Status of NHTSA's THOR-05F Evaluation

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Motivation

- NHTSA developed the THOR-50M ATD to better evaluate injury risk of mid-sized adults
  - Alternative to Hybrid-III in frontal crash tests
    - Improved biofidelity and measurement capability
    - More thoroughly evaluate & improve advanced restraint systems

- Similarly, THOR-05F was developed to evaluate the risks and biomechanics of smaller female adults.

ATD Development

- Human-like
- Repeatable & reproducible
- Durable
- Easy to use

	Dummy Inspection	Lab Testing	Sled Testing	Crash Testing
Biofidelity		✓	✓	
Qualification		✓		
R&R		✓		
Durability	Coming soon!			
Drawing Package				
User's Manual				

Rhule, Rhule and Donnelly, 19th ESV Conference, Washington, DC, 2005

Biofidelity Evaluation

Body Region	Biofidelity*
Head	Excellent
Neck	Good
Shoulder	Excellent
Thorax	Good
Abdomen	Good
Knee-Thigh-Hip	Good
Lower Extremity	Good
Overall	**Good**

*As presented at 2018 IRCOBI (Wang et al.)

R&R Testing at VRTC

- **<u>Purpose:</u> Test 3 THOR-05F ATDs at VRTC to begin developing qualification criteria**
- Based on THOR-50M qualification tests
  - Uses J-211 conventions
  - Scaled probe masses & velocities (DOT HS 812 370)
  - 15 test modes: Probe impacts & pendulum tests
    - Head
    - Face
    - Neck flexion
    - Neck extension
    - Neck lateral (L & R)
    - Neck torsion (L & R)
    - Upper thorax
    - Lower thorax (L & R)
    - Lower abdomen
    - Upper leg (L & R)
    - Knee slider (L & R)
    - Ankle inversion (L & R)
    - Ankle eversion (L & R)
    - Ball-of-foot (L & R)
    - Heel-of-foot (L & R)

5 repeats x
(15+9) modes x 3 ATDs
= 360 tests

R&R Testing at VRTC

- Depending on the test mode, measures of interest include:
  - Peak forces
  - Peak moments
  - Peak rotations
  - Peak deflections
  - Peak accelerations
  - Peak angular rates
- To evaluate R&R, the following were calculated for each measure of interest:
  - Average
  - Standard deviation
  - Coefficient of variation $\left(CV = \frac{StDev}{Avg}\right)$

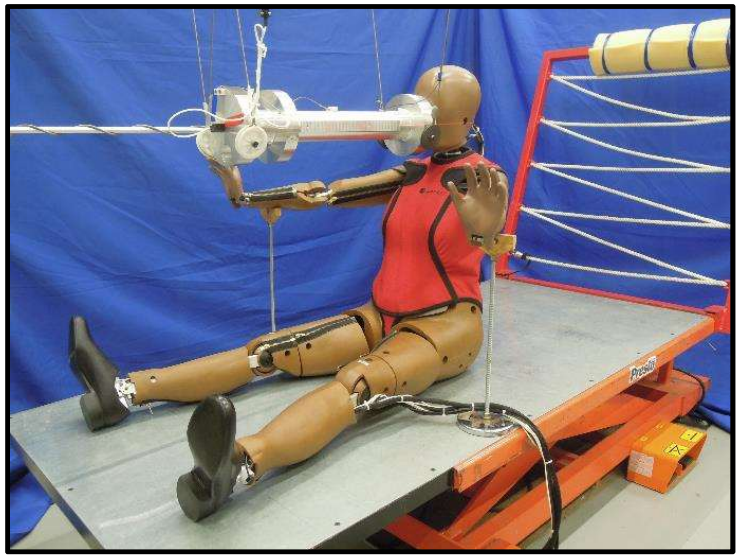
CV	Required Action
$\leq 5\%$	No further investigation
$> 5\%$ & $\leq 10\%$	Sources of variability investigated; outliers may exist
$> 10\%$	Test procedure thoroughly reviewed & ATDs inspected.

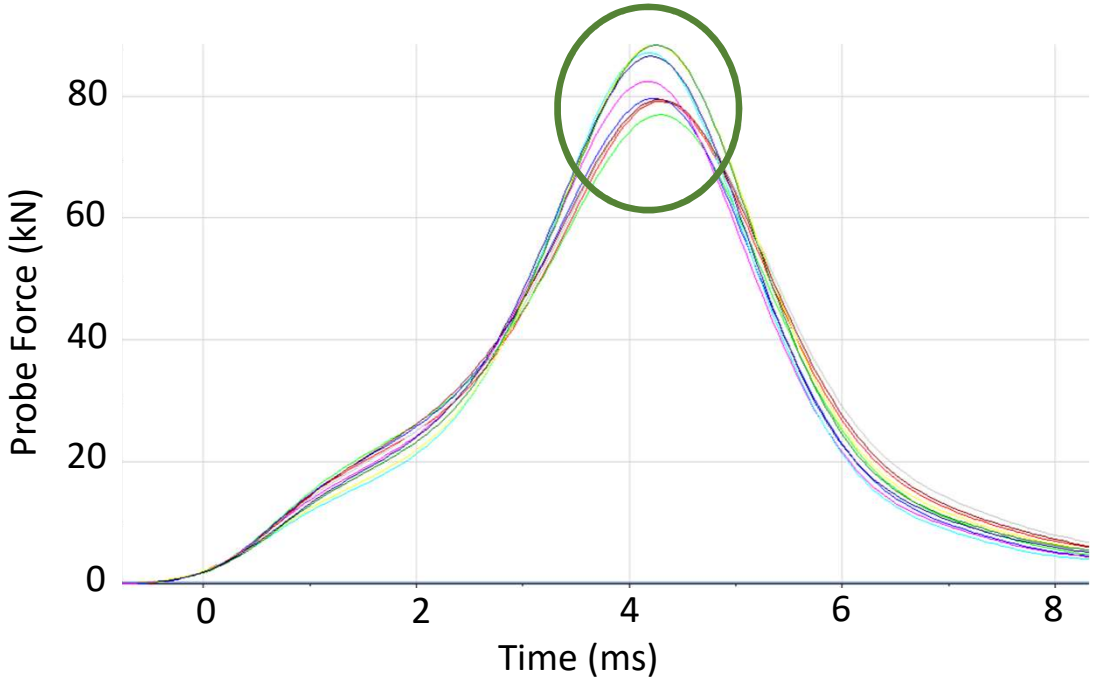
R&R Testing at VRTC

Mode	Measures of interest	Max CV (%)	Required Action
Head	Probe Force Head CG Resultant Acceleration	4.2	None
Face		27.5	Face insert investigation
Neck Flexion	Head Rotation & Angular Rate Upper Neck Force & Moment	7.5	Analyzed data by ATD. Individual CVs < 5%.
Neck Extension		6.5	
Neck Lateral Bending	Head Rotation Upper Neck Force & Moment	2.2	None
Neck Torsion		2.1	None
Upper Thorax	Probe Force Resultant Deflection	10.2	Analyzed data by ATD. 1 outlier to be investigated further.
Lower Thorax		4.1	None
Abdomen	Probe Force Abdomen Pressures	12.9	Abdomen CT scan investigation
Upper Leg	Probe Force Femur Z-Force Resultant Acetabulum Force	14.4	Analyzed data by ATD. Individual CVs as large as 12.6%. Pelvis design & test procedure investigations
Knee Slider	Femur Z-Force Knee Slider Deflection	5.0	None
Ankle Inversion	Tibia Z-Force Ankle Moment Ankle Rotation	5.1	None (monitor closely, though)
Ankle Eversion		3.9	None
Ball of Foot		12.5	Test procedure investigation.
Heel of Foot	Tibia Z-Force	4.2	None

Face Impact Test

- **Inputs:** 10.7 kg probe at 6.73 m/s
- **Outputs:** Peak probe force
  Peak head CG resultant acceleration





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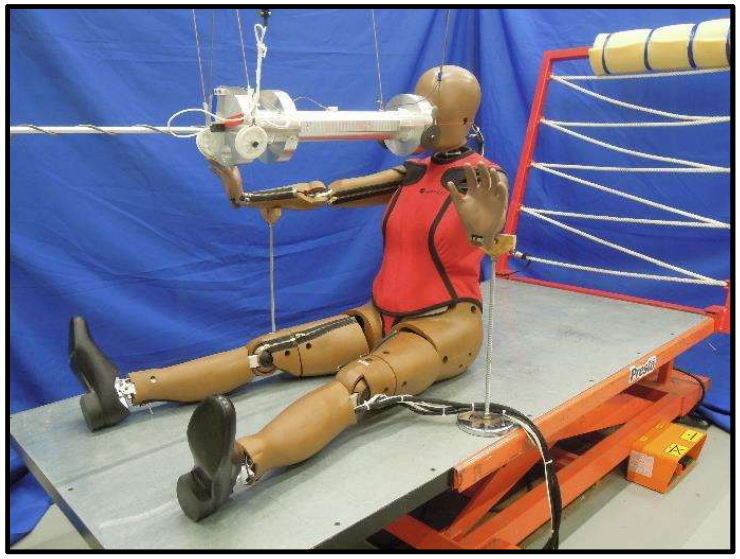
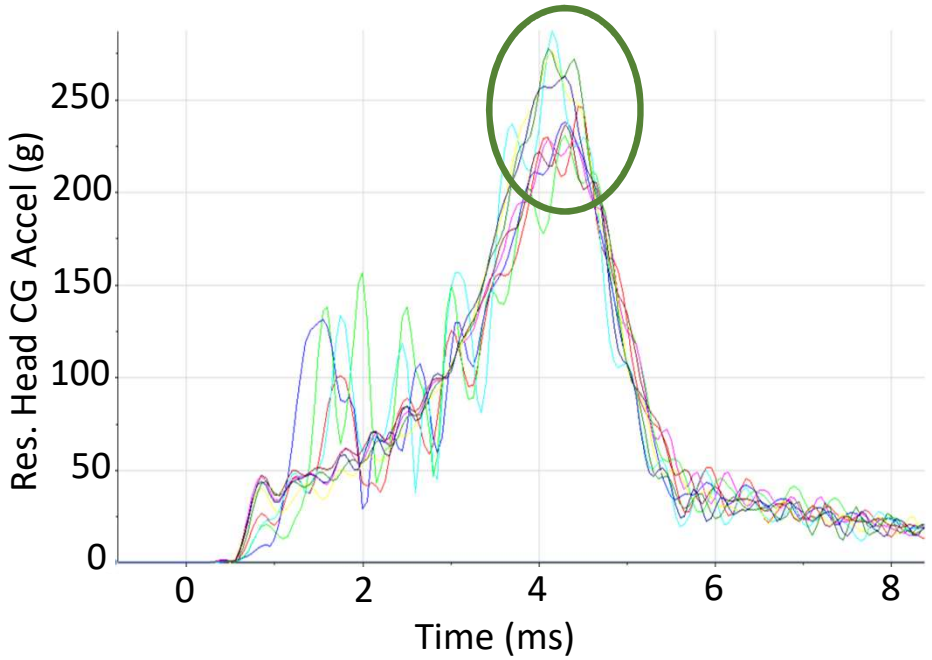


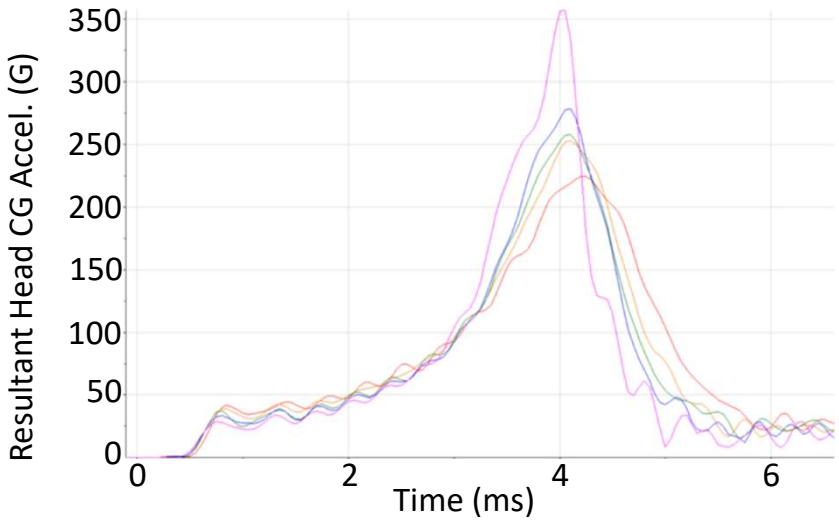


Face Impact Test

- **Inputs:** 10.7 kg probe at 6.73 m/s
- **Outputs:** Peak probe force
  Peak head CG resultant acceleration

Statistic	Probe Force (N)	Resultant Accel (G)
Average	8052.03	290.74
StDev	520.58	79.88
CV	6.47%	27.47%

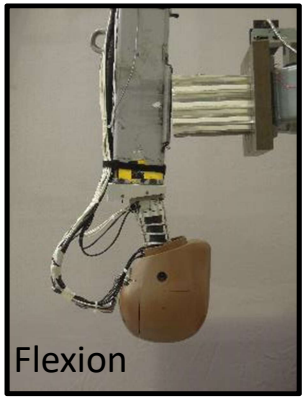
- Similar to THOR-50M, the face insert is made from memory foam.
- Performance changes based on total number & time between impacts.
- Humanetics is currently exploring an improved design.

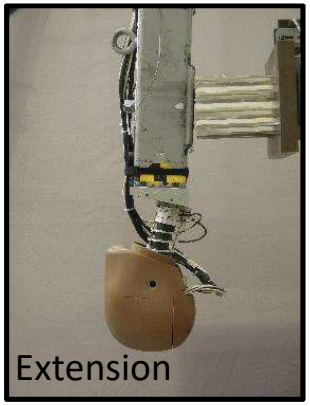


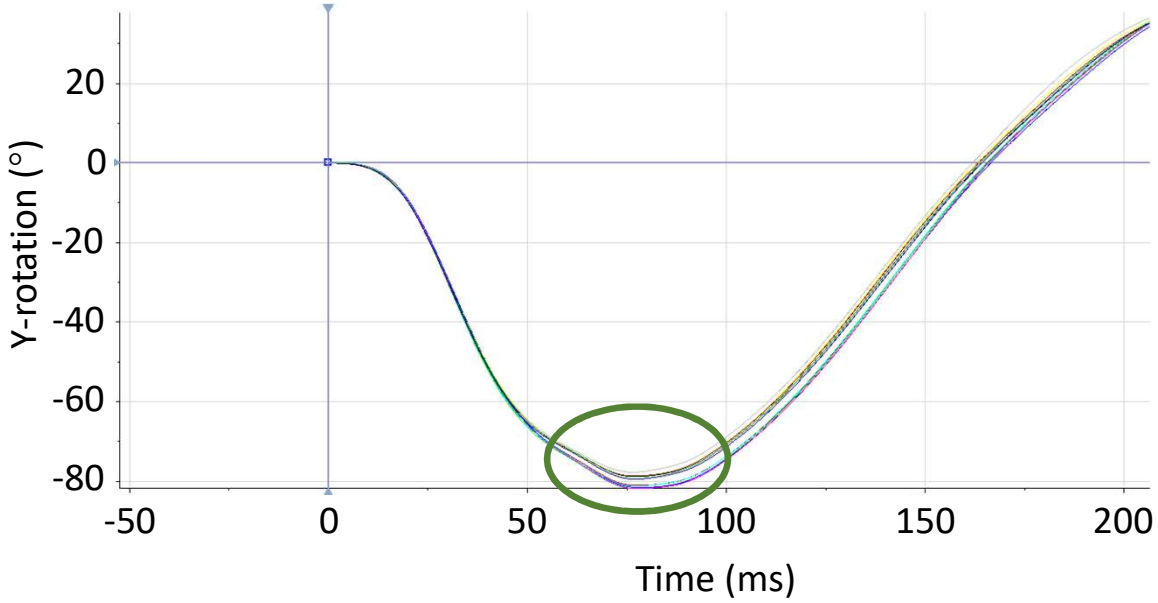
Hit #	Test ID	Resultant Accel (G)
1	190717-2	224.73
2	190718-5	253.06
3	190722-1	258.14
4	190723-2	278.77
5	190724-1	357.23

Neck Flexion & Extension Tests

- **Inputs:** Pendulum impact to 6” aluminum honeycomb at 5.0 m/s
- **Outputs:** Peak head Y-rotation
  Peak head angular rate about Y-axis
  Peak upper neck Z-force
  Peak upper neck Y-moment







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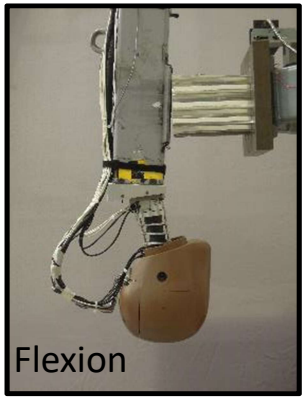

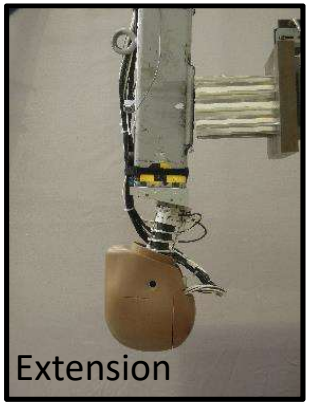

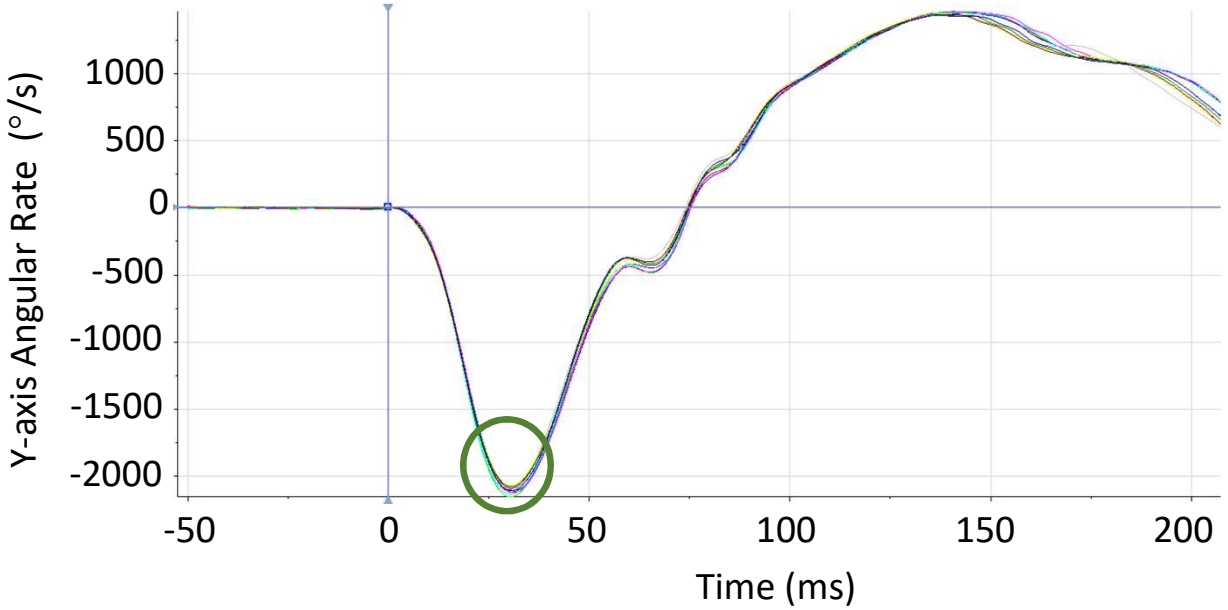

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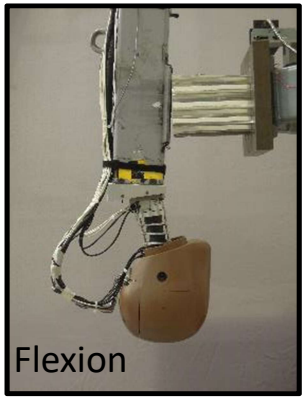

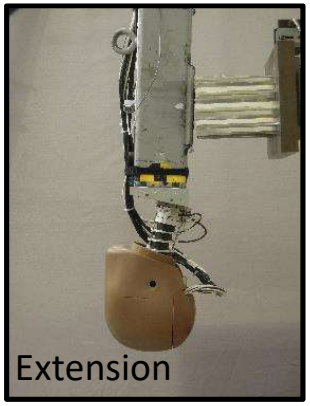

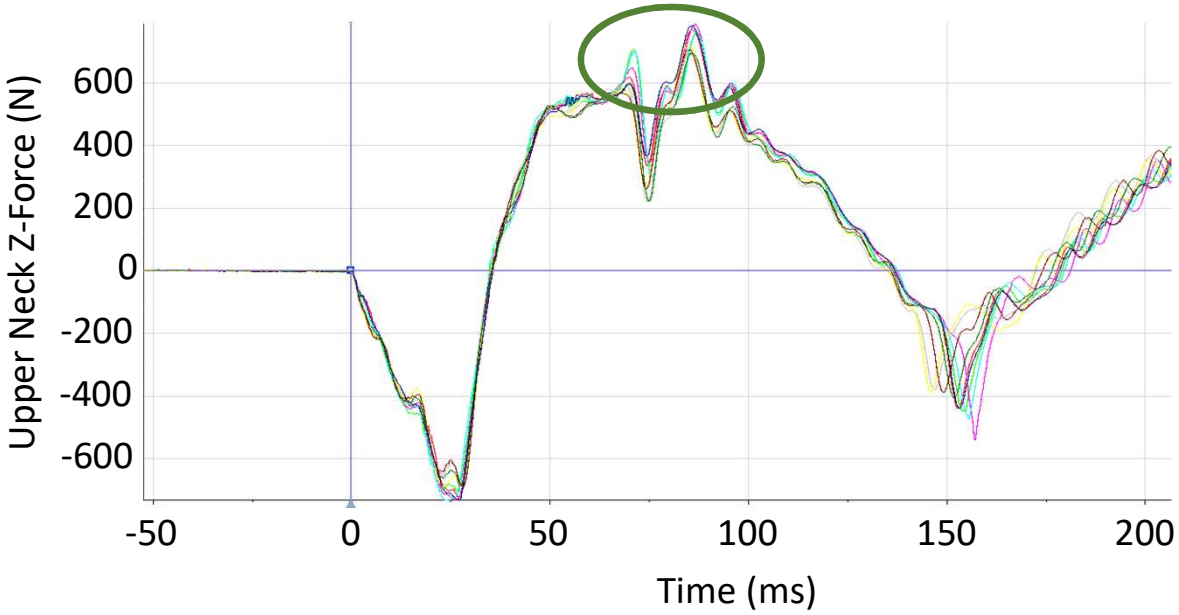

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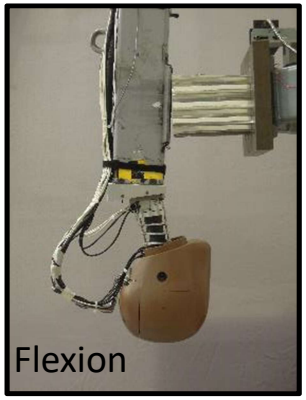

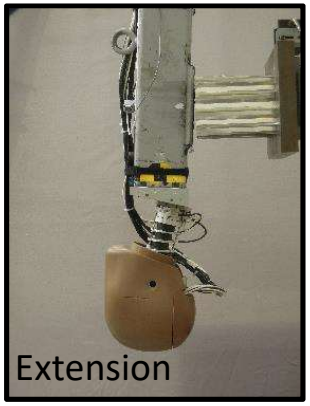

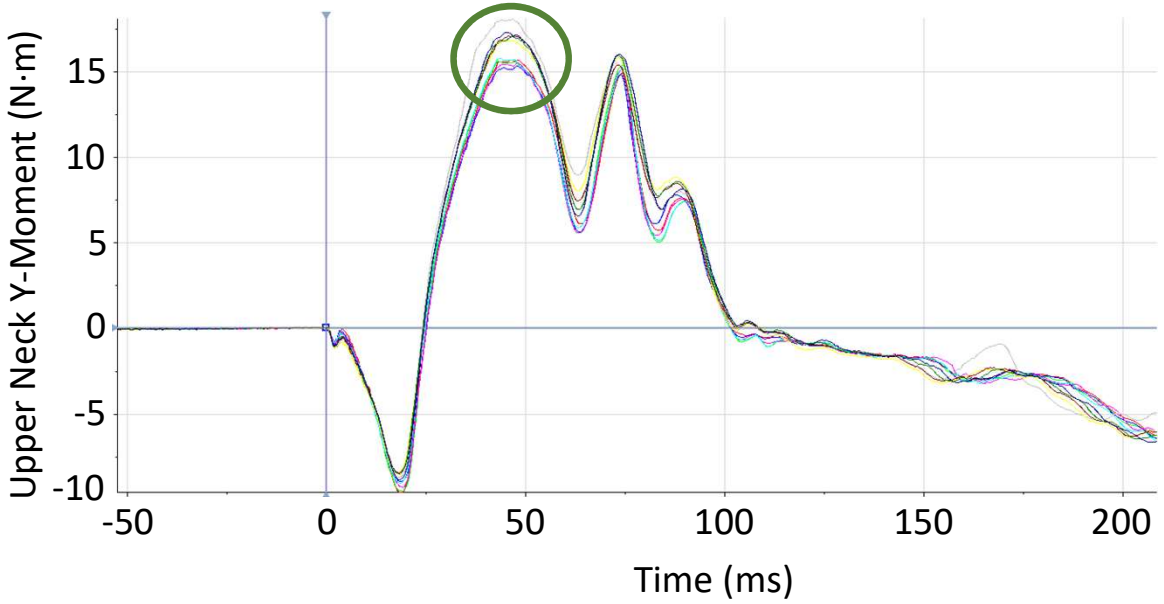

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- **Outputs:** Peak head Y-rotation
  Peak head angular rate about Y-axis
  Peak upper neck Z-force
  Peak upper neck Y-moment

All ATDs:

Statistic	Rotation (°)	Angular Rate (°/s)	Z-Force (N)	Y-Moment (N·m)
Average	-79.40	-2127.51	760.15	16.72
StDev	1.62	41.35	57.34	0.89
CV	2.04%	1.94%	7.54%	5.32%

- Moment and force CVs > 5%
- Appears to be variation between ATDs
  - Individual CVs < 3%

	Statistic	Z-Force (N)	Y-Moment (N·m)
ED7441	Average	773.62	15.61
	StDev	12.33	0.18
	CV	1.59%	1.12%
ED2634	Average	687.28	17.30
	StDev	6.94	0.48
	CV	1.01%	2.78%
ED7448	Average	819.56	17.26
	StDev	5.52	0.44
	CV	0.67%	2.57%

Neck Extension Test

- **Inputs:** Pendulum impact to 6” aluminum honeycomb at 5.0 m/s
- **Outputs:** Peak head Y-rotation
  Peak head angular rate about Y-axis
  Peak upper neck Z-force
  Peak upper neck Y-moment

All ATDs:

Statistic	Rotation (°)	Angular Rate (°/s)	Z-Force (N)	Y-Moment (N·m)
Average	87.64	2418.86	-1552.41	-16.92
StDev	1.28	40.50	101.15	0.86
CV	1.46%	1.67%	6.52%	5.08%

- Moment and force CVs > 5%
- Appears to be variation between ATDs
  - Individual CVs < 4%

	Statistic	Z-Force (N)	Y-Moment (N·m)
ED7441	Average	773.62	15.61
	StDev	12.33	0.18
	CV	1.59%	1.12%
ED2634	Average	687.28	17.30
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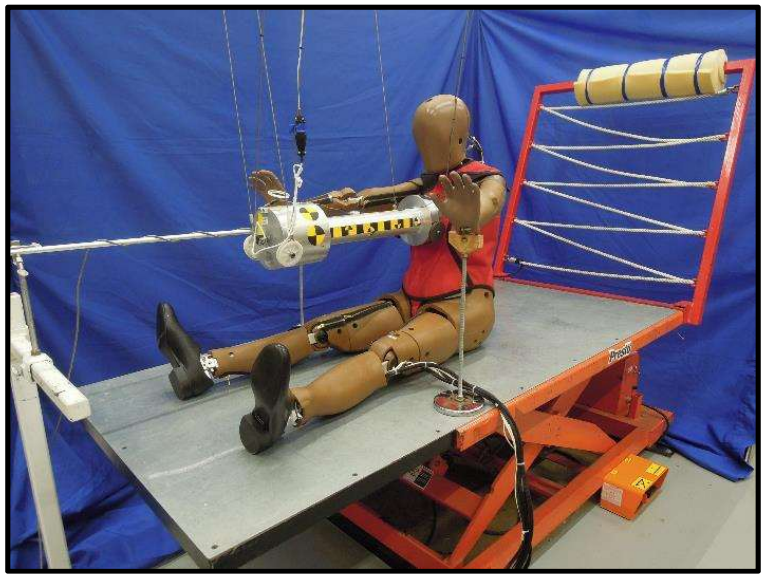
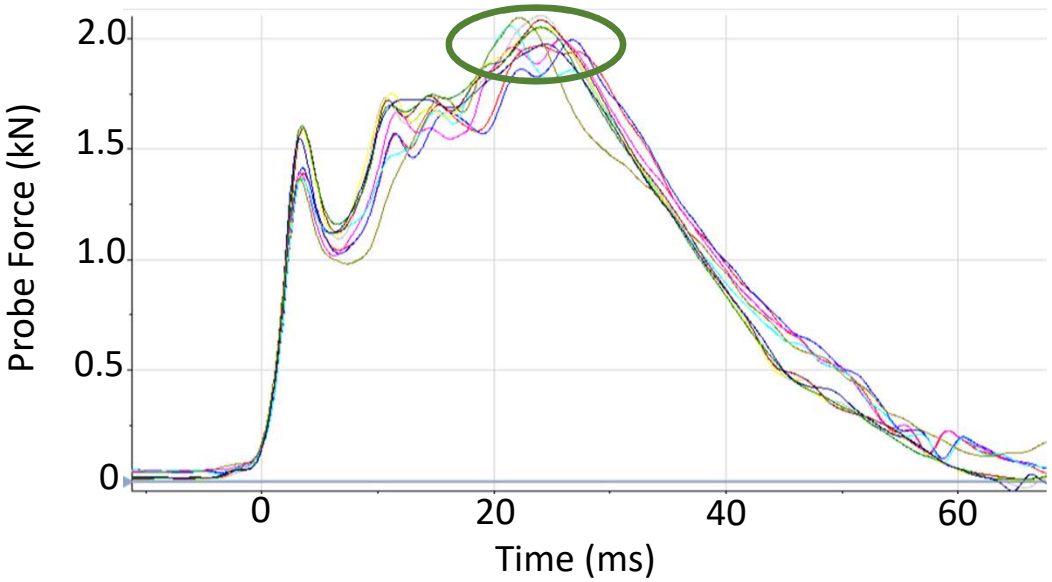
ED7448	Average	819.56	17.26
	StDev	5.52	0.44
	CV	0.67%	2.57%

Upper Thorax Impact Test

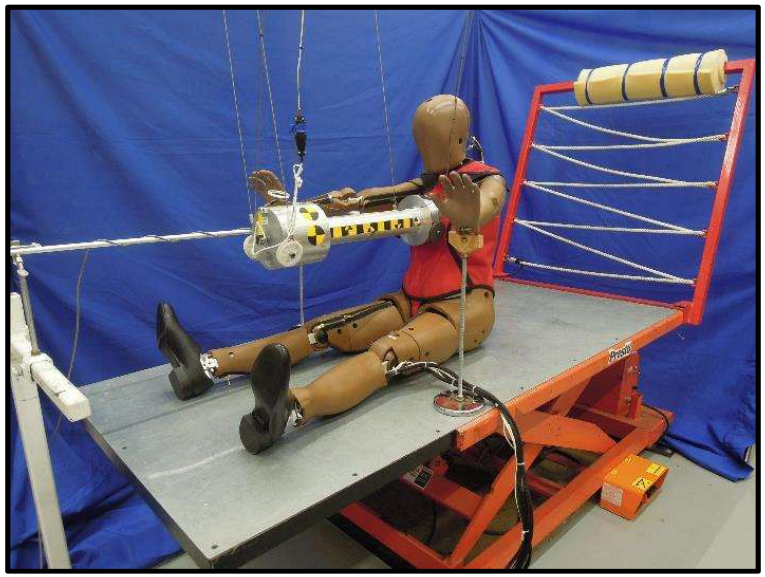
- **Inputs:** 13.97 kg probe at 4.3 m/s
- **Outputs:** Peak probe force
  Peak upper left & right resultant deflections
  Forces at peak upper left & right resultant deflections

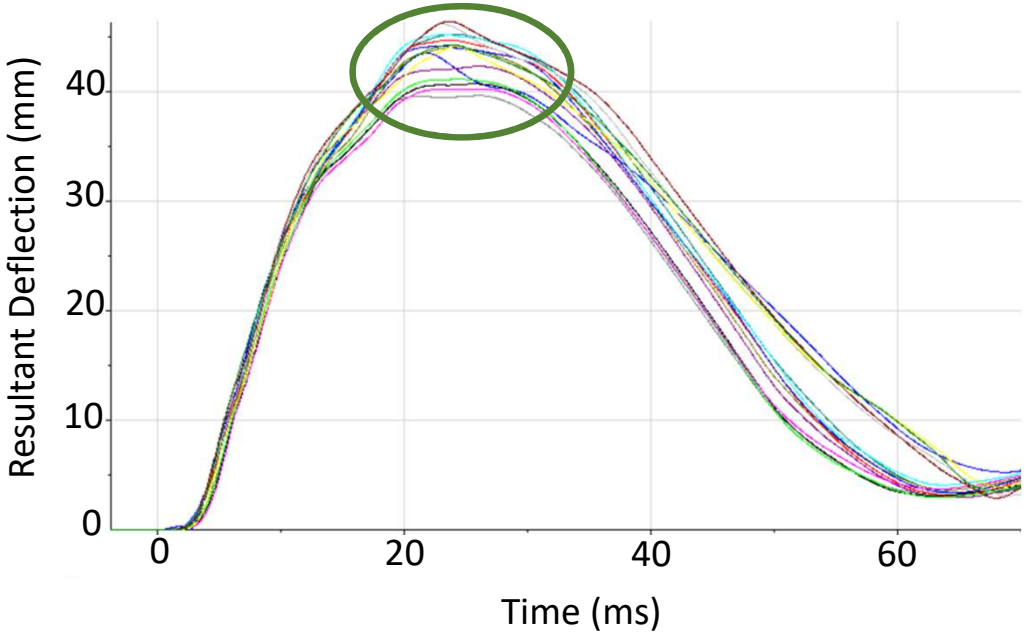




Upper Thorax Impact Test

- **Inputs:** 13.97 kg probe at 4.3 m/s
- **Outputs:** Peak probe force
  Peak upper left & right resultant deflections
  Forces at peak upper left & right resultant deflections





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- **Outputs:** Peak probe force
  Peak upper left & right resultant deflections
  Forces at peak upper left & right resultant deflections

All ATDs:

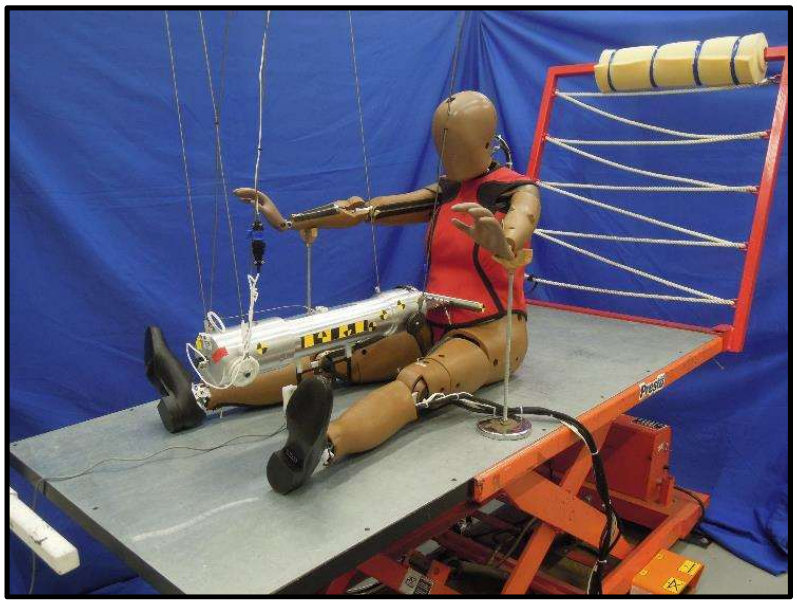
Stat	Probe Force (N)	Peak Deflection (mm)		Force at Peak Defl. (N)	
		Left	Right	Left	Right
Avg	2053.85	43.56	45.19	1991.97	1870.59
StDev	80.51	2.52	0.78	103.46	190.89
CV	3.92%	5.78%	1.72%	5.19%	10.21%

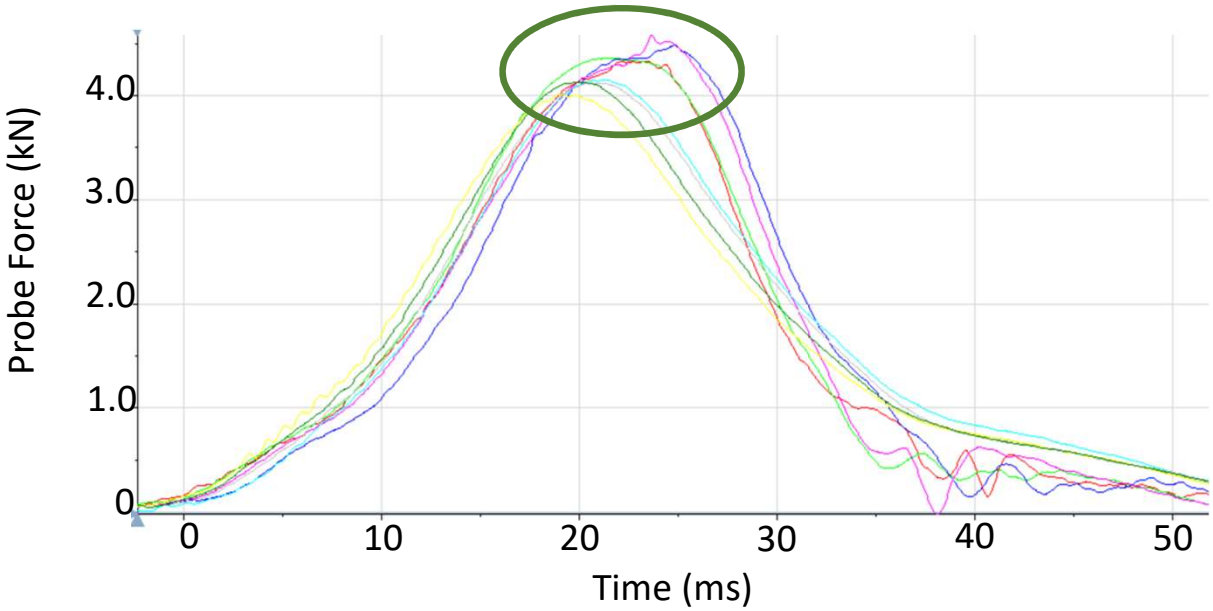
- Deflection and force CVs > 5%
- ED2634 has significant L-to-R differences

	Stat	Peak Deflection (mm)	Force at Peak Defl. (N)	
		Left	Left	Right
ED7441	Avg	40.83	2006.38	2041.44
	StDev	1.01	65.53	47.63
	CV	2.47%	3.27%	2.33%
ED2634	Avg	43.40	2062.90	1645.58
	StDev	1.02	120.22	109.94
	CV	2.34%	5.83%	6.68%
ED7448	Avg	46.45	1906.64	1924.74
	StDev	0.58	55.37	98.74
	CV	1.24%	2.90%	5.13%

Lower Abdomen Impact Test

- **Inputs:** 16.0 kg bar probe at 6.0 m/s
- **Outputs:** Peak probe force
  Peak left and right abdomen pressure





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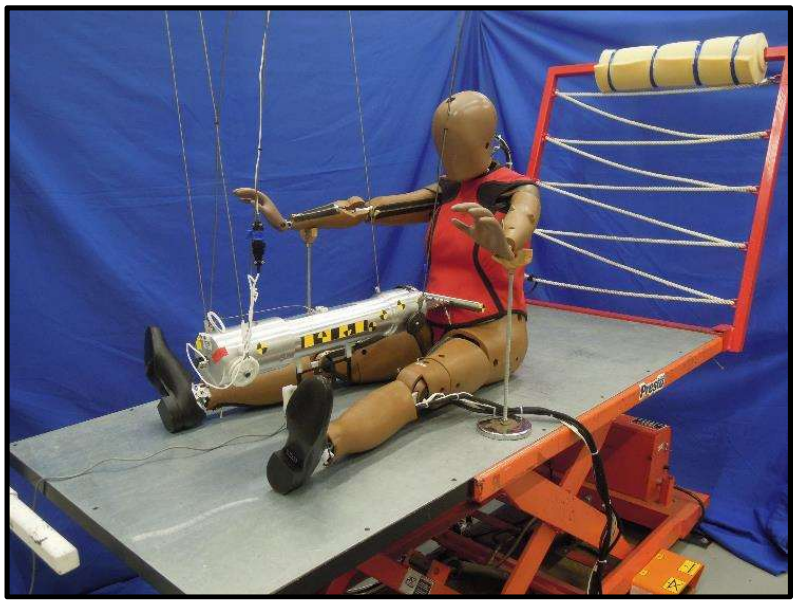

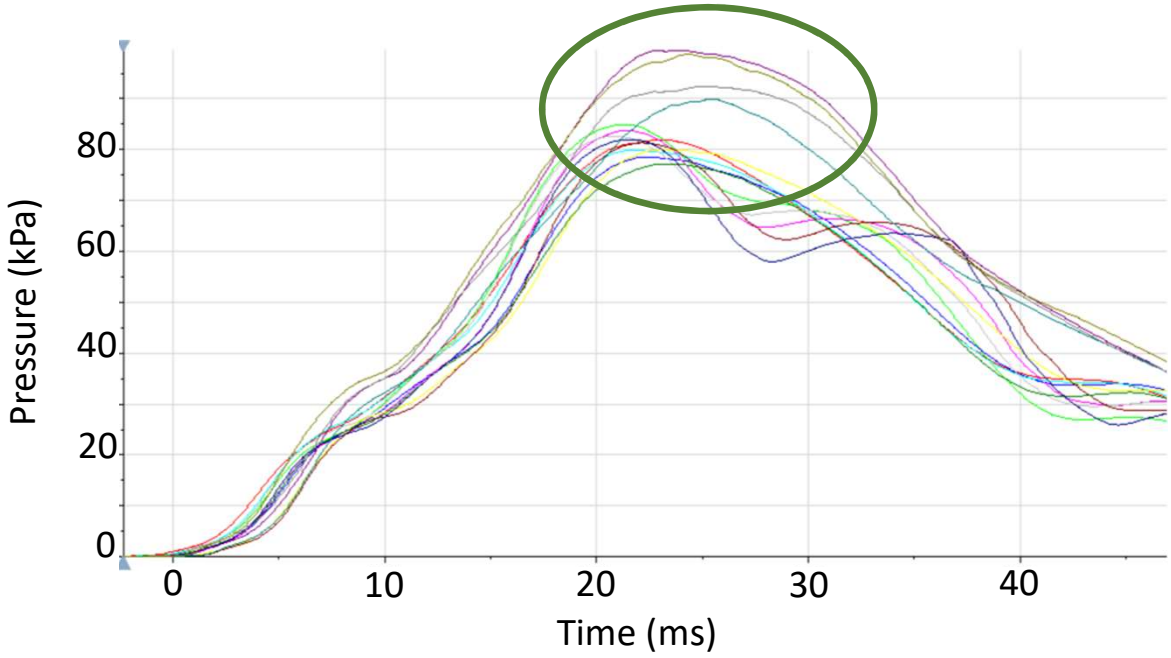

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- **Inputs:** 16.0 kg bar probe at 6.0 m/s
- **Outputs:** Peak probe force
  Peak left and right abdomen pressure

All ATDs:

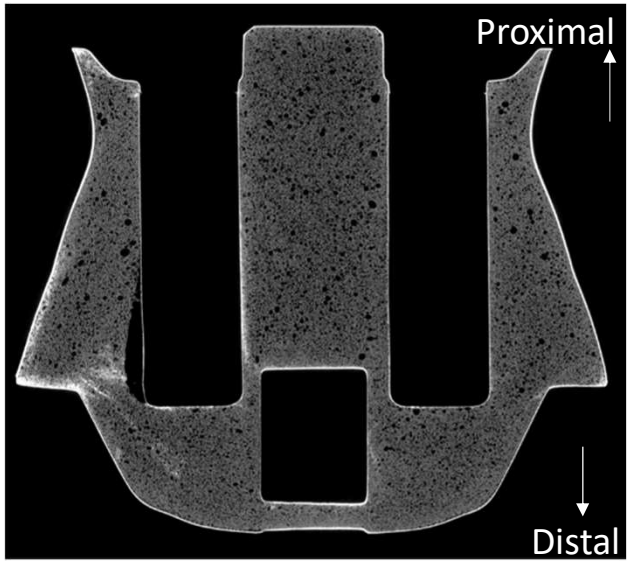
Stat	Probe Force (N)	Pressure (kPa)		
		Left	Right	L-R
Avg	4686.75	168.71	172.31	-3.59
StDev	606.69	17.92	9.99	11.50
CV	12.94%	10.62%	5.80%	

	Stat	Probe Force (N)	Pressure (kPa)		
			Left	Right	L-R
ED7441	Avg	4129.94	192.35	184.50	12.97
	StDev	83.46	6.80	7.74	7.63
	CV	2.02%	3.53%	4.20%	
ED2634	Avg	4448.44	159.02	165.94	-6.93
	StDev	102.58	3.56	2.89	3.17
	CV	2.31%	2.24%	1.74%	
ED7448	Avg	5481.85	154.77	166.47	-11.70
	StDev	148.33	2.58	1.32	2.43
	CV	2.71%	1.66%	0.79%	

- Force & pressure CVs > 5%
- Maybe due to part differences in the abdomen

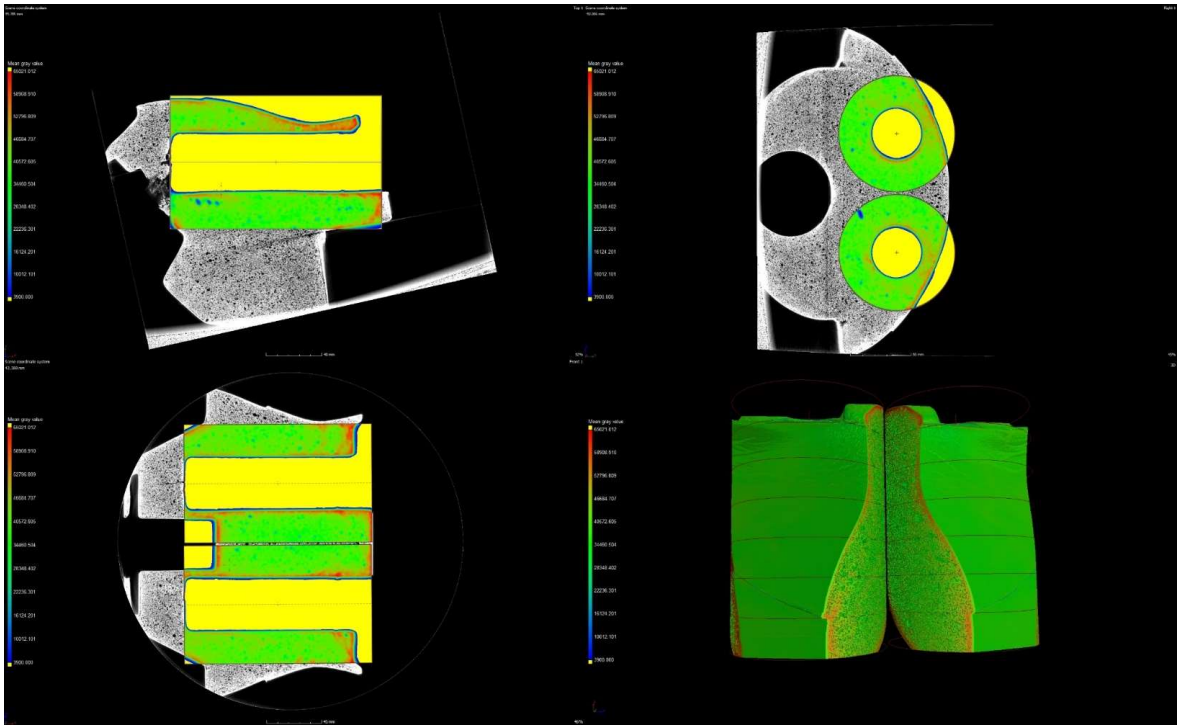
Abdomen CT Scan Study

- **Objective:** Quantify the variation in the foam abdomens to find the cause of the force and pressure differences between parts and within a part.
- **Method:** Performed a CT scan on each abdomen & quantified the percentage of voids and material surrounding the pressure sensors.
  - Compared between the 3 abdomens
  - Compared within each abdomen: Left - Right



Abdomen CT Scan Processing

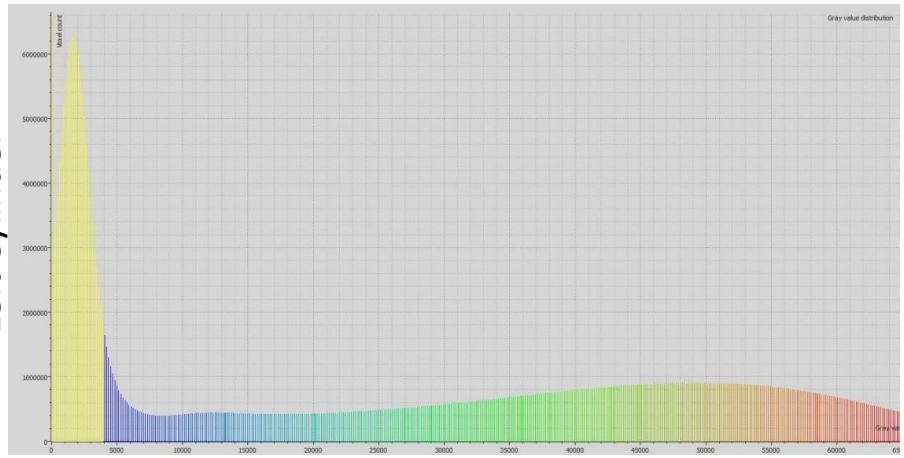
- 2 cylinders were virtually placed around the pressure sensor cavities (concentrically).
- Each grayscale value was assigned a color
  - Yellow = empty space
  - Blue-to-red = material voids-to-highly dense



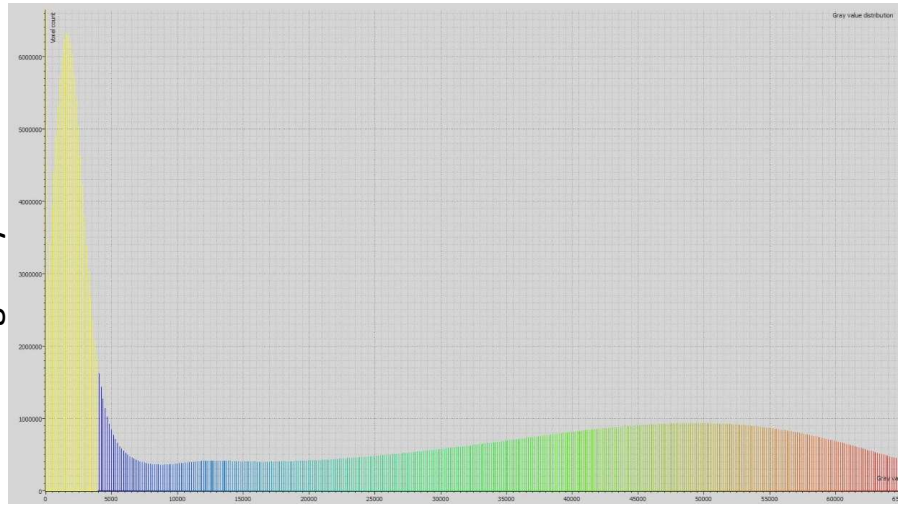
Abdomen CT Scan Processing

- Plotted the number of voxels in each color for each cylinder

Left Cylinder

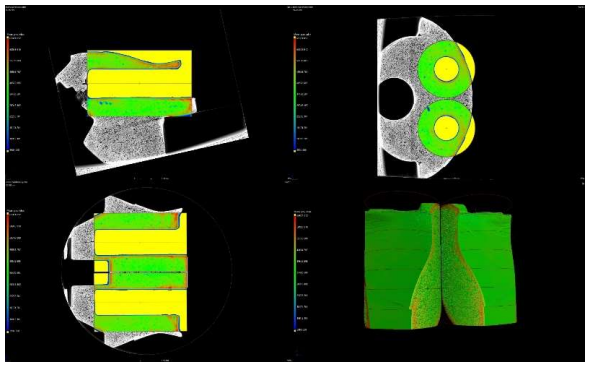


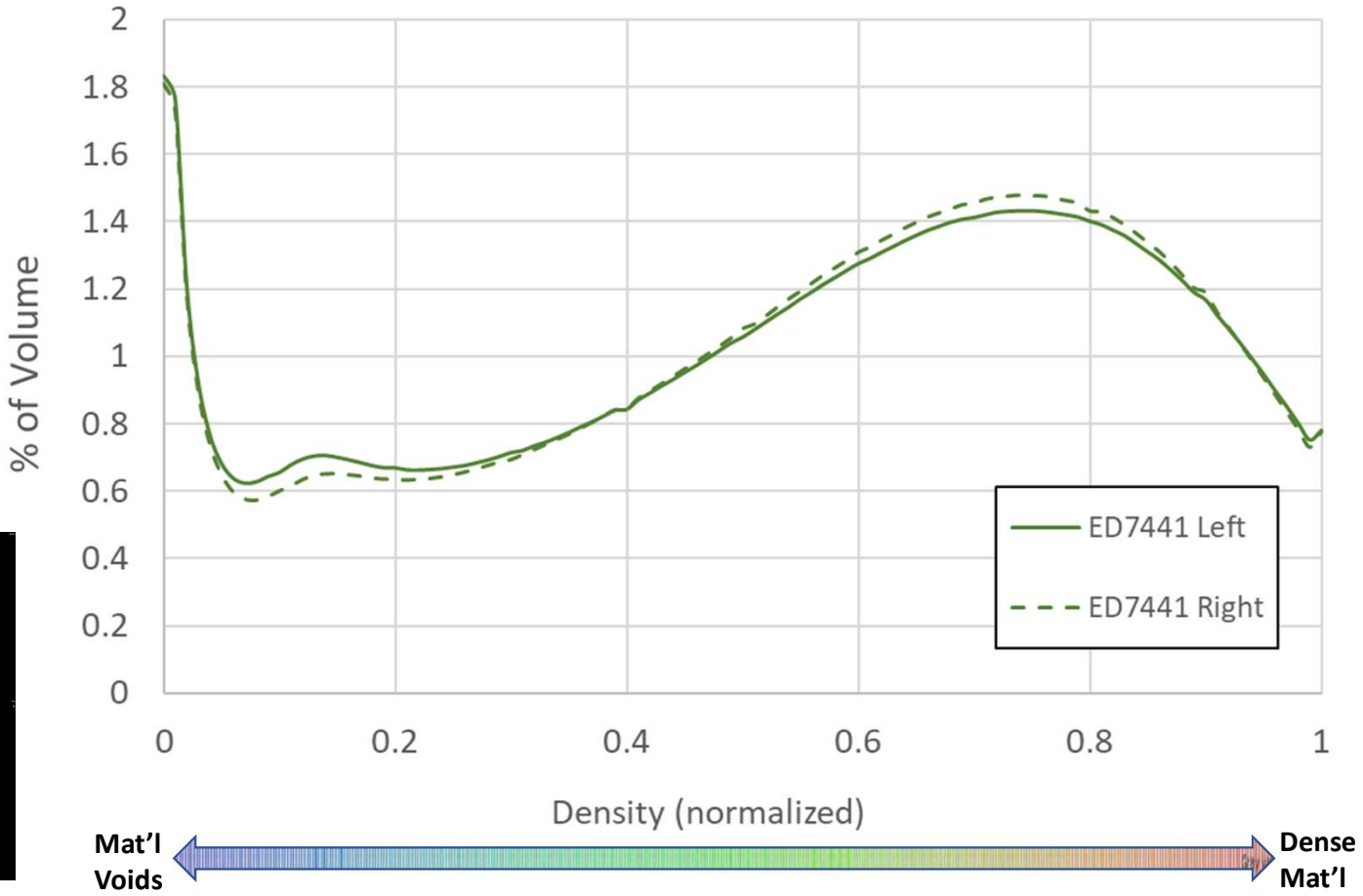
Right Cylinder



Abdomen CT Study: Density Profiles

- Truncated the “yellow” empty space data to understand what’s going on in the part
- Area under the curve = 100%

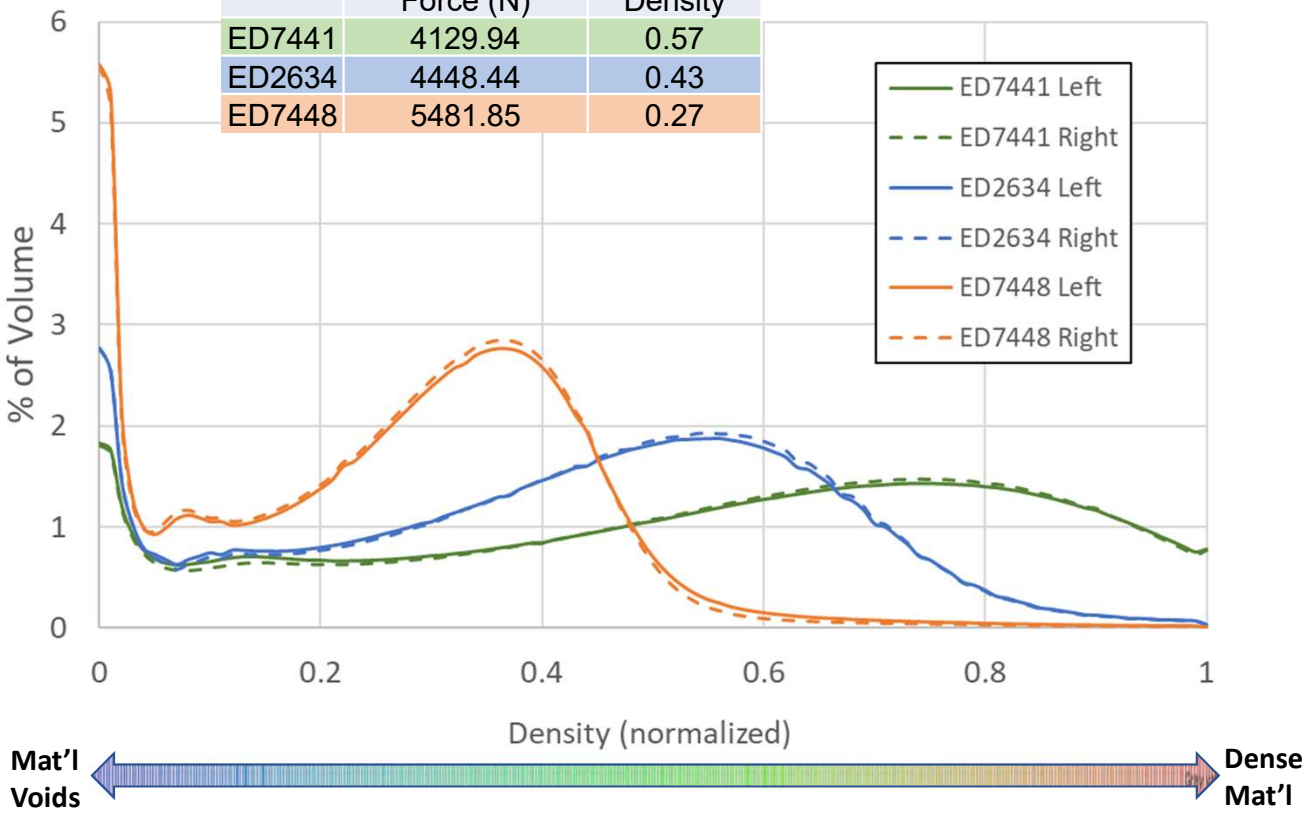




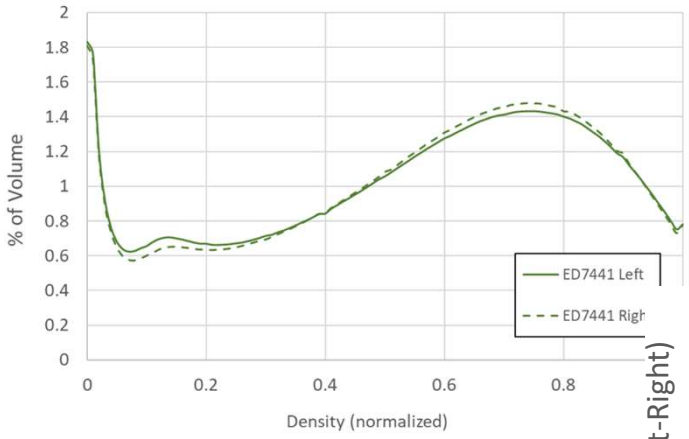
Abdomen CT Study: Density Profiles

- **Results:** Each abdomen foam has a unique density profile.
- Possible explanation for differences in probe force between ATDs.

ATD	Avg Peak Probe Force (N)	Avg Norm Density
ED7441	4129.94	0.57
ED2634	4448.44	0.43
ED7448	5481.85	0.27

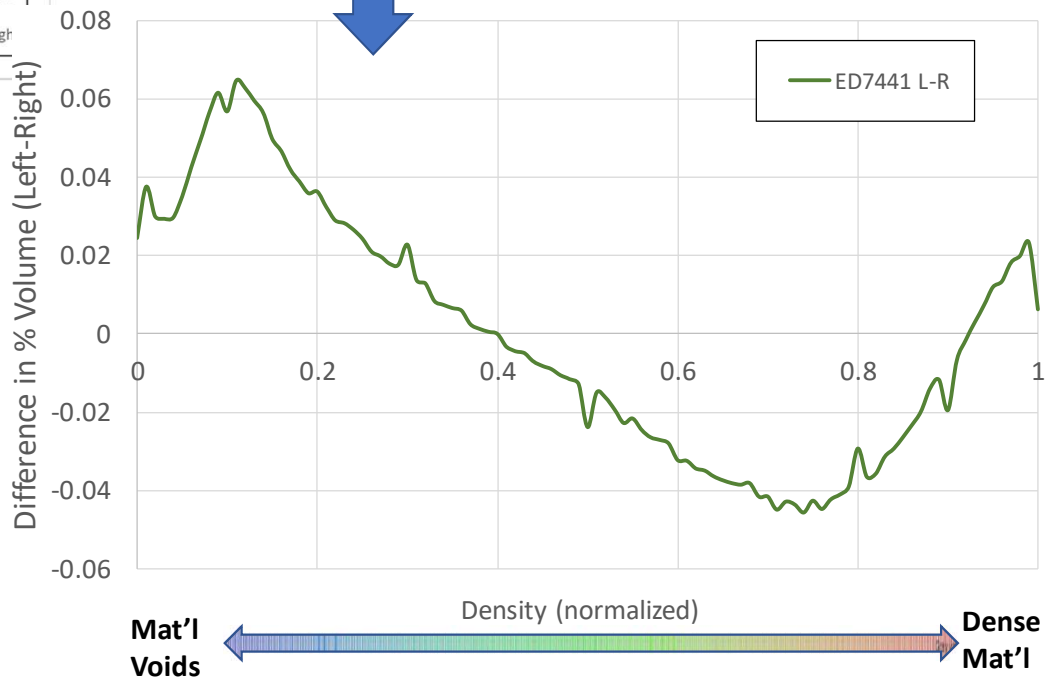


Abdomen CT Study: Intra-part Differences



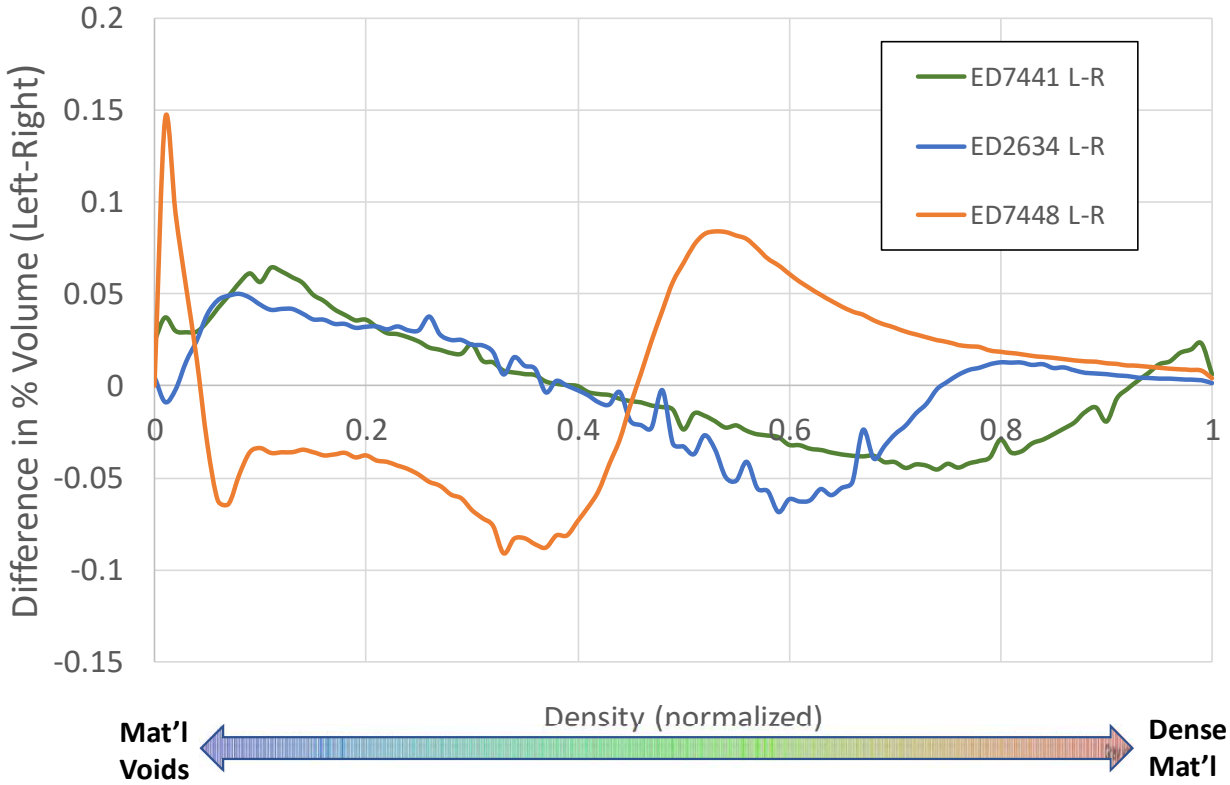
- Difference between left and right
- Closer to 0 indicates more homogenous foam density through part

Left - Right



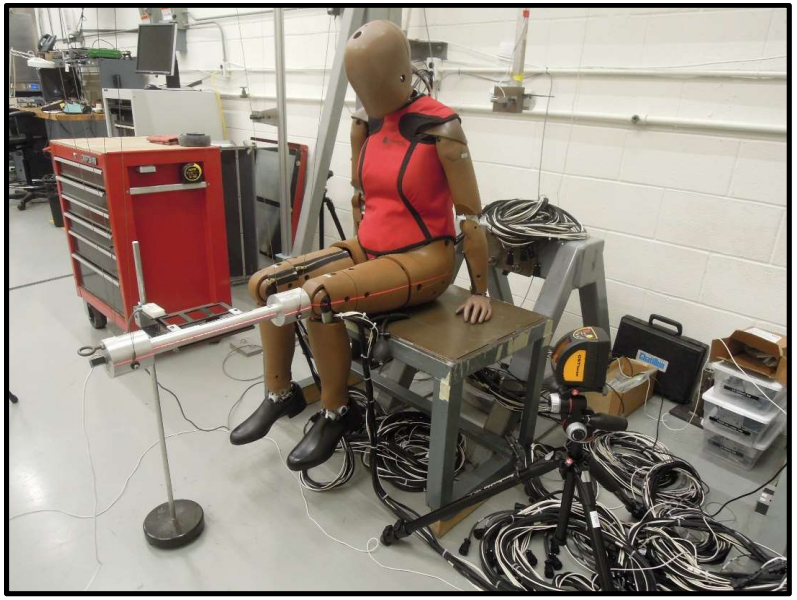
Abdomen CT Study: Intra-part Differences

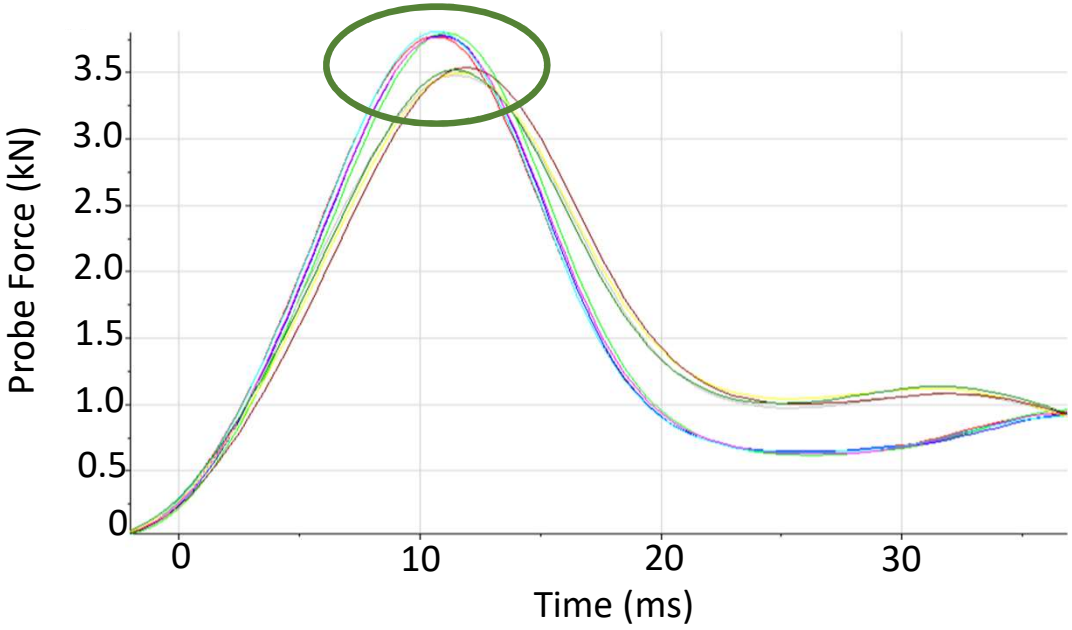
- **Results:** Ideally, the L-R curve should always be close to zero & values are small for all 3 abdomen foams.
- ED7448 demonstrates more L-R variability by CT and in the R&R data



Upper Leg Impact Test

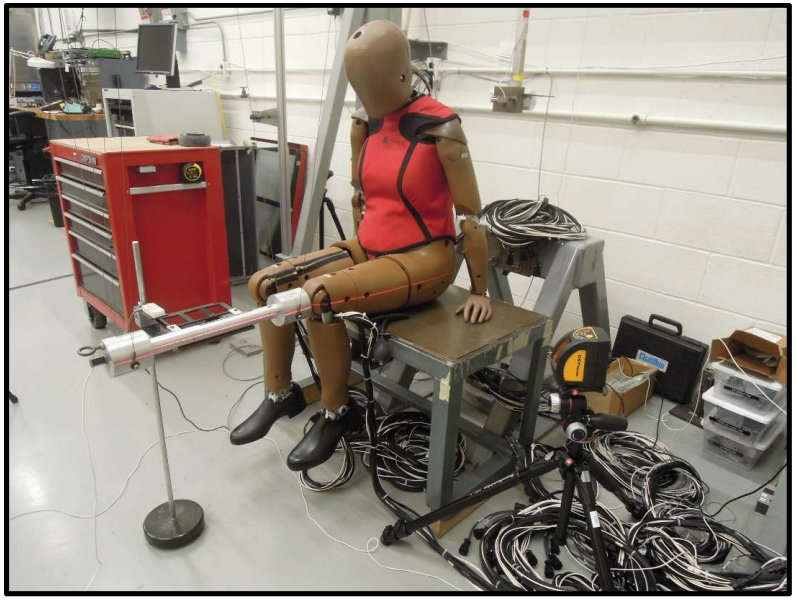
- **Inputs:** 2.99 kg probe at 2.6 m/s
- **Outputs:** Peak probe force
  Peak femur Z-force
  Peak resultant acetabulum force

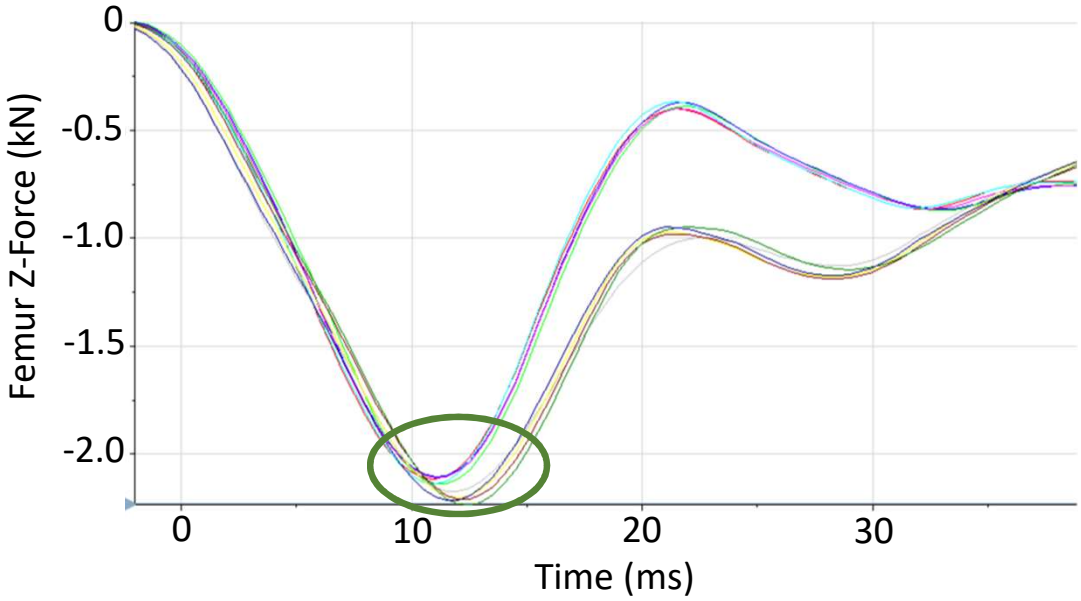




Upper Leg Impact Test

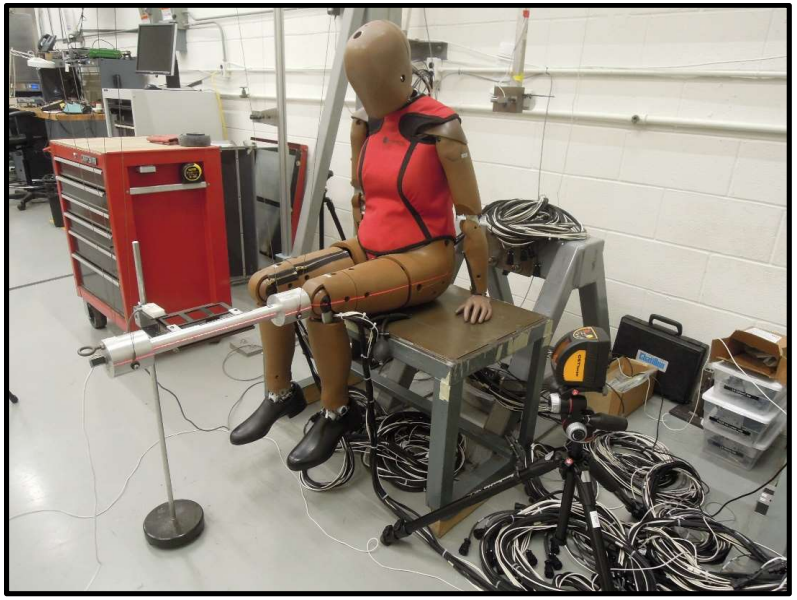
- **Inputs:** 2.99 kg probe at 2.6 m/s
- **Outputs:** Peak probe force
  Peak femur Z-force
  Peak resultant acetabulum force

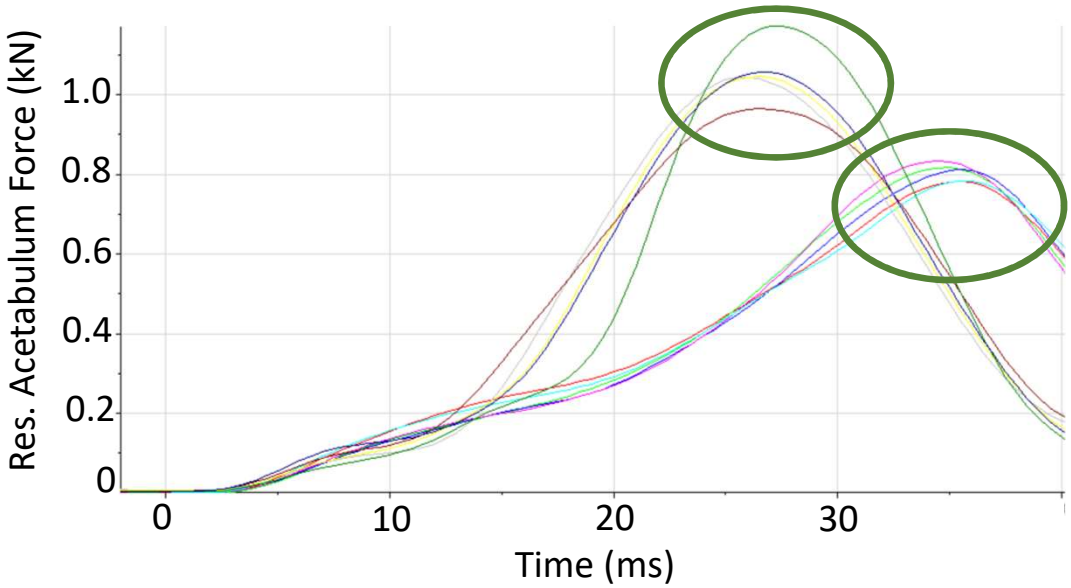




Upper Leg Impact Test

- **Inputs:** 2.99 kg probe at 2.6 m/s
- **Outputs:** Peak probe force
  Peak femur Z-force
  Peak resultant acetabulum force





Upper Leg Impact Test

- For femur Z-force & resultant acetabulum force, CV > 5%
- Significant leg-to-leg variation
- Investigating a change in pelvis flesh material to minimize relative motion between bone & flesh
- Considering changes to test procedure

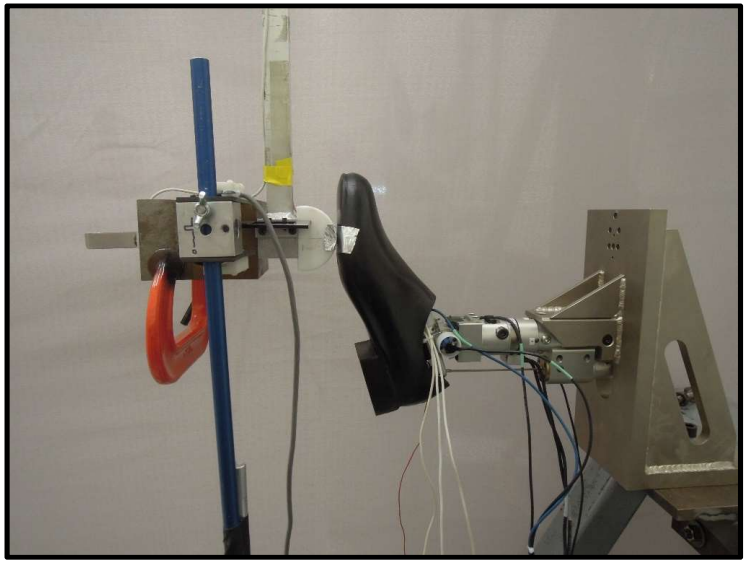
All ATDs:

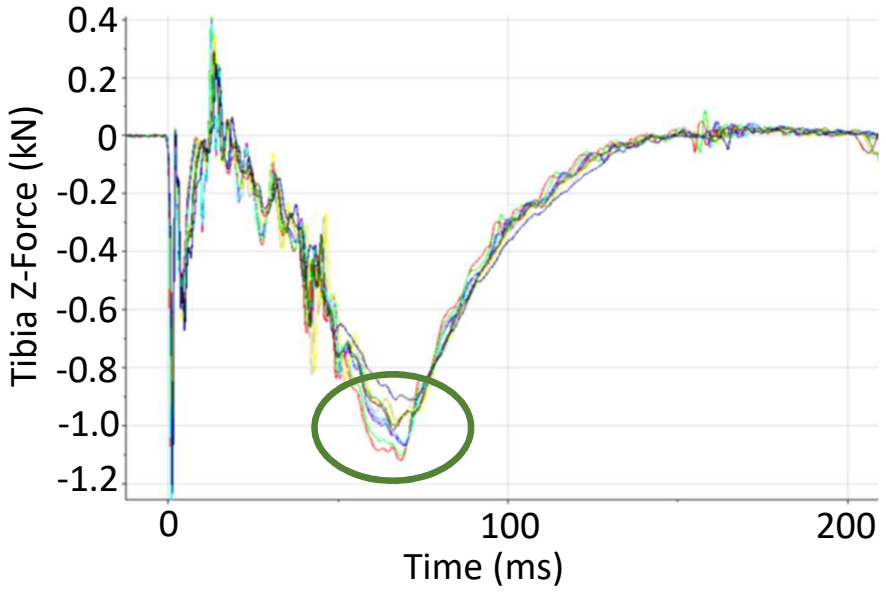
Statistic	Probe Force (N)	Femur Z-Force (N)	Res. Acetab Force (N)
Average	3641.02	-2159.73	953.30
StDev	146.73	128.38	137.12
CV	4.03%	5.94%	14.38%

Leg		Stat	Probe Force (N)	Femur Z-Force (N)	Res. Acetab. Force (N)
ED7441	Left	Average	3788.90	-2120.67	805.77
		StDev	15.44	15.21	22.38
		CV	0.41%	0.72%	2.78%
	Right	Average	3445.86	-1926.19	792.50
		StDev	22.58	14.53	48.97
		CV	0.66%	0.75%	**6.18%**
ED2634	Left	Average	3840.79	-2343.33	1022.90
		StDev	46.10	29.89	35.81
		CV	1.20%	1.28%	3.50%
	Right	Average	3508.07	-2206.41	1056.89
		StDev	21.48	22.40	74.58
		CV	0.61%	1.02%	**7.06%**
ED7448	Left	Average	3597.34	-2174.44	928.43
		StDev	35.12	23.80	117.69
		CV	0.98%	1.09%	**12.68%**
	Right	Average	3665.18	-2187.32	1113.32
		StDev	38.53	30.37	30.71
		CV	1.05%	1.39%	2.76%

Ball of Foot Test

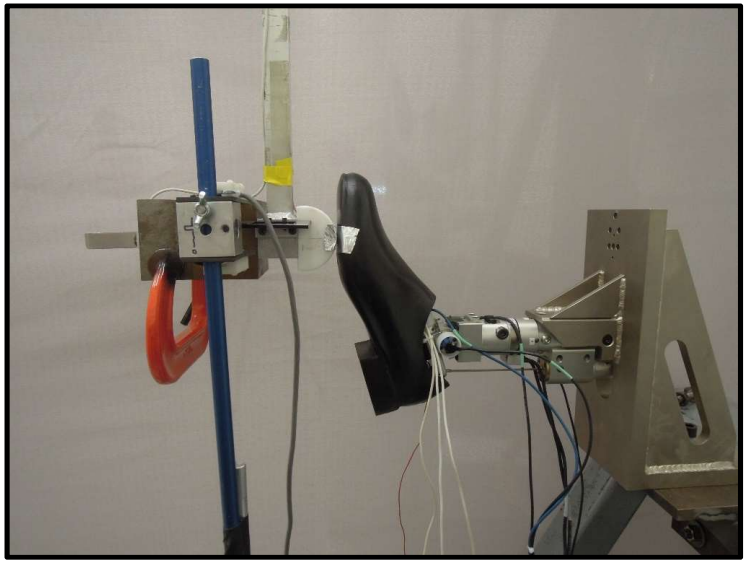
- **Inputs:** 7.45 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force after 10ms
  Peak ankle Y-moment
  Peak ankle Y-rotation

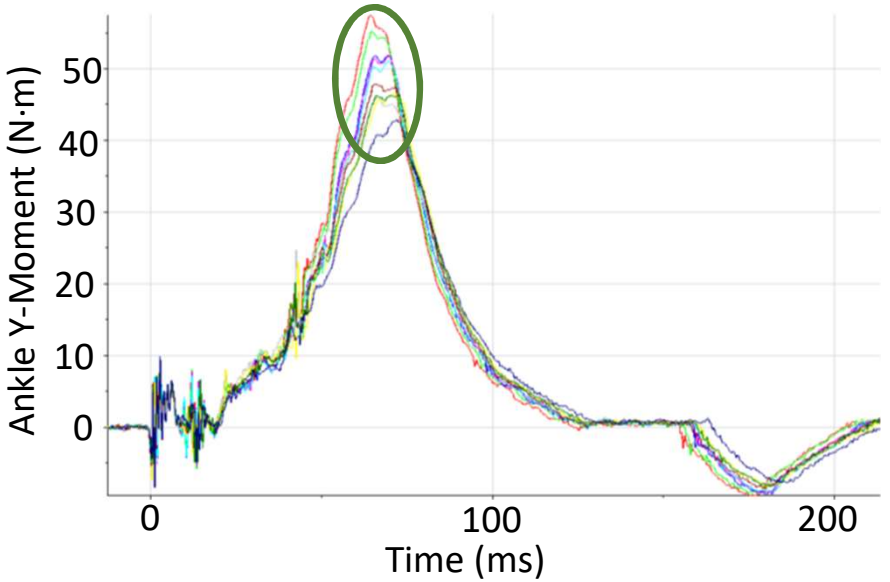




Ball of Foot Test

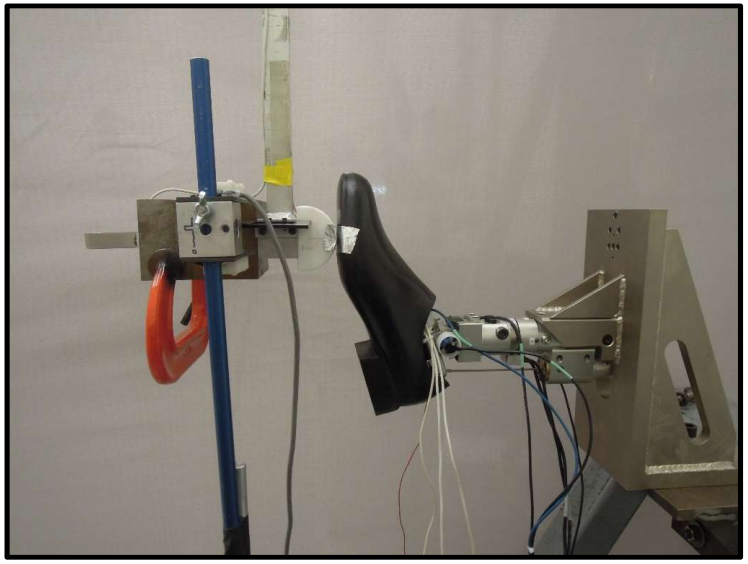
- **Inputs:** 7.45 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force after 10ms
  Peak ankle Y-moment
  Peak ankle Y-rotation

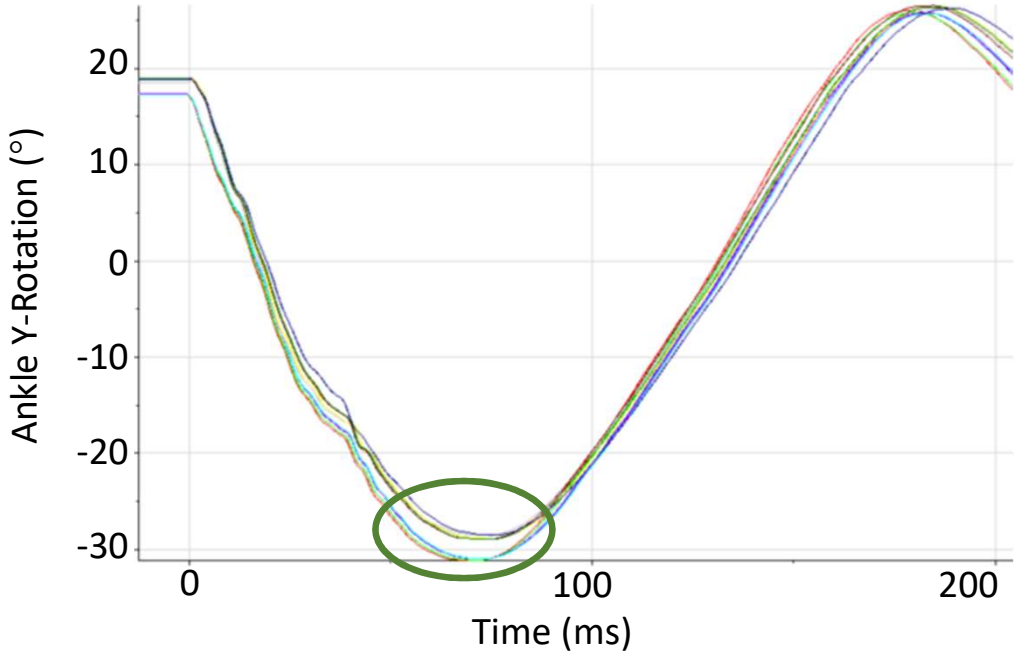




Ball of Foot Test

- **Inputs:** 7.45 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force after 10ms
  Peak ankle Y-moment
  Peak ankle Y-rotation





Ball of Foot Test

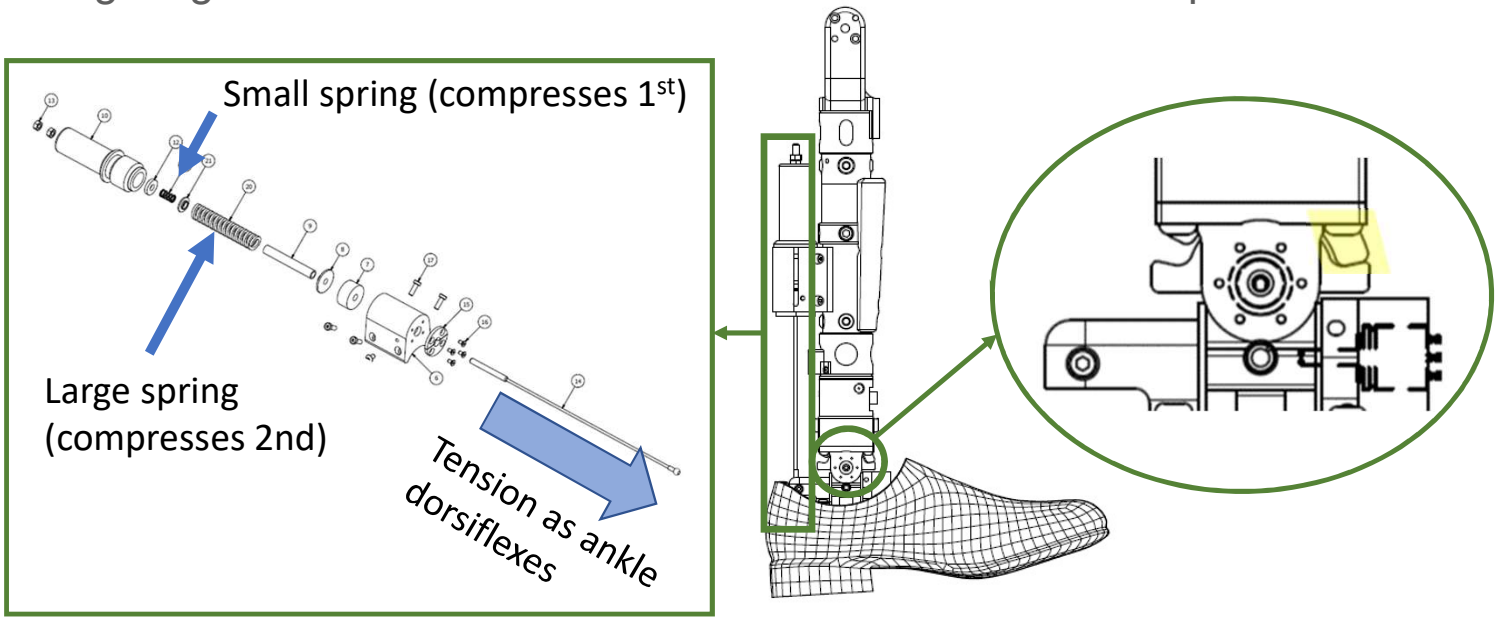
- **Inputs:** 7.45 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force after 10ms
  Peak ankle Y-moment
  Peak ankle Y-rotation
- For tibia Z-force & ankle Y-moment, CV > 5%
- Significant leg-to-leg variation

Statistic	Z-Force (N)	Y-Moment (N·m)	Y-Rotation (°)
Average	-969.50	47.66	-30.26
StDev	90.60	5.97	1.22
CV	9.35%	12.53%	4.04%

Leg		Stat	Z-Force (N)	Y-Moment (N·m)	Y-Rotation (°)
ED7441	Left	Average	-978.33	46.01	-28.73
		StDev	39.87	1.84	0.22
		CV	4.08%	3.99%	0.77%
	Right	Average	-1004.85	49.52	-30.32
		StDev	5.76	0.36	0.03
		CV	0.57%	0.73%	0.11%
ED2634	Left	Average	-1083.58	53.54	-30.99
		StDev	26.48	2.73	0.12
		CV	2.44%	4.10%	0.40%
	Right	Average	-884.84	39.09	-31.71
		StDev	1.09	0.39	0.09
		CV	0.12%	1.01%	0.29%
ED7448	Left	Average	-870.48	48.68	-31.28
		StDev	24.06	1.92	0.35
		CV	2.76%	3.94%	1.12%
	Right	Average	-1026.78	51.37	-28.65
		StDev	16.56	1.84	0.44
		CV	1.61%	3.58%	1.53%

Ball of Foot Test

- Ankle mechanics during this test are affected primarily by:
  - Dorsiflexion stopper
    - Probably not the source of variation
    - Same material used for inversion/eversion stoppers
  - Achilles cable tension
    - Investigating a robust method to ensure initial conditions are repeatable



Conclusions

- From head-to-toe, 360 tests have been performed at VRTC on 3 THOR-05F ATDs.
- Based on this limited data set, R&R measures of interest have CV < 10% for:
  - Head
  - Neck
  - Thorax
  - Knee slider
  - Ankle inversion/eversion
  - Heel of foot
- Further investigation (ATD design & test procedure) is on-going for:
  - Face
  - Abdomen
  - Upper leg
  - Ball of foot
- Additional future work includes R&R in crash environments, round robin testing, durability testing, drawing package release, & standard ATD documentation.

Thank You!

- Questions?

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NHTSA – Applied Biomechanics Division
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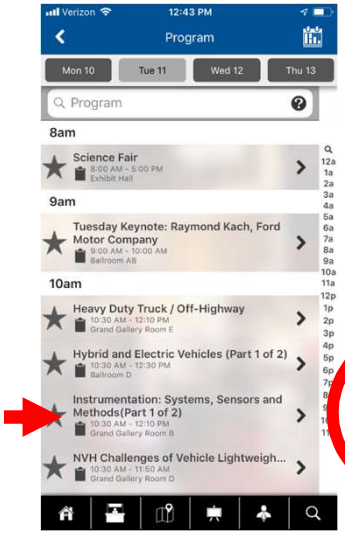
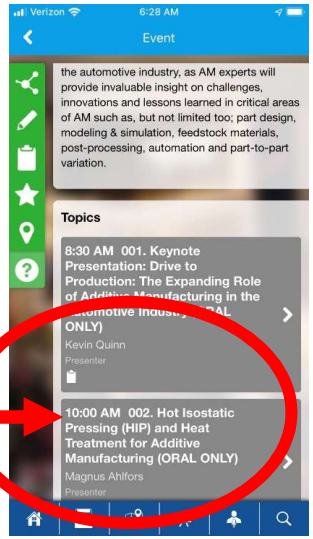
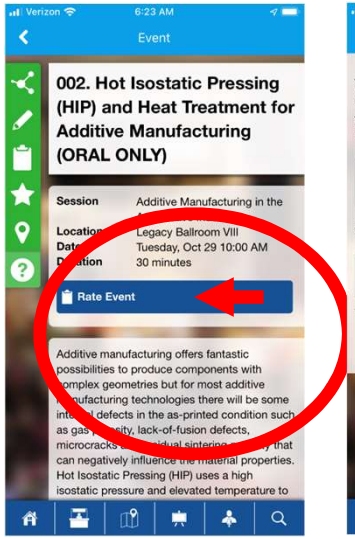
Rate my talk in the app



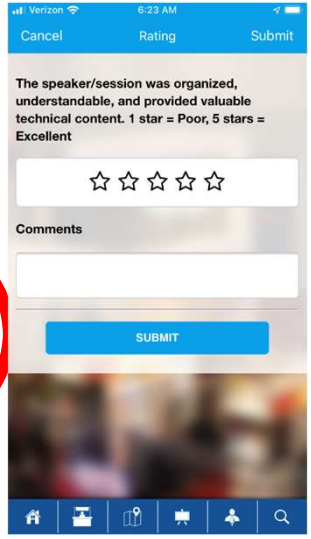
1. Navigate to session listing under Program



2. Click on individual presentation



3. Click on "Rate Event" button

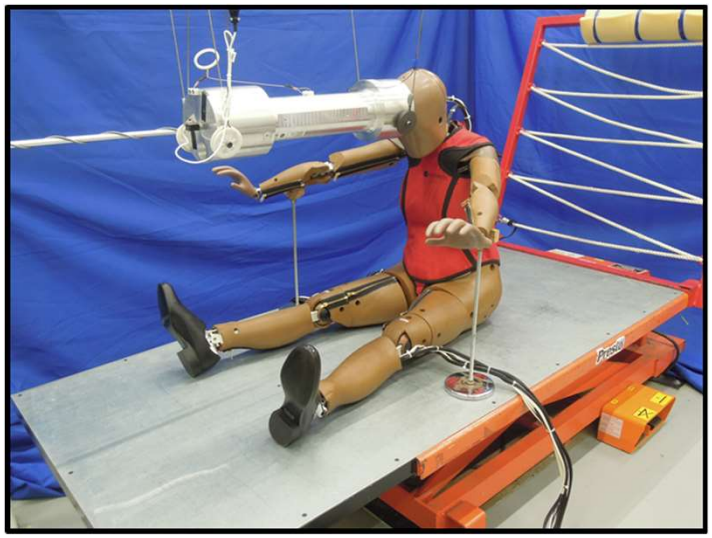


4. Rate speaker


Appendix

Head Impact Test

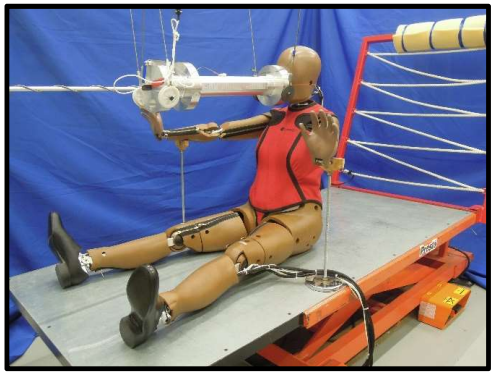
- **Inputs:** 19.2 kg probe at 2.0 m/s
- **Outputs:** Peak probe force
  Peak head CG resultant acceleration



ATD	Test ID	Probe Force (N)	Resultant Accel (G)
ED7441	190222-1	5083.30	142.60
	190222-3	5064.50	145.70
	190222-4	4987.10	141.70
	190222-5	4979.50	141.60
	190222-6	4958.20	141.10
ED2634	190716-3	4980.39	152.84
	190716-5	5049.18	155.99
	190716-6	5090.73	156.73
	190716-9	5082.10	156.07
	190716-12	5065.96	155.45
ED7448	190910-6	5160.79	146.37
	190910-8	5202.55	149.11
	190910-9	5150.96	144.33
	190910-10	5082.16	143.28
	190910-12	5077.62	141.46
Average		5067.67	147.62
StDev		70.36	6.14
CV		1.39%	4.16%

Face Impact Test

- **Inputs:** 10.7 kg probe at 6.73 m/s
- **Outputs:** Peak probe force
  Peak head CG resultant acceleration



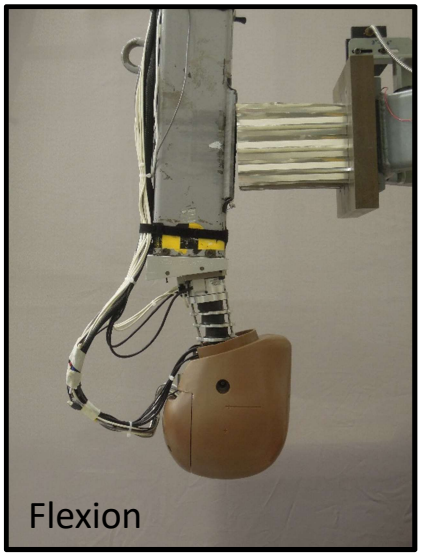
ATD	Test ID	Probe Force (N)	Resultant Accel (G)
ED7441	191007-2	7915.57	246.85
	191008-2	7697.20	230.78
	191009-1	7968.37	293.83
	191010-6	8245.18	498.31
	191016-5	8718.29	436.90
ED2634	190717-2	7297.57	224.73
	190718-5	7470.27	253.06
	190722-1	7428.53	258.14
	190723-2	7612.87	278.77
	190724-1	8194.21	357.23
ED7448	190916-1	7935.37	228.48
	190917-5	8845.73	276.40
	190919-6	7946.85	236.87
	190924-2	8843.74	278.11
	190925-1	8660.67	262.58
Average		**8052.03**	**290.74**
StDev		**520.58**	**79.88**
CV		**6.47%**	**27.47%**

- Similar to THOR-50M, the face insert is made from memory foam.
- Performance changes based on total number & time between impacts.
- Humanetics is currently exploring an improved design.

Neck Flexion Test

- **Inputs:** Pendulum impact to 6” aluminum honeycomb at 5.0 m/s
- **Outputs:** Peak head Y-rotation
  Peak head angular rate about Y-axis
  Peak upper neck Z-force
  Peak upper neck Y-moment

- Moment and force CVs > 5%
- Appears to be variation between ATDs
  - Individual CVs < 3%



ATD	Test ID	Rotation (°)	Angular Rate (°/s)	Z-Force (N)	Y-Moment (N·m)
ED7441	191007-2	-80.99	-2116.30	771.60	15.72
	191008-2	-81.79	-2152.90	761.80	15.66
	191009-1	-81.52	-2103.60	783.10	15.35
	191010-6	-81.79	-2121.40	789.30	15.54
	191016-5	-81.17	-2132.30	762.30	15.80
ED2634	190717-2	-77.68	-2094.20	692.49	18.11
	190718-5	-78.68	-2070.13	690.12	16.86
	190722-1	-78.64	-2085.27	675.22	17.14
	190723-2	-78.87	-2074.25	690.67	17.09
	190724-1	-79.42	-2106.28	687.90	17.31
ED7448	190916-1	-77.49	-2170.91	813.06	17.81
	190917-5	-78.15	-2167.86	820.89	17.39
	190919-6	-77.83	-2196.33	814.53	17.44
	190924-2	-77.60	-2124.10	825.30	17.01
	190925-1	-79.42	-2196.78	824.00	16.64
Average		**-79.40**	**-2127.51**	**760.15**	**16.72**
StDev		**1.62**	**41.35**	**57.34**	**0.89**
CV		**2.04%**	**1.94%**	**7.54%**	**5.32%**

	Rotation (°)	Angular Rate (°/s)	Z-Force (N)	Y-Moment (N·m)
Average	-81.45	-2125.30	773.62	15.61
StDev	0.36	18.56	12.33	0.18
CV	0.45%	0.87%	1.59%	1.12%

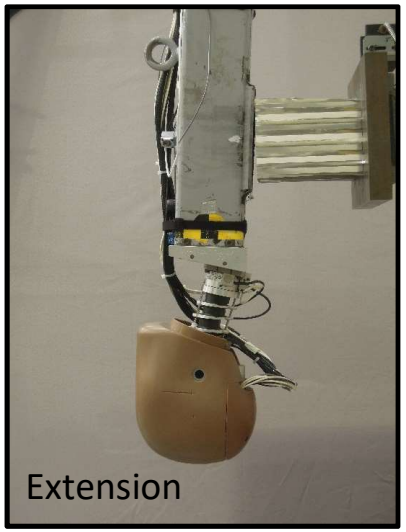
Average	-78.66	-2086.03	687.28	17.30
StDev	0.63	14.74	6.94	0.48
CV	0.80%	0.71%	1.01%	2.78%

Average	-78.10	-2171.20	819.56	17.26
StDev	0.78	29.65	5.52	0.44
CV	1.00%	1.37%	0.67%	2.57%

Neck Extension Test

- **Inputs:** Pendulum impact to 6” aluminum honeycomb at 5.0 m/s
- **Outputs:** Peak head angular rate about Y-axis
  Peak head rotation
  Peak upper neck Z-force
  Peak upper neck Y-moment

- Moment and force CVs > 5%
- Appears to be variation between ATDs
  - Individual CVs < 4%



ATD	Test ID	Rotation (°)	Angular Rate (°/s)	Z-Force (N)	Y-Moment (N·m)
ED7441	181203-2	87.18	2394.20	-1415.50	-17.20
	181203-8	88.96	2408.70	-1426.00	-16.26
	181203-10	89.27	2420.20	-1417.60	-17.06
	181203-15	89.04	2452.00	-1414.20	-16.84
	181203-17	88.67	2369.90	-1416.20	-16.09
ED2634	190604-4	85.00	2390.55	-1607.81	-17.06
	190604-7	85.75	2426.06	-1631.72	-16.06
	190604-8	87.00	2387.93	-1586.35	-15.82
	190604-10	86.90	2342.67	-1576.70	-15.69
	190604-12	86.88	2415.86	-1583.45	-16.66
ED7448	190905-1	86.58	2403.09	-1651.89	-17.00
	190905-2	88.51	2488.96	-1651.58	-17.53
	190905-4	88.29	2440.11	-1638.19	-17.82
	190905-5	88.09	2472.33	-1639.82	-18.59
	190905-6	88.48	2470.42	-1629.20	-18.17
Average		**87.64**	**2418.86**	**-1552.41**	**-16.92**
StDev		**1.28**	**40.50**	**101.15**	**0.86**
CV		**1.46%**	**1.67%**	**6.52%**	**5.08%**

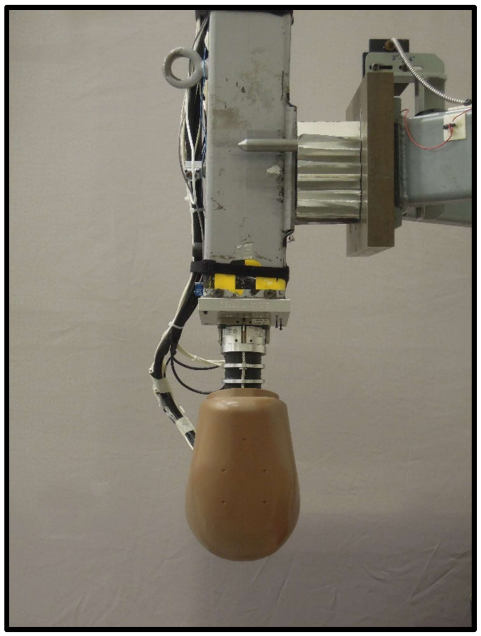
	Rotation (°)	Angular Rate (°/s)	Z-Force (N)	Y-Moment (N·m)
Average	88.62	2409.00	-1417.90	-16.69
StDev	0.84	30.51	4.69	0.49
CV	0.94%	1.27%	0.33%	2.94%

Average	86.31	2392.62	-1597.20	-16.26
StDev	0.89	32.33	22.53	0.58
CV	1.03%	1.35%	1.41%	3.59%

Average	87.99	2454.98	-1642.14	-17.82
StDev	0.80	33.94	9.65	0.61
CV	0.91%	1.38%	0.59%	3.41%

Neck Lateral Bending Test

- **Inputs:** Pendulum impact to 6” aluminum honeycomb at 3.4 m/s
- **Outputs:** Peak head X-rotation
  Peak head angular rate about X-axis
  Peak upper neck X-moment



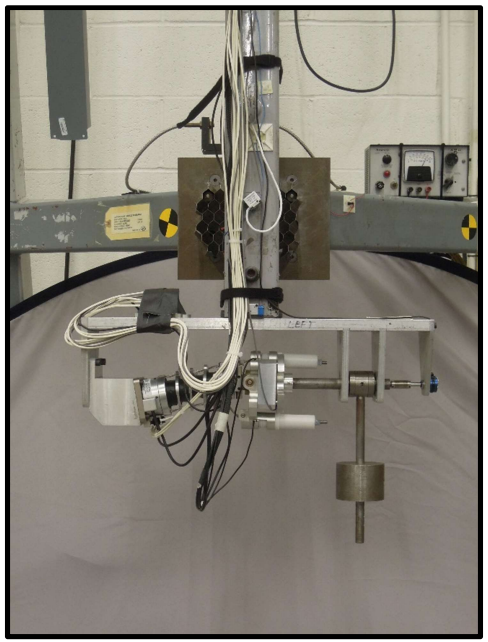
	ATD	Test ID	Rotation (°)	Angular Rate (°/s)	Moment (N·m)
Left	ED7441	181204-2	53.38	1402.58	28.50
		181204-4	53.93	1387.10	27.86
		181204-5	53.66	1362.30	27.61
		181204-7	53.97	1368.53	27.96
		181204-10	53.92	1363.80	27.60
	ED2634	190611-19	49.78	1309.71	29.62
		190611-20	51.36	1313.23	29.14
		190612-1	51.57	1314.57	28.89
		190612-3	52.24	1323.70	28.68
		190612-15	51.58	1319.23	28.58
	ED7448	190906-3	53.23	1354.71	29.16
		190906-5	53.17	1361.51	28.52
		190906-6	53.68	1358.07	28.83
		190906-7	53.71	1374.57	29.09
		190906-8	53.86	1382.14	29.22
Average			**52.87**	**1353.05**	**28.62**
StDev			**1.27**	**29.78**	**0.62**
CV			**2.40%**	**2.20%**	**2.16%**

	ATD	Test ID	Rotation (°)	Angular Rate (°/s)	Moment (N·m)
Right	ED7441	181204-12	53.69	1353.60	28.97
		181204-15	54.03	1355.80	27.86
		181204-19	54.01	1332.94	27.56
		181204-20	54.46	1351.03	27.34
	ED2634	190612-4	50.90	1308.13	28.78
		190612-8	52.35	1315.31	28.52
		190612-9	52.31	1305.69	28.38
		190612-10	52.26	1316.69	28.32
		190612-11	52.05	1316.71	28.82
	ED7448	190906-9	52.60	1363.54	29.55
		190906-10	53.17	1350.61	29.35
		190906-11	52.80	1354.74	28.89
		190906-12	53.08	1356.24	29.20
		190906-13	53.67	1384.19	29.30
Average			**1340.37**	**52.96**	**28.63**
StDev			**24.17**	**0.97**	**0.68**
CV			**1.80%**	**1.82%**	**2.36%**

Left & Right	Average	**52.95**	**1347.06**	**28.60**
	StDev	**1.11**	**27.03**	**0.64**
	CV	**2.10%**	**2.01%**	**2.22%**

Neck Torsion Test

- **Inputs:** Pendulum impact to 6” aluminum honeycomb at 3.4 m/s using the modified THOR-50M torsion fixture
- **Outputs:** Peak head Z-rotation
  Peak head angular rate about Z-axis
  Peak upper neck Z-moment



	ATD	Test ID	Rotation (°)	Angular Rate (°/s)	Moment (N·m)
Left	ED7441	181206-1	51.53	1292.30	20.37
		181206-2	52.31	1241.40	20.04
		181206-3	52.78	1252.50	20.06
		181206-4	52.89	1254.60	19.97
		181206-5	53.01	1267.80	20.00
	ED2634	190612-17	49.40	1209.31	20.72
		190612-19	50.16	1233.16	20.71
		190613-7	50.59	1234.55	20.58
		190613-8	50.62	1250.65	20.61
		190613-10	50.49	1240.10	20.58
	ED7448	190909-3	52.63	1251.83	19.78
		190909-4	53.85	1273.43	19.76
		190909-6	53.01	1267.05	19.77
		190909-7	53.00	1252.70	19.85
		190909-9	52.62	1266.50	19.85
Average			**51.93**	**1252.52**	**20.18**
StDev			**1.34**	**19.84**	**0.37**
CV			**2.58%**	**1.58%**	**1.85%**

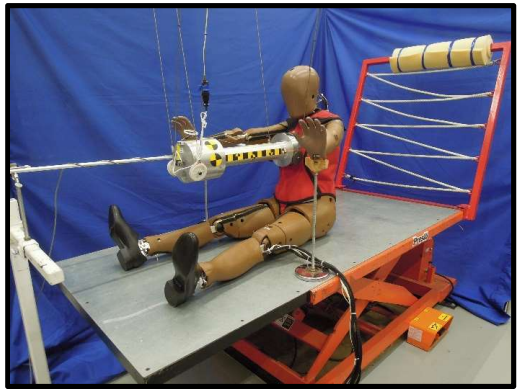
	ATD	Test ID	Rotation (°)	Angular Rate (°/s)	Moment (N·m)
Right	ED7441	181206-8	52.57	1252.60	19.99
		181206-9	52.69	1268.10	19.97
		181207-1	51.91	1250.40	19.92
		181207-2	52.89	1273.10	20.10
		181207-3	52.67	1248.80	19.96
	ED2634	190613-12	50.69	1243.79	20.75
		190613-13	51.03	1240.48	20.79
		190613-14	51.18	1233.16	20.73
		190613-15	51.08	1238.71	20.73
		190613-16	51.11	1232.04	20.60
	ED7448	190909-10	51.66	1254.66	20.03
		190909-11	52.54	1291.80	20.00
		190909-13	52.61	1294.33	19.98
		190909-14	52.95	1278.78	19.86
		190910-1	52.55	1286.74	19.78
Average			**52.01**	**1259.17**	**20.21**
StDev			**0.80**	**21.36**	**0.38**
CV			**1.54%**	**1.70%**	**1.87%**

Left & Right	Average	**51.97**	**1255.85**	**20.19**
	StDev	**1.09**	**20.53**	**0.37**
	CV	**2.09%**	**1.63%**	**1.83%**

Upper Thorax Impact Test

- **Inputs:** 13.97 kg probe at 4.3 m/s
- **Outputs:** Peak probe force
  Peak upper left & right resultant deflections
  Forces at peak upper left & right resultant deflections

- Deflection and force CVs > 5%
- ED2634 has significant L-to-R differences

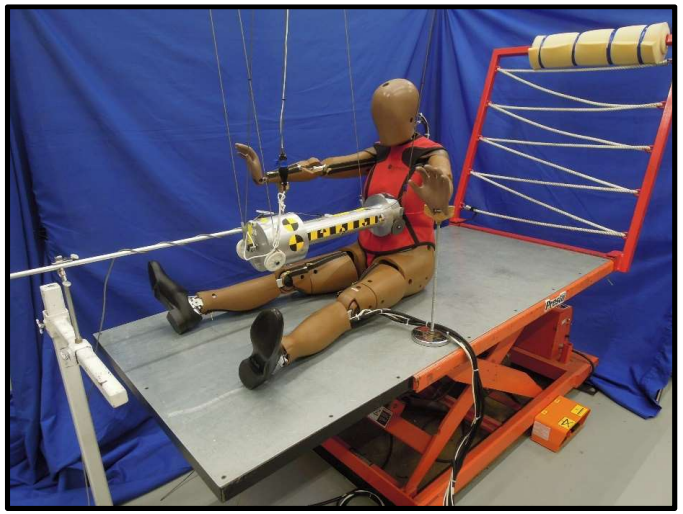


ATD	Test ID	Probe Force (N)	Peak Deflection (mm)		Force at Peak Defl. (N)	
			Left	Right	Left	Right
ED7441	181130-6	2051.50	39.66	44.01	1960.40	2049.60
	181130-7	2048.00	41.16	44.17	2048.00	2021.10
	181130-8	2083.20	40.73	44.74	2020.80	2078.60
	181130-9	2104.10	40.26	45.24	2082.20	2087.70
	181130-10	1874.30	42.33	45.28	1920.50	1970.20
ED2634	190805-1	2186.09	43.59	45.15	2184.70	1588.81
	190805-2	2094.07	43.51	45.87	2089.18	1491.41
	190805-3	1980.52	44.59	46.12	1873.51	1773.16
	190805-4	2099.73	43.56	45.88	2030.80	1658.95
	190805-6	2151.05	41.78	46.21	2136.29	1715.57
ED7448	190930-1	2056.63	46.18	44.18	1903.20	1826.87
	190930-3	1995.73	46.42	44.31	1885.99	1886.99
	190930-4	1993.57	46.27	45.93	1827.14	1872.90
	190930-5	2121.68	45.94	45.89	1950.12	2080.67
	190930-6	1967.61	47.43	44.93	1966.76	1956.27
Average		**2053.85**	**43.56**	**45.19**	**1991.97**	**1870.59**
StDev		**80.51**	**2.52**	**0.78**	**103.46**	**190.89**
CV		**3.92%**	**5.78%**	**1.72%**	**5.19%**	**10.21%**

	Probe Force (N)	Peak Deflection (mm)		Force at Peak Defl. (N)	
		Left	Right	Left	Right
Average	2032.22	40.83	44.69	2006.38	2041.44
StDev	91.28	1.01	0.59	65.53	47.63
CV	4.49%	2.47%	1.32%	3.27%	2.33%
Average	2102.29	43.40	45.85	2062.90	1645.58
StDev	77.94	1.02	0.42	120.22	109.94
CV	3.71%	2.34%	0.91%	5.83%	6.68%
Average	2027.04	46.45	45.05	1906.64	1924.74
StDev	62.18	0.58	0.84	55.37	98.74
CV	3.07%	1.24%	1.87%	2.90%	5.13%

Lower Thorax Impact Test

- **Inputs:** 13.97 kg probe at 4.3 m/s aligned to left & right anterior lower IR-TRACCs
- **Outputs:** Peak probe force
  Deflection at peak force



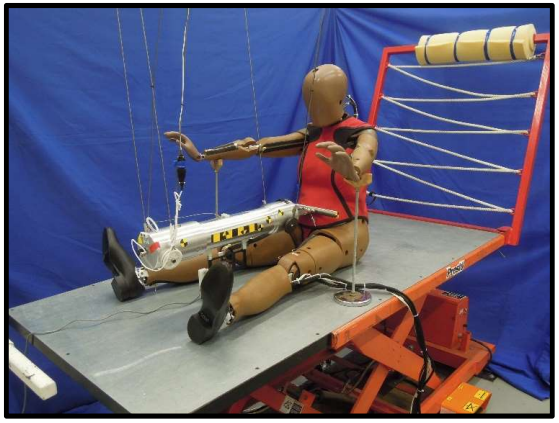
	ATD	Test ID	Probe Force (N)	Defl. at Peak Force (mm)
Left	ED7441	181129-8	2075.60	43.83
		181129-9	2063.20	44.95
		181129-10	2091.70	44.39
		181129-11	2018.80	43.09
		181129-12	2052.73	44.25
	ED2634	190806-1	2086.83	45.73
		190806-2	2085.07	45.68
		190806-3	2123.44	46.31
		190806-4	2048.94	46.07
		190806-5	2070.84	46.68
	ED7448	191002-2	2169.25	43.17
		191002-3	2117.59	44.59
		191002-10	2110.57	44.80
		191002-11	2100.93	43.66
		191002-12	2073.07	44.88
Average			**2085.90**	**44.81**
StDev			**36.07**	**1.12**
CV			**1.73%**	**2.49%**

	ATD	Test ID	Probe Force (N)	Defl. at Peak Force (mm)
Right	ED7441	181130-1	2142.10	44.68
		181130-2	2057.50	44.64
		181130-3	2080.10	44.33
		181130-4	2072.70	44.54
		181130-5	2080.70	45.32
	ED2634	190806-7	2076.78	47.85
		190806-12	2109.33	49.26
		190807-2	2091.16	50.47
		190807-5	2140.36	48.42
		190807-7	2125.15	49.50
	ED7448	191003-1	2114.12	46.38
		191003-2	2098.37	46.61
		191003-5	2096.99	46.31
		191003-10	2097.18	46.89
		191003-11	2117.97	47.54
Average			**2100.03**	**46.85**
StDev			**24.79**	**1.97**
CV			**1.18%**	**4.20%**

		Probe Force (N)	Defl. at Peak Force (mm)
Left & Right	Average	**2092.97**	**45.83**
	StDev	**31.24**	**1.88**
	CV	**1.49%**	**4.11%**

Lower Abdomen Impact Test

- **Inputs:** 16.0 kg bar probe at 6.0 m/s
- **Outputs:** Peak probe force
  Peak left and right abdomen pressure



ATD	Test	Probe Force (N)	Pressure (kPa) Left	Right	L-R
ED7441	181128-1	4149.70	199.16	180.28	18.88
	181128-2	4120.00	185.10	197.65	-12.55
	181128-3	4009.71	185.11	184.19	0.92
	181128-4	4243.54	197.58	177.75	19.83
	181128-5	4126.77	194.82	182.64	12.18
ED2634	190807-18	4329.42	163.91	169.94	-6.03
	190808-6	4361.92	159.66	165.39	-5.74
	190808-10	4484.71	157.21	167.67	-10.46
	190812-3	4484.14	159.99	162.69	-2.70
	190812-4	4582.04	154.33	164.03	-9.70
ED7448	190926-3	5589.64	158.88	167.43	-8.56
	190926-4	5480.73	153.97	164.22	-10.25
	190927-1	5664.52	151.77	166.68	-14.91
	190927-2	5361.29	154.61	167.42	-12.81
	190927-3	5313.08	154.63	166.61	-11.99
Average		4686.75	168.71	172.31	-3.59
StDev		606.69	17.92	9.99	11.50
CV		12.94%	10.62%	5.80%	

	Probe Force (N)	Pressure (kPa) Left	Right	L-R
Average	4129.94	192.35	184.50	12.97
StDev	83.46	6.80	7.74	7.63
CV	2.02%	3.53%	4.20%	

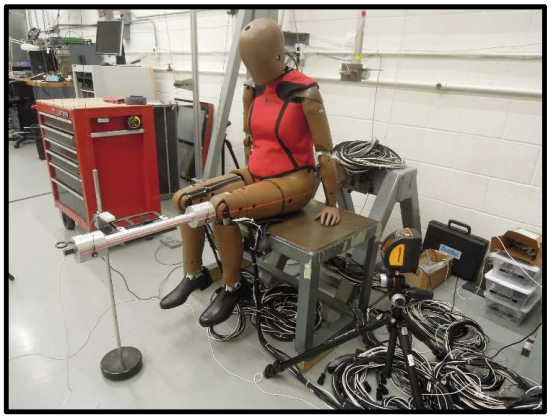
Average	4448.44	159.02	165.94	-6.93
StDev	102.58	3.56	2.89	3.17
CV	2.31%	2.24%	1.74%	

Average	5481.85	154.77	166.47	-11.70
StDev	148.33	2.58	1.32	2.43
CV	2.71%	1.66%	0.79%	

- Force & pressure CVs > 5%
- Maybe due to part differences in the abdomen

Upper Leg Impact Test

- **Inputs:** 2.99 kg probe at 2.6 m/s
- **Outputs:** Peak probe force
  Peak femur Z-force
  Peak resultant acetabulum force



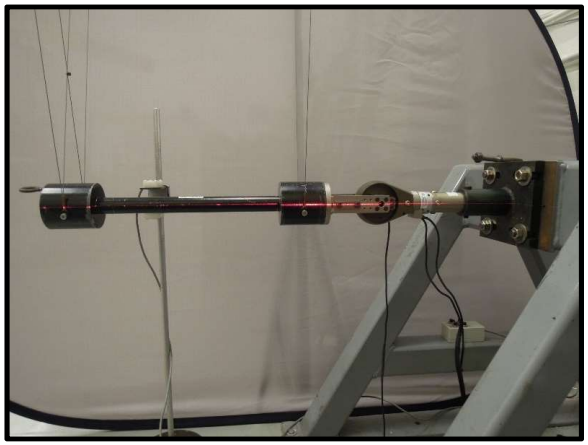
	ATD	Test ID	Probe Force (N)	Femur Z-Force (N)	Res. Acetab. Force (N)
Left	ED7441	190220-5	3801.42	-2136.30	816.74
		190220-7	3783.85	-2104.20	812.54
		190220-8	3775.25	-2110.64	833.82
		190220-9	3808.81	-2137.30	783.43
		190220-10	3775.16	-2114.93	782.30
	ED2634	190814-3	3767.98	-2290.77	1048.65
		190814-6	3827.02	-2349.10	1051.93
		190814-7	3871.51	-2358.47	1040.51
		190814-9	3884.61	-2364.07	968.09
		190814-10	3852.85	-2354.21	1005.32
	ED7448	191101-1	3657.69	-2135.33	759.79
		191101-2	3586.41	-2172.10	858.98
		191101-3	3568.22	-2178.29	964.84
		191101-4	3579.48	-2195.29	1013.74
		191101-5	3594.89	-2191.20	1044.80
Average			**3742.34**	**-2212.81**	**919.03**
StDev			**113.02**	**100.62**	**113.73**
CV			**3.02%**	**4.55%**	**12.37%**

	ATD	Test ID	Probe Force (N)	Femur Z-Force (N)	Res. Acetab. Force (N)
Right	ED7441	190220-11	3461.70	-1948.90	830.99
		190221-1	3423.00	-1915.58	748.83
		190221-2	3439.92	-1922.23	786.80
		190221-3	3428.38	-1912.98	853.22
		190221-4	3476.28	-1931.25	742.65
	ED2634	190815-2	3481.85	-2173.69	1043.92
		190815-4	3501.90	-2200.63	1046.40
		190815-7	3498.29	-2208.59	964.64
		190815-8	3520.92	-2213.64	1056.58
		190815-10	3537.40	-2235.50	1172.92
	ED7448	191101-6	3598.14	-2135.81	1075.25
		191101-7	3695.41	-2215.37	1086.45
		191101-8	3671.03	-2188.60	1143.39
		191101-9	3683.50	-2199.37	1124.12
		191101-10	3677.82	-2197.46	1137.40
Average			**3539.70**	**-2106.64**	**987.57**
StDev			**99.13**	**134.08**	**153.29**
CV			**2.80%**	**6.36%**	**15.52%**

Left & Right	Average	**3641.02**	**-2159.73**	**953.30**
	StDev	**146.73**	**128.38**	**137.12**
	CV	**4.03%**	**5.94%**	**14.38%**

Knee Slider Impact Test

- **Inputs:** 7.26 kg probe at 2.15 m/s
- **Outputs:** Peak femur Z-force
  Deflection at peak femur Z-Force



Left

ATD	Test ID	Peak Z-Force (N)	Defl. at Peak Force (mm)
ED7441	190212-7	-3836.19	14.01
	190212-8	-4193.23	14.21
	190212-9	-4378.93	14.19
	190212-11	-4385.78	14.28
	190212-12	-4384.26	14.27
ED2634	190815-14	-3670.57	13.95
	190815-19	-4217.70	14.09
	190815-21	-4277.36	14.15
	190815-22	-4260.80	14.21
	190815-24	-4265.84	14.23
ED7448	191104-1	-3549.70	13.92
	191104-2	-4141.52	14.30
	191104-3	-4368.39	14.42
	191104-4	-4333.07	14.48
	191104-5	-4371.97	14.47
Average		**-4175.69**	**14.21**
StDev		**270.00**	**0.17**
CV		**6.47%**	**1.22%**

Right

ATD	Test ID	Peak Z-Force (N)	Defl. at Peak Force (mm)
ED7441	190212-1	-3460.26	13.86
	190212-2	-4085.19	14.13
	190212-4	-4150.44	14.16
	190212-5	-4260.92	14.23
	190212-6	-3984.08	14.21
ED2634	190820-2	-3920.76	14.09
	190820-4	-3992.56	14.20
	190820-6	-4202.54	14.30
	190820-8	-4158.13	14.35
	190820-10	-4198.33	14.36
ED7448	191105-2	-3903.43	13.67
	191105-3	-4008.91	13.79
	191105-4	-4030.92	13.85
	191105-5	-3943.14	13.83
	191105-6	-3986.49	13.91
Average		**-4019.07**	**14.06**
StDev		**190.78**	**0.22**
CV		**4.75%**	**1.60%**

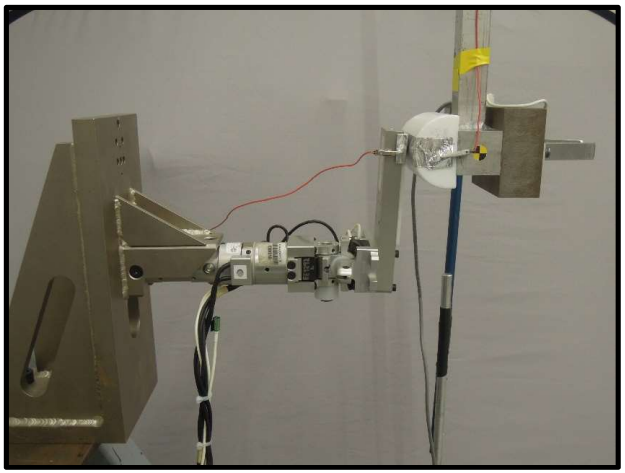
Left & Right

	Peak Z-Force (N)	Defl. at Peak Force (mm)
Average	**-4097.38**	**14.14**
StDev	**243.12**	**0.21**
CV	**5.03%**	**1.49%**

- Force CV > 5%
- Continue to monitor

Ankle Inversion Test

- **Inputs:** 3.00 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force
  Peak ankle X-moment
  Peak ankle X-rotation



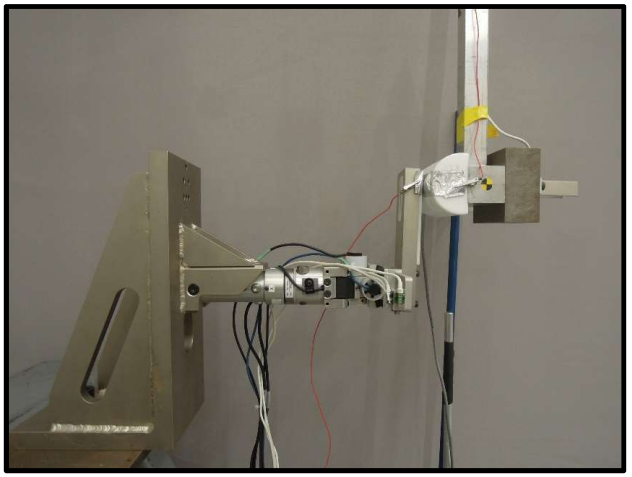
Left	ATD	Test ID	Force (N)	Moment (N·m)	Rotation (°)
	ED7441	190214-10	-310.27	28.83	47.70
		190214-11	-314.66	30.96	48.13
		190214-12	-317.76	31.06	48.37
		190214-13	-306.34	30.94	48.46
		190214-14	-316.61	31.11	48.59
	ED2634	190701-13	-266.85	30.60	46.25
		190701-14	-272.38	31.32	46.61
		190701-15	-272.87	31.26	46.74
		190701-16	-274.73	31.69	46.84
		190701-17	-271.63	31.89	46.91
	ED7448	191105-7	-237.12	26.49	46.17
		191105-8	-255.99	30.08	47.08
		191105-9	-267.65	32.01	47.51
		191105-10	-268.86	31.82	47.61
		191106-1	-264.88	31.42	47.54
Average			**-261.62**	**30.77**	**47.37**
StDev			**10.84**	**1.43**	**0.79**
CV			**4.14%**	**4.64%**	**1.66%**

Right	ATD	Test ID	Force (N)	Moment (N·m)	Rotation (°)
	ED7441	190130-5	-277.56	30.07	46.53
		190130-6	-294.35	32.73	47.20
		190130-7	-293.26	33.01	47.42
		190130-8	-290.90	32.78	47.50
		190130-9	-298.38	32.85	47.60
	ED2634	190618-15	-262.83	31.03	47.48
		190618-17	-274.91	32.76	48.04
		190618-18	-276.68	33.13	48.17
		190618-19	-279.36	33.26	48.20
		190618-20	-274.99	33.00	48.25
	ED7448	200107-2	-239.04	27.82	45.17
		200107-3	-260.90	31.09	46.19
		200107-4	-265.10	31.79	46.48
		200107-5	-259.61	32.02	46.53
		200107-6	-260.18	32.28	46.59
Average			**-273.87**	**31.97**	**47.16**
StDev			**16.28**	**1.47**	**0.89**
CV			**5.94%**	**4.61%**	**1.88%**

Left & Right	Stat	Force (N)	Moment (N·m)	Rotation (°)
	Average	**-267.74**	**31.37**	**47.26**
	StDev	**14.95**	**1.55**	**0.83**
	CV	**5.08%**	**4.95%**	**1.76%**

Ankle Eversion Test

- **Inputs:** 3.00 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force
  Peak ankle X-moment
  Peak ankle X-rotation



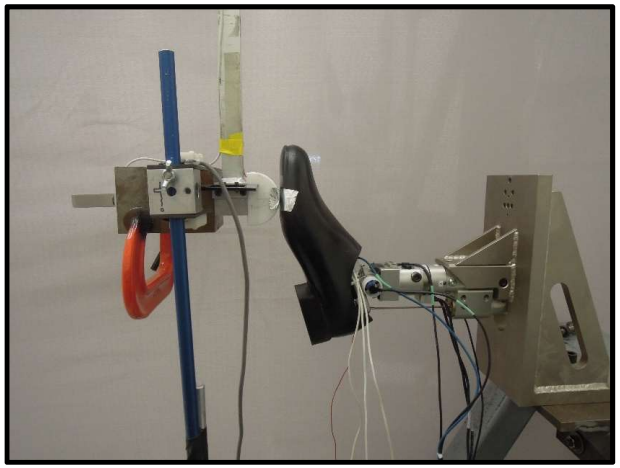
	ATD	Test ID	Force (N)	Moment (N·m)	Rotation (°)
Left	ED7441	190214-5	-291.52	28.39	33.05
		190214-6	-307.09	29.18	33.57
		190214-7	-333.73	29.46	33.62
		190214-8	-327.62	29.69	33.88
		190214-9	-330.10	29.73	33.86
	ED2634	190701-19	-302.56	29.22	32.32
		190701-20	-321.28	31.12	32.85
		190701-22	-318.34	31.29	32.97
		190701-23	-324.89	31.33	33.12
		190708-2	-310.36	29.37	32.94
	ED7448	191106-2	-311.60	30.96	31.98
		191106-3	-302.55	29.97	31.93
		191106-4	-302.93	30.04	31.98
		191106-5	-310.19	30.07	32.22
		191106-6	-308.05	30.22	32.27
Average			**-313.52**	**30.00**	**32.84**
StDev			**12.03**	**0.86**	**0.69**
CV			**3.84%**	**2.87%**	**2.11%**

	ATD	Test ID	Force (N)	Moment (N·m)	Rotation (°)
Right	ED7441	190129-6	-329.75	30.66	32.94
		190130-1	-328.26	30.67	33.05
		190130-2	-333.43	31.28	33.23
		190130-3	-330.26	30.87	33.22
		190130-4	-331.95	31.21	33.34
	ED2634	190619-2	-294.74	28.71	31.97
		190619-4	-318.98	30.74	32.44
		190619-5	-313.11	30.49	32.56
		190619-6	-310.14	30.52	32.61
		190619-8	-313.52	30.80	32.62
	ED7448	200107-12	-291.89	28.24	-32.41
		200107-13	-312.57	30.63	-33.06
		200107-14	-320.03	31.08	-33.21
		200107-15	-315.95	31.64	-33.28
		200107-16	-314.03	31.54	-33.33
Average			**-317.24**	**30.61**	**-32.88**
StDev			**12.54**	**0.94**	**0.42**
CV			**3.95%**	**3.06%**	**1.28%**

	Stat	Force (N)	Moment (N·m)	Rotation (°)
Left & Right	Average	**-315.38**	**30.30**	**32.86**
	StDev	**12.22**	**0.94**	**0.56**
	CV	**3.88%**	**3.09%**	**1.71%**

Ball of Foot Test

- **Inputs:** 7.45 kg probe at 2.00 m/s
- **Outputs:** Peak lower tibia Z-force after 10ms
  Peak ankle Y-moment
  Peak ankle Y-rotation



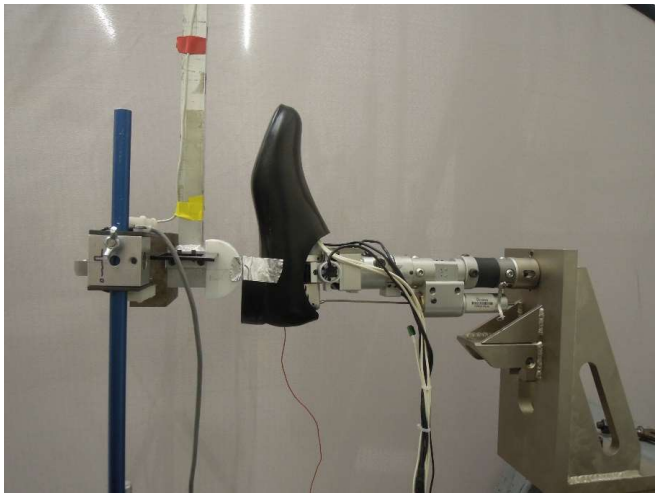
	ATD	Test ID	Force (N)	Moment (N·m)	Rotation (°)
Left	ED7441	191113-11	-980.10	46.19	-28.50
		191113-12	-1014.97	47.90	-28.89
		191113-13	-987.46	46.64	-28.85
		191113-14	-998.14	46.38	-28.92
		191113-15	-910.98	42.95	-28.47
	ED2634	190828-3	-1000.09	49.47	-30.30
		190828-4	-1000.34	49.03	-30.30
		190828-5	-1006.74	49.58	-30.30
		190828-6	-1003.14	49.49	-30.34
		190828-8	-1013.96	50.05	-30.37
	ED7448	191106-13	-1120.16	57.49	-31.16
		191107-1	-1103.32	55.30	-31.10
		191107-2	-1068.16	51.82	-30.92
		191107-3	-1064.44	51.95	-30.90
		191107-4	-1061.84	51.16	-30.90
Average			**-1022.26**	**49.69**	**-30.01**
StDev			**52.96**	**3.64**	**0.99**
CV			**5.18%**	**7.33%**	**3.31%**

	ATD	Test ID	Force (N)	Moment (N·m)	Rotation (°)
Right	ED7441	191115-3	-725.50	27.90	-31.09
		191115-4	-886.22	39.17	-31.57
		191115-5	-884.06	39.32	-31.74
		191115-6	-883.87	39.37	-31.78
		191115-7	-885.22	38.52	-31.75
	ED2634	190626-3	-841.30	46.30	-30.70
		190626-4	-847.30	46.90	-31.20
		190626-6	-890.60	50.20	-31.50
		190626-8	-887.40	50.20	-31.50
		190626-9	-885.80	49.80	-31.50
	ED7448	200108-11	-1016.22	48.42	-27.86
		200108-12	-1053.18	53.26	-28.79
		200108-13	-1032.11	52.04	-28.82
		200108-14	-1020.48	52.15	-28.89
		200108-15	-1011.92	50.96	-28.86
Average			**-916.75**	**45.63**	**-30.50**
StDev			**90.75**	**7.20**	**1.41**
CV			**9.90%**	**15.77%**	**4.61%**

Left & Right	Stat	Force (N)	Moment (N·m)	Rotation (°)
	Average	**-969.50**	**47.66**	**-30.26**
	StDev	**90.60**	**5.97**	**1.22**
	CV	**9.35%**	**12.53%**	**4.04%**

Heel of Foot Test

- **Inputs:** 3.00 kg probe at 4.00 m/s
- **Outputs:** Peak lower tibia Z-force



	ATD	Test ID	Force (N)
Left	ED7441	190219-9	-1940.69
		190219-10	-1968.42
		190219-11	-1961.92
		190219-12	-1953.92
		190219-13	-1911.48
	ED2634	190828-11	-2080.80
		190828-12	-2021.21
		190828-13	-2048.05
		190828-14	-1999.89
		190828-16	-2003.16
	ED7448	191107-6	-2063.71
		191107-7	-2081.53
		191107-8	-2087.61
		191107-9	-2030.05
		191107-10	-1980.83
Average			**-2008.89**
StDev			**55.86**
CV			**2.78%**

	ATD	Test ID	Force (N)
Left	ED7441	190131-6	-2182.04
		190131-7	-2221.12
		190204-1	-1910.27
		190204-2	-1890.88
		190204-3	-1867.56
	ED2634	190619-9	-2073.27
		190619-11	-2060.93
		190619-14	-2000.97
		190619-15	-2019.46
		190619-16	-2001.01
	ED7448	200108-4	-1935.08
		200108-5	-1932.04
		200108-6	-1887.49
		200108-7	-1963.34
		200108-8	-1929.92
Average			**-1991.69**
StDev			**105.46**
CV			**5.29%**

	Stat	Force (N)
Left & Right	Average	**-2000.29**
	StDev	**83.38**
	CV	**4.17%**