

INCH-POUND

MIL-C-2939F(SH)

31 December 1990

SUPERSEDING

MIL-C-2939E(SH)

21 March 1984

(See 6.9)

MILITARY SPECIFICATION

COOLING COILS, AIR, DUCT TYPE AND GRAVITY TYPE, NAVAL SHIPBOARD ENVIRONMENTAL CONTROL SYSTEMS

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 duct type and gravity type air cooling coils for use in Naval shipboard environmental control systems.

1.2 Classification. Air cooling coils shall be of the following classes, sizes, and compositions, as specified (see 6.2):

- Class 1 - Chilled water (DW), duct mounted.
- 2 - Seawater (DWS), duct mounted.
- 3 - Chilled water (GW), gravity.

- Sizes 61-68 (DW only), see 3.4.3.
- 57-58 (DWS only), see 3.5.4.
- 1G, 3G, and 5G (GW only), see 3.6.3.

- Composition M - Magnetic
- N - Nonmagnetic

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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2. APPLICABLE DOCUMENTS

2.1 Government documents.

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

SPECIFICATIONS

FEDERAL

- QQ-A-250/1 - Aluminum 1100, Plate and Sheet.
- QQ-N-286 - Nickel-Copper-Aluminum Alloy, Wrought (UNS N05500).
- QQ-P-35 - Passivation Treatments for Corrosion-Resistant Steel.
- TT-P-645 - Primer, Paint, Zinc Chromate, Alkyd Type.
- TT-P-664 - Primer Coating, Alkyd, Corrosion-Inhibiting, Lead and Chromate Free, VOC-Compliant.

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- MIL-P-116 - Preservation, Methods of.
- MIL-S-901 - Shock Tests, H.I. (High-Impact) Shipboard Machinery, Equipment, and Systems, Requirements for.
- MIL-A-907 - Antiseize Thread Compound, High Temperature.
- MIL-F-1183 - Fittings, Pipe, Cast Bronze, Silver-Brazing, General Specification for.
- MIL-F-1183/10 - Fittings, Pipe, Cast Bronze, Silver-Brazing; Union, Pipe.
- MIL-S-1222 - Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts.
- MIL-A-3316 - Adhesives, Fire-Resistant, Thermal Insulation.
- 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.
- DOD-P-15328 - Primer (Wash), Pretreatment (Formula No. 117 for Metals) (Metric).
- MIL-C-15726 - Copper-Nickel Alloy, Sheet, Plate, Strip, Bar, Rod and Wire.
- MIL-F-20042 - Flanges, Pipe and Bulkhead, Bronze (Silver Brazing).
- MIL-I-24703 - Insulation, Pipe Polyphosphazene Sheet and Tubular.

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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-248 - Welding and Brazing Procedure and Performance Qualification.

MIL-STD-278 - Welding and Casting Standard.

MIL-STD-889 - Dissimilar Metals.

MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking and Waterproofing; with Appropriate Test Methods.

MIL-STD-2073-1 - DoD Materiel Procedures for Development and Application of Packaging Requirements.

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

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

DRAWINGS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

S3803-532636 - Cooling Coils - Gravity Type.

803-5001031 - Air Cooling Coils Seawater - Coil Size 57 and 58.

803-6397313 - Cooling Coils Air Class 1 Duct MTD CHW (DW) Sizes 61 through 66.

803-6397314 - Cooling Coils Air Class 1 Duct MTD CHW (DW) Sizes 67 and 68.

(Application for copies should be addressed to: Commander, Portsmouth Naval Shipyard, Naval Engineering Drawing Support Activity, Code 202.2, Portsmouth, NH 03804-5000.)

PUBLICATIONS

NAVSEA

NAVSEA S9086-CH-STM-010/CH-74 V1 - Naval Ships Technical Manual. Chapter 074 Volume 1, Welding and Allied Processes.

NAVSEA S9512-BS-MMA-010 - Heating, Ventilating, and Air Conditioning Equipment Manual.

NAVSHIPS 0900-LP-003-8000 - Metals Surface Inspection Acceptance Standards.

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(Application for copies should be addressed to the Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

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

AIR CONDITIONING AND REFRIGERATION INSTITUTE (ARI)

410 - Forced Circulation Air Cooling and Air Heating Coils.

(Application for copies should be addressed to the Air Conditioning and Refrigeration Institute, 1501 Wilson Boulevard, Suite 600, Arlington, VA 22209.)

AMERICAN SOCIETY OF HEATING, REFRIGERATING, AND AIR CONDITIONING ENGINEERS (ASHRAE)

33 - Methods of Testing Forced Circulation Air Cooling and Air Heating Coils.

(Application for copies should be addressed to the American Society of Heating, Refrigerating and Air Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, GA 30329.)

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code

Section VIII, Division 1 - Pressure Vessels.

(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 123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products. (DoD adopted)
- A 240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels. (DoD adopted)
- A 269 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service. (DoD adopted)
- A 276 - Standard Specification for Stainless and Heat Resisting Steel Bars and Shapes. (DoD adopted)
- A 312 - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes. (DoD adopted)
- A 525 - Standard Specification for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process. (DoD adopted)

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ASTM (Continued)

- B 5 - Standard Specification for Electrolytic Tough-Pitch Copper Refinery Shapes.
- B 6 - Standard Specification for Zinc.
- B 42 - Standard Specification for Seamless Copper Pipe, Standard Sizes. (DoD adopted)
- B 75 - Standard Specification for Seamless Copper Tube. (DoD adopted)
- B 88 - Standard Specification for Seamless Copper Water Tube. (DoD adopted)
- B 111 - Standard Specification for Copper and Copper-Alloy Seamless Condenser Tubes and Ferrule Stock. (DoD adopted)
- B 152 - Standard Specification for Copper Sheet, Strip, Plate, and Rolled Bar. (DoD adopted)
- B 159 - Standard Specification for Phosphor Bronze Wire. (DoD adopted)
- B 201 - Standard Practice for Testing Chromate Coatings on Zinc and Cadmium Surfaces.
- B 302 - Standard Specification for Threadless Copper Pipe.
- B 633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel. (DoD adopted)
- D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)
- F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs. (DoD adopted)
- F 594 - Standard Specification for Stainless Steel Nuts. (DoD adopted)

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

SHEET METAL AND AIR CONDITIONING CONTRACTORS' NATIONAL ASSOCIATION, INC. (SMACNA)

Eads, William G., Testing, Balancing and Adjusting of Environmental Systems, Sheet Metal and Air Conditioning Contractors' National Association, Inc., Vienna, VA, 1981.

(Application for copies should be addressed to the Sheet Metal and Air Conditioning Contractors' National Association, Inc., 8224 Old Courthouse Road, Tysons Corner, Vienna, VA 22180.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

- J 429 - Mechanical and Material Requirements for Externally Threaded Fasteners.

(Application for copies should be addressed to the Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, PA 15096.)

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

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

3. REQUIREMENTS

3.1 Qualification. The cooling coils furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products list at the time of award of contract (see 4.3 and 6.3).

3.2 Materials. Materials for use in the construction of duct type and gravity type cooling coils shall be as specified in 3.4.1, 3.5.1, or 3.6.1. Materials shall be high-grade and free from defects. The contractor shall certify and be able to demonstrate through a material control program that the materials used in the production of the cooling coils are in accordance with this specification.

3.2.1 Materials not specified. When a definite material is not specified, a material shall be used which will enable the cooling coil to meet the qualification requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

3.2.2 Dissimilar metals. To prevent galvanic corrosion, direct contact of electrolytically dissimilar metals, as defined in MIL-STD-889, shall be prohibited.

3.2.3 Recovered materials. Unless otherwise specified herein, all equipment, materials, 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 specified.

3.3 Design and construction. The cooling coils supplied under this specification shall be of the extended surface type for the cooling and dehumidification of air and shall use water (either chilled water or seawater) as the cooling medium. The cooling coils shall be built as a single unit consisting of supporting framework, drain pans, and cooling element. Each cooling coil shall be ready for installation and connection to the appropriate water supply and return lines. The design and construction of duct type and gravity type cooling coils shall be as specified in 3.4, 3.5, and 3.6.

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3.4 Class 1 - chilled water (DW) cooling coils duct.

3.4.1 Materials. Materials for use in the construction of DW cooling coils shall be in accordance with table I.

TABLE I. Class 1 (DW) cooling coil materials.

Application	Materials	Specification
Frame, bottom sheet, bottom sheet support, tube sheet, intermediate tube sheet, end covers, protective cover, and coil baffle	304 stainless steel	ASTM A 240
Access panel	Aluminum	QQ-A-250/1
Caulking	Clear silicone	Not applicable
Drain pans	304 stainless steel	ASTM A 240
Hose connection	304 stainless steel	ASTM A 312
Drain tube	Copper	ASTM B 75
Drain tube support	304 stainless steel	ASTM A 240
Fasteners	304 stainless steel	ASTM F 593 or F 594 and FED-STD-H28
Hangers (end and intermediate)	304 stainless steel	ASTM F 593 or F 594
Cooling element:		
Tubes	Seamless copper tube	ASTM B 75
Return bends: U-bends and hairpin tubes	Seamless copper tube	ASTM B 75
Turbospirals	Phosphor bronze	ASTM B 159
Headers	Seamless copper tube	ASTM B 88 (type L)
Connection ring	304 stainless steel	ASTM A 312
End discs	Copper plate	ASTM B 152

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TABLE I. Class I (DW) cooling coil materials - Continued.

Application	Materials	Specification
End disc plate	304 stainless steel	ASTM A 240
Supply and return connections (unions)	Bronze	MIL-F-1183/10
Connection stub	Threadless copper pipe	ASTM B 302
Vent and drain:		
Pipe	Seamless copper pipe	ASTM B 42
Fittings	Bronze	MIL-F-1183
Tubing (site-glass)	Vinyl	Not applicable
Fins	Electrolytic tough-pitch copper	ASTM B 152
Ferrules	Copper	ASTM B 152
Insulation	Polyphosphazene	MIL-I-24703
Insulation adhesive	Class II, fire-resistant	MIL-A-3316
Identification plate	316 stainless steel	ASTM A 240

3.4.1.1 Corrosion protection. Brass, copper, and stainless steel are considered corrosion-resisting materials for this application. When the corrosion-resistance of stainless steel has been degraded by fabrication processes, it shall be restored by heat treatment.

3.4.2 Design and construction. DW cooling coils shall be designed and constructed to use chilled water as the cooling fluid. Unless otherwise specified (see 6.2), DW cooling coils shall be constructed in accordance with Drawings 803-6397313 and 803-6397314.

3.4.2.1 Frame. The frame shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. The frame shall be of continuous-welded construction and shall be attached to the tube sheets (and where applicable, intermediate tube sheets) with continuous welds in accordance with Drawings 803-6397313 and 803-6397314. Corners of duct flanges shall be made airtight and smooth by welding and grinding to receive matching duct flanges.

3.4.2.2 Bottom sheet and bottom sheet support. The bottom sheet and bottom sheet support shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. The bottom sheet and bottom support sheet shall be attached to the

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frame, tube sheets, intermediate tube sheets, and drain pans, as applicable, with continuous welds in accordance with Drawings 803-6397313 and 803-6397314.

3.4.2.3 Tube sheet. The tube sheet shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. Each tube sheet shall be attached to the frame, bottom sheet, and drain pans with continuous welds in accordance with Drawings 803-6397313 and 803-6397314.

3.4.2.4 Intermediate tube sheet. Intermediate tube sheets shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. Intermediate tube sheets shall be provided to support the tubes when the coil face dimension length exceeds 26 inches. Distances between intermediate tube sheets shall not exceed 19 inches. Each intermediate tube sheet shall be attached to the frame, bottom sheet, and drain pans with welds in accordance with Drawings 803-6397313 and 803-6397314. Each intermediate tube sheet shall extend into the drain pan on both sides of the bottom support. The weld shall wrap around the edges of the intermediate tube sheet where it attaches to the drain pan.

3.4.2.5 End covers, protective cover, and access panels. End covers, protective cover, and access panels shall be provided in accordance with table I and Drawings 803-6397313 and 803-6397314. End covers shall be sealed by the external coil insulation.

3.4.2.6 Coil baffle. The coil baffles shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. Each baffle shall be attached to the tube sheets with welds in accordance with Drawings 803-6397313 and 803-6397314.

3.4.2.7 Intermediate and bottom drain pans. Intermediate and bottom drain pans shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. An intermediate drain pan shall be provided on coil sizes 67 and 68. Drain tubes in accordance with table I and Drawing 803-6397314 shall be used to drain the intermediate drain pan into the bottom drain pan. The drain tubes shall be secured to the tube sheets by the drain tube supports in accordance with table I and Drawing 803-6397314. Both drain pans shall be nonremovable parts of the coil and shall be attached to the frame, end sheets, intermediate sheets, and bottom support sheet, as applicable, with welds in accordance with Drawings 803-6397313 and 803-6397314. Hose connections shall be attached to each end of the drain pan in accordance with table I and Drawings 803-6397313 and 803-6397314.

3.4.2.8 Fasteners. Bolts, nuts, studs, screws, and all other fasteners shall be in accordance with table I. Self-tapping sheet metal screws shall not be used. Threads shall be coated with an anti-seize compound that conforms to MIL-A-907.

3.4.2.9 Hangers. Hangers shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. The hangers shall have a tensile strength of 85,000 pounds per square inch (lb/in²) and a yield strength of 35,000 lb/in². Each hanger shall be threaded in accordance with Drawings 803-6397313 and 803-6397314 and FED-STD-H28.

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3.4.2.10 Welding. The surfaces of all parts to be welded shall be free from rust, scale, paint, grease, and other foreign matter. Welding shall be as specified in MIL-STD-248 and MIL-STD-278. Welding procedures and qualification of the welder may be in accordance with a nationally recognized welding code if they meet the requirements of this specification and the acceptance of the qualifying activity.

3.4.2.10.1 Weld defect correction. Weld defects that exceed the parameters established by NAVSHIPS 0900-LP-003-8000 shall be corrected through:

- (a) Weld rework - A procedure that will bring the part into total compliance with the drawing and specification requirements, does not diminish the thickness of the parent metal by more than 10 percent, and does not affect the parent metal surface by more than 1/32 inch for 15 percent of the weld length or 12 inches, whichever is the least. Rework actions may be completed at the discretion of the manufacturer.
- (b) Weld repair - Repairs are required whenever a defect exceeds the rework limits above. A repair action, if successfully completed, will create a serviceable yet not fully conforming unit. Cracks shall be repaired in accordance with NAVSEA S9086-CH-STM-010/CH-74 V1. Weld repairs shall be inspected in accordance with MIL-STD-278.

3.4.2.11 Cooling element. The cooling element shall be of the extended surface type consisting of tubes expanded into fins. The cooling element shall have six rows of tubes staggered in the direction of air flow. The return bends of the cooling element tubes shall be constructed of U-bends or hairpin tubes. The brazed joints of the cooling element shall be in accordance with 3.4.2.11.9. The cooling element shall be circuited as shown on Drawings 803-6397313 and 803-6397314 for the sizes specified.

3.4.2.11.1 Tubes and return bends. Tubes and return bends (U-bends and hairpin tubes) shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. U-bends shall have a wall thickness not less than 0.025 inch after fabrication.

3.4.2.11.2 Turbospirals. DW cooling coils shall have turbospirals in all tubes. Turbospirals shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. The turbospirals shall have a uniform pitch of at least 16 turns per linear foot of tube and shall fit snugly against the inside surface of each tube.

3.4.2.11.3 Headers. DW cooling coils shall have twin headers in accordance with table I and Drawings 803-6397313 and 803-6397314. The headers shall be enclosed within the coil end cover but not in the air stream. The supply and return connections to the headers shall be secured to a connection ring on the coil end cover to relieve the header joints from stresses due to external pipe whip. The connection ring shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. The ends of the headers shall be sealed with end

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discs, reinforced with end disc support plates which are secured to the end cover. The header end discs and end disc support plates shall be in accordance with table I and Drawings 803-6397313 and 803-6397314.

3.4.2.11.4 Supply and return connections. Unless otherwise specified (see 6.2), the supply and return connections shall be straight-threaded union connections, fitted with O-rings, in accordance with table I and Drawings 803-6397313 and 803-6397314. The unions shall be rated for a service pressure of 300 lb/in². The female tailpiece shall be silver brazed to the connection stub of the header. The connection stub shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. The female threadpiece shall be adequately protected to prevent damage during shipping and installation.

3.4.2.11.5 Vent. DW cooling coils shall be provided with a means for venting the cooling element in accordance with table I and Drawings 803-6397313 and 803-6397314. The vent shall be provided with a valve mounted on the exterior of the coil. The water discharged from the valve shall be routed to the bottom drain pan in such a manner that will allow for visual indication of flow. A site-glass of clear vinyl tubing shall be supplied in the vent line and located near the top of the supply header.

3.4.2.11.6 Drain. DW cooling coils shall be provided with a means for draining the cooling element in accordance with table I and Drawings 803-6397313 and 803-6397314. The drain shall be located at the bottom of the header in a position low enough to provide complete draining of the coil. The drain shall be provided with a valve mounted on the exterior of the coil. The water discharged from the valve shall be routed to the bottom drain pan in such a manner that will allow for visual indication of the flow.

3.4.2.11.7 Fins. Fins shall be of the continuous plate type in accordance with table I and Drawings 803-6397313 and 803-6397314. The fins shall be uniformly spaced with the number of fins per linear inch of tube not less than 8 or more than 8-1/2. The fins shall have rolled collars with tubes expanded into the collars to form a permanent bond. The fins shall be configured to have a low sinusoidal wave pattern in the direction of air flow as shown on Drawings 803-6397313 and 803-6397314. The fins shall be modified to provide outlet airflow that is perpendicular to the face of the coil by flattening 3/8 inch of the leading and trailing edges of each wavy fin. Outlet flow from the coil shall be uniform (see 3.7.4).

3.4.2.11.8 Ferrules. Ferrules shall be in accordance with table I and Drawings 803-6397313 and 803-6397314. Ferrules shall be provided where tubes pass through tube sheets and intermediate tube sheets. Tubes shall be expanded into the ferrules to allow wear, due to shipboard vibration and thermal expansion and contraction of the tubes, to occur between the ferrules and the tube sheets and intermediate tube sheets.

3.4.2.11.9 Brazing. Piping connections shall be brazed in accordance with MIL-STD-278. Brazing procedures and the qualification of the brazer shall be in accordance with MIL-STD-248. Brazing procedures and the qualification of the

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brazer may be in accordance with a nationally recognized brazing code if they meet the requirements of this specification and the acceptance of the contracting activity.

3.4.2.12 Insulation. DW cooling coils shall be insulated in accordance with table I and Drawings 803-6397313 and 803-6397314 for the sizes specified. An adhesive in accordance with table I shall be used to bond the insulation in place.

3.4.2.13 Identification plates. Each cooling coil shall be provided with an identification plate in accordance with table I and Drawings 803-6397313 and 803-6397314. The identification plates shall be color style II and shall conform to types A, B, D, F, or H of MIL-P-15024 and MIL-P-15024/5. The physical dimensions of the identification plates shall be equal to or less than the dimensions of a size No. 10 plate in accordance with MIL-P-15024.

3.4.2.13.1 Plate information. The identification plate shall contain the following information:

- (a) Nomenclature.
- (b) Size.
- (c) Part or identifying number (see 6.5).
- (d) Component identification number.
- (e) Contract or purchase order number.
- (f) Manufacturer's part number, name, and address.

3.4.2.13.2 Type designation. The letters DW shall be added after the size designation to designate that the coil is constructed for use with chilled water.

3.4.3 Sizes. Sizes of DW cooling coils shall be numbered 61 through 68 and limited to those specified on Drawings 803-6397313 and 803-6397314 (see 6.2).

3.4.4 Physical dimensions. Mounting dimensions, tolerances, duct flange connections, and tube spacing shall be in accordance with Drawings 803-6397313 and 803-6397314.

3.4.5 Weight. The weights of DW cooling coils shall be as specified on Drawings 803-6397313 and 803-6397314.

3.5 Type 1 - duct, class 2 - seawater (DWS), cooling coils.

3.5.1 Materials. Materials for use in the construction of DWS cooling coils shall be as specified in table II (see 6.2).

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TABLE II. Class 2 (DWS) cooling coil materials.

Application	Materials	Specification
Casing, end frame, bottom sheet, baffle strip, intermediate sheets, end sheet, drain pans:		
Magnetic	Galvanized steel	ASTM A 525
Nonmagnetic	304 stainless steel	ASTM A 240, A 269, A 276
Drain tube	Copper	N/A
End enclosure	Aluminum	N/A
Fasteners, fittings:		
Magnetic	Corrosion-resisting, passivated steel	QQ-P-35 and FED-STD-H28
Nonmagnetic	304 stainless steel	ASTM F 593
Mounting hangers:		
Magnetic	Grade 5 bolt, heat-treated steel	SAE J429
Nonmagnetic	Grade 500, nickel-copper-aluminum	QQ-N-286, MIL-S-1222
Cooling element:		
Tubes, U-bends, hairpin tubes	90-10 copper-nickel	MIL-T-15005
Box header	90-10 copper-nickel	MIL-C-15726
Supply header plate	90-10 copper-nickel	MIL-C-15726
Gasket	Rubber	
Supply and return connections	Bronze	MIL-F-20042
Vent and drain pipe	Copper	ASTM B 88
Vent and drain fittings	Bronze	MIL-F-1183

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TABLE II. Class 2 (DWS) cooling coil materials - Continued.

Application	Materials	Specification
Fins	Electrolytic tough-pitch copper	ASTM B 5
Ferrules	Copper	ASTM B 111
Insulation	Polyphosphazene	MIL-I-24703
Insulation adhesive	Class II, fire-resistant	MIL-A-3316
Identification plate	Aluminum	N/A

3.5.1.1 Corrosion protection. Brass, copper, copper-nickel alloy, galvanized steel, and stainless steel are considered corrosion-resisting materials for this application. When the corrosion resistance of the stainless steel is degraded by fabrication processes, it shall be restored by heat treatment. Parts fabricated from other than corrosion-resisting materials shall be protected against corrosion after fabrication by chemical treatment, electrolytic processes, plating, or specified paints. The following methods provide adequate corrosion protection methods when properly applied:

- (a) Hot-dip galvanizing in accordance with ASTM A 123 with the spelter conforming to special high grade of ASTM B 6.
- (b) Electroplating with zinc in accordance with ASTM B 633, followed by a chromate treatment conforming to ASTM B 201.
- (c) Hot phosphoric or chromate treatment, or a coating of primer in accordance with DOD-P-15328 followed by two coats of primer conforming to TT-P-664.

3.5.1.2 Nonmagnetic material. When nonmagnetic cooling coils are specified (see 6.2), parts normally fabricated of galvanized steel shall be fabricated of stainless steel which has a permeability of less than 2.0 after fabrication (see table II).

3.5.2 Design and construction. DWS cooling coils shall be designed and constructed to use seawater as a cooling fluid. DWS cooling coils shall be constructed in accordance with Drawing 803-5001031 and as specified (see 6.2).

3.5.2.1 Casing. The casing shall be in accordance with table II and Drawing 803-5001031. The casing shall be of continuous-welded construction in accordance with Drawing 803-5001031. Corners of casing duct flanges shall be made airtight and smooth by welding and grinding to receive matching duct flanges.

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3.5.2.2 End frame. The return end frame shall be in accordance with table II and Drawing 803-5001031. The return end frame shall be of continuous-welded construction in accordance with Drawing 803-5001031. The return end frame shall be attached to the end sheet and coil casing with continuous welds in accordance with Drawing 803-5001031.

3.5.2.3 Bottom sheet and baffle strip. The bottom sheet and baffle strip shall be in accordance with table II and Drawing 803-5001031. The bottom sheet and baffle strip shall be attached to the end frame, end sheets, and intermediate sheets, as applicable, with continuous welds in accordance with Drawing 803-5001031.

3.5.2.4 Return end sheet. The end sheets shall be in accordance with table II and Drawing 803-5001031. Each end sheet shall be attached to the frame and bottom sheet with continuous welds in accordance with Drawing 803-5001031.

3.5.2.5 Intermediate sheets. Intermediate sheets shall be in accordance with table II and Drawing 803-5001031. Intermediate sheets shall be provided to support the tubes. Distances between intermediate sheets shall not exceed 19 inches. Each intermediate sheet shall be attached to the casing, bottom sheet and the bottom pan with continuous welds in accordance with Drawing 803-5001031.

3.5.2.6 Intermediate and bottom drain pans. The intermediate and bottom drain pans shall be in accordance with table II and Drawing 803-5001031. The intermediate drain pan shall contain an insert to facilitate drainage. Drain tubes in accordance with table II and Drawing 803-5001031 shall be used to drain the intermediate drain pan into the bottom drain pan. The bottom drain pan shall be bolted to the casing and the end frame for easy access and removal. The intermediate drain pan shall be continuously welded to the casing, the end sheets and the intermediate sheets.

3.5.2.7 End enclosure. A removable end enclosure shall be provided in accordance with table II and Drawing 803-5001031. The removable end enclosure on the supply end shall be omitted.

3.5.2.8 Fasteners and fittings. Bolts, nuts, studs, screws, and all other fasteners or fittings as may be used in the construction of DWS cooling coils shall be of passivated corrosion-resisting material in accordance with table II or of a material treated in a manner to render it adequately resistant to corrosion. Self-tapping sheet metal screws shall not be used. Threads shall be coated with an anti-seize compound that conforms to MIL-A-907 when nonmagnetic materials are used in the construction of the cooling coil.

3.5.2.9 Mounting hangers. Mounting hangers shall be in accordance with table II and Drawing 803-5001031. The mounting hangers for magnetic construction shall have a tensile strength of 150,000 lb/in². The mounting hangers for nonmagnetic construction shall have a minimum yield strength of 90,000 lb/in². Each mounting hanger shall be threaded in accordance with Drawing 803-5001031 and FED-STD-H28.

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3.5.2.10 Welding. The surfaces of all parts to be welded shall be free from rust, scale, paint, grease, and other foreign matter. Welding shall be in accordance with MIL-STD-248 and MIL-STD-278. Welding procedures and qualification of the welder may be in accordance with a nationally recognized welding code if they meet the requirements of this specification and the acceptance of the qualifying activity.

3.5.2.10.1 Zinc-coated surfaces. Where zinc-coated steel is used for fabricating parts, the metallic zinc shall be removed from joints and surfaces on which welds are to be deposited and for a distance of 1 inch from the expected toes of the welds. Welding over the zinc-coated surfaces is permitted where metallic zinc cannot be removed. Where zinc coating is removed or welded over, the area shall be coated with a cold galvanizing compound having a minimum thickness of 5 mils.

3.5.2.10.2 Weld defect correction. Weld defects that exceed the parameters established by NAVSHIPS 0900-LP-003-8000 shall be corrected through:

- (a) Weld rework - A procedure that will bring the part into total compliance with the drawing and specification requirements, does not diminish the thickness of the parent metal by more than 10 percent, and does not effect the parent metal surface by more than 1/32 inch for 15 percent of the weld length or 12 inches, whichever is the least. Rework actions may be completed at the discretion of the manufacturer.
- (b) Weld repair - Repairs are required whenever a defect exceeds the rework limits above. A repair action, if successfully completed, will create a serviceable yet not fully conforming unit. Cracks shall be repaired in accordance with NAVSEA S9086-CH-STM-010/CH-74 V1. Weld repairs shall be inspected in accordance with MIL-STD-278.

3.5.2.11 Cooling element. The cooling element shall be the extended surface type consisting of tubes expanded into fins with a single header. The cooling element shall have eight rows of tubes staggered in the direction of air flow. The tubes at the return end of the cooling element shall be connected with U-bends or hairpin tubes. The tubes at the supply end of the cooling element shall terminate at and be rolled into the supply header plate. The brazed joints of the cooling element shall be in accordance with 3.5.2.11.8.

3.5.2.11.1 Tubes, U-bends, and hairpin tubes. Tubes, U-bends, and hairpin tubes shall be in accordance with table II and Drawing 803-5001031. U-bends shall have an internal diameter at least equal to the inside diameter of the tube.

3.5.2.11.2 Header.

3.5.2.11.2.1 Box header. A single, removable, box type header shall be gasketed and bolted to the supply end of the cooling element to facilitate cleaning the internal surfaces of the tubing and header. The header and gasket shall be in accordance with table II, Drawing 803-5001031, and as specified (see 6.2). The header shall be of continuous-welded construction. The header shall also be in accordance with the following:

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- (a) Designed for an operation pressure of at least 100 lb/in².
- (b) Baffled for double serpentine circuitry.
- (c) Contain a 1/4 inch outside diameter (od) tubing connection in each corner for draining and venting.

3.5.2.11.2.2 Supply header plate. The supply header plate shall be in accordance with table II and Drawing 803-5001031 and have a minimum thickness of 3/4 inch.

3.5.2.11.3 Supply and return connections. Unless otherwise specified (see 6.2), the supply and return connections shall be silver-brazed, flanged connections with preinserted rings in accordance with table II and Drawing 803-5001031. Flange sizes shall be in accordance with Drawing 803-5001031.

3.5.2.11.4 Vent. DWS cooling coils shall be provided with a means for venting the cooling element in accordance with table II and Drawing 803-5001031.

3.5.2.11.5 Drain. DWS cooling coils shall be provided with a means for draining the cooling element in accordance with table II and Drawing 803-5001031. The drain shall be located at the bottom of the header in a position low enough to provide complete draining of the coil. The drain shall be provided with a valve mounted on the exterior of the coil. The water discharged from the valve shall be routed to the drain pan to allow for visual indication of the flow.

3.5.2.11.6 Fins. The fins shall be of the smooth continuous plate type, in accordance with table II and Drawing 803-5001031. The fins shall be uniformly spaced with the number of fins per linear inch of tube not less than 7 or more than 7-1/2. The fins shall have rolled collars with the tubes expanded into the collars to form a permanent bond.

3.5.2.11.7 Ferrules. Ferrules shall be as specified in table II and in accordance with Drawing 803-5001031. They shall be provided where tubes pass through the return end sheet and intermediate tube sheets. Tubes shall be expanded into the ferrules to allow wear due to shipboard vibration and thermal expansion and contraction of the tubes to occur between the ferrules, return end sheet, and the intermediate sheets.

3.5.2.11.8 Brazing. Piping connections shall be brazed in accordance with MIL-STD-278. Brazing procedures and the qualification of the brazer shall be in accordance with MIL-STD-248. Brazing procedures and the qualification of the brazer may be in accordance with a nationally recognized brazing code if they meet the requirements of this specification and the acceptance of the qualifying activity.

3.5.2.12 Insulation. DWS cooling coils shall be insulated in accordance with table II and Drawing 803-5001031 for the sizes specified. An adhesive in accordance with table II shall be used to bond the insulation in place.

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3.5.3 Identification.

3.5.3.1 Identification plates. Each cooling coil shall be provided with an identification plate in accordance with table II and Drawing 803-5001031. The identification plates shall be color style II and shall conform to types A, B, D, F, or H of MIL-P-15024 and MIL-P-15024/5. The physical dimensions of the identification plates shall be equal to or less than the dimensions of a size No. 10 plate in accordance with MIL-P-15024.

3.5.3.1.1 Plate information. The identification plate shall contain the following information:

- (a) Nomenclature.
- (b) Size.
- (c) Part or identifying number (see 6.5).
- (d) Component identification number.
- (e) Contract or purchase order number.
- (f) Manufacturer's part number, name, and address.

3.5.3.1.2 Type designations. The letters DWS shall be added after the size designation to designate that the coil is constructed for use with seawater. In addition to the type designation, the letters N or M shall be used to designate that the cooling coil is constructed of nonmagnetic or magnetic material and shall be added after the type designation, as applicable.

3.5.3.2 Painting. Interior and exterior surfaces of cooling coils except the cooling elements and those surfaces constructed of brass, copper, copper-nickel alloy, or stainless steel shall be thoroughly cleaned and coated as follows:

- (a) One coat of pretreatment coating in accordance with DOD-P-15328.
- (b) Two coats of zinc chromate primer in accordance with TT-P-645.

3.5.4 Sizes. Sizes of DWS cooling coils shall be numbered 57 and 58 and limited to those specified on Drawing 803-5001031 (see 6.2).

3.5.5 Physical dimensions. Mounting dimensions, tolerances, duct flange connections, and tube spacing shall conform to Drawing 803-5001031 for the sizes specified.

3.5.6 Weight. The weights of DWS cooling coils shall be as specified on Drawing 803-5001031.

3.6 Gravity, class 3 - chilled water (GW), cooling coils.

3.6.1 Materials. Materials for use in the construction of GW cooling coils shall be in accordance with table III and Drawing S3803-532636 (see 6.2).

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TABLE III. Class 3 (GW) cooling coil materials.

Application	Materials	Specification
Frame, drain pan, tube sheet:		
Magnetic	Galvanized steel	ASTM A 525
Nonmagnetic	316 stainless steel	ASTM A 240, A 269, A 276
Couplings:		
Magnetic	Corrosion-resisting, passivated steel	
Nonmagnetic	304 stainless steel	N/A
Fasteners	Brass	N/A
Support channels:		
Magnetic	Galvanized steel	ASTM A 525
Nonmagnetic	316 stainless steel	ASTM A 240, A 269, A 276
Cooling element:		
Tubes, U-bends, hairpin tubes	Seamless copper tube	ASTM B 88
Fins	Electrolytic tough-pitch copper	ASTM B 5
Ferrules	Copper	ASTM B 111
Identification plate	Aluminum	N/A

3.6.1.1 Corrosion protection. Brass, copper, galvanized steel, and stainless steel are considered corrosion-resisting materials for this application. When the corrosion resistance of the stainless steel is degraded by fabrication processes, it shall be restored by heat treatment. Parts fabricated from other than corrosion-resisting materials shall be protected against corrosion after fabrication by chemical treatment, electrolytic processes, plating, or specified paints. The following methods are considered to provide adequate corrosion protection when properly applied:

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- (a) Hot-dip galvanizing in accordance with ASTM A 123 with the spelter conforming to special high grade of ASTM B 6.
- (b) Electroplating with zinc in accordance with ASTM B 633, followed by a chromate treatment conforming to ASTM B 201.
- (c) Hot phosphoric or chromic treatment, or a coating of primer in accordance with DOD-P-15328 followed by two coats of primer conforming to TT-P-664.

3.6.1.2 Nonmagnetic material. When nonmagnetic cooling coils are specified (see 6.2), parts normally fabricated of galvanized steel shall be fabricated of stainless steel in accordance with table III and Drawing S3803-532636. The stainless steel shall have a permeability of less than 2.0 after fabrication.

3.6.2 Design and construction. GW cooling coils shall be designed and constructed to use chilled water as a cooling fluid. Unless otherwise specified (see 6.2), GW cooling coils shall be constructed in accordance with Drawing S3803-532636.

3.6.2.1 Frame. The frame for GW cooling coils shall be of continuous weld construction in accordance with table III and Drawing S3803-532636.

3.6.2.2 Drain pan. The drain pan for GW cooling coils shall be of continuous weld construction in accordance with table III and Drawing S3803-532636. The drain pan shall be bolted to the frame for easy access and removal. Couplings, in accordance with table III and Drawing S3803-532636, shall be attached to the drain pan for connection to the appropriate shipboard drainage system.

3.6.2.3 Tube sheets. The tube sheets shall be in accordance with table III and Drawing S3803-532636. Each tube sheet shall be attached to the frame with continuous welds. Distances between tube sheets shall not exceed 19 inches.

3.6.2.4 Fasteners. Bolts, nuts, studs, screws, and all other fasteners as may be used in the construction of GW cooling coils shall be in accordance with table III and Drawing S3803-532636. Self-tapping sheet metal screws shall not be used. Threads shall be coated with an anti-seize compound that conforms to MIL-A-907 when nonmagnetic materials are used in the construction of the cooling coil.

3.6.2.5 Support channels. Support channels in accordance with table III and Drawing S3803-532636 shall be used to mount the coil to the overhead deck. Support channels shall be attached to the frame with continuous welds in accordance with Drawing S3803-532636.

3.6.2.6 Welding. The surfaces of all parts to be welded shall be free from rust, scale, paint, grease, and other foreign matter. Welding shall be as specified in MIL-STD-248 and MIL-STD-278. Welding procedures and qualification of the welder may be in accordance with a nationally recognized welding code if they meet the requirements of this specification and the acceptance of the qualifying activity.

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3.6.2.6.1 Zinc-coated surfaces. Where zinc-coated steel is used for fabricating parts, the metallic zinc shall be removed from joints and surfaces on which welds are to be deposited and for a distance of 1 inch from the expected toes of the welds. In areas where the metallic zinc cannot be removed and welding over the zinc-coated surfaces is necessary, electrode types shall be in accordance with MIL-STD-248 and MIL-STD-278. Where zinc coating is removed or welded over, the area shall be coated with a cold galvanizing compound having a minimum thickness of 5 mils.

3.6.2.6.2 Weld defect correction. Weld defects that exceed the parameters established by NAVSHIPS 0900-LP-003-8000 shall be corrected through:

- (a) Weld rework - A procedure that will bring the part into total compliance with the drawing and specification requirements, does not diminish the thickness of the parent metal by more than 10 percent, and does not affect the parent metal surface by more than 1/32 inch for 15 percent of the weld length or 12 inches, whichever is the least. Rework actions may be completed at the discretion of the manufacturer.
- (b) Weld repair - Repairs are required whenever a defect exceeds the rework limits above. A repair action, if successfully completed, will create a serviceable yet not fully conforming unit. Cracks shall be repaired in accordance with NAVSEA S9086-CH-STM-010/CH-74 V1. Weld repairs shall be inspected and accepted in accordance with MIL-STD-278.

3.6.2.7 Cooling element. The cooling element shall be of the extended surface type consisting of interconnected tubes expanded into fins. The coils shall have two rows of tubes staggered in the direction of air flow. The tubes shall be interconnected with U-bends or hairpin tubes. The brazed joints of the cooling element shall be as specified in 3.6.2.7.4. The cooling element shall be circuited in accordance with Drawing S3803-532636 for the sizes specified.

3.6.2.7.1 Tubes, U-bends, and hairpin tubes. The tubes, U-bends, and hairpin tubes shall be in accordance with table III and Drawing S3803-532636. U-bends shall have an internal diameter at least equal to the inside diameter of the tube.

3.6.2.7.2 Fins. The fins shall be of the smooth continuous plate type, in accordance with table III and Drawing S3803-532636. The fins shall be uniformly spaced with the number of fins per linear inch of tube not less than 3 or more than 3-1/2. The fins shall have rolled collars with the tubes expanded into the collars to form a permanent bond.

3.6.2.7.3 Ferrules. Ferrules shall be in accordance with table III and Drawing S3803-532636. They shall be provided where tubes pass through tube sheets. Tubes shall be expanded into the ferrules to allow wear, due to shipboard vibration and thermal expansion and contraction of the tubes, to occur between the ferrules, end sheets, and intermediate sheets.

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3.6.2.7.4 Brazing. Piping connections shall be brazed in accordance with MIL-STD-278. Brazing procedures and the qualification of the brazer shall be in accordance with MIL-STD-248. Brazing procedures and the qualification of the brazer may be in accordance with a nationally recognized brazing code if they meet the requirements of this specification and the acceptance of the qualifying activity.

3.6.2.8 Painting. Interior and exterior surfaces of cooling coils, except the cooling elements and those surfaces constructed of brass, copper, copper-nickel alloy, or stainless steel shall be thoroughly cleaned and coated as follows:

- (a) One coat of pretreatment coating in accordance with DOD-P-15328.
- (b) Two coats of zinc chromate primer in accordance with TT-P-645.

3.6.3 Sizes. Sizes of GW cooling coils shall be numbered 1G, 3G, and 5G and limited to those specified on Drawing S3803-532636 (see 6.2).

3.6.4 Physical dimensions. Mounting dimensions, tolerances, and tube spacing shall conform to Drawing S3803-532636 for the sizes specified.

3.7 Performance. DW cooling coils shall meet the requirements specified in 3.7.1 through 3.7.5. DWS and GW cooling coils shall meet the requirements specified in 3.7.1, 3.7.2, and 3.7.5.

3.7.1 Shock. Cooling coils shall pass the shock tests specified in 4.5.2 for grade A, class I equipment.

3.7.2 Vibration. Cooling coils shall pass the environmental vibration tests specified in 4.5.3.

3.7.3 Capacity. The capacity of the DW cooling coil shall be not less than the capacities listed in table IV (see 4.5.4) for the following conditions: entering water temperature equals 45 degrees Fahrenheit (°F), leaving water temperature equals 51.67°F, gallons per minute (gal/min) per ton of cooling equals 3.6, and entering air temperature equals 80 degrees dry bulb (DB)/67 degrees wet bulb (WB). In lieu of these conditions, the conditions and capacities in NAVSEA S9512-BS-MMA-010 may be substituted as specified by the contracting activity (see 6.2). Table IV shows capacity in MBH, 1000 British Thermal Units (Btu) per hour. Airflow is given in cubic feet per minute (ft³/min) and feet per minute (ft/min).

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TABLE IV. DW cooling coil capacities.

Coil size	Airflow ft ³ /min (ft/min)	Leaving air temperatures in DB/WB	Capacity MBH
61	280 (491)	58.6/56.8	9.02
62	450 (500)	56.9/55.3	16.47
63	670 (496)	55.3/53.8	27.26
64	975 (488)	55.2/53.7	39.97
65	1450 (485)	53.1/52.5	63.44
66	2500 (500)	52.7/52.1	112.20
67	3800 (507)	51.1/50.8	183.60
68	5000 (500)	51.1/50.9	240.70

3.7.4 Air distribution. The outlet air flow of the DW cooling coil shall be uniform across the face of the coil as shown on figure 1 (see 4.5.5).

3.7.5 Leakage. Cooling coils shall pass the leakage test specified in 4.5.6.

3.8 Workmanship. Cooling coils shall be free from defects that affect their appearance and operation. Tube sheets shall not show cracks from punching or forming, and fin collars shall not show cracks after tubes are expanded into collars. Fin edges shall be free of burrs and shall not be bent. Casing corners shall be square. Flanges shall be parallel and smooth.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of the 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.

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

- (a) Qualification inspection (see 4.3).
- (b) Quality conformance inspection (see 4.4).

4.3 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production. Prior to test authorization, drawings delineating the products covered by this specification shall be submitted to NAVSEA for review and approval. The drawings shall include the following:

- (a) Methods and sizes of fastening and clearances for installation and servicing.
- (b) Supplementary data necessary to permit shipyard installation without manufacturer's assistance.
- (c) Total weight of each assembled cooling coil.
- (d) Center of gravity of each assembled cooling coil.
- (e) List of materials.

4.3.1 Sample. The sample shall be taken at random from each lot in accordance with table V and shall be produced with equipment and procedures normally used in production. The sample units shall pass the qualification inspections prior to acceptance by the Government and delivery of the first cooling coil. Qualification inspection shall be performed on one cooling coil of each size to be manufactured.

TABLE V. Qualification and quality conformance inspection.

Inspection	Type	Requirement	Test method	Qualification	Quality conformance
Group A					
Subgroup 1					
Visual and dimensional	DW	3.2, 3.3, 3.4	4.5.1	X	X
	DWS	3.2, 3.3, 3.5			
	CW	3.2, 3.3, 3.6			
Subgroup 2					
Inspection of cleaning	All	5.1.1	4.6		X
Inspection of packaging	All	5.1, 5.2, 5.3	4.6		X

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TABLE V. Qualification and quality conformance inspection - Continued.

Inspection	Type	Requirement	Test method	Qualification	Quality conformance
Group B Capacity	DW	3.7.3	4.5.4, 4.5.4.1	X	X
Air distribution	DW	3.7.4	4.5.5	X	
Leakage	All	3.7.5	4.5.6	X	
Group C <u>1/</u> Shock	All	3.7.1	4.5.2	X	
Vibration	All	3.7.2	4.5.3	X	

1/ For series 60 DW cooling coils, qualifying size 64 also qualifies sizes 61, 62, and 63; qualifying size 66 also qualifies size 65; and qualifying size 68 also qualifies size 67.

4.3.2 Inspection routine. Sample cooling coils shall be subjected to the qualification inspections specified in table V. Qualification will not be granted if the requirements examined in the group A, B, and C inspections are not met.

4.3.3 Failures. Failure to pass all inspections specified in table V shall be cause for refusal of qualification. The ability to rework failed samples shall be at the discretion of the qualifying activity.

4.3.4 Retention of qualification. Retention of qualification is achieved by testing the cooling coil every 5 years for capacity and air distribution in accordance with table V. Manufacturers shall submit test data to NAVSEA for review and approval. It shall be determined, by NAVSEA discretion, which sizes of cooling coils shall be tested.

4.4 Quality conformance inspection. Quality conformance inspection shall be performed by the contractor on samples selected from normal production lots of qualified cooling coils.

4.4.1 Lot. Cooling coils of the same type, class, size, and composition from the same production run shall be considered a lot.

4.4.2 Sample. Sample cooling coils shall be selected at random from each lot in accordance with table VI.

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TABLE VI. Sampling for quality conformance inspection.

Lot size number of units	Sample size number of units	Defective cooling coils	
		Acceptance number	Rejection number
1 to 13	All	-	-
14 to 40	13	0	1
41 to 110	22	1	2
111 to 300	30	2	3
301 and above	36	3	4

4.4.3 Inspection routine. Sample units shall be subjected to the quality conformance inspections specified in table V.

4.4.4 Rejected lots. If a lot is rejected, the contractor may correct or screen out the defective units, and resubmit the lot for acceptance. The contractor shall disclose that the resubmitted lot was rejected. All cooling coils in a rejected lot shall be inspected.

4.4.5 Noncompliance. If a sample fails to pass group A inspections, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes, or both, as warranted, and on all units of product which can be corrected and which were manufactured with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action, acceptable to the qualifying activity, has been taken. After the corrective action has been taken, group A inspections shall be repeated on additional sample units (all examinations, or the examination which the original sample failed, at the option of the qualifying activity). In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.5 Examinations and tests.

4.5.1 Visual and dimensional examinations. Each cooling coil selected in accordance with 4.3 or 4.4 shall be examined and measured to verify compliance with the requirements of this specification. The classification of defects in table VII is the minimum that is to be considered in the examination. Any cooling coil that contains one or more defects shall be rejected.

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TABLE VII. Defects.

Categories	Defects
Critical:	None defined.
Major:	
101	Size, class, and type not as specified.
102	Physical dimensions not as shown in drawings or limiting dimensions exceeded.
103	Materials defective or not as specified.
104	Not in accordance with approved drawings.
105	Incomplete, component parts missing or improperly assembled.
106	Corners of flanges not smooth and airtight.
107	Flange holes for duct not as specified.
108	Tube sheets exceed 26-inch maximum spacing.
109	Coil baffle (as applicable) missing or not as shown in drawings.
110	Drain pan missing or not as specified.
111	Drain tubes not secured to the coil.
112	Hose connections on drain pan (as applicable) not as shown in drawings.
113	Bolts, nuts, and screws not tight or missing (parts shall be properly fastened and secured).
114	Mounting dimensions for mounting hangers or support channels not as specified.
115	Welding incomplete, not continuous, not free of cracks, non-fusion, heavy porosity, heavy undercut, slag inclusions, improper weld metal.
116	Tube construction not as specified.
117	Tube wall thickness or header wall thickness less than specified minimum.
118	U-bends not maintaining minimum wall thickness or internal diameter.
119	Header end disc and end disc plate (as applicable) not as shown on drawings.
120	Connection stub of header (as applicable) not secured to coil frame.
121	Fin thickness and spacing not as specified, or fins not tight on tubes.
122	Ferrules missing or not as specified.
123	Fin collars and tube sheets not free of cracks and burrs.
124	Supply and return connections not secured to frame or casing.
125	Vent and drain lines (as applicable) not as shown on standard drawing.
126	Brazing material not as specified or brazing of poor quality.
127	Thermal insulation (as applicable) missing or not as specified.

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TABLE VII. Defects - Continued.

Categories	Defects
128	Painting (as applicable) non-conforming.
129	Marking, identification plate incomplete, missing, not permanent, illegible, or not as specified.
130	Workmanship not conforming to the specification.
Minor:	None defined.

4.5.2 Shock test. Cooling coils shall be shock tested on the medium weight machine as specified for type A in accordance with MIL-S-901 if its weight with fixture and mounting bracket exceeds 550 pounds or if the mounting bracket extends beyond the anvil; otherwise, they shall be shock tested on the light weight machine as specified for type A in accordance with MIL-S-901. A hydrostatic pressure of at least 100 lb/in² shall be maintained on the cooling element of the cooling coil during the shock tests. The shock test shall be conducted prior to the tests specified in 4.5.3 through 4.5.6. Further testing shall not be performed until the cooling coil passes the shock test. Evidence of fragmentation or missile effects of parts, deformation of parts that will cause active interference between parts, or leakage of the cooling element, shall be cause for rejection.

4.5.3 Vibration test. Cooling coils shall be subjected to type I environmental vibration tests as specified in MIL-STD-167-1. The exploratory vibration test specified in MIL-STD-167-1 shall include frequencies up to and including 33 hertz (Hz) at the table amplitude specified therein. The vibration test shall be conducted prior to the tests specified in 4.5.4 through 4.5.6. The cooling coil shall not be damaged or malfunction as a result of environmental vibration.

4.5.4 Capacity test. When specified, DW cooling coils shall be tested in accordance with ASHRAE 33 to determine the capacity at conditions specified in 3.7.3. Coils that fail to meet the minimum requirements of 3.7.3 shall not be offered for delivery.

4.5.4.1 Alternate test conditions. If tests are conducted at conditions other than those specified in 3.7.3, a manufacturer shall use the procedure in ARI 410 to calculate the air side thermal resistance. Four nonsensible and four sensible cooling load tests, as required by ARI 410 and tested in accordance with ASHRAE 33 shall be used for rating the coil.

4.5.5 Air distribution test. The outlet airflow shall be tested to ensure uniform air distribution across the face of the coil. Air velocity across the face of the coil during this test shall not be less than 400 ft/min. The air distribution test shall consist of taking either air velocity measurements with a calibrated hot wire anemometer or velocity pressure measurements with a pitot

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tube. Measurements shall be taken at points shown on figure 1, using the 16 point traverse method. Measurements shall be taken not more than 12 inches from the coil face. The average air velocity shall vary not more than 20 percent between any quadrant of the coil face. Measurement techniques shall be in accordance with SMACNA Testing, Balancing, and Adjusting of Environmental Systems.

4.5.6 Leakage test. The cooling coil shall be tested in accordance with ASME Boiler and Pressure Vessel Code, section VIII, division I for a working pressure of 200 lb/in² for DW and GW coils and 73 lb/in² for DWS coils. The cooling element shall be drained and filled with air or gas at a pressure not less than 50 lb/in² and immersed in water to determine whether leaks have developed. Any cooling coil in which there is evidence of leakage when tested shall not be offered for delivery.

4.6 Inspection of packaging. Sample packs and the inspection of preservation, 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 6.7.)

5.1 Preservation. Preservation shall be level A or commercial as specified (see 6.2).

5.1.1 Level A. Each cooling coil shall be cleaned by process C-1, dried by procedure D-1, and unit protected in accordance with method IC of MIL-P-116 and as follows:

- (a) Each coil shall be flushed to remove flux, loose particles, dirt and oil. Flushing for cleanliness shall be accomplished prior to hydrostatic testing.
- (b) Each coil shall be thoroughly drained and blown out by clean, dry, compressed air.
- (c) Open ends of the coil piping shall be sealed to prevent the entrance of dirt and moisture.
- (d) The fins shall be protected to prevent damage during shipping and handling.

5.1.2 Commercial. Commercial packaging (cleaning, drying, preservation, and unit pack) shall be in accordance with ASTM D 3951.

5.2 Packing. Packing shall be level A, B, C or commercial as specified (see 6.2).

5.2.1 General requirements for levels A, B, and C. Containers selected (see 5.2.2) shall be of minimum weight and cube consistent with the protection required, and of uniform size.

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5.2.1.1 Anchoring, blocking, bracing, and cushioning. Anchoring, blocking, bracing, and cushioning of the container contents shall be in accordance with the appendix to the container specification and MIL-STD-1186.

5.2.2 Levels A, B, and C containers. Each cooling coil preserved as specified (see 5.1), shall be individually packed in an exterior wood or plywood box or crate shipping container, for the level of packing specified (see 5.2), in accordance with table VII, exterior shipping container requirements, of MIL-STD-2073-1, appendix C, and herein. Unless otherwise specified (see 6.2), container selection and options shall be at the contractor's option.

5.2.2.1 Caseliners, closure and gross weight.

5.2.2.1.1 Caseliners. When specified (see 6.2), level A shipping containers containing items preserved commercial (see 5.1.2) shall be provided with water-proof caseliners in accordance with MIL-STD-2073-1.

5.2.2.1.2 Closure. Container closure, reinforcing, or banding shall be in accordance with the applicable container specification or appendix thereto.

5.2.2.1.3 Weight. Wood, plywood, and cleated type containers (boxes) exceeding 200 pounds gross weight shall be modified by the addition of skids in accordance with MIL-STD-2073-1 and the applicable container specification or appendix thereto.

5.2.3 Commercial. Each cooling coil preserved as specified (see 5.1) shall be packed for shipment in accordance with ASTM D 3951 and herein.

5.2.3.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical handling equipment during shipment, stowage and storage.

5.3 Marking, levels A, B, C, and commercial. In addition to any special marking required (see 6.2), interior (unit) packs and shipping containers shall be marked for shipment and storage in accordance with MIL-STD-2073-1, appendix F.

6. NOTES

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

6.1 Intended use. Duct type and gravity type air cooling coils are intended for use in heating, ventilating, and air conditioning systems on board Navy ships.

6.2 Acquisition requirements. Acquisition documents must specify the following:

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- (a) Title, number, and date of this specification.
- (b) Issue of DoDISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- (c) Type, class, size and composition required (type and class see 1.2; size see 3.4.3, 3.5.4, or 3.6.3; composition see 3.5.1 and 3.5.1.2, or 3.6.1 and 3.6.1.2).
- (d) Modification for special application, if a cooling fluid other than as specified is to be used, or if construction is other than as shown on applicable drawings (see 3.4.2, 3.5.2, and 3.6.2).
- (e) For DWS coils, if a removable box type header is to be attached to the return end of the cooling element (see 3.5.2.11.2.1).
- (f) Supply and return connections if other than as specified or shown on applicable drawings (see 3.5.2.11.3 or 3.4.2.11.4).
- (g) For DW coils, capacity test conditions if other than as specified (see 3.7.3).
- (h) Level of preservation and packing required (see 5.1 and 5.2).
- (i) Container selection if other than contractors option (see 5.2.2).
- (j) When caseliners are not required (see 5.2.2.1.1).
- (k) Special marking required (see 5.3).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List No. 2939 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Sea Systems Command, SEA 5523, Department of the Navy, Washington, DC 20362-5101 and information pertaining to qualification of products may be obtained from that activity. Application for qualification tests must be made in accordance with "Provisions Governing Qualification SD-6" (see 6.3.1).

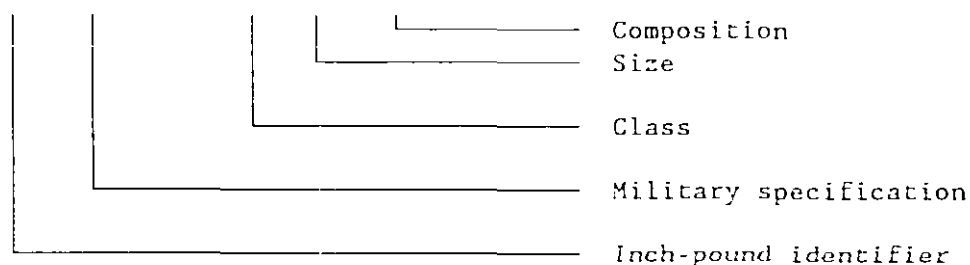
6.3.1 Copies of "Provisions Governing Qualification SD-6" may be obtained upon application to Commanding Officer, Standardization Documents Order Desk, BLDG. 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

6.4 Defective units. If the number of defective cooling coils in any sample exceeds the acceptance number in table VI for that sample, the lot represented by the sample should be rejected.

6.5 Part or identifying number (PIN). Cooling coils should be identified by a code number arranged sequentially by Military specification, class, size, and composition as defined in 1.2 and the following example:

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M 2939 - 1 68 N



6.6 Cross-reference of classifications. Table VIII cross-references the cooling coil classifications used in the superseded issue of this specification to the new issue.

TABLE VIII. Cross-reference of classifications.

MIL-C-2939E(SH)	MIL-C-2939F(SH)
Type I - Cooling coil, air	Duct
Style A - Duct	DISCONTINUED CLASSIFICATION
Class 1 - Chilled water (DW)	Class 1 - Chilled water (DW)
	Size
Class 2 - Refrigerant (DF)	DISCONTINUED CLASSIFICATION
Class 3 - Seawater (DWS)	Class 2 - Seawater (DWS)
Size	Size
Composition a - Magnetic	Composition M - Magnetic
Composition b - Nonmagnetic	Composition N - Nonmagnetic
Style B - Gravity	Gravity
Class 1 - Chilled water (CW)	Class 3 - Chilled water (CW)
	Size
	Composition M - Magnetic
	Composition N - Nonmagnetic
Class 2 - Refrigerant (GF)	DISCONTINUED CLASSIFICATION
Size	DISCONTINUED CLASSIFICATION
Composition a - Magnetic	DISCONTINUED CLASSIFICATION
Composition b - Nonmagnetic	DISCONTINUED CLASSIFICATION
Type II - Unit coolers	DISCONTINUED CLASSIFICATION
Class 1 - Chilled water (UW)	DISCONTINUED CLASSIFICATION
Class 2 - Refrigerant (UF)	DISCONTINUED CLASSIFICATION
Size	DISCONTINUED CLASSIFICATION
Composition a - Magnetic	DISCONTINUED CLASSIFICATION
Composition b - Nonmagnetic	DISCONTINUED CLASSIFICATION

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6.7 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.

6.8 Subject term (key word) listing.

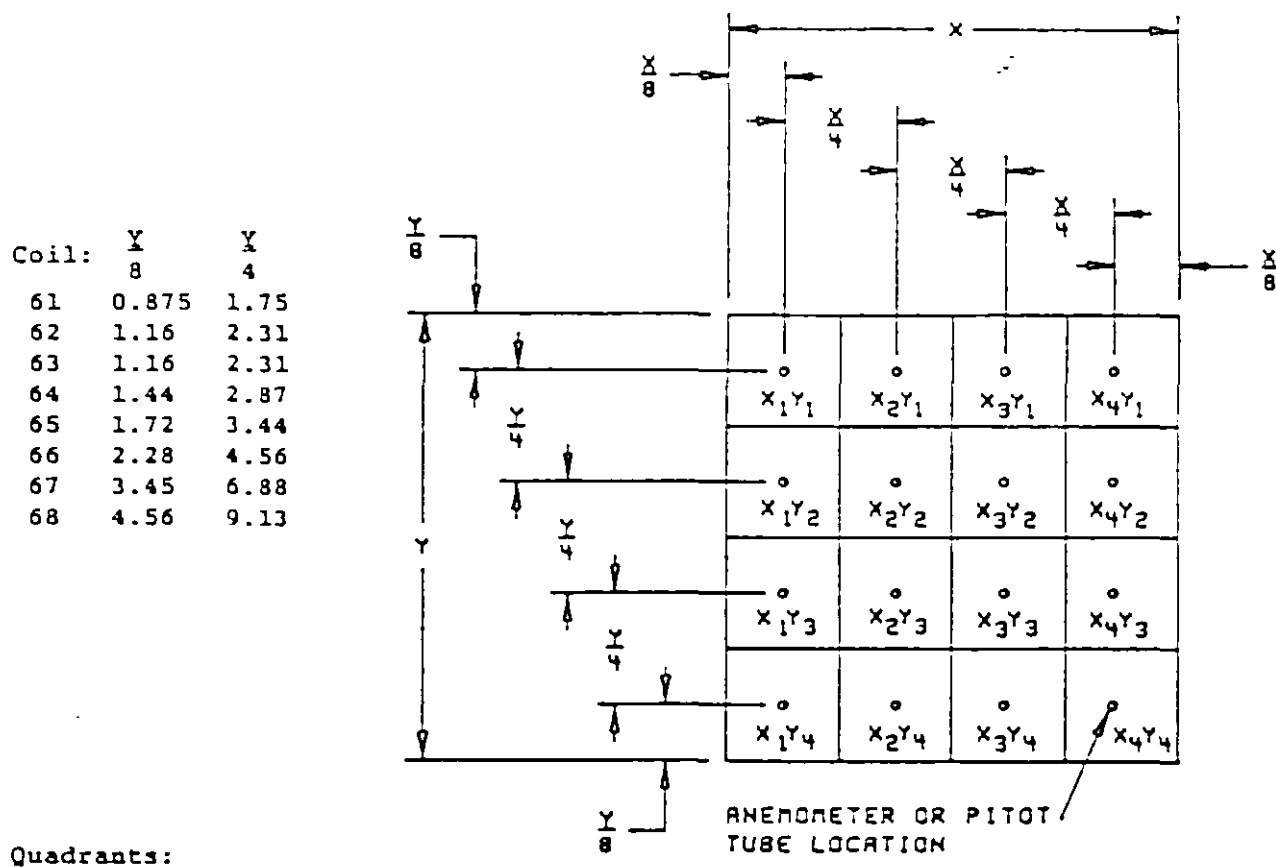
Air conditioning
Chilled water
Dehumidifying
Heat exchanger
Heat transfer
Heating
HVAC
Seawater
Ventilation

6.9 Changes from previous issue. Marginal notations 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 4130-N309)

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Coil:	61	62	63	64	65	66	67	68
$\frac{X}{8}$	1.47	1.75	2.63	3.13	3.94	4.94	4.94	4.94
$\frac{Y}{4}$	2.94	3.50	5.25	6.25	7.87	9.88	9.88	9.88



Quadrants:

$$\text{I: } [X_1Y_1 + X_2Y_1 + X_1Y_2 - X_2Y_2] \frac{1}{4}$$

$$\text{II: } [X_3Y_1 + X_4Y_1 + X_3Y_2 - X_4Y_2] \frac{1}{4}$$

$$\text{III: } [X_1Y_3 + X_2Y_3 + X_1Y_4 - X_2Y_4] \frac{1}{4}$$

$$\text{IV: } [X_3Y_3 + X_4Y_3 + X_3Y_4 - X_4Y_4] \frac{1}{4}$$

FIGURE 1. 16 point traverse for cooling coils.

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:

1. DOCUMENT NUMBER

MIL-G-2939F(SH)

2. DOCUMENT DATE (YYMMDD)

31 December 1990

3. DOCUMENT TITLE COOLING COILS, AIR, DUCT TYPE AND GRAVITY TYPE, NAVAL SHIPBOARD ENVIRONMENTAL CONTROL SYSTEMS

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

6. SUBMITTER

a. NAME (Last, First, Middle Initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)

(1) Commercial

(2) AUTOVON

(If applicable)

7. DATE SUBMITTED (YYMMDD)

8. PREPARING ACTIVITY

a. NAME Technical Point of Contact (TPOC):

Mr. Saavedra (SEA 56Y11)

PLEASE ADDRESS ALL CORRESPONDENCE AS FOLLOWS:

b. TELEPHONE (Include Area Code)

(1) Commercial

(2) AUTOVON

TPOC: (703) 602-5487 8-332-5487

c. ADDRESS (Include Zip Code)

Commander, Naval Sea Systems Command
Department of the Navy (SEA 5523)
Washington, DC 20362-5101

IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:

Defense Quality and Standardization Office
5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466
Telephone (703) 756-2340 AUTOVON 289-2340