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Environmental testing

Part 2. Methods of test

Test Fg. Vibration, acoustically induced

The European Standard EN 60068-2-65 : 1994 has the status of a British Standard

This Part should be read in conjunction with BS EN 60068-1 : 1995
General and guidance

Committees responsible for this British Standard

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- AEA Technology
- Association of Manufacturers of Domestic Electrical Appliances
- BEAMA Ltd.
- Federation of the Electronics Industry
- Ministry of Defence
- Electrical Installation Equipment Manufacturers' Association (BEAMA Ltd.)

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National foreword

This Section of BS EN 60068 has been prepared by Technical Committee GEL/50/1 and is the English Language version of EN 60068-2-65 : 1994 *Environmental testing Part 2: Methods of test Test Fg: Vibration, acoustically induced*, published by the European Committee for Electrotechnical Standardization (CENELEC). It is identical with IEC 68-2-65 : 1993, published by the International Electrotechnical Commission (IEC).

Cross-references

Publication referred to	Corresponding British Standard
EN 60068-1 (IEC 68-1)	BS EN 60068 <i>Environmental testing</i> Part 1 : 1995 <i>General and guidance</i>
EN 60651 (IEC 651)	BS EN 60651 : 1994 <i>Specification for sound level meters</i>
IEC 50 (151)	BS 4727 <i>Glossary of electrotechnical, power, telecommunication, electronics, lighting and colour terms</i> Part 1 <i>Terms common to power, telecommunications and electronics</i> Group 02 : 1980 <i>Electrical and magnetic devices terminology</i>

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

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English version

Environmental testing
Part 2: Methods of test
Test Fg: Vibration, acoustically induced
(IEC 68-2-65 : 1993)

Essais d'environnement

Partie 2: Méthodes d'essais

Essai Fg: Vibrations, induites acoustiquement
(CEI 68-2-65 : 1993)

Umweltprüfungen

Teil 2: Prüfverfahren

Prüfung Fg: Schwingen, akustisch angeregt
(IEC 68-2-65 : 1993)

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European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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Central Secretariat: rue de Stassart 35, B-1050 Brussels

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Foreword

The text of the International Standard IEC 68-2-65 : 1993, prepared by SC 50A, Vibration impact and other dynamic tests, of IEC TC 50, Environmental testing, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60068-2-65 on 1994-09-01 without any modification

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 1995-10-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 1995-10-01

Annexes designated 'normative' are part of the body of the standard. Annexes designated 'informative' are given for information only. In this standard, annex ZA is normative and annexes A and B are informative. Annex ZA has been added by CENELEC.

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INTRODUCTION

Acoustic noise may produce significant vibration in components and equipment. In the acoustic noise field, pressure fluctuations impinge directly on the specimen and the response may be different to that produced by mechanical excitation.

Items particularly sensitive to acoustic noise include relatively lightweight items whose dimensions are comparable to an acoustic wavelength in the frequency range of interest and whose mass per unit area is low, such as dish antennas and solar panels, electronic devices, printed circuit boards, wiring, optical elements, etc.

This test is applicable to components, equipment and other products, herein after referred to as "specimens", which are liable to be exposed to and/or required to function in conditions of high sound-pressure levels. It should be noted that, under service conditions, the specimen may be subjected to simultaneous mechanical and acoustical excitation.

High sound-pressure levels may be generated by jet engines and other aircraft propulsion systems, rocket motors, high-powered gas circulators, etc. This standard deals with acoustic testing in compressible gases and can also be used to simulate the excitation response caused by turbulence resulting from high velocity separated gas flows.

Testing for the effects of vibration caused by acoustic noise demands a certain degree of engineering judgment and this should be recognized both by the manufacturer/supplier and the purchaser of the specimen. Based on the guidance provided in this part of IEC 68 the writer of the relevant specification is expected to select the most appropriate method of test and values of severity, taking account of the nature of the specimen and its intended use.

Since the acoustic levels occurring during testing are high enough to be potentially damaging to human hearing, appropriate measures need to be taken to reduce preparatory operation and the noise exposure of operators performing the test, to a level regarded as permissible from the standpoint of hearing conservation.

ENVIRONMENTAL TESTING

Part 2: Methods of test – Test Fg: Vibration, acoustically induced

1 Object

To provide standard procedures and guidance for conducting acoustic tests in order to determine the ability of a specimen to withstand vibration caused by a specified sound-pressure level environment to which it is, or is liable to be, subjected. For sound-pressure level environments of less than 120 dB acoustic tests are not normally required.

To determine mechanical weakness and/or degradation in the performance of specimens and to use this information, in conjunction with the relevant specification, to decide their acceptability. In some cases, the methods of test may also be used as a means of establishing the mechanical robustness or fatigue resistance of specimens.

This part of IEC 68 describes the procedures for conducting tests and for measurement of the sound-pressure levels within the acoustic noise field and considers the need for measurement of the vibration responses at specified points on the specimen. It also gives guidance for the selection of the acoustic noise environment, spectrum, sound-pressure level and duration of exposure.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 68. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 68 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 50(151): 1978, *International Electrotechnical Vocabulary (IEV) – Chapter 151: Electrical and magnetic devices*

IEC 50(801): 1984, *International Electrotechnical Vocabulary (IEV) – Chapter 801: Acoustics and electro-acoustics*

IEC 68-1: 1988, *Environmental testing – Part 1: General and guidance*

IEC 651: 1979, *Sound level meters*

ISO 266: 1975, *Acoustics – Preferred frequencies for measurements*

ISO 2041: 1990, *Vibration and shock – Vocabulary*

ISO 2671: 1982, *Environmental tests for aircraft equipment – Part 3.4: Acoustic vibration*

3 Definitions, symbols and abbreviations

The terms used are generally defined in ISO 2041, IEC 68-1 and IEC 50(801). 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 (see also 3.2). The additional terms and definitions that follow are applicable for the purposes of this standard.

3.1 Definitions

3.1.1 acoustic horn (not identical to 801-07-12): Tube of generally exponentially varying section, larger at one end than at the other, used to couple an acoustic source to the test volume, for example the inside of a reverberation room, thus achieving the maximum transfer of energy.

NOTE - Each acoustic horn has individual transfer characteristics which affect the sound spectrum.

3.1.2 analysis integration time: Time duration over which a signal is averaged (see A.8).

3.1.3 bandwidth (identical to B.19 of ISO 2041): Difference between the nominal upper and lower cut-off frequencies.

NOTE - It may be expressed

- a) in hertz;
- b) as a percentage of the pass-band centre frequency; or
- c) as the interval between the upper and lower nominal cut-off frequencies in octaves.

3.1.4 overall sound-pressure level (OASPL): Value computed from the third-octave or octave band sound-pressure levels L_i

$$L_G = 10 \log_{10} \sum_{i=1}^m 10^{L_i/10}$$

where

L_G is the overall sound-pressure level in dB

L_i is the sound-pressure level in the i th third-octave or octave band and

m is the number of third-octave or octave bands.

3.1.5 centre frequency (identical to B.31 of ISO 2041): Geometric mean of the nominal cut-off frequencies of a pass-band.

NOTES

1 ISO 2041 defines the nominal upper and lower cut-off frequencies of a filter pass-band as those frequencies above and below the frequency of maximum response of a filter at which the response to a sinusoidal signal is 3 dB below the maximum response.

2 The geometric mean is equal to $(f_1 \cdot f_2)^{1/2}$, where f_1 and f_2 are the cut-off frequencies.

3.1.6 constant-bandwidth filter (identical to B.21 of ISO 2041): Filter which has a bandwidth of constant value when expressed in hertz. It is independent of the centre frequency of the filter.

3.1.7 cut-off frequency (of acoustic horn): Frequency below which an acoustic horn becomes progressively ineffective; it is a main characteristic of an acoustic horn.

3.1.8 diffuse sound field: (identical to 801-03-31). Sound field which, in a given region, has statistically uniform energy density, for which the directions of propagation at any point are randomly distributed.

NOTE - In a diffuse sound field, the sound-pressure level measured with a directional microphone would give the same results whatever its orientation.

3.1.9 electro or hydraulic-pneumatic transducer: The most generally employed laboratory source of acoustic noise to simulate sound-pressure levels encountered in a high operational ambient acoustic noise environment. It consists of a pneumatic transducer supplied with pressurized gas modulated by an electromagnetic or hydraulic valve.

NOTE - This type of transducer provides a continuous spectrum of energy over a wide frequency band with random amplitude distribution and is capable of providing a shaped sound spectrum to meet the specifications in acoustic testing (see A.5).

3.1.10 frequency interval (identical to 801-10-07): Ratio of two frequencies.

3.1.10.1 octave: Interval between two frequencies which have a ratio of two.

3.1.10.2 one-third octave (1/3): Interval between two frequencies which have a ratio equal to $2^{1/3}$.

NOTE - Octave and third-octave frequency bands are defined by their geometric centre frequencies in ISO 266.

3.1.10.3 one-twelfth octave (1/12): Interval between two frequencies which have a ratio equal to $2^{1/12}$.

3.1.11 measuring points: Specific points at which data are gathered for the conduct of the test. These points are of two main types which are defined below.

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

3.1.11.1 check-points: Points located on a fictitious surface surrounding the specimen and at a fixed distance from it.

3.1.11.2 reference points: Points chosen from the check-points, whose signals are used to control the test so that the requirements of this standard are satisfied.

3.1.12 multipoint control: Control achieved by using the average of the signals at the reference points (see 3.1.11.2).

NOTE - When using multipoint control, each microphone signal relates to the sound-pressure level at one position. The average sound-pressure level L_{AV} can be computed as given in IEC 50 (801), definition 801-11-36, when