

## Aircraft Material Specification

## LUBRICATING OIL, GENERAL PURPOSE: Low Temperature

NATO Code Number: 0-142

Joint Service Designation: OM-12

NOTES. (1) This specification is one of a series issued by the Ministry of Aviation, either to meet a limited requirement not covered by any existing British Standard or to serve as a basis for inspection of material, the properties and uses of which are not sufficiently developed to warrant submission to the British Standards Institution for standardisation.

(2) Requirements contained herein are absolute and are not subject to corrections for tolerance of test methods. If multiple determinations are made by the inspecting laboratory, average results will be used except for those test methods where repeatability data are given. In those cases the average value derived from the individual results that agree within the repeatability limits for the test method may be used if the Inspection Authority permits.

(3) The DEF-2000, ASTM, IP and Joint ASTM-IP methods of testing mentioned in this specification are those of the current editions of Ministry of Defence Specification DEF-2000 'Standard Methods for Testing Petroleum Oils and Lubricants (P.O.L.) and Allied Products', ASTM Standards Parts 17 and 18, 'Petroleum Products' and 'IP Standards for Petroleum and its Products' respectively.

(4) Further details concerning the test apparatus specified in this specification can be obtained from the Chemist in Charge, Chemical Inspectorate, Harefield House, Harefield, Uxbridge, Middlesex.

(5) This material is intended as a low temperature lubricant for lightly loaded bearing surfaces.

## SECTION I

## Requirements

## 1. Description

The material shall consist of a refined mineral oil containing approved additives to provide oxidation stability and corrosion protective properties.

## 2. Freedom from impurities

The material, by visual inspection, shall be clear and free from dirt and other impurities.

## 3. Viscosity

The kinematic viscosity of the material, when determined by Joint Method ASTM D445-IP71, shall be not less than 10 centistokes at 37.8°C (100°F), and not greater than 4,000 centistokes at minus 40°C (minus 40°F).

## 4. Flash point

The flash point of the material shall be not lower than 130°C (265°F) when determined by Joint Method ASTM D92-IP36.

## 5. Pour point

The pour point of the material shall not be above minus 57°C (minus 70°F) when determined by Joint Method ASTM D97-IP15.

## 6. Neutralisation number (total acid number)

The total acid number of the material shall not exceed 0.2 when determined by Joint Method ASTM D974-IP139.

## 7. Precipitation number

The precipitation number shall be zero when determined by Method ASTM D91.

## 8. Corrosivity

(a) The corrosiveness of the material shall be such that, when determined by the method described in Appendix I, the change in weight of the steel, aluminium alloy, magnesium alloy, copper and cadmium plated steel test pieces shall be not more than  $\pm 0.2$  milligramme per square centimetre of surface. There shall be no pitting, etching or visible corrosion of the surface of any of the test pieces when examined under a magnification of 20 diameters. Slight discolouration of the copper shall be permissible but dark brown, grey or black stain shall be cause for rejection. Slight discolouration of the cadmium shall also be permissible.

(b) The material when tested for 3 hours at 100°C (212°F) according to Joint Method ASTM D130-IP154, shall cause no pitting, etching or visible corrosion of the copper strip, and the staining of the copper shall not exceed ASTM-IP Classification 1.

### 9. Resistance to oxidation

The resistance to oxidation of the material shall be such that, when tested according to the method described in Appendix I, the viscosity shall be within the limits of minus 5 or plus 20 per cent of the original viscosity at 37.8°C (100°F), and the total acid number shall not have increased by more than 0.2. There shall be no visible evidence of separation of insoluble matter, or of gummying of the material.

### 10. Corrosion protection

- (a) The corrosion protective properties of the material on steel in contact with brass at 25°C (77°F) and 50 per cent relative humidity shall be such that, when tested by the method described in Appendix II, the test areas of at least two of three steel discs shall show no evidence of corrosion, pitting or other attack; one disc may show not more than three spots within the test area.
- (b) The corrosion protective properties of the material on steel conforming to B.S. S511 shall be such that not more than one steel panel out of five, prepared and tested according to Method ASTM D1748, shall exceed the following corrosion limits after 100 hours at 49° ± 1°C (120° ± 2°F) and 100 per cent relative humidity:
  - (i) A corroded area of 2 millimetres diameter or larger;
  - (ii) Two or more spots of between 1 and 2 millimetres diameter;
  - (iii) Ten or more spots of any size.

If more than one panel fails, the test shall be repeated with an additional ten panels. Not more than four panels shall fail out of the total of fifteen panels.

### 11. Low temperature stability

The material shall show no signs of gelling, separation of liquid or solid phases, or precipitation after 72 hours at minus 54°C (minus 65°F) when tested in accordance with Method No. 7 of DEF-2000. Presence of a cloud which does not settle out shall not be cause for rejection.

### 12. Resistance to evaporation

The evaporation loss of the material in 22 hours at 99°C (210°F) shall be not more than 22 per cent by weight when determined according to the Procedure for Oils described in Method ASTM D972.

## SECTION II

### Inspection

### 13. Type approval

Before material is accepted as complying with the requirements of this specification, the manufacturer shall obtain type approval. Applications for type approval shall be submitted to the Director of Chemical Inspection (G1), Royal Arsenal, Woolwich, London, S.E.18 together with a sample of the material (approximately 1 gallon, preferably in a single container, will be required). Details of formulation and evidence that the material complies with all the requirements of Section I of this specification shall also be submitted.

The material shall also pass such functional tests as are deemed necessary by the Director of Chemical Inspection.

Failure to show satisfactory compatibility with other materials approved to this specification shall be sufficient cause for rejection.

After formal approval has been given no change in formulation will be permitted unless approval of the change has been sought and given.

### 14. Routine inspection

A representative sample of each batch shall be tested for compliance with all the requirements of Section I.

The manufacturer shall state on each test certificate that the material is identical in formulation and method of manufacture with the material which has been previously type approved in accordance with Clause 13.

## APPENDIX I

### Method for the determination of corrosivity and resistance to oxidation

The apparatus shall consist of a large test tube of heat resisting glass about 65 millimetres outside diameter and about 300 millimetres long, fitted by means of a ground glass connection to a water-cooled reflux condenser, and an air delivery tube of heat resisting glass about 6 to 8 millimetres in outside diameter and at least 50 millimetres longer than the total length of the test-tube and condenser when assembled. One end of the air delivery tube shall be drawn out to a round aperture 1.6 ± 0.4 millimetres internal diameter.

Test pieces about 2.5 centimetres square of copper (conforming to B.S.1036 in the form of annealed strip conforming to B.S.899), low carbon steel (B.S. S514), aluminium alloy (B.S. 2L70), magnesium alloy (D.T.D. 118B) and cadmium plated steel (conforming to B.S. S514, cadmium plated to an average thickness of 0.015 millimetres minimum in accordance with specification D.T.D. 904C, excluding dichromate seal and with a matt finish), shall be cut from thin gauge sheet and drilled in each corner with 1.6 mm holes. The cadmium plated steel test piece, which shall have been plated after cutting and drilling, shall be cleaned by rinsing in toluene and the other four test pieces shall be cleaned and polished according to the method described in IP154.

The test pieces shall be weighed individually to the nearest milligram and tied together in the form of a pentagon by means of a cotton cord which has been previously boiled in distilled water and dried. The order of the metals in the pentagon shall be magnesium alloy, aluminium alloy, copper, cadmium plated steel and steel.

The metal pentagon shall be placed in the test tube and the whole weighed to the nearest 0.1 gramme. A volume of about 100 ml of the material shall be introduced, and the whole again weighed to the nearest gramme.

The test tube shall be connected to the reflux condenser and placed in a thermostatically controlled liquid bath maintained at  $121^{\circ} \pm 1^{\circ}\text{C}$  ( $250^{\circ} \pm 2^{\circ}\text{F}$ ). The air delivery tube shall be adjusted down the central tube of the reflux condenser so that its lower end with the 1.6 mm aperture shall be within 3.2 mm of the bottom of the test tube and centrally within the metal pentagon. Clean, dry air shall be passed through the air delivery tube at the rate of  $5 \pm 0.5$  litres per hour.

After 168 hours, the aeration and heating shall be stopped and the apparatus disconnected. The test tube and contents shall be removed from the bath, cooled to room temperature, cleaned externally and weighed to the nearest 0.1 gramme. Any loss by evaporation shall be calculated as a percentage of the weight of material originally taken. In the event of the evaporation loss being in excess of 8 per cent, the determination shall be disregarded and a new determination made after the excessive vapour leakage has been corrected.

Without removing the material from the test tube, the metal pentagon shall be withdrawn and taken apart. The test pieces shall be rinsed in toluene, then acetone, air dried and weighed individually to the nearest milligramme. The change in weight of each test piece shall be calculated in milligrammes per square centimetre of metal surface exposed to the material.

The test pieces shall be examined microscopically under a magnification of 20 diameters for visual evidence of pitting or etching.

The material remaining in the test tube shall be examined visually for evidence of deposition of gummy or other insoluble matter, its viscosity determined at  $37.8^{\circ}\text{C}$  ( $100^{\circ}\text{F}$ ), and its neutralization number (total acid number) determined according to Joint Method ASTM D974-IP139.

## APPENDIX II

### Method for the determination of corrosion protection of steel at 50 per cent relative humidity

Three steel discs  $\frac{1}{2}$  inch thick shall be cut from 1 inch diameter bar steel (B.S.970, En 31). The discs shall be heat treated to a Diamond Pyramid Hardness (HD/30) of not less than 800.

*NOTE.* Rollers that may be obtained from roller-bearings, and that have similar chemical, physical and dimensional properties to the above bar stock after heat treatment, can be substituted for the formation of the discs. In this case, no additional heat treatment is necessary.

The discs shall be slowly ground on one face to a finish of less than 20 micro-inches C.L.A. If a coolant is used in grinding, the discs shall be rinsed in absolute methanol. The ground surfaces shall then be polished by successive applications of emery polishing paper, grades 1/0, 2/0, 3/0 and finally 4/0. (Papers incorporating iron oxide as a polishing medium and wet-dry type papers shall not be used). The discs shall be wiped clean with sterile absorbent gauze and examined under a magnification of 10 diameters for any signs of corrosion or other defects. Defective specimens shall not be used. The discs shall not be touched by hand after cleaning, and shall be stored in a desiccator containing silica gel until required for use.

Three brass clips of dimensions shown in Figure 1 shall be prepared from thin gauge brass sheet (B.S. 267 cold worked to a spring temper). The clips shall be immersed for 20 seconds in the following etching solution:

- 450 ml water
- 225 ml concentrated nitric acid
- 300 ml concentrated sulphuric acid
- 8 ml concentrated hydrochloric acid

After etching the clips shall be washed thoroughly in mains water, rinsed in distilled water and finally dried with sulphur free acetone. The clips shall not be touched by hand after cleaning and shall be stored in a desiccator containing silica gel until required for use.

The three discs shall be coated with the material by dipping a glass rod in the material and allowing the oil from the rod to drop on the polished side of the discs. The drops shall be spread so as to completely cover the discs. The brass clips shall then be clamped on the coated discs and the assemblies placed in a test chamber which shall be maintained at  $25^{\circ}\text{C}$  ( $77^{\circ}\text{F}$ ) and 50 per cent relative humidity for a period of 10 days. (A saturated aqueous solution of calcium nitrate tetrahydrate,  $\text{Ca}(\text{NO}_3)_2 \cdot 4\text{H}_2\text{O}$ , in contact with an excess of the solid phase shall be used for maintaining the humidity). At the end of this time, the assemblies shall be removed, and the areas covered by the brass clips outlined on the discs, using the clips as templates.

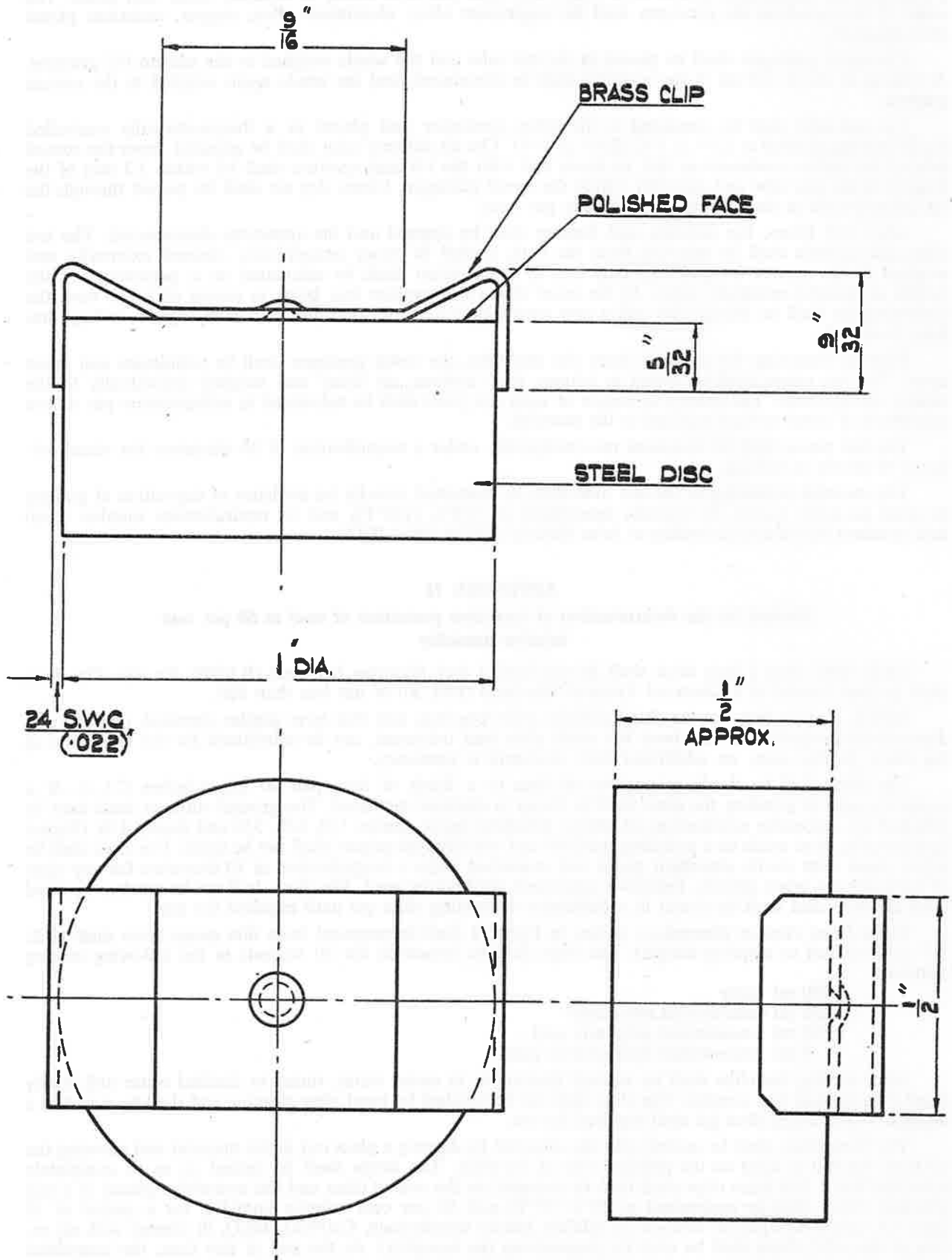
The clips shall then be removed and the discs wiped clean with sterile absorbent gauze. The discs shall be examined under a magnification of 10 diameters for signs of corrosion, pitting or other detrimental effects. If the test results are questionable, the whole test shall be repeated with new specimens except that the period of time shall be extended to 20 days.

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Approved for issue,

E. W. RUSSELL,

Director of Material Research and Development.



**FIG. 1 TEST SPECIMEN FOR 50 PER CENT RELATIVE HUMIDITY CORROSION PROTECTION TEST**

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**Clause 6**

*Delete* Existing clause entirely

*Insert* New clause:

**6. Acidity**

(a) The total acidity of the material shall not exceed 0.2 milligramme of KOH per gramme when determined by Method IP1.

(b) The inorganic acidity of the material shall be nil when determined by Method IP182.

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