BS EN 60811-504:2012

BSI Standards Publication

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

## Part 504: Mechanical tests — Bending tests at low temperature for insulation and sheaths

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## National foreword

This British Standard is the UK implementation of EN 60811-504:2012. It is identical to IEC 60811-504:2012.

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Superseded standards are withdrawn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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**Compliance with a British Standard cannot confer immunity from legal obligations.**

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## Amendments issued since publication

| Amd. No. | Date | Text affected |
|---|---|---|

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

# EN 60811-504

June 2012

ICS 29.035.01; 29.060.20

Supersedes EN 60811-1-4:1995 (partially) + A2:2001 (partially)

English version

# Electric and optical fibre cables - Test methods for non-metallic materials - Part 504: Mechanical tests - Bending tests at low temperature for insulation and sheaths

(IEC 60811-504:2012)

Câbles électriques et à fibres optiques - Méthodes d'essai pour les matériaux non-métalliques - Partie 504: Essais mécaniques - Essais d'enroulement à basse température pour les enveloppes isolantes et les gaines
(CEI 60811-504:2012)

Kabel, isolierte Leitungen und Glasfaserkabel - Prüfverfahren für nichtmetallene Werkstoffe - Teil 504: Mechanische Prüfungen - Biegeprüfungen bei niedriger Temperatur für Isolierhüllen und Mäntel
(IEC 60811-504:2012)



CENELEC

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

**Management Centre: Avenue Marnix 17, B - 1000 Brussels**



Ref. No. EN 60811-504:2012 E

## Foreword

The text of document 20/1300/FDIS, future edition 1 of IEC 60811-504, prepared by IEC/TC 20 "Electric cables" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 60811-504:2012.

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) | 2013-01-17 |
| • latest date by which the national standards conflicting with the document have to be withdrawn | (dow) | 2015-04-17 |

This document supersedes 8.1 and 8.2 of EN 60811-1-4:1995 + A2:2001 (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 60811-1-4:1995, but see the Foreword to EN 60811-100.

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 60811-504:2012 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated :

| | | |
|---|---|---|
| IEC 60811-1-4:1985 | NOTE | Harmonized as EN 60811-1-4:1995 (not modified). |

# 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 60811-505 | - | Electric and optical fibre cables - Test methods for non-metallic materials - Part 505: Mechanical tests - Elongation at low temperature for insulations and sheaths | EN 60811-505 | - |

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 504: Mechanical tests – Bending tests at low temperature for insulation and sheaths

## 1 Scope

This Part 504 of IEC 60811 gives the procedure for performing bending tests at low temperature on extruded 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 60811-505, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths*

## 3 Terms and definitions

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

## 4 Test method

### 4.1 General

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

All the tests shall be carried out not less than 16 h after the extrusion or cross-linking of the insulating or sheathing compounds.

Tests shall be carried out at the temperature specified in the relevant cable standard.

For tests on the insulation, the test is intended for insulated conductors of circular cross-section having an external diameter up to and including 12,5 mm and for sector-shaped cores where it is not possible to prepare dumb-bells.

For tests on sheaths, the test is intended for cables with an overall diameter up to and including 12,5 mm; and for flat cables, with a major axis dimension up to and including 12,5 mm.

If required by the relevant cable standard the test shall also be carried out on larger cables. Note that equipment may need to be modified in accordance with the cable standard. Otherwise, the insulation and sheath of larger cables shall be subjected to the elongation test described in IEC 60811-505.

### 4.2 Bending test at low temperature for insulation

#### 4.2.1 Sampling and preparation of test pieces

Each core to be tested shall be represented by two samples of suitable length. After removal of the coverings, if any, the samples shall be used as test pieces.

#### 4.2.2 Apparatus

The apparatus recommended for this test is represented in Figure 1, with explanations. It consists essentially of one revolving mandrel and guiding devices for the test pieces.

Other single-mandrel apparatus, substantially equivalent to the one represented in Figure 1, may also be used.

The apparatus shall be located in a suitable low temperature cabinet before and during the test.

#### 4.2.3 Procedure

The test piece shall be fixed in the apparatus, as shown in Figure 1.

The apparatus with the test piece in position shall be maintained in the suitable low temperature cabinet at the specified temperature for a period of not less than 16 h. The cooling period of 16 h includes the time necessary for cooling down the apparatus.

If the apparatus has been pre-cooled, a shorter cooling period is permissible, but not less than 4 h at test temperature. If the apparatus and test specimens have been pre-cooled, a cooling time of 1 h after each test piece has been fixed to the apparatus is sufficient.

At the end of the prescribed time, the mandrel shall be rotated, in accordance with the conditions specified in 4.2.4, the test piece being guided so that it is bent tautly round the mandrel in a close helix. In the case of sector-shaped test pieces, the circular “back” part of the test piece shall be in contact with the mandrel.

Afterwards, the test piece, still on the mandrel, shall be allowed to attain approximately ambient temperature.

#### 4.2.4 Test conditions

The cooling and test temperature shall be as specified for the type of compound in the relevant standard for the type of cable.

The diameter of the mandrel shall be between 4 and 5 times the diameter of the test piece.

The mandrel shall be uniformly rotated at a rate of one revolution in about 5 s and the number of turns shall be as specified in Table 1:

**Table 1 –Rotations of mandrel**

| **Overall diameter, $d$, of the test piece** mm | **Number of turns** |
|---|---|
| $< d \leq 2{,}5$ | 10 |
| $2{,}5 < d \leq 4{,}5$ | 6 |
| $4{,}5 < d \leq 6{,}5$ | 4 |
| $6{,}5 < d \leq 8{,}5$ | 3 |
| $8{,}5 < d$ | 2 |

The actual diameter of each test piece shall be measured by a vernier calliper, a micrometer or a measuring tape. For sector-shaped test pieces, the minor axis is taken as the parameter equivalent to the diameter for determining the mandrel diameter and the number of turns.

For flat cables, the mandrel diameter shall be based on the minor axis dimension of the test piece, which is wound on with its minor axis perpendicular to the mandrel.

#### 4.2.5 Evaluation of results

At the end of the procedure described in 4.2.3, the test pieces shall be examined while still on the mandrel. The insulation of both test pieces shall not show any cracks when examined with normal or corrected vision, without magnification.

### 4.3 Bending test at low temperature for sheaths

#### 4.3.1 Sampling and preparation of test pieces

For each sheath to be tested, two pieces of cable of suitable length shall be taken.

Before starting the test, any covering shall be removed from the sheath.

#### 4.3.2 Apparatus, procedure and test conditions

In accordance with 4.2.2, 4.2.3 and 4.2.4, for cables having an armour or a concentric conductor under the outer sheath, the diameter of the mandrel shall be as specified in the cable standard for the type of cable.

#### 4.3.3 Evaluation of results

At the end of the procedure described in 4.2.3, the test pieces shall be examined while still on the mandrel. The sheath of both test pieces shall not show any cracks when examined with normal or corrected vision, without magnification.

## 5 Test report

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

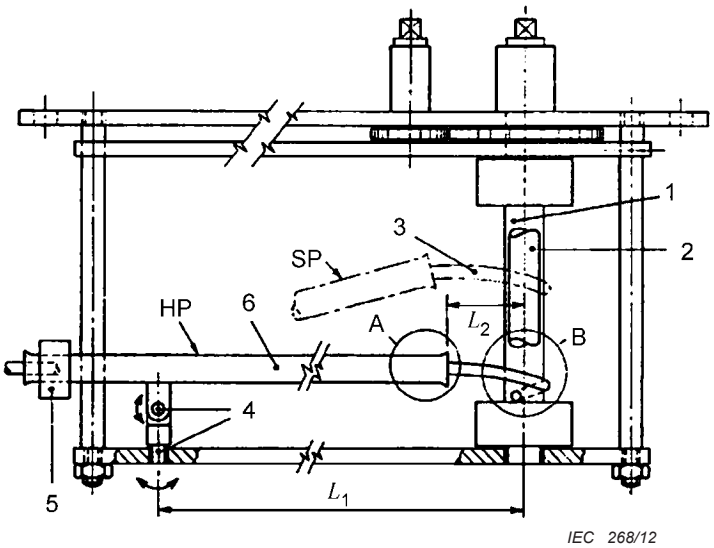


**Figure 1a – Front view**

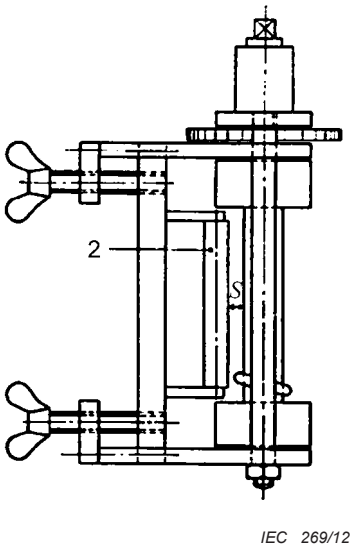


**Figure 1b – Right side view**

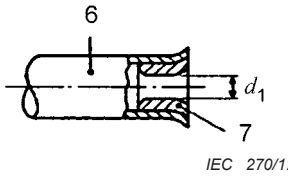


**Figure 1c – Detail A**

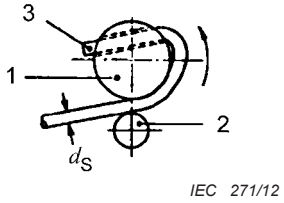


**Figure 1d – Detail B (fixing of the test piece)**

NOTE 1 $d_s < S < 1{,}5\ d_s$

NOTE 2 $d_1$ = 1,2 to 1,5 × $d_s$

NOTE 3 In horizontal position (HP), the tube should not press the test pieces down.

NOTE 4 In slope position (SP), the tube should not press the test pieces upwards.

**Key**

**Front view**

| | | | |
|---|---|---|---|
| 1 | mandrel | $L_1$ | approximately 270 mm |
| 2 | adjustable round bar | $L_2$ | approximately 30 mm |
| 3 | test piece | SP | slope position |
| 4 | rotation points | HP | horizontal position |
| 5 | counter weight | | |
| 6 | Tube | | |

**Detail A**

| | | | |
|---|---|---|---|
| 6 | tube | 7 | nozzle |

**Detail B** (fixing of the test piece)

| | | | |
|---|---|---|---|
| 1 | mandrel | 3 | test piece |
| 2 | adjustable round bar | | |

**Figure 1 – Cold bend test apparatus**

## Bibliography

IEC 60811-1-4:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section four – Test at low temperature* (withdrawn)

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