IEC 60068-2-53

Edition 2.0 2010-04

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Environmental testing –
Part 2-53: Tests and guidance – Combined climatic (temperature/humidity) and dynamic (vibration/shock) tests

Essais d'environnement –
Partie 2-53: Essais et guide – Essais combinés climatiques (température/humidité) et dynamiques (vibrations/chocs)

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ENVIRONMENTAL TESTING –

Part 2-53: Tests and guidance – Combined climatic (temperature/humidity) and dynamic (vibration/shock) tests

FOREWORD

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International Standard IEC 60068-2-53 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test.

This second edition cancels and replaces

- the first edition of IEC 60068-2-50, published in 1983,
- the first edition of IEC 60068-2-51, published in 1983 and
- the first edition of 60068-2-53, published in 1984

and constitutes a technical revision.

The main changes with respect to the previous editions of all three standards cited above is to update and group tests. In this way it allows for the possibility to use different kinds of vibration excitation – sine, random or mixed mode – or shocks, with different tests for climatic conditions – cold, dry heat, change of temperature or constant and cyclic damp heat

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

FDIS	Report on voting
104/499/FDIS	104/514/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 list of all the parts in 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 stability 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- withdrawn,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.

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INTRODUCTION

Equipment and components are required to function without significant reduction in performance when subjected to different environmental parameters.

The type and severity of the environmental parameters depend on the operational, transport and storage environments to which the equipment and components are subjected. The environmental effects on the performance of equipments in the tropics and subtropics are totally different from those in arctic regions. Individual parameters cause a variety of different and overlapping effects on the equipment and components.

The manufacturer attempts to ensure, and the user expects, that equipment and components will survive the environments to which they will be subjected throughout their useful life. This expectation can be assessed by exposure of the specimen to a range of simulated environmental parameters controlled in the laboratory. The severity of the environmental parameters is often increased to obtain meaningful results in a relatively short period of time. This allows assessment of the likely effects of applied environmental conditions.

The combination of temperature, humidity and vibration occurs especially in the domains of automotive, rail and aerospace environments.

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ENVIRONMENTAL TESTING –

Part 2-53: Tests and guidance – Combined climatic (temperature/humidity) and dynamic (vibration/shock) tests

1 Scope

This part of IEC 60068 provides a description of test methods and guidance for testing equipment or components under combined climatic and dynamic conditions.

The purpose of combined testing is to investigate to what extent the equipment or components are affected by combined climatic and dynamic tests.

The method of combined tests detects electrical, mechanical or other physical variations.

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, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1, *Environmental testing – Part 2-1: Tests – Test A: Cold*

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

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

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

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

IEC 60068-2-30, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-64, *Environmental testing – Part 2-64: Tests – Test Fh: Vibration, broadband random (digital control) and guidance*

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

IEC 60068-2-80, *Environmental testing – Part 2-80: Tests – Test Fi: Vibration – Mixed mode*

3 Testing

3.1 General

All parameters such as temperatures, cold, dry heat, temperature change, type of vibration, exposure time to temperature, exposure time to vibration, number of shocks, repetition time of

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shocks, axis of shock or vibration, state of operation and so on, shall be selected from the relevant IEC 60068-2 standards or relevant specification.

The combinations of environmental conditions should be selected to ensure that electrical and mechanical performances of the specimen are satisfactory under storage, transportation and operational conditions. Certain combinations of possible tests shown in Table 1 may not be practicable.

Examples of these include the following:

– full sweep of sinusoidal vibration spectrum not completed during change of temperature or temperature cycling;
– temperature stabilization of dynamic non linear systems, e.g. anti vibration mounts during vibration with change of temperature or temperature cycling;
– full cycle of mixed mode vibration during change of temperature or temperature cycling.

Table 1 – Allowable combinations of IEC standards

Climatic tests	Dynamic tests			
	Shock	Vibration (sinusoidal)	Vibration (broad band random)	Vibration (mixed mode)
	IEC 60068-2-27	IEC 60068-2-6	IEC 60068-2-64	IEC 60068-2-80
Cold IEC 60068-2-1	X	X	X	X
Dry heat IEC 60068-2-2	X	X	X	X
Change of temperature IEC 60068-2-14	X	X	X	X
Damp heat, cyclic IEC 60068-2-30	X	X	X	X
Damp heat, constant IEC 60068-2-78	X	X	X	X

Specimens may be repositioned for shock or vibration along another axis at standard climatic conditions according to IEC 60068-1, as required by the relevant specification. The dynamic test shall be continued when the required test temperature and humidity has been reached.

3.2 Temperature information

If cold or dry heat testing is required, the exposure time shall not commence until all parts of the specimen have reached a temperature within at least 3 K of the working space temperature. For heat-dissipating specimens, the period of exposure shall not begin until the temperature of the specimens changes not more than 1 K within 1 h at the stabilized working space temperature. The last hour of the temperature-soaking time shall be considered to be the first hour of the exposure period.

If a damp heat constant testing is required, the exposure time shall not commence until all parts of the specimen have reached a temperature within at least 3 K of the temperature, and a relative humidity within 3 % of the humidity, within the working space of the test chamber. For heat-dissipating specimens, the period of exposure shall not begin until the temperature of the specimens changes not more than 1 K within 1 h at the stabilized working space temperature. The last hour of the temperature-soaking time shall be considered to be the first hour of the exposure period.

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If slow temperature change test or damp heat cyclic test is performed, the required exposure time starts with the beginning of temperature change.

If the specimen is mounted on shock absorbers, time shall be given for temperature stabilization of the absorber elements.

3.3 Dynamic test information

The relevant specification shall contain dynamic test information. The dynamic test information includes following details (see also Clause 5):

a) identification of dynamic test (such as sinusoidal, random, mixed mode vibration or impact);

b) severities of dynamic stress;

c) axis and directions of dynamic stress;

d) duration and timing of dynamic stress (see Annex A);

e) IEC 60068-2-47 shall be referred to concerning mounting of specimen;

f) other details specified in the reference standards.

3.4 Initial measurement and functional performance test

The specimen shall be submitted to the visual, dimensional, functional and any other checks prescribed by the relevant specification.

3.5 Operating condition of specimen

In the case of electrically-operated specimens, the times at which the power supply shall be powered on or off and the voltage of the power supply within each temperature cycle shall be specified in the relevant specification.

The times at which other functions such as cooling, heating and various loads are switched on or off shall be stipulated in the relevant specification or controlled by a special type of test equipment.

3.6 Mechanical conditioning of specimen

The mechanical conditioning of the specimen per cycle shall preferably be performed in the last hour of the hot or cold phase, i.e. prior to the changeover to the following limit temperature, or shall be performed in any other combination which can be defined in the relevant specification. If the specimen is operated by power supply, this shall be connected for the duration of the mechanical conditioning.

4 Final measurements

The specimen shall be submitted to the visual, dimensional and functional checks prescribed by the relevant specification.

The relevant specification shall provide the criteria upon which the acceptance or rejection of the specimen is to be based.

5 Information to be given in the relevant specification

The relevant specification shall contain the following details as far as they are applicable:

a) exposure time to temperature;

b) test chamber temperature change rate;

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c) test temperature;
d) number of temperature cycles;
e) combined test schedule;
f) vibration severity;
g) number of cycles, by damp heat, cyclic;
h) shock severity;
i) axis and directions of shock and/or vibration;
j) state of operation;
k) number of specimens,
l) humidity if relevant for combined test;
m) preconditioning;
n) type and scope of initial measurement;
o) period of operation;
p) type and scope of intermediate measurement;
q) recovery;
r) type and scope of final measurement;
s) criteria for evaluation;
t) type and scope of test report.

6 Information to be given in the test report

When this test included in the relevant specification, the following details shall be given where applicable:

a)	Customer	(name and address)
b)	Test laboratory	(name and address and details of accreditation – if any)
c)	Test dates	(dates when test was run)
d)	Type of test	(kind of vibration or shock, cold or dry heat, slow temperature change, damp heat, cyclic or constant)
e)	Required values	(temperature, humidity, acceleration, frequency range, etc.)
f)	Purpose of test	(development, qualification, etc.)
g)	Test standard, edition	(IEC 60068-2-53, edition used)
h)	Relevant laboratory test procedure	(code and issue)
i)	Test specimen description	(drawing, photo, quantity build status, etc.)
j)	Test chamber and vibration system identity	(manufacturer, model number, unique id, etc.)
k)	Performance of test apparatus	(set point temperature control, set point acceleration control air flow, etc.)
l)	Air velocity and direction	(air velocity and direction of incident air to the specimen)
m)	Uncertainties of measurement system	(uncertainties data, including temperature stability of transducer sensitivities)
n)	Calibration data	(last and next due date)
o)	Initial, intermediate and final measurements	(initial, intermediate and final measurements)
p)	Required severities	(from relevant specification)

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q)	Test severities	(measuring points, data, etc.)
r)	Performance of test specimens	(results of functional tests etc.)
s)	Observations during testing and actions taken	(any pertinent observations)
t)	Summary of test	(test summary)
u)	Distribution	(distribution list)

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