

Specification for sleeves of insulating material for live working

The European Standard EN 60984:1992, with the incorporation of amendments A11:1997 and A1:2002, has the status of a British Standard

ICS 13.340.10

Cooperating organizations

The European Committee for Electrotechnical Standardization (CENELEC), under whose supervision this European Standard was prepared, comprises the national committees of the following countries:

Austria	Italy
Belgium	Luxembourg
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Finland	Norway
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Germany	Spain
Greece	Sweden
Iceland	Switzerland
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This British Standard, having been prepared under the direction of the Power Electrical Engineering Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 15 April 1993

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Amendments issued since publication

Amd. No.	Date	Comments
9891	April 1998	
13831	20 November 2002	Indicated by a sideline in the margin and see national foreword

The following BSI references relate to the work on this standard:
Committee reference PEL/88
Draft for comment 91/26507 DC

ISBN 0 580 22035 4

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National foreword

This British Standard has been prepared under the direction of the Power Electrical Engineering Standards Policy Committee and is the English language version of EN 60984:1992 *Sleeves of insulating material for live working*, including amendment A11:1997, published by the European Committee for Electrotechnical Standardization (CENELEC). It was derived by CENELEC from IEC 60984:1990, including Corrigendum July 1999 and Corrigendum May 2000, published by the International Electrotechnical Commission (IEC).

The CENELEC common modifications have been implemented at the appropriate places in the text. Parts of the original IEC text that have been modified by CENELEC have been quoted in National annex NA. Amendment A11 to EN 60984:1992 introduces further CENELEC common modifications to IEC 60984:1990 (viz. the inclusion of new Annex A and Annex E). Amendment A1 is indicated in the text by a sideline in the margin.

Corrigendum July 1999 introduces changes to **6.4.2.3** and Corrigendum May 2000 introduces a change to **E.1**.

IEC 60212:1971, IEC 60410:1979, ISO 2592:1973, ISO 2977:1974, and ISO 3104:1976, to which reference is made in the text, are available from Publications, Customer Services, BSI.

The graphic signs, symbols and letters used may be found in the following documents.

BS 3939, *Graphical symbols for electrical power, telecommunications and electronic diagrams*

— *Part 1:1986 General information, general index (Related to IEC 60617-1)*

— *Part 2:1985 Symbol elements, qualifying symbols and other symbols having general applications.*

(Identical with IEC 60617-2)

From 1 January 1997, all IEC publications have the number 60000 added to the old number. For instance, IEC 27-1 has been renumbered as IEC 60027-1. For a period of time during the change over from one numbering system to the other, publications may contain identifiers from both systems.

Cross-references

The British Standards which implement international or European publications referred to in this document may be found in the *BSI Catalogue* under the section entitled “International Standards Correspondence Index”, or by using the “Search” facility of the *BSI Electronic Catalogue* or of British Standards Online.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 39 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Sidelining in this document indicates the most recent changes by amendment.

Descriptors: Electrical insulation, work safety, accident prevention, protection against electrical contact, dimensions, tests, protective clothing, arm

English version

Sleeves of insulating material for live working

(includes amendments A11:1997 and A1:2002)
(IEC 60984:1990 + A1:2002, modified)

Protège-bras en matériaux isolants pour
travaux électriques
(inclut les amendements A11:1997 et A1:2002)
(CEI 60984:1990 + A1:2002, modifiée)

Isolierende Ärmel zum Arbeiten unter
Spannung
(enthält Änderungen A11:1997 und A1:2002)
(IEC 60984:1990 + A1:2002, modifiziert)

This European Standard was approved by CENELEC on 1992-09-15; amendment A11 was approved by CENELEC on 1997-03-11 and amendment A1 was approved by CENELEC on 2002-07-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The CENELEC questionnaire procedure, performed for finding out whether or not the International Standard IEC 60984:1990 could be accepted without textual changes, has shown that some common modifications were necessary for the acceptance as European Standard.

The reference document, together with the common modifications prepared by the CENELEC Technical Committee TC 78, was submitted to the CENELEC members for formal vote.

The text of the draft was approved by CENELEC as EN 60984 on 15 September 1992.

The following dates were fixed:

- latest date of publication of an identical national standard (dop) 1993-09-01
- latest date of withdrawal of conflicting national standards (dop) 1993-09-01

For products which have complied with the relevant national standard before 1993-09-01, as shown by the manufacturer or by a certification body, this previous standard may continue to apply for production until 1998-09-01.

Annexes and appendices designated “normative” are part of the body of the standard. Annexes and appendices designated “informative” are given only for information. In this standard, Appendix C and Appendix D and Annex ZA are normative, Appendix F and Appendix G are informative.

Foreword to amendment A11

This amendment was prepared by the Technical Committee CENELEC TC 78, Equipment and tools for live working.

It comprises the texts of two draft amendments.

The text of prAB was submitted to the formal vote and was approved by CENELEC on 1996-10-01 for inclusion into the future amendment A11.

The text of prAA was submitted to the Unique Acceptance Procedure and was approved by CENELEC as amendment A11 to EN 60984:1992 on 1997-03-11.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1997-12-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 1997-12-01

Foreword to amendment A1

The text of document 78/438/FDIS, future amendment 1 to IEC 60984:1990, prepared by IEC TC 78, Live working, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as amendment A1 to EN 60984:1992 on 2002-07-01.

The following dates were fixed:

- latest date by which the amendment has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2003-04-01
- latest date by which the national standards conflicting with the amendment have to be withdrawn (dow) 2005-07-01

Annexes designated “normative” are part of the body of the standard. In this standard, Annex ZA is normative. Annex ZA has been added by CENELEC.

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1 Scope

This international standard is applicable to insulating sleeves for the protection of workers from accidental contact with live electrical conductors, apparatus or circuits.

1.1 Five classes of sleeve, differing in electrical characteristics, are provided and designated as: Class 0, Class 1, Class 2, Class 3 and Class 4.

1.2 Five categories of sleeve with different properties are provided, related to the following: resistance to acid, resistance to oil, resistance to ozone, combined resistance to oil and ozone, and also resistance to extreme low temperature. These are designated as Categories A, H, Z, S and C respectively.

1.3 Two styles of sleeve, differing in configuration, are provided and designated as straight taper and curved elbow.

2 Definitions

For the purpose of this standard, the terms hereafter have the following meanings:

elastomer

a generic term that includes rubbers, latex and elastomeric compounds that may be natural or synthetic, or a mixture, or a combination of both

type test

a test of one or more devices made to a certain design to show that the design meets certain specifications (IEV¹⁾ 151-04-15)

routine test

a test to which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria (IEV 151-04-16)

sampling test

a test on a number of devices taken at random from a batch (IEV 151-04-17)

acceptance test

a contractual test to prove to the customer that the device meets certain conditions of its specification (IEV 151-04-20)

shoulder roll

the rolled or reinforced edge of an insulating sleeve nearest to the shoulder

cuff roll

the roll or reinforced edge of a sleeve at the cuff

electrical puncture

a disruptive breakdown through a solid insulant (IEV 121-03-13)

flashover

an arc by-passing an insulating body (IEV 121-03-14)

nominal voltage

a suitable approximate value of voltage used to designate or identify a system (IEV 601-01-21)

3 Composition

The sleeves shall be manufactured of elastomers and produced by a seamless process. The holes provided in sleeves, for the purposes of strap or harness attachments, shall have non-metallic reinforced edges, and shall be nominally 8 mm in diameter.

¹⁾ See the International Electrotechnical Vocabulary (IEV) (IEC Publication 60050).

4 Classification

The sleeves covered under this standard shall be designated as follows:

- by class as Class 0, Class 1, Class 2, Class 3 and Class 4;
- by special properties, by the addition of a suffix as shown in Table I;
- by style as described in sub-clause 4.1.1.

Table I — Special properties

Category	Resistant to
A	Acid
H	Oil
Z	Ozone
S ^a	Oil and ozone
C	Extreme low temperature

^a Category S combines the characteristics of Categories H and Z.

NOTE Guidance for use will be given in Appendix A (under consideration).

4.1.1 Style: Two styles are provided as indicated:

- Style A: Straight taper (see Figure 1).
- Style B: Curved elbow (see Figure 2).

5 Physical requirements

5.1 Shape

5.1.1 The shape of the straight taper sleeve is indicated in Figure 1.

5.1.2 The shape of the curved elbow sleeve is indicated in Figure 2.

Table II — Dimensions^a

Style	Size	Dimensions			
		(mm)			
		A	B	C	D
Style A (Figure 1) (Straight taper)	Small	630	370	270	140
	Medium	670	410	290	140
	Large	720	450	330	175
	Extra large	760	500	340	175
Style B (Figure 2) (Curved elbow)	Small	630	370	290	145
	Medium	670	410	310	145
	Large	710	420	330	175
	Extra large	750	460	330	180

^a Tolerances shall be as follows:
 Dimension A: ± 15 mm;
 Dimension B: ± 15 mm;
 Dimension C: ± 15 mm;
 Dimension D: ± 5 mm;

5.2 Dimensions

5.2.1 Dimensions and tolerances are indicated in Table II.

5.2.2 Straight taper and curved elbow sleeves: The dimensions are shown in Figure 1 and Figure 2.

5.2.3 To minimize problems of marking and identification, the following standard abbreviations may be used:

small (S), medium (M), large (LG), extra large (XLG).

Class 0, Class 1, Class 2, Class 3 and Class 4, right or left shall not be abbreviated (see sub-clause 5.5).

5.3 Thickness

5.3.1 The *maximum* thickness of the elastomer on the flat surface (not ribbed area, if present) of a sleeve shall be as follows in order to obtain appropriate flexibility.

Table III — Maximum elastomer thickness

Class	mm
0	1.00
1	1.50
2	2.50
3	2.90
4	3.60

5.3.2 The *minimum* thickness shall be determined only by the ability to pass the tests defined in clause 6 and clause 7.

5.3.3 Sleeves of Categories A, H, and Z may require additional thickness which shall not exceed 0.6 mm.

5.4 Workmanship and finish

Sleeves shall be free on both inner and outer surfaces from harmful physical irregularities that can be detected by thorough test and inspection.

Harmful physical irregularities shall be defined as any feature that disrupts the uniform, smooth surface contour, such as pinholes, cracks, blisters, cuts, conductive embedded foreign matter, creases, pinch marks, voids (entrapped air), prominent ripples and prominent mould marks.

Non-harmful physical irregularities shall be defined as surface irregularities present on the inner and outer surfaces of the sleeve due to imperfections on forms or moulds or other imperfections inherent in the manufacturing process. These irregularities appear as mould marks that look like cuts even though they are actually raised ridges of elastomer, indentations, or protuberances that are acceptable provided that:

- a) the depression is not larger than 1.6 mm in diameter, has rounded edges and no visible break in the surface, and cannot be seen on the opposite side when stretched over the thumb;
- b) there are not more than five depressions as described in a) anywhere on the sleeve and any two are separated by at least 15 mm;
- c) the indentations, protuberances or mould marks tend to blend into a smooth surface upon stretching of the material;
- d) the small projections or protuberances represent only a small amount of excess elastomer that cannot be readily removed with the finger and these projections do not appreciably affect the stretching of the elastomer.

5.5 Marking

5.5.1 Each sleeve which is claimed to comply with the requirements of this standard shall be marked with the following (see Figure 3 and sub-clause 5.2.3):

- a) symbol IEC-60417-5216 — Suitable for live working; double triangle;
- b) number of the relevant IEC standard immediately adjacent to the symbol;
- c) name, trademark, or identification of the manufacturer;
- d) category, if applicable;
- e) size;
- f) class;
- g) right or left;
- h) month and year of manufacture.

In addition, each sleeve shall have a group of rectangles or other suitable means to identify when the sleeve was put into service and the dates of periodic inspection and testing.

5.5.2 The marking shall be durable and shall not impair the quality of the sleeve.

The durability of the marking is checked by rubbing the marking for 15 s with a piece of lint-free cloth soaked in soapy water and then rubbing it for a further 15 s with a piece of lint-free cloth soaked in denatured alcohol. At the end of the test, the marking must remain legible.

5.5.3 Any additional marking shall be subject to agreement between the manufacturer and the customer.

5.5.4 When a colour code is used the colour of the symbol (double triangle) shall correspond to the following code:

- Class 0: red
- Class 1: white
- Class 2: yellow
- Class 3: green
- Class 4: orange

5.6 Packaging

Each pair of sleeves (right and left) shall be packaged in an individual container or package of sufficient strength to properly protect the sleeves from damage. The outside of the container or package shall be marked with the name of the manufacturer or supplier, classification, category, size, length, and style.

At the request of the customer and in accordance with any national regulation, information contained in Appendix G and any additional or amended instructions shall be included in the package.

6 Tests on sleeves

6.1 General

There are four categories of tests: type, routine, sampling and acceptance. These are defined in clause 2: Definitions.

The allotment of these sleeves in various testing lots, the size of each lot, and the order in which these tests are carried out are given in Appendix C.

Each of the following sub-clauses defines whether type, routine or sampling tests are required.

In order to carry out the type tests, it is necessary to have:

- 8 sleeves to cover all tests common to all categories of sleeves (clause 6);
- 4 additional sleeves of Category A;
- 4 additional sleeves of Category H;
- 4 additional sleeves of Category Z;
- 5 additional sleeves of Category S.

Sleeves shall be pre-conditioned for a period of 2 ± 0.5 h at a temperature of 23 ± 2 °C and 50 ± 5 % relative humidity (see IEC Publication 60212, standard atmosphere B).

6.2 Visual inspection and measurements

6.2.1 Shape

Type test and sampling test (see sub-clause 5.1).

The shape shall be verified by visual inspection.

The taper of sleeves should be uniform as this is significant in the use of dry-form electrical testing.

6.2.2 Dimensions

Type test and sampling test (see sub-clause 5.2 and Figure 1 and Figure 2).

6.2.2.1 Straight taper sleeves

Dimensions of straight taper sleeves, as illustrated in Figure 1, shall be determined with the sleeve in a flat condition (that is, with one side firmly and uniformly pressed against the other). A convenient device for measuring is a board with a centre line upon which the sleeve is placed so that D_1 equals D_2 and E_1 equals E_2 , in which case C_1 will be greater than C_2 .

- Dimension A — The overall length shall be measured from the outside edge of the wrist opening to the outside edge of the shoulder opening, parallel to the centre line.
- Dimension B — The underarm length shall be measured from the outside edge of the cuff opening to the lowest point of the underarm opening along the centre line.
- Dimension C — The shoulder opening width shall be the sum of C_1 and C_2 , minus twice the thickness of the sleeve, measured perpendicular to the centre line as shown in Figure 1.
- Dimension D — The wrist opening width shall be the sum of D_1 and D_2 , minus twice the thickness of the sleeve, measured perpendicular to the centre line as shown in Figure 1.

6.2.2.2 Curved elbow sleeves

Dimensions of curved elbow sleeves, as illustrated in Figure 2, shall be determined with the sleeve in a flat condition (that is, with one side firmly and uniformly pressed against the other). The sleeve shall be oriented along a line from the midpoint of the wrist opening through the centre of the uppermost button hole.

- Dimension A — The overall length shall be measured from the outside edge at the midpoint of the wrist opening to the outside edge of the shoulder opening, parallel to the orientation line.
- Dimension B — The underarm length shall be measured from the outside edge at the midpoint of the wrist opening to the lowest point of the shoulder, parallel to the orientation line.
- Dimension C — The shoulder opening width shall be measured as the maximum width at the shoulder opening minus twice the sleeve thickness.
- Dimension D — The wrist opening width shall be measured as the outside width above the reinforcing edge at the wrist opening, minus twice the sleeve thickness.

6.2.3 Thickness

Type test and sampling test (see sub-clause 5.3).

Thickness measurements shall be made at eight or more points uniformly distributed over the total area of the sleeve.

Measurements shall be made with a micrometer (see Figure 4) or any alternative instrument giving substantially the same results. The micrometer shall be graduated to within 0.02 mm, have an anvil of 6 mm in diameter, and a presser foot 3.17 ± 0.25 mm in diameter. The presser foot shall exert a total force of 0.83 ± 0.03 N. Sufficient support shall be given the sleeve so that it will present an unstressed flat surface between the anvil faces of the micrometer.

In case of dispute, the micrometer method described above shall be used.

6.2.4 *Workmanship and finish*

Type test and sampling test (see sub-clause 5.4).

The workmanship and finish shall be verified by visual inspection.

6.2.5 *Marking*

Type test and routine test (see sub-clause 5.5).

The marking shall be verified by visual inspection and durability test (see sub-clause 5.5.2) for type tests. No durability test is required for routine tests.

6.2.6 *Packaging*

Type test and sampling test (see sub-clause 5.6).

The packaging shall be verified by visual inspection.

6.3 Mechanical tests

6.3.1 *General*

All mechanical tests shall be performed on test pieces which have been conditioned by storing each sleeve separately in a horizontal position for 24 h at a room temperature of 23 ± 2 °C, 50 ± 5 % relative humidity (see IEC Publication 60212, standard atmosphere B).

NOTE The properties of vulcanized elastomeric materials change continuously with time, these changes being particularly rapid in the period immediately following vulcanization.

6.3.2 *Tensile strength and elongation at break*

Type test and sampling test.

Four dumb-bell test pieces each having the outline shown in Figure 5 shall be cut from the sleeve under test, one from the outer and one from the inner part of the sleeve at each end.

Reference lines, 20 mm apart, shall be marked on these test pieces, symmetrically placed on the narrow part of the dumb-bell (see Figure 5).

The test pieces shall be tested in a tensile testing machine which shall be power driven at a sufficient speed to maintain the rate of traverse of the driven grip at 500 ± 50 mm/min up to the maximum force capacity of the machine.

The tensile strength shall be calculated by dividing the force at break by the initial area of the cross section under test. The average of the four test pieces shall not be less than 14 MPa.

The elongation at break shall be calculated by subtracting the initial distance between the reference lines on the test piece from the distance between the lines at breaking point and expressing the result as a percentage of the initial distance.

The average of the four test pieces shall not be less than 600 %.

NOTE 1 The machine shall be equipped to give a continuous indication of the force applied to the test piece and a graduated scale to measure the elongation.

NOTE 2 After the test piece has been broken, the machine shall give a permanent indication of the maximum force and where possible the maximum elongation.

6.3.3 *Mechanical puncture resistance*

Type test and sampling test.

Two circular test pieces 50 mm in diameter shall be cut from the sleeve and each shall be clamped between two flat 50 mm diameter test plates. The top plate shall have a circular opening 6 mm in diameter and the bottom plate a 25 mm diameter circular opening. The edges of both openings shall be rounded to a radius of 0.8 mm (see Figure 6).

A needle shall be produced from 5 mm diameter metal rod and one end shall be machined to produce a taper with an angle of 12° and with the tip rounded to a radius of 0.8 mm (see Figure 6). The needle shall be clean at time of use.

The needle shall be positioned perpendicularly above the test piece (clamped between the plates) and shall be driven into and through the test-piece. The rate of traverse shall be 500 ± 50 mm/min. The force required to puncture the test-piece shall be measured.

The puncture resistance shall be calculated by dividing the puncturing force by the thickness of the test-piece and for each test the result shall be greater than 18 N/mm.

6.3.4 Tension set

Type test and sampling test.

Three test pieces, having the outline shown in Figure 5 shall be cut from each sleeve under test, one from each side near the wrist end and one from near the underarm end. The test pieces shall be fitted in a straining device consisting of a metal rod or other suitable guide fitted with a pair of holders, one fixed and one movable for the ends of the test piece. The measurement of the unstrained reference length (shown as l_o in Figure 5) shall be checked to the nearest 0.1 mm and the test-piece shall be placed in the holder. The test-piece shall be extended at a speed of between 2 mm/s and 10 mm/s to a 400 ± 10 % elongation and held for 10.0 min. After this time the strain shall be released at a speed of between 2 mm/s and 10 mm/s, and then the test piece shall be removed from the holders and laid free on a flat surface. After a 10.0 min recovery time the reference length shall be measured again.

The tension set is calculated as a percentage of the initial strain as follows:

$$\text{tension set} = 100 \times \frac{l_1 - l_o}{l_s - l_o}$$

where:

l_o = original unstrained reference length

l_s = strained reference length

l_1 = reference length after recovery

The tension set shall not exceed 15 %.

6.4 Dielectric tests

6.4.1 General

Dielectric testing at a.c. or d.c. voltage shall be carried out on three sleeves and at a temperature of 23 ± 2 °C. The choice of a.c. or d.c. shall be made between the manufacturer and customer.

NOTE The equivalence of d.c. tests and a.c. tests is under consideration and consequently the values of d.c. test voltages are under consideration.

For type and sampling tests the sleeves shall be conditioned for moisture absorption by immersion in water for a period of 16 ± 0.5 h. For routine tests such conditioning is not required.

All dielectric tests shall be performed on sleeves right side out. Four methods of mounting sleeves are provided, with test limitations on some of the methods. Electrode to electrode clearances shall be as specified in Table IV.

NOTE Both a.c. and d.c. test procedures are included in the following sub-clauses. It is intended that one mounting method and one testing procedure be selected for the electrical acceptance test.