INTERNATIONAL STANDARD

IEC 61249-2-13

First edition
1999-02

Materials for printed boards and other interconnecting structures –

Part 2-13:
Sectional specification set for reinforced base materials, clad and unclad –
Cyanate ester non-woven aramid laminate of defined flammability, copper-clad

Matériaux pour circuits imprimés et autres structures d'interconnexion –

Partie 2-13:
Collection de spécifications intermédiaires pour les matériaux de base renforcés, recouverts ou non de feuille conductrice – Stratifié à base d'aramide non tissé collé avec de la résine cyanate ester, recouvert de cuivre, d'inflammabilité définie

Reference number
IEC 61249-2-13:1999(E)

Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

Consolidated publications

Consolidated versions of some IEC publications including amendments are available. 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.

Validity of this publication

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 the date of the reconfirmation of the publication is available in the IEC catalogue.

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 to be found at the following IEC sources:

- **IEC web site***
- **Catalogue of IEC publications**
  Published yearly with regular updates
  (On-line catalogue)*
- **IEC Bulletin**
  Available both at the IEC web site* and as a printed periodical

Terminology, graphical and letter symbols

For general terminology, readers are referred to IEC 60050: *International Electrotechnical Vocabulary* (IEV).

For graphical symbols, and letter symbols and signs approved by the IEC for general use, readers are referred to publications IEC 60027: *Letter symbols to be used in electrical technology*, IEC 60417: *Graphical symbols for use on equipment. Index, survey and compilation of the single sheets* and IEC 60617: *Graphical symbols for diagrams.*

* See web site address on title page.

INTERNATIONAL STANDARD

IEC 61249-2-13

First edition
1999-02

Materials for printed boards and other interconnecting structures –

Part 2-13:
Sectional specification set for reinforced base materials, clad and unclad –
Cyanate ester non-woven aramid laminate of defined flammability, copper-clad

Matériaux pour circuits imprimés et autres structures d'interconnexion –

Partie 2-13:
Collection de spécifications intermédiaires pour les matériaux de base renforcés, recouverts ou non de feuille conductrice – Stratifié à base d'aramide non tissé collé avec de la résine cyanate ester, recouvert de cuivre, d'inflammabilité définie

International Electrotechnical Commission 3, rue de Varembé Geneva, Switzerland
Telefax: +41 22 919 0300 e-mail: inmail@iec.ch IEC web site http://www.iec.ch

Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

MATERIALS FOR PRINTED BOARDS AND OTHER INTERCONNECTING STRUCTURES –

Part 2-13: Sectional specification set for reinforced base materials, clad and unclad –

Cyanate ester non-woven aramid laminate of defined flammability, copper-clad

FOREWORD

1) The IEC (International Electrotechnical Commission) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the 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, the IEC publishes International Standards. 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. The 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 the 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 National Committees.
3) The documents produced have the form of recommendations for international use and are published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.
4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.
5) The IEC provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with one of its standards.
6) Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. The IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 61249-2-13 has been prepared by IEC technical committee 52: Printed circuits.

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

FDIS	Report on voting
52/791/FDIS	52/802/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.

Annex A is for information only.

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

MATERIALS FOR PRINTED BOARDS AND OTHER INTERCONNECTING STRUCTURES –

Part 2-13: Sectional specification set for reinforced base materials, clad and unclad –

Cyanate ester non-woven aramid laminate of defined flammability, copper-clad

1 Scope

This part of IEC 61249 gives requirements for properties of cyanate ester non-woven aramid copper-clad laminate of defined flammability, in thicknesses of 0,05 mm up to 6,4 mm.

NOTE – To designate this material, the reference: 61249-2-13 – FV1 0– IEC – CE – AP – Cu may be used; if there is no risk of confusion, the type designation may be abbreviated to read IEC-61249-2-13-FV1.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61249-2. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61249-2 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid International standards.

IEC 61189-2:1997, *Test methods for electrical materials, interconnection structures and assemblies – Part 2: Test methods for materials for interconnection structures*

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

3 Materials and construction

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

3.1 Insulating base

Cyanate ester resin bonded non-woven aramid laminate. 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. The preferred foils are type E1 (standard electro-deposited copper) of standard ductility.

4 Internal marking

Not specified.

5 Electrical properties

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 min.
Surface resistance after damp heat and recovery	2E03	100 000 MΩ min.
Volume resistivity after damp heat while in the humidity chamber (optional)	2E04	1 000 MΩm min.
Volume resistivity after damp heat and recovery	2E04	10 000 MΩm min.
Surface corrosion	2E08	No visible corrosion products in the gap
Corrosion at the edge	2E13	Positive pole: not worse than A/B Negative pole: not worse than 1,4
Relative permittivity after damp heat and recovery	2E10	The average value shall not exceed 4,0
Dielectric dissipation factor after damp heat and recovery	2E10	The average value shall not exceed 0,03
Electrical strength (optional) material thickness not greater than 0,8 mm	2E11	30 kV/mm min.
Surface resistance at 200 °C	2E07	100 000 MΩ min.
Volume resistivity at 200 °C	2E07	10 000 MΩm min.

6 Non-electrical properties of the copper-clad laminate

6.1 Appearance of the copper-clad face

6.1.1 Normal surface appearance

The copper-clad face shall be substantially free from blisters, wrinkles, pin-holes, deep scratches, pits and resin. Any discoloration or contamination shall be readily removable with a hydrochloric acid solution of density 1,02 g/cm^2 with a suitable organic solvent.

6.1.2 Qualified surface appearance (optional)

If a surface of high quality is essential for precious metal plating or fine line etching and is ordered by the purchaser, the following requirements shall apply in addition to those of 6.1.1 when inspected in accordance with 2M18 of IEC 61189-2.

The surface appearance of the copper-clad face shall be such as not to conceal imperfections.

The surface of the copper foil shall be free from scratches of depth greater than 10 μm or 1/5 of the nominal thickness of the copper foil, whichever is lower.

The total length of scratches of depth greater than 5 μm but not more than 10 μm shall not exceed 1 m per square metre of the total area of the sheet under test.

This requirement applies to the surface of 35 μm and 70 μm (305 g/m^2 and 610 g/m^2) foils. Permitted scratches on surfaces of 18 μm (152 g/m^2) foil are still under consideration.

The total area of all pin-holes in an area of 0,5 m^2 shall not exceed 0,012 mm^2.

No sheet shall have more imperfections of the types listed than those permitted by table 2.

6.1.3 Surface waviness (optional)

Under consideration.

6.2 Appearance of the unclad face

The unclad face of laminate, copper-clad on one side only, shall be free from all materials, for example release agents, oils or lubricants, that might interfere with its adhesion in the multilayer fabrication operation.

Table 2 – Types, sizes and permitted number of imperfections

Type	Size (length unless otherwise indicated)		Number of imperfections permitted	
	Above mm	Not above mm	In any sheet of area about 1 m^2	In any area 300 mm × 300 mm
Inclusions	– 0,1 0,25	0,1 0,25 –	Any number 30 0	Any number 4 0
Indentations	– 0,25 1,25 3,0 or width 1,0	0,25 1,25 3,0 or width 1,0 –	Any number 13** 3** 0	Any number 3* 1* 0
Bumps	– 0,1 4,0 or height 0,1	0,1 4,0 or height 0,1	Any number 10 0	Any number 2 0
Wrinkles Blisters	Of any size		0	0
* The total for these sizes of indentation is 3. ** The total for these sizes of indentation is 13.				
NOTE – For sheets 1 m^2 or greater, the values of the fourth column apply for any area of 1 m^2; for the same sheets in any area of 300 mm × 300 mm, however, the values of the fifth column apply. For sheets smaller than 1 m^2, the fifth column applies for any area of 300 mm × 300 mm.				

6.3 Thickness

– Including copper foil

If the copper-clad laminate is tested in accordance with test method 2D01 of IEC 61189-2, the thickness, including the copper foil, shall not depart from the nominal thickness by more than the appropriate value shown in table 3. The coarse tolerances shall apply unless the fine tolerances are ordered.

– Excluding copper foil

If the base material is tested in accordance with test method 2D01 of IEC 61189-2 the thickness, excluding the copper foil, shall not depart from the nominal thickness by more than the appropriate value shown in table 3. The coarse tolerances shall apply unless the fine tolerances are ordered.

Table 3 – Nominal thickness and tolerances of metal-clad laminate

Nominal thickness with copper foil mm	**Tolerance** ± mm	
	Coarse (normal)	**Fine (special)**
0,8	0,15	0,09
1,0	0,17	0,11
1,2	0,18	0,12
1,5	0,20	0,14
1,6	0,20	0,14
2,0	0,23	0,15
2,4	0,25	0,18
3,2	0,30	0,20
6,4	0,56	0,30
Nominal thickness without copper foil mm	**Coarse (normal)**	**Fine (special)**
≥ 0,05; < 0,11	0,03	0,02
≥ 0,11; < 0,15	0,04	0,03
≥ 0,15; < 0,3	0,05	0,04
≥ 0,3; < 0,5	0,08	0,05
≥ 0,5; < 0,8	0,09	0,06

The thickness and tolerance do not apply to the outer 25 mm of the trimmed laminate as manufactured and delivered by the supplier. At least 90 % of the area, regardless of size, shall be within the tolerance given, and at no point shall the thickness vary from the nominal by a value greater than 125 % of the specified tolerance.

For any nominal thickness within the range of 0,8 mm to 6,4 mm, which is not given in the table of nominal thicknesses and corresponding tolerances, the tolerance applicable to the thickness shall be that for the next greater nominal thickness given in table 3.

6.4 Bow and twist

Under consideration.

6.5 Properties relating to the copper foil bond

Table 4 – Pull-off and peel strength

Property	Test method (IEC61189-2)	Requirement	
Pull-off strength	2M05	Not less than 60 N	
		Thickness of copper foil	
		18 mm (152 g/m^2)	35 mm (305 g/m^2) and heavier
Peel strength after heat shock of 20 s	2M14	Not less than 0,7 N/mm	Not less than 0,8 N/mm
		No blistering or delamination	
Peel strength after dry heat at 175 °C	2M15	Not applicable	Not applicable
Peel strength after exposure to solvent vapour. Solvents as agreed upon between purchaser and supplier	2M06	Not applicable	Not applicable
Peel strength after simulated plating	2M16	Not less than 0,7 N/mm	Not less than 0,8 N/mm
Peel strength at high temperature Temperature 260 °C (optional) Temperature 125 °C (optional)	2M17	 Not applicable Not less than 0,7 N/mm	 Not applicable Not less than 0,8 N/mm
Blistering after 20 s heat shock	2C05	No blistering or delamination	
NOTE – In the case of difficulty due to the breakage of the foil or reading range of the force measuring device, the measurement of the 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 the depth of delamination may not be 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

Table 5 – Dimensional stability

Nominal thickness mm	Test method (IEC 61189-2)	Requirement mm/m
0,05 – 0,5	2X02, but:	0,8 max.
> 0,5	T = (170 ± 2) °C t = (45 to 50) minutes	0,5 max.