

Insulating and sheathing materials of electric cables

Part 1. Methods of test for general application

Section 1.1 Measurement of thickness and overall dimensions — Tests for determining the mechanical properties

(Implementation of HD 505.1.1 S3)

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Cables and Insulation Standards Policy Committee (CIL/-) to Technical Committee CIL/20, upon which the following bodies were represented:

Aluminium Federation
 Association of Consulting Engineers
 Association of Manufacturers of Domestic Electrical Appliances
 British Approvals Service for Cables
 British Cable Makers' Confederation
 British Plastics Federation
 British Steel Industry
 British Telecommunications plc
 Department of the Environment (Property Services Agency)
 Department of Trade and Industry (Consumer Safety Unit, CA Division)
 Electricity Association
 Engineering Equipment and Materials Users' Association
 Institution of Electrical Engineers
 London Regional 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.
 ERA Technology Ltd.
 GAMBICA (BEAMA Ltd.)
 Institution of Incorporated Executive Engineers
 London Underground Ltd.
 Queen Mary and Westfield College
 Telecommunications Cables Group of BCMC

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National foreword

This Section of BS 6469 has been prepared under the direction of the Cables and Insulation Standards Policy Committee. BS 6469 : Parts 1 to 5 and Part 99 supersede BS 6469 : 1990 which is withdrawn.

Parts 1 to 5 implement CENELEC HD 505 : Parts 1 to 5 which were derived from IEC 811 : Parts 1 to 5. Part 99 describes test methods having national applicability only.

The International Electrotechnical Commission has completed its comprehensive update of the test methods previously given in IEC 538, IEC 538A and IEC 540, which are now largely brought together in IEC 811. Electrical tests from IEC 540 have been incorporated into IEC 885. The technical changes introduced during this update, and endorsed by CENELEC in HD 505, are now included in BS 6469.

BS 6469 : Section 4.2 includes a number of test methods described in BS 6234. Other test methods from BS 6234, from BS 6746 and from BS 6899 have been incorporated in BS 6469 : Part 99. The status of these test methods in BS 6234, BS 6746 and BS 6899 will be reviewed separately.

BS 6469 describes methods of test, but does not specify requirements for products or materials. These will be specified in the relevant cable standards or cable material standards.

This Section of BS 6469 implements CENELEC Harmonization Document HD 505.1.1 S3 : 1991, which is identical with IEC 811-1-1 : 1985 plus Amendment No. 1 (1988) plus Amendment No. 2 (1989) plus Corrigendum 1986.

In order to describe more explicitly the method of measurement of the thickness of non-metallic sheath of national types of flat multi-core cables, amplification of the method given in HD 505.1.1 S3 is detailed in national annex NA.

Definitions of terms relating to electric cables are given in BS 4727 : Part 2 : Group 08.

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 described 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.

The complete IEC standard (IEC 811) will eventually replace IEC Publications 538 and 540. To enable users to compare the relevant clauses in all three publications, a table of cross-references is given in appendix A.

Cross-references between the relevant clauses in BS 6469 : 1990 and those in BS 6469 : Parts 1 to 5 and Part 99 are given in table NC.1. Tests included in BS 6469 : Sections 1.3 and 5.1 which were not given in BS 6469 : 1990 are listed in table ND.1.

References to page numbers in the text relate to the IEC page numbers and should be ignored.

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

UDC 621.315.61 : 621.315.2/.3 : 620.1

Descriptors: Electric cable, insulated cable, electrical insulation, sheath, insulation, measurement of dimension, thickness, mechanical property

English version

Common test methods for insulating and sheathing materials of electric cables

Part 1. Methods for general application

Section one — Measurement of thickness and overall dimensions — Tests for determining the mechanical properties

(IEC 811-1-1 : 1985 + Amendment 1 : 1988 + Amendment 2 : 1989)

Méthodes d'essais communes pour les matériaux d'isolation et de gainage des câbles électriques
Première partie: Méthodes d'application générale
Section un: Mesure des épaisseurs et des dimensions extérieures — Détermination des propriétés mécaniques
(CEI 811-1-1 : 1985 + Modification 1 : 1988 + Modification 2 : 1989)

Allgemeine Prüfungen für Isolier- und Mantelwerkstoffe für Kabel und isolierte Leitungen
Teil 1: Allgemeine Prüfverfahren
Hauptabschnitt 1: Messung der Wanddicke und der Außenabmessungen — Prüfungen zur Bestimmung der mechanischen Eigenschaften
(IEC 811-1-1 : 1985 + Änderung 1 : 1988 + Änderung 2 : 1989)

This Harmonization Document was approved by CENELEC on 1990-12-10. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this Harmonization Document on a national level.

Up-to-date lists and bibliographical references concerning national implementation may be obtained on application to the Central Secretariat or to any CENELEC member.

This Harmonization Document exists in three official versions (English, French, German).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 811-1-1 : 1985 and its amendments 1 : 1988 and 2 : 1989 could be accepted without textual changes, has shown that no CENELEC common modifications were necessary for the acceptance as Harmonization Document.

The reference document was submitted to the CENELEC members for formal vote and was approved by CENELEC as HD 505.1.1 S3 on 10 December 1990.

The following dates were fixed:

- latest date of (doa) 1991-06-01
announcement of the HD
at national level
- latest date of publication (dop) 1991-12-01
of a harmonized national
standard
- latest date of withdrawal (dow) 1991-12-01
of conflicting national
standards

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COMMON TEST METHODS FOR INSULATING AND SHEATHING MATERIALS OF ELECTRIC CABLES

Part 1: Methods for general application

Section One – Measurement of thickness and overall dimensions

Tests for determining the mechanical properties

1. Scope

This standard specifies the test methods to be used for testing polymeric insulating and sheathing materials of electric cables for power distribution and telecommunications including cables used on ships.

This Section 1 of Part 1 gives the methods for measuring the thicknesses and overall dimensions and for determining the mechanical properties, which apply to the most common types of insulating and sheathing compounds (elastomeric, PVC, PE, PP etc).

2. Test values

Full test conditions (such as temperatures, durations, etc.) 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 and of cables, wires and cords.

4. Type tests and other tests

The test methods described in this standard are intended, in the first instance, to be used for 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.

Note. – For multicore cables and cords, not more than three cores (of different colours, if any) need be tested unless otherwise specified in the relevant cable standard.

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 ambient temperature.

Note. – In the UK ambient temperature is defined as 20 ± 5 °C.

7. Median value

When several test results have been obtained and ordered in an increasing or decreasing succession, the median value is the middle value if the number of available values is odd, and is the mean of the two middle values if the number is even.

8. Measurement of thicknesses and overall dimensions

8.1 *Measurement of insulation thickness*

8.1.1 *General*

Measurement of insulation thickness may be required as an individual test, or as a step in the procedure for carrying out other tests, such as the determination of mechanical properties.

In each case, the methods of selection of samples shall be in accordance with the relevant cable standard.

8.1.2 *Measuring equipment*

A measuring microscope or a profile projector of at least $10 \times$ magnification. Both types of equipment shall allow a reading of 0.01 mm and an estimated reading to three decimal places when measuring insulation with a specified thickness less than 0.5 mm.

In case of doubt, the measuring microscope shall be taken as the reference method.

8.1.3 *Preparation of test pieces*

Any covering shall be removed from the insulation, and the conductor(s), together with separator (if any) shall be withdrawn, care being taken to avoid damage to the insulation. Semi-conducting inner and/or outer layers, if bonded to the insulation, shall not be removed.

Each test piece shall consist of a thin slice of insulation. The slice shall be cut with a suitable device (sharp knife, razor blade, etc.) along a plane perpendicular to the longitudinal axis of the conductor.

The cores of non-sheathed flat cords shall not be separated.

If the insulation carries an indented marking, thus giving rise to a local reduction in thickness, the test piece shall be taken so as to include such marking.

8.1.4 *Measuring procedure*

The test piece shall be placed under the measuring equipment with the plane of the cut perpendicular to the optical axis.

- a) When the inner profile of the test piece is of circular form, six measurements shall be made as shown in Figure 1, page 24. For sector-shaped cores, six measurements shall be made as shown in Figure 2, page 24.
- b) When the insulation is taken from a stranded conductor, six measurements shall be made as shown in Figures 3 and 4, page 25.

- c) When the outer profile shows unevenness, the measurements shall be carried out as shown in Figure 5, page 26.
- d) When there are unremovable screening layers under and/or over the insulation, they shall be excluded from the measurements.
If unremovable screening layers are present under and/or over an opaque insulation, a measuring microscope shall be used.
- e) Flat non-sheathed cords shall be measured according to Figure 6, page 26 the thickness of insulation in the direction of the other core being taken as half the distance between the conductors.

In all cases, the first measurement shall be taken where the insulation is thinnest.

If the insulation carries an indented marking, this shall not be included in the measurements made for the calculation of mean thickness. In any case, the thickness at the position of the indented marking shall comply with the minimum requirement specified in the relevant cable standard.

The readings shall be made in millimetres to two decimal places if the specified thickness is 0.5 mm or above and to three estimated decimal places if the specified thickness of the insulation is less than 0.5 mm.

8.1.5 *Evaluation of the measurement results*

The results shall be evaluated as specified in the test requirements of the relevant cable standard.

In the case of mechanical tests, the mean value of the thickness, δ , of each test piece (see Item b1) of Sub-clause 9.1.4) shall be calculated from the six measurement results obtained on that test piece.

8.2 *Measurement of thickness of non-metallic sheath*

8.2.1 *General*

The measurement of sheath thickness may be required as an individual test, or as a step in the procedure for carrying out other tests, such as the measurement of mechanical properties. The test method applies to the measurement of all sheaths for which thickness limits are specified, for example separation sheaths, as well as external sheaths.

In each case, the method of selecting samples shall be in accordance with the relevant cable standard.

8.2.2 *Measuring equipment*

(See Sub-clause 8.1.2.)

8.2.3 *Preparation of test pieces*

After all materials, if any, inside and outside the sheath have been removed, each test piece shall be prepared by cutting with a suitable device (sharp knife, razor blade, etc.) a thin slice along a plane perpendicular to the longitudinal axis of the cable.

If the sheath carries an indented marking, thus giving rise to a local reduction in thickness, the test piece shall be taken so as to include such marking.

8.2.4 *Measuring procedure*

The test piece shall be placed under the measuring equipment with the plane of the cut perpendicular to the optical axis.

- a) When the inner profile of the test piece is of circular form, six measurements shall be made as shown in Figure 1, page 24.

- b) If the inner substantially circular surface is not regular or smooth, six measurements shall be made radially at the positions where the sheath is thinnest, as shown in Figure 7, page 27.
- c) When the inner profile exhibits deep grooves caused by the cores, measurements shall be taken at the bottom of each groove, as shown in Figure 8, page 27.

When the number of grooves exceeds six, Item b) applies.

- d) In order to eliminate the influence of any irregularities in the outer surface, which may be due to the presence of a proofed tape or a ribbed sheath finish, the measurements shall be made as shown in Figure 9, page 28.
- e) In the case of sheathed flat cords, measurements shall be taken on lines approximately parallel to the minor axis and on the major axis of the cross-section, at the position of each core, one of the measurements being, however, made at the thinnest place, as shown in Figure 10, page 28.
- * f) For sheathed flat cables composed of up to and including six single cores, measurement shall be taken as shown in Figure 11, page 29:
 - on both rounded off sides, along the major axis of the cross-section,
 - on both flat sides, on the first and nth core and at the thinnest place (plus opposite sheath thickness) if this does not coincide with any of the other measurements.

For cables composed of more than six cores, the above applies but measurements shall also be taken on the middle core or on one of the two middle cores in case of an even number of cores.

In all cases, one of the measurements shall be taken where the sheath is thinnest.

If the sheath carries an indented marking, this shall not be included in the measurements made for the calculation of mean thickness. In any case, the thickness of the position of the indented marking shall comply with the minimum requirement specified in the relevant cable standard.

The readings shall be made in millimetres to two decimal places.

8.2.5 *Evaluation of the measurement results*

The results shall be evaluated as specified in the test requirements of the relevant cable standard.

In the case of mechanical tests, the mean value of the thickness, δ , of each test piece (see Sub-clause 9.2.4) shall be calculated from all measurement results obtained on that test piece.

8.3 *Measurement of overall dimensions*

8.3.1 *General*

The measurement of the dimensions over the insulation of cores or over the sheath may be required as individual tests or as steps in the procedure for carrying out other tests.

The methods in Sub-clause 8.3.2 below are for general use except where the procedure for a particular test specifies a different or alternative method.

In each case, the method of selecting samples shall be in accordance with the relevant cable standard.

* See national annex NA.