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INTERNATIONAL STANDARD

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BASIC SAFETY PUBLICATION

PUBLICATION FONDAMENTALE DE SÉCURITÉ

Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock

Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs

IEC 60068-2-27:2008

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). 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. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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International Standard IEC 60068-2-27 has been prepared by IEC technical committee 104: Environmental conditions, classification and methods of test

This fourth edition cancels and replaces the third edition, published in 1987, and includes the merging of IEC 60068-2-29, second edition (1987). It constitutes a technical revision.

The major changes with regard to the previous edition concern:

– the merging of IEC 60068-2-29 into this edition of IEC 60068-2-27; Part 2-29 will be withdrawn as soon as this edition is published;
– the introduction of soft packaged specimens as defined in the IEC ad hoc working group document agreed in Stockholm:2000.

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

FDIS	Report on voting
104/448/FDIS	104/457/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

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

This standard is to be used in conjunction with IEC 60068-1.

A list of all the parts in the IEC 60068 series, under the general title *Environmental testing*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

INTRODUCTION

This part of IEC 60068 deals with components, equipments and other electrotechnical products, hereinafter referred to as “specimens”, which, during transportation, storage and handling, or in use, may be subjected either to conditions involving relatively infrequent non-repetitive or repetitive shocks. The shock test may also be used as a means of establishing the satisfactory design of a specimen in so far as its structural integrity is concerned and as a means of quality control. It consists of subjecting a specimen either to non-repetitive or repetitive shocks of standard pulse shapes with specified peak acceleration and duration.

Specification writers will find a list of details to be considered for inclusion in specifications in Clause 11. The necessary guidance is given in Annex A.

ENVIRONMENTAL TESTING –

Part 2-27: Tests – Test Ea and guidance: Shock

1 Scope

This part of IEC 60068 provides a standard procedure for determining the ability of a specimen to withstand specified severities of non-repetitive or repetitive shocks.

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 the latter may be considered to be part of the specimen. 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. When used in conjunction with IEC 60068-2-47, this standard may be used for testing packaged products. This possibility was included in the 2005 version of IEC 60068-2-47 for the first time.

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 The term “shock testing machine” is used throughout this standard, but other means of applying pulse shapes are not excluded.

One of the responsibilities of a technical committee is, wherever applicable, to make use of basic safety publications in the preparation of its publications.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60068-1, E*nvironmental testing – Part 1: General and guidance*

IEC 60068-2-47:2005, *Environmental testing – Part 2-47: Tests – Mounting of specimens for vibration, impact and similar dynamic tests*

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

IEC 60721-3-1, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 1: Storage*

IEC 60721-3-5, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 5: Ground vehicle installations*

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 document, the following terms and definitions apply.

NOTE The terms used are, for the most part, defined in ISO 2041[1]1 or IEC 60068-1. The following additional terms and definitions are also applicable for the purposes of this standard.

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 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.

3.3
***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/s^2.

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

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1 Figures in square brackets refer to the bibliography.

3.6
velocity change
absolute value of the sudden change of velocity resulting from the application of the specified acceleration

NOTE The change of velocity is normally considered sudden if it takes place in a time that is short compared with the fundamental period of the test specimen.

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

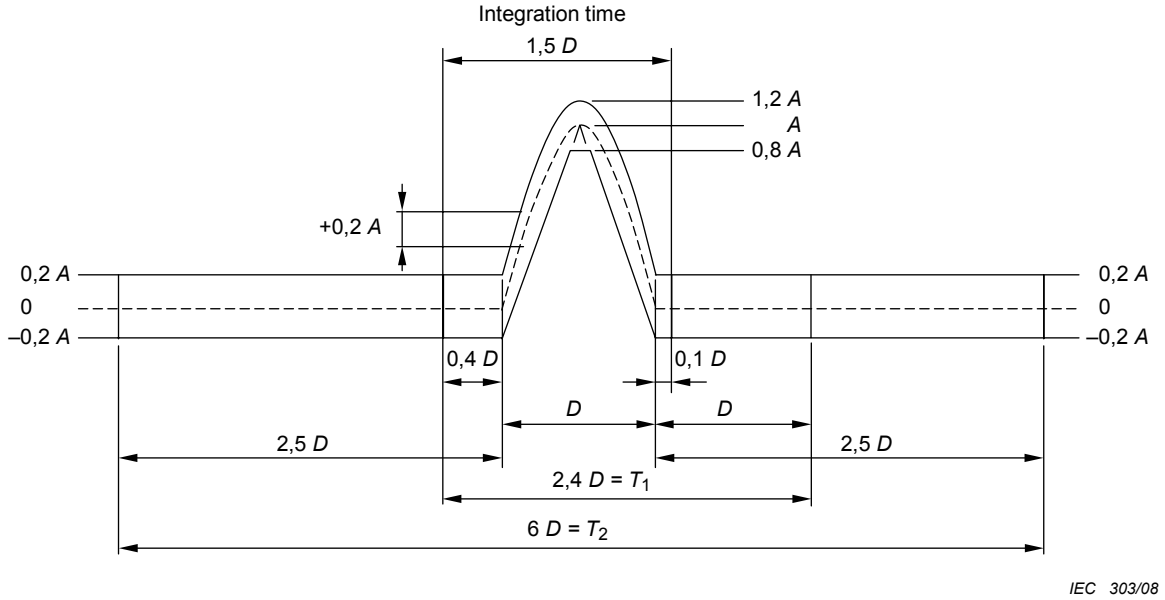
Three types of pulse, namely the half-sine pulse, the final-peak saw-tooth pulse and the trapezoidal pulse, are included in this standard. The choice of pulse shape depends on a number of factors, and the difficulties inherent in making such a choice preclude a preferred order being given in this standard (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 (applicable for all three Figures 1 to 3)

– – – 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

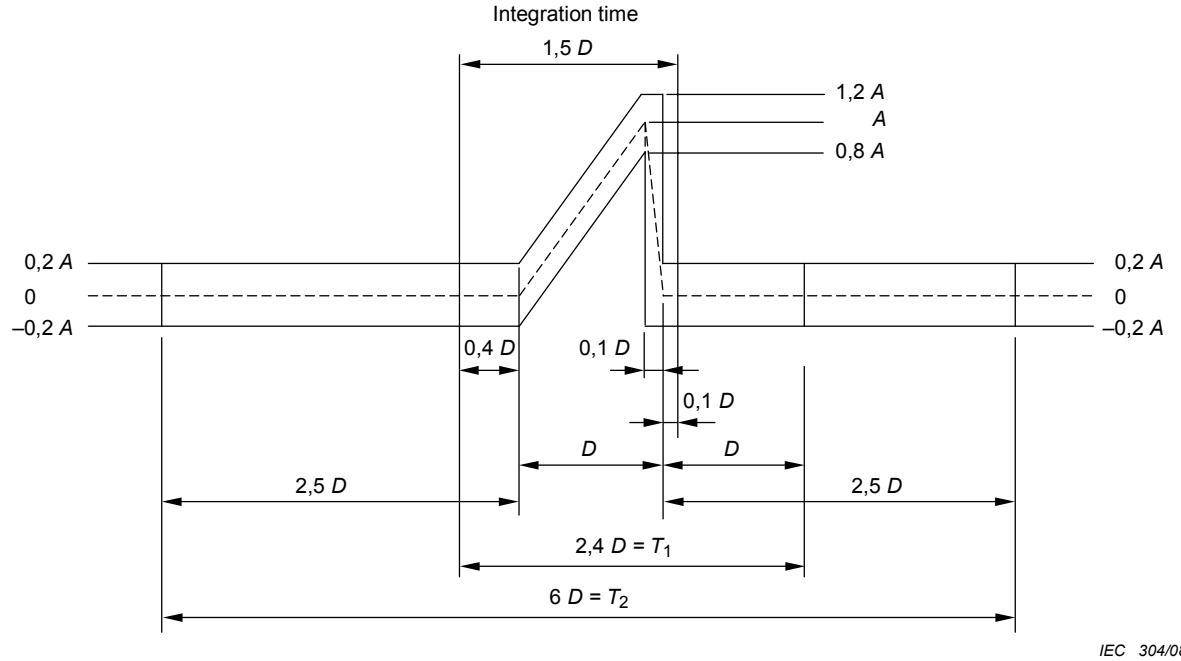


Figure 2 – Pulse shape and limits of tolerance for final-peak saw-tooth pulse

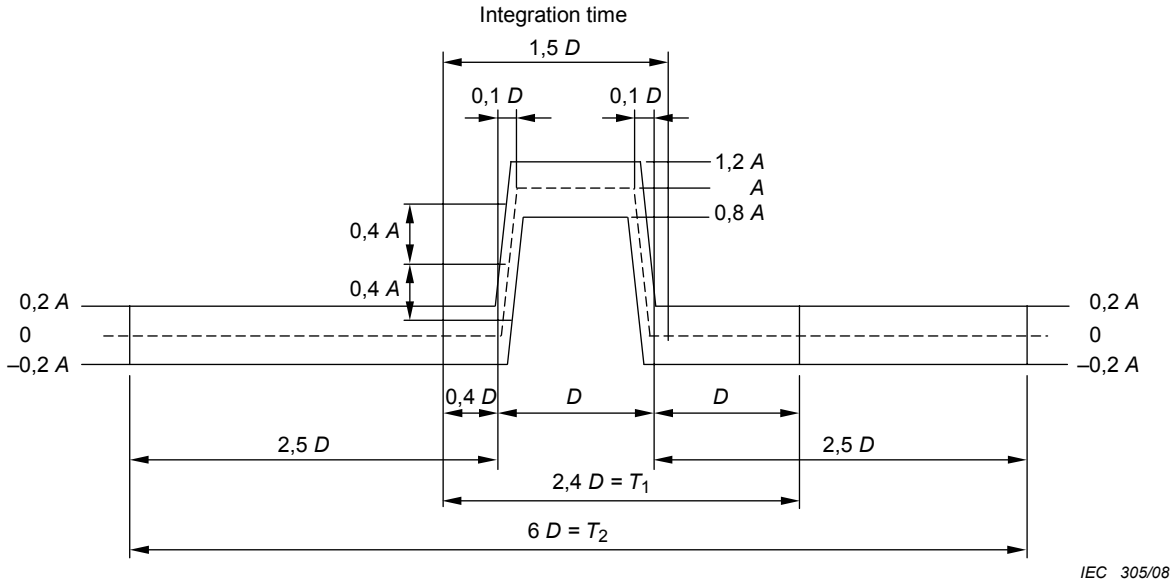


Figure 3 – Pulse shape and limits of tolerance for trapezoidal pulse

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 Figure 1 (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 ±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 0,4 *D* before the pulse to 0,1 *D* 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.

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 checkpoint(s) is within the tolerances required by the Figures 1, 2 and 3.

The requirements of Figure 4 apply to the frequency response of the measuring system without the use of a low-pass filter on the control signal. 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:

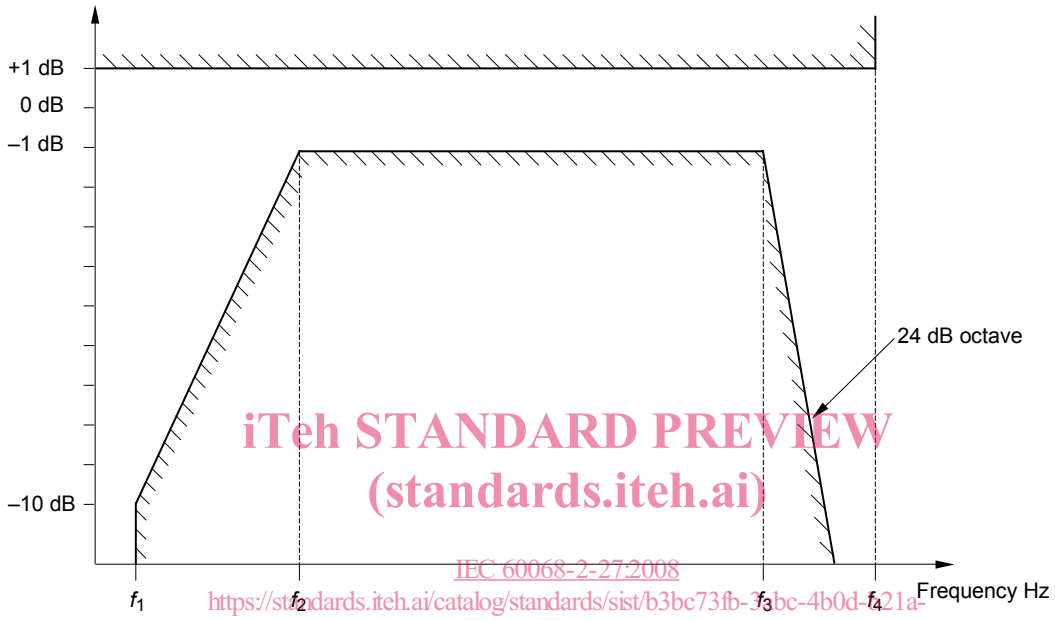
$$f_g = \frac{1{,}5}{D}$$

where

f_g is the cut-off frequency of a low-pass filter in kHz;

D is the pulse duration in 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).



Duration of pulse ms	**Low-frequency cut-off** Hz		**High-frequency cut-off** kHz	**Frequency beyond which the response may rise above +1 dB** kHz
	f_1	f_2	f_3	f_4
0,2 and 0,3	20	120	20	40
0,5	10	50	15	30
1	4	20	10	20
2and 3	2	10	5	10
6	1	4	2	4
11	0,5	2	1	2
16, 18 and 30	0,2	1	1	2

NOTE For shocks of duration equal to or less than 0,5 ms, the value of f_3 and f_4 indicated in Figure 4 may be unnecessarily high. In such instances, the relevant specification should state which alternative values are to be adopted.

Figure 4 – Frequency characteristics of the overall measuring system

4.3 Mounting

The specimen shall be mounted on the table of the shock-testing machine or fixture in accordance with IEC 60068-2-47.

5 Severities

The relevant specification shall prescribe the pulse shape and the shock severity. Shocks shall be applied in all three axes and in both a positive and negative direction, as required by the relevant specification. The effects of gravity shall be considered when considering the attitude of the test. Unless real usage conditions are known or otherwise specified, one of the pulse shapes given in 4.1.1 and a severity shown on the same line in Table 1 shall be used. The preferred combinations are in bold. The corresponding velocity changes are also given in Table 1.

The number of shocks in each direction may be chosen from the following values:

3 ± 0

100 ± 5

500 ± 5

1 000 ± 10

5 000 ± 10

NOTE If the effects of the known environment on the specimen cannot be reproduced by severities given here, the relevant specification may prescribe an appropriate severity using one of the standard pulse shapes, shown in Figures 1, 2 and 3 (see also Clause A.4).