INTERNATIONAL STANDARD

IEC 61189-2

1997

AMENDMENT 1
2000-01

Amendment 1

Test methods for electrical materials, interconnection structures and assemblies –

Part 2: Test methods for materials for interconnection structures

Amendement 1

Méthodes d'essai pour les matériaux électriques, les structures d'interconnexion et les ensembles –

Partie 2: Méthodes d'essai des matériaux pour structures d'interconnexion

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PRICE CODE W

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FOREWORD

This amendment has been prepared by IEC technical committee 52: Printed circuits.

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

FDIS	RVD
52/832/FDIS	52/840/RVD

Full information on the voting for the approval of this amendment can be found in the report on voting indicated in the above table.

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

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Add the following table to the list of tables:

Table 5 – Number of plies per specimen as a function of glass thickness

Add the following figures to the list of figures:

Figure 13 – Thickness measuring points

Figure 14 – Test fixture

Figure 15 – Example of prepreg melting viscosity

Figure 16 – Position of specimens for resin content

Figure 17 – Differential scanning colorimeter

Figure 18 – Thermomechanical analysis (expansion mode)

Figure 19 – Scaled flow test specimen before lamination

Figure 20 – Scaled flow test specimen measurement points

Figure 21 – Location of specimens on original sheet for dimensional stability test

Figure 22 – Location of marks on specimen for dimensional stability

Add the following annexes to the list of annexes

Annex C (normative) Laboratory pro forma (form)

Annex D (informative) Laboratory pro forma (form)

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2 Normative references

Insert, in the existing list, the titles of the following standards:

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60249-1:1982, *Base materials for printed circuits – Part 1: Test methods*

IEC 60326-3:1991, *Printed boards – Part 3: Design and use of printed boards*

IEC 60707:1981, *Methods of test for the determination of the flammability of solid electrical insulating materials when exposed to an igniting source*

ISO 3274:1996, *Geometrical Products Specifications (GPS) – Surface texture: Profile method – Nominal characteristics of contact (stylus) instruments*

ANSI/UL-94:1996, *Standard for tests for flammability of plastic materials for parts in devices and appliances*

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7.1 Test 2D01: Thickness (under consideration)

Replace this subclause by the following subclause:

7.1 Test 2D01: Thickness of base materials and rigid boards

7.1.1 Object

This test method covers the procedure for the determination of the thickness of base materials, clad or unclad.

7.1.2 Test specimens

Standard sheet sizes of metal-clad or unclad base materials.

Standard panel sizes of metal-clad or unclad base materials.

7.1.3 Test apparatus and material

A suitable micrometer having a resolution of 0,01 mm or better shall be used.

7.1.4 Procedure

a) General conditions

- Test specimens shall be placed between the two faces of the micrometer, so that the whole face of the pressure-foot will fall within the area of the material. The pressure-foot shall be lowered gently, slowly and with great care onto the test specimen so that all punching effect is avoided.

– No stress shall be imposed by hand on the instrument or the material when a reading is being taken. The reading shall be taken as soon as the pointer has ceased to move. It is necessary to take care in avoiding parallax errors and vibrations which may significantly affect the results.

b) Method 1

– This procedure is intended for the thickness measurement of the sheets of metal-clad or unclad base materials.

– The specimen shall be held vertically or horizontally.

– Thickness to the nearest 0,01 mm at two points 25 mm or more inside each edge, at eight points, and additionally at two points in the middle parts, so that a total of 10 points, shall be measured as shown in figure 13.

– The measurement shall be made twice at each point and the mean value shall be determined as the thickness of each point.

– For automatic thickness inspection, continuous measuring shall be performed in three measuring tracks parallel to the longitudinal axis of the sheet, two at least 25 mm from the longitudinal edges and the third near the midline.

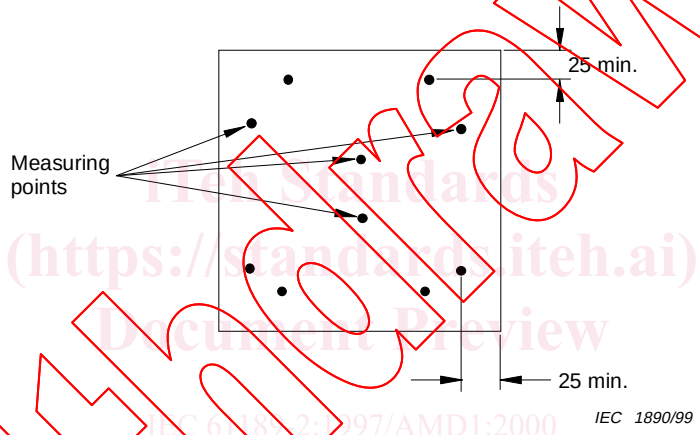

Figure 13 – Thickness measuring points

c) Method 2

– This procedure is intended for the thickness measurement of panels of metal-clad or unclad base materials. The thickness of the specimens held vertically or horizontally shall be measured at the places which are agreed between the interested parties.

7.1.5 Report

The report shall include

a) the test method number and revision;

b) the date of the test;

c) the identification of the material tested;

d) a statement certifying that the test was carried out for as-received metal-clad or unclad base materials;

e) the thicknesses measured and the nominal thickness with its tolerance;

f) any deviation from this test method;

g) the name of the person conducting the test.

7.1.6 Additional information

The use of a micrometer with a damping device, or controlled rate of movement of the pressure-foot, is advantageous.

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8.6 Test 2C06: Flammability, vertical (under consideration)

Replace this subclause by the following subclause:

8.6 Test 2C06: Flammability, vertical burning test for rigid materials

8.6.1 Object

This test method is intended as a laboratory quality control technique using a low energy source of ignition. Results from this test should not be used to attempt to predict the behaviour of materials in a large-scale fire.

This test should be used for materials having good resistance to ignition. The test is carried out using a small test flame having an intensity similar to that of an actual source of fire.

Timings measured by this test are an indication of the ability of the material(s) to self-extinguish. There is no correlation with other properties of the material(s), such as the oxygen index.

Materials suitable for testing in accordance with this technique include rigid substrates and rigid substrates in combination with any surface coating(s).

8.6.2 Test specimens

The test specimens shall be prepared from a sample of the metal-clad base material under test. The metal shall be completely removed using any etching method of commercial practice.

The specimen strip shall be (125 ± 5) mm long and (13 ± 0,3) mm wide. The edges shall be smooth. The corners of the specimens shall be rounded with a radius not exceeding 1,3 mm. The corners of the specimens shall be rounded with a radius not exceeding 1,33 mm. The thickness of the sample will prejudice the results obtained.

A minimum of 10 specimens shall be tested. However, it is usual to take a total of 20 specimens for conditioning and testing to cover the eventuality of a failure during the test of the first set of specimens.

8.6.3 Test apparatus and materials

The following test apparatus and materials shall be used.

a) A draught-free room, test chamber or enclosure which provides a means of venting the fumes from burning specimens. A hood may be used, but its exhaust fan shall be disabled during the tests and allowed to operate only between tests in order to clear fumes. Subdued light is advantageous.

b) The igniting source consisting of a blue flame, (20 ± 2) mm high, produced using a laboratory burner (Bunsen or Tirril burner) having a tube with a length of 100 mm and an inside diameter of (9,5 ± 0,5) mm. The tube shall not be equipped with end attachments such as stabilizers.

c) A supply of technical grade methane gas with a suitable regulator and meter to produce a uniform gas flow. If natural gas is used as an alternative to methane, it should have a heat content of approximately 37 MJ/m^3. This has been found to produce similar results.

The required flame shall be obtained by adjusting the gas supply and air inlets of the burner until a yellow-tipped blue flame of the specified height is produced, and then by increasing the air supply until the yellow tip has just disappeared. The height of the flame shall then be measured again and corrected if necessary.

d) A test fixture shall be comprised of a ring stand with two clamps or similar apparatus which is adjustable for vertical positioning of the specimen. Each specimen is to be held by clamping the upper 6 mm of the specimen with the long dimension oriented vertically, so that the lower end of the specimen is 10 mm above the top of the burner tube and 300 mm above a horizontal layer of dry tissue paper (50 mm × 50 mm swatch). An adjustable, movable holder maintains the burner tube centrally under the lower end of the specimen to an angle of 5° and the 10 mm distance between the lower end of the specimen and the top of the burner is to be maintained during the flame applications.

e) A hand-operated timing device with a resolution of 1 s or better.

8.6.4 Procedure

Ten specimens shall be preconditioned in accordance with the requirements of 5.3 of IEC 60068-1 for a period of 48 h as a referee and 24 h for normal quality conformance prior to testing. The detail requirements are

a) a temperature of 15 °C to 35 °C;

b) a humidity of 25 % RH to 75 % RH;

c) an air pressure of 86 kPa to 106 kPa.

Fluctuations shall be kept to a minimum.

The remaining 10 specimens shall be preconditioned in a circulating air oven for 24 h at (125 ± 2) °C. They shall then be allowed to cool in a desiccator until specimens reach room temperature prior to testing.

Each specimen shall be held in the test fixture by clamping the upper 6 mm of the specimen with the long direction oriented vertically so that the lower end of the specimen is 10 mm above the top of the burner tube and 300 mm above a horizontal layer of dry tissue papers (50 mm × 50 mm swatch).

The burner, in a remote position from the specimen, shall be adjusted by controlling the gas supply and air inlets of the burner until a yellow-tipped blue flame (20 ± 2) mm in height is produced. The air supply is then increased until the yellow tip has disappeared. The height of the flame shall then be measured again and corrected if necessary.

The burner shall be placed centrally beneath the lower end of the specimen and allowed to remain for 10 s. The burner shall then be moved at least 150 mm away from the specimen, and the time taken by the specimen to self-extinguish shall be measured. This shall be defined as the time from removal of the test flame from the specimen until the time when the specimen ceases to burn. Record the burn time on the laboratory pro forma in annex C.

When the specimen ceases to burn, the burner shall immediately be replaced in its original position beneath the specimen. After 10 s, the test flame shall again be withdrawn and the duration of flaming shall again be measured. Record the burn time on the laboratory pro forma in annex C.

If the test flame is extinguished during either application, it shall be reignited immediately and reapplied so that the total time of application is still 10 s. There shall be no more than three applications of the test flame during any 10 s ignition period, otherwise the material cannot be evaluated by this technique.

If the specimen drips molten or flaming material during either application of the test flame, the burner may be tilted to an angle of up to 45° and also slightly withdrawn from one of the 13 mm sides of the specimen during the flame application to avoid material dripping into the tube of the burner.

If the specimen drips molten or flaming material, or is consumed during the test, the burner shall be hand-held and the 10 mm distance between the bottom of the specimen and the top of the burner tube shall be maintained throughout the flame application. Any molten strings of material shall be ignored, and the flame shall be applied to the major part of the specimen. Record observed dripping or other significant observations on the laboratory pro forma in annex C.

If the total of the ten burn times meets the requirements of the relevant specification but individual burning times exceed the relevant requirements, a further set of five specimens shall be tested. If the second set meets all the requirements, these requirements shall be deemed to be satisfied.

If the total of ten burning times for any set of five specimens exceed the specified requirements by no more than 5 s, a second set of five specimens shall be tested, and if the requirements for total and individual burning times are met, these requirements shall be deemed to be satisfactory.

8.6.5 Report

In addition to the general requirements for reporting, the report shall include

a) test number and revision;
b) identification of the material tested;
c) testing date;
d) the thickness of the specimen;
e) the duration of flaming of each specimen after the first removal of the test flame;
f) the duration of flaming of each specimen after the second removal of the test flame;
g) whether the specimen burns up to the holding clamp;
h) whether the specimen drips flaming particles which ignite the tissue paper;
i) any deviation from this test method;
j) the name of the person performing the test;
k) the type of combustion. Flaming combustion is the combustion of the specimen in the gaseous phase with the emission of light. Glowing combustion of the specimen is the combustion without flame;
l) the evaluated results.

8.6.6 Additional information

Annex C shows a suggested pro forma for reporting.

There are obvious hazards associated with flammability testing. Training of test operators, and familiarity with laboratory safety procedures is of paramount importance.

All fire effluent should be considered to be toxic, for the purposes of safety if not in fact.

Uncertainty of measurement calculations for burn times, although a variable, prove to be impractical. The result of the test is an attribute; the FV-0, FV-1 rating etc.

This test method is based upon the method given in IEC 60707. Some minor technical differences do exist between this test method and that given in IEC 60707.

It is understood that a nominal substrate thickness of 1,6 mm will be used throughout the industry. IEC 60707 specifies a thickness of (3 ± 0,2) mm. Differences in thickness will prejudice test results.

IEC 60707 requires a specimen width of 13 mm with a tolerance of ±0,3 mm. The previous edition of this method as published in IEC 60249-1 required a tolerance of ±1,0 mm. American industry requirements (Underwriter's Laboratory Specification ANSI/UL-94) detail a specimen width of 12,7 mm to 13,2 mm.

The specimen width of (13 ± 0,3) mm has therefore been chosen since this will accommodate both IEC 60707 and ANSI/UL-94.

The smoothness of the specimen edges can be critical to the performance of the specimen. A polished finish is recommended. A rough finish (for example blanked) will significantly degrade performance due to the increase in surface area available to the flame.

Small-scale flammability tests, such as the one described herein, are an indicator of the behaviour of the material(s) tested. Fire integrity of equipments in which printed boards are used can only be assessed by equipment level testing.

Materials in combination may produce results that are different to those of the separate materials.

A material that is rated FV-1 or FV-2 when bonded to an inert substrate may produce an FV-0 performance (for example rigid polyimide/glass constrained with copper-invar). A FV-0 material in combination with a surface coating (for example solder resist) may be degraded to FV-1.

8.7 Test 2C07: Flammability, horizontal (under consideration)

Replace this subclause by the following subclause:

8.7 Test 2C07: Flammability; horizontal burning test for rigid materials

8.7.1 Object

This test method is intended as a laboratory quality control technique using a low energy source of ignition. Results from this test should not be used to attempt to predict the behaviour of materials in a large-scale fire.

This test is significantly less onerous than the similar vertical burn test and is intended to be used for materials having a limited resistance to ignition. The test is carried out using a small test flame having an intensity similar to that of an actual source of fire. This method does have an obvious application for printed board assemblies used in a horizontal configuration. Otherwise, due consideration should be given to its applicability.

Reference should be made to 8.3 of IEC 60326-3, with regard to the fire integrity of printed circuit boards and the suitability of test methods.

Timings measured by this test are an indication of the ability of the material(s) to self-extinguish. There is no correlation with other properties of the material(s), such as the oxygen index.

Materials suitable for testing in accordance with this technique include rigid substrates and rigid substrates in combination with any surface coating(s).

8.7.2 Test specimen

The test specimens shall be prepared from a sample of the metal-clad base material under test. The metal shall be completely removed using any etching method of commercial practice.

The specimen strip shall be (125 ± 5) mm long and (13 ± 0,3) mm wide. The edges shall be smooth. The corners of the specimens shall be rounded with a radius not exceeding 1,3 mm. The thickness of the sample will prejudice the results obtained.

The specimens shall be marked with an indelible line (for example by scribing) which is perpendicular to the longitudinal axis, and which is (25 ± 0,5) mm away from the end which is to be ignited.

A minimum of four specimens shall be tested.

8.7.3 Test apparatus and materials

The following test apparatus and materials shall be used.

a) A draught-free room, test chamber or enclosure which provides a means of venting the fumes from burning specimens. A hood may be used, but its exhaust fan shall be disabled during the tests and allowed to operate only between tests in order to clear fumes. Subdued light is advantageous.

b) The igniting source consisting of a blue flame, (25 ± 1) mm high, produced using a laboratory burner (Bunsen or Tirril burner) having a tube with a length of 100 mm and an inside diameter of (9,5 ± 0,5) mm. The tube shall not be equipped with end attachments such as stabilizers.

c) A supply of technical grade methane gas with a suitable regulator and meter to produce a uniform gas flow. If natural gas is used as an alternative to methane, it should have a heat content of approximately 37 MJ/m^3. This has been found to produce similar results.

   The required flame shall be obtained by adjusting the gas supply and air inlets of the burner until a yellow-tipped blue flame of the specified height is produced, and then by increasing the air supply until the yellow tip has just disappeared. The height of the flame shall then be measured again and corrected if necessary.

d) A test fixture comprised of a ring stand with two clamps, adjustable for horizontal positioning of the specimen, and of a wire gauze. This shall enable the test specimen to be fixed with its long dimension horizontally, and with its transverse axis inclined at 45° to the horizontal line.

e) A wire gauze (100 mm × 100 mm, 8 meshes per cm or 20 meshes per inch, 0,043 mm diameter steel wire) shall be clamped horizontally beneath the test specimen. An adjustable, movable holder maintains the burner tube in the same vertical plane as the lower longitudinal edge of the specimen and at an angle of approximately 45° to the horizontal line.

f) A hand-operated timing device with a resolution of ±1 s or better.

8.7.4 Test procedure

The specimens shall be preconditioned in accordance with the requirements of 5.3 of IEC 60068-1 for a period of 48 h as a referee or 24 h as normal quality conformance prior to testing. The detail requirements are

a) a temperature of 15 °C to 35 °C;

b) a humidity of 25 % RH to 75 % RH;

c) an air pressure of 86 kPa to 106 kPa.

Fluctuations shall be kept to a minimum.

The test specimen shall be mounted in the test fixture such that the distance between the lowest edge of the specimen and gauze shall be 10 mm, with (13 ± 2) mm of the unsupported end of the specimen projecting beyond the edge of the gauze as shown in figure 14.

The burner, in a remote position from the specimen, shall be adjusted by controlling the gas supply and air inlets of the burner until a yellow-tipped blue flame (20 ± 2) mm in height is produced. The air supply is then increased until the yellow tip has disappeared. The height of the flame shall be measured again and corrected if necessary.

The burner shall be placed beneath the free end of the specimen so that a length of approximately 6,5 mm is subjected to the flame. The centre axis of the burner shall be in the same vertical plane as the lower horizontal edge of the specimen and at an angle of (45 ± 10)° to the horizontal line. Its position shall remain unchanged whilst the flame is applied.

The flame shall be applied to the specimen for 30 s and then removed. The burn time, in seconds, shall be measured from the instant of removal of the burner flame until the specimen extinguishes. Observation shall be made as to whether the burning proceeds beyond the indelible line.

The burn times and other observations shall be recorded on the laboratory pro forma as shown in annex D.

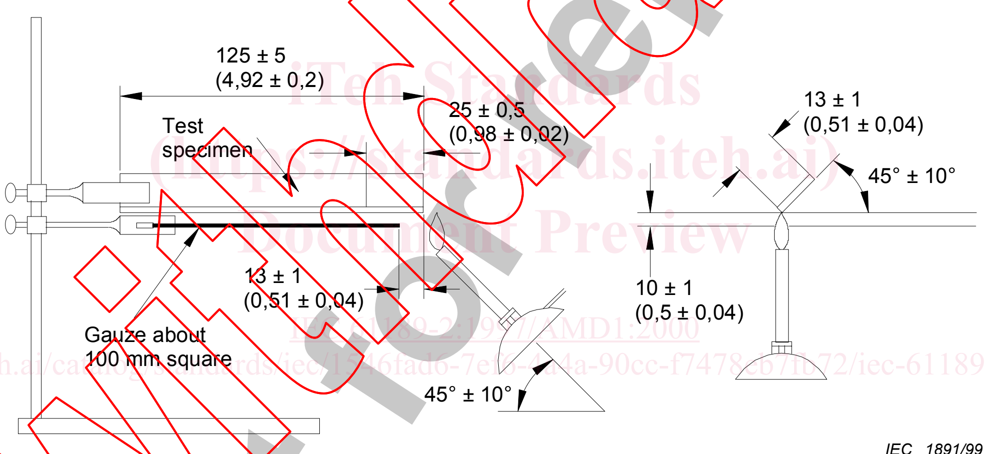

Figure 14 – Test fixture

8.7.5 Report

In addition to the general requirements for reporting, the report shall include

a) the test method;

b) the average of the four burning times;

c) the identification and description of the specimens;

d) the thickness of the specimen;

e) the average of the four burning times;

f) whether the burning of any of the specimens proceeds past the indelible line;

g) whether the specimen material melts or produces burning drips;

h) any deviation from this test method;

i) the name of the person performing this test.

8.7.6 Additional information

Annex D comprises a suggested pro forma for reporting.

There are obvious hazards associated with flammability testing. Training of test operators, and familiarity with laboratory safety procedures is of paramount importance.

All fire effluent should be considered to be toxic, for the purposes of safety, if not in fact.

Uncertainty of measurement for burn times, although a variable, prove to be impractical.

The result of the test is an attribute; the HB rating, etc.

This test method is based upon the method given in IEC 60707. Some minor technical differences do exist between this test method and that given in IEC 60707.

It is understood that a nominal substrate thickness of 1,6 mm will be used throughout the industry. IEC 60707 specifies a thickness of (3,0 ± 0,2) mm. Differences in thickness will prejudice test results.

IEC 60707 requires a specimen width of 13 mm with a tolerance of ±0,3 mm. The previous edition of this method as published in IEC 60249-1 required a tolerance of ±1,0 mm. American Industry requirements (Underwriter's Laboratory Specification ANSI/UL-94) detail a specimen width of 12,7 mm to 13,2 mm .

The specimen width of (13 ± 0,3) mm has therefore been chosen since this will accommodate both IEC 60707 and ANSI/UL-94.

The smoothness of the specimen edges can be critical to the performance of the specimen. A polished finish is recommended. A rough finish (for example, blanked) will significantly degrade performance due to the increase in surface area available to the flame.

Small-scale flammability tests, such as the one described, herein are an indicator of the behaviour of the material(s) tested. Fire integrity of equipment in which printed boards are used can only be assessed by equipment level testing.

8.9 Test 2C09: Melting viscosity of prepregnation materials (under consideration)

Replace this subclause by the following subclause:

8.9 Test 2C09: Melting viscosity of prepreg materials

8.9.1 Object

This test method covers the procedure for the determination of the isothermic melting viscosity of prepregs at elevated temperatures using a rotating cone-and-plate viscosimeter.

8.9.2 Test specimens

The test specimens shall be cut not less than 25 mm from the edge or selvedge of the prepreg.

The test specimens shall be prepared from a sample of the prepreg material under test by cutting rectangular pieces of approximately 200 mm × 300 mm, separating the resin from the reinforcement material by folding and crushing the prepreg and collecting it in a plastic bag.