INCH-POUND

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MILITARY SPECIFICATION

BOILERS, STEAM AND HOT WATER, WATERTUBE (STRAIGHT BARE AND FINNED TUBE), CAST IRON AND FIREBOX, PACKAGED TYPE (40,000 TO 35,000,000 BTU/HR THERMAL OUTPUT CAPACITY)

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers watertube (straight bare and finned tube), cast iron, and firebox packaged steam boilers and hot water generators.

1.2 Classification. Boilers are of the following types, sizes and classes, as specified (see 6.2).

TYPES

Type I - Steam boiler producing low pressure steam not greater than 15 pounds per square inch gage (psig) pressure.
Type II - Steam boiler producing high pressure steam between 16 and 150 psig.
Type V - Hot water generator producing low temperature water not greater than 160 psig or 250 degrees Fahrenheit (°F).

SIZES

Size 1 - Thermal output capacity between 40,000 and 320,000 British thermal units per hour (Btu/hr).
Size 2 - Thermal output capacity between 320,001 and 10,000,000 Btu/hr.
Size 3 - Thermal output capacity between 10,000,001 and 35,000,000 Btu/hr.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commanding Officer (Code 156), Naval Construction Battalion Center, Port Hueneme, CA 93043, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 4410

DISTRIBUTION STATEMENT A. Approved for public release, distribution is unlimited.

CLASSES

Class 1 - Heavy oil fired.
Class 2 - Light oil fired.
Class 3 - Gas fired.
Class 4 - Combination heavy oil and gas fired.
Class 5 - Combination light oil and gas fired.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standard. The following specifications and standard form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the specification (see 6.2).

SPECIFICATIONS

MILITARY

MIL-B-3180 - Boiler and Related Equipment, Packaging of.
MIL-B-18796 - Burners, Single: Oil, Gas and Gas-Oil Combination, for Packaged Boilers (320,000 to 125,000,000 Btu/Hr Thermal Output Capacity).
MIL-B-18797 - Burners, Single: Light Oil, Gas, and Light Oil-Gas Combination for Packaged Boilers (Up to 320,00 Btu/hr Thermal Output Capacity).

STANDARD

MILITARY

MIL-STD-209 - Slinging and Tiedown Provision for Lifting and Tying Down Military Equipment.

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME Boiler and Pressure Vessel Code.
Section I - Power Boilers.
Section IV - Heating Boilers.
Section VIII - Pressure Vessels.

ASME CSD-1 - Controls and Safety Devices for Automatically Fired Boilers.
ASME Performance Test Code (PTC).
PTC 4.1 - Steam Generating Units.

(Application for copies should be addressed to the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

NEMA ICS 1 - General Standards for Industrial Control and Systems.
NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies
NEMA ICS 6 - Enclosures for Industrial Control and Systems.
NEMA MG 1 - Standards for Motors and Generators.

(Application for copies should be addressed to the National Electrical Manufacturers Association, 2101 L Street, N.W., Washington, DC 20037.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 - National Electrical Code.
NFPA 85A - Prevention of Furnace Explosions in Fuel Oil- and Natural Gas-Fired Single Burner Boiler-Furnaces.

(Application for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)

UNDERWRITERS LABORATORIES, INC. (UL)

UL-353 - Limit Controls.
UL-726 - Oil-Fired Boiler Assemblies.
UL-795 - Commercial-Industrial Gas-Heating Equipment.

(Application for copies should be addressed to the Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.2 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification takes precedence. Nothing in this specification, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The packaged unit shall either be a steam boiler or a hot water generator as specified (see 6.2). The steam boiler or hot water generator shall be either a watertube design with straight bare or finned tubes,

a cast iron design, or a firebox design as specified (see 6.2). Finned water tube and cast iron units shall only be of type I or type IV service. Finned watertube units shall also only be of class 2, class 3, or class 5 design. Size 1 units shall not be of the firebox design. Size 3 units shall not be of the watertube or cast iron design. The steam boiler or hot water generator shall be capable of producing the thermal output specified (see 6.2). The steam boiler or hot water generator shall be fired on the fuel specified (see 6.1.1 and 6.2). The steam boiler or hot water generator shall be furnished complete with the burner specified in MIL-B-18796 or MIL-B-18797 as applicable.

3.2 Codes and standards. The boiler or hot water generator shall conform to the applicable requirements of Section I, Section IV, and Section VIII of the ASME Boiler and Pressure Vessel Code (hereinafter referred to as the ASME Code), ASME CSD-1, NFPA 85A, UL 726 and UL 795. Limit controls and interlock switches shall be in accordance with UL-353.

3.3 Standard commercial product. The steam boiler or hot water generator shall, as a minimum, be in accordance with the requirements of this specification and shall be the manufacturer's standard commercial product. Additional or better features which are not specifically prohibited by this specification but which are a part of the manufacturer's standard commercial product, shall be included in the steam boiler or hot water generator being furnished. A standard commercial product is a product which has been sold or is being currently offered for sale on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model.

3.3.1 System of measurement. The dimensions used in this specification are not intended to preclude the use of the metric system of measurement in the fabrication and production of the material, individual parts, and the finished product, provided form, fit, and function requirements are satisfied.

3.4 Materials. Materials used shall be free from defects which would adversely affect the performance of maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification shall be new.

3.5 Interchangeability. All steam boilers or hot water generators of the same classification furnished with similar options under a specific contract shall be identical to the extent necessary to insure interchangeability of component parts, assemblies, accessories, and spare parts.

3.6 Design. The steam boiler or hot water generator shall be designed to withstand the normal strains, jars, and vibrations incidental to shipping, storage, and installation. The steam boiler or hot water generator shall be designed for an indoor or outdoor installation as specified (see 6.2). The steam boiler or hot water generator shall be designed for the following operating parameters as specified (see 6.2):

a. Design pressure (psig).
b. Operating pressure of steam at packaged unit outlet (psig).
c. Design temperature (°F).

d. Operating temperature of steam at packaged unit outlet (°F).
e. Maximum continuous steam output (Btu/hr).
f. Feedwater temperature (°F).
g. Maximum, minimum, and average anticipated ambient air temperatures (°F).
h. Site elevation above sea level (feet).

3.6.1 Design for thermal shock. The steam boiler or hot water generator shall be designed to withstand the water temperature differentials anticipated at the required operating conditions. Unless otherwise specified (see 6.2), the manufacturer may use any of the following methods to minimize potential thermal shock damage:

a. Natural internal circulation: Steam boilers or hot water generators designed for natural internal circulation shall be equipped with supply and return connections sized and located in accordance with the manufacturer's standard practice to provide sufficient natural thermal circulation for minimizing the effects of thermal shock.
b. Controlled internal circulation: Steam boilers or hot water generators designed for controlled internal circulation shall be equipped with supply and return connections so located that the return water on entering the shell will be mixed for tempering purposes with the hottest water in the boiler.
c. External controls: Controls shall consist of an automatic valve assembly mounted on the return connection which shall cause return water to be by-passed from the inlet piping on the unit to the system supply piping whenever the temperature of the return automatically re-establish flow through the return inlet when the unit has recovered sufficiently to restore the predetermined temperature differential.
d. Fuel rate control interlock: The system shall include a fuel rate control interlock that will limit the fuel feed rate until the water in the steam boiler or hot water generator attains a manually adjustable setpoint temperature.

3.7 Performance characteristics.

3.7.1 Steam purity. When a type I or type II boiler is required (see 3.1), the moisture content of the steam leaving the steam separator shall be not greater than 1.5 percent.

3.7.2 Thermal efficiency. When tested in accordance with 4.6.2, the thermal efficiency shall be not less than 81 percent for light and heavy oil fuels and not less than 81 percent for gas fuel, except for type I, size 1 steam boiler or type V, size 1 hot water generator at any firing rate. Type I, size 1 steam boilers or type V, size 1 hot water generators shall have a thermal efficiency of not less than 75 percent at any firing rate.

3.7.3 Furnace heat input rate. The steam boiler or hot water generator shall not exceed the required heat input rate to the furnace. The heat input rate for finned tube steam boiler or hot water generator shall not be greater than 12,000 Btu/hr based on internal heating area. The heat input rate for other steam boilers or hot water generators shall be not greater than 6,700 Btu/hr per square foot of fireside heating surface.

3.7.4 Exit temperature at stack. Unless otherwise specified (see 6.2), the exit temperature of the flue gas at the stack shall be not less than 325°F without an economizer. When exit temperatures of less than 325°F without an economizer are allowed, the flue gas passages shall be of corrosion resistant materials to prevent potential flue gas condensate corrosion problems.

When operating at minimum load and an economizer is required (see 3.16), the exiting flue gas temperature shall be not less than 300°F . The economizer water temperature at flue gas exit shall not be less than 220°F . When exit flue gas temperatures of less than 300°F are allowed, use corrosion resistant materials in the flue gas passages and economizer to prevent potential flue gas condensate corrosion problems.

3.8 Environmental requirements. The emission requirements shall be met at the maximum required continuous output. The steam boiler or hot water generator and burner, as applicable, shall meet the legal emission requirements required by the local, state, and Federal environmental rules and regulations. The emission requirements for opacity, particulates, nitrogen oxides, carbon monoxide, and sulfur dioxide shall be as specified (see 6.1.1 and 6.2)

3.9 Construction. Steam boilers or hot water generators shall be constructed for the specified design conditions and performance requirements and in accordance with the applicable sections of the ASME Code, UL-726, and UL-795 and the additional requirements specified herein.

3.9.1 Access and observations ports. Access doors and clean-out openings shall be furnished to provide access to all fireside surfaces for inspection, cleaning and repair. Heat-resisting observation ports shall be furnished to provide visual observation of combustion conditions. Manway ports shall be readily removable without damaging refractory. All openings shall be gas tight.

3.9.2 Refractories. Refractories shall withstand the temperatures present under maximum load conditions. The refractories shall be formed in place or cast in sections of such size as to be easily replaceable through existing openings. The refractory sections shall be designed and secured in position in such a manner as to withstand the vibration and shocks occurring during shipment.

3.9.3 Insulation. Insulation shall be in accordance with the requirements of UL-726 or UL-795. Asbestos material shall not be used for gaskets or insulation materials.

3.9.4 Hot water generator. When furnished (see 3.1), a hot water generator shall be designed to operate in a flooded condition without a steam space for pressure control. The expansion or pressure regulating vessel, feed water regulating valve, and associated controls are not considered part of this specification (see 6.1.1). The hot water generator shall have sufficient internal water for distribution to protect all tubes and prevent steam formation throughout the entire range of required operating condition.

3.9.5 Water pressure drop. Unless otherwise specified (see 6.2), the water pressure drop in a hot water generator shall be not greater than 10 psig. Flow restrictions causing temporary pressure drops shall not cause cavitation or flashing of the hot water when the generator is operated at the required temperature and pressure.

3.9.6 Drainage. The circulation system shall be equipped with a valve or valves to permit complete drainage by gravity or by blowing with compressed air in the tubes and vessels.

3.9.7 Hot water coils. When specified (see 6.2), manufacturer's standard internal hot water coils shall be provided for an auxiliary hot water generator. Coils may be constructed of either steel or copper tubing of not less than 0.75 inch outside diameter. The coils shall terminate in threaded inlet and outlet connections on the boiler exterior. The maximum temperature increase and flow rate required of the coil shall be as specified (see 6.2).

3.9.8 Combustion chamber. The combustion setting, walls , and floor shall be constructed in accordance with the commercial design utilized by the manufacturer and shall permit free expansion of the steam boiler or hot water generator without placing undue stress on any part of the boiler setting or tubes and tube sheets.

3.10 Watertube steam boilers and hot water generators. When required (see 3.1), straight bare or finned watertube steam boilers or hot generators shall be in accordance with the additional construction requirements of 3.10.1 through 3.10.2.

3.10.1 Tubes. Tubes shall be either electric-resistance welded or seamless steel. Tubes shall be either steel or copper. Tube bends shall be performed in a manner to permit cleaning of the internal surface of tubes with conventional tube-cleaning tools. Copper tubes shall be allowed only for type V hot water generators. Spinners, turbulators, and other such devices shall not be permitted in the tubes.

3.10.2 Baffles. Baffles shall be arranged to diffuse the gas properly over heating surfaces in order to obtain maximum heat absorption. The baffles shall be held securely in place without being affected by or interfering with the free expansion or contraction of the unit. If the baffles are steel they shall be not less than 0.25 inch thick, or of heat resistant alloy not less than 0.125 inch thick. Tangent tube baffles may be used in lieu of metal plate baffles. Baffles shall withstand the temperature under maximum load conditions. The partition wall between the furnace and boiler bank shall be of membrane wall construction if the remainder of the furnace is of similar construction.

3.11 Cast iron boilers and hot water generators. When required, cast iron steam boilers or hot water generators shall be in accordance with the additional construction requirements of 3.11.1 through 3.11.2.

3.11.1 Cast iron sections. Cast iron sections shall be connected to be free of leaks under all operating conditions.

3.11.2 Tubes. Cast iron headers may be connected with copper or steel bare or finned tubes. Access shall be provided to permit cleaning of the internal tube surface.

3.12 Firebox boilers and hot water generators. When required, firebox steam boilers or hot water generators shall be in accordance with the additional construction requirements of 3.12.1 through 3.12.4.

3.12.1 Shell. The shell shall be a horizontal steel pressure vessel of sufficient size to meet the performance requirements of this specification. The shell shall be equipped with all necessary connections including outlet nozzles, return connections, and connections for pressure relief valves, water level controls, and other required trim.

3.12.2 Tubes. Tubes shall be either electric-resistance welded or seamless steel. Tubes shall be attached to the tube sheets by a method permissible by the ASME Code.

3.12.3 Base. The boiler or hot water generator shall be mounted on steel saddles or equivalent steel supports fastened securely to a structural steel base. The base shall be capable of supporting the weight of the unit and its contained water.

3.12.4 Baffles. Baffles shall be arranged to diffuse the gas properly over heating surfaces in order to obtain maximum heat absorption. The baffles shall be held securely in place without being affected by or interfering with the free expansion or contraction of the unit.

3.13 Steam boiler and hot water generator trim. Each steam boiler or hot water generator shall be fully equipped with the trim required under the applicable section of the ASME Code for the type of unit specified herein. The additional appurtenances specified herein shall also be furnished. When disassembly is required for shipping clearance and prevention of damage during shipment, such trim and appurtenances may be field installed. The trim, valves, connection piping and fittings shall be suitable for the design pressure and temperature as specified herein. Instrumentation limit controls and switches shall be in accordance with the applicable requirements of ASME CSD-1, NFPA 85A, and UL-353. Signals shall be compatible with the control system required in the associated specification MIL-B-18796 or MIL-B-18797. Unless otherwise specified (see 6.2), the trim and appurtenances shall include but not necessarily be limited to the following:

a. High water level alarm for steam boilers.
b. Low water level alarm and a low water level fuel cutoff switch. The switch shall be mounted on a separate bridle with a drain valve.
c. A manual bypass momentary contact push button switch for the low water level cutoff switch of item b shall be located adjacent to the drain valves for the low water cutoff switch.
d. Piping and valves on steam boilers for continuous blowdown. The continuous blowdown valve shall have stainless steel trim and be able to maintain the position of a manual setting. The blowoff valves shall be one quick opening and one slow opening valve or a unit-tandem blowoff valve.

e. A top drum vent valve with threaded connection and corrosion resistant trim.
f. A chemical feed pipe connection with a diameter of not less than 0.75 inch with a corrosion-resistant trimmed stop valve installed on the feedwater inlet piping.
g. A temperature gage on the fluid outlet. This temperature gage may be one of the four gages to be furnished with an economizer when an economizer is to be furnished (see 3.16).

3.14 Feedwater regulator. Steam boilers, when furnished, shall be provided with an automatic feedwater regulating system to maintain the boiler manufacturer's established steaming water level. Feedwater regulators shall include the required sensing, actuating, regulating, and controlling equipment necessary to perform under the required conditions specified herein. The regulating system shall be provided complete with all necessary fittings, tubing, piping, mechanical linkages, wiring and other material or parts required to connect the operating components.

3.14.1 Feedwater regulating valve. Regulating valves shall be furnished with a double block and bleed piping bypass to allow the regulator valve to be removed while the boiler is operating. The regulating valve shall be equipped with a handwheel or knob for manual control and operation and shall have the manufacturer's standard position indicator. The valve shall be constructed with a balanced force design to allow the valve to move easily against the force of the feedwater flow. Materials of construction shall be the manufacturer's standard for good corrosion resistance in boiler feedwater service.

3.14.2 Manual feedwater regulator control. When specified (see 6.2), the feedwater regulator system shall be furnished with a switch for selecting manual or automatic control and a control mechanism for manually adjusting the feedwater regulator position. The direction in which the control mechanism should be operated to raise or lower the water level shall be clearly indicated.

3.15 Burners. Size 1 steam boilers or hot water generators shall be furnished with a factory installed burner, ignition system, programmed control system, and associated fuel system in accordance with MIL-B-18797. Size 2 and size 3 steam boilers or hot water generators shall be furnished with a factory installed burner, ignition system, programmed control system, and associated fuel system in accordance with MIL-B-18796.

3.15.1 Burner combustion control system. The burner firing rate shall be controlled as a function of the outlet pressure on steam boilers or outlet temperature on hot water generators. The burner combustion control system shall be in accordance with MIL-B-18796 or MIL-B-18797 as applicable. When specified (see 6.1.1 and 6.2), the combustion control system shall be furnished with an oxygen compensation system and shall be one of the following as specified (see 6.2).

a. Fixed rate, on-off control.
b. Three position high-low-off control.
c. Single point positioning control.
d. Parallel positioning control.
e. Metering control.

3.15.2 Control panel. The controls for the steam boiler or hot water generator, including operating switches, indicating lights, gages, alarms, motor starters, fuses and control system circuits shall be mounted on a single control panel or cabinet as practicable in order to centralize the control functions. The location of the panel shall either be at the side of the steam boiler or hot water generator, or in a remote, free-standing control cabinet as specified (see 6.2).

3.16 Economizer. When specified (see 6.1.1 and 6.2), a separately packaged economizer shall be furnished. The economizer shall be complete with prefabricated interconnecting breaching for attachment to the flue gas outlet and to the feed piping between the economizer and the feedwater inlet and shall require minimum field assembly. The economizer shall be equipped to heat feedwater. An automatic feedwater preheat system shall be provided when necessary to prevent potential flue gas condensation and corrosion. Temperature gages shall be furnished on the inlet and outlet piping of the flue gas and the feedwater. Manual valving shall also be provided to allow the feedwater to bypass around the economizer. The valving and piping shall be designed so that there is no shutoff valve between the economizer outlet and the steam drum inlet to eliminate the need for a separate economizer relief valve. The economizer shall be designed and constructed in accordance with the applicable the applicable section of the ASME Code. Materials used in construction shall withstand the temperatures and pressures prevailing under maximum load conditions.

3.17 Fuel oil preheaters. When specified (see 6.1.1 and 6.2), fuel preheating systems shall be furnished as part of the packaged steam boilers or hot water generators in addition to the trim preheater described in MIL-B-18796. The heater shall be either electric or steam, as specified (see 6.2). The heater and associated controls may be supplied either mounted on the packaged assembly or supplied separately for installation by the mechanical contractor. The preheating equipment shall be designed in accordance with Section VIII of the ASME Code. The system shall be designed to heat 120 percent of the maximum fuel oil flow from the specified oil supply temperature (see 6.2) to the required atomization temperature. Pressure drop across the preheater shall not exceed 15 psi. When the required fuel oil temperature is reached and maintained by the heater, a thermostatic control or limit switch shall cutoff the heater. A high temperature preheater cutoff switch shall also be provided with a manual reset. Temperature gages shall be provided to measure fuel oil inlet and outlet temperatures across the preheater.

3.17.1 Electric preheater. When the electric preheater is required (see 3.17), the preheater shall be furnished with a temperature controller to maintain the fuel oil temperature within 5 percent of the set point temperature. Preheater operating voltage shall be not greater than 480 volts. Electric preheaters rated up to 1,800 watts (W) shall be controlled by a line voltage thermostat switch or by a magnetic contactor with a coil operated by a thermostat. Preheaters rated at greater than 1,800 W shall be controlled by a magnetic contactor having a magnetic coil operated by a thermostat. The electric power and separate control circuits shall be protected by a circuit breaker located on the boiler assembly.

3.17.2 Steam preheater. When the steam preheater is required (see 3.17), the heater shall be designed for the boiler design pressure specified in 3.6 and shall use steam generated by the boiler. The preheater shall be furnished with an adjustable oil temperature regulator to maintain the fuel oil temperature with 5 percent of the set point temperature. Means shall be provided for visually detecting oil in the preheater condensate line.

3.17.2.1 Electric preheater within steam preheater. When specified (see 6.2), the steam preheater shall be furnished with an electric preheater in the same exchanger shell for cold start up. The electric preheater shall have sufficient capacity for the firing rate occurring when the combustion controls are in the position for low fire starts. The electric preheater shall be furnished in accordance with the requirements of 3.17.1.

3.18 Transition piece. Unless otherwise specified (see 6.2), the manufacturer's standard transition piece for adapting the flue gas outlet to a vertical free standing circular stack shall be furnished.

3.19 Electrical requirements. Electrical wiring design practices shall be in accordance with the applicable requirements of NFPA 70. The steam boiler or hot water generator and associated equipment shall obtain power from a circuit with a single master manual service disconnect switch and automatic circuit breaker for all boiler electrical equipment. Motors shall be in accordance with the provisions of NEMA MG 1, shall be totally enclosed fan cooled, and designed for operation on the voltage, phase, and frequency as specified (see 6.2). Unless otherwise specified (see 6.2), motors of 100 horsepower and less shall be provided with magnetic across-the-line starter and overload protection. Motors over 100 horsepower shall have reduced voltage starting. Motor starters shall conform to the applicable requirements of NEMA ICS 1 and ICS 2. Motor starters and controls shall be enclosed in NEMA ICS 6 Type 12 enclosures and may be installed in the control panel of 3.15.2.

3.20 Cleaning, treatment, and painting. All bare steel surfaces shall be cleaned and a good primer coat applied. Paint shall be applied over the primer coat to normally painted surfaces in good commercial practice.

3.21 Lifting and tiedown attachments. Size 3 steam boilers or hot water generators shall be equipped with lifting and tiedown attachments. Lifting and tiedowns attachments shall conform to type II or type III of MIL-STD-209. A nonferrous transportation plate shall be provided and mechanically attached to the unit. Transportation plates shall be inscribed with a diagram showing the lifting attachments and lifting slings, the capacity of each attachment, and the required length and size of each sling cable. A silhouette of the item furnished showing the center of gravity shall be provided on the transportation plate. Tiedown attachments may be identified by stenciling or other suitable marking. Tiedown marking shall clearly indicate that the attachments are intended for the tiedown of the boiler on the carrier when shipped.

3.22 Mounted operating instructions. Unless otherwise specified (see 6.2), operating instructions shall be summarized on a decal or corrosion resistant plate to be mounted inside the control panel door or similar weatherproofed location.

3.23 Identification marking. Identification shall be permanently and legibly marked directly on the unit or on a corrosion-resistant metal plate. Identification shall include manufacturer's name, unit model and serial number, thermal capacity, maximum allowable working pressure, ASME code stamp, year manufactured, and other pertinent information as identified in the ASME codes. The Department of Defense contract number that this equipment is procured under shall also be marked on the equipment or identification plate.

3.24 Spare parts. When specified (see 6.2), spare parts shall be furnished and shipped with each steam boiler or hot water generator. When furnished, the spare parts required and the quantity thereof shall be as specified (see 6.2).

3.25 Factory start-up service. Unless otherwise specified (see 6.1.1 and 6.2), factory service personnel shall be provided to supervise installation start-up of the packaged steam boiler or hot water generator for two 8-hour working days.

3.26 Workmanship. Workmanship shall be of such quality as to produce a steam boiler or hot water generator in accordance with the ASME Code, as applicable and shall meet the requirements of this specification and standards prevailing among manufacturers who normally produce this type of equipment.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of section 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 Component and material inspection. Components and materials shall be inspected in accordance with all the requirements specified herein and in applicable referenced documents.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

a. Quality conformance inspection (see 4.2.1).
b. On-site inspection (see 4.2.2).

4.2.1 Quality conformance. This inspection shall be performed at the manufacturer's facilities. Unless otherwise specified (see 6.2), the quality conformance inspection shall include the examination of 4.3, the fuel system test of 4.4, and the relief valve set pressure test of 4.5, and the packaging inspection of 4.7.

4.2.2 On-site inspection. The on-site inspection shall be in addition to the quality conformance inspection performed at the manufacturer's facilities. Unless otherwise specified (see 6.2), the on-site inspection shall consist of the tests of 4.6. All or part of the on-site inspection may be performed at the manufacturer's facilities when specified by the contracting officer (see 6.2). The tests of 4.3 and 4.4 shall be repeated on-site if specified (see 6.2).

4.3 Examination. Each steam boiler or hot water generator and related equipment supplied under this specification shall be examined for compliance with the requirements specified in section 3 of this specification. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability.

4.4 Fuel systems. The preassembled fuel system that is furnished integrally with the steam boiler or hot water generator shall be checked for leakage during the fire testing of the steam boiler or hot water generator. The soap bubble or the halogen-sniff test method shall be used to verify integrity of the gas fuel system. Failure to meet the requirements of 3.15 shall constitute cause for rejection.

4.5 Relief valve set pressure test. Relief valves required by the ASME Code shall be individually tested on a test bench using a gas to confirm the required set pressure. The test shall be conducted at a facility that normally performs this work.

4.6 On-site tests. Operational fire tests and auxiliary equipment tests shall be performed on each installed steam boiler or hot water generator. These tests shall be in addition to any manufacturer's standard fire test procedure, unless compliance evidence provided by the manufacturer is accepted at the discretion of the contracting officer or authorized representative. Acceptable fire test results from identical or similar equipment installed at the same site may also be used at the discretion of the contracting officer as proof that equipment procured with this specification is in compliance with one or more of the tests of 4.6.1 through 4.6.8.

4.6.1 Operational tests. The steam boiler or hot water generator shall be tested to demonstrate control and operational conformance to the requirements of this specification and MIL-B-18796, or MIL-B-18797, as applicable, under varying load conditions ranging from the specified maximum capacity to the minimum turndown ratio without on-off cycling. Unless otherwise specified (see 6.2), oil burners shall be tested for ability to make a cold start from the fuel oil supply temperature specified in 3.17. Automatic burners shall also be tested for ability to provide steam or hot water in accordance with demand when on-off cycling is required. The economizer, when required, shall satisfy the temperature requirements of 3.16. A steam boiler or hot water generator that

exhibits (1) excessive or unexplained loss of ignition, (2) nuisance shutdown due to faulty burner or control operation, (3) improper flame, (4) excessive carbon deposits, or (5) necessity for frequent or difficult adjustments shall be rejected.

4.6.2 Capacity and efficiency tests. The capacity and efficiency of type I, size 1 steam boilers or type V, size 1 hot water generators shall be determined in accordance with the Hydronics Institute Testing and Rating Standard for Heating Boilers. The capacity and efficiency, and if required, steam quality at the maximum specified capacity of all other steam boilers or hot water generators shall be determined in accordance with the abbreviated efficiency test of ASME PTC 4.1 using the heat loss method. Performance shall be as specified in 3.7. Methods of measuring the flow of steam, water, and fuel other than weighing will be allowed. The accuracy of the method shall assure the Government the performance specified in 3.7 and be acceptable to the contracting officer or authorized representatives. Failure to meet the requirements of 3.7 shall constitute cause for rejection.

4.6.3 Equipment tests. Control panels, preheaters, insulation, valves, controllers, regulators, soot blowers, electric motors, dampers, and other boiler related equipment shall be operated as part of the capacity and efficiency tests. The operation of this equipment shall be closely observed during the operational tests for possible defects or nonconformance. The action of dampers, actuators, and valves shall be smooth without backlash.

4.6.4 Sequencing. The steam boiler or hot water generator shall start, operate, and stop in strict accordance with the specified operating sequence.

4.6.5 Burner tests. Tests shall be conducted on the burner as specified in MIL-B-18796 and MIL-B-18797 as applicable, addition to the testing specified herein.

4.6.6 Limit and cutout switches. Safety shutdowns shall be caused by simulating fuel safety interlock actuating conditions for each steam boiler or hot water generator limit and cutout switch specified in 3.13. The safety shutdowns shall occur without damage to the equipment.

4.6.7 Blowdown valves and try cocks. All blowdown valves and try cocks shall be tested for proper operation.

4.6.8 Emissions testing. The emissions testing for opacity, particulates, nitrogen oxides, carbon monoxide, and sulfur dioxide specified in 3.8 shall be conducted in accordance with the procedures of the governing Federal, state, or local environmental agency, as specified (see 6.2).

4.7 Inspection of packaging. The inspection of the preservation, packing, and container marking shall be in accordance with the requirements of section 4 of MIL-B-3180.

5. PACKAGING

5.1 Preservation, packing, and marking. The steam boilers or hot water generator shall be preserved, packed and marked in accordance with MIL-B-3180. The level of preservation and packing shall be as specified (see 6.2).

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The steam boilers and hot water generators covered by this specification are intended for generation of steam or hot water to be used in processing operations and space heating systems in land installations.

6.1.1 Selection factors. The following should be considered in the selection of a boiler and the exercise of options herein:

a. The fuel class should be determined in accordance with the availability or economics of the fuel supply and any DOD requirements for capability of firing multiple fuels (see 3.1).
b. Normally, oil-fired units above 5,000,000 Btu/hr thermal output should be capable of burning fuel oil grades No. 2, No. 4, No. 5, and No. 6. When changing grade of fuel, replacement may be necessary (1) of the fuel nozzles because of the different fuel viscosity, and (2) of the fuel pump motor to drive the pump at a speed that ensures required fuel pressure in order to maintain the required burner output and meet the optimum air to fuel ratio (see 3.1).
c. If the unit is subject to environmental regulations, each agency should consult with their environmental support office since regulation limits of emissions vary between local, state, and federal agencies (see 3.8).
d. Hot water generator systems should use a nitrogen pressured vessel for pressure control. The pressure control vessel is not part of the typical packaged unit. The feedwater controller for the hot water generator should be mounted on the nitrogen pressured vessel (see 3.9.4).
e. Oxygen compensation systems should not be specified for fixed rate on-off, or three position high-low combustion controls (see 3.15.1).
f. The minimum water outlet temperature shall be 170°F to protect the tubes from corrosion caused by condensing flue gases. A separate mixing system should be installed if a lower hot water temperature is required (see 3.16).
g. A packaged steam boiler or hot water generator mounted preheater should be specified only at installations of single heavy oil fired units. It is more economic for multiple unit installations to use a common preheater that is external from the individual packaged unit skids (see 3.17).
h. Electric preheaters should be furnished on units firing No. 4 or No. 5 (light) fuel oil if required for proper atomization in low pressure, air atomizing systems (see 3.17).
i. Factory service should be specified only if the unit will be installed and tested without a long period of interim storage (see 3.25).
j. Fungus resistant varnish conforming to MIL-V-173 should be used to coat electrical components and circuit elements, including terminal and circuit connections, when the boiler is to be installed in humid conditions. Components and elements inherently inert to fungi or in hermetically sealed enclosures or current-carrying contact surfaces should not be coated.

1. Electromagnetic interference suppression (EMI), when required, should conform to the EMI suppression requirements and test limits for class C3, group I equipment as specified in MIL-STD-461. The boiler should be subjected to tests to determine conformance in accordance with MIL-STD-462.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, date, and number of this specification.
b. Types, sizes, and classes of steam boilers boilers or hot water generators required (see 1.2).
c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
d. When the packaged unit is a steam boiler or hot water generator (see 3.1).
e. Whether the steam boiler or hot water generator is to be a watertube design with straight bare or finned tubes, a cast iron design, or a firebox design (see 3.1).
f. Thermal output capacity of steam boiler or hot water generator (see 3.1).
g. Fuel required (see 3.1).
h. When the steam boiler or hot water generator is to be designed for an indoor or outdoor installation (see 3.6).
i. Design parameters for steam boiler or hot water generator (see 3.6):

   (1) Design pressure (psig).
   (2) Operating pressure at packaged unit outlet (psig).
   (3) Design temperature (°F).
   (4) Operating temperature of steam at packaged unit outlet (°F).
   (5) Maximum continuous thermal output (Btu/hr).
   (6) Feedwater temperature (°F).
   (7) Maximum, minimum, and average anticipated ambient air temperature (°F).
   (8) Site elevation above sea level (feet).

j. When the method to control thermal shock is to be a specific method or methods (see 3.6.1).
k. When the flue gas exit temperature may be less than 325°F (See 3.7.4).
l. Emission requirements for opacity, particulates, and nitrogen oxides, carbon monoxide, and sulfur dioxide (see 3.8).
m. When water pressure drop in a hot water generator is to be greater than 10 psig (see 3.9.5).
n. When hot water coils are to be provided (see 3.9.7).
o. Maximum temperature increase and flow rate in hot water coil (see 3.9.7).
p. Steam boiler or hot water generator trim and appurtenances, if other than as specified (see 3.13).
q. When a feedwater regulator system is to be furnished with a switch for selecting manual and automatic switch and a control mechanism for manually adjusting the feedwater regulator position (see 3.14.2)

r. Whether the combustion control system shall be furnished with an unburned combustible gas analyzer or neither (see 3.15.1).
s. Type of burner combustion control system required (see 3.15.1).
t. Location of control panel (see 3.15.2).
u. When an economizer is required (see 3.16).
v. When a fuel preheater is required. If required, type of preheater to be provided (see 3.17).
w. Fuel oil supply temperature (see 3.17).
x. When the steam preheater is to be furnished with an electric preheater (see 3.17.2.1).
y. When the transition piece is to be other than as specified (see 3.18).
z. Required voltage, phase, and frequency for operation of motors (see 3.19).
aa. When motors of 100 horsepower and less are not to be provided with magnetic across-the-line starter and overload protection (see 3.19).
bb. When mounted operating instructions are other than as specified (see 3.22).
cc. When spare parts are required. If required, the type of spare parts and quantity to be provided (see 3.24).
dd. When factory start-up service is other than as specified (see 3.25).
ee. Quality conformance inspection, of other than as specified (see 4.2.1).
ff. On-site inspection, if other than as specified (see 4.2.2).
gg. Location of on-site inspection tests, if other than as specified (see 4.2.2).
hh. Whether tests of 4.3 or 4.4 shall be repeated after boiler delivery on-site (see 4.2.2).
ii. When oil burners are not to be cold start tested (see 4.6.1).
jj. Testing procedures of the governing Federal, state, or local environmental agency for opacity, particulates, nitrogen oxides, carbon monoxide, and sulfur dioxide (see 4.6.8).
kk. Level of preservation and level of packing required (see 5.1).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Description (DIDs) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DIDs are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Reference paragraph	DID Number	DID Title
6.3.1.1, 6.3.1.2 6.3.1.3, 6.3.2, 6.3.4 and 6.3.6	MISC-80678	Certification, Data/Report
6.3.3	UDI-E-21344	Instruction, Equipment Installation
6.3.5	DI-M-2050	Commercial Manuals

The above DIDs were those cleared as of the date of this specification. The current issue of DoD 5010.12L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DIDs are cited on the DD Form 1423.

6.3.1 Compliance. Prior to approval of shipment, the contractor should submit to the contracting officer or authorized representative satisfactory evidence that the proposed boiler or hot water generator to be furnished under this specification meets the requirements of Section I, Section IV, and Section VIII of the ASME Code, ASME CSD-1, NFPA 85A, UL-353, UL-726, and UL-795.

6.3.1.1 ASME Code requirements. Acceptable evidence of meeting the requirements of Section I, Section IV, and when an economizer or preheater is required, Section VIII of the ASME Code should be the ASME Code symbol and when specified, receipt of the completed manufacturer's data reports for the specified steam boiler or hot water generator, or pressure vessel.

6.3.1.2 ASME CSD-1 requirements. Acceptable evidence of meeting the requirements of ASME CSD-1 should be the receipt of a manufacturer's certificate of compliance, stating the equipment procured with this specification is in accordance with the applicable requirements of ASME CSD-1.

6.3.1.3 NFPA requirements. Acceptable evidence of meeting the requirements of NFPA 70 and NFPA 85A should be the receipt of the manufacturer's certificate of compliance stating the equipment procured with this specification is in accordance with the applicable requirements of NFPA 70 and 85A.

6.3.1.4 UL requirements. Acceptable evidence of meeting the requirements of UL-353, UL 726 or UL 795 should be the certification symbol, or listing mark on the products, or a certified test report from a recognized independent testing laboratory indicating the steam boiler or hot water generator controls have been tested and conforms to UL requirements.

6.3.2 Design Verification. The manufacturer should furnish data to verify compliance with the specified heat input rate (see 3.7.3).

6.3.3 Control panel. When a remote, free-standing mounted control panel is to be furnished, skid wiring or tubing should terminate in a skid mounted junction box and installation instructions covering the connection of the control panel should be provided (see 3.15.2).

6.3.4 Relief valve. A certificate of compliance verifying the performance and results of the relief valve pressure test (see 4.5) should be provided to the contracting officer.

6.3.5 Technical manuals. The manufacturer should provide three commercial technical manuals normally prepared and supplied with the steam boiler or hot water generator.

6.3.6 Design for thermal shock. The manufacturer should furnish data to verify compliance with the design for thermal shock (see 3.6.1).

6.3.7 Boiler operational certification (Navy Only). The boiler operational certification should be performed, where applicable, per NAVFAC MO-324, after the boiler complies with the on-site tests (see 4.6). The boiler inspector should be certified by NAVFAC and licensed by the Engineering Field Division.

6.4 Definitions. Definitions used in this specification have been in accordance with the ABMA Lexicon of Boiler and Auxiliary Equipment. Other terms used in this specification should be interpreted in accordance with the referenced national standards.

6.5 Cross-reference of classifications. The classification of boilers in this document differs from the previous revision in the following respects:

MIL-B-18897E		MIL-B-18897F	
	TYPES		TYPES
Type I	- Firetube (horizontal return tubular and horizontal fire box).	Type I	- Steam boiler producing low pressure steam not greater than 15 psig.
Type II	- Water tube (steel-tube, copper tube).	Type II	- Steam boiler producing high pressure steam between 16 and 150 psig.
Type III	- Cast Iron Sectional	Type III	- None.
Type V	- None.	Type V	- Hot water generator producing low temperature water not greater than 160 psig or 250°F.
	SIZES		SIZES
Size 1	- None.	Size 1	- Thermal output capacity between 40,000 and 320,000 Btu/hr).
Size 2	- None.	Size 2	- Thermal output capacity between 320,001 and 10,000,000 Btu/hr.
Size 3	- None.	Size 3	- Thermal output capacity between 10,000,001 and 35,000,000 Btu/hr.

MIL-B-18897E - Continued		MIL-B-18897F - Continued	
CLASSES		CLASSES	
Class 1	- Steam.	Class 1	- Heavy oil fired.
Class 2	- Hot water.	Class 2	- Light oil fired.
Class 3	- None.	Class 3	- Gas fired.
Class 4	- None.	Class 4	- Combination heavy oil and gas fired.
Class 5	- None	Class 5	- Combination light oil and gas fired.
STYLES		STYLES	
Style B	- Coal automatic, stoker fired.	Style B	- Deleted.
Style C	- Oil, automatic, fired.	Style C	- Deleted.
Style D	- Gas, automatic, fired.	Style D	- Deleted.
Style G	- Oil and gas combination, automatic-fired.	Style G	- Deleted.
Style H	- Oil, automatic-fired, convertible to solid fuel firing; gross output capacity 2,000,000 Btu/hr or greater.	Style H	- Deleted.
Style I	- Gas, automatic-fired, convertible to solid fuel firing; gross output capacity 2,000,000 Btu/hr or greater.	Style I	- Deleted.

6.6 Subject term (key word) listing.

Boiler
Cast iron
Firebox
Firetube
Finned tube

Gas fired
Hot water generator
Oil fired
Steam
Watertube

6.7 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - ME
Navy - YD
Air Force - 99

Review Activities:
Navy - SA
Air Force - 84

User Activities:
Army - CE
Navy - MC

Preparing Activity:
Navy - YD

(Project 4410-0070)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE	1. DOCUMENT NUMBER	2. DOCUMENT DATE (YYMMDD)
	MIL-B-18897F	1990 September 6

3. DOCUMENT TITLE BOILERS, STEAM AND HOT WATER, WATERTUBE (STRAIGHT BARE AND FINNED TUBE), CAST IRON AND FIREBOX, PACKAGED TYPE (40,000 to 35,000,000 BTU/HR THERMAL OUTPUT CAPACITY

4. NATURE OF CHANGE *(Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)*

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, MI)	b. ORGANIZATION	
c. ADDRESS (Include Zip Code)	d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	e. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME	b. TELEPHONE (Include Area Code) (1) Commercial	(2) AUTOVON
D. C. MUI, Project Manager FACILITIES ENGINEERING DEV.CRITERIA DIV.	(805) 982-5801 x424	551-5801 x424
c. ADDRESS (Include Zip Code) Commanding Officer (156) Naval Construction Battalion Center Port Hueneme, CA 93043-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	