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Road vehicles — Sled test procedure for the evaluation of restraint systems by simulation of frontal collisions

Véhicules routiers — Mode opératoire d'essai sur chariot pour l'évaluation des systèmes de retenue par simulation de collisions frontales

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Foreword

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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 7862 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 10, *Impact test procedures*.

This second edition cancels and replaces the first edition (ISO 7862:1992), which has been technically revised.

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Road vehicles — Sled test procedure for the evaluation of restraint systems by simulation of frontal collisions

1 Scope

This International Standard specifies a sled test procedure for the evaluation of restraint systems in road vehicles by the simulation of frontal collisions. Its main purposes are to improve test methods for evaluating restraint system efficacy and harmonize existing test methods — especially to enable the comparison of results of tests carried out in different laboratories. It is applicable to restraint systems used within the structure of a passenger car as defined in ISO 3833. Deviations from its requirements are permitted, provided they have no significant effect on the results of the test.

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 3833, *Road vehicles — Types — Terms and definitions*

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

ISO 6549:1999, *Road vehicles — Procedure for H- and R-point determination*

ISO TR 10982, *Road vehicles — Test procedures for evaluating out-of-position vehicle occupant interactions with deploying air bags*

ISO/TR 12349-1, *Road vehicles — Dummies for restraint system testing — Part 1: Adult dummies*

49 CFR Part 571-208, *Crashworthiness — Occupant crash protection* [1)]

SAE J 211-1, *Instrumentation for impact test — Part 1: Electronic instrumentation*

SAE J 211-2, *Instrumentation for impact test — Part 2: Photographic instrumentation*

SAE J 1980, *Guidelines for evaluating out-of-position vehicle occupant interactions with deploying frontal airbags — Information report*

1) Code of Federal Regulations (CFR), issued by the US National Highway Traffic Safety Administration, Department of Transportation.

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3 Terms and definitions

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

3.1
occupant restraint system
arrangement of components which is intended to diminish the risk of injury to the occupant in the event of a vehicle collision by controlling the occupant displacement and acceleration

3.2
seat
structure, complete with trim, intended to provide a seating position for one person

3.3
bench seat
structure, which may or may not be integral with the vehicle structure, complete with trim, intended to provide a seating position for more than one person seated side by side

3.4
H-point
pivot centre of the torso and thigh of the three-dimensional H-point machine which simulates the pivot centre of the human torso and thigh and is used for actual H-point determination

NOTE It is located on the centreplane of the device which is midway between the H-point sight buttons on either side of the H-point machine.

[ISO 6549, definition 3.2] [2)]

3.5
seating reference point
R-point
SgRP
design H-point
manufacturer's intended location for the fundamental reference point used to establish occupant accommodation tools and dimensions

NOTE 1 It simulates the position of the pivot centre of the human torso and thigh, has coordinates established with respect to the designed vehicle structure, and establishes the rearmost normal design driving or riding H-point location of each designated seating position, which accounts for all modes of adjustment, horizontal, vertical and tilt, that are available for the seat, but not including seat travel used for purposes other than normal driving and riding.

NOTE 2 Adapted from ISO 6549, definition 3.2.1 [2)].

3.6
sled
rigid guided platform which can be accelerated or decelerated within specified limits and on which the vehicle or its test-relevant structure(s) can be mounted

3.7
pulse-generating device
device for submitting the sled to speed variation according to a predetermined displacement/time curve

2) The meaning of H-point and R-point is identical in known regulations and according to ISO 6549, but the actual localization of each of these points may be slightly different from one regulation to another and in relation to ISO 6549.

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3.8
attachment system
arrangement of components which is intended to attach and to secure the vehicle or test structure(s) on the sled

3.9
equivalent pulse
velocity/time relationship representative of the body of one specific vehicle in an impact against a rigid or deformable fixed object or another vehicle

3.10
standard pulse
acceleration and/or velocity-time relationships intended for general use

NOTE See Annexes A, B and C.

4 Test equipment

4.1 Anthropomorphic test dummies, chosen from those recommended in ISO/TR 12349-1.

4.2 Instrumentation and photographic (or equivalent) documentation, according to ISO 6487 and SAE J 211-1 and SAE J 211-2.

4.3 Filter for filtering dummy measurements, which should be in accordance with ISO 6487 and SAE J 211-1 and SAE J 211-2.

4.4 Accelerometers for measurements on the sled, located in accordance with 5.3.17.

4.5 Sled, which shall be guided such that, during simulation of the impact, its angular deviation is less than 2°.

4.6 Pulse-generating device, which shall be able to produce a standardized pulse in accordance with Annex A, alternative pulses for unbelted occupants in accordance with Annex B and an equivalent pulse in accordance with Annex C.

5 Preparation for test

5.1 Vehicle components

In principle, all vehicle components which can influence the test results shall be present. The test may be carried out on a reduced structure (car body) with at least the following components: the steering system, windscreen and roof. The other components are not mandatory, but if in place they shall comply with the requirements of 5.3. The doors may be replaced by other constructions if it can be demonstrated that the test results are not affected.

5.2 Attachment of vehicle structure on sled

5.2.1 The method of attachment shall not modify the performance of the safety device(s) involved.

5.2.2 The vehicle structure shall be firmly attached to the sled so that no relative displacement occurs during the test [3]. In order to achieve this, the vehicle structure may be strengthened in the attachment area.

3) Work is in progress to define a procedure reproducing a pitching motion of the vehicle occupant compartment.

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The structure should rest on supports arranged approximately in line with the wheel axes or, failing this, in line with the suspension attachment points.

5.3 Positioning and adjustment of components

5.3.1 Steering wheel and foot controls

If used when adjustable, the steering-wheel and foot controls shall be set as close as possible to the range mid-point for normal use, or as specified by the vehicle manufacturer.

5.3.2 Windows

Normally, the tests shall be carried out with the windows closed. For measurement purposes some windows, but not the windscreen, may be removed.

5.3.3 Doors

The doors shall be closed but not locked. The doors may be replaced by other constructions (see 5.1).

5.3.4 Gearlever

If used, the gearlever shall be placed in the neutral position.

5.3.5 Sun-visors

If used, the sun-visors shall be in the folded-away position.

5.3.6 Rear-view mirror

If used, the interior rear-view mirror shall be in the normal-use position.

5.3.7 Arm-rests

Arm-rests, where fitted and adjustable, shall be in the normal-use position (folded out) unless the installation of dummies in the vehicle does not allow it.

5.3.8 Head-restraints

Where adjustable head-restraints are fitted, they shall be adjusted to suit the dummy in accordance with the manufacturer's user information instructions. Where such instructions are not explicit, the head-restraint shall be adjusted as close as possible to the back of the dummy's head with the head-restraint centre at the head centre of gravity level.

5.3.9 Seat positioning and adjustment

The driver's seat shall be adjusted to put the dummy's H-point as close as possible to a point 50 mm forward of the R-point. If the vertical adjustment is independent, it shall be set as close as possible to the range mid-point for normal driving, as specified by the vehicle manufacturer.

The front passenger seat shall be adjusted so that it is as nearly as possible in the same transverse vertical and horizontal planes as the driver's seat.

If the front seat is a bench seat, it shall be adjusted according to the procedure for the driver's seat.

Rear seats, if adjustable, shall be as far to the rear as possible.

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Lumbar support and other inflatable/adjustable devices on seating systems such as cushion thigh rolls and knee supports shall be adjusted in accordance with manufacturer's recommendations.

Where test dummies of small sizes (5th percentile) are used, the front seat shall be adjusted in its most forward longitudinal position.

5.3.10 Seatback adjustment

The seatback, if adjustable for inclination, shall be adjusted in accordance with the manufacturer's instructions. In the absence of any such specification, it shall be adjusted to produce a torso line angle as near as possible to 25° towards the rear from vertical when measured using the three-dimensional dummy specified in ISO 6549.

5.3.11 Convertibles and sunroofs

In the case of convertibles, the test shall be carried on with the roof closed or up. If there is a sunroof, it shall be in the closed position.

5.3.12 Other components

Components and which are not specified here but which may have an influence during the simulation of impact adjustable, shall be placed in their normal-use position when the vehicle is in motion.

5.3.13 Test dummy adjustment

The test dummy shall be adjusted according to the specification of 4.1.

5.3.14 Number of test dummies

The number of test dummies and their location depends on the crash condition being simulated.

5.3.15 Arrangement and installation of test dummies

Arrangement and installation of the test dummies shall be made in the same locations and manner as would be the case for the vehicle and vehicle condition being simulated. These should be documented for each test.

5.3.16 Occupant restraint system

The occupant restraint system(s) shall be installed and adjusted in accordance with the manufacturer's or installer's specification, in a way that allows the restraint system to function as designed.

5.3.17 Location of accelerometers

Accelerometers shall be mounted on the sled and set to measure sled acceleration in the sled travel direction (see also C.2).

6 Test conditions

6.1 Vehicle structure orientation on the sled

To represent a 0° barrier test, the longitudinal median plane of the car body shall be oriented at 0° relative to the sled path.

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To represent an angled barrier test, the orientation shall be at a standard angle [4] of 15° so that the motion of the occupant is forward and towards the car corner which would receive the first impact to a flat barrier.

6.2 Conditions at start of simulation of impact

Immediately before the simulation of the impact, the positions of the dummies, components and occupant restraint system configuration shall be in the initial positions according to 5.3.1 to 5.3.16. In particular, in the case of seat belts incorporating an emergency locking retractor, the locking mechanism shall be in the unlocked state, at the test onset.

6.3 Simulated impact pulse shape

The shape of the sled acceleration pulse or integrated change in velocity pulse obtained from the accelerometer defined in 5.3.17 shall be either one of the standard pulse shapes defined in Annex A or B or an equivalent pulse defined in Annex C.

4) The standard angle is intended to be representative for all models. To cover other cases, a method for calculating an equivalent angle, specific to each model, is to be prepared.

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Annex A
(normative)

Standard pulse for belted occupants

A.1 Data acquisition

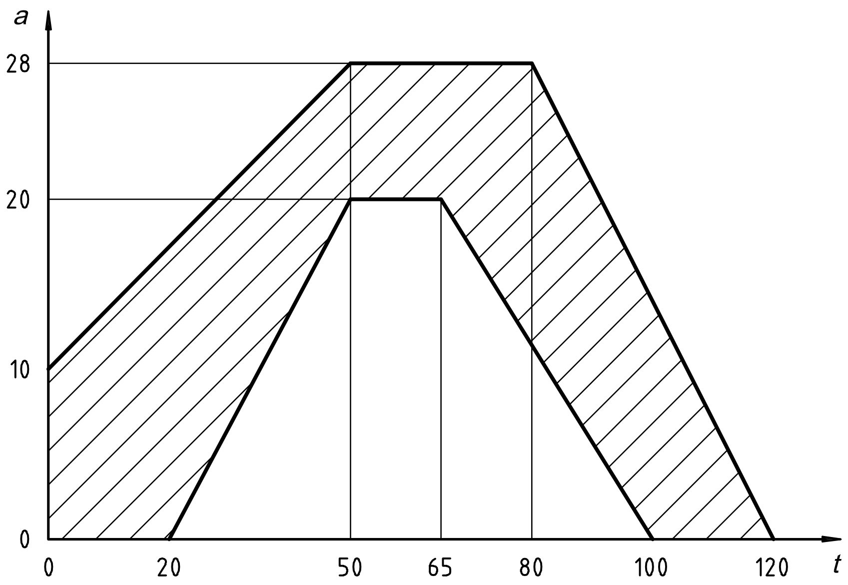
The sled shall be fitted with instruments that provide longitudinal horizontal acceleration data.

The instrumentation and measurements shall be in accordance with ISO 6487.

The acceleration signal from the transducer shall be filtered using a channel frequency class 60 filter.

A.2 Example of standard pulse

Figure A.1 shows an example of a standard pulse, with the acceleration pulse given as the appropriate standard pulse to reproduce a 0° angle barrier test with Δv of $50\,^{0}_{-2}$ km/h. For other values of Δv, different curves will be necessary.



Stopping distance: 650 mm ± 30 mm

Key

a acceleration, *g*

t time, ms

Figure A.1 — Standard pulse

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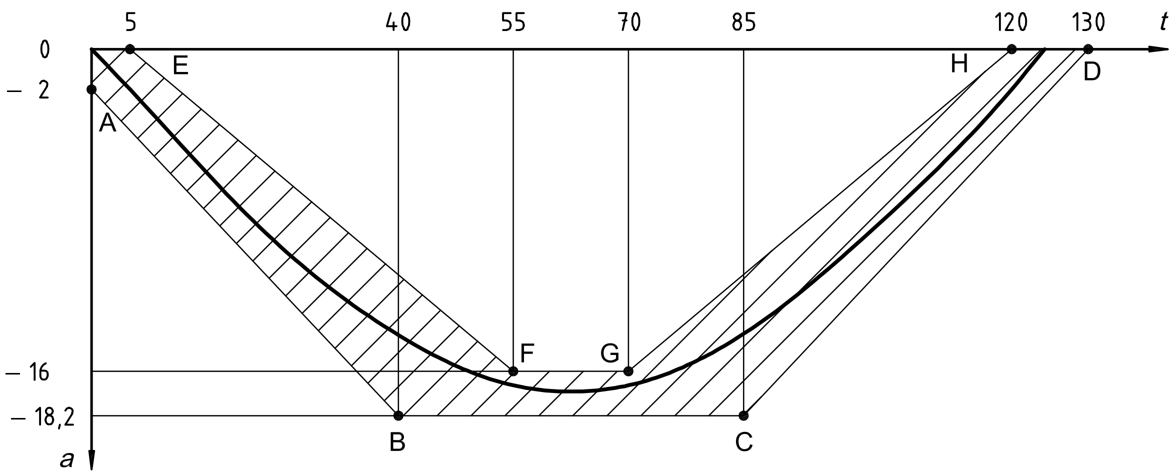
Annex B
(normative)

Standard pulses for unbelted occupants

The following standard sled pulses currently in use may be used to evaluate occupant restraint systems.

— The 50 km/h sled pulse specified by 49 CFR Part 571-208 for evaluating airbag restraint for an unbelted HYBRID III mid-size adult male dummy (see Figure B.1).

— The mild and moderate severity sled pulses specified by SAE J1980 and ISO TR 10982 for evaluating out-of-position vehicle occupant interactions with deploying frontal airbags (see Figures B.2 and B.3).



Reference point	Time, t ms	Acceleration, a g
A	0	− 2
B	40	− 18,2
C	85	− 18,2
D	130	0
E	5	0
F	55	− 16
G	70	− 16
H	120	0,00

Sled pulse acceleration = 17,2 sin(t/125) expressed in g, for $\Delta v = (49{,}56\ ^{0}_{-3{,}3})$ km/h.

Key

a acceleration, g

t time, ms

Figure B.1 — 50 km/h sled pulse — Evaluation of airbag restraint of unbelted occupant

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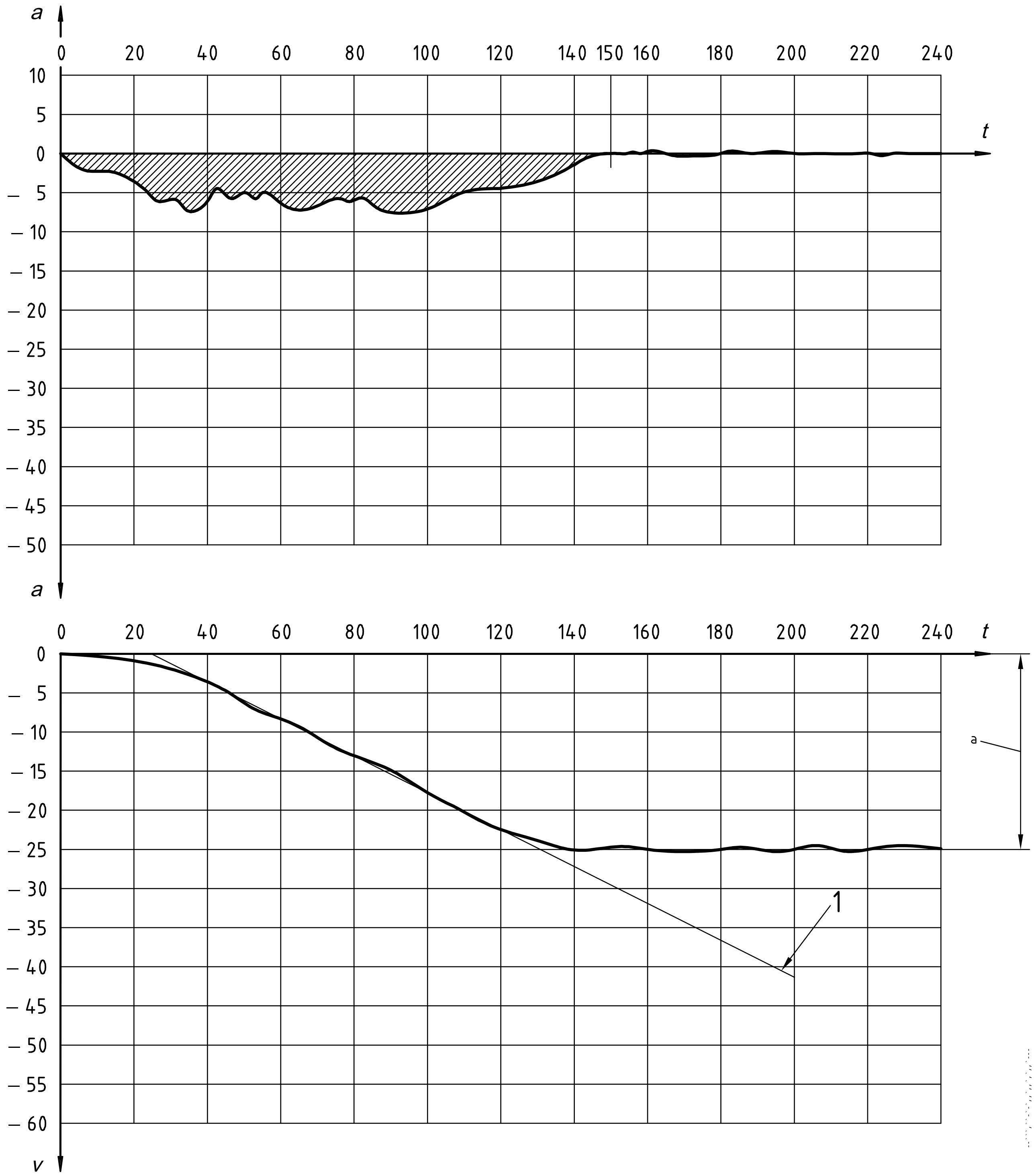

Nominal acceleration = 6,7 g

Key

a acceleration, g

t time, ms

v longitudinal velocity, km/h

1 slope

a $\Delta v = 25$ km/h.

Figure B.2 — Acceleration and velocity time histories for mild severity sled pulse — Evaluation of out-of-position occupant interactions with deploying airbag

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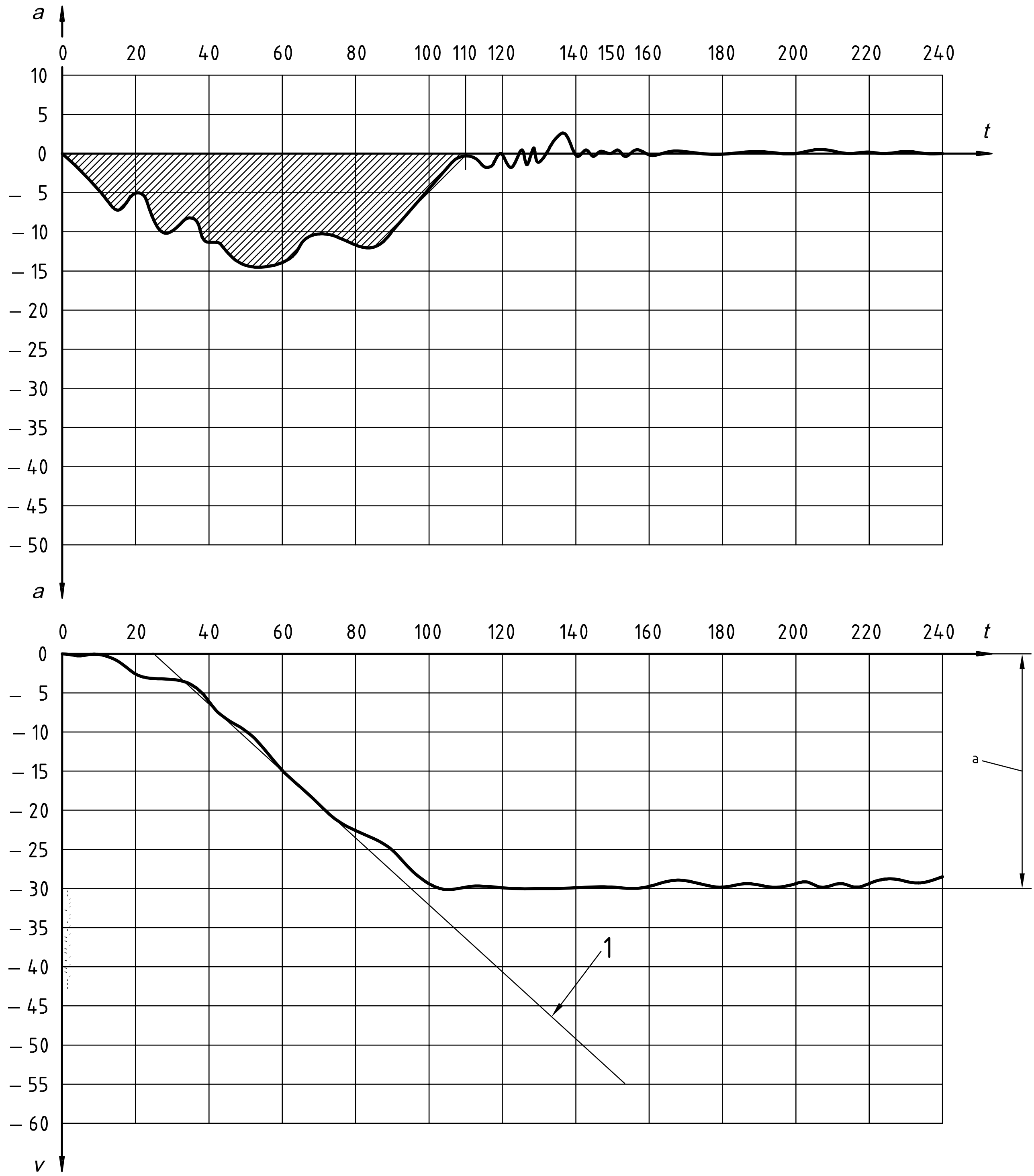

Nominal acceleration = 12 g

Key

a acceleration, g

t time, ms

v longitudinal velocity, km/h

1 slope

[a] $\Delta v = 29$ km/h.

Figure B.3 — Acceleration and velocity time histories for moderate severity sled pulse — Evaluation of out-of-position occupant interactions with deploying airbag

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Annex C
(normative)

Equivalent pulse for belted or unbelted occupants

C.1 General

This annex specifies the method for simulating a barrier impact test when the impact is required to be more representative of a specific vehicle than is possible using the standard pulse according to Annex A.

The barrier impact is simulated using a velocity/time history as the reference. This is the most appropriate parameter to use since the function of any occupant restraint system is to control the velocity difference between the occupant and vehicle.

The velocity/time curve shall be obtained by the usual practice of integrating the acceleration/time pulse.

C.2 Barrier impact data acquisition

The barrier test vehicle or vehicles shall have instruments which provide longitudinal horizontal acceleration data representative of that experienced in the passenger compartment.

The transducer measuring vehicle acceleration shall be located on the sill near the B pillar. The parameter to be used is the horizontal longitudinal component of the acceleration.

In a 0° angle barrier test, the accelerometer situated on the driver's side shall be used; whereas in an angled barrier test, the accelerometer situated on the side first impacted shall be used.

The instrumentation and measurements shall be in accordance with ISO 6487.

C.3 Determination of target waveform

C.3.1 Number of tests

The number of barrier tests selected (one or more) shall be sufficient to establish an acceleration/time history representative of the vehicle model being studied.

C.3.2 Acceleration/time history

The acceleration signal from the transducer shall be filtered with a channel frequency class 180 filter.

If data from two or more vehicles are available, the installer of the restraint system may decide which is the more representative.

C.3.3 Velocity/time history

The reference velocity/time history is calculated by integrating the acceleration/time history up to the time of maximum velocity change, Δv; it is expressed as a relative velocity starting from 0 (see Figure C.1).

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C.4 Sled test

C.4.1 Duplication of test conditions

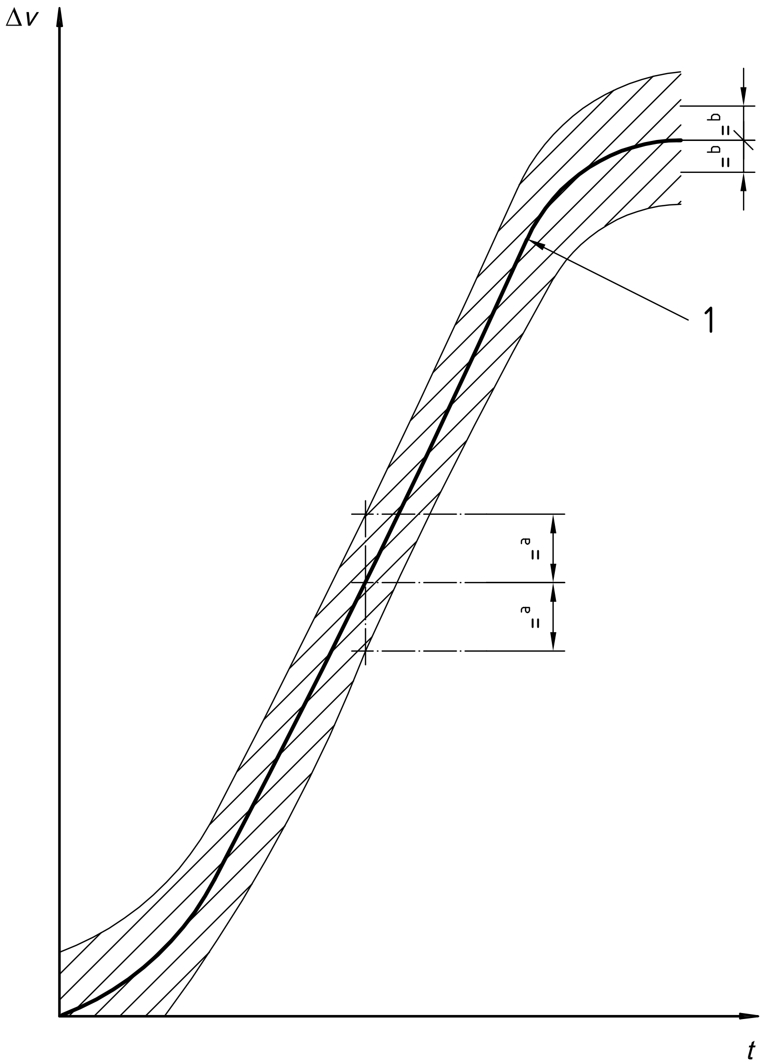
For each sled test, the velocity/time history is developed in the same way as for barrier tests. The characteristics of the methods for doing this, such as filter type and integration technique, shall be considered and preferably be as similar as possible to those used for the barrier tests, in order to obtain the best possible comparability between the barrier and sled test results.

C.4.2 Requirements

The velocity/time history of the sled test shall be within ± 1 m/s of the reference velocity/time history (see Figure C.1).

In addition, the sled overall velocity change shall be within ± 0,5 m/s of the reference velocity/time history.

Shifting the sled velocity/time history in time to obtain the best fit is permitted.



Key

Δv change of velocity, m/s

t time, s

1 reference barrier velocity/time history

[a] ± 1 m/s.

[b] ± 0,5 m/s.

Figure C.1 — Equivalent pulse — Construction of tolerance band for reference velocity/time history

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