

Minutes for the 4th meeting of the Informal Group on Global Technical Regulation No. 9 – Phase 2 (IG GTR9-PH2)	
Venue	U.S. Department of Transportation, NHTSA offices, 1200 New Jersey Avenue SE, Washington D.C. 20590
Date	17 to 19 Sept. 2012
Status: Final	

A: List of Attendees

Beebe	MaryAnn	Ms.	General Motors (U.S.A.)	maryann.beebe@gm.com
Beebe	Mike	Mr.	Humanetics (U.S.A.)	mbeebe@humaneticsatd.com
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Yim	Wilson	Mr.	BMW (U.S.A.)	Wilson.Yim@bmwna.com

Ms. Mallory/NHTSA, as well as Messrs. Briggs/JP Research, Burleigh/Humanetics, Edwards/Alliance, Gehring/BGS Boehme & Gehring, Hand/U.K.DfT, Hardy/TRL, Pingston/GM, Suntay/NHTSA and Zander/BASt attended the meeting via telephone/WebEx.

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	end of Oct. 2012
A-2-12	Update manual with visual inspection parameters	Humanetics	15.10.2012
A-3-08	Provide details on updating existing FlexPLI's to the latest build level (time, costs, check list etc.)	Humanetics	closed
A-3-11	Provide drawing (with disclaimer for the time being) to be sent to the secretary of IG	Humanetics	01.11.2012
A-3-12	Provide information on technical feasibility of vehicle countermeasures to meet FlexPLI requirements	OICA	5th meeting
A-4-01	Provide a status report of the TF-BTA	EC	5th meeting
A-4-02	Check current inverse test device with respect to friction (velocity measurement, defined distance of 150 mm)	All Labs	5th meeting
A-4-03	Review of TEG FlexPLI thresholds / criteria	ALL	5th meeting
A-4-04	Check document GTR9-4-16 towards vehicle masses over 2500 kg and acquisition periods	BASt	closed
A-4-05	Humanetics provides a list of master leg parts to be renewed including the respective costs	Humanetics	
A-4-06	Propose a template of a logbook which accompanies the master legs on their travel for RR tests	BASt	ASAP
A-4-07	Provide friction values / loss of velocity based on distance 150 mm (200 mm) in simulations	Concept Tech	5th meeting
A-4-08	Provide a proposal of tolerance for initial vehicle ride height for testing	OICA	5th meeting

A-4-09	Prepare a first draft document of a FlexPLI amendment to the IG	Chair, Vice Chair	5th meeting
A-4-10	Contact NHTSA on the benefit assessment for the FlexPLI	Chair	before 5th meeting
A-4-11	Review of GIDAS data for the benefit assessment	BASt	5th meeting

C: List of Meeting Documents

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

GTR doc		title	by	agenda item	related action
GTR9-3-02	r1	Rev1 of the minutes of the 3rd IG meeting	secretary	4	
GTR9-4-01	r1	Rev1 of the agenda of the 4th meeting	secretary	3	
GTR9-4-02		Reserved for the minutes (this document)			
GTR9-4-03		Status of activity list items	secretary	14	
GTR9-4-04		EEVC WG10 report, Nov. 1994	UK DfT	6	A-2-01
GTR9-4-05		EEVC WG10 report to the 15 th ESV conference, May 1996	UK DfT	6	A-2-01
GTR9-4-06		EEVC WG17 report, Dec. 1998, update Sep. 2002	UK DfT	6	A-2-01
GTR9-4-07		Activity report TF-RUCC	Chair of TF-RUCC	8	A-3-02 A-3-04
GTR9-4-08		To conduct FlexPLI round robin car tests, smooth and affectively	Chair of TF-RUCC	10.1	
GTR9-4-09		Round robin certification test results	Humanetics	10.1	

GTR9-4-10		Special Resolution No. 2 (informal document WP.29-157-16)	Chair of IG	9	A-3-10
GTR9-4-11		Investigation of the influence of friction within the inverse certification test setup	Concept Tech	10.2	A-3-09
GTR9-4-12		JP Research report on benefit as a technical information	JP Research / Alliance	7	A-2-04
GTR9-4-13		JP Research presentation on benefit as a technical information	JP Research / Alliance	7	A-2-04
GTR9-4-14		Comparison of FlexPLI performance in vehicle tests with prototype and series production legforms	BASt	10.1	
GTR9-4-15		Second progress report of IG-GTR9-PH2 (informal document WP.29-157-21)	Chair of IG	5	
GTR9-4-16	r1	Pedestrian lower extremity injury risk	BASt	6	A-3-01
GTR9-4-17		FlexPLI round robin car test schedule	Chair of TF-RUCC	10.1	A-3-06 A-3-07
GTR9-4-18		FlexPLI vs. EEVC WG17 PLI, benefit estimation	BASt	7	
GTR9-4-19		Overview of NHTSA pedestrian activities	NHTSA	6	A-2-03
GTR9-4-20		Validation of Pedestrian Lower Limb Injury Assessment using Subsystem Impactors (IRCOBI conference, 12th – 14th Sept. 2012)	JASIC	7	
GTR9-4-21		OSRP Pedestrian Lower Leg Response Research test series	USCAR/ Alliance	7	
GTR9-4-22		Checklist for Vehicle Testing	IG GTR9 PH2		

D: Summary of Meeting**1: Welcome**

The chair welcomed the group at the Offices of the NHTSA as well as the participants via WebEx. He also thanked NHTSA for hosting the meeting.

Also, the chair informed the attendees that Dr. Ries (OICA/Volkswagen) has kindly agreed to act as the secretary for this meeting since the secretary of the informal group, Mr. Kinsky (OICA/General Motors Europe), unfortunately is not available.

2: Roll call of participants

The participants introduced themselves in a tour de table – list see above.

3: Adoption of the agenda

Document GTR9-4-01

The secretary presented the agenda with two small changes in the titles of agenda items 10.1 and 17. No further changes were requested. The final agenda was agreed as document GTR9-4-01r1. The group went through the open action items and the submitted documents – see lists above.

4: Review of the minutes of the 3rd Meeting

Document GTR9-3-02r1

The document was presented. All proposed changes received so far were agreed. In addition, the wording in chapter 12 (replace “action item” by “activity item”) was corrected. The updated minutes of the 3rd meeting will be put on the UNECE website ASAP.

5: Review of information provided to and discussed at the WP.29 during their 157th session in June 2012

Document GTR9-4-15

The chair presented the second progress report of the IG GTR9-PH2 which was submitted to WP.29 in their June 2012 session. He pointed out the need to keep the time schedule agreed with the group’s Terms of Reference (see also page 7 of document GTR9-4-15). Some activity items are still in progress and should be finalized in due time.

The next report of IG-GTR9-PH2 to WP.29 in November 2012 will cover the results of the 3rd and the 4th meeting.

6: Review of accident data, especially related to tibia and knee injuries (U.K. DfT, NHTSA, OICA, BAST,

all)

Documents GTR9-4-16r1, GTR9-4-19, GTR9-4-21

Three action items were discussed:

Under **action item A-2-01**, the UK DfT provided some information from EEVC WG10 and WG17. These papers are the reports of EEVC on which many pedestrian protection activities are based. The chair noted that there is also some further information from EEVC WG7. All these EEVC papers are dated before 1998. It appeared that no further conclusions for this group can be drawn from these documents. **Action item A-2-01 was closed.**

NHTSA presented a broad overview of their pedestrian protection activities in the USA (document GTR9-4-19). For pedestrian legform tests, NHTSA pointed out the need of the assessment of benefit, injury reduction, costs, feasibility and applicability especially with respect to the US vehicle fleet. As regards the FlexPLI the aspects of biofidelity, durability, repeatability, reproducibility, injury criteria, certifications and specifications are of high interest. NHTSA raised several questions in their overview. The chair stated that many of these issues are covered by the workplan of this group (repeatability, durability injury criteria, certification etc.). But some (e. g. upper body mass) are not within the scope of this group. NHTSA also emphasized that a clear cost-benefit analysis has a high priority for their rule making procedure. NHTSA promised to circulate the report of their research project on the issue of lower extremities to bumper injuries by mid October 2012. **Action item A-2-03 was modified accordingly and was kept open.**

BASt presented a collection of GIDAS data (document GTR9-4-16, see **action A-3-01**) to show the relevance of pedestrian leg injuries. The presentation is based on findings of BASt and of a study of the Technical University of Dresden (Germany). Around 30% of the identified pedestrian injuries are lower extremity injuries. Around 66% of the lower extremity injuries are lower leg injuries (42%) or knee injuries (24%). 34% of all AIS2+ pedestrian injuries (caused by vehicle parts) are lower extremity injuries and are caused by the bumper in accidents of cars with < 2500 kg gross vehicle mass and up to 40 km/h impact speed.

NHTSA asked whether the study allows conclusions for heavier cars. The Alliance asked for information on the data acquisition period. BASt was requested to provide the information as **action item A-4-04**.

During the meeting BASt submitted a revised version of their document (document GTR9-4-16r1) which answered the questions above. The data was collected from 1999 to 2005. 19% of all pedestrian injuries (caused by vehicle parts) are lower extremity injuries and are caused by the bumper in accidents of M1 vehicles above 2500 kg GVM. 2.5% of all pedestrian injuries (caused by vehicle parts) are lower extremity injuries and are caused by the bumper in accidents of N1 vehicles above 2500 kg GVM. In addition, BASt provided the internet link to the Dresden study. The group agreed **to close action items A-3-01 and A-4-04**.

The Alliance reported about FlexPLI tests against a test rig performed by USCAR (United States Council for automotive Research, document GTR9-4-21). The test rig can be modified to illustrate different

bumper designs. New test series with the FlexPLI and with the EEVC LFI are planned. USCAR will inform about the test results in due time.

7: Discussion on cost-benefit assessment (OICA, all)

Documents GTR9-4-12, GTR9-4-13, GTR9-4-18, GTR9-4-20

The chair explained that the cost-benefit assessment appears to be a major topic in this group. JASIC elaborated a study on cost benefit (documents GTR9-2-07r1 and GTR9-3-12). During the 2nd and 3rd meeting the Alliance expressed orally their concerns related to the accident database used in the JASIC papers. For the 4th meeting the Alliance submitted two documents (documents GTR9-4-12 - report and GTR9-4-13 - presentation) as technical information to the group as result of a request to JP Research as their contractor to assess, among others, the appropriateness of several accident data sources (PCDS – Pedestrian Crash Data Study, FARS – Fatality Analysis Reporting Systems, NASS/CDS – National Automotive Sampling System/Crashworthiness Data System etc., including their combinations) and the use MAIS levels 4+ for estimating leg fractures and fatalities. JP Research found some differences in the case numbers used by JASIC. In addition, JP Research stated that the PCDS data set is not representing the current US fleet and appears to be statistically not valid. There are also remaining concerns regarding the combination of the existing data.

JASIC clarified the different case numbers in their study. JASIC omitted those cases with fractures in the upper tibia plateau and in the ankle area and explained that the focus was on tibia shaft fractures only.

In addition BAST presented a benefit estimation of FlexPLI vs. EEVC LFI (document GTR9-4-18). BAST concluded that the injury assessment ability using the FlexPLI is better than using the EEVC LFI due to the direct measurements of ligament elongations and bone bending. For example, the fracture risk can be measured at 4 locations along the tibia bone shaft for the FlexPLI while the fracture risk judgment of the EEVC LFI concentrates to the upper tibia part. BAST reported about back to back tests conducted with both the FlexPLI and the EEVC LFI. Here, cars which fulfilled the FlexPLI draft legal requirements entirely passed the legal requirements with the EEVC LFI. On the other hand it showed that meeting the current legal requirements with the EEVC LFI did not always lead to also meeting the FlexPLI draft requirements. OICA opposed that this is not necessarily true for all vehicle types. Japan stated that the better biofidelity of the test tool should be decisive for those questions.

JASIC presented the Honda document for the 2012 IRCOBI conference (held in Dublin from 12th – 14th September 2012) which was agreed to be circulated as document GTR9-4-20 to the group. JASIC concluded among others that the correlation with human injury measures was found to be significantly improved for FlexPLI relative to EEVC legform for tibia fracture and ACL failure measures.

JASIC stated that Japan had made its study on cost-benefit and that no further work is planned for this issue. The chair proposed to have a deeper look into the GIDAS data and requested BAST to provide some additional information (**action item A-4-11**) by the next meeting. Since this issue is also of high priority for NHTSA (see agenda item 5) the chair additionally proposed to contact with NHTSA to find a

common solution (**action item A-4-10**) for the next informal group meeting. NHTSA will undertake additional studies.

8: Status of ongoing discussion on the certification corridors: activities of the “Task Force Review and Update of Certification Corridors” (TF-RUCC chair, Bertrandt, OICA, all)

Documents GTR9-4-07, GTR9-4-09

The chair of the TF-RUCC presented the status report (document GTR9-4-07e) with updated certification corridors (**action items A-3-02 and A-3-04**): After further FlexPLI design optimizations, three master legs were prepared to redefine the certification corridors with respect to the quasi-static certification tests (tibia, knee and femur) as well as the dynamic certification tests (pendulum test and inverse test). All future FlexPLI's (orders on master leg level) will now be able to pass both dynamic certification tests. TF-RUCC proposed new certification corridors which were accepted by the IG GTR9-PH2. The updated certification corridors should now be considered as the final ones.

Humanetics presented their certification test results with two FlexPLI master legs (document GTR9-4-09). The results are well in line with the results of other test houses (JARI, BAST and Bertrandt). Nevertheless, Humanetics are concerned that the narrow corridor range for the tibia 4 sensor could create problems related to the durability issue. The chair proposed that the test houses involved in the round robin tests should inform the group if any durability problems etc. will be observed. A document with dynamic test instructions (document GTR9-4-22e) was prepared by the Informal Group that should accompany the FlexPLI master legs in addition to the revised manual that will be submitted by Humanetics in October 2012 (see also **action item A-2-12**).

Action item **A-3-03** was not discussed because it was part of TF-RUCC working items. Thus, **action items A-3-02, A-3-03 and A-3-04 were closed**.

9: Update on the FlexPLI design and PADI (Humanetics, U.K. DfT, all)

Document GTR9-4-10

Humanetics stated that progress is made so far. The updated manual will be circulated by mid of October 2012. **Action item A-2-12 is kept** so far.

Regarding action item **A-3-08** there was no input available so far by Humanetics. Humanetics explained that costs and time (to overhaul FlexPLI's that already were delivered to the customers to the master leg status) strongly depends on the attrition condition of the individual FlexPLI. As a first idea, Humanetics estimated about 2 weeks after receiving an order for the repairing period. The costs cannot be estimated precisely. Thus, this should be negotiated bilaterally. Humanetics will provide a list of related master leg spare parts including the costs (**action item A-4-05**) to give a first hint of costs. Following this new action item, **action item A-3-08 is closed**.

The chair informed about the state of Special Resolution No. 2 in WP.29 (repository for test tools used in UNECE regulations). Each new test tool should be equally described in terms of general design,

instrumentation, physical properties, assembly and disassembly, maintenance and certification etc. Engineering drawings (but not manufacturing drawings) shall be included in the annexes to the Special Resolution. The aim is to provide test tool information in a common regulative language in Geneva. The FlexPLI is seen as one of the first candidates for this new procedure in the Special Resolution No. 2. The chair informed the group that the representatives of the U.K. and the USA are currently preparing a proposal for WP.29 to change the name to mutual resolution that allows the application under the 1958 and the 1998 Agreements. **Action item A-3-10 is closed.**

Drawings of the FlexPLI (with disclaimer) will be provided by Humantics to the secretary of the IG by beginning of November 2012 (**action item A-3-11**). The chair and the secretary will follow the coming process with the mutual resolution in Geneva. **Action item A-3-11 is kept.**

10: Further experiences from testing with the FlexPLI

10.1: Vehicle testing (All)

Documents GTR9-4-14, GTR9-4-08, GTR-4-17

Before the summer break, the secretariat of this group requested to indicate interest in participating in the round robin vehicle test program with the three master FlexPLI's. In the meantime the vice-chair of this IG distributed a schedule for interested organizations in Europe, USA and Korea (document GTR9-4-17). **Action items A-3-06 and A-3-07 are closed.**

In addition, the vice-chair provided guidelines how to perform round robin tests smoothly and effectively (document GTR9-4-08). The round robin tests should give answers on repeatability, reproducibility and durability when used in real vehicle impacts. One focus is of course the confirmation of the updated certification corridors. After some discussion the following was agreed:

- After a maximum of 9 vehicle tests a re-certification should be done, preferably with both, the pendulum and the inverse test. In case one organization cannot do both tests, the respective master FlexPLI should be re-certified with the pendulum test at least.
- A re-certification should be done when the test result exceeds a certain measurement value (10% above the threshold).
- A logbook is to be prepared accompanying the master legs during their travel for the round robin test series. This logbook should contain information regarding re-certification results, all observations etc., but no vehicle test results.

Details were agreed and recorded during the meeting and will be added to the FlexPLI master legs (document GTR9-4-22) ASAP. BAST/BGS Boehme & Gehring are responsible to circulate a logbook ASAP (**action item A-4-06**).

BAST presented first test results of tests with several FlexPLI prototypes and the three master legs against two series cars (document GTR9-4-14). The production cars were those used during the TEG activities (FlexPLI prototypes). Thus, the vehicle behavior was assumed to be identical, too. It was noted that during all tests the tentative FlexPLI thresholds for tibia bending moments as well as

ligament elongations were entirely met. It appears that the master legs tend to lower output responses than the prototypes. This observation is in line with the inverse certification test results reported in TF-RUCC-4-04. The repeatability is satisfactory for the master legs.

NHTSA mentioned that the lower output of the measurements should be discussed under the issue of threshold / criteria.

Japan insisted that the flexible legform impactor prototype's conditions were not always on an acceptable level. It was pointed out that the results from tests with brand-new flexible legform impactors (representing the master leg level) shall be used for this discussion.

10.2: Influence of friction on impact speed during the test (Concept Technologies, all)

Document GTR9-4-11

Concept Tech presented the simulation findings comparing EEVC lower legform impactor responses under inverse tests without ram friction and with a ram friction of 300 N (document GTR9-4-11). (With this, **action item A-3-09 is closed.**) Concept Tech had no FlexPLI model, so they used EEVC lower legform impactor model instead.

According to Concept's findings the ram friction could have significant influence on the inverse certification test results for EEVC lower legform impactor (around 10%). During the discussion some other test houses did not fully agree. According their opinion the ram friction has only minor influence on the test results. BAST stated that the impact velocity is measured directly before the impact and therefore the friction is expected to have no significant influence on the test results.

However, Chrysler stated that friction always is there if there is movement. It was therefore finally agreed that test labs should check the ram friction of their test rigs considering a velocity loss at a distance of 150 mm (**action item A-4-02**). In addition, Concept is requested to provide respective friction limits based on simulations (**action item A-4-07**).

10.3: Further information, if available (All)

OICA addressed the problem of a tolerance specification related to the initial vehicle ride height for testing and marking up the vehicle. This is a very important issue in order to have common understanding among test houses when testing the same vehicles. It is true that such a tolerance is specified in the UN Regulation on pedestrian safety (R127) but it is only available in the preamble of the gtr No. 9. For the gtr9 this should also be placed into the text (e.g. under definitions). OICA was requested to provide more explanations as **action item A-4-08**.

11: Discussion on performance and injury criteria

On the basis of some discussions of injury criteria / thresholds during this meeting the chair initiated the **action item A-4-03** for the next meeting. All parties of IG GTR9-PH2 should be prepared to review

the current FlexPLI thresholds / criteria which were developed by the former TEG (Technical Evaluation Group).

12: Technical feasibility: possible vehicle countermeasures to meet FlexPLI requirements (OICA, all)

OICA announced to submit a document for the next meeting related to the groups activity item on the evaluation of vehicle countermeasures (assessment of technical feasibility, item 1. k) of the Terms of Reference (see also agenda item 14). **Action item A-3-12** was modified accordingly and was kept open.

13: Status of discussion on the legform test area: establishing/activities of the new “Task Force Bumper Test Area” (European Commission, all)

The chair / secretary informed about the current state of the activities in the TF-BTA (Task Force Bumper Test Area). A 1st telephone meeting took place on 4th September 2012. Several actions were discussed. All documents can be downloaded from the UN website. The chair of the TF-BTA (EC) is requested to provide a status report to IG GTR9-PH2 before the next meeting (**action item A-4-01**). The next meeting is foreseen for 5th December 2012, probably also at BASt in Germany (before the next IG meeting).

14: Consideration of activity list, work plan and identification of further open issues

Document GTR9-4-03

The group went through the activity items' list of the Terms of Reference (document GTR9-4-03). The chair explained the intention to review the activity item to know the current status and to use colors in order to give an overview which activity is finalized so far. The result will be circulated as document GTR9-4-03r1.

Regarding the activity item 1k (see also agenda item 12), OICA is going to prepare a document for the next meeting. OICA will also prepare a document on test procedure issues (activity item 1f, e. g. definition of rebound phase, etc.). Some discussion came up related to the activity item for evaluation of reproducibility and repeatability (item 1i). Japan states that this activity should be indicated in green (finalized) on basis of the certification tests - the impactor is proven to be repeatable. BASt agreed and stated that idealized test conditions should be used and vehicle tests omitted because in this context the scatter of test results should focus on the legform itself. OICA opposed because repeatability and reproducibility are also linked to vehicle tests. This is of high priority for car manufacturers since they must be sure that the type approval labs will achieve the same (plus/minus) results than the development departments. It was agreed to keep the activity item 1i in yellow (in process). The outcome of the round robin tests should remain to be seen.

15: Consideration of schedule

As already mentioned in agenda item 5 the chair of this group emphasizes to keep the time schedule

agreed with the Terms of References. He announced that a first FlexPLI draft amendment for the gtr9 and if available also for UN Regulation R128 (Pedestrian safety) will be discussed in the next meeting (**action item A-4-09**). The text will be prepared by the chair and the vice chair.

The Japanese representative also strongly underlines to keep the schedule. In Japan, a Pedestrian Protection Regulation – including the FlexPLI – has already been approved. There is an urgent need for an amendment to the current gtr9.

16: Review of action items' list

The secretary summarized the action items' list and the submitted documents. The group decided on the closure of actions. The remaining / modified action items are listed under item B in the minutes above.

17: Next meeting (Proposal: 6th - 7th December 2012, at BAST in Bergisch Gladbach/Germany)

It was agreed to hold the next meeting in Germany at BAST's offices on 6th – 7th December 2012 (the week before the December GRSP session).

18: A.O.B.

The IG GTR9-PH2 encouraged the FE consortium under the auspices of Humanetics to restart their work on the FlexPLI FE model since the master leg's design is now a stable hardware impactor design. Each involved organization is requested to inform their FE experts accordingly.