IEC 60684-3-247

Edition 2.0 2019-08
REDLINE VERSION

INTERNATIONAL STANDARD

colour inside

Flexible insulating sleeving –
Part 3: Specifications for individual types of sleeving –
Sheet 247: Heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded, thick and medium wall

IEC 60684-3-247:2019-08 RLV(en)

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FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 247: Heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded, thick and medium wall

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.
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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

International Standard IEC 60684-3-247 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This second edition cancels and replaces the first edition published in 2011 and Amendment 1:2016. This edition constitutes a technical revision.

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

a) removal of the colour fastness to light test, as this is covered by the test for carbon black content;
b) change of low temperature flexibility test to -20 °C to align with sheet 214;
c) change of final conditioning temperature of peel strength samples to 200 ºC to align with the temperature in Clause 5;
d) removal of the fungus resistance test as there is no evidence that fungus growth is an issue either by testing or in use.

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

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

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

A list of all the parts in the IEC 60684 series, 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.

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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 247: Heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded, thick and medium wall

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 247: Heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded, thick and medium wall

1 Scope

This part of IEC 60684 gives the requirements for two types of heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded with a nominal shrink ratio of 3:1.

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

- Type A: Medium wall, internal diameter up to 200,0 mm typically.
- Type B: Thick wall, internal diameter up to 200,0 mm typically.

These sleevings are normally supplied in colour black.

Since these types of ~~sleevings~~ sleving cover a significantly large range of sizes and wall thicknesses, Annex A (Tables A.1 and A.2) provides a guide to the range of sizes available. The actual size ~~shall~~ will be agreed between the user and 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.

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 60502-1:2004, *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)*~~

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 2 (2005)~~

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

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

ISO 868:2003, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 11357-3:~~1999~~2018, Plastics – *Differential scanning calorimetry (DSC) – Part 3: Determination of temperature and enthalpy of melting and crystallization*

ISO 11358-1:~~1997~~2014, *Plastics – Thermogravimetry (TG) of polymers – Part 1: General principles*

3 Terms and definitions

No terms and definitions are listed this document.

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

- IEC Electropedia: available at http://www.electropedia.org/
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4 Designation

The sleeving shall be identified by the following designation:

Description	IEC publication number	IEC part number	IEC sheet number	Type	Size (expanded and recovered internal diameter in mm)	Colour	~~Table 4*~~ ~~code~~
↓	↓	↓	↓	↓	↓	↓	↓
Sleeving	IEC 60684	- 3	- 247	- B	- 85,0/25,0	- BK	~~X~~

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

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

~~* 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.~~

5 Conditions of test

Unless otherwise specified, the sleeving shall be shrunk in a forced air circulation oven for (10 ± 1) min at 200 °C ± 3 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, and 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:

- Type A: Recovered ~~ID~~ internal diameter 25 mm to 30 mm

- Type B: Recovered ~~ID~~ internal diameter 25 mm to 30 mm

For the peel strength test, select a size to comply with the dimensions as detailed under the remarks in Table 1.

Table 1 – Property requirements *(1 of 3)*

~~Property~~	~~IEC 60684-2 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 purchaser and supplier~~ ~~50~~ ~~85~~	
~~Heat shock~~ ~~Tensile strength~~ ~~Elongation at break~~	~~6~~ ~~19.1 and 19.2~~ ~~19.1 and 19.2~~	~~-~~ ~~MPa~~ ~~%~~	~~-~~ ~~Min.~~ ~~Min.~~	 ~~10~~ ~~200~~	~~Heat at 200 °C ± 5 K~~ ~~Jacket only, ignore flowing adhesive~~
~~Longitudinal change~~	~~9~~	~~%~~	~~Max.~~	~~–10~~ ~~+ 5~~	
~~Bending at low temperature~~	~~14~~	~~-~~		~~No cracking shall be visible.~~	~~Test at – 40 °C.~~ ~~For strips, the mandrel shall be between 20 and 22 times the wall thickness. Full section sleeving is tested unfilled and the mandrel shall be between 20 and 22 times the outer diameter.~~
~~Dimensional stability on storage~~	~~16~~	~~-~~	~~-~~	~~The dimensions shall remain as agreed.~~	~~See Clause 1 Scope.~~
~~Tensile strength~~ ~~Elongation at break~~	~~19.1 and 19.2~~ ~~19.1 and 19.2~~	~~MPa~~ ~~%~~	~~Min.~~ ~~Min.~~	~~13~~ ~~350~~	~~Jacket only.~~ ~~Use a jaw separation rate of 100 mm/min. Below 6,5mm ∅ as sleeving.~~ ~~At 6,5 mm ∅ and above as dumbbells.~~
~~Secant modulus at 2% elongation~~	~~19.4~~	~~MPa~~ ~~MPa~~	~~Min.~~ ~~Max.~~	~~80~~ ~~160~~	~~Calculate cross- section area without adhesive.~~
~~Breakdown voltage~~	~~21~~	~~kV~~	~~Min.~~	~~Table 2~~	
~~Volume resistivity at room temperature after damp heat~~	~~23~~ ~~23.4.2~~ ~~23.4.4~~	 ~~Ω·m~~ ~~Ω·m~~	 ~~Min.~~ ~~Min.~~	 ~~10^{12}~~ ~~10^{11}~~	

Property	IEC 60684-2 clause or subclause	Units	Max. or Min.	Requirements	Remarks
Colour fastness to light Standard identification number	34		Min.	The colour standard contrast between the exposed and unexposed parts of the specimen shall be equal to or less than that of the fastness standard.	Fastness standard 5
Resistance to selected fluids Tensile strength Elongation at break	36 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 10 250	Use the fluids and test temperatures specified in Table 3. Immersion time (24 ± 1)h
Heat ageing Tensile strength Elongation at break	39 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 10 200	Heat at 150 °C ± 3 K. Jacket only.
Long term ageing Elongation at break	50 19.2	 %	 Min.	 175	The ageing temperature shall be 100 °C ± 3 K.
Carbon black content	ISO 11358	%	Min.	2,5	
Hardness	ISO 868	Shore D	Min.	40	
Water absorption	40	%	Max.	0,5	

Property	IEC 60684-2 clause or subclause	Units	Max. or Min.	Requirements	Remarks
Peel strength	54	N/25 mm	Min.	Cu – 50 Al – 75 Pb – 40 PE – 100 PVC – 40 EPR – 50	Condition at 150 °C ± 3 K for (10 ± 1) min. For tests in addition to aluminium replace the mandrel with cable jacket material of PE, PVC and/or EPR that conforms to IEC 60502-1. See note 2
Melting temperature	ISO 11357-3	º C	Min.	100	Adhesive only
NOTE 1 Where jacket only is indicated, the tensile strength calculation for cross-sectional area is based on the thickness of the jacket. NOTE 2 Use a substrate diameter that is a minimum of 25 mm and is at least 20% above the recovered internal diameter of the sleeving.					

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Dimensions	3				
Internal diameter	3.1.2	mm			
Wall thickness	3.3.2	mm		To be agreed between purchaser and supplier	
Concentricity	3.3.3	%			
expanded			Min.	50	
recovered			Min.	85	
Heat shock	6	-	-		Heat at 200 °C ± 5 K
Tensile strength	19.2 and 19.3	MPa	Min.	10	Jacket only, ignore flowing adhesive
Elongation at break	19.2 and 19.3	%	Min.	200	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.	–10 + 5	
Bending at low temperature	14	-	-	No cracking shall be visible	Test at -20 °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	19.2 and 19.3	MPa	Min.	13	Jacket only
Elongation at break	19.2 and 19.3	%	Min.	350	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.
Secant modulus at 2 % elongation	19.5	MPa MPa	Min. Max.	80 160	Calculate cross- section area without adhesive.
Breakdown voltage	21.2	kV	Min.	Table 2	
Volume resistivity at room temperature after damp heat	23 23.5.2 23.5.4	 Ω·m Ω·m	 Min. Min.	 10^{12} 10^{11}	

Table 1 *(2 of 3)*

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Resistance to selected fluids	36				Use the fluids and test temperatures specified in Table 3
Tensile strength	19.2 and 19.3	MPa	Min.	10	Immersion time (24 ± 1) h
Elongation at break	19.2 and 19.3	%	Min.	250	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
Heat ageing	39				Heat at 150 °C ± 3 K
Tensile strength	19.2 and 19.3	MPa	Min.	10	Jacket only
Elongation at break	19.2 and 19.3	%	Min.	200	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	50				The ageing temperature shall be 100 °C ± 3 K
Elongation at break	19.2 and 19.3	%	Min.	175	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
Carbon black content	ISO 11358-1	%	Min.	2,5	Identify carbon black peak and report weight loss %
Hardness	ISO 868	Shore D	Min.	40	
Water absorption	40	%	Max.	0,5	

Table 1 *(3 of 3)*

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Peel strength	54	N/25 mm	Min.	Cu – 50 Al – 75 PO-X – 100	Use a Cu or Al tube with a minimum outer diameter of 25 mm and at least 20 % above the fully recovered internal diameter of the sleeving. The sleeving under test shall have a thickness of 2,0 mm ± 0,5 mm when recovered on the tube. Other substrate materials and methods are subject to agreement between the supplier and the user. Prepare the Cu and Al tubes in the manner defined in IEC 60684-2:2011, 54.3. Precondition the prepared Cu and Al tubes in an oven at 100 ºC for at least 30 min. Immediately place the sleeving on the prepared Cu or Al tubes and condition at 200 ºC ± 3 K for (10 ± 1) min. To make the cross-linked polyolefin (PO-X) specimens shrink the sleeving onto the Cu or Al tubes by conditioning at 200 °C ± 3 K for (10 ± 1) min. Allow to cool, then abrade and clean the outer surface as detailed in IEC 60684-2:2011, 54.3. Finally, fix the narrow strip of adhesive masking tape longitudinally on the sleeving, then place the same sleeving on top and condition at 200 ºC ± 3 K for (10 ± 1) min.
Melting temperature	ISO 11357-3	° C	Min.	100	Adhesive only Value to be recorded is peak melting temperature (T_{pm})

Table 2 – Requirements for breakdown voltage

Expanded wall thickness mm	Expanded ID	Dielectric strength [a] Min. kV/mm
All dimensions	**Type A**	
	10 to 25	14
	26 to 50	12
	51 to120	10
	121 and above	8
	Type B	
	10 to 25	12
	26 to 50	10
	51 to 120	8
	121 and above	6
~~The breakdown voltage shall be determined by the method described in 21.4 of IEC 60684-2. The central value shall comply with the minimum value in this table.~~ 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 conditions.		
[a] Measure the expanded jacket wall thickness and calculate the electric strength by dividing the breakdown voltage by this value.		

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	Cleaning fluids		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 customer.

~~**Table 4 – Additional property requirements**~~

~~Property~~	~~IEC 60684-2 clause or subclause~~	~~Units~~	~~Max. or Min.~~	~~Requirement~~	~~Remarks~~
~~Fungus resistance~~					~~Jacket only for the measurement of tensile strength.~~
~~Tensile strength~~	~~19.1 and 19.2~~	~~MPa~~	~~Min.~~	~~13~~	~~The test method shall be ISO 846 method B.~~
~~Elongation at break~~		~~%~~	~~Min.~~	~~350~~	~~56 days exposure.~~

Annex A
(informative)

Guide to the available sizes and wall thicknesses

Table A.1 – Type A medium wall

Internal diameter		Wall
Expanded Min. mm	**Recovered Max.** mm	**Recovered wall thickness (jacket only)** Min. mm
10	3	1,0
10	4	1,4
12	3	1,4
16	5	1,4
19	6	2,0
25	8	2,0
28	10	2,0
33	10	2,0
35	12	2,0
38	13	2,3
43	13	2,3
50	18	2,3
63	19	2,3
70	26	2,3
85	25	2,5
90	30	2,5
115	34	2,5
120	54	2,5
140	42	2,8
152	48	2,8
160	50	3,0
180	60	3,0
200	77	3,3

Table A.2 – Type B thick wall

Internal diameter		Wall
Expanded Min. mm	**Recovered Max.** mm	**Recovered wall thickness (jacket only) Min.** mm
9	3	1,8
13	4	2,4
19	6	2,4
20	6	2,4
28	9	3,0
33	8	3,2
38	12	4,0
43	12	4,0
48	15	4,0
51	16	4,0
68	22	4,0
70	21	4,0
85	25	4,0
90	30	4,0
105	26	4,0
105	30	4,0
115	40	4,0
130	36	4,0
130	40	4,2
150	48	4,3
160	50	4,3
170	60	4,3
200	77	4,3

NOTE 1 The wall thickness of the adhesive will typically lie between 0,5 mm and 1,5 mm after recovery.

NOTE 2 In those cases where the inner wall distorts or flows during recovery, it ~~may~~ might not be possible to determine the recovered inside diameter accurately. In these cases, the sleeving ~~may~~ can be recovered over a mandrel or plug gauge of the specified diameter after recovery for the size being measured.

Bibliography

IEC 60502-1, *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)*

IEC 60684-3 (all sheets), *Flexible insulating sleeving – Part 3: Specifications for individual types of sleeving*

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NORME INTERNATIONALE

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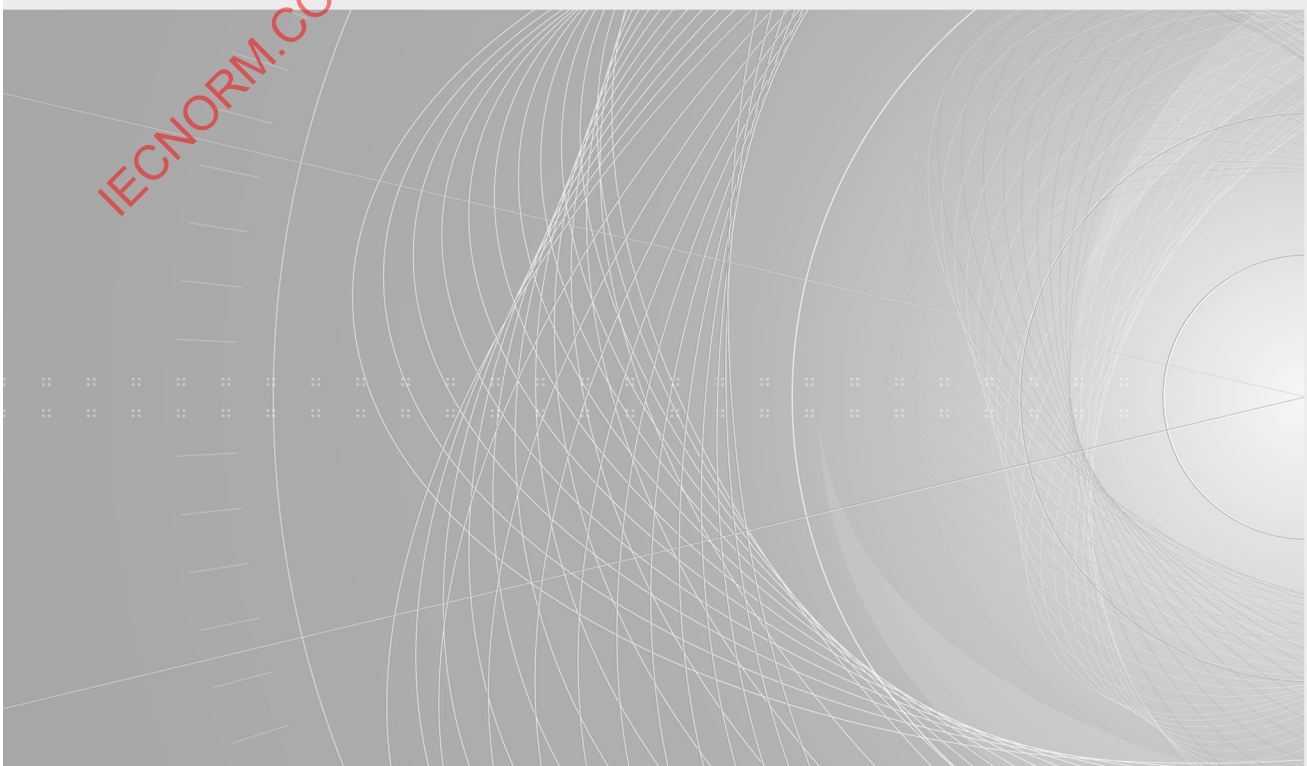
Gaines isolantes souples –
Partie 3: Spécifications pour types particuliers de gaines –
Feuille 247: Gaines thermorétractables en polyoléfine, à double paroi, non ignifugées à paroi épaisse et moyenne



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

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

A list of all the parts in the IEC 60684 series, 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.

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 247: Heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded, thick and medium wall

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 247: Heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded, thick and medium wall

1 Scope

This part of IEC 60684 gives the requirements for two types of heat-shrinkable, polyolefin sleeving, dual wall, not flame retarded with a nominal shrink ratio of 3:1.

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

- Type A: Medium wall, internal diameter up to 200,0 mm typically.
- Type B: Thick wall, internal diameter up to 200,0 mm typically.

These sleevings are normally supplied in colour black.

Since these types of sleving cover a significantly large range of sizes and wall thicknesses, Annex A (Tables A.1 and A.2) provides a guide to the range of sizes available. The actual size will be agreed between the user and 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 will be based on the actual requirements necessary for adequate performance in that application and not based on this specification alone.

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

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

IEC 60684-2:2011, *Flexible insulating sleeving – Part 2: Methods of test*

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

ISO 868:2003, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 11357-3:2018, Plastics – *Differential scanning calorimetry (DSC) – Part 3: Determination of temperature and enthalpy of melting and crystallization*

ISO 11358-1:2014, *Plastics – Thermogravimetry (TG) of polymers – Part 1: General principles*

3 Terms and definitions

No terms and definitions are listed 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	Type	Size (expanded and recovered internal diameter in mm)	Colour
↓	↓	↓	↓	↓	↓	↓
Sleeving	IEC 60684	- 3	- 247	- B	- 85,0/25,0	- BK

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

NOTE This information is for package 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 °C ± 3 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, and 3 where applicable.

7 Sleeving conformance

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

- Type A: Recovered internal diameter 25 mm to 30 mm
- Type B: Recovered internal diameter 25 mm to 30 mm

For the peel strength test, select a size to comply with the dimensions as detailed under the remarks in Table 1.

Table 1 – Property requirements *(1 of 3)*

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Dimensions	3				
Internal diameter	3.1.2	mm			
Wall thickness	3.3.2	mm		To be agreed between purchaser and supplier	
Concentricity	3.3.3	%			
expanded			Min.	50	
recovered			Min.	85	
Heat shock	6	-	-		Heat at 200 °C ± 5 K
Tensile strength	19.2 and 19.3	MPa	Min.	10	Jacket only, ignore flowing adhesive
Elongation at break	19.2 and 19.3	%	Min.	200	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.	–10 + 5	
Bending at low temperature	14	-	-	No cracking shall be visible	Test at -20 °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	19.2 and 19.3	MPa	Min.	13	Jacket only
Elongation at break	19.2 and 19.3	%	Min.	350	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.
Secant modulus at 2 % elongation	19.5	MPa MPa	Min. Max.	80 160	Calculate cross- section area without adhesive.
Breakdown voltage	21.2	kV	Min.	Table 2	
Volume resistivity at room temperature after damp heat	23 23.5.2 23.5.4	 Ω·m Ω·m	 Min. Min.	 10^{12} 10^{11}	

Table 1 *(2 of 3)*

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Resistance to selected fluids	36				Use the fluids and test temperatures specified in Table 3
Tensile strength	19.2 and 19.3	MPa	Min.	10	Immersion time (24 ± 1) h
Elongation at break	19.2 and 19.3	%	Min.	250	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
Heat ageing	39				Heat at 150 °C ± 3 K
Tensile strength	19.2 and 19.3	MPa	Min.	10	Jacket only
Elongation at break	19.2 and 19.3	%	Min.	200	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	50				The ageing temperature shall be 100 °C ± 3 K
Elongation at break	19.2 and 19.3	%	Min.	175	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
Carbon black content	ISO 11358-1	%	Min.	2,5	Identify carbon black peak and report weight loss %
Hardness	ISO 868	Shore D	Min.	40	
Water absorption	40	%	Max.	0,5	

Table 1 *(3 of 3)*

Property	IEC 60684-2:2011 clause or subclause	Units	Max. or min.	Requirements	Remarks
Peel strength	54	N/25 mm	Min.	Cu – 50 Al – 75 PO-X – 100	Use a Cu or Al tube with a minimum outer diameter of 25 mm and at least 20 % above the fully recovered internal diameter of the sleeving. The sleeving under test shall have a thickness of 2,0 mm ± 0,5 mm when recovered on the tube. Other substrate materials and methods are subject to agreement between the supplier and the user. Prepare the Cu and Al tubes in the manner defined in IEC 60684-2:2011, 54.3. Precondition the prepared Cu and Al tubes in an oven at 100 ºC for at least 30 min. Immediately place the sleeving on the prepared Cu or Al tubes and condition at 200 ºC ± 3 K for (10 ± 1) min. To make the cross-linked polyolefin (PO-X) specimens shrink the sleeving onto the Cu or Al tubes by conditioning at 200 °C ± 3 K for (10 ± 1) min. Allow to cool, then abrade and clean the outer surface as detailed in IEC 60684-2:2011, 54.3. Finally, fix the narrow strip of adhesive masking tape longitudinally on the sleeving, then place the same sleeving on top and condition at 200 ºC ± 3 K for (10 ± 1) min.
Melting temperature	ISO 11357-3	° C	Min.	100	Adhesive only Value to be recorded is peak melting temperature (T_{pm})

Table 2 – Requirements for breakdown voltage

Expanded wall thickness mm	Expanded ID	Dielectric strength [a] Min. kV/mm
All dimensions	**Type A**	
	10 to 25	14
	26 to 50	12
	51 to120	10
	121 and above	8
	Type B	
	10 to 25	12
	26 to 50	10
	51 to 120	8
	121 and above	6
The sleeving shall be tested in the expanded condition. The rate of application of the voltage shall be 500 V/s. Care should be taken on selection of sizes based on these values. Refer to the manufacturer for actual values on installed conditions.		
[a] Measure the expanded jacket wall thickness and calculate the electric strength by dividing the breakdown voltage by this value.		

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	Cleaning fluids		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 customer.

Annex A
(informative)

Guide to the available sizes and wall thicknesses

Table A.1 – Type A medium wall

Internal diameter		Wall
Expanded Min. mm	**Recovered Max.** mm	**Recovered wall thickness (jacket only)** Min. mm
10	3	1,0
10	4	1,4
12	3	1,4
16	5	1,4
19	6	2,0
25	8	2,0
28	10	2,0
33	10	2,0
35	12	2,0
38	13	2,3
43	13	2,3
50	18	2,3
63	19	2,3
70	26	2,3
85	25	2,5
90	30	2,5
115	34	2,5
120	54	2,5
140	42	2,8
152	48	2,8
160	50	3,0
180	60	3,0
200	77	3,3

Table A.2 – Type B thick wall

Internal diameter		Wall
Expanded Min. mm	**Recovered Max.** mm	**Recovered wall thickness (jacket only) Min.** mm
9	3	1,8
13	4	2,4
19	6	2,4
20	6	2,4
28	9	3,0
33	8	3,2
38	12	4,0
43	12	4,0
48	15	4,0
51	16	4,0
68	22	4,0
70	21	4,0
85	25	4,0
90	30	4,0
105	26	4,0
105	30	4,0
115	40	4,0
130	36	4,0
130	40	4,2
150	48	4,3
160	50	4,3
170	60	4,3
200	77	4,3

NOTE 1 The wall thickness of the adhesive will typically lie between 0,5 mm and 1,5 mm after recovery.

NOTE 2 In those cases where the inner wall distorts or flows during recovery, it might not be possible to determine the recovered inside diameter accurately. In these cases, the sleeving can be recovered over a mandrel or plug gauge of the specified diameter after recovery for the size being measured.

Bibliography

IEC 60502-1, *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)*

IEC 60684-3 (all sheets), *Flexible insulating sleeving – Part 3: Specifications for individual types of sleeving*

SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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GAINES ISOLANTES SOUPLES –

Partie 3: Spécifications pour types particuliers de gaines – Feuille 247: Gaines thermorétractables en polyoléfine, à double paroi, non ignifugées à paroi épaisse et moyenne

AVANT-PROPOS

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La Norme internationale IEC 60684-3-247 a été établie par le comité d'études 15 de l'IEC: Matériaux isolants électriques solides.

Cette deuxième édition annule et remplace la première édition parue en 2011 et l'Amendement 1:2016. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) suppression de l'essai de solidité de la couleur à la lumière, cet essai étant couvert par l'essai de détermination de la teneur en noir de carbone;

b) modification de la température de l'essai de flexion à basse température qui devient -20 °C pour aligner la valeur avec celle donnée dans la feuille 214;

c) modification de la température de conditionnement finale des échantillons pour la résistance à l'arrachement qui devient 200 ºC pour aligner la valeur avec celle donnée à l'Article 5;

d) suppression de l'essai de résistance aux moisissures étant donné qu'il n'a pas été démontré, ni par des essais, ni en fonctionnement, que le développement de moisissures constituait un problème.

Le texte de cette Norme internationale est issu des documents suivants:

FDIS	Rapport de vote
15/890/FDIS	15/900/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette Norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 60684, publiées sous le titre général *Gaines isolantes souples*, peut être consultée sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "http://webstore.iec.ch" dans les données relatives au document recherché. A cette date, le document sera

- reconduit,
- supprimé,
- remplacé par une édition révisée, ou
- amendé.

INTRODUCTION

Le présent document fait partie d'une série de normes traitant des gaines isolantes souples à usages électriques.

Cette série est constituée de trois parties:

Partie 1: Définitions et exigences générales (IEC 60684-1)

Partie 2: Méthodes d'essai (IEC 60684-2)

Partie 3: Spécifications pour types particuliers de gaines (IEC 60684-3)

Le présent document contient l'une des feuilles qui composent la Partie 3, comme suit:

Feuille 247: Gaines thermorétractables en polyoléfine, à double paroi, non ignifugées, à paroi épaisse et moyenne

GAINES ISOLANTES SOUPLES –

Partie 3: Spécifications pour types particuliers de gaines – Feuille 247: Gaines thermorétractables en polyoléfine, à double paroi, non ignifugées à paroi épaisse et moyenne

1 Domaine d'application

La présente partie de l'IEC 60684 donne les exigences relatives à deux types de gaines thermorétractables en polyoléfine, à double paroi, non ignifugées, dont le rapport de rétreint nominal est 3:1.

Ces gaines se sont avérées appropriées pour une utilisation à des températures allant jusqu'à 100 °C.

- Type A: Paroi moyenne, diamètre intérieur généralement jusqu'à 200 mm
- Type B: Paroi épaisse, diamètre intérieur généralement jusqu'à 200 mm

La couleur de ces gaines est normalement le noir.

Comme ces types de gaines couvrent une plage très étendue de tailles et d'épaisseurs de paroi, l'Annexe A (Tableaux A.1 et A.2) fournit un guide des tailles disponibles dans cette plage. La taille réelle fait l'objet d'un accord entre l'utilisateur et le fournisseur.

Les matériaux conformes à la présente spécification satisfont à des niveaux de performances établis. Cependant, le choix d'un matériau par un utilisateur, pour une application spécifique, est fondé sur les exigences réelles nécessaires pour obtenir des performances adéquates pour l'application concernée, et n'est pas fondé sur cette seule spécification.

2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60296:2012, *Fluides pour applications électrotechniques – Huiles minérales isolantes neuves pour transformateurs et appareillages de connexion*

IEC 60684-1:2003, *Gaines isolantes souples – Partie 1: Définitions et exigences générales*

IEC 60684-2:2011, *Gaines isolantes souples – Partie 2: Méthodes d'essai*

IEC 60757:1983, *Code de désignation de couleurs*

ISO 868:2003, *Plastiques et ébonite – Détermination de la dureté par pénétration au moyen d'un duromètre (dureté Shore)*

ISO 11357-3:2018, *Plastiques – Analyse calorimétrique différentielle (DSC) – Partie 3: Détermination de la température et de l'enthalpie de fusion et de cristallisation*