

JIS

JAPANESE
INDUSTRIAL
STANDARD

Translated and Published by
Japanese Standards Association

JIS C 6484 : 2005
(JPCA)

**Base materials for printed circuits —
Epoxide woven E-glass laminated
sheet of defined flammability (vertical
burning test)**

ICS 31.180

Reference number : JIS C 6484 : 2005 (E)

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee, as the result of proposal for revision of Japanese Industrial Standard submitted by Japan Printed Circuit Association (JPCA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently JIS C 6484:1997 (revised) and JIS C 6486:1996 (withdrawn and integrated) are replaced with this Standard.

This revision has been made based on IEC 61249-2-7:2002 *Materials for printed boards and other interconnecting structures—Part 2-7: Reinforced base materials clad and unclad—Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad* and IEC 61249-2-8:2003 *Materials for printed boards and other interconnecting structures—Part 2-8: Reinforced base materials clad and unclad—Modified brominated epoxide woven fiberglass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad* for the purposes of making it easier to compare this Standard with International Standard; to prepare Japanese Industrial Standard conforming with International Standard; and to propose a draft of an International Standard which is based on Japanese Industrial Standard.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

Date of Establishment: 1966-04-01

Date of Revision: 2005-03-20

Date of Public Notice in Official Gazette: 2005-03-22

Investigated by: Japanese Industrial Standards Committee
Standards Board

Technical Committee on Electronics Technology

JIS C 6484 : 2005, First English edition published in 2005-08

Translated and published by: Japanese Standards Association
4-1-24, Akasaka, Minato-ku, Tokyo, 107-8440 JAPAN

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Printed in Japan

NH/HB

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Base materials for printed circuits — Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test)

Introduction This Japanese Industrial Standard has been prepared based on the first edition of IEC 61249-2-7 *Materials for printed boards and other interconnecting structures — Part 2-7: Reinforced base materials clad and unclad — Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test)*, copper-clad published in 2002 and the first edition of IEC 61249-2-8 *Materials for printed boards and other interconnecting structures — Part 2-8: Reinforced base materials clad and unclad — Modified brominated epoxide woven fibreglass reinforced laminated sheets of defined flammability (vertical burning test)*, copper-clad published in 2003 with some modifications of the technical contents of the original International Standards.

The portions given dotted underlines are the matters in which the contents of the original International Standards have been modified. A list of modification with the explanation is given in annex 1 (informative).

1 Scope This Standard gives requirements for properties of epoxide woven E-glass laminated sheet 0.05 mm up to 3.2 mm, of defined flammability (vertical burning test), copper-clad hereafter referred to as copper-clad laminated sheet.

2 Classification In this Standard, copper-clad laminated sheets are classified by the glass transition temperature as shown in table 1. Some property requirements which have several classes (coarse, fine, extra-fine) of performance shall be specified according to the agreement between the parties concerned with delivery.

Table 1 Classification of copper-clad laminates

Class	Glass transition temperature (°C)	Information Corresponding International Standard
GE4F	120 min.	(IEC 61249-2-7)
CE2F	150 to 190	(IEC 61249-2-8)

Information : The class (GE2F, 4F) is not specified in the original International Standard (IEC 61249-2-7, IEC 61249-2-8), however, the designations used in the former JIS C 6484: 1997 have been used for clarifying the division.

Remarks : The International Standards corresponding to this Standard are as follows.

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standards and JIS are IDT (identical), MOD (modified), and NEQ (not equivalent) according

to ISO/IEC Guide 21.

IEC 61249-2-7:2002 *Materials for printed boards and other inter-connecting structures—Part 2-7: Reinforced base materials clad and unclad—Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad (MOD)*

IEC 61249-2-8:2003 *Materials for printed boards and other inter-connecting structures—Part 2-8: Reinforced base materials clad and unclad—Modified brominated epoxide woven fibreglass reinforced laminated sheets of defined flammability (vertical burning test), copper-clad (MOD)*

3 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

JIS C 6481 *Test methods of copper-clad laminates for printed wiring boards*

JIS C 6515 *Copper foil for printed wiring boards*

JIS Q 9001 *Quality management systems—Requirements*

NOTE : ISO 9001 *Quality management systems—Requirements* is identical with the said standard.

JIS Q 14001 *Environmental management systems—Requirements with guidance for use*

NOTE : ISO 14001 *Environmental management systems—Specification with guidance for use* is identical with the said standard.

JIS Z 7250 *Safety data sheet for chemical products—Part 1: Content and order of sections*

NOTE : ISO 11014-1 *Safety data sheet for chemical products—Part 1: Content and order of sections* is equivalent to the said standard.

IEC 60249-1 *Base materials for printed circuits. Part 1: Test methods*

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

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

4.1 Insulating base Majority difunctional epoxide woven E-glass laminate with a glass transition temperature of 120 °C minimum and brominated epoxide, modified with multifunctional epoxide resulting in a laminate with a glass transition temperature of between 150 °C and 190 °C.

Contrast agents may be added to enhance processing such as automated optical in-

spection (AOI). Its flame resistance is defined in terms of the flammability requirements of 7.3.

4.2 Metal foil Copper foil specified in JIS C 6515 (for the manufacture of copper-clad materials). The preferred foils are electrodeposited of defined ductility and malleability specified in JIS C 6515.

4.3 Reinforcement Woven E-glass: woven E-glass fabric (for the manufacture of prepreg and copper-clad materials).

5 Electrical properties The electrical property requirements are shown in table 2.

Table 2 Electrical properties

Property		Test method (IEC 61189-2)	Requirement
Resistance of foil		2E12	As specified in JIS C 6515
Surface resistance after damp heat while in the humidity chamber (optional) (1)		2E03	$\geq 10\,000\text{ M}\Omega$
Surface resistance		2E03	$\geq 50\,000\text{ M}\Omega$
Volume resistivity after damp heat while in the humidity chamber (optional) (1)		2E04	$\geq 5\,000\text{ M}\Omega\text{m}$
Volume resistivity after damp heat and recovery		2E04	$\geq 10\,000\text{ M}\Omega\text{m}$
Relative permittivity (1 MHz)		2E10 (in process of investigation) (3) or 2.7 of IEC 60249-1	≤ 5.4
Dissipation factor (1 MHz)		2E10 (in process of investigation) (3) or 2.7 of IEC 60249-1	≤ 0.035
Electric strength (under 0.5 mm in thickness) (1)		2E11 (in process of investigation) (3) or 2.8 of IEC 60249-1	$\geq 30\text{ kV/mm}$
Arc resistance (1)		2E14	$\geq 60\text{ s}$
Dielectric breakdown (0.5 mm or over in thickness) (1)		2E15 (in process of investigation) (3)	$\geq 40\text{ kV}$
Surface resistance at 125 °C (1)		2E07	$\geq 1\,000\text{ M}\Omega$
Volume resistivity at 125 °C (1)		2E07	$\geq 1\,000\text{ M}\Omega\text{m}$
Insulation resistance (2)	Original state	5.11 of JIS C 6481 or 2E17 of IEC 61189-2 (in process of investigation) (3)	$\geq 500\,000\text{ M}\Omega\text{ min.}$
	After boiling		$\geq 1\,000\text{ M}\Omega\text{ min.}$

Notes (1) It may be omitted according to the agreement between the parties concerned with delivery.

(2) It is the test method which has much actual results in Japan and now has been in process of proposal to IEC. Until it will be adopted in IEC, the test method for insulation resistance in JIS C 6481 shall be applied.

(3) When IEC 61189-2 is revised and the test methods are added, the test

methods shall be used.

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 fitness for use for the intended purpose.

For the following specific defects, the requirements given in 6.1.1 to 6.1.4 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 using table 3.

Table 3 Pits and dents

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 pits and dents are measured using a magnifier of about $3\times$ magnification with a scale attached or a surface roughness tester, and the total point count for any 300 mm $\times$ 300 mm area shall be calculated to determine the class of the material.

Class	Total point count
Class A	over 17 to and incl. 29
Class B	over 5 to and incl. 17
Class C	5 max.
Class D	0
Class X	to be agreed upon between the parties concerned with delivery

Remarks : The materials of which total value is over 29 shall be rejected.

The required class of material shall be agreed upon between the parties concerned with delivery. 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. For thick foil (50 μm or over in thickness) the maximum scratch depth shall not exceed 10 μm .

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 $\times$ 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.

Raised areas that are 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

The required class of material shall be agreed upon between the parties concerned with delivery. Class A applies unless otherwise specified.

6.1.5 Surface waviness When examined in accordance to 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 a 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 than, 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 4. The fine tolerances shall apply unless the other tolerances are ordered.

Table 4 Nominal thickness and tolerance of metal-clad laminate

Unit : mm

Thickness excluding metal foil (material intended for multi- layer boards) Nominal thickness	Thickness including metal foil (material intended for single or double-sided boards) Nominal thickness	Tolerance requirement		
		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 ⁽⁴⁾	≥ 0.80 ≤ 1.00	± 0.13	± 0.09	± 0.07
> 1.00 ≤ 1.30 ⁽⁴⁾	> 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