NOTICE OF CANCELLATION

INCH-POUND

W-H-2904
NOTICE 1
29 January, 2001

FEDERAL SPECIFICATION

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

W-H-2904, dated 2 June 1997, is hereby cancelled without replacement.

MILITARY INTERESTS:

Custodians:
Army - CE
Navy - SH
DLA - CC

Review activity:
Navy - SA

CIVIL AGENCY COORDINATING ACTIVITY:

GSA/FSS

Preparing activity:
DLA - CC

(Project 4420-0083)

AMSC N/A

FSC 4420

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[INCH-POUND]
W-H-2904
June 2, 1997
SUPERSEDING
MIL-H-17660D
18 June 1993

FEDERAL SPECIFICATION

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

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

1. SCOPE AND CLASSIFICATION

1.1 Scope. This specification covers direct-contact deaerating heaters either vented to atmosphere or under pressure ranging between 3 pounds per square inch gage and 15 psig (20.7 kilopascals (kPa (gage) and 103.4 kPa (gage)).

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, clarifications, etc. and any data which may improve this document should be sent to: Commanding Officer (Code 15E2), Naval Construction Battalion Center, 1000 23rd Avenue, Port Hueneme, CA 93043-4301, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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

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

2. APPLICABLE DOCUMENTS

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

Commercial Item Description

A-A-50562 - Pump Units, Centrifugal, Water, Horizontal; General Service and Boiler-Feed: Electric-Motor- or Steam-Turbine Driven.

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

2.1.1 Other Government documents, drawings, and publications. The following other Government documents form a part of this specification to the extent specified herein.

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

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

ANSI Bl.l - Unified Inch Screw Threads (UN and UNR Thread Form).
ANSI B1.20.1 - Pipe Threads, General Purpose (Inch).
ANSI B1.20.3 - Dryseal Pipe Threads (Inch).
ANSI B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

ANSI B16.11 - Forged Fittings, Socket-Welding and Threaded.
ANSI B31.1 - Power Piping.

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

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.

(Private sector and civil agencies may purchase copies of these voluntary standards from the American Society of Mechanical Engineers, United Engineering Center, 345 East 47th Street, New York, NY 10017.)

ASTM

ASTM A 36 - Structural Steel.
ASTM A 53 - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
ASTM A 135 - Electric-Resistance-Welded Steel Pipe.
ASTM A 278 - Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650 Degrees F.
ASTM A 285 - Pressure Vessel Plates, Carbon Steel, Low- and Intermediate Tensile-Strength.
ASTM A 516 - Pressure Vessel Plates, Carbon Steel, for Moderate and Lower-Temperature Service.
ASTM B 111 - Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock.
ASTM D 513 - Total and Dissolved Carbon Dioxide in Water.

(Private sector and civil agencies may purchase copies of these voluntary standards from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.)

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

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

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

(DoD activities may obtain copies of those adopted voluntary standards listed in the DoD Index of Specifications and Standards free of charge from the Defense Automated Printing Services, Attn: DoDSSP, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited 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 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 3.17).

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.

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 material, 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 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 Bl.l, 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).

TABLE I. Design conditions.

Design pressure	_____	psig (kPa (gage)) (see 3.7.1 and 3.7.2)
Normal working pressure	_____	psig (kPa (gage)) (see 3.4)
Capacity pounds (kilograms) of feedwater per hour	_____	(minimum)

Inlet conditions at heater

	Pressure psig (kPa (gage))	Temperature range °F (°C)	Max flow rate lb (kg) per h
Surface condenser condensate or heating system returns	_____	_____	_____
High pressure heater drips	_____	_____	_____
High pressure trap returns	_____	_____	_____
Makeup water (softened)	_____	_____	_____
Emergency makeup water	_____	_____	_____

Outlet temperature of feedwater from heater at _____ design capacity. _____°F (°C)

Inlet makeup water characteristics (softened):

pH	_____	
Hardness	_____	
Clarity	_____	
Heating steam enthalpy	_____	psig (kPa (gage))
Heating steam pressure	_____	British thermal units (Btu) per lb (kilojoule per kilogram (kJ/kg))
Storage capacity	_____	gallons (litre)

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.

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 D 513, and shall be not greater than 1 milligram per litre (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 +0.1 pH unit. The meter shall have a compensation control for a temperature range of 60 degrees Fahrenheit (°F) to 250 °F (15 degrees Celsius (°C) to 221 °C), and shall be rated for continuous use. The meter probe shall operate in a temperature range of 60 °F to 250 °F (15 °C to 221 °C). 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 I. 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 A 278, 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 working pressure of not greater than 20 pounds per square inch (psig) (137.9 kPa (gage)).

3.7.2 Steel. Steel shells and steel storage tanks shall be of welded construction with material in accordance with ASTM A 36, ASTM A 53, ASTM A 285 or ASTM A 516. Unless otherwise specified (see 6.2), the shells shall be designed for 30 psig (206.8 kPa (gage)).

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 not less than 1-foot (304.8 millimetre (mm)) 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 (101.6 mm) nominal pipe size and larger shall have standard 125 lb (56.7 kg) 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.

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 (103.4 kPag (gage)) or less. For pressures 15 psig (103.4 kPag (gage)) or less, piping may use galvanized schedule 10, ASTM A 135 or ASTM A 53 pipe. Galvanized malleable threaded fittings 2-1/2-inch (73mm) pipe size or smaller may be used for pressures 15 psig (103.4 kPag (gage)) 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 be not greater than 10 feet per second (3 metre per second (m/s). 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 channeling-through. The interior of all steel shell heaters shall be provided with effective material to protect the shell and heads against corrosive gases and aerated 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. The water is introduced through a spray distributor into a steam atmosphere providing heating and deaeration. The 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. It shall be provided with all interconnecting piping, valves, thermometers, temperature regulator, and other appurtenances as are necessary.

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. This shall be accomplished when the heater is operating at full rated capacity with the inlet water mixture at a temperature not greater than 180 °F (82 °C) 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. This may also be accomplished 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 B1.1. The outside diameter of tubes shall be not less than 0.25-inch (19 mm), and the wall thickness shall be not less than 0.049-inch (1.24 mm). 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. This shall occur 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. This shall also happen when 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 psig (20.7-103.4 kPa (gage)) air. Valves shall be designed for the following conditions indicated in table II as specified (see 6.2):

TABLE II. Valve design conditions.

	Condensate	Makeup water
Capacity (gallons per minute) (litre per second)	_____	_____
Maximum pressure drop at above capacity	_____	_____
Available pressure psig (kPa (gage))	_____	_____
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 psig (20.7-103.4 kPa (gage)) 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.

Dearating heater outlet capacity lb/h (kg/h)	Nominal pipe size, USA (inches)	Nominal pipe size, ISO (millimetre)
10,000 through 15,000 (4,536 through 6,804)	2	50
15,001 through 20,000 (6,804.5 through 9,075)	2-1/2	65
20,001 through 35,000 (9,072.5 through 15,876)	3	80
35,001 through 80,000 (15,875.5 through 36,288)	4	100
80,001 through 150,000 (36,288.5 through 68,040)	5	125
150,001 through 250,000 (68,040.5 through 113,400)	6	150
250,001 through 500,000 (113,400.5 through 226,800)	8	200
500,001 through 700,000 (226,800.5 through 317,520)	10	225
700,001 through 1,000,000 (317,520.5 through 456,600)	12	300
1,000,001 through 1,600,000 (456,600.5 through 725,760)	14 (outside diameter)	350 (outside diameter)

3.13 Pressure relief valve. All model A pressurized deaerators and all external pressure vessels shall be equipped with a spring loaded relief valve. The relief valve 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. The relief valve shall also relieve any steam pressure generated by inlet water flashing to steam. The valve shall be set to open at 5 psig (103.4 kPa (gage)) 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 A-A-50562 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 A-A-50562, 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 standard practice. All exterior surfaces of the unit, except the doors, end covers, handholes, manholes, and vents, shall be covered where practical. It shall be covered with not less than 2 inches (50.8 mm) of fibrous glass, mineral wool, or thermal block. An equivalent insulation having a heat transfer coefficient at a mean temperature of 200 °F (99 °C) not greater than 0.45 Btu per hour per square foot per inch thickness per °F (144.13 watts per square metre kelvin per millimetre) temperature difference may also be used. The insulation shall be so formed and secured in place as to prevent 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 not less than 1.25-inch (37.75 mm) radius and an ultimate strength of not less than 1.5 times the yield strength. The lifting attachments shall be identified by stenciling or other suitable marking.

3.21 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 ensure that they are free from contaminants such as oil, grease, welding slag and spatter, loose mill scale, water, dirt, corrosion products, or any other contaminating substances. As soon as practicable after cleaning and before any corrosion product or other interfering material can result, the surface shall be prepared or treated to ensure the adhesion of the coating system. The painting shall consist of at least one coat of primer and one finish coat of acrylic-based enamel. 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 that produce a total dry film thickness of not less than 2.5 mils (0.64 mm) over the entire surface. The paint shall be free from runs, sags, orange peel, or other defects. The compartment housing interior color may be the manufacturer's standard.

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 0.125-inch (3 mm) 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 the finished product. Manufacturing processes shall not reduce the strength of 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.

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, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure that 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).

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 tests 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 psig (206.8 kPa (gage)). 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.

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.

5. PACKAGING

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

6. NOTES

(This section contains information of a general or explanatory nature which is helpful but is not mandatory.)

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 (54,432 kg/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 (136,080 kg/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 (27,246 kg/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 are greater than 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 dumps. The acquisition documents for the pumps in A-A-50562 should specify the number of pumps as to type, style, and class with type of drive and applicable electrical characteristics. The pumps' service requirements should be as specified in A-A-50562 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 A-A-50562.

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.

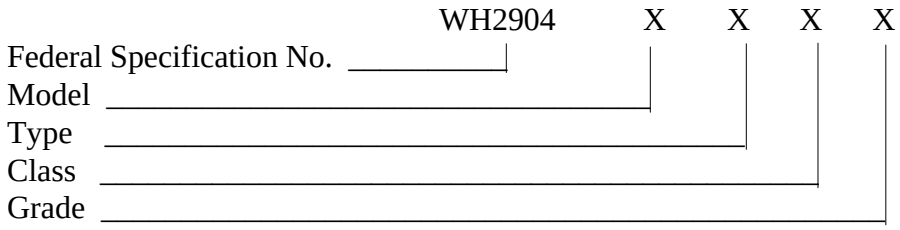
6.2 Acquisition requirements. Acquisition documents should specify the following:

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 (kilograms) per hour (see 1.2).
e. When a complete packaged deaerating heater with interconnecting piping, valves, and fittings is required (see 3.1).
f. Applicable design conditions required (see 3.4, 3.6, and table I).
g. When pH meter is required (see 3.6.3).
h. Designed working pressure of steel shells required if other than that specified (see 3.7.2).
i. When heating and deaerating element shall be type I or type II (see 3.8).
j. Type of water-regulating valves required, if different than that specified (see 3.10).
k. Whether valve actuators shall be mechanically, electrically, or pneumatically driven (see 3.10).
l. Valve design conditions required (see 3.10 and table II).
m. Whether float controllers shall be direct acting, or mechanically, electrically, or pneumatically actuated (see 3.11).
n. Characteristics of overflow control required (see 3.12).
o. Size of overflow piping required, if other than that shown in table III (see 3.12).
p. When thermometers shall be other than the manufacturer's standard (see 3.15).
q. When oil separator is required (see 3.16).
r. When boiler feedwater pumps with the applicable characteristics are required (see 3.17.1 and 6.1.4).
s. When condensate pumps with the applicable characteristics are required (see 3.17.2 and 6.1.4).
t. When controls are to be mounted on a single control panel or cabinet (see 3.18).
u. When control panel enclosure shall be mounted on the unit or be free standing (see 3.18).
v. When main circuit breaker is to be furnished and when main circuit breaker is to be packaged separately (see 3.18).
w. When insulation of heater is to be different and when heater is to be factory insulated (see 3.19).
x. When lifting attachments are required (see 3.20).
y. When cleaning, treatment, and painting shall be other than specified (see 3.21).
z. Color of finish paint required, if other than the manufacturer's standard color (see 3.21).
aa. When servicing and adjusting of each deaerating heater by contractor is required after installation (see 3.24).
bb. Who will perform on-site testing (see 4.5).

6.3 Supersession data. This specification replaces Military Specification MIL-H-17660D dated 18 June 1993.

6.4 Classification cross reference. Classification used in this specification (see 1.2) are identical to those found in the superseded Military Specification MIL-H-17660D.

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



6.6 Subject term (key word) listing.

Direct-contact
Dissolved oxygen
Spray-type
Tray-type

MILITARY INTERESTS:

Custodians:
Navy - YD1
Army - CE

CIVIL AGENCY COORDINATION ACTIVITY:

GSA-FSS

Preparing Activity:
Navy - YD1

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