# INTERNATIONAL STANDARD

# IEC 60371-3-5

Second edition
2005-11

## Insulating materials based on mica –

## Part 3:
## Specifications for individual materials –
## Sheet 5: Glass-backed mica paper with an epoxy resin binder for post-impregnation (VPI)



Reference number
IEC 60371-3-5:2005(E)

## 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 On-line information is also available on recently issued publications, withdrawn and replaced publications, as well as corrigenda.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

# INTERNATIONAL STANDARD

# IEC 60371-3-5

Second edition
2005-11

## Insulating materials based on mica –

## Part 3:
## Specifications for individual materials –
## Sheet 5: Glass-backed mica paper with an epoxy resin binder for post-impregnation (VPI)





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 L

*For price, see current catalogue*

# CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

# INSULATING MATERIALS BASED ON MICA –

## Part 3: Specifications for individual materials – Sheet 5: Glass-backed mica paper with an epoxy resin binder for post-impregnation (VPI)

## 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 60371-3-5 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 1992, and constitutes a technical revision.

The main changes with regard to the previous edition include adjustments needed to align this standard with changes included in the latest edition of IEC 60371-2.

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

| FDIS | Report on voting |
|---|---|
| 15/228/FDIS | 15/246/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 part of IEC 60371 forms part of a series which deals with insulating materials built up from mica splittings or mica paper with or without reinforcement, and with mica paper in its pure state for use in electrical equipment..

IEC 60371 consists of three parts under the main title *Specification for insulating materials based on mica:*

Part 1: Definitions and general requirements

Part 2: Methods of test

Part 3: Specifications for individual materials

This standard contains one of the sheets comprising part 3, as follows:

Sheet 5: Glass-backed mica paper with an epoxy resin binder for post-impregnation (VPI – *vacuum pressure impregnation)*

# INSULATING MATERIALS BASED ON MICA –

## Part 3: Specifications for individual materials – Sheet 5: Glass-backed mica paper with an epoxy resin binder for post-impregnation (VPI)

## 1 Scope

This part of IEC 60371 gives requirements for electrical insulating materials made by combining mica paper with glass fabric and bonding them together with a small amount of epoxy resin. The material is supplied in a flexible state and is designed for use in conjunction with vacuum pressure impregnation (VPI) with compatible impregnates. The final cured properties will be primarily dependent on the VPI resin used.

Two bond contents are specified:

– low bond with a resin content of (8 ± 3) %;

– medium bond with a resin content of (16 ± 3) %.

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 60371-2:2004, *Specification for insulating materials based on mica – Part 2: Methods of test*

IEC 60371-3-2, *Insulating materials based on mica – Part 3: Specifications for individual materials – Sheet 2: Mica paper*

ISO 5636-5:2003, *Paper and board – Determination of air permeance and air resistance (medium range) – Part 5: Gurley method*

## 3 Designation

When ordering materials to this specification only the specification and type numbers need be quoted (see Tables 1 and 2).

*Example:* IEC 60371-3-5: type 5.1.01

The type number is derived from:

– the specification sheet number 5

– plus the sheet table number 5.1

– plus the number of the product in the sheet table 5.1.01

The descriptive code quoted in Tables 1 and 2, for example G23/M80/R08 for type 5.1.01, Table 1, is derived from:

– glass content (G) 23 g/m²
– muscovite mica content (M) 80 g/m²
– resin content (R) 8 ± 3 %.

NOTE For phlogopite mica paper the letter "M" is replaced by the letter "P".

**Table 1 – Composition low bond, with a resin content in the range (8 ± 3) %**

| Type | Descriptive code | Glass content g/m² | | Mica content g/m² | | Mass/ unit area g/m² | | Permissable thickness range mm | | Volatile content |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Nom. | Tol. ± | Nom. | Tol. ± | Nom. | Tol. ± | Mean | Individual | max. % |
| 5.1.01 | G23/M80/R08 | 23 | 2 | 80 | 7 | 112 | 12 | 0,08-0,12 | 0,07-0,13 | 0,5 |
| 5.1.02 | G23/P80/R08 | 23 | 2 | 80 | 7 | 112 | 12 | 0,08-0,12 | 0,07-0,13 | 0,5 |
| 5.1.03 | G23/M120/R08 | 23 | 2 | 120 | 10 | 155 | 15 | 0,09-0,13 | 0,08-0,14 | 0,5 |
| 5.1.04 | G23/P120/R08 | 23 | 2 | 120 | 10 | 155 | 15 | 0,09-0,13 | 0,08-0,14 | 0,5 |
| 5.1.05 | G32/M120/R08 | 32 | 3 | 120 | 10 | 165 | 17 | 0,10-0,14 | 0,09-0,15 | 0,5 |
| 5.1.06 | G32/P120/R08 | 32 | 3 | 120 | 10 | 165 | 17 | 0,10-0,14 | 0,09-0,15 | 0,5 |
| 5.1.07 | G23/M160/R08 | 23 | 2 | 160 | 13 | 199 | 20 | 0,11-0,16 | 0,10-0,17 | 0,5 |
| 5.1.08 | G23/P160/R08 | 23 | 2 | 160 | 13 | 199 | 20 | 0,11-0,16 | 0,10-0,17 | 0,5 |
| 5.1.09 | G32/M160/R08 | 32 | 3 | 160 | 13 | 209 | 21 | 0,12-0,17 | 0,11-0,18 | 0,5 |
| 5.1.10 | G32/P160/R08 | 32 | 3 | 160 | 13 | 209 | 21 | 0,12-0,17 | 0,11-0,18 | 0,5 |
| 5.1.11 | G23/M180/R08 | 23 | 2 | 180 | 14 | 220 | 22 | 0,13-0,18 | 0,12-0,19 | 0,5 |
| 5.1.12 | G23/P180/R08 | 23 | 2 | 180 | 14 | 220 | 22 | 0,13-0,18 | 0,12-0,19 | 0,5 |
| 5.1.13 | G32/M180/R08 | 32 | 3 | 180 | 14 | 231 | 23 | 0,14-0,19 | 0,13-0,20 | 0,5 |
| 5.1.14 | G32/P180/R08 | 32 | 3 | 180 | 14 | 231 | 23 | 0,14-0,19 | 0,13-0,20 | 0,5 |
| 5.1.15 | G23/M250/R08 | 23 | 2 | 250 | 20 | 297 | 30 | 0,16-0,21 | 0,15-0,22 | 0,5 |
| 5.1.16 | G23/P250/R08 | 23 | 2 | 250 | 20 | 297 | 30 | 0,16-0,21 | 0,15-0,22 | 0,5 |
| 5.1.17 | G32/M250/R08 | 32 | 3 | 250 | 20 | 307 | 31 | 0,17-0,22 | 0,16-0,23 | 0,5 |
| 5.1.18 | G32/P250/R08 | 32 | 3 | 250 | 20 | 307 | 31 | 0,17-0,22 | 0,16-0,23 | 0,5 |

**Table 2 – Composition medium bond, with a resin content in the range of (16 ± 3) %**

| Type | Descriptive code | Glass content g/m² | | Mica content g/m² | | Mass/ unit area g/m² | | Permissable thickness range mm | | Volatile content |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Nom. | Tol. ± | Nom. | Tol. ± | Nom. | Tol. ± | Mean | Individual | max. % |
| 5.2.01 | G23/M120/R16 | 23 | 2 | 120 | 10 | 170 | 17 | 0,10-0,14 | 0,09-0,15 | 0,5 |
| 5.2.02 | G23/P120/R16 | 23 | 2 | 120 | 10 | 170 | 17 | 0,10-0,14 | 0,09-0,15 | 0,5 |
| 5.2.03 | G32/M120/R16 | 32 | 3 | 120 | 10 | 181 | 18 | 0,12-0,16 | 0,11-0,17 | 0,5 |
| 5.2.04 | G32/P120/R16 | 32 | 3 | 120 | 10 | 181 | 18 | 0,12-0,16 | 0,11-0,17 | 0,5 |
| 5.2.05 | G23/M160/R16 | 23 | 2 | 160 | 13 | 218 | 22 | 0,12-0,17 | 0,11-0,18 | 0,5 |
| 5.2.06 | G23/P160/R16 | 23 | 2 | 160 | 13 | 218 | 22 | 0,12-0,17 | 0,11-0,18 | 0,5 |
| 5.2.07 | G32/M160/R16 | 32 | 3 | 160 | 13 | 229 | 23 | 0,14-0,19 | 0,13-0,20 | 0,5 |
| 5.2.08 | G32/P160/R16 | 32 | 3 | 160 | 13 | 229 | 23 | 0,14-0,19 | 0,13-0,20 | 0,5 |
| 5.2.09 | G23/M180/R16 | 23 | 2 | 180 | 14 | 242 | 24 | 0,14-0,19 | 0,13-0,20 | 0,5 |
| 5.2.10 | G23/P180/R16 | 23 | 2 | 180 | 14 | 242 | 24 | 0,14-0,19 | 0,13-0,20 | 0,5 |
| 5.2.11 | G32/M180/R16 | 32 | 3 | 180 | 14 | 253 | 26 | 0,16-0,21 | 0,15-0,22 | 0,5 |
| 5.2.12 | G32/P180/R16 | 32 | 3 | 180 | 14 | 253 | 26 | 0,16-0,21 | 0,15-0,22 | 0,5 |
| 5.2.13 | G23/M250/R16 | 23 | 2 | 250 | 20 | 325 | 33 | 0,17-0,22 | 0,16-0,23 | 0,5 |
| 5.2.14 | G23/P250/R16 | 23 | 2 | 250 | 20 | 325 | 33 | 0,17-0,22 | 0,16-0,23 | 0,5 |
| 5.2.15 | G32/M250/R16 | 32 | 3 | 250 | 20 | 336 | 34 | 0,19-0,24 | 0,18-0,25 | 0,5 |
| 5.2.16 | G32/P250/R16 | 32 | 3 | 250 | 20 | 336 | 34 | 0,19-0,24 | 0,18-0,25 | 0,5 |

## 4 Requirements: raw materials

### 4.1 Mica paper

Mica paper referred to in this specification shall comply with the requirements of IEC 60371-3-2.

### 4.2 Glass fabric

Normally the glass fabric shall be continuous filament glass fibre made from E glass. Unless otherwise agreed to between purchaser and seller, the glass fibre shall be in the loom state and have a size content not greater than 3 % by weight.

For some applications a special type of size may be necessary and any requirements shall be subject to the purchase contract.

### 4.3 Epoxy resin

Any epoxy resin system may be used which enables the material to meet the requirements of this specification.

## 5 Requirements: composition and tolerances

When tested by the method of Clause 7 of IEC 60371-2 the composition of the products shall lie within the limits of Tables 1 and 2 for the appropriate grade of mica paper.

## 6 Requirements for material (as received)

### 6.1 General

All materials in any one consignment shall have the same properties, within the limits of this specification, throughout the length of each roll.

The surfaces shall be uniform and free from defects such as bubbles, pin-holes, creases and flaws.

Material supplied in rolls shall be capable of being unrolled continuously without damage, and the force required to unroll the material shall be substantially uniform. The material shall be supplied non-interleaved.

Unless otherwise specified in the purchase contract the material shall be rolled with the mica surface on the outside.

### 6.2 Width

This specification contains no requirement for width of tape. However, the following widths are preferred: 10, 12, 15, 20, 25, 30, 40 and 50 mm.

The maximum trimmed width of full width material and sheet normally available is 1 000 mm.

The tolerance on the width of the material shall be as in Table 3.

**Table 3 – Tolerance on width**

| Nominal width<br>mm | Tolerance<br>mm |
|---|---|
| ≤ 20<br>> 20 ≤ 500<br>> 500 | ±0,5<br>±1,0<br>±5,0 |

### 6.3 Thickness

Measure the thickness in accordance with Clause 4 of IEC 60371-2, using the apparatus given in 4.1.1 of that standard, making 10 measurements on one thickness of material. The measured values shall be in accordance with the requirements of Tables 1 and 2.

### 6.4 Length

There is no requirement in this specification for roll length, and this shall therefore be subject to the purchase contract.

For sheet material, the tolerance on length shall be the same as for width.

### 6.5 Cores

The tape shall be supplied compactly wound on cores of 25 mm, 40 mm, 55 mm, or 76 mm inside diameter which shall be free from sharp edges.

The width of the cores in relation to that of the tape shall be subject to the purchase contract.

Full width material and material wider than 100 mm shall be supplied on 55 mm or 76 mm cores.

### 6.6 Joins

The number of rolls with joins shall be limited to 25 % of any one consignment. Joined rolls of length less than 100 m shall contain no more than one join. The number of joins in rolls of length of 100 m or greater shall be subject to the purchase contract.

The method of making joins shall be subject to the purchase contract.

### 6.7 Tensile strength in the warp direction

When tested by the method of Clause 8 of IEC 60371-2, the tensile strength in the warp direction shall not be less than 100 N/10 mm width for 32 g/m² glass fabric and 60 N/10 mm width for 23 g/m² glass fabric.

For some applications lower or higher tensile strengths may be necessary, and any requirements shall be subject to the purchase contract.

### 6.8 Stiffness

The material shall be tested by the method of Clause 11 of IEC 60371-2.

The stiffness of the material shall be subject to the purchase contract.

### 6.9 Air porosity

The air permeance shall be measured in accordance with ISO 5636-5. The air permeance of the material shall be subject to purchase contract, except for low bond materials made with class 3 mica paper, based on non-calcinated muscovite, where the requirements of Table 4 shall apply.

**Table 4 – Air porosity**

| Type | Descriptive code | Air porosity s/100 ml max |
|---|---|---|
| 5.1.01 | G23/M80/R08 | 800 |
| 5.1.03 | G23/M120/R08 | 800 |
| 5.1.05 | G32/M120/R08 | 800 |
| 5.1.07 | G23/M160/R08 | 800 |
| 5.1.09 | G32/M160/R08 | 800 |
| 5.1.15 | G23/M250/R08 | 1 500 |
| 5.1.17 | G32/M250/R08 | 1 500 |

## 7 Packing

The materials shall be packaged to ensure adequate protection during transport, handling and storage. Any necessary packing requirements shall be subject to the purchase contract.

Each package containing a number of unit packs shall have the following information clearly and indelibly marked on it:

a) description of the material and the number of this specification;

b) for material delivered in rolls, the width of the material and the length;

c) for material delivered as sheets, the dimensions of the sheet and the number of sheets in a stack, or the weight of the stack;

d) the number of rolls, if applicable;

e) the date of manufacture;

f) shelf-life and storage conditions.

The manufacturer's reference number and batch number shall be identified on each package or roll.

Joined rolls shall be packed together clearly labelled on the outside of the container.

**Standards Survey**

**The IEC would like to offer you the best quality standards possible. To make sure that we continue to meet your needs, your feedback is essential. Would you please take a minute to answer the questions overleaf and fax them to us at +41 22 919 03 00 or mail them to the address below. Thank you!**

Customer Service Centre (CSC)

**International Electrotechnical Commission**
3, rue de Varembé
1211 Genève 20
Switzerland

or

Fax to: **IEC**/CSC at +41 22 919 03 00

Thank you for your contribution to the standards-making process.

Nicht frankieren
Ne pas affranchir

Non affrancare
No stamp required

**A Prioritaire**

**RÉPONSE PAYÉE**

**SUISSE**

Customer Service Centre (CSC)
**International Electrotechnical Commission**
3, rue de Varembé
1211 GENEVA 20
Switzerland

**Q1** Please report on **ONE STANDARD** and **ONE STANDARD ONLY**. Enter the exact number of the standard: *(e.g. 60601-1-1)*

.....

**Q2** Please tell us in what capacity(ies) you bought the standard *(tick all that apply).* I am the/a:

purchasing agent ❑
librarian ❑
researcher ❑
design engineer ❑
safety engineer ❑
testing engineer ❑
marketing specialist ❑
other.....

**Q3** I work for/in/as a: *(tick all that apply)*

manufacturing ❑
consultant ❑
government ❑
test/certification facility ❑
public utility ❑
education ❑
military ❑
other.....

**Q4** This standard will be used for: *(tick all that apply)*

general reference ❑
product research ❑
product design/development ❑
specifications ❑
tenders ❑
quality assessment ❑
certification ❑
technical documentation ❑
thesis ❑
manufacturing ❑
other.....

**Q5** This standard meets my needs: *(tick one)*

not at all ❑
nearly ❑
fairly well ❑
exactly ❑

**Q6** If you ticked NOT AT ALL in Question 5 the reason is: *(tick all that apply)*

standard is out of date ❑
standard is incomplete ❑
standard is too academic ❑
standard is too superficial ❑
title is misleading ❑
I made the wrong choice ❑
other .....

**Q7** Please assess the standard in the following categories, using the numbers:
(1) unacceptable,
(2) below average,
(3) average,
(4) above average,
(5) exceptional,
(6) not applicable

timeliness.....
quality of writing.....
technical contents.....
logic of arrangement of contents .....
tables, charts, graphs, figures.....
other .....

**Q8** I read/use the: *(tick one)*

French text only ❑
English text only ❑
both English and French texts ❑

**Q9** Please share any comment on any aspect of the IEC that you would like us to know:

.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....
.....

ISBN 2-8318-8284-2


**ICS 29.035.10; 29.035.50**

Typeset and printed by the IEC Central Office
GENEVA, SWITZERLAND