

Environmental testing —

Part 2: Tests methods —

Test Fe: Vibration — Sine beat method

This Part should be read in conjunction with Part 1.1 General and guidance

The European Standard EN 60068-2-59:1993 has the status of a
British Standard

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the General Electrotechnical Standards Policy Committee (GEL/-) to Technical Committee GEL/15, upon which the following bodies were represented:

- Directorate of Telecommunications
- EEA (The Association of Electronics, Telecommunications and Business Equipment Industries)
- Electronic Components Industry Federation
- Ministry of Defence
- National Supervising Inspectorate
- Society of Environmental Engineers
- Society of Motor Manufacturers and Traders Limited

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

- Association of Manufacturers of Domestic Electrical Appliances
- BEAMA Ltd.
- British Telecommunications plc
- Department of Trade and Industry (National Engineering Laboratory)
- United Kingdom Atomic Energy Authority

This British Standard, having been prepared under the direction of the General Electrotechnical Standards Policy Committee, was published under the authority of the Standards Board and comes into effect on 31 July 1991

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The following BSI references relate to the work on this standard:
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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 68-2-59:1990 “*Environmental testing — Part 2: Test methods — Test Fe: Vibration — Sine-beat method*” published by the International Electrotechnical Commission (IEC).

In 1993 the European Committee for Electrotechnical Standardization (CENELEC) accepted IEC 68-2-59:1990 as European Standard EN 60068-2-59:1993. As a consequence of implementing the European Standard this British Standard is renumbered as BS EN 60068-2-59 and any reference to BS 2011-2.1 Fe should be read as a reference to BS EN 60068-2-59.

The title of BS 2011 has been changed to “Environmental testing” to correspond with the change in the title of IEC Publication 68. This change reflects the fact that IEC Publication 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 are not being issued to the other Parts of BS 2011, but their titles are being changed when these Parts are revised.

Cross-references

International standard ^a	Corresponding British Standard
	BS 2011 Environmental testing
IEC 68-1:1988	Part 1.1:1989 General and guidance (Identical)
IEC 68-2-6:1982	Part 2.1Fc:1983 Test Fc. Vibration (sinusoidal) (Identical)
IEC 68-2-47:1982	Section 4.1:1983 Specification for mounting of components, equipment and other articles for dynamic tests (Identical)
IEC 68-3-3:1991	Section 4.3 Guidance on seismic test methods for equipment ^b (Identical)

^a Undated in the text.

^b In Preparation.

The Technical Committee has reviewed the provisions of ISO 2041:1975, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this standard. A related British Standard to ISO 2041:1975 is BS 3015:1976 “*Glossary of terms relating to mechanical vibration and shock*”.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 24, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Descriptors: Electricity, component, equipment, vibration, seism, sine-beat, procedures, components specifications writing, equipment specifications writing

English version

Environmental testing Part 2: Test methods Test Fe: Vibration — Sine beat method

(IEC 68-2-59:1990)

Essais d'environnement

Deuxième partie: Méthodes d'essai Essai Fe:

Vibrations — Méthode par sinusoïdes modulées
(CEI 68-2-59:1990)

Umweltprüfungen

Teil 2: Prüfungen

Prüfung Fe: Schwingen Sinusimpulse
(IEC 68-2-59:1990)

This European Standard was approved by CENELEC on 1993-03-09. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

Central Secretariat: rue de Stassart 35, B-1050 Brussels

Foreword

At the request of CENELEC Reporting Secretariat SR 50A, HD 323.2.59 S1:1991 (IEC 68-2-59:1990) was submitted to the CENELEC voting procedure for conversion into a European Standard.

The text of the International Standard was approved by CENELEC as EN 60068-2-59 on 9 March 1993. The following dates were fixed:

- latest date of publication of
an identical national standard (dop) 1994-3-01
- latest date of withdrawal of
conflicting national standards (dow) —

Annexes designated “normative” are part of the body of the standard. Annexes designated “informative” are given only for information. In this standard, Annex A is informative and Annex ZA is normative.

Introduction

This standard details methods for testing components, equipments and other electrotechnical products (hereinafter referred to as “specimens”) which in service can be subjected to pulsating or oscillating forces of short duration caused, for example, by seismic or explosive phenomena or by vibration in machinery.

In this test the specimen is excited at fixed frequencies with a preset number of sine beats (see Figure 1). These fixed test frequencies are predetermined frequencies, critical frequencies identified by means of a sinusoidal vibration test (IEC 68-2-6) or both. Pauses are provided between the individual sine beats in order to allow decay of the free response of the specimen.

Specification writers will find in clause 12 a list of details to be considered for inclusion in specifications and, in Annex A, the guidance.

Related documents

The following international standards are directly referred to in this standard:

IEC 68, *Environmental testing*.

IEC 68-1:1988, *Part 1: General and guidance*.

IEC 68-2-6:1982, *Part 2: Tests — Test Fc and guidance: Vibration (sinusoidal)*.

IEC 68-2-47:1982, *Mounting of components, equipment and other articles for dynamic tests including shock (Ea), bump (Eb), vibration (Fc and Fd) and steady-state acceleration (Ga) and guidance*.

IEC 68-3-3:19.., *Part 3: Guidance. Section 3: Seismic test methods for equipments*.

ISO 2041:1975, *Vibration and shock — Vocabulary*.

1 Object

To provide a standard procedure for determining, by the sine-beat method, the ability of a specimen to withstand specified severities of transient vibration.

2 General description

The purpose of this test is to determine mechanical weakness and/or degradation in specified performance and to use this information, in conjunction with the relevant specification, to decide whether a specimen is acceptable or not. It may also be used, in some cases, to demonstrate the mechanical robustness of specimens and/or to study their dynamic behaviour.

The extent to which a specimen has to function during vibration or merely to survive conditions of vibration shall be stated in the relevant specification.

Procedures are described for conducting the test and for the measurement of the vibration at given points. The requirements for the vibration motion and for the choice of severities (including frequency range, test levels, sine-beat cycles and number of sine beats) are also detailed.

It is emphasized that vibration testing always demands a certain degree of engineering judgement and both supplier and purchaser should be fully aware of this fact. The writer of the relevant specification is expected to select the testing procedure and the values of severity appropriate to the specimen and its use.

For the purpose of this test the specimen is always fastened to the vibration table.

In order to facilitate the use of this standard, references are given in the main part where the reader is invited to refer to Annex A; additionally the clause numbers in the main part are referred to in Annex A which also gives specific information on the correlation between sine beats of displacement, velocity and acceleration.

This standard is to be used in conjunction with IEC 68-1.

3 Definitions

The terms used are generally defined in ISO 2041 and in IEC 68-1 or 68-2-6. Where, for the convenience of the reader, a definition from one of those sources is included here, the derivation is indicated. Departures from the definitions in those sources are also indicated.

The additional terms and definitions that follow are also applicable for the purpose of this standard.

3.1

critical frequency (definition technically equivalent to that of 8.1 of IEC 68-2-6)

frequencies at which:

- malfunctioning and/or deterioration of performance of the specimen which are dependent on vibration are exhibited, and/or
- mechanical resonances and/or other response effects occur, for example chatter.

3.2

crossover frequency (definition technically equivalent to that of ISO 2041)

that frequency at which the characteristic of a vibration changes from one relationship to another

NOTE For example, a crossover frequency may be that frequency at which the test vibration amplitude changes from a constant displacement value versus frequency to a constant acceleration value versus frequency.

3.3

damping (not identical with ISO 2041 definitions)

damping is the generic term ascribed to the numerous energy dissipation mechanisms in a system. In practice, damping depends on many parameters, such as the structural system, mode of vibration, strain, applied forces, velocity, materials, joint slippage, etc.

3.3.1

critical damping

minimum viscous damping that will allow a displaced system to return to its initial position without oscillation

3.3.2

damping ratio

ratio of actual damping to critical damping in a system with viscous damping

3.4

distortion (definition identical with that in clause 3 of IEC 68-2-6; not identical with ISO 2041 definition):

$$\text{distortion } d = \frac{\sqrt{a_{\text{tot}}^2 - a_1^2}}{a_1} \cdot 100 \text{ (in per cent)}$$

where

a_1 is the r.m.s. value of the acceleration at the driving frequency

a_{tot} is the total r.m.s. value of the applied acceleration (including a_1).

3.5

fixing point (definition technically equivalent to that of 3.1 of IEC 68-2-6)

part of the specimen in contact with the fixture or vibration table at a point where the specimen is normally fastened in service

NOTE If a part of the real mounting structure is used as the fixture, the fixing points are taken as those of the mounting structure and not of the specimen.

3.6

“ g_n ” standard acceleration due to the earth’s gravity, Which itself varies with altitude and geographical latitude

NOTE For the purpose of this standard, the value of g_n is rounded up to the nearest whole number, that is 10 m/s².

3.7

measuring points (definition technically identical with that of **3.2** of IEC 68-2-6)

specific points at which data are gathered for conducting the test. These points are of two main types as defined below

NOTE Measurements may be made at points within the specimen in order to assess its behaviour; these are not considered as measuring points in the sense of this standard.

3.7.1

check point

point located on the fixture, on the vibration table or on the specimen as close as possible to one of its fixing points and in any case rigidly connected to it

NOTE 1 A number of check points are used as a means of ensuring that the test requirements are satisfied.

NOTE 2 If four or fewer fixing points exist, each is used as a check point. If more than four fixing points exist, four representative fixing points will be defined in the relevant specification to be used as check points.

NOTE 3 In special cases, for example for large or complex specimens, the check points will be prescribed by the relevant specification if not close to the fixing points.

NOTE 4 Where a large number of small specimens are mounted on one fixture, or in the case of a small specimen where there are several fixing points, a single check point (that is the reference point) may be selected for the derivation of the control signal. This signal is then related to the fixture rather than to the fixing points of the specimen(s). This procedure is only valid when the lowest resonance frequency of the loaded fixture is well above the upper frequency of the test.

3.7.2

reference point (definition technically identical with that of **3.2.2** of IEC 68-2-6)

point, chosen from the check points, whose signal is used to control the test, so that the requirements of this standard are satisfied

3.8

modulating frequency

frequency with which the test frequency is modulated (see clauses **A.2** and **A.3** and Figure 1)

3.9

high-stress cycles

response cycles giving rise to values of stress which would cause fatigue in the specimen

3.10

pause

interval between two consecutive sine beats

NOTE A pause should be such as to result in no significant superposition of the response motion of the specimen and can be obtained from:

$$T > \frac{1}{f} \cdot \frac{100}{d}$$

where

T is the duration (s)

f is the test frequency (Hz)

d is the critical damping at the test frequency (in per cent).

3.11

preferred testing axes

three orthogonal axes which correspond to the most vulnerable axes of the specimen

3.12

sine beat

continuous sinusoidal wave of one frequency which is modulated by a sinusoidal wave of a lower frequency. The duration of one sine beat is half the period of the modulating frequency (see Figure 5)

NOTE See **A.2.1** for a mathematical explanation of the sine-beat signal.