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## Road vehicles — Pedestrian protection — Head impact test method

*Véhicules routiers — Protection des piétons — Méthode d'essai de choc de la tête*

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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.

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](http://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](http://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](#)

The committee responsible for this document is ISO/TC 22, *Road vehicles*, Subcommittee SC 36, *Safety and impact testing*.

This second edition cancels and replaces the first edition (ISO 14513:2006), of which it constitutes a minor revision.

It also incorporates the Technical Corrigendum ISO 14513:2006/Cor 1:2007.

## Introduction

The intent of this International Standard is to help reduce pedestrian head injuries by providing a standardized test method which will allow different test organizations to use the results from pedestrian impact tests conducted by other organizations. The test method specified applies to adults, but it is anticipated that biomechanical data for children will later be studied in order to determine the potential for child pedestrian protection.

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# Road vehicles — Pedestrian protection — Head impact test method

## 1 Scope

This International Standard specifies a test method to simulate the head impact of an adult pedestrian to the bonnet top of passenger vehicles or light truck vehicles of up to 3,5 t (GVM), as defined in ISO 3833. The impact device to be used in this test method will be robust for a vehicle impact velocity of up to 11 m/s. The test method specified addresses the reduction of an adult pedestrian head injury risk; it does not test for injuries to other regions of the pedestrian. The evaluation of injury risk to other pedestrian body regions is to be determined using other test methods. This test method does not consider downward pitching of the vehicle due to pre-impact braking. This test method and the corresponding HIC measurement utilizes a free flight head form impactor and does not consider the kinematics of the pedestrian body as a whole, nor does it consider the subsequent post-impact kinematics and potential injury risk.

NOTE The test method covers an adult pedestrian head in a simulated impact with a motorized road vehicle. Research suggests vehicle safety improvements in vehicle derived from such pedestrian impact tests may be beneficial also to bicyclists in vehicle front impact.

## 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.

ISO 3784, *Road vehicles — Measurement of impact velocity in collision tests*

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

## 3 Terms and definitions

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

### 3.1

#### normal ride attitude

vehicle attitude in driving order positioned on the ground, with the tires inflated to recommended pressures, the front wheels in the straight-ahead position, with maximum capacity of all fluids necessary for operation of the vehicle (with all standard as provided by the vehicle manufacturer), with one adult male 50th percentile dummy or an equivalent mass placed on the driver's seat and with one adult male 50th percentile dummy or an equivalent mass placed on the passenger's seat, and the suspension set in normal running conditions specified by the manufacturer (especially for vehicles with an active suspension or a device for automatic levelling)

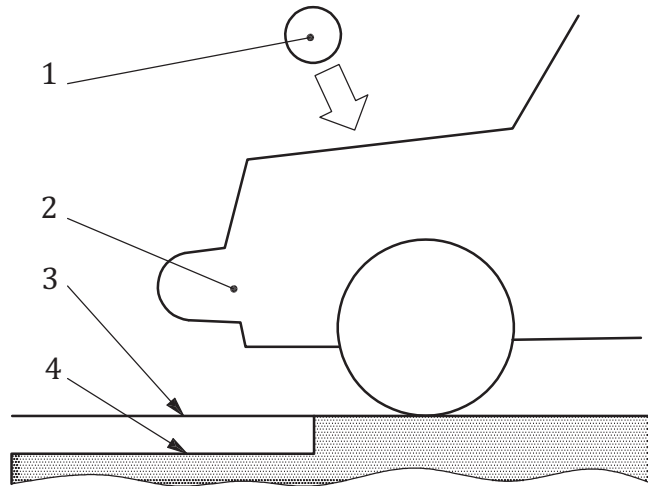
### 3.2

#### ground reference plane

horizontal plane, either real or imaginary, that passes through all tire contact points of a vehicle while the vehicle is in its *normal ride attitude* (3.1)

Note 1 to entry: See [Figure 1](#).

Note 2 to entry: If the vehicle is resting on the ground, then the ground plane and the ground reference plane are one and the same. If the vehicle is raised off the ground such as to allow extra clearance below the bumper, then the ground reference plane is above the ground plane.



**Key**

- 1 impactor
- 2 vehicle
- 3 ground reference plane
- 4 ground

**Figure 1 — Configuration of ISO head impact test method**

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**3.3 bonnet top**

outer structure that includes the upper surfaces of the bonnet (hood) and of the wings (outer fenders), the scuttle (cowl top), and the lower edge of the windscreen

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**3.4 wrap around distance**

geometric trace described on the top of the bonnet by one end of a long flexible tape, the other end held in contact with the *ground reference plane* (3.2) when it is held in a vertical fore and aft plane of the vehicle and traversed across the front of the bonnet and bumper of the vehicle, when it is in the normal ride attitude

Note 1 to entry: See [Figure 2](#).

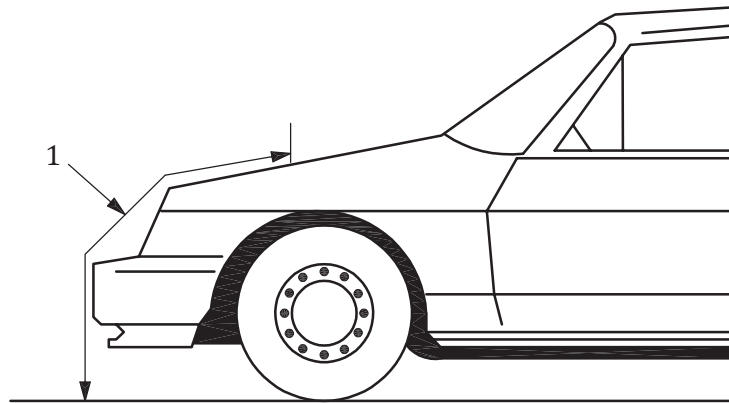
Note 2 to entry: The tape is held taught throughout the operation with one end held in contact with the ground reference plane, vertically below the front face of the bumper and the other end held in contact with the bonnet top. The length of the tape is the same as values of wrap around distance required in [5.2](#).

**3.5 bonnet side reference line**

geometric trace of the highest points of contact between a straight edge and the side of a bonnet, when the straight edge, held parallel to the lateral vertical plane of the vehicle and inclined inwards at 45° is traversed down the side of the bonnet, while maintaining contact with the surface of the body shell

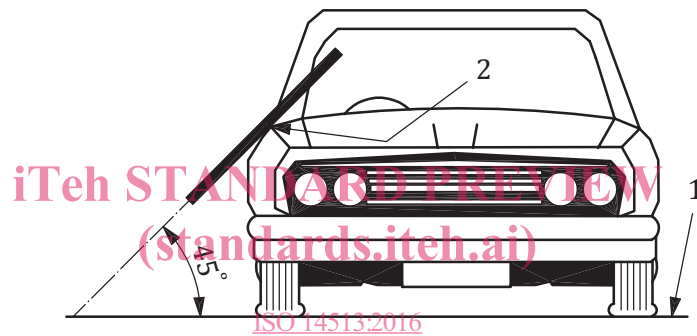
Note 1 to entry: See [Figure 3](#).



**Key**

- 1 wrap around distance

**Figure 2 — Determination of wrap around distance**

**Key**

- 1 straight line reference  
2 bonnet side reference line

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**Figure 3 — Determination of bonnet side reference line**

**3.6****head injury criterion****HIC**

calculated value describing the injury risk to pedestrian head colliding with a vehicle, and calculated from the head resultant acceleration time history

**4 Test equipment****4.1 Impact test site**

The test shall be conducted on a flat, smooth, and hard surface with a slope not exceeding 1 %.

**4.2 Head form impactor**

Head form impactor described in [Clause 5](#) shall be used in this test method.

## 5 Requirements

### 5.1 Head form impactor

#### 5.1.1 Size and mass

The contact surface of the head form impactor shall be spherical. The diameter is 165 mm as shown in [Figure 4](#). The mass shall be  $(4,5 \pm 0,1)$  kg. The centre of gravity of the head form impactor shall be located in the geometric centre of the sphere with a tolerance of  $\pm 5$  mm.

#### 5.1.2 Instrumentation

A recess in the sphere shall allow for mounting one triaxial or three uniaxial accelerometers within  $\pm 10$  mm seismic mass location tolerance from the centre of the sphere for the measurement axis, and  $\pm 1$  mm seismic mass location tolerance from the centre of the sphere for the perpendicular direction to the measurement axis.

If three uniaxial accelerometers are used, one of the accelerometers shall have its sensitive axis perpendicular to the mounting face and its seismic mass shall be positioned within a cylindrical tolerance field of 1 mm radius and 20 mm length. The centre line of the tolerance field shall run perpendicular to the mounting face and its mid-point shall coincide with the centre of the sphere of the headform impactor.

The remaining accelerometers shall have their sensitive axes perpendicular to each other and parallel to the mounting face A and their seismic mass shall be positioned within a spherical tolerance field of 10 mm radius. The centre of the tolerance field shall coincide with the centre of the sphere of the headform impactor.

The instrumentation response value CFC, as defined in ISO 6487, shall be 1,000. The CAC response value, as defined in ISO 6487, shall be 500 g for the acceleration.

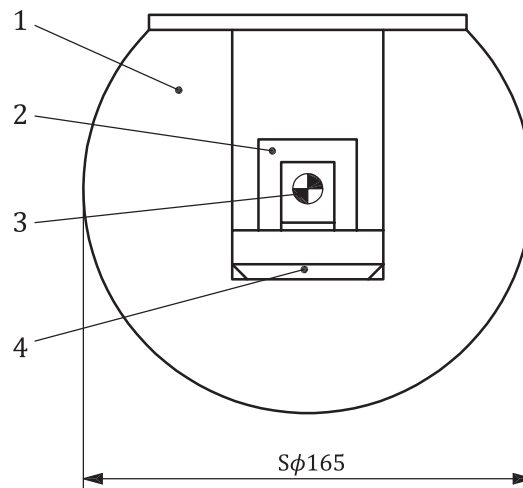
### 5.2 Impact area

Bonnet top shall be bounded by the geometric trace of the 1 500 mm wrap around distance in the front, as defined in [3.4](#), and the bonnet side reference lines, as defined in [3.5](#), in which the angle of the straight edge inclined inwards shall be  $45^\circ$  and rear boundary shall be the forward most of either the 2 100 mm wrap around distance or the rear most line created when the head form makes contact with the bonnet without first contacting the windscreen.

### 5.3 Impact angle

The head form impactor shall be propelled at a given angle into the bonnet top so as to ensure that the impact angle at the impact moment is as specified in [7.1](#).

Dimensions in millimetres

**Key**

- 1 spherical
- 2 accelerometer
- 3 impactor centre of gravity
- 4 accelerometer mount

**Figure 4 — Head form impactor**  
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**5.4 Head form impactor calibration**

The head form impactor shall meet the calibration requirements specified in [Annex A](#).

**5.5 Propulsion of head form impactor**

The head form impactor shall be propelled into a stationary vehicle. The method of head form impactor propulsion is at the discretion of the test office; however, the head form impactor should be launched to free flight at a required velocity.

**5.6 Rear face of head impactor**

This is a plane at the outer surface of the head form impactor which is perpendicular to the direction of travel, and typically perpendicular to the axis of one of the accelerometers, as well as being a flat plate used for access to the accelerometers and an attachment point for the propulsion system.

**6 Preparation of test vehicle****6.1 Components**

Either a complete vehicle or a cut-body, adjusted to the following conditions, shall be used for the test. All the parts of the vehicle structure and components that may be involved in a pedestrian head impact shall be in place in the test vehicle.

**6.2 Parking brake**

The parking brake shall be applied, or the cut-body shall be securely mounted.