

**INCH-POUND**

MIL-H-15787F(SH)

2 September 1988

SUPERSEDING

MIL-H-15787E(SHIPS)

10 March 1955

(See 6.8)

**MILITARY SPECIFICATION****HEATERS (TANKS), FLUID, DEAERATING, BOILER FEED WATER,  
NAVAL SHIPBOARD USE**

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

**1. SCOPE**

1.1 Scope. This specification covers deaerating feed tanks for Naval shipboard applications, surface ships only.

1.2 Classification. Deaerating feed tanks shall be of the following types as specified (see 6.2.1):

Type I - With surface (straight or U-bend tube) vent condenser.

Type II - With direct contact (spray) vent condenser.

**2. APPLICABLE DOCUMENTS****2.1 Government documents.**

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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## SPECIFICATIONS

## FEDERAL

- HH-P-151 - Packing; Rubber-Sheet, Cloth-Insert.
- QQ-N-281 - Nickel-Copper Alloy Bar, Rod, Plate, Sheet, Strip, Wire, Forgings, and Structural and Special Shaped Sections.
- QQ-N-286 - Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500).
- QQ-N-288 - Nickel-Copper Alloy and Nickel-Copper-Silicon Alloy Castings.
- PPP-B-636 - Boxes, Shipping, Fiberboard.
- PPP-F-320 - Fiberboard; Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.

## MILITARY

- MIL-P-116 - Preservation, Methods of.
- MIL-S-901 - Shock Tests, H.I. (High-Impact); Shipboard Machinery, Equipment and Systems, Requirement for.
- MIL-S-1222 - Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts.
- MIL-T-15005 - Tubes, 70-30 and 90-10 Copper Nickel Alloy, Condenser and Heat Exchanger.
- MIL-P-15024 - Plates, Tags and Bands for Identification of Equipment.
- MIL-P-15024/5 - Plates, Identification.
- MIL-C-15726 - Copper-Nickel Alloy, Rod, Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate) and Forgings.
- MIL-E-15809 - Expander, Tube, Condenser and Heat Exchangers.
- MIL-I-17244 - Indicators, Temperature, Direct-Reading, Bimetallic, (3 and 5 Inch Dial).
- MIL-G-18997 - Gauge, Pressure, Dial Indicating.
- MIL-L-19140 - Lumber and Plywood, Fire-Retardant Treated.
- MIL-I-20037 - Indicators, Sight, Liquid Level, Direct/Indirect Reading, Tubular Glass/Plastic.
- MIL-V-20065 - Valves, Angle, Pressure Relief, Naval Shipboard, for Steam Service.
- MIL-G-24696 - Gaskets, Sheet, Non-Asbestos.

## STANDARDS

## FEDERAL

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

## MILITARY

- MIL-STD-167-1 - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited).
- MIL-STD-271 - Requirements for Nondestructive Testing Methods.
- MIL-STD-278 - Welding and Casting Standard.
- MIL-STD-763 - Locking Devices.

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- MIL-STD-792 - Identification Marking Requirements for Special Purpose Components.
- MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking and Waterproofing; with Appropriate Test Methods.
- DOD-STD-1399, Section 301 - Interface Standard for Shipboard Systems, Ship Motion and Attitude. (Metric)
- MIL-STD-2073-1 - DoD Materiel Procedures for Development and Application of Packaging Requirements.

2.1.2 Other Government drawing and publication. The following other Government drawing and publication form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

DRAWING

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

- B-214 - Root Connections for Attaching Piping.

PUBLICATION

NAVSEA

- 0908-LP-000-3010 - Shock Design Criteria for Surface Ships.

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

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

- Boiler and Pressure Vessel Code, Section VIII, Division 1.

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

- A 582 - Standard Specification for Free-Machining Stainless and Heat-Resisting Steel Bars, Hot-Rolled or Cold-Finished. (DoD adopted)
- B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications. (DoD adopted)
- D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)

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

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AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)  
B16.5 - Pipe Flanges and Flanged Fittings. (DoD adopted)

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

(Nongovernment standards and other publications are normally available from the organizations which prepare or which 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 specification and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

### 3. REQUIREMENTS

3.1 First article. When specified in the contract or purchase order, a sample shall be subjected to first article inspection (see 4.4 and 6.3).

3.2 Material. Materials used in the construction of the tanks shall be as shown in table I. Under conditions of vertical shock the materials shall withstand the combined dynamic stress of weight of contained water plus design pressure.

TABLE I. Materials.

Part	Material	Specification
Tube sheets	Copper-nickel alloy	MIL-C-15726
Tubes	Copper-nickel alloy	MIL-T-15005
Shell structure including internal baffles	Nickel-copper	QQ-N-281
Spray valves and atomizing valves	Nickel-copper or Nickel-copper (K-monel) or Nickel-copper castings	QQ-N-281 QQ-N-286 QQ-N-288
Spray valve and atomizing valve stems	Nickel-copper alloy or Corrosion-resistant steel type 303 or 416	QQ-N-281 ASTM A 582
Vent condenser waterboxes	Bronze, sand castings alloy 905 or 922	ASTM B 584

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TABLE I. Materials. - Continued

Part	Material	Specification
<b>Gaskets:</b>		
For metal temperatures less than 250°F	Rubber, synthetic, class 1, grade 80	HH-P-151
For metal temperatures 250°F and greater	Non-asbestos, sheet	MIL-G-24696
<b>Bolts, studs, and nuts:</b>		
In contact with steam or water	Nickel alloys	MIL-S-1222
For other services	Nickel alloys or copper alloys	MIL-S-1222

3.2.1 Ultrasonic inspection. Nickel-copper material for the external pressure boundary of the deaerating feed tank shall be ultrasonically inspected in accordance with MIL-STD-271. Acceptance criteria shall be in accordance with QQ-N-281.

3.2.2 Welding and allied processes. Welding and allied processes shall be in accordance with MIL-STD-278.

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

3.2.4 Prohibited materials. The following materials shall not be used for service, manufacture, test or inspection of deaerating feed tanks.

- (a) Mercury (except fluorescent or mercury vapor lighting).
- (b) Carcinogenic materials.
- (c) Cadmium, magnesium or asbestos.

3.3 Connections. Location of connections shall be as specified (see 6.2.1). Root connections for attaching piping shall conform to Drawing B-214.

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3.4 Threaded parts. Threads of threaded parts shall conform to FED-STD-H28. Threaded fasteners and threaded machine elements, including setscrews, for use where continuous satisfactory operation under conditions of shock, vibration, and heat specified herein depends on maintenance of tight connections shall be secured by locking devices. Locking devices shall be in accordance with MIL-STD-763. Use of tapered pipe threads is prohibited. Cap screws are prohibited where they would be axially loaded in vertical shock, and their use discouraged wherever they would be axially loaded in shock.

3.5 Flanges. Flanges shall be of the same material as the attached piping. Flanges shall be dimensioned, drilled, and finished for use with compressed non-asbestos gaskets in accordance with ANSI B16.5.

3.6 Nozzle neck thickness. Wall thickness of nozzle necks shall be the greater of that determined for the following:

- (a) Calculations based on shell thickness requirements for internal and external pressure and temperature in accordance with ASME Boiler and Pressure Vessel Code, section VIII, division 1.
- (b) Calculations based on stresses due to the effects of attached external piping. Loadings to be as specified (see 6.2.1).

3.7 Tank life. Tank life shall be as specified (see 6.2.1). Tank life shall include a specified number of starts and stops during operating hours. Parts subject to heavy erosion shall have a tank life of a specified number of operating hours.

3.8 Tank form and material thickness. Tanks shall be as light and compact as practical, consistent with their function. Unless otherwise specified (see 6.2.1), tanks shall be cylindrical and fitted with ellipsoidal, torispherical, or hemispherical heads. Torispherical heads that have a knuckle radius less than 10 percent of the shell diameter shall have a skirt not less than 2 inches long. Structural attachments or openings shall not be located on or adjacent to the head knuckles. Unless otherwise specified (see 6.2.1), tanks shall be identical to one another, without left-hand or right-hand distinction.

3.9 Space limits. The space envelope for the tank shall be as specified (see 6.2.1).

3.10 Operating features. Operating features shall be as specified in 3.10.1 through 3.10.4.

3.10.1 Heating and deaerating. The deaerating feed tanks shall be fully enclosed and shall transfer heat from steam to water by direct contact or mixing. They shall heat the feedwater to the saturation temperature corresponding to the pressure at the top of the tank. The heated water shall be finally deaerated and distributed by positive energy operated spraying devices and shall be treated in free suspension that the deaeration is independent of ship attitude and motion within the limits specified in DOD-STD-1399, section 301, unless otherwise specified in the contract or purchase order (see 6.2.1).

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3.10.1.1 Saturated steam systems. The deaerating feed tanks shall deaerate the feedwater to the extent that the residual oxygen shall be less than 0.007 parts per million (p/m) dissolved oxygen regardless of the concentration of oxygen in the influent water or steam.

3.10.1.2 Superheated steam systems. The deaerating feed tanks shall deaerate the feedwater to the extent that the residual oxygen shall be less than 0.014 p/m dissolved oxygen, with the upper limit of oxygen concentration in the influent water dependent on processing capacity of the tank as specified below:

- (a) Tank capacity 50,000 pounds per hour (lb/hour) or less. Oxygen concentration in influent water shall be less than 2500 p/m.
- (b) Tank capacity greater than 50,000 lb/hour. Oxygen concentration in influent water shall be less than 5000 p/m.

3.10.2 Load range. The tanks shall meet performance requirements under the specified conditions (see 6.2.1) for all loads between 3 and 125 percent of full load.

3.10.3 Pressure range. Tanks shall be operated at internal pressures that range between the tank operating pressure (see 6.2.1) and an internal absolute pressure of 12 pounds per square inch (lb/in<sup>2</sup>). Tanks shall not suffer damage if subjected to an internal pressure equivalent to full vacuum.

3.10.4 Feedwater storage. Below the deaerating zone, the tank shall form a storage space for the specified amount of feedwater (see 6.2.1). This storage space shall be adequately baffled and sized to minimize swash and to prevent flash in the boiler feed pump suction under changing conditions of load, level, and pressure. The water storage space shall include features for collecting and removing corrosion products. Removal of these products shall be effected through a drain or blowdown connection in the tank bottom. The feed booster pump connection shall be located away from the center of the bottom head.

3.11 Influent from vents and drains. Deaerating feed tanks shall include internal piping and (if necessary) an external or internal flash chamber for accommodating steam and water from vents and drains. Steam from the vents and drains shall be admitted to the auxiliary exhaust steam inlet steam chest. Water from the drains shall be admitted either into the steam chest or into the condensate inlet upstream of the spray nozzles. The objects of this arrangement are that the vent steam and steam flashed from the hot drains shall be used for atomization, and that all unflashed water in the drains shall be subjected to atomization and deaeration. A trap or valve in the flash-chamber water drain line, and an orifice or needle valve in its steam vent line, shall be provided as necessary.

3.12 Discharge strainer. A strainer shall be provided over the feed discharge opening to the feed pump (or feed booster pump) suction. Strainer holes shall be small enough to prevent passage of internal parts or fastening devices into the pump suction. Total open area of the strainer shall be not less than 2.5 times the area of the pump connection.



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3.13 Access to interior. One or more manholes shall be provided in the shell for access to the tank interior. Manholes shall be large enough to permit removal of detachable internal parts. The internal condensate chamber shall have inspection and cleanout openings arranged so as to allow the entire chamber to be cleaned.

3.14 Supports. Supports, including sway braces as necessary, shall secure the unit and its components and accessories against the shock of gunfire, underwater explosion, and ship attitude and motion. A girth plate around the shell shall be provided at approximately the height of the center of mass (operating condition). Pads or brackets for attaching shipbuilder furnished foundation or support members shall be attached to the girth plate at intervals of not more than 90 degrees. Where the unit or its components or accessories are supported from vertical structures, dependence shall not be placed on bolts in shear as the primary means of support. Nozzle flanges or piping shall not constitute the means of support of components or accessories. Connections shall withstand piping loads.

3.14.1 Girth plate fatigue hazard. Configuration shall be such as to preclude fatigue failure caused by differential expansion of the shell and girth plate. Stress concentrations, as at shell penetrations, shall be eliminated or analyzed to show that they will not cause fatigue failure.

3.14.2 Shell constraint stress hazard. Constraint of the shell against thermal and pressure expansion shall be avoided. Use of internal structure that extends completely across the tank shall be avoided, unless the structure allows for differential expansion between itself and the shell.

3.15 Backflow prevention. The tank shall be provided with positive means of preventing discharge of water or steam from the tank into the auxiliary exhaust line and other influent lines to the tank.

3.16 Pressure relief and vacuum breaker. A relief valve conforming to type I, composition D, of MIL-V-20065 shall be provided of sufficient size to prevent excessive rise in shell pressure under all conditions of operation. A vacuum breaker shall be provided, set to open at a negative gauge pressure of  $2.5 \pm 0.5$  lb/in<sup>2</sup>.

3.17 Spray nozzles. Multiple internal spring-loaded water spray nozzles shall be employed to distribute incoming condensate. Failure of a pin in shear shall not cause failure of the disk or baffle arrangement on spray nozzles.

3.18 Atomizing valve (where used). Particular attention shall be given to the following during development and design of the atomizing valve and associated parts.

- (a) Stress concentrations in the stem, particularly in fillets at changes in stem diameter, shall be minimized.
- (b) Keyways shall have adequate length to prevent interference fits.
- (c) Heat treating for the stem shall ensure a sound material for the particular application.



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- (d) Piston ring material and configuration shall preclude sticking in service.
- (e) Deflection plates shall have sufficient rigidity to preclude fatigue failure due to overflexing.

3.19 Indicating instruments. Indicating instruments shall be in accordance with 3.19.1 through 3.19.3.

3.19.1 Liquid level. An indirect indicating liquid level indicator in accordance with MIL-I-20037 shall be provided to indicate the level of feedwater in the shell of the deaerating feed tank. When specified (see 6.2.1) provisions for remote reading liquid level indication shall be provided.

3.19.2 Pressure. Tank pressure indicators shall be provided that conform to MIL-G-18997, one to indicate tank pressure, and one to indicate pressure drop across the vent orifice.

3.19.3 Temperature. Tank temperature indicators shall be provided that conform to MIL-I-17244, one to indicate tank steam temperature, and one to indicate stored water temperature.

3.20 Liquid level control. Level control shall be provided by variable-leg, constant-leg reference, external or internal standpipes or by float controls as specified (see 6.2.1). Internal standpipes shall be located as near the center of the tank as practical. External or internal standpipes shall be located near the fore-and-aft centerline of the tank to minimize the effect of roll.

3.21 Manual overrides. Automatic devices shall be provided with means for manual control, which shall preempt automatic control.

3.22 Orifice plate. The contractor shall provide an orifice plate to maintain a vent steam rate of not more than 0.05 percent of rated load at design operating pressure. This orifice shall be installed with no valve in series between tank and orifice or between orifice and atmosphere. There shall, however, be a tee fitting or other branch connection in the line leading from tank to orifice plate. A larger valve, to be provided by the shipbuilder, shall be placed in a branch from this fitting for use in purging the tank during startup. Pressure gauges, to be provided with the tank, shall be mounted upstream and downstream of the orifice plate to monitor flow.

3.23 Interchangeability. In no case shall parts be physically interchangeable or reversible unless such parts are also interchangeable or reversible with regard to function, performance, and strength.

3.24 Shock resistance. Shock resistance shall be in accordance with 3.24.1 through 3.24.7.

3.24.1 Shock resistance testing. Complete tank assemblies or components that weigh 400,000 pounds or less shall withstand the shock tests as specified herein (see 4.5.3). (This weight includes the weight of the unit or component, test fixture, ancillary equipment, and fluids.) Shock tests shall be performed as specified in MIL-S-901 with the following modifications:

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- (a) Under the test procedure for medium weight equipment, the first blow in each group shall be applied using the standard horizontal mounting adapter; the second blow in each group shall be applied with the unit mounted on an adapter holding it at a 30-degree angle from the horizontal in the direction of its least transverse strength.
- (b) Shock test extensions will be considered as specified in 4.5.3.

3.24.2 Shock resistance grades. The specification of shock resistance grade depends on whether the equipment is mission essential in its intended configuration. If it is mission essential, shock grade A will be specified; otherwise, shock grade B will be specified (see 6.2.1). Equipment criteria for the two grades are as follows:

- (a) Grade A. The tank assembly, after sustaining mechanical shock, shall operate normally, and no parts of the assembly shall create a missile hazard to personnel or to other equipment; nor shall the assembly otherwise constitute a personnel hazard (as by rupture of parts containing steam or hot water, with consequent danger of scalding) at the time of the shock.
- (b) Grade B. The requirements of grade B are the same as those of grade A except that the tank assembly need not operate normally after sustaining mechanical shock.

3.24.3 Shock analysis in lieu of test. Tank assemblies that cannot be shock tested shall be dynamically analyzed in accordance with NAVSEA 0908-LP-000-3010. The air ejectors and their subbases, feet, structural members, and holddown bolts shall be included in the analysis.

3.24.4 Bolt holes for shear-stressed bolts. Unless otherwise specified in the contract or purchase order (see 6.2.1), bolts designed to be stressed in shear shall be installed in holes no greater in diameter than the following:

<u>Nominal bolt diameter</u>	<u>Maximum diameter of hole</u>
3/4 inch and smaller	Nominal bolt diameter plus 1/32 inch
Larger than 3/4 inch	Nominal bolt diameter plus 1/16 inch

3.24.5 Rigidity of support structures. Assemblies that are rigidly supported shall be attached only to structures that cannot deflect relative to one another under shock loadings.

3.24.6 Bracing. Where braces must be employed to afford stability under vibration, the braces shall fail under a force load equal to five times the weight of the unit. This load shall be considered to act at the center of mass of the unit.

3.24.7 Deflection snubbers. Where snubbers must be employed to limit deflection under shock loading, they shall be in accordance with NAVSEA 0908-LP-000-3010.

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3.25 Vibration. If specified (see 6.2.1), the tank shall be able to withstand the spectra of vibration applied at the foundation, in accordance with type I of MIL-STD-167-1. Excessive vibration is vibration that can lead to damage or malfunction of the component. Swash plates shall have a natural frequency greater than the lower limit specified, to preclude propeller-induced vibration.

3.26 Lifting means. Eyebolts, lugs, holes, or other workable means shall be provided to permit lifting the tank for installation. Lifting devices shall support twice the dry weight of the tank without causing permanent deformation. Similar lifting means shall be provided for handling parts and components that cannot be handled manually during unit overhaul or maintenance actions. Lifting devices shall be located away from head knuckles.

3.27 Thermal insulation. The tanks will be insulated by the shipbuilder, but the tanks as provided to the shipbuilder shall have features to facilitate attachment of the insulation. An acceptable means of providing attachment points for this purpose is to provide rings of clips (of the same base material as the tank shell) welded to the tank surface at the following approximate locations:

- (a) Near the top, immediately below the weld between tank head and shell.
- (b) On the side immediately above the girth plate.
- (c) On the side immediately below the girth plate.
- (d) On the bottom head close to the tank outlet.

3.28 Identification. Identification shall be in accordance with 3.28.1 and 3.28.2.

3.28.1 Nameplates. Nameplates shall be prepared in accordance with MIL-P-15024 and MIL-P-15024/5. Identification plate data shall include the following:

- (a) Name of unit, such as deaerating feed tank.
- (b) Type of unit (see 1.2).
- (c) Name of manufacturer.
- (d) Manufacturer's service part number.
- (e) Government contract number (allow full width of plate for number).
- (f) National stock number (allow 20 spaces).
- (g) Date of manufacture.
- (h) Serial number.
- (i) Blank space for Government inspector's stamp.
- (j) Blank space for unit number (to be stamped by shipbuilder).
- (k) Design pressure and temperature.
- (l) Designation "U.S." without quotation marks.

3.28.2 Identification marking. Identification marking shall be in accordance with MIL-STD-792.

3.29 Painting. The tanks shall be left unpainted.

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3.30 Type I distinctive features. Tanks of type I shall have a vent condenser composed of straight or U-tubes expanded into a tube sheet at both ends. The vent condenser shall be provided with an inlet waterbox for introduction of feedwater and with means for delivering feedwater to the spray nozzle chamber after the feedwater passes through the vent condenser tubes. Means for removal of the tubular vent condenser shall be provided.

3.30.1 Tubes. Tubes in vent condensers for tanks of type I shall be seamless drawn, 5/8-inch outside diameter, with a wall thickness of 0.049 inch. Tube spacing shall be not less than 13/16 inch, center to center. The radius of bend of U-bend tubes shall be not less than 15/16 inch. Water inlet ends of tubes shall be expanded and belled to suit holes in tube sheets as specified in 3.30.2, then faced off flush with surface of tube sheet. Water outlet ends of tubes shall be expanded. Outlet ends of tubes shall project not more than 1/16 inch beyond the tube sheet face but shall not terminate within the tube sheet. In order that tube metal shall not be overworked, tubes shall be expanded by means of an automatic tube expander control. The tube expander used shall be in accordance with MIL-E-15809, and shall be adjusted so that the depth of expansion does not extend farther than within 1/8 inch of the inner face of the tube sheet.

3.30.2 Tube sheets. Tube sheets in vent condensers for tanks of type I shall be machined to accommodate tubes expanded at both ends. Holes for expanded tubes shall be drilled and smoothly reamed to a diameter of 0.626 inch with a tolerance of plus 0.005 inch, minus 0.000 inch. Tube holes shall be rounded off on the inner (steam) side of the tube sheet to a radius of approximately 1/16 inch. At the water inlet end of tubes, on the outer (water) side of the tube sheet, tube holes shall be belled at 1/2-inch radius to a diameter of 3/4 inch. At the water outlet end of tubes, on the outer side of the tube sheet, holes shall be free from burrs. Holes for expanded tubes shall be provided with one annular groove, 0.025-inch wide, 0.007-inch deep, with the outer edge of the groove 3/8 inch from the outer (water) side of the tube sheet. Tube sheet thickness shall be not less than 3/4 inch.

3.31 Type II distinctive features. The tanks shall have a direct-contact vent condenser in which the condensing of steam prior to release of air and other noncondensables to atmosphere is accomplished by a spray of feedwater.

3.32 Drawings. When specified in the contract or order, drawings shall be prepared (see 6.2.2).

3.33 Certification data/report. When specified in the contract or order certification data/report shall be prepared (see 6.2.2).

3.34 Parts and tools. Parts and tools shall be provided as specified (see 6.4 through 6.4.3).

3.35 Workmanship. Surfaces of shell, piping, and other parts shall be smooth, clean, and free of cracks, dents, bumps, scale, other foreign matter, as revealed by visual examination. Minor imperfections such as handling marks will not be considered cause for rejection provided that the required material

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thickness is maintained (see 3.8). Spilled paint or ink (as left from stenciled or stamped administrative records) remaining in or on tank will be considered injurious. Mating parts that show evidence of having to be forced in order to match or align properly will also be considered injurious.

#### 4. QUALITY ASSURANCE PROVISIONS

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

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

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

- (a) First article inspection (see 4.4).
- (b) Quality conformance inspection (see 4.5).

4.3 Inspection conditions. Unless otherwise specified (see 6.2.1), all inspections shall be performed in accordance with the test conditions specified herein.

4.4 First article inspection. Deaerating feed tanks of a model or configuration whose performance has not been satisfactorily demonstrated in Naval shipboard service or in a previous laboratory test shall be subject to first article inspection. First article inspection shall consist of the examinations and tests specified in 4.5 plus the performance test specified in 4.4.2 and a design report as specified in 4.4.1. When specified in the contract or order, a first article inspection report shall be prepared (see 6.2.2).

4.4.1 Design report. When specified in the contract or order, a first article design report shall be prepared (see 6.2.2 and appendix).

4.4.2 Performance test. The tank shall be subjected to factory or laboratory performance tests, while operating throughout the range of 3 to 125 percent of full load rating, to demonstrate the ability of the tank to heat the feedwater to local boiling temperature and to deaerate the feedwater to the

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required residual dissolved oxygen content (see 3.10.1.1 and 3.10.1.2). When specified in the contract or order, an inspection and test report shall be prepared (see 6.2.2).

4.5 Quality conformance inspection. Each tank presented for delivery under a contract or order shall be tested to determine conformance to this specification. Requirements specified herein are listed by paragraph number in table II, along with the paragraphs in which the corresponding analysis, inspection, or test as specified.

TABLE II. Quality conformance inspection.

Inspection	Requirement	Test
Tank life (to include fatigue)	3.7	4.1
Heating and deaerating	3.10.1 through 3.10.1.2	4.4.2
Pressure range	3.10.3	4.4.2
Hydrostatic test	3.10.3	4.5.1
Compression test	3.10.3	4.5.2
Atomizing valve (if used)	3.18	4.4.2
Orifice plate	3.22	4.4.2
Shock resistance	3.24	4.5.3
Vibration	3.25	4.5.4
Lifting means	3.26	4.4.1

4.5.1 Hydrostatic test. Each tank shall be tested to a hydrostatic test pressure of 45 lb/in<sup>2</sup> at the top of the tank. A flash chamber, if provided (see 3.11) shall be tested to a hydrostatic pressure of 112 lb/in<sup>2</sup>. When specified in the contract or order, a test report shall be prepared (see 6.2.2).

4.5.2 Compression test. Each tank shall be tested to a compressive pressure test to determine whether it can withstand the stress induced by an internal pressure equivalent to full vacuum. The test shall consist of reducing the internal pressure to 1.5 lb/in<sup>2</sup> absolute and visually examining the external portions of the tank. Tanks that show evidence of distortion as a result of the test shall be deemed to have failed the compression test. When specified in the contract or order, a test report shall be prepared (see 6.2.2).

4.5.3 Shock tests. Shock tests shall be conducted as specified in 3.24 and 3.24.2 or analyzed as specified in 3.24.3. When specified in the contract or order equipment shock test reports shall be prepared (see 6.2.2). Shock test extensions will be considered by the Command or agency concerned for assemblies that are similar in design, construction, weight, and materials to units that have successfully passed the tests previously. Shock test extension requests shall be prepared in accordance with the instructions specified in MIL-S-901.

4.5.4 Vibration tests. Tanks or their components (or both) shall be tested in accordance with MIL-STD-167-1 as specified (see 6.2.1). Test acceptance criteria shall be those of MIL-STD-167-1.



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4.6 Storage of supplies. Supplies shall be stored in a dry area.

4.7 Inspection of packaging. Sample packages and packs, and the inspection of the preservation-packaging, packing and marking for shipment and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

## 5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisition. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.6.)

5.1 General.5.1.1 Navy fire-retardant requirements.

5.1.1.1 Lumber and plywood. When specified (see 6.2.1), all lumber and plywood including laminated veneer material used in shipping container and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Level A and B - Type II - weather resistant.  
Category 1 - general use.

Level C - Type I - non-weather resistant.  
Category 1 - general use.

5.1.1.2 Fiberboard. Fiberboard used in the construction of class-domestic, non-weather resistant fiberboard, and cleated fiberboard boxes shall meet the flammability and smoke requirements of PPP-F-320 and amendments thereto.

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

5.2.1 Level A and C.

5.2.1.1 Cleaning and drying. Cleaning and drying of tank surfaces, internally and externally, and tank accessories shall be by a process and procedure in accordance with MIL-P-116 which shall ensure removal of corrosion, dirt, grease, and other foreign material without damage to the item.

5.2.1.2 Heaters (tanks). Tanks shall be unit protected to meet the requirements for method III (physical and mechanical protection) of MIL-P-116. Tank openings and flange connections shall be closed off and sealed to prevent entrance of foreign material.

5.2.1.2.1 Detached parts. Assembled or disassembled piping and fittings shall be individually protected in accordance with method III of MIL-P-116, with thread protection and capping of openings to prevent contamination. Gauges and electrical items shall be individually protected in accordance with method IC of MIL-P-116, with selection of submethod at the option of the contractor. Methods



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of preservation shall be supplemented with fiberboard boxes conforming to PPP-B-636, class domestic, or encased in wrappings of equivalent material. No type of loose-fill material shall be used for cushioning, fill, stuffing, or dunnage. Fiberboard boxes shall be closed in accordance with the appendix to the box specification, method I with pressure sensitive tape.

5.2.2 Commercial. Preservation shall be in accordance with ASTM D 3951.

5.3 Packing. Packing shall be level B and C, or commercial as specified (see 6.2.1).

5.3.1 Level B and C. Each tank shall be anchored, blocked, braced and cushioned in its shipping container in accordance with MIL-STD-1186 and the applicable container specification or appendix thereto. Detached parts shall be packed and secured within a void area or areas of the tank container. Shipping containers shall be of the wood or wood cleated plywood, domestic type box construction, or wood crates of the open or closed type as specified in the exterior shipping container tables of MIL-STD-2073-1 and appendix C thereto. Boxes exceeding a gross weight of 200 pounds shall be modified with skids in accordance with the applicable box specification. Crates shall be used for tanks exceeding the weight limitation of the applicable box specification. Tanks, if shipped in open type crates, shall be provided with a flexible, reinforced, waterproof, barrier material shroud. Plastic shrouds shall be of not less than 0.006 inch thickness. Shrouds shall be secured to prevent damage or loss during handling, shipment and storage. Shipping container closure shall be in accordance with the applicable container specification or appendix thereto.

5.3.2 Commercial. Packing shall be in accordance with ASTM D 3951.

5.4 Marking. In addition to any special marking required (see 6.2.1), interior (unit) packs and shipping containers shall be marked in accordance with MIL-STD-2073-1 and appendix F thereto. Marking shall include bar coding. Containers with detached parts shall be marked to indicate the type of installation and that the detached parts are contained therein, for example, "(CONTAINS DETACHED PARTS) CONTAINER 1 of 2."

## 6. NOTES

6.1 Intended use. The tanks covered by this specification are intended for heating, storing, and deaerating boiler feedwater, and for providing a surge volume in feedwater systems in Naval surface ships. The tanks are categorized by type (I or II) according to whether they have surface (tube) vent condensers or direct contact (spray) vent condensers.

## 6.2 Ordering data.

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Type required (see 1.2).
- (c) Whether first article inspection is required (see 3.1).
- (d) Location of connections (see 3.3).

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- (e) Nozzle and external pipe loadings (see 3.6).
- (f) Tank life, in operating hours or other suitable units (see 3.7).
- (g) Tank form if other than as normally specified; and thickness, if to be specified (see 3.8).
- (h) Space envelope (see 3.9).
- (i) Full load amount of feedwater, estimated amount of drains introduced, available steam pressure and temperature, stowage capacity, and other pertinent operating data (see 3.10.1, 3.10.2, and 3.10.4).
- (j) Tank operating pressure (see 3.10.3).
- (k) Whether remote liquid level indicator is required (see 3.19.1).
- (l) Means of liquid level control (see 3.20).
- (m) Shock resistance grade (see 3.24.2).
- (n) Whether bolt holes for shear-stressed bolts are specially restricted (see 3.24.4).
- (o) Vibration requirements (see 3.25 and 4.5.4).
- (p) Unusual or special inspection conditions (see 4.3).
- (q) Whether fire-retardant wood and plywood are required (see 5.1.1.1).
- (r) Level of preservation and packing required (see 5.2 and 5.3).
- (s) Special marking required (see 5.4).
- (t) Tools required (see 6.4.3).

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

<u>Paragraph no.</u>	<u>Data requirement title</u>	<u>Applicable DID no.</u>	<u>Option</u>
3.32	Drawings, engineering and associated lists	DI-E-7031	Level 3
3.33	Certification data/report	UDI-A-23264	----
4.4	First article inspection report	DI-T-4902	----
4.4.1 and appendix	Report, design	DI-R-24039	
4.4.2, 4.5.1 and 4.5.2	Inspection and test reports	DI-T-5329	----
4.5.3	Reports, equipment shock test	UDI-T-23753	----

(Data item descriptions related to this specification and identified in section 6 will be approved and listed as such in DoD 5010.12-L., AMSDL. Copies of data item descriptions required by the contractors in connection with specific acquisition functions should be obtained from the Naval Publications and Forms Center or as directed by the contracting officer.)

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

6.2.2.2 Technical manuals. The requirement for technical manuals should be considered when this specification is applied on a contract. If technical manuals are required, military specifications and standards which have been cleared and listed in DoD 5010.12-L (AMSDL) must be listed on a separate GDRL (DD Form 1423), included as an exhibit to the contract. The technical manuals must be acquired under separate contract line item in the contract.

6.3 First article. When a first article inspection is required, the item should be a first article sample. The first article should consist of one unit. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract.

6.4 Provisioning. Provisioning Technical Documentation (PTD), spare parts, repair parts and special tools to be furnished should be specified in the contract (see 3.34).

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

6.4.2 On board repair parts. The following on board repair parts should be furnished for each tank as applicable:

	<u>Percent</u>
Relief valves	(As required by MIL-V-20065)
Vacuum breakers	100
Vacuum breaker springs	100
Sight glass indicator glasses, with packing	100
Spray nozzle assembly	10 (not fewer than two)
Spray nozzle springs	50
Check valve spring	100

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	<u>Percent</u>
Atomizing valve spring	100
Atomizing valve stem	100
Atomizing valve piston rings	100

6.4.3 Tools (on board). One of each special tool (including test fixtures for spray valves) required for maintenance or periodic test should be provided with each tank. By "special tool" is meant any tool not listed in the Federal Supply Catalog, copies of which may be consulted in any office of the Defense Contract Administration Services Management Area (DCASMA). The following additional tools should be furnished for each ship for which a tank of type I is specified (see 6.2.1).

<u>Tool</u>	<u>Quantity</u>
Tube expanders	2
Condenser tube plug (MIL-P-15742)	10
Belling tool (flaring tool)	2

6.5 Cross-reference. Navy deaerating feedwater tanks were formerly divided into four classes, A through D, according to the material of which they were constructed. With issue of this specification after 1986, class designations have been eliminated, and tanks described herein are made of basically one kind of material (see 3.2). Type designations remain (see 1.2).

6.6 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material and parts are acquired by the contractor for incorporation into the equipment and lose their separate identity when the equipment is shipped.

6.7 Subject term (key word) listing.

Deaeration  
Heat treatment  
Steam power plants

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

Preparing activity:  
Navy - SH  
(Project 4420-N057)

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## APPENDIX

## REPORT TECHNICAL CONTENT REQUIREMENTS

## 10. SCOPE

10.1 Scope. This appendix covers the technical content requirements that should be included on reports when required by the contract or order. This appendix is mandatory only when the appropriate data item description is cited on the DD Form 1423.

## 20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

## 30. REPORTS

30.1 Reports. When required by the contract or order, reports shall include the following technical justification for the deaerating feed tank and its appurtenances:

- (a) Bolt torques - Torque values for bolts and nuts shall be supported by calculations.
- (b) Lifting means - Calculations showing that the lifting devices shall support twice the dry weight of the tank without permanent deformation.
- (c) Capacity - An analysis shall be made to verify the capacity of the tank when the water level is at the dumping valve actuating point and of the makeup feed valve actuating point.
- (d) Shell and head thickness - An analysis shall be included substantiating the strength, under steady state conditions of corrosion, erosion, temperature, and pressure, for the thicknesses of the shell and head construction.
- (e) Strength calculations for the swash plates, baffle, nozzle ring and atomizing valve (if used) structural attachments to the tank shell.
- (f) Baffles and plates - An analysis to ensure preclusion of failure from erosion or forces exerted by impingement of condensate and exhaust steam.
- (g) Tank foundation - An analysis to establish the integrity of the tank integral support designs.
- (h) Atomizing valve (if used) - An analysis showing how the following faults shall be prevented:
  - (1) Stress concentrations in valve stems particularly in the fillets at changes in stem diameter.
  - (2) Interference fit in keyways due to inadequate length.
  - (3) Defective stem material due to improper heat treating.
  - (4) Prevention of piston sticking.
  - (5) Resistance to fatigue of deflection plates.

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- (i) Spray nozzle - Design of disk or baffle arrangement for distributing the water shall be substantiated by an analysis.
- (j) Swash plates - Vibration analysis of the swash plate construction to ensure that the natural frequency shall be above the level required to preclude excitation by propeller vibration.
- (k) Relief valve and vacuum breaker - Design analysis ensuring the relief valve and vacuum breaker capacities at the set pressures.
- (l) Vent condensing section - Analysis substantiating that the vent condensing section is designed for the most efficient operation.
- (m) Shock and vibration - Stress calculations shall be provided for equipment that cannot be tested.
- (n) Weight and volume - Calculations shall be provided.
- (o) Center of mass - Calculations shall be provided.
- (p) Pressure boundary penetrations - An analysis showing how the threat of discontinuity stresses at pressure boundary penetrations is avoided.
- (q) Fatigue adequacy - Calculations substantiating fatigue adequacy for the required number of startup and shutdown cycles.
- (r) Calculations verifying pressure drop from the strainer inlet at the bottom of the tank to the pump suction flange.

**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (**DO NOT STAPLE**), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

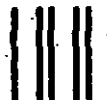
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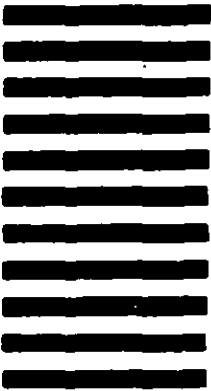
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## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-H-15787F(SH)		2. DOCUMENT TITLE HEATERS (TANKS), FLUID, DEAERATING, BOILER FEED WATER, NAVAL SHIPBOARD USE	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one): <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER (Specify): _____	
b. ADDRESS (Street, City, State, ZIP Code)			
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		8. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		9. DATE OF SUBMISSION (YYMMDD)	

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