Informal Group on gtr No 9 - Phase 2 (IG GTR9-PH2)
2nd meeting, Osaka/Japan, 28 - 29 March 2012

FlexPLI Comparison

Action item A-1-14

Impactors: SN02, SN04, IND-Impactor Test experiences

Data provided by Audi/Volkswagen

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

- test experience with 3 different Flex-PLI impactors
  - August 2009: SN04 prototype
  - July 2011: SN02 prototype
  - July 2011: Industrial Serial-impactor (Fa. Bertrandt)
- test of 3 different Vehicle-classes
  - sedan car
  - SUV
  - sport car
- testing areas (Y-co-ordinates) are the same with all 3 different impactors

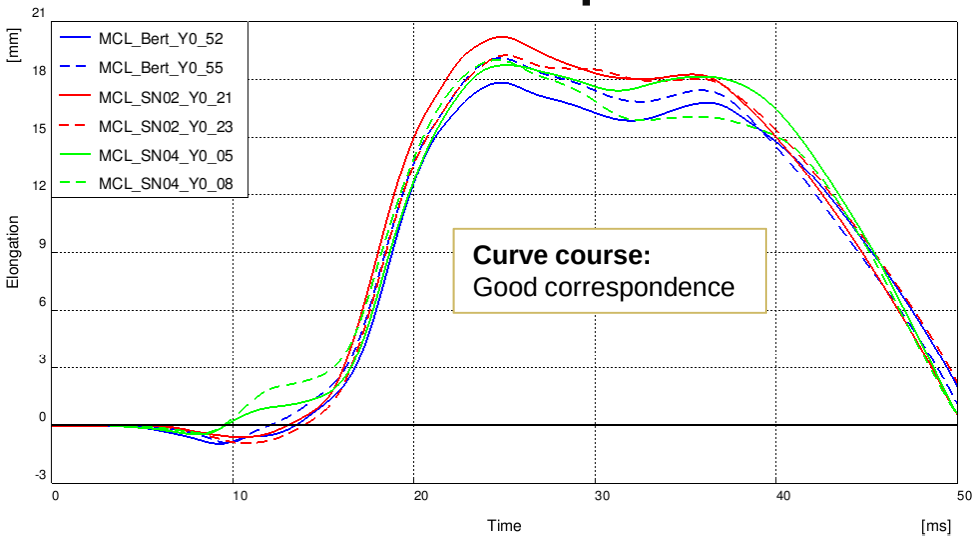
Overview of results

							max-value of column	229,6	208,8	249,2	275,9	20,2	5,7	15,2
				s1 = single test result			min-value of column	73,7	91,0	108,6	133,1	12,5	2,3	5,1
				m3 = mean value of 3 test result /										
No	Flex-GTR No	vehicle type	location	test	ACEA-membe	car No	Legende	Tibia A4	Tibia A3	Tibia A2	Tibia A1	MCL	PCL	ACL
1	IN01	sedan	Y=0	s5	M1	C1	IN01/sedan/M1/C1	152,70	199,10	223,50	196,60	17,83	5,15	5,35
2	IN01	sedan	Y=0	s6	M1	C1	IN01/sedan/M1/C1	148,30	201,70	224,20	206,80	19,01	4,92	6,31
3	SN02	sedan	Y=0	s3	M1	C1	SN02/sedan/M1/C1	147,30	200,90	202,70	192,20	20,19	5,60	5,82
4	SN02	sedan	Y=0	s4	M1	C1	SN02/sedan/M1/C1	150,60	208,80	222,60	199,60	19,23	4,86	6,04
5	SN04	sedan	Y=0	s1	M1	C1	SN04/sedan/M1/C1	130,00	156,30	200,60	175,70	18,73	5,53	5,09
6	SN04	sedan	Y=0	s2	M1	C1	SN04/sedan/M1/C1	126,20	162,40	199,40	185,30	18,99	5,71	5,18
7	IN01	sedan	Y=340	s5	M1	C1	IN01/sedan/M1/C1	153,90	174,80	182,00	180,80	17,31	5,21	5,33
8	IN01	sedan	Y=340	s6	M1	C1	IN01/sedan/M1/C1	154,40	178,00	192,30	191,90	17,55	5,02	5,63
9	SN02	sedan	Y=340	s3	M1	C1	SN02/sedan/M1/C1	151,80	173,00	176,20	181,70	17,66	5,69	5,24
10	SN04	sedan	Y=340	s1	M1	C1	SN04/sedan/M1/C1	154,20	152,50	183,90	207,40	13,66	4,66	8,35
11	SN04	sedan	Y=340	s2	M1	C1	SN04/sedan/M1/C1	138,80	164,10	191,70	200,80	15,19	4,57	6,75
12	IN01	SUV	Y=0	s5	M1	C2	IN01/SUV/M1/C2	96,30	177,80	238,90	259,90	15,69	3,59	9,43
13	IN01	SUV	Y=0	s6	M1	C2	IN01/SUV/M1/C2	86,60	175,30	249,20	275,90	16,56	3,90	9,16
14	SN02	SUV	Y=0	s3	M1	C2	SN02/SUV/M1/C2	76,30	169,40	235,90	271,90	15,44	3,21	9,01
15	SN02	SUV	Y=0	s4	M1	C2	SN02/SUV/M1/C2	75,10	168,50	229,20	272,70	14,42	2,29	9,39
16	SN04	SUV	Y=0	s1	M1	C2	SN04/SUV/M1/C2	79,60	161,60	231,30	260,20	14,72	3,56	9,39
17	SN04	SUV	Y=0	s2	M1	C2	SN04/SUV/M1/C2	76,80	156,80	227,40	255,90	14,06	2,53	8,75
18	IN01	SUV	Y=390	s5	M1	C2	IN01/SUV/M1/C2	77,50	143,70	173,90	184,70	13,79	3,87	8,36
19	IN01	SUV	Y=390	s6	M1	C2	IN01/SUV/M1/C2	88,30	163,10	199,20	202,10	15,37	3,71	8,27
20	SN02	SUV	Y=390	s3	M1	C2	SN02/SUV/M1/C2	85,90	160,40	178,90	194,20	14,02	3,51	9,61
21	SN02	SUV	Y=390	s4	M1	C2	SN02/SUV/M1/C2	82,90	169,30	181,70	199,80	12,54	2,87	7,78
22	SN04	SUV	Y=390	s1	M1	C2	SN04/SUV/M1/C2	73,70	149,40	154,50	166,80	13,98	4,45	7,98
23	SN04	SUV	Y=390	s2	M1	C2	SN04/SUV/M1/C2	79,80	152,80	143,20	160,10	14,65	4,49	7,87
24	IN01	sport	Y=-226	s5	M1	C3	IN01/sport/M1/C3	192,00	95,50	126,40	161,30	15,09	4,03	12,64
25	IN01	sport	Y=-226	s6	M1	C3	IN01/sport/M1/C3	184,70	105,20	124,90	157,60	15,06	5,61	13,02
26	SN02	sport	Y=-226	s3	M1	C3	SN02/sport/M1/C3	214,10	130,50	114,00	146,60	14,67	4,29	12,97
27	SN02	sport	Y=-226	s4	M1	C3	SN02/sport/M1/C3	184,90	98,90	113,30	153,60	15,62	4,61	13,31
28	SN04	sport	Y=-226	s1	M1	C3	SN04/sport/M1/C3	228,30	142,90	121,70	143,50	14,29	4,45	15,18
29	SN04	sport	Y=-226	s2	M1	C3	SN04/sport/M1/C3	229,60	134,30	118,90	133,10	13,00	4,51	14,84
30	IN01	sport	Y=270	s5	M1	C3	IN01/sport/M1/C3	194,40	91,00	121,40	150,60	15,16	4,54	12,27
31	SN02	sport	Y=270	s3	M1	C3	SN02/sport/M1/C3	194,70	103,70	112,60	153,90	15,33	4,25	13,58
32	SN02	sport	Y=270	s4	M1	C3	SN02/sport/M1/C3	206,50	119,30	108,60	140,90	14,78	4,22	13,43
33	SN04	sport	Y=270	s1	M1	C3	SN04/sport/M1/C3	171,40	98,30	121,30	141,10	12,52	4,65	12,79
34	SN04	sport	Y=270	s2	M1	C3	SN04/sport/M1/C3	196,50	113,40	123,00	139,90	13,01	4,15	14,23

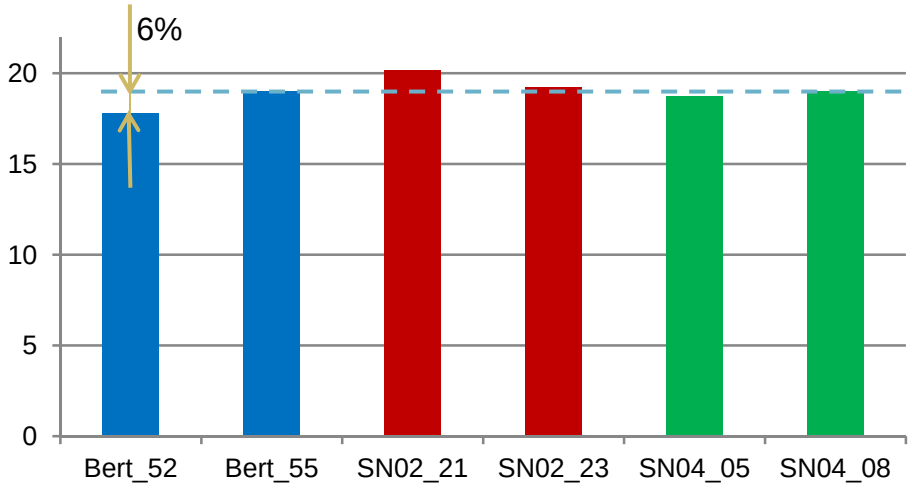
Test experiences Sedan at Y0

Test experiences Sedan at Y0

MCL



	MCL	t (max)
Bert_52	17.83	24.8
Bert_55	19.01	24.7
SN02_21	20.19	24.9
SN02_23	19.23	25.1
SN04_05	18.73	25.1
SN04_08	18.99	24.6



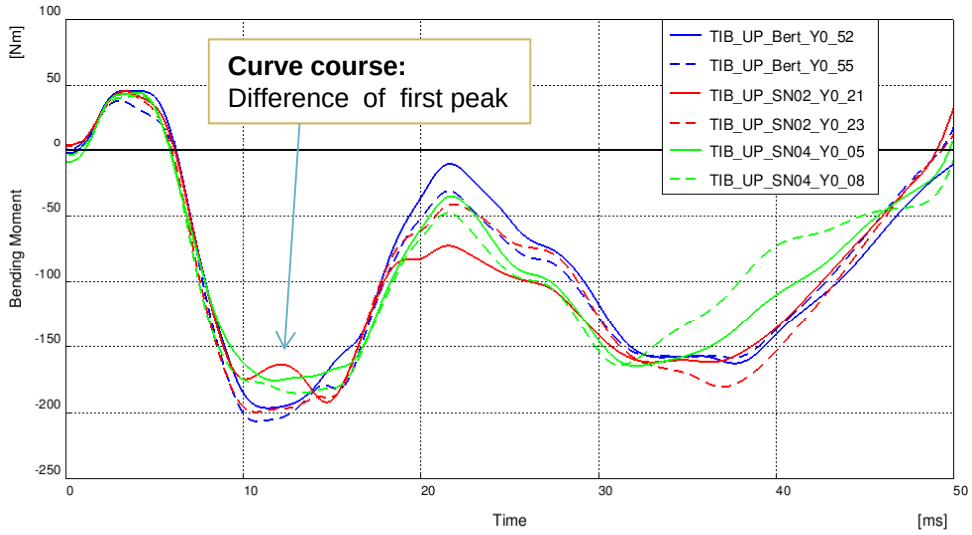
Result comparison of the max.value

Good correspondence (<10%)
-> Industrial-Imp. is comparable with SN04 (Aug.2009)

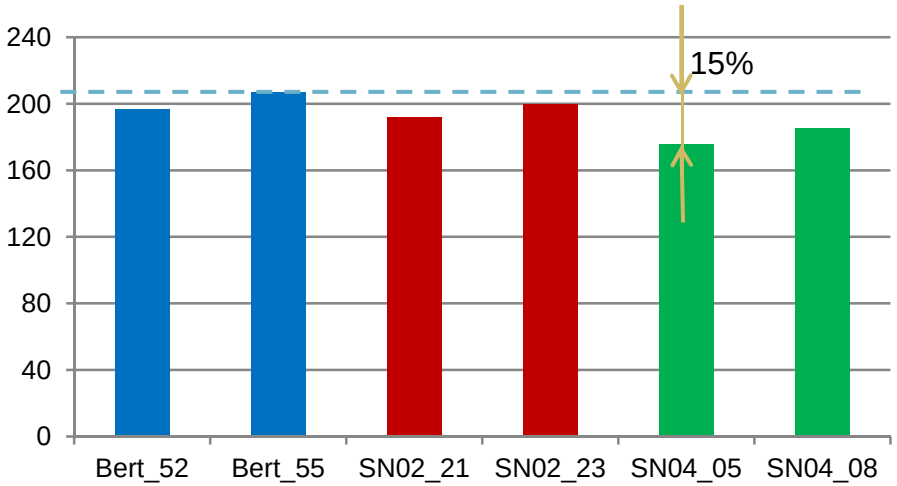
Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)
Repetition test

Test experiences Sedan at Y0

TIBIA (1) UP



	TIB UP	t (max)
Bert_52	196.6	11.4
Bert_55	206.8	10.8
SN02_21	192.2	14.7
SN02_23	199.6	10.7
SN04_05	175.7	11.8
SN04_08	185.3	13.1



Result comparison of the max.value

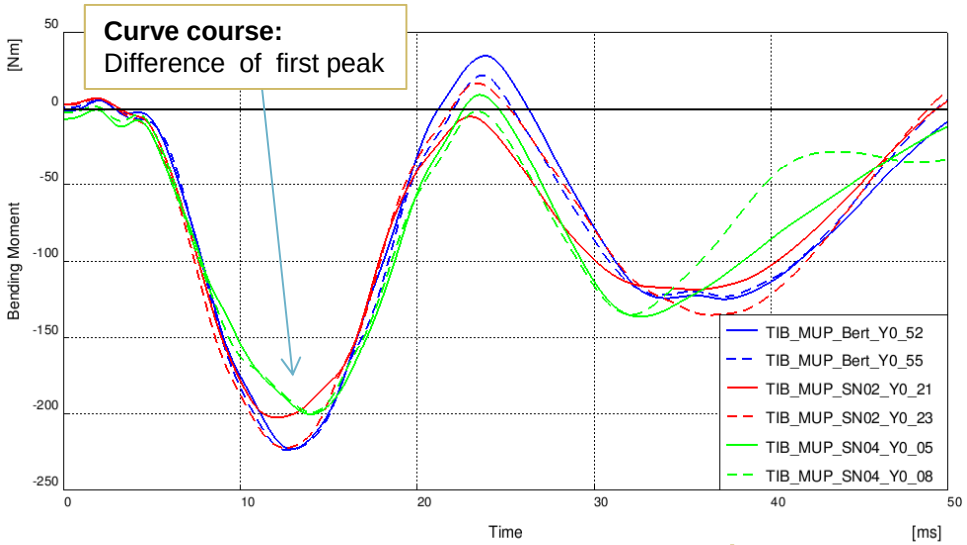
High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

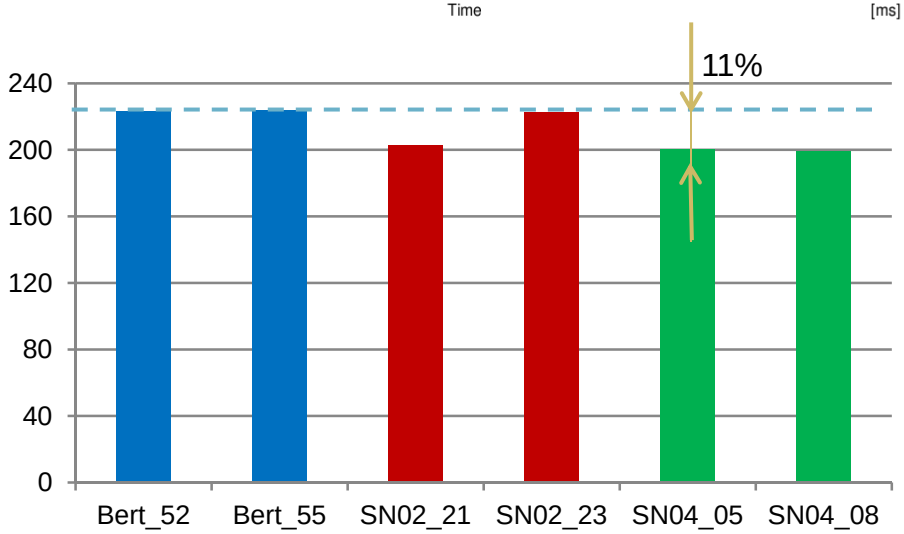
Repetition test

Test experiences Sedan at Y0

TIBIA(2) MUP



	TIB MUP	t (max)
Bert_52	223.5	12.9
Bert_55	224.2	12.7
SN02_21	202.7	12.1
SN02_23	222.6	12.5
SN04_05	200.6	13.9
SN04_08	199.4	14



Result comparison of the max.value

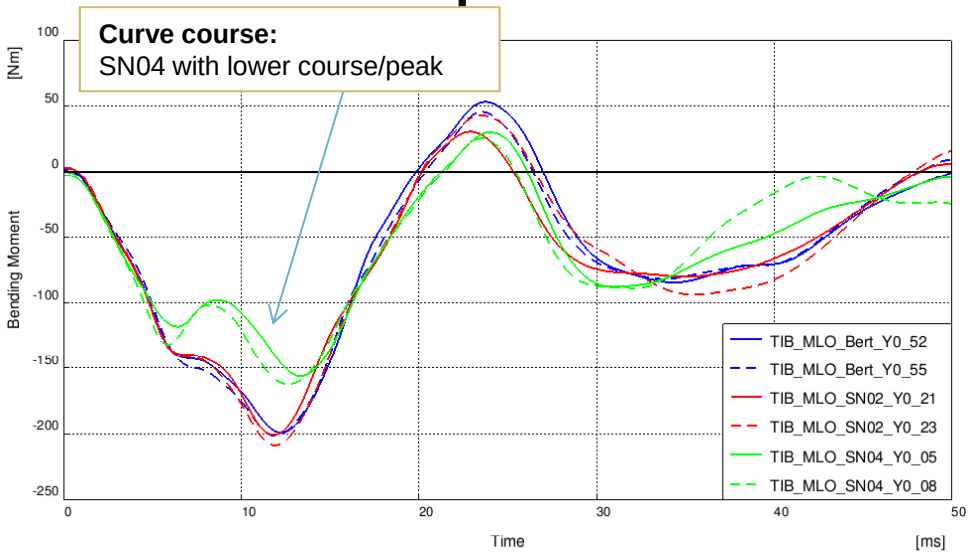
Divergence near 10%
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

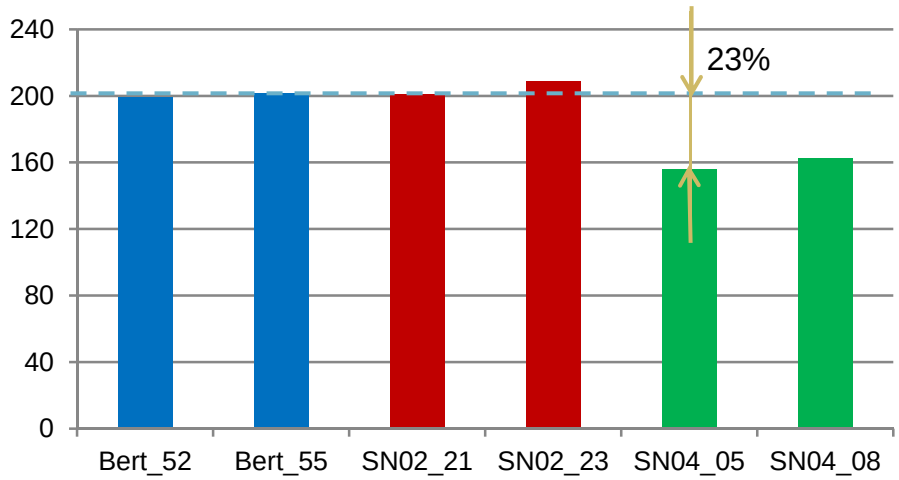
Repetition test

Test experiences Sedan at Y0

TIBIA(3) MLO



	TIB MLO	t (max)
Bert_52	199.1	12.2
Bert_55	201.7	11.9
SN02_21	200.9	11.8
SN02_23	208.8	11.9
SN04_05	156.3	13.3
SN04_08	162.4	12.7



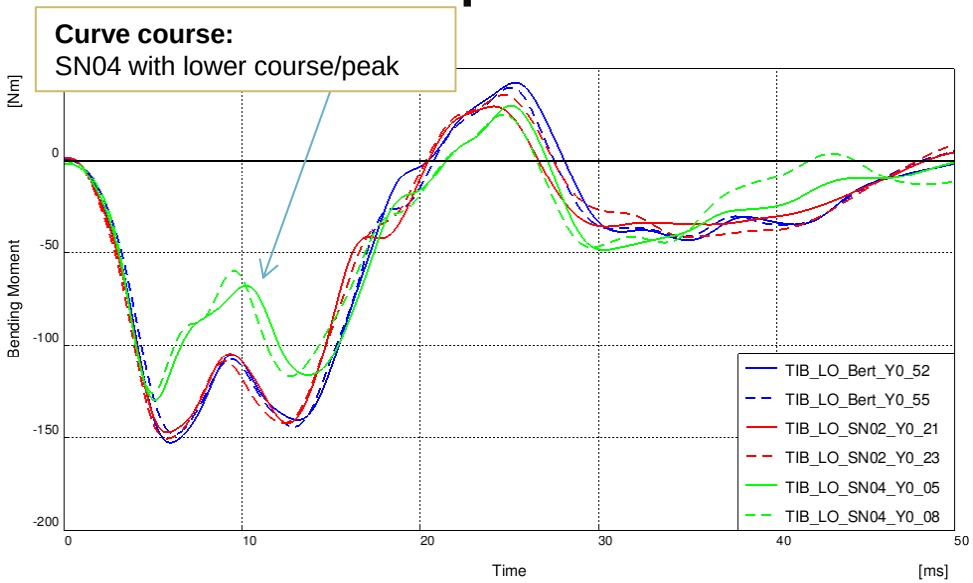
Result comparison of the max.value

High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

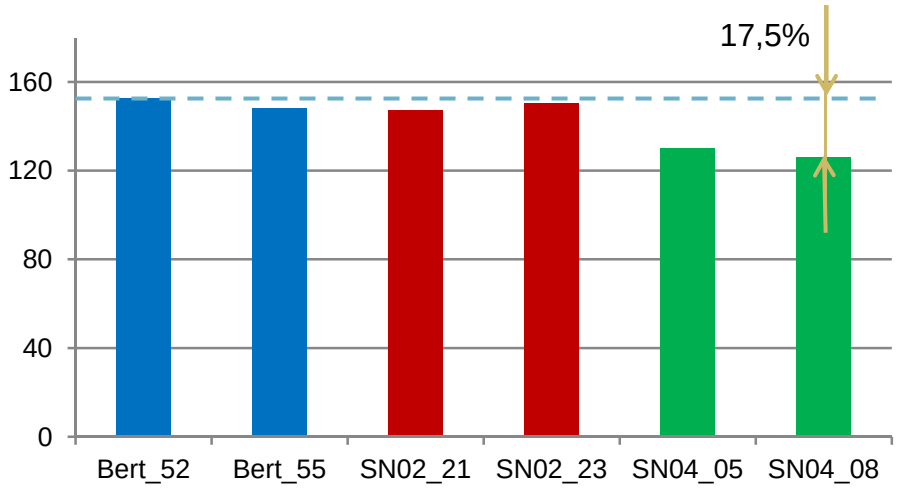
Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)
Repetition test

Test experiences Sedan at Y0

TIBIA(4) LO



	TIB LO	t (max)
Bert_52	152.7	5.9
Bert_55	148.3	6.2
SN02_21	147.3	5.8
SN02_23	150.6	5.8
SN04_05	130	5.1
SN04_08	126.2	4.9



Result comparison of the max.value

High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

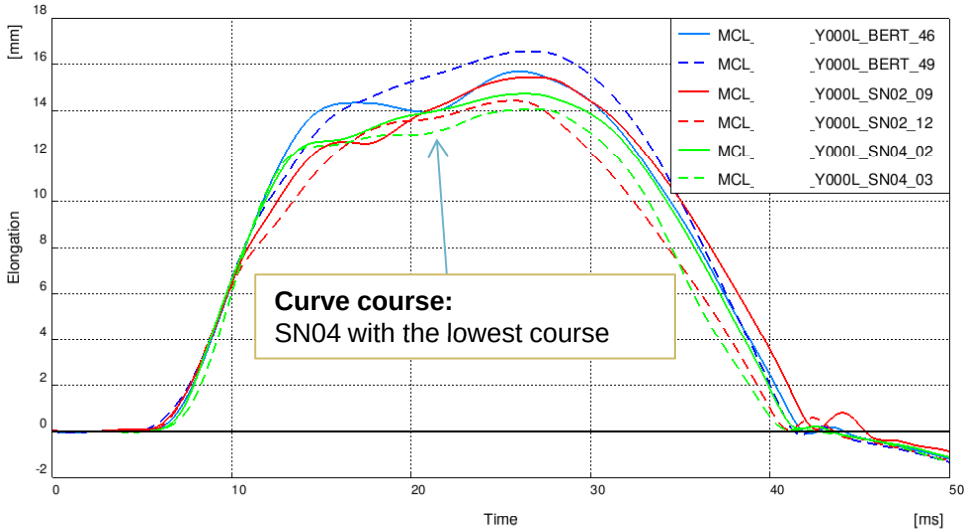
Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

Repetition test

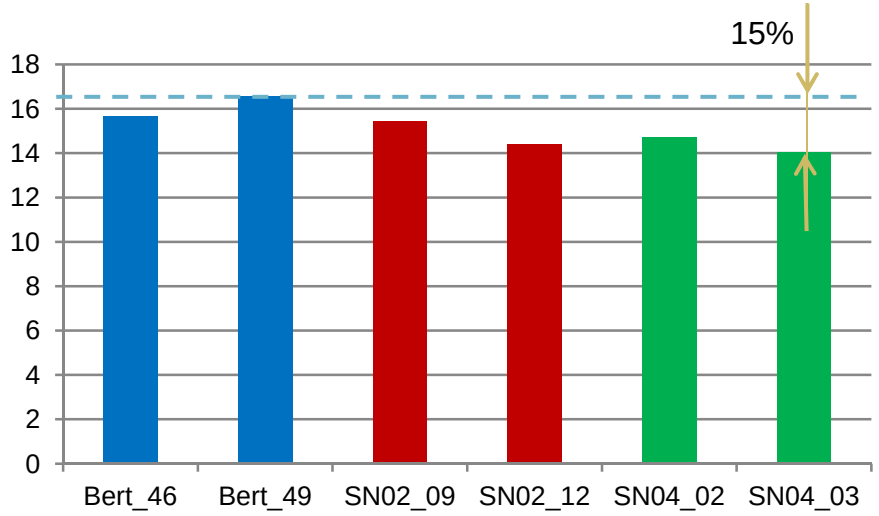
Test experiences SUV at Y0

Test experiences SUV at Y0

MCL



	MCL	t (max)
Bert_46	15,69	26
Bert_49	16,56	26,6
SN02_09	15,44	26,7
SN02_12	14,42	25,7
SN04_02	14,72	26,3
SN04_03	14,06	26,9



Result comparison of the max.value

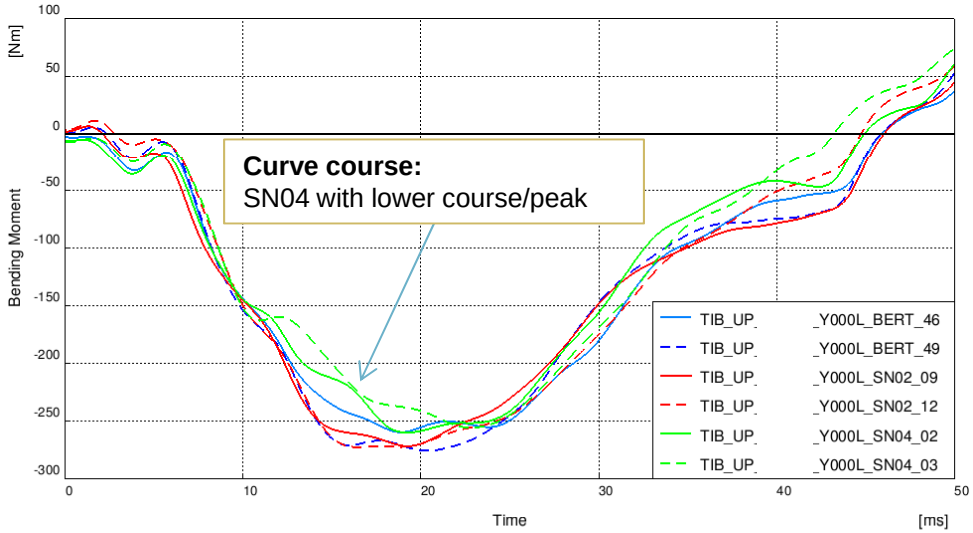
High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

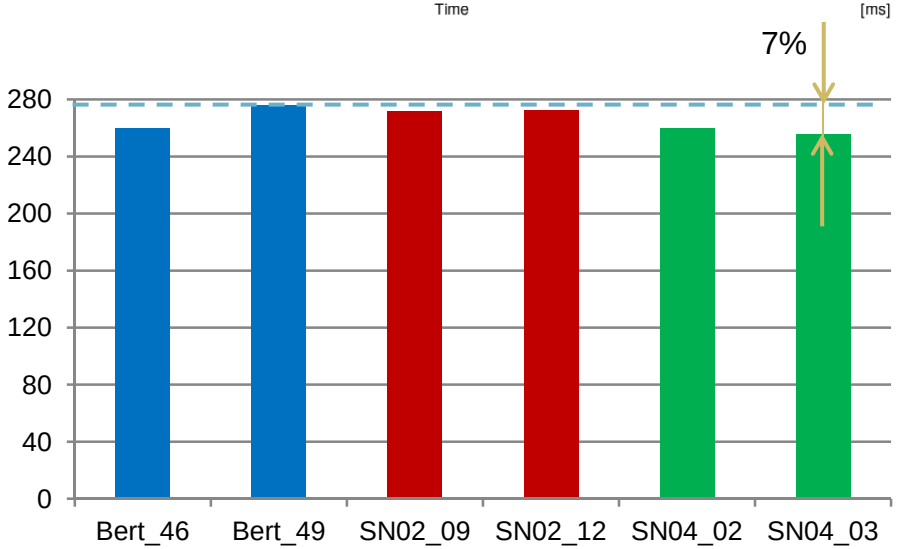
Repetition test

Test experiences SUV at Y0

TIBIA(1) UP



	TIB UP	t (max)
Bert_46	259,9	18,9
Bert_49	275,9	20,4
SN02_09	271,9	19,3
SN02_12	272,7	16,4
SN04_02	260,2	19,2
SN04_03	255,9	22,8



Result comparison of the max.value

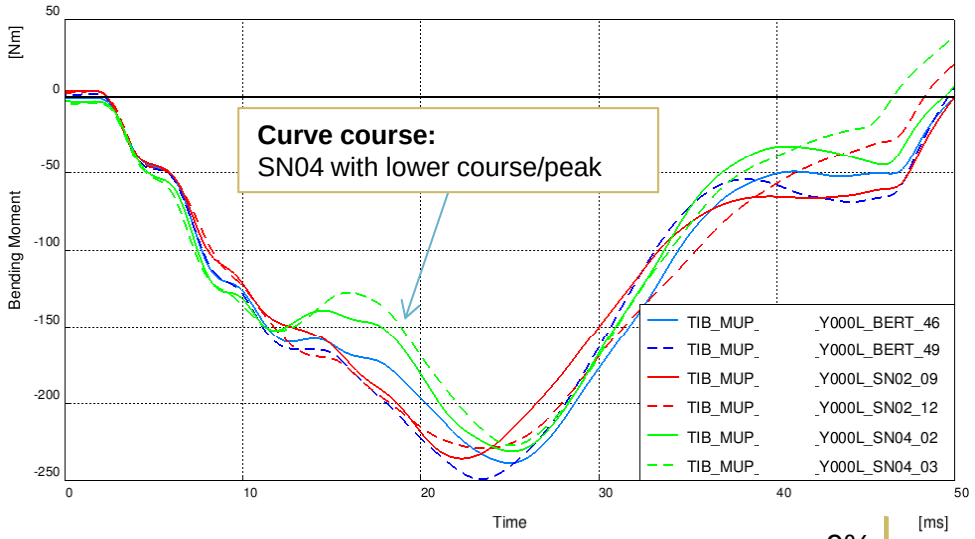
Good correspondence (<10%)
-> Industrial-Imp. is comparable with SN04 (Aug.2009)

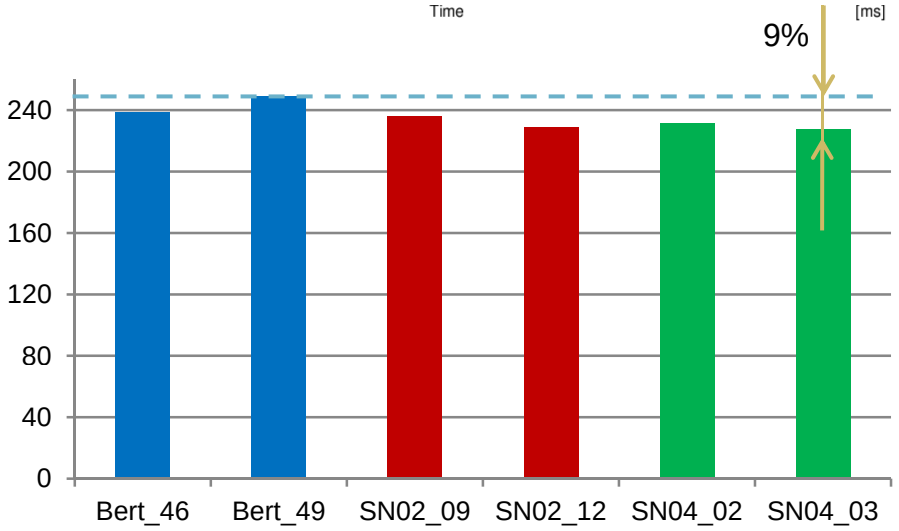
Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

Repetition test

Test experiences SUV at Y0

TIBIA(2) MUP





	TIB MUP	t (max)
Bert_46	238,9	25
Bert_49	249,2	23,4
SN02_09	235,9	22,3
SN02_12	229,2	23,5
SN04_02	231,3	25,1
SN04_03	227,4	25,1

Result comparison of the max.value

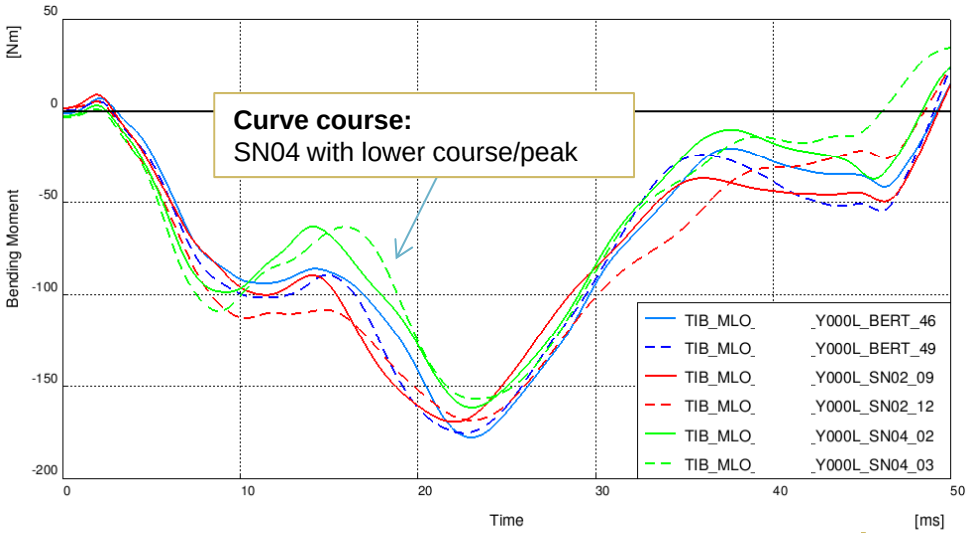
Good correspondence (<10%)
-> Industrial-Imp. is comparable with SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

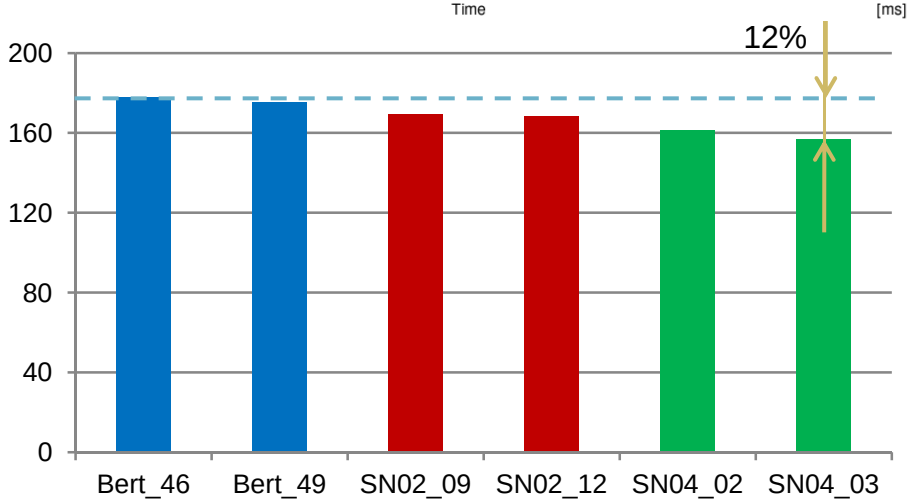
Repetition test

Test experiences SUV at Y0

TIBIA(3) MLO



	TIB MLO	t (max)
Bert_46	177,8	23
Bert_49	175,3	22,6
SN02_09	169,4	22,1
SN02_12	168,5	23
SN04_02	161,6	23
SN04_03	156,8	23,4



Result comparison of the max.value

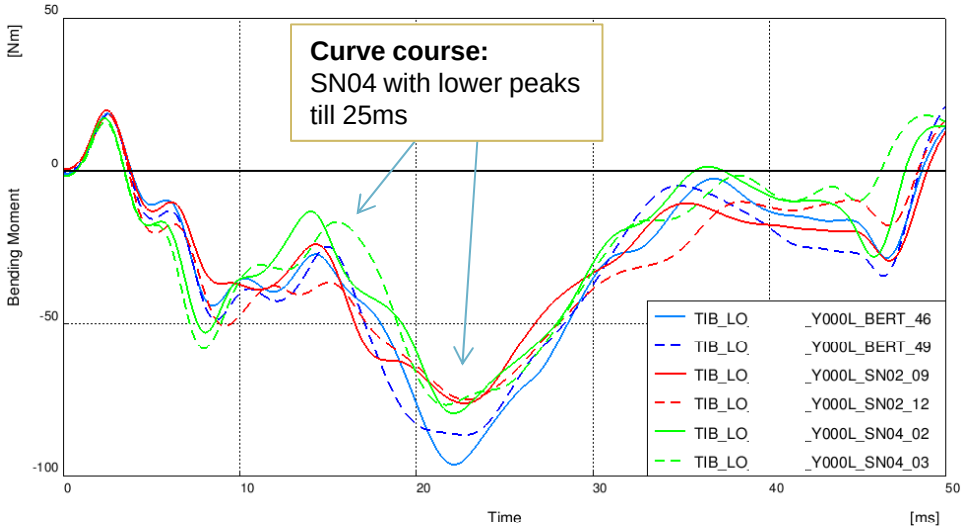
High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

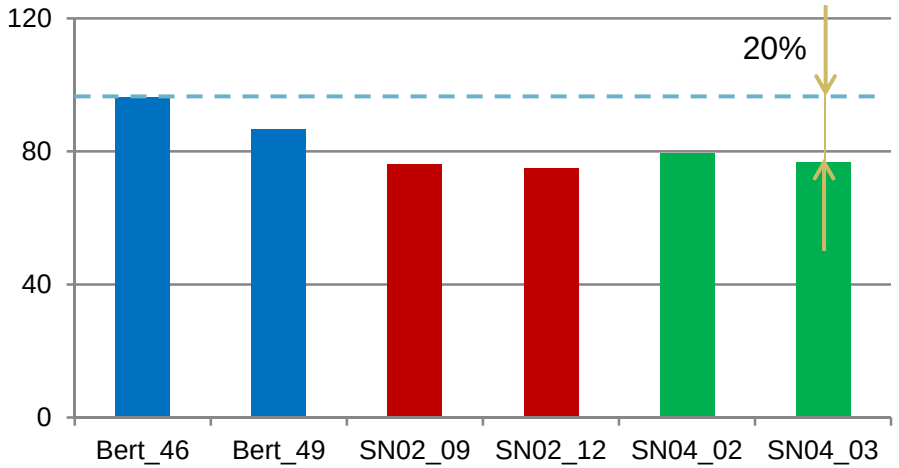
Repetition test

Test experiences SUV at Y0

TIBIA(4) LO



	TIB LO	t (max)
Bert_46	96,3	22,2
Bert_49	86,6	22,8
SN02_09	76,3	22,8
SN02_12	75,1	22,9
SN04_02	79,6	22,1
SN04_03	76,8	21,7



Result comparison of the max.value

High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

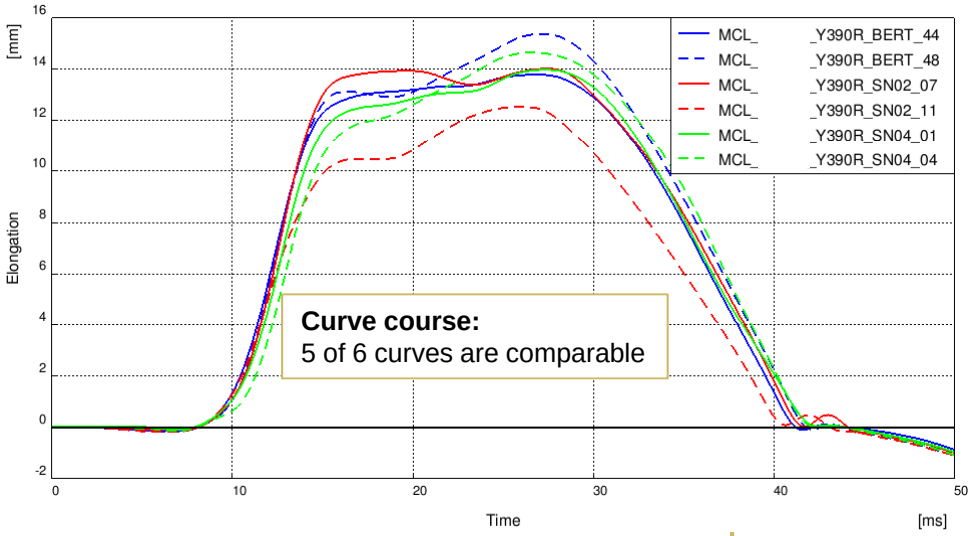
Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

Repetition test

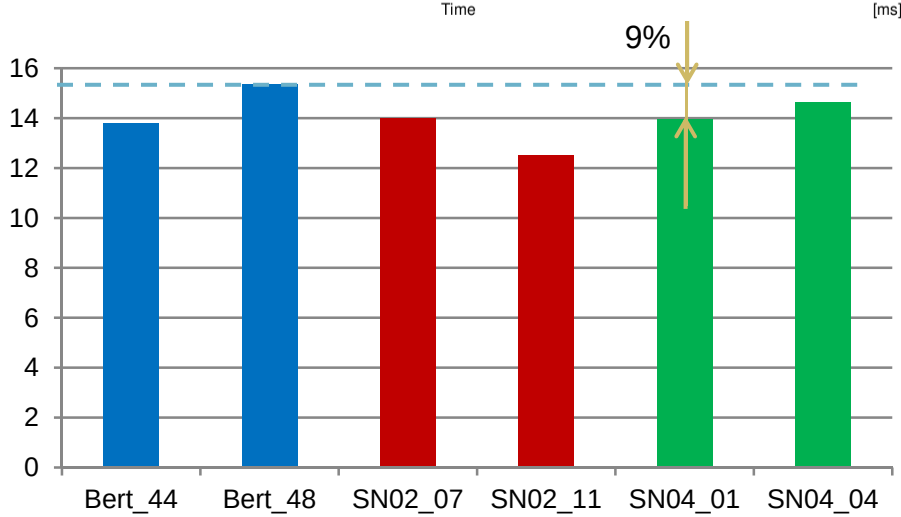
Test experiences SUV at Y390

Test experiences SUV at Y390

MCL



	MCL	t (max)
Bert_44	13,79	26,9
Bert_48	15,37	27,2
SN02_07	14,02	27,4
SN02_11	12,54	26
SN04_01	13,98	27,3
SN04_04	14,65	26,6



Result comparison of the max.value

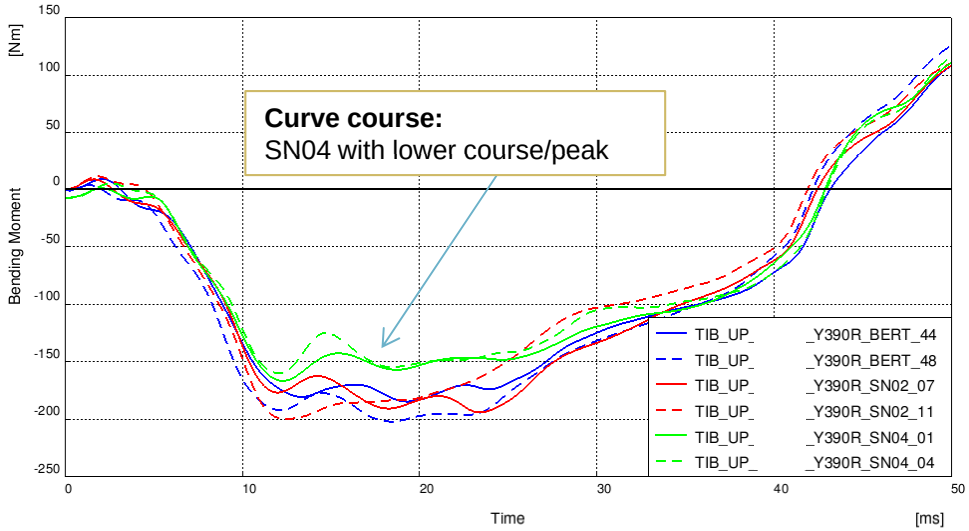
Acceptable near 10%
-> Industrial-Imp. is comparable with SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

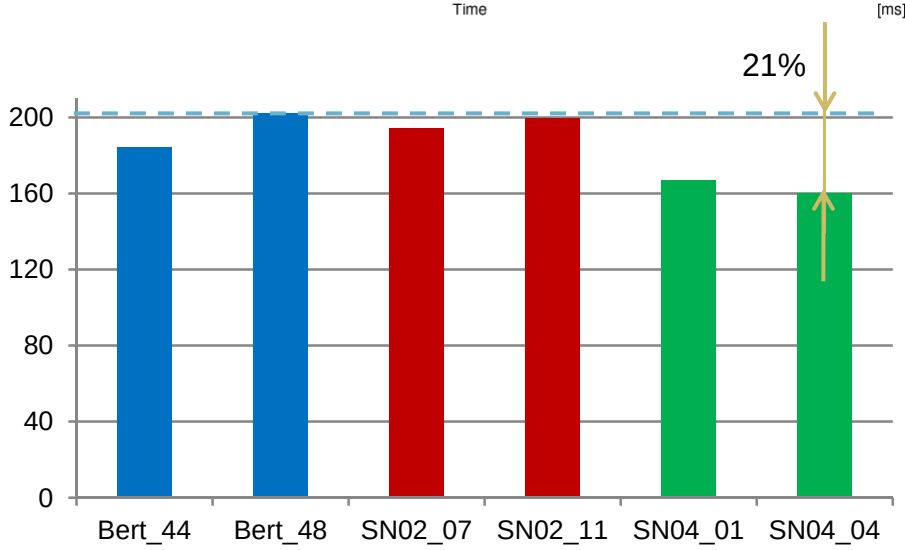
Repetition test

Test experiences SUV at Y390

TIBIA(1) UP



	TIB UP	t (max)
Bert_44	184,7	19,3
Bert_48	202,1	18,4
SN02_07	194,2	23,4
SN02_11	199,8	12,5
SN04_01	166,8	12,3
SN04_04	160,1	12,1



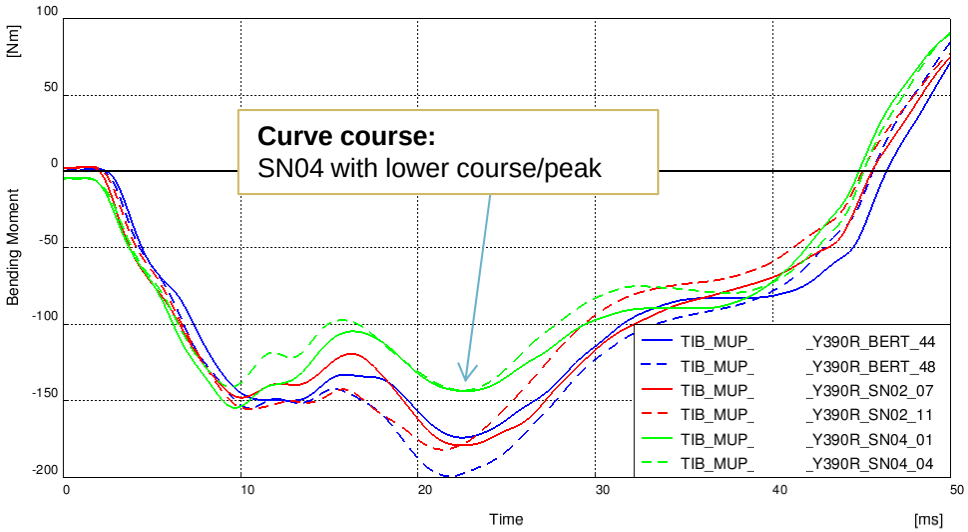
Result comparison of the max.value

High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

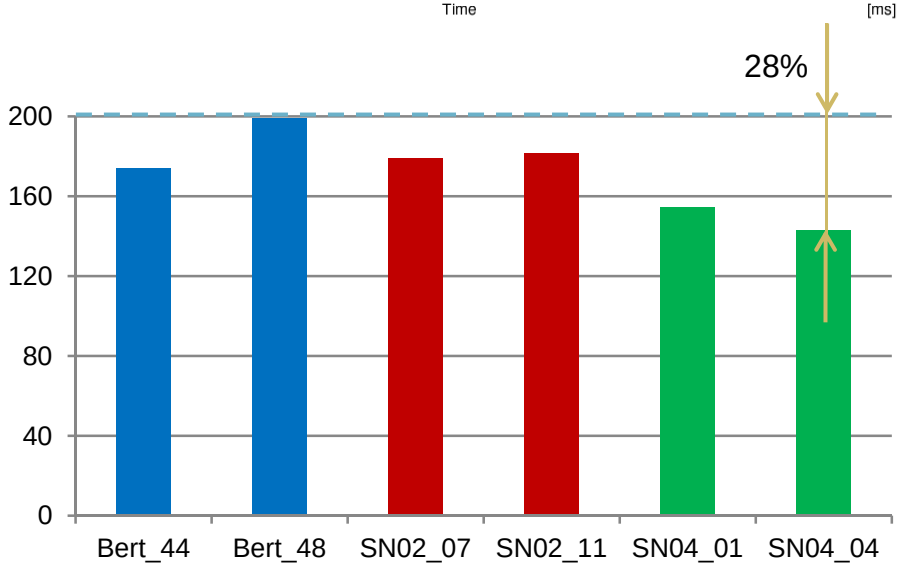
Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)
Repetition test

Test experiences SUV at Y390

TIBIA(2) MUP



	TIB MUP	t (max)
Bert_44	173,9	22,5
Bert_48	199,2	21,8
SN02_07	178,9	22,5
SN02_11	181,7	21,4
SN04_01	154,5	9,7
SN04_04	143,2	22,5



Result comparison of the max.value

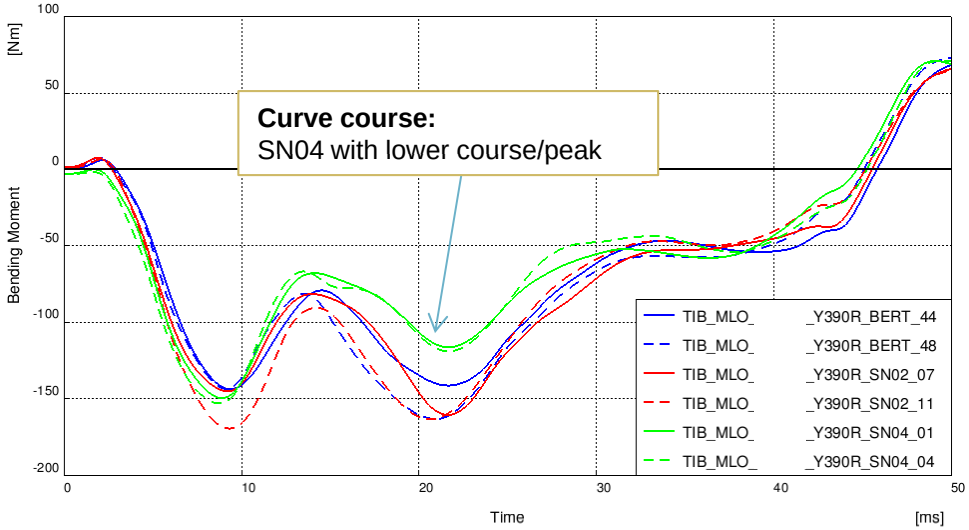
High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

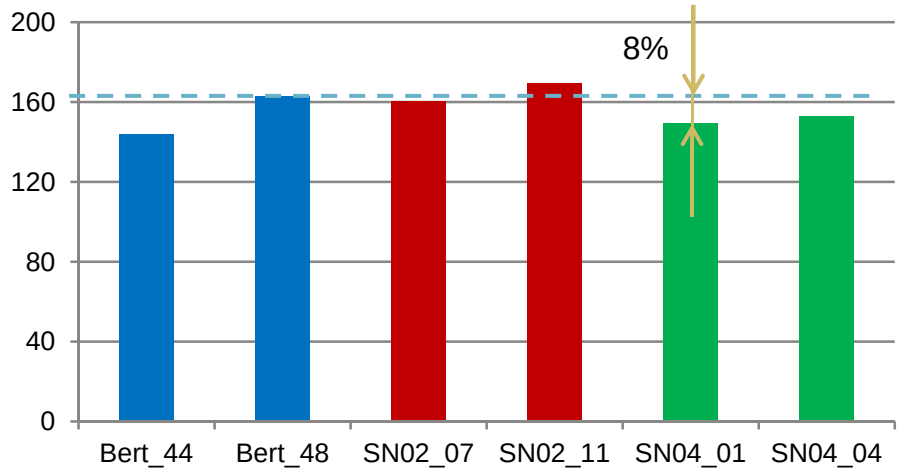
Repetition test

Test experiences SUV at Y390

TIBIA(3) MLO



	TIB MLO	t (max)
Bert_44	143,7	9,4
Bert_48	163,1	20,9
SN02_07	160,4	21,7
SN02_11	169,3	9,3
SN04_01	149,4	8,9
SN04_04	152,8	8,8



Result comparison of the max.value

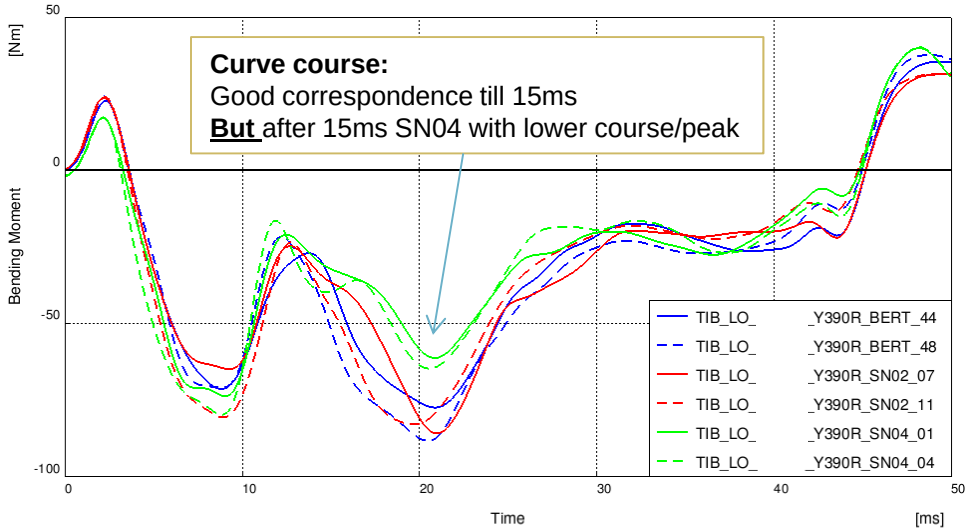
Good correspondence (<10%)
-> Industrial-Imp. is comparable with SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

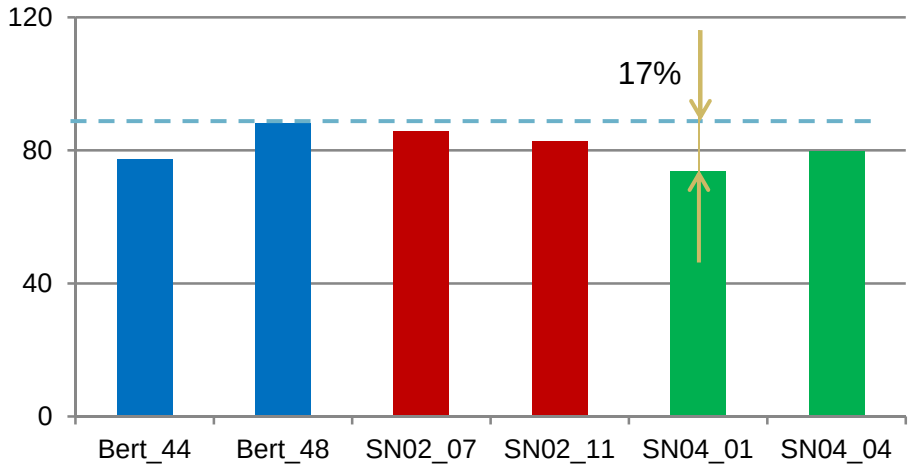
Repetition test

Test experiences SUV at Y390

TIBIA(4) LO



	TIB LO	t (max)
Bert_44	77,5	20,9
Bert_48	88,3	20,5
SN02_07	85,9	20,9
SN02_11	82,9	19,7
SN04_01	73,7	9
SN04_04	79,8	8,9



Result comparison of the max.value

High divergence (>10%)
-> Industrial-Imp. shows higher values than SN04 (Aug.2009)

Industrial-Imp. (July 2011)
SN02 (July 2011)
SN04 (August 2009)

Repetition test

Summary

- Y0 Sedan: test experiences with SN02/SN04/Industrial
  - MCL: Good correspondence (divergence of 6%)
  - Tibia: **Divergence up to 23%** (Tibia3);
    nearly in every Tibia-curve the SN04 has lower course/peak
- Y0 SUV: test experiences with SN02/SN04/Industrial
  - MCL: Values with **divergence of 15%**;
    Curve course: SN04 with the lowest course
  - Tibia: **Divergence up to 20%** (Tibia4);
    nearly in every Tibia-curve the SN04 has lower course/peak
- Y390 SUV: test experiences with SN02/SN04/Industrial
  - MCL: Acceptable correspondence (divergence near 9%)
  - Tibia: **High divergence up to 28%** (Tibia2);
    nearly in every Tibia-curve the SN04 has lower course/peak
- Test results: SN04 Impactor (August 2009) shows lower curve course und values

Overview of results

							max-value of column	229,6	208,8	249,2	275,9	20,2	5,7	15,2
				s1 = single test result			min-value of column	73,7	91,0	108,6	133,1	12,5	2,3	5,1
				m3 = mean value of 3 test result /										
No	Flex-GTR No	vehicle type	location	test	ACEA-membe	car No	Legende	Tibia A4	Tibia A3	Tibia A2	Tibia A1	MCL	PCL	ACL
1	IN01	sedan	Y=0	s5	M1	C1	IN01/sedan/M1/C1	152,70	199,10	223,50	196,60	17,83	5,15	5,35
2	IN01	sedan	Y=0	s6	M1	C1	IN01/sedan/M1/C1	148,30	201,70	224,20	206,80	19,01	4,92	6,31
3	SN02	sedan	Y=0	s3	M1	C1	SN02/sedan/M1/C1	147,30	200,90	202,70	192,20	20,19	5,60	5,82
4	SN02	sedan	Y=0	s4	M1	C1	SN02/sedan/M1/C1	150,60	208,80	222,60	199,60	19,23	4,86	6,04
5	SN04	sedan	Y=0	s1	M1	C1	SN04/sedan/M1/C1	130,00	156,30	200,60	175,70	18,73	5,53	5,09
6	SN04	sedan	Y=0	s2	M1	C1	SN04/sedan/M1/C1	126,20	162,40	199,40	185,30	18,99	5,71	5,18
7	IN01	sedan	Y=340	s5	M1	C1	IN01/sedan/M1/C1	153,90	174,80	182,00	180,80	17,31	5,21	5,33
8	IN01	sedan	Y=340	s6	M1	C1	IN01/sedan/M1/C1	154,40	178,00	192,30	191,90	17,55	5,02	5,63
9	SN02	sedan	Y=340	s3	M1	C1	SN02/sedan/M1/C1	151,80	173,00	176,20	181,70	17,66	5,69	5,24
10	SN04	sedan	Y=340	s1	M1	C1	SN04/sedan/M1/C1	154,20	152,50	183,90	207,40	13,66	4,66	8,35
11	SN04	sedan	Y=340	s2	M1	C1	SN04/sedan/M1/C1	138,80	164,10	191,70	200,80	15,19	4,57	6,75
12	IN01	SUV	Y=0	s5	M1	C2	IN01/SUV/M1/C2	96,30	177,80	238,90	259,90	15,69	3,59	9,43
13	IN01	SUV	Y=0	s6	M1	C2	IN01/SUV/M1/C2	86,60	175,30	249,20	275,90	16,56	3,90	9,16
14	SN02	SUV	Y=0	s3	M1	C2	SN02/SUV/M1/C2	76,30	169,40	235,90	271,90	15,44	3,21	9,01
15	SN02	SUV	Y=0	s4	M1	C2	SN02/SUV/M1/C2	75,10	168,50	229,20	272,70	14,42	2,29	9,39
16	SN04	SUV	Y=0	s1	M1	C2	SN04/SUV/M1/C2	79,60	161,60	231,30	260,20	14,72	3,56	9,39
17	SN04	SUV	Y=0	s2	M1	C2	SN04/SUV/M1/C2	76,80	156,80	227,40	255,90	14,06	2,53	8,75
18	IN01	SUV	Y=390	s5	M1	C2	IN01/SUV/M1/C2	77,50	143,70	173,90	184,70	13,79	3,87	8,36
19	IN01	SUV	Y=390	s6	M1	C2	IN01/SUV/M1/C2	88,30	163,10	199,20	202,10	15,37	3,71	8,27
20	SN02	SUV	Y=390	s3	M1	C2	SN02/SUV/M1/C2	85,90	160,40	178,90	194,20	14,02	3,51	9,61
21	SN02	SUV	Y=390	s4	M1	C2	SN02/SUV/M1/C2	82,90	169,30	181,70	199,80	12,54	2,87	7,78
22	SN04	SUV	Y=390	s1	M1	C2	SN04/SUV/M1/C2	73,70	149,40	154,50	166,80	13,98	4,45	7,98
23	SN04	SUV	Y=390	s2	M1	C2	SN04/SUV/M1/C2	79,80	152,80	143,20	160,10	14,65	4,49	7,87
24	IN01	sport	Y=-226	s5	M1	C3	IN01/sport/M1/C3	192,00	95,50	126,40	161,30	15,09	4,03	12,64
25	IN01	sport	Y=-226	s6	M1	C3	IN01/sport/M1/C3	184,70	105,20	124,90	157,60	15,06	5,61	13,02
26	SN02	sport	Y=-226	s3	M1	C3	SN02/sport/M1/C3	214,10	130,50	114,00	146,60	14,67	4,29	12,97
27	SN02	sport	Y=-226	s4	M1	C3	SN02/sport/M1/C3	184,90	98,90	113,30	153,60	15,62	4,61	13,31
28	SN04	sport	Y=-226	s1	M1	C3	SN04/sport/M1/C3	228,30	142,90	121,70	143,50	14,29	4,45	15,18
29	SN04	sport	Y=-226	s2	M1	C3	SN04/sport/M1/C3	229,60	134,30	118,90	133,10	13,00	4,51	14,84
30	IN01	sport	Y=270	s5	M1	C3	IN01/sport/M1/C3	194,40	91,00	121,40	150,60	15,16	4,54	12,27
31	SN02	sport	Y=270	s3	M1	C3	SN02/sport/M1/C3	194,70	103,70	112,60	153,90	15,33	4,25	13,58
32	SN02	sport	Y=270	s4	M1	C3	SN02/sport/M1/C3	206,50	119,30	108,60	140,90	14,78	4,22	13,43
33	SN04	sport	Y=270	s1	M1	C3	SN04/sport/M1/C3	171,40	98,30	121,30	141,10	12,52	4,65	12,79
34	SN04	sport	Y=270	s2	M1	C3	SN04/sport/M1/C3	196,50	113,40	123,00	139,90	13,01	4,15	14,23

Divergence > 15%

Thank You

For detailed questions please refer to the author Mr. Christian Hess / Audi and Dr. Oskar Ries / Volkswagen.