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Edition 3.0 2007-10

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electric cables – Tests on extruded oversheaths with a special protective function

Câbles électriques – Essais sur les gaines extérieures extrudées avec fonction spéciale de protection

IEC 60229:2007

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CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTRIC CABLES – TESTS ON EXTRUDED OVERSHEATHS WITH A SPECIAL PROTECTIVE FUNCTION

FOREWORD

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International Standard IEC 60229 has been prepared by IEC technical committee 20: Electric cables.

This third edition cancels and replaces the second edition published in 1982 and constitutes a technical revision.

The significant technical changes with respect to the previous edition are as follows:

– The text has been modified in order to consider the function of the oversheath, irrespective of the way the metallic sheath or screen of the cable is earthed because, in some cases, the oversheath is designed to act not only as a protection against corrosion, but also to reduce the risk of degradation of the cable insulation system. This requirement may be independent of the nature of the insulation and independent of the rated voltage of the cable.
– More precise wording has been introduced regarding the application of some tests (if the sheaths or foils are bonded to the oversheath or not).
– The test requirements have been revised in order to be in line with the standards published after the second edition.

– The pressure test at high temperature has been deleted as the requirement is specified in the relevant cable standards.

– A “Guidance on tests after installation” (Annex B) has been included.

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

FDIS	Report on voting
20/901/FDIS	20/908/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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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- withdrawn,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 – TESTS ON EXTRUDED OVERSHEATHS WITH A SPECIAL PROTECTIVE FUNCTION

1 Scope

This International Standard provides a range of tests which may be required for electric cables which have an extruded oversheath and where that oversheath performs a special protective function.

NOTE 1 The need for the special functions may be independent of the nature of the insulation type or independent of the rated voltage of the cable.

The standard covers cables for use in insulated systems and in uninsulated systems.

The tests are categorized for use as

a) routine tests,

b) type tests,

c) tests after installation.

These tests comprise:

– electrical routine tests on cable oversheath used in insulated or uninsulated systems,

– abrasion and corrosion spread type tests,

– electrical test on cable oversheath after installation.

Routine tests and tests after installation, as specified in the relevant cable standards, are applicable for all situations.

Type tests depend upon the nature of the system and the construction of the cable and do not have to be carried out for normal conditions of use.

The application of the abrasion test is given in Annex A.

NOTE 2 Guidance on tests after installation is given in Annex B.

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.

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

IEC 62230, *Electric cables – Spark test method*

3 Routine tests

The electrical integrity of the oversheath shall be tested using either a d.c. voltage test (3.1) or a spark test (3.2).

NOTE The spark test method is not applicable when a conducting layer is already applied to the oversheath. In such cases only the test according to 3.1 may be used.

Testing is applicable in all cases.

3.1 D.C. voltage test

A d.c. voltage of 8 kV per millimetre of the specified nominal thickness of the extruded oversheath shall be applied for 1 min between the underlying metal layer at negative polarity and the outer conducting layer, subject to a maximum voltage of 25 kV.

No breakdown of the oversheath shall occur during the test.

NOTE The outer conducting layer may consist of a conductive layer applied to the extruded oversheath or obtained by immersion in water for the duration of the test.

3.2 Spark test

A spark test according to the method given in IEC 62230 shall be carried out by earthing the underlying metallic layer for an a.c. test or connecting it to the negative pole in the case of a d.c. supply. The voltages shall be 6 kV a.c. per millimetre or 9 kV d.c. per millimetre of the specified nominal thickness of the extruded oversheath, subject to maximum values of 15 kV a.c. and 25 kV d.c., respectively.

The dwell time of the cable in the region of test shall be of sufficient duration to detect any defect.

No faults shall be detected during the test.

4 Type tests

4.1 Abrasion test

4.1.1 Purpose

The purpose of this test is to demonstrate that the extruded oversheath will withstand abrasion during the laying operation.

The abrasion test shall be carried out if the oversheath material is not of type ST1, ST2, ST3 or ST7 compound and if the thickness does not comply with the particular IEC cable standard.

4.1.2 Test procedure

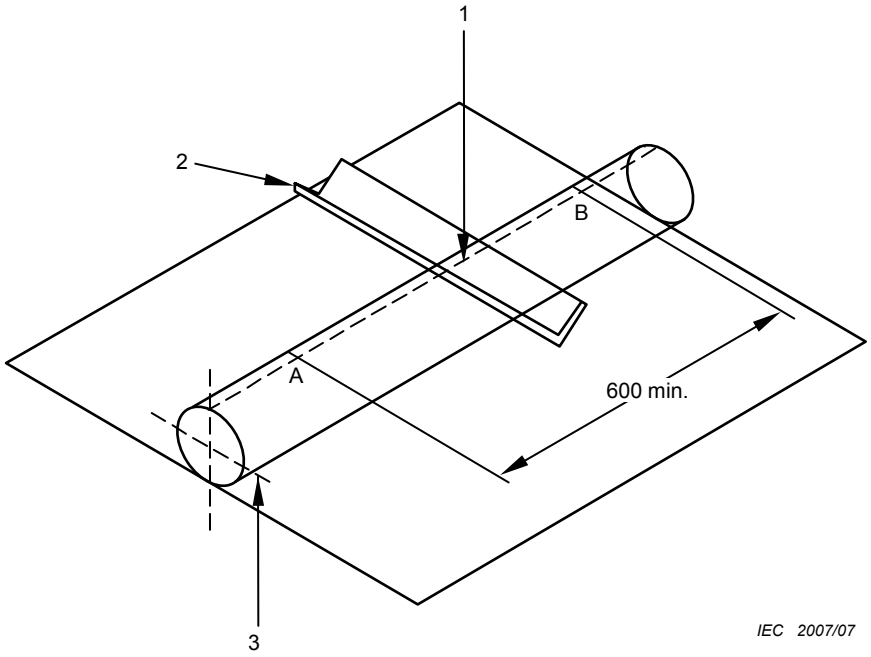
A sample of the cable, of sufficient length, shall be submitted to the bending operation given in the bending test, as specified in the particular IEC cable standard.

After bending, the procedure specified in 4.1.2.1 shall be carried out at a temperature of (20 ± 5) °C for cases a) and b), as described in Annex A. This shall be followed by the electrical test in 4.1.2.2 for case a) only.

4.1.2.1 Abrasion

The sample of cable shall be laid out straight and horizontal on a firm base, with the plane of the previous bending operation in the horizontal plane. In the middle of the sample and perpendicular to it, a length of mild steel angle shall be placed horizontally, at right angles to the cable, with its angle edge resting on the cable and with its arms symmetrical about the vertical plane through the longitudinal axis of the cable. The outer radius of curvature of the angle edge shall be not less than 1 mm and not greater than 2 mm (see Figure 1).

Dimensions in millimetres



Key

1	force (see Table 1)	A	start/finish position
2	mild steel angle	B	finish/start position
3	plane of bending	A-B	test path length (minimum)

Figure 1 – Abrasion test

The steel angle shall be vertically loaded, above the point of contact, with a force in accordance with Table 1.

The steel angle shall be dragged horizontally along the cable for a distance not less than 600 mm at a speed of between 150 mm/s and 300 mm/s. The direction of movement shall be reversed at the end of each pass to give 50 passes, 25 in each direction over the 600 mm test path.

Table 1 – Vertical force on steel angle

Overall measured diameter of cable mm		**Force** N
Above and including	**Up to**	
30	40	65
40	50	105
50	60	155
60	70	210
70	80	270
80	90	340
90	100	420
100	110	500
110 and above		550

4.1.2.2 Electrical test

The middle of the cable sample, conditioned as above, shall be submerged at ambient temperature in a 0,5 % by weight solution of sodium chloride in water containing approximately 0,1 % by weight of a suitable non-ionic surface active agent.

After at least 24 h of constant immersion, a d.c. voltage of 20 kV shall be applied for a period of 1 min between the saline solution and the underlying metal layer which shall be at negative polarity.

With the middle of the cable still submerged at ambient temperature in the sodium chloride solution, apply 10 positive, followed by 10 negative impulse voltages, in accordance with IEC 60230, and Table 2:

Table 2 – Impulse test voltage

Rated lightning impulse withstand voltage of main insulation voltage (peak) kV	Impulse test voltage (peak) kV
$V \leq 325$	30
$325 < V \leq 750$	37,5
$750 < V < 1\,175$	47,5
$1\,175 \leq V < 1\,550$	62,5
$V \geq 1\,550$	72,5

4.1.3 Inspection

The cable sample shall be taken (from the solution if test following 4.1.2.2 is performed) and a 1 m length, which includes the abraded area of the extruded oversheath, shall be removed, employing two longitudinal cuts which do not pass through the conditioned area. The test sample shall be cleaned of foreign material.

4.1.4 Performance requirement

The oversheaths shall be deemed satisfactory provided that

a) the electrical test has been passed, where required, and

b) an examination of the sample with normal or corrected vision without magnification reveals no cracks or splits in the internal and external surfaces.

4.2 Corrosion spread (aluminium metallic screen only)

4.2.1 General

The corrosion spread test is relevant in the case of aluminium wires, aluminium sheaths and aluminium foils when not bonded to the oversheath. It is not applicable in the case of aluminium sheaths or foils bonded to the oversheath.

The purpose is to demonstrate that, in the event of local damage to an oversheath, any consequential corrosion of the outer surface of the aluminium screen will remain virtually confined to the damaged area of covering.

4.2.2 Test procedure

a) Bending operation

   A sample of cable shall be submitted to the bending procedure of the bending test, as specified in the particular IEC cable standard.

b) Local damage

The oversheath shall be punctured down to the aluminium sheath or wires, in four places, by means of a core drill of 10 mm diameter. These four holes shall be arranged spirally about the mid-portion of the cable sample, at longitudinal intervals of about 100 mm and circumferential spacings of 90°. All material shall be removed from each hole to expose the 10 mm diameter of bare aluminium.

c) Corrosion procedure

The sample shall be formed into a U-shape with the curved portion having a radius of curvature not greater than specified in the bending operation above. The curved portion shall be submerged in a 1 % solution of sodium sulphate in water at ambient temperature, with the cable ends in the air. All four holes shall be submerged to a depth of at least 500 mm in the solution. With a d.c. voltage applied between the metallic screen and the solution and with metallic screen at negative polarity, a current of 10 mA shall flow for a total period of (100 ± 2) h. This value of current shall be maintained substantially constant. This may be achieved by the inclusion of a series resistor, resistance value of about 10 kΩ, in the electrical circuit. If two or more samples are electrically tested simultaneously, each sample shall be independently controlled (for example by being connected through its own series resistor).

4.2.3 Inspection

The cable sample shall be taken from the solution and the oversheath removed for a length of about 500 mm, extending to at least 100 mm beyond each of the outer holes. All other material in this region shall be removed from the metallic screen to expose bare aluminium.

4.2.4 Performance requirement

The oversheath shall be deemed satisfactory provided that, by examination with normal or corrected vision without magnification, there are no signs of corrosion extending more than 10 mm beyond the rim of any hole at any point.

5 Electrical test after installation

Where an ‘after installation’ test of the oversheath is performed, a d.c. voltage of 4 kV per millimetre of specified thickness of extruded oversheath shall be applied with a maximum of 10 kV d.c. between the underlying metallic layers and the outer electrode, for a period of 1 min. All metallic layers under the oversheath shall be connected together.

This test requires that the oversheath has an outer “electrode” which may be moist backfill or a conductive layer.

No breakdown of the oversheath shall occur during the test.