



# *A Comparison of Head Restraint Height Measurement Techniques*

**GTR7 Meeting**  
**London, England**  
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# Objective

## n **The objective of the testing was to:**

- Compare the height measurement results of three methods
  - FMVSS202a
  - GTR7, Annex 1
  - Netherlands proposed “Effective height measurement” per GTR7 mtg, 5-6 December, 2011
- Comment on the ease of interpretation and implementation of each method.



# Methods

- n **Selected six vehicles from VRTC test fleet**
  - Range of seat adjustment options
  - Variety of Head Restraint configuration/contours
  - Measurement of Driver's seat position

- n **Vehicles evaluated:**

2010 Acura MDX	2011 Ford Explorer	2011 Ford F-150
2011 Suzuki FX4	2011 Cadillac CTS	2011 Hyundai Sonata



# Methods *continued*

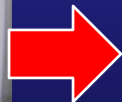
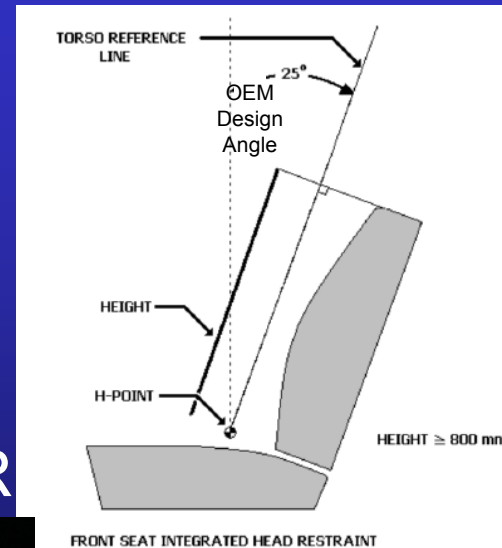
## Head Restraint Configurations



# Methods *continued*

## FMVSS 202a (reference TP-202aS-01)

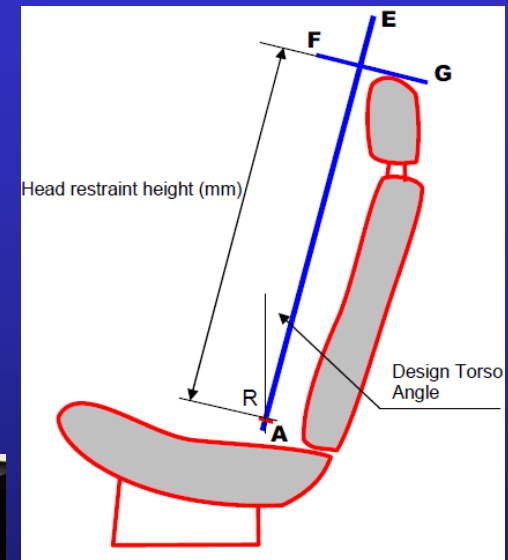
- OEM torso angle
- Seat is manipulated to obtain the highest H-pt relative to the seat back
- Measurement taken from H-pt
- Height  $\perp$  to torso ref. line / tangent to HR



# Methods *continued*

## GTR7 Annex 1

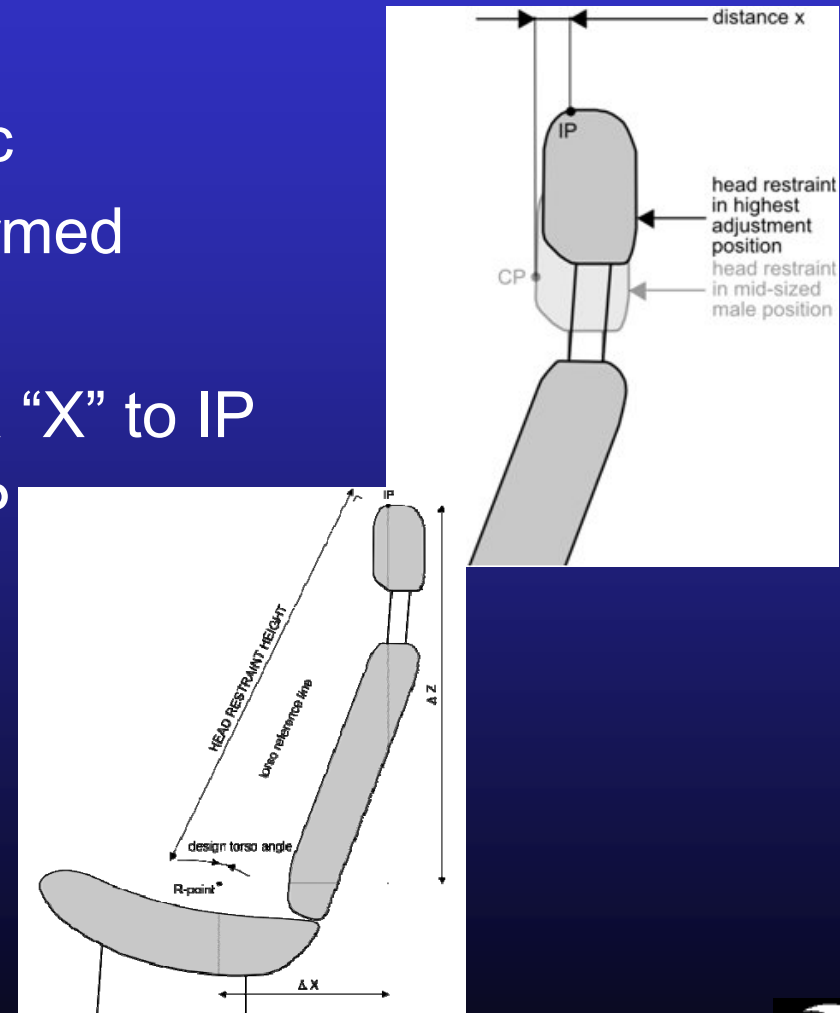
- Seat set to OEM design spec
- H-pt / R-pt relationship confirmed
- Measurement from R-pt
- Height  $\perp$  to torso ref. line



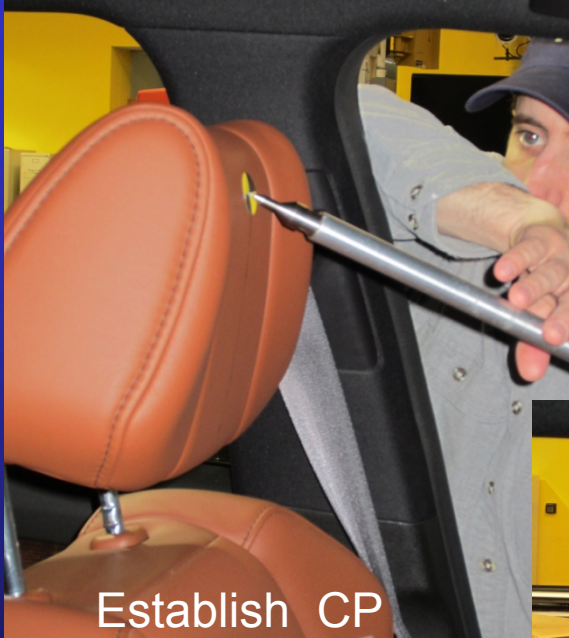
# Methods *continued*

## Netherlands proposal

- Seat set to OEM design spec
- H-pt / R-pt relationship confirmed
- Utilize “Head Position Table”
- Identify CP then translate via “X” to IP
- Measurement from R-pt to IP along torso ref. line



# Methods *continued*



Establish CP



Establish IP



Calculate height using torso angle, R-pt, and IP coordinates





# Measurement Data

Vehicle Description	Seat Description	Manufacture's R-pt Position (mm) (Relative to set-up origin - door striker or seat anchor bolt)	Measurement Procedure	H-Point			Head Restraint Height	
				X (mm)	Z (mm)	Torso Angle (°)	Highest Position	Lowest Position
2010 Acura MDX	10-way Power Power Lumbar	X = 131 Z = 124	FMVSS 202a	190	138	23	814	747
			GTR7	131	125	22	822	754
			Netherlands	131	125	23	821	755
2011 Suzuki SX4	6-way Manual	X = 52.8 Z = 182	FMVSS 202a	166	179	23	828	755
			GTR7	53	181	23	829	754
			Netherlands	53	181	22	829	761
2011 Ford Explorer	10-way Power Manual Lumbar	X = 129 Z = 94	FMVSS 202a	158	115	21	833	772
			GTR7	130	94	23	868	808
			Netherlands	130	94	21	825	784
2011 Cadillac CTS	10-way Power	X = 73 Z = 100	FMVSS 202a	87	109	22	799	738
			GTR7	73	102	24	823	762
			Netherlands	73	102	25	809	757
2011 Ford F150	4-way Manual Manual Lumbar	X = 290 Z = 56	FMVSS 202a	347	54	19	857	796
			GTR7	291	55	19	860	800
			Netherlands	291	55	19	840	793
2011 Hyundai Sonata	6-way Manual	X = 149 Z = 263	FMVSS 202a	210	285	27	863	779
			GTR7	150	260	26	878	801
			Netherlands	150	260	26	848	785



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Note :  
NL measurements using fixed IP plane established in high position.



# Comments

## Comment regarding NL Procedure

### n Section 2.3.4 Determination of the lowest head restraint height

“In this position the head restraint height is the distance from the R-point, parallel to the torso reference line and limited by a line perpendicular to the torso line intersecting the IP (as determined in paragraph 2.3.3.) in its lowered position.”

VRTC found confusing the determination of the IP for measurement for the lowest H/R position:

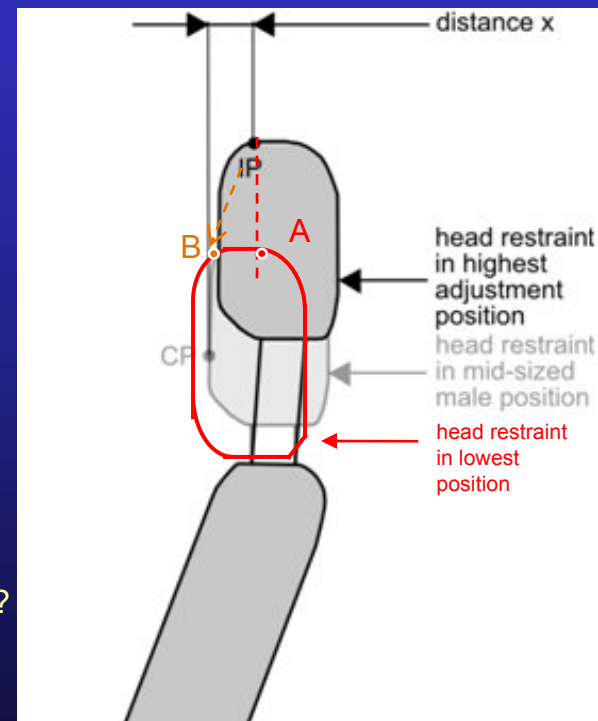
- Is a new IP determined using the “Distance X” y-z plane?

Point A

Or

- Is the “high position” IP point used for measurement?

Point B



# Measurement Data

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				X (mm)	Z (mm)	Torso Angle (°)	Highest Position (A / B)	Lowest Position (A / B)
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Note :  
NL measurements using high position IP (B) translated to low position.

Note :  
NL measurements using fixed IP (A) plane established in high position.



# Observations

## n Data

- The GTR7 method produced the largest H/R height measurements of all three methods.
- The GTR7 method high and low position measurements were consistently greater than NL measurements except in cases where the H/R adjustment was nearly vertical.
- The GTR7 high position heights range from 0 to 5% greater than the NL heights for these vehicles evaluated. The low position heights are more similar (3% or less difference).
- Depending on the interpretation of how to locate the IP for the low position measurement, the GTR7 measurements can range from 0 to 6% greater than the NL measurements.



# Observations

## n **Methods**

- Both the GTR7 and the NL methods present easier, more intuitive and readily attainable seat set-up for collecting measurements than FMVSS202a.
- Once the relationship of the R-pt and the H-pt is confirmed, NL method offers the opportunity to gather measurements with no encumbering hardware in the vehicle space.
- Both the GTR7 and the NL measurement methods were more straight forward with left less opportunity for interpretation than the FMVSS202a method.
- Measurements collected using the FMVSS202a method were more time consuming than the GTR7 method. The NL method was about the same as the GTR7 with the opportunity to be more time efficient.
- Clarification for determining the IP for low position measurements would be helpful.



***Thank you***

