

INTERNATIONAL STANDARD

**Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) –
Part 4: Test requirements on accessories for cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)**

IECNORM.COM : Click to view the full PDF of IEC 60502-4:2023



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

IECNORM.COM : Click to view the full PDF of IEC 60502-1:2023

INTERNATIONAL STANDARD

**Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) –
Part 4: Test requirements on accessories for cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.060.20

ISBN 978-2-8322-7701-0

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

CONTENTS

FOREWORD	4
1 Scope	6
2 Normative references	6
3 Terms and definitions	7
4 Types of accessories	9
5 Voltage designations and maximum conductor temperatures	9
5.1 Rated voltages	9
5.2 Maximum conductor temperatures	9
6 Components	9
6.1 Connectors	9
6.2 Materials	9
7 Assembly of accessories to be tested	10
7.1 Identification	10
7.1.1 Cables	10
7.1.2 Connectors	10
7.1.3 Accessories	10
7.2 Installation and connections	10
7.2.1 General	10
7.2.2 Non-range-taking terminations, joints and stop ends	10
7.2.3 Range-taking terminations, joints and stop ends	11
7.2.4 Separable connectors	11
7.2.5 Assembly	12
7.2.6 Conditioning	12
7.2.7 Terminations	12
7.2.8 Terminal boxes	12
7.2.9 Joints and stop ends	13
7.2.10 Separable connectors	13
7.2.11 Set-up	13
7.2.12 Test arrangements and number of samples	13
8 Range of approval	13
8.1 General	13
8.2 Cable	14
8.3 Three-core to single-core accessory	14
8.4 Non-range-taking terminations, joints and stop ends	15
8.5 Range-taking terminations, joints and stop ends	15
8.6 Terminations in terminal boxes	16
8.7 Separable connectors	16
9 Test sequences	16
9.1 General	16
9.2 Dynamic short-circuit performance	17
10 Test results	17
10.1 General remarks	17
10.2 Test reports	18
10.3 Failures	18
10.3.1 Accessory failure	18
10.3.2 Cable failure	18

10.3.3 Bushing failure.....	18
11 Visual examination	19
Annex A (normative) Identification of test cable	34
Annex B (normative) Identification of connector	35
Annex C (normative) Visual examination.....	36
C.1 Method	36
C.2 Examination sheet	36
Bibliography.....	37
 Figure 1 – Test arrangements and number of samples for terminations (see Table 9)	29
Figure 2 – Test arrangements and number of samples for straight, branch or loop joints (see Table 10)	30
Figure 3 – Test arrangements and number of samples for stop ends (see Table 11)	31
Figure 4 – Test arrangements and number of samples for screened deadbreak separable connectors (see Table 12)	32
Figure 5 – Test arrangements and number of samples for unscreened deadbreak separable connectors (see Table 13)	33
 Table 1 – Compliance and qualification scheme for non-range-taking terminations, joints and stop ends	11
Table 2 – Compliance and qualification scheme for range-taking terminations, joints, and stop ends	11
Table 3 – Test cable conductor cross-sections for separable connectors	12
Table 4 – Range of approval for cable insulation.....	14
Table 5 – Extension of compliance from a three-core accessory to a single-core accessory of the same design	15
Table 6 – Extension of compliance and qualification scheme for non-range-taking terminations, joints and stop ends.....	15
Table 7 – Extension of compliance and qualification scheme for range-taking terminations, joints, and stop ends.....	16
Table 8 – Test sequences	17
Table 9 – Test sequences and requirements for terminations.....	20
Table 10 – Test sequences and requirements for straight, branch or loop joints.....	21
Table 11 – Test sequences and requirements for stop ends.....	22
Table 12 – Test sequences and requirements for screened deadbreak separable connectors	23
Table 13 – Test sequences and requirements for unscreened separable connectors (excluding shrouded terminations)	24
Table 14 – Additional tests for smaller conductor cross-sectional areas	25
Table 15 – Additional tests for separable connector compliance extension to largest cable cross-section	26
Table 16 – Summary of tests	27
Table 17 – Summary of test voltages (see Clause 9)	28

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**POWER CABLES WITH EXTRUDED INSULATION AND
THEIR ACCESSORIES FOR RATED VOLTAGES FROM
1 kV ($U_m = 1,2$ kV) UP TO 30 kV ($U_m = 36$ kV) –****Part 4: Test requirements on accessories for cables with
rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ 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 free from 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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch> shall not be held responsible for identifying any or all such patent rights.

IEC 60502-4 has been prepared by IEC technical committee 20: Electric cables. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2010. This edition constitutes a technical revision.

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

- a) Terminations, joints and stop ends are now characterized as either non-range-taking or range-taking and are tested accordingly.

- b) Introduction of the 240 mm² conductor size for testing non-range-taking terminations, joints and stop ends.
- c) Introduction of the 2 500 A separable connector size in Table 3 and the method of testing in Figure 5.
- d) Introduction of dynamic short-circuit classes 0, 1, 2 and 3 in 9.2.
- e) Introduction of specific requirements for test reports in Clause 10 and Clause 11 and specific recording sheets for cables, connectors and examination in Annex A, Annex B and Annex C.
- f) Option to use 2 U_0 for partial discharge testing and removal of DC testing from Table 9, Table 10, Table 11, Table 12, Table 13 and Table 14.

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

Draft	Report on voting
20/2110/FDIS	20/2133/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60502 series, published under the general title *Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV)*, 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 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.

**POWER CABLES WITH EXTRUDED INSULATION AND
THEIR ACCESSORIES FOR RATED VOLTAGES FROM
1 kV ($U_m = 1,2$ kV) UP TO 30 kV ($U_m = 36$ kV) –**

**Part 4: Test requirements on accessories for cables with
rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)**

1 Scope

This part of IEC 60502 specifies the test requirements for type testing of accessories for power cables with rated voltages from 3,6/6 (7,2) kV up to 18/30 (36) kV, complying with IEC 60502-2 or other relevant cable standards.

Accessories for special applications, such as aerial cables, submarine or ship cables or hazardous situations (explosive environments, fire-resistant cables or seismic conditions), are not included.

It is not necessary to repeat these tests, once successfully completed, unless changes are made in the materials, design or manufacturing process which can affect the performance characteristics.

Test methods are included in IEC 61442.

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 60183, *Guide to the selection of high-voltage AC cable systems*

IEC 60502-2:2014, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) – Part 2: Cables for rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)*

IEC 61238-1-3, *Compression and mechanical connectors for power cables – Part 1-3: Test methods and requirements for compression and mechanical connectors for power cables for rated voltages above 1 kV ($U_m = 1,2$ kV) up to 30 kV ($U_m = 36$ kV) tested on non-insulated conductors*

IEC 61442:2023, *Test methods for accessories for power cables with rated voltages from 6 kV ($U_m = 7,2$ kV) up to 30 kV ($U_m = 36$ kV)*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

connector

device for connecting a conductor to an equipment terminal or for connecting two or more conductors to each other

[SOURCE: IEC 60050-461:2008, 461-17-03 [1], modified – "metallic" has been deleted and "to connect cable conductors together" has been replaced with "for connecting a conductor to an equipment terminal or for connecting two or more conductors to each other".]

3.2

termination

device fitted to the end of a cable to ensure electrical connection with other parts of the system and to maintain the insulation up to the point of connection

[SOURCE: IEC 60050-461:2008, 461-10-01]

3.3

indoor termination

termination intended for use where it is not exposed to either solar radiation or weathering

3.4

outdoor termination

termination intended for use where it is exposed to either solar radiation or weathering or both

3.5

terminal box

air- or compound-filled box fully enclosing a termination

[SOURCE: IEC 60050-461:2008, 461-10-03, modified – "air- or compound-filled" has been added, "enclosing a cable termination and forming a part thereof" has been replaced with "fully enclosing a termination" and the Note has been deleted.]

3.6

shrouded termination

indoor termination with additional insulation at the bushing connection and used in an air-filled terminal box

3.7

straight joint

accessory making a connection between two cables to form a continuous circuit

[SOURCE: IEC 60050-461:2008, 461-11-01]

3.8

branch joint

accessory making a connection of a branch cable to a main cable

[SOURCE: IEC 60050-461:2008, 461-11-17]

3.9

transition joint

straight or branch joint making a connection between cables having different types of insulation

[SOURCE: IEC 60050-461:2008, 461-11-04, modified – "accessory" has been replaced with "straight or branch joint" and "two" has been deleted.]

3.10

stop end

accessory providing a means of insulating the unconnected end of an energized cable

[SOURCE: IEC 60050-461:2008, 461-10-07, modified – The preferred terms "pot end" and "insulating cap" have been deleted and "insulating device to terminate" has been replaced with "accessory providing a means of insulating".]

3.11

separable connector

fully insulated termination permitting the connection and the disconnection of a cable to other equipment

3.12

screened separable connector

separable connector which has a fully screened external surface

3.13

unscreened separable connector

separable connector which does not have an external screen

3.14

plug-in type separable connector

separable connector in which the electrical contact is made by a sliding device

3.15

bolted type separable connector

separable connector in which the electrical contact is made by a bolted device

3.16

deadbreak separable connector

separable connector designed to be connected and disconnected on de-energized circuits only

3.17

range-taking accessory

accessory designed to take more than one cross-section of cable

3.18

metallic housing

metal enclosure in intimate contact with the outer screen of a separable connector and having at least the same current carrying capacity to earth as the metallic screen of the cable with which the separable connector is used

3.19

loop joint

accessory making an end connection between two parallel cables to form a continuous circuit constructed as a branch joint with the single end replaced with a stop end

4 Types of accessories

The accessories covered by this document are listed below:

- indoor and outdoor terminations of all designs, including terminal boxes;
- straight joints, branch joints and stop ends of all designs, suitable for use underground or in air;
- screened or unscreened plug-in type or bolted type separable connectors.

NOTE Transition joints connecting cables with extruded insulation to paper-insulated cables are not included in the scope of this document. The requirements for these accessories are dealt with in the IEC 60055 series [2]¹.

5 Voltage designations and maximum conductor temperatures

5.1 Rated voltages

The rated voltages U_0/U (U_m) of accessories considered in this document are given in IEC 60502-2:2014, 4.1.

For a given application, the rated voltage of an accessory shall be consistent with that of the cable, and shall be suitable for the operating condition of the system in which they are used, in accordance with the recommendations of IEC 60183.

5.2 Maximum conductor temperatures

The accessories shall be suitable for use on cables having the conductor temperatures specified in IEC 60502-2:2014, 4.2 for normal operation.

The maximum conductor temperatures of the cables under short-circuit conditions are given in IEC 60502-2:2014, Table 3.

6 Components

6.1 Connectors

Connectors used within the accessory shall comply with IEC 61238-1-3, or with another relevant standard or specification when agreed between either the manufacturer or supplier and the customer. All connectors shall be identified in accordance with Annex B.

6.2 Materials

It is not a prerequisite for compliance with this document that any component material (resin, heat-shrink tubing, etc.) should be subject to any form of individual type testing.

If type testing of resins, pressure sensitive adhesive tapes and flexible insulating sleeveings for electrical purposes is required, reference should be made to the relevant standards developed by IEC technical committee 15, as listed for information in the Bibliography [3], [4], [5].

¹ Numbers in square brackets refer to the Bibliography.

The term "material characterization" is sometimes used in conjunction with both type testing and fingerprinting of component materials, but it is undefined, and its use should therefore be avoided.

7 Assembly of accessories to be tested

7.1 Identification

7.1.1 Cables

Cables used for testing shall comply with IEC 60502-2 and shall be of the same rated voltage as the accessories to be tested.

Constructional details of the cables shall be identified (refer to Annex A).

7.1.2 Connectors

Connectors used within the accessories shall be identified in accordance with Annex B.

7.1.3 Accessories

Accessories to be tested shall be correctly identified with respect to

- name of manufacturer or supplier;
- type, designation, manufacturing date or code, end of shelf-life date;
- non-range-taking (for only one size of cable)
 - specific cross-sections or cable insulation diameter;
 - minimum and maximum cable insulation diameter;
- range-taking (for minimum two different sizes of cable)
 - minimum and maximum nominal cross-sections, material and shape of cable conductor;
 - minimum and maximum cable insulation diameters;
- connector type(s);
- rated voltage (see 5.1);
- minimum value of U_0 for separable connector screen fault current initiation;
- installation instructions (reference and date);
- inside dimensions or type of terminal box if applicable;
- list of kit contents.

7.2 Installation and connections

7.2.1 General

The conductor cross-sectional area shall be as specified in 7.2.2, 7.2.3 and 7.2.4, unless otherwise specified.

7.2.2 Non-range-taking terminations, joints and stop ends

For joints, terminations and stop ends, which are declared as non-range-taking, one of the following cable cross-sections shall be used: 120 mm² or 150 mm² or 185 mm² or 240 mm².

Compliance for one type of accessory, for the range of cable cross-sections from 95 mm² to 300 mm², shall be obtained by successfully completing all the appropriate tests of Table 9, Table 10 and Table 11 on any one of the cable cross-sections specified above.

Table 1 – Compliance and qualification scheme for non-range-taking terminations, joints and stop ends

Accessory size tested	Cable cross-section selected	Test Sequences ^a	Samples	Range of cross-sections qualified
Specific for one of the conductor sizes described in 7.2.2	one of:	1.1, 2.1, 3.1	4 (1- core) 2 (3- core)	95 mm ² to 300 mm ²
	120 mm ²	1.2, 1.3, 2.2, 2.3	3 (1- core) 1 (3- core)	
	150 mm ²			
	185 mm ²	1.4,1.5	3 (1- core) 1 (3- core)	
240 mm ²				
^a Test sequences refer to Table 9, Table 10 and Table 11.				

7.2.3 Range-taking terminations, joints and stop ends

For joints, terminations and stop ends, the behaviour of the accessory shall be tested at the limits of the accessory application range. The accessory application range shall include one of the cable cross-sections 120 mm² or 150 mm² or 185 mm² or 240 mm² within its range.

The tests described in sequences 1.1, 2.1, 3.1 of Table 9, Table 10 and Table 11 shall be carried out with the minimum and maximum cable cross-section of the accessory, declared by the accessory manufacturer or supplier as the range of application.

Additionally, the tests described in sequences 1.2, 1.3, 1.4 and 1.5 of Table 9 and test sequences 2.2 and 2.3 of Table 10 shall be carried out on the maximum cable cross-section of the accessory application range.

Table 2 – Compliance and qualification scheme for range-taking terminations, joints, and stop ends

Accessory size tested ^b	Cable cross-section selected	Test sequences ^a	Samples	Range of cross-sections qualified
Accessory test size having at least one of the conductor sizes described in 7.2.3 within its range	Minimum of range	1.1, 2.1, 3.1	2 (1- core) 1 (3- core)	Minimum of range to maximum of range
	Maximum of range	1.1, 2.1, 3.1	2 (1- core) 1 (3- core)	
		1.2,1.3, 1.4, 1.5, 2.2, 2.3	3 (1- core) 1 (3- core)	
^a Test sequences refer to Table 9, Table 10 and Table 11.				
^b The accessory test size of the range-taking accessory should have at least one of the sizes described in 7.2.3 within its range, but it is not necessary for the minimum and maximum to be one of these values. For example, the range can be (95 mm ² to 300 mm ²) or (150 mm ² to 400 mm ²).				

7.2.4 Separable connectors

For separable connectors: each rating shall be tested as indicated in Table 3, using either aluminium or copper conductors.

Table 3 – Test cable conductor cross-sections for separable connectors

Rating of separable connector A	Cable conductor cross-section mm ²			
	Test sequence 4.1/5.1 ^a		Test sequence 4.2/5.2 ^{c, d}	
	Cu	Al	Cu	Al
250	50	70	50	70
400	95	150	95	120
630	185	300	120	185
800	300	400	150	240
1 250	500	630	240	400
2 500 ^b	2 × 500	2 × 630	500	800

^a The use of the cross-sections in this Table 3 can lead to overheating of the bushing while achieving the required conductor temperature. Under these circumstances, it is permissible to use a conductor one size smaller. If bushing failure occurs, the test will be declared void (see 10.3).

^b MV cables with 2 500 A rating are not readily available. Separable connectors for this rating are therefore tested with a dual cable connection, where two cables connected in parallel each supply half of the total current.

^c The equipment bushing short-circuit rating of $25 \times I_r$ (IEC 60137:2017, 4.3 [6]) is limiting the short-circuit current value. Cross-sections listed are selected to reach the cable short-circuit temperature θ_{sc} .

^d Test sequence 4.2/5.2 can be done on a cable cross-section from test sequence 4.1/5.1.

7.2.5 Assembly

Accessories shall be assembled in the manner specified by the manufacturer's instructions, with the grade and quantity of materials supplied, including lubricants, if any. A joint designed for crossed cores shall be assembled with the cores crossed.

7.2.6 Conditioning

Accessories shall be dry and clean, but neither the cables nor the accessories shall be subjected to any form of conditioning which can modify the electrical or thermal or mechanical performance of the test assemblies. Contact with chemicals, for example transformer oil, can affect the properties of the accessory and shall be avoided.

7.2.7 Terminations

Where terminations are to be tested, the connection between lugs shall have the same electrical cross-sectional area as that of the cable conductor. Terminations (non-range-taking and range-taking) shall be tested using the arrangements detailed in Figure 1.

In all cases the number of samples shall be as defined in Figure 1.

7.2.8 Terminal boxes

A termination intended to be used in a metallic terminal box shall be tested in the specified terminal box, which shall conform to the relevant standards.

For practical reasons, it is permissible to carry out the tests with the terminations enclosed in a test terminal box fabricated from rigid metallic mesh or from insulating material lined with metal foil. The box shall allow humidity ingress.

The test terminal box shall be of the same shape and dimensions (e.g. creepage lengths and clearances) as the specified terminal box and be provided with conductor terminals and bushings of the type used in service. The box selected for testing should represent the minimum clearance applicable for the design to operate successfully.

When only one of the termination samples is required to be tested in the terminal box, the remote end of the test cable may be terminated by any suitable means.

7.2.9 Joints and stop ends

Joints and stop ends shall be tested to withstand a water height of 1 m (equivalent to 10 kPa relative).

Where a water height of 1 m is deemed insufficient, upon agreement with the manufacturer or supplier, accessories shall be tested using an increased water height of 20 m (equivalent to 200 kPa relative).

The water height used shall be recorded in the test report.

Testing at one water height demonstrates compliance for that water height only.

Testing at both 1 m and 20 m water heights demonstrates compliance at those water heights and at all intermediate water heights.

NOTE The equivalent water height can be achieved using a pressurized water tank.

Where a branch joint or loop joint is being tested, only the main cable shall carry heating current.

7.2.10 Separable connectors

Separable connectors shall be connected to their mating bushing, and the connection between bushings shall have the same electrical cross-sectional area as bushing conductor rod, unless otherwise specified.

For unscreened separable connectors, the minimum phase-to-phase and phase-to-earth clearances, recommended by the manufacturer, shall be tested.

The current value shall be sufficient to achieve the specified temperature of the cable conductor (see IEC 61442:2023, 10.1).

7.2.11 Set-up

The main details regarding test mounting, especially supporting devices, shall be recorded.

7.2.12 Test arrangements and number of samples

Test arrangements and number of samples are detailed in Figure 1 to Figure 5.

8 Range of approval

8.1 General

Compliance shall extend the use of an accessory on cables of the same U_0 as the test cable but with equal or greater nominal insulation thickness. The converse shall not apply.

Compliance of an accessory tested for a specified U_0 shall extend to operation of the accessory at a lower U_0 provided that the radial electrical stress at the insulation screen of the cable of a lower U_0 is not greater than that of the test cable. Compliance of separable connectors used at a lower U_0 is subject to an additional requirement for screen fault initiation testing (see 8.7).

8.2 Cable

8.2.1 Approval is independent of the cable conductor material: tests may therefore be carried out using cables with either aluminium or copper conductors.

8.2.2 The tests performed on accessories installed on cables having shaped conductors shall be deemed to cover the same type of accessory when used on cables having circular conductors; however, the converse does not apply.

In order to achieve extension of approval from round to sector-shaped conductors, additional tests shall be performed according to Table 9, Table 10, Table 11, Table 12 and Table 13, test sequences 1.1, 2.1, 3.1, 4.1 and 5.1, respectively.

8.2.3 Approval is dependent on the cable insulation tested as detailed in Table 4.

Table 4 – Range of approval for cable insulation

Insulation of test cable	Range of approval
XLPE	XLPE, EPR, HEPR and PVC
EPR or HEPR	EPR, HEPR and PVC
PVC	PVC

Accessories tested on cables with one type of non-metallic insulation screen demonstrate compliance when used with another type of non-metallic insulation screen after successful completion of the tests in Table 9, Table 10, Table 11, Table 12 and Table 13, test sequences 1.1, 2.1, 3.1, 4.1 and 5.1, respectively.

8.2.4 Approval obtained by testing on a non-longitudinally water-blocked type of cable shall be extended to a cable with means of longitudinal water-blocking in the metallic screen area but otherwise of the same design. The converse shall not apply.

8.3 Three-core to single-core accessory

Compliance obtained for a three-core accessory can be extended to a single-core accessory of the same design by performing the tests specified in Table 5.

The converse shall not apply.

NOTE Triplex cables are handled as single-core cables

Table 5 – Extension of compliance from a three-core accessory to a single-core accessory of the same design

Cable accessory type	Test sequence
Indoor terminations	Table 9, tests 13 and 15
Outdoor terminations	Table 9, tests 5, 11, 12, 14, 15
Joints	Table 10, tests 5, 6, 12, 13, 14
Stop ends	Table 11, tests 5, 8, 9, 10, 11
Screened separable connectors	Table 12, tests 8, 12, 14, 15
Unscreened separable connectors	Table 13, tests 8, 12, 13, 14, 15

8.4 Non-range-taking terminations, joints and stop ends

Compliance for one type of accessory is defined in 7.2.2.

Extension of compliance for the same design of accessory to smaller or larger cable cross-sections shall be obtained by the satisfactory completion of the relevant tests, according to Table 6.

NOTE "Same design" includes: same architecture, same manufacturing process, same conception, same materials, same sealings, compatible electrical stress (maximum electrical stress less or equal to the maximum electric stress at the tested cable accessory interface), compatible interfaces (interfaces of the same or longer lengths between conductive parts). Other differences observed between accessories are subject to an agreement between the manufacturer or supplier and the purchaser.

Table 6 – Extension of compliance and qualification scheme for non-range-taking terminations, joints and stop ends

Accessory size tested	Test sequences	Samples	Range of cross-sections qualified
Size < 95 mm ²	Table 14	2 (1- core) 1 (3- core)	Extension down to and including the size tested
Size > 300 mm ²	1.1, 2.1, 3.1 ^a	2 (1- core) 1 (3- core)	Extension up to and including the size tested
^a Test sequences refer to Table 9, Table 10 and Table 11.			

8.5 Range-taking terminations, joints and stop ends

The tests carried out on the limits of the accessory application range, according to 7.2.3, give compliance for cross-sections tested and intermediate cross-sections.

Extension of compliance for the same design of accessory to smaller or larger cable cross-sections shall be obtained by the satisfactory completion of the relevant tests, according to Table 7.

NOTE Same design includes: same architecture, same manufacturing process, same conception, same materials, same sealings, compatible electrical stress (maximum electrical stress less or equal to the maximum electric stress at the tested cable accessory interface), compatible interfaces (interfaces of the same or longer lengths between conductive parts). Other differences observed between accessories are subject to an agreement between the manufacturer or supplier and the purchaser.

Table 7 – Extension of compliance and qualification scheme for range-taking terminations, joints, and stop ends

Accessory size tested	Cable cross-section selected	Test sequences ^a	Samples	Range of cross-sections qualified
Smallest size	Smallest cable	Table 14	2 (1- core) 1 (3- core)	Extension to smallest cable
Largest size	Largest cable	1.1, 2.1, 3.1	2 (1- core) 1 (3- core)	Extension to largest cable
Intermediate size	No test required as included within the range of smallest to largest			
^a Test sequences refer to Table 9, Table 10 and Table 11.				

8.6 Terminations in terminal boxes

Compliance for a particular design of termination in a specified terminal box shall be obtained by the satisfactory completion of the test sequence in Table 9. If compliance has already been obtained for a termination design separate from the terminal box, it is necessary to carry out the test sequence with only one of the terminations in a terminal box.

Satisfactory completion of the appropriate tests of Table 9 for a termination for one design of terminal box may allow the compliance to be extended to that termination in another terminal box design by comparison of the detail drawings of the boxes. If there are differences in the design or dimensions or both, the impulse voltage test at ambient temperature shall be repeated, by agreement between the manufacturer or supplier and the customer.

8.7 Separable connectors

Compliance for one type of separable connector, for the cross-section tested, shall be obtained by successfully completing all the tests of Table 12 or Table 13 on the cross-section specified in Table 3.

In addition, for screened separable connectors, the screen fault current initiation test shall be done at the lowest U_0 for which compliance is required.

Extension of the range of compliance for the same type of separable connector to smaller cable conductor cross-sections shall be obtained by successfully completing the additional test sequence in Table 14, on the appropriate smaller cross-section. Such a test qualifies the range of conductors from the cross-section tested to the requirements of Table 3 to the smaller size tested as part of the extension, in either a copper or aluminium conductor.

Extension of the range of compliance for the same type of separable connector to larger cable conductor cross-sections shall be obtained by successfully completing the additional test sequence in Table 15, on the appropriate larger cross-section. Such a test qualifies the range of conductors from the cross-section tested to the requirements of Table 3 to the larger size tested as part of the extension, in either a copper or aluminium conductor.

9 Test sequences

9.1 General

The tests applicable to accessories shall be carried out in the sequences listed in the tables and figures mentioned in Table 8.

Table 8 – Test sequences

Accessories	Table	Figure
Terminations	Table 9	Figure 1
Straight, branch or loop joints	Table 10	Figure 2
Stop ends	Table 11	Figure 3
Screened deadbreak separable connectors	Table 12	Figure 4
Unscreened deadbreak separable connectors	Table 13	Figure 5
Additional tests for smaller conductor cross-sectional areas	Table 14	–
Additional tests for separable connector compliance extension to largest cable cross-section	Table 15	–
NOTE In Table 9 to Table 13, the symbols have the meaning given in IEC 61442, i.e.: I_{sc} short-circuit current (RMS value) in the metallic screen; I_d short-circuit current (initial peak value) in the conductor; θ_{sc} maximum permissible short-circuit temperature of the cable conductor; θ_t maximum cable conductor temperature in normal operation +5 K to 10 K.		

The tests on terminations and joints may be combined, provided the sequences and requirements are the same.

A summary of the tests required is given in Table 16. The test voltages and requirements are summarized in Table 17.

9.2 Dynamic short-circuit performance

This test is a three-phase test required for single-core cable accessories designed for initial peak current higher than 80 kA and for three-core cable accessories designed for an initial peak current higher than 63 kA.

Class 0 Three-core accessories designed for an initial peak current below 63 kA and single-core accessories designed for an initial peak current below 80 kA.

No test is required.

Class 1 Three-core accessories designed for initial peak currents above 63 kA up to and including 80 kA.

The test current shall be 80 kA initial peak.

Class 2 Three-core and single-core accessories designed for initial peak currents above 80 kA up to and including 100 kA.

The test current shall be a 100 kA initial peak.

Class 3 Three-core and single-core accessories designed for initial peak currents above 100 kA up to and including 125 kA.

The test current shall be a 125 kA initial peak.

The dynamic short-circuit test may be combined with the first thermal short-circuit tests (on the conductor) at ambient temperature.

10 Test results

10.1 General remarks

All test samples, tested as indicated in Clause 7 and Clause 8 and Table 9 to Table 15, shall meet the requirements for all test sequences.

If any of the test samples do not meet the requirements, they shall be dismantled, inspected to determine if 10.3.1 or 10.3.2 or 10.3.3 applies and the result of the inspection recorded.

The examination at the end of a test sequence is mandatory, but the results are for information only. They shall be recorded in the test report.

10.2 Test reports

Written reports on type tests proving compliance with this document shall be made available to the customer. The test report shall comprise:

- test arrangement;
- test sequence table;
- identification of accessory;
- identification of cable (Annex A);
- identification of connector (Annex B);
- examination check list (Clause C.2);
- minimum clearance to any test box, if applicable;
- for each test, how many samples have passed or not passed the test.

The test reports shall be signed by a representative of the body carrying out the tests. This may be the manufacturer or supplier or a recognized test laboratory.

10.3 Failures

10.3.1 Accessory failure

If an accessory fails to meet the requirements due to either installation or test procedure errors, the test shall be declared void without discrediting the accessories.

The complete test sequence shall be repeated on a new set of samples.

If there is no evidence of such an error, the type of accessory is not approved.

10.3.2 Cable failure

If a cable fails beyond any part of an accessory, the tests shall be declared void without discrediting the accessories. Tests may be repeated using new accessories (start testing from the beginning of the test sequence) or alternatively by repair of the cable (continue testing from the point of break).

10.3.3 Bushing failure

If a bushing failure occurs, the test shall be declared void without discrediting the accessory.

Tests may be repeated on a new sample or possibly on a new set of samples, starting from the beginning of the test sequence.

11 Visual examination

The purpose of the examination is to document the status of the accessory, connector and cable after the tests.

All the accessories that have been submitted to a test sequence shall be examined according to Annex C, and the information shall be documented in the report as required by Annex C.

The manufacturer or supplier shall be actively involved in the examination and its findings unless they agree otherwise.

Prior to the examination of the accessory, a drawing shall be supplied by the manufacturer or supplier identifying seals and the parts of the accessory from which moisture shall be excluded to ensure reliable operation in service.

It should be stressed that no acceptance criteria is specified in Annex C.

IECNORM.COM : Click to view the full PDF of IEC 60502-4:2023

Table 9 – Test sequences and requirements for terminations

Tests ^a		Requirements	Test methods of IEC 61442:2023	Test sequences (see Figure 1)				
				1.1	1.2	1.3	1.4	1.5
1	AC voltage dry	5 min at 4,5 U_0 . No breakdown nor flashover.	Clause 5	X	X	X		
	AC (wet)	1 min at 4 U_0 ^b . No breakdown nor flashover.	Clause 5	X				
2	Partial discharge at ambient	10 pC max. at 1,73 U_0 ^c .	Clause 8	X				
3	Impulse at θ_t	10 impulses of each polarity. No breakdown nor flashover.	Clause 7	X				
4	Heating cycles in air	Min. 60 cycles at θ_t and 2,5 U_0 .	10.2	X				
5	Immersion test ^b	10 cycles at θ_t .	10.4	X				
6	Partial discharge at θ_t and ambient temperature	10 pC max. at 1,73 U_0 ^c .	Clause 8	X				
7	Thermal short-circuit (screen) ^d	Two short-circuits at I_{sc} of the cable screen. No visible deterioration.	Clause 11		X	X		
8	Thermal short-circuit (conductor)	Two short-circuits to raise conductor to θ_{sc} of the cable. No visible deterioration.	Clause 12		X	X ^e		
9	Dynamic short-circuit ^f	One short-circuit at I_d . No visible deterioration.	Clause 13			X ^e		
10	Impulse at ambient	10 impulses of each polarity. No breakdown nor flashover.	Clause 7	X	X	X		
11	AC voltage dry	5 min at 4,5 U_0 . No breakdown nor flashover.	Clause 5	X	X	X		
12	Partial discharge at ambient	10 pC max. at 1,73 U_0 ^c .	Clause 8	X				
13	Humidity ^{g, h}	300 h at 1,25 U_0 , see Table 16.	Clause 14				X	
14	Salt fog ^{b, h}	1 000 h at 1,25 U_0 , see Table 16.	Clause 14					X
15	Examination according to Annex C	Shall be documented in the report.	–	X	X	X	X	X

^a The tests shall be carried out at ambient temperature, unless otherwise specified.

^b For outdoor terminations only.

^c Not required for accessories installed on 3,6/6 (7,2) kV cables having unscreened insulation. This requirement can also be achieved with partial discharge tests conducted at 2 U_0 .

^d This test is only required for terminations that are equipped with a connection to, or adaptor for, the metallic screen of the cable.

^e The thermal short-circuit may be combined with the dynamic short-circuit.

^f Applies to three-core cables only. For the value of the current I_d , see 9.2. Due consideration shall be given to ensure that the installation arrangement is representative for the application. The value of the class shall be declared by the manufacturer, in accordance with 9.2.

^g For indoor terminations only. Not required for compound-filled terminal boxes. Shrouded terminations shall be tested in a three-phase condition.

^h Not required for terminations having porcelain insulators.

Table 11 – Test sequences and requirements for stop ends

Tests ^a		Requirements	Test methods of IEC 61442:2023	Test sequence (see Figure 3)
				3.1
1	AC voltage dry	5 min at 4,5 U_0 . No breakdown.	Clause 5	X
2	Partial discharge at ambient	10 pC max. at 1,73 U_0^b .	Clause 8	X
3	Impulse at ambient	10 impulses of each polarity. No breakdown.	Clause 7	X
4	AC voltage in air	500 h at 2,5 U_0 , no breakdown.	Clause 5	X
5	AC voltage withstand in water (without oversheath damage)	24 h ^d at 2,5 U_0 , no breakdown.	Clause 5	X
6	AC voltage withstand in water (with oversheath damage for non-water blocked cables, without oversheath damage for water blocked cables)	428 h at 2,5 U_0 , no breakdown. Insulation resistance – screen to water 50 MΩ minimum ^c .	Clause 5	X
7	Partial discharge at ambient	10 pC max. at 1,73 U_0^b .	Clause 8	X
8	Impulse at ambient	10 impulses of each polarity. No breakdown.	Clause 7	X
9	AC voltage dry	5 min at 4,5 U_0 . No breakdown.	Clause 5	X
10	Partial discharge at ambient	10 pC max. at 1,73 U_0^b .	Clause 8	X
11	Examination according to Annex C	Shall be documented in the report.	–	X
^a The tests shall be carried out at ambient temperature, unless otherwise specified. ^b Not required for accessories installed on 3,6/6 (7,2) kV cables having unscreened insulation. This requirement can also be achieved with partial discharge tests conducted at 2 U_0 . ^c Insulation resistance applicable to water blocked cable only. ^d The test duration shall be a minimum of 24 h.				

Table 12 – Test sequences and requirements for screened deadbreak separable connectors

Tests ^a		Requirements	Test methods of IEC 61442:2023	Test sequences (see Figure 4)			
				4.1	4.2	4.3	4.4
1	AC voltage dry	5 min at 4,5 U_0 . No breakdown.	Clause 5	X	X	X	
2	Partial discharge at ambient	10 pC max. at 1,73 U_0^b .	Clause 8	X			
3	Impulse at θ_t	10 impulses of each polarity. No breakdown.	Clause 7	X			
4	Thermal short-circuit (screen) ^c	Two short-circuits at I_{sc} of the cable screen. No visible deterioration.	Clause 11		X	X	
5	Thermal short-circuit (conductor)	Two short-circuits to raise conductor to θ_{sc} of the cable. No visible deterioration.	Clause 12		X	X ^d	
6	Dynamic short-circuit for three-core cable only ^{e d}	One short-circuit at I_d . No visible deterioration.	Clause 13			X ^d	
7	Heating cycles in air	Min. 30 cycles at θ_t and 2,5 U_0^i .	Clause 10	X			
8	Heating cycles in water	Min. 30 cycles at θ_t and 2,5 U_0^i .	Clause 10	X			
9	Disconnect/connect ^f	Five times. No visible damage to contact.	–	X	X	X	
10	Partial discharge at θ_t and ambient temperature	10 pC max. at 1,73 U_0^b .	Clause 8	X			
11	Impulse at ambient	10 impulses of each polarity. No breakdown.	Clause 7	X	X	X	
12	AC voltage dry	5 min at 4,5 U_0 . No breakdown.	Clause 5	X	X	X	
13	Operating eye	Axial force 1 300 N for 1 min. Torque 14 N·m.	Clause 20				X
14	Partial discharge at ambient	10 pC max. at 1,73 U_0^b .	Clause 8				X
15	Examination according to Annex C	Shall be documented in the report.	–	X	X	X	X
16	Screen resistance ^g	Maximum 5 000 Ω .	Clause 16	Tests 16 to 20 are carried out on separate samples. For tests 16 and 19, no cable is required. For tests 17, 18 and 20, appropriate cable lengths shall be used.			
17	Screen leakage current ^g	Maximum 0,5 mA at U_m .	Clause 17				
18	Fault current initiation	See notes ^{g h} .	Clause 18				
19	Operating force	Force < 900 N.	Clause 19				
20	Capacitive test point	Capacitance of test point to cable conductor: $C_{tc} > 1,0$ pF. Ratio of capacitance of test point to earth C_{te} and capacitance of test point to cable conductor C_{tc} : $C_{te}/C_{tc} \leq 12,0$.	Clause 21				

^a	The tests shall be carried out at ambient temperature, unless otherwise specified.
^b	Not required for accessories installed on 3,6/6 (7,2) kV cables having unscreened insulation. This requirement can also be achieved with partial discharge tests conducted at $2 U_0$.
^c	This test applies only to separable connectors that are equipped with a connection to, or adaptor for, the metallic screen of the cable.
^d	The thermal short-circuit may be combined with the dynamic short-circuit.
^e	Only required for single-core cable accessories designed for initial peak currents $I_p > 80$ kA and three-core accessories designed for $I_p > 63$ kA. For the value of the current I_d see 9.2.
^f	The test shall be carried out only when the cable is de-energized.
^g	The test is required for separable connectors without a metallic housing or with a removable metallic housing. The metallic housing shall be removed prior to the test. This test is not required for separable connectors which can only be used in service with the metallic housing in position.
^h	For solidly earthed systems, the fault initiation shall occur within 3 s. For unearthed or impedance earthed systems, the fault current shall flow continuously.
ⁱ	Current, see Table 3.

**Table 13 – Test sequences and requirements for unscreened separable connectors
(excluding shrouded terminations)**

Tests ^a		Requirements	Test methods of IEC 61442:2023	Test sequences (see Figure 5)			
				5.1	5.2	5.3	5.4
1	AC voltage dry	5 min at $4,5 U_0$. No breakdown nor flashover.	Clause 5	X	X	X	
2	Partial discharge at ambient	10 pC max. at $1,73 U_0^b$.	Clause 8	X			
3	Impulse at θ_t	10 impulses of each polarity. No breakdown nor flashover.	Clause 7	X			
4	Thermal short-circuit (screen) ^c	Two short-circuits at I_{sc} of the cable screen. No visible deterioration.	Clause 11		X	X	
5	Thermal short-circuit (conductor)	Two short-circuits to raise conductor to θ_{sc} of the cable. No visible deterioration.	Clause 12		X	X ^d	
6	Dynamic short-circuit ^e	One short-circuit at I_d . No visible deterioration.	Clause 13			X ^d	
7	Heating cycles in air	Min. 30 cycles at θ_t and $2,5 U_0$.	Clause 10	X			
8	Heating cycles in water	Min. 30 cycles at θ_t and $2,5 U_0$.	Clause 10	X			
9	Disconnect/connect ^f	Five complete operations. No visible damage to contact.	–	X	X	X	
10	Partial discharge at θ_t and ambient temperature	10 pC max. at $1,73 U_0^b$.	Clause 8	X			
11	Impulse at ambient	10 impulses of each polarity. No breakdown nor flashover.	Clause 7	X	X	X	
12	AC voltage dry	5 min at $4,5 U_0$. No breakdown nor flashover.	Clause 5	X	X	X	
13	Partial discharge at ambient	10 pC max. at $1,73 U_0^b$.	Clause 8	X			
14	Humidity ^g	300 h at $1,25 U_0$, see Table 16.	Clause 14				X
15	Examination according to Annex C	Shall be documented in the report.	–	X	X	X	X

- a The tests shall be carried out at ambient temperature, unless otherwise specified.
- b Not required for accessories installed on 3,6/6 (7,2) kV cables having unscreened insulation. This requirement can also be achieved with partial discharge tests conducted at $2 U_0$.
- c This test applies only to separable connectors that are equipped with a connection to, or adaptor for, the metallic screen of the cable.
- d The thermal short-circuit may be combined with the dynamic short-circuit.
- e Only required for single-core cable accessories designed for initial peak currents $I_p > 80$ kA and three-core accessories designed for $I_p > 63$ kA. For the value of the current I_d see 9.2.
- f The test shall be carried out only when the cable is de-energized.
- g The test shall be carried out with three samples in a test terminal box.

Table 14 – Additional tests for smaller conductor cross-sectional areas

Tests ^a		Requirements	Test methods of IEC 61442:2023	Test sequences (see Figure 1, Figure 2, Figure 3)		
				1.1 ^b	2.1 ^c	3.1 ^d
1	AC voltage dry	5 min at $4,5 U_0$. No breakdown nor flashover.	Clause 5	X	X	X
2	Partial discharge at ambient	10 pC max. at $1,73 U_0^e$	Clause 8	X	X	X
3	Impulse	10 impulses of each polarity. No breakdown nor flashover.	Clause 7	X	X	X
4	Heating cycles	No breakdown nor flashover. Terminations. Min. 10 cycles in air at θ_t^g and $2,5 U_0$. Joints, screened and unscreened separable connectors. Min. 10 cycles ^f in water at θ_t^g and $2,5 U_0$. Stop ends. 96 h in water at $2,5 U_0$.	10.2 and 10.3	X	X	X
5	AC voltage dry	5 min at $4,5 U_0$. No breakdown nor flashover.	Clause 5	X	X	X
6	Partial discharge at θ_t^g and ambient temperature	10 pC max. at $1,73 U_0^e$.	Clause 8	X	X	X
7	Examination according to Annex C	Shall be documented in the report.	–	X	X	X

- a The tests shall be carried out at ambient temperature, unless otherwise specified.
- b Terminations: test half the number of samples given in Figure 1.
- c Joints: test half the number of samples given in Figure 2.
- d Stop ends: test half the number of samples given in Figure 3.
- e Not required for accessories installed on 3,6/6 (7,2) kV cables having unscreened insulation. This requirement can also be achieved with partial discharge tests conducted at $2 U_0$.
- g θ_t is the maximum cable conductor temperature in normal operation +5 K to 10 K.

Table 15 – Additional tests for separable connector compliance extension to largest cable cross-section

Tests ^{a, c}		Requirements	Test methods of IEC 61442:2023	Test sequences (see Figure 4 and Figure 5)		
1	AC voltage dry	5 min at 4,5 U_0 . No breakdown nor flashover.	Clause 5	X		
2	Impulse at ambient	10 impulses of each polarity. No breakdown nor flashover.	Clause 7	X		
3	AC voltage dry	5 min at 4,5 U_0 . No breakdown nor flashover.	Clause 5	X		
4	Partial discharge at ambient temperature	10 pC max. at 1,73 U_0 ^b .	Clause 8	X		
5	Examination according to Annex C	Shall be documented in the report.	-	X		
^a The tests shall be carried out at ambient temperature, unless otherwise specified. ^b This requirement can also be achieved with partial discharge tests conducted at 2 U_0 . ^c The number of samples tested is as follows: – screened separable connectors: see Figure 4. – unscreened separable connectors: see Figure 5.						

IECNORM.COM : Click to view the full PDF of IEC 60502-4:2023

Table 16 – Summary of tests

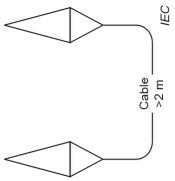
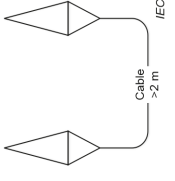
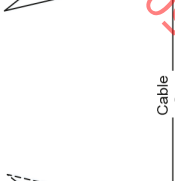
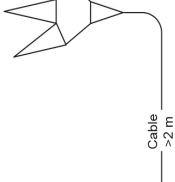
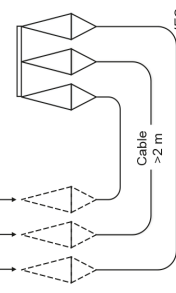
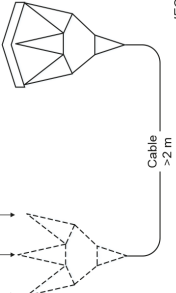
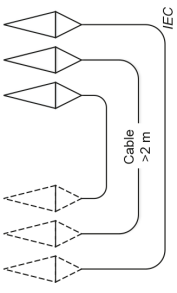
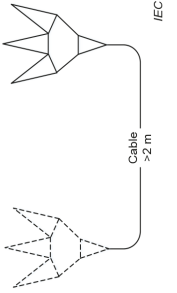
Tests	Terminations		Straight and branch joints	Stop ends	Separable connectors	
	Indoor	Outdoor			Deadbreak	
					Screened	Unscreened
AC voltage						
– 4,5 U_0 /5 min dry	x	x	x	x	x	x
– 2,5 U_0 /24 h wet				x		
– 2,5 U_0 /428 h wet				x		
– 4 U_0 /1 min wet		x				
Partial discharge						
– at θ_t	x	x	x		x	x
– at ambient temperature	x	x	x	x	x	x
Impulse						
– at θ_t	x	x	x		x	x
– at ambient temperature	x	x	x	x	x	x
Heating cycles						
– in air	x	x	x		x	x
– in water			x		x	x
Immersion test		x				
Thermal short-circuit						
– screen	x	x	x		x	x
– conductor	x	x	x		x	x
Dynamic short-circuit	x	x	x		x	x
Humidity	x					x
Salt fog		x				
Disconnect/connect					x	x
Operating eye					x	
Screen resistance					x	
Screen leakage current					x	
Fault current initiation					x	
Operating force					x	
Capacitive test point					x	
Examination	x	x	x	x	x	x

NOTE The purpose of this Table 16 is to list tests, and not sequences.

Table 17 – Summary of test voltages (see Clause 9)

Rated voltage U_0/U (U_m) kV						
Test	Test voltage	3,6/6 (7,2)	6/10 (12)	8,7/15 (17,5)	12/20 (24)	18/30 (36)
Humidity and salt fog	$1,25 U_0$	4,5	7,5	11	15	22,5
Partial discharge ^a	$1,73 U_0$	6	10	15	20	30
Heating cycle voltage and AC voltage/500 h	$2,5 U_0$	9	15	22	30	45
AC voltage/1 min	$4 U_0$	14,5	24	35	48	72
AC voltage/5 min	$4,5 U_0$	16	27	39	54	81
Impulse (peak)	–	60	75	95	125	170
^a Not required for accessories installed on 3,6/6 (7,2) kV cables having unscreened insulation. This requirement can also be achieved with partial discharge tests conducted at $2 U_0$.						

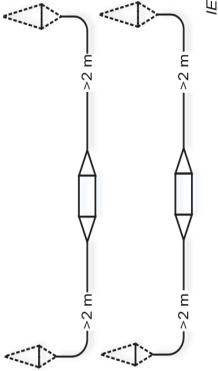
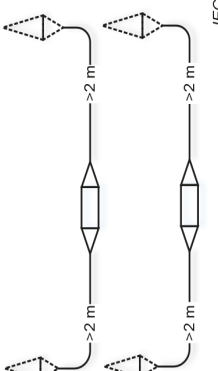
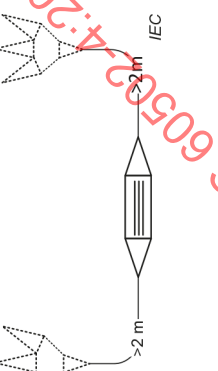
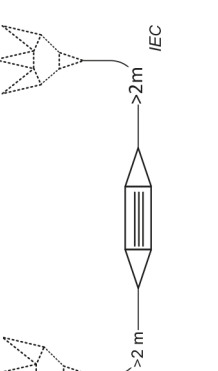
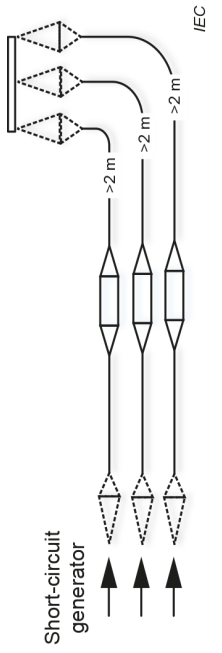
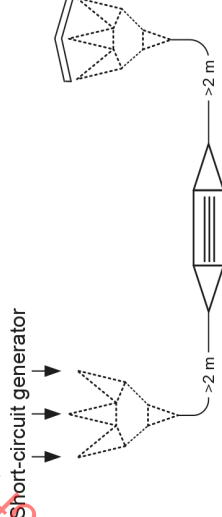
IECNORM.COM : Click to view the full PDF of IEC 60502-4:2023

Sequence	Single-core accessories		Three-core accessories	
	Two ^a samples on minimum size of application range	Two ^a samples on maximum size of application range	One ^b sample on minimum size of application range	One ^b sample on maximum size of application range
1.1 ^{e f g}				
1.2 or 1.3 ^{e f h}	Three^c samples on maximum size of application range Short-circuit generator 		One^d sample on maximum size of application range Short-circuit generator 	
1.4 or 1.5 ^{e f}	Three^c samples on maximum size of application range 		One^d sample on maximum size of application range 	

NOTE The number of samples for an extension of compliance is given in Table 6.

- ^a For non-range-taking terminations test four samples of the same selected size.
- ^b For non-range-taking terminations test two samples of the same selected size.
- ^c For non-range-taking terminations test three samples of the same selected size.
- ^d For non-range-taking terminations test one sample of the selected size.
- ^e The cable lengths measured between the cable entry points of the accessories shall be > 2 m.
- ^f Dotted line terminations are not subject to test.
- ^g Testing of terminations in combined loops is permitted.
- ^h The thermal short-circuit test can be done on individual loops.

Figure 1 – Test arrangements and number of samples for terminations (see Table 9)

Sequence	Single-core accessories		Three-core accessories	
	Two ^a samples on minimum size of application range	Two ^a samples on maximum size of application range	One ^b sample on minimum size of application range	One ^b sample on maximum size of application range
2.1 ^{e f g}				
2.2 or 2.3 ^{e g h}	Three^c samples on maximum size of application range 			One^d sample on maximum size of application range 

NOTE The number of samples for an extension of compliance is given in Table 6.

^a For non-range-taking joints test four samples of the same selected size.

^b For non-range-taking joints test two samples of the same selected size.

^c For non-range-taking joints test three samples using the selected cable size.

^d For non-range-taking joints test one sample using the selected cable size.

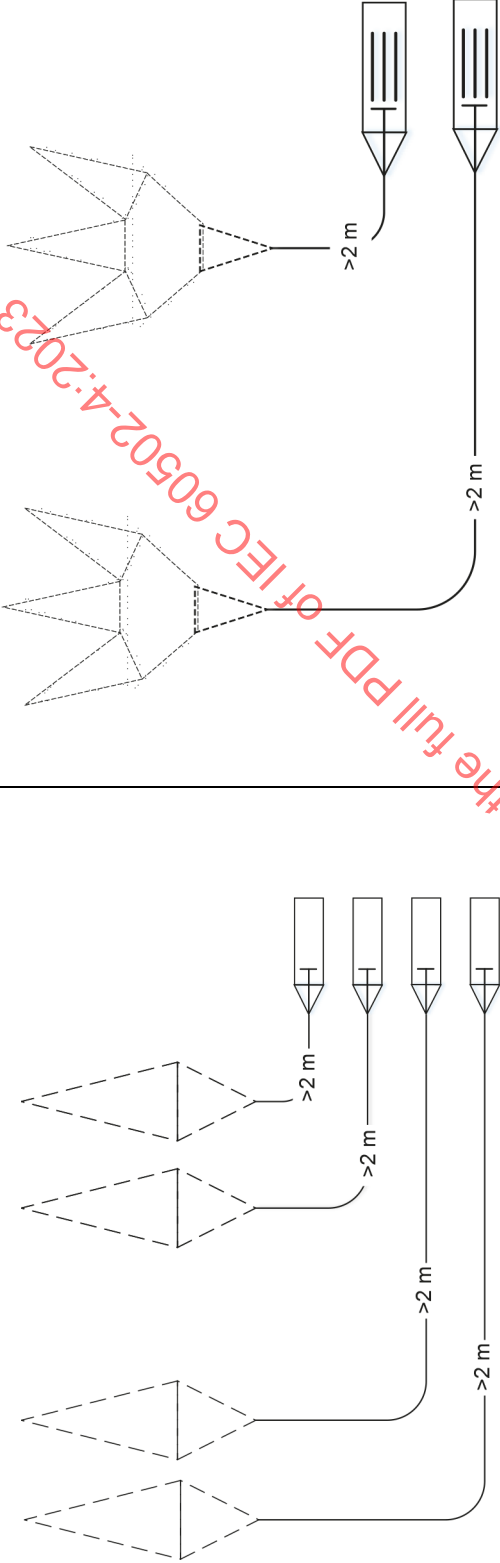
^e The cable lengths measured between the cable entry points of the accessories shall be > 2 m.

^f Testing of joints in combined loops is allowed.

^g Dotted line terminations are not subject to test.

^h Sequence 2.2 can be combined with sequence 2.3. For single-core accessories, sequence 2.2 can be carried out on separate loops. The cable and accessories clamping method and the spacing between accessories shall be as recommended by the manufacturer.

Figure 2 – Test arrangements and number of samples for straight, branch or loop joints (see Table 10)

Sequence	Single-core accessories		Three-core accessories	
	Two ^a samples on minimum size of application range	Two ^a samples on maximum size of application range	One ^b sample on minimum size of application range	One ^b sample on maximum size of application range
3.1 ^{c d}				

NOTE The number of samples for an extension of compliance is given in Table 6.

- ^a For non-range-taking stop ends test four samples using the selected cable size.
- ^b For non-range-taking stop ends test two samples using the selected cable size.
- ^c The cable lengths measured between the cable inlet points of the accessories shall be > 2 m.
- ^d Accessories drawn with dashed lines are not test objects.

Figure 3 – Test arrangements and number of samples for stop ends (see Table 11)