

INTERNATIONAL STANDARD



**Flexible insulating sleeving –
Part 3: Specifications for individual types of sleeving –
Sheet 280: Heat-shrinkable, polyolefin sleeving, anti-tracking**



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IEC 60684-3-280

Edition 2.0 2019-08
REDLINE VERSION

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Sheet 280: Heat-shrinkable, polyolefin sleeving, anti-tracking**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.035.20

ISBN 978-2-8322-7326-5

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 280: Heat-shrinkable, polyolefin sleeving, anti-tracking

FOREWORD

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International Standard IEC 60684-3-280 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This second edition cancels and replaces the first edition published in 2010 and Amendment 1:2013. This edition constitutes a technical revision.

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

- a) change of moulded plaque thickness for resistance to tracking and weathering tests to $(6 \pm 0,5)$ mm.

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

FDIS	Report on voting
15/891/FDIS	15/898/RVD

Full information on the voting for the approval of this International Standard can be found in the report

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

A list of all parts in the IEC 60684 series, published under the general title *Flexible insulating sleeving*, 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- withdrawn,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.

IMPORTANT – The 'colour inside' logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This document is one of a series of standards which deals with flexible insulating sleeving for electrical purposes.

The series consists of three parts:

Part 1: Definitions and general requirements (IEC 60684-1)

Part 2: Methods of test (IEC 60684-2)

Part 3: Specifications for individual types of sleeving (IEC 60684-3)

This document comprises one of the sheets of Part 3 as follows:

Sheet 280: Heat-shrinkable, polyolefin sleeving, anti-tracking

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 280: Heat-shrinkable, polyolefin sleeving, anti-tracking

1 Scope

This part of IEC 60684 gives the requirements for heat-shrinkable, polyolefin sleeving, anti-tracking with a nominal shrink ratio of 3:1.

This sleeving has been found suitable for use at temperatures up to 100 °C.

Typically: medium wall, internal diameter up to 110 mm.

~~These sleeveings are~~ This sleeving is normally supplied in the colours red or brown.

Since these types of sleeveings cover a significantly large range of sizes and wall thicknesses, Annex A (Table A.1) provides guidance on the range of sizes available. The actual size ~~shall~~ will be agreed between the user and the supplier.

Materials which conform to this specification meet established levels of performance. However, the selection of a material by a user for a specific application ~~should~~ will be based on the actual requirements necessary for adequate performance in that application and not based on this specification alone.

This sleeving is designed to be used in medium voltage cable accessories and as such electrical performance ~~must~~ will be proven as part of the assembly. Examples of this are described in HD 629.1 and IEC 60502 (all parts).

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 60296:2003/2012, *Fluids for electrotechnical applications – Unused mineral insulating oils for transformers and switchgear*

~~IEC 60502 (all parts), Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV)~~

IEC 60684-1:2003, *Flexible insulating sleeving – Part 1: Definitions and general requirements*

IEC 60684-2:1997/2011, *Flexible insulating sleeving – Part 2: Methods of test*
~~Amendment 1 (2003)~~
~~Amendment 2 (2005)~~

IEC 60757:1983, *Code for designation of colours*

ISO 846:1997/2019, *Plastics – Evaluation of the action of micro-organisms*

ISO 4892-3:2006/2016, *Plastics – Methods of exposure to laboratory light sources – Part 3: Fluorescent UV lamps*

~~HD 629, Test requirements on accessories for use on power cables of rated voltages from 3,6/6(7,2)kV up to 20,8/36(42)kV – Part 1: Cables with extruded insulation~~

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

4 Designation

The sleeving shall be identified by the following designation:

Description	IEC publication number	IEC part number	IEC sheet number	Size (expanded and recovered internal diameter in millimetres)	Colour	Table 4 ^a code
↓	↓	↓	↓	↓	↓	↓
Sleeving	IEC 60684	- 3	-280	- 60,0/19,0	- Red	X

^a NOTE 1 The addition of "X" at the end of the designation indicates that the properties contained in Table 4 have been agreed upon between the user and supplier.

Any colour abbreviation shall comply with IEC 60757, where applicable. Non-standard colours shall be written out in full.

NOTE 2 This information is for labelling only, in accordance with IEC 60684-1.

5 Conditions of test

Unless otherwise specified, the sleeving shall be shrunk in a forced air circulation oven for (10 ± 1) min at $200 \text{ }^{\circ}\text{C} \pm 3 \text{ K}$ prior to testing.

6 Requirements

In addition to the general requirements given in IEC 60684-1, the sleeving shall comply with the requirements of Tables 1, 2, 3, and 4 where applicable.

7 Sleeving conformance

Conformance to the requirements of this specification shall normally be based on the results from typical sizes:

- Recovered ID 20 mm to 30 mm

Table 1 – Property requirements

Property	IEC 60684-2: 2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Dimensions Internal diameter Wall thickness Concentricity expanded recovered	3 3.1.2 3.3.2 3.3.3	mm mm %	Min. Min.	To be agreed between the purchaser and the supplier 60 85	
Heat shock Tensile strength Elongation at break	6 19.12 and 19.23 19.12 and 19.23	MPa %	Min. Min.	8 200	Heat at 150 °C ± 5 K Use a jaw separation rate of 100 mm/min. For internal diameters < 6,5 mm, use sleeving samples for testing. On 6,5 mm and larger diameter sleeving, use dumb-bell samples cut from the sleeving
Longitudinal change	9	%	Max.	+5 –10	Heat expanded sleeving at 150 °C ± 3 K for (10 ± 1) min
Bending at low temperature	14	–	–	No cracking shall be visible.	Test at – 40 °C. For strips, the mandrel shall be between 20 times and 22 times the wall thickness. Full section sleeving is tested unfilled and the mandrel shall be between 20 times and 22 times the outer diameter
Dimensional stability on storage	16	–	–	The dimensions shall remain as agreed.	See Clause 1 .
Tensile strength Elongation at break	19.12 and 19.23 19.12 and 19.23	MPa %	Min. Min.	10 300	Use a jaw separation rate of 100 mm/min. Below 6,5 mm Ø as sleeving. At 6,5 mm Ø and above as dumbbells. For internal diameters < 6,5 mm, use sleeving samples for testing. On 6,5 mm and larger diameter sleeving, use dumb-bell samples cut from the sleeving
Secant modulus at 2 % elongation	19.45	MPa MPa	Min. Max.	80 160	
Dielectric strength	See Table 2 of this document.	kV/m m	Min.	Table 2	
Breakdown voltage	21.2	kV/m m	Min.	See Table 2	
Volume resistivity at room temperature	23 23.45.2	Ω·m	Min.	10 ¹²	

Property	IEC 60684-2: 2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Resistance to tracking	25	–	Min.	Class 2A 2,5 kV – 1 h 2,75 kV – 1 h 3,0 kV – 1 h 3,25 kV – 20 min	Specimens shall be prepared from cross-linked moulded plaques of thickness $(6 \pm 0,5)$ mm Specimens should not be abraded but cleaned with an appropriate solvent. The method of cleaning shall be recorded.
Resistance to selected fluids Tensile strength Elongation at break	36 19.12 and 19.23 19.12 and 19.23	MPa %	Min. Min.	8 200	Use the fluids and test temperatures specified in Table 3. Use a jaw separation rate of 100 mm/min. For internal diameters < 6,5 mm, use sleeving samples for testing. On 6,5 mm and larger diameter sleeving, use dumb-bell samples cut from the sleeving Immersion (24 ± 1) h
Heat ageing Tensile strength Elongation at break	39 19.12 and 19.23 19.12 and 19.23	MPa %	Min. Min.	8 200	Heat at $150\text{ °C} \pm 3\text{ K}$ Use a jaw separation rate of 100 mm/min. For internal diameters < 6,5 mm, use sleeving samples for testing. On 6,5 mm and larger diameter sleeving, use dumb-bell samples cut from the sleeving
Long term ageing Elongation at break	50 19.2 and 19.3	%	Min.	150	The ageing temperature shall be $100\text{ °C} \pm 3\text{ K}$ Use a jaw separation rate of 100 mm/min. For internal diameters < 6,5 mm, use sleeving samples for testing. On 6,5 mm and larger diameter sleeving, use dumb-bell samples cut from the sleeving

Table 2 – Requirements for dielectric strength

Expanded wall thickness mm	Dielectric strength ^a Min.	
All dimensions	Expanded ID	Dielectric strength kV/mm
	10 to 25	14
	26 to 59	12
	60 to 120	10
^a Measure the expanded wall thickness and calculate the dielectric strength by dividing the breakdown voltage by this value.		

~~The breakdown voltage shall be determined by the method described in 21.4 of IEC 60684-2.~~

The sleeving shall be tested in the expanded condition.

The rate of application of the voltage shall be 500 V/s.

NOTE Care should be taken on selection of sizes based on these values. Refer to the manufacturer for actual values on installed condition.

Table 3 – Resistance to selected fluids

Test fluid No.	Fluids	Type	Standard or symbol	Immersion temperature °C ± 2 K
1	Insulating oil	Mineral based	IEC 60296	23
2			Isopropyl alcohol	23
3	-	Water	De-ionized	85

Other fluids and/or temperatures may be specified for customers with specific needs. These additional fluids and/or temperatures shall be applicable when incorporated into agreements between the supplier and the customer.

Table 4 – Additional property requirements

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Fungus resistance Tensile strength Elongation	19.42 and 19.23	MPa %	Min. Min.	8 250	The test method shall be ISO 846, Method B. 56 days exposure Use a jaw separation rate of 100 mm/min. For internal diameters < 6,5 mm, use sleeving samples for testing. On 6,5 mm and larger diameter sleeving, use dumb-bell samples cut from the sleeving

Resistance to weathering	<p>ISO 4892-3:2016 Method 4 C</p> <p>After 5 000 3 000 h Test to</p> <p>19.1 19.2 and 19.3 19.2 and 19.3 25</p>	MPa %	Min. Min. Min.	<p>8 200 Class 2A 2,5 kV – 1 h</p>	<p>Test method to ISO 4892-3.</p> <p>Samples for test 19.12 and 19.23 should be taken from recovered sleeving which is flattened. Use a jaw separation rate of 100 mm/min</p> <p>Samples for Test 25 should be taken from specially prepared test sheets ($6 \pm \del{0,1}{0,5}$) mm thick. All samples should be cut to the appropriate size to fit the sample holders</p> <p>Intermediate tests may also be done at 1 000 h intervals as an intermediate check on performance</p>
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Annex A (informative)

Guidance on the available sizes and wall thicknesses

Table A.1 – Guidance on the available sizes and wall thicknesses

Internal diameter		Wall
Expanded Min. mm	Recovered Max. mm	Recovered wall thickness Min. mm
16,0	8,0	1,4
20,0	10,0	1,4
26,0	12,0	2,4
30,0	15,0	2,6
33,0	9,0	3,0
35,0	12,0	3,0
45,0	20,0	3,0
60,0	19,0	3,1
65,0	30,0	3,1
80,0	26,0	3,2
90,0	30,0	3,3
95,0	45,0	3,5
110,0	37,0	3,5