IEC 61249-2-38

Edition 1.0 2008-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Materials for printed boards and other interconnecting structures – Part 2-38: Reinforced base materials, clad and unclad – Non-halogenated epoxide woven E-glass laminate sheets of defined flammability (vertical burning test), copper-clad for lead-free assembly

Matériaux pour circuits imprimés et autres structures d'interconnexion – Partie 2-38: Matériaux de base renforcés, plaqués et non plaqués – Feuilles stratifiées en tissu de verre de type E époxyde non halogénées, plaquées cuivre, d'inflammabilité définie (essai de combustion verticale) pour les assemblages sans plomb

IEC 61249-2-38:2008

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2008 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, 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 either IEC or IEC's member National Committee in the country of the requester.
If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de la CEI ou du Comité national de la CEI du pays du demandeur.
Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

- Catalogue of IEC publications: www.iec.ch/searchpub
The IEC on-line Catalogue enables you to search by a variety of criteria (reference number, text, technical committee,…). It also gives information on projects, withdrawn and replaced publications.
- IEC Just Published: www.iec.ch/online_news/justpub
Stay up to date on all new IEC publications. Just Published details twice a month all new publications released. Available on-line and also by email.
- Electropedia: www.electropedia.org
The world's leading online dictionary of electronic and electrical terms containing more than 20 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary online.
- Customer Service Centre: www.iec.ch/webstore/custserv
If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:
Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) est la première organisation mondiale qui élabore et publie des normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications CEI

Le contenu technique des publications de la CEI est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm
Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,…). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.
- Just Published CEI: www.iec.ch/online_news/justpub
Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.
- Electropedia: www.electropedia.org
Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International en ligne.
- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm
Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:
Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

IEC 61249-2-38

Edition 1.0 2008-11

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Materials for printed boards and other interconnecting structures – Part 2-38: Reinforced base materials, clad and unclad – Non-halogenated epoxide woven E-glass laminate sheets of defined flammability (vertical burning test), copper-clad for lead-free assembly

Matériaux pour circuits imprimés et autres structures d'interconnexion – Partie 2-38: Matériaux de base renforcés, plaqués et non plaqués – Feuilles stratifiées en tissu de verre de type E époxyde non halogénées, plaquées cuivre, d'inflammabilité définie (essai de combustion verticale) pour les assemblages sans plomb

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX S

ICS 31.180

ISBN 978-2-88910-460-4

® Registered trademark of the International Electrotechnical Commission
Marque déposée de la Commission Electrotechnique Internationale

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

CONTENTS

FOREWORD 4
1 Scope 6
2 Normative references 6
3 Materials and construction 6
3.1 Resin system 6
3.2 Metal foil 7
3.3 Reinforcement 7
4 Internal marking 7
5 Electrical properties 7
6 Non-electrical properties of the copper-clad laminate 8
6.1 Appearance of the copper-clad sheet 8
6.1.1 Indentations (pits and dents) 8
6.1.2 Wrinkles 8
6.1.3 Scratches 8
6.1.4 Raised areas 8
6.1.5 Surface waviness 9
6.2 Appearance of the unclad face 9
6.3 Laminate thickness 9
6.4 Bow and twist 9
6.5 Properties related to the copper foil bond 10
6.6 Punching and machining 11
6.7 Dimensional stability 11
6.8 Sheet sizes 12
6.8.1 Typical sheet sizes 12
6.8.2 Tolerances for sheet sizes 12
6.9 Cut panels 12
6.9.1 Cut panel sizes 12
6.9.2 Size tolerances for cut panels 12
6.9.3 Rectangularity of cut panels 13
7 Non-electrical properties of the base material after complete removal of the copper foil 13
7.1 Appearance of the dielectric base material 13
7.2 Flexural strength 13
7.3 Flammability 14
7.4 Water absorption 14
7.5 Measling 15
7.6 Glass transition temperature and cure factor 15
7.7 Decomposition temperature 15
7.8 Thermal resistance 16
7.9 Z-axis expansion 16
8 Quality assurance 16
8.1 Quality system 16
8.2 Responsibility for inspection 16
8.3 Qualification inspection 16
8.4 Quality conformance inspection 16
8.5 Certificate of conformance 17

AVA Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

8.6 Safety data sheet 17
9 Packaging and marking 17
10 Ordering information 17
Annex A (informative) Engineering information 18
Annex B (informative) Common laminate constructions 20
Annex C (informative) Guideline for qualification and conformance inspection 22
Bibliography 23

Table 1 – Electrical properties 7
Table 2 – Nominal thickness and tolerance of metal-clad laminate 9
Table 3 – Bow and twist 10
Table 4 – Pull-off and peel strength 11
Table 5 – Dimensional stability 12
Table 6 – Size tolerance for cut panels 12
Table 7 – Rectangularity of cut panels 13
Table 8 – Flexural strength 14
Table 9 – Flammability 14
Table 10 – Water absorption 14
Table 11 – Measling 15
Table 12 – Glass transition temperature and cure factor 15
Table 13 – Decomposition temperature 15
Table 14 – Thermal resistance 16
Table 15 – Z-axis expansion 16

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MATERIALS FOR PRINTED BOARDS AND OTHER INTERCONNECTING STRUCTURES –

Part 2-38: Reinforced base materials, clad and unclad – Non-halogenated epoxide woven E-glass laminate sheets of defined flammability (vertical burning test), copper-clad for lead-free assembly

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 61249-2-38 has been prepared by IEC technical committee 91: Electronics assembly technology.

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

FDIS	Report on voting
91/812/FDIS	91/834/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.

AVA Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

A list of all parts of the IEC 61249 series, under the general title *Materials for printed boards and other interconnecting structures*, 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.

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

MATERIALS FOR PRINTED BOARDS AND OTHER INTERCONNECTING STRUCTURES –

Part 2-38: Reinforced base materials, clad and unclad – Non-halogenated epoxide woven E-glass laminate sheets of defined flammability (vertical burning test), copper-clad for lead-free assembly

1 Scope

This part of IEC 61249 gives requirements for properties of di-functional non-halogenated epoxide woven E-glass laminate sheet 0,05 mm up to 3,2 mm, of defined flammability (vertical burning test), copper-clad. The glass transition temperature is defined to be 120 °C minimum.

Its flame resistance is defined in terms of the flammability requirements of 7.3.

Some property requirements may have several classes of performance. The class desired should be specified on the purchase order otherwise the default class of material will be supplied.

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 61189-2:2006, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 2: Test method for interconnection structures*

IEC 61249-5-1:1995, *Materials for interconnection structures – Part 5 : Sectional specification set for conductive foils and films with and without coatings – Section 1: Copper foils (for the manufacture of copper-clad base materials)*

ISO 9000, *Quality management systems – Fundamentals and vocabulary*

ISO 11014-1, *Safety data sheet for chemical products – Part 1: Content and order of sections*

ISO 14001, *Environmental management systems – Requirements with guidance for use*

3 Materials and construction

The sheet consists of an insulating base with metal-foil bonded to one side or both.

3.1 Resin system

Majority di-functional non-halogenated epoxide, modified non-halogenated epoxide, woven E-glass laminate with a glass transition temperature of 120 °C minimum. The flammability rating is achieved through the use of non-halogenated flame retardants reacted into the polymer. Inorganic fillers may be used. Contrast agents may be added to enhance processing such as automated optical inspection (AOI).

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

The maximum total halogens contained in the resin plus reinforcement matrix is 1 500 × 10^{-6} with a maximum chlorine of 900 × 10^{-6} and maximum bromine being 900 × 10^{-6}.

Its flame resistance is defined in terms of the flammability requirements of 7.3.

3.2 Metal foil

Copper as specified in IEC 61249-5-1, copper foil (for the manufacture of copper-clad materials). The preferred foils are electro-deposited of defined ductility.

3.3 Reinforcement

Woven E-glass as specified in the future IEC 61249-6-3, Woven E-glass fabric (for the manufacture of prepreg and copper clad materials).

4 Internal marking

Not specified.

5 Electrical properties

The electrical property requirements are shown in Table 1.

Table 1 – Electrical properties

Property	Test method (IEC 61189-2)	Requirements
Resistance of foil	2E12	As specified in IEC 61249-5-1
Surface resistance after damp heat while in the humidity chamber (optional)	2E03	≥10 000 MΩ
Surface resistance after damp heat and recovery	2E03	≥50 000 MΩ
Volume resistivity after damp heat while in the humidity chamber (optional)	2E04	≥5 000 MΩm
Volume resistivity after damp heat and recovery	2E04	≥10 000 MΩm
Relative permittivity after damp heat and recovery (1 MHz)	2E10	≤5,4
Dissipation factor after damp heat and recovery (1 MHz)	2E10	≤0,035
Electric strength (only for material thickness less than 0,5 mm)	2E11	≥30 kV/mm
Arc resistance	2E14	≥60 s
Dielectric breakdown (only for material thicknesses ≥0,5mm)	2E15	≥40 kV
Surface resistance at 125 °C	2E07	≥1 000 MΩ
Volume resistivity at 125 °C	2E07	≥1 000 MΩm

Documents
Document Sharing Hub
Full document details: IEC 61249-2-38 2008

6 Non-electrical properties of the copper-clad laminate

6.1 Appearance of the copper-clad sheet

The copper-clad face shall be substantially free from defects that may have an impact on the material´s fitness for use for the intended purpose.

For the following specific defects the requirements given shall apply when inspection is made in accordance with IEC 61189-2 method 2M18.

6.1.1 Indentations (pits and dents)

The size of an indentation, usually the length, shall be determined and given a point value to be used as measure of the quality.

Size mm	**Point value for each indentation**
0,13 – 0,25	1
0,26 – 0,50	2
0,51 – 0,75	4
0,76 – 1,00	7
Over 1,00	30

The total point count for any 300 mm × 300 mm area shall be calculated to determine the class of the material.

Class A 29 maximum

Class B 17 maximum

Class C 5 maximum

Class D 0

Class X To be agreed upon by user and supplier

The required class of material shall be specified in the purchase order. Class A applies unless otherwise specified.

6.1.2 Wrinkles

There shall be no wrinkles in the copper surface.

6.1.3 Scratches

Scratches deeper than 20 % of the nominal thickness of the foil thickness are not permitted.

Scratches with a depth less than 5 % of the nominal thickness of the foil shall not be counted unless this depth is 10 µm or more.

Scratches with a depth between 5 % and 20 % of the nominal thickness of the foil are permitted to a total length of 100 mm for a 300 mm × 300 mm area.

6.1.4 Raised areas

Raised areas are usually impressions in the press plates used during manufacture but may also be caused by blisters or inclusions of foreign particles under the foil.

Raised areas caused by blisters or inclusions are not permitted.

AVA Documents Document Sharing Hub

Full document details: IEC 61249-2-38 2008

Raised areas being impressions of defects in press plates are permitted to the following extent:

Class A and X material	maximum height 15 µm and maximum length 15 mm;
Class B and C material	maximum height 8 µm and maximum length 15 mm;
Class D material	maximum height 5 µm and maximum length 15 mm.

6.1.5 Surface waviness

When examined in accordance with test method 2M12 of IEC 61189-2, the surface waviness in both the machine and cross machine direction shall not exceed 7 µm.

6.2 Appearance of the unclad face

The unclad face of single side clad sheet shall have the natural appearance resulting from the curing process. Small irregularities in colour are permitted. The gloss of the unclad face shall be that given by the press plate or release foil used. Variations of gloss due to the impact of pressure of gases released during the curing are permitted.

6.3 Laminate thickness

The laminate thickness may be ordered to include or exclude the copper foil contribution as specified in the purchase order. As a general rule, laminates less than 0,8 mm are measured excluding copper and laminates greater or equal to 0,8 mm are measured including copper. If the copper-clad laminate is tested in accordance with test method 2D01 of IEC 61189-2, the thickness shall not depart from the nominal thickness by more than the appropriate value shown in Table 2. The fine tolerances shall apply unless the other tolerances are ordered.

Table 2 – Nominal thickness and tolerance of metal-clad laminate

Nominal thickness excluding metal foil (material intended for multilayer boards) mm	Nominal thickness including metal foil (material intended for single or double sided boards) mm	Tolerance requirements ±mm		
		Coarse	Fine	Extra fine
≥0,05 ≤ 0,10		0,03	0,02	0,01
>0,10 ≤ 0,15		0,04	0,03	0,02
>0,15 ≤ 0,30		0,05	0,04	0,03
>0,30 ≤ 0,50		0,08	0,05	0,04
>0,50 ≤ 0,80		0,09	0,06	0,05
>0,80 ≤ 1,00	≥0,80 ≤ 1,00	0,13	0,09	0,07
>1,00 ≤ 1,30	>1,00 ≤ 1,30	0,17	0,11	0,08
	>1,30 ≤ 1,70	0,20	0,13	0,10
	>1,70 ≤ 2,10	0,23	0,15	0,12
	>2,10 ≤ 2,60	0,25	0,18	0,15
	>2,60 ≤ 3,20	0,30	0,20	0,15

The thickness and tolerances do not apply to the outer 25 mm of the trimmed master sheet or the outer 13 mm of the cut-to-size panel as manufactured and delivered by the supplier. At no point shall the thickness vary from the nominal by a value greater than 125 % of the specified tolerance.

6.4 Bow and twist

When the copper-clad laminate is tested in accordance with test method 2M01 of IEC 61189-2 the bow and twist shall not exceed the values given in Table 3.

AVA Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

Table 3 – Bow and twist

Property	Test method (IEC 61189-2)	Nominal thickness mm	Panel dimension longest side mm	Requirements %	
				Copper foil on one side	Copper foil on both sides
Bow and twist	2M01	≥0,8 ≤ 1,3	≤350	≤2,0	≤1,5
			>350 ≤500	≤1,8	≤1,3
			>500	≤1,5	≤1,0
		>1,3 < 1,7	≤350	≤1,5	≤1,0
			>350 ≤500	≤1,3	≤0,8
			>500	≤1,0	≤0,5
		≥1,7 ≤ 3,2	≤350	≤1,0	≤0,5
			>350 ≤500	≤0,8	≤0,4
			>500	≤0,5	≤0,3

NOTE The requirements for bow and twist apply only to one sided copper-clad laminates with maximum foil thickness of 105 µm (915 g/m^2) and double sided copper-clad laminates with maximum foil thickness difference of 70 µm (610 g/m^2).

Requirements for laminates with copper foil configurations beyond these limits are subject to agreement between purchaser and supplier.

6.5 Properties related to the copper foil bond

Pull-off and peel strength requirements are shown in Table 4. These requirements apply to copper foil with a normal profile depth. In the case of low or very low profile copper foil, the requirements shall be at least 50 % of that shown in Table 4 as a minimum.

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008

Table 4 – Pull-off and peel strength

Property	Test method (IEC 61189-2)	Requirements			
Pull-off strength	2M05	≥25 N			
		Thickness of the copper foil			
		≤12 µm (≤101 g/m^2)	18 µm (152 g/m^2)	35 µm (305 g/m^2)	≥70 µm (≥610 g/m^2)
Peel strength after heat shock of 20 s	2M14	≥0,7 N/mm	≥0,9 N/mm	≥1,2 N/mm	≥1,6 N/mm
		No blistering nor delamination			
Peel strength after dry heat 125 °C	2M15	≥0,7 N/mm	≥0,9 N/mm	≥1,2 N/mm	≥1,6 N/mm
		No blistering nor delamination			
Peel strength after exposure to solvent vapour. Solvents as agreed upon between purchaser and supplier	2M06	≥0,7 N/mm	≥0,9 N/mm	≥1,2 N/mm	≥1,6 N/mm
		No blistering nor delamination			
Peel strength after simulated plating	2M16	≥0,6 N/mm	≥0,8 N/mm	≥1,0 N/mm	≥1,2 N/mm
		No blistering nor delamination			
Peel strength at high temperature Temperature 125 °C (optional)	2M17	Not specified	≥0,7 N/mm	≥0,9 N/mm	≥1,1 N/mm
Blistering after 20 s heat shock	2C05	No blistering nor delamination			
NOTE In case of difficulty due to breakage of the foil or reading range of the force measuring device, the measurement of peel strength at high temperature may be carried out using conductor widths of more than 3 mm.					

6.6 Punching and machining

Punching is not applicable. The laminate shall, in accordance with the manufacturer's recommendations, be capable of being sheared or drilled. Delamination at the edges due to the shearing process is permissible, provided that the depth of delamination is not larger than the thickness of the base material. Delamination at the edges of drilled holes due to the drilling process is not permissible. Drilled holes shall be capable of being through-plated with no interference from any exudations into the hole.

6.7 Dimensional stability

The dimensional stability requirements are shown in Table 5. When specimens are tested in accordance to IEC 61189-2, 2X02, the observed tolerance shall be as specified in Table 5. The nominal dimensional stability value shall be as agreed upon between user and vendor. The tolerance range around the agreed upon nominal thickness shall be range B unless otherwise specified on the purchase order.

The choice of the glass fabrics in the construction of the laminate has a significant impact on dimensional stability. Examples of typical constructions used in printed board applications can be found in Annex B.

Class A performance shall apply unless otherwise noted on the purchase order.

AVA Documents Document Sharing Hub

Full document details: IEC 61249-2-38 2008

Table 5 – Dimensional stability

Property	Test method (IEC 61189-2)	Class	Requirements ppm
Dimensional stability	2X02	A	±300
		B	±200
		C	±100
		X	As agreed upon between user and supplier

6.8 Sheet sizes

6.8.1 Typical sheet sizes

Sheet sizes are matters of agreement between purchaser and supplier. However the recommended sizes are listed below:

– 915 mm × 1 220 mm;
– 1 065 mm × 1 155 mm;
– 1 065 mm × 1 280 mm;
– 1 000 mm × 1 000 mm;
– 1 000 mm × 1 200 mm.

6.8.2 Tolerances for sheet sizes

The size of sheet delivered by the supplier shall not deviate more that $^{+20}_{0}$ mm from the ordered size.

6.9 Cut panels

6.9.1 Cut panel sizes

Cut panel sizes shall be, when delivered, in accordance with the purchaser's specification.

6.9.2 Size tolerances for cut panels

For panels cut to size according to the purchaser's specification, the following tolerances for length and width shall apply as shown in Table 6. Tolerances indicated as normal shall be in effect unless otherwise specified by in the purchasing specification.

Table 6 – Size tolerance for cut panels

Panel size mm	Tolerance requirements ± mm	
	Normal	Close
≤300	2,0	0,5
>300 ≤600	2,0	0,8
>600	2,0	1,6
NOTE The specified tolerances include all deviations caused by cutting the panels.		

Documents
Document Sharing Hub
Full document details: IEC 61249-2-38 2008

6.9.3 Rectangularity of cut panels

For panels cut to size according to the purchaser's specification, the following requirements for rectangularity shall apply as shown in Table 7. Tolerance indicated as normal shall be in effect unless otherwise specified in the purchasing specification.

Table 7 – Rectangularity of cut panels

Property	Test method (IEC 61189-2)	Requirements mm/m	
		Normal	Close
Rectangularity of cut panels	2M23	≤3	≤2

7 Non-electrical properties of the base material after complete removal of the copper foil

7.1 Appearance of the dielectric base material

The etched specimens shall be inspected to verify that no surface or subsurface imperfections of the dielectric material exceed those shown below. The panels shall be inspected using an optical aid apparatus which provides a minimum magnification of 4X.

Referee inspection shall be conducted at 10X magnification. Lighting conditions of inspection shall be appropriate to the material under inspection or as agreed upon between user and supplier.

Surface and subsurface imperfections (such as weave texture, resin starvation, voids, foreign inclusions) shall be acceptable provided that the imperfections meet the following:

- the reinforcement fibres are not cut or exposed;
- the foreign inclusions are not conductive;
- the imperfections do not propagate as a result of thermal stress;
- the foreign inclusions are translucent;
- opaque foreign fibres are less than 15 mm in length and average no more than one per 300 mm × 300 mm area;
- opaque foreign inclusions other than fibres shall not exceed 0,50 mm. Opaque foreign inclusions less than 0,15 mm shall not be counted. Opaque foreign inclusions between 0,50 mm and 0,15 mm shall average no more than two spots per 300 mm × 300 mm area;
- voids (sealed voids or surface void) have a longest dimension less than 0,075 mm and there should not be more than three voids in a 3,5 mm diameter circle.

7.2 Flexural strength

When the laminate is tested in accordance with test method 2M20 of IEC 61189-2 the flexural strength shall be as shown in Table 8.

Documents
Document Sharing Hub

Full document details: IEC 61249-2-38 2008