

Aircraft Material Specification
OIL RESISTANT VULCANISED SILICONE RUBBERS FOR AIRCRAFT

NOTE 1. This specification is one of a series issued by the Ministry of Aviation, either to meet a limited requirement not covered by an existing British Standard for aircraft material, 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.

NOTE 2. It is one of a series of rubber specifications in which the material is classified by the base polymer employed.

NOTE 3. The tests employed in this specification are chosen for their reproducibility and ability to control the properties of the material. They are not intended to be simulated service tests, which, because of variability of test conditions, may be unsatisfactory for control purposes.

NOTE 4. The intended applications and the limitations of materials to this specification are given in Section 1 of the specification and are for guidance only. In case of doubt users are advised to confirm the suitability of the material for any given application.

NOTE 5. Further guidance on the choice of rubber for any particular purpose may be obtained from Appendix I of D.Mat. Tech. Memo. No. 7 "Rubber in Engineering Design".

NOTE 6. Except where otherwise stated, the methods of test shall be as described in British Standard 903 — "Methods of Testing Vulcanized Rubber", the edition current at the date of tender or contract being intended.

SECTION 1

Scope

1. The materials covered by this specification are intended for the production of items such as sheets, mouldings and certain extrusions, mainly for fluid sealing applications where low compression set is of prime importance. They can be used in contact with heavy mineral and diester-based oils within the temperature range -65°C to 150°C for continuous operation or 200°C for short intermittent periods. For applications in contact with air they may be considered also for use up to 250°C . They are unsuitable for use in contact with petroleum based fuels, light mineral oils or greases derived from them. They have excellent ozone resistance.

2. Four different hardness values are covered (Grades 50, 60, 70 and 80, Grade 50 being the softest) and the grade required must therefore be stated on all drawings and contracts. Where a nominal hardness other than those quoted is necessary, this can be specified and the basic requirements other than hardness shall be those specified for the grade embracing the proposed nominal hardness. If a tolerance is required which is tighter than those quoted (+4, -5), this should be specified but should not be less than ± 3 .

SECTION 2

Related documents

3. Reference is made in this document to the following:

B.S.903 — Methods of testing vulcanized rubber.

B.S.1134 — Centre-line-average height method for the assessment of surface texture.

B.S.2L70 — Aluminium - copper - magnesium - silicon - manganese alloy sheets and strips.

A.S.T.M. D.471 — Change in properties of elastomeric vulcanizates resulting from immersion in liquids.

D.Eng.R.D.2487 — Aircraft turbine engine oil.

Except where otherwise stated, the latest issue of these documents is intended.

SECTION 3

General requirements

4. Description

The materials covered by this specification shall consist of a silicone polymer suitably compounded and cured to meet the requirements of Sections 4 and 5 of this specification. No reclaim or ground vulcanized waste shall be used. All ingredients of the mix shall be of recognised rubber quality and shall be free from foreign matter.

5. Freedom from defects

The selection and processing of the ingredients shall be such that the mix is homogeneous and that the parts made from it shall be free from surface imperfections, blisters, porosity, inclusions and undispersed ingredients and other defects which would impair satisfactory performance.

SECTION 4

Type approval of rubber compound

6. Type approval

Before any particular rubber compound is approved and accepted for the production of parts complying with this specification, the manufacturer (of the fully compounded stock) must satisfy the Director of Chemical Inspection (D.C.I.), Ministry of Defence (Army Dept.), Headquarters Buildings, Royal Arsenal, Woolwich, London, S.E.18, that it will meet the appropriate requirements specified in Table 1.

7. Test samples

When applying for approval, the manufacturer shall forward to D.C.I. the following:

- 7.1 A sample of the cured material in the form of a two-thickness test sheet 20-30 cm (8-12 in) square, thickness 2.5 ± 0.15 mm (0.100 ± 0.006 in) with an area, preferably at one corner, of thickness 6.35 ± 0.15 mm (0.250 ± 0.006 in), this thicker area being approximately 1/10th of the whole sheet and not less than 5 cm (2 in) wide. The test sheet shall be cured at the standard temperature for the mix, for a time appropriate to the dimensions of the sheet. No additional vulcanizing shall be given to the thicker section of the sheet.
- 7.2 Full details, in duplicate, of the proposed composition together with details of the standard curing conditions. This information will be treated as confidential.
- 7.3 The normal specific gravity of the compound submitted and, if a nominal hardness other than those specified (see Clause 2), the proposed hardness and hardness tolerance.
- 7.4 Test results on a sample identical to the one submitted and prepared from the same batch of mix.

8. Change of composition

After formal approval has been given, no change in the composition shall be permitted without the prior approval of D.C.I.

9. Tests

The tests listed in Table 1 shall be carried out to the satisfaction of the inspector on test pieces cut from the sample sheet specified in Clause 7. Each property of the material, when determined by the method given in Table 1, shall comply with the requirement also listed in Table 1. No absolute limits are set for specific gravity, but this shall be determined ($20^{\circ}/20^{\circ}\text{C}$) and a value agreed between D.C.I. and the manufacturer for each compound.

SECTION 5

Routine inspection

10. Routine inspection

- 10.1 The first production batch and subsequently at least one batch in every ten batches of rubber mix shall be tested for compliance with the requirements of Tests (a) to (e), (f)(i)(b), (f)(ii)(b), (g) and (h) of Table 1, by tests on a sample sheet cured as defined in Clause 7.
- 10.2 All other batches shall be tested for compliance with the requirements of Tests (a), (b), (e) and (h) of Table 1, by tests on a sample sheet cured as defined in Clause 7.
- 10.3 Parts of each design produced from each batch of compound shall be tested for compliance with the requirements of Test (b) and, where suitable test pieces can be prepared, of Test (e) of Table 1. Hardness shall also be determined, using one of the following methods as appropriate, due regard being paid to the dimensional limits for test pieces laid down in each:
 - 10.3.1 B.S.903, Part A7. Test results shall comply with the requirements of Test (a) of Table 1.
 - 10.3.2 B.S.903, Part A20.
 - 10.3.3 For parts with curved surfaces, one of the methods described in B.S.903, Part A22.

For 10.3.2 and 10.3.3, the nominal hardness or nominal apparent hardness and tolerance for each design shall be the subject of agreement between the manufacturer, the customer and the Inspecting Authority and test results shall comply with these requirements.

10.4 The Inspecting Authority may, at any time, require any of the tests specified in Table 1 to be carried out on a sample sheet cured as defined in Clause 7 or, where appropriate, on parts of each design.

11. Release notes

The manufacturer shall state on each release note the specification number, grade and date of cure (quarter and year). He shall also state the batch number and compound code of the rubber used.

TABLE 1

Test	Test requirement				Test method
	Grade 50	Grade 60	Grade 70	Grade 80	
(a) Hardness °B.S.	50 + 4 - 5	60 + 4 - 5	70 + 4 - 5	80 + 4 - 5	Appendix I
(b) Specific gravity (20°/20°C)	within ± 0.05 of the agreed value				B.S.903: Part A1 Method A
(c) Tensile strength lbf/in ² min.	700	700	800	800	Appendix II
(d) Elongation at break, % min.	200	140	100	70	Appendix II
(e) Compression set, % max.	15	15	20	20	Appendix III
(f) Resistance to oils					Appendix IV
(i) Volume change % max. after immersion in:					
(a) Mineral oil	+ 10	+ 10	+ 10	+ 10	
(b) Aircraft turbine engine oil	+ 14	+ 14	+ 14	+ 14	
(ii) Change in hardness, °B.S. max., after im- mersion in:					
(a) Mineral oil	- 12	- 12	- 12	- 12	
(b) Aircraft turbine engine oil	- 12	- 12	- 10	- 10	
(iii) Change in tensile strength, % of original value after im- mersion in:					
(a) Mineral oil	- 25	- 25	- 25	- 25	
(b) Aircraft turbine engine oil	- 35	- 35	- 35	- 35	
(iv) Change in elongation at break, % of original value after immer- sion in:					
(a) Mineral oil	- 20	- 20	- 20	- 20	
(b) Aircraft turbine engine oil	- 35	- 35	- 35	- 35	
(g) Resistance to heat ageing					B.S.903: Part A19 Method A or B 336 hours at 200° ± 2°C
(i) Change in hardness, °B.S. max.	+ 5	+ 5	+ 5	+ 5	
(ii) Change in tensile strength, % of original value, max.	- 3	- 3	- 3	- 3	
(iii) Change in elongation at break, % of original value, max.	- 20	- 20	- 20	- 20	
(h) Tear strength lbf, min.	5	5	5	5	B.S.903: Part A3
(j) Freedom from adhesion to and corrosion of metals	No adhesion to the metal surfaces nor corrosion or pitting of the metal. Discolouration of the metal surfaces will not be considered objectionable.				Appendix V

APPENDIX I**Method for the determination of hardness**

- (i) Hardness measurements required for Test (a) of Table 1 shall be made by the method described in B.S.903, Part A7, using one specimen of the thicker part of the test sheet specified in Clause 7 superimposed upon the thinner part of the same test sheet.
- (ii) For the determination of change in hardness required for Tests (f)(ii) and (g)(i), the measurements shall be carried out, before and after ageing, by the method described in B.S.903, Part A7, using two specimens plied together, of the thinner part of the test sheet specified in Clause 7.

APPENDIX II**Method for the determination of tensile strength and elongation at break**

Tensile strength and elongation at break measurements shall be carried out by the method described in B.S.903, Part A2, using Type E test pieces.

APPENDIX III**Method for the determination of compression set**

Compression set measurements shall be made by Method A of B.S.903, Part A6: 1957, using Type I test pieces from the thicker section of the test sheet specified in Clause 7. No glass paper shall be used, the steel surfaces which contact the test pieces being hardened, ground and finally lapped. The roughness value of the finish of these surfaces shall not exceed 8CLA when assessed in accordance with B.S.1134.

The time of test shall be 24 hours and the temperature during the compression period shall be $150^{\circ} \pm 2^{\circ}\text{C}$. A recovery period of 10 minutes shall be allowed.

APPENDIX IV**Method for the determination of resistance to fluids**

Measurement of volume change, test (f)(i), hardness change, test (f)(ii), change in tensile strength, test (f)(iii) and change in elongation at break, test (f)(iv), shall be made after immersion in:

- (a) mineral oil complying with the requirements of Oil No. 1 of A.S.T.M.D.471; or
- (b) aircraft turbine engine oil, Esso Extra Turbo Oil 274, complying with the requirements of D.Eng. R.D.2487.

For all tests, the temperature of the oil shall be $120^{\circ} \pm 2^{\circ}\text{C}$ and the period of immersion 168 hours.

- (i) Volume change measurements shall be made by the volumetric method of B.S.903, Part A16.
- (ii) Hardness change measurements shall be made as described in Appendix I.
- (iii) Change in tensile strength and elongation at break shall be carried out using the method described in B.S.903 Part A2, using Type E test pieces.

APPENDIX V**Method of test for freedom from adhesion to and corrosion of metals**

A test piece, approximately 1 inch square, shall be placed on the clean, smooth finely-ground surface of a mild steel plate, approximately 2 inches square and not less than $\frac{1}{8}$ inch thick. A plate of aluminium alloy to B.S.2L70, similar to the steel plate in dimensions and finish shall be placed over the test piece in line with the steel plate. The rubber surfaces shall be brought into intimate contact with the metal surfaces and the assembly secured by means of wire or a suitable clamp.

The assembly shall be placed in an air oven at $70^{\circ} \pm 1^{\circ}\text{C}$ for 168 hours. At the end of this period it shall be allowed to cool to room temperature and the wire or clamp removed.

The assembly shall be carefully parted and the metal surfaces examined for corrosion and pitting and adhesion of the rubber to either metal. Adhesion shall be considered to have occurred if, on separation, particles of the rubber remain adhered to the metal surfaces.

Approved for issue,

E. W. RUSSELL,

Director of Materials Research and Development.

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