

# WorldSID 50<sup>th</sup> Male Seating Evaluation and Fleet Testing

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Government Industry 2012  
January 25, 2012

# Background

- ▶ 2009-2011: Seating Evaluation and Initial Crash Testing
  - FMVSS 214 (WS & ES2-re)
  - WS Version 5.1 - 5.4 (WS)
  - UMTRI (WS)
  - FMVSS 214 (-20mm midtrack) (WS)

# Differences between the WorldSID seating procedures and FMVSS 214

## WorldSID 5.4 Version

- Initial seat setup
  - Seat cushion: lowers the seat to lowest, taking out pitch of seat in some cases
  - Seat Travel:  
midtrack - 20mm
- OSCAR tolerance
  - WS H-point: Add 20mm +/- 5mm

## FMVSS 214

- Initial seat setup
  - Seat cushion: lowers the seat to lowest, but keeps the mid angle
  - Seat Travel:  
midtrack
- OSCAR tolerance
  - ES2-re H-point: (+/-) 10 mm





# Observations from Seating Evaluation

- ▶ Head CG differences
- ▶ Similar final target H-points
- ▶ Issues with leg lengths at FMVSS 214 (midtrack position)
- ▶ Recommendations for WorldSID seating procedure
  - Use FMVSS 214 seat cushion setup (mid angle / lowest height) with seat track at midtrack-20mm
  - Use WS5.4 in setting the dummy (tilt sensors) + Oscar H-point tolerance



FMVSS 214



FMVSS 214(-20mm)



WS 5.4



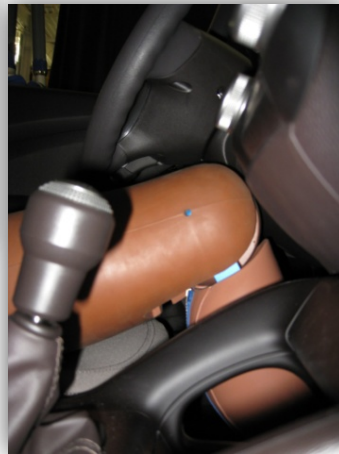
ES2-RE 214

# 2011 Hyundai Tucson FMVSS 214



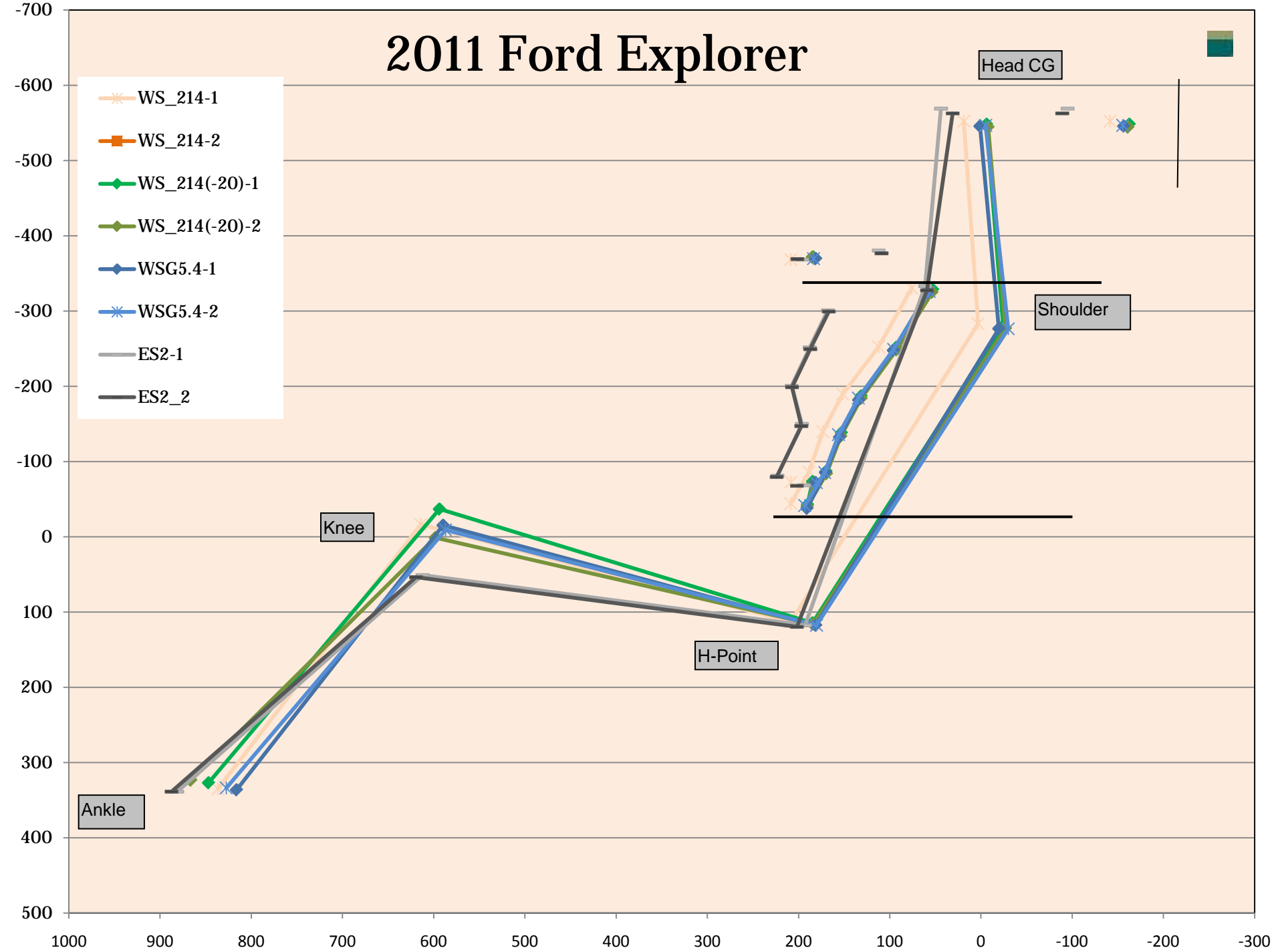
Interference with steering  
column and dash

Knee to Knee: 220  
Foot interference with clutch



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# 2011 Ford Explorer



# Fleet Testing



# Injury Criteria

## ▶ ES2-re\*

- ES2-re injury limits based on AIS 3 with 50% risk of injury except for pelvic criterion
  - HIC36: 1000
  - Chest: 44mm
  - Abdominal Force: 2500 N
  - Pubic Force: 6000N
  - Lower Spine: 82 g's (monitored)

## ▶ WorldSID\*

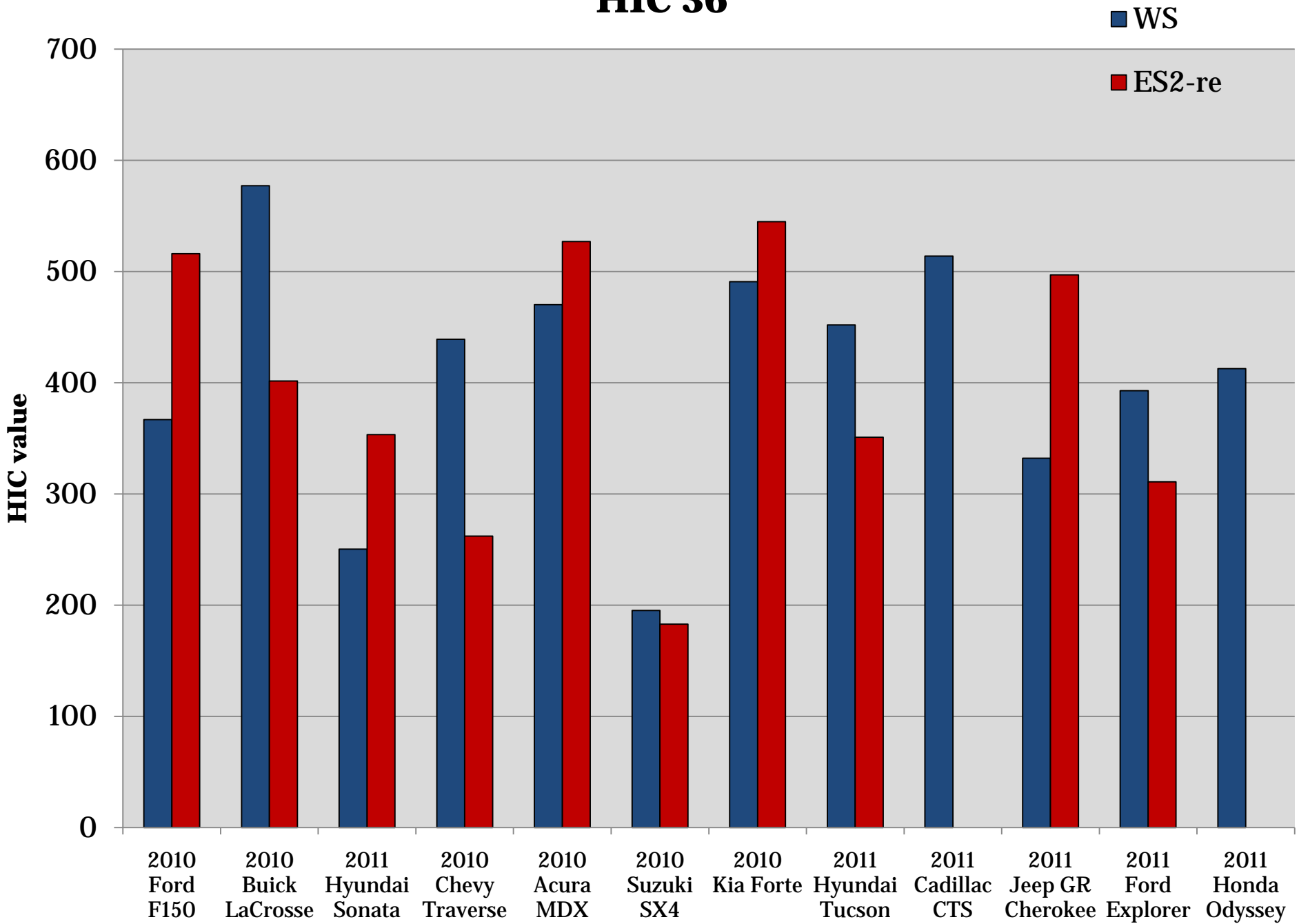
- Using similar reasoning as the ES2-re (AIS 3 with 50% risk of injury except for pelvic and shoulder\*)
  - HIC36: 1000
  - Thoracic Rib Def.: 57mm
  - Abdomen Def.: 57mm
  - Pubic Force: 2780 N
  - Lower Spine: 105 g's
  - Shoulder Def: 65mm
  - Shoulder Force: 2560N

\*Current regulation FMVSS 214

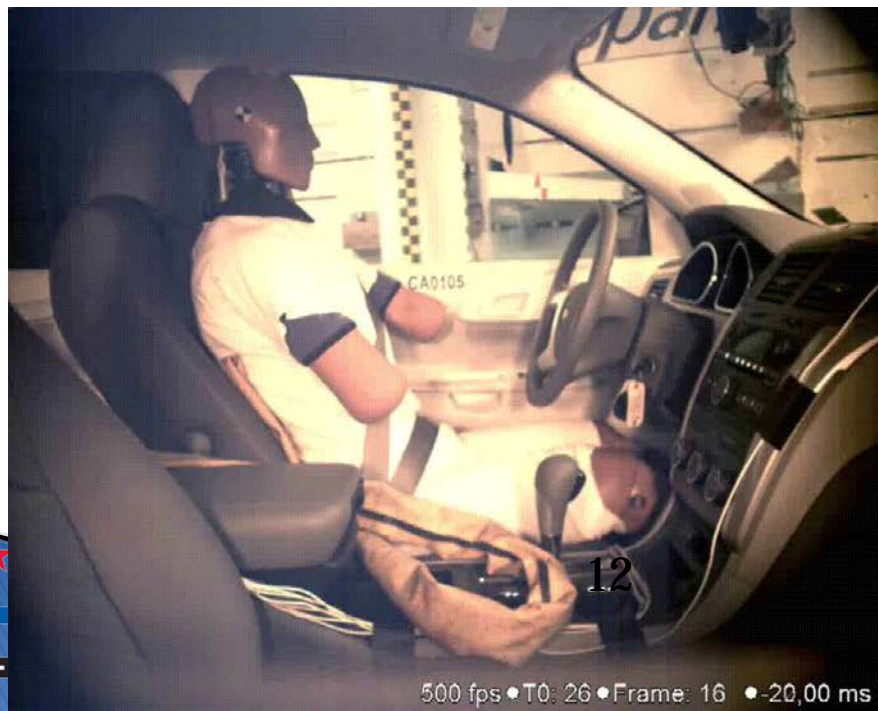
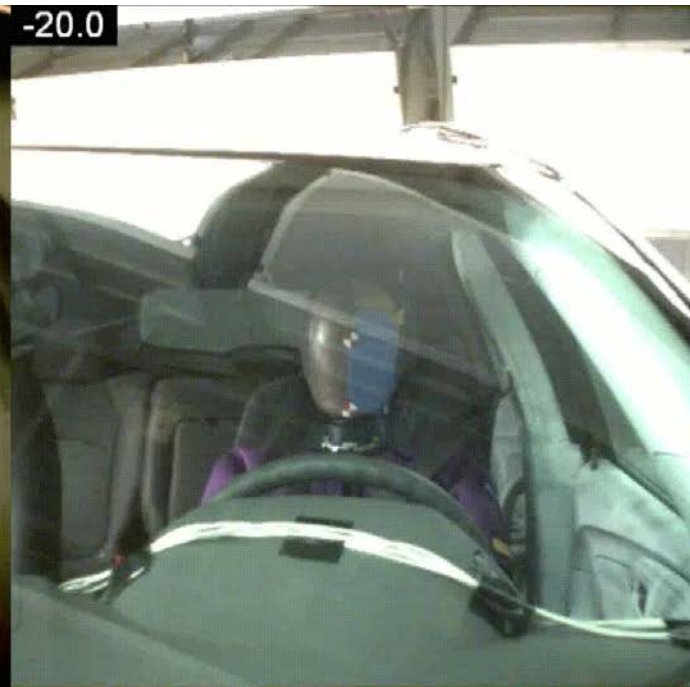
\*Injury Risk Curves from 2009 & 2010 Stapp Papers on Injury Criterion by Audrey Petijean

Vehicle	Dummy	HIC36	Shoulder Deflection (mm)	Max Thorax Rib Deflection (mm)	Max Abdomen Rib Deflection (mm)	Lower Spine (G's)	Pubic Force (N)	Pelvis Resultant Acceleration (G's)	Abdominal Force (N)
Injury Values	<b>WS</b>	<b>1000</b>	<b>65</b>	<b>57</b>	<b>57</b>	<b>75</b>	<b>2780</b>	<b>105</b>	<b>n/a</b>
(AIS3)	<b>ES2-re</b>	<b>1000</b>	<b>n/a</b>	<b>44</b>	<b>n/a</b>	<b>82</b> (monitored)	<b>6000N</b>	<b>n/a</b>	<b>2500</b>
2010 Ford	WS	367	38	41	33	57	1110	44	n/a
F150	ES2-re	516	n/a	31	not instrumented		2575	not instrumented	1349
2010 Buick	WS	577	54	43	26	61	1201	87	n/a
LaCrosse	ES2-re	402	n/a	23	not instrumented		2752	not instrumented	1051
2011 Hyundai	WS	250	57	32	44	73	1433	72	n/a
Sonata	ES2-re	354	n/a	24	not instrumented		2182	not instrumented	1305
2010 Chevy	WS	439	66	46	36	54	1557	71	n/a
Traverse	ES2-re	262	n/a	37	not instrumented		2697	not instrumented	1248
2010 Acura	WS	470	62	29	42	54	812	52	n/a
MDX	ES2-re	527	n/a	38	not instrumented		1614	not instrumented	not calculated
2010 Suzuki	WS	195	25	35	42	53	1107	69	n/a
SX4	ES2-re	183	n/a	29	not instrumented		2265	not instrumented	1765
2010 Kia	WS	491	55	25	34	46	1151	79	n/a
Forte	ES2-re	545	n/a	26	not instrumented		2570	not instrumented	1410
2011 Hyundai	WS	452	55	35	42	57	936	54	n/a
Tuscon	ES2-re	351	n/a	34	not instrumented		2093	not instrumented	1523
2011 Jeep	WS	332	51	30	23	36	1227	58	n/a
Gr Cherokee	ES2-re	497	n/a	10	not instrumented		1248	not instrumented	1545
2011 Ford	WS	393	60	43	39	81	912	81	n/a
Explorer	ES2-re	311	n/a	25	not instrumented		2969	not instrumented	818

# HIC 36



# 2010 Chevy Traverse





ES2-re

WorldSID

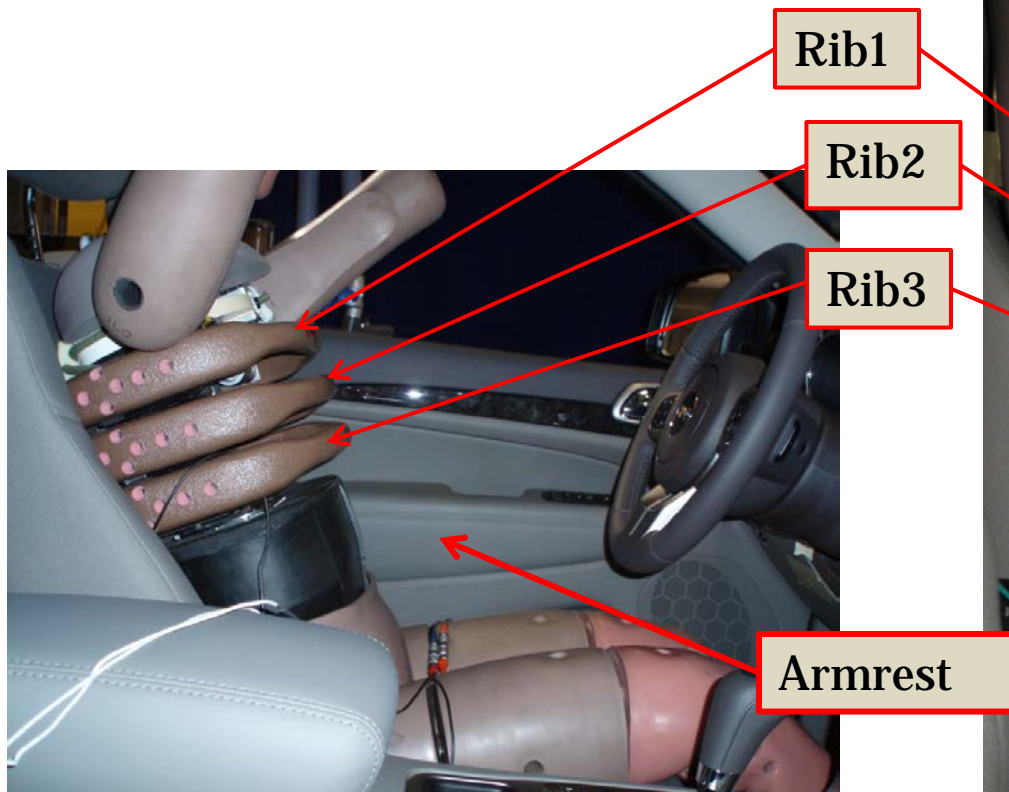
SHOULDER

THORAX

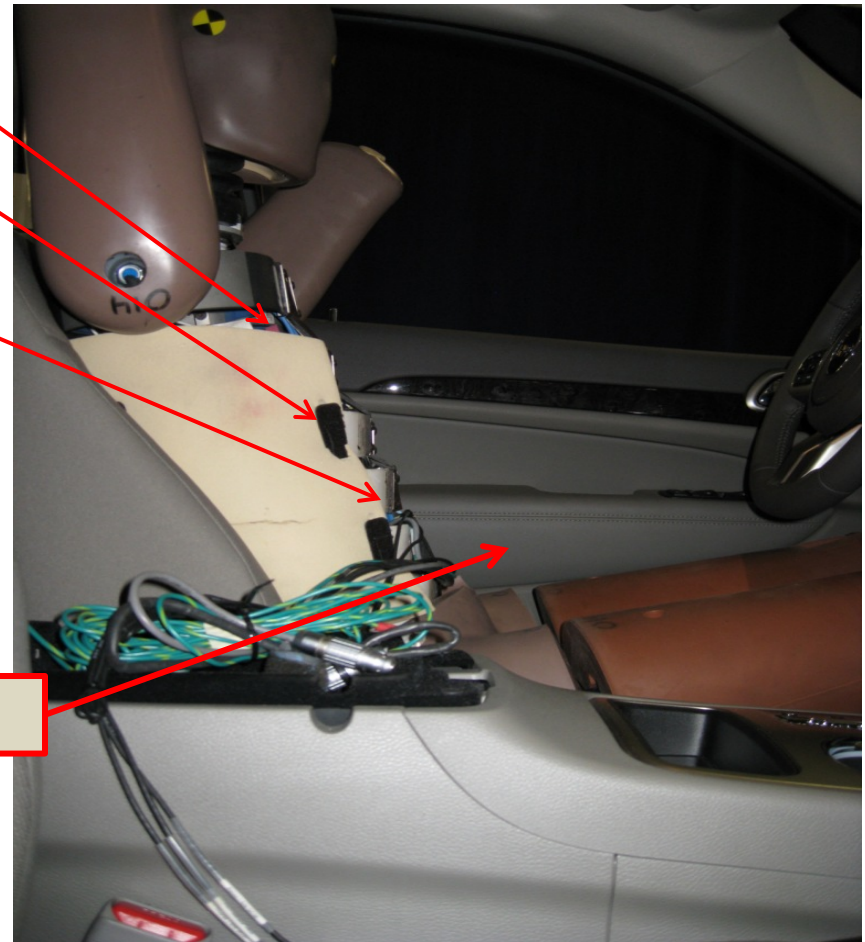
ABDOMEN

PELVIS





ES2-re without  
jacket



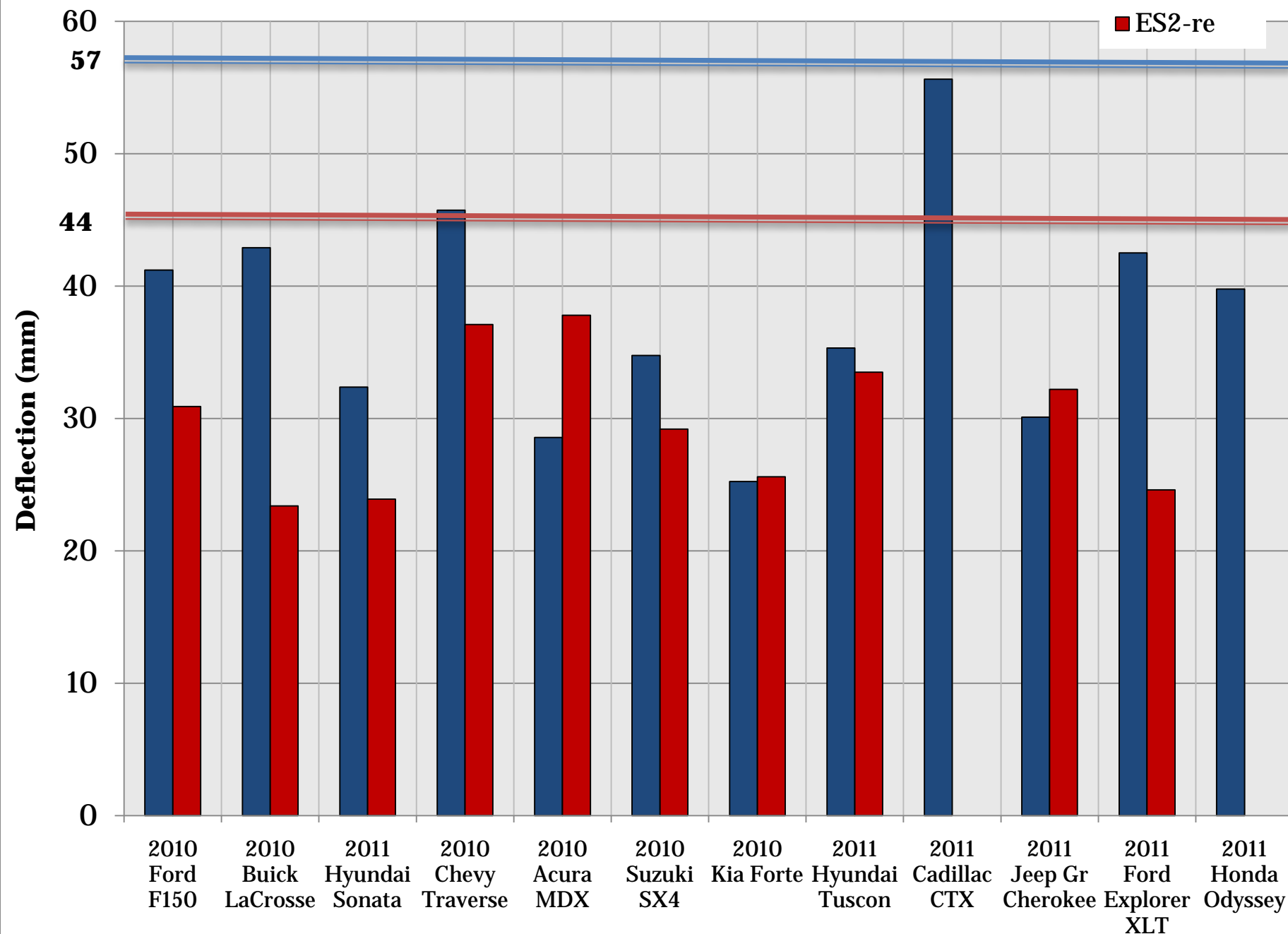
WorldSID  
without jacket

**SAE** International™

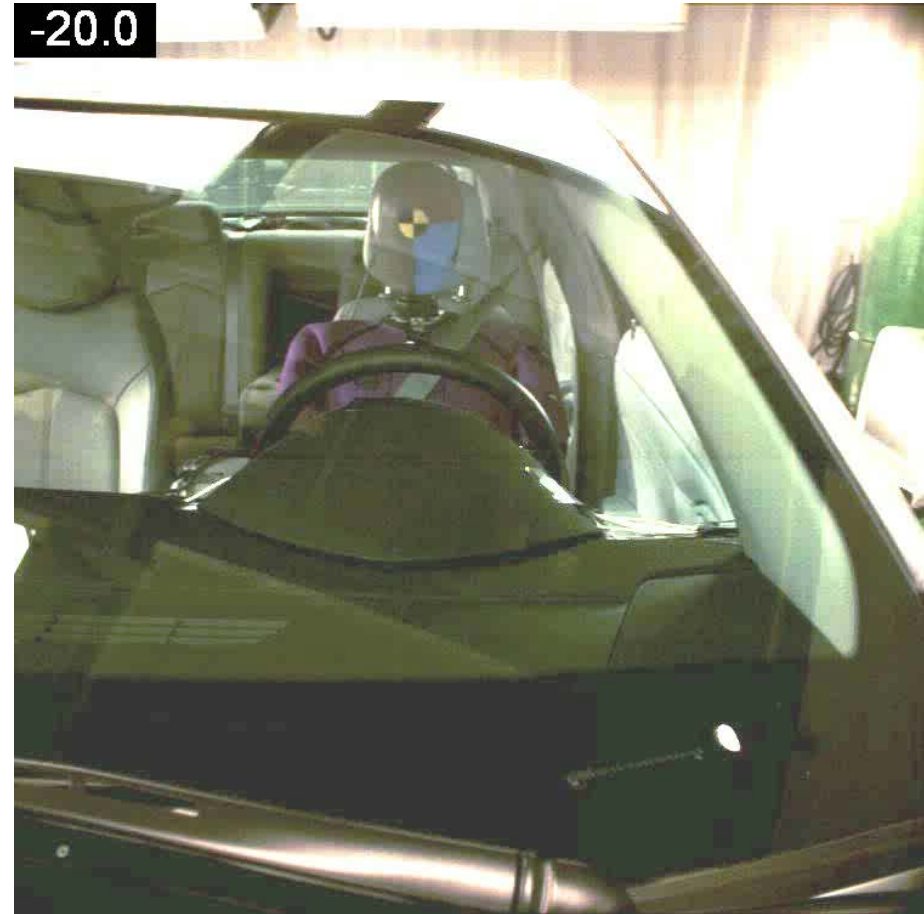
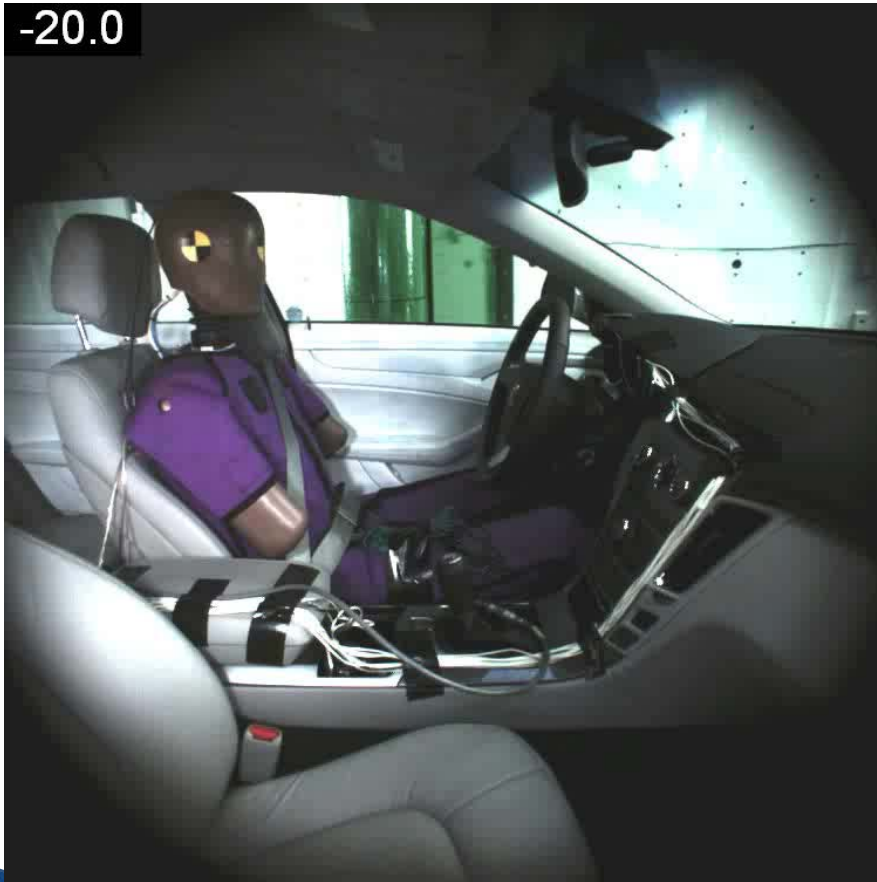
# Maximum Thorax Rib Deflection

■ WorldSID

■ ES2-re



# Cadillac CTS WorldSID

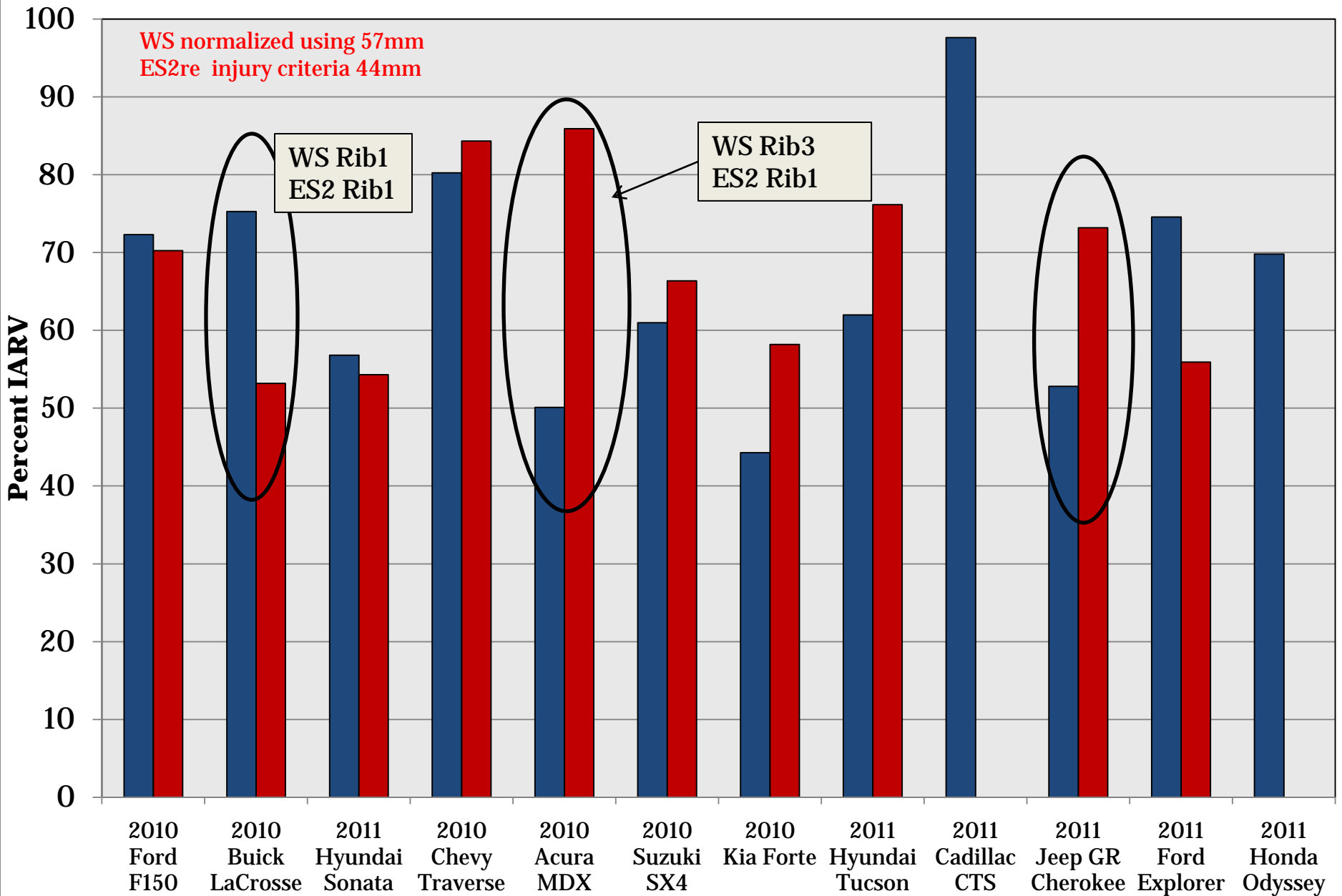


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# Maximum Thorax Rib Deflection (Normalized)

■ WorldSID ■ ES2-re



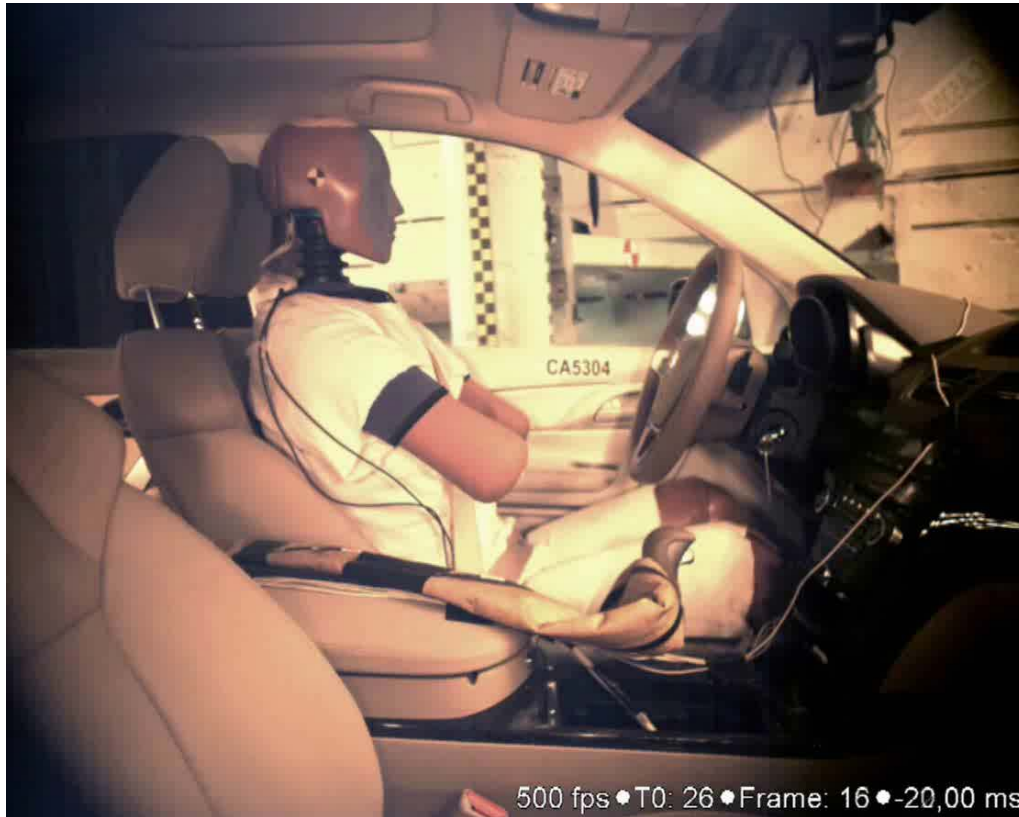
# 2011 Buick LaCrosse



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# 2010 Acura MDX

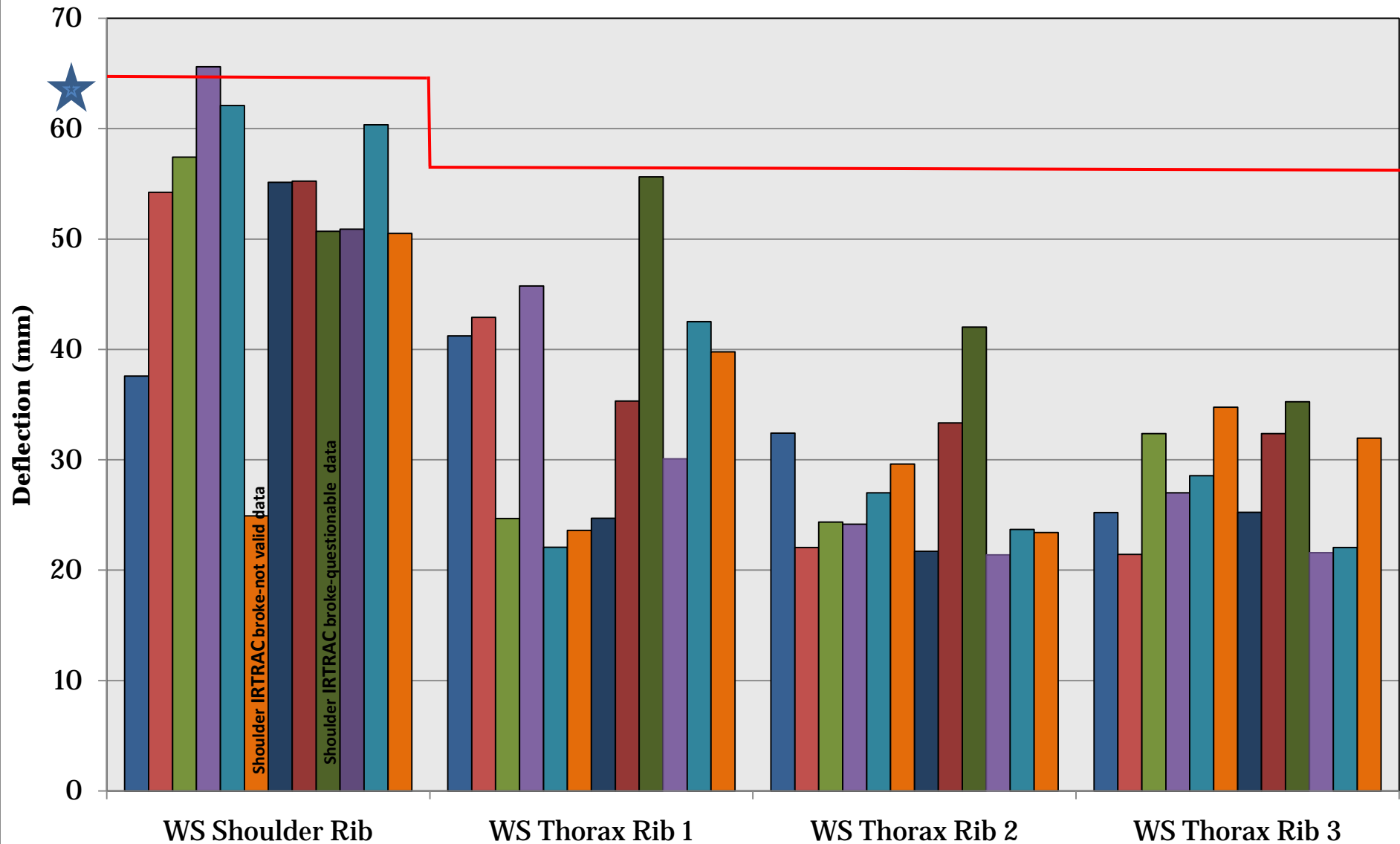


Max Rib  
Deflection ES2re  
Rib 1

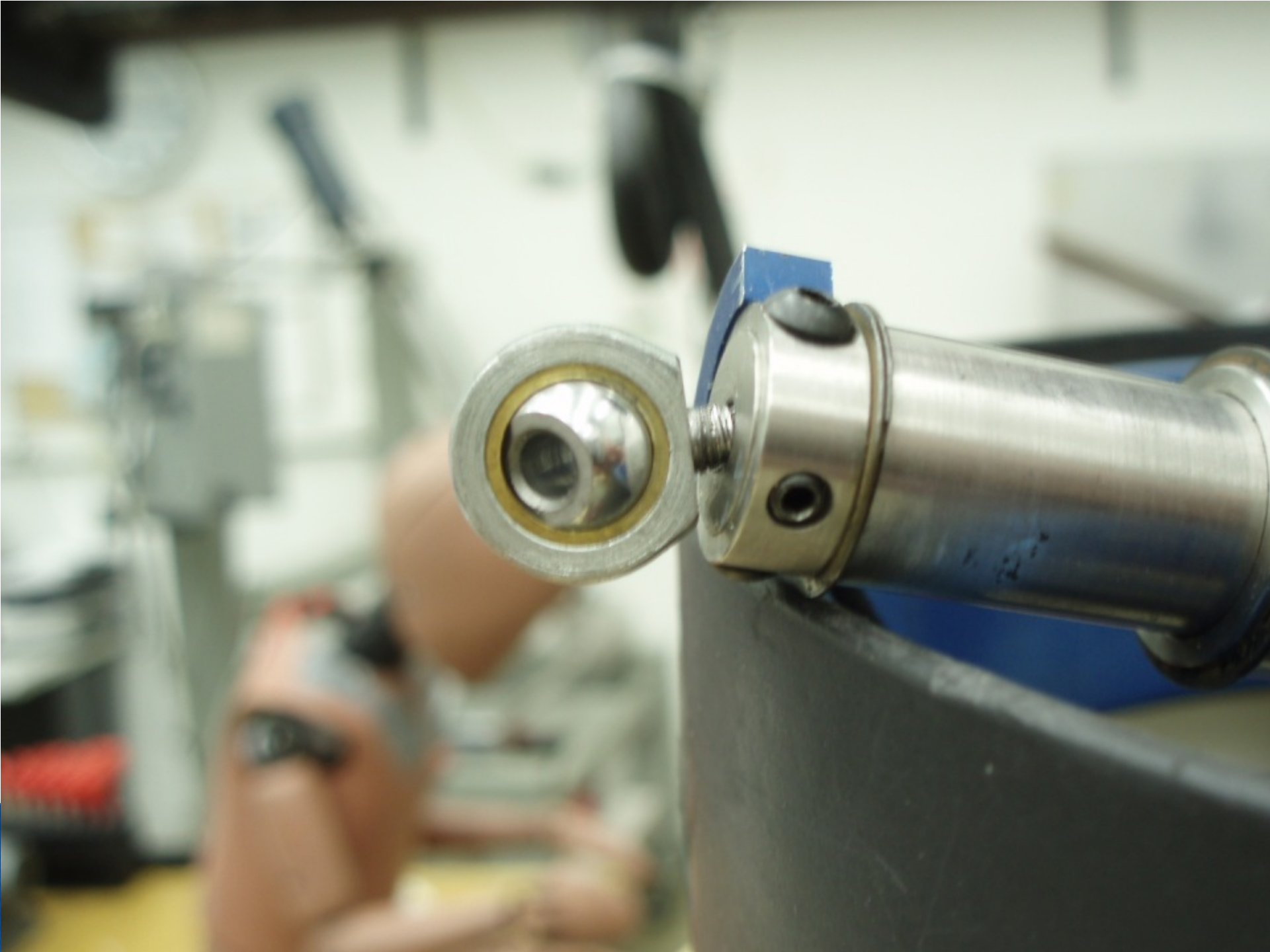


Max Rib Deflection WS  
Rib 3

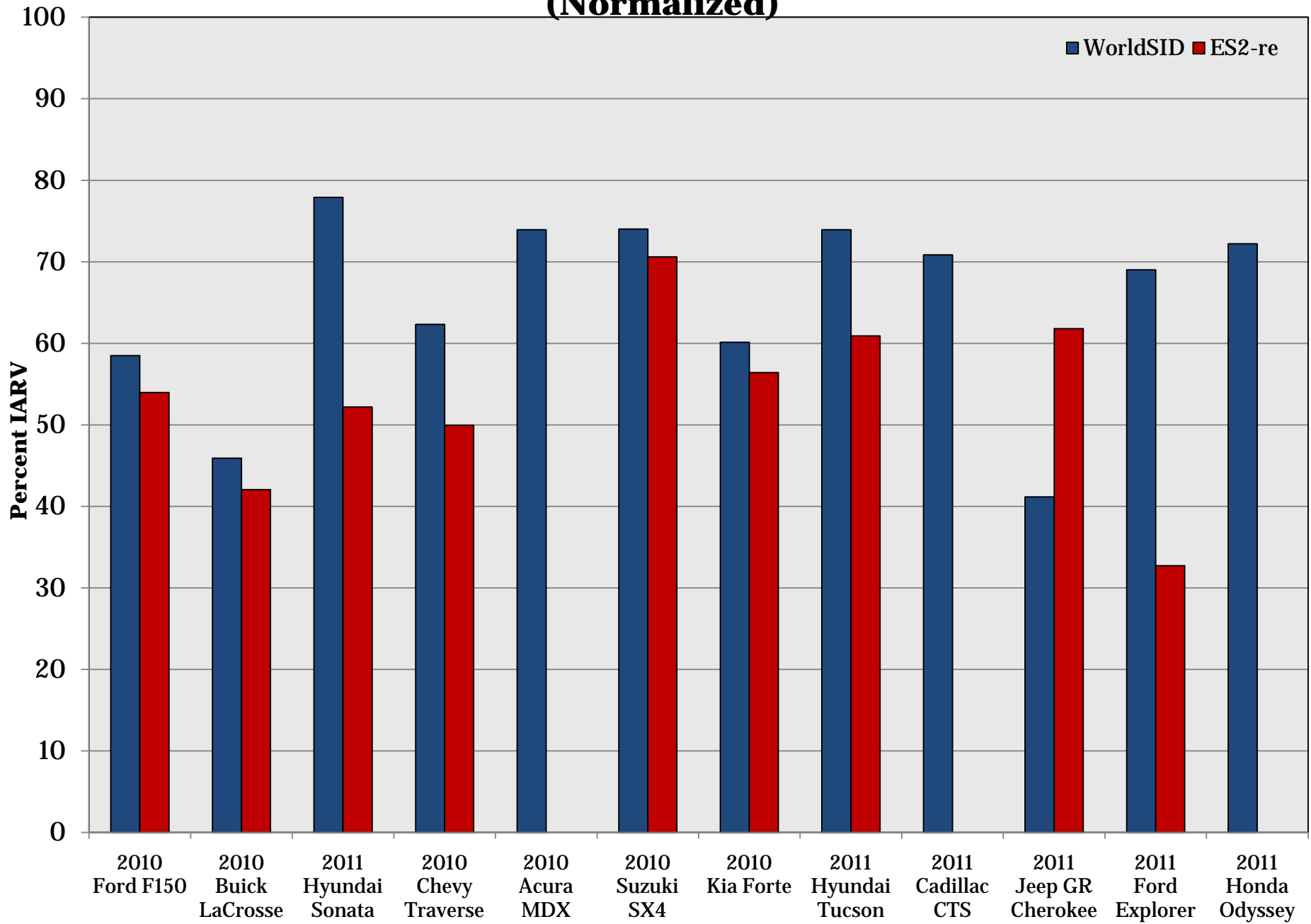
# WorldSID Shoulder and Thorax Ribs







# WS Abdominal Ribs vs ES2-re Abdominal Force (Normalized)



# 2011 Ford Explorer

**ES2-re**

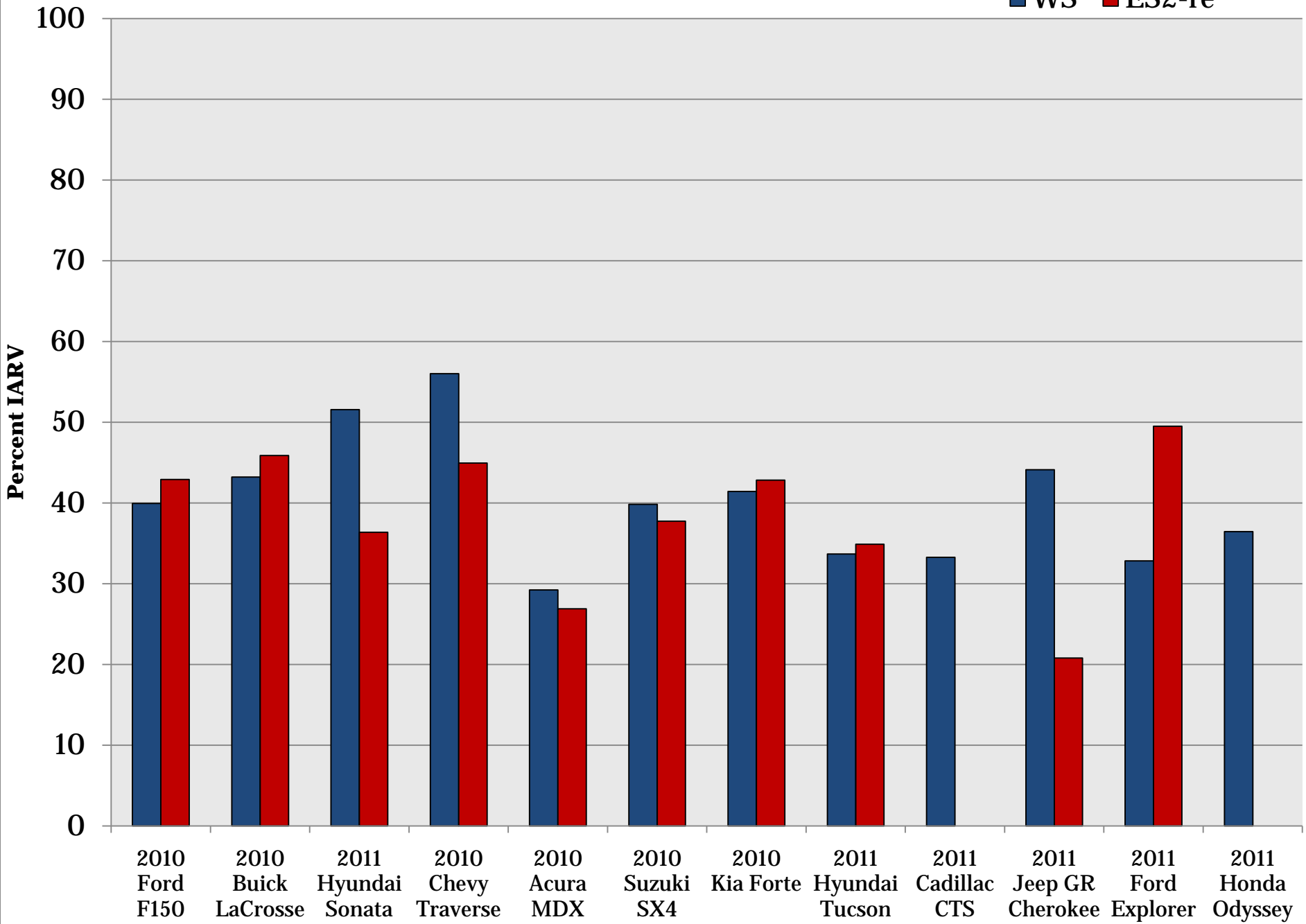


**WorldSID**



# Normalized Pubic Force

■ WS ■ ES2-re





# Observations

- ▶ WorldSID overall kinematics very similar to ES2-re
- ▶ All vehicles were below target IARVs with both dummies
  - Some rib responses were elevated (over 80% IARV) for each dummy
  - Abdominal loading was generally higher for the WS than for the ES2-re, although all were below 80% IARV
  - All HICs and pubic forces were below 60% IARV for both dummies
- ▶ Several shoulder deflections, lower spine accelerations, and pelvic accelerations were elevated in the WS
  - These were not measured in the ES2-re
- ▶ WorldSID dummy: very durable
  - Broke shoulder IRTRAC swivel in 2/12 vehicles

Thanks for your attention!

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