

SECTION 15D

HOT WATER HEATING SYSTEM: OIL OR GAS FIRED

1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Federal Specifications (Fed. Spec.):

F-F-300B	Filter, Air Conditioning: Viscous Impingement and Dry Types, Cleanable
CC-M-1807	Motors, Alternating Current, Fractional and Integral Horsepower (500 Hp and Smaller)
GG-G-76E & Am-1	Gages, Pressure and Vacuum, Dial Indicating (for Air, Steam, Oil, Water, Ammonia, Chloro-Fluoro Hydrocarbon Gases, and Compressed Gases)
GG-T-321D & Am-2	Thermometers, Self-Indicating, Liquid-in-Glass for Machinery and Piping Systems
HH-P-46E	Packing; Asbestos, Sheet, Compressed
QQ-B-654A	Brazing Alloys, Silver
QQ-S-571E & Am-2	Solder, Tin Alloy: Tin-Lead Alloy; and Lead Alloy
QQ-S-775E & Int Am-1	Steel Sheets, Carbon, Zinc-Coated (Galvanized) by the Hot-Dip Process
VV-F-815D	Fuel Oil, Burner
WW-F-406D	Flanges, Cast-Iron (Classes 125 and 250) and Bronze (Classes 150 and 300)
WW-N-351C & Int Am-1	Nipples, Pipe, Threaded
WW-P-406D & Int Am-1	Pipe, Steel (Seamless and Welded) (for Ordinary Use)
WW-P-501E	Pipe Fittings, Cast Iron, Screwed 125 and 250 Pound
WW-P-521G	Pipe Fittings, Flange Fittings, and Flanges: Steel and Malleable Iron (Threaded and Butt-Welding) Class 150
WW-T-799F	Tube, Copper, Seamless, Water (for Use with Solder- Flared- or Compression-Type Fittings)

WW-U-511E Unions, Pipe, Steel or Malleable Iron;
Threaded Connection, 150 Lb and 250 Lb

WW-V-51F Valve, Angle, Check, and Globe, Bronze
(125, 150 and 200 Pound) Threaded End,
Flange Ends, Solder Ends, and Brazed
End, for Land Use

WW-V-54D Valve, Gate, Bronze (125, 150 and 200
& Int Am-3 Pound, Threaded Ends, Flange Ends, Solder
Ends and Brazed Ends, for Land Use)

WW-V-58B Valves, Gate, Cast Iron; Threaded and
Flanged (for Land Use)

Federal Standard (Fed. Std.):

H28 Screw-Thread Standards for Federal Services
& Suppl 1A

1.3 Military Specifications (Mil. Spec.):

MIL-S-16293G Strainers, Sediment: Pipeline, Water, Air,
Gas, Oil, or Steam

MIL-B-17228D Boilers, Steam, High and Low Pressure:
Forced-Circulation, Packaged Type (500 to
10,350 Pounds Per Hour)

MIL-T-27730A Tape, Antiseize, Polytetrafluoroethylene,
with Dispenser

American Boiler Manufacturers Association (ABMA) Publication:

Packaged Firetube Boiler Ratings (1978)

Air Movement and Control Association, Inc. (AMCA) Publication:

210-74 Laboratory Methods of Testing Fans for
Rating Purposes

American National Standards Institute, Inc. (ANSI) Standards:

B16.1-1975 Cast Iron Pipe Flanges and Flanged
Fittings, Class 25, 125, 250 and 800

B16.4-1977 Cast Iron Threaded Fittings Class 125
and 250

B16.5-1981 Pipe Flanges and Flanged Fittings

B16.9-1978 Factory-Made Wrought Steel Buttwelding
& Errata Fittings
& B16.9a-1981

B16.11-1980	Forged Steel Fittings, Socket-Welding and Threaded
B16.18-1978	Cast Copper Alloy Solder-Joint Pressure Fittings
B16.22-1980	Wrought Copper and Copper Alloy Solder Joint Pressure Fittings
B16.26-1975	Cast Copper Alloy Fittings for Flared Copper Tubes
B19-1938	Safety Code for Compressed Air Machinery and Equipment
B31.1-1980 & B31.1a-1980 & B31.1b-1981 & B31.1c-1981 & B31.1d-1982	Power Piping
Z21.13-1977 & Z21.13a-1979 & Z21.13b-1979	Gas-Fired Low-Pressure Steam and Hot Water Heating Boilers
Z21.52-1971 & Z21.52a-1973	Gas-Fired Single Firebox Boilers
Z83.3-1971 & Z83.3a-1972 & Z83.3b-1976	Gas Utilization Equipment in Large Boilers

American Society of Mechanical Engineers (ASME) Publications:

Boiler and Pressure Vessel Code and Interpretations:

Section IV	Heating Boilers (1980; Addenda: Summer & Winter 1980; Summer & Winter 1981; Summer & Winter 1982)
Section VIII	Pressure Vessels, Division 1 (1980; Addenda: Summer & Winter 1980; Summer & Winter 1981; Summer 1982 with Suppl & Winter 1982)
Section IX	Welding and Brazing Qualifications (1980; Addenda: Summer & Winter 1980; Summer & Winter 1981; Summer & Winter 1982)

American Society for Testing and Materials (ASTM) Publications:

A 53-82	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
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- A 120-82 Pipe, Steel, Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless, for Ordinary Uses
- A 234-82a Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures
- A 366-72 Steel, Carbon, Cold-Rolled Sheet, (R 1979) Commercial Quality
- A 516-82 Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service
- D 635-81 Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- D 1248-81a Polyethylene Plastics Molding and Extrusion Materials
- D 1693-70 Environmental Stress-Cracking of (R 1980) Ethylene Plastics

American Welding Society (AWS) Publication:

- D1.1 Structural Welding Code - Steel

1.9 American Water Works Association (AWWA) Standard:

- C203-78 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines--Enamel and Tape--Hot-Applied

The Hydronics Institute (HI) Publication:

- I=B=R and SBI Testing and Rating Standard for Cast Iron and Steel Heating Boilers (January 1980)

1.11 Manufacturers Standardization Society of the Valve and Fittings Industry (MSS) Publications:

- SP-58 Pipe Hangers and Supports - Materials, Design and Manufacture (1975)
- SP-69 Pipe Hangers and Supports - Selection and Application (1976)

National Fire Protection Association (NFPA) Standards:

- No. 31-1978 Installation of Oil Burning Equipment
- No. 54-1980 National Fuel Gas Code
- No. 211-1980 Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances

Steel Structures Painting Council (SSPC) Specifications:

SSPC-SP 6-82	Commercial Blast Cleaning
SSPC-SP 8-82	Pickling
SSPC-Paint 16-82	Coal Tar Epoxy-Polyamide Black (or Dark Red) Paint
SSPC-PS 10.01-82	Hot Applied Coal Tar Enamel Painting System

Underwriters Laboratories, Inc. (UL) Standards:

UL 296	Oil Burners (Aug 22, 1980, 7th Ed.; Rev Aug 25, 1980)
UL 726	Oil-Fired Boiler Assemblies (Oct 13, 1975, 5th Ed. Rev thru Aug 15, 1980)
UL 795	Commercial-Industrial Gas-Heating Equipment (Apr 1, 1973; Errata, Apr 1, 1973; Rev thru Feb 26, 1982)

Gas and Oil Equipment Directory (Sep 1980 with Quarterly Supplements)

2. GENERAL:

2.1 Conformance with Agency Requirements: Where materials or equipment are specified to conform to the requirements of agencies such as the Underwriters Laboratories, Inc. (UL); American National Standards Institute (ANSI); The Hydronics Institute (HI) (formerly SBI and IBR); and American Boiler Manufacturers Association (ABMA), the Contractor shall submit proof of such conformance. The label or listing of the specified agency will be acceptable evidence. In lieu of the label or listing, the Contractor may submit a written certificate from any nationally recognized testing organization adequately equipped and competent to perform such services, stating that the items have been tested and that the units conform to the requirements, including methods of testing, of the specified agency. Where equipment is specified to conform to requirements of the ASME Boiler and Pressure Vessel Code, the design, fabrication, testing, and installation shall conform to the code in every respect.

2.2 Nameplates: Each major item of equipment shall have the manufacturer's name, address, and catalog number on a plate securely attached to the item. Additional nameplate data for boilers shall be as hereinafter specified.

2.3 Safety Requirements: Belts, pulleys, chains, gears, couplings, projecting setscrews, keys, and other rotating parts so located that any person can come in close proximity thereto, shall be fully and properly guarded. Equipment and piping so located as to endanger personnel or create a fire hazard shall be properly guarded or covered with insulation of a type specified in SECTION: THERMAL INSULATION FOR MECHANICAL SYSTEMS.

Items such as catwalks, ladders, operating platforms and guardrails shall be provided where indicated and shall be constructed in accordance with SECTION: MISCELLANEOUS METAL.

2.4 Verification of Dimensions: The contract drawings show the extent and general arrangement of the heating system. The Contractor shall visit the premises to become thoroughly familiar with all details of the work and working conditions and verify all dimensions in the field, and shall advise the Contracting Officer of any discrepancy before performing any work. The Contractor shall be specifically responsible for the coordination and proper integration of the work of all trades. Materials and equipment shall fit into the space allotted without interference with building features or other equipment and with adequate clearance allowed for entry, operation and maintenance.

3. MATERIALS AND EQUIPMENT shall conform to the respective publications and other requirements specified below. Other materials and equipment shall be as specified elsewhere herein and as shown on the drawings, and shall be the products of manufacturers regularly engaged in the manufacture of such products. Materials and equipment shall essentially duplicate items that have been in satisfactory use at least 2 years prior to bid opening, and shall be supported by a service organization that is, in the opinion of the Contracting Officer, reasonably convenient to the site.

3.1 Filters for Air Conditioning: Fed. Spec. F-F-300.

3.2 Motors:

3.2.1 Fractional Horsepower: Fed. Spec. CC-M-1807, Type I, Class I, Style 1 or 2, or Style B. Polyphase motors shall be Type II, Class 3. All motors shall be continuous duty with the enclosure as specified.

3.2.2 Integral Horsepower: Fed. Spec. CC-M-1807, Type II, continuous duty, and with enclosure as specified.

3.3 Pipe, Pipe Fittings, Materials and Tubing:

3.3.1 Pipe and Fittings:

3.3.1.1 Cast-Iron Flanges and Flanged Fittings: Fed. Spec. WW-F-406, Class 125 or 250 as required to match adjacent piping for flanges; ANSI B16.1 as required to match adjacent piping for flanged fittings.

3.3.1.2 Cast Iron Pipe Fittings: ANSI B16.4, Class 125 standard weight pipe and Class 250 extra strong pipe. Fed. Spec. WW-P-501, Class 125 or 250 as hereinafter specified, type as required to match adjacent piping.

3.3.1.3 Copper Tubing and Fittings: Fed. Spec. WW-T-799, Type K or L. Fittings shall conform to ANSI B16.22. Solder type shall conform to ANSI B16.18 and B16.26 for flared tubing.

3.3.1.4 Malleable-Iron Pipe Fittings: Fed. Spec. WW-P-521, type as required to match adjacent piping.

3.3.1.5 Nipples: Fed. Spec. WW-N-351, Type I or II as required to match adjacent piping.

3.3.1.6 Steel or Iron Pipe: ASTM A 53, Grade A, standard or extra strong weight, black; or ASTM A 120, standard or extra strong weight, black; or Fed. Spec. WW-P-406, Weight A, Class 1.

3.3.1.7 Steel Pipe Fittings: Fed. Spec. WW-P-521, Type I or II as specified; ASTM A 234, Grade A, for welding fittings. Butt-welding fittings shall conform to ANSI B16.9, and forged steel socket-welding fittings shall conform to ANSI B16.11. Flanged fittings shall conform to ANSI B16.5. As an option, convoluted cold-formed steel flanges conforming to Section VIII of ASME Boiler and Pressure Vessel Code in lieu of ANSI B16.5 standard steel flanges may be provided. Convoluted flange material shall conform to ASTM A 516. Flanges shall mate with ANSI B16.5, class 150 flanges. Installation and gasketing of flanges and flange joints shall be in accordance with the manufacturer's recommendations.

3.3.1.8 Unions: Fed. Spec. WW-U-531, type as required to match adjacent piping.

3.3.1.9 Solder: Fed. Spec. QQ-S-571 Composition Sn50 for cold water and silver solder Fed. Spec. QQ-B-654, Grade III for steam and condensate.

3.3.2 Packing, Asbestos: Fed. Spec. HH-P-46.

Pipe Supports: MSS SP-58 and SP-69.

3.3.4 Pipe Threads: Fed. Std. H28, right-hand or left-hand, tapered thread, as required.

3.3.5 Strainers: Mil. Spec. MIL-S-16293, Type I or II, Style Y, Class 125.

3.3.6 Tape, Antiseize, for Threaded Pipe Joints: Mil. Spec. MIL-T-27730.

3.4 Pressure Gages: Fed. Spec. GG-G-76, Type I, Class 1 or 2, as applicable, style as required, suitable for pressure or vacuum specified, with minimum 6-inch diameter dial, except as otherwise specified.

3.5 Sheet Steel: The gage numbers specified hereinafter are United States Standard Gage.

3.5.1 Galvanized Sheet Steel: Fed. Spec. QQ-S-775, Class d.

3.5.2 Uncoated Black Sheet Steel: ASTM A 366.

3.6 Thermometers: Fed. Spec. GG-T-321, Type I, Class 3, Range c, Style 3, 7-inch length and form to suit application.

Valves:

3.7.1 Manual air vents shall be brass or bronze valves or cocks suitable for 125 psig service.

3.7.2 Check Valves: Fed. Spec. WW-V-51, Type III or IV, Class A. Iron-body check valves in sizes above 3 inches shall be the swing type designed for 125 pounds of steam working pressure. All check valves shall have renewable composition disks or shall have metallic disks of the regrinding type to permit regrinding without removing valve from the line. End connection and sizes shall be as required to match connecting piping. regrinding type to permit regrinding without removing valve from the line. End connection and size shall be as required to match connecting piping.

3.7.3 Gate Valves: Sizes 3 inches or less, Fed. Spec. WW-V-54, Class A; end connection and size as required, 2-inch size, Fed. Spec. WW-V-58, Type I, Class 1, non-rising stem, screwed ends; over 3-inch size, Fed. Spec. WW-V-58, Type I, Class 1, outside screw and yoke, screwed or flanged ends as required.

3.7.4 Balancing Flow Control Valves: The Contractor shall provide automatic flow control valves to maintain constant flow, designed to be sensitive to pressure differential across the valve to provide the required opening. The valve shall be selected for the flow required and provided with a permanent tag carrying a permanent record of the factory-determined flow rate and flow control pressure levels. The valve shall control the flow within 5 percent of the tag rating. The valve shall be suitable for the maximum operating pressure of 125 psi or 150 percent of the system operating pressure, whichever is the greater. Where the available system pressure is not adequate to provide the minimum pressure differential that still allows flow control, the system pump head capability shall be increased, and the cost of the increase shall be borne by the Contractor. The valve body shall be provided with tapped openings and pipe extensions with shut-off valves outside of pipe insulation. The pipe extensions shall be provided with quick connecting hose fittings for a portable meter to measure the pressure differential across the automatic flow control valve. The Contractor shall provide one portable meter with necessary accessory kit recommended for the project by the automatic valve manufacturer. The flow meter and flow control valve manufacturer or his authorized agent shall furnish a certificate to the effect that the system is hydronically balanced within plus or minus 5 percent of specified flows. The hydronic balancing tests shall be performed in the presence of the Contracting Officer.

4. APPROVAL OF MATERIALS AND EQUIPMENT: Within 60 days of receipt of notice to proceed, and before starting installation of any material or equipment, the Contractor shall submit to the Contracting Officer for approval, in triplicate, layout drawings of the boiler and equipment rooms and lists of materials and equipment to be incorporated in the work. The layout drawings shall include plans and elevations of the proposed piping and equipment, to establish that the equipment will fit the allotted spaces with clearance for installation and maintenance. If departures from the contract drawings are deemed necessary by the Contractor, detail drawings of such departures, including changes in related portions of the project and the reasons therefore, shall be submitted by the Contractor for approval before proceeding with any work. Where such departures require piping or equipment to be supported otherwise than as shown, the details submitted shall include loadings, type and kind of frames, hangers, brackets, stanchions, or other necessary supports. Approved departures shall be made at no additional cost to the Government. The lists of

materials and equipment shall be supported by sufficient descriptive material, such as catalogs, cuts, diagrams, and other data published by the manufacturer, to demonstrate conformance to the specification requirements; catalog numbers alone will not be acceptable. The data shall include the name and address of the nearest service and maintenance organization that regularly stocks repair parts. Listings of items that function as parts of an integrated system shall be furnished at one time. One copy of the layout drawings and of each list will be returned, marked to indicate approval.

5. SHOP DRAWINGS: After receiving approval of the lists of materials and equipment, and not later than 90 days before starting installation of any materials or equipment, the Contractor shall submit for approval in accordance with SPECIAL PROVISIONS, complete shop drawings and other descriptive data as the Contracting Officer may require to demonstrate compliance with the contract documents. Shop drawings shall be submitted at one time. If departures from the contract drawings are deemed necessary by the Contractor, details of such departures, including changes in related portions of project and the reasons therefore shall be submitted with the shop drawings. Approved departures shall be made at no additional cost to the Government.

6. WORKMANSHIP:

6.1 General: Materials and equipment shall be installed in accordance with the approved recommendations of the manufacturer for obtaining conformance with the contract documents.

6.2 Welding: Contractor is responsible for qualifying any welding procedure for weldments to be used in the work on this project. The welding procedures shall be qualified by conducting the tests required in Section IX, ASME Boiler and Pressure Vessel Code or the qualified welding procedures of another employer may be accepted as permitted by ANSI B31.1.

6.3 Qualification of Welder: The determination for the performance qualification is the responsibility of the Contractor and each welder or welding operator shall be qualified by tests using equipment, procedures and a base metal and electrode or filler wire from the same compatible group number that will be encountered in the applicable procedure. Welders or welding operators who make acceptable procedure qualification test welds will be considered performance qualified for the welding procedures used. Performance qualification shall be determined in accordance with Section IX of the ASME Boiler and Pressure Vessel Code. Welders and welding operators qualified by another employer may be accepted as permitted by ANSI B31.1. The Contracting Officer shall be notified 24 hours in advance as to the time and place of tests and wherever practical the tests shall be performed at the work site. The Contracting Officer shall be furnished a listing of the names and identification symbol as noted on the performance qualification test records to be used to identify the work performed by the welder or welding operator who after completing a welded joint shall identify it as his work by applying his assigned symbol for permanent record.

7. ELECTRICAL WORK: Electric-motor-driven equipment specified herein shall be provided complete with motors, motor starters, and controls.

serial number, maximum continuous output rating in Btuh, maximum allowable working pressure and the year the boiler was built. The year built may be incorporated as part of the model or serial number.

8.3 Performance: Each boiler shall have a gross output capacity as indicated on the drawings when fired with No. 2 fuel oil, natural gas at a pressure of 10 inches of water, a calorific value of 1020 Btu per cubic foot, or liquid propane at a pressure of 14 inches of water with a calorific value of 2500 Btu per cubic foot. Fuel oils shall conform to Fed. Spec. VV-F-815. Output capacity shall be determined in accordance with paragraph Testing and Rating.

8.4 Testing and Rating: Each boiler shall be tested and rated and shall meet the label or listing requirements of the following codes or standards as specified for the type boiler provided.

8.4.1 Cast-Iron Sectional Boilers: Oil-fired boilers shall be tested and rated in accordance with the HI I=B=R and SBI Testing and Rating Standard for Cast Iron and Steel Heating Boilers or ANSI Z21.13.

8.4.2 Steel Firetube Boilers: Oil-fired boilers shall be tested and rated in accordance with the ABMA Packaged Firetube Boiler Ratings or the HI I=B=R and SBI Testing and Rating Standard for Cast Iron and Steel Heating Boilers. Gas-fired boilers shall be tested and rated in accordance with the ABMA Packaged Firetube Boiler Ratings, HI I=B=R and SBI Testing and Rating Standard for Cast Iron and Steel Heating Boilers or ANSI Z21.13.

8.4.3 Steel or Copper Watertube Boilers: Oil-fired boilers shall be tested and rated in accordance with the performance and quality assurance provisions of Mil. Spec. MIL-B-17228. Gas-fired boilers shall be tested and rated in accordance with Mil. Spec. MIL-B-17228 or ANSI Z21.13.

8.5 Combustion and Safety Controls and Equipment: Electrical combustion and safety controls shall be rated at 120 volts single phase, 60 Hz and shall be connected as specified in SECTION: ELECTRICAL WORK, INTERIOR. A 4-inch diameter alarm bell shall be provided with a suitable transformer and shall be located where indicated or directed. The alarm bell shall ring when the boiler is shut down by any safety control or interlock. Indicating lights shall be provided on the control panel. A red light shall indicate flame failure and a green light shall indicate that the main fuel valve is open. The following shut-down conditions shall require a manual reset before the boiler can automatically recycle:

- a. Flame failure.
- b. Failure to establish pilot flame.
- c. Failure to establish main flame.
- d. Low-water cutoff.
- e. High temperature cutoff.

8.5.1 Boiler unit shall meet the requirements of the safety codes or standards specified below:

8.5.1.1 Gas-Fired Units Over 400,000 Btuh Gross Output: ANSI Z21.13, or ANSI Z21.52, or UL 795.

8.5.1.2 Oil-Fired Units Over 400,000 Btuh Gross Output: UL 726 as specified for boilers without a competent attendant except that cast-iron sectional boilers shall meet the requirements of UL 296 or UL 726 as specified for boilers without a competent attendant.

8.5.2 Boiler units shall be provided with the following combustion controls.

8.5.2.1 Gas-fired boiler units shall be provided with high-low-off combustion controls with an interrupted or intermittent spark ignited gas pilot.

8.5.2.2 Oil-fired boiler units shall be provided with high-low-off combustion controls with direct electric spark ignition system, spark ignited No. 2 oil, natural gas, or liquefied petroleum gas pilot. Oil and gas pilots shall be of the interrupted or intermittent type.

8.5.3 Low-Water Cutoff: Low-water cutoff shall be provided to cutoff the burner when the water level drops below a predetermined point. It shall consist of a float chamber with float, float switch, and drain valve. Float switch shall be mounted on the float chamber with a packless type, leakproof connection. Float mechanism and drain valve shall be constructed of a corrosion-resistant material. The low-water cutoff shall be approved by the Underwriters Laboratories, Inc.

8.5.4 Draft Controls:

8.5.4.1 Boilers under 2,000,000 Btuh gross output shall be provided with dampers, draft hoods, or barometric dampers as recommended by the boiler manufacturer to maintain proper draft in the boiler.

8.5.4.2 Draft Interlock: Mechanical-draft boilers shall be provided with a draft interlock to prevent ignition until airflow has been established and to close the fuel valve in the event of draft failure.

8.6 Draft Fans:

8.6.1 General: Draft fans, when required, shall be furnished with the boiler as a part of the complete unit; and shall be as specified below.

8.6.2 Forced-Draft-Fan Unit: The forced-draft fan shall be an electric-motor-driven, damper controlled, centrifugal or axial-flow type unit. The unit shall have sufficient air capacity for complete combustion of the maximum fuel quantity to be burned at maximum firing rate plus 10 percent excess volume against a 20 percent static pressure overload. Motors, unless otherwise indicated, shall not exceed 1800 rpm and shall have drip-proof enclosure. The unit shall be rated in accordance with AMCA 210. Corrections shall be included in the fan selection or design for maximum burner and boiler pressure drop, combustion air, and plant elevation above sea level.

8.7 Flue-Gas Thermometer: Flue-gas thermometer of the dial type calibrated from 200 degrees F. to 750 degrees F. shall be mounted in the flue-gas outlet of each boiler.

9. FUEL OIL SYSTEM: The fuel oil system shall be installed in strict accordance with NFPA No. 31, unless otherwise indicated.

9.1 Fuel-Oil Storage Tanks: Fuel-oil storage tanks shall be fabricated in accordance with requirements of the Underwriters Laboratories, Inc., Standards for the location and the service intended and shall be provided with other openings and appurtenances as indicated. Manholes with water-tight covers shall be provided for all tanks with storage capacity of over 4000 gallons. Fuel-oil storage tanks shall be installed above or below ground as indicated. An oil-level-indicating device either of the float or pressure-actuated type shall be installed where indicated or directed for each oil-storage tank.

9.1.1 Protective Coating for Underground Steel Storage Tanks: Steel tanks may be coated in the shop or in the field at the option of the Contractor. The exterior surfaces of the tank to be shop-coated shall be prepared by blasting. Blasting shall conform to SSPC-SP 6, and pickling shall conform to SSPC-SP 8. Prepared surfaces shall be primed as soon as practicable but in any event prior to any evidence of corrosion and in accordance with coating manufacturer's recommendation. The coating system shall be the products of a single manufacturer and shall be one of the following at the option of the Contractor:

a. Coal-tar primer and enamel shall conform to SSPC-PS 10.01. A copy of the manufacturer's application instructions shall be furnished to the Contracting Officer. The work shall be done by personnel specifically experienced in the hot application of coal-tar enamel and, except as may be otherwise specified herein, in strict accordance with the manufacturer's instructions. Temperature at the time of application shall be not less than 50 degrees F. The primer shall be applied to clean exterior surfaces. After the primer has dried thoroughly, and within the time specified by the manufacturer, the enamel shall be hot-applied. The use of fluxing oils or thinners to reduce susceptibility to cracking in cold weather will not be permitted. The thickness of the dry coating system shall not be less than 1/16 inch at any point.

b. Coal-tar epoxy paint shall conform to SSPC-Paint 16. The two components of the coal-tar epoxy paint shall be thoroughly mixed together with a heavy-duty mechanical stirrer just prior to use, and the mixed material shall be used before unreasonable increase in viscosity takes place. The use of not more than 1 pint of xylene thinner per gallon of coal-tar epoxy paint shall be permitted in order to improve application properties and extend pot life. The paint may be applied by brush or spray. Excessive brushing shall be avoided. The coating shall be applied in not less than two coats and the minimum dry film thickness at any point shall be not less than 16 mils. If the system is applied in two coats, the drying time between coats shall be not less than 12 hours. If the coating is applied in three coats, two of them may be applied the same day provided at least 6 hours of drying time, or as specified by the manufacturer, is allowed between coats and provided all coats are approximately the same

thickness. The maximum drying time between coats shall not exceed 72 hours. The paint shall not be applied when the receiving surface or the ambient temperature is below 50 degrees F., nor unless it can reasonably be anticipated that the average ambient temperature will be 50 degrees F. or higher for the 5-day period subsequent to the application of any coat. Formulations based on compositions of epoxy resin and coal tar are the subject of US Patent 2,765,288.

c. Testing and Repairing Coating: The coating shall be examined for flaws and shall be tested for thickness and holidays. The Contractor shall provide the facilities, personnel, and equipment for testing for holidays and thickness. Thickness of coating shall be measured by commercial film thickness gage. Coating shall be tested for pinholes, holidays, and other defects directly prior to placement, using an electric-flaw detector equipped with a bell, buzzer or other type of audible signal that operates when a flaw is detected. The detector for the hot-applied coal-tar enamel shall have an operating peak voltage from 8,000 to 10,000 volts. The detector for the coal-tar epoxy coating shall be a low voltage, 22-1/2 volts minimum/100-volts maximum, wet sponge holiday detector. The holiday detector potential may be checked by the Contracting Officer at any time to determine the suitability of the detector. Faulty detectors shall be replaced by direction of the Contracting Officer. Damaged areas, including area damaged during testing, shall be repaired with material identical with that used originally and, after drying, shall be retested as specified above. Where underground tanks are anchored to concrete foundations, metal-hold-downs such as straps, cables, tie-rods and associated clips, eye bolts, turnbuckles, clamps and clevises, which may be subject to corrosion, shall be coated as specified for steel tanks. The parts of these devices which are embedded in concrete shall not be coated. Visual inspection only for continuity of the coating on miscellaneous steel shall be required.

9.1.2 Storing, handling, and placing of coated steel tanks shall be done with care and in a manner that will minimize damage to the coating and will not reduce the protective effectiveness of the coating. The coated tanks shall be placed carefully in position with a minimum of handling. All damaged surfaces which occur during these operations shall be repaired as outlined by and at the expense of the Contractor. For all underground tanks, backfill shall not be started until the in-place tank has been inspected and certified by the Contracting Officer to be ready for backfilling. Backfilling shall be as specified in SECTION: EXCAVATION, FILLING, AND BACKFILLING FOR BUILDINGS.

9.1.3 Painting Aboveground Steel Tanks: The exterior surface of all aboveground steel tanks and the exposed surfaces of all ferrous metal appurtenances such as ladders, handrails, platforms, supports, bracing and the like which are not factory finished to withstand the corrosive effect of outside installation shall be cleaned, primed, and painted as specified in SECTION: PAINTING, GENERAL.

9.1.4 Tank Calibration: The tank manufacturer shall provide a calibration chart for each tank showing the liquid contents in gallons per inch of tank depth. Six reproductions of the calibration chart inclosed in plastic envelopes and bound in a stiff back binder shall be provided for each tank. The Contractor shall provide one gage stick suitable for gaging

all tanks provided. The gage stick shall be wood, graduated in inches and eighths of an inch and shall be properly treated after graduation to prevent swelling or damage from the fuel. Calibration charts shall be delivered with each tank.

9.2 Oil Pipe and Fittings: Oil pipe shall be seamless copper tubing with wrought bronze fittings. Before covering the joints, the piping shall be tested in accordance with paragraph Fuel-Oil System Test. After approval by the Contracting Officer the joints and fittings shall be covered with material identical to that used on the steel pipe or shall be primed and handwrapped with primer and hot-applied preformed coal-tar tape conforming to AWWA C203.

9.3 Automatic Safety Shutoff Valve: Oil supply line to each oil burner shall be equipped with an automatically operated valve designed to shutoff the oil supply in case of fire in the immediate vicinity of the burner. Valve shall be thermoelectrically actuated or thermomechanically actuated type. Valve shall be located immediately downstream of the manual shutoff valve at day tank inside of building if used, or immediately downstream of building shutoff devices where oil supply line enters the building. Thermoelectrical or thermomechanical detection device shall be located over the oil burner. Fire shutoff valve may be combined with other automatic shutoff devices if listed in the Gas and Oil Equipment Directory of the Underwriters Laboratories, Inc.

9.4 Cleaning Interior Surface of Tanks: Before the Contractor withdraws from the job, the interior of tanks that are accessible shall be cleaned and made free from all foreign matter, such as dirt, debris, grease, and oils, that might later interfere with the operation of the system or that might be a source of contamination of the product to be stored in the tank. The cleaning shall be done to the satisfaction of the Contracting Officer.

10. GAS FUEL SYSTEM: Gas piping, fittings, valves, regulators, tests, cleaning and adjustments shall be in accordance with all requirements of ANSI Z83.3 unless otherwise specified herein. Burners, pilots, and all accessories shall conform to requirements of UL Gas and Oil Equipment Directory. The fuel system shall be provided with a gas tight, manually operated, lubricated plug-type stop valve at the gas-supply connections, and a gas strainer, a pressure regulator, pressure gages, a burner-control valve, safety shutoff valve suitable for size of burner and sequence of operation, and all other components required for safe, efficient, and reliable operation as hereinbefore specified. Approved permanent and ready facilities to permit periodic valve leakage tests on the safety shutoff valve or valves shall be provided.

11. SMOKE CONNECTION: Each boiler shall be connected to the stack or flue by means of a smoke connection constructed of black iron or steel sheets not less than 0.0478-inch in nominal thickness. The clear distance between any portion of the smoke connection surface and any combustible material shall be not less than that specified in NFPA No. 211. Joints and seams shall be securely fastened and made substantially air tight. Suitable cleanouts shall be provided which will permit cleaning the entire smoke connections without dismantling.

12. THERMOMETERS, PRESSURE GAGES, AND RELIEF VALVES:

12.1 Pressure Gage and Thermometer: Pressure gage and thermometer in combination and with suitable temperature and pressure ranges shall be installed on each boiler.

12.2 Pressure-Relief Valves: Each boiler shall be provided with one or more relief valves, constructed and installed in strict accordance with the ASME Boiler and Pressure Vessel Code, Section IV. The aggregate relieving capacity of the relief valves shall be not less than that required by the above-mentioned code. This discharge from the valves shall be installed as directed by the Contracting Officer.

13. CIRCULATING PUMPS for hot water shall be of the single-stage centrifugal type and shall be electrically driven. The pumps shall be supported on a concrete foundation or by the piping on which installed. The pumps shall have a capacity not less than that indicated, and shall be either integrally mounted with the motor or direct-connected by means of a flexible-shaft coupling on a cast iron or steel subbase. The pump shaft shall be constructed of alloy steel, with sleeve bearings and glands of bronze, and with housing of close-grained cast iron. The motor shall have sufficient power to prevent overloading with the pump operating at any point on its characteristic curve, shall have splashproof enclosure, shall be of a type approved by the manufacturer of the pump, shall be suitable for the available electric service, and shall conform to the requirements specified in SECTION: ELECTRICAL WORK, INTERIOR. The motor shall be controlled by a suitable switch activated as hereinafter indicated in paragraph Space-Temperature Controls.

14. SPACE-TEMPERATURE CONTROLS:

14.1 General: The space-temperature control system shall be pneumatic, electric, or electronic to provide the control sequences hereinafter specified. All control wiring and tubing required to complete the space-temperature control system shall be included in this section of the specifications. Pneumatic controls may be provided in lieu of electric controls. Where pneumatic controls are furnished, an air compressor of the standard piston type, complete with air tanks, pressure reducing valves, vents, drains, valves, gages, regulators, air intake filters, belt guards, air dryer and other appurtenances shall be provided and the compressor and installation shall conform to ANSI B19. The compressor shall be of sufficient capacity to provide continuous control air when operating on a 1/3-on 2/3-off cycle and shall be provided with a visible oil-level sight glass and oil filter. The controls equipment manufacturer shall provide air dryers of the silica-gel type with reactivation or of the refrigerated dryer type. The air dryer capacity shall be sufficient to maintain the air in the system with a dew point low enough to prevent condensation. The air dryer shall be located on the outlet of the compressor to insure a dry storage tank. The dew point of the air to the system shall be at least 15 degrees less than the inlet air dew point at design conditions. Air lines for pneumatic controls shall be seamless copper tubing or nonmetallic tubing. All piping shall be concealed except in mechanical rooms or areas where other piping is exposed. Copper tubing shall be hard drawn in

exposed areas and either hard drawn or annealed in concealed areas. Where copper tubing is run exposed, each tube shall be securely fastened at regular intervals and shall run parallel to the lines of the building. Only tool-made bends will be acceptable. Fittings for copper tubing shall be brass or copper solder joint-type except at connections to apparatus, where brass compression-type fittings shall be used. Nonmetallic tubing shall be compounded from low-density virgin polyethylene, ASTM D 1248, Type I, Category 5, Class B or C; meeting the stress crack test performed per ASTM D 1693. All individual tube polyethylene or multi-tube instrument tubing bundle shall be classified as flame retardant and shall be rated as self-extinguishing when tested under ASTM D 635 flammability test. All nonmetallic tubing shall be run within adequately supported covered rigid metallic raceway or electric metallic tubing, except as indicated on the drawings. Terminal single line shall be hard drawn copper tubing except if the run is less than 12 inches, flexible polyethylene may be used. Multi-tube instrument bundle may be used in place of single tube where a number of tubes run to the same points. All tubing shall be periodically tested for leaks during installation and all tubing shall be blown out to rid itself of installation impurities and moisture before connecting to the control instrument. Fittings for polyethylene tubing shall be for instrument service and may be brass or delrin of the compression or barb push-on type. All tubing shall be number coded or color coded and keyed to the submittal drawings for future identification and servicing the control system. Nonmetallic tubing will not be used for boiler safety and combustion controls and applications where the tubing could be subjected to a temperature exceeding 130 degrees F. The control tubing shall be installed in accordance with the control manufacturer's instructions as specified.

14.2 Space-Temperature Controls:

14.2.1 Space-Temperature Control; Outdoor-Thermostat Method, Without Indirect Domestic Hot-Water Coil: The temperature in the space to be heated shall be automatically controlled by means of an outdoor reset control, a water-temperature controller, and equipment that will control the operation of the fuel supply and combustion air to maintain the required supply water temperature. The circulating pump shall operate continuously except when stopped by the outside high limit thermostat when the temperature exceeds 60 degrees F.

14.2.2 Outdoor reset thermostat shall be of the adjustable type set for the following conditions:

<u>Outside Temperature (Degrees F)</u>	<u>Supply Water Temperature (Degrees F)</u>
Less than 30	
30 to 40	
40 to 50	160
50 to 60	

A suitable ventilated weather shelter shall be provided for the outside sensing element. The unit shall be mounted indoors with its sensing element located in the outdoor air. It shall proportionally reset the control point of a remote sensing temperature controller.

14.3 Space-Temperature Control for Unit Heaters: The space temperature shall be maintained automatically by stopping and starting the unit-heater fan by means of the room thermostat.

15. COLD-WATER CONNECTIONS shall be made to the water-supply system as indicated. Necessary pipe, fittings and valves required for water connections between the boiler and cold-water main shall be provided as shown on the drawings and in conformance with requirements of SECTION: PLUMBING, GENERAL PURPOSE. Pipe shall be specified hereinafter in paragraph PIPING.

15.1 Relief Valve: The pressure-relief valve shall be adjusted to open automatically when the pressure within the heating system rises above 30 psig. The discharge from the relief valve shall be installed as directed. The valve shall be equipped with a level for manual operation. All pressure relief valves shall be in accordance with ASME Boiler and Pressure Vessel Code, Section IV.

15.2 Strainers: Basket or Y-type strainers shall be the same size as the pipelines in which they are installed. The strainer bodies shall be heavy and durable, of the best grade cast iron, with bottoms drilled and plugged. The bodies shall have arrows clearly cast on the sides to indicate the direction of flow. Each strainer shall be equipped with an easily removable cover and sediment basket. The basket shall be of not less than 0.025-inch thick, 22-gage, sheet brass with small perforations of sufficient number but not less than 400 per square inch to provide a net free area through the basket of at least 3.30 times that of the entering pipe. The flow shall be into the basket and out through the perforations.

15.3 Pressure-Regulating Valve: Pressure-regulating valve shall be of a type that will not stick nor allow pressure to build up on the low side. The valve shall be set to maintain a terminal pressure of approximately 5 psi in excess of the static head on the system and shall operate within a 2 psi variation regardless of initial pressure and without objectionable noise under any condition of operation.

16. EXPANSION TANK shall be constructed of steel. The tank size and connections shall conform to the ASME Boiler and Pressure Vessel Code, Section IV. The expansion tank for systems operating at water working pressures exceeding 30 psi shall be constructed in accordance with Section VIII of the ASME Boiler and Pressure Vessel Code. Air charging and drain valves shall be designed for air to flow to the top of tank and for displaced water to flow back to the system.

17. PIPING: Unless otherwise specified herein, pipe and fittings shall conform to the requirements of ANSI B31.1. Pipe shall be cut accurately to measurements established at the jobsite, shall be worked in place without springing or forcing, and shall properly clear windows, doors, and other openings. Cutting or other weakening of the building structure to

burrs removed by reaming, and shall be so installed as to permit free expansion and contraction without causing damage to 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 center-line radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations, will not be accepted. Steel piping to be bent shall conform to ASTM A 53, Grade A, standard or extra strong. 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, final connections to appliances 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.

17.1 Hot Water Piping: Hot water piping shall be steel, conforming to ASTM A 53, Grade A, standard weight, black; ASTM A 120, standard weight, black; Fed. Spec. WW-P-406, Weight A, Class 1; or copper tubing conforming to Fed. Spec. WW-T-799, Type K or L.

17.2 Fittings: Fittings adjacent to valves shall suit valves specified. Reducing fittings shall be used for changes in pipe sizes. In horizontal lines, reducing fittings shall be the eccentric type to maintain the bottom of the adjoining pipes at the same level.

17.3 Vent Piping: Vent piping shall be steel, conforming to ASTM A 53, Grade A, standard weight, black; ASTM A 120, standard weight, black; Fed. Spec. WW-P-406, Weight A, Class 1.

17.4 Gage Piping: Gage piping shall be copper tubing conforming to Fed. Spec. WW-T-799, Type K or L.

17.5 Connections: Connections between sections of steel pipe and between steel-pipe fittings shall be threaded for piping 1 inch and smaller, threaded or welded for piping 1-1/4 inches through 2-1/2 inches, and flanged using welding-neck steel flanges or butt welded for piping 3 inches and larger except that connections shall be welded for extra strong pipe 1-1/4 inches and larger. Connections between copper tubing and fittings shall be soldered using solid core Sn50 solder. Connections between ferrous and copper piping shall be made with dielectric unions for piping 2-1/2 inches and below and dielectric flanges for piping 3 inches and above. Connections to equipment shall be made with unions for piping 2-1/2 inches and below and with flanges for piping 3 inches and above.

17.5.1 Threaded joints shall have American National Taper Pipe Threads conforming to Fed. Std. H28 with graphite or inert filler and oil, an approved graphite compound, or polytetrafluoroethylene tape applied to the male threads only. Threaded piping fitting may be either cast iron

conforming to Fed. Spec. WW-P-521 or malleable iron conforming to Fed. Spec. WW-P-501. Type and class shall suit the adjacent piping.

17.5.2 Welded joints shall be fusion-welded in accordance with ANSI B31.1 unless otherwise required. 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 improved flow characteristics where attached to the run, reinforced against external strains, and designed to withstand full pipe-bursting strength.

17.5.2.1 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 prior to welding.

17.5.2.2 Alinement: Before welding, the component parts to be welded shall be alined so that no strain is placed on the weld when finally positioned. Height shall be so alined 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 alinement 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 welding operation.

17.5.2.3 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 material cools to 32 degrees F.

17.5.2.4 Weld Inspection: Welds shall be inspected for defects in accordance with the following:

- a. Cracks shall not be acceptable regardless of length or location.
- b. Undercut shall not be deeper than 5 percent of the base-metal thickness or 1/32 inch, whichever is less.
- c. Overlap shall not be permitted.

The Contracting Officer reserves the right to further examine the welds by radiography, liquid penetrant, magnetic particle or ultrasonic or any other means to establish the soundness of any weld. Weld defects shall be removed and repairs made to the weld, or the weld joints shall be entirely removed and rewelded at no additional cost to the Government.

17.5.2.5 Electrodes: Electrodes shall be stored in accordance with AWS D1.1 or as recommended by the manufacturer. Electrodes that have lost any part of their coating shall not be used.

17.5.3 Dielectric Unions and Flanges: Dielectric unions and flanges when called for shall meet the dimensional and tensile strength requirements of Fed. Spec. WW-U-531, and shall have metal connections at

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both ends of the union. The ends of the unions shall be threaded, welded, or soldered to match adjacent piping. The metal parts of unions and flanges shall be separated so that the electrical current is below 1 percent of the galvanic current which would exist with metal to metal contact.

17.5.4 Solder Joints: Solder joints shall be made by competent workmen in accordance with the fitting manufacturer's recommendations. Tube shall be cut square with burrs removed. Outside of tube where engaged in the fitting and inside of fitting in contact with tube shall be cleaned with an abrasive material before soldering. Care shall be taken to prevent annealing of tube and fittings when making connections, and joints 2-1/2 inches and larger shall be made with heat applied uniformly with a multi-flame torch. Joints shall be made using a noncorrosive paste flux and solid string or wire solder. Core solder will not be permitted.

17.6 Connections to Equipment: Supply and return connections shall be provided by the Contractor unless otherwise shown. Connections shall be made with malleable-iron unions. Valves, strainers, vents and the like shall be installed in accordance with the manufacturer's recommendations and in an acceptable manner. The size of the supply and return pipes to each piece of equipment shall not be smaller than the outlets on the equipment.

17.7 Branch Connections: Branches from the mains shall pitch with a slope of not less than 1 inch in 10 feet. Connections shall be carefully made to insure unrestricted circulation, eliminate air pockets, and permit the complete drainage of the system.

17.8 Hangers, Supports, Anchors and Guides:

17.8.1 General: Pipe hangers, brackets, saddles, support inserts, clamps, pipe rolls, hanger rods, bolts, turnbuckles, and bases shall conform to MSS SP-58 and SP-69. Chain, wire strap, or other makeshift devices will not be permitted as hangers or supports. Hangers, clamps, anchors, guides and other supports in contact with copper or brass pipe and tubing shall be compatible nonferrous material or electrolytically coated steel as required for hangers for brass or copper pipe and tubing in MSS SP-58 and SP-69. Hangers and other supports for insulated pipe shall be sized to accommodate the insulation and protection shield required by SECTION: THERMAL INSULATION FOR MECHANICAL SYSTEMS or saddles specified below. Hangers used for support of 2-1/2 inch nominal pipe or tubing size and larger shall be fabricated to permit adequate adjustment after erection while still supporting the load. In lieu of separate hangers or supports, the Contractor may submit for approval a detailed drawing of the type of hanger or support which is proposed to be furnished for hanging and supporting multiple pipes.

17.8.2 Attachment to Structure: Supports, anchors and guides shall be attached to structural framing members, concrete slabs or masonry walls. Where supports are required between structural framing members, suitable intermediate framing shall be provided. Detail drawings of intermediate framing shall be submitted for approval.

17.8.3 Horizontal Piping: The maximum spacing between pipe supports for straight runs shall comply with MSS SP-69. Pipe hangers or supports shall be spaced not over 5 feet apart at heavy fittings and valves such as pressure-reducing and zone-control valves.

17.8.3.1 Piping Supported from Above: A hanger shall be installed not over 1 foot from each change in direction of piping. Suspended piping hangers shall be Types 1, 6, 7, 9, 10, or 11. Roller supports may be used as specified in MSS SP-58 and SP-69. Type 13 or 15 turnbuckles shall be used where required for vertical adjustment of the piping. Piping 4 inches and larger shall have Type 39 protective saddles. A Type 3 steel double bolt pipe clamp may be used in lieu of the hangers and protection saddle specified above if the bottom of the clamp will not extend through the insulation and the attachment to the top of the clamp will not make contact with the insulation during pipe movements. Vector forces on hanger rod from vertical angle deflection shall not exceed that allowed by MSS SP-58. Brackets for support of piping at wall shall be Type 34, unless otherwise shown.

17.8.3.2 Piping Supported from Below: Piping shall be supported from below with steel, graphite or polytetrafluoroethylene (PTFE) slides. Slide materials shall be suitable for the temperature of the piping system. Guides shall be provided where required to maintain longitudinal pipe movement. Unless otherwise shown, a Type 39 protective saddle shall provide the upper part of the steel slide for piping 4 inches and larger. Graphite slides shall have a compressive strength of 2000 psi and have a minimum 1/2-inch graphite slide plate and a minimum 3-1/2 inch thick cradle. The graphite slide plate shall be cemented to the beam or bracket and the graphite cradle shall be strapped to the pipe using 3/4-inch by 0.020-inch stainless steel straps. PTFE slides shall be Type 35 reinforced PTFE and shall accommodate loads of 2000 psi at ambient temperature.

17.8.4 Vertical Piping: Supports shall be located as indicated or as directed and shall be Type 8.

17.9 Pipe Sleeves:

17.9.1 General: Pipes passing through concrete or masonry walls or concrete floors or roofs shall be provided with pipe sleeves fitted into place at the time of construction. Sleeves shall not be installed in structural members except where indicated or approved. All rectangular and square openings shall be as detailed on the drawing. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface. Unless otherwise indicated, sleeves shall provide a minimum of 1/4-inch all around clearance between bare pipe and sleeves or between jacket over insulation and sleeves. Sleeves in bearing walls, waterproofing membrane floor, and wet areas shall be steel pipe or cast-iron pipe. Sleeves in non-bearing walls, floors, or ceilings may be steel pipe, cast-iron pipe, or galvanized sheet metal with lock-type longitudinal seam and of the metal thickness indicated on the drawing. Except in pipe chases or interior walls, the annular space between pipe and sleeve or between jacket over insulation and sleeve shall be sealed as indicated and specified in SECTION: CALKING AND SEALANTS. The annular space between pipe and sleeve or between insulation jacket and sleeve will

not be sealed for interior partition or pipe chases which are not designated as fire rated. Penetrations through fire-rated interior wall and pipe chases shall be sealed to maintain the fire rating.

17.9.2 Pipes Passing Through Fire Walls, Fire Partitions, and Floors: Where pipes pass through fire walls, fire partitions, or floors, a fire seal of asbestos rope, mineral wool, or similar noncombustible material shall be placed behind the backup material.

17.10 Floor, Wall, and Ceiling Escutcheons: Escutcheons shall be provided at all finished surfaces where exposed piping, bare or insulated, 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 chromium-plated iron or chromium-plated brass, either one-piece or split pattern, held in place by internal tension spring or setscrew.

17.11 Identification Tags: Identification tags made of brass or aluminum, indicating the function of the valve, size and the working pressure shall be installed on system and branch circuit type valves as indicated or directed by the Contracting Officer for isolating various parts of the system. Tags shall be a minimum of 1-3/8 inches in diameter and No. 16 B&S Gage in weight. The markings shall be stamped and tags secured to the valve by means of No. 12 AWG wire of the same material as the tag.

18. UNIT HEATERS:

18.1 General: The unit heaters shall have a Btu capacity not in excess of 125 percent of that specified. The noise level of each unit heater shall be appropriate for the space in which the heater is installed. Upon completion of the installation, unit heaters that are considered to be objectionably noisy shall be replaced with acceptable heaters at no additional cost to the Government. A gate valve in the supply line and a balancing cock in each return line shall be provided for each unit heater.

18.2 Propeller-Type Unit Heaters: Propeller-type unit heaters shall be designed for suspension and arranged for horizontal discharge of air. The casings shall be of sturdy, rigid, sparkproof construction where indicated in Unit Heater Schedule. Suitable stationary or rotating air deflectors shall be provided to assure proper air and heat penetration capacity at floor level based on established design temperature. Suspension from heating pipes will not be permitted. Horizontal-discharge-type unit heaters shall have discharge or face velocities not exceeding the following:

<u>Unit Capacity</u> <u>Cubic Feet Per Minute</u>	<u>Face Velocity</u> <u>Feet Per Minute</u>
Up to 1,000	800
1,001 to 3,000	900
3,001 and over	1,000

18.3 Heating Elements: Heating coils and radiating fins shall be of suitable nonferrous alloy. The heating elements shall be free to expand or

contract without developing leaks and shall be properly pitched for drainage. The elements shall be tested under a hydrostatic pressure of 200 psig, and a certified report of the test shall be submitted to the Contracting Officer.

18.4 Motors: Motors shall be provided with manual selection switches for On, Off, and Automatic operation, and shall be equipped with thermal-overload protection. Motors shall have explosionproof enclosure, as indicated in Unit Heater Schedule.

INSTALLATION OF VALVES:

19.1 General: Valves shall be installed in conformance with ASME Boiler and Pressure Vessel Code, Section IV, at the locations shown, where specified, and elsewhere as required or directed for the proper functioning and maintenance of the system. Gate valves shall be used unless otherwise shown, specified, or directed. All valves shall be installed with stems horizontal or above. Stop valves shall be installed in the supply lines and shall be so located or equipped as to permit operation from floor level, or provided with safe access in the form of walkways or ladders.

19.2 Air-Vent Valves: Air-vent valves shall be installed where shown, where specified, and otherwise required to properly vent the heating system. Air-vent valves shall be installed at the high points of each main and on the high point of each unit heater.

19.3 Flow-Control Valve: Flow-control valve to control the flow of water shall be installed in the supply main near the boiler. The valve shall operate so that when the circulating pump starts, the increased pressure within the main will open the valve, and when the pump stops, the valve will close. The valve shall be constructed with a cast-iron body and shall be provided with a device whereby the valve can be opened manually to allow gravity circulation. The flow-control valve shall be designed for the intended purpose, and shall be installed as recommended by the manufacturer.

19.4 Air Charging and Drain Fitting: Air charging and drain fitting shall be installed in expansion tank as indicated to permit recharging the tank with air.

20. INSULATION:

20.1 Factory Applied Insulation: Factory applied insulation shall be as herein specified under the equipment to be insulated and shall comply with the fire hazard rating specified in SECTION: THERMAL INSULATION FOR MECHANICAL SYSTEMS.

20.2 Field Applied Insulation: Field applied insulation shall be as specified in SECTION: THERMAL INSULATION FOR MECHANICAL SYSTEMS.

PAINTING AND FINISHING:

21.1 Factory Coating: Convector enclosures shall be coated with the manufacturer's standard rust inhibiting primer. Other equipment and

component items, when fabricated from ferrous metal, shall be factory finished with the manufacturer's standard finish.

21.2 Field Painting: Painting required for surfaces not otherwise specified and finish painting of items only primed at the factory are specified in SECTION: PAINTING, GENERAL.

22. OPERATING AND MAINTENANCE INSTRUCTIONS:

22.1 Bound Instructions: Six complete sets of instructions containing the manufacturer's operating and maintenance instructions for each piece of equipment shall be furnished the Contracting Officer. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished at the time the test procedure is submitted, and the remaining sets shall be furnished before the contract is completed. The following identification shall be inscribed on the covers: "OPERATING AND MAINTENANCE INSTRUCTION," the name and location of the building, the name of the Contractor, and the contract number. Flysheets shall be placed before instructions covering the subject. The instruction sheets shall be approximately 8-1/2 by 11 inches, with large sheets of drawings folded in. The instructions shall include, but not be limited to, the following:

22.1.1 System layout showing piping, valves, and controls.

22.1.2 Approved wiring and control diagrams.

22.1.3 A control sequence describing startup, operation, and shutdown.

22.1.4 Operating and maintenance instructions for each piece of equipment, including lubrication instructions.

22.1.5 Manufacturer's bulletins, cuts, and descriptive data.

22.1.6 Parts, lists, and recommended spare parts.

22.2 Diagrams and Operating Instructions: Approved wiring and control diagrams showing the complete layout of the entire system, including equipment, piping valves, and control sequence, framed under glass or in approved laminated plastic, shall be posted where directed. In addition, 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. Proposed diagrams, instructions, and other sheets shall be submitted for approval prior to posting. The framed instructions shall be posted before acceptance testing of the systems.

22.3 Field Instruction: Upon completion of the work and at a time designated by the Contracting Officer, the services of one or more competent engineers shall be provided by the Contractor for a period of not less than 3 days to instruct a representative of the Government in the operation and maintenance of the heating system. These field instructions shall cover all the items contained in the bound instructions.

23. TESTS: The Contractor shall furnish all instruments, test equipment, test personnel, and fuel oil required for the following test. Natural gas, water and electricity shall be obtained as specified in the SPECIAL PROVISIONS. When fuel oil is required for testing, the Contractor shall provide a minimum of 500 gallons of grade No. 2 fuel oil. All indicating instruments shall be read at half-hour intervals unless otherwise directed. The report of the test shall be supplied in quadruplicate to the Contracting Officer.

23.1 Fuel System Tests:

23.1.1 Fuel-Oil System Test: The entire fuel system shall be treated for leaks after installation and before the underground tank and fittings are covered, and prior to operational test of the heating system as hereinafter specified. Fuel piping shall be tested hydrostatically, or with equivalent air pressure, at not less than 1-1/2 times the maximum working pressure but not less than 5 psi in excess of the static pressure produced with the oil level at the highest point of the fuel system. The test shall be so made as not to impose a pressure of more than 10 psi on the tank. In lieu of the pressure test, the suction piping may be tested under a vacuum of not less than 20 inches of mercury.

23.1.2 Gas System Test: The gas fuel system shall be tested in accordance with the test procedures outlined in NFPA No. 54.

23.2 Heating System Tests:

23.2.1 Hydrostatic Test: Before any covering is installed, the entire heating system, including boiler, terminal heating units, and fittings, shall be tested hydrostatically and proved tight under a pressure of 150 percent of the design operating pressure or 45 psig, whichever is larger.

23.2.2 Operating Tests: On completion and prior to acceptance of the installation, the Contractor shall subject the heating system to such operating tests as may be required to demonstrate satisfactory functional and operating efficiency. Operating tests shall cover a period of 48 consecutive hours for each system, and shall include the following specific information in a report, together with conclusions as to the adequacy of the system:

- a. Time, date, and duration of test.
- b. Outside and boiler-room dry-bulb temperatures.
- c. Water pressure at boiler.
- d. Temperature of hot water supply and return to boiler.
- e. Boiler make, type, serial number, design pressure, rated capacity, and heating surface in square feet.
- f. Fuel burner make, model, and rated capacity; ammeter and voltmeter readings for oil-burner motor, when supplied.

g. Circulating pump make, model, and rated capacity, ammeter and voltmeter readings for the pump motor during operation.

h. Temperature and pressure of fuel oil at burner for pre-heated fuels.

i. Grade or type and calorific value of fuel.

j. Flue-gas temperature at boiler outlet.

k. Percent CO(2) in flue gas.

l. Quantity of water circulated.

m. Quantity of fuel consumed.

24. CLEANING OF BOILERS AND PIPING: After the hydrostatic tests have been made, and prior to performance of operating tests, the boilers shall be effectively cleaned of foreign materials. Wherever possible, water-contacted surfaces shall be wire-brushed to remove loose material, and following which the boilers shall be filled with a solution consisting of 1 pound of caustic soda or 3 pounds of trisodium phosphate per 100 gallons of water and operated at approximately 150 degrees for a period of 24 to 48 hours. The system shall then be drained and thoroughly flushed out with fresh water. Strainers shall be thoroughly cleaned.