

SECTION 22 00 00

PLUMBING, GENERAL PURPOSE

PART 1 GENERAL

1.1 REFERENCES

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.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI Z21.22/CSA 4.4 (2015; R 2020) Relief Valves for Hot Water Supply Systems

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

ANSI/ASHRAE 18 (2008; R 2013) Methods Of Testing For Rating Drinking Water Coolers With Self-Contained Mechanical Refrigeration

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME A112.14.1 (2003; R 2017; R 2022) Backwater Valves

ASME A112.19.3/CSA B45.4 (2022) Stainless Steel Plumbing Fixtures

ASME B1.20.1 (2013; R 2018) Pipe Threads, General Purpose (Inch)

ASME B16.3 (2021) Malleable Iron Threaded Fittings, Classes 150 and 300

ASME B16.15 (2018) Cast Copper Alloy Threaded Fittings Classes 125 and 250

ASME B16.18 (2021) Cast Copper Alloy Solder Joint Pressure Fittings

ASME B16.22 (2021) Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings

ASME B16.24 (2022) Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves Classes 150, 300, 600, 900, 1500, and 2500

ASME B16.39 (2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300

ASME BPVC SEC VIII D1 (2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1

AMERICAN SOCIETY OF SANITARY ENGINEERING (ASSE)

ASSE 1001	(2021) Performance Requirements for Atmospheric Type Vacuum Breakers
ASSE 1003	(2020) Performance Requirements for Water Pressure Reducing Valves for Domestic Water Distribution Systems - (ANSI approved 2010)
ASSE 1010	(2021) Performance Requirements for Water Hammer Arresters
ASSE 1011	(2017) Performance Requirements for Hose Connection Vacuum Breakers
ASSE 1012	(2023) Performance Requirements for Backflow Preventer with an Intermediate Atmospheric Vent
ASSE 1013	(2021) Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies
ASSE 1020	(2020) Performance Requirements for Pressure Vacuum Breaker Assemblies

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

ASTM INTERNATIONAL (ASTM)

ASTM A47/A47M	(1999; R 2018; E 2018) Standard Specification for Ferritic Malleable Iron Castings
ASTM A53/A53M	(2020) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A536	(1984; R 2019; E 2019) Standard Specification for Ductile Iron Castings
ASTM A733	(2016) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples
ASTM B42	(2020) Standard Specification for Seamless Copper Pipe, Standard Sizes
ASTM B43	(2020) Standard Specification for Seamless Red Brass Pipe, Standard Sizes
ASTM B75/B75M	(2020) Standard Specification for Seamless Copper Tube
ASTM B88	(2022) Standard Specification for Seamless Copper Water Tube

ASTM B88M	(2020) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM B584	(2014; R 2022) Standard Specification for Copper Alloy Sand Castings for General Applications
ASTM B828	(2016) Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings
ASTM B117	(2019) Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D1785	(2015; E 2018) Standard Specification for Poly(Vinyl Chloride) (PVC), Plastic Pipe, Schedules 40, 80, and 120
ASTM D2241	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D2464	(2015) Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2466	(2017) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40
ASTM D2467	(2015) Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2672	(2014) Joints for IPS PVC Pipe Using Solvent Cement
ASTM D3035	(2015) Polyethylene (PE) Plastic Pipe (DR-PR) Based on Controlled Outside Diameter
ASTM D2239	(2012) Standard Specification for Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter
ASTM D3261	(2016) Standard Specification for Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D2683	(2020) Standard Specification for Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing
ASTM D2737	(2012a) Polyethylene (PE) Plastic Tubing
ASTM D2846/D2846M	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC)

	Plastic Hot- and Cold-Water Distribution Systems
ASTM F441/F441M	(2020) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80
ASTM F442/F442M	(2020) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR)
ASTM F437	(2021) Standard Specification for Threaded Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F438	(2017) Standard Specification for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40
ASTM F439	(2019) Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80
ASTM F877	(2020) Standard Specification for Crosslinked Polyethylene (PEX) Plastic Hot- and Cold-Water Distribution Systems
ASTM F2389	(2021) Standard Specification for Pressure-rated Polypropylene (PP) Piping Systems
AMERICAN WATER WORKS ASSOCIATION (AWWA)	
AWWA C700	(2020) Cold-Water Meters - Displacement Type, Metal Alloy Main Case
AWWA C701	(2019) Cold-Water Meters - Turbine Type for Customer Service
AWWA D100	(2021) Welded Steel Tanks for Water Storage
U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)	
PL 93-523	(1974; A 1999) Safe Drinking Water Act
INTERNATIONAL CODE COUNCIL (ICC)	
ICC A117.1 COMM	(2017) Standard and Commentary Accessible and Usable Buildings and Facilities
INTERNATIONAL SAFETY EQUIPMENT ASSOCIATION (ISEA)	
ANSI/ISEA Z358.1	(2014; R 2020) American National Standard for Emergency Eyewash and Shower Equipment
NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)	
NFPA 90A	(2018) Standard for the Installation of

Air Conditioning and Ventilating Systems

PLASTIC PIPE AND FITTINGS ASSOCIATION (PPFA)

PPFA Fire Man	(2016) Firestopping: Plastic Pipe in Fire Resistive Construction
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JAPAN WATER WORKS ASSOCIATION (JWWA)

JWWA K 115	(2018) Tar Epoxy Resin Paint of Water Works and Painting Method
JWWA K 120	(2008) Water Works Sodium Hypochlorite
JWWA S 101	(2019) Polyethylene Pipe Fitting for Water Distribution

JAPANESE STANDARDS ASSOCIATION (JSA)

JIS A 4420	(2018) Components for Kitchen Equipments
JIS A 4421	(1991) Drain With Traps for Equipment Units
JIS A 5207	(2014) Sanitary Wares
JIS A 5532	(2011) Bathtubs
JIS A 5758	(2022) Sealants for Sealing and Glazing in Buildings
JIS A 6005	(2005) Asphalt Roofing Felts
JIS B 0203	(1999) Taper Pipe Threads
JIS B 2003	(2013) General Rules for Inspection of Valves
JIS B 2004	(1994) General Rules for Marking on Valves
JIS B 2011	(2013) Bronze, Gate, Globe, Angle, and Check Valves (Amendment 2)
JIS B 2031	(2015) Gray Cast Iron Valves (Amendment 1)
JIS B 2061	(2017) Faucets, Ball Taps and Flush Valves
JIS B 2071	(2000) Steel Valves
JIS B 2220	(2012) Steel Pipe Flanges
JIS B 2240	(2006) Copper Alloy Pipe Flanges
JIS B 2301	(2013) Screwed Type Malleable Cast Iron Pipe Fittings
JIS B 2302	(2013) Screwed Type Steel Pipe Fittings
JIS B 2308	(2013) Stainless Steel Threaded Fittings

JIS B 2309	(2009) Butt-Welding Pipe Fittings for Light Gauge Stainless Steel Tubes for Ordinary Use
JIS B 2404	(2018) Dimensions of Gaskets for Use with Pipe Flanges
JIS B 7414	(2018) Glass Thermometers
JIS B 7505-1	(2017) Aneroid Pressure Gauges-Part 1: Bourdon Tube Pressure Gauges
JIS B 8225	(2012) Safety Valves-Measuring Methods for Coefficient of Discharge
JIS B 8285	(2010) Welding Procedure Qualification Test for Pressure Vessels
JIS B 8325	(2003; R 2008; R 2013) Submersible Motor Pumps For Sump
JIS B 8372-1	(2003) Pneumatic Fluid Power-Compressed Air Pressure Regulators and Filter-Regulators-Part 1: Main Characteristics to be Included in Literature from Suppliers and Product-Making Requirements
JIS B 8410	(2015) Pressure Reducing Valves for Water Works
JIS B 8414	(2011) Relief Valves for Hot Water Appliances (Amendment 3)
JIS B 8570-1	(2013) Meters for Cold Water and Hot Water - Part 1: General Specifications
JIS C 4212	(2010; R 2022) Low-Voltage Three-Phase Squirrel-Cage High-Efficiency Induction Motors (Amendment 1)
JIS C 9219-1	(2005) Electric Storage Tank Water Heaters
JIS C 9335-2-35	(2019) Household and Similar Electrical Appliances-Safety-Part 2-35: Particular Requirements for Instantaneous Water Heaters
JIS C 9618	(1992) Drinking-Water Coolers
JIS G 3103	(2012) Carbon Steel and Molybdenum Alloy Steel Plates for Boilers and Pressure Vessels
JIS G 3118	(2017) Carbon Steel Plates for Pressure Vessels for Intermediate and Moderate Temperature Services
JIS G 3201	(2008) Carbon Steel Forgings for General

	Use (Amendment 1)
JIS G 3452	(2016) Carbon Steel Pipes for Ordinary Piping (Amendment 1)
JIS G 4051	(2018) Carbon Steels for Machine Structural Use (Amendment 1)
JIS G 4107	(2015) Alloy Steel Bolting Materials for High Temperature Service (Amendment 1)
JIS G 4303	(2012) Stainless Steel Bars
JIS G 5502	(2007) Spheroidal Graphite Iron Castings
JIS G 5526	(2014) Ductile Iron Pipes
JIS G 5705	(2018) Malleable Iron Castings
JIS H 3100	(2018) Copper and Copper Alloy Sheets, Plates and Strips
JIS H 3250	(2015) Copper and Copper Alloy Rods and Bars
JIS H 3300	(2018) Copper and Copper Alloy Seamless Pipes and Tubes
JIS H 3401	(2001) Pipe Fittings of Copper and Copper Alloys
JIS H 5120	(2016) Copper and Copper Alloy Castings
JIS K 5981	(2006) Thermoplastic and Thermosetting Powder Coated Films
JIS K 6353	(2011) Rubber Goods for Water Works
JIS K 6739	(2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipe Fittings for Drain
JIS K 6741	(2016; R 2021) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipes
JIS K 6743	(2016) Unplasticized Poly (Vinyl Chloride) (PVC-U) Pipe Fittings for Water Supply
JIS K 7013	(2009) Fibre Reinforced Plastic Pipes (Amendment 1)
JIS K 7014	(1997) Fittings and Joints for Fibre Reinforced Plastic Pipes
JIS K 7128-3	(1998) Plastics-Film and Sheeting-Determination of Tear Resistance-Part 3 : Right Angled Tear Method
JIS K 7129-7	(2019) Plastics-Film and Sheeting-

	Determination of Water Vapour Transmission Rate- Part 7: Calcium Corrosion Method
JIS K 7139	(2009) Plastics-Test Specimens
JIS K 7350-3	(2008) Plastics Methods of Exposure to Laboratory Light Sources Part 3 : Fluorescent UV Lamps
JIS R 3644	(1998) Glass Tubes
JIS S 2109	(2019) Gas Burning Water Heaters for Domestic Use
JIS S 2116	(2013) Water Heaters Containing Water Under Atmospheric Pressure
JIS S 2120	(2019) Gas Valves
JIS S 2135	(2013) Quick Coupling Unit for Gas Appliances
JIS S 3021	(2017) Oil Burning Water Boilers
JIS S 3024	(2017) Oil Burning Water Heaters for Domestic Use
JIS S 3030	(2009) General Rules for Construction of Oil Burning Appliances
JIS S 3200-3	(1997) Equipment for Water Supply Service-Test Method of Water Hammer
JIS S 3200-5	(1997) Equipment for Water Supply Service-Test Methods of Destruction by Vacuum Pressure
JIS S 3201	(2017) Testing Methods for Household Water Purifiers
JIS Z 0208	(1976) Testing Methods for Determination of the Water Vapour Transmission Rate of Moisture-Proof Packaging Materials (Dish Method)
JIS Z 2371	(2015) Methods of Salt Spray Testing
JIS Z 3284-1	(2014) Solder Paste-Part 1: Kinds and Quality Classification
JIS Z 3313	(2009) Flux Cored Wires for Gas Shielded and Self-Shielded Metal Arc Welding of Mild Steel, High Strength Steel and Low Temperature Service Steel
JIS Z 3621	(2014) Recommended Practice for Brazing
JIS Z 3801	(2018) Standard Qualification Test and Acceptance Requirements for Manual Welding

Technique

JIS Z 9102 (1987) Identification Marking for Piping Systems

JAPAN VALVE MANUFACTURERS' ASSOCIATION (JVMA)

JV-5 (2008) Pipe end Anticorrosion Screwed Valve

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 14024 Environmental Labels and Declarations-Type I Environmental Labelling-Principles and Procedures

JAPAN PIPE FITTINGS ASSOCIATION (JPFA)

JPF-MP-006 (2019) Rool Grooving Dimension Fitting

JPF-DP-001 (2010) Screwed Cast Iron Fitting

JAPAN CAST IRON COVER & WASTE FITTING ASSOCIATION (JCW)

JCW 203 (2012) Floor Clean Out

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

MSS SP-44 (2019) Steel Pipeline Flanges

MSS SP-67 (2022) Butterfly Valves

MSS SP-70 (2011) Gray Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71 (2018) Gray Iron Swing Check Valves, Flanged and Threaded Ends

MSS SP-72 (2010a) Ball Valves with Flanged or Butt-Welding Ends for General Service

MSS SP-78 (2011) Cast Iron Plug Valves, Flanged and Threaded Ends

MSS SP-80 (2019) Bronze Gate, Globe, Angle and Check Valves

MSS SP-83 (2014) Class 3000 Steel Pipe Unions Socket Welding and Threaded

MSS SP-110 (2010) Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends

MINISTRY OF LAND, INFRASTRUCTURE, TRANSPORT AND TOURISM (MLIT)

MLIT-M (2019) Public Building Construction Standard Specification

NSF INTERNATIONAL (NSF)

NSF 372	(2016) Drinking Water System Components - Lead Content
NSF/ANSI 14	(2021) Plastics Piping System Components and Related Materials
NSF/ANSI 61	(2022) Drinking Water System Components - Health Effects

MINISTRY OF HEALTH, LABOUR AND WELFARE, GOVERNMENT OF JAPAN (MHLW)

INDUSTRIAL SAFETY AND HEALTH ACT

CCPV	(2016) Construction Code of Pressure Vessel
PSCP	Performance Standard Compliant Product

PLUMBING AND DRAINAGE INSTITUTE (PDI)

PDI WH 201	(2010) Water Hammer Arresters Standard
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U.S. NATIONAL ARCHIVES AND RECORDS ADMINISTRATION (NARA)

10 CFR 430	Energy Conservation Program for Consumer Products
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UNDERWRITERS LABORATORIES (UL)

UL 174	(2004; Reprint Dec 2021) UL Standard for Safety Household Electric Storage Tank Water Heaters
UL 499	(2014; Reprint May 2023) UL Standard for Safety Electric Heating Appliances
UL 732	(2018; Reprint Aug 2018) UL Standard for Safety Oil-Fired Storage Tank Water Heaters

1.2 SUBMITTALS

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.] Submittals with an "S" are for inclusion in the Sustainability eNotebook, in conformance to Section 01 33 29 SUSTAINABILITY REPORTING. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

[SD-02 Shop Drawings

Plumbing System; G[, [_____]]

Detail drawings consisting of schedules, performance charts, instructions, diagrams, and other information to illustrate the requirements and operations of systems that are not covered by the Plumbing Code. 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.

] SD-03 Product Data

Water Heaters

Pumps

Backflow Prevention Assemblies

Swimming Pool [and Spa]Suction Fittings; G[, [____]]

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[, [____]].

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-10 Operation and Maintenance Data

Plumbing System

Submit in accordance with Section 01 78 23 OPERATION AND MAINTENANCE DATA.

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. Standard products shall have been in satisfactory commercial or industrial use for 2 years prior to bid opening. The 2-year use shall include

applications of equipment and materials under similar circumstances and of similar size. The product shall have been for sale on the commercial market through advertisements, manufacturers' catalogs, or brochures during the 2 year period.

1.3.1 Alternative Qualifications

Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturer's factory or laboratory tests, can be shown.

1.3.2 Service Support

The equipment items shall be supported by service organizations. Submit a certified list of qualified permanent service organizations for support of the equipment which includes their addresses and qualifications. These service organizations shall be reasonably convenient to the equipment installation and able to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

1.3.3 Manufacturer's Nameplate

Each item of equipment shall have a nameplate bearing the manufacturer's name, address, model number, and serial number securely affixed in a conspicuous place; the nameplate of the distributing agent will not be acceptable.

1.3.4 Modification of References

In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word, "shall" had been substituted for "should" wherever it appears. Interpret references in these publications to the "authority having jurisdiction", or words of similar meaning, to mean the Contracting Officer.

1.3.4.1 Definitions

For the International Code Council (ICC) Codes referenced in the contract documents, advisory provisions shall be considered mandatory, the word "should" shall be interpreted as "shall." Reference to the "code official" shall be interpreted to mean the "Contracting Officer." For Navy owned property, references to the "owner" shall be interpreted to mean the "Contracting Officer." For leased facilities, references to the "owner" shall be interpreted to mean the "lessor." References to the "permit holder" shall be interpreted to mean the "Contractor."

1.3.4.2 Administrative Interpretations

For ICC Codes referenced in the contract documents, the provisions of Chapter 1, "Administrator," do not apply. These administrative requirements are covered by the applicable Federal Acquisition Regulations (FAR) included in this contract and by the authority granted to the Officer in Charge of Construction to administer the construction of this project. References in the ICC Codes to sections of Chapter 1, shall be applied appropriately by the Contracting Officer as authorized by his administrative cognizance and the FAR.

1.4 DELIVERY, STORAGE, AND HANDLING

Handle, store, and protect equipment and materials to prevent damage before and during installation in accordance with the manufacturer's recommendations, and as approved by the Contracting Officer. Replace damaged or defective items.

1.5 PERFORMANCE REQUIREMENTS

1.5.1 Welding

[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 JIS Z 3801. Welding procedures qualified by others, and welders and welding operators qualified by another employer, may be accepted as permitted by JIS B 8285. The Contracting Officer shall be notified 24 hours in advance of tests, and the tests shall be performed at the work site if practicable. Welders or welding operators shall apply their assigned symbols near each weld they make as a permanent record. Structural members shall be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING.] [Welding and nondestructive testing procedures are specified in Section 40 05 13.96 WELDING PROCESS PIPING.] Structural members shall be welded in accordance with Section 05 05 23.16 STRUCTURAL WELDING.

1.5.2 Cathodic Protection and Pipe Joint Bonding

Cathodic protection and pipe joint bonding systems shall be in accordance with [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)][Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES] [and] [Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT]Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE) and Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT.

1.6 REGULATORY REQUIREMENTS

Unless otherwise required herein, plumbing work shall be in accordance with MLIT-M.

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.

1.8 INSTRUCTION TO GOVERNMENT PERSONNEL

When specified in other sections, furnish the services of competent instructors to give full instruction to the designated Government personnel in the adjustment, operation, and maintenance, including pertinent safety requirements, of the specified equipment or system. Instructors shall be thoroughly familiar with all parts of the installation and shall be trained in operating theory as well as practical operation and maintenance work.

Instruction shall be given during the first regular work week after the equipment or system has been accepted and turned over to the Government

for regular operation. The number of man-days (8 hours per day) of instruction furnished shall be as specified in the individual section. When more than 4 man-days of instruction are specified, use approximately half of the time for classroom instruction. Use other time for instruction with the equipment or system.

When significant changes or modifications in the equipment or system are made under the terms of the contract, provide additional instruction to acquaint the operating personnel with the changes or modifications.

1.9 ACCESSIBILITY OF EQUIPMENT

Install all work so that parts requiring periodic inspection, operation, maintenance, and repair are readily accessible. Install concealed valves, expansion joints, controls, dampers, and equipment requiring access, in locations freely accessible through access doors.

PART 2 PRODUCTS

2.1 MATERIALS

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/ANSI 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 and shall comply with NSF/ANSI 14, NSF/ANSI 61 and ASTM F2389. Polypropylene piping that will be exposed to UV light shall be provided with a Factory applied UV resistant coating. 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 a weighted average of greater than 0.25 percent lead shall not be used in any potable water system intended for human consumption, and shall be certified in accordance with NSF/ANSI 61, Annex G or NSF 372. In line devices such as water meters, building valves, check valves, meter stops, valves, fittings and back flow preventers shall comply with or PL 93-523 and NSF/ANSI 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/ANSI 61. 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.

The NSF requirements of this specification and specification section 01 11 00.0010 Mandatory US Tested Products are independent of the Japanese standards listed elsewhere in this specification.

Thus where Japanese standards are listed for potable water equipment, in line devices, and end point devices, the products must meet both NSF and the Japanese standards. The purpose is to promote the use of Japanese products to the greatest extent possible. Japanese products that are not NSF certified will not be allowed for potable water systems. For the majority of material and equipment that must be NSF certified and where other standards are required both the Japanese and US Standards are

referenced in this specification.

A searchable database of NSF certified products and materials is available online at: <https://www.nsf.org/certified-products-systems>

2.1.1.1 Pipe Joint Materials

Grooved pipe and hubless cast-iron soil pipe shall not be used underground. Solder containing lead shall not be used with copper pipe.

- a. Coupling for Cast-Iron Pipe: for hub and spigot type JIS G 5526, JPF-MP-006. For hubless type: JIS G 5526.
- b. Coupling for Steel Pipe: JPF-MP-006.
- c. Couplings for Grooved Pipe: [Ductile Iron JIS G 5502] [Malleable Iron JIS G 5705].[Copper JIS G 5502].
- d. Flange Gaskets: Gaskets shall be made of non-asbestos material in accordance with JIS B 2404. Gaskets shall be flat, 1.6 mm 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.
- e. Brazing Material: Brazing material shall conform to JIS Z 3621.
- f. 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.
- g. Solder Material: Solder metal shall conform to JIS Z 3284-1.
- h. Solder Flux: Flux shall be liquid form, non-corrosive, and conform to JIS Z 3313.
- i. PTFE Tape: PTFE Tape, for use with Threaded Metal or Plastic Pipe.
- j. Rubber Gaskets for Cast-Iron Soil-Pipe and Fittings (hub and spigot type and hubless type): JIS K 6353.
- k. Rubber Gaskets for Grooved Pipe: JIS B 2404.
- l. Flexible Elastomeric Seals: JIS A 5758.
- m. Bolts and Nuts for Grooved Pipe Couplings: Heat-treated carbon steel, JIS G 4051.
- n. Solvent Cement for Transition Joints between ABS and PVC Nonpressure Piping Components: JWWA S 101.
- o. Plastic Solvent Cement for ABS Plastic Pipe: JWWA S 101.
- p. Plastic Solvent Cement for PVC Plastic Pipe: JWWA S 101 and JWWA S 101.
- q. Plastic Solvent Cement for CPVC Plastic Pipe: JWWA S 101.

- r. Flanged fittings including, but not limited to, flanges, bolts, nuts and bolt patterns shall be in accordance with JIS B 2220 and shall have the manufacturer's trademark affixed in accordance with JIS B 2004 and JIS Z 9102. Flange material shall conform to JIS G 3201. Blind flange material shall conform to JIS G 3118 and JIS G 3118 cold service and JIS G 3103 and JIS G 3118 for hot service. Bolts shall be high strength or intermediate strength with material conforming to JIS G 4107 and JIS G 4303.
- s. Plastic Solvent Cement for Styrene Rubber Plastic Pipe: JIS K 6743.
- t. Press fittings for Copper Pipe and Tube: Copper press fittings shall conform to the material and sizing requirements of JIS H 3401. Sealing elements shall be factory installed or an alternative supplied fitting manufacturer. Sealing element shall be selected based on manufacturer's approved application guidelines.
- u. Copper tubing shall conform to JIS H 3300 or ASTM B88M, Type K, L or M.

2.1.2 Miscellaneous Materials

Miscellaneous materials shall conform to the following:

- a. Water Hammer Arrester: Performance standards of products conforming to the Japanese Water Supply Law or PDI WH 201.[Water hammer arrester shall be [diaphragm][or][piston] type.]
- b. Copper, Sheet and Strip for Building Construction: JIS H 3100.
- c. Asphalt Roof Cement: JIS A 6005.
- d. Hose Clamps: MLIT-M.
- e. Metallic Cleanouts: JCW 203.
- f. 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.
- g. Coal-Tar Protective Coatings and Linings for Steel Water Pipelines: JWWA K 115.
- h. Hypochlorites: JWWA K 120.
- i. Liquid Chlorine: JWWA K 120.
- j. Gauges - Pressure and Vacuum Indicating Dial Type - Elastic Element: JIS B 7505-1.
- k. Thermometers: JIS B 7414. Mercury shall not be used in thermometers.

2.1.3 Pipe Insulation Material

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

2.2 PIPE HANGERS, INSERTS, AND SUPPORTS

Pipe hangers, inserts, and supports shall conform to MLIT-M.

2.3 VALVES

Valves shall be provided on supplies to equipment and fixtures. Valves 65 mm and smaller shall be bronze with threaded bodies for pipe and solder-type connections for tubing. Valves 80 mm 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 for potable water system. JPF-DP-001 or MSS SP-67 for other than potable water system.	JPF-DP-001 or MSS SP-67
Cast-Iron Gate Valves, Flanged and Threaded Ends: MSS SP-70 for potable water system. JIS B 2031 or MSS SP-70 for other than potable water system	JIS B 2031 or MSS SP-70
Cast-Iron Swing Check Valves, Flanged and Threaded Ends: MSS SP-71 for potable water system. JIS B 2011 or MSS SP-71 for other than potable water system	JIS B 2011 or MSS SP-71
Ball Valves with Flanged Butt-Welding Ends for General Service: MSS SP-72 for potable water system. JV-5 or MSS SP-72 for other than potable water system	JV-5 or MSS SP-72
Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends: MSS SP-110 for potable water system. JV-5 or MSS SP-110 for other than potable water system	MSS SP-110 or JV-5
Bronze Gate, Globe, Angle, and Check Valves: MSS SP-80 for potable water system. JV-5 or MSS SP-80 for other than potable water system.	JV-5 or MSS SP-78
Steel Valves, Socket Welding and Threaded Ends: ASME B16.34 for potable water system. JIS B 2003 or ASME B16.34 for other than potable water system.	JIS B 2003 or MSS SP-80
Cast-Iron Globe and Angle Valves, Flanged and Threaded Ends: MSS SP-85 for potable water system. JIS B 2071 or MSS SP-80 for other than potable water system	JIS B 2071 or ASME A112.14.1

Backwater Valves	
Vacuum Relief Valves: "ANSI Z21.22/CSA 4.4 for potable water system. JIS B 8372-1 or ANSI Z21.22/CSA 4.4 for other than potable water system	JIS B 8372-1 and JIS B 8225 or ANSI Z21.22/CSA 4.4
Water Pressure Reducing Valves: ASSE 1003 for potable water system. JIS B 8410 or ASSE 1003 for other than potable water system.	JIS B 8410 or ASSE 1003
Water Heater Drain Valves: ASME BPVC SEC IV, Part HLW-810; Requirements for Potable-Water Heaters Bottom Drain Valve for potable water system. JIS B 2011 or ASME BPVC SEC IV, Part HLW-810; Requirements for Potable-Water Heaters Bottom Drain Valve for other than potable water system	JIS B 2011 or ANSI Z21.22/CSA 4.4
Trap Seal Primer Valves	JIS B 2061
Temperature and Pressure Relief Valves for Hot Water Supply Systems: ANSI Z21.22/CSA 4.4 for potable water system. JIS B 8414 and JIS B 2011 or ANSI Z21.22/CSA 4.4 for other than potable water system.	JIS B 8414 and JIS B 2011 or ANSI Z21.22/CSA 4.4
Temperature and Pressure Relief Valves for Automatically Fired Hot Water Boilers	JIS B 8414

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 male inlet threads, hexagon shoulder, and 20 mm hose connection. Faucet handle shall be securely attached to stem.

2.3.3 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 pipe. Body shall be suitable for

wrench grip. Faucet spout shall have 20 mm exposed hose threads. Faucet handle shall be securely attached to stem.

2.3.4 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.

2.3.5 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 JIS B 8225. Relief valves for systems where the maximum rate of heat input is less than 59 kW shall have 20 mm minimum inlets, and 20 mm outlets. Relief valves for systems where the maximum rate of heat input is greater than 59 kW shall have 25 mm minimum inlets, and 25 mm outlets. The discharge pipe from the relief valve shall be the size of the valve outlet.

2.3.6 Thermostatic Mixing Valves

Provide thermostatic mixing valve for lavatory faucets. 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 of any setting.

2.4 FIXTURES

Water closet replacements in major renovations may have a flush valve of up to 6.1 LPF to accommodate existing plumbing capacity. [JIS B 2308 302 stainless steel] [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 valves and 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][shall be copper alloy with all visible surfaces chrome plated]. [Plastic in contact with hot water shall be suitable for 82 degrees C water temperature.]

2.4.1 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.] Provide faucet with a maximum flow rate of 1.9 L/min at a flowing pressure of 414 kPa. Water volume must be limited to 1.0 L per metering cycle.

2.4.2 Automatic Controls

Provide automatic, sensor operated faucets and flush valves to comply with JIS A 5207 or ASSE 1037 for lavatory faucets, urinals, and water closets. Flushing and faucet systems shall consist of solenoid-activated valves with light beam sensors. Flush valve for water closet shall include an override pushbutton. Flushing devices shall be provided as described in paragraph FIXTURES AND FIXTURE TRIMMINGS.

2.4.3 Flush Valve Water Closets

JIS A 5207, [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 Stainless Steel,] siphon jet, elongated bowl, [floor-mounted, floor outlet][wall mounted, wall outlet]. Top of toilet seat height above floor shall be 360 to 380 mm, except 435 to 480 mm for wheelchair water closets. Provide wax bowl ring including plastic sleeve. Provide [white] [_____] solid plastic elongated [open-front seat] [closed-front seat with cover].

Water flushing volume of the water closet and flush valve combination shall not exceed 4.85 liters per flush. [Provide a dual-flush water closet and flush valve combination that will also provide a second flushing water volume not to exceed 4.8 liters per flush.]

Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 280 mm above the fixture. Mounted height of flush valve shall not interfere with the hand rail in ADA stalls. [Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.][Provide piston type, oil operated, flush valve and wall support for salt water service.]

2.4.4 Flush Valve Urinals

JIS A 5207, [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], wall-mounted, wall outlet, siphon jet, integral trap, and extended side shields. Provide urinal with the rim 430 mm above the floor.

Provide urinal with the rim 610 mm above the floor. Water flushing volume of the urinal and flush valve combination shall not exceed 1.9 liters per flush. Provide large diameter flush valve including angle control-stop valve, vacuum breaker, tail pieces, slip nuts, and wall plates; exposed to view components shall be chromium-plated or polished stainless steel. Flush valves shall be nonhold-open type. Mount flush valves not less than 280 mm above the fixture.[Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.] [Provide piston type, oil operated, flush valve and wall support for salt water service.]

2.4.5 Wheelchair Flush Valve Type Urinals

JIS A 5207 [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], wall-mounted, wall outlet, blowout action, integral trap, elongated projecting bowl, 510 mm long from wall to front of flare, and JIS B 2061 trim. Provide large diaphragm (not less than 65 mm upper chamber inside diameter at the point where the diaphragm is sealed between the upper and lower chambers), nonhold-open flush valve of chrome plated cast brass conforming to JIS B 2061, including vacuum breaker and angle (control-stop) valve with back check. The water flushing volume of the flush valve and urinal combination shall not exceed 1.9 liters per flush. Furnish urinal manufacturer's certification of conformance. Mount urinal with front rim a maximum of 430 mm above floor and flush valve handle a maximum of 1120 mm above floor for use by handicapped on wheelchair.[Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.]

2.4.6 Flush Tank Water Closets

JIS A 5207 [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel], siphon jet, round bowl, pressure assisted, floor-mounted, floor outlet. Top of toilet seat height above floor shall be 360 to 380 mm, except 435 to 480 mm for wheelchair water closets.[Nonfloat swing type flush tank valves are not acceptable.][Gravity tank type water closets are not permitted.] Provide wax bowl ring including plastic sleeve. Water flushing volume of the water closet shall not exceed 4.8 liters per flush.[Provide a dual-flush toilet with a second flushing option that shall not exceed 4.1 liters per flush.] Provide [white] [_____] solid plastic round closed-front seat with cover.[Provide solenoid-activated flush valves including electrical-operated light-beam-sensor to energize the solenoid.]

2.4.7 Non-Flushing Toilets

[Provide composting toilets in accordance with manufacturer's recommendations.][Provide vacuum toilet systems in accordance with manufacturer's recommendations.]

2.4.8 Wall Hung Lavatories

JIS A 5207 [[white] [_____] vitreous china, JIS B 2308 and JIS B 2309 302 stainless steel], straight back type, minimum dimensions of 480 mm, wide by 430 mm front to rear, with supply openings for use with top mounted centerset faucets, and openings for concealed arm carrier installation.[Provide aerator with faucet.]Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. Provide concealed chair carriers with vertical steel pipe supports and concealed arms for the lavatory. Mount lavatory with the

front rim 865 mm above floor and with 740 mm minimum clearance from bottom of the front rim to floor.[Provide top mounted washerless centerset lavatory faucets.][Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.] [Provide filters for chlorine in supply piping to faucets.]

2.4.9 Countertop Lavatories

JIS A 5207 [white] [_____] vitreous china, [JIS B 2308 and JIS B 2309 302 stainless steel],self-rimming, minimum dimensions of 480mm wide by 430 mm front to rear, with supply openings for use with top mounted centerset faucets. Furnish template and mounting kit by lavatory manufacturer.[Provide aerator with faucet.]Provide lavatory faucets and accessories meeting the flow rate and product requirements of the paragraph LAVATORIES. [Provide top mounted washerless centerset lavatory faucets.][Provide top-mounted solenoid-activated lavatory faucets including electrical-operated light-beam-sensor to energize the solenoid.] [Provide filters for chlorine in supply piping to faucets.]

2.4.10 Kitchen Sinks

JIS B 2308 and JIS B 2309 or ASME A112.19.3/CSA B45.4 20 gage stainless steel with integral mounting rim for flush installation, minimum dimensions of 840 mm wide by 535 mm front to rear, two compartments, with undersides fully sound deadened, with supply openings for use with top mounted washerless sink faucets with hose spray, and with 90 mm drain outlet.[Provide aerator with faucet.]Water flow rate shall not exceed 8.3 L per minute when measured at a flowing water pressure of 414 kPa. Provide stainless steel drain outlets and stainless steel cup strainers. Provide separate 38 mm P-trap and drain piping to vertical vent piping from each compartment. Provide top mounted washerless sink faucets with hose spray. [Provide filters for chlorine in supply piping to faucets.][Provide JIS A 4420 waste disposer in right compartment.][Provide pedal valve for foot-operated flow control.][Provide secondary kitchen sink that drains to graywater system.][Provide sink with disposal chute to compost bucket under sink.]

2.4.11 Service Sinks

JIS A 5207, [[white] [_____] vitreous china JIS B 2308 and JIS B 2309 302 stainless steel] with integral back and wall hanger supports, minimum dimensions of 560 mm wide by 510 mm front to rear, with two supply openings in 254 mm high back. Provide floor supported wall outlet cast iron P-trap and stainless steel rim guards as recommended by service sink manufacturer. Provide back mounted washerless service sink faucets with vacuum breaker and 19 mm external hose threads.

2.4.12 Drinking-Water Coolers

JIS C 9618 or ANSI/ASHRAE 18 with more than a single thickness of metal between the potable water and the refrigerant in the heat exchanger, wall-hung, bubbler style, air-cooled condensing unit, 5 ml per second minimum capacity, stainless steel splash receptor and basin, [bottle filler] and stainless steel cabinet. Bubblers shall be controlled by push levers or push bars, front mounted or side mounted near the front edge of the cabinet. Bubbler spouts shall be mounted at maximum of 915 mm above floor and at front of unit basin. Spouts shall direct water flow at least 100 mm above unit basin and trajectory parallel or nearly parallel to the front of unit. [Provide filters for chlorine in supply piping to faucets.]

Provide concealed steel pipe chair carriers.

2.4.13 Wheelchair Drinking Water cooler

JIS C 9618 or ANSI/ASHRAE 18 wall-mounted bubbler style with concealed chair carrier, air-cooled condensing unit, 5 mL per second minimum capacity, stainless steel splash receptor, and all stainless steel cabinet, with 690 mm minimum knee clearance from front bottom of unit to floor and 915 mm maximum spout height above floor [and bottle filler]. 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. [Provide filters for chlorine in supply piping to faucets.]

2.4.14 Plastic Bathtub/Shower Units

JIS A 5207 multi-piece white solid acrylic pressure molded fiberglass reinforced plastic bathtub/shower units. Units shall be scratch resistant, waterproof, and reinforced. Provide showerheads meeting the requirements of the paragraph BATHTUB AND SHOWER FAUCETS AND DRAIN FITTINGS. [Provide flow restrictor in handshower to flow 6.6 L/min.] [Provide filters for chlorine in supply piping to faucets and showerheads.]

Provide recessed type units approximately 1520 mm wide, 760 mm front to rear, 1830 mm high with 380 mm high rim for through-the-floor drain installation with unit bottom or feet firmly supported by a smooth level floor. Provide left or right drain outlet units as required. Units shall have built-in soap dish and minimum of 305 mm long stainless steel horizontal grab bar located on back wall for standing use. Units shall meet performance requirements of JIS A 5207. Install unit in accordance with the manufacturer's written instructions. Finish installation by covering unit attachment flanges with wall board in accordance with unit manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the unit and the adjacent walls and floor surfaces.

2.4.15 Plastic Bathtubs

JIS A 5207 one piece [white] [_____] solid acrylic pressure molded fiberglass reinforced plastic bathtubs. Bathtubs shall be scratch resistant, waterproof, and reinforced. Provide recessed type bathtubs approximately 1520 mm wide, 760 mm front to rear, 380 mm high rim for through-the-floor drain installation with bathtub bottom or feet firmly supported by a smooth level floor. Provide left or right drain outlet bathtub as required. [Provide filters for chlorine in supply piping to faucets.] Bathtubs shall meet performance requirements of JIS A 5207. Install bathtub in accordance with the manufacturer's written instructions. Finish installation by covering bathtub attachment flanges with dry-wall in accordance with bathtub manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the bathtub and the adjacent walls and floor surfaces.

2.4.16 Plastic Shower Stalls

JIS A 5207 four piece [white] [_____] solid acrylic pressure molded fiberglass reinforced plastic shower stalls. Shower stalls shall be scratch resistant, waterproof, and reinforced. Provide showerheads meeting the requirements of the paragraph BATHTUB AND SHOWER FAUCETS AND DRAIN FITTINGS. [Provide flow restrictor in handshower to flow 6.6 L/min.] [Provide filters for chlorine in supply piping to showerheads.] Provide recessed type shower stalls approximately 915 mm wide, 915 mm front to rear,

1830 mm high, and 125 mm high curb with shower stall bottom or feet firmly supported by a smooth level floor. Provide PVC shower floor drains and stainless steel strainers. Shower stalls shall meet performance requirements of JIS A 5207. Install shower stall in accordance with the manufacturer's written instructions. Finish installation by covering shower stall attachment flanges with dry-wall in accordance with shower stall manufacturer's recommendation. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the top, sides, and bottom of shower stalls and bathroom walls and floors.

2.4.17 Plastic Bathtub Liners

JIS A 5532 one piece [white] [_____] plastic bathtub liners. Existing bathtubs shall be identified and measured to insure proper identification in order that each new bathtub liner shall be custom molded to fit the exact contours of the existing bathtubs. Provide left or right drain outlet bathtub liners as required. Bathtub liners shall be inserted over and into the existing bathtubs without disturbing the existing ceramic tile wainscot walls and existing floor material. Prepare the existing cast-iron bathtubs, ceramic tile wainscots, and floor to receive the new bathtub liners in accordance with the bathtub liner manufacturer's written instructions. Installation personnel shall be trained by the bathtub liner manufacturer. Seal the bathtub liner to existing bathtub with waterproof adhesive as required to keep moisture out from behind the bathtub liner. Provide smooth [white] [_____] waterproof bathtub sealant between bathtub drains, bathtub, and bathtub liners. Provide replacement chromium-plated overflow cover plates and push-pull bathtub drain stopper assembly. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the bathtub liner and the adjacent walls and floor surfaces in accordance with the bathtub liners manufacturer's written instructions.

2.4.18 Plastic Bathtub Wall Surrounds

JIS A 5207 three piece [white] [_____] sectional pressure molded fiberglass plastic bathtub wall surrounds suitable for installation with existing bathtubs which are approximately 1520 mm wide by 760 mm front to rear. Wall surrounds shall have built-in soap dish and minimum of 305 mm long stainless steel horizontal grab bar located on back wall for standing use. Bathtub wall surrounds shall meet performance requirements of JIS A 5207. for compliance. Install bathtub wall surrounds in accordance with the manufacturers written instructions. Finish installation by covering bathtub wall surround attachment flanges with dry-wall in accordance with bathtub wall surround manufacturer's recommendations. Provide smooth 100 percent silicone rubber [white] [_____] bathtub caulk between the bathtubs and the adjacent walls and floor surfaces.

2.4.19 Precast Terrazzo Shower Floors

Terrazzo shall be made of marble chips cast in white portland cement to produce 25 mPa minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo, with polished stainless steel strainers.

2.4.20 Precast Terrazzo Mop Sinks

Terrazzo shall be made of marble chips cast in white portland cement to produce 25 mPa minimum compressive strength 7 days after casting. Provide floor or wall outlet copper alloy body drain cast integral with terrazzo,

with polished stainless steel strainers.

2.4.21 Bathtubs, Cast Iron

JIS A 5207 [white] [_____] enameled cast iron, recessed type, minimum dimensions of 1520 mm wide by 760 mm front to rear by 410 mm high with drain outlet for above-the-floor drain installation. Provide left or right drain outlet bathtub as indicated. [Provide filters for chlorine in supply piping to faucets.]

2.4.22 Bathtubs, Porcelain

JIS A 5207 [white] [_____] porcelain bonded to enameling grade metal, bonded to a structural composite, recessed type, minimum dimensions of 1520 mm wide by 760 mm front to rear by 410 mm high with drain outlet for above-the-floor drain installation. Provide left or right drain outlet bathtub as indicated. [Provide filters for chlorine in supply piping to faucets.]

2.4.23 Emergency Eyewash and Shower

Ministry of Labour Ordinance (Tokutei-Kagaku-bushitsu-Shogai-Yobou-Kisoku) Article 38 or ANSI/ISEA Z358.1, floor supported free standing unit. Provide deluge shower head, stay-open ball valve operated by pull rod and ring or triangular handle. Provide eyewash and stay-open ball valve operated by foot treadle or push handle.

2.4.24 Emergency Eye and Face Wash

Ministry of Labour Ordinance (Tokutei-Kagaku-bushitsu-Shogai-Yobou-Kisoku) Article 38 or ANSI/ISEA Z358.1, wall-mounted self-cleaning, nonclogging eye and face wash with quick opening, full-flow valves, stainless steel eye and face wash receptor. Unit shall deliver 0.19 L/s of aerated water at 207 kPa (gage) flow pressure, with eye and face wash nozzles 840 to 1140 mm above finished floor. Provide copper alloy control valves. Provide an air-gap with the lowest potable eye and face wash water outlet located above the overflow rim by not less than the International Plumbing Code minimum.[Provide a pressure-compensated tempering valve, with leaving water temperature setpoint adjustable throughout the range 15.5 to 35 degrees C.][Provide packaged, alarm system; including an amber strobe lamp, horn with externally adjustable loudness and horn silencing switch, mounting hardware, and waterflow service within enclosures[and for explosion proof service within enclosures].]

2.5 BACKFLOW PREVENTERS

Backflow preventers with intermediate atmospheric vent shall conform to JIS S 3200-5, or ASSE 1012. Reduced pressure principle backflow preventers shall be approved product of quality certification center of JWWA or ASSE 1013. Hose connection vacuum breakers shall be approved product of quality certification center of JWWA or ASSE 1011. Pipe applied atmospheric type vacuum breakers shall be approved product of quality certification center of JWWA or ASSE 1001. Pressure vacuum breaker assembly shall be approved product of quality certification center of JWWA or ASSE 1020. Air gaps in plumbing systems shall conform to Ministry of Health Labor and Welfare Ordinance Article 123.

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 may be installed, provided that the drain is specifically designed for the rubber gasket compression type joint. Floor and shower drains shall conform to JCM 201.

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 JIS K 7350-3. 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 Bathtub and Shower Faucets and Drain Fittings

Provide single control pressure equalizing bathtub and shower faucets with body mounted from behind the wall with threaded connections. Provide ball joint self-cleaning shower heads. Provide tubing mounted from behind the wall between bathtub faucets and shower heads and bathtub diverter spouts. Provide separate globe valves or angle valves with union connections in each supply to faucet. Provide trip-lever pop-up drain fittings for above-the-floor drain installations. The top of drain pop-ups, drain outlets, tub overflow outlet, and; control handle for pop-up drain shall be chromium-plated or polished stainless steel. Linkage between drain pop-up and pop-up control handle at bathtub overflow outlet shall be copper alloy or stainless steel. Provide 40 mm copper alloy adjustable tubing with slip nuts and gaskets between bathtub overflow and drain outlet; chromium-plated finish is not required.[Provide bathtub and shower valve with ball type control handle.]

2.6.3 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 nominal overall width or diameter and 250 mm 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 JIS A 5207.

2.6.4 Floor Sinks

Floor sinks shall be [circular] [square], with 300 mm nominal overall width or diameter and 250 mm nominal overall depth. Floor sink shall have an acid-resistant enamel interior finish with cast-iron body, [aluminum][ABS] 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.

2.6.5 Boiler Room Drains

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. The grate area shall be not less than 0.065 square meters.

2.6.6 Pit Drains

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

2.6.7 Sight Drains

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

Area of strainer and collar: 0.023 square meters

Height of funnel: 95 mm

Diameter of lower portion: 50 mm of funnel

Diameter of upper portion: 100 mm of funnel

2.6.8 Roof Drains and Expansion Joints

Roof drains shall conform to MLIT-M, 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 3.5 mm. 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.

2.6.9 Swimming Pool [and Spa]Suction Fittings

Pool water suction fittings in swimming pools [and spas]shall comply with Pool Safety Standard Guidelines. The compliance of the fitting shall include of the associated drain cover, sump, and hardware.

2.7 SHOWER PAN

Shower pan may be copper, or nonmetallic material.

2.7.1 Sheet Copper

Sheet copper shall be 4.9 kg per square meter weight.

2.7.2 Plasticized Polyvinyl Chloride Shower Pan Material

Material shall be sheet form. The material shall be 1.015 mm minimum thickness of plasticized polyvinyl chloride or chlorinated polyethylene and shall be in accordance with JIS K 5981.

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 1.015 mm minimum thickness of nonplasticized PVC and shall have the following minimum properties:

a. JIS K 7139

Ultimate Tensile Strength:	1.79 MPa
Ultimate Elongation:	398 percent
100 Percent Modulus:	3.07 MPa

b. JIS K 7128-3

Tear Strength:	53 kilonewtons per meter
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c. JIS Z 0208 and JIS K 7129-7:

Permeance: 0.46 ng per Pa per second per sq meter

d. Other Properties:

Specific Gravity:	1.29
PVC Solvent:	Weldable
Cold Crack:	minus 47 degrees C
Dimensional stability	100 degrees C
Hardness, Shore A:	89

2.8 TRAPS

Unless otherwise specified, traps shall be [plastic per JIS K 6741 and JIS K 7014] [or] [copper-alloy adjustable tube type with slip joint inlet and swivel]. Traps shall be without a cleanout.[Provide traps with removable access panels for easy clean-out at sinks and lavatories.]Tubes shall be copper alloy with walls not less than 0.813 mm 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. The interior diameter shall be not more than 3.2 mm 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 INTERCEPTORS

2.9.1 Grease Interceptor

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 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. Concrete shall have 21 MPa minimum compressive strength at 28 days. Provide flow control fitting.

2.9.2 Oil Interceptor

Cast iron or welded steel, coated inside and outside with white acid resistant epoxy, with internal air relief bypass, bronze cleanout plug, double wall trap seal, removable combination pressure equalizing and flow diffusing baffle and sediment bucket, horizontal baffle, adjustable oil draw-off and vent connections on either side, gas and watertight gasketed nonskid cover, and flow control fitting.

2.9.3 Sand Interceptors

Sand interceptor of the size indicated shall be of reinforced concrete,

[or precast concrete construction] [or equivalent capacity commercially available steel sand interceptor] with manufacturer's standard checker-plate cover, and shall be installed [outside the building][top flush with the floor][floor mounted]. Steel sand interceptor shall be installed in accordance with manufacturer's recommendations and shall be coated to resist corrosion as recommended by the manufacturer.[Concrete shall have 21 MPa minimum compressive strength at 28 days.]

2.10 WATER HEATERS

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. Each gas-fired water heater and booster water heater shall have controls with an adjustable range that includes 49 to 82 degrees C. 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 in PART 3 of this Section 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 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 water temperature and 1034 kPa 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 combination pressure and temperature relief valve.

2.10.1.1 Oil-Fired Type

Oil-fired type water heaters shall conform to JIS S 3024 or UL 732.

2.10.1.2 Gas-Fired Type

Gas-fired water heaters shall conform to JIS S 2109 when input is 70 KW per hour or less for simultaneous heater and 42 KW per hour or less for storage type or JIS S 2116 for heaters with input greater than 42 KW per hour.

2.10.1.3 Electric Type

Electric type water heaters shall conform to JIS C 9219-1 or 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.

2.10.1.4 Indirect Heater Type

Steam and high temperature hot water (HTHW) heaters with storage system shall be the assembled product of one manufacturer, and shall be in accordance with MLIT-M or 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.

- a. HTHW Energy Source: The heater element shall have a working pressure of 2758 kPa with water at a temperature of 204 degrees C. The heating surface shall be based on 0.093 square meter of heating surface to heat 76 L or more of water in 1 hour from 4 to 82 degrees C using hot water at a temperature of 178 degrees C. Carbon steel heads shall be used. Tubing shall conform to JIS H 3300 or ASTM B75/B75M. Heating elements shall withstand an internal hydrostatic pressure of 4137 kPa 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 metergauge (psig) with steam at a temperature of 185 degrees C. The heating surface shall be based on 0.093 square meter of heating surface to heat 76 L or more of water in 1 hour from 4 to 82 degrees C using steam at atmospheric pressure.[Cast iron] [bronze] heads shall be used. Tubing shall be light-drawn copper tubing conforming to JIS H 3300 or ASTM B75/B75M. Heating elements shall withstand an internal hydrostatic pressure of 1551 kPa 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 MLIT-M or ASME BPVC SEC VIII D1, and shall be certified for 1.03 MPa working pressure in the shell and 1.03 MPa working pressure in the coils. Shell shall be carbon steel with copper lining. Heads shall be [cast iron] [bronze] [carbon steel plate with copper lining]. Coils shall be [copper] [copper-nickel]. Shell shall have metal sheathed fiberglass insulation, combination pressure and temperature relief valve, and thermometer. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

2.10.3 Electric Instantaneous Water Heaters (Tankless)

JIS C 9335-2-35 or UL 499 flow switch activated, tankless electric instantaneous water heater for wall mounting below sink or lavatory.

2.10.4 Phenolic Resin Coatings for Heater Tubes

The phenolic resin coating system shall be applied at either the coil or coating manufacturer's factory in accordance with manufacturer's standard proven production process. The coating system shall be a product specifically intended for use on the material the water heating tubes/coils are made of and shall be acceptable for use in potable water systems.

[The entire exterior surface] [and] [the first 125 mm to 200 mm inside the tubes] of each coil shall be coated with phenolic resin coating system.

2.10.4.1 Standard Product

Provide a phenolic resin coating system that is a standard product of a manufacturer regularly engaged in the manufacturing of products that are of a similar material, design and workmanship.

Standard products are defined as components and equipment that have been in satisfactory commercial or industrial use in similar applications of similar size for at least two years before bid opening.

Prior to this two year period, these standard products were sold on the commercial market using advertisements in manufacturers' catalogs or brochures. These manufacturers' catalogs, or brochures shall have been copyrighted documents or be identified with a manufacturer's document number.

2.11 HOT-WATER STORAGE TANKS

Hot-water storage tanks shall be constructed by one manufacturer, and nameplate shall indicate the working pressure. The tank shall be cement-lined or glass-lined steel type in accordance with MLIT-M or AWWA D100. Each tank shall be equipped with a thermometer, style and form as required for the installation, and with 175 mm scale. Thermometer shall have a separable socket suitable for a 20 mm tapped opening. Tanks shall be equipped with a pressure gauge 155 mm minimum diameter face. Insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS. Storage tank capacity shall be as shown.

2.12 PUMPS

2.12.1 Sump Pumps

Sump pumps shall be of capacities indicated. The pumps shall be of the automatic, electric motor-driven, submerged type, complete with necessary control equipment and with a split or solid cast-iron or steel cover plate. 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. The across-the-line magnetic controller shall be equipped with industrial use type enclosure. Integral size motors shall be the premium efficiency type in accordance with JIS B 8325. 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 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 an industrial use type 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 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 for the service required. Each pump motor shall be equipped with
an across-the-line magnetic controller in an industrial type enclosure
with "START-STOP" switch in cover.

Integral size motors shall be premium efficiency type in accordance with
JIS C 4212. Pump motors smaller than 746 W shall have integral thermal
overload protection in accordance with Section 26 20 00 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, head in
meters, efficiency, brake wattage, 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 an industrial use type 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

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.

2.12.5 Sewage Pumps

Provide single type duplex type with automatic controls to alternate the operation from one pump to the other pump and to start the second pump in the event the first pump cannot handle the incoming flow. Provide high water alarm and check valve.

2.13 WATER PRESSURE BOOSTER SYSTEM

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 be industrial use type 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

Hydro-pneumatic water tank shall be constructed in accordance with pressure vessel construction standard (atsuryoku-youki-kouzou-kisoku).

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 industrial use type 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 an industrial use type enclosure. 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

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 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 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 Construction Code for Pressure Vessel (CCPV) and shall have the design working pressures specified herein.

2.14.4 Intake Air Supply Filter

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, 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 and a maximum temperature of 93 degrees C. 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. Regulator shall be sized as indicated.

2.15 DOMESTIC WATER SERVICE METER

[The requirements for metering and submetering are specified in Section 33 11 00 WATER UTILITY DISTRIBUTION PIPING.

] [Cold water meters 50 mm and smaller shall be positive displacement type conforming to JIS B 8570-1 or AWWA C700. Cold water meters 64 mm and larger shall be turbine type conforming to JIS B 8570-1 or 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.

Meters must be connected to the base wide energy and utility monitoring and control system (if this system exists) using the installation's advanced metering protocols.

] 2.16 ELECTRICAL WORK

Provide electrical motor driven equipment specified complete with motors, motor starters, and controls as specified herein and in Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM. Provide internal wiring for components of packaged equipment as an integral part of the equipment. Provide [high efficiency type,]single-phase, fractional-horsepower alternating-current motors, including motors that are part of a system, corresponding to the applications in accordance with JIS C 4212.[In addition to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM, provide polyphase, squirrel-cage medium induction motors with continuous ratings, including motors that are part of a system, that meet the efficiency ratings for premium efficiency motors in accordance with JIS C 4212.] Provide motors in accordance with JIS C 4212 and of sufficient size to drive the load at the specified capacity without exceeding the nameplate rating of the motor.

Motors shall be rated for continuous duty with the enclosure specified. Motor duty requirements shall allow for maximum frequency start-stop operation and minimum encountered interval between start and stop. Motor torque shall be capable of accelerating the connected load within 20 seconds with 80 percent of the rated voltage maintained at motor terminals during one starting period. Motor bearings shall be fitted with grease supply fittings and grease relief to outside of the enclosure.

Controllers and contactors shall have auxiliary contacts for use with the controls provided. Manual or automatic control and protective or signal devices required for the operation specified and any control wiring required for controls and devices specified, but not shown, shall be provided. For packaged equipment, the manufacturer shall provide controllers, including the required monitors and timed restart.

Power wiring and conduit for field installed equipment shall be provided under and conform to the requirements of Section 26 20 00 INTERIOR DISTRIBUTION SYSTEM.

2.17 MISCELLANEOUS PIPING ITEMS

2.17.1 Escutcheon Plates

Provide one piece or split hinge metal plates for piping entering floors, walls, and ceilings in exposed spaces. Provide chromium-plated or copper alloy plates or polished stainless steel finish in finished spaces. Provide paint finish on plates in unfinished spaces.

2.17.2 Pipe Sleeves

Provide where piping passes entirely through walls, ceilings, roofs, and floors. Sleeves are not required where [supply] drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade, except where penetrating a membrane waterproof floor.

2.17.2.1 Sleeves in Masonry and Concrete

Provide steel pipe sleeves or schedule 40 PVC plastic pipe sleeves. Sleeves are not required where drain, waste, and vent (DWV) piping passes through concrete floor slabs located on grade. Do not core drill masonry or concrete.

2.17.2.2 Sleeves Not in Masonry and Concrete

Provide 26 gage galvanized steel sheet or PVC plastic pipe sleeves.

2.17.3 Pipe Hangers (Supports)

Provide Pipe hangers and supports in accordance with MLIT-M.

2.17.4 Nameplates

Provide 3.2 mm thick melamine laminated plastic nameplates, black matte finish with white center core, for equipment, gages, thermometers, and valves; valves in supplies to faucets will not require nameplates. Accurately align lettering and engrave minimum of 6.4 mm high normal block lettering into the white core. Minimum size of nameplates shall be 25 by 63 mm. Key nameplates to a chart and schedule for each system. Frame charts and schedules under glass and place where directed near each system. Furnish two copies of each chart and schedule.

2.17.5 Labels

Provide labels for sensor operators at flush valves and faucets. Include the following information on each label:

- a. Identification of the sensor and its operation with [graphic]

[written] [Braille] description.

- b. Range of the sensor.
- c. Battery replacement schedule.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION REQUIREMENTS

Piping located in air plenums shall conform to NFPA 90A. 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 Fire Man. 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 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 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 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 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 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

Pipe drains indicated shall consist of 20 mm hose bibb with renewable seat and [gate] [full port ball] [ball] valve ahead of hose bibb. At other low points, 20 mm 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 and changes in direction where indicated and required. Risers shall be securely anchored as required or where indicated to force expansion to loops. Branch connections from risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Horizontal runs of pipe over 15 m 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 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 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

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 or the Performance Standards Compliant Product (PSCP) of the Water Supply Law. Water hammer arresters, where concealed, shall be accessible by means of access doors or removable panels. Commercial-type water hammer arresters shall conform to JIS S 3200-3 or 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 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

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 JIS B 0203. 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

Mechanical couplings may be used in conjunction with grooved pipe for aboveground, ferrous or non-ferrous, domestic hot and cold water systems, in lieu of unions, brazed, soldered, welded, flanged, or threaded joints.

Mechanical couplings are permitted in accessible locations including behind access plates. Flexible grooved joints will not be permitted, except as vibration isolators adjacent to mechanical equipment. Rigid grooved joints shall incorporate an angle bolt pad design which maintains metal-to-metal contact with equal amount of pad offset of housings upon installation to ensure positive rigid clamping of the pipe.

Designs which can only clamp on the bottom of the groove or which utilize gripping teeth or jaws, or which use misaligned housing bolt holes, or which require a torque wrench or torque specifications will not be permitted.

Grooved fittings and couplings, and grooving tools shall be provided from the same manufacturer. Segmentally welded elbows shall not be used. Grooves shall be prepared in accordance with the coupling manufacturer's latest published standards. Grooving shall be performed by qualified grooving operators having demonstrated proper grooving procedures in accordance with the tool manufacturer's recommendations.

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

3.1.3.3 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 and smaller; flanges shall be used on pipe sizes 80 mm 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 JIS Z 3621, JIS H 3300, and JIS H 3300 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 and smaller. Soldered joints shall conform to JIS H 3300 and JIS H 3300. 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 MLIT-M.

- d. Press connection. Copper press connections shall be made in **strict** accordance with the manufacturer's installation instructions for manufactured rated size. The joints shall be pressed using the tool(s) approved by the manufacturer **of that joint**. Minimum distance between fittings shall be in accordance with the manufacturer's requirements.

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. 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

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

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 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)] [and] [Section 26 42 17.00 10 CATHODIC PROTECTION SYSTEM (IMPRESSED CURRENT)][Section 26 42 13.00 20 CATHODIC PROTECTION BY GALVANIC ANODES] [and] [Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT] [Section 26 42 14.00 10 CATHODIC PROTECTION SYSTEM (SACRIFICIAL ANODE)][Section 26 42 19.00 20 CATHODIC PROTECTION BY IMPRESSED CURRENT]. 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 JWAA K 115 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

Unless indicated otherwise, provide pipe sleeves meeting the following requirements:

Secure sleeves in position and location during construction. Provide sleeves of sufficient length to pass through entire thickness of walls, ceilings, roofs, and floors.

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 above the finished floor.

Unless otherwise indicated, sleeves shall be of a size to provide a minimum of [6 mm] [25 mm] 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 JIS A 5758 and with a primer, backstop material and surface preparation as specified in Section 07 92 00 JOINT SEALANTS. The annular space between pipe and sleeve, between bare insulation and sleeve or between jacket over insulation and sleeve shall not be sealed for interior walls which are not designated as fire rated.

Sleeves through below-grade walls in contact with earth shall be recessed 12 mm 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 07 84 00 FIRESTOPPING.

3.1.6.2 Flashing Requirements

Pipes passing through roof shall be installed through a 4.9 kg per square meter 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 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. 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 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 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

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 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; 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 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 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 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 wide by 6 to 10 mm deep shall be formed around the pipe, fitting or drain. The groove shall be filled with a sealant as specified in Section 07 92 00 JOINT SEALANTS.

3.1.6.6 Pipe Penetrations

Provide sealants for all pipe penetrations. All pipe penetrations shall be sealed to prevent infiltration of air, insects, and vermin.

3.1.7 Fire Seal

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

3.1.8 Supports

3.1.8.1 General

Hangers used to support piping 50 mm 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

Piping and attached valves shall be supported and braced to resist seismic loads as specified in Section 13 48 00 [SEISMIC] BRACING FOR MISCELLANEOUS EQUIPMENT and [Section 23 05 48.19 [SEISMIC] BRACING FOR HVAC][Section 22 05 48.00 20 MECHANICAL SOUND, VIBRATION, AND SEISMIC CONTROL] [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 05 12 00 STRUCTURAL STEEL][Section 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS].

3.1.8.3 Pipe Hangers, Inserts, and Supports

Installation of pipe hangers, inserts and supports shall conform to MLIT-M except as modified herein.

- a. Horizontal pipe supports shall be spaced as specified in MLIT-M and a support shall be installed not over 300 mm from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 1.5 m apart at valves. Operating temperatures in

determining hanger spacing for PVC or CPVC pipe shall be 49 degrees C for PVC and 82 degrees C for CPVC. Horizontal pipe runs shall include allowances for expansion and contraction.

- b. Vertical pipe shall be supported at each floor, except at slab-on-grade, at intervals of not more than 4.5 m nor more than 2 m from end of risers, and at vent terminations. Vertical pipe risers shall include allowances for expansion and 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 JIS B 8285. 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

Pipe cleanouts shall be the same size as the pipe except that cleanout plugs larger than 100 mm 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. 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 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

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 above the top of the tank or water heater.

3.2.2 Installation of Gas- and Oil-Fired Water Heater

Installation shall conform to JIS S 2120, and JIS S 2135, for gas fired and JIS S 3024, JIS S 3021 and JIS S 3030 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 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.

3.2.3 Heat Traps

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

3.2.4 Connections to Water Heaters

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

3.2.5 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.

3.2.6 Direct Fired and Domestic Water Heaters

Notify the Contracting Officer when any direct fired domestic water heater over 117 kw is operational and ready to be inspected and certified.

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

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 above the floor, except at water closets intended for use by the physically handicapped where flushometer valves shall be mounted at approximately 760 mm 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 above finished floor. Wall-hung drinking fountains and water coolers shall be installed with rim 1020 mm above floor. Wall-hung service sinks shall be mounted with rim 700 mm above the floor. Installation of fixtures for use by the physically handicapped shall be in accordance with ICC A117.1 COMM.

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

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 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 MLIT-M 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 05 50 13 MISCELLANEOUS METAL FABRICATIONS][Section 05 51 33 METAL LADDERS][Section 05 52 00 METAL RAILINGS][Section 05 51 00 METAL STAIRS].

3.3.8 Sight Drains

Sight drains shall be installed so that the indirect waste will terminate 50 mm 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 JIS A 4421. 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 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 flintlock 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. 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 Plasticized Chlorinated Polyethylene Shower Pans

Corners of plasticized 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 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 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 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 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 in room areas and 75 mm 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 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. 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 at a time shall be welded. On wood subflooring, two layers of 0.73 kg per square meter felt shall be installed prior to installation of shower pan to ensure a smooth surface installation.

3.4 VIBRATION-ABSORBING FEATURES

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 23 05 48.19 [SEISMIC] BRACING FOR HVAC.

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 23 05 48.19 [SEISMIC] BRACING FOR HVAC.

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

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 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

Color code marking of piping shall be as specified in Section 09 90 00 PAINTS AND COATINGS.

3.6.3 Color Coding Scheme for Locating Hidden Utility Components

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 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 width, 750 mm height, and 12 mm thickness. The board shall be made of wood fiberboard and framed under glass or 1.6 mm transparent plastic cover. Unless otherwise directed, the color code symbols shall be approximately 20 mm in diameter and the related lettering in 12 mm 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 09 90 00 PAINTS AND COATINGS.

3.8.1 Painting of New Equipment

New equipment painting shall be factory applied or shop applied, and shall be as specified herein, and provided under each individual section.

3.8.1.1 Factory Painting Systems

Manufacturer's standard factory painting systems may be provided subject to certification that the factory painting system applied will withstand 125 hours in a salt-spray fog test, except that equipment located outdoors shall withstand 500 hours in a salt-spray fog test. Salt-spray fog test shall be in accordance with JIS Z 2371 or ASTM B117, and for that test the acceptance criteria shall be as follows: immediately after completion of the test, the paint shall show no signs of blistering, wrinkling, or cracking, and no loss of adhesion; and the specimen shall show no signs of rust creepage beyond 3 mm on either side of the scratch mark.

The film thickness of the factory painting system applied on the equipment shall not be less than the film thickness used on the test specimen. If manufacturer's standard factory painting system is being proposed for use on surfaces subject to temperatures above 50 degrees C, the factory painting system shall be designed for the temperature service.

3.8.1.2 Shop Painting Systems for Metal Surfaces

Clean, pretreat, prime and paint metal surfaces; except aluminum surfaces need not be painted. Apply coatings to clean dry surfaces. Clean the surfaces to remove dust, dirt, rust, oil and grease by wire brushing and solvent degreasing prior to application of paint, except metal surfaces subject to temperatures in excess of 50 degrees C shall be cleaned to bare metal.

Where more than one coat of paint is specified, apply the second coat after the preceding coat is thoroughly dry. Lightly sand damaged painting and retouch before applying the succeeding coat. Color of finish coat shall be aluminum or light gray.

- a. Temperatures Less Than 50 Degrees C: Immediately after cleaning, the metal surfaces subject to temperatures less than 50 degrees C shall receive one coat of pretreatment primer applied to a minimum dry film thickness of 0.0076 mm, one coat of primer applied to a minimum dry film thickness of 0.0255 mm; and two coats of enamel applied to a minimum dry film thickness of 0.0255 mm per coat.
- b. Temperatures Between 50 and 205 Degrees C: Metal surfaces subject to temperatures between 50 and 205 degrees C shall receive two coats of 205 degrees C heat-resisting enamel applied to a total minimum thickness of 0.05 mm.
- c. Temperatures Greater Than 205 Degrees C: Metal surfaces subject to temperatures greater than 205 degrees C shall receive two coats of 315 degrees C heat-resisting paint applied to a total minimum dry film thickness of 0.05 mm.

3.9 TESTS, FLUSHING AND DISINFECTION

3.9.1 Plumbing System

The following tests shall be performed on the plumbing system in accordance with MLIT-M, 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 and reasons for choosing this option in lieu of the smoke test 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.

Backflow prevention assembly test gauges shall be tested annually for accuracy in accordance with the requirements of State or local regulatory agencies. If there is no State or local regulatory agency requirements,

gauges shall be tested annually for accuracy in accordance with the requirements of 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), or any other approved testing laboratory having equivalent capabilities for both laboratory and field evaluation of backflow prevention assembly test gauges. 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 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 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 [hot] 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 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/ANSI 61, Section 9, shall be flushed a minimum of 1 L 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 according to manufacturer's instructions. Flow rates on fixtures must not exceed those stated in PART 2 of this Section. Unless more stringent local requirements exist, lead levels shall not exceed limits established by JIS S 3201. 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 installation, connections, adjustments, and 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

After all system components are provided and operational tests are complete, the entire domestic hot- and cold-water distribution system shall be disinfected. Before introducing disinfecting chlorination material, entire system shall be flushed with potable water until any entrained dirt and other foreign materials have been removed.

Water chlorination procedure shall be in accordance with Japanese Water Supply Law, Article 20 as modified and supplemented by this specification. The chlorinating material shall be hypochlorites or liquid chlorine. 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). Feed a properly adjusted hypochlorite solution injected into the system with a hypochlorinator, or inject liquid chlorine into the system through a solution-feed chlorinator and booster pump until the entire system is completely filled.

Test the chlorine residual level in the water at 6 hour intervals for a continuous period of 24 hours. If at the end of a 6 hour interval, the chlorine residual has dropped to less than 25 ppm, flush the piping including tanks with potable water, and repeat the above chlorination procedures. During the chlorination period, each valve and faucet shall be opened and closed several times.

After the second 24 hour period, verify that no less than 25 ppm chlorine residual remains in the treated system. The 24 hour chlorination procedure must be repeated until no less than 25 ppm chlorine residual remains in the treated system.

Upon the specified verification, the system including tanks shall then be flushed with potable 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.

Take additional samples of water in disinfected containers, for bacterial examination, at locations specified by the Contracting Officer

Test these samples for total coliform organisms (coliform bacteria, fecal coliform, streptococcal, and other bacteria) in accordance with MLIT-M. The testing method used shall be EPA approved for drinking water systems and shall comply with applicable local and state requirements.

Disinfection shall be repeated until bacterial 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 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.

3.11 PERFORMANCE OF WATER HEATING EQUIPMENT

Standard rating condition terms are as follows:

EF = Energy factor, minimum overall efficiency.

ET = Minimum thermal efficiency with 21 degrees C delta T.

SL = Standby loss is maximum (Btu/h) based on a 38.9 degree C temperature difference between stored water and ambient requirements.

V = Rated volume in gallons

Q = Nameplate input rate in kW (Btu/h)

3.11.1 Storage Water Heaters

3.11.1.1 Electric

- a. Storage capacity of 227 liters shall have a minimum energy factor (EF) of 0.93 or higher per FEMP requirements.
- b. Storage capacity of 227 liters or more shall have a minimum energy factor (EF) of 0.91 or higher per FEMP requirements.

3.11.1.2 Gas

- a. Storage capacity of 189 liters or less shall have a minimum energy factor (EF) of 0.67 or higher per FEMP requirements.
- b. Storage capacity of 75.7 liters - or more and input rating of 23 KW W or less:
- c. Rating of less than 22980 W: (75,000 Btu/h) ET shall be 80 percent; maximum SL shall be $(Q/800+110 \times (V^{1/2}))$, per JIS S 2109

3.11.1.3 Oil

- a. Storage capacity of 75.7 liters or more and input rating of 31 KW W or less:
- b. Rating of less than 309.75 W/L or input rating more than 31 KW: ET shall be 78 percent; maximum SL shall be $(Q/800+100 \times (V^{1/2}))$, per JIS S 2109.

3.11.2 Unfired Hot Water Storage

All volumes and inputs: shall meet or exceed R-12.5.

3.11.3 Instantaneous Water Heater

3.11.3.1 Gas

- a. Rating of 309.75 W/L and greater and less than 7.57 L with an input greater than 14.66 kW and less than 58.62 kW
- b. Rating of 309.75 W/L and greater and less than 37.85 L with an input of 58.62 kW and greater shall have a minimum thermal efficiency (ET) of 80 percent per JIS S 2109
- c. Rating of 309.75 W/L and greater and 37.85 L and greater with an input of 58.62 kW and greater shall have a minimum thermal efficiency (ET) of 80 percent and the maximum SL shall be $Q/800+110 \times (V^{1/2})$ per JIS S 2109

3.11.3.2 Oil

- a. Rating of 309.75 W/L and greater and less than 7.57 L with an input of 61.55 kW and less
- b. Rating of 309.75 W/L and greater and less than 37.85 L with an input greater than 61.55 kW shall have a minimum thermal efficiency (ET) of 80 percent per JIS S 2109
- c. Rating of 309.75 W/L and 37.85 L and greater with an input of greater than 61.55 kW shall have a minimum thermal efficiency (ET) of 78 percent and the maximum SL shall be $Q/800+110 \times (V^{1/2})$ per JIS S 2109

3.11.4 Pool Heaters

- a. Gas/oil fuel, capacities and inputs: ET shall be 78 percent.
- b. Heat Pump, All capacities and inputs shall meet a COP of 4.0.

3.12 TABLES

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
1	Cast iron soil pipe and fittings, hub and spigot, JIS G 5526 with compression gaskets. .	X	X	X	X	X		
2	Cast iron soil pipe and fittings hubless, JIS G 5526 and JIS B 2302 and JIS B 2301.		X	X	X	X		
3	Cast iron drainage fittings, threaded, JIS B 2302 and JIS B 2301 for use with Item 10	X		X	X			
4	Cast iron screwed fittings (threaded) JIS B 2302 and JIS B 2301 for use with Item 10				X	X		
5	Grooved pipe couplings, ferrous and non-ferrous pipe JIS G 5502 And JIS G 5705	X	X		X	X		

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
6	Ductile iron grooved joint fittings for ferrous pipe JIS G 5502 and JIS G 5705 for use with Item 5	X	X		X	X		
7	Bronze sand casting grooved joint pressure fittings for non-ferrous pipe JIS H 5120, for use with Item 5	X	X		X	X		
8	Wrought copper grooved joint pressure fittings for non-ferrous pipe JIS H 3250, Copper Rand Bores JIS H 3401 JIS H 3401 for use with Item 5	X	X					
9	Malleable-iron threaded fittings, galvanized JIS B 2301 for use with Item 10				X	X		
10	Steel pipe, seamless galvanized, JIS G 3452 Type S, Grade B	X			X	X		

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
11	Seamless red brass pipe, JIS H 3300				X	X		X
12	Bronzed flanged fittings, JIS B 2240 for use with Items 11 and 14				X	X		X
13	Cast copper alloy solder joint pressure fittings, JIS H 3401 for use with Item 14				X	X		X
14	Seamless copper pipe, JIS H 3300						X	X
15	Cast bronze threaded fittings, JIS H 3401				X	X		
16	Copper drainage tube, (DWV), JIS H 3300	X*	X	X*	X	X		X
17	Wrought copper and wrought alloy solder-joint drainage fittings. JIS H 3401	X	X	X	X	X		X
18	Cast copper alloy solder joint drainage fittings, DWV, JIS H 3401	X	X	X	X	X		X

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
19	Acrylonitrile-Butadiene (ABS) plastic drain, waste, and vent pipe and fittings JIS H 3401	X	X	X	X	X	X	
20	Polyvinyl Chloride plastic drain, waste and vent pipe and fittings, JIS K 6739 OR JIS K 6741	X	X	X	X	X	X	X
21	Process glass pipe and fittings, JIS R 3644						X	
22	High-silicon content cast iron pipe and fittings (hub and spigot, and mechanical joint), JPF-DP-001		X			X	X	
23	Filament-wound reinforced thermosetting resin (RTRP) pipe, JIS K 7013						X	

TABLE I								
PIPE AND FITTING MATERIALS FOR DRAINAGE, WASTE, VENT AND CONDENSATE DRAIN PIPING SYSTEMS								
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D	SERVICE E	SERVICE F	SERVICE G
<p>SERVICE:</p> <p>A - Underground Building Soil, Waste and Storm Drain</p> <p>B - Aboveground Soil, Waste, Drain In Buildings</p> <p>C - Underground Vent</p> <p>D - Aboveground Vent</p> <p>E - Interior Rainwater Conductors Aboveground</p> <p>F - Corrosive Waste And Vent Above And Belowground</p> <p>G - Condensate Drain Aboveground</p> <p>* - Hard Temper</p>								

TABLE II						
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS						
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE 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 A536 and ASTM A47/A47M, non-ferrous pipe, ASTM A536 and ASTM A47/A47M	X	X	X		
3	Ductile iron grooved joint fittings for ferrous pipe ASTM A536 and ASTM A47/A47M, for use with Item 2	X	X	X		

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
4	Steel pipe:				
	a. Seamless, galvanized, ASTM A53/A53M, Type S, Grade B	X	X	X	X
	b. Seamless, black, ASTM A53/A53M, Type S, Grade B			X	
5	Seamless red brass pipe, ASTM B43	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 B42	X	X		X
8	Seamless copper water tube, ASTM B88, ASTM B88M	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, ASME B16.18 for use with Item 8	X	X	X	X
12	Bronze and sand castings groovedjoint pressure fittings for non-ferrous pipe ASTM B584, for use with Item 2	X	X	X	
13	Polyethylene (PE) plastic pipe, Schedules 40 and 80, based on outside diameter	X			X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
14	Polyethylene (PE) plastic pipe (SDR-PR), based on controlled outside diameter, ASTM D3035	X			X
15	Polyethylene (PE) plastic pipe (SIDR-PR), based on controlled inside diameter, ASTM D2239	X			X
16	Butt fusion polyethylene (PE) plastic pipe fittings, ASTM D3261 for use with Items 14, 15, and 16	X			X
17	Socket-type polyethylene fittings for outside diameter-controlled polyethylene pipe, ASTM D2683 for use with Item 15	X			X
18	Polyethylene (PE) plastic tubing, ASTM D2737	X			X
19	Chlorinated polyvinyl chloride (CPVC) plastic hot and cold water distribution system, ASTM D2846/D2846M	X	X		X
20	Chlorinated polyvinyl chloride (CPVC) plastic pipe, Schedule 40 and 80, ASTM F441/F441M	X	X		X
21	Chlorinated polyvinyl chloride (CPVC) plastic pipe (SDR-PR) ASTM F442/F442M	X	X		X
22	Threaded chlorinated polyvinyl chloride (chloride CPVC) plastic pipe fittings, Schedule 80, ASTM F437 for use with Items 20, and 21	X	X		X

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
23	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings, Schedule 40, ASTM F438 for use with Items 20, 21, and 22	X	X		X
24	Socket-type chlorinated polyvinyl chloride (CPVC) plastic pipe fittings Schedule 80, ASTM F439 for use with Items 20, 21, and 22	X	X		X
25	Polyvinyl chloride (PVC) plastic pipe, Schedules 40, 80, and 120, ASTM D1785	X			X
26	Polyvinyl chloride (PVC) pressure-rated pipe (SDR Series), ASTM D2241	X			X
27	Polyvinyl chloride (PVC) plastic pipe fittings, Schedule 40, ASTM D2466	X			X
28	Socket-type polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2467 for use with Items 26 and 27	X			X
29	Threaded polyvinyl chloride (PVC) plastic pipe fittings, schedule 80, ASTM D2464	X			X
30	Joints for IPS PVC pipe using solvent cement, ASTM D2672	X			X
31	Polypropylene (PP) plastic pipe and fittings; ASTM F2389	X	X		X
32	Steel pipeline flanges, MSS SP-44	X	X		

TABLE II					
PIPE AND FITTING MATERIALS FOR PRESSURE PIPING SYSTEMS					
Item #	Pipe and Fitting Materials	SERVICE A	SERVICE B	SERVICE C	SERVICE D
33	Fittings: brass or bronze; ASME B16.15, and ASME B16.18 ASTM B828	X	X		
34	Carbon steel pipe unions, socket-welding and threaded, MSS SP-83	X	X	X	
35	Malleable-iron threaded pipe unions ASME B16.39	X	X		
36	Nipples, pipe threaded ASTM A733	X	X	X	
37	Crosslinked Polyethylene (PEX) Plastic Pipe ASTM F877	X	X		X
38	Press Fittings	X	X		
	SERVICE: A - Cold Water Service Aboveground B - Hot and Cold Water Distribution 82 degrees C 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				
FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
A. STORAGE WATER HEATERS				
Elect.	227 max		ISO 14024	EF = 0.93

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
FUEL	STORAGE CAPACITY LITERS	INPUT RATING	TEST PROCEDURE	REQUIRED PERFORMANCE
Elect.	227 min		ISO 14024	EF = 0.91
Elect.	75.7 min.	12 kW max.	ISO 14024	EF = 0.93-0.00132V minimum
Elect.	75.7 min. OR	12 kW min.	JIS S 2109	SL = $20+35x(V^{1/2})$ maximum
Elect. Heat Pump		24 Amps or less and 250 Volts or less	ISO 14024	EF = 0.93-0.00132V
Gas	189 max		ISO 14024	EF = 0.67-0.0019V min
Gas	75.7 min.	22 kW max.	ISO 14024	EF = 0.80-0.0019V minimum
Gas	309.75 W/L max.	22 kW max.	JIS S 2109	ET= 80 percent; SL = $1.3+38/V$ max.
Oil	75.7 min.	30.8 kW max.	ISO 14024	EF = 0.59-0.0019V min
Oil	309.75 W/L max	30.8 kW	JIS S 2109	ET = 78 percent; SL = $(Q/800+110x(V^{1/2}))$ maximum
B. Unfired Hot Water Storage, R = 2.2 minimum				
C. Instantaneous Water Heater				
Gas	309.75 W/L min.	14.66 kW min.	ISO 14024	EF = 0.62-0.0019V and 7.57 L max 58.62 kW max.
Gas	309.75 W/L min.	58.62 kW min.	JIS S 2109	ET = 80 percent and 37.85 L max 58.62 kW max.
Gas	309.75 W/L min.	58.62 kW min.	JIS S 2109	ET = 80 percent and 37.85 L min. SL + $(Q/800+110x(V^{1/2}))$

TABLE III				
STANDARD RATING CONDITIONS AND MINIMUM PERFORMANCE RATINGS FOR WATER HEATING EQUIPMENT				
<u>FUEL</u>	<u>STORAGE CAPACITY LITERS</u>	<u>INPUT RATING</u>	<u>TEST PROCEDURE</u>	<u>REQUIRED PERFORMANCE</u>
Oil	309.75 W/L min.	61.552 kW max.	ISO 14024	EF = 0.59-0.0019V and 37.85 L max.
Oil	309.75 W/L min.	61.552 kW max.	JIS S 2109	ET = 80 percent and 37.85 L min. SL + (Q/800+110x(V ^{1/2}))
Oil	309.75 W/L min.	61.552 kW max.	JIS S 2109	ET = 78 percent and 37.85 L max SL = (Q800+110x(V ^{1/2}))
D. Pool Heater				
Gas or Oil	All	All		ET = 78 percent
Heat Pump All	All	All		COP = 4.0
TERMS: EF = Energy factor, minimum overall efficiency. ET = Minimum thermal efficiency with 21 degrees C delta T. SL = Standby loss is maximum Watts based on a 38.9 degrees C temperature difference between stored water and ambient requirements. V = Rated storage volume in gallons Q = Nameplate input rate in Watts				

-- End of Section --