

Specification for

# Insulating and sheathing materials for cables —

Part 1: Cross-linked elastomeric insulating compounds —

Section 1.5: Flame retardant composites

**IMPORTANT NOTE** This section of BS 7655 is to be read in conjunction with BS 7655-0.

ICS 29.035.20

# Committees responsible for this British Standard

The preparation of this British Standard was entrusted by Technical Committee GEL/20, Electric cables, to Subcommittee GEL/20/3, Insulation and sheath, upon which the following bodies were represented:

Association of Consulting Engineers  
 British Approvals Service for Cables  
 British Cables Association  
 British Plastics Federation  
 British Rubber Manufacturers' Association Ltd.  
 Department of Trade and Industry (Consumer Safety Unit, CA Division)  
 Electricity Association  
 ERA Technology Ltd.  
 GAMBICA (BEAMA Ltd.)  
 Institute of Fire Prevention Officers  
 London Underground Ltd.  
 Ministry of Defence  
 Queen Mary and Westfield College  
 Railtrack  
 Warrington Fire Research Centre

This British Standard, having been prepared under the direction of the Electrotechnical Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 November 2000

© BSI 11-2000

First published April 1993  
 Second edition November 2000

The following BSI references relate to the work on this standard:  
 Committee reference GEL/20/3  
 Draft for comment 99/240495 DC

ISBN 0 580 33190 3

## Amendments issued since publication

Amd. No.	Date	Comments

---

# Contents

	Page
Committees responsible	Inside front cover
Foreword	ii
<hr/>	
1 Scope	1
2 Normative references	1
3 Definitions	1
4 Requirements	1
<hr/>	
Bibliography	5
<hr/>	

## Foreword

This section of BS 7655 has been prepared by Subcommittee GEL/20/3. It supersedes BS 7655-1.5:1993 which is withdrawn. It specifies the requirements for flame retardant composite cross-linked elastomeric insulating compounds.

This revision brings this section of BS 7655 fully into line with BS 7655-0:1997, including amendment 1:2000.

Test methods are specified in this section of BS 7655 by reference to the latest edition of standards in which they appear. A dated reference to the most recent edition of the relevant standard for each test method is given in BS 7655-0, which is to be read in conjunction with this section.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their 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 and ii, pages 1 to 5 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

## 1 Scope

This section of BS 7655 specifies the requirements for the flame retardant composite cross-linked elastomeric insulating compound listed in Table 1. The relevant test methods are given in BS EN 60811 and BS 6469.

These compounds are for use on coil end leads conforming to BS 6195, but may be used for other suitable applications as detailed in the cable specification.

This section is to be read in conjunction with BS 7655-0, which contains essential provisions for the application of this section of BS 7655.

**Table 1 — Type of flame retardant cross-linked insulation**

Type	Maximum material operating temperature °C	General application
FR 1	85	Flame retardant composite for type 4 cable conforming to BS 6195 <sup>1)</sup>
FR 2	85	Flame retardant composite for type 4 cable conforming to BS 6195 <sup>1)</sup>
<sup>1)</sup> The voltage designation of the cable will have a bearing on the type of compound selected for a particular application.		

## 2 Normative references

For the purposes of this section of BS 7655, the requirements of BS 7655-0, **2.1** apply with regard to normative references.

The latest editions of the standards giving test methods are listed in the most recent edition of BS 7655-0.

## 3 Definitions

For the purposes of this section of BS 7655 the definitions given in BS 7655-0, clause **3** apply.

## 4 Requirements

The requirements specified for the compound listed in Table 2 shall be met when the compound is tested using the test methods listed against each particular requirement.

NOTE For cross-references to the latest editions of the test method standards see BS 7655-0, Table 2.

Table 2 — Test requirements

Test <sup>1)</sup>	Test method in accordance with BS EN 60811 unless otherwise stated		Requirements for compound type	
	Section	Clause	FR 1	FR 2
<b><i>Properties in the state as manufactured for thicknesses up to and including 2.5 mm</i></b>	1-1	<b>9.1</b>		
Minimum tensile strength (N/mm <sup>2</sup> )			5.5	5.5
Minimum elongation at break (%)			200	200
<b><i>Properties in the state as manufactured for thicknesses over 2.5 mm (inner layer)</i></b>	1-1	<b>9.1</b>		
Minimum tensile strength (N/mm <sup>2</sup> )			6.5	6.5
Minimum elongation at break (%)			200	200
<b><i>Properties in the state as manufactured for thicknesses over 2.5 mm (outer layer)</i></b>	1-1	<b>9.1</b>		
Minimum tensile strength (N/mm <sup>2</sup> )			7	7
Minimum elongation at break (%)			200	200
<b><i>Properties after ageing in air oven for thicknesses up to and including 2.5 mm</i></b>	1-2	<b>8.1</b>		
Temperature (°C)			120 ± 2	120 ± 2
Duration (h)			7 × 24	7 × 24
Maximum variation for tensile strength (%)			30	30
Maximum variation for elongation at break (%)			40	40
<b><i>Properties after ageing in air oven for thicknesses over 2.5 mm (inner layer)</i></b>	1-2	<b>8.1</b>		
Temperature (°C)			135 ± 2	135 ± 2
Duration (h)			7 × 24	7 × 24
Maximum variation for tensile strength (%)			30	30
Maximum variation for elongation at break (%)			30	30
<b><i>Properties after ageing in air oven for thicknesses over 2.5 mm (outer layer)</i></b>	1-2	<b>8.1</b>		
Temperature (°C)			120 ± 2	120 ± 2
Duration (h)			7 × 24	7 × 24
Maximum variation for tensile strength (%)			30	30
Maximum variation for elongation at break (%)			40	40
<b><i>Properties after ageing in air bomb for thicknesses up to and including 2.5 mm</i></b>	1-2	<b>8.2</b>		
Temperature (°C)			127 ± 2	127 ± 2
Duration (h)			40	40
Maximum variation for tensile strength (%)			50 <sup>2)</sup>	50 <sup>2)</sup>
Maximum variation for elongation at break (%)			50 <sup>2)</sup>	50 <sup>2)</sup>

Table 2 — Test requirements (continued)

Test <sup>1)</sup>	Test method in accordance with BS EN 60811 unless otherwise stated		Requirements for compound type	
	Section	Clause	FR 1	FR 2
<b>Properties after ageing in air bomb for thicknesses over 2.5 mm (inner layer)</b> Temperature (°C) Duration (h) Maximum variation for tensile strength (%) Maximum variation for elongation at break (%)	1-2	<b>8.2</b>	127 ± 2 40 30 30	127 ± 2 40 30 30
<b>Properties after ageing in air bomb for thicknesses over 2.5 mm (outer layer)</b> Temperature (°C) Duration (h) Maximum variation for tensile strength (%) Maximum variation for elongation at break (%)	1-2	<b>8.2</b>	127 ± 2 40 50 <sup>2)</sup> 50 <sup>2)</sup>	127 ± 2 40 50 <sup>2)</sup> 50 <sup>2)</sup>
<b>Ozone resistance</b> Temperature (°C) Duration (h) Ozone concentration (ppm) Requirement	2-1	<b>8</b>	— — — —	25 ± 2 3 250 to 300 no cracks
<b>Alternative ozone resistance test (low concentration)</b> Temperature (°C) Duration (h) Ozone concentration (pphm) Requirement	BS 6469-99.1, Clause <b>13</b>		— — — —	40 ± 2 8 200 ± 50 no cracks
<b>Mineral oil immersion test for thicknesses over 2.5 mm (outer layer)</b> Temperature (°C) Duration (h) Maximum variation for tensile strength (%) <sup>2)</sup> Maximum variation for elongation at break (%) <sup>2)</sup>	2-1	<b>10</b>	100 ± 2 24 40 40	100 ± 2 24 40 40
<b>Insulation resistance constant</b> Temperature (°C) Minimum <i>K</i> value (MΩ·km)	BS 6469-99.2, Clause <b>8</b>		20 ± 2 1 900	20 ± 2 3 700
<b>Power factor and permittivity test</b> Maximum power factor at 20 °C Maximum permittivity at 20 °C	BS 6469-99.2, Clause <b>9</b>		— —	0.035 5.5

Table 2 — Test requirements (continued)

Test <sup>1)</sup>	Test method in accordance with BS EN 60811 unless otherwise stated		Requirements for compound type	
	Section	Clause	FR 1	FR 2
<b><i>Water absorption determined by the capacitance method</i></b>	BS 6469-99.2, Clause <b>10</b>			
Maximum increase in capacitance				
1 to 14 days (%)			15	10
7 to 14 days (%)			5	3
<sup>1)</sup> Unless otherwise stated, all tests shall be performed on the composite insulation. <sup>2)</sup> Only a reduction in values is subject to verification.				



## Bibliography

See BS 7655-0, **2.2**.

---

# BSI — British Standards Institution

BSI is the independent national body responsible for preparing British Standards. It presents the UK view on standards in Europe and at the international level. It is incorporated by Royal Charter.

## Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover. Tel: 020 8996 9000. Fax: 020 8996 7400.

BSI offers members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

## Buying standards

Orders for all BSI, international and foreign standards publications should be addressed to Customer Services. Tel: 020 8996 9001. Fax: 020 8996 7001.

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

## Information on standards

BSI provides a wide range of information on national, European and international standards through its Library and its Technical Help to Exporters Service. Various BSI electronic information services are also available which give details on all its products and services. Contact the Information Centre. Tel: 020 8996 7111. Fax: 020 8996 7048.

Subscribing members of BSI are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration. Tel: 020 8996 7002. Fax: 020 8996 7001.

## Copyright

Copyright subsists in all BSI publications. BSI also holds the copyright, in the UK, of the publications of the international standardization bodies. Except as permitted under the Copyright, Designs and Patents Act 1988 no extract may be reproduced, stored in a retrieval system or transmitted in any form or by any means – electronic, photocopying, recording or otherwise – without prior written permission from BSI.

This does not preclude the free use, in the course of implementing the standard, of necessary details such as symbols, and size, type or grade designations. If these details are to be used for any other purpose than implementation then the prior written permission of BSI must be obtained.

If permission is granted, the terms may include royalty payments or a licensing agreement. Details and advice can be obtained from the Copyright Manager. Tel: 020 8996 7070.