



NHTSA

NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

NHTSA's R&R Evaluation of the WorldSID 50th Male ATD

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Agenda

- Overview of Testing Performed
- Objectives
- Build Level of WorldSID 50th Male Used
- Seating Procedure and Results
- Results of MDB and Pole Tests
- Observations

Overview of Testing Performed

- Crash tests performed with 2018 Honda Accord LX 4-door sedans with manual seats at 3 different labs
 - 1 side impact moving deformable barrier test based off current NCAP procedure
 - Impact speed: 61.9 km/h (38.5 mph)
 - ATDs: WorldSID 50th Male(driver), SID-IIs(rear passenger)
 - 1 side impact rigid pole test based off of current FMVSS 214 procedure
 - Impact speed: 32.2 km/h (20 mph)
 - ATDs: WorldSID 50th Male(driver)
- Pre- and post-test qualifications performed on WorldSID and SID-IIs
 - WorldSID qualifications performed per draft NHTSA procedures and corridors

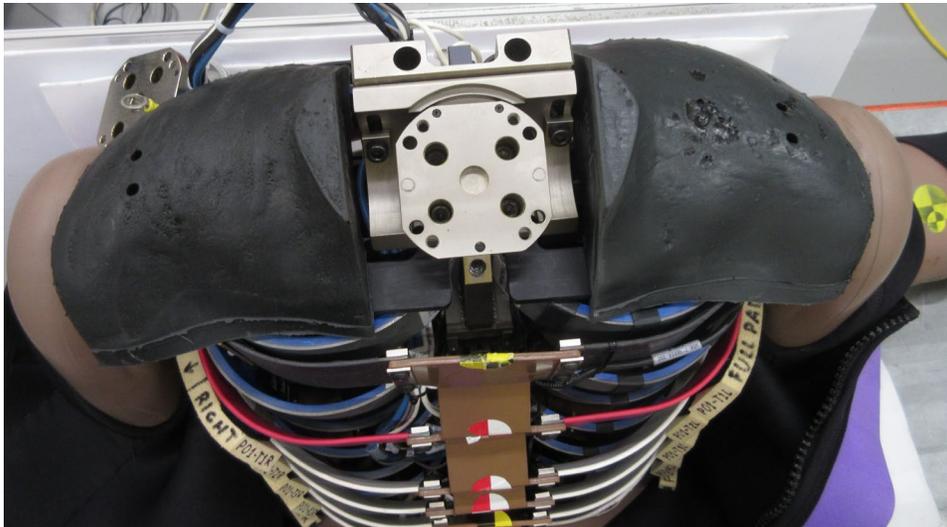


Objectives

- Evaluate the performance and durability of the WorldSID equipped with RibEye™ in NCAP MDB and rigid pole crash tests
 - Using in-dummy DAS at different test facilities
 - Assessing performance of modified WorldSID components (sleeveless suit, split thorax pads, and shoulder pads)
- Evaluate the latest WorldSID seating procedure

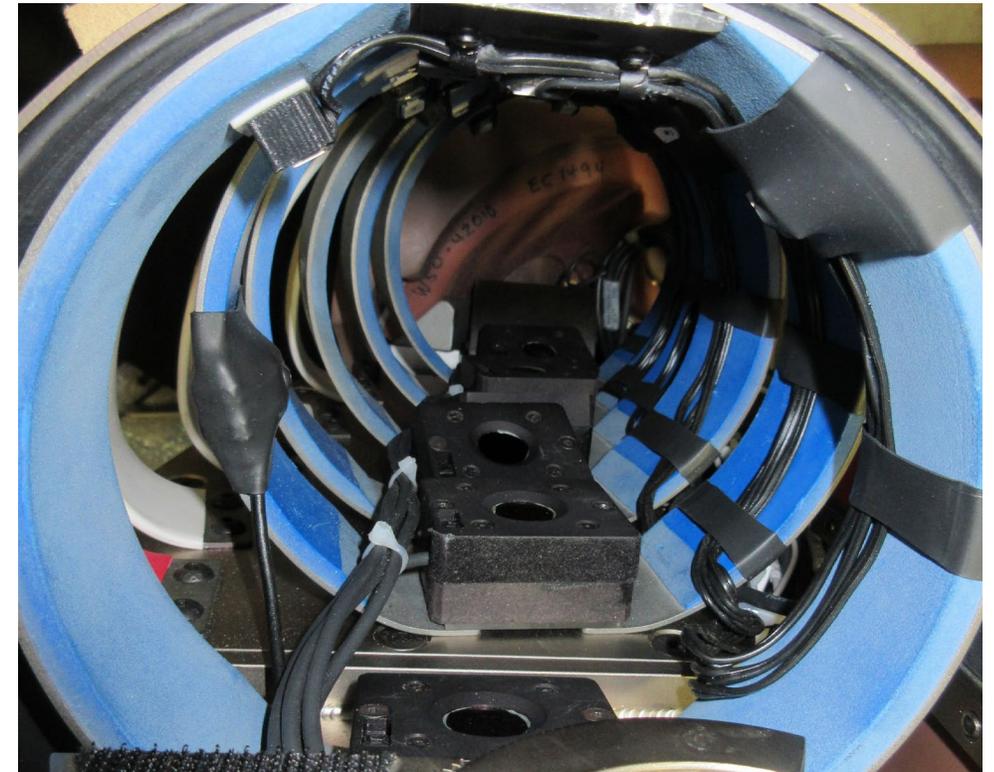
WorldSID 50th Male S/N: EB8888

- Standard Build Level F with the following modifications
 - RibEye™ Multipoint Deflection Measurement System
 - Sleeveless suit
 - Split thorax pads
 - Modified shoulder pads
- In-Dummy DTS G5 Data Acquisition System

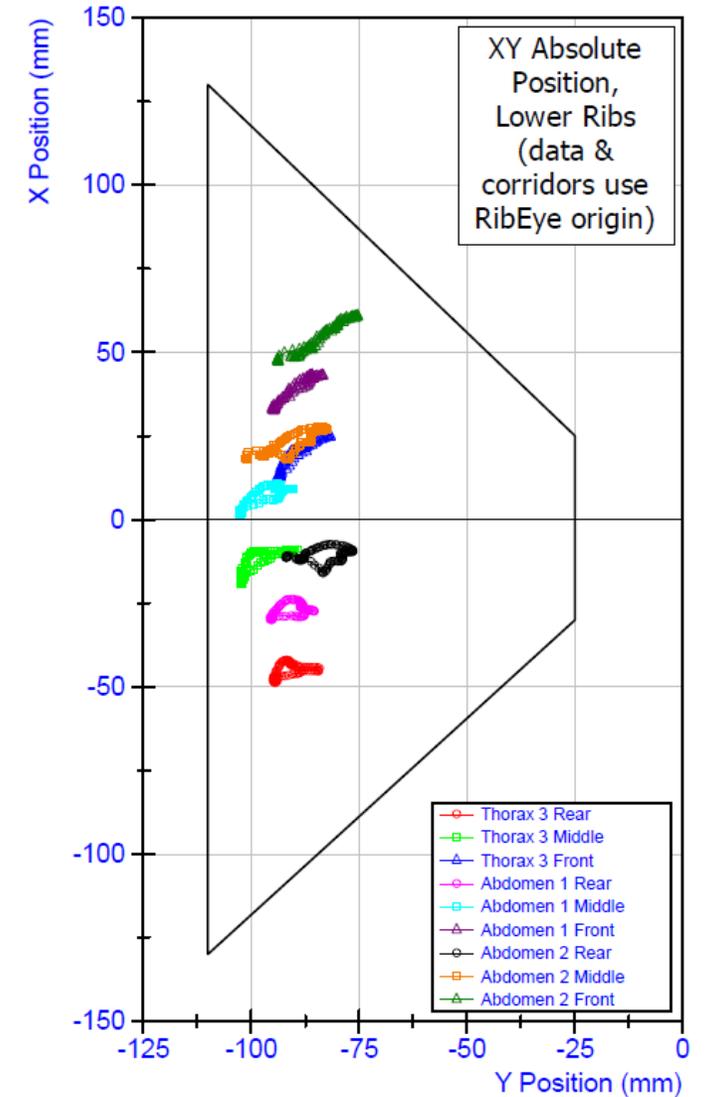
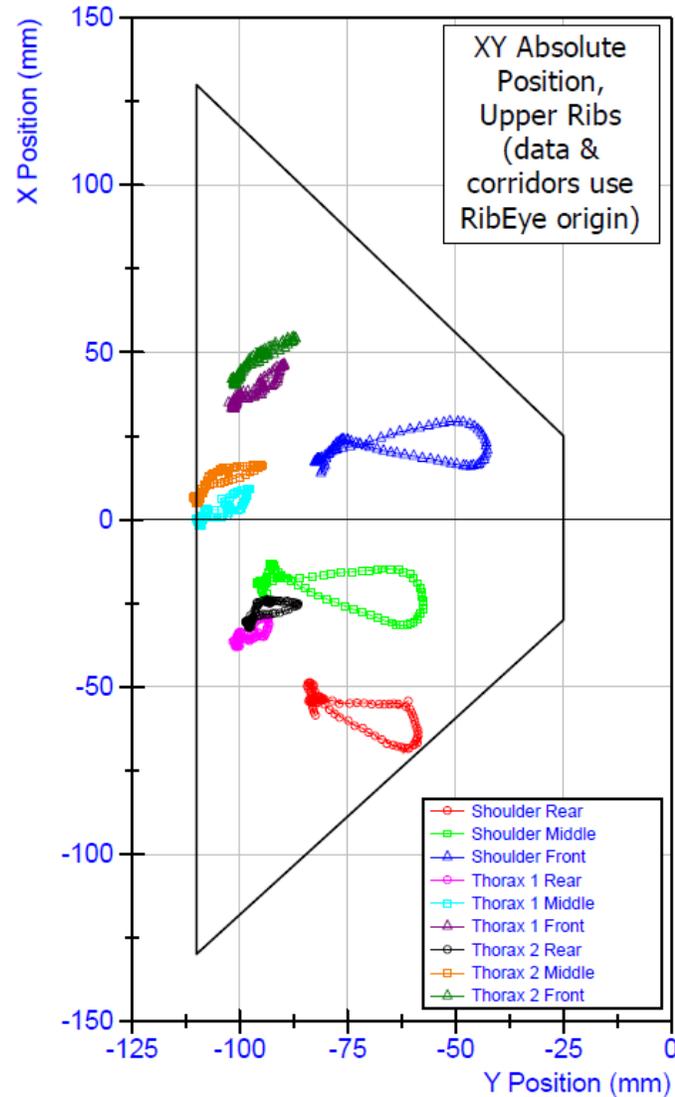


RibEye™ System

- RibEye™ is used to measure 3D rib deflection at multiple points on each rib
 - 6 optical sensors are mounted along the spine box (1 at each rib)
 - Each rib has 3 LEDs spaced 35 mm apart
 - Optical sensors can track X, Y, and Z location of all LEDs



RibEye™ System



Sleeveless Suit

- Original design of the WorldSID suit was modified to remove the sleeves in an effort to allow the arms to move more freely, as well as to prevent ambient light from getting into the chest cavity



Sleeveless Suit

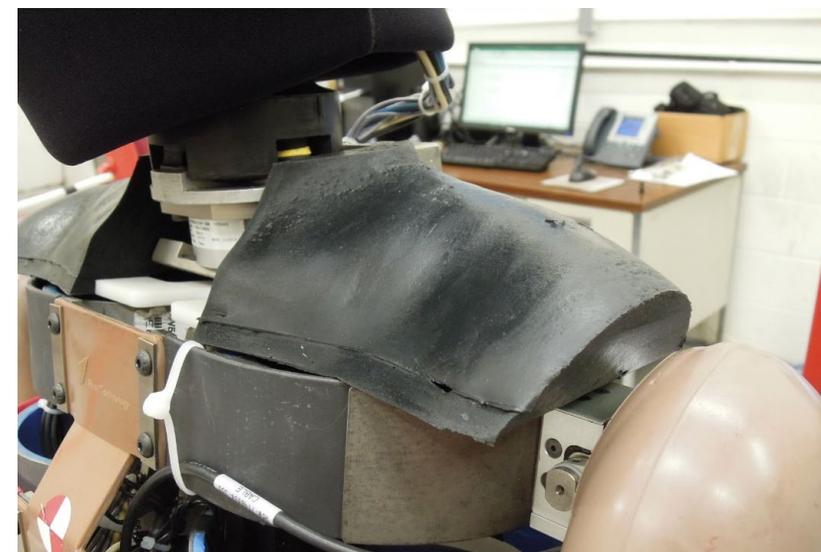
Split Thorax Pads

- Original thorax pad cut into 5 pieces to cover each rib individually
- Prevents tearing between ribs caused by ribs moving independent of one another



Modified Shoulder Pads

- Original shoulder pad design allowed for the pads to compress down inside of the shoulder rib
- Modified shoulder pad
 - Attached to shoulder at the shoulder rib mounting plate
 - Pads fastened together via plastic brace
- No issues with shoulder pads in this test series



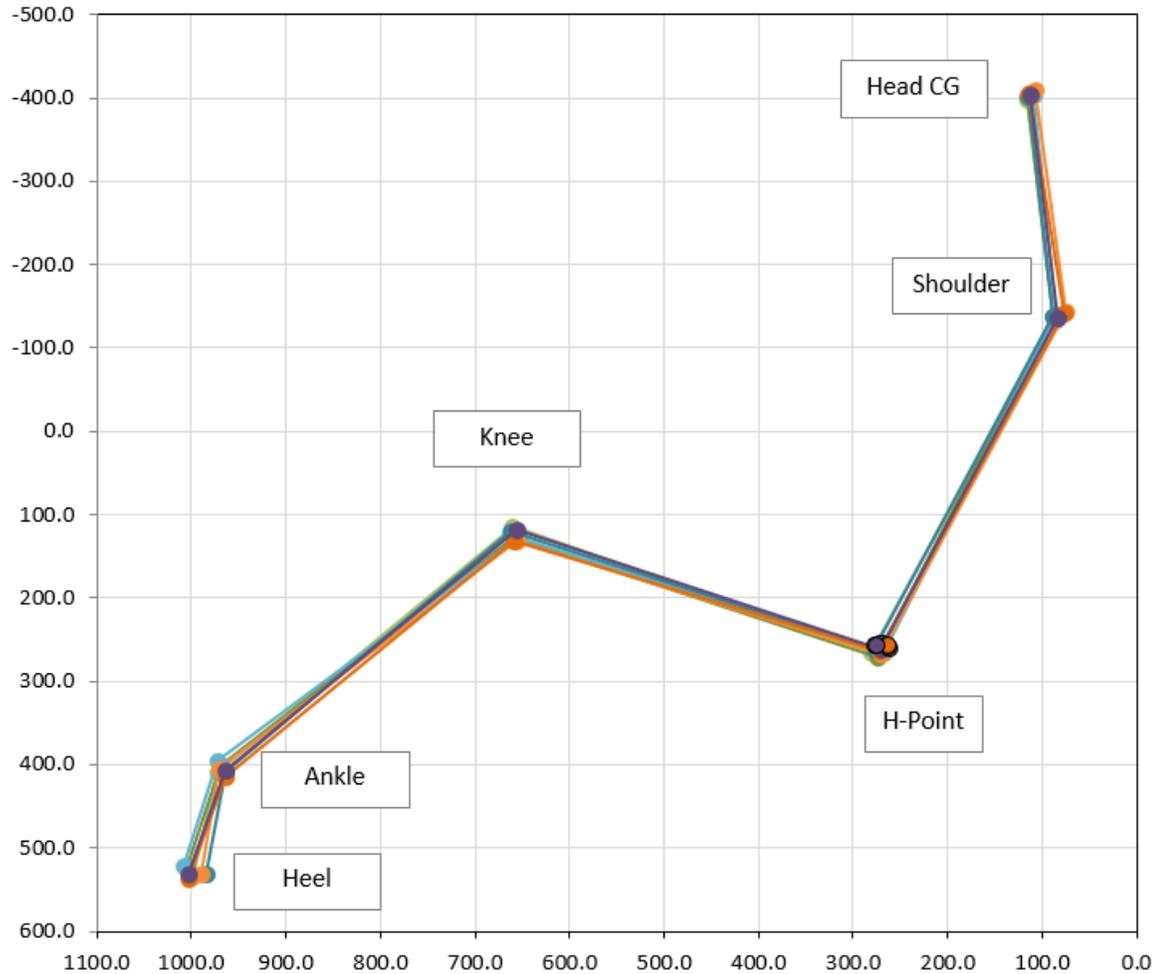
WorldSID Seating Procedure

- Latest seating procedure – “NHTSA WSID-50M_Rev2 Seating Procedure”
(<https://rosap.ntl.bts.gov/view/dot/41900> & Research Docket NHTSA-2019-0108)
- Steps:
 - Seat cushion set to mid-angle, lowest height
 - Seat back at manufacturer’s nominal design riding position
 - To avoid knees interfering with dash, ATD initially positioned in seat with the seat at full rear
 - If knees have clearance, seat can be moved forward:
 - First to 25 mm rearward of midtrack
 - Then to midtrack
 - Final Target:
 - WorldSID Target H-point: 20 mm forward, 20 mm above OSCAR H-point with seat at midtrack
 - Head and Pelvis Tilt Sensor Target: $0^{\circ} \pm 2.5^{\circ}$ about both X and Y axes
 - Right foot centered laterally on accelerator pedal, heel on floorboard 200 mm away from center point of pedal; Left foot equidistant from seat centerline or on foot rest (if equipped)



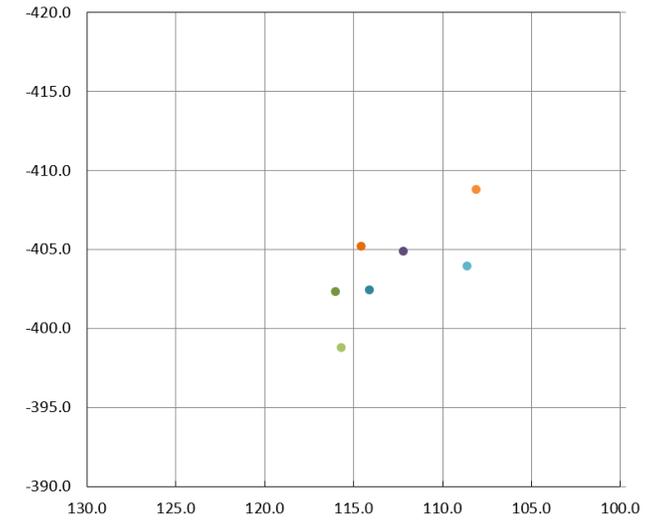
Seating Comparison

2018 Honda Accord Driver Overlays

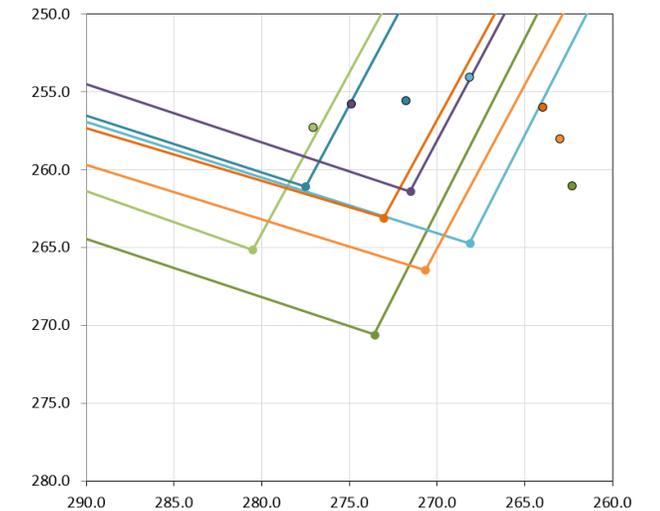


- TRC MDB
- TRC Pole
- Idiada MDB
- Idiada Pole
- MCW MDB
- MCW Pole
- VRTC Baseline

Head CG



H-Point



MDB High Speed Video

Lab 1



Lab 3

Lab 2



MDB Results



Lab 1



Lab 2



MDB impact location in test at Lab 3 was rearward of target

Lab 3

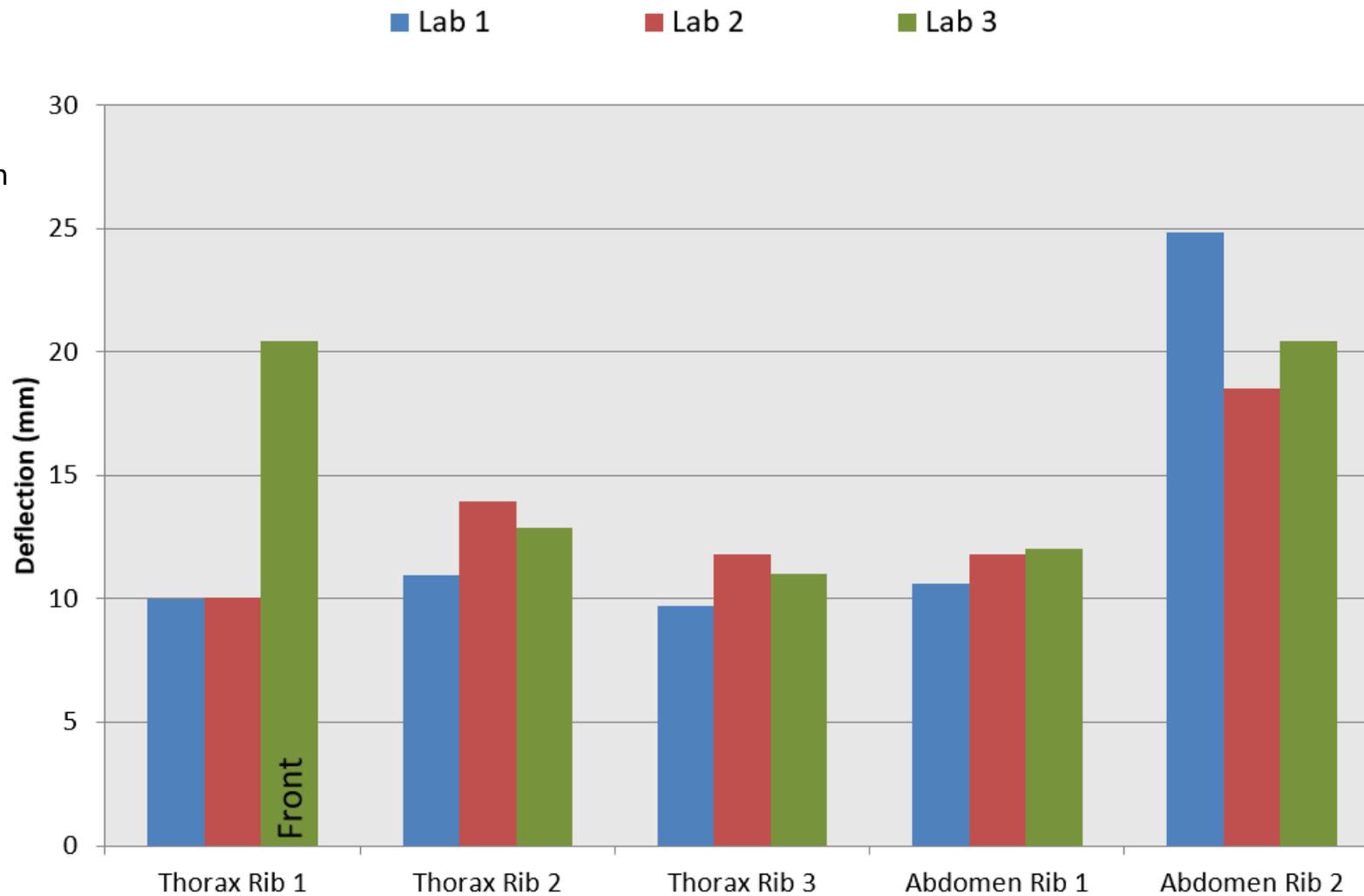
MDB Results

| Test Date | HIC15 | HIC36 | BRIC | Shoulder Lateral Force (N) | Maximum Thoracic Ribs 1-3 Deflection (mm) | Maximum Abdominal Ribs 1-2 Deflection (mm) | Maximum Overall Rib Deflection (mm) |
|------------|-------|-------|------|----------------------------|---|--|-------------------------------------|
| 7/24/2019 | 53 | 102 | 0.81 | -1983 | 11 | 25 | 25 |
| 9/9/2019 | 48 | 100 | 0.72 | -1856 | 14 | 19 | 19 |
| 10/29/2019 | 60 | 99 | 0.79 | -1772 | 20 | 20 | 20 |

| Test Date | Lower Spine Resultant Acceleration (G's) | Pubic Symphysis Lateral Force (N) | Pelvis Resultant Acceleration (G's) | Sacro-Iliac Lateral Force (N) | Sacro-Iliac Resultant Force (N) | Ambient Temp. (°C) | Controller Temp. (°C) | Rib Temp. (°C) |
|------------|--|-----------------------------------|-------------------------------------|-------------------------------|---------------------------------|--------------------|-----------------------|----------------|
| 7/24/2019 | 26 | -833 | 41 | -1773 | 1794 | 21.1 | 25.3 | 23.9 |
| 9/9/2019 | 27 | -850 | 42 | -1848 | 1882 | 30.0 | 25.5 | 22.5 |
| 10/29/2019 | 27 | -854 | 39 | -1666 | 1734 | 20.0 | 23.7 | 23.2 |

WorldSID Ribeye Maximum Deflection

MDB impact location in test at Lab 3 was rearward of target



MDB High Speed Video – SID-IIs

Lab 1



Lab 3

Lab 2

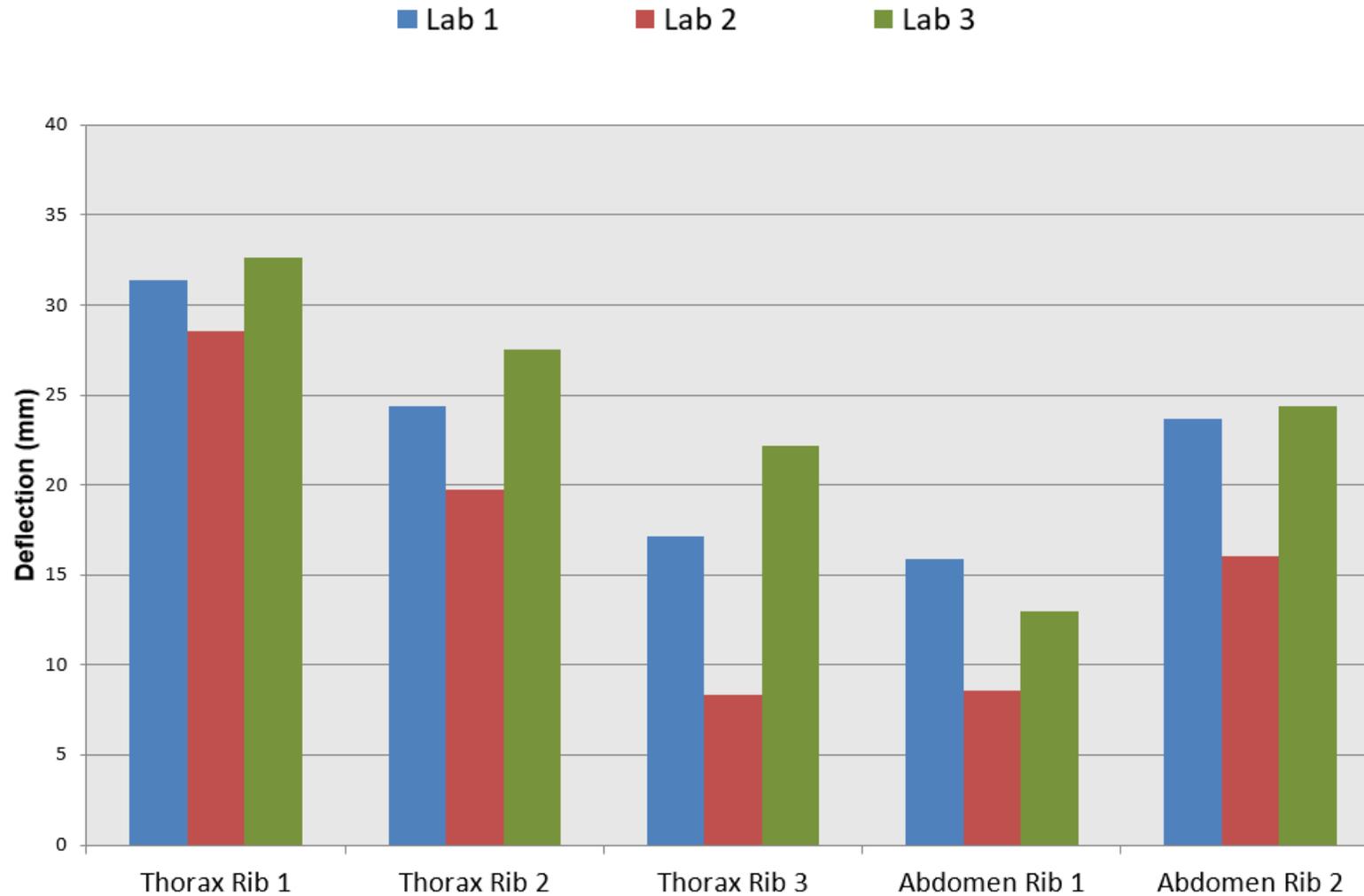


MDB Results – SID-IIs

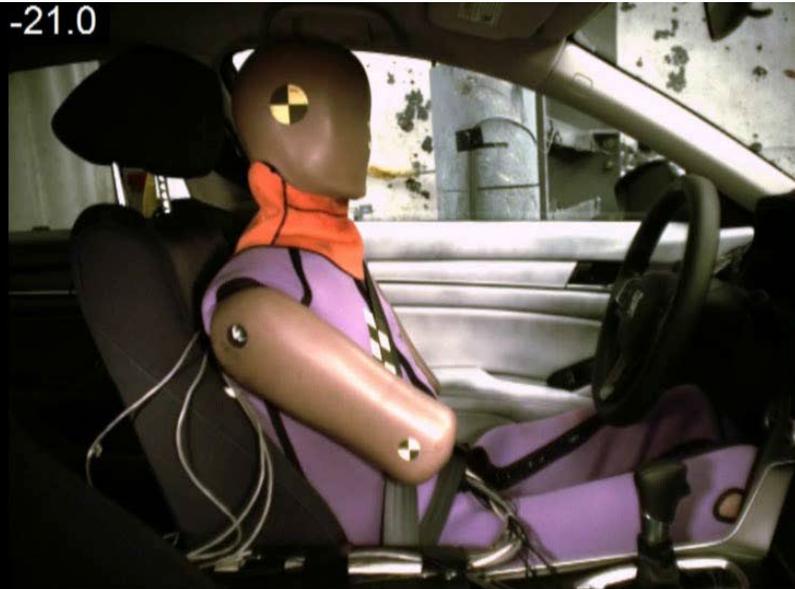
| Test Date | HIC 15 | HIC36 | BRIC | Shoulder Force (N) | Maximum Thoracic Ribs 1-3 Deflection (mm) | Maximum Abdominal Rib 1-2 Deflection (mm) | Maximum Overall Rib Deflection (mm) | Lower Spine Resultant Acceleration (G's) | Pelvis Resultant Acceleration (G's) | Iliac Wing FY (N) | Acetabulum Force (N) | Combined Pelvis Sum Force (N) |
|------------|--------|-------|------|--------------------|---|---|-------------------------------------|--|-------------------------------------|-------------------|----------------------|-------------------------------|
| 7/24/2019 | 219 | 338 | 0.87 | -1787 | 31 | 24 | 31 | 49 | 50 | 541 | 855 | 1327 |
| 9/9/2019 | 200 | 336 | 0.77 | -1265 | 29 | 16 | 29 | 50 | 58 | 204 | 969 | 1011 |
| 10/29/2019 | 275 | 364 | 0.66 | -1109 | 33 | 24 | 33 | 61 | 57 | 857 | 1388 | 1272 |

| Test Date | Maximum Deflection | | | | |
|------------|--------------------|--------------|--------------|---------------|---------------|
| | Thorax Rib 1 | Thorax Rib 2 | Thorax Rib 3 | Abdomen Rib 1 | Abdomen Rib 2 |
| 7/24/2019 | 31 | 24 | 17 | 16 | 24 |
| 9/9/2019 | 29 | 20 | 8 | 9 | 16 |
| 10/29/2019 | 33 | 27 | 22 | 13 | 24 |

SID-IIs Rib Maximum Deflection



Side Pole High Speed Video



Lab 1
Left arm
moved prior
to impact in
test at Lab 1



Lab 2



Lab 3

Side Pole Results



Lab 1



Lab 2



Lab 3

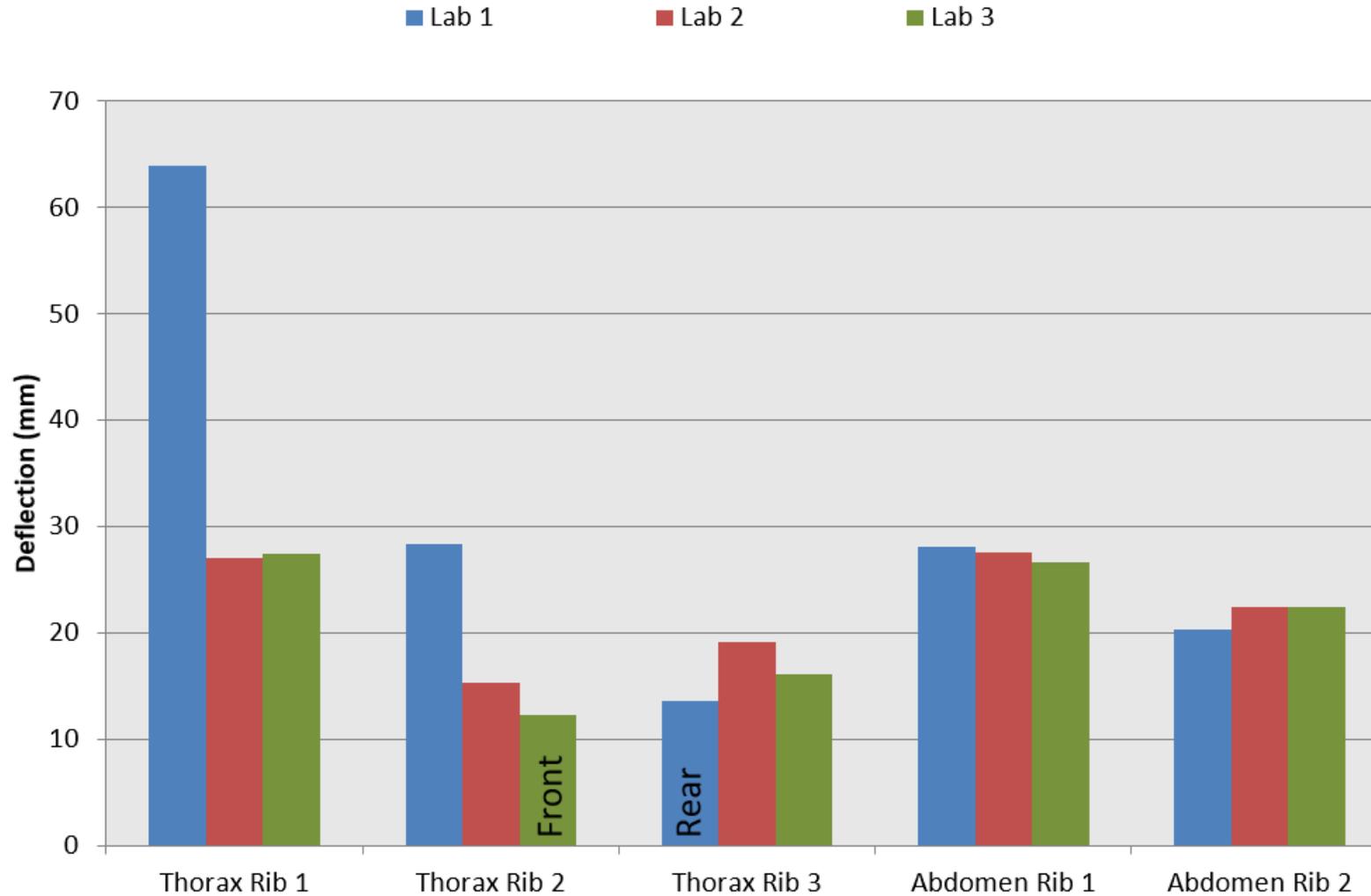
Side Pole Results

| Test Date | HIC15 | HIC36 | BRIC | Shoulder Lateral Force (N) | Maximum Thoracic Ribs 1-3 Deflection (mm) | Maximum Abdominal Ribs 1-2 Deflection (mm) | Maximum Overall Rib Deflection (mm) |
|------------|-------|-------|------|----------------------------|---|--|-------------------------------------|
| 7/29/2019 | 149 | 249 | 0.58 | -2124 | 64 | 28 | 64 |
| 9/11/2019 | 154 | 245 | 0.52 | -2657 | 27 | 28 | 28 |
| 10/31/2019 | 192 | 306 | 0.61 | -1552 | 27 | 27 | 27 |

| Test Date | Lower Spine Resultant Acceleration (G's) | Pubic Symphysis Lateral Force (N) | Pelvis Resultant Acceleration (G's) | Sacro-Iliac Lateral Force (N) | Sacro-Iliac Resultant Force (N) | Ambient Temp. (°C) | Controller Temp. (°C) | Rib Temp. (°C) |
|------------|--|-----------------------------------|-------------------------------------|-------------------------------|---------------------------------|--------------------|-----------------------|----------------|
| 7/29/2019 | 41 | -919 | 44 | -2531 | 2572 | 21.8 | 22.4 | 22.7 |
| 9/11/2019 | 41 | -906 | 46 | -2510 | 2523 | 23.0 | 27.5 | 24.8 |
| 10/31/2019 | 42 | -928 | 47 | -2526 | 2557 | 20.0 | 27.3 | 24.9 |

Side Pole Results

WorldSID Ribeye Maximum Deflection



Left arm moved prior to impact in test at Lab 1

- Objectives were met:
 - WorldSID with sleeveless suit, split thorax pads, and modified shoulder pads performed well and proved to be durable
 - Flesh of half arm on struck side of WorldSID was found to be pulling away from the hard plastic around the pivot point after testing at lab #2 and was replaced
- Reproducibility was good, but based on limited testing
 - Kinematics and dummy injury responses were very similar
 - Thorax response of 3rd MDB test was different (attributed to impact point being rearward of target)
 - Thorax response of 1st pole test was different (attributed to arm placement prior to impact)
- Seating procedure evaluation
 - Seated positions were very repeatable amongst the three labs
- Onboard data acquisition implementation
 - Labs gained experience using WorldSID dummy with onboard data acquisition



Thanks for your attention Questions?

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