**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
**********

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DIVISION 23 - HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

SECTION 23 22 26.00 20

STEAM SYSTEM AND TERMINAL UNITS

**02/10, CHG 1: 05/15**

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| | |
|---|---|
| **USACE / NAVFAC / AFCEC / NASA** | **UFGS-23 22 26.00 20 (February 2010)**<br>**Change 1 - 05/15**<br>**----------** |
| **Preparing Activity: NAVFAC** | **Superseding**<br>**UFGS-23 22 26.00 20 (November 2009)** |

**UNIFIED FACILITIES GUIDE SPECIFICATIONS**

**References are in agreement with UMRL dated July 2023**
**********

SECTION 23 22 26.00 20

STEAM SYSTEM AND TERMINAL UNITS
**02/10, CHG 1: 05/15**

**********
**NOTE: This guide specification covers the requirements for provision of a complete steam system within the building including steam, condensate, and terminal units for heating.**

**Adhere to UFC 1-300-02 Unified Facilities Guide Specifications (UFGS) Format Standard when editing this guide specification or preparing new project specification sections. Edit this guide specification for project specific requirements by adding, deleting, or revising text. For bracketed items, choose applicable item(s) or insert appropriate information.**

**Remove information and requirements not required in respective project, whether or not brackets are present.**

**Comments, suggestions and recommended changes for this guide specification are welcome and should be submitted as a Criteria Change Request (CCR).**
**********

**********
**NOTE: This guide specification does not include steam boilers, feedwater treatment equipment, or process steam terminal units, boiler feed, and blow-off piping.**
**********

**********
**NOTE: The following information shall be shown on the project drawings:**

**1. Extent of work including point of connection of new work to existing**

**2. General arrangement of the piping**

**3. Valve locations**

**4. Safety valve location, setting, pipe size, and method of termination**

**5. Valve clearances to permit proper valve operation in confined spaces**

**6. Floor stand, chainwheel operator, and power operator locations, when required**

**7. Floor stand details, when required**

**8. Electrical or compressed air power supply for power operators, when required**

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**13. Unit heaters, when required**

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**15. Condensate return pumping units including pump capacity and electrical characteristics for the pump motor**

**16. Radiation units including size and capacity**

**17. Location where cold-springing is permitted**

**18. Connections for future equipment, when required.**

**********

PART 1 GENERAL

1.1 REFERENCES

**********

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

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

**References not used in the text will automatically**

**be deleted from this section of the project specification when you choose to reconcile references in the publish print process.**
**********

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

AIR-CONDITIONING, HEATING AND REFRIGERATION INSTITUTE (AHRI)

| | |
|---|---|
| AHRI 410 | (2001; Addendum 1 2002; Addendum 2 2005; Addendum 3 2011) Forced-Circulation Air-Cooling and Air-Heating Coils |

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

| | |
|---|---|
| ASME A13.1 | (2020) Scheme for the Identification of Piping Systems |
| ASME B1.1 | (2003; R 2018) Unified Inch Screw Threads (UN and UNR Thread Form) |
| 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 B16.5 | (2020) Pipe Flanges and Flanged Fittings NPS 1/2 Through NPS 24 Metric/Inch Standard |
| ASME B16.9 | (2018) Factory-Made Wrought Buttwelding Fittings |
| ASME B16.11 | (2022) Forged Fittings, Socket-Welding and Threaded |
| ASME B16.18 | (2021) Cast Copper Alloy Solder Joint Pressure Fittings |
| ASME B16.20 | (2017) Metallic Gaskets for Pipe Flanges |
| ASME B16.21 | (2021) Nonmetallic Flat Gaskets for Pipe Flanges |
| 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 B16.34 | (2021) Valves - Flanged, Threaded and Welding End |
| ASME B16.39 | (2020) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300 |

| | |
|---|---|
| ASME B18.2.1 | (2012; Errata 2013) Square and Hex Bolts and Screws (Inch Series) |
| ASME B18.2.2 | (2022) Nuts for General Applications: Machine Screw Nuts, and Hex, Square, Hex Flange, and Coupling Nuts (Inch Series) |
| ASME B31.1 | (2022) Power Piping |
| ASME B40.100 | (2022) Pressure Gauges and Gauge Attachments |
| ASME BPVC | (2010) Boiler and Pressure Vessels Code |
| ASME BPVC SEC IX | (2017; Errata 2018) BPVC Section IX-Welding, Brazing and Fusing Qualifications |
| ASME BPVC SEC VIII D1 | (2019) BPVC Section VIII-Rules for Construction of Pressure Vessels Division 1 |

AMERICAN WELDING SOCIETY (AWS)

| | |
|---|---|
| AWS Z49.1 | (2021) Safety in Welding and Cutting and Allied Processes |

ASTM INTERNATIONAL (ASTM)

| | |
|---|---|
| ASTM A53/A53M | (2022) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless |
| ASTM A106/A106M | (2019a) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service |
| ASTM A194/A194M | (2023) Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both |
| ASTM A307 | (2021) Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength |
| ASTM B32 | (2020) Standard Specification for Solder Metal |
| ASTM B88 | (2022) Standard Specification for Seamless Copper Water Tube |
| ASTM B88M | (2020) Standard Specification for Seamless Copper Water Tube (Metric) |

COPPER DEVELOPMENT ASSOCIATION (CDA)

| | |
|---|---|
| CDA A4015 | (2016; 14/17) Copper Tube Handbook |

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

| | |
|---|---|
| MSS SP-45 | (2020) Bypass and Drain Connections |
| MSS SP-58 | (2018) Pipe Hangers and Supports - Materials, Design and Manufacture, Selection, Application, and Installation |
| MSS SP-69 | (2003; Notice 2012) Pipe Hangers and Supports - Selection and Application (ANSI Approved American National Standard) |
| MSS SP-80 | (2019) Bronze Gate, Globe, Angle and Check Valves |

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

| | |
|---|---|
| NEMA ICS 2 | (2000; R 2020) Industrial Control and Systems Controllers, Contactors, and Overload Relays Rated 600 V |
| NEMA ICS 6 | (1993; R 2016) Industrial Control and Systems: Enclosures |
| NEMA MG 1 | (2021) Motors and Generators |

U.S. DEPARTMENT OF DEFENSE (DOD)

| | |
|---|---|
| MIL-DTL-17813 | (2009; Rev H; Supp 1 2009; Notice 1 2013) Expansion Joints, Pipe, Metallic Bellows, General Specification for |
| MIL-DTL-18436 | (2017; Rev G) Valves, Check, Bronze, Cast Iron, and Steel Body |
| MIL-E-17814 | (1992; Rev F; CANC Notice 1) Expansion Joints, Pipe, Slip-Type, Packed |

U.S. GENERAL SERVICES ADMINISTRATION (GSA)

| | |
|---|---|
| CID A-A-1689 | (Rev B) Tape, Pressure-Sensitive Adhesive, (Plastic Film) |
| CID A-A-50494 | (Basic; Notice 1) Exhaust Head, Steam |
| CID A-A-50543 | (Basic; Notice 2; Notice 3) Heaters, Convection, Steam or Hot Water |
| CID A-A-50544 | (Basic; Notice 2; Notice 3) Radiators, Heating, Steam and Hot Water, Cast Iron |
| CID A-A-50545 | (Basic; Notice 2; Notice 3) Radiator, Heating, Baseboard Panel, Steam and Hot Water |
| CID A-A-50558 | (Basic; Notice 1) Valves, Pressure Regulating, Steam |

| | |
|---|---|
| CID A-A-50559 | (Basic; Notice 1) Valves, Temperature-Regulating (Thermostatically Controlled) |
| CID A-A-50568 | (Basic; Notice 1) Gages, Liquid Level Measuring, Tank |
| CID A-A-59617 | (Basic, Notice 1) Unions, Brass or Bronze, Threaded Pipe Connections and Solder-Joint Tube Connections |
| CID A-A-60001 | (Rev A) Traps, Steam |
| FS F-P-2908 | (Basic; Notice 1) Pumping Units, Condensate, Return; and Boiler Feed Package |
| FS F-V-2906 | (Basic; Notice 1) Valves, Air Venting, Steam |
| FS QQ-B-654 | (Rev A; Notice 1; Notice 2) Brazing Alloys, Silver |
| FS S-R-2834 | (Basic; Notice 1; CANC Notice 1) Radiators: Heating, Steel, Multifin Type |
| FS S-U-2833 | (Basic; Notice 1) Unit Heater, Air-Circulating, Steam - Hot Water |
| FS WW-H-191 | (Rev E; Notice 2) Heater, Fluid, Industrial (Instantaneous, Steam, Water Converter Type) |
| FS WW-S-2739 | (Basic; Notice 1; Notice 2) Strainers, Sediment: Pipeline, Water, Air, Gas, Oil, or Steam |

## 1.2 GENERAL REQUIREMENTS

Section 23 03 00.00 20 BASIC MECHANICAL MATERIALS AND METHODS, applies to this section, with the additions and modifications specified herein. This section includes steam and condensate piping, [unit heaters,] [convertors,] [condensate return units,] [radiation units,] [and steam coils] used for heating within the building. Steam boilers, feedwater treatment equipment, process steam terminal units, boiler feed piping, and blow-off piping are not covered in this section.

### 1.2.1 Classes and Maximum Working Pressures

Equipment, piping, and piping components shall be suitable for use under the maximum working pressure indicated. Except as modified herein, the pressure temperature limitations shall be as specified in the referenced standards and specifications.

### 1.2.2 Standard Commercial Product

The terminal units provided shall, as a minimum, comply with the features specified herein and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited herein but which are a part of the manufacturer's standard

commercial product, shall be included in the terminal units being furnished. A standard commercial product is a product which has been sold or is currently being offered for sale, on the commercial market through advertisements or manufacturer's catalogs or brochures. Provide Institute of Boiler and Radiator Manufacturer (IBR) or Steel Boiler Institute (SBI) rating for required capacity.

1.2.3 Welding Safety

AWS Z49.1.

1.2.4 Definitions

1.2.4.1 High Pressure Piping System

A system whose pressure is greater than 103 kPa (gage) 15 psig and shall conform to ASME B31.1.

1.2.4.2 Low Pressure Piping System

A system whose pressure is 103 kPa (gage) 15 psig or less.

1.2.4.3 Terminal Unit

An enclosed unit that provides heated air from a steam coil and includes natural convection units, radiation, and forced air units.

1.2.4.4 Piping and Piping System

Includes pipe, tubing, flanges, bolting, gaskets, valves, safety valves, fittings, and pressure containing parts of other piping components, hangers, supports, guides, expansion joints, anchors, and other equipment items necessary to prevent overstressing the pressure containing parts.

1.3 SUBMITTALS

**********

**NOTE: Review Submittal Description (SD) definitions in Section 01 33 00 SUBMITTAL PROCEDURES and edit the following list, and corresponding submittal items in the text, to reflect only the submittals required for the project. The Guide Specification technical editors have classified those items that require Government approval, due to their complexity or criticality, with a "G." Generally, other submittal items can be reviewed by the Contractor's Quality Control System. Only add a "G" to an item if the submittal is sufficiently important or complex in context of the project.**

**For Army projects, fill in the empty brackets following the "G" classification, with a code of up to three characters to indicate the approving authority. Codes for Army projects using the Resident Management System (RMS) are: "AE" for Architect-Engineer; "DO" for District Office (Engineering Division or other organization in the District Office); "AO" for Area Office; "RO" for Resident Office; and "PO" for Project Office. Codes**

**following the "G" typically are not used for Navy, Air Force, and NASA projects.**

**The "S" classification indicates submittals required as proof of compliance for sustainability Guiding Principles Validation or Third Party Certification and as described in Section 01 33 00 SUBMITTAL PROCEDURES.**

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

Government approval is required for submittals with a "G" or "S" classification. Submittals not having a "G" or "S" classification are [for Contractor Quality Control approval.][for information only. When used, a code following the "G" classification identifies the office that will review the submittal for the Government.] Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Unit Heaters

Convertors

Condensate Return Pumping Units

Finned Tube Radiation Units

Cast Iron Baseboard Radiation Units

Convectors

Steam to Air Heating Coils

Valves

Valve Operating Mechanism

Steam Meters

Traps

Strainers

Flash Tanks

Expansion Joints

Instrumentation

SD-06 Test Reports

Steam Piping tests

Copper Tubing test

Valves tests

Expansion Joints tests

Instrumentation tests

Pipe and Pipe System

Unit Heaters tests

Convertors tests

Condensate Return Pumping Units tests

Radiation Units tests

Steam to Air Heating Coils tests

Submit reports of tests required by the reference specification and standards.

SD-07 Certificates

Welding Procedure

Welder's Performance Qualification Record

List of Welders and Welder's Symbols

SD-08 Manufacturer's Instructions

Unit Heaters

Convertors

Condensate Return Pumping Units

Include manufacturer's recommendations for equipment foundations.

## 1.4 QUALITY ASSURANCE

### 1.4.1 Welding Procedure

Submit welding procedure specification for metals included in the work, together with proof of the procedure's qualifications as outlined in ASME B31.1.

### 1.4.2 Welder's Performance Qualification Record

Submit [to the Contracting Officer] the Welder's Performance Qualification Record in conformance with ASME B31.1 for each welder, showing that the welder was tested under the approved procedure specification submitted by the Contractor. In addition, the Contractor shall submit list of welders and welder's symbols, assigned number, or letter which shall be used to identify the work of the welder which shall be affixed immediately upon completion of the weld. Welders making defective welds after passing a qualification test shall be required to take a requalification test. Welders failing the requalification tests will not be permitted to work under this contract.

1.4.3 Previous Qualifications

Welding procedures, welders, and welding operators previously qualified by test may be accepted for this contract without requalification subject to approval if the conditions specified in ASME B31.1 are met before a procedure can be used.

PART 2 PRODUCTS

2.1 PIPE AND PIPE SYSTEM

2.1.1 High Pressure Steam Piping System (Over 103 kPa (Gage)Over 15 psig)

**********
**NOTE: Specify the operating pressures and temperatures.**
**********

ASME B31.1 for a steam working pressure of [_____] kPa (gage) psig and a temperature of [_____] degrees C F, a condensate pressure f [_____] kPa (gage) psig, and a temperature of [_____] degrees C F.

2.1.1.1 High Pressure Steam Piping

**********
**NOTE: Specify Schedule 40 pipe for systems operating at 862 kPa 125 pounds or less steam pressure. For systems operating at pressures greater than 862 kPa 125 pounds or where piping will be subjected to high stress, determine pipe thickness required and specify the appropriate pipe schedule.**
**********

ASTM A106/A106M or ASTM A53/A53M, Grade B, Schedule [_____], black steel, [electric-resistance welded] [or] [seamless]. Use ASTM A53/A53M pipe for bending.

2.1.2 Low Pressure Steam Piping System

**********
**NOTE: Specify the operating pressures and temperatures.**
**********

ASME B31.1 for a steam working pressure of 103 kPa (gage) 15 psig or less, a condensate pressure of [_____] kPa (gage) psig, and a temperature of [_____] degrees C F.

2.1.2.1 Low Pressure Steam Piping

a. Steel Piping: ASTM A53/A53M, Schedule 40, black, [electric-resistance welded] [or] [seamless]. Use ASTM A53/A53Mpipe for bending.

b. Copper Tubing: ASTM B88M ASTM B88, Type K.

2.1.3 Condensate Return Piping (690 kPa (gage)100 psig or Less)

2.1.3.1 Steel Piping

ASTM A106/A106M or ASTM A53/A53M, Grade B, Schedule 80, black, [electric-resistance welded] [or] [seamless].

2.1.3.2 Copper Tubing (103 kPa (Gage)15 psig or Less)

ASTM B88MASTM B88, Type K.

2.1.4 Fittings

Provide fittings compatible in all respects (material, size, pressure, and temperature limitations) with the pipe being used and within any further limitations of ASME B31.1.

2.1.4.1 Fittings for Steel Pipe

a. Sizes 3 to 50 mm 1/8 to 2 inches:

(1) Steel Fittings: ASME B16.11, socket welding or threaded. Where pressure exceeds 103 kPa (gage) 15 psig, provide socket-welding type only.

(2) Malleable Iron Fittings: ASME B16.3, threaded.

b. Sizes 65 mm 2 1/2 inches and larger:

(1) Steel Fittings: ASME B16.9, buttwelding or ASME B16.5, flanged.

(2) Bronze Fittings: ASME B16.24, flanged. Sizes larger than 200 mm 8 inches are not permitted.

2.1.4.2 Fittings for Copper Tubing

ASME B16.18, cast copper alloy or ASME B16.22, wrought copper, solder joint type. Flared or compression joint type fittings for tube sizes not exceeding 50 mm 2 inches outside diameter (O.D.) may be provided as permitted in ASME B31.1.

2.1.5 Unions

2.1.5.1 Unions for Steel Pipe

ASME B16.39, threaded.

2.1.5.2 Unions for Copper Tubing

CID A-A-59617, solder joint end type.

2.1.6 Flanges

Remove the raised faces on flanges when used with flanges having a flat face.

2.1.6.1 Steel Flanges

ASME B16.5, forged steel, welding type.

2.1.6.2 Bronze Flanges

ASME B16.24, threaded.

2.1.7 Valves

Shall conform to the following paragraphs. End connections shall conform to paragraph END CONNECTIONS.

2.1.7.1 Gate Valves

a. Bronze Gate Valves: MSS SP-80, [Type 1 (solid wedge, non-rising stem)] [or] [Type 2 (solid wedge, inside screw, rising stem)], 80 mm 3 inches and smaller, threaded or solder joint ends, and not less than Class 150.

**********
**NOTE: When special trim material is required, revise latter portion of paragraph to identify the special trim material.**
**********

b. Steel Gate Valves: ASME B16.34. Provide outside screw and yoke type with solid wedge or flexible wedge disc, and with trim suitable for the service temperature and pressure.

2.1.7.2 Globe and Angle Valves

a. Bronze Globe and Angle Valves: MSS SP-80, Type 1 (metal disc, integral seat) or Type 3 (metal disc, renewable seat), 80 mm 3 inches and smaller, threaded or solder joint ends, Class 200 except that Class 150 with solder joint ends may be used for copper tubing. Valves shall have renewable seats and discs, except solder joint end valves which shall have integral seats.

**********
**NOTE: When special trim material is required, revise latter portion of paragraph to identify the special trim material.**
**********

b. Steel Globe and Angle Valves: ASME B16.34, with trim suitable for the service temperature and pressure.

2.1.7.3 Check Valves

a. Bronze Check Valves: MSS SP-80, Type 3 (swing check, metal disc to metal seat), 80 mm 3 inches and smaller, threaded or solder joint ends, Class 200, regrinding type.

**********
**NOTE: When special trim material is required, revise latter portion of paragraph to identify the special trim material.**
**********

b. Steel Check Valves: MIL-DTL-18436, with trim suitable for the service

temperature and pressure.

(1) Swing Check Valves: Shall have bolted caps.

(2) Lift Check Valves: Shall have threaded or bolted caps.

2.1.7.4 Steam Pressure Reducing Valves

CID A-A-50558, Type [_____], Class [_____], Construction [_____], Load Characteristics [_____], cast iron prohibited.

2.1.7.5 Temperature Regulating Valves

CID A-A-50559, Type [_____], Style [_____], Class [_____], cast iron prohibited.

2.1.7.6 Air Vent Valves

FS F-V-2906, [with] [without] vacuum holding device, pressure rated for the intended service, and with a [capacity of [_____] liter per second cfm ] [capacity based on manufacturer's standard for the connection size], cast iron prohibited.

2.1.7.7 Radiator Valves

Provide angle or straightway pattern with packed or packless bonnet shutoff globe type designed especially for steam heating system. Valve shall be constructed of copper alloy conforming to ASTM specifications for materials with non-metallic renewable disc and plastic wheel handle for shutoff service.

2.1.7.8 Valve Operating Mechanism

**********

**NOTE: Show location of each floor stand, chainwheel, or power operator required in the project. Delete paragraph VALVE OPERATING MECHANISM and its subparagraphs if these items are not required in the project.**

**********

Provide [floor stands] [chainwheels] [power operators] [and extension stems] where indicated and as specified.

**********

**NOTE: Show floor stand details including distance from centerline of valve to top of floor, floor thickness, and handwheel height.**

**********

a. Floor Stands: Shall be cast iron or steel, constructed for bolting to the floor and shall include an extension stem, an operating handwheel, and a position indicator for non-rising stems. Floor stand shall be not less than 762 mm 30 inches high. Handwheel shall identify rotation direction for closing the valve and shall be of such diameter as to permit operation of the valve with a force of not more than 178 Newton 40 pounds.

b. Chainwheel Operator: Shall be fabricated of cast iron or steel and

shall include a wheel, an endless chain, and a guide to keep the chain on the wheel. Provide galvanized steel endless chain extending to within 914 mm 3 feet of the floor.

**********
**NOTE: Show electric or compressed air power supply required to operate the power operators.**
**********

c. Power Operators: Shall be [electric] [pneumatic]. Power operated valves shall open and close at rates no slower than 254 mm 10 inches per minute for gate valves and 100 mm 4 inches per minute for globe and angle valves. Valves shall open fully or close tightly without requiring further attention when the actuating control is moved to the open or close position. A predetermined thrust exerted on the stem during operation resulting from an obstruction in the valve shall cause the motor to automatically stop. Power operators shall be complete with all gearing and controls necessary for the size of valve being provided. Power operators shall be designed to operate on the [electric] [compressed air] power supply indicated.

d. Extension Stem: Shall be corrosion resisting steel designed for rising and non-rising stems, as applicable, and for connection to the valve stem by a sleeve coupling or universal joint. Provide in length required to connect the valve stem and the [handwheel] [operating mechanism] and of sufficient cross section to transfer the torque required to operate the valve.

2.1.7.9 Safety Valves

**********
**NOTE: The designer shall ensure that safety valves are installed for proper personnel protection. Vent piping shall be sized to minimize back pressure. The pipe sizes and the method of termination shall be shown on the drawings.**
**********

**********
**NOTE: Consult reference document to determine Type, Class, and Style as appropriate for the project.**
**********

MIL-DTL-18436, Type 1, Class [_____], Style [_____], and sized in accordance with ASME BPVC. Set point shall be as indicated, cast iron prohibited.

2.1.8 End Connections

2.1.8.1 Steel Piping

Sizes 50 mm 2 inches and smaller threaded or socket welded; sizes 65 mm 2 1/2 inches and larger flanged or butt welded.

a. Threaded Joints: ASME B1.20.1.

b. Flanged Joints: Flanges shall conform to paragraph entitled "Flanges." Bolting and gaskets shall be as follows:

**********

**NOTE: For temperature limitations on the use of these bolts, consult ASME B31.1.**

**********

(1) Bolting: Material used for bolts and studs shall conform to ASTM A307, Grade B; and material for nuts shall conform to ASTM A194/A194M, Grade 2. Dimensions of bolts, studs, and nuts shall conform to ASME B18.2.1 and ASME B18.2.2 with threads conforming to ASME B1.1coarse type, with Class 2A fit for bolts and studs, and Class 2B fit for nuts. Bolts or bolt-studs shall extend completely through the nuts and may have reduced shanks of a diameter not less than the diameter at root of threads. Carbon steel bolts shall have American Standard regular square or heavy hexagon heads and shall have American Standard heavy semifinished hexagonal nuts, conforming to ASME B18.2.1 and ASME B18.2.2.

(2) Gaskets: Gaskets shall be as follows:

| Working Conditions | Material |
|---|---|
| Saturation | |
| [_____] kPa (gage) [_____] degrees C | Composition or Copper |
| Superheated Steam, Less Than 400 degrees C | |
| [_____] kPa (gage) [_____] degrees C | Metal-Jacketed Composition, Monel, Steel, or Soft Steel |

| Working Conditions | Material |
|---|---|
| Saturation | |
| [_____] psig [_____] degrees F | Composition or Copper |
| Superheated Steam, Less Than 750 degrees F | |
| [_____] psig [_____] degrees F | Metal-Jacketed Composition, Monel, Steel, or Soft Steel |

Gaskets shall be as thin as the finish of surfaces will permit. Metal or metal-jacketed non-asbestos gaskets shall be used with small male and female or small tongue-and-groove flanges or flanged fittings; they may be used with steel flanges with lapped, large male and female, large tongue-and-groove, or raised faces. Full faced gaskets shall be used with flat-faced bronze flanges. Lapped steel flanges, or raised-face steel flanges shall have ring gaskets with an outside diameter extending to the inside of the bolt holes. Widths of gaskets for small male and female and for tongue-and-groove joints shall be equal to the widths of the male face or tongue. Gaskets shall have an inside diameter equal to or larger than the port openings. Rings for ring joints shall be in accordance with dimensions in ASME B16.20, suitable for the service conditions encountered, and shall be softer than the flanges. Dimensions for non-metallic gaskets shall be in

accordance with ASME B16.21.

c. Butt Weld Joints: ASME B31.1. The use of backing rings shall conform to ASME B31.1. Ferrous rings shall be of good weldable quality and shall not exceed 0.05 percent sulfur; for alloy pipe, backing rings shall be of material compatible with the chemical composition of the parts to be welded and preferably of the same composition. Backing rings shall be continuous machined or split band type.

d. Socket Weld Joints: ASME B31.1.

2.1.8.2 Joints for Copper Tubing

a. Solder Joints: ASTM B32, alloy grade Sb5 solder for steam pressure 103 kPa (gage) 15 psig or less.

b. Brazed Joints: FS QQ-B-654 for steam pressure 827 kPa (gage) 120 psig or less.

2.1.9 Expansion Joints

2.1.9.1 Packless Type

**********
**NOTE: Consult reference document to determine Type, Class, and Style as appropriate for the project.**
**********

MIL-DTL-17813, Type [_____], Class [_____], located as indicated. Bellows material shall be [_____]. Expansion joint shall be designed for [_____] cycles of movement.

2.1.9.2 Guided Slip-Tube Type

**********
**NOTE: Consult reference document to determine Type, Class, and Style as appropriate for the project.**
**********

MIL-E-17814, Type [_____], Style [_____], Class [_____], locate as indicated. Expansion joint material shall be [_____].

2.1.10 Instrumentation

2.1.10.1 Pressure and Vacuum Gages

ASME B40.100 with restrictor, locate as indicated. Provide scale range for intended service. Scale range not to exceed two times (2X) the indicated pressure of piping.

2.1.10.2 Tank Gages

CID A-A-50568, locate as indicated.

2.1.10.3 Indicating Thermometers

Thermometers shall be dial type with an adjustable angle suitable for the service. Provide thermowell sized for each thermometer in accordance with the thermowell specification. Fluid-filled thermometers (mercury is not

acceptable) shall have a nominal scale diameter of 125 mm 5 inches. Construction shall be stainless-steel case with molded glass cover, stainless-steel stem, and bulb. Stem shall be straight, length as required to fit well. Bimetal thermometers shall have a scale diameter of 90 mm 3 1/2 inches. Case shall be hermetic. Case and stem shall be constructed of stainless steel. Bimetal stem shall be straight and of a length as required to fit the well.

2.1.11 Miscellaneous Pipeline Components

2.1.11.1 Steam Meters

[ a. Rotary Axial-Turbine Steam Meter

(1) Provide rotary axial-turbine totalizing type designed for mounting directly in the steam line (for sizes up to 100 mm 4 inches inclusively) or in a bypass piping arrangement with orifice plate in the main line (for sizes 125 mm 5 inches and up). Bypass meter shall be furnished for horizontal or vertical upward flow or vertical downward flow.

(2) The meter shall be self-contained and self-operating requiring no mercury, pressure piping, compressed air, or electrical connections except for operation of accessory contacts where required or desired. The meter shall include a dampened fan shaft assembly, fixed internal orifice, and magnetically driven counter of [dial and pointer type] [cyclometer type]. Stuffing box shall not be allowed.

(3) Materials of construction shall be [cast iron body with 113 kg 250 pounds flanged ends for pressures up to 1724 kPa 250 psig and temperatures up to 232 degrees C 450 degrees F] [cast steel body with 136 kg 300 pounds flanged ends for pressures up to 2070 kPa 300 psig and temperatures up to 400 degrees C 750 degrees F]. Wear parts shall be of monel or stainless steel with graphite top bearing and jewelled bottom bearing.

(4) Meter shall be direct reading in pounds of steam over a 10 to 1 range, with continuous overload capability up to 150 percent of rated capacity and temporary overload capability up to 200 percent of rated capacity.

(5) Accuracy shall be within plus or minus 2 percent of actual flow over the entire 10 to 1 range at flow rates and pressures within the limits set forth in the capacity tables.

[ (6) Meter shall be equipped with pressure compensating counter for automatically and continuously correcting meter readings to compensate for line pressure variations. The counter shall be self-contained and self-operating and require no connections other than a single tap to the steam main. Pressure compensation range shall be [_____] to [_____] kPa psi.]

[ (7) Meter counter shall be equipped with electric contactor to operate a remote totalizer, or for providing impulses for interfacing with an energy monitoring system. Contacts or impulses to be proportional to pressure compensated steam flow.]]

[ b. Variable Orifice Steam Meters

(1) Provide spring loaded variable orifice principle type steam meters, density compensated, to ensure accuracy within plus or minus 2 percent of actual flow rate independent of line pressure changes.

(2) Provide a computer to display totalized flow, flow rate, temperature, pressure, time, and date.

(3) The computer shall be capable of providing high and low flow rate and temperature alarm set points, four independent timers to store peak flow rate and total flow, a 4 to 20 mA output and a communication port for energy management interface.]

2.1.11.2 Air Traps

CID A-A-60001 for float-operated steam traps (non-thermostatic), except that the valve mechanism shall be inverted so as to be closed, not opened, by rising water. Arrange float-controlled valves to close promptly when water enters the traps. Locate traps as indicated.

2.1.11.3 Steam Traps

**********
**NOTE: Consult reference document to determine Type, Class, and Style as appropriate for the project.**
**********

CID A-A-60001, Type [_____], Style [_____], thermostatic and non-thermostatic steam traps. Provide traps with separate strainers and locate as indicated.

2.1.11.4 Strainers

FS WW-S-2739, Style Y (Y pattern) for Class 125 and 250 piping in sizes 15 to 200 mm 1/2 to 8 inches, inclusive, locate as indicated, cast iron prohibited.

2.1.11.5 Exhaust Heads

CID A-A-50494, for atmospheric discharge of exhaust steam.

2.1.11.6 Hangers, Supports, Spacing Requirements, and Attachments

MSS SP-58 and ASME B31.1 for materials, design, and manufacture. MSS SP-69 for selection and application.

2.1.11.7 Flash Tanks

Construct of steel for a minimum working pressure of 862 kPa 125 psig. Provide the tank with a vent and valved drain.

2.2 UNIT HEATERS

FS S-U-2833, [propeller] [centrifugal] fan type with [horizontal] [vertical] air delivery and with capacity as indicated for the design conditions. Fans shall be dynamically balanced only.

## 2.3 CONVERTORS

FS WW-H-191, steam to hot water convertors, with capacity as indicated for the design conditions. Design convertor for support by [system piping] [separate pipe hangers], and provide [temperature regulator] [air vent valve] [air and steam trap].

## 2.4 CONDENSATE RETURN UNITS

**********

**NOTE: The discharge pressure limitations for condensate pumping unit with hexahedral or vertical receiver is 69 to 517 kPa (gage) 10 to 75 psig, for horizontal receiver, it is 69 to 1379 kPa (gage) 10 to 200 psig.**

**********

### [2.4.1 Condensate Return Pumping Units

FS F-P-2908, with [hexahedral, floor-mounted receiver,] [horizontal, cylindrical, stand-mounted receiver,] [vertical, cylindrical, underground receiver], and a [single] [duplex] pump unit, with capacity as indicated.

### ]2.4.2 Pump Motors

NEMA MG 1, suitable for the electrical characteristics as indicated. Motors shall be [open] [splash proof] [totally enclosed] type.

### 2.4.3 Motor Starters

**********

**NOTE: The motor control requirements should be coordinated with Section 26 20 00, INTERIOR DISTRIBUTION SYSTEM and will depend on field conditions. The following types of motor starters should be used as a guide only. When electrical equipment is connected to heavily loaded power circuits, the starting current may cause an excessive voltage drop on the circuit.**

| Motor kW | Voltage | Type Starter |
|---|---|---|
| Up to 5.50 | 208-230 | Across-the-line-magnetic |
| 5.50 to 11 | 208-230 | Across-the-line-magnetic, part winding or wye-delta |

| Motor h.p | Voltage | Type Starter |
|---|---|---|
| Up to 7 1/2 | 208-230 | Across-the-line-magnetic |
| 7 1/2 to 15 | 208-230 | Across-the-line-magnetic, part winding or wye-delta |

**********

NEMA ICS 2, [manual] [across-the-line magnetic,] [reduced voltage-start]

[part-winding] [wye-delta] type with NEMA ICS 6 [general purpose] [weather-resistant] [water tight] enclosure.

## 2.5 RADIATION UNITS

### 2.5.1 Finned Tube Radiation Units

[FS S-R-2834, steel tube with steel fins,] [CID A-A-50545, copper tube with aluminum fins,] [with an adjustable damper,] size and capacity not less than indicated.

### 2.5.2 Cast Iron Baseboard Radiation Units

CID A-A-50545, size and capacity not less than indicated.

### 2.5.3 Convectors

CID A-A-50543, CID A-A-50544, design and capacity not less than indicated.

## 2.6 STEAM TO AIR HEATING COILS

Heating and ventilating units for steam system shall be as specified in [Section 23 30 00 HVAC AIR DISTRIBUTION,] except that steam coils shall be provided in lieu of water coils. Coils for factory fabricated air handlers and reheat coils shall be constructed as follows: Construct steam distribution (nonfreeze type) coils of cast semi-steel, welded-steel, or copper headers, red brass or copper tubes, and copper or aluminum fins mechanically bonded or soldered or helically wound to tubes. Roll and bush, braze, or weld tubes into headers. Condensing tubes shall be not less than 16 mm 5/8 inch outside diameter. Distributing tubes shall be not less than 10 mm 3/8 inch outside diameter, with orifices to discharge steam to condenser tubes and shall be held securely in position. The maximum length of a single coil shall be limited to 120 times the outside diameter of the tube. Coil casings and tube support sheets, with collars of ample width, shall be not lighter than 16 gage 1.6129 mm thick 0.0635 inch thick galvanized steel, formed to provide structural strength. When required, provide multiple tube supports to prevent tube sag. The finned tube and header section shall float within the casing to allow free expansion of tubing for coils subject to high pressure steam service. Factory test coils at 1724 kPa (gage) 250 psig hydrostatic test pressure or under water at 1724 kPa (gage) 250 psig air pressure. Coils shall be suitable for 1379 kPa (gage) 200 psig steam working pressure. Test rate coils in accordance with AHRI 410.

# PART 3 EXECUTION

## 3.1 INSTALLATION

Work material and equipment into a complete, convenient, and economical system or systems; and provide apparatus, parts, materials, and accessories which are necessary to accomplish this result.

### 3.1.1 Piping

Fabricate, assemble, weld, solder, braze, and install piping and pipe system in accordance with ASME B31.1 and as further qualified herein. Piping shall follow the general arrangement shown. Cut piping accurately to measurements established, for the work shown, by the Contractor, and work into place without springing or forcing, except where cold-springing

is indicated. Locate piping and equipment within buildings entirely out of the way of lighting fixtures, conduit, and doors, windows, and other openings. Run overhead piping in buildings in the most inconspicuous positions. Provide adequate clearances from walls, ceilings, and floors to permit the welding of joints; at least 150 mm 6 inches for pipe sizes 100 mm 4 inches and smaller, 250 mm 10 inches for pipe sizes larger than 100 mm 4 inches, and in corners provide sufficient clearance to permit the welder to work between the pipe and one wall. Make provision for expansion and contraction of pipe lines. Do not bury, conceal, or insulate piping until it has been inspected, tested, and approved. Do not conceal piping in walls, partitions, underground, or under the floor except as indicated. Where pipe passes through building structure, do not conceal pipe joints, but locate where they may be readily inspected and not weaken building structure. Run insulated pipe as shown and as required with sufficient clearance to permit application of insulation. Use flanged joints only where necessary for normal maintenance and where required to match valves and equipment. Gaskets, packing, and thread compounds shall be suitable for the service. Apply joint compound or tape on male thread only. Use long radius ells wherever possible to reduce pressure drops. Pipe bends may be used in lieu of welding fittings where space permits. Pipe bends shall have a uniform radius of at least five times the pipe diameter and shall be free from any appreciable flattening, wrinkling, or thinning of the pipe. Mitering of pipe to form elbows, notching straight runs to form full sized tees, or any similar construction shall not be used. Make branch connections with welding tees except factory made forged welding branch outlets or nozzles having integral reinforcements conforming to ASME B31.1 may be used, provided the nominal diameter of the branch is at least one pipe size less than the nominal diameter of the run. Run piping as indicated, and avoid interference with other piping, conduit, or equipment. Run vertical piping plumb and straight and parallel to walls, except where specifically shown otherwise. Do not trap lines, except where indicated. Use reducing fittings for changes in pipe sizes. The use of bushings is prohibited. In horizontal lines 65 mm 2 1/2 inches and larger, use reducing fittings of the eccentric type to maintain the bottom of the lines in the same plane for steam lines and to maintain the top of the lines in the same plane for condensate lines except where a trap or pocket would result. Provide suitable size sleeves for lines passing through building structure. Install piping connected to equipment to provide flexibility for thermal stresses and for vibration. Support and anchor pipe so that strain from weight and thermal movement of piping is not imposed on the equipment. Thoroughly clean each section of pipe, fittings, and valves of foreign matter before erection. Before placing in position, clean the inside of black steel pipe by rapping along its full length to loosen sand, mill scale, and other foreign matter; pipe 50 mm 2 inches and larger shall have a wire brush of a diameter larger than that of the inside of the pipe drawn through its entire length several times. Before final connections are made to the apparatus, thoroughly wash out the piping interior with water. Blow out steam piping with high-pressure steam, if available, or compressed air, removing rust, oil, chips, sand, and other material. Plug or cap open ends of mains during shutdown periods. Do not leave lines open at any place where any foreign matter might accidentally enter pipe.

3.1.1.1 Welding

a. Welding of Piping: Welding of joints in piping, butt welds, fillet welds, bends, loops, offsets, and preparation and cleaning of pipe shall be in accordance with ASME B31.1. Welds shall be visually

examined and meet acceptance standards indicated in Chapter VI of ASME B31.1.

b. Quality of Welds: Quality of welds, correction of defects, stress relieving, and preheating shall be in accordance with ASME B31.1.

c. Arc Welding and Gas Welding: In accordance with ASME BPVC SEC IX.

3.1.1.2 Brazing and Soldering

a. Brazing and soldering procedure qualification shall conform to ASME B31.1. Brazing procedure for joints shall be as outlined in the CDA A4015.

b. Soldering, soldering preparation, and procedures for joints shall be in accordance with ASME B31.1 and as outlined in the CDA A4015.

c. Copper Tube Extracted Joint: An extracted mechanical tee joint may be made in copper tube. Make joint with an appropriate tool by drilling a pilot hole and drawing out the tube surface to form a collar having a minimum height of three times the thickness of the tube wall. To prevent the branch tube from being inserted beyond the depth of the extracted joint, provide dimpled depth stops. Notch the branch tube for proper penetration into fitting to ensure a free flow joint. Braze extracted joints using a copper phosphorous classification brazing filler metal. Soldered joints shall not be permitted.

3.1.1.3 Hangers and Supports

Unless otherwise indicated, horizontal and vertical piping attachments shall conform to MSS SP-58. Continuous inserts and expansion bolts may be used.

3.1.1.4 Grading and Venting of Pipe Lines

Unless otherwise indicated, install horizontal lines of steam and return piping to grade down in the direction of flow with a pitch of not less than 25 mm in 9 meters one inch in 30 feet, except in loop mains and main headers where the flow may be in either direction. When counterflow of condensate within the steam pipe occurs in a portion of a pipeline, pitch up in the direction of steam flow a minimum of 150 mm per 30 meters 6 inches per 100 feet and increase pipe diameters by one standard pipe size. Steam mains pitched away from the boiler shall contain drip connection and air vent valves at the extreme end. Air vents shall be provided at the highest point of any vertical riser. Drip connections shall not be interconnected above the water line of the boiler.

3.1.1.5 Pipe Sleeves

**********

**NOTE: Specify flanges and clamping rings where waterproofed construction is required.**

**********

Provide pipe sleeves where pipes and tubing pass through masonry or concrete walls, floors, roofs, and partitions. Use Schedule 40 galvanized steel pipe sleeves in outside walls below and above grade, in floor, and in roof slabs. Sleeves in partitions shall be zinc-coated sheet steel having a weight of not less than 4.43 kg per square meter 0.907 psf.

Space between pipe, tubing, or insulation and the sleeve shall be not less than 25 mm 1 inch. Hold sleeves securely in proper position and location before and during construction. Sleeves shall be of sufficient length to pass through entire thickness of walls, partitions, or slabs. Sleeves in floor slabs shall extend 50 mm 2 inches above the finished floor. Pack space between the pipe or tubing and the sleeve firmly with oakum and caulk both ends of the sleeve with elastic cement. [Furnish sleeves in waterproofed construction with flanges and clamping rings].

3.1.1.6 Floor, Wall, and Ceiling Plates

**********
**NOTE: Provide floor, wall, and ceiling plates for buildings other than power plants and heating plants.**
**********

Secure plates to the pipe with enough clearance for thermal expansion of pipe. Use chromium-plated steel or nickel-plated cast iron plates on pipes passing through floors and partitions of toilet rooms and where indicated; use painted cast iron, malleable iron, or steel for all other plates.

3.1.1.7 Flashing for Buildings

Provide tight waterproof flashing where pipes pass through building roofs and outside walls.

3.1.1.8 Unions and Flanges

Provide unions and flanges where necessary to permit easy disconnection of piping and apparatus, and as indicated. Provide a union for each threaded end valve. [Place unions or flanges no farther apart than 30 meters 100 feet.] [Place unions or flanges as indicated.] Use unions on piping smaller than 50 mm 2 inches in diameter, and use flanges on piping 50 mm 2 inches and larger in diameter. Provide dielectric unions or flanges between ferrous and non-ferrous piping, equipment, and fittings; except that bronze valves and fittings may be used without dielectric couplings for ferrous-to-ferrous or non-ferrous to non-ferrous connections. Dielectric fittings shall utilize a non-metallic filler which will prevent current flow. The spacer shall be suitable for the pressure and temperature of the service. The fittings shall otherwise conform to the requirements of paragraph entitled "Fittings."

3.1.1.9 Traps and Connections

Traps shall be of the type and capacity for the service and shall be properly supported and connected. Except for thermostatic traps in pipe coils, radiators, and convectors, install traps with a dirt pocket and strainer between it and the piping or apparatus it drains. When necessary to maintain in continuous service apparatus or piping which is to be drained, provide a three-valve bypass so that the trap may be removed and repaired and condensate may drain through the throttled bypass valve. Provide a check valve on the discharge side of the trap whenever the trap is installed for lift or operating against a back pressure, or discharges into a common return line. When a thermodynamic trap is used, a check valve is not required or recommended. Provide test connections on the discharge side of the high and medium pressure traps when they are specifically required. The test connection shall include a 15 mm 1/2 inch globe valve with uncapped nipple.

3.1.1.10 Connections for Future Equipment

Locate capped or plugged outlets for connections to future equipment as indicated.

3.1.2 Valves

3.1.2.1 General

Install valves in conformance with ASME B31.1, ASME BPVC SEC VIII D1, and as required herein, at the locations indicated and elsewhere as required for the proper functioning of the system. Use gate valves unless otherwise directed. Install stop valves in the supply lines equipped or located so as to permit operation from floor level, or provided with safe access in the form of walkways or ladders. Install valves in positions accessible for operation and repair. Provide gate valves 200 mm 8 inches and larger with globe-valved bypass in accordance with MSS SP-45.

3.1.2.2 Globe Valves

Install globe valves so that the pressure shall be below the disk. Install globe valves with the stems horizontal on steam and exhaust lines.

3.1.2.3 Steam Pressure-Reducing Valves

**********

**NOTE: The designer shall ensure that safety valves are installed for proper personnel protection. Vent piping shall be sized to minimize back pressure. The pipe sizes and the method of termination shall be shown on the drawings.**

**********

**********

**NOTE: The bypass valves shall be located in bypass piping. The valve and piping shall be sized to restrict the capacity to approximately that of the reducing valve and the sizes shall be indicated on the drawings.**

**********

**********

**NOTE: Provide a drip trap upstream of the pressure reducing valve to preclude the build-up of condensate and potential water hammer through the valve and downstream piping.**

**********

Provide the steam line entering each pressure-reducing valve with a strainer. Provide each pressure-reducing valve unit with two cutout valves and with a globe or angle bypass valve and bypass piping. Provide each pressure-reducing valve unit with an indicating steam gage to show the reduced pressure, and a safety valve on the low pressure side with sufficient capacity to relieve the high pressure steam.

3.1.2.4 Valves for Radiators

Install a radiator valve on each radiator.

3.1.2.5 Safety Valves

Provide with drip pan elbows.

3.1.3 Pressure Gages

Install a shutoff valve or petcock between each pressure gage and the line, and gages on steam lines shall have a syphon installed ahead of the gage.

3.1.4 Thermometers

Provide thermometers and thermal sensing elements of control valves with a separable socket. Install separable sockets in pipe lines in such a manner to sense the temperature of the flowing fluid and minimize obstruction to flow.

3.1.5 Steam Meters

Provide steam meters with a suitable three-valve bypass to permit dismantling and inspection without interference with the service.

3.1.6 Strainers

Provide strainers with meshes suitable for the services where indicated, and where dirt might interfere with the proper operation of valve parts, orifices, and moving parts of equipment.

3.1.7 Equipment Foundations

Design equipment foundations of sufficient size and weight to provide isolation and to preclude shifting of equipment under operating conditions. Foundations shall meet the requirements of the equipment manufacturer. When required by the Contracting Officer, the equipment manufacturer's approval of the foundation design and construction for the equipment involved shall be obtained.

3.1.8 Equipment Installation

Install equipment as specified and in accordance with the manufacturer's installation instructions. Grout equipment mounted on concrete foundations before piping is installed. Install piping in such a manner as not to place a strain on any of the equipment. Do not bolt flanged joints tight unless they match. Adequately extend expansion bends before installation. Grade, anchor, guide, and support piping without low pockets.

3.1.9 Cleaning of System

As installations of the various system components are completed, clean before final closing. Remove foreign matter from equipment and surrounding areas. Preliminary or final tests shall not be performed until the cleaning is approved.

3.1.10 Cleaning and Painting of Piping and Equipment

**********

**NOTE: When the project specification does not have a section on field painting, the requirements for cleaning and painting of pipe and equipment,**

**contained in Section 09 90 00, PAINTS AND COATINGS, shall be included in this section.**
**********

Clean and paint piping and equipment in accordance with Section [09 90 00 PAINTS AND COATINGS].

3.1.11 Identification of Piping

Labels for pipes 20 mm 3/4 inch diameter and larger shall bear printed legends to identify contents of pipes and arrows to shown direction of flow. Labels shall have color coded background to signify levels of hazard in accordance with ASME A13.1. Legends and type and size of characters shall also conform as ASME A13.1. Make labels of plastic sheet CID A-A-1689 with pressure sensitivity suitable for the intended applications, or they may be premolded of plastic to fit over pipe. For pipe smaller than 20 mm 3/4 inch diameter, provide brass identification tags 40 mm 1 1/2 inches in diameter with legends in depressed black filled characters.

3.2 FIELD TESTS AND INSPECTIONS

**********
**NOTE: For Contractor Quality Control projects, include field inspections.**
**********

**********
**NOTE: Coordinate with Division 1 concerning the availability of water and electric power.**
**********

Field [inspections, field] tests, and trial operations specified in this section shall be performed by the Contractor. The Contractor shall provide gas, oil, labor, equipment, and incidentals required for testing[, except that in accordance with Division 1 the Government will provide water or electric power required for tests]. The Contractor shall give the Contracting Officer [_____] days' advance written notice of the dates and times scheduled for tests and trial operations.

3.2.1 Field Inspections

Inspect piping system prior to initial operation, for conformance to drawings, specifications, and ASME B31.1. Equipment, material, or work rejected because of defects or non-conformance with drawings, specifications, and ASME B31.1 shall be replaced or corrected by the Contractor, as directed by the Contracting Officer.

3.2.2 Field Tests

Conduct the following tests after completion of the piping installation and prior to initial operation.

3.2.2.1 Piping System

Test piping system hydrostatically using water not exceeding 38 degrees C 100 degrees F. Conduct tests in accordance with the requirements of ASME B31.1 and as follows. Test the piping system after the lines have been cleaned as herein specified and before any insulation covering has

been applied. Test piping system at 1 1/2 times the system pressure or 345 kPa (gage) 50 psig whichever is greater. Before performing tests, remove or valve off from the system, gages, traps, and other apparatus which may be damaged by the test pressure. Install a calibrated test pressure gage in the system to observe any loss in pressure. Maintain the required test pressure for a sufficient length of time to enable an inspection to be made of joints and connections. Perform tests after installation and prior to acceptance.

3.2.2.2 Start-Up and Operational Test

Start-up the system and initially operate with components operating. During the test, periodically clean the various strainers until no further accumulation of foreign material occurs. Exercise care so that minimum loss of [water] [steam] occur when strainers are cleaned. Adjust safety and automatic control instruments as necessary to place them in proper operation and sequence.

3.2.2.3 Extent of Field Tests

After installation and before acceptance, subject the work of this section to necessary field tests, including those herein specified, and in Section 23 05 93 TESTING, ADJUSTING, AND BALANCING FOR HVAC.

-- End of Section --