British Standard

BRITISH STANDARD

BS 6469 : Section 98.1 : 1996

Insulating and sheathing materials of electric cables

Part 98. Additional harmonized non-electrical test methods

Section 98.1 Test for TMPU sheath

Committees responsible for this British Standard

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

Association of Consulting Engineers
Association of Manufacturers of Domestic Electrical Appliances (AMDEA)
BEAMA Electrical Cable and Conductor Accessory Manufacturers' Association
British Approvals Service for Cables
British Cable Makers Confederation
British Iron and Steel
Department of Trade and Industry
Electricity Association
Engineering Equipment and Materials Users' Association
Institution of Electrical Engineers
London Transport

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

British Railways Board
British Rubber Manufacturers Association Ltd.
British Telecommunications plc
ERA Technology Ltd.
GAMBICA (BEAMA) Ltd.
Institution of Incorporated Executive Engineers
London Underground Ltd.
Ministry of Defence
Queen Mary and Westfield College
Telecommunications Cables Group of BCMC
Warrington Fire Research Centre

This British Standard, having been prepared under the direction of the Electrotechnical Sector Board, was published under the authority of the Standards Board and comes into effect on
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Amendments issued since publication

Amd. No.	Date	Text affected

The following BSI references relate to the work on this standard:
Committee reference GEL/20
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Contents

Foreword

This British Standard has been prepared under the direction of Technical Committee GEL/20.

Most Sections of BS 6469 have been superseded by the corresponding Sections of BS EN 60811. BS 6469 : Sections 4.2 and 5.1 implement corresponding Sections of CENELEC Harmonization Document HD 505, which were derived from IEC 811.

BS 6469 : Part 98 describes additional harmonized non-electrical test methods. Section 98.1 details tests for TMPU sheath, which have not been included in CENELEC HD 505 or EN 60811. These tests are called up in electric cable specifications for harmonized national types in HD 22.10.S1.

To facilitate cross-referencing, the clause structure of the BS EN 60811 series is used in this British Standard.

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

WARNING. The methods of test desribed in this British Standard do not necessarily detail all precautions necessary to meet the requirements of the Health and Safety at Work etc. Act 1974. Attention should be paid to any appropriate safety precautions and the tests should be carried out only by trained personnel.

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

Methods

1 Scope

BS 6469 specifies the methods to be used for testing polymeric insulating and sheathing materials of electric cables.

This section of BS 6469 gives methods for non-electrical tests not included in the CENELEC Harmonization Document HD 505, and hence not given in BS EN 60811 or other Sections of BS 6469.

The methods of test described in this section of BS 6469 are as follows:

a) tensile test on polyurethane sheath after immersion in water;

b) tear resistance test for polyurethane sheath;

c) determination of the saponification value of the polyurethane sheath.

1.1 Normative references

This British Standard incorporates, by dated or updated reference, provisions from other publications. These normative references are made at the appropriate places in the text and the cited publications are listed on the inside back cover. For dated references, only the edition cited applies; any subsequent amendments to or revisions of the cited publications apply to this British Standard 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.

1.2 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.

2 Test values

Full test conditions (such as temperature and durations) and full test requirements are not specified in this standard; it is intended that they should be specified by the standard dealing with the relevant type of cable.

Any test requirements which are given in this standard may be modified by the relevant cable standard to suit the needs of a particular type of cable.

3 Applicability

Conditioning values and testing parameters are specified for the most common types of insulating and sheathing compounds for cables, wires and cords.

4 Type tests and other tests

The test methods described in this standard are suitable for use as type tests. In certain tests, where there are essential differences between the conditions for type tests and those for more frequent tests, such as routine tests, these differences are indicated.

5 Pre-conditioning

All the tests shall be carried out not less than 16 h after the extrusion or vulcanization (or cross-linking), if any, of the insulating or sheathing compounds.

6 Test temperature

Unless otherwise specified, tests shall be made at a temperature of 20 ± 5 °C.

7 Definitions

For the purpose of this section of BS 6469, the definitions given in BS 4727 : Part 2 : Group 08 apply, together with the following.

7.1 Saponification value

The amount of potassium hydroxide, in mg, which is necessary for the saponification of 1 g of the sample to be tested.

8 Tensile test on polyurethane sheath after immersion in water

8.1 Test piece preparation

Prepare the test specimen in accordance with **9.2** of BS EN 60811-1-1 : 1995. Determine the cross-sectional area before immersion in water.

8.2 Immersion and tensile test procedure and expression of results

Immerse the test specimen in deionized (or distilled) water at the temperature and for the time specified in the particular specification. At the end of the immersion period, remove the test specimens from the water and suspend them in air at ambient temperature, avoiding direct sunlight, for period of not less than 16 h but not exceeding 24 h.

The expression of results shall be in accordance with **9.1.8** of BS EN 60811-1-1 : 1995.

9 Tear resistance test for polyurethane sheath

9.1 Sampling and preparation of test piece

Take a sample of the sheath from the cable and prepare three test specimens, having the dimensions shown in figure 1, by accurately cutting or punching them from the sample.

NOTE 1. For cables having an outer diameter of less than 10 mm, the width of the test piece may be approximately equal to the circumference of the sheath.

NOTE 2. Due to the relatively small outer diameter and the nature of the material, it is not possible to prepare flat test pieces.

Using a sharp blade, make a central longitudinal cut, as shown in figure 1, perpendicular to the width of the test piece. Where grooves caused by the cores are present, make the cut at the thinnest part of one of the grooves nearest the centre of the test specimen.

Determine the mean thickness of each test piece from three measurements taken at points equidistant along the expected tear length.

9.2 Conditioning of test pieces

Before commencing the test, all test pieces shall be kept for at least three hours at a temperature of $(20 \pm 5)\ ^{\circ}C$.

9.3 Test procedure

Place the halves of the split end of the test piece, as shown in figure 2, in the jaws of a tensile testing machine.

Separate the jaws at a rate of 250 ± 50 mm/min.

9.4 Expression of results

If the tear reaches the markerline indicated in figure 1, the test shall be deemed valid. If the tear runs towards one of the sides of the test piece before the markerline, it shall be ignored. At least two valid results shall be obtained otherwise more test pieces shall be prepared.

The tear resistance of each test piece shall be determined by dividing the maximum tear load, in N, by the mean thickness, in mm.

The value of the tear resistance recorded shall be the mean value of the valid values obtained.

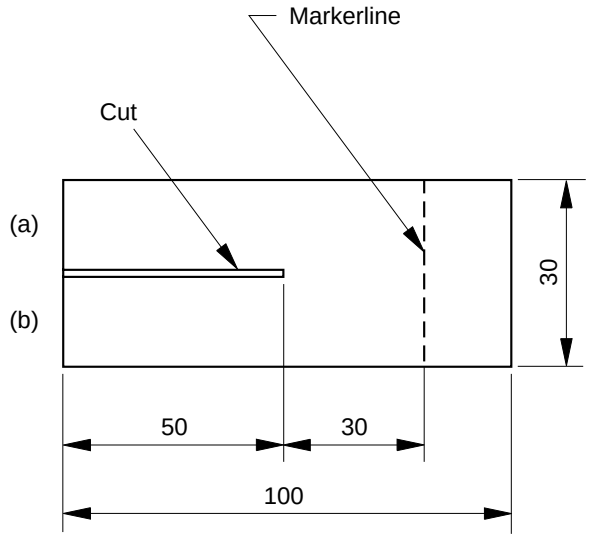

Figure 1. Test specimen for tear resistance test: dimensions and preparation details

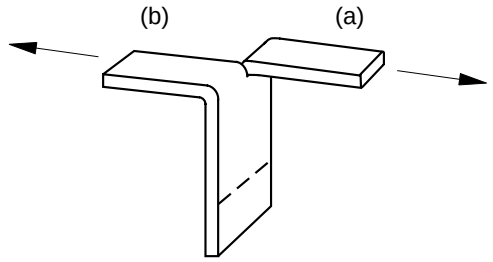

Figure 2. Test specimen for tear resistance test: arrangement for tensile testing

10 Determination of the saponification value of the polyurethane sheath

10.1 Sampling

Take from the sheath a sample of sufficient mass, after removing any filler or separator from the inside of the sheath. Clean the sample using a suitable solvent, for instance ethanol or petrol.

10.2 Principle

Hydrolysis of any ester groups of the polyurethane compound by potassium hydroxide in alcoholic solution.

Back-titration of excess of potassium hydroxide with hydrochloric acid, using phenolphthalein as indicator.

10.3 Reagents

10.3.1 *Potassium hydroxide*, approximately 1N ethanolic solution.

10.3.2 *Hydrochloric acid*, approximately 1N solution.

10.3.3 *Phenolphthalein*, 1 % in ethanol.

10.4 Apparatus

10.4.1 *burette* of capacity 50 ml.

10.4.2 *conical flask* of capacity of 200 ml or 300 ml.

10.4.3 *reflux condenser*, which can be fitted to the conical flask.

10.4.4 *analytical balance.*

10.4.5 *waterbath.*

10.4.6 *centrifugal mill.*

10.4.7 *test sieve*, wire gauze 1 mm.

10.4.8 *glass electrode.*

10.5 Procedure

Grind and sieve approximately 20 g of the sample, and remove the deposit on the sieve.

Weigh, to the nearest 0.001 g, approximately 2.5 g of the sieved sample and put it into the conical flask.

By means of the burette, add 25 ml of potassium hydroxide solution.

Place the flask fitted with the reflux condenser in the water bath and maintain the content of the flask at boiling temperature for 5 h.

Remove the flask from the waterbath and, without cooling it down, titrate the flask content with the hydrochloric acid solution. Determine the end point either:

a) by using three drops of the phenolphthalein solution as an indicator; or

b) electrometrically, using a glass electrode and after adding approximately 75 ml of distilled water.

10.6 Blank test

Perform a blank test, without a sample, following the same procedure and using the same quantities of all the reagents as used in the procedure given in **10.5**.

10.7 Expression of results

The saponification value is given in (mg KOH/g) by the formula:

$$\frac{(v_2 - v_1) \times 56.1 \times f}{m}$$

where

v_1 is the volume, in ml, of the HCl used in the procedure given in **10.5**.

v_2 is the volume, in ml, of the HCl used in the blank test.

m is the mass, in g, of the test portion.

f is the correction factor for the normality of the hydrochloric acid.

Determine the mean value after performing the procedures given in **10.5** and **10.6** three times.

blank

List of references (see clause 2)

Normative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 4727 :	*Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms*
BS 4727 : Part 2 :	*Terms particular to power engineering*
BS 4727 : Part 2 : Group 8 : 1994	*Electric cables*
BS EN 60811 :	*Insulating and sheathing materials of electric cables — Common test methods*
BS EN 60811-1 :	*General application*
BS EN 60811-1-1 : 1995	*Measurement of thickness and overall dimensions — Tests for determining the mechanical properties*

Informative references

BSI publications

BRITISH STANDARDS INSTITUTION, London

BS 6469 :	*Insulating and sheathing materials of electric cables*
BS 6469 : Part 4 :	*Methods of test specific to polyethylene and polypropylene compounds*
BS 6469 : Section 4.2 : 1992	*Elongation at break after pre-conditioning.* *Wrapping test after pre-conditioning.* *Wrapping test after thermal ageing in air.* *Measurement of mass increase.* *Long-term stability test.* *Test method for copper catalysed oxidative degradation*
BS 6469 : Part 5 :	*Methods of test specific to filling compounds*
BS 6469 : Section 5.1 : 1992	*Drop-point. Separation of oil. Lower temperature brittleness. Total acid number. Absence of corrosive components. Permittivity at 23 ˚C. D.C. resistivity at 23 ˚C and 100 ˚C*

IEC publications

INTERNATIONAL ELECTROTECHNICAL COMMISSION (IEC), Geneva.
(All publications are available from Customer Services, BSI).

IEC 811 : 1995	*Common test methods for insulating and sheathing materials of electric cables*

CENELEC publications

EUROPEAN COMMITTEE FOR ELECTROTECHNICAL STANDARDIZATION (CENELEC), Brussels.
(All publications are available from Customer Services, BSI.)

HD 22.10. S1[1)]	*Rubber insulated cables of rated voltages up to and including 450/750 V Part 10: EPR insulated and polyurethane sheathed flexible cable*
HD 505[1)]	*Common test methods for insulating and sheathing materials of electric cables*

[1)] Referred to in the foreword only.

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