IEC TR 61901

Edition 2.0 2016-05

TECHNICAL REPORT

Tests recommended on cables with a longitudinally applied metal foil for rated voltages above 30 kV (U_m = 36 kV) up to and including 500 kV (U_m = 550 kV)

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TESTS RECOMMENDED ON CABLES WITH A LONGITUDINALLY APPLIED METAL FOIL FOR RATED VOLTAGES ABOVE 30 kV (U_m = 36 kV) UP TO AND INCLUDING 500 kV (U_m = 550 kV)

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IEC TR 61901, which is a Technical Report, has been prepared by IEC technical committee 20: Electric cables.

This second edition cancels and replaces the first edition, published in 2005. This edition constitutes a technical revision.

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

a) Recommendations on the tests to be performed at the different stages of the cable and cable system qualification (development tests, type tests, sample tests, routine tests, after installation tests) have been provided.

b) The performance level of the tests related to the longitudinally applied metal foil which depends on the cable design has been detailed.

c) Three cable designs that represent the world production of cables with longitudinally applied metal foil have been detailed.

d) A test on the weld design has been included, following the appearance of a new cable design with smooth and longitudinally welded aluminium foil (referred to in this document as combined design).

e) An examination of the cable at the end of the type test has been included.

f) The cable system approach (cable with installed accessories) has been considered and a short circuit test with accessories has been introduced.

The text of this Technical Report is based on the following documents:

Enquiry draft	Report on voting
20/1551/DTR	20/1621/RVC

Full information on the voting for the approval of this Technical Report 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 stability date indicated on the IEC website 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- withdrawn,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.

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

INTRODUCTION

Numerous technical improvements have appeared on laminated coverings since 1992 and the publication of CIGRE Electra 141[1][1], in parallel with service experience. In 2006, CIGRE requested an upgrade of Electra 141 which was issued in February 2011 as Technical Brochure 446[2].

This new data was analysed and resulted in the revision of the first edition of IEC TR 61901.

1 Numbers in brackets refer to the Bibliography.

TESTS RECOMMENDED ON CABLES WITH A LONGITUDINALLY APPLIED METAL FOIL FOR RATED VOLTAGES ABOVE 30 kV (U_m = 36 kV) UP TO AND INCLUDING 500 kV (U_m = 550 kV)

1 Scope

IEC TR 61901, which is a Technical Report, specifies test methods and requirements for power cable systems, cables with extruded insulation and their accessories for fixed installations, for rated voltages above 30 kV (U_m = 36 kV) up to and including 500 kV (U_m = 550 kV).

The requirements apply to single-core cables and to their accessories for usual conditions of installation and operation, but not to special cables and their accessories, such as submarine cables, for which modifications to the tests may be necessary or special test conditions may need to be devised.

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.

There are no normative references in this document.

3 Terms and definitions

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

3.1 Definitions concerning the tests

3.1.1
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

3.1.2
sample test
test made by the manufacturer on samples of complete cable or components taken from a complete cable or accessory, at a specified frequency, so as to verify that the finished product meets the specified requirements

3.1.3
development test
test made during the development of the cable system

3.1.4
type test
test made before supplying on a general commercial basis a type of cable system in order to demonstrate satisfactory performance characteristics to meet the intended application

Note 1 to entry: Once successfully completed, these tests need not be repeated, unless changes are made in the cable or accessory materials, or design or manufacturing process which might change the performance characteristics.

3.1.5
prequalification test
test made before supplying on a general commercial basis a type of cable system in order to demonstrate satisfactory long term performance of the complete cable system

3.1.6
electrical test after installation
test made to demonstrate the integrity of the cable system as installed

3.2 Definitions concerning cable design

NOTE The following explanations are definitions of general designs types and not related to any specific construction specified in any IEC standard. Technological advances may lead to developments of these examples.

3.2.1
combined design
CD
metal screen that combines radial watertightness and electrical properties

Note 1 to entry: More details are given in Clause A.1.

3.2.2
separate design
SD
design with radial watertightness and electrical properties, managed by different metal components

Note 1 to entry: More details are given in Clause A.2.

3.2.3
separate semi-conductive design
SscD
design with separated electrical and radial watertightness properties with semi-conductive plastic coated foil

Note 1 to entry: More details are given in Clause A.3.

3.3 Other definitions

3.3.1
cable system
cable with installed accessories including components used for thermomechanical restraint of systems limited to those used for terminations and joints only

4 Development tests

4.1 Tests on cables

4.1.1 Impact test

There are three classes for resistance of the cable sheath to mechanical impact depending on the design and installation conditions of the cable, see Table 1.

Table 1 – Impact test requirements

Impact test	Design CD	Design SD	Design SscD [a]
Height (m)	0,27	1	N/A
Weight (kg)	27	5	N/A
Radius (*R*) (mm)	1	2	N/A
Number of impacts per location	4 impacts per location	1 impact per location	N/A
Number of locations	2 different points (see Figure 2 for locations)	5 different points more than 100 mm apart	N/A
[a] Impact test is not needed as this cable design is not intended to be directly buried.			

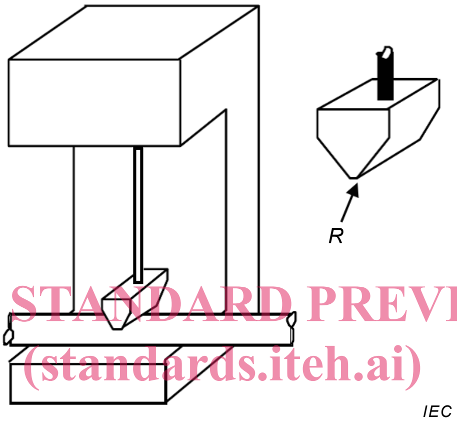


Figure 1 – Test apparatus for the impact test

Sample: A piece of cable, at least 1 m in length.

Test:

a) Test on CD design

The cable should be installed on a rigid metal base.

The test should be undertaken at a temperature of (20 ± 15) °C using a weighted metal of 27 kg, wedge of 90°, falling onto the cable from a height of 0,27 m. The wedge should have a radius of curvature of R = 1 mm at the point of impact and its axis should be perpendicular to that of the cable (Figure 1).

The requirements for the impact test are presented in Table 1.

The test should be performed on the overlap or on the welded seam (Impact point A) and on the opposite side of the cable (Impact point B) (see Figure 2).

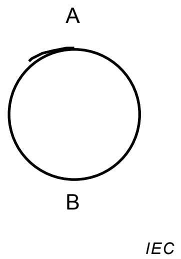


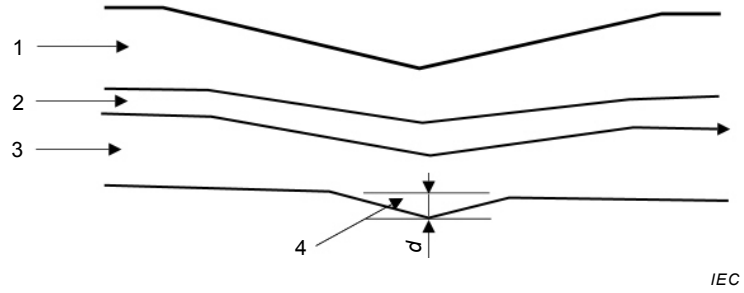
Figure 2 – Positions of the points of impact

Result: Visual inspection and measurement of impact depth.

After the impacts, the sample should be cut longitudinally along two lines at 90° from the points of impact. The inner side of the metal screen or metal sheath should be examined with normal vision:

– there should be no puncture at the points of impact A and B;

– a longitudinal cut should be made through the points of impact A and B (Figure 3). The insulation should not be deformed by more than 1 mm (distance *d,* see Figure 3) and should not show a deflection having a sharp angle into the insulation at the point of impact.



Key

1 oversheath

2 screen or metal sheath

3 outer semiconductive layer

4 penetration into the insulation

Figure 3 – Deformation at the impact points to be examined

b) Test on SD design

The cable, at least 1 m in length, should be installed on a rigid metallic base. The test should be undertaken at (20 ± 15) °C using a weighted metal wedge of 5 kg falling onto the cable from a height of 1 m. The 90° wedge should have a radius of curvature of R = 2 mm at the point of impact and its axis should be perpendicular to that of the cable (Figure 1).

An impact should be successively made at five different points along the cable; the distance between any two impact points should be at least 100 mm.

Result: Visual inspection

A 1 m sample should be dissected and visually examined. Examination of the samples with normal or corrected vision without magnification should reveal no cracks or separation of the metal foil of laminated protective coverings or harmful damage to other parts of the cable.

c) Test on SscD design

No test is needed due to the specific installation conditions.

4.1.2 Abrasion test

The abrasion test should be carried out if the oversheath material is not of type ST2 (PVC) or ST7 (MDPE – HDPE) as mentioned in IEC 60840[3] and IEC 62067[4].

The abrasion test should be performed on new materials, where satisfactory feedback on abrasion resistance from operation has not been provided.

Test:

A complete piece of cable should be tightly fixed to a metal base.