

MIL-C-16388C(SHIPS)
15 December 1965SUPERSEDING
MIL-C-16388B(SHIPS)
28 May 1954
(See 6.3)

MILITARY SPECIFICATION

COOLERS, FLUID, NAVAL SHIPBOARD (HULL COOLERS)

1. SCOPE

1.1 Scope. - This specification covers hull mounted engine jacket water coolers for Naval shipboard application.

1.2 Classification. - Coolers shall be of the following classes and sizes, unless otherwise specified (see 6.1) coolers shall be class B.

Class A - See 3.2.1
 Class B - See 3.2.2
 Class C - See 3.2.3
 Class D - See 3.2.4
 Size 40 - See 3.7.11.1
 Size 50 - See 3.7.11.2
 Size 100 - See 3.7.11.3
 Size 150 - See 3.7.11.4
 Size 180 - See 3.7.11.5
 Size 300 - See 3.7.11.6
 Size 301 - See 3.7.11.7

2. APPLICABLE DOCUMENTS

2.1 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.

SPECIFICATIONS

FEDERAL

FF-P-386 - Pins, Cotter (Split).
 QQ-A-200/6 - Aluminum Alloy Bar, Rod, Shapes, and Tube, Extruded 5454.
 QQ-A-200/8 - Aluminum Alloy Bar, Rod, Shapes, and Tube, Extruded, 6061 and 6062.
 QQ-A-225/8 - Aluminum Alloy Bar, Rod, Wire, and Special Shapes; Rolled, Drawn, or Cold Finished 6061.
 QQ-B-679 - Bronze, Aluminum; Rod, Flat Products With Finished Edges (Flat Wire, Strip, and Bar), Shapes, and Forgings.
 QQ-B-750 - Bronze, Phosphor; Bar, Plate, Rod, Sheet, Strip, Flat Wire, and Structural and Special Shaped Sections.
 QQ-C-450 - Copper-Aluminum Alloy (Aluminum Bronze) Plate, Sheet, Strip, and Bar Copper Alloy Numbers 606, 612, 613, 614, and 628).
 QQ-C-591 - Copper-Silicon, Copper-Zinc-Silicon, and Copper-Nickel-Silicon Alloy; Rod, Wire, Shapes, Forgings, and Flat Products, (Flat Wire, Strip, Sheet, Bar, and Plate).

MILITARY

MIL-B-857 - Bolts, Nuts and Studs.
 MIL-D-963 - Drawings, Electrical, Hull and Mechanical Equipment for Naval Shipboard Use.
 MIL-R-1149 - Rubber Sheets, Strips, and Gaskets; Solid, Synthetic, Medium and Medium Hard.

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- MIL-T-15005 - Tubes, 70-30 and 90-10 Copper Nickel Alloy, Condenser and Heat Exchanger.
 MIL-P-15137 - Provisioning Technical Documentation for Repair Parts for Electrical and Mechanical Equipment (Naval Shipboard Use).
 MIL-C-15726 - Copper-Nickel Alloy Rod, and Flat Products (Flat Wire, Strip, Sheet, Bar, and Plate).
 MIL-T-16420 - Tube, 70-30 and 90-10 Copper-Nickel Alloy, Seamless and Welded.
 MIL-M-16576 - Metal, Gun: Castings.
 MIL-A-18001 - Anodes, Corrosion Preventive, Zinc; Slab Disc and Rod Shaped.

STANDARDS

MILITARY

- MIL-STD-278 - Welding and Allied Processes for Machinery for Ships of the United States Navy.

PUBLICATIONS

BUREAU OF SHIPS

- NAVSHIPS 0900-001-7000 - Fabrication and Inspection of Brazed Piping Systems.

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

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

OFFICIAL CLASSIFICATION COMMITTEE

Uniform Freight Classification Ratings, Rules and Regulations.

(Application for copies should be addressed to the Official Classification Committee, 1 Park Avenue at 33rd Street, New York, N. Y. 10016.)

NATIONAL BUREAU OF STANDARDS

Handbook H28 - Screw-Thread Standards for Federal Services.

(Application for copies should be addressed to the Superintendent of Documents, Government Printing Office, Washington, D. C. 20401.)

3. REQUIREMENTS

3.1 Preproduction sample. - Prior to beginning production a sample cooler shall be inspected as specified in 4.2 (see 6.2).

3.2 Materials. - The materials used in the construction of hull coolers shall be as specified herein for the individual class.

3.2.1 Class A. - Materials for class A coolers shall be as specified in table I.

Table I - Materials for class A coolers.

Part	Material	Specification
Basic cooler except tubes	Copper-nickel alloy, composition 70-30	MIL-C-15726 or MIL-T-16420
Tubes or tube elements	Copper-nickel alloy, composition 70-30	MIL-T-15005 ¹ / or MIL-C-15726

See footnotes at end of table.

Table I - Materials for class A coolers (cont'd.).

Part	Material	Specification
Housing	Copper-nickel alloy, composition 70-30	MIL-C-15726
Protective anodes	Zinc, type ZPN	MIL-A-18001
Bolts, studs, nuts ^{2/} , and washers	Copper-nickel alloy, composition 70-30	MIL-C-15726
	Bronze, aluminum; composition 5, stress relieved.	QQ-B-679
	Phosphor bronze; composition A or D, or Copper silicon alloy	QQ-B-750
Pins, cotter (split)	Commercial brass, type A	QQ-C-591
Gaskets	Synthetic rubber	FF-P-386 MIL-R-1149

^{1/} (a) When tubes of either rectangular or obround cross section are used, the following exceptions to MIL-T-15005 will apply:

- (1) Requirements for outside diameter, wall thickness, and expansion test are not applicable.
- (2) The hydrostatic test pressure shall be the same as that required for the completed cooler.
- (3) A tolerance of plus 0.000 inch and minus 0.005 inch of the specified outside dimensions will be permitted.

(b) When tubes of rectangular cross section are used, the following additional exception to MIL-T-15005 will apply:

- (1) Requirements for the flattening test are not applicable.

^{2/} Form of bolts, studs, and nuts shall be in accordance with MIL-B-857. Gun metal in accordance with MIL-M-16576 is an acceptable alternate material for nozzle nuts.

3.2.2 Class B. - Materials for class B coolers shall be as specified in table I except copper-nickel alloy shall be composition 90-10.

3.2.3 Class C. - Materials for class C coolers shall be as specified in table II.

Table II - Materials for class C coolers.

Part	Material	Specification
Basic cooler except tubes	Copper-aluminum; alloy 614 ^{3/} or 613	QQ-C-450
Tubes ^{1/} or tube elements	Copper-aluminum; alloy 614 ^{3/} or 613	QQ-C-450
Housing	Copper-aluminum; alloy 614 ^{3/} or 613	QQ-C-450
Protective anodes	Zinc, type ZPN	MIL-A-18001
Bolts, studs, nuts ^{2/} , and washers	Bronze, aluminum; composition 5, stress relieved.	QQ-B-679
	Phosphor bronze; composition A or D, or Copper-silicon alloy	QQ-B-750
		QQ-C-591

See footnotes at end of table.

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Table II - Materials for class C coolers (cont'd.).

Part	Material	Specification
Pins, cotter, (split)	Commercial brass, type A	FF-P-386
Gaskets	Synthetic rubber	MIL-R-1149

- 1/ Tubes shall be in accordance with MIL-T-15005 with the following exceptions:
- (a) Requirements for chemical composition and wall thickness are not applicable.
 - (b) When tubes of rectangular or obround cross section are used the following apply:
 - (1) Requirements for outside diameter and expansion test are not applicable.
 - (2) The hydrostatic test shall be the same as that required for the cooler.
 - (3) A tolerance of plus 0.000 inch and minus 0.005 inch of the specified outside dimensions will be permitted.
 - (c) When tubes of rectangular cross section are used, the following additional exception to MIL-T-15005 will apply:
 - (1) Requirements for the flattening test are not applicable.
- 2/ Form of bolts, studs, and nuts shall be in accordance with MIL-B-857. Gun metal in accordance with MIL-M-16576 is an acceptable alternate material for nozzle nuts.
- 3/ Parts fabricated of alloy 614 copper-aluminum shall be adequately stress relieved after welding to prevent stress corrosion cracking.

3.2.4 Class D. - Materials for class D coolers shall be as specified in table III.

Table III - Materials for class D coolers.

Part	Material	Specification
Tubes and headers	Aluminum Alloy 5454	QQ-A-200/6
Bolts, nuts, studs and washers <u>1/</u>	Aluminum Alloy 6061 Temper T6510.	QQ-A-200/8 or
	Aluminum Alloy 6061, Temper T651.	QQ-A-225/8
Gaskets	Synthetic rubber	MIL-R-1149
Pins, cotter (split)	Aluminum	Commercial

- 1/ Form of bolts, studs, and nuts shall be in accordance with MIL-B-857.

3.3 Threaded parts. - Threaded parts shall conform to Handbook H28. Designs shall permit the use of standard wrenches throughout. A number 2 fit shall be used as the general working fit. Bolts and studs shall not be less than 1/2 inch in diameter. Threading of nozzles and support studs shall permit nuts to run down to within 1/2 inch of header or support.

3.4 Welding and allied processes. - Welding and allied processes shall be in accordance with MIL-STD-278. Brazing shall be in accordance with NAVSHIPS 0900-001-7000, except that requirements for use of preinserted brazing rings are applicable only to pipe fittings. Brazing will not be permitted on class D coolers.

3.5 Space and weight. - In all designs space and weight shall be held to a minimum consistent with strength and reliability of the coolers.

3.6 Hydrostatic or air pressure. - Coolers shall be designed to withstand the hydrostatic or air pressure tests specified in 4.3.2.

3.7 Design and construction. -

3.7.1 Interchangeability. - Interchangeability of cooler parts shall be achieved wherever possible. Particular attention shall be given to developing interchangeability of zincs.

3.7.2 Coolers shall be constructed of straight tubes welded or brazed into headers, or passages for the cooled fluid shall be constructed of formed plate similarly secured to headers. Tubes of round, round flattened on two sides, or rectangular, section may be used. Tube wall or formed plate thickness shall be a minimum of 0.062 inch. Packed joints will not be acceptable.

3.7.3 Headers shall be not less than 1/8 inch thick.

3.7.4 Ambient cooling water temperature shall be assumed to be 85° F. for design purposes.

3.7.5 The amount of cooling surface provided in all coolers shall be based on the service specified (see 3.7.11), applying a 10 percent fouling factor to the heat transfer coefficient for clean tubes.

3.7.6 Adequate provision shall be made for draining the cooler. Drain connections shall not project more than 1/4 inch below the bottoms of the headers. To achieve this dimension, 1/8 inch iron pipe size tapped drains with slotted head pipe plugs will be acceptable.

3.7.7 Housings shall not be furnished.

3.7.8 Protective anodes (not applicable to class D coolers). - The design of the cooler shall provide for protective anodes (zincs) as a safeguard against galvanic corrosion. Anodes shall be installed in such a way to permit ready disassembly from the cooler for cleaning or replacement. The anodes shall be in the form of 1/2-inch thick plate. Each anode shall be secured against bosses on the cooler header, the face of each boss having a minimum of two sharp concentric ridges at least 1/16 inch high machined on them. The zinc shall be secured by stud, washer, nut, and split cotter pin, or by a washer and tap bolt. The face of the washer toward the zinc shall be ridged as described above. Two of such fastenings may be used per anode where desirable. An anode shall be provided at each end of the cooler. Requirements for zinc anodes specified herein and throughout this specification are not applicable to class D coolers.

3.7.9 Gaskets. - Gaskets shall be 1/8 inch thick. Gaskets shall be provided for the joints between boat hull and tops of headers and center supports, and also to go inside the hull under the nozzle and support stud washers.

3.7.10 Nozzles, nuts and washers. - Hexagonal nuts and separate washers shall be furnished for the threaded portion of each nozzle.

3.7.11 Dimensions and performance requirements. - Coolers as designated by size shall conform to the following dimensions and performance requirements. These dimensions have been established to maintain standardization and interchangeability and should not be altered without specific approval of the Bureau of Ships.

3.7.11.1 Size 40 cooler. - The cooler shall be of two pass design. The inlet and outlet nozzles shall be located 1-1/2 inches from one end of the cooler, shall be 3 inches apart equidistant (1-1/2 inches) from the cooler center line, and shall lead from the header at right angles to the plane of the tubes or tube elements. These nozzles shall be threaded with a 1-inch straight pipe thread to a distance of 2-1/8 inches from the header. An additional length of each nozzle shall extend 3 inches from the threaded portion to provide a hose connection. This additional length of nozzle shall be 1-inch outside diameter (O. D.) and shall be formed out at the end to provide a bead 1-1/16 inches O. D. , in order to better secure the hose and clamps. One and one half inches from the other end of the cooler there shall be provided two 5/8 inch diameter studs with nuts and washers. These studs shall be 3 inches apart and equidistant (1-1/2 inches) from the cooler center line. The studs shall extend upward 2-1/8 inches from the top of this header. The overall height of the cooler shall be 1-3/4 inches exclusive of nozzles, studs and zinc anodes. The zinc anodes and their fastenings may extend an additional 1-5/16 inches below the bottom of the cooler. The overall length of the cooler shall be 2 feet - 3 inches exclusive of zinc anodes. The zinc anodes may extend an additional 3/8 inch at either end if desirable. The overall width of the cooler shall be 5-3/8 inches.

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- (a) Engine application. The size 40 cooler is intended for jacket water cooling of the Navy DA engine.
- (b) Fluid to be cooled, fresh water.
- (c) Rate of flow of fresh water, 8.5 gallons per minute (g. p. m.).
- (d) Inlet temperature of fresh water, 165°F.
- (e) Outlet temperature of fresh water, 140°F.
- (f) For design purposes assume a boat speed of 7 knots at full power operation.
- (g) Allowable design point pressure drop of fresh water, 2 pounds per square inch (p. s. i.).
- (h) Hydrostatic test pressure for cooler, 50 p. s. i.

3.7.11.2 Size 50 cooler. - The cooler shall be of single pass design. Nozzles, 2 feet by 3 inches apart center to center, shall lead, at right angles to the plane of tubes, from the headers. These nozzles shall be threaded with a 1-1/2 inch straight pipe thread to a distance of 2-1/8 inches from the headers. An additional length of the nozzle shall extend 3 inches from this threaded portion to provide a hose connection. This additional length of nozzle shall be 1-1/2 inches O. D. and shall be formed out at the end to provide a bead 1-9/16 inches O. D., in order to better secure the hose and clamps. No center support for the cooler is required. The overall height of the cooler shall be 1-3/4 inches exclusive of nozzles, studs and zinc anodes. The zinc anodes and fastenings may extend an additional 1-5/16 inches below the bottom of the cooler. The overall length of the cooler shall be 2 feet - 6 inches exclusive of zinc anodes. The zinc anodes may extend an additional 3/8 inch at either end if desirable. The overall width of the cooler shall not exceed 5-5/8 inches.

- (a) Engine application. The size 50 cooler is intended for jacket water cooling of a 50 horsepower (HP) engine.
- (b) Fluid to be cooled, fresh water.
- (c) Rate of flow of fresh water, 28 gallons per minute (g. p. m.)
- (d) Inlet temperature of fresh water, 190°F.
- (e) Outlet temperature of fresh water, 176°F.
- (f) For design purposes assume a boat speed of 7-1/2 knots at full power operation.
- (g) Allowable design point pressure drop of fresh water, less than 2 p. s. i. Pressure drop shall not exceed 2 p. s. i. when flow rate is increased to 35 g. p. m.
- (h) Hydrostatic test pressure for cooler, 50 p. s. i.

3.7.11.3 Size 100 cooler. - The cooler shall be of single pass design. Nozzles, 4 feet - 0 inch apart center to center, shall lead, at right angles to the plane of tubes, from the headers. These nozzles shall be threaded with a 1-1/2 inch straight pipe thread to a distance of 2-1/8 inches from the headers. An additional length of the nozzle shall extend 3 inches from this threaded portion to provide a hose connection. This additional length of nozzle shall be 1-1/2 inches O. D. and shall be formed out at the end to provide a bead 1-9/16 inches O. D. in order to better secure the hose and clamps. A center support for the cooler shall be provided. To attach this to the boat hull there shall be provided two 1/2 inch diameter studs with nuts and washers. These studs shall be located on a line midway between the nozzles and shall be 4-5/16 inches apart, equidistant from the cooler center line. The top of the center support shall be in the plane of the tops of the headers. The studs shall extend upward 2-1/8 inches from the top of the center support. The overall height of the cooler shall be 1-3/4 inches exclusive of nozzles, studs and zinc anodes. The zinc anodes and fastenings may extend an additional 1-5/16 inches below the bottom of the cooler. The overall length of the cooler shall be 4 feet - 3 inches exclusive of zinc anodes. The zinc anodes may extend an additional 3/8 inch at either end if desirable. The overall width of the cooler shall be 5-5/8 inches.

- (a) Engine application. The size 100 cooler is intended for jacket water cooling of a 100 HP engine.
- (b) Fluid to be cooled, fresh water.
- (c) Rate of flow of fresh water, 60 g. p. m.
- (d) Inlet temperature of fresh water, 190°F.
- (e) Outlet temperature of fresh water, 177°F.
- (f) For design purposes assume a boat speed of 7-1/2 knots at full power operation.
- (g) Allowable design point pressure drop of fresh water, 7 p. s. i. Pressure drop shall not exceed 2 p. s. i. when flow rate is reduced to 40 g. p. m.
- (h) Hydrostatic test pressure for cooler, 50 p. s. i.

3.7.11.4 Size 150 cooler. - The cooler shall be of single pass design. Nozzles, 4 feet - 6 inches apart, center to center, shall lead, at right angles to the plane of tubes, from the headers. These nozzles shall be threaded with a 2 inch straight pipe thread to a distance of 2-3/8 inches from the headers. An

additional length of the nozzle shall extend 3 inches from this threaded portion to provide a hose connection. This additional length of nozzle shall be 2 inches O.D. and shall be formed out at the end to provide a bead 2-1/16 inches O.D., in order to better secure the hose and clamps. A center support for the cooler shall be provided. To attach this to the boat hull there shall be provided two 1/2 inch diameter studs with nuts and washers. These studs shall be located on a line midway between the nozzles and shall be 5-5/8 inches apart, equidistant from the cooler center line. The top of the center support shall be in the plane of the tops of the headers. The studs shall extend upward 2-1/4 inches from the top of the center support. The overall height of the cooler shall be 1-15/16 inches exclusive of nozzles, studs and zinc anodes. The zinc anodes and fastenings may extend an additional 1-5/16 inches below the bottom of the cooler. The overall length of the cooler shall be 4 feet - 9-1/2 inches exclusive of zinc anodes. The zinc anodes may extend an additional 3/8 inch at either end if desirable. The overall width of the cooler shall be 7-5/16 inches:

- (a) Engine application. The size 150 cooler is intended for jacket water cooling of the Gray Marine 64HN9 engine.
- (b) Fluid to be cooled, fresh water.
- (c) Rate of flow of fresh water, 85 g.p.m.
- (d) Inlet temperature of fresh water, 180°F.
- (e) Outlet temperature of fresh water, 165°F.
- (f) For design purposes assume a boat speed of 7-1/2 knots at full power operation.
- (g) Allowable design point pressure drop of fresh water, 5 p.s.i.
- (h) Hydrostatic test pressure for cooler, 50 p.s.i.

3.7.11.5 Size 180 cooler. - The cooler shall be of single pass design. Nozzles, 5 feet - 0 inches apart center to center, shall lead at right angles to the plane of tubes, from the headers. These nozzles shall be threaded with a 2 inch straight pipe thread to a distance of 2-3/8 inches from the headers. An additional length of the nozzle shall extend 3 inches from this threaded portion to provide a hose connection. This additional length of nozzle shall be 2 inches O.D. and shall be formed out at the end to provide a bead 2-1/16 inches O.D., in order to better secure the hose and clamps. A center support for the cooler shall be provided. To attach this to the boat hull there shall be provided two 1/2 inch diameter studs with nuts and washers. These studs shall be located on a line midway between the nozzles and shall be 5-5/8 inches apart, equidistant from the cooler center line. The top of the center support shall be in the plane of the tops of the headers. The studs shall extend upward 2-1/4 inches from the top of the center support. The overall height of the cooler shall be 1-15/16 inches exclusive of nozzles, studs and zinc anodes. The zinc anodes and fastenings may extend an additional 1-5/16 inches below the bottom of the cooler. The overall length of the cooler shall be 5 feet - 3-1/2 inches exclusive of zinc anodes. The zinc anodes may extend an additional 3/8 inch at either end if desirable. The overall width of the cooler shall be 7-5/16 inches:

- (a) Engine application. The size 180 cooler is intended for jacket water cooling of the Detroit Diesel 64HN10 engine.
- (b) Fluid to be cooled, fresh water.
- (c) Rate of flow of fresh water, 85 g.p.m.
- (d) Inlet temperature of fresh water, 180°F.
- (e) Outlet temperature of fresh water, 164°F.
- (f) For design purposes assume a boat speed of 7-1/2 knots at full power operation.
- (g) Allowable design point pressure drop of fresh water, 5 p.s.i.
- (h) Hydrostatic test pressure for cooler, 50 p.s.i.

3.7.11.6 Size 300 cooler. - The cooler shall be of single pass design. Nozzles, 7 feet - 0 inches apart, center to center, shall lead, at right angles to the plane of the tubes, from the headers. These nozzles shall be threaded with a 2-1/2 inch straight pipe thread for a distance of 4-1/2 inches from the headers. An additional length of the nozzle shall extend 2-1/2 inches from this threaded portion to provide a hose connection. This additional length of nozzle shall be 2-1/2 inches O.D. and shall have a bead 2-9/16 inches O.D. at its end, in order to better secure the hose and clamps. Two intermediate supports for the cooler shall be provided, being located 2 feet - 0 inch from the respective nozzle centers, and 3 feet - 0 inch apart. For attaching to the boat hull each of these intermediate supports shall be fitted with two 5/8 inch diameter studs with nuts and washers. The two studs on each support shall be 5-5/8 inches apart, equidistant from the cooler center line. The tops of the intermediate supports shall be in the plane of the tops of the headers. The studs shall extend upwards 4 inches from the tops of the supports. The overall height of the cooler shall be 2-3/4 inches exclusive of nozzles, studs and zinc anodes. The zinc anodes with their bosses and fastenings may extend an additional 1-5/16 inches below the bottom of the cooler. The overall

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length of the cooler shall be 7 feet - 4 inches exclusive of zinc anodes. The zinc anodes may extend an additional 3/8 inch at either end if desirable. The overall width of the cooler shall not exceed 7-5/16 inches:

- (a) Engine application. The size 300 cooler is intended for jacket water cooling of the Packard ZD-850 engine, or the Detroit Diesel 12-71 engine.
- (b) Fluid to be cooled, fresh water.
- (c) Rate of flow of fresh water, 100 g.p.m.
- (d) Inlet temperature of fresh water, 180° F.
- (e) Outlet temperature of fresh water, 160° F.
- (f) For design purposes assume a boat speed of 6-1/2 knots at full power operation.
- (g) Allowable design point pressure drop of fresh water, less than 5 p.s.i. Pressure drop shall not exceed 5 p.s.i. when flow rate is increased to 162 g.p.m.
- (h) Hydrostatic test pressure for cooler, 35 p.s.i.
- (i) Hull application. The size 300 cooler has relatively long nozzles and support studs and is suited to installation on wooden boats such as the MSB's.

3.7.11.7 Size 301 cooler. - This cooler shall be identical to the size 300 cooler, except that the threaded portion of the nozzles shall extend a distance of 2 inches from the headers, and the support studs shall extend upwards 2 inches from the tops of the supports:

- (a) Hull application. The size 301 cooler has relatively short nozzles and support studs and is suited to installation on steel boats such as the LCM (8)'s.

3.8 Manufacturer's service part number. - The manufacturer's service part number is defined as a constant number, assigned by the manufacturer, which is the infallible identification of a part wherever used. When it is the manufacturer's practice to assign part numbers to all pieces, these shall be recorded on the proper drawings. Where a complete part numbering system is not in use, the manufacturer shall assign service part numbers to each cooler and to each other part or subassembly which in his judgement may require replacement during the life of the unit. Such numbers shall then be recorded on the proper drawings.

3.9 Identification of coolers. - Coolers shall be permanently marked with data which shall include manufacturer's name, service part number, date of manufacture and Federal Stock Number. Consideration will be given to stamping this information on the cooler in lieu of providing an identification plate.

3.10 Stock repair parts. - The provisions of MIL-P-15137 shall be carried out for stock repair parts. No onboard repair parts will be required.

3.11 Drawings. -

3.11.1 Drawings shall be in accordance with MIL-D-963. The format for production drawings shall be used. Assembly and detail drawings shall be master drawings. Drawings shall be submitted for approval as soon as possible after award of contract. The initial submission of drawings shall consist of a complete set covering the design so that as far as practicable consecutive master drawing numbers can be assigned. Coolers and repair parts shall be manufactured in accordance with approved drawings. The dry weight of the cooler shall be shown in the first submission of working drawings.

3.11.2 Class A. - Master drawings shall show details of all equipment furnished. Sectional views and enlarged views shall be liberally employed to indicate details of parts, subassemblies and assemblies. The word "ASSEMBLY" shall appear in the title of the assembly drawing only. Where multiple detail views are shown on more than one sheet, the drawing titles shall be distinctive, that is; the title "DETAILS" will not be sufficient.

3.11.3 Class B. - One drawing shall be a certification data sheet. The designation "MASTER DRAWING" shall be omitted from the title block of this drawing. It shall be titled "DRAWING LIST AND PERFORMANCE DATA FOR HULL.....". (Type of cooler, for example, jacket water cooler, and its designation by model number or by service part number to be entered to complete the title.)

3.11.3.1 The "drawing list" tabulation shall include the following columns:

- (a) Drawing title.
- (b) Manufacturer's drawing number.
- (c) Revision symbol.

This list shall include all master drawings which comprise the given design. The revision symbol column shall be kept up-to-date to the time of manufacture so that it will finally indicate the latest revision of each drawing applicable to the equipment as built.

3.11.3.2 The "performance data" tabulation shall include the following information:

- (a) Identification of cooled medium.
- (b) Flow rate of cooled medium (g. p. m.).
- (c) Inlet temperature of cooled medium ($^{\circ}$ F.).
- (d) Outlet temperature of cooled medium ($^{\circ}$ F.).
- (e) Pressure drop of cooled medium through cooler (p. s. i.).
- (f) Velocity of cooled medium at inlet connection (feet per second (f. p. s.)).
- (g) Velocity of cooled medium through tubes (f. p. s.).
- (h) Number of passes of cooled medium through cooler.
- (i) Working pressure of cooled medium (pounds per square inch gage (p. s. i. g.)).
- (j) Test pressure p. s. i. g.
- (k) Logarithmic mean temperature difference, ($^{\circ}$ F.).
- (l) Heat transfer rates (British thermal units (B. t. u.) per hour per square foot per $^{\circ}$ F. logarithmic mean temperature difference).
 Service _____
 Clean tube _____
- (m) Cooling surface (square feet).
- (n) Heat transfer capacity at design point (B. t. u. per hour).
- (o) Boat speed in knots at design point. (If this figure is classified it may be omitted.)

3.11.3.3 The certification data shall include notes indicating the contract or order number, the application (service) of the unit, the number of coolers per ship and per unit of parent equipment, that is, per engine, and dry and wet weights of the cooler. The following examples illustrate the type of notes required:

- "(a) Bureau of Ships Contract NObs-1234 with ABC Engine Company; ABC Engine Company Purchase order 5678 on EFG Cooler Mfg. Co.
- "(b) Service: Jacket water cooling for main propulsion diesel engine.
- "(c) Two coolers per boat, one cooler per engine; or 12 coolers furnished as stock material.
- "(d) Dry weight of cooler _____pounds; wet weight of cooler _____pounds."

3.11.3.4 Above the title block of the certification data sheet there shall be entered the designations of the applicable ships or boat types.

3.12 Workmanship. - Workmanship shall be first class in every respect.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to 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 Quality program requirements. - The supplier shall provide and maintain a quality program acceptable to the Government. The program shall be in accordance with the appendix to this specification. The supplier is in no way relieved of the final responsibility to furnish coolers meeting the requirements of this specification.

4.2 Preproduction inspection. - A sample cooler of each size covered in the contract or order shall be inspected as specified in 4.2.1 through 4.3.2.

4.2.1 Performance test. - A performance test shall be conducted on the cooler under the design conditions of flow, B. t. u. removal, and temperatures of cooling medium.

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4.2.2 Pressure drop test. - The cooler shall be tested to determine pressure drop under various flow conditions.

4.2.3 Design, materials, and workmanship shall be evaluated and weight shall be determined.

4.3 Quality conformance inspection. -

4.3.1 Examination. - Each cooler offered for delivery shall be examined for alignment, fit, material, finish and conformance with the requirements of this specification not requiring tests.

4.3.2 Hydrostatic or air pressure test. - Each cooler offered for delivery shall be hydrostatically or air pressure tested as specified in 4.3.2.1 or 4.3.2.2.

4.3.2.1 Hydrostatic test. - The cooler shall be given a hydrostatic test. The test pressure shall be as specified for the particular size of cooler.

4.3.2.2 Air pressure test. - An air pressure test in which the cooler is subjected to an internal pressure equal to that specified for hydrostatic testing, and is submerged in water, may be substituted for the hydrostatic test.

5. PREPARATION FOR DELIVERY

5.1 Domestic shipment and early equipment installation. -

5.1.1 Coolers. -

5.1.1.1 Preservation and packaging. - Preservation and packaging, which may be the supplier's commercial practice, shall be sufficient to afford adequate protection against corrosion, deterioration and physical damage during shipment from the supply source to the using activity and until early installation.

5.1.1.2 Packing. - Packing shall be accomplished in a manner which will insure acceptance by common carrier at the lowest rate and will afford protection against physical or mechanical damage during direct shipment from the supply source to the using activity for early installation. The shipping containers or method of packing shall conform to the Uniform Freight Classification Ratings, Rules and Regulations or other carrier regulations as applicable to the mode of transportation and may conform to the suppliers commercial practice.

5.1.1.3 Marking. - Shipment marking information shall be provided on interior packages and exterior shipping containers in accordance with the contractor's commercial practice. The information shall include nomenclature, Federal stock number or manufacturer's part number, contract or order number, contractor's name and destination.

5.2 Domestic shipment and storage or overseas shipment. - The requirements, and levels of preservation, packaging, packing and marking for shipment shall be specified by the procuring activity (see 6.1).

(5.2.1 The following provides various levels for protection of domestic shipment and storage or overseas shipment, which may be required when procurement is made.

5.2.1.1 Coolers. -

5.2.1.1.1 Preservation and packaging. -

5.2.1.1.1.1 Level A. - The coolers shall be preserved and packaged in accordance with method III of MIL-P-116. All openings shall be sealed with noncorrosive materials in a manner to prohibit the entrance of foreign matter.

5.2.1.1.1.2 Level C. - Preservation and packaging shall be sufficient to afford adequate protection against corrosion, deterioration and physical damage. This level may conform to the supplier's commercial practice.

5.2.1.1.2 Packing. -

5.2.1.1.2.1 Level A. - Each cooler preserved and packaged as specified in 5.2.1.1.1 shall be packed for overseas shipment in containers conforming to any one of the following specifications at the option of the contractor:

<u>Specification</u>	<u>Type or class</u>
PPP-B-585	Class 3
PPP-B-591	Class II
PPP-B-601	Overseas type
PPP-B-621	Class 2
PPP-B-636	Weather-resistant

When required, shipping containers shall have caseliners conforming to MIL-L-10547. Caseliners shall be closed and sealed in accordance with the appendix to MIL-L-10547. Caseliners for fiberboard boxes, PPP-B-636, may be omitted provided all centers and edge seams and manufacturer's joints are sealed and waterproofed with pressure sensitive tape in accordance with the applicable fiberboard box specification. Shipping containers shall be closed, strapped or banded in accordance with the applicable box specification or appendix thereto. The gross weight of wood or wood-cleated boxes, shall not exceed 200 pounds; fiberboard boxes shall not exceed the weight limitations of the applicable fiberboard box specification. Fiberboard boxes conforming to weather-resistant class of PPP-B-636 closed, sealed and banded as specified herein may be used as the shipping container.

5.2.1.1.2.2 Level B. - Each cooler preserved and packaged as specified in 5.2.1.1.1 shall be packed for domestic shipment and storage in containers conforming to any one of the following specifications at the option of the contractor:

<u>Specification</u>	<u>Type or class</u>
PPP-B-585	Class 1
PPP-B-591	Class I
PPP-B-601	Domestic
PPP-B-621	Class 1
PPP-B-636	Domestic

Shipping containers shall be closed in accordance with the applicable box specification or appendix thereto. The gross weight of wood or wood-cleated boxes shall not exceed 200 pounds; fiberboard boxes shall not exceed the weight limitations of the applicable fiberboard box specification. Fiberboard boxes conforming to PPP-B-636, closed as specified herein may be used as the shipping container.

5.2.1.1.2.3 Level C. - Each cooler packaged as specified in 5.2.1.1.1 shall be packed in containers, at the lowest rate, in a manner which will insure acceptance by the common carrier and will afford protection against physical or mechanical damage during direct shipment from the supply source to the first receiving activity for immediate use. This level shall conform to the Uniform Freight Classification Ratings, Rules and Regulations or other carrier regulations as applicable to the mode of transportation and may be the supplier's commercial practice when such meets the requirements of this level.

5.2.1.1.3 Cushioning, blocking and bracing. - Cushioning, blocking, and bracing shall be in accordance with MIL-STD-1186, except that excelsior and shredded newspaper shall not be used.

5.2.1.1.4 Marking. - In addition to any special marking requirements, interior packages and exterior shipping containers, shall be marked in accordance with MIL-STD-129.

5.2.1.2 Stock repair parts. - Stock repair parts shall be preserved and packaged level A; packed level A, B, or C and marked in accordance with MIL-R-196.)

6. NOTES

6.1 Ordering data. - Procurement documents should specify the following:

- (a) Title, number, and date of this specification.
- (b) Class if other than class B is required and size (see 1.2).

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- (c) Preservation, packaging, packing and marking requirements other than those required by 5.1 (see 5.2).

6.2 Preproduction. - Invitations for bids should provide that the Government reserves the right to waive the requirement for preproduction samples as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

6.3 CHANGES FROM PREVIOUS ISSUE. THE EXTENT OF CHANGES (DELETIONS, ADDITIONS, ETC.) PRECLUDE THE ANNOTATION OF THE INDIVIDUAL CHANGES FROM THE PREVIOUS ISSUE OF THIS DOCUMENT.

Preparing activity:
Navy - SH
(Project 4420-N086SH)

APPENDIX
QUALITY PROGRAM REQUIREMENTS
FOR COOLERS, FLUID, NAVAL
SHIPBOARD (HULL COOLERS)

10. SCOPE

10.1 This appendix requires the establishment of a quality control program by the contractor to assure that supplies meet the quality standards established by the contract. This program, including procedures, is subject to surveillance by the Government representative. The procedures shall be designed by the contractor. The contractor's procedures used to implement the requirements of this appendix shall be subject to the disapproval of the Government representative.

10.2 Applicability. - This appendix shall apply to all supplies on which Government inspection is required.

10.3 Significance. - This appendix and any procedure or document executed in implementation thereof, shall be in addition to and not in derogation of other contract requirements.

20. REQUIREMENTS

20.1 Outline. - The contractor shall maintain an effective and economical quality control program planned and developed in conjunction with other planning functions. The program, including procedures, shall be adjusted to suit production procurement. The program shall be based upon consideration of the complexity of product design, quantity under procurement, interchangeability and reliability requirements, and manufacturing techniques. The program shall assure that adequate control of quality is maintained throughout all areas of contract performance, including, as applicable, the receipt, identification, stocking and issue of material, and the entire process of manufacture, packaging, shipping, storage, and maintenance. All supplies under the contract, whether manufactured or performed within the contractor's plant or at any other source, shall be subject to control at such points as necessary to assure conformance to contractual requirements. The program shall provide for the prevention and ready detection of discrepancies and for timely and positive corrective action. The contractor shall make objective evidence of quality conformance readily available to the Government representative. It is the intent of this appendix to provide a quality control procedure suitable for production of coolers for military use utilizing as much as possible normal control procedures for commercial production. Where differences exist between items for Naval use and commercial use, those items for Naval use shall be identified during production process. Where items for Naval use are identical to those produced for commercial use, the supplier shall verify that these items meet the requirements specified herein. The commercial product should be utilized to satisfy contract requirements insofar as practicable.

20.2 Description of procedures. - The contractor shall provide and maintain a description of procedures for control of quality. To the extent necessary, written examination and test procedures shall be prepared to supplement the applicable drawings and specifications, and shall make clear the manner in which such examination and test procedures are to be used. This description may be a compilation of existing shop travelers, routing cards, inspection method sheets, test procedures, route sheets, or other documents normally used by the contractor to define inspection operations. The description of the quality control program and all applicable examination and test procedures shall be available to the Government representative.

20.3 Drawing and change control. - A procedure shall be maintained by the contractor to assure that the latest applicable drawing, technical requirement, and contract change information will be available at the time and place of contractor's inspection. Concurrently with the effectivity of revised drawings or changes, the contractor's drawing and change control shall assure that obsolete information is removed from all points of issue and use. All changes shall be processed in a manner which will assure accomplishment on the affected supplies at the specified effective points. The contractor shall maintain a record of the point of effectivity of changes. This record shall be available for ready reference by the Government representative.

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20.4 Measuring and testing equipment. - Unless otherwise specified in the contract, the contractor shall provide and maintain gages and other measuring and testing devices necessary to assure that supplies conform to contract requirements. These devices shall be calibrated against measurement standards or designed measuring equipment at established periods to assure continued accuracy. The contractor shall prepare and maintain a written schedule for the maintenance and calibration of such equipment based on type, purpose, and degree of usage.

20.4.1 Production tooling used as media of inspection. - When production jigs, fixtures, tool masters and other such devices are used as media of inspection they shall be initially inspected or, by other suitable means, proved for accuracy prior to release for production use. The devices shall be reinspected or proved at established intervals.

20.4.2 Use of contractor's inspection equipment. - The contractor's gages, measuring, and testing devices shall be made available for reasonable use by the Government, when required, to determine conformance with contract requirements. If conditions warrant, contractor's personnel shall be made available for operation of such devices and for verification of their accuracy and condition.

20.5 Inspection during manufacture. - The contractor shall establish and maintain inspection at appropriately located points in the manufacturing process to assure continuous control of quality of parts, components, and assemblies.

20.6 Special processes. - When Government approval or certification of processes, equipment, or personnel is required under the contract, the contractor shall assure that he is fully qualified prior to requesting Government approval.

20.7 Inspection of completed supplies. - The contractor shall inspect completed supplies as necessary to assure that contract requirements have been met.

20.8 Sampling inspection. - Any sampling procedures, in addition to those required by contract, used by the contractor to determine the acceptability of supplies, shall afford reliable assurance of the maintenance of acceptable quality levels.

20.9 Indication of inspection status. - The contractor shall maintain a program for identifying the inspection status of supplies. Identification may be accomplished by means of stamps, tags, routing cards, move tickets, tote box cards or other normal control devices. Such controls shall be of a design distinctly different from Government inspection identification.

20.10 Nonconforming supplies. - Procedures shall be provided for control of nonconforming supplies, including procedures for the identification, presentation and disposition of reworked, repaired or waived supplies. The acceptance of nonconforming supplies is a prerogative of and shall be as prescribed by the Government. All nonconforming supplies shall, when practicable, be diverted from normal material movement channels. The nonconforming supplies shall be positively identified to prevent use until disposition is made. Holding areas mutually agreeable to the contractor and Government representative shall be provided.

20.11 Evidence of approvals. - When engineering inspection, tests or Government approvals are contractually required on supplies, such as engineering models, qualification test articles, preproduction test articles and "first articles", these supplies shall be subject to the requirements of this appendix. The contractor shall maintain current records of such approvals.

20.12 Storage. - The contractor shall provide adequate procedures for control of supplies stored for the Government or to be applied to Government contracts to insure preservation and treatment in accordance with applicable requirements. Procedures shall define inspections to be conducted at scheduled intervals.

20.13 Transportation. - The contractor shall provide procedures for protecting the quality of supplies during transit in accordance with contract requirements.

20.14 Quality program records. - The contractor shall maintain adequate records throughout all stages of contract performance of examination and tests, including checks made to assure accuracy of inspection, testing equipment and other control media. All quality program records shall be available for review by the Government representative, and copies of individual records shall be furnished him upon request.

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20.15 Corrective action: - The contractor shall take prompt action to correct conditions which might result in defective supplies or services. Use shall be made of feedback data generated and furnished by using activities as well as that generated in the contractor's facility.

SPECIFICATION ANALYSIS SHEET

Form Approved
Budget Bureau No. 119-R004INSTRUCTIONS

This sheet is to be filled out by personnel either Government or contractor, involved in the use of the specification in procurement of products for ultimate use by the Department of Defense. This sheet is provided for obtaining information on the use of this specification which will insure that suitable products can be procured with a minimum amount of delay and at the least cost. Comments and the return of this form will be appreciated. Fold on lines on reverse side, staple in corner, and send to preparing activity (as indicated on reverse hereof).

SPECIFICATION

ORGANIZATION (Of submitter)

CITY AND STATE

CONTRACT NO.

QUANTITY OF ITEMS PROCURED

DOLLAR AMOUNT

\$

MATERIAL PROCURED UNDER A

DIRECT GOVERNMENT CONTRACT

SUBCONTRACT

1. HAS ANY PART OF THE SPECIFICATION CREATED PROBLEMS OR REQUIRED INTERPRETATION IN PROCUREMENT USE?

A. GIVE PARAGRAPH NUMBER AND WORDING.

B. RECOMMENDATIONS FOR CORRECTING THE DEFICIENCIES.

2. COMMENTS ON ANY SPECIFICATION REQUIREMENT CONSIDERED TOO RIGID

3. IS THE SPECIFICATION RESTRICTIVE?

YES

NO IF "YES", IN WHAT WAY?

4. REMARKS (Attach any pertinent data which may be of use in improving this specification. If there are additional papers, attach to form and place both in an envelope addressed to preparing activity)

SUBMITTED BY (Printed or typed name and activity)

DATE

FOLD

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BUREAU OF SHIPS
WASHINGTON, D. C. 20360**

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