

Transmitted by the expert from Japan

***Status Report on  
Flexible Pedestrian Legform Impactor  
Technical Evaluation Group (Flex-TEG)  
Activities***

Atsuhiko Konosu  
Chairperson of Flex-TEG, Japan

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

Participants of the 7<sup>th</sup> Flex-TEG meeting (8 Dec. 2008, BASt, Germany)

A. Konosu (Flex-TEG chairperson/J-MLIT/JARI)

B. Been (Flex-TEG secretariat/FTSS-Europe)

O. Zander (BASt)

D.U. Gehring and P. Lessmann (BGS)

O. Ries (ACEA/VW)

R. Fleischhacker (ACEA/Porsche)

T. Kinsky and B. Dreyer (ACEA/Opel)

A. Sipido (ACEA/Ford)

I. Imaizumi (JAMA/HONDA)

W. Liebers (TUV)

K. Wolff (Continental)

J.C. Kolb (Berbraudt)

M. Winkler (MESSRING)

D. Martin (DTS)

T. Inoue (JASTI)

R. Kant and S.J.P. Jansen (FTSS-Europe)

**Total: 19 persons**

# Main Agenda of the 7<sup>th</sup> Flex-TEG meeting

## 5. Flex-GTR-prototype development

- 5.1. FTSS Development Report
- 5.2. Japan (J-MLIT, JAMA, and JARI) Evaluation Tests Report
- 5.3. MESSRING Proposal to use ISO MME codes for the Flex Measurements

## 6. Dynamic Calibration Method for Flex-GTR-prototype

- 6.1. FTSS Report (Pendulum type)
- 6.2. BASt Report (Impact type)

## 7. Injury Criteria

- 7.1. JAMA Proposal (MCL)
- 7.2. JAMA Proposal (Tibia)
- 7.3. BASt Proposal (ACL, PCL, and MCL)

## 8. Evaluation Test Schedule for the Flex-GTR-prototype

- 8.1. JAMA Proposal (Test Schedule)

## 9. DRAFT of PS-gtr (gtr 9) Phase 2 using Flex-PLI requirements

- 9.1. J-MLIT DRAFT Proposal (base)

## 10. Working schedule for the Flex-TEG

- 10.1. J-MLIT Proposal

## 11. Future action plans

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 5. Flex-GTR-prototype development

5.1. FTSS Development Report

5.2. Japan (J-MLIT, JAMA, and JARI) Evaluation Tests Report

5.3. MESSRING Proposal to use ISO MME codes for the Flex Measurements

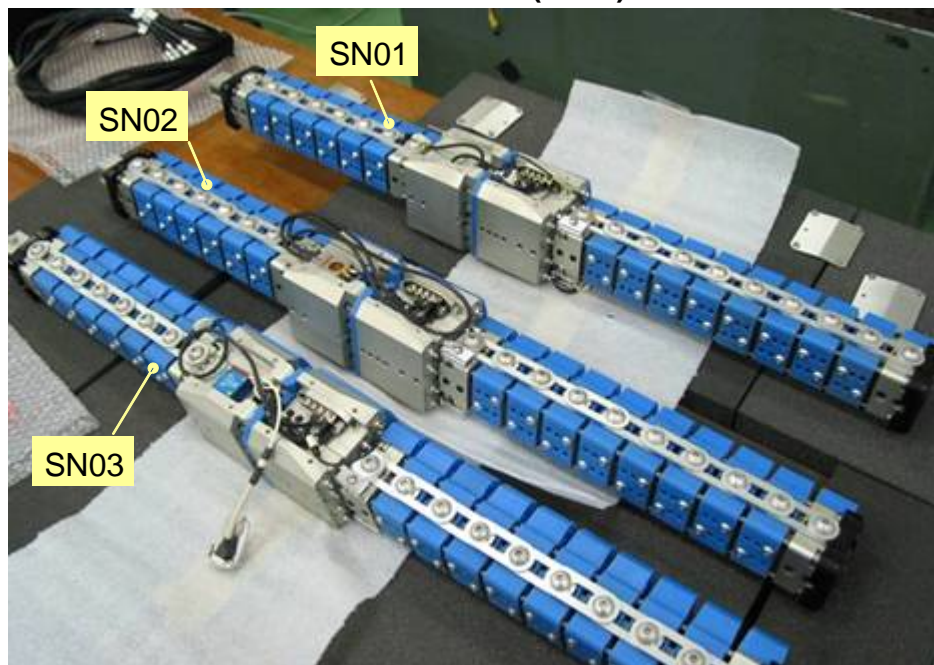
## Flex-GTR-prototype (SN01, SN02, SN03)

### Measurement systems

SN01: Off-board DAS

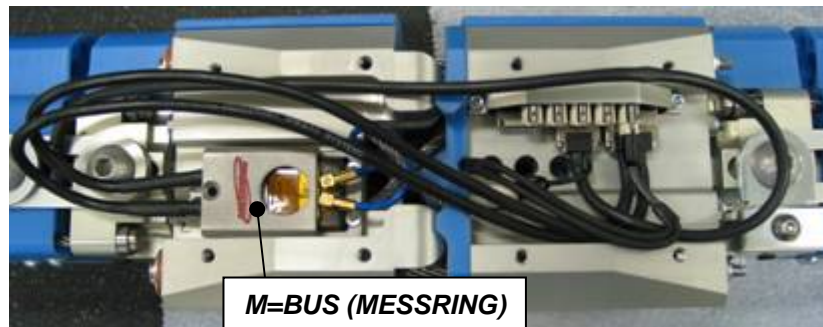
SN02: Can select On-board DAS (M=BUS) or Off-board DAS

SN03: Can select On-board DAS (Slice) or Off-board DAS

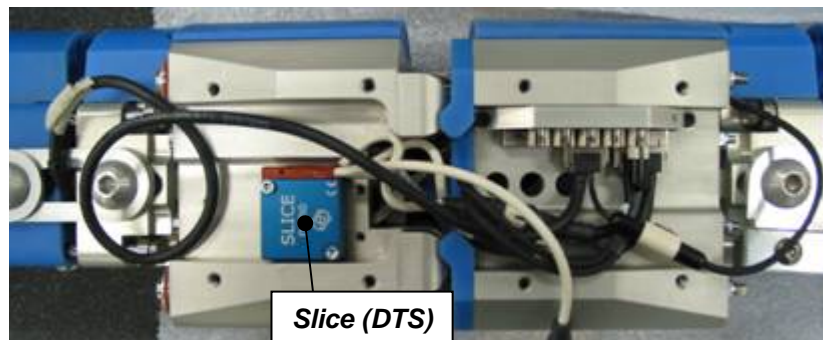


### Onboard DAS

SN02: Can select to use On-board DAS (M=BUS)



SN03: Can select to use On-board DAS (Slice)



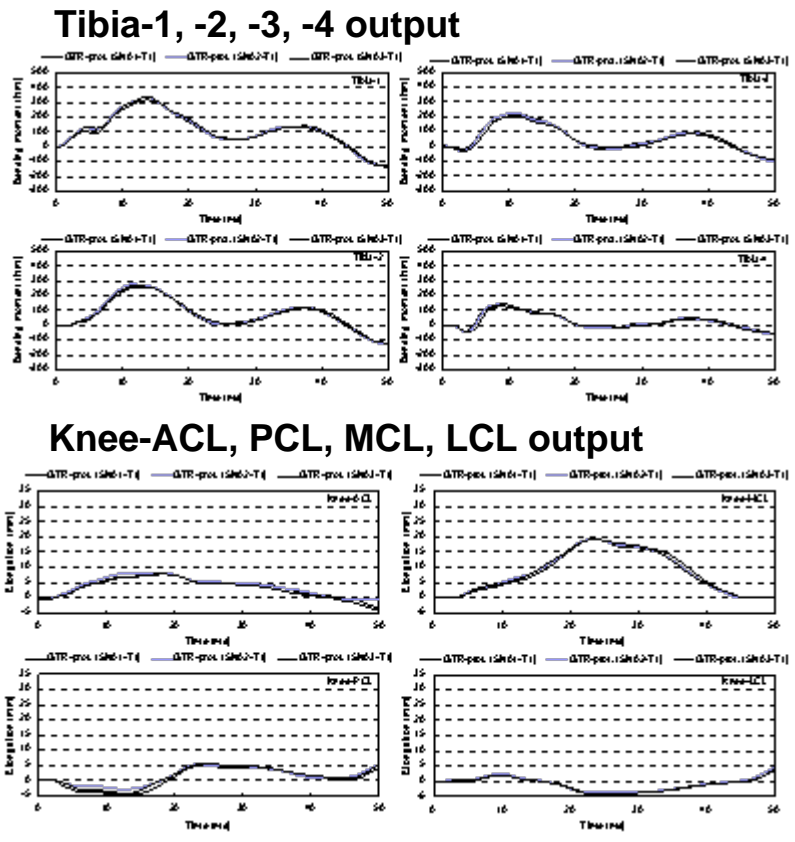
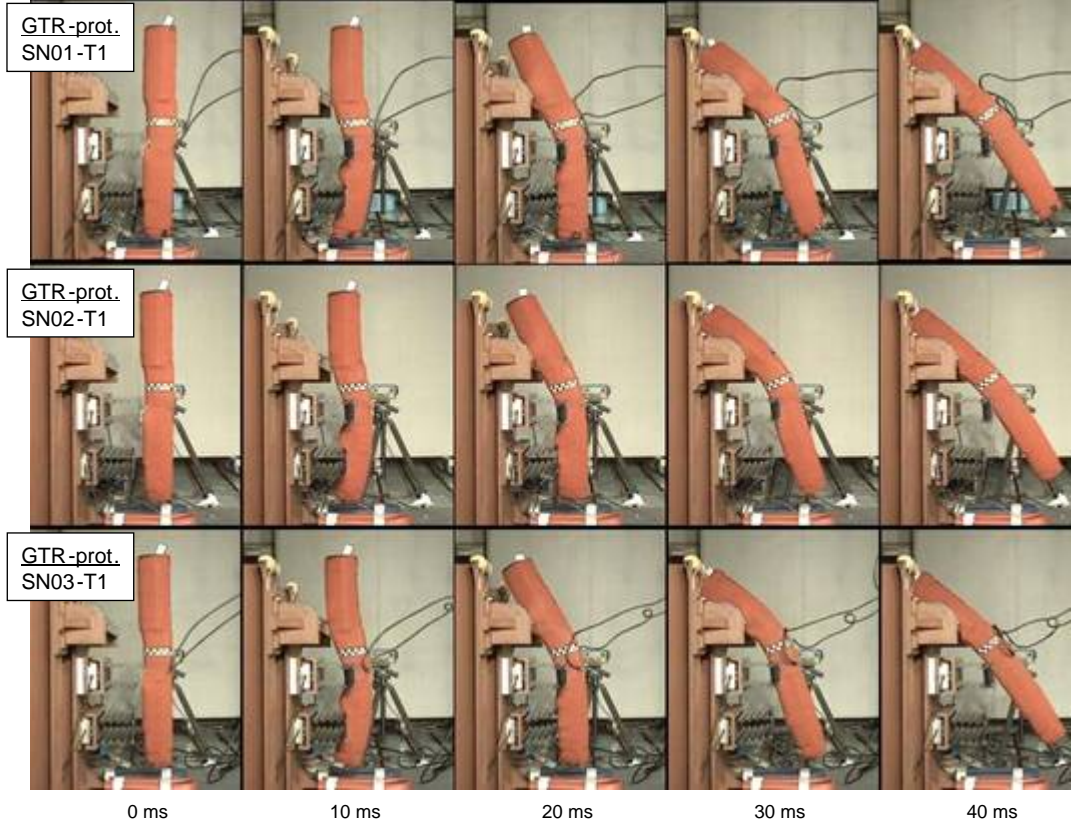
- Three Flex-GTR-prototype were developed (SN01, SN02, and SN03).
- User can select to use on-board DAS (M=BUS or Slice) for SN02 and SN03.

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 5. Flex-GTR-prototype development

- 5.1. FTSS Development Report
- 5.2. Japan (J-MLIT, JAMA, and JARI) Evaluation Tests Report
- 5.3. MESSRING Proposal to use ISO MME codes for the Flex Measurements

### Japan Evaluation Test Results (e.g. Reproducibility)



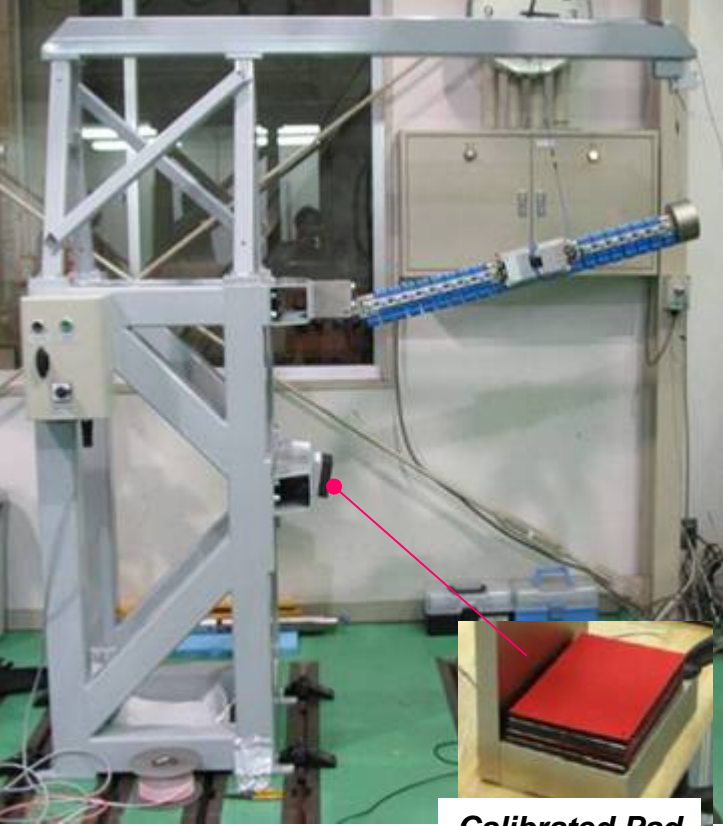
- Reproducibility & Repeatability of the Flex-GTR-prototypes, and Comparison with Flex-GT (previous) output are conducted by Japan (J-MLIT, JAMA and JARI collaboration).
- Evaluation tests in Europe are proposed to be conducted from Jan. to Apr. in 2009.

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 6. Dynamic Calibration Method for Flex-GTR-prototype

- 6.1. FTSS Report (Pendulum type)
- 6.2. BAST Report (impact type)

### Pendulum type calibration test



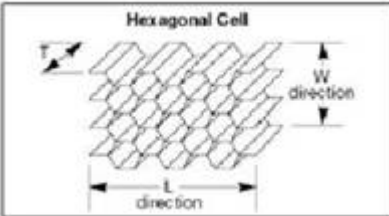
Calibrated Pad

### Impact type calibration test



Flex-GT inverse testing

Honeycomb



- TEG member discussed which is better test method for the Flex-GTR calibration.
- TEG member are going to continue this discussion by the next TEG meeting and will decide which shall be adopted for the Flex-GTR calibration test method.

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 7. Injury Criteria

- 7.1. JAMA Proposal (MCL), 7.2. JAMA Proposal (Tibia)
- 7.3. BAST Proposal (ACL, PCL, and MCL)

- **MCL: JAMA proposal is 23 mm. TEG agreed after some discussion that the muscle effects need to be considered for the Flex-GTR. TEG also agreed that the criterion needs to consider all vehicle categories in the scope of the GTR, such as e.g. high-bumper vehicles. The muscle effect explanations of JAMA are accepted by TEG. However, for the high-bumper effect explanations of JAMA are required more detailed information from BAST before to adopt.**
- **MCL: BAST proposal was presented as 16 mm (upper performance limit) and 20 mm (lower performance limit), while the high bumper vehicles still need to be included in an appropriate, weighted manner.**
- **Tibia: JAMA proposal, 318Nm, had no objection from the TEG members.**
- **ACL and PCL: BAST proposal, 12.7 mm, for the time being agreed by TEG for monitoring purposes only. This threshold value still needs to be discussed and decided whether being introduced for homologation purpose at the next meeting.**

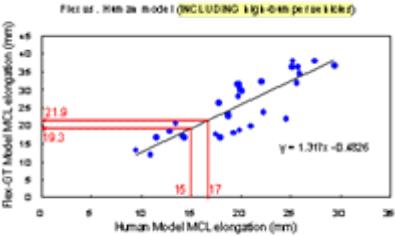
### Effect of Muscle Tone

- Lloyd and Buchanan (1996) – Muscles are activated to support about 15% of static varus-valgus loads. Muscular contribution increased with increasing magnitude of VV moments
- Lloyd and Buchanan (2001) – For volunteers, average contribution to varus is  $17 \pm 9.7\%$  and to valgus is  $10 \pm 6.3\%$  of externally applied moment

David G. Lloyd, Thomas S. Buchanan  
 The angles of muscular support of varus and valgus loads are related to the external knee J. of Biomechanics 34 (2001) 1257-1267

The effect of muscle tone has been addressed in Lloyd and Buchanan (1996, 2001) from the Journal of Biomechanics

### Estimation of MCL Failure Threshold



Flex-GT MCL elongation thresholds will be 19-22 mm when the correlation obtained using the FE simulation results with simplified vehicle models INCLUDING those representing high-bumper vehicles is used

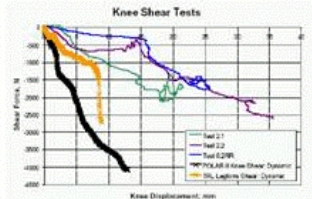
### MCL injury threshold



- Conclusions / Proposal:
1. As starting point, the dynamic bending limit response corridor according to injury definition B [approx 16... 20°] and the injury risk curve by Konosu (2001) [19,8°] for a 50% injury risk might be appropriate
  2. Those bending limits could be used (as before) as human model knee bending angle and then be transformed accordingly into:
    - human model knee MCL elongation
    - Flex-GT model knee MCL elongation (= Flex-GT knee MCL EL)
  3. Under the previously made observation (Human knee bending angle [deg] – Flex-GT MCL elongation [mm]) the following, first estimation could be done:
    - Flex-GT MCL elongation lower performance limit: 20 mm
    - Flex-GT MCL elongation upper performance limit: 16 mm
  4. Note:
    - Effect of muscle tone has already been taken into account
    - High bumper vehicles still have to be taken into account in an appropriate, weighted manner
- Oliver Zander      December 8th, 2008      Slide No. 17

### Thresholds for ACL and PCL

- Therefore, it appears more appropriate to stick with PMHS knee shearing results evaluated by Bhatta et al (2003) that state a tolerance of at least 12.7 mm for knee shear displacement of the 50th male, even though the timing of injury could not be clearly identified:



© Copyright 2003 by the TEG, highest and PCL/ACL knee joint position along with the PMHS knee as performed by the TEG, December 2003

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 8. Evaluation Test Schedule for the Flex-GTR-prototype

### 8.1. JAMA Proposal (Test Schedule)

Items	Promoter	2008		2009			May
		Dec	Jan	Feb	Mar	Apr	
1. Feasibility Study with JAMA -proposed threshold values	ACEA JAMA	JMLIT JARI JAMA (3)	BASt (3)	← ACEA(2) →		→	TEG
2. Comparison of Flex-GT and Flex-GTR	ALL			← ACEA(2) →		→	
3. Usability	ALL			← JARI JAMA (1) →		→	
4. Repeatability and Reproducibility	BASt JARI JMLIT	JMLIT (3)	BASt (3)	(): Number of Flex-GTR-prototypes to use for the analysis			
5. A required frequency of dynamic assembly calibration test	ALL					→	

- TEG assessed the test schedule as very challenging.
- However, if possible TEG member will meet the proposed timing.



# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 9. DRAFT of PS-gtr (gtr 9) Phase 2 using Flex-PLI requirements

### 9.1. J-MLIT DRAFT Proposal (base)

#### *J-MLIT Draft Proposal (basic idea)*

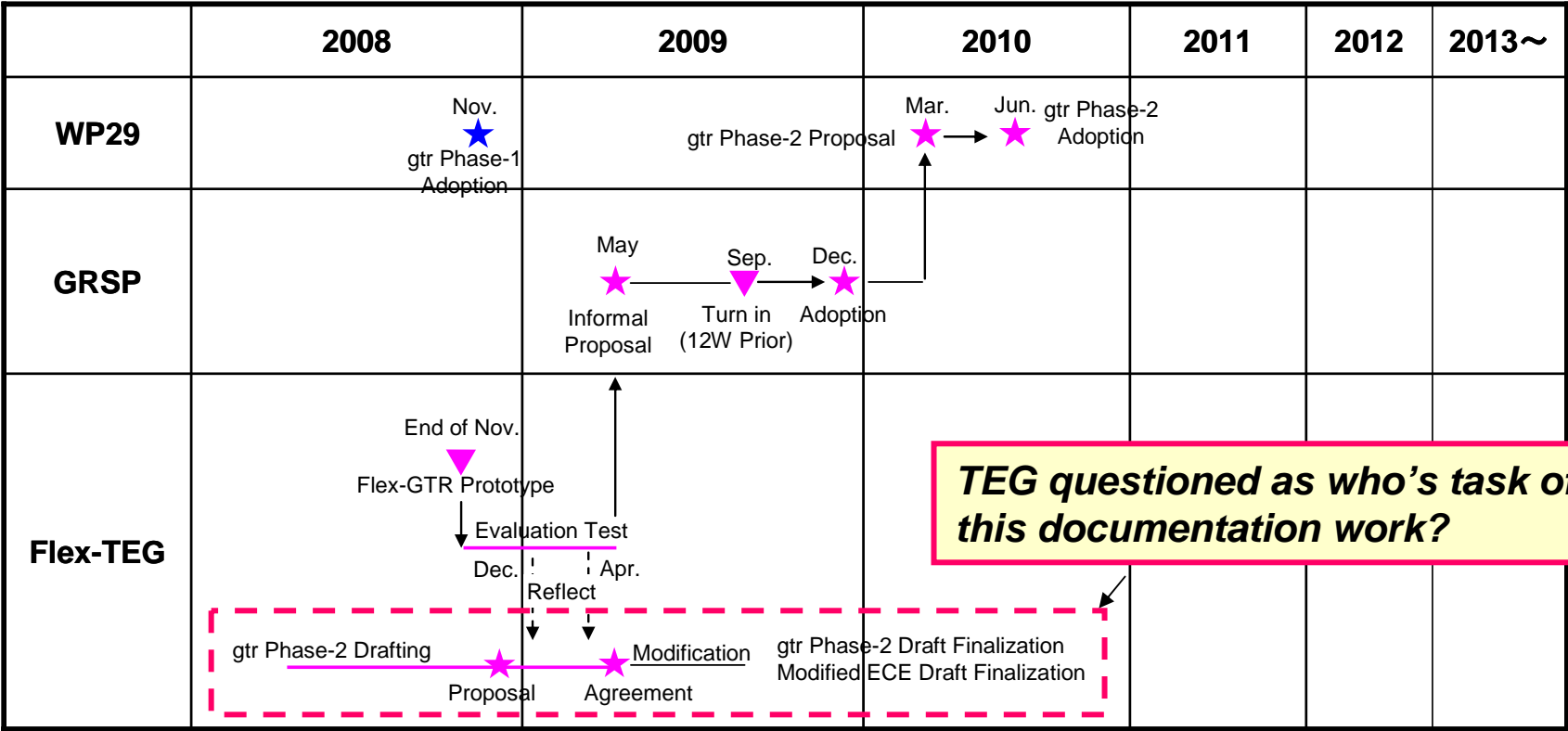
- J-MLIT showed their DRAFT Proposal on the PSgtr (gtr9) phase 2 using Flex-PLI requirements to share this information with the TEG members.
- Some of TEG members stated that the PS gtr Phase-2 Draft making is out of TEG task. TEG chair will confirm that at the 44th GRSP meeting.

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 10. Working schedule for the Flex-TEG

### 10.1. J-MLIT Proposal

### Flex-TEG Working Schedule (J-MLIT proposal)



- TEG assessed the J-MLIT proposed schedule as very challenging.
- Some TEG members even feel that it will not be possible to finish all tasks by May 2009 GRSP since the test are just finished at that time in best case.

# Latest Flex-TEG Activities (7<sup>th</sup> Flex-TEG meeting)

## 11. Future action plans

### By the end of December, 2008

- TEG members will discuss the JAMA Proposed Test Schedule and will give their discussion results to the TEG members by end of Dec. 2008.

### Preferably by the end of April, 2009

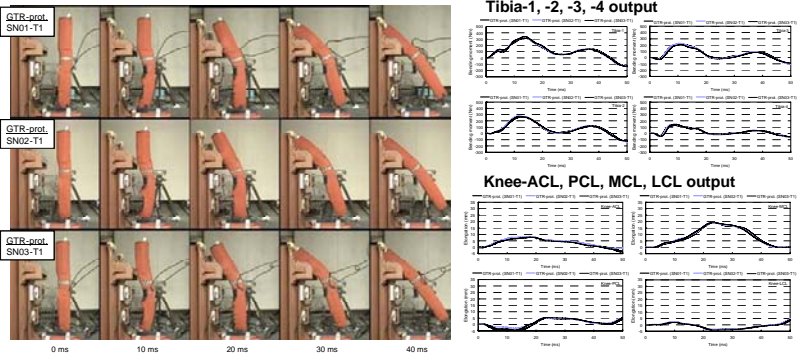
- Flex-TEG members will conduct evaluation tests with the Flex-GTR-prototypes.

- Flex-TEG members will further discuss the open issues identified above.

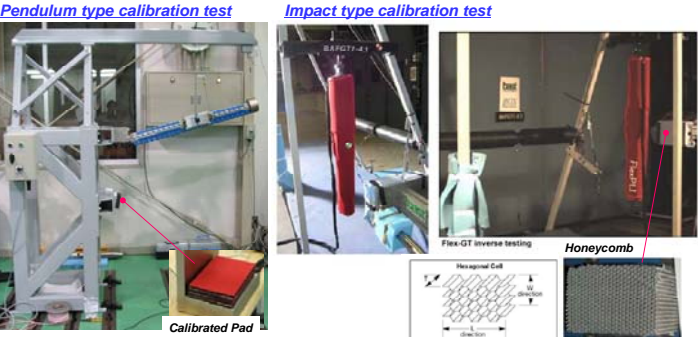
### JAMA Proposal (Test Schedule)

Items	Promoter	2008					2009		TEG
		Dec	Jan	Feb	Mar	Apr	May		
1. Feasibility Study with JAMA -proposed threshold values	ACEA JAMA		JMLIT JARI JAMA (3)		BAS(3)	ACEA(2) JAMA(1)			
2. Comparison of Flex-GT and Flex-GTR	ALL				ACEA(2) JARI JAMA(1)				
3. Usability	ALL								
4. Repeatability and Reproducibility	BAS JARI JMLIT		JMLIT(3)	BAS(3)					
5. A required frequency of dynamic assembly calibration test	ALL								

### Conduct evaluation tests



### Analysis on the dynamic assembly calibration tests

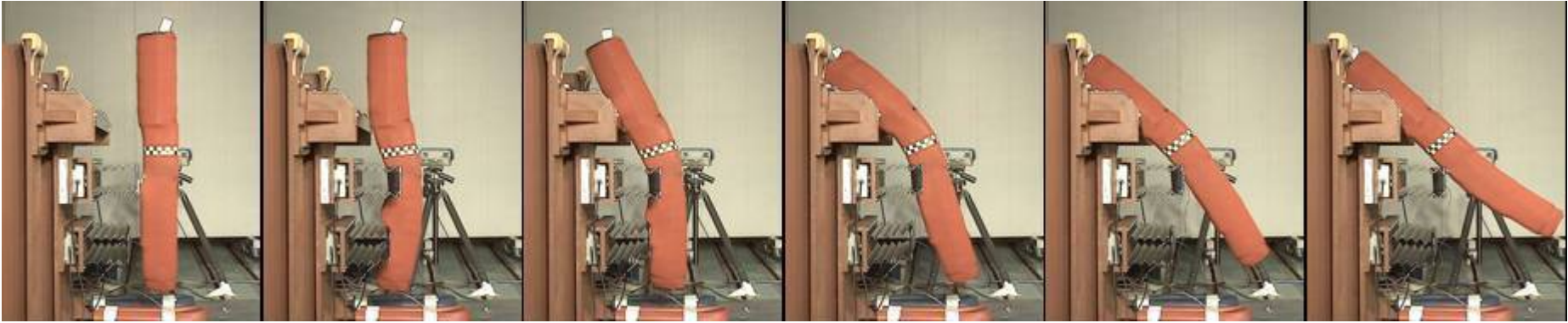


### May, 2009

★ 8<sup>th</sup> Flex-TEG meeting



★ 45<sup>th</sup> GRSP meeting



**Thank you for your attentions!**

