भारतीय मानक

Indian Standard

IS 15382 (Part 3) : 2024
IEC 60664-3 : 2016

निम्न वोल्टता प्रणालियों में उपकरणों का विद्युतरोधी समन्वय

भाग 3 प्रदुषण से सुरक्षा के लिए लेपन, पोटिंग या मोल्डिंग का प्रयोग

(दूसरा पुनरीक्षण)

Insulation Coordination for Equipment within Low-Voltage Systems

Part 3 Use of Coating, Potting or Moulding for Protection against Pollution

(Second Revision)

ICS 29.080.30

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High Voltage Engineering Sectional Committee, ETD 19

NATIONAL FOREWORD

This Standard (Part 3) (Second Revision) which is identical to IEC 60664-3 : 2016 'Insulation co-ordination for equipment within low-voltage systems — Part 3 Use of coating, potting or moulding for protection against pollution' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of the High Voltage Engineering Sectional Committee and approval of the Electrotechnical Division Council.

This standard was originally published in 2006 and subsequently revised in 2019. This revision has been undertaken to align it with the latest version of IEC 60664-3 : 2016.

This Indian Standard is published in several parts. The other parts in this series are:

Part 1	Principles requirements and tests
Part 2	Application guide
Part 4	Consideration of high-frequency voltage stress

The text of the IEC standard has been approved as suitable for publication as an Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appears referring to this standard, they should be read as 'Indian Standard'; and

b) Comma (,) has been used as a decimal marker, while in Indian Standards the current practice is to use a point (.) as the decimal marker.

In this adopted standard, reference appears to International Standards for which Indian Standards also exists. The corresponding Indian Standards, which are to be substituted, are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 60068-2-1 : 1990 Environmental testing — Part 2-1: Tests — Tests A: Cold	IS/IEC 60068-2-1 : 2007 Environmental testing: Part 2 Tests, Section 1 Tests A: Cold	Identical with IEC 60068-2-1 : 2007
IEC 60068-2-2 : 1974 Basic environmental testing procedures — Part 2-2: Tests — Tests B : Dry heat	IS/IEC 60068-2-2 : 2007 Environmental testing: Part 2 Tests — Test B, Section 2: Dry heat	Identical with IEC 60068-2-2 : 2007
IEC 60068-2-14 : 1984 Basic environmental testing procedures — Part 2-14: Tests — Test N: Change of temperature	IS/IEC 60068-2-14 : 2009 Environmental testing: Part 2 Tests, Section 14: Test N: Change of temperature	Identical with IEC 60068-2-14 : 2009
IEC 60664-1 : 2007 Insulation coordination for equipment within low-voltage systems — Part 1: Principles, requirements and tests	IS 15382 (Part 1) : 2022/ IEC 60664-1 : 2020 Insulation coordination for equipment within low-voltage systems: Part 1 Principles requirements and tests	Identical with IEC 60664-1 : 2020

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CONTENTS

INTRODUCTION

This part of IEC 60664 details the conditions in which the reduction of clearance and creepage distances can apply to rigid assemblies such as **printed boards** or terminals of components. **Protection** against pollution can be achieved by any kind of encapsulation such as **coating**, potting or moulding. The **protection** may be applied to one or both sides of the assembly. This standard specifies the insulating properties of the protecting material.

Between any two unprotected conductive parts, the clearance and creepage distance requirements of IEC 60664-1 apply.

This document refers only to permanent **protection**. It does not cover assemblies after repair.

Technical committees should consider the influence on the **protection** of overheating **conductors** and components, especially under fault conditions, and to decide if any additional requirements are necessary.

Safe performance of assemblies is dependent upon a precise and controlled manufacturing process for the application of the protective system. Requirements for quality control, e.g. by sampling tests, should be considered by technical committees.

Indian Standard

INSULATION COORDINATION FOR EQUIPMENT WITHIN LOW-VOLTAGE SYSTEMS

PART 3 USE OF COATING, POTTING OR MOULDING FOR PROTECTION AGAINST POLLUTION

(Second Revision)

1 Scope

This part of IEC 60664 applies to assemblies protected against pollution by the use of **coating**, potting or moulding, thus allowing a reduction of clearance and creepage distances as described in IEC 60664-1.

This document describes the requirements and test procedures for two methods of **protection**:

– type 1 **protection** improves the microenvironment of the parts under the **protection**;
– type 2 **protection** is considered to be similar to **solid insulation**.

This document also applies to all kinds of protected **printed boards**, including the surface of inner layers of multi-layer boards, substrates and similarly protected assemblies. In the case of multi-layer **printed boards**, the distances through an inner layer are covered by the requirements for **solid insulation** in IEC 60664-1.

NOTE Examples of substrates are hybrid integrated circuits and thick-film technology.

This document refers only to permanent **protection**. It does not cover assemblies that are subjected to mechanical adjustment or repair.

The principles of this standard are applicable to functional, basic, supplementary and reinforced insulation.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

IEC 60068-2-2, *Environmental testing – Part 2-2: Tests – Test B: Dry heat*

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-78, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60326-2:1990, *Printed boards – Part 2: Test methods*

IEC 60454-3-1:1998/AMD1:2001, *Pressure-sensitive adhesive tapes for electrical purposes – Part 3: Specifications for individual materials – Sheet 1: PVC film tapes with pressure – sensitive adhesive*

IEC 60664-1:2007, *Insulation coordination for equipment within low-voltage systems – Part 1: Principles, requirements and tests*

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 61189-3:2007, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 3: Test methods for interconnection structures (printed boards)*

IEC 61249-2 (all parts), *Materials for printed boards and other interconnecting structures – Reinforced base materials, clad and unclad*

IEC Guide 104:2010, *The preparation of safety publications and the use of basic safety publications and group safety publications*

ISO/IEC Guide 51, *Safety aspects – Guidelines for their inclusion in standards*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60664-1 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org
- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
base material
insulating material upon which a conductive pattern may be formed

Note 1 to entry: The **base material** may be rigid or flexible, or both. It may be a dielectric or an insulated metal sheet.

[SOURCE: IEC 60050-541:1990, 541-02-01]

3.2
printed board
base material cut to size containing all required holes and bearing at least one conductive pattern.

Printed boards are typically subdivided according to

– their structure (e.g., single- and double-sided, multilayers)
– the nature of the **base material** (e.g., rigid, flexible)

[SOURCE: IEC 60050-541:1990, 541-01-03]

3.3
conductor (of a printed board) single conductive path in a conductive pattern

[SOURCE: IEC 60050-541:1990, 541-01-20]

3.4
protection
measure which reduces the influence of the environment

3.5
coating
insulating material such as varnish or dry film laid on the surface of the assembly

Note 1 to entry: **Coating** and **base material** of a **printed board** form an insulating system that may have properties similar to **solid insulation**

[SOURCE: IEC 60050-212:2010, 212-11-61].

3.6
solid insulation
solid insulating material, or a combination of solid insulating materials, placed between two conductive parts or between a conductive part and a body part

EXAMPLE In the case of a printed board with a coating, solid insulation consists of the board itself as well as the coating. In other cases, solid insulation consists of the encapsulating material.

[SOURCE: IEC 60050-903:2013, 903-04-14]

3.7
spacing
any combination of clearances, creepage distances and insulation distances through insulation

[SOURCE: IEC 60050-471:2007, 471-01-20]

4 Design requirements

4.1 Principles

The dimensioning of **spacings** between **conductors** depends on the type of **protection** used.

When type 1 **protection** is used, dimensioning of clearances and creepage distances shall follow the requirements of IEC 60664-1. If the requirements of this standard are met, pollution degree 1 applies under the **protection**.

When type 2 **protection** is used, **spacings** between conductive parts shall meet the requirements and tests for **solid insulation** of IEC 60664-1 and their dimensions shall not be less than the minimum clearances specified in IEC 60664-1 for homogeneous field conditions.

4.2 Application range with regards to the environment

The design requirements are applicable in all microenvironments.

Stresses such as temperature, chemical or mechanical stresses, or those listed in 5.3.2.4 of IEC 60664-1:2007 shall be taken into account when the protective material is selected.

Absorption of humidity by the protective material shall not impair the insulation properties of the parts being protected.

NOTE Absorption of humidity can be checked by an insulation resistance measurement under humid conditions.

4.3 Requirements for the types of protection

Protection is achieved in the following ways.

– Type 1 **protection** improves the microenvironment of the parts under the **protection**. The clearance and creepage distance requirements of IEC 60664-1 for pollution degree 1 apply under the **protection**. Between two conductive parts, it is a requirement that one or both conductive parts, together with all the **spacings** between them, are covered by the **protection**.

– Type 2 **protection** is considered to be similar to **solid insulation**. Under the **protection**, the requirements for **solid insulation** specified in IEC 60664-1 are applicable and the **spacing**s shall be not less than those specified in Table 1. The requirements for clearances and creepage distances in IEC 60664-1 do not apply. Between two conductive parts, it is a requirement that both conductive parts, together with all the **spacings** between them, are covered by the **protection** so that no air gap exists between the protective material, the conductive parts and the **printed board**.

Clearance and creepage distance requirements according to IEC 60664-1 apply to all unprotected parts of the equipment.

4.4 Dimensioning procedures

For type 1 **protection**, the dimensioning requirements of 5.1 and 5.2 of IEC 60664-1:2007 apply.

For type 2 **protection**, the **spacing** between the **conductors** before the **protection** is applied shall not be less than the values as specified in Table 1. These values apply to basic insulation, supplementary insulation as well as reinforced insulation. These values may also be applied to functional insulation.

NOTE In case of multi-layer boards, the **spacing** between the **conductors** at the surface of inner layers is dimensioned as specified for type 1 **protection** or type 2 **protection** depending on the result of the tests on the **protection**.

Table 1 – Minimum spacings for type 2 protection

Maximum peak value of any voltage [a] kV	**Minimum spacings** mm
≤ 0,33	0,01
> 0,33 and ≤ 0,4	0,02
> 0,4 and ≤ 0,5	0,04
> 0,5 and ≤ 0,6	0,06
> 0,6 and ≤ 0,8	0,1
> 0,8 and ≤ 1,0	0,15
> 1,0 and ≤ 1,2	0,2
> 1,2 and ≤ 1,5	0,3
> 1,5 and ≤ 2,0	0,45
> 2,0 and ≤ 2,5	0,6
> 2,5 and ≤ 3,0	0,8
> 3,0 and ≤ 4,0	1,2
> 4,0 and ≤ 5,0	1,5
> 5,0 and ≤ 6,0	2
> 6,0 and ≤ 8,0	3
> 8,0 and ≤ 10	3,5

Maximum peak value of any voltage [a)] kV	Minimum spacings mm
> 10 and ≤ 12	4,5
> 12 and ≤ 15	5,5
> 15 and ≤ 20	8
> 20 and ≤ 25	10
> 25 and ≤ 30	12,5
> 30 and ≤ 40	17
> 40 and ≤ 50	22
> 50 and ≤ 60	27
> 60 and ≤ 80	35
> 80 and ≤ 100	45
a) Transient overvoltages are disregarded since they are unlikely to degrade the protected assembly.	

Compliance is checked by measurement of the **spacing** before applying the **protection**.

5 Tests

5.1 General

The suitability of **protection** is evaluated by carrying out all the tests described in 5.8 after the conditioning described in 5.7.

The suitability of **protection** is evaluated after the visual examination test described in 5.5, the scratch-resistance test described in 5.6 and the subsequent conditioning described in 5.7. Six specimens are used unless otherwise specified by technical committees. In addition, technical committees may specify the additional tests of 5.9, each of which is carried out on a separate new specimen.

These tests are designed for type testing. Technical committees should consider if any of the tests shall be specified for routine or sampling tests.

The sequence of tests is shown in Annex A.

No failure of any specimen under test is permitted.

Annex B lists the decisions required to be taken by technical committees when referring to this standard.

5.2 Specimens for testing coatings

Test specimens may be:

– test specimens according to Annex C, which specifically applies for printed wiring boards; the specimen used for testing shall have the same minimum distances as those from production;
– specimens from production; or
– any **printed board**, as long as the test specimens are representative of those from production.

5.3 Specimens for testing mouldings and potting

Production specimens shall be used, or they shall be representative of those from production.

5.4 Preparation of test specimens

Printed boards shall be cleaned and coated using the normal procedure of the manufacturer. The soldering procedure is carried out but without the components being in place. Moulded and potted specimens shall be tested without further preparation.

5.5 Visual examination

The specimens shall be visually examined according to test 3V02 in 6.2 of IEC 61189-3:2007.

The specimens shall show no

– blistering,
– swelling,
– separation from the **base material**,
– cracks,
– voids,
– areas with adjacent unprotected conductive parts, with the exception of lands,
– electromigration (following electromigration conditioning),

following the test sequence criteria given in the tables within Annex A.

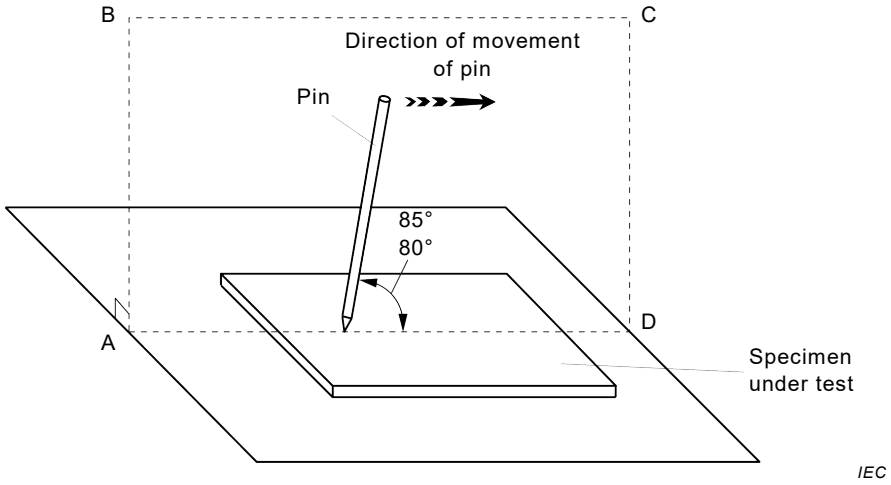
5.6 Scratch-resistance test

The scratch-resistance test is only carried out for type 2 **protection**. Prior to the sequence of tests for type 2 **protection**, the test samples shall be subjected to the scratch-resistance test.

NOTE In some cases, the scratch-resistance test cannot be applied to assemblies protected against pollution by the use of potting or moulding. In such cases, considerations for any alternative or additional tests can be necessary.

Scratches shall be made across five pairs of conducting parts and the intervening separations at points where the insulation will be subject to the maximum electric field strength between **conductors**.

Protective layers shall be scratched by means of a hardened steel pin, the end of which has the form of a cone with an angle of 40°. Its tip shall be rounded and polished, with a radius of 0,25 mm ± 0,02 mm. The pin shall be loaded so that the force exerted along its axis is 10 N ± 0,5 N. The scratches shall be made by drawing the pin along the surface in a plane perpendicular to the **conductor** edges of the protective layer at a speed of approximately 20 mm/s as shown in Figure 1. Five scratches shall be made at least 5 mm apart and at least 5 mm from the edges.



NOTE The pin is in the plane ABCD which is perpendicular to the specimen under test.

Figure 1 – Scratch-resistance test for protecting layers

5.7 Conditioning of the test specimens

5.7.1 General

The conditioning methods are suitable for the majority of applications. For particular applications, a modification of the parameters specified for the conditioning may be appropriate and should be considered by technical committees.

NOTE The climatic sequence from 5.7.2 to 5.7.5 is intended to simulate ageing.

5.7.2 Cold conditioning

The cold conditioning (simulation of storage and transportation) is carried out according to test Ab of IEC 60068-2-1. The severities shall be specified by the technical committees and selected from the following temperatures:

– −10 °C
– −25 °C
– −40 °C
– −65 °C

The duration of the test is 96 h.

5.7.3 Dry-heat conditioning

The dry-heat conditioning is carried out according to test Bb of IEC 60068-2-2. However, the conditioning time and conditioning temperature corresponds to the composition of the **printed board** and the working surface temperature shown in Table 2. Interpolation of Table 2's maximum working surface temperatures and corresponding conditioning temperature values is allowed.

Table 2 – Dry-heat conditioning

Resin/base material	Maximum working surface temperature °C	Conditioning temperature °C	Conditioning time h
Epoxide/cellulose paper	105	165	1 000
	75	125	1 000
Epoxide/woven glass surfaces/cellulose paper core	140	175	1 000
	100	125	1 000
	75	95	1 000
Epoxide/woven glass surfaces/ non-woven glass core	140	175	1 000
	100	125	1 000
	75	95	1 000
Epoxide/woven glass	140	175	1 000
	100	125	1 000
	75	95	1 000
Polyester/glass mat	160	200	1 000
	100	130	1 000
	75	100	1 000
Phenolic/cellulose paper (with defined flammability – vertical burning test) [a)]	110	155	1 000
	75	110	1 000
Phenolic/cellulose paper	125	170	1 000
	100	140	1 000
	75	110	1 000

[a)] For defined flammability, refer to 8.6 of IEC 61189-2:2006 and the relevant part of IEC 61249-2.

5.7.4 Rapid change of temperature

The rapid change of temperature conditioning is in accordance with test Na of IEC 60068-2-14. The temperatures are in accordance with Table 3, where the degree of severity shall be specified by the relevant technical committee.

Table 3 – Degrees of severities for rapid change of temperature

Degree of severity	Minimum temperature °C	Maximum temperature °C
1	−10	125
2	−25	125
3	−40	125
4	−65	125

The conditioning is carried out as follows:

– duration of one cycle: 1 h (30 min ± 2 min at each temperature)
– rate of change of temperature: within 30 s
– number of cycles: 50

When a protected assembly is likely to be subjected to many variations of temperature during its service life, the technical committee may specify an increased number of cycles.

5.7.5 Damp heat, steady-state with polarizing voltage

5.7.5.1 General conditioning

The test specimens shall be placed in the humidity chamber for 96 h under conditions defined in test Cab of IEC 60068-2-78 as follows:

– temperature: 40 °C ± 2 °C

– relative humidity: $93\,\%^{+2\,\%}_{-3\,\%}$

A DC voltage of 100 V is applied between **conductors** and adjacent lands. When a test specimen as defined in Annex C is used, the positive pole of the supply shall be connected to the “common”.

The test result is assessed according to 5.6, 5.8.3, 5.8.4 and 5.8.5.

5.7.5.2 Additional conditioning with respect to electromigration

When equipment can be expected to be subject to abnormally severe conditions of pollution or humidity for significant periods during its service life, technical committees may specify a longer DC voltage test under damp heat conditions.

In order to minimize the overall testing time, this test should be carried out on six new test specimens which have been subjected to the soldering process (see 5.4), scratch-resistance test (only for type 2 **protection**) (see 5.6) and visual examination (see 5.5) only. The test is carried out according to 5.7.5.1. Preferred durations are 10 days, 21 days or 56 days.

5.8 Mechanical and electrical tests after conditioning and electromigration

5.8.1 General test conditions

The tests are carried out in a room having a temperature of between 15 °C to 35 °C and a relative humidity of between 45 % and 75 %.

For the tests of 5.8.3, 5.8.4 and 5.8.5, the specimens are placed in a chamber having a temperature of 40 °C ± 2 °C and a relative humidity of $93\%^{+2\%}_{-3\%}$ in accordance with IEC 60068-2-78 for 48 h. The test in 5.8.3 shall be conducted while the specimens are in the humidity chamber. The tests in 5.8.4 and 5.8.5 shall be conducted within one hour after removing the specimens from the humidity chamber.

5.8.2 Adhesion of coating

The tested area shall contain portions of metalization and **base material**.

The specimen shall be cleaned with a suitable organic solvent and allowed to dry.

Non-transferable transparent pressure-sensitive tape, in accordance with IEC 60454-3-1, is used. The tape shall have a minimum width of 13 mm. A suitable tape is IEC 60454-3-1-5/F-PVCP/90x. A new piece of tape shall be used for each test.

A 50-mm length of the tape is applied to the test specimen. Air bubbles are excluded by using means such as finger pressure, a hand roller or an eraser.

Within 10 s, the tape is removed by a snap pull applied approximately perpendicular to the surface of the test specimen.

NOTE A minimum achievable pull force can be specified by technical committees.

After the test, the **coating** shall not have loosened and there shall be no material transferred to the tape that is visible to the naked eye. In order to assess whether there has been any transfer of material, the tape may be placed on a sheet of white paper or card. If a white or light-coloured **coating** is being tested, a suitably contrasting coloured paper or card is used instead.

5.8.3 Insulation resistance between conductors

The test shall be carried out according to 10.3 of IEC 61189-3:2007, the voltage specified for test method 3E03 being as close to the working voltage as possible.

The minimum value for the insulation resistance between the **conductors** shall be 100 MΩ, unless otherwise specified by technical committees.

5.8.4 Voltage test

With a type 1 **protection** the impulse voltage test shall be carried out according to 6.1.2.2.1 of IEC 60664-1:2007.

NOTE 1 Because there is no relation between pollution degree and the Uimp withstand, a conductive layer, applied on the surface of the **protection** to perform the test, is not necessary.

With a type 2 **protection**, the electrical tests on the protected specimen shall be carried out according to 6.1.3.4 of IEC 60664-1:2007 with the exception that the test voltage is either as specified in 5.3.3.2.3 of IEC 60664-1:2007 or 0,707 times the relevant rated impulse voltage according to Table F.1 of IEC 60664-1:2007, whichever is the higher value. If the assembly is subjected to pollution degree 3 or 4, the withstand voltage test shall be carried out with a conductive layer on the surface of the **protection** to simulate the pollution degree.

NOTE 2 The conductive layer is not connected to the test generator or to one of the lands.

Reinforced insulation shall be tested with twice the test voltage required for basic insulation.

5.8.5 Partial discharge extinction voltage

The partial discharge test is only carried out for type 2 **protection**. The partial discharge extinction voltage and the test method are specified in 6.1.3.5 of IEC 60664-1:2007. The partial discharge test voltage is 700 V peak or the peak value of the working voltage multiplied by the relevant factors described in 6.1.3.5 of IEC 60664-1:2007, whichever is higher. If the assembly is subjected to pollution degree 3 or 4, the measurement of the partial discharge extinction voltage shall be carried out with a conductive layer on the surface of the **protection**.

The partial discharge extinction voltage is reached when the magnitude of the discharge does not exceed 5 pC.

5.9 Additional tests

5.9.1 General

Technical committees may require one or more of the tests in 5.9.2, 5.9.3 and 5.9.4 to be carried out.

5.9.2 Resistance to soldering heat

The test shall be carried out according to test 3N02 of 11.2 of IEC 61189-3:2007.

The floating time shall be 20 s. After the test, the test specimen shall be assessed according to 5.6.

5.9.3 Flammability

The test shall be carried out according to test 3C02 of 8.2 of IEC 61189-3:2007. The temperature shall be specified by the relevant technical committee.

The test shall be carried out on protected and unprotected assemblies. The results of the test shall not be adversely affected by the **protection**.

5.9.4 Solvent resistance

This test shall be carried out according to test 17a of 8.5 of IEC 60326-2:1990.

The test shall be carried out using such organic solvent as agreed between user and manufacturer and as appropriate to the application.

During the handling of the organic solvent, appropriate personal protective equipment should be used.

After the test, the solvent shall be removed and the test specimen shall be assessed according to 5.6.

Annex A
(normative)

Test sequences

The following Table A.1, Table A.2 and Table A.3 show the order in which the tests of Clause 5 have to be carried out. No failure of any specimen under test is permitted.

Table A.1 – Test sequence 1

Reference	**Test/conditioning requirements (six specimens)**		
5.4	Soldering with the normal soldering procedure of the manufacturer, e.g. with the steps cleaning, protecting, soldering		
5.6	Scratch resistance test (type 2 **protection** only)		
5.5	Visual examination		
5.7	**Conditioning of the test specimens**		
	Temperature/Humidity	**Time**	**Condition**
5.7.2	−10 °C −25 °C −40 °C −65 °C	96 h	Cold
5.7.3	Temperature from Table 2	1 000 h	Dry heat
5.7.4	−10 °C/+125 °C −25 °C/+125 °C −40 °C/+125 °C −65 °C/+125 °C	50 cycles	Rapid change of temperature 0,5 h/30 s/0,5 h
5.7.5.1	40 °C/93 % r.h. DC 100 V	96 h	Damp heat, steady state with polarizing voltage
5.8	**Mechanical and electrical tests after conditioning and electromigration**		
5.8.2	Adhesion of **coating** (tape test)		
5.5	**Visual examination**		
5.8.1	40 °C/93 % r.h	48 h	Humidity conditioning
5.8.3	Insulation resistance ≥ 100 MΩ		
5.8.4	Voltage test		
5.8.5	Partial discharge extinction voltage (type 2 **protection** only)		

Table A.2 – Test sequence 2 additional conditioning with respect to electromigration

Reference	Test/conditioning requirements (six specimens)		
5.4	Soldering with the normal soldering procedure of the manufacturer, e.g. with the steps cleaning, protecting, soldering		
5.6	Scratch resistance test (type 2 **protection** only)		
5.5	Visual examination		
5.7	**Conditioning of the test specimens**		
	Temperature/Humidity	**Time**	**Condition**
5.7.5.2	40 °C/93 % r.h. DC 100 V	10 or 21 or 56 days	Damp heat, steady state with polarizing voltage
5.8	**Mechanical and electrical tests after conditioning and electromigration**		
5.8.2	Adhesion of **coating** (tape test)		
5.5	**Visual examination**		
5.8.1	40 °C/93 % r.h	48 h	Humidity conditioning
5.8.3	Insulation resistance ≥ 100 MΩ		
5.8.4	Voltage test		
5.8.5	Partial discharge extinction voltage (type 2 **protection** only)		

Table A.3 – Additional tests

Reference	Test/conditioning requirements (one specimen for each test)	Reference
5.9.2	Resistance to soldering heat	11.2 of IEC 61189-3:2007 t = 20 s
5.9.3	Flammability	Test 3C02 of 8.2 of IEC 61189-3:2007
5.9.4	Solvent resistance	Solvent as agreed between user and manufacturer

Annex B
(normative)

Decisions to be taken by the technical committees

B.1 General

When referring to the standard, technical committees are required to decide on the severity levels for some of the tests and are allowed to vary some of the test conditions.

B.2 Decisions required by technical committees

The following severities have to be specified:

5.7.2	Cold	Severity temperature
5.7.4	Rapid change of temperature	Degree of severity
5.9.3	Flammability	Test temperature (if the test is specified)

B.3 Optional test conditions

The following test conditions may be varied:

5	Tests	Number of specimens specifying routine tests
5.7	Conditioning of the test specimens	Modification of the parameters
5.7.4	Rapid change of temperature	Number of cycles
5.7.4.2	Additional conditioning with respect to electromigration	Duration of damp heat test
5.8.2	Adhesion of **coating**	Specifying the pull force
5.8.3	Insulation resistance between **conductors**	Minimum value for insulation resistance
5.9	Additional tests	Specifying which additional tests are necessary
5.9.4	Solvent resistance	Specifying the solvent

Annex C
(normative)

Printed wiring board for testing coatings

C.1 General

The printed wiring board described in this annex is suitable for assessing **coatings** that have to be tested in accordance with this standard.

C.2 Specification of the printed wiring board

In order to take into account the most unfavourable conditions, the following criteria have to be considered in order to provide a standard test specimen:

– the **base material**;
– the **coating** material;
– the **conductor** material;
– the mutual adhesion of the materials;
– the thickness of the **coating** material;
– the thickness, width and shape of the **conductor**;
– the **coating** pattern (e.g. size and shape of the access holes) in relation to the conductive pattern (e.g. lands); and
– the electrical field configuration.

The standard test specimen shall incorporate the same materials and shall use the same processing procedures as the **printed boards** for production. For instance, the standard test specimen has to be subjected to all processes (e.g. cleaning and soldering) to which the **printed boards** are exposed to in the specific application.

The size of the standard test specimen shown in Figure C.1 allows for **conductor spacing**s up to 0,5 mm and **conductor** widths up to 2 mm. For larger **conductor spacings** or larger **conductor** widths, it may be necessary to use a larger board than that shown in Figure C.1.

The standard test specimen shall have the configurations as shown in Figure C.1 and Figure C.2.

C.3 Arrangement of the conductors

Ten pairs of parallel **conductors**, each **conductor** having a length of 100 mm, are terminated alternatively at the edge board contacts on either side of the **printed board**, as shown in section C of Figure C.1.

– The **spacing** between the first five pairs of **conductors** is equal to the minimum **spacing** that will be used in production. These **conductors** are shown as section A in Figure C.1.
– The **spacing** between the other five pairs of **conductors** is equal to the **spacing** used in production where the highest electrical stress occurs. These **conductors** are shown as section B in Figure C.1.

The **conductors** terminating on the left-hand side of the **printed board** (side X) have equal width. This width is equivalent to the minimum width used in production.

The **conductors** terminating on the right-hand side of the **printed board** (side Y) under section A in Figure C.1 have a width progressively increasing in five steps from the smallest

to the largest used in production. This configuration is repeated for the **conductors** terminating under section B in Figure C.1.

Conductor width is an important parameter regarding the adhesion of the **coating**. Therefore, the intermediate widths shall, as far as possible, represent the widths used in production.

The ends of the **conductors** opposite to the edge board contacts shall be formed as follows:

– enlarged to 1 mm in diameter, for **conductors** less than 1 mm in width;
– semi-circular, for **conductors** having a width of 1 mm or greater.

The **spacing** between adjacent pairs of **conductors** is at least five times the **spacing** between the **conductor** pair.

The part of the **printed board** covered by section C in Figure C.1 is coated, with the exception of the edge board contacts.

C.4 Arrangement of lands

Eighty-four (84) lands shall be arranged in six groups, each group comprising two rows of seven lands, as shown in section L of Figure C.1. The lands shall be surrounded on three sides by **conductors**, as shown in Figure C.2.

The **spacing** between the lands and **conductors** for three of the groups is equal to the minimum **spacing** used in production, shown as section M in Figure C.1.

The **spacing** between the lands and **conductors** for the other three groups is equal to the **spacing** used in production where the highest electrical stress occurs, shown as section N in Figure C.1.

The dimensions of the lands, together with the dimensions and arrangement of **conductors**, shall be representative of those used in production. Examples of different lands and arrangements of **conductors** are shown in Figure C.2.

All lands in each group are connected together and terminate at an edge board contact on the right-hand side of the **printed board** (side Y). All **conductors** in each group are connected together and terminate at an edge board contact on the left-hand side of the board (side X).

The part of the **printed board** covered by section L in Figure C.1 is coated, with the exception of the edge board contacts. In addition, the lands are not coated if this is the case in production.

C.5 Connections for the tests

The measurements required in 5.8.3, 5.8.4 and 5.8.5 are made between an edge board contact X and the corresponding edge board contact Y.

For the tests of 5.7.5.1 and 5.7.5.2, the edge board contacts of side Y are connected together by means of a short-circuit connector. The test voltage is applied between the common edge board contact on side X and all the other edge board contacts are connected together.

Dimensions in millimetres

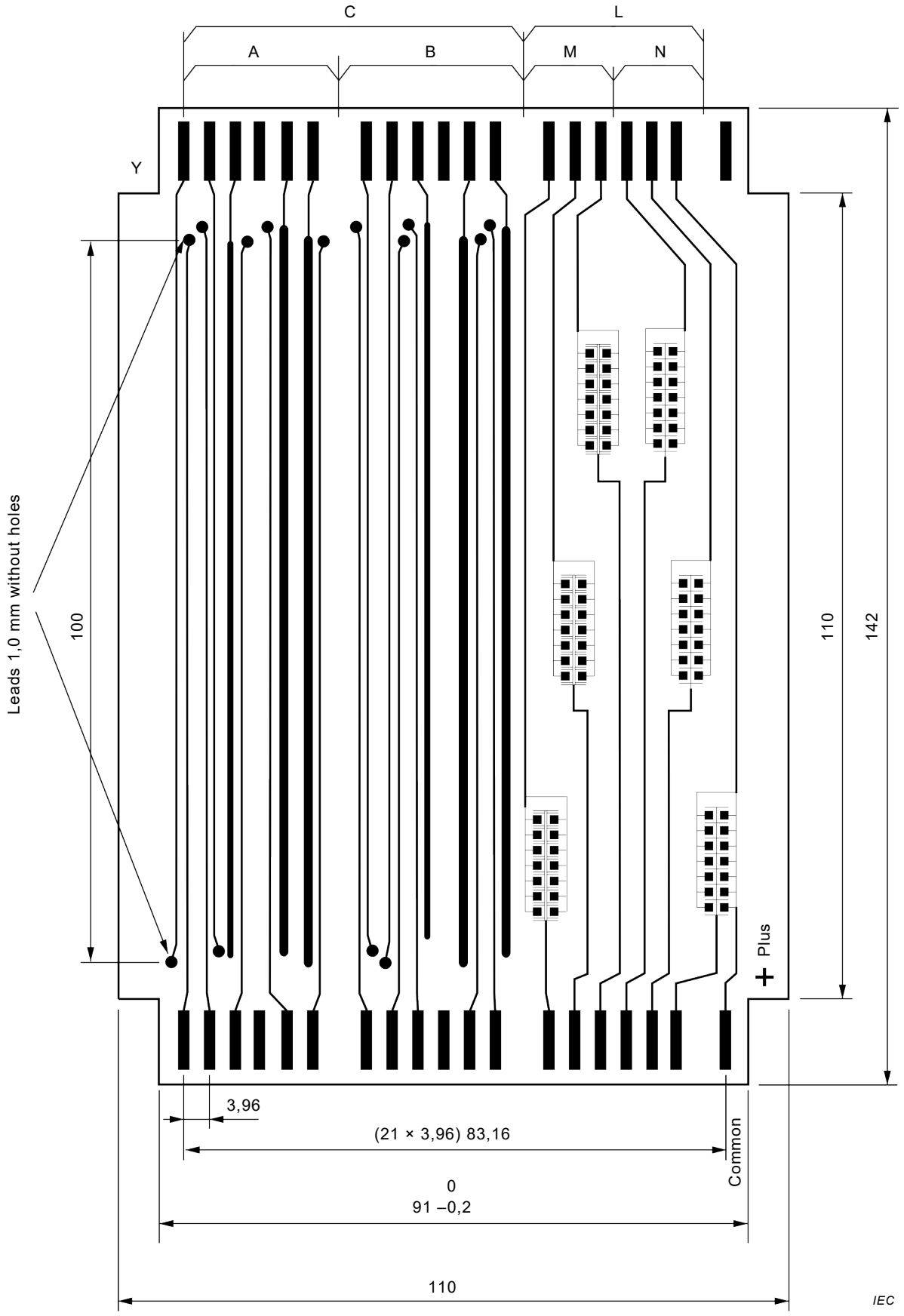


Figure C.1 – Configuration of the test specimen

Dimensions in millimetres

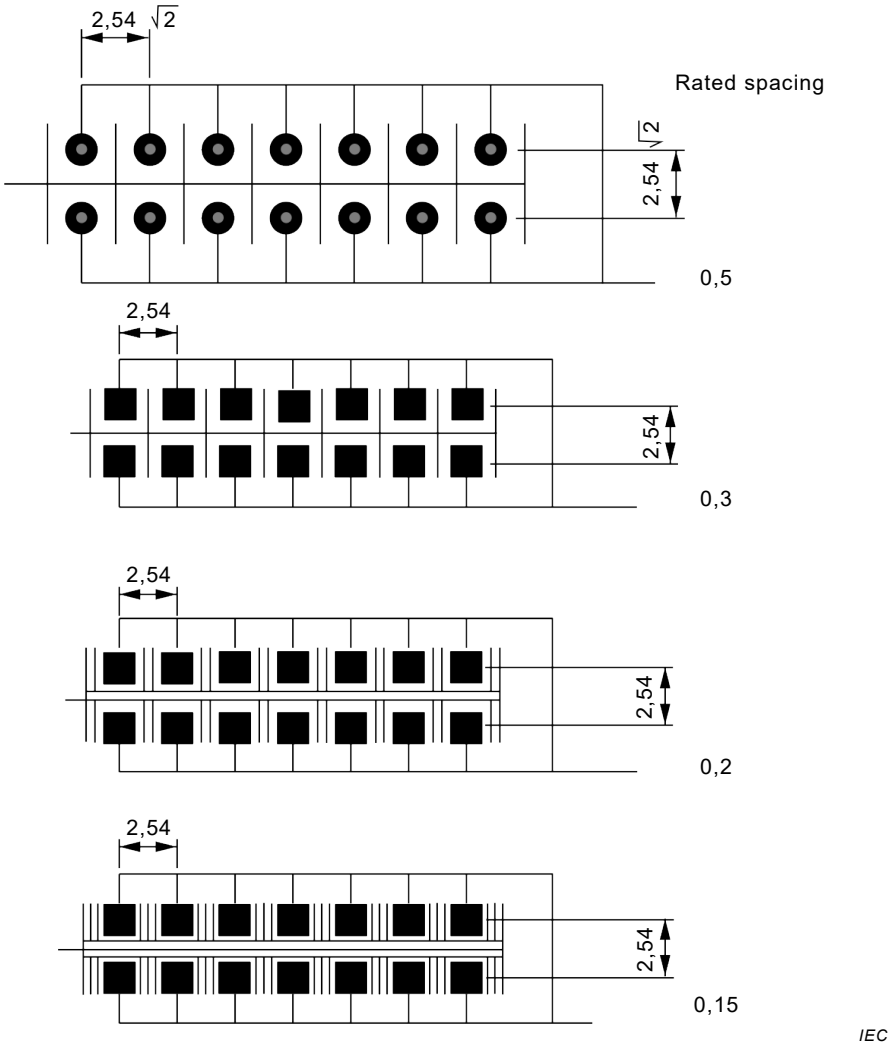


Figure C.2 – Configuration of lands and adjacent conductors

Bibliography

IEC 60194:2006, *Printed board design, manufacture and assembly – Terms and definitions*

(Continued from second cover)

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 61189-2 : 2006 Test methods for electrical materials, printed boards and otherinter connection structures and assemblies — Part 2: Test methods for materials for interconnection structures	IS/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	Identical
IEC 61189-3 : 2007 Test methods for electrical materials, printed boards and other interconnection structures and assemblies — Part 3: Test methods for interconnection structures (printed boards)	IS/IEC 61189-3 : 2007 Test methods for electrical materials, printed boards and other interconnection structures and assemblies: Part 3 Test methods for interconnection structures (printed boards)	Identical
ISO/IEC Guide 51 Safety aspects — Guidelines for their inclusion in standards	IS/ISO/IEC GUIDE-51 : 2014 Safety aspects — Guidelines for their inclusion in standards (*second revision*)	Identical

The Committee has reviewed the provisions of the following International Standards referred in this adopted standard and decided that they are acceptable for use in conjunction with this standard.

International Standard	*Title*
IEC 60068-2-78 : 2001	Environmental testing — Part 2-78: Tests — Test Cab: Damp heat, steady state
IEC 60326-2 : 1990	Printed boards — Part 2: Test methods
IEC 60454-3-1 : 1998/ AMD 1 : 2001	Pressure-sensitive adhesive tapes for electrical purposes — Part 3: Specifications for individual materials — Sheet 1: PVC film tapes with pressure sensitive adhesive
IEC 61249-2 (all parts),	Materials for printed boards and other interconnecting structures — Reinforced base materials, clad and unclad
IEC Guide 104 : 2010	The preparation of safety publications and the use of basic safety publications and group safety publications

Only the English language text has been retained while adopting it in this Indian Standard, and as such, the page number given here are not the same as in the IEC publication.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated expressing the result of a test, shall be rounded off in accordance with IS 2 : 2022 ‘Rules for rounding off numerical values (*second revision*)’. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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Amendments Issued Since Publication

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