Transmitted by the expert from Japan

Informal document No. **GRSP-47-16/Rev.1**
(47th GRSP, 17 - 21 May 2010,
agenda item 3)

FIRST PROGRESS REPORT OF THE INFORMAL WORKING GROUP ON gtr No.7 (Head Restraint) PHASE 2

(DRAFT)

(Transmitted by the Technical Sponsor of the gtr No.7 Phase2 Informal Working Group)

OBJECTIVE OF THE PROPOSAL

The representative of Japan proposes the development of Phase 2 of gtr No. 7 and has incorporated the amendments proposed by the United State of America. 1/ He also proposes the establishment of an informal group for the development of this Phase. The informal group will discuss appropriate methods for testing and evaluating injuries due to rear impact crashes.

BACKGROUND

At its one-hundred-and-forty-third session, in November 2007, the World Forum for Harmonization of Vehicle Regulations (WP.29) agreed to provide guidance to the Working Party on Passive Safety (GRSP) for the development of the draft gtr on head restraints (ECE/TRANS/WP.29/1064, para. 81) and that Phase 2 of the gtr should consider, as indicated in informal document No. WP.29-143-23-Rev.1, the following issues:

(a) The head restraint height of 850 mm;
(b) The appropriate dynamic test, including the test procedure, injury criteria and the associated corridors for the biofidelic rear impact dummy II (BioRID II).

At its one-hundred-and-forty-eighth session, in June 2009, the Executive Committee of the 1998 Agreement (AC.3) agreed on the two-step approach suggested by the representatives of the United Kingdom and of the United States of America. This approach will consider whether BioRID II can more effectively address injuries occurring in low speed rear impact crashes and focus on reducing injuries in higher speed rear impact crashes as a second step.

To address minor neck injuries (maximum abbreviated injury scale 1 (MAIS)) that occur in low speed rear impact crashes, insurance industry groups, such as the International Insurance Whiplash Prevention Group (IIWPG) (Insurance Institute for Highway Safety (IIHS) and Thatcham), have been conducting dynamic evaluations of seats. The European new car assessment programme (EuroNCAP) introduced dynamic evaluations of seats in 2008, and the Japanese new car assessment programme (JNCAP) introduced dynamic evaluations of seats in 2009. However, the testing and evaluation methods vary from one programme to another. Additionally, the European Enhanced Vehicle-safety Committee (EEVC) Working Group 12 has been investigating the appropriate dynamic test, to address minor injuries in low speed crashes, including the test procedure, injury criteria and the associated corridors for the BioRID II dummy. At its June 2009 session, AC.3 gave its consent to establish the informal group, under the

---

1/ ECE/TRANS/WP.29/2008/115, ECE/TRANS/WP.29/2009/47 and ECE/TRANS/WP.29/2009/48

chairmanship of the United Kingdom and with the technical sponsorship by Japan, to evaluate whether the BioRID II dummy can be adopted into gtr 7 to assess the protection against low speed rear impact injuries.

At higher speed rear impact crashes ($\Delta V \geq 18$ km/h), there are as many minor injuries as recorded in the low speed crashes and there are a significant number of more severe injuries (MAIS 2 and MAIS 3) occurring in some countries. The United States of America is currently evaluating several dummies and a dynamic test that could address these injuries. As a second step, AC.3 will resume consideration of development of a high speed test at its November 2010 session.

At its one-hundred-and-forty-ninth session, in November 2009, Japan submitted to AC.3 a proposal for the development of amendments to the gtr, prepared jointly with the United Kingdom and the United States of America, and the revised timetable. AC.3 agreed to develop the amendment to the gtr. As a first step, the amendment work will focus on developing a low speed dynamic test using the BioRID II dummy. Regarding the head restraint height, as a first step the procedures for defining the effective height will be considered. Detailed discussions on dummies will be conducted by a Technical Evaluation Group (TEG), which is to be established under the umbrella of the informal group. Drawings detailing the uniform specification of the test tools will be developed and provided to the Secretariat as reference material.

SUBJECTS FOR REVIEW AND TASKS TO BE UNDERTAKEN (Terms of Reference)
With regard to head restraint height, the informal group should decide:

(a) How to define the effective height;
(b) The height requirements.

With regard to low speed dynamic test, the informal group should:

(a) Define test conditions that reflect accidents in the real world, including the performance of seat backs and head restraints as a system;
(i) Tests conducted on the whole vehicle as available on the market, and/or on production seats mounted on sleds;
(ii) Number and conditions of sled pulses;

(b) Working within the accepted knowledge concerning the mechanism of minor neck injury and other rear impact injuries, identify parameters that may be used to advance developments in occupant protection through, for example;
(i) Analyzing accidents;
(ii) Performing volunteer tests (low speed only) and simulations with human body finite elements (FE) models;

(c) Evaluate dummies that reflect the above mechanism with high fidelity to the human body and which demonstrate an acceptable level of perfection as a measuring instrument;
(i) In particular, the dummy evaluations shall include an assessment of their biofidelity in the critical areas associated with the safety technology under review, their repeatability and their reproducibility;

(ii) Define the dummy sitting conditions to minimise variation in test results;
(iii) Harmonize the test dummy and calibration test;

(d) Evaluate indicators of human body injury that reflect the minor neck and other rear impact injury mechanisms;
(i) E.g. measure the relative movement between the upper and lower parts of the neck and the forces applied to each of these parts;
(e) Define reference values which should be based on the results of injury risk analysis and feasibility studies.

With regard to evaluation, the informal group should evaluate the effects on reduction of injury and cost-effectiveness of the proposals.

History of the Discussions

1) Head Restraint Height

The Netherlands proposed to measure the height by combining it with the backset in order to ensure the effectiveness of head restraints for tall occupants. At the 2nd informal group meeting, the Netherlands pointed out that the backset is not considered under the methods of the current R17, EuroNCAP, and IIWPG and proposed a new evaluation method that combines the height and backset. In this evaluation method, measurements are performed at the center only. Measurements according to this evaluation method would require the height to be raised by about 40 mm. Some issues related to this method were pointed out, such as remaining uncertainties, reproducibility/repeatability, and hindrance to rear visibility. The Netherlands was to conduct additional evaluations taking these issues into consideration by the next meeting.

2) Dynamic Evaluation Method
Number and conditions of sled pulses for the low speed dynamic test

The results of accident analysis and accident simulation tests indicate that, for reducing permanent disabilities, it is appropriate to set the sled pulse at EuroNCAP's medium waveform between ΔV=16 km/h and 22 km/h. However, it has been found that in the repeatability test at 20 km/h the result largely varies due to variations in the seat deformation. In the future, improvements in reproducibility and repeatability at high speeds will be studied using a new dummy calibration method.

Accident analysis

In Japan, rear impact crashes account for 31% of all traffic collisions, and 92% of these result in minor neck injuries based on all accident macro analyses. As for the crash speed, the accidents occur most frequently at ΔV15 km/h and below, which can be seen in about 60% of all cases. Even at ΔV20km/h and above, AIS2+ neck injuries account for 2% only, and most of the resulting injuries (60% or more) are AIS1 neck injuries. In recent years, the number of permanent disabilities has been increasing, and they occur most frequently at ΔV16-22 km/h, however, these ΔV analyses are based on small accident numbers micro analyses.

Volunteer tests and simulation

Japan gave a presentation at the 0th informal meeting (a meeting of "interested experts" that met in advance of the establishment of the informal group). It had been found in the results of the past studies on neck injuries and volunteer tests that there are correlations between neck strains/strain rates and occurrences of injuries. Risk curves for each case were created based on the results of accident analysis and simulations. Injury indicators that have high correlations with strains/strain rates and can be measured using dummies were extracted. As a result, relationships between strain rates and NIC and between neck strains and neck force (Upper& Lower Fx, Fz, My) were shown, and their risk curves were created. For some indicators no risk curve could be drawn and other alternative indicators were used.

3) Dummies

Discussions on dummies had been conducted as part of the Global BioRid Users Meetings (GBUM) activities up to the 1st informal meeting. However, starting with the 2nd meeting, the GBUM activities were incorportated into those of the TEG who hold web meeting approximately once a month.

Biofidelity
At the 0th informal meeting, the current status of the study by EEVC WG12 and WG20 and results of discussions on biofidelity were reported. The biofidelity in volunteer tests at 7-9 km/h was verified using qualitative procedures and quantitative CORE method, and BioRID II presented the best results.

The United States of America reported the progress of its studies on the biofidelity of dummies and injury mechanisms for the evaluation of AIS3+ injuries in mid- and high-speed rear impact crashes. Based on their results, a seat for sled tests was created. In addition, the biofidelity was compared with data from PMHS experiments, BioRID, RID3D, and Hybrid III to determine the most appropriate dummy. Further, the injury mechanisms were examined to determine and verify the instrumentation to the spine and to define the injury behavior.

At the 2nd informal meeting, NHTSA reported the progress of its research. To define the injury movement, the rear impact test was conducted, using the test seat, at 24 km/h with a deceleration of 10.5g. The test was also performed at 16.7 km/h and 8.5g. The PMHS test is also being conducted, and it is scheduled to be completed in August 2010.

Repeatability and reproducibility
In testing, good repeatability is obtained if the same dummy is used. However, there are problems with reproducibility among different dummies. Work to establish a common build level for the BIoRid IIg, together with improvements to the dummies and revisions of certification tests are being discussed to improve the repeatability and reproducibility.

Dummy seating conditions
At the 0th and 1st informal meetings, regarding the seating procedures of IWPG and EuroNCAP,

Japan made proposals on (1) design reference torso angle, (2) reduction of backset tolerance, and (3) special adjustment in the case of smaller torso angle seat, and explained the reasons for the proposals (GTR7-01-09e).

At the 1st informal meeting, Japan reported that in general the torso angle is at about 15° in trucks and vans, and it proposed to specify an optional spine angle to accommodate these upright seats. Denton Inc. (a manufacturer of BioRid) presented a new spine comb to set the dummy for a more erect seating posture. The appropriateness of the dummy when set to this condition is being evaluated.

New HRMD drawing
The current H-point machine is defined in SAE J826, and the HRMD was developed in the 90s. For either machine, there are large variations in products available on the market, resulting in variations in the backset measurements.

At the 2nd informal meeting, the result of research conducted by the German manufacturer's association (VDA) was introduced. VDA developed a new H-point machine and a testing jig called DILEMMA by taking the average of many H-point machines and harmonizing it with the SAE standard. For this, it is scheduled to issue the VDA specifications in February 2010, propose it to EuroNCAP, and also propose amendments to the SAE standard.

Dummy drawings (2D & 3D)
At the 1st and 2nd informal meetings, the progress of the drawing harmonization by Denton and FTSS was reported. The 2D drawing (PDF form), 3D drawing (STEP form), and user's manual are scheduled to be created jointly between the two manufacturers. The draft drawing package is scheduled to be submitted to the informal group by 30 April. However, the user's manual will be created after the certification method is complete.

Certification procedures
At the 0th informal meeting, the history of discussions on the new certification test at GBUM and the summary of those discussions were presented. As regards the new certification test, tests were completed in Korea, Japan, the United States of America, and Europe. The sled waveform has become more flat, showing good reproducibility. At the 2nd informal meeting, it was proposed to change the calibration waveform in order to match the EuroNCAP medium pulse and dummy input. However, the Chairman commented that since the TOR of this gtr states that our objective is to specify the uniform method for evaluating low speed impacts and the low speed is defined as ΔV18 km/h or below, we should aim the sled waveform at around 16-18 km/h and discuss the calibration waveform based on the current proposal (GBUM2009).

WORK SCHEDULE

First step (under the chairmanship of the United Kingdom and with the technical sponsorship by Japan)

Working Groups	Dates/Venue
0th informal meeting	2009/11/6 (Washington D.C., United States of America)
1st informal meeting	2009/12/8 (Geneva, Switzerland)

2nd informal meeting	2010/2/2-3 (Tokyo, Japan)
3rd informal meeting	2010/5/17(Geneva, Switzerland)
4th informal meeting	2010/9/20-21 (Germany)
5th informal meeting	2010/12 (Geneva, Switzerland)
6th informal meeting	2011/1
7th informal meeting	2011/5 (Geneva, Switzerland)

Tasks	Dates
At the 145 session of WP.29, Japan officially proposed to set up Phase 2 of the Head Restraint gtr.	2008/6
At WP.29/AC.3, it was proposed to establish the informal group.	2009/6
At WP.29/AC.3,TOR was approved.	2009/11
1st progress report to GRSP	2010/5
1st progress report to WP.29/AC.3	2010/11
2nd progress report to GRSP	2010/12
3rd (final) progress report to GRSP; official proposal for low-speed requirements submitted	2011/5
2nd progress report to WP.29/AC.3	2011/6
Proposal for low-speed requirements adopted at WP.29	2011/11

Second step (High-speed requirements) (under the chairmanship of (TBD) and with the technical sponsorship by the United States of America)

Tasks	Dates
Draft TOR submitted to GRSP	2010/5
Establishment of high-speed test methods to be decided at WP.29	2010/11

- - - - -

Documents for the meetings

WM-0-1	1st Dummy TEG Attendance list
WM-0-2	EEVC presentation
WM-0-3	(JASIC) Biorid seating position
WM-0-4	(Denton) Biorid II user's meeting
WM-0-5	(First technology) Whiplash update
WM-0-6	(Japan) Neck injury criteria risk
WM-0-7	(NHTSA) VRTC rear impact
WM-0-8	Rear impact task definition
GTR7-01-02	(JASIC) Proposal for BioRIID II dummy standardizatiion activity for gtr No.7-Phase2
GTR7-01-03	(The Netherlands) Front contact surface
GTR7-01-04	Comparisons for different Spine adjustment
GTR7-01-05	(Japan) Schedule of Head Restraint gtr Phase-2 Informal Working Group

GTR7-01-06	(Denton) Global BioRID-II User's Meeting
GTR7-01-07	(Republic of Korea) GTR No.7 2nd Phase Research Results
GTR7-01-08	Terms of reference of the informal group on Head Restraints phase 2
GTR7-01-09	(Japan) Biorid II seating proposal
GTR7-01-10	Draft minutes of the 1st Informal Working Group Meeting for gtr No. 7 – Head Restraints Phase 2
GTR7-02-01	Draft agenda of the 2nd Informal Working Group Meeting for gtr No. 7 – Head Restraints Phase 2
GTR7-02-02	(LEAR) HPM Variations
GTR7-02-03	(LEAR) HRMD Variations
GTR7-02-04	(AUDI) New HPM and HRMD Standards
GTR7-02-05	(VDA) Certification of the H-Pt. and Backset measuring equipment and its calibration
GTR7-02-06	(First technology) Global BioRID-II User's Meeting
GTR7-02-07	(First technology) Seat/Head Restraint Test Sled Pulse Summary
GTR7-02-08	(NHTSA) Rear Impact Dummy Biofidelity
GTR7-02-09	(First technology) BioRID II Drawing Harmonization
GTR7-02-10	(First technology) Seat/Head Restraint Test Sled Pulse Summary
GTR7-02-11	(Chalmers) Biorid new certification procedure
GTR7-02-12	(Denton) Background of GBUM certification test
GTR7-02-13	(Denton) Pulse feasibility investigation
GTR7-02-14	(Denton) New dummy head
GTR7-02-15	(The Netherlands) Head Restraints Static Height and Backset Measurement
GTR7-02-16	(Jasic) Crash pulse research status based on Japan accident research and vehicle rear impact test
GTR7-02-17	(Jasic) Japan research activities for new bio rid ii calibration method in the gtr-7 phase 2 iwg
GTR7-02-18	(The Netherlands) Head Restraints Static Height and Backset Measurement
TEGID-01	(first technology) Seat/Head Restraint Test Sled Pulse Summary
TEGID-02	(Denton) Global BioRID-II User's Meeting