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Edition 2.1
2001-07

Edition 2:1993 consolidated with amendment 1:2001

Common test methods for insulating and sheathing materials of electric cables and optical cables –

Part 1-1: Methods for general application – Measurement of thickness and overall dimensions – Tests for determining the mechanical properties

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



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IEC 60811-1-1:1993

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**COMMON TEST METHODS FOR INSULATING AND
SHEATHING MATERIALS OF ELECTRIC CABLES
AND OPTICAL CABLES –****Part 1-1: Methods for general application –
Measurement of thickness and overall dimensions –
Tests for determining the mechanical properties**

FOREWORD

- 1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60811-1-1 has been prepared by IEC technical committee 20: Electric cables.

This second edition cancels and replaces the first edition published in 1985, the corrigendum to the IEC 60811 series, published in 1986, amendment 2, 1989, incorporating amendment 1, 1988, and constitutes a technical revision.

This consolidated version of IEC 60811-1-1 consists of the second edition (1993) 20(CO)205/FDIS and 20(CO)208/RVD] and its amendment 1 (2001) [documents 20/455/FDIS and 20/465/RVD].

The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience.

It bears the edition number 2.1.

A vertical line in the margin shows where the base publication has been modified by amendment 1.

Annex A is for information only.

The committee has decided that the contents of the base publication and its amendments will remain unchanged until 2006. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

COMMON TEST METHODS FOR INSULATING AND SHEATHING MATERIALS OF ELECTRIC CABLES AND OPTICAL CABLES –

Part 1-1: Methods for general application – Measurement of thickness and overall dimensions – Tests for determining the mechanical properties

1 Scope

The International Standard IEC 60811-1 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, and in offshore applications.

This section of IEC 60811-1 gives the methods for measuring 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.).

1.1 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60811-1. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this part of IEC 60811-1 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60811-1-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Two: Thermal ageing methods*

IEC 60811-1-3:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Three: Methods for determining the density – Water absorption tests – Shrinkage test*

IEC 60811-2-1:1986, *Common test methods for insulating and sheathing materials of electric cables – Part 2: Methods specific to elastomeric compounds – Section 1: Ozone resistance test – Hot set test – Mineral oil immersion test*

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 section 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 section 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.

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.

Unless otherwise specified, before any test, all test pieces, aged and unaged, shall be kept for at least 3 h at a temperature of $(23 \pm 5) ^\circ\text{C}$.

6 Test temperature

Unless otherwise specified, tests shall be made at ambient temperature.

7 Definitions

For the purposes of this section of IEC 60811-1, the following definitions apply:

7.1

maximum tensile force

highest value reached by the load during the test

7.2

tensile stress

tensile force per unit of the cross-sectional area of the unstretched test piece

7.3

tensile strength

maximum tensile stress recorded in extending the test piece to breaking point

7.4

elongation at break

increase of the reference length of the test piece, expressed as the percentage of the reference length of the unstretched test piece, at breaking point

7.5

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 x 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 radially as shown in figure 1. For sector-shaped cores, six measurements shall be made as shown in figure 2.
- b) When the insulation is taken from a stranded conductor, six measurements shall be made radially as shown in figures 3 and 4.
- c) When the outer profile shows unevenness, the measurement shall be carried out as shown in figure 5.
- 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, 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 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 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 a thin slice along a plane perpendicular to the longitudinal axis of the cable, using a suitable device (sharp knife, razor blade, etc.).

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 radially as shown in figure 1.
- b) If the substantially circular inner 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.

- c) When the inner profile exhibits deep grooves caused by the cores, radial measurements shall be taken at the bottom of each groove, as shown in figure 8.

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

- d) In order to eliminate the influence of any irregularities on 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.
- 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.
- f) For sheathed flat cables composed of up to and including six single cores, measurement shall be taken as shown in figure 11:
- on both rounded off sides, along the major axis of the cross-section;
 - on both flat sides, on the first and last 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 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 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.