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FEDERAL SPECIFICATION

TANKS, POTABLE HOT WATER STORAGE

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 potable hot water storage tanks.

1.2 Classification. The tanks shall be of the following types, classes, styles, sizes, and capacities, as specified (see 6.2):

- Type II - Cement or siliceous lined steel.
- Type III - Copper-silicon alloy.
- Type IV - Glass-lined steel.
- Type VI - Copper-lined steel.
- Type VII - Nickel-copper alloy.
- Type VIII - Copper tank.
- Type IX - Stainless steel.
- Type X - Copper-nickel alloy.
- Type XI - Electroless nickel plated steel overcoated with fluorocarbon-based polymer.
- Type XII - Steel overcoated with fluorocarbon-based polymer.

Beneficial comments, recommendations, additions, deletions, clarifications, etc. and any data which may improve this document should be sent to: Commanding Officer (Code 1581), Naval Construction Battalion Center, Port Hueneme, CA 93043-4301, by using the Standardization Documents Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 4520

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

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- Class 1 - 85 pounds per square inch gage (psig) (5.9 kilograms force per square centimetre (kgf/cm²) working pressure.
 - Class 2 - 100 psig (7 kgf/cm²) working pressure.
 - Class 3 - 125 psig (9 kgf/cm²) working pressure.
 - Class 4 - 150 psig (10 kgf/cm²) working pressure.
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- Style A - Horizontal.
 - Style B - Vertical.

Size and capacity (see 3.9).

2. APPLICABLE DOCUMENTS

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

Federal Standard

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

Military Standards

- MIL-STD-130 - Identification Marking of US Military Property.
- MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking, and Waterproofing; with Appropriate Test Methods.

(Copies of federal and military standards required by contractors in connection with specific procurement functions are obtained from the Defense Automation Printing Service, ATTN: DODSSP, Building 4D, 700 Robbins Avenue, Philadelphia. PA 19111-5094.)

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

AMERICAN IRON AND STEEL INSTITUTE (AISI)

- Steel Products Manual - AISI Sheet Steel.

(Private sector and civil agencies may purchase copies of these voluntary standards from the American Iron and Steel Institute, 150 East 42nd Street, New York, NY 10017.)

AMERICAN NATIONAL STANDARDS INSTITUTE, INC. (ANSI)

- ANSI - Z1.4 Procedures, Sampling and Tables for Inspection by Attributes.

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

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code, Section IV - Rules for Construction of Heating Boilers.

Boiler and Pressure Vessel Code, Section IX - Welding Qualifications.

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

ASTM

- ASTM A240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Fusion-Welded Unfired Pressure Vessels.
- ASTM B96 - Standard Specification for Copper-Silicon Alloy Plate and Sheet for Pressure Vessels.
- ASTM B107 - Standard Specification for Magnesium-Alloy Extruded Bars, Rods, Shapes, Tubes, and Wire.
- ASTM B122 - Standard Specification for Copper-Nickel-Tin Alloy, Copper-Nickel-Zinc Alloy (Nickel Silver), and Copper-Nickel Alloy Plate, Sheet, Strip, and Rolled Bar.
- ASTM B127 - Standard Specification for Nickel-Copper Alloy (UNS N04400) Plate, Sheet and Strip.
- ASTM B152 - Standard Specification for Copper Sheet, Strip, and Rolled Bar.
- ASTM B607 - Standard Specification for Autocatalytic Nickel Boron Coatings for Engineering Use.
- ASTM C150 - Standard Specification for Portland Cement

(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.)

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AMERICAN WELDING SOCIETY (AWS)

AWS D1.1 - Structural Welding Code, Section 5, Qualifications.

(Private sector and civil agencies may purchase copies of these voluntary standards from the American Welding Society, 550 N.W. LeJeune Rd, Miami, FL 33126.)

(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 Automation Printing Service, ATTN: DODSSP, Building 4D, 700 Robbins Avenue, Philadelphia, PA, 19111-5094.)

3. REQUIREMENTS

3.1 Description. The tanks shall be of the specified type, class, style and size (see 1.2, 3.1.1, 3.1.2, 3.9 and 6.2), and shall consist of welded cylindrical shells provided with heads, tappings and openings.

3.1.1 Style A, horizontal. Unless otherwise specified (see 6.2), the tank shall be fabricated with plus heads.

3.1.2 Style B, vertical. Unless otherwise specified (see 6.2), the tank shall be fabricated with a plus bottomhead.

3.2 Standard commercial product. The tanks 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 tanks being furnished. A standard commercial product is a product which has been sold or is currently for sale on the commercial market through advertisements or manufacturer's catalogs, or brochures, and represents the latest production model.

3.3 First article (preproduction model(s)). When specified (see 6.2), a sample shall be subjected to first article inspection in accordance with 4.3.

3.4 Code compliance. The hot water storage tanks shall be constructed, tested, and marked in accordance with the applicable requirements of ASME Boiler and Pressure Vessel Code, Section IV, Rules for Construction of Heating Boilers, and as specified herein. The presence of the ASME Official Code HLW-symbol stamped or marked on the tank and the furnishing of a copy of the applicable ASME REQUIRED Manufacturers' Master Data Report will be accepted as evidence that the tanks conform to the ASME Rules for Construction of Heating Boilers.

3.5 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

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covered by this specification are to be new and fabricated using materials produced from recovered materials to the maximum extent possible without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. Unless otherwise specified, none of the above shall be interpreted to mean that the use of used or rebuilt products are allowed under this specification.

3.5.1 **Steel.** Steel for fabrication of the water storage tank shall be of the type recommended in the ASME Boiler and Pressure Vessel Code or AISI Steel Products Manual as suitable for storage of service hot water of temperatures as high as 200 degrees Fahrenheit (°F) (93.33 degrees Celsius (°C)). The steel shall also be suitable for application of lining material. Tanks with glass linings shall be fabricated of commercial quality sheet or plate, chemically constituted and processed to adapt the steel for application of glass linings. Steel tanks shall be constructed of sheet steel with welded seams. Tanks constructed for U-tube insertion type heating elements using steam or hot water as a heating medium shall be equipped with a neck and a heating element support. The neck for U-tube insertion shall be constructed of the same material as the tank. For types II, III, IV, VI, XI, and XII tanks, the heating element supports shall be constructed of copper-silicon. For types VII, VIII, IX, and X, the heating element supports shall be constructed of the same material as the tank.

3.6 **Safety.** Nonfunctional sharp edges, projecting points, welding burrs, and protruding lengths more than two full threads of tappings, handhole or manhole yokes, or fastening devices shall be avoided. Materials in contact with potable water shall be nontoxic, and shall not impart odor, color, or taste to the contained water.

3.7 **Tappings and openings.** Unless otherwise specified (see 6.2), tappings and openings shall be provided in the tanks, except that the location of the tappings in the top of the horizontal glass-lined tanks may be located where necessary to eliminate interference with the magnesium anodic rod. The tappings shall have tapered pipe threads conforming to FED-STD-H28 and shall be equipped with plugs or caps of the same material alloy as the tapping itself. Manhole and handhole openings shall be equipped with pressure-type, yoked, covers and gasketed rims. Tappings and fittings for cement/siliceous-lined, glass-lined, and fluorocarbon based polymer overcoated tanks shall be of the same base material as the tank, with all surfaces exposed to storage water protected with the same lining/coating as the tank. Fittings and tappings for copper and copper-lined tanks shall be brass, copper-silicon, or tin or brass-plated steel. For copper-silicon tanks the tappings and fittings shall be of the same material as the tank. For copper-nickel, nickel-copper, and stainless-steel tanks, the tappings and fittings shall be copper-silicon stainless steel or the same material as the tank.

3.8 **Tank supports.** Tank supports shall be the manufacturer's standard supports. Angle legs and base rings shall be welded to the storage tank before shipment. Cradles for horizontal tanks shall be shipped loose. When specified (see 6.2), threaded bosses for pipe legs shall be provided on the supports.

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3.9 Sizes and capacities. The diameters, overall lengths, and rated capacities shall be as shown in tables I and II. The storage capacity of each tank shall be within plus or minus 5 percent of rated capacity.

TABLE I . Sizes and capacities ,U.S. gallons, (litre) of type II, III, VI, VII, VIII, IX, and X tanks.

Overall Tank Length inch max. (mm max.)	Outside diameter of shell inches max. (mm max.)										
	24 (609)	30 (762)	36 (914)	42 (1067)	48 (1219)	54 (1372)	60 (1524)	66 (1676)	72 (1829)	84 (2134)	96 (2438)
48 (1219)	84 (318)	127 (481)	-	-	-	-	-	-	-	-	-
60 (1524)	107 (405)	163 (617)	232 (878)	-	-	-	-	-	-	-	-
72 (1829)	130 (492)	199 (753)	284 (1075)	379 (1435)	490 (1855)	-	-	-	-	-	-
84 (2134)	153 (579)	235 (890)	335 (1268)	450 (1703)	-	-	-	-	-	-	-
96 (2438)	176 (666)	270 (1022)	387 (1465)	575 (2177)	675 (2555)	844 (3195)	1030 (3899)	1281 (4849)	-	-	-
108 (2743)	-	306 (1158)	439 (1662)	591 (2237)	765 (2896)	-	-	-	-	-	-
120 (3048)	222 (840)	342 (1295)	490 (1855)	661 (2502)	860 (3255)	1077 (4077)	1320 (4997)	1632 (6178)	1864 (7056)	2490 (9426)	3193 (12 087)
144 (3658)	-	-	594 (2249)	802 (3036)	1045 (3956)	1311 (4963)	1609 (6091)	1983 (7506)	2281 (8634)	3038 (11 500)	3935 (14 896)
168 (4267)	-	-	697 (2638)	943 (3570)	1230 (4656)	1546 (5852)	1899 (7188)	2334 (8835)	2699 (10 217)	3626 (13 726)	4677 (17 704)
192 (4877)	-	-	-	1084 (4103)	1415 (5356)	1780 (6738)	2188 (8282)	2685 (10 164)	3116 (11 795)	4195 (15 880)	5419 (20 513)
216 (5486)	-	-	-	-	1600 (6057)	2014 (7624)	2478 (9380)	3036 (11 492)	3533 (13 374)	4763 (18 030)	6162 (23 326)
240 (6096)	-	-	-	-	-	2248 (8510)	2768 (10 478)	3387 (12 821)	3950 (14 952)	5331 (20 180)	6904 (26 134)
264 (6706)	-	-	-	-	-	-	-	-	-	5899 (22 330)	7646 (28 943)
288 (7315)	-	-	-	-	-	-	3347 (12 670)	4089 (15 479)	4784 (18 109)	6467 (24 480)	8388 (31 752)
312 (7925)	-	-	-	-	-	-	-	-	-	7035 (26 630)	9131 (34 564)
336 (8534)	-	-	-	-	-	-	-	-	-	7603 (28 780)	9873 (37 373)
360 (9144)	-	-	-	-	-	-	4215 (15 955)	5141 (19 461)	6036 (22 849)	8171 (30 981)	10615 (40 182)
384 (9754)	-	-	-	-	-	-	-	-	-	-	11357 (42 991)
408 (10 363)	-	-	-	-	-	-	-	-	-	-	12100 (45 803)

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TABLE II. Sizes and capacities of type IV, XI and XII tanks.

Capacity		Inside diameter (maximum)		Tank length (maximum)	
<u>U. S. Gallons</u>	<u>Litre</u>	<u>Inches</u>	<u>Metric</u>	<u>Inches</u>	<u>Metric</u>
80	303	20.0	508 mm	65.25	1 657 mm
140	530	24.5	622 mm	77.50	1 966 mm
200	757	30.0	762 mm	78.00	1 981 mm
350	1 325	36.0	9 144 mm	95.00	2 413 mm
500	1 893	42.0	1 066 mm	81.00	2 057 mm
750	2 839	48.0	1 219 mm	97.00	2 464 mm
1000	3 785	54.0	1 371 mm	99.00	2 515 mm

3.10 Identification marking. When specified (see 6.2) each tank shall be identified in accordance with MIL-STD-130. Normally the manufacturer's standard commercial marking are acceptable.

3.11 Cleaning, treatment, and painting. Surfaces normally painted in good commercial practice shall be cleaned, treated, and painted as specified herein. The color of the finish coat shall be as specified (see 6.2). Surfaces to be painted shall be cleaned and dried to ensure that they are free from contaminants such as oil, grease, welding slag and splatter, loose mil scale, water, dirt, corrosion product, or any other contaminating substances. As soon as practicable after cleaning and before any corrosion product or other contamination can result, the surfaces shall be prepared or treated to ensure the adhesion of the coating system. The painting shall consist of at least one coat of primer and one finish coat. The primer shall be applied to a clean, dry surface as soon as practicable after cleaning and treating. Painting shall be with manufacturer's current materials according to manufacturer's current processes and the total dry film thickness shall be not less than 2.5 mils over the entire surface. The paint shall be free from runs, sags, orange peel, or other defects.

3.12 Tank preparation. When a lined tank is specified (see 1.2 and 6.2), interior surfaces of tanks shall be cleaned prior to the application of the linings. The interior surfaces of tanks, including welds, manhole and handhole covers when applicable, shall be prepared for coating by sand blasting, grit blasting or by pickling in an acid bath. When specified (see 6.2 and 6.5), for tanks scheduled to receive cement or siliceous lining, wire brushing and hand scraping may be employed.

3.13 Type II, cement or siliceous lined steel tanks.

3.13.1 Cement lining. Unless otherwise specified (see 6.2), the cement lining shall be a low-soluble hydraulic cement lining material containing not more than 35 percent calcium oxide and not less than 25 percent silica. The remaining dry aggregate shall be cement conforming to

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ASTM C150, type optional. The lining material shall be applied in one or two coats. Both coats shall be applied the same day. The lining material shall be cured and shall adhere firmly to and cover the interior of the tank. The joint between lining and tank at the tappings shall be sealed to prevent corrosion in back of the lining.

3.13.2 Siliceous lining. Unless otherwise specified (see 6.2), siliceous lining shall be composed of commercial grade silica aggregate of 100-mesh and 325-mesh particle size, a cementitious binder material, calcium hydroxide, water repellents, and hygroscopic salts. The materials shall not contaminate hot or cold water with odors or toxic matter and shall contain no greases, resins, stearates, stearic acid derivative, sand, mica, or pumice. Materials that will deteriorate when continually immersed in hot or cold potable water under the normal pressures maintained in public utilities shall not be used. The lining material shall be applied in two coats to steel tank surfaces with a stiff brush, trowels, or other hand tools. The lining material shall be cured and shall adhere firmly to and cover the interior of the tank. The joint between lining and tank at the tappings shall be sealed to prevent corrosion in back of the lining.

3.14 Type III, copper-silicon alloy tanks. The copper-silicon alloy tanks shall be fabricated of material conforming to ASTM B96, Copper Alloy UNS No. C65500.

3.15 Type IV, glass-lined steel tank. Glass lining formulation shall contain not less than 70 percent of refractory oxides such as silicon oxide, aluminum oxide, calcium oxide, magnesium oxide, titanium oxide, or zirconium oxide. The glass lining shall be fused to the steel base by firing at not less than 1500 °F (815.56 °C). The glass lining shall be continuous over the entire interior surface of the tank including handhole and manhole covers when applicable. The lining may be applied with a primer coat. The type IV tanks shall conform to the following requirements:

- a. Thickness. The thickness of the glass lining shall be not less than 0.006-inch (0.152 mm) and not greater than 0.020-inch (0.508 mm).
- b. Discontinuities. Discontinuities shall be not less than 0.025 square inch per square foot (173 square centimetre per square metre) of internal surface, excluding edges, fittings and welded areas, after applying the glass lining. No single defect shall be greater than 0.125-inch (6 mm) in diameter.
- c. Edges and fittings. All edges and fittings shall be coated with glass lining. Where sharp edges cannot be avoided, a slight “burn-off” of the lining that does not extend more than 0.062-inch (1.575 mm) back from the sharp edge will be allowed. All fittings that are welded to the tank shall be coated with the lining on those areas that are exposed to the water except for threads and small areas immediately adjacent to them.
- d. Welds. Removal of the glass lining due to welding or mating of parts after glass lining shall not result in exposed base metal in excess of 0.025 square inch per gallon (4.2 square mm per litre) of storage capacity.

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- e. Glass lining solubility. The weight loss of the glass lining shall be not greater than 0.231 grains per square inch (0.023 milligrams per square mm).

3.16 Type VI, copper-lined steel tank. Copper lining shall be continuous over entire interior surface of the tank. All seams in the lining shall be welded to form solid, permanent joints between the copper sheets as well as the tank steel. The copper lining shall be welded to extra heavy copper silicon reinforcements at all threaded opening which in turn shall be welded to the steel shell. The manhole or handhold covers shall be solid bronze. When specified (see 6.2), the area between the shell and lining shall retain a vacuum of 6 inches mercury (Hg) (150 mm Hg) for a period of 12 hours. After the 12-hour period, the vacuum tapping shall be sealed while retaining the 6-inches Hg (150 mm Hg) between the shell and lining. Material for copper lining shall be copper sheet, hot-rolled, conforming to ASTM B152, Alloy UNS No. C10200, C10400, C10500, C10700, C12200, or C12300.

3.17 Type VII, nickel-copper alloy tank. Nickel-copper alloy shall conform to ASTM B127, Alloy UNS No. N04400.

3.18 Type VIII, copper tank. Copper shall conform to ASTM B152, cold-rolled, Temper H00, UNS Alloy C10200, C10400, C10500, C10700, C12200 or C12300.

3.19 Type IX, stainless steel tank. Stainless steel shall conform to ASTM A240, No. 1 finish, composition UNS 30400, 30403, 31600, S31603, or S43035.

3.20 Type X, copper-nickel alloy tank. Copper-nickel alloy shall conform to ASTM B122, alloy UNS C70600, Temper 0S035.

3.21 Type XI - electroless nickel-plated steel overcoated with fluorocarbon based polymer. The steel tank shall be internally electroless-nickel-coated as specified ASTM B607. After complete fabrication, the tank shall be lined over the electroless nickel with three separate applications of polymerized fluorocarbon with individual curing cycles.

3.22 Type XII -steel overcoated with fluorocarbon based polymer. The steel tank, after complete fabrication, shall be lined with three separate applications of polymerized fluorocarbon with individual curing cycles.

3.23 Cathodic protection. Unless otherwise specified (see 6.2), type IV heater shall be provided with magnesium anodes for cathodic protection. The anode shall be located so as to ensure protection to all interior parts of the vessel. An electrical connection shall be established and maintained between the anode and the metal tank (heater) shell. Anode or anodes shall be located in a vertical position and shall extend to within 4 inches (100 mm) of the bottom of the tank.

3.23.1 Magnesium anode. The magnesium anode shall be fabricated from material conforming to ASTM B107. Shapes of anodes shall be as applicable, and anodes shall be reinforced with steel wire.

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3.23.2 Other anodes. The tank (heater) wall potential for any anode used shall not be more positive than -0.85 volts.

3.24 Workmanship. The general construction and assembly of the hot water storage tank shall be of a neat and workman-like character with parts well fitted and bolts and other fasteners correctly torqued to give rigidity.

3.24.1 Castings and forgings. All parts, components, and assemblies of the tank which include castings and forgings shall be clean of harmful extraneous material such as sand, dirt, pits, spurs, scale, and flux. Rework shall be limited to procedures which do not reduce strength or affect function.

3.24.2 Metal fabrication. Flame cutting, using tips suitable for the thickness of the steel may be employed instead of shearing and sawing. All bends shall be made with controlled means to ensure uniformity of size and shape. Corners shall be square and true. Precaution shall be taken to avoid overheating. Heated steel shall be allowed to cool slowly. External surfaces shall be free of burrs, sharp edges and corners, except when sharp edges or corners are required or where they are not detrimental to safety.

3.24.3 Welding. The surfaces of parts to be welded shall be free from rust, scale, paint, grease, mill scale and other foreign matter that can be removed by chipping and wire brushing. Welds shall transmit stress without permanent deformation or failure when the parts connected by the welds are subjected to proof and service loading. Parent materials, weld filler metals, and fabrication techniques shall be as required to enable the tank to conform to the examination and test requirements specified in section 4. Parts to be joined by fillet welds shall be brought into as close contact as possible and in no event shall be separated by more than 0.187-inch (4.750 mm), unless appropriate bridging techniques are used. Unless otherwise specified (see 6.2), the welding process used in fabrication of the tanks shall be at the option of the contractor.

3.24.3.1 Welders. Any welder assigned to manual welding work covered by this specification shall be certified by the contractor to the contracting officer that the welder has passed qualification tests as prescribed by either of the following listed codes for the type of welding operations to be performed and that such qualification is effective as defined by the particular code:

AWS D1.1 Structural Welding Code, Section 5, Qualification.

ASME Boiler and Pressure Vessel Code, Section IX, Welding Qualifications.

Contractors who only make horizontal welds need not qualify welders for "all position welding." Subject to approval by the Government, contractor's standard welder qualification may be substituted in lieu of the above codes provided that the contractor procedure is equivalent to the above codes. The contractor shall be responsible for determining that automatic welder equipment operators are capable of producing quality welds.

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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 assure supplies and services conform to prescribed requirements.

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

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

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

- a. Preproduction inspection (see 4.3).
- b. Quality conformance inspection (see 4.4).
- c. Inspection of packaging (see 4.6).

4.3 Preproduction inspection.

4.3.1 Examination. The preproduction tank shall be examined as specified in 4.5. Presence of one or more defects shall be cause for rejection.

4.3.2 Tests. The tank shall be tested as specified in table III. Failure of any test shall be cause for rejection.

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TABLE III. Test schedule.

Type of inspection		Examination or test	Type of tank	Inspection paragraph	Requirement paragraph
Preproduction	Quality Conformance				
1	2	3	4	5	6
X	-	Capacity test	All	4.6.1	3.9
X	-	Cement/siliceous lining thickness test	II	4.6.2	3.13.1 3.13.2
X	-	Cement/siliceous lining absorption test	II	4.6.3	3.13.1
X	-	Organic materials test	II	4.6.4.1	3.13.2
X	-	Stearates or stearic acid derivatives test	II	4.6.4.2	3.13.2
X	-	Hygroscopic salts tests	II	4.6.4.3	3.13.2
X	-	Solubility in carbon dioxide test	II	4.6.4.4	3.13.2
X	-	Saline resistance test	II	4.6.4.5	3.13.2
X	-	Glass lining tests	IV	4.6.5	3.15
X	X	Copper lining tests	VI	4.6.6	3.16
X	-	Electroless nickel-plated steel overcoated with fluorocarbon-based	XI	4.6.7	3.21
X	-	Steel overcoated with fluorocarbon-based polymerized lining tests	XII	4.6.8	3.22
X	-	Cathodic protection test	II IV	4.6.10	3.23

4.4 Quality conformance inspection. The quality conformance inspection shall include the examination of 4.5, the tests of 4.6, and the packaging inspection of 4.7. This inspection shall be performed on the samples selected in accordance with 4.3.

4.5 Examination. Each tank 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.

4.6 Tests. Each distillation unit shall be tested as specified in 4.3.1. The first article unit shall be tested as specified in 4.3.1. Failure to pass any test shall be cause for rejection of a unit.

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4.6.1 Capacity. If tank dimensions are different from those specified in tables I and II, determine the storage capacity of the tank by weighing the empty tank and then fill the tank with water and reweigh. Convert the liquid capacity of the tank to U.S. gallons or liters. Nonconformance to the capacity rating specified shall constitute failure of this test.

4.6.2 Cement and siliceous lining thickness. Determine the thickness of the lining by spear measurements with a hardness steel point not larger than 0.063-inch (1.600 mm) in diameter. Take not less than three measurements at random locations immediately after application of each coat and before the lining has set. Nonconformance of any measurement to 3.13.1 or 3.13.2 shall constitute failure of this test.

4.6.3 Cement and siliceous lining absorption. Determine the water absorption of lining materials by immersing dry specimens of the materials in water and comparing the weights of the specimens before and after the immersion. The test specimens shall be approximately 4-inch (100 mm) squares of clean, dry tank steel lined on one side with cement or siliceous lined that is identical in mix, thickness, method of application, and curing process to the linings used. Determine and record the weight of each steel square before the lining is applied. Determine the dry weight of the lining material as follows: heat the lined test specimens at a temperature of not less than 230 °F (110 °C) for a period of not less than 2 hours, cool to room temperature, and weigh. The difference between the weights of corresponding unlined steel squares and the heated specimens is the dry weight of the lining material. Determine the water absorption of the lining in the following manner. Immediately after heating and weighing, immerse the test specimens for a period of not less than 5 hours in distilled water that is maintained at a temperature of 180 °F to 190 °F (82.22 °C to 87.78 °C). At the end of this period, cool the specimens in water to room temperature, remove from the water, wipe dry, and immediately weigh. The difference between the weights of the test specimens before and after immersion is the weight of the water absorbed and shall be reported as a percentage of the dry weight of the lining material. Use the mean value of not less than two specimens to determine the weight of the water absorbed. A water absorption of more than 17 percent of the dry weight shall constitute failure of this test.

4.6.4 Siliceous lining materials.

4.6.4.1 Organic materials. Prepare a specimen of materials, and after mixing, let stand for 5 minutes. Remix the specimen and trowel on bright tinned plate. Allow to dry 2 hours at room temperature. Bonding of material to the tinned plate indicates the presence of organic binder and shall constitute failure of this test.

4.6.4.2 Stearates or stearic acid derivatives. Place 3.38 fluid ounces (100 millilitre (mL)) of the dry material in a 8.45 fluid ounce (250 mL) beaker and add an equal amount of water. Do not stir the mixture. The powder should repel the wetting action of the water for 5 seconds. Then mix the powder and water and let stand for a period of 10 minutes. Any formation of scum floating on the surface indicates the presence of stearates or stearic acid derivatives and shall constitute failure of this test.

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4.6.4.3 Hygroscopic salts. Mix 0.070 ounces (2 grams) of the materials with 0.675 fluid ounces (20 mL) of water and allow to stand for a period of 30 minutes. Filter the supernatant liquid and make slightly acid with nitric acid (1:5). Add 1.69 fluid ounces (5 mL) of silver nitrate. Any evidence of a white precipitate (silver chloride) indicates the presence of chloride and shall constitute failure of this test.

4.6.4.4 Solubility in carbon dioxide. Determine the loss of weight of materials by immersing cured specimens in a carbon dioxide solution and comparing the weights of the specimens before and after the immersion. Mix specimens of powdered material to a workable consistency and cast in 2-inch by 3-inch by 0.5-inch (50 mm by 80 mm by 15 mm) molds (a total of six molds). Remove test specimens from molds and cure at room temperature and a relative humidity of 95 percent plus or minus 2 percent for a period of 12 hours. After completion of the 12-hour curing period, immerse the test specimens in tap water at room temperature then increase temperature of water to 140 °F ±5 °F (60 °C ±2.78 °C) and maintain this temperature for a period of 4 hours. After completion of the 4-hour curing period, remove the test specimens and immerse in tap water at room temperature for a period of 24 hours. After the test specimens have been cured, remove specimens from the curing water, wipe surfaces with a clean damp cloth, and weigh immediately to the nearest 0.0003 ounce (0.01 grams). Immerse test specimens in a closed vessel containing tap water saturated with carbon dioxide. Raise temperature of water to 200 °F ± 5 (93.33 °C ± 2.78 °C) and maintain this condition for a period of 72 hours. Care should be taken to resaturate the water with carbon dioxide every 12 hours. After completion of the 72-hour soaking period, remove the test specimens from the solution, wipe with a damp cloth, and weigh immediately. This shall constitute one test cycle. Repeat the test for an additional two cycles for a total of three cycles. Calculate the weight loss utilizing the following formula:

$$W_L = \frac{W_S - W_A}{W_S} \times 100$$

where:

W_L = Weight loss, percentage by weight.

W_S = Weight before saturation in carbon dioxide for 72 hours.

W_A = Weight after saturation in carbon dioxide for 72 hours.

Use the mean value of not less than two specimens to determine the weight loss. The following shall constitute failure of this test:

- a. Weight loss in excess of 3.0 percent after the first cycle.
- b. A total weight loss in excess of 4.0 percent after the second cycle.
- c. Any weight loss after the third cycle.

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4.6.4.5 Saline resistance. Test specimens of the material after being mixed, cast, cured as specified in 4.6.4.4, and of the same quantity, shall be used in this test. Remove test specimens from curing water and wipe surfaces with a clean damp cloth and weigh. Immerse test specimens in a closed vessel containing sea water. Raise temperature of the water to $195^{\circ}\text{F} \pm 54^{\circ}\text{F}$ ($90.56^{\circ}\text{C} \pm 12.22^{\circ}\text{C}$) and maintain this condition for a period of 72 hours, reweigh specimens. Calculate the weight loss utilizing the formula specified in 4.6.4.4. Use the mean value of not less than two specimens to determine the weight loss. A weight loss in excess of greater than 3.0 percent shall constitute failure of this test.

4.6.5 Glass lining tests. Type IV glass (porcelain enamel) linings shall be inspected and tested as follows for coverage, thickness, and solubility. Upon approval of the contracting officer, the manufacturer may furnish a certification of compliance as part of the first article. The certification shall provide data necessary to evaluate compliance with the coverage, thickness, and solubility requirements of 3.15. Nonconformance with 3.15 shall constitute failure of this test.

4.6.5.1 Lining coverage. A glass lined tank that has not been subjected to test pressure greater than 150 pounds per square inch gage (psig) (10 kgf/cm^2) shall be cut into four or more segments using a band saw, bayonet saw, or other suitable mechanical cutting device. Each segment shall be visually inspected for the presence of areas of exposed metals except that cracked and spalled areas of lining caused by the cutting operation shall not be considered. Exposed areas of metal shall be measured with a low powered microscope with a calibrated eyepiece. Nonconformance to 3.15(b) and 3.15(c) shall constitute failure of this test.

4.6.5.2 Thickness of glass lining. Thickness measurements shall be taken at not less than 10 representative points on the shell and heads of the tank using a calibrated magnetic or similar thickness gage. Nonconformance to 3.15(a) shall constitute failure of this test.

4.6.5.3 Solubility of glass lining.

- a. Apparatus. The cylinder assembly shall be constructed of 16 gage, type 304 stainless steel; the ends shall be ground so as to conform with the curvature of the tank to be tested. The gaskets shall be made of neoprene rubber. The cell shall be heated with a small gas burner or a small electric heater placed immediately below the cylinder assembly midway between the ends.
- b. Test specimens. The test specimens for this test shall consist of four 3.5-inch by 3.5-inch (88 mm by 88 mm) sections cut from the outer wall (not the center flue) of the tank approximately midway between the ends.
- c. Preparation of specimens. The specimens shall be buffed with a rubbing stone or suitable abrasive paper around the entire perimeter of the panel to completely remove rough edges and glass lining fragments. The specimens shall then be scrubbed on both sides using a nylon brush and a mildly abrasive detergent cleaner powder, rinsed with distilled water, dried for 1 hour in a drying oven at 225°F (107.22°C) and placed in a desiccator while hot.

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- d. Initial weight measurements. The specimens, after cooling to room temperature, shall be weighed to the closest 0.002 grain (0.1 milligram).
- e. Calibration of test cell. Because of small variations in cell dimensions and configuration, each test cell must be calibrated before it is used. The procedure is as follows:
 - (1) Assemble the cell as it is to be operated.
 - (2) Fill with water to just below where the condenser tube is welded into the cylinder.
 - (3) Adjust the input of the heat source to give a slow, rolling boil. If water rises in the condenser, remove small amounts of water until the boil will operate without surging.
 - (4) Remove from the heat and check to see if water level is completely covering the panels.
 - (5) Cool to room temperature, then measure the volume of water contained in the cell.
 - (6) Record this volume in the cell and use this amount of test solution in all subsequent tests.
- f. Test solution. The test solution used for each exposure cycle shall consist of 6.17 grains (400 milligrams) of reagent grade sodium bicarbonate dissolved in 0.264 gallons (1 L) of distilled water.
- g. Test procedure.
 - (1) Assemble the test cell using weighed specimens from the same tank on each end of the test cell.
 - (2) Pour the correct volume of test solution into the cell.
 - (3) Adjust the input of the heater to give a consistent slow, rolling boil.
 - (4) After 18 hours boil time, dismantle the cell and discard the used test solution.
 - (5) Clean the specimens using a soft cloth wetted with a solution of 1 percent trisodium phosphate to remove loosely adhering deposits, wipe dry, and store in desiccator between solution treatment.

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(6) After 8 cycles of 18 hours each, clean specimens as above, rinse with distilled water, and dry at 225 °F (107.22 °C) for 1 hour. Place the specimens in a desiccator while hot and after cooling to room temperature, weigh to the closest 0.002 grain (0.1 milligram).

- h. Calculation of results. The exposed areas of each specimen shall be calculated from the average diameter of the test spot, pressured to the closed 0.015-inch (0.381 mm) taken in three different locations. The solubility of the lining shall be calculated by dividing the weight loss in milligrams (grains) by the exposed area in square inches.
- i. Interpretation of results. Nonconformance with 3.15(e) shall constitute failure of this test.

4.6.6 Copper lining. When specified (see 6.2), evacuate the area between the shell and copper lining to a negative pressure of 6 inches Hg (150 mm of Hg). Stop the evacuating device and after a 12-hour period, determine the negative pressure in the area between the shell and copper lining. A negative pressure of less than 6 inches Hg (150 mm of Hg) shall constitute failure of this test.

4.6.7 Electroless nickel-plated steel overcoated with fluorocarbon-based polymerized lining test. Type XI electroless nickel-plated steel overcoated with fluorocarbon-base polymer linings shall be inspected and tested as follows for plating thickness, plating adhesion, lining coverage, lining thickness, and lining solubility. Upon approval of the contracting officer, the manufacturer may furnish a certification of compliance as part of the first article. The certification shall provide data necessary to evaluate compliance with plating lining requirements in 3.21. Nonconformance with 3.21 shall constitute failure of this test.

- a. Compliance with the plating requirement shall be determined in accordance with ASTM B607.
- b. Compliance with the plating adhesion requirement shall be determined in accordance with ASTM B607.
- c. Compliance with the lining coverage requirement shall be determined in accordance with 4.6.5.1 except that nonconformance with 3.21 shall constitute failure of the test.
- d. Compliance with the lining thickness requirement shall be determined in accordance with 4.6.5.2 except that nonconformance with 3.21 shall constitute failure of the test.
- e. Compliance with the lining solubility requirement shall be determined in accordance with 4.6.5.3 except that nonconformance with 3.21 shall constitute failure of the test.

4.6.8 Steel overcoated with fluorocarbon-based polymerized lining test. Type XII steel overcoated with fluorocarbon-base polymer linings shall be inspected and tested as follows for lining coverage, lining thickness, and lining solubility. Upon approval of the contracting officer, the manufacturer may furnish a certification of compliance as part of the first article. The

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certification shall provide data necessary to evaluate compliance with plating and lining requirements in 3.22. Nonconformance with 3.22 shall constitute failure of this test.

- a. Compliance with the lining coverage requirement shall be determined in accordance with 4.6.5.1 except that nonconformance with 3.22 shall constitute failure of the test.
- b. Compliance with the lining thickness requirement shall be determined in accordance with 4.6.5.2. except that nonconformance with 3.22 shall constitute failure of the test.
- c. Compliance with the lining solubility requirement shall be determined in accordance with 4.6.5.3 except that nonconformance with 3.22 shall constitute failure of the test.

4.6.9 Toxicity, odor, color and taste. A certification of compliance with the ASME Code, as required by 3.4, will be accepted as evidence that materials in contact with potable water are nontoxic and do not impart objectionable odor, color, or taste to the water.

4.6.10 Cathodic protection. Measure the tank wall potential relative to a standard copper sulphate half cell before and after installation of the anode or anodes. Locate the copper sulphate half cell inside the tank adjacent to the tank shell at maximum distance from the anode or anodes. Use a portable potentiometer or high-resistance voltmeter to measure the potential. Nonconformance to 3.23 shall constitute failure of this test.

4.7 Inspection of packaging.

4.7.1 Preproduction pack inspection.

4.7.1.1 Examination. The preproduction pack shall be examined for the defects listed in table IV. Presence of one or more defects shall be cause for rejection of the preproduction pack.

4.7.1.2 Tests. The preproduction pack for level A shall be subjected to the guided-impact test (railroad-car) in Appendix A to MIL-STD-1186. The test car shall strike a string of five empty cars with draft gear extended and brakes set, at a speed of not less than 10 miles per hour (mph) (16 kilometre/hr (km/h)) and not more than 11 mph (18 km/h). When it is impractical to test in accordance with the railroad-car method, the incline-impact test or the pendulum-impact test in Appendix A to MIL-STD-1186, may be substituted.

4.7.1.3 Basis for rejection. Any shifting of contents, visible damage to the contents, or any loose, broken, or displaced anchoring, blocking, or bracing within the container shall be cause for rejection.

4.7.2 Quality conformance inspection of pack.

4.7.2.1 Unit of product. For the purpose of inspection, a completed pack prepared for shipment shall be considered a unit of product.

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TABLE IV. Classification of defects.

Classification	Defect	Requirement paragraph
Critical	None defined.	
Major		
101	ASTM stamp not as specified.	3.4
102	Materials not as specified.	3.5
103	Tappings and openings not provided or not as specified.	3.7
104	Tank supports not as specified.	3.8
105	Components comprising glass, cement or siliceous lining material not as specified.	3.13.1, 3.13.2, 3.15
106	Dimensions not as specified.	3.9
107	Tank lining not as specified.	3.7
Minor		3.13 thru 3.22
201	Missing or incorrect identification markings.	3.10
202	Treatment and painting not as specified.	3.11
203	Area of no coating, coating not dry, evidence of rust or corrosion, and runs or sags.	3.11
204	Color of coating not as specified.	3.11
205	Sharp edges, points, or corners, welding burrs, excessively long tappings, yokes and fastening devices.	3.24.2, 3.24.3

4.7.2.2 Sampling. Sampling for examination shall be in accordance with ANSI Z1.4.

5. PACKAGING

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

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6. NOTES

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

6.1 Intended use. The tanks are intended for storing potable service hot water.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Type, class, style, size, and capacity required (see 1.2, 3.1, 3.1.1, 3.1.2, and 3.12).
- c. Whether tank fabrication shall be other than as specified (see 3.1.1 and 3.1.2).
- d. When a first article is required, number of first article tanks required and time frame required for submission of first article tank(s) when required (see 3.3 and 4.3).
- e. Tappings and openings if other than as specified (see 3.7).
- f. When threaded pipe leg bosses are required in tank supports (see 3.8).
- g. When identification marking is to be other than manufacturer's standard commercial marking and in accordance with MIL-STD-130 (see 3.10).
- h. When color of finish coat is required (see 3.11).
- i. When wire brushing and hand scraping may be employed (see 3.12).
- j. When lining other than as specified is required (see 3.13.1, 3.13.2).
- k. When vacuum test of copper lined tanks is required (see 3.16).
- l. When cathodic protection shall be other than as specified (see 3.23).

6.3 Supersession data. This specification replaces Military Specification MIL-T-12295E dated 13 April 1981.

6.4 Classification cross reference. Classifications used in this specification (see 1.2) are identical to those found in the superseded Military Specification MIL-T-12295E.

6.5 First article tanks. When first article tanks are specified, any changes or deviations of production tanks from the first article tanks during production will be subject to the approval of the contracting officer. Approval of the first article tanks will not relieve the contractor of his obligation to furnish tanks conforming to this specification.

6.6 Lining. It is recommended that, whenever practicable and when recommended by the contractor, cement and siliceous lining be applied by the contractor after the tank is installed. This avoids shipping damages to which these linings are susceptible. If the lining applicator intends to use wire brushing and hand-scraping to clean tank surfaces rather than acid cleaning or sand or grit blasting, it is recommended that the contracting officer obtain a 5 or 10 year unconditional warranty for the lining under the applicable operating conditions (i.e. water temperature, location, source of supply etc. (see 3.12)) with the repair work being done at the location of the tank. This method of cleaning generally applies to tanks which will be lined at the job site.

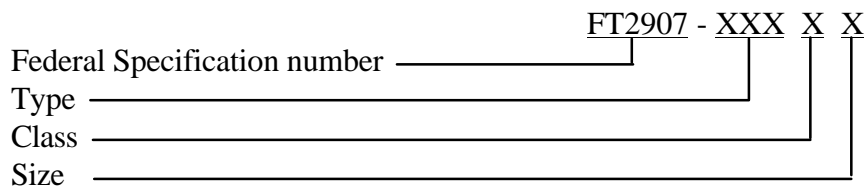
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6.7 Tank construction. Minus heads are generally not available commercially from contractors and should only be specified when a particular need exists. Tank supports should be the contractor's commercial supports and should be used for economic reasons. A 4-inch by 6-inch (100 mm by 150 mm) handhole may be specified in tanks 36 inches (915 mm) or less in diameter when required. In lieu of the tests specified for type II tanks in 4.6.3 and 4.6.4, the contracting officer may elect to accept an appropriate test report covering the lining of an established contractor from an independent test laboratory.

6.8 Preproduction packs. Any changes or deviations of production packs from the approved preproduction pack will be subject to the approval of the contracting officer. Approval of the preproduction pack will not relieve the contractor of his obligation to preserve, pack, and mark the tanks in accordance with this specification.

6.9 First article test. When first article tests are required, appropriate provisions should be included in the contract, to allow the contracting officer to waive completely or in part the first article tests and reduce the bid price accordingly if the successful bidder has previously performed any or all of the first article tests in recent procurements, or if quantities involved are less than 10. When the contract allows for waiver of first article tests, the contract should require that the successful bidder seeking such a waiver submit satisfactory evidence, including test and inspection reports that the tests have been performed successfully in the past and additional information such as the contract identification, the procuring activity, the date, and other pertinent data deemed necessary by the contracting officer. If the first article tests are desired, the contracting officer will normally elect to have these performed at the manufacturer's plant. He may also elect to have these tests performed at a Government laboratory, or at an independent private test organizations. Note that deletion of first article tests does not delete the tests required by Section IV of the ASME Code.

6.10 Part or Identifying Numbers (PINs). The specification number, type, class, and size are combined to form PINs for diesel-engine-driven water distillation units covered by this document (see 1.2). PINs for the diesel-engine-driven water distillation units are established as follows:



6.11 Subject term (key word) listing.

- Copper-lined steel
- Glass-lined steel
- Plus bottomhead
- Potable hot water storage tanks

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6.12 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

MILITARY INTERESTS:

Custodians:

Navy - YD1

Air Force - 99

Review Activities:

Army - MD, CE

Navy - CG, MC

CIVIL AGENCY COORDINATING ACTIVITY:

GSA-FSS

Preparing Activity:

Navy - YD1

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