MINISTRY OF AVIATION

D.T.D. 5527

May, 1965

Aircraft Material Specification

GREASE, AIRCRAFT: Synthetic, Molybdenum Disulphide

Joint Services Designation: XG-276

NATO Code Number: G-353

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*) *The ASTM and IP methods of testing mentioned in this specification are those of the current editions of 'ASTM Standards on Petroleum Products and Lubricants' and 'IP Standards for Petroleum and its Products' respectively.*

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

(*4*) *This material is intended for use mainly on plain bearings and low efficiency screw threads.*

SECTION I

Requirements

1. Composition

The material shall consist of a uniform mixture of Grease XG-275 conforming to Specification D.T.D. 825B and not less than 5 per cent nor more than 10 per cent by weight of molybdenum disulphide conforming to Specification C.S.2819.

NOTE: *It is proposed that in any future revision of the specification, reference to D.T.D.825B shall be deleted.*

2. Description

The material shall be a smooth homogeneous grease, free from lumps, crusts and granular or abrasive particles.

3. Abrasiveness

The material shall cause no visible scratching of the brass plates when tested by the method described in Appendix I.

4. Molybdenum content

The molybdenum content of the material when determined, after ashing at a temperature not exceeding 600°C, by the method described in specification C.S.2819 shall be not less than 3.0 per cent and not more than 6.0 per cent by weight.

5. Penetration

(*a*) The unworked penetration when determined by method IP50 shall be not less than 200.

(*b*) The worked penetration of the material when determined by Method IP50 shall be not greater than 310 or less than 260.

6. Drop point

The drop point of the material when determined by Method IP132 shall be not less than 163°C (325°F).

7. Corrosion

The material when tested by Method IP112 at 100°C (212°F) for 24 hours shall cause no etching, pitting, or grey or black discoloration of the copper strip.

8. Resistance to oxidation

The resistance to oxidation of the material shall be such that the fall in pressure shall be not more than 10 pounds per square inch at the end of 100 hours, when determined by Method IP142.

9. Load carrying capacity

The load carrying capacity of the material shall be such that when determined by the method described in Appendix II, the Mean Hertz Load shall be not less than 55.

10. Bearing protection

The rust preventive properties of the material shall be such that when determined by the method described in Appendix III the corrosion rating shall not exceed 2.

11. Storage stability

The storage stability of the material shall be such that the worked penetration determined by Method IP50 on the material after storage in the dark in a 1 lb. oiltight container for 6 months at 38± 1°C (100±2°F) shall not differ from the original worked penetration by more than 30 units, and the unworked penetration shall be not less than 200. There shall be no settling out of molybdenum disulphide from the stored material.

SECTION II

Inspection

12. Type approval

Before material is accepted as complying with the requirements of this specification, the manufacturer must obtain type approval.

Applications for type approval shall be submitted to Chemical Inspectorate, (G1) Branch, Headquarters Building, Royal Arsenal, Woolwich, London, S.E.18, accompanied by details of the formulation and evidence that the material complies with all the requirements of Section I of this Specification.

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

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

13. Routine inspection

A representative sample of each batch shall be tested for compliance with Clauses 2 to 8 inclusive and Clause 10.

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 12.

The Director of Chemical Inspection may require the manufacturer to test to Clauses 9 and 11 at any time.

APPENDIX I

Method for the Determination of Abrasiveness

A pair of brass discs approximately 3 inches in diameter, the edges of which have been chamfered, shall be polished with successively finer emery cloth, and finally with rouge to give a mirror surface. Two grams of the material shall be squeezed between the polished faces and the plates rubbed together vigorously for one minute. The plates shall then be washed clean with a suitable solvent and examined for visible scratchings.

APPENDIX II

Method for the Determination of Mean Hertz Load

Apparatus.—The apparatus shall be an approved Four-Ball Machine, the essential feature of which, shown diagrammatically in Fig. 1, consists of an assembly of four steel balls, each of which is in contact with the other three. The balls are supported in such a manner that the upper ball can be rotated at constant speed in chosen conditions of load against the three lower balls which are held stationary in respect of each other.

As indicated in Fig. 1, the vertical driving shaft terminates in the ball chuck holder which carries the ball chuck. The upper ball which is held firmly in the ball chuck rests upon the three lower balls which are gripped firmly together in the ball pot by means of a lock ring and nut. The ball pot assembly and mounting disc rest upon the thrust bearing and are free to rotate about the vertical axis of the apparatus. Load can be applied to the ball pot by the addition of weights to the weight tray which can be suspended at any desired position along the graduated lever arm. The actual load on the balls is obtained by multiplying the total weight of the tray and weights by the lever arm ratio. Power for the driving shaft is supplied by a motor (not shown in Fig. 1) operating at a nominal speed of 1,500 r.p.m.

Preparation for Test.—A set of four new balls, ½ inch in diameter, of Grade 1 ball bearing steel shall be used for each run. These, and the ball pot and chuck shall be cleaned in light petroleum spirit before the run is commenced (chlorinated solvents shall not be used).

Test Procedure.—For each run a new ball shall be placed in the ball chuck and three new balls in the ball pot. A sample of the material to be tested, sufficient to cover the balls when the assembly has been completed, shall be placed in the ball pot and worked around the balls. The lock ring and lock nut shall then be screwed into position and the ball pot assembly placed in the apparatus in contact with the single ball. The desired load shall then be applied and the motor started. After ten seconds the motor shall be stopped, and the ball pot assembly removed from the apparatus. The single ball in the ball chuck shall be discarded and the three balls from the ball pot set aside for measurement of the wear spots formed by the rubbing of the single ball upon them.

A series of twenty ten-second runs shall be made at the pre-selected loads shown in Column 1 of Table 1. The first run shall be made with a load of 40 kilograms, and subsequent runs at the successively higher loads until welding of the balls occurs. Two further runs shall be made at the welding load. If welding does not occur in both these further runs, an additional run at the next higher load shall be made to confirm the welding. If welding occurs at or below 355 kilograms, additional runs shall be made at loads successively lower than 40 kilograms to complete a total of 20 determinations free of welding.

Wear Measurement.—The wear spots on the three lower balls from each run shall be measured by means of a microscope, preferably binocular, having a magnification of approximately 60 diameters, and fitted with a micrometer eyepiece. Two measurements of each wear spot shall be made, normal and parallel to the direction of the striations in the wear surface. The mean of the six readings, expressed in millimetres to the nearest 0.01 mm. shall be recorded as the mean measured diameter.

Hertz Diameter.—The Hertz diameter, which is the diameter of the static deformation caused by the indentation of the balls under load at the start of the test, shall be calculated from the following formula for each applied load.

$$dH = 8.73 \times 10^{-2} \times \sqrt[3]{L}$$

where dH = Hertz diameter in millimetres
L = applied load in kilograms

Corrected Load.—The corrected load shall be obtained for each run by multiplying the applied load by the ratio between the Hertz diameter at that load and the mean measured diameter of the wear spots, e.g.,

$$\text{Corrected Load} = \frac{L\ dH}{\text{Mean measured diameter}}$$

Since the applied loads and the corresponding Hertz diameters are known, the factor L. dH has been calculated for each load and included in Table 1.

Calculation of Mean Hertz Load.—The corrected loads for runs made with loads of 316 kilograms and less shall be added together, (A). If no runs at loads greater than 316 kilograms have been made, (A) divided by 20 gives the Mean Hertz Load. If runs with loads greater than 316 kilograms have been made the mean (B) of their corrected loads shall be taken (to represent the twentieth load). The sum of (A) and (B) divided by 20 gives the Mean Hertz Load.

TABLE I

Applied Load Kilograms	Factors L.dH
6	0.952
7	1.169
8	1.397
9	1.634
10	1.881
11	2.135
13	2.668
14	2.946
16	3.520
18	4.118
20	4.740
22	5.382
25	6.382
28	7.423
32	8.869
36	10.38
40	11.94
45	13.97
50	16.08
56	18.70
63	21.88
71	25.67
79	29.59
89	34.69
100	40.52
112	47.13
126	55.14
141	64.07
158	74.57
178	87.41
200	102.1
224	118.8
251	138.2
282	161.4
316	187.9
355	219.4
398	255.6
447	298.4
501	347.3
562	404.9
631	472.4
708	550.8
794	641.8

APPENDIX III

Method for the Determination of Bearing Protection

Method ASTMD1743 shall be used with the following modifications:

(*a*) *Apparatus*

(i) *Bearings* from British Timken Ltd. are acceptable.

(ii) *Motor and spindle* — a 1450 r.p.m. motor fitted with a suitable rubber stopper may be used.

(iii) *Thrust Loading Device* — alternative devices may be used subject to the approval of the Inspection Authority.

(*b*) *Materials*

(i) Isopropyl alcohol — shall comply with B.S. 1595.

(ii) Stoddart solvent — White Spirit to B.S.245 shall be used in lieu of this material.

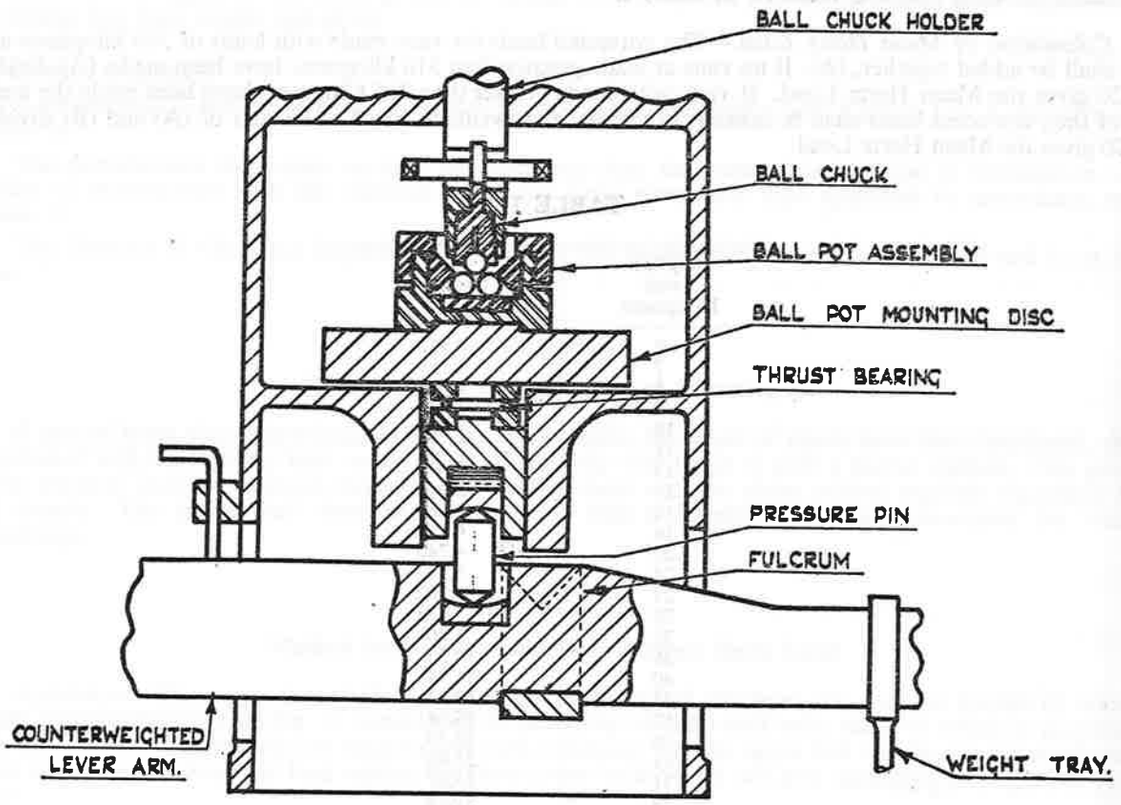

Fig. 1. Load carrying capacity test apparatus.

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