BRITISH STANDARD

BS EN
61138:2007

Cables for portable earthing and short-circuiting equipment

ICS 29.060.20

BSI
British Standards

National foreword

This British Standard is the UK implementation of EN 61138:2007. It was derived by CENELEC from IEC 61138:2007. It supersedes BS EN 61138:1998 which is withdrawn.

The CENELEC common modifications have been implemented at the appropriate places in the text and are indicated by tags (e.g. [C> <C]).

The UK participation in its preparation was entrusted by Technical Committee GEL/20, Electric cables, to Subcommittee GEL/20/17, Low voltage cables.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

Compliance with a British Standard cannot confer immunity from legal obligations.

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EUROPEAN STANDARD

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EN 61138

December 2007

ICS 29.060.20

Supersedes EN 61138:1997 + A11:2003

English version

Cables for portable earthing and short-circuiting equipment
(IEC 61138:2007, modified)

Câbles d'équipements portables
de mise à la terre et de court-circuit
(CEI 61138:2007, modifiée)

Leitungen für ortsveränderliche
Erdungs- und Kurzschließ-Einrichtungen
(IEC 61138:2007, modifiziert)

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Ref. No. EN 61138:2007 E

Foreword

The text of document 20/881/FDIS, future edition 3 of IEC 61138, prepared by IEC TC 20, Electric cables, was submitted to the IEC-CENELEC parallel vote.

A draft amendment containing common modifications to the future IEC 61138 was prepared by the Technical Committee CENELEC TC 20, Electric cables, and was submitted to formal vote.

The combined text was approved by CENELEC as EN 61138 on 2007-10-01.

This European Standard supersedes EN 61138:1997 + A11:2003.

The significant technical changes with respect to EN 61138:1997 are as follows:

– extension of the scope to cover silicone rubber as an insulation material;

– introduction of a new normative annex for clashing test.

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2008-10-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2009-10-01

Annex ZA has been added by CENELEC.

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Endorsement notice

The text of the International Standard IEC 61138:2007 was approved by CENELEC as a European Standard with agreed common modifications.

CONTENTS

CABLES FOR PORTABLE EARTHING AND SHORT-CIRCUITING EQUIPMENT

1 Scope

This International Standard applies to flexible cables with insulation based on ethylene propylene rubber (EPR), polyvinyl chloride (PVC) or silicone rubber (SiR) for portable earthing and short-circuiting equipment.

For this type of cable no rated voltage is given as such cables are exclusively intended for earthing and short-circuiting equipment.

The particular types of cable and their code designations are specified in Clause 6 of this standard.

The test methods specified in this standard are given in 〚C〛 EN 50395, EN 50396 〚C〛, IEC 60811 and IEC 62230.

NOTE In addition to the requirements given in this standard, mechanical requirements and requirements for the marking for the complete equipment should be taken into account. These requirements can be found in IEC 61230.

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.

NOTE One or more references to the standard below are in respect of a specific subdivision of that standard, for instance a clause, a table, a class or a type. Cross-references to these standards are undated and, at all times, the latest version should be applied.

〚C〛 EN 50363-2-1, *Insulating, sheathing and covering materials for low voltage energy cables – Part 2-1: Cross-linked elastomeric sheathing compounds*

EN 50363-4-1, *Insulating, sheathing and covering materials for low voltage energy cables – Part 4-1: PVC sheathing compounds*

EN 50395, *Electrical test methods for low voltage energy cables*

EN 50396, *Non-electrical test methods for low voltage energy cables* 〚C〛

IEC 60228, *Conductors of insulated cables*

〚C〛 *Text deleted* 〚C〛

IEC 60502-1, *Extruded solid dielectric insulated power cables for rated voltages from 1 kV up to 30 kV*

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

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

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

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

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

IEC 60811-3-2, *Common test methods for insulating and sheathing materials of electric and optical cables – Part 3-2: Methods specific to PVC compounds – Loss of mass test – Thermal stability test*

IEC 61230, *Live working – Portable equipment for earthing or earthing and short-circuiting*

IEC 62230, *Electrical cables – Spark-test method*

3 Terms and definitions

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

3.1
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

NOTE 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, design or type of manufacturing process which might change the performance characteristics.

3.2
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

3.3
routine tests
symbol *R*
tests made on all production cable lengths to demonstrate their integrity

4 General requirements for the construction of cables

4.1 Conductors

4.1.1 Material

The conductor shall consist of annealed copper, aluminium or aluminium alloy in accordance with IEC 60228. The wires of copper conductors may be plain or tinned. Tinned wires shall be covered with an effective layer of tin.

4.1.2 Construction

The maximum diameter of the conductor wires is specified in Table 3 and Table 4.

4.1.3 Check of construction

Compliance with the requirements of 4.1.1 and 4.1.2 shall be checked by visual inspection and by measurement.

4.1.4 Electrical resistance

The d.c. resistance of copper conductors at 20 °C is specified in IEC 60228 Class 6.

The d.c. resistance of aluminium conductors at 20 °C is specified in Table 4 of this standard.

The test shall be carried out in accordance with IEC 60228, Annex A.

The current density shall not exceed 1 A/mm² to avoid any significant increase of temperature during the test.

4.2 Separator between conductor and insulation

A separating tape made of suitable material may be placed between the conductor and the insulation.

4.3 Insulation

4.3.1 Material

The insulation shall be one of the following types specified for each type of cable in Clause 6:

– an elastomeric insulation compound based on a cross-linked ethylene propylene rubber (EPR) or similar (EPM or EPDM);
– a general purpose thermoplastic insulation compound based on polyvinylchloride (PVC);
– a cold-resistant thermoplastic insulation compound based on polyvinylchloride (PVC);
– a cross-linked silicone rubber insulation compound (SiR).

For the requirements of these compounds, see 4.3.5.

The temperature limits for cables insulated by the above compounds are given in Clause 7.

4.3.2 Colour of insulation

There is no preferred colour for the insulation. The colour of the insulation shall be achieved by the use of coloured compounds or other suitable method.

The insulation, whether coloured or not, may be transparent.

4.3.3 Application to the conductor

The insulation shall be closely applied to the conductor or separator. It shall be possible to remove the insulation 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.

4.3.4 Thickness

The mean value of the thickness of the insulation shall be not less than the specified value in Table 3 and Table 4.

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. Compliance shall be checked by the test given in ▌Ⓒ⟩ 4.1 of EN 50396 ⟨Ⓒ▐.

4.3.5 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 for each type of insulation in:

– IEC 60502-1, Table 15 for EPR or similar; in addition, cables covered by this type of compound shall be subjected to a cold bending or elongation test at –50 °C;
– ▌Ⓒ⟩ EN 50363-4-1, Table 2, TM 2 as a general purpose PVC compound;
– EN 50363-4-1, Table 2, TM 6 as a cold-resistant PVC compound; in addition cables covered with this type of compound shall be subjected to a cold impact test at -35 °C;
– EN 50363-2-1, Table 2, EM 9 as a cross-linked silicone rubber compound ⟨Ⓒ▐.

The applicable test methods and the results to be obtained for each type of insulation are also specified in the above-mentioned tables.

4.4 Marking

4.4.1 Indication of origin

Cables shall be provided with an indication of origin consisting of either

– the manufacturer's identification thread; or
– the continuous marking of the manufacturer's name or trade mark, by printing, or by indenting or embossing on the insulation.

4.4.2 Indication of code designation and cross-sectional area of the conductor

Cables shall be provided with an indication of the code designation according to 6.2 and the cross-sectional area of the conductor "..... mm^2". (See Table 3 and Table 4).

This shall be made by printing or by indenting or embossing on the insulation.

4.4.3 Continuity of marks

The distance between the end of one complete set of marks and the beginning of the next shall not exceed 550 mm.

4.4.4 Durability

Printed markings shall be durable. Compliance with this requirement shall be checked by the test given in [C] 5.1 of EN 50396 [C].

4.4.5 Legibility

All marking 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 solvent.

5 Tests on completed cables

5.1 Electrical properties

5.1.1 General

The cables shall have adequate dielectric strength.

Compliance shall be checked by carrying out the following tests.

5.1.2 Voltage test

A sample of cable shall be immersed in water and then the voltage specified below shall be applied between the conductor and the water, with the following test conditions:

– minimum length of sample: 10 m
– minimum period of immersion in water: 1 h
– temperature of water: 20 °C ± 5 °C
– voltage applied (a.c.): 1 000 V
– duration of application of voltage, minimum: 5 min
– result to be obtained: during test no breakdown shall occur

5.1.3 Spark test

The integrity of the insulation shall be verified by compliance with IEC 62230.

Table 1 – Requirement for test voltages

Tabulated radial thickness of layer under test mm		Test voltage kV			
from	up to	a.c.	d.c.	h.f.	pulse
1,01	1,25	9	13	10 [a]	13
1,26	1,50	10	15	11 [a]	15
1,51	1,75	12	17	13 [a]	17
1,76	2,00	13	20	14 [a]	20
2,01	2,25	14	22	15 [a]	-
2,26	2,50	16	24	17 [a]	-
2,51	2,75	17	26	18 [a]	-
2,76	3,00	19	28	20 [a]	-
[a] h.f. Voltage testing for layer thickness greater than 1,0 mm should be limited to frequencies between 500 Hz and 4 kHz					

The insulation shall exhibit no fault when tested with the above mentioned test method.

5.2 Overall diameter

The mean overall diameter of the cables shall be within the limits specified in Table 3 and 4.

The difference between any two values of the overall diameter of the cables at 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 test given in 〖C〗 4.4 of EN 50396 〖C〗.

5.3 Flexibility test

5.3.1 General

The cables shall be sufficiently flexible in normal use.

5.3.2 Test for cables with copper conductors

Compliance shall be checked by carrying out the test specified in 〖C〗 6.1 of EN 50396 〖C〗.

Before the test, the samples shall be conditioned at 20 °C ± 5 °C for 24 h in a vertical position, after which the test shall be carried out within the same temperature limits.

The mean of the two values of /′ (see 〖C〗 Figure 3 of EN 50396 〖C〗) shall not exceed the values specified in Table 2.

Table 2 – Requirements for the static flexibility test

Nominal cross-sectional area of conductor mm²	Max distance *l'* EPR, PVC and SiR insulation m
16	0,45
25	0,45
35	0,50
50	0,50
70	0,55
95	0,60
120	0,65
150	0,65

5.3.3 Test for cables with aluminium conductors

The test shall be carried out by means of an apparatus shown in Figure 1. This apparatus has a carrier C supporting two pulleys A and B arranged so that the cable is horizontal between the pulleys. The carriers make backward and forward movements over a distance of 1 m, at an approximately constant speed of 0,33 m/s (〈C〉 see also EN 50396 〈C〉).

A sample of flexible cable about 5 m long shall be stretched over the pulleys, as shown in Figure 1, each end being loaded with a weight having a mass of 10 kg. The diameter of the pulleys A and B shall be 120 mm.

The pulleys have a semi-circular shaped groove, the diameter of which is 30 mm. An electrical current of 5 A shall be applied to the sample; the voltage shall be about 230 V, the frequency of which shall be between 48 Hz and 62 Hz.

A total of 2 000 movements (1 000 in each direction) shall be made.

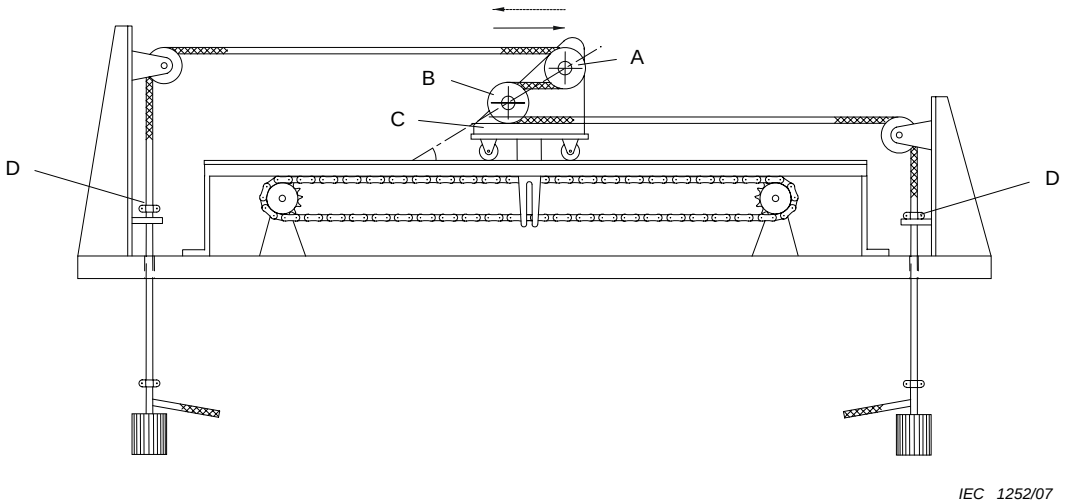


Figure 1 – Flexing apparatus

At the conclusion of the flexing movements no crack shall appear on the insulation. Furthermore, the value of the electrical resistance at the end of the test shall not vary by more than 10 % from the electrical resistance at the beginning of the test.

5.4 Optional clashing test

This test is optional and limited only on PVC insulated cables and carried out according to special national rules or customers requirement.

Cable satisfying the clashing test shall be identified by the manufacturer by printing of the words “Clashing test” on the insulation.

Test shall be carried as described in Annex A.

6 Particular specifications

6.1 General

Each cable shall comply with the appropriate requirements given in Clauses 4 and 5 and the particular requirements of this Clause 6.

6.2 Code designation

Type of insulation and of conductor	Code designation
EPR – Copper	61138 IEC 60110
EPR – Aluminium	61138 IEC 60210
PVC/ST 5 – Copper	〚C〉 H00V-D 〈C〛
PVC/ST 5 – Aluminium	〚C〉 H00V-AD 〈C〛
PVC/ST 11 – Copper	〚C〉 H00V3-D 〈C〛
PVC/ST 11 – Aluminium	〚C〉 H00V3-AD 〈C〛
SiR – Copper	〚C〉 H00S-D 〈C〛
SiR – Aluminium	〚C〉 H00S-AD 〈C〛

6.3 Rated voltage

Not specified, see Clause 1.

6.4 Construction

6.4.1 Conductors

Number of conductors: 1.

The conductor shall comply with the requirements given in Table 3 and 4, column 2.

6.4.2 Insulation

Conductor and separator if any shall be protected by an insulation as specified in 4.3.

The thickness of insulation shall comply with the specified value given in Table 3 and 4, column 3.

6.4.3 Overall diameter

The mean overall diameter shall be within the limits given in Table 3 and 4, columns 4 and 5.

6.5 Tests

Compliance with the requirements of 6.4 shall be checked by inspection and by the tests given in Table 5 for EPR insulated cables, in Table 6 for PVC insulated cables, and in Table 8 for SiR insulated cables.

7 Guide to the use of the cables

These cables shall be exclusively used for portable earthing and short-circuiting equipment (see IEC 61230).

These cables are suitable for indoor and outdoor use within the following temperature limits:

〖C〗 EPR: –40 °C to + 70 °C
TM 2: –5 °C to + 70 °C
TM 6: –25 °C to + 55 °C
EM 9: –40 °C to + 70 °C 〖/C〗

〖C〗 Table 3 – General data for Type 61138 IEC 60110, and types H00V-D, H003V-D, H00S-D 〖/C〗

1	2	3		4		5		
Nominal cross-sectional area of conductor	Maximum diameter of wires in conductor	Thickness of insulation Nominal specified value		Mean overall diameter				
		EPR and PVC	SiR	Lower limit		Upper limit		
				EPR and PVC	SiR	EPR	PVC	SiR
mm²	mm	mm	mm	mm	mm	mm	mm	mm
COPPER								
16	0,21	1,2	1,4	7,1	7,5	8,9	8,6	9,5
25	0,21	1,2	1,4	8,4	8,8	10,6	10,2	11,2
35	0,21	1,2	1,4	9,7	10,1	12,1	11,7	12,7
50	0,31	1,5	1,6	11,7	11,9	14,6	14,2	15,2
70	0,31	1,8	2,1	13,4	14,6	16,8	16,2	17,4
95	0,31	1,8	2,3	15,5	16,5	19,3	18,7	19,9
120	0,31	1,8	2,7	17,1	18,9	21,4	20,6	22,0
150	0,31	1,8	2,8	18,6	20,6	23,3	22,5	24,0

[C] Table 4 – General data for Type 61138 IEC 60210, and types H00V-AD, H003V-AD, H00S-AD [C]

1	2	3		4		5			6
Nominal cross-sectional area of conductor	Maximum diameter of wires in conductor	Thickness of insulation Nominal specified value		Mean overall diameter Lower limit		Mean overall diameter Upper limit			Maximum conductor resistance at 20 °C
		EPR and PVC	SiR	EPR and PVC	SiR	EPR	PVC	SiR	
mm²	mm	mm	mm	mm	mm	mm	mm	mm	Ω/km
ALUMINIUM									
35	0,46	1,2	1,4	9,7	10,1	12,1	11,7	12,7	0,886
50	0,46	1,5	1,6	11,7	11,9	14,6	14,2	15,2	0,616
70	0,46	1,8	2,1	13,4	14,6	16,8	16,2	17,4	0,440
95	0,46	1,8	2,3	15,5	16,5	19,3	18,7	19,9	0,326
120	0,46	1,8	2,7	17,1	18,9	21,4	20,6	22,0	0,254
150	0,46	1,8	2,8	18,6	20,6	23,3	22,5	24,0	0,208

Table 5 – Tests for Types 61138 IEC 60110 and 60210 (EPR insulation)

1	2	3	4	
Reference No.	Test	Category of test	Test method described in	
			[C] IEC publication or EN where shown [C]	Clause or sub-clause
1	***Electrical tests***			
1.1	Resistance of conductors	T, S	[C] EN 50395 [C]	[C] 5 [C]
1.2	Voltage test on completed cable at 1 000 V	T, S	[C] EN 50395 [C]	[C] 6 [C]
1.3	Absence of faults in insulation	R	62230	
2	***Provisions covering constructional and dimensional characteristics***			
2.1	Checking of compliance with constructional provisions	T, S	61138	4
2.2	Measurement of thickness of insulation	T, S	[C] EN 50396 [C]	[C] 4.1 [C]
2.3	Measurement of overall diameter			
2.3.1	Mean value	T, S	[C] EN 50396 [C]	[C] 4.4 [C]
2.3.2	Ovality	T, S	60245-2	1.11
3	***Insulation material tests***	T	60502-1	Tables 15 and 17 [a]
4	***Elasticity at low temperature***			
4.1	Bending test for insulation at – 50 °C	T	60811-1-4	8.2
4.2	Elongation test for insulation at low temperature – 50 °C [b]	T	60811-1-4	8.4
5	***Flexibility test***			
5.1	Cables with copper conductor	T	61138	5.3.2
5.2	Cables with aluminium conductor	T	61138	5.3.3

[a] These tables includes all the test methods and requirements for the material. Material to be tested is taken from the finished cable.

[b] Only applicable if the overall diameter of the cable exceeds the limit specified in the test method.

[C] Table 6 – Tests for types H00V-D, H00V-AD, H00V3-D and H00V3-AD (PVC insulation) [C]

1	2	3	4	
Reference No.	Test	Category of test	Test method described in	
			[C] IEC publication or EN where shown [C]	Clause or sub-clause
1	***Electrical tests***			
1.1	Resistance of conductors	T, S	[C] EN 50395 [C]	[C] 5 [C]
1.2	Voltage test on completed cable at 1 000 V	T, S	[C] EN 50395 [C]	[C] 6 [C]
1.3	Absence of faults in insulation	R	62230	
2	***Provisions covering constructional and dimensional characteristics***			
2.1	Checking of compliance with constructional provisions	T, S	61138	4
2.2	Measurement of thickness of insulation	T, S	[C] EN 50396 [C]	[C] 4.1 [C]
2.3	Measurement of overall diameter			
2.3.1	Mean value	T, S	[C] EN 50396 [C]	[C] 4.4 [C]
2.3.2	Ovality	T, S	[C] EN 50396 [C]	[C] 4.4 [C]
[C] 3	***Insulation material tests***			
3.1	- TM 2 (cable types H00V-D and H00V-AD)	T	EN 50363-4-1	Table 2 [a]
3.2	- TM 6 (cable types H00V3-D and H00V3-AD)	T	EN 50363-4-1	Table 2 [a] [C]
4	***Flexibility test***			
4.1	Cables with copper conductor	T	61138	5.3.2
4.2	Cables with aluminium conductor	T	61138	5.3.3
5	***Clashing test (if required)***	T	61138	Annex A

[a] These tables include all the test methods and requirements for the material. Material to be tested is taken from the finished cable.

[C] Spare [C]

[C] Table 8 – Tests for types H00S-D and H00S-AD (SiR insulation) [C]

1	2	3	4	
Reference No.	Test	Category of test	Test method described in	
			[C] IEC publication or EN where shown [C]	Clause or sub-clause
1	***Electrical tests***			
1.1	Resistance of conductors	T, S	[C] EN 50395 [C]	[C] 5 [C]
1.2	Voltage test on completed cable at 1 000 V	T, S	[C] EN 50395 [C]	[C] 6 [C]
1.3	Absence of faults in insulation	R	62230	
2	***Provisions covering constructional and dimensional characteristics***			
2.1	Checking of compliance with constructional provisions	T, S	61138	4
2.2	Measurement of thickness of insulation	T, S	[C] EN 50396 [C]	[C] 4.1 [C]
2.3	Measurement of overall diameter			
2.3.1	Mean value	T, S	[C] EN 50396 [C]	[C] 4.4 [C]
2.3.2	Ovality	T, S	[C] EN 50396 [C]	[C] 4.4 [C]
[C] 3	***Insulation material tests***	T	EN 50363-2-1	Table 2 [a] [C]
4	***Impact test at –50 ± 2 °C***	T	60811-1-4	8.5
5	***Flexibility test***			
5.1	Cables with copper conductor	T	61138	5.3.2
5.2	Cables with aluminium conductor	T	61138	5.3.3

[a] This table includes all the test methods and requirements for the material. Material to be tested is taken from the finished cable.

[C] *Table deleted* [C]

Annex A
(normative)

Clashing test

A.1 Preparation of test pieces

Three pieces of complete cable each having a length with a minimum of 150 mm shall be taken.

A.2 Apparatus and test conditions

The apparatus to be used for the test is represented in Figure A.1.

The steel intermediate piece has a radius of 0,8 mm.

The apparatus should be placed on a pad of sponge rubber about 40 mm thick.

The test temperature should be 23 °C ± 3 °C.

The mass of the hammer should be 5 kg or 10 kg depending of the cross-section. See Table A.1.

Table A.1 – Height of fall

Nominal cross-section mm²	**Mass of the hammer** kg	**Height *S*** mm
16	5	150
25	5	150
35	5	200
50	5	300
70	5	400
95	10	200
120	10	250
150	10	300

A.3 Procedure

Each test piece shall be placed in position as shown in Figure A.1 and the hammer shall be allowed to fall from the height *S*.

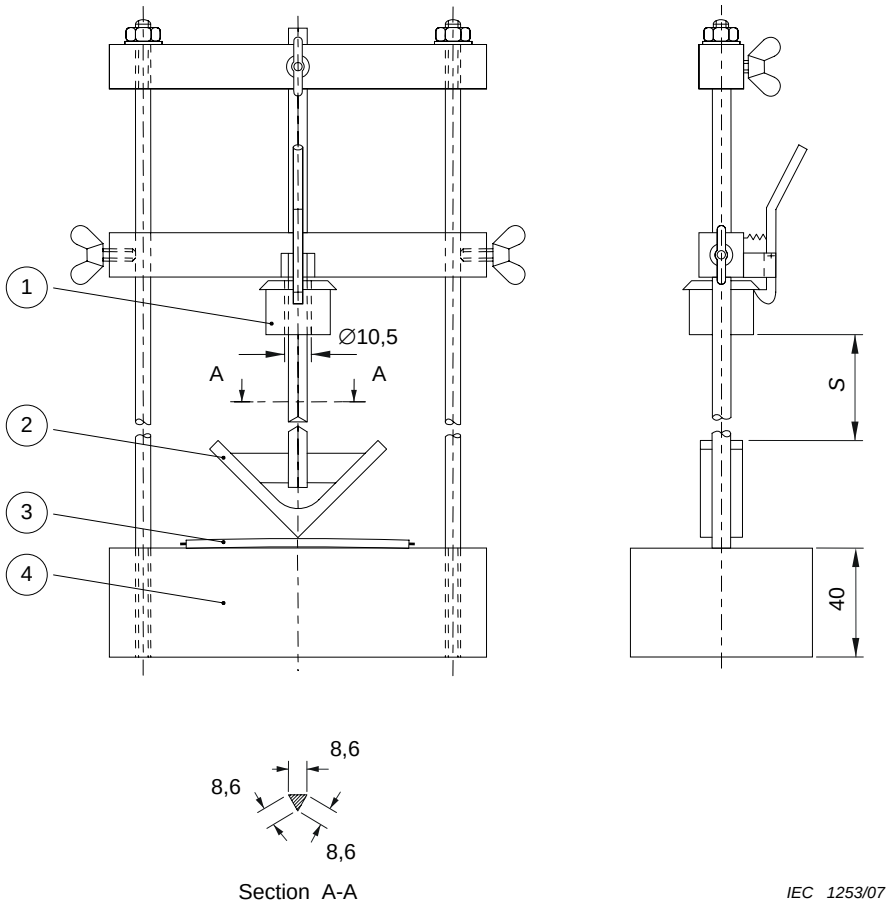
The test piece shall then be examined for cracks and breaks in the insulation. The action of applying torsion to the sample assists in the examination and should be used whenever possible.

If however, it is not possible to apply torsion to the samples in this way, the insulation shall then be cut open in the direction of the axis of the cable. The inside and outside of the insulation shall then be examined.

A.4 Expression of results

Three test pieces shall show no cracks when examined with normal or corrected vision without magnification.

If only one of the three shows cracks, then the test may be repeated on three further test pieces and, if none of these shows cracks the requirements of the test are met, but if any one of the three shows cracks, then the cable or sheath does not comply with the test requirements.



Dimensions in millimetres

Key

1 hammer

2 steel intermediate piece L= 40 x 40 x 5

3 test piece

4 steel base

Figure A.1 – Impact test apparatus (vertical impact)

_____

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
–	–	Insulating, sheathing and covering materials for low voltage energy cables – Part 2-1: Cross-linked elastomeric sheathing compounds	EN 50363-2-1	2005[2)]
–	–	Insulating, sheathing and covering materials for low voltage energy cables – Part 4-1: PVC sheathing compounds	EN 50363-4-1	2005[2)]
–	–	Electrical test methods for low voltage energy cables	EN 50395	2005[2)]
–	–	Non-electrical test methods for low voltage energy cables	EN 50396	2005[2)]
IEC 60228	–[1)]	Conductors of insulated cables	EN 60228 + corr. May	2005[2)] 2005
IEC 60502-1	–[1)]	Power cables with extruded insulation and their accessories for rated voltages from 1 kV (U_m = 1,2 kV) up to 30 kV (U_m = 36 kV) – Part 1: Cables for rated voltages of 1 kV (U_m = 1,2 kV) and 3 kV (U_m = 3,6 kV)	-	-
IEC 60811-1-1	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods - Part 1-1: General application - Measurement of thickness and overall dimensions - Tests for determining the mechanical properties	EN 60811-1-1	1995[2)]
IEC 60811-1-2	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods - Part 1: Methods for general application - Section 2: Thermal ageing methods	EN 60811-1-2	1995[2)]

[1)] Undated reference.

[2)] Valid edition at date of issue.

Publication	Year	Title	EN/HD	Year
IEC 60811-1-3	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods – Part 1-3: General application - Methods for determining the density - Water absorption tests - Shrinkage test	EN 60811-1-3	1995[2)]
IEC 60811-1-4	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods - Part 1: Methods for general application - Section 4: Tests at low temperature	EN 60811-1-4	1995[2)]
IEC 60811-2-1	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods – Part 2-1: Methods specific to elastomeric compounds - Ozone resistance, hot set and mineral oil immersion tests	EN 60811-2-1	1998[2)]
IEC 60811-3-1	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods - Part 3: Methods specific to PVC compounds - Section 1: Pressure test at high temperature - Tests for resistance to cracking	EN 60811-3-1	1995[2)]
IEC 60811-3-2	–[1)]	Insulating and sheathing materials of electric and optical cables - Common test methods - Part 3: Methods specific to PVC compounds - Section 2: Loss of mass test - Thermal stability test	EN 60811-3-2	1995[2)]
IEC 61230 (mod)	–[1)]	Live working - Portable equipment for earthing or earthing and short-circuiting	EN 61230 + A11	1995[2)] 1999
IEC 62230	–[1)]	Electric cables - Spark-test method	EN 62230	2007[2)]

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