

INTERNATIONAL STANDARD

IEC 60068-2-21

Fifth edition
1999-01

Environmental testing –

Part 2-21:

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

Essais d'environnement –

Partie 2-21:

*Essais – Essai U: Robustesse des sorties
et des dispositifs de fixation*

IEC 60068-2-21:1999

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Reference number
IEC 60068-2-21:1999(E)

Numbering

As from 1 January 1997 all IEC publications are issued with a designation in the 60000 series.

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Commission Electrotechnique Internationale
International Electrotechnical Commission
Международная Электротехническая Комиссия

PRICE CODE

U

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CONTENTS

	Page
FOREWORD	4
Clause	
1 Scope	5
2 Normative references	5
3 Test Ua ₁ : tensile	6
3.1 Object	6
3.2 General description	6
3.3 Preconditioning	6
3.4 Initial measurements	6
3.5 Test method	6
3.6 Final measurements	7
3.7 Information to be given in the relevant specification	7
4 Test Ua ₂ : thrust	8
4.1 Object	8
4.2 General description	8
4.3 Preconditioning	8
4.4 Initial measurements	8
4.5 Test method	8
4.6 Final measurements	9
4.7 Information to be given in the relevant specification	9
5 Test Ub: bending	10
5.1 Object	10
5.2 General description	10
5.3 Preconditioning	10
5.4 Initial measurements	10
5.5 Test method	11
5.6 Final measurements	13
5.7 Information to be given in the relevant specification	13
6 Test Uc: torsion	14
6.1 Object	14
6.2 Preconditioning	14
6.3 Initial measurements	14
6.4 Test method	14
6.5 Final measurements	15
6.6 Information to be given in the relevant specification	15
7 Test Ud: torque	15
7.1 Object	15
7.2 General description	15
7.3 Preconditioning	15
7.4 Initial measurements	15

Clause	Page
7.5 Test method	15
7.6 Final measurements	16
7.7 Information to be given in the relevant specification.....	16
8 Test Ue: robustness of terminations for SMD in the mounted state	17
8.1 Object.....	17
8.2 General description.....	17
8.3 Mounting.....	18
8.4 Initial measurements.....	19
8.5 Test methods.....	19
8.6 Final measurements	21
8.7 Information to be given in the relevant specification.....	22

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –

Part 2-21: Tests –

Test U: Robustness of terminations and integral mounting devices

FOREWORD

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International Standard IEC 60068-2-21 has been prepared by IEC technical committee 50: Environmental testing, and is published by IEC technical committee 91: Surface mounting technology.

This fifth edition cancels and replaces the fourth edition, published in 1983, and its Amendments 1, 2 and 3 published in 1985, 1991 and 1992, respectively, and constitutes a technical revision.

The text of this edition is based on the following documents.

FDIS	Report on voting
91/156/FDIS	91/163/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.

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 ₁	Tensile	Leaded devices	Not mounted
Ua ₂	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 ₁	Bending	Surface mounted devices	Mounted
Ue ₂	Pull/push	Surface mounted devices	Mounted
Ue ₃	Shear	Surface mounted devices	Mounted

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 60068. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 60068 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

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

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

IEC 60249-2-4:1987, *Base materials for printed circuits – Part 2 : Specifications – Specification No. 4: Epoxy woven glass fibre copper-clad laminated sheet, general purpose grade*

IEC 61191-2: — *Printed board assemblies – Part 2: Sectional specification – Surface mount soldered assemblies* ¹⁾

¹⁾ To be published.

ISO 31-3:1992, *Quantities and units – Part 3: Mechanics*

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

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

3 Test U_{a1} : 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

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.

NOTE – For components with oversized wire terminations, the appropriate force should be given in the relevant specification.

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 U_{a1}

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

* 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.

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 U_{a2}: 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.

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 $10\text{ s} \pm 1\text{ s}$.

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 $10\text{ s} \pm 1\text{ s}$.

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 as given in table 3.

Table 3 – Value of applied force for test U_{a2}

Nominal cross-sectional area (S)* mm ²	Corresponding diameter (d) for circular-section wire mm	Force with tolerance of ± 10 % N
$S \leq 0,05$	$d \leq 0,25$	0,25
$0,05 < S \leq 0,10$	$0,25 < d \leq 0,35$	0,5
$0,10 < S \leq 0,20$	$0,35 < d \leq 0,50$	1
$0,20 < S \leq 0,50$	$0,50 < d \leq 0,80$	2
$0,50 < S \leq 1,20$	$0,80 < d \leq 1,25$	4
$S > 1,20$	$d > 1,25$	8

* 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.

Insulated wires shall be stripped of the insulation at the point at which the load is applied. Where the technical features of insulated wires may give rise to difficulties during the stripping, 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.

- 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.

4.6 Final measurements

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

4.7 Information to be given in the relevant specification

	Subclause
a) Method of preconditioning	4.3
b) Initial measurements	4.4
c) Indication as to whether the test is applicable	4.5.1
d) Number of terminations to be tested, if more than three	4.5.1
e) Direction of applied force	4.5.1
f) Details of stripping, if necessary	4.5.2
g) Force, for other than wire terminations or pins	4.5.2
h) Final measurements	4.6