



British Standard Aerospace Series

Sleeves for aircraft electric cables and equipment wires

Part 3. Specification for heat-shrinkable sleeving for binding and insulation

Série aérospatiale. Manchons pour câbles électriques et fils électriques d'équipements aéronautiques
Partie 3. Manchons thermo-rétractables pour ligatures et isolation — Spécifications

Luft- und Raumfahrt-Reihe. Hülsen für elektrische Kabel und Verdrahtung in Flugzeugen
Teil 3. Aufschrumpfbare Umhüllungen als Bandage und zur Isolierung

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Foreword

This Part of British Standard 2G 198 has been prepared under the direction of the Aerospace Standards Committee and at the request of the aircraft industry to provide a statement of the requirements for sleeves and sleeving for aircraft electric cables and insulated equipment wires. British Standard 2G 198 is published in separate Parts: Part 1 relating to elastomeric sleeves, Part 2 to slip-on sleeves and Part 3 to heat-shrinkable sleeving.

This Part refers to the requirements for heat-shrinkable sleeving, in a range of colours, diameters, lengths and materials suitable for binding and insulation purposes on electric cables and insulated equipment wires in aircraft. Sleeves for identification purposes will be covered by a further Part to be published at a later date.

The various types of sleeving covered by this 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 Parts of British Standard 2G 198. Types 20 and 21 relate to high performance sleeving requiring alternative methods of test, and will be covered by a further Part to be published at a later date.

Sleeving should be installed in accordance with manufacturer'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 sleeve life may also be reduced.

It should be noted that the majority of heat guns available for the application of sleeving are not suitable for use in flammable atmospheres. Application tools suitable for the installation of heat-shrinkable sleeving in these areas should be designed for Division 2 areas as specified in CP 1003 : Part 3.

The importance of toxicity has been recognized, but no suitable test has been found to date which has proved acceptable for this standard. Pending the development of such a test, the materials from which the sleeving is manufactured should present the minimum hazard from toxic fumes and smoke emission.

All types of sleeving covered by this Part are intended for use as insulation. For this reason, they should be subjected to abrasion testing similar to that for aircraft cables. The development of suitable tests has proved to be difficult however, and the tests have been omitted at this stage.

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

Specification

1 Scope

This Part of British Standard 2G 198 specifies the design, performance requirements, quality assurance requirements and test procedures for the following types of heat-shrinkable sleeving suitable for binding and insulating purposes on electrical cables and insulated equipment wires in aircraft.

Type 10A. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -75°C to 120°C for at least 20 000 h;
- (b) up to 150°C for at least 168 h;
- (c) up to 200°C for one period of 5 min.

NOTE 1. The minimum shrink temperature is 120°C and the shrink ratio (nominal) is 2:1.

This sleeving has very good flexibility, good abrasion resistant properties, and is suitable for use as cable protection in areas where wiring is subject to contamination by aircraft fuels and hydraulic fluids.

Type 10B. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -75°C to 105°C for at least 20 000 h;
- (b) up to 135°C for at least 168 h;
- (c) up to 175°C for one period of 5 min.

NOTE 2. The minimum shrink temperature is 120°C and the shrink ratio (nominal) is 2:1.

This sleeving has good flexibility and abrasion resistant properties and is suitable for use as cable protection in areas where wiring is subject to occasional contamination by aircraft fuels and hydraulic fluids.

Type 11A. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -55°C to 135°C for at least 20 000 h;
- (b) up to 175°C for at least 168 h;
- (c) up to 225°C for one period of 5 min.

NOTE 3. The minimum shrink temperature is 100°C and the shrink ratio (nominal) is 2:1.

This sleeving has good flexibility and will shrink at low temperatures to ensure sensitive and delicate wiring will not be damaged from excessive heat during recovery. It is suitable for use in areas where good flame retardancy is required.

Type 11B. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -55°C to 135°C for at least 20 000 h;
- (b) up to 175°C for at least 168 h;
- (c) up to 225°C for one period of 5 min.

NOTE 4. The minimum shrink temperature is 120°C and the shrink ratio (nominal) is 2:1.

This is general purpose, flexible, flame retardant sleeving.

Type 11C. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -55°C to 135°C for at least 20 000 h;
- (b) up to 175°C for at least 168 h;
- (c) up to 225°C for one period of 5 min.

NOTE 5. The minimum shrink temperature is 120°C and the shrink ratio (nominal) is 2:1.

This sleeving is semi-rigid and flame retardant and is suitable for use where strain relief and mechanical support are required.

Type 12A. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -55°C to 200°C for at least 20 000 h;
- (b) up to 250°C for at least 168 h;
- (c) up to 300°C for one period of 5 min.

NOTE 6. The minimum shrink temperature is 175°C and the shrink ratio (nominal) is 2:1.

This sleeving has good resistance to aircraft fuels and is suitable for use in areas subject to prolonged contamination by aircraft fuels and hydraulic fluids with the exception of phosphate ester-based hydraulic fluids. It has low electric strength.

Type 12B. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -55°C to 200°C for at least 20 000 h;
- (b) up to 250°C for at least 168 h;
- (c) up to 300°C for one period of 5 min.

NOTE 7. The minimum shrink temperature is 175°C and the shrink ratio (nominal) is 2:1.

This sleeving has good resistance to aircraft fuels and is suitable for use in areas subject to prolonged contamination by aircraft fuels and hydraulic fluids with the exception of phosphate ester-based hydraulic fluids. It has high electric strength.

Type 13. This sleeving, when fitted, is suitable for use in the temperature ranges:

- (a) -55°C to 90°C for at least 20 000 h;
- (b) up to 120°C for at least 168 h;
- (c) up to 150°C for one period of 5 min.

NOTE 8. The minimum shrink temperature is 150°C and the shrink ratio (nominal) is 2:1.

This sleeving has good flexibility and abrasion resistant properties and is suitable for use as cable protection in areas where wiring is subject to possible contamination by aircraft fuels and hydraulic fluids.

NOTE 9. The minimum shrink temperature is the minimum temperature at which full recovery can be achieved.

NOTE 10. 'Suitable for use in the temperature ranges' means:

- (a) a retention of 50 % actual elongation measured at normal conditions (see 7.2) after the times and temperatures specified (see 10.22);
- (b) a retention of actual elongation of the values given in 10.15 measured at normal conditions (see 7.2) after the times and temperatures specified;
- (c) the ability to withstand cracking when subjected to the conditions specified in 10.19.

NOTE 11. The titles of the publications referred to in this Part of British Standard 2G 198 are listed on the inside back page.

NOTE 12. The latest revision of an Aerospace Series Standard is indicated by a prefix number.

Guidance for the storage of finished sleeves is given in appendix A, and appendix B describes a recommended ordering procedure.

2 Materials

Sleeving shall be made from materials which ensure that the finished sleeving complies with the appropriate requirements of clause 10.

NOTE. Materials known to meet the requirements of the tests specified in clause 10 are as given in the following table:

Type no. Material

10A	Very flexible polymer
10B	Flexible polymer
11A	Flexible polyolefin
11B	Semi-flexible polyolefin
11C	Semi-rigid polyolefin
12A	Heat stabilized co-polymer of vinylidene fluoride and hexafluoropropylene (low electric strength)
12B	Heat stabilized co-polymer of vinylidene fluoride and hexafluoropropylene (high electric strength)
13	Polychloroprene

3 Colour

3.1 Sleeving shall be manufactured in the colours given in table 1 for the appropriate type of sleeving. Where applicable, the colours shall be recognizable as those given in BS 6746C (see appendix B).

3.2 The colour of sleeving shall be uniform and evenly dispersed.

3.3 For green and yellow striped sleeving, the percentage of either colour shall be not less than 30 % of the external surface area.

4 Finish

The sleeving, both before and after shrinkage, shall be free from bubbles, pinholes, creases and other defects that may affect performance. After shrinkage, the sleeving surface shall be smooth.

5 Dimensions

The internal diameters and related wall thicknesses of the sleeving, both before and after unrestricted shrinkage, as applicable, shall comply with the requirements given in tables 2, 3, 4, 5, 6, 7 and 8 (see appendix B).

Sleeving shall be supplied to lengths specified by the purchaser. It shall be cut to the tolerances specified in table 9.

6 Shelf life

The manufacturer shall declare the shelf life of the sleeving when stored under specified storage conditions. The declaration shall be based on the maximum storage time that the sleeving retains the 'as supplied' internal diameter specified in this standard. Following unrestricted shrinkage, in accordance with 10.3, the stored sleeving shall conform to the internal diameter, wall thickness and longitudinal change requirements of this standard.

7 Type testing

7.1 Type tests

The manufacturer shall produce evidence to the satisfaction of the Approving Authority* that sleeving supplied to this standard fulfils all the requirements of the tests listed in table 10, details of which are given in clause 10.

In the event of a failure of a specimen to comply with the requirements of any test, two additional sets of samples shall be taken and tested. Both sets shall comply with the appropriate test requirements, otherwise the sleeving shall be deemed not to comply with the requirements of this standard.

If any changes are made in the techniques or material composition used in the production of the sleeving, the manufacturer shall inform the Approving Authority.

NOTE. Following such changes, the Approving Authority may require a repetition of type testing.

Type tests shall be repeated every 5 years, except for the thermal endurance test (10.22), which shall be repeated every 10 years.

7.2 Test conditions

Unless otherwise specified in a particular test, the tests shall be carried out under normal atmospheric conditions, as follows.

(a) Temperature of $20 \pm 5^\circ\text{C}$. In the event of a dispute, the tests shall be conducted at $23 \pm 2^\circ\text{C}$.

(b) Relative humidity (r.h.) not greater than 65 %.

The heat-shrinkable sleeving and measurement gauges (if used) shall be conditioned for at least 4 h under these conditions prior to testing. When the sleeving is tested after heat-shrinking, conditioning of the sleeving shall take place after completion of the heat-shrinking procedure.

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

8 Production and quality testing

8.1 Production routine tests

Production routine tests shall be applied to samples, taken at random, from every batch, and shall consist of the tests listed in table 11.

8.2 Production quality tests

The frequency of application of each production quality test shall be to the requirements of the Approving Authority and will depend on the maintenance of the basic formulation of the sleeving material and the manufacturing conditions. Production quality tests shall be applied to samples taken at random from batches, and shall consist of the tests listed in table 12.

8.3 Batch

A batch of sleeving shall consist of that sleeving of the same type, nominal internal diameter and colour produced from a single mix, provided that the cross linking conditions are maintained constant throughout. For continuous processing a 'single mix' shall be defined by the manufacturer to the satisfaction of the Approving Authority.

9 Packaging and identification

Each container shall be marked with the following information:

- the number and date of this British Standard, i.e. BS 2G 198 : Part 3 : 1985†;
- the type number;
- the size;
- the length and quantity of sleeving;
- the manufacturer's name;
- the batch number and year of manufacture;
- use by date‡.

If packed in non-transparent containers, the outside of the container shall in addition be marked to show the colour of the sleeving.

NOTE. Packaging requirements will vary and should be specified by the purchaser in the order. For UK Government Services, these instructions will be based on Defence Standard 81-41/2 'Packaging of defence material', available from the Directorate of Standardization, Montrose House, Stan 1 Room 105, 187 George Street, Glasgow, G1 1YU.

* 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 the Procurement Executive, Ministry of Defence, DGDQA/TS, Material Centre, Royal Arsenal East, London SE18 6TD.

† Marking BS 2G 198 : Part 3 : 1985 on or in relation to a product is a claim by the manufacturer that the product has been manufactured to the requirements of the standard. The accuracy of such a claim is therefore solely the manufacturer's responsibility. Enquiries as to the availability of third party certification to support such claims should be addressed to the Director, Quality Assurance Division, BSI, PO Box 375, Milton Keynes MK14 6LO for certification marks administered by BSI or to the appropriate authority for other certification marks.

‡ The 'use by date' will only apply when the storage conditions given in appendix A have been complied with.

10 Tests

Clause	Title	Description	Requirement																																																		
10.1	Finish	Inspect	All sleeving shall comply with clause 4.																																																		
10.2	Dimensions	Select sufficient specimens (a minimum of 3) for measurement to ensure that the sleeving complies with the requirements. Measure the specimens in the 'as supplied' condition and after unrestricted shrinkage. Determine unrestricted shrinkage as specified in 10.3. Determine the minimum and maximum wall thickness at a single position, and the concentricity as the ratio between the minimum and maximum values of wall thickness obtained, expressed as a percentage. Make the measurements of internal diameter and wall thickness to the nearest 0.05 mm. In cases of dispute use an optical method of measurement, in which the error of determination does not exceed 0.025 mm. The measurements obtained by it shall be accepted as final.	All specimens shall comply with clause 5. Concentricity shall be not less than 65 %.																																																		
10.3	Longitudinal change	From the specimens used in 10.2, select at least three specimens of length approximately 100 mm for test. Measure the sleeving in the 'as supplied' condition and after unrestricted shrinkage to an accuracy of within ± 0.5 %, and express the results as a percentage. Determine unrestricted shrinkage as follows. Lay the 100 mm lengths of sleeving on a preheated tray* in an oven at the following temperatures and times: <table><tr><th>Type</th><th>Temperature</th><th>Time (min.)</th></tr><tr><td></td><td>$^{\circ}\text{C}$</td><td>min</td></tr><tr><td>10A</td><td>200 ± 2</td><td>5</td></tr><tr><td>10B</td><td>200 ± 2</td><td>5</td></tr><tr><td>11A</td><td>200 ± 2</td><td>3</td></tr><tr><td>11B</td><td>200 ± 2</td><td>3</td></tr><tr><td>11C</td><td>200 ± 2</td><td>3</td></tr><tr><td>12A</td><td>200 ± 2</td><td>5</td></tr><tr><td>12B</td><td>200 ± 2</td><td>5</td></tr><tr><td>13</td><td>150 ± 2</td><td>10</td></tr></table>	Type	Temperature	Time (min.)		$^{\circ}\text{C}$	min	10A	200 ± 2	5	10B	200 ± 2	5	11A	200 ± 2	3	11B	200 ± 2	3	11C	200 ± 2	3	12A	200 ± 2	5	12B	200 ± 2	5	13	150 ± 2	10	The longitudinal change shall not exceed the following limits: <table><tr><th>Type</th><th>Longitudinal change</th></tr><tr><td></td><td>%</td></tr><tr><td>10A</td><td>± 10</td></tr><tr><td>10B</td><td>± 10</td></tr><tr><td>11A</td><td>+5, -10</td></tr><tr><td>11B</td><td>+5, -10</td></tr><tr><td>11C</td><td>+5, -10</td></tr><tr><td>12A</td><td>± 20</td></tr><tr><td>12B</td><td>± 10</td></tr><tr><td>13</td><td>+5, -15</td></tr></table>	Type	Longitudinal change		%	10A	± 10	10B	± 10	11A	+5, -10	11B	+5, -10	11C	+5, -10	12A	± 20	12B	± 10	13	+5, -15
Type	Temperature	Time (min.)																																																			
	$^{\circ}\text{C}$	min																																																			
10A	200 ± 2	5																																																			
10B	200 ± 2	5																																																			
11A	200 ± 2	3																																																			
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10A	± 10																																																				
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11A	+5, -10																																																				
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11C	+5, -10																																																				
12A	± 20																																																				
12B	± 10																																																				
13	+5, -15																																																				

 Documents

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* The tray should be PTFE coated or dusted with talcum powder.

10 (continued)

Clause	Title	Description	Requirement																														
		Remove the sleeving from the oven, and allow to cool naturally to the temperature specified in 7.2.																															
10.4	Colour	Select a specimen of each colour for test. Examine the specimen visually for colour, both before and after unrestricted shrinkage. Shrink the specimen as specified in 10.3.	The colour of the specimen shall be recognizable as the relevant colour given in BS 6746C and shall be uniform and evenly dispersed throughout.																														
10.5	Colour stability	Shrink a specimen of each colour and of 25 mm minimum length as specified in 10.3, and place in an air-circulating oven at the following temperature and for the following time: <table><thead><tr><th>Type</th><th>Temperature</th><th>Time</th></tr></thead><tbody><tr><td></td><td>°C</td><td>h</td></tr><tr><td>10A</td><td>—</td><td>—</td></tr><tr><td>10B</td><td>—</td><td>—</td></tr><tr><td>11A</td><td>175 ± 2</td><td>24 ± 0.25</td></tr><tr><td>11B</td><td>175 ± 2</td><td>24 ± 0.25</td></tr><tr><td>11C</td><td>175 ± 2</td><td>24 ± 0.25</td></tr><tr><td>12A</td><td>—</td><td>—</td></tr><tr><td>12B</td><td>—</td><td>—</td></tr><tr><td>13</td><td>—</td><td>—</td></tr></tbody></table> After removal from the oven allow the specimen to cool naturally to the temperature specified in 7.2, and examine visually for colour.	Type	Temperature	Time		°C	h	10A	—	—	10B	—	—	11A	175 ± 2	24 ± 0.25	11B	175 ± 2	24 ± 0.25	11C	175 ± 2	24 ± 0.25	12A	—	—	12B	—	—	13	—	—	The colour of the specimen shall be recognizable as the relevant colour given in BS 6746C and shall be uniform and evenly dispersed throughout.
Type	Temperature	Time																															
	°C	h																															
10A	—	—																															
10B	—	—																															
11A	175 ± 2	24 ± 0.25																															
11B	175 ± 2	24 ± 0.25																															
11C	175 ± 2	24 ± 0.25																															
12A	—	—																															
12B	—	—																															
13	—	—																															
10.6	Colour fastness to light	Shrink the sleeving as specified in 10.3 and subject to the test for colour fastness given in BS 2782 : Method 540B, with the additional provision that no control of humidity shall be exercised. Note the number of the wool standard whose first detectable fading corresponds with that of the specimen sleeve.	Colour fastness Standard No. 5. The colour shall be recognizable.																														
10.7	Relative density	Conduct the test in accordance with method A of BS 903 : Part A1.	The relative 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 during subsequent production routine testing.																														
10.8	Resistance to mould growth	Shrink at least two lengths of sleeving as specified in 10.3, cut to lengths of approximately 25 mm and subject to tests in accordance with the 28 day test of BS 2011 : Part 2.1J.	Mould growth shall not be greater than scale 2.																														

10 (continued)

Clause	Title	Description	Requirement																																								
10.9	Elongation at break after contact with copper	Use cylindrical mandrels made from copper of at least 99 % purity that provide a snug fit for the recovered sleeving under test. When cylindrical mandrels are not available or are impracticable to use, then copper plates of 99 % purity may be used. In order to minimize surface contamination, in all the following operations, handle the test specimens and test copper mandrels or plates using polyethylene gloves, medical fingercoats, or polypropylene forceps. Thoroughly scour the surface of the copper mandrels or plates using a pumice or rouge water slurry, e.g. pumice powder 30 mesh/distilled or deionized water applied with a cotton wool pad, until a matt surface is obtained. Rinse the copper initially with distilled or deionized water, then with acetone of analytical quality and finally dry. NOTE 1. Where prepared copper is not used immediately after cleaning, it may be stored up to a maximum of 24 h in a clean desiccator over dried silica gel prior to testing. Select sufficient length of sleeving to provide five samples 150 mm long after unrestricted shrinkage. Shrink the sample as specified in 10.3 and fit to the cleaned mandrels ensuring a snug fit is obtained. When plates are used instead of mandrels the samples shall be slit lengthways, opened out and clamped between two plates with sufficient pressure to ensure 75 % of the inside surface is in contact with the plate. NOTE 2. It may be necessary to heat the sleeving to a temperature not exceeding those given in the table below to enable sufficient contact to be obtained. Condition the specimens in a humidity chamber at 90 % to 95 % relative humidity and 23 ± 2 °C for 24 ± 0.25 h, and then place the prepared test assembly in a uniformly heated air oven at the following temperature for 168 h minimum. NOTE 3. Care should be taken to ensure that the sleeving is not in contact with the oven walls or supports. <table><tr><th>Type</th><th>Temperature</th></tr><tr><td></td><td>°C</td></tr><tr><td>10A</td><td>135 ± 2</td></tr><tr><td>10B</td><td>120 ± 2</td></tr><tr><td>11A</td><td>160 ± 2</td></tr><tr><td>11B</td><td>160 ± 2</td></tr><tr><td>11C</td><td>160 ± 2</td></tr><tr><td>12A</td><td>175 ± 2</td></tr><tr><td>12B</td><td>175 ± 2</td></tr><tr><td>13</td><td>85 ± 1</td></tr></table>	Type	Temperature		°C	10A	135 ± 2	10B	120 ± 2	11A	160 ± 2	11B	160 ± 2	11C	160 ± 2	12A	175 ± 2	12B	175 ± 2	13	85 ± 1	The elongation at break shall not be less than the following: <table><tr><th>Type</th><th>Elongation</th></tr><tr><td></td><td>%</td></tr><tr><td>10A</td><td>200</td></tr><tr><td>10B</td><td>200</td></tr><tr><td>11A</td><td>200</td></tr><tr><td>11B</td><td>200</td></tr><tr><td>11C</td><td>150</td></tr><tr><td>12A</td><td>200</td></tr><tr><td>12B</td><td>150</td></tr><tr><td>13</td><td>150</td></tr></table> The test report shall state whether mandrels or plates were used for the test.	Type	Elongation		%	10A	200	10B	200	11A	200	11B	200	11C	150	12A	200	12B	150	13	150
Type	Temperature																																										
	°C																																										
10A	135 ± 2																																										
10B	120 ± 2																																										
11A	160 ± 2																																										
11B	160 ± 2																																										
11C	160 ± 2																																										
12A	175 ± 2																																										
12B	175 ± 2																																										
13	85 ± 1																																										
Type	Elongation																																										
	%																																										
10A	200																																										
10B	200																																										
11A	200																																										
11B	200																																										
11C	150																																										
12A	200																																										
12B	150																																										
13	150																																										

10 (continued)

Clause	Title	Description	Requirement																				
		After the period of test remove the specimens on their mandrels or plates from the oven and allow to cool naturally to the temperature specified in 7.2. Remove the specimens from the mandrel or plates and subject them to the elongation at break test method described in 10.11. Some types of sleeving tend to adhere to copper and if damage occurs to the specimen during removal from the copper repeat the test.																					
10.10	Copper mirror corrosion	For sizes 10 mm and larger (maximum internal diameter after unrestricted shrinkage), cut a 6.5 mm by 25 mm strip longitudinally from the shrunk sleeving. For sizes smaller than 10 mm (maximum internal diameter after unrestricted shrinkage), use a number of pieces of shrunk sleeving having a total minimum volume of 150 mm³. Shrink the specimen as specified in 10.3. Place the strip or pieces of shrunk sleeving in the bottom of a clean, dry, 13 mm by 300 mm test tube. Suspend a copper glass mirror, about 6.5 mm by 25 mm, with its centre 150 mm to 170 mm above the bottom of the test tube by means of a fine, clean copper wire attached to a cork that has been wrapped in clean aluminium foil. Monitor the temperature within the test tube in the vicinity of the glass mirror using a thermocouple. Use a second clean test tube, containing only the mirror and temperature measuring device as a control. Maintain the lower, 50 mm approximately, of the test tubes at the appropriate following temperature for 16 ± 0.25 h. <table><tr><th>Type</th><th>Temperature</th></tr><tr><td></td><td>°C</td></tr><tr><td>10A</td><td>150 ± 2</td></tr><tr><td>10B</td><td>135 ± 2</td></tr><tr><td>11A</td><td>175 ± 2</td></tr><tr><td>11B</td><td>175 ± 2</td></tr><tr><td>11C</td><td>175 ± 2</td></tr><tr><td>12A</td><td>175 ± 2</td></tr><tr><td>12B</td><td>175 ± 2</td></tr><tr><td>13</td><td>100 ± 2</td></tr></table> Maintain the temperature of that portion of the test tubes containing the mirrors below 60 °C. After removal from the heat source immediately visually examine the mirrors for corrosion against a white background in good light. Evidence of corrosion shall be the removal of the copper film from the mirror as evidenced by the white background showing through.	Type	Temperature		°C	10A	150 ± 2	10B	135 ± 2	11A	175 ± 2	11B	175 ± 2	11C	175 ± 2	12A	175 ± 2	12B	175 ± 2	13	100 ± 2	Disregarding removal of copper from the bottom 8 % by area of the mirror, there shall be no removal of the copper. Discoloration of the copper film shall not be considered to be corrosion.
Type	Temperature																						
	°C																						
10A	150 ± 2																						
10B	135 ± 2																						
11A	175 ± 2																						
11B	175 ± 2																						
11C	175 ± 2																						
12A	175 ± 2																						
12B	175 ± 2																						
13	100 ± 2																						

10 (continued)

Clause	Title	Description	Requirement																														
		The mirrors* shall be vacuum deposited copper with a thickness equal to $10 \pm 5\%$ of the transmission of normal light of wavelength 500 nm (5000 Å). They shall be stored in their original containers and shall be used only if no oxide film is present and the copper is not damaged or contaminated.																															
10.11	Tensile strength and elongation at break	Shrink at least five specimens as specified in 10.3. For sleeving of recovered internal diameter less than 6 mm, cut five lengths of not less than 150 mm from the recovered sleeving. For sleeving of recovered internal diameter of 6 mm or over, cut five dumb-bell test pieces according to the requirements of type 2 of BS 903 : Part A2, from the recovered sleeving, with their lengths parallel to the extruded axis. Conduct the tests for tensile strength and elongation at break in accordance with method 320A of BS 2782 : Methods 320A to 320F, with the exceptions that specimens 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 central value† of the results obtained. A break at a bench mark or outside the gauge length shall be cause for retest.	The tensile strength and elongation at break shall not be less than the following. <table><tr><th>Type</th><th>Tensile strength</th><th>Elongation at break</th></tr><tr><td></td><td>MPa</td><td>%</td></tr><tr><td>10A</td><td>12</td><td>300</td></tr><tr><td>10B</td><td>12</td><td>300</td></tr><tr><td>11A</td><td>10</td><td>250</td></tr><tr><td>11B</td><td>10</td><td>250</td></tr><tr><td>11C</td><td>17</td><td>250</td></tr><tr><td>12A</td><td>10</td><td>250</td></tr><tr><td>12B</td><td>10</td><td>200</td></tr><tr><td>13</td><td>10</td><td>250</td></tr></table>	Type	Tensile strength	Elongation at break		MPa	%	10A	12	300	10B	12	300	11A	10	250	11B	10	250	11C	17	250	12A	10	250	12B	10	200	13	10	250
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10.12	Dielectric strength	Test at least two specimens of sleeving, not less than 100 mm long. Provide a mandrel consisting of a straight clean metal wire, rod or tube of diameter equal to the maximum nominal recovered internal diameter of the sleeving, protruding at least 25 mm beyond the ends of the sleeving. Shrink the sleeving onto the mandrel in accordance with the temperatures specified in 10.3 until fully recovered onto the mandrel. Support the mandrel horizontally such that the sleeving is not in contact with the supports. Wrap an outer electrode, consisting of a strip of metal foil 25 ± 1 mm wide and not more than 0.025 mm thick, around the sleeving in such a manner that it is in intimate contact. Condition the prepared test assembly in accordance with 7.2 prior to testing. Test the conditioned test assembly in air or, if flash-over occurs below the required minimum dielectric strength, in oil complying with BS 148 using new specimens. Carry out the test under the conditions specified in 7.2.	The dielectric strength shall not be less than the following values. <i>Types 10A and 10B:</i> (a) wall thickness of 1.8 mm or less: 10 kV/mm; (b) wall thickness of over 1.8 mm: 8 kV/mm. <i>Types 11A and 11B:</i> (a) wall thickness of 0.9 mm or less: 20 kV/mm; (b) wall thickness of over 0.9 mm: 10 kV/mm. <i>Type 11C:</i> (a) wall thickness of 0.9 mm or less: 20 kV/mm; (b) wall thickness of over 0.9 mm: 12 kV/mm. <i>Type 12A:</i> all wall thicknesses: 6 kV/mm. <i>Type 12B:</i> all wall thicknesses: 20 kV/mm.																														

* Suitable mirrors are available from Evaporate Metal Films Corp., 701 Spencer Road, Ithaca, N.Y. 14850, USA.

† The central value is the middle result of an odd number of tests or the mean of the two middle results of an even number of tests when arranged in order of magnitude.