

Sleeves and moulded components for aircraft electric cables and equipment wires —

Part 5: Specification for heat shrinkable moulded shapes

ICS 49.060

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee ACE/6, Aerospace avionic, electrical and fibre optic technology, upon which the following bodies were represented:

- 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 and specifies requirements for heat-shrinkable moulded shape materials for aircraft electric cables and insulated equipment wires. BS G 198 is published in the following 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 heat-shrinkable sleeving for binding and insulation;*
- *Part 5: Specification for heat-shrinkable moulded shapes.*

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

This Part of BS G 198 specifies requirements for heat-shrinkable moulded shapes in a range of configurations and materials suitable for insulation, environmental sealing, mechanical protection and strain relief for connector/cable terminations and multi-way transitions. These shapes are normally available in black, but other colours may be available.

Moulded shapes should be installed in accordance with manufacturer's or supplier's instructions and, in particular, it should be noted that when shrinkage is restricted some properties may be impaired, e.g. wall thickness will be reduced; and moulded shape performance may also be reduced. A guide to installation is detailed in Annex F.

Heat-shrinkable moulded shapes are normally used with a bonding adhesive as detailed in Annex E Table E.1. Some of these adhesives may be supplied pre-coated or as a separate component. Annex E also details the recommended combinations of adhesive types, moulded shapes and sleeveings. The requirements for adhesive compatibility are detailed in Annex D.

It should be noted that the majority of heat guns available for the application of moulded shapes are not suitable for use in potentially explosive atmospheres. Application tools suitable for the installation of heat-shrinkable moulded shapes in those areas should be designed for zone 2 areas as specified in BS 5345-2:1983.

WARNING NOTE 1. This standard requires 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 combustion characteristics tests detailed in this standard, i.e. flammability, oxygen index, flammability temperature, smoke index and combustion products index are in no way suitable for assessing a total fire hazard situation. They are solely for the purpose of specifying the basic material quality requirements of the heat-shrinkable shapes.

WARNING NOTE 3. The use of heat-shrinkable materials entails the risk from heat, solvents and gases. Every precaution is to be exercised against the harmful effects by the use of protective gloves and good ventilation etc.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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 to iv, pages 1 to 59 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

1 Scope

This Part of BS G 198 specifies the design, material performance requirements, quality assurance requirements and test procedures for the types of heat-shrinkable moulded shapes shown in Table 1.

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 Guidance for the storage of finished moulded shapes is given in Annex A.

NOTE 2 The latest revision of an aerospace series standard is indicated by a prefix number.

NOTE 3 Moulded shapes that have been shrunk are referred to as recovered.

When specified, moulded shapes used with bonding adhesives shall conform to the compatibility test requirements detailed in Annex D.

2 References

2.1 Normative references

This British Standard incorporates, by reference, provisions from specific editions of other publications. These normative references are cited at the appropriate points in the text and the publications are listed on page 58. Subsequent amendments to, or revisions of, any of these publications apply to this British Standard only when incorporated in it by updating or revision.

2.2 Informative references

This British Standard 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 to be supplied by the purchaser

The following information to be supplied by the purchaser 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 G 198-5:1996);
- b) the total quantity required;
- c) the colour, if other than black;
- d) the potting ports, if required (see clause 12);
- e) the codified identification (see clause 12);
- f) the packaging requirements;
- g) compatibility, if required (see Annex D);
- h) whether the material is to be tested in any further fluids in addition to those given in Table 6 (see 11.13).

The description and dimensions of non-standard shapes shall be agreed between the purchaser and the manufacturer or supplier.

Table 1 — Types of heat-shrinkable moulded shape materials

Type code	Guide to temperature range °C	Exposure temperature °C			Recommended min. shrink temperature °C (4)	Guide to stiffness	Other main properties
		(1)	(2)	(3)			
DA	– 55 to + 135	135	175	225	135	Semi rigid	Flame retardant
DB	– 55 to + 135	135	175	225	125	Flexible	Flame retardant, low shrink temperature
DC	– 75 to + 130	130	175	250	135	Very flexible	Flame resistant
DD	– 55 to + 200	200	250	300	175	Flexible	Flame retardant, oil and fuel resistant
DE	– 75 to + 120	120	160	215	150	Semi rigid	Flame retardant, oil resistant
DF	– 30 to + 105	105	150	175	135	Semi rigid	Limited fire hazard
Temperature (1) is for a minimum of 20 000 h when assessed in accordance with 11.16. Temperature (2) is for a minimum of 168 h when assessed in accordance with 11.10. Temperature (3) is for a minimum of 4 h when assessed in accordance with 11.14. The minimum shrink temperature (4) is the minimum temperature at which full recovery can be guaranteed. Refer to the manufacturer/supplier for actual value.							

4 Materials and characteristics

Shapes shall be made from materials which meet the appropriate requirements of clause 11.

NOTE Materials known to meet the requirements of the tests specified in clause 11 will have the characteristics shown in Table 2.

5 Colour

The colour shall be uniform and evenly dispersed, and recognizable as one of those given in BS 6746C:1993.

6 Finish

The moulded shapes, both before and after unrestricted shrinkage, shall be free from bubbles, pinholes, and other defects that may affect performance.

7 Dimensions

The dimensions for standard moulded shapes, both before and after unrestricted shrinkage shall be as specified in the appropriate table of Table 7 to Table 27.

NOTE 1 Unless otherwise indicated, the dimensions in Table 7 to Table 27 are in millimetres.

NOTE 2 Non-standard moulded shapes are available in dimensions other than those specified in Table 7 to Table 27.

8 Shelf life

The “use-by” date shall indicate the end of the guaranteed storage time for which clause 7 still applies when stored under the conditions as specified in Annex A.

NOTE The “use-by” date is the shelf life.

Table 2 — Materials and characteristics

Type code	Material	Characteristics
DA	Semi-rigid modified polyolefin	These moulded shapes are semi-rigid and flame retardant. They are suitable for mechanical protection, strain relief and for use in areas subject to occasional contamination by aircraft fuels and hydraulic fluids. The standard colour is black.
DB	Flexible modified polyolefin	These moulded shapes are flexible, flame retardant, and have a lower shrink temperature than type DA. They are suitable where flexible terminations are required and where sensitive components and delicate wiring needs protection from excessive heat during recovery. The standard colour is black.
DC	Silicone	These moulded shapes are very flexible, flame retardant and exhibit ablative characteristics. They are suitable for use in areas subject to short periods of extreme heat. The standard colour is black.
DD	Fluorocarbon	These moulded shapes are flexible and flame retardant. They are suitable for use in areas subject to prolonged contamination by aircraft fuel and hydraulic fluids, with the exception of phosphate ester based fluids. The standard colour is black.
DE	Elastomer	These moulded shapes are semi-rigid and flame retardant. They are suitable for mechanical protection, strain relief and for use in areas subject to contamination by aircraft fuels and hydraulic fluids. The standard colour is black.
DF	Polymer limited fire hazard	These moulded shapes are semi-rigid, flame retardant and emit minimum smoke, gases and corrosive by-products when exposed to fire. They are suitable for mechanical protection, strain relief and for use in areas where smoke, gases or corrosive by-products would constitute a particular hazard. The standard colour is black.
NOTE If the material is required to withstand certain specific environmental conditions not covered by this standard, then guidance should be sought from the manufacturer or supplier.		

9 Type testing

9.1 Type tests

9.1.1 The manufacturer or supplier shall provide details of the following:

- a) material composition;
- b) agreed techniques; and
- c) evidence to the satisfaction of the approving authority¹⁾ that the material used to manufacture the moulded shapes conforms to the appropriate type tests listed in Table 3, details of which are given in clause 11.

All test results shall be recorded and retained for the duration of the approval.

The dimensions of the moulded shapes shall be as specified in Table 7 to Table 27.

9.1.2 Unless otherwise specified type tests shall be performed using test sheets as specified in clause 10.4.

In the event of a failure of the moulding material to conform to the requirements of any test, the batch of material shall be re-sampled and the test repeated using two further sets of test pieces. Both sets shall conform to the appropriate test requirements, otherwise the batch of material shall be deemed not to conform to the requirements of this standard.

9.1.3 No changes shall be made to the declared material composition and agreed techniques used in the production of the moulded shapes, without the prior written agreement of the type approving authority.

¹⁾ The approving authority for civil aircraft applications is the Civil Aviation Authority, Airworthiness Division or an organization approved by them, and for Ministry of Defence applications is an organization nominated by the Directorate of Standardization.

NOTE Following such changes, the type approving authority may require a repetition of type testing.

9.1.4 Type approval is valid for 5 years, after which time the manufacturer or supplier shall apply for re-approval of the material.

Table 3 — Type tests

Title	Clause
Finish	11.1
Density	11.3
Resistance to mould growth	11.4
Copper mirror corrosion	11.5
Tensile strength and elongation at break	11.6
Dielectric strength	11.7
Volume resistivity after damp heat	11.8
Low temperature flexibility	11.9
Heat ageing	11.10
Water absorption	11.11
Flammability	11.12
Resistance to fluids	11.13
Heat shock	11.14
Secant modulus at 2 % strain	11.15
Thermal endurance	11.16
Oxygen index	11.17
Flammability temperature	11.18
Smoke index	11.19
Combustion products index	11.20
Colour	11.21
Colour stability	11.22
Colour fastness to light	11.23
Compatibility test	Annex D

9.2 Test conditions

9.2.1 Unless otherwise specified in a particular test, the tests shall be carried out under normal test conditions without control of humidity, at a temperature of $(20 \pm 5) ^\circ\text{C}$. In the event of a dispute, the tests shall be conducted at $(23 \pm 2) ^\circ\text{C}$.

9.2.2 A fan assisted air oven shall be used for heating unless otherwise specified in a particular test.

9.3 Conditioning

The heat-shrinkable moulded shapes test sheets and measurement gauges if used shall be conditioned for at least 4 h under the conditions specified in **9.2.1** prior to testing.

10 Production routine and quality testing

10.1 Production routine tests

Production routine tests shall be applied to test sheets, unless otherwise specified, moulded from every batch of material, and shall consist of the tests listed in Table 4. Sample every batch of shapes for dimensions. All test results shall be recorded and retained for the duration of the approval.

Table 4 — Production routine tests

Title	Clause
Finish	11.1
Dimensions	11.2
Density	11.3
Tensile strength and elongation at break	11.6
Dielectric strength	11.7
Heat shock	11.14
Secant modulus at 2 % strain	11.15
Colour	11.21

10.2 Production quality tests

The frequency of application of each production quality test shall be to the satisfaction of the approving authority and will depend on the maintenance of the basic formulation of the moulding material, and the manufacturing conditions. Production quality tests shall be applied to test sheets, unless otherwise specified, moulded from batches of material, and shall consist of the tests listed in Table 5. All test results shall be recorded and retained for the duration of the approval.

Table 5 — Production quality tests

Title	Clause
Resistance to mould growth	11.4
Copper mirror corrosion	11.5
Volume resistivity after damp heat	11.8
Low temperature flexibility	11.9
Heat ageing	11.10
Water absorption	11.11
Flammability	11.12
Resistance to fluids	11.13
Thermal endurance	11.16
Oxygen index	11.17
Flammability temperature	11.18
Smoke index	11.19
Combustion products index	11.20
Colour stability	11.22
Colour fastness to light	11.23
Compatibility test	Annex D

10.3 Batch**10.3.1 Batch of material**

A batch of material shall consist of that quantity of moulding material, mixed and/or homogeneously blended at any one time. For continuous mixing processes a batch shall be defined by the manufacturer or supplier to the satisfaction of the approving authority.

10.3.2 Batch of moulded shapes

A batch of moulded shapes is that quantity of the same material type, dimensions and colour produced from one moulding machine, at one time under the same conditions from the same batch of moulding material.

10.4 Test sheets

Standard test sheets, (2 ± 0.15) mm thick unless otherwise specified, shall be prepared from the same heat-shrinkable material that is to be used to manufacture the heat-shrinkable moulded shapes. The dimensions of the sheet shall be sufficient to enable any of the relevant tests in clause 11 to be performed.

NOTE A suitable size has been found to be 150 mm $\times$ 150 mm.

11 Tests and requirements

Clause	Title	Method	Requirements														
11.1	Finish	Inspect	All moulded shapes shall conform to clause 5.														
11.2	Dimensions	Measure the shapes in the “as supplied” condition and after unrestricted shrinkage. Carry out unrestricted shrinkage by conditioning in an oven at the following temperatures for at least 10 min. <table><tr><th>Type</th><th>Temperature ± 2 °C</th></tr><tr><td>DA</td><td>150</td></tr><tr><td>DB</td><td>150</td></tr><tr><td>DC</td><td>175</td></tr><tr><td>DD</td><td>200</td></tr><tr><td>DE</td><td>200</td></tr><tr><td>DF</td><td>150</td></tr></table> Remove the shapes from the oven and allow to cool naturally to the temperature specified in 9.2.1. The methods of measurement can be mechanical, or optical. Wall thickness shall be measured to an accuracy of 0.05 mm and bore to an accuracy of 0.1 mm. In the case of dispute an optical method shall be used.	Type	Temperature ± 2 °C	DA	150	DB	150	DC	175	DD	200	DE	200	DF	150	All shapes shall conform to clause 6.
Type	Temperature ± 2 °C																
DA	150																
DB	150																
DC	175																
DD	200																
DE	200																
DF	150																
11.3	Density	A test piece shall be cut from a standard test sheet. Conduct the test in accordance with method A of BS 903-A1:1980.	The density of the material shall be initially established and declared during type testing, and shall not deviate from this value by more than ± 0.03 mg/m³ during subsequent production routine testing.														
11.4	Resistance to mould growth	Two test pieces approximately 25 mm × 25 mm shall be cut from a standard test sheet, and subjected to the 28 day test of BS 2011-2.1J:1989.	Mould growth shall be not greater than scale 2.														

Clause	Title	Method	Requirements														
11.5	Copper mirror corrosion	The copper glass mirrors^a for this test shall be approximately 6 mm wide by 25 mm long and shall be of vacuum deposited copper, with a thickness giving (10 ± 5) % transmission of normal incident light of a wavelength of 500 nm (5 000 Å). They shall be stored in a desiccator in their original containers and shall be used only if no oxide film is present and the copper is not damaged or contaminated. Cut two strips approximately 6.5 mm × 25 mm from a standard test sheet. Place each strip in the bottom of a clean, dry, 13 mm by 300 mm test tube. Suspend the mirrors with the lower edge 150 mm to 180 mm above the bottom of the test tubes. Support the mirrors by forming a single loop of fine clean copper wire, having a diameter not greater than 0.25 mm, around its upper end and attach the other end of the wire to a cork. Ensure that each mirror is vertical. Seal each test tube with the cork wrapped in aluminium foil. Prepare a third test tube containing only a suspended mirror as a control. Maintain the lower 50 mm (approximately) of the test tubes at the appropriate following temperatures for (16 ± 0.25) h. <table><tr><th>Type</th><th>Temperature ± 2 °C</th></tr><tr><td>DA</td><td>175</td></tr><tr><td>DB</td><td>175</td></tr><tr><td>DC</td><td>175</td></tr><tr><td>DD</td><td>200</td></tr><tr><td>DE</td><td>150</td></tr><tr><td>DF</td><td>150</td></tr></table>	Type	Temperature ± 2 °C	DA	175	DB	175	DC	175	DD	200	DE	150	DF	150	There shall be no further removal of the copper.
Type	Temperature ± 2 °C																
DA	175																
DB	175																
DC	175																
DD	200																
DE	150																
DF	150																

^a For information on the availability of suitable mirrors write to the Information Centre, BSI, 389 Chiswick High Road, London W4 4AL.

Clause	Title	Method	Requirements																					
11.5		Maintain the temperature of that portion of the test tubes containing the mirrors below 60 °C. Monitor this temperature using a thermocouple in the vicinity of the glass mirror in one of the test tubes containing a test sample. After cooling, remove the mirrors and examine each one by placing it against a white background in good light. Any removal of copper from the mirror will be a sign of corrosion. Disregard, however, any removal of copper from the bottom of the mirror, provided the area does not exceed 8 % of the total area of the mirror, since condensation may cause this condition. Discolouration of the copper film or reduction of its thickness shall not be considered as corrosion. Only the area over which the removal of copper has made the mirror transparent shall be considered as corrosion. If the mirror in the control tube shows any signs of corrosion, the test shall be repeated.																						
11.6	Tensile strength and elongation at break	Cut five type 2 dumb-bell test pieces in accordance with BS 903-A2:1989 from a standard test sheet. Conduct the tests for tensile strength and elongation at break in accordance with method 320A of BS 2782-3:1976, except that the test pieces are as described above and the rate of grip separation used is (100 ± 10) mm/min. The values of tensile strength and elongation at break shall be the median value of the results obtained. Breaks at a bench mark or outside the gauge length shall be disregarded and further test pieces shall be tested until five satisfactory breaks are obtained.	The tensile strength and elongation at break shall be not less than the following. <table><tr><th>Type</th><th>Tensile strength</th><th>Elongation at break %</th></tr><tr><td>DA</td><td>10</td><td>250</td></tr><tr><td>DB</td><td>8</td><td>250</td></tr><tr><td>DC</td><td>4</td><td>200</td></tr><tr><td>DD</td><td>12</td><td>300</td></tr><tr><td>DE</td><td>12</td><td>350</td></tr><tr><td>DF</td><td>7</td><td>200</td></tr></table>	Type	Tensile strength	Elongation at break %	DA	10	250	DB	8	250	DC	4	200	DD	12	300	DE	12	350	DF	7	200
Type	Tensile strength	Elongation at break %																						
DA	10	250																						
DB	8	250																						
DC	4	200																						
DD	12	300																						
DE	12	350																						
DF	7	200																						

Clause	Title	Method	Requirements
11.7	Dielectric strength	A standard test sheet shall be tested in accordance with method 1 A (rapidly applied voltage test), BS 903-C4:1983 (BS 2782-2:Method 220 and BS 2782-2:Method 221), at $(20 \pm 5) ^\circ\text{C}$. Test the conditioned test assembly in air, or oil, conforming to BS 148:1984. If flash-over occurs in air below the required minimum dielectric strength, repeat the test in the oil using a new test sheet. Apply an alternating voltage with a nominal frequency of 50 Hz and a waveform approximately sinusoidal with a peak factor within limits of $\sqrt{2} \pm 7\%$ (1.32 to 1.51) between the two electrodes. Apply the test voltage from zero at a uniform rate, such that breakdown or flash-over occurs between 10 s and 20 s. Calculate the dielectric strength by dividing the voltage at which breakdown or flash-over occurs by the thickness of the test sheet. Express the result in kV/mm.	The dielectric strength shall be not less than 8 kV/mm.

Clause	Title	Method	Requirements														
11.8	Volume resistivity after damp heat	Condition two standard test sheets as follows.	The volume resistivity shall be as follows. <table><tr><th>Type</th><th>Volume resistivity Ω cm (minimum)</th></tr><tr><td>DA</td><td>1 × 10¹⁴</td></tr><tr><td>DB</td><td>1 × 10¹²</td></tr><tr><td>DC</td><td>1 × 10¹⁰</td></tr><tr><td>DD</td><td>1 × 10¹⁰</td></tr><tr><td>DE</td><td>1 × 10¹³</td></tr><tr><td>DF</td><td>1 × 10¹²</td></tr></table>	Type	Volume resistivity Ω cm (minimum)	DA	1 × 10 ¹⁴	DB	1 × 10 ¹²	DC	1 × 10 ¹⁰	DD	1 × 10 ¹⁰	DE	1 × 10 ¹³	DF	1 × 10 ¹²
		Type		Volume resistivity Ω cm (minimum)													
		DA		1 × 10 ¹⁴													
		DB		1 × 10 ¹²													
		DC		1 × 10 ¹⁰													
		DD		1 × 10 ¹⁰													
		DE		1 × 10 ¹³													
		DF		1 × 10 ¹²													
Place two standard test sheets in a suitable chamber provided with the means for circulating damp air, and subject them to the damp heat treatment as follows.																	
a) Maintain the chamber for 16 h ± 15 min in such conditions that the temperature near the test sheet is (50 ± 1) °C and the relative humidity is not less than 95 %.																	
b) Turn off the source of heat and allow the closed chamber to cool for at least 5 h with the damp air circulation maintained.																	
c) Turn on the source of the heat so that at the end of 24 h ± 15 min from the beginning of the treatment the chamber conditions specified in a) are restored.																	
d) Repeat the cycle of operations described in a), b) and c).																	
e) Repeat the cycle of operations described in a) and b) except that between 4 h and 5 h after the source of heat has been turned off withdraw the test sheets from the chamber, remove surface water and leave them to recover in normal atmospheric conditions.																	
Within 2 h of removing the test sheets from the chamber, measure the volume resistivity detailed in BS 903-C2 (BS 2782-2:Method 230A) at a test temperature of (20 ± 5) °C.																	

Clause	Title	Method	Requirements																												
11.9	Low temperature flexibility	Cut three test pieces approximately 150 mm × 6 mm from the standard test sheet. The test pieces shall be conditioned for a minimum of 4 h with a mandrel of diameter (20 ± 1) mm in a cold chamber maintained at the temperature specified for each type in the following table. While still at the conditioning temperature, wrap each test piece within 10 s through 360° around the mandrel in a close helix. Inspect each test piece whilst it is still on the mandrel. <table><thead><tr><th>Type</th><th>Temperature °C ± 2 °C</th></tr></thead><tbody><tr><td>DA</td><td>– 55</td></tr><tr><td>DB</td><td>– 55</td></tr><tr><td>DC</td><td>– 75</td></tr><tr><td>DD</td><td>– 55</td></tr><tr><td>DE</td><td>– 75</td></tr><tr><td>DF</td><td>– 30</td></tr></tbody></table>	Type	Temperature °C ± 2 °C	DA	– 55	DB	– 55	DC	– 75	DD	– 55	DE	– 75	DF	– 30	There shall be no signs of cracking as seen by normal reading vision.														
Type	Temperature °C ± 2 °C																														
DA	– 55																														
DB	– 55																														
DC	– 75																														
DD	– 55																														
DE	– 75																														
DF	– 30																														
11.10	Heat ageing	Age a suitable number of test pieces (see 11.6) in accordance with BS 903-A19:1986 for a period of (168 ± 2) h at the relevant temperature specified as follows. <table><thead><tr><th>Type</th><th>Temperature °C ± 2 °C</th></tr></thead><tbody><tr><td>DA</td><td>175</td></tr><tr><td>DB</td><td>175</td></tr><tr><td>DC</td><td>175</td></tr><tr><td>DD</td><td>250</td></tr><tr><td>DE</td><td>160</td></tr><tr><td>DF</td><td>150</td></tr></tbody></table> After removal from the oven allow the test pieces to cool naturally to the temperature specified in 9.2.1 and then test in accordance with the method in 11.6.	Type	Temperature °C ± 2 °C	DA	175	DB	175	DC	175	DD	250	DE	160	DF	150	The elongation at break shall be as follows. <table><thead><tr><th>Type</th><th>Elongation at break % (min.)</th></tr></thead><tbody><tr><td>DA</td><td>150</td></tr><tr><td>DB</td><td>150</td></tr><tr><td>DC</td><td>120</td></tr><tr><td>DD</td><td>250</td></tr><tr><td>DE</td><td>250</td></tr><tr><td>DF</td><td>100</td></tr></tbody></table>	Type	Elongation at break % (min.)	DA	150	DB	150	DC	120	DD	250	DE	250	DF	100
Type	Temperature °C ± 2 °C																														
DA	175																														
DB	175																														
DC	175																														
DD	250																														
DE	160																														
DF	150																														
Type	Elongation at break % (min.)																														
DA	150																														
DB	150																														
DC	120																														
DD	250																														
DE	250																														
DF	100																														

Clause	Title	Method	Requirements														
11.11	Water absorption	Carry out the test in accordance with method 430A of BS 2782-4:1983 except that the test pieces shall be cut from the standard test sheet.	The water absorption shall be as follows.<table><tr><th>Type</th><th>Water absorption % (max.)</th></tr><tr><td>DA</td><td>0.5</td></tr><tr><td>DB</td><td>0.5</td></tr><tr><td>DC</td><td>1.0</td></tr><tr><td>DD</td><td>0.5</td></tr><tr><td>DE</td><td>0.5</td></tr><tr><td>DF</td><td>0.5</td></tr></table>	Type	Water absorption % (max.)	DA	0.5	DB	0.5	DC	1.0	DD	0.5	DE	0.5	DF	0.5
Type	Water absorption % (max.)																
DA	0.5																
DB	0.5																
DC	1.0																
DD	0.5																
DE	0.5																
DF	0.5																
11.12	Flammability	Prepare a 3 mm thick test sheet for the test. Cut the test pieces in accordance with method A: BS 2782-140A, except that after the flame is removed the time for the flame to extinguish shall be recorded. WARNING. Care should be exercised during this test as toxic fumes may be given off during combustion. It is recommended that the test chamber should be placed in a fume cabinet to allow evacuation of gaseous products of combustion. In addition some materials may produce corrosive pyrolysis products and skin contact should be avoided.	FH2 and 30 s max. duration of burning time after removal of the gas flame.														

Clause	Title	Method	Requirements																					
11.13	Resistance to fluids	Test pieces shall be prepared in accordance with 11.6 Totally immerse the test pieces in the relevant fluid^a for (24 ± 1) h at the temperature specified in Table 6. The volume of the fluid shall be not less than 20 times that of the test pieces. Remove the test pieces from the fluid, lightly wipe them and then condition them for (45 ± 15) min in accordance with 9.2.1. Examine the test pieces under normal reading vision. If the test pieces are found to be acceptable on visual examination, then test them for tensile strength and elongation at break in accordance with the method given in 11.6. Calculate the tensile strength based on the original cross-sectional areas, and the elongation based on the gauge lengths marked on the test pieces after immersion. WARNING. Some test fluids may have a flashpoint close to or below the temperature of test. Appropriate precautions should be taken during testing. Some test fluids may themselves, or in combination with the test piece be toxic. Due consideration should be given to this possibility before commencing the test.	Test pieces shall not show any marked change of colour, except as given in note 2 of the following table, nor any signs of crumbling, splitting or blistering. The tensile strength and elongation at break shall be not less than the following. <table><tr><th>Type</th><th>Tensile strength MPa</th><th>Elongation at break %</th></tr><tr><td>DA</td><td>5</td><td>200</td></tr><tr><td>DB</td><td>4</td><td>200</td></tr><tr><td>DC</td><td>4</td><td>200</td></tr><tr><td>DD</td><td>8</td><td>200</td></tr><tr><td>DE</td><td>8</td><td>250</td></tr><tr><td>DF</td><td>4</td><td>100</td></tr></table> NOTE 1 It should be recognized that the values apply to material tested after 45 min conditioning. Results immediately after immersion may be significantly different. NOTE 2 Commercial fluids of the types represented by test fluids c), d) and r) in Table 6 will stain materials. As indicated by the “not applicable” column in Table 6, some material types are not suitable under the conditions of this test for extended contamination. These shapes may be suitable for occasional (class A) or intermittent (class B) as given in BS 3G 100-2.3.12:1991. The manufacturer or supplier shall demonstrate compliance with the minimum requirements specified above if the shapes are claimed to be suitable for exposure to the conditions for class A or class B contamination.	Type	Tensile strength MPa	Elongation at break %	DA	5	200	DB	4	200	DC	4	200	DD	8	200	DE	8	250	DF	4	100
			Type	Tensile strength MPa	Elongation at break %																			
DA	5	200																						
DB	4	200																						
DC	4	200																						
DD	8	200																						
DE	8	250																						
DF	4	100																						
^a The purchaser may require materials to be tested in further fluids in addition to those listed in Table 6, in which case the additional fluids should be discussed with the manufacturer or supplier. See clause 3																								

Clause	Title	Method	Requirements														
11.14	Heat shock	Cut three test pieces approximately 150 mm × 6 mm from a standard test sheet. Suspend the test pieces vertically in an oven at the relevant temperature specified below for a period of 4 h ± 10 min. <table><tr><th>Type</th><th>Temperature °C</th></tr><tr><td>DA</td><td>225 ± 2</td></tr><tr><td>DB</td><td>225 ± 2</td></tr><tr><td>DC</td><td>250 ± 2</td></tr><tr><td>DD</td><td>300 ± 2</td></tr><tr><td>DE</td><td>215 ± 2</td></tr><tr><td>DF</td><td>175 ± 2</td></tr></table> WARNING. Care should be exercised when performing this test, as toxic fumes may be given off. It is recommended that the test be conducted with fume extraction. After removal from the oven, examine the test pieces for evidence of dripping. Leave the test pieces in the conditions specified in 9.2.1 for a period of 1 h ± 30 min and then wrap in a close helix, through 360° around a mandrel of diameter (20 ± 1) mm. While the test pieces are still on the mandrel, examine them using normal reading vision.	Type	Temperature °C	DA	225 ± 2	DB	225 ± 2	DC	250 ± 2	DD	300 ± 2	DE	215 ± 2	DF	175 ± 2	The test pieces shall show no sign of flowing or dripping. After bending through 360° the test pieces shall show no signs of cracking. Any change of colour shall be ignored.
Type	Temperature °C																
DA	225 ± 2																
DB	225 ± 2																
DC	250 ± 2																
DD	300 ± 2																
DE	215 ± 2																
DF	175 ± 2																