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Road vehicles – Airbag components – Part 2: Testing of airbag modules

The International Standard ISO 12097-2:1996 has the status of a Swedish Standard. This document contains the official English version of ISO 12097-2: 1996.

Swedish Standard corresponding to documents referred to in this Standard are listed in "Catalogue of Swedish Standards", issued by SIS. The Catalogue lists, with reference number and year of Swedish approval, International and European Standards approved as Swedish Standards as well as other Swedish Standards.

Vägfordon – Airbagkomponenter – Del 2: Provning av airbagmoduler

Den internationella standarden ISO 12097-2:1996 gäller som svensk standard. Detta dokument innehåller den officiella engelska versionen av ISO 12097-2:1996.

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ISO 12097-2

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Road vehicles — Airbag components —

Part 2:
Testing of airbag modules

Véhicules routiers — Composants des sacs gonflables —

Partie 2: Essais des modules de sac gonflable

Reference number
ISO 12097-2:1996(E)

Contents

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Annexes

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.

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.

International Standard ISO 12097-2 was prepared by Technical Committees ISO/TC 22, *Road vehicles*, Subcommittee SC 12, *Restraint systems*.

ISO 12097 consists of the following parts, under the general title *Road vehicles — Airbag components*:

— *Part 1: Vocabulary*

— *Part 2: Testing of airbag modules*

— *Part 3: Testing of inflator assemblies*

Annex A forms an integral part of this part of ISO 12097. Annexes B and C are for information only.

Road vehicles — Airbag components —

Part 2:
Testing of airbag modules

1 Scope

This part of ISO 12097 establishes uniform test methods and specifies environmental procedures and requirements for airbag modules in road vehicles.

Part 3 of ISO 12097 covers testing of inflator assemblies.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this part of ISO 12097. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this part of ISO 12097 are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

ISO 6487:1987, *Road vehicles — Measurement techniques in impact tests — Instrumentation.*

ISO 12103-1:— [1], *Road vehicles — Test dust for filter evaluation — Part 1: Arizona test dust.*

3 Definitions

For the purposes of this part of ISO 12097, the definitions given in ISO 12097-1 and the following definitions apply.

3.1 airbag module: Assembly consisting of at least an inflator assembly and a bag with a cover, if applicable.

3.1.1 driver airbag module: Airbag module which is normally installed in the steering wheel.

3.1.2 front passenger airbag module: Airbag module which is normally installed ahead of the front seat passenger.

3.2 unexposed sample: Test sample not subjected to environmental testing. (Also referred to as baseline.)

3.3 exposed sample: Test sample subjected to environmental testing.

3.4 intact: State of the test sample, after completion of the test, in which the sample is sufficiently undamaged to enable the test sequence to continue.

4 General test conditions

CAUTION — There is a possibility of accidental firing of the airbag during any of the tests described in this part of ISO 12097. Appropriate precautions should therefore be taken both in terms of handling the module and in terms of the design of test equipment.

4.1 Purpose of environmental testing

Environmental tests simulate the effects of environmental loads on the airbag module with respect to its functional behaviour and service life.

The tests are based on the typical life cycle of an airbag module covering shipping, storage, mounting into the vehicle and operation, maintenance, and repair of the vehicle.

1) To be published.

The complete environmental test programme is composed of individual test methods which simulate automobile related influences such as mechanical shocks and vibration, heat and cold, humidity, sunlight, dust and corrosive agents.

Simulating the total service life may require more severe test levels than those seen in real world conditions to accelerate ageing and degradation processes.

The environmental test programme for airbag modules as specified in this part of ISO 12097 shall be a minimum requirement to ensure the verification of environmental robustness.

Table 1 gives an overview of the complete test programme applied to 10 identical test samples.

Table 2 lists the performance tests which shall be applied to 10 exposed samples and additionally to nine unexposed samples.

4.2 Test sequence

It is imperative that the sequence of the tests, Nos. 1, 2, 3, 6, 7 and 8, is in accordance with table 1. The sequence of tests 4 and 5 may be reversed if required.

The test purpose and sequence are based on life cycle considerations and on possible failure mechanisms which are described in 4.2.1 to 4.2.6.

4.2.1 The drop test and the mechanical impact test reflect handling, transportation and mounting which occur mainly during an early stage of the life cycle.

4.2.2 Dust may penetrate during all phases of the life cycle. It is important to carry out the dust test before the vibration test because of the damaging effect of abrasive particles. However, the dust test is performed after the mechanical impact test which can cause fissures, cracks and sealing damages.

Table 1 — Airbag module environmental test programme

Test No.	Test	Subclause	Sample number																		
			Exposed samples										Unexposed samples								
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Drop test	5.1	×	×	×	×	×	×	×	×											
2	Mechanical impact test at – 35 °C 23 °C 85 °C	5.2	 × × ×	 × × ×	 × × ×	 × × ×	 × × ×	 × × ×	 × × ×	 × × ×											
3	Dust test	5.3	×	×	×	×	×	×	×	×											
4	Simultaneous vibration temperature test	5.4	×	×	×	×	×	×	×	×											
5	Thermal humidity cycling test	5.5	×	×	×	×	×	×	×	×											
6	Salt spray test	5.6	×	×	×	×	×	×	×	×											
7	Solar radiation simulation test	5.7									×	×									
8	Temperature shock test	5.8									×	×									

Table 2 — Performance test programme

Test No.	Test	Subclause	Sample number																		
			Exposed samples										Unexposed samples								
			1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1	Static deployment test at – 35 °C 23 °C 85 °C	6.1	×	×	×	×					×	×	×	×	×	×	×	×			
2	Tank test at – 35 °C 85 °C	6.2					×	×											×	×	
3	Bag test	6.3					×	×											×	×	
4	Spare units	—							×	×											×

4.2.3 The simultaneous vibration temperature test simulates the combined action of vibration and temperature which occurs during the life cycle. Dynamic loads during driving can be described as broadband random vibrations. Additionally, increased vibration levels occur at several characteristic frequency ranges. Dynamic loads may cause damage due to friction, abrasion, fatigue, and other effects. It is important to apply vibrations to the test sample at various temperatures, as many of the materials, especially polymers, have mechanical properties which vary with temperature. A simultaneous vibration/temperature regime simulates the real vehicle environment.

4.2.4 The thermal humidity cycling test simulates changing climatic influences with special emphasis on the penetration of water into the module during periods when the airbag module temperature is below the dew-point temperature of the ambient air. This test can cause electrical failures, material swelling, shrinking, corrosion and fouling due to biodegradation.

4.2.5 Salt spray is an accelerating agent for any kind of chemical alteration, especially for corrosion. The salt spray test is used to identify compatibility of the airbag module materials.

4.2.6 The solar radiation simulation test and the temperature shock test serve do determine the ageing behaviour of polymer parts, in their original installation equipment and types of mounting. Complex groups of components are used, and it is therefore suitable to establish the reciprocal effects of various materials within a component, or between several components. This test is used to evaluate changes in all the characteristics relevant to use and the consequences of various thermal expansions through the effects of synthetic global irradiation, heat/cold and humidity.

4.3 Measurements and test report

The following items shall be measured and recorded on a data sheet before and/or during each test of table 1:

— test number, sample number, test temperature and date;

— visual inspection of the samples and, if necessary, photographic documentation;

— definition of the three main axes (see example in figure 1);

— ambient temperature during the test in degrees Celsius (°C);

— squib resistance of the inflator assembly (if applicable).

All relevant observations and any unusual event shall be noted and included in the test report.

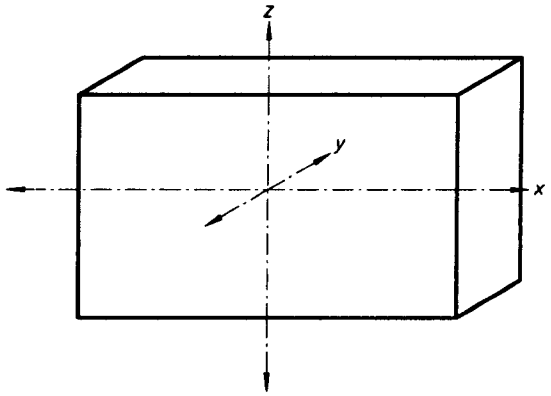


Figure 1 — Definition of airbag module main axes

4.4 Test programme

This part of ISO 12097 specifies a test programme with 19 identical samples of an airbag module that are numbered in accordance with table 1 and table 2. Ten airbag modules are subjected to the environmental test programme (multiple exposure) and nine airbag modules are unexposed samples.

The plug and ignition cable shall be connected, if applicable; the test current (an example is shown in figure 2) shall be applied according to the system used (with the exception of the mechanical impact test, the drop test, the solar radiation simulation test and the temperature shock test). After each test measure and record the squib resistance.

5 Environmental testing

The following test procedures are based on the documents listed in annex B. Certain modifications from these International Standards were made in order to recognize vehicle specific conditions.

5.1 Drop test

5.1.1 General

The purpose of this test is to determine whether the complete airbag module experiences any detrimental effect when dropped from a specified height and orientation.

5.1.2 Equipment

A steel impact plate of minimum dimensions 1 m × 1 m × 10 mm, resting on a solid floor and a fixture that supports the sample at the specified height shall be used.

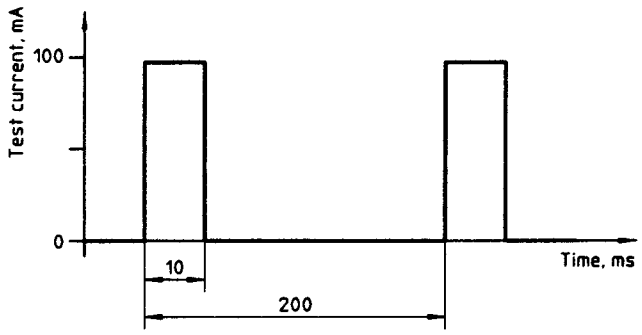


Figure 2 — Example of a test current for environmental simulation

5.1.3 Test sample

Eight airbag modules shall be tested in the sequence given in table 1.

5.1.4 Test conditions

Drop height: 1 m $^{+0,2}_{0}$ m

The ambient temperature shall be (23 ± 5) °C

5.1.5 Test procedure

Mount test sample No. 1 onto 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 module.

Release the module, allowing it to free fall onto the impact plate. Repeat the test using test samples Nos. 2 to 8, each arranged to fall in a different direction as follows:

— along one of the remaining directions indicated in figure 1, for samples Nos. 2 to 6;

— along two other appropriate directions selected by the test engineer, for samples Nos. 7 and 8.

5.1.6 Requirements

On completion of the test, the airbag module shall be intact (3.4).

Any visible damage shall be noted. The unit under test must continue the test programme according to table 1 even if there is visible damage. It is permissible to repair any damage to the airbag module which prevents mounting, to allow the test to proceed.

5.2 Mechanical impact test

5.2.1 General

The purpose of this test is to determine whether the complete airbag module experiences any detrimental effect when subjected to a series of shock impacts at normal and extreme temperatures.

5.2.2 Equipment

A climate chamber shall be used which is capable of maintaining the test conditions stated in 5.2.4.

A shock testing machine, onto which an airbag module can be fastened to its fixture or table, shall be used.

The characteristics of the shock testing machine shall be such that the true value of the actual pulse, as measured in the intended direction at the check point, is within the tolerances shown in figure 3.

The check point is the fixing point of the airbag module which is nearest to the centre of the table surface of the shock testing machine, unless there is a fixing point having a more rigid connection to the table, in which case this latter point shall be used. The frequency response of the overall shock testing machine, which includes the accelerometer, can have a significant effect on accuracy and shall be within the limits shown in figure 4.

5.2.3 Preparation of test sample

Eight airbag modules shall be preconditioned at each of the following temperatures:

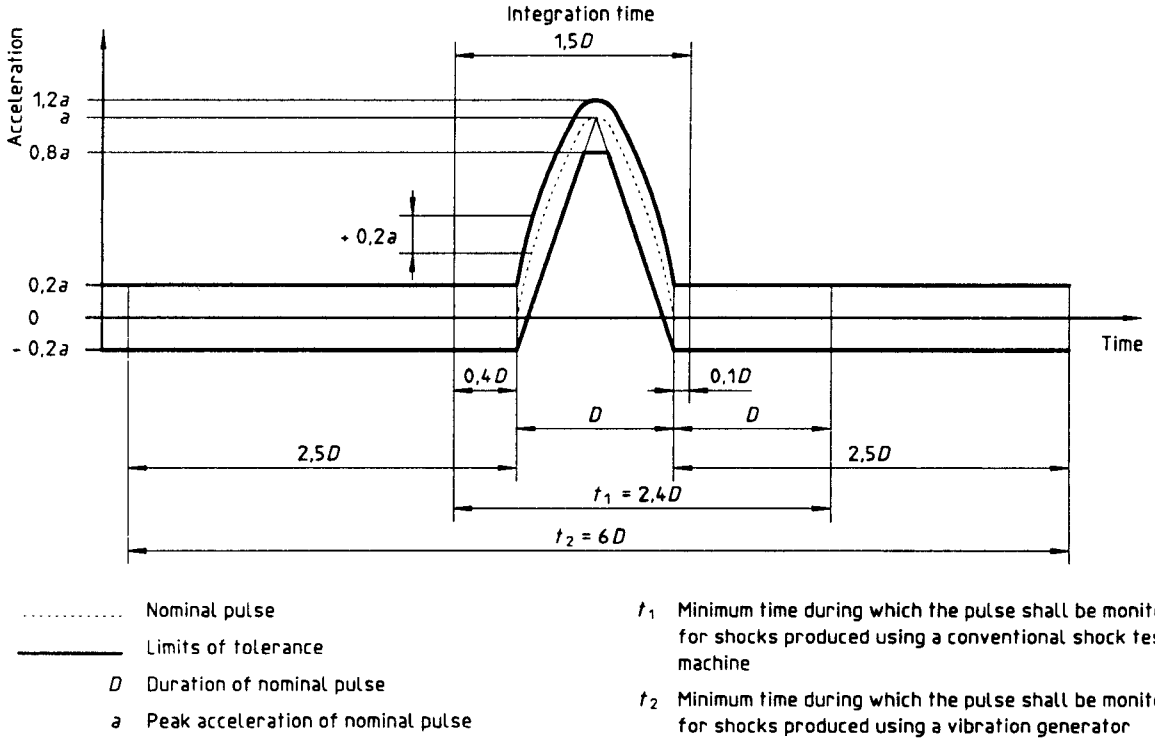
(– 35 ± 2,5) °C

(23 ± 5) °C

(85 ± 2,5) °C

Before mounting onto the test rig, each sample shall be preconditioned in the climate chamber at the required temperature for at least 4 h or for the time t_e, which is determined in accordance with the procedure specified in annex A.

NOTE 1 The reference point for measuring t_e should be at the slowest point of temperature adaptation within the bag folded into the airbag module.



..... 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 — Half-sine pulse

5.2.4 Test conditions

Each airbag module shall be subjected to a total of 36 shocks; 12 shocks at each of the test temperatures. Each series of 12 shocks consists of two successive shocks applied in each direction of the three mutually perpendicular axes of the airbag modules (see figure 1).

5.2.5 Test procedure

The 24 airbag modules shall be tested in the sequence given in table 1. Each airbag module is mounted outside the climate chamber on the test rig and subjected to the test conditions specified in 5.2.4. However, if the climate chamber is large enough, the test may be conducted inside it.

Airbag modules which include a trigger device shall be tested in the disarmed condition.

Consecutive impact tests can be conducted outside the climate chamber. After 5 min the airbag module shall be reconditioned for 10 min, or for the time t_e, which is determined in accordance with the procedure specified in annex A.

5.2.5.1 Basic pulse shape

The applied pulse shall be a half-sine (see figure 3). The true value of the actual pulse shall be within the limits of tolerance shown by the solid lines in figure 3.

5.2.5.2 Velocity change tolerance

The actual velocity change at the pulse shall be within ± 15 % of the value corresponding to the nominal pulse. Where the velocity change is determined by integration of the actual pulse, this shall be done from 0,4D before the pulse to 0,1D beyond the pulse, where D is the duration of the nominal pulse.

5.2.5.3 Transverse motion

The positive or negative peak acceleration at the check point, perpendicular to the intended shock direction, shall not exceed 30 % of the value of the peak acceleration at the nominal pulse in the intended direction, when determined with a measuring system in accordance with 5.2.2.

5.2.5.4 Severity

The shock severity shall correspond to the values of table 3.

5.2.6 Requirements

On completion of the test, the airbag module shall be intact (3.4).

Any visible damage shall be noted. The unit under test must continue the test programme according to table 1 even if there is visible damage. It is permissible to repair any damage to the airbag module which prevents mounting, to allow the test to proceed.