

14th Meeting of the GTR 7 (Phase II) Informal Group
10/11 September 2013

Venue: Chalmers University of Technology
Gothenburg, Sweden

Minutes

1. Minutes from Meeting 13 – Paris (GTR7-13-05)

The minutes were approved with an amendment to the attendance list.

2. Chairman's update from the June session of WP.29/AC.3.

The chair gave the meeting an update on the verbal progress report that he gave to WP29 at its last meeting and noted that he intended to present a written report to WP29 at its November session. He reported that WP 29 had agreed to extend the mandate for the group as requested for a further 6 months until the end of 2015. A copy of the relevant paragraph from the WP.29 June 2013 report is copied below.

Dr Moorhouse asked if there was a general timeline given that much of the injury data to be discussed at this meeting would need to be kept in square brackets. This then raised the issue of when these brackets would be removed. The chair noted that the target for this would be the May GRSP meeting.

Extract from last WP.29 159 Head Restraint GTR report.

B. GTR No. 7 (Head restraints) (agenda item 17.2)

111. The representative of the United Kingdom, on behalf of the Chair of the IWG on UN GTR No. 7 Phase 2, gave an oral report on the work progress. He informed AC.3 that, as a result of its activities, the group had agreed on: (i) an effective head restraint height measurement procedure and (ii) an appropriate dynamic test, including the test procedure and the associated corridors for the Biofidelic Rear Impact Dummy (BioRID II). However, he added that the development of injury criteria for the use of the BioRID II was at a critical point, because medical research in the United States was still progressing but not as rapidly as was expected. As the deadline of the IWG is December 2013, he sought AC.3 guidance on whether the upcoming proposal of UN GTR could be delayed by more than one year to encompass as a whole the two above-mentioned issues or to proceed in two steps: adopt (i) the measurement of height of head restraint and then (ii) the dynamic test procedure with the dummy and the associated injury criteria. AC.3 preferred to proceed in a one-step approach, to consider a complete proposal, including a draft Addendum to M.R.1 and agreed to extend the mandate of the IWG until the end of 2015.

3. Injury Criteria

a. Presentations

i. EEVC Studies – Mr Davidsson (GTR7-14-02)

Mr J Davidsson gave a presentation looking at the standard methods of developing injury criteria and the reasons that “whiplash” injuries do not necessarily lend themselves to these methods. The presented method of developing injury criteria is intended to be complementary to the other methods currently been used and is not intended to replace them. The presentation used data from 1998-2012 from rear +/- 30 degree accidents with a minimum of 150 accidents (Swedish insurance data has seen a drop in whiplash injuries due to the introduction of a different classification method for whiplash injuries used by medics).

In the study BioRID II data from sled tests was compared with real-life accident data. This study was carried out to serve as a complimentary to traditional studies, e.g. studies with volunteers or PMHSs. The approach used evaluate the injury predictability of the complete sled test method, which includes performance criteria, the use of a generic acceleration pulse, and the BioRID, etc.

Real-life injury risk was calculated for 17 groups of similar seat designs from data provided by Folksam. The number of insurance cases range from 150 to 1136 per group. Accident year influence injury classification; all insurance risk data was compensated to that of year 2005. Regression coefficients were calculated: R^2 was used to assess the correlation between the BioRID data and insurance data.

Two types of injury risks were used: those leading to documented symptoms of more than one month’s duration and those classified as leading to permanent medical impairment as a consequence of a rear-end impact. These risks were compared to parameter values from sled tests performed with a BioRID II at 16 km/h pulses.

NIC, the maximum rearward Occipital Condyle relative T1 x-displacements and L1 x-acceleration best predicted the risk of developing permanent medical impairment and symptoms of more than one month, given the occupant had initial symptoms following a rear-end impact. The maximum neck extension and T1 x-acceleration were also found to correlate somewhat to the estimated risks.

Discussions followed on the effect of using BioRID II data from the past, grouping vehicle models, effect of outliers and the compensation method used.

Conclusions :

- NIC, L1-acceleration and Occipital condyles relative T1 x displacement correlate with long term injury risk:
 - NIC 25 m/s²
 - L1 x-acceleration 120 m/s²
 - Occipital Condyle x-displacement 22 mm
- Neck extension and T1 x-acceleration may be candidates but appear to be sensitive to set model inclusion
- These findings are in partial agreement with other studies on this
- Additional parameters may predict PMI and long term symptoms

LAB asked why the Peugeot outline had been removed; as it felt that this may show other symptoms and the use of weighted classifications (covering in some cases so many vehicles) would seem to make drawing these sort of conclusions very difficult.

ii. NHTSA Studies – Dr Moorhouse (GTR7-14-03)

Dr Moorhouse gave a presentation of the further test results to add to those that he had presented previously to the group. He suggested that IV-NIC and NDCrot essentially provide redundant (duplicate) information – thus no need for both. In terms of the “better” of the two at this point – IV-NIC shows better correlation to injury (because it has a closer direct link to the injury mechanism). However, NDCrot does show good correlation as well (just not as much). So even though IV-NIC showed better correlation he recommended that NDCrot might be preferable for a two reasons:

- 1) No need for adding instrumentation to the dummy;
- 2) Consistency with current FMVSS 202a.

When considering consistency with current FMVSS 202a he considered that the term NDCrot was only necessary if NDCx and/or NDCz were to be included. If the latter two are not considered then NDCrot can simply be called ‘Head-to-T1 rotation’ as in FMVSS 202a. A general description could be as simple as “Rotation of Head CG minus Rotation of T1). Both of these rotations can be determined directly either through video analysis of targets or by integrating angular velocity sensors.

Conclusions:

- That NHTSA would conduct one more paired PMHS/BioRID test
- Then finalise a decision about the inclusion of NIC and NDCx
- That the NDCx kinematics need to be transformed from CG to OC
- That this requires video analysis of targets
- To use the head-to-T1 rotation instead of NDCrot (if no NDCx)
- Need to make a decision about IV rotation versus global measures
- To continue to investigate direct BioRID correlations
- Finish analysis of kinetic measures to compare with Japan
- Repeat the sled series again but with two BioRID dummies
- Certify and upgrade BioRID dummies
- Review design changes that improved reproducibility?
- Conduct all 8 tests in one week
- Improve direct correlations and intervertebral kinematics?
- Use 2 dummies to evaluate reproducibility

Mr Davidsson asked whether using 50% of AIS 1 would make a difference. He also questioned whether criteria for an AIS 1+ neck injury would be a likely regulatory criteria; if so would this be seen as a political decision.

The chair noted that currently we have a GTR with pass fail criteria using the HIII dummy, and asked if we should be looking to establish criteria introducing the BioRID that give the same level of protection. He noted that, as NHTSA currently use HIII, they may want to see an improvement in protection before adopting BioRID, whereas those contracting parties who were not persuaded of the benefits of using HIII may prefer to amend the GTR and add the BioRID for dynamic testing.

NHTSA plans to carry out additional testing, hopefully by the year end, but this assumes that practical issues (money, seats and dummy availability) can be met.

iii. JARI Studies – Dr Ono

Presentation by Dr Ono

(GTR7-14-04 Progress Report on Neck Injury Criteria (IC) Works for Discussion, and GTR7-14-05 Tentative Draft Proposal on Evaluation of Injury Parameters (IEP) and Injury Risk Curve (IRC), a collaborative undertaking between NHTSA and Japan)

The report included the background and the current status of the possible injury evaluation methods on minor neck injuries during rear-end impacts. It also showed the approaching flowchart for the IEPs and IC based on the human volunteer tests (HVT), the 20 case accident reconstruction simulation (CAE) done by Japan, and the existing PMHS tests done by NHTSA.

Through the collaboration work with NHTSA, they were able to develop the IV-NIC value corresponding to the AIS1+ 50% on the IRC obtained by the PMHS Tests (Production seat). This IV-NIC value 1.1 also corresponds to 82.9% of WAD2+ risk curve with respect to the IV-NIC. The neck forces/moments (NFM) and NIC will be created by WAD2+82.9% based on the risk curve of WAD2+ with respect to IV-NIC.

Through discussions at the informal GTR7, it was agreed that the higher correlation factors and criteria for IC and IEP such as NDCr, NIC, Upper/Lower Neck Forces (X), Moments (My-Flex/Ext) should be adapted (see Table 1). By the next meeting on December, 2013, this should be refined and reviewed carefully, and should also be updated/revised as the final proposal on the neck injury evaluation parameters and the neck injury criteria for the informal GTR7.

Summary:

The correlation coefficient between WAD and IV-NIC is quite high. On the other hand, it is quite low for the correlation coefficient between WAD and NDC.

The correlation among the Strain, the NDC, and the IV-NIC as predictors of the cervical vertebral motion is quite high.

According to the significant correlation among those parameters shown as the cervical injury risks, it is possible to predict cervical injuries with the common indicator of IV-NIC based on the results among the human volunteer tests, the CAE (20 cases of accident reconstruction simulations), and the PMHS tests.

The injury risk curves, both of WAD and IV-NIC based on the CAE, and AIS and IV-NIC based on the PMHS tests, are established. Although it is under review by NHTSA and JAPAN, the injury evaluation parameters and the injury criteria for informal GTR7 are tentatively reported as shown in the table below.

b. Discussion

- i. Injury risk
- ii. Injury parameters
- iii. Indicative regulatory values.

NHTSA believed that by the October time frame this work will be complete.

PDB reminded the group that the Swedish presentation suggested the need for multiple criteria, NHTSA suggested 3 and Dr Ono in his presentation suggests 11 criteria. He wondered if this many was necessary. Although all are listed it was agreed that they are not all necessary and the group worked through the list from Dr Ono to produce a draft workable solution:

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**Table 1 (from JASIC Presentation - red and crossed-through as modified at Gothenburg)
Tentative Draft on Injury Evaluation Parameters and Injury Criteria (refer to the presentation for further information).**

Injury Criteria		WAD2+	AIS1+	Literature
		82.9% Value (IV-NIC=1.1)	50.0% Value (IV-NIC=1.1)	Human Tolerance
IV Rotation		?	3.7 deg.	
NDCrot		12.0 deg	12.2 deg.	
NDCx		30.5 mm	117.8 mm	
NIC Max		23.2	29.7	-
Upper	FX	636.5	? ?	845 ¹⁾²⁾
	FZ	979.2	?	1134^{1),2)}
Neck	MY(Flx) (or Ext)	33.5	? ?	50.2 ²⁾
	MY(Ext)	33.5	?	20.3²⁾
Lower Neck	FX	636.5	? ?	600~800 ³⁾
	FZ	1135.9	?	-
	MY(Flx) (or Ext)	33.5	? ?	-
	MY(Ext)	33.5	?	-

NHTSA works
 Japan works
 Less likely candidates

A general discussion on injury criteria followed where Mr H Ammerlaan highlighted some of the previous issues found when using film analysis and suggested that using dummy measurements are much more accurate. OICA highlighted some of the issues they would have if the exact injury criteria decisions are left and the time frame for finalisation maintained.

NHTSA noted that there were some issue with the current dummies they are using and that they intend during the next set of tests to run back to back tests to ensure they can answer this question. The Chair concluded that the Z criteria could possibly be removed but other decisions were more difficult.

The tentative injury criteria, could be as suggested (above), this would allow a reduction to 8 with the possibility of reducing to 6.

NHTSA was asked if it could guarantee the final set of testing will take place as scheduled. NHTSA noted that it could not guarantee this as some of the necessary decision is not in their control, ultimately funding sign-off.

4. TEG / Workshop

i. Update – Mr Ammerlaan

Mr Ammerlaan gave a presentation updating the group on the BIORID TEG workshop

He noted that since the previous GTR 7 meeting two workshops have taken place at BAST.

The issues discovered during the workshops were that:-

The BioRID should not be positioned in a seat with a back angles/torso angle under 20 degrees or over 30 degrees. For this reason the workshop concluded that the dynamic test should be restricted for use only on seats meeting this criterion.

The workshop also proposed to introduce the R50 concept; which was a seating position for the 50 %ile, new test procedure will be supplied for Annex 9 detailing this.

He noted that the first workshop delivered a method for measuring Head restraint height without the need of the HMRD. This therefore was no longer needed for static assessment and BioRID positioning. This was seen as offering significant benefits and contracting parties were urged to review this proposal.

ii. J-NCAP BioRID dummy seating observation – Mr Kadotani (GTR7-14-07)

Japan's presentation compared the current J-NCAP seating procedure to the one proposed from the BAST workshop. It was found to show a good relationship but with a few of the Hip-point (Z) measurements out of tolerance. In the future Japan is planning on carrying out further studies using the R50 Hip Point, which they believe will give them more control.

The Chair asked if this planned future work could possibly delay the development of the "injury criteria", which in turn could delay the final document? The expert for the Netherlands, Mr Ammerlaan, questioned how Japan can measure angles under 20 degrees when we saw this as an issue during the workshop, seating the dummy in positions under 20 degrees required the BioRID to be "forced". Japan committed to looking into their test process in more detail as they do not believe they "forced" the dummy.

5. Certification Update

Presentation - Mr Depinet (GTR7-14-08, GTR7-14-09)

Mr Depinet noted that three main issues still remain:-

- Spine bumper stiffness
- Jacket stiffness
- Pelvis Stiffness.

Further work was required before certification test corridors could be finalised.

Certification of the dummy will most probably require two tests the first a Mini sled test without head restraint and the other sled test with head restraint. BAST, Heidelberg and Humanetics' own labs will be able to check different lab repeatability once the data are available.

It was suggested that the BioRID TEG should meet to recommend how to address the following items:

- Spine quasi-static setup
- Mini-sled without head restraint
- Mini-sled with seat back and head restraint
- Jacket only impact
- Pelvis only Impact (bottom only)

The tests above are not in order but need to be considered for dummy certification.

It was recommended that the following tests are stopped:-

- Mini-sled WITH head restraint
- Pelvis impact (back)
- Spine quasi-static bending

With regard to re- certification, it was asked if the following tests are required, and if they are when and how many tests would be needed? The question therefore is should the following tests be dropped or should all of them be part of the certification tests:

- Spine bumper stiffness
- Pelvis shape check
- Would be helpful but not essential for Regulation
 - Pelvis quasi-static compression check
 - Jacket quasi-static compression check.

6. Development of GTR7/Amend 1 (based on the Dual Pane document GTR7-14-02).

Due to time constraints only Annex 9 of the dual page document was discussed. With specific time spent discussing “seat angle” or “torso angle”.

7. Mutual Resolution

- a. Draft Text
- b. Drawing Review.

The current draft text of the mutual resolution can be downloaded from the PDB website the Chair thanked PDB for making storage space available for this document.

Mutual resolution link: - <https://pdb-org.com/cgi-bin/pdbfm/Manager.pl?file=Draft%20Mutual%20Resolution%20add%201%20version%203.doc&link=9a34d675d3c709f34960f85bf7faa953&a=84>

Humanetics committed to review and confirm that the drawing package groupings are correct. It was noted that the specific UN-ECE drawing numbers still need to be assigned but this is not seen as a particularly arduous task and it was assumed that this final classification could be carried out quite quickly at the end of this work.

PDB suggested a small amendment in the way that the Mutual Resolution references other dummy information as it may need to be made as a link to USA FMMVSS which does not seem possible. The Group agreed with the intent of the amendment and Chair committed to discuss this further with the chairs of other ECRS groups and the Pedestrian Protection Group.

To conclude it was noted that final comments would be needed at the same time as our final meeting this year, December 2013. The chair also committed to check with UN Secretariat if these documents need translating into all the UN-ECE languages.

8. A.O.B.

- a. Schedule of meetings.

GTR HR work Plan

Work Plan covering Injury Criteria:

30 October 2013 WebEx

- Consider the revised list of injury criteria (not values)
- Upper neck, lower neck forces and moments based on existing data.

21 November 2013 WebEx output (assumption dummy qualification, money and seats all agreed and received)

- Finalise criteria list (BioRID tests)
- Revised BioRID data feedback, both BioRIDs

16 December 2013 Face to Face Geneva (afternoon and morning)

- Results from pair HIII tests including neck extension results.
- Injury criteria values.

Week 3-7 February 2014 2 day GTR-HR Face to Face – Location to be determined.

- Final criteria
- Final document for May 2014 GRSP.

TEG Work Plan:

31 October 2013 – TEG 12:00 CET (11:00 GMT)

20 November 2013 – TEG 12.00 CET (11:00 GMT)

13 December 2013 – TEG 12.00 CET (11.00 GMT)

Final TEG on one of the days of the two day GTR HR in week 3-7 February 2014 Face to Face – Location to be determined.