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(RCJ/JSA)

**Environmental testing—
Part 2-27: Tests—Test Ea: Shock**

ICS 19.040

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment 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.

Consequently **JIS C 60068-2-27:1995** has been replaced with this Standard, and also **JIS C 60068-2-29:1995** has been withdrawn and replaced with this Standard.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 methods 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 + 12-Hour 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 *Part 2: Tests. 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 *Environmental 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 *Part 2: Tests. 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, broad-band random (digital control) 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 *Part 2: Tests—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 *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 *Part 3: 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 2-27: Tests— Test Ea: Shock

Introduction

This Japanese Industrial Standard has been prepared based on the fourth edition of **IEC 60068-2-27** published in 2008 without modifying the technical contents.

The original International Standard **IEC 60068-2-27** 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.

1 Scope

This Standard specifies the shock test for components, equipments, and other electrotechnical products (hereafter referred to as “specimens”) which during transportation, storage and handling, or in use, may be subjected either to conditions involving relatively infrequent non-repetitive¹⁾ or repetitive²⁾ shocks.

Notes ¹⁾ Non-repetitive shock tests were referred to as “shock tests in **JIS C 60068-2-27**:1995, before the revision.

²⁾ Repetitive shock tests were referred to as “bump tests” in **JIS C 60068-2-29**, which was withdrawn when this Standard was revised.

The shock test basically consists of subjecting a specimen either to non-repetitive or repetitive shocks of standard pulse shapes with specified peak acceleration and duration.

The purpose of this test is to reveal mechanical weakness and/or degradation in specified performances, or accumulated damage or degradation caused by shocks. In conjunction with the relevant specification, this may be used in some cases to determine the structural integrity of specimens or as a means of quality control (see clause **A.2**).

This test is primarily intended for unpackaged specimens and for items in their transport case. When used in conjunction with **JIS C 60068-2-47**, this Standard may be used for testing packaged products. If an item is to be tested unpackaged, it is referred to as a test specimen. 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.

NOTE 1 As for mounting method of packaged products, see **JIS C 60068-2-47**.

This Standard is written in terms of prescribed pulse shapes. Guidance for the selection and application of these pulses is given in Annex A and the characteristics of the different pulse shapes are discussed in Annex B.

Wherever possible, the test severity and the shape of the shock pulse applied to the specimen should be such as to reproduce the effects of the actual transport or operational environment to which the specimen will be subjected, or to satisfy the design requirements if the object of the test is to assess structural integrity (see clauses **A.2** and **A.4**).

For the purposes of this test, the specimen is always mounted to the fixture or the table of the shock testing machine during testing.

NOTE 2 The International Standard corresponding to this Standard and the symbol of degree of correspondence are as follows.

IEC 60068-2-27:2008 *Environmental testing—Part 2-27: Tests—Test Ea and guidance: Shock* (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. The most recent editions (including amendments) indicated below shall be applied.

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

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

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

IEC 60068-2-55 *Environmental testing—Part 2-55: Tests—Test Ee and guidance: Bounce*

3 Terms and definitions

For the purposes of this Standard, the terms and definitions given in **JIS B 0153** and **JIS C 60068-1** together with the following apply.

3.1 check point

point located on the fixture, on the table surface of the shock-testing machine or on the specimen as close as possible to the fixing point, 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 more than four fixing points exist, the relevant specification should state the number of fixing points 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 a number of 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.

3.2 fixing point

part of the specimen in contact with the fixture or the table of the shock-testing machine 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 In the case of packaged products, the surface of the specimen in contact with the table is taken as the fixing point.

3.3 gravitational acceleration, 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 unity, that is 10 m/s².

3.4 repetition rate

number of shocks per second

3.5 shock severity

combination of the peak acceleration, the duration of the nominal pulse and the number of shocks

3.6 velocity change

absolute value of the change of velocity resulting from the application of the specified acceleration

4 Description of test apparatus

4.1 Required characteristics

When the shock-testing machine with or without fixture is loaded with the specimen, the waveform measured at the check point(s) shall consist of a pulse approximating to one of the nominal acceleration against time curves given by the broken lines in figures 1, 2 and 3.

4.1.1 Basic pulse shapes

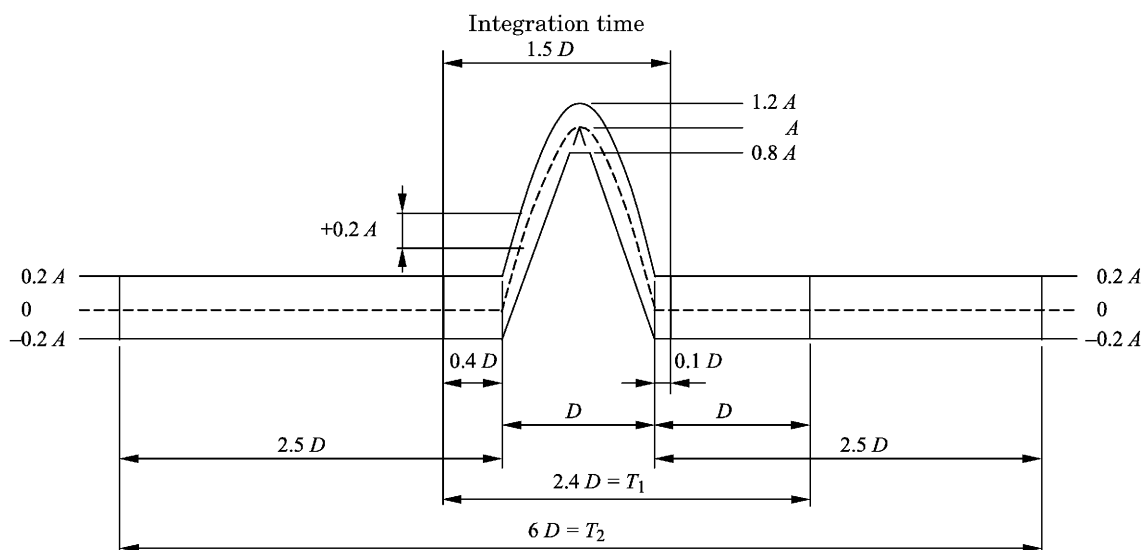
Three types of pulse, namely the half-sine pulse, the final-peak saw-tooth pulse and the trapezoidal pulse, are included in this Standard. The choice of pulse shape depends on a number of factors, and the difficulties inherent in making such a choice preclude a preferred order being given in this Standard (see clause A.3).

The specified basic pulse shapes are given below (see clause **A.3**):

- half-sine: one half-cycle of a sine wave, as shown in figure 1;
- final-peak saw-tooth: asymmetrical triangle with short fall time, as shown in figure 2;
- trapezoidal: symmetrical trapezoid with short rise and fall times, as shown in figure 3.

The true value of the actual pulse shall be within the limits of tolerance shown by the solid lines in the relevant figure.

NOTE : Where it is not practicable to achieve a pulse shape falling within the specified tolerance, the relevant specification should state the alternative procedure to be applied (see clause **A.5**).



Key

— — — nominal pulse

— — — limits of tolerance

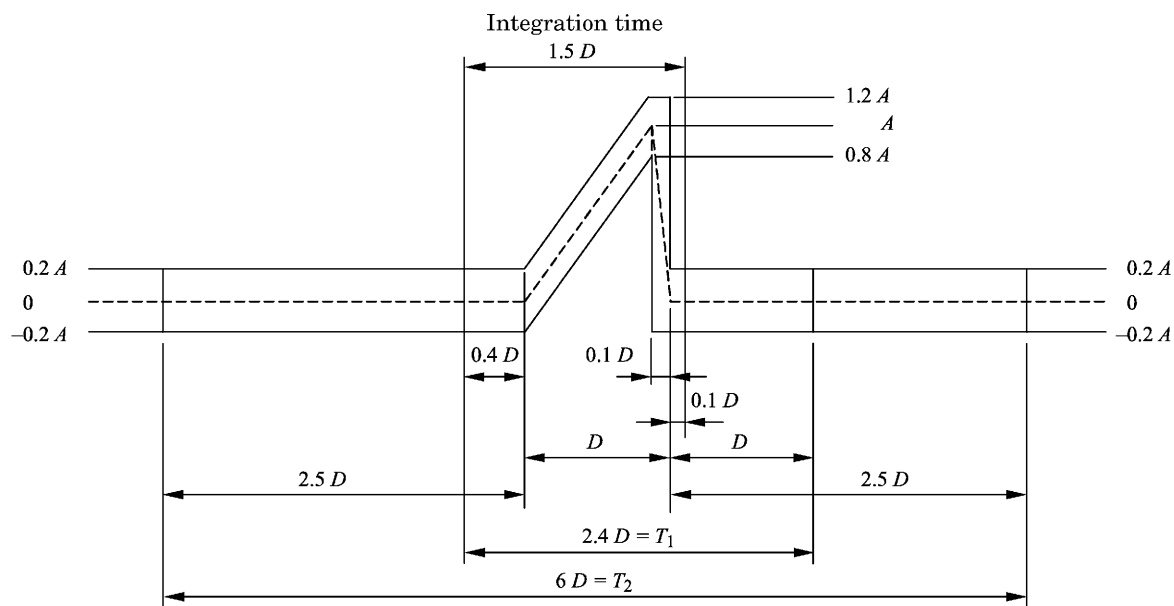
D : duration of nominal pulse

A : peak acceleration of nominal pulse

T_1 : minimum time during which the pulse shall be monitored for shocks produced using a conventional shock-testing machine

T_2 : minimum time during which the pulse shall be monitored for shocks produced using a vibration generator

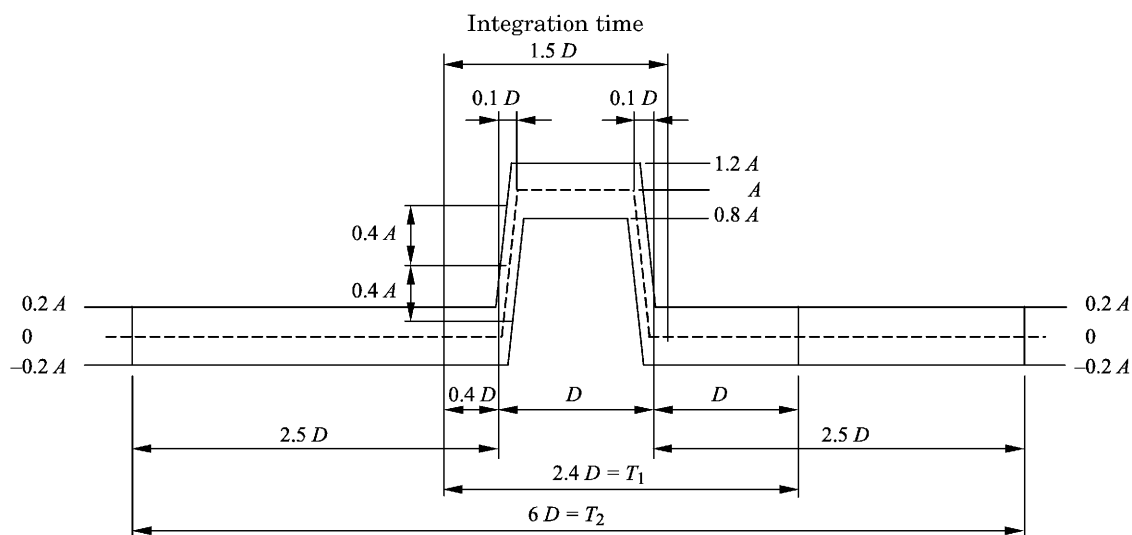
Figure 1 Pulse shape and limits of tolerance for half-sine pulse



Key

--- nominal pulse

— limits of tolerance

 D : duration of nominal pulse A : peak acceleration of nominal pulse T_1 : minimum time during which the pulse shall be monitored for shocks produced using a conventional shock-testing machine T_2 : minimum time during which the pulse shall be monitored for shocks produced using a vibration generator**Figure 2 Pulse shape and limits of tolerance for final-peak saw-tooth pulse**

Key

--- nominal pulse

— limits of tolerance

 D : duration of nominal pulse A : peak acceleration of nominal pulse T_1 : minimum time during which the pulse shall be monitored for shocks produced using a conventional shock-testing machine T_2 : minimum time during which the pulse shall be monitored for shocks produced using a vibration generator**Figure 3 Pulse shape and limits of tolerance for trapezoidal pulse**

4.1.2 Repetition rate

The repetition rate shall be such that the relative motion within the specimen between shocks shall be substantially zero and the value of acceleration at the check point shall be within the limits shown in figures 1, 2 and 3 (see clause **A.7**).

NOTE : A formula for evaluation of repetition rate is shown in clause **A.7**.

4.1.3 Velocity change tolerances

For all pulse shapes, the actual velocity change shall be within $\pm 15\%$ of the value corresponding to the nominal pulse.

Where the velocity change is determined by integration of the actual acceleration pulse, this shall be effected from $0.4D$ before the pulse to $0.1D$ beyond the pulse, where D is the duration of the nominal pulse.

NOTE : If the velocity change tolerance cannot be achieved without the use of elaborate facilities, the relevant specification should state the alternative procedure to be adopted (see clauses **A.5** and **A.6**).

4.1.4 Cross axis motion

The positive or negative peak acceleration at the check point(s), perpendicular to the intended shock direction, shall not exceed 30% of the value of the peak acceleration of the nominal pulse in the intended direction, when determined by **4.2** (see clause **A.5**).

NOTE : If the cross axis motion tolerance cannot be achieved, the relevant specification should state the alternative procedure to be adopted (see clause **A.5**).

4.2 Measuring system

The characteristics of the measuring system shall be such that it can be determined that the true value of the actual pulse, as measured above, in the intended direction at the check point(s) is within the tolerances required by the figures 1, 2 and 3.

When a low-pass filter is used, the characteristics of the filter should be such that its cut-off frequency f_g (-3 dB point) is not lower than:

$$f_g \geq \frac{1.5}{D}$$

where, f_g : the cut-off frequency of a low-pass filter (kHz)

D : the pulse duration (ms)

The frequency response of the overall measuring system, which includes the accelerometer, can have a significant effect on the accuracy and shall be within the limits shown in figure 4 (see also clause **A.5**).