

# INTERNATIONAL STANDARD



**Low-frequency cables and wires with PVC insulation and PVC sheath –  
Part 1: General test and measuring methods**

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INTERNATIONAL  
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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**LOW-FREQUENCY CABLES AND WIRES WITH  
PVC INSULATION AND PVC SHEATH –****Part 1: General test and measuring methods**

## FOREWORD

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International Standard IEC 60189-1 has been prepared by subcommittee 46C: Wires and symmetric cables, of IEC technical committee 46: Cables, wires, waveguides, RF connectors, RF and microwave passive components and accessories.

This fourth edition cancels and replaces the third edition published in 2007. This edition constitutes a technical revision. This edition includes the following significant technical changes with respect to the previous edition:

- a) Test methods for dielectric strength and insulation resistance that were referenced in the previous edition have been withdrawn. They have been replaced with references to similar test methods described in current standards.
- b) References to the IEC 60811 series have been updated as the numbering of this series has completely been changed.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
46C/1099/FDIS	46C/1100/RVD

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

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

A list of all the parts in the IEC 60189 series, under the general title *Low-frequency cables and wires with PVC insulation and PVC sheath*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
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# LOW-FREQUENCY CABLES AND WIRES WITH PVC INSULATION AND PVC SHEATH –

## Part 1: General test and measuring methods

### 1 Scope

This part of IEC 60189 specifies mechanical, electrical and climatic test methods for low-frequency cables and wires designed for use in telecommunication inside plants and equipment and in electronic devices employing similar techniques.

NOTE The other parts of IEC 60189 describe the construction and characteristics of each type of cable and wire.

### 2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

~~IEC 60028, International standard of resistance for copper~~

IEC 60068 (all parts), *Environmental testing*

IEC 60068-2-20:1979<sup>1</sup>, *Basic environmental testing procedures – Part 2: Tests – Test T: Soldering*

IEC 60227-2:1997, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 2: Test methods*

~~IEC 60332-1 (all parts), Tests on electric and optical fibre cables under fire conditions – Part 1: Test for vertical flame propagation for a single insulated wire or cable~~

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*

~~IEC 60332-2 (all parts), Tests on electric and optical fibre cables under fire conditions – Part 2: Test for vertical flame propagation for a single small insulated wire or cable~~

IEC 60332-2-2, *Tests on electric and optical fibre cables under fire conditions – Part 2-2: Test for vertical flame propagation for a single small insulated wire or cable – Procedure for diffusion flame*

~~IEC 60811-1-1:1998, 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~~

<sup>1</sup> This fourth edition was replaced in 2008 by a fifth edition *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*.



~~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 60811-1-3:1993, Common test methods for insulating and sheathing materials of electric and optical cables – Part 1-3: General application – Methods for determining the density – Water absorption tests – Shrinkage test~~

~~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~~

~~IEC 60811-3-1:1985, Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section One: Pressure test at high temperature – Tests for resistance to cracking~~

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

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

IEC 60811-203, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 203: General tests – Measurement of overall dimensions*

IEC 60811-401, *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, *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*

IEC 60811-502, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations*

IEC 60811-504, *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 60811-508, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulation and sheaths*

IEC 60811-509, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 509: Mechanical tests – Test for resistance of insulations and sheaths to cracking (heat shock test)*

~~IEC 60885-1:1987, Electrical test methods for electric cables – Part 1: Electrical tests for cables, cords and wires for voltages up to and including 450/750 V~~

~~ISO 6892:1998, Metallic materials – Tensile testing at ambient temperature~~

ISO 6892-1, *Metallic materials – Tensile testing – Part 1: Method of test at room temperature*

EN 50289-1-5, *Communication cables – Specifications for test methods – Part 1-5: Electrical test methods – Capacitance.SEC5:Capacitance*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

#### 3.1

##### **conductor**

part of the cable or wire intended to carry electric current

Note 1 to entry: The conductor may be

- a) solid – made of a single strand of circular cross-section;
- b) stranded – made of several strands of circular cross-section assembled either by laying up concentrically or by bunching, and without insulation between them.

~~The properties of the copper are in accordance with IEC 60028.~~

#### 3.2

##### **low-frequency wire**

insulated conductor or assembly of several insulated conductors, laid up together and which may be provided with a screen

Note 1 to entry: The wire may be

- a) single – consists of a single insulated conductor;
- b) multiple – consists of several insulated conductors.

Note 2 to entry: The following designations are used:

- |           |   |  |
|-----------|---|--|
| pair      | – | for multiple wire with two conductors;   |
| triple    | – | for multiple wire with three conductors; |
| quad      | – | for multiple wire with four conductors;  |
| quintuple | – | for multiple wire with five conductors.  |

#### 3.3

##### **low-frequency cables – sheathed cable**

assembly of insulated conductors enclosed in a common continuous protective covering

### 4 Standard conditions for testing

Unless otherwise specified, all tests shall be carried out under the conditions specified in IEC 60068.

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

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.

## 5 Dimensions

### 5.1 Selection and preparation of samples

#### 5.1.1 Insulation

Samples of insulated conductors, approximately 100 mm in length, shall be taken at both ends of the cable or wire.

One sample shall be taken at each end. Any covering(s) shall be removed from the insulation and the conductor withdrawn, care being taken not to damage the insulation. Each test piece shall consist of a thin slice of insulation. The slice shall be cut with a suitable device along a plane perpendicular to the longitudinal axis of the conductor.

#### 5.1.2 Sheath

Samples, approximately 100 mm in length, shall be taken from the finished cable at both ends.

One sample shall be taken at each end. The insulated conductors binding tapes and screening, if any, shall then be removed from the sheath, and each test piece shall be prepared by cutting with a suitable device a thin slice along a plane perpendicular to the axis of the cable. If necessary, the planes of the cuts shall be carefully smoothed.

If not specified differently by the respective detail specification, the following rules shall apply. If a marking is stamped into the sheath, thus giving rise to a local reduction of thickness, the test piece shall be taken so as to include such marking. The test piece shall not include such a reduction of thickness if it is made by the rip cord.

#### 5.1.3 Finished cable or wire

Samples of finished cable or wire, approximately 100 mm in length, shall be taken at both ends. One sample shall be taken at each end.

### 5.2 Measurement of dimensions

#### 5.2.1 Minimum thickness of insulation or sheath

##### 5.2.1.1 Insulation

Both samples (one at each end) shall be measured. Each test piece shall be placed under the measuring equipment with the plane of the cut perpendicular to the optical axis.

Each test piece shall be measured with equipment in accordance with ~~8.1.2 of IEC 60811-1-1~~ IEC 60811-201.

The readings shall be made, in millimetres, to two decimal places, if the thickness of insulation is 0,5 mm or above, and to three estimated decimal places, if the thickness of insulation is less than 0,5 mm.

The minimum thickness shall be found and measured.

**NOTE** Alternative test methods may be used, provided that they give equivalent results.

##### 5.2.1.2 Sheath

Both samples (one at each end) shall be measured. Each test piece shall be placed under the measuring equipment with the plane of the cut perpendicular to the optical axis.

Each test piece shall be measured with equipment in accordance with ~~8.1.2 of IEC 60811-1-1~~ IEC 60811-202.

A micrometer applying a pressure of between 50 kPa and 80 kPa can also be used for measurement of samples of the sheath.

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

The minimum thickness shall be found and measured.

**NOTE** Alternative test methods may be used, provided that they give equivalent results.

### 5.2.2 Mean thickness of insulation or sheath

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

Six measurements shall be made radially, as far as possible equally spaced around the circumference.

When the insulation is taken from a stranded conductor, six measurements shall be made radially in the positions where the insulation is thinnest, i.e. between the ridges caused by strands.

In all cases, the first measurement shall be made at the place where the insulation is thinnest.

The readings shall be made, in millimetres, to two decimal places, if the thickness of insulation is 0,5 mm or above, and to three estimated decimal places, if the thickness of insulation is less than 0,5 mm.

In the case of mechanical tests, the mean value of thickness of each test piece shall be calculated from the six measurement results obtained on that test piece.

### 5.2.3 Diameter of finished cable or wire

Both samples (one at each end) shall be measured.

Measurements shall be made in accordance with the method specified in ~~8.3.2 of IEC 60811-1-1~~ IEC 60811-203.

## 6 Mechanical tests

### 6.1 Selection, marking and preparation of samples for tensile tests

#### 6.1.1 Conductors

Solid conductors only shall be subjected to the tensile tests. Samples of convenient length shall be taken at the end of the cable or wire.

#### 6.1.2 Insulation

##### 6.1.2.1 General

These tests are to determine the tensile strength and elongation at break of the insulating material in the condition as manufactured (i.e. without any ageing) and, when required, after accelerated ageing treatment.