

Sleeves and moulded components for aircraft electric cables and equipment wires

Part 1. Specification for elastomeric sleeves for binding and identification

ICS 49.060

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- British Airways
- British Cable Makers' Confederation
- British Rubber Manufacturers' Association
- Civil Aviation Authority (Airworthiness Division)
- Federation of the Electronics Industry
- Ministry of Defence
- Society of British Aerospace Companies

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Foreword

This Part of BS G 198 has been prepared by Technical Committee ACE/6. It specifies requirements for elastomeric sleeves for aircraft electric cables and insulated equipment wires. BS G 198 is published in the following separate Parts.

Part 1 *Specification for elastomeric sleeves for binding and identification*

Part 2 *Specification for slip-on sleeves for identification purposes*

Part 3 *Specification for heat-shrinkable sleeving for binding, insulation and identification*

Part 4 *Specification for fluoropolymer heat-shrinkable sleeving for binding and insulation*

Part 5 *Specification for heat-shrinkable moulded shapes*¹⁾

NOTE. It is envisaged that there will be a further Part on heat-shrinkable dual wall sleeves.

This Part of BS G 198 supersedes BS 3G 198 : Part 1 : 1989 which is withdrawn.

This Part of BS G 198 specifies requirements for elastomeric sleeves, in a range of diameters, lengths and materials, for binding and identification purposes on electric cables, and insulated equipment wires in aircraft. Sleeves are available in a range of colours.

The various types of sleeves specified by this British Standard have been designated by the allocation of type numbers. These numbers have been adopted by the aircraft industry over a period of years and do not necessarily run consecutively through the different Parts of BS G 198.

Sleeves should be installed in accordance with the manufacturer's or the supplier's instructions. It should be noted that the sleeves are to be used under mechanical strain not exceeding 50 % diameter expansion.

WARNING NOTE 1. This standard calls for the use of substances and/or test procedures that may be injurious to health if adequate precautions are not taken. It refers only to technical suitability and in no way absolves either the supplier or the user from statutory obligations relating to health and safety at any stage of manufacture or use.

WARNING NOTE 2. It should be clearly understood that the flammability tests specified in this standard are not for assessing a total fire hazard situation. It is solely for the purpose of specifying the basic material quality requirements of the elastomeric sleeves.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 26, an inside back cover and a back cover.

¹⁾ In preparation.

Specification

1 Scope

This Part of BS G 198 specifies the design, performance, quality assurance and methods of test for the types of elastomeric sleeves shown in table 1. These sleeves are for binding and identification purposes. Routine and quality tests are specified.

In addition to the definitive requirements, this standard also requires the items detailed in clause 3 to be documented. For compliance with this standard, both the definitive requirements and the documented items have to be satisfied.

NOTE 1. Recommendations for the storage of finished sleeves is given in annex A.

NOTE 2. The latest revision of an Aerospace Series standard is indicated by a prefix number.

Whilst not primarily intended for insulation purposes, this standard includes electrical tests to determine insulating properties.

2 References

2.1 Normative references

This Part of BS 4G 198 incorporates, by dated or undated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on page 26.

For dated references, only the edition cited applies, any subsequent amendments to or revisions of the cited publication apply to this Part of BS 4G 198 only when incorporated in the reference by amendment or revision. For undated references, the latest edition of the cited publication applies, together with any amendments.

2.2 Informative references

This Part of BS 4G 198 refers to other publications that provide information or guidance. Editions of these publications current at the time of issue of this standard are listed on the inside back cover, but reference should be made to the latest editions.

3 Information and requirements to be agreed and documented

The following items to be agreed between the contracting parties, which are specified in the clauses referred to, or shall be fully documented. Both the definitive requirements specified throughout the standard and the following documented items shall be satisfied before a claim of compliance with the standard can be made and verified.

- a) the number of this British Standard (i.e. BS 4G 198 : Part 1 : 1997);
- b) the total quantity required;
- c) cut length, if required (see 7.2) and tolerance on cut length, if the tolerance required is different from that given in table 2;
- d) the printing requirements (see clause 8 and clause 10);
- e) the codified identification(see note 1 to 13.1);
- f) the packaging requirements (see clause 13);
- g) other environmental requirements (see the note to table 3);
- h) whether the sleeving is to be tested in any other fluids, in addition to those given in table 4 (see 12.7);
- i) the test fluid(see table 4);
- j) the dimensional requirements, if non-standard (see clause 7).

Table 1. Types of elastomeric sleeve materials

Type	Guide to temp range °C ¹⁾	Exposure temperature °C			Material	Other main properties
		(1)	(2)	(3)		
1	– 40 to + 70	70	95	115	Polychloroprene	Flame retardant
2	– 25 to + 75	75	100	120	PVC-Nitrile	Oil resistant
3	– 65 to + 140	140	170	190	Fluorinated Silicone	Flame retardant and oil resistant
4	– 65 to + 160	160	220	260	Silicone	Heat resistant

¹⁾ Low temperature flexibility is assessed in accordance with clause 12.14.

NOTE 1. Exposure (1) is for a minimum of 20,000 h when assessed in accordance with clause 12.16.

NOTE 2. Exposure (2) is for a minimum of 1000 h when assessed by clause 12.17.

NOTE 3. Exposure (3) is for a minimum of 168 h when assessed by clause 12.17.

Table 2. Standard cutting tolerances for cut lengths of sleeves	
Cut length (mm)	Tolerance (mm)
0 to 9.9	± 0.5
10 to 24.9	± 1.0
25 to 49.9	± 1.5
50 to 99.9	± 3.0
100 to 149.9	± 4.0
150 to 249.9	± 5.0
250 to 1200	± 12.5

Table 3. Materials and characteristics		
Type	Material	Characteristics
1	Polychloroprene	Occasional contamination by mineral oils, petroleum fuels, and mineral or castor oil based hydraulic fluids
2	PVC-Nitrile	Occasional contamination by fuels, lubricants and non-ester based hydraulic fluids
3	Fluorinated Silicone	Oil, hydraulic fluid and fuel resistant
4	Silicone	Oil and hydraulic fluid resistant. Not for contact with fuels
NOTE. If the material is required to withstand certain specific environmental conditions not specified by this standard, then guidance should be sought from the manufacturer/supplier.		

Table 4. List of test fluids				
Test fluid reference (See BS 3G 100 : Part 2 : Section 3 : Subsection 3.12 : 1991)	Sleeve type			
	1	2	3	4
	Test temperature (°C)	Test temperature (°C)	Test temperature (°C)	Test temperature (°C)
(b) Aircraft fuel. Gasoline (piston engine). BS 903 : Part A.16	Test 1 (40 ± 1)	Test 1 (40 ± 1)	Test 1 (40 ± 1)	Not suitable
(d) Phosphate ester-based (synthetic). BS 903 : Part A.16	Not suitable	Not suitable	Test 1 (70 ± 1)	Test 2 (125 ± 2)
(g) Lubricating oil. Ester based (synthetic). BS 903 : Part A.16	Not suitable	Test 2 (100 ± 2)	Test 1 (150 ± 2)	Test 2 (150 ± 2)
(c) Hydraulic fluid. Mineral-based to NATO H-520 (OM-18) ²⁾	Test 2 (95 ± 1)	Test 2 (100 ± 2)	Test 1 (80 ± 1)	Test 2 (150 ± 2)
(h) De-icing fluid; Propan-2-ol (isopropyl alcohol) to BS 1595 : Part 1 : 1986	Test 1 (50 ± 1)	Test 1 (50 ± 1)	Test 1 (50 ± 1)	Test 2 (50 ± 1)
(m) De-icing fluid; inhibited ethylene glycol 50 % solution in water (V/V). BS 6580	Test 1 (50 ± 1)	Test 1 (50 ± 1)	Test 1 (50 ± 1)	Test 1 (50 ± 1)
Cleaning fluid ¹⁾	Test 2 (50 ± 1)	Test 2 (50 ± 1)	Test 2 (50 ± 1)	Not suitable
(r) Sullage fluid; (4 ± 0.1 %) formaldehyde plus (1 ± 0.1 %) o-cresol (GPR) in water.	Test 1 (20 ± 5)	Test 1 (20 ± 5)	Test 1 (20 ± 5)	Test 1 (20 ± 5)
(e) Silicone based synthetic hydraulic fluid; dimethyl silicone 10 mm ² /s (cst) at 25 °C ZX42; NATO SI714	Test 1 (80 ± 1)	Test 1 (80 ± 1)	Test 1 (80 ± 1)	Not suitable
¹⁾ The test fluid shall be agreed between the manufacturer/supplier and the purchaser and shall be documented (see 3i)). ²⁾ Defence Standards are obtainable from Ministry of Defence, Directorate of Standardization. NOTE. Commercial fluids of the types represented by test fluids (c), (d) and (r) will stain subjected sleeving. Sleeves should not be used purely as colour identifiers in areas subject to contamination by the fluids.				

4 Materials and characteristics

4.1 Materials and characteristics

Sleeves shall be made from materials that ensure that the finished sleeves conform to the appropriate requirements of clause 12. Printing on sleeves shall conform to clause 8 and the appropriate requirements of table 5.

NOTE 1. Materials known to meet the requirements of the tests specified in clause 12 have the characteristics shown in table 3.

NOTE 2. Printing on sleeves may affect properties.

NOTE 3. The tests specified in clause 12 are performed on finished sleeves, except for test 12.9.

4.2 Overlays

Overlays may be used to provide added protection for the sleeve or marking, provided the finished sleeve conforms to clause 12. For the purpose of this standard the overlay shall be regarded as part of the sleeve.

Table 5. Type tests	
Title	Clause
Finish	12.1
Printing	12.2
Dimensions	12.3
Circumferential extension	12.4
Tension set	12.5
Voltage proof ¹⁾	12.6
Resistance to fluids ^{1) 2)}	12.7
Silver staining ²⁾	12.8
Volume resistivity	12.9
Resistance to extremes of temperature ¹⁾	12.10
Colour fastness to light ^{1) 2) 3)}	12.11
Resistance to mould growth ²⁾	12.12
Resistance to ozone	12.13
Low temperature flexibility	12.14
Flammability ²⁾	12.15
Thermal endurance ²⁾	12.16
Extensibility after ageing	12.17

¹⁾ If the manufacturer/supplier intends to supply printed sleeves, only printed sleeves shall be tested.
²⁾ For the purposes of this test, one sleeve may be taken as representative of other sizes.
³⁾ All colours are to be tested.

5 Colour

The colour shall be uniform and evenly dispersed, and where applicable, the colour shall be recognizable as those given in BS 6746C. Standard colours are detailed in table 6.

Table 6. Standard colours availability and their allocated numbers			
Colour	Types	Printed number	Colour code
Black	All	0	0
Brown	All	1	1
Red	All	2	2
Orange	All	3	3
Yellow	All	4	4
Green	All	5	5
Blue	All	6. or 6	6
Violet	All	7	7
Grey	All	8	8
White	All	9. or 9	9
Pink	All	—	2L
Translucent	3 and 4	—	TL

6 Finish

The sleeves shall be free from bubbles, pinholes, and other defects that may affect performance.

7 Dimensions

NOTE. If sizes and/or tolerances other than those specified in this standard are required, full details of the requirements should be specified by the purchaser in the contract or order (see clause 3).

7.1 The internal diameter and the wall thickness of the sleeves shall conform to the requirements of tables 7, 8, and 9.

7.2 Sleeves shall be supplied to lengths specified by the purchaser and shall be cut to the tolerances specified in table 2.

8 Printing

8.1 When required, sleeves shall be indelibly printed with a character or legend to the specific requirements of the purchaser and such printing shall not be affected by normal handling.

8.2 The printing shall be blue-black except on sleeves that would not provide adequate contrast.

The characters shall be clearly printed, of uniform density and shall be legible with normal reading vision.

The characters shall be underlined or have a dot following the legend when it is capable of being misinterpreted e.g. M. W. 6. 9.

The printing shall be longitudinal on the sleeve. (See figure 1).

8.3 When sleeves are marked more than once, the printing shall be equally spaced around the sleeve. The characters shall be of a height such that the total number of upper case characters shall cover at least 25 % of the circumference. Lower case characters shall be the same point size as the upper case characters.

NOTE. The preferred size and repetition of characters are given in table 10.

8.4 Single printed colour code numbers shall conform to table 6.

8.5 The production routine test for sleeves shall be 25 strokes of tissue paper impregnated with fluid h in table 4 after which the printing shall be legible with normal reading vision.

Table 7. Dimensions of type 1 sleeves

Size code	Internal diameter (mm)			Wall thickness (mm)		
	Nominal	Minimum	Maximum	Nominal	Minimum	Maximum
01	0.5	0.4	0.7	0.5	0.4	0.6
02	0.8	0.6	0.9	0.5	0.4	0.6
03	1.0	0.9	1.2	0.5	0.4	0.6
04	1.2	1.1	1.4	0.5	0.4	0.6
05	1.2	1.1	1.4	0.7	0.6	0.8
06	1.5	1.3	1.8	0.6	0.5	0.7
07	1.5	1.3	1.8	0.8	0.7	0.9
08	2.0	1.7	2.3	0.6	0.5	0.7
09	2.0	1.7	2.3	0.8	0.7	0.9
22	2.5	2.1	2.9	0.6	0.5	0.7
23	2.5	2.1	2.9	0.8	0.7	0.9
10	3.0	2.5	3.5	0.6	0.5	0.7
11	3.0	2.5	3.5	0.8	0.7	0.9
24	4.0	3.3	4.6	0.65	0.5	0.8
25	4.0	3.3	4.6	0.85	0.7	1.0
26	4.0	3.3	4.6	1.05	0.9	1.2
12	5.0	4.2	5.8	0.65	0.5	0.8
27	5.0	4.2	5.8	0.85	0.7	1.0
13	5.0	4.2	5.8	1.05	0.9	1.2
14	8.0	6.8	9.2	0.65	0.5	0.8
28	8.0	6.8	9.2	0.9	0.7	1.1
15	8.0	6.8	9.2	1.25	1.0	1.5
16	10.0	8.6	11.4	0.65	0.5	0.8
29	10.0	8.6	11.4	1.0	0.8	1.2
17	10.0	8.6	11.4	1.5	1.2	1.8
18	15.0	13.0	17.0	0.7	0.5	0.9
30	15.0	13.0	17.0	1.15	0.9	1.4
19	15.0	13.0	17.0	1.7	1.4	2.0
20	20.0	17.5	22.5	0.7	0.5	0.9
31	20.0	17.5	22.5	1.2	0.9	1.5
21	20.0	17.5	22.5	2.05	1.7	2.4
32	25.0	21.5	28.5	0.7	0.5	0.9
33	25.0	21.5	28.5	1.2	0.9	1.5
34	25.0	21.5	28.5	2.05	1.7	2.4

NOTE. The data of this table is arranged so that the nominal internal diameters are in consecutive numeric order.

Table 8. Dimensions of type 2 sleeves (mm)

Size code	Internal diameter (mm)			Wall thickness (mm)		
	Nominal	Minimum	Maximum	Nominal	Minimum	Maximum
01	0.5	0.4	0.7	0.6	0.5	0.7
02	0.8	0.6	0.9	0.6	0.5	0.7
03	1.0	0.9	1.2	0.6	0.5	0.7
04	1.5	1.3	1.8	0.6	0.5	0.7
05	2.0	1.7	2.3	0.6	0.5	0.7
06	3.0	2.5	3.5	1.0	0.8	1.2
07	4.0	3.3	4.6	1.0	0.8	1.2
08	5.0	4.2	5.8	1.0	0.8	1.2
09	8.0	6.8	9.2	1.25	1.0	1.5
10	10.0	8.6	11.4	1.4	1.0	1.8
11	15.0	13.0	17.0	1.4	1.0	1.8
12	20.0	17.5	22.5	1.4	1.0	1.8
13	25.0	21.1	28.5	1.4	1.0	1.8

NOTE. The data of this table is arranged so that the nominal internal diameters are in consecutive numeric order.

Table 9. Dimensions of type 3 and 4 sleeves

Size code	Internal diameter (mm)			Wall thickness (mm)		
	Nominal	Minimum	Maximum	Nominal	Minimum	Maximum
01	0.5	0.4	0.7	0.5	0.4	0.6
02	1.0	0.9	1.2	0.5	0.4	0.6
03	1.5	1.3	1.8	0.5	0.4	0.6
04	2.0	1.7	2.3	0.5	0.4	0.6
05	2.5	2.1	2.9	0.5	0.4	0.6
06	3.0	2.5	3.5	0.5	0.4	0.6
07	4.0	3.3	4.6	0.5	0.4	0.6
08	5.0	4.2	5.8	0.5	0.4	0.6
09	6.0	5.1	6.9	0.7	0.55	0.85
10	7.0	6.0	8.0	0.7	0.55	0.85
11	8.0	6.8	9.2	0.7	0.55	0.85
12	9.0	7.7	10.3	0.7	0.55	0.85
13	10.0	8.6	11.4	0.7	0.55	0.85
14	11.0	9.5	12.5	1.0	0.8	1.2
15	12.0	10.4	13.6	1.0	0.8	1.2
16	15.0	13.0	17.0	1.0	0.8	1.2

NOTE. The data of this table is arranged so that the nominal internal diameters are in consecutive numeric order.