

SECTION 33 60 00.00 10

CENTRAL HIGH TEMPERATURE WATER (HTW) GENERATING PLANT AND AUXILIARIES

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.

ASME INTERNATIONAL (ASME)

ASME B1.20.1	(1983; R 2006) Pipe Threads, General Purpose (Inch)
ASME B16.11	(2005) Forged Fittings, Socket-Welding and Threaded
ASME B16.18	(2001; R 2005) Cast Copper Alloy Solder Joint Pressure Fittings
ASME B16.21	(2005) Nonmetallic Flat Gaskets for Pipe Flanges
ASME B16.26	(2006) Standard for Cast Copper Alloy Fittings for Flared Copper Tubes
ASME B16.3	(2006) Malleable Iron Threaded Fittings, Classes 150 and 300
ASME B16.34	(2004) Valves - Flanged, Threaded and Welding End
ASME B16.39	(1998; R 2006) Standard for Malleable Iron Threaded Pipe Unions; Classes 150, 250, and 300
ASME B16.5	(2003) Standard for Pipe Flanges and Flanged Fittings: NPS 1/2 Through NPS 24

ASME B16.9	(2007) Standard for Factory-Made Wrought Steel Buttwelding Fittings
ASME B31.1	(2007; Addenda 2008) Power Piping
ASME BPVC SEC I	(2007; Addenda 2008) Boiler and Pressure Vessel Code; Section I, Power Boilers
ASME BPVC SEC VIII D1	(2007; Addenda 2008) Boiler and Pressure Vessel Code; Section VIII, Pressure Vessels Division 1 - Basic Coverage
ASTM INTERNATIONAL (ASTM)	
ASTM A 106/A 106M	(2008) Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service
ASTM A 36/A 36M	(2008) Standard Specification for Carbon Structural Steel
ASTM A 53/A 53M	(2007) Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
ASTM A 568/A 568M	(2007a) Standard Specifications for Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements for
ASTM A 653/A 653M	(2008) Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
ASTM A 733	(2003) Standard Specification for Welded and Seamless Carbon Steel and Austenitic Stainless Steel Pipe Nipples

ASTM B 68	(2002) Standard Specification for Seamless Copper Tube, Bright Annealed
ASTM B 88	(2003) Standard Specification for Seamless Copper Water Tube
ASTM B 88M	(2005) Standard Specification for Seamless Copper Water Tube (Metric)
ASTM C 155	(1997; R 2007) Standard Specification for Insulating Firebrick
ASTM C 27	(1998; R 2008) Fireclay and High-Alumina Refractory Brick
ASTM C 34	(2003) Structural Clay Load-Bearing Wall Tile
ASTM C 401	(1991; R 2005) Alumina and Alumina-Silicate Castable Refractories
ASTM C 62	(2005) Building Brick (Solid Masonry Units Made from Clay or Shale)

EXPANSION JOINT MANUFACTURERS ASSOCIATION (EJMA)

EJMA Stds	(2003) EJMA Standards
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MANUFACTURERS STANDARDIZATION SOCIETY OF THE VALVE AND FITTINGS
INDUSTRY (MSS)

MSS SP-58	(2002) Standard for Pipe Hangers and Supports - Materials, Design and Manufacture
MSS SP-69	(2003; R 2004) Standard for Pipe Hangers and Supports - Selection and Application
MSS SP-70	(2006) Standard for Cast Iron Gate Valves, Flanged and Threaded Ends

MSS SP-71	(2005) Standard for Gray Iron Swing Check Valves, Flanged and Threaded Ends
MSS SP-80	(2003) Bronze Gate, Globe, Angle and Check Valves
MSS SP-85	(2002) Standard for Cast Iron Globe & Angle Valves, Flanged and Threaded Ends

1.2 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for information only. When used, a designation following the "G" designation identifies the office that will review the submittal for the Government. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

Shop Drawings

Boiler Tubes; G

Detail drawings showing as a minimum tube sizes, lengths, and bends.

Product Data

Manufacturer's design data and structural computations, as specified; G

Boiler Tube Material; G

Insulating Materials; G

Refractory Materials; G

Steel Casing Materials; G

Paint; G

Tests; G

Test procedure, as specified.

Welding Qualifications; G

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

R Stamp Certification; G

Test Reports

Tests; G

Test reports shall be submitted 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, upon completion and testing of the installed system. Each test report shall indicate the final

position of controls. The action settings for all automatic controls in the form of a typed, tabulated list indicating the type of control, location setting, and function shall be included. A written statement from the manufacturer's representative certifying that combustion control equipment has been properly installed and is in proper operating condition, upon completion of the installation.

1.3 QUALITY ASSURANCE

1.3.1 Welding Qualifications

Welding and nondestructive testing procedures are specified in Section 43 02 00 WELDING PRESSURE PIPING.

1.4 DELIVERY, STORAGE, AND HANDLING

All equipment delivered and placed in storage shall be stored with protection from the weather, humidity and temperature variation, dirt and dust, or other contaminants.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

2.1.1 Standard Products

Provide materials and equipment which are the standard products of a manufacturer regularly engaged in the manufacture of the products and that essentially duplicate items that have been in satisfactory use for at least 2 years prior to bid opening.

2.1.2 Nameplates

Secure to each major item of equipment a plate with the manufacturer's name, address, type or style, model or serial number, and catalog number.

2.1.3 Prevention of Rust

Unless otherwise specified, surfaces of ferrous metal subject to corrosion shall be factory prime painted with a rust inhibiting coating and subsequently factory finish painted in accordance with the manufacturer's standard practice. Equipment exposed to high temperature when in service shall be prime and finish painted with the manufacturer's standard heat resistant paint to a minimum thickness of 1 mil.

2.1.4 Equipment Guards and Access

Fully enclose or guard belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts exposed to personnel contact.

High temperature equipment and piping exposed to contact by personnel or where it creates a fire hazard shall be properly guarded or covered with insulation of a type specified. Provide items such as catwalks, operating platforms, ladders, and guardrails where shown.

2.1.5 Use of Asbestos Products

Products which contain asbestos are prohibited. This prohibition includes items such as packings or gaskets, even though the item is encapsulated or the asbestos fibers are impregnated with binder material.

2.2 HIGH TEMPERATURE WATER GENERATORS

Boiler #2 in F/34019 shall have the capacity indicated when operating with 340 degrees F entering water temperature and 400 degrees F outlet temperature with a water flow of 330 gpm. Boiler #2 shall be designed for a maximum allowable working pressure of 500 psig at 400 degrees F. The equipment design and accessory locations shall permit accessibility for maintenance and service.

2.3 HIGH TEMPERATURE WATER GENERATOR DETAILS

Mercury shall not be used in thermometers.

2.3.1 HTW Generators and Components

2.3.1.1 Headers

Headers are seamless steel ASTM A 106/A 106M, Grade B. Bottom portion of header at tube connection shall not be insulated. Method of tube attachment to headers shall be by strength welding in accordance with ASME BPVC SEC I.

2.3.1.2 Tubes

Tubes located in the primary furnace shall be designed for horizontal or upflow of water. The water shall be distributed to the heating surface in proportion to the heat absorbing capacities of these surfaces. Tube heat absorbing surfaces shall be located so that radiant and convection sections provide for series flow of water, from generator inlet to outlet, to ensure uniform water distribution and uniform temperature rise from inlet to outlet.

Where required, flow orifices shall be provided. Each orifice shall be protected from clogging by individual strainers or by the master strainer located in the HTW generator return line. If individual strainers are utilized, individual access openings for each strainer shall be provided. Access plugs, if used, shall be of the shoulder type with machined surface. The individual access openings shall be provided with stainless steel filled gaskets. All header gasket surfaces shall be machined to provide proper seating of gasket.

2.3.1.3 Baffles

Baffles shall be arranged to bring the products of combustion into contact with the heating surfaces. Baffles shall be either water-cooled or a refractory material or metal suitable for temperatures encountered. Steel plate or refractory baffles, if used, shall be provided with water cooling on the radiant heat (furnace) side. The generator's convection section shall have counterflow, water-to-gas, to provide an integral economizer arrangement for optimum heat absorption, gas-to-water. Draft loss shall be held to a minimum.

2.3.1.4 Furnace

Furnace shall be water-cooled and the combustion space shall be provided with water cooling on sidewalls, rear wall, roof, front, and floor, except the portion of the front wall section required for burner installation. The armor block shall be keyed and held in place without the use of bolts, pins, or mastic. The armor block shall be readily replaceable without the use of special tools.

2.3.2 HTW Generator Setting Materials

Materials shall conform to the following:

- a. Firebrick: ASTM C 27, class shall be as recommended by the HTW generator manufacturer.
- b. Insulating Brick: ASTM C 155, Class A.
- c. Castable Refractory: ASTM C 401. The minimum modulus of rupture for transverse strength shall not be less than 600 psi after being heat-soaked for 5 hours or more at a temperature in excess of 2500 degrees F.
- d. Mortar, Air-Setting, Refractory: As recommended by the HTW generator manufacturer.

- e. Brick, Common: ASTM C 62.
- f. Tile, Load-Bearing, Hollow: ASTM C 34, Grade LBX.
- g. Iron and Steel Sheets: Galvanized, ASTM A 653/A 653M; gauge numbers specified refer to United States Standard gauge. Uncoated, black: ASTM A 568/A 568M, or ASTM A 36/A 36M.

2.3.2.1 HTW Generator Casing

HTW generator walls shall be steel-encased wall construction with fabrication details as recommended by the HTW generator manufacturer. HTW generator wall, roof, and floor lining shall consist of a continuous screen of closely spaced water tubes. Casing for HTW generators shall be double wall construction. Reinforced, welded, gas-tight inner casing shall be constructed of 3/16" steel sheets. Outer casing shall be constructed of 12 gauge steel sheets. Outer casing may be either bolted or welded. Inner casing shall be reinforced with structural steel to provide rigidity and prevent buckling. Inner casing in furnace section shall abut furnace tubes with no foreign sealer between the tube steel and the casing steel. Casing shall not be attached to tubes. Each horizontal tube shall be supported independently of casing at intervals not exceeding 6 feet. The inner casing shall be applied so as to form expansion joints at the point of tube support. Where refractory is installed at access doors, the double casing shall be constructed to form a gas-tight seal and at no point shall combustion gases be able to enter between inner and outer casing. Block insulation shall be applied between the inner and outer casings and held securely with insulating pins.

2.3.2.2 Walls

Refractory behind the waterwall tubes shall be high-duty refractory not less than 2-1/2 inches thick conforming to manufacturer's requirements. High temperature block and mineral wool blanket shall be provided between the refractory backup and steel casing or between an inner and outer casing. Thickness of insulation shall be such that an average casing temperature in the furnace area will not exceed 130 degrees F with a surface air velocity of 100 fpm, and an ambient air temperature of 80 degrees F when operating at full capacity.

2.3.2.3 HTW Generator Roof

Refractory lining conforming to manufacturer's requirements shall consist of not less than 2-1/2 inches of high-duty refractory backup behind the roof tubes and sufficient thickness of high temperature block insulation or

mineral-wool blanket suitable for the temperature encountered to limit casing temperature in the furnace area to 130 degrees F, with a surface air velocity of 100 fpm and an ambient air temperature of 80 degrees F when operating at full capacity. Manholes and other inspection and access openings, and identification plates and stamps shall have insulation finished neatly against a metal ring provided for this purpose.

2.3.2.4 Expansion Joints

Expansion joints shall be provided where indicated and elsewhere as required to permit all brickwork to expand freely without interference with the boiler. Joints shall be of adequate width, tightly sealed against leakage and free from mortar, with the outer 4 inches sealed with resilient mineral wool suitable for 1700 to 2000 degrees F. In addition, to allow for expansion of the inner face, a series of 1/8 inch wide vertical openings, spaced 6 feet apart, shall be provided on the furnace side of the wall. Proper provision shall be made for expansion and contraction between boiler foundation and floor as specified.

2.3.2.5 Firebrick

Firebrick shall be laid up in air-setting mortar. Each brick shall be dipped in mortar, rubbed, shoved into its final place, and then tapped with a wooden mallet until it touches the adjacent bricks. Mortar thick enough to lay with a trowel shall not be permitted. Maximum mortar joint thickness shall not exceed 1/8 inch and average joint thickness shall not exceed 1/16 inch.

2.3.2.6 Plastic Refractory

Plastic refractory shall be installed in accordance with the manufacturer's recommendation and by workmen skilled in its application.

2.3.3 Boiler Fittings and Appurtenances

HTW generator fittings and appurtenances suitable for a HTW working pressure of 500 psig and 450 degrees F shall be installed with each HTW generator in accordance with ASME BPVC SEC I.

2.3.3.1 Drain Valves

Drain valves in tandem shall be provided at each drain point of blowdown as recommended by the HTW generator manufacturer. Piping shall conform to the requirements of ASME BPVC SEC I and shall be extra strong weight black steel

pipe conforming to ASTM A 53/A 53M. Drain valves shall conform to ASME BPVC SEC I and shall be the balanced seatless type unless otherwise approved.

2.4 PIPING

Unless otherwise specified herein, pipe and fittings shall conform to the requirements of ASME B31.1.

2.4.1 Pipe

Pipe material shall be as specified in TABLE I.

2.4.2 Fittings

Pipe fittings shall be as specified in TABLE II.

2.4.3 Nipples

Nipples shall conform to ASTM A 733, Type I or II, as required to match adjacent piping.

2.4.4 Unions

Unions shall conform to ASME B16.39, type as required to match adjacent piping.

2.4.5 Pipe Threads

Pipe threads shall conform to ASME B1.20.1, right- or left-hand tapered thread as required.

2.4.6 Pipe Expansion

2.4.6.1 Expansion Joints

Expansion joints shall be designed for a HTW working pressure not less than 500 psig and shall be in accordance with applicable requirements of ASME B31.1 and EJMA Stds. End connections shall be flanged. Type II joints shall be suitable for repacking under full line pressure.

2.4.7 Valves

Valves shall be installed at all indicated locations, where specified, and where required for proper functioning and servicing of the system.

2.4.7.1 Check Valves

- a. Valves for 125 pound class steel piping shall conform to the following:
 - (1) Sizes 2-1/2 inches and less, bronze: MSS SP-80, Type 3 or 4, Class 125.
 - (2) Sizes 3 inches through 24 inches, cast-iron: MSS SP-71, Type III or IV, Class 125.
- b. Valves for 150 pound class steel piping shall conform to the following:
 - (1) Sizes 2-1/2 inches and less, bronze: MSS SP-80, Class 150 minimum.
 - (2) Sizes 3 inches through 24 inches, steel: ASME B16.34, Class 150 minimum, flanged ends, swing disc.
- c. Valves for 300 pound class steel piping shall conform to the following:
 - (1) Sizes 2-1/2 inches and less, steel: ASME B16.34, Class 300 minimum.
 - (2) Sizes 3 inches through 24 inches, steel: ASME B16.34, Class 300 minimum flanged ends, swing disc.

2.4.7.2 Gate Valves

Unless otherwise indicated or specified, gate valves used as shutoff valves at main headers and elsewhere, as indicated, shall be the chain-operated type and shall have sufficient chain for easy operation from the operating floor or walkway. Gate valves 8 inches and larger shall be provided with a globe valve bypass. Gate valves shall be the wedge disc type with outside screw and yoke and bonnet bushings. Valve body shall have straight-through ports without recesses except between seats to assure minimum turbulence, erosion, and resistance to flow. Motor-operated gate valves shall be installed in the HTW supply and return mains, where indicated, to isolate the distribution zones from the plant in case of a line break. The valves shall be closed by a pressure switch operated by return main water pressure. The pressure switch shall be the Bourdon tube, actuated mercury switch type with an adjustable operating range of 50 to 350 psi. A three-position selector switch shall also be provided for automatic or manual operation of the valve position.

- a) Valves for 125 pound class steel piping shall conform to the following:
 - (1) Sizes 2-1/2 inches and less, bronze: MSS SP-80, Type 1 or 2, Class 125.
 - (2) Sizes 3 inches through 48 inches, cast-iron: MSS SP-70, Type I, Class 125, Design OT or OF (OS&Y), bronze trim.

b) Valves for 150 pound class steel piping shall conform to the following:

- (1) Sizes 2-1/2 inches and less, bronze: MSS SP-80, Type 1 or 2, Class 150 minimum.
- (2) Sizes 3 inches through 24 inches, steel: ASME B16.34, Class 150 minimum, flanged ends.

c) Valves for 300 pound class steel piping shall conform to the following:

- (1) Sizes 2-1/2 inches and less, steel: ASME B16.34, Type 1 or 2, Class 300 minimum.
- (2) Sizes 3 inches through 24 inches, steel: ASME B16.34, Class 300 minimum, flanged ends.

2.4.7.3 Globe Valves and Angle Valves

Globe type valves shall have outside screw and yoke with bolted bonnets, stainless steel trim, and flat seats, but shall not be the reversed cup type. The stuffing boxes shall be large and deep. Valves shall be installed with the stem horizontal or above. A distribution system bypass motor-operated globe-valved piping connection between the supply and return mains, where required, shall be installed to ensure uninterrupted water flow to the HTW generator in case of low return pressure. In operation, valve shall modulate to the open position on low return main pressure signal. A three position selector switch shall be provided for automatic or manual selection of valve position. For each distribution zone, a manually-operated handwheel or chainwheel globe valve shall be installed in each high temperature return main to control the flow and the resultant differential temperature drop through each system.

a. Valves for 125 pound class steel piping shall conform to the following:

- (1) Sizes 2-1/2 inches and less, bronze: MSS SP-80, Type 1, 2, or 3, Class 125.
- (2) Sizes 3 inches through 12 inches, cast-iron: MSS SP-85, Type III and Type IV, Class 125.

b. Valves for 150 pound class steel piping shall conform to the following:

- (2) Sizes 2-1/2 inches and less, bronze: MSS SP-80, Type 1, 2, or 3, Class 150 minimum.
- (2) Sizes 3 inches through 24 inches, steel: ASME B16.34, Class 150 minimum, flanged ends.

c. Valves for 300 pound class steel piping shall conform to the following:

- (3) Sizes 2-1/2 inches and less, steel: ASME B16.34, Type 1, 2, or 3, Class 300 minimum.

- (2) Sizes 3 inches through 24 inches, steel: ASME B16.34, Class 300 minimum, flanged ends.

2.4.8 Pipe Hangers, Inserts, and Supports

Pipe hangers, inserts, and supports shall conform to MSS SP-58 and MSS SP-69, except as modified herein.

2.4.8.1 Types 5, 12, and 26

Types 5, 12, and 26 shall not be used.

2.4.8.2 Type 3

Type 3 shall not be used on insulated pipe which has a vapor barrier. Type 3 may be used on insulated pipe that does not have a vapor barrier if clamped directly to the pipe and if the clamp bottom does not extend through the insulation and the top clamp attachment does not contact the insulation during pipe movement.

2.4.8.3 Type 18

Type 18 inserts shall be secured to concrete forms before concrete is placed. Continuous inserts which allow more adjustment may be used if they otherwise meet the requirements for Type 18 inserts.

2.4.8.4 Types 19 and 23

Types 19 and 23 C-clamps shall be torqued in accordance with MSS SP-69 and have both locknuts and retaining devices furnished by the manufacturer. Field-fabricated C-clamp bodies or retaining devices are not acceptable.

2.4.8.5 Type 20

Type 20 attachments used on angles and channels shall be furnished with an added malleable-iron heel plate or adapter.

2.4.8.6 Type 24

Type 24 may be used only on trapeze hanger systems or on fabricated frames.

2.4.8.7 Type 39 Saddle or Type 40 Shield

Where Type 39 saddle or Type 40 shield is permitted for a particular pipe attachment application, the Type 39 saddle shall be used on all pipe 4 inches and larger.

2.4.8.8 Horizontal Pipe Supports

Horizontal pipe supports shall be spaced as specified in MSS SP-69 and a support shall be installed not over 1 foot from the pipe fitting joint at each change in direction of the piping. Pipe supports shall be spaced not over 5 feet apart at valves. 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 any of the individual pipes in the multiple pipe run. The clips or clamps shall be rigidly connected to the common base member. A clearance of 1/8 inch shall be provided between the pipe and clip or clamp for all piping which may be subjected to thermal expansion.

2.4.8.9 Vertical Pipe Supports

Vertical pipe shall be supported at each floor, except at slab-on-grade, and at intervals of not more than 15 feet not more than 8 feet from end of risers, and at vent terminations.

2.4.8.10 Type 35 Guides with Slides

Type 35 guides using steel, reinforced polytetrafluoroethylene (PTFE) or graphite slides shall be provided, where required, to allow longitudinal pipe movement. Lateral restraints shall be provided as required. Slide materials shall be suitable for the system operating temperatures, atmospheric conditions, and bearing loads encountered.

- a) Where steel slides do not require provisions for restraint of lateral movement, an alternate guide method may be used. On piping 4 inches and larger, a Type 39 saddle may be welded to the pipe and freely rest on a steel plate. On piping under 4 inches, a Type 40 protection shield may be attached to the pipe or insulation and freely rest on a steel slide plate.
- b) Where there are high system temperatures and welding to piping is not desirable, then the Type 35 guide shall include a pipe cradle, welded to the guide structure and strapped securely to the pipe. The pipe shall be separated from the slide material by at least 4 inches, or by an amount adequate for the insulation, whichever is greater.

2.4.8.11 Pipe Hangers on Horizontal Insulated Pipes

Pipe hangers on horizontal insulated pipes, except Type 3, shall be the size of the outside diameter of the insulation.

2.5 INSULATION

Shop and field applied insulation shall be as specified in Section 23 07 00 THERMAL INSULATION FOR MECHANICAL SYSTEMS.

PART 3 EXECUTION

3.1 EXAMINATION

After becoming familiar with all details of the work, verify all dimensions in the field, and advise the Contracting Officer of any discrepancy before performing the work.

3.2 ERECTION OF BOILER AND AUXILIARY EQUIPMENT

Boiler and auxiliary equipment shall be installed as indicated and in accordance with manufacturers' instructions.

3.3 PIPING INSTALLATION

Pipe shall be cut accurately to measurements established at the jobsite, shall be installed without cold springing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to facilitate piping installation will not be permitted. Piping shall be free of burrs, oil, grease, and other foreign matter. Piping shall be installed to permit free expansion and contraction without damaging building structure, pipe, joints, or hangers. Changes in direction shall be made with fittings, except that bending of pipe 4 inches and smaller will be permitted provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall not be less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations will not be accepted. Carbon steel piping to be bent shall conform to ASTM A 53/A 53M, Grade A, standard, or Grade B extra-heavy weight. Vent pipes shall be carried through the roof and shall be properly flashed. Unless otherwise indicated, horizontal supply mains shall pitch down in the direction of flow with a grade of not less than 1 inch in 40 feet. Open ends of pipelines and equipment shall be properly capped or plugged during installation to keep dirt or other foreign materials out of the systems. Pipe not otherwise

specified shall be uncoated. Unless otherwise specified or shown, connections to equipment shall be made with malleable-iron unions for steel pipe 2-1/2 inches or less in diameter and with flanges for pipe 3 inches or more in diameter. Unions for copper pipe or tubing shall be brass or bronze. Connections between ferrous piping and copper piping shall be electrically isolated from each other with dielectric couplings or other approved methods. Reducing fittings shall be used for changes in pipe sizes. In horizontal HTW lines, reducing fittings shall be eccentric type to maintain the top of the lines at the same level.

3.3.1 Pipe Joints

Joints between sections of pipe and fittings shall be welded or flanged on all HTW piping. On auxiliary piping, except as otherwise specified, fittings 1 inch and smaller shall be threaded; fittings 1-1/4 inches up to, but not including, 2-1/2 inches may be either threaded or welded; and fittings 2-1/2 inches and larger shall be either flanged or welded. Pipe and fittings 1-1/4 inches and larger installed in inaccessible conduits or trenches beneath concrete floor slabs shall be welded. Connections to equipment shall be made with black malleable-iron unions for pipe 2 inches or smaller in diameter, and with flanges for pipe 2-1/2 inches or larger in diameter.

3.3.1.1 Threaded Joints

Threaded joints shall be made with tapered threads properly cut and shall be made perfectly tight with a stiff mixture of graphite and oil, or polytetrafluoroethylene tape or equal, applied to the male threads only, and in no case to the fittings.

3.3.1.2 Welded Joints

Welded joints shall be fusion welded in accordance with ASME B31.1, unless otherwise required. 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 acceptable. Branch connections may be made with either welding tees or forged branch outlet fittings, either being acceptable without size limitation. Branch outlet fittings, where used, shall be forged, flared for improvement flow where attached to the run, reinforced against external strains, and designed to withstand full pipe bursting strength.

- a) Beveling: Field and shop bevels shall be in accordance with the

recognized standards and shall be done by mechanical means or flame cutting. Where beveling is done by flame cutting, surfaces shall be cleaned of scale and oxidation before welding.

- b) b. Alignment: Before welding, the component parts to be welded shall be aligned so that no strain is placed on the weld when finally positioned. Height shall be so aligned that no part of the pipe wall is offset by more than 20 percent of the wall thickness. Flanges and branches shall be set true. This alignment shall be preserved during the welding operation. If tack welds are used, welds shall be of the same quality and made by the same procedure as the completed weld; otherwise, tack welds shall be removed during the final welding operation.
- c) Erection: Where the temperature of the component parts being welded reaches 32 degrees F or lower, the material shall be heated to approximately 100 degrees F for a distance of 3 feet on each side of the weld before welding, and the weld shall be finished before the materials cool to 32 degrees F.
- d) Defective Welding: Defective welds shall be removed and replaced. Repairing of defective welds shall be in accordance with ASME B31.1.
- e) Electrodes: 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.

3.3.1.3 Flanges and Unions

Flanges and unions shall be faced true, and made square and tight. Gaskets shall be nonasbestos compressed material in accordance with ASME B16.21, 1/16 inch thickness, full-face or self-centering flat ring type. The gaskets shall contain aramid fibers bonded with styrene butadiene rubber (SBR) or nitrile butadiene rubber (NBR). NBR binder shall be used for hydrocarbon service. Union or flange joints shall be provided in each line immediately preceding the connection to each piece of equipment or material requiring maintenance such as coils, pumps, control valves, and other similar items.

3.3.2 Supports

3.3.2.1 General

Hangers used to support piping 2 inches and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. Pipe guides and anchors shall be installed to keep pipes in accurate alignment, to direct the expansion movement, and to prevent buckling, swaying, and undue strain. Piping subjected to vertical movement, when operating temperatures exceed ambient temperatures, shall be supported by variable spring hangers and supports or by constant support hangers.

3.3.2.2 Structural Reinforcements

Structural steel reinforcements required to support piping, headers, and equipment, but not shown, shall be provided under this section.

3.3.3 Anchors

Anchors shall be provided wherever necessary, or indicated, to localize expansion or prevent undue strain on piping. Anchors shall consist of heavy steel collars with lugs and bolts for clamping and attaching anchor braces, unless otherwise indicated. Anchor braces shall be installed in the most effective manner to secure the desired results, using turnbuckles where required. Supports, anchors, or stays shall not be attached where they will injure the structure or adjacent construction during installation or by the weight of expansion of the pipeline.

3.3.4 Valves

Gate valves and globe valves shall be installed with the stem horizontal or above. Swing check valves shall be installed in horizontal piping with the cap or bonnet up, or in vertical piping with the flow upward. Lift or piston check valves shall always be installed in horizontal piping with the cap or bonnet up.

3.4 FIELD PAINTING AND COATING

Except as otherwise specified, ferrous metal shall be cleaned, prepared, and painted. Buried steel shall be given a protective coating as specified by COR. Exposed pipe covering shall be painted. Aluminum sheath over insulation shall not be painted.

3.5 TESTS

The Contractor shall submit the proposed performance test procedure for required tests, 30 days prior to the proposed test date, containing a

complete description of the proposed test, along with calibration curves or test results furnished by an independent testing laboratory of each instrument, meter, gauge, and thermometer to be used in the tests. The test shall not commence until the procedure has been approved. The Contractor's complete plan for water treatment, including proposed chemicals to be used and nationally recognized testing codes applicable to the system, shall be submitted prior to system startup.

3.5.1 Hydrostatic Tests

Following erection, each HTW generator shall be tested hydrostatically and proved tight under a gauge pressure of 1.5 times the specified working pressure. Following the installation of all piping and boiler house equipment, but before the application of any insulation, hydrostatic tests shall be made and the system proved tight under gauge pressures of 1.5 times the specified working pressure. Tests shall be made under the direction of, and subject to, the approval of the Contracting Officer. The Contractor shall adjust all equipment and controls before the scheduled operational test. A testing schedule shall be submitted at least 5 days before scheduled test.

3.5.1.1 Water Sides Including Fittings and Accessories

Water sides shall be hydrostatically tested in accordance with the requirements of ASME BPVC SEC I and ASME BPVC SEC VIII D1 as applicable. The ASME stamp will be accepted as evidence of this test.

3.6 CLEANING OF HTW GENERATORS AND PIPING

3.6.1 HTW Generator Cleaning

After the hydrostatic tests have been made, and before performance of the operating tests, the boilers shall be thoroughly and effectively cleaned of foreign materials. Wherever possible, surfaces in contact with water shall be wire brushed to remove loose material. The Contractor may use the following procedure or may submit his own standard procedure for review and approval by the Contracting Officer. HTW generators shall be filled with a solution consisting of the following proportional ingredients for every 1000 gallons of water, and operated at approximately 30 to 50 psig for a period of 24 to 48 hours:

- a) Use 24 lb. caustic soda; 8 lb. sodium nitrate; 24 lb. disodium phosphate, anhydrous; and 1/2 lb. approved wetting agent.
- b) Chemicals in the above proportions, or as otherwise approved, shall be thoroughly dissolved in the water before being placed in the HTW generator. After the specified boiling period, the boilers shall be allowed to cool, and then drained and thoroughly flushed. Piping shall be cleaned by operating the HTW generators for a period of approximately 48 hours.

Note 1: No bending of pipe will be permitted. Crosses with pipe plugs at connection shall be provided by contractor.

Note 2: Extra Strong (XS) minimum weight. Conform to ASME B31.1 for wall thickness.

-- End of Section --