

INTERNATIONAL STANDARD

NORME INTERNATIONALE



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

**Gaines isolantes souples –
Partie 3: Spécifications pour types particuliers de gaines – Feuille 247: Gaines
thermorétractables en polyoléfine, à double paroi (épaisse et moyenne), non
retardées à la flamme**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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This consolidated version of the official IEC Standard and its amendment has been prepared for user convenience.

IEC 60684-3-247 edition 1.1 contains the first edition (2011-06) [documents 15/625/FDIS and 15/637/RVD] and its amendment 1 (2016-12) [documents 15/754/CDV and 15/790/RVC].

In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.

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

This publication 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 the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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INTRODUCTION

This International Standard is one of a series 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 standard gives one of the sheets comprising part 3 as follows:

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

Amendment 1 to IEC 60684-3-247 changes the requirements for peel strength. Major problems have been experienced with reliability and repeatability of results when selecting cable jackets of material types PE, PVC and EPR. The method requires conditioning at 150 °C, so careful selection of cable jackets that have a minimum rating exceeding this temperature is essential. Even when cables that exceed this temperature are selected experience has shown reproducible adhesive peel forces are difficult to achieve. While it is appreciated that these cable jackets are used with this type of sleeveings as recovery of the sleeving is normally achieved by either flame or hot air devices. This means of recovery could be inserted into the method, but extensive testing has shown reproducibility of adhesive peel forces still to be major problem. Due to these issues of lack of reliability and repeatability these substrates have been removed. Lead has also been removed due to health and safety reasons. Additional text has been included to aid clarification of the method that deviates from Clause 54 of IEC 60684-2:2011.

[IEC 60684-3-247:2011](https://standards.iteh.ai/catalog/standards/sist/17492e2-da51-4354-ac4f-c4a98ae2db95/iec-60684-3-247-2011)

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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

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 sleeveings are normally supplied in colour black.

Since these types of sleeveings cover a significantly large range of sizes and wall thicknesses, Tables A.1 and A.2 provide a guide to the range of sizes available. The actual size shall 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 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 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 60296:2003, *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, *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, *Plastics – Differential scanning calorimetry (DSC) – Part 3: Determination of temperature and enthalpy of melting and crystallization*

ISO 11358:1997, *Plastics – Thermogravimetry (TG) of polymers – General principles*

3 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.

4 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.

5 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.

6 Sleeving conformance

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

Type A : Recovered ID 25 mm – 30 mm

Type B : Recovered ID 25 mm – 30 mm

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

Table 1 – Property requirements

Property	IEC 60684-2 clause or subclause	Units	Max. or Min.	Requirements	Remarks
Dimensions	3				
Internal diameter	3.1.2	mm		To be agreed between purchaser and supplier	
Wall thickness	3.3.2	mm			
Concentricity expanded recovered	3.3.3	%	Min. Min.		
Heat shock	6	-	-		Heat at 200 °C ± 5 K
Tensile strength	19.1 and 19.2	MPa	Min.	10	Jacket only, ignore flowing adhesive
Elongation at break	19.1 and 19.2	%	Min.	200	
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	19.1 and 19.2	MPa	Min.	13	Jacket only.
Elongation at break	19.1 and 19.2	%	Min.	350	Use a jaw separation rate of 100 mm/min. Below 6,5mm Ø as sleeving. At 6,5 mm Ø 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	

Table 1 (continued)

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	

Table 1 (continued)

Property	IEC 60684-2 clause or subclause	Units	Max. or Min.	Requirements	Remarks
Peel strength	54	N/25 mm	Min.	<p>Cu – 50</p> <p>Al – 75</p> <p>Pb – 40</p> <p>PE – 100</p> <p>PVC – 40</p> <p>EPR – 50</p> <p>PO-X – 100</p>	<p>Condition at 150 °C ± 3 K for (10 ± 1) min.</p> <p>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.</p> <p>See note 2</p> <p>Use as 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.</p> <p>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 °C for at least 30 min. Immediately place the sleeving on the prepared Cu or Al tubes and condition at 150 °C ± 3 K for (10 ± 1) min.</p> <p>To make the cross-linked polyolefin (PO-X) specimens shrink the sleeving onto the Cu or Al tubes by conditioning at 150 °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 150 °C ± 3 K for (10 ± 1) min.</p>
Melting temperature	ISO 11357-3	° C	Min.	100	<p>Adhesive only</p> <p>Value to be recorded is peak melting temperature (T_{pm})</p>

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.

Table 2 – Requirements for breakdown voltage

Expanded wall thickness mm	Expanded ID	Dielectric strength ^a kV/mm
All dimensions	Type A	
	10-25	14
	26-50	12
	51-120	10
	121 and above	8
	Type B	
	10-25	12
	26-50	10
	51-120	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		Iso propyl 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	19.1 and 19.2	MPa	Min.	13	Jacket only for the measurement of tensile strength.
Tensile strength					
Elongation at break					