

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Flexible insulating sleeving –**  
**Part 3: Specifications for individual types of sleeving – Sheet 211: Heat-**  
**shrinkable sleeving, semi-rigid polyolefin, shrink ratio 2:1**

**Gaines isolantes souples –**  
**Partie 3: Spécifications pour types particuliers de gaines – Feuille 211: Gaines**  
**thermorétractables, en polyoléfine, semi-rigides, à rapport de rétreint 2:1**



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IEC 60684-3-211

Edition 3.0 2007-02

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

PRICE CODE  
CODE PRIX

K

ICS 29.035.20

ISBN 978-2-88910-247-1

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## FLEXIBLE INSULATING SLEEVING –

**Part 3: Specifications for individual types of sleeving –  
Sheet 211: Heat-shrinkable sleeving,  
semi-rigid polyolefin, shrink ratio 2:1**

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International Standard IEC 60684-3-211 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

This third edition cancels and replaces the second edition published in 2002 and constitutes a technical revision.

The major technical changes with regard to the second edition concern a better alignment with existing national specifications.

This bilingual version, published in 2009-06, corresponds to the English version.

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

FDIS	Report on voting
15/357/FDIS	15/370/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.

The French version of this standard has not been voted upon.

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

A list of all parts of 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 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

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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 comprises one of the sheets of Part 3 as follows:

Sheet 211: Heat-shrinkable sleeving, semi-rigid polyolefin, shrink ratio 2:1

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## FLEXIBLE INSULATING SLEEVING –

### Part 3: Specifications for individual types of sleeving – Sheet 211: Heat-shrinkable sleeving, semi-rigid polyolefin, shrink ratio 2:1

#### 1 Scope

This part of IEC 60684 gives the requirements for four types of semi-rigid, heat-shrinkable polyolefin sleeving with a nominal shrink ratio of 2:1 that has been found suitable for temperatures up to 135 °C.

- Type A: general purpose, flame-retarded, opaque colours;
- Type B: general purpose, non flame-retarded, translucent;
- Type C: fluid resistant, flame-retarded, opaque colours;
- Type D: fluid resistant, non flame-retarded, translucent.

The sleeving is normally available in internal diameter sizes up to 12,7 mm as supplied, in the following colours: black, white, red, yellow, blue and translucent.

Sizes or colours other than those specifically listed in this standard may be available as custom items. The items are considered to comply with this standard if they comply with the property requirements listed in tables 2, 3 and also with the property requirements of Table 4 for types C and D, excluding dimensions.

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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*<sup>1)</sup>  
Amendment 1 (2003)  
Amendment 2 (2005)

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

ISO 1817:2005, *Rubber, vulcanized – Determination of the effect of liquids*

<sup>1)</sup> A consolidated edition 2.1 exists, including IEC 60684-2:1997 and its Amendment 1 (2003).



### 3 Designation

The sleeving shall be identified by the following designation:

Description	IEC publication number	IEC part number	IEC sheet number	IEC Type	Size (expanded/ recovered internal diameter, in millimetres)	Colour
↓ Sleeving	- ↓ IEC 60684	- ↓ 3	- ↓ 211	- ↓ B	- ↓ 12,7/6,4	- ↓ TT

Any abbreviation used for colour 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  $(5 \pm 1)$  min at  $200 \text{ }^\circ\text{C} \pm 3 \text{ K}$  before being tested.

### 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.

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### 6 Sleeving conformance

Conformance with the requirements of this specification shall normally be based on the results from size 12,7 mm/6,4 mm black sleeving. The colour fastness to light shall be determined for all colours.

**Table 1 – Dimensional requirements**

Size code	Internal diameter mm		Recovered wall thickness mm
	Expanded min.	Recovered max.	
1,2/0,6	1,2	0,6	$0,50 \pm 0,10$
1,6/0,8	1,6	0,8	$0,50 \pm 0,10$
2,4/1,2	2,4	1,2	$0,50 \pm 0,10$
3,2/1,6	3,2	1,6	$0,50 \pm 0,10$
4,8/2,4	4,8	2,4	$0,65 \pm 0,15$
6,4/3,2	6,4	3,2	$0,65 \pm 0,15$
9,5/4,8	9,5	4,8	$0,75 \pm 0,15$
12,7/6,4	12,7	6,4	$0,75 \pm 0,15$

**Table 2 – Property requirements**

Property	IEC 60684-2 clause or subclause	Units	Max. or min.	Requirements	Remarks
Dimensions	3				
– internal diameter	3.1.2	mm		Table 1	
– wall thickness	3.3.2	mm		Table 1	
– concentricity	3.3.3	%	Min.		
– expanded				65	
– recovered				85	
Density	4	g/cm <sup>3</sup>	Max.	Type A and C: 1,40 Type B and D: 1,00	
Heat shock (Type A and B)	6	–	–	No sign of dripping, cracking or flowing	The heating temperature shall be 250 °C ± 5 K
Heat shock (Type C and D)	6				
Tensile strength	19.1 and 19.2	MPa	Min.	12	Heat at 200 °C ± 5 K
Elongation	19.1 and 19.2	%	Min.	100	
Longitudinal change	9	%	Max.	+1 –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 on storage	16	–	–	The dimensions shall be as specified in table 1	
Tensile strength	19.1 and 19.2	MPa	Min.	14	Use a jaw separation rate of 100 mm/min. Below 6,5 mm diameter, as sleeving; at 6,5 mm diameter and above, as dumb-bells.
Elongation at break	19.1 and 19.2	%	Min.	200	
Secant modulus at 2 % elongation	19.4	MPa	Min.	175	
Breakdown voltage	21	kV	Min.	See Table 3	
Volume resistivity	23				
– at room temperature	23.4.2	Ω×m	Min.	10 <sup>12</sup>	
– after damp heat	23.4.4	Ω×m	Min.	10 <sup>11</sup>	
Flame propagation	26 Method C				Type A and C only
Time of burning		s	Max.	30	
Length burned		mm	Max.	75	
Copper corrosion	33	%	Max.	None above the allowable 8 %	Heat for (16 ± 0,5) h at 175 °C ± 3 K

Table 2 (continued)

Property	IEC 60684-2 clause or subclause	Units	Max. or min.	Requirements	Remarks
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 N°. 5
Long-term ageing Elongation at break	50	%	Min.	125	Heat at 135 °C ± 3 K
Heat ageing Tensile strength Elongation at break	39 19.1 and 19.2 19.1 and 19.2	MPa %	Min. Min.	12 100	Heat at 175 °C ± 3 K
Water absorption	40	%	Max.	0,5	

Breakdown voltage shall be determined at room temperature by any of the methods described in 21.2, 21.3 or 21.4 of IEC 60684-2.

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

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Table 3 – Breakdown voltage

Nominal recovered wall thickness mm	Breakdown voltage kV
0,50	10,0
0,65	12,0
0,75	13,5

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 0,50 mm, the electric strength shall be at least 20,0 kV/mm.

Table 4 – Fluid resistant property requirements for types C and D

Property	IEC 60684-2 subclause	Units	Max. or min.	Requirements	Remarks
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.	100	