[INCH-POUND]
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SUPERSEDING
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FEDERAL SPECIFICATION

BOILERS, STEAM AND HOT WATER, FIRETUBE, SCOTCH PACKAGED TYPE (320,001 TO 35,000,000 BTU/HR THERMAL OUTPUT CAPACITY)

The General Services Administration has authorized the use of this specification by all Federal agencies.

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers scotch firetube packaged steam boilers and hot water generators.

1.2 Classification. The steam boiler or hot water generator shall be of the following types, sizes, and classes (see 6.2).

TYPES

Type I - Steam boiler producing low pressure steam not greater than 15 pounds per square inch gage pressure (psig) (103 kilopascal gage (kPa (gage)) pressure.
Type II - Steam boiler producing high pressure steam between 16 and 150 psig (111 and 1 034 kPa (gage)).
Type III - Steam boiler producing high pressure steam between 151 and 350 psig (1 041 and 2 413 kPa (gage)).
Type V - Hot water generator producing low temperature water not greater than 160 psig (1 103 kPa (gage)) or 250 degrees Fahrenheit (°F) (121° Celsius (°C)).
Type VI - Hot water generator producing high temperature water not less than 161 psig (1 110 kPa (gage)) or 251 °F (121 °C).

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data which may improve this document should be sent to: Officer In Charge (Code 15E2), Seabee Logistics Center, 4111 San Pedro St., Port Hueneme, CA 93043-4410, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

SIZES

Size 2 - Thermal output capacity between 320,001 and 10,000,000 British thermal units per hour (Btu/hr) (93 783 and 2 930 711 watts (W)).
Size 3 - Thermal output capacity between 10,000,001 and 35,000,000 Btu/hr (2 930 711 and 10 257 489 W).

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 publications. The following documents, of this issues in effect on the date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

Federal Specification

F-B-2910 - Burners, Single: Oil, Gas, and Gas-Oil Combination for Packaged Boilers (320,000 to 125,000,000 Btu/hr Thermal Output Capacity).

Military Standard

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

(Copies federal and military specifications and standards required by contractors in connection with specific procurement functions are obtained from Defense Automated Printing Services, Attn: DoDSSP, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply.

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI S1.13 - Measurement of Sound Pressure Levels in Air.

(Private sector and civil agencies may purchase copies of this voluntary standards from the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

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

(Private sector and civil agencies may purchase copies of these voluntary standards from 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 Controls and Systems.
NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
NEMA MG 1 - Standards for Motors and Generators.

(Private sector and civil agencies may purchase copies of these voluntary standards from the National Electrical Manufacturers Association, 1300 North 17th Street, Suite 1847, Rosslyn, VA 22209.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA 70 - National Electrical Code.
NFPA 8501 - Single Burner-Boiler Operation.

(Private sector and civil agencies may purchase copies of these voluntary standards from the National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.)

UNDERWRITERS LABORATORIES, INC. (UL)

UL 353 - Limit Controls.

(Private sector and civil agencies may purchase copies of these voluntary standards from the Underwriters Laboratories, Inc., 333 Pfingsten Road, Northbrook, IL 60062.)

(DoD activities may obtain copies of those adopted voluntary standards listed in the DoD Index of Specifications and Standards free of charge from the from Defense Automated Printing Services, Attn: DoDSSP, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Description. The packaged unit shall be a steam boiler or a hot water generator as specified (see 6.2). The steam boiler or hot water generator shall be of a packaged scotch firetube design. The boiler or hot water generator shall be capable of producing the thermal output as specified (see 6.2). The steam boiler or hot water generator shall be furnished complete with all appurtenances specified herein and shall be factory-wired and ready for operation when connected to water, fuel, and electrical supplies. The steam boiler or hot water generator shall be fired on the fuel specified (see 6.1 and 6.2). The steam boiler or hot water generator shall be furnished complete with the burner specified in F-B-2910.

3.2 Codes and standards. The steam 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, and NFPA 8501. 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.

3.4 Materials. Materials used shall be free from defects which would adversely affect the performance or 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 are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification.

3.5 Interchangeability. All units of the same classification furnished with similar options under a specific contract shall be identical to the extent necessary to ensure interchangeability of component parts, assemblies, accessories, and spare parts.

3.5.1 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 finished product, provided form, fit, and function requirements are satisfied.

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 (kPa (gage)).

b. Operating pressure of steam at packaged unit outlet (psig (kPa (gage)).

c. Design temperature (°F (°C)).

d. Operating temperature of steam or water at packaged unit outlet (°F (°C)).

e. Maximum continuous thermal output (Btu/hr (W)).

f. Feedwater temperature (°F (°C)).

g. Maximum, minimum, and average anticipated ambient air temperatures (°F (°C)).

h. Site elevation above sea level (feet (metre (m)).

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. The connections shall be sized and located in accordance with the manufacturer's standard practice. These connections shall 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. The connections shall be located so that the return water on entering the shell will be mixed for tempering purposes with the hottest water in the boiler.

c. External controls: External control shall consist of an automatic valve assembly mounted on the return connection. The control shall cause return water to be by-passed from the

inlet piping on the steam boiler or hot water generator to the system supply piping whenever the temperature of the return water falls below a preset temperature. The bypass system shall automatically reestablish flow through the return inlet when the steam boiler or hot water generator has recovered sufficiently to restore the predetermined temperature differential.

d. Fuel rate control interlock. The steam 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, type II, or type III steam boiler is required (see 1.2 and 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 fuel oils and 77 percent for gas fuel at any firing rate.

3.7.3 Furnace heat input rate. Unless otherwise specified (see 6.2), when the steam boiler or hot water generator is operating at maximum output, the heat transfer rate shall be not greater than 6,700 Btu/hr per square foot (21 136 watts per square metre). The heat transfer rate shall be determined on the basis of the furnace input Btu/hr (W) times the thermal efficiency divided by the total furnace 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 (162 °C) without an economizer. When exit temperatures of less than 325 °F (162 °C) 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 3.13), the exiting flue gas temperature shall be not less than 300 °F (149 °C). The economizer water temperature at flue gas exit shall not be less than 220 °F (104 °C). When exit flue gas temperatures of less than 300 °F (149 °C) 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, 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 and when specified see 6.2). When specified (see 6.2), sound levels shall be not greater than 85 DBA when measured 4.5 feet (1.5 m) above the floor and 3 feet (1 m) horizontally from each surface of the smallest imaginary rectangular box which could completely enclose the entire unit which contains the sound source. Sound level limitations apply to the operation of the equipment at all loads within the equipment requirements. Sound level limitations apply to all burners, fans, blowers, pumps, compressors,

control valves, pressure reducing valves, motors, turbines. Tests will be performed using a standard sound level meter on the "A" scale, slow response. At the option and expense of the procuring agency, a testing company may be employed to conduct tests using methods conforming ANSI S1.13. If sound levels exceed requirements, modify or replace the equipment as necessary to achieve required sound levels and other specified requirements.

a. Submit all proposed modifications or replacements for review prior to starting the work.
b. After completing the work, provide complete retest of equipment operation.

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

3.9.1 Hot water generator. When furnished (see 3.1), a hot water generator shall be constructed to operate in a flooded condition without 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 when a hot water generator is required (see 6.1).

3.9.2 Water pressure drop. Unless otherwise specified (see 6.2), when a hot water generator is furnished (see 3.1), the water pressure drop shall be not greater than 10 psig (69 kPa (gage)). Flow restrictions causing temporary pressure drops shall not cause cavitation of flushing of the hot water when the hot water generator is operated at the required temperature and pressure.

3.9.3 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. Spinners, turbulators, and other such devices shall not be permitted in the firetubes.

3.9.4 Base. The steam 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 steam boiler or hot water generator and its contained water.

3.9.5 Access door and observation ports. The steam boiler or hot water generator shall be equipped with an access door for internal inspection and repairing of the furnace fireside. The steam boiler or hot water generator shall be equipped with coverplates and handholes to allow for internal inspection and cleaning. Not less than one observation port shall be provided to permit operators to see the furnace interior and flame pattern. Observation ports may be clear or tinted.

3.9.6 Baffles. Baffles, as required, 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 boiler.

3.9.7 Refractories. Refractories shall withstand the temperature existing 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.

3.9.8 Insulation. All exterior surfaces of the steam boiler or hot water generator, including the floor, but excluding doors, handholes, manholes, vents, and appurtenances, shall be insulated and jacketed. No asbestos material shall be used. The insulation shall be so formed and secured in place as to prevent sagging or displacement during shipment and operation. The insulation shall be covered with a sheet metal jacket made of steel having a thickness of not less than 24 Standard Gage (0.023-inch) (0.584 millimetre (mm)) or of nonferrous sheet metal having a thickness of not less than 22 Standard Gage (0.029-inch) (0.737 mm). All sections of the steam boiler or hot water generator exposed to the products of combustion shall be backed by refractory, by insulation, or both, to maintain a casing temperature of not greater than 130 °F (54 °C) with a surface air velocity of 5 feet (1.5 m) per second and an ambient temperature of 80 °F (27 °C) while the boiler is operating at maximum capacity.

3.10 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 steam boiler or hot water generator 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, connecting piping, and fittings shall be suitable for the design pressure and temperature as specified herein. Instrumentation limit controls and interlock switches shall be in accordance with the applicable requirements of ASME CSD-1, NFPA 8501, and UL 353. Signals shall be compatible with the control system required in F-B-2910. 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, with manual reset 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.

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 (19.05 mm) with a corrosion-resistant trimmed stop valve installed on the top drum and 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 3.13).

h. A flow switch (as specified) installed on the inlet hot water return piping and interlocked with the fuel-burning equipment to prevent start-up and initiate a unit shutdown if a no-flow condition is sensed (hot water boilers only).

3.11 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.

3.11.1 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.

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

3.12 Burners. The steam boiler or hot water generator shall be furnished with a factory installed burner, ignition system, and associated fuel system in accordance with F-B-2910.

3.12.1 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 F-B-2910. When specified (see 6.1 and 6.2), the combustion control system shall be furnished with oxygen compensation system or an oxygen compensation system with an unburned combustible gas analyzer. The combustion control system 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.

3.12.2 Control panel. The controls for the steam boiler or hot water generator and burner, 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 steam boiler or hot water generator, or in a remote, free-standing control cabinet as specified (see 6.2). All control circuits shall be two wire, one side grounded, not greater than nominal 120 volts, and be protected, with suitable fuses or circuit breakers.

3.13 Economizer. When specified (see 6.1 and 6.2), a separately packaged economizer shall be furnished. The economizer shall be complete with prefabricated interconnecting breeching 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. The economizer shall be designed and constructed in accordance with the applicable section of the ASME Code. Materials used in construction shall withstand the temperatures and pressures prevailing under maximum load conditions.

3.14 Soot blowers. When specified (see 6.1 and 6.2), the steam boiler or hot water generator shall be provided with a soot blowing system. The system shall be able to remove soot from the firetubes while the steam boiler or hot water generator is operating. Soot blower piping shall be able to be operated from the floor and shall include the necessary gages, valves, and drains. The soot blower piping shall be fitted with a continuous purge to prevent plugging of blower nozzles while the system is not operated.

3.15 Fuel oil preheaters. When specified (see 6.1 and 6.2), fuel preheating systems shall be furnished as part of the packaged boiler in addition to the trim preheater described in F-B-2910. 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 be not greater than 15 psi (103 kPa (gage)). When the required fuel oil temperature is reached and maintained by the heater, a thermostatic control or limit switch shall cut off 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.

3.15.1 Electric preheater. When the electric preheater is required (see 3.15), 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 not be greater than 230 volts. Electric preheaters rated up to 1,800 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.

3.15.2 Steam preheater. When the steam preheater is required (see 3.15), 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 within 5 percent of the set point temperature. Means shall be provided for visually detecting oil in the preheater condensate line.

3.15.2.1 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 startup. 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 3.15.1.

3.16 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.

3.17 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 (74 570 W) and less shall be provided with magnetic across-the-line starter and overload protection. Motors over 100 horsepower (74,570 W) 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 3.12.1.

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

3.19 Lifting and tiedown attachments. When specified (see 6.2), the steam boiler or hot water generator shall be equipped with lifting and tiedown attachments. Lifting and tiedown 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 boiler. 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 tie down of the boiler on the carrier when shipped.

3.20 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.

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

3.22 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).

3.23 Factory start-up service. Unless otherwise specified (see 6.1 and 6.2), factory authorized service personnel shall be provided to supervise installation and startup of the packaged steam boiler or hot water generator for two 8-hour working days.

3.24 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, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract, 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 this document where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this document shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this document shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain

conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept 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 inspection. The quality conformance inspection shall include the examination of 4.3, the fuel system test of 4.4, and the relief valve test of 4.5. This inspection shall be performed at the manufacturer's facilities on the samples selected in accordance with 4.3.

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). When specified (see 6.2), the examination of 4.3 and the fuel system test of 4.4 shall be repeated on-site.

4.3 Examination. Each 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 3.12 shall constitute cause for rejection.

4.5 Relief valve set pressure test. Relief valves required by the ASME Code shall be individually tested in a 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 test 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 boiler or hot water generator manufacturer is accepted at the discretion of the contracting officer or authorized representative. Acceptable fire test results from identical or similar boiler equipment

installed at the same site may 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 test 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 F-B-2910. The test shall be performed 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 3.15. 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 3.13. 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, and if required, steam quality at the specified maximum capacity of the steam boiler or hot water generator 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 desired 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 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 test. Burner test shall be conducted on the burner as specified in F-B-2910 in addition to the testing specified herein.

4.6.6 Limit and cutoff switches. Safety shutdowns shall be caused by simulating fuel safety interlock actuating conditions for each steam boiler or hot water generator limit cutoff switch specified in 3.10. 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 required 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).

5. PACKAGING

5.1 Packaging requirements. The preservation, packing, and marking shall be as specified by the contract or order.

6. NOTES

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

6.1 Intended use. The steam boilers and hot water generators covered by this specification range up to 350 psig (1041 kPa (gage)) and 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 steam boiler or hot water generator 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 steam boilers or hot water generators above 5,000,000 Btu/hr (1 465 356 W) 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 steam boiler or hot water generator 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 steam boiler or hot water generator. The feedwater controller for the hot water generator should be mounted on the nitrogen pressured vessel (see 3.9.1).

e. Oxygen compensation systems should not be specified for fixed rate on-off, or three position high-low-off combustion controls (see 3.12.1).

f. The water outlet temperature should be not less than 220 °F (104 °C) 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 3.13).

g. Soot blowers should only be specified for size 3, class 1 or class 4 steam boiler or hot water generator. Soot blowers are seldom required and almost never used on scotch boilers firing even no. 6 oil (see 3.14).

h. A mounted preheater should be specified only at installations of steam boiler or hot water generator installations to use a common preheater that is external from the individual packaged steam boiler or hot water generator skids (see 3.15).

i. 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 3.15).

j. Factory service should be specified only if the steam boiler or hot water generator will be installed and tested without a long period of interim storage (see 3.23).

k. 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.

l. Electromagnetic interference suppression (EMI), when required, should conform to the EMI suppression requirements and test limits for Class 3, Group I equipments as specified in MIL-STD-461. The steam 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 or hot water generators required (see 1.2).
c. When the packaged unit is a steam boiler or hot water generator (see 3.1).
d. Thermal output capacity of steam boiler or hot water generator (see 3.1).
e. Fuel required (see 3.1).
f. Whether the steam boiler or hot water generator is to be designed for an indoor or outdoor installation (see 3.6).
g. Design parameters for steam boilers or hot water generators (see 3.6).
h. Method to control thermal shock, if other than as specified (see 3.6.1).
i. The heat transfer rate, if other than as specified (See 3.7.3).
j. When the flue gas exit temperature may be less than 325 °F (163 °C) (see 3.7.4).
k. Emission requirements for opacity, particulates, nitrogen oxides, carbon monoxides, and sulfur dioxide (see 3.8).
l. When sound levels of not greater than 85 DBA as specified is required (See 3.8).

m. When the water pressure drop in a hot water generator is to be greater than 10 psig (see 3.9.2).
n. Steam boiler or hot water generator trim and appurtenance, if other than as specified (see 3.10).
o. When a feedwater regulating system is to be furnished with a manual and automatic switch and a control mechanism for manually adjusting the feedwater regulator positions (see 3.11.2).
p. When the combustion control system is to be furnished with an oxygen compensation system or oxygen compensation system with an unburned combustible gas analyzer (see 3.12.1).
q. Type of burner combustion control system required (see 3.12.1).
r. Location of control panel (see 3.12.2).
s. When a economizer is required (see 3.13).
t. When soot blowers are required (see 3.14).
u. When fuel oil preheater is required. If required, type of preheater to be provided (see 3.15).
v. Fuel oil supply temperature (see 3.15).
w. When the steam preheater is to be furnished with an electric preheater (see 3.15.2.1).
x. When the transition piece is to be other than as specified (see 3.16).
y. Required voltage, phase, and frequency for operation of motors (see 3.17).
z. When motors of 100 horsepower (74 570 W) and less are not to be provided with across-the-line starter and overload protection (see 3.17).
aa. When lifting and tiedown attachments are required (see 3.19).
bb. When mounted operating instructions are other than as specified (see 3.20).
cc. When spare parts are required. If required, the type of spare parts and quantity to be provided (see 3.22).
dd. When factory startup service is other than as specified (see 3.23).
ee. On-site inspection, if other than as specified (see 4.2.2). Location of on-site inspection
ff. tests, if other than as specified (see 4.2.2).Whether examination of 4.3 and the test of 4.4
gg. are to be repeated after delivery on-site (see 4.2.2)
hh. When oil burners are not to be tested to make a cold start (see 4.6.1).
ii Agency required procedures for emission source testing (see 4.6.8).

6.3. Compliance. Prior to approval of shipment, the contractor should submit to the contracting officer or authorized representative satisfactory evidence that the proposed steam boiler or hot water generator to be furnished under this specification meets the applicable requirements of section I, section IV, and section VIII of the ASME CSD-1, and UL 353.

6.3.1 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.

6.3.2 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.

6.3.3 NFPA requirements. Acceptable evidence of meeting the requirements of NFPA 70 and NFPA 8501 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 NFPA 8501.

6.3.4 UL requirements. Acceptable evidence of meeting the requirements of UL 353 should be the certification symbol, or a 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.

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

6.3.6 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 3.12.1).

6.3.7 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.

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

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

6.3.10 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. After all tests are complete, the boilers should be drained, opened and cleaned by the contractor and inspected by an authorized boiler inspector employed by the Government.

6.4 Supersession data. This Federal Specification replaces Military Specification MIL-B-17452E, dated 28 August 1990.

6.5 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.

6.6 Classification cross reference. Classification used in this specification (see 1.2) are identical to those found in the superseded MIL-B-17452E.

6.7 Part or Identifying Numbers (PINs). The specification number, type, size, and class are combined to form PINs for boiler units covered by this document (see 1.2). PINs for the boiler units are established as follows:

FB2903 X X X

Federal Specification No. _____
Type _____
Size _____
Class _____

6.7.1 Type. The type of units (see 1.2) is identified by a single numerical character (see table I).

TABLE I. Code number to type.

Type	Code
I	1
II	2
III	3
V	4
VI	5

6.7.2 Size. The size of units (see 1.2) are identified by a single alphabetic character (see table II).

TABLE II Code letter to size.

Size	Code
2	A
3	B

6.7.3 Class. The class of the units (see 1.2) is identified by a single numerical character (see table III).

TABLE III. Code number to class.

Class	Code
1	1
2	2
3	3
4	4
5	5

6.8 Subject term (key word) listing.

Gas fired
Hot water generator
Oil fired

MILITARY INTERESTS:

Custodians:
Navy - YD1
Air Force - 99

Review Activities:
Navy - MC
Air Force - 84

CIVIL AGENCY COORDINATION ACTIVITY:

GSA-FSS

Preparing Activity:
Navy - YD1

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