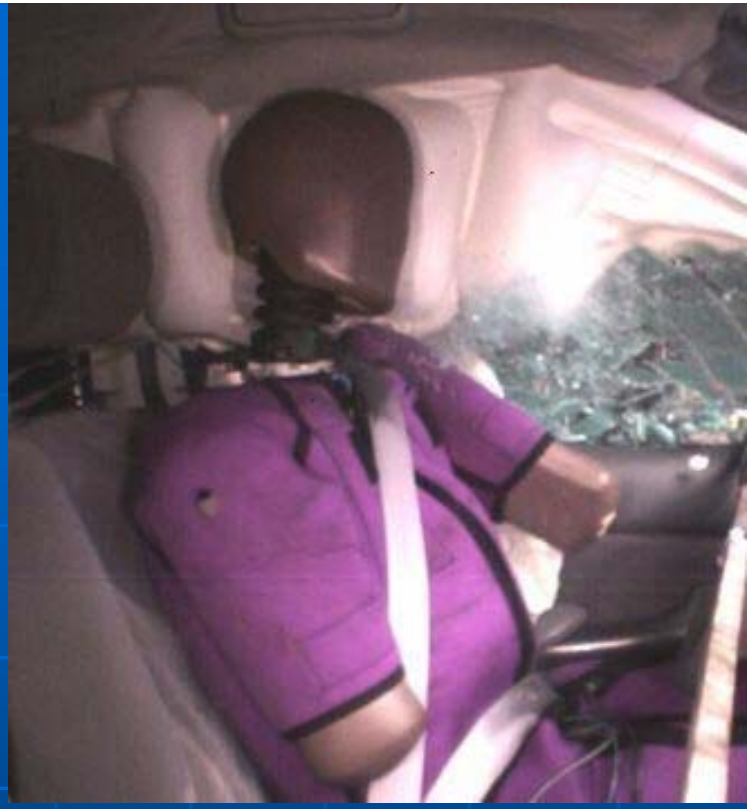
50th Male WorldSID Test Results in FMVSS 214 Test Conditions & ES-2re Comparisons



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NHTSA/VRTC

Background

- FMVSS 214 final rule released in September 2007
  - Updated the dummies and test configurations
  - NHTSA states it will begin evaluations with the WorldSID dummy
- Industry petitioned the Agency to include the WorldSID 50th in Part 572 and FMVSS 214

Bio-Mechanics Conclusions

- WSID biofidelity is better than ES-2re
- WSID shoulder has improved ROM, measures displacement
- WSID shoulder & thorax have improved oblique response
- WSID abdomen measures displacement
- WSID Durability, R&R and Usability are acceptable

The WorldSID 50th male dummy is an improved side impact test dummy

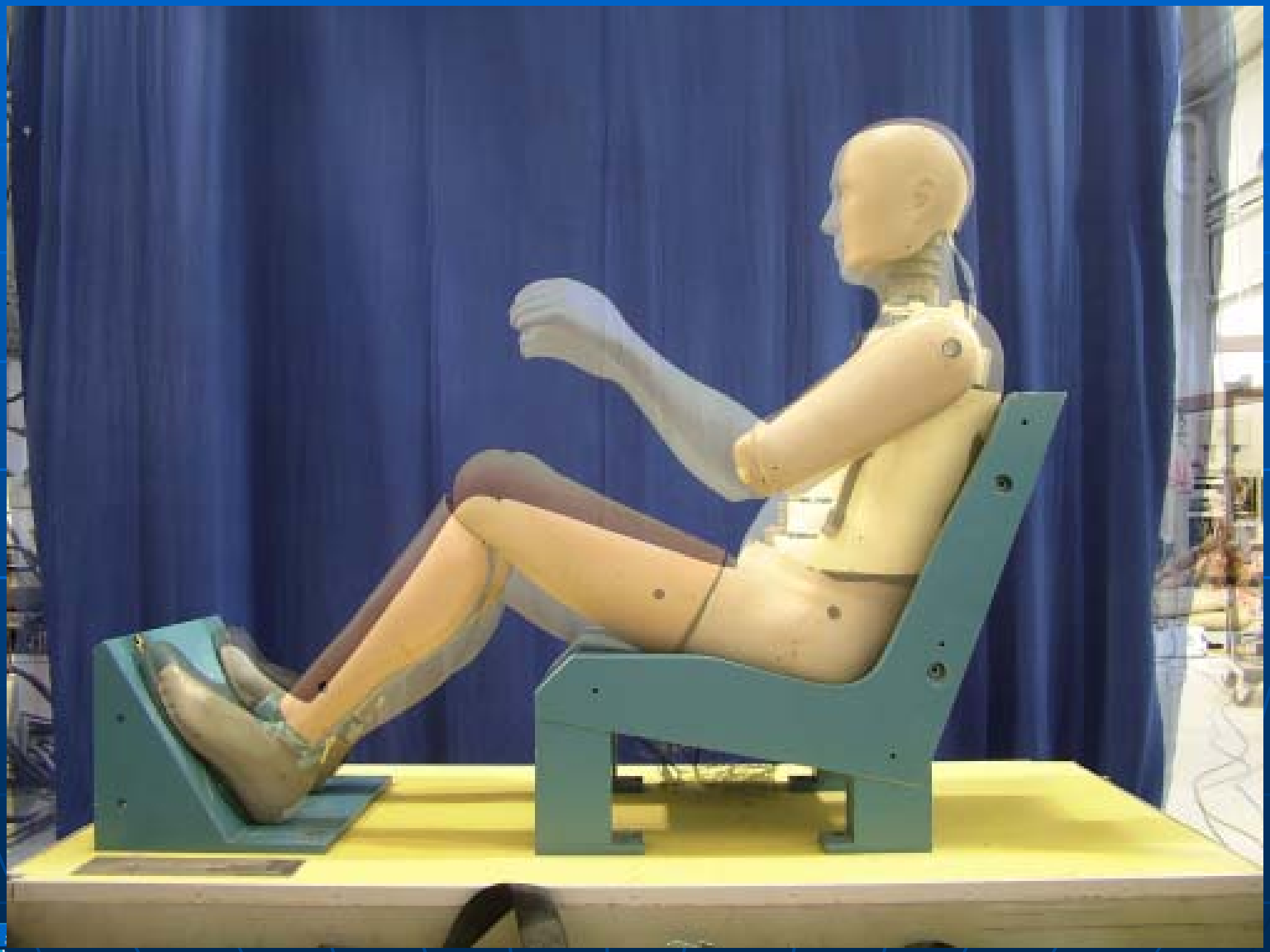
Anthropometry Measurements of ES-2re and WorldSID

	WorldSID	ES-2re
	mm	mm
Shoulder width	480	485
Thorax width (nipple)	371	337
Pelvis width	410	355
Sitting height (neck/torso interface)	600	660
Sitting height (erect)	870	920
Leg Length	555	452

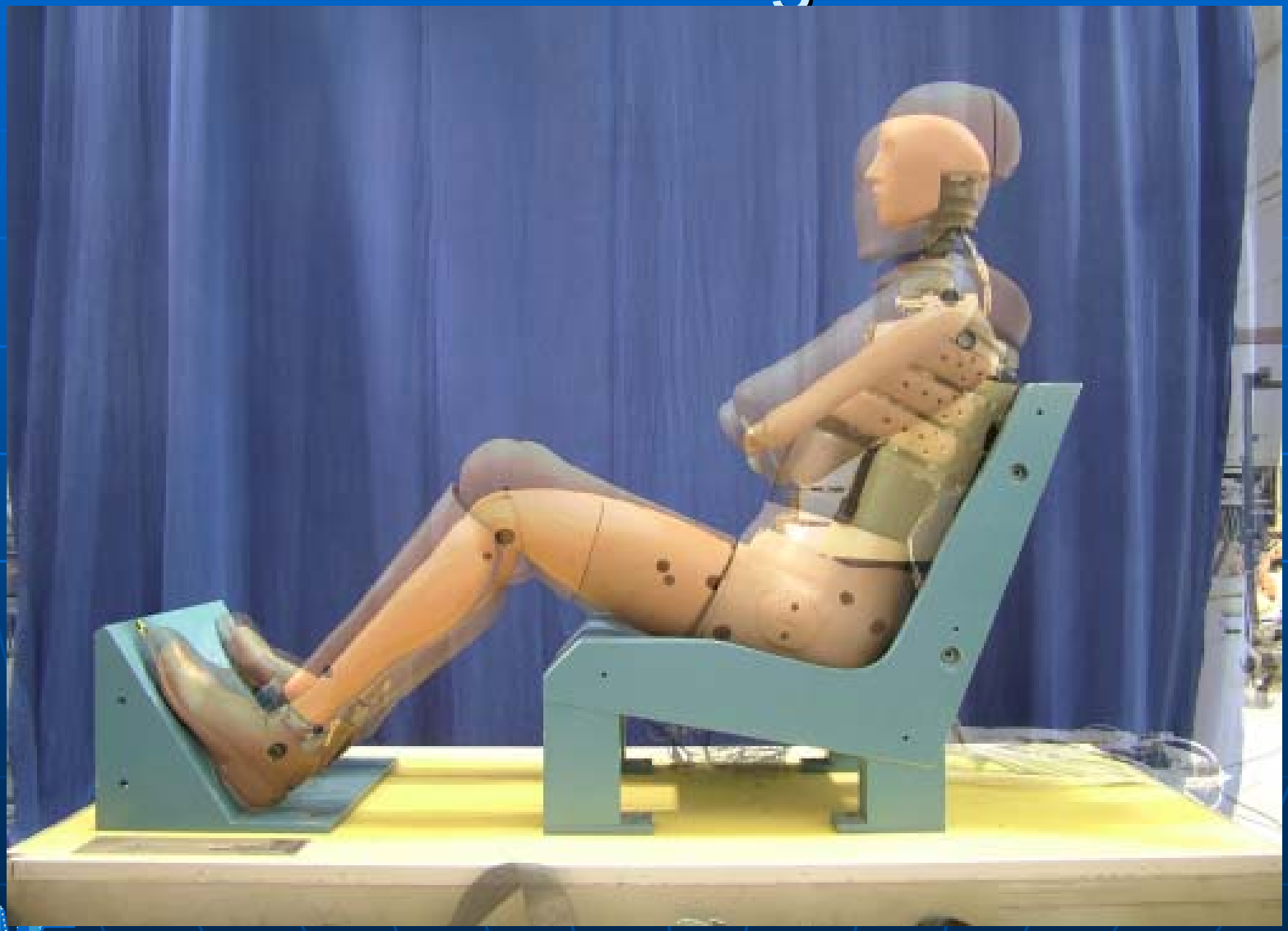
UMTRI Manikin-
Most recent anthropometry study

ES-2re vs UMTRI seating

WorldSID vs UMTRI seating



WorldSID vs ES-2re in UMTRI Seating



Seating Procedure Differences

- Same initial seat position for both dummies
- Target H-Point positions are slightly different
  - Both based on OSCAR positioning
- WorldSID seating procedures allows for the angle of the seatback to be adjusted to level the thorax
- These can further change the already existing differences in the head and thorax positions

Seating Procedure

WorldSID Seating Procedure Draft 1.0

- Placed seat according to current FMVSS 214 procedure for 50th Male (S8.3.1 and S10.3.1)
  - At rearmost position find mid angle of cushion, keeping mid angle, adjust to lowest position, move seat to midtrack
  - Oscar the seat at this position
- Began with step #20 of seating procedure
  - "Draft Test Procedure V.1.0", 6/6/06
- Adjusted dummy using the tilt sensors
  - Head, thorax and pelvis were adjusted to 0±2°

Test Vehicles

Same fleet vehicles used to evaluate the ES-2re

- FMVSS 214 Pole Test
  - 2004 Honda Accord
  - 2005 Subaru Forester
  - 2006 Toyota Sienna
  - 2005 Ford 500
  - 2006 VW Jetta
  - 2005 Saturn Ion
  - 2005 Ford Expedition
  - 2005 VW Beetle (Convertible)
- FMVSS 214 MDB TEST
  - 2005 Subaru Forester
  - 2005 Ford 500
  - 2006 VW Jetta
  - 2005 Saturn Ion
  - 2005 Honda CRV

Note: None of the vehicles were designed for the 214 pole test

MDB Test Summary

- ES-2re - All vehicles passed IARVs
- WorldSID – All vehicles passed IARVs, except the Saturn Ion's max rib thorax deflection reached its maximum and had more elevated responses
  - WorldSID IARV's proposed by WorldSID working group; the values represent a 50% risk of AIS3+ injury
- Differences are more pronounced in the pole testing

MDB – Driver WorldSID

Vehicles	HIC36	Thorax Deflection (mm)	Abdomen Deflection (mm)	Lower Spine (G's)	Pubic Force (N)	Pelvis Resultant (g's)
Proposed Injury Criteria	1000	56	53	78	1790	77
VW Jetta	131	40	27	48	1355	44
Saturn Ion	136	56	51	56	1571	75
Ford 500	42	20	23	47	778	38
Subaru Forester	33	22	9	35	849	55
Honda CRV	47	18	8	31	746	40

MDB-Driver ES-2re

Vehicles	HIC36	Rib Deflection (mm)	Lower Spine (G's)	Pubic Force (N)	Abdomen Force (N)
IARVs	1000	44	82	6000	2500
VW Jetta	101	26	28	1969	733
Saturn Ion	110	29	52	2431	1524
Ford 500	66	25	35	1176	1006
Subaru Forester	44	21	33	1694	598
Honda CRV	100	35	31	1137	524

MDB- Passenger WorldSID

Vehicles	HIC36	Rib Deflection (mm)	Abdomen Deflection (mm)	Lower Spine (G's)	Pubic Force (N)	Pelvis Resultant (G's)
Proposed Injury Criteria	1000	56	53	78	1790	77
VW Jetta	131	18	23	38	871	47
Saturn Ion	260	39	41	55	1192	54
Ford 500	242	36	32	46	1068	68
Subaru Forester	122	21	30	36	n/a	43
Honda CRV	89	21	32	39	1052	74

MDB-Passenger ES-2re

Vehicles	HIC36	Rib Deflection (mm)	Lower Spine (G's)	Pubic Force (N)	Abdomen Force (N)
IARVs	1000	44	82	6000	2500
VW Jetta	211	29	53	2542	1378
Saturn Ion	168	27	47	2275	1511
Ford 500	213	25	44	1407	1649
Subaru Forester	226	23	35	1948	967
Honda CRV	126	5	33	1847	1192

Pole Test Summary

- ES-2re
  - 5 out of 8 vehicles exceeded IARVs
  - Jetta, Accord, Beetle passed all IARVs
- WorldSID
  - 5 out of 8 vehicles exceeded **proposed** IARVs
  - Jetta, Accord, Sienna passed all IARVs
- Beetle and Sienna “flip/flopped” with each of the dummies

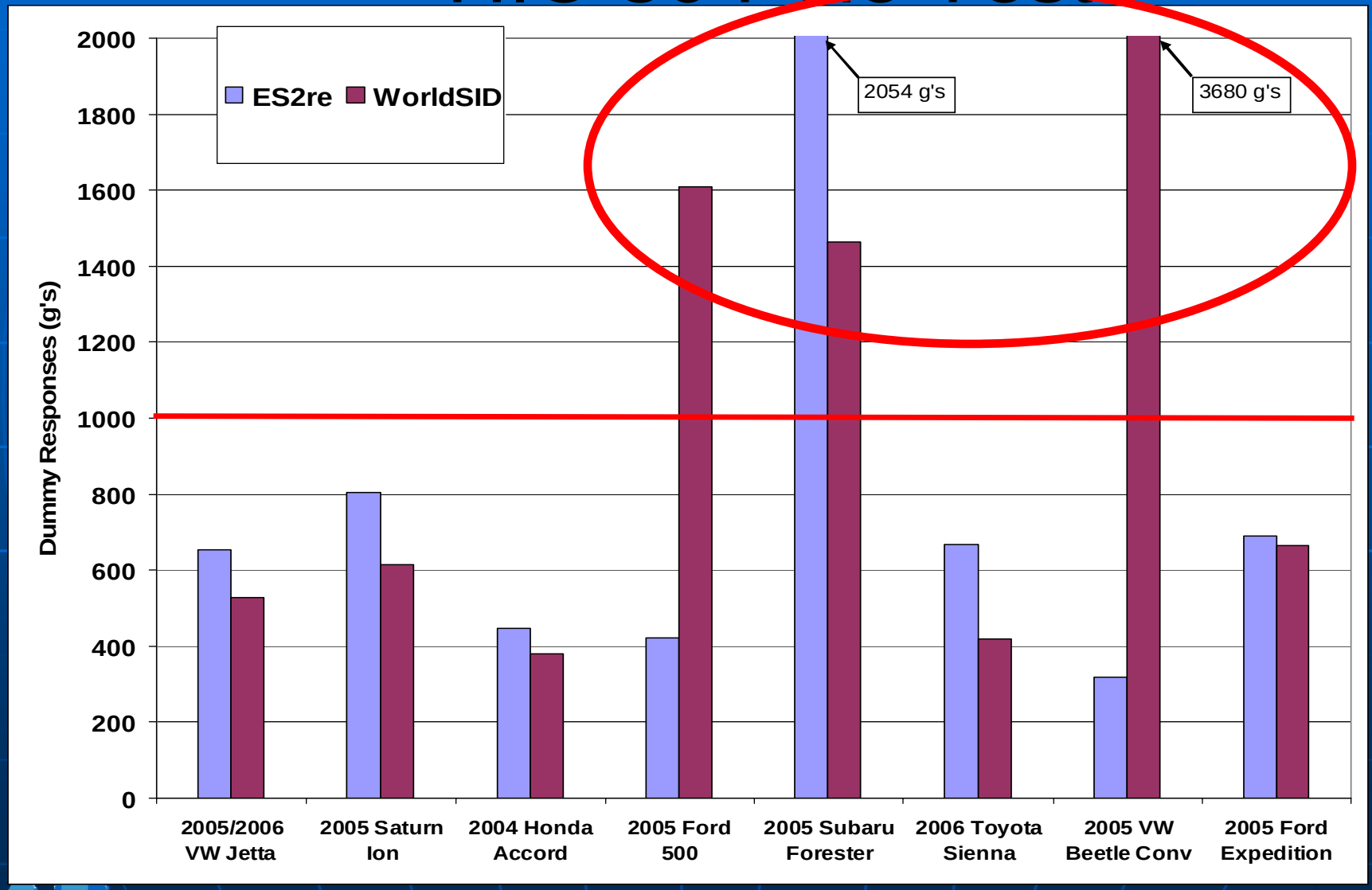
Pole Test Results- WorldSID

Vehicles	HIC36	Thorax Def. (mm)	Abdomen Def. (mm)	Lower Spine Result. (g's)	Pubic Force (N)	Pelvis Result. Accel. (g's)
Proposed Injury Criteria	1000	56	53	78	1790	77
2006 VW Jetta (C+T)	528	48.1	49.9	63.3	1001.9	56.6
2005 Saturn Ion (C)	612	49.0	70.1	79.8	1263.9	68.1
2005 Honda Accord (C+T)	380	26.2	28.8	51.7	1304.5	53.0
2005 Ford 500 (C+T)	1609	62.4	65.7	82.0	1208.6	66.0
2005 Subaru Forester (Combo)	1463	60.8	36.6	79.3	1227.4	77.0
2006 Toyoto Sienna (C+T)	418	38.0	52.3	67.9	1085.3	62.3
2005 VW Beetle Convertible (Combo)	3680	44.2	24.7	69.2	1127.3	80.6
2005 Ford Expedition (C)	665	36.3	70.9	76.6	1269.9	85.9

Pole Test Results- ES-2re

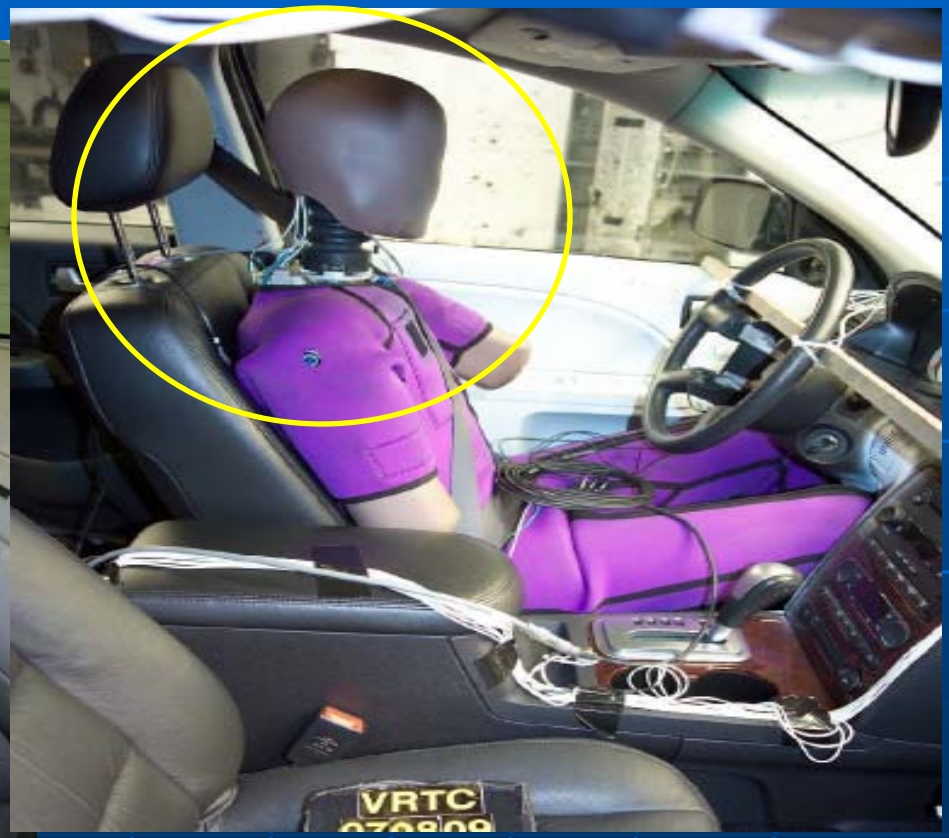
ES-2re Test Results	HIC36	Rib Deflection (mm)	Lower Spine (G's) (monitored)	Pubic Force (N)	Abd'm Force (N)
IARVs	**1000**	**44**	**82**	**6000**	**2500**
VW Jetta	652	36	60	3372	1663
Saturn Ion	806	50	76	1585	1494
Honda Accord	446	31	52	2463	1397
Ford 500	422	35	68	2133	3020
Subaru Forester	2054	43	46	2291	1377
Toyota Sienna	667	47	60	2127	1751
VW Beetle Convertible	315	37	69	3815	1018
Ford Expedition	689	26	75	6973	2575

ES-2re vs WorldSID
HIC 36 Pole Test



2005 Ford 500
Difference in head positions

ES-2re

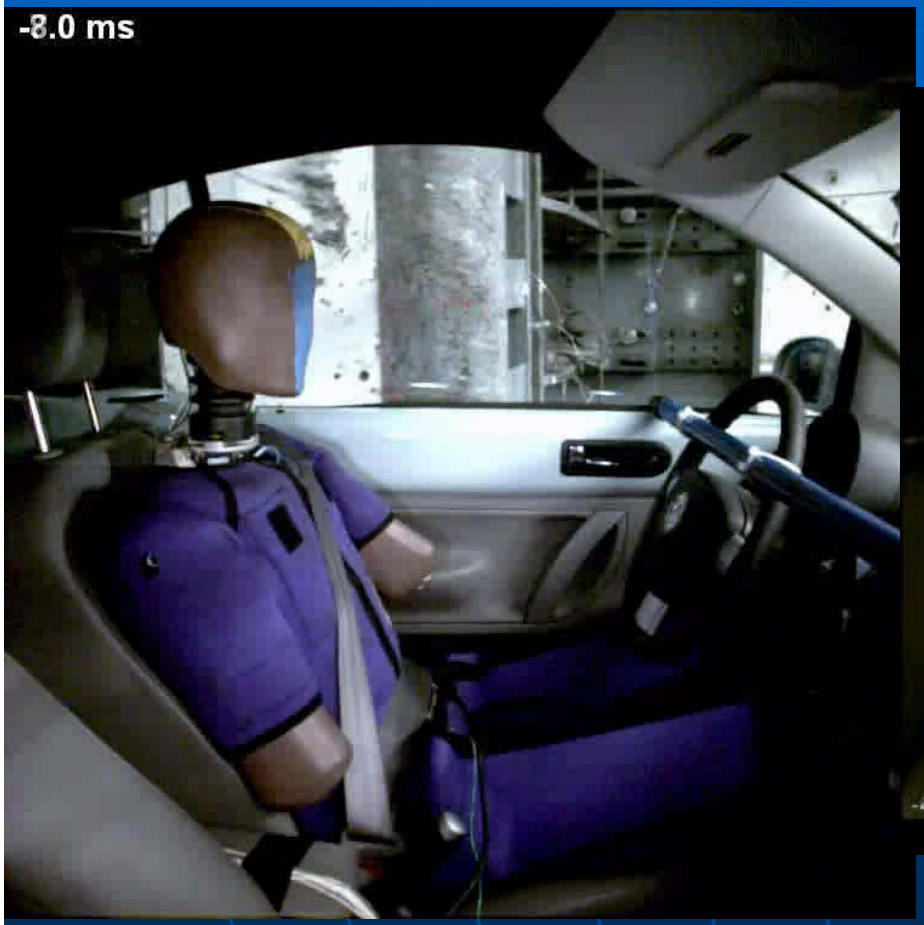


WorldSID

2005 Ford 500

- Different head positions due to dummy anthropometry and seating procedures
  - WorldSID head is lower and 3½ inches forward of ES-2re's head
  - Therefore the pole strikes the vehicle more forward in WorldSID test
  - Air curtain deployed 15 ms later in the WS test
- Different pole positions can affect:
  - head impact location on air curtain
  - sensor response
  - structural deformation
- Different impact location may have caused different sensor response and late curtain deployment.

VW Beetle
WorldSID vs ES-2re



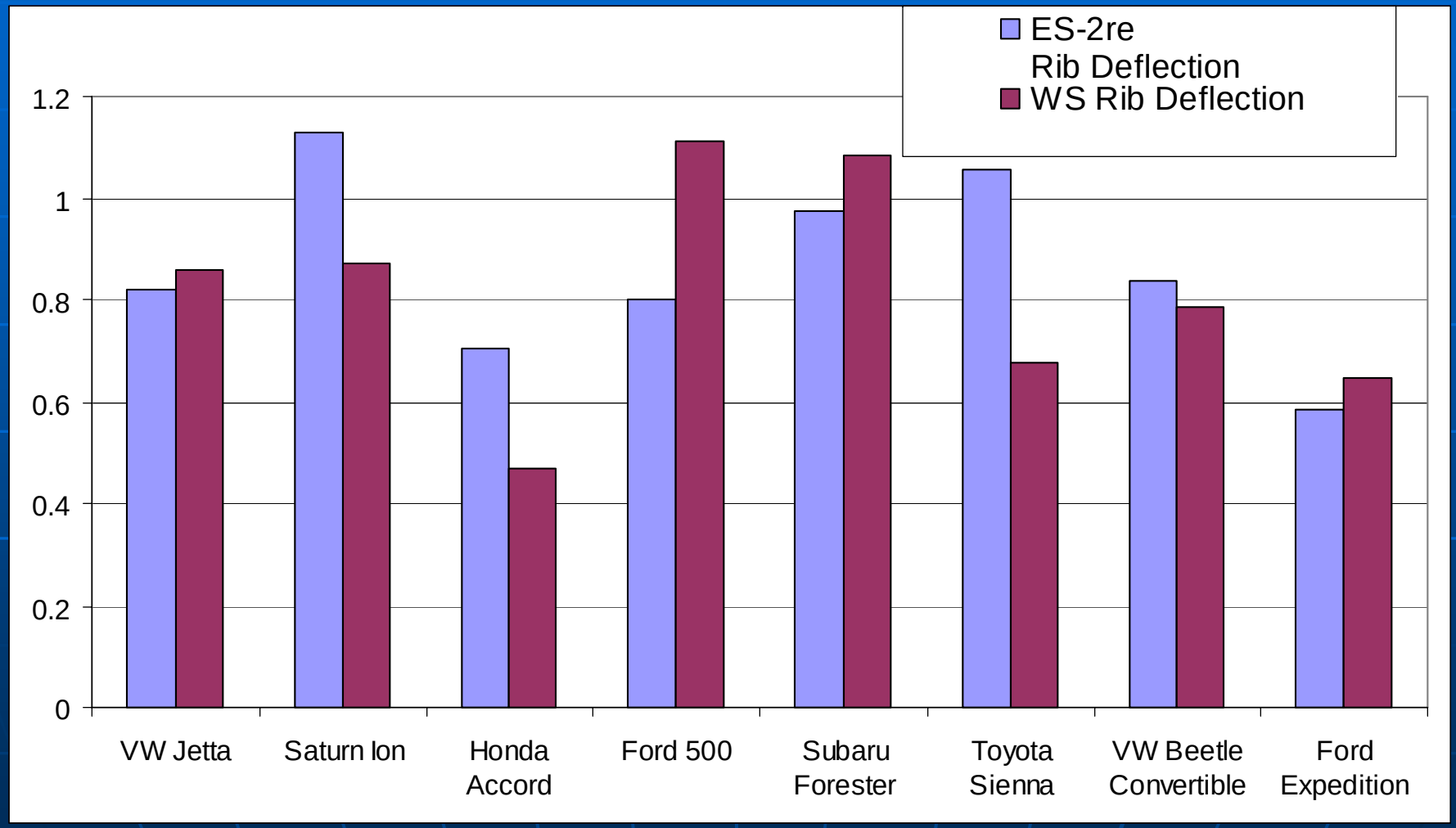
WorldSID

ES-2re

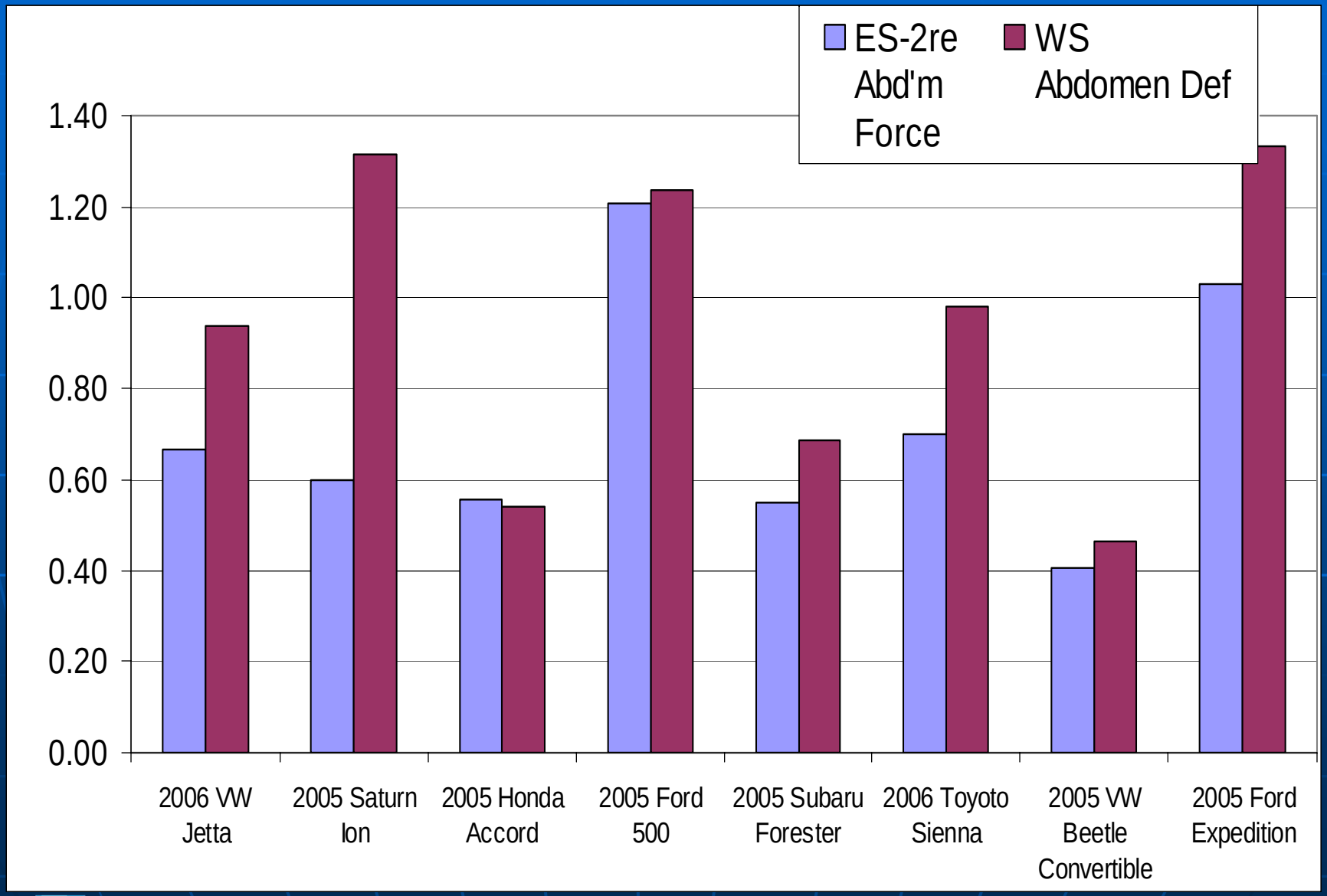
2005 VW Beetle

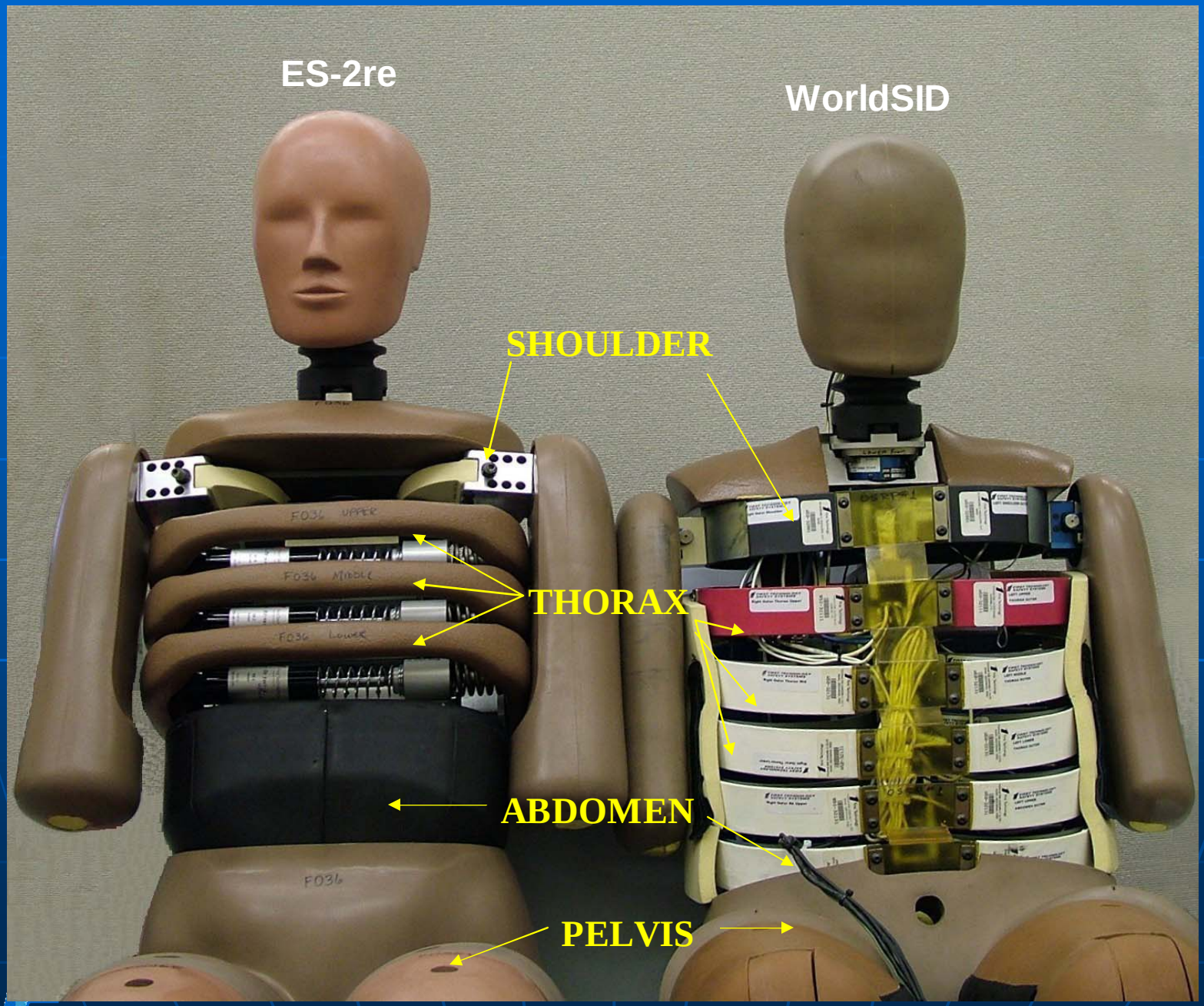
- Pole impact was 1½ inches rearward in WorldSID test
- Seatback position was more rearward in WorldSID test
- Combo bag inflated behind seat and did not protect head in WorldSID test
- Different impact location and/or seatback location may have caused different deployment path of combo bag

Pole Test Thorax Comparison

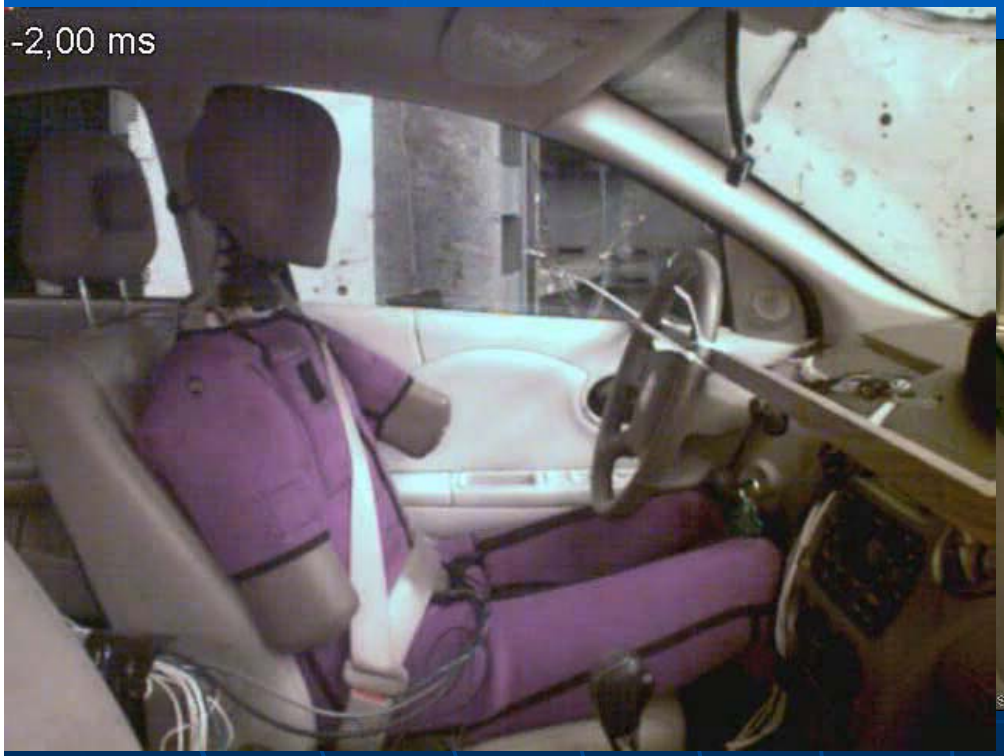


Pole Test Abdomen Comparison




ES-2re
WorldSID
SHOULDER
THORAX
ABDOMEN
PELVIS

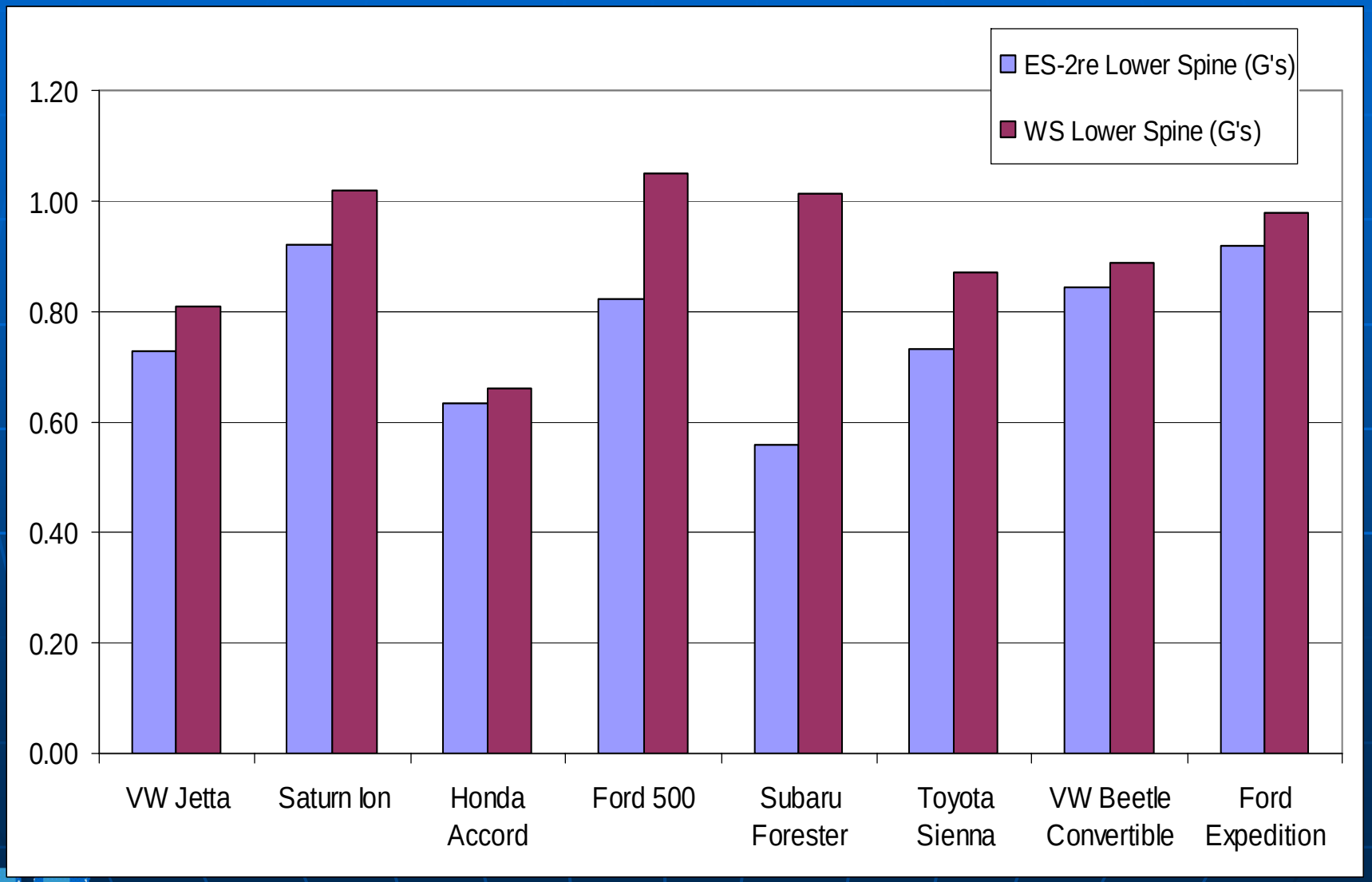
Thorax Impacts
Armrest interaction



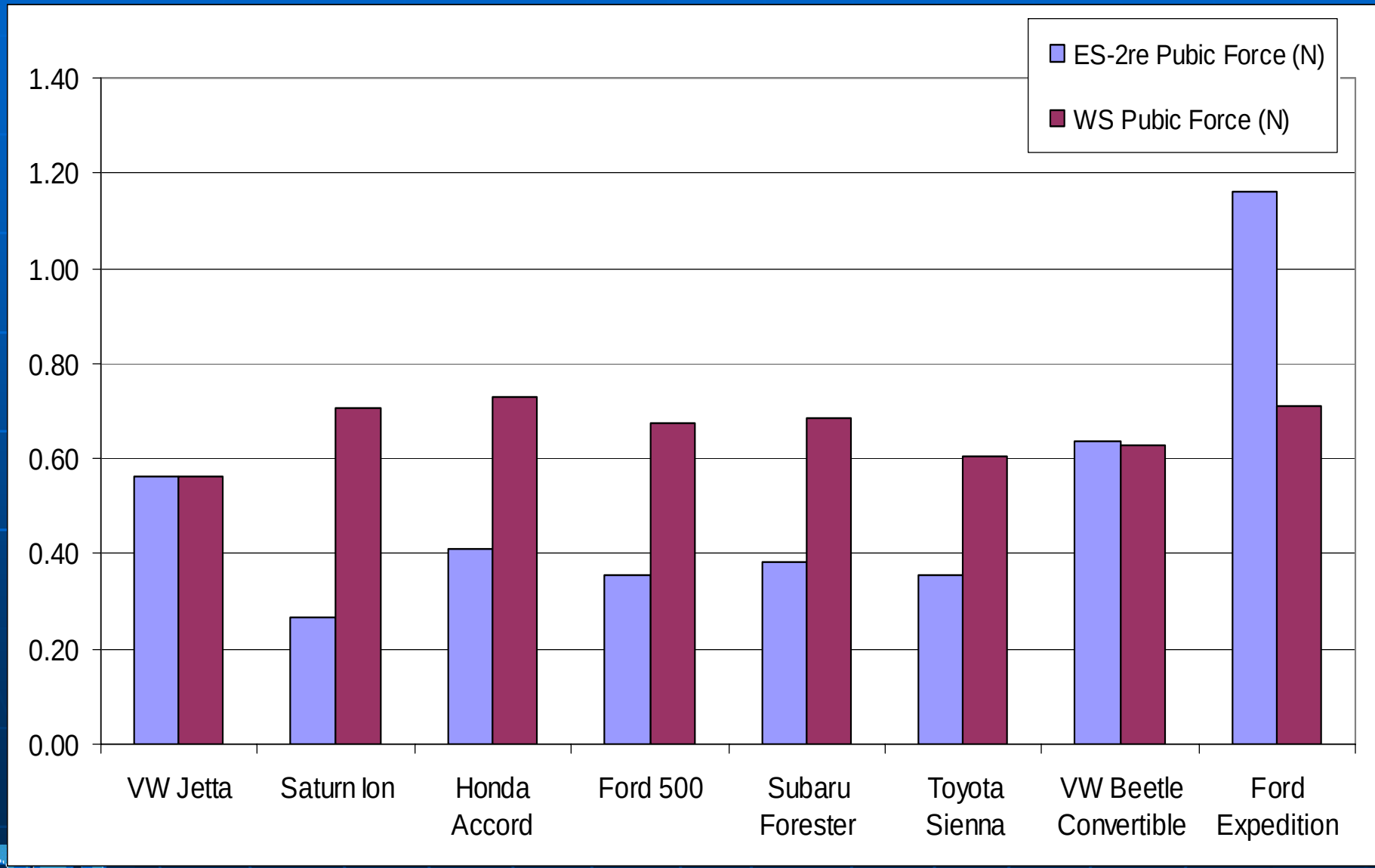
WorldSID

ES-2re

Pole Test - Lower Spine



Pole Test - Pubic Force (N)



Dummy Durability

- MDB Tests – no damage reported
- Pole Testing had minor damage
  - IR-TRACC was bent and broken on both ends on one test
  - Rib damping material debonding
  - Shoulder deflection response
    - Maximum deflection reached on 4/8 tests

Crash Test Summary

- Regardless of dummy used:
  - 4 of 5 vehicles passed MDB test
  - 4 of 8 vehicles failed pole test
  - 2 of 8 vehicles passed pole test
- Pass/Fail performance of Beetle and Sienna in pole test switched depending on dummy used.
- WorldSID produced more marginal/ exceeding IARV responses than ES-2re
- The WorldSID dummy durability is good

Conclusions

- Biofidelity of WorldSID is improved over ES-2re
- WorldSID and ES-2re are designed from different anthropometry data sets
  - WorldSID anthropometry is more like UMTRI human anthropometry study
  - WorldSID is more “slouched” and sits lower than ES-2re
  - Body regions are in different locations

Conclusions (cont'd)

- Different head positions produce different impact locations in pole tests. This can affect:
  - head impact location on air curtain
  - sensor response
  - structural deformation
- Thorax and abdomens are aligned differently with the vehicle interior
  - Can produce different loading on dummy (e.g. armrest to abdomen)

Future R&D Activities for WorldSID

- Biomechanics
  - Preparation of documentation needed to Federalize the 50th Male
  - Injury Criteria development
  - Evaluation of 5th Female
- Crashworthiness
  - Evaluate seating procedure
  - Fleet Testing
    - Vehicles certified to New FMVSS 214
    - Beginning with Model Year 2010

Thanks

Questions and Comments:

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