# SLOVENSKI STANDARD
# SIST EN 60068-2-64:2001

**01-september-2001**

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**Environmental testing - Part 2: Test methods - Test Fh: Vibration, broad-band random (digital control) and guidance**

Environmental testing -- Part 2: Test methods - Test Fh: Vibration, broad-band random (digital control) and guidance

Umweltprüfungen -- Teil 2: Prüfverfahren - Prüfung Fh: Schwingen, Breitbandrauschen (digital geregelt) und Leitfaden



Essais d'environnement - Partie 2: Méthodes d'essai - Essai Fh: Vibrations aléatoires à large bande (asservissement numérique) et guide



**Ta slovenski standard je istoveten z:** **EN 60068-2-64:1994**

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**ICS:**

| | | |
|---|---|---|
| 19.040 | Preskušanje v zvezi z okoljem | Environmental testing |

**SIST EN 60068-2-64:2001** **en**

EUROPEAN STANDARD EN 60068-2-64

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Descriptors: Environmental testing, electricity, component, equipment, mechanical test, vibration, broad band random, digital control, procedures, components specifications writing, equipment specifications writing

ENGLISH VERSION

# Environmetal testing
# Part 2: Test methods
# Test Fh: Vibration, broad-band random (digital control) and guidance
# (IEC 68-2-64:1993 + corrigendum 1993)

Essais d'environnement
Partie 2: Méthodes d'essai
Essai Fh: Vibrations aléatoires à large bande (asservissement numérique) et guide
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(IEC 68-2-64:1993 + Corrigendum 1993)



This European Standard was approved by CENELEC on 1994-03-08. 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.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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 the CENELEC Reporting Secretariat SR 50A, the International Standard IEC 68-2-64:1993 and its corrigendum October 1993, were submitted to the CENELEC Unique Acceptance Procedure (UAP) in July 1993 for acceptance as a European Standard.

The text of the International Standard was approved by CENELEC as EN 60068-2-64 on 8 March 1994.

The following dates were fixed:

| | | |
|---|---|---|
| - latest date of publication of an identical national standard | (dop) | 1995-03-15 |
| - latest date of withdrawal of conflicting national standards | (dow) | 1995-03-15 |

Annexes designated "normative" are part of the body of the standard. Annexes designated "informative" are given only for information. In this standard, annexes A and ZA are normative and annexes B and C are informative.



## ENDORSEMENT NOTICE



The text of the International Standard IEC 68-2-64:1993 and its corrigendum October 1993, was approved by CENELEC as a European Standard without any modification.

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## ANNEX ZA (normative)

## OTHER INTERNATIONAL PUBLICATIONS QUOTED IN THIS STANDARD WITH THE REFERENCES OF THE RELEVANT EUROPEAN PUBLICATIONS

This European Standard incorporates by dated or undated reference, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this European Standard only when incorporated in it by amendment or revision. For undated references the latest edition of the publication referred to applies.

NOTE : When the international publication has been modified by CENELEC common modifications, indicated by (mod), the relevant EN/HD applies.

| IEC Publication | Date | Title | EN/HD | Date |
|---|---|---|---|---|
| 50(301) | 1983 | International Electrotechnical Vocabulary (IEV) - Chapter 301: General terms on measurements in electricity | - | - |
| 50(302) | 1983 | Chapter 302: Electrical measuring instruments | - | - |
| 50(303) | 1983 | Chapter 303: Electronic measuring instruments (Advanced edition) | - | - |
| 68-1 | 1988 | Environmetal testing - Part 1: General and guidance (corrigendum October 1988) | HD 323.1 S2 | 1988 |
| 68-2-6 | 1982 | Part 2: Tests - Test Fc and guidance: Vibration (sinusoidal) | HD 323.2.6 S2* | 1988 |
| 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 | EN 60068-2-47 | 1993 |
| 721 | series | Classification of environmental conditions | HD 478<br>EN 60721 | series<br>series |

| Other publication |
|---|
| ISO 2041:1990 - Vibration and shock - Vocabulary |



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* HD 323.2.6 S2 includes A1:1983 + A2:1985 to IEC 68-2-6

# NORME INTERNATIONALE
# INTERNATIONAL STANDARD

**CEI**
**IEC**
**68-2-64**

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## Essais d'environnement

**Partie 2:**
Méthodes d'essai
Essai Fh: Vibrations aléatoires à large bande (asservissement numérique) et guide



## Environmental testing



**Part 2:**
Test methods
Test Fh: Vibration, broad-band random (digital control) and guidance



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Международная Электротехническая Комиссия

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*For price, see current catalogue*

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

# ENVIRONMENTAL TESTING

## Part 2: Test methods
## Test Fh: Vibration, broad-band random (digital control) and guidance

### FOREWORD

1) The IEC (International Electrotechnical Commission) is a world-wide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of the IEC is to promote international cooperation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, the IEC publishes International Standards. Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. The IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.



2) The formal decisions or agreements of the IEC on technical matters, prepared by technical committees on which all the National Committees having a special interest therein are represented, express, as nearly as possible, an international consensus of opinion on the subjects dealt with.



3) They have the form of recommendations for international use published in the form of standards, technical reports or guides and they are accepted by the National Committees in that sense.

4) In order to promote international unification, IEC National Committees undertake to apply IEC International Standards transparently to the maximum extent possible in their national and regional standards. Any divergence between the IEC Standard and the corresponding national or regional standard shall be clearly indicated in the latter.

This International Standard has been prepared by sub-committee 50A: Shock and vibration tests, of IEC technical committee 50: Environmental testing.

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

| DIS | Report on Voting | Amendment to DIS | Report on Voting |
|---|---|---|---|
| 50A(CO)206 | 50A(CO)223 | 50A(CO)224 | 50A(CO)227 |

Full information on the voting for the approval of this standard can be found in the reports on voting indicated in the above table.

It has the status of a basic safety publication in accordance with IEC Guide 104.

IEC 68 consists of the following parts, under the general title: Environmental testing.

- Part 1: General and guidance
- Part 2: Tests
- Part 3: Background information
- Part 4: Information for specification writers – Test summaries
- Part 5: Guide to drafting of test methods

Annex A forms an integral part of this standard.

Annexes B and C are for information only.

## INTRODUCTION

This standard for broad-band random vibration testing is intended for general application to specimens of electrotechnical products that may be subjected to vibrations of a stochastic nature. The methods and techniques in this standard are based on digital control of random vibration. It permits the introduction of variations to suit individual cases, if these are prescribed by the relevant specification. The standard provides an alternative to the established analogue versions of the random vibration wide-band tests (test Fd, IEC 68-2-34 to 68-2-37).

It should be noted that random vibration testing is a complex subject requiring both a good basic understanding of the philosophy of the test and the exercise of considerable engineering judgement.

Compared with most other tests, test Fh is not based on deterministic but on statistical techniques. Broad-band random vibration testing is therefore described in terms of probability and statistical averages.

Annex A is a normative annex giving the requirements for the vibration response investigation.

Specification writers will find in clause 11 a list of details to be considered for inclusion in specifications, and in annex B (informative), the guidance.



Annex C is an informative annex, cross-referenced to the relevant clauses, giving the conversion between the quoted values (in dB or percentages) and the values with the alternative magnitudes.

# ENVIRONMENTAL TESTING

## Part 2: Test methods
## Test Fh: Vibration, broad-band random (digital control) and guidance

### 1 Object

The object of this International Standard is to provide two standard test methods (method 1 and method 2) for determining the ability of a specimen to withstand specified severities of broad-band random vibration. Neither test method can be considered more severe than the other, the difference being primarily that method 2 provides more information to quantify the applied test, and is therefore more reproducible.

It is also to reveal the accumulated effects of stress induced by random vibration, and the resulting mechanical weakness and degradation in specified performance and to use this information, in conjunction with the relevant specification, to assess the acceptability of specimens. In some cases, this standard may also be used to demonstrate the mechanical robustness of specimens and/or to study their dynamic behaviour.



This standard is applicable to specimens which may be subjected to vibration of a stochastic nature resulting from transportation or operational environments, for example in aircraft, space vehicles and land vehicles. It is primarily intended for unpackaged specimens, and for items in their transportation container when the latter may be considered as part of the specimen itself.



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

### 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 current valid International Standards.

IEC 50(301, 302, 303): 1983, *International Electrotechnical Vocabulary (IEV).*
*Chapter 301: General terms on measurements in electricity.*
*Chapter 302: Electrical measuring instruments.*
*Chapter 303: Electronic measuring instruments.* (Advance edition)

IEC 68, *Environmental testing.*

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

IEC 68-2, *Environmental testing – Part 2: Tests.*

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

IEC 68-2-47: 1982, *Environmental testing – Part 2: Tests – 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 721, *Classification of environmental conditions.*

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

## 3 Definitions

The terms used are generally defined in ISO 2041 or IEC 50 (301, 302, 303) and in IEC 68-1 or IEC 68-2-6. Where, for the convenience of the reader, a definition from one of those sources is included here, the derivation is indicated and departures from the definitions in those sources are also indicated.

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



3.1 **–3 dB bandwidth, $B_r$** (ISO 2041 modified): Frequency bandwidth between two points in a frequency response function which is 0,707 of the maximum response when associated with a single resonance peak (see 4.3.6.2).



3.2 **acceleration spectral density** (ISO 2041 modified): Mean-square value of that part of an acceleration signal passed by a narrow-band filter of a centre frequency, per unit bandwidth, in the limit as the bandwidth approaches zero and the averaging time approaches infinity (see 4.3.4).

3.3 **bias error:** Systematic error in the estimate of the acceleration spectral density due to the finite frequency resolution used in practice (see 4.3.6.2).

3.4 **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 (see A.2.4.1).

NOTES

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

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.

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.

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.

3.5 **control acceleration spectral density:** Acceleration spectral density measured at the reference point (see 4.3.3).

3.6 **control system loop:** Sum of the following actions:

- digitizing the analogue random waveform of the signal derived from the reference point;
- performing the necessary processing;
- producing an updated analogue random waveform to the vibration system power amplifier (see B.1).

3.7 **crest factor** (ISO 2041): Ratio of the peak value to the r.m.s. value (see 4.3.3).

3.8 **damping ratio:** Ratio of actual damping to critical damping in a system with viscous damping.

3.9 **distortion:** (Definition identical to that in clause 3 of IEC 68-2-6, not identical with ISO 2041 definition.)

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



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 $a_1$.



3.10 **drive signal clipping:** Limitation of the instantaneous value of the drive signal (see 4.3.3).

3.11 **effective frequency range:** Range from the actual frequency below $f_1$ to the actual frequency above $f_2$ due to initial and final slopes (see figure 2).

3.12 **error acceleration spectral density:** Difference between the specified acceleration spectral density and the control acceleration spectral density.

3.13 **equalization:** Minimization of the error acceleration spectral density.

3.14 **final slope:** Part of the specified acceleration spectral density above $f_2$ (see B.2.4).

3.15 **frequency resolution:** Width of the frequency intervals in the acceleration spectral density in Hertz. It is equal to the reciprocal of the record length in digital analysis. The number of frequency lines is equal to the number of intervals in a given frequency range (see 4.3.6).

3.16 "$g_n$": Standard acceleration due to the earth's gravity, which itself varies with altitude and geographical latitude (see 5.3).

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

3.17 **indicated acceleration spectral density:** Estimate of the true acceleration spectral density read from the analyser presentation corrupted by the instrument error, the random error and the bias error (see 4.3.6).

3.18 **initial slope:** Part of the specified acceleration spectral density below $f_1$ (see B.2.4).

3.19 **instrument error:** Error associated with each analogue item of the input to the control system and control system analogue items (see B.2.3.2).

3.20 **multipoint control, averaging:** Control acceleration spectral density formed from the arithmetic average of the acceleration spectral densities at more than one check-point (see B.2.1.2).

3.21 **multipoint control, extremal:** Control acceleration spectral density formed from the maximum of the acceleration spectral density of each frequency line at more than one check-point (see B.2.1.2).

3.22 **preferred testing axes:** Three orthogonal axes which correspond, as far as is practicable, to the most vulnerable axes of the specimen (see 8.1).



3.23 **random error:** Error changing from one estimate to another of the acceleration spectral density because of the limitation of averaging time and filter bandwidth in practice (see B.2.3.3).



3.24 **record:** Collection of equally spaced data points in the time domain that are used in the calculation of the Fast Fourier Transform (see B.1).

3.25 **reference point:** Point, chosen from the check-points, whose signal is used to control the test, so that the requirements of this standard are satisfied.

NOTE - The point may be a fictitious reference point (see A.2.4.2).

3.26 **reproducibility** [IEC 50 (301, 302, 303)]: The closeness of the agreement between the results of measurements of the same value of the same quantity, where the individual measurements are made:

- by different methods;
- with different measuring instruments;
- by different observers;
- in different laboratories;
- after intervals of time which are long compared with the duration of a single measurement;
- under different customary conditions of use of the instruments employed.

NOTE - The term "reproducible" also applies to the case where only certain of the preceding conditions are taken into account.