

MIL-H-16313D(SH)
31 August 1982

SUPERSEDING
MIL-H-16313C(SHIPS)
6 June 1961
(See 6.7)

MILITARY SPECIFICATION

HEATERS, FLUID, FUEL OIL, NAVAL SHIPBOARD

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

1. SCOPE

1.1 Scope. This specification covers self-contained steam heaters used for heating fuel oil preparatory to delivery to centrifugal purifiers and gas turbines.

1.2 Classification. Fuel oil heaters shall be of the following types, as specified (see 6.2.1):

- Type B - Extended surface tube type with fuel oil outside the tubes, the tubes having longitudinal fins and being individually encased by tubes of larger diameter (see 3.3.1).
- Type C - Extended surface tube type with fuel oil outside the tubes, each shell enclosing more than one tube element (see 3.3.2).
- Type D - Shell and bayonet tube type, with steam inside and fuel oil outside the tubes; tubes being either plain or extended surface (see 3.3.3).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation form a part of this specification to the extent specified herein.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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SPECIFICATIONS

FEDERAL

- HH-P-46 - Packing: Asbestos, Sheet, Compressed.
- TT-P-28 - Paint, Aluminum, Heat Resisting (1200°F).
- PPP-B-601 - Boxes, Wood, Cleated-Plywood.
- PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.

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- MIL-P-116 - Preservation, Methods of.
- MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirements for.
- MIL-S-1222 - Studs, Bolts, Hex Cap Screws, and Nuts.
- MIL-L-10547 - Liners, Case, and Sheet, Overwrap; Water-Vaporproof or Waterproof, Flexible.
- MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
- MIL-P-15024/5 - Plates, Identification.
- MIL-T-16286 - Tube, Steel, Seamless, Marine Boiler Application.
- MIL-F-16884 - Fuel Oil, Diesel, Marine.
- MIL-T-17188 - Tube, Carbon Steel, Electric Resistance Welded, Marine Boiler.
- MIL-C-52950 - Crates, Wood, Open and Covered.

STANDARDS

FEDERAL

- FED-STD-H28 - Screw-Thread Standards for Federal Services.

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.

2.1.2 Government drawings. The following Government drawing forms a part of this specification to the extent specified herein.

DRAWING

NAVSHIPS

- B-214 - Root Connections for Attaching Piping.

(Copies of specifications, standards, and drawings, required by contractors in connection with specific acquisition functions should be obtained from the contracting 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. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN IRON AND STEEL INSTITUTE (AISI)
Steel Products Manual.

(Application for copies should be addressed to the American Iron and Steel Institute, 150 East 42nd Street, New York, NY 10017.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 27 - Mild- to Medium-Strength Carbon-Steel Castings for General Application.
- A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless. (DoD adopted)
- A 105 - Forgings, Carbon Steel, for Piping Components.
- A 106 - Seamless Carbon Steel Pipe for High-Temperature Service. (DoD adopted)
- A 285 - Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength. (DoD adopted)
- A 515 - Pressure Vessel Plates, Carbon Steel, for Intermediate- and Higher-Temperature Service. (DoD adopted)
- A 516 - Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service. (DoD adopted)
- A 675 - Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties. (DoD adopted)

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

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

- B16.5 - Pipe Flanges and Flanged Fittings.
- B16.11- Forged Steel Fittings, Socket - Welding and Threaded. (DoD adopted)

(Application for copies should be addressed to the American National Standards Institute, Inc., 1430 Broadway, New York, NY 10018.)

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

(Application for copies should be addressed to the National Motor Freight Traffic Association, Inc., ATA TRAFFIC Dept., 1616 "P" Street, NW, Washington, DC 20036.)

UNIFORM CLASSIFICATION COMMITTEE AGENT
Uniform Freight Classification Ratings, Rules and Regulations

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2.1), a sample shall be subjected to first article inspection (see 4.3 and 6.3).

3.2 Materials. Materials shown in table I shall be used as the basis for design. If use of a substitute material is approved by the contracting activity, the manufacturer shall include two columns in the list of materials on his drawings; one column shall be used for the specified specifications, and the other shall show the specification number for the substituted material. Notes shall then appear on the drawings stating that:

- (a) The design is based on the specification materials.
- (b) The materials listed in the substitution specification column have physical and chemical properties which are equal to or better than the specified material and may be substituted by the manufacturer.

TABLE I. Material requirements.

Item	Material	Applicable document
Shells, heads, and condensate chambers	Seamless drawn steel tubing, grade B	ASTM A 106
	Steel	ASTM A 285
	Steel (AISI 1023) <u>1/</u>	AISI Steel Products Manual
	Steel castings, grade 60-30	ASTM A 27
	Steel forging	ASTM A 105
	Steel	ASTM A 515
Tubes	Steel	ASTM A 516
	Seamless steel tubing, grade A or B	ASTM A 106
	Tubes, boiler, seamless, class a	MIL-T-16286
	Tubes, boiler, resistance welded	MIL-T-17188
Tube sheets	Steel, firebox quality	ASTM A 285
	Steel	ASTM A 515
Stay rods	Steel bars	ASTM A 675
	Steel pipe, extra strong seamless	ASTM A 53

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TABLE I. Material requirements. - Continued

Item	Material	Applicable document
Bolts and studs	Steel, grade 2	MIL-S-1222
Nuts	Steel, grade 2 or 2H	MIL-S-1222
Baffle plates	Steel	ASTM A 283 ^{2/}
Fins	Steel	ASTM A 283 ^{2/}
Gaskets	Asbestos sheet, compressed ^{3/}	HH-P-46

^{1/} Normalized and drawn at 1150°F.

^{2/} Maximum carbon content - 0.35 percent.

^{3/} If gaskets incorporating asbestos are incorporated, the technical manual shall contain an appropriate caution and warning regarding the hazard of handling asbestos.

3.2.1 Recovered materials. Unless otherwise specified herein, all equipment, material, and articles incorporated in the products covered by this specification shall be new and shall be fabricated using materials produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specifically specified.

3.3 Design and construction.

3.3.1 Type B heater.

3.3.1.1 Type B heater shall consist of several longitudinally finned tubes individually encased in tubes of a larger diameter. Steam shall pass through the inner tubes. Fuel oil passage shall be through the annular space between the two tubes. Construction shall be such that all the fuel oil passages in the heater will be in series. When two or more steam passages are in series, the contraflow principle shall be employed. In all cases, the steam inlet and fuel oil outlet connections shall be at the top, and the fuel oil inlet and condensate drain connections at the bottom. Steam side inlet and outlet connections shall consist of welding sockets in the tail pieces conforming to ANSI B16.11.

3.3.1.2 Outer tubes shall be welded to the tube sheets. Ground union joints will be permitted for connecting inner tubes and for a seal between inner and outer tubes.

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3.3.1.3 Type B heater shall be designed for quick and easy removal of the inner tubes for cleaning and replacement. The design shall insure complete and free drainage of condensate during operation, with no pockets or recesses where condensate may collect. Provision shall be made for free motion due to differential expansion without any rubbing between the outer tube wall and the extended surface of the inside tube.

3.3.2 Type C heater.

3.3.2.1 Type C heater shall consist of one or more extended surface U-tubes enclosed in a shell. Steam shall pass through the U-tubes and the fuel oil shall pass through the shell and around the tubes. Baffles shall be fitted to direct the flow of fuel oil within the shell. U-tube and tube sheet sub-assembly shall be readily removable.

3.3.2.2 Tubes shall be fastened to the tube sheets either by roller expanding, by welding, or by a combination of the two.

3.3.2.3 Where a nonwelded expanded joint is used, the tube expander shall be adjusted so that the depth of expansion does not extend further than within 1/8-inch of the inner face of the tube sheet. If tubes are expanded, the holes in the tube sheet for them shall be drilled and reamed 0.005 inch larger than the nominal tube diameter with 0.002 inch tolerance, and shall be provided with two grooves. The grooves shall be approximately 1/64-inch deep by 3/32-inch wide.

3.3.2.4 Tube sheet shall be the same diameter as the shell and steam head flanges or of smaller diameter and secured in position by recesses turned in the faces of the flanges.

3.3.3 Type D heater.

3.3.3.1 Type D heater shall consist of multiple bayonet type tubes; double tube sheets with condensate removal space between the tube sheets, the inner tube secured in the outer tube sheet and the outer tube secured in the inner tube sheet; a steam head which supplies steam to the bayonet tubes; a shell with flange secured to the inner tube sheet; multiple cross baffles to direct flow of fuel oil across the tubes; shell end opposite the steam head blanked; fuel oil inlet, outlet, vent and drain connections on the shell; steam, condensate outlet, and steam vent connections on the steam side; and necessary supports for attachment to foundation. A variation in the construction may provide for subdividing the steam and condensate chambers, when separate steam side connections shall be made to each of the subdivisions. Another variation may employ steam and condensate chambers at both ends of the shell, with double tubes extending into the shell from each end and steam side connections appropriate to the subdivided steam and condensate spaces.

3.3.3.2 Tubes shall be fastened to the tube sheets by roller expanding, by welding, or by a combination of the two.

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3.3.3.3 Where nonwelded expanded tube joints are used, the tube expander shall be adjusted so that the depth of expansion does not extend further than within 1/8-inch of the inner face of the tube sheet. For joints of this type, the holes in the tube sheet shall be drilled and reamed 0.005 inch larger than the nominal tube diameter with 0.002 inch tolerance, and holes for 5/8-inch outside diameter and larger shall be provided with two grooves approximately 1/64-inch deep by 3/32-inch wide.

3.3.3.4 Minimum thickness of tube sheets shall be 3/4 inch for 5/8-inch outside diameter tubes or larger and 1/2 inch for tubes less than 5/8-inch outside diameter.

3.3.3.5 The inner tube sheet shall be of the same diameter as those of the shell and steam head flanges and the joint between the inner tube sheet, and the shell flange shall be so secured by the bolting that it will not be broken when the steam head is removed.

3.3.3.6 The steam head, outer tube sheet, and inner bayonet tubes shall be removable. The inner tube sheet, the outer tubes, and baffles shall also be removable as a unit. A guide plate, drilled for the inner tubes, shall be provided to facilitate reassembly.

3.3.3.7 If specified (see 6.2.1), the baffles shall be so arranged that they can be moved backwards and forwards a distance equal to the space between baffles by a stem extending through the blanked end of the shell. A handwheel or crank shall be fitted to the stem, and a yoke shall be provided close to the handwheel or crank to support the stem. The stem shall be provided with a packing gland. Holes for tubes in the baffle shall be of such diameter that a minimum clearance exists between tubes and baffles, so that a scraping action occurs to clean off accumulated deposits on the tubes. The handwheel or crank shall be of such size that the baffle assembly can be moved readily by one man when the tubes are fouled and the packing gland is adjusted to prevent leakage with full fuel oil pressure in the shell.

3.3.3.8 If specified (see 6.2.1), the heater may be of the evaporator type, in which an intermediate fluid, watersteam, is used to transfer heat from a primary heating coil to the bayonet type fuel oil heating elements. An evaporator section, with the primary heating coil mounted on its cover, shall bolt to the heater in place of a steam chest cover. A filling connection shall be provided on the evaporator. Condensate return piping shall be provided between the condensate chamber and the evaporator section. A connection shall be provided for a safety valve in such a location that the valve can be used for initial purging of air from the intermediate fluid system. A pressure gage connection shall be provided for the intermediate fluid system.

3.4 Standardization. Each contractor of heaters shall standardize the proposed equipment as far as possible, holding the number of models and sizes offered to the Government to a minimum commensurable to the range of capacity and the operating pressures which may be required. The greatest possible interchangeability of service parts among the several models and sizes shall be developed by each contractor. Parts built to the same drawings shall be interchangeable. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

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3.5 Threaded parts. Threaded parts shall conform to FED-STD-H28.

3.6 Welding. Welding shall be in accordance with MIL-STD-278.

3.7 Painting. Painting shall be as follows:

- (a) Internal surfaces shall not be painted.
- (b) External steel surfaces shall be thoroughly cleaned and coated with two coats of heat resisting paint in accordance with TT-P-28.

3.8 Space envelope and weight. Space envelope and weight shall be held to a minimum consistent with strength and reliability.

3.9 Inclining, pitching, and rolling. Heaters shall meet the performance requirements specified in this specification when the ship is under any of the following conditions:

- (a) Up to 5 degrees from the normal horizontal position in the fore and aft plane (permanently inclined).
- (b) Up to 15 degrees to either side (permanently inclined).
- (c) With the vessel rolling up to 45 degrees from the vertical to either side or pitching 10 degrees up or down from the normal horizontal plane.

Note: Degrees are measured from the horizontal fore-and-aft plane, up or down for trim and pitch, and from the vertical to either side for list and roll. The conditions for permanent list and roll or for trim and pitch shall not be considered additive.

3.10 Shock resistance. If specified (see 6.2.1), fuel oil heaters shall be grade A, hull mounted class I in accordance with MIL-S-901.

3.11 Capacity. A combination of two or more heaters designed to group as a compact bank shall be used to heat the fuel oil for purifiers in fuel oil transfer systems and gas turbines in fuel oil service systems (see 6.2.1). These heaters shall be connected in parallel. The heater bank (or subdivision thereof) shall heat fuel conforming to MIL-F-16884 (NATO F-76) from 30 to 70 degrees Fahrenheit (°F) in fuel transfer systems and from 40 to 85°F in fuel oil service systems at a flow rate from 15 percent (minimum duty) to 100 percent (maximum duty) of full load requirements (see 6.2.1).

3.12 Pressures and temperatures.

3.12.1 Pressures. Standard fuel oil operating pressure will be 150 pounds per square inch (lb/in²). Heaters subject to fuel oil filling pressure shall withstand 200 lb/in². Standard steam supply pressures will be 150 and 600 lb/in². Other operating pressures may be specified in the contract or order (see 6.2.1) if circumstances require, but it is intended that standard lines of heaters designed for the above conditions will be used as widely as possible. At the minimum duty conditions, steam pressure in the operating portion of the bank shall be not less than 5 lb/in² (see 6.2.1).

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3.12.2 Temperatures. The maximum steam temperature is that of saturation at the operating steam pressure. The maximum fuel oil side operating temperature is the saturation temperature of the operating steam.

3.12.3 Allowable pressure drop. When heating fuel at maximum duty conditions, the pressure drop across the heater shall not exceed 20 lb/in².

3.13 Connections. Except as specified in 3.3.1.1, connections for fuel oil, steam and condensate service shall be flanged. Root connections shall conform to Drawing B-214. Flanged connections shall be 150-pound series for welding neck or integrally cast flanges in conformance with ANSI B16.5 modified for flat face.

3.14 Relief valve fitting. Each heater shall be provided with a flanged fitting for a 1/2-inch relief valve on the fuel oil side. This fitting shall be located so that it can be used as a chemical cleaning connection, unless a 1/2-inch flanged vent fitting, suitably located for this purpose, is fitted.

3.15 Venting and draining. Each heater shall be provided with a 1/2-inch flanged drain fitting. This fitting shall be located so that it can be used as a chemical cleaning connection in conjunction with the relief valve fitting (or vent fitting). Each heater shall be fitted with a 1/2-inch flanged fuel oil side vent fitting if the fuel oil side is not self-venting.

3.16 Fouling factor. In computing the design overall (service) coefficient of heat transfer at maximum duty, the following minimum fouling resistances shall be applied:

<u>Heater type</u>	<u>Fouling resistance</u>
B	0.005
C	.005
D	.002

Performance at duty points other than the maximum shall be computed on a "clean tube" basis in order that pressure on the steam side will show as the lowest value which may be encountered for the given duty point. Calculations of coefficients shall be based on fuel oil side area, with the effective outside area being used for finned tube heaters.

3.17 Technical data. The contractor shall prepare the following technical data in accordance with the data ordering documents included in the contract or order (see 6.2.2), and as specified in 3.17.1 through 3.17.3.

3.17.1 Drawings. Drawings shall be furnished in accordance with the data ordering document (see 6.2.2), and as specified in 3.17.1.1 through 3.17.2.2.

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3.17.1.1 The external arrangement drawing shall show external views of the heater, shall include external dimensions required for reproduction on ship's machinery arrangement drawings, for guidance of the shipyard in designing the foundation structure for the heater(s), for installation thereof, and for connection of the heater(s) to external piping. The drawing shall show the space required for removal and replacement of tubes.

3.17.1.2 The assembly drawing shall show complete longitudinal and transverse cross-sectional views of the heater. This drawing shall show the relationship of all parts and liberal use of enlarged views or sections shall be made to illustrate features of the design.

3.17.1.2.1 The assembly drawing shall contain a list of materials showing names, identifying numbers, materials and material specifications for all parts. The identifying numbers shall also be shown adjacent to the parts depicted in the various views, with arrows pointing to the parts.

3.17.1.3 Detail drawings of all major parts or subassemblies such as shells, tube bundles and steam heads shall be furnished. The drawings shall be completely dimensioned, with finishes and welding symbols indicated, as required for manufacture.

3.17.2 Certification data sheets. Certification data sheets shall be prepared with a dual tabulation to cover the maximum duty and minimum duty conditions of one bank (see 3.11). For each condition the following entries shall be shown:

- (a) Fuel oil working pressure, lb/in².
- (b) Rate of fuel oil flow, pounds per hour.
- (c) Fuel oil inlet temperature, °F.
- (d) Fuel oil outlet temperature, °F.
- (e) Fuel oil pressure drop lb/in².
- (f) Steam supply pressure, lb/in².
- (g) Steam supply temperature, °F.
- (h) Steam pressure in heater, lb/in².
- (i) Steam condensed, pounds per hour.
- (j) Steam side hydrostatic test pressure, lb/in².
- (k) Fuel oil side hydrostatic test pressure, lb/in².
- (l) Fuel oil side hot oil test pressure, lb/in².
- (m) Effective heating surface, square feet.
- (n) Logarithmic mean temperature difference, °F.
- (o) Total heat transferred, British thermal units per hour.
- (p) Clean overall coefficient of heat transfer.
- (q) Design overall (service) coefficient of heat transfer (see 3.16).
- (r) Number of heaters per ship, per bank, and number of banks per system.
- (s) The number of banks per system.
- (t) The method of connecting heaters within the bank.
- (u) Dry and wet weights of each size of heater and bank.

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3.17.2.1 The certification data sheet shall also include a view of the identification plate with all data entered except date of manufacture and serial number. This view shall be enlarged to insure that data entries will be legible should the drawing be reduced in size in the process of reproduction for manuals or booklets.

3.17.2.2 On the certification data sheets, there shall be provided a tabulation to show the combination of heater sections or combination of heaters within a bank, which is recommended for use at the various standard flow rates, including full load, maximum duty and minimum duty (see 6.2.1). For each of these standard load conditions there shall be shown the steam pressure in the heater.

3.17.3 Technical manuals. Technical manuals shall be furnished in accordance with the data ordering document (see 6.2.2), and the number of technical manuals provided shall be as specified (see 6.2.1).

3.18 Identification plates. Identification plates shall be provided in accordance with MIL-P-15024 and MIL-P-15024/5 and shall include the following:

- (a) Name of unit, "FUEL OIL HEATER".
- (b) Type of unit (see 1.2).
- (c) Manufacturer's service part number.
- (d) National stock number (allow 17 spaces).
- (e) Name of manufacturer.
- (f) Contract number. (The acquiring activity's contract or purchase order number.)
- (g) Blank space for inspector's stamp.
- (h) Date of manufacture.
- (i) Serial number.
- (j) Maximum test pressure, shell side.
- (k) Maximum test pressure, tube side.
- (l) Blank space for "unit" number (allow four spaces). (This space will be used for numbering for shipboard reference purposes when required, the stamping to be done by shipyard.)
- (m) Designation "U.S."

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Inspection system. The contractor shall provide and maintain an inspection system in accordance with the data ordering documents included in the contract or order (see 6.2.2).

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

- (a) First article inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 First article inspection. First article inspection shall consist of the examination and tests specified in 4.5 and 4.6.1 through 4.6.4.

4.3.1 First article test report. The contractor shall prepare a first article test report in accordance with the data ordering document (see 6.2.2).

4.4 Quality conformance inspection. Each heater offered for delivery shall be subjected to the examination of 4.5 and the tests specified in 4.6.2.

4.5 Examination. Each heater offered for delivery shall be examined for adjustment, fit, material, finish, and any other requirement not involving tests in conformance with this specification.

4.6 Tests.

4.6.1 Weight. The dry and operating weight shall be measured.

4.6.2 Pressure. The pressure tests specified in 4.6.2.1 through 4.6.2.3 shall be applied. For operating pressures, the highest of the standard operating pressures specified in 3.12.1 for which the manufacturer certifies the particular heater shall be used. Leaking heaters shall be rejected.

4.6.2.1 Fuel oil side. The fuel-oil-side of each heater shall be subjected to a hydrostatic pressure test of 150 percent of the fuel oil operating pressure. Heaters installed in ships systems subject to fuel oil filling pressure shall be subjected to a hydrostatic pressure test of 300 lb/in².

4.6.2.2 Steam side. The steam side of each heater shall be subjected to a hydrostatic pressure test of 150 percent of the steam operating pressure.

4.6.2.3 Hot fuel oil pressure. The fuel oil side of each heater shall be subjected to a hot fuel oil pressure test of the design oil operating pressure. Marine diesel fuel oil in accordance with MIL-F-16884 at 200°F shall be used.

4.6.3 Capacity. Capacity runs shall be conducted under the operating conditions at maximum and minimum duty points. Fuel oil side pressure drop across the heater shall be determined at these points. The heater shall meet the clean overall coefficient of heat transfer.

4.6.4 Shock test. A type A test of the fuel oil heaters shall be performed in accordance with MIL-S-901. Following the shock test, a pressure test at design pressure of both the steam and oil sides shall be performed. Any leakage shall be cause for rejection.

4.7 Inspection of packaging. Preservation, packaging, packing, and marking shall be inspected for compliance with section 5 of this document.

5. PACKAGING

(The preparation for delivery requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the preparation for delivery requirements of referenced documents listed in section 2, see 6.5.)

5.1 Preservation. Preservation shall be level A or C, as specified (see 6.2.1).

5.1.1 Level A. Fuel oil heaters shall be preserved in accordance with method 1 of MIL-P-116 as follows:

- (a) Type P-2 preservative shall be used for surfaces normally in contact with fuel oil.
- (b) Type P-3 preservative shall be used for surfaces normally in contact with steam or water.
- (c) All openings shall be sealed with a greaseproof, waterproof, flexible barrier material and secured with a waterproof pressure sensitive adhesive tape.

5.1.2 Level C. Fuel oil heaters shall be preserved to afford protection against corrosion, deterioration and physical damage during shipment from the supply source to the first receiving activity for immediate use. The contractor's normal preservation methods may be utilized when such meets the requirements of this level.

5.2 Packing. Packing shall be level A, B or C, as specified (see 6.2.1).

5.2.1 Level A. Heaters shall be individually packed in nailed wood or wood cleated plywood boxes or sheathed wood crates conforming to PPP-B-621 (class 2), PPP-B-601 (overseas type) or MIL-C-52950 respectively at the option of the contractor. Boxes shall have caseliners conforming to MIL-L-10547. Caseliners shall be closed and sealed accordance with MIL-L-10547. Box and crate closures and strapping shall be as specified in the applicable container specification or appendix thereto. When the gross weight of wood boxes exceeds 200 pounds, they shall be modified by the addition of skids in accordance with the applicable box specification. Anchoring, blocking, bracing and cushioning of the equipment shall be provided so as to prevent damage from movement during handling, multiple domestic and overseas shipments and indeterminate storage.

5.2.2 Level B. Heaters packaged as specified shall be individually packed in nailed wood or wood cleated plywood boxes, or sheathed wood crates conforming to PPP-B-621, class 1, PPP-B-601 domestic class or MIL-C-52950 respectively, at the option of the contractor. Closures of shipping containers shall be as specified in the applicable box specification, or the appendix thereto. When the gross weight of wood boxes exceeds 200 pounds, they shall be modified by the addition of skids in accordance with the applicable box specification. Anchoring, blocking, bracing and cushioning of the equipment shall be provided so as to prevent damage from movement during handling, multiple domestic and overseas shipments and intermediate storage.

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5.2.3 Level C. Heaters preserved as specified in 5.1 shall be packed in containers acceptable to the common carrier and which will insure safe delivery at destination in a satisfactory condition at the lowest applicable rate. Containers, packing, and method of shipment shall comply with Uniform Freight or National Motor Freight Classification Rules or Regulations or other carrier rules as applicable to the mode of transportation.

5.3 Marking. In addition to any special marking required (see 6.2.1), interior packages and exterior shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The heaters covered by this specification are intended to heat fuel in the transfer system for centrifugal purifiers and in the service system for gas turbines.

6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type required (see 1.2).
- (c) If first article inspection is required (see 3.1).
- (d) Whether movable baffle tube cleaning arrangement shall be provided (applicable to type D heaters only) (see 3.3.3.7).
- (e) Whether evaporator type heaters shall be provided (applicable to type D heaters only) (see 3.3.3.8).
- (f) If fuel oil heaters are to be shock resistant (see 3.10).
- (g) Number of banks required (see 3.11).
- (h) Number of heaters per bank, if established (see 3.11).
- (i) Fuel oil rate at full load, pounds per hour (see 3.11).
- (j) Fuel oil rates at other standard operating conditions, including maximum and minimum duties; pounds per hour (see 3.11 and 3.17.2.2).
- (k) Pressure and condition of heating steam (see 3.12.1).
- (l) Operating pressure of fuel oil (see 3.12.1).
- (m) Number of technical manuals required (see 3.17.3).
- (n) Levels of preservation and packing required (see 5.1 and 5.2).
- (o) Special marking required (see 5.3).

6.2.2 When this specification is used in an acquisition which incorporates a DD Form 1423, Contract Data Requirements List (CDRL), the data requirements identified below shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved CDRL incorporated into the contract. When the provisions of DAR 7-104.9 (n) (2) are invoked and the DD Form 1423 is not used, the data specified below shall be delivered by the contractor in accordance with the contract or purchase order requirements. Deliverable data required by this specification is cited in the following paragraphs.

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<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.17.1	Drawings, engineering and associated lists	DI-E-7031	Level 3 Drawing number- contractor Design activity designation - contractor Certification data sheets required
3.17.3	Manual, technical manuscript copy	DI-M-2042	Type I of MIL-M-15071
4.1.1	Inspection system program plan	DI-R-4803	-----
4.3.1	First article inspection report	DI-T-4902	-----

(Data item descriptions related to this specification, and identified in section 6 will be approved and listed as such in DoD 5000.19L., Vol II, AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 of the specification required to be performed to meet a data requirement may be waived by the contracting/acquisition activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item acquired to this specification. This does not apply to specific data which may be required for each contract regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 First article inspection. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending acquisition.

6.4 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

6.4.1 When ordering spare parts or repair parts for the equipment covered by this specification, the contract should state that such spare parts and repair parts should meet the same requirements and quality assurance provisions as the parts used in the manufacture of the equipment. Packaging for such parts should also be specified.

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6.5 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 acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.6 Type A. Type A heaters of MIL-H-16313C(SHIPS) have been deleted from MIL-H-16313D(SH). Type A heaters are obsolete and no longer in Naval service.

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

Preparing activity:
Navy - SH
(Project 4420-N046)

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