INTERNATIONAL STANDARD

IEC 60684-3-211

Third edition
2007-02

Flexible insulating sleeving –

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



Reference number
IEC 60684-3-211:2007(E)

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS

Not for Resale

Publication numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series. For example, IEC 34-1 is now referred to as IEC 60034-1.

Consolidated editions

The IEC is now publishing consolidated versions of its publications. For example, edition numbers 1.0, 1.1 and 1.2 refer, respectively, to the base publication, the base publication incorporating amendment 1 and the base publication incorporating amendments 1 and 2.

Further information on IEC publications

The technical content of IEC publications is kept under constant review by the IEC, thus ensuring that the content reflects current technology. Information relating to this publication, including its validity, is available in the IEC Catalogue of publications (see below) in addition to new editions, amendments and corrigenda. Information on the subjects under consideration and work in progress undertaken by the technical committee which has prepared this publication, as well as the list of publications issued, is also available from the following:

- **IEC Web Site (www.iec.ch)**

- **Catalogue of IEC publications**

  The on-line catalogue on the IEC web site (www.iec.ch/searchpub) enables you to search by a variety of criteria including text searches, technical committees and date of publication. On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.

- **IEC Just Published**

  This summary of recently issued publications (www.iec.ch/online_news/ justpub) is also available by email. Please contact the Customer Service Centre (see below) for further information.

- **Customer Service Centre**

  If you have any questions regarding this publication or need further assistance, please contact the Customer Service Centre:

  Email: custserv@iec.ch
  Tel: +41 22 919 02 11
  Fax: +41 22 919 03 00

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS
Not for Resale

INTERNATIONAL STANDARD

IEC 60684-3-211

Third edition
2007-02

Flexible insulating sleeving –

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

© IEC 2007 — Copyright - all rights reserved

No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from the publisher.

International Electrotechnical Commission, 3, rue de Varembé, PO Box 131, CH-1211 Geneva 20, Switzerland
Telephone: +41 22 919 02 11 Telefax: +41 22 919 03 00 E-mail: inmail@iec.ch Web: www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE K

For price, see current catalogue

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS

Not for Resale

CONTENTS

FOREWORD 3
INTRODUCTION 5

1 Scope 6
2 Normative references 6
3 Designation 7
4 Conditions of test 7
5 Requirements 7
6 Sleeving conformance 7

Table 1 – Dimensional requirements 7
Table 2 – Property requirements 8
Table 3 – Breakdown voltage 9
Table 4 – Fluid resistant property requirements for types C and D 9
Table 5 – Resistance to selected fluids 10

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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

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.
2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
5) IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
6) All users should ensure that they have the latest edition of this publication.
7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

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.

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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.

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

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

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

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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.

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*[1)]
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*

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

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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 ± 1) min at 200 °C ± 3 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.

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 ± 0,10
1,6/0,8	1,6	0,8	0,50 ± 0,10
2,4/1,2	2,4	1,2	0,50 ± 0,10
3,2/1,6	3,2	1,6	0,50 ± 0,10
4,8/2,4	4,8	2,4	0,65 ± 0,15
6,4/3,2	6,4	3,2	0,65 ± 0,15
9,5/4,8	9,5	4,8	0,75 ± 0,15
12,7/6,4	12,7	6,4	0,75 ± 0,15

--`,,```,,,,````-`-,,`,,`,`,,`---

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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^3	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^{12}	
– after damp heat	23.4.4	Ω×m	Min.	10^{11}	
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

--`,,```,,,,````-`-`,,`,,`,`,,`---

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

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.

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	

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

Table 5 – Resistance to selected fluids

Fluids	Type	Standard or symbol	Immersion temperature °C ± 2 K
Fuels	Gasoline	ISO 1817 Liquid B	40
	Kerosene	ISO 1817 Liquid F	40
Hydraulic fluids	Silicone base	S-1714 *	50
	Mineral base	H-520 *	50
Oils	Synthetic base	ISO 1817 Liquid 101	100
	Mineral base	ISO 1817 Oil No 2	70
	Mineral base	O-1176*	70
	Mineral base	O-142*	50
Cleaning fluids	Solvents	Isopropyl alcohol	23
		Propanol 25 % White spirit 75 %	23
		Methylethylketone	23
De-icing fluids	Runway de-icers	Inhibited potassium Acetate 50 % in water	23
	Aircraft de-icers	Ethylene glycol 80 % Water 20 %	23

* These are commercially available fluids which can be identified in Aviation Fluid Guides. 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.

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS Not for Resale

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS
Not for Resale

ISBN 2-8318-9018-7



ICS 29.035.20

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND

Copyright International Electrotechnical Commission
Provided by IHS under license with IEC
No reproduction or networking permitted without license from IHS

Not for Resale