

**Informal Group on gtr No 9 – Phase 2 (IG GTR9-PH2)  
1<sup>st</sup> meeting, Geneva/Switzerland, 1 – 2 December 2011**

# **FlexPLI Version GTR Prototype SN-02 - Durability Assessment**



Presented by the pedestrian safety experts of the  
International Automobile Manufacturers' Organization (OICA)

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## Remarks

- Experiences are based on European industry's experiences collected from 2009 – 2011 mainly with prototype impactor SN-02 (and a few tests with SN-04)
- The impactors were kindly provided by the Japan Automobile Research Institute (JARI)
- In total, around 300 tests with SN-02 at manufacturers' labs, at BAST\*) as well as at contracted test labs were reported in this period
- Non of the vehicles was designed to meet any FlexPLI requirements
  - ⇒ It can be assumed that a number of tests were conducted where thresholds/injury criteria were well exceeded

\*) BAST = Federal Highway Research Institute  
(Bundesanstalt für Straßenwesen / Germany)

## Remarks (Continued)

- At least in the beginning, test labs involved did not have experience in working with the FlexPLI
  - ⇒ It can be assumed that handling was not always as usually wished for
- In between manufacturers' tests, the legform was regularly closely inspected and, if necessary, maintained by BGS Boehme & Gehring (the company operating BASt's test lab) in Bergisch Gladbach
- On 7 November 2011, the legform was completely disassembled and inspected at BGS Boehme & Gehring's

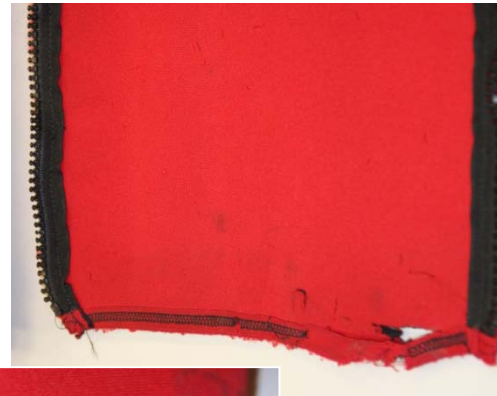
## Damages to the impactor – Outer Skin

All photographs taken by  
BGS Boehme & Gehring or Th. Kinsky



- Skin well used after 50 – 100 tests, depending on structures/objects struck
- Zippers and zipper handle frequently break / wear out

## Damages to the impactor – Inner Skins



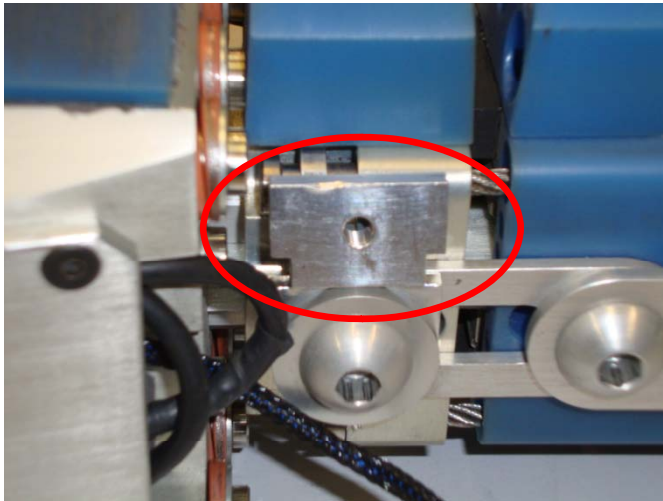
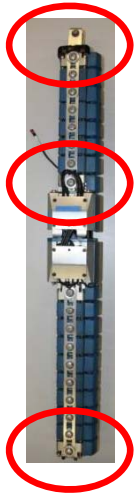
- Innermost skin parts with clear marks of tibia/femur segments



- Skins well used
- Zipper handles broken / worn out



## Damages to the impactor – Tibia / Femur



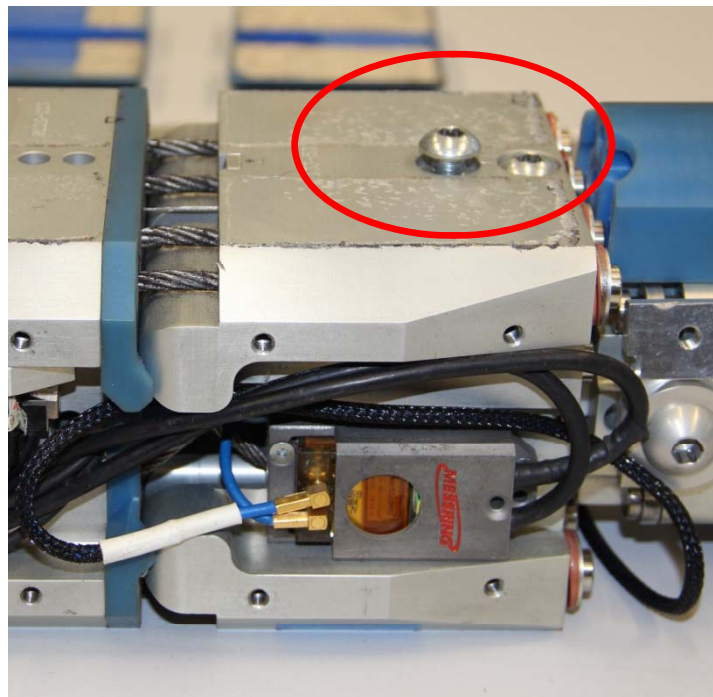
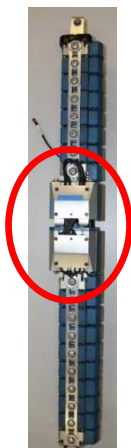
- Stress relief for trigger cable at knee element missing



- Lower protective cap broken (plastic part)



## Damages to the impactor – Knee Element (1)

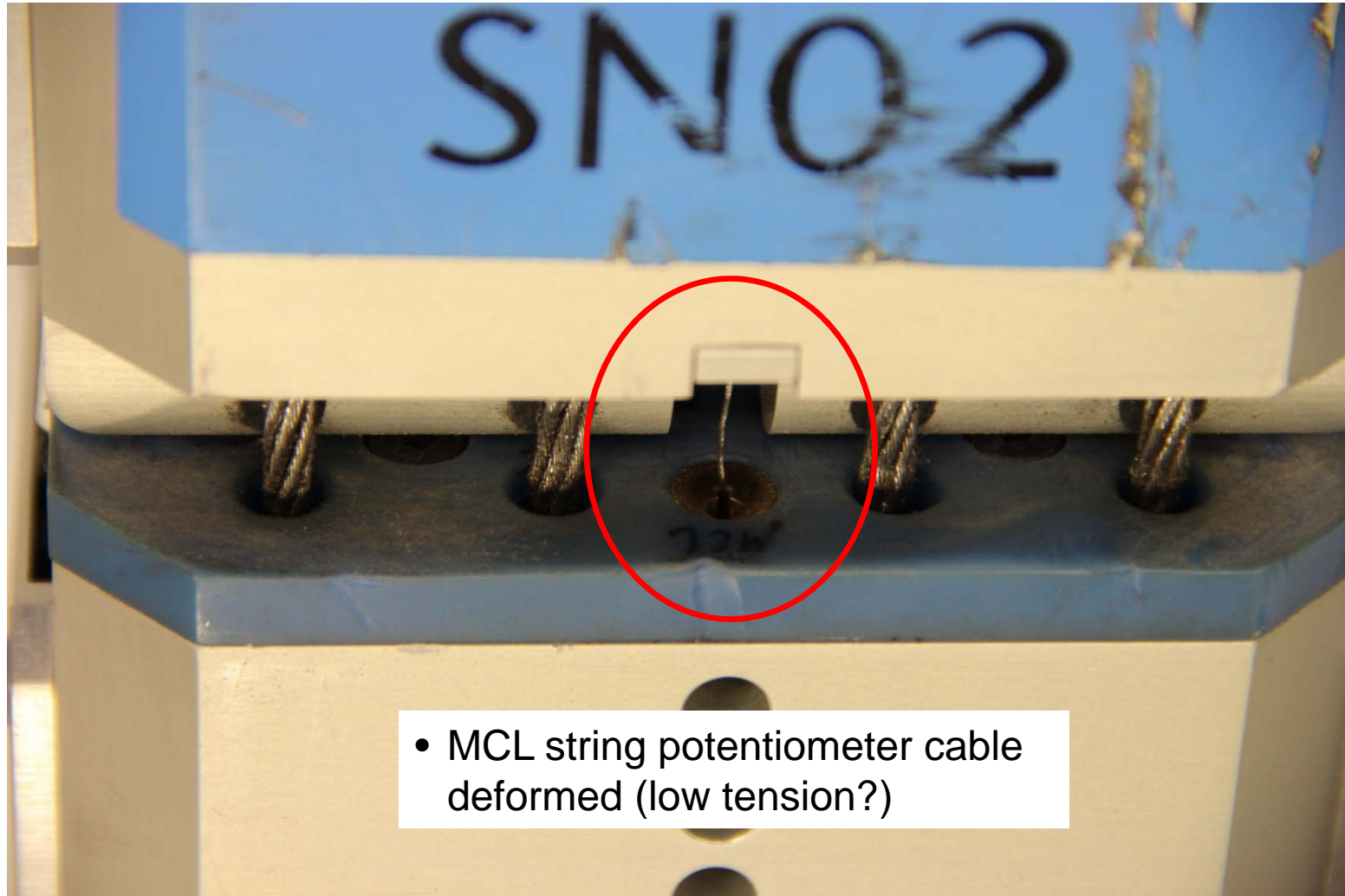
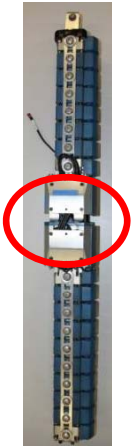


- Loose screw at knee element, only visible after removal of plastic parts
- Further loose screws were found at inner parts, which are not regularly checked

- Mechanical damages to metal parts (hard impacts, misuse?)



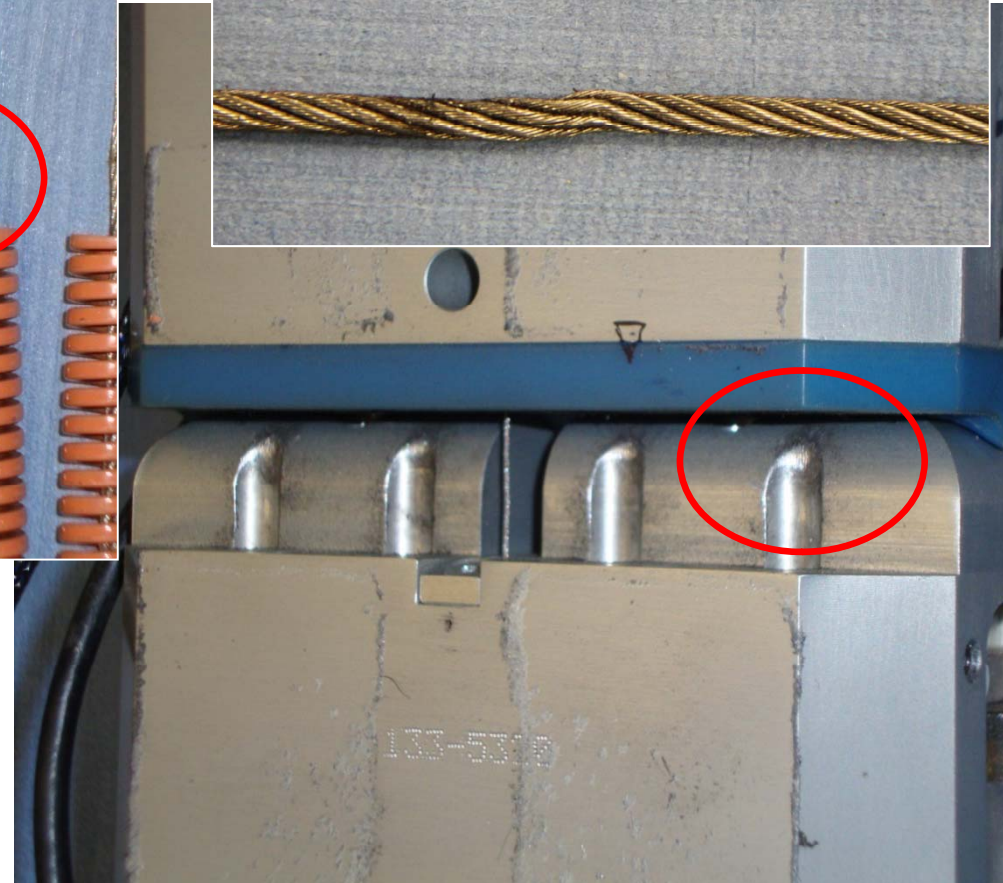
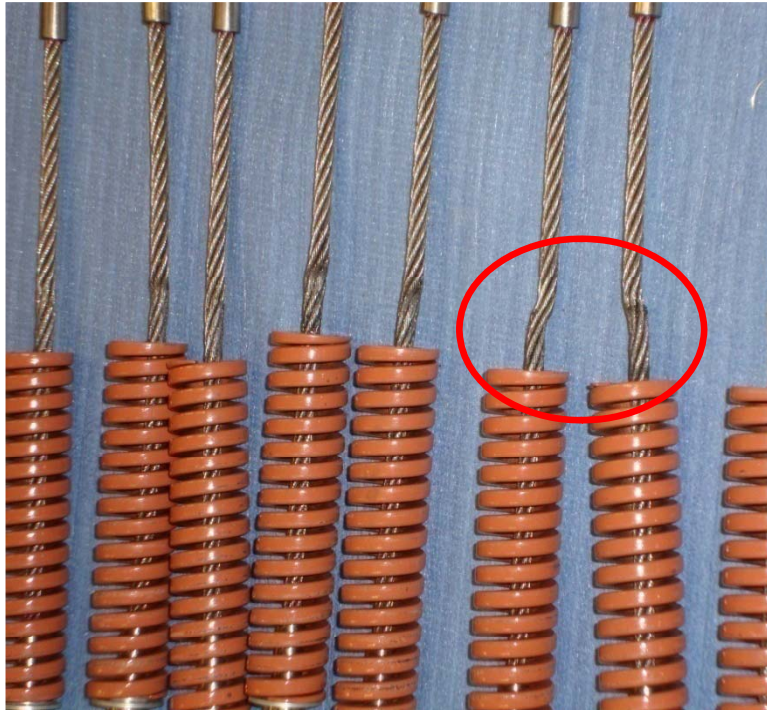
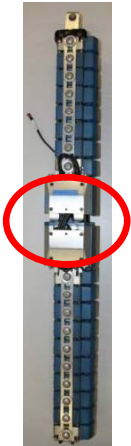
## Damages to the impactor – Ligament Sensors



- MCL string potentiometer cable deformed (low tension?)

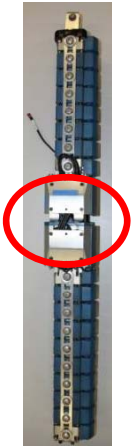


## Damages to the impactor – Knee Element (2)



- Wearing at steel cables representing collateral ligaments as well as at their housing

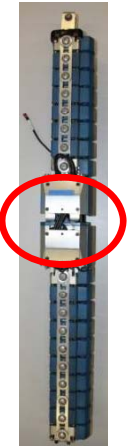
## Damages to the impactor – Knee Element (3)



- Wearing/deformation at steel cables representing cruciate ligaments

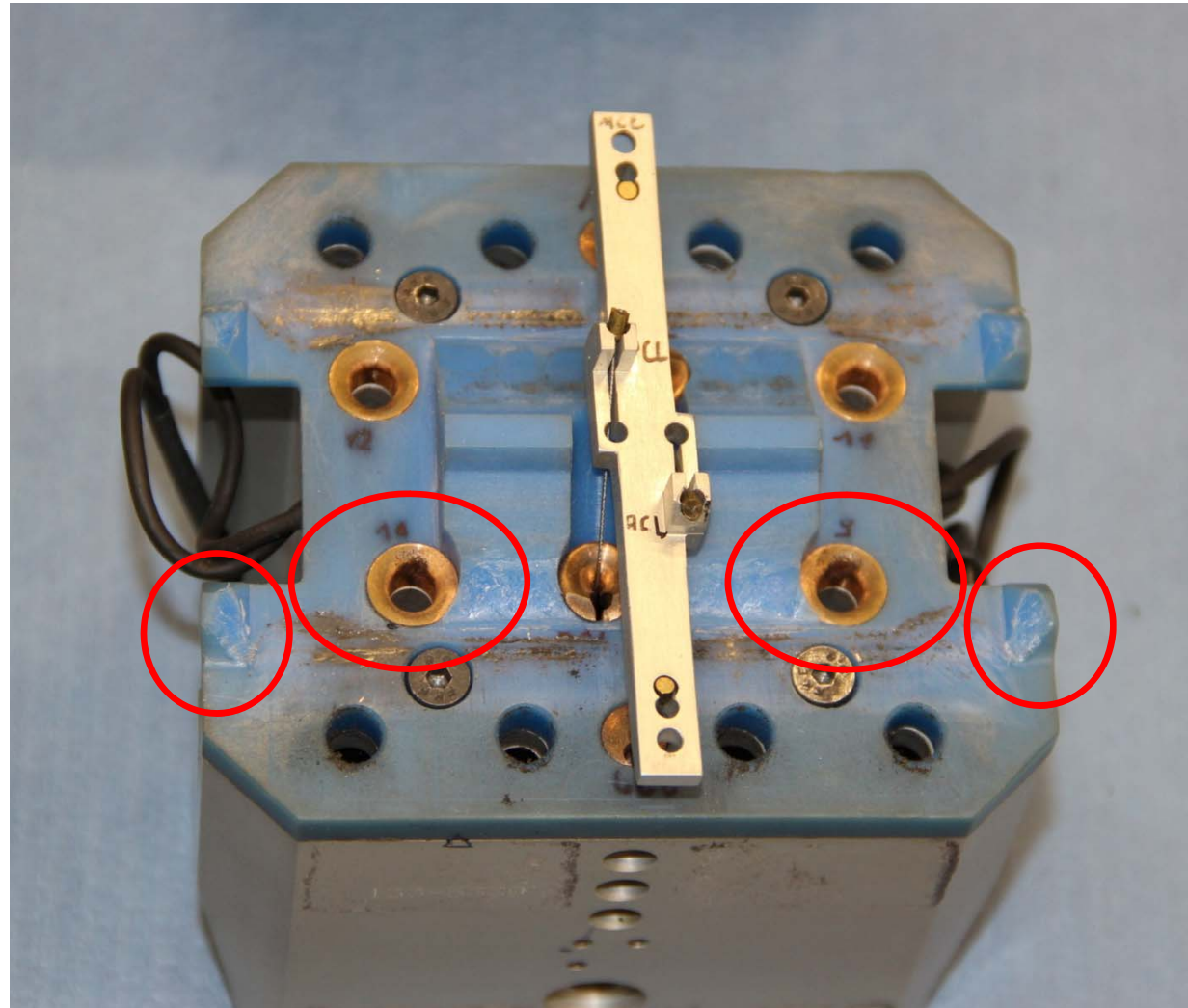


## Damages to the impactor – Knee Element (4)

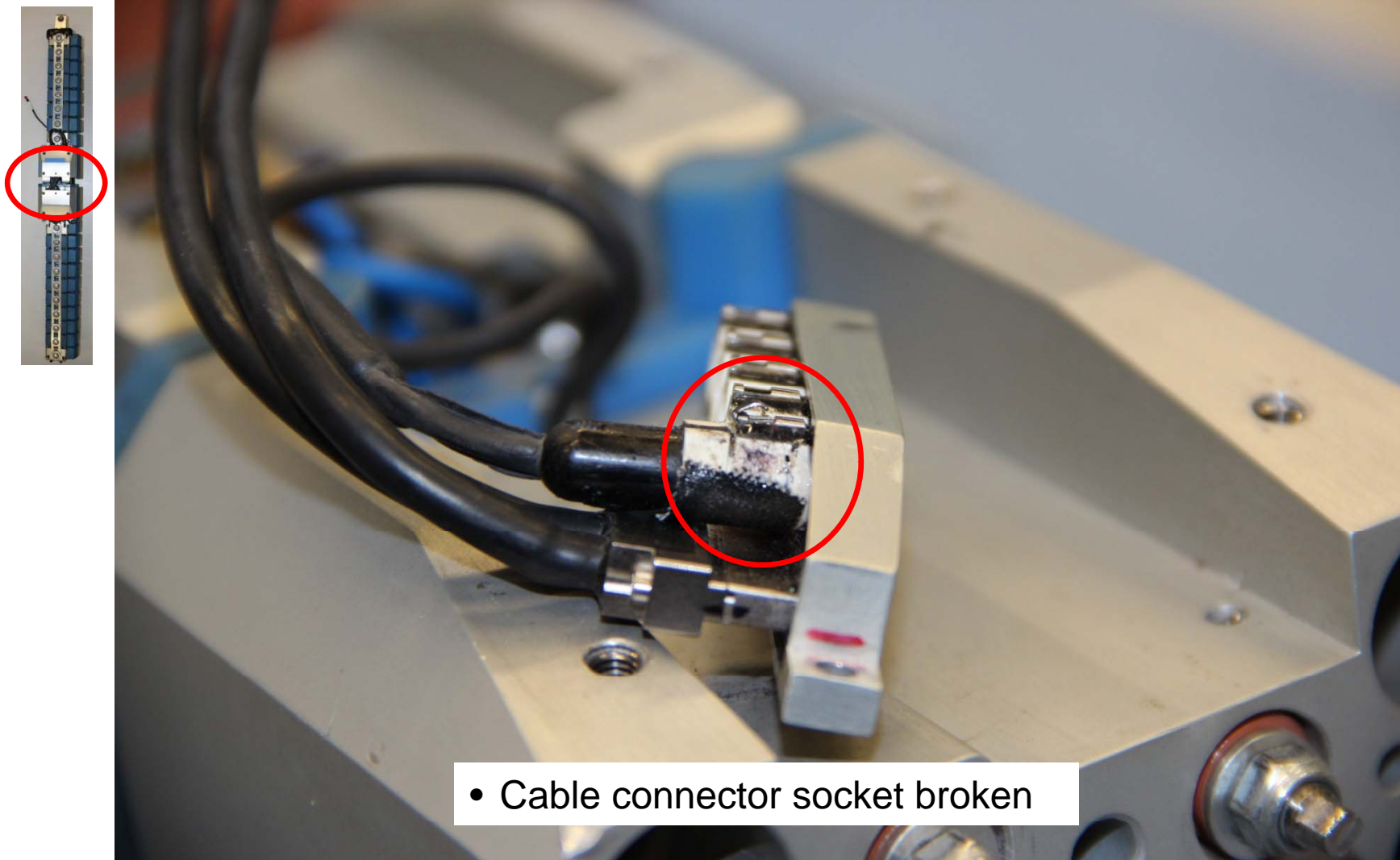


Top view of lower knee segment:

- Wearing at cruciate ligament cable bushes (bronze)
- Wearing at plastic material

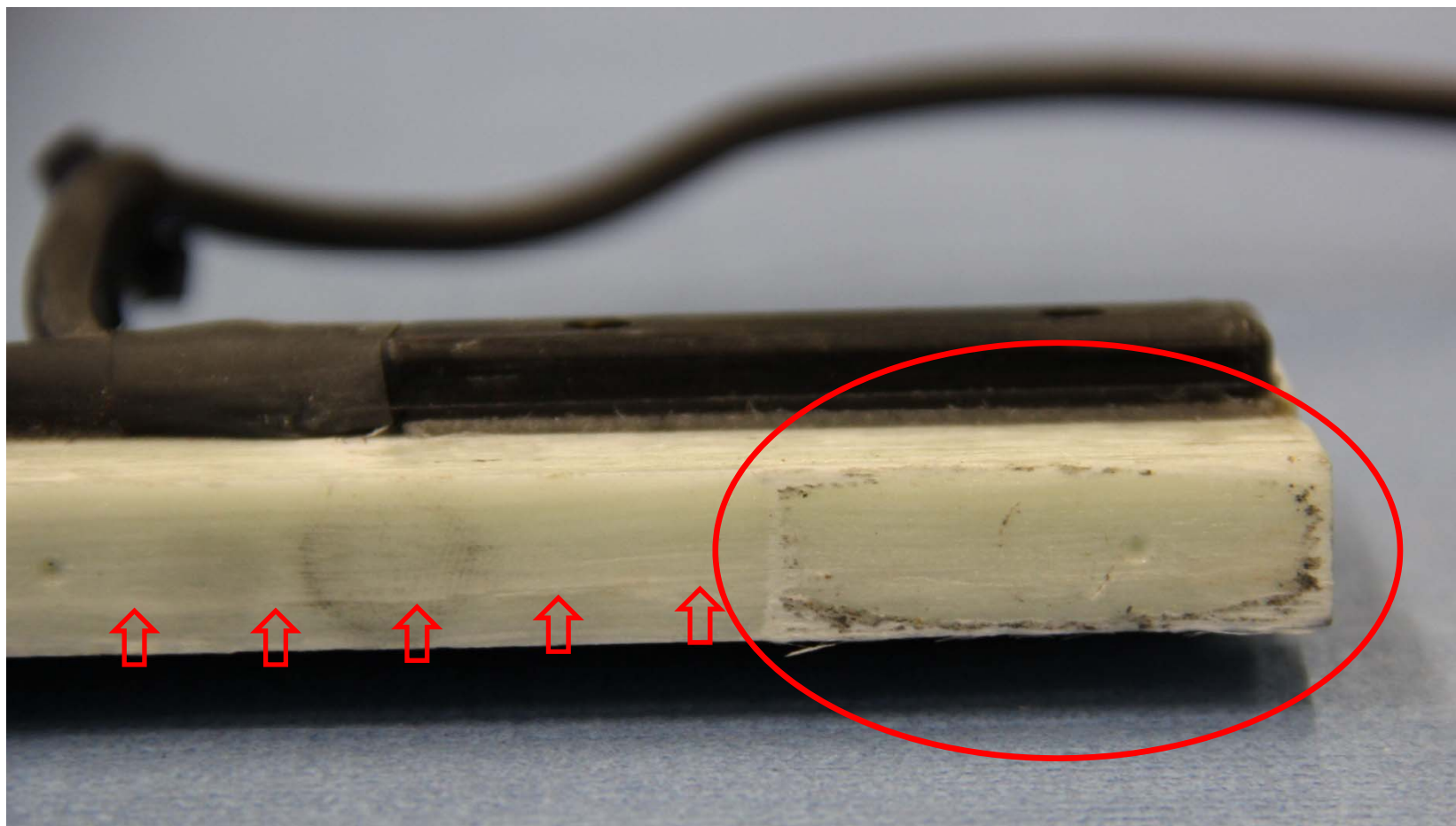
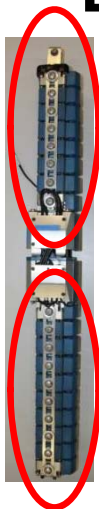


## Damages to the impactor – Data Acquisition System



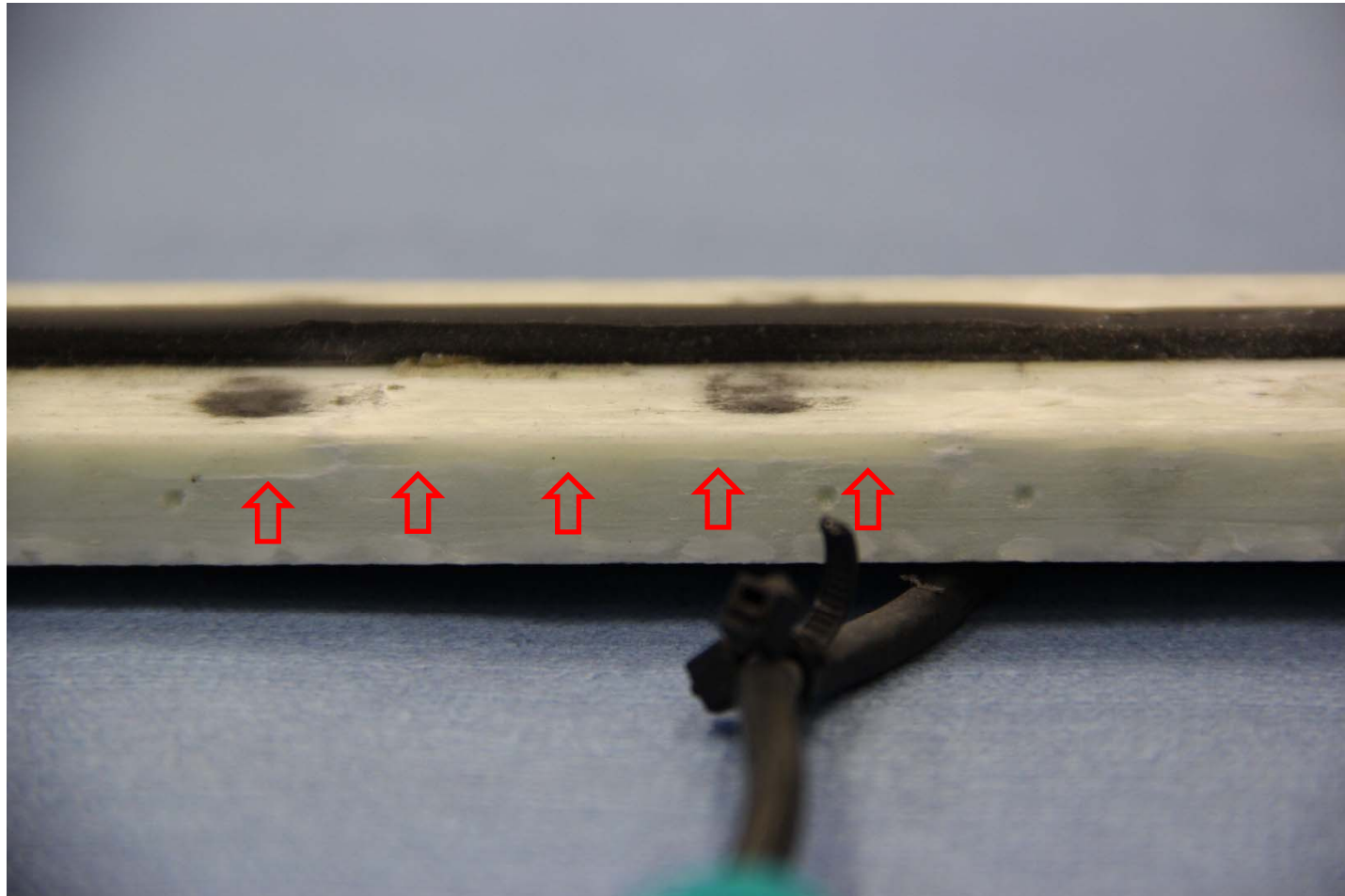


## Damages to the impactor – Polyester Bone Cores (1)



- Wearing and white cracks near/at knee clamping area

## Damages to the impactor – Polyester Bone Cores (2)



- White cracks (femur section)

## Re-Assembling

- Impactor was re-assembled without changing parts
- After this, an inverse certification test was performed
- The impactor met the respective certification corridors<sup>\*)</sup> agreed for the draft amendment to gtr No 9

Test number	Variable	Value	Specification*	Spec. Complied**
SN02-1111-I	Impact velocity	11.04 m/s	10.9 – 11.3 m/s	Yes
	Temperature	21.4 °C	16 – 24 °C	Yes
	Tibia 1	258.3 Nm	237 – 277 Nm	Yes
	Tibia 2	224.9 Nm	223 – 269 Nm	Yes
	Tibia 3	181.1 Nm	176 – 204 Nm	Yes
	Tibia 4	91.0 Nm	98 – 120 Nm	No
	ACL	10.2 mm	8.5 – 10.5 Nm	Yes
	PCL	5.28 mm	4.5 – 6 Nm	Yes
	MCL	19.6 mm	18 – 23 Nm	Yes

<sup>\*)</sup> The impactor did again not meet the corridor at Tibia 4. However, this is a known problem of this specific impactor.

## Conclusions

- Some components that are obviously not intended to be replaced are showing significant wear
- Wear to the components appears not to affect the ability to certify the impactor so far
- However, PADI<sup>\*)</sup> should also cover:
  - Recommendations for a regular complete disassembly and checking of the impactor's condition (e.g. after 100 tests?)
  - Recommendations on frequency of components' replacement as well as related procedures
  - Remarks for the time necessary to do the respective operations (e.g. around 2 hours for complete disassembly, around 3 hours for reassembly plus additional time in case parts are to be changed)

<sup>\*)</sup> PADI = procedures for assembly and disassembly and instructions, meaning drawings and user manual



## Conclusions (Continued)

- Currently seen as most critical: Availability of spare parts is unclear or delivery times are unacceptably long (min. 6 months)
- Costs of spare parts are not fully clear and will affect the costs of testing (which currently are understood to be comparable to the EEVC LFI)



New skin peaces are offered for around 60 euro + VAT ✓<sup>\*)</sup>

New protective caps are offered for about 400 euro + VAT

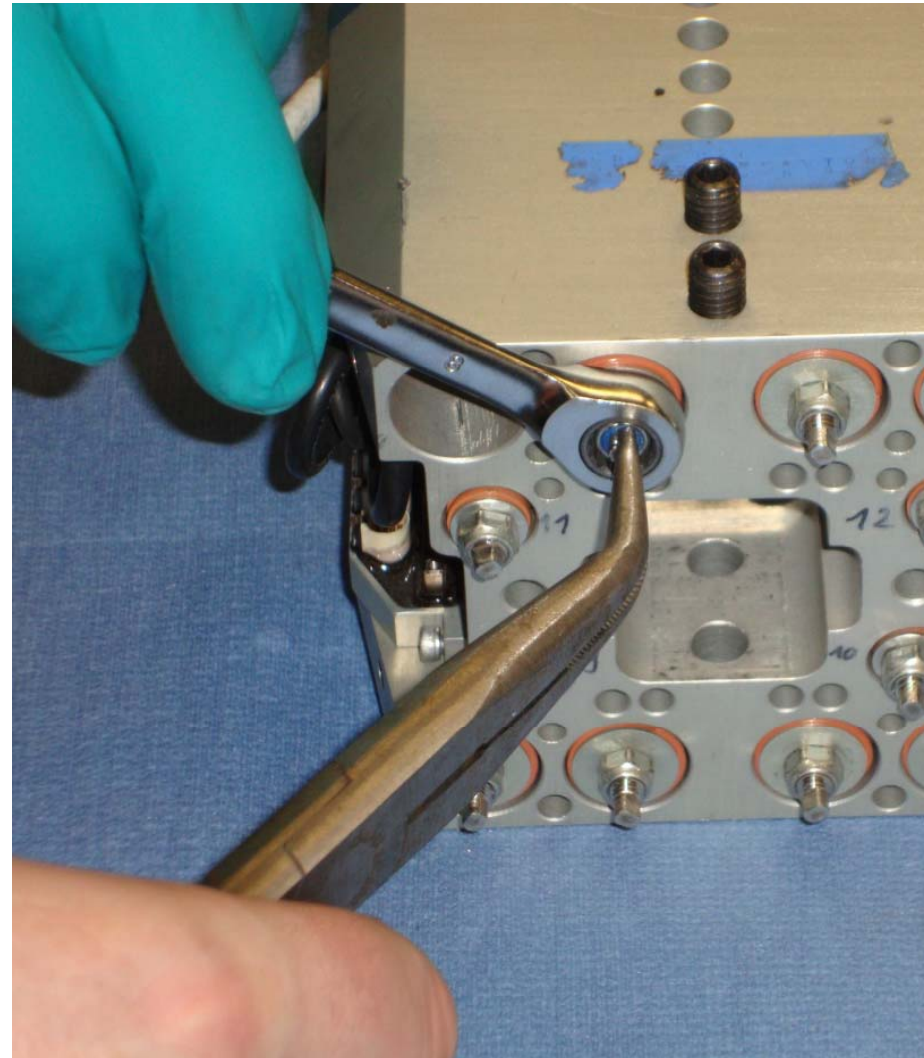


- Further assessment needed if bone core material is changed

<sup>\*)</sup> Assessment purely based on OEM's perspective

## Acknowledgements

Special thanks to  
BGS Boehme & Gehring  
and especially to the  
helping hands of Mr. Th. Junker!





# THANKS

For detailed questions please refer to the author, Mr. Thomas Kinsky / General Motors Europe Engineering,  
as representative of the Task Force Pedestrians of the European Automobile Manufacturers' Association ACEA

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