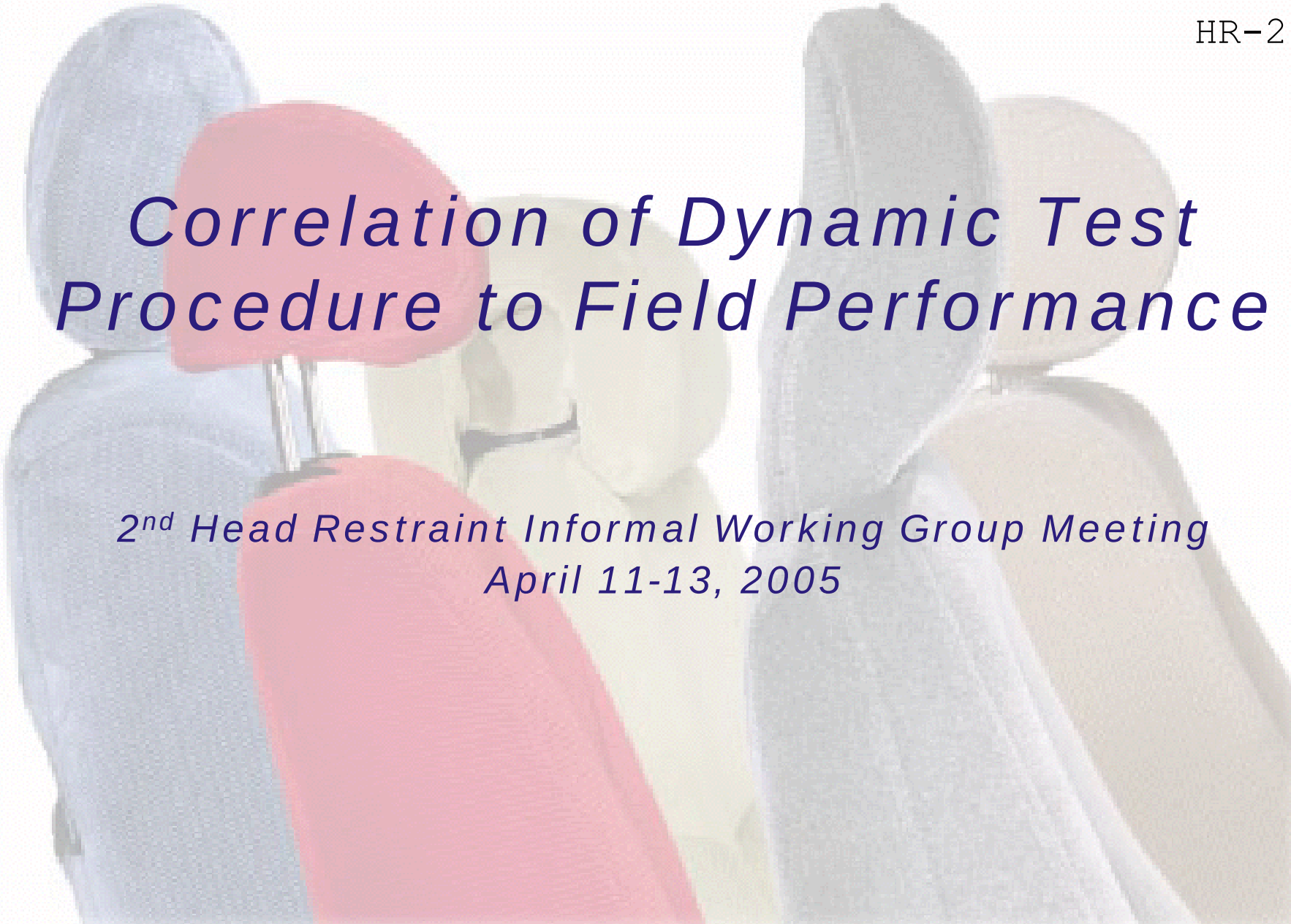
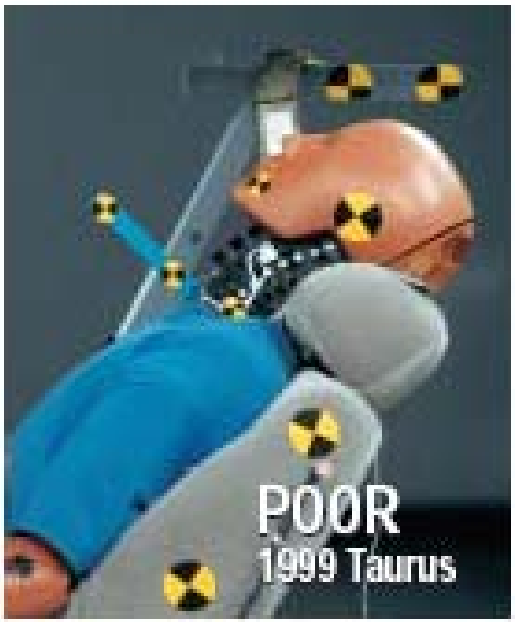


Correlation of Dynamic Test Procedure to Field Performance

2nd Head Restraint Informal Working Group Meeting
April 11-13, 2005

NHTSA

IIHS Static Head Restraint Rating and Field Performance

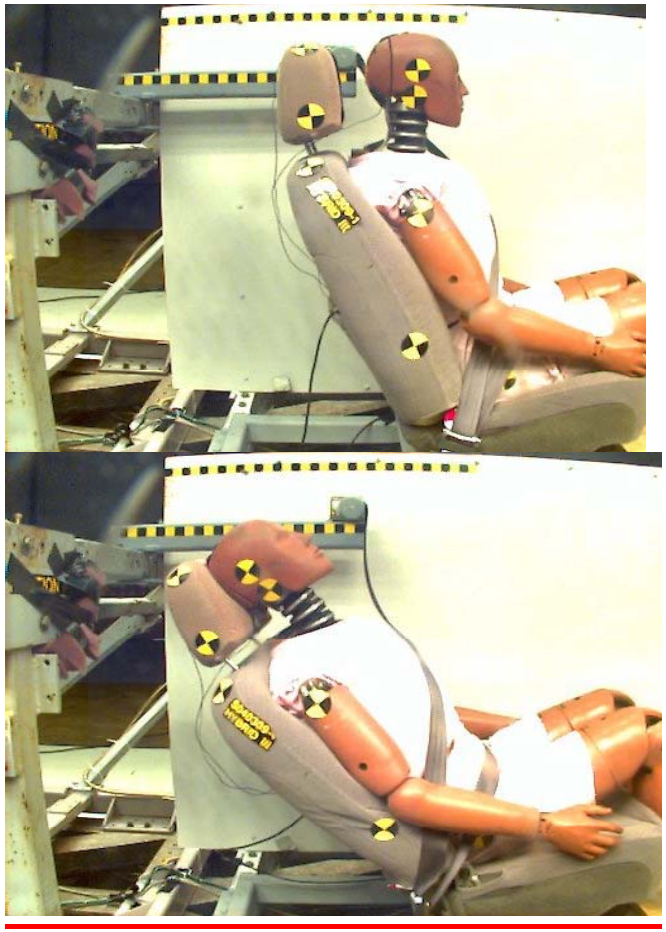
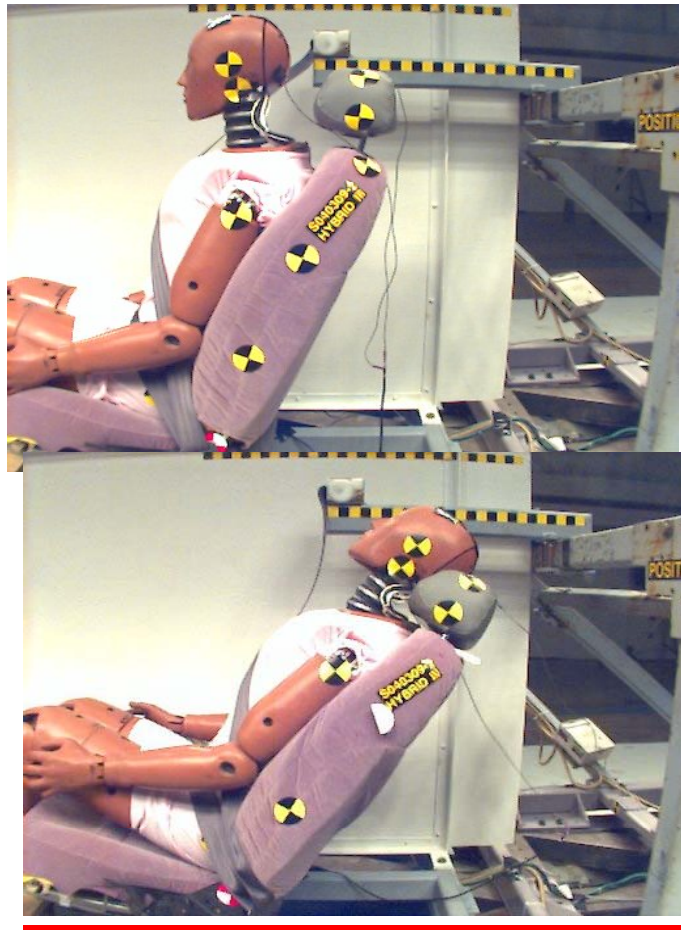


IIHS Status Report Vol. 37, No. 9, Oct. 26, 2002.

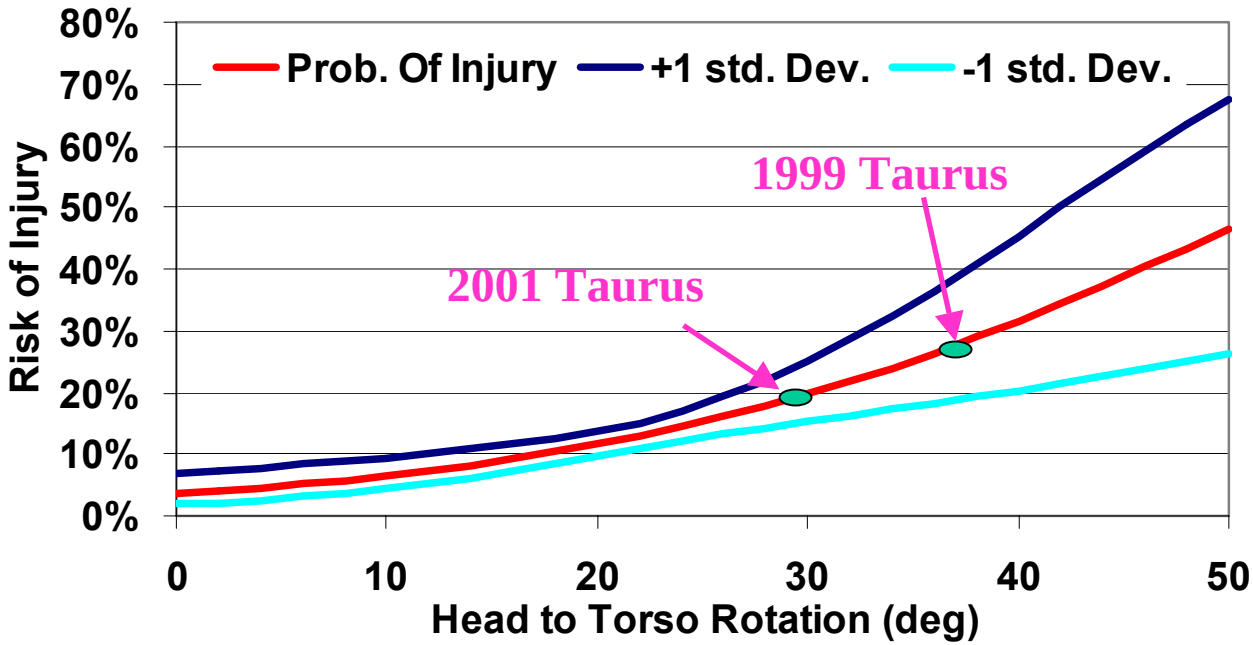
Vehicle	Backset (mm)		Vertical (mm)		IIHS static Rating
HR position	Down	Up	Down	Up	
1999 Taurus	125	85	165	125	poor
2001 Taurus	65	70	80	30	acceptable

18 percent reduction in neck injury claim rates in 2001 Taurus than 1999 Taurus

FMVSS No. 202 Dynamic Option Sled Tests with 1999 and 2001 Models Ford Taurus

	2001 Ford Taurus	1999 Ford Taurus
Peak rearward Head excursion →		
Head-to-torso rotations =	29.5 deg.	38.1 deg.

Comparison of Head Restraint Effectiveness in Field and in Dynamic Sled Tests



Improved effectiveness in sled tests with HR in up position: 33%

Improved effectiveness of 2001 Taurus from field data: 18%
(HR in up and down position)

Development of a Whiplash Injury Risk Curve

Field Data

Viano et al. (2001) – Study of Saab SAHR Effectiveness

Seat Type	No. of Cases	No neck Injury	Short term neck pain	Medium term (MT) whiplash injury	Long term (LT) whiplash injury	% MT and LT injury
Saab 900	48	22	19	1	8	18.80%
Saab 9-3	38	19	17	1	1	5.30%

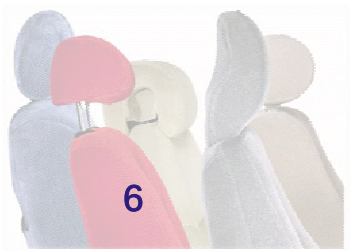
Farmer et al. (2002) - Neck Injury Rates from Insurance Claims

Vehicle	Number of Drivers	Number with medium and long term whiplash injuries	Percentage of insurance claims with whiplash injuries
Saab 900	112	18	16%
Saab 9-3	84	7	8%

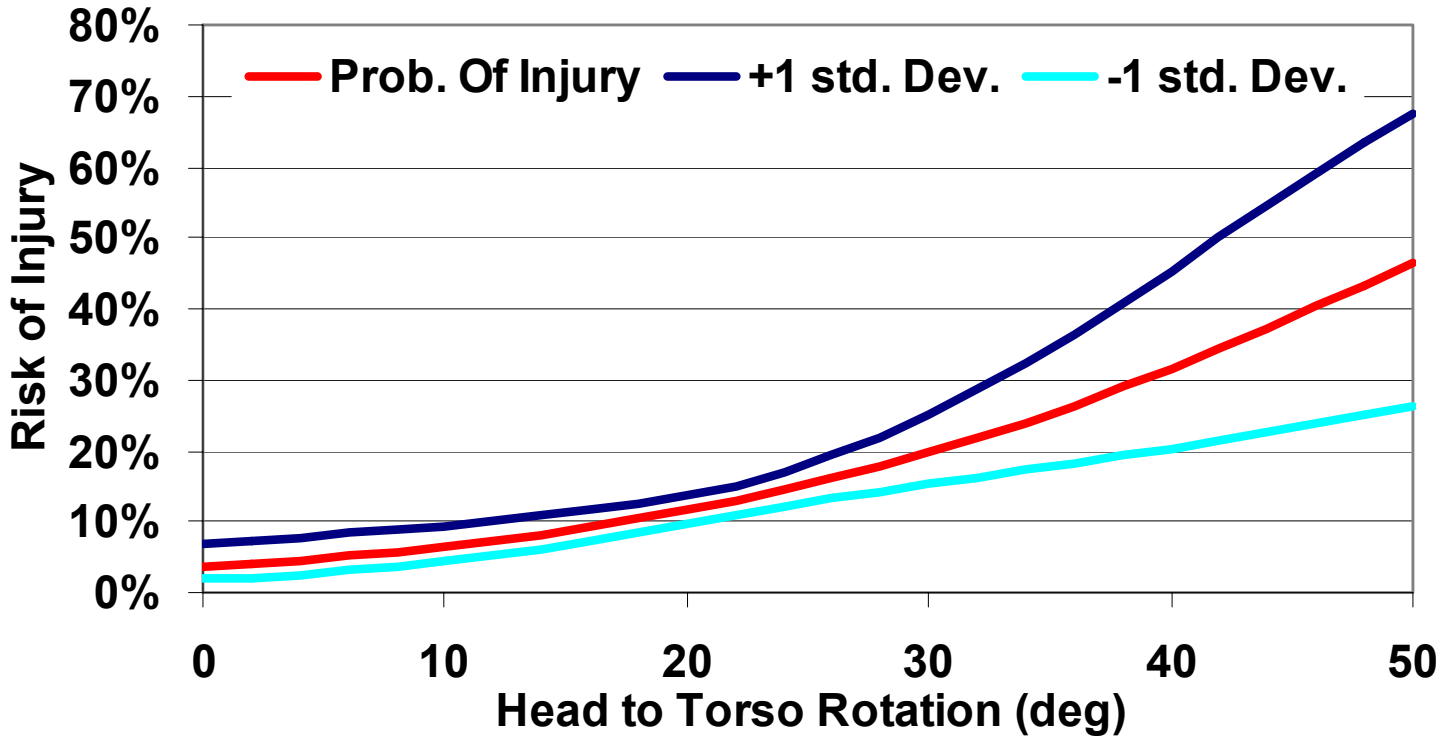
Rear Impact Sled Test Data

16 and 30 km/h tests with HIII 50M dummy

Seat	DeltaV (km/h)	HR height position	Initial backset (mm)	Head to torso rotation (deg)	Head to torso x-translation (mm)
900	16	Up	35	20.5	31.9
900	16	Down	35	28.9	40.4
9-3 SAHR	16	Up	35	6.5	4.9
9-3 SAHR	16	Down	35	15.9	18.4
900	30.5	Up	35	25	
9-3 SAHR	31.3	Up	35	10	



Logistic Regression

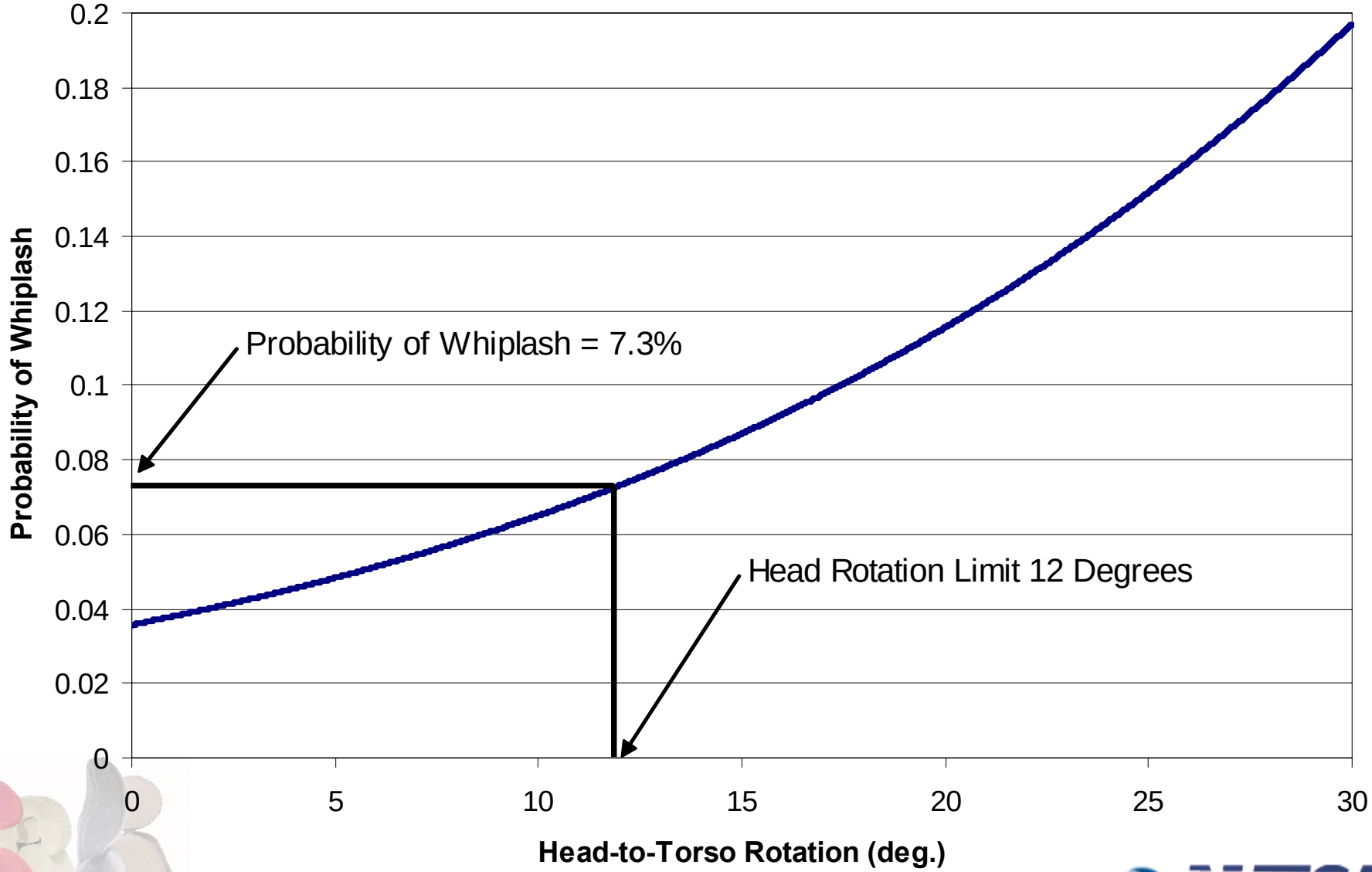


Risk curve developed relating low speed sled test data with field data.

Average head-to-torso rotation from sled tests weighted by estimated head restraint position – 60% in down position and 40% in up position.

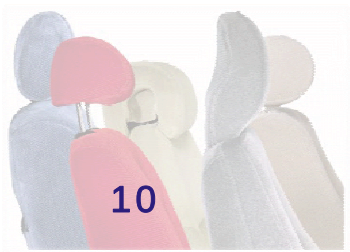
Head-to-Torso Rotation Limit

Probability of Whiplash



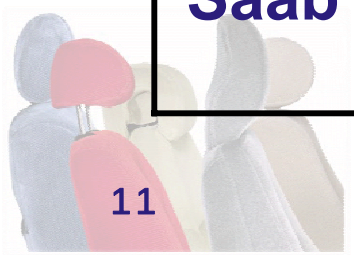
Selection of Rotation Limit in Optional Dynamic Test

- **Final Rule → 12°**
  - 50th %ile male Hybrid III dummy.
  - Head restraint in mid-height position.
- **Relief provided from NPRM, which required the head restraint comply in the lowest position.**
  - Desire to not discourage active systems.



Sled Test Data Showing Performance of Active Head Restraints (Viano et al.)

Vehicle	Delta V km/h	Backset (mm)	HR Position	Head Rotation
Saab 9-5	12.8	35	Up	1°
Saab 9-3	16	41 - 43	Up	4.6° - 6.5°
Saab 9-5	30	35	Up	11°
Saab 9-3	23.5	46	Mid	10°
Saab 9-3	16	48-65	Down	13.3° -16°



Head-to-Torso Rotation Limit

- **NHTSA believes current active systems can readily meet 12° requirement.**
- **Current static head restraints may need modifications.**
  - Optimization of seat back characteristics.
  - Stronger attachment of head restraint to seat back. (Docket NHTSA-2002-8570-57, 58, 59)