

# INTERNATIONAL STANDARD

**IEC**  
**60068-2-21**

Sixth edition  
2006-06

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**Environmental testing –**

**Part 2-21:**

**Tests – Test U: Robustness of terminations  
and integral mounting devices**

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## INTERNATIONAL ELECTROTECHNICAL COMMISSION

## ENVIRONMENTAL TESTING –

**Part 2-21: Tests – Test U: Robustness of terminations  
and integral mounting devices**

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International Standard IEC 60068-2-21 has been prepared by IEC technical committee 91: Electronics assembly technology.

This sixth edition cancels and replaces the fifth edition, published in 1999, and constitutes a technical revision.

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

- Addition of torque severity for nominal thread diameter of 8 mm in Test Ud: torque in accordance with IEC 60252-2 (see table 5)
- Modification of substrate specification and mounting method describing lead-free solder in Test Ue (see Figure 5 and 8.3.3 et al.)

- Modification of test jig and test condition in Test Ue<sub>1</sub>: substrate bending test (see Figure 7 et al.)
- Change of pushing force from 10 N to 5 N in Test Ue<sub>3</sub>: shear test (see 8.5.3.2)

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

FDIS	Report on voting
91/582/FDIS	91/607/RVD

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

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

A complete list of all parts comprising the IEC 60068 series, under the general title *Environmental testing*, can be found on the IEC website.

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

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- withdrawn;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

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

The contents of the corrigendum of January 2012 have been included in this copy.

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## ENVIRONMENTAL TESTING –

### Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices

#### 1 Scope

This part of IEC 60068 is applicable to all electrical and electronic components whose terminations or integral mounting devices are liable to be submitted to stresses during normal assembly or handling operations.

Table 1 provides details of the applicable tests.

**Table 1 – Application**

Test	Type	Component	Mounted/not mounted
Ua <sub>1</sub>	Tensile	Leaded devices	Not mounted
Ua <sub>2</sub>	Thrust	Leaded devices	Not mounted
Ub	Bending	Leaded devices	Not mounted
Uc	Torsion	Leaded devices	Not mounted
Ud	Torque	Threaded stud or screw termination	Not mounted
Ue <sub>1</sub>	Bending	Surface mounted devices	Mounted
Ue <sub>2</sub>	Pull/push	Surface mounted devices	Mounted
Ue <sub>3</sub>	Shear	Surface mounted devices	Mounted

#### 2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*  
Amendment 1 (1992)

IEC 60068-2-20:1979, *Environmental testing – Part 2: Tests – Test T: Soldering*  
Amendment 2 (1987)

IEC 60068-2-58:2004, *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 60068-2-61:1991, *Environmental testing – Part 2: Tests – Test Z/ABDM: Climatic sequence*

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

IEC 61188-5 (all parts), *Printed boards and printed board assemblies – Design and use*

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



IEC 61191-2:1998, *Printed board assemblies – Part 2: Sectional specification – Requirements for surface mount soldered assemblies*

ISO 272:1982, *Fasteners – Hexagon products – Widths across flats*

ISO 9453:1990, *Soft solder alloys – Chemical compositions and forms*

### 3 Test U<sub>a1</sub>: tensile

This test is applicable to all types of terminations.

#### 3.1 Object

The purpose of this test is to verify that the terminations and attachment of the terminations to the body of the component will withstand such axial stresses as are likely to be applied during normal assembly or handling operations.

#### 3.2 General description

With the termination in its normal position and the component held by its body, a force is applied to the termination in the direction of its axis and acting in a direction away from the body of the component. The force shall be applied progressively (without any shock) and then maintained for a period of  $10\text{ s} \pm 1\text{ s}$ .

#### 3.3 Preconditioning

The method of preconditioning shall be as prescribed in the relevant specification.

#### 3.4 Initial measurements

The specimen shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

#### 3.5 Test method

Unless otherwise specified in the relevant specification, the test method shall be as follows:

Refer to Figure 2a.

##### 3.5.1 Application

This test applies to all types of terminations. It shall be carried out on all the terminations, except where a component has more than three terminations, in which case the specification shall state the number of terminations per component to be tested. The test shall be carried out in such a manner that all the terminations of the component have an equal probability of being subjected to test.

##### 3.5.2 Procedure

With the termination in its normal position and the component held by its body, a force with a value as stated in Table 2 shall be applied to the termination in the direction of its axis and acting in a direction away from the body of the component. The force shall be applied progressively (without any shock) and then maintained for a period of  $10\text{ s} \pm 1\text{ s}$ .

The value of the applied force is as follows:

a) Wire terminations (circular section or strip) or pins

The value of the force applied shall be that indicated in Table 2.

Insulated wires shall be stripped of the insulation at the point at which the load is applied.

Stranded wires shall be united mechanically at the point of application of the load (such as by soldering or knotting), prior to the application of the load. Where the technical features of insulated or stranded wires may give rise to difficulties during the stripping, joining or knotting operations and be liable to cause dispute for the test results, such operations shall be in accordance with the relevant specification or, where necessary, with the instructions of the component manufacturer.

**Table 2 – Value of applied force for test Ua<sub>1</sub>**

Nominal cross-sectional area (S) <sup>a</sup> mm <sup>2</sup>	Corresponding diameter (d) for circular-section wires mm	Force with tolerance of ±10 % N
s ≤ 0,05	d ≤ 0,25	1
0,05 < s ≤ 0,10	0,25 < d ≤ 0,35	2,5
0,10 < s ≤ 0,20	0,35 < d ≤ 0,50	5
0,20 < s ≤ 0,50	0,50 < d ≤ 0,80	10
0,50 < s ≤ 1,20	0,80 < d ≤ 1,25	20
s > 1,20	d > 1,25	40

<sup>a</sup> For circular-section wires, strips or pins, the nominal cross-sectional area is equal to the value calculated from the nominal dimension(s) given in the relevant specification. For stranded wires, the nominal cross-sectional area is obtained by taking the sum of the cross-sectional areas of the individual strands of the conductor specified in the relevant specification.

b) Other terminations (tag terminations, threaded studs, screws, terminals, etc.)

The value of the force to be applied shall be given in the relevant specification.

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**3.6 Final measurements**

The specimen shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

**3.7 Information to be given in the relevant specification**

	Subclause
a) Method of preconditioning	3.3
b) Initial measurements	3.4
c) Number of terminations to be tested, if more than three	3.5.1
d) Force (for oversized and other terminations)	3.5.2
e) Details of stripping, joining or knotting operations, if necessary	3.5.2
f) Final measurements	3.6

## 4 Test Ua<sub>2</sub>: thrust

### 4.1 Object

The purpose of this test is to verify that the terminations and attachment of the terminations to the body of the component will withstand such thrusts as are likely to be applied during normal assembly or handling operations. This test applies only to specimens of small dimensions and of low mass, to the exclusion of equipment and assemblies.

NOTE This test does not apply to flexible terminations. The tests for flexible terminations are given in a) and b) of 5.1.

### 4.2 General description

With the termination in its normal position and the component held by its body, thrust is applied to the termination as close as possible to the body of the component, but leaving a clear 2 mm of wire between the body of the component and the nearest point of the device applying the force. The force shall be applied progressively (without any shock) and then maintained for a period of 10 s ± 1 s.

### 4.3 Preconditioning

The method of preconditioning shall be as prescribed in the relevant specification.

### 4.4 Initial measurements

The specimen shall be visually inspected and electrically and mechanically checked, as required by the relevant specification.

### 4.5 Test method

Refer to Figure 2b.

#### 4.5.1 Application

The relevant specification shall state whether this test is applicable. When applicable, it shall be carried out on all the terminations, except where a component has more than three terminations, in which case the specification shall state the number of terminations per component to be tested. The test shall be carried out in such a manner that all the terminations of the component have an equal probability of being subjected to test. The relevant specification shall define the direction of applied force.

#### 4.5.2 Procedure

With the termination in its normal position and the component held by its body, thrust shall be applied to the termination as close as possible to the body of the component, but leaving a clear 2 mm of wire between the body of the component and the nearest point of the device applying the force. The force shall be applied progressively (without any shock) and then maintained for a period of 10 s ± 1 s.

The value of the applied force is as follows:

- a) Wire terminations (circular-section or strip) or pins

The value of the force applied shall be as given in Table 3.