



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)

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.060.20

ISBN 978-2-8322-3386-3

Warning! Make sure that you obtained this publication from an authorized distributor.

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions	7
3.1 Definitions concerning the tests	7
3.2 Definitions concerning cable design.....	8
3.3 Other definitions.....	8
4 Development tests	8
4.1 Tests on cables.....	8
4.1.1 Impact test.....	8
4.1.2 Abrasion test.....	10
4.1.3 Sidewall loading test	11
4.1.4 Long-term ageing of adhesive bonds of components of laminated covering.....	13
4.1.5 Mechanical properties of the weld (case of CD design)	13
4.2 Tests on cable systems	14
4.2.1 General	14
4.2.2 Short-circuit test.....	15
4.2.3 Corrosion at the accessories	18
5 Type tests	18
5.1 Test on cables – Bending test.....	18
5.2 Tests on cable system.....	19
6 Sample test on cables.....	19
6.1 Adhesion and peel strength of the laminated metal foil.....	19
6.2 Electrical properties and dimensions.....	21
7 Routine tests	21
8 After installation tests	21
Annex A (informative) Details on cable designs given in 3.2.....	22
A.1 Combined design (CD)	22
A.2 Separate design (SD).....	22
A.3 Separate semi-conductive design (SscD).....	23
Bibliography	25
Figure 1 – Test apparatus for the impact test.....	9
Figure 2 – Positions of the points of impact	9
Figure 3 – Deformation at the impact points to be examined	10
Figure 4 – Test arrangement for the abrasion test.....	11
Figure 5 – Sidewall loading test arrangements.....	12
Figure 6 – Test arrangement for the measurement of the mechanical properties of the weld .	14
Figure 7 – Short-circuit test arrangement for three kinds of joints.....	16
Figure 8 – Adhesion of metal foil	20
Figure 9 – Example of overlapped metal foil	21
Figure 10 – Peel strength of overlapped metal foil	21

Figure A.1 – Example of combined design 500 kV cable	22
Figure A.2 – Example of separate design 400 kV cable.....	23
Figure A.3 – Example of separate semi-conductive design 275 kV cable	24
Table 1 – Impact test requirements	9
Table 2 – Maximum acceptable sidewall loadings	11
Table 3 – Minimum acceptable adhesion or peel strength forces	19

INTERNATIONAL ELECTROTECHNICAL COMMISSION

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)

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

The main task of IEC technical committees is to prepare International Standards. However, a technical committee may propose the publication of a Technical Report when it has collected data of a different kind from that which is normally published as an International Standard, for example "state of the art".

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.