

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux
non-métalliques –
Partie 504: Essais mécaniques – Essai d'enroulement à basse température
pour les enveloppes isolantes et les gaines**



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

K

ICS 29.035.01; 29.060.20

ISBN 978-2-88912-978-2

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC AND OPTICAL FIBRE CABLES –
TEST METHODS FOR NON-METALLIC MATERIALS –****Part 504: Mechanical tests –
Bending tests at low temperature for insulation and sheaths**

FOREWORD

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International Standard IEC 60811-504 has been prepared by IEC technical committee 20: Electric cables.

This Part 504 of IEC 60811 cancels and replaces 8.1 and 8.2 of IEC 60811-1-4:1985, which is withdrawn. Full details of the replacements are shown in Annex A of IEC 60811-100:2012.

There are no specific technical changes with respect to the previous edition, but see the Foreword to IEC 60811-100: 2012.

The text of this standard is based on the following documents:

FDIS	Report on voting
20/1300/FDIS	20/1349/RVD

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

A list of all the parts in the IEC 60811 series, published under the general title *Electric and optical fibre cables – Test methods for non-metallic materials*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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- withdrawn,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

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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.

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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*

[IEC 60811-504:2012](https://standards.iteh.ai/catalog/standards/sist/9af7a9d2-aa5d-45de-a50f-966f071ddb7d/iec-60811-504-2012)

3 Terms and definitions

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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.

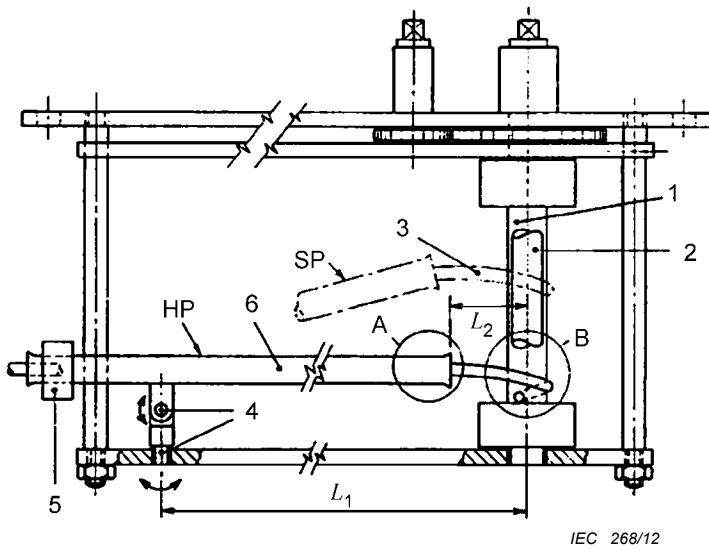


Figure 1a - Front view

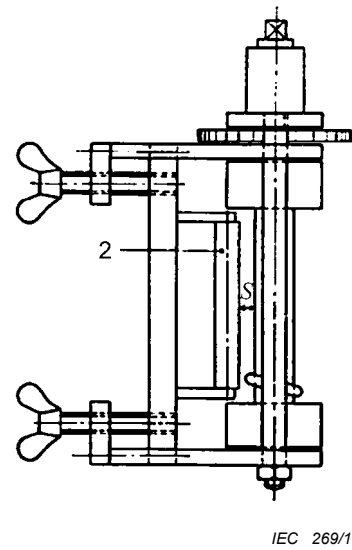


Figure 1b - Right side view

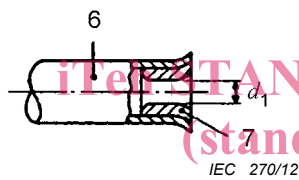


Figure 1c - Detail A

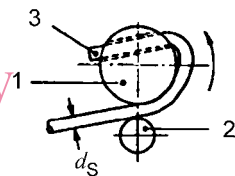


Figure 1d - Detail B (fixing of the test piece)

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NOTE 1 $d_s < S < 1,5 d_s$

NOTE 2 $d_1 = 1,2 \text{ to } 1,5 \times d_s$

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