INTERNATIONAL STANDARD

ISO 14451-2

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Pyrotechnic articles — Pyrotechnic articles for vehicles —

Part 2: Test methods

Articles pyrotechniques — Articles pyrotechniques pour véhicules —

Partie 2: Méthodes d'essai

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14451-2 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 212, *Pyrotechnic articles,* in collaboration with Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 12, *Passive safety crash protection systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

ISO 14451 consists of the following parts, under the general title *Pyrotechnic articles — Pyrotechnic articles for vehicles*:

- *Part 1: Terminology*
- *Part 2: Test methods*
- *Part 3: Labelling*
- *Part 4: Requirements and categorization for micro gas generators*
- *Part 5: Requirements and categorization for airbag gas generators*
- *Part 6: Requirements and categorization for airbag modules*
- *Part 7: Requirements and categorization for seatbelt pretensioners*
- *Part 8: Requirements and categorization for igniters*
- *Part 9: Requirements and categorization for actuators*
- *Part 10: Requirements and categorization for semi-finished products*

Pyrotechnic articles — Pyrotechnic articles for vehicles —

Part 2: Test methods

1 Scope

This part of ISO 14451 establishes uniform test methods for pyrotechnic articles for vehicles.

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.

ISO 14451-1, *Pyrotechnic articles — Pyrotechnic articles for vehicles — Part 1: Terminology*

ISO 14451-3, *Pyrotechnic articles — Pyrotechnic articles for vehicles — Part 3: Labelling*

ISO 14451-5, *Pyrotechnic articles — Pyrotechnic articles for vehicles — Part 5: Requirements and categorization for airbag gas generators*

ISO 14451-6, *Pyrotechnic articles — Pyrotechnic articles for vehicles — Part 6: Requirements and categorization for airbag modules*

ISO 14451-7, *Pyrotechnic articles — Pyrotechnic articles for vehicles — Part 7: Requirements and categorization for seatbelt pretensioners*

ISO 14451-9, *Pyrotechnic articles — Pyrotechnic articles for vehicles — Part 9: Requirements and categorization for actuators*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 14451-1 apply.

NOTE Wherever reference is made to *pyrotechnic article(s)* only *pyrotechnic articles for vehicles* are meant.

4 Test methods

4.1 Verification of design and documentation

The manufacturer shall supply a document which describes the pyrotechnic article. The typical content of the document shall include the following information:

— description of the purpose of the pyrotechnic article;

— sketch with external dimensions;

— total mass of the pyrotechnic article;

— cross section and part list;

— mass and pyrotechnic composition(s) contained in the article;

— description of intended behaviour;

— description of foreseeable behaviour during fire test if applicable;

— proposed labelling in accordance with ISO 14451-3;

— safety data sheet/handling instructions, including electrical characteristics (e.g. all-fire current, no-fire current, resistance, etc.) which shall be provided with the pyrotechnic article.

This shall be verified by visual inspection by the naked eye.

4.2 Drop test

4.2.1 Purpose

The purpose of this test is to determine whether the pyrotechnic article experiences any detrimental effect when dropped from a specified height and at specified orientations.

4.2.2 Equipment

A steel impact plate of a minimum of 1 m x 1 m with at least 10 mm thickness, resting on a solid floor, with a fixture that supports the pyrotechnic article at the specified height, shall be used.

4.2.3 Test conditions

The drop height shall be $1\ ^{+0,2}_{0}$ m.

The test shall be done with the pyrotechnic article at ambient temperature.

4.2.4 Test procedure

Mount one pyrotechnic article into the support fixture at the specified height above the impact plate and oriented such that it will fall in one of the six directions indicated in Figure 1. Disarm the trigger device, if included in the pyrotechnic article.

Release the pyrotechnic article, allowing it to free fall onto the impact plate. Repeat the test using the same pyrotechnic article oriented to fall in the opposite direction.

Repeat the test twice more, once using a second pyrotechnic article and once using a third pyrotechnic article, each time along one of the remaining directions indicated in Figure 1.

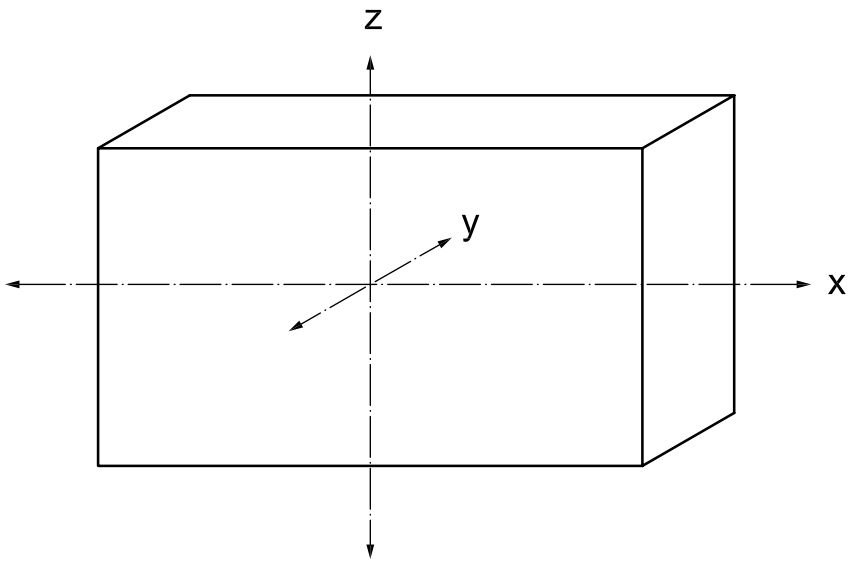


Figure 1 — Definition of main axes

4.3 Vibration and temperature test

4.3.1 Purpose

The purpose of this test is to determine the ability of the pyrotechnic article to withstand vibration and temperature conditions. The test may be performed simultaneously or sequentially.

4.3.2 Equipment

The equipment shall consist of a vibration table capable of producing the vibration loads as characterized in Figure 2 and a climatic chamber capable of controlling the temperature during the test in accordance with Figure 3. In case the test is being performed simultaneously the vibration table shall be mounted within the climatic chamber.

4.3.3 Test conditions

The temperature tolerance shall be ± 2,5 °C.

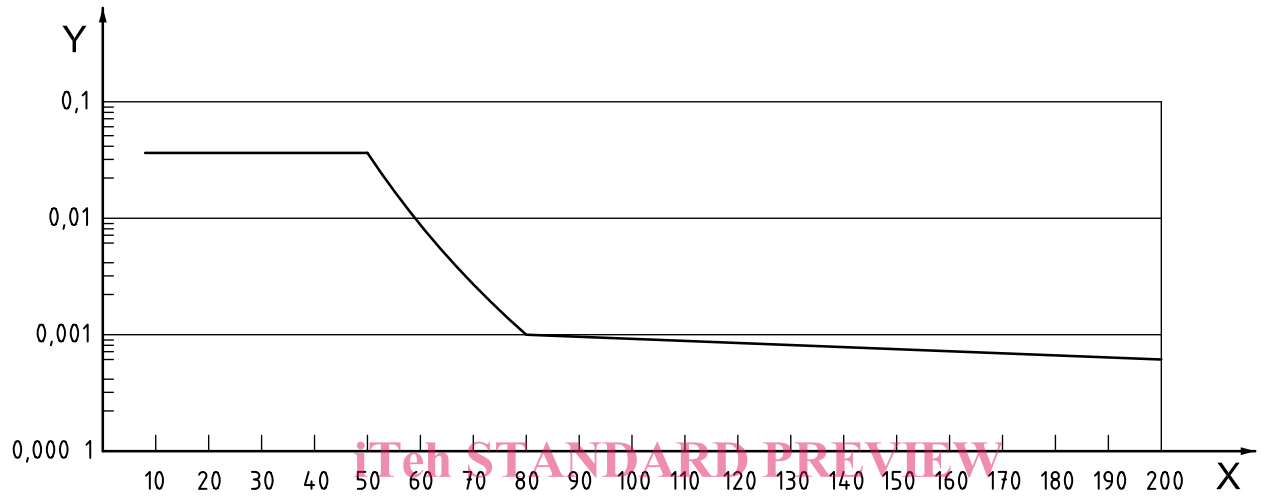
4.3.4 Test procedure

Fix the pyrotechnic article to the vibration table by an appropriate method insuring correct transmission of the vibration load. Apply random vibration in accordance with Table 1 and Figure 2 along each of the three main axes (see Figure 1) of each pyrotechnic article for 24 h.

Place the pyrotechnic article in the climatic chamber. The temperature shall be changed in accordance with Figure 3. It may be changed simultaneously with application of the vibration load.

Table 1 — Frequency characteristics at RMS of 1,34 g

Frequency Hz	Power spectral density g^2/Hz
8	0,035
50	0,035
80	0,001
200	0,000 5



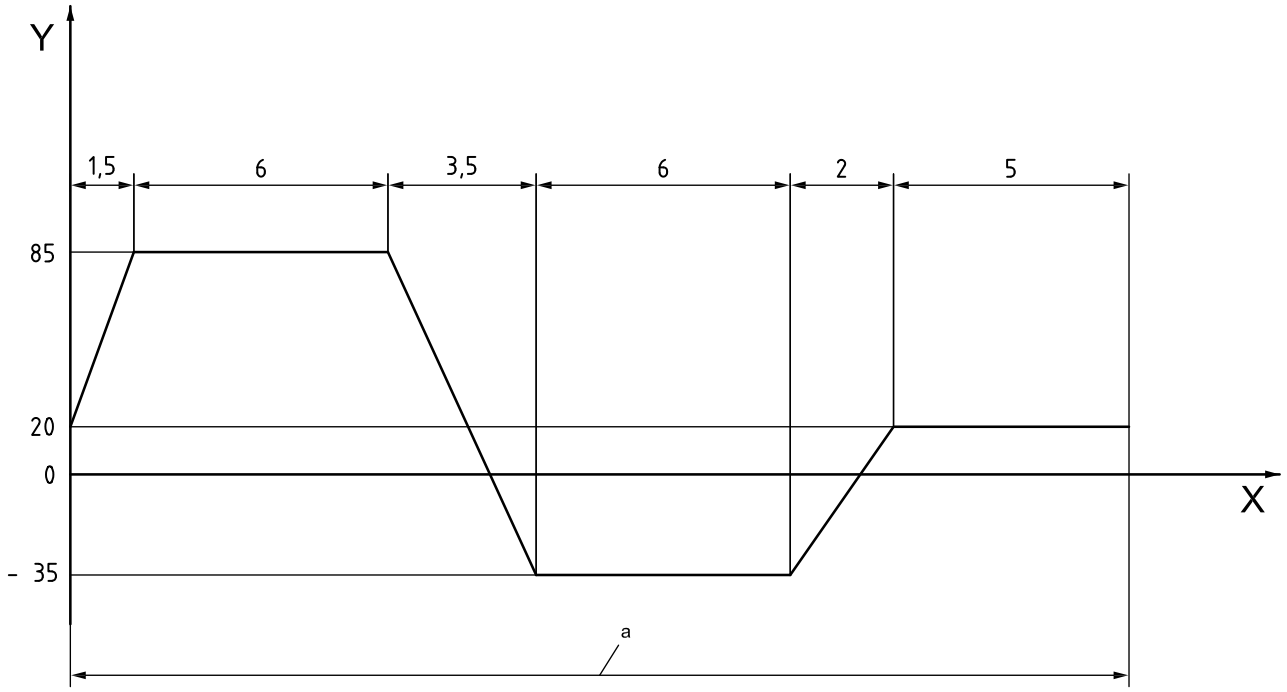
Key

X frequency, expressed in hertz

Y power spectral density, expressed in g^2 per hertz

Figure 2 — Vibration test

Note to Figure 2: Number of lines: 400; Range of analysis (filter bandwidth 1,25 Hz): 500 Hz; Degree of freedom (DOF): 154; Abort limits lines: ± 5 dB; Abort limits g RMS: ± 5 dB.



Key

X time, expressed in hours

Y temperature, expressed in degrees Celsius

a Duration of one cycle: 24h

Figure 3 — Temperature cycle

4.4 Thermal humidity cycling test

4.4.1 Purpose

The purpose of this test is to determine the ability of the pyrotechnic article to withstand high humidity and temperature variations.

4.4.2 Equipment

A climatic chamber with recirculating air shall be used.

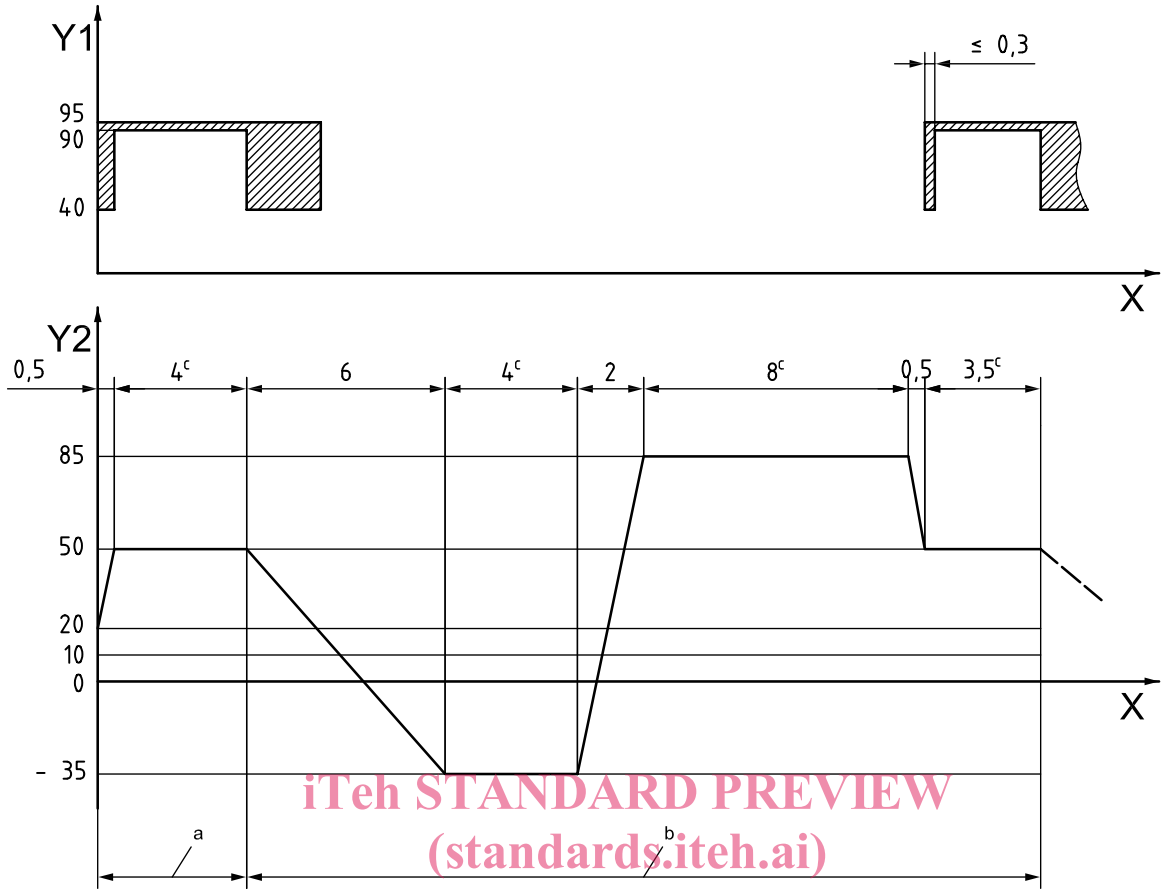
4.4.3 Test condition

The temperature tolerance shall be ± 2,5 °C.

4.4.4 Test procedure

Place the pyrotechnic article in the climatic chamber and subject it to 30 thermal humidity cycles in accordance with Figure 4.

NOTE 1 The temperature reference point is within the propelling media.



X time, expressed in hours

Y_1 relative air humidity, expressed as a percentage

Y_2 temperature, expressed in degrees Celsius

a Lead time

b Duration of one cycle: 24h, or less using t_e.

c Or: reference temperature build-up time, t_e.

NOTE 2 The relevant temperature build-up times, t_e, may be used instead of the given hours; if t_e is used, it shall be determined prior to the test according to the procedure in Annex A.

Figure 4 — Thermal humidity cycle

4.5 Electrostatic discharge (ESD) test

4.5.1 Purpose

The purpose of this test is to prove the ability of the pyrotechnic article to withstand electrostatic discharges without unintended ignition.

4.5.2 Equipment

An ESD generator capable of producing the test pulse, adjustable within the limits given in 4.5.3, shall be used consisting in its main parts of the following and meeting the respective requirements:

— charging resistor: resistance, R_{ch}, between 50 MΩ and 100 MΩ;

— energy-storage capacitor: capacitance, C_s; (C_s + C_d) 150 pF ± 10 %;

— distributed capacitance, C_d;

— hand capacitor: capacitance, C_h of 10 pF ± 10 %;

— discharge resistor: resistance, R_d, of 330 Ω ± 10 %;

— voltage indicator: tolerance of the output voltage indication, ± 5 %;

— output voltage (see Note 1 of Figure 5), up to 8 kV (nominal) for contact discharge;

— polarity of the output voltage: positive and negative;

— discharge switch;

— discharge return cable;

— holding time: at least 5 s;

— discharge, mode of operation: single discharge; the generator should be able to generate at a rate of at least 20 discharges per second for exploratory purposes only;

— time between successive discharges: at least 1 s;

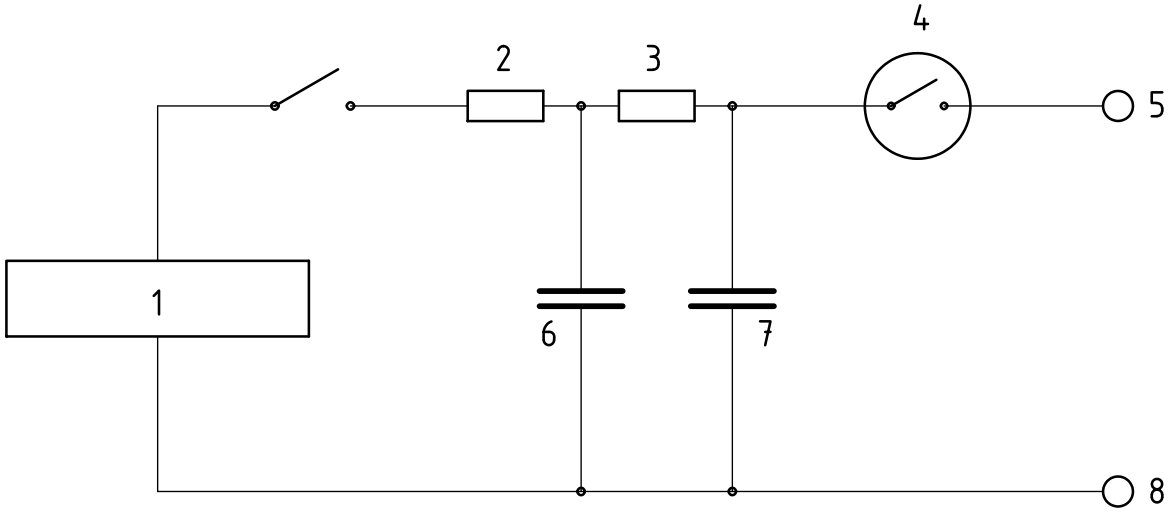
— power supply unit.

NOTE Open circuit voltage is measured at the energy storage capacitor.

The generator shall be provided with a means of preventing unintended radiated or conducted emissions, of either pulse or continuous type, so that the pyrotechnic article and auxiliary test equipment are not disturbed by these effects.

The discharge return cable of the test generator shall be constructed to allow the generator to meet the waveform specification. It shall be sufficiently insulated to prevent the flow, during the ESD test, of the discharge current to personnel or conducting surfaces other than via its termination.

Figure 5 presents a simplified diagram of the ESD generator. Construction details are not given.



Key

1	DC HV supply	5	discharge contact
2	charging resistor (R_{ch})	6	energy-storage capacitor (C_s)
3	discharge resistor (R_d)	7	hand capacitor (C_h)
4	discharge switch	8	discharge return connection

NOTE 1 C_d, omitted from Figure 5, is a distributed capacitance existing between generator and the pyrotechnic article, ground reference planes and coupling planes.

NOTE 2 Because the capacitance is distributed over the whole generator, it is not possible to show this in the circuit.

Figure 5 — Simplified diagram of the ESD generator

4.5.3 Test conditions

4.5.3.1 General

The pyrotechnic article shall be at ambient temperature.

4.5.3.2 Calibration of the test set-up for contact discharge

The calibration shall be done in such a way that the impulse shown in Figure 6 and given in Table 2 is measured by a suitable device connected to the ESD-simulator in accordance with the wiring diagram in Figure 7.

The values of the parameters of the discharge current shall be verified with 1 000 MHz bandwidth-measuring instrumentation.

A lower bandwidth implies limitations in the measurement of rise time and amplitude of the first current peak.

4.5.4 Test procedure

Electrostatic discharge shall be applied in accordance with Figure 6.

Place the pyrotechnic article under test on a conductive bench.

The bench ESD simulator and power source shall be grounded to earth.

Identify specific test points on the pyrotechnic article prior to conducting the test.

If an igniter is present, apply the discharge to the igniter from pin to pin and from each pin to all those other areas of the casing accessible to personnel in normal use.

Perform the test with contact discharges and with positive and negative voltages. Subject each discharge point to a minimum of three positive and three negative discharges at the voltage level as shown in Figure 6. The time duration between discharges shall be at least 5 s.