

Australian Standard™

Environmental testing

**Part 4: Information for specification
writers—Test summaries**



This Australian Standard was prepared by Committee EL-026, Protective Enclosures and Environmental Testing for Electrical/Electronic Equipment. It was approved on behalf of the Council of Standards Australia on 28 February 2003 and published on 8 May 2003.

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Australian Electrical and Electronic Manufacturers Association
Electrical Compliance Testing Authorities
Electrical Regulatory Authorities Council
Electricity Supply Association of Australia
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Australian Standard™

Environmental testing

Part 4: Information for specification writers—Test summaries

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PREFACE

This Standard was prepared by the Standards Australia Committee EL-026, Protective Enclosures and Environmental Testing for Electrical/Electronic Equipment to supersede AS 1099.4—1994, *Basic environmental testing procedures for electrotechnology Part 4: Information for specification writers—Test summaries*.

The objective of this Standard is to provide the electrotechnology industry with a complete set of environmental test procedures published as a series under AS 60068 *Environmental testing*. This Standard is Part 4 of that series.

This Standard is identical with, and has been reproduced from, consolidated IEC 60068-4:1997 Ed 1.2, *Environmental testing – Part 4: Information for specification writers – Test summaries* which includes its Amendments 1 and 2.

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In this Standard, the following print types are used:

- requirements proper: in arial type;
- *test specifications: in italic type;*
- explanatory matter: in smaller arial type.

Any international Standard referenced should be replaced by an equivalent Australian Standard when one is available. The availability of equivalent Australian Standards can be determined either from the Standards Australia catalogue or from the Standards Australia website (www.standards.com.au).

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STANDARDS AUSTRALIA

Australian Standard**Environmental testing****Part 4: Information for specification writers—Test summaries**

1 Object

To provide information in summarized form on the individual environmental tests in IEC 60068-2 to serve the purposes of specification writers and others when a knowledge of the detailed provisions of the complete standards is not required.

It should be particularly borne in mind by all concerned with laboratory testing that these summaries are *not intended* to be a substitute for the relevant complete standards.

2 General

The standards in IEC 60068-2 for the individual environmental tests are based on the general considerations, including definitions and guidance, to be found in IEC 60068-1. That standard gives an explanation of the method used to designate the various tests.

The uniform presentation of these summaries on a single page has resulted in varying degrees of “reduction” of original texts which themselves vary widely in length and complexity. Although, in order to facilitate the use of the summaries in this publication, the presentation has been made as consistent as possible, it should be remembered that the original texts are of different dates and are the responsibility of IEC technical committee 50 or its subcommittees.

Tolerances have been omitted from these summaries; they can be found in IEC 60068-2.

The information in 2.1, 2.2 and 2.3, although not necessarily applicable to all the summaries, is of general application.

2.1 Guidance

Many of the standards in IEC 60068-2 contain guidance on the application of the testing procedure and much of this is of particular value to specification writers and others who are not required to have a knowledge of the detailed provisions of a test. In the case of these standards, the summaries will make no specific reference to guidance.

There are other cases, for example solar radiation testing (IEC 60068-2-5), where guidance is to be found in another standard in the IEC 60068-2 series (IEC 60068-2-9 in the case of the example), or – and then described as “background information” – in a standard in the IEC 60068-3 series. In these cases, reference is made in the summary to the other standards concerned irrespective of their degree of relevance for specification writers in order that they can indicate fully in their specifications the sources of detailed information which laboratories will require. The standard will then be listed in clause 5.

2.2 Storage

Guidance on the application of tests in the IEC 60068-2 series to simulate the effects of storage, from short-term to long-term, is given in IEC 60068-2-48, to which reference should be made in appropriate cases.

2.3 Mounting

The mounting requirements for specimens to be subjected to certain of the vibration and shock tests covered by the summaries, namely shock and bump (Test Ea, IEC 60068-2-27; Test Eb, IEC 60068-2-29), sinusoidal and random vibration (Test Fc, IEC 60068-2-6; Test Fd, IEC 60068-2-34, IEC 60068-2-35, IEC 60068-2-36 and IEC 60068-2-37) and steady-state acceleration (Test Ga, IEC 60068-2-7), are the subject of IEC 60068-2-47, to which attention should be drawn in relevant specifications. This applies also, of course, when dealing with "combined" or "composite" tests, as defined in clause 3, embodying one or more of the tests mentioned.

3 Definitions

The following list of generally applicable definitions is based, with some editing, on those given in IEC 60068-1.

For other definitions, refer to IEC 60068-1 and IEC 60068-2.

3.1 Test

Complete series of operations implied by its title, normally comprising the following operations, when required:

- a) preconditioning;
- b) initial examination and measurements;
- c) conditioning;
- d) recovery;
- e) final examination and measurements.

NOTE – Intermediate measurements may be required during conditioning and/or recovery.

3.1.1 Preconditioning

Treatment of a specimen with the object of removing or partly counteracting the effects of its previous history.

3.1.2 Conditioning

Exposure of a specimen to environmental conditions in order to determine the effect of such conditions on the specimen.

3.1.3 Recovery

Treatment of a specimen, after environmental conditioning, in order that the properties of the specimen may be stabilized before measurement.

3.2 Specimen

Product designated to be tested in accordance with the procedures of IEC 60068.

NOTE – The term "specimen" includes any auxiliary parts or systems that are integral functional features of the specimen, for example systems for cooling and heating.

3.2.1 Heat-dissipating specimen

Specimen with the hottest point on its surface, measured in free air conditions and under the air pressure specified in 5.3.1 of IEC 60068-1, more than 5 °C above the ambient temperature of the surrounding atmosphere after temperature stability has been reached.

3.2.2 Non-heat-dissipating specimen

Specimen other than as defined in 3.2.1.

3.3 Relevant specification

Set of requirements to be satisfied by a product, indicating the procedure(s) necessary to determine whether the requirements given are satisfied.

3.4 Severity

Set of parameters for the conditioning of the specimen.

3.5 Combined test

Test in which two or more test environments act upon the specimen simultaneously.

3.6 Composite test

Test in which the specimen is exposed to two or more test environments in close succession.

4 Lists of test summaries

To facilitate the finding of the required summary, the summaries are listed in numerical order in 4.1 and in alphabetical order in 4.2. The sheets for the individual summaries are filed in alphabetical order.

NOTE – A reference to a publication is to the edition of the standard identified by its date on the corresponding test summary sheet and to all similarly identified amendments.

4.1 Numerical list

<i>IEC Publication</i>	<i>Test designation and title</i>	<i>Sheet</i>
60068-2-1	Tests A: Cold	A/B-1
60068-2-2	Tests B: Dry heat (including First Supplement 60068-2-2A)	A/B-1
60068-2-3	Test Ca: Damp heat, steady state	C-1
60068-2-5	Test Sa: Simulated solar radiation at ground level	S-1
60068-2-6	Test Fc and guidance: Vibration (sinusoidal)	F-1
60068-2-7	Test Ga and guidance: Acceleration, steady state	G-1
60068-2-10	Test J and guidance: Mould growth	J-1
60068-2-11	Test Ka: Salt mist	K-1
60068-2-13	Test M: Low air pressure	M-1
60068-2-14	Test N: Change of temperature	N-1
60068-2-17	Test Q: Sealing	Q-1 to Q-8
60068-2-18	Test R and guidance: Water	R-1 to R-4
60068-2-20	Test T: Soldering	T-1, T-3, T-4, T-5
60068-2-21	Test U: Robustness of terminations and integral mounting devices	U-1 to U-6
60068-2-27	Test Ea and guidance: Shock	E-1
60068-2-29	Test Eb and guidance: Bump	E-2
60068-2-30	Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)	D-1
60068-2-31	Test Ec: Drop and topple, primarily for equipment-type specimens	E-3

<i>IEC Publication</i>	<i>Test designation and title</i>	<i>Sheet</i>
60068-2-32	Test Ed: Free fall	E-4
60068-2-34	Test Fd: Random vibration wideband – General requirements	F-2
60068-2-35	Test Fda: Random vibration wideband – Reproducibility High	F-2
60068-2-36	Test Fdb: Random vibration wideband – Reproducibility Medium	F-2
60068-2-37	Test Fdc: Random vibration wideband – Reproducibility Low	F-2
60068-2-38	Test Z/AD: Composite temperature/humidity cyclic test	Z-1
60068-2-39	Test Z/AMD: Composite sequential cold, low air pressure and damp heat test	Z-4
60068-2-40	Test Z/AM: Combined cold/low air pressure tests	Z-3
60068-2-41	Test Z/BM: Combined dry heat/low air pressure tests	Z-3
60068-2-42	Test Kc: Sulphur dioxide test for contacts and connections	K-3
60068-2-43	Test Kd: Hydrogen sulphide test for contacts and connections	K-3
60068-2-45	Test XA and guidance: Immersion in cleaning solvents	X-1
60068-2-50	Test Z/AFc: Combined cold/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens	Z-2
60068-2-51	Test Z/BFc: Combined dry heat/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens	Z-2
60068-2-52	Test Kb: Salt mist, cyclic (sodium chloride solution)	K-2
60068-2-54	Test Ta: Soldering. Solderability testing by the wetting balance method	T-2
60068-2-55	Test Ee and guidance: Bounce	E-5
60068-2-56	Test Cb: Damp heat, steady state (for equipment)	C-2
60068-2-57	Test Ff: Vibration, time-history method	F-4
60068-2-58	Test Td: Solderability, resistance to dissolution of metallization and to soldering heat of Surface Mounting Devices (SMD)	T-5
60068-2-59	Test Fe: Vibration. Sine-beat method	F-3
60068-2-61	Test Z/ABDM: Climatic sequence	Z-5
60068-2-62	Test Ef: Impact, pendulum hammer	E-6
60068-2-63	Test Eg: Impact, spring hammer	E-7
60068-2-64	Test Fh: Vibration, broadband random (digital control) and guidance	F-6
60068-2-65	Test Fg: Vibration, acoustically induced	F-5

4.2 Alphabetical list

<i>Test designation</i>	<i>IEC Publication</i>	<i>Title</i>	<i>Sheet</i>
A, Aa, Ab, Ad	60068-2-1	Tests A: Cold	A/B-1
B, Ba, Bb, Bc, Bd	60068-2-2	Tests B: Dry heat (including First Supplement 60068-2-2A)	A/B-1
Ca	60068-2-3	Test Ca: Damp heat, steady state	C-1
Cb	60068-2-56	Test Cb: Damp heat, steady state (for equipment)	C-2
Db	60068-2-30	Test Db and guidance: Damp heat, cyclic (12 + 12-hour cycle)	D-1
Ea	60068-2-27	Test Ea and guidance: Shock	E-1
Eb	60068-2-29	Test Eb and guidance: Bump	E-2
Ec	60068-2-31	Test Ec: Drop and topple, primarily for equipment-type specimens	E-3
Ed	60068-2-32	Test Ed: Free fall	E-4
Ee	60068-2-55	Test Ee and guidance: Bounce	E-5
Ef	60068-2-62	Test Ef: Impact, pendulum hammer	E-6
Eg	60068-2-63	Test Eg: Impact, spring hammer	E-7
Fc	60068-2-6	Test Fc and guidance: Vibration (sinusoidal)	F-1
Fd	60068-2-34	Test Fd: Random vibration wideband – General requirements	F-2
Fda	60068-2-35	Test Fda: Random vibration wideband – Reproducibility High	F-2
Fdb	60068-2-36	Test Fdb: Random vibration wideband – Reproducibility Medium	F-2
Fdc	60068-2-37	Test Fdc: Random vibration wideband – Reproducibility Low	F-2
Fe	60068-2-59	Test Fe: Vibration. Sine-beat method	F-3
Ff	60068-2-57	Test Ff: Vibration. Time-history method	F-4
Fg	60068-2-65	Test Fg: Vibration, acoustically induced	F-5
Fh	60068-2-64	Test Fh: Vibration, broadband random (digital control) and guidance	F-6
Ga	60068-2-7	Test Ga and guidance: Acceleration, steady state	G-1
J	60068-2-10	Test J: Mould growth	J-1
Ka	60068-2-11	Test Ka: Salt mist	K-1
Kb	60068-2-52	Test Kb: Salt mist, cyclic (sodium chloride solution)	K-2
Kc	60068-2-42	Test Kc: Sulphur dioxide test for contacts and connections	K-3
Kd	60068-2-43	Test Kd: Hydrogen sulphide test for contacts and connections	K-3
M	60068-2-13	Test M: Low air pressure	M-1

<i>Test designation</i>	<i>IEC Publication</i>	<i>Title</i>	<i>Sheet</i>
N, Na, Nb, Nc	60068-2-14	Test N: Change of temperature	N-1
Q	60068-2-17	Test Q: Sealing	Q-1
Qa		Test Qa: Sealing of bushes, spindles and gaskets	Q-2
Qc		Test Qc: Container sealing, gas leakage	Q-3
Qd		Test Qd: Container sealing, seepage of filling liquid	Q-4
Qf		Test Qf: Immersion	Q-5
Qk		Test Qk: Sealing tracer gas method with mass spectrometer	Q-6
Ql		Test Ql: Bomb pressure test	Q-7
Qm		Test Qm: Tracer gas sealing test with internal pressurization	Q-8
R	60068-2-18	Test R and guidance: Water	R-1
Ra		Falling drops	R-2
Rb		Impacting water	R-3
Rc		Immersion	R-4
Sa	60068-2-5	Test Sa: Simulated solar radiation at ground level	S-1
T		Test T: Soldering	
Ta	60068-2-20	Test Ta: Solderability of wire and tag terminations	T-1
	60068-2-54	Test Ta: Soldering – Solderability testing by the wetting balance method	T-2
Tb	60068-2-20	Test Tb: Resistance of components to soldering heat	T-3
Tc	60068-2-20	Test Tc: Solderability of printed boards and metal-clad laminates	T-4
Td	60068-2-58	Test Td: Solderability, resistance to dissolution of metallization and to soldering heat of Surface Mounting Devices (SMD)	T-5
U	60068-2-21	Test U: Robustness of terminations and integral mounting devices	
Ua ₁		Test Ua ₁ : Tensile	U-1
Ua ₂		Test Ua ₂ : Thrust	U-2
Ub		Test Ub: Bending	U-3
Uc		Test Uc: Torsion	U-4
Ud		Test Ud: Torque	U-5
Ue		Test Ue: Surface Mounting Devices (SMD) in the mounted state (applicable to SMD)	U-6
Xa	60068-2-45	Test Xa and guidance: Immersion in cleaning solvents	X-1

<i>Test designation</i>	<i>IEC Publication</i>	<i>Title</i>	<i>Sheet</i>
Z/ABDM	60068-2-61	Test Z/ABDM: Climatic sequence	Z-5
Z/AD	60068-2-38	Test Z/AD: Composite temperature/humidity cyclic test	Z-1
Z/AFc	60068-2-50	Test Z/AFc: Combined cold/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens	Z-2
Z/AM	60068-2-40	Test Z/AM: Combined cold/low air pressure tests	Z-3
Z/AMD	60068-2-39	Test Z/AMD: Composite sequential cold, low air pressure and damp heat test	Z-4
Z/BFc	60068-2-51	Test Z/BFc: Combined dry heat/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens	Z-2
Z/BM	60068-2-41	Test Z/BM: Combined dry heat/low air pressure tests	Z-3

5 Lists of guidance documents

Many of the publications referred to in 4.1 and 4.2 contain guidance on the execution or application of the test procedure. In some cases, there is reference to other publications, containing guidance only, and these are listed in 5.1 and 5.2.

NOTE – A reference to a publication is to the edition of the standard identified by its date on the corresponding test summary sheet and to all similarly identified amendments.

5.1 Numerical list

<i>IEC Publication</i>	<i>Test designation</i>	<i>Title</i>	<i>Sheet</i>
60068-2-9	Sa	Guidance for solar radiation testing	S-1
60068-2-28	Ca, Db, Z/AD	Guidance for damp heat tests	C-1, D-1, Z-1
60068-2-33	N	Guidance on change of temperature tests	N-1
60068-2-44	T	Guidance on Test T: Soldering	T-1, T-3, T-4
60068-2-46	Kd	Guidance to Test Kd: Hydrogen sulphide test for contacts and connections	K-3
60068-2-49	Kc	Guidance to Test Kc: Sulphur dioxide test for contacts and connections	K-3
60068-2-53	Z/AFc and Z/BFc	Guidance to Tests Z/AFc and Z/BFc: Combined temperature (cold and dry heat) and vibration (sinusoidal) tests	Z-2
60068-3-1	A and B	Background information: Section One – Cold and dry heat tests	A/B-1
60068-3-1A	A and B	First supplement to IEC 60068-3-1	A/B-1
60068-3-2	Z/AM and Z/BM	Background information: Section Two – Combined temperature/low air pressure tests	Z-3

<i>IEC Publication</i>	<i>Test designation</i>	<i>Title</i>	<i>Sheet</i>
(260)	(Ca and Db)	Test enclosures of non-injection type for constant relative humidity	(C-1, D-1)
(355)	(Kb, Kc, Kd)	An appraisal of the problems of accelerated testing for atmospheric corrosion	(K-2, K-3)

5.2 Alphabetical list

<i>Test designation</i>	<i>IEC Publication</i>	<i>Title</i>	<i>Sheet</i>
A and B	60068-3-1	Background information: Section One – Cold and dry heat tests	A/B-1
Ca	60068-2-28	Guidance for damp heat tests	C-1
(Ca)	(260)	Test enclosures of non-injection type for constant relative humidity	(C-1)
Db	60068-2-28	Guidance for damp heat tests	D-1
(Db)	(260)	Test enclosures of non-injection type for constant relative humidity	(D-1)
(Kb, Kc, Kd)	(355)	An appraisal of the problems of accelerated testing for atmospheric corrosion	(K-2, K-3)
Kc	60068-2-49	Guidance to Test Kc: Sulphur dioxide test for contacts and connections	K-3
Kd	60068-2-46	Guidance to Test Kd: Hydrogen sulphide test for contacts and connections	K-3
N	60068-2-33	Guidance on change of temperature tests	N-1
R	60068-2-18	Test R and guidance: Water	R-1
Sa	60068-2-9	Guidance for solar radiation testing	S-1
T	60068-2-44	Guidance on Test T: Soldering	T-1, T-3, T-4
Z/AD	60068-2-28	Guidance for damp heat tests	Z-1
Z/AFc	60068-2-53	Guidance to Tests Z/AFc and Z/BFc: Combined temperature (cold and dry heat) and vibration (sinusoidal) tests	Z-2
Z/AM	60068-3-2	Background information: Section Two – Combined temperature/low air pressure tests	Z-3
Z/BFc	60068-2-53	Guidance to Tests Z/AFc and Z/BFc: Combined temperature (cold and dry heat) and vibration (sinusoidal) tests	Z-2
Z/BM	60068-3-2	Background information: Section Two – Combined temperature/low air pressure tests	Z-3

6 Test summaries

The sheets for the individual summaries in this clause are identified by the letters identifying the test(s) considered and are filed in alphabetical order of the related sheet reference. Current sheets with their identifying date of issue are listed below in the order in which they are filed. This list, together with these introductory sentences in clause 6, will be reissued every time that new individual summaries are added or existing ones are revised or withdrawn.

<i>Sheet</i>	<i>Issue date</i>	<i>Test designation(s)</i>	<i>IEC Publication(s)</i>
A/B-1	1991	Tests A and	60068-2-1 and
	1974	Tests B	60068-2-2
C-1	1991	Test Ca	60068-2-3
C-2	1991	Test Cb	60068-2-56
D-1	1991	Test Db	60068-2-30
E-1	1987	Test Ea	60068-2-27
E-2	1987	Test Eb	60068-2-29
E-3	1969	Test Ec	60068-2-31
E-4	1991	Test Ed	60068-2-32
E-5	1987	Test Ee	60068-2-55
E-6	1991	Test Ef	60068-2-62
E-7	1991	Test Eg	60068-2-63
F-1	1982	Test Fc	60068-2-6
F-2	1973	Test Fd	60068-2-34,
		Test Fda	60068-2-35
		Test Fdb	60068-2-36
		Test Fdc	60068-2-37
F-3	1991	Test Fe	60068-2-59
F-4	1991	Test Ff	60068-2-57
F-5	1993	Test Fg	60068-2-65
F-6	1993	Test Fh	60068-2-64
G-1	1983	Test Ga	60068-2-7
J-1	1991	Test J	60068-2-10
K-1	1981	Test Ka	60068-2-11
K-2	1984	Test Kb	60068-2-52
K-3	1982, 1976	Test Kc and	60068-2-42 and
		Test Kd	60068-2-43
M-1	1983	Test M	60068-2-13
N-1	1984	Test N	60068-2-14
Q-1	1991	Test Q	60068-2-17
Q-2	1978	Test Qa	60068-2-17
Q-3	1978	Test Qc	60068-2-17

<i>Sheet</i>	<i>Issue date</i>	<i>Test designation(s)</i>	<i>IEC Publication(s)</i>
Q-4	1978	Test Qd	60068-2-17
Q-5	1978	Test Qf	60068-2-17
Q-6	1991	Test Qk	60068-2-17
Q-7	1978	Test Ql	60068-2-17
Q-8	1991	Test Qm	60068-2-17
R-1	1991	Test R	60068-2-18
R-2	1989	Test Ra	60068-2-18
R-3	1989	Test Rb	60068-2-18
R-4	1989	Test Rc	60068-2-18
S-1	1975	Test Sa	60068-2-5
T-1	1979	Test Ta	60068-2-20
T-2*	1985	Test Ta*	60068-2-54
T-3	1979	Test Tb	60068-2-20
T-4	1979	Test Tc	60068-2-20
T-5	1989	Test Td	60068-2-58
U-1	1983	Test Ua ₁	60068-2-21
U-2	1983	Test Ua ₂	60068-2-21
U-3	1983	Test Ub	60068-2-21
U-4	1983	Test Uc	60068-2-21
U-5	1983	Test Ud	60068-2-21
U-6	1991	Test Ue	60068-2-21
X-1	1980	Test XA	60068-2-45
Z-1	1974	Test Z/AD	60068-2-38
Z-2	1983	Test Z/AFc and Test Z/BFc	60068-2-50 and 60068-2-51
Z-3	1976	Test Z/AM and Test Z/BM	60068-2-40 and 60068-2-41
Z-4	1976	Test Z/AMD	60068-2-39
Z-5	1991	Test Z/ABDM	60068-2-61

* Sheet T-1 deals with Methods 1, 2 and 3 of Test Ta of IEC 60068-2-20.

COLD: Tests A – IEC 60068-2-1 (1990).

DRY HEAT: Tests B – IEC 60068-2-2 (1974)* and IEC 60068-2-2A (1976).

1 Introduction

IEC 60068-2 deals with cold and dry heat tests applicable both to heat-dissipating and non-heat-dissipating specimens.

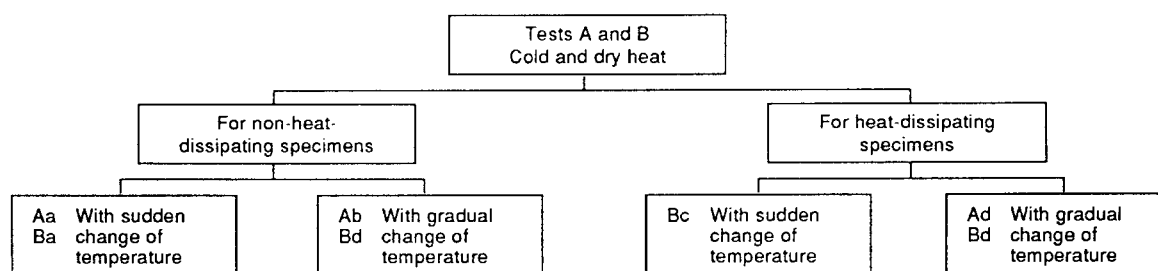
They are subdivided into tests with sudden and gradual change of temperature.

The object of these tests is to determine the ability of components, equipment or other articles to be used or stored at low or high temperature. They do not permit the assessment of the ability of specimens to withstand or operate during temperature variations, for which it is necessary to use Test N: Change of temperature.

The procedures given in these tests are normally intended for specimens which achieve temperature stability during the performance of the test.

Tests Aa, Ba and Bc shall be used only when it is known that the effects of a sudden change of temperature are not detrimental to the test specimen.

The cold and dry heat tests are subdivided as in the block diagram below:



2 General description

The specimen is at the ambient temperature of the laboratory when introduced into the chamber. For tests with sudden change of temperature the chamber is at the temperature appropriate to the degree of severity as specified in the relevant specification; for the tests with gradual change of temperature it is at the temperature of the laboratory. In the latter case the temperature is then changed to the temperature appropriate to the degree of severity specified in the relevant specification.

After temperature stability of the specimen has been reached the specimen is exposed to the test conditions for the specified duration.

Non-heat-dissipating specimens under test are normally in non-operating conditions. Forced air circulation is normally used for this test. For heat-dissipating specimens the relevant specification defines the functioning of the specimens under test and testing with no forced air circulation is the preferred method. Forced air circulation may, however, be used when it is difficult or impossible to meet the conditions specified for testing without air circulation. Alternative methods for this situation are given in IEC 60068-2.

* The 1987 reprint includes IEC 60068-2-2A.

3 Severities

Tests A: Cold			Tests B: Dry heat			
Temperature °C		Duration h	Temperature °C 1)			Duration h
-65	-10	2	+200	+100	+40	2
-55	-5	16	+175	+85	+30	16
-40	+5	72	+155	+70		72
-25		96	+125	+55		96

1) In the absence of other considerations, temperatures above 200 °C and up to 1 000 °C should be chosen from the following values: 250 °C, 315 °C, 400 °C, 500 °C, 630 °C, 800 °C, 1 000 °C.

4 Information to be given in the relevant specification

The relevant specification shall identify the test to be used (including the following details) taking account of clause 1 of this summary.

- | | |
|--|---|
| a) Preconditioning. | f) Measurements and/or loading during conditioning. |
| b) Initial measurements. | g) Recovery if non-standard. |
| c) Details of mounting or supports. | h) Final measurements. |
| d) State of specimen including cooling system during conditioning. | i) Any deviation in procedure as agreed upon between customer and supplier. |
| e) Severity, temperature and duration of exposure. | |

IEC 60068-4: INFORMATION FOR SPECIFICATION WRITERS – TEST SUMMARIES **Ca**

DAMP HEAT, STEADY STATE: Test Ca – IEC 60068-2-3 (1969) and Amendment 1 (1984)

See also: IEC 60068-2-28: Guidance for damp heat tests (1990) and IEC 260: Test enclosures of non-injection type for constant relative humidity (1968).

1 Introduction

The object of this test is to determine the suitability of components, equipment or other electrotechnical products for use and storage under conditions of high relative humidity.

This test is primarily intended to permit the observation of the effects of high humidity at constant temperature over a prescribed period.

2 General description

Specimens are exposed to a damp heat environment which is maintained at a temperature of 40 °C and a relative humidity of 93 %.

3 Severities

The exposure time is chosen from the following:

- 4 days
- 10 days
- 21 days
- 56 days

4 Information to be given in the relevant specification

- a) Preconditioning procedure.
- b) Electrical and mechanical checks to be made prior to the test.
- c) State of the specimen as introduced into the chamber.
- d) Severity.
- e) Loading during conditioning.
- f) Electrical and mechanical checks to be made during conditioning and the period(s) after which they shall be performed.
- g) Special precautions to be taken regarding removal of surface moisture.
- h) Recovery conditions if other than standard.
- i) Electrical and mechanical checks to be made at the end of the test, the parameters to be measured first, and the maximum period allowed for the measurement of these parameters.

IEC 60068-4: INFORMATION FOR SPECIFICATION WRITERS – TEST SUMMARIES **Cb**
 DAMP HEAT, STEADY STATE, PRIMARILY FOR EQUIPMENT:
 Test Cb – IEC 60068-2-56 (1988)

1 Introduction

The object of this test is to determine the suitability of electrotechnical products, primarily for equipment, for use and storage under conditions of high humidity.

This test is primarily intended to permit the observation of the effect of high humidity at constant temperature without condensation of the specimen over a prescribed period.

The test is particularly applicable to large equipment or equipment having complex interconnections with test equipment external to the chamber, requiring a set-up time which prevents the use of pre-heating and the maintenance of specified conditions during the installation period.

2 General description

Specimens are exposed to a damp heat environment.

3 Severities

Combinations of temperature and relative humidity shall be selected from the following:

30 ± 2 °C	93 ± 3 % H.R.
30 ± 2 °C	85 ± 3 % H.R.
40 ± 2 °C	93 ± 3 % H.R.
40 ± 2 °C	85 ± 3 % H.R.

Preferred test durations: 2, 4, 10, 21 days.

4 Information to be given in the relevant specification

- a) Specific mounting structures, if required.
- b) Test severity: – temperature,
– relative humidity,
– duration.
- c) Initial measurements.
- d) Conditioning.
- e) Intermediate measurements.
- f) Recovery conditions.
- g) Final measurements.

IEC 60068-4: INFORMATION FOR SPECIFICATION WRITERS – TEST SUMMARIES

Db**DAMP HEAT, CYCLIC (12 + 12-HOUR CYCLE):**

Test Db – IEC 60068-2-30 (1980) and Amendment 1 (1985)

See also: IEC 60068-2-28: Guidance for damp heat tests (1990) and IEC 260: Test enclosures of non-injection type for constant relative humidity (1968).

1 Introduction

The object of this test is to determine the suitability of components, equipment or other electrotechnical products for use and storage under conditions of high humidity when combined with cyclic temperature changes and, in general, producing condensation on the surface of the specimen.

2 General description

This test comprises one or more temperature cycles between 25 °C and the upper temperature of the cycle in which the relative humidity is maintained at a high level.

Two variants of the cycle are given; they are identical except for the temperature fall period. During this part of the cycle, variant 2 allows wider tolerances of relative humidity and rate of temperature fall.

3 Severities

The severity is chosen from the following:

- a) upper temperature: 40 °C,
number of cycles: 2, 6, 12, 21, 56;
- b) upper temperature: 55 °C,
number of cycles: 1, 2, 6.

4 Information to be given in the relevant specification

- a) Severity.
- b) Initial measurements.
- c) State of the specimen during conditioning.
- d) Details of mounting or supports.
- e) Variant 1 or 2.
- f) Intermediate measurements.
- g) Recovery conditions.
- h) Special precautions to be taken regarding the removal of surface moisture.
- i) Electrical and mechanical checks to be made at the end of the test, the parameters to be measured first, and the maximum period allowed for the measurement of these parameters (final measurements).

1 Introduction

The object of this test is to reveal mechanical weakness and/or degradation in specified performance in specimens for applications in which they will be subjected to non-repetitive mechanical shocks. It may also be used to determine their structural integrity and as a means of quality control. It is intended as a means of producing in the specimen, the effects of relatively infrequent non-repetitive shocks likely to be encountered by equipments and components in service or during transportation.

2 General description

For the purpose of this test the specimen is always fastened to the fixture or the table of the shock testing machine during conditioning and is subjected to a pulse (acceleration against time) whose shape can be either half-sine (most generally applicable), final-peak saw-tooth, or trapezoidal (not primarily intended for component type specimens) as prescribed in the relevant specification.

3 Severities

Peak acceleration		Corresponding duration of the nominal pulse
g_n	(Equivalent m/s^2)	ms
5	(50)	30
15	(150)	11
<u>30</u>	<u>(300)</u>	<u>18</u>
30	(300)	11
30	(300)	6
<u>50</u>	<u>(500)</u>	<u>11</u>
50	(500)	3
100	(1 000)	11
<u>100</u>	<u>(1 000)</u>	<u>6</u>
200	(2 000)	6
200	(2 000)	3
<u>500</u>	<u>(5 000)</u>	<u>1</u>
1 000	(10 000)	1
<u>1 500</u>	<u>(15 000)</u>	<u>0,5</u>
3 000	(30 000)	0,2

In the above table the preferred combinations of peak acceleration and corresponding duration of the nominal pulse are underlined.

4 Information to be given in the relevant specification

- Pulse shape.
- Tolerances, special cases.
- Velocity change, special cases.
- Transverse motion, special cases.
- Method of mounting.
- Severity.
- Preconditioning.
- Initial measurements.
- Directions and number of shocks, in special cases only.
- Operating modes and functional monitoring.
- Acceptance and rejection criteria.
- Recovery.
- Final measurements.
- High-frequency cut-off.

1 Introduction

The object of this test is to reveal the accumulated damage or degradation in specimens for applications in which they will be subjected to repetitive shocks. It may also be used to assess their structural integrity. It is intended as a means of producing, in the specimen, effects similar to those resulting from repetitive shocks likely to be encountered by equipments and components in service or during transportation.

The test is primarily intended for unpackaged specimens and for items in their transport case, when the latter may be considered as part of the specimen itself.

2 General description

For the purpose of this test the specimen is always fastened to the fixture or the table of the bump tester during conditioning and is subjected to repeated half-sine pulses for which the number, peak acceleration and duration is prescribed by the relevant specification.

3 Severities

The severity is defined as a combination of peak acceleration, duration and number of bumps. The number of bumps in each direction is chosen from 100, 1 000, 4 000.

Peak acceleration		Corresponding duration of the nominal pulse
g_n	(Equivalent m/s^2)	
10	(100)	16
15	(150)	6
25	(250)	6
40	(400)	6
100	(1 000)	2

4 Information to be given in the relevant specification

- Tolerances, special cases.
- Velocity change, special cases.
- Transverse motion, special cases.
- Method of mounting.
- Severity.
- Preconditioning.
- Initial measurements.
- Directions and number of bumps, in special cases only.
- Operating modes and functional monitoring.
- Acceptance and rejection criteria.
- Recovery.
- Final measurements.

IEC 60068-4: INFORMATION FOR SPECIFICATION WRITERS – TEST SUMMARIES **Ec**
 DROP AND TOPPLE, PRIMARILY FOR EQUIPMENT-TYPE SPECIMENS:
 TEST Ec – IEC 60068-2-31 (1969) and Amendment 1 (1982).

1 Introduction

The object of this test, which is primarily for equipment type specimens, is to assess the effects upon a specimen of knocks and jolts likely to occur during repair work or rough handling in use, on a table or bench.

It may also be used to demonstrate a minimum degree of robustness for the purpose of assessing safety requirements.

It is primarily intended for specimens out of their packing and for items in their transport cases, when the latter may be considered as part of the specimen itself.

2 General description

The test consists of three distinct procedures:

- a) Dropping on to a face.
- b) Dropping on to a corner.
- c) Toppling (or pushover).

The relevant specification shall state the procedure to be used, taking into account the dimensions and the positions of the centre of gravity of the specimen.

3 Severities

- a) Dropping on to a face

One edge of the specimen is lifted to 25 mm, 50 mm or 100 mm, as prescribed by the relevant specification, or so that an angle of 30° is formed, whichever condition is the less severe. It is then allowed to fall freely.

The specimen is subjected to one drop about each of the four bottom edges.

- b) Dropping on to a corner

A wooden block 10 mm high is placed under one corner and a 20 mm wooden block under an adjacent corner of one of the bottom edges. The other corner adjacent to the 10 mm block is raised to 25 mm, 50 mm or 100 mm, as prescribed in the relevant specification, or so that an angle of 30° is formed, whichever condition is the less severe. It is then allowed to fall freely.

The specimen is subjected to one drop on each of four bottom corners by applying the test along four bottom edges in turn.

- c) Topple (or pushover)

The specimen is tilted about one bottom edge until it reaches a position of instability. It is then allowed to fall.

The specimen is subjected to one topple about each of four bottom edges.

4 Information to be given in the relevant specification

- a) Initial measurements.
- b) Conditioning procedure.
- c) Fitting of cables, covers, etc.
- d) Whether or not the specimen is operational during the test.
- e) Edges to be used in the test, where there are more than four bottom edges.
- f) The height of drop on to a face.
- g) The height of drop on to a corner.
- h) Final measurements.

1 Introduction

This test is divided into: Procedure 1 – Free fall, and Procedure 2 – Free fall – repeated. The first simulates falls which a specimen, normally in the unpacked state, could undergo during handling.

The second simulates repeated falls, for example by means of a tumbling barrel. Such repeated falls may occur to devices such as connectors or small remote control units which are normally attached to cables during use.

2 General description

2.1 Free fall

The specimen is dropped freely from a prescribed height on to a smooth, hard, rigid, test surface, normally of concrete or steel.

2.2 Free fall – repeated

The specimen is allowed to fall a prescribed number of times from a height of 500 mm at a rate of approximately 10 falls per min on to a smooth, hard, rigid test surface which, unless otherwise prescribed by the relevant specification, is of steel of 3 mm in thickness backed by wood between 10 mm and 19 mm in thickness. These requirements can be fulfilled by using a rotating or tumbling barrel.

3 Severities

3.1 Free fall

The height of fall is selected from the following values, 25 mm, 50 mm, 100 mm, 250 mm, 500 mm, 1 000 mm. The values underlined are preferred. It may not be appropriate for heavy equipment to be subjected to the higher severities.

3.2 Free fall – repeated

The total number of falls is selected from the following values: 50, 100, 200, 500, 1 000.

4 Information to be given in the relevant specification

4.1 Free fall

- Test surface if other than concrete or steel.
- Height of fall.
- Initial measurements.
- Attitude from which the specimen is dropped.
- Number of falls, if other than two. Unless otherwise prescribed in the relevant specifications, the specimen shall be subjected to two falls from each prescribed attitude.
- Final measurements.

4.2 Free fall – repeated

- Initial measurements.
- Number of falls.
- Final measurements.
- Type of cable to be attached.

1 Introduction

The object of this test is to determine the ability of a specimen to withstand the effects of bouncing, such as is caused, for example, by random shocks during transport as loose cargo. It may also be used to determine the structural integrity of specimens.

NOTE – In practice, this test is primarily applicable to equipment-type specimens.

This test is primarily intended for specimens prepared for transportation, including those in their transport case when the latter may be considered as part of the specimen itself.

2 General description

For this test, the specimen prepared as for transportation, with or without its transport case, is placed, without being attached, on the platform of the bounce tester during conditioning. The motion of the platform may be "synchronous circular" (Method A) or "non-synchronous" (Method B), varying cyclically between a linear vertical and an oscillatory motion.

Normally, for this test the specimen is not functioning and it is sufficient that it should survive the conditioning.

3 Severities

The duration of the conditioning expressed in minutes, exclusive of recovery periods, is selected from the following values: 180, 60, 15, 5. This duration is divided equally between the specified attitudes.

4 Information to be given in the relevant specification

- a) Acceptance and rejection criteria.
- b) Test method and motion of the platform.
- c) Testing with or without the transport case.
- d) Size of test facility.
- e) Severity.
- f) Preconditioning.
- g) Initial measurements.
- h) Attitude and orientation of the specimen.
- i) Stacking requirements.
- j) Final measurements.

1 Introduction

The object of this test is to determine the ability of a specimen to withstand specified values of impact, principally to demonstrate mechanical robustness when assessing the safety of a specimen, in particular electrical accessories such as switches and lampholders.

2 General description

The test apparatus, of which an example is described in annex A, applies an impact value horizontally to the specimen mounted on the apparatus (0,15 J to 0,50 J).

The relevant specification shall state whether the specimen is required to operate during impact and if functional monitoring is required.

3 Severities

The severity is defined by the number of impacts, which is five unless otherwise prescribed by the relevant specification, in each attitude of the specimen, and the nominal height of fall (in mm), which is selected by the relevant specification from the following:

Height of fall: 75; 100; 150; 200; 250.

4 Information to be given in the relevant specification

Particular attention shall be paid to the items marked with an asterisk (*) which indicates that this information is always required:

- a) Method of mounting, if other than direct.
- b) Height of fall*.
- c) Number of impacts (in each attitude), if other than 5.
- d) Preconditioning.
- e) Initial measurements.
- f) Attitudes and impact locations*.
- g) Operating mode and functional monitoring*.
- h) Acceptance and rejection criteria*.
- i) Recovery.
- j) Final measurements*.

1 Introduction

The object of this test is to determine the ability of a specimen to withstand specified severities of impact, principally to demonstrate mechanical robustness when assessing the safety of a specimen, in particular household and similar appliances, accessories and similar items.

2 General description

The spring-operated impact (spring hammer) hand-held test apparatus described in the standard is used to apply a prescribed number of impacts, defined by their impact energy, as the prescribed location(s) on the specimen. The relevant specification shall state whether the specimen is required to operate during impact and if functional monitoring is required.

As prescribed by the relevant specification, the specimen is mounted by its normal means on a rigid plane support or is placed against a rigid plane support. The relevant specification shall also state any requirements for securing bases, covers and similar components before the specimen is subjected to the impacts.

3 Severities

The severity is defined by the number of impacts, which is five unless otherwise prescribed by the relevant specification, and the impact energy (in joules) selected by the relevant specification from the following:

Impact energy: 0,20; 0,35; 0,50; 0,70; 1,00.

4 Information to be given in the relevant specification

Particular attention shall be paid to the items marked with an asterisk (*) which indicates that this information is always required:

- a) Method of mounting.
- b) Impact energy*.
- c) Number of impacts, if other than 5.
- d) Preconditioning.
- e) Initial measurements*.
- f) Impact locations*.
- g) Securing of bases, covers and similar components, when prescribed.
- h) Operating mode and functional monitoring*.
- i) Acceptance and rejection criteria*.
- j) Conditions for recovery, when prescribed.
- k) Final measurements*.

IEC 60068-4: INFORMATION FOR SPECIFICATION WRITERS – TEST SUMMARIES **Fc**
 VIBRATION (SINUSOIDAL):
 Test Fc – IEC 60068-2-6 (1982) and Amendment 1 (1983) and 2 (1985).

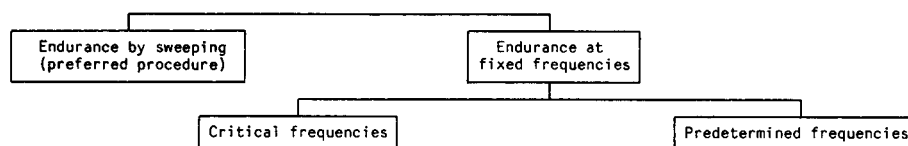
1 Introduction

The object of this test is to determine mechanical weakness and/or degradation of specimens which, during transportation or in service, may be subjected to vibration of a harmonic pattern, generated primarily by rotating, pulsating or oscillating forces such as occur in ships, aircraft, land vehicles, rotorcraft and space applications or are caused by machinery and seismic phenomena.

It may be used to determine the structural integrity of specimens and/or to study their dynamic behaviour.

2 General description

The relevant specification is required to state whether or not a vibration response investigation shall be performed and to select the suitable endurance procedure(s) from the following:



The specimen is subjected to sinusoidal vibration over a specified frequency range, or at discrete frequencies for a given period of time. In certain circumstances, the relevant specification may require an additional response investigation on completion of the endurance procedure(s).

3 Severities

The vibration severity is defined by the combination of frequency range, vibration amplitude and duration of endurance (in sweep cycles, for example 10 to 150 to 10 Hz, or time).

Frequency ranges and vibration amplitudes (peak values):

Recommended frequency range	
Hz	
1	~ 35
1	~ 100
10	~ 55
10	~ 150
10	~ 500
10	~ 2000
10	~ 5000
55	~ 500
55	~ 2000
55	~ 5000
100	~ 2000

Recommended vibration amplitudes with a cross-over frequency of					
8 Hz to 9 Hz: lower			57 Hz to 62 Hz: higher		
Note 1	Note 2		Note 1	Note 2	
mm	(in)	m/s ² (g _n)	mm	(in)	m/s ² (g _n)
0.35	(0.014)	0.98 (0.1)	0.035	(0.0014)	4.9 (0.5)
0.75	(0.03)	1.96 (0.2)	0.075	(0.003)	9.8 (1.0)
1.5	(0.06)	4.9 (0.5)	0.15	(0.006)	19.6 (2.0)
3.5	(0.14)	9.8 (1.0)	0.35	(0.014)	49 (5.0)
7.5	(0.30)	19.6 (2.0)	0.75	(0.03)	98 (10)
10	(0.40)	29.4 (3.0)	1.0	(0.04)	147 (15)
15	(0.60)	49 (5.0)	1.5	(0.06)	196 (20)
			2.0	(0.08)	294 (30)
			3.5	(0.14)	490 (50)

Note 1.- Displacement amplitude below the cross-over frequency
 Note 2.- Acceleration amplitude above the cross-over frequency

Recommended vibration displacement amplitudes applicable only for frequency ranges with an upper frequency of 10 Hz	
Displacement amplitude	
mm	(in)
10	(0.40)
35	(1.4)
75	(3.0)
100	(4.0)

Duration of endurance

- Endurance by sweeping.** The duration of the endurance in each axis shall be specified as a number of sweep cycles chosen from the following values: 1, 2, 5, 10, 50, 100.
- Endurance at critical frequencies.** The duration of the endurance in each appropriate axis at each frequency found during the vibration response investigation shall be specified from the following values: 10 min, 30 min, 90 min, 10 h.
- Endurance at predetermined frequencies.** The duration shall have an upper limit of 10⁷ reversals for each state combination of frequency and axis.

4 Information to be given in the relevant specification

Particular attention should be paid to the items marked with an asterisk (*) where this information is always required.

- | | | |
|------------------------------------|--|---|
| a) Measuring points | k) Preconditioning | |
| b) Transverse motion | l) Initial measurements* | s) Predetermined frequencies |
| c) Distortion | m) Axes of vibration | t) Conditioning at the resonance frequencies of the specimen on its isolators |
| | | u) Final measurements* |
| d) Derivation of control signal | n) Force limitation | |
| e) Tolerances at checkpoints | o) Test stages to be performed and sequence* | |
| f) Mounting of specimen(s) | p) Functioning and functional checks* | |
| g) Frequency range* | q) Action to be taken after the vibration response investigation | |
| h) Vibration amplitude* | | |
| i) Special crossover frequency | | |
| j) Type and duration of endurance* | | |