GTR-04-07

Technical perfection, automotive passion

faurecia
Automotive Seating

Whiplash Criteria

Repeatability with different dummies & sleds

Ines Levallois, F. Fays, B. Calais, J. Basilautzkis

21/09/2010

Repeatability test series

faurecia
Automotive Seating

Test description :

9 whiplash tests with Biorid IIg
Old calibration procedures (tests realized in end of 2008)
Pulse : IIWPG 16 km/h pulse

Seats :

- 9 identical front driver seats from the same serial production batch
- Seats with marginal results at EuroNcap whiplash tests
- Static backset : 25mm measured with HRMD, -> identical for all tests to avoid seating procedure variations

Repeatability test series

faurecia
Automotive Seating

Test description :

2 different dummies

2 sled types : acceleration (sled1) & deceleration sled (sled2)

Each dummy/sled combination repeated 3 times

Test matrix :

	Sled	Biorid II g
Seat 5	Sled 1	Dummy1
Seat 6	Sled 1	Dummy1
Seat 1	Sled 1	Dummy1
Seat 3	Sled 2	Dummy1
Seat 4	Sled 2	Dummy1
Seat 7	Sled 2	Dummy1
Seat 2	Sled 2	Dummy2
Seat 8	Sled 2	Dummy2
Seat 9	Sled 2	Dummy2

Repeatability test series

faurecia
Automotive Seating

Results :

Sled / Dummy		Backset (mm)	Nkm	Fx N	Fz N	NIC m2/s2	dyn. Backset mm	T1x max m/s2
Sled 1	Dummy1	25	0,373	145	576	19,1	68	10,07
Sled 1	Dummy1	25	0,335	136	598	21,32	80	10,64
Sled 1	Dummy1	25	0,364	149	562	20,9	77	10,32
Sled 2	Dummy1	25	0,363	131	489	17,1	61,4	12,7
Sled 2	Dummy1	25	0,354	124	511	17,2	66,1	11,3
Sled 2	Dummy1	25	0,349	119	521	16,9	56	11,6
Sled 2	Dummy2	25	0,375	129	447	15,9	57,6	11,2
Sled 2	Dummy2	25	0,376	130	450	18,9	55	11,7
Sled 2	Dummy2	25	0,369	136	492	21,2	57,9	11
overall	Min		0,335	119,0	447,0	15,9	55,0	10,1
variation	Max		0,376	149,0	598,0	21,3	80,0	12,7
	delta max		0,041	30,0	151,0	5,4	25,0	2,6
	mean		0,362	133,2	516,2	18,7	64,3	11,2
	sigma		0,0137	9,510	53,516	2,063	9,181	0,796
	delta max/mean		11%	23%	29%	29%	39%	24%
dummy	Min		0,349	119,0	447,0	15,9	55,0	11,0
variation	Max		0,376	136,0	521,0	21,2	66,1	12,7
	delta max		0,027	17,0	74,0	5,3	11,1	1,7
	mean		0,364	128,2	485,0	17,9	59,0	11,6
	delta max/mean		7%	13%	15%	30%	19%	15%
sled	Min		0,335	119,0	489,0	16,9	56,0	10,1
variation	Max		0,373	149,0	598,0	21,3	80,0	12,7
	delta max		0,038	30,0	109,0	4,4	24,0	2,6
	mean		0,356	134,0	542,8	18,8	68,1	11,1
	delta max/mean		11%	22%	20%	24%	35%	24%

Repeatability test series

faurecia
Automotive Seating

Results : upper neck force Fx

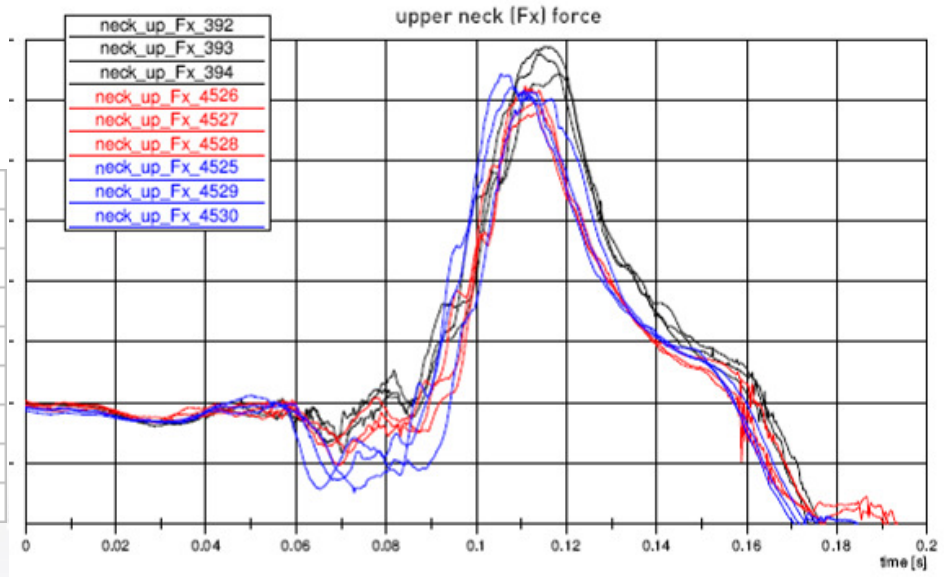
Mean values of 3 tests vary from 125N to 143N

Overall values vary from 119N to 149N

Overall variation of results is 23%. When considering only sled variations it is 22% and dummy variations 13%.

		Fx
Sled / Dummy		**N**
Sled 1	Dummy1	145
Sled 1	Dummy1	136
Sled 1	Dummy1	149
Sled 2	Dummy1	131
Sled 2	Dummy1	124
Sled 2	Dummy1	119
Sled 2	Dummy2	129
Sled 2	Dummy2	130
Sled 2	Dummy2	136

Sled1/D1	Mean	143,3
	delta	13,0
	delta/mean	9,1%
Sled2/D1	Mean	124,7
	delta	12,0
	delta/mean	9,6%
Sled2/D2	Mean	131,7
	delta	7,0
	delta/mean	5,3%

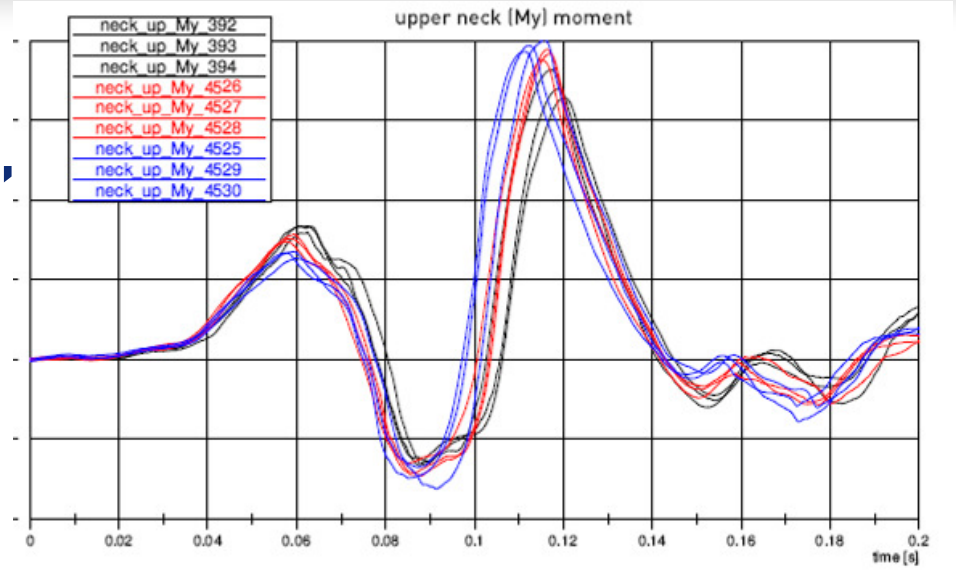


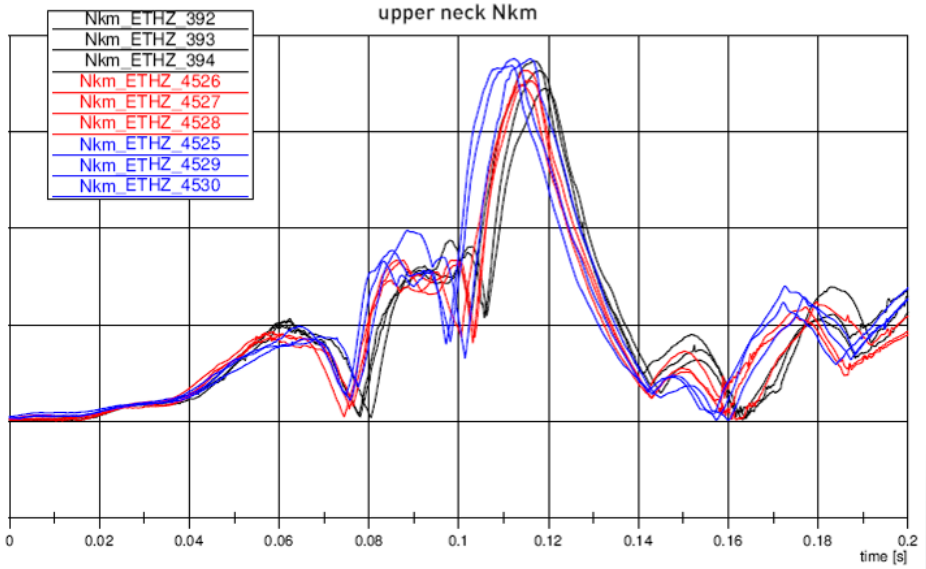
Repeatability test series

faurecia
Automotive Seating

Results : upper neck Nkm

Overall variation was about 11%, but the original variations of the dummy readings of upper My (t) are high. In this case My variations were compensated by Fx variations.





		Nkm
Sled / Dummy		
Sled 1	Dummy1	0,373
Sled 1	Dummy1	0,335
Sled 1	Dummy1	0,364
Sled 2	Dummy1	0,363
Sled 2	Dummy1	0,354
Sled 2	Dummy1	0,349
Sled 2	Dummy2	0,375
Sled 2	Dummy2	0,376
Sled 2	Dummy2	0,369

Sled1/D1	Mean	0,357
	delta	0,038
	delta/mean	10,6%
Sled2/D1	Mean	0,355
	delta	0,014
	delta/mean	3,9%
Sled2/D2	Mean	0,373
	delta	0,007
	delta/mean	1,9%

Repeatability test series

faurecia
Automotive Seating

Results : upper neck force Fz

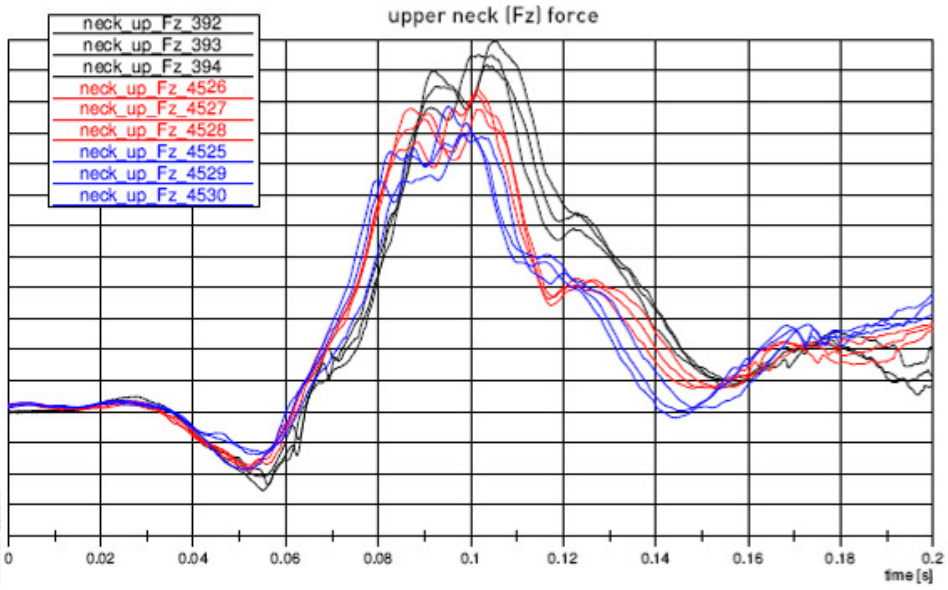
Mean values of 3 tests vary from 463N to 579N

Also the timing of the mean values is shifting.

Overall variation of results is 29%. When considering only sled variations it is 20% and dummy variations 15%.

		Fz
Sled / Dummy		**N**
Sled 1	Dummy1	576
Sled 1	Dummy1	598
Sled 1	Dummy1	562
Sled 2	Dummy1	489
Sled 2	Dummy1	511
Sled 2	Dummy1	521
Sled 2	Dummy2	447
Sled 2	Dummy2	450
Sled 2	Dummy2	492

Sled1/D1	Mean	578,7
	delta	36,0
	delta/mear	6,2%
Sled2/D1	Mean	507,0
	delta	32,0
	delta/mear	6,3%
Sled2/D2	Mean	463,0
	delta	45,0
	delta/mear	9,7%



Repeatability test series

faurecia
Automotive Seating

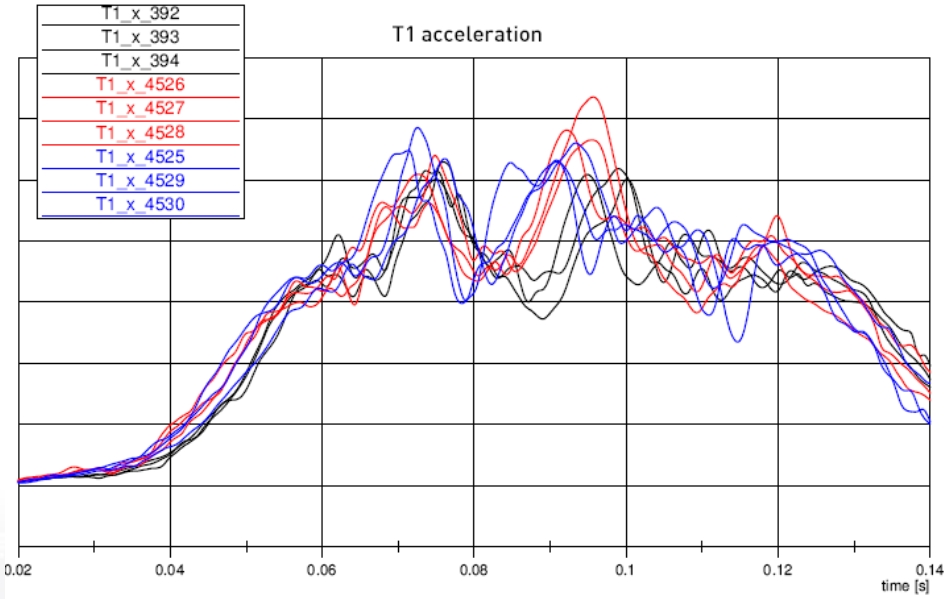
Results : T1 acceleration

T1 maximum decelerations do not occur at the same time.

Overall variation of the results of 24% are identical to the differences between the 2 sleds.

		γ T1x max
Sled / Dummy		**m/s2**
Sled 1	Dummy1	10,07
Sled 1	Dummy1	10,64
Sled 1	Dummy1	10,32
Sled 2	Dummy1	12,7
Sled 2	Dummy1	11,3
Sled 2	Dummy1	11,6
Sled 2	Dummy2	11,2
Sled 2	Dummy2	11,7
Sled 2	Dummy2	11

Sled1/D1	Mean	10,3
	delta	0,6
	delta/mean	5,5%
Sled2/D1	Mean	11,9
	delta	1,4
	delta/mean	11,8%
Sled2/D2	Mean	11,3
	delta	0,7
	delta/mean	6,2%



Repeatability test series

faurecia
Automotive Seating

Results : NIC

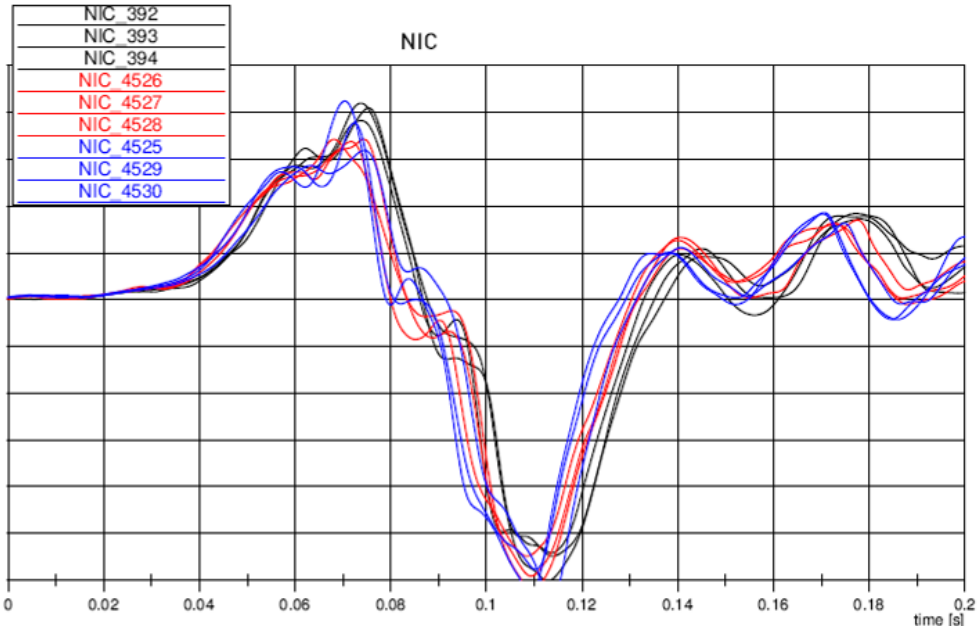
Significant variation within the test series of sled2/dummy2.

Overall variation of the results of 29% are identical to the overall variations of all tests on sled 2.

Absolute values vary from 15.9 to 21.3 m2/s2

Sled / Dummy		NIC m2/s2
Sled 1	Dummy1	19,1
Sled 1	Dummy1	21,32
Sled 1	Dummy1	20,9
Sled 2	Dummy1	17,1
Sled 2	Dummy1	17,2
Sled 2	Dummy1	16,9
Sled 2	Dummy2	15,9
Sled 2	Dummy2	18,9
Sled 2	Dummy2	21,2

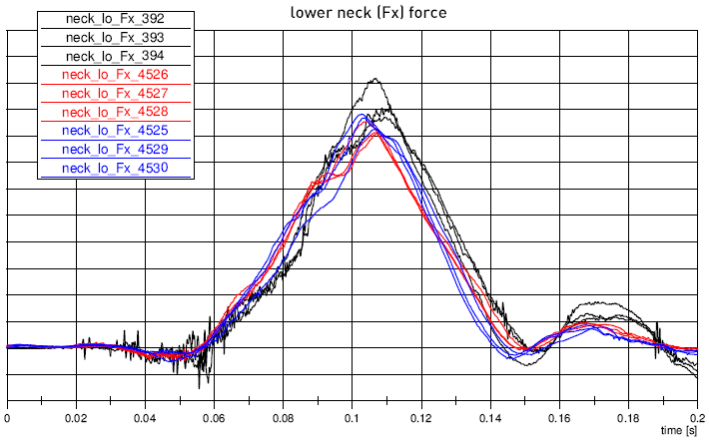
Sled1/D1	Mean	20,4
	delta	2,2
	delta/mean	10,9%
Sled2/D1	Mean	17,1
	delta	0,3
	delta/mean	1,8%
Sled2/D2	Mean	18,7
	delta	5,3
	delta/mean	28,4%

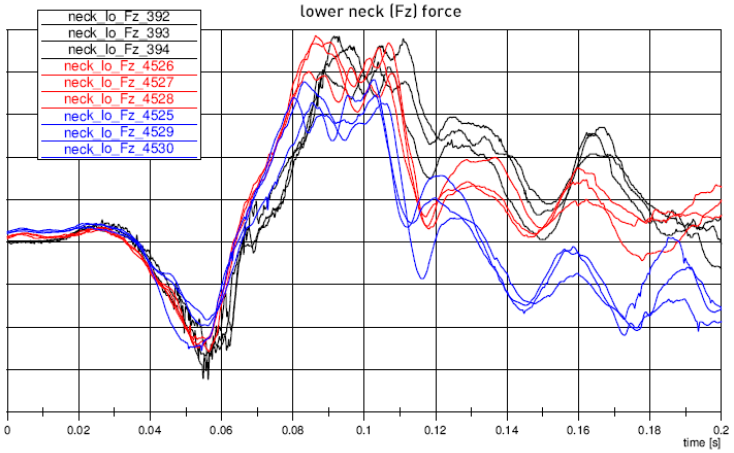


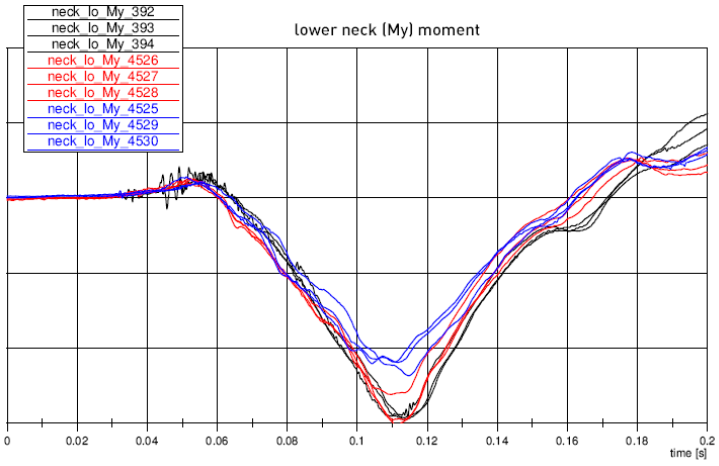
Repeatability test series

faurecia
Automotive Seating

Results : lower neck loads Fx, Fz ,moment My







Repeatability test series

faurecia
Automotive Seating

Further results :

- important variations of the dynamic backset : the difference of the maximum and minimum value in comparison to the mean value is even 40%.
- in a first analysis the influence of the sled type is the main cause

Sled1/D1	Mean	75,0
	delta	12,0
	delta/mean	16,0%
Sled2/D1	Mean	61,2
	delta	10,1
	delta/mean	16,5%
Sled2/D2	Mean	56,8
	delta	2,9
	delta/mean	5,1%

	dyn. Backs
Sled / Dummy	**mm**
Sled 1 Dummy1	68
Sled 1 Dummy1	80
Sled 1 Dummy1	77
Sled 2 Dummy1	61,4
Sled 2 Dummy1	66,1
Sled 2 Dummy1	56
Sled 2 Dummy2	57,6
Sled 2 Dummy2	55
Sled 2 Dummy2	57,9

Repeatability test series

faurecia
Automotive Seating

Results :

- criteria with significant variations when the dummy was changed : NIC, upper neck Fz, upper neck Fx, dynamic backset, T1 maximum deceleration
- in spite of important upper My variations, the Nkm (function of upper My and upper Fx) variation were lower.
- the influence of the sled is higher than the dummy influence in this test series (difference acceleration, deceleration sled)

The impact of the sled to the biomechanical criteria is an important factor of study.

Another comparison test series with 2 different acceleration sleds are planned later this year.