IEC 60227-5

Edition 4.0 2024-02
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V –
Part 5: Flexible cables (cords)

IEC 60227-5:2024-02 RLV(en)

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

Part 5: Flexible cables (cords)

FOREWORD

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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 60227-5:2011. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 60227-5 has been prepared by IEC technical committee 20: Electric cables. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 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a) the reference to tests according to IEC 60227-2 has been withdrawn and replaced with a reference to IEC 63294;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
20/2143/FDIS	20/2156/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:—[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- withdrawn, or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.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

[1] Fourth edition under preparation. Stage at the time of publication IEC FDIS 60227-1:2023.

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 (cords).

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

Part 5: Flexible cables (cords)

~~1 General~~

1 Scope

This part of IEC 60227 details the particular specifications or polyvinyl chloride insulated flexible cables (cords), 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 flexible cables (cords) 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 will be given in IEC 60811-100.~~

IEC 60227-1:~~2007~~ [2], *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 60811-1-1:1993, *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)~~

[2] Fourth edition under preparation. Stage at the time of publication IEC FDIS 60227-1:2023.

~~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 60811-3-1:1985, *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*~~
~~Amendment 1 (1993)~~
~~Amendment 2 (2003)~~

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 60811-405, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 405: Miscellaneous tests – Thermal stability test for PVC insulations and PVC 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*

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 62440, *Electric cables with a rated voltage not exceeding 450/750 V – Guide to use*

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 Flat tinsel cord

4.1 Code designation

60227 IEC 41.

4.2 Rated voltage

300/300 V.

4.3 Construction

4.3.1 Conductors

Number of conductors: 2.

Each conductor shall comprise a number of strands or groups of strands, twisted together, each strand being composed of one or more flattened wires of copper or copper alloy, helically wound on a thread of cotton, polyamide or similar material.

The conductor resistance shall not exceed the value given in Table 1, column 5.

4.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The specified value of the insulation thickness ~~shall comply with the specified value~~ is given in Table 1, column 1.

The insulation resistance shall be not less than the value given in Table 1, column 4.

4.3.3 Assembly of cores

The conductors shall be laid parallel and covered with the insulation.

The insulation shall be provided with a groove on both sides, between the conductors, to facilitate separation of the cores.

4.3.4 Overall dimensions

The mean overall dimensions shall be within the limits given in Table 1, columns 2 and 3.

4.4 Tests

4.4.1 General

Compliance with the requirements of 4.3 shall be checked by inspection and by the sample tests and type tests given in Table 2.

4.4.2 Bending test

The requirements are given in IEC 60227-1:—, 6.6.3.3.

4.4.3 Drop test

The requirements are given in IEC 60227-1:—, 6.6.3.4.

4.5 Guidance on use

The maximum conductor temperature in normal use is 70 °C.

~~NOTE Other guidelines are under consideration.~~

The use of the cable type 60227 IEC 41 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 1 – General data for type 60227 IEC 41

1	2	3	4	5
Insulation thickness	**Mean overall dimensions[a]**		**Minimum insulation resistance at 70 °C**	**Maximum conductor resistance at 20 °C**
Specified value mm	**Lower limit** mm	**Upper limit** mm	MΩ · km	Ω/km
0,8	2,2 × 4,4	3,5 × 7,0	0,019	270
[a] The mean overall dimensions have been calculated in accordance with IEC 60719.				

Table 2 – Tests for type 60227 IEC 41

1	2	3	4
Ref. No.	**Test**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	~~60227-2~~ IEC 63294:2021, 5.1
1.2	Voltage test on completed cable at 2 000 V	T, S	~~60227-2~~ IEC 63294:2021, 5.2
1.3	Insulation resistance at 70 °C	T	~~60227-2~~ IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		~~60227-1~~ ~~60227-2~~
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness	T, S	~~60227-2~~ IEC 63294:2021, 6.2
2.3	Measurement of overall dimensions	T, S	~~60227-2~~ IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before and after ageing	T	~~60811-1-1~~ ~~60811-1-2~~ IEC 60811-501
3.2	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
4	Pressure test at high temperature	T	~~60811-3-1~~ IEC 60811-508
5	Elasticity at low temperature		
5.1	Bending test for insulation at low temperature	T	~~60811-1-4~~ IEC 60811-504
6	Heat shock test	T	~~60811-3-1~~ IEC 60811-509
7	Mechanical strength of completed cable		
7.1	Bending test	T	~~60227-2~~ IEC 63294:2021, 6.8 See also 4.4.2 of this document
7.2	Drop test	T	~~60227-2~~ IEC 63294:2021, 6.10 See also 4.4.3 of this document
8	Test of flame retardance	T	~~60332-1~~ IEC 60332-1-2

5 (Vacant)

6 Cord for indoor decorative lighting chains

6.1 Code designation

60227 IEC 43.

6.2 Rated voltage

300/300 V.

6.3 Construction

6.3.1 Conductors

Number of conductors: 1.

The conductor shall comply with the requirements given in IEC 60228 for Class 6 conductors.

6.3.2 Insulation

The insulation shall be polyvinyl chloride of type PVC/D, it shall consist of two layers and applied by dual extrusion around the conductor.

The outer layer of insulation shall be of a colour contrasting with that of the inner layer but shall adhere to the inner layer.

~~The combined thickness of the inner and outer layer of insulation shall comply with the overall thickness specified in Table 5, columns 3 and 4, but at no point the thickness of either layer shall be less than the value specified in column 2.~~

The specified value of combined thickness of the inner and outer layers of insulation is given in Table 3, column 4, the minimum thickness of the combined layers at any point is given in Table 3, column 3 but at no point the thickness of either layer shall be less than the value specified in Table 3, column 2.

The insulation resistance at 70 °C shall be not less than the values given in ~~Table 5~~ Table 3, column 7.

6.3.3 Cord identification

Preferred colour of outer layer: green.

6.3.4 Overall diameter

The mean overall diameter shall be within the limits given in ~~Table 5~~ Table 3, columns 5 and 6.

6.4 Tests

6.4.1 General

Compliance with the requirements of 6.3 shall be checked by inspection and by the sample tests and type tests given in ~~Table 6~~ Table 4~~, and additionally by the test for long term resistance of insulation to d.c., as given in 4.4.2~~.

~~**4.4.2 Long term resistance of insulation to d.c.**~~

~~a) Test sample~~

~~Carry out the test on a sample of cable of 5 m length from which all coverings have been removed. The cores of flat unsheathed cords shall not be separated.~~

~~For cables having up to five cores, each core shall be tested. For multicore cables having more than five cores, one core of each colour in the cable shall be tested, and where the number of colours is less than 5, duplicate coloured cores shall be tested as necessary to bring the number of cores tested up to a minimum of 5.~~

~~Take care to avoid damage to the core(s) during removal of the coverings.~~

~~b) Procedure~~

~~Immerse the sample in an aqueous solution of sodium chloride having a concentration of 10 g/l and a temperature of (60 ± 5) °C, with a length of about 250 mm at each end of the sample projecting above the solution. Connect the negative pole of a 220 V d.c. supply to the conductor(s) of the sample and the positive pole to a copper electrode immersed in the solution, for a period of 240 h.~~

~~c) Requirement~~

~~No breakdown of the insulation shall occur during the test and, after the test, the exterior of the insulation shall show no sign of damage.~~

~~Discoloration of the insulation should be ignored.~~

6.4.2 (Vacant)

6.5 Guidance on use

Maximum conductor temperature in normal use: 70 °C.

The use of the cable type 60227 IEC 43 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 3 – General data for type 60227 IEC 43

1	2	3	4	5	6	7
Nominal cross-sectional area of conductor	**Thickness of each layer of insulation**	**Overall insulation thickness**	**Overall insulation thickness**	**Mean overall diameter[a]**		**Minimum insulation resistance at 70 °C**
	Minimum value	**Minimum value**	**~~Mean~~ Specified value**	**Lower limit**	**Upper limit**	
mm2	mm	mm	mm	mm	mm	MΩ · km
0,5	0,2	0,6	0,7	2,3	2,7	0,014
0,75	0,2	0,6	0,7	2,4	2,9	0,012
[a] The mean overall dimensions have been calculated in accordance with IEC 60719.						

Table 4 – Tests for type 60227 IEC 43

1	2	3	4
Ref. No.	**Tests**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	~~60227-2~~ IEC 63294:2021, 5.1
1.2	Voltage test on completed cable at 2 000 V	T, S	~~60227-2~~ IEC 63294:2021, 5.3
1.3	Insulation resistance at 70 °C	T	~~60227-2~~ IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
1.4	Long term resistance of insulation to direct current at 60 ± 5 °C for a period of 240 h	T	~~60227-5~~ IEC 63294:2021, 5.6
2	Constructional and dimensional characteristics		~~60227-1~~ ~~60227-2~~
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness of inner layer (minimum thickness only)	T, S	~~60227-5~~ ~~60227-2~~ IEC 63294:2021, 6.2
2.3	Measurement of insulation thickness of outer layer (minimum thickness only)	T, S	~~60227-2~~ IEC 63294:2021, 6.2
2.4	Measurement of overall thickness	T, S	~~60227-2~~ IEC 63294:2021, 6.2
2.5	Measurement of overall diameter	T, S	~~60227-2~~ IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before ageing[a]	T	~~60811-1-1~~ IEC 60811-501
3.2	Tensile test after ageing[a]	T	~~60811-1-2~~ IEC 60811-501
3.3	Loss of mass test[a]	T	~~60811-3-2~~ IEC 60811-409
4	Pressure test at high temperature[a]	T	~~60811-3-1~~ IEC 60811-508
5	Elasticity at low temperature		
5.1	Bend test for insulation[a]	T	~~60811-1-4~~ IEC 60811-504
6	Heat shock test[a]	T	~~60811-3-1~~ IEC 60811-509
7	Test of flame retardance	T	~~60332-1~~ IEC 60332-1-2

[a] Because of the simultaneous extrusion of the same compound for both layers of insulation, the composite layer shall be tested as one layer and evaluated accordingly.

7 Light polyvinyl chloride sheathed cord

7.1 Code designation

60227 IEC 52.

7.2 Rated voltage

300/300 V.

7.3 Construction

7.3.1 Conductors

Number of conductors: 2 and 3.

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

7.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The specified value of insulation thickness ~~shall comply with the specified value~~ is given in Table 6, column 2.

The insulation resistance shall be not less than the values given in Table 6, column 6.

7.3.3 Assembly of cores

Circular cord: the cores shall be twisted together.

Flat cord: the cores shall be laid parallel.

7.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST5 applied around the cores.

~~The sheath thickness shall comply with~~ The specified value of sheath thickness is given in Table 6, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores. The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cords shall have a practically circular cross-section.

7.3.5 Overall dimensions

The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 6, columns 4 and 5.

7.4 Tests

7.4.1 General

Compliance with the requirements of 7.3 shall be checked by inspection and by the sample tests and type tests given in Table 7.

7.4.2 Flexing test

7.4.2.1 General

The requirements are given in IEC 60227-1:—, 6.6.3.2.

7.4.2.2 Sample preparation

The mass of the weight and the diameter of pulleys A and B are given in Table 5.

Table 5 – Mass of weight and diameter of pulleys

Number of cores	Nominal cross-sectional area	Mass of weight	Diameter of pulleys[a]
	mm^2	kg	mm
2	0,5	0,5	60
	0,75	1,0	80
3	0,5	0,5	80
	0,75	1,0	80

[a] Diameter measured at the lowest point of the groove.

7.4.2.3 Current loading of cores

During the flexing test, the cable sample shall be loaded as follows:

- two- and three-core cables: all cores to be loaded with 1 A/mm^2 $^{+10}_{0}$ %.

7.5 Guidance on use

Maximum conductor temperature in normal use: 70 °C.

~~NOTE Other guidelines are under consideration.~~

The use of the cable type 60227 IEC 52 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 6 – General data for type 60227 IEC 52

1	2	3	4	5	6
Number and nominal cross-sectional area of conductors	Thickness of insulation	Thickness of sheath	Mean overall dimensions[a]		Minimum insulation resistance at 70 °C
	Specified value	Specified value	Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ · km
2 × 0,5	0,5	0,6	4,6 or 3,0 × 4,9	5,9 or 3,7 × 5,9	0,012
2 × 0,75	0,5	0,6	4,9 or 3,2 × 5,2	6,3 or 3,8 × 6,3	0,010
3 × 0,5	0,5	0,6	4,9	6,3	0,012
3 × 0,75	0,5	0,6	5,2	6,7	0,010

[a] The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 7 – Tests for type 60227 IEC 52

1	2	3	4
Ref. No.	**Test**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	~~60227-2~~ IEC 63294:2021, 5.1
1.2	Voltage test on cores at 1 500 V	T, S	~~60227-2~~ IEC 63294:2021, 5.3
1.3	Voltage test on completed cable at 2 000 V	T, S	~~60227-2~~ IEC 63294:2021, 5.2
1.4	Insulation resistance at 70 °C	T	~~60227-2~~ IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		~~60227-1~~ ~~60227-2~~
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness	T, S	~~60227-2~~ IEC 63294:2021, 6.2
2.3	Measurement of sheath thickness	T, S	~~60227-2~~ IEC 63294:2021, 6.3
2.4	Measurement of overall dimensions:		
2.4.1	• mean value	T, S	~~60227-2~~ IEC 63294:2021, 6.4
2.4.2	• ovality	T, S	~~60227-2~~ IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before and after ageing	T	~~60811-1-2~~ IEC 60811-501
3.2	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
4	Mechanical properties of sheath		
4.1	Tensile test before and after ageing	T	~~60811-1-2~~ IEC 60811-501
4.2	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
5	Pressure test at high temperature		
5.1	Insulation	T	~~60811-3-1~~ IEC 60811-508
5.2	Sheath	T	~~60811-3-1~~ IEC 60811-508
6	Elasticity and impact strength at low temperature		
6.1	Bending test for insulation at low temperature	T	~~60811-1-4~~ IEC 60811-504
6.2	Bending test for sheath at low temperature	T	~~60811-1-4~~ IEC 60811-504
6.3	Impact test on completed cable at low temperature	T	~~60811-1-4~~ IEC 60811-504
7	Heat shock test		
7.1	Insulation	T	~~60811-3-1~~ IEC 60811-509
7.2	Sheath	T	~~60811-3-1~~ IEC 60811-509
8	Mechanical strength of completed cable		
8.1	Flexing test	T	~~60227-2~~ IEC 63294:2021, 6.6 See also 7.4.2 of this document
9	Test of flame retardance	T	~~60332-1~~ IEC 60332-1-2

8 Ordinary polyvinyl chloride sheathed cord

8.1 Code designation

60227 IEC 53.

8.2 Rated voltage

300/500 V.

8.3 Construction

8.3.1 Conductors

Number of conductors: 2, 3, 4 or 5.

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

8.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The specified value of insulation thickness ~~shall comply with the specified value~~ is given in Table 8, column 2.

The insulation resistance shall be not less than the value given in Table 8, column 6.

8.3.3 Assembly of cores and fillers, if any

Circular cord: the cores and the fillers shall be twisted together.

Flat cord: the cores shall be laid parallel.

For a circular cord having two cores, the space between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

Any filler shall not adhere to the cores.

8.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST5 applied around the cores.

~~The sheath thickness shall comply with~~ The specified value of sheath thickness is given in Table 8, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores. The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cords shall have a practically circular cross-section.

8.3.5 Overall dimensions

The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 8, columns 4 and 5.

Table 8 – General data for type 60227 IEC 53

1	2	3	4	5	6
Number and nominal cross-sectional area of conductors	**Thickness of insulation**	**Thickness of sheath**	**Mean overall dimensions[a]**		**Minimum insulation resistance at 70 °C**
	Specified value	**Specified value**	**Lower limit**	**Upper limit**	
mm^2	mm	mm	mm	mm	MΩ · km
2 × 0,75	0,6	0,8	5,7 or 3,7 × 6,0	7,2 or 4,5 × 7,2	0,011
2 × 1	0,6	0,8	5,9 or 3,9 × 6,2	7,5 or 4,7 × 7,5	0,010
2 × 1,5	0,7	0,8	6,8	8,6	0,010
2 × 2,5	0,8	1,0	8,4	10,6	0,009
2 × 4	0,8	1,1	9,7	12,1	0,007
3 × 0,75	0,6	0,8	6,0	7,6	0,011
3 × 1	0,6	0,8	6,3	8,0	0,010
3 × 1,5	0,7	0,9	7,4	9,4	0,010
3 × 2,5	0,8	1,1	9,2	11,4	0,009
3 × 4	0,8	1,1	10,3	12,8	0,007
4 × 0,75	0,6	0,8	6,6	8,3	0,011
4 × 1	0,6	0,9	7,1	9,0	0,010
4 × 1,5	0,7	1,0	8,4	10,5	0,010
4 × 2,5	0,8	1,1	10,1	12,5	0,009
4 × 4	0,8	1,2	11,5	14,3	0,007
5 × 0,75	0,6	0,9	7,4	9,3	0,011
5 × 1	0,6	0,9	7,8	9,8	0,010
5 × 1,5	0,7	1,1	9,3	11,6	0,010
5 × 2,5	0,8	1,2	11,2	13,9	0,009
5 × 4	0,8	1,3	12,8	15,9	0,007

[a] The mean overall dimensions have been calculated in accordance with IEC 60719.

8.4 Tests

8.4.1 General

Compliance with the requirements of 8.3 shall be checked by inspection and by the sample tests and type tests given in Table 10.

8.4.2 Flexing test

8.4.2.1 General

The requirements are given in IEC 60227-1:—, 6.6.3.2.

8.4.2.2 Sample preparation

The mass of the weight and the diameter of pulleys A and B are given in Table 9.

Table 9 – Mass of weight and diameter of pulleys

Number of cores	Nominal cross-sectional area mm²	Mass of weight kg	Diameter of pulleys[a] mm
2	0,5 0,75 1 1,5 2,5	0,5 1,0 1,0 1,0 1,5	60 80 80 80 120
3	0,5 0,75 1 1,5 2,5	0,5 1,0 1,0 1,0 1,5	80 80 80 80 120
4	0,5 0,75 1 1,5 2,5	0,5 1,0 1,0 1,5 1,5	80 80 80 120 120
5	0,5 0,75 1 1,5 2,5	1,0 1,0 1,0 1,5 2,0	80 80 120 120 120

[a] Diameter measured at the lowest point of the groove.

8.4.2.3 Current loading of cores

During the flexing test, the cable sample shall be loaded as follows:

- two- and three-core cables: all cores to be loaded with 1 A/mm² $^{+10}_{0}$ %;
- four- and five-core cables: three cores to be loaded with 1 A/mm² $^{+10}_{0}$ % or all cores to be loaded with $\sqrt{3/n}$ A/mm² $^{+10}_{0}$ %, where n is the number of cores.

8.5 Guidance on use

Maximum conductor temperature in normal use: 70 °C.

~~NOTE Other guidelines are under consideration.~~

The use of the cable type 60227 IEC 53 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 10 – Tests for type 60227 IEC 53

1	2	3	4
Ref. No.	**Test**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	~~60227-2~~ IEC 63294:2021, 5.1
1.2	Voltage test on cores according to specified insulation thickness:		
1.2.1	• at 1 500 V up to and including 0,6 mm	T	~~60227-2~~ IEC 63294:2021, 5.3
1.2.2	• at 2 000 V exceeding 0,6 m	T	~~60227-2~~ IEC 63294:2021, 5.3
1.3	Voltage test on complete cable at 2 000 V	T, S	~~60227-2~~ IEC 63294:2021, 5.2
1.4	Insulation resistance at 70 °C	T	~~60227-2~~ IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness	T, S	~~60227-2~~ IEC 63294:2021, 6.2
2.3	Measurement of sheath thickness	T, S	~~60227-2~~ IEC 63294:2021, 6.3
2.4	Measurement of overall dimensions:		
2.4.1	• mean value	T, S	~~60227-2~~ IEC 63294:2021, 6.4
2.4.2	• ovality	T, S	~~60227-2~~ IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before and after ageing	T	~~60811-1-2~~ IEC 60811-501
3.2	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
4	Mechanical properties of sheath		
4.1	Tensile test before and after ageing	T	~~60811-1-2~~ IEC 60811-501
4.2	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
5	~~*Test of non-contamination*~~ Compatibility test	T	~~60811-1-2~~ IEC 60811-501
6	Pressure test at high temperature		
6.1	Insulation	T	~~60811-3-1~~ IEC 60811-508
6.2	Sheath	T	~~60811-3-1~~ IEC 60811-508
7	Elasticity and impact strength at low temperature		
7.1	Bending test for insulation at low temperature	T	~~60811-1-4~~ IEC 60811-504
7.2	Bending test for sheath at low temperature	T	~~60811-1-4~~ IEC 60811-504
7.3	Impact test on completed cable at low temperature	T	~~60811-1-4~~ IEC 60811-506
8	Heat shock test		
8.1	Insulation	T	~~60811-3-1~~ IEC 60811-509
8.2	Sheath	T	~~60811-3-1~~ IEC 60811-509
9	Mechanical strength of completed cable		
9.1	Flexing test	T	~~60227-2~~ IEC 63294:2021, 6.6 See also 9.4.2 of this document
10	Test of flame retardance	T	~~60332-1~~ IEC 60332-1-2

9 Heat-resistant light PVC-sheathed cord for a maximum conductor temperature of 90 °C

9.1 Code designation

60227 IEC 56.

9.2 Rated voltage

300/300 V.

9.3 Construction

9.3.1 Conductors

Number of conductors: 2 and 3.

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

9.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/E applied around each conductor.

The specified value of insulation thickness ~~shall comply with the specified value~~ is given in Table 12, column 2.

The insulation resistance shall be not less than the values given in Table 12, column 6.

9.3.3 Assembly of cores

Circular cord: the cores shall be twisted together.

Flat cord: the cores shall be laid parallel.

9.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST10, applied around the cores.

~~The sheath thickness shall comply with~~ The specified value of sheath thickness is given in Table 12, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores. The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cords shall have a practically circular cross-section.

9.3.5 Overall dimensions

The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 12, columns 4 and 5.

9.4 Tests

9.4.1 General

Compliance with the requirements of 9.3 shall be checked by inspection and by the sample tests and type tests given in Table 13.

9.4.2 Flexing test

9.4.2.1 General

The requirements are given in IEC 60227-1:—, 6.6.3.2.

9.4.2.2 Sample preparation

The mass of the weight and the diameter of pulleys A and B are given in Table 11.

Table 11 – Mass of weight and diameter of pulleys

Number of cores	Nominal cross-sectional area mm²	Mass of weight kg	Diameter of pulleys[a] mm
2	0,5	0,5	60
	0,75	1,0	80
3	0,5	0,5	80
	0,75	1,0	80

[a] Diameter measured at the lowest point of the groove.

9.4.2.3 Current loading of cores

During the flexing test, the cable sample shall be loaded as follows:

- two- and three-core cables: all cores to be loaded with 1 A/mm² $^{+10}_{0}$ %.

9.5 Guidance on use

Maximum conductor temperature in normal use: 90 °C.

~~NOTE Other guidelines are under consideration.~~

The use of the cable type 60227 IEC 56 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 12 – General data for type 60227 IEC 56

1	2	3	4	5	6
Number and nominal cross-sectional area of conductors	Insulation thickness	Sheath thickness	Mean overall dimensions[a]		Minimum insulation resistance at 90 °C
	Specified value	Specified value	Lower limit	Upper limit	
mm^2	mm	mm	mm	mm	MΩ · km
2 × 0,5	0,5	0,6	4,6 or 3,0 × 4,9	5,9 or 3,7 × 5,9	0,012
2 × 0,75	0,5	0,6	4,9 or 3,2 × 5,2	6,3 or 3,8 × 6,3	0,010
3 × 0,5	0,5	0,6	4,9	6,3	0,012
3 × 0,75	0,5	0,6	5,2	6,7	0,010

[a] The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 13 – Tests for type 60227 IEC 56

1	2	3	4
Reference No.	Test	Category of test	Test methods described in
1	Electrical tests		
1.1	Resistance of conductors	T, S	~~60227-2~~ IEC 63294:2021, 5.1
1.2	Voltage test on completed cable at 2 000 V	T, S	~~60227-2~~ IEC 63294:2021, 5.2
1.3	Voltage test on cores at 1 500 V	T	~~60227-2~~ IEC 63294:2021, 5.3
1.4	Insulation resistance at 90 °C	T	~~60227-2~~ IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of thickness of insulation	T, S	IEC 63294:2021, 6.2
2.3	Measurement of thickness of sheath	T, S	IEC 63294:2021, 6.3
2.4	Measurement of overall dimensions		
2.4.1	Mean value	T, S	~~60227-2~~ IEC 63294:2021, 6.4
2.4.2	Ovality	T, S	~~60227-2~~ IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before ageing	T	~~60811-1-1~~ IEC 60811-501
3.2	Tensile test after ageing	T	~~60811-1-2~~ IEC 60811-401
3.3	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
4	Mechanical properties of sheath		
4.1	Tensile test before ageing	T	~~60811-1-1~~ IEC 60811-501
4.2	Tensile test after ageing	T	~~60811-1-2~~ IEC 60811-401
4.3	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
5	Pressure test at high temperature		
5.1	Insulation	T	~~60811-3-1~~ IEC 60811-508
5.2	Sheath	T	~~60811-3-1~~ IEC 60811-508

1	2	3	4
Reference No.	Test	Category of test	Test methods described in
6	Tests at low temperature		
6.1	Bending test for insulation	T	~~60811-1-4~~ IEC 60811-504
6.2	Bending test for sheath	T	~~60811-1-4~~ IEC 60811-504
6.3	Impact test	T	~~60811-1-4~~ IEC 60811-506
7	Heat shock test		
7.1	Insulation	T	~~60811-3-1~~ IEC 60811-509
7.2	Sheath	T	~~60811-3-1~~ IEC 60811-509
8	Thermal stability		
8.1	Insulation	T	~~60811-3-2~~ IEC 60811-403
8.2	Sheath	T	~~60811-3-2~~ IEC 60811-405
9	Mechanical strength of complete cable		
9.1	Flexing test	T	~~60227-2~~ IEC 63294:2021, 6.6 See also 9.4.2 of this document
10	Test of flame retardance	T	~~60332-1~~ IEC 60332-1-2

10 Heat-resistant ordinary PVC-sheathed cord for a maximum conductor temperature of 90 °C

10.1 Code designation

60227 IEC 57.

10.2 Rated voltage

300/500 V.

10.3 Construction

10.3.1 Conductors

Number of conductors: 2, 3, 4 or 5.

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

10.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/E applied around each conductor.

The specified value of insulation thickness ~~shall comply with the specified value~~ is given in Table 14, column 2.

The insulation resistance shall be not less than the value given in Table 14, column 6.

10.3.3 Assembly of cores and fillers, if any

Circular cord: the cores and the fillers, if any, shall be twisted together.

Flat cord: the cores shall be laid parallel.

For a circular cord having two cores, the space between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

Any filler shall not adhere to the cores.

10.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST10 applied around the cores.

~~The sheath thickness shall comply with~~ The specified value of sheath thickness is given in Table 14, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores.

The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cords shall have a practically circular cross-section.

10.3.5 Overall dimensions

The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 14, columns 4 and 5.

Table 14 – General data for type 60227 IEC 57

1	2	3	4	5	6
Number and nominal cross-sectional area of conductors	**Thickness of insulation**	**Thickness of sheath**	**Mean overall dimensions**[a]		**Minimum insulation resistance at ~~70~~ 90 °C**
	Specified value	**Specified value**	**Lower limit**	**Upper limit**	
mm^2	mm	mm	mm	mm	MΩ · km
2 × 0,75	0,6	0,8	5,7 or 3,7 × 6,0	7,2 or 4,5 × 7,2	0,011
2 × 1	0,6	0,8	5,9 or 3,9 × 6,2	7,5 or 4,7 × 7,5	0,010
2 × 1,5	0,7	0,8	6,8	8,6	0,010
2 × 2,5	0,8	1,0	8,4	10,6	0,009
2 × 4	0,8	1,1	9,7	12,1	0,007
3 × 0,75	0,6	0,8	6,0	7,6	0,011
3 × 1	0,6	0,8	6,3	8,0	0,010
3 × 1,5	0,7	0,9	7,4	9,4	0,010
3 × 2,5	0,8	1,1	9,2	11,4	0,009
3 × 4	0,8	1,1	10,3	12,8	0,007
4 × 0,75	0,6	0,8	6,6	8,3	0,011
4 × 1	0,6	0,9	7,1	9,0	0,010
4 × 1,5	0,7	1,0	8,4	10,5	0,010
4 × 2,5	0,8	1,1	10,1	12,5	0,009
4 × 4	0,8	1,2	11,5	14,3	0,007
5 × 0,75	0,6	0,9	7,4	9,3	0,011
5 × 1	0,6	0,9	7,8	9,8	0,010
5 × 1,5	0,7	1,1	9,3	11,6	0,010
5 × 2,5	0,8	1,2	11,2	13,9	0,009
5 × 4	0,8	1,3	12,8	15,9	0,007

[a] The mean overall dimensions have been calculated in accordance with IEC 60719.

10.4 Tests

10.4.1 General

Compliance with the requirements of 10.3 shall be checked by inspection and by the sample tests and type tests given in Table 16.

10.4.2 Flexing test

10.4.2.1 General

The requirements are given in IEC 60227-1:—, 6.6.3.2.

10.4.2.2 Sample preparation

The mass of the weight and the diameter of pulleys A and B are given in Table 15.

Table 15 – Mass of weight and diameter of pulleys

Number of cores	Nominal cross-sectional area mm²	Mass of weight kg	Diameter of pulleys[a] mm
2	0,5 0,75 1 1,5 2,5	0,5 1,0 1,0 1,0 1,5	60 80 80 80 120
3	0,5 0,75 1 1,5 2,5	0,5 1,0 1,0 1,0 1,5	80 80 80 80 120
4	0,5 0,75 1 1,5 2,5	0,5 1,0 1,0 1,5 1,5	80 80 80 120 120
5	0,5 0,75 1 1,5 2,5	1,0 1,0 1,0 1,5 2,0	80 80 120 120 120

[a] Diameter measured at the lowest point of the groove.

10.4.2.3 Current loading of cores

During the flexing test, the cable sample shall be loaded as follows:

- two- and three-core cables: all cores to be loaded with 1 A/mm² $^{+10}_{0}$ %;
- four- and five-core cables: three cores to be loaded with 1 A/mm² $^{+10}_{0}$ % or all cores to be loaded with $\sqrt{3/n}$ A/mm² $^{+10}_{0}$ %, where n is the number of cores.

10.5 Guidance on use

Maximum conductor temperature in normal use: 90 °C.

~~NOTE Other guidelines are under consideration.~~

The use of the cable type 60227 IEC 57 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 16 – Tests for type 60227 IEC 57

1	2	3	4
Reference No	**Tests**	**Category of test**	**Test methods described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	~~60227-2~~ IEC 63294:2021, 5.1
1.2	Voltage test on completed cable at 2 000 V	T, S	~~60227-2~~ IEC 63294:2021, 5.2
1.3	Voltage test on cores according to specified insulation thickness:		
1.3.1	• at 1 500 V up to and including 0,6 mm	T	~~60227-2~~ IEC 63294:2021, 5.3
1.3.2	• at 2 000 V exceeding 0,6 mm	T	~~60227-2~~ IEC 63294:2021, 5.3
1.4	Insulation resistance at 90 °C	T	~~60227-2~~ IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of thickness of insulation	T, S	~~60227-2~~ IEC 63294:2021, 6.2
2.3	Measurement of thickness of sheath	T, S	~~60227-2~~ IEC 63294:2021, 6.3
2.4	Measurement of overall dimensions		
2.4.1	• mean value	T, S	~~60227-2~~ IEC 63294:2021, 6.4
2.4.2	• ovality	T, S	~~60227-2~~ IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before ageing	T	~~60811-1-1~~ IEC 60811-501
3.2	Tensile test after ageing	T	~~60811-1-2~~ IEC 60811-401
3.3	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
3.4	Compatibility test~~[b]~~	T	~~60811-1-2~~ IEC 60811-401 See also IEC 60227-1:—, 6.3.1
4	Mechanical properties of sheath		
4.1	Tensile test before ageing	T	~~60811-1-1~~ IEC 60811-501
4.2	Tensile test after ageing	T	~~60811-1-2~~ IEC 60811-401
4.3	Loss of mass test	T	~~60811-3-2~~ IEC 60811-409
5	Pressure test at high temperature		
5.1	Insulation	T	~~60811-3-1~~ IEC 60811-508
5.2	Sheath	T	~~60811-3-1~~ IEC 60811-508
6	Tests at low temperature		
6.1	Bending test for insulation	T	~~60811-1-4~~ IEC 60811-504
6.2	Bending test for sheath[a]	T	~~60811-1-4~~ IEC 60811-504
6.3	Elongation test for sheath[b]	T	~~60811-1-4~~ IEC 60811-505
6.4	Impact test	T	~~60811-1-4~~ IEC 60811-506
7	Heat shock test		
7.1	Insulation	T	~~60811-3-1~~ IEC 60811-509
7.2	Sheath	T	~~60811-3-1~~ IEC 60811-509
8	Thermal stability		
8.1	Insulation	T	~~60811-3-2~~ IEC 60811-405
8.2	Sheath	T	~~60811-3-2~~ IEC 60811-504
9	Mechanical strength of complete cable		
9.1	Flexing test	T	~~60227-2~~ IEC 63294:2021, 6.6 See also 10.4.2 of this document
10	Test of flame retardance	T	~~60332-1~~ IEC 60332-1-2

~~[b] See 5.3.1 of IEC 60227-1.~~

[a] Only applicable to cables having mean overall diameters up to and including 12,5 mm.

[b] Only applicable if the mean overall diameter of the cable exceeds 12,5 mm.

Bibliography

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*

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IEC 60227-5

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INTERNATIONAL STANDARD

Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V –
Part 5: Flexible cables (cords)

IEC 60227-5:2024-02(en)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 5: Flexible cables (cords)

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IEC 60227-5 has been prepared by IEC technical committee 20: Electric cables. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 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
20/2143/FDIS	20/2156/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:—[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.

1 Fourth edition under preparation. Stage at the time of publication IEC FDIS 60227-1:2023.

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 (cords).

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

Part 5: Flexible cables (cords)

1 Scope

This part of IEC 60227 details the particular specifications or polyvinyl chloride insulated flexible cables (cords), of rated voltages up to and including 300/500 V.

This document provides the particular requirements for flexible cables (cords) 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.

IEC 60227-1:—[2], *Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

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 60811-405, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 405: Miscellaneous tests – Thermal stability test for PVC insulations and PVC 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*

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*

[2] Fourth edition under preparation. Stage at the time of publication IEC FDIS 60227-1:2023.

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 62440, *Electric cables with a rated voltage not exceeding 450/750 V – Guide to use*

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 Flat tinsel cord

4.1 Code designation

60227 IEC 41.

4.2 Rated voltage

300/300 V.

4.3 Construction

4.3.1 Conductors

Number of conductors: 2.

Each conductor shall comprise a number of strands or groups of strands, twisted together, each strand being composed of one or more flattened wires of copper or copper alloy, helically wound on a thread of cotton, polyamide or similar material.

The conductor resistance shall not exceed the value given in Table 1, column 5.

4.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The specified value of the insulation thickness is given in Table 1, column 1.

The insulation resistance shall be not less than the value given in Table 1, column 4.

4.3.3 Assembly of cores

The conductors shall be laid parallel and covered with the insulation.

The insulation shall be provided with a groove on both sides, between the conductors, to facilitate separation of the cores.

4.3.4 Overall dimensions

The mean overall dimensions shall be within the limits given in Table 1, columns 2 and 3.

4.4 Tests

4.4.1 General

Compliance with the requirements of 4.3 shall be checked by inspection and by the sample tests and type tests given in Table 2.

4.4.2 Bending test

The requirements are given in IEC 60227-1:—, 6.6.3.3.

4.4.3 Drop test

The requirements are given in IEC 60227-1:—, 6.6.3.4.

4.5 Guidance on use

The maximum conductor temperature in normal use is 70 °C.

The use of the cable type 60227 IEC 41 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 1 – General data for type 60227 IEC 41

1	2	3	4	5
Insulation thickness	**Mean overall dimensions[a]**		**Minimum insulation resistance at 70 °C**	**Maximum conductor resistance at 20 °C**
Specified value mm	**Lower limit** mm	**Upper limit** mm	MΩ · km	Ω/km
0,8	2,2 × 4,4	3,5 × 7,0	0,019	270

[a] The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 2 – Tests for type 60227 IEC 41

1	2	3	4
Ref. No.	**Test**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	IEC 63294:2021, 5.1
1.2	Voltage test on completed cable at 2 000 V	T, S	IEC 63294:2021, 5.2
1.3	Insulation resistance at 70 °C	T	IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness	T, S	IEC 63294:2021, 6.2
2.3	Measurement of overall dimensions	T, S	IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before and after ageing	T	IEC 60811-501
3.2	Loss of mass test	T	IEC 60811-409
4	Pressure test at high temperature	T	IEC 60811-508
5	Elasticity at low temperature		
5.1	Bending test for insulation at low temperature	T	IEC 60811-504
6	Heat shock test	T	IEC 60811-509
7	Mechanical strength of completed cable		
7.1	Bending test	T	IEC 63294:2021, 6.8 See also 4.4.2 of this document
7.2	Drop test	T	IEC 63294:2021, 6.10 See also 4.4.3 of this document
8	Test of flame retardance	T	IEC 60332-1-2

5 (Vacant)

6 Cord for indoor decorative lighting chains

6.1 Code designation

60227 IEC 43.

6.2 Rated voltage

300/300 V.

6.3 Construction

6.3.1 Conductors

Number of conductors: 1.

The conductor shall comply with the requirements given in IEC 60228 for Class 6 conductors.

6.3.2 Insulation

The insulation shall be polyvinyl chloride of type PVC/D, it shall consist of two layers and applied by dual extrusion around the conductor.

The outer layer of insulation shall be of a colour contrasting with that of the inner layer but shall adhere to the inner layer.

The specified value of combined thickness of the inner and outer layers of insulation is given in Table 3, column 4, the minimum thickness of the combined layers at any point is given in Table 3, column 3 but at no point the thickness of either layer shall be less than the value specified in Table 3, column 2.

The insulation resistance at 70 °C shall be not less than the values given in Table 3, column 7.

6.3.3 Cord identification

Preferred colour of outer layer: green.

6.3.4 Overall diameter

The mean overall diameter shall be within the limits given in Table 3, columns 5 and 6.

6.4 Tests

6.4.1 General

Compliance with the requirements of 6.3 shall be checked by inspection and by the sample tests and type tests given in Table 4.

6.4.2 (Vacant)

6.5 Guidance on use

Maximum conductor temperature in normal use: 70 °C.

The use of the cable type 60227 IEC 43 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 3 – General data for type 60227 IEC 43

1	2	3	4	5	6	7
Nominal cross-sectional area of conductor	**Thickness of each layer of insulation**	**Overall insulation thickness**	**Overall insulation thickness**	**Mean overall diameter[a]**		**Minimum insulation resistance at 70 °C**
	Minimum value	**Minimum value**	**Specified value**	**Lower limit**	**Upper limit**	
mm2	mm	mm	mm	mm	mm	MΩ · km
0,5	0,2	0,6	0,7	2,3	2,7	0,014
0,75	0,2	0,6	0,7	2,4	2,9	0,012

[a] The mean overall dimensions have been calculated in accordance with IEC 60719.

Table 4 – Tests for type 60227 IEC 43

1	2	3	4
Ref. No.	**Tests**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	IEC 63294:2021, 5.1
1.2	Voltage test on completed cable at 2 000 V	T, S	IEC 63294:2021, 5.3
1.3	Insulation resistance at 70 °C	T	IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
1.4	Long term resistance of insulation to direct current at 60 ± 5 °C for a period of 240 h	T	IEC 63294:2021, 5.6
2	Constructional and dimensional characteristics		
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness of inner layer (minimum thickness only)	T, S	IEC 63294:2021, 6.2
2.3	Measurement of insulation thickness of outer layer (minimum thickness only)	T, S	IEC 63294:2021, 6.2
2.4	Measurement of overall thickness	T, S	IEC 63294:2021, 6.2
2.5	Measurement of overall diameter	T, S	IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before ageing[a]	T	IEC 60811-501
3.2	Tensile test after ageing[a]	T	IEC 60811-501
3.3	Loss of mass test[a]	T	IEC 60811-409
4	Pressure test at high temperature[a]	T	IEC 60811-508
5	Elasticity at low temperature		
5.1	Bend test for insulation[a]	T	IEC 60811-504
6	Heat shock test[a]	T	IEC 60811-509
7	Test of flame retardance	T	IEC 60332-1-2

[a] Because of the simultaneous extrusion of the same compound for both layers of insulation, the composite layer shall be tested as one layer and evaluated accordingly.

7 Light polyvinyl chloride sheathed cord

7.1 Code designation

60227 IEC 52.

7.2 Rated voltage

300/300 V.

7.3 Construction

7.3.1 Conductors

Number of conductors: 2 and 3.

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

7.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The specified value of insulation thickness is given in Table 6, column 2.

The insulation resistance shall be not less than the values given in Table 6, column 6.

7.3.3 Assembly of cores

Circular cord: the cores shall be twisted together.

Flat cord: the cores shall be laid parallel.

7.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST5 applied around the cores.

The specified value of sheath thickness is given in Table 6, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores. The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cords shall have a practically circular cross-section.

7.3.5 Overall dimensions

The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 6, columns 4 and 5.

7.4 Tests

7.4.1 General

Compliance with the requirements of 7.3 shall be checked by inspection and by the sample tests and type tests given in Table 7.

7.4.2 Flexing test

7.4.2.1 General

The requirements are given in IEC 60227-1:—, 6.6.3.2.

7.4.2.2 Sample preparation

The mass of the weight and the diameter of pulleys A and B are given in Table 5.

Table 5 – Mass of weight and diameter of pulleys

Number of cores	Nominal cross-sectional area mm²	Mass of weight kg	Diameter of pulleys[a] mm
2	0,5	0,5	60
	0,75	1,0	80
3	0,5	0,5	80
	0,75	1,0	80
[a] Diameter measured at the lowest point of the groove.			

7.4.2.3 Current loading of cores

During the flexing test, the cable sample shall be loaded as follows:

- two- and three-core cables: all cores to be loaded with 1 A/mm² $^{+10}_{0}$ %.

7.5 Guidance on use

Maximum conductor temperature in normal use: 70 °C.

The use of the cable type 60227 IEC 52 shall comply with IEC 62440, which provides guidance on the safe use of electric cables with a rated voltage not exceeding 450/750 V.

Table 6 – General data for type 60227 IEC 52

1	2	3	4	5	6
Number and nominal cross-sectional area of conductors	Thickness of insulation	Thickness of sheath	Mean overall dimensions[a]		Minimum insulation resistance at 70 °C
	Specified value	Specified value	Lower limit	Upper limit	
mm²	mm	mm	mm	mm	MΩ · km
2 × 0,5	0,5	0,6	4,6 or 3,0 × 4,9	5,9 or 3,7 × 5,9	0,012
2 × 0,75	0,5	0,6	4,9 or 3,2 × 5,2	6,3 or 3,8 × 6,3	0,010
3 × 0,5	0,5	0,6	4,9	6,3	0,012
3 × 0,75	0,5	0,6	5,2	6,7	0,010
[a] The mean overall dimensions have been calculated in accordance with IEC 60719.					

Table 7 – Tests for type 60227 IEC 52

1	2	3	4
Ref. No.	**Test**	**Category of test**	**Test method described in**
1	Electrical tests		
1.1	Resistance of conductors	T, S	IEC 63294:2021, 5.1
1.2	Voltage test on cores at 1 500 V	T, S	IEC 63294:2021, 5.3
1.3	Voltage test on completed cable at 2 000 V	T, S	IEC 63294:2021, 5.2
1.4	Insulation resistance at 70 °C	T	IEC 63294:2021, 5.4 IEC 60227-1:—, Table 3
2	Provisions covering constructional and dimensional characteristics		
2.1	Checking of compliance with constructional provisions	T, S	IEC 60227-1 Inspection and manual test
2.2	Measurement of insulation thickness	T, S	IEC 63294:2021, 6.2
2.3	Measurement of sheath thickness	T, S	IEC 63294:2021, 6.3
2.4	Measurement of overall dimensions:		
2.4.1	• mean value	T, S	IEC 63294:2021, 6.4
2.4.2	• ovality	T, S	IEC 63294:2021, 6.4
3	Mechanical properties of insulation		
3.1	Tensile test before and after ageing	T	IEC 60811-501
3.2	Loss of mass test	T	IEC 60811-409
4	Mechanical properties of sheath		
4.1	Tensile test before and after ageing	T	IEC 60811-501
4.2	Loss of mass test	T	IEC 60811-409
5	Pressure test at high temperature		
5.1	Insulation	T	IEC 60811-508
5.2	Sheath	T	IEC 60811-508
6	Elasticity and impact strength at low temperature		
6.1	Bending test for insulation at low temperature	T	IEC 60811-504
6.2	Bending test for sheath at low temperature	T	IEC 60811-504
6.3	Impact test on completed cable at low temperature	T	IEC 60811-504
7	Heat shock test		
7.1	Insulation	T	IEC 60811-509
7.2	Sheath	T	IEC 60811-509
8	Mechanical strength of completed cable		
8.1	Flexing test	T	IEC 63294:2021, 6.6 See also 7.4.2 of this document
9	Test of flame retardance	T	IEC 60332-1-2

8 Ordinary polyvinyl chloride sheathed cord

8.1 Code designation

60227 IEC 53.

8.2 Rated voltage

300/500 V.

8.3 Construction

8.3.1 Conductors

Number of conductors: 2, 3, 4 or 5.

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

8.3.2 Insulation

The insulation shall be polyvinyl chloride compound of type PVC/D applied around each conductor.

The specified value of insulation thickness is given in Table 8, column 2.

The insulation resistance shall be not less than the value given in Table 8, column 6.

8.3.3 Assembly of cores and fillers, if any

Circular cord: the cores and the fillers shall be twisted together.

Flat cord: the cores shall be laid parallel.

For a circular cord having two cores, the space between the cores shall be filled either by separate fillers or by the sheath filling the interstices.

Any filler shall not adhere to the cores.

8.3.4 Sheath

The sheath shall be polyvinyl chloride compound of type PVC/ST5 applied around the cores.

The specified value of sheath thickness is given in Table 8, column 3.

The sheath may fill the spaces between the cores, thus forming a filling, but it shall not adhere to the cores. The assembly of cores may be surrounded by a separator, which shall not adhere to the cores.

The assembly of circular cords shall have a practically circular cross-section.

8.3.5 Overall dimensions

The mean overall diameter of circular cords and the mean overall dimensions of flat cords shall be within the limits given in Table 8, columns 4 and 5.