

Test of force controlled yielding seats to draft GTR head restraint dynamic test

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Head Restraint Informal Working Group Meeting
January 23-26, 2006
BASt, Köln, Germany

GTR Draft

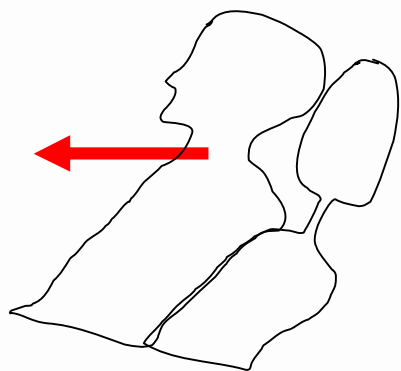
Either 55 mm* backset

or

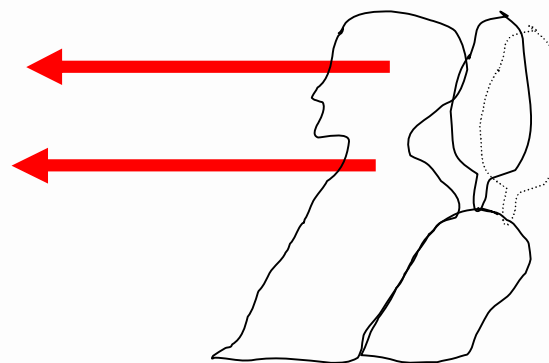
**< 12 degree Hybrid III head-torso
rotation in dynamic test**

***IIWPG 70 mm**

Two basic concepts of dynamic neck protection

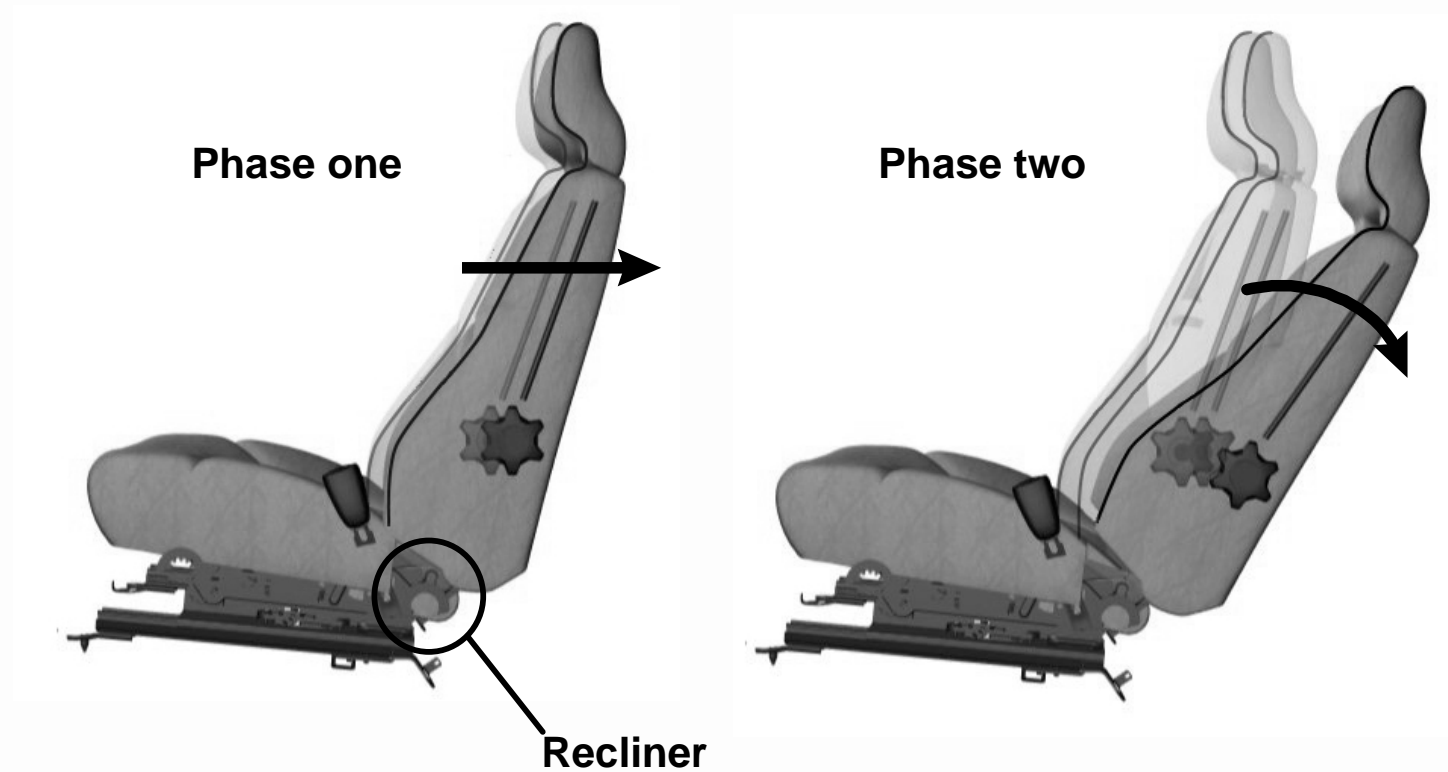


Reduce elastic force
by force controlled yielding
(cf belt force limiter)



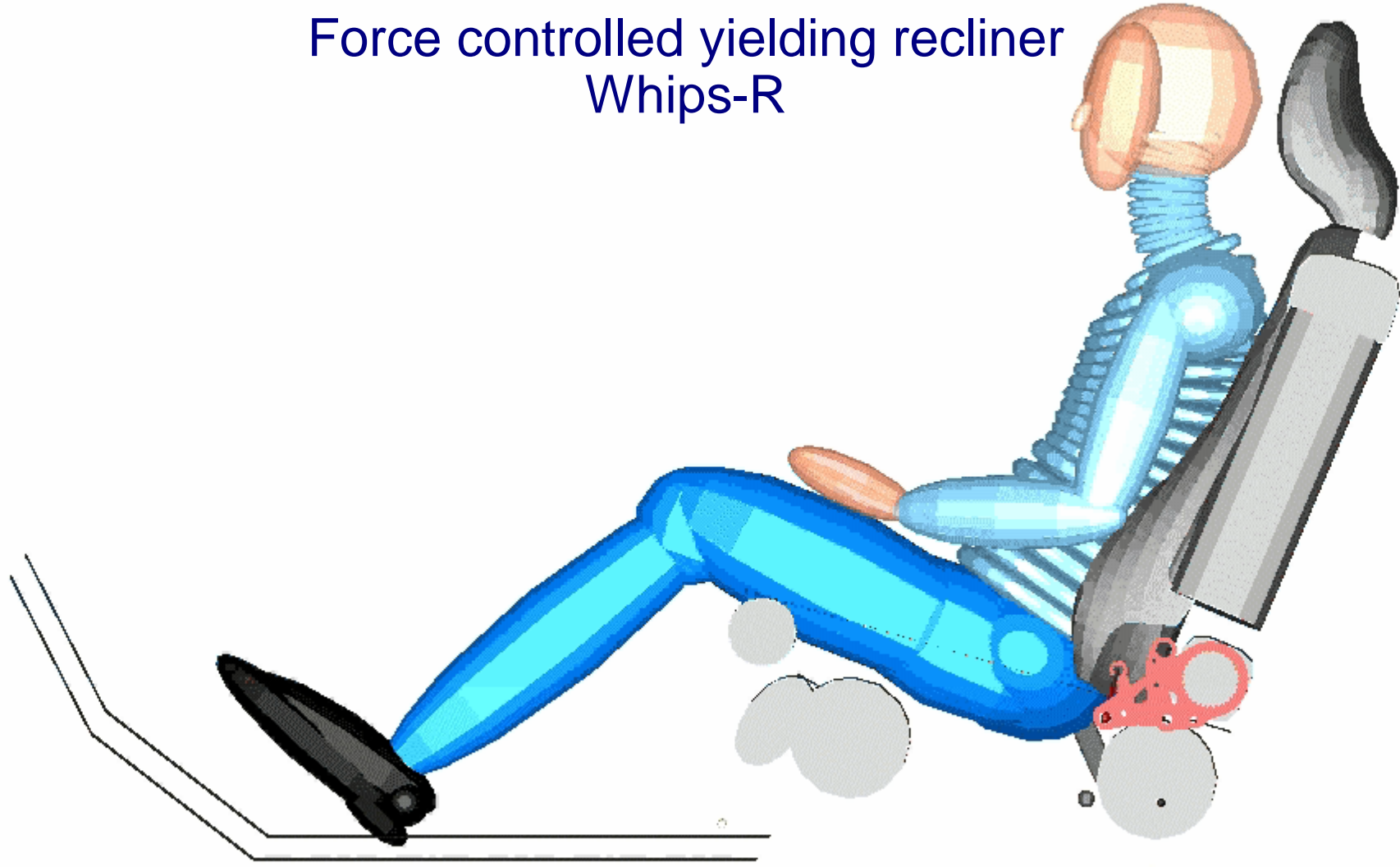
Reduce time of head-to-
headrest contact by reduced
backset or active headrest
(cf belt pretensioner)

Force controlled yielding recliner, named Whips-R



Whips-R in Volvo seats

Force controlled yielding recliner Whips-R



Whips-R in Volvo seats

X Time step 1 at time 0

Real-life and rating facts

Whips-R

Volvo seats with force controlled yielding recliners reduce risk of short and long term soft tissue neck injuries in real life*

Volvo seats with force controlled yielding recliners are on the top of all consumer rating lists**

*Jakobsson “Field analysis of AIS1 neck injuries in rear-end car impacts- injury reducing effect of the WHIPS seat”, J of Whiplash & Related Disorders Vol 3 No 2 2004.

Jakobsson & Norin “AIS1 neck injury reducing effect of WHIPS”, Int IRCOBI Conf. 2005).

Farmer et al, “Effects of head restraint and seat redesign on neck injury risk in rear-end crashes”, TIP Vol 4, 2003).

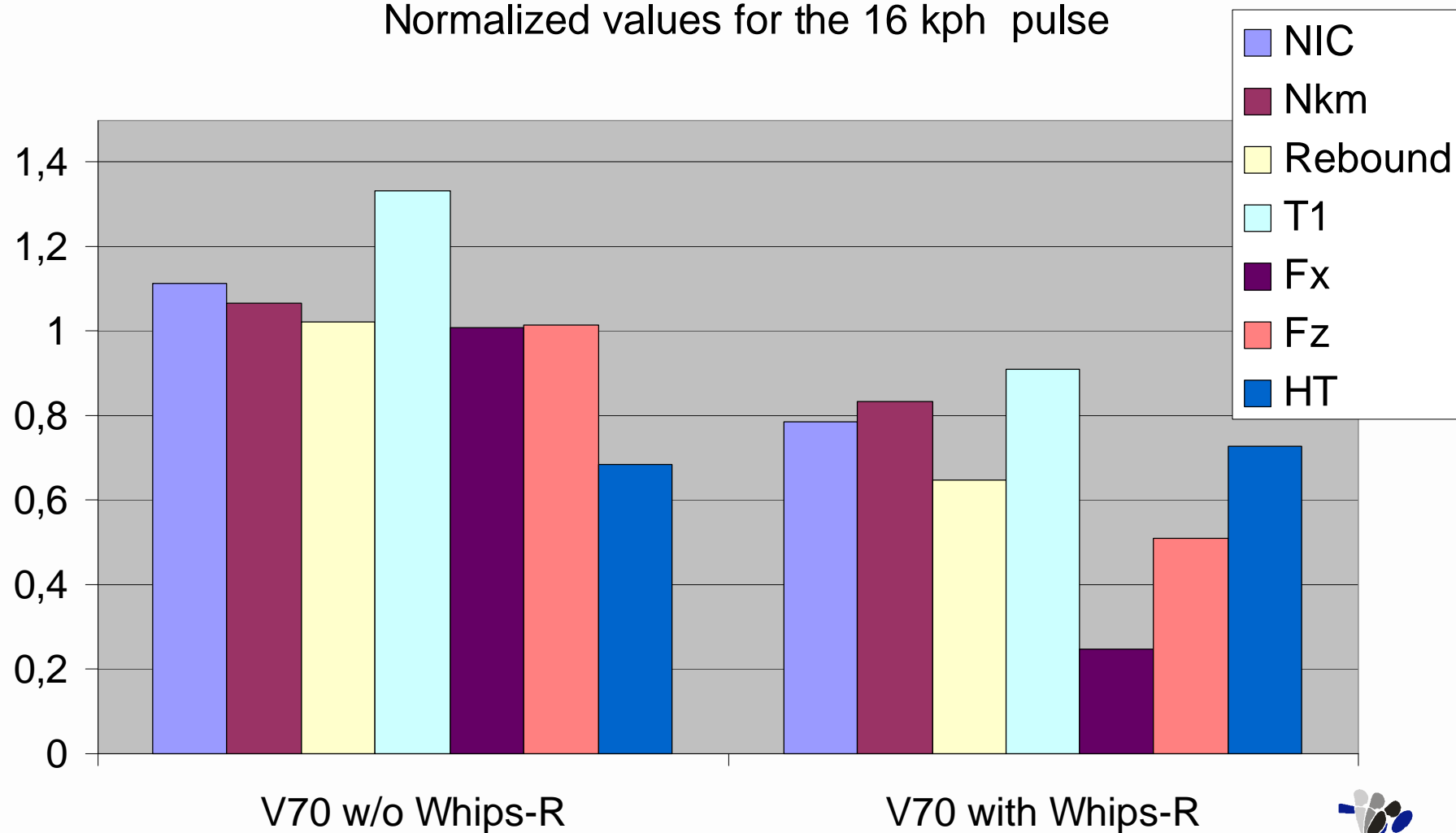
Krafft et al, “Assessment of whiplash protection in rear impacts – crash tests and real-life crashes” , Folksam and SRA Press release June 2004).

Krafft, “A comparison of short- and long-term consequences of AIS1 neck injuries, in rear impacts”, Int. IRCOBI Conf. 1998).

**Folksam/SRA (criteria based on scientific facts) and IIWPG (IIHS/Thatcham/ADAC) (criteria based on best practice)

Combined IIWPG and Folksam&SNRA evaluation

Normalized values for the 16 kph pulse



Autoliv draft GTR dynamic test evaluation

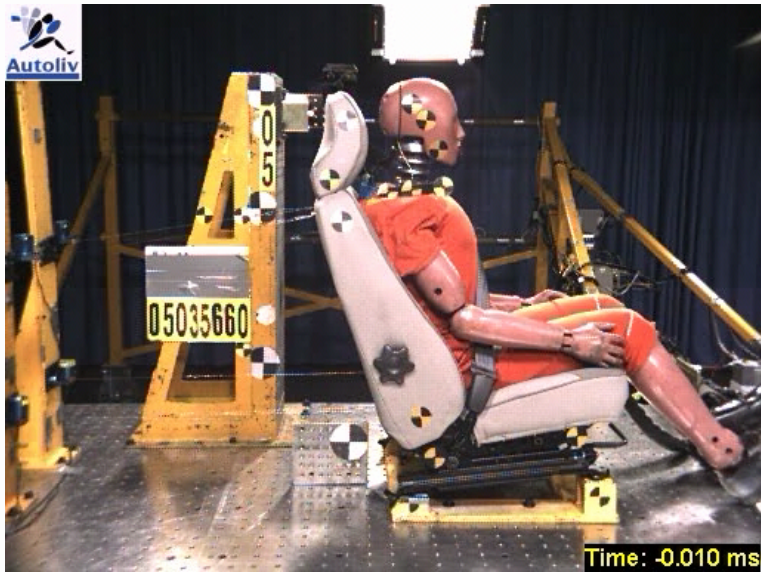
Hybrid III (draft GTR)

V70 w/o Whips-R

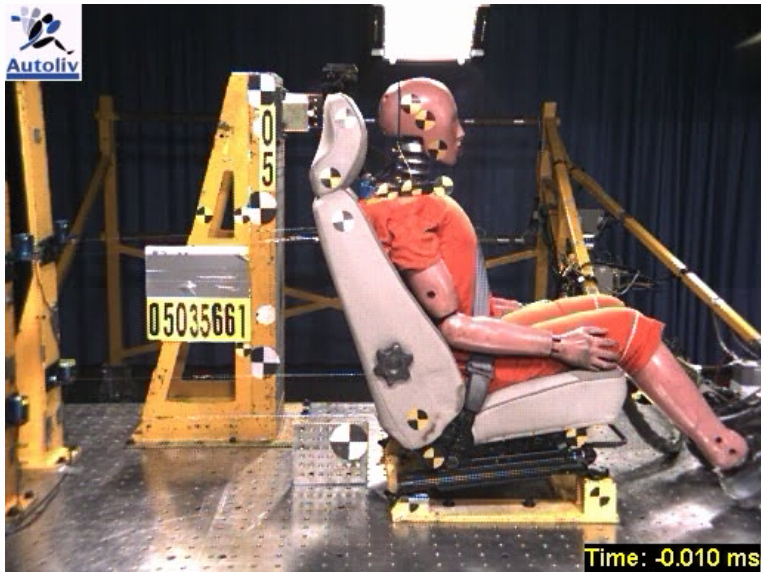
V70 with Whips-R

BioRID (sole deviation from draft GTR)

V70 with Whips-R



V70 with Whips-R

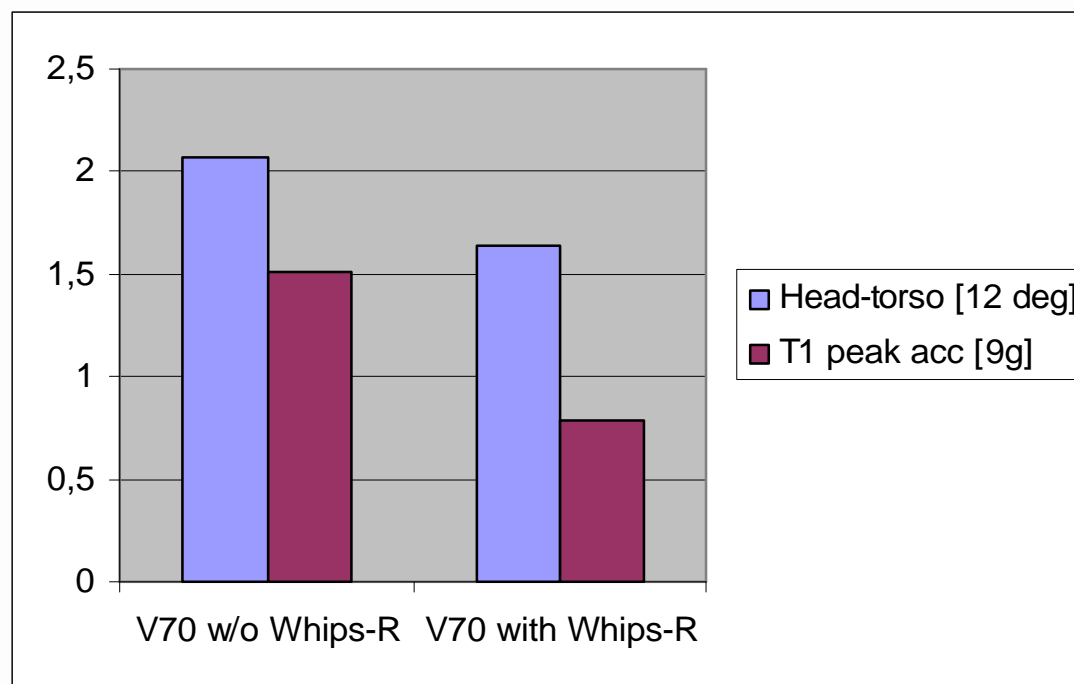


V70 w/o Whips-R

Test results draft GTR (Hybrid III)

| | Volvo w/o Whips-R | Volvo with Whips-R |
|-------------------------------|----------------------|-----------------------|
| Head-torso angle [deg] | 24,8 | 19,6 |
| NIJ | 0,14 | 0,11 |
| T1 peak acc | 13,6 | 7,1 |
| Head angular velocity | 1010 | 642 |
| Head peak angle | 29,7 | 32,7 |
| Torso peak angle | 8,2 | 20,7 |
| Upper seat back disp. | 74,7 | 172 |

Head-torso rotation and T1 acceleration normalized results



Test results BioRID instead of HIII

| Criteria | Results | "Good Rating" |
|-------------------|----------------------|--------------------|
| NIC | 10.4m/s ² | 15m/s ² |
| Nkm | 0,17 | 0.3 |
| T1 acc | 7.3g | 9.5g |
| Head contact time | 52ms | 70ms |
| Upper neck Fx | 32.4N | 130N |
| Upper neck Fz | 304N | 600N |

Remark: reflects highest possible rating (Folksam/SRA and IIWPG)

Summary test results

Volvo Whips-R test results are excellent when BioRID and BioRID performance criteria are used

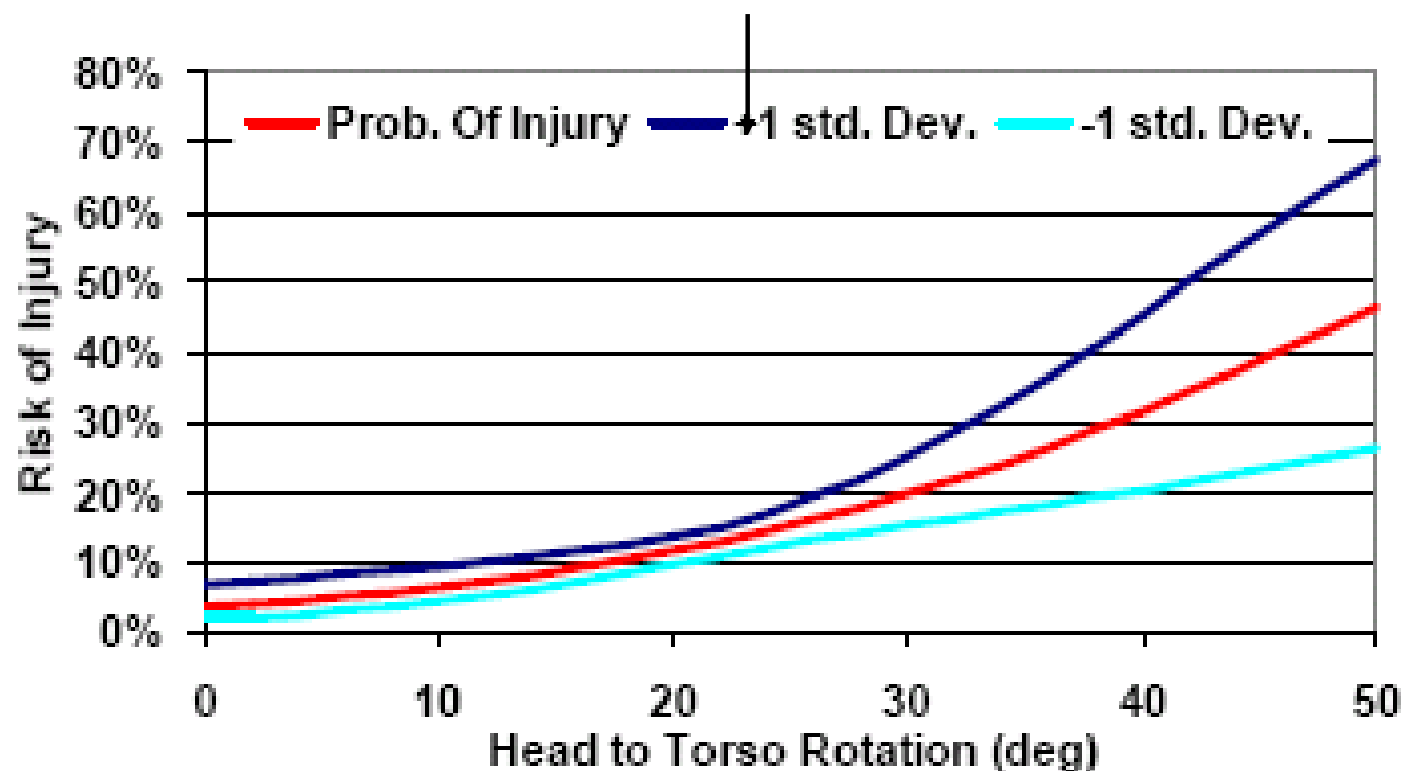
When tested with Hybrid III, the head-torso rotation is reduced, but exceeds 12 degrees

Remark: Volvo seats meet backset requirement of less than 55 mm, irrespective of Whips-R

Head-torso rotation risk curve

The FMVSS202 risk curve is based on two (2) observations. No force controlled yielding systems were taken into account.

| Seat | Field Data | | Sled Tests (16 km/h) weighted | |
|----------|------------------|--------------------------------------|-------------------------------|----------------------------------|
| | No. of occupants | No. with MT and LT whiplash injuries | Head to torso rotation (deg) | Head to torso x-translation (mm) |
| Saab 900 | 160 | 25 | 25.5 | 37 |
| Saab 9-3 | 122 | 9 | 12.1 | 13 |



Discussion

Proposed GTR head-torso rotation **risk curve** is based on only two observations of claim frequency where sample data- Δv median is only 10 km/h

Conclusion

Proposed GTR dynamic test does not acknowledge force controlled yielding seats

