

British Standard

Environmental testing

Part 1.1 General and guidance

Essais d'environnement

Partie 1.1 Généralités et guide

Grundsätzliche Umweltprüfverfahren

Teil 1.1 Allgemeines und Leitfaden

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National foreword

This British Standard has been prepared under the direction of the General Electrotechnical Standards Policy Committee. It is identical with IEC Publication 68-1 : 1988 (Sixth Edition) 'Environmental testing Part 1 : General and guidance' published by the International Electrotechnical Commission (IEC). Like most parts of the IEC Publication 68 it is subject to CENELEC Harmonization Document (HD) 323.

This is the sixth revision of this British Standard and it supersedes BS 2011 : Part 1.1 : 1983, which is withdrawn.

The title of BS 2011 has been changed to 'Environmental testing' to correspond with the change in the title of IEC 68. This change reflects that IEC 68 and BS 2011 are concerned with the whole subject of testing, and avoids any possible confusion over whether it is the 'procedures' or the 'testing' that are basic. Amendments will not be issued to the other Parts of BS 2011, but their titles will be changed when these Parts are revised.

Cross-references

International standard *	Corresponding British Standard
	BS 2011 Basic environmental testing procedures
IEC 68-2-14 : 1984	Part 2.1N : 1985 Test N. Change of temperature (Identical)
IEC 68-2-20 : 1979	Part 2.1T : 1981 Test T. Soldering (Identical)
IEC 68-2-27 : 1987	Part 2.1Ea : 1988 Test Ea. Shock (Identical)
IEC 68-2-38 : 1974	Part 2.1Z/AD : 1977 Test Z/AD. Composite temperature/humidity cyclic test (Identical)
IEC 68-2-47 : 1982	Section 4.1 : 1983 Specification for mounting of components, equipment and other articles for dynamic tests (Identical)
IEC 68-2-48 : 1982	Section 4.2 : 1984 Guidance on the application of tests of BS 2011 to simulate the effects of storage (Identical)
	Part 3 Background information
IEC 68-3-1 : 1974	Part 3A & B : 1977 Tests A (cold) and tests B (dry heat) (Identical)
IEC 68-3-1A : 1978	Part 3A & B : Supplement No. 1 : 1980 Tests A (cold) and tests B (dry heat) (Identical)
IEC 68-4 : 1987	PD 6521 : 1988 Summaries of test methods for environmental testing of electrotechnical products (Identical)
IEC 529 : 1976	BS 5490 : 1977 Specification for degrees of protection provided by enclosures (Identical)
	BS 6458 Fire hazard testing for electrotechnical products
IEC 695-2-1 : 1980	Section 2.1 : 1984 Glow-wire test (Identical)
IEC 695-2-2 : 1980	Section 2.2 : 1984 Needle-flame test (Identical)
IEC 695-2-3 : 1984	Section 2.3 : 1985 Bad-connection test with heaters (Identical)
IEC 50(301, 302, 302 : 1983)	BS 4727 Glossary of electrotechnical power, telecommunication, electronics lighting and colour terms Part 1 Terms common to power telecommunications and electronics Group 04 : 1986 Measurement terminology (Technically equivalent)

The Technical Committee has reviewed the provisions of IEC 271 and IEC 3205, referred to in the text, and has decided that they are acceptable for use in conjunction with this standard. British Standards that are related to these international standards are listed below.

IEC 271 : 1974	BS 4200 Guide to the reliability of electronic equipment and parts used therein Part 2 : 1974 Terminology
ISO 3205 : 1976	BS 2782 Methods of testing plastics Part 0 : 1982 Introduction

There are no corresponding British Standards for IEC 721 : Guide 104 : 1984 or ISO 554 : 1976. The Technical Committee has reviewed the provisions of these publications and has decided that they are acceptable for use in conjunction with this standard.

Additional information

Some of the tests in Part 2 of this British Standard call for the use of substances and procedures that may be injurious to health if adequate precautions are not taken. The tests refer only to technical suitability and do not absolve the user from legal obligations relating to health and safety at any stage. Attention is particularly drawn to the Health and Safety at Work etc. Act 1974.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

* Undated in the text.

ENVIRONMENTAL TESTING

Part 1: General and guidance

1. Introduction

- 1.1 IEC Publication 68 contains fundamental information on environmental testing procedures and severities of tests. In addition, Part 1 contains information on atmospheric conditions for measurement and testing.

It is intended to be used in those cases where a relevant specification for a certain type of product (electrical, electromechanical and electronic equipment and devices, their sub-assemblies and constituent parts and components), hereinafter referred to as “specimen”, has to be prepared, so as to achieve uniformity and reproducibility in the environmental testing of this product.

Note. — Although primarily intended for electrotechnical products, many of the environmental testing procedures in Part 2 of this publication are equally applicable to other industrial products.

The expression “environmental conditioning” or “environmental testing” covers the natural and artificial environments to which specimens may be exposed so that an assessment can be made of their performance under conditions of use, transport and storage to which they may be subjected in practice.

The requirements for the performance of specimens subjected to environmental conditioning are not covered by this publication. The relevant specification for the specimen under test defines the allowed performance limits during and after environmental testing.

When drafting a relevant specification or purchasing contract, only those tests should be specified that are necessary for the relevant specimen taking into account the technical and economic aspects.

IEC Publication 68 consists of:

- a) this first Part (Publication 68-1) which deals with generalities;

Note. — Attention is drawn to Publication 68-2-48.

- b) the second Part (Publication 68-2) published as separate booklets each dealing with a family of tests or a particular test or guidance for their application;

Note. — Attention is drawn to Publication 68-2-47.

- c) the third Part (Publication 68-3) published as separate booklets each dealing with background information on a family of tests;

- d) the fourth Part (Publication 68-4), giving information for specification writers, published in two sections of which the second, in loose-leaf form, contains summaries of all the current tests in Publication 68-2;

Note. — Fire hazard tests are separately published in IEC Publication 695.

- 1.2 The following historical survey gives the significant features of this and of the earlier editions:

First edition (1954)

Contained not only the general part but also many of the individual tests which now form part of the Publication 68-2 series.

Second edition (1960)

Format changed to Publication 68-1: General. Tests published separately as Publication 68-2 series. Degrees of severity were included for all tests.

Third edition (1968)

Degrees of severity dropped, many more definitions included which were amended and added to in Amendment No.1, December 1972, and component climatic category introduced. The recovery clause (Sub-clause 5.4) was intended to apply to normal applications so that ALL SPECIMENS would be submitted to rigidly controlled conditions, unless otherwise specified. Supplement A was issued in December 1974 to add further definitions of combined and composite tests and sequences of tests.

Fourth edition (1978)

Amendment No.1 and Supplement A to the third edition were incorporated in this edition and an amendment to standard recovery conditions, also including further recovery conditions with wider tolerances on temperature and humidity, was added to the original Sub-clause 5.4 of the third edition.

Fifth edition (1982)

This edition comprised the text of the fourth edition with the addition of Clause 10: Significance of the numerical value of a quantity, and of an appendix giving general guidance on environmental testing.

Sixth edition (1988)

This edition contains a largely editorial revision of the fifth edition, the technical content of IEC Publication 160, which will be withdrawn, and technical amendments of Clause 7 and Appendix A.

- 1.3 The families of tests comprising Part 2 of this publication are designated by the following upper case letters:

- A: Cold.
- B: Dry heat.
- C: Damp heat (steady state).
- D: Damp heat (cyclic).
- E: Impact (for example shock and bump).
- F: Vibration.
- G: Acceleration (steady state).

H: Awaiting allocation (was originally allotted to “storage” tests for which see note in Item *a*) of Sub-clause 1.1.

J: Mould growth.

K: Corrosive atmospheres (for example salt mist).

L: Dust and sand.

M: Air pressure (high or low).

N: Change of temperature.

P: Awaiting allocation (was originally allotted to “flammability” tests now being dealt with as “fire hazard” tests in IEC Publication 695).

Q: Sealing (including panel sealing, container sealing and protection against ingress and leakage of fluid).

R: Water (for example rain, dripping water).

S: Radiation (for example solar, but excluding electromagnetic).

T: Soldering (including resistance to heat from soldering).

U: Robustness of terminations (of components).

V: Awaiting allocation (was originally allocated to “acoustic noise” but “vibration, acoustically induced” will now be Test Fg, one of the “vibration” family of tests).

W: Awaiting allocation.

Y: Awaiting allocation.

The letter X is used as a prefix together with a second upper case letter providing for extension of the list of families of tests, e.g. Test XA: Immersion in cleaning solvents. The letter Z is used to denote combined tests and composite tests as follows: Z is followed by a solidus and a group of upper case letters relating to the combined or composite stresses, for example Test Z/AM: Combined cold and low air pressure tests.

If appropriate, any test may be designated as “primarily intended for components” or “primarily intended for equipment”.

- 1.4 To provide for future expansion within a family of tests and to maintain consistency of presentation, each family of tests may be subdivided. The subdivisions are identified by the addition of a (lower case) second letter, for example:

U: Robustness of terminations and integral mounting devices

Test Ua: Subdivided as Test Ua₁: Tensile and Test Ua₂: Thrust

Test Ub: Bending

Test Uc: Torsion

Test Ud: Torque

This subdivision will be made even though only one test is published and no further tests are immediately contemplated in the relevant family.

In order to avoid confusion with numbers, the letters i, I, o and O will not be used.

- 1.5 See editorial footnote.

Editorial note. — “Safety pilot functions” (see IEC Guide 104) have been allocated to Sub-Committee 50A for “mechanical robustness” testing and to Sub-Committee 50B for “corrosion” testing.

2. Scope

Publication 68 includes a series of methods of environmental test and their appropriate severities, and prescribes various atmospheric conditions for measurements and tests designed to assess the ability of specimens to perform under expected conditions of transportation, storage and all aspects of operational use.

Although primarily intended for electrotechnical products this publication is not restricted to them and may be used in other fields where desired.

Other methods of environmental test, specific to the individual types of specimen, may be included in the relevant specifications.

3. Object

The object of Publication 68 is to provide a series of uniform and reproducible methods of environmental (primarily climatic and mechanical robustness) test, with standard atmospheric conditions for measurements and tests, for those preparing specifications and for those engaged in the testing of those products.

These methods of test have been based upon available international engineering experience and judgement and are primarily designed to provide information on the following properties of specimens:

- a) The ability to operate within specified limits of temperature, pressure, humidity, mechanical stress or other environmental conditions and certain combinations of these conditions.

Note. — IEC Publication 721-1 defines “environmental conditions”, and environmental conditions occurring in nature are classified in IEC Publications 721-2 and 721-3.

- b) The ability to withstand conditions of transportation and storage.

The tests in this publication permit the comparison of the performance of sample products. To assess the quality or useful life, as defined in Sub-clause 16.4 of IEC Publication 271, of a given production lot, the methods of test should be applied in accordance with a suitable sampling plan and may be supplemented by appropriate additional tests if necessary.

To provide tests appropriate to the different intensities of an environmental condition, some of the test procedures have a number of degrees of severity. These different degrees of severity are obtained by varying the time, temperature, air pressure or some other determining factor separately or in combination.

This standard should be used in conjunction with the relevant specification which will define the tests to be used, the required degree of severity for each of them, their order, if relevant, and the permissible performance limits.

4. Definitions

The tests covered by this publication may in themselves consist of a series of operations in order to determine the effect of such a test, or series of tests, on a specimen. The following terminology has been adopted for the purpose of this publication.

4.1 *Test*

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

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

Notes 1. — Intermediate measurements may be required during conditioning and/or recovery.

2. — When the temperature and humidity for conditioning of a specimen for measurement (see Sub-clause 4.15) are the same as those prescribed for pre-conditioning, the pre-conditioning and conditioning may be merged, and the pre-conditioning may be said to take the place of conditioning for measurement.

4.1.1 *Pre-conditioning*

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

Notes 1. — Where pre-conditioning is called for, it is the first process in the test procedure.

2. — Pre-conditioning may be effected by subjecting the specimen to climatic, electrical, or any other conditions required by the relevant specification in order that the properties of the specimen may be stabilized before measurement and test.

4.1.2 *Conditioning*

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

Note. — For the definition of “conditioning (of a specimen for measurement)” see Sub-clause 4.15.

4.1.3 *Recovery*

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

4.2 *Specimen*

Product designated to be tested in accordance with the procedures of Publication 68.

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.

4.3 *Heat-dissipating specimen*

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

Note. — Measurements required to prove that a specimen can be regarded as non-heat-dissipating can be made under standard atmospheric conditions for measurement and tests if care has been taken that no outside influence (for example draughts or sunlight) affects the measurements. In the case of large or complicated specimens, it may be necessary to make measurements at several points.

4.4 *Free air conditions*

Conditions within an infinite space where the movement of the air is affected only by the heat-dissipating specimen, and the energy radiated by the specimen is absorbed.

Note. — Theoretically, this definition does not apply to the case where the heating of the specimen is by direct radiation. In practice, however, the definition may be used also for this case.

4.5 *Relevant specification*

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

4.6 *Ambient temperature*

Temperature of the air defined for the two following cases.

Note. — In applying these definitions, guidance should be sought from Publication 68-3-1 and its supplement 68-3-1A.

4.6.1 *Non-heat-dissipating specimens*

Temperature of the air surrounding the specimen.

4.6.2 *Heat-dissipating specimens*

Temperature of the air in free air conditions at such a distance from the specimen that the effect of the dissipation is negligible.

Note. — In practice, the ambient temperature is taken as the average of temperatures measured at a number of points in a horizontal plane situated between 0 mm and 50 mm below the specimen at half the distance between the specimen and the wall of the chamber or at 1 m distance from the specimen, whichever is less. Suitable precautions should be taken to avoid heat radiation affecting these measurements.

4.7 *Surface temperature (case temperature)*

Temperature measured at one or more specified points on the surface of the specimen.

4.8 *Thermal stability*

State when the temperatures of all parts of the specimen are within 3 °C, or as otherwise prescribed by the relevant specification, of their final temperature.

Notes 1. — For non-heat-dissipating specimens, the final temperature will be the mean (in time) temperature of the chamber in which the specimen is placed. For heat-dissipating specimens, it is necessary to make repeated measurements to determine the interval of time for the temperature to change 3 °C, or as otherwise prescribed by the relevant specification. Thermal stability has been reached when the ratio between two consecutive time intervals exceeds 1.7.

2. — Where the thermal time constant of the specimen is short compared with the duration of the exposure to a given temperature, no measurement is needed. Where the thermal time constant of the specimen is of the same order as the duration of the exposure, checks should be made to ascertain:

- a) that non-heat-dissipating specimens are within the required limit of the mean (in time) ambient temperature;
- b) that for heat-dissipating specimens the ratio between two consecutive time intervals exceeds 1.7 when repeated measurements are made to determine the interval of time required for the temperature to change by 3 °C, or as otherwise prescribed by the relevant specification.