

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**Materials for printed boards and other interconnecting structures –  
Part 4-17: Sectional specification set for prepreg materials, unclad (for the  
manufacture of multilayer boards) – Non-halogenated epoxide woven E-glass  
prepreg of defined flammability (vertical burning test) for lead-free assembly**

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**Matériaux pour circuits imprimés et autres structures d'interconnexion –  
Partie 4-17: Série de spécifications intermédiaires pour matériaux préimprégnés,  
non plaqués (pour la fabrication des cartes multicouches) – Tissu de verre  
époxyde préimprégné non halogéné de type E d'inflammabilité définie (essai de  
combustion verticale) destiné aux assemblages sans plomb**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**MATERIALS FOR PRINTED BOARDS AND  
OTHER INTERCONNECTING STRUCTURES –**

**Part 4-17: Sectional specification set for prepreg materials,  
unclad (for the manufacture of multilayer boards) –  
Non-halogenated epoxide woven E-glass prepreg of defined  
flammability (vertical burning test) for lead-free assembly**

FOREWORD

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International Standard IEC 61249-4-17 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
91/853/FDIS	91/865/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 bilingual version, published in 2010-01, corresponds to the English version.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The French version of this standard has not been voted upon.

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

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## MATERIALS FOR PRINTED BOARDS AND OTHER INTERCONNECTING STRUCTURES –

### Part 4-17: Sectional specification set for prepreg materials, unclad (for the manufacture of multilayer boards) – Non-halogenated epoxide woven E-glass prepreg of defined flammability (vertical burning test) for lead-free assembly

#### 1 Scope

This part of IEC 61249-4-17 gives requirements for properties of prepreg that are mainly intended to be used as bonding sheets in connection with laminates according to IEC 61249-2-38 when manufacturing multilayer boards according to IEC 62326-4. Multilayer boards comprised of these materials are suitable for lead-free assembly processes. This material may also be used to bond other types of laminates.

Prepreg according to this standard is of defined flammability (vertical burning test). The flammability rating on fully cured prepreg is achieved through the use of non-halogenated fire retardants contained as an integral part of the polymeric structure. After curing of the prepreg according to the supplier's instructions, the glass transition temperature is defined to be 120 °C minimum.

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#### 2 Normative references

[IEC 61249-4-17:2009](#)

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 methods for materials for interconnection structures*

IEC 61249-2-38, *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*

IEC 62326-4, *Printed boards – Part 4: Rigid multilayer printed boards with interlayer connections – Sectional specification*

ISO 11014-1:1994, *Safety data sheet for chemical products – Part 1: Content and order of sections*

#### 3 Materials and construction

The prepreg consists of a reinforcing E-glass fabric which is impregnated with di-functional and multi-functional epoxide resin and partially cured to the B-stage.

##### 3.1 Reinforcement

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



### 3.2 Resin system

Majority di-functional non-halogenated epoxide and modified non-halogenated epoxide with a glass transition temperature after curing according to the manufacturer's instructions 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. The maximum total halogens contained in the resin plus reinforcement matrix is 1500 ppm with a maximum chlorine of 900 ppm and maximum bromine being 900 ppm. Contrast agents may be added to enhance processing such as automated optical inspection (AOI).

Its flame resistance is defined in terms of the flammability requirements of 4.3.2.

## 4 Properties

### 4.1 Properties related to the appearance of the prepreg

The prepreg 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 of method 2V01 (under consideration) of IEC 61189-2 will apply as soon as this test will be available.

#### 4.1.1 Dewetted areas (fish eyes)

Dewetted areas with a diameter >10 mm are not permissible.

Dewetted areas with a diameter ≤10 mm are permitted to an extent of a maximum 10 fish eyes in any 300 mm × 300 mm area of the prepreg.

#### 4.1.2 Broken filaments

When judging the presence of broken filaments, not only are their sizes and frequency of occurrence important for assessing acceptability, but also the flow characteristic of the prepreg shall be taken into consideration. The acceptance conditions for broken filaments shall be as agreed upon between user and supplier.

#### 4.1.3 Distortion

When the prepreg will be tested in accordance with test method 2M29 (under consideration) of IEC 61189-2, the distortion or non-perpendicular orientation of the fill or weft yarns in the glass fabric shall not exceed 10 % measured over any 300 mm test distance.

#### 4.1.4 Creases

Creases caused by handling of the prepreg where only a negligible loss of resin has occurred are permitted.

Creases where the glass yarns are exposed due to loss of resin are not permitted.

#### 4.1.5 Edge conditions

Cut-to-size panels shall have even edges and shall not show loss of resin at the edge due to the cutting process of more than 2 mm. Excessive occurrence of resin dust released during the cutting shall be removed before packaging for shipment.

## 4.2 Properties related to B-stage prepreg

A number of characteristics can describe thickness, reactivity and rheology of B-stage prepreg. The choice of characteristics to be used as qualification and quality conformance testing as well as the nominal performance levels are as agreed upon between user and supplier.

Several of the characteristics shown below are interrelated and should not be specified individually. Ordering requirements should preferably be restricted to the glass style, one characteristic marked (a) in combination with one characteristic marked (b). One or both of the optional characteristics (c) of B-stage prepreg may be included.

Glass style

Thickness parameter

- Resin content (a)
- Treated weight (a)

Reactivity/rheology parameter

- Resin flow (b)
- Scaled flow thickness (b)
- Melt viscosity (b)
- Cured thickness (b)

Optional parameter

- Volatile content (c) [IEC 61249-4-17:2009](https://standards.iteh.ai/catalog/standards/sist/34525eca-ccf4-4e68-a470-9338248833c/iec-61249-4-17-2009)
- Gel time (c) [e9338248833c/iec-61249-4-17-2009](https://standards.iteh.ai/catalog/standards/sist/34525eca-ccf4-4e68-a470-9338248833c/iec-61249-4-17-2009)

### 4.2.1 Resin content

When tested in accordance with test method 2C03 or 2C10 of IEC 61189-2, the nominal resin content shall be as agreed upon between user and supplier.

The tolerance around the ordered nominal value shall be  $\pm 3$  %, for example  $(45 \pm 3)$  %.

### 4.2.2 Treated weight

When tested in accordance with test method 2C03 of IEC 61189-2, the nominal treated weight shall be as agreed upon between user and supplier.

The tolerance around the ordered nominal value shall be  $\pm 3$  %, for example  $(350 \pm 10,5)$  g.

### 4.2.3 Resin flow

When tested in accordance with test method 2M09 of IEC 61189-2, the nominal resin flow shall be as agreed upon between user and supplier.

The tolerance around the ordered nominal value shall be  $\pm 5$  %, for example  $(25 \pm 5)$  %.

### 4.2.4 Scaled flow thickness

When tested in accordance with test method 2M26 of IEC 61189-2, the nominal scaled flow and the tolerance shall be as agreed upon between user and supplier.

#### 4.2.5 Melting viscosity

When tested in accordance with test method 2C09 of IEC 61189-2, the nominal melt viscosity shall be as agreed upon between user and supplier.

The tolerance around the ordered nominal value shall be  $\pm 20$  m Pa s, for example  $(240 \pm 20)$  m Pa s.

#### 4.2.6 Gel time

When tested in accordance with test method 2C02 of IEC 61189-2, the nominal gel time shall be as agreed upon between user and supplier.

The tolerance around the ordered nominal value shall be  $\pm 20$  s, for example  $(160 \pm 20)$  s.

#### 4.2.7 Volatile content

When tested in accordance with test method 2C04 of IEC 61189-2, the volatile content shall be 0,75 % maximum.

### 4.3 Properties related to prepreg after curing

#### 4.3.1 Electric strength

A total of 2 plies of prepreg of minimum size 300 mm  $\times$  300 mm shall be bonded together and cured in accordance with the manufacturer's recommendations whereupon the thickness shall be determined using a micrometer.

When tested in accordance with test method 2E11 of IEC 61189-2, the minimum electric strength shall be 25 V/ $\mu$ m.

#### 4.3.2 Flammability

A number of plies of minimum size 300 mm  $\times$  300 mm of the prepreg under test shall be bonded together and cured in accordance with the manufacturer's recommendations. The number of plies shall be chosen so that a specimen thickness of approximately (0,4 to 0,5) mm is obtained as measured with a micrometer.

When tested in accordance with test method 2C06 of IEC 61189-2, the flammability shall be as shown in Table 1.

**Table 1 – Flammability, vertical burning test**

Property	Test method (IEC 61189-2)	Requirements
Flammability	2C06	<b>Designation</b>
		FV 0
	Flaming combustion time after each application of the flame for each test specimen	$\leq 10$ s
	Total flaming combustion time for the 10 flame applications for each set of five specimens	$\leq 50$ s
	Glowing combustion time after the second removal of the test flame	$\leq 30$ s
	Flaming or glowing combustion up to the holding clamp	None
Dripping flaming particles that ignite the tissue paper	None	

**4.3.3 Relative permittivity and dissipation factor**

A total of 2 plies of prepreg of minimum size 300 mm × 300 mm shall be bonded together and fully cured in accordance with the manufacturer’s recommendations whereupon the thickness shall be determined using a micrometer.

When tested in accordance with test method 2E10 of IEC 61189-2, the relative permittivity and dissipation factor at 1 MHz shall be 5,4 and 0,035 maximum respectively.

**4.3.4 Cured thickness**

The nominal thickness and the tolerance of the cured prepreg shall be as agreed upon between user and supplier. The prepreg under test shall be bonded together and fully cured in accordance with the manufacturer’s recommendations. The test method shall be as agreed upon between user and supplier.

**4.3.5 Glass transition temperature (Tg)**

The glass transition temperature of the cured prepreg shall be 120 °C minimum as determined by test method 2M10 or 2M11 of IEC 61189-2. The prepreg under test shall be bonded together and full cured in accordance with the manufacturer’s recommendations.

**4.3.6 Decomposition temperature (Td)**

The requirement for decomposition temperature is found in Table 2. The prepreg under test shall be bonded together and fully cured in accordance with the manufacturer’s recommendations.

**Table 2 – Decomposition temperature requirements**

Property	Test method (IEC 61189-2)	Requirements
Decomposition temperature (5 % weight loss from 50 °C)	2MXX	≥310 °C

**4.3.7 Thermal resistance**

The requirements for thermal resistance are found in Table 3. The prepreg under test shall be bonded together and fully cured in accordance with the manufacturer’s recommendations. The specimen shall not have copper foil on any layer.

**Table 3 – Thermal resistance requirements**

Property	Test method (IEC 61189-2)	Requirements
T260	2MXX	≥30 min
T288		≥5 min
T300		TBD

**4.3.8 Z-axis expansion**

The requirements for Z-axis expansion are found in Table 4. The prepreg under test shall be bonded together and fully cured in accordance with the manufacturer’s recommendations.