PAKISTAN STANDARD

Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 $\rm V$

Part-1: General requirements



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Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V

Part-1:General requirements

0. FOREWORD

- 0.1 This Pakistan Standard was adopted by the authority of the Board of Directors of Pakistan Standard and Quality Control Authority after the draft prepared by the Technical Committee for **"Electric Cables"** (TC-7)" had been approved and endorsed by the National Standards Committee on 27 June 2007.
- 0.2 This Pakistan Standard was adopted on the basis of IEC: 60227-1 since IEC Standard have been established in 1997, hence it is deemed necessary to adopt the International standard to keep abreast with the latest technology and as par with IEC standard.
- 0.3 This Pakistan Standard is an adoption of IEC: 60227-1-2007 Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V Part-1: General requirements," and its use hereby acknowledged with thanks.
- 0.4 This standard is subject to periodical review in order to keep pace with the development in industry. Any suggestions for improvement shall be recorded and placed before the revising committee in due course.
- 0.5 This standard is intended chiefly to cover the technical provisions relating to this standard and it does not include all the necessary provisions of a Contract.

CONTENTS

FO	REWC)RD							
1	General								
	11	Scope							
	12	Norma	tive references						
2	Defin	itions							
-	2 1	Dofiniti	ions relating to insulating and shoothing materials						
	2.1	2 1 1							
		2.1.1							
	22	Z. I.Z Dofiniti	Type of compound						
	2.2	221	Type tests (symbol T)						
		2.2.1	Sample tests (symbol S)						
	23	Z.Z.Z	voltage						
з	Z.0 Mark	ina							
0	2 4	Indiaat	ion of origin and apple identification						
	3.1								
	20	J.I.I Durahi							
	3.Z	Logibili	iity						
٨	J.J Core	identific	ny						
4									
	4.1		Concercing the second s						
		4.1.1							
		4.1.2	Colour scheme						
	4.0	4.1.3 Coro io							
	4.2								
		4.2.1	Breferred errongement of marking						
		4.2.2							
F	Cono	4.2.3	buildbillity						
5	Gene								
	5.1	Condu	ctors						
		5.1.1							
		5.1.2							
		5.1.3							
	F 0	5.1.4							
	5.2	Insulat	Matarial						
		5.2.1							
		5.2.2							
		5.2.3	Mechanical properties before and ofter accing						
	E 2	5.2.4 Filler	Mechanical properties before and after ageing						
	5.5	Fillel	Matarial						
		532							
	5 /	5.5.Z							
	5.4		Material						
		542	Annlication						
		5.4.3	Thickness						
	55	Sheath							
	0.0	5 5 1	Material						
		0.0.1	ind order						

	5.5.2	Application							
	5.5.3	Thickness							
	5.5.4	Mechanical properties before and after ageing							
5.6	Tests o	n completed cables							
	5.6.1	Electrical properties							
	5.6.2	Overall dimensions							
	5.6.3	Mechanical strength of flexible cables							
	5.6.4	Flame retardance							
6 Guide	e to use	of the cables							
Annex A	normati	ve) Code designation							
-		.,							
Table 1		\mathbf{D}							
insulation	Require	ements for the non-electrical tests for polyvinyl chloride (PVC)							
Toble 2	Doquire	$P_{\rm A}$							
	Require	ements for the non-electrical test for polyviny chloride (PVC) sheaths							
Table 3 – Requirements for electrical tests for PVC insulated cables									

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

Part 1: General requirements

1 General

1.1 Scope

This part of International Standard IEC 60227 applies to rigid and flexible cables with insulation, and sheath if any, based on polyvinyl chloride, of rated voltages U_0/U up to and including 450/750 V used in power installations of nominal voltage not exceeding 450/750 V a.c.

NOTE For some types of flexible cables the term cord is used.

The particular types of cables are specified in IEC 60227-3, IEC 60227-4, etc. The code designations of these types of cables are given in Annex A.

The test methods specified in Parts 1, 3, 4, etc. are given in IEC 60227-2, IEC 60332-1-2 and in the relevant parts of IEC 60811.

1.2 Normative references

The following referenced documents are indispensable for the application 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 60173, Colours of the cores of flexible cables and cords

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

IEC 60227-3, Polyvinyl chloride insulated cables of rated voltage up to and including 450/750 V – Part 3: Non-sheathed cables for fixed wiring

IEC 60227-4, Polyvinyl chloride insulated cables of rated voltage up to and including 450/750 V – Part 4: Sheathed cables for fixed wiring

IEC 60227-5, Polyvinyl chloride insulated cables of rated voltages up to and including 450/750 V – Part 5: Flexible cables (cords)

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 premixed flame

IEC 60811-1-1, Common test methods for insulating and sheathing materials of electric cables and optical cables – Part 1: Methods for general application –Measuring of thickness and overall dimensions – Tests for determining the mechanical properties

IEC 60811-1-2, Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Two: Thermal ageing methods

IEC 60811-1-4, Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperature

IEC 60811-3-1, 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 60811-3-2, 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 tests

IEC 62440, Electric cables – Guide to use for cables with a rated voltage not exceeding $450/750V^{1}$

2 Definitions

For the purpose of this standard the following definitions shall apply.

2.1 Definitions relating to insulating and sheathing materials

2.1.1 Polyvinyl chloride compound (PVC)

Combination of materials suitably selected, proportioned and treated, of which the characteristic constituent is the plastomer polyvinyl chloride or one of its copolymers. The same term also designates compounds containing both polyvinyl chloride and certain of its polymers.

2.1.2 Type of compound

The category in which a compound is placed according to its properties, as determined by specific tests. The type designation is not directly related to the composition of the compound.

2.2 Definitions relating to the tests

2.2.1 Type tests (symbol *T*)

Tests required to be made before supplying a type of cable covered by this standard on a general commercial basis in order to demonstrate satisfactory performance characteristics to meet the intended application. These tests are of such a nature that, after they have been made, they need not be repeated unless changes are made in the cable materials or design which might change the performance characteristics.

2.2.2 Sample tests (symbol S)

Tests made on samples of completed cable or components taken from a completed cable, adequate to verify that the finished product meets the design specifications.

2.3 Rated voltage

The rated voltage of a cable is the reference voltage for which the cable is designed and which serves to define the electrical tests.

¹ In preparation.

The rated voltage is expressed by the combination of two values U_0/U , expressed in volts:

- *U*_o being the r.m.s. value between any insulated conductor and "earth" (metal covering of the cable or the surrounding medium);
- *U* being the r.m.s. value between any two-phase conductors of a multicore cable or of a system of single-core cables.

In an alternating current system, the rated voltage of a cable shall be at least equal to the nominal voltage of the system for which it is intended.

This condition applies both to the value U_0 and to the value U.

In a direct current system, the nominal voltage of the system shall be not higher than 1,5 times the rated voltage of the cable.

NOTE The operating voltage of a system may permanently exceed the nominal voltage of such a system by 10 %. A cable can be used at a 10 % higher operating voltage than its rated voltage if the latter is at least equal to the nominal voltage of the system.

3 Marking

3.1 Indication of origin and cable identification

Cables shall be provided with an indication of the manufacturer, which shall be either an identification thread or a repetitive marking of the manufacturer's name or trade-mark.

Cables for use at a conductor temperature exceeding 70 °C shall also be marked either with the code designation or with the maximum conductor temperature.

Marking may be by printing or by reproduction in relief on or in the insulation or sheath.

3.1.1 Continuity of marks

Each specified mark shall be regarded as continuous if the distance between the end of the mark and the beginning of the next identical mark does not exceed

- 550 mm if the marking is on the outer sheath of the cable;
- 275 mm if the marking is
 - a) on the insulation of an unsheathed cable;
 - b) on the insulation of a sheathed cable;
 - c) on a tape within a sheathed cable.

3.2 Durability

Printed markings shall be durable. Compliance with this requirement shall be checked by the test given in 1.8 of IEC 60227-2.

3.3 Legibility

All markings shall be legible.

The colours of the identification threads shall be easy to recognize or easily made recognizable, if necessary, by cleaning with petrol or other suitable solvent.

4 Core identification

Each core shall be identified as follows:

- in cables having up to and including five cores by colour, see 4.1;
- in cables having more than five cores by number, see 4.2.

NOTE The colour scheme, and in particular the scheme for rigid multicore cables, is under consideration.

4.1 Core identification by colours

4.1.1 General requirements

Identification of the cores of a cable shall be achieved by the use of coloured insulation or other suitable method.

Each core of a cable shall have only one colour, except the core identified by a combination of the colours green-and-yellow.

The colours green and yellow, when not in combination, shall not be used for any multicore cable.

NOTE The colours red and white should preferably be avoided.

4.1.2 Colour scheme

The preferred colour scheme for flexible cables and single-core cables is:

- single-core cable: no preferred colour scheme;
- two-core cable: no preferred colour scheme;
- three-core cable:
 either green-and-yellow, blue, brown, or, brown, black, grey
- four-core cable:
 either green-and-yellow, brown, black, grey, or blue, brown, black, grey
- five-core cable:
 either green-and-yellow, blue, brown, black, grey, or blue, brown, black, grey, black.

The colours shall be clearly identifiable and durable. Durability shall be checked by the test given in 1.8 of IEC 60227-2.

4.1.3 Colour combination green-and-yellow

The distribution of the colours for the core coloured green-and-yellow shall comply with the following condition (which is in accordance with IEC 60173): for every 15 mm length of core, one of these colours shall cover at least 30 % and not more than 70 % of the surface of the core, the other colour covering the remainder.

NOTE Information on the use of the colours green-and-yellow and blue.

It is understood that the colours green and yellow, when they are combined as specified above, are recognized exclusively as a means of identification of the core intended for use as earth connection or similar protection, and that the colour blue is intended for the identification of the core intended to be connected to neutral. If, however, there is no neutral, blue can be used to identify any core except the earthing or protective conductor.

4.2 Core identification by numbers

4.2.1 General requirements

The insulation of the cores shall be of the same colour and numbered sequentially, except for the core coloured green-and-yellow, if one is included.

The green-and-yellow core, if any, shall comply with the requirement of 4.1.3 and shall be in the outer layer.

The numbering shall start by number 1 in the inner layer.

The numbers shall be printed in arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of the insulation. The numerals shall be legible.

4.2.2 Preferred arrangement of marking

The numbers shall be repeated, at regular intervals along the core, consecutive numbers being inverted in relation to each other.

When the number is a single numeral, a dash shall be placed underneath it. If the number consists of two numerals, these shall be disposed one below the other and a dash placed below the lower numeral. The spacing *d* between consecutive numbers shall not exceed 50 mm.

The arrangement of the marks is shown in the figure below.



4.2.3 Durability

Printed numerals shall be durable. Compliance with this requirement shall be checked by the test given in 1.8 of IEC 60227-2.

5 General requirements for the construction of cables

5.1 Conductors

5.1.1 Material

The conductors shall consist of annealed copper, except for the wires of tinsel cords, for which a copper alloy may be used. The wires may be plain or tinned.

5.1.2 Construction

The maximum diameters of the wires of flexible conductors – other than the conductors of tinsel cords – and the minimum number of the wires of rigid conductors shall be in accordance with IEC 60228.

The classes of the conductors relevant to the various types of cables are given in the particular specifications (see IEC 60227-3, IEC 60227-4, etc.).

Conductors of cables for fixed installations shall be circular solid, circular stranded or compacted circular stranded conductors.

For tinsel cords 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.

5.1.3 Check on construction

Compliance with the requirements of 5.1.1 and 5.1.2, including the requirements of IEC 60228, shall be checked by inspection and by measurement.

5.1.4 Electrical resistance

For cables – other than tinsel cords – the resistance of each conductor at 20 °C shall be in accordance with the requirements of IEC 60228 for the given class of the conductor.

Compliance shall be checked by the test given in 2.1 of IEC 60227-2.

5.2 Insulation

5.2.1 Material

The insulation shall be polyvinyl chloride compound of the type specified for each type of cable in the particular specifications (see IEC 60227-3, IEC 60227-4, etc.).

Type PVC/C in the case of cables for fixed installation.

Type PVC/D in the case of flexible cables.

Type PVC/E in the case of heat-resistant cables for internal wiring.

The test requirements for these compounds are specified in Table 1.

The maximum operating temperatures for cables insulated with any of the above types of compound and covered by the particular specifications (see IEC 60227-3, IEC 60227-4, etc.) are given in those publications.

5.2.2 Application to the conductor

The insulation shall be so applied that it fits closely on the conductor, but for cables other than tinsel cords, it shall be possible to remove it without damage to the insulation itself, to the conductor or to the tin coating if any. Compliance shall be checked by inspection and by manual test.

5.2.3 Thickness

The mean value of the thickness of insulation shall be not less than the specified value for each type and size of cable shown in the tables of the particular specifications (IEC 60227-3, IEC 60227-4, etc.).

However, the thickness at any place may be less than the specified value provided that the difference does not exceed 0,1 mm + 10 % of the specified value.

Compliance shall be checked by the test given in 1.9 of IEC 60227-2.

5.2.4 Mechanical properties before and after ageing

The insulation shall have adequate mechanical strength and elasticity within the temperature limits to which it may be exposed in normal use.

Compliance shall be checked by carrying out the tests specified in Table 1.

The applicable test methods and the results to be obtained are specified in Table 1.

1	2	3	4	5	6	7										
Reference No.	Test	Unit	Туре	Type of component			nethod bed in									
			PVC/C	PVC/D	PVC/E	IEC	subclause									
1	Tensile strength and elongation at break					60811-1-1	9.1									
1.1	Properties in the state as delivered															
1.1.1	Values to be obtained for the tensile strength: – median, min.	N/mm ²	12,5	10,0	15,0											
1.1.2	Values to be obtained for the elongation at break: - median, min.	%	125	150	150											
1.2	Properties after ageing in air oven					60811-1-2 and	8.1.3.1 and									
1.2.1	Ageing conditions: – temperature – duration of treatment	°C h	80 ± 2 7 × 24	80 ± 2 7 × 24	135 ± 2 10 × 24	60811-1-1	9.1									
1.2.2	Values to be obtained for the tensile strength: – median, min. – variation ¹⁾ , max.	N/mm² %	12,5 ±20	10,0 ±20	15,0 ±25											
1.2.3	Values to be obtained for the elongation at break: - median, min. - variation ¹⁾ , max.	% %	125 ±20	150 ±20	150 ±25											
2	Loss of mass test					60811-3-2	8.1									
2.1	Ageing conditions: – temperature – duration of treatment	°C h	80 ± 2 7 × 24	80 ± 2 7 × 24	115 ± 2 10 × 24											
2.2	Values to be obtained for the loss of mass, max.	mg/cm ²	2,0	2,0	2,0											
3	Compatibility test ²⁾															
3.1	Ageing conditions	°C h	80 ± 2 7 × 24	80 ± 2 7 × 24	100 ± 2 10 × 24	60811-1-2	8.1.4									
3.2	Mechanical properties after ageing Values to be obtained		As Nos.	in referend 1.2.2 and												
4	Heat shock test					60811-3-1	9.1									
4.1	Test conditions: – temperature – duration of treatment	°C h	150 ± 2 1	150 ± 2 1	150 ± 2 1											
4.2	Results to be obtained		Abs	ence of cra	acks											
 Variation a percen If applica 	n: difference between the median tage of the latter. able, see 5.3.1.	value after	r ageing ar	id the medi	an value w	ithout ageing,	4.2 Results to be obtained Absence of cracks 1) Variation: difference between the median value after ageing and the median value without ageing, expressed as a percentage of the latter. 2) If applicable, see 5.3.1.									

Table 1 – Requirements for the non-electrical tests for polyvinyl chloride (PVC) insulation

1	2	3	4	5	6	7		
Reference No.	Test	Unit	Type of component			Test method described in		
			PVC/C	PVC/D	PVC/E	IEC	subclause	
5	Pressure test at high temperature					60811-3-1	8.1	
5.1	Test conditions: – force exercised by the blade – duration of heating under load – temperature	Se Se	See 8.1.4 of IEC 60811-3-1 See 8.1.5 of IEC 60811-3-1					
5.2	Results to be obtained: — median of the depth of penetration, max.	%	50 ± 2	50	90 ± 2 50			
6	Bending test at low temperature					60811-1-4	8.1	
6.1	Test conditions: – temperature ¹⁾ – period of application of low temperature	°C See 8.1	-15 ± 2 .4 and 8.1	-15 ± 2 .5 of IEC 60	-15 ± 2 0811-1-4			
6.2	Results to be obtained		Abs	sence of cra	acks			
7	Elongation test at low temperature					60811-1-4	8.3	
7.1	Test conditions: – temperature ¹⁾ – period of application of low temperature	°C See 8.3	–15 ± 2 3.4 and 8.3	-15 ± 2 .5 of IEC 60	_ 0811-1-4			
7.2	Result to be obtained: – elongation without break, min.	%	20	20	-			
8	Impact test at low temperature ²⁾					60811-1-4	8.5	
8.1	Test conditions: – temperature ¹⁾ – period of application of low temperature – mass of hammer	°C Se Se	-15 ± 2 ee 8.5.5 of	–15 ± 2 IEC 60811- IEC 60811-	– 1-4 1-4			
8.2	Results to be obtained	Se	e 8.5.6 of	IEC 60811-	1-4			
9	Thermal stability test					60811-3-2	9	
9.1	Test conditions: – temperature	°C	_	_	200 ± 0,5			
9.2	Result to be obtained: – mean value of the thermal stability time, min.	min	-	_	180			
¹⁾ Due to climatic conditions, national standards may require a lower test temperature to be used.								

Table 1 (continued)

²⁾ If specified in the particular specifications (IEC 60227-3, IEC 60227-4, etc.).

5.3 Filler

5.3.1 Material

Unless otherwise specified in the particular specifications (IEC 60227-3, IEC 60227-4, etc.), the fillers shall be composed of one of the following or of any combination of the following:

- a compound based on unvulcanized rubber of plastics; or
- natural or synthetic textiles; or
- paper.

When the filler is composed of unvulcanized rubber, there shall be no harmful interactions between its constituents and the insulation and/or the sheath. Compliance with this requirement shall be checked by the test given in 8.1.4 of IEC 60811-1-2.

5.3.2 Application

For each type of cable, the particular specifications (IEC 60227-3, IEC 60227-4, etc.) specify whether that cable includes fillers or whether the sheath or inner covering may penetrate between the cores, thus forming a filling.

The fillers shall fill the spaces between the cores giving the assembly a practically circular shape. The fillers shall not adhere to the cores. The assembly of cores and fillers may be held together by a film or tape.

5.4 Extruded inner covering

5.4.1 Material

Unless otherwise specified in the particular specifications (IEC 60227-4, etc.), the extruded inner covering shall be composed of a compound based on unvulcanized rubber or plastics.

Where the inner covering is composed of unvulcanized rubber, there shall be no harmful interactions between its constituents and the insulation and/or the sheath.

Compliance with this requirement shall be checked by the test given in 8.1.4 of IEC 60811-1-2.

5.4.2 Application

The extruded inner covering shall surround the cores and may penetrate the spaces between them giving the assembly a practical circular shape. The extruded inner covering shall not adhere to the cores.

For each type of cable, the particular specifications (IEC 60227-4, etc.) indicate whether that cable includes an extruded inner covering or not, or whether the outer sheath may penetrate between the cores, thus forming a filling.

5.4.3 Thickness

Unless otherwise specified in the particular specifications (IEC 60227-4, etc.), no measurement is required for the extruded inner covering.

5.5 Sheath

5.5.1 Material

The sheath shall be polyvinyl chloride compound of the type specified for each type of cable in the particular specifications (see IEC 60227-4, etc.):

- type PVC/ST4 in the case of cables for fixed installations;
- type PVC/ST5 in the case of flexible cables;
- type PVC/ST9 in case of oil-resistant flexible cables;
- type PVC/ST10 in the case of cables sheathed with a 90° polyvinyl chloride compound.

The test requirements for these compounds are specified in Table 2.

5.5.2 Application

The sheath shall be extruded in a single layer:

- a) on the core, in the case of single-core cables;
- b) on the assembly of cores and fillers or inner covering, if any, in the case of other cables.

The sheath shall not adhere to the cores. A separator, consisting of a film or tape, may be placed under the sheath.

In certain cases, indicated in the particular specifications (IEC 60227-4, etc.), the sheath may penetrate into the spaces between the cores, thus forming a filling (see 5.4.2).

5.5.3 Thickness

The mean value of the thickness shall not be less than the specified value for each type and size of cable shown in the tables of the particular specifications (IEC 60227-4, etc.).

However, the thickness at any place may be less than the specified value provided that the difference does not exceed 0,1 mm + 15 % of the specified value, unless otherwise specified.

Compliance shall be checked by the test given in 1.10 of IEC 60227-2.

5.5.4 Mechanical properties before and after ageing

The sheath shall have adequate mechanical strength and elasticity within the temperature limits to which it may be exposed in normal use.

Compliance shall be checked by carrying out the tests specified in Table 2.

The applicable test values and the results to be obtained are specified in Table 2.

1	2	3	4	5	6	7		8	
Reference No.	Test	Unit		Type of c	Test i descr	nethod ibed in			
			PVC/ ST4	PVC/ ST5	PVC/ ST9	PVC/ ST10	IEC	clause/ subclause	
1	Tensile strength and elongation at break						60811-1-1	9.2	
1.1	Properties in the state as delivered								
1.1.1	Values to be obtained for the tensile strength: – median, min.	N/mm ²	12,5	10,0	10,0	10, 0			
1.1.2	Values to be obtained for the elongation at break – median, min.	%	125	150	150	150			
1.2	Properties after ageing in the air oven						60811-1-2	8.1	
1.2.1	Ageing conditions: – temperature – duration of treatment	°C h	80 ± 2 7 × 24	80 ± 2 7 × 24	80 ± 2 7 × 24	135 ± 2 10 × 24	60811-1-1	9.2	
1.2.2	Values to be obtained for the tensile strength: - median, min. - variation ¹⁾ , max.	N/mm² %	12,5 ±20	10,0 ±20	10,0 ±20	10,0 ±25			
1.2.3	Values to be obtained for the elongation at break: – median, min. – variation ¹⁾ , max.	% %	125 ±20	150 ±20	150 ±20	150 ±25			
2	Loss of mass test						60811-3-2	8.2	
2.1	Ageing conditions: – temperature – duration of treatment	°C h	As in re	ference N	lo. 1.2.1	115 ± 2 10 × 24			
2.2	Values to be obtained for the loss of mass, max.	mg/cm ²	2,0	2,0	2,0	2,0			
3	Compatibility test ²)						60811-1-2	8.1.4	
3.1	Ageing conditions: – temperature – duration of treatment	°C h	As in re	ference N	lo. 1.2.1	100 ± 2 10 × 24			
3.2	Mechanical properties after ageing Values to be obtained		As in references Nos. 1.2.2 and 1.2.3						
4	Heat shock test						60811-3-1	9.2	
4.1	Test conditions: – temperature – duration of treatment	°C h	150 ± 2 1	150 ± 2 1	150 ± 2 1	150 ± 2 1			
4.2	Result to be obtained			Absence					
¹⁾ Variation: difference between the median value after ageing and the median value without ageing, expressed as a									

Table 2 – Requirements for the non-electrical test for polyvinyl chloride (PVC) sheaths

percentage of the latter.

²⁾ Only applicable when called up by the particular cable standard, see also 5.3.1.

1	2	3	4	5	6	7	8			
Reference No.	Test	Unit	Type of compound				Test method described in			
			PVC/ ST4	PVC/ ST5	PVC/ ST9	PVC/ ST10	IEC	clause/ subclause		
5	Pressure test at high temperature						60811-3-1	8.2		
5.1	Test conditions: – force exercised by the blade – duration of heating under load – temperature	h °C	80 ± 2	70 ± 2	70 ± 2	90 ± 2	60811-3-1 60811-3-1	8.2.4 8.2.5		
5.2	Results to be obtained: – median of the depth of penetration, max.	%	50	50	50	50				
6	Bending test at low temperature						60811-1-4	8.2		
6.1	Test conditions: – temperature ¹⁾ – period of application of low temperature	°C h	-15 ± 2	-15 ± 2	-15 ± 2	-15 ± 2	60811-1-4	8.2.3		
6.2	Results to be obtained			Absence of cracks						
7	Elongation test at low temperature						60811-1-4	8.4		
7.1	Test conditions: – temperature ¹⁾ – period of application of low temperature	°C h	-15 ± 2	-15 ± 2	-15 ± 2	-15 ± 2	60811-1-4	8.4.4 and		
7.2	Result to be obtained: – elongation without break, min.	%	20	20	20	20		8.4.5		
8	Impact test at low temperature						60811-1-4	8.5		
8.1	Test conditions: – temperature ¹⁾ – period of application of low temperature – mass of hammer	°C h	-15 ± 2	-15 ± 2	–15 ± 2	-15 ± 2	60811-1-4 60811-1-4	8.5.5 8.5.4		
8.2	Result to be obtained						60811-1-4	8.5.6		
9	Mechanical properties after immersion in mineral oil						60811-2-1	10		
9.1	Test conditions: – temperature of oil – duration of immersion in oil	°C h	_ _	_ _	90 ± 2 24	_ _				
9.1.1	Value to be obtained for the tensile strength: - variation max. ²⁾	%	_	_	±30	_				
9.1.2	Value to be obtained for the elongation at break: ²⁾ - variation max.	%	_	_	±30	_				
10	Minimum thermal stability at 200 °C	min	_	_	_	180	60811-3-2	9		
1) Due to	1) Due to climatic conditions, national standards may require the use of a lower test temperature									

Table 2 (continued)

2) Variation is the difference between the median value after ageing and the median value without ageing, expressed as a percentage of the latter.

5.6 Tests on completed cables

5.6.1 **Electrical properties**

The cables shall have adequate dielectric strength and insulation resistance.

Compliance shall be checked by carrying out the tests specified in Table 3.

The test methods and the results to be obtained are specified in Table 3.

1	2	3	4	5	6	-	7
Reference No.	Test	Unit	Rated	Rated voltage of cables			nethod bed in
			300/ 300 V	300/ 500 V	450/ 750 V	IEC	subclause
1	Measurement of the resistance of conductors					60227-2	2.1
1.1	Values to be obtained, max.		See IEC 60228 and particular specifications (IEC 60227-3, IEC 60227-4, etc.)				
2	Voltage test on completed cables					60227-2	2.2
2.1	Test conditions: – minimum length of the sample – minimum period of immersion in water – temperature of the water	m h °C	10 1 20 ± 5	10 1 20 ± 5	10 1 20 ± 5		
2.2	Voltage applied (a.c.)	V	2 000	2 000	2 500		
2.3	Duration of each application of voltage, min.	min	5	5	5		
2.4	Results to be obtained		N	o breakdov	vn		
3	Voltage test on cores					60227-2	2.3
3.1	Test conditions: – length of sample – minimum period of immersion in water – temperature of the water	m h °C	5 1 20 ± 5	5 1 20 ± 5	5 1 20 ± 5		
3.2	Applied voltage (a.c.) according to specified thickness of insulation: - up to and including 0,6 mm - exceeding 0,6 mm	V V	1 500 2 000	1 500 2 000	_ 2 500		
3.3	Duration of each application of voltage, min.	min	5	5	5		
3.4	Results to be obtained		N	o breakdov	vn		
4	Measurement of insulation resistance					60227-2	2.4
4.1	Test conditions: – length of sample – previous voltage test as in Ref. Nos. 2 or 3	m	5	5	5		
	 minimum period of immersion in hot water temperature of water 	h	2 2 2 See tables in the particular				
4.2	Results to be obtained		(IEC 60227-3, IEC 60227-4, etc.)				

Table 3 – Requirements for electrical tests for PVC insulated cables

5.6.2 Overall dimensions

The mean overall dimensions of the cables shall be within the limits specified in the tables in the particular specifications (see IEC 60227-3, IEC 60227-4, etc.).

The difference between any two values of the overall diameter of sheathed circular cables of the same cross-section (ovality) shall not exceed 15 % of the upper limit specified for the mean overall diameter.

Compliance shall be checked by the tests given in 1.11 of IEC 60227-2.

5.6.3 Mechanical strength of flexible cables

The flexible cables shall be capable of withstanding bending and other mechanical stresses occurring in normal use.

When specified in the particular specifications (see IEC 60227-5, etc.), compliance shall be checked by the test given in Clause 3 of IEC 60227-2.

5.6.3.1 Flexing test for flexible cables

See 3.1 of IEC 60227-2.

During the test with 15 000 backward and forward movements, i.e. 30 000 single strokes, neither interruption of the current nor short circuit between the conductors shall occur.

After the test, the sample shall withstand the voltage test carried out in accordance with 2.2 of IEC 60227-2.

5.6.3.2 Bending test for tinsel cord

See 3.2 of IEC 60227-2.

During the test with 60 000 bending cycles, i.e. 120 000 single strokes, interruption of the current shall not occur.

After the test, the sample shall withstand the voltage test carried out in accordance with 2.2 of IEC 60227-2, the voltage, however, being 1 500 V and applied only between the conductors connected together and the water.

5.6.3.3 Snatch test for tinsel cord

See 3.3 of IEC 60227-2.

During the test, interruption of the current shall not occur.

5.6.3.4 Test for separation of cores

See 3.4 of IEC 60227-2.

The force shall be between 3 N and 30 N.

5.6.4 Flame retardance

All the cables shall comply with the test specified in IEC 60332-1-2.

6 Guide to use of the cables

See the future IEC 62440.

Annex A

(normative)

Code designation

Cables of the types covered by this standard are designated by two numerals, preceded by the reference number of this standard.

The first numeral indicates the basic class of cable; the second numeral indicates the particular type within the basic class.

The classes and types are as follows:

- 0. Non-sheathed cables for fixed wiring.
 - 01. Single-core non-sheathed cable with rigid conductor for general purposes (60227 IEC 01).
 - 02. Single-core non-sheathed cable with flexible conductor for general purposes (60227 IEC 02).
 - 05. Single-core non-sheathed cable with solid conductor for internal wiring for a conductor temperature of 70 °C (60227 IEC 05).
 - 06. Single-core non-sheathed cable with flexible conductor for internal wiring for a conductor temperature of 70 °C (60227 IEC 06).
 - 07. Single-core non-sheathed cable with solid conductor for internal wiring for a conductor temperature of 90 °C (60227 IEC 07).
 - 08. Single-core non-sheathed cable with flexible conductor for internal wiring for a conductor temperature of 90 °C (60227 IEC 08).
- 1. Sheathed cables for fixed wiring.
 - 10. Light polyvinyl chloride sheathed cable (60227 IEC 10).
- 4. Non-sheathed flexible cables for light duty.
 - 41. Flat tinsel cord (60227 IEC 41).
 - 43. Cord for decorative chains (60227 IEC 43).
- 5. Sheathed flexible cables for normal duty.
 - 52. Light polyvinyl chloride sheathed cord (60227 IEC 52).
 - 53. Ordinary polyvinyl chloride sheathed cord (60227 IEC 53).
- 7. Sheathed flexible cables for special duty.
 - 71c Circular polyvinyl chloride sheathed lift cable and cable for flexible connections (60227 IEC 71c).
 - 71f Flat polyvinyl chloride sheathed lift cables and cables for flexible connections (60227 IEC 71f).