IEC 60227-7

Edition 2.0 2024-02
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V –
Part 7: Flexible cables screened and unscreened with two or more conductors and of rated voltages up to and including 300/500 V

IEC 60227-7:2024-02 RLV(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

POLYVINYL CHLORIDE INSULATED CABLES OF RATED VOLTAGES UP TO AND INCLUDING 450/750 V –

Part 7: Flexible cables screened and unscreened with two or more conductors and of rated voltages up to and including 300/500 V

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 60227-7:1995+AMD1:2003+AMD2:2011 CSV. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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IEC 60227-7 has been prepared by IEC technical committee 20: Electric cables. It is an International Standard.

This second edition cancels and replaces the first edition published in 1995, Amendment 1:2003 and Amendment 2:2011. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) the reference to tests according to IEC 60227-2 has been withdrawn and replaced with a reference to IEC 63294;

b) normative references have been updated.

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

Draft	Report on voting
20/2144/FDIS	20/2157/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60227 series, published under the general title *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V* can be found on the IEC website.

This document is to be used in conjunction with IEC 60227-1.

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

- reconfirmed,
- withdrawn, or
- revised.

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INTRODUCTION

The IEC 60227 series, published under the general title *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V,* consists of the following parts:

IEC 60227-1: General requirements;

IEC 60227-2: Test methods (withdrawn and replaced by IEC 63294);

IEC 60227-3: Non-sheathed cables for fixed wiring;

IEC 60227-4: Sheathed cables for fixed wiring;

IEC 60227-5: Flexible cables (cords);

IEC 60227-6: Lift cables and cables for flexible connections;

IEC 60227-7: Flexible cables screened and unscreened with two or more conductors and of rated voltages up to and including 300/500 V.

This part of IEC 60227, when used in conjunction with IEC 60227-1, forms the complete standard for flexible cables screened and unscreened with two or more conductors and of rated voltages up to and including 300/500 V only.

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POLYVINYL CHLORIDE INSULATED CABLES OF RATED VOLTAGES UP TO AND INCLUDING 450/750 V –

Part 7: Flexible cables screened and unscreened with two or more conductors and of rated voltages up to and including 300/500 V

~~1 General~~

1 Scope

This part of IEC 60227 details the particular specifications for polyvinyl chloride insulated, screened and unscreened control cables of rated voltages up to and including 300/500 V.

~~All cables comply with the appropriate requirements given in IEC 60227-1 and each individual type of cable complies with the particular requirements of this part.~~

This document provides the particular requirements for screened and unscreened control cables of rated voltages up to and including 300/500 V, which apply in addition to the appropriate requirements specified in IEC 60227-1, which apply to all cables. The tests for cables specified in the IEC 60227 series are described in IEC 63294.

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.

~~NOTE The IEC 60811 series is currently undergoing a revision, which will lead to a restructuring of its parts. A description of this, as well as a cross-reference table between the current and planned parts is given in IEC 60811-100.~~

IEC 60227-1~~:2007~~, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

~~IEC 60227-2:1997, *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 2: Test methods*~~
~~Amendment 1 (2003)~~

IEC 60228, *Conductors of insulated cables*

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 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 60811-404, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 404: Miscellaneous tests – Mineral oil immersion tests for sheaths*

IEC 60811-409, *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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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 60811-504, *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 60811-505, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 505: Mechanical tests – Elongation at low temperature for insulations and sheaths*

IEC 60811-506, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 506: Mechanical tests – Impact test at low temperature for insulations 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 60502-1:~~2004~~2021, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1,2 kV) up to 30 kV (U_m = 36 kV) – Part 1: Cables for rated voltages of 1 kV (U_m = 1,2 kV) and 3 kV (U_m = 3,6 kV)*
~~Amendment 1 (2009)~~

IEC 60719~~:1992~~, *Calculation of the lower and upper limits for the average outer dimensions of cables with circular copper conductors and of rated voltages up to and including 450/750 V*

~~IEC 60811-1-1:1993, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section 1: Measurement of thickness and overall dimensions – Tests for determining the mechanical properties*~~
~~Amendment 1 (2001)~~

~~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*~~
~~Amendment 1 (1989)~~
~~Amendment 2 (2000)~~

~~IEC 60811-1-4:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperature*~~
~~Amendment 1 (1993)~~
~~Amendment 2 (2001)~~

~~IEC 60811-2-1:1998, *Common test methods for insulating and sheathing materials of electric and optical cables – Part 2-1: Methods specific to elastomeric compounds – Ozone resistance, hot set and mineral oil immersion tests*~~
~~Amendment 1 (2001)~~

~~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*~~
~~Amendment 1 (1994)~~
~~Amendment 2 (2001)~~

~~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*~~

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~~Amendment 1 (1993)~~
~~Amendment 2 (2003)~~

IEC 62153-4-3:~~2006~~2013, *Metallic communication cable test methods – Part 4-3: Electromagnetic compatibility (EMC) – Surface transfer impedance – Triaxial method*

IEC 63294:2021, *Test methods for electric cables with rated voltages up to and including 450/750 V*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60227-1 and the following apply.

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

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

3.1
type test
test made before supplying a type of cable covered by this document on a general commercial basis in order to demonstrate satisfactory performance characteristics to meet the intended application

Note 1 to entry: Type tests are of such a nature that, after they have been made, it is not necessary for them to be repeated, unless changes are made in the cable materials or design which can change the performance characteristics.

Note 2 to entry: The symbol T is used to refer to type tests.

3.2
sample test
test made on samples of completed cable or components taken from a completed cable to verify that the finished product meets the design standards

Note 1 to entry: The symbol S is used to refer to sample tests.

4 Oil resistant, polyvinyl chloride sheathed, screened and unscreened flexible cable

4.1 Code designation

60227 IEC 74 for screened cables;

60227 IEC 75 for unscreened cables.

4.2 Rated voltage

300/500 V.

4.3 Construction

4.3.1 Conductors

Number of conductors: 2 to 60.

Preferred number of conductors: 2, 3, 4, 5, 6, 7, 12, 18, 27, 36, 48 and 60.

The conductors shall comply with the requirements given in IEC 60228 for class 5 conductors.

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4.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D (see IEC 60227-1) applied around each conductor.

The specified value of the insulation thickness ~~shall comply with the specified value~~ is given in Table 2, column 2 and Table 3, column 2. The insulation resistance shall be not less that the value given in Table 2, column 8 or Table 3, column 6.

4.3.3 Assembly of cores and fillers, if any

The cores shall be twisted together, where appropriate in several concentric layers.

A centre core is not permitted but a centre filler of suitable material shall be applied for cables with five or more cores in the first layer. Assemblies with three or more cores shall have one core which is coloured green-and-yellow.

Around each layer a tape may be applied which ~~may~~ can cover the cores fully or partially. The tape shall not adhere to the cores.

For two-core cables, the space between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

4.3.4 Inner sheath for screened cables

The inner sheath shall be a polyvinyl chloride compound of type PVC/ST5 (see IEC 60227-1) applied around the core assembly. For all cables, the thickness of the inner sheath shall be determined by the formula:

$$t_{is} = 0{,}02\ D_f + 0{,}6\ \text{mm},$$

where D_f is the fictitious diameter over the laid-up core, calculated in accordance with ~~A.2.1, A.2.2 and A.2.3 of IEC 60502, annex A~~ IEC 60502-1:2021, A.3.1, A.3.2 and A.3.3, and where the fictitious diameter (d_l) of 0,5 mm^2, 0,75 mm^2 and 1,0 mm^2 conductors (not given in ~~A.2.1~~ IEC 60502-1:2021, A.3.1) shall be taken to be 0,8 mm, 1,0 mm and 1,1 mm, respectively.

For cables with the preferred number of cores, the calculated values of the inner sheath thickness are given in Table 2, column 3.

NOTE In the case of cables comprising 10 or more cores, the values specified apply to a core assembly in two or more layers.

The mean value of the thickness of the sheath shall be not less that the calculated value. However, the thickness at any ~~place~~ point may be less than the calculated value provided that the difference does not exceed 0,1 mm + 15 % of the calculated value.

The inner sheath may fill the interstices of the laid-up core assembly, but it shall not adhere to the cores.

4.3.5 Screen

For screened cables, the screen shall be applied over the inner sheath, in the form of a braid of plain or tinned copper wires.

For cables with the preferred number of cores, the diameter of the copper wires shall comply with the values given in Table 2, column 4.

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For the other cables, the following maximum values apply:

– 0,16 mm for d ≤ 10,0 mm
– 0,21 mm for 10,0 mm < d ≤ 20,0 mm
– 0,26 mm for 20,0 mm < d ≤ 30,0 mm
– 0,31 mm for d > 30,0 mm

where d is the fictitious diameter under the braid which is calculated by adding to the fictitious diameter over laid-up cores, twice the specified thickness of inner sheath.

The screening efficiency shall be determined by measuring the transfer impedance. The value obtained shall not exceed 250 Ω/km at 30 MHz.

4.3.6 Sheath or oversheath

The sheath or oversheath shall be polyvinyl chloride compound of type PVC/ST9 (see IEC 60227-1) applied either:

– as an oversheath around the screen of screened cables, or
– as a sheath around the laid-up cores of unscreened cables.

An optional tape may be applied between the screen and oversheath.

For all cables the thickness or the sheath or oversheath shall be determined by the formula:

$$t_s = 0{,}08\ d_L + 0{,}4 \text{ mm}$$

with a maximum value of 2,4 mm, where d_L is the fictitious diameter over the screen of the screened cables or over the laid-up core assembly of unscreened cables.

The fictitious diameter shall be calculated in accordance with IEC 60502-1:2021, Annex A and 4.3.4 of this document. The increase in diameter due to the braided screen is four times the diameter of the braiding wire specified in Table 2, column 4.

For cables with the preferred number of cores, the ~~calculated~~ specified values of the sheath and over-sheath thickness are given in Table 2, column 5 and in Table 3, column 3 (see note in 4.3.4). Both for sheath and oversheath, the thickness requirements apply as specified in IEC 60227-1.

In unscreened cables, the sheath may fill the interstices of the laid-up core assembly, but it shall not adhere to the cores. In screened cables, the oversheath shall fit closely but not adhere to the screen.

All cables shall have practically a circular cross-section.

4.3.7 Core identification

Except for the green-and-yellow core, if any, all cores shall be identified by numbers in accordance with IEC 60227-1.

4.3.8 Overall diameter

The mean overall diameter of the cables shall be within the limits to be determined in accordance with IEC 60719. For cables with the preferred number of cores, the limits, according to IEC 60719 are given in Table 2, columns 6 and 7 or in Table 3, columns 4 and 5, (see note in 4.3.4).

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