IS/IEC 60371-3-6 (1992): Specification for Insulating Materials based on MICA, Part 3 Specifications for Individual Materials, Section 6: Glass –backed Mica Paper with a B-stage Epoxy Resin Binder [ETD 2: Solid Electrical Insulating Materials and Insulation Systems]

BLANK PAGE

IS/IEC 60371-3-6 : 1992
[Superseding IS 9299 (Part 3/Sec 6) : 1993]

भारतीय मानक

अभ्रक आधारित उष्मारोधी सामग्री की विशिष्टि

भाग 3 एकल सामग्री की विशिष्टियाँ

अनुभाग 6 बी-स्टेज एपॉक्सी रेजिन बाइंडर सहित कांच-पृष्ठित अभ्रक पेपर

Indian Standard

SPECIFICATION FOR INSULATING MATERIALS BASED ON MICA

PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS

Section 6 Glass-Backed Mica Paper with a B-Stage Epoxy Resin Binder

ICS 29.035.50

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

March 2012 **Price Group 6**

NATIONAL FOREWORD

This Indian Standard (Part 3/Sec 6) which is identical with IEC 60371-3-6 : 1992 'Specification for insulating materials based on mica — Part 3: Specifications for individual materials — Sheet 6: Glass-backed mica paper with a B-stage epoxy resin binder' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the Solid Electrical Insulating Materials and Insulating Systems Sectional Committee and approval of the Electrotechnical Division Council.

This standard was first published as IS 9299 (Part 3/Sec 6) : 1993 'Insulating materials based on built-up mica or treated mica paper: Part 3 Specification for individual materials, Section 6 Glass-backed mica paper with B-stage epoxy resin bond'. The committee has now decided to adopt the IEC Standard to harmonize it with the latest developments taken place at international level. This standard is now being published in single number based on IEC 60371 in various parts/sections. Other parts in this series are:

Part 1 Definitions and general requirements

Part 2 Methods of test

Part 3 Specifications for individual materials,

- Section 1 Commutator separators and materials
- Section 2 Mica paper
- Section 3 Specification for rigid mica materials for heating equipment
- Section 4 Polyester film-backed mica paper with a B-stage epoxy resin binder
- Section 5 Glass-backed mica paper with an epoxy resin binder for post-impregnation (VPI)
- Section 7 Polyester film mica paper with an epoxy resin binder for single conductor taping
- Section 8 Mica paper tapes for flame-resistant security cables
- Section 9 Moulding micanite

This standard supersedes IS 9299 (Part 3/Sec 6) : 1993 and after the publication of this standard IS 9299 (Part 3/Sec 6) shall be treated as withdrawn.

The text of IEC Standard has been approved as suitable for publication as an Indian Standard without deviations. Certain terminology and conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards, the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their respective places are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60243-1 : 1988[1)] Methods of test for electrical strength of solid insulating materials — Part 1: Tests at power frequencies	IS 2584 : 1963 Method of test for electric strength of solid insulating materials at power frequencies	Technically Equivalent

[1)] Since revised in 1998.

(*Continued on third cover*)

Indian Standard

SPECIFICATION FOR INSULATING MATERIALS BASED ON MICA

PART 3 SPECIFICATIONS FOR INDIVIDUAL MATERIALS

Section 6 Glass-Backed Mica Paper with a B-Stage Epoxy Resin Binder

1 Scope

This International Standard gives requirements for electrical insulating materials made by combining mica paper with glass fabric and impregnating the mica paper with an epoxy resin. The material is supplied in a flexible state with the resin in the B-stage for final cure after application. It may be supplied in the form of sheets or rolls.

The specification covers material having nominal thickness from 0,09 mm to 0,28 mm.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 243-1: 1988, *Methods of test for electric strength of solid insulating materials - Part 1: Tests at power frequencies.*

IEC 371-2: 1987, *Specification for insulating materials based on mica. Part 2: Methods of test.*

IEC 371-3-2: 1991, *Specification for insulating materials based on mica - Part 3: Specifications for individual materials - Sheet 2: Mica paper.*

3 Designation

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

Example: IEC 371-3-6: type 6.1.01

The type number is derived from:

- the specification sheet number 6
- plus the sheet table number 6.1
- plus the number of the product in the sheet table 6.1.01.

The descriptive code quoted in tables 1 and 2, for example G32/M75/R71 for type 6.1.01, table 1 is derived from:

- glass content (G) 32 g/m²
- muscovite mica content (M) 75 g/m²
- resin content (R) 71 g/m².

NOTE - For phlogopite mica paper the letter "M" is replaced by the letter "P" (table 2 only).

Table 1 – Composition for calcinated muscovite mica paper (IEC 371-3-2, classes 1 and 2)

Type	Descriptive code	Glass content g/m²		Mica content g/m²		Resin content g/m²		Mass/ unit area g/m²		Permissible thickness range mm		Volatile content
		Nom.	Tol. ±	Nom.	Tol. ±	Nom.	Tol. ±	Nom.	Tol. ±	Mean	Individual	Max. %
6.1.01	G32/M75/R71	32	3	75	6	71	9	178	19	0,12-0,15	0,11-0,16	1,0
6.1.02	G32/M80/R71	32	3	80	7	71	9	183	19	0,12-0,15	0,11-0,16	1,0
6.1.03	G32/M90/R81	32	3	90	8	81	10	203	21	0,15-0,18	0,14-0,19	1,0
6.1.04	G32/M120/R105	32	3	120	10	105	13	257	26	0,18-0,22	0,17-0,23	1,0
6.1.05	G32/M150/R120	32	3	150	12	120	15	302	30	0,20-0,24	0,19-0,25	1,0
6.1.06	G32/M160/R130	32	3	160	13	130	16	322	32	0,20-0,24	0,19-0,25	1,0
6.1.07	G32/M180/R150	32	3	180	15	150	19	362	37	0,22-0,26	0,21-0,27	1,0
6.1.08	G32/M240/R180	32	3	240	20	180	23	452	45	0,26-0,30	0,25-0,31	1,0
6.1.09	G32/M250/R190	32	3	250	21	190	24	472	47	0,26-0,30	0,25-0,31	1,0
6.1.10	G43/M240/R180	43	4	240	20	180	23	463	46	0,26-0,32	0,25-0,33	1,0
6.1.11	G43/M250/R190	43	4	250	21	190	24	483	48	0,26-0,32	0,25-0,33	1,0

* Related to the total mass per unit area the resin content is approximately 40 %.

Table 2 – Composition for uncalcinated muscovite and phlogopite mica papers (IEC 371-3-2, classes 3 and 4)

Type	Descriptive code	Glass content g/m²		Mica content g/m²		Resin content g/m²		Mass/ unit area g/m²		Permissible thickness range mm		Volatile content
		Nom.	Tol. ±	Nom.	Tol. ±	Nom.	Tol. ±	Nom.	Tol. ±	Mean	Individual	Max. %
6.2.01	G23/P63/R49	23	2	63	5	49	8	135	15	0,09-0,10	0,08-0,11	1,0
6.2.02	G32/M75/R60	32	3	75	6	60	9	167	18	0,12-0,15	0,11-0,16	1,0
6.2.03	G32/M80/R63	32	3	80	7	63	9	175	19	0,12-0,15	0,11-0,16	1,0
6.2.04	G32/P80/R63	32	3	80	7	63	9	175	19	0,12-0,15	0,11-0,16	1,0
6.2.05	G32/M90/R69	32	3	90	8	69	10	191	21	0,15-0,18	0,14-0,19	1,0
6.2.06	G32/M120/R86	32	3	120	10	86	13	238	26	0,18-0,22	0,17-0,23	1,0
6.2.07	G32/P120/R86	32	3	120	10	86	13	238	26	0,18-0,22	0,17-0,23	1,0
6.2.08	G32/M150/R102	32	3	150	12	102	15	284	30	0,20-0,24	0,19-0,25	1,0
6.2.09	G32/M160/R108	32	3	160	13	108	16	300	32	0,20-0,24	0,19-0,25	1,0
6.2.10	G32/P160/R108	32	3	160	13	108	16	300	32	0,20-0,24	0,19-0,25	1,0
6.2.11	G32/M180/R119	32	3	180	15	119	19	331	37	0,22-0,26	0,21-0,27	1,0
6.2.12	G32/P180/R119	32	3	180	15	119	19	331	37	0,22-0,26	0,21-0,27	1,0
6.2.13	G32/M240/R153	32	3	240	20	153	23	425	45	0,26-0,30	0,25-0,31	1,0
6.2.14	G32/P240/R153	32	3	240	20	153	23	425	45	0,26-0,30	0,25-0,31	1,0
6.2.15	G32/M250/R159	32	3	250	21	159	24	441	47	0,26-0,30	0,25-0,31	1,0
6.2.16	G32/P250/R159	32	3	250	21	159	24	441	47	0,26-0,30	0,25-0,31	1,0
6.2.17	G43/M240/R159	43	4	240	20	159	23	442	46	0,26-0,32	0,25-0,33	1,0
6.2.18	G43/P240/R159	43	4	240	20	159	23	442	46	0,26-0,32	0,25-0,33	1,0
6.2.19	G43/M250/R165	43	4	250	21	165	24	458	48	0,26-0,32	0,25-0,33	1,0
6.2.20	G43/P250/R165	43	4	250	21	165	24	458	48	0,26-0,32	0,25-0,33	1,0

* Related to the total mass per unit area the resin content is approximately 36 %.

4 Requirements: raw materials

4.1 *Mica paper*

Mica paper referred to in this specification shall comply with the requirements of IEC 371-3-2.

4.2 *Glass fabric*

Normally the glass fabric shall be in the loom state, but by agreement between purchaser and seller, it may be treated. It shall have a size content not greater than 3 % by weight.

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 6 of IEC 371-2 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. Where interleaving is necessary or required by the purchaser, it shall not have any deleterious effect.

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 requirements 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 mm	Tolerance mm
≤ 20	±0,5
> 20 ≤ 500	±1,0
> 500	±5,0

6.3 *Thickness*

Measure the thickness in accordance with clause 3 of IEC 371-2, using the apparatus given in 3.1.1 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*

The length of material in a roll shall be not less than that specified in the purchase contract.

Preferred lengths are 25 m, 50 m, 100 m and 150 m.

6.5 *Cores*

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

The width of the cores in relation to that of the tape should be subject to agreement between purchaser and supplier.

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 should be subject to the purchase contract.

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

6.7 *Tensile strength*

When tested by the method of clause 7 of IEC 371-2, the tensile strength in the warp and weft directions shall be as shown in table 4.

Table 4 – Tensile strength

Glass substance g/m^2	Minimum tensile strength N/10 mm	
	Warp	Weft
23	80	20
32	140	30
43	140	30

6.8 *Stiffness*

The stiffness of the material should be subject to the purchase contract. When the stiffness is specified, the material should be tested by the method of clause 10 in IEC 371-2.

6.9 *Resin flow*

When tested at (160 ± 2) °C by the method of clause 13 of IEC 371-2, resin flow shall be between 40 % and 70 %.

7 Requirements for material after curing

7.1 *General*

When required by the purchaser the supplier shall provide evidence that the material meets the requirements of clause 7.

For the following tests the specimens shall be prepared in accordance with method 1 of clause 2 of IEC 371-2, the number of layers being chosen to give a final thickness as required for the measurement of properties after curing. Curing conditions should follow the recommendations of the supplier.

7.2 *Density*

When tested by the method of clause 4 of IEC 371-2, the density shall be between 1,8 g/cm^3 and 2,2 g/cm^3.

7.3 *Flexural strength*

When tested by the method of clause 8 of IEC 371-2, the flexural strength shall be not less than 150 N/mm^2 at (23 ± 2) °C nor less than 100 N/mm^2 at (155 ± 5) °C.

7.4 *Elastic modulus*

When tested by the method of clause 8 of IEC 371-2, the elastic modulus shall be not less than 30 kN/mm^2.

7.5 *Electric strength*

When tested by the method of clause 15 of IEC 371-2 with electrodes according to 4.1.1.1 (25/75 mm diameter) of IEC 243-1, the electric strength shall be not less than 30 kV/mm.

7.6 *Dissipation factor /temperature characteristics at 48-62 Hz*

When tested by the method of clause 16 of IEC 371-2, the dissipation factor shall not exceed the values stated in table 5 at the temperature given.

Table 5 - Dissipation factor requirements

Temperature °C	Dissipation factor Max.
30	0,02
130	0,07
155	0,20

7.7 *Thermal endurance*

This shall be tested in accordance with clause 20 of IEC 371-2 using flexural strength at (23 ± 2) °C as the property with reduction to 50 % of the original value as the end point criterion.

This temperature index shall be not less than 155.

8 Packing

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

AMENDMENT NO. 1

Page 1

1 Scope

Insert the following two paragraphs after the existing paragraphs:

Materials which conform to this specification meet established levels of performance. However, the selection of materials 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.

Safety warning:

It is the responsibility of the user of the methods contained or referred to in this document to ensure that they are used in a safe manner.

2 Normative references

Replace the existing references by the following:

IEC 60243-1:1998, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

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

IEC 60371-3-2:2005, *Insulating materials based on mica – Part 3: Specifications for individual materials – Sheet 2: Mica paper*

3 Designation

Replace the existing first two paragraphs by the following new paragraphs:

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

Example: IEC 60371-3-6: type 6.1.01

The type number is derived from:

– the specification sheet number 6
– followed by the sheet table number 1
– followed by the number of the product in the sheet table 01

Thus giving type number 6.1.01.

The final paragraph and note remain unchanged.

Page 2

Table 1

Replace the title of Table 1 by the following new title:

Composition for calcinated muscovite mica paper (IEC 60371-3-2, classes 1 and 2)

Page 3

Table 2

Replace the title of Table 2 by the following new title:

Composition for uncalcinated muscovite and phlogopite mica papers (IEC 60371-3-2, classes 3 and 4)

4.1 Mica paper

Replace the text of this subclause by the following new text:

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

5 Requirements: compositions and tolerances

Replace the text of this clause by the following new text:

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

Page 4

6.3 Thickness

Replace the first sentence of this subclause by the following new sentence:

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 of one thickness of material.

Page 5

6.7 Tensile strength

Replace the first paragraph by the following new paragraph:

When tested by the method of Clause 8 in IEC 60371-2, the tensile strength in the warp and weft directions shall be as shown in Table 4.

6.8 Stiffness

Replace the text of this subclause by the following new text:

The stiffness of the material should be subject to the purchase contract. When the stiffness is specified, the material should be tested by the method of Clause 11 in IEC 60371-2.

6.9 Resin flow

Replace the text of this subclause by the following new text:

When tested at (160 ± 2) °C by the method of Clause 14 of IEC 60371-2, resin flow shall be between 40 % and 70 %.

7.1 General

Replace the first sentence of the second paragraph by the following new sentence:

For the following tests, the specimens shall be prepared in accordance with method 1 of Clause 3 of IEC 60371-2, the number of layers being chosen to give a final thickness as required for the measurement of properties after curing.

Page 6

7.2 Density

Replace the text of this subclause by the following new text:

When tested by the method of Clause 5 of IEC 60371-2, the density shall be between 1,8 g/cm^3 and 2,2 g/cm^3.

7.3 Flexural strength

Replace the text of this subclause by the following new text:

When tested by the method of Clause 9 of IEC 60371-2, the flexural strength shall be not less than 150 MPa at (23 °C ± 2 K) nor less than 100 MPa at (155 °C ± 5 K).

7.4 Elastic modulus

Replace the text of this subclause by the following new text:

When tested by the method of Clause 9 of IEC 60371-2, the elastic modulus shall be not less than 30 GPa.

7.5 Electric strength

Replace the text of this subclause by the following new text:

When tested by the method of Clause 16 of IEC 60371-2 with electrodes according to 4.1.1.1 (25/75 mm diameter) of IEC 60243-1, the electric strength shall be not less than 30 kV/mm.

7.6 Dissipation factor/temperature characteristics at 48–62 Hz

Replace the first sentence by the following new sentence:

When tested by the method of Clause 17 of IEC 60371-2, the dissipation factor shall not exceed the values stated in Table 5 at the temperature given.

7.7 Thermal endurance

Replace the first paragraph by the following new paragraph:

This shall be tested in accordance with Clause 21 of IEC 60371-2 using flexural strength at (23 °C ± 2 K) as the property with reduction of 50 % of the original value as the end point criterion.

(*Continued from second cover*)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60371-2 : 1987[1)] Specification for insulating materials based on mica — Part 2: Methods of test	IS/IEC 60371-2 : 2004 Specification for insulating materials based on mica: Part 2 Methods of test	Technically Equivalent
IEC 60371-3-2 : 1991[2)] Specification for insulating materials based on mica — Part 3: Specifications for individual materials — Sheet 2: Mica paper	IS/IEC 60371-3-2 : 2005 Specification for insulating materials based on mica: Part 3 Specifications for individual materials, Section 2 Mica paper	do

Amendment No. 1 issued in the year 2006 to the above International Standard has been given at the end of this standard.

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard, and as such the page numbers given here are not the same as in the IEC Standard.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

[1)] Since revised in 2004.
[2)] Since revised in 2005.

Bureau of Indian Standards

BIS is a statutory institution established under the *Bureau of Indian Standards Act*, 1986 to promote harmonious development of the activities of standardization, marking and quality certification of goods and attending to connected matters in the country.

Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard alongwith amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

This Indian Standard has been developed from Doc No.: ETD 02 (6094).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

BUREAU OF INDIAN STANDARDS

Headquarters:

Manak Bhavan, 9 Bahadur Shah Zafar Marg, New Delhi 110002
Telephones: 2323 0131, 2323 3375, 2323 9402 *Website*: www.bis.org.in

Regional Offices: *Telephones*

Central	:	Manak Bhavan, 9 Bahadur Shah Zafar Marg NEW DELHI 110002	2323 7617 2323 3841
Eastern	:	1/14 C.I.T. Scheme VII M, V.I.P. Road, Kankurgachi KOLKATA 700054	2337 8499, 2337 8561 2337 8626, 2337 9120
Northern	:	SCO 335-336, Sector 34-A, CHANDIGARH 160022	260 3843 260 9285
Southern	:	C.I.T. Campus, IV Cross Road, CHENNAI 600113	2254 1216, 2254 1442 2254 2519, 2254 2315
Western	:	Manakalaya, E9 MIDC, Marol, Andheri (East) MUMBAI 400093	2832 9295, 2832 7858 2832 7891, 2832 7892

Branches : AHMEDABAD. BANGALORE. BHOPAL. BHUBANESHWAR. COIMBATORE. DEHRADUN. FARIDABAD. GHAZIABAD. GUWAHATI. HYDERABAD. JAIPUR. KANPUR. LUCKNOW. NAGPUR. PARWANOO. PATNA. PUNE. RAJKOT. THIRUVANANTHAPURAM. VISAKHAPATNAM.

Published by BIS, New Delhi