Verification of Draft FlexPLI prototype impactor limits and application to FlexPLI serial production level

5th Meeting of Informal Group GTR9 Phase 2
Bergisch Gladbach, December 6th - 7th, 2012

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Background

- **During their 9th meeting, the members of the FlexPLI Technical Evaluation Group agreed on draft FlexPLI threshold values for tibia bending moments as well as the medial collateral ligament (see Doc TEG-109r1)**

- **The studies these limits are based on are in principal described in Doc TEG-127**

- **All tentative FlexPLI thresholds are described in ECE-TRANS-WP29-GRSP-2011-14e:**

  MCL elongation: 22 mm
  ACL/PCL elongation: 13 mm
  Tibia bending moments: 340 Nm
  (w/ relaxation zone (380 Nm) of twice the impactor width)

Dynamic certification test results

- **In the course of the past months, the FlexPLI series production level has been found in most occasions to not being able to fulfill both the inverse and pendulum draft certification corridors.**

- **The TF-RUCC has reviewed and updated the corridors based on a proposal by BASt (Doc TF-RUCC-4-04). This proposal was agreed by the IG GTR9-PH2 during their 4th session.**

- **The original tibia draft corridor mean values were shifted down between 2,3 and 7,8 % for the inverse test and shifted up between 0 and 3,4% for the pendulum test. For the ligaments, the corridor mean values were entirely shifted down (between 4,8 and 9,6 %).**

Inverse corridors MV shift

Tibia A1	Tibia A2	Tibia A3	Tibia A4	ACL	PCL	MCL
-6	-15	-11	-8,5	-0,5	-0,25	-1,5
-2,33	-6,10	-5,79	-7,80	-5,26	-4,76	-7,32

abs.
[%]

Pendulum corridors MV shift

Tibia A1	Tibia A2	Tibia A3	Tibia A4	ACL	PCL	MCL
0	5	5	-0,5	-0,75	-0,45	-2,25
0,00	2,53	3,39	-0,50	-7,50	-9,57	-9,18

Vehicle test results

- **At the 4th meeting of the IG GTR9-PH2, a comparison of vehicle tests with FlexPLI prototypes and serial production legs on identical cars and impact locations was presented by BASt (GTR9-4-14).**
- **The study underlines that the serial production impactors, while all meeting the updated dynamic certification corridors, are producing in most cases lower output values than the prototypes.**

	Tibia A1	Tibia A2	Tibia A3	Tibia A4	ACL	PCL	MCL
Proto	311,83	326,33	264,87	177,50	8,47	7,50	19,67
Ser. Prod.	285,97	277,47	238,63	188,87	9,23	5,77	19,50
Dev. [%]	-8,30	-14,97	-9,90	6,40	9,06	-23,11	-0,85

Sedan #1 – Impact location #1 (3 PT, 3 SP)

	Tibia A1	Tibia A2	Tibia A3	Tibia A4	ACL	PCL	MCL
Proto	239,07	282,27	243,50	164,97	6,50	6,43	21,30
Ser. Prod.	212,20	260,00	227,03	149,77	6,07	5,30	19,43
Dev. [%]	-11,24	-7,89	-6,76	-9,21	-6,67	-17,62	-8,76

Sedan #1 – Impact location #2 (3 PT, 3 SP)

	Tibia A1	Tibia A2	Tibia A3	Tibia A4	ACL	PCL	MCL
Proto	198,58	156,21	263,31	209,81	5,32	5,33	17,17
Ser. Prod.	184,66	146,40	240,29	206,29	4,91	4,51	15,70
Dev. [%]	-7,01	-6,28	-8,74	-1,68	-7,72	-15,42	-8,54

Sedan #2 – Impact location #1 (9 PT, 9 SP)

	Tibia A1	Tibia A2	Tibia A3	Tibia A4	ACL	PCL	MCL
Proto	201,40	161,37	222,57	154,87	7,53	6,67	21,80
Ser. Prod.	170,30	135,40	205,20	153,20	6,20	7,00	19,00
Dev. [%]	-15,44	-16,09	-7,80	-1,08	-17,70	5,00	-12,84

Sedan #2 – Impact location #2 (3 PT, 1 SP)

Conclusion

- **The updated inverse certification corridor mean values are entirely shifted down.**
- **During the vehicle tests, the serial production impactors showed lower output values in the majority of cases, too.**
- **It is therefore suggested to also shift down the Flex-GTR draft threshold values in GTR9-PH2, reflecting the lower output values of the serial production legforms.**
- **As the inverse test well represents the real impactor kinematics during vehicle tests (Doc. TEG-075), it is suggested to use the shift of the inverse corridor mean values for calculating new impactor threshold values.**

Revision of limits

Leg area	Draft threshold Value (ECE-TRANS-WP29-GRSP-2011-14e)	Max. inverse corridors MV shift	Proposal for revised threshold value
Tibia	340 Nm	- 7,80 %	313 Nm*
Tibia relaxation zone	380 Nm	- 7,80 %	350 Nm*
ACL / PCL	13 mm	- 5,26 %	12 mm*
MCL	22 mm	- 7,32 %	20 mm*

*** rounded values**

Thank you !