INTERNATIONAL STANDARD

IEC 60684-3-248

First edition
2007-02

Flexible insulating sleeving –

Part 3:
Specifications for individual types of sleeving – Sheet 248: General purpose, heat-shrinkable, dual wall polyolefin sleeving, flame retarded, shrink ratios 2:1, 3:1, 4:1



Reference number
IEC 60684-3-248:2007(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 On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.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 60684-3-248

First edition
2007-02

Flexible insulating sleeving –

Part 3:
Specifications for individual types of sleeving – Sheet 248: General purpose, heat-shrinkable, dual wall polyolefin sleeving, flame retarded, shrink ratios 2:1, 3:1, 4:1

© 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 M

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
7 Elevated temperature performance test....8

Figure 1 – Test assembly for elevated temperature performance....8

Table 1 – Size of stepped mandrel for elevated temperature performance test....8
Table 2 – Dimensional requirements – Type AL and AH....9
Table 3 – Dimensional requirements – Type BL and BH....9
Table 4 – Dimensional requirements – Type CL and CH....10
Table 5 – Property requirements....11
Table 6 – Requirements for breakdown voltage....12
Table 7 – Resistance to selected fluids....13
Table 8 – Additional property requirements....13

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 248: General purpose, heat-shrinkable, dual wall polyolefin sleeving, flame retarded, shrink ratios 2:1, 3:1, 4:1

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 60684-3-248 has been prepared by IEC technical committee 15: Solid electrical insulating materials.

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

FDIS	Report on voting
15/359/FDIS	15/372/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.

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

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 248: General purpose, heat-shrinkable, dual wall polyolefin sleeving, flame retarded, shrink ratios 2:1, 3:1, 4:1

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 248: General purpose, heat-shrinkable, dual wall polyolefin sleeving, flame retarded, shrink ratios 2:1, 3:1, 4:1

1 Scope

This part of IEC 60684 gives the requirements for six types of general purpose, heat shrinkable dual wall polyolefin sleevings, flame retarded with nominal shrink ratios of 2:1, 3:1 or 4:1 and available in low and high temperature adhesive inner walls.

The low temperature adhesive sleeving has been found suitable for temperatures up to 105 °C and the high temperature adhesive sleeving has been found suitable for temperatures up to 125 °C.

– Type AL:
  2:1 shrink ratio, internal diameter up to 51 mm, low temperature adhesive inner wall.
– Type AH:
  2:1 shrink ratio, internal diameter up to 51 mm, high temperature adhesive inner wall.
– Type BL:
  3:1 shrink ratio, internal diameter up to 40 mm, low temperature adhesive inner wall.
– Type BH:
  3:1 shrink ratio, internal diameter up to 40 mm, high temperature adhesive inner wall.
– Type CL:
  4:1 shrink ratio, internal diameter up to 52 mm, low temperature adhesive inner wall.
– Type CH:
  4:1 shrink ratio, internal diameter up to 52 mm, high temperature adhesive inner wall.

The sleeving consists of an outer layer being of a flexible cross-linked polyolefin. The inner wall consists of a hot melt adhesive that flows and fuses during the shrinking process to provide a bond.

These sleevings are normally supplied in colour black.

Sizes or colours other than those 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, 5 and 6 and Table 8 where applicable, with the exception of 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.*

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

IEC 60684-2:1997, *Flexible insulating sleeving – Part 2: Methods of test*[1)]
Amendment 1 (2003)
Amendment 2 (2005)

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

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

3 Designation

This 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 millimetres)	Colour	Table 8 Code
↓	↓	↓	↓	↓	↓	↓	↓
Sleeving	IEC 60684 –	3 –	248 –	AL	– 12,7/6,4 –	BK –	X

NOTE The addition of "X" at the end of the designation indicates that the properties contained in Table 8 have been agreed upon and are included in the purchase contract.

Any abbreviation of 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 ± 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 in Tables 2, 3, 4 and 5, 6 and 8 where applicable.

6 Sleeving conformance

Conformance to the requirements of this specification shall normally be based on the results obtained for black sleeving of the following sizes:

– Type AL and AH: 12,7 mm / 6,4 mm;
– Type BL and BH: 24 mm / 8 mm;
– Type CL and CH: 32 mm / 8 mm.

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

[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

7 Elevated temperature performance test

Three specimens for each size as detailed in Table 1 shall be tested.

(100 ± 2) mm lengths of expanded sleeving shall be cut and recovered, according to the manufacturer's or supplier's recommendations, onto the appropriate size of stepped mandrel, as detailed in Figure 1.

After recovery onto the stepped mandrel, the assembly shall be allowed to cool to room temperature and the lengths of sleeving over the masking tape shall be removed.

The assembly shall then been conditioned for (24 ± 0,5) h in an oven at the temperature specified in Table 8.

On removal from the oven the assembly shall be allowed to cool to room temperature and any movement of the sleeving away from the masking tape on the Y diameter shall be measured as specified in Table 8 to an accuracy of ±1 mm.

All measurements shall be recorded and the result is the mean of the three measurements.

All dimensions in millimetres

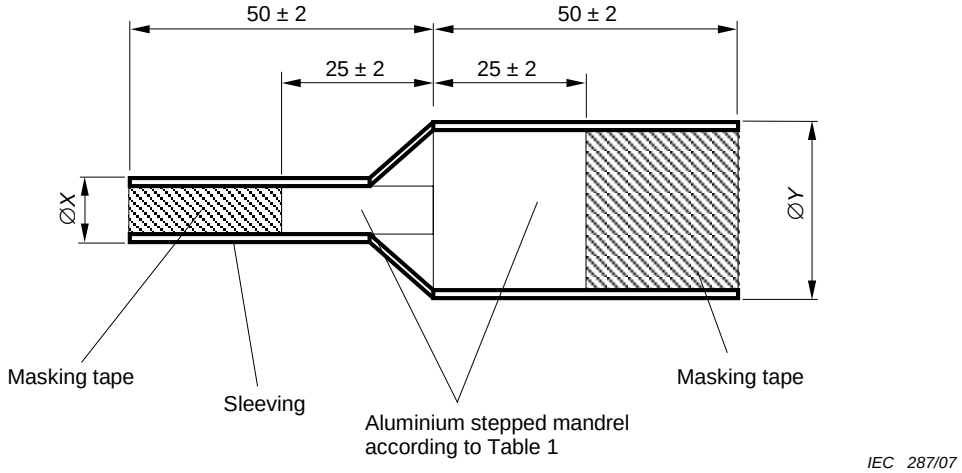

Figure 1 – Test assembly for elevated temperature performance

Table 1 – Size of stepped mandrel for elevated temperature performance test.

Type	Size	Diameters mm	
		X	Y
AL and AH	12,7/6,4	6,4 ± 0,1	10 ± 1
BL and BH	24/8	8,0 ± 0,1	20 ± 1
CL and CH	32/8	8,0 ± 0,1	26 ± 1

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

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 – Dimensional requirements – Type AL and AH

Size code	Internal diameter mm		Recovered total wall thickness mm	Recovered meltable wall thickness mm
	Expanded min.	Recovered max.		Nominal [a]
3,2/1,6	3,2	1,6	0,70 ± 0,10	0,10
4,8/2,4	4,8	2,4	0,70± 0,10	0,10
6,4/3,2	6,4	3,2	0,75 ± 0,15	0,13
9,5/4,8	9,5	4,8	0,75 ± 0,15	0,13
12,7/6,4	12,7	6,4	0,80 ± 0,15	0,15
19,0/9,5	19,0	9,5	0,90 ± 0,15	0,15
25,4/12,7	25,4	12,7	1,10 ± 0,20	0,20
38,0/19,0	38,0	19,0	1,20 ± 0,20	0,20
51,0/25,4	51,0	25,4	1,50 ± 0,25	0,40
[a] For customer information only.				

In those cases where the inner wall distorts or flows during recovery, it may not be possible to determine the recovered inside diameter accurately. In these cases, the sleeving may be recovered over a mandrel or plug gauge of the specified diameter after recovery for the size being measured.

Following recovery, the specimen shall be examined for complete contact with the mandrel or plug gauge to establish compliance with the requirements for recovered diameter.

Table 3 – Dimensional requirements – Type BL and BH

Size code	Internal diameter mm		Recovered total wall thickness mm	Recovered meltable wall thickness mm
	Expanded min.	Recovered max.		Nominal [a]
3/1	3	1	1,0 ± 0,30	0,5
4,5/1,5	4,5	1,5	1,0 ± 0,30	0,5
6/2	6	2	1,0 ± 0,30	0,6
9/3	9	3	1,4 ± 0,30	0,6
12/4	12	4	1,8 ± 0,40	0,8
19/6	19	6	2,2 ± 0,60	0,8
24/8	24	8	2,5 ± 0,60	1,0
40/13	40	13	2,5 ± 0,60	1,0
[a] For customer information only.				

In those cases where the inner wall distorts or flows during recovery, it may not be possible to determine the recovered inside diameter accurately. In these cases, the sleeving may be recovered over a mandrel or plug gauge of the specified diameter after recovery for the size being measured.

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

Following recovery, the specimen shall be examined for complete contact with the mandrel or plug gauge to establish compliance with the requirements for recovered diameter.

Table 4 – Dimensional requirements – Type CL and CH

Size code	Internal diameter mm		Recovered total wall thickness mm	Recovered meltable wall thickness mm
	Expanded min.	Recovered max.		Nominal [a]
4/1	4	1	1,0 ± 0,30	0,5
8/2	8	2	1,0 ± 0,30	0,5
12/3	12	3	1,4 ± 0,30	0,6
16/4	16	4	1,8 ± 0,40	0,8
24/6	24	6	2,2 ± 0,60	0,8
32/8	32	8	2,5 ± 0,60	1,0
52/13	52	13	2,5 ± 0,60	1,0

[a] For customer information only.

In those cases where the inner wall distorts or flows during recovery, it may not be possible to determine the recovered inside diameter accurately. In these cases, the sleeving may be recovered over a mandrel or plug gauge of the specified diameter after recovery for the size being measured.

Following recovery, the specimen shall be examined for complete contact with the mandrel or plug gauge to establish compliance with the requirements for recovered diameter.

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 – Property requirements

Property	IEC 60684-2 clause or subclause	Units	Max. or Min.	Requirements		Remarks
Dimensions	3					
Internal diameter	3.1.2	mm		Tables 2, 3 and 4		
Wall thickness	3.3.2	mm		Tables 2, 3 and 4		
Concentricity expanded	3.3.3	%	Min.	Tables 2 and 3: 60 Table 4: 50		
Heat shock	6					Heat at 200 °C ± 5K
Tensile strength	19.1 and 19.2	MPa	Min.	7		
Elongation at break	19.1 and 19.2	%	Min.	150		
Longitudinal change	9	%	Max.	Type A and B –15 +1	Type C –20 +1	Heat the expanded sleeving at 200 °C ± 5 K for (5 ± 1) min
Bending at low temperature	14	–	–	No cracking shall be visible		Test at – 55 °C± 3 K after conditioning at the same temperature for 4 h For strips, the mandrel shall be between 15 and 17 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 be as specified in Tables , 2,3 and 4		For non-standard sizes as agreed between customer and supplier
Tensile strength	19.1 and 19.2	MPa	Min.	9		The cross sectional area shall be calculated based on the jacket thickness only. Use a jaw separation rate of 100 mm/min. Below 6,5 mm ∅ as sleeving. At 6,5 mm ∅ and above as dumbells
Elongation at break	19.1 and 19.2	%	Min.	200		
Secant modulus at 2 % elongation	19.4	MPa MPa	Min. Max.	40 175		The cross-sectional area shall be calculated based on the jacket thickness only
Breakdown voltage	21	kV	Min.	Table 6		
Volume resistivity at room temperature	23 23.4.2	Ωm	Min.	10^{11}		
Flame propagation	26					
Time of burning	Method A	s	Max.	30		

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 – Property requirements (*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
Copper corrosion	33	%	Max.	None above the allowable 8 %	Heat for (16 ± 0,5) h at 150 °C ± 3 K
Heat ageing Tensile strength Elongation at break	39 19.1 and 19.2 19.1 and 19.2	 MPa %	 Min. Min.	 7 150	Heat at 150 °C ± 3 K
Water absorption	40	%	Max.	0,5	Total wall

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

Table 6 – Requirements for breakdown voltage

Nominal recovered wall thickness [a] mm	Breakdown voltage min. kV
0,70	10
0,75	11
0,80	12
0,90	13
1,00	15
1.10	16
1,20	18
1,40	21
1,50	22
1,80	23
2,20	24
2,50	25

[a] 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 0,70mm, the electric strength shall be at least 15 kV/mm.

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

Table 7 – 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	Silicone base	S- 1714 [a]	23
	Phosphate base	ISO 1817 Liquid 103	23
	Mineral base	H-520 [a]	23
Oils	Synthetic base	ISO 1817 Liquid 101	23
	Mineral base	ISO 1817 Oil No 2	23
	Mineral base	0-1176 [a]	23
	Mineral base	0-142 [a]	23
Cleaning fluids	Solvents	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

[a] These are commercially available fluids which can be identified in aviation fluid guides.

Other fluids and/or temperatures may be specified by agreement between supplier and customer.

Table 8 – Additional property requirements

Property	IEC 60684-2 Clause or subclause	Units	Max. or Min.	Requirements	Remarks
Resistance to selected fluids	36				Use the fluids and test temperatures specified in Table 7
Tensile strength	19.1 and 19.2	MPa	Min.	7	
Elongation at break	19.1 and 19.2	%	Min.	200	
Elevated temperature performance	–	Mm	Max	3,0	Heat at 105 °C ± 2 K for low temperature adhesive. Heat at 125 °C ± 2 K for high temperature adhesive

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

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

ISBN 2-8318-9020-9



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