INCH-POUND
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MILITARY SPECIFICATION

COOLERS, LUBRICATING OIL, AIRCRAFT ENGINE, SYNTHETIC OIL, GENERAL SPECIFICATION FOR

This specification is approved FOR use by the Department of the Air Force and is available for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1. 1 Scope This specification establishes the general requirements for an extended surface air-cooled oil cooler to provide oil temperature regulation for aircraft gas turbine engines utilizing high temperature synthetic lubricating oil.

1.2 Classification The model designation will be assigned by the Government and shall be specified in the contractor's detail specification.

2. APPLICABLE DOCUMENTS

2.1 Government

2.1.1 Specifications. 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 shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited m the solicitation (see 6.2) .

SPECIFICATIONS

Federal

QQ-C-320	Chromium Plating (Electrodeposited)
PPP-B-636	Box, Shipping, Fiberboard

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Oklahoma City Air Logistics Center/TICLA, Tinker AFB OK 73145-5990 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter

Military

MIL-P-116	Preservation, Methods Of
MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible
MIL-P-71 05	Pipe Threads, Taper, Aeronautical National Form, Symbol Anpt, General Requirements For
MIL-S-007742	Screw Threads, Standard, Optimum Selected Series, General Specification For
MIL-A-8625	Anodic Coatings, For Aluminum And Aluminum Alloys
MIL-T-3 1000	Technical Data Packages, General Specification For
MIL-C-83488	Coating, Aluminum, ION Vapor Deposited

STANDARDS

Military

MIL-STD-129	Marking For Shipment And Storage
MIL-STD-130	Identification Markings Of US Military Property
MIL-STD-889	Dissimilar Metals
MIL-STD-970	Standards & Specifications, Order Of Preference For The Selection Of
MIL-STD-1523	Age Control Of Age-Sensitive Elastomeric Material
MIL-STD-1595	Qualification Of Aircraft, Missile& Aerospace Fusion Welders
MIL-STD-2073-I	Criteria For Control And Development Of Packaging
MIL-STD-2073-2	Packaging Requirement Codes
MS20995	Wire, Safety Or Lock
MS33786	Fitting Installation, Flared Tube And Hose, Swivel (ASG)

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

2.1.2 Other Govenment document 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.

Air Force-Navy Aeronautical

AND10068	Nuts and Plate Nuts-Self-Locking, Functional Limitations Of (Use MS33588)

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

2.2 Non-Government The following document(s) form a part of this document to the extent specified herein Unless otherwise specified, the issuses 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 the documents not listed in the DODISS are the issues of the documents cited m the solicitation (see 6.2)

American Society For Testing And Materials (ASTM)
ASI M D3958 1 Packaging Commercial

(Application for copies should be addressed to: ASTM, 1916 Race St, Philadelphia, PA 19103.)

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

2.3 Order of precedence In the event of a conflict between the test of this specification and references cited herein (except for associated detail specifications, specifications sheets or MS standards), the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First articles. When specified (see 6.5), a sample shall be subjected to frost article inspection (see 6.5) in accordance with 4.2.

3.2 Component parts .The oil cooler shall consist of the core assembly which is made up of extended surfaces, the inlet and outlet ports, and a drain plug. A thermostatic temperature control valve and warm-up passages shall be provided unless otherwise specified in the contractor's detail specification.

3 . 3 Specifications and standards. for necessary commodities and services not specified herein shall be selected according to MI L- STD-970 except as provided in 3.3.1 and 3.3.2

3.3.1 Commercial parts. Commercial parts having suitable properties may be used where, on the date of invitation for bids, there are no suitable standard parts. In any case, commercial utility parts, like screws, bolts, nuts, cotter pins, having suitable properties maybe used provided:

a. They can be replaced by the standard parts (MS or AN) without alteration.

b. The corresponding standard part numbers are referenced in the parts list and, if practical, on the contractor's drawings.

3.3.2 Standard parts. With the exception in 3.3.1, MS or AN standard parts shall be used where they suit the purpose. They shall be identified on the drawings by their part numbers.

3.4 Materials.

3.4.1 Metals. Metals shall be of a corrosion-resistant type or suitably treated to resist corrosion in fuels, salt fog, or atmospheric conditions to which the oil cooler shall be subjected when in storage or during normal service life. Copper shall not be used.

3.4.1.1 Dissimilar metals Unless suitably protected against electrolytic corrosion, dissimilar metals shall not be used in intimate contact with each other. Dissimilar metals are defined in MIL-STD-889.

3.4.2 NON-metals Non-metallic materials shall be suitably resistant to the synthetic high temperature lubricating oil specified in the contractor's detail specification.

3.4.3 Recovered materials. Recovered materials are used to the maximum extent possibie without jeopardizing the end use of the item.

3.5 Castings Casting shall be of high quality. clean. sound. and free from blow-h oles. porosity. cracks, and other defects

3.6 Manufacturing process. Processes used for the manufacture of oil coolers shall be consistent with high quality aeronautical practice, suitable for the purpose, and shall conform to the applicable Government specifications. Processes conforming to the contractor's specifications may be used, provided they are released by the Government and contain provision for adequate tests. The use of contractor's process specifications will not constitute waiver of Government inspection.

3.7 Design and construction

3.71 General. If the oil cooler is to be installed in the inlet duct of the engine or if the cooler airflow is directed through or past any portion of the engine, it is imperative that the cooler be structurally sound to insure no oil leakage. Construction and design shall provide adequate plate thickness and sound joints capable of withstanding the strains, jars, shocks, vibrations, or other conditions incident to shipping, storage, installation, and ordinary service. The maximum outlet oil temperature, the maximum allowable back pressure on the engine scavenging system, and the maximum pressure drop across cooler shall be as specified in the contractor's detail specification.

3.7.2 Flanges. Oil inlet and outlet flanges conforming to Standard MS33786 shall be provided on the oil cooler.

3.7.3 Oil. The oil cooler shall be designed for operation with oil conforming to that specified m the contractor's detail 1 specification.

3.7.4 Drainage. Drainage provisions shall be incorporated either through the use of a drain plug or valve which permits complete drainage of the cooler when installed in the aircraft.

3.7.5 Temperature. The temperature regulation of the cooler assembly shall be designed to control the cooler outlet oil temperature to a value specified in the contractor's detail specification commensurate with the critical design condition. The cooler shall incorporate a bypass warm-up jacket and a temperature control valve unless otherwise specified in the contractor's detail specification.

37.5.1 Temperature valve. The thermostatic temperature control valve, if provided, shall be supplied as a part of the cooler assembly and shall be removable from the cooler. The valve shall include a standard thermostatic element, which incorporates a relief element, allowing pressure relief of the cooler core when the core pressure drop becomes excessive. The pressure relief setting shall be commensurate with the pressure drop allowable in the aircraft installation. The valve shall be designed and tested in accordance with the contractor's detail specification requirements The valve housing shall be so arranged as to mix oil from the oil cooler bypass warm-up jacket or inlet, and the cooler core to control final oil-out temperature. The valve shall incorporate MS33786 flanges on all parts.

3.7.6 Ratings.

3.7.6.1 Rated oil flow. The oil cooler shall be designed for an oil flow commensurate with the critical design conditions of the aircraft engine as specified in the contractor's detail specification.

3.7.6.2 Rated air flow Rated air flow shall be commensurate with the properly corrected static air pressure drop available in the aircraft installation at the critical design condition as specified in the contractor's detail specification.

3.7.6.3 Oil heat rejection At rated oil flow, rated air flow, and inlet air temperature commensurate with the critical design condition, the total heat rejection (BTU/min) from the oil cooler shall be equal to or greater than that total heat rejection necessary at the critical design condition

3.7.6.4 Direction of air flow Unless otherwise specified m the contractor's detail specification, the oil cooler shall meet performance requirements with the air flow in either direction.

3.7.7 Dimensions The overall dimensions and weight shall be kept to a minimum and in accordance with best aircraft practice. The size, shape, and weight shall be as specified in the contractor's detail specification and shall be subject to the approval of the procuring activity.

3.7.8 Threads

3.7.8.1 Screw threads All machine screw threads shall be in accordance with MIL-S-7742.

3.7.8.2 Pipe threads. Pipe threads shall be used only for permanently plugging drilled or cored openings. Where tapered pipe threads are used they shall conform to MIL-P-7 105.

3.7.8.3 Locking threads. All threaded parts shall be securely locked by safety wiring self-locking nuts, cotter pins, or other approved means. Safety wire shall have a minimum diameter of 0.32 inch and shall conform to Drawing MS20995. Self-locking nuts shall conform to Government Standards and shall be used in accordance with AND 10068. Staking and the use of lockwashers shall not be permitted.

3.7.9 Finish protective treatment. The finish and protective treatment used shall be specified in the detail specification.

3.7.9.1 Anodizing. All aluminum alloy parts shall be anodized in accordance with MIL-A-8625, or adequately treated in some other acceptable manner for corrosion prevention.

3.7.9.2 Steelparts. Steel parts shall be coated with ion vapor deposited aluminum, where practicable, in accordance with MIL-C-83488, type I or II as applicable and of a class that is adequate to achieve the degree of protection required. Other protective coating, in lieu of MIL-C-83488, may be used if demonstrated to be satisfactory and approved by the preparing activity. Cadimum plating must be avoided when satisfactory alternative processes can be used.

3.7.9.3 Paint Paint shall not be used for a protective finish unless specifically approved by the procuring activity. Cadimum plating must be avoided when satisfactory alternative processes can be used.

3.7.10 Synthetic rubber parts.

3.7.10.1 Marking. All synthetic rubber parts such as diaphragms, but excepting parts with no suitable surface, shall have painted, stamped with ink, or otherwise noted on the part, the quarter and year of the curing date of the part.

3.7.10.2 Curing. A decalcomania or a small metal tag giving the quarter and year of the curing date of the oldest synthetic robber part in the cooler assembly shall be securely attached to the outside of the cooler.

37.10.3 Serviveability. All synthetic rubber parts shall be readily replaceable with a minimum replacement of attaching parts.

3.710.4 Unifiormity. For coolers which include parts fabricated of synthetic material in contact with oil, manufacturers shall control subsequent batches to provide for uniformity

3.8 Performance Thee oil cooler shall satisfy the following perfomance requirements when tested as specified in Section 4.

3,8.1 Static pressure. There shall be no leakage or distortion of the oil cooler when subjected to the hydrostatic pressures specified in 4.6.3.

3 8.2 Pressure drop with air floww. The pressure drop across the cooler shall not exceed 20 psi, or the value specified in the contractor's detail specification, when tested in accordance with 4.64, with air flow through the cooler as specified

3.8.3 Pressure drop without flow. The pressure drop across the cooler assembly with no air flow through the cooler shall not exceed the maximum allowable pressures for the oil scavenging system as specified in the contractor's detail specification when tested in accordance with 4.6.5.

3.8.4 Pressure There shall be no leakage or permanent distortion of the cooler when tested as specified in 4.6.6 for oil flow pressure resistance.

3.8.5 Vibration. There shall be no leakage or distortion of the cooler, nor shall there be any failure of the mounting structure or other structural assembly of the cooler when subjected to the vibration test specified in 4.6.7.

386 Pressures cycles There shall be no leakage or permanent distortion of the cooler when subjected to 50,000 pressure cycles as specified in 4.6.8.

3.8.7 Fluid resistance. There shall be no leakage of the oil cooler when subjected to the fluid resistance test as specified in 4.6.9,

3.9 Interchangeability. All parts having the same manufacturer's part number shall be fictionally and dimensionally interchangeable, The technical date package requirements of MIL-T-3 1000 shall govern the manufacturer's drawings.

3.10 Identifaction Equipment, assemblies, and parts shall be marked for identification in accordance with MIL-STD-l 30.

3.10.1 Synthetic rubber Equipment and assemblies containing synthetic rubber parts shall also be marked in accordance with MIL-STD- 1523.

3.11 Workmanship All details of workmanship shall be in accordance with high-grade aircraft manufacturing practice for this type of accessory.

3.11.1 Welding All welding operations shall be performed by operators certified in accordance with MIL-STD-1595.

3 11.2 Cleaning. The assembled cooler shall be completely free of dirt, sand, meal chips, or other extraneous materials in addition, the cooler shall be cleaned thoroughly of all soldering, welding, and brazing residue

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection Unless otherwise specified in the contractor 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 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 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. The inspection requirements specified herein are classified as follows:

a. First reticle inspection (4.3).

b. Quality conformance inspection (see 4.4).

4.3 First Article.

4.3.1 First article tests. First articles tests shall consist of all tests described under 4.6 TEST METHODS.

4.4 Quality inspection. Quality conformance tests shall consists of:

a. Individual Tests (see 4.4.1).

b. Sampling Plan and Tests (see 4.4.2).

4.4.1 Individual tests. Each oil cooler shall be subjected to the following tests as described under 4.6 Methods of inspection of this specification:

a. Examination of product (see 4.6.1).

b. Cleaning (see 4.6.2).

c. Static pressure test (see 4.6.3).

4.4.2 Sampling plans and tests Three coolers shall be selected at random from each lot of 300 or less and subjected to the tests listed below (except that m the pressure drop test only one run, with oil at a temperature of 145° ± 2°F, shall be made). Samples subjected to the pressure cycling tests shall not be accepted by the inspector in fulfillment of any contract, but shall be clearly marked to show that it has been overstressed and returned to the contractor for disposition. A lot shall be defined as all coolers of the same type. manufactured under essentially the same conditions. and submitted for acceptance at the same time

a. Oil pressure drop test (see 4.65)

b. Pressure cycling test (see4.6.8)

4.4.2.1 Rejection and retest When one or more items from a lot fail to meet the specification, acceptance of all items in the lot will be withheld until the extent and cause of failure are determined. After corrections have been made, all necessary tests shall be repeated

4 4 2.2 **Individual tests may continue** For production reasons, individual tests may be continued pending the investigation of a sampling test failure. But final acceptance of the entire lot shall not be made until it is determined that the lot meets all the requirements of the specification.

4.4.2.3 Defects in items already accepted The investigation of a test faiIure could indicate that defects may exist in items already accepted. If so, the contractor shall fully advise the procuring activity of all defects likely to be found and methods of correction them.

4.5, Inspection conditions. Unless otherwise specified, all inspections shall be performed m accordance with the test conditions specified in this specification.

4.5 1 Ducting The cooling air relet and outlet ducts shall be equivalent in size and shape to that of the aircraft installation on which the cooler IS to be used Dimensions shall be as specified m the contractor's detail specification.

4.5.2 Oil Oil as designated in the contractor's detail specification shall be used for all oil cooler tests.

4.5.2.1 Oil temperature. Unless otherwise specified, the inlet oil temperature shall be commensurate with the critical design conditions as specified in the contractor's detail specification.

4.5,3 Oil pressure connections. Oil pressure connections shall be made to a flange which shall mount directly between the oil cooler and the thermostatic control valve. If no temperature regulating valve is used, the connections shall be made to adapters mounted at the cooler inlet and outlet ports.

4.5.4 Data be obtained-instrumentation. The variables in TABLE I shall be measured for each run.

4.5.5 Control limits and data observations. Unless otherwise specified, the variables specified at fixed values for points and runs are permitted to deviate from the specified conditions ±2°F for all temperatures, ±2 percent for oil flow and ± 2 percent of rated air flow for any air flow. The observed data shall be recorded. All points for each test, unless otherwise noted, shall be recorded only y after all variables have been adjusted and substantially stabilized, The degree of stabilization and accuracy of observations is acceptable if the calculated heat added to the air (air temperature rise x air flow x specific heat of air) checks within 5 percent of the calculated heat transferred from the oil (oil temperature drop x oil flow x specific heat of oil). Heat balance discrepancies of more than 5 percent, for all heat rejection runs other than "Oil Temperature Drop With Air Flow", are acceptable.

TABLE I

Quantity Measured	Method of Measurement	Overall Accuracy of Instrumentation
Oil-in temperature	Suitable thermometer or thermocouple	± 0.5°F
Air-in temperature	Suitable thermometer or thermocouple	± 0.5°F
Oil-out temperature (To be of mixed stream from core and warm-up passage)	Suitable temperature instrumentation to assure sure true average oil temperature readings	± 0.5°F
Air-out temperature	Suitable temperature instrumentation to assure true average air temperature readings	± 0.1°F
Oil temp. rise (optional) Air temp. rise (optional)	Series thermocouple	± 0.1°F
Oil flow, lb/min		± 1%
Air flow, lb/min		± 1%
Oil-in press., psi Oil-out press., psi	Bourdon tube gage, or suitable manometer, connected with noncon-gealing fluid lines	± 0.5 psi ± 0.5 psi
Air press. oil cooler static drop	Measured in duct 4 in. upstream and 4 in. down stream with manometer	± 0.1 in. H_20
Air pres. Upstream	Duct to atmosphere by manometer	±0.1 in. H_20
Air press downstream	Duct to atmosphere by manometer	± 0.1 in. H_20
Air pressure oil cooler drop	Upstream static head to downstream static head by manometer, as per FIGURE 1	
Atmospheric pressure Barometer		±.05 in Hg

4.5.6 The data furnished shall be as specified in TABLE II

TABLE II

Item	Oil Flow Percent Rated	Air Flow Percent Rated	Inlet Air Temperature °F
1	150	50, 100, 150, 200	*
2	100	50, 100, 150, 200	*
3	70	50, 100, 150, 200	*
4	50	50, 100, 150, 200	*
5	100	100	40, 0, -65
6	100	200	40, 0, -65
7	50	100	40, 0, -65

Use critical design condition temperature of the contractor's detail specification.

4.5.7 The instantaneous specific heat of the oil shall be assumed to be as specified in TABLE I of the contractor's detail specification. The method for determining specific heat and the values used, in all calculations, shall be approved by the procuring activity.

4.5.8 The specific heat of the air shall be assumed to be 0.240 BTU/°F/lb, or it may be taken in accordance with the relative humidity indicated in TABLE III.

TABLE III

Specific Heat of Air		
Temp °F	Cp. Dry Air	Cp. Saturated Air
30 or less	.240	0.240
60	.240	.241
80	.240	.243
100	.240	.246
120	.240	.250

4.5.9 Pressure drop corrections The air pressure drop measurements taken in accordance with FIGURE 1 shall be corrected to standard conditions by use of the following formula:

$$P_o = P_{eo}$$

Where

P = corrected drop
PO = measured pressure drop
e = inlet air density lb/ft^3
e_0 = standard air density 0.07651 b/ft^3

4.6 Test methods.

4.6.1 Examination Each oil cooler shall be examined to determine general conformance with this specification in respect to material, workmanship, design, construction, and nameplate.

4.6.2 Cleaning. Steam shall be passed through the oil cooler and a sample of the condensate collected. A portion of the condensate shall be tested with litmus paper. A second portion shall be tested by adding a drop of dilute silver nitrate solution and a few drops of nitric acid. The formation of even a slight precipitation is an indication of the presence of halides. Coolers showing either acid or alkali reaction or the presence of halides shall be rewashed and rinsed until a clean condition is indicated by the test.

4.63 Static pressure test The oil cooler shall be subjected to 200 ± 10 psi hydrostatic pressure for one minute and checked for leakage or distortion if the cooler is to be used without a surge protection valve or if the cooler is installed in the inlet duct or if the cooler airflow is directed through or past any portion of the engine. the hydrostatic pressure requirement shall be 400 ± 20 psi. The hydrostatic pressure at which the cooler shall be tested, depending upon conditions as expressed in this paragraph, shall be specified in the contractor's detail specification. There shall be no leakage.

4.6.4 Decongealing characteristics and oil pressure drop with air. The oil cooler shall be soaked for 72 hours at -65% while filled with oil. (The temperature regulating valve will be installed if it is to be used in the final installation .) Rated air flow shall be passed through the cooler at -65° ± 2°F throughout the soaking period and the testing period. Oil flow shall gradually be applied to the cooler from 50 percent rated flow at a temperature the same as that of the oil in the cooler to 100 percent rated flow at a temperature of 325° ± 5°F. At the end of 3 minutes, rated oil flow shall be established, the inlet oil temperature shall be 325° ± 5°F, and the pressure drop across the cooler shall not exceed 20 psi or the value specified in the contractor's detail specification The oil cooler shall decongeal so that the pressure drop through the cooler shall be compatible with the maximum allowable back pressure on the engine scavenging system. Pressure shall be recorded at approximately 1/2 minute internals.

4.6.5 Oil pressure drop witout air flow. The oil pressure drop through the complete cooler assembly shall be determined. The cooler assembly shall be defined as the cooler core plus the oil temperature resulting an surge protection valve if required by the contractor's details specifiation. The test shall be run at rated oil flow, and at oil inlet temperature of 145°, 205°, 267.5°, and 325 F. The pressure drop across the cooler assembly shall be compatible with the maximum allowable pressures in the oil scavenging pump system as specified. in the contractor's detail specification.

4.6.6 Oil flow pressure resistance. With an oil temperature of less than 100°F, and the warm-up outlet closed, the flow of oil through the cooler shall be adjusted so that an oil pressure drop of 80 psi occurs from the inlet of the cooler to the outlet of the cooler The outlet pressure shall be maintained at 10 pounds per square inch maximum. Any leakage or permanent distortion shall be cause for rejection.

4.6.7 Vibration test The cooler shall be be so installed m a test system that rated flow at 225°F flows through the cooler with a pressure of 20 psig relet pressure The cooler shall be vibrated along each of 3 mutually perpendicular axes through a frequency survey of 25 to 150 cps in order to determine whether resonant frequency exists. If a resonant frequency is found, the cooler shall be vibrated at this frequency If more than one resonant frequency is observed, the vibration frequency should be at the point of most severe resonance If no resonance is observed, the cooler shall be vibrated at 150 cps. The test shall be conducted for 35 hours for each of the 3 mutually perpendicular axes, or, if using a two-directional vibrator, for 50 hours with the cooler m the horizontal position and 50 hours m the vertical position. The vibration shall be maintained at an amplitude such that an acceleration of 10 G's is imposed upon the cooler. The cooler shall be examined periodically for evidence of leakage, failure, or distortion. If any leaks occur, the cooler shall be rejected. Any failure of the mounting structure integral to the cooler or other cooler structural assembly shall be cause for rejection. At the completion of the test, the cooler shall satisfy the requirements of the static pressure test 4.6.3.

4.6.8 Pressure cycles. The oil cooler shaIl be completely submerged in oil at 350° ± 10°F. An air pressure cycle of 3 ± 3 to 60 ± 1 pounds per square inch shall be applied to the inlest with the outlest closed and with the pressure rise and al taking place in 2 to 2.5 seconds each. The cooler shall be subjected to the 50,000 cycles without leakage or permanent distortion. Following the pressure cycle test the static pressure test shall be repeated.

4.6.9 Fluid resistance test. This test shall be applicable to all oil coolers containing non-metallic parts.

4.6.9.1 High temprature test Synthetic oil as specified in the contractor's detail specification at a temperature of 350° ± 10°F shall be circulated through the cooler for 24 hours. Following this the cooler shall be tested at room temperature at pressures of 1 psi, 50 psi, and 100 psi. The pressure shall be held for 30 seconds during each test. There shall be no leakage. The above cycle shall be repeated 7 times for a total test time of 168 hours.

4.6.9.2 Low tempemature test. Following the high temperature part of the fluid resistance test the cooler shall be soaked for 72 hours at -65° ± 5°F while filled with the synthetic oil specified in the contractors' detail specification, While at -65°F, pressure of 1 psi, 50 psi, and 100 psi shall be applied alternately at least 10 times. The pressure shall be held for 30 seconds during each test. There shall be no leakage.

4.6.10 First article inspection. The first article inspection shall consist of two synthetic oil coolers representative of the production equipment when a first article sample is required (see 3.1 and 6.5). They shall be tested at a laboratory designated by the procuring activity or, when so stated in the contract. as the contractor's plant under supervision of the procuring activity. These coolers shall be accompanied by one complete set of detail and assembly drawings, in reproducible form, and a complete test report, insofar as possible, showing results of the manufacturer's tests on a duplicate oil cooler in accordance with this specification. These test reports shall include the following:

a. Description of test equipment. This description shall include the diagram of the general setup, the type and capacity of the various components of apparatus and instruments, and methods of controlling the test variables, The description shall include photographs, wherever possible, of the general setup and of the installation of the cooler. This data need be supplied only once. Compliance with this paragraph m subsequent reports may be made by reference to the original report. The original data shall be kept up to date by revision, as necessary.

b Copies of original data sheets for all tests required by this specifiation, including corrected values from which curves are plotted.

c. Curves similar to those shown on FIGURES 2, 3. and 4.

5. PACKAGING

5.1 **Preservation-packaging** Preservation-packaging shall be level A, C, or industrial as specified (see 6.2).

5.1.1 Level A. Unless otherwise specified by the procuring activity, each oil cooler shall be individually preserved and packaged according to MIL-STD-2073- 1 and MIL-STD-2073-2. The method of preservation shall conform to method 1 C- 1 of MIL-P- 116.

5.1.2 Level C. Each oil cooler shall be preserved and-packaged in a manner which will afford adequate protection against corrosion, deterioration, and physical damage during shipments from supply source to the first receiving activity for immediate use.

5.1.3 Industrial. The industrial preservation of valve shall be in accordance with ASTM D395 1.

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

5.2.1 Level(s)A. B. or C. The level of packing shall be specified by the procuring activity. The level of packing shall be accomplished in accordance with the requirements outlined in MIL-STD-2073- 1 and MIL-STD-2073-2.

5.2.2 Industrial. The packaged oil cooler shall be packed in accordance with ASTM D3951.

5.3 Marking. In addition to any special marking required by the contractor order, marking shall be in accordance with MIL-STD- 129.

5.4 Inspection and test. Test methods of preservation and packaging shall be accomplished in accordance with section 4 of MIL-P-116 to insure compliance with section 5 of this specification.

6. NOTES

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

6. 1 Intened use. Oil coolers covered by this specification are intended for use in aircraft turbine engine lubricating oil systems.

6.2 Acquisition requirements Acquisition documents must specify the following:

a. Title, number, and date of the specification.

b. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1)

c Selection of applicable levels of preservation and packaging and packing

(I) Level B preservation and packaging is intended to provide economical but limited protection, and should be specified only when it is determined to be appropriate The effective period of protection shall be 180 days f from the date of initial packaging

6.3 Storage surveil Items preserved and packaged in accordance with level B requirements must be inspected to determine condition when not used within the time period indicated. Items not used within the time period specified must either be represerved or repackaged in accordance with level B requirements in this specification or with level A requirements if storage beyond an additional year is anticipated.

6.4 Definitions

6.4.1 Critical design condition The critical design condition is that condition at which maximum air-oil cooling is required.

6.5 First article When first article inspection is required, the contracting oficer shall provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from. the first production items, a standard production item from the contractor's current inventory (see 3.1), and the number of items to be tested as specified in 4.2.

6.6 Subject term (keyword) listing.

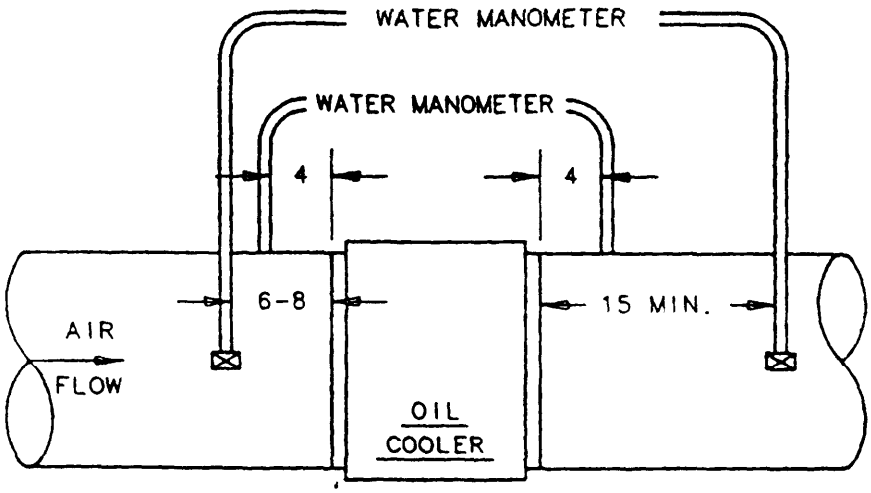
Aircraft oil
Gas turbine engines
High temperature oil
Lubricating oil
Oil
Synthetic oil

6.7 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

Custodian
AIR FORCE -99

Preparing activity:
AIR FORCE -7 I

Project No.
2935-F031

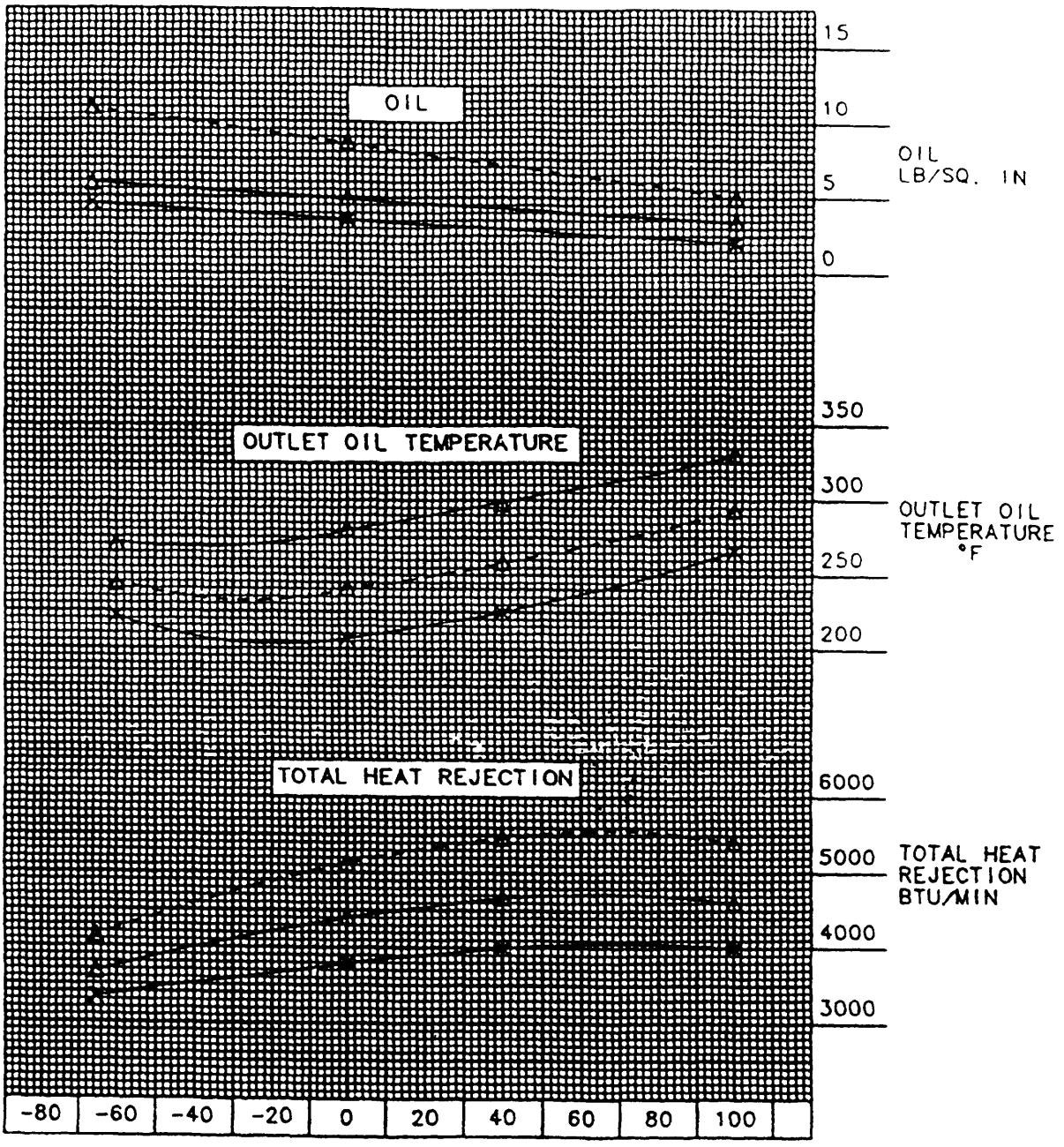


PRESSURE DROP TO BE UPSTREAM STATIC MINUS DOWNSTREAM STATIC. TOTAL PRESSURE TUBES ARE NOT REQUIRED BUT ARE RECOMMENDED AS A MEANS OF CROSS CHECKING ACCURACY OF THE REQUIRED PRESSURE MEASUREMENTS. TOTAL PRESSURES TO BE MEASURED BY SHIELDED TOTAL PRESSURE TUBES OR REVERE INSTRUMENT COMPANY (PART NUMBER R-302-DP) OR EQUIVALENT, LOCATED WITHIN ONE INCH OF THE CENTER OF THE DUCT.

DIMENSIONS IN INCHES.

METHOD OF MEASURING AIR PRESSURE DROP

FIGURE 1.



OIL SPECIFICATION_____
OIL FLOW
RATED LB/MIN
1/2 RATED LB/MIN
OIL INLET TEMPERATURE 400° F
AIR FLOW
_____ RATED LB/MIN
- - - - - - - 2 RATED LB/MIN

BLANK MFG. CO._____*SIZE
OIL COOLER
MFG'S DWG NO
VARIABLE AIR TEMPERATURE

PERFORMANCE CURVES
FIGURE

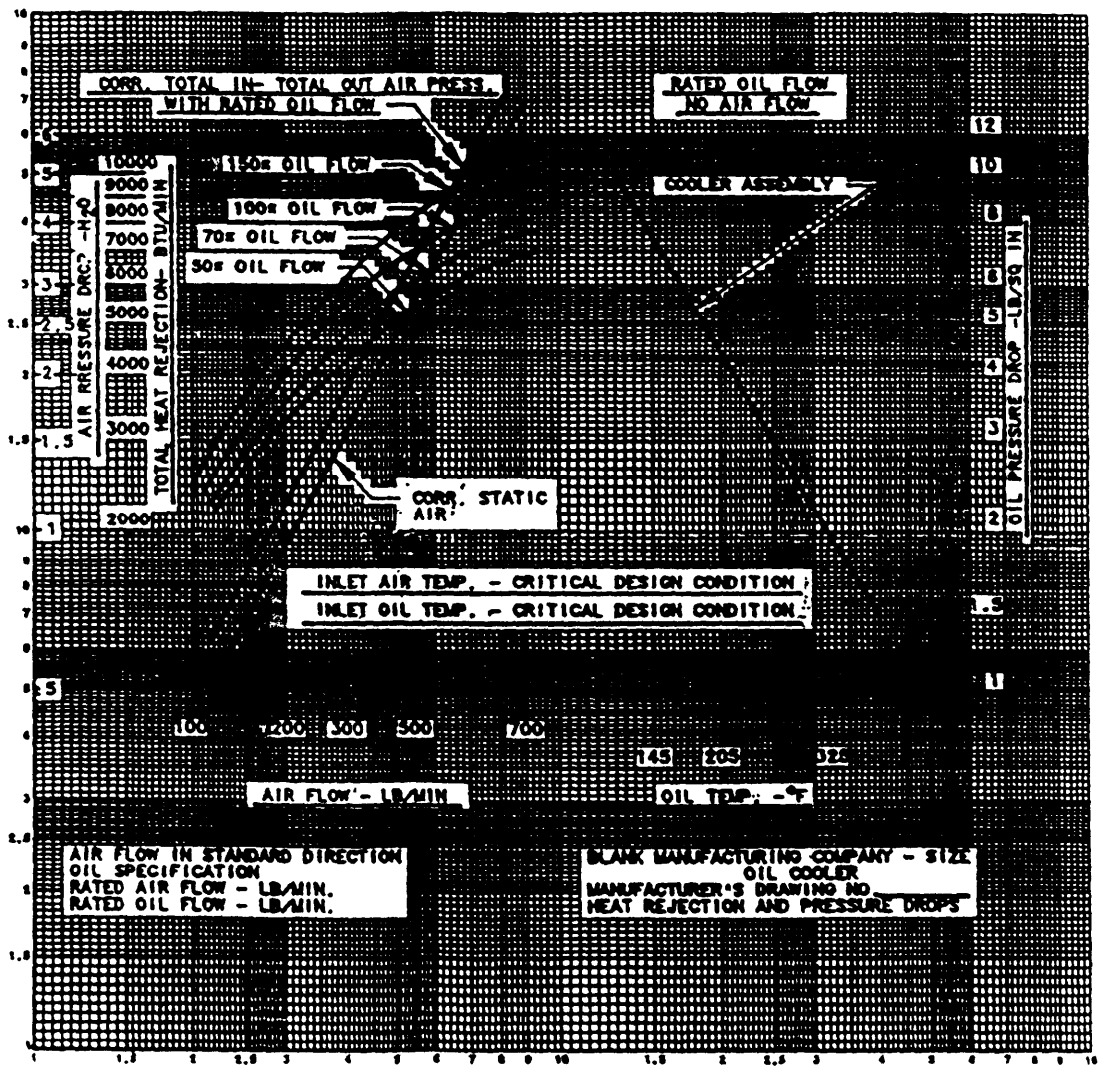


FIGURE 3. PERFORMANCE CURVES