IS 9002-10-1 (1985): Equipment for Environmental Tests for Electronic and Electrical Items, Part 10: Shock Test Machine, Section 1: Free Fall Type [LITD 1: Environmental Testing Procedure]

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(Reaffirmed 2004)

Indian Standard

SPECIFICATION FOR EQUIPMENT FOR ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 10 SHOCK TEST MACHINE
Section 1 Free Fall Type

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INDIAN STANDARDS INSTITUTION
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Gr 4

Indian Standard

SPECIFICATION FOR EQUIPMENT FOR ENVIRONMENTAL TESTS FOR ELECTRONIC AND ELECTRICAL ITEMS

PART 10 SHOCK TEST MACHINE

Section 1 Free Fall Type

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0. FOREWORD

0.1 This Indian Standard (Part 10 / Sec 1) was adopted by the Indian Standards Institution on 25 July 1985, after the draft finalized by the Environmental Testing Procedures Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

0.2 The object of this standard (Part 10/Sec 1) is primarily to guide the environmental equipment manufacturers with respect to broad specifications for their equipment and to assist the users of such equipment to properly define their requirements in the indent for the equipment. The requirements of the equipment for a particular application largely depend on the conditions of environmental tests to be simulated or created.

0.3 Certain requirements have been specified in a general form in view of practical difficulties in defining such requirements quantitatively. It is presumed that with the experience gained, more precise requirements will be laid down for such equipment.

0.4 An overall performance assessment of the complete equipment for a short duration has been included although it may be realised that it may not be entirely sufficient. This will at least ensure the functional performance and operatability of the equipment. Many of the constructional requirements specified can be checked through visual examination.

0.5 In view of the subjective nature of some of the requirements, sufficient care shall be taken in using the standard.

0.6 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated,

*Rules for rounding off numerical values (*revised*).

expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2 - 1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This standard (Part 10/Sec 1) lays down salient features of shock test machine of free fall type required for carrying out shock test in accordance with Section 1 of IS : 9000 (Part 7) - 1979*

NOTE — The guidance details for the shock test are covered in Section 1 of IS : 9001 (Part 17) - 1985†.

2. TERMINOLOGY

2.1 For the purpose of this standard, the definitions and explanation of terms given in IS : 9000 (Part 1) - 1977‡ shall apply.

3. TEST MACHINE AND MEASURING SYSTEM

3.1 Characteristics of the Shock Test Machine — The shock test machine (a typical machine shown in Fig. 1) shall satisfy the various parameters specified below. The characteristics shall be checked for its performance.

a) Shock severity in m/s^2;

b) Pulse shapes (saw-tooth : Fig. 2; half-sine : Fig. 3; or trapezoidal : Fig. 4); and

c) Time duration of shock pulse in ms.

NOTE — The shock spectra and characteristics of the pulse shapes are given in Appendix A of Section 1 of IS : 9000 (Part 7) - 1979*.

3.1.1 *Velocity Change Tolerance* — For all pulse shapes, the actual velocity change should be within ± 10 per cent of the value corresponding to the nominal pulse. To determine the velocity change, the actual pulse should be integrated from 0·4 *D* before the pulse to 0·1 *D* beyond the pulse, where *D* is the length of the nominal pulse (*see* Fig. 2 to 4).

*Basic environmental testing procedures for electronic and electrical items : Part 7 Impact test.

†Guidance for environmental testing : Part 17 Impact test.

‡Basic environmental testing procedures for electronic and electrical items : Part 1 General.

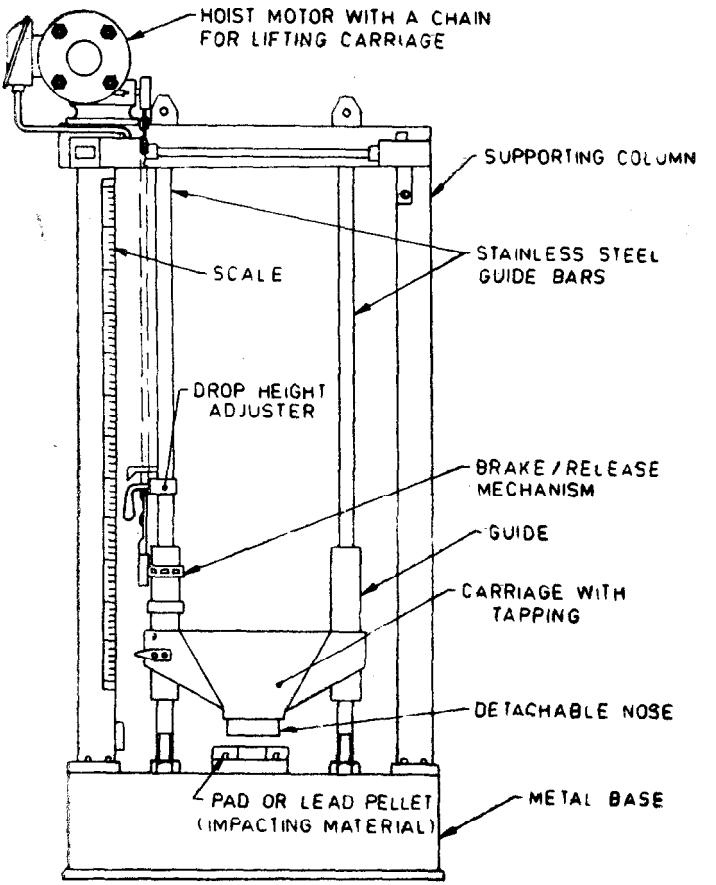
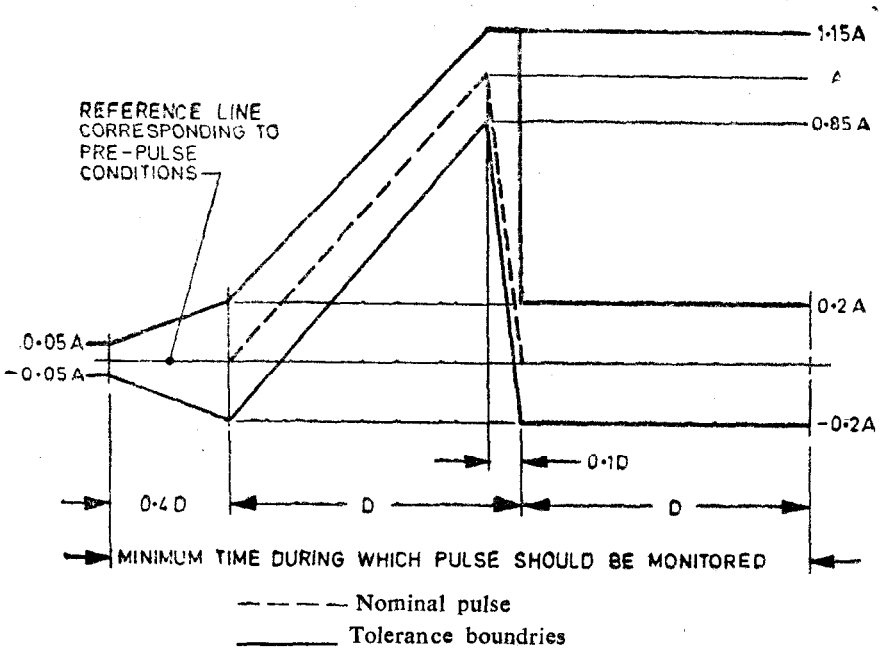


FIG. 1 TYPICAL SHOCK TEST MACHINE (FREE FALL TYPE)

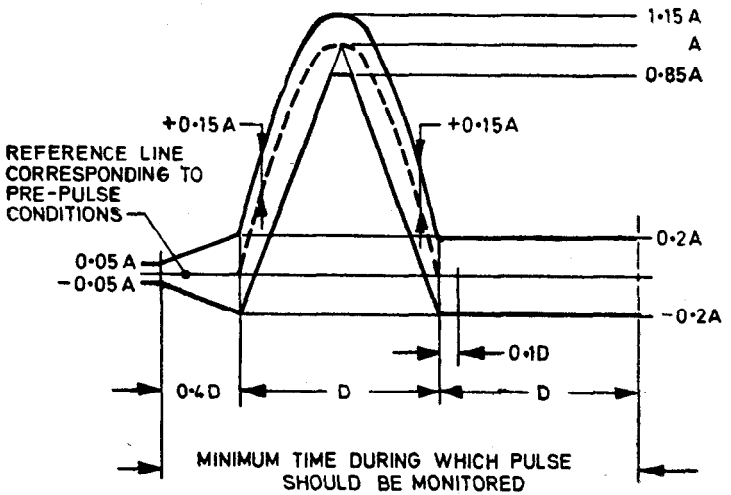


D = Duration of nominal pulse

A = Peak acceleration of nominal pulse

The reference line shall not differ more than $\pm 0{\cdot}05$ A or ± 10 m/s^2 (± 1 g), whichever is the greater, from zero acceleration.

FIG. 2 FINAL-PEAK SAW-TOOTH PULSE

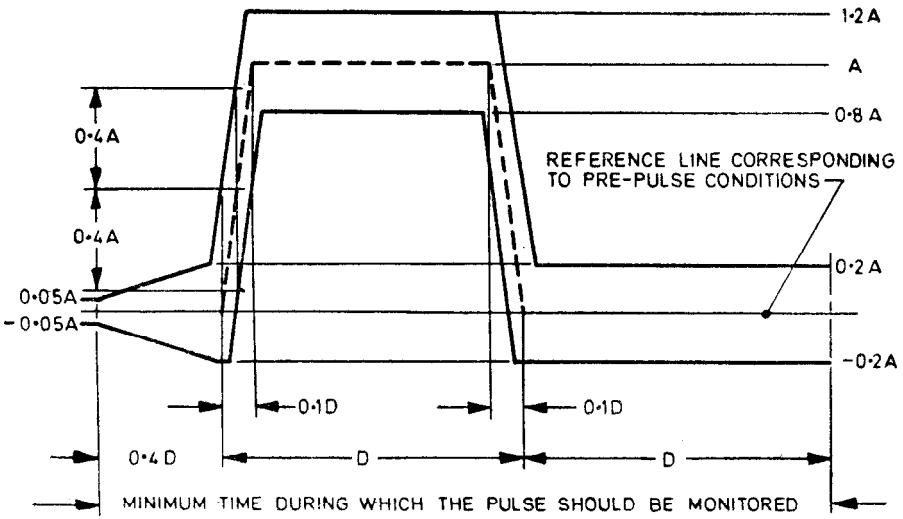


D = Duration of nominal pulse

A = Peak acceleration of nominal pulse

The reference line shall not differ more than $\pm 0{\cdot}05$ A or ± 10 m/s^2 (± 1 g) whichever is greater, from zero acceleration.

FIG. 3 HALF-SINE PULSE



— — · — — Nominal pulse

_____ Tolerance boundaries

D = duration of nominal pulse.

A = peak acceleration of nominal pulse.

The reference line shall not differ more than $\pm 0{\cdot}05$ A or ± 10 m/s2 (± 1 g), whichever is the greater, from zero acceleration.

FIG. 4 TRAPEZOIDAL PULSE

3.1.2 *Transverse Motion* — The positive or negative peak acceleration, at the monitoring point, perpendicular to the intended shock direction, shall not exceed at any time 30 percent of the value of the peak acceleration of the nominal pulse in the intended direction, when determined with a measuring system in accordance with **3.2**.

3.1.3 The carriage should have its natural resonance frequency outside the range of shock pulse frequency. The carriage should also have high internal damping.

3.1.4 The carriage shall be guided during free fall to prevent rotation.

3.1.5 Impacting materials capable of producing desired shock severities pulses shapes and pulse durations should be provided alongwith a

proper fixing arrangement on the anvil. Lead pellet positioning fixture and spike nose shall be provided.

3.1.6 Pulse generators generally furnished are rubber pads for half sine, and lead pellets for saw tooth and trapezoidal wave pulses. Calibration charts for each shock pad shall be supplied with the machine.

3.1.7 A brake system shall be provided to prevent the rebound (secondary) of the carriage and also hold the carriage at the desired drop height.

3.1.8 Break release system shall be provided.

3.2 Measuring System

3.2.1 *Monitoring* — The shock pulse shall be measured by an accelerometer placed at the monitoring point. This point shall be the item fixing point nearest to the centre of the table surface, unless there is an item fixing point having a more rigid connection to the table, in which case that point shall be chosen.

3.2.1.1 The shock parameters shall be measured with the help of an accelerometer, preamplifier and storage oscilloscope. The measuring set up is shown in Fig. 5.

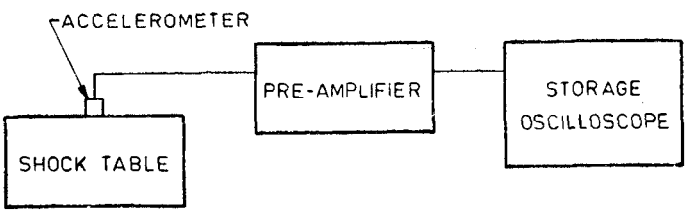


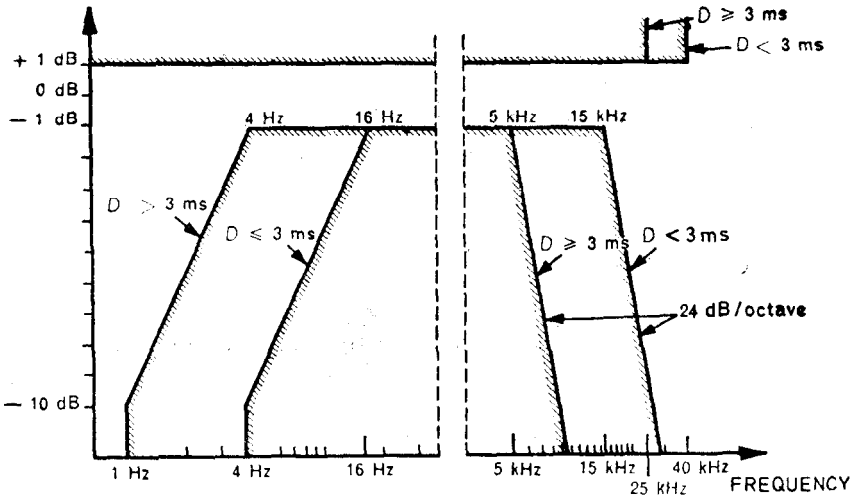
FIG. 5 MEASURING SET UP

3.2.2 *Accuracy* — The accuracy of the measuring system shall be such that the measured value is within the given tolerances of the true value.

3.2.3 *Frequency Chara teristics* — The frequency response of the overall measuring system, including the accelerometer, shall be within the limits shown in Fig. 6.

3.3 Optional Facilities

3.3.1 Remote operating switch may be provided, if specified by the indentor.



Duration of Pulse	*Low-Frequency Cut-Off*		*High-Frequency Cut-Off*	*Frequency Beyond Which the Response May Rise Above* +1 dB
(ms)	(Hz)		(kHz)	(kHz)
	—1 db	—10 db	—1 db	
<3	16	4	15	40
3	16	4	5	25
3<*D*≤18	4	1	5	25

FIG. 6 FREQUENCY CHARACTERISTICS OF THE MEASURING SYSTEM

3.3.2 A trigger switch may be provided, if specified by the indentor.

4. CONSTRUCTION, WORKMANSHIP AND FINISH

4.1 A typical shock test machine of free fall type is shown in Fig. 1. The general description of this machine is prescribed in Appendix A.

NOTE — This type of shock test machine operates in a vertical direction using gravity as the velocity producing force. This machine requires no special foundation.

4.1.1 The capacity of the machine shall be suitable to take up the load of the item, weightwise and volumewise. The carriage should be free on all the sides.

4.1.2 Tapped holes with steel inserts shall be provided for securing the item.

4.1.3 Facility for changing the type of nose for carriage should be provided for generation of different pulse shapes.

4.1.4 The metal base shall be made of mild steel.

4.1.5 The supporting columns shall be made of mild steel angle and shall form the frame of the shock test machine.

4 1.6 The impacting material shall be detachable and should consist of aluminium plate with rubber top or a positioning fixture with provision to keep lead pellets for the purpose of achieving the desired pulse shape.

4.1.7 The carriage should be made of solid magnesium/aluminium alloy with facility for fixing either spherical nose or spike nose at the bottom of the carriage.

NOTE — Spherical nose and spike nose should be provided separately, as the former one is used to generate half sine and saw tooth pulses and the latter one is used for generating square pulses.

4.1.8 The guides shall be made of ebonite or any other suitable material to give a free fall to the table.

4.1.9 The guide rails shall be of stainless steel and are meant for smooth and resistance free falling of table with the help of guides.

4.1.10 Suitable brake and release mechanism shall be provided for the table for operation as and when required and to avoid secondary fall/ impacts.

4.1.11 The machine shall be provided for the drop height adjustment. The machine shall have a plunger device which can release the brake for carriage movement.

4.1.12 A suitable calibrated scale shall be provided for adjustment of drop height.

4.1.13 An ac motor with a pulley and chain (hoist motor) alongwith lifting hook shall be provided for lifting the carriage.

4.1.14 A lead pellet casting machine may be provided with desired casting of different sizes and shapes of lead pellets.

4.1.15 The machine should be provided with eye bolts for ease of handling.

4.2 Workmanship — The workmanship shall be of good engineering practice.

4.3 Finish — The finish of machine shall be as specified for parts not otherwise covered so as to ensure protection against corrosion and other similar effects.

4.4 MISCELLANEOUS

4.4.1 The machine shall be designed for optimum performance and economic continuous operation with minimum maintenance requirement.

4.4.2 The electrical components should conform to relevant Indian Standards, wherever available.

5. INSTRUMENT CONSOLE

5.1 The instrument console shall contain the following :

a) Accelerometer and accessories,

b) Pre-amplifier, and

c) Storage oscilloscope.

6. POWER SUPPLY REQUIREMENTS

6.1 The test machine shall be capable of operating from an ac supply of 50 Hz single phase 240 V $\pm$10 percent or three phase 415 V $\pm$10 percent. Total power supply input shall be declared.

7. SAFETY

7.1 Adequate electrical safety arrangement shall be incorporated in the machine design to avoid electric shock to personnel and damage to machine.

7.2 The safety protections shall be as follows :

a) Protection against supply voltage variation,

b) Safety cut-outs for high temperature of motor winding,

c) Suitable safety device for the carriage to prevent accidental drop of carriage, and

d) Safety guard with suitable interlocking to screen the splinters thrown out from the test object.

8. MARKING

8.1 The shock test machine shall be marked with the following information :

a) Manufacturer's name or trade-mark,
b) Type designation,
c) Table size,
d) Maximum loading,
e) Height adjustment,
f) Maximum severity level,
g) Power supply requirements, and
h) Any other additional marking, as required.

8.1.1 The machine may also be marked with the ISI Certification Mark.

NOTE — The use of the ISI Certification Mark is governed by the provisions of the Indian Standards Institution (Certification Marks) Act, and the Rules and Regulations made thereunder. The ISI Mark on products covered by an Indian Standard conveys the assurance that they have been produced to comply with the requirements of that standard under a well-defined system of inspection, testing and quality control which is devised and supervised by ISI and operated by the producer. ISI marked products are also continuously checked by ISI for conformity to that standard as a further safeguard. Details of conditions, under which a licence for the use of the ISI Certification Mark may be granted to manufacturers or processors, may be obtained from the Indian Standards Institution.

9. INSTALLATION

9.1 A suitable concrete block of area, thickness and mass as recommended by the manufacturer of the shock test machine shall be cast to a convenient height for operation of the machine.

10. TESTS

10.1 Each machine shall be subjected to the following tests :

a) Visual examination and inspection (**10.2**), and
b) Performance (**10.3**).

10.2 Visual Examination — Each machine shall be visually examined and inspected for compliance with the relevant requirements of the standard.

10.3 Performance — Each machine shall be subjected to performance test to conform to the requirements ordered by the indentor.

11. INSTRUCTION MANUAL

11.1 Each machine shall be provided with an instruction manual which shall contain the following:

a) Installation instructions;

b) Operating instructions;

c) Maintenance and service instructions;

d) Schematic diagrams, actual circuit diagram and design of layout;

e) List of component parts with performance data; and

f) List of spare parts.

12. INFORMATION TO BE FURNISHED BY THE INDENTOR

12.1 The following information shall be furnished by the indentor :

a) Table size,

b) Maximum load,

c) Maximum severity required,

d) Finish of the machine,

e) Total power supply input, and

f) Any other characteristics or parameters.

APPENDIX A

(*Clause* 4.1)

GENERAL DESCRIPTION OF SHOCK TEST MACHINE

A-1. The shock testing machine shall be designed around a substantial seismic base.

A-2. A superstructure consisting of two guide rods and two supporting columns is erected from the base. The hoisting motor and electrical control to operate the machine shall be mounted on the supporting column.

A-3. The carriage for mounting the test object is located between the guide rods. This carriage may be of magnesium alloy or aluminium

alloy casting and contoured for maximum rigidity with minimum mass. The resonance frequency of the carriage mass shall be within four to ten times the minimum pulse duration required, in order to eliminate ringing. The carriage shall be guided by non-metallic bushings on either of the guide rods so as to isolate the effects of hoisting mechanism from the carriage.

A-4. A safety guard all round the machine, if required, may be mounted on the supporting column to protect the operator.

A-5. The base of the machine shall be equipped with anchor points for bolting it to the floor to prevent shifting.

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