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 XX-P-2801  
 August 28, 1992  
 SUPERSEDING  
 MIL-P-17597D  
 26 October 1987

## FEDERAL SPECIFICATION

### PUMP AND HEATER, FUEL OIL

This specification is approved by the Commissioner, Federal Supply Service, General Services Administration, for the use of all Federal agencies.

#### 1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers two types of pump and heater units for fuel oil, having wide ranges of required performance characteristics.

#### 1.2 Classification.

1.2.1 Types and styles. The pump and heater units are of the following types and styles, as specified (see 6.2 and 6.5):

Type I - Simplex

Type II - Duplex

Style A - Steam heated

Style B - Water heated

#### 2. APPLICABLE DOCUMENTS

##### 2.1 Government documents.

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

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 \*Beneficial comments (recommendations, additions, deletions) and any pertinent\*  
 \*data which may be of use in improving this document should be addressed to: \*  
 \*Commanding Officer (Code 156), Naval Construction Battalion Center, \*  
 \*621 Pleasant Valley Road, Port Hueneme, CA 93043-4300, by using the \*  
 \*Standardization Document Improvement Proposal (DD Form 1426) appearing at \*  
 \*the end of this document or by letter. \*  
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FSC 4320

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

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Federal Standard

FED-STD-123 - Marking for Shipment (Civil Agencies)

Military Specifications

MIL-B-3180 - Boilers and Related Equipment, Packaging of

MIL-F-3541 - Fittings, Lubrication, General Specification for

Military Standards

MIL-STD-129 - Marking for Shipment and Storage

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

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

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

American Society of Mechanical Engineers (ASME):

ASME B1.1 - Unified Screw Threads (UN and UNR Thread Form)

ASME B1.20.1 - Pipe Threads, General Purpose (Inch)

ASME B31.1 - Power Piping

ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element

ASME Boiler and Pressure Vessel Code

Section VIII, Division 1 - Rules for Construction of Pressure Vessels

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

ASTM:

ASTM D 396 - Fuel Oils

(Application for copies should be addressed to ASTM, 1916 Race Street, Philadelphia, PA 19103.)

Hydraulic Institute (HI):

Hydraulic Institute Standards

(Application for copies should be addressed to the Hydraulic Institute, 30200 Detroit Road, Cleveland, OH 44145-1967.)

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National Electrical Manufacturers Association (NEMA):

NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches  
NEMA ICS 1 - General Standards for Industrial Controls and Systems  
NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies  
NEMA ICS 6 - Enclosures for Industrial Controls and Systems  
NEMA MG 1 - Motors and Generators  
NEMA SM 23 - Steam Turbine for Mechanical Drive Service

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

National Fire Protection Association (NFPA):

NFPA 70 - National Electrical Code

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

Tubular Exchanger Manufacturer's Association, Inc. (TEMA):

Standards for Tubular Exchanger Manufacturer's Association

(Application for copies should be addressed to the Tubular Exchanger Manufacturer's Association, Inc., 25 N. Broadway, Tarrytown, NY 10591.)

Underwriters Laboratories Inc. (UL):

UL 489 - Molded-Case Circuit Breakers and Circuit-Breaker Enclosures  
UL 574 - Electric Oil Heaters

(Application for copies should be addressed to the Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.)

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

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

### 3. REQUIREMENTS

3.1 Description. The pump and heater unit shall be a complete unit for supplying heated fuel oil under pressure to one or more oil burners, or for transferring fuel oil from one tank to another. Each unit shall consist essentially of a pump and heater combination mounted on a frame or fabricated steel base, with governors, relief valves, gauges, thermometers, strainers, and other components, as required. The pumps shall be of the rotary type, with either steam-turbine or electric-motor drive as specified in 3.7 or 3.8. All interconnecting piping and valves shall be supplied. All parts necessary for

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satisfactory operation of the equipment shall be supplied whether specifically mentioned or not. The unit may be provided with a thermostatically controlled electric heater when specified in 3.7.3.9, for use on cold starts.

3.2 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.2.1, 6.2, and 6.4).

3.3 Materials. Materials used shall be free from defects which would adversely affect the performance or maintainability of individual components or of the overall assembly. Materials not specified herein shall be of the same quality used for the intended purpose in commercial practice. Unless otherwise specified herein, all equipment, material, and articles incorporated in the work covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification.

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

3.5 Safety standards. Pump and heater units furnished under this specification shall conform to the requirements of the following safety standards to the extent specified:

- a. Heater shells - ASME Boiler and Pressure Vessel Code, Section VIII, Division 1
- b. Electric oil heater - UL 574

3.5.1 Standards compliance. Prior to approval of the first article, if one is specified, or prior to approval of the first shipment by the contractor, if a first article is not specified, the contractor shall make available to the contracting officer, or his authorized representative, satisfactory evidence that the pump and heater units he proposes to furnish under this specification meet the applicable requirements of 3.5. Acceptable evidence of meeting the applicable requirements of 3.5 shall be the UL label, or Listing Mark, or certification from a recognized independent testing laboratory and an ASME stamp symbol of the applicable section of the ASME Boiler and Pressure Vessel Code, or a certification from a recognized independent testing laboratory indicating that the fuel oil heater shell has been tested and conforms to the applicable requirements of 3.5.

3.6 Design. The design of the equipment and accessories shall permit easy accessibility for maintenance and service in the field. The design shall be such as to prevent conditions hazardous to personnel or deleterious to equipment. All threaded parts shall be in the inch system and shall conform to ASME B1.1 and ASME B1.20.1, as applicable. Unless otherwise specified (see 6.2), the pump and heater unit shall be designed to handle grade No. 6 fuel oil as defined in ASTM D 396.

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3.6.1 Suction lift. The pump shall be designed for a suction lift, including friction losses of not less than the equivalent of 10 feet of water, unless otherwise specified (see 6.2).

3.6.2 Performance. Unless otherwise specified (see 6.2), the pump shall be capable of continuous operation while pumping oil having a viscosity of up to 5,000 Saybolt Seconds Universal (SSU), at a pumping temperature of 80 degrees Fahrenheit (oF). The pump shall operate under startup conditions with an oil viscosity of up to 10,000 SSU without vibration or damage to pump, motor, or connection pipe lines.

3.6.3 Other design conditions. Other design conditions shall be as specified (see 6.2), and shall include the following:

- a. Quantity of fuel oil in gallons per hour (gph), to be pumped and heated
- b. Oil pressure, in pound-force per square inch gage (psig), at heater outlet
- c. Oil temperature, in oF, at heater inlet and outlet
- d. For style A, available minimum and maximum steam pressures, in psig (and temperature in oF, if superheated)
- e. For style B, available minimum and maximum inlet and outlet water temperatures, and minimum and maximum water pressure
- f. For style B, pH of water, water analysis, and total solids

3.7 Type I, simplex unit. The type I simplex unit shall consist of a one-pump and one-heater combination, equipped with all accessories and interconnecting piping and fittings. The pump shall be of the rotary type, either steam-turbine- or electric-motor-driven (see 3.9 and 3.10), as specified (see 6.2). The unit shall be capable, under the suction and performance conditions given in 3.6.1 and 3.6.2, of delivering and heating the specified fuel oil at the design conditions outlined in 3.6.3.

3.7.1 Fuel oil pump. The pump shall be rotary gear of the internal, screw, or lobe type. The design shall conform to the Rotary Section of the Hydraulic Institute Standards. Unless otherwise specified (see 6.2), the capacity shall be based on a viscosity of 5,000 SSU. All parts exposed to the action of fluid pumped shall be of suitable material designed to resist corrosion and erosion. Casings shall be of cast iron. The pump shall operate without valves or springs and shall be balanced and quiet in operation. Unless otherwise specified (see 6.2), the pump shall require no priming or foot valves on the suction side. When the pump and heater unit is designed to handle No. 6 fuel oil, the pump speed shall not exceed 450 revolutions per minute (rpm), except that screw type pumps may operate at speeds of up to 1,200 rpm if pumps are equipped with timing gears; and up to 1,800 rpm if screw pumps operate without timing gears. However, for No. 6 fuel oil, the pump speed shall in no case exceed the manufacturer's published rated speed for a viscosity of 10,000 SSU. When the pump and heater unit is designed for handling other than No. 6 fuel oil, the pump speed shall not exceed the manufacturer's published rated speed for the viscosity of the specified fuel at 90oF. Moving parts shall be lubricated in a positive manner, with use of lubricants other than the fuel oil when necessary. Shaft bearings shall be of the frictionless or sleeve type. All parts shall be of adequate strength for the service intended and for durability. The discharge from the pump shall be a continuous stream,

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and air chambers shall not be necessary to reduce pulsations. When electric-motor-driven, the pump shall be direct-connected or driven through a reduction, as required. The reduction may be a gear head type motor, a separate gear box, or a V-belt drive. When specified (see 6.2), a variable frequency controller may be utilized for speed reduction.

3.7.2 Oil heater. An oil heater shell complying with the ASME Pressure and Vessel Code, Section VIII, Division 1, for the construction of unfired pressure vessels, shall be supplied with each unit. The heater shall raise the temperature of the quantity of fuel oil from the specified inlet temperature to the outlet temperature, using saturated steam at the pressure or water at a temperature specified herein. The test capacity shall exceed that specified herein by an amount necessary to compensate for the fouling factors specified in TEMA Standards. Oil pressure drop through the heater shall not exceed 15 psig. The heater shall be designed for the working pressures of steam and oil and for the corresponding steam temperature, as specified herein. Unless otherwise specified (see 6.2, 3.7.2.1, and 3.7.2.2), the heater shall be of the bare-tube or extended-surface type. When specified (see 6.2), the heater shall not exceed a given length.

3.7.2.1 Bare-tube heater. The bare-tube heater shall be a high-performance multipass unit of the horizontal-shell-and-tube type with removable head and replaceable tube nest, or of the fixed-tube-sheet design, as specified (see 6.2). The heat exchanger shall comply with TEMA Standard, class C. The outer shell shall not be less than schedule 10 steel pipe for style A. Tubes and tube sheet shall be steel. For style B, unless otherwise specified (see 6.2), tubes and tube sheet shall be admiralty metal, alloy UNS C44300. Tubes shall be rolled into tube sheets with no packing.

3.7.2.2 Extended-surface heater. The extended-surface-type heater shall be of the pipe-within-a-pipe type, with steam in the inner pipe and oil in the annular space between the inner and outer pipe or several extended surface tubes equally spaced in a single shell with flow parallel with extended surfaces. The extended surfaces shall consist of longitudinal fins welded or mechanically bonded to the inner pipe for the entire fin length. The outer pipe or shell shall be not less than schedule 10 steel pipe. For style A, tubes and fins shall be steel or aluminum, for style B, materials for tubes, fins, and tube sheet shall be compatible for use with fluids employed in the application. Tubes and fins shall be of thickness, length, spacing, and number conforming to the manufacturer's standard engineering practice. The pipe-within-a-pipe heater may be made up of sections, with the length of each section and the number of sections required determined by the optimum arrangement, based on ease of handling and accessibility.

### 3.7.3 Auxiliaries.

3.7.3.1 Pump governor. The turbine-driven pump shall be equipped with a constant-pressure governor or a constant-speed governor, as specified (see 6.2). The constant-pressure governor shall be of the self-contained, internal pilot, piston, or piston- or diaphragm-operated type designed to maintain a constant predetermined pressure in the pump discharge line by control of the steam supply

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to the turbine. The constant-speed governor shall consist of a speed sensing element and a steam-throttling valve to automatically maintain a constant predetermined turbine speed. When a constant-speed governor is specified, the pump and heater set shall be equipped with a pressure regulator (see 3.7.3.2).

3.7.3.2 Pressure regulator. The electric-driven pump and turbine-driven pump furnished with constant-speed governor shall be equipped with a constant pressure regulator on the pump outlet. The pressure regulator shall be of the self-contained or pilot-operated type, except that for heaters having a pressure drop exceeding 10 psig, the regulator shall be of the pilot-operated type only, with the sensing element located at the heater discharge outlet. The regulator shall be adjustable for pressure level and shall maintain a constant oil pressure at the heater discharge by bypassing the excess oil back to the oil-return line, or when so approved, to the oil-suction line. Diaphragm-type regulators shall have stainless steel trim, and shall have a 50 percent service factor over performance curves, based on water. The regulator shall be ruggedly constructed, and valve seats and disks shall be replaceable. The valve shall not chatter or hammer at any flow condition. When specified (see 6.2), means shall be provided for remote indication and adjustment of pressure with type and characteristics, as specified (see 6.2).

3.7.3.3 Relief valves. Two automatic pressure-relief valves shall be installed, one on the pump discharge and one on the heater discharge, for protection against excessive pressure. Each valve shall be an adjustable spring-loaded type installed complete with escape piping to the fuel oil return line to the tank. The pump-relief valve shall have ample capacity to relieve the full oil flow. A 1/4-inch nominal pipe size bypass shall be installed around the pump-relief valve to manually bleed gas and air from the line. The bypass shall be equipped with a shutoff valve and a valved oil sampling connection.

3.7.3.4 Temperature regulator. A temperature regulator requiring no external source of power and adjustable over a temperature range of 100oF shall be provided to control the oil temperature. The regulator shall include a steam-diaphragm valve, tubing, thermostatic element, and a steam strainer. The diaphragm valve shall close the steam line automatically when the oil temperature reaches the set value. The diaphragm valve shall be all metal. Seat and disk shall be renewable. The seat shall be corrosion-resistant steel. The regulator shall control the oil-outlet temperature to within +5oF. When specified (see 6.2), means shall be provided for remote indication and adjustment of temperature with type and characteristics as specified (see 6.2). The temperature regulator, requiring no external source of power, shall then become the temperature-limiting means.

3.7.3.5 Steam trap. Unless otherwise specified (see 6.2), the heater shall be provided with a steam trap of the nonreturn type for removal of the condensate. The trap shall be large enough to handle the entire condensate flow when the exchanger is operating at maximum capacity, at which condition the trap shall not have reached the point of continuous discharge. Seats and valves shall be replaceable. Floats, if provided, shall be corrosion-resisting metal. The trap shall be capable of withstanding a hydrostatic pressure of 1.5 times the working steam pressure, in no case less than 40 psig, and shall have an integral or separate strainer at the inlet.

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3.7.3.6 Strainers. Duplex oil strainers, self-cleaning strainers, or simplex strainers with bypass shall be provided and mounted on the unit, one on the suction side of the fuel-oil pump and one on the discharge from the fuel-oil heater, to insure delivery of clean oil to the burner(s). Steam strainers shall be furnished and installed upstream from the temperature and pressure regulators. Each oil strainer shall be equipped with a globe-type blowdown valve. Strainer shells shall withstand a hydraulic pressure of 1.5 times the pressures and temperatures specified in 3.6.3.

3.7.3.7 Thermometers. Two industrial mercury-in-glass thermometers, with separable threaded well connections, shall be provided to measure incoming and outgoing oil temperatures. The range shall be 30oF to 300oF. The thermometers shall be in protected positions and clearly visible to the operator.

3.7.3.8 Gages. Pressure gages shall conform to ASME B40.1. The following gages shall be supplied: one for pump suction, one for pump discharge, two for steam line to heater, one ahead of and one after the temperature regulator, and one for oil discharge from heater. The gages shall be located in protected positions, shall be clearly visible to the operator, and when required to reduce indicator-pointer pulsations, shall be equipped with snubbers.

3.7.3.9 Electric heaters. When specified (see 6.1 and 6.2), the unit shall be provided with a thermostatically controlled electric heater for preheating the oil. The heater shall have capacity in kilowatts (kW) and electric characteristics as specified (see 6.2). Electric heaters shall have steel sheaths and shall meet the codes and standards requirements of 3.5, as applicable. The electric heater shall be provided with an adjustable thermostat and a limit switch that operates independently of the thermostat switch. Heaters rated at a minimum of 5,000 watts and a nominal 240 volts (V) shall be controlled by a magnetic contactor having a magnetic coil operated by a thermostat. Heaters of smaller size, rated at a nominal 240V and less than 15 amperes per circuit, may be controlled by a line-voltage thermostat switch or by a magnetic contactor with a coil operated by disconnection, and shall be protected by circuit breakers. Separate circuits shall be provided for limit switches, and control circuits shall not exceed 120V, shall be two-wire with one side grounded, and shall be protected by circuit breakers. When adequate heavy oil temperature is reached and maintained by the steam or hot water heater, the thermostatic control or limit switch shall cut off the electric heater. Heater controllers shall conform to NEMA ICS 1 and NEMA ICS 2. Circuit breakers shall conform to UL 489 and NEMA AB 1 requirements. Unless otherwise specified (see 6.2), circuit breakers and controllers shall be enclosed in NEMA type 12 enclosures conforming to NEMA ICS 6 with "Hand-Off-Auto" switches conforming to NEMA ICS 2. All wiring practices shall be in accordance with NFPA 70 with properly sized protective elements for all phases of multiphase circuits.

3.7.4 Frame. The unit shall be integrally mounted on a sturdy, rigid, cast-iron or steel frame, or fabricated steel base. Each pump shall be provided with a drip pan or the entire unit shall be mounted on a separate base pan. All parts requiring adjustment, servicing, or inspection shall be readily accessible.

3.7.4.1 Pump pan. When the pan is provided under the pump(s) only, the pan size shall be such that the oil strainers, pipe, valves, and fittings associated with the pump assembly shall be within the outline of the pan.



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3.7.4.2 Base pan. When the base pan is provided under the entire unit, the pan(s) size shall be such that the items outlined in 3.7.4.1 and the heater with its auxiliaries shall contain all possible leaks and drips.

3.7.5 Pipe, valves, and fittings. Pipe, valves, and fittings shall comply with the requirements of ASME B31.1, and shall be of material suitable for fluids, pressures, and temperatures of 3.6.3.

3.8 Type II, duplex units. Type II duplex units shall consist of two type I units, each of sufficient pumping and heating capacity to carry the entire load. The type II unit shall be complete with all accessories except that:

- a. Only one suction strainer and one discharge strainer shall be furnished, each of which shall be of the duplex type
- b. Only one temperature regulator shall be required
- c. Only one electric heater shall be furnished when specified herein

The duplex unit shall include all interconnecting piping and fittings mounted as a single unit on a sturdy, rigid, cast iron or steel frame, or fabricated steel base. The type II unit shall comprise two steam-turbine-driven pumps or two electric-motor-driven pumps, or one of each, as specified (see 6.2). Piping and valves shall permit either pump to discharge through either heater while the remaining pump or heater is being serviced.

3.9 Steam turbines. Steam turbines shall conform to NEMA SM 23. When provided with steam at the specified inlet temperature and inlet and outlet pressures, each turbine shall develop ample power at the proper speeds to drive its pump efficiently under all normal conditions of pump loading. The speed regulating governor shall be of the constant-pressure type or of the excess-pressure type, as specified (see 6.2). The over-speed governor shall limit the turbine speed to within 115 percent of the rated speed.

3.10 Motors. Motors shall have electric characteristics as specified (see 6.2). Unless otherwise specified (see 6.2), electric motors shall be drip-proof with sealed winding. Motors shall conform to the requirements of NEMA MG 1. When viscous fuel oil (No. 5 or 6) is used, the motor size shall be based on fuel oil having a maximum viscosity of 10,000 SSU. The motor temperature rise shall not exceed 55o Celsius (C) when operating in an ambient temperature of 40oC. Motor controllers shall conform to NEMA ICS 6 with "Hand-Off-Auto" switches conforming to NEMA ICS 2. All wiring shall be in accordance with NFPA 70 with properly sized thermal overload elements for all phases of multiphase motors. When electric heaters are provided for preheating purposes (see 3.7.3.9), electric motors shall be so controlled that they will not start until the fuel oil is up to proper pumping temperature.

3.11 Cleaning, treatment, and painting. Surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein. The color of the finish coat shall be as specified (see 6.2). Surfaces to be painted shall be cleaned and dried to insure that they are free from contaminants such as oil, grease, welding slag and spatter, loose mill scale, water, dirt, corrosion product, or any other contaminating substances. As soon as practicable after cleaning and before any corrosion product or other contamination can result, the surfaces shall be prepared or treated to ensure the adhesion of the coating system. The painting shall consist of at least one

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coat of primer and one finish coat. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness shall be not less than 2.5 mils over the entire surface. The paint shall be free from runs, sags, orange peel, or other defects.

3.12 Lubrication. All moving parts requiring lubrication shall have means provided for such lubrication. Pressure lubrication fittings shall not be employed where normal lubrication pressure may damage seals or other parts unless a means for automatically relieving such pressure is provided. Lubrication fittings shall conform to MIL-F-3541 and shall be located in accessible, protected positions.

3.13 Identification marking. Identification shall be permanently and legibly marked directly on the pump and heater at the source of manufacture. Identification shall include the manufacturer's model and serial number, name and trademark to be readily identifiable to the manufacturer.

3.14 Instruction plate. The pump and heater shall be equipped with instruction plates suitably located, describing any special or important procedures to be followed in operating and servicing the equipment. Plates shall be of a material which will last and remain legible for the life of the equipment. Plates shall be securely affixed to the equipment with nonferrous screws or bolts of not less than 1/8-inch diameter.

3.15 Servicing and adjusting. Prior to acceptance of the pump and heater by the Government inspector, the contractor shall service and adjust each unit and its mounted equipment for operational use, including at least the following: adjustment of the motor, electrical, and regulation systems; complete lubrication of pump, and the turbine, if furnished, with grades of lubricants recommended for the ambient air temperature at the delivery point.

3.16 Lifting and tiedown attachments. When specified (see 6.2), the pump and heater unit shall be equipped with lifting and tiedown attachments. Lifting and tiedown attachments shall conform to type II or type III of MIL-STD-209. A nonferrous transportation plate shall be provided and mechanically attached to the pump and heater. Transportation plates shall be inscribed with a diagram showing the lifting attachments and lifting slings, the capacity of each attachment, and the required length and size of each sling cable. A silhouette of the item furnished showing the center of gravity shall be provided on the transportation plate. Tiedown attachments may be identified by stenciling or other suitable marking. Tiedown marking shall clearly indicate that the attachments are intended for the tiedown of the pump and heater on the carrier when shipped.

### 3.17 Workmanship.

3.17.1 Steel fabrication. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be deleterious to the finished product. Manufacturing processes shall not reduce the strength of the steel to a value less than intended by the design. Manufacturing processes shall be done neatly and accurately. All bends shall be made by controlled means to ensure uniformity of size and shape.

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3.17.2 Bolted connections. Bolt holes shall be accurately punched or drilled and shall have the burrs removed. Washers or lockwashers shall be provided in accordance with good commercial practice, and all bolts, nuts, and screws shall be tight.

3.17.3 Riveted connections. Rivet holes shall be accurately punched or drilled and shall have the burrs removed. Rivets shall be driven with pressure tools and shall completely fill the holes. Rivet heads, when not countersunk or flattened, shall be of approved shape and uniform size for the same diameter of rivet. Rivet heads shall be full, neatly made, concentric with the rivet holes, and in full contact with the surface of the member.

3.17.4 Welding. Welding procedures shall be in accordance with a nationally recognized welding code. The surface of parts to be welded shall be free from rust, scale, paint, grease, or other foreign matter. Welds shall be of sufficient size and shape to develop the full strength of the parts connected by the welds. Welds shall transmit stress without permanent deformation or failure when the parts connected by the weld are subjected to proof and service loadings.

#### 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 (examinations and tests) 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 this document where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this document shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in this document shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

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

- a. First article inspection (see 4.2.1).
- b. Quality conformance inspection (see 4.2.2).

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4.2.1 First article inspection. The first article inspection shall be performed on the pump and heater unit when a first article is required (see 3.2 and 6.2). This inspection shall include the examination of 4.3 and the tests of 4.4, and, when specified, the preproduction pack inspection of 4.5 (see 4.5 and 6.2). The first article may be either a first production item or a standard production item from the supplier's current inventory provided the item meets the requirements of the specification and is representative of the design, construction, and manufacturing technique applicable to the remaining items to be furnished under the contract.

4.2.2 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.3, the tests of 4.4.1 and 4.4.4, and the packaging inspection of 4.5.

4.3 Examination. Each pump and heater unit shall be examined for compliance with the requirements specified in section 3 of this document. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirement or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection.

4.3.1 Standards compliance. The contractor shall make available to the contracting officer or his authorized representative evidence of compliance with the applicable standards cited in 3.5.

4.3.2 Pump performance. The contractor shall have available capacity and horsepower curves certified by the manufacturer of the fuel oil pump. The data shall include the density, viscosity, and temperature of the oil being pumped.

4.3.3 Heater performance. The contractor shall have available capacity curves and performance data certified by the manufacturer of the oil heaters. Data shall include specific heat and weight per unit of time for both the heated fluid and heating fluid; and if electric heaters are specified, the actual kW.

4.3.4 Turbine performance. When steam-turbine drive is furnished, the contractor shall have available power and efficiency curves certified by the manufacturer of the steam turbines, and certified data covering the performance characteristics of the turbine-regulating governors.

4.4 Tests. The pump and heater unit shall be tested as applicable. The tests shall be conducted as specified herein and in accordance with referenced documents.

4.4.1 Hydrostatic test. Hydrostatically test each complete production unit as outlined in the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1.

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4.4.2 Pump capacity test. Test the pump in accordance with the Hydraulic Institute Standards for the required capacity in gph under the specified volume pressure, temperature, and viscosity conditions (see 3.6.2 and 3.6.3). The contractor may, upon approval of the contracting officer, make available evidence of compliance as part of the first article in lieu of the test, together with the evidence of 4.3.1. Failure of the pump to meet the required capacity in gph shall be cause for rejection.

4.4.3 Heater capacity test. Test the heater for the required temperature rise under conditions specified in 4.4.2 to verify conformance to 3.7.2. The contractor may, upon approval of the contracting officer, make available evidence of compliance as part of the first article in lieu of the test, together with the evidence of 4.3.2. Failure of the heater to meet the required temperature rise shall be cause for rejection.

4.4.4 Operational test. Each production unit shall be operated sufficiently to show that it functions in accordance with this specification. Where feasible, changes in pressure or temperature shall be made to test settings of instrument gages.

4.5 Preparation for delivery inspection. The preservation, packaging, packing, and marking of the item shall be inspected to verify conformance to the requirements of section 5. When specified (see 6.2), a preproduction pack shall be furnished for examination and test, and within the timeframe required (see 6.2).

## 5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. Preservation, packaging, and packing shall be in accordance with the requirements of MIL-B-3180 with the level of preservation, packaging and the level of packing as specified (see 6.2).

### 5.2 Marking.

5.2.1 Military agencies. Shipments to military agencies shall be marked in accordance with MIL-STD-129.

5.2.2 Civil agencies. Shipments to civil agencies shall be marked in accordance with FED-STD-123.

## 6. NOTES

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

6.1 Intended use. The pump and heater units specified herein are used for pumping heavy fuel oil to burners, and tank and pipeline transfer. Specifications for pump and heater units usually involve a service factor of 1.5 times and 2.0 times the actual capacity requirements of the system. An electric heater (see 3.7.3.9) is normally required on cold startup because of the necessity of raising the fuel oil temperature above 80oF in the suction line to lower the viscosity below the limit of pumpability.

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6.1.1 Insulation information. Whenever possible, it is recommended that pump and heater units be procured without insulation. It is preferable that the heaters be lagged at the site after the pump and heater unit is in place, connected, and pumping oil. Not only is the insulation susceptible to damage during shipment and handling at the job site, but, should any leaks develop in joints or fittings due to strains and jars incident to shipment and handling, the lagging will be damaged to an extent normally requiring complete replacement.

6.1.2 Governors. When the pump and heater unit is to be used with burners operating under a fluctuating load demand, constant-speed governors should be specified (see 3.7.3.1). With reduced loads and consequent low oil flow, a constant-pressure governor with throttling steam valve results in low turbine efficiencies and induces condensation. With a very reduced oil flow, the speed of the turbine can become critical with a possibility of damage to the turbine buckets from the condensation accumulated in the housing, should the load demand require a sudden increase in oil flow. Also, with a constantly fluctuating load, the inertia of the turbine will not afford precise control of the oil pressure.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Type and style of pump and heater required (see 1.2 and 6.5)
- c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2)
- d. Fuel oil grade, if different (see 3.6)
- e. Suction lift requirement, if other than as specified (see 3.6.1)
- f. Performance and viscosity requirements, if different (see 3.6.2)
- g. Design conditions required (see 3.6.3)
- h. Whether type I unit is to have a steam-turbine- or electric-motor-driven pump (see 3.7)
- i. When pump capacity is to be based on a different viscosity; when foot valves are permitted; when a variable frequency controller is permitted for speed reduction (see 3.7.1)
- j. Whether heater is to be the bare-tube or extended-surface type; if bare-tube, whether replaceable-tube-nest or fixed-tube-sheet design (see 3.7.2, 3.7.2.1, and 3.7.2.2)
- k. When heater shall not exceed a certain length, length required (see 3.7.2)
- l. For style B heater, when tube and tube sheet material is to be different (see 3.7.2.1)
- m. Whether a constant-pressure governor or constant-speed governor is required (see 3.7.3.1)
- n. When means is to be provided for connection of remote pressure indication and adjustment; and type and characteristics of such remote connections (see 3.7.3.2)
- o. When means is to be provided for connection of remote temperature indication and adjustment; and type and characteristics of such remote connections (see 3.7.3.4)
- p. When steam trap is not required (see 3.7.3.5)

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- q. When unit is to be provided with an electric heater; kW capacity, voltage per phase, line voltage, and current of the heater (see 3.7.3.9)
- r. When circuit breaker and controller enclosures for electric heaters are to be different (see 3.7.3.9)
- s. Whether type II unit is to have two steam-turbine-driven or two electric-motor-driven pumps, or one of each (see 3.8)
- t. When turbine speed-regulating governor is to be of the constant-pressure type or of the excess-pressure type (see 3.9)
- u. Electric motor voltage, phases, and frequency required, and type of enclosure, if different (see 3.10)
- v. When electric motor controller enclosures are to be different (see 3.10)
- w. Color of finish paint required (see 3.11)
- x. When lifting and tiedown attachments are required (see 3.16)
- y. Level of preservation and level of packing required (see 5.1)

6.3 Data requirements. When this specification is used in an acquisition and data are required to be delivered, the data requirements shall be developed as specified by an approved Data Item Description (DD Form 1664) and delivered in accordance with the approved Contract Data Requirements List (CDRL), incorporated into the contract. When the provisions of DoD Federal Acquisition Regulations (FAR) Supplement, Part 27, Sub-Part 27.475-1 (DD Form 1423) are invoked and the DD Form 1423 is not used, the data should be delivered by the contractor in accordance with the contract or purchase order requirements.

6.4 First article. When a first article inspection is required, the item will be tested and should be a first production item or it may be a standard production item from the contractor's current inventory as specified in 4.2.1. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examination, test, and approval of the first article.

6.5 Part or identifying number (PIN). The PIN to be used for pump and heater units applied to this specification is assigned as follows:

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	*            *
Specification part number	-----*
Type and style code	-----*

6.5.1 Type and style code. The type and style of the pump and heater (see 1.2) are identified by a two-digit number and letter (see table I).

TABLE I. Code number to type and style.

*-----*-----*				
* Style A * Style B *				
*-----*-----*				
* Type I	*	1A	*	1B
*	*		*	*
* Type II	*	2A	*	2B
*	*		*	*
*-----*-----*				

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6.6 Supersession data. This specification supersedes MIL-P-17597D dated 26 October 1987.

6.7 Subject term (key word) listing.

Oil transfer equipment  
Pump and heater, fuel oil

MILITARY INTERESTS:

Custodian

Army - ME

Review Activities

Army - MD

DLA - CS

User Activity

Navy - CG

CIVIL AGENCY COORDINATING ACTIVITY:

GSA - FSS

PREPARING ACTIVITY:

Navy - YD

DOD project 4320-0357

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Orders for this publication are to be placed with General Services Administration, acting as an agent for the Superintendent of Documents. See section 2 of this specification to obtain extra copies and other documents referenced herein.