Transmitted by the expert from OICA

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Pedestrian Protection
OICA proposal to amend the draft gtr - ECE/TRANS/WP.29/GRSP/2006/2

Following the proposal submitted by the GRSP Informal Group on Pedestrian Safety and the subsequent discussions at GRSP relating to the proposed application of the global technical regulation, OICA herewith submits some further background information and a new proposal which aims at finding a suitable solution, enabling the draft gtr to be finalised and submitted to AC.3 for voting.

While OICA strongly favours the current application of the draft gtr, as contained in document TRANS/WP29/GRSP/2006/2, with the possibility to extend it in a later stage, OICA equally understands the need to find a compromise, following the discussions at GRSP and WP29/AC3.

I. Introductory Remarks / Basic Facts

1. A market analysis was done by OICA, covering almost 40 million vehicles (category 1-1 and 2) with a GVM up to 4,500 kg, sold worldwide in 2005, with detailed figures in the USA, in Europe, in Japan and in Korea

2. This market analysis shows the following facts:

   a. The category between 3,500 kg and 4,500 kg represents only 1.6% (or 630,000 vehicles) of the total. Virtually the totality (603,000 vehicles) of these vehicles were sold in the USA alone

   b. The category between 3,500 kg and 4,500 kg consequently seems to be specific to only one market and even so, the numbers are extremely low compared to the others.

   c. The category between 2,500 kg and 3,500 kg represents almost 20% (almost 8 million vehicles) of the total. The majority of these vehicles (about 72%) are sold in the USA; in Europe and Japan/Korea, these vehicles represent about 10% of the market.

3. It is widely recognised that the most crucial parameter to determine whether or not a vehicle should be included in the application of the gtr is the shape of the vehicle, its mass playing only a secondary role.

4. However, it has not been possible to develop a criterion which would distinguish between the various shapes of vehicles, whether past, currently existing, or potentially future shapes. Therefore the commonly retained criterion remains the mass (gross vehicle maximum), with the recognition that some specific cases need to be carefully studied, such as "High Front Vehicles" (HFV) and "Flat Front Vehicles" (FFV).

II. Interpretations / Challenges

1. Vehicles in the 2,500 kg to 3,500 kg range:

a. OICA understands that it would be rather difficult to justify a complete exclusion of the scope of the gtr, in view of the rather important number of vehicles in this range sold worldwide
b. This range of vehicles encompasses both Category 1-1 (passenger cars) and Category 2 (goods transport). It is assumed that many of these Category 2 vehicles are not necessarily derived from a Category 1-1 vehicle
c. The current draft gtr is clearly based on data and experience gathered for vehicles up to 2,500 kg GVM and only few data are available for vehicles in the 2,500 kg to 3,500 kg range, which encompasses vehicles with a variety of shapes

2. Specific issues arising when extending the applicability of the gtr to vehicles above 2,500 kg

2.1 High Front Vehicles - HFV

a. The current draft gtr is based on studies globally available and conducted in the past in the European Union, Japan, as well in the framework of IHRA
b. These studies however were largely based on classical (sedan-type) passenger cars, were the Bonnet Leading Edge Height (BLEH) is typically below the head impact zone on the bonnet
c. Little data exists for vehicles where this BLEH is substantially higher, i.e. large SUV type vehicles:
    - The proposed test sequence might not be fully representative of the pedestrian impact dynamics
    - In order to solve the technical constraints for such vehicles to meet the proposed requirements, adequate lead time will be necessary
    - For vehicles where the BLEH is close to or exceeds the lower border of the head impact zone, it appears, from the sales data collected, that a majority of such vehicles have a GVM of more than 2,500 kg.

2.2 Flat Front Vehicles - FFV

a. The same statements as for the HFV apply to these Flat Front Vehicles, namely that the studies conducted for the drafting of the gtr did not really take into account these vehicles, where the front shape is close to the vertical (e.g. where the bonnet effective angle as defined in the Japanese legislation exceeds 40°) and where the bonnet is very short (e.g. several goods delivery vans); such vehicles can be considered as "equivalent" to the former "forward control vehicle".

b. In such cases, difficulties exist to determine the reference lines for the test zones. Moreover, also the pedestrian kinematics are different. Such uncertainties were also recently highlighted by TRL in its 2006 final project report (UPR/VE/045/06 under EC contract ENTR/05/17.01) to the European Commission, with the following statement:
"Some N1 vehicles have a vertical frontal shape to which, with the exception of the bumper test, the pedestrian test methods are less well suited, because they were intended for cars".

c. No commonly agreed definition however exists for such Flat Front Vehicles. No data exist to justify either their inclusion in or their exclusion from the applicability of this global technical regulation. Some of these vehicles may be specific to some markets and national jurisdictions should carefully consider this issue when transposing the global technical regulation into national law; if it is decided to regulate these vehicles, as a minimum adequate lead time should be given.

2.3 Vehicles with a small bonnet test area

In some cases, the bonnet test area may be so small that proper definition and the whole concept of the 1/3 - 2/3 head impact test area becomes impracticable, with the only head impacts being on the hardest points. Therefore, major re-design or development of new design solutions would be needed for such vehicles.

2.4 Special purpose vehicles

Just like for High Front Vehicles and Flat Front Vehicles, extension of the applicability of the global technical regulation to vehicles above 2,500 kg exacerbates the difficulties for special purpose vehicles, such as farm or forestry vehicles, or vehicles for the armed forces, which were never expected to have to meet pedestrian protection requirements. Such vehicles however are usually subject to national legislation, outside the scope of the 1998 Agreement. OICA consequently recommends that national jurisdictions exempt these from the pedestrian protection requirements, when implementing the global technical regulation.

3. Specific vehicle ranges in national markets: 3,500 kg to 4,500 kg range

a. OICA considers that the total number of vehicles in the 3,500 kg to 4,500 kg range is negligible, compared to the total number of vehicles, regardless of the market. This small number is in addition almost exclusively sold in the USA.

b. OICA believes that many vehicles in the 3,500 kg to 4,500 kg range are rather "special", such as small buses and recreational vehicles, not having much in common with classical vehicles observed on the road. There is very limited data and experience as to the pedestrian protection performance of these vehicles and first indications are that, while some may meet the requirements, some others would need major and costly re-design.

c. Inclusion, in the application of the gtr, of vehicles in the 3,500 kg to 4,500 kg range therefore can most likely not be justified based on cost/benefit analysis, in view of their very low number and of the re-design costs.

III. Conclusions and OICA proposal

Taking all the above, OICA suggests the following, as possible solution for the future adoption of the draft gtr:

1. Regardless of the possible extension of the applicability of the gtr, as described below, OICA suggests that a general recommendation be added to the preamble of the gtr regarding the potential implementation dates. OICA recognises that some countries already have legislation on pedestrian protection or are in the process of adopting it; industry consequently has started development accordingly. The requirements of the draft gtr are however substantially more severe than any existing legislation and it is therefore recommended that Contracting Parties implementing this gtr **allow adequate lead time before full mandatory application to the vehicles below 2,500 kg, after establishment in the Global Registry**, considering the necessary vehicle development time and product lifecycle.

2. **Extend the application of the draft gtr to <u>all</u> Category 1-1 and Category 2 vehicles from 2,500 kg up to 3,500 kg GVM**

3. This means that the gtr would apply to:

    a. All Category 1-1 and category 2 vehicles below 2,500 kg GVM
    b. All Category 1-1 and category 2 vehicles between 2,500 kg and 3,500 GVM

4. The current **concept of "derived from"**, defined as those vehicles having the same general structure and shape, **could be abandoned**

5. The gtr would not apply to vehicles above 3,500 kg GVM

6. This extension to all vehicles up to 3,500 kg however needs to recognise that some additional lead-time will be needed, as follows:

    a. Extension would also mean that many vehicles, currently exempted from the requirements, would be included
    b. These vehicles in particular would comprise High Front Vehicles, Flat Front Vehicles, vehicles with a very small bonnet area, special purpose vehicles, etc, where manufacturers need to review future developments
    c. **For vehicles between 2,500 kg and 3,500 kg, the requirements of the gtr should therefore not be mandated until 5 years after the corresponding application for vehicles below 2,500 kg**
    d. Because the 98 Agreement does not foresee administrative provisions, such "transitional provisions" should be contained in the preamble of the gtr, and possibly be part of the AC3 minutes when establishing the gtr in the Global Registry

Annex 1

Market composition

The following 2005 sales data were collected, for the various GVM ranges of Category 1-1 and Category 2 vehicles, differentiating among the various Bonnet Leading Edge Heights:

	USA				EUROPE				JAPAN OR KOREA				WORLD OR TOTAL US/EUROPE/JAPAN			
	Cat 1-1 + 2 <2,5t GVM	Cat 1-1 + 2 2,5t<GVM<3,5t	Cat 1-1 + 2 3,5t<GVM<4,5t	Total	Cat 1-1 + 2 <2,5t GVM	Cat 1-1 + 2 2,5t<GVM<3,5t	Cat 1-1 + 2 3,5t<GVM<4,5t	Total	Cat 1-1 + 2 <2,5t GVM	Cat 1-1 + 2 2,5t<GVM<3,5t	Cat 1-1 + 2 3,5t<GVM<4,5t	Total	Cat 1-1 + 2 <2,5t GVM	Cat 1-1 + 2 2,5t<GVM<3,5t	Cat 1-1 + 2 3,5t<GVM<4,5t	Total
BLE < 835	6 921 173	599 219	0	7 520 392	4 950 708	0	0	4 950 708	2 967 215	0	0	2 967 215	25 791 439	624 598	0	26 416 037
835 < BLE < 917.5	704 204	199 363	19 578	923 145	286 777	25 319	0	312 096	789 917	14 433	0	804 350	2 175 232	500 064	19 578	2 694 874
917.5 < BLE < 950	714 840	69 317	0	784 157	210 092	61 679	0	271 771	239 870	0	0	239 870	1 164 802	211 427	0	1 376 229
950 < BLE < 1000	666 539	300 427	0	966 966	168 534	65 763	0	234 297	253 361	43 820	12 807	309 988	1 088 434	585 337	12 807	1 686 578
1000 < BLE	521 690	4 551 941	583 918	5 657 549	3 341	494 375	2 516	500 232	562 123	406 826	12 000	980 949	1 087 154	5 996 412	598 434	7 682 000
Total	9 528 446	5 720 267	603 496	15 852 209	5 619 452	647 136	2 516	6 269 104	4 812 486	465 079	24 807	5 302 372	31 307 061	7 917 838	630 819	39 855 718

	2005 sales Cat 1-1 + 2 <2,5t GVM			2005 sales Cat 1-1 + 2 2,5t<GVM<3,5t			2005 sales Cat 1-1 + 2 3,5t<GVM<4,5				
	Number	% of total vehicles with corresponding BLE	% of total vehicles	Number	% of total vehicles with corresponding BLE	% of total vehicles	Number	% of total vehicles with corresponding BLE	% of total vehicles	Total	% of total
BLE < 835	25 791 439	97,6%	64,7%	624 598	2,4%	1,6%	0	0,0%	0,0%	26 416 037	66,3%
835 < BLE < 917.5	2 175 232	80,7%	5,5%	500 064	18,6%	1,3%	19 578	0,7%	0,0%	2 694 874	6,8%
917.5 < BLE < 950	1 164 802	84,6%	2,9%	211 427	15,4%	0,5%	0	0,0%	0,0%	1 376 229	3,5%
950 < BLE < 1000	1 088 434	64,5%	2,7%	585 337	34,7%	1,5%	12 807	0,8%	0,0%	1 686 578	4,2%
1000 < BLE	1 087 154	14,2%	2,7%	5 996 412	78,1%	15,0%	598 434	7,8%	1,5%	7 682 000	19,3%
Total	31 307 061		78,6%	7 917 838		19,9%	630 819		1,6%	39 855 718	100,0%

Annex 2

Flat Front Vehicles

Typical examples of Flat front Vehicles are shown below.

The studies conducted for the drafting of the gtr did not really take into account such vehicles, where the front shape is close to the vertical and where the bonnet is very short (e.g. several goods delivery vans).

In such cases, difficulties exist to determine the reference lines for the test zones.

Moreover, also the pedestrian kinematics are different.

Detailed studies would be needed before including such vehicles in the national implementation of the pedestrian protection requirements and, as a minimum, adequate lead time should be given.

Annex 3

OICA proposes to amend the draft global technical regulation as follows. The changes indicated in blue are taken from the proposal transmitted by the USA (ECE/TRANS/WP.29/GRSP/2006/7), while the changes indicated in red are proposed by OICA.

A. STATEMENT OF TECHNICAL RATIONALE AND JUSTIFICATION

I. SAFETY NEED
No change to this section

II. SUMMARY: DESCRIPTION OF THE PROPOSED REGULATION
No change to this section

III. PROCEDURAL BACKGROUND
No change to this section

IV. EXISTING REGULATIONS, DIRECTIVES, AND INTERNATIONAL VOLUNTARY STANDARDS
No change to this section

V. GENERAL ISSUES

(a) Scope
No change to this section

(b) Applicability - Replace this whole section by the following text

The application of the requirements of this gtr refers, to the extent possible, to the revised vehicle classification and definitions outlined in the 1998 Global Agreement Special Resolution No. 1 concerning the common definitions of vehicle categories, masses and dimensions (S.R.1).

Difficulties, due to differing existing regulations and divergent vehicle fleets, were encountered in determining which vehicles would be included in the scope. The Japanese regulation applies to passenger cars for up to nine occupants and commercial vehicles up to a Gross Vehicle Mass (GVM) of ~~**2.5 tonnes**~~ **2,500 kg**. The IHRA recommends tests and procedures for passenger vehicles of ~~**GVM 2.5 tonnes**~~ **2,500 kg GVM** or less. The European Union (EU) Directive applies to M_1 vehicles up to ~~**2.5 tonnes**~~ **2,500 kg** and N_1 vehicles up to ~~**2.5 tonnes**~~ **2,500 kg**, which are derived from M_1. The ISO recommendations are for M_1 and N_1 vehicles that have a GVM of ~~**3.5 tonnes**~~ **3,500 kg** or less. In addition, some countries, taking into account their current fleet composition, considered that care should be taken not to exclude from the requirements too large a number of vehicles, such as light trucks and sport utility vehicles.

The group originally reviewed in detail the IHRA recommendation to take into account the shape of the front of the vehicle, as an important parameter when discussing the types of pedestrian injuries to be mitigated. IHRA specifies three groups of vehicle shape: sedan, SUV, and 1-box. For the adult and head impacts, IHRA foresees different impact test speeds and different impact angles. The Japanese legislation is based on the IHRA recommended method. The EU requirements, on the contrary, do not differentiate between the various test speeds and impact angles.

The group compared these various considerations and, on the basis of simulations (INF GR/PS/129), concluded that the EU requirements in effect are more severe than the Japanese proposals. For safety reasons, the group therefore uses the EU approach, not taking into account the shape of the vehicle front in defining the requirements. Furthermore, the group also determined that the IHRA recommendations would be difficult to put in place in the context of a regulatory and certification approach.

There was considerable discussion over the mass of the vehicles to which this gtr should apply. Using the categories described in S.R.1, there were several options examined.

Some delegates wanted to limit application of the gtr to vehicles in Category 1-1 with a vehicle mass of less than 2,500 kg GVM. Other delegates did not agree with a 2,500 kg limit on GVM, believing that since the front-end structure of vehicles with 3,000 or 3,500 kg GVM usually is similar to the lighter vehicles, the application of the gtr should include the heavier vehicles.

Detailed worldwide sales data were also studied in order to have a clear picture of the existing markets (see inf. doc GRSP-41-XX). It appears that the total number of so-called light vehicles with a GVM exceeding 3,500 kg is negligible, compared to the total number of vehicles, regardless of the market examined. In 2005, the total number of such vehicles represented only 1.6% (630,000 vehicles) of the total light vehicle sales (almost 40 million units).
Furthermore those light vehicles with a GVM exceeding 3,500 kg are rather "special", such as small buses and recreational vehicles, not having much in common with classical vehicles observed on the road. There is very limited data and experience as to the pedestrian protection performance of these vehicles.

In addition, some delegates sought to limit application of the gtr to vehicles of a GVM more than 500 kg, while other delegates expressed concern about having a lower mass limit, believing that a particular jurisdiction might determine there is a need to apply the gtr requirements in that jurisdiction to vehicles with a GVM less than 500 kg.

There was a suggestion that the gtr should also apply to vehicles in Category 2 that had the "same" general structure and shape forward of the A-pillars as vehicles in Category 1-1. However, some were concerned that it could be unfeasible to define objectively what was meant by "same".

After considering these issues, it was recommended that the gtr should be drafted to have a rather wide application to vehicles, by covering those with a GVM of maximum 3,500 kg, to maximize the ability of jurisdictions to address effectively regional differences in pedestrian accident crash characteristics. The gtr would provide that if a

jurisdiction determines that its domestic regulatory scheme is such that full applicability is inappropriate, it may limit domestic regulation to certain vehicle types, or may even impose only some of the gtr requirements to a particular vehicle type.

This approach was recommended because it maximizes the discretion of jurisdictions to decide whether vehicles should be excluded from the gtr for feasibility or practical reasons, or for lack of a safety need to regulate the vehicles. It was recognized that the front-end shape of the vehicle is an important factor affecting the kinematics of the pedestrian. However, this approach recognizes that jurisdictions should make their own determinations as to whether the front-end shapes of vehicles in their region fall within the shape corridors upon which the gtr was developed. Niche vehicles that are unique to a jurisdiction could also be addressed specifically by that jurisdiction, without affecting the ability or need of other jurisdictions to regulate the vehicles. When a contracting party proposes to adopt the gtr into its domestic regulations, it is expected that the Contracting Party will provide reasonable justification concerning the application of the standard to the vehicle types.

Accordingly, the gtr on pedestrian protection would apply to all vehicles in Category 1-1 and Category 2, both with a GVM of 3,500 kg or less. A jurisdiction may restrict application of the requirements in its domestic regulation if the jurisdiction decides restricting application in its domestic regulation is appropriate.

(c) Implementation Generally
No change to this section

Insert a new section (d) as follows:
(d) Recommendations regarding the implementation of the requirements

Regarding the applicability of this gtr, it should be noted that the requirements of the draft gtr are substantially more severe than any existing legislation. In addition, many countries do not yet have pedestrian safety requirements.
It is therefore recommended that Contracting Parties implementing this gtr allow adequate lead time before full mandatory application to the vehicles with a GVM of 2,500 kg or less, after establishment in the Global Registry, considering the necessary vehicle development time and product lifecycle.

Furthermore, during the whole development phase of this gtr, the main focus was with vehicles of a GVM of 2,500 kg or less, that are also addressed in all existing legislation. The later extension to vehicles with a GVM of 3,500 kg or less however needs to recognise that some additional lead-time would be necessary, because many current vehicles, exempted from existing national or regional requirements, are now included. In addition, while the test procedures and requirements of this gtr were based on requirements originally developed for "classical" (sedan type) passenger cars, the gtr now also covers vehicles with specific shapes or features (High Front Vehicles, Flat Front Vehicles, vehicles with very small bonnet area, special purpose vehicles, etc), for which it is recognised that manufacturers need to review future developments (see GRSP-41-…). Therefore, for vehicles with a GVM above 2,500 kg but not exceeding 3,500 kg, it is recommended that jurisdictions should not mandate the requirements of this gtr until 5 years after the corresponding application for vehicles with a GVM of 2,500 kg or less.

(**e**) Future Consideration
No change to this section

VI. PEDESTRIAN HEAD PROTECTION
No change to this section

VII. PEDESTRIAN LEG PROTECTION

(a) General

1. Purpose
No change to this section

2. Rationale for Limiting the Lower Legform Test

The reason that the lower legform test would not be applied to certain vehicles is due to the height limitations of the impactor, and the feasibility limitations of high-bumper vehicles to meet the test. The contact point between impactor and bumper should be below the knee, due to the impactor's structure and characteristics 1/. The EEVC WG17 states in its report, paragraph 7.2.1. (see also working paper INF GR/PS/159):

> Some vehicles, like off-road vehicles, have high bumpers for certain functional reasons. These high bumpers will impact the femur part of the legform impactor, where no acceleration is measured to assess the risk of fractures. Moreover, there is often no structure below the bumper to restrain the tibia part of the legform, for instance because an off-road vehicle needs a certain ramp angle and ground clearance. Therefore WG17 decided to include an optional, alternative horizontal upper legform test with an impact speed of 40 km/h, when the lower bumper height is more than 500 mm above the ground.

The informal group concurs with the determination of WG17 that the lower leg impactor test would be inappropriate for vehicles with high bumpers 2/.

At the same time, the informal group believes that high bumpers should be more energy absorbing, and for that reason adopts in this gtr the upper legform test for vehicles with a lower bumper height of more than 500 mm.

1/ There is also a concern that the lower leg test could readily be met by simply allowing the lower legform to slide and/or rotate beneath the high bumper. This could have an unintended consequence of encouraging high bumpers as a way to meet the requirements, and lead to more pedestrian injury due to run-over.

2/ WG17 stated that the alternative legform test should be available for vehicles with a lower bumper height of more than 500 mm. However, WG17 referenced a value that WG10 had associated with the upper (rather than lower) bumper reference line. Also, since pedestrians are usually wearing shoes, the bottom of the legform impactor was determined to be 25 mm above the ground, the same height as the sole of a shoe (INF GR/PS/98). Accordingly, the informal group believes that the value of 425 mm (not 500 mm), measured to the lower bumper reference line is consistent with WG17's provision.

For vehicles that have a lower bumper height between 425 mm and 500 mm, the gtr provides that the vehicle manufacturer can elect to perform either a lower legform test or an upper legform test. Investigations conducted with vehicles with lower bumper heights between 400 and 500 mm indicate that a large majority of these vehicles have features for off-road capability. For these off-road vehicles, it is technically not feasible to have a countermeasure that will enable the vehicle to support the tibia part of the lower legform. That is, data show (see INF GR/PS/175/Rev.2) that the absence of a lower structure to support the lower part of the leg, due to the necessary off road capacities, make it very difficult for these vehicles to meet the proposed lower leg criteria, especially the bending angle. Therefore, the group **recommends** to use the upper legform to bumper test as an optional alternative to the lower legform to bumper test for these vehicles.

The group recognizes that excluding vehicles from the lower legform test will affect the target population of a lower extremity pedestrian regulation, and will reduce the benefits of the leg protection requirements, particularly with regard to knee injuries.

3. Handling Procedures
No change to this section

(b) Lower Legform Test

1. Impactor

It was agreed **to recommend using** the legform impactor developed by TRL, for the time being, to evaluate the performance of vehicles in protecting the lower leg. However, it was also **recommended** to consider the possible future use of the Flex-PLI, which is considered by some to be more biofidelic and expected to be highly usable and repeatable, following the evaluation to be conducted by the Technical Evaluation Group (INF GR/PS/106) 3/.

The TRL legform is able to estimate human knee injury risk and has been shown to be a durable and repeatable test tool, provided that handling procedures for the legform are carefully followed 4/.

2. Injury Criteria
No change to this section

3. Relaxation of Acceleration Limit
No change to this section

3/ The size and mass of both the present rigid lower legform and the Flex-PLI were determined to be equivalent to those of a 50th percentile adult male (INF GR/PS/79). The results of computer simulation analyses and experimental data indicate that the mass of the upper body need not be taken into consideration for those impacts where the bumper strikes the legs below knee level (INF GR/PS/105).

4/ "Use of the TRL Legform to Assess Lower Leg Injury Risk," Stammen and Mallory, NHTSA VRTC, February 2006. INF GR/PS/XX

(c) Upper Legform Test for High Bumpers

As discussed above, the informal group recognized that the lower leg impactor test would be inappropriate for vehicles whose bumpers strike the legs above knee level, but the group believed that vehicles with high bumpers should be subject to a test that would require the bumper to be more energy absorbing. For that reason, **the informal working group recommends** an upper legform test for vehicles with a lower bumper height of more than 500 mm.

Data provided in INF GR/PS/175 Rev.2 indicate that, in order to meet the proposed criteria for the upper legform test, energy absorbing foam will have to be added to the bumper; such modifications are expected to reduce the risk of fractures which also constitutes an important injury risk.

1. Impactor

As the majority of victims of upper leg injuries are adults, the informal group generally agreed to **recommend** a subsystem test using a legform impactor that represents an upper adult leg. The impactor specifications in this proposed gtr are those used in the EU Directive 2003/102/EC for the upper legform impactor.

2. Injury Criteria
No change to this section

3. Limits of the Upper Legform Test
No change to this section

VIII. OTHER ISSUES

1. Systems or components that change position

Any vehicle system or component which could change shape or position, such as pop-up headlights or headlamp cleaners, other than active devices to protect pedestrians, were considered by the informal group to possibly create additional injury risks for pedestrians. It therefore was discussed whether such systems need to meet the requirements in their "normal position of use" or in any other possible position. During the discussion it became clear that currently, due to the fact of the latest developments in lighting technology, no vehicles with pop-up headlights exist on the market. Other systems such as headlamp cleaners move back to their stowed position under a small preload. Finally, the informal group therefore decided to **recommend** such active systems to be set to their stowed position when determining the test areas. When performing the tests, the vehicle shall comply to the requirements with the components in each fixed shape or position (e.g. stowed and popped-up).

2. Active devices to protect pedestrians
No change to this section

3. Impact on Existing Standards
No change to this section

IX. REGULATORY IMPACT AND ECONOMIC EFFECTIVENESS

This global technical regulation is expected to reduce the number of pedestrian fatalities and injuries resulting from head impacts against the bonnet and leg impacts with the bumper. It will also maximize economic effectiveness of pedestrian protection regulations globally.

(a) Benefits
No change to this section

1. Head Protection
No change to this section

2. Leg Protection

The group did not have assessments of the potential leg/knee injury benefits from each of the regions. At the end of the activities of the informal group, the United States of America made a preliminary assessment based upon NHTSA's Pedestrian Crash Data Study (PCDS is a database of 550 pedestrian crashes that occurred between 1994 and 1998), and for the approximately 70,000 annual pedestrian injuries in the United States.

Target population

The 32 per cent target population from INF GR/PS/169 includes both passenger cars and LTVs. The gtr exempts a rather large percentage of LTVs from having to test with a lower legform, therefore the target population should only include passenger cars and LTVs that have bumper heights below the defined cutoff.

Based on cases in the PCDS database, 56 per cent of pedestrians sustain injuries at the MAIS 2-6 severity level, and 42 per cent of those pedestrians have a lower extremity injury as their most severe, or tied for most severe, injury. Therefore, based on the current US injury rate of 68,000 pedestrians, the annual number of pedestrians with a lower extremity injury as their most severe injury are:

Number of pedestrians with AIS 2+ lower extremity injuries as most serious injury:
- **= (number of annual injured pedestrians) x (percentage at MAIS2-6 level) x (percentage where LE most serious)**
- **= 68,000 x 0.56 x 0.42**
- **= 15,994 pedestrians with AIS 2+ lower extremity injury as a highest severity injury.**

This number is the target **population** for all lower extremity **(LE)** injuries, not the ones specific to the gtr. Thus, the group had to account for the **percentage of specific** injury types **and vehicles** covered by the gtr. **Of the AIS 2-6 lower extremity injuries in PCDS, 56 per cent are to the knee and lower leg and are considered target injuries for the gtr**. According to the PCDS data, 100 per cent of passenger cars and 87 per cent of light trucks **and vans** have a **lower** bumper height **at or below 500 mm, and could potentially be tested with the lower legform test. PCDS data show that passenger cars account for 84 per cent and light trucks and vans for 16 per cent of the total lower leg and knee injuries at the AIS 2-6 severity level. In passenger car impacts to pedestrians, 81 per cent of knee and lower leg injuries were attributed to bumper contact, while in light truck and van impacts**, 72 per cent of the knee and lower leg injuries were attributed to bumper contact.

Based on these proportions, the number of pedestrians with AIS 2-6 lower extremity injuries that could potentially be addressed by the gtr:

Estimated number of pedestrians with AIS 2+ lower extremity injuries addressed by regulation caused by vehicles covered by regulation:

= (number of annual LE MAIS 2+ injured pedestrians) x (percentage to knee and lower leg) x (percentage sustained by vehicle type x percentage of vehicle type covered by regulation x percentage attributed to bumper contact by vehicle)

= 15,994 x 0.56 x (0.84 x 1.00 x 0.81+0.16 x 0.87 x 0.72)

= 6,992 pedestrians with AIS 2-6 knee or lower leg injury as highest severity injury impacted by vehicle bumper covered by regulation

Lower leg benefits

The United States of America calculated benefits based on experimental testing of 5 vehicles 5/ in collaboration with Transport Canada. An estimate based on the geometry of the 5 bumpers tested showed that the total testable area on the bumpers was approximately 80 per cent of their width. The 264 mm relaxation zone of the bumper that is required to meet the **less stringent** 250 g requirement is approximately 15 per cent of the total bumper width **on average**. The remaining primary test area of the bumper covered by the **more stringent** 170 g requirement is approximately 65 per cent. Results from the testing estimated 42 per cent improvement to the overall **AIS 2-6 knee and lower leg** injury **risk** in the primary test area and 14 per cent improvement in the relaxation zone. Accordingly, the **knee and** lower leg injuries prevented by the gtr:

AIS 2+ knee and lower leg injuries prevented:

= (target population) x ($improvement_{primary}$ x $testzone_{primary}$ + $improvement_{relax}$ x $testzone_{relax}$)

= 6,992 x (0.42 x 0.65 + 0.14 x 0.15)

= 2,056

As stated above the testable percentage of the bumper was estimated to be 80 per cent, about 10 per cent of which is outboard of the gtr-defined bumper "corner". This area is generally oriented laterally and would therefore not be expected to deliver a direct blow to a pedestrian leg. In fact, it is expected that the vast majority of lower extremity impacts would occur between the bumper corners, suggesting that closer to 90 per cent of all bumper-related injuries occur with the testable area, rather than the 80 per cent estimated in these calculations. If the higher testable area number were used, the injuries prevented would be expected to increase by approximately 10 per cent.

As a result of these conservatively low estimates of target population, improvement **percentages** and testable area, these estimates of injuries prevented should be considered as the minimum likely benefit from the gtr requirements.

(b) Costs

No change to this section

5/ Mallory A, Stammen JA, Legault F. "Component Leg Testing of Vehicle Front Structures," Paper No. 05-0194, Nineteenth International Technical Conference on the Enhanced Safety of Vehicles, June 2005.

B. TEXT OF THE REGULATION

Paragraph 2, Application, replace by the following:

2. APPLICATION

~~**This global technical regulation (gtr) shall apply to the frontal surfaces of power driven vehicles of category 1-1 [with a gross vehicle mass exceeding 0.5 tonnes but not exceeding 2.5 tonnes], and of category 2 [with a gross vehicle mass exceeding 0.5 tonnes but not exceeding 2.5 tonnes], which forward of the A-pillars have the same general structure and shape as a pre-existing category 1-1 vehicle**~~.

This global technical regulation (gtr) shall apply to the frontal surfaces of power driven vehicles of category 1-1 with a gross vehicle mass not exceeding 3,500 kg, and of category 2 with a gross vehicle mass not exceeding 3,500 kg.

All definitions of Special Resolution No. 1 (S.R.1) shall apply as necessary.

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