

PROPOSED FORMAT FOR GLOBAL TECHNICAL REGULATION (GTR)
on
PEDESTRIAN PROTECTION.

Transmitted by the European Commission

FOR DISCUSSION
ONLY

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FOR DISCUSSION
ONLY

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

Transmitted by the Chairman of the Informal Group

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

A. Technical Rationale and Justification

Relevant traffic accident data, accumulated from many sources¹, provides indications that pedestrians and cyclists are a significant proportion of all road casualties, a fact which is supported by in-depth accident data provided by the IHRA Pedestrian Safety –Working Group. Figures from UN statistics for pedestrian traffic accidents show a decrease in the fatality and injury numbers of 30 to 40% over the last 20 years, but the absolute numbers of casualties are still high enough to indicate that some actions must yet be taken.

On a comparison of the ages of victims, the statistics show that the highest frequency of accidents involves children from of 5 to 9 years of age and adults of over 60 years of age.

According to the study made by the IHRA/PS-WG, the frequency of fatal and serious injuries (AIS 2-6) is highest for the following body regions:

- head injuries for adult and child,
- leg injuries for adult.

Each of these body regions accounts for more than 30% of total injuries and any improvement should focus on the protection of these body regions.

The next body region of concern is the chest which accounts for approximately 10 % of injuries sustained. Other body regions are injured at much lower percentages and are consequently of lower immediate concern. Accident data gathered from details of severe accidents has shown that the head, the legs and the thorax are the first priorities when combining injury severity and the frequency of injuries.

In the construction of vehicles, the major sources of adult head injuries are the top surface of bonnet/wing, the windscreen area and the A-pillars. For the child head injury, the area of most concern is the top surface of the bonnet / wing. For the adult leg injury, the major source of injury is the front bumper of vehicles.

Pedestrian accident data for crash speed between vehicles and pedestrians showing a cumulative frequency of the crash speeds has shown that a crash speed of up to 40 km/h is involved in more than 75% of total pedestrian accidents. Thus it is decided that a major benefit could be achieved by testing up to the equivalent of this speed.

In summary, the following conclusions may be made:

- (a) Accident statistics show that there is an important decrease in the injury and fatality numbers over the past decades. However, absolute numbers of injuries are still high enough to require some actions to be taken.
- (b) The majority of fatalities and serious injuries (in terms of numbers) have occurred in the following combinations:
 - Child head vs. top surface of bonnet/ wing.
 - Adult head vs. top surface of bonnet/wing, windscreen area and A-pillars,

¹ The data used came from the IHRA/Pedestrian Safety WG, the United Nations, Canada, Germany, Italy, Netherlands, Spain, Sweden and the European industry.

- Adult leg vs. front bumper of vehicles,

- (c) A crash speed (between a car and a pedestrian) of 40 km/h would cover up to 75% of all injuries including fatalities. Injuries caused at higher speeds crashes would also be influenced positively by a reduction in injury severity.

The proposal provides for the testing of the fronts of vehicles and, in particular, those areas which have been most identified as causing injury when in collision with a pedestrian or other vulnerable road user. In addition, the tests proposed 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 impactors representing those body regions and impacted at speeds representative of that under which the majority of injuries occur.

The vehicles to be tested under the proposal 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.

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B. Text of Regulation

GLOBAL TECHNICAL REGULATION NO. Y
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
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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 impactors 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. [Examples provided for illustration]

- 2.1 The regulation is required to apply the 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 In order to take account of the legitimate concerns of the Contracting Parties on the fleet differences and the vehicles to which the tests must be applied a matrix is provided as follows which provides detail of which tests should be applied to which vehicles and in which regions:

	Category 1-1 with a gross vehicle mass < 2500 kg	Category 1-1	Category 2 derived from category 1-1 with a gross vehicle mass < 2500 kg	Category 2 derived from category 1-1 with a mass in running order < 2500 kg	Category 2 with a mass in running order < [2500] kg	...
gtr test 1	Region x Region y Region z	Region y	...	...	...	...
gtr test 2	Region x Region y	Region z	...	...	...	...
gtr 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.

[2.3 The categories to be applied will ultimately be required to comply with the GRSG Common Tasks categories when approved by WP29.]

[2.4 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 new types of vehicle would be subject to the test requirements followed by a further stage where all new vehicles would be required to pass the tests.]

3. Definitions. [Examples provided for illustration]

3.1 For the purposes of this global technical regulation the following definitions will apply:

3.1.1 **“Category 1 vehicle”** means a power driven vehicle with four or more wheels designed and constructed primarily for the carriage of (a) person(s).

3.1.1.1 **“Category 1-1 vehicle”** means a category 1 vehicle comprising not more than eight seating positions in addition to the driver’s seating position. A category 1-1 vehicle cannot have standing passengers

3.1.2 **“Category 2 vehicle”** means a power driven vehicle with four or more wheels designed and constructed primarily for the carriage of goods. This category shall also include:

- i tractive units
- ii chassis designed specifically to be equipped with special equipment.

3.1.3 To determine whether a vehicle is to be regarded as a category 1 vehicle or a category 2 vehicle for the application of gtrs, the following shall apply:

3.1.3.1 If a vehicle meets all of the following conditions:

$P - (M + N \times 68) > N \times 68,$

$N \leq 6$ and

Pay mass as defined in paragraph 3.1.4.6 exceeds [150/200] kg the vehicle shall be deemed to be a category 2 vehicle. In all other cases, the vehicle shall be deemed to be a category 1 vehicle.

Where

P= Gross vehicle mass as defined in paragraph 3.1.4.4

M= Mass in running order as defined in paragraph 3.1.4.3

N= Maximum number of simultaneous seating positions excluding the driver seating position

3.1.3.2 If there is a seat anchor for a removable seat, the removable seat is to be counted in the determination of the number of seating positions and of the paymass. Seating position means any individual seat or any part of a bench seat intended to seat one person.

3.1.4 Masses

3.1.4.1 All masses shall be expressed in kilograms (kg).

3.1.4.2 **“Unladen Vehicle Mass”** means the nominal mass of a complete vehicle as determined by the following criteria:

[3.1.4.2.1 Mass of the vehicle with bodywork and all factory fitted accessories, electrical and auxiliary equipment for normal operation of vehicle, including liquids, tools, fire extinguisher, standard spare parts, chocks and spare wheel, if fitted.]

3.1.4.2.2 The fuel tank shall be filled to at least 90 percent of rated capacity and the other liquid containing systems (except those for used water) to 100 percent of the capacity specified by the manufacturer.

[3.1.4.2.3 If the vehicle is intended to be capable of towing, the mass in running order shall include the mass of the coupling device or, if one is not fitted by the manufacturer, a notional mass representing a typical towing device suitable for the vehicle and loads concerned.]

3.1.4.3 **“Mass in running order”** means the nominal mass of a vehicle as determined by the following criteria:

3.1.4.3.1 In respect of a complete vehicle:

Sum of unladen vehicle mass, driver’s mass and mass of any additional accessories that come on top of that weight. The driver mass is applied in accordance with 3.1.4.5.1 below.

3.1.4.4 **“Gross vehicle mass”** of a vehicle means the maximum mass of the fully laden solo vehicle, based on its construction and design performances, as declared by the manufacturer. This shall be less than or equal to the sum of the maximum axles’ capacity.

3.1.4.5 Occupant mass

3.1.4.5.1 **“Driver Mass”** means the nominal mass of a driver that shall be 75 kg (subdivided into 68 kg occupant mass at the seat and 7 kg luggage mass in accordance with ISO standard 2416–1992).

3.1.4.5.2 **“Passenger mass”** means the nominal mass of a passenger that shall be 68 kg.

In the case of Category 1-1 vehicle, each passenger must additionally have 7 kg

provision for luggage which shall be located in the luggage compartment(s) in accordance with ISO standard 2416–1992.

- 3.1.4.6 “**Pay mass**” means the goods-carrying capacity of the vehicle which is the figure obtained by subtracting the unladen vehicle mass and the driver and passenger masses from the gross vehicle mass.
- 3.1.5 “**A-pillar**” means the foremost and outermost roof support extending from the chassis to the roof of the vehicle.
- 3.1.6 “**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.
- 3.1.7 “**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;

[Further examples should be included in this section which will provide adequate explanation for all the terms used within the body of this regulation and its annexes]

4. General Requirements. [Examples provided for illustration]

- 4.1 The following tests are required to be carried out;
- 4.1.1 Legform to Bumper: one of the following legform tests are required to be performed:
- 4.1.1.1 Lower legform to bumper: complying with the test conditions specified in paragraph 6.1.1.1, the test procedures specified in paragraph 7.1.1.1 and the performance requirements as specified in paragraph 5.1.1.1.
- 4.1.1.2 Upper legform to bumper: complying with the test conditions specified in paragraph 6.1.1.2, the test procedures specified in paragraph 7.1.1.2 and the performance requirements as specified in paragraph 5.1.1.2.
- 4.1.2 Child headform to bonnet top: complying with the test conditions specified in paragraph 6.1.2, the test procedures specified in paragraph 7.1.2 and the performance requirements as specified in paragraph 5.1.2.
- 4.1.3 Upper legform to bonnet leading edge: complying with the test conditions specified in paragraph 6.1.3, the test procedures specified in paragraph 7.1.3 and the performance requirements as specified in paragraph 5.1.3.
- 4.1.4 Adult headform to windscreen: complying with the test conditions specified in paragraph 6.1.4, the test procedures specified in paragraph 7.1.4 and the performance requirements as specified in paragraph 5.1.4.

[Any further statements introducing any general requirements required for the tests may be entered in this section.]

5. Performance Requirements. [Examples provided for illustration]

- 5.1. The following performance requirements have to be complied with:
- 5.1.1 Legform to Bumper:
- 5.1.1.1. Lower legform 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
- 5.1.1.2 Upper legform 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.
- 5.1.2. Child headform to bonnet top: The Head Performance Criterion (HPC) shall not exceed 1000 over all of the bonnet test area.

- 5.1.3. Upper legform to bonnet leading edge: The instantaneous sum of the impact forces with respect to time should not exceed a possible target of 5.0kN and the bending moment on the test impactor should not exceed a possible target of 300Nm.
- 5.1.4. Adult headform to windscreen: The Head Performance Criterion (HPC) should not exceed a possible target of 1000.

[This section should contain descriptions of all agreed tests which may be carried out under this regulation and will provide detail of the criteria to be achieved in each test.]

6. Test Conditions. [Example of one section provided for illustration]

6.1 Preparations for the carrying out of the tests on complete vehicles shall comply with the conditions detailed in paragraphs 6.1.1, 6.1.2, 6.1.3, 6.1.4, 6.1.5, 6.1.6 and 6.1.7.

6.1.1 Legform to Bumper:

6.1.1.1 Lower legform to bumper:

6.1.1.2 Upper legform to bumper:

6.1.2 Child Head to bonnet:

6.1.2.1 Test apparatus

6.1.2.1.1 The child headform impactor is a sphere made of aluminium and of homogenous construction.

6.1.2.1.2 The sphere shall be covered with a 13.9 ± 0.5 mm thick synthetic skin, which shall cover at least half of the sphere.

6.1.2.1.3 The centre of gravity of the child headform impactor, including instrumentation, shall be located in the centre of the sphere with a tolerance of ± 5 mm. The moment of inertia about an axis through the centre of gravity and perpendicular to the direction of impact shall be 0.010 ± 0.0020 kgm².

6.1.2.1.4 A recess in the sphere shall allow for mounting one triaxial or three uniaxial accelerometers. The accelerometers shall be positioned according paragraphs 6.1.2.1.4.1 and 6.1.2.1.4.2

6.1.2.1.4.1 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 headform impactor.

6.1.2.1.4.2 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. 3.4.1.2 One triaxial (or three uniaxial) accelerometer shall be mounted in the centre of the sphere.

6.1.2.1.5 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.

6.1.2.1.6 The child headform impactor shall meet the performance requirements specified in the certification Annex. 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.

6.1.2.1.7 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. The headform impactor for the bonnet top test shall be in 'free flight' at the moment of impact. 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.

6.1.3 Upper Leg to Bonnet Leading Edge:

6.1.4 Adult Head to windscreen:

6.1.5 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 with the hand brake on.

6.1.6 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 applicant for approval to show that the devices will act as intended in a pedestrian impact.

6.1.6 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.

[More detail of test conditions may be entered in this section and any diagrams or calculation charts included.

Each test agreed and required by any part of the Regulation should be included in this section as sub-sections 6.2, 6.3, etc.]

7. Test Procedures. [Example of one section provided for illustration]

7.1 The tests shall be performed complying with the requirements of paragraphs 7.1.1, 7.1.2, 7.1.3 and 7.1.4.

7.1.1 Legform to Bumper:

7.1.1.1 Lower legform to bumper:

7.1.1.2 Upper legform to bumper:

7.1.2 Child Headform to Bonnet Top Tests:

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

7.1.2.1 Child headform impactor tests

The tests shall be carried out on the bonnet top as follows;

7.1.2.1.1 A minimum of eighteen tests shall be carried out with the headform impactor, six tests each to the middle and the outer thirds of the bonnet top, as described in [.....], 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.

7.1.2.1.2 The test points shall be located so that the impactor is not expected to impact the bonnet top with a glancing blow and then impact the windscreen or an A pillar more severely. The selected test points for the child headform impactor shall be a minimum of 165 mm apart, a minimum of 82.5 mm inside the defined bonnet side reference lines, a minimum of 82.5 mm forwards of the defined bonnet rear reference line. Each selected test point for the child headform shall also be a minimum of 165 mm rearwards of the bonnet leading edge reference line.

7.1.2.1.3 These minimum distances are to be set with a flexible tape held tautly along the outer surface of the vehicle. If a number of test positions have been selected in order of potential to cause injury and the test area remaining is too small to select another test position while maintaining the minimum spacing between tests, then less than eighteen tests may be performed. The positions tested by the laboratories shall be indicated in the test report.

7.1.2.1.4 However, the technical services conducting the tests shall perform as many tests as necessary to guarantee the compliance of the vehicle with the Head Protection Criteria (HPC) limit value of 1000.

7.1.2.2 Child Headform Test procedure

7.1.2.2.1 The stabilised temperature of the test apparatus and the vehicle or sub-system shall be $20^{\circ} \pm 4^{\circ} \text{C}$.

7.1.2.2.2 Tests shall be made to the bonnet top within the boundaries as defined in section 6.1.2 above. For tests at the rear of the bonnet top the headform impactor shall not contact the windscreen or A pillar before impacting the bonnet top.

7.1.2.2.3 A child headform impactor as defined in section 6.1.1 shall be used for tests to the

bonnet top, with the points of first contact lying between boundaries described by a wrap around distance of 1000 mm and by the bonnet rear reference line as defined.

7.1.2.2.4 The direction of impact shall be as specified in paragraph 6.1.3.5 and the impact velocity as specified in paragraph 6.1.3.6.

7.1.2.2.5 The direction of impact shall be in the fore and aft vertical plane of the section of the vehicle to be tested. The tolerance for this direction is $\pm 2^\circ$. The direction of impact of tests to the bonnet top shall be downward and rearward, as if the vehicle were on the ground. The angle of impact for tests with the child headform impactor shall be $50^\circ \pm 2^\circ$ to the Ground Reference Level. The effect of gravity shall be taken into account when the impact angle is obtained from measurements taken before the time of first contact.

7.1.2.2.6 At the time of first contact, the point of first contact of the headform impactor shall be within a ± 10 mm tolerance to the selected impact location.

7.1.2.2.7 The impact velocity of the headform impactor when striking the bonnet top shall be 9.7 ± 0.2 m/s. The effect of gravity shall be taken into account when the impact velocity is obtained from measurements taken before the time of first contact.

7.1.3. Upper legform to bonnet leading edge:

7.1.4 Adult headform to windscreen:

8. Annexes

[Annexes may include further technical detail used for setting up individual tests, the requirements for the certification of the impactor tools, clarification of the administrative requirements for the granting of approval under the Regulation, interface with national legislation and their reciprocal recognition including any approval markings and conditions for ensuring conformity of production.]