

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Power cables with extruded insulation and their accessories for rated voltages above 30 kV ($U_m = 36$ kV) up to 150 kV ($U_m = 170$ kV) – Test methods and requirements

Câbles d'énergie à isolation extrudée et leurs accessoires pour des tensions assignées supérieures à 30 kV ($U_m = 36$ kV) et jusqu'à 150 kV ($U_m = 170$ kV) – Méthodes et exigences d'essai



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CONTENTS

FOREWORD	8
INTRODUCTION	10
1 Scope	11
2 Normative references	11
3 Terms and definitions	13
3.1 Definitions of dimensional values (thicknesses, cross-sections, etc.)	13
3.2 Definitions concerning tests	13
3.3 Other definitions	14
4 Voltage designations, materials and rounding of numbers	15
4.1 Rated voltages	15
4.2 Cable insulating compounds	15
4.3 Cable metal screens/sheaths	15
4.4 Cable oversheathing compounds	16
4.5 Rounding of numbers	16
5 Precautions against water penetration in cables	16
6 Cable characteristics	17
7 Accessories characteristics	18
7.1 Gas immersed cable terminations	18
7.2 Composite insulators for outdoor cable terminations	18
7.3 Accessory characteristics to be declared	18
8 Test conditions	19
8.1 Ambient temperature	19
8.2 High voltage tests	19
8.3 Waveform of lightning impulse test voltages	19
8.4 Relationship of test voltages to rated voltages	19
8.5 Determination of the cable conductor temperature	19
9 Routine tests on cables and accessories	19
9.1 General	19
9.2 Partial discharge test	20
9.3 Voltage test	20
9.4 Electrical test on oversheath of the cable	21
10 Sample tests on cables	21
10.1 General	21
10.2 Frequency of tests	21
10.3 Repetition of tests	21
10.4 Conductor examination	21
10.5 Measurement of electrical resistance of conductor and metal screen	22
10.6 Measurement of thickness of cable insulation and oversheath	22
10.6.1 General	22
10.6.2 Requirements for the insulation	22
10.6.3 Requirements for the cable oversheath	23
10.7 Measurement of thickness of metal sheath	23
10.7.1 General	23
10.7.2 Lead or lead alloy sheath	23
10.7.3 Copper or aluminium sheath	24

10.7.4	Metal tape for CD design	24
10.8	Measurement of diameters	24
10.9	Hot set test for XLPE, EPR and HEPR insulations	24
10.9.1	Procedure	24
10.9.2	Requirements	24
10.10	Measurement of capacitance	25
10.11	Measurement of density of HDPE insulation	25
10.11.1	Procedure	25
10.11.2	Requirements	25
10.12	Lightning impulse voltage test	25
10.13	Water penetration test	25
10.14	Additional tests on components of cables with a longitudinally applied metal tape or foil, bonded to the oversheath	25
11	Sample tests on accessories	26
11.1	Tests on components of accessory	26
11.2	Tests on complete accessory	26
12	Type tests on cable systems	26
12.1	General	26
12.2	Range of type approval	27
12.3	Summary of type tests	28
12.4	Electrical type tests on cable systems	28
12.4.1	Test voltage values	28
12.4.2	Tests and sequence of tests	29
12.4.3	Bending test	29
12.4.4	Partial discharge tests	30
12.4.5	Tan δ measurement	30
12.4.6	Heating cycle voltage test	30
12.4.7	Lightning impulse voltage test followed by a power frequency voltage test	31
12.4.8	Examination	31
12.4.9	Resistivity of semi-conducting screens	32
12.5	Non-electrical type tests on cable components and on complete cable	32
12.5.1	General	32
12.5.2	Check of cable construction	33
12.5.3	Tests for determining the mechanical properties of insulation before and after ageing	33
12.5.4	Tests for determining the mechanical properties of oversheaths before and after ageing	33
12.5.5	Ageing tests on pieces of complete cable to check compatibility of materials	34
12.5.6	Loss of mass test on PVC oversheaths of type ST ₂	34
12.5.7	Pressure test at high temperature on oversheaths	34
12.5.8	Test on PVC oversheaths (ST ₁ , ST ₂) and LSHF oversheaths (ST ₁₂) at low temperature	35
12.5.9	Heat shock test for PVC oversheaths (ST ₁ and ST ₂)	35
12.5.10	Ozone resistance test for EPR and HEPR insulations	35
12.5.11	Hot set test for EPR, HEPR and XLPE insulations	35
12.5.12	Measurement of density of HDPE insulation	35

12.5.13	Measurement of carbon black content of black PE oversheaths (ST ₃ and ST ₇)	36
12.5.14	Test under fire conditions	36
12.5.15	Water penetration test	37
12.5.16	Tests on components of cables with a longitudinally applied metal tape or foil, bonded to the oversheath	37
12.5.17	Shrinkage test for PE, HDPE and XLPE insulations	37
12.5.18	Shrinkage test for PE oversheaths (ST ₃ , ST ₇) and LSHF oversheaths (ST ₁₂)	37
12.5.19	Determination of hardness of HEPR insulation	38
12.5.20	Determination of the elastic modulus of HEPR insulation	38
13	Prequalification test of the cable system	38
13.1	General and range of prequalification test approval	38
13.2	Prequalification test on complete system	39
13.2.1	Summary of prequalification tests	39
13.2.2	Test voltage values	39
13.2.3	Test arrangement	39
13.2.4	Heating cycle voltage test	40
13.2.5	Lightning impulse voltage test	41
13.2.6	Examination	41
13.3	Tests for the extension of the prequalification of a cable system	41
13.3.1	Summary of the extension of prequalification test	41
13.3.2	Electrical part of the extension of prequalification tests on complete cable system	41
14	Type tests on cables	43
14.1	General	43
14.2	Range of type approval	44
14.3	Summary of type tests	44
14.4	Electrical type tests on completed cables	45
15	Type tests on accessories	45
15.1	General	45
15.2	Range of type approval	45
15.3	Summary of type tests	46
15.4	Electrical type tests on accessories	47
15.4.1	Test voltage values	47
15.4.2	Tests and sequence of tests	47
16	Electrical tests after installation	47
16.1	General	47
16.2	DC voltage test of the oversheath	47
16.3	AC voltage test of the insulation	47
Annex A (informative)	Determination of the cable conductor temperature	55
A.1	Purpose	55
A.2	Calibration of the temperature of the main test loop	55
A.2.1	General	55
A.2.2	Installation of cable and temperature sensors	55
A.2.3	Calibration method	57
A.3	Heating for the test	57
A.3.1	Method 1 – Test using a reference cable	57

A.3.2	Method 2 – Test using conductor temperature calculations and measurement of the surface temperature	58
Annex B	(normative) Rounding of numbers	59
Annex C	(informative) List of type, prequalification and extension of prequalification tests for cable systems, cables and accessories	60
Annex D	(normative) Method of measuring resistivity of semi-conducting screens	62
Annex E	(normative) Water penetration test.....	65
E.1	Test piece	65
E.2	Test	65
E.3	Requirements	66
Annex F	(normative) Test for water penetration in the conductor.....	67
F.1	Test piece	67
F.2	Test	67
F.3	Requirements	67
Annex G	(normative) Tests on components of cables with a longitudinally applied metal tape or foil, bonded to the oversheath	69
G.1	Visual examination.....	69
G.2	Adhesion and peel strength.....	69
G.2.1	General	69
G.2.2	Test: Adhesion strength.....	69
G.2.3	Test: Peel strength of overlapped metal foil	70
G.2.4	Requirements	71
Annex H	(normative) Additional tests for accessories.....	73
H.1	General.....	73
H.2	Range of approval.....	74
H.2.1	Range of approval for joints without screen or metal sheath interruption.....	74
H.2.2	Range of approval for joints with screen or metal sheath interruption.....	74
H.2.3	Range of approval for accessories for cable screen interruption and/or earth connection.....	74
H.2.4	Range of approval for terminations with sectionalizing insulation	75
H.3	Tests of joints with or without screen or metal sheath interruption and accessories for cable screen interruption and/or earth connection	75
H.3.1	Water immersion	75
H.3.2	Electrical tests	75
H.4	Tests of terminations with sheath sectionalizing insulation	77
H.4.1	DC voltage withstand test between screen and earth	77
H.4.2	Lightning impulse voltage withstand test between screen and earth.....	77
H.5	Examination	77
H.6	Tests for composite insulators for outdoor terminations.....	78
H.6.1	General	78
H.6.2	Internal pressure test.....	78
H.6.3	Cantilever load test.....	78
Annex I	(normative) Determination of hardness of HEPR insulations.....	79
I.1	Test piece	79
I.2	Test procedure.....	79
I.2.1	General	79
I.2.2	Surfaces of large radius of curvature	79
I.2.3	Surfaces of small radius of curvature	79
I.2.4	Conditioning and test temperature	79

I.2.5	Number of measurements	80
Annex J (informative)	Guidance on examination of cable and accessories	81
Annex K (normative)	Methods of determining the weighted value of the cable for measurement of halogen content	82
K.1	Calculating the weighted value of the cable when the halogen content of individual materials is tested	82
K.2	Preparation of the test sample for measurement of halogen content on a sample representative of the cable construction	82
Bibliography	83
Figure 1	– Example of the test arrangement for the prequalification test	40
Figure 2	– Example of extension of prequalification test arrangement for the prequalification of a system with another joint, designed for rigid as well as flexible installation	42
Figure A.1	– Typical test set-up for the reference loop and the main test loop	56
Figure A.2	– Example of an arrangement of the temperature sensors on the conductor of the reference loop	57
Figure D.1	– Preparation of samples for measurement of resistivity of conductor and insulation screens	64
Figure E.1	– Schematic diagram of apparatus for water penetration test	66
Figure F.1	– Schematic diagram of apparatus for water penetration test in the conductor	68
Figure G.1	– Adhesion of metal tape or foil	70
Figure G.2	– Example of overlapped metal foil	71
Figure G.3	– Peel strength of overlapped metal foil	71
Figure G.4	– Typical strength versus grip spacing curve (1)	72
Figure G.5	– Typical strength versus grip spacing curve (2)	72
Figure I.1	– Test on surfaces of large radius of curvature	80
Figure I.2	– Test on surfaces of small radius of curvature	80
Table 1	– Insulating compounds for cables	48
Table 2	– Oversheathing compounds for cables	48
Table 3	– Tan δ requirements for insulating compounds for cables	48
Table 4	– Test voltages	49
Table 5	– Non-electrical type tests for insulating and oversheathing compounds for cables	49
Table 6	– Test requirements for mechanical characteristics of insulating compounds for cables (before and after ageing)	50
Table 7	– Test requirements for mechanical characteristics of oversheathing compounds for cables (before and after ageing)	51
Table 8	– Test requirements for particular characteristics of insulating compounds for cables	52
Table 9	– Test requirements for particular characteristics of PVC and LSHF oversheathing for cables	53
Table 10	– Maximum mechanical load for composite insulators for outdoor terminations	54
Table C.1	– Type tests on cable systems, on cables and on accessories	60

Table C.2 – Prequalification tests on cable systems with a calculated nominal conductor electric stress above 8,0 kV/mm or a calculated nominal insulation electric stress above 4,0 kV/mm.....	61
Table C.3 – Extension of prequalification tests on cable systems with a calculated nominal conductor electric stress above 8,0 kV/mm or a calculated nominal insulation electric stress above 4,0 kV/mm	61
Table G.1 – Minimum acceptable adhesion or peel strength forces	72
Table H.1 – Test sequence	73
Table H.2 – Lightning impulse voltage withstand test between screen and earth of joints with or without screen or metal sheath interruption and accessories for cable screen interruption and/or earth connection	76
Table H.3 – Lightning impulse voltage withstand test between screen and screen of joints with screen or metal sheath interruption and accessories for cable screen interruption and/or earth connection.....	77
Table H.4 – Lightning impulse voltage withstand tests between screen and earth of terminations with sheath sectionalizing insulation	77

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**POWER CABLES WITH EXTRUDED INSULATION
AND THEIR ACCESSORIES FOR RATED VOLTAGES
ABOVE 30 kV ($U_m = 36$ kV) UP TO 150 kV ($U_m = 170$ kV) –
TEST METHODS AND REQUIREMENTS**

FOREWORD

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International Standard IEC 60840 has been prepared by IEC technical committee 20: Electric cables.

This fifth edition cancels and replaces the fourth edition, published in 2011. This edition constitutes a technical revision.

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

- Gas immersed cable terminations for use at rated voltages above 52 kV are required to be designed, type and routine tested in accordance with IEC 62271-209 in addition to the routine and type tests specified in this document.
- Requirements are introduced for composite outdoor termination insulators.
- The test cylinder diameters specified for the bending test (type and prequalification tests) have been modified in line with IEC TR 61901:2016.
- A low smoke halogen free oversheath material, designated ST₁₂ is introduced.

- Additional tests under fire conditions are introduced: vertical flame spread, smoke density, acidity and conductivity, which shall be applied according to the fire performance declared for the cable.
- A test for water penetration in the conductor is added.
- In addition to tests on the outer protection of joints, type tests on the screen sectionalizing insulation of all accessories have been introduced.

NOTE For a more detailed history of events leading up to this fifth edition, see the Introduction.

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

FDIS	Report on voting
20/1909/FDIS	20/1910/RVD

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

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

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

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INTRODUCTION

The first edition of IEC 60840, published in 1988, dealt only with cables. Accessories were added to the second edition, published in February 1999, which separately covered test methods and test requirements for

- a) cables alone,
- b) cables together with accessories (a cable system).

Some countries then suggested that a better discrimination be made between systems, cables and accessories, particularly for the lower voltages of the scope, for example 45 kV. This was taken into account in the third edition (2004) and has been retained subsequently, giving the type approval requirements and the range of approvals for:

- a) cable systems,
- b) cables alone,
- c) accessories alone.

Manufacturers and users may choose the most appropriate option for type approval.

The fourth edition (2011) introduced the prequalification test procedure, as a cable system inclusive of accessories, for cables with high electrical stresses at the conductor screen and/or insulation screen.

Other significant changes in the fourth edition were:

- a) The clause numbering of this document and IEC 62067 was coordinated to achieve as much commonality as possible.
- b) In the case of the sample test, the lightning impulse voltage test is no longer followed by a power frequency voltage test.

In this fifth edition the principle changes are as follows:

- a) New definitions have been added for three different cable screen designs following IEC TR 61901:2016.
- b) Gas immersed cable terminations for use at rated voltages above 52 kV are required to be designed, type and routine tested in accordance with IEC 62271-209 in addition to the routine and type tests specified in this document.
- c) Requirements are introduced for composite outdoor termination insulators.
- d) The test cylinder diameters specified for the bending test (type and prequalification tests) have been modified in line with IEC TR 61901:2016.
- e) A low smoke halogen free oversheath material, designated ST₁₂ is introduced.
- f) Additional tests under fire conditions are introduced: vertical flame spread, smoke density, acidity and conductivity, which are applied according to the fire performance declared for the cable.
- g) A test for water penetration in the conductor is added.
- h) In addition to tests on the outer protection of joints, type tests on the screen sectionalizing insulation of all accessories have been introduced.
- i) A list of relevant CIGRE references is given in the bibliography.

POWER CABLES WITH EXTRUDED INSULATION AND THEIR ACCESSORIES FOR RATED VOLTAGES ABOVE 30 kV ($U_m = 36$ kV) UP TO 150 kV ($U_m = 170$ kV) – TEST METHODS AND REQUIREMENTS

1 Scope

This document specifies test methods and requirements for power cable systems, cables alone and accessories alone, for fixed installations and for rated voltages above 30 kV ($U_m = 36$ kV) up to and including 150 kV ($U_m = 170$ kV).

The requirements apply to single-core cables and to individually screened three-core cables and to their accessories for usual conditions of installation and operation, but not to special cables, such as submarine cables and their accessories, for which modifications to the standard tests or the setup of special test conditions can be necessary.

This document does not cover transition joints between cables with extruded insulation and paper insulated cables.

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 60060-1:2010, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60228, *Conductors of insulated cables*

IEC 60229:2007, *Electric cables – Tests on extruded oversheaths with a special protective function*

IEC 60230, *Impulse tests on cables and their accessories*

IEC 60287-1-1:2006, *Electric cables – Calculation of the current rating – Part 1-1: Current rating equations (100 % load factor) and calculation of losses – General*

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

IEC 60332-3-24, *Tests on electric and optical fibre cables under fire conditions – Part 3-24: Test for vertical flame spread of vertically-mounted bunched wires or cables – Category C*

IEC 60754-2, *Test on gases evolved during combustion of materials from cables – Part 2: Determination of acidity (by pH measurement) and conductivity*

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

IEC 60811-202:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 202: General tests – Measurement of thickness of non-metallic sheath*
IEC 60811-202:2012/AMD1:2017

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

IEC 60811-401, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 401: Miscellaneous tests – Thermal ageing methods – Ageing in an air oven*

IEC 60811-403, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 403: Miscellaneous tests – Ozone resistance test on cross-linked compounds*

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 60811-501:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 501: Mechanical tests – Tests for determining the mechanical properties of insulation and sheathing compounds*
IEC 60811-501:2012/AMD1:2018

IEC 60811-502:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 502: Mechanical tests – Shrinkage test for insulations*

IEC 60811-503, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 503: Mechanical tests – Shrinkage test for 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 60811-507, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 507: Mechanical tests – Hot set test for cross-linked materials*

IEC 60811-508:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 508: Mechanical tests – Pressure test at high temperature for insulations and sheaths*
IEC 60811-508:2012/AMD1:2017

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 60811-605:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 605: Physical tests – Measurement of carbon black and/or mineral filler in polyethylene compounds*

IEC 60811-606, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 606: Physical tests – Methods for determining the density*

IEC 60885-3, *Electrical test methods for electric cables – Part 3: Test methods for partial discharge measurements on lengths of extruded power cables*

IEC 61034-2, *Measurement of smoke density of cables burning under defined conditions – Part 2: Test procedure and requirements*

IEC 61462:2007, *Composite hollow insulators – Pressurized and unpressurized insulators for use in electrical equipment with rated voltage greater than 1 000 V – Definitions, test methods, acceptance criteria and design recommendations*

IEC 62271-209, *High-voltage switchgear and controlgear – Part 209: Cable connections for gas-insulated metal-enclosed switchgear for rated voltages above 52 kV. Fluid-filled and extruded insulation cables – Fluid-filled and dry-type cable-terminations*

ISO 48-2, *Rubber, vulcanized or thermoplastic – Determination of hardness – Part 2: Hardness between 10 IRHD and 100 IRHD*

3 Terms and definitions

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

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

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

3.1 Definitions of dimensional values (thicknesses, cross-sections, etc.)

3.1.1

nominal value

value by which a quantity is designated and which is often used in tables

Note 1 to entry: Usually, in this document, nominal values give rise to values to be checked by measurements taking into account specified tolerances.

3.1.2

median value

when several test results have been obtained and ordered in an increasing (or decreasing) succession, middle value if the number of available values is odd, and mean of the two middle values if the number is even

3.2 Definitions concerning tests

3.2.1

routine test

test made by the manufacturer on each manufactured component (length of cable or accessory) to check that the component meets the specified requirements

3.2.2

sample test

test made by the manufacturer on samples of completed cable or components taken from a completed cable or accessory, at a specified frequency so as to verify that the finished product meets the specified requirements

3.2.3

type test

test made before supplying on a general commercial basis a type of cable system or cable or accessory covered by IEC 60840, 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, they need not be repeated unless changes are made in the materials, design or type of manufacturing process of cable or accessory which might change the performance characteristics.