INTERNATIONAL STANDARD

IEC 60684-3-212

Second edition
2005-11

Flexible insulating sleeving –

Part 3:
Specifications for individual types of sleeving –
Sheet 212: Heat-shrinkable polyolefin sleevings

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 212: Heat-shrinkable polyolefin sleevings

FOREWORD

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International Standard IEC 60684-3-212 has been prepared by IEC technical committee 15: Standards on specifications for electrical Insulating materials.

This second edition cancels and replaces the first edition published in 1998, and constitutes a technical revision.

This edition includes the following significant changes with regards to the previous edition:

Replacement of the thermal endurance test method according to IEC 60216 with a long term ageing test, i.e. 3 000 h at the recommended maximum temperature found suitable for use, to provide safe thermal test data within a workable time scale.

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

FDIS	Report on voting
15/229/FDIS	15/247/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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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

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- withdrawn;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

A bilingual version of this publication may be issued at a later date.

INTRODUCTION

This International Standard is part 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 is one of the sheets comprising Part 3, as follows:

Sheet 212: Heat-shrinkable polyolefin sleevings.

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 212: Heat-shrinkable polyolefin sleevings

1 Scope

This standard gives the requirements for four types of heat-shrinkable polyolefin sleevings suitable for use at temperatures up to 135 °C.

Type A Flame retarded, shrink ratio 2:1

Type B Not flame retarded, shrink ratio 2:1

Type C Flame retarded, shrink ratio 3:1

Type D Not flame retarded shrink ratio 3:1

These sleevings are normally supplied with internal diameters up to 102 mm for shrink ratios of 2:1 and up to 39 mm for shrink ratios of 3:1 and in the following colours for types A and C: black, brown, red, yellow, green, blue, orange, violet, grey, white and green/yellow. Types B and D are transparent.

Sizes or colours other than those specifically listed in this standard may be available as custom items. These items are considered to comply with this standard if they comply with the property requirements listed in Tables 3, 4, 5 and 6 except for dimensions and mass.

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

IEC 60684-2:1997, *Flexible insulating sleeving – Part 2: Methods of test*

IEC 60684-2 Amendment 1: 2003, *Flexible insulating sleeving – Part 2: Methods of test*

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

ISO 846:1997, *Plastics – Evaluation of the action of microorganisms*

ISO 1817:1999, *Rubber, vulcanized – Determination of the effect of liquids*

3 Designation

The sleeving shall be identified by the following designation:

Description	IEC publication number	IEC part number	IEC sheet number	Type	Size (expanded/ recovered internal diameter, in mm)	Colour
↓	↓	↓	↓	↓	↓	↓
Sleeving	IEC 60684	3	212	B	12,7/6,4	TT

Any colour abbreviation shall comply with IEC 60757. Where no abbreviation is given, the colour shall be written in full.

4 Conditions of test

Unless otherwise specified, the sleeving shall be shrunk in a forced air circulation oven for (5 ± 1) min at 200 °C ± 5 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, 4, 5 and 6.

6 Sleeving conformance

Conformance with the requirements of this specification shall normally be based on the results from sizes and colours:

Type A: 12,7/6,4 mm, black

Type B: 12,7/6,4 mm, transparent

Type C: 12,0/4,0 mm, black

Type D: 12,0/4,0 mm, transparent

The colour fastness to light shall be determined for all colours.

Table 1 – Dimensional and mass requirements for Types A and B

Size code	Internal diameter mm		Recovered wall thickness mm	Mass per unit length max. g/m	
	Expanded min.	Recovered max.		Type A	Type B
1,2/0,6	1,2	0,6	0,45 ± 0,10	2,7	2,0
1,6/0,8	1,6	0,8	0,45 ± 0,10	3,2	2,3
2,4/1,2	2,4	1,2	0,50 ± 0,10	4,6	3,4
3,2/1,6	3,2	1,6	0,50 ± 0,10	5,6	4,1
4,8/2,4	4,8	2,4	0,50 ± 0,10	7,6	5,7
6,4/3,2	6,4	3,2	0,65 ± 0,15	13,6	10,0
9,5/4,8	9,5	4,8	0,65 ± 0,15	19,0	14,1
12,7/6,4	12,7	6,4	0,65 ± 0,15	24,4	18,1
19,0/9,5	19,0	9,5	0,75 ± 0,15	39,7	29,4
25,4/12,7	25,4	12,7	0,90 ± 0,15	61,2	45,3
38,0/19,0	38,0	19,0	1,00 ± 0,20	103	76,1
51,0/25,4	51,0	25,4	1,15 ± 0,25	159	118
76,0/38,0	76,0	38,0	1,25 ± 0,25	252	186
102,0/51,0	102,0	51,0	1,40 ± 0,25	369	273

Table 2 – Dimensional and mass requirements for Types C and D

Size code	Internal diameter mm		Recovered wall thickness mm	Mass per unit length max. g/m	
	Expanded min.	Recovered max.		Type C	Type D
1,5/0,5	1,5	0,5	0,45 ± 0,10	2,5	1,8
3,0/1,0	3,0	1,0	0,55 ± 0,10	4,6	3,4
6,0/2,0	6,0	2,0	0,65 ± 0,10	8,8	6,5
9,0/3,0	9,0	3,0	0,75 ± 0,15	14,9	11,0
12,0/4,0	12,0	4,0	0,75 ± 0,15	18,7	13,9
18,0/6,0	18,0	6,0	0,85 ± 0,20	31,4	23,2
24,0/8,0	24,0	8,0	1,00 ± 0,20	46,8	34,7
39,0/13,0	39,0	13,0	1,10 ± 0,20	82,1	60,8

Table 3 – Property requirements

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.	 Tables 1 and 2 Tables 1 and 2 Type A and B 65 Type C and D 50 All types 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
Longitudinal change	9	%	Max.	+ 5 – 10	Heat the expanded sleeving at 200 °C ± 5 K for (5 ± 1) min
Bending at low temperature	14	–	–	No cracks shall be visible	Condition at – 55 °C ± 3 K. For strips, the mandrel shall be no more than 10 times the wall thickness. Full section sleeving is tested unfilled and the mandrel shall be no more than 10 times the outer diameter
Dimensional stability during storage	16	–	–	The dimensions shall be as specified in Tables 1 and 2	
Tensile strength Elongation at break	19.1 and 19.2 19.1 and 19.2	MPa %	Min. Min.	10 250	Use a jaw separation rate of 100 mm/min. Below 6,5 mm diameter test as sleeving, at 6,5 mm diameter and above test as dumb-bells
Secant modulus at 2 % elongation	19.4	MPa MPa	Min. Max.	50 175	
Breakdown voltage	21	kV	Min.	Table 4	

(continued)

Table 3 *(continued)*

Property	IEC 60684-2 Clause or subclause	Units	Max. or min.	Requirements	Remarks
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}	
Flame propagation Time of burning Length burned	26 Method C	 s mm	 Max. Max.	 30 75	Types A and C only
Transparency	28	-	-	Printing shall be legible	Transparent sleeving only
Copper corrosion	33	%	Max.	None above the allowable 8 %	Heat for (16 ± 0,5) h at 175 °C ± 3 K
Colour fastness to light	34			The colour contrast between the exposed and unexposed parts of the specimens shall be equal to or less than that of the fastness standard. After this test transparent sleevings, Type B and D, shall meet the requirements for transparency	Fastness standard No. 5
Resistance to selected fluids Tensile strength Elongation at break	36 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 7 200	Use the fluids and test temperatures specified in Table 5
Mass per unit length	38	g/m	Max.	Table 1 and 2	
Heat ageing Tensile strength Elongation at break	39 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 10 150	Heat at 150 °C ± 3 K
Water absorption	40	%	Max.	0,5	
Long term ageing Elongation	50 (Amendment 1) 19.1 and 19.2	 %	 Min.	 125	The ageing temperature shall be 135 °C ± 3 K

7 Breakdown voltage

The breakdown voltage shall be determined by any of the methods described in 21.2, 21.3 or 21.4 of IEC 60684-2. The central value shall comply with the minimum value in Table 4.

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

Table 4 – Requirements for breakdown voltage

Nominal recovered wall thickness* mm	**Breakdown voltage min.** kV
0,45	9,0
0,50	10,0
0,55	10,5
0,65	12,0
0,75	13,5
0,85	15,0
0,90	16,0
1,00	17,5
1,10	18,5
1,15	19,0
1,25	20,0
1,40	22,0

* For non-standard wall thicknesses, the electric strength shall be at least that of the next smaller standard wall thickness. For wall thicknesses smaller than 0,45 mm, the electric strength shall be at least 20,0 kV/mm.

Table 5 – Resistance to selected fluids

Fluids	Type	Standard or symbol	Immersion temperature °C ± 2 K
Fuels	Gasoline	ISO 1817 Liquid B	23
	Kerosene	ISO 1817 Liquid F	23
Hydraulic fluids	Phosphate base	ISO 1817 Liquid 103	23
	Silicone base	S-1714*	23
	Mineral base	H-520*	23
Oils	Synthetic base	ISO 1817 Liquid 101	23
	Mineral base	ISO 1817 Oil no. 2	23
	Mineral base	O-1176*	23
	Mineral base	O-142*	23
Cleaning fluids	Solvent	Isopropyl alcohol	23
		Propanol 25 % White spirit 75 %	23
		Methylethylketone	23
De-icing fluids	Runway de-icers	Inhibited potassium acetate in water, 50 %	23
	Aircraft de-icers	Ethylene glycol 80 %, water 20 %	23
* These are commercially available fluids which can be identified in aviation fluid guides.			
NOTE Other fluids and/or temperatures may be specified with specific needs. These additional fluids and/or temperatures should be applicable when incorporated into agreements between the supplier and the customer.			

Table 6 – Additional property requirements

Property	IEC 60684-2 Subclause	Units	Max. or min.	Requirements	Remarks
Fungus resistance Tensile strength Elongation at break	 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 10 250	The test method shall be ISO 846, method B. 56 days exposure
Shelf life*				The dimensions shall be as specified in Tables 1 or 2	Condition the sleeving for 60 months at ambient temperature prior to testing; interim measurements shall to be made every 12 months
* Due to the duration of this test, lack of completion of this test shall not preclude certification of this sleeving. Additional evidence of compliance with this requirement in the interim shall be as agreed between the supplier and/or the approval authority and/or the customer.					

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