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(RCJ/JSA)

Environmental testing—Part 2-64: Tests—Test Fh: Vibration, broadband random and guidance

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Foreword

This translation has been made based on the original Japanese Industrial Standard revised by the Minister of Economy, Trade and Industry, through deliberations at the Japanese Industrial Standards Committee as the result of proposal for revision of Japanese Industrial Standard submitted by Reliability Center for Electronic Components of Japan (RCJ)/Japanese Standards Association (JSA) with the draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law applicable to the case of revision by the provision of Article 14.

Consequently **JIS C 60068-2-64:1997** has been replaced with this Standard.

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JIS C 60068 consists of the following 58 parts;

JIS C 60068-1 *General and guidance*

JIS C 60068-2-1 *Part 2-1: Tests—Test A: Cold*

JIS C 60068-2-2 *Part 2-2 : Tests—Test B: Dry heat*

JIS C 60068-2-6 *Part 2-6: Tests—Test Fc: Vibration (sinusoidal)*

JIS C 60068-2-7 *Test Ga and guidance: Acceleration, steady state*

JIS C 60068-2-11 *Test Ka: Salt mist*

JIS C 60068-2-13 *Test M: Low air pressure*

JIS C 60068-2-14 *Part 2-14: Tests—Test N: Change of temperature*

JIS C 60068-2-17 *Test Q: Sealing*

JIS C 60068-2-18 *Part 2-18: Tests—Test R and guidance: Water*

JIS C 60068-2-20 *Part 2-20: Tests—Test T: Test method for solderability and resistance to soldering heat of devices with leads*

JIS C 60068-2-21 *Part 2-21: Tests—Test U: Robustness of termination and integral mounting devices*

JIS C 60068-2-27 *Part 2-27: Tests—Test Ea: Shock*

JIS C 60068-2-30 *Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

JIS C 60068-2-31 *Test Ec: Drop and topple, primarily for equipment-type specimens*

JIS C 60068-2-32 *Test Ed: Free fall*

JIS C 60068-2-38 *Test Z/AD: Composite temperature/humidity cyclic test*

JIS C 60068-2-39 *Test Z/AMD: Combined sequential cold, low air pressure, and damp heat test*

JIS C 60068-2-40 *Test Z/AM: Combined cold/low air pressure tests*

JIS C 60068-2-41 *Test Z/BM: Combined dry heat/low air pressure tests*

- JIS C 60068-2-42 *Test Kc: Sulphur dioxide test for contacts and connections*
- JIS C 60068-2-43 *Test Kd: Hydrogen sulphide test for contacts and connections*
- JIS C 60068-2-45 *Testing procedures of electronic and electrical resistance to solvents (immersion in cleaning solvents)*
- JIS C 60068-2-46 *Guidance to Test Kd: Hydrogen sulphide test for contacts and connections*
- JIS C 60068-2-47 *Part 2-47: Tests—Mounting of specimens for vibration, impact and similar dynamic tests*
- JIS C 60068-2-48 *Guidance on the application of the tests of JIS environmental testing series to simulate the effects of storage*
- JIS C 60068-2-49 *Guidance to Test Kc: Sulphur dioxide test for contacts and connections*
- JIS C 60068-2-50 *Tests Z/AFc: Combined cold/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens*
- JIS C 60068-2-51 *Tests Z/BFc: Combined dry heat/vibration (sinusoidal) tests for both heat-dissipating and non-heat-dissipating specimens*
- JIS C 60068-2-52 *Test Kb: Salt mist, cyclic (sodium, chloride solution)*
- JIS C 60068-2-53 *Guidance to tests Z/AFc and Z/BFc: Combined temperature (cold and dry heat) and vibration (sinusoidal) tests*
- JIS C 60068-2-54 *Test Ta: Solderability testing of electronic components by the wetting balance method*
- JIS C 60068-2-57 *Time-history vibration test method*
- JIS C 60068-2-58 *Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*
- JIS C 60068-2-59 *Test Fe: Vibration—Sine-beat method*
- JIS C 60068-2-60 *Test Ke: Flowing mixed gas corrosion test*
- JIS C 60068-2-61 *Test Z/ABDM: Climatic sequence*
- JIS C 60068-2-64 *Test Fh: Vibration, broadband random and guidance*
- JIS C 60068-2-65 *Part 2-65: Vibration, acoustically induced*
- JIS C 60068-2-66 *Test Cx: Damp heat, steady state (unsaturated pressurized vapour)*
- JIS C 60068-2-67 *Test Cy: Damp heat, steady state, accelerated test primarily intended for components*
- JIS C 60068-2-68 *Dust and sand test*
- JIS C 60068-2-69 *Part 2-69: Tests—Test Te: Solderability testing of electronic components for surface mounting devices (SMD) by the wetting balance method*
- JIS C 60068-2-70 *Test Xb: Abrasion of markings and letterings caused by rubbing of fingers and hands*
- JIS C 60068-2-75 *Part 2-75: Tests—Test Eh: Hammer tests*

- JIS C 60068-2-77 *Part 2-77: Tests—Test 77: Body strength and impact shock*
- JIS C 60068-2-78 *Part 2-78: Tests—Test Cab: Damp heat, steady state*
- JIS C 60068-2-80 *Part 2-80: Tests—Test Fi: Vibration—Mixed mode*
- JIS C 60068-2-81 *Part 2-81: Shock—Shock response spectrum synthesis*
- JIS C 60068-2-82 *Part 2-82: Tests—Test XW1: Whisker test methods for electronic and electric components*
- JIS C 60068-3-1 *Background information, Section One—Cold and dry heat tests*
- JIS C 60068-3-2 *Background information Section Two—Combined temperature / low air pressure tests*
- JIS C 60068-3-3 *Guidance Seismic test method for equipments*
- JIS C 60068-3-4 *Part 3-4: Supporting documentation and guidance—Damp heat tests*
- JIS C 60068-3-5 *Part 3-5: Supporting documentation and guidance—Confirmation of the performance of temperature chambers*
- JIS C 60068-3-6 *Part 3-6: Supporting documentation and guidance—Confirmation of the performance of temperature / humidity chambers*
- JIS C 60068-3-7 *Part 3-7: Supporting documentation and guidance—Measurements in temperature chambers for tests A and B (with load)*
- JIS C 60068-3-8 *Part 3-8: Supporting documentation and guidance—Selecting amongst vibration tests*

Environmental testing—Part 2-64: Tests—Test Fh: Vibration, broadband random and guidance

Introduction

This Japanese Industrial Standard has been prepared based on the second edition of **IEC 60068-2-64** published in 2008 without modifying the technical contents. The corresponding International Standard **IEC 60068-2-64** has the status of a basic safety publication in accordance with **IEC Guide 104**.

The portions with dotted underlines are the matters not given in the corresponding International Standard.

This Standard deals with broadband random vibration testing intended for general application to components, equipment and other products, hereinafter referred to as “specimens”, 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 specifications.

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

It is emphasized that random 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.

The test method is based primarily on the use of an electrodynamic or a servo-hydraulic vibration generator with an associated computer based control system used as a vibration testing system.

Annexes A and B are informative annexes giving examples of test spectra for different environmental conditions, a list of details to be considered for inclusion in specifications and guidance.

1 Scope

This Standard demonstrates the adequacy of specimens to resist dynamic loads without unacceptable degradation of its functional and/or structural integrity when subjected to the specified random vibration test requirements.

Broadband random vibration may be used to identify accumulated stress effects and the resulting mechanical weakness and degradation in the specified performance. This information, in conjunction with the relevant specification, may be used to assess the acceptability of specimens.

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

unpacked specimens, and for items in their transportation container when the latter may be considered as part of the specimen itself. However, if the item is packaged, then the item itself is referred to as a product and the item and its packaging together are referred to as a test specimen. This Standard may be used in conjunction with **JIS C 60068-2-47**, for testing packaged products.

If the specimens are subjected to vibration of a combination of random and deterministic nature resulting from transportation or real life environments, for example in aircraft, space vehicles and for items in their transportation container, testing with pure random may not be sufficient. See **JIS C 60068-3-8** for estimating the dynamic vibration environment of the specimen and based on that, selecting the appropriate test method.

Although primarily intended for electrotechnical specimens, this Standard is not restricted to them and may be used in other fields where desired (see Annex A).

NOTE : The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60068-2-64:2008 *Environmental testing—Part 2-64: Tests—Test Fh: Vibration, broadband random and guidance* (IDT)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and the revisions (including amendments) made thereafter shall not be applied. For those without the indication of the year, the most recent edition (including amendments) shall be applied.

JIS B 0153 *Glossary of terms used in mechanical vibration and shock*

NOTE : Corresponding International Standard: ISO 2041 *Vibration and shock—Vocabulary* (MOD)

JIS C 60068-1 *Environmental testing Part 1: General and guidance*

NOTE : Corresponding International Standard: IEC 60068-1 *Environmental testing—Part 1: General and guidance* (IDT)

JIS C 60068-2-6 *Environmental testing—Part 2-6: Tests—Test Fc: Vibration (sinusoidal)*

NOTE : Corresponding International Standard: IEC 60068-2-6 *Environmental testing—Part 2-6: Tests—Test Fc: Vibration (sinusoidal)* (IDT)

JIS C 60068-2-47:2008 *Environmental testing—Part 2-47: Tests—Mounting of specimens for vibration, impact and similar dynamic tests*

NOTE : Corresponding International Standard: IEC 60068-2-47:2005 *Environmental testing—Part 2-47: Test—Mounting of specimens for vibration, impact and similar dynamic tests* (IDT)

JIS C 60068-3-8:2006 *Environmental testing—Part 3-8: Supporting documentation and guidance—Selecting amongst vibration tests*

NOTE : Corresponding International Standard: IEC 60068-3-8:2003 *Environmental testing—Part 3-8: Supporting documentation and guidance—Selecting amongst vibration tests* (IDT)

JIS C 60721-3 (series) *Classification of environmental conditions Part 3: Classification of groups of environmental parameters and their severities*

NOTE : Corresponding International Standard: IEC 60721-3 (all parts) *Classification of environmental conditions—Part 3: Classification of groups of environmental parameters and their severities* (IDT)

IEC 60050-300 *International Electrotechnical Vocabulary—Electrical and electronic measurements and measuring instruments—Part 311: General terms relating to measurements—Part 312: General terms relating to electrical measurements—Part 313: Types of electrical measuring instruments—Part 314: Specific terms according to the type of instrument*

IEC 60068-5-2:1990 *Environmental testing—Part 5: Guide to drafting of test methods—Terms and definitions*

IEC Guide 104 *The preparation of safety publications and the use of basic safety publications and group safety publications*

3 Terms and definitions

For the purposes of this Standard, the following terms and definitions apply.

NOTE : The terms used are generally defined in **JIS B 0153**, **JIS C 60068-1**, **JIS C 60068-2-6**, **IEC 60050-300** and **IEC 60068-5-2**. If 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.

3.1 cross-axis motion

motion not in the direction of the stimulus; generally specified in the two axes orthogonal to the direction of the stimulus

NOTE : The cross-axis motion should be measured close to the fixing points.

3.2 actual motion

motion represented by the wideband signal returned from the reference point transducer

NOTE : This term is not used in the text but the definition in the corresponding International Standard is kept as it is in this Standard.

3.3 fixing point

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

NOTE 1 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.

NOTE 2 For packaged products, the fixing point of the specimen is interpreted as the packaging surface in contact with the vibration table.

3.4 control methods

3.4.1 single point control

control method using the signal from the transducer at the reference point in order to maintain this point at the specified vibration level

3.4.2 multipoint control

control method using the signals from each of the transducers at the checkpoints

NOTE : The signals are either continuously averaged arithmetically or processed by using comparison techniques, depending upon the relevant specification. See also 3.13.

3.5 g_n

standard acceleration due to the earth's gravity, which itself varies with altitude and geographical latitude

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.

3.6 measuring points

specific points at which data are gathered for conducting the test

NOTE : These points are of three types, as defined in 3.7 to 3.9.

3.7 checkpoint

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 checkpoints 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 checkpoint. For packaged products, where a fixing point may be interpreted as the packaging surface in contact with the vibration table, one checkpoint may be used, provided that there are no effects due to resonances of the vibration table or the mounting structure in the frequency range specified for the test. If this is the case, multipoint control may be necessary. If more than four fixing points exist, four representative fixing points will be defined in the relevant specification to be used as checkpoints.

NOTE 3 In special cases, for example for large or complex specimens, the checkpoints 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 with a number of fixing points, a single checkpoint (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.

3.8 reference point (single-point control)

point, chosen from amongst the checkpoints, whose signal is used to control the test, such that the requirements of this Standard are satisfied

3.9 fictitious reference point (multipoint control)

point, derived from multiple checkpoints either manually or automatically, the result of which is used to control the test so that the requirements of this Standard are satisfied

3.10 response points

specific points on the specimen from which data is gathered for the purpose of the vibration response investigation

NOTE : These points are not the same as checkpoints or reference points.

3.11 preferred testing axes

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

3.12 sampling frequency

number of discrete magnitude values taken per second to record or represent a time-history in a digital form

NOTE : This term is not used in the text but the definition in the corresponding International Standard is kept as it is in this Standard.

3.13 multipoint control strategies

method for calculating the reference control signal when using multipoint control

NOTE : Different frequency domain control strategies, averaging and extremal defined below, are discussed in **4.7.1**.

3.14 averaging

process of determining the control acceleration spectral density formed from the arithmetic average of the acceleration spectral densities at each frequency line of more than one checkpoint

3.15 extremal (maximum or minimum)

process of determining the control acceleration spectral density formed from the maximum or minimum acceleration spectral density at each frequency line of more than one checkpoint

3.16 crest factor

ratio of the peak value to the r.m.s. value of the time history (see **JIS B 0153**)

3.17 -3 dB bandwidth

frequency bandwidth between two points in a frequency response function which are at 0.707 of the maximum response when associated with a single resonance peak

3.18 acceleration spectral density ASD

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

3.19 control acceleration spectral density

acceleration spectral density measured at the reference point or the fictitious reference point

3.20 control system loop

such of the following actions:

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

NOTE : This term is not used in the text but the definition in the corresponding International Standard is kept as it is in this Standard.

3.21 drive signal clipping

limitation of the maximum crest factor of the drive signal effective frequency range

3.22 effective frequency range

frequency range between 0.5 times f_1 and 2.0 times f_2 (see also figure 1)

NOTE : Due to initial and final slope, the effective frequency range is higher than the test frequency range between f_1 and f_2 .

3.23 error acceleration spectral density

difference between the specified acceleration spectral density and the control acceleration spectral density

3.24 equalization

minimization of the error acceleration spectral density

3.25 final slope

part of the specified acceleration spectral density above f_2 (see also figure 1)