTM B 42				X		
15	Cast bronze threaded fittings, ASME B16.15				X	X	
16	Copper drainage tube, (DWV), ASTM B 306	X*	X	X*	X	X	
17	Wrought copper and wrought alloy solder-joint drainage fittings. ASME B16.29	X	X	X	X	X	
18	Cast copper alloy solder joint drainage fittings, DWV, ASME B16.23	X	X	X	X	X	
19	Acrylonitrile-Butadiene-Styrene (ABS) plastic drain, waste, and vent pipe and fittings ASTM D 2661, ASTM F 628	X	X	X	X	X	X
20	Polyvinyl Chloride plastic drain,	X	X	X	X	X	X

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

		SERVICE					
Item #	Pipe and Fitting Materials	A	B	C	D	E	F
	waste and vent pipe and fittings, ASTM D 2665, ASTM F 891, (Sch 40) ASTM F 1760						
21	Process glass pipe and fittings, ASTM C 1053						X
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), ASTM A 518/A 518M		X			X	X
23	Polypropylene (PP) waste pipe and fittings, ASTM D 4101						X
24	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996						X

SERVICE:

- 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

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
1	Malleable-iron threaded fittings, a. Galvanized, ASME B16.3 for use with Item 4a	X	X	X	X
	b. Same as "a" but not galvanized 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	
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	
4	Steel pipe: a. Seamless, galvanized, ASTM A 53/A 53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A 53/A 53M, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B 43	X	X		X
6	Bronze flanged fittings, ASME B16.24 for use with Items 5 and 7	X	X		X
7	Seamless copper pipe, ASTM B 42	X	X		X
8	Seamless copper water tube, ASTM B 88, ASTM B 88M	X**	X**	X**	X***
9	Cast bronze threaded fittings, ASME B16.15 for use with Items 5 and 7	X	X		X
10	Wrought copper and bronze solder-joint pressure fittings, ASME B16.22 for use with Items 5, 7 and 8	X	X	X	X
11	Cast copper alloy solder-joint pressure fittings,	X	X	X	X

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
	ASME B16.18 for use with Item 8				
12	Bronze and sand castings grooved joint pressure fittings for non-ferrous pipe ASTM B 584, for use with Item 2	X	X	X	
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter ASTM D 2447	X			X
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D 3035	X			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D 2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D 3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D 2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D 2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D 2846/D 2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F 441/F 441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F 442/F 442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings,	X	X		X

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
	Schedule 80, ASTM F 437, for use with Items 20, and 21				
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F 438 for use with Items 20, 21, and 22	X	X		X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F 439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D 1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D 2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D 2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D 2464	X			X
30	Joints for IPS pvs pipe using solvent cement, ASTM D 2672	X			X
31	Filament-wound reinforced thermosetting resin (RTRP) pipe, ASTM D 2996	X	X		
32	Steel pipeline flanges, MSS SP-44	X	X		
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B 828	X	X		
34	Carbon steel pipe unions,	X	X	X	

TABLE II  
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS

Item No.	Pipe and Fitting Materials	SERVICE			
		A	B	C	D
	socket-welding and threaded, MSS SP-83				
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A 733	X	X	X	
37	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F 877.	X			X

A - Cold Water Service Aboveground

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

C - Compressed Air Lubricated

D - Cold Water Service Belowground

Indicated types are minimum wall thicknesses.

\*\* - Type L - Hard

\*\*\* - Type K - Hard temper with brazed joints only or type K-soft temper  
without joints in or under floors

\*\*\*\* - In or under slab floors only brazed joints

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

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY LITERS		INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	454 max.		12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	454 min.	OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/0.09 sq. m. maximum
Gas	380 max.		22 kW max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	380 min.	OR	22 kW min.	ANSI Z21.10.3	ET= 77 percent; SL = 1.3+38/V max.
Oil	190 max.		30.8 kW	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	190 min.	OR	30.8 kW	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, Instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 20.5 W/sq. meter

C. Instantaneous Water Heater

Gas	All	All	ANSI Z21.10.3	ET = 80 percent
Oil	All	All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All	All	ANSI Z21.56	ET = 78 percent
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TERMS:

EF = Energy factor, overall efficiency.  
ET = Thermal efficiency with 21 degrees C delta T.  
EC = Combustion efficiency, 100 percent - flue loss when smoke = 0  
(trace is permitted).  
SL = Standby loss in W/0.09 sq. m. based on 27 degrees C delta T, or in  
percent per hour based on nominal 32 degrees C delta T.  
HL = Heat loss of tank surface area  
V = Storage volume in gallons

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

A. STORAGE WATER HEATERS

FUEL	STORAGE CAPACITY GALLONS		INPUT RATING	TEST PROCEDURE	REQUIRED
Elect.	120 max.		12 kW max.	10 CFR 430	EF = 0.95-0.00132V minimum
Elect.	120 min.	OR	12 kW min.	ASHRAE 90.1 (Addenda B)	SL = 1.9 W/sq. ft. maximum
Gas	100 max.		75,000 Btu/h max.	10 CFR 430	EF = 0.62-0.0019V minimum
Gas	100 min.	OR	75,000 Btu/h	ANSI Z21.10.3	ET = 77 percent; SL = 1.3+38/V max.
Oil	50 max.		105,000 Btu/h	10 CFR 430	EF = 0.59-0.0019V minimum
Oil	51 min.	OR	105,000 Btu/h	10 CFR 430	EC = 83 percent; SL = 1.3+38/V maximum

B. Unfired Hot Water Storage, instantaneous water heater, and pool heater.

Volumes and inputs: maximum HL shall be 6.5 Btu/h/sq. ft.

C. Instantaneous Water Heater

Gas	All		All	ANSI Z21.10.3	ET = 80 percent
Oil	All		All	ANSI Z21.10.3	EC = 83 percent

D. Pool Heater

Gas or Oil	All		All	ANSI Z21.56	ET = 78 percent
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TERMS:

EF = Energy factor, overall efficiency.

ET = Thermal efficiency with 70 degrees F delta T.

EC = Combustion efficiency, 100 percent - flue loss when smoke = 0  
(trace is permitted).

SL = Standby loss in W/sq. ft. based on 80 degrees F delta T, or in  
percent per hour based on nominal 90 degrees F delta T.

HL = Heat loss of tank surface area

V = Storage volume in gallons

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