

# INTERNATIONAL STANDARD



**High frequency inductive components – Non-electrical characteristics and measuring methods –  
Part 2: Test methods for non-electrical characteristics**

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Part 2: Test methods for non-electrical characteristics**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HIGH FREQUENCY INDUCTIVE COMPONENTS –  
NON-ELECTRICAL CHARACTERISTICS AND MEASURING METHODS –****Part 2: Test methods for non-electrical characteristics**

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International Standard IEC 62025-2 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This second edition cancels and replaces the first edition published in 2005. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) revision of Table 5;
- b) revision of normative references.

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

| CDV         | Report on voting |
|-------------|------------------|
| 51/1273/CDV | 51/1301/RVC      |

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

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

A list of all parts in the IEC 62025 series, published under the general title *High frequency inductive components – Non-electrical characteristics and measuring methods*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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# HIGH FREQUENCY INDUCTIVE COMPONENTS – NON-ELECTRICAL CHARACTERISTICS AND MEASURING METHODS –

## Part 2: Test methods for non-electrical characteristics

### 1 Scope

This part of IEC 62025 specifies a test method for the non-electrical characteristics of the surface mounted device (SMD) inductors to be used for electronic and telecommunication equipment. The object of this part of this document is to define methods for measuring mechanical performance only. As the reliability performances and specifications relative to non-electrical performances are defined in IEC 62211, detailed measuring methods for mechanical performance of reliability testing are defined in this document.

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

IEC 60068-2-6:~~1995~~2007, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-20:~~1979~~, *Environmental testing – Part 2-20: Tests – Test T: ~~Soldering~~ Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21:~~1999~~2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27:~~1987~~, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-45:1980, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*  
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-58:~~2004~~2015, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*  
IEC 60068-2-58:2015/AMD1:2017

IEC 60068-2-69, *Environmental testing – Part 2-69: Tests – Test Te/Tc: Solderability testing of electronic components ~~for surface mount technology~~ and printed boards by the wetting balance (force measurement) method*

IEC 60068-2-77:~~1999~~, *Environmental testing – Part 2-77: Tests – Test 77: Body strength and impact shock*

IEC 61188-5-2:~~2003~~, *Printed boards and printed board assemblies – Design and use – Part 5-2: Attachment (land/joint) considerations – Discrete components*



IEC 61190-1-2:~~2002~~2014, *Attachment materials for electronic assembly – Part 1-2: Requirements for soldering pastes for high-quality interconnections in electronics assembly*

IEC 61190-1-3:~~2002~~, *Attachment materials for electronic assembly – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non-fluxed solid solder for electronic soldering applications*

IEC 62211:~~2003~~2017, *Inductive components – Reliability management*

### 3 Terms and definitions

~~For the purpose of this part of IEC 62025, the terms and definitions given in the normative references apply.~~

No terms and definitions are listed in this document.

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>

### 4 Test conditions

#### 4.1 Standard atmospheric conditions for test

Unless otherwise specified in the detail specification, the tests and measurements shall be carried out under the standard atmospheric conditions for test as given in ~~5.3.1~~ the requirements for standard reference atmosphere of IEC 60068-1:

- temperature: 15 °C to 35 °C;
- relative humidity: 25 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

In the event of dispute or where required, the measurements shall be repeated using the referee temperatures (as given in 4.2) and such other conditions as are ~~prescribed~~ specified in this document.

In addition, when it is difficult to make measurements in standard atmospheric conditions, unless a doubt arises about the validity of the result, the tests and measurements may be performed in non-standard atmospheric conditions.

#### 4.2 Referee conditions

For referee purposes, one of the standard atmospheric conditions for referee tests taken from ~~5.2~~ the requirements for standard atmospheres for referee measurements and tests of IEC 60068-1, shall be selected and shall be as follows:

- temperature: 20 °C ± 2 °C;
- relative humidity: 60 % to 70 %;
- air pressure: 86 kPa to 106 kPa.

## 5 Mechanical characteristics test

### 5.1 Body strength test

#### 5.1.1 Body strength test procedures

The body strength test procedure, as ~~referenced~~ specified in IEC 60068-2-77, shall be as follows:

a) Preconditioning

If required, preconditioning shall be performed on the specimens in accordance with the detail specification.

b) Initial measurement

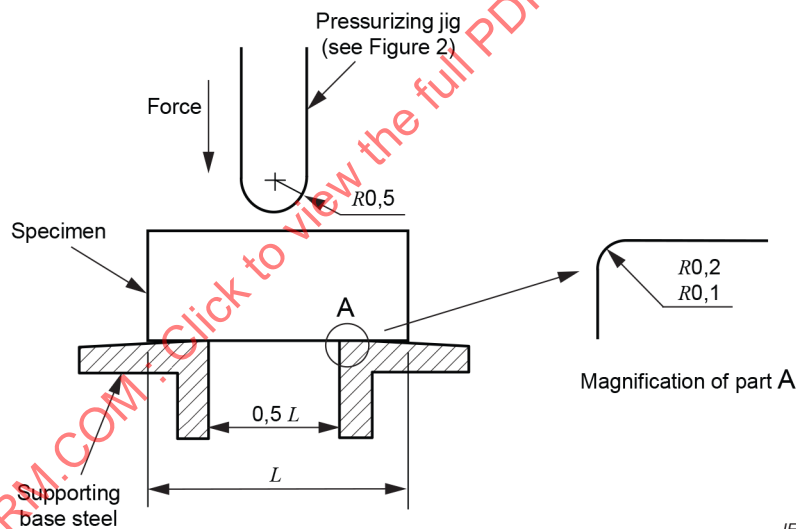
The appearance of the specimen shall be checked with a magnification of at least 10× under adequate light.

If specified in the detail specification, the electrical performances shall be measured.

c) Layout

Unless otherwise specified in the detail specification, the specimen shall be placed on the supporting base, as shown in Figure 1, so that both ends of the specimen are symmetrically positioned on the supporting base. The test table shall be placed on a plane, robust platform so that the test result ~~shall~~ is not ~~be~~ affected when a force is applied.

Dimensions en millimètres



IEC

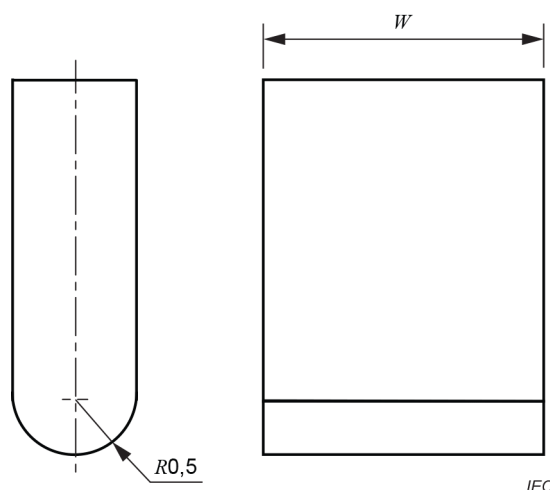
NOTE The angle of the taper in part A shall be between 70° and 90°.

**Figure 1 – Method for pressurizing the body**

d) Applied force

The force shall be applied to the centre of the specimen by the pressurizing jig as shown in Figure 2, for a duration of  $(10 \pm 1)$  s. Unless otherwise specified in the detail specification, the force shall be selected from either (one of) 10 N, 20 N or 30 N. If specified in the detail specification, the electrical performances shall be measured during the application of the force.

Dimensions in millimetres



NOTE 1 Dimension  $W$  of the pressurizing jig is wider than the width of the specimen.

NOTE 2 Hardness: HV 500 and more.

NOTE 3 When the length of the specimen is 2 mm or less, the radius of the pressurizing jig should be 0,2 mm.

**Figure 2 – Pressurizing jig**

e) Recovery

If required, recovery conditioning shall be performed for the specimens in accordance with the detail specification.

f) Final measurement

After the test, the appearance of the specimen shall be checked with a magnification of at least 10× under adequate light. There shall be no signs of damage such as cracks or flaws. If specified in the detail specification, the electrical performances shall be measured.

### 5.1.2 Information to be given in the detail specification

The following information shall be given in the detail specification:

- a) preconditioning (if required) – see 5.1.1.a);
- b) initial measurement items, final measurement items (if required) – see 5.1.1.b) and f);
- c) measurement during applied force (if required) – see 5.1.1.d);
- d) recovery (if required) – see 5.1.1.e).

## 5.2 Robustness of terminations (electrodes)

### 5.2.1 Resistance to bending of printed-circuit board

#### 5.2.1.1 General

The test for the resistance of terminations and electrodes mounted on a printed-circuit board shall be as follows.

#### 5.2.1.2 Specification of soldering lands

The soldering lands of multi-layer chip inductors shall be designed according to Table 1, as specified in ~~11.5 of~~ IEC 61188-5-2. With regard to inductors, except for those specified in IEC 61188-5-2, the size of the solder lands shall be specified in the detail specification.

**Table 1 – Size of soldering lands ~~by~~ according to the code of multi-layer chip inductors**

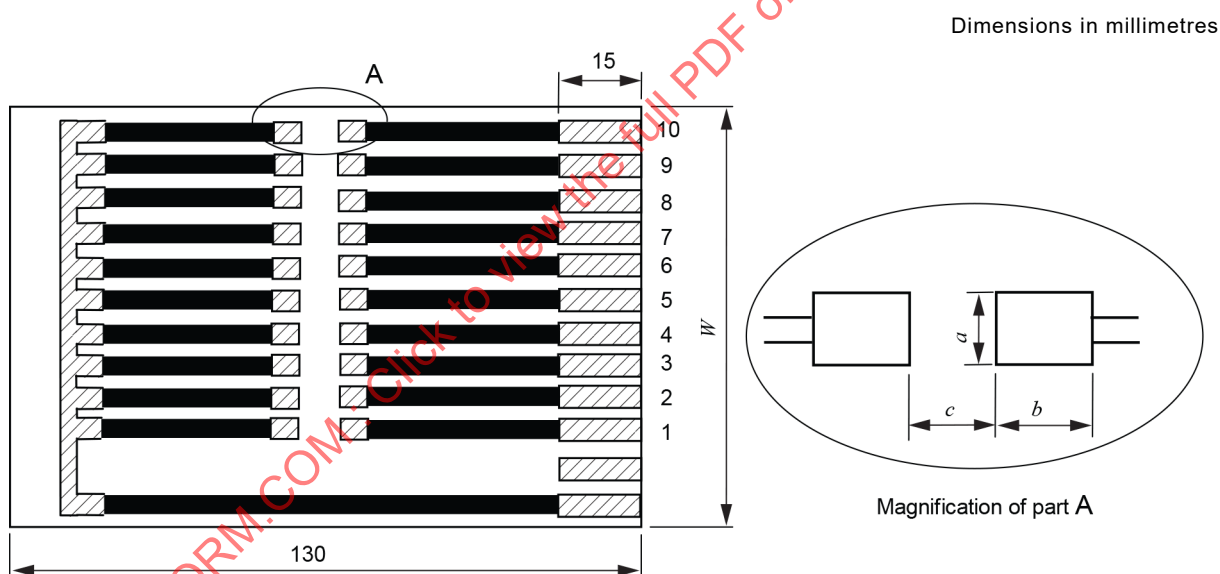
*Dimensions in millimetres*

| Size code | <i>a</i> | <i>b</i> | <i>c</i> |
|-----------|----------|----------|----------|
| 1005      | 0,65     | 0,55     | 0,50     |
| 1608      | 0,95     | 0,85     | 0,50     |
| 2012      | 1,45     | 1,10     | 0,50     |
| 3216      | 1,80     | 1,30     | 1,20     |
| 3225      | 2,70     | 1,05     | 1,80     |
| 4532      | 3,40     | 1,10     | 3,00     |
| 5650      | 5,30     | 1,30     | 3,70     |

NOTE Tolerance: 0,05 mm; see Figure 3.

### 5.2.1.3 Specification of printed-circuit board

The printed-circuit board shall be made of epoxide woven glass (FR4) as specified in IEC 60068-2-21, and, unless specified in the detail specification, the printed-circuit board shall be as shown in Figure 3. The dimension of *W* shall be specified in the detail specification.



#### Key

- solderable areas
- non-solderable areas (covered with non-solderable lacquer)

Materials of substrate: epoxide woven glass (FR4)

Thickness: 1,6 mm ± 0,2 mm (for size code from 1608)

Thickness: 0,8 mm ± 0,1 mm (for size code up to 1005)

Conductors: copper

Thickness: 0,035 mm ± 0,010 mm

**NOTE** When the board is designed to mount more than two specimens, allow sufficient space between specimens so as not to influence the test result. Dimensions not given shall be chosen according to the design and size of the specimen to be tested.

**Figure 3 – Example of printed-circuit board**

#### 5.2.1.4 Mounting of specimen

The specimen shall be mounted on the printed-circuit board in accordance with Annex A and other specifications as mentioned below.

- a) The solder paste shall be placed on the soldering lands. The applied solder paste shall cover the soldering lands completely. The thickness of the solder paste ~~by~~ according to the size code of inductors is recommended in Table 2. The appropriate height of the fillet should be the smaller value of either 50 % of the thickness of the specimen or 0,5 mm.

**Table 2 – Thickness of solder paste by the size code of inductors**

| Size code  | Thickness of solder paste<br>μm |
|------------|---------------------------------|
| Up to 1608 | 100 to 150                      |
| From 2012  | 150 to 200                      |

- b) The specimen shall then be placed on the printed-circuit board. The terminations of the specimen shall be placed on the soldering lands symmetrically in both horizontal and vertical directions.
- c) The printed-circuit board with the specimen shall be reflow soldered. Care shall be taken when mounting the inductor on the printed-circuit board so that warp or twist does not occur.
- d) If specified in the detail specification, the printed-circuit board shall be cleaned according to Annex A.

#### 5.2.1.5 Preconditioning

Preconditioning shall be carried out as specified in the detail specification when preconditioning is necessary.

#### 5.2.1.6 Initial measurement

Prior to conducting the mechanical test, the appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If an abnormal or rejectable appearance is found, the specimen shall be excluded from the evaluation on this test. The electrical performances shall be measured if specified in the detail specification.

#### 5.2.1.7 Bending tool

The bending tool shall be a support jig as shown in Figure 4 and a pressurizing jig as shown in Figure 5. The radius of the pressurizing jig should be 5 mm. If specified in the detail specification, the radius of the pressurizing jig may be 340 mm or 230 mm.

#### 5.2.1.8 Layout

The printed-circuit board with the soldered specimen is placed on the support jig as shown in Figure 4.

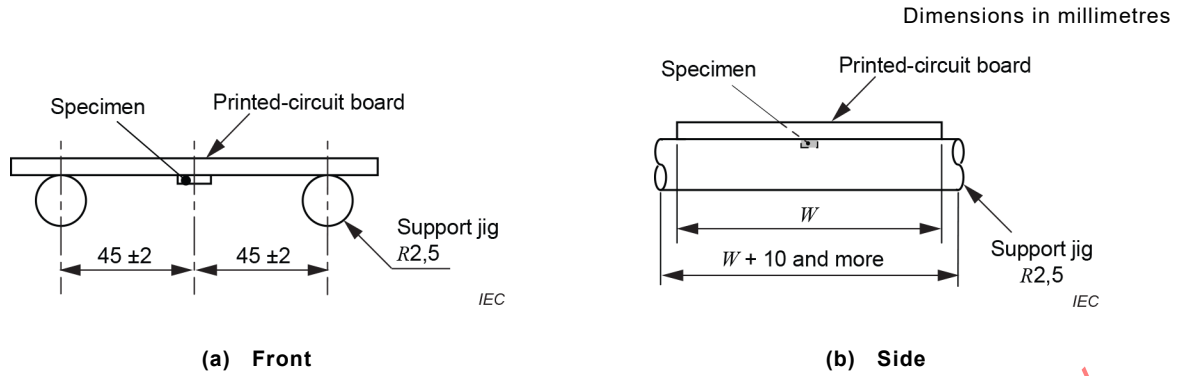
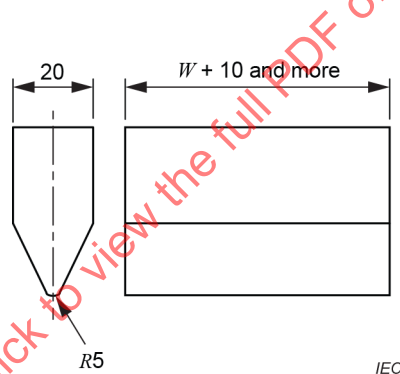


Figure 4 – Layout

#### 5.2.1.9 Test

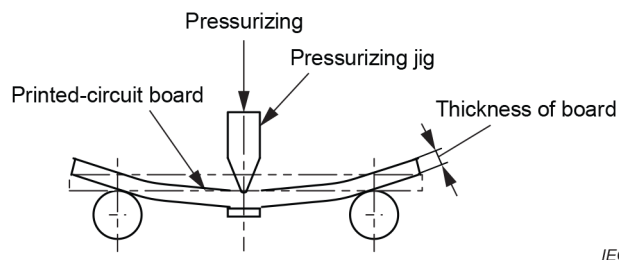
The printed-circuit board shall be bent by using the pressurizing jig as shown in Figure 5 at a rate of  $(1 \pm 0,5)$  mm/s and to the bending depth of 1 mm, 2 mm, 3 mm or 4 mm (see Figure 6). The bending depth shall be specified in the detail specification. After reaching the specified bending depth, it shall be maintained for  $(20 \pm 1)$  s. Then the bending force shall be relaxed. Unless specified in the detail specification, the number of bends shall be one.



#### Key

R radius

Figure 5 – Pressurizing jig



NOTE The relative position between the centre of the specimen on the soldering land of the printed-circuit board and the contact-line of the pressurizing jig on the printed-circuit board ~~should~~ does not exceed 0,5 mm.

Figure 6 – Pressurizing

#### 5.2.1.10 Measurement during pressurizing

If specified in the detail specification, the measurement shall be carried out during pressurizing in accordance with the provisions of the detail specification.

#### 5.2.1.11 Recovery

If specified in the detail specification, the recovery shall be carried out in accordance with the provisions of the detail specification.

#### 5.2.1.12 Final measurement

The appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. In this case, abnormalities such as peel and crack found at the solder joint shall not be treated as defects of the inductor. If specified in the detail specification, the electrical performances shall then be measured.

#### 5.2.1.13 Items to be specified in detail specification

The following items shall be specified in the detail specification.

- a) Dimensions of land, if different from Table 1 (see 5.2.1.2).
- b) Dimension of  $W$  of the testing printed-circuit board (see 5.2.1.3).
- c) Applied solder (see 5.2.1.4).
- d) Cleaning (if necessary) (see 5.2.1.4).
- e) Preconditioning (if necessary) (see 5.2.1.5).
- f) Initial measurement items (see 5.2.1.6).
- g) Bending depth and number of bends (see 5.2.1.9).
- h) Measurement during pressurizing (if necessary) (see 5.2.1.10).
- i) Recovery (if necessary) (see 5.2.1.11).
- j) Final measurement items (see 5.2.1.12).

### 5.2.2 Adherence test (see test of $U_{e3}$ of IEC 60068-2-21)

#### 5.2.2.1 General

The test for the strength of adhesion against the side stress of the specimen mounted ~~to~~ on the testing printed-circuit board shall be carried out as follows.

#### 5.2.2.2 Mounting of specimen

The specimen shall be mounted ~~to~~ on the testing printed-circuit board specified in the detail specification in accordance with the provisions of Annex A. Unless otherwise specified in the detail specification, the printed-circuit board shall be as specified in 8.2 of IEC 60068-2-21:2006.

#### 5.2.2.3 Preconditioning

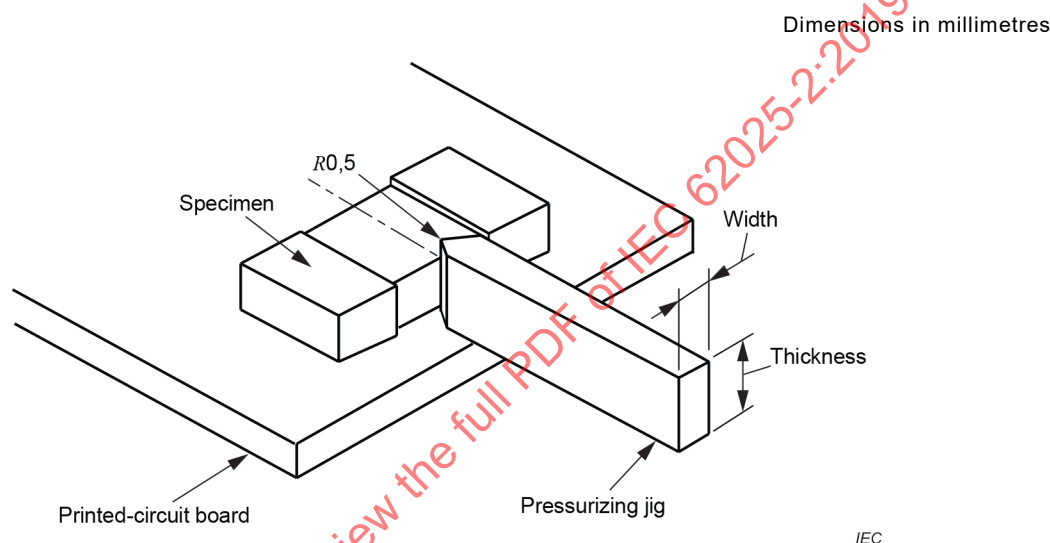
Preconditioning shall be carried out as specified in the detail specification on the specimen when preconditioning is necessary.

#### 5.2.2.4 Initial measurement

Prior to conducting the mechanical test, the appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If an abnormal or rejectable appearance is found, the specimen shall be excluded from the evaluation ~~on~~ of this test. The electrical performances shall be measured if specified in the detail specification.

#### 5.2.2.5 Pressurizing

The specimen shall be mounted as shown in Figure 7. The force shall be gradually applied by means of the pressurizing jig to the centre of the longitudinal side of the specimen in a direction horizontal to the testing printed-circuit board. Unless otherwise specified in the detail specification, the pressurizing force shall be 5 N and the duration shall be  $(10 \pm 1)$  s.



NOTE 1 Thickness of jig: thicker than the test surface of the specimen.

NOTE 2  $R$  at the end: when the length of specimen is 2,0 mm or less, the radius of the pressurizing jig ~~should be~~ is 0,2 mm.

NOTE 3 Width of jig: not specified.

**Figure 7 – Pressurizing and shape of jig**

#### 5.2.2.6 Recovery

Recovery shall be carried out as specified in the detail specification on the specimens when recovery is necessary.

#### 5.2.2.7 Final measurement

The appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. In this case, abnormalities such as peel and crack found at the solder joint shall not be treated as defects of the inductor. If specified in the detail specification, the electrical performances shall then be measured.

#### 5.2.2.8 Items to be specified in the detail specification

The following items shall be specified in the detail specification.

- Testing printed-circuit board (see 5.2.2.2).
- Applied solder (see 5.2.2.2).



- c) Preconditioning (if necessary) (see 5.2.2.3).
- d) Initial measurement items (see 5.2.2.4).
- e) Pressurizing force (if necessary) (see 5.2.2.5).
- f) Recovery (if necessary) (see 5.2.2.6).
- g) Final measurement items (see 5.2.2.7).

### 5.3 Solderability

#### 5.3.1 General

The test for solderability shall be in accordance with the provisions of IEC 60068-2-58 and other specifications as mentioned below.

This part of IEC 62025 specifies a solder bath method and a reflow method for solderability. If the wetting balance method is applied, this shall be specified in the detail specification in accordance with the provisions of IEC 60068-2-69.

#### 5.3.2 Preconditioning

Unless otherwise specified in the detail specification, the specimen shall be tested in the “as-received” condition. Care should be taken that no contamination occurs, by contact with the fingers or by other means.

When accelerated ageing is applied, one of the methods given in ~~4.5~~ the requirements for accelerated ageing of IEC 60068-2-20 shall be specified in the detail specification.

#### 5.3.3 Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If specified in the detail specification, the electrical performances shall be measured.

#### 5.3.4 Test method

##### 5.3.4.1 Solder bath method

###### a) Solder bath

The solder bath dimensions shall comply with the requirements ~~of 4.6.1~~ for solder bath of IEC 60068-2-20.

###### b) Flux

The flux shall be the flux specified in ~~6.1.2 of~~ IEC 60068-2-58.

###### c) Solder

The solder composition shall be in accordance with item a)1) or b)1) of Clause A.3.

###### d) Test procedure

The test procedure shall be in accordance with ~~6.2~~ the requirements for the test procedure and conditions of IEC 60068-2-58. Unless otherwise specified in the detail specification, the specimen shall be preheated to a temperature of 80 °C to 120 °C and maintained for 10 s to 30 s. The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

###### e) Conditions of immersion into solder

Unless otherwise specified in the detail specification, the conditions of immersion into the solder shall be in accordance with Table 3.

### Table 3 – Conditions of immersion into solder

| Alloy composition           | Condition     |             |
|-----------------------------|---------------|-------------|
|                             | Temperature   | Duration    |
| Lead-free solder (Sn-Ag-Cu) | 245 °C ± 5 °C | 3 s ± 0,3 s |
| Lead-containing solder      | 235 °C ± 5 °C | 2 s ± 0,2 s |
|                             |               | 5 s ± 0,5 s |

#### 5.3.4.2 Solder reflow method

The reflow equipment should be forced gas convection.

a) Solder paste

The solder paste shall be in accordance with items a) or b) of Clause A.3.

### b) Test substrates

The test substrate shall consist of ceramic (alumina 90 % to 98 %) or epoxide woven glass (FR4). The dimensional details and number of specimen(s) to be tested shall be given in the detail specification.

### c) Preparation

The solder paste shall be coated on the lands and the specimen shall be placed in accordance with Clause A.4.

d) Preheating

Unless otherwise specified in the detail specification, the specimen and test substrate shall be preheated in accordance with Clause A.5.

e) Reflow temperature profile

Unless otherwise specified in the detail specification, the reflow temperature profile shall be in accordance with Table 4 and Figure 8.

### Table 4 – Reflow temperature

| Alloy composition              | $T_1$<br>°C  | $T_2$<br>°C  | $t_1$<br>s | $T_3$<br>°C | $t_2$<br>s | $T_4$<br>°C | $t_3$<br>s             |
|--------------------------------|--------------|--------------|------------|-------------|------------|-------------|------------------------|
| Lead-free solder<br>(Sn-Ag-Cu) | $150 \pm 5$  | $180 \pm 5$  | 60 to 120  | 225         | $20 \pm 5$ | 235         | —                      |
| Lead-containing<br>solder      | $150 \pm 10$ | $150 \pm 10$ | 60 to 120  | —           | —          | $215 \pm 3$ | $10 \pm 1$<br>at $T_4$ |

NOTE. See profile in Figure 8.

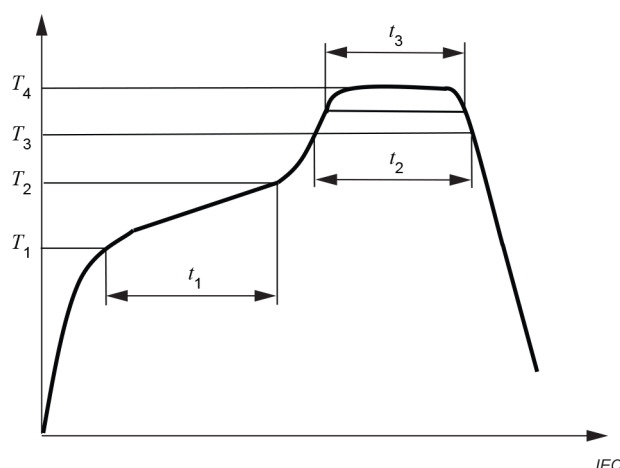


Figure 8 – Reflow temperature profile

### 5.3.5 Recovery

The flux residues shall be removed with a suitable solvent (see 3.4.2 the requirements for solvents of IEC 60068-2-45).

### 5.3.6 Final measurement

~~The wetting shall be assessed visually under adequate light with a binocular microscope of magnification in the range between 10× and 25×, in accordance with 9.3.1 of IEC 60068-2-58. Then, if specified in the detail specification, the electrical performances shall be measured.~~

The final measurement shall be in accordance with the requirements of wetting of the final measurements in IEC 60068-2-58. Then, if specified in the detail specification, the electrical performances shall be measured.

### 5.3.7 Items to be specified in detail specification

#### 5.3.7.1 General

The following items shall be specified in the detail specification.

#### 5.3.7.2 Solder bath method

- Applied solder.
- Accelerated ageing (if necessary) (see 5.3.2).
- Initial measurement items (see 5.3.3).
- Preheating (if necessary) (see 5.3.4.1d)).
- Conditions of immersion into solder (if necessary) (see 5.3.4.1e)).
- Final measurement items (see 5.3.6).

#### 5.3.7.3 Solder reflow method

- Applied solder.
- Accelerated ageing (if necessary) (see 5.3.2).
- Initial measurement items (see 5.3.3).
- Dimensional details of the test substrate and number of specimen(s) (see 5.3.4.2b)).
- Preheating (if necessary) (see 5.3.4.2d)).
- Final measurement items (see 5.3.6).

## 5.4 Resistance to soldering heat

### 5.4.1 General

The test for resistance to soldering heat shall be in accordance with the provisions of IEC 60068-2-58 and other specifications as mentioned below.

### 5.4.2 Preconditioning

Unless otherwise specified in the detail specification, the specimen shall be tested in the “as-received” condition. Care should be taken that no contamination occurs, by contact with the fingers or by other means.

### 5.4.3 Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If specified in the detail specification, the electrical performances shall be measured.

### 5.4.4 Test method

#### 5.4.4.1 Solder bath method

##### a) Solder bath

The solder bath shall be as specified in item a) of 5.3.4.1.

##### b) Flux

The flux shall be as specified in item b) of 5.3.4.1.

##### c) Solder

The solder composition shall be in accordance with items a)1) or b)1) of Clause A.3.

##### d) Test procedure

The test procedure shall be in accordance with ~~6.2~~ the requirements for the test procedure and conditions of IEC 60068-2-58. Unless specified in the detail specification, the specimen shall be preheated to a temperature of 80 °C to 120 °C and maintained for 10 s to 30 s. The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

##### e) Severity

Unless otherwise specified in the detail specification, the duration and temperature of immersion shall be as given in Table 5.

**Table 5 – Severity**

| Alloy composition                                                                | Severity                     |                         |
|----------------------------------------------------------------------------------|------------------------------|-------------------------|
|                                                                                  | Temperature                  | Duration                |
| Lead-free solder (Sn-Ag-Cu)                                                      | <del>255</del> 260 °C ± 5 °C | 10 s ± 1 s              |
| Lead-containing solder                                                           | 260 °C ± 5 °C                | 10 s ± 1 s <sup>a</sup> |
| <sup>a</sup> If specified in the detail specification, 5 s ± 1 s may be applied. |                              |                         |

#### 5.4.4.2 Solder reflow method

The reflow equipment shall be forced gas convection.

##### a) Solder paste

The solder paste shall be in accordance with item a) or b) of Clause A.3.

##### b) Test substrates

The test substrate shall be as specified in item b) of 5.3.4.2.

## c) Preparation

The solder paste shall be coated on the lands and the specimen shall be placed in accordance with Clause A.4.

## d) Preheating

Unless otherwise specified in the detail specification, the specimen and test substrate shall be preheated in accordance with Clause A.5.

## e) Reflow temperature profile

Unless otherwise specified in the detail specification, the reflow temperature profile shall be in accordance with Table 6.

The profile of test 1 is recommended for lead-free solder. The profile for lead-free solder in Table 6 shall be specified as the acceptable upper limit of severity.

Unless otherwise specified in the detail specification, the number of test cycles shall be a minimum of one and a maximum of three.

**Table 6 – Reflow temperature**

| Alloy composition              |        | $T_1$<br>°C | $T_2$<br>°C | $t_1$<br>s | $T_3$<br>°C | $t_2$<br>s | $T_4$<br>°C | $t_3$<br>s              |
|--------------------------------|--------|-------------|-------------|------------|-------------|------------|-------------|-------------------------|
| Lead-free solder<br>(Sn-Ag-Cu) | Test 1 | 150 ± 5     | 180 ± 5     | 120 ± 5    | 220         | 60 to 90   | 250         | 20 to 40 at $T_4 - 5$ K |
|                                | Test 2 | 150 ± 5     | 180 ± 5     | 120 ± 5    | 220         | ≤ 60       | 255         | ≤ 20 at $T_4 - 10$ K    |
| Lead-containing solder         |        | 150 ± 10    | 150 ± 10    | 60 to 120  | –           | –          | 235 ± 5     | 10 ± 1 at $T_4$         |
| NOTE See profile in Figure 8.  |        |             |             |            |             |            |             |                         |

#### 5.4.5 Recovery

The flux residues shall be removed with a suitable solvent (see 3.1.2 3.1.3 of IEC 60068-2-45:1980 and IEC 60068-2-45:1980/AMD1:1993).

#### 5.4.6 Final measurement

After recovery, the appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. Then, if specified in the detail specification, the electrical performances shall be measured.

#### 5.4.7 Items to be specified in detail specification

##### 5.4.7.1 General

The following items shall be specified in the detail specification.

##### 5.4.7.2 Solder bath method

- Applied solder.
- Initial measurement items (see 5.4.3).
- Preheating (if necessary) (see 5.4.4.1.d)).
- Severity (if necessary) (see 5.4.4.1 e)).
- Final measurement items (see 5.4.6).

##### 5.4.7.3 Solder reflow method

- Applied solder.
- Initial measurement items (see 5.4.3).
- Dimensional detail of the test substrate and number of specimen(s) (see 5.4.4.2 b)).

- d) Preheating (if necessary) (see 5.4.4.2 d)).
- e) Reflow temperature profile (see 5.4.4.2 e)).
- f) Number of test cycles (see 5.4.4.2 e)).
- g) Final measurement items (see 5.4.6).

## 5.5 Resistance to dissolution of metallization

### 5.5.1 General

The test for resistance to the dissolution of metallization shall be in accordance with the provisions of IEC 60068-2-58 and other specifications as mentioned below.

### 5.5.2 Preconditioning

Unless otherwise specified in the detail specification, the specimen shall be tested in the “as-received” condition. Care should be taken that no contamination occurs, by contact with the fingers or by other means.

### 5.5.3 Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If specified in the detail specification, the electrical performances shall be measured.

### 5.5.4 Test methods

Subclause 5.5.4 specifies the test method pertaining to lead-containing solder. If lead free-solder is applied, this shall be specified in the detail specification.

#### a) Solder bath

The solder bath shall be as specified in item a) of 5.3.4.1.

#### b) Flux

The flux shall be as specified in item b) of 5.3.4.1.

#### c) Solder

The solder composition shall be in accordance with item a)1) of Clause A.3.

#### d) Test procedure

The test procedure shall be in accordance with ~~6.2~~ the requirements for the test procedure and conditions of IEC 60068-2-58. Unless otherwise specified in the detail specification, the specimen shall be preheated to a temperature of 80 °C to 120 °C and maintained for 10 s to 30 s. The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

#### e) Severity

Unless otherwise specified in the detail specification, the temperature of the solder bath shall be  $(260 \pm 5) ^\circ\text{C}$  and the duration of immersion shall be  $(30 \pm 1) \text{ s}$ .

#### f) Recovery

The recovery shall be as specified in 5.3.5.

### 5.5.5 Final measurements

The resistance to dissolution of metallization shall be assessed visually under adequate light with a binocular microscope of magnification in the range between 10× and 25×, in accordance with ~~9.3.4~~ the requirements for resistance to the dissolution of metallization of IEC 60068-2-58. Then, if specified in the detail specification, the electrical performances shall be measured. ~~The following criteria shall be applied. If these criteria cannot be applied, the criteria shall be prescribed in the detail specification.~~

- ~~a) Areas where metallization is lost during immersion shall not individually exceed 5 % of the total electrode area, and shall not collectively exceed 10 % of the total electrode area.~~
- ~~b) The functional connection of the electrode to the interior of the specimen shall not be exposed.~~
- ~~c) Where the metallization of the electrode extends over edges onto adjacent surfaces, loss of metallization on the edges shall not exceed 10 % of their total length.~~

### 5.5.6 Items to be specified in detail specification

The following items shall be specified in the detail specification.

- a) Initial measurement items (see 5.5.3).
- b) Applied solder (if necessary) (see 5.5.4).
- c) Preheating (if necessary) (see 5.5.4 d)).
- d) Severity (if necessary) (see 5.5.4 e)).
- e) Final measurement items (see 5.5.5).

## 5.6 Vibration

### 5.6.1 Test equipment

The test device shall satisfy the requirements for vibration test equipment as ~~prescribed~~ specified in Clause 4 of IEC 60068-2-6:2007.

### 5.6.2 Preparation

The specimen shall be mounted firmly on the vibration table in accordance with the method specified in the detail specification, either by means of fixtures or directly.

### 5.6.3 Test method

The electrical performances of the specimen shall be measured in accordance with the provisions of the detail specification, and then the vibration specified in Clause 5 of IEC 60068-2-6:2007 shall be applied to the specimen mounted in accordance with 5.6.2. Unless otherwise specified in the detail specification, the condition of the test shall be selected from Table 7 (based on Table 3 of IEC 62211:2017). After the vibration, the electrical performances shall be measured in accordance with the detail specification and the variation shall be calculated in the measured values of each performance taken before and after the test. Furthermore, the specimen shall be visually examined. There shall be no visible damage.

**Table 7 – Conditions of vibration**

|                        | Level 1                                                                                                 | Level 2                                                                                            | Level 3                                                                      |
|------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <b>Test conditions</b> | 10 Hz to 2 000 Hz<br>$A = 1,5 \text{ mm}$ or $a = 200 \text{ m/s}^2$ max.<br>1 oct/min<br>10 cycle/axis | 10 Hz to 500 Hz<br>$A = 0,75 \text{ mm}$ or $a = 100 \text{ m/s}^2$<br>1 oct/min<br>10 cycles/axis | 10 Hz to 55 Hz<br>$A = 1,5 \text{ mm}$ , sweep 1 min<br>3 axes, 2 h/axis 6 h |

### 5.6.4 Items to be specified in detail specification

The following information shall be given in the detail specification.

- a) Mounting (mounting fixture and mounting method) (see 5.6.2).
- b) Type of vibration (if necessary) (see 5.6.3).
- c) Direction of vibration (if necessary) (see 5.6.3).

- d) Duration of vibration (if necessary) (see 5.6.3).
- e) Severity (see 5.6.3).
- f) Performance to be measured before and after the test (see 5.6.3).
- g) Measurement during vibration (if necessary).

## 5.7 Resistance to shock

### 5.7.1 Mechanical shock method

The shock test of the specimen shall be carried out by the mechanical shock method. The test method shall be as follows (see IEC 60068-2-27).

#### a) Test equipment

The equipment shall satisfy the characteristics required ~~of~~ for the shock test equipment specified in ~~4.1 of~~ IEC 60068-2-27.

#### b) Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. The electrical performances shall be measured in accordance with the provisions of the detail specification.

#### c) Preparation

The specimen shall be firmly mounted ~~to~~ on the shock table in accordance with the method specified in the detail specification either by means of a mounting fixture or directly.

#### d) Test

The shock specified in ~~Clause 5 of~~ IEC 60068-2-27 shall be applied to the specimen. The severity shall be either

- peak acceleration 1 000 m/s<sup>2</sup>, duration 6 ms, velocity change 3,7 m/s (sine wave), 3 axes, or
- peak acceleration 2 000 m/s<sup>2</sup>, duration 6 ms, velocity change 7,5 m/s (sine wave), 3 axes,

in accordance with Table 3 of IEC 62211:2017. The severity shall be specified in the detail specification.

#### e) Final measurement

After the test, the electrical performances shall be measured in accordance with the provisions of the detail specification. The appearance of the specimen shall be checked for any remarkable change in appearance and mechanical damage by using a magnifier with a magnification of at least 10× under adequate light.

### 5.7.2 Items to be specified in detail specification

The following items shall be specified in the detail specification.

- a) Initial measurement items (see 5.7.1b)).
- b) Mounting (mounting fixture or mounting method) (see 5.7.1c)).
- c) Severity (see 5.7.1d)).
- d) Final measurement items (see 5.7.1e)).



## Annex A (normative)

### Mounting of surface mounting inductor ~~to~~ on test printed-circuit board

#### A.1 General

Annex A specifies the method for mounting a surface mounting inductor to be tested (hereinafter referred to as “specimen”) ~~to~~ on the test printed-circuit board.

#### A.2 Mounting printed-circuit board and mounting land

A mounting printed-circuit board suitable to the construction of the specimen shall be used, and this shall be specified in the detail specification. If there is no provision in the detail specification, the copper-clad laminate of FR4 (thickness  $1,6 \text{ mm} \pm 0,20 \text{ mm}$ , copper foil  $0,035 \text{ mm} \pm 0,010 \text{ mm}$ ) shall be used and it shall be a printed-circuit board on which the land for mounting the specimen is previously located. As for the land, the detail specification shall specify the details.

#### A.3 Solder

The solder should be either of solder a) or solder b). Unless otherwise specified in the detail specification, the solder shall be that specified in a).

##### a) Lead-containing solder paste

###### 1) Alloy composition

The solder composition shall be either 60 weight % tin and 40 weight % lead ~~according to Annex B of IEC 60068-2-20~~ (Sn60Pb40A, according to IEC 61190-1-3) or 63 weight % tin and 37 weight % lead (Sn63Pb37A, according to IEC 61190-1-3).

###### 2) Solder powder

Unless otherwise specified in the detail specification, the particle size of the solder paste shall be  $20 \text{ }\mu\text{m}$  to  $45 \text{ }\mu\text{m}$ .

###### 3) Flux composition

The flux to be used shall consist of 25 weight % of colophony in 75 weight % of 2-propanol (isopropanol) or of ethyl alcohol (as specified in ~~Annex C of~~ IEC 60068-2-20).

###### 4) Solder paste composition

The viscosity range and method of measurement shall be specified in the detail specification.

##### b) Lead-free solder paste

###### 1) Alloy composition

The alloy composition to be used shall consist of 3,0 weight % Ag (silver), 0,5 weight % Cu (copper) and the remainder of Sn (tin), with a variation of Ag content between 3,0 weight % and 4,0 weight % of Cu content between 0,5 weight % and 1,0 weight %.

###### 2) Solder powder

The powder size shall be ~~symbol~~ type 3 specified in Table 2 of IEC 61190-1-2:2014.

###### 3) Flux composition

The flux to be used shall consist of 30 weight % of polymerization rosin (softening point, approximately  $95 \text{ }^{\circ}\text{C}$ ), 30 weight % of dibasic acid degeneration rosin (softening point, approximately  $140 \text{ }^{\circ}\text{C}$ ), 34,7 weight % of diethylene glycol monobutyl ether,

0,8 weight % of 1,3-diphenylguanidine HBr, 0,5 weight % of adipic acid (chlorine content less than 0,1 weight %) and 4 weight % of stiffening castor oil.

4) Solder paste composition

The solder paste to be used shall consist of 88 weight % of solder powder and 12 weight % of flux. The viscosity range shall be  $(180 \pm 50)$  Pa·s.

#### A.4 Preparation

The solder paste shall be coated on the lands of the test printed-circuit board to a thickness of 100 µm and 250 µm and the specimen shall be placed so that its terminations or electrodes are positioned on the pasted lands. If specified in the detail specification, the thickness of the solder paste shall be in accordance with the provisions of the detail specification.

#### A.5 Preheating

In the case of lead-containing solder paste a) (see Clause A.3), the printed-circuit board on which the specimen is placed shall be preheated at  $(150 \pm 10)$  °C for 60 s to 120 s. In the case of lead-free solder paste b) (see Clause A.3), the printed-circuit board on which the specimen is placed shall be preheated in accordance with the detail specification.

#### A.6 Soldering

After the preheating, the soldering shall be carried out immediately by using the reflow soldering device. In case of lead-containing solder paste a), the solder temperature shall be between 215 °C and 235 °C, and the time at the peak temperature shall not exceed 10 s, and the total time above 185 °C shall be 45 s minimum. In case of lead-free solder paste b), the soldering temperature should be 235 °C to 250 °C according to Table 1 of IEC 60068-2-58:2015.

#### A.7 Cleaning

If specified in the detail specification, the printed-circuit board shall be cleaned by using a suitable solvent (see 3.1.2. the requirements for solvents of IEC 60068-2-45).

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE

**High frequency inductive components – Non-electrical characteristics and measuring methods –**

**Part 2: Test methods for non-electrical characteristics**

**Composants inductifs à haute fréquence – Caractéristiques non électriques et méthodes de mesure –**

**Partie 2: Méthodes d'essai pour caractéristiques non électriques**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**HIGH FREQUENCY INDUCTIVE COMPONENTS –  
NON-ELECTRICAL CHARACTERISTICS AND MEASURING METHODS –****Part 2: Test methods for non-electrical characteristics**

## FOREWORD

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International Standard IEC 62025-2 has been prepared by IEC technical committee 51: Magnetic components, ferrite and magnetic powder materials.

This second edition cancels and replaces the first edition published in 2005. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) revision of Table 5;
- b) revision of normative references.

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

| CDV         | Report on voting |
|-------------|------------------|
| 51/1273/CDV | 51/1301/RVC      |

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

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

A list of all parts in the IEC 62025 series, published under the general title *High frequency inductive components – Non-electrical characteristics and measuring methods*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed;
- withdrawn;
- replaced by a revised edition, or
- amended.

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# HIGH FREQUENCY INDUCTIVE COMPONENTS – NON-ELECTRICAL CHARACTERISTICS AND MEASURING METHODS –

## Part 2: Test methods for non-electrical characteristics

### 1 Scope

This part of IEC 62025 specifies a test method for the non-electrical characteristics of the surface mounted device (SMD) inductors to be used for electronic and telecommunication equipment. The object of this part of this document is to define methods for measuring mechanical performance only. As the reliability performances and specifications relative to non-electrical performances are defined in IEC 62211, detailed measuring methods for mechanical performance of reliability testing are defined in this document.

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

IEC 60068-2-6:2007, *Environmental testing – Part 2: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-45:1980, *Basic environmental testing procedures – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*  
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-58:2015, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*  
IEC 60068-2-58:2015/AMD1:2017

IEC 60068-2-69, *Environmental testing – Part 2-69: Tests – Test Te/Tc: Solderability testing of electronic components and printed boards by the wetting balance (force measurement) method*

IEC 60068-2-77, *Environmental testing – Part 2-77: Tests – Test 77: Body strength and impact shock*

IEC 61188-5-2, *Printed boards and printed board assemblies – Design and use – Part 5-2: Attachment (land/joint) considerations – Discrete components*



IEC 61190-1-2:2014, *Attachment materials for electronic assembly – Part 1-2: Requirements for soldering pastes for high-quality interconnections in electronics assembly*

IEC 61190-1-3, *Attachment materials for electronic assembly – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non-fluxed solid solder for electronic soldering applications*

IEC 62211:2017, *Inductive components – Reliability management*

### 3 Terms and definitions

No terms and definitions are listed in this document.

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>

### 4 Test conditions

#### 4.1 Standard atmospheric conditions for test

Unless otherwise specified in the detail specification, the tests and measurements shall be carried out under the standard atmospheric conditions for test as given in the requirements for standard reference atmosphere of IEC 60068-1:

- temperature: 15 °C to 35 °C;
- relative humidity: 25 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

In the event of dispute or where required, the measurements shall be repeated using the referee temperatures (as given in 4.2) and such other conditions as are specified in this document.

In addition, when it is difficult to make measurements in standard atmospheric conditions, unless a doubt arises about the validity of the result, the tests and measurements may be performed in non-standard atmospheric conditions.

#### 4.2 Referee conditions

For referee purposes, one of the standard atmospheric conditions for referee tests taken from the requirements for standard atmospheres for referee measurements and tests of IEC 60068-1, shall be selected and shall be as follows:

- temperature: 20 °C ± 2 °C;
- relative humidity: 60 % to 70 %;
- air pressure: 86 kPa to 106 kPa.

### 5 Mechanical characteristics test

#### 5.1 Body strength test

##### 5.1.1 Body strength test procedures

The body strength test procedure, as specified in IEC 60068-2-77, shall be as follows:

a) Preconditioning

If required, preconditioning shall be performed on the specimens in accordance with the detail specification.

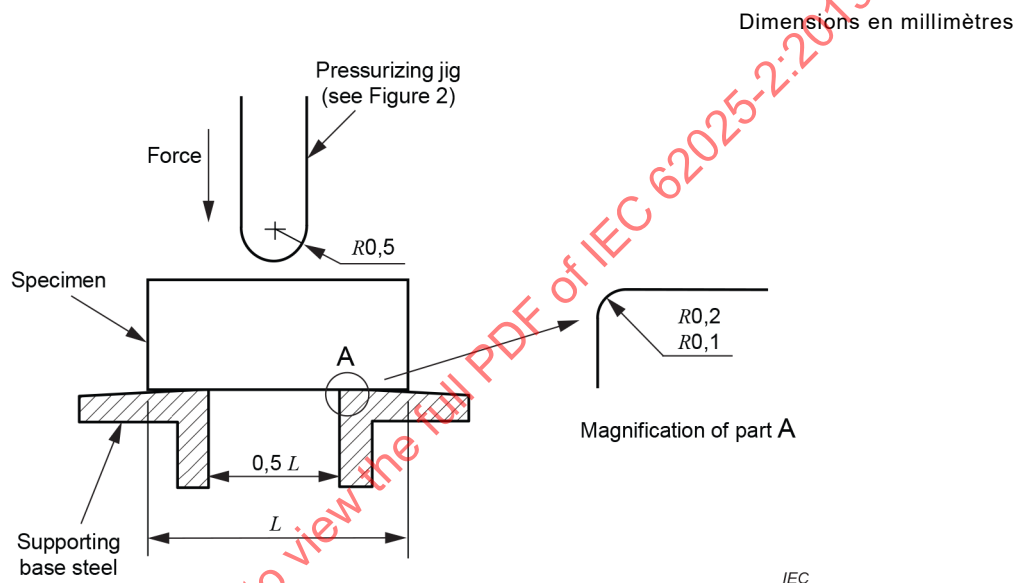
b) Initial measurement

The appearance of the specimen shall be checked with a magnification of at least 10× under adequate light.

If specified in the detail specification, the electrical performances shall be measured.

c) Layout

Unless otherwise specified in the detail specification, the specimen shall be placed on the supporting base, as shown in Figure 1, so that both ends of the specimen are symmetrically positioned on the supporting base. The test table shall be placed on a plane, robust platform so that the test result is not affected when a force is applied.



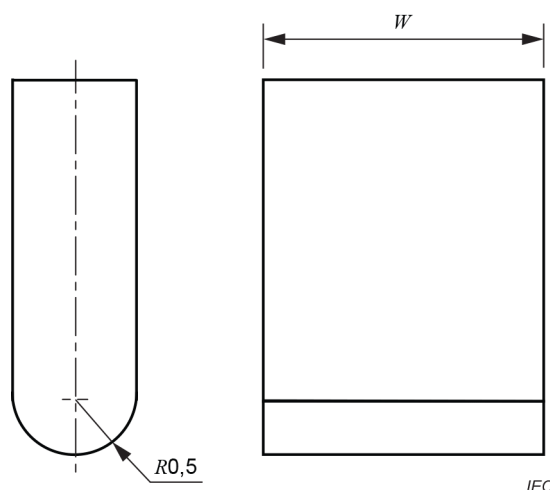
NOTE The angle of the taper in part A shall be between 70° and 90°.

**Figure 1 – Method for pressurizing the body**

d) Applied force

The force shall be applied to the centre of the specimen by the pressurizing jig as shown in Figure 2, for a duration of  $(10 \pm 1)$  s. Unless otherwise specified in the detail specification, the force shall be selected from either (one of) 10 N, 20 N or 30 N. If specified in the detail specification, the electrical performances shall be measured during the application of the force.

Dimensions in millimetres



NOTE 1 Dimension  $W$  of the pressurizing jig is wider than the width of the specimen.

NOTE 2 Hardness: HV 500 and more.

When the length of the specimen is 2 mm or less, the radius of the pressurizing jig should be 0,2 mm.

**Figure 2 – Pressurizing jig**

e) Recovery

If required, recovery conditioning shall be performed for the specimens in accordance with the detail specification.

f) Final measurement

After the test, the appearance of the specimen shall be checked with a magnification of at least 10× under adequate light. There shall be no signs of damage such as cracks or flaws. If specified in the detail specification, the electrical performances shall be measured.

### 5.1.2 Information to be given in the detail specification

The following information shall be given in the detail specification:

- a) preconditioning (if required) – see 5.1.1.a);
- b) initial measurement items, final measurement items (if required) – see 5.1.1.b) and f);
- c) measurement during applied force (if required) – see 5.1.1.d);
- d) recovery (if required) – see 5.1.1.e).

## 5.2 Robustness of terminations (electrodes)

### 5.2.1 Resistance to bending of printed-circuit board

#### 5.2.1.1 General

The test for the resistance of terminations and electrodes mounted on a printed-circuit board shall be as follows.

#### 5.2.1.2 Specification of soldering lands

The soldering lands of multi-layer chip inductors shall be designed according to Table 1, as specified in IEC 61188-5-2. With regard to inductors, except for those specified in IEC 61188-5-2, the size of the solder lands shall be specified in the detail specification.

**Table 1 – Size of soldering lands according to the code of multi-layer chip inductors**

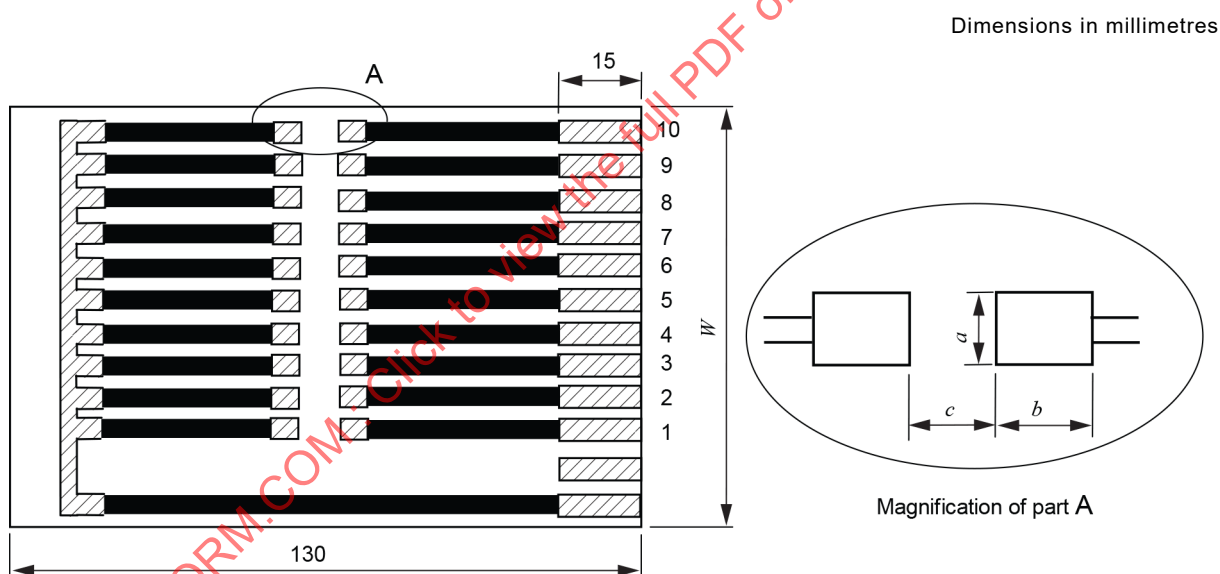
*Dimensions in millimetres*

| Size code | <i>a</i> | <i>b</i> | <i>c</i> |
|-----------|----------|----------|----------|
| 1005      | 0,65     | 0,55     | 0,50     |
| 1608      | 0,95     | 0,85     | 0,50     |
| 2012      | 1,45     | 1,10     | 0,50     |
| 3216      | 1,80     | 1,30     | 1,20     |
| 3225      | 2,70     | 1,05     | 1,80     |
| 4532      | 3,40     | 1,10     | 3,00     |
| 5650      | 5,30     | 1,30     | 3,70     |

NOTE Tolerance: 0,05 mm; see Figure 3.

### 5.2.1.3 Specification of printed-circuit board

The printed-circuit board shall be made of epoxide woven glass (FR4) as specified in IEC 60068-2-21, and, unless specified in the detail specification, the printed-circuit board shall be as shown in Figure 3. The dimension of *W* shall be specified in the detail specification.



#### Key

- solderable areas
- non-solderable areas (covered with non-solderable lacquer)

Materials of substrate: epoxide woven glass (FR4)

Thickness: 1,6 mm ± 0,2 mm (for size code from 1608)

Thickness: 0,8 mm ± 0,1 mm (for size code up to 1005)

Conductors: copper

Thickness: 0,035 mm ± 0,010 mm

When the board is designed to mount more than two specimens, allow sufficient space between specimens so as not to influence the test result. Dimensions not given shall be chosen according to the design and size of the specimen to be tested.

**Figure 3 – Example of printed-circuit board**

#### 5.2.1.4 Mounting of specimen

The specimen shall be mounted on the printed-circuit board in accordance with Annex A and other specifications as mentioned below.

- a) The solder paste shall be placed on the soldering lands. The applied solder paste shall cover the soldering lands completely. The thickness of the solder paste according to the size code of inductors is recommended in Table 2. The appropriate height of the fillet should be the smaller value of either 50 % of the thickness of the specimen or 0,5 mm.

**Table 2 – Thickness of solder paste by the size code of inductors**

| Size code  | Thickness of solder paste<br>$\mu\text{m}$ |
|------------|--------------------------------------------|
| Up to 1608 | 100 to 150                                 |
| From 2012  | 150 to 200                                 |

- b) The specimen shall then be placed on the printed-circuit board. The terminations of the specimen shall be placed on the soldering lands symmetrically in both horizontal and vertical directions.
- c) The printed-circuit board with the specimen shall be reflow soldered. Care shall be taken when mounting the inductor on the printed-circuit board so that warp or twist does not occur.
- d) If specified in the detail specification, the printed-circuit board shall be cleaned according to Annex A.

#### 5.2.1.5 Preconditioning

Preconditioning shall be carried out as specified in the detail specification when preconditioning is necessary.

#### 5.2.1.6 Initial measurement

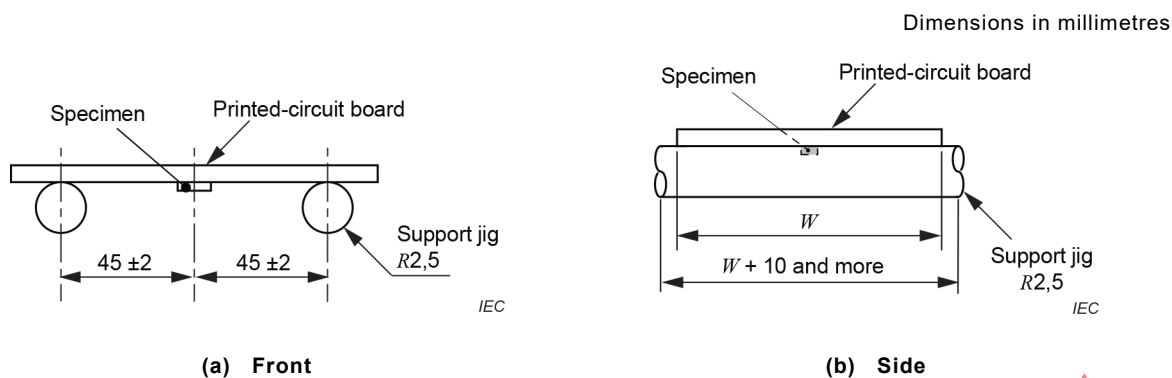
Prior to conducting the mechanical test, the appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10 $\times$  under adequate light. If an abnormal or rejectable appearance is found, the specimen shall be excluded from the evaluation on this test. The electrical performances shall be measured if specified in the detail specification.

#### 5.2.1.7 Bending tool

The bending tool shall be a support jig as shown in Figure 4 and a pressurizing jig as shown in Figure 5. The radius of the pressurizing jig should be 5 mm. If specified in the detail specification, the radius of the pressurizing jig may be 340 mm or 230 mm.

#### 5.2.1.8 Layout

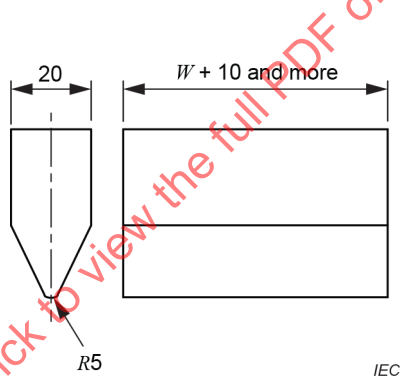
The printed-circuit board with the soldered specimen is placed on the support jig as shown in Figure 4.



**Figure 4 – Layout**

### 5.2.1.9 Test

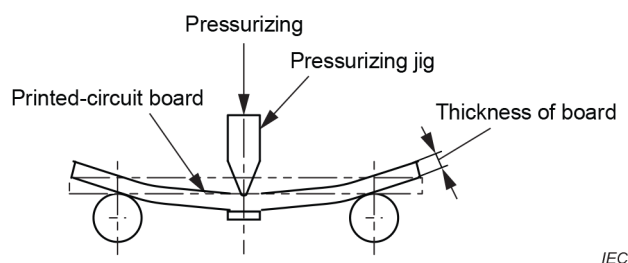
The printed-circuit board shall be bent by using the pressurizing jig as shown in Figure 5 at a rate of  $(1 \pm 0,5)$  mm/s and to the bending depth of 1 mm, 2 mm, 3 mm or 4 mm (see Figure 6). The bending depth shall be specified in the detail specification. After reaching the specified bending depth, it shall be maintained for  $(20 \pm 1)$  s. Then the bending force shall be relaxed. Unless specified in the detail specification, the number of bends shall be one.



#### Key

*R* radius

**Figure 5 – Pressurizing jig**



NOTE The relative position between the centre of the specimen on the soldering land of the printed-circuit board and the contact-line of the pressurizing jig on the printed-circuit board does not exceed 0,5 mm.

**Figure 6 – Pressurizing**

#### **5.2.1.10 Measurement during pressurizing**

If specified in the detail specification, the measurement shall be carried out during pressurizing in accordance with the provisions of the detail specification.

#### **5.2.1.11 Recovery**

If specified in the detail specification, the recovery shall be carried out in accordance with the provisions of the detail specification.

#### **5.2.1.12 Final measurement**

The appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. In this case, abnormalities such as peel and crack found at the solder joint shall not be treated as defects of the inductor. If specified in the detail specification, the electrical performances shall then be measured.

#### **5.2.1.13 Items to be specified in detail specification**

The following items shall be specified in the detail specification.

- a) Dimensions of land, if different from Table 1 (see 5.2.1.2).
- b) Dimension of  $W$  of the testing printed-circuit board (see 5.2.1.3).
- c) Applied solder (see 5.2.1.4).
- d) Cleaning (if necessary) (see 5.2.1.4).
- e) Preconditioning (if necessary) (see 5.2.1.5).
- f) Initial measurement items (see 5.2.1.6).
- g) Bending depth and number of bends (see 5.2.1.9).
- h) Measurement during pressurizing (if necessary) (see 5.2.1.10).
- i) Recovery (if necessary) (see 5.2.1.11).
- j) Final measurement items (see 5.2.1.12).

### **5.2.2 Adherence test (see test of $U_{e3}$ of IEC 60068-2-21)**

#### **5.2.2.1 General**

The test for the strength of adhesion against the side stress of the specimen mounted on the testing printed-circuit board shall be carried out as follows.

#### **5.2.2.2 Mounting of specimen**

The specimen shall be mounted on the testing printed-circuit board specified in the detail specification in accordance with the provisions of Annex A. Unless otherwise specified in the detail specification, the printed-circuit board shall be as specified in 8.2 of IEC 60068-2-21:2006.

#### **5.2.2.3 Preconditioning**

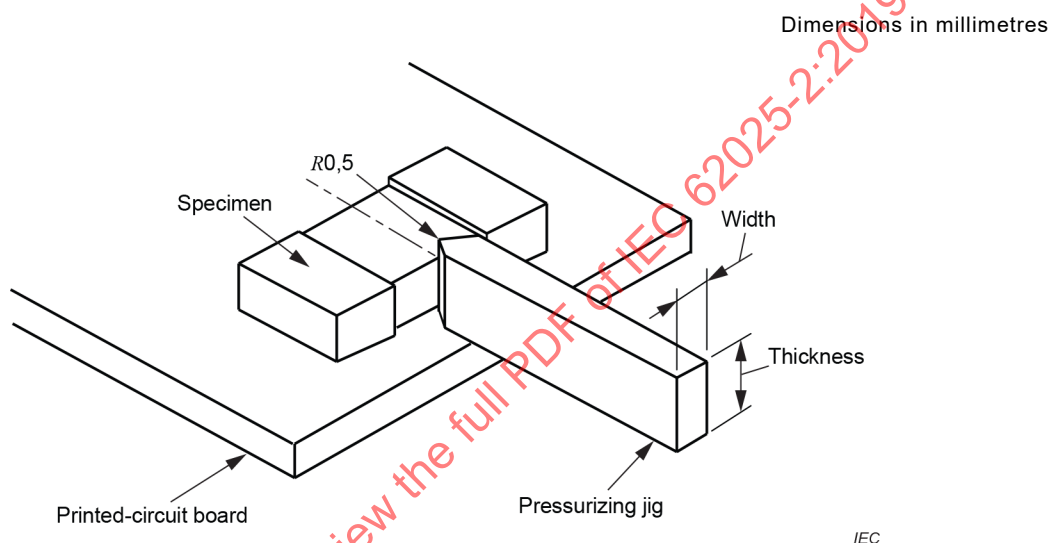
Preconditioning shall be carried out as specified in the detail specification on the specimen when preconditioning is necessary.

#### 5.2.2.4 Initial measurement

Prior to conducting the mechanical test, the appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If an abnormal or rejectable appearance is found, the specimen shall be excluded from the evaluation of this test. The electrical performances shall be measured if specified in the detail specification.

#### 5.2.2.5 Pressurizing

The specimen shall be mounted as shown in Figure 7. The force shall be gradually applied by means of the pressurizing jig to the centre of the longitudinal side of the specimen in a direction horizontal to the testing printed-circuit board. Unless otherwise specified in the detail specification, the pressurizing force shall be 5 N and the duration shall be  $(10 \pm 1)$  s.



NOTE 1 Thickness of jig: thicker than the test surface of the specimen.

NOTE 2  $R$  at the end: when the length of specimen is 2,0 mm or less, the radius of the pressurizing jig is 0,2 mm.

NOTE 3 Width of jig: not specified.

**Figure 7 – Pressurizing and shape of jig**

#### 5.2.2.6 Recovery

Recovery shall be carried out as specified in the detail specification on the specimens when recovery is necessary.

#### 5.2.2.7 Final measurement

The appearance of the specimen and the soldered parts shall be checked by using a magnifier with a magnification of at least 10× under adequate light. In this case, abnormalities such as peel and crack found at the solder joint shall not be treated as defects of the inductor. If specified in the detail specification, the electrical performances shall then be measured.

#### 5.2.2.8 Items to be specified in the detail specification

The following items shall be specified in the detail specification.

- Testing printed-circuit board (see 5.2.2.2).
- Applied solder (see 5.2.2.2).
- Preconditioning (if necessary) (see 5.2.2.3).



- d) Initial measurement items (see 5.2.2.4).
- e) Pressurizing force (if necessary) (see 5.2.2.5).
- f) Recovery (if necessary) (see 5.2.2.6).
- g) Final measurement items (see 5.2.2.7).

### 5.3 Solderability

#### 5.3.1 General

The test for solderability shall be in accordance with the provisions of IEC 60068-2-58 and other specifications as mentioned below.

This part of IEC 62025 specifies a solder bath method and a reflow method for solderability. If the wetting balance method is applied, this shall be specified in the detail specification in accordance with the provisions of IEC 60068-2-69.

#### 5.3.2 Preconditioning

Unless otherwise specified in the detail specification, the specimen shall be tested in the “as-received” condition. Care should be taken that no contamination occurs, by contact with the fingers or by other means.

When accelerated ageing is applied, one of the methods given in the requirements for accelerated ageing of IEC 60068-2-20 shall be specified in the detail specification.

#### 5.3.3 Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If specified in the detail specification, the electrical performances shall be measured.

#### 5.3.4 Test method

##### 5.3.4.1 Solder bath method

###### a) Solder bath

The solder bath dimensions shall comply with the requirements for solder bath of IEC 60068-2-20.

###### b) Flux

The flux shall be the flux specified in IEC 60068-2-58.

###### c) Solder

The solder composition shall be in accordance with item a)1) or b)1) of Clause A.3.

###### d) Test procedure

The test procedure shall be in accordance with the requirements for the test procedure and conditions of IEC 60068-2-58. Unless otherwise specified in the detail specification, the specimen shall be preheated to a temperature of 80 °C to 120 °C and maintained for 10 s to 30 s. The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

###### e) Conditions of immersion into solder

Unless otherwise specified in the detail specification, the conditions of immersion into the solder shall be in accordance with Table 3.

### Table 3 – Conditions of immersion into solder

| Alloy composition           | Condition     |             |
|-----------------------------|---------------|-------------|
|                             | Temperature   | Duration    |
| Lead-free solder (Sn-Ag-Cu) | 245 °C ± 5 °C | 3 s ± 0,3 s |
| Lead-containing solder      | 235 °C ± 5 °C | 2 s ± 0,2 s |
|                             |               | 5 s ± 0,5 s |

#### 5.3.4.2 Solder reflow method

The reflow equipment should be forced gas convection.

a) Solder paste

The solder paste shall be in accordance with items a) or b) of Clause A.3.

### b) Test substrates

The test substrate shall consist of ceramic (alumina 90 % to 98 %) or epoxide woven glass (FR4). The dimensional details and number of specimen(s) to be tested shall be given in the detail specification.

### c) Preparation

The solder paste shall be coated on the lands and the specimen shall be placed in accordance with Clause A.4.

d) Preheating

Unless otherwise specified in the detail specification, the specimen and test substrate shall be preheated in accordance with Clause A.5.

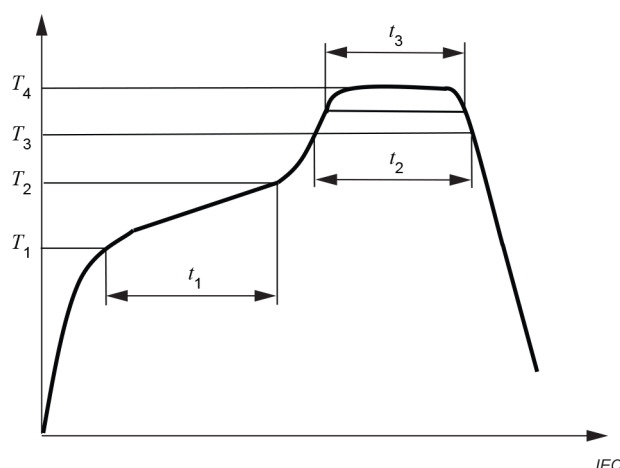
e) Reflow temperature profile

Unless otherwise specified in the detail specification, the reflow temperature profile shall be in accordance with Table 4 and Figure 8.

### Table 4 – Reflow temperature

| Alloy composition              | $T_1$<br>°C  | $T_2$<br>°C  | $t_1$<br>s | $T_3$<br>°C | $t_2$<br>s | $T_4$<br>°C | $t_3$<br>s             |
|--------------------------------|--------------|--------------|------------|-------------|------------|-------------|------------------------|
| Lead-free solder<br>(Sn-Ag-Cu) | $150 \pm 5$  | $180 \pm 5$  | 60 to 120  | 225         | $20 \pm 5$ | 235         | —                      |
| Lead-containing<br>solder      | $150 \pm 10$ | $150 \pm 10$ | 60 to 120  | —           | —          | $215 \pm 3$ | $10 \pm 1$<br>at $T_4$ |

NOTE. See profile in Figure 8.



**Figure 8 – Reflow temperature profile**

### 5.3.5 Recovery

The flux residues shall be removed with a suitable solvent (see the requirements for solvents of IEC 60068-2-45).

### 5.3.6 Final measurement

The final measurement shall be in accordance with the requirements of wetting of the final measurements in IEC 60068-2-58. Then, if specified in the detail specification, the electrical performances shall be measured.

### 5.3.7 Items to be specified in detail specification

#### 5.3.7.1 General

The following items shall be specified in the detail specification.

#### 5.3.7.2 Solder bath method

- Applied solder.
- Accelerated ageing (if necessary) (see 5.3.2).
- Initial measurement items (see 5.3.3).
- Preheating (if necessary) (see 5.3.4.1d)).
- Conditions of immersion into solder (if necessary) (see 5.3.4.1e)).
- Final measurement items (see 5.3.6).

#### 5.3.7.3 Solder reflow method

- Applied solder.
- Accelerated ageing (if necessary) (see 5.3.2).
- Initial measurement items (see 5.3.3).
- Dimensional details of the test substrate and number of specimen(s) (see 5.3.4.2b)).
- Preheating (if necessary) (see 5.3.4.2d)).
- Final measurement items (see 5.3.6).

## 5.4 Resistance to soldering heat

### 5.4.1 General

The test for resistance to soldering heat shall be in accordance with the provisions of IEC 60068-2-58 and other specifications as mentioned below.

### 5.4.2 Preconditioning

Unless otherwise specified in the detail specification, the specimen shall be tested in the “as-received” condition. Care should be taken that no contamination occurs, by contact with the fingers or by other means.

### 5.4.3 Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If specified in the detail specification, the electrical performances shall be measured.

### 5.4.4 Test method

#### 5.4.4.1 Solder bath method

##### a) Solder bath

The solder bath shall be as specified in item a) of 5.3.4.1.

##### b) Flux

The flux shall be as specified in item b) of 5.3.4.1.

##### c) Solder

The solder composition shall be in accordance with items a)1) or b)1) of Clause A.3.

##### d) Test procedure

The test procedure shall be in accordance with the requirements for the test procedure and conditions of IEC 60068-2-58. Unless specified in the detail specification, the specimen shall be preheated to a temperature of 80 °C to 120 °C and maintained for 10 s to 30 s. The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

##### e) Severity

Unless otherwise specified in the detail specification, the duration and temperature of immersion shall be as given in Table 5.

**Table 5 – Severity**

| Alloy composition                                                                | Severity      |                         |
|----------------------------------------------------------------------------------|---------------|-------------------------|
|                                                                                  | Temperature   | Duration                |
| Lead-free solder (Sn-Ag-Cu)                                                      | 260 °C ± 5 °C | 10 s ± 1 s              |
| Lead-containing solder                                                           | 260 °C ± 5 °C | 10 s ± 1 s <sup>a</sup> |
| <sup>a</sup> If specified in the detail specification, 5 s ± 1 s may be applied. |               |                         |

#### 5.4.4.2 Solder reflow method

The reflow equipment shall be forced gas convection.

##### a) Solder paste

The solder paste shall be in accordance with item a) or b) of Clause A.3.

##### b) Test substrates

The test substrate shall be as specified in item b) of 5.3.4.2.

## c) Preparation

The solder paste shall be coated on the lands and the specimen shall be placed in accordance with Clause A.4.

## d) Preheating

Unless otherwise specified in the detail specification, the specimen and test substrate shall be preheated in accordance with Clause A.5.

## e) Reflow temperature profile

Unless otherwise specified in the detail specification, the reflow temperature profile shall be in accordance with Table 6.

The profile of test 1 is recommended for lead-free solder. The profile for lead-free solder in Table 6 shall be specified as the acceptable upper limit of severity.

Unless otherwise specified in the detail specification, the number of test cycles shall be a minimum of one and a maximum of three.

**Table 6 – Reflow temperature**

| Alloy composition              |        | $T_1$<br>°C  | $T_2$<br>°C  | $t_1$<br>s  | $T_3$<br>°C | $t_2$<br>s | $T_4$<br>°C | $t_3$<br>s                |
|--------------------------------|--------|--------------|--------------|-------------|-------------|------------|-------------|---------------------------|
| Lead-free solder<br>(Sn-Ag-Cu) | Test 1 | $150 \pm 5$  | $180 \pm 5$  | $120 \pm 5$ | 220         | 60 to 90   | 250         | 20 to 40 at $T_4 - 5$ K   |
|                                | Test 2 | $150 \pm 5$  | $180 \pm 5$  | $120 \pm 5$ | 220         | $\leq 60$  | 255         | $\leq 20$ at $T_4 - 10$ K |
| Lead-containing solder         |        | $150 \pm 10$ | $150 \pm 10$ | 60 to 120   | –           | –          | $235 \pm 5$ | $10 \pm 1$ at $T_4$       |
| NOTE See profile in Figure 8.  |        |              |              |             |             |            |             |                           |

### 5.4.5 Recovery

The flux residues shall be removed with a suitable solvent (see 3.1.3 of IEC 60068-2-45:1980 and IEC 60068-2-45:1980/AMD1:1993).

### 5.4.6 Final measurement

After recovery, the appearance of the specimen shall be checked by using a magnifier with a magnification of at least  $10\times$  under adequate light. Then, if specified in the detail specification, the electrical performances shall be measured.

### 5.4.7 Items to be specified in detail specification

#### 5.4.7.1 General

The following items shall be specified in the detail specification.

#### 5.4.7.2 Solder bath method

- Applied solder.
- Initial measurement items (see 5.4.3).
- Preheating (if necessary) (see 5.4.4.1.d)).
- Severity (if necessary) (see 5.4.4.1 e)).
- Final measurement items (see 5.4.6).

#### 5.4.7.3 Solder reflow method

- Applied solder.
- Initial measurement items (see 5.4.3).
- Dimensional detail of the test substrate and number of specimen(s) (see 5.4.4.2 b)).

- d) Preheating (if necessary) (see 5.4.4.2 d)).
- e) Reflow temperature profile (see 5.4.4.2 e)).
- f) Number of test cycles (see 5.4.4.2 e)).
- g) Final measurement items (see 5.4.6).

## **5.5 Resistance to dissolution of metallization**

### **5.5.1 General**

The test for resistance to the dissolution of metallization shall be in accordance with the provisions of IEC 60068-2-58 and other specifications as mentioned below.

### **5.5.2 Preconditioning**

Unless otherwise specified in the detail specification, the specimen shall be tested in the “as-received” condition. Care should be taken that no contamination occurs, by contact with the fingers or by other means.

### **5.5.3 Initial measurement**

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. If specified in the detail specification, the electrical performances shall be measured.

### **5.5.4 Test methods**

Subclause 5.5.4 specifies the test method pertaining to lead-containing solder. If lead free-solder is applied, this shall be specified in the detail specification.

#### **a) Solder bath**

The solder bath shall be as specified in item a) of 5.3.4.1.

#### **b) Flux**

The flux shall be as specified in item b) of 5.3.4.1.

#### **c) Solder**

The solder composition shall be in accordance with item a)1) of Clause A.3.

#### **d) Test procedure**

The test procedure shall be in accordance with the requirements for the test procedure and conditions of IEC 60068-2-58. Unless otherwise specified in the detail specification, the specimen shall be preheated to a temperature of 80 °C to 120 °C and maintained for 10 s to 30 s. The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

#### **e) Severity**

Unless otherwise specified in the detail specification, the temperature of the solder bath shall be  $(260 \pm 5) ^\circ\text{C}$  and the duration of immersion shall be  $(30 \pm 1) \text{ s}$ .

#### **f) Recovery**

The recovery shall be as specified in 5.3.5.

### **5.5.5 Final measurements**

The resistance to dissolution of metallization shall be assessed visually under adequate light with a binocular microscope of magnification in the range between 10× and 25×, in accordance with the requirements for resistance to the dissolution of metallization of IEC 60068-2-58. Then, if specified in the detail specification, the electrical performances shall be measured.

### 5.5.6 Items to be specified in detail specification

The following items shall be specified in the detail specification.

- a) Initial measurement items (see 5.5.3).
- b) Applied solder (if necessary) (see 5.5.4).
- c) Preheating (if necessary) (see 5.5.4 d)).
- d) Severity (if necessary) (see 5.5.4 e)).
- e) Final measurement items (see 5.5.5).

## 5.6 Vibration

### 5.6.1 Test equipment

The test device shall satisfy the requirements for vibration test equipment as specified in Clause 4 of IEC 60068-2-6:2007.

### 5.6.2 Preparation

The specimen shall be mounted firmly on the vibration table in accordance with the method specified in the detail specification, either by means of fixtures or directly.

### 5.6.3 Test method

The electrical performances of the specimen shall be measured in accordance with the provisions of the detail specification, and then the vibration specified in Clause 5 of IEC 60068-2-6:2007 shall be applied to the specimen mounted in accordance with 5.6.2. Unless otherwise specified in the detail specification, the condition of the test shall be selected from Table 7 (based on Table 3 of IEC 62211:2017). After the vibration, the electrical performances shall be measured in accordance with the detail specification and the variation shall be calculated in the measured values of each performance taken before and after the test. Furthermore, the specimen shall be visually examined. There shall be no visible damage.

**Table 7 – Conditions of vibration**

|                        | Level 1                                                                                                 | Level 2                                                                                            | Level 3                                                                      |
|------------------------|---------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------|
| <b>Test conditions</b> | 10 Hz to 2 000 Hz<br>$A = 1,5 \text{ mm}$ or $a = 200 \text{ m/s}^2$ max.<br>1 oct/min<br>10 cycle/axis | 10 Hz to 500 Hz<br>$A = 0,75 \text{ mm}$ or $a = 100 \text{ m/s}^2$<br>1 oct/min<br>10 cycles/axis | 10 Hz to 55 Hz<br>$A = 1,5 \text{ mm}$ , sweep 1 min<br>3 axes, 2 h/axis 6 h |

### 5.6.4 Items to be specified in detail specification

The following information shall be given in the detail specification.

- a) Mounting (mounting fixture and mounting method) (see 5.6.2).
- b) Type of vibration (if necessary) (see 5.6.3).
- c) Direction of vibration (if necessary) (see 5.6.3).
- d) Duration of vibration (if necessary) (see 5.6.3).
- e) Severity (see 5.6.3).
- f) Performance to be measured before and after the test (see 5.6.3).
- g) Measurement during vibration (if necessary).

## 5.7 Resistance to shock

### 5.7.1 Mechanical shock method

The shock test of the specimen shall be carried out by the mechanical shock method. The test method shall be as follows (see IEC 60068-2-27).

a) Test equipment

The equipment shall satisfy the characteristics required for the shock test equipment specified in IEC 60068-2-27.

b) Initial measurement

The appearance of the specimen shall be checked by using a magnifier with a magnification of at least 10× under adequate light. The electrical performances shall be measured in accordance with the provisions of the detail specification.

c) Preparation

The specimen shall be firmly mounted on the shock table in accordance with the method specified in the detail specification either by means of a mounting fixture or directly.

d) Test

The shock specified in IEC 60068-2-27 shall be applied to the specimen. The severity shall be either

- peak acceleration 1 000 m/s<sup>2</sup>, duration 6 ms, velocity change 3,7 m/s (sine wave), 3 axes, or
- peak acceleration 2 000 m/s<sup>2</sup>, duration 6 ms, velocity change 7,5 m/s (sine wave), 3 axes,

in accordance with Table 3 of IEC 62211:2017. The severity shall be specified in the detail specification.

e) Final measurement

After the test, the electrical performances shall be measured in accordance with the provisions of the detail specification. The appearance of the specimen shall be checked for any remarkable change in appearance and mechanical damage by using a magnifier with a magnification of at least 10× under adequate light.

### 5.7.2 Items to be specified in detail specification

The following items shall be specified in the detail specification.

- a) Initial measurement items (see 5.7.1b)).
- b) Mounting (mounting fixture or mounting method) (see 5.7.1c)).
- c) Severity (see 5.7.1d)).
- d) Final measurement items (see 5.7.1e)).



## **Annex A**

(normative)

### **Mounting of surface mounting inductor on test printed-circuit board**

#### **A.1 General**

Annex A specifies the method for mounting a surface mounting inductor to be tested (hereinafter referred to as “specimen”) on the test printed-circuit board.

#### **A.2 Mounting printed-circuit board and mounting land**

A mounting printed-circuit board suitable to the construction of the specimen shall be used, and this shall be specified in the detail specification. If there is no provision in the detail specification, the copper-clad laminate of FR4 (thickness  $1,6 \text{ mm} \pm 0,20 \text{ mm}$ , copper foil  $0,035 \text{ mm} \pm 0,010 \text{ mm}$ ) shall be used and it shall be a printed-circuit board on which the land for mounting the specimen is previously located. As for the land, the detail specification shall specify the details.

#### **A.3 Solder**

The solder should be either of solder a) or solder b). Unless otherwise specified in the detail specification, the solder shall be that specified in a).

##### **a) Lead-containing solder paste**

###### **1) Alloy composition**

The solder composition shall be either 60 weight % tin and 40 weight % lead (Sn60Pb40A, according to IEC 61190-1-3) or 63 weight % tin and 37 weight % lead (Sn63Pb37A, according to IEC 61190-1-3).

###### **2) Solder powder**

Unless otherwise specified in the detail specification, the particle size of the solder paste shall be  $20 \text{ }\mu\text{m}$  to  $45 \text{ }\mu\text{m}$ .

###### **3) Flux composition**

The flux to be used shall consist of 25 weight % of colophony in 75 weight % of 2-propanol (isopropanol) or of ethyl alcohol (as specified in IEC 60068-2-20).

###### **4) Solder paste composition**

The viscosity range and method of measurement shall be specified in the detail specification.

##### **b) Lead-free solder paste**

###### **1) Alloy composition**

The alloy composition to be used shall consist of 3,0 weight % Ag (silver), 0,5 weight % Cu (copper) and the remainder of Sn (tin), with a variation of Ag content between 3,0 weight % and 4,0 weight % of Cu content between 0,5 weight % and 1,0 weight %.

###### **2) Solder powder**

The powder size shall be type 3 specified in Table 2 of IEC 61190-1-2:2014.

###### **3) Flux composition**

The flux to be used shall consist of 30 weight % of polymerization rosin (softening point, approximately  $95 \text{ }^{\circ}\text{C}$ ), 30 weight % of dibasic acid degeneration rosin (softening point, approximately  $140 \text{ }^{\circ}\text{C}$ ), 34,7 weight % of diethylene glycol monobutyl ether,

0,8 weight % of 1,3-diphenylguanidine HBr, 0,5 weight % of adipic acid (chlorine content less than 0,1 weight %) and 4 weight % of stiffening castor oil.

4) Solder paste composition

The solder paste to be used shall consist of 88 weight % of solder powder and 12 weight % of flux. The viscosity range shall be  $(180 \pm 50)$  Pa·s.

#### A.4 Preparation

The solder paste shall be coated on the lands of the test printed-circuit board to a thickness of 100 µm and 250 µm and the specimen shall be placed so that its terminations or electrodes are positioned on the pasted lands. If specified in the detail specification, the thickness of the solder paste shall be in accordance with the provisions of the detail specification.

#### A.5 Preheating

In the case of lead-containing solder paste a) (see Clause A.3), the printed-circuit board on which the specimen is placed shall be preheated at  $(150 \pm 10)$  °C for 60 s to 120 s. In the case of lead-free solder paste b) (see Clause A.3), the printed-circuit board on which the specimen is placed shall be preheated in accordance with the detail specification.

#### A.6 Soldering

After the preheating, the soldering shall be carried out immediately by using the reflow soldering device. In case of lead-containing solder paste a), the solder temperature shall be between 215 °C and 235 °C, and the time at the peak temperature shall not exceed 10 s, and the total time above 185 °C shall be 45 s minimum. In case of lead-free solder paste b), the soldering temperature should be 235 °C to 250 °C according to Table 1 of IEC 60068-2-58:2015.

#### A.7 Cleaning

If specified in the detail specification, the printed-circuit board shall be cleaned by using a suitable solvent (see the requirements for solvents of IEC 60068-2-45).

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## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

### COMPOSANTS INDUCTIFS À HAUTE FRÉQUENCE – CARACTÉRISTIQUES NON ÉLECTRIQUES ET MÉTHODES DE MESURE –

#### Partie 2: Méthodes d'essai pour caractéristiques non électriques

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Cette deuxième édition annule et remplace la première édition parue en 2005. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) révision du Tableau 5;
- b) révision des références normatives.

Le texte de cette norme est issu des documents suivants:

| CDV         | Rapport de vote |
|-------------|-----------------|
| 51/1273/CDV | 51/1301/RVC     |

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme internationale.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2.

Une liste de toutes les parties de la série IEC 62025, publiées sous le titre général *Composants inductifs à haute fréquence – Caractéristiques non électriques et méthodes de mesure*, peut être consultée sur le site web de l'IEC.

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# COMPOSANTS INDUCTIFS À HAUTE FRÉQUENCE – CARACTÉRISTIQUES NON ÉLECTRIQUES ET MÉTHODES DE MESURE –

## Partie 2: Méthodes d'essai pour caractéristiques non électriques

### 1 Domaine d'application

La présente partie de l'IEC 62025 spécifie une méthode d'essai pour les caractéristiques non électriques pour inductances à montage en surface (CMS) utilisées pour les équipements électroniques et de télécommunications. L'objet du présent document concerne uniquement les méthodes de mesure de la performance mécanique. Comme les performances de fiabilité ainsi que les spécifications relatives aux performances non électriques sont spécifiées dans l'IEC 62211, les méthodes de mesures détaillées pour les performances mécaniques des essais de fiabilité sont définies dans le présent document.

### 2 Références normatives

Les documents suivants cités dans le texte constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60068-1, *Essais d'environnement – Partie 1: Généralités et lignes directrices*

IEC 60068-2-6:2007, *Essais d'environnement – Partie 2: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-20, *Essais d'environnement – Partie 2-20: Essais – Essai T: Méthodes d'essai de la brasabilité et de la résistance à la chaleur de brasage des dispositifs à broches*

IEC 60068-2-21:2006, *Essais d'environnement – Partie 2-21: Essais – Essai U: Robustesse des sorties et des dispositifs de montage incorporés*

IEC 60068-2-27, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

IEC 60068-2-45:1980, *Essais fondamentaux climatiques et de robustesse mécanique – Partie 2-45: Essais – Essai XA et guide: Immersion dans les solvants de nettoyage*  
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-58:2015, *Essais d'environnement – Partie 2-58: Essais – Essai Td: Méthodes d'essai de la soudabilité, résistance de la métallisation à la dissolution et résistance à la chaleur de brasage des composants pour montage en surface (CMS)*  
IEC 60068-2-58:2015/AMD1:2017

IEC 60068-2-69, *Essais d'environnement – Partie 2-69: Essais – Essai Te/Tc Essai de brasabilité des composants électroniques et cartes imprimées par la méthode de la balance de mouillage (mesure de la force)*

IEC 60068-2-77, *Essais d'environnement – Partie 2-77: Essais – Essai 77: Résistance du corps et résistance aux chocs par impact*

IEC 61188-5-2, *Cartes imprimées et cartes imprimées équipées – Conception et utilisation – Partie 5-2: Considérations sur les liaisons pistes-soudures – Composants discrets*



IEC 61190-1-2:2014, *Matériaux de fixation pour les assemblages électroniques – Partie 1-2: Exigences relatives aux pâtes à braser pour les interconnexions de haute qualité dans les assemblages de composants électroniques*

IEC 61190-1-3, *Matériaux de fixation pour les assemblages électroniques – Partie 1-3: Exigences relatives aux alliages à braser de catégorie électronique et brasure solide fluxée et non fluxée pour les applications de brasage électronique*

IEC 62211:2017, *Inductive components – Reliability management* (disponible en anglais seulement)

### 3 Termes et définitions

Aucun terme n'est défini dans le présent document.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <http://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse <http://www.iso.org/obp>

### 4 Conditions d'essai

#### 4.1 Conditions atmosphériques normales pour les essais

Sauf mention contraire dans la spécification particulière, les essais et les mesurages doivent être effectués dans des conditions atmosphériques normales pour les essais comme indiqué dans les exigences relatives aux conditions atmosphériques normales de référence de l'IEC 60068-1:

- température: de 15 °C à 35 °C;
- humidité relative: de 25 % à 75 %;
- pression atmosphérique: de 86 kPa à 106 kPa.

Dans l'éventualité d'un litige ou si cela est exigé, les mesurages doivent être répétés en utilisant les températures de référence (données en 4.2) et les autres conditions spécifiées dans le présent document.

De plus, lorsqu'il est difficile d'effectuer les mesurages dans les conditions atmosphériques normales, sauf en cas de doute dans le jugement de la validité des résultats, les essais et les mesurages peuvent être réalisés dans des conditions atmosphériques non normales.

#### 4.2 Conditions d'arbitrage

Pour les besoins d'arbitrage, une des conditions atmosphériques normales pour les essais de référence, données dans les exigences relatives aux conditions atmosphériques normales pour les mesurages et les essais de référence de l'IEC 60068-1, doit être sélectionnée et doit correspondre à ce qui suit:

- température: 20 °C ± 2 °C;
- humidité relative: de 60 % à 70 %;
- pression atmosphérique: de 86 kPa à 106 kPa.

## 5 Essais des caractéristiques mécaniques

### 5.1 Essai de résistance du corps

#### 5.1.1 Procédures d'essai de résistance du corps

La procédure d'essai de résistance du corps, telle que spécifiée dans l'IEC 60068-2-77, doit être comme suit:

##### a) Préconditionnement

Si cela est exigé, le preconditionnement doit être réalisé sur les éprouvettes conformément à la spécification particulière.

##### b) Mesurage initial

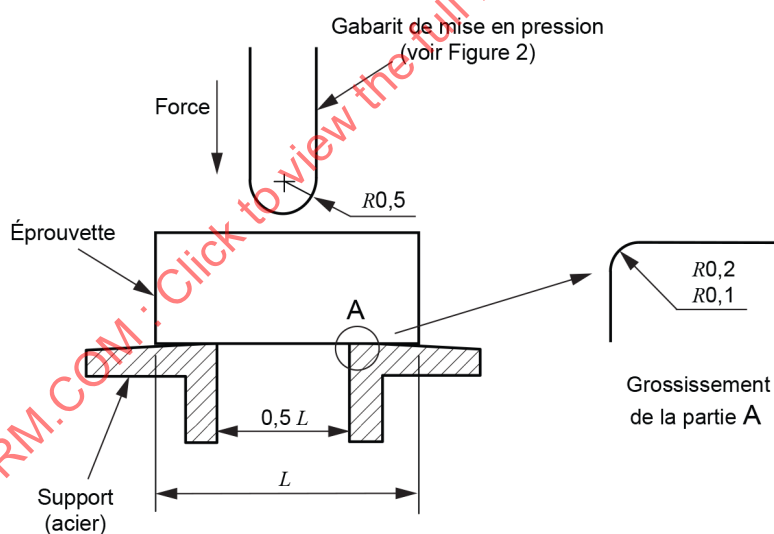
Les éprouvettes doivent être examinées visuellement avec un grossissement d'au moins 10× et un éclairage approprié.

Les performances électriques doivent être mesurées, si cela est spécifié dans la spécification particulière.

##### c) Disposition

Sauf mention contraire dans la spécification particulière, l'éprouvette doit être placée sur le support comme représenté à la Figure 1, de sorte que les deux extrémités de l'éprouvette soient placées symétriquement sur le support. La table d'essai doit être placée sur une plate-forme plane et robuste. Ainsi le résultat d'essai n'est pas affecté lorsqu'une force est appliquée.

Dimensions en millimètres



IEC

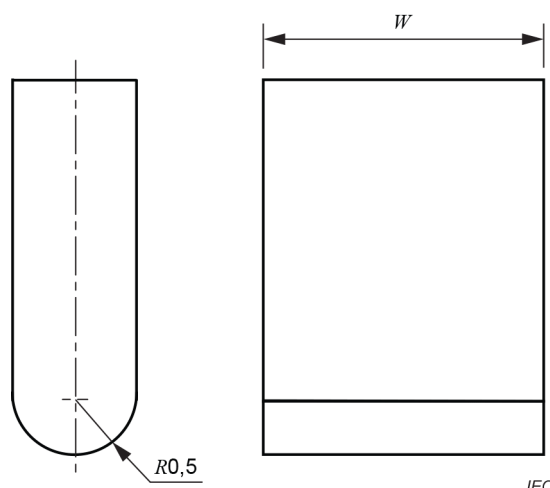
NOTE L'angle au sommet du cône d'entrée dans la partie A doit se situer entre 70° et 90°.

**Figure 1 – Méthode pour exercer la pression sur le corps**

##### d) Force appliquée

La force doit être appliquée au centre de l'éprouvette par un gabarit de mise en pression (gabarit presseur) comme représenté à la Figure 2, pendant  $(10 \pm 1)$  s. Sauf mention contraire dans la spécification particulière, la force doit être choisie parmi l'une des suivantes: 10 N, 20 N ou 30 N. Si la spécification particulière le précise, les performances électriques doivent être mesurées au cours de l'application de la force.

Dimensions en millimètres



NOTE 1 La dimension  $W$  du gabarit de mise en pression est plus large que la largeur de l'éprouvette.

NOTE 2 Dureté: HV 500 et supérieur.

Lorsque la longueur de l'éprouvette est de 2 mm ou inférieure, il convient que le rayon du gabarit de mise en pression soit de 0,2 mm.

**Figure 2 – Gabarit de mise en pression (gabarit presseur)**

e) Reprise

Si cela est exigé, la reprise doit être réalisée pour les éprouvettes conformément à la spécification particulière.

f) Mesurage final

Après l'essai, les éprouvettes doivent être examinées visuellement avec un grossissement d'au moins 10× et un éclairage approprié. Il ne doit y avoir aucun signe de dommages tels que fissures ou défauts. Les performances électriques doivent être mesurées, si cela est spécifié dans la spécification particulière.

## 5.1.2 Informations à donner dans la spécification particulière

Les informations suivantes doivent être spécifiées dans la spécification particulière:

- a) le préconditionnement (si exigé) – voir 5.1.1.a);
- b) les éléments du mesurage initial et du mesurage final (si exigé) – voir 5.1.1.b) et f);
- c) le mesurage pendant l'application de la force (si exigé) – voir 5.1.1.d);
- d) la reprise (si exigé) – voir 5.1.1.e).

## 5.2 Robustesse des sorties (électrodes)

### 5.2.1 Résistance à la flexion des cartes de circuits imprimés

#### 5.2.1.1 Généralités

L'essai de résistance des sorties et électrodes montées sur une carte de circuit imprimé doit être réalisé comme suit.

#### 5.2.1.2 Spécification des pastilles de soudure

Les pastilles de soudure des inductances miniatures multicouches doivent être conçues conformément au Tableau 1, comme spécifié dans l'IEC 61188-5-2. Pour ce qui concerne les inductances, sauf pour celles spécifiées dans l'IEC 61188-5-2, la taille des pastilles de soudure doit être précisée dans la spécification particulière.

**Tableau 1 – Taille des pastilles de soudure selon le code des inductances miniatures multicouches**

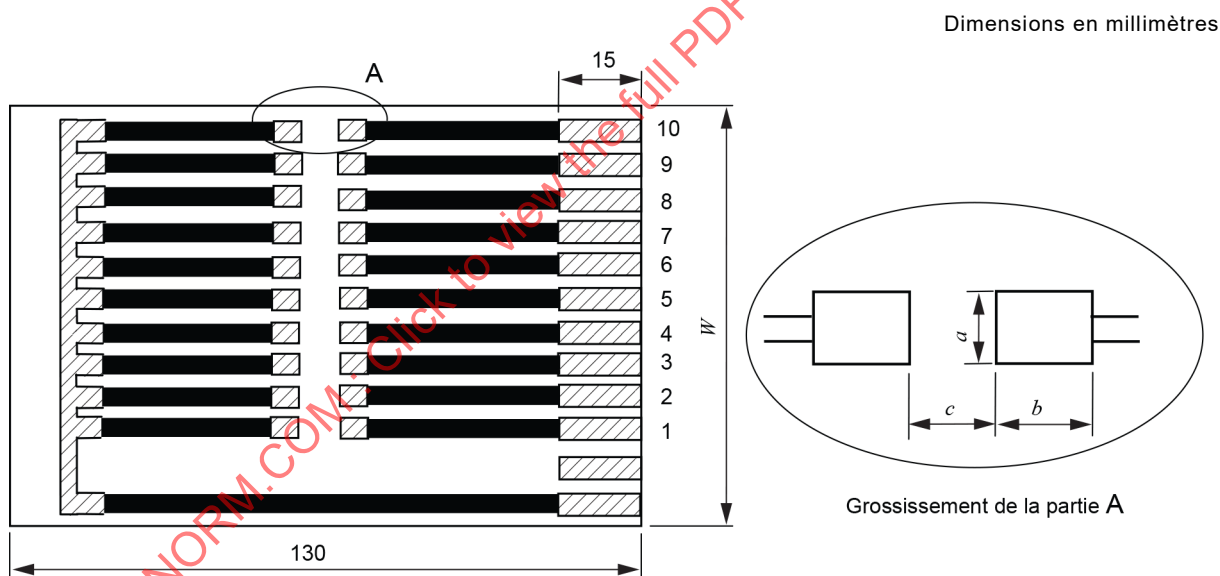
*Dimensions en millimètres*

| Code de taille | <i>a</i> | <i>b</i> | <i>c</i> |
|----------------|----------|----------|----------|
| 1005           | 0,65     | 0,55     | 0,50     |
| 1608           | 0,95     | 0,85     | 0,50     |
| 2012           | 1,45     | 1,10     | 0,50     |
| 3216           | 1,80     | 1,30     | 1,20     |
| 3225           | 2,70     | 1,05     | 1,80     |
| 4532           | 3,40     | 1,10     | 3,00     |
| 5650           | 5,30     | 1,30     | 3,70     |

NOTE Tolérance: 0,05 mm; voir la Figure 3.

### 5.2.1.3 Spécification des cartes de circuits imprimés

La carte de circuit imprimé doit être en tissu de verre d'époxyde (FR4), tel que spécifié dans l'IEC 60068-2-21 et, sauf mention contraire dans la spécification particulière, la carte de circuit imprimé doit être telle que représentée à la Figure 3. La dimension de *W* doit être spécifiée dans la spécification particulière.



#### Légende

- zones soudables
- zones non soudables (couvertes par une laque non soudable)

Matériaux de substrat: tissu de verre d'époxyde (FR4)

Épaisseur: 1,6 mm ± 0,2 mm (pour code de taille à partir de 1608)

Épaisseur: 0,8 mm ± 0,1 mm (pour code de taille jusqu'à 1005)

Conducteurs: cuivre

Épaisseur: 0,035 mm ± 0,010 mm

Lorsque la carte est conçue pour comporter plus de deux éprouvettes, prévoir un espace suffisant entre les éprouvettes de façon à ne pas interférer sur le résultat de l'essai. Les dimensions non indiquées doivent être choisies conformément à la conception et à la taille de l'éprouvette à soumettre à l'essai.

**Figure 3 – Exemple de carte de circuit imprimé**