UN/ECE/WP29/GRSP PEDESTRIAN SAFETY GTR INFORMAL GROUP

PRELIMINARY REPORT

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1. INTRODUCTION

1.1. SET-UP OF GRSP AD HOC GROUP BY GRSP/WP29

During the 126th session of WP.29 in March 2002, AC.3 concluded on their considerations of priorities for developing future global technical regulations. WP.29 adopted the 1998 Global Agreement Program of Work, which included pedestrian safety and decided to start the work on pedestrian safety in the 31st session of GRSP in May 2002, by creating an informal group to draft the GTR.

1.2. MANDATE

Informal document 10 of the 31st session of GRSP lays down the terms of reference of the group and the document was adopted by GRSP. (INF GR / PS / 2)

1.3. NUMBER OF MEETINGS

The group has held four meetings:
- September 4-5, Paris
- December 10, Geneva
- January 15-16, Santa Oliva
- May 15-16, Tokyo

1.4. PARTICIPANTS

The meetings were attended by representatives of:
The Netherlands, France, Canada, EU, Spain, Japan, USA, Italy, EEVC, CI, CLEPA and OICA.
The meetings were chaired by Mr Mizuno (Japan) and Mr Friedel (EU) whilst the Secretariat was provided for by Mr Van der Plas (OICA).

1.5. STATUS

This report responds to paragraph 5 of documents TRANS/WP29/2002/24 and TRANS/WP29/2002/49 as adopted by AC3 and endorsed during the 127th session of WP29. The documents were consolidated in the final document TRANS/WP29/882.

1.6. FUTURE STEPS

Due to the time schedule and the nature of the discussions, preliminary discussions on the content of the GTR have already begun.

2. ACCIDENT ANALYSIS

2.1. OVERALL PEDESTRIAN FATALITIES / INJURIES AND THEIR EVOLUTION OVER TIME

The Pedestrian Safety GTR Informal Group tried to accumulate all available pedestrian traffic accident data.

As result, the group received pedestrian accident databases from the IHRA/Pedestrian Safety WG (comprehensive in-depth accidents study - INF GR/PS/3-31), German accident data (INF GR/PS/12-13-25), Italian data (INF GR/PS/14), UN accident data (INF GR/PS/15), Spanish data (INF GR/PS/16), European Industry's data (INF GR/PS/17), Canadian data (INF GR/PS/20) and Netherlands data (INF GR/PS/21).

The most in depth accident data came from the IHRA/PS-WG, but all the above mentioned data supports the same trends seen in the IHRA/PS study.
The 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 absolute numbers are still important enough to make some actions.

2.2. DISTRIBUTION OF INJURIES

Comparing the ages, statistics show the highest frequency of accidents is for children of 5 to 9 years old, and for adults over 60 years old.
According to the in-depth study of the IHRA/PS-WG, the frequency of fatal and serious injuries (AIS 2-6) is highest for following body regions: head injuries for adult and child, and leg injuries for adult.
Each of these body regions cover more than 30% of total accidents and the group believes it should focus on protecting these body regions.
The highest next to head and leg injuries are chest injuries with about 10 %. Other injured body regions are much lower with only a few percents.
For the vehicle parts, the major sources of adult head injuries are the top surface of bonnet/wing and windscreen glass plus A-pillars. For the child head injury, this is the top surface of the bonnet / wing. For the adult leg injury, the major source is the front bumper of vehicles. (INF GR/PS/3-31)

2.3. CRASH SPEEDS

Pedestrian accident data for crash speed between vehicles and pedestrians are collected and the cumulative frequency of the crash speeds shows that a crash speed of up to 40 km/h can cover more than 75% of total pedestrian accidents. 60 km/h can cover nearly all accidents. (INF GR/PS/3-31)

2.4. CONCLUSION: JUSTIFICATION / NO JUSTIFICATION TO WORK ON PEDESTRIAN SAFETY

The Pedestrian Safety GTR Informal Group collected all available traffic accident data for pedestrians from all available sources.
Based on these accident data, the Informal Pedestrian GTR Safety Group concludes and recommends that:

i. The majority of fatalities (numbers) and serious injuries occurred on:
   - Adult head vs. top surface of bonnet/wing + windscreen glass and A-pillars,
   - Adult leg vs. front bumper of vehicles,
   - Child head vs. top surface of bonnet/ wing.

ii. A crash speed (between a car and a pedestrian) of 40 km/h can cover more than 75% of total injuries including fatalities and this speed is covered, injuries caused by higher speed crashes will also be influenced positively by a reduction in injury level.

3. EXISTING OR FUTURE NATIONAL / REGIONAL LEGISLATIVE ACTION PLANS

During the discussion in the ECE/GRSP Informal Group on pedestrian safety drafts of regulation for the protection of pedestrians in an collision with a motor vehicle are published by the Japanese Government and by the Commission of the European Communities.

3.1. SITUATION IN JAPAN

Pedestrian fatalities account for about 30% of all traffic fatalities in Japan. The new regulation is addressed to the protection of the head and the outline is as follows:

i. Scope of vehicles

- Passenger cars having no more than 10 seats
- Trucks having a GVW not exceeding 2,500kg and a similar front shape as the passenger cars above mentioned

ii. Effective Date

- Vehicles except for vehicles defined in the next indent
  - New-type vehicles: September 2005
  - Continuously-manufactured vehicles: September 2010
- Low height vehicles, Vehicles requiring high endurance, such as SUVs and trucks, Full cab over vehicles, Hybrid-engine vehicles
  - New-type vehicles: September 2007
  - Continuously-manufactured vehicles: September 2012

iii. Outline of the regulation

Test Procedure

a) Test area
The child and adult head impactor test will be considered for the regulation.
Test area for child head impactor: 1,000mm ≤ WAD ≤ 1,700mm
Test area for adult head impactor: 1,700mm ≤ WAD ≤ 2,100mm
Note: WAD (Wrap-Around Distance) means the distance from the ground to the point on the bonnet along the vehicle front structure.

b) Impactor (See Appendix 3)
Child head impactor: Diameter 165mm, weight 3.5kg
Adult head impactor: Diameter 165mm, weight 4.5kg

c) Impact speed and angle

	Child head impactor		Adult head impactor	
	Speed (km/h)	Angle (deg)	Speed (km/h)	Angle (deg)
Category 1	32	65	32	65
Category 2	32	60	32	90
Category 3	32	25	32	50

(Above head impact conditions were estimated from the IHRA car-pedestrian 40 km/h impact computer simulation results)

	Definition	Note
Category 1	Vehicle having a BLE height of less than 835mm	Sedan type
Category 2	Vehicle having a BLE height of not less than 835mm	SUV type
Category 3	Vehicle having a bonnet angle of not less than 30 deg.	1 Box type

Note: BLE height: Bonnet Leading Edge height

Criteria
HIC (Head Injury Criteria), defined by the following formula, should not exceed 1,000 on two-thirds or more of the test area. On the remaining area, HIC should not exceed 2,000.

In appendix 1 of the regulation the Draft test procedure is illustrated, in Appendix 2 the test area is specified as well as the bonnet leading edge reference line, in Appendix 3 the specifications and certification test of head form impactors are outlined.
Japan has already indicated that a next step will include requirements for the lower leg. In order to achieve this, Japan will use the content of the GTR as its next step in legislation.
For more details see INF GR/PS/33.

3.2. SITUATION IN EU
About 8,000 pedestrians and cyclists are killed and a further 300,000 injured in the European Community each year in road accidents. On the 19th of February, 2003 the European Commission voted to adopt a draft proposal for a Directive on Pedestrian Protection which would be presented to the Council and European Parliament. The contents of the proposal are based on the industry commitment, on the scientific work performed by Working Group 17 of the European Enhanced Vehicle-safety Committee (EEVC) and the Joint Research Centre (JRC) of the European Commission.
This proposal lays down technical requirements for the type approval of motor vehicles with regard to pedestrian protection. The proposed measures apply to passenger cars and car-derived vans (category M1, of a total permissible mass not exceeding 2.5 tonnes, and N1 derived from M1, of a total permissible mass not exceeding 2.5 tonnes).
As the construction of passenger cars is covered by Community legislation under the EC whole vehicle type approval system set up by Directive 70/156/EEC, as amended, the proposed requirements will also be incorporated into this system.
The technical provisions are described in Appendix 1 of the proposal. The proposed basic requirements will be tested according to detailed prescriptions which will be set out in a Commission decision.
In a first phase, starting in 2005, new types of vehicles must comply with two tests concerning protection against head injuries and leg injuries:

- Legform to Bumper: One of the two following legform tests are required to be performed:
  - Lower legform to bumper: The test is performed at an impact speed of 40km/h. 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
  - Upper legform to bumper: The test is performed at an impact speed of 40km/h. 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.
- Child/Small Adult headform to bonnet top: The test is performed at an impact speed of 35 km/h using a 3.5 kg test impactor with a diameter of 165 mm. The Head Performance Criterion (HPC) shall not exceed 1000 over 2/3 of the bonnet test area and 2000 for the remaining 1/3 of the bonnet test area.

In Phase 1 the following tests are required for monitoring purposes only:

- Upper legform to bonnet leading edge: The test is performed at an impact speed up to 40 km/h. The instantaneous sum of the impact forces with respect to time should not exceed a possible target of 5.0 kN and the bending moment on the test impactor shall be recorded and compared with the possible target of 300 Nm.
- Adult headform to windscreen: The test is performed at an impact speed of 35 km/h using a 4.8 kg test impactor. The Head Performance Criterion (HPC) shall be recorded and compared with the possible target of 1000.

In a second phase, starting in 2010, four tests of increased severity according to the recommendations by EEVC will be required for new types of vehicles, two tests concerning head injuries and two concerning leg injuries. Within five years all new vehicles will have to comply with these test requirements.

- Legform to Bumper:
- One of the two following legform tests are required to be performed:
  - Lower legform to bumper: The test is performed at an impact speed of 40km/h. The maximum dynamic knee bending angle shall not exceed 15.0°, 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 150g.
  - Upper legform to bumper: The test is performed at an impact speed of 40 km/h. The instantaneous sum of the impact forces with respect to time shall not exceed 5.0kN and the bending moment on the test impactor shall not exceed 300Nm.
- Child headform to bonnet top: The test is performed at an impact speed of 40km/h using a 2.5kg test impactor with a diameter of 130 mm. The Head Performance Criterion (HPC) shall not exceed 1000 for the whole of the bonnet test area.
- Adult headform to bonnet top: The test performed at an impact speed of 40km/h using a 4.8kg test impactor with a diameter of 165 mm. The Head Performance Criterion (HPC) shall not exceed 1000 for the whole bonnet test area.
- Upper legform to bonnet leading edge: The test is performed at an impact speed up to 40km/h. The instantaneous sum of the impact forces with respect to time

shall not exceed 5.0kN and the bending moment on the test impactor shall not exceed 300Nm.

Pedestrian protection objectives can be achieved by active or passive safety measures. Considering the speed of technological development in this area, this proposal foresees that alternative measures to the requirements laid down in the proposal might be developed. A feasibility assessment will therefore be carried out by 1 July 2004 concerning the proposed technical test provisions and in particular other measures which potentially may have at least equal protective effects to those proposed. Should the feasibility assessment show that these alternative measures have at least equal protective effects the Commission shall consider relevant proposals to amend this Directive.
Concerning the withdrawal of rigid bull bars, following the views expressed by the Council and the European Parliament, suggesting that a legislative approach would cover not only the original equipment manufacturers but also the independent after-market, the Commission intends to propose a Directive containing a test procedure for all bull-bars and similar devices placed on the market.
For more details see INF GR/PS/34.

3.3. SITUATION IN OTHER COUNTRIES
Canada is currently reviewing their bumper regulation. The Canadian bumper regulation is one if not the most stringent in the world (all the safety features of the vehicle have to be functional after an 8 km/h impact). Canada needs to investigate the effect of the Canadian bumper designs on pedestrian safety.
If other countries start working on pedestrian safety and are able to share their work with the Pedestrian Safety GTR Informal Group, it will be taken into account in future discussions.

3.4. SCOPE FOR HARMONISATION
The accident data learns us that next to the EU and Japan, other countries also suffer high pedestrian fatalities. Establishing a GTR (with harmonized tools, methods and level of protection) offers the opportunity not only to align existing requirements (in the EU and Japan) but also to potentially lower pedestrian injuries worldwide.
It is the intention of Japan to use the content of the GTR for their next step in their national legislation. Also the second phase of the EU provisions offer the possibility for alignment with the GTR.

4. PARAMETERS TO BE TAKEN INTO ACCOUNT
4.1. ACCIDENTOLOGY
Based on the IHRA accident study (INF GR/PS/3-31) the group concluded that:
- Head and leg are the most injured body regions
- Child head mostly injured by the top surface of the bonnet
- Adult head mostly injured by the windscreen glass but with the windscreen frame / A-pillar and top surface of the bonnet / wing as additional important sources
- Adult leg mostly injured by the bumper

This was confirmed by the GIDAS data (INF GR/PS/25) from which the group concluded that head tests on the bonnet and lower leg tests need to be included.
The bonnet leading edge appears not to be a problem so no tests needed.

Spanish accident data (INF GR/PS/16) showed that head and thorax are the first priority for severity and the extremities for the frequency of the injuries.

The group also considered the selection of the injury parameter for the head. HIC was preliminary chosen because HIC is well accepted and used in areas not designed for (like side impact for example). Drawbacks are known, people are working on it but worldwide no alternative has been found yet. Another value / parameter will cost a lot of time / money to convince the world. The HIC limit would be either 1000 or different (higher); if higher a very good justification will be needed. The selection of the limit itself will be dependant amongst others on the outcome of the feasibility study.
Results from a Japanese ITARDA study on leg injuries (INF GR/PS/26) showed that it is necessary to protect both the tibia and the knee joint. As a consequence it was deemed necessary to look into a new lower legform developed by JARI. This new lower legform would make it possible to assess the injury risk of both the tibia and the knee joint.

4.2. RELEVANCE (FULL SCALE / SUBSYSTEM)
The group agreed that a simple, reliable, repeatable test is better for legislation. For research simulation, PMHS and a dummy can be very helpful.
However, simulation could be of assistance in the selection of the most severe impact point.
The general conclusion thus was that sub system tests are the best way forward.

4.3. SCOPE (CATEGORIES / SHAPES, CRASH SPEED)
Vehicle shape is important. It influences the speed and angle of the head test conditions. The shapes specified by IHRA can serve as basis and it needs to be checked how light trucks / vans / exotic shapes can be included (if not included yet). If additional shapes are identified to which the sub system tests have not been validated, this should be mentioned in the preliminary report.
The group agreed that the work of the GRSG Common Tasks group should be taken into account as well. Based on the GRSG common Tasks proposed definitions the group suggested to preliminary set the scope as follows:

Category 1-1 < 2,5 tonnes*
Category 2-1 < 2,5 tonnes * derived from ** Category 1-1
Category 1-1 and 2-1 are the categories as defined by the GRSG Common Tasks group
* The weight limit can be revised depending on data on the vehicle fleet in the US, to be provided to the group by the US.
** 'Derived from' means 'having the same front shape'.

The group agreed that the scope should be limited to new types only since the necessary technical changes to the vehicle needed for achieving the high level of protection can only be brought into a vehicle during the development of a new type.

4.4. COST (MONETORY, SOCIAL)
It was considered that a cost study can only be done in a pragmatic way. It was tried within EEVC and even within the EU it was not possible because amongst others the differences in the hospital care system. It can only be done as examples for separate countries. The other option would be to use an idealised standard.

Members of the group also referred to three papers that were produced based on the EEVC reports. These cost effectiveness studies are from bast, the Netherlands and MIRA and could be provided to this group.
However the group would request guidance to WP29 on what monetary value has to be used since different regions use different values.

4.5. FEASIBILITY (TECHNICAL, OTHER REASONS)
The group already took note of the feasibility study performed in IHRA (INF GR/PS/5) on the IHRA proposed head tests. The main conclusions are:

- No vehicle fulfils EEVC/WG17 requirements completely
- No traditional solution possible to pass EEVC/WG17 requirements (not possible with padding only)
- No sensor techniques are available yet to offer other solutions

The group will also check with various NCAP programs around the world if data from their tests could give an insight in the feasibility of certain pedestrian tests. As more tests are performed by these NCAP programs, the results will be fed into the discussions of the Pedestrian Safety GTR Informal Group.
As the group reaches conclusions on various parts of the proposed tests for the draft GTR, more feasibility studies / assessments will have to be performed by the group members.

4.6. CONFLICTS WITH EXISTING LEGISLATION / REQUIREMENTS
During the preliminary activities of the informal group, it was generally recognized that any future proposed legislative requirements on pedestrian protection should be assessed against other vehicle parameters.

OICA pointed out that both existing and future vehicle requirements should be taken into account, internationally as well as nationally, to ensure that potential conflicts are reduced as much as possible. OICA also stressed that, in addition to legislative requirements, other vehicle parameters also need verification, in terms of customer satisfaction, repairability, comfort, handling, etc.

The group asked OICA to prepare such list of all necessary parameters for evaluation for inclusion in this report. OICA consequently provided the input attached as INF GR/PS/35.

5. REQUEST FOR ADDITIONAL RESEARCH AND TESTING
The group was informed about research ongoing in Japan on the development of a new and more biofidelic lower legform (including amongst others bendable bones). The group sees this as a vital part of research which has the possibility to further improve the protection of the lower leg and the group will take the outcome of this research into account in its discussions.
The group also recognizes the importance of the work underway in IHRA and will use this as basis for its discussions. The IHRA proposals are based on input from the relevant ISO and EEVC working groups.

6. CONTENTIOUS ISSUES
Referring to item 4.4 above, the group requests guidance to WP29 on what monetary value has to be used since different regions use different values.

7. OTHER MEASURES THAT CAN POTENTIALLY REDUCE PEDESTRIAN INJURIES

The group, taking note of the terms of reference, also reviewed the issue of other safety measures besides passive safety measures on the vehicle itself.

The group recognized that active safety measures are not within its field of competence but at the same time agreed that such issues should be brought to the attention of WP29 and AC.3.

As pointed out by several experts, including OICA, pedestrian protection could be considered as a whole, including active and passive measures. Some experts noted that consideration of other safety measures might help in ensuring that the vehicle passive safety requirements are kept at a realistic and feasible level.

OICA in particular mentioned brake assisting systems which can, in emergency situations, substantially improve the braking performance and consequently reduce the impact speed when the impact is unavoidable.

OICA also pointed to the importance of the infrastructure and presented the results of a 1998 study conducted on behalf of ACEA by the consultants ORIENTATIONS (F) and TMS Consultancy (UK) – INF GR/PS/29. This study, which evaluated the effect of infrastructural measures based on real data evaluations, concluded that such measures could dramatically reduce the number of pedestrian victims (fatalities/injuries) at low cost.

While it was agreed that such infrastructure measures are not within the remit of the group, it was also agreed that it could be useful and efficient to inform WP29 as well as other authorities of the need to take these issues into account for real world safety improvements. The group also noted the importance of educational measures as well as the need to enforce existing road traffic legislation.

8. REQUEST THAT THE GR BE ALLOWED TO BEGIN WORK ON A DRAFT REGULATION BASED ON THE PROPOSAL AND THE REVIEW

Because of our assigned Terms of Reference, our Pedestrian Safety GTR informal group should make a final proposal to GRSP before spring 2005. To do so, the group should prepare its draft proposal to GRSP before autumn 2004.

Based on this schedule, the time to prepare the draft proposal is limited. That is only one year after submission of our final preliminary report to GRSP.

If the group waits to start drafting the GTR until final approval of WP29 is received, our time for study will be much shorter than one year. In such a short period, a proposal can not be finalised.

For these reasons, the Informal Group asks GRSP's confirmation to start our study to establish the Pedestrian Safety GTR proposal immediately after the submission of our Step 1 report.

Of course, after we receive advices, suggestions and comments from GRSP and/or WP29, our study results will be modified based on such suggestions, comments and advices from GRSP/ WP29.

Then in line with the proposed time schedule, the Informal Group will prepare a Draft GTR for Pedestrian Safety.

LEGEND

Documents used by this group are available on the UN/ECE website:

Number	Title
INF GR/PS/1	Agenda 1st meeting
INF GR/PS/2	Terms of reference
INF GR/PS/3	IHRA accident study presentation
INF GR/PS/4	JMLIT proposed legislation
INF GR/PS/5	IHRA feasibility study
INF GR/PS/6	J information on possible scope
INF GR/PS/7	Attendance list 1st meeting
INF GR/PS/8	Draft Meeting Minutes 1st meeting
INF GR/PS/9	Report to GRSP 32 inf doc
INF GR/PS/10	Draft action plan
INF GR/PS/11	Agenda 2nd meeting
INF GR/PS/12	GIDAS accident data
INF GR/PS/13	GIDAS accident data graphs
INF GR/PS/14	Italian accident data
INF GR/PS/15	UN accident data
INF GR/PS/16	Spanish accident data
INF GR/PS/17	ACEA accident data
INF GR/PS/18	Draft Meeting Minutes 2nd meeting
INF GR/PS/19	Agenda 3rd meeting
INF GR/PS/20	Canadian accident data
INF GR/PS/21	Netherlands accident data
INF GR/PS/22	Scope overview
INF GR/PS/23	Draft content table preliminary report
INF GR/PS/24	Attendance list 3rd meeting
INF GR/PS/25	GIDAS presentation
INF GR/PS/26	Leg injuries ITARDA
INF GR/PS/27	Draft Meeting Minutes 3rd meeting
INF GR/PS/28	Technical feasibility general
INF GR/PS/29	Infrastructure effectiveness
INF GR/PS/30	Pelvis / Femur fracture
INF GR/PS/31	IHRA/PS-WG Pedestrian Accident data
INF GR/PS/32	ESV summary paper on IHRA PS WG report
INF GR/PS/33	NISHIMOTO, Toshiyuki : Introduction of the regulation of pedestrian head protection in Japan
INF GR/PS/34	Commission of the European Communities: Proposal for a directive of the European Parliament and the Council relating to the protection of pedestrians and other vulnerable road users in the event of a collision with a motor vehicle and amending Directive 70/156/EEC, Brussels, February 2003
INF GR/PS/35	List of conflicts with existing legislation / requirements