

**NOTICE OF  
CANCELLATION**

**INCH-POUND**

**MIL-H-17660D  
NOTICE 1  
2 June 1997**

**MILITARY SPECIFICATION**

**HEATERS, FLUID DEAERATING (FOR WATER ONLY) 1,000 TO 1,600,000 POUNDS  
PER HOUR CAPACITY**

Military Specification MIL-H-17660D, dated 18 June 1993, is hereby canceled. Future acquisition of this material should refer to Federal Specification W-H-2904.

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

Custodian:  
Navy - YD1  
Army - CE

Preparing Activity:  
Navy-YD1

(Project 4420-0077)

INCH-POUND

MIL-H-17660D  
18 June 1993  
SUPERSEDING  
MIL-H-17660C  
17 March 1981

## MILITARY SPECIFICATION

HEATERS, FLUID, DEAERATING (FOR WATER ONLY)  
1,000 TO 1,600,000 POUNDS PER HOUR CAPACITY

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

## 1. SCOPE

1.1 Scope. This specification covers direct-contact deaerating heaters either vented to atmosphere or under pressure ranging between 3 pounds per square inch gage (psig) and 15 psig.

1.2 Classification. Deaerating heaters shall be of the following models, types, classes, grades, and capacities, as specified (see 6.2):

Model A - Pressurized operation, with pressure as specified (see 6.2).  
Model B - Fully-vented operation.

Type I - Tray-type heating and deaerating element.  
Type II - Spray-type heating and deaerating element.  
Type III - Packed-column type heating and deaerating element.

Class 1 - 2-minute water storage capacity.  
Class 2 - 5-minute water storage capacity.  
Class 3 - 10-minute water storage capacity.  
Class 4 - Greater than 10-minute water storage capacity.

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.

AMSC N/A

FSC 4420

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

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- Grade A - Guaranteed removal from water of all dissolved oxygen in excess of 0.007 milligrams per liter, over a 10-1 load swing.
- Grade B - Guaranteed removal from water of all dissolved oxygen in excess of 0.04 milligrams per liter, over a 10-1 load swing.

Capacity - Pounds (lb) per hour of water heated by steam, as specified (see 6.2.).

## 2. APPLICABLE DOCUMENTS

### 2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks 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).

#### SPECIFICATIONS

##### MILITARY

- MIL-B-3180 - Boilers and Related Equipment, Packaging of.
- MIL-P-17552 - Pump Units, Centrifugal, Water, Horizontal; General Service and Boiler-Feed: Electric-Motor- or Steam-Turbine-Driven.

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

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

#### DEPARTMENT OF LABOR (DoL) OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA)

- Occupational Safety and Health Standards.
- 1910.219 - Mechanical Power Transmission Apparatus.

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

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

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AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

- B1.1 - Unified Inch Screw Threads (UN and UNR Thread Form).
- B1.20.1 - Pipe Threads General Purpose (Inch).
- B1.20.3 - Dryseal Pipe Threads (Inch).
- B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
- B16.11 - Forged Fittings, Socket-Welding and Threaded.
- B31.1 - Power Piping.

(Application for copies should be addressed to the American National Standards Institute, Inc., 11 W. 42nd Street, New York, NY 10036.)

ASTM

- A36 - Structural Steel.
- A53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
- A135 - Electric-Resistance-Welded Steel Pipe.
- A278 - Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 Degrees F.
- A285 - Pressure Vessel Plates, Carbon Steel, Low- and Intermediate-Tensile Strength.
- A516 - Pressure Vessel Plates, Carbon Steel, for Moderate- and Lower-Temperature Service.
- B111 - Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock.
- D513 - Total and Dissolved Carbon Dioxide in Water.

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division I.
- PTC 12.3 Performance Test Code for Deaerators.

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

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

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

(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.)

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

### 3. REQUIREMENTS

3.1 Description. The deaerating heater shall be an assembly consisting of a shell, water storage compartment, heating and deaerating elements, a vent condensing arrangement, water-regulating valves, level control, and overflow control, gage glasses, and other accessories as required (see 3.7.5, 3.14, and 3.17). When specified (see 6.2), the deaerating heater shall include feedwater-condensate pumps, fittings, valves, mechanical linkage, control panels, and all interconnecting piping, interconnecting wiring, and all other accessories as are necessary for a complete packaged deaerating heater ready for operation when connected to associated steam, water, and condensate lines (see 3.18).

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

3.2.1 System of measurement. The dimensions used in this specification are not intended to preclude the use of the metric system of measurement in the fabrication and production of the material, individual parts, and finished product, provided form, fit, and function requirements are satisfied (see 6.2).

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. None of the above shall be interpreted to mean that the use of used or rebuilt products is allowed under this specification unless otherwise specified.

3.4 Design conditions. The design of the equipment and accessories shall permit easy accessibility for maintenance and service in the field. All threaded parts shall be in the inch system and shall conform to ANSI B1.1, B1.20.1 and B1.20.3 as applicable. The deaerator and storage tank shall be designed to meet or exceed the conditions indicated in Table I, as specified (see 6.2).

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TABLE I. Design conditions.

Design pressure	_____	psi (see 3.7.1 and 3.7.2)
Normal working pressure	_____	psi (see 3.4)
Capacity pounds of	_____	(minimum)

Inlet conditions at heater

	Pressure psi	Temperature range deg. F	Max flow rate lb per hour (lb/h)
Surface condenser condensate or heating system returns	_____	_____	_____
High pressure heater drips	_____	_____	_____
High pressure trap returns	_____	_____	_____
Makeup water (softened)	_____	_____	_____
Emergency make-up water	_____	_____	_____

Outlet temperature of feedwater from heater at \_\_\_\_\_ design capacity.  
\_\_\_\_\_ deg. F

Inlet makeup water characteristics (softened):

pH \_\_\_\_\_

Hardness \_\_\_\_\_

Clarity \_\_\_\_\_

Heating steam pressure \_\_\_\_\_ psi

Heating steam pressure \_\_\_\_\_ British Thermal units per lb

Storage capacity \_\_\_\_\_ gallons

3.5 Safety. All parts which are subject to high operating temperatures shall be insulated (factory insulated or insulated at site), fully enclosed, or guarded when such parts are exposed to contact by personnel, or otherwise create a hazard. All moving parts hazardous to personnel shall be enclosed or guarded in accordance with OSHA 1910.219. Exhaust or discharges from the deaerating heater shall be vented to the atmosphere so that they do not endanger personnel. Nonfunctional sharp edges, projecting points, and excessive length of fastening devices shall be avoided. Protective devices shall not impair the operating functions. Warnings shall be mounted on or near components containing hidden hazards.

3.6 Performance. The deaerating heater shall deliver the specified quantity of water (see 1.2), heated from the inlet temperature resulting from the inlet mixture as specified (see 6.2), to a temperature equal to that of saturated steam at the pressure existing in the heater. The delivered water shall be free of dissolved oxygen and carbon dioxide to the extent specified in 1.2, over the load swings of 1 to 10. The deaerator shall operate without rumbling, pounding, or other noise at all load rates from zero to maximum rated outlet capacity.

3.6.1 Storage capacity. The water-storage capacity for each class heater shall represent the time required to deliver, at the specified rate of flow, the volume of water contained within the cylindrical portion of the tank between the overflow level and the bottom of the storage space.

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3.6.2 Oxygen and carbon dioxide removal. The amount of oxygen remaining in the heated water shall be determined by either the electronic or starch end point method of ASME PTC 12.3. Free carbon dioxide shall be determined by ASTM D513, and shall not exceed 1 mg/l.

3.6.3 pH meter. When specified (see 6.2), a pH meter shall be furnished, mounted in the control panel in 3.18. The pH meter shall measure accuracy of  $\pm 0.1$  pH unit. The meter shall have a compensation control for a temperature range of 60 degrees Fahrenheit (deg. F) to 250 deg. F, and shall be rated for continuous use. The meter probe shall operate in a temperature range of 60 deg. F to 250 deg. F. The meter shall be easily removed from its control panel mounting to permit daily calibration with reference pH buffers.

3.7 Shells and surge tanks. Heater shells and storage surge tanks, if a separate deaerator water surge tank is furnished (see 6.1.3), shall be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division 1. Plate and casting thickness of shell and heads shall be determined by applying the stress values, design rules, and dimensions in applicable sections of the ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division I. Vessels bearing the ASME Code symbol stamp will be accepted as complying with ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division I.

3.7.1 Cast iron. Cast iron heater shells shall comply with ASTM A278, class 25 or greater, or the equivalent. Shells comprised of more than one section shall have machined and gasketed joints. Shells of one-piece cast construction shall be ribbed. Door and flange surfaces shall be machined. Cast iron shells shall be designed for a maximum working pressure of 20 pounds per square inch (psi).

3.7.2 Steel. Steel shells and steel storage tanks shall be of welded construction with material in accordance with ASTM A36, ASTM A53, ASTM A285 or ASTM A516. Unless otherwise specified (see 6.2), the shells shall be designed for 30 psi.

3.7.3 Supports. Suitable iron or steel supporting feet or saddles shall be provided for shells and tanks. When a package deaerator is specified in 3.1, supports shall have sufficient height to supply the pumps with water at least one foot in height greater than the net positive suction head (NPSH) required at the lowest possible water level of the deaerator without causing cavitation to affect the life of the pump.

3.7.4 Openings. Openings shall be provided for steam inlet, water inlet, high-temperature returns, pump suction, overflow, drain, vent, pressure relief valve, a sampling connection, gages, and when required (see 3.15), thermometer connections. Connections 4 inches nominal pipe size and larger shall have standard 125 lb flanges in accordance with ANSI B16.1. All connections shall be taper threaded. ANSI B1.20.1 Steel Connections shall conform to ANSI B16.11 Class 3000 couplings. When shells are stainless steel clad (see 3.8), connections shall be made of the same material as the cladding of the shell. Access doors or manholes with manhole covers equipped with permanent-type gaskets shall be provided to allow ready inspection and removal of internal parts and entrance to the storage section.

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3.7.5 Piping. When interconnecting piping, fittings, and valves are required (see 3.1), pipe and fittings shall be suitable to meet the pressure requirements for conformance to ANSI B31.1, except for pressures 15 psig or less. For pressures 15 psig or less, piping may use galvanized schedule 10, ASTM A135 or ASTM A53 pipe. Galvanized malleable threaded fittings 2-1/2-inch pipe size or smaller may be used for pressures 15 psig or less. Valves other than in 3.11 and 3.13 shall be bronze suitable to meet the pressure and temperature requirements. Gate valves shall be provided at suction and discharge of each pump to allow complete isolation of the pumps. Check valves shall be provided at each pump discharge connection to prevent back flow. Fluid flow in pipes shall not exceed 10 feet per second. All pipe shall be cut to proper length and installed without pipe strain.

3.8 Heating and deaerating element. The heating and deaerating element shall be type I or type II as specified (see 6.2). The water shall be brought into intimate contact with steam, and shall be finely-divided or flashed into steam, while passing through the element. The design shall be such that all loads, both water and steam, will flow without short-circuiting or channelling-through. The interior of all steel shell heaters shall be provided with effective material to protect the shell and heads against corrosive gases and undeaerated water.

3.8.1 Type I. Type I shall be the tray type wherein deaeration and heating is accomplished principally by the water showering or cascading through a number of tiers of trays with steam in a designated flow configuration. Trays, tray supports, and water distributors shall be of cast iron or of corrosion-resistant material. All bolts, nuts, and other fittings inside the deaerating element shall be of corrosion-resistant steel. The tray system shall be so arranged that precise leveling of individual trays or tray stacks will not be required to obtain proper functioning. Trays shall be so grouped that they can be readily removed by one man.

3.8.2 Type II. Type II shall be the spray atomizing type wherein water is introduced through a spray distributor into a steam atmosphere providing heating and deaeration with final deaeration and heating accomplished by steam jet action on the water stream, or direct intermixing or agitation of the water or the water stream with the steam from the main. A check valve or other positive means shall be provided to prevent possible reverse flow of steam and water into the inlet steam main under abnormal operating conditions. Water inlet spray valves or spray arrangements shall be spring loaded or diaphragm motor operated. The spray ports shall be of a nonclogging, self-cleaning design and shall be adjustable to obtain uniform breakup of the effluent stream at all loads. Diaphragm motors, when used, shall be operated by pneumatic or hydraulic power controlled from the water level. The diaphragm shall be of rubber reinforced by cloth or of synthetic material suitable for the intended use. Diaphragm plates and other parts against which the diaphragm flexes shall be smooth and well-rounded. If an external heater is required for initial heating, the heater shall be constructed in accordance with the ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division I requirements for the maximum working steam pressure, and shall be provided with all interconnecting piping, valves, thermometers, temperature regulator, and other appurtenances as are necessary.



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3.8.3 Type III. Type III shall be the packed column type wherein deaeration and heating is accomplished by water being introduced through a spray distributor and cascading through the packing with steam in counter-flow. Packing, liner and water distributor shall be of corrosion-resistant material. The spray distributor shall be of a nonclogging, self-cleaning design and shall be adjustable to obtain uniform break up of the effluent stream at all loads. Column packing shall be designed to be readily removable.

3.9 Vent condensing arrangement. The vent condensing arrangement shall condense the steam and allow the noncondensables to be vented to the atmosphere when the heater is operating at full rated capacity with the inlet water mixture at the maximum temperature of 180 deg. F resulting from the mixture specified herein. It may be of the tubular or direct-contact type and may be internal or external. When the condenser is external, suitable means for supporting the condenser on the deaerating heater, and the water and vapor piping between the condenser and heater shall be provided. The vent outlet shall be taper threaded in accordance with ANSI B1.20.1. Vent condensers shall be of such size and design that the guaranteed grade A or grade B oxygen removal will be maintained without venting more than 0.1 percent of steam per hour of the rated heater capacity, or at the operating capacity over a 10 percent to 100 percent range, as applicable.

3.9.1 Tubular-type condenser. The shell and heads shall be of cast iron, cast steel, or of fabricated steel plate. Tube sheets shall be of muntz metal, naval brass, or admiralty metal. Condenser tubes shall be of admiralty metal or arsenical copper conforming to ASTM B111. The outside diameter of tubes shall be not less than 3/4 inch, and the wall thickness shall be not less than 0.049 inch. Tubes shall be readily removable for cleaning and inspection without disturbing connection piping.

3.10 Water-regulating valves. One or more valves as required shall be provided to automatically regulate the admission of water to the deaerating heater. The valves shall be controlled by the changes in water level in such a way that makeup water will be admitted only when the amount of condensate, high-pressure drips, and high-pressure trap returns is less than the amount needed to maintain the normal level in the water storage space; and emergency makeup is unable to maintain the normal level in the water storage space. Valves, valve seats, and other internal trim shall be of wear- and corrosion-resistant material. Rubbing and seating surfaces shall operate without sticking, pitting, or galling. Valve bodies shall be bronze and be designed to withstand the system pressures in accordance with manufacturer's standard practice. Valve actuators shall be modulating type and shall be mechanically driven, electrically driven, or pneumatically driven, as specified (see 6.1.2 and 6.2). Electric driven control circuits shall be not greater than nominal 120 volt (V), 60 hertz (Hz), 2 pole, one side grounded, and enclosures shall be NEMA 3R or NEMA 12 in accordance with NEMA ICS-6. When pneumatic driven, valve actuators shall operate on 3-15 psi air. Valves shall be designed for the following conditions indicated in Table II as specified (see 6.2):

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TABLE II. Valve design conditions.

	Condensate	Makeup water
Capacity (gallons per minute),	_____	_____
Maximum pressure drop at above capacity	_____	_____
Available pressure psi	_____	_____
Minimum flow coefficient at 100 percent open	_____	_____

3.11 Level controllers. The water-regulating valves shall be controlled from the motion of one or more floats, as required (see 3.10). Floats shall be located in a separate chamber connected to the water storage space by piping and isolating valves, or shall be located internally in the storage tank and protected by perforated corrosion-resistant steel tubes from the surging action of the water in the tank. The separate chamber shall be of cast iron, or of cast steel. Floats shall be corrosion-resistant steel. Each float shall be mounted on a float-rod in such a way that it will not loosen in service, and yet will permit ready disassembly of the float from the float-rod. The positioning of the floats shall be such that the water-regulating valves shall operate in the sequence specified (see 3.10). Float controllers shall be direct acting, mechanically actuated, electrically actuated with dry contact switches, or pneumatic actuated with 3-15 psi air having proportional band adjustments, as specified (see 6.1.2 and 6.2). Electrical circuits shall be not greater than 120 V, 60 Hz, 2 pole, one side grounded.

3.12 Overflow control. An overflow control consisting of a riser or weir with a loop seal (may be within the storage space) shall be provided, or a float-controlled overflow trap shall be provided, as specified (see 6.2). Loop seal shall be provided with blow-down, drain connection, and recharge connection (for cold water recharge in operation). The overflow control on Model A shall maintain the pressure within the heater. The nominal size of overflow control, overflow piping and accessories shall be not less than as shown in Table III, except when larger sizes are specified (see 6.2).

TABLE III. Overflow pipe sizes.

Deaerating heater outlet capacity lb/h	Nominal pipe size, inches
10,000 through 15,000	2
15,001 through 20,000	2-1/2
20,001 through 35,000	3
35,001 through 80,000	4
80,001 through 150,000	5
150,001 through 250,000	6
250,001 through 500,000	8
500,001 through 700,000	10
700,001 through 1,000,000	12
1,000,001 through 1,600,000	14 (outside diameter)

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3.13 Pressure relief valve. All model A pressurized deaerators and all external pressure vessels shall be equipped with a spring loaded relief valve which shall have capacity sufficient to protect the deaerator from excessive steam pressure generated by the fail open capacity of either the steam supply valve or the pressure reducing valve, whichever is greater, plus any steam pressure generated by inlet water flashing to steam. The valve shall be set to open at 5 psig above the specified maximum operating working pressure and be sized as to not allow a pressure buildup of more than 10 percent above this pressure but below the design pressure. The ASME Code symbol stamp on the valve will be accepted as meeting the above requirements.

3.14 Gage glasses. One or more water level gages to indicate the water level over the whole range of water level variation shall be provided, and shall be of a safety type to prevent spillage if the glass should be broken.

3.15 Thermometers. Unless otherwise specified (see 6.2), the manufacturer's standard thermometers shall be furnished for the storage tank and heater section.

3.16 Oil separator. When specified (see 6.2), an oil separator shall be furnished and may be a separate unit or integral with the deaerating heater. The separator shall be self-cleaning. The internal passages shall be sufficiently large to minimize frictional resistance to steamflow. It shall be so designed, and so connected to the deaerating heater that accumulated oil or oil-water mixture cannot be drawn into the heater.

3.17 Boiler feedwater and condensate pumps.

3.17.1 Boiler feedwater pumps. When specified (see 6.2), boiler feedwater pumps shall be furnished. The number of pumps, drives, and associated equipment shall conform to type II of MIL-P-17552 with applicable characteristics as specified (see 6.1.4 and 6.2).

3.17.2 Condensate pumps. When specified (see 6.2), condensate pumps shall be furnished. The number of pump drives and associated equipment shall conform to type I of MIL-P-17552, with applicable characteristics as specified (see 6.1.4 and 6.2).

3.18 Control panel. When specified (see 6.2), controls, including operating switches, indicating lights, temperature gages, alarms, motor starters, fuse, and circuit elements of the control system shall be mounted on a single control panel or cabinet insofar as practicable in order to centralize the control in accordance with NEMA ICS-1 and ICS-2. Color indicating lights shall be provided and shall be activated to show status of the system. The control panel or cabinet shall be provided with NEMA 12 enclosures in accordance with NEMA ICS-6 and shall either be mounted on the unit or shall be free standing, as specified (see 6.2). When specified (see 6.2), a main circuit breaker shall be furnished and mounted adjacent to the control panel or packaged separately for remote mounting at the site.

3.19 Insulation. Unless otherwise specified (see 6.1.1 and 6.2), the deaerating heater shall be insulated at the site of installation in accordance with the contract. When specified (see 6.2), the deaerating heater shall be factory insulated in accordance with the manufacturer's

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standard practice. All exterior surfaces of the unit, except the doors, end covers, handholes, manholes, and vents, shall be covered where practical with at least 2 inches of fibrous glass, mineral wool, thermal block, or equivalent insulation having a heat transfer coefficient at a mean temperature of 200 deg. F not exceeding 0.45 British thermal units per hour per square foot per inch thickness per deg. F temperature difference. The insulation shall be so formed and secured in place as to present sagging or displacement during shipment and operation.

3.20 Lifting attachments. When specified (see 6.2), the equipment shall be equipped with lifting attachments. Each lifting attachment shall be in the form of a lifting eye having 1.25-inch minimum radius and an ultimate strength at least 1.5 times the yield strength. The lifting attachments shall be identified by stenciling or other suitable marking.

3.21 Cleaning, treatment, and painting. Unless otherwise specified (see 6.2), surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein. Unless otherwise specified (see 6.2), the color of the finish coat shall be the manufacturer's standard color. 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 insure the adhesion of the coating system. The painting shall consist of at least one 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.

3.22 Identification marking. Identification shall be permanently and legibly marked directly on the deaerating heater or on an aluminum, brass, or corrosion-resisting steel plate, firmly affixed to the item. The information shall include the manufacturer's name or trademark, model number, and serial number.

3.23 Instruction plates. The equipment shall be provided with instruction plates describing special or important procedures for operating and servicing equipment and warnings of hazardous procedures. The plates shall be durable and legible throughout the life of the equipment. The plates shall be conspicuously located. Brass screws or bolts not less than 1/8 inch in diameter shall be used to affix the plates to the equipment.

3.24 Servicing and adjusting. When specified (see 6.2), prior to acceptance of the deaerating heater by the Government, and after installation, the contractor shall service and adjust each deaerating heater and all accessories the contractor furnishes. The servicing and adjustment shall be performed at the installation site and under actual operating conditions.

3.25 Workmanship.

3.25.1 Steel fabrication. The steel used in fabrication shall be free from kinks, sharp bends, and other conditions which would be deleterious to

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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 insure uniformity of size and shape.

3.25.2 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.

3.25.3 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 of 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.

3.25.4 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.

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

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

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4.2.1 Quality conformance inspection. Quality conformance inspection shall be performed on each unit of production. This inspection shall include the examination of 4.3 and the tests of 4.4.1 and 4.4.3, and 4.4.4 at the factory. Failure to pass the examination or any of the test shall be cause for rejection of the unit.

4.2.2 On-site inspection. On-site inspection shall include the examination of 4.3 and test of 4.5 on each unit. Failure to pass the examination or any of the tests shall be cause for rejection of the unit.

4.3 Examination. The deaerating heater shall be examined for compliance with the requirements specified in section 3 of this specification. Any redesign or modification of the contractor's standard product to comply with specified requirements, or any necessary redesign or modification following failure to meet specified requirements shall receive particular attention for adequacy and suitability. This element of inspection shall encompass all visual examinations and dimensional measurements. Noncompliance with any specified requirements or presence of one or more defects preventing or lessening maximum efficiency shall constitute cause for rejection. Failure of the contractor to make evident the certified information specified in 4.3.1 and 4.3.2 herein shall be cause for rejection of the deaerating heater.

4.3.1 Pressure relief valve performance. When a pressure relief valve is furnished, the contractor shall have available certified data covering the performance characteristics of the pressure relief valve.

4.3.2 Oil separator performance. When an oil separator is furnished, the contractor shall have available certified data covering the performance characteristics of the oil separator.

4.4 Tests. Each deaerating heater shall be tested, and any unit failing to pass the following tests, as applicable, shall be rejected. Tests shall be conducted as outlined in the referenced documents as herein specified.

4.4.1 Operation test. All regulating and relief valves, pressure and overflow controllers, pump controls, and similar accessories shall be tested for proper functioning. Failure of any device to function properly shall be cause to reject the deaerator.

4.4.2 Performance. Prior to final acceptance, each unit shall be tested for conformance with the requirements of this specification, in accordance with the applicable testing of the ASME PTC 12.3, by either the electronic or starch end point method at the site of installation. Nonconformance to 3.6 shall constitute failure of this test.

4.4.3 Cast iron shells. Cast iron shells shall be subjected to a hydrostatic test pressure of 30 psi. Leakage, sweating, or deformation shall be cause for rejection.

4.4.4 Steel shells. Each steel shell heater shall be tested in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section VIII, Pressure Vessels, Division I. Nonconformance to 3.7 shall constitute failure of this test.

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4.5 On-site testing. Testing shall be performed on the units at the site after installation. This testing shall be in addition to quality conformance inspection performed at the factory. On-site testing shall include the test of 4.4.2 to verify compliance with the performance requirements of this specification. On-site testing shall be performed either by the deaerator manufacturer or by the installing contractor, as specified (see 6.2). The manufacturer shall have the privilege of representation at tests performed by others. The manufacturer is responsible for the detailed requirements and schedule for the test program as specified herein. In all cases, deficiencies revealed by on-site testing shall be corrected at the deaerator manufacturer's expense, and any required retesting shall also be at the manufacturer's expense.

4.6 Packaging inspection. The preservation, packing, and marking of the heaters shall be inspected to verify conformance to the requirements of section 4 of MIL-B-3180. The inspection shall consist of a preproduction pack inspection when specified (see 6.2), and a quality conformance inspection.

## 5. PACKAGING

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

## 6. NOTES

6.1 Intended use. Direct-contact deaerating heaters covered in this specification are intended for use in stationary power plants for shore installations. Type I deaerating heaters should not be used where the feedwater is excessively corrosive or encrusting. Model B deaerating heaters should not normally be specified where capacities greater than 120,000 lb/h are required. Packaged deaerators, complete with heater, storage tank, surge tank, feedwater-condensate pumps, control panel, and all accessories are available in capacities up to 300,000 lb/h of water heated by steam.

6.1.1 Insulation. Whenever possible, it is recommended that deaerating heaters be procured without insulation. It is preferable that the unit be lagged at the site after the deaerator is in place, connected, and tested. 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 Mechanically operated modulating-valve actuators. It is normal practice on small deaerators with capacities of 60,000 lb/h or less to have the modulating water-regulating valves be mechanically operated by actuated internal level controllers.

6.1.3 Surge tanks. Where the uncontrolled returns exceed 25 percent of the boiler makeup water, a complete system with separate surge tanks and transfer pumps should be supplied to eliminate the waste of steam and water overflow of deaerated water.

6.1.4 Boiler feedwater and condensate pumps. The acquisition documents for the pumps in MIL-P-17552 should specify the number of pumps as to type,

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style, and class with type of drive, and applicable electrical characteristics. The pumps' service requirements should be specified in MIL-P-17552 as to capacity, pumping temperature, and pH of liquid. Head required (suction discharge and NPSH), rating of boiler and other applicable characteristics should be as specified in MIL-P-17552.

## 6.1.5 Conversion of units.

0.007 mg/l = 0.007 parts per million = 7 parts per billion.

0.04 mg/l = 0.04 parts per million = 40 parts per billion.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Model, type, class, and grade required (see 1.2).
- c. Pressure, when specified on model A (see 1.2).
- d. Capacity of deaerating heaters in pounds per hour (see 1.2).
- e. 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).
- f. When a complete packaged deaerating heater with interconnecting piping, valves, and fittings is required (see 3.1).
- g. If machine is required to be configured in a specific measurement system (US or SI), state required system (see 3.2.1).
- h. Applicable design conditions required (see 3.4, 3.6, and Table I).

Design pressure \_\_\_\_\_ psi (see 3.7.1 and 3.7.2)  
 Normal working pressure \_\_\_\_\_ psi (see 3.4)  
 Capacity lb of feedwater per hour. \_\_\_\_\_ (minimum)

## Inlet conditions at heater

	Pressure psi	Temperature range deg. F	Max flow rate lb/h
Surface condenser condensate or heating system returns	_____	_____	_____
High pressure heater drips	_____	_____	_____
High pressure trap returns	_____	_____	_____
Make-up water	_____	_____	_____
Emergency make-up water	_____	_____	_____
Outlet temperature of feedwater from heater at _____ design capacity _____ deg. F			

## Inlet makeup water characteristics (softened):

pH \_\_\_\_\_  
 Hardness \_\_\_\_\_  
 Clarity \_\_\_\_\_  
 Heating steam pressure \_\_\_\_\_ psi  
 Heating steam enthalpy \_\_\_\_\_ British Thermal units per lb  
 Storage capacity \_\_\_\_\_ gallons

- i. When pH meter is required (see 3.6.3).



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- j. Designed working pressure of steel shells required if other than that specified (see 3.7.2).
- k. When heating and deaerating element shall be type I or type II (see 3.8).
- l. Type of water-regulating valves required, if different than that specified (see 3.10).
- m. Whether valve actuators shall be mechanically, electrically, or pneumatically driven (see 3.10).
- n. Valve design conditions required (see 3.10).

	Condensate	Makeup water
Capacity (gallons per minute)	_____	_____
Maximum pressure drop at above capacity	_____	_____
Available pressure psi	_____	_____
Minimum flow coefficient at 100 percent open	_____	_____

- o. Whether float controllers shall be direct acting, or mechanically, electrically, or pneumatically actuated (see 3.11).
- p. Characteristics of overflow control required (see 3.12).
- q. Size of overflow piping required, if other than that shown in Table III (see 3.12).
- r. When thermometers shall be other than the manufacturer's standard (see 3.15).
- s. When oil separator is required (see 3.16).
- t. When boiler feedwater pumps with the applicable characteristics are required (see 3.17.1 and 6.1.4).
- u. When condensate pumps with the applicable characteristics are required (see 3.17.2 and 6.1.4).
- v. When controls are to be mounted on a single control panel or cabinet (see 3.18).
- w. When control panel enclosure shall be mounted on the unit or be free standing (see 3.18).
- x. When main circuit breaker is to be furnished (see 3.18).
- y. When main circuit breaker is to be packaged separately (see 3.18).
- z. When insulation of heater is to be different and when heater is to be factory insulated (see 3.19).
- aa. When lifting attachments are required (see 3.20).
- bb. When cleaning, treatment, and painting shall be other than specified (see 3.21).
- cc. Color of finish paint required, if other than the manufacturer's standard color (see 3.21).
- dd. When servicing and adjusting of each deaerating heater by contractor is required after installation (see 3.24).
- ee. Who will perform on-site testing (see 4.5).
- ff. When a preproduction pack inspection is required (see 4.6).
- gg. 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 (DD Form 1423), incorporated into the contract, When the provisions of DoD Federal Acquisition Regulations (FAR) Supplement, Part 27, Sub-Part 27.475-1 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.

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Federal Acquisition Regulations (FAR) Supplement, Part 27, Sub-Part 27.475-1 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 Subject term (key word) listings.

Direct-contact  
Dissolved oxygen  
Spray-type  
Tray-type

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

Custodian:  
Navy - YD

Preparing activity:  
Navy - YD

User activity:  
Army - CE

(Project 4420-0073)