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Road vehicles — Offset frontal impact test procedure

Véhicules routiers — Mode opératoire d'essai de choc frontal décalé

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Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
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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 15828 was prepared by Technical Committee ISO/TC 22, *Road vehicles*, Subcommittee SC 10, *Impact test procedures*.

Road vehicles — Offset frontal impact test procedure

1 Scope

This International Standard specifies a full scale test procedure for frontal offset deformable barrier impacts, that will ensure such tests are conducted under the same conditions. It is applicable to passenger cars and light trucks as defined in ISO 3833 with dummies in front seat positions.

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 209-1, *Wrought aluminium and aluminium alloys — Chemical composition and forms of products — Part 1: Chemical composition*

ISO 1176:1990, *Road vehicles — Masses — Vocabulary and codes*

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

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

ISO 8721, *Road vehicles — Measurement techniques in impact tests — Optical instrumentation*

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

FMVSS 208, *Occupant crash protection* [1)]

NHTSA TP-214D, *Dynamic side impact protection* [2)]

SAE J211-1, *Instrumentation for Impact Test — Part 1: Electronic Instrumentation* [3)]

SAE J211-2, *Instrumentation for Impact Test — Part 2: Photographic Instrumentation*

3 Terms and definitions

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

3.1
deformable barrier face
energy-absorbing barrier face mounted on the front of a rigid block

1) FMVSS, Federal Motor Vehicle Safety Standards and Regulations.

2) NHTSA, National Highway Traffic Safety Administration, US Department of Transportation.

3) SAE, Society of Automotive Engineers.

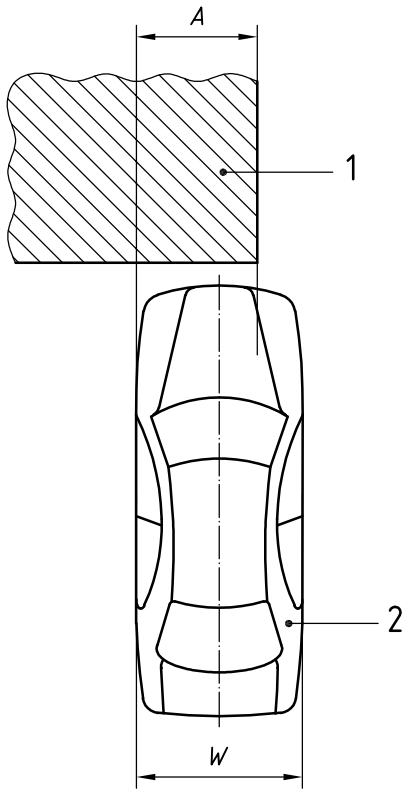
3.2
test vehicle width
W
distance between two planes parallel to the longitudinal median plane (of the test vehicle) and touching the test vehicle on either side of the longitudinal median plane

NOTE All parts of the test vehicle, including any lateral projections of fixed parts (wheels, hubs, door-handles, bumpers, etc.) are contained between these two planes, except the rear-view mirrors, side marker lamps, tyre pressure indicators, direction indicator lamps, position lights, customs seals, flexible mud-guards, door-edge guards, hinged side windows in the open position, fuel filler flaps in the open position, retractable steps, snow chains and the deflected part of the tyre walls immediately above the point of contact with the ground.

3.3
overlap
percentage of the test vehicle width covered by the barrier face

EXAMPLE Overlap = 75 %.

NOTE The overlap may be left or right. Figure 1 shows a left side overlap.



Key

1 barrier
2 test vehicle

$$\text{Overlap} = \frac{A}{W} \times 100$$

where

A is the test vehicle width covered by the barrier face

W is the test vehicle width

Figure 1 — Example of a left side overlap

3.4
passenger compartment
space for occupant accommodation, bounded by the roof, floor, side walls, doors, outside glazing, bulkhead, and plane of the rear compartment bulkhead or plane of the rear-seat back support

4 Test facility and equipment

4.1 Impact test site

The impact test site shall be a horizontal, smooth and hard surface which is of sufficient area for the test vehicle to reach the specified speed prior to impact and to come to rest after impact.

4.2 Barrier

The front face of the barrier consists of a deformable structure. The front face of the deformable structure is vertical $\pm$ 1° and perpendicular to the line of travel $\pm$ 1° when installed. The barrier face is secured to a mass of not less than (7×10^4) kg. This mass is anchored in the ground or placed on the ground with, if necessary, additional arresting devices to restrict its movement at impact to $\pm$ 2 mm.

4.3 Deformable barrier face characteristics

4.3.1 General

The dimensions and constituent materials of the deformable barrier face shall be in accordance with 4.3.2 to 4.3.6. See Figure 2.

4.3.2 Main deformable block

— Width 1 000 mm $\pm$ 2,5 mm

— Height 650 mm $\pm$ 2,5 mm

— Depth 450 mm $\pm$ 2,5 mm

— Material Aluminium 3003 [4)]

  1) Foil thickness 0,076 mm

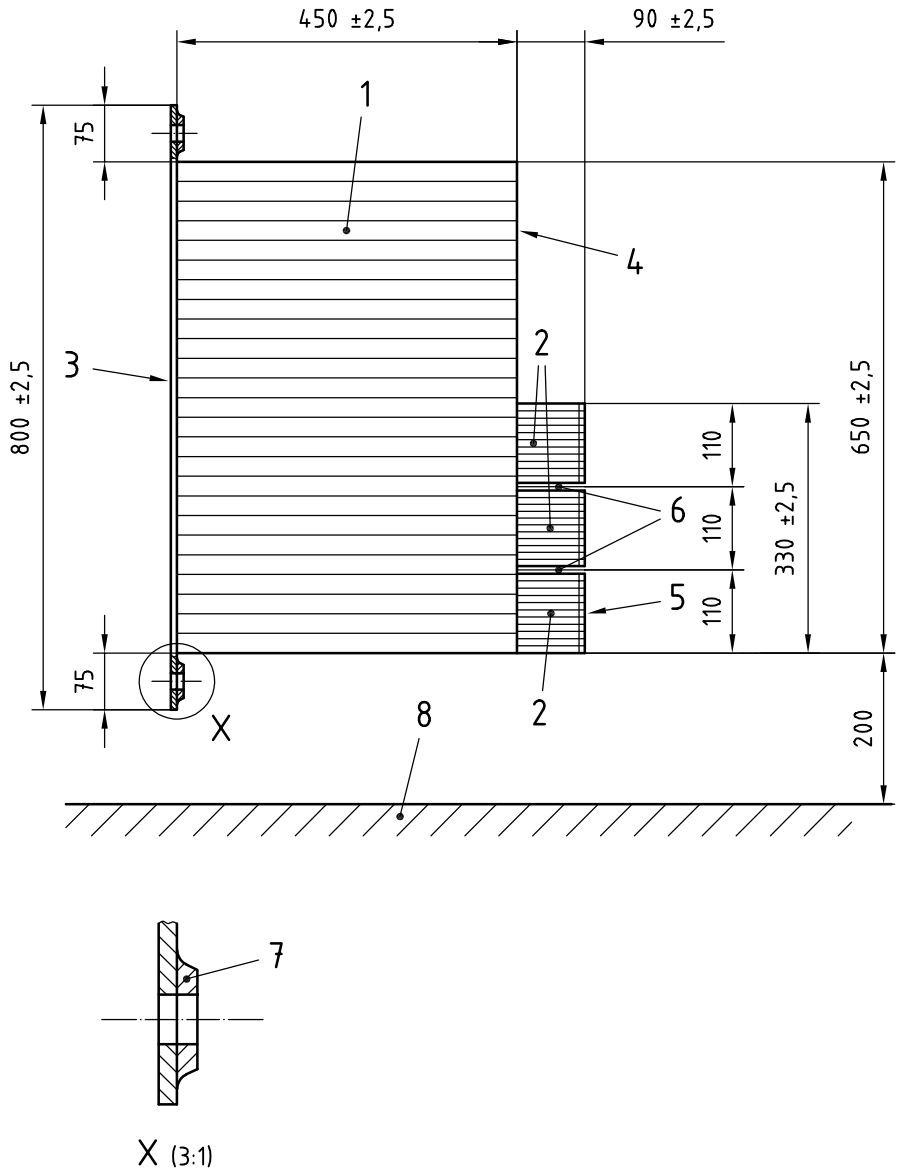
  2) Cell size 19,14 mm

  3) Density 28,6 kg/m^3

— Crush strength 0,342 MPa $^{0}_{-10}$ %

4) See ISO 209-1.

Dimensions in millimetres



Key

1 main deformable block [a]
2 bumper element [b]
3 backing sheet
4 cladding sheet
5 bumper facing sheet
6 slots in bumper
7 mounting flange
8 ground

[a] Crush strength = 0,342 MPa $^{0}_{-10}$ %

[b] Crush strength = 1,711 MPa $^{0}_{-10}$ %

Figure 2 — Deformable barrier for offset frontal impact testing

4.3.3 Bumper element

— Width 1 000 mm ± 2,5 mm

— Height 330 mm ± 2,5 mm

— Depth 90 mm ± 2,5 mm

— Material Aluminium 3003 [5)]

1) Foil thickness 0,076 mm

2) Cell size 6,4 mm

3) Density 82,6 kg/m^3

— Crush strength 1,711 MPa $^{0}_{-10}$ %

4.3.4 Backing sheet

— Width 1 000 mm ± 2,5 mm

— Height 800 mm ± 2,5 mm

— Thickness 2,0 mm ± 0,1 mm

— Material Aluminium 5251/5052 [5)]

4.3.5 Cladding sheet

— Width 1 000 mm ± 2,5 mm

— Height 650 mm ± 2,5 mm

— Thickness 0,81 mm ± 0,07 mm

— Material Aluminium 5251/5052 [5)]

4.3.6 Bumper facing sheet

— Width 1 000 mm ± 2,5 mm

— Height 330 mm ± 2,5 mm

— Thickness 0,81 mm ± 0,07 mm

— Material Aluminium 5251/5052 [5)]

5) See ISO 209-1.

4.3.7 Deformable barrier face calibration

The supplier of the deformable barrier face shall provide a certificate of calibration. The supplier shall also provide an analysis of his product's conformance to the calibration requirements as described in NHTSA TP-214D.

4.4 Propulsion of test vehicle

The test vehicle shall be propelled to a point as close as possible to the deformable barrier face at which point it shall be released to travel freely. At the moment of impact, the test vehicle shall be moving at the prescribed velocity.

4.5 Impact point on test vehicle

The test vehicle shall impact the barrier such that its longitudinal axis is within $\pm$ 2° of the intended angle of impact. The orientation of the barrier is such that the first contact of the vehicle with the barrier is on the steering-wheel side. The vehicle shall overlap the barrier face by the prescribed percentage. The tolerance on the offset of the impact shall not exceed $\pm$ 20 mm.

4.6 Tolerance on impact speed

The impact speed shall be measured within 0,5 m of the barrier following release of the propulsion system. The impact speed tolerance shall be $\pm$ 0,5 km/h.

5 Preparation of test vehicle

5.1 Mass of test vehicle

The vehicle test mass, m_t, shall be calculated as follows:

$$m_t = m_k + m_l + m_d$$

where

m_k is the complete vehicle kerb mass (ISO-M06), as defined in ISO 1176:1990, 4.6, in kilograms;

m_l is the rated cargo and luggage mass, in kilograms, such that

$$m_l = m_p - (68 \times DSC)$$

where

m_p is the maximum design pay mass (ISO-M09) as defined in ISO 1176:1990, 4.9, in kilograms;

DSC is the designated seating capacity of the test vehicle;

m_d is the test dummy mass.

The vehicle shall be ballasted to achieve the test mass to within $\pm$ 10 kg. The ballast shall be located and secured to the vehicle so that it does not alter the structural characteristics of the parts of the vehicle expected to deform during the test.

At the time of impact, the vehicle shall be at its normal ride height and attitude defined by the manufacturer.

The instrumentation and cameras required for testing should not change the mass distribution between the axles by more than 20 kg.

5.2 Condition of the test vehicle

5.2.1 Vehicle liquids

5.2.1.1 Fuel tank

The fuel tank shall be filled to 90 % of the mass of a full load of fuel with a non-flammable liquid having a density of 700 kg/m^3 to 1 000 kg/m^3.

5.2.1.2 Other liquids

All other systems (brakes, cooling, etc.) may be empty. In this case, the mass of the liquids shall be offset.

5.2.2 Doors

The doors shall be fully closed and latched but not locked.

5.2.3 Glazing

The movable glazing of the vehicle shall be in the closed position. For test measurement purposes and in agreement with the manufacturer, it may be lowered, provided that the position of the operating handle, if present, corresponds to the closed position.

5.2.4 Seats

When using a midsized adult male dummy, adjustable seats shall be in the adjustment position midway between the foremost and rearmost position, and if separately adjustable in a vertical direction, are at the reference position defined by the manufacturer. If on the same model adjustable and fixed seats exist, the vertical position of the fixed seat shall be used. If an adjustment position does not exist midway between the foremost and rearmost positions, the closest adjustment position rearward of the midpoint is used.

If the test vehicle has seats equipped with adjustable side bolsters or wings, these should be adjusted to their nominal position, as defined by the manufacturers. If the nominal position does not allow the test device to be positioned, the adjustable seat side bolsters or wings should be adjusted to fit the test device.

5.2.5 Position of the front seat-backs

If adjustable, the seat-backs shall be adjusted so that the resulting inclination of the torso of the dummy is as close as possible to that recommended by the manufacturer for normal use or, in the absence of any particular recommendation by the manufacturer, to 25° towards the rear from the vertical.

5.2.6 Head restraints

Head restraints adjustable for height shall be such that the vertical centre is aligned with the vertical centre of gravity of the dummy's head.

5.2.7 Position of steering wheel

The steering wheel, if adjustable, shall be placed in the normal position indicated by the manufacturer or, failing that, midway between the limits of its range(s) of adjustment. At the end of propelled travel, the steering wheel shall be left free, with its spoke(s) in the position which according to the manufacturer corresponds to straight-ahead travel of the vehicle.

5.2.8 Position of gear-shift lever

The gear-shift lever shall be in the neutral position.

5.2.9 Position of pedals

The pedals shall be in the normal position of rest. If adjustable, they shall be set in their mid position unless another position is specified by the manufacturer.

5.2.10 Tyre pressure

All tyres shall be inflated to manufacturer's specifications.

5.2.11 Opening roof

5.2.11.1 Convertible

If the test vehicle has a convertible top, the convertible structure shall be in the closed, up position for the test.

If an opening or removable roof is fitted, it shall be in place and in the closed position. For test measurement purposes and in agreement with the manufacturer, it may be open.

5.2.11.2 Sun roof

If the test vehicle has a sun roof, that roof shall be in the closed position for the test.

5.2.12 Position of sun-visor

The sun visors shall be in the stowed position.

5.2.13 Position of armrests

Armrests at the front and rear, if movable, shall be in the usable position, unless this is prevented by the position of the dummy(ies) in the vehicles.

5.2.14 Position of rearview mirror

The interior rearview mirror shall be in a normal position of use.

5.2.15 Restraint systems

The test vehicle shall be tested with all restraint systems in use or functional, as provided by the manufacturer. The upper anchorage setting shall be as recommended by the manufacturer.

6 Description of test dummy

A dummy corresponding to the specifications of the dummies described in ISO/TR 12349-1 and complying with the specifications for its adjustments is installed in each of the front outboard seats.

6.1 Dummy clothing

6.1.1 Garments

The instrumented dummies shall be clothed in formfitting cotton stretch garments with short sleeves and above the knee length trousers specified in FMVSS 208, or their equivalent.

6.1.2 Shoes

A shoe, specified in FMVSS 208, or its equivalent, shall be placed on each foot of the test dummy.

6.2 Test dummy temperature

The test dummy temperature shall be within the temperature range and at a relative humidity specified by the dummy's manufacturer.

7 Installation of test dummy

The positioning of the test dummy will form the subject of a future International Standard. Until then, the procedures outlined in FMVSS 208 may be considered for guidance.

8 Impact response measurements

ISO/TR 12349-1 shall be taken into account.

Data acquisitions and photographic (or equivalent) documentation shall be in accordance with ISO 6487, ISO 8721 and SAE J211-1 and SAE J211-2. The data specified in Tables 1 and 2 shall be obtained.

Dummy head contact with the passenger compartment shall be identified by chalking or painting the outboard side of the dummy head prior to the test.

Dummy knee contact with the passenger compartment shall be identified by chalking or painting the dummy knees prior to the test.

Table 1 — Test vehicle measurements

Value to be measured	Direction
Acceleration [a]: sill, right and left sides	X, Y and Z axes ($a_{V,X}$; $a_{V,Y}$ and $a_{V,Z}$)
Speed [b], v_V	In line of travel of test vehicle
Leakage of liquid from any part of fuel system	Any
[a] CFC (frequency class) = 60 Hz.	
[b] Number of channels = 1.	

Table 2 — Dummy measurements

Value to be measured	Directions
Head:	
— Acceleration at centre of gravity, a_H	X, Y and Z axes ($a_{H,X}$; $a_{H,Y}$ and $a_{H,Z}$)
Upper neck:	
— Forces, F_N	X, Y and Z axes ($F_{N,X}$; $F_{N,Y}$ and $F_{N,Z}$)
— Moments, M_N	X, Y and Z axes ($M_{N,X}$; $M_{N,Y}$ and $M_{N,Z}$)
Thorax:	
— Deflection of thorax, D_T	X axis ($D_{T,X}$)
Femur:	
— Force (right and left), F_F	Z axis ($F_{F,Z}$)
Tibia:	
— Force (right and left), F_t	X and Z axes ($F_{t,X}$ and $F_{t,Z}$)
— Upper moment (right and left), M_{tupp}	X and Y axes ($M_{tupp,X}$ and $M_{tupp,Y}$)
— Lower moment (right and left), M_{tlow}	X and Y axes ($M_{tlow,X}$ and $M_{tlow,Y}$)
Knee:	
— Displacement of sliding knee joint (right and left), D_K	X axis ($D_{K,X}$)
Pelvis:	
— Acceleration, a_P	X, Y and Z axes ($a_{P,X}$; $a_{P,Y}$ and $a_{P,Z}$)

Bibliography

[1] ISO 3560, *Road vehicles — Frontal fixed barrier or pole impact test procedure*

[2] ISO 6549, *Road vehicles — Procedure for H- and R-point determination*

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