

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 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV)**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2021 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 Central Office
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 It also gives information on projects, replaced and withdrawn publications.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 online collection - oc.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 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV)**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.060.20

ISBN 978-2-8322-9315-7

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	8
4 Voltage designations and materials	9
5 Conductors.....	12
6 Insulation.....	12
7 Assembly of multicore cables, inner coverings and fillers.....	14
8 Metal layers for single-core and multicore cables.....	16
9 Metal screen.....	16
10 Concentric conductor.....	17
11 Metal sheath.....	17
12 Metal armour	17
13 Oversheath.....	21
14 Test conditions	22
15 Routine tests	22
16 Sample tests	24
17 Type tests, electrical.....	27
18 Type tests, non-electrical.....	29
19 Electrical tests after installation	35
Annex A (normative) Fictitious calculation method for determination of dimensions of protective coverings.....	45
Annex B (normative) Rounding of numbers	51
Annex C (normative) Determination of hardness of HEPR insulation	52
Bibliography.....	55
Figure C.1 – Test on surfaces of large radius of curvature	53
Figure C.2 – Test on surfaces of small radius of curvature.....	54
Table 1 – Recommended rated AC voltages U_0	10
Table 2 – Insulating compounds.....	11
Table 3 – Maximum conductor temperatures for different types of insulating compound.....	11
Table 4 – Sheathing compounds and maximum conductor temperatures for different types of sheathing compound	12
Table 5 – Nominal thickness of PVC/A insulation	13
Table 6 – Nominal thickness of cross-linked polyethylene (XLPE) insulation	13
Table 7 – Nominal thickness of ethylene propylene rubber (EPR) and hard ethylene propylene rubber (HEPR) insulation	14
Table 8 – Thickness of extruded inner covering	15
Table 9 – Nominal diameter of round armour wires	20
Table 10 – Nominal thickness of armour tapes.....	20
Table 11 – Routine test voltages.....	23

Table 12 – Number of samples for sample tests	24
Table 13 – Electrical type test requirements for insulating compounds	36
Table 14 – Non-electrical type tests (see Tables 15 to 23)	37
Table 15 – Test requirements for mechanical characteristics of insulating compounds (before and after ageing)	38
Table 16 – Test requirements for particular characteristics of PVC insulating compounds	39
Table 17 – Test requirements for particular characteristics of various cross-linked insulating compounds	40
Table 18 – Test requirements for mechanical characteristics of sheathing compounds (before and after ageing)	41
Table 19 – Test requirements for particular characteristics of PVC sheathing compounds	42
Table 20 – Test requirements for particular characteristics of thermoplastic PE sheathing compounds	43
Table 21 – Test requirements for particular characteristics of halogen free sheathing compounds	43
Table 22 – Test requirements for particular characteristics of elastomeric sheathing compounds	44
Table 23 – Test methods and requirements for halogen free compounds	44
Table A.1 – Fictitious diameter of conductor	46
Table A.2 – Assembly coefficient k for laid-up cores	47
Table A.3 – Increase of diameter for concentric conductors and metal screens	48
Table A.4 – Increase of diameter for additional bedding	50

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 1: Cables for rated voltages of 1 kV
($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ 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.

IEC 60502-1 has been prepared by IEC technical committee 20: Electric cables. It is an International Standard.

This third edition cancels and replaces the second edition published in 2004 and Amendment 1:2009. This edition constitutes a technical revision.

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

- a) references to IEC 60811 (all parts) have been updated and mechanical testing requirements specific to halogen free low-smoke oversheath of material type ST₈ have been considered;
- b) the use of the types of sheathing material to be used is now clearly defined;
- c) the applicability of cables for use in DC systems is now included in the scope;

d) items which were earlier marked as "under consideration" were studied either for an appropriate solution if found available, or for removal for the time being.

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

Draft	Report on voting
20/1938/FDIS	20/1949/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/standardsdev/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 "<http://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 1: Cables for rated voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV)

1 Scope

This part of IEC 60502 specifies the construction, dimensions and test requirements of power cables with extruded solid insulation for rated AC voltages of 1 kV ($U_m = 1,2$ kV) and 3 kV ($U_m = 3,6$ kV) for fixed installations such as distribution networks or industrial installations.

Cables of rated AC voltage 1 kV ($U_m = 1,2$ kV) designed and tested in accordance with this document can also be used, if declared by the manufacturer, in DC distribution systems having their nominal voltage ≤ 750 V DC (with a maximum of 900 V DC) between a live conductor and neutral/earth, or $\leq 1\,500$ V DC (with a maximum 1 800 V DC) between two live conductors. Applicable core identification for DC systems are considered in accordance with local installation regulations.

NOTE 1 Recommendations for preferred core colours for line conductors in DC systems are given in IEC 60445. However, local installation regulations for DC systems can already contain specific identification requirements.

This document includes cables which exhibit properties of reduced flame spread, low levels of smoke emission and halogen-free gas emission when exposed to fire.

Cables for special installation and service conditions are not included, for example cables for overhead networks, the mining industry, nuclear power plants (in and around the containment area), submarine use or shipboard application, or cables directly connected to photovoltaic systems.

NOTE 2 Cables for photovoltaic systems are covered by IEC 62930.

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 60060-1, *High-voltage test techniques – Part 1: General definitions and test requirements*

IEC 60183, *Guidance for the selection of high-voltage A.C. cable systems*

IEC 60228, *Conductors of insulated cables*

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

IEC 60332-1-2, *Tests on electric and optical fibre cables under fire conditions – Part 1-2: Test for vertical flame propagation for a single insulated wire or cable – Procedure for 1 kW pre-mixed flame*