

Specification for

Polyethylene insulation and sheath of electric cables

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- Aluminium Federation
- Association of Consulting Engineers
- Association of Manufacturers of Domestic Electrical Appliances
- British Approvals Service for Electric Cables
- British Plastics Federation
- British Railways Board
- British Shipbuilders
- British Telecommunications plc
- Department of Energy (Electricity Division)
- Department of the Environment (Property Services Agency)
- Department of Trade and Industry (Consumer Safety Unit, C S Division)
- ERA Technology Ltd.
- Electric Cable Makers' Confederation
- Electricity Supply Industry in England and Wales
- Engineering Equipment and Materials Users' Association
- Institution of Electrical Engineers
- London Regional Transport
- Ministry of Defence

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Association of Supervisory and Executive Engineers
- British Rubber Manufacturers' Association
- Home Telephone Cable Makers' Association (1960)
- Queen Mary College Industrial Research

This British Standard, having been prepared under the direction of the General Electrotechnical Engineering Standards Committee, was published under the authority of the Board of BSI and comes into effect on 31 December 1987

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Foreword

This revision of BS 6234 has been prepared under the direction of the General Electrotechnical Engineering Standards Committee and supersedes BS 6234:1969 which is withdrawn.

This standard has been revised to specify requirements for compliance with the methods of tests detailed in BS 6469 and specifies a complete list of tests for insulation and sheaths of telecommunication cables, radio-frequency cables and electricity supply cables. The method of each test is detailed in Appendix A to Appendix K.

This standard is in technical agreement with the harmonization documents in CENELEC HD 385/S2 (European Committee for Electrotechnical Standardization) insofar as the test methods are applicable to harmonized types of cables and cords.

The test methods specified are in general agreement with those described in IEC Publications 538, 538A and 540 (second edition) of the International Electrotechnical Commission (IEC). These test methods are currently being revised and republished by IEC in their 811 series "Common test methods for insulating and sheathing materials of electric cables".

Product certification/inspection/testing. Users of this British Standard are advised to consider the desirability of third-party certification/inspection/testing of product conformity with this British Standard. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 14, an inside back cover 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 British Standard specifies the physical requirements, electrical requirements and test methods for the types of polyethylene insulation and sheath of electric cables given in Table 1.

Compounds and products with densities greater than 0.910 g/cm^3 at 23°C and having melt flow index values between 0.05 and 3 are included in this standard.

This standard does not apply to cross-linked, flame retardant or semi-conductive compounds or submarine cable materials.

NOTE The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definitions

For the purposes of this British Standard the following definitions apply.

2.1

median value

when a number of test values have been obtained and arranged in order of increasing size, one of the following is called the median value:

- the value located in the middle of the series if the series comprises an uneven number of values;
- the mean of the two values located in the middle if the series comprises an even number of values.

2.2

variation

the difference between the median value after ageing and the median value without ageing, expressed as a percentage of the latter

3 Designations

3.1 General

The compounds used to manufacture insulation or sheath for compliance with this standard are classified by their end use, melt flow index or colour, and for telecommunication and radio-frequency cables also by their density. Compounds are divided into types as shown in Table 1.

3.2 Density

Three density ranges of polyethylene are generally recognized, these being:

- low density polyethylene less than 0.925 g/cm^3 ;
- medium density polyethylene greater than 0.925 g/cm^3 but less than 0.940 g/cm^3 ;
- high density polyethylene greater than 0.940 g/cm^3 .

However, for the purposes of this standard the low and medium density materials for insulation and sheath complying with the requirements for telecommunication and radio-frequency cables are considered as one type, and a distinction is only made between densities less than 0.940 g/cm^3 and greater than 0.940 g/cm^3 as follows:

- low/medium density polyethylene greater than 0.910 g/cm^3 and less than 0.940 g/cm^3 at 23°C ;
- high density polyethylene greater than 0.940 g/cm^3 at 23°C .

NOTE 1 These densities refer to the base polymer, without pigment or carbon black, before extrusion, as determined by the method described in Appendix A. For compounds containing a nominal 2.5 % carbon black, a correction factor of $+0.01 \text{ g/cm}^3$ can be used. In case of doubt, the correction formula given in A.1 applies.

NOTE 2 For foamskin insulation the density for classification purposes is based on the cellular component, i.e. that of the cellular compound before extrusion.

3.3 Melt flow index

For the purpose of this standard a distinction is made between materials having a melt flow index of 1 and 2 for telecommunication and radio-frequency cable compounds and 0.4 for electricity supply cables.

NOTE The term "melt flow index" is sometimes replaced by "melt flow rate" in international standards.

4 Compositions

4.1 Insulation shall be any one of the following: solid, cellular or foamskin, natural or coloured.

The cellular and solid components shall be of polyethylene complying with the requirements of 4.2.

NOTE Foamskin insulation consists of a central core of cellular insulation surrounded by a solid skin. The skin may be of the same or different polyethylene type as the cellular component.

Sheath shall be either natural or coloured and for weather resistant purposes shall contain a nominal 2.5 % loading of carbon black.

4.2 The insulation or sheath shall consist of a compound based on one of the following materials, compounded and processed to meet the requirements of this standard:

- ethylene homopolymer;
- ethylene copolymers or mixtures of ethylene polymers and copolymers containing up to 10 % of non-ethylene monomer.

NOTE The use of reprocessed material is permitted provided the requirements of the specification are met.

5 Antioxidant

Insulation and sheath complying with the requirements for telecommunication and radio-frequency cables given in Table 2, Table 3, Table 4, and Table 5 shall be extruded from compounds with added antioxidant selected in accordance with group 2 of Table 2 in BS 3412:1976.

NOTE Additional stabilizers such as metal deactivators are also permitted. The quantity of antioxidant or metal deactivator may be determined, if required, by BS 2782:Method 434A, Method 434B, Method 434C or Method 434D as appropriate or by any other approved method.

6 Standard colours

Colours of opaque insulation and sheath shall match the colours specified in BS 6746C.

7 Permittivity and loss tangent for radio-frequency and telecommunication cables

7.1 General

When required by the customer, and indicated at the time of tender or order, the permittivity and loss tangent determinations shall be measured at a frequency of 1 MHz to 20 MHz in accordance with either BS 2067 or any other suitable method, e.g. method of ASTM D 1531.

7.2 Permittivity

The permittivity of test sheets, made from raw material in accordance with the method described in Appendix G, shall not be greater than 2.35.

7.3 Loss tangent

The loss tangent of test sheets, made in accordance with the method described in Appendix G, shall not be greater than 0.0009.

8 General properties

8.1 When tested by the methods specified in **8.2** and **8.3** the properties of the insulation or sheath shall be in accordance with the test values for the properties given in Table 2 to Table 6 for the particular type of material.

8.2 The methods of sampling and testing properties shall be carried out in accordance with the following:

- a) density: **2.4** in BS 6469:1984 and Appendix A;
- b) melt flow index: **5.1** in BS 6469:1984 and Appendix B;
- c) mechanical properties of insulation: **2.2.1** in BS 6469:1984 and Appendix C;
- d) mechanical properties of sheath: **2.2.2** in BS 6469:1984 (see also Appendix D);
- e) compatibility with filling compound: Appendix E;
- f) environmental stress crack resistance: **5.2** in BS 6469:1984 and Appendix F;
- g) resistance to oxidation: Appendix H;
- h) oxidative induction time: Appendix J;
- i) carbon black content: **5.3** in BS 6469:1984;
- j) carbon black dispersion: Appendix K;
- k) ageing in air: **2.3** in BS 6469:1984;
- l) pressure test at high temperature: **4.2** in BS 6469:1984;
- m) gravimetric water absorption test: **2.6** in BS 6469:1984;
- n) shrinkage test: **2.5** in BS 6469:1984.

8.3 Unless otherwise stated in the specification for the type of cable, the tests on insulation and sheath shall be made on samples from every colour of core. The test shall be carried out not less than 16 h after extrusion.

8.4 When tested for resistance to oxidation, as described in Appendix H, the increase in mass of cable components shall not be greater than 1 mg, when reweighed to the nearest 0.1 mg, and the cable colour shall be readily identifiable.