

INTERNATIONAL STANDARD

**Halogen-free thermoplastic insulated and sheathed flexible cables of rated voltages up to and including 300/300 V –
Part 2: Test methods**

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Part 2: Test methods**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HALOGEN-FREE THERMOPLASTIC
INSULATED AND SHEATHED FLEXIBLE CABLES
OF RATED VOLTAGES UP TO AND INCLUDING 300/300 V –**

Part 2: Test methods

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International Standard IEC 63010-2 has been prepared by IEC technical committee 20: Electric cables.

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

FDIS	Report on voting
20/1759/FDIS	20/1776/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.

A list of all parts in the IEC 63010 series, published under the general title *Halogen-free thermoplastic insulated and sheathed flexible cables of rated voltages up to and including 300/300 V*, can be found on the IEC website.

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- withdrawn,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.

A bilingual version of this publication may be issued at a later date.

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HALOGEN-FREE THERMOPLASTIC INSULATED AND SHEATHED FLEXIBLE CABLES OF RATED VOLTAGES UP TO AND INCLUDING 300/300 V –

Part 2: Test methods

1 Scope

This part of IEC 63010 specifies test methods that are particular for cables with insulation and sheath based on halogen-free thermoplastic compounds having rated voltage up to and including 300/300 V for use with small devices and for short connections to desktop electrical appliances where flexibility is of prime importance.

General requirements and cable types are specified in IEC 63010-1.

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

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

IEC 63010-1:2017, *Electric cables – Halogen-free thermoplastic insulated and sheathed cables of rated voltage up to and including 300/300 V – Part 1: General requirements and cables*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 63010-1 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>

4 General requirements

4.1 Pre-conditioning

All the tests shall be carried out not less than 16 h after the extrusion of the insulating or sheathing compounds.

4.2 Test temperature

Unless otherwise specified, tests shall be carried out at an ambient temperature of $(20 \pm 5) ^\circ\text{C}$.

4.3 Test voltage

Unless otherwise specified in the individual clause of this document, the test voltage shall be AC of approximately sine wave form and of frequency between 49 Hz and 61 Hz. The ratio of peak value to r.m.s. value shall be equal to $\sqrt{2}$ with a tolerance of $\pm 7\%$.

The values quoted are r.m.s. values.

4.4 Test values

Full test conditions (such as temperatures and durations) and full test requirements are not specified in this document; it is intended that they should be specified by the document dealing with the relevant type of cable.

Any test requirements that are given in this document may be modified by the relevant cable standard to suit the needs of a particular type of cable.

5 Test methods

5.1 Electrical test methods

5.1.1 Long term resistance of insulation to DC

5.1.1.1 Test sample

Carry out the test on a sample of cable of 5 m in length from which all coverings have been removed. Take care to avoid damage to the core(s) during removal of the coverings.

5.1.1.2 Procedure

Immerse the sample, for the period and at the temperature given in Table 4 of IEC 63010-1:2017, in an aqueous solution of sodium chloride having a concentration of 10 g/l, with a length of about 250 mm at each end of the sample projecting above the solution. Connect the negative pole of a 220 V DC supply to the conductor(s) of the sample and the positive pole to a copper electrode immersed in the solution for the time given in the relevant cable standard.

5.1.1.3 Requirement

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

Discoloration of the insulation should be ignored.

5.1.2 Absence of faults in insulation

5.1.2.1 General

Test all the cable that is in the final stage of manufacture, whether it is in delivery lengths or in manufacturing lengths prior to being cut into delivery lengths.

Test all cables with the voltage test in accordance with 5.1.2.3.

The requirements of 4.1 of this document do not apply when the check for absence of faults is carried out as a routine (R) test.

5.1.2.2 Spark test

5.1.2.2.1 Procedure

Carry out the test according to IEC 62230, except that the option to use a pulsed-waveform high-voltage source is not permitted.

5.1.2.2.2 Requirement

No faults shall be detected during the test.

5.1.2.3 Voltage test on cable

5.1.2.3.1 Procedure

With the cable in a dry state and at ambient temperature, apply a voltage of the magnitude given in Table 4 of IEC 63010-1:2017. This voltage may be supplied either from an AC source or from a DC source, between each conductor and all the other conductors.

Increase the voltage gradually and maintain it at the full value for the duration given in Table 4 of IEC 63010-1:2017.

5.1.2.3.2 Requirement

No breakdown of the insulation shall occur during the test.

5.1.3 Surface resistance of sheath

5.1.3.1 Test samples

Carry out the test on three samples of completed cable, each about 250 mm in length.

5.1.3.2 Procedure

Clean the sheath of each of the samples with industrial methylated spirit, and apply to each sample two electrodes, consisting of wire helices of copper wire of between 0,2 mm and 0,6 mm diameter, at a distance of (100 ± 2) mm from each other. After the wire has been applied, clean the surface of the sheath again thoroughly between the electrodes.

Condition the samples with electrodes attached in a conditioning chamber at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) % for 24 h.

Immediately after removal from the conditioning chamber, apply a DC voltage of between 100 V and 500 V between the electrodes, and measure the resistance after 1 min.

Multiply the measured resistance of each sample, in ohms, by $a/100$, where a is the circumference of the sheath of the sample, in millimetres. Record the median of the three values so obtained as the surface resistance of the sheath.

5.1.3.3 Requirement

The surface resistance, as determined in 5.1.3.2, shall be not lower than $10^9 \Omega$.

5.1.4 Voltage test on cores in water

5.1.4.1 Test sample

Prepare a sample of cable 5 m long by carefully removing, without damaging the cores, the sheath or the overall braid and any other covering or filling from a length of completed cable.

5.1.4.2 Procedure

Immerse the sample in water at the temperature, and for the period, specified in Table 4 of IEC 63010-1:2017. Ensure that the ends of the cores protrude above the water by a distance sufficient to prevent excessive surface leakage when the test voltage is applied. Apply a voltage, of the magnitude specified in Table 4 of IEC 63010-1:2017, between the conductors and the water.

5.1.4.3 Requirement

No breakdown of the insulation shall occur during the test.

5.2 Mechanical test methods

5.2.1 Water immersion on sheath

5.2.1.1 General

This test is to demonstrate the effect of water on the mechanical properties of sheathing by determining the tensile strength and elongation at break of the sheathing materials in the unconditioned state as manufactured and in the conditioned state after immersion in water.

The tests on the conditioned and unconditioned test pieces shall be made in immediate succession.

5.2.1.2 Sampling and preparation of test pieces

Prepare test pieces in accordance with the procedure described in IEC 60811-501.

The cross-sectional area of the sample shall be determined before immersion in water.

5.2.1.3 Procedure

Immerse the dumb-bell test pieces in de-ionized water for the time and at the temperature given Table 3 in IEC 63010-1:2017. Following this immersion, allow the test pieces to cool to a temperature of (20 ± 5) °C before removing them from the water. Dry the test pieces with absorbent paper and, within 60 min of drying, measure both the tensile strength and the elongation at break in accordance with the procedure described in IEC 60811-501.

5.2.1.4 Evaluation of results

Calculate the tensile strength and the elongation at break in accordance with the procedure described in IEC 60811-501. The tensile and elongation shall not vary by more than the values specified in Table 3 of IEC 63010-1:2017.

5.3 Chemical test: determination of halogens – elemental test

5.3.1 Warning

Owing to its potentially hazardous nature, the fusion operation should be carried out in a fume cupboard, using a safety screen.

5.3.2 Equipment

- 1) Bunsen burner
- 2) Three small/medium soda glass test tubes (approximately 50 mm × 10 mm)
- 3) Test tube holder
- 4) Evaporating basin/mortar
- 5) Wire gauze
- 6) Funnel
- 7) Filter paper

5.3.3 Materials

- 1) Sample to be analysed
- 2) Sodium metal
- 3) Dilute nitric acid (5 %)
- 4) Aqueous silver nitrate (5 %)
- 5) Dilute ammonia (10 %)
- 6) Freshly made up zirconium-alizarin red S reagent
- 7) Glacial acetic acid
- 8) Acid/pH indicator papers

5.3.4 Procedure

5.3.4.1 Sodium fusion

Place 200 mg to 250 mg of the sample into the bottom of a small soda glass test tube. Add 10 ml of distilled/de-ionized water to the evaporating basin and place this in the fume cupboard behind the safety screen. Whilst holding the test tube firmly with the test tube holder at an angle of 45° to 60° to the vertical, introduce a piece of freshly cut, clean sodium (about the size of a small pea) (200 mg to 250 mg) into the mouth of the test tube without allowing it to come into contact with the sample.

With the safety screen in place, heat the sodium gently until it melts and runs down on to the sample (there can be a vigorous reaction when the molten sodium reaches the sample if halogens are present). Heat the tube gently for about 1 min, then increase the heat until the lower 20 mm of the tube glows red hot. Plunge the red hot tube into the water in the evaporating basin, immediately placing the gauze on top.

NOTE The gauze prevents any loss of material when the tube shatters on contact with the water.

Allow any unreacted sodium to react before grinding up the solution and glass. Filter, and separate the filtrate into two equal portions.

5.3.4.2 Chlorine and bromine

To the first portion of the filtrate, add a sufficient quantity of nitric acid to make the solution acidic. Boil this solution until its total volume has been reduced by half.

NOTE 1 This is to remove any HCN or H₂S, if present, which would interfere with the test.

Add 1 ml silver nitrate solution; a white or yellowish-white precipitate indicates the presence of halogen (Cl, Br) in the original sample.

NOTE 2 If the liquor is decanted, and the precipitate is white and readily soluble in dilute ammonia, then chloride is present.

5.3.4.3 Fluorine

To the second portion of the filtrate, acidify with glacial acetic acid. Boil this solution until its total volume has been reduced by half. Add 2 to 3 drops of freshly prepared zirconium lake reagent, which contains equal volumes of:

- a) alizarin solution: 0,05 g Alizarin Red-S in 50 ml distilled water;
- b) zirconium solution: 0,05 g zirconium nitrate in 10 ml concentrated HCl diluted with 50 ml distilled water.

Heat for 1 h at 40 °C. The presence of fluoride is indicated by the red/pink colouration being bleached to yellow.