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MILITARY SPECIFICATION

BOILERS, STEAM, HIGH PRESSURE, NAVAL SHIP PROPULSION

This specification is approved for use by the Naval Sea Systems Command and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 This specification covers oil fired natural circulation water tube boilers, and their appurtenances, for generating steam for propulsion of Naval ships.

2. APPLICABLE DOCUMENTS

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

SPECIFICATIONS

FEDERAL

PPP-P-40 - Packaging and Packing of Hand Tools.

MILITARY

MIL-C-717 - Castable Mix, Refractory, High-Temperature, Hydraulic Setting.
MIL-S-901 - Shock Tests H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements For.
MIL-B-1947 - Blowers, Soot (Shipboard Use).
MIL-I-2002 - Indicators, Boiler Smoke, Naval Shipboard.
MIL-B-2128 - Burner, Oil Pressure Atomizing.
MIL-B-2678 - Brushes, Wire, Boiler Tube (Expanding Type for Use With Cleaning-Outfits, Boiler-Tube, Electric and Air-Motor-Driven).
MIL-I-2819 - Insulation Block, Thermal.
MIL-V-2962 - Valves, Pressure Regulating, Boiler Fuel-Oil.
MIL-J-5624 - Jet Fuel, Grades JP-4 and JP-5.
MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
MIL-P-15024/5 - Plates, Identification.
MIL-P-15137 - Provisioning Technical Documentation For Repair Parts For Electrical and Mechanical Equipment (Naval Shipboard Use).
MIL-B-15382 - Bolt, Firebrick Anchor.
MIL-B-15606 - Bricks, Refractory, Naval Boiler Furnace Lining Quality.
MIL-M-15842 - Mortar, Refractory (High Temperature, Air Setting).
MIL-B-16008 - Brick, Insulation, High Temperature, Fire Clay.
MIL-T-16286 - Tubes, Steel, Seamless, Marine Boiler Application.
MIL-B-16305 - Brick, Refractory, Insulating.
MIL-G-16356 - Gages, Boiler-Water, Direct Reading.
MIL-F-16884 - Fuel Oil, Diesel (Marine).
MIL-T-17188 - Tubes, Carbon Steel, Resistance Welded, Marine Boiler.
MIL-I-17244 - Indicators, Temperature, Direct-Reading Bimetallic, (3 and 5 Inch Dial).
MIL-T-17370 - Tube and Flue Cleaner, Boiler, Internal, Air-Motor-Driven.
MIL-V-17462 - Valve, Safety; Boiler (Shipboard Use).
MIL-G-17489 - Gage, Pressure (Air) Boiler.
MIL-V-17737 - Valves, Boiler Blow (Shipboard Use).
MIL-I-18997 - Indicator, Pressure, Panel Mounted or Case Supported, General Specification.
MIL-T-19646 - Thermometers, Remote Reading, Self-Indicating Dial, Gas Actuated.
MIL-T-20157 - Tube and Pipe, Carbon Steel, Seamless.
MIL-I-22610 - Indicator, Remote Reading Boiler Water Level.

STANDARDS

MILITARY

MIL-STD-129 - Marking for Shipment and Storage.
MIL-STD-278 - Fabrication Welding and Inspection; and Casting Inspection and Repair for Machinery, Piping and Pressure Vessels in Ships of the United States Navy.

MILITARY (con.)
MIL-STD-777 - Schedule of Piping, Valves, Fittings and Associated Piping Components for Surface Ships.
MIL-STD-1362 - Procedures for Steam Purity Measurement Naval Propulsion Boilers.

DRAWINGS

MILITARY
5000-S5102-1385784 - Brick, Refractory, For Marine Boilers.
5000-S5102-1385785 - Bolts, Clips and Strips for Anchoring Boiler Refractory Material.
5000-S5102-841581 - Clamps for Boiler Casing and Doors.
810-1385708 - Burner Tile Refractory For Marine Boilers.
810-1385936 - Tile Baffle, Silicon-Carbide for Marine Boilers.
9000-S6202-73980 - Systems, Standards, Diagrams of Electric Plant Installations, Standard Methods.

PUBLICATIONS

MILITARY
NAVSHIPS 250-423-30 - Shock Design of Shipboard Equipment Dynamic Analysis Method.
NAVSHIPS 250-423-31 - Shock Design of Shipboard Equipment Interim Design Inputs for Submarine and Surface Ship Equipment.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)
Boiler and Pressure Vessel Code, Section I - Rules for Construction of Power Boilers.
SA-53 - Welded and Seamless Steel Pipe.
SA-106 - Seamless Carbon Steel Pipe for High-Temperature Service.
SA-193 - Alloy Steel Bolting Materials for High Temperature Service.
SA-213 - Seamless Ferritic and Austenitic Alloy Steel Boiler, Superheater and Heat Exchanger Tubes.
SA-240 - Corrosion-Resisting Chromium and Chromium-Nickel Steel Plate, Sheet and Strip for Fusion-Welded Unfired Pressure Vessels.
SA-266 - Carbon Steel Seamless Drum Forgings.
SA-268 - Seamless and Welded Ferritic Stainless Steel Tubing for General Service (Straight Chromium Types).
SA-283 - Low and Intermediate Tensile Strength Carbon-Steel Plates of Structural Quality.
SA-335 - Seamless Ferritic Alloy Steel Pipe for High Temperature Service.
SA-336 - Alloy Steel Seamless Drum Forgings.
SA-515 - Carbon Steel Plates of Intermediate Tensile Strength for Fusion Welded Boilers and Other Pressure Vessels for Intermediate and Higher Temperature Service.

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)
A36 - Structural Steel.
A569 - Steel, Carbon, Hot-Rolled Sheet and Strip, Commercial.
A588 - High Strength Low-Alloy Structural Steel.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

UNIFORM CLASSIFICATION COMMITTEE
Uniform Freight Classification Rules.

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, Illinois 60606.)

NATIONAL MOTOR FREIGHT TRAFFIC ASSOCIATION INCORPORATED, AGENT
National Motor Freight Classification Rules.

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., 1616 P Street, N.W., Washington, D.C. 20036.)

(Technical society and technical association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

3. REQUIREMENTS

3.1 Materials. Materials shall conform to the requirements specified herein, unless otherwise specified in the contract or order. Commercial materials in accordance with ASME or ASTM publications may be substituted for the materials specified herein providing that the materials substituted are equal or better than those specified. However, materials specified for tubes, superheater supports, and refractories shall be as specified herein.

3.2 General design. Boiler shall be a completely integrated unit utilizing the heat resulting from the combustion of fuel for generating steam at the pressure and temperature specified. It shall include the burners, the furnace, the steam generating sections, steam superheating sections, water heating sections, desuperheater, air preheater, if specified, drums and headers, safety valves, casings, brickwork and insulation and such appurtenances as covered herein required for safe continuable and controllable generation of steam. The boiler shall be designed for 30 years service, including 200,000 steaming hours, 3000 light-off to full operating pressure and temperature cycles, 90 cycles of 150 percent of design hydrostatic test pressure and 300 cycles of 125 percent of design pressure hydrostatic test pressure. The boiler, unless otherwise specified in the contract or order, shall operate with combustion gas pressures higher than atmospheric pressure (forced draft) in an open fireroom or machinery room. The boiler, unless otherwise specified in the contract or order, shall be doubly encased including the floors with the space between the inner and outer casings designed to form a ductwork for supplying air to the burners and to maintain a positive air pressure seal on the inner casing. Reliability in service and accessibility of all parts for repair, replacement, and cleaning by ship's forces shall be paramount. Design and construction shall be light and compact to the greatest extent practicable and consistent with the requirements specified herein. Boilers shall be designed for fore and aft arrangement of drums onboard ship. A right handed boiler is defined as a boiler with the uptake or main generating bank on the right side of the steam drum when facing the burner front. A left hand boiler, accordingly, is a boiler with the uptake or main generating bank on the left side of steam drum when facing the burner front.

3.2.1 The boiler shall be designed to operate with feed water and boiler water with the following limits:

Feed water:	
Chlorides	0.10 equivalents per million (epm) or less.
Oxygen	0.014 parts per million (p/m) or less.
Boiler water:	
Alkalinity - pH	10.4 - 11.0 pH.
Phosphates - PO_4	10 - 25 p/m.
Chlorides	2 epm or less.
Hardness	Zero.
Total solids	1150 p/m or less.

3.2.2 The boiler shall be capable of burning and effectively utilizing marine diesel fuel oil conforming to MIL-F-16884 and under emergency conditions aircraft turbine and jet engine fuel grade JP-5 conforming to MIL-T-5624. For boiler component design purposes fuel oil may contain as much as 3.50 percent sulfur, 0.04 percent vanadium. For heat transfer calculation purposes the following ultimate analysis and the higher heating value of the fuel oil shall be considered as:

C	85.80 percent
H_2	13.20 percent
O_2 and undetermined	0.10 percent
S	0.80 percent
N_2	0.10 percent
Higher heating value	19,500 British thermal units (Btu).

3.2.3 Air entering the boiler air casing or air preheater, if provided, shall be considered as 100°F having 0.0165 pound of water per pound of dry air.

3.2.4 The steam from the steam drum shall have a minimum quality of 99.75 percent or better as determined by the purity of its condensate with the boiler water having a total dissolved solid concentration of 1100 p/m, plus or minus 50 p/m, while the boiler is operating at any steady load from 10 percent full-power to 120 percent full-power condition and at any water level in the steam drum as measured by the direct water level indicator 4.0 $^{+0.0}_{-0.5}$ inches above the normal water level to 4 $^{+0.0}_{-0.5}$ inches below the normal water level. Procedures for steam purity measurements shall be as outlined in MIL-STD-1362.

3.2.5 Under all operating conditions the boiler shall operate in accordance with all requirements of this specification with water in the steam drum as indicated by the water level in the gage glass from 8-inches below to 4-inches above the normal water level. The normal water level shall be the centerline of the steam drum unless designated otherwise by the boiler manufacturer. The design of the boiler shall be such that bottom blow at the water drum can be performed at a rate of 200 pounds per minute (lbs/min) at 50 percent boiler full-power. Blow down shall consist of dropping the water level 3-inches below the normal working level.

3.2.6 During any steam load changes required of the boiler up to its full-power steaming rate, the boiler characteristics shall be such that the water level does not exceed that of the visible 18-inch range of the water level gage glass necessitating the securing of burners or resulting in carryover. Also, the boiler shall be capable of being maneuvered at increasing and decreasing ramp load changes between 10 percent and 80 percent full-power steam flow in 45 seconds, with a controlled pressure variation of not more than 10 percent below the normal operating pressure and not more than 3 percent above the normal operating pressure or that pressure which results in lifting of safety valves; a water level variation of not more than 4-inches above or below the normal operating water level; and a superheater outlet temperature not to exceed the maximum safe operating steam temperature specified (see 6.1.1). These maneuvers shall be accomplished smokelessly with all burners in use utilizing full-power sprayer plates. In case straight mechanical pressure atomizing burners are specified (see 6.1.1), the cutting in and out of burners during these maneuvers shall be permitted.

3.2.7 In emergencies it shall be possible, without damage to the boiler, to light off from a cold condition and raise steam to the designed operating pressure, with electric power and diesel fuel oil available, within 40 minutes when superheater protection steam is used and within 60 minutes when protection steam is not used. The boiler shall be capable of being operated at all steaming rates up to and including the maximum boiler rating at 85 percent of the designed operating pressure. Between 50 and 85 percent of full-power operating pressure, the boiler shall be capable of being operated at 50 percent of full-power steaming rate. The boiler shall also be capable of satisfactory operation at all rates under emergency cold feed conditions when feed water is supplied at 100°F with resulting increase of superheat temperature of no more than 50°F above normal.

3.2.8 The boiler shall be designed so that approximately 5 percent of the tubes in the main generating bank after the superheater and approximately 5 percent of the superheater tubes can be plugged without limiting the ability of the boiler to deliver its designed full-power quantity of steam at the specified delivery pressure, (but not necessarily steam temperature) and without overheating of other boiler parts to the extent that the safety and usefulness of the boiler would be jeopardized.

3.2.9 Boiler shall operate under all conditions specified herein when the ship is permanently trimmed down by bow or stern as much as 5 degrees from the normal horizontal plane, permanently listed up to 15 degrees to either side of the vertical, pitching 10 degrees up or down from its normal horizontal plane, and rolling up to 45 degrees to either side of the vertical. Downcomer tubes shall not uncover under any of the above conditions.

3.2.10 Vibration. Boiler shall be designed and installed so that it will not be adversely affected by resonant vibration in range of frequencies caused by propeller blade excitation.

3.2.11 Shockproofness. The boiler shall meet grade A shock requirements of MIL-S-901. Any degradation of the boiler after it has experienced the underwater shock tests, shall not prevent the boiler from being steamed at full-power continuously for 100 hours. The ship's foundation, boiler footings, saddles, and holding down bolts, treating the boiler as a single mass system, shall be capable of withstanding static loads shock design numbers of 20 g in the vertical direction, 10 g in the athwartship direction and 6 g in the fore and aft direction. Where sliding feet are used to provide for expansion of the boiler, the base plates

shall be grooved on the face resting on the phosphor bronze facing of ship's foundation for grease lubrication. Grease fittings and piping shall be installed at a convenient location outside of the outer casing to permit greasing of the sliding feet. Material for saddles and boiler base plates shall be grade 70 of ASME SA-515 and holding down bolts shall be grade B-7 of ASME SA-193. The shipbuilder shall furnish the holding down bolts which shall be fitted or body bound type bolts. The allowable stress in using the static design method for shock shall be the yield strength (0.2 percent offset) of the material. Collision chocks shall be furnished by the shipbuilder on ship's foundation structure so that shock loads need not be entirely absorbed by the bolting.

3.2.12 Technical report. The supplier shall provide a report in accordance with the data ordering document included in the contract or order (see 6.1.3) and shall include the data specified in 3.2.12.1.

3.2.12.1 Dynamic analysis. When dynamic analysis is specified to be accomplished in accordance with NAVSHIPS 250-423-30 and NAVSHIPS 250-423-31 (see 6.1.1), the following rules shall apply:

(a) Unidirectional analysis in each direction or a coupled mode analysis for the athwartship and vertical directions is acceptable.
(b) The number of modes to be considered in each case to equal one-half the number of lumped masses.
(c) The minimum model effective included to be 80 percent in each direction or when coupled.
(d) The minimum design acceleration input of 6 g's is not applicable when the calculated acceleration is less than 6 g's.
(e) Normal operating stresses will be combined with the dynamic stresses. Thermal stresses will not be included in the final stress.
(f) The combined design stresses shall not exceed the effective strength as described in NAVSHIPS 250-423-30. In tubular pressure parts when the combined design stresses exceed, the effective yield consideration will be given to the acceptance of calculated stresses up to 2.0 times the yield stress of material, provided the configuration does not become unstable or result in fracture.

3.2.13 Pressure parts. All pressure parts of the boiler including the economizer, superheater, desuperheater and air preheater, if furnished as part of the boiler, shall be in accordance with the rules of the ASME Boiler and Pressure Vessel Code, Section I and requirements specified herein. In the design of pressure parts the boiler manufacturer shall take into consideration the external loads due to thermal expansion, to thermal and mechanical shock, pipe nozzle reactions and support loads the pressure part is required to carry and transmit, as well as the pressure loading. The ASME Boiler and Pressure Vessel Code and this specification do not contain rules to cover all details of design and construction. Where complete details are not given, the manufacturer shall provide details of the design procedures and construction for review by the command or agency concerned. The maximum allowable working pressure and external loading for pressure parts of boilers for which the strength cannot be computed with assurance of accuracy, shall be established by a proof test of full scale sample.

3.2.13.1 Drums and headers shall be fabricated of plate, forgings and seamless piping and welded in accordance with MIL-STD-278. Welds shall be of the full penetration type for class A-1 pressure vessels. Drums and headers shall be sand or shot blasted before drilling to clean surfaces of all mill scale. The finish of all machined, bored, and welded surfaces shall be 250 roughness height rating (rhr) or better for detection of flaws and cracks by magnetic particle inspection. Tube holes to be used for tubes secured therein by rolling shall have a finish of 125 rhr or better . Sharp edges left in drilling tube holes shall be removed on both sides of the plate. Sharp inside or outside corners on machined and bored and counterbored surfaces shall be eliminated by radiusing and chamfering. On inside corners the radius shall be not less than 1/32 of an inch. Except on seating surfaces for gasketed handhole and manway closures, outside corners shall be radiused at least 1/8 inch for exposed bores and counterbores up to 1.5 inch diameter and at least 3/16 inch for exposed bores and counterbores having a diameter greater than 1.5 inch diameter.

3.2.13.2 Finished drums and headers shall be clean and free of scale. Tubes when installed shall be clean and free of all scale and deposits. The boiler manufacturer shall pickle hot finished boiler tubes except corrosion resisting 18 Cr - 8 Ni steel superheater and desuperheater tubes prior to preservation for shipping to their destination for installation and erection in the boiler. Should there be any question on cleanliness and proper preservation of tubes at the erection site of the boiler, the shipbuilder or erection supplier shall have the tubes pickled before they are installed in the boiler.

3.2.14 Piping, valves and fittings. Piping, valves and fittings shall conform to the requirements of MIL-STD-777, unless otherwise specified herein.

3.2.15 Design pressures.

3.2.15.1 Design pressure of the boiler including the superheater but not the economizer, shall be at least a gage pressure of 50 lb/in^2 or 8 percent higher, whichever is the greater than the steady steaming drum pressure at the 120 percent overload condition. Further, the sizing and settings of the safety valves to be furnished with the boiler shall be considered to assure that the design pressure of the boiler shall not be exceeded by more than 6 percent when the all steam stops are closed and the boiler is firing at the 120 percent firing rate with all steam discharging through the popped opened safety valves. The desuperheater shall be designed for the maximum differential pressure to which it is subjected, that is the differential between the maximum steam drum pressure and the minimum desuperheater outlet pressure.

3.2.15.2 Design pressure of the economizer shall be design pressure of the boiler as determined above plus the pressure drop between the steam drum and economizer inlet at the 120 percent overload rating.

3.2.15.3 Design pressure of the casing for strength shall be based on the shut-off pressure of the forced draft blowers operating at their maximum speed, as specified (see 6.1.1).

3.2.16 The supplier shall closely collaborate with the shipbuilder in the design of the installation and shall furnish design information as expeditiously as possible, as may be required by the shipbuilder and automatic combustion control designer.

3.3 Oil burners. The boiler shall be equipped with burners of the wide range type conforming to MIL-B-2128, having an operating range of not less than 10 to 1 based on oil flow. The number of burners installed per boiler shall be such that when a boiler is operating at a rate of combustion necessary for the overload rate of the boiler, the capacity of each burner shall not exceed the capacity curve limits submitted for that burner. Consideration shall be given to the furnace volume, furnace heat absorption surface, furnace refractory surface, and number of burners installed in the boiler in comparison with the test conditions under which the burners were tested. The boiler manufacturer shall assure that the design of burner and burner installation provides boiler performance in accordance with the requirements of this specification. The fuel oil burner shall be capable of burning efficiently the quantity of oil required for boiler operation from lowest firing rate to the 120 percent overload firing rate with all burners in operation. The minimum firing rate of the burner shall be 260 pounds per hour, or as specified (see 6.1.1). Each burner shall be capable of operation between the fuel oil pressures specified (see 6.1.1). The burners shall be designed so that the flow of fuel oil will automatically shut-off when the atomizer barrel is removed from the burner. Provision shall be made against either the accidental discharge of oil or steam into the fireroom with the atomizer removed or into the furnace with the atomizer not fully secured in position. Each boiler shall be furnished with 250 percent of burner barrel assemblies for each burner of the boiler. Boilers shall be capable of being operated through a minimum range of 10 to 100 percent full steaming rate without changing the sprayer plates or the number of burners in use. Based on the use of marine diesel fuel, the full-power sprayer plates shall be sized to restrict the full-power oil flow from being exceeded by greater than 10 percent. On the same basis, the overload sprayer plates shall be sized to restrict the overload oil rate from being exceeded by greater than 5 percent. Sprayer plates capacity curves based on a maximum fuel gage pressure of 350 lb/in^2 at full-power and overload, will be provided and will reflect difference in capacity with operation of diesel fuel and JP-5 when a sprayer plate is intended for utilization with both fuels. The quantities of sprayer plates and adapters to be furnished shall be as follows:

(a) For each installed burner when burning marine diesel fuel:
  (1) One lighting-off plate for normal burner mode.
  (2) Three full-power plates for normal burner mode.
  (3) Two overload plates for normal burner mode.
  (4) Two adapters for straight mechanical pressure atomizing mode.
  (5) One lighting-off plate for "straight mechanical" pressure atomizing mode.
  (6) Two overload plates for straight mechanical pressure atomizing mode.
  (7) Three of each size plate needed between light-off and overload rate for straight mechanical pressure atomizing mode.

(b) For each installed burner when burning jet engine fuel grade JP-5:
(1) One lighting-off plate for straight mechanical pressure atomizing mode.
(2) Three of each size plate needed between light-off up to and including 100 percent boiler full-power for straight mechanical pressure atomizing mode.

NOTES:
(1) It is not intended that separate sets of sprayer plates be provided for both types of fuel. Sprayer plates may be sized so as to satisfy the requirement for both fuels providing satisfactory operation is achieved.
(2) Adapters shall be satisfactory for operation with either fuel.
(3) Wide range burners of MIL-B-2128 shall be furnished with adapters to permit conversion to the straight pressure atomizing mode. In addition, sufficient straight pressure atomizing plates shall be furnished to permit operation including light-off through overload when burning marine diesel fuel, and light-off through boiler, full-power (100 percent evaporation rate) when burning jet engine fuel grade JP-5.

3.3.1 Operation of burners shall be with air registers wide open under all operating rates, unless an automatic air register control is furnished as a part of the burner. The settings of the diffuser withdrawal and barrel positions shall be the same for all operating conditions, although they may be different on each burner of a boiler. Boiler shall be capable of operation in accordance with the requirements of this specification when burning unheated marine diesel oil and JP-5 fuel. Air for combustion entering the boiler casing may be expected in the temperature range of 50°F to 130°F.

3.3.2 Each burner register shall be distinctly marked by use of a brass plate indicating the order of firing precedence. All burners shall be operable from the firing aisle without the use of a ladder.

3.4 Furnace. This section is the space provided for the combustion of fuel before the products of combustion enter any part of the tube bank. The section shall be measured from the waterwalls and the refractories or insulating materials enclosing that volume.

3.4.1 Furnace refractories and insulating materials shall compromise only those shapes and dimensions of materials carried in standard Naval supply and shown on Drawing 5000-S5102-1385784.

3.4.1.1 Furnace refractories and insulating materials shall be of a quality and arranged to withstand the effects of the heat of combustion, and the normal mechanical and thermal shock incident to Naval ship operation for a minimum of 12,000 hours without major deterioration, spalling or crumbling.

3.4.2 The floor including any sloping sections shall be anchored and shall be built up in a manner at least equivalent to the following, beginning at the furnace floor pan:

(a) One inch high temperature insulating block, conforming to class 3 of MIL-I-2819, laid up dry.
(b) Two inches high temperature insulating brick, conforming to MIL-B-16008, laid at right angles to the first course.
(c) Four and one-half inches of refractory firebrick, conforming to grade A of MIL-B-15606, each brick anchored to the floor pan and laid up with air setting mortar conforming to MIL-M-15842.
(d) On sloping floors, the firebrick should be laid so that the 9-inch dimension is perpendicular to the slope line, and each brick anchored to the floor pan.

3.4.2.1 If floor tubes are used, the design of the furnace floor shall be submitted for review by the command or agency concerned. Furnace floor tubes sloping less than 15 degrees shall be covered with 2-1/2 inches of firebrick, conforming to MIL-B-15606, grade A.

3.4.2.2 Refractory furnace side and rear walls shall be built up in a manner at least equivalent to the following, beginning at the casing:

(a) One inch high temperature insulating block, conforming to class 3 of MIL-I-2819, laid up dry.
(b) Two and one-half inches high temperature insulating brick, conforming to MIL-B-16008, laid up dry.
(c) Four and one-half inches of refractory firebrick, conforming to grade A of MIL-B-15606, laid up with air setting mortar conforming to MIL-M-15842. The firebrick shall be laid up to break joints with the insulating brick.

3.4.2.3 When water walls are used, the insulation and refractory shall be built up at least equivalent to the following, beginning at the casing:

(a) For tangent tubes (tubes shall be considered tangent only if the clearance space between tubes does not exceed 1/8 of an inch):
  (1) One inch thick layer of insulating block, conforming to class 3 of MIL-I-2819.
  (2) Two and one-half inches of high temperature insulating brick, conforming to class B of MIL-B-16305.

(b) For nontangent tubes (clearance space between tubes if 3/16 inch or more):
  (1) One inch thick layer of insulating block, conforming to class 3 of MIL-I-2819.
  (2) Two inches of high temperature insulating brick, conforming to MIL-B-16008.
  (3) Two and one-half inches of refractory firebrick, conforming to grade A of MIL-B-15606.

3.4.2.3.1 When waterwalls are used, provision shall be made in the casings of water walls for examination of the insulation and refractory without the necessity of removing tubes or cutting casing panels (see 3.13).

3.4.2.4 The front wall shall be built up of courses of the same materials and in the same manner as the side and rear walls, except that the total wall thickness may differ depending on the type and arrangement of burners. In no case shall the total wall thickness be less than 6-3/4 inches.

3.4.2.5 There shall be at least two expansion joints 1/4 inch wide extending vertically in the rear wall and at least two similar expansion joints in the front wall. Wooden or metal batten strips used for forming expansion joints shall be removed prior to lighting off the boiler.

3.4.3 Brickwork around the furnace access openings in the casings shall be aligned to allow ready entrance without needless destruction of the furnace wall. A step shall be cut in the refractory bricks adjacent to lintels and support bars to provide a refractory overlap for protection of these metal parts. Provision shall be made for a hinged burner or a hinged furnace access door for access to the furnace.

3.4.4 Refractory used as a protective covering for headers shall be high temperature castable in accordance with MIL-C-717.

3.4.5 Anchor bolts shall be furnished in accordance with class A of MIL-B-15382. Each refractory brick shall be secured by at least one bolt. Poured or tamped refractory shall be secured by at least one anchor strip per 100 square inches of surface area and the strips shall be not more than 12-inches apart, center-to-center. There shall be no areas of unsecured poured or tamped refractory regardless of area. All refractory in contact with headers, drums or brickpans shall be anchored to these items with sufficient anchor strips to prevent dislodgement during shock. Anchoring by means of anchor bolts, clips and strips shall be in accordance with Drawing 5000-S5102-1385785. Superheater screen tube baffles shall be formed by installing preformed wedged shaped silicon carbide tiles across the clearance space of a single tube row using tiles as shown on Drawing 810-1385936. Unsupported castable refractory screen baffles shall not be used.

3.4.6 Burner throat refractory shall be of the shape required for the burners used, and shall be built up as follows, beginning at the casing:

(a) One inch of high temperature insulating block, conforming to class 3 of MIL-I-2819, laid up dry and terminating about 1-1/2 inches from the burner opening in the front plate.
(b) The remainder of the required thickness shall consist of tile conforming to grade A of MIL-B-15606 and in accordance with Drawing 810-1385708.

3.5 Drums and headers. This section includes steam and water drums and water wall headers. Materials for steam and water drums shall be in accordance with grade 70 of ASME SA-515. Water drums may be manufactured of seamless forgings in accordance with class 2 of ASME SA-266.

3.5.1 Tolerances of finished drums shall conform to the latest ASME code for power boilers. No welding of drum defects or correction of surface irregularities to maintain these conditions shall be permitted without specific authority from the command or agency concerned. The heads of any drum or header larger than 12-inches inside diameter (i.d.) shall

be hemispherical or semi-ellipsoidal in form. If the latter type is used, half of the minor axis or the depth of the head, shall be at least equal to one quarter of the i.d. of the head or skirt. For this purpose an "approximate ellipsoidal" head having crown and knuckle radii which provide a contour approximating a true ellipse, within the tolerances permitted by the ASME Code for Power Boilers, will be acceptable as an ellipsoidal head. The thickness of a manhead of such hemispherical or ellipsoidal form containing a flanged in manhole may be calculated from the following formula in lieu of that specified in the ASME Code for Power Boilers:

$$t = \frac{0.864PD}{SE}$$

Where: t = minimum thickness of plate, inches.
P = design pressure, lb/in^2.
D = the i.d. (which is twice the inside radius of the wrapper sheet), inches.
E = efficiency of weakest joint used in forming and welding the head (ordinarily 100 percent).
S = allowable working tensile stress, maximum lb/in^2 using values shown in appendix A-24 of ASME Code for Power Boilers.

3.5.2 Serrations shall be provided for all tube holes with the exception of 1-inch and 1-1/4 inch generating tube bank holes in the steam and water drums and tubes welded to headers or stubs. All tube holes shall be free of scratches or defects which would prevent a good metal-to-metal contact after rolling. The inner and outer edges of all tube holes shall be sufficiently rounded to prevent cutting the tubes during or after expansion; rough edges of grooves or counterbores shall be removed. Maximum and minimum finished diameters of tube holes shall be within the limits of table I.

Table I - Diameters of tube holes.

Size tube	Diameter (finished)	
	Minimum	Maximum
Inches	Inches	Inches
1	1.009	1.015
1-1/4	1.260	1.269
1-1/2	1.512	1.522
1-3/4	1.763	1.775
2	2.015	2.028
2-1/4	2.265	2.278
2-1/2	2.517	2.530
3	3.020	3.032
3-1/4	3.270	3.282
3-1/2	3.520	3.532
4	4.020	4.035
4-1/2	4.520	4.535
5	5.020	5.035

3.5.3 Tube holes found defective shall not be welded or processed without referral to the command or agency concerned.

3.5.4 One elliptical manhole, 12 inches by 16 inches, centered on the head, shall be required for each drum. Flanging or reinforcement of the manhole opening shall conform to the requirements of the latest ASME Code for Power Boilers. A cover or plate shall be provided for closure, and seating surfaces shall be faced and machined to a minimum width of 11/16 inch with a flat surface tolerance of plus or minus 0.003 inch. Clearance between cover shoulder and the edge of the opening shall not exceed 1/16 inch. The manhole cover shall be a true ellipse and shall be hinged on the inside of the drum. Attachment of manhole covers shall be made by the use of arch bars, bolts, and nuts. Manhole cover bolts shall be removable. Manhole cover shoulders shall be tapered to permit the cover to center itself on the manhole.

3.5.5 Drums and other pressure parts constructed with welded seams shall be tested hydrostatically by the manufacturer, before drilling, to 1-1/2 times the design pressure of the boiler.

3.5.6 Provision shall be made to minimize drum exposure to hot combustion gases so that the temperature of the outer skin of the drums will not exceed 700°F nor produce excessive thermal gradients. Drum protection shall be provided by arranging tube holes so that the ligament width between holes shall not exceed 4-inches.

3.5.7 Nozzles for drums and headers shall be constructed from the same materials as the drums and headers to which they are attached, or from materials weldably compatible with the drums or headers. Nozzles shall be reinforced to meet shock and vibration requirements with equipment or piping attached if necessary. Design of the reinforcement shall be reviewed by the command or agency concerned.

3.5.8 Materials used for headers shall be manufactured of seamless tubing in accordance with grade B of ASME SA-106 or of seamless forgings in accordance with class 2 of ASME SA-266. The thickness and tolerances of the finished headers shall conform to the ASME Code for Power Boilers.

3.5.9 All drums and headers shall be sand or shot blasted before drilling to clean internal surfaces of all mill scale.

3.5.10 Headers, except economizer headers, shall have handhole access sufficient to permit examination of the tube to header joints, cleaning and plugging tubes, and rolling tubes to the header. The number of handholes shall be the minimum consistent with this requirement. Handhole openings shall be shaped as a true ellipse, circular, or a shape previously supplied. Inside edges of handholes shall be rounded off to a radius or chamfered to a minimum of 1/16 inch. Handhole fittings shall be designed to permit seal welding, the plate to the header if desired after delivery of the boilers. Examination ports and lights shall be provided to permit examination of all header handhole plates while the boiler is steaming.

3.5.10.1 Economizer headers, if designed so that no handhole plates are required shall have two flanged openings in each header, directly opposite the tube ends, to permit examination and cleaning out the interior of the headers. If the headers are designed with handhole plates, the plates shall be welded shut upon completion of erection. The manufacturer shall demonstrate the feasibility of removing handhole plates and rewelding. Any special weld removal tools shall be supplied by the supplier.

3.5.10.1.1 Access to the headers shall be provided by easily removable and replaceable access doors or covers (see 3.13). The design of the economizer headers shall include stub nozzle connections forged as part of the header or welded to the outside of the header and stress relieved at the manufacturer's plant. Economizer tubes shall be connected to the stubs on the headers by a full strength field weld. Means shall be provided for external tube plugging. As an alternative, socket welding the economizer tube to the header will be acceptable.

3.5.11 Consideration will be given to handholes and handhole closures of improved design which will facilitate easier removal and replacement and will not lose their effectiveness under repeated removal and replacement.

3.5.12 One 1-1/2 inch iron pipe size (i.p.s.) bottom blow connection shall be provided at the longitudinal center and lowest part of the water drum and two 1-1/2 inch i.p.s. bottom blow connections shall be installed on horizontal water wall headers and water screen header located one quarter of the length of the header from each end.

3.5.13 A 1-1/2 inch connection shall be provided at the highest point in the interconnecting piping between the steam drum and the superheater. The 1-1/2 inch connection is intended for use in connection with chemical (acid) cleaning of the water and steam sides of the boiler and venting purposes. A 1/2 inch valve with a weld end on one side and attached by means of a nipple to a 1-1/2 inch flange for attachment to the 1-1/2 inch connection may be used for venting purposes. During chemical cleaning the vent valve shall be removed and the connection used for chemical cleaning purposes. Additional 1/2 inch vents shall be provided on the steam drum outside the dry box or dry pipe as necessary to completely vent the steam drum during boiler back filling.

3.5.14 A 1/2 inch flanged connection shall be provided for the steam drum pressure gage.

3.5.15 All necessary connections required for combustion controls and feed water regulators shall be provided. These connections shall not be used for any other purpose.

3.5.16 All nozzle connections shall be arranged for butt welding of piping and fittings, unless otherwise specified herein.

3.5.17 Torch cutting of edges, drums, headers and their nozzles will not be permitted. All edges shall be machined to a smooth finish.

3.6 Drum internals.

3.6.1 Moisture separators, driers, pipes, plates or baffling arrangements shall be utilized to produce steam with a moisture content not to exceed the requirements of 3.2.4. The arrangement of internal fittings in the steam drum shall be such as to provide maximum practical accessibility for examination and cleaning of the interiors of the drum and tubes, and permit reasonable ease in their removal when necessary. The design shall be such that removal and replacement of all drum internals which must be removed to permit examination and brushing of all tubes from the steam drum shall not require more than approximately 5 hours. Baffle material shall be hot rolled sheet steel in accordance with ASME SA-283. Consideration will be given to the use of quick disconnect couplings for installation and removal of all drum internals. To prevent freezing of nuts and bolts, a small amount of molykote or graphite coating shall be carefully applied to threads.

3.6.2 Internal feed piping. Feed water piping shall enter the drum through a thermal sleeve and shall be disposed to cause minimum shock effect of feed water on hot surfaces and provide even feed water distribution along the length of the drum. Piping used shall be welded or seamless or class 1 or 2 of ASME SA-53.

3.6.3 Surface blow. An internal perforated pipe or other means of removing dissolved and suspended solids in the steam drum, shall be provided. The top of the pipe shall be located 3-inches below the design working level of the water in the steam drum. Surface blow pipe shall be welded or seamless steel pipe in accordance with class 1 or 2 of ASME SA-53.

3.7 Generating tubes, downcomers and risers. This section includes all tubes in the generating bank(s), the furnace floor, waterwalls, downcomers, and risers.

3.7.1 Generating tubes shall be arranged to permit complete and thorough cleaning by use of soot blowers. Maximum practicable accessibility for manual cleaning of soot and slag accumulations on boiler surfaces, and soot and slag deposits in cavities and pockets along the path of the combustion gases shall be provided. All tubes, tube circuits, and headers shall be drainable, to the greatest possible extent under normal conditions of trim, and adequate venting shall be provided to preclude the possibility of trapping air in the boiler when filling. The main generating tube bank shall have an in-line tube arrangement to facilitate cleaning of firesides. When gas flow baffles are employed to direct or confine the gas flow across the superheater, the baffling shall consist of a tube wall formed by proper arrangement and bending of the screen tubes, and preformed silicon carbide tiles fitted between adjacent tubes in one tube row to form a solid baffle using standard tiles shown on Drawing 810-1385936. Furnace water wall surfaces shall consist of bare tubes. Superheater screen tube rows shall be arranged to provide adequate protection of the superheater from excessive temperatures.

3.7.2 Generating tubes with an outside diameter (o.d.) of 1-1/2 inches or less shall not be bent to a radius of less than 5-inches, and tubes with an o.d. greater than 1-1/2 inches shall not be bent to a radius of less than 6-inches, unless the boiler manufacturer certifies that the smaller bend radius can be traversed with a standard tube cleaning brush effectively operating in straight and curved sections of the tube. Tubes shall extend through the tube sheet and project beyond it not less than 3/16 inch and not more than 5/16 inch for tubes less than 2-inches in diameter, and not less than 5/16 inch and not more than 7/16 inch for tubes 2-inches or more in diameter. The ends of each tube shall be cut at right angles to the axis of the tube and the sharp edges shall be rounded off. Where tubes are rolled but not welded, the tube ends shall be belled.

3.7.3 The use of bifurcated, trifurcated or stud tubes shall not be permitted without review by the command or agency concerned.

3.7.4 All generating tubes between the superheater and economizer shall be removable and replaceable without cutting of any structural members. All generating tubes except screen and furnace wall tubes shall be removable and replaceable from the side of the boiler without removing the superheater tubes. Screen, rear and side wall tubes shall be removable and replaceable through boiler access openings without the necessity of cutting boiler casings (see 3.13).

3.7.5 Materials used for generating tubes shall conform to the following:

(a) For boilers of design pressure up to and including a gage pressure of 750 lb/in^2:
(1) Class a of MIL-T-16286, seamless carbon steel tubes, or
(2) MIL-T-17188, carbon steel welded boiler tubes.
(b) For boilers of design pressure up to and including a gage pressure of 1500 lb/in^2:
(1) Class g of MIL-T-16286, medium carbon steel seamless boiler tubes. Tubes shall be annealed.

3.7.6 Sizes and thicknesses of generating tubes shall be in accordance with table II.

Table II - Sizes and thicknesses of generating tubes.

Size	Thickness, inches	
o.d.	750 lb/in^2 maximum	1500 lb/in^2 maximum
Inches		
1	1/ 0.085	0.095
1-1/4	.109	.120
1-1/2	.120	.135
2	.134	.165

1/ Limited to a maximum mean metal temperature of 650°F.

3.7.7 The material and thickness of special tubes such as superheater support tubes, finned tubes, economizer tubes, superheater tubes, circulating tubes, and downcomer tubes shall be reviewed by the command or agency concerned. If finned tubes are used they shall be so designed and dimensioned that adequate cooling of the fin shall take place and no warpage of the tube shall occur when in service.

3.7.8 Unheated downcomer tubes shall be provided on boilers. Downcomer tubes connecting the steam and water drums, and the steam drum and water wall and water screen headers shall be installed between the inner and outer casings and shall not be imbedded in refractory. The tubes shall connect to the steam and water drum shells at the end of the cylindrical portion and shall not connect to the drum heads except that if the drum heads are hemispherical, downcomer tubes may connect to the heads. External downcomers, external risers and superheater support tubes (larger than 2 inches o.d. shall be attached by field welding to stubs which shall be shop welded to drums and headers. When welding downcomer tubes to stub connections, on steam or water drums or headers, during erection, the use of a standard backing ring will be permitted, provided that the welded joint is ground smooth and flush wherever accessible, and it is shown that where not accessible waterside brushing of downcomers is feasible; otherwise, a consumable type backing ring shall be used in making this field closure weld. Downcomers shall not be insulated. The i.d. of the downcomer tube shall be the same as the i.d. of the stub connection to which it is welded.

3.8 Superheaters. This section includes the tubes required for heating steam from the saturated temperature to the required outlet temperature, and associated headers, supports, and seal plates.

3.8.1 Each boiler shall be provided with a convection type superheater in the generating tube bank. It shall be protected from the intense direct furnace radiation by a water tube screen. Superheater tubes and all superheater components shall be so placed, arranged, and supported that examination, cleaning, and repair may be accomplished readily and effectively. The superheater shall be provided with an access space approximately midway through the superheater tube bank, extending across its full length and approximately 18-inches in width for accomplishing readily and effectively routine examination, cleaning, and repair of the superheater. Unless the superheater tubes are provided with an in-line arrangement and of sufficient transverse pitch so that more than 4 rows of tubes can be effectively cleaned from the superheater access space, the access space shall be located not more than 4 superheater tube rows from the furnace. Easily removable and replaceable access doors shall be provided for entry to the superheater access space. Areas of the front and rear walls of the superheater cavity which are not used for actual access shall be of easily replaceable firebrick construction. In way of the superheater headers the casing shall be fabricated

so that the headers are enclosed and may be exposed for examination with the boiler in operation. The vestibule shall be provided with a 1 inch i.p.s. drain leading through the outside casing to facilitate detection of superheater handhole leaks. When a horizontal superheater arrangement is used, the tubes shall be withdrawable from the front of the boiler. When an inverted "U" vertical superheater is used, the tubes shall be removable through the furnace and burner front. Replacement of superheater tubes shall be accomplished without the necessity of cutting superheater support tubes. The last pass of the superheater shall be designed for parallel flow between the steam and the combustion gases.

3.8.2 The joints and lintel of the inner casing access door to the superheater access space shall be kept as cool as practicable, and protected from direct hot gas impingement. The superheater screen in the vicinity of the access doors shall be adequately deep and, in conjunction with the first two rows beyond the superheater, be arranged or baffled to prevent direct impingement of gases on the doors. A step shall be cut in the refractory bricks adjacent to lintels and support bars to provide a refractory overlap for protection of these metal parts.

3.8.3 Superheater support members operating at temperatures of 1450°F and above if used, shall be of the individually replaceable type and shall be of 60 Cr - 40 Ni composition. Material chemistry shall be as follows:

Carbon	- 0.05 maximum
Sulphur	- 0.02 maximum
Phosphorous	- 0.02 maximum
Manganese	- 0.30 maximum
Silicon	- 1.0 maximum
Chromium	- 58-62 percent
Nickel	- Balance

3.8.3.1 The total of all elements other than nickel and chromium shall not exceed 1.5 percent. Chemistry shall be determined from metal cutoff at the junction of the casting ingate or riser of the casting. All finished castings shall be capable of meeting the minimum requirements of level 2 for RT acceptance criteria for ferrous castings of MIL-STD-278. The design shall be such that the replaceable supports are shielded from the hot furnace gases as far as practicable, and so that their replacement can be accomplished without the necessity of removing superheater tubes. Support clips used for positioning replaceable supports shall be welded to superheater support tubes by a full penetration weld. Superheater support members operating at less than 1450°F shall be cast or wrought 25 Cr - 20 Ni. Where the superheater is supported at the inner casing, castable refractory reinforced with nichrome wire lacing or mesh may be used as a partial support and for protection of the inner casing provided that the ligament spacing between tubes is sufficiently open to permit effective application of refractory. Consideration will be given to the use of an asbestos fiber rope packing, Fibre Frax or equal, for the service intended as a substitute for refractory for protection of the inner casing. Where superheater tubes are arranged horizontally and supported at the front and rear walls, superheater support tubes will not be required.

3.8.4 The arrangement of the superheater shall be such that it is completely drainable and ventable under normal conditions of trim of the ship. A vertical type superheater of the inverted "U" type that is completely drainable will be considered ventable. Horizontal type superheaters shall have their tubes sloped at least 3 degrees downward toward the header to assure positive drainage. A definite slope shall be provided at superheater tube welds to assure positive drainage in the vicinity of welds. Superheater tubes shall not be looped or offset, if by so doing, the superheater tube is only partially drainable.

3.8.5 Superheaters shall be provided with connections to facilitate chemical cleaning of the steam side (see 3.8.12).

3.8.6 Where counterboring of headers is required for welding, the counterbores shall be filled by finished weld. Nevertheless, the counterbore shall not exceed 3/8 inch between the bottom of the counterbore and inner surface of the header. For boilers where the superheater outlet temperature exceeds 875°F each superheater tube shall be connected to nipples on headers by a full strength field weld, or lightly rolled directly into the header and strength welded on the inside of the header. The latter method shall not be employed where all the welding must be accomplished in the overhead position, i.e.; on headers whose tube hole centerlines are less than 15 degrees from the vertical. Further where welding is accomplished on the inside of headers the inner surface of the header shall be shaped so that the centerlines of the tubes are not more than 12 degrees off of being perpendicular to the chord drawn between the intersection of the tube hole boundary and inner surface of the header. Nipples shall be forged as part of the header or welded to the header and stress relieved at the manufacturer's plant. The arrangement of the superheater, superheater

header, and handholes shall be such as to provide access and visibility for a qualified welder to make sound welds from the position he is required to assume when installing and replacing superheater tubes onboard ship. Special tools required for preparing header tube holes for welding shall be furnished as required in 3.24. The field weld shall be made on similar type materials only. The nipple or tube shall be safe-ended in the shop to effect the transition from austenitic to ferritic material so that the field weld shall be of compatibly weldable materials. The procedure for ferritic to austenitic tube welds shall require review by the command or agency concerned. Superheater tube ends shall be chamfered with a radius of 1/8 inch after welding.

3.8.6.1 The weld of the safe-end shall be ground or machined smooth with the i.d. of the tube or stub and shall not form a pocket for collection of condensate. The tube or nozzle opening shall be reamed and faced or counterbored to assure a true circular opening for effective plugging of tubes.

3.8.6.2 For boilers where the steam of the superheater outlet temperature is 875°F or less the superheater tubes shall be rolled into the header. The header shall be constructed so as to provide a minimum effective seat length of 1.25 inches and the tube hole serrated to provide the required holding power. Tube hole diameter tolerance shall be in accordance with table I. The effective seat length is considered that length of tube which is in contact with the wall of 360 degrees around the tube. The inner surface of the header shall be shaped so that the tube centerlines are not more than 12 degrees off of being perpendicular to the chord drawn between the intersection of the tube hole boundary and the inner surface of the header.

3.8.7 With the following maximum superheater tube metal temperatures, the tubes shall be fabricated from material conforming to the following classes of MIL-T-16286 as a minimum:

1100°F or less	Class e
1101°F to 1200°F	Class c

3.8.7.1 Tube metal temperature shall not exceed 1200°F.

3.8.8 Superheater headers shall be fabricated from the following material:

2-1/4 Cr - 1 Mo	ASME SA-335, grade P-22, SA-336, class F-22 or SA-213, grade T-22.

3.8.9 Materials utilized for superheater seal or header protection which are exposed to the products of combustion but are not effectively cooled by steam, water or air, and also metal seal plates used in conjunction with refractory at superheater tube penetration points, shall be of a heat resisting alloy suitable for the temperature involved.

3.8.10 Provisions shall be made to protect the superheater of each boiler against excessive temperatures while raising steam through the use of a bleeder valve, discharging steam from the superheater via the desuperheater to the auxiliary exhaust line. The safe firing rates and steam flow shall be specified by the boiler manufacturer and furnished the shipbuilder for the design of bleed off line. The size of this line shall be at least 1-1/2 inch i.p.s. Furthermore, for more rapid warming up and light off, provision shall be made to utilize steam from the ships gage pressure of 150 lb/in^2 steam line for superheater protection. This piping shall connect to cross over piping from steam drum to superheater in the vicinity of steam drum and shall also serve as entry point for boiler steam blanket lay-up. The size of this line shall be 1-1/2 inch i.p.s. The superheater shall operate under all conditions of operation at the normal operating pressures, with the steam temperature not exceeding the maximum design steam temperature at steady load conditions.

3.8.11 Headers shall have handhole access sufficient to permit plugging all superheater tubes and welding of tubes to headers where tubes are welded to the inside of the headers. The number of handholes shall be the minimum consistent with this requirement. Accessibility to permit mechanical cleaning of the lowest part of ends of each header shall be provided. Handhole fittings shall comply with 3.5.10.

3.8.12 Superheater headers shall be provided with 1/2 inch i.p.s. vent and 3/4 inch i.p.s. drain connections to vent and drain the superheater. Drainability shall be provided as to prevent standing water in any part of the superheater including the inlet, intermediate and outlet headers. A 1-1/2 inch i.p.s. connection shall be provided at the superheater outlet and equipped with a cut out valve and a 1-1/2 inch hose connection. The drain on the outlet header may be used for this purpose provided it is increased in size to 1-1/2 inches i.p.s. The main steam inlet connection to the superheater inlet header shall be so designed as to permit internal plugging of this connection through adjacent handhole fittings. The

plug design shall be such that the superheater can be effectively isolated during chemical cleaning operations of either the superheater or the boiler water sides. A drain connection and valve shall also be provided on the main steam inlet stub connection to the superheater, just ahead of the plug. As an alternative, the main steam inlet piping to the superheater may be plugged at the steam drum end provided any drum internals required to be removed are easily accessible and removable.

3.9 Economizers. This term represents the heating surface located in the combustion gas stream, after the boiler generating surfaces for additional preheating of the boiler feed water. Tubes, fins, headers, and support plates are included in this section.

3.9.1 Economizer tube materials shall be in accordance with and subject to the same limitations as materials for tubes of the generating surfaces (see 3.7.5).

3.9.1.1 Materials used for headers shall be of carbon steel, conforming to grade B of ASME SA-106 or of seamless forgings in accordance with class 2 of ASME SA-266.

3.9.1.2 The thickness and tolerances of the finished headers shall conform to the ASME Code for Power Boilers.

3.9.1.3 Materials used for support plates shall be of a quality best suited for the installation.

3.9.1.4 Materials used for fins shall be of same material as economizer tubes.

3.9.2 Economizer headers shall conform to the requirements of 3.5.10.1

3.9.3 The economizer and all of its elements shall be drainable. Each element shall have a seal ring at one support plate to permit the element to freely expand with respect to the support plate. The elements shall be removable and replaceable singly or at least by pairs without disturbing other elements of the economizer.

3.9.4 The economizer vestibules shall be designed so that soot will not accumulate on the return bends or elsewhere in the vestibules.

3.9.5 A 1 inch i.p.s. drain shall be provided from the lowest point of each economizer header vestibule, leading through the outer casing and terminating above the floor plates at the front of the boiler, to facilitate detection of tube joint and handhole plate (if installed) leakage. No valves shall be installed in this line.

3.9.6 A 3/4 inch i.p.s. flanged drain connection shall be provided at the lowest portion of each header to permit complete drainability. A 1/2 inch i.p.s. flanged vent connection shall be located at the highest point of the economizer header and economizer inlet piping. A chemical cleaning connection shall be provided in the outlet. This connection may be combined with the economizer drain connection.

§ 3.10 Desuperheaters. A submerged type of desuperheater shall be provided in the steam or water drum to provide auxiliary steam at the required pressure, temperature, and flow conditions. The design shall permit disassembly and withdrawal through the manhole. It shall be detachable by a flanged connection at both ends inside the drum. The inlet connection shall incorporate a thermal sleeve designed to prevent crevice corrosion. When the desuperheated steam conditions result in a residual superheat of 100°F or higher at any rating, the outlet connection shall also incorporate a thermal sleeve. In addition, an internal corrosion-resistant steel liner shall be provided extending from the external inlet flange to the internal desuperheater flange inside the drum. Liner sleeve will be of ASME SA-213 type 321, 347, or 348 material.

3.10.1 The desuperheater assembly, including tubes and tube flanges or headers shall be fabricated from 16 percent chromium and 1 percent nickel alloy steel in accordance with ASME SA-268, TP-430. The chemical composition and properties shall be modified as follows:

Carbon	- 0.035 maximum
Manganese	- 1.00 maximum
Silicon	- 0.75 maximum
Chromium	- 14.0 to 16.5
Nickel	- 0.80 to 1.50
Sulphur	- 0.030 maximum
Phosphorus	- 0.030 maximum
Elongation in 2-inches minimum	- 20 percent
Tensile strength minimum	- 60,000 lb/in^2
Yield point minimum	- 35,000 lb/in^2
Hardness	- 207 BHN or R_B 0.95 maximum

3.10.1.1 Desuperheater support plates shall conform to grade 60 or 70 of ASME SA-515. The tube holes in the support plates shall have edges rounded or beveled at edges to minimize the possibility of deposit build-up in crevices between tubes and support plate tube holes. Tube to header or tube to flange joints shall be welded externally to eliminate formation of crevices on boiler water side of the desuperheater tubes.

3.10.2 Consideration will be given to providing a heat exchanger type of desuperheater, fed with cooling water directly from the water or steam drum without intervening valves, preferably located between the inner and outer casing.

3.11 Air preheaters. Where preheaters are specified (see 6.1.1), the air preheater shall be considered an integral part of the boiler. The design of the air preheater shall be the command or agency concerned.

3.12 Interconnecting piping. The boiler manufacturer shall be responsible for the design and shall furnish all piping to the terminal points. All drain, vent and blowdown connections shall terminate with flanges outside the outer casing. Drain, vent, and blowdown piping will be provided with expansion joint at outer casing. The shipbuilder shall determine the type of terminal connections to be supplied by the boiler manufacturer and the boiler manufacturer shall be responsible for providing on the boiler, terminal connections to the shipbuilder.

3.12.1 Unless otherwise specified in the contract or order, the shipbuilder shall be responsible for the design and shall supply all interconnecting piping between the steam drum and superheater, between the economizer and steam drum, between the superheater outlet and desuperheater and safety valve actuating piping. The interconnecting piping between the economizer outlet and the steam drum shall be designed with a loop seal to prevent the economizer from draining into the steam drum when the boiler is secured.

3.12.2 No valves shall be installed in the piping between the steam drum and superheater inlet header. The shipbuilder shall install a 1/2 inch calorimeter connection in the connection in the connecting pipe between the steam drum and superheater inlet. A lift check valve with a 1/8 inch hole drilled in the valve bridge shall be installed at the steam drum in the feed line from the economizer. A stop-check valve shall be installed in the piping from the superheater outlet to the desuperheater. The stop-check valve shall be fitted with a means for locking it in the open position and shall be fitted with a means for indicating whether the valve is open or closed.

3.12.3 The shipbuilder shall furnish fuel oil manifolds and branch oil fittings, valves and piping from burners to the manifold. Socket welded root valves shall be provided at the manifold for each branch pipe. The branch piping shall be installed with sufficient flexibility for easy retraction and placing of diffusers and barrels in their operating positions, and shall not vibrate excessively. The hand wheel of each root valve shall be provided with a brass plate identifying the number corresponding to the identifying number of the burner for which it serves. Connections shall be provided on the fuel oil supply manifold for thermometer and pressure gage. Flange connections shall be provided on the manifold for connecting to the fuel oil service piping. The branch lines connecting the burners to the fuel oil supply manifold shall be arranged so as not to interfere with operation, adjustment, repair, or removal of any burner. Take-down joints on oil lines shall be shielded flanges. Burner lead piping shall be made up of MIL-T-20157, type D, seamless carbon steel piping 0.840 inch o.d. with an 0.120 inch minimum wall thickness. Steam atomization steam leads shall each be furnished with ball check valves and steam strainers. Fuel oil pressure regulating valve shall conform to MIL-V-2962 and shall be furnished for the supply line in a valved, by-pass arrangement to the burners for operating wide range burner system as a straight mechanical system. For steam atomization systems the shipbuilder will furnish LP compressed air quick disconnect connection with a two valve shut-off to atomizing steam manifold for cold plant light off purposes. One of these valves will have a check feature.

3.13 Casings. This section includes the outer and inner covering which encloses the boiler, structural support members, and access doors (see 3.4.2.3.1, 3.5.10.1.1 and 3.7.4).

3.13.1 The inner casing shall be constructed of structural steel in accordance with ASTM A36, ASTM A569 or ASTM A588. The manufacturer shall specify such alloying requirements and treatments to the basic materials as required to meet the boiler weight limitations, fabricating methods strength requirements of the casing, and the corrosive environment in which the casing is subjected. Sections of the inner casing which are in contact with combustion gases and operate at temperatures in excess of 700°F shall be corrosion-resistant steel type 310 or type 321 in accordance with ASME SA-240. The air pressurized side of the casing (as distinct from the furnace side) except where corrosion resistant steels make it unnecessary shall be painted with a heat resisting paint suitable for 600°F. In locations where the outer casing once installed prevents the reapplication of paint at regular intervals

for upkeep, the casing material shall include alloying elements, cladding or cermet coatings applied to the steel to assure a service life of 30 years. The casing assembly shall be of welded construction except in zones where removable access, observation, and cleaning panels are required.

3.13.2 The inner casing in the vicinity of the generating bank shall be protected by a layer of firebrick anchored to the casing unless it is made of heat resisting alloy and cooled so that the metal temperature does not exceed 1100°F. A clearance of 1/4 inch shall be provided between the tubes and inner face of the refractory.

3.13.3 The outer casing shall be constructed of the materials previously described as being acceptable for use of the inner casing. The inner side of inner casing shall be painted with heat resistant paint suitable for 600°F. In locations where access to the inner casing is not accessible for reapplication of paint at five-year intervals, the casing material shall include alloying elements, cladding or cermet coatings applied to the steel. Reinforcing bars, Z's, U's or T's shall be installed on the inside of the outer casing panels only. In the way of burner front access panels, access doors and in way of soot blower heads, panels at the floor plate level outer casing shall be insulated and sealed with metal sheathing. The temperature of these metal sheathed surfaces shall not exceed an average temperature of 140°F except in the way of structural ties based on an ambient temperature of 100°F and an air velocity of 0.3 feet per second. The remaining outer casing panels shall be insulated and lagged in accordance with the requirements of the shipbuilder (see 6.1.1). When combustion air is to be led underneath the boiler to the burner front the outer casing shall extend to the tank top and the underside of the outer casing above the tank top shall be insulated with permanent insulation such that the average surface temperature does not exceed 140°F.

3.13.4 Convenient accessibility shall be provided to all manholes and handholes. Access doors or removable and replaceable access panels shall be provided to the superheater access space (cavity), the sides of the generating tube bank and immediately above and below the economizer and air preheater for examination, cleaning, and maintenance. The inner casing access door to the superheater cavity shall be designed and constructed so that metal parts are protected by the refractory and are not exposed to combustion gases. Furthermore, the design shall be such that frequent and ready entrance can be made to the superheater cavity without needless destruction of adjacent refractory walls. If a vertical superheater is used, access to the superheater cavity shall be provided through both the front and rear casings. The shipbuilder shall provide access above the economizer should the boiler manufacturer's material cognizance terminate immediately above these components. Provision shall be made for permitting access to the furnace through both outer and inner casings. Access doors shall be capable of convenient removal and handling, without mechanical aids, by 2 men. Access doors shall not exceed 12 square feet in area and shall not weigh more than 60 pounds. A drain connection shall be provided in the furnace floor and another outboard of the water drum for drainage during water washing. Provisions shall be made in the outer casing of each boiler for connection of forced draft blower air ducts. Peepholes for viewing the furnace floor, screen row tubes, rear walls, side walls, and flame conditions while firing shall be provided in the boiler front. A lighting off port shall also be provided in the burner front. Air duct connections for the forced draft blowers shall be positioned so as not to discharge air across the economizer headers, nor shall the headers restrict the flow of forced draft air. Provision shall be made in the outer casing of each boiler or in the duct between the blower and the boiler for connection to an electric motor-driven lighting off blower.

3.13.5 Access doors and panels shall be secured in such a manner as to permit them to be opened or taken down without the removal of the clamps or bolts and nuts from the outer portion of the casing. Other arrangements will be permitted if equal reliability and tightness is insured. Clamps shall conform to Drawing 5000-S5102-841581. Positioning guides shall be provided for supporting and alining casing access doors prior to installation and securing.

§ 3.13.6 Casing materials shall be of sufficient thickness or shall be sufficiently strengthened by appropriate stiffeners to withstand vibration during operation. The casings shall also be capable of withstanding the air pressure of the forced draft blowers operating at maximum speed against a sudden closing of all air registers, with a maximum permissible permanent distortion of the casings of 1/2 inch. Strength members or casings shall be designed to support furnace floor brickwork, economizers, air heaters, or other components where necessary, and other loads such as that due to differential expansion of drums and casings. Securing devices for brickwork or refractory materials except burner tile, shall not penetrate the inner casing.

3.13.7 With the boiler uptake open, burner openings blanked off, and air pressure between casings maintained at a value equal to the draft loss anticipated at the maximum overload boiler rate with 260 cubic feet of 68°F air per pound of fuel fired, combined leakage through inner and outer casings shall not exceed 6 percent of the anticipated combustion air flow required under those conditions. To insure minimum dilution of combustion products, leakage through the inner casing shall not exceed two percent of the anticipated combustion air flow, under the maximum draft loss conditions noted above, when the differential pressure across the inner casing is equal to the anticipated register air pressure drop at the same conditions.

3.13.8 Examination ports and lights. Examination ports shall be provided in the boiler casing to permit observation of the inner front casing and the space beneath the fuel oil burners for evidence of fuel oil leakage. Examination port design shall be reviewed by the command or agency concerned. Lights shall be installed as necessary to provide adequate illumination for the examination of the above space, and shall be in accordance with sheet 20, section 3 of Drawing 9000-S6202-73980 (see 3.5.10).

3.14 Safety valves. The boiler shall be equipped with safety valves conforming to MIL-V-17462.

3.14.1 The aggregate relieving capacity of the safety valves of each boiler shall be such that all of the steam generated at the overload condition will be discharged without allowing the drum pressure to increase more than 3 percent above the highest pressure at which any valve is set, and in no case to increase more than 6 percent above the boiler design pressure. The relieving capacity of the superheater safety valve shall be such that the superheater will not be damaged by overheating or bursting should the firing rate be maintained for 30 seconds at any firing rate from the specified minimum to maximum overload rate. The safety valve installation on the steam drum shall consist of at least two valves of which one may be the drum pilot operator.

3.14.2 The capacity of the steam drum safety valves shall be not less than 75 percent of the steam generated at the overload condition. The relieving capacity of the drum pilot actuator valve shall be as small as practicable consistent with proper design and operation.

3.14.3 Safety valves shall be connected directly to the boiler without any intervening valves or fittings. The valves shall be mounted in an upright position. Safety valves of a given type installed on a boiler shall all be of the same hand, shall have inlet and outlet flanges drilled in an identical manner, and shall have drain connections located in the same position.

3.14.4 The superheater safety valve shall be a drum pilot operated valve. The drum pilot actuator valve shall be designed to open the superheater valve at the same time the drum pilot valve pops open.

3.14.5 The steam drum pilot actuator valve shall be set to pop and open the superheater safety valve at a gage pressure of 50 lb/in^2 or 8 percent greater, whichever is greater than the highest working steam drum pressure (120 percent overload). The first steam drum safety valve shall be set to pop open at a pressure approximately 2 percent of the highest working drum pressure higher than the steam drum pilot actuator valve. Additional steam drum safety valves shall be set to pop progressively at pressure increments equal to 1.5 percent of the highest working drum pressure. The third and fourth steam drum safety valves may be set at the same pressure. If the superheater safety valve is of the spring loaded type it shall be set at a pressure approximately 3 percent above the drum pilot actuator valve set pressure. All safety settings shall be set to the nearest gage pressure of 5 lb/in^2 value and to provide allowance for safety valve setting tolerances.

3.15 Soot blowers. The boiler shall be equipped with soot blowers conforming to MIL-B-1947. The number and location of soot blowers shall insure adequate cleaning of the boiler firesides. A soot blower shall be located in the generating bank 13-inches directly over the water drum to assist in keeping the water drum free of deposits and soot accumulations. Stationary type soot blowers shall be provided as follows:

(a) One outboard and below the horizontal centerline of the water drum.
(b) One between the economizer and the steam drum (only required when the bottom of the economizer extends more than 12 inches below the horizontal centerline of the steam drum).

If soot blower heads are located in the rear of the furnace they shall be air operated and provision shall be made for withdrawal of the soot blower elements through the front casing.

3.15.1 Steam soot blower heads shall be designed for boiler superheater outlet pressure and temperature, however provision shall be made at or in the head to attain an optimum reduced operating pressure and a gage pressure of 300 lb/in^2 for fixed and rotary elements, and a gage pressure of 175-300 lb/in^2 for retractable elements. The soot blower heads shall be provided with a gage connection to enable checking of the soot blower operating pressure. Steam for the soot blowers shall be taken from the desuperheater outlet of the boiler at the full boiler pressure, unless otherwise specified by the procuring activity.

3.16 Steam drum water level indicators. Each boiler shall be equipped with a direct reading water level gage glass and 2 remote reading water level indicators. The direct reading water gage shall be located on the front steam drum head by the boiler manufacturer with nozzle connections and the gage proper located as close to the drum centerline as possible. Remote indicators shall be connected to the front steam drum head by means of separate connections and independent from any other functions, except that one remote may be connected to the direct reading, gage glass connection. The independent water leg connection shall be located as close to the drum centerline as possible. Remote indicators shall be mounted side by side at the firing aisle level. The direct reading gage and remote indicators shall be equipped with shut-off valves and shall be arranged so that each gage is removable and drainable while the boiler is steaming. The gage glass and indicators shall be installed on the drum head so that no interference occurs or disconnecting of instrument is required for access to the drum interior. All connections to the drum head shall be sufficiently long to clear the drum insulation and to permit rotation of the direct reading gage for optimum visibility of the feed valve operator.

3.16.1 Each direct reading gage glass shall conform to MIL-G-16356. Two drain valves shall be furnished with each direct reading water level gage by the boiler manufacturer so that one can be used as a throttle. Water gages shall be furnished with illuminators.

3.16.2 The remote reading water level indicators shall be identical and be of the same manufacturer and shall conform to MIL-I-22610. Each of the remote level indicators shall be equipped with an electrical transmitting mechanism to transmit and repeat water level signals to the secondary indicators. For each boiler only the remote level indicator attached to the drum by separate connections and with no other appurtenance attached thereto shall actually be wired to transmit level signals to the secondary indicators to be mounted on the fireroom and engine room gage boards in the respective fireroom and engine room operating stations. In addition, each indicator shall be equipped with a separate set of electrical contacts to be used for energizing visual and audible high and low water alarms to be furnished by the shipbuilder; however only the indicator attached to the drum by separate connections will actually be wired to the high and low level alarms. The secondary indicators shall be full scale secondary indicators in accordance with MIL-I-22610 provided by the boiler manufacturer with the remote indicator directly connected to the drum head for installation by the shipbuilder. All the required electrical wiring shall be provided by the shipbuilder. The high and low water alarms shall be set for plus and minus 5-inches, respectively from the normal water level. A setting chamber shall be provided for each remote water level indicator.

3.17 Connections and controls. Connections for the feed water regulator and combustion controls shall be provided on the boiler as specified (see 6.1.1). The water level sensing connections for the feed water regulator shall be provided on steam drum centerline to provide minimum of fluctuation due to roll and list.

3.18 Boiler blow system. Unless otherwise specified in the contract or order, the shipbuilder shall furnish the boiler blow valves, guarding valves, boiling out valves and piping required for installing the boiler blow system. The boiler blow valves shall be flanged and conform to MIL-V-17737. All piping connections and pipe joints shall be made with full penetration welds and butt joints without crevices such as obtained with socket welds. Internal backing rings used in welding shall be machined out. Except for the surface blow down connection all piping runs shall permit gravity drain of headers and drums. All blow system pressure vessel piping shall conform to MIL-T-20157 and consist of carbon steel 1-1/2 inch i.p.s. schedule 80 piping to the blow valves and shall be uniform in thickness throughout.

3.19 Miscellaneous instruments and appurtenances. The shipbuilder will provide the following instruments and appurtenances for each boiler, unless otherwise specified (see 6.1.1):

(a) Smoke indicator - One smoke indicator, complete with light unit, vision unit, damper, and reflection unit, in accordance with MIL-I-2002.
(b) Two steam pressure indicators 8-1/2 inch o.d. dials in accordance with MIL-I-18997, one for indicating the superheater outlet pressure and one for indicating the steam drum pressure. The indicator used for control shall be furnished with a suppressed scale and a gage pressure of 300 lb/in^2 below to a gage pressure 300 lb/in^2 above the normal operating pressure.
(c) One desuperheater outlet pressure indicator, 8-1/2 inch o.d. dial, in accordance with MIL-I-18997.
(d) One supply oil pressure indicator, 8-1/2 inch o.d. dial in accordance with MIL-I-18997.
(e) One 4-1/2 inch o.d. dial pressure indicator with a scale range of and a gage pressure of 0-150 lb/in^2 for steam atomizing pressure indication in accordance with MIL-I-18997.
(f) One distant reading dial thermometer, conforming to MIL-T-19646, for the superheater outlet temperature.
(g) One direct-mounted dial thermometer, conforming to MIL-T-19646 for the superheater outlet steam temperature.
(h) One distant reading dial thermometer, conforming to MIL-T-19646, for the desuperheater outlet steam temperature.
(i) One direct mounted dial thermometer, conforming to MIL-T-19646, for the desuperheater outlet steam temperature.
(j) One direct-mounted indicator (30°F - 240°F) conforming to MIL-I-17244, for oil temperature.
(k) One multiple pointer air draft gage in accordance with type B of MIL-G-17489. Class 3 shall be used for combatant type ships, class 2 shall be used for all other ships.
(l) One direct mounted dial thermometer, conforming to MIL-T-19646, for the economizer inlet temperature.
(m) One direct mounted dial thermometer conforming to MIL-T-19646 for the economizer outlet temperature.

3.19.1 The boiler manufacturer shall furnish connnections as may be required for the piping up of items specified in 3.19(b) through (k).

3.19.2 The boiler manufacturer shall supply the following valves:

(a) Safety valves.
(b) Direct reading water level gage shut-off valves and drain valves.
(c) Remote reading water level indicator shut-off valves.

3.19.2.1 All other valves shall be furnished by the shipbuilder.

3.20 Drawings. The supplier shall prepare engineering drawings in accordance with the data ordering document included in the contract or order (see 6.1.3). In addition to the requirements of the data ordering documents, drawings shall include the following information specified in 3.20.1 through 3.20.4.

(a) Steam drum, water drum and waterwall header details. Show diameter and grooving of tube seats, transverse cross-sectional view, longitudinal sectional elevation, details of external (nozzle) connections (reduced size), bill of material, welding and heat treatment procedure and other pertinent notes relative to fabrication and installation.
(b) Superheater header and tubes, arrangement and detail. Show details of all nozzles, vent and drains, superheater element assembly, section through tube seat, tube to header welding detail, header elevation and plan view section. A bill of material and pertinent notes relative to welding procedures, heat treatment, fabrication and installation shall be included.
(c) Superheater details, miscellaneous. Show section through handhole plate opening, and plug details, single line sketch showing how elements are displaced from horizontal, arrangement and detail of superheater tube supports, plug and plugging tools. A bill of material, plugging instructions and support installation procedure, and procedure for replacement of superheater tube elements shall also be included.

(d) Economizer arrangement and detail. Show detail of nozzle connections, handhole plate seat details, partial sectional elevation, detail of welding tubes to headers and procedure to be followed, section through tube seat.

(e) Tube drawing. A cross-sectional drawing enabling operators to identify every tube and downcomer in the boiler including economizer and air preheater where installed. A flow pattern shall also be shown on the economizer section. Screen tubes, support tubes and main generating bank tubes shall be lettered and numbered, starting with the first screen row as "A" and numbered from front to rear. Sidewall tubes shall be lettered and numbered from front to rear as follows: SW1, SW2, etc. Rear wall tubes shall be similarly identified from left to right as follows: RW1, RW2, etc. Roof tubes where installed shall be designated R1, R2, etc., counting from left to right on upper rear header. Floor tubes, if installed, shall be designated F1, F2, etc., counting from front to rear. Economizer and air heater tubes from left to right A, B, C, etc. and from bottom to top 1, 2, 3, etc. Superheater tubes shall be counted from bottom to top and shall be additionally identified by loops. That is, the row nearest the furnace shall be designated the "outer loop". Following this will be the "intermediate loop(s)", and the "inner loop". Downcomers in water drum be designated DC1, DC2, etc., starting from front on side wall header, moving to rear and continuing from left to right on rear wall header. A word description of how to use the drawing in identifying tubes shall be included. Tracing of the tube identification drawing shall be forwarded to NAVSEC for use in preparing forms for the ship's boiler records.

(f) Details of tools.

(g) List of drawings.

(h) List of spares and tools.

(i) Details of boiler and downcomer tubes. (Pertinent notes shall include sufficient information to permit a repair activity to order, cut, bend and install tubes without aid of boiler manufacturer.)

(j) General arrangement, front sectional elevation and plan view. Drawing shall contain a sectional front view including economizer looking toward rear of boiler, and a sectional plan view as viewed from the top after passing a section through the furnace parallel to the base line. A tabulation of all boiler data shall be included on this drawing.

(k) Brickwork arrangement. Arrangement of all brickwork with various sections taken at pertinent locations to permit complete installation without reference to other drawings. The drawings shall contain all pertinent information relative to materials and installation procedures, including details of castable refractory forms.

(l) Arrangement of valves and fittings. Show all valves, fittings and appurtenances as viewed from front, both sides and top of boiler. A bill of material and expansion data shall be included on this drawing. The maximum permissible external loads on the boiler connection shall also be shown.

(m) Arrangement of steam drum internals. Shall show sufficient views to facilitate removal and installation. Pertinent notes relative to proper installation procedures and a bill of material shall be included on this drawing.

(n) Arrangement and details of desuperheater. Shall show details of tubes, supports, arrangement, welding, heat treatment and fabrication instructions, a bill of material, design and test pressures.

(o) Arrangement of front outer casing. Shall show all access openings, doors and panels, including economizer, and shall include typical sectional views specificially where various boiler parts and appurtenances pierce the casing, all expansion joints, seals and attachments to drum and header structurals.

(p) Arrangement of front inner casing. Same as "o".

(q) Arrangement of rear outer casing. Same as "o".

(r) Arrangement of rear inner casing. Same as "o".

(s) Arrangement of inner economizer casing. Same as "o".

(t) Arrangement of furnace side inner casing. Same as "o".

(u) Arrangement of furnace side outer casing. Same as "o".

(v) Arrangement of outer economizer casing. Same as "o".

(w) Casings, cutaway view. Show a cutaway view of the assembled casings, taken from the front, and a portion of the sides, including economizer, and shall depict a complete picture of the casings, insulation and brickwork without the necessity of referring to other drawings. Specifically, the drawing shall show a section through the sides, front and those areas where drums and headers are attached to the casings. A typical tie bar installation shall also be shown.

(x) Fuel oil burner assembly.
(y) Fuel oil burner lists of material.
(z) Safety valve assembly.
(aa) Safety valve details.
(bb) Safety valve tools.
(cc) Soot blower assembly and details.
(dd) Boiler gage glasses, arrangements and details.
(ee) Arrangement and details of smoke indicator.
(ff) Boiler seating arrangement. Show location of boiler footings and the bolting arrangement.
(gg) Welding procedures. Show all welding procedures heat treatment and non-destructive tests used in the fabrication and erection of the boiler. All drawings showing welding shall note the procedures used and refer to this drawing.
(hh) List of drawings. Showing the title of the drawing and drawing number of the equipment furnished, including equipment furnished but not manufactured by the boiler manufacturer.

3.20.1 Tracings of all drawings shall be maintained by the supplier and his subcontractors at their plant.

30.2.2 The supplier shall prepare microfilm in accordance with the data ordering document included in the contract or order (see 6.1.3). Complete sets of microfilm required shall be specified by the shipbuilder and shall include the following:

1 roll microfilm, type I, class 1 to Commander, Naval Sea Systems Command, Washington, D.C. 20362.
1 roll microfilm, type II, class 2 to Naval Ship Engineering Center, Hyattsville, Md. 20782.
1 roll microfilm, type II, class 2 to Naval Ship Engineering Center, Philadelphia Division, Philadelphia, Pa. 19112.
1 roll microfilm, type II, class 2 to Naval Sea Center, Pacific San Diego Division, San Diego, Calif. 92138.
1 roll microfilm, type II, class 2 to the following Naval Shipyards:

Philadelphia Naval Shipyard, Philadelphia, Pa. 19112.
Norfolk Naval Shipyard, Portsmouth, Va. 23709.
Charleston Naval Shipyard, Naval Base, Charleston, S.C. 29408.
Long Beach Naval Shipyard, Long Beach, Calif. 90891.
Mare Island Naval Shipyard, Vallejo, Calif. 94592.
Puget Sound Naval Shipyard, Bremerton, Wash. 98314.
Pearl Harbor Naval Shipyard, Box 400 FPO San Francisco 96610.

3.20.3 Copies of drawings shall be forwarded as follows:

1 copy (blueprint) to Naval Ship Engineering Center, Hyattsville, Md. 20782.
1 copy (vandyke) to the planning Naval shipyard.
1 copy (blueprint) to Naval Ship Engineering Center, Philadelphia Division, Philadelphia, Pa. 19112.
1 copy tracing of tube renewal sheet to NAVSEC (see 3.20.1(a)).
1 copy (blueprint) to Ships Parts Control Center, Mechanicsburg, Pa. 17055.

3.20.4 Drawings (general arrangement) shall include the following information:

(a) Design pressures.
(1) Boiler pressure parts. . . . . .lb/in^2.
(2) Economizer . . . . . .lb/in^2.
(3) Air casing . . . . . .inches water.
(b) Generating surfaces.
(1) Main tube bank or secondary tube bank. . . . . .square feet.
(2) Screen tubes . . . . . .square feet.
(3) Furnace rear wall tubes. . . . . .square feet.
(4) Furnace front wall tubes . . . . . .square feet.
(5) Furnace side wall tubes. . . . . .square feet.
(6) Furnace side plus roof tubes, if continuous. . . . . .square feet.
(7) Furnace floor tubes, bare. . . . . .square feet.
(8) Superheater surface. . . . . .square feet.
(9) Economizer surface . . . . . .square feet.
(10) Desuperheater surface. . . . . .square feet.
(11) Air heater surface . . . . . .square feet.

(12) Safety valve settings. . . . . .lb/in^2.
(13) Hydrostatic test pressures before assembly . . . . . .lb/in^2.
(14) Hydrostatic test pressure on completion of assembly. . . . .lb/in^2.
(15) Inner casing leakage test pressure . . . . . .inches water.
(16) Outer casing leakage test pressure . . . . . .inches water.

(c) Furnace data.
(1) Furnace volume . . . . . ft^3.
(2) Furnace depth. . . . . feet.

(d) Total effective projected radiant heat absorbing surface.
(1) Fireside row . . . . . square feet (equivalent).
(2) Front wall tubes . . . . . square feet (equivalent).
(3) Rear wall tubes. . . . . square feet (equivalent).
(4) Side (roof tubes). . . . . square feet (equivalent).
(5) Roof tubes . . . . . square feet (equivalent).
(6) Floor tubes. . . . . square feet (equivalent).
(7) Refractory surface . . . . . square feet (equivalent).

(e) Overall dimensions and weights.
(1) Maximum height over economizer . . . . . feet.
(2) Maximum height over drum . . . . . feet.
(3) Maximum width. . . . . feet.
(4) Maximum depth. . . . . feet.
(5) Maximum dry weight . . . . . pounds.
(6) Maximum wet weight steaming. . . . . pounds.
(7) Box volume . . . . . ft^3.
(8) Location of center-of-gravity from steam drum centerline

(f) Anticipated performance shall be as follows:

	10 percent	Cruising	Astern	F.P.	Maximum overload
Rate of operation, percent					
Total steam generated, lbs/hr.					
Superheated steam, lbs/hr.					
Desuperheated or saturated steam, lbs/hr.					
Boiler drum pressure, lb/in^2.					
Superheater outlet pressure, lb/in^2.					
Superheater outlet temperature, °F					
Desuperheater or saturated steam outlet pressure, lb/in^2.					
Desuperheater or saturated steam, outlet temperature °F					
Economizer inlet pressure, lb/in^2.					
Economizer inlet temperature, °F					
Economizer outlet pressure, lb/in^2.					
Economizer outlet temperature, °F					
Casing air inlet temperature, °F					
Air heater outlet temperature, °F					
Burner air inlet temperature, °F					
Total air flow, lbs/hr.					
Total oil flow, lbs/hr.					
Anticipated efficiency, percent					
Guaranteed efficiency, percent					
Radiation and unaccounted for losses, percent					
Excess air, percent					
Percent carbon dioxide					
Number of burners in operation					
Throttle or nonthrottle of air doors					
Draft loss, total inches water[1/]					
Through steam air heater, inches water					
Through double casing, inches water					
Through burner register, inches water					
Through boiler and superheater, inches water					
Through economizer, inches water					

See footnote at end of table.

	10 percent	Cruising	Astern	F.P.	Maximum overload
Gas temperature leaving superheater screen, °F					
Gas temperature leaving superheater, °F					
Gas temperature leaving main bank, °F					
Gas temperature leaving economizer, °F					
Heat release, Kilo B.t.u./hr./sq. ft. radian heat absorbing surface					
Heat release, KB/hr.sq. ft., total heating surface					
Heat release, KB/hr./ft^3 furnace volume					
Furnace heat absorption, first water screen row, KB/hr./sq. ft.					
Heat absorption maximum and location KB/hr./sq. ft.					
Anticipated metal temperatures, °F					
Water screen tubes, outside					
Water screen tubes, inside					
Superheater tubes, outside, maximum					
Superheater tubes, inside, maximum					
Maximum inner casing temperature and location					
Maximum outer casing temperature and location					
Average outer casing temperature					

1/ The number of cubic feet of air required shall be based on the pounds of air required for smokeless operation with air at 100°F at the boiler casing inlet or air heater inlet if an air heater is specified. For overload condition the draft losses shall also be specified for 260 ft^3 of air at 68°F per pound of oil.

3.21 Design reports. The boiler manufacturer shall furnish 5 copies of the following:

(a) Complete stress calculations of drums, headers and tubes.
(b) Calculations of circulation at 10 percent, 50 percent and 80 percent, 100 percent of full-power and at the overload rating. Shrink and swell of water level during the maneuvers specified in 3.2.6.
(c) Anticipated over-all thermodynamic performance, heat absorption in various sections of the boiler and air and gas side pressure losses.
(d) A list of components showing estimated weights and final weights for the boiler components. The list should be corrected as soon as actual weights are known.

3.22 Technical manuals. The supplier shall prepare manuals in accordance with the data ordering document included in the contract or order (see 6.1.3) and as specified in 3.22.1 through 3.22.5. Those portions of the manuals and drawings which do not set forth proprietary data and those which set forth proprietary data relating to the following nine categories shall not be subject to any limitations on rights and data and shall not be marked with or indicated as subject to any restrictive legend or marking. The nine categories are as follows:

(a) Burner nozzles, sprayer plates and tips.
(b) Steam generating, downcomer and superheater tubes.
(c) Superheater support plates and fittings.
(d) Drums and headers.
(e) Insulation, refractory and anchor bolts.
(f) Miscellaneous nuts and bolts.
(g) Handhole plates, manhole plates and breach bars.
(h) Gaskets and packing.
(i) Metal structural shapes and sheets.

3.22.1 Unless otherwise specified in the contract or order, 4 copies of the preliminary manual complete with figures and photographs shall be forwarded (for review by the shipbuilder and the command or agency concerned) no later than 30 days after shipment of first unit.

3.22.2 The distribution and number of copies of the technical manuals required shall be specified (see 6.2) and shall include the following:

2 Copies for Naval Ship Engineering Center, Hyattsville, Md. 20782.
1 Copy for Naval Ship Engineering Center, Philadelphia Division, Philadelphia, Pa. 19112.
1 Copy for Naval Ship Engineering Center, Norfolk Division, Norfolk, Va. 23511.
1 Copy for Naval Sea Center, Pacific, San Diego, Calif. 92138.

3.22.3 In addition to the technical manuals specified in 3.22, the boiler manufacturer shall furnish the shipbuilder and the command or agency concerned notes on erection and installation of boilers, care of boilers after installation, and operational procedures while the boiler and ship are in the shipbuilder's hands prior to acceptance of the ship by the Government. These notes shall include preservation and cleaning of boilers, preparations prior to lighting off, care of burners and refractory, feed and boiler water conditioning and care of the boilers.

3.22.4 A boiler identification plate shall be furnished for each boiler in accordance with type D of MIL-P-15024 and MIL-P-15024/5.

3.22.5 An "A" frame for erection of the boilers shall be supplied by the boiler manufacturer.

3.23 Provisioning and repair parts. The supplier shall prepare a provisioning parts list in accordance with the data ordering document included in the contract or order (see 6.1.3) and as specified in 3.23.1 and 3.23.2.

3.23.1 Onboard repair parts. Repair parts shall be furnished by the boiler manufacturer in accordance with MIL-P-15137 (see 6.2) in the following quantities:

Items		Quantities
(a)	Manhole plates (complete with bolts, nuts and dogs)	Complete for one boiler per ship.
(b)	Handhole plates (complete with bolts, nuts and dogs)	100 percent of each size in all boilers.
(c)	Gaskets, manhole and handhole	200 percent of the number in all boilers.
(d)	Gaskets for internal joints in drums	200 percent of all number of each size in all boilers.
(e)	Tubes (tubes shall be completely fabricated, bent and ready for installation):	
	(1) Screen tubes	1 boiler's worth per ship.1/
	(2) Water wall tubes	1 boiler's worth per ship.1/
	(3) Superheater tubes	1 boiler's worth per ship.1/
	(4) Spare economizer elements	1 per boiler room.1/
(f)	Water level gage glasses	200 percent of the number in all boilers.
(g)	Burner impeller plates	25 percent of the number installed in all burners.
(h)	Burner air regulating shutters	10 percent of the number installed in all burners.
(i)	Gaskets used on burners for oil tightness	200 percent of number installed of each size and type.
(j)	Gaskets used on burners for air tightness	10 percent of number installed of each size and type.

1/ When one boiler's worth of repair parts is specified, it shall include one boiler's worth of each hand of such parts if the contract or order specifies right and left handed boilers.

3.23.2 Stock repair parts. Stock repair parts shall be furnished in accordance with MIL-P-15137. Shipping destination for stock repair parts shall be furnished by the Ships Parts Control Center, Mechanicsburg, Pa. One ship set of special boiler tubes consisting of economizer, superheater, special generating or water wall tubes with support castings or swaged ends shall be processed in a production list.

3.24 The following tools shall be furnished by the boiler manufacturer in the quantities indicated:

(a) Wrenches for handhole nuts, two for each boiler.
(b) Wrenches for manhole nuts, one for each boiler.

(c) Tube expanders (cage with rolls, mandrels and extra set of rolls) complete, including required accessories such as right-angle gear drives, parallel gear drives, universal joints, and rachet wrenches for each size generating, water wall, superheater, economizer, and air heater tube, one set for each boiler.
(d) Tube expanders (cage with rolls, mandrels, and extra set of rolls), complete, for every other size of tube, one set for each fireroom.
(e) Metal tube plugs per boiler as follows:
  (1) 6 for generating tubes.
  (2) 2 for each size screen and water wall tubes.
  (3) 4 for each size superheater tube.
  (4) 4 for economizer tubes.
(f) Blind nipples per boiler as follows:
  (1) 2 for generating tubes.
  (2) 2 for each size screen and water wall tubes.
(g) One boiler hydrostatic test pump unit, a gage pressure of 100 lb/in^2 compressed air operated Sprague Engineering Corporation Model S-440 or equivalent to test up to 150 percent of economizer design pressure. This power unit assembly is to consist of air-operated pump, muffler, lubro-control unit (filter, airline lubricator, air reducing valve, pressure gage), driving air shut-off valve output pressure gage at pressure outlet, bleed valve and hose, basic parts mounted on baseplate with mounting holes. The pump shall be fitted with 10-foot suction and 24-foot pressure (discharge) hose, complete with couplings and connections to suit fitting on the boiler. Acceptable capacities are gage pressures of 3000 to 3500 lb/in^2 outlet fluid pressure for testing a gage pressure of 1200 lb/in^2 boilers gage pressures of 1000 to 2000 lb/in^2 outlet fluid pressure for testing a gage pressure of 600 lb/in^2 boilers.
(h) Gasket templates one for each size handhole. The templates shall be of steel, 1/16 inch thick.
(i) Air-driven tube cleaning outfits, in accordance with MIL-T-17370, one per boiler for each size of tubes 2 inches in diameter or less, and one per fireroom for each size of tube over 2 inches in diameter.
(j) Tube cleaner brush sets in accordance with MIL-B-2678 as follows:
  (1) One brush set for each 50 tubes or fraction thereof installed in the A and B rows on the ship.
  (2) One brush set for each 200 tubes or fraction thereof (other than A and B rows) of each size on the ship.
  (3) One brush set for each 300 superheater tubes or fraction thereof on the ship.
(k) One set of aluminum forms per ship, for use in installing or repairing burner throat refractory, and one sweep.
(l) All special tools used for repair or cleaning boilers and appurtenances and auxiliary equipment shall be furnished as required. Special tools are defined as those tools not listed in the Federal Supply Catalog (copies of this catalog may be consulted in the office of the Defense Contract Administration Service (DCAS)).
(m) Special wrenches for burner atomizers, one of each for each boiler.
(n) Special tools required for assembly or for normal maintenance, repair and adjustment of burners, one of each per ship.
(o) Tool for preparing superheater header tube holes for welding, one of each per ship.
(p) Tube plug extractors, one of each size for each fireroom.
(q) Reamers for preparing seating surface for metal tubes plugs or for superheater tube seats, one set per boiler.
(r) Air motor-driven tools, including speed wrenches for casing bolts, one set per fireroom.
(s) Air motor-driven handhole seat cleaner, with a metal cup brush, one cleaner and 12 spare cup brushes per fireroom.
(t) Air motor driven safer saw for cutting out superheater and economizer tubes.
(u) Burner sprayer plate go-no-go gauges for each size plate provided.

3.25 Technical data. The supplier shall prepare technical data in accordance with the data ordering document included in the contract or order (see 6.1.3) and as specified in the following:

(a) Technical report (see 3.2.12).
(b) Drawings (see 3.20).

(c) Microfilm (see 3.20.2).
(d) Manual technical, preliminary (see 3.22).
(e) Provisioning parts list (see 3.23).
(f) Quality program plan (see 4.1.1).
(g) Test procedures (see 4.3.2).

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 Quality program. The supplier shall provide and maintain a quality program in accordance with the data ordering documents included in the contract or order (see 6.1.1 and 6.1.3). The minimum verification inspection by the Goverment will be as follows:

(a) Thickness and diameters of headers and drums.
(b) Hydrostatic test of headers and drums.
(c) Review nondestructive testing (NDT) including radiographic examination of finished welds.

4.2 Whether the boiler is erected at the manufacturer's plant or erected in the field (shipyard, site local to shipyard, or onboard the ship) the minimum verification by the Government shall be as follows:

(a) Hydrostatic test of assembled boiler.
(b) Air casing tests.
(c) Visual and NDT examination of finished welds.
(d) Assembly of drum internals.
(e) Mechanical cleaning demonstration.
(f) Records of method of preservation, boiling out procedures, and condition of feed water and boiler water.

4.3 Tests.

4.3.1 Static tests. During the course of erection, or upon completion of assembly of the pressure parts, the pressure parts of the boiler shall be hydrostatically tested to 1-1/2 times the design pressure of those parts for strength and tightness.

4.3.1.1 After erection onboard ship, or after the erected boiler has been installed onboard ship the complete boiler shall be hydrostatically tested to 1-1/4 times the design pressure of the boiler for tightness.

4.3.1.2 Inner casing integrity test. During the erection of the boiler, the inner casing of the boiler shall be subjected to a pressure of 15 inches of water on the furnace side, with the uptakes and burner openings temporarily blanked off to insure tightness of the inner casing welds and bolted panels doors.

4.3.1.3 Outer casing leakage test. After erection of the boiler with the stack opening temporarily blanked closed and registers open, air shall be introduced in the boiler between casings and the furnace at increments of pressure up to the design pressure. The leakage rate which represents the leakage rate of the outer casing shall be measured up to an air pressure corresponding to the 120 percent overload condition. At pressures above this pressure to the design pressure of the casing, the casing shall not exhibit any deformation of panels and register doors which shall result in higher leakage rates more than 15 percent of that previously measured after the air pressure is reduced.

4.3.1.4 Inner casing leakage test. After erection of the boiler with the burner registers temporarily blanked closed and the stack open similar to the casing strength test specified in 4.3.1.5, air shall be introduced between inner and outer casing and tested to the pressure corresponding to the pressure differential across the burner register at 120 percent full-power overload condition. The inner casing leakage shall be calculated as the difference between leakage measured less the outer casing leakage measured as specified in 4.3.1.3.

4.3.1.5 Casing strength test. After erection of the boiler and casings with the stack open and burner openings temporarily blanked closed, air shall be introduced between the inner and outer casing tip to the air pressure corresponding to the 120 percent overload condition blowers operating at maximum speed with registers closed to determine the adequacy of the strength of the casings. Casing deflection measurements shall be made. The maximum permissible permanent distortion shall not exceed 1/2 inch.

4.3.1.6 Tests specified in 4.3.1.2 through 4.3.1.4 shall be conducted on each boiler. The test specified in 4.3.1.5 shall be conducted on the landbase boiler to be tested or on any one of the boilers furnished of identical design where the casing design is at variance with that of a previously tested design.

4.3.2 Operating test. The supplier shall provide a test procedure in accordance with the data ordering document included in the contract or order (see 6.1.3). The acceptance of a boiler and its components shall be predicated upon performance during a landbase boiler test, if required (see 6.1.1) and during acceptance trials of the ship. A propose test agenda shall be submitted.

4.3.2.1 Landbase boiler tests. Landbase boiler tests shall be conducted at a facility or on board ship where facilities are available for furnishing feed water, fuel oil, handling the steam generated and instrumentation of the boiler. The purpose of the landbase boiler tests shall be to determine whether the boiler meets the requirements of this specification and shall include the following:

(a) Verification of safety devices, monitoring equipment and controls.
(b) Standard and rapid lighting-off and securing tests.
(c) Efficiency, heat transfer, pressure loss and circulation tests. These tests shall be conducted with boiler water conditions maintained between 1000 to 1100 p/m using feed water of the standard quality consisting of 8 continuous hours at the 100 percent and 120 percent full-power conditions and 4 continuous hours each at the 10 percent and 50 percent full-power conditions. Instrumentation shall be furnished and installed by the supplier for these tests to enable computation of efficiency by the heat loss and input-output method, measurement of downcomer flows, superheating of steam generated in the generating tubes by fusible cadmium alloy wires, selected metal temperatures of the generating and superheater tubes, casing and superheater support temperatures and fluid (air, gas and oil) pressure temperatures and flow.
(d) Steam purity test. This test may be conducted in accordance with MIL-STD-1362 during the efficiency test.
(e) Low steam pressure operation. One hour operation at each of the loads from 10 percent, 25 percent and 50 percent and to a load not to exceed the allowable superheater outlet steam temperature.
(f) Blow down test.
(g) Operation with different number burners in use at 10 percent, 25 percent, 50 percent and 75 percent loads up to the maximum capacity of each burner.
(h) Cold feed water test to determine limitations of operation using cold feed.
(i) Transient response of boiler during rapid load changes.

4.3.2.2 If a boiler of the same or higher capacity has been tested at NAVSECPHILADIV or other test facility and the boiler manufacturer can document by design analysis that he is not extrapolating the performance and is not including in the design of the boiler untested features of construction and fabrication, the landbase boiler tests specified in 4.3.2.1 may be omitted in part or in their entirety subject to review by the command or agency concerned.

4.3.2.2.1 The factors to be considered in performance are: The burner and furnace configuration, heat release rates per unit burner frontal area and windbox depth, burner clearances, heat release rate per unit volume and heat release and heat absorption rates per radiant heat absorbing surface, generating, superheating, and economizer surface areas, steam mass flow rates through the superheater and gas mass flow rates through the tube banks, steam separator configuration, free surface area of the steam water interface in the steam drum, and circulation rates.

4.4 Inspection of preparation for delivery. The preservation, packaging, packing, and marking shall be inspected for compliance with section 5 of this document.

5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein shall apply only for direct Government procurements. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.4.)

5.1 Boilers. Boilers shall be shipped in an unassembled condition except for economizer assembly for erection in the ship by the shipbuilder, unless otherwise specified in the contract or order.

5.2 Level C preservation-packaging. Preservation-packaging of all boiler equipment shall afford protection against corrosion, deterioration, and physical damage during shipment from the supply source to the shipbuilder until early installation. Preservatives used on steamsides and watersides of boiler equipment shall be removable by boilout methods. All openings shall be sealed to prevent entrance of foreign matter. The suppliers normal preservation-packaging methods may be used when such methods meet the requirements of this level.

5.3 Level C packing. Items, preserved-packaged as specified shall be packed in containers acceptable to the common carrier which will insure safe delivery at the destinations in a satisfactory condition at the lowest applicable rate. Containers or method of packing shall comply with Uniform Freight or National Motor Freight Classification Rules or Regulations as applicable to the mode of transportation.

5.4 Marking. In addition to any special markings required by the contract or order (see 6.1.1), interior packages and exterior shipping containers or unpacked equipment shall be marked in accordance with MIL-STD-129.

5.5 Repair parts and tools. Repair parts and tools shall be preserved-packaged, packed, and marked in accordance with PPP-P-40. Repair parts and tools shall be packed separately and shipped concurrently with the equipment.

6. NOTES

6.1 Ordering data.

6.1.1 Procurement requirements. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Number of boilers.
(c) The maximum superheater outlet steam temperature not to be exceeded under any steady steaming condition (see 3.2.6).
(d) The minimum outlet pressure and corresponding maximum outlet temperature from the desuperheater at the overload condition (see 3.2.6).
(e) Burner type, burner minimum firing rate and special sprayer plate required (see 3.2.6 and 3.3).
(f) Dynamic analysis, if required (see 3.2.12.1).
(g) Casing design pressure (see 3.2.15.3 and 3.13.3).
(h) Burner fuel oil pressure range (see 3.3).
(i) Engineering services required.
(j) Additional equipment required, as applicable, such as:
  (1) Air preheaters (see 3.11).
  (2) Combustion controls (see 3.17).
  (3) Miscellaneous instruments and appurtenances required (see 3.19).
(k) Maximum height over economizer (see 3.20.4(e)).
(l) Maximum height over drum safety valves (see 3.20.4(e)).
(m) Maximum width (see 3.20.4(e)).
(n) Maximum depth (see 3.20.4(e)).
(o) Maximum dry weight allowable per boiler (see 3.20.4(e)).
(p) Maximum wet weight (steaming) (see 3.20.4(e)).
(q) Conditions as follows at (a) cruising, (b) full-power, (c) overload, (d) maximum astern, and other conditions as may be required to meet ship characteristics (see 3.20.4(f)).
  (1) Percent full-power rating.
  (2) Total evaporation (lbs/hr).
  (3) Superheated steam (lbs/hr).
  (4) Desuperheated steam (lbs/hr).
  (5) Economizer inlet pressure (lb/in^2).
  (6) Economizer inlet temperature (°F).
  (7) Boiler drum pressure (lb/in^2).
  (8) Superheater header outlet (SHO) pressure (lb/in^2).
  (9) SHO temperature (°F) minimum allowable.
  (10) SHO temperature (°F) maximum allowable.
  (11) Desuperheater outlet pressure (lb/in^2).
  (12) Desuperheater outlet temperature (°F).

(13) Fuel rate (lbs/hr).
(14) Anticipated overall efficiency (percent).
(15) Guaranteed overall efficiency (percent).
(16) Anticipated radiation and unaccounted for losses (percent).
(17) Anticipated percent carbon dioxide.
(18) Exit gas temperature.
(19) Boiler air inlet temperature (°F).
(20) Cubic feet of air per pound of oil.
(21) Total air flow (lbs/hr).
(22) Draft losses inches of water:
a. Air preheater.
b. Double casing.
c. Boiler and superheater.
d. Economizer.
e. Burner.
f. Total draft loss.
(23) Number of burners in use.

(r) Location of air inlet openings.
(s) Maximum conditions of roll, pitch and permanent list of the ship and the range of propeller frequencies.
(t) Quality assurance requirements (see 4.1.1).
(u) Type of boiler test required, landbase and shipboard or shipboard (see 4.3.2).
(v) Preservation, packaging, packing and marking requirements if other than as specified in section 5.
(w) Special markings required (see 5.4).

6.1.2 The boiler manufacturer shall assure that the quantity of desuperheated steam required for soot blowing in addition to the quantities specified in 6.1.1 can be furnished without reducing the desuperheater pressure below the minimum specified.

6.1.3 Contract data requirements. When this specification is used in a procurement invoking the data requirement clause of the Armed Services Procurement Regulations (ASPR) paragraph 7-104.9(n) and which incorporates a DD Form 1423 Contract Data Requirements List (CDRL), the data requirements identified below will be developed as specified in the cited Data Item Description (DID) and delivered in accordance with such CDRL. When the ASPR provisions are not invoked, the data specified below shall be delivered in accordance with the contract requirements.

Specification paragraph	DID requirements	Service	Applicable DID	Options
3.2.12	Report, technical	SH	UDI-S-23272	-------
3.20	Drawings	SH	UDI-E-23174	Categories A, B, D, G, H and I type II, form 2
3.20.2	Microfilm	SH	UDI-E-23140	-------
3.22	Manual, technical preliminary	SH	DI-M-2043	-------
3.23	Provisioning parts list	SH	DI-V-2078	-------
4.1.1	Quality program plan	SH	UDI-R-23743	-------
4.3.2	Test, procedures	SH	UDI-T-23649	-------

(Copies of DID's required by the supplier in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2 Management control system documents. The following management control system document should be included on DD Form 1660:

(a) MIL-P-15137 (see 3.23.1).

6.3 Data furnished with bid. The bidder should furnish the following information as a part of his bid:

(a) Complete anticipated and guaranteed performance data as outlined in 6.1.1.
(b) Furnace volume, effective projected radiant heat absorbing surface, furnace water wall surface, boiler heating surface, economizer heating surface, total generating heating surface, superheater surface and total of all heating surfaces.
(c) Design pressures of boiler, economizer, and air casing.
(d) Maximum heat absorption and location.
(e) Maximum superheater metal temperatures inside and outside, location, and the approximate rate at which it occurs.
(f) General outline arrangement drawings showing external connections, safety valve outline, withdrawal spaces, and access panels and doors.
(g) Sectional elevation and plan views of the boiler complete with radiant dimensions, weights, approximate location of center-of-gravity, design water level and material specifications.
(h) A complete list of major and auxiliary components, valves, and fittings to be furnished.
(i) List of special tools furnished and standard tools required but not furnished.
(j) List of repair parts to be furnished.

6.4 Sub-contracted material and parts. The preparation for delivery requirements of referenced documents listed in section 2 do not apply when material and parts are procured by the supplier for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.5 THE MARGINS OF THIS SPECIFICATION ARE MARKED "#" TO INDICATE WHERE CHANGES (ADDITIONS, MODIFICATIONS, CORRECTIONS, DELETIONS) FROM THE PREVIOUS ISSUE HAVE BEEN MADE. THIS WAS DONE AS A CONVENIENCE ONLY AND THE GOVERNMENT ASSUMES NO LIABILITY WHATSOEVER FOR ANY INACCURACIES IN THESE NOTATIONS. BIDDERS AND CONTRACTORS ARE CAUTIONED TO EVALUATE THE REQUIREMENTS OF THIS DOCUMENT BASED ON THE ENTIRE CONTENT IRRESPECTIVE OF THE MARGINAL NOTATIONS AND RELATIONSHIP TO THE LAST PREVIOUS ISSUE.

Preparing activity:
Navy - SH
(Project 4410-N040)

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
	☐ VENDOR
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ USER
	☐ MANUFACTURER
	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*