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2013-11-15

Road vehicles — Test procedures for evaluating out-of-position vehicle occupant interactions with deploying air bags

Véhicules routiers — Méthodes d'essai pour l'évaluation des interactions d'un occupant en position anormale dans un véhicule et des sacs gonflables en cours de déploiement

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Contents

Page

Foreword .... **iv**

Introduction .... **v**

1 Scope **1**

2 Normative references **1**

3 Terms and definitions **1**

4 Test drive **1**
- 4.1 General 1
- 4.2 50th percentile male Hybrid III dummy 2
- 4.3 "Small female" Hybrid III dummy 2
- 4.4 Three-year-old child Hybrid III dummy 2

5 Instrumentation **2**
- 5.1 Adult size dummy 2
- 5.2 Three-year-old child dummy 2
- 5.3 Data requirements 3
- 5.4 Dummy test temperature 3

6 Sled pulses **3**
- 6.1 General 3
- 6.2 Mild severity crash pulse 3
- 6.3 Moderate severity crash pulse 3

7 Static and dynamic test for driver air bag systems **6**
- 7.1 Test set-up 6
- 7.2 Prepositioned driver tests 6
- 7.3 Acceleration-induced out-of-position driver dynamic tests 7

8 Static and dynamic tests for passenger air bag systems, using child dummy **8**
- 8.1 General 8
- 8.2 Test set-up 8
- 8.3 Child dummy test positions 8
- 8.4 Child dummy static tests for passenger air bag systems 10
- 8.5 Child dummy dynamic tests for passenger air bag systems 10

9 Static and dynamic tests for passenger air bag systems using adult dummies **10**
- 9.1 General 10
- 9.2 Test set-up 10
- 9.3 Adult dummy positions near instrument panel 11
- 9.4 Adult dummy static tests for passenger air bag systems 11
- 9.5 Adult dynamic tests for passenger air bag systems 11

Bibliography **13**

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ISO/TR 10982:2013
https://standards.iteh.ai/catalog/standards/sist/f79a3826-d23e-4cf8-b23d-a6019ce959e2/iso-tr-10982-2013

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

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The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 10, *Impact test procedures*.

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This second edition cancels and replaces the first edition (ISO/TR 10982:1998), which has been technically revised.

Annex A of this Technical Report is for information only.

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Introduction

Although laws concerning the mandatory use of seat belts and child restraints have been enacted in most ISO member countries, surveys and accident statistics indicate that between 10 % and 50 % of front seat occupants involved in accidents had not used these restraint systems. Most, if not all, new vehicles marketed with air bags in ISO member countries specify that the air bag is supplemental to the existing belt/child seat restraint systems. However, front seat occupants may not comply with manufacturer's recommendations and laws. Hence, they may be near or against deploying driver and/or passenger air bag modules during collisions. Some data indicate that small, unrestrained children may get into such positions due to voluntary precrash riding positions[1] and/or due to preimpact braking and/or collision forces.[2] These factors may also cause some adults to be near the air bag modules, but preimpact braking is likely to have less effect on adults.

During the inflation process, an air bag generates a considerable amount of kinetic energy and as a result substantial forces can be developed between the deploying air bag and the out-of-position occupant. Accident data and laboratory test results[4][9] have indicated that these forces could cause injuries to the head, neck, thorax, abdomen and legs.

Both mild and moderate severity crash pulses are described in this Technical Report. These pulses represent general deceleration-time histories. The mild severity crash pulse is near the threshold of many air bag deployments and represents a frequent accident event. This pulse can be used for child testing, since they are more likely than adults to be near the air bag modules in threshold deployment collisions. Since preimpact braking has much less of an effect on adults, the moderate severity crash pulse can be used for adult testing. These described pulses or other vehicle-specific pulses may be used.

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This Technical Report describes the more common interactions, recognizing that the range of possible interactions is essentially limitless.

This document is published as a Technical Report, rather than as an International Standard, because of the general inexperience in air bag testing and lack of real-world accident data correlation. When sufficient real-world data are available and/or there is sufficient testing experience, it may be appropriate to develop an International Standard.

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Road vehicles — Test procedures for evaluating out-of-position vehicle occupant interactions with deploying air bags

1 Scope

This Technical Report outlines a number of test procedures that can be used for investigating the interactions that could occur between the deploying air bag and the occupant who is near the module at the time of deployment. Static and dynamic tests to investigate both driver and passenger systems are described. Comparative evaluation of the designs can be conducted using static tests. Favourable systems may be evaluated, if deemed necessary, by appropriate dynamic tests.

Children and infants restrained in child or infants seats are the subject of another Technical Report.[20]

2 Normative references

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

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ISO 6487:2012, *Road vehicles — Measurement techniques in impact tests — Instrumentation*

SAE J211, *Part-1 Instrumentation for impact test*

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3 Terms and definitions

For the purposes of this document, the following definitions apply.

3.1
passenger air bag module location
<low mounted> rearward deploying module location in the area of the instrument panel, normally used for knee bolsters

3.2
passenger air bag module location
<mid mounted> rearward deploying module location above the knee bolster area in the instrument panel

3.3
passenger air bag module location
<top mounted> air bag system that deploys through the top surface of the instrument panel

3.4
out-of-position occupant
vehicle occupant who is near the air bag module at the time of deployment

4 Test drive

4.1 General

Two sizes of adult dummies and one child size dummy are available for out-of-position occupant investigations. It is suggested that the adult dummies be equipped with an optional neck cover to give a more humanlike shape to the neck and neck-head junction.

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4.2 50th percentile male Hybrid III dummy

This dummy is specified in FMVSS part 572, subpart E.

4.3 "Small female" Hybrid III dummy

The small female dummy is a scaled-down version of the Hybrid III 50th percentile male dummy. The size, shape, response and measurement capability were defined by a task force of the SAE Human Biomechanics and Simulation Standards Committee.[11] This dummy is specified in FMVSS part 572, subpart O.

4.4 Three-year-old child Hybrid III dummy

This dummy was developed for passenger air bag testing[12] by a task force of the SAE Human Biomechanics and Simulation Standards Committee and is commercially available. This dummy is specified in FMVSS part 572, subpart P.

5 Instrumentation

5.1 Adult size dummy

Measurements that can be made or calculated using these test devices are listed below:

— facial forces;[19]

— head triaxial acceleration (three channels);

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— head angular acceleration in sagittal place (at least one channel for an extra linear accelerometer);

— upper neck (C-1: occipital condyles) forces and moments (six channels);

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— lower neck (C-7, T-1) forces and moments (six channels);

— chest triaxial acceleration (three channels);

— mid-sternum to thoracic spine deflection (one channel);

— mid-sternum acceleration (one channel);

— upper and lower ribcage deflection1) (five channels);

— lower thoracic spine (T-12) forces and moments2) (five to six channels);

— pelvis triaxial acceleration (three channels);

— for systems using inflatable knee restraints, the full spectrum of Hybrid III multi-channel femur and tibia load cells and knee displacement transducers can be used to measure leg loading.

5.2 Three-year-old child dummy

Measurements that can be made or calculated using the child dummy are listed below:

— head triaxial acceleration (three channels);

— head angular acceleration in sagittal plane (at least one channel for an extra linear accelerometer);

— upper neck (C-1) forces and moments (six channels);

1) Instrumentation for measurements is being developed and is expected to be available for both dummies at a later date.

2) Only available for the small female.

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— lower neck (C-1/T-1) forces and moments (six channels);

— shoulder forces (F_x, F_z; four channels);

— sternal acceleration (a_x; two channels);

— sternal deflection (one channel);

— spine triaxial accelerations (T-1, T-4, T-12; nine channels);

— lumbar forces and moments (six channels);

— pubic forces (F_x, F_z; two channels);

— pelvis triaxial acceleration (three channels).

5.3 Data requirements

All measurements should be recorded and filtered according to ISO 6487 and SAE J211 for body regions. These measurements should be continuous functions of time so other quantities, such as those found in references[8],[9],[13]-[17] may be derived.

5.4 Dummy test temperature

The test dummy temperature should be within the range of 20,6 °C to 22,2 °C (69 °F to 72 °F) at a relative humidity of 10 % to 70 % after a soak period of at least four hours prior to its application in a test.

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6 Sled pulses

6.1 General

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Mild severity and moderate severity crash pulses are defined in 6.2 and 6.3. The out-of-position child may be exposed to a pulse similar to the mild severity crash pulse since collisions of similar severity occur most often, and preimpact braking will cause the child to be out-of-position more often than the collision dynamics.

6.2 Mild severity crash pulse

This pulse is a half sine type with a peak acceleration occurring near the centre of the time duration of (8 ± 1)g[3)] between 40 ms to 100 ms, a velocity change of (27 ± 2) km/h, and a (150 ± 5) ms pulse duration. Typical acceleration-time and velocity-time curves, and nominal acceleration are shown in Figures 1 and 2.

6.3 Moderate severity crash pulse

This pulse is a half sine type with a peak acceleration occurring near the centre of the time duration of (13 ± 1)g between 40 ms to 80 ms, a velocity change of (29 ± 2) km/h, and a (110 ± 5) ms pulse duration. Typical acceleration-time and velocity-time curves, and nominal acceleration are shown in Figures 3 and 4.

3) $g = 9{,}806\ 65\ \text{m/s}^2$

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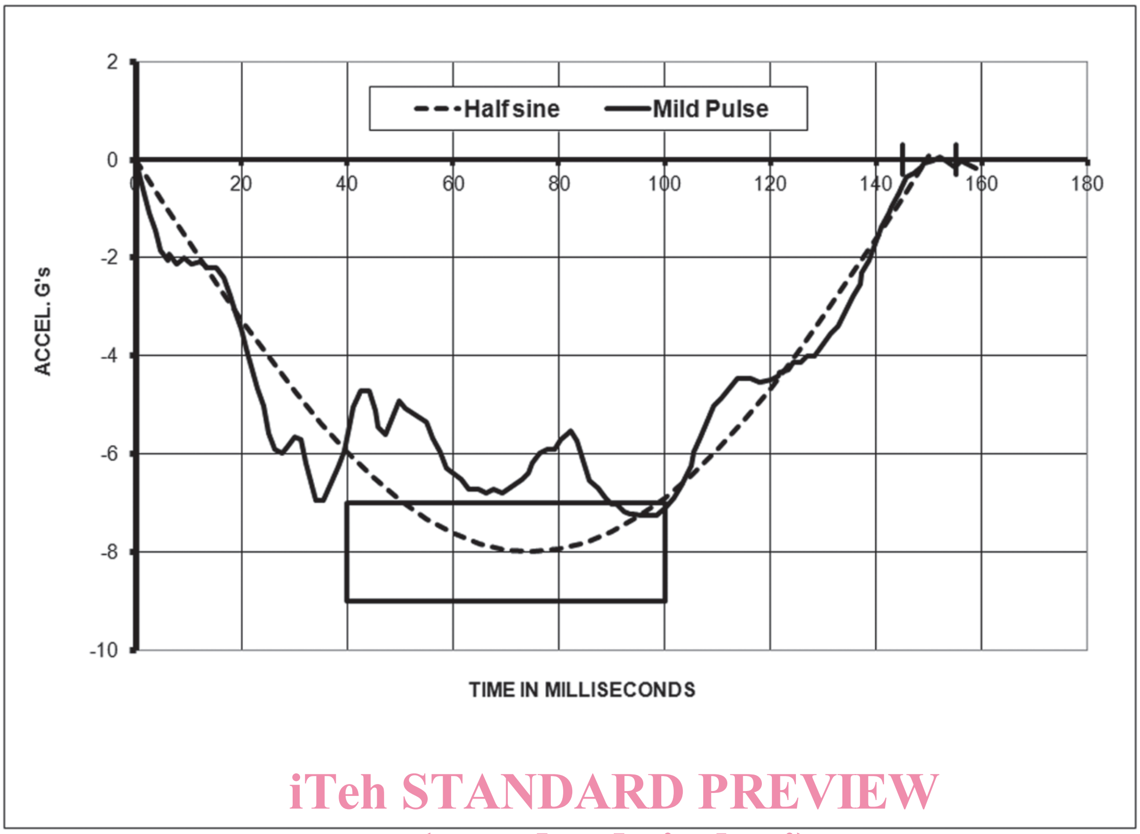

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Figure 1 — Generic Hyge sled pulse for a mild crash severity

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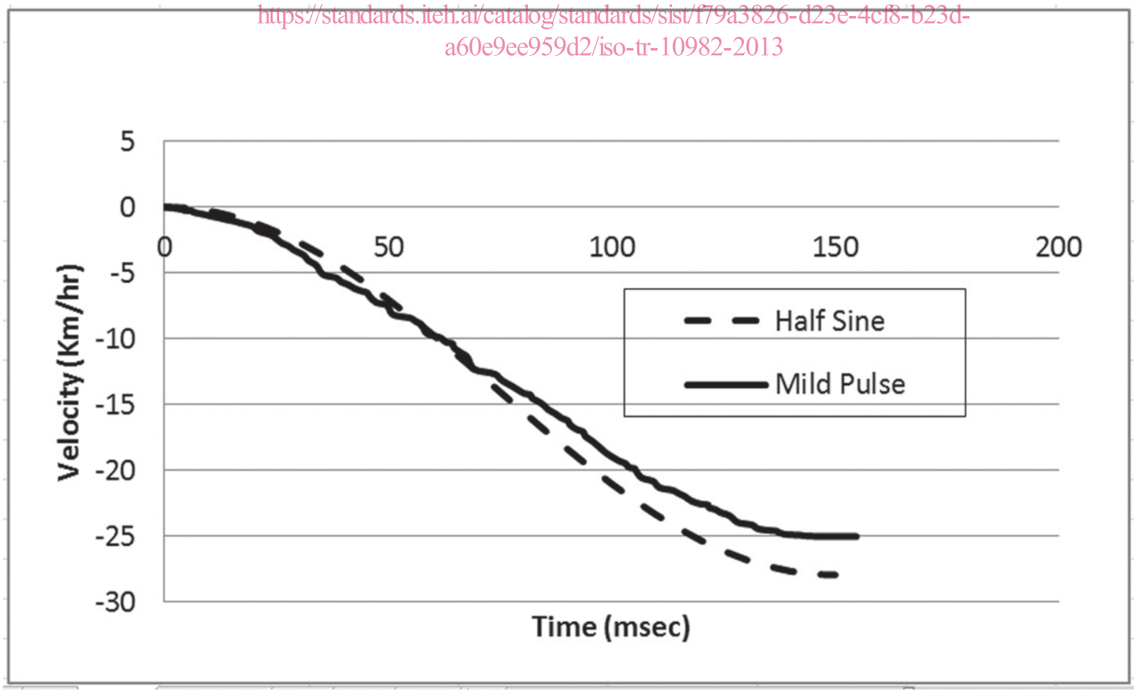

Figure 2 — Velocity-time history of the generic mild crash severity sled pulse

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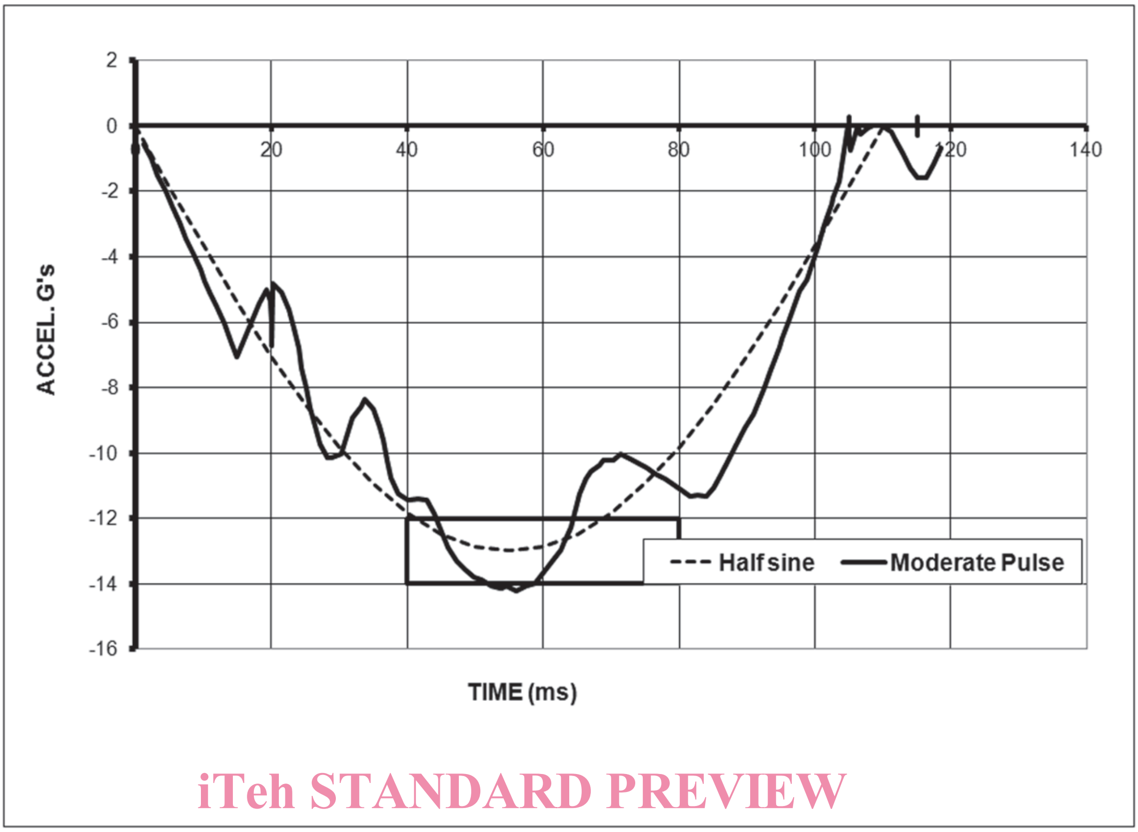

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Figure 3 — Generic Hyge sled pulse for a moderate crash pulse

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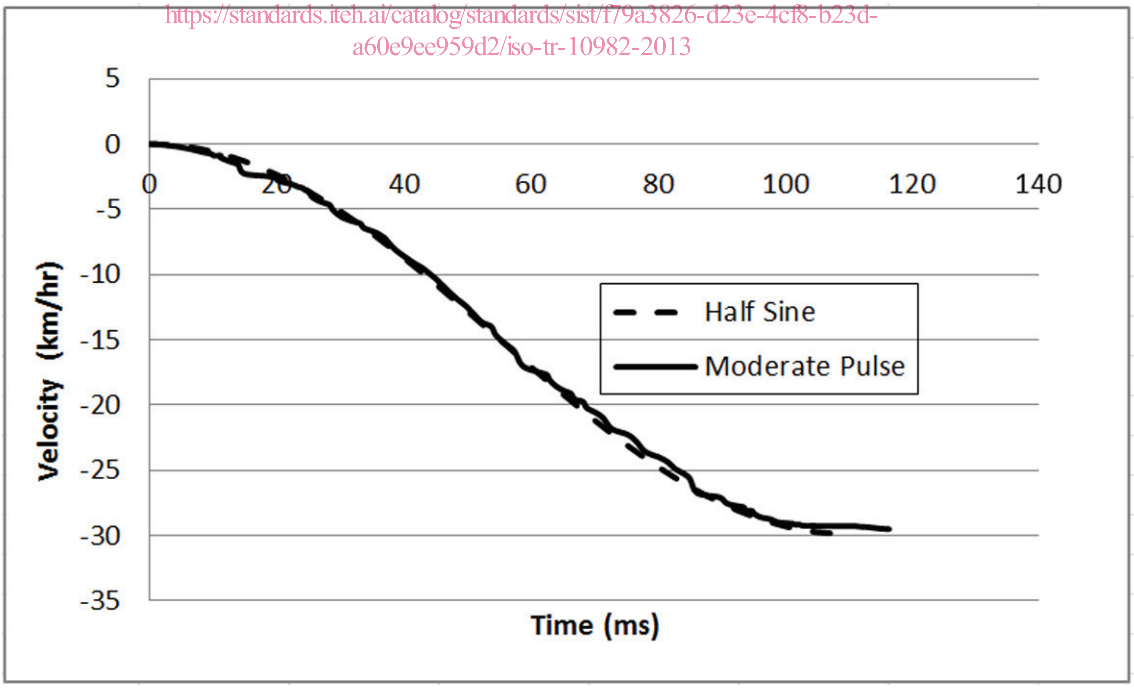

Figure 4 — Velocity-time history of the generic moderate crash severity sled pulse