BS EN 60811-409:2012

BSI Standards Publication

Electric and optical fibre cables — Test methods for non-metallic materials

Part 409: Miscellaneous tests — Loss of mass test for thermoplastic insulations and sheaths

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National foreword

This British Standard is the UK implementation of EN 60811-409:2012. It is identical to IEC 60811-409:2012.

In the UK, the relationship between the supersessions of BS EN 60811 series can be summarized as follows.

BS EN 60811-100 together with	Supersedes -
-201, -202, -203, -501	BS EN 60811-1-1:1995
-301, -302, -411, -601, -602, -603, -604	BS EN 60811-5-1:2000
-401, -412	BS EN 60811-1-2:1995
-402, -502, -503, -606	BS EN 60811-1-3:1995
-403, -404, -507	BS EN 60811-2-1:1998
-405, -409	BS EN 60811-3-2:1995
-406, -511, -605, -607	BS EN 60811-4-1:2004
-407, -408, -410, -510, -512, -513	BS EN 60811-4-2:2004
-504, -505, -506	BS EN 60811-1-4:1995
-508, -509	BS EN 60811-3-1:1995

Superseded standards are withdrawn

The UK participation in its preparation was entrusted by Technical Committee GEL/20, Electric cables, to Subcommittee GEL/20/17, Electric Cables - Low voltage.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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English version

Electric and optical fibre cables - Test methods for non-metallic materials - Part 409: Miscellaneous tests - Loss of mass test for thermoplastic insulations and sheaths

(IEC 60811-409:2012)

Câbles électriques et à fibres optiques - Méthodes d'essai pour les matériaux non-métalliques - Partie 409: Essais divers - Essai de perte de masse des enveloppes isolantes et gaines thermoplastiques (CEI 60811-409:2012)

Kabel, isolierte Leitungen und Glasfaserkabel - Prüfverfahren für nichtmetallene Werkstoffe - Teil 409: Sonstige Prüfungen - Prüfung des Masseverlusts von Isolierhüllen und Mänteln (IEC 60811-409:2012)

CENELEC

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Foreword

The text of document 20/1293/FDIS, future edition 1 of IEC 60811-409, prepared by IEC/TC 20 "Electric cables" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60811-409:2012.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2013-01-16
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2015-04-16

This document supersedes Clause 8 of EN 60811-3-2:1995 + A2:2004 (partially). Full details of the replacements are shown in Annex A of EN 60811-100:2012.

There are no technical changes with respect to EN 60811-3-2:1995 + A2:2004, but see the Foreword to EN 60811-100:2012.

This standard is to be read in conjunction with EN 60811-100.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

This standard covers the Principle Elements of the Safety Objectives for Electrical Equipment Designed for Use within Certain Voltage Limits (LVD - 2006/95/EC)

Endorsement notice

The text of the International Standard IEC 60811-409:2012 was approved by CENELEC as a European Standard without any modification.

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60811-100	2012	Electric and optical fibre cables - Test methods for non-metallic materials - Part 100: General	EN 60811-100	2012
IEC 60811-201	2012	Electric and optical fibre cables - Test methods for non-metallic materials - Part 201: General tests - Measurement of insulation thickness	EN 60811-201	2012
IEC 60811-202	2012	Electric and optical fibre cables - Test methods for non-metallic materials - Part 202: General tests - Measurement of thickness of non-metallic sheath	EN 60811-202	2012
IEC 60811-401	2012	Electric and optical fibre cables - Test methods for non-metallic materials - Part 401: Miscellaneous tests - Thermal ageing methods - Ageing in an air oven	EN 60811-401	2012
IEC 60811-501	2012	Electric and optical fibre cables - Test methods for non-metallic materials - Part 501: Mechanical tests - Tests for determining the mechanical properties of insulating and sheathing compounds	EN 60811-501	2012

CONTENTS

INTRODUCTION

The IEC 60811 series specifies the test methods to be used for testing non-metallic materials of all types of cables. These test methods are intended to be referenced in standards for cable construction and for cable materials.

NOTE 1 Non-metallic materials are typically used for insulating, sheathing, bedding, filling or taping within cables.

NOTE 2 These test methods are accepted as basic and fundamental and have been developed and used over many years principally for the materials in all energy cables. They have also been widely accepted and used for other cables, in particular optical fibre cables, communication and control cables and cables for ships and offshore applications.

ELECTRIC AND OPTICAL FIBRE CABLES – TEST METHODS FOR NON-METALLIC MATERIALS –

Part 409: Miscellaneous tests – Loss of mass test for thermoplastic insulations and sheaths

1 Scope

This Part 409 of IEC 60811 gives the procedure for measuring the loss of mass which normally applies to PVC insulations and sheaths.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60811-100:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 100: General*

IEC 60811-201:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 201: General tests – Measurement of insulation thickness*

IEC 60811-202:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath*

IEC 60811-401:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven*

IEC 60811-501:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulation and sheathing compounds*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60811-100 apply.

4 Loss of mass test for insulation

4.1 General

This part of IEC 60811 shall be used in conjunction with IEC 60811-100

Unless otherwise specified, all test procedures, except the period in the ageing oven, shall be carried out at room temperature.

4.2 Test equipment

The test equipment shall consist of:

a) An oven with natural air flow or air flow by pressure. The air shall enter the oven in such a way that it flows over the surface of the test pieces and leaves near the top of the oven. The oven shall have not less than 8 and not more than 20 complete air changes per hour at the specified ageing temperature, as described in 4.2.1 of IEC 60811-401:2012. In case of dispute, an oven with natural air circulation shall be used.

   A rotating fan shall not be used inside the oven.

b) An analytical balance with a sensitivity of 0,1 mg.

c) Punching dies for dumb-bell test pieces, according to 4.2.3 b) of IEC 60811-501:2012.

d) A desiccator with silica gel or similar material.

4.3 Sample and test pieces preparation

If the loss of mass test is combined (see 4.1 d) of IEC 60811-401:2012) with the mechanical test (4.2. of IEC 60811-501: 2012), the test pieces shall be three of those subjected to the ageing in the air oven specified in 4.2.3.1 of IEC 60811-401:2012, one from each core sample.

Alternatively, three of the other test pieces prepared from each core in accordance with 4.2 of IEC 60811-501: 2012, may be used, if they are not required for other purposes and if their thickness complies with item c) below.

Otherwise, three samples, each about 100 mm long, of each core or the insulation from each core to be tested shall be taken, and a test piece prepared from each one in the same way as specified below.

a) Any coverings shall be removed. The conductor shall be removed and semi-conducting layers on the insulation, if any, shall be removed mechanically, i.e. without using solvent.

b) The test shall be made on

   1) dumb-bell test pieces illustrated in Figure A.1, whenever practicable,

   2) dumb-bell test pieces illustrated in Figure A.2, if the core dimensions are too small to permit dumb-bells according to Figure A.1 to be used,

   3) tubular test pieces, as an alternative to dumb-bells, for inner diameters not exceeding 12,5 mm, provided that there is not an adherent semi-conducting layer on the inside of the insulation and that any remaining separator shall be removed in a suitable way but without using solvent.

      The ends of tubular test pieces shall not be closed.

c) Dumb-bell test pieces shall be prepared as specified in 4.2.3 b) of IEC 60811-501:2012, except that the test pieces shall have two parallel surfaces over the whole length, their thickness shall be (1,0 ± 0,2) mm, and marker lines are not required.

d) Tubular test pieces shall be prepared as specified in 4.2.3 c) of IEC 60811-501:2012, without applying marker lines. The total surface area A of each test piece (see Annex A) shall be not less than 5 cm^2.

e) Flat twin flexible cables provided with a groove on both sides between the cores shall be tested without separation of the cores. For calculation of its surface of evaporation, the twin cable may be considered as being two separated tubular pieces.

The surface area, A, in square centimetres, of each test piece shall be determined before conducting the loss of mass test using the formulae as described in Annex A.

4.4 Test procedure

a) The prepared test pieces shall be placed for at least 20 h at ambient temperature in a desiccator. Immediately after removal from the desiccator, each test piece shall be weighed accurately, in milligrams, to one decimal place.

b) Thereafter, the three test pieces shall be maintained in the oven (see 4.2), in air at atmospheric pressure for 7 × 24 h at (80 ± 2) °C, unless otherwise specified, under the following conditions:
   – compounds of obviously different compositions shall not be tested at the same time in the same oven;
   – test pieces shall be suspended vertically in the middle of the oven so that each piece is at least 20 mm from any other piece;
   – not more than 0,5 % of the oven volume shall be occupied by the test pieces.
c) After this heat treatment, the test pieces shall again be placed for 20 h in a desiccator at ambient temperature.

4.5 Measurements

Each test piece shall then be re-weighed accurately, in milligrams, to one decimal place.

The difference between the weights determined before and after treatment, for each test piece, shall be calculated and rounded off to the nearest milligram to calculate the “weight difference”.

4.6 Expression of results

The loss of mass of each test piece shall be determined by dividing its “weight difference” in milligrams, by its surface area (see Annex A) in square centimetres.

The median value of the results for the three test pieces from each core, expressed in milligrams per square centimetre, shall be taken as the loss of mass of the core.

5 Test report

The test report shall be in accordance with that given in IEC 60811-100.

6 Loss of mass test for sheaths

6.1 General

Unless otherwise specified, all test procedures, except the period in the ageing oven, shall be carried out at room temperature.

6.2 Test equipment

The test equipment is described in 4.2.

6.3 Sample and test pieces preparation

Three samples of the sheath shall be taken in accordance with 4.3.

All constructional elements arranged under (and, if any, over) the sheath shall be removed, taking care not to damage the sheath, and the test pieces prepared in accordance with 4.3.

6.4 Test procedure

The test procedure shall be carried out in accordance with 4.4.

6.5 Measurements

The surface of evaporation shall be calculated by the formulae given in Annex A.

6.6 Expression of results

The expression of results shall be in accordance with that given in 4.6.

7 Test report

The test report shall be in accordance with that given in IEC 60811-100.

Annex A
(normative)

Calculation of the evaporation area

A.1 Calculation for dumb-bell test piece

A.1.1 Dumb-bell test piece, size as Figure A.1

The evaporation area, A, is calculated according to the following formula:

$$A = \frac{1256 + (180\,\delta)}{100} \text{ cm}^2$$

where δ is the mean thickness of the strips, in millimetres, to two decimal places, determined as specified in 4.2.4 a) of IEC 60811-501:2012.

A.1.2 Dumb-bell test piece, size as Figure A.2

The evaporation area, A, is calculated according to the following formula:

$$A = \frac{624 + (118\,\delta)}{100} \text{ cm}^2$$

where δ is the mean thickness of the strips, in millimetres, to two decimal places, determined as specified in 4.2.4 a) of IEC 60811-501:2012.

A.2 Calculation for tubular test piece

A.2.1 Thermoplastic insulation

For tubular test pieces, the evaporation area, A, is calculated according to the following formula:

Surface A = outer surface + inner surface + cut surface

$$A = \frac{2\pi\,(D-\delta)\times(\ell+\delta)}{100} \text{ cm}^2$$

where

δ is the average thickness of the test piece, in millimetres, to two decimal places if $\delta \leq$ 0,4 mm, and to one decimal place above this limit;

D is the mean outer diameter of the test piece, in millimetres, to two decimal places if $D \leq$2 mm, and to one decimal place above this limit;

ℓ is the length of the test piece, in millimetres, to one decimal place;

both δ and D being measured as specified in the test method in 4.4 of IEC 60811-201:2012 and in 4.4 of IEC 60811-202:2012, on a thin slice cut from the end of each tubular test piece.

The formula may be applied also to a tubular test piece having a cross-section as shown in Figure A.3.

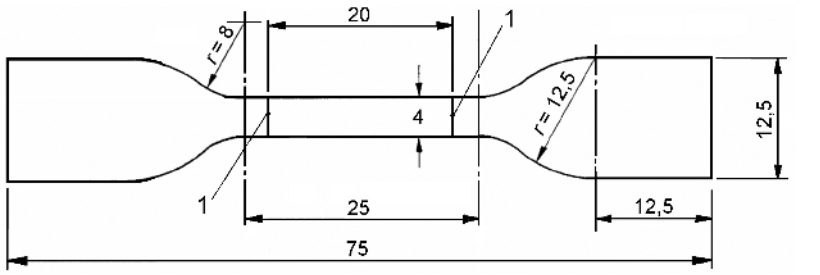
A.2.2 Thermoplastic sheath

The surface of evaporation shall be calculated by the formulae given in A.2.1 with the following modification:

The formula given for tubular test pieces is only applicable in the case of the cross-sections shown in Figures A.4 and A.5. The inner and outer surfaces of evaporation of sheaths of flat cables shall be calculated from the dimensions of the cross-section of the sheath. These dimensions shall be determined in millimetres to two decimal places.

The inner side of flat sheaths, having a wedge-shaped ridge, may be considered as being flat.

Dimensions in millimetres

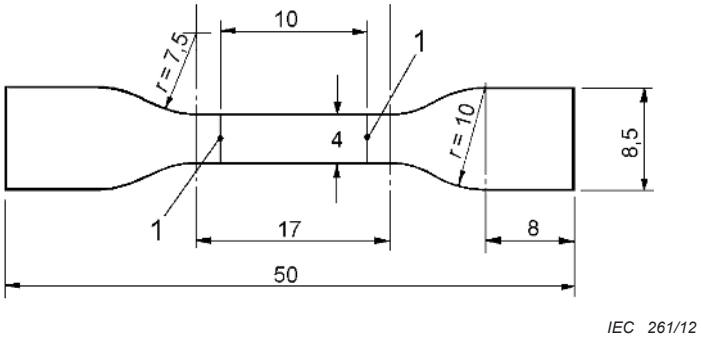


Key

1 marker lines

Figure A.1 – Dumb-bell test piece

Dimensions in millimetres



Key

1 marker lines

Figure A.2 – Small dumb-bell test piece

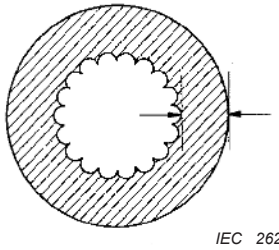


Figure A.3 – Measurement of insulation thickness (stranded conductor)

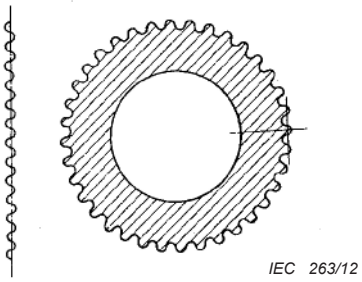


Figure A.4 – Measurement of thickness (uneven outer circular profile)

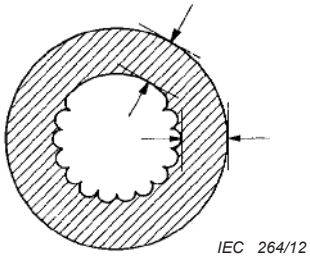


Figure A.5 – Measurement of sheath thickness (irregular inner circular profile)

Bibliography

IEC 60811-3-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section Two – Loss of mass test – Thermal stability test*
(withdrawn)

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