

PROPOSED DRAFT GLOBAL TECHNICAL REGULATION (GTR)  
on  
PEDESTRIAN PROTECTION.

Transmitted by OICA

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PROPOSAL FOR A GLOBAL TECHNICAL REGULATION  
ON  
UNIFORM PROVISIONS FOR THE CONSTRUCTION OF THE FRONT OF MOTOR  
VEHICLES IN ORDER TO IMPROVE THE PROTECTION OF PEDESTRIANS AND  
MITIGATE THE SEVERITY OF INJURIES TO PEDESTRIANS AND OTHER  
VULNERABLE ROAD USERS IN THE EVENT OF A COLLISION

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Note: This document is distributed to the Experts on Passive Safety Provisions only.

GLOBAL TECHNICAL REGULATION NO. Y  
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UNIFORM PROVISIONS FOR THE CONSTRUCTION OF THE FRONT OF MOTOR  
VEHICLES IN ORDER TO IMPROVE THE PROTECTION OF PEDESTRIANS AND  
MITIGATE THE SEVERITY OF INJURIES TO PEDESTRIANS AND OTHER  
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NOTE: PREAMBLE WILL BE ADDED LATER (TECHNICAL RATIONALE AND JUSTIFICATION)

## B Text of the Regulation

### 1. Purpose and Scope.

- 1.1 The purpose of this regulation is to bring about an improvement in the construction of the fronts of vehicles and, in particular, those areas which have been most frequently identified as causing injury when in collision with a pedestrian or other vulnerable road user. The tests required are limited to those elements of the child and adult body most frequently identified as sustaining injury, i.e. the adult head and leg and the child head. To achieve the required improvements in construction, the tests are based on sub-system component impactor representing those body regions and impacted at speeds representative of that below which the majority of injuries occur.
- 1.2 The vehicles to be tested under the regulation are representative of the majority of vehicles in circulation in the urban environment, where there is a greater potential for collision with pedestrians and other vulnerable road users, and include passenger cars, vans and light trucks.

### 2. Application.

- 2.1 This global technical regulation aims at requiring specified tests for the purpose of qualifying vehicles, including passenger cars, vans and light trucks, with respect to the safety of pedestrians and other vulnerable road users.
- 2.2 *This global technical regulation applies to the following categories of power-driven vehicles, as defined in the Resolution [XYZ], annexed to the 1998 Agreement, setting forth common definitions and procedures to be used in global technical regulations, for which the procedures of this global technical regulation have been validated:*
- *Vehicles of category 1-1 of less than 2.5 ton GVM*
  - *Vehicles of category 2 of not more than 2.5 ton GVM, derived from category 1-1*

*Comment from Mr Doyle: The above paragraph could well be the final version somewhere down the line, but presently there may have to be some consideration provided to take care of the variation of vehicle fleets and the means by which they are now categorised.*

- 2.3 It is dependent on contracting parties to expand the application of this global technical regulation to additional specific vehicle categories on the basis of technical and economic feasibility and of effectiveness, taking into account the need to validate the test procedures and the requirements for these vehicle categories, *based on the results of studies conducted by IHRA*. Contracting Parties may also, taking into account the fleet differences and the vehicles to which the tests must be applied, restrict application of specific test procedures and requirements to specific vehicle categories. A matrix is provided as follows which provides detail as to which tests apply to which vehicles and in which regions:

*Comment from Mr Doyle: This paragraph should be to the effect that the contracting parties to the agreement may elect to accept what is appropriate for them and for whatever reason. It could also provide an understanding that the*

*choices will be limited to the combinations which are accepted initially, that any alterations will be on the basis of reducing the variations available and that any parties contracting to the regulation at a later date will be required to accept the alternatives available at that time.*

	Category 1-1 with GVM < 2500 kg	Category 1-1 with GVM > 2500 kg	Category 2, derived from category 1-1, with GVM < 2500 kg	Category 2, derived from category 1-1, with GVM > 2500 kg	Category 2 with a mass in running order < [3500] kg	...
test 1	Region x Region y Region z	Region y	...	...	...	...
test 2	Region x Region y	Region z	...	...	...	...
test 3	...	Region x	...	...	Region z	...
...	...	...	...	...	...	...

Examples of Region:

Region x covers all European Member states,  
Region y covers Japan,  
Region z covers the US,  
Etc. for other contracting parties.

Examples of Tests:

gtr test 1 is the Child Head to Bonnet,  
gtr test 2 is the Adult Leg to Bumper,  
Etc. for each of the different agreed tests.

The use of this approach still requires some guidance and approval from WP.29. The use of, such as, the 2500kg GVM will need to be defined and agreed

- [2.4 It is recommended that the application to the agreed vehicle categories would be phased in with respect to the date of acceptance of the GTR by any contracting party. In a first stage only new types of vehicles would be subject to the test requirements possibly followed by a further stage where all new vehicles would be required to pass the tests.]

*NOTE: in view of the fact that GTR's in principle do not contain certification procedures, this paragraph might be better placed in the Preamble section of this GTR.*

*Definition of New Types of vehicles regarding this GTR will need careful consideration by GRSP as well as appropriate lead times.*

### 3. Definitions.

*Comment from Mr Doyle: It is reasonable to assume at this time that this listing of definitions may be altered, replaced or added to, following further discussion*

For the purposes of this global technical regulation the following definitions will apply  
*Note: to the maximum extent, these definitions should be based on existing EU and IHRA ones and those from the MLIT draft):*

- 3.1. "Adult Head form Test Area" means the outer front structure that includes the upper surfaces of the bonnet and of the wings (outer fenders), the scuttle (cowl top), the windscreen, the A pillars and the roof. It is bounded by the front reference line for adult head form in the front and the rear reference line in the rear, as defined in paragraphs 3.12. and 3.24., and by the side reference lines as defined in paragraphs 3.27. and 3.28
- 3.2. "A-pillar" means the foremost and outermost roof support extending from the chassis to the roof of the vehicle.
- 3.3. "Bonnet angle" means .....[to be completed]
- 3.4. "Bonnet leading edge (BLE)" means .....[to be completed]
- 3.5. "Bonnet leading edge height (BLEH)" means .....[to be completed]
- 3.6. "Bonnet leading edge reference line" means .....[to be completed]
- 3.7. "Bonnet rear reference line (BRL)" means the geometric trace of the most rearward points of contact between a 165 mm sphere and a bonnet when the sphere is traversed across a bonnet while maintaining contact with the windscreen (see Figure 1).
- 3.8. "Bonnet top" means the outer structure that includes the upper surface of all outer structures except the windscreen, the A-pillars and structures rearwards of them. It therefore includes, but is not limited to, the bonnet, wings, scuttle, wiper spindle and lower windscreen frame.
- 3.9. "Child Head form Test Area" means the outer front structure that includes the upper surfaces of the bonnet and of the wings (outer fenders), and the scuttle (cowl top). It is bounded by the front reference line in the front and the rear reference line in the rear, as defined in paragraph 3.13. and 3.24., and by the side reference lines as defined in paragraphs 3.26. and 3.27.
- 3.10. "Corners of front face" means vertical lines that pass through the points at which vertical planes, set at 60° to the vertical longitudinal plane of a vehicle, contact and are tangential to the outer surface of the front face (see Figure 2).
- 3.11. "Front face" means the front part of a vehicle likely to strike the pedestrian's leg
- 3.12. "Front reference line for Adult Head form (AFL)" means the geometric trace described on the vehicle front structure by one end of a 1700 mm long flexible tape, when it is held in a vertical fore and aft plane of the vehicle and traversed across the front of the vehicle front structure and bumper of the vehicle when it is in the normal ride attitude. 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 vehicle front structure (see [Figure 3A](#), [Figure 3B](#), [Figure 3C](#)).

- 3.13. "Front reference line for Child Head form (CFL)" means the geometric trace described on the vehicle front structure by one end of a 1000 mm long flexible tape, when it is held in a vertical fore and aft plane of the vehicle and traversed across the front of the vehicle front structure and bumper of the vehicle when it is in the normal ride attitude. 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 vehicle front structure (see [Figure 3A](#), [Figure 3B](#), [Figure 3C](#)).

In the case of vehicles where the wrap around distance to the bonnet leading edge reference line as defined in paragraph 3.6. is more than 1000 mm at any point, then the bonnet leading edge reference line will be used as the front reference line at that point.

- 3.14. "Front structure" means the front part of a vehicle likely to be impacted by a pedestrian when the vehicle collides with the pedestrian at a speed of up to 40 km/h.
- 3.15. "Ground reference plane" means a 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. 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.
- 3.16. "Head Injury Criterion" means HIC shall be calculated from the resultant of accelerometer time histories using the formula ( $t_2 - t_1 \leq 15$  msec )

$$\text{HIC} = \left[ \frac{1}{t_2 - t_1} \int_{t_1}^{t_2} a \, dt \right]^{2.5} (t_2 - t_1)$$

Where:

$a$  is the resultant acceleration measured in units of gravity "g" ( $1 \text{ g} = 9.81 \text{ m/s}^2$ );

$t_1$  and  $t_2$  are the two time instants ( expressed in seconds ) during the impact, defining an interval between the beginning and the end of the recording for which the value of HIC is a maximum

- 3.17. "Impact point" means the point on the vehicle where initial contact by the test tool occurs. The proximity of this point with the target point is dependent upon both the angle of travel by the test tool and contour of the vehicle surface (see [Figure 4](#)).
- 3.18. "Impact Recommended Line (IRL) for the A-pillar", means the geometric trace of contact between a straight edge, held horizontally and transversally to the vehicle median longitudinal plane, and the the vehicle A pillar (see [Figure 6](#))
- 3.19. "Knee joint centre" means the centre of the bending part of the deformable element before deformation.
- 3.20. "Leg" means those mechanical components below the leg form impactor knee joint.
- 3.21. "Leg form impactor knee joint" means the mechanical joint of a leg form impactor with deformable elements to simulate a human knee in lateral impact only.

- 3.22. “Masses” means all the different masses as defined in Resolution XYZ annexed to the 1998 Agreement
- 3.23. “Normal ride attitude” means the 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 equipment 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 front 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) .

*Note: should a dummy be mentioned or a mass of 75 kg?*

- 3.24. “Rear reference line (RL) – Adult Head form Test Area” means the geometric trace described on the vehicle front structure by one end of a 2100 mm long flexible tape using a similar procedure to that used for the determination of the Front Reference Line (AFL) as per paragraph 3.12. above (see [Figure 3A](#), [Figure 3B](#), [Figure 3C](#)).

In the case of vehicles where the wrap around distance to the rear windscreen reference line as defined in paragraph 3.25 is less than 2100 mm at any point, the rear windscreen reference line will be used as the rear reference line at that point (see [Figure 3B](#)).

For vehicles where the wrap around distance to the rear reference line is over the vertical limit reference line, as defined in paragraph 3.32., at any point, then the vertical limit reference line will be used as the rear reference line (see [Figure 3C](#)).

- 3.25. “Rear reference line (RL) – Child Head form Test Area” means the geometric trace described on the vehicle front structure by one end of a 1700 mm long flexible tape using a similar procedure to that used for the determination of the Front Reference Line (CFL) as per paragraph 3.13. above (see [Figure 3A](#), [Figure 3B](#), [Figure 3C](#)).

In the case of vehicles where the wrap around distance to the bonnet rear reference line as defined in paragraph 3.7 is less than 1700 mm at any point, then the bonnet rear reference line will be used as the rear reference line at that point.

- 3.26 “Rear windscreen reference line (RWL)” means the geometric trace of contact between a straight edge and the upper windscreen frame, when the straight edge, held parallel to the vertical longitudinal plane of the car and inclined rearwards by 75 degrees, is traversed across and in contact with the upper windscreen frame (see [Figure 3A](#)).

*Note: probably a sphere should be used to define RWL, as foreseen in EU*

- 3.27. “Side reference lines (SL) of front structure up to the BRL” means the geometric traces of the highest points of contact between a straight edge and the sides of a front structure, when the straight edge, held parallel to the lateral vertical plane of the vehicle and inclined inwards by 45° is traversed down the sides of the front structure, while maintaining contact with the surface of the body shell (see [Figure 5A](#)).

- 3.28. “Side reference lines beyond the BRL” means the geometric traces of the highest points of contact between a straight edge and the sides of a front structure, when the straight edge, held parallel to the lateral vertical plane of the vehicle and inclined inwards by 45° is traversed down the sides of the front structure, while maintaining contact with the surface



of the body shell (see [Figure 5B](#)).

- 3.29. “Target Point” means the interparagraph of the head form longitudinal axis projection onto the vehicle (point A on [Figure 4](#)).
- 3.30. “Thigh” means mechanical components above the leg form impactor knee joint.
- 3.31. “Valgus angle” means the angle of the knee joint in abduction.
- [3.32. “Vehicle Type” means a category of vehicles which, forward of the A-pillars, do not differ in such essential respects as:
- the structure,
  - the main dimensions,
  - the materials of the outer surfaces of the vehicle,
  - the component arrangement (external or internal),
- insofar as they may be considered to have a negative effect on the results of the impact tests prescribed in this Regulation;]
- 3.33. “Vertical limit reference line (VLL)” means a horizontal line on the vehicle at a vertical height of 1900 mm (see [Figure 3C](#)).
- 3.34. “Windscreen” means the frontal glazing of the vehicle situated between the A-pillars

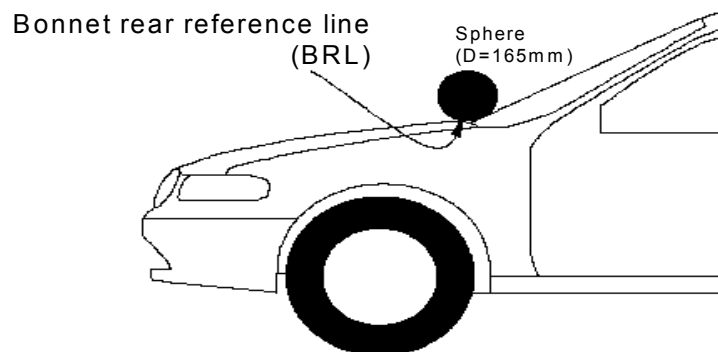


Figure 1: Determination of bonnet rear reference line (BRL)

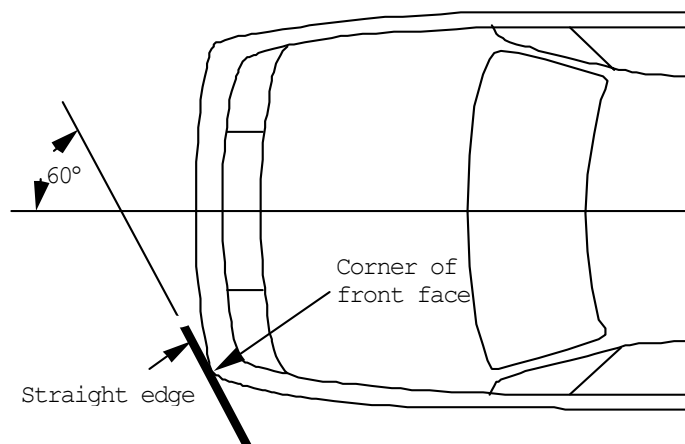


Figure 2

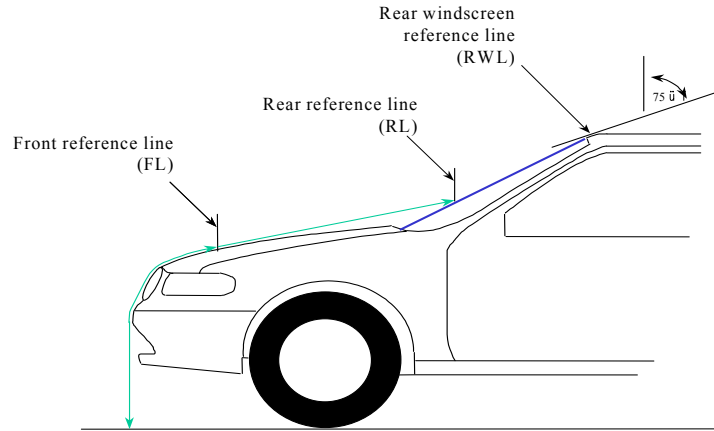


Figure 3A. Determination of FL, RL and RWL

*Note: probably a sphere should be used to define RWL, as foreseen in EU*

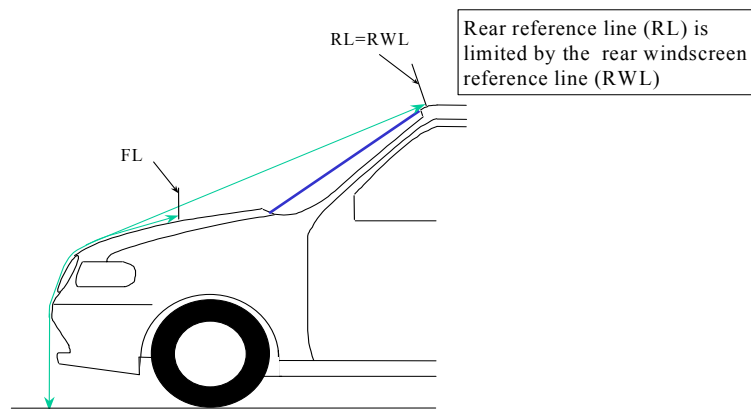


Figure 3B. Determination of FL, RL and RWL for smaller vehicles

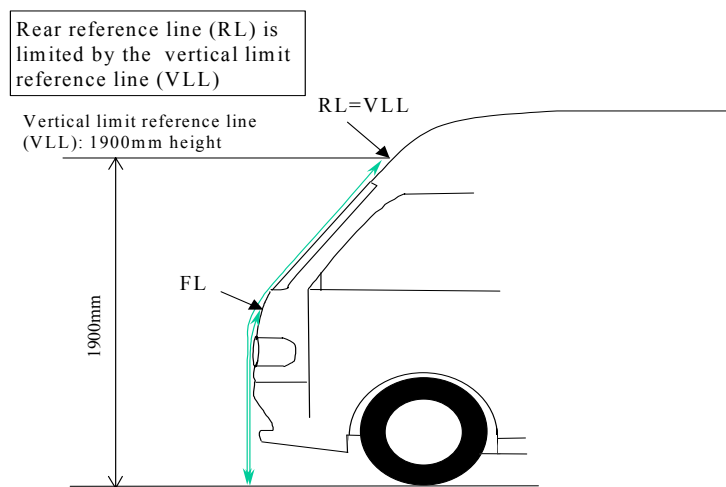


Figure 3C. Determination of FL, RL and VLL for large vehicles

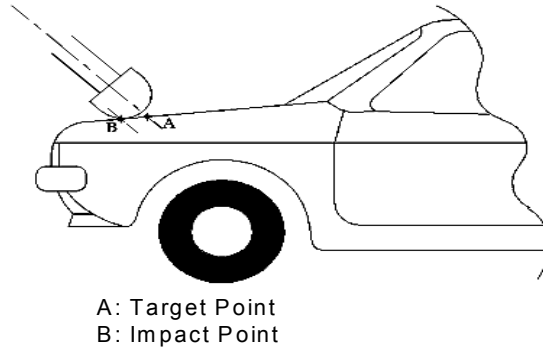


Figure 4: Target point and impact point

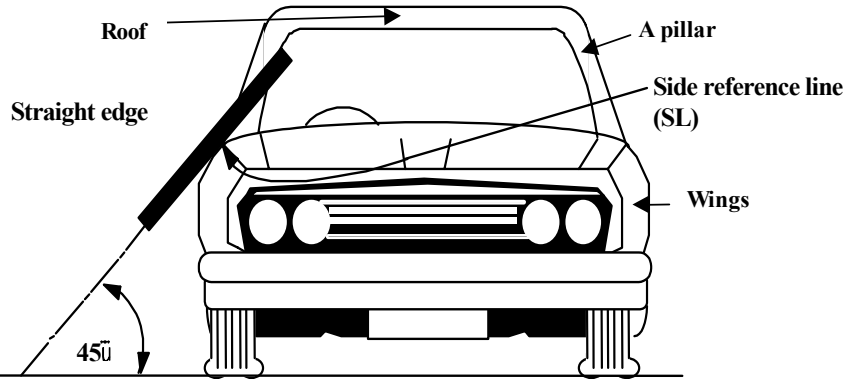


Figure 5A: Determination of side reference lines of front structure up to the BRL

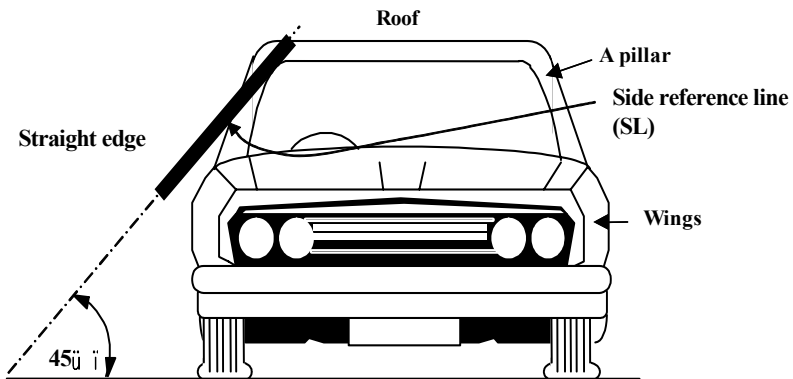


Figure 5B: Determination of side reference lines of front structure beyond the BRL

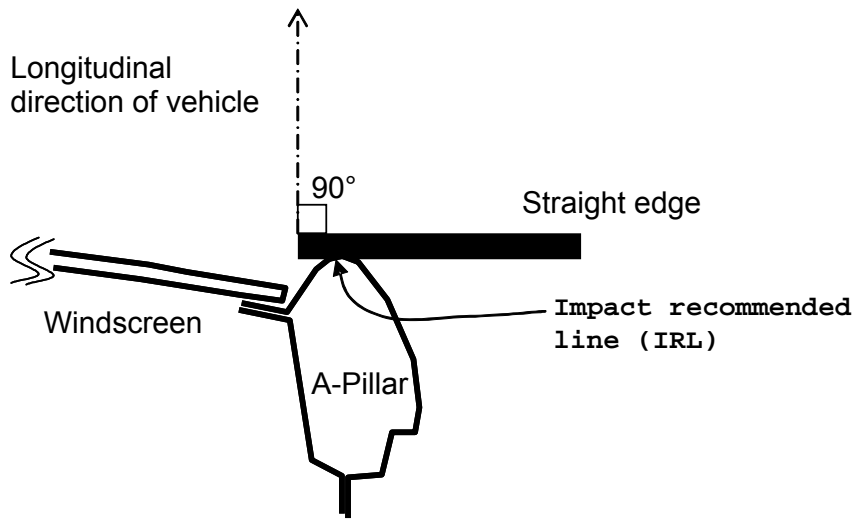


Figure 6: Impact recommended line (IRL) for the A-Pillar  
*Note: this issue needs further detailed review*

## 4. General Requirements.

*Comment from Mr Doyle: These requirements (and following sections) should still have the inclusion of a test for the upper leg form to the bonnet leading edge as this test is still to be considered.*

This Global Technical Regulation specifies the following tests to verify compliance of vehicles

- 4.1. Leg form to bumper: one of the following leg form tests are required to be performed:
  - 4.1.1. Lower leg form to bumper: complying with the test conditions specified in paragraph 6.1. and 6.2.1., the test procedures specified in paragraph 7.1.1. and the performance requirements as specified in paragraph 5.1.1.
  - 4.1.2. Upper leg form to bumper: complying with the test conditions specified in paragraph 6.1. and 6.2.2. , the test procedures specified in paragraph 7.1.2. and the performance requirements as specified in paragraph 5.1.2.
  - 4.1.3. Child head form impact: complying with the test conditions specified in paragraphs 6.1., 6.3. and 6.4., the test procedures specified in paragraph 7.2. and the performance requirements as specified in paragraph 5.2.
  - 4.1.4. Adult head form impact: complying with the test conditions specified in paragraphs 6.1., 6.3. and 6.5., the test procedures specified in paragraph 7.3. and the performance requirements as specified in paragraph 5.3.

## 5. Performance Requirements.

*Comment from Mr Doyle: The limits required here are in line with those required under Phase I of the EU Pedestrian Directive. Whilst taking account of any possibilities of change to the Phase II requirements of this Directive, the gtr should have ultimate requirements more in line with the EU Directive Phase II, - even on a phased timescale.*

*As stated above this section should also address the upper leg form to bonnet leading edge test.*

- [5.1. Leg form to Bumper:
  - 5.1.1. When tested in accordance with paragraph 7.1.1.(lower leg form to bumper), the maximum dynamic knee bending angle shall not exceed 21.0°, the maximum dynamic knee shearing displacement shall not exceed 6.0mm, and the acceleration measured at the upper end of the tibia shall not exceed 200g
  - 5.1.2. When tested in accordance with paragraph 7.1.2. (Upper leg form to bumper), the instantaneous sum of the impact forces with respect to time shall not exceed 7.5kN and the bending moment on the test impactor shall not exceed 510Nm.]
- 5.2. When tested according to paragraphs xxx and yyy , 2/3 of the total test area as impacted by the child or adult head forms, limited to the bonnet top defined in paragraph 3.8., shall meet an HIC limit of 1000, the remaining 1/3 of the impacted area meeting an HIC limit of [2000]

- 5.3. If the tested front structure as impacted by the child or adult head forms includes parts of the A-pillar/windscreen area, the Head Injury Criterion (HIC) shall not exceed 1000 for all the selected impact points within the A-pillar/windscreen area, defined as follows: ***TO BE DEFINED***

*NOTE: test method to be added later*

## 6. Test Conditions

*Comment from Mr Doyle: As stated above this section should also address the upper legform to bonnet leading edge test.*

### 6.1. General

#### 6.1.1. Temperature and humidity conditions

The stabilised temperature of the test tools and of the vehicle or sub-system at the time of testing shall be  $20^{\circ} \pm 4^{\circ}$  C.

The relative humidity of the test tools impactor should be 10 to 70 percent after a soak period of at least four hour prior to its application in a test.

#### 6.1.2. Atmospheric conditions

Relative humidity and temperature shall be measured at the time of the test, and recorded in the test report.

#### 6.1.3. Recording

Recording of test results shall be acquired in accordance with ISO 6487 [2000].

### 6.2. Test condition for Leg form to Bumper test

6.2.1 Lower leg form to bumper:

6.2.2 Upper leg form to bumper:

### 6.3 General test conditions for head impactors (adult and child)

6.3.1. The impactors used for these tests are described in paragraphs 6.4 and 6.5 below.

6.3.2. The test procedures are detailed in paragraphs 7.2 and 7.3 below.

#### 6.3.3. Impact test site

The test site shall consist in a flat, smooth and hard surface with a slope not exceeding 1 %.

*Comment from Mr Doyle: This requirement is somewhat restrictive unless further explained.*

### 6.3.4. Preparation of the test vehicle

6.3.4.1 Either a complete vehicle or a cut - body, adjusted to the following conditions, shall be used for the test.

*Comment from Mr Doyle: It may be appropriate to expand on the idea of a 'cut-body' to ensure all necessary elements are included.*

- 6.3.4.2 The vehicle shall be in its normal ride attitude and shall be either securely mounted on raised supports or at rest on a flat surface. The parking brake shall be applied, or the cut - body shall be securely mounted.
- 6.3.4.3 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.  
All devices designed to protect vulnerable road users shall be correctly activated before and/or be active during the appropriate test. It shall be the responsibility of the manufacturer to show that the devices will act as intended in a pedestrian impact.
- 6.3.4.4 Any vehicle component which could change shape or position, such as 'pop-up' headlights, other than active devices to protect pedestrians, shall be set to a shape or position that the test institutes in consultation with the manufacturer consider to be the most appropriate for these tests.
- 6.3.4.5 Sufficient time must be allowed before testing for the temperature of all vehicle components to stabilize (see paragraph [6.1.1](#)).
- 6.3.5. Propulsion of the head form impactor  
The head form impactor shall be in 'free flight' at the moment of impact, at the required impact velocity (see paragraphs [7.2.7](#). and [7.3.7](#).) and the required direction of impact (see paragraphs [7.2.8](#). and [7.3.8](#).)  
The impactor shall be released to free flight at such a distance from the vehicle that the test results are not influenced by contact of the impactor with the propulsion system during rebound of the impactor.  
The method of head form propulsion is at the discretion of the test authorities [Alternative: the impactor may be propelled by an air, spring or hydraulic gun, or by other means that can be shown to give the same result].
- 6.3.6 Measurement of impact velocity  
The velocity of the head form impactor shall be measured at some point during the free flight before impact, in accordance with the method specified in ISO 3784 [year to be added]. The accuracy of velocity measurement shall be  $\pm 0,01$  m/sec.  
The measured velocity shall be adjusted considering all factors which may affect the impactor between the point of measurement and the point of impact to give the velocity of the impactor at the time of impact.  
The angle of the velocity vector at the time of impact shall be calculated or measured.  
The acceleration time histories shall be recorded, and HIC shall be calculated.  
The first point of contact on the front structure of the vehicle shall be recorded

*Comment from Mr Doyle: The angle of impact will, presumably, relate to the details in section 7.2.8. The angles referred to may require some clarification.*

6.3.7. Determination of impact points

To be completed as to the location of the impact points (exact points or zones?)

6.4. Description of Child Head impactor

6.4.1. Size and mass

The contact surface of the head form impactor shall be made of aluminium, be of homogenous construction and be spherical.

The diameter is  $[165 \pm 1]$  mm as shown in Figure 6.

The mass shall be  $[3,5 \pm 0,07]$  kg.

The moment of inertia about an axis through the centre of gravity and perpendicular to the direction of impact shall be within the range of  $[0,0075 \text{ to } 0,0200 [0.010 \pm 0.0020 ?]]$   $\text{kgm}^2$ .

The centre of gravity of the head form impactor including instrumentation shall be located in the geometric centre of the sphere with a tolerance of  $\pm 2 [5 \text{ mm?}]$  mm.

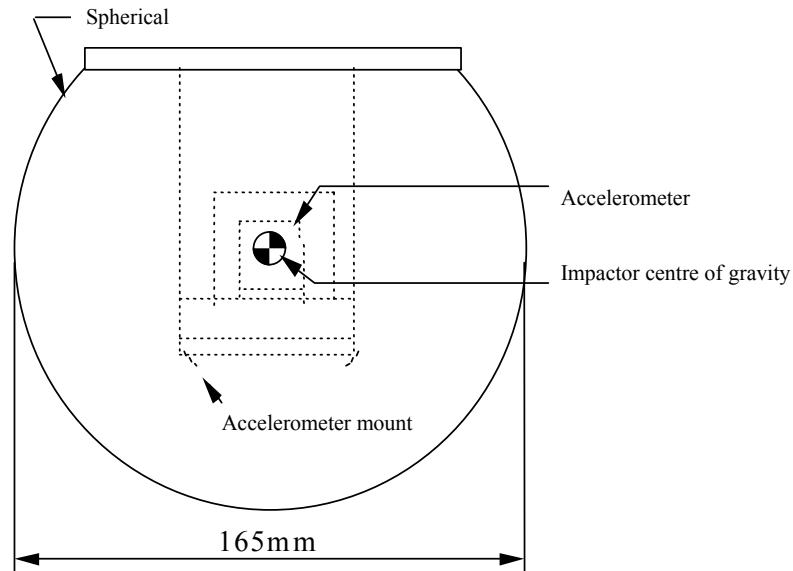


Figure 6: Head form impactor

6.4.2. The sphere shall be covered with a  $[13.9 \pm 0.5]$  mm thick synthetic skin, which shall cover at least half of the sphere.

6.4.3. Certification of the head form impactor

The head form impactor shall meet the performance requirements specified in Annex A. The certified impactor may be used for a maximum of 20 impacts before re-certification. The impactor shall be re-certified if more than one year has elapsed since the previous certification or if the transducer output, in any impact, has exceeded the specified CAC.

6.4.4. 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.

*[ One of the accelerometers shall have its sensitive axis perpendicular to the mounting face A (figure 10) 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 head form 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 head form impactor.*

*One triaxial (or three uniaxial) accelerometer shall be mounted in the centre of the sphere]*

The instrumentation response value CFC, as defined in ISO 6487: [2000], shall be 1000. The CAC response value, as defined in ISO 6487: [2000], shall be 500 g for the acceleration.

6.4.5. First natural frequency

First natural frequency of the head form impactor shall be over 5000 Hz.

6.4.6. Rear face of head impactor

*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. Note: text probably to be clarified*

6.5 Description of Adult Head Impactor

6.5.1. Size and mass

The contact surface of the head form impactor shall be made of aluminium, be of homogenous construction and be spherical.

The diameter is 165 mm as shown in Figure 7.

The mass shall be  $[4,5 \pm 0,1]$  kg.

The moment of inertia about an axis through the centre of gravity and perpendicular to the direction of impact shall be within the range of  $[0,0075 \text{ to } 0,0200 [0.010 \pm 0.0020 ?]]$   $\text{kgm}^2$ .

The centre of gravity of the head form impactor including instrumentation shall be located in the geometric centre of the sphere with a tolerance of  $\pm 2 [5 \text{ mm?}]$  mm.

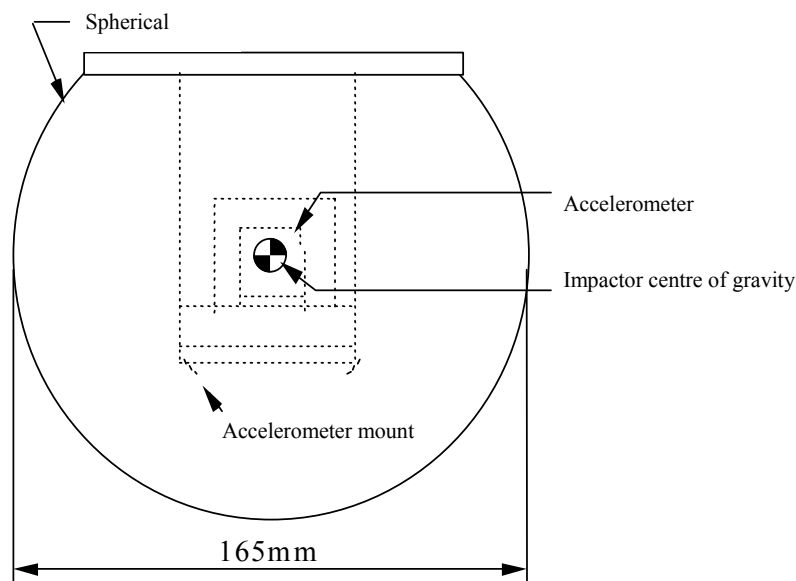


Figure 7: Head form impactor

6.5.2. The sphere shall be covered with a  $[13.9 \pm 0.5]$  mm thick synthetic skin, which shall cover at least half of the sphere.

6.5.3. Certification of the head form impactor

The head form impactor shall meet the performance requirements specified in Annex A. The certified impactor may be used for a maximum of 20 impacts before re-certification. The impactor shall be re-certified if more than one year has elapsed since the previous certification or if the transducer output, in any impact, has exceeded the specified CAC.

6.5.4. 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.

*[ One of the accelerometers shall have its sensitive axis perpendicular to the mounting face A (figure 10) 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 head form 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 head form impactor.*

*One triaxial (or three uniaxial) accelerometer shall be mounted in the centre of the sphere]*

The instrumentation response value CFC, as defined in ISO 6487: [2000], shall be 1000. The CAC response value, as defined in ISO 6487: [2000], shall be 500 g for the acceleration.

6.5.5. First natural frequency

First natural frequency of the head form impactor shall be over 5000 Hz.

6.5.6. Rear face of head impactor

*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. Note: text probably to be clarified*

## 7. **Test Procedures.**

*Comment from Mr Doyle: This section also should have reference to the upper legform to bonnet leading edge test.*

### 7.1. **Leg form to Bumper Test Procedure**

7.1.1. Lower leg form to bumper:

To be completed

7.1.2. Upper leg form to bumper:

To be completed

### 7.2 **Child Head form Tests Test Procedure**

This test procedure is applicable with respect to the requirements of paragraph 5.2 of this Regulation.

7.2.1 Tests shall be made to the front structure within the boundaries as defined in paragraph 3.9.

For tests on the rear area of the bonnet top, the head form impactor shall not contact the windscreen or A pillar before impacting the bonnet top.

7.2.2. A minimum of eighteen tests shall be carried out with the child head form impactor, six tests each to the middle and the outer thirds of the bonnet top, as described in paragraph 6.3.7 , at positions judged to be the most likely to cause injury.

Tests shall be to different types of structure, where these vary throughout the area to be assessed.

7.2.3. The test points shall be located so that the impactor is not expected to impact the test area with a glancing blow resulting in a more severe second impact.

The selected test points for the child head form impactor shall , at the time of first contact:

- be a minimum of 165 mm apart,
- be a minimum of 82.5 mm inside the defined bonnet side reference lines, as defined in paragraphs 3.26 and 3.27.
- be a minimum of 82.5 mm forwards of the rear reference line as defined in paragraph 3.24.

Each selected test point for the child head form shall also be a minimum of 165 mm rearwards of the bonnet leading edge reference line defined in paragraph 3.6.

7.2.4. These minimum distances are to be set with a flexible tape held tautly along the outer surface of the vehicle.

If however the vehicle configuration does not allow the number of eighteen impact points to be reached while maintaining the minimum spacing between impact points, then less than eighteen tests may be performed.

7.2.5. The points selected for testing shall be indicated in the test report.

- 7.2.6. The point of first contact of the head form impactor shall be within a  $\pm 10$  mm tolerance to the selected impact location.
- [7.2.7. The head form velocity at the time of impact shall be  $8.9 \pm 0.2$  m/s (32km/h) [which simulates the vehicle impact speed of 40 km/h, the shape category of the vehicle under test and the location of each selected test point].  
The effect of gravity shall be taken into account when the impact velocity is obtained from measurements taken before the time of first contact.]

*Comment from Mr Doyle: This paragraph is presently the one most important in terms of understanding and agreement. The only item truly agreed is the initial 40km/h impact speed.*

- 7.2.8 The direction of impact shall be as specified as follows:
- 7.2.8.1. The direction of impact shall be in the fore and aft vertical plane of the paragraph of the vehicle to be tested. The tolerance for this direction is  $\pm 2^\circ$ .  
The direction of impact of tests to the front structure shall be downward and rearward.
- 7.2.8.2 For vehicles where the bonnet angle, as defined in paragraph 3.3., is not lower than  $30^\circ$ , the angle of impact on the bonnet shall be  $25^\circ \pm [2]^\circ$  to the Ground Reference Level.
- 7.2.8.3 For vehicles where the bonnet angle, as defined in paragraph 3.3., is lower than  $30^\circ$ :
- 7.2.8.3.1 If the bonnet leading edge height (BLEH), as defined in paragraph 3.5, is not lower than 835 mm, the angle of impact on the bonnet shall be  $60^\circ \pm [2]^\circ$  to the Ground Reference Level.
- 7.2.8.3.2. If the bonnet leading edge height (BLEH), as defined in paragraph 3.5, is lower than 835 mm, the angle of impact on the bonnet shall be  $65^\circ \pm [2]^\circ$  to the Ground Reference Level.
- 7.2.8.4 The effect of gravity shall be taken into account when the impact angle is obtained from measurements taken before the time of first contact

### **7.3 Adult head form test procedure**

This test procedure is applicable with respect to the requirements of paragraph 5.3. of the performance requirements of this Regulation.

- 7.3.1 Tests shall be made to the front structure within the boundaries as defined in paragraph 3.1 above.  
For tests at the rear of the bonnet top, the head form impactor shall not contact the windscreen or A pillar before impacting the bonnet top
- 7.3.2. A minimum of eighteen tests shall be carried out with the adult head form impactor, six tests each to the middle and the outer thirds of the test area, as described in paragraph 6.3.7, at positions judged to be the most likely to cause injury.  
Tests shall be to different types of structure, where these vary throughout the area to be assessed.

- 7.3.3. The test points shall be located so that the impactor is not expected to impact the test area with a glancing blow resulting in a more severe second impact.  
The selected test points for the adult head form impactor shall, at the time of first contact:
- be a minimum of 165 mm apart,
  - be a minimum of 82.5 mm inside the defined bonnet side reference lines, as defined in paragraphs 3.26. and 3.27.
  - be a minimum of 82.5 mm forwards of the rear reference line, as defined in paragraph 3.23.
- Each selected test point for the adult head form on the bonnet top (see paragraph 3.8.) shall also be a minimum of 165 mm rearwards of the bonnet leading edge reference line (see paragraph 3.6.).
- 7.3.4. These minimum distances are to be set with a flexible tape held tautly along the outer surface of the vehicle.  
If however the vehicle configuration does not allow the number of eighteen impact points to be reached while maintaining the minimum spacing between impact points, then less than eighteen tests may be performed.
- 7.3.5. The points selected for testing shall be indicated in the test report.
- 7.3.6. The point of first contact of the head form impactor shall be within a  $\pm 10$  mm tolerance to the selected impact location.
- 7.3.7. The head form velocity at the time of impact shall be  $8.9 \pm 0.2$  m/s (32km/h) [which simulates the vehicle impact speed of 40 km/h, the shape category of the vehicle under test and the location of each selected test point].  
The effect of gravity shall be taken into account when the impact velocity is obtained from measurements taken before the time of first contact

*Comment from Mr Doyle: This paragraph is presently the one most important in terms of understanding and agreement. The only item truly agreed is the initial 40km/h impact speed.*

- 7.3.8. The direction of impact shall be as specified as follows
- 7.3.8.1. The direction of impact shall be in the fore and aft vertical plane of the paragraph of the vehicle to be tested. The tolerance for this direction is  $\pm 2^\circ$ .  
The direction of impact of tests to the front structure shall be downward and rearward.
- 7.3.8.2. For vehicles where the bonnet angle, as defined in paragraph 3.3., is not lower than  $30^\circ$ , the angle of impact shall in all case be  $50^\circ \pm [2]^\circ$  to the Ground Reference Level.
- 7.3.8.3. For vehicles where the bonnet angle, as defined in paragraph 3.3., is lower than  $30^\circ$ :
- 7.3.8.3.1. If the bonnet leading edge height (BLEH), as defined in paragraph 3.5., is not lower than 835 mm, the angle of impact on the bonnet shall be  $90^\circ \pm [2]^\circ$  to the Ground Reference Level.  
In the case the impact points includes parts of the A-pillar/windscreen area, the angle of impact shall be  $40^\circ \pm [2]^\circ$  to the Ground Reference Level.
- 7.3.8.3.2. If the bonnet leading edge height (BLEH), as defined in paragraph 3.5., is lower than 835 mm, the angle of impact on the bonnet shall be  $65^\circ \pm [2]^\circ$  to the Ground

Reference Level.

In the case the impact points includes parts of the A-pillar/windscreen area, the angle of impact shall be  $40^{\circ} \pm [2]^{\circ}$  to the Ground Reference Level.

- 7.3.8.4 The effect of gravity shall be taken into account when the impact angle is obtained from measurements taken before the time of first contact
- 7.3.8.5 For impacts against A-pillars, the headform shall impact the A-pillar on points situated along the Impact Reference Line, as defined in item ;

*Comment from Mr Doyle: Annexes will be required for, such as, the requirements of impactor certification, etc.*

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