

# INTERNATIONAL STANDARD

**IEC**  
**60245-1**

Fourth edition  
2003-12

---

---

**Rubber insulated cables –  
Rated voltages up to and including 450/750 V –**

**Part 1:  
General requirements**

*iteh Standards*  
*(<https://standards.iteh.ai>)*  
*Document Preview*

[IEC 60245-1:2003](#)

<https://standards.iteh.ai/catalog/standards/iec/b7784dc1-d983-4164-827d-966c792b9184/iec-60245-1-2003>

*This **English-language** version is derived from the original **bilingual** publication by leaving out all French-language pages. Missing page numbers correspond to the French-language pages.*



Reference number  
IEC 60245-1:2003(E)

## Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

## Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

## Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site ([www.iec.ch](http://www.iec.ch))**
- **Catalogue of IEC publications**

The on-line catalogue on the IEC web site ([www.iec.ch/searchpub](http://www.iec.ch/searchpub)) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.
- **IEC Just Published**

This summary of recently issued publications ([www.iec.ch/online\\_news/justpub](http://www.iec.ch/online_news/justpub)) is also available by email. Please contact the Customer Service Centre (see below) for further information.
- **Customer Service Centre**

If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

https://standards.iteh.ai/catalog/standards/iec/b7784dc1-d983-4164-827d-966c792b9184/iec-60245-1-2003

Email: [custserv@iec.ch](mailto:custserv@iec.ch)  
Tel: +41 22 919 02 11  
Fax: +41 22 919 03 00

# INTERNATIONAL STANDARD

**IEC**  
**60245-1**

Fourth edition  
2003-12

---

---

## **Rubber insulated cables – Rated voltages up to and including 450/750 V –**

### **Part 1: General requirements**

**iTeh Standards**  
**(<https://standards.iteh.ai>)**  
**Document Preview**

[IEC 60245-1:2003](https://standards.iteh.ai/catalog/standards/iec/b7784dc1-d983-4164-827d-966c792b9184/iec-60245-1-2003)

<https://standards.iteh.ai/catalog/standards/iec/b7784dc1-d983-4164-827d-966c792b9184/iec-60245-1-2003>

© IEC 2003 Copyright - all rights reserved

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 the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland  
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: [inmail@iec.ch](mailto:inmail@iec.ch) Web: [www.iec.ch](http://www.iec.ch)



Commission Electrotechnique Internationale  
International Electrotechnical Commission  
Международная Электротехническая Комиссия

## CONTENTS

|                                                                                                                                                    |    |
|----------------------------------------------------------------------------------------------------------------------------------------------------|----|
| FOREWORD .....                                                                                                                                     | 3  |
| 1 General .....                                                                                                                                    | 9  |
| 1.1 Scope .....                                                                                                                                    | 9  |
| 1.2 Normative references .....                                                                                                                     | 9  |
| 2 Terms and definitions .....                                                                                                                      | 11 |
| 2.1 Definitions relating to insulating and sheathing materials .....                                                                               | 11 |
| 2.2 Definitions relating to the tests .....                                                                                                        | 13 |
| 3 Marking .....                                                                                                                                    | 13 |
| 3.1 Indication of origin and cable identification .....                                                                                            | 13 |
| 3.2 Durability .....                                                                                                                               | 15 |
| 3.3 Legibility .....                                                                                                                               | 15 |
| 4 Core identification .....                                                                                                                        | 15 |
| 4.1 Core identification by colours .....                                                                                                           | 15 |
| 4.2 Core identification by numbers .....                                                                                                           | 17 |
| 5 General requirements for the construction of cables .....                                                                                        | 19 |
| 5.1 Conductors .....                                                                                                                               | 19 |
| 5.2 Insulation .....                                                                                                                               | 21 |
| 5.3 Filler .....                                                                                                                                   | 25 |
| 5.4 Textile braid .....                                                                                                                            | 27 |
| 5.5 Sheath .....                                                                                                                                   | 27 |
| 5.6 Tests on completed cables .....                                                                                                                | 33 |
| 6 Guide to use of the cables .....                                                                                                                 | 39 |
| Annex A (normative) Code designation .....                                                                                                         | 41 |
| Annex B (normative) Calculation method for determination of the thickness of sheath<br>of cable types 60245 IEC 53, 57 and 66 of IEC 60245-4 ..... | 45 |
| Bibliography .....                                                                                                                                 | 49 |
| Figure 1 – Arrangement of marking .....                                                                                                            | 19 |
| Table 1 – Requirements for non-electrical tests for cross-linked rubber insulation .....                                                           | 23 |
| Table 2 – Requirements for non-electrical tests for cross-linked rubber sheath .....                                                               | 29 |
| Table 3 – Requirements for electrical tests for cross-linked rubber insulated cables .....                                                         | 35 |
| Table 4 – Requirements for the static flexibility test for arc-welding electrode cables .....                                                      | 37 |
| Table 5 – Requirements for the static flexibility test for lift cables .....                                                                       | 37 |
| Table B.1 – Fictitious diameter per nominal cross-sectional area .....                                                                             | 47 |

IEC 60245-1:2003

<https://standards.iteh.ai/>
<https://standards.iteh.ai/document/iec-60245-1-2003/784dc1-d983-4164-827d-966c792b9184>

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**RUBBER INSULATED CABLES –  
RATED VOLTAGES UP TO AND INCLUDING 450/750 V –****Part 1: General requirements**

## 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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

International Standard IEC 60245-1 has been prepared by IEC technical committee 20: Electric cables.

This fourth edition cancels and replaces the third edition, published in 1994, and its amendments 1 and 2, both published in 1997.

The principal change with respect to the previous edition is the replacement of insulation IE 1 with IE 4. This fourth edition does not constitute a full technical revision.

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

| FDIS        | Report on voting |
|-------------|------------------|
| 20/659/FDIS | 20/679/RVD       |

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

IEC 60245 consists of the following parts, under the general title *Rubber insulated cables – Rated voltages up to and including 450/750 V*:

Part 1: General requirements

Part 2: Test methods

Part 3: Heat resistant silicone insulated cables

Part 4: Cords and flexible cables

Part 5: Lift cables

Part 6: Arc welding electrode cables

Part 7: Heat resistant ethylene-vinyl-acetate rubber insulated cables

Part 8: Cords for applications requiring high flexibility

Parts 3 to 8 are for particular types of cable and should be read in conjunction with Part 1 and Part 2. Further parts may be added as other types are standardized.

The committee has decided that the contents of this publication will remain unchanged until 2009. At this date, the publication will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

[IEC 60245-1:2003](https://standards-iteh.ai/catalog/standards/iec/b7784dc1-d983-4164-827d-966c792b9184/iec-60245-1-2003)

<https://standards-iteh.ai/catalog/standards/iec/b7784dc1-d983-4164-827d-966c792b9184/iec-60245-1-2003>

# RUBBER INSULATED CABLES – RATED VOLTAGES UP TO AND INCLUDING 450/750 V –

## Part 1: General requirements

### 1 General

#### 1.1 Scope

This part of IEC 60245 applies to rigid and flexible cables with insulation, and sheath if any, based on vulcanized rubber of rated voltages  $U_0/U$  up to and including 450/750 V used in power installations of nominal voltage not exceeding 450/750 V a.c.

NOTE For some types of flexible cables the term 'cord' is used.

The particular types of cables are specified in IEC 60245-3, IEC 60245-4, etc. The code designations of these types of cables are given in Annex A.

The test methods specified in Parts 1 to 8 are given in IEC 60245-2, IEC 60332-1 and in the relevant parts of IEC 60811.

#### 1.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60173:1964, *Colours of the cores of flexible cables and cords*

IEC 60228:1978, *Conductors of insulated cables*

IEC 60245-2:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 2: Test methods*

IEC 60245-3:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 3: Heat resistant silicone insulated cables*

IEC 60245-4:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 4: Cords and flexible cables*

IEC 60245-7:1994, *Rubber insulated cables – Rated voltages up to and including 450/750 V – Part 7: Heat resistant ethylene-vinyl-acetate rubber insulated cables*

IEC 60332-1:1993, *Tests on electric cables under fire conditions – Part 1: Test on a single vertical insulated wire or cable*

IEC 60811-1-1:1993, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section 1: Measurement of thickness and overall dimensions – Tests for determining the mechanical properties*

IEC 60811-1-2:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Two: Thermal ageing methods*

IEC 60811-1-4:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 1: Methods for general application – Section Four: Tests at low temperature*

IEC 60811-2-1:1998, *Insulating and sheathing materials of electric and optical cables – Common test methods – Part 2-1: Methods specific to elastomeric compounds – Ozone resistance, hot set and mineral oil immersion tests*

IEC 60811-3-1:1985, *Common test methods for insulating and sheathing materials of electric cables – Part 3: Methods specific to PVC compounds – Section One: Pressure test at high temperature – Tests for resistance to cracking*

## 2 Terms and definitions

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

### 2.1 Definitions relating to insulating and sheathing materials

#### 2.1.1

##### **type of compound**

category in which a compound is placed according to its properties, as determined by specific tests

NOTE The type designation is not directly related to the composition of the compound.

#### 2.1.2

##### **rubber compound**

combination of materials suitably selected, proportioned, treated and vulcanized, of which the characteristic constituent is a rubber and/or synthetic elastomer

NOTE Vulcanization is defined as a post-application treatment taking place after the insulation and/or sheath has been applied in order to induce permanent cross-linking of the elastomer.

#### 2.1.3

##### **polychloroprene compound (PCP) or other equivalent synthetic elastomer**

vulcanized compound in which the elastomer is polychloroprene or other equivalent synthetic elastomer providing a compound with properties similar to PCP

#### 2.1.4

##### **ethylene-vinyl acetate rubber compound (EVA) or other equivalent synthetic elastomer**

cross-linked compound in which the elastomer is ethylene-vinyl acetate or other equivalent synthetic elastomer providing a compound with properties similar to EVA

#### 2.1.5

##### **ethylene-propylene rubber compound (EPR) or equivalent synthetic elastomer**

cross-linked compound in which the elastomer is ethylene-propylene or equivalent synthetic elastomer providing a compound with properties similar to EPR



### 2.1.6

#### **cross-linked polyvinyl chloride (XLPVC)**

combinations of materials of which polyvinyl chloride is the characteristic constituent, including adequate cross-linking agents, suitably selected, proportioned and treated which, when cross-linked, meet the requirements given in the particular specification

## 2.2 Definitions relating to the tests

### 2.2.1

#### **type tests**

**T**

tests required to be made before supplying a type of cable covered by this standard on a general commercial basis, in order to demonstrate satisfactory performance characteristics to meet the intended application

NOTE These tests are of such a nature that, after they have been made, they need not be repeated, unless changes have been made in the cable materials or design which might change the performance characteristics.

### 2.2.2

#### **sample tests**

**S**

tests made on samples of completed cable, or components taken from a completed cable, adequate to verify that the finished product meets the design specifications

### 2.3

#### **rated voltage**

reference voltage for which the cable is designed, and which serves to define the electrical tests

NOTE 1 The rated voltage is expressed by the combination of two values:  $U_0/U$  expressed in volts (V):

$U_0$  being the r.m.s. value between any insulated conductor and "earth" (metal covering of the cable or the surrounding medium);

$U$  being the r.m.s. value between any two phase conductors of a multicore cable or of a system of single-core cables.

In an alternating-current system, the rated voltage of a cable is at least equal to the nominal voltage of the system for which it is intended.

This condition applies both to the value  $U_0$  and to the value  $U$ .

In a direct current system, the nominal voltage of the system is not higher than 1,5 times the rated voltage of the cable.

NOTE 2 The operating voltage of a system may permanently exceed the nominal voltage of such a system by 10 %. A cable can be used at a 10 % higher operating voltage than its rated voltage if the latter is at least equal to the nominal voltage of the system.

## 3 Marking

### 3.1 Indication of origin and cable identification

Cables shall be provided with an indication of the manufacturer, which shall be either an identification thread or a repetitive marking of the manufacturer's name or trademark.

Marking may be by printing or by reproduction in relief on, or in, the insulation or sheath, or by printing on a proofed tape or a separate marker tape.

### 3.1.1 Continuity of marks

Each specified mark shall be regarded as continuous if the distance between the end of the mark and the beginning of the next identical mark does not exceed

550 mm if the marking is on the outer sheath of the cable,

275 mm if the marking is

- on the insulation of an unsheathed cable, or
- on the insulation of a sheathed cable, or
- on a tape within a sheathed cable.

### 3.2 Durability

Printed markings shall be durable. Compliance with this requirement shall be checked by the test given in 1.8 of IEC 60245-2.

### 3.3 Legibility

All markings shall be legible.

The colours of the identification threads shall be easy to recognize or easily made recognizable, if necessary, by cleaning with petrol or other suitable solvent.

## 4 Core identification

Each core shall be identified as follows:

- in cables having up to and including five cores, by colour; see 4.1;
- in cables having more than five cores by colour or by number; see 4.1 and 4.2.

NOTE The colour scheme is under consideration.

### 4.1 Core identification by colours

#### 4.1.1 General requirements

Identification of the cores of a cable shall be achieved by the use of coloured insulation or other suitable method.

Each core of a cable shall have only one colour, except the core identified by a combination of the colours green and yellow.

The colours red, grey, white and, when not in combination, green and yellow, shall not be used for any multicore cable.

#### 4.1.2 Colour scheme

The preferred colour scheme is as follows:

|                                     |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |
|-------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| single-core cable:                  | no preferred colour scheme;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| two-core cable:                     | no preferred colour scheme;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| three-core cable:                   | either green/yellow, light blue, brown;<br>or light blue, black, brown                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| four-core cable:                    | either green/yellow, light blue, black, brown,<br>or light blue, black, brown, black or brown                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| five-core cable:                    | either green/yellow, light blue, black, brown, black or brown,<br>or light blue, black, brown, black or brown, black or brown;                                                                                                                                                                                                                                                                                                                                                                                                                                                                          |
| cables having more than five cores: | either in the outer layer one core green/yellow, one core light blue, and the other cores of one and the same colour, however not green, yellow, light blue or brown; in the other layers one core brown, and the other cores of one and the same colour, however not green, yellow, light blue or brown, or in the outer layer one core light blue, one core brown and the other cores of one and the same colour, however not green, yellow, light blue or brown; in the other layers one core brown, and the other cores of one and the same colour, however not green, yellow, light blue or brown. |

The colours shall be clearly identifiable and durable. Durability shall be checked by the test given in 1.8 of IEC 60245-2.

#### 4.1.3 Colour combination green/yellow

The distribution of the colours for the core coloured green/yellow shall comply with the following condition (which is in accordance with IEC 60173): for every 15 mm length of core, one of these colours shall cover at least 30 % and not more than 70 % of the surface of the core, the other colour covering the remainder.

NOTE Information on the use of the colours green/yellow and light blue.

It is understood that the colours green and yellow, when they are combined as specified above, are recognized exclusively as a means of identification of the core intended for use as earth connection or similar protection, and that the colour light blue is intended for the identification of the core intended to be connected to neutral. If, however, there is no neutral, light blue can be used to identify any core except the earthing or protective conductor.

### 4.2 Core identification by numbers

#### 4.2.1 General requirements

The insulation of the cores shall be of the same colour and numbered sequentially, except for the core coloured green/yellow, if one is included.

The green/yellow core, if any, shall comply with the requirement of 4.1.3 and shall be in the outer layer.

The numbering shall start with the number “1” in the inner layer.

The numbers shall be printed in arabic numerals on the outer surfaces of the cores. All the numbers shall be of the same colour, which shall contrast with the colour of the insulation. The numerals shall be legible.