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MILITARY SPECIFICATION

# COOLERS, FLUID, BLEED AIR, GAS TURBINE, NAVAL SHIPBOARD

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 after air coolers for bleed air from gas turbine engines for Naval shipboard application. Only one classification of coolers is covered by this specification.

## 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).

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.

AMSC N/A FSC 4420

SPECIFICATIONS

FEDERAL

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| HH-P-46 | - Packing; Asbestos, Sheet, Compressed. |
| HH-P-151 | - Packing; Rubber-Sheet, Cloth-Insert. |
| QQ-B-654 | - Brazing Alloys, Silver. |
| QQ-C-390 | - Copper Alloy Castings (Including Cast Bar). |

MILITARY

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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-S-1222 | - Studs, Bolts, Hex Cap Screws, Socket Head Cap Screws and Nuts. |
| MIL-T-15005 | - Tubes, Condenser and Heat Exchanger, Copper-Nickel Alloys (UNS C70600 & C71500). |
| MIL-P-15024 | - Plates, Tags and Bands for Identification of Equipment. |
| MIL-P-15024/5 | - Plates, Identification. |
| MIL-C-15726 | - Copper-Nickel Alloy, Sheet Plate, Strip, Bar, Rod and Wire. |
| MIL-E-15809 | - Expander, Tube, Condenser and Heat Exchangers. |
| MS16142 | - Boss, Gasket Seal Straight Thread Tube Fitting, Standard Dimensions for. |
| MIL-T-16420 | - Tube, Copper-Nickel Alloy, Seamless and Welded (Copper Alloy Numbers 715 and 706). |
| MIL-L-19140 | - Lumber and Plywood, Fire-Retardant Treated. |
| MIL-A-19521 | - Anodes, Corrosion Preventive, Zinc and Plugs, Zinc Anode Retaining: Design of and Installation in Shipboard Condensers and Heat Exchangers. |
| MIL-F-20042 | - Flanges, Pipe and Bulkhead, Bronze (Silver Brazing). |
| MIL-G-21610 | - Gaskets, Heat Exchanger, Various Cross Section Rings, Synthetic Rubber. |
| MIL-C-22214 | - Tube, Condenser and Heat Exchanger with Integral Fins. |
| MIL-S-22473 | - Sealing, Locking, and Retaining Compounds: (Single-Component). |
| MIL-C-24679 | - Copper-Nickel Alloy Forgings and Forging Stock. |
| MIL-G-24696 | - Gasket, Sheet, Non-Asbestos. |

STANDARDS

FEDERAL

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

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| MIL-STD-22 | - Welded Joint Design. |
| MIL-STD-167-1 | - Mechanical Vibrations of Shipboard Equipment (Type I - Environmental and Type II - Internally Excited). |

MILITARY (Continued)

MIL-STD-278 - Welding and Casting Standard.
MIL-STD-1186 - Cushioning, Anchoring, Bracing, Blocking and Waterproofing; with Appropriate Test Methods.
DOD-STD-1399, Section 301 - Interface Standards for Shipboard Systems Section 301 Ship Motion and Attitude. (Metric)
MIL-STD-2073-1 - DOD Materiel Procedures for Development and Application of Packaging Requirements.

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)

NAVSHIPS 810-1385915 - Fittings, Pipe, Composition, Flanged. 100 P.S.I. Max. at 425°F Max. for All Services.
NAVSHIPS B-214 - Root Connections for Attaching Piping.

(Application for copies should be addressed to: Commander, Portsmouth Naval Shipyard, Code 202.2, Portsmouth, NH 03801.)

PUBLICATIONS

NAVAL SEA SYSTEMS COMMAND (NAVSEA)

0900-LP-001-7000 - Piping Systems Brazed, Fabrication and Inspection.

(Applications 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 the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

Boiler and Pressure Vessel Code (BPVC), Section III, Nuclear Power Plant Components.
Boiler and Pressure Vessel Code (BPVC), Section VIII, Division 1 - Rules for Construction of Unfired Pressure Vessels.

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

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

A 240 - Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate Sheet, and Strip for Pressure Vessels.
A 473 - Standard Specification for Stainless and Heat-Resisting Steel Forgings.
B 61 - Standard Specification for Steam or Valve Bronze Castings.
B 505 - Copper Base Alloy Continuous Casting.
B 584 - Standard Specification for Copper Alloy Sand Castings for General Applications.
D 3951 - Standard Practice for Commercial Packaging. (DoD adopted)
F 593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws and Studs.

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1137.)

(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.)

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 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.4) in accordance with 4.4.

3.2 Reliability. The mean-time-between-failures (MTBF) of the cooler assembly shall be not less than 18,000 hours of operating time. A failure is any condition or malfunction that requires the cooler to be taken or kept out of service for corrective maintenance.

3.3 Maintainability. The cooler shall be constructed so that all maintenance, both preventive and corrective, can be accomplished at the organizational level without outside assistance.

3.3.1 Preventive maintenance time. The mean preventive maintenance time shall be not greater than 3 man-hours per month. The time required to perform any one preventive maintenance action shall be not greater than 5 man-hours.

3.3.2 Corrective maintenance time. The heater shall have a geometric mean time to repair (MTTRg) of not more than 5 man-hours. The maximum time to perform any corrective action (95th percentile) shall be not greater than 8 man-hours. Times to repair are assumed to fit a lognormal distribution for purposes of calculating MTTRg and maximum time to repair.

3.4 Materials. The materials shown in table I for coolers shall be used as the basis for design. These materials shall be used in the construction of the coolers, except that the manufacturer shall have the option of substituting commercial material that has physical and chemical properties equal to or better than those of the materials specified in the cited Federal or Military specifications.

TABLE I. Cooler materials.

| Part | Material | Specification |
|---|---|---|
| Shell 1/<br>Stay bolts and shell side baffles | Stainless steel (AISI grade 347) | ASTM A 240 or<br>ASTM A 473 or<br>ASTM F 593 |
| Waterboxes | Copper alloy C90300 or<br>Valve bronze, alloy C92200 | QQ-C-390<br>ASTM B 584 or<br>ASTM B 61 |
| Tube sheets | Copper-nickel alloy, composition 70-30 | MIL-C-15726 |
| Tubes | Copper-nickel alloy, composition 70-30 | MIL-T-15005 or<br>MIL-T-22214 |
| Threaded fasteners | Nickel alloy | MIL-S-1222 |
| Zinc protectors | Zinc | MIL-A-19521 |
| Plugs, zinc support | Copper-nickel alloy, composition 70-30 | MIL-C-15726 |
| Gaskets 1/ | Rubber sheet, cloth insert; or<br>Non-asbestos sheet, compressed | HH-P-151<br>HH-P-46<br>MIL-G-24696 |
| Pipe plugs and adapters | Valve bronze, alloy C92200<br>Copper alloy C90300; or<br>Copper-nickel alloy, composition 70-30 | ASTM B 505<br>QQ-C-390<br>MIL-C-15726 or<br>MIL-C-24679 |
| Zinc inspection covers | Copper-nickel alloy, composition 90-10;<br>Copper alloy C90300; or<br>Valve bronze, alloy C92200 | MIL-C-15726<br><br>QQ-C-390<br>ASTM B 584 or<br>ASTM B 61 |

1/ For applications at temperature 400 degrees Fahrenheit (°F) or higher use HH-P-46. For water systems at below 250°F HH-P-151, class 4, shall be used. For temperatures 250 to 400°F use MIL-G-24696.

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

3.5 Construction. Construction of coolers shall be as specified in 3.5.1 through 3.5.21.7 (see 6.3). Structural design calculations shall be in accordance with ASME BPVC, section VIII, division I.

3.5.1 Ship attitude and motion. Coolers shall perform satisfactorily under conditions of list, trim, roll, and pitch as specified in DOD-STD-1399, section 301.

3.5.2 Cooler supports. Coolers shall be constructed with supports for securing to a foundation. Where required by the conditions of service, provision shall be made for the supports to provide for expansion and contraction of the shell. Cooler support shall be independent of any attached piping. Bolts in shear shall not constitute the primary means of support. Coolers shall not be supported by plates or brackets in such a manner that the primary means of support is obtained from bolts that secure the joint between shell-end flange, tube sheet, and waterbox flange.

3.5.3 Thermal expansion. Cooler assembly shall allow for thermal expansion and contraction of the tube bundle and shell.

3.5.4 Shock. If the engine application requires high-impact shock resistance in accordance with grade A or B of MIL-S-901 (see 4.7.2), the cooler shall be of corresponding shock-resistant construction (see 6.2).

3.5.4.1 Structure, supports, and bolting. Unless otherwise specified (see 6.2), cooler structure, supporting members, and bolting shall meet the shock grade specified in 3.5.4, without deformation of base, holddown bolts, or footing. Shock design forces shall be applied at the points of attachment to the hull structure.

3.5.4.2 Rigidity of support structure. Units that are rigidly supported shall not be attached to two structures that can deflect relative to each other under shock loadings. The points of rigid support shall lie in a single plane.

3.5.4.3 Assembly weight applicable. Where two or more components are installed on a common rigid subbase, the feet and holddown bolts, as well as the subbase, shall withstand accelerations that are based on the total weight of the assembly.

3.5.4.4 Use of shock mounts. Shock mounts shall not be used without prior approval of the contracting activity.

3.5.5 Vibration. Each cooler shall withstand type I vibration of MIL-STD-167-1 if separately mounted, and a combination of types I and II vibration of MIL-STD-167-1 if engine mounted. The type or types of vibration (and the order of type II vibration) of MIL-STD-167-1 shall be as specified (see 6.2).

3.5.6 Threaded fasteners. Threads shall be in accordance with FED-STD-H28. Parts shall permit use of standard wrenches throughout. Capscrews in blind holes shall not be used. Stud sizes and number of studs for bolt circles for corrosion preventive anode covers shall be comparable to those required for bolt circle layouts for coolant side flanges. Bolts for pressure joints shall be 7/16-inch diameter or larger. Threaded parts shall be unified thread form. The setting end of studs shall be a class 3 fit used with sealing compound, grade AV or AVV in accordance with MIL-S-22473, and the class 2 fit shall be used as the general working fit. The waterbox(s) and air and water terminal connections shall be fastened with bolts with nuts.

3.5.6.1 Lubricant. Threaded fasteners that have torque requirements shall be lubricated before assembly. The lubricant used shall be in accordance with MIL-A-907.

3.5.6.2 Bolt hole sizes. Unless otherwise specified (see 6.2), bolts to be stressed in shear shall be installed in holes of size not larger than as specified in table II.

TABLE II. Bolt hole sizes.

| Nominal bolt diameter (inch) | Maximum diameter of hole (inch) |
|---|---|
| 3/4 and smaller | Nominal bolt diameter plus 1/32 |
| Larger than 3/4 | Nominal bolt diameter plus 1/16 |

3.5.7 Welding and allied processes. Welding shall be in accordance with MIL-STD-278. Brazing may be used where applicable. For brazing nickel-containing alloys such as composition 70-30 or 90-10 copper-nickel, grade IV silver-base brazing alloy in accordance with QQ-B-654 shall be used. Brazing of piping joints including root connections shall be accomplished in accordance with NAVSEA 0900-LP-001-7000; where these joints are 1/2 inch or larger in nominal size, preinserted ring fittings shall be used. Face feed fittings may be used in sizes smaller than 1/2 inch.

3.5.7.1 Weld strength. For calculating the strength of welded joints, weld efficiencies shall be in accordance with MIL-STD-278.

3.5.7.2 Penetration weld criterion. Welded connections (except vents, drains and gage connections) shall be full penetration welded.

3.5.8 Piping connections. Inlet and outlet connections for seawater shall be flanged if hose connections are not specified (see 6.2). Unless otherwise specified (see 6.2), flanges shall be type PR, plain, 250 pounds, 1/4- to 12-inch size, inclusive, of MIL-F-20042, with cast nozzles conforming to the dimensions

shown on Drawing 810-1385915. For fabricated nozzles, in lieu of the plain, 250-pound flange of MIL-F-20042, slip-on flanges of the same dimensions in diameter, thickness, and drilling will be acceptable. For higher pressures, the flange design shall be as specified. Root connections shall have the increased wall thickness in accordance with Drawing B-214.

3.5.9 Vents and drains. Coolers shall be provided with vent and drain connections located to permit complete venting and draining of the coolant and draining of condensed moisture from the shell (air) side of the cooler. Size for vents and drains shall be not smaller than 1/2-inch nominal pipe size (nps). Such root connections shall have the wall thickness in accordance with MIL-T-16420, 70-30 copper nickel tube (class 6000 for 1-inch and smaller; class 3300 for 1.050-inch and larger) and shall be of the following types:

(a) Full penetration weld with joint design in accordance with P-70, P-71, or P-72 of MIL-STD-22 shall be used. Nipples shall be composition 70-30 copper-nickel, in accordance with MIL-C-15726.
(b) Single J, fillet-reinforced weld V-27 in accordance with MIL-STD-22. Nipples shall be copper-nickel in accordance with MIL-T-16420.
(c) Tapped hole in accordance with MS16142 fitted with an adapter of composition 70-30 copper-nickel alloy in accordance with MIL-C-15726.
(d) In addition to methods of (b) above, for other applications where the connection will not normally be in contact with salt water, a socket weld using a T by 2T minimum fillet in accordance with P-14 of MIL-STD-22 will be acceptable.

3.5.10 Pressure gauge connections. Connections for pressure gauges shall be provided at inlets and outlets of coolant sides as specified (see 6.2). The connections shall be as specified in 3.5.7.

3.5.11 Design pressures. The design air side and water side pressures shall be as specified (see 6.2). Hydrostatic tests shall be as specified in 4.7.4.

3.5.12 Corrosion preventive anodes. The cooling water side of coolers shall be fitted with corrosion preventive anodes in accordance with MIL-A-19521.

3.5.13 Gaskets. Gasket material shall be as specified in 3.4. Compressed asbestos gaskets shall be 1/16 inch thick. Cloth inserted rubber gaskets shall be 1/16 inch thick. Coolers shall be configured so that an adequate gasket width is provided under waterbox partitions. In coolers that have an equivalent shell diameter of 12 inches or greater, gasket width shall be not less than 5/16 inch. Where a test pressure greater than 200 pounds per square inch ($lb/in^2$) is specified, recessed flat gaskets or O-ring gaskets in accordance with MIL-G-21610 shall be provided.

3.5.14 Temperature limits for packing materials. In selection of packing materials full consideration shall be given to temperature resistance requirements.

3.5.15 Cooler tubes. Coolers shall have straight or U-bent plain or finned tubes with seawater circulated through the tubes.

3.5.16 Passes. Coolers shall be either single pass or multipass on the coolant side.

3.5.17 Pressure drops. Unless otherwise specified (see 6.2), the permissible pressure drop under design conditions shall be not more than 6 $lb/in^2$ for the coolant water nor more than 1 inch mercury (Hg) for the air side.

3.5.18 Cooling water temperature. Unless otherwise specified (see 6.2), the design cooling water inlet temperature shall be 85°F.

3.5.19 Cooling surface. Unless otherwise specified (see 6.2), the amount of cooling surface installed in coolers shall be based on a 10 percent fouling factor applied to the heat transfer coefficient for clean tubes.

3.5.20 Waterboxes. The waterbox depth measured normal to the tube sheet shall be not less than 1/2 the mean diameter of the tube sheet area (including tube holes) exposed to the flow of incoming cooling water. For cylindrical coolers having an inside shell diameter D, the waterbox head depth shall be not less than 0.50 D for single-pass coolers, 0.35 D for two-pass coolers, or 0.25 D for four-pass coolers. Waterboxes shall be in accordance with ASME BPVC, section VIII, division 1, and addenda thereto. Heads shall be hemispherical.

3.5.20.1 Flow path arrangements. The water inlet connection to coolers shall be as nearly normal to the tube sheet as practical. Shell connections shall be located to give counterflow between the coolant and the cooled medium as far as practical. Cooling water flow between passes in multipass coolers shall pass horizontally or upward, not downward. Vent holes shall be provided in the waterbox partitions.

3.5.20.2 Cooling water velocity. In cooling water spaces and connections, a smooth flow path shall be constructed in order to minimize erosion and corrosion. Sharp corners and projecting edges shall be avoided. Corrosion preventive anodes and internal fittings shall be arranged so as to impede water flow as little as practical. Cooling water velocity at design point shall not exceed 6.5 feet per second through the inlet flange, or 4.5 feet per second through the tubes (see 6.2).

3.5.21 Tubes, tube support sheets, and tube sheets. Coolers shall be provided with tubes of 5/8-inch outside diameter, 0.049-inch (number 18 Birmingham wire gauge (BWG)) wall thickness, or 1/2-inch outside diameter, 0.049-inch (number 18 BWG) wall thickness, as specified (see 6.2). Tube sheet thickness shall be not less than 3/4 inch.

3.5.21.1 Tube expansion. Tubes of coolers shall be expanded into the tube sheets at both ends. The expansion shall be by means of a tube expander in accordance with MIL-E-15809 and shall be governed by an automatic tube expander control. The minimum depth of expansion of tubes shall be 5/8 inch. When pressure or other design considerations require thicker tube sheets than specified, the depth of the tube expansion may be increased, but a distance of 1/8 inch from the inner face of the outer tube sheet shall be the limit of expansion.

3.5.21.2 Tube sheet holes. Holes for tubes in tube sheets shall be reamed to diameters shown in table III, and center-to-center spacing of holes shall be as listed.

TABLE III. Diameter and spacing of holes in tube sheets.

| Outside tube diameter (inch) | Diameter of holes for tubes1/ (inch) | Tube sheet hole spacing2/ (inch) |
|---|---|---|
| 5/8 | 0.626 | 13/16 |
| 1/2 | .501 | 21/32 |

1/ A tolerance of plus 0.005-inch will be permitted.
2/ Center to center; tolerance of plus 0.015-inch or minus 0.017-inch on the ligament thickness will be permitted.

3.5.21.3 Hole flaring. Tube sheet holes for inlet ends of tubes shall be flared in accordance with table IV, to allow for belling the ends of the tubes.

TABLE IV. Flaring of holes for inlet ends.

| Outside tube diameter (inch) | Radius of flare (inch) | Diameter of flared hole, at outside face of tube sheet (inch) |
|---|---|---|
| 5/8 | 1/2 | 3/4 |
| 1/2 | 3/8 | 5/8 |

3.5.21.4 Grooving of holes in tube sheets. Holes for tubes in tube sheets shall have one annular groove, 1/16 inch wide and 0.012 ± 0.005 inch deep, with groove centered between the faces of the tube sheet.

3.5.21.5 Hole edge rounding. Edges of holes for tubes shall be rounded on a 1/16-inch radius except where a flared contour is required for the tube inlet end (see 3.5.21.3).

3.5.21.6 Tube endings. Inlet ends of tubes shall be expanded and belled, and the ends shall then be finished flush with the face of the tube sheet. Discharge ends of tubes shall protrude not more than 1/16 inch beyond the face of the tube sheet. No tube shall terminate within a tube sheet.

3.5.21.7 Tube supports. For coolers mounted on the engine, the distance between tube support plates shall be not less than 12 inches. For separately mounted coolers, the distance between tube support plates shall be not less than 18 inches. The thickness of support plates shall be not less than 1/4 inch.

3.6 Painting. External and internal nonferrous surfaces of waterboxes, tubes, and tube sheets shall not be painted.

3.7 Identification plates. Identification plates shall be prepared in accordance with MIL-P-15024 and MIL-P-15024/5, and shall include the following:

(a) Name of unit.
(b) Manufacturer's service part number.
(c) Stock number (allow 17 spaces).
(d) Name of manufacturer.
(e) Contract number. (The contract or purchase order number shall be entered in this space, with full width of plate allowed for number entry.)
(f) Blank space for Government inspector's stamp.
(g) Date of manufacture.
(h) Serial number.
(i) Maximum test pressure, tube side/shell side.
(j) Blank space for "unit" number. (This space will be used for numbering for shipboard reference purposes if required, the stamping to be done by shipyard; allow four spaces.)
(k) Designation of "U.S." (without quotation marks).

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 this 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.

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

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

4.3 Inspection conditions. Unless otherwise specified herein, inspections shall be conducted under conditions that simulate those encountered in operation on board ship, except that ship attitude and motion need not be simulated for inspections conducted on shore.

4.4 First article inspection. First article inspection shall consist of the tests specified in 4.7.

4.5 Quality conformance inspection. Quality conformance inspection shall consist of the examination and tests specified in 4.6 and 4.7.4.

4.6 Examination. Each cooler shall be examined to determine conformance to the requirements of this specification not involving tests.

4.7 Tests.

4.7.1 Performance test. A performance test shall be conducted to determine conformance to performance requirements (see 6.3). This test shall include accurate measurements of coolant and cooled medium flow rates, pressure drops, and heat dissipated under operating conditions or corrected to operating conditions.

4.7.2 Shock tests.

4.7.2.1 Shock test with engine. If shock resistance is required and the engine has not undergone high-impact shock test (see 6.2), no shock test is required for engine-mounted coolers.

4.7.2.2 Separate shock test. If shock resistance is required and the cooler is separately mounted, or if the engine on which it will be mounted has already passed high-impact shock test (see 6.2), then coolers shall be shock tested (see 6.3). Shock tests shall be performed in accordance with MIL-S-901 with the following modification. Under the test procedure for medium weight equipment, the first blow in each group shall be applied using the standard (horizontal) mounting adapter; the second blow in each group shall be applied with the unit mounted on adapters that hold it at a 45-degree angle from the horizontal in the direction of its least transverse strength. The cooler shall withstand the shock requirements specified in 3.5.4.

4.7.3 Vibration test. A vibration test shall be conducted in accordance with MIL-STD-167-1. The cooler shall withstand the vibration requirements specified in 3.5.5 (see 6.3).

4.7.4 Hydrostatic pressure test. Unless otherwise specified (see 6.2), the air side and waterside of the cooler shall each be hydrostatically tested at 1-1/2 times the design pressure or 100 $lb/in^2$, whichever is greater (see 6.3). Joints shall be bone dry after pressure has been held for 15 minutes. Clean fresh water shall be used unless specified otherwise.

4.7.5 Inspection of silver brazing in hazardous system. Where silver brazed pipe joints have been used for making equipment connections that are to become part of a system designated as hazardous in accordance with NAVSEA 0900-LP-001-7000, inspection shall be in accordance with NAVSEA 0900-LP-001-7000.

4.7.6 Reliability evaluation. A reliability demonstration shall be conducted and the cooler shall meet the requirements as specified in 3.2 (see 6.3).

4.7.7 Maintainability evaluation. A maintainability demonstration shall be conducted by removing and replacing or reinstalling each removable part expected to be removed incident to preventive and corrective maintenance on board ship (see 3.3 and 6.3).

4.8 Inspection of packaging. Sample packages and packs, and the inspection of the 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 6.6.)

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

5.1.1 Levels A and C. Coolers constructed of corrosion-resistant material (nonferrous) shall be unit protected in accordance with method III of MIL-P-116. Preservative shall not be applied to the coolant or the cooled-air side of coolers.

5.1.1.1 Sealing of openings. All inlet and outlet openings shall be covered with a waterproof barrier material and further protected with a blank flange of ordinary strength steel, tempered hard board, or fully waterproof plywood. Flanges shall be secured with not less than 4 bolts with nuts and lockwashers. For openings up to 2-1/2 inches in diameter, plastic caps may be used in lieu of barrier material and blank flanges.

5.1.2 Commercial. Coolers shall be preserved in accordance with ASTM D 3951 with sealing of openings as specified in 5.1.1.1.

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

5.2.1 General.

5.2.1.1 Navy shipboard stowage fire-retardant requirements. When specified (see 6.2), all lumber and plywood including laminated veneer material used in shipping containers and pallet construction, members, blocking, bracing, and reinforcing shall be fire-retardant treated material in accordance with MIL-L-19140 as follows:

| | |
|---|---|
| Levels A and B | - Type II - weather resistant. Category 1 - general use. |
| Level C | - Type I - non-weather resistant. Category 1 - general use. |

5.2.2 Levels A, B, and C. Each cooler shall be anchored, blocked, braced, and cushioned within its shipping container in accordance with MIL-STD-1186 and the applicable container specification or appendix thereto. Shipping containers shall be of the wood cleated box construction, wood or plywood, open or closed

type crate construction as specified in table VII, exterior shipping containers, in accordance with MIL-STD-2073-1, appendix C therein. Boxes exceeding a gross weight of 200 pounds shall be modified with skids in accordance with the applicable box specification. Crates shall be used for coolers exceeding the weight limitation of the box specification. Coolers when shipped in open type crates shall be provided with flexible, reinforced, waterproof barrier material shrouds. Plastic shrouds shall be of minimum 0.006 inch thickness. Shrouds shall be secured to prevent their loss or damage during handling, shipment and storage. Shipping container closure and reinforcing shall be in accordance with the applicable container specification or appendix thereto.

5.2.3 Commercial. Commercial packing shall be 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, storage and stowage.

5.3 Marking.

5.3.1 Levels A, B, C, and commercial. In addition to any special marking required (see 6.2), shipping containers shall be marked 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. Gas turbine engine bleed air after air coolers described in this specification are intended for use on ships and craft of the U.S. Navy. The engines may be main propulsion engines or may serve other functions; not all engines will require after air coolers.

6.2 Acquisition requirements. Acquisition documents must specify the following:

(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) Identification of fluid to be cooled.
(d) Rate of flow of fluid to be cooled, cubic feet per minute at 60°F and 30 inches Hg.
(e) Inlet temperature of fluid to be cooled, °F.
(f) Outlet temperature of fluid to be cooled, °F; or rate of heat exchange, British thermal units per hour (Btu/h).
(g) Identification of coolant.
(h) Whether first article inspection is required (see 3.1).
(i) Whether engine application requires high-impact shock resistance, and to which grades (see 3.5.4).

(j) Shock grade for cooler structure, supporting member, and bolting, if other than specified (see 3.5.4.1).
(k) Types and order of vibration to be withstood (see 3.5.5).
(l) Size of hole for bolts to be installed, if other than specified (see 3.5.6.2).
(m) Whether hose connections are required (see 3.5.8).
(n) Type of flanged connections, if other than specified (see 3.5.8).
(o) Whether pressure gauge connections are required at inlet and outlet of coolant and cooled fluid sides (see 3.5.10).
(p) Design pressures both air and waterside (see 3.5.11).
(q) Allowable design point pressure drops of respective coolant and air sides, $lb/in^2$ and inches Hg, if other than as specified (see 3.5.17).
(r) Inlet temperature of coolant, if other than 85°F (see 3.5.18).
(s) Fouling factor used to calculate heat exchange surface if other than specified (see 3.5.19).
(t) Rate of flow of coolant, if established (see 3.5.20.2).
(u) Outside diameter and thickness of tubes (see 3.5.21).
(v) If cooler is to be engine mounted, whether the engine that it will serve has passed the high-impact shock test (see 4.7.2.1 and 4.7.2.2).
(w) Hydrostatic test water requirements, if other than as specified (see 4.7.4).
(x) Selection of applicable levels of preservation and packing (see 5.1 and 5.2).
(y) When fire retardant materials are required (see 5.2.1.1).
(z) Special markings required on interior packages or shipping containers (see 5.3.1).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Descriptions (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DoD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

| Reference Paragraph | DID Number | DID Title | Suggested Tailoring |
|---|---|---|---|
| 3.5 and appendix A | DI-DRPR-80651 | Engineering drawings | ---- |
| 4.7.1, 4.7.4, and appendix B | DI-MISC-80653 | Test reports | ---- |
| 4.7.2.2 | DI-ENVR-80708 | Shock test report | ---- |
| 4.7.3 | UDI-T-23762 | Report, vibration testing | ---- |
| 4.7.6 | DI-RELI-80252 | Reliability test reports | ---- |
| 4.7.7 | DI-MNTY-80832 | Maintainability/ testability demonstration test report | ---- |

The above DID's were those cleared as of the date of this specification. The current issue of DoD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, (see 3.1), to be tested as specified in 4.4. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Provisioning. Provisioning Technical Documentation (PTD), spare parts, and repair parts should be furnished as specified in the contract.

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

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

6.7 Subject term (key word) listing.

Compressed air systems components
Heat exchangers
Heat transfer

6.8 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 4420-N067)

# APPENDIX A

## ENGINEERING DRAWINGS TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers information that shall be included on the drawings when specified in the contract or order. This appendix is mandatory only when data item description DI-DRPR-80651 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. DRAWING CONTENTS

30.1 Drawings and certification data. Drawings shall be not smaller than 430 by 560 mm nor larger than 710 by 1020 mm. The size drawing scale shall be so that the number of sheets required shall be the minimum consistent with content and clarity. Drawings shall contain the following information:

(a) Manufacturer's name and model number.
(b) Reference to this specification.
(c) List of parts, tabulating part identification, including original manufacturer's part number, dimensions of component parts, number of identical parts installed in the unit, material from which the parts are made, and find number corresponding to part flags of outline drawings.
(d) Maximum inlet and outlet temperature flow rate and pressure for which the cooler was designed for air and coolant side.
(e) Schematic diagrams.
(f) Shock classification and approval reference.
(g) Outline drawing of the assembly including:

    (1) Overall and mounting dimensions.
    (2) Location and size of mounting holes.
    (3) Weight of the assembly wet and dry.
    (4) Position size, and marking of terminal connections.
    (5) Hydrostatic test pressure air and coolant side.

(h) Class and service of the cooler.
(i) Pressure gauge connections.
(j) Graphic or tabular presentation of heat transfer characteristics of the cooler.
(k) List of recommended test equipment and special tools required for tube removal, installation, and plugging.
(l) Lubricant used for threaded fasteners.

# APPENDIX B

## TEST REPORT TECHNICAL CONTENT REQUIREMENTS

10. SCOPE

10.1 Scope. This appendix covers the information that shall be included in the reports when specified in the contract or order. This appendix is mandatory only when data item description DI-MISC-80653 is cited on the DD Form 1423.

20. APPLICABLE DOCUMENTS

This section is not applicable to this appendix.

30. TEST REPORT CONTENT

30.1 Format and content. The test report shall be submitted in the form of a printed text on 8 by 11 inch white bond paper. The use of graphs, charts, and photographs to show instrument primary sensing element location is permitted. The report shall contain the following information:

(a) Manufacturer's name, model number, and contract number.
(b) Reference to this specification.
(c) List of instruments used naming the fluid measurement made on each.
(d) Schematic diagrams or photographs showing instrument primary sensing element location.
(e) Date and time of the test.
(f) Duration of the test period.
(g) Cooled and coolant fluid flow rates in pounds per hour taken every 15 minutes during the test period.
(h) Inlet and outlet temperatures of the cooled and coolant fluids in °F taken every 15 minutes during the test period.
(i) Inlet and outlet pressure of the cooled and coolant fluids in $lb/in^2$ gauge taken every 15 minutes during the test period.
(j) Heat dissipated in Btu/h of cooled fluid per hour calculated for each 15 minute interval of the test run.
(k) The hydrostatic pressures applied to the cooled and coolant side of the heat exchanger.
(l) Leakage identified and method of correction.

# 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 | 2. DOCUMENT DATE (YYMMDD) |
|---|---|---|
| | MIL-C-19713B(SH) | 92 February 14 |

3. DOCUMENT TITLE
COOLERS, FLUID, BLEED AIR, GAS TURBINE, NAVAL SHIPYARD

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)<br>(1) Commercial<br>(2) AUTOVON<br>(If applicable) | 7. DATE SUBMITTED (YYMMDD) |

8. PREPARING ACTIVITY

| a. NAME (Technical Point of Contact)<br>William Austin, SEA 56X23 | b. TELEPHONE (Include Area Code)<br>(1) Commercial: (703) 602-8818<br>(2) AUTOVON: (AV) 332-8818 |
|---|---|
| c. ADDRESS (Include Zip Code)<br>Commander<br>Naval Sea Systems Command<br>Attn: SEA 55Z33<br>Washington, DC 20362-5101 | IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT:<br>Defense Quality and Standardization Office<br>5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466<br>Telephone (703) 756-2340 AUTOVON 289-2340 |