

<b><u>Minutes of the 5th meeting of the Informal Group on Global Technical Regulation No. 9 – Phase 2 (IG GTR9-PH2)</u></b>	
Venue	Bundesanstalt fuer Strassenwesen (Federal Highway Research Institute – BAST), Fritz-Heller-Saal, Bruederstrasse 53, D-51427 Bergisch Gladbach/Germany  <b>Please note:</b> WebEx access to the meeting will be provided for those who cannot attend the meeting in person.
Date	6 December 2012, 10:00 a.m. – 6:00 p.m. and 7 December 2012, 9:00 a.m. – 3:10 p.m.
<b><u>Status:</u> Final</b>	

### A) List of Attendees

The attendance lists for days 1 and 2 are attached as scans at the end of this document.

In addition, Ms. Chaka (Ford), Ms. Dausse (Renault) and Ms. Versailles (NHTSA) as well as Messrs. Bilkhu (Chrysler), Borde (Faurecia), Burleigh (Humanetics), Corwin and Uikey (both Shape), Edwards (Alliance), Knotz (Concept Tech), Nguyen and Stammen (both NHTSA) and Tedesco (General Motors) attended the meeting via WebEx/telephone.

### B) List of Actions

(Note: Modified wordings for open action items A-2-xx and A-3-xx are indicated in **bold letters**.)

ID	Open Action Item	Responsibility	Due
A-2-03	Provide more details / the final document from the research project with Autoliv on pedestrian injuries	NHTSA	<b>closed</b>
A-2-12	Update manual with visual inspection parameters	Humanetics	<b>closed</b>
A-3-11	Provide drawing (with disclaimer for the time being) to be sent to the secretary of IG	Humanetics	<b>End of 2012</b>
A-3-12	Provide information on technical feasibility of vehicle countermeasures to meet FlexPLI requirements	OICA	<b>6th meeting</b>

A-4-01	Provide a status report of the TF-BTA	EC	<b>closed</b>
A-4-02	Check current inverse test device with respect to friction (velocity measurement, defined distance of 150 mm)	All Labs	<b>closed</b>
A-4-03	Review of TEG FlexPLI thresholds / criteria	ALL	<b>6<sup>th</sup> meeting</b>
A-4-05	Humanetics provides a list of master leg parts to be renewed including the respective costs	Humanetics	<b>6<sup>th</sup> meeting</b>
A-4-06	Propose a template of a logbook which accompanies the master legs on their travel for RR tests	BAS <sup>t</sup>	<b>closed</b>
A-4-07	Provide friction values / loss of velocity based on distance 150 mm (200 mm) in simulations	Concept Tech	<b>closed</b>
A-4-08	Provide a proposal of tolerance for initial vehicle ride height for testing	OICA	<b>closed</b>
A-4-09	Prepare a first draft document of a FlexPLI amendment to the IG	Chair, Vice Chair	<b>closed</b>
A-4-10	Contact NHTSA on the benefit assessment for the FlexPLI	Chair	<b>closed</b>
A-4-11	Review of GIDAS data for the benefit assessment	BAS <sup>t</sup>	<b>closed</b>
<b>A-5-01</b>	<b>Start review process of drawing package</b>	<b>Chair</b>	<b>15 Jan. 2013</b>
<b>A-5-02</b>	<b>Start comparing drawings with the impactor hardware</b>	<b>Chair</b>	<b>15 Jan. 2013</b>
<b>A-5-03</b>	<b>Inform the Informal Group about issues that occurred during the master leg vehicle testing (logbook information)</b>	<b>Regional co-ordinaters</b>	<b>6<sup>th</sup> meeting</b>
<b>A-5-04</b>	<b>Update FlexPLI manual with the information on friction of the moving ram during the inverse certification test</b>	<b>Humanetics</b>	<b>6<sup>th</sup> meeting</b>
<b>A-5-05</b>	<b>Provide a proposal for gtr9 amendment regarding the exclusion of the rebound phase</b>	<b>OICA</b>	<b>6<sup>th</sup> meeting</b>
<b>A-5-06</b>	<b>Provide an alternative proposal for gtr9 amendment regarding the exclusion of the rebound phase</b>	<b>BAS<sup>t</sup></b>	<b>6<sup>th</sup> meeting</b>

A-5-07	Provide draft gtr text for addressing the vehicle ride height tolerances issue	OICA	6 <sup>th</sup> meeting
A-5-08	Clarify the details on how to bring the amendment into the gtr 9 (discussion with GRSP chair and UNECE secretariat)	Chair	6 <sup>th</sup> meeting
A-5-09	Provide comments or a list of questions on documents GTR9-5-14 and GTR9-5-19	NHTSA	15 Feb. 2013
A-5-10	Submit updated schedule/request for the extension of the mandate to GRSP	Chair	52 <sup>nd</sup> GRSP

### C: List of Meeting Documents

(Note: Documents which were submitted during the meeting are indicated in **bold letters**.)

Document No.	Rev.	Handed in by	Document title
GTR9-4-02	<b>1</b>	Chair/Secretary	Minutes of the 4th meeting of the Informal Group on Global Technical Regulation No. 9 - Phase 2 (IG GTR9-PH2) - <b>Final</b>
GTR9-5-01	<b>1</b>	Chair/Secretary	Agenda for the 5th meeting of the Informal Group on Global Technical Regulation No. 9 - Phase 2 (IG GTR9-PH2) - <b>Final</b>
GTR9-5-02		Chair/Secretary	Draft Minutes (this document)
GTR9-5-03		NHTSA	Pedestrian Injuries By Source: Serious and Disabling Injuries in US and European Cases (Mallory et al. Paper for 56th AAAM Annual Conference)
GTR9-5-04		Humanetics	Flex PLI GTR User Manual Rev. D, Oct. 2012
GTR9-5-05	<b>1</b>	Bertrandt	FlexPLI - Round Robin Tests, <b>Rev. 1</b>
GTR9-5-06		Chair	Informal document WP29-158-28: Draft 3rd progress report
GTR9-5-07	<b>c1</b>	OICA	Discussion on Feasibility of FlexPLI Countermeasures ( <b>corrected</b> )
GTR9-5-08		OICA	Proposal for Procedure to Process FlexPLI Measurements in Rebound Phase
GTR9-5-09		JAMA	Applicability Information
GTR9-5-10		JAMA	FlexPLI Durability Against Larger Vehicles
GTR9-5-11		JAMA	FlexPLI Repeatability in Car Tests

GTR9-5-12		JASIC	Experimental Validation of Human and FlexPLI FE Models
GTR9-5-13		JASIC	FlexPLI vs. EEVC LFI Correlation
GTR9-5-14		JASIC	Benefit and Cost; Additional Analysis based on GTR9-2-07r1
GTR9-5-15		JASIC	Moving Ram Friction Effect
GTR9-5-16	<b>1</b>	KATRI	Round Robin Test Result (E-Leg)
GTR9-5-17		Concept Tech	FlexPLI Test Results (SN-03)
GTR9-5-18		BGS Boehme & Gehring	Flex PLI Logbook for the IG GTR9-PH2 Round Robin Tests
GTR9-5-19		BASt	Estimation of Cost Reduction due to Introduction of FlexPLI within GTR9
GTR9-5-20		BASt	Verification of Draft FlexPLI prototype impactor limits and application to FlexPLI serial production level
GTR9-5-21		US	US Round Robin Test Status
<b>GTR9-5-22</b>		<b>NHTSA</b>	<b>Information on vehicle data used in NHTSA's studies</b>
<b>GTR9-5-23</b>	<b>c1</b>	<b>OICA</b>	<b>Initial comments of OICA representatives to the 5th IG GTR9-PH2 meeting in response to document GTR9-5-20 (corrected)</b>
<b>GTR9-5-24</b>		<b>OICA</b>	<b>Height tolerance for pedestrian protection</b>
<b>GTR9-5-25</b>		<b>BGS Boehme &amp; Gehring</b>	<b>Flex PLI Inverse Test Setup - Moving Ram Friction</b>
<b>GTR9-5-26</b>		<b>Concept Tech</b>	<b>Investigation of the Influences of Friction within the Inverse Certification Test Setup of the FlexPLI - Lower Legform Impactor</b>
<b>GTR9-5-27</b>		<b>OICA</b>	<b>Clarification of Injury Threshold Determination Process Used by JAMA</b>
<b>GTR9-5-28</b>		<b>Chair</b>	<b>Operating Principles and Terms of Reference for the IG GTR9-PH2, updated version 5th meeting</b>
<b>GTR9-5-29</b>		<b>Chair/ Vice-chair</b>	<b>Draft gtr No 9 amendment, version 2012-12-06</b>
<b>GTR9-5-30</b>		<b>OICA</b>	<b>Discussion of the Rebound Issue, ACEA comments</b>

## D: Summary of Meeting

### 1. Welcome

The chair welcomed the attendees to the 5<sup>th</sup> meeting. In addition, Mr. Andre Seeck (head of the Department Automotive Engineering at BASt) welcomed all attendees at BASt's offices in Bergisch Gladbach.

**2. Roll call of participants**

See attendance list.

**3. Adoption of the agenda**

The secretary complained that most of the documents had been handed in very late so that a proper preparation of attendees may not have been possible in all cases. However, to address all documents already available a modified version of the agenda had been prepared by the chair, the vice-chair and the secretary. Also, some new agenda items were added to have a specified agenda item for some of those documents. This revised agenda had been shared on 5 Dec. 2012 and this version (document GTR9-5-01r1) was finally agreed.

**4. Review of the draft minutes of the 4<sup>th</sup> Meeting (GTR9-4-02)**

Regarding the list of open action items from the last meeting (see section B of the draft minutes, document GTR9-4-02) it was noted that action items A-2-03, A-2-12, A-4-06 and A-2-10 can be closed in the meantime since the respective actions had been undertaken.

For action item A-3-11, Mr. Burleigh mentioned that the drawings still are in the approval process in his company but will be made available in December 2012.

Finally, it was noted that for most of the other action items a discussion will take place during the course of this meeting.

For the draft minutes, comments had been received by Mr. Zander and further comments were provided by Mr. Stammen. The Informal Group went through the minutes in detail, reviewed all comments and modified the minutes accordingly. The revised minutes were made available as document GTR9-4-02r1.

**5. Review of information provided to and discussion at WP.29 during their 158<sup>th</sup> session in November 2012**

(Chair)

(document GTR9-5-06 (informal document WP29-158-28))

The chair presented the proposed third progress report of the work of the group. He mentioned that WP.29 had noted the proposal during their 158<sup>th</sup> session in November 2012. The document now should be modified to also reflect the discussion in this meeting and at the upcoming 52<sup>nd</sup> GRSP session and then will be handed in as document for the 159<sup>th</sup> session of WP.29 in March 2013. Since no further comments were received this will be done accordingly.

**6. Review of accident data, especially related to tibia and knee injuries**

(NHTSA, all)

(document GTR9-5-03)

Action item A-2-03 had been closed since the document on lower extremities injuries caused by the bumper systems had been provided by NHTSA before the meeting. Mr. Stammen

introduced document GTR9-5-03.

No comments on the document were made and no questions were asked. Consequently, it was noted that the respective item can be closed.

**7. Discussion (ongoing) on cost-benefit assessment**  
(NHTSA, BAST, all)  
(documents GTR9-5-14, GTR9-5-19)

Dr. Konosu introduced document GTR9-5-14 on behalf of JASIC. The document is intended to provide supplementary information to document GTR9-2-07r1 that was already discussed during the last meetings. He highlighted that only accident data are used in the analysis where lower extremities are the most severely injured body region. Besides, he explained that fatality data are excluded in the analysis and that moreover impact speed influences are also considered. Dr. Konosu explained in detail the process used by JASIC to analyze the cost reduction achieved by the reduction of tibia injuries using the submitted document. Additionally, he explained information from JAMA that the costs of vehicle countermeasures should not change compared to the EEVC LFI since the countermeasures in principle are comparable: the need to control the stiffness of the energy absorber in front of the bumper beam and the stiffness of the lower part of the bumper to fulfill Flex-PLI requirements though.

Mr. Stammen requested more time to check the information. The Alliance will review the document as well. Consequently, it was agreed to re-discuss this item during the next meeting. Mr. Broertjes requested that then the costs may also be explained in more detail.

Mr. Zander asked whether his understanding was correct that up to a travel speed of 60 km/h, i.e. at speeds more than 40 km/h, lower extremity injuries still occur as most severe injuries. Dr. Konosu replied that no definite answer can be given to that question, but that, at the high impact speed cases, head injuries tend to be more severe than injuries to the lower extremities. "Japan national traffic accident data" only record the most severe injured body part/region of pedestrians for each accident. Therefore, for impact speeds exceeding 60 km/h Japan did not conduct any benefit analyses because of the uncertainty of the number of tibia injuries in those accidents.

On request of Mr. Burleigh Dr. Konosu explained in addition that, based on the "Japan regional traffic accident data" analyses, the travel speed was found to be in average around 5 km/h higher than the impact speed. Therefore, in the JASIC analysis for the assessment the impact speed was decreased by 5 km/h from the travel speed of the vehicles. This considers that the "Japan national traffic accident data" does not have any information of impact speed but of the travel speed of vehicle only.

Mr. Zander presented document GTR9-5-19. He pointed out that the data are based on German accident data. He explained the process to estimate the benefit of the FlexPLI introduction and concluded that the estimated annual benefit will be around 44.6 million euros per year in Germany.

Mr. Bilkhu wondered why the fatalities are counting for 20 % of the injury costs since tibia fractures are unlikely to lead to fatal injuries. Mr. Zander responded that the study is not limited to tibia fractures only but also includes other lower extremity injuries as e.g. ligament ruptures. Furthermore, he stated that national cost data do not consider the MAIS why he had to use the costs for fatally, severe and slightly injured people. This covers the correct

costs (at least for Germany) here. Mr. Zander added that an AIS shift of a legform injury does not necessarily lead to a lower MAIS and that this is reflected in the data accordingly. Mr. Bilkhu concluded that he can understand the arguments of BAST but that he cannot fully accept this approach. The data with fatalities therefore should be removed. Mr. Zander replied that the cost reduction due to fatality reduction considers the occurrence of fatal lower extremity injuries. The US attendees will come back to this and will probably provide some further questions on the details of the study.

On request of Mr. Hardy Mr. Zander explained that the dataset refers to the original German vehicle fleet. Some vehicles may comply with pedestrian requirements. For the shifted data it is assumed that a pedestrian friendly bumper system will lead to a shifting of one AIS degree for the addressed lower extremity injuries. Specifically for the FlexPLI, the dataset then is considering that 70% injury risk is addressed. This finally leads to the mentioned benefit.

The chair concluded the discussion and noted that the item will be kept on the agenda for the next meeting. All Informal Group members are kindly invited to provide more information that helps to come to a final conclusion on this cost benefit issue. NHTSA promised on request to provide their comments/open questions on the documents discussed under this agenda item by 15 February 2013 so that the discussion can be prepared accordingly in due time before the 6<sup>th</sup> meeting of the informal group (**action item A-5-09**).

**8. Update on the FlexPLI design, PADI, review of drawing package**  
(Humanetics, all)  
(document GTR9-5-04)

The chair mentioned that the manual (Rev. D) is available as document GTR9-5-04. Mr. Burleigh added that, while he has already received comments from BAST, he would appreciate to receive comments on this especially for the new sections. Mr. Burleigh explained that the drawing package has not yet been made available since a final internal review at Humanetics is currently taking place. The package will be shared soon.

The chair also explained that for the discussion in Geneva the drawing package and the PADI have to be made available. The respective information needs to be prepared so that the impactor can be added to the "Mutual Resolution of the 1958 and the 1998 Agreements concerning test tools" that will cover all details of test tools used in either UN-regulations or global technical regulations. Also, this information then needs to be reviewed and the drawings need to be compared with the original hardware. The chair was wondering whether members of the Informal Group are already prepared to support these activities. He explained that three steps are currently planned: a) review of the drawings, b) check consistency of drawings and physical impactor, c) prepare the draft proposal for the incorporation into the mutual resolution. He volunteered to start the process by 15 January 2013 (**action item A-5-01 and A-5-02**).

## **9. Testing activities with the master legs**

### **9.1. Status of testing activities with the master legs**

(Vice-chair, all involved labs)

(documents GTR9-5-16, GTR9-5-17, GTR9-5-18, GTR9-5-21)

Mr. Yun presented the test results of KATRI (see document GTR9-5-16) with the so-called “E-Leg”, the engineering legform of Humanetics that was modified to be one of the three “master legs”. Mr. Yun explained that first KATRI compared the design of the master leg with the FlexPLI owned by KATRI. They found that basically the design has not changed but that the E-Leg appears to be stiffer. Then, the legform was tested with vehicles (a sedan and an SUV) as well as in pendulum certification tests and test results were compared with test results from the KATRI legform as well as from an EEVC LFI. Mr. Yun concluded that the repeatability of FlexPLI especially in vehicle tests is not good. However, it seemed that this was not related to the impactor but to vehicle issues such as e.g. uncertainties of the headlamp fracture mode or the bumper shape complexity of the vehicles. The tested vehicles nearly meet the criteria when they are designed to meet the EEVC LFI criteria. However, this tendency does not apply for other vehicle cases - it only applies for the tested vehicle this time. FlexPLI durability and usability are acceptable but some further improvements in the impactor design are needed (e.g. zippers, connectors).

Mr. Zander welcomed the presentation but questioned whether the repeatability can be concluded from just two test results in the vehicle tests.

Dr. Konosu wondered whether the test points in the vehicle tests are inside the bumper corners or outside. Mr. Yun confirmed that they are inside. Dr. Konosu mentioned that the complexity of car bumper shapes at around the bumper corner seems to affect the test results significantly. The impactor cannot help on such issues.

Mr. Edwards asked where the 75 mm height of the FlexPLI above the ground level derived from. Dr. Konosu responded that this is the test procedure that was established during the former activities of the Technical Evaluation Group (TEG) and that all details can be found in the documents of this group. *[Note of the secretary: Those documents can be found at the website*

*[http://www.unece.org/trans/main/wp29/wp29wgs/wp29grsp/pedestrian\\_flexpli.html](http://www.unece.org/trans/main/wp29/wp29wgs/wp29grsp/pedestrian_flexpli.html)*]

Mr. Knotz presented his document GTR9-5-17 on test results with the SN-03, one of the master legs. He concluded that test results during the pendulum as well as the inverse certification tests show good reproducibility. This also applies for vehicle tests but Concept Tech noted significant influences of the impact height when testing a sedan-type vehicle with a ride height that was adjustable (around 37 mm in this case). Mr. Gehring added that this effect was already recognized in earlier tests and is explained in the documents of the TEG. As a result, TEG therefore had set  $\pm 10$  mm tolerance for the impact height.

Regarding the FlexPLI test logbook it was just noted that the document had been shared in advance with all labs involved in the vehicle testing and is now also publically available as document GTR9-5-18. The coordinators in each region, BAST/BGS in Europe, KATRI in Korea and Ford in the US, are requested to collect the respective information and to present it as an overview during the next meeting.

Ms. Chaka presented the overview on the planned tests with the master legs in the US (see document GTR9-5-21). The test series should be finished by mid of February 2013. On



request it was clarified by Mr. Gehring that a delay on this has to be expected since the data acquisition system of one of the legs (SN-03) in Europe had been out of order. BAST/BGS Boehme & Gehring were working to fix this issue and it was solved just in the morning of the meeting right after the delivery of the spare part. However, the problems will result in a delay of around three weeks for the round robin test schedule in Europe. This will automatically lead to also three weeks delay for the delivery of the legform from Europe to the US.

After some discussion on the delay it was found that the legform used by KATRI, the E-Leg, will be available and may be sent to the US on short notice. It was finally agreed that Mr. Yun will send the E-Leg to Humanetics Korea and they will send it ASAP to the US. BAST/BGS Boehme & Gehring will maintain SN-03 so that it could be used ASAP for the round robin tests in Europe and will keep it in Germany for the time being.

Finally, it was agreed that the regional coordinators should inform the Informal Group about any issues that have occurred or will occur during the tests with the master legs and that is recorded in the respective logbooks (**action item A-5-03**).

## **9.2. Possible influence of friction on impact speed during the test**

(Concept Tech, all)

(document GTR9-5-15)

Dr. Konosu explained that originally JASIC and JARI did not see a need to assess the friction of their test rigs since the impact speed of the FlexPLI is measured close to the impact point. Therefore, they saw a good opportunity to learn from this. Dr. Konosu presented the respective findings (document GTR9-5-15). He explained that JASIC found that the friction is around 52 N in average under dynamic inverse test conditions and that its variation is clearly less than 10 %. JASIC then used simulation to assess whether the friction could cause issues during the testing. They discovered that changing the friction has a minor effect and only with a friction force well above 100 N it may have any influence. JASIC therefore proposes to describe a caution clause regarding moving ram friction in the user manual so that users who install an inverse test rig in their test labs shall check the average moving ram friction to assure that the friction force is less than e.g. 100 N.

Mr. Gehring presented an analysis done at BAST (document GTR9-5-25). He explained that two potential risks are seen: The distance between the velocity measuring point and the impact point may have an influence as well as the deceleration caused by the friction. For the distance Mr. Gehring stated that usually the velocity is measured very close to the impact point and therefore the distance does not need to be considered. Second, the peaks occur within 20 ms after the first impact, i.e. that any influence of the friction after 20 ms is not relevant. In addition, as BAST is using heavy duty roller bearings for the guiding system, the friction is minimized even during the impact phase, i.e. that any friction within 20 ms is assumed to be negligible, too. The presentation concludes to take the speed measurement immediately before the impact and not to set any additional requirements on the friction in case of using smoothly running bearings.

A presentation of Concept Technologies on the same subject was also reviewed (see document GTR9-5-26). Mr. Knotz had kindly provided the document but unfortunately was not available at that time of the meeting for further explanation. However, it was found that the information is completely in line with the information presented before.

Therefore, it was finally agreed that the subject should be mentioned in the documentation and that the methods to measure the friction should be described. Mr. Burleigh was requested to bring this into the next edition of the FlexPLI manual. Mr. Burleigh accepted this and announced version E of the manual to be available by the next meeting (**action item A-5-04**).

### **9.3. Further experiences from testing with the FlexPLI**

(All)

(document GTR9-5-05)

Document GTR9-5-05 was presented by Mr. Kolb. He noted that the intention was to finalize the test activities that had been started in the Task Force Review and Update of Certification Corridors (TF-RUCC). Bertrandt tested several series production FlexPLI's on behalf of some OEM's and collected the information of identical tests done at BAST. The purpose was to support the discussion on new thresholds for the pendulum as well as for the inverse certification test. Summarizing all test results, Mr. Kolb concluded that also with production legforms that had not yet represented the build level of the master legs the performance in the certification tests was acceptable with the new thresholds.

On request of the attendees, two mistakes in the presentation were corrected. A revised version was made available as document GTR9-5-05r1.

Mr. Zander noted that the comparison of the coefficients of variation (CV) for the pendulum tests (page 35 of document GTR9-5-05) covers information that may be misleading: For the MCL elongation, the diagrams use a different legend than the other diagrams. This can lead to overestimating the test variances, especially when just having a short look onto the information provided. Indeed, scatter in test results is very small for the MCL elongation, Mr. Kolb agreed that it will be better to correct this and promised to provide a further revised version of the document. This will be available as document GTR9-5-05r2.

Mr. Zander asked for an explanation of the scatter in tibia test results from the pendulum tests in lab 2 being significantly higher. Mr. Kolb said that no explanation is available but mentioned that the CVs in Lab 2 were still fine.

### **9.4. Test procedure (activity item 1.f)**

(document GTR9-5-08, **GTR9-5-30**)

Mr. Takahashi presented document GTR9-5-08. He explained in detail that the FlexPLI has a very good biofidelity in the forward moving phase but does not good correlate with the real world accident scenario during the rebound phase of the impactor due to the missing body mass of a pedestrian. Therefore, it is needed to exclude those recordings from the test data that are measured during the rebound phase. Mr. Takahashi proposed that the tibia bending moment time histories should be limited when certain conditions (see page 8 of the presentation) are met. He showed some case studies that underlined the proposal.

Mr. Buenger asked which human body simulation model had been used and whether it is a validated model. Mr. Takahashi replied that the model is one of those in the list of Euro NCAP and that it is well validated. He offered to explain this in more detail later in the meeting, if wished for.

Mr. Zander asked whether the second peak of the tibia bending moment of the human

model was observed to be always lower than the one of the FlexPLI model. Mr. Takahashi replied that not necessarily the peak value but the increase of the second peak of the tibia bending moment of the human model was always lower than the one of the FlexPLI model. Mr. Zander also asked whether the second peak of the human model was observed to be always lower than the first peak, which was confirmed by Mr. Takahashi. Then, Mr. Zander asked for the corresponding time history curves of the ligament elongation. He explained that within simulations carried out at BAST a ligament failure was observed at a certain time which is expected to have an influence on the tibia results, too. Mr. Takahashi replied that he can provide the ligament curves. He added that ligament failure functions were not applied in his simulation model to compare the results with those of the FlexPLI without failure representation and therefore no effect on tibia bending moment time histories is foreseen.

The question whether the proposal for the tibia can also be used also for the ligaments was brought up by Mr. Gehring. Dr. Ries presented some further information on this that was collected by the European manufacturers (document GTR9-5-30). He noted that the discussion on this also had started in the TEG and that there a first proposal had already been presented in document TEG-128. This document had explained that the responses of the FlexPLI are biofidelic only during the impact phase with a vehicle. It had been proposed to define the rebound phase as starting after around 50 ms and that details could be assessed from video analyses if necessary. However, this was found being too subjective at that time. Therefore, European OEM's had started to look for a more objective solution that is presented in this document. Dr. Ries finally proposed that for the tibia moments the time history recordings should be limited to the first zero crossing and for the ligaments to 50 ms.

Mr. Gehring wondered whether there will be always a zero crossing but Dr. Ries explained that the rebound phase must not lead to a zero crossing in all cases but this should cover the vast majority of cases. However, both were in agreement that just defining a time period may not be sufficient. Mr. Zander added that he cannot agree to the idea of using the zero crossing for all tibia segments together but thinks that it needs to be assessed individually for each segment because the segments are distributed over the entire tibia and are impacting the vehicle at different times. He also asked the vice-chair on his view regarding the biofidelity of the FlexPLI after the first impact phase and a definition of a rebound phase. Dr. Konosu replied that in his point of view in order to avoid complications the rebound of the tibia segments should entirely start at the same time. He also suggested as a way forward to take the MCL signal as for deciding about the knee rebound.

It was finally agreed that the subject should remain on the agenda for the next meeting and that both, OICA and BAST will prepare a proposal for a possible solution of the issue (**action items A-5-05 and A-5-06**).

**10. Technical feasibility: possible vehicle countermeasures to meet FlexPLI requirements**  
(OICA, all)  
(documents GTR9-5-07, GTR9-5-09, **GTR9-5-22**)

Document GTR9-5-07 was presented by Dr. Ries. He noted that feasibility in general does not seem to be an issue. However, knowledge for niche vehicles still is limited. Dr. Ries presented the test results from a number of vehicles and compared the performance of the EEVC LFI with the FlexPLI. He stated that the test results do not necessarily correlate well and that therefore industry requests to allow existing designs to further use the EEVC LFI also in the

future.

An intense discussion came up on the findings of BAST that vehicles complying with the FlexPLI criteria have a high chance to also comply with criteria of the EEVC LFI. Mr. Zander explained that Euro NCAP did not find any case where this is not true while Messrs. Ries, Roth and Buenger explained that Industry also needs a safety margin (of usually 20 %) to assure that the requirements are met also when considering lab-to-lab or test-to-test variety. Therefore, from OEM's point of view the test results cannot only compare the real threshold but needs to also consider this safety margin. Mr. Zander stated that on the other hand, from legislator's point of view the 20 % margin is not necessarily of a high relevance. Mr. Gehring pointed out that the 20 % safety margin is partly not fulfilled not only for the FlexPLI but also for the EEVC LFI, which was confirmed by members of ACEA.

Mr. Takahashi presented document GTR9-5-09 on the feasibility of vehicle countermeasures especially for larger vehicles such as SUV's and pick-up trucks. He concluded that the general design approaches are similar. Also, Mr. Takahashi presented some test data from the upper leg test as requested by NHTSA during the last meeting. On request of Mr. Stammen he explained that the latter data was provided from JAMA and that the vehicles have bumper heights of at least 425 mm. Also, Mr. Stammen wondered why the approach angle had been chosen as a criterion for the SUV's. Mr. Broertjes explained that this is one of the criteria to define the off-road capabilities of vehicles. Mr. Chaka added that similar requirements exist in the US.

Mr. Stammen introduced document GTR9-5-22. He stated that NHTSA is looking for combining their data with those shown e.g. by Industry to have a better data base. He informed participants about the data that can be downloaded from the NHTSA website. It was also explained that the FlexPLI used for the testing does fulfill the updated pendulum corridor and therefore the data generated should be included in the work of the informal group for the analyses and comparison of data. The chair appreciated the data provided by NHTSA but also stated that it would be welcome that the impactors used also meet the inverse corridors.

#### **11. Status of discussion in the "Task Force Bumper Test Area"** (European Commission, all)

The chair of the Task Force Bumper Test Area (TF-BTA) Mr. Broertjes gave an oral report of the 2<sup>nd</sup> meeting of TF-BTA that had taken place on 5<sup>th</sup> December. In the meeting it had been discussed what a useful process could be to assess existing front end structures. OEM's were requested to support the work of TRL as the Commission's contractor with providing vehicles and spare parts for tests. Those tests should identify whether the 60° planes used for the definition of the bumper corners can be modified to better guarantee that the front ends are pedestrian friendly. Mr. Broertjes also highlighted that test results of JNCAP and Euro NCAP on the testability of vehicles outside the bumper corners had been shared. Finally, some vehicle models had been provided to assess current bumper systems.

Mr. Broertjes concluded that the members of the next meeting of the TF-BTA should be able to assess first results. This meeting has not yet been scheduled but may be in connection with the next IG GTR9-PH2 meeting.

**12. Draft of the amendment to gtr No. 9****12.1. Discussion on injury thresholds / criteria**

(All)

(documents GTR9-5-13, GTR9-5-20, **GTR9-5-23, GTR9-5-27**)

Document GTR9-5-13 was presented by Mr. Takahashi. First, he explained the process how leg fractures had been evaluated. Using this process, JASIC found from their computational studies that there was no correlation between the EEVC LFI tibia acceleration and the human tibia bending moment but the FlexPLI tibia bending moment well correlated with that of the human. For FlexPLI MCL elongation, a good correlation was found with the EEVC LFI knee bending angle. Finally, no good correlation was seen for the FlexPLI ACL elongation compared to the EEVC LFI knee shear displacement. However, the elongation also was well correlating with the human ACL elongation.

Following the discussion during the last meeting initiated by NHTSA about the influence of changes in performances of the FlexPLI master legs compared to the prototypes, Mr. Zander presented document GTR9-5-20. He explained that the injury criteria and impactor thresholds had been agreed in the former Technical Evaluation Group (TEG). However, during the work of this Informal Group it was found that the certification corridors for the FlexPLI had to be updated. With the master legforms prepared for the purposes of that, BAST received lower outputs for the measurements. Therefore, as the inverse test well represents the vehicle tests, BAST proposes to also update the impactor limits accordingly. Mr. Zander pointed out that this proposal is not intended to reopen the discussion on the injury criteria but to adapt the limits to the test results seen in the work of this Informal Group. On request of Mr. Buenger Mr. Zander stated that the proposal is based on multiple tests and that the number of tests is indicated on the respective page as PT for test with prototype legforms and SP for tests with series production legforms. Later on Mr. Zander explained that the legforms referred to as series production legforms are the three “master legs” that had been specifically prepared for the work of the Task Force Review and Update of Certification Corridors and that reflect the latest and final impactor build level.

Dr. Ries provided some initial comments (see document GTR9-5-23c1 that represents a corrected version of GTR9-5-23) on the document. He pointed out that Industry prefers to not change thresholds. However, if the Informal Group decides to do so Industry sees a clear need to extend the mandate by at least 2 years.

Mr. Zander highlighted that the BAST presentation was completely misinterpreted by document GTR9-5-23 because his intention is not to reopen the discussion on the injury criteria. However, BAST noted that the sensor output of the FlexPLI master legs is lower than with the prototypes used for the definition of the thresholds. Therefore, this adaptation in terms of a shifting of the impactor threshold values for vehicle testing is suggested. Furthermore, Mr. Zander stated that GTR9-5-23 contains several significant errors. First, the terms injury criteria and threshold values are confused, leading to wrong conclusions and recommendations. Second, the shift of impactor threshold values is based on the inverse certification results from the master legs and not, as assumed in the document, from vehicle testing. Third, the underlying tests were generated in three experienced test houses using the results from all three master legs, 27 tests in total, that also formed the data basis for the revised corridors and not, as stated within document GTR9-5-23, using a relatively low number of tests. Four, the TEG agreements regarding injury criteria are not touched at all within document GTR9-5-20.

Mr. Buenger wondered whether the data from the certification tests can be generalized for the discussion on the threshold issue since the sensors do not reach their maxima during those tests. Mr. Zander replied that an alternative option could be to consider the comparative test results with the FlexPLI prototypes and master legs carried out on identical vehicles as presented in document GTR9-5-20 but that his preference would be to align the thresholds with testing under idealized conditions.

To better explain how JAMA had derived the injury thresholds Mr. Takahashi presented document GTR9-5-27. He explained that human injury probability functions were derived solely from biomechanical data and that the only part of this process (the process to determine the injury thresholds) that relates to the impactor response was the determination of the transfer functions. He also added that the transfer functions were developed by correlating the human and FlexPLI responses using their FE models and that the FlexPLI FE model was validated against component certification corridors. He concluded that, due to the fact that the component certification corridors have been unchanged, the injury thresholds should be seen independent from the certification thresholds and that therefore the Japanese manufacturers do not see a need to modify the injury thresholds.

Mr. Zander replied that the threshold values agreed by TEG were also based on findings of BAST. Here, besides a biomechanical study also correlation studies had been carried out including hardware tests. Thus, the change in performance between the prototype impactors and the master legs is of importance.

However, Mr. Takahashi explained that the component certification corridors had been used for the determination of the transfer functions used to derive the threshold values and that these had not been changed. Mr. Zander asked whether his understanding is correct that the ratio between the FlexPLI model and the FlexPLI hardware impactor was assumed at 1:1 which was confirmed by Mr. Takahashi. Dr. Konosu added that he also sees the performance of the master legs to be within all necessary corridors and that therefore the issue of the thresholds does not need to be touched. Mr. Zander stated that in this case the draft threshold values were not related to the FlexPLI prototypes and therefore must have been inconsistent with the prototypes. This was also confirmed by Mr. Takahashi. Mr. Zander summarized that in that case the master legs are assumed to be identical to the performance of the leg that was previously used by JAMA to derive the transfer functions and the threshold values. Also this was confirmed by Mr. Takahashi. Thus, the ratio between the FlexPLI model and the master legs should be 1:1.

It was finally agreed that the agenda item will be kept for the next meetings. The chair added that he is optimistic that for the next meeting new test results will be available and that this may allow a better assessment of the issue. Therefore, he hopes to finalize the discussion on this during the 6<sup>th</sup> meeting.

**12.2. Proposal on tolerances for initial vehicle ride height**  
(OICA, all)  
**(document GTR9-5-24)**

Mr. Schmitt explained the need for tolerances especially for the vehicle ride height (see

document GTR9-5-24). This item had been covered by legislation in the past and from a technical perspective there are several reasons that justify the need of such tolerances. Mr. Schmitt therefore concluded that the regulatory language of gtr No 9 should be adapted accordingly.

Dr. Konosu wondered whether the presentation should already refer to gtr No 9 in its current version or whether it is sufficient for the phase 2 of gtr No 9 that is discussed by this group. Mr. Schmitt explained that with the new impactor the issue becomes even more important and that therefore it fits the tasks of this group. This was confirmed by the chair.

Mr. Stammen confirmed that NHTSA also has an interest in the subject and would appreciate discussion on this during the next meeting. Also Mr. Bilkhu pointed out that from the manufacturers' point of view this is a very important subject since small changes to the ride height may create issues with the test area or even with the impactors to be used when seeing the alternative bumper test for high bumper vehicles.

It was finally agreed that the issue should be further discussed during the next meeting. The chair requested OICA to propose some draft text to amend gtr No 9 (**action item A-5-07**).

**12.3. Review of the first draft document**  
(Chair, Vice-chair)  
(**document GTR9-5-29**)

A first draft proposal for the amendment to gtr No 9 had been prepared by the vice-chair. He explained that the document is based on the one that had already been handed in for the discussion in GRSP in 2011 (GRSP/2011/13). However, following the work of this group (and especially also of the Task Force Review and Update of Certification Corridors) and following first agreements that have been achieved the 2011 document was updated and represents the status of discussion at the beginning of the 5<sup>th</sup> Informal Group meeting.

Mr. Schmitt mentioned that, from a first glance, it seems that the requirements of the EEVC LFI are completely deleted. However, seeing that there will be transitional provisions needed Mr. Schmitt wondered whether the old wording should be kept.

The chair explained that the perception of Mr. Schmitt is correct: The new phase 2 of gtr 9 should only cover the FlexPLI but of course the original version of gtr 9 will still be available and can be used by Contracting Parties. However, for other legislation such as UN Regulation 127 clear transitional provisions between the EEVC LFI and the FlexPLI could be defined.

Ms. Versailles stated that there is still some clarification needed on the status of the different phases of a gtr. This may be procedural questions that affect the work of the UNECE working groups and different scenarios on how to proceed in detail may be possible. Ms. Versailles suggested discussing this specific item with the Geneva secretariat during the next GRSP and the chair promised to do so (**action item A-5-08**).

**13. Consideration of activity list, work plan and identification of further open issues**

(Chair, all)

(documents GTR9-C-07r1 and GTR9-4-03r1)

**13.1. Durability**

(All)

(document GTR9-5-10)

NHTSA had brought up several questions with document GTR9-4-19. Mr. Takahashi presented document GTR9-5-10 that responds to the issue of the durability of the impactor, especially when testing larger vehicles. Mr. Takahashi noted that, even when testing a large vehicle, no damages to the FlexPLI had been found and that therefore no issue with the durability is expected.

**13.2. Biofidelity**

(All)

(document GTR9-5-12)

Mr. Takahashi also presented how the human, FlexPLI and EEVC LFI FE models, which were used to evaluate the biofidelity of the FlexPLI, had been validated in response to the question raised by NHTSA in document GTR9-4-19 (see document GTR9-5-12).

The chair appreciated that this was obviously a quite extensive piece of work and thanked Mr. Takahashi for this. He requested all Informal Group members to carefully check the content and come back to the group in case of further questions.

**13.3. Repeatability**

(All)

(document GTR9-5-11)

In his final presentation Mr. Takahashi explained the findings of JAMA regarding the repeatability of FlexPLI during vehicle tests. He concluded that JAMA found the repeatability to be good or at least acceptable in their study and that therefore this should not be an issue.

**14. Consideration of schedule**

(Chair)

**(document GTR9-5-28)**

The chair had already pointed out that the test schedule with the master legs will need some further time and that therefore the mandate of the group should be extended. The chair and the vice-chair are consequently proposing an extension of the mandate of 6 months. Also, it may be needed to add further meetings to the overall schedule. The planning now foresees submitting a formal proposal for the December 2013 session of GRSP and to aim for adoption by WP.29 at the June 2014 session.

Mr. Broertjes stated clearly to support this extension.

Mr. Buenger stressed that, seeing the discussion under agenda item 12.1, a further extension of the mandate may be considered. The chair replied that the subject of the evaluation of



injury criteria and limits had been in the Terms of Reference of this group from the beginning and that therefore this now should not lead to a further extension. The group was clearly requested to stick as much as possible to the foreseen timeframe to assure that results are available as soon as possible. Also, the chair again pointed out the urgency of the FlexPLI issue for Japan.

It was finally concluded that for the time being the chair will submit an updated schedule to GRSP in their 52<sup>nd</sup> session from 11 – 14 December and will request GRSP to extend the mandate by end of 2013 (**action item A-5-10**).

**15. Review of action list**  
(Secretary)

See section B) of these minutes.

**16. A.O.B.**

None.

**17. Next meeting**

The next meeting will take place from 18 – 20 March 2013. The venue of the meeting will be decided during the 52<sup>nd</sup> GRSP. The secretary then will provide the information to all Informal Group members as soon as possible.

The chair stressed that the issues of the cost benefit assessment, the rebound of the FlexPLI, the injury criteria and impactor thresholds and the drawing packages should preferably be finalized during the next meeting. Also, a detailed review of the gtr No 9 draft amendment will take place.










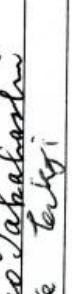

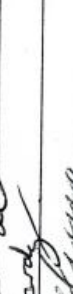








Finally, the chair and the secretary request again that all documents for discussion at the next meeting should be handed in as soon as possible but the latest 5 working days before the meeting.

The chair thanked BAST for hosting the meeting and all attendees for their support in the meeting and wished them a very nice Christmas time.

## Attachment to section A) List of Attendees

DAY 1

5<sup>th</sup> Meeting of the Informal Group GTR9 Phase 2 – December 6<sup>th</sup> & 7<sup>th</sup>, 2012  
 BAST, Bergisch Gladbach, Germany  
 - Attendance List -

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DAY 2

5<sup>th</sup> Meeting of the Informal Group GTR9 Phase 2 – December 6<sup>th</sup> & 7<sup>th</sup>, 2012  
 BAST, Bergisch Gladbach, Germany  
 - Attendance List -

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