

MIL-C-5545C
 14 July 1983
 SUPERSEDING
 MIL-C-5545B
 6 February 1968

MILITARY SPECIFICATION

CORROSION PREVENTIVE, AIRCRAFT ENGINE, HEAVY OIL TYPE

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

1. SCOPE

1.1 Scope. This specification establishes the requirements for the heavy oil type reciprocating aircraft engine corrosion preventive (see 6.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. Unless otherwise specified, the following specifications and standards of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

Federal

P-D-680	Dry Cleaning Solvent
PPP-D-729	Drums, Shipping and Storage, Steel, 55 Gallon (208 Liters)
PPP-P-704	Pail, Metal, Shipping, Steel (1 through 12 Gallons)

Military

MIL-D-3716	Desiccants, Activated for Dynamic Dehumidification
------------	--

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department (Code 93), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

MIL-C-5545C

SPECIFICATIONS (Continued)

Military (Continued)

MIL-L-6082	Lubricating Oil, Aircraft Reciprocating Engine (Piston)
MIL-C-16173	Corrosion Preventive Compound; Solvent Cutback, Cold-Application
MIL-L-22851	Lubricating Oil, Aircraft Piston Engine (Ashless Dispersant)

STANDARDS

Federal

FED-STD-313	Material Safety Data Sheets, Preparation and Submission of
FED-STD-791	Lubricant, Liquid Fuel, and Related Products; Methods of Testing

Military

MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-129	Marking for Shipment and Storage
MIL-STD-290	Packaging of Petroleum and Related Products

(Copies of specifications, standards, drawings, and publications required by manufacturers in connection with specific acquisition functions should be obtained from the contracting 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. The issues of the document which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

American National Standards Institute

ANSI Z129.1	Chemicals, Hazardous Industrial, Precautionary Labeling of
-------------	--

(Applications for copies should be addressed to American National Standards Institute, 1430 Broadway, New York, NY 10018.)

MIL-C-5545C

Society of Automotive Engineers

AMS 6440 Steel Bars, Forgings, and Tubing 1.45 CR
(0.98-1.10C) (SAE 52100) for Bearing Applications

(Applications for copies should be addressed to SAE, 400 Commonwealth Drive, Warrendale, PA 15096.)

American Society for Testing and Materials (ASTM)

ASTM A 568	Steel, Carbon and High Strength Low Alloy, Hot Rolled Sheet, Hot Rolled Strip and Cold Rolled Sheet, General Requirements
ASTM D 92	Flash and Fire Points by Cleveland, Open Cup, Test for
ASTM D 97	Pour Point of Petroleum Oils, Test for
ASTM D 130	Copper Corrosion from Petroleum Products by the Copper Strip Tarnish Test, Test for Detection of
ASTM D 189	Conradson Carbon Residue of Petroleum Products, Test for
ASTM D 270	Petroleum and Petroleum Products Sampling
ASTM D 445	Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity)
ASTM D 874	Sulfated Ash From Lubricating Oils and Additives, Test for
ASTM D 892	Foaming Characteristics of Lubricating Oils, Test for
ASTM D 1092	Apparent Viscosity of Lubricating Greases, Test for
ASTM D 1748	Rust Protection by Metal Preservatives in the Humidity Cabinet, Test for

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

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references herein, the text of this specification shall take precedence.

MIL-C-5545C

3. REQUIREMENTS

3.1 Qualification. The heavy oil type of aircraft engine corrosion preventive furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.5 and 6.4).

3.2 Materials. Materials used in the manufacture of engine corrosion preventive shall be entirely suitable for the purpose intended. The ingredient materials shall be such that the corrosion preventive can be easily poured, without stirring, from the container in which it is received, at any temperature above 10°C (50°F), so as to uniformly fill another container.

3.2.1 Toxicity. The corrosion preventative compound shall have no adverse effect on the health of personnel when used for its intended purpose. Questions pertinent to this effect shall be referred by the acquiring activity to the appropriate medical service who will act as adviser to the acquiring activity. Material Safety Data Sheets (MSDS) shall be prepared by the manufacturer in accordance with FED-STD-313 and submitted as directed in the contract or order at the time of acquisition award. Copies shall be forwarded to the designated industrial hygienist and the focal point of the activity that acquired the item, the focal point of the using activity, if different, and to the qualifying laboratory (see 4.3, 4.5.1.1 and 6.2).

3.3 High and low temperature stability. A thoroughly mixed one-to-one (1:1) preparation of the corrosion preventive and any oil conforming to MIL-L-6082, grade 1100, or MIL-L-22851, type II, that is tested for high and low temperature stability shall show no separation (see 4.6.6.1).

3.4 Carbon residue. The carbon residue shall be loose and flaky, not exceeding 3.0 percent and calculated on the sulphated residue-free basis (see 4.6.6.2).

3.5 Viscosity. The viscosity shall be $24 \times 10^{-6} \text{ m}^2/\text{sec}$ at 99°C (24 centistokes at 210°F) to $32 \times 10^{-6} \text{ m}^2/\text{sec}$ at 99°C (32 centistokes at 210°F). The viscosity of the corrosion preventive furnished under the contract shall not differ from the viscosity established on qualification by more than $\pm 1 \times 10^{-6} \text{ m}^2/\text{sec}$ (1 centistoke) (see 4.6.6.2).

3.6 Flash point. The flash point shall be at least 176.7°C (350°F) (see 4.6.6.2).

3.7 Corrosion. The corrosion preventive shall cause no pitting or discoloration (black or green) of a copper strip for a period of 20 hours (see 4.6.6.2).

MIL-C-5545C

3.8 Sulphated residue. The sulphated residue shall not exceed 1.0 percent (see 4.6.6.2). The sulphated residue of the corrosion preventive furnished under contract shall be restricted as follows:

<u>When value established on qualification and appearing on applicable QPL is:</u>	<u>Control limits for inspection shall be:</u>
0 to 0.10 percent	0 min to +0.10
0.11 to 0.50 percent	+0.10
0.51 percent and up	+20 percent of established value

3.9 Volatility. The volatile content shall not exceed 3.0 percent by weight (see 4.6.6.3).

3.10 Protection. Not more than one panel out of five shall fail after being covered with the corrosion preventive and tested for a period of 30 days (see 4.6.6.4). A panel shall be considered as having failed the protection test if at the end of the test period one of the following conditions exists in the significant area of the panels as defined by ASTM D 1748, considering both sides of the panel:

- a. A corroded area of 2 millimeters diameter or larger.
- b. Two or more spots of between 1 and 2 millimeters maximum diameter.

More than one panel in five failing as defined above shall be sufficient cause for retest. Retests shall consist of repeating the protection test, using an additional 10 panels. Upon completion of the retest, the failure of more than 4 panels, adding failures of both test and retest, shall be cause for rejection of the material.

3.11 Hydrobromic acid neutralization. When tested, at least two of the three grit-blasted exposed panels shall show no discernible increase in corrosion, pitting or other attack involving either surface over that of the controlled control panels (see 4.6.6.5).

3.12 Five-hour engine endurance. The engine shall show no deleterious effect attributed to the corrosion preventive after the five-hour engine endurance test (see 4.6.6.6). Any malfunctioning in the operation of the engine attributable to the corrosion preventive shall be cause for rejection.

3.13 Apparent viscosity. The apparent viscosity shall not exceed 6,000 poises at a test temperature of -18°C (0°F) and a shear rate of 20 reciprocal seconds (see 4.6.6.2). The apparent viscosity of

MIL-C-5545C

corrosion preventive furnished under contract shall not differ from that established on qualification (as shown on applicable QPL) by more than +20 percent and shall in no case exceed 6,000 poises.

3.14 Effect on bearing alloys. When tested for 10 days, the material shall cause no evidence of scoring, pitting, corrosion, nor black discoloration on the bearings of the machine (see 4.6.6.7).

3.15 Effect of the corrosion preventive on the color-indicating property of cobalt chloride-impregnated silica-gel. The material shall have no adverse effect on silica gel conforming to type IV of MIL-D-3716 to perform as a desiccant. If cobalt, chloride-impregnated silica-gel, remains blue after the first test, retest. A failure after retest shall be cause for rejection of the material (see 4.6.6.8).

3.16 Flow properties. A mixture containing equal parts by volume of the corrosion preventive and any oil conforming to MIL-L-6082, grade 1100 or MIL-L-22851, type II, shall show no evidence of flow or movement after heating and cooling. After performance of the foregoing, the mixture shall flow after agitating for 1 minute (see 4.6.6.2).

3.17 Dye for identification. A dye, National Brilliant Oil Blue BMA or an equivalent which passes the test specified in 4.6.6.9, shall be completely dissolved in the corrosion preventive. The dye shall be present as 100 ppm by weight in the corrosion preventive.

3.18 Foaming. A compatible antifoaming agent may be added to the corrosion preventive if necessary. The corrosion preventative shall demonstrate the following foaming characteristics: The sample, maintained at a temperature of $93 \pm 0.5^{\circ}\text{C}$ ($200 \pm 1^{\circ}\text{F}$), shall have a volume of not more than 25 ml of foam remaining following the end of the aeration period. No foam shall remain at the end of the 10 minute setting period (see 4.6.6.2).

3.19 Storage stability.

3.19.1 Thirty-day period. At the end of a 30-day storage period at $25 \pm 3^{\circ}\text{C}$ ($77 \pm 5^{\circ}\text{F}$) away from light, the corrosion preventive shall show no evidence of separation and shall again be subjected to the protection test. The sample for the protection test shall be taken from the top third of the unstirred corrosion preventive. If the corrosion preventive passes the above requirements, in addition to all the other tests of the specification, tentative approval will be granted. However, failure to pass this test shall be cause for rejection. Final approval is subject to the results of the 12-month storage stability test (see 4.6.6.10.1).

MIL-C-5545C

3.19.2 Twelve-month period. After a 12-month storage period of $25 \pm 3^{\circ}\text{C}$ ($77 \pm 5^{\circ}\text{F}$) away from light, the corrosion preventive shall meet the protection test requirements and shall meet the requirements for viscosity, sulphated residue, and apparent viscosity within the tolerances as required for samples furnished under contract. The samples for these tests shall be taken from the top third of the unstirred corrosion preventive. Failure to pass these tests shall be cause for abolishing the tentative approval. If the corrosion preventive passes the above four tests, final approval shall be granted (see 4.6.6.10.2).

3.20 Workmanship. All details of workmanship shall be in accordance with the best commercial practice covering this type of material.

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

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

- a. Qualification inspection (see 4.5).
- b. Quality conformance inspection (see 4.6).

4.3 Submission of Material Safety Data Sheets. The contractor shall furnish to the contracting activity the toxicological data and formulations required to evaluate the safety of the material for the proposed use through the submission of the Material Safety Data Sheet detailed in FED-STD-313. When the Material Safety Sheet is a requirement, one copy shall accompany the samples being submitted for test (see 3.2.1 and 6.2).

4.4 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in the applicable paragraph of the specification.

4.5 Qualification inspection. The qualification inspection shall consist of all the examinations and tests specified in table I.

MIL-C-5545C

TABLE I. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph
High and low temperature stability	3.3	4.6.6.1
Carbon residue	3.4	4.6.6.2
Viscosity	3.5	4.6.6.2
Flash point	3.6	4.6.6.2
Corrosion	3.7	4.6.6.2
Sulphated residue	3.8	4.6.6.2
Volatility	3.9	4.6.6.3
Protection	3.10	4.6.6.4
Hydrobromic acid neutralization	3.11	4.6.6.5
Five-hour engine endurance	3.12	4.6.6.6
Apparent viscosity	3.13	4.6.6.2
Effect on bearing alloys	3.14	4.6.6.7
Effect of the corrosion preventive on the color-indicating property of cobalt chloride-impregnated silica-gel	3.15	4.6.6.8
Flow properties	3.16	4.6.6.2
Dye for identification	3.17	4.6.6.9
Foaming	3.18	4.6.6.2
Storage, 30-day period	3.19.1	4.6.6.10.1
Storage, 12-month period	3.19.2	4.6.6.10.2

MIL-C-5545C

4.5.1 Qualification test samples. Qualification test samples shall consist of a 5-gallon container of the corrosion preventive which will be used for all tests except the five-hour engine endurance test. If the corrosion preventive satisfactorily passes the required tests except for the five-hour engine endurance test, the manufacturer will then be requested to submit an additional 55-gallon drum of material identical to the 5-gallon sample. The latter material shall then be used for the five-hour engine endurance test. The sulphated residue, protection, and apparent viscosity tests will be repeated to determine whether the drum sample is the same as the 5-gallon sample. Samples shall be forwarded to the Commander, Naval Air Development Center, Aircraft and Crew Systems Technology Directorate (Code 60622), Warminster, PA 18974. Samples shall be plainly identified by securely attached durable tags marked with the following information:

CORROSION PREVENTIVE, AIRCRAFT ENGINE,
HEAVY OIL TYPE
Samples for Qualification Tests
Name of Manufacturer (Plant in which material is
manufactured)
Manufacturer's Designation
Date of Manufacture
Submitted by (Name) (Date) for Qualification tests
in accordance with the requirements of MIL-C-5545C
under authorization (reference authorizing letter)

4.5.1.1 Qualification test report and other data. The contractor shall submit a test report, in duplicate, to accompany the qualification inspection samples. This report shall include the results of the manufacturer's tests, reported quantitatively, where applicable, in the units specified for all of the requirements specified herein. A quantitative statement of the formulation of the product in terms of each individual ingredient, identified by chemical name and specification number, if any, shall be provided. The contractor shall also furnish toxicological data and formulations necessary to evaluate the safety of the corrosion preventive compound for the proposed use (see 3.2.1). The formulation shall be clearly identified by the manufacturer's formula number.

4.5.2 Retention of qualification. In order to retain qualification of a product approved for listing on the Qualified Products List (QPL), the manufacturer shall verify by certification to the qualifying activity that the manufacturer's product complies with the requirements of this specification. The time of periodic verification by certification shall be in two-year intervals from the date of the original qualification. The Government reserves the right to re-examine the qualified product whenever deemed necessary to determine that the product continues to meet any or all of the specification requirements.

MIL-C-5545C

4.6 Quality conformance inspection. Quality conformance inspection shall consist of the examinations and tests listed in table II.

4.6.1 Inspection lot. Inspection test samples shall be selected and submitted for acceptance under contract in accordance with ASTM D 270, except that a sample of not less than 5 gallons shall be selected from each lot. A lot shall consist of one batch of finished corrosion preventive manufactured as a unit. The unused portion of the test sample shall be retained for referee test, if required.

4.6.2 Examination of product.

4.6.2.1 Sampling for visual inspection. A random sample of filled containers shall be selected from each inspection lot in accordance with MIL-STD-105 at Inspection Level I and an AQL of 2.5 percent defective to verify conformance to all requirements of this specification regarding material (3.2).

4.6.2.2 Packaging inspection.

4.6.2.2.1 Examination of packaging. An examination shall be made to determine that preservation, packing and marking comply with the requirements of section 5 of this specification. Inspection level shall be S-2, and the AQL shall be 2.5 percent per 100 units. The sample unit for this examination shall be a full container. The shipping container used for this examination shall be the same as those selected for visual inspection, samples for tests, and need not be sealed. Shipping containers shall be examined for defects of closure.

<u>Examine</u>	<u>Defect</u>
Preservation and packing	Container not as specified, closures not accomplished by specified or required methods or materials. Leakage or seepage of contents. Bulged or distorted container.
Markings	Data, including directions for use, omitted, illegible, incorrect, incomplete, or not in accordance with contract requirements.

MIL-C-5545C

TABLE II. Quality conformance inspection.

Examination or test	Requirement paragraph	Examination or test paragraph
Visual inspection	3.2	4.6.2.1
Packaging inspection	Section 5	4.6.2.2
High and low temperature stability	3.3	4.6.6.1
Carbon residue	3.4	4.6.6.2
Viscosity	3.5	4.6.6.2
Flash point	3.6	4.6.6.2
Corrosion	3.7	4.6.6.2
Sulphated residue	3.8	4.6.6.2
Volatility	3.9	4.6.6.3
Protection	3.10	4.6.6.4
Hydrobromic acid neutralization	3.11	4.6.6.5
Apparent viscosity	3.13	4.6.6.2
Effect of the corrosion preventive on the color indicating property of cobalt chloride-impregnated silica-gel	3.15	4.6.6.8
Flow properties	3.16	4.6.6.2
Dye for identification	3.17	4.6.6.9
Foaming	3.18	4.6.6.2

MIL-C-5545C

4.6.3 Quality conformance tests. The quality conformance tests shall consist of the following:

<u>Test</u>	<u>Test paragraph</u>
High and low temperature stability	4.6.6.1
Carbon residue	4.6.6.2
Viscosity	4.6.6.2
Flash point	4.6.6.2
Corrosion	4.6.6.2
Sulphated residue	4.6.6.2
Volatility	4.6.6.3
Protection	4.6.6.4
Hydrobromic acid neutralization	4.6.6.5
Apparent viscosity	4.6.6.2
Effect of the corrosion preventive on cobalt chloride, indicating type desiccant	4.6.6.8
Flow properties	4.6.6.2
Dye for identification	4.6.6.9
Foaming characteristics	4.6.6.2

4.6.4 Samples for tests. Samples shall be selected in accordance with MIL-STD-105, Inspection Level S-3 with an AQL of 4.0 percent defective. Sample unit for test shall be one gallon of corrosion preventive.

4.6.5 Test conditions. Unless otherwise specified, physical tests contained in this specification shall be made under controlled atmospheric conditions having a relative humidity of 50 \pm 5 percent and a temperature range of from 21°C (70°F) to 27°C (80°F). Waiver of this requirement may be permitted where proper conditioning facilities are not available for control testing. However, for referee purposes, the specified tests shall be made upon the corrosion preventive under the specified atmospheric conditions.

4.6.6 Test methods.

4.6.6.1 High and low temperature stability. Fifteen grams of a thoroughly mixed 1:1 proportion of the corrosion preventive and any oil conforming to MIL-L-6082, grade 1100 or MIL-L-22851, type II, shall be prepared at a temperature of 25 \pm 3°C (77 \pm 5°F), and the mixture shall be placed in a test tube 150 mm by 19 mm diameter. The tube shall be placed in an oven maintained at 96 \pm 3°C (205 \pm 5°F) for 24 hours, allowed to cool to room temperature undisturbed and then further cooled by placing the tube in a cold box maintained at -18 \pm 3°C (0 \pm 5°F) for 4 hours, followed by allowing the sample to return to room temperature. The mixture shall then be allowed to stand for 10 days at room temperature. At the end of this period, the tube shall be examined by transmitted light for any evidence of separation of insoluble material (see 3.3).

MIL-C-5545C

4.6.6.2 Test methods conducted in accordance with ASTM methods. The following tests shall be conducted in accordance with applicable methods in the ASTM standard and the results of the tests shall meet the requirements in the applicable paragraph listed below.

<u>Test</u>	<u>Method No.</u>	<u>Requirement paragraph</u>
Carbon residue	D 189	3.4
Viscosity	D 445	3.5
Flash point	D 92	3.6
Corrosion <u>1/</u>	D 130	3.7
Sulphated residue	D 874	3.8
Apparent viscosity <u>2/</u>	D 1092	3.13
Flow properties	D 97	3.16
Foaming characteristic	D 892	3.18

1/ Test run at 100°C (212°F)

2/ Corrosion preventive cooled to -18 +3°C (0 +5°F) in 2 hours, maintained at this temperature for 16 hours prior to test.

4.6.6.3 Volatility. A 10-gram sample shall be weighed into a tared aluminum foil dish, 2-1/4 inches in diameter, 5/8-inch deep. The dish shall then be placed in a gravity convection oven maintained at 104 +2°C (220 +3°F) for a period of 24 hours. After the specified time has elapsed, the dish shall be removed, weighed, and the volatile loss determined by calculation. The volatile loss shall not exceed the limit listed in 3.9.

4.6.6.4 Protection.

4.6.6.4.1 Panel composition and size. Five panels shall be cut from open hearth, cold finish, dead soft temper, low carbon steel conforming to ASTM A 568. The panels shall be 1/8 by 2 by 4 inches, conforming to the description contained in ASTM D 1748.

4.6.6.4.2 Panel finish and cleaning. The surfaces of the test panels shall be prepared by use of 240- or 280-grit alundum abrasive cloth or paper so as to produce a surface finish of 6-12 microinches (rms). The final abrasion marks shall be in the direction parallel to the length of panel. The surface shall be thoroughly cleaned by a method which will reduce all types of superficial contamination to the practical minimum. A cleaning method which has proved satisfactory is described in 6.3.1.

4.6.6.4.3 Procedure. The five panels prepared as directed in 4.6.6.4.2 shall be dipped in a suitable sample of hot corrosion preventive which is maintained at 96 +1°C (205 +3°F) by means of a heated oil bath. The panels shall be completely submerged and removed from the

MIL-C-5545C

compound 3 minutes after the corrosion preventive has come up to the 96.1°C (205°F) controlled temperature. The panels shall then be suspended by monel or stainless steel hooks for 4 hours at room temperature and 20 hours in an atmosphere maintained at 60 +1°C (140 +3°F). At the end of this period, the panels shall be suspended in a humidity cabinet conforming to the description in ASTM D 1748 for a period of 30 days, taking care that the top of the panel is level, bending the hooks if necessary for minor adjustment. During this period the humidity cabinet shall be maintained at 100 percent relative humidity and at a dry bulb temperature of 49 +1°C (120 +2°F). The panels shall be removed from the cabinet, cleaned with solvent conforming to P-D-680, and examined. A corrosive condition on the panels shall not exceed the criteria in 3.10.

4.6.6.5 Hydrobromic acid neutralization.

4.6.6.5.1 Preparation of panels. Five panels shall be cut from steel conforming to ASTM A 568. The size of the panels and location of the holes shall be as shown in ASTM D 1748. Remove all burrs, sharp edges, including edges of holes. The panels shall be uniformly grit-blasted using No. 36 nonmetallic grit. Unless the panels are to be used immediately, they shall be preserved in an atmosphere having a relative humidity not greater than 20 percent. Immediately prior to use, the panels shall be cleaned by washing in a solvent conforming to P-D-680, drained thoroughly, followed by slushing in boiling 95 percent methanol, and finally in boiling absolute methanol. After cleaning, the panels shall be cooled in a desiccator. Care must be taken during cleaning and preparation that the surface is not contaminated by fingerprints. The panels shall be handled by tongs during the cleaning operation and by hooks during and after immersion.

4.6.6.5.2 Preparation of emulsion. Six hundred milliliters (600 ml) of a 10 percent by volume emulsion consisting of 0.20 +0.02 percent hydrobromic acid solution and lubricating oil conforming to MIL-L-6082, grade 1100 or MIL-L-22851, type II, shall be prepared by placing the oil and acid in a beaker of suitable size and thoroughly emulsifying by a mechanical stirrer operated at 1700-2500 rpm for approximately 1 hour. The bottom tips of the blades shall be kept within 1/4 inch of the bottom of the beaker to prevent separation of the hydrobromic acid layer.

4.6.6.5.3 Procedure. Three panels shall be immersed singly in the specified emulsion and slushed vigorously for 1 minute at 25 +1°C (77 +3°F). These panels shall be removed from the emulsion, allowed to drain for 1 minute, and then dipped 10 times per minute in 360-380 ml of the corrosion preventive contained in a 400 ml tall form beaker. The three panels shall then be suspended by monel or stainless steel test

MIL-C-5545C

hooks for 2 hours in an atmosphere maintained at a relative humidity not exceeding 50 percent (see 6.3.3) and a temperature of $25 \pm 3^{\circ}\text{C}$ ($77 \pm 5^{\circ}\text{F}$). At the end of this period the panels shall be suspended in the humidity cabinet conforming to ASTM D 1748, previously referred to, and subjected to the specified conditions for 24 hours. Two additional panels shall be immersed and drained in the emulsion as specified above and immediately after the 1-minute drain period, the emulsion shall be quickly removed from the panels by slushing in a beaker of water-displacing compound conforming to MIL-C-16173, grade III, followed by washing in solvent conforming to P-D-680. The panels shall then be placed immediately in a desiccator for storage until completion of the humidity exposure test on the other three panels. Immediately after removal of the three panels from the humidity cabinet, they shall be cleaned with a suitable solvent and compared with the two panels stored in the desiccator. The two sets of panels shall be examined for any visible corrosion, pittings or staining (see 3.11).

4.6.6.6 Five-hour engine endurance. An engine having a total displacement of 1800 cubic inches or greater shall be mounted on a test stand, and provisions shall be made for the following readings:

- a. RPM
- b. Manifold pressure
- c. Main oil pressure
- d. Nose oil pressure
- e. Fuel pressure
- f. Fuel consumption
- g. Cylinder head temperature
- h. Cylinder base temperature
- i. Oil-in temperature
- j. Oil-out temperature
- k. Carburetor air temperature
- l. Oil consumption
- m. Oil flow
- n. Crankcase pressure
- o. Time of day

4.6.6.6.1 Engine shake-down run. The engine shall be given the following shake-down run with lubricating oil conforming to MIL-L-6082, grade 1100 or MIL-L-22851, type II, and using normal service leaded fuel before the test is started.

<u>Time (min)</u>	<u>Rated power</u>
30	50 percent
30	75 percent

Drain the oil.

MIL-C-5545C

4.6.6.6.2 Engine test run. Fill engine oil reservoir with corrosive preventive. The engine shall be operated oil-in temperature of 95 to 102°C (203° to 215°F). The test shall be conducted as follows:

- a. Two and one-half hours at 50 percent rated power.
- b. Two and one-half hours at 75 percent rated power.
- c. The corrosion preventive shall not be drained from the engine from the time the engine starts its endurance run until it is taken off the stand. Corrosion preventive shall be added as needed during the test.

At the completion of the test, the engine shall be completely disassembled and inspected for any deleterious effect caused by the corrosion preventive (see 3.12).

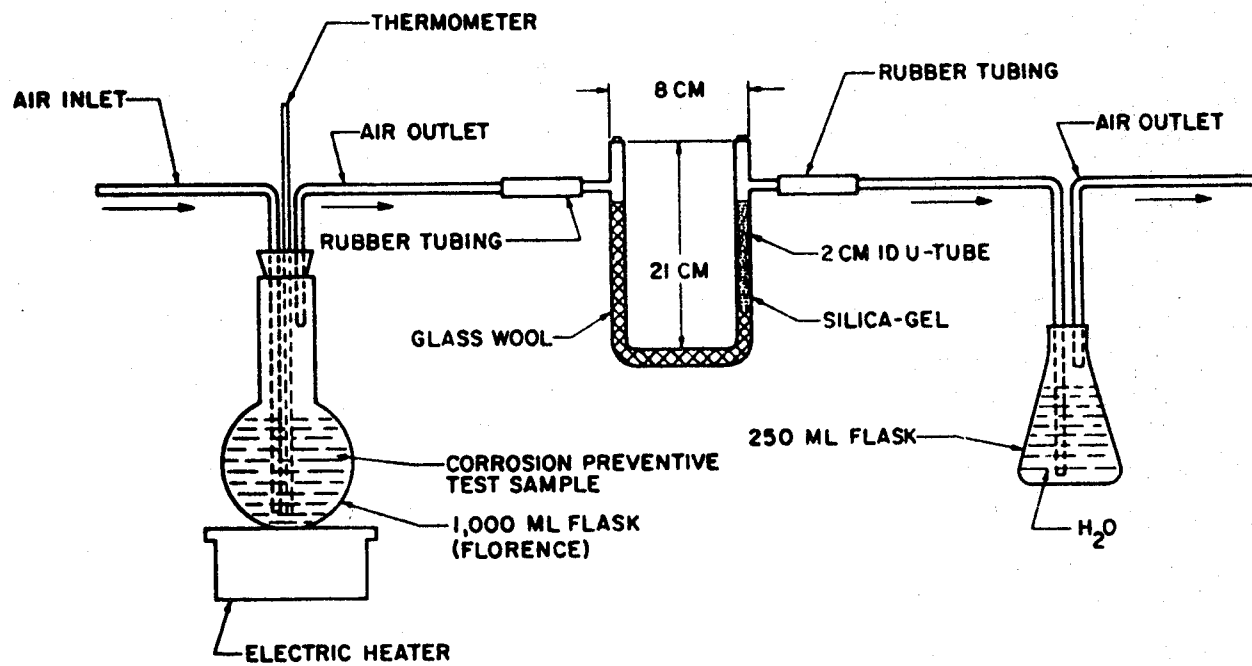
4.6.6.7 Effect on bearing alloys. The material shall be tested in accordance with test method 5322 of FED TEST METHOD STD 791 and the results of the test shall meet the requirement in 3.14. (Note: For the steel disks in 4.1 and the brass clips in 4.2 of method 5322 use AMS-6440 and QQ-B-613, type UNS C26000, respectively (see 6.6)).

4.6.6.8 Test for effect of the corrosion preventive on the color-indicating property cobalt chloride-impregnated silica-gel.

4.6.6.8.1 Apparatus. The apparatus as shown on figure 1, shall consist of a 1000 ml flask fitted with a tight-fitting cork stopper carrying a glass air inlet tube to within 1 cm of bottom, a 93.3°C (200°F) thermometer with the bulb reaching well below the 800 ml material sample level, and a glass outlet tube for conveying air from the top of flask to a U-shaped drying tube. A stopper and rubber tube for conveying air from the U-tube shall be provided to measure air flow periodically. Measurement of the air flow rate may be accomplished by placing the end of the outlet airtube beneath water and under the mouth of an inverted water-filled graduate. All apparatus contacting the oil or air and vapors from the oil must be clean prior to testing a sample of the material. There shall be no leaks of air from the apparatus.

4.6.6.8.2 Procedure. A test on a blank shall first be made by placing 800 ml of oil conforming to MIL-L-6082, grade 1100 or MIL-L-22851, type II, in the flask, connecting the air supply to the air inlet tube and the air outlet tube to the U-tube carrying glass wool on the inlet side and 5 grams of desiccant on the outlet side of the tube. An air flow of 1.5 liters/hour shall be bubbled into the oil after the oil has been uniformly heated to 71.1 \pm 1°C (160 \pm 2°F), and the air with the

MIL-C-5545C

FIGURE 1. Test Apparatus - silica-gel.

MIL-C-5545C

entrained vapors passed through the U-tube carrying the desiccant. The air shall be passed through the oil for 3 hours, then the desiccant shall be removed and placed in an open "Petri" dish and left in the 100 percent RH static humidity chamber overnight. If there is no oil contamination of the desiccant during the test and no ammonia in the air supply, the desiccant shall show no trace of blue coloration. Eight hundred milliliters of the material under test shall then be substituted for the MIL-L-6082 or MIL-L-22851, type II, oil and the test repeated using a new 5-gram sample of MIL-D-3716, type IV desiccant. Any granules of desiccant remaining blue in color after exposure overnight in 100 percent relative humidity will require a retest of the material, using a new sample of desiccant. If granules of the desiccant again remain blue after exposure to 100 percent relative humidity on retests, the material shall be rejected (see 3.15).

4.6.6.9 Dye for identification. One part by volume of the corrosion preventive and one part by volume of carbon tetrachloride shall be mixed in a small test tube and then two parts by volume of absolute methanol shall be added and the mixture shaken vigorously for 15 seconds. After standing for 5 minutes, the methanol layer shall show a distinct blue or green coloration. When the above extraction is repeated on a sample of the corrosion preventive which has been heated in an evaporating dish at 148.8°C (300°F) for 6 hours, the coloration shall be evident. The coloration shall meet the requirements in 3.17.

4.6.6.10 Storage stability.

4.6.6.10.1 Thirty-day period. A 1-gallon sample stored in a clean, wide-mouth glass container (10 inches by 5-1/2 inches OD with a 2-1/2 inch opening) shall be examined after the storage period for any evidence of separation, and the protection test shall be performed on a sample that has been drawn from the top third of the stored material (see 3.19.1).

4.6.6.10.2 Twelve-month period. The tests specified in 3.19.2 shall be repeated at the end of one year's storage period on samples that have been drawn from the top third of the material stored in containers 10 inches tall by 5-1/2 inches OD and a mouth opening of 2-1/2 inches. The results of these four tests shall determine final approval of the material (see 3.19.2).

4.6.7 Rejection criteria for tests. Failure of any sample to conform to the tests specified herein shall reject the lot or batch.

4.6.8 Rejection and retest. Material, which has been rejected, may be reworked or replaced to correct the defects and resubmitted for acceptance. Before resubmitting, full particulars concerning

MIL-C-5545C

previous rejection and the action taken to correct the defects found in the original corrosion preventive shall be furnished to the acquisition activity. Material rejected after retest shall not be resubmitted without specific approval of the acquiring activity.

5. PACKAGING

5.1 Preservation and unit pack. The corrosion preventive shall be preserved in accordance with MIL-STD-290 in five-gallon pails or fifty-five gallon drums, in the quantity and level of preservation specified in the contract or order. The five-gallon pails shall conform to PPP-P-704, type II, class 8. The fifty-five gallon drums shall conform to PPP-D-729, type IV.

5.2 Packing. The corrosion preventive unit pack as specified in 5.1 requires no packing.

5.3 Marking. The unit pack shall be marked in accordance with MIL-STD-129 and any special marking requirements specified by the acquisition activity, and if toxic and hazardous, labeled in accordance with the applicable laws, statutes, regulations or ordinances, including Federal, State and municipal requirements. In addition the unit pack shall be marked with the applicable precautionary information detailed in American National Standard ANSI Z129.1.

6. NOTES

6.1 Intended use. The corrosion preventive is intended for use on the internal parts and surfaces of reciprocating aircraft engines and equipment to prevent damage by corrosion. The corrosion preventive covered by this specification is to be employed only for static preservation and is to be removed from the engine prior to flight.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number and date of this specification.
- b. Quantity desired (furnished in 5 or 55-gallon containers).
- c. Level of preservation.
- d. Special markings if required.
- e. Addresses for submission of MSDSs (see 3.2.1).

MIL-C-5545C

6.3 Suggested testing procedures.6.3.1 Preparation of specimens for protection test.

6.3.1.1 Cleaning. The following procedure will produce specimen surfaces of high-level cleanliness:

- a. After rounding the edges of the panel and reaming out suspension holes, wipe the surfaces with solvent-saturated rags.
- b. Scrub the panel with a clean cotton or surgical gauze.
- c. Swab in a beaker of hot petroleum naphtha (P-D-680, Type II).
- d. Rinse in clean hot petroleum naphtha.
- e. Rinse in hot commercial anhydrous methyl alcohol for 10 seconds and let panel dry. If the specimens are not processed at once, preserve them in a desiccator.
- f. Buff the panels, ending with a new section of 240 or 280 grit carborundum or alundum abrasive paper with strokes in a direction parallel to the length of the panel, so as to produce a surface finish of 6-12 microinches (rms).
- g. Wipe off superficial dust from the abrasion operation, using surgical gauze.
- h. Scrub abraded face of panel thoroughly with clean surgical gauze until there is no dark stain on a clean section of gauze.
- i. Spray the panel with hot naphtha from a wash bottle. The panel should be held in a rack at $7 \pm 3^{\circ}\text{C}$ ($20 \pm 5^{\circ}\text{F}$) from the vertical. The spray should be directed vertically downward on the panel flushing the test surface progressively downward. Spray both sides of the panel.
- j. Finally rinse the panel in fresh boiling anhydrous methanol allowing the panel to be immersed for at least 10 seconds to permit the panel to reach the temperatures of the methanol before withdrawal.
- k. Permit the specimen to dry and preserve in a desiccator, using it on the day of preparation.

6.3.1.2 Other precautions. The following comments are also important or pertinent to the cleaning method:

MIL-C-5545C

a. The utensils and the solvents used in the preparation of the panels must be clean and free from contamination.

b. In all stages of treatment beginning with step "b," manual handling must be avoided. The panels must be handled with hooks or forceps, etc., and contact with the contaminated surfaces during cleaning procedure should be avoided.

c. In general (1) the naphtha removes oily or grease-like contamination; (2) the methyl alcohol removes most water-soluble contaminants likely to be encountered, such as fingerprints, salt-like, or acridic contaminants from atmospheric dust or fumes, etc.; and (3) the rubbing and spraying operations aid in the removal of the foregoing as well as inert materials, adherent films, and smuts, etc. The solvents are heated so that the specimen temperature is maintained above the ambient dew point at all points where rapid solvent evaporation might cause moisture condensation and consequent rapid rusting.

d. The following test method may be used in evaluating the surface cleanliness:

Place the panel directly under a burette on a table free of vibrations or drafts. A drop of distilled water 0.05 ml in volume is allowed to drop vertically and perpendicular to the panel from a distance of 30 centimeters above the panel. If the surface is absolutely clean, successive droplets on various parts of the surface will spread out completely in spots of closely reproducible dimensions. A clean panel should give a spread of 21 to 23 millimeters for each 0.05 ml of distilled water. This test is considered necessary and important because of variations found in different abrasive materials and because the personal factors involved in the procedure require some method of check of final results.

6.3.2 Examining test panels. It is recommended that examination of the test panels be carried out under a shaded fluorescent light (15W) of the analytical balance illuminator type, so suspended that the panel may be held at a distance of approximately 12 inches from the light, and further, that all examination be made without the aid of magnification.

6.3.3 Maintaining constant humidity of test chamber. It has been found that a satisfactory constant humidity test chamber may be obtained by using a deep desiccator with a saturated magnesium nitrate solution in the base and by suspending the test specimens from a rack supported by a desiccator plate.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products, which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List (QPL-5545) whether or not such products have

MIL-C-5545C

actually been so listed by that date. The attention of the contractors is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Commander, Naval Air Systems Command, AIR-5304, Washington, DC 20360; however, information pertaining to qualification of products may be obtained from the Commander, Naval Air Development Center, Code 6062, Warminster, PA 18974.

6.4.1 Letter of authorization. It is to be understood that upon receipt of the Letter of Authorization, samples shall be furnished at no cost to the Government, and that the manufacturer shall pay the transportation charges to and from the designated point where tests are to be made. In the case of failure of the sample or samples submitted, consideration will be given to the request of the manufacturer for additional tests only after it has been clearly shown that changes have been made in the product which the qualifying agency considers sufficient to warrant additional tests.

6.5 Contract certificate. It is understood that the corrosion preventive supplied under contract shall be identical in every respect to the sample tested and found satisfactory except for changes previously approved by the acquiring agency. Any unapproved changes from the qualification sample shall constitute cause for rejection. In addition, the manufacturer shall submit a certificate stating that the product as delivered under contract passes the requirements of the specification and that the product is in all respects the same as that submitted for acceptance and approval and listed in the applicable Qualified Products List.

6.6 Type designations. The unified numbering system (UNS) designation is listed for information purposes only and similar alloys shall not be construed as an acceptable alternate, unless all requirements of this specification are met.

6.7 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
 Army - SM
 Navy - AS
 Air Force - 11

Preparing activity:
 Navy - AS
 (Project No. 6850-0711)

Review activity:
 Air Force - 68
 DLA - GS, PS

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION <i>(Mark one)</i> <input type="checkbox"/> VENDOR <input type="checkbox"/> USER <input type="checkbox"/> MANUFACTURER <input type="checkbox"/> OTHER <i>(Specify):</i> _____
b. ADDRESS <i>(Street, City, State, ZIP Code)</i>	
5. PROBLEM AREAS	
a. Paragraph Number and Wording:	
b. Recommended Wording:	
c. Reason/Rationale for Recommendation:	
6. REMARKS	
7a. NAME OF SUBMITTER <i>(Last, First, MI) - Optional</i>	b. WORK TELEPHONE NUMBER <i>(Include Area Code) - Optional</i>
c. MAILING ADDRESS <i>(Street, City, State, ZIP Code) - Optional</i>	8. DATE OF SUBMISSION <i>(YYMMDD)</i>

(TO DETACH THIS FORM, CUT ALONG THIS LINE.)