

JIS

JAPANESE INDUSTRIAL STANDARD

Basic Environmental Testing Procedures Part 2: Tests, Test Ea: Shock

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In the event of any doubt arising,
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J I S

Basic Environmental Testing Procedures
Part 2: Tests, Test Ea: Shock

C 0041-1987

1. Introduction and Scope

This test is applicable to components and equipment, hereinafter referred to as the "specimens" which are subjected to relatively infrequent non-repetitive shocks in service and transportation.

The shock test may be used as a means of design to satisfy the structural integrity and a means of quality control. Basically the aim of this test consists in subjecting a specimen to a standard pulse with specified peak acceleration and duration.

Information to be specified in the relevant specification will be found in Clause 12, and the necessary guidance will be found in Appendix A.

Remark: The units and numerical values shown in { } in this Standard are based on the customary units and are currently the criteria in force.

Reference: This Standard has been prepared based on IEC 68-2-27 (1972) Basic environmental testing procedures Part 2: Tests, Test Ea: Shock, and 50 A (CO) 161, and in addition IEC 68-2-47 (1982) Basic environmental testing procedures Part 2: Tests, mounting of components, equipment and other articles for dynamic tests including shock (Ea), bump (Eb), vibration (Fe and Fd) and steady-state acceleration (Ga) and guidance. However they are partly modified to meet the actual circumstances in this country.

The above-mentioned IEC 68-2--47 is not a part of 68-2-27, but, it is given as Appendix C in this Standard.

2. Object

The object of this Standard is to specify the standard test method to judge the ability of specimens to withstand the severity of specified shock.

Applicable Standards and Corresponding International Standards: See page 39.

3. General

This Standard specifies three kinds of pulse waveform (half-sine wave, sawtooth wave and trapezoidal waveform). The guidances for selection and using of pulse are shown in Appendix A, and the characteristics of each pulse are shown in Appendix B. As the selection of waveform depends upon many factors, it is difficult to decide the precedence order (refer to Appendix A 3).

The object of this test is to examine the mechanical weakness and/or the lowering of function of the specified characteristics, and to decide whether a specimen is acceptable or not referring to the test results. It may also be used to determine the structural integrity of specimens, and/or as a means of quality control (refer to Appendix A 2).

This test is intended for unpackaged specimens and for items in their transport case when the latter may be considered as a part of the specimen itself.

The shock pulses are not intended to reproduce those encountered in practice. The severity of test and the shock pulse waveform are to reproduce, as far as possible, the effects likely to be encountered by specimens in service or in transportation.

If the object of test is to assess the structural integrity, it is desirable that the severity of test and the shock pulse waveform satisfy the design requirements (refer to Appendix A 2 and A 4)

In order to facilitate the use of this Standard, reference is given in the main part where the reader is invited to refer to Appendix A and the clause numbers in the main part are also referred to in Appendix A.

This specification is to be used in conjunction with JIS C 0010.

4. Definitions

For the purposes of this Standard, the following definitions apply, in addition to those specified in JIS B 0153 and JIS C 0010:

4.1 fixing point Part of the specimen which is in contact with the fixture or the table of shock tester and at which the specimen is normally fastened to them in service.

4.2 check point Fixing point nearest to the centre of the table surface of the shock tester, unless there is a fixing point having a more rigid connection to the table, in which case this latter point shall be used.

4.3 shock severity Combination of peak acceleration of nominal pulse and the duration.

4.4 velocity change Absolute value of the sudden change of speed resulting from the application of the specified acceleration.

5. Test Apparatus

5.1 Required Characteristics When the shock machine and fixtures are loaded with the specimen, the applied shocks shall, at the monitoring point, be a pulse approximate to the nominal acceleration-versus-time curves given by the broken lines in Figs. 1 to 3.

5.1.1 Basic Pulse Shapes The true value of the actual pulse shall be within the limit of tolerance as shown by the solid lines in each figure.

Remark: If it is practically impossible to make the pulse waveform within the limit of tolerance, it is necessary to specify other methods in the relevant specification. (refer to Appendix A 5).

The specified waveforms are listed below. However, the order of the lists does not indicate any preference.

Final peak sawtooth: Asymmetric triangle with short fall time, as shown in Fig. 1.

Half-sine : One half cycle of a sine wave, as shown in Fig. 2.

Trapezoidal : Symmetrical trapezoid with short rise and fall times, as shown in Fig. 3.

Remark: The sinusoidal half wave is the most common pulse.
The trapezoidal wave is not intended for components as a rule.

5.1.2 Velocity Change Tolerance The velocity change of all pulse waveforms shall be within $\pm 15\%$ of the value corresponding to the nominal pulse. To determine the velocity change by the integration of actual pulse, the pulse shall be integrated from $0.4D$ before the pulse to $0.1D$ beyond the pulse, where D is the duration of the nominal pulse.

Remark: If the use of complicated equipment is required to limit the velocity change within the tolerance, that method must be specified in the relevant specification.

5.1.3 Transverse Motion The positive and negative peak acceleration at the monitoring point, perpendicular to the intended shock direction, shall not exceed at any time 30% of the value of the peak acceleration of the nominal pulse in the intended direction, when measured with a measuring system in accordance with 5.2 (refer to Appendix A 5).

5.2 Measuring System The characteristic of the measuring system shall be such that the true value of the actually measured pulse at the check point in the intended direction is within the tolerance given in Figs. 1 to 3.

The frequency response of the overall measuring system including accelerometers shall be within the range shown in Fig. 4, since it exerts a serious influence on the accuracy (refer to Appendix A 5).

5.3 Mounting The specimens shall be fastened to the table or the fixture of test machine by its normal means of attachment. The requirements for mounting are given in Appendix C.

6. Severities

The relevant specification shall prescribe pulse shapes, peak acceleration and duration, which are chosen from those given in the pulse shapes prescribed in subclause 5.1.1 and in the Table of this clause.

Unless otherwise specified, one of the combinations underlined in the same line of the Table shall be used (refer to Appendix A 4).

Remark: If the influence of known environment exerted to the specimen cannot be reproduced by the said severity, and appropriate severity may be specified in the relevant specification using one of the standard pulse shapes in Figs. 1 to 3.

Table Peak Acceleration and Duration of Pulse

Peak acceleration A $\text{m/s}^2 \{G\}$	Duration D ms	Velocity change (V)		
		Half-sine $V = \frac{2}{\pi} AD$ m/s	Sawtooth $V = 0.5 AD$ m/s	Trapezoidal $V = 0.9 AD$ m/s
49 {5}	30	1.0	—	—
147 {15}	11	1.0	0.8	1.5
<u>294</u> { <u>30</u> }	<u>18</u>	<u>3.4</u>	<u>2.6</u>	<u>4.8</u>
294 {30}	11	2.1	1.6	2.9
294 {30}	6	1.1	0.9	1.6
<u>490</u> { <u>50</u> }	<u>11</u>	<u>3.4</u>	<u>2.7</u>	<u>4.9</u>
490 {50}	3	0.9	0.7	1.3
981 {100}	11	6.9	5.4	9.7
<u>981</u> { <u>100</u> }	<u>6</u>	<u>3.7</u>	<u>2.9</u>	<u>5.3</u>
1 960 {200}	6	7.5	5.9	10.6
1 960 {200}	3	3.7	2.9	5.3
<u>4 900</u> { <u>500</u> }	<u>1</u>	<u>3.1</u>	—	—
9 810 {1 000}	1	6.2	—	—
<u>14 700</u> { <u>1 500</u> }	<u>0.5</u>	<u>4.7</u>	—	—
29 400 {3 000}	0.2	3.7	—	—

7. Preconditioning

If necessary, preconditioning should be specified in the relevant specification.

8. Initial Measurements

The specimen shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

9. Conditioning

9.1 Application of Shock Unless otherwise specified in the relevant specification, three successive shocks shall be applied in each direction of three mutually perpendicular axes (18 shocks in total). When many of the same components are tested, the specimens may be so arranged that the shock is applied at the same time to the above-mentioned axes and directions (refer to Appendix A 7).

9.2 Operating Mode and Functional Monitoring When the specimens are required to operate during the shock test, the following information shall be specified in the relevant specification:

- (1) Operating conditions
- (2) Monitoring conditions in operation (if any functional monitoring is required)
- (3) The criteria upon which acceptance or rejection of the specimen is to be based (if any functional monitoring is required).

10. Recovery

If necessary, the relevant specification may specify recovery.

11. Final Measurements

The specimens shall be visually inspected and electrically and mechanically checked as required by the relevant specification.

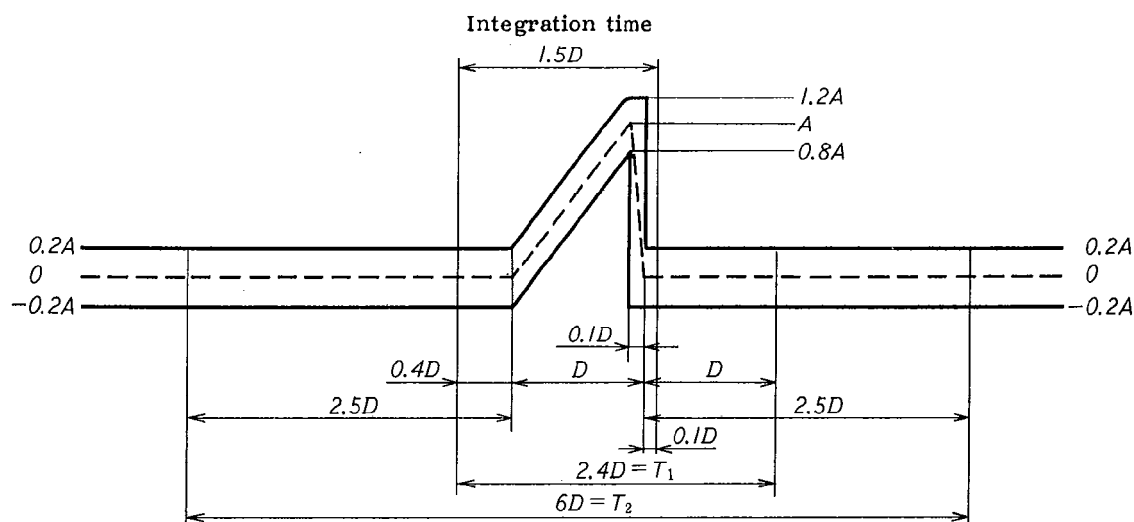
The relevant specification shall state the criteria upon which the acceptance or rejection of the specimen is to be based.

12. Information to Be Given in the Relevant Specification

- | | |
|--|-------|
| (1) Pulse shape (refer to Appendix A 3) | 5.1.1 |
| (2) Tolerance (if necessary) (refer to Appendix A 5) | 5.1.1 |
| (3) Velocity change (if necessary) (refer to Appendix A 6) | 5.1.2 |
| (4) Transverse motion (if necessary) | 5.1.3 |
| (5) Mounting method | 5.3 |

(6) Severity, acceleration and duration (refer to Appendix A 4)	6
(7) Preconditioning (if necessary)	7
(8) Initial measurements	8
(9) Directions and number of shocks (if necessary) (refer to Appendix 7)	9.1
(10) Monitoring of operation and function during test (if necessary)	9.2
(11) Criteria of acceptance or rejection	9.2 and 11
(12) Recovery (if necessary)	10
(13) Final measurements	11
(14) Upper cutoff frequency (refer to Appendix A 5)	Fig. 4

Fig. 1. Final Peak Sawtooth Pulse



--- nominal pulse

— tolerance boundaries

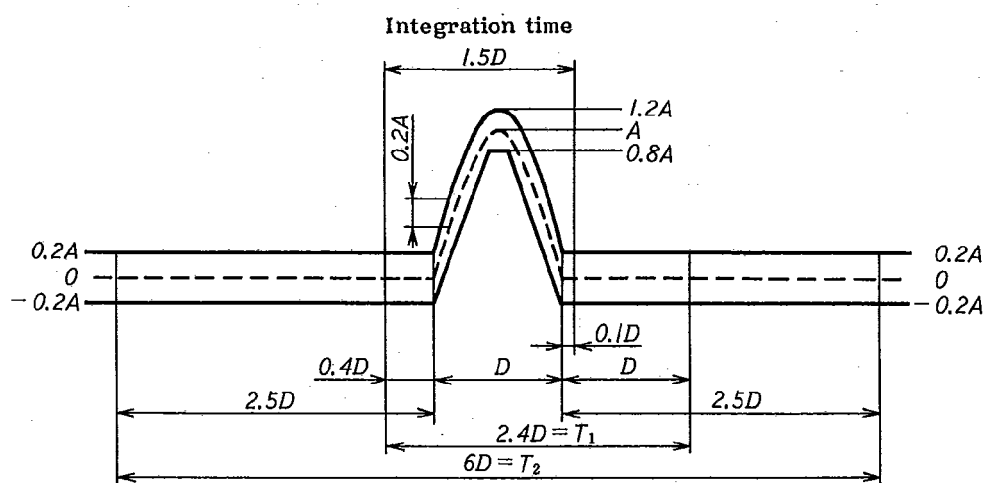
D : duration of nominal pulse

A : peak acceleration of nominal pulse

T_1 : minimum time during which the shock shall be monitored for shock produced using a conventional shock tester

T_2 : minimum time during which the shock shall be monitored for shock produced using a vibration tester

Fig. 2. Half-Sine Pulse



--- nominal pulse

— tolerance boundaries

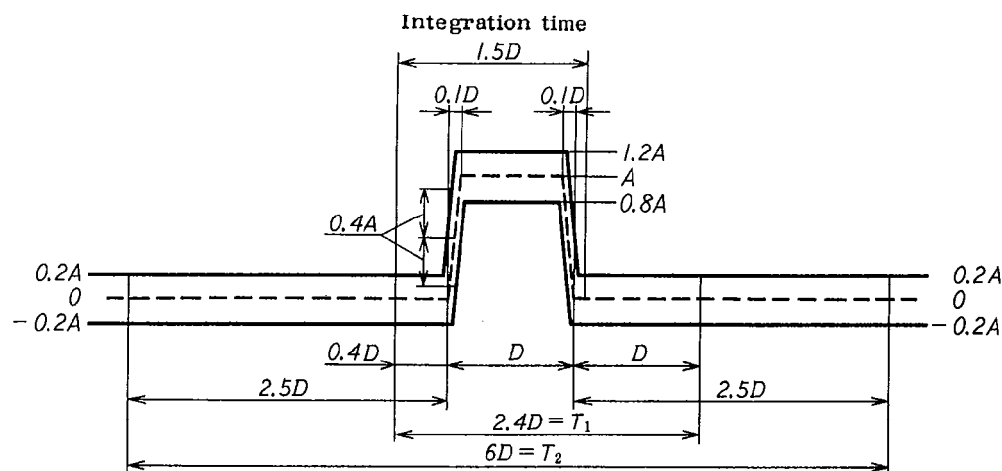
D : duration of nominal pulse

A : peak acceleration of nominal pulse

T_1 : minimum time during which the shock shall be monitored for shock produced using a conventional shock tester

T_2 : minimum time during which the shock shall be monitored for shock produced using a vibration tester

Fig. 3. Trapezoidal Pulse

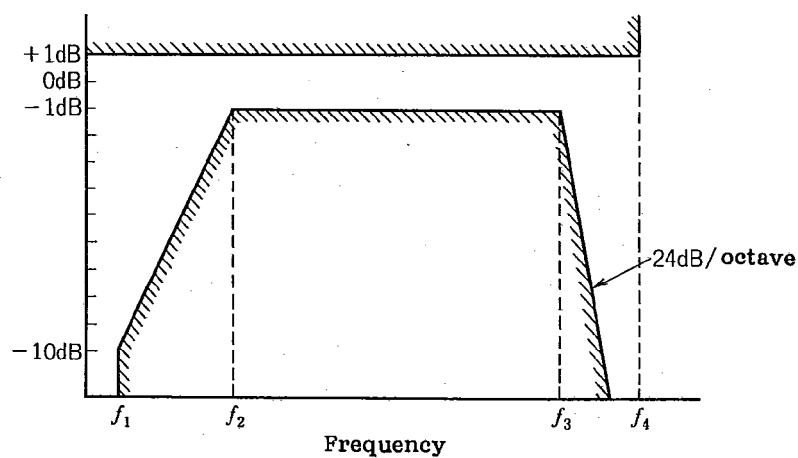


--- nominal pulse

— tolerance boundaries

 D : duration of nominal pulse A : peak acceleration of nominal pulse T_1 : minimum time during which the shock shall be monitored for shock produced using a conventional shock tester T_2 : minimum time during which the shock shall be monitored for shock produced using a vibration tester

Fig. 4. Frequency Characteristics of Measuring System



Duration of pulse ms	Low-frequency cutoff Hz		High-frequency cutoff kHz	Frequency beyond which the response may rise above +1 dB (kHz)
	f_1	f_2	f_3	f_4
0.2	20	120	20	40
0.5	10	50	15	30
1	4	20	10	20
3	2	10	5	10
6	1	4	2	4
11	0.5	2	1	2
18	0.2	1	1	2

Remark: For the shock of 0.5 ms or less duration, f_3 and f_4 may not have such high values given in this Figure. In this case, different values shall be specified in the relevant specification.