INTERNATIONAL STANDARD

IEC 60684-3-233

Second edition
2006-01

Flexible insulating sleeving –

Part 3:
Specifications for individual types of sleeving – Sheet 233: Heat-shrinkable fluoroelastomer sleeving, flame retarded, fluid resistant, shrink ratio 2:1

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 233: Heat-shrinkable fluoroelastomer sleeving, flame retarded, fluid resistant, shrink ratio 2:1

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International Standard IEC 60684-3-233 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.

The main change with regard to the previous edition concerns the replacement of the thermal endurance test, according to IEC 60216, by a long-term ageing test, i.e. 3 000 h, at the maximum recommended temperature for such use, in order to furnish thermal test data within a workable time frame.

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

FDIS	Report on voting
15/231/FDIS	15/249/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- withdrawn;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 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 233: Heat-shrinkable fluoroelastomer sleeving, flame retarded, fluid resistant, shrink ratio 2:1.

FLEXIBLE INSULATING SLEEVING –

Part 3: Specifications for individual types of sleeving – Sheet 233: Heat-shrinkable fluoroelastomer sleeving, flame retarded, fluid resistant, shrink ratio 2:1

1 Scope

This standard gives the requirements for two types of heat-shrinkable, flame retarded, fluid resistant[1)], nominal shrink ratio 2:1, fluoroelastomer sleeving for use at temperatures up to 200 °C:

- Type A: thick wall;
- Type B: thin wall.

These sleevings are normally supplied with internal diameters up to 51 mm, and the standard colour is black.

Sizes or colours other than those specifically listed in this standard may be available as custom items. These items shall be 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 60684-2.1:1997, *Flexible insulating sleeving – Part 2: Methods of test*

Amendment (2003)

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

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

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

1) Except to phosphate ester-based hydraulic fluids.

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
↓	↓	↓	↓	↓	↓	↓
Sleeving	IEC 60684	- 3	-233	-A	- 12,7/6,4	- BK

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

Product conformance shall normally be based on the results from size 12,7/6,4 mm black sleeving. The colour fastness to light shall be qualified for all colours.

Table 1 – Type A dimensional and mass requirements

Size code	Internal diameter mm		Recovered wall thickness mm	Mass per unit length g/m
	Expanded min.	Recovered max.		Max.
3,2 / 1,6	3,2	1,6	0,75 ± 0,15	13,8
4,8 / 2,4	4,8	2,4	0,85 ± 0,20	22,2
6,4 / 3,2	6,4	3,2	0,90 ± 0,20	29,0
9,5 / 4,8	9,5	4,8	1,00 ± 0,20	44,1
12,7 / 6,4	12,7	6,4	1,20 ± 0,30	72,6
19,0 / 9,5	19,0	9,5	1,45 ± 0,35	125
25,4 / 12,7	25,4	12,7	1,80 ± 0,45	206
38,0 / 19,0	38,0	19,0	2,40 ± 0,50	389
51,0 / 25,4	51,0	25,4	2,80 ± 0,50	580

Table 2 – Type B dimensional and mass requirements

Size code	Internal diameter mm		Recovered wall thickness mm	Mass per unit length g/m
	Expanded min.	Recovered max.		Max.
3,2 / 1,6	3,2	1,6	0,90 ± 0,20	20,5
4,8 / 2,4	4,8	2,4	0,90 ± 0,20	26,6
6,4 / 3,2	6,4	3,2	0,90 ± 0,20	32,7
9,5 / 4,8	9,5	4,8	0,90 ± 0,20	44,8
12,7 / 6,4	12,7	6,4	0,90 ± 0,20	57,0
19,0 / 9,5	19,0	9,5	1,10 ± 0,20	97,0
25,4 / 12,7	25,4	12,7	1,20 ± 0,30	147
38,0 / 19,0	38,0	19,0	1,40 ± 0,40	259
51,0 / 25,4	51,0	25,4	1,70 ± 0,40	409
76,2/38,1	76,2	38,1	1,70 ± 0,40	600

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 65 85	
Heat shock Tensile strength Elongation at break	6 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 8 150	Heat at 300 °C ± 5 K
Longitudinal change	9	%	Max.	± 20	Heat the expanded sleeving at 200 °C ± 5 K for (15 ± 1) min
Bending at low temperature	14	–	–	There shall be no signs of cracking	Test temperature –55 °C ± 3 K. For strips, the mandrel shall be no more than 20 times the wall thickness. Full section sleeving is tested unfilled and the mandrel shall be no more than 20 times the outer diameter
Dimensional stability on 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.	8,2 250	Rate of jaw separation 100 mm/min. Below 6,5 mm diameter as sleeving; at 6,5 mm diameter and above as dumb-bells
Secant modulus at 2 % elongation	19.4	MPa MPa	Min. Max.	30 100	
Breakdown voltage	21	kV	Min.	Table 4	
Volume resistivity – at room temperature – after damp heat	23 23.4.2 23.4.4	 Ω m Ω m	 Min. Min.	 10^{10} 10^{9}	
Flame propagation Time of burning Length burned	26 Method C	 s mm	 Max. Max.	 30 75	

Table 3 *(continued)*

Property	IEC 60684-2 Clause or subclause	Units	Max. or min.	Requirements	Remarks
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	Fastness standard No. 5
Resistance to selected fluids	36				Use the fluids and test temperatures specified in Table 5
Tensile strength	19.1 and 19.2	MPa	Min.	8	
Elongation at break	19.1 and 19.2	%	Min.	200	
Mass per unit length	38	g/m	Max.	Tables 1 and 2	
Heat ageing	39				Heat at 250 °C ± 5 K
Tensile strength	19.1 and 19.2	MPa	Min.	8,2	
Elongation at break	19.1 and 19.2	%	Min.	150	
Water absorption	40	%	Max.	1,0	
Long term ageing	50				; The ageing temperature shall be 200 °C ± 5K
Elongation	19.1 and 19.2	%	Min	125	

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 this table.

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
0,75	4,5
0,85	5,0
0,90	5,5
1,00	6,0
1,10	6,5
1,20	7,0
1,40	8,5
1,45	8,5
1,70	10,0
1,80	11,0
2,40	14,5
2,80	17,0

* For non-standard wall thicknesses, the electric strength shall be at least that of the next smallest standard wall thickness. For wall thicknesses smaller than 0,75 mm, the electric strength shall be at least 6,0 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	70
Hydraulic fluids	Silicone base	S-1714*	70
	Mineral base	H-520*	50
Oils	Synthetic base	ISO 1817 Liquid 101	70
	Mineral base	ISO 1817 Oil no. 2	70
	Mineral base	O-1176*	70
	Mineral base	O-142*	50
Cleaning fluids	Solvent	Isopropyl alcohol	23
		Propanol 25 % White spirit 75 %	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 customer.			

Table 6 – Additional property requirements

Property	IEC 60684-2 subclause	Units	Max. or min.	Requirements	Remarks
Fungus resistance					The test method shall be ISO 846, method B.
Tensile strength	19.1 and 19.2	MPa	Min.	10,5	56 days exposure
Elongation at break	19.1 and 19.2	%	Min.	250	
Shelf life*				The dimensions shall be as specified in Tables 1 and 2	Condition the sleeving for 60 months at ambient temperature prior to testing; interim measurements are 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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