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Preparing Activity: NASA Superseding
UFGS-22 00 00.00 40 (April 2006)
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UNIFIED FACILITIES GUIDE SPECIFICATIONS

References are in agreement with UMRL dated 9 October 2006

Latest change indicated by CHG tags

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DIVISION 22 - PLUMBING

SECTION 22 00 00.00 40

PLUMBING

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PLUMBING 06/06

NOTE: Delete, revise, or add to the text in this section to cover project requirements. Notes are for designer information and will not appear in the final project specification.

This broadscope section covers general requirements, equipment, materials, installation, and testing of plumbing systems.

Avoid locating cleanouts in above-grade slabs having additional finish treatment, such as tiled terrazzo and carpeted floors. Required cleanouts should be located within piping below the floor, in walls, in cleanout access spaces, and, typically, on the toilet-room side rather than in a corridor or lobby.

In specific places, where wall boxes are not required due to practical aesthetics and cost considerations, drawings should read: "exposed cleanout acceptable."

Select CO-1 for yard cleanouts set in concrete driveways, concrete floors in machine shops, equipment rooms, garages, or heavy vehicular traffic areas.

Select CO-2 for heavy-duty service in laboratories, test rooms, and similar areas with finished concrete floors.

Select CO-3 for building floor areas subject to wheeled traffic loads not as heavy as CO-2 service. Usual selection would be laboratories, test rooms, and similar spaces with finished concrete or tiled floors.

Select CO-4 for resilient-flooring materials.

Select CO-5 for terrazzo-finished floors.

Check to verify that specified or proposed epoxy and polyester terrazzo materials will adhere to nickel-bronze and nickel-brass materials.

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.

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

PART 1 GENERAL

1.1 REFERENCES

NOTE: This paragraph is used to list the publications cited in the text of the guide specification. The publications are referred to in the text by basic designation only and listed in this paragraph by organization, designation, date, and title.

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

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

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

AIR-CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

ARI 1010 (2002) Standard for Self Contained Mechanically Refrigerated Drinking Water Coolers

AMERICAN GAS ASSOCIATION (AGA)

AGA Z21.22 (1999) Standard for Relief Valves for Hot

Water Supply System

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- ANSI A112.19.5 (1999) Trim for Water-Closet Bowls, Tanks, and Urinals
- ANSI Z358.1 (2004) Standard for Emergency Eyewash and Shower Equipment
- ANSI Z535.1 (2002) Standard for Safety Color Code

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

- ASSE (sanitary)1013 (2005) Performance Requirements for Reduced Pressure Principle Backflow Preventers and Reduced Pressure Fire Protection Principle Backflow Preventers
- ASSE (sanitary)1015 (2005) Performance Requirements for Double Check Backflow Prevention Assemblies and Double Check Fire Protection Backflow Prevention Assemblies
- ASSE 1010 (2004) Performance Requirements for Water Hammer Arresters
- ASSE 1037 (1990) Performance Requirements for Pressurized Flushing Devices (Flushometer) for Plumbing Fixtures

AMERICAN WATER WORKS ASSOCIATION (AWWA)

- AWWA C200 (1997) Standard for Steel Water Pipe 6 in. and Larger
- AWWA C203 (2002) Standard for Coal-Tar Protective Coatings and Linings for Steel Water Pipelines - Enamel and Tape - Hot Applied
- AWWA C206 (2003) Standard for Field Welding of Steel Water Pipe
- AWWA C207 (2001; R 2002) Standard for Steel Pipe Flanges for Waterworks Service-Sizes 100 mm through 3600 mm 4 in. through 144 in.
- AWWA C500 (2002; R 2003) Metal-Seated Gate Valves for Water Supply Service
- AWWA C510 (1997e2) Standard for Double Check Valve Backflow Prevention Assembly
- AWWA C511 (1997e1) Standard for Reduced-Pressure Principle Backflow Prevention Assembly
- AWWA C606 (2004) Standard for Grooved and Shouldered Joints

AWWA C651	(2005; Errata 2005) Standard for Disinfecting Water Mains
AWWA C700	(2002; R 2003) Standard for Cold Water Meters - Displacement Type, Bronze Main Case
AWWA C900	(1997) Standard for Polyvinyl Chloride (PVC) Pressure Pipe, and Fabricated Fittings, 100 mm through 300 mm 4 in. through 12 in. for Water Distribution
AWWA C901	(2002; R 2003) Polyethylene (PE) Pressure Pipe and Tubing, 13 mm through 76 mm 1/2 in. through 3 in., for Water Service
AWWA C905	(1997) Polyvinyl Chloride (PVC) Water Transmission Pipe, Nominal Diameters 350 mm through 1200 mm 14 in through 36 in

AMERICAN WELDING SOCIETY (AWS)

AWS A5.8/A5.8M	(1992; R 2004) Specification for Filler Metals for Brazing and Braze Welding
AWS WHB-2.9	(2004) Welding Handbook; Volume Two - Welding Processes
AWS-03	(2001) Welding Handbook, Volumes 1 thru 4

ASME INTERNATIONAL (ASME)

ASME A112.18.1	(2003) Standard for Plumbing Fixture Fittings
ASME A112.19.1M	(2004) Enameled Cast Iron Plumbing Fixtures
ASME A112.19.2	(2003) Standard for Vitreous China Plumbing Fixtures and Hydraulic Requirements for Water Closets and Urinals
ASME A112.6.1M	(1997; R 2002) Standard for Floor-Affixed Supports for Off the Floor Plumbing Fixtures for Public Use
ASME A112.6.3	(2001) Standard for Floor and Trench Drains
ASME B1.20.7	(1991; R 2003) Standard for Hose Coupling Screw Threads (Inch)
ASME B1.21M	(1997; Addenda 1998) Standard for Metric Screw Threads - MJ Profile
ASME B16.1	(1998) Standard for Gray Iron Threaded Fittings; Classes 125 and 250
ASME B16.12	(1998) Cast Iron Threaded Drainage Fittings
ASME B16.22	(2001) Standard for Wrought Copper and

Copper Alloy Solder Joint Pressure Fittings

ASME B16.23	(2002) Cast Copper Alloy Solder Joint Drainage Fittings-DWV
ASME B16.26	(1988) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(1998) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B31.1	(2004) Power Piping
ASME BPVC SEC IX	(2004) Boiler and Pressure Vessel Code; Section IX, Welding and Brazing Qualifications

ASTM INTERNATIONAL (ASTM)

ASTM A 126/A 126M	(2004) Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A 176	(2004) Standard Specification for Stainless and Heat-Resisting Chromium Steel Plate, Sheet, and Strip
ASTM A 197/A 197M	(2000) Standard Specification for Cupola Malleable Iron
ASTM A 307	(2004) Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
ASTM A 53/A 53M	(2004a) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 536	(1984; R 2004) Standard Specification for Ductile Iron Castings
ASTM A 563	(2004) Standard Specification for Carbon and Alloy Steel Nuts
ASTM A 563M	(2004) Standard Specification for Carbon and Alloy Steel Nuts (Metric)
ASTM A 74	(2005) Standard Specification for Cast Iron Soil Pipe and Fittings
ASTM B 306	(2002) Standard Specification for Copper Drainage Tube (DWV)
ASTM B 370	(2003) Standard Specification for Copper Sheet and Strip for Building Construction
ASTM B 584	(2004) Standard Specification for Copper Alloy Sand Castings for General

Applications

ASTM B 749	(2003) Standard Specification for Lead and Lead Alloy Strip, Sheet and Plate Products
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2003) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 109/C 109M	(2005) Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2-in. or (50-mm) Cube Specimens)
ASTM C 1107	(2005) Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
ASTM C 547	(2003) Standard Specification for Mineral Fiber Pipe Insulation
ASTM C 564	(2003a) Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings
ASTM C 592	(2000) Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type)
ASTM C 67	(2003a) Standard Test Methods for Sampling and Testing Brick and Structural Clay Tile
ASTM C 920	(2005) Standard Specification for Elastomeric Joint Sealants
ASTM D 1784	(2003) Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2665	(2004e2) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Drain, Waste, and Vent Pipe and Fittings
ASTM F 568M	(2004) Standard Specification for Carbon and Alloy Steel Externally Threaded Metric Fasteners

FM GLOBAL (FM)

FM P7825	(2003) Approval Guide
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FOUNDATION FOR CROSS-CONNECTION CONTROL AND HYDRAULIC RESEARCH (FCCCHR)

FCCCHR Manual	(1988e9) Manual of Cross-Connection Control
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INTERNATIONAL CODE COUNCIL (ICC)

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

ICC IPC (2003) International Plumbing Code

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

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

MSS SP-69 (2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application

MSS SP-80 (2003) Bronze Gate, Globe, Angle and Check Valves

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 54 (2006) National Fuel Gas Code

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201 (1988; R 1992) Water Hammer Arrestors Standard

U.S. DEPARTMENT OF ENERGY (DOE)

DOE RE-4 (2000) How to Buy an Energy-Efficient Electric Water Heater

DOE RE-5 (2000) How to Buy an Energy-Efficient Gas Water Heater

DOE WS-1 (2000) How to Buy a Water-Saving Faucet

DOE WS-2 (2000) How to Buy a Water-Saving Showerhead

DOE WS-3 (2000) How to Buy a Water-Saving Replacement Toilet

DOE WS-4 (2000) How to Buy a Water-Saving Replacement Urinal

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

FS FF-S-325 (Int Amd 3) Shield, Expansion; Nail, Expansion; and Nail, Drive Screw (Devices, Anchoring, Masonry)

UNDERWRITERS LABORATORIES (UL)

UL 8730 (1998, R 2003e1) Standard for Automatic Electrical Controls for Household and Similar Use; Part 2: Particular Requirements for Electrically Operated

Water Valves Including Mechanical
Requirements

1.2 DESIGN REQUIREMENTS

NOTE: If Section 23 00 00.00 40 HEATING,
VENTILATING, AND AIR-CONDITIONING is not included in
the project specification, applicable requirements
therefrom should be inserted and the following
paragraph deleted.

Section 23 00 00.00 40 HEATING, VENTILATING, AND AIR-CONDITIONING applies
to work specified in this section.

Plumbing systems shall be provided and shall include the water supply
system, the waste and vent system, and all required plumbing fixtures and
fittings. Plumbing fixtures and fittings shall be selected in accordance
with the water conservation guidelines as described in ICC IPC, Table 604.4.

1.3 SUBMITTALS

NOTE: Review Submittal Description (SD) definitions
in Section 01 33 00 SUBMITTAL PROCEDURES and edit
the following list to reflect only the submittals
required for the project. Submittals should be kept
to the minimum required for adequate quality control.

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

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

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

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are [for Contractor Quality Control

approval.][for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-01 Preconstruction Submittals

Material, Equipment, and Fixture Lists shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

SD-02 Shop Drawings

Detail Drawings shall be submitted in accordance with paragraph entitled, "General Requirements," of this section.

Installation Drawings shall be submitted for piping systems in accordance with paragraph entitled, "Pipe Installation," of this section.

SD-03 Product Data

Equipment and Performance Data shall be submitted for storage-type water heaters consisting of storage capacity and energy efficiency.

SD-06 Test Reports

Test Reports shall be submitted for hydrostatic pressure tests in accordance with paragraph entitled, "Tests," of this section.

1.4 GENERAL REQUIREMENTS

NOTE: If Section 23 31 13.20 40 WELDING METAL DUCTWORK is not included in the project specification, applicable requirements therefrom should be inserted and the following paragraph deleted.

Section 23 31 13.20 40 WELDING METAL DUCTWORK applies to work specified in this section.

Detail Drawings shall be submitted for plumbing systems including spring-support data.

Material, Equipment, and Fixture Lists shall be submitted for plumbing systems.

PART 2 PRODUCTS

2.1 WATER SUPPLY SYSTEM COMPONENTS

2.1.1 Pipe and Fittings

2.1.1.1 Copper Pipe

Above ground copper tubing shall conform to ASTM B 88M, Type B ASTM B 88, Type L, hard-drawn for horizontal and exposed vertical lines.

Underground copper tubing shall conform to [ASTM B 88M, Type A](#) [ASTM B 88, Type K](#), seamless. No joints shall be permitted in underground copper piping unless specifically approved. Fittings for connection to corporation cocks shall be cast bronze, flared type, conforming to [ASME B16.26](#). Underground joints shall be brazed.

Fittings and unions shall be [1034 kilopascal](#) [150 pounds per square inch gage \(psig\)](#) working steam pressure (wsp), wrought-copper solder joint conforming to [ASME B16.22](#).

Solder shall be 95-5 tin-antimony, alloy Sb5, conforming to [AWS WHB-2.9](#). Brazing rod shall be classification BP-5, conforming to [AWS A5.8/A5.8M](#).

Copper tubing systems may be installed using mechanical pipe couplings of a bolted type with a central cavity design pressure responsive gasket. Copper pipe and fittings are to be grooved in accordance with the coupling manufacturers specifications.

2.1.1.2 Plastic Pipe and Fittings

Solvent weld pipe shall be extruded of an Chlorinated Poly-vinyl Chloride (CPVC) virgin pipe compound. Compound shall conform to [ASTM D 1784](#), Cell Classification 12454-B, and have a [13790 kilopascal](#) [2,000-pound per square inch \(psi\)](#) hydrostatic design stress rating. Pipe and fittings shall conform to [\[AWWA C900\]](#) [\[AWWA C901\]](#) [\[AWWA C905\]](#), Schedule [\[40\]](#) [\[80\]](#).

Grooved pipe and fittings shall conform to [AWWA C606](#).

Pipe shall bear the following markings: manufacturer's name, nominal pipe size, schedule or class, pressure rating in [kilopascal psi](#), and NS International (NS) seal of approval. Manufacturer shall also mark the date of extrusion on the pipe.

Solvent cement or rubber-gasket joints for pipe and fittings shall be made in accordance with the manufacturer's instruction.

Fittings shall be PVC Schedule [\[40\]](#) [\[80\]](#).

Fittings shall be injection-molded of an improved PVC compound. Fittings shall conform to [ASTM D 1784](#), Cell Classification 12454-B.

Tees and ells shall be side gated.

Fittings shall bear the company's name or trademark, material designation, size, applicable iron pipe size (rips) schedule, and NS seal of approval.

Threaded nipples shall be standard weight Schedule 80 with molded threads.

2.1.1.3 Galvanized Carbon Steel Pipe

NOTE: This pipe is applicable for potable water and rain water leader systems.

Pipe size [DNA15 through DN250](#) [1/2 through 10 inches](#), and where indicated shall be in accordance with [AWWA C200](#), Schedule 40 seamless or electric-resistance welded galvanized steel conforming to [ASTM A 53/A 53M](#),

[Type E, Grade B (electric-resistance welded)] [Type S (seamless)].

Fittings DN50 2 inches and under shall be 1034 kilopascal 150-psig wsp banded galvanized malleable iron screwed, conforming to ASTM A 197/A 197M and ASME B16.3.

Unions DN50 2 inches and under shall be 2068 kilopascal 300-psig wsp female, screwed, galvanized malleable iron with brass-to-iron seat and ground joint.

Fittings DN65 2-1/2 inches and over shall be 862 kilopascal 125-psig wsp cast-iron flanges and flanged fittings, conforming to ASTM A 126/A 126M, Class A and ASME B16.1.

Steel flanges shall conform to AWWA C207.

Field welding of steel pipe shall be as specified in AWWA C206.

Contractor has the option of using 1034 kilopascal 150-psig wsp banded galvanized malleable iron screwed fittings, conforming to ASTM A 197/A 197M and ASME B16.3.

Grooved fittings may be used in lieu of threaded, flanged, or welded fittings. Fittings shall be [cast ductile iron in accordance with ASTM A 536.] [fabricated of Schedule 40 carbon steel pipe conforming to ASTM A 53/A 53M.] Grooves shall conform to AWWA C606.

2.1.2 Valves and Specialties

2.1.2.1 Gate Valves

Valves shall be designed for a minimum of [1034] kilopascal [150] psi [_____]. Valves shall have [bell-and-spigot ends] [screw joints]. Valves smaller than DN80 3 inches shall be all brass and shall conform to MSS SP-80, Type I. Valves DN80 3 inches and larger shall be iron-body, brass-mounted, conforming to AWWA C500.

2.1.2.2 Vacuum and Relief Valves

Vacuum and relief valves shall be size and type to relieve pressure and prevent the formation of a vacuum. Valves shall automatically remove air from the lines when the lines are being filled and admit air into the lines when water is being withdrawn in excess of the inflow.

2.1.2.3 Hose Faucets

NOTE: Normally delete vacuum breaker when faucets
are installed in nonpotable-water lines.

Hose faucets shall be constructed with 15 millimeter 1/2-inch male inlet threads, hexagon shoulder, and 20 millimeter 3/4-inch hose connection, conforming to ASME A112.18.1. Hose-coupling screw threads shall conform to ASME B1.20.7 and ASME B1.21M.

Vandalproof, atmospheric-type vacuum breaker shall be provided on discharge.

2.1.2.4 Globe Valves

Valves shall be 862 kilopascal 125-psi, bronze body, conforming to MSS SP-80. Disk shall be free to swivel on the stem. Composition seating surface disk construction may be substituted for all-metal disk construction. Packing shall be a woven non-asbestos material, impregnated with not less than 25 percent, by weight, tetrafluoroethylene resin.

2.1.2.5 Check Valves

Standard check valves in sizes DN50 2 inches and smaller shall be 862 kilopascal 125-psi swing check conforming to MSS SP-80. Lift checks (lift check horizontal) and 862 kilopascal 125-psi valves conforming to MSS SP-80, shall be provided.

Check valves in sizes DN65 2-1/2 inches and larger shall be cast iron, bronze trim, swing type. Valve bodies shall be [cast iron, conforming to ASTM A 126/A 126M, Class A] [ductile iron, conforming to ASTM A 536]. Valve ends shall be flanged in conformance with ASME B16.1. Swing-check pin shall be AISI Type [304] [316] [_____] corrosion-resistant steel. Valves shall have bolted and gasketed covers.

Grooved end check valves may be used provided that the manufacturer certifies to the performance requirements of MSS SP-80.

2.1.2.6 Backflow Prevention Devices

NOTE: Approved backflow prevention devices are defined by method of use as air gap, atmospheric vacuum breaker, pressure vacuum breaker, double check backflow, and reduced pressure principle.

Backflow prevention devices shall conform to AWWA C510 and AWWA C511.

Devices DN50 2 inches ips and smaller with moving components defined in AWWA C511, shall be constructed of nonferrous metals. Nonmetal components of such devices shall be rated for the applicable service temperature.

Bodies of devices DN65 2-1/2 inches and larger shall be corrosion-resistant ferrous material or bronze, with flanged connections. Metallic operating components and trim shall be nonferrous. Nonmetallic parts shall be rated for the applicable service temperature.

External surfaces of devices used in conjunction with equipment with polished or chrome-plated surfaces shall be similarly finished.

External surfaces of devices may be rough castings where these devices are used outside of the building or in equipment rooms. Devices shall be protected from freezing and shall be installed, tested, and used in strict conformance with the manufacturer's instructions.

Air gaps shall be at least two times the supply pipe diameter, but not less than 25 millimeter 1 inch, as measured vertically, from the flood rim of the supplied device. There shall be no provision for a temporary bypass line around the air gap or water supply tank and pump.

Atmospheric Vacuum Breakers (AVB) shall be used only where no back-pressure

may occur. Atmospheric vacuum breakers will only provide protection against back-siphonage of nontoxic pollutants. AVB shall be installed downstream of the last shutoff valve and at least 300 millimeter 12 inches above the highest sprinkler head or outlet. Under no circumstances shall the AVB be installed where it will be under continuous pressure for more than 12 hours in any 24-hour period. AVB shall be installed in an accessible location.

Type PVB pressure vacuum breaker devices used only where there is no possibility of back-pressure. PVB shall be installed in an accessible location to facilitate inspection and servicing. PVB shall be installed a minimum of [300] millimeter [12] inches [_____] above the highest outlet, shall conform to ASSE 1010, and shall have tightly closing shutoff valves on each end, and be fitted with properly located test cocks. PVB devices may have pressure on downstream side and may be used for back-siphonage only, against pollutants or contaminants.

NOTE: Type DC backflow and reduced pressure principle devices is normally supplied in sizes 3/4 inch through 10 inches DN20 through DN250. Larger sizes will be rated by the Foundation for Cross-Connection Control and Hydraulic Research.

Type DC backflow devices or assemblies are used for low degree of hazard nonpollutants or contaminants. This device shall conform to [AWWA C510] [ASSE (sanitary)1015], and FCCCHR Manual standard. This unit shall be installed a minimum of [_____] [300] millimeter [12] inches above the ground or flood level. When installed in a pit, a drain must be provided. This assembly device must be furnished with tightly closing shutoff resilient seated valves on each end and be fitted with properly located test cocks. Outside locations shall include protection against freezing. Critical facility potable water systems and DN65 2-1/2 inch and larger shall have dual-parallel installation which should be installed in accessible locations. When DC backflow assemblies are used on fire suppression water systems, the shutoff valves must be OS&Y resilient seated gate valves.

Reduced pressure principle devices shall conform to [] [AWWA C511] and FCCCHR Manual. This unit shall be installed a minimum of ASSE (sanitary)1013 [_____] [300] millimeter [12] inches above ground or flood level. This unit shall include tightly closing shut-off valves on each end and be fitted with properly located test cocks. Indoor installations shall include an airgap-equipped drain adequate for relief valve discharge. Outside installations shall include protection against freezing. Critical water supplies shall have dual-parallel installations which shall be installed in accessible locations.

2.1.2.7 Water Meters

Positive displacement disk meters shall conform to AWWA C700, except as otherwise noted. Parts wetted by water shall be [bronze] [rubber] [plastic]. Casing shall be flanged in sizes DN65 2-1/2 inches and larger. Registers shall be magnetic drive, straight reading. Maximum pressure drop at maximum capacity shall not exceed [_____] [70] kilopascal [_____] [10] psi for meters sized DN40 1-1/2 inches ips and smaller; and [_____] [103] kilopascal [_____] [15] psi for meters 50 millimeter 2 inches ips and larger.

2.1.2.8 Goosenecks

Copper tubing for gooseneck connections shall conform to **ASTM B 88M, Type A**
ASTM B 88, Type K, annealed.

2.1.2.9 Service Stops

Service stops shall be waterworks ground-key type, oval flowway, T-handle, without drain. Pipe connections shall be suitable for the type of service pipe used. Parts shall be cast red brass having a nominal composition of 85 percent copper, 5 percent tin, 5 percent lead, and 5 percent zinc, with female ips connections designed for a minimum pressure of [_____] [1379] kilopascal [_____] [200] psi.

2.1.2.10 Valve Boxes

Valve boxes shall be [cast iron] [plastic], complete with covers. [Cast-iron boxes shall be the extension type with [screw] [slide] adjustments and with flared bases.] [Plastic boxes shall be constructed as indicated.] The word "WATER" shall be cast in the cover. Boxes shall be installed over each gate valve. Boxes shall be of such a length as can be adapted, without full extension, to the depth of cover required over the pipe at the valve location. [Plastic boxes may be installed only in locations not subjected to traffic.]

2.1.2.11 Valve Manholes

Valve manholes shall be constructed in accordance with the design details.

2.1.2.12 Water-Hammer Arresters

Water-hammer arresters shall be commercially manufactured products consisting of bellows arranged to absorb the energy of pressure waves generated by valve closure in a line in which water is flowing. Arresters shall be nonferrous construction, shall be rated as to capacity, and shall be certified in accordance with **PDI WH 201**.

2.1.2.13 Wall Hydrants

NOTE: Include "backflow preventers (vacuum breakers)" when the following paragraph is selected.

Wall hydrants shall have brass wall-boxes with nozzles and detachable T-handles and shall be provided with vandalproof type BAT vacuum breakers. Exterior surfaces shall be chrome-plated.

2.1.3 Storage-Type Water Heaters

Storage-type water heaters shall be [gas-fired], [electric] type. [Gas-fired water heaters shall be installed in accordance with **NFPA 54**.] [Electric water heaters shall be UL listed.]

Water heaters shall be commercially available models. Model selected shall be of the energy efficient type insulated to an R value of at least [_____] [1.8 square meter Celsius per watt (10 square foot Fahrenheit per Btu)] [_____] [10] and shall have efficiencies in accordance with the levels

specified in DOE RE-4 and/or DOE RE-5. Submit equipment and performance data for verification of storage capacity and energy efficiency.

Temperature- and pressure-relief valves shall conform to AGA Z21.22. Type I, combination pressure- and temperature-relief valves shall be installed when the heat input is less than 30 kilowatt 100,000 Btu per hour and when the storage is less than 454 liter 120 gallons. When either or both of the specified conditions are reached or exceeded, [Type II, temperature relief, water rated] [Type III, temperature relief, steam rated valves] shall be installed. Vacuum-relief valves shall be installed on each cold-water branch connection on the bottom of the water heaters at an elevation above the top of the heater. Vacuum relief valve shall be designed to prevent water heater damage from a reverse flow vacuum.

2.1.4 Plumbing Fixtures and Trim

Vitreous-china and enameled cast-iron plumbing fixtures shall be white, and shall be the product of the same manufacturer.

Exposed traps and double-cone supply tubes for fixtures and equipment shall be connected to rough-piping at the wall, unless otherwise specified in the contract documents. Floor and wall plates shall be as specified herein or as covered by the outfit numbers. Exposed-to-view fixture trimmings, fittings, and fasteners shall be chromium-plated or nickel-plated brass with polished, bright surfaces.

Supplies and wastes for lavatories shall be to wall, except as otherwise indicated on the construction drawings. Sleeves are not required at penetrations.

Rubber compression type connections shall not be acceptable. Brass ferrule type fittings shall be required.

2.1.4.1 Fixture Supports

Wall-hung fixtures shall be supported by ferrous-metal carriers suited to the particular installation conditions. Carriers may be combination type with adjustable fittings. Water closets and urinals shall have supporting feet not less than [] [250] millimeter [] [10] inches long. Lavatories shall be supported from the wall by wall-carriers with concealed arms.

2.1.4.2 Lavatories

Lavatories and fittings shall conform to ASME A112.19.2.

Type L-S lavatories shall be Type V, slab type, Class 4, wall hung, 20 by 18 inches 508 by 457 millimeter. Inside opening shall be substantially rectangular.

Type L-B lavatories shall be Type I, straight back, 508 by 457 millimeter 20 by 18 inches. Inside opening shall be substantially rectangular.

Type L-C lavatories shall be Type IV, countertop, Class 2, oval, flat rim, beadless, self-rimming with rounded rim corner and back ledge, front overflow, oval shaped, seamless, and mirror finish. Materials shall be 1.3 millimeter 18-gage corrosion-resistant steel conforming to ASTM A 176, Class 302, A, annealed. Internal size of the lavatory shall be [] [384 by 289 by 152] millimeter [] [15-1/2 by 11-3/8 by 6] inches deep.

Bowls shall be coated externally with sound deadening, nonmarring mastic.

Supply fittings shall conform to applicable requirements for faucets in ASME A112.19.2 and shall be in accordance with the recommended levels specified in DOE WS-1.

Supply fitting shall be a 100 millimeter 4-inch, centerset type with a vandalproof aerator. [Automatic supply fittings shall conform to ICC A117.1 and UL 8730 for faucets.]

Supply fitting spout angle and length over the bowl shall provide a water-free back ledge. Horizontal distance from the centerline of the spoutless aerator to the centerline of the supply piping shall be not less than [] [111] millimeter [] [4-3/8] inches, and the vertical distance between the centerline of the spout, less aerator, and the fitting base shall be not less than [] [DN65] [] [2-1/2] inches. Supply fittings with handles capable of being turned 360 degrees shall not be acceptable. [Faucet supply shall be automatic [battery] [electronic] motion sensing detector type activation.]

Supply piping shall be chrome-plated brass and threaded in accordance with the requirements of ASME A112.19.2.

Drain fittings shall conform to ASME A112.19.2, strainer drain, but with perforated removable strainer and DN32 1-1/4-inch tailpiece. Adjustable P-trap, with cleanout, shall be Type I.

Corrosion-resistant steel lavatories shall be equipped with corrosion-resistant steel drain fittings.

2.1.4.3 Service Sinks

Service sinks and fittings shall conform to ASME A112.19.1M, ASME A112.19.2. [Automatic controlled fittings shall conform to UL 8730 and ICC A117.1.]

Type SS-W service sinks shall be single bowl, mounting trap standard with high nondrilled back, and without a finished apron. Supply fittings shall be a DN250 10-inch chrome-plated spout, Type SS-W, single, compression, with vacuum breaker and 1220 millimeter 4-foot hose with holding bracket.

Waste shall be to the wall. P-trap shall be cast iron with acid-resisting enamel inside, brass clean-out plug, and strainer.

Type SS-F service sinks shall be single bowl, mounting floor with high nondrilled back, floor-corner mounted, curved or straight front, and enameled cast iron with rim guard. Sinks shall be 711 by 711 millimeter 28 by 28 inches overall, 330 millimeter 13 inches back height from the floor, and 150 millimeter 6 inches deep. Supply fittings shall be single, compression, with vacuum breaker and 1220 millimeter 4-foot hose with holding bracket. Supply fittings shall be in accordance with the recommended levels specified in DOE WS-1. Drain fittings shall be 80 millimeter 3 inches.

Type SS-T service sinks shall be single bowl, three-side access, floor mounted, terrazzo, with four-side cap-tiling flange, and fabricated from Class 302, annealed corrosion-resistant steel. Fixtures shall be 914 by 600 millimeter 36 by 24 inches overall and 300 millimeter 12 inches high. Supply fittings shall be a DN250 10-inch spout, chrome-plated, single, compression, with vacuum breaker and 4-foot hose with holding bracket.

Drain fittings shall be 80 millimeter 3 inches.

2.1.4.4 Urinals and Fittings

Urinals shall be top-connected, wall-hung bowl with integral flush distribution, wall-hung with integral trap and extended shields, [washout flushing action, in conformance with ANSI A112.19.5 with flush valve.] [auto flush conforming to ICC A117.1 and UL 8730 and ASSE 1037.] Urinals shall be in accordance with the recommended levels specified in DOE WS-4.

[Flush valve shall be exposed flushometer, large diaphragm and large piston, side oscillating handle,] [Flush shall be auto flush motion sensing [battery] [electrically wired] operated] with [25] [19] millimeter [1-inch] [3/4-inch] inlet and outlet pipe connections, a vacuum breaker and screwdriver stop, constructed for quiet operation. Exposed parts shall be chrome-plated.

2.1.4.5 Water Closets

Water closet, Type WC-1, shall be office and industrial type, elongated bowl with flush valve, siphon, jet, and wall outlet, in conformance with ANSI A112.19.5, constructed for quiet operation. Seat shall be elongated, open-front, solid-molded, high-impact, polystyrene, white, with check hinge, less cover. [Flush valve shall be exposed flushometer, large diaphragm and large piston, side oscillating handle with vacuum breaker and screwdriver stop, constructed for quiet operation.] [Flush valve shall be auto motion sensing conforming to ICC A117.1 and UL 8730 and ASSE 1037.]

Women's room outfit, Type WC-2, shall be identical, except that seat shall be elongated bowl, industrial, open front with cover. [Bumper shall be provided on flush valve.]

All water closets shall be in accordance with recommended levels specified in DOE WS-3.

2.1.4.6 Shower Fittings

Shower fittings shall conform to ANSI Z358.1 with concealed piping and pressure-balancing mixing valve. Shower head shall be Type I, Class 2, adjustable spray. Showerheads shall be in accordance with recommended levels specified in DOE WS-2.

2.1.4.7 Emergency Shower and Shower Equipment

Emergency shower shall conform to ANSI Z358.1. Markings identifying emergency shower shall be as detailed on plans conforming to ANSI Z535.1. Outdoor emergency showers shall have freeze-proof valves that allow full drainage of piping to below frost line after each operation.

2.1.4.8 Electric Water Cooler

ARI 1010, [floor] [wall]-mounted, bubbler style, air-cooled condensing unit, 15 liter per hour 4.0 gph steel splash receptor, and all stainless steel cabinet. [Provide ASME A112.6.1M concealed [chair carriers] [wall hangers with thru-bolts and back plates for mounting on wall hung coolers].] CFC refrigerants are not allowed.

2.1.4.9 Wheelchair Electric Water Cooler

ARI 1010, wall-mounted bubbler style with ASME A112.6.1M concealed chair carrier, air-cooled condensing unit, 18 liter per hour 4.75 gph minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 675 millimeter 27-inch clearance from front bottom of unit to floor and 900 millimeter 36-inch maximum spout height above floor. Bubblers shall also be controlled by push levers, by push bars, or touch pads one on each side or one on front and both sides of the cabinet. CFC refrigerants are not allowed.

2.2 SANITARY DRAIN, WASTE, AND VENT SYSTEM (DWV)

2.2.1 DWV Piping

2.2.1.1 Cast-Iron

Soil pipe drain, waste, and vent bell-and-spigot type shall conform to ASTM A 74. Joints shall be calked and leaded in lines where necessary to provide proper leaktight support and alignment. Joints may be elastomeric compression conforming to ASTM C 564. Hubless joints may be used. Pipe class shall be standard weight CISP-DWV.

2.2.1.2 Copper

Pipe shall be type DWV copper drainage tube conforming to ASTM B 306, with [cast brass] [wrought copper] drainage fittings conforming to ASTM B 584 and ASME B16.23.

2.2.1.3 Polyvinylchloride (PVC)

Polyvinylchloride drain, waste, and vent piping-system materials shall be manufactured from Type I normal impact resins in conformance with ASTM D 2665 and with ASME B16.12. Pipe and fittings shall be white and specifically suited for joining socket interfaces into a homogeneous mass by solvent-cement welding.

Fittings shall be molded to produce upon insertion of pipe an interference fit at two-thirds depth of socket. No thread cutting shall be permitted.

2.2.2 Sanitary Drain Waste and Vent Fixtures

2.2.2.1 Floor Drains (FD)

NOTE: Select floor drain Type FD-1 for toilet
rooms, locker rooms, and similar duty.

Floor drains shall be complete with traps, and bottom outlets.

Floor drains located in slabs on earth shall have hub outlets. Drains in slabs not on earth shall have threaded outlets or hub outlets, as required to match piping used.

Floor drains shall have integral seepage pans and weepholes.

Floor drains fitted with membrane or metal-pan waterproofing shall have clamping-collar assemblies.

Ferrous floor-drain surfaces, except the top of grates, shall be given a heavy coating of coal-tar enamel. Coating shall be applied either at the factory or in the field before installation and before any rusting has occurred.

Type FD-1 floor drains shall conform to **ASME A112.6.3** and as indicated. Adjustable collar strainer and fasteners shall be nickel-bronze. Exposed-to-view surfaces shall be satin polished, except in mechanical rooms. Strainer holes shall be square. Strainer diameter shall be nominal **125 millimeter 5 inches** Strainer and body shall be capable of sustaining specified platen load of not less than [_____] **[8900] newton [_____] [2,000] pounds** with not more than **[1.6] millimeter [1/16] inch** deflection with load applied within [5] [_____] seconds. Strainer-free area shall be not less than [_____] **[4516] millimeter [_____] [7] inches** square.

2.2.2.2 Cleanouts (CO)

NOTE: Select cleanout that is applicable to job.

Cleanouts shall be gastight and watertight, sized to provide quick and easy access for plug removal and rodding tools in their specific location. Cleanouts shall be aesthetically located with respect to tile patterns, masonry bond, and alignment.

Cleanouts in ceramic-tile and resilient-tile flooring and wall finish shall be rectangular.

No cleanout plug shall terminate in or above a finished floor or wall surface except in stack bases and where indicated on the construction drawings.

Cleanouts shall have cast-brass raised-head plugs. Not less than two tools for each size and type of plug shall be delivered to the Contracting Officer.

Cleanout plugs under pressure and where specified in the contract documents shall be lead gasketed.

Cleanouts in aboveground floors shall have integral seepage pans and weepholes.

Cleanouts fitted with membrane or metal-pan waterproofing shall have integral seepage pans and weepholes, and clamping-collar assemblies.

Cleanouts set outside of the building and all cleanouts in building floors shall have adjustable housings.

Cast-iron bodies shall be coated with manufacturer's standard material.

Type CO-1 shall be cast-iron body and setscrew-adjustable housing with deep-set tractor-type cast-iron scoriated cover. Construction shall be heavy duty, suitable for AASHTO H-10 loading.

Type CO-2 shall be cast-iron body and setscrew-adjustable housing with deep-set tractor-type polished nickel-brass or nickel-bronze scoriated cover. Construction shall be heavy duty, suitable for AASHTO H-10 loading.

Type CO-3 shall be cast-iron body and adjustable housing with polished nickel-brass or nickel-bronze heavy-duty frame and scoriated secured cover. Cover thickness shall be not less than [_____] [10] millimeter [_____] [3/8] inch.

Type CO-4 shall be cast-iron body and adjustable housing with cover recessed to a depth to accommodate specified resilient-flooring material. Surfaces and fasteners exposed to view shall be constructed of polished nickel-bronze or approved nickel-brass.

Type CO-5 shall be cast-iron body and adjustable housing with [_____] [19] millimeter [_____] [3/4] inch minimum recessed anchor cover. Surfaces and fasteners exposed to view shall be constructed of nickel-bronze or approved nickel-brass. Cover shall be equipped with lifting screw.

2.3 SUPPORTING ELEMENTS

Necessary piping-system components and miscellaneous supporting elements shall be provided, including, but not limited to, building structure attachments; supplementary steel; hanger rods, stanchions, and fixtures; vertical pipe attachments; horizontal pipe attachments; anchors; and variable and constant supports. Supporting elements shall be suitable for stresses imposed by systems pressures and temperatures, and natural and other external forces.

Supporting elements shall be in accordance with FM P7825 and be UL listed and shall conform to ASME B31.1, MSS SP-58, MSS SP-69, and requirements specified herein.

Types of devices specified herein are defined in referenced MSS standards.

2.3.1 Building Structure Attachments

2.3.1.1 Anchor Devices, Concrete and Masonry

Anchor devices shall conform to requirements of FS FF-S-325, [Group I] [Group II, Type 2, Class 2, Styles [1] [2];] [Group III] [Group VIII].

Anchor devices for cast-in floor-mounted equipment shall provide for adjustable positions.

Masonry anchor devices shall be built-in.

Powder-actuated anchoring devices shall not be used to support any mechanical-system components.

2.3.1.2 Beam Clamps

Beam clamps shall be center-loading MSS SP-58 Types D21, 28, 29, and 30, UL listed, cataloged and load-rated, commercially manufactured products.

2.3.1.3 Inserts, Concrete

Concrete inserts shall be constructed in accordance with the requirements of MSS SP-58 for Type 18 and MSS SP-69. When applied to piping in sizes DN50 2-inch ips and larger, and where otherwise required by imposed loads, a 305 millimeter 1-foot length of 13 millimeter 1/2-inch reinforcing rod shall be inserted and wired through slots. Proprietary continuous inserts

shall be similarly used.

2.3.1.4 C-Clamps

[C-clamps shall not be used.]

[C-clamps shall be used to support piping sizes 40 millimeter 1-1/2 inches and smaller. C-clamps shall be FM P7825 approved and UL listed with hardened cup tip, setscrew, locknut, and retaining strap. Retaining-strap section shall be not less than [_____] [3] millimeter [_____] [1/8] inch Beam-flange thickness to which clamps are attached shall not exceed [_____] [15] millimeter [_____] [0.60] inch.]

2.3.2 Horizontal Pipe Attachments

2.3.2.1 Single Pipes

Piping in sizes through DN50 2-inch ips shall be supported by MSS SP-58 Type 6 solid malleable-iron pipe rings, except that split-band rings shall be used in sizes up to DN25 1-inch ips.

Piping in sizes through DN200 8-inch ips inclusive shall be supported by MSS SP-58 Type [1] [3] [4] attachments.

MSS SP-58 Type 1 and 6 assemblies shall be used on vapor-sealed insulated piping and shall have an inside diameter 1-ips larger than the pipe being supported, to provide adequate clearance during pipe movement.

MSS SP-58 Type 12 devices with double-bolted, angle-iron wall or fixture clips shall be used in pipe chases to support fixture-supply piping.

MSS SP-58 Type 40 shields shall be used on insulated piping. Area of the supporting surface shall be such that compression deformation of insulated surfaces does not occur. Longitudinal and transverse shield edges shall be rolled away from the insulation.

MSS SP-58 Type 39 saddles shall be used for pipe guiding.

Spring supports shall be provided.

2.3.2.2 Parallel Pipes

Trapeze hangers fabricated from, structural-steel shapes, with U-bolts shall be used in congested areas and where multiple pipe runs occur. Structural-steel shapes and structural supports shall be a commercially available, of a preengineered design, rolled steel.

2.3.3 Vertical Single Pipe Attachments

Vertical pipe attachments shall be MSS SP-58 Type 8.

2.3.4 Hanger Rods

Only circular cross-section rod hangers shall be used to connect building-structure attachments to pipe supports. Pipe, straps, or bars of equivalent strength shall be used for hangers only where approved by the Contracting Officer.

2.3.5 Copper Tubing and Pipe Supports

Metal surfaces in contact with copper tubing or pipe shall be [copper-plated] [plastic-coated].

Support surfaces shall have large contact areas to prevent point loading with consequent cutting. Minimum direct-contact areas shall be equal to commercially available Type I hangers.

2.4 INSULATION

Hot-water-piping insulation shall be fiberglass with factory-applied jacket conforming to ASTM C 547.

Composite UL-listed jacket and insulation shall have a Fire-Hazard Classification of flame-spread 25, smoke-developed 50. Wall penetrations shall be sleeved with foamed, flexible insulation, continuous through the sleeve.

Potable hot- and cold-water lines shall be insulated to the extent shown with standard nominal 19 millimeter 3/4-inch foamed, flexible insulation. Insulation shall be slipped onto the pipe prior to making up fittings. Butt joints shall be sealed with adhesive as recommended by the insulation manufacturer. Outdoor insulation shall be coated with an ultraviolet light protective coating recommended by the insulation manufacturer.

For pipe hangers and supports where the insulation rests on the 32 millimeter 1-1/4-inch strap of the adjustable clevis pipe hanger, the insulation shall be cut with a brass cork-borer and a number 15 superior grade cork shall be inserted. Seams shall be sealed with suitable adhesive. Cork shall be centered on the strap. Length of the cork shall be modified to suit the insulation thickness.

Fitting shall be insulated with miter-cut pieces of pipe insulation of the same size as applied to the adjacent pipe. Miter-cut pieces shall be joined with adhesive, the covers slit, snapped over the fittings, and the joints sealed with adhesive.

After the piping system has been installed, tested, and placed in satisfactory operation, the hanger load nut above the clevis shall be firmly tightened to ensure proper hanger performance. A nipple shall be placed over the 13 millimeter 1/2-inch diameter clevis bolt as a spacer to ensure that the lower U-strap will not move in on the bolt and deform or compress the insulation.

2.5 MISCELLANEOUS MATERIALS

2.5.1 Bituminous Coating

Bituminous coating shall be a solvent cutback, heavybodied material to produce not less than a [] [0.3] millimeter [] [12] mil dry-film thickness in one coat, and shall be recommended by the manufacturer as compatible with factory-applied coating and rubber joints.

For previously coal-tar coated and uncoated ferrous surfaces underground, bituminous coating shall be solvent cutback coal-tar type, conforming to AWWA C203.

2.5.2 Bolting

Flange and general purpose bolting shall be hex-head and shall conform to [ASTM F 568M](#), Class 4.8 or above [ASTM A 307](#), Grade B bolts, for flanged joints in piping systems where one or both flanges are cast iron. Heavy hex-nuts shall conform to [ASTM A 563M](#) [ASTM A 563](#). Square-head bolts and nuts shall not be acceptable. Threads shall be coarse-thread series.

2.5.3 Elastomer Calk

[Polysulfide-] [Polyurethane]-base elastomer calking material shall be two-component type, conforming to [ASTM C 920](#).

2.5.4 Escutcheons

Escutcheons shall be manufactured from nonferrous metals and shall be chrome-plated except when AISI 300 series corrosion-resistant steel is provided. Metals and finish shall conform to [ASME A112.19.1M](#), [ASME A112.19.2](#).

Escutcheons shall be one-piece type where mounted on chrome-plated pipe or tubing, and one-piece of split-pattern type elsewhere. Escutcheons shall have provisions consisting of internal spring-tension devices or setscrews for maintaining a fixed position against a surface.

2.5.5 Flashing

Sheet lead shall conform to [ASTM B 749](#), Grade [B] [C] [D].

Sheet copper shall conform to [ASTM B 370](#) and shall weigh not less than [_____] [4.8] kilogram per square meter [_____] [16] ounces per square foot.

2.5.6 Grout

NOTE: When moisture or uncured concrete occurs, metallic grout may cause buildup of pressure that, under confinement, could be sufficient to misalign equipment.

Epoxy grout shall be specified particularly where mild chemical resistance is necessary or where oil soaking may occur.

Where high anchor-bolt torques (2,000 ft-lb) (2712 newton-meter) are applied, epoxy polyamides will cold-flow.

Shrink-resistant grout shall be a premixed and packaged metallic-aggregate, mortar-grouting compound conforming to [ASTM C 1107](#).

Shrink-resistant grout shall be a combination of premeasured and packaged [epoxy polyamide] [amine resins] and selected aggregate mortar grouting compound with a tensile strength of 13100 kilopascal 1,900 psi, minimum in accordance with a compressive strength of 96.53 Megapascal 14,000 psi, minimum in accordance with [ASTM C 109/C 109M](#). Linear shrinkage shall be 0.003 millimeter per millimeter 0.00012 inch per inch with water absorption of 0.1 percent in accordance with [ASTM C 67](#). Bond strength to steel in

shear shall be 6895 kilopascal 1,000 psi, minimum.

2.5.7 Pipe Thread Compounds

Tetrafluoroethylene tape [] [50] millimeter [] [2] mils thick shall be used in potable and process water and in chemical systems for pipe sizes to and including DN25 1-inch ips. Tetrafluoroethylene dispersions and other suitable compounds may be used for other applications upon approval by the Contracting Officer. Lead-containing compounds shall not be used in potable water systems.

PART 3 EXECUTION

3.1 EXCAVATION AND BACKFILL

Excavation and backfill operations shall performed in accordance with Section 31 00 00 EARTHWORK.

3.2 PIPE INSTALLATION

Installation drawings shall be submitted and piping systems shall be fabricated and installed in accordance with ASME B31.1 and MSS SP-69.

Final connections to equipment shall be made with unions or flanges. A union or flange shall be provided every 30480 millimeter 100 feet of straight run. Unions shall be provided in the line downstream of screwed- and welded-end valves.

Metallic pipe ends shall be reamed before joint connections are made.

Pipe ends shall be reamed before joint connections are made.

Screwed joints shall be made up with tetrafluoroethylene joint compound or tape and not more than three threads shall show after the joint is made up.

Connections between copper and steel pipe or equipment shall be made using dielectric [unions having 1207 kilopascal 175-psi minimum pressure] [flanges having 99 degrees C 210-degree F minimum temperature ratings] [clearflow nipples specifically recommended and/or designed by pipe manufacturer].

Cutting of metallic piping shall be by wheel cutters or other machines designed specifically for that purpose. Electric-arc and oxyacetylene cutting shall not be permitted.

Plastic pipe shall be cut square with pipe. Burrs shall be removed by smoothing edges.

Schedule 40 plastic pipe shall not be threaded.

Joint compounds shall be applied to the male thread only and care shall be exercised to prevent compound from reaching the unthreaded interior of the pipe.

Screwed unions, welded unions, or bolted flanges shall be provided wherever required to permit convenient removal of equipment, valves, and piping accessories from the piping system for maintenance.

Piping systems shall be securely supported with due allowance for thrust

forces and thermal expansion and contraction, and shall not be subjected to mechanical, chemical, vibration, or other damage as specified in ASME B31.1.

Field welded joints shall conform to the requirements of the AWS-03, ASME B31.1, and ASME BPVC SEC IX.

3.3 VALVES

Valves shall be provided in piping mains, on branches, and at equipment locations.

Valves shall be provided to permit isolation of branch piping and each equipment item from the balance of the system.

Riser and downcomer drains above piping shutoff valves in piping DN65 2-1/2 inches and larger shall be provided. Shutoff valve body shall be tapped and fitted with a DN15 1/2-inch plugged globe valve.

Valves unavoidably located in furred or other normally inaccessible places shall be provided with adequately sized access panels approved for the location.

3.4 SUPPORTING ELEMENTS INSTALLATION

Supporting elements shall be provided as indicated.

Piping shall be supported from building structure only. Piping shall not be supported from roof deck or from other pipe.

Piping shall run parallel with the lines of the building. Piping and components shall be spaced and installed so that a threaded pipe fitting may be removed between adjacent pipes and so that there shall be no less than [13] [1/2] [] millimeter [] inch of clear space between the finished surface and other work and between the finished surface of parallel adjacent piping. Hangers on different adjacent service lines running parallel with each other shall be arranged to be in line with each other and parallel to the lines of the building.

Piping support elements shall be installed at intervals not more than [] [914] millimeter [] [3] feet from the ends of each runout, and not over [] [300] millimeter [] [1] foot from each change in direction of piping.

Load rating for pipe-hanger supports shall be based on insulated weight of lines filled with water and forces imposed. Deflection per span shall not exceed slope gradient of pipe. Supports shall be in accordance with the following minimum rod size and maximum allowable hanger spacing for specified pipe. For concentrated loads such as valves, the allowable span shall be reduced proportionately:

<u>PIPE SIZE (DN)</u> <u>MILLIMETER</u>	<u>ROD SIZE</u> <u>MILLIMETER</u>	<u>STEEL PIPE</u> <u>MILLIMETER</u>	<u>COPPER PIPE</u> <u>MILLIMETER</u>
25 and smaller	10	2500	1830
32 to 40	10	3050	2500
50	10	3700	3050

PIPE SIZE (DN) MILLIMETER	ROD SIZE MILLIMETER	STEEL PIPE MILLIMETER	COPPER PIPE MILLIMETER
65 to 90	15	3700	3700
100 to 125	18	3700	3700
150	22	3700	3700
200 to 300	25	3700	3700
356 to 457	28	3700	3700
508 and over	35	3700	3700
PIPE SIZE INCHES	ROD SIZE INCHES	STEEL PIPE FEET	COPPER PIPE FEET
1 and smaller	3/8	8	6
1-1/4 to 1-1/2	3/8	10	8
2	3/8	12	10
2-1/2 to 3-1/2	1/2	12	12
4 to 5	5/8	12	12
6	3/4	12	12
8 to 12	7/8	12	12
14 to 18	1	12	12
20 and over	1-1/4	12	12

Vibration isolation supports shall be provided.

All PVC piping shall be supported at intervals of no more than [_____] [1219] millimeter [_____] [four] feet and CPVC support spacing at no more than [_____] [910] millimeter [_____] [three] feet.

Vertical risers shall be supported independently of connected piping, whenever practicable, with fixed or spring supports at the base and at intervals to accommodate system range of thermal conditions. Risers shall be guided for lateral stability. For risers subject to expansion, only one rigid support shall be provided at a point approximately one-third down from the top. Clamps shall be placed under fittings. Carbon-steel pipe shall be supported at each floor and at not more than [_____] [4600] millimeter [_____] [15] foot intervals for pipe DN50 2 inches and smaller and at not more than [_____] [6096] millimeter [_____] [20] foot intervals for pipe DN65 2-1/2 inches and larger.

3.5 PENETRATIONS

Effective sound stopping and adequate operating clearance shall be provided to prevent structure contact where piping penetrates walls, floors, or ceilings into occupied spaces adjacent to equipment rooms; where similar penetrations occur between occupied spaces; and where penetrations occur

from pipe chases into occupied spaces. Occupied spaces shall include space above ceilings where no special acoustic treatment of ceiling is provided. Penetrations shall be finished to be compatible with surface being penetrated.

[Sound stopping and vapor-barrier sealing of pipe shafts and large floor and wall openings shall be accomplished by packing to high density with properly supported fibrous-glass insulation or, where ambient or surface temperatures do not exceed 49 degrees C 120 degrees F, by foaming-in-place with self-extinguishing, 0.9 kilogram 2-pound density polyurethane foam to a depth not less than [] [150] millimeter [] [6] inches. Foam shall be finished with a rasp. Vapor barrier shall be not less than [] [3] millimeter [] [1/8] inch thick vinyl coating applied to visible and accessible surfaces. Where high temperatures and fire stopping are a consideration, only mineral wool shall be used and openings shall, in addition, be covered with [] [1.6] millimeter [] [16] gage sheet metal.]

3.6 SLEEVES

Sleeves shall be provided where piping passes through roofs, masonry or concrete walls, and floors.

Sleeves passing through steel decks shall be continuously welded or brazed to the deck.

Sleeves that extend through floors, roofs, load bearing walls, and fire barriers shall be continuous and fabricated from Schedule 40 steel pipe, with welded anchor lugs. Other sleeves shall be formed by molded linear polyethylene liners or similar materials which are removable. Diameter of sleeves shall be large enough to accommodate pipe, insulation, and jacketing without touching the sleeve and shall provide a minimum [] [10] millimeter [] [3/8] inch clearance. Sleeve size shall accommodate mechanical and thermal motion of pipe to preclude transmission of vibration to walls and the generation of noise.

Space between a pipe, bare or insulated, and the inside of a pipe sleeve or a construction surface penetration shall be packed solid with a mineral fiber conforming to ASTM C 592. This packing shall be provided wherever the piping passes through firewalls, equipment room walls, floors, and ceilings connected to occupied spaces, and other locations where sleeves or construction-surface penetrations occur between occupied spaces. Where sleeves or construction surface penetrations occur between conditioned and unconditioned spaces, the space between a pipe, bare or insulated, and the inside of a pipe sleeve or construction surface penetration shall be filled with an elastomer calk to a depth of [] [13] millimeter [] [1/2] inch. Surfaces to be calked shall be oil-and grease-free.

Exterior wall sleeves shall be calked watertight with [lead and oakum.] [mechanically expandable chloroprene inserts with mastic-sealed metal components.]

Sleeve height above roof surface shall account for roof flooding conditions and shall be a minimum of [] [300] millimeter [] [12] inches and a maximum of [] [457] [] [18].

3.7 ESCUTCHEONS

Escutcheons shall be provided at penetrations of piping into finished

areas. Where finished areas are separated by partitions through which piping passes, escutcheons shall be provided on both sides of the partition. Where suspended ceilings are installed, plates shall be provided at the underside only of such ceilings. For insulated pipes, the plates shall be large enough to fit around the insulation. Escutcheons shall be chrome-plated in occupied spaces and of size sufficient to effectively conceal openings in building construction. Escutcheons shall be firmly attached with setscrews.

3.8 FLASHINGS

Flashings shall be provided at penetrations of building boundaries by mechanical systems and related work.

3.9 UNDERGROUND PIPING INSTALLATION

Prior to being lowered into a trench, piping shall be cleaned, visually and audibly inspected for apparent defects.

Suspect cast-ferrous piping shall be further inspected by painting with kerosene on external surfaces to reveal cracks.

Defective materials found shall be distinctly marked using a road-traffic quality yellow paint. Defective material shall be promptly removed from the site.

After conduit has been inspected, and not less than 48 hours prior to being lowered into a trench, external surfaces of cast ferrous conduit shall be coated with a compatible bituminous coating for protection against brackish ground water. Application shall be single coat, in accordance with the manufacturer's instructions, to result in a dry-film thickness of not less than [0.3] [12] [] millimeter [] mils.

Excavations shall be dry and clear of extraneous materials when pipe is being laid.

Laying of pipe shall begin at the low point of a system. When in final acceptance position, it shall be true to the grades and alignment, with unbroken continuity of invert. Blocking and wedging shall not be permitted.

Bell or grooved ends of piping shall point upstream, unless otherwise approved by the Contracting Officer.

Changes in direction shall be made with long sweep fittings unless otherwise approved by the Contracting Officer .

Necessary socket clamping, piers, bases, anchors, and thrust blocking shall be provided. Rods, clamps, and bolting shall be protected with a coating of bitumen.

Underground piping below supported or suspended slabs shall be supported from the slab with a minimum of two supports per length of pipe. Supports shall be protected with a coating of bitumen.

On excavations that occur near and below building footings, the backfilling material shall consist of 14 Megapascal 2,000-psi cured compressive-strength concrete poured or pressure grouted up to the level of the footing.

Vertical downspouts and similar work shall be properly supported on approved piers at the base and provided with approved structural supports attached to building construction.

When PVC pipe is installed in a trench, single conductor No. 14 AWG wire with Type TW insulation shall be installed above the pipe, not less than 300 millimeter 12 inches below grade, to facilitate pipe location.

3.10 TESTS

Test reports shall be submitted in accordance with referenced standards in this section.

Plumbing systems shall be tested to prove tightness of piping and connections and proper operation of equipment and fixtures.

Hydrostatic tests shall be performed by completely filling the piping system with water and eliminating accumulation of air so that any leakage will be immediately apparent. Pressure shall be maintained until pipe under test has been examined, but in no case for less than [1] [_____] hour.

Hot- and cold-water piping shall be hydrostatically tested at 1.5 times the design pressure under [862] [125] [_____] kilopascal [_____] psi pressure for not less than [8] [_____] hours with no loss of pressure. Leaks shall be eliminated by replacing the pipe or fitting in question at no additional cost to the Government. Underground hot- and cold-water piping shall be tested before backfilling.

Drainage and venting piping shall be tested before the fixtures are installed. Underground soil and waste piping shall be tested before backfilling. Testing shall be applied to the system [in its entirety] [in sections].

When the entire system is tested, openings in the pipes shall be tightly closed except the highest opening, and the system shall be filled with water to the point of overflow.

When the system is tested in sections, each opening except the highest opening of the section under test shall be tightly plugged, and each section shall be filled with water and tested with at least a 30 kilopascal 10-foot head of water. In testing successive sections, at least the upper 3050 millimeter 10 feet of the next preceding section shall be tested so that each joint or pipe except the uppermost 3000 millimeter 10 feet of the system has been submitted to a test of at least a [_____] [30] kilopascal [_____] [10] foot head of water. Water shall be kept in the system or in the portion under test for at least [2] [_____] hours before the inspection starts. System shall be proved tight at all joints.

3.11 DISINFECTION

Water piping, including valves, fittings, and other devices, shall be disinfected with a solution of chlorine and water, and tested according to AWWA C651. Solution shall contain not less than [50] [_____] parts per million (ppm) of available chlorine. Solution shall be held for a period of not less than [8] [_____] hours, after which time the solution shall contain not less than [10] [_____] ppm of available chlorine or the piping shall be disinfected again. After successful disinfection, the piping shall be flushed before placing into service. Water for disinfection will be furnished by the Government, but disposal shall be the responsibility of

the Contractor.

3.12 PLUMBING FIXTURES

Materials, equipment, and fixtures shall be installed in accordance with the manufacturer's recommendations. Fixtures and equipment shall be installed to comply with ICC IPC for water conservation.

Fixtures shall be clean and free of deleterious material before being installed. Before connecting to water, waste, vent, or trap service, the fixture lines shall be blown out with compressed air. During the progress of construction, open ends of fixtures shall be protected at all times to prevent the admission of foreign matter.

3.13 INSULATION

After tests have been completed and surfaces cleaned, insulation shall be installed on hot-water piping except for chrome-plated brass pipe and other hot-water-exposed supplies to fixtures.

Thickness shall be not less than [] [19] millimeter [] [3/4] inch for piping DN25 1 inch or less and [] [25] millimeter [] [1] inch for piping larger than DN25 1 inch.

Valves and fittings shall be insulated with segments of insulation of the same material and thickness as the adjoining pipe insulation.

3.14 ADJUSTING

Automatic control devices shall be adjusted for proper operation.

[Autoflush controls shall be tested to ensure correct adjustment sensitivity.]

-- End of Section --