IEC 60840

Edition 5.0 2020-05

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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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 ST_{12} 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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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 ST_{12} 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.