IEC 62821-2

Edition 1.0 2015-02

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V –
Part 2: Test methods**

**Câbles électriques – Câbles à isolation et gaine thermoplastique sans halogène à faible dégagement de fumée, de tension assignée au plus égale à 450/750 V –
Partie 2: Méthodes d'essais**

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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ELECTRIC CABLES – HALOGEN-FREE, LOW SMOKE, THERMOPLASTIC INSULATED AND SHEATHED CABLES OF RATED VOLTAGES UP TO AND INCLUDING 450/750 V –

Part 2: Test methods

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International Standard IEC 62821-2 has been prepared by IEC technical committee 20: Electric cables.

The text of this standard is based on the following documents:

FDIS	Report on voting
20/1553/FDIS	20/1566/RVD

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

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

A list of all parts in the IEC 62821 series, published under the general title, *Electric cables – Halogen-free, low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V*, can be found on the IEC website.

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

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- withdrawn,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

ELECTRIC CABLES – HALOGEN-FREE, LOW SMOKE, THERMOPLASTIC INSULATED AND SHEATHED CABLES OF RATED VOLTAGES UP TO AND INCLUDING 450/750 V –

Part 2: Test methods

1 Scope

This part of IEC 62821 specifies test methods which are particular for cables with insulation, and sheath based on halogen-free, thermoplastic compound, and having low emission of smoke and corrosive gases when exposed to fire, of rated voltages U_0/U up to and including 450/750 V a.c.

General requirements are specified in IEC 62821-1 and particular types of flexible cables are specified in IEC 62821-3.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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 62821-1, *Electric cables – Halogen-free low smoke, thermoplastic insulated and sheathed cables of rated voltages up to and including 450/750 V – Part 1: General requirements*

IEC 62821-3, *Electric cables – Halogen-free low smoke thermoplastic insulated and sheathed cables of rated voltage up to and including 450/750 V – Part 3: Flexible cables (cords)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62821-1 apply.

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 made at an ambient temperature of (20 ± 15) °C.

4.3 Test voltage

Unless otherwise specified in the individual clause of this standard or in the product standard, the test voltage shall be a.c. 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 ±7 %.

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

4.4 Test values

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

Any test requirements which are given in this standard 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 d.c. voltage

5.1.1.1 Test sample

Carry out the test on a sample of cable of 5 m length from which all coverings have been removed. The cores of flat unsheathed cords shall not be separated.

For cables having up to five cores, each core shall be tested. For multicore cables having more than five cores, one core of each colour in the cable shall be tested, and where the number of colours is less than 5, duplicate coloured cores shall be tested as necessary to bring the number of cores tested up to a minimum of 5.

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 the relevant cable standard, 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 d.c. 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 single core cables, whether sheathed or unsheathed, by the spark test in accordance with 5.1.2.2. Test all other cables, including sheathed flat cables, with the voltage test in accordance with 5.1.2.3.

The requirements of 4.1 of this standard 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

5.1.2.3.1 Procedure

With the cable in the dry state and at ambient temperature apply a voltage of the magnitude given in the relevant cable standard, supplied either from an a.c. source or from a d.c. source, between each conductor and all the other conductors and, if any, the metallic layer connected to earth.

Increase the voltage gradually and maintain it at the full value for the duration given in the relevant cable standard.

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 d.c. 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 median of the three values so obtained shall be not lower than the value in the cable standard.

5.1.4 Voltage test on cores in water

5.1.4.1 General

The test applies to sheathed cables, braided cables and flat unsheathed cords.

5.1.4.2 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.

In the case of flat unsheathed cord, make a cut in the insulation between the cores and separate the cores by hand over a length of 2 m.

5.1.4.3 Procedure

Immerse the sample in water at the temperature, and for the period, specified in the cable standard. 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 the cable standard between the conductors and the water for the time specified in the cable standard.

5.1.4.4 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 sheath 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 tensile 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 in the relevant standard for the cable sheathing material. 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.

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

– Bunsen burner
– 3 small/medium soda glass test tubes (approximately 50 mm × 10 mm)
– Test tube holder
– Evaporating basin/mortar
– Wire gauze
– Funnel
– Filter paper

5.3.3 Materials

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

5.3.4 Procedure

5.3.4.1 Sodium fusion

Place 200 mg – 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° – 60° to the vertical, introduce a piece of freshly cut, clean sodium (about the size of a small pea) (200 mg – 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, gently heat the sodium until it melts and runs down on to the sample (there may be a vigorous reaction when the molten sodium reaches the sample if halogens are present). Heat the tube gently for about 1 min, then more strongly 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. (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 Identification of the presence of chlorine and/or bromine

To the first portion of the filtrate, add sufficient nitric acid to make the solution acidic. Boil this solution until its total volume has been reduced by half (this is to remove any HCN or H2S, if present, which would interfere with the test). Add 1 ml silver nitrate solution.