

REPORT NUMBER: R&D-CAL-14-007

**MOVING BARRIER TO VEHICLE CRASH TEST IN SUPPORT OF NHTSA'S
FRONTAL OBLIQUE OFFSET PROGRAM
RESEARCH MOVING DEFORMABLE BARRIER INTO LEFT FRONT OF A**

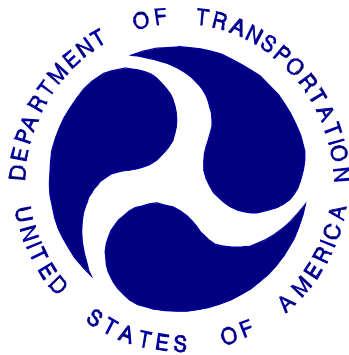
2013 Hyundai Elantra

90.1KPH, 15 DEGREE ANGLE, 35% OVERLAP

TEST DATE: 07/15/2014

NHTSA No: RD0529

**CALSPAN CORPORATION
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February 20, 2015

PREPARED FOR:

**U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Vehicle safety Research
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STRUCTURAL AND RESTRAINTS RESEARCH DIVISION:

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16. Abstract A test was conducted in accordance with Task Order 0002 of Contract DTNH22-10-D-00155. The Test consisted of a Research Moving Deformable Barrier (RMDB) traveling at a target speed of 90.12 kph into a stationary 2013 Hyundai Elantra four door sedan. The struck vehicle was positioned 15 degrees relative to the moving barrier and impacted 35% of the left side of the vehicle. The test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The test was conducted at the Calspan Corporation's Transportation Test Operation's facility in Buffalo, New York on July 15, 2014. The RMDB impact velocity was 89.89 kph and the ambient temperature at the test vehicle at the time of impact was 21°C. The target vehicle post-test maximum crush was 434 mm. The test vehicle's performance was as follows: <table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD</th> <th colspan="2">Pass. ATD</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>700</td> <td>250.17</td> <td>700</td> <td>249.37</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>-60.63</td> <td>63</td> <td>-41.50</td> </tr> <tr> <td>Neck Injury Criteria (Nij)</td> <td>N/A</td> <td>1</td> <td>0.36</td> <td>1</td> <td>0.28</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4,170</td> <td>1907.33</td> <td>4,170</td> <td>1378.09</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4,000</td> <td>-310.04</td> <td>4,000</td> <td>-102.98</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10,008</td> <td>-4391.95</td> <td>10,008</td> <td>-4635.36</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10,008</td> <td>-8116.91</td> <td>10,008</td> <td>-969.61</td> </tr> </tbody> </table>					Measurement Description	Units	Driver ATD		Pass. ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)	N/A	700	250.17	700	249.37	Maximum Chest Compression	mm	63	-60.63	63	-41.50	Neck Injury Criteria (Nij)	N/A	1	0.36	1	0.28	Neck Tension	N	4,170	1907.33	4,170	1378.09	Neck Compression	N	4,000	-310.04	4,000	-102.98	Left Femur Force	N	10,008	-4391.95	10,008	-4635.36	Right Femur Force	N	10,008	-8116.91	10,008	-969.61
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DISCLAIMER

The contents of this report relate only to the specific product evaluated under the specific test conditions, as defined within this report. The findings and conclusions are those of the author(s) and not necessarily those of Calspan Corporation. For the purposes of this report, Calspan Corporation provided test services only and was not involved with the consulting, design or manufacture of any product. Calspan Corporation does not endorse products or manufacturers. Further, Calspan Corporation (to include: any of its affiliates, parent companies or subsidiaries) assumes no liability associated with the contents of this report or the use of this report.

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TABLE OF CONTENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

<u>Section</u>	<u>Page No.</u>
1 Purpose of Test	1-1
2 Summary of Test	2-1
Crash Vehicle Summary	2-3
Preliminary Injury Summary: Driver	2-4
Preliminary Injury Summary: Driver Legs	2-6
Preliminary Injury Summary: Front Right Passenger	2-7
Preliminary Injury Summary: Front Right Passenger Legs	2-9
3 Data Sheets	3-1

<u>Data Sheet No.</u>	<u>Page No.</u>
1 General Test and Vehicle Parameter Data	3-2
2 Seat Adjustment, Fuel System, and Steering Wheel	3-6
3 Dummy Longitudinal Clearance Dimensions	3-8
4 Dummy Lateral Clearance Dimensions	3-10
5 Seat Belt Positioning Data	3-11
6 High-Speed Camera Locations and Data	3-12
7 Vehicle Instrumentation Data	3-15
8 Photographic Reference Target Locations	3-18
9 Test Vehicle Summary of Results	3-25
10 Post-Test Observations	3-26
11 Vehicle Profile Measurements	3-27
12 Accident Investigation Division Data	3-29
13 Vehicle Intrusion Measurements	3-30
14 RMDB Crush Measurements	3-47
15 Summary of FMVSS 212, 219 (Partial), and 301 Data	3-48
Windshield Periphery Measurements	3-48
Areas of Protected Zone Failures	3-48
Fuel System Integrity Post Impact Data	3-49
16 FMVSS 301 Static Rollover Results	3-50
17 Dummy / Vehicle Temperature Stabilization	3-51

<u>Appendix</u>	<u>Page No.</u>
A Photographs	A-1
B Vehicle & Dummy Response Data Traces	B-1
C Part 572 E/O Dummy Calibration and Performance Verification Data Sheets	C-1
D CMM Measurement Procedures	D-1

SECTION 1
PURPOSE OF TEST

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

This 90.12 kph (56 mph) Moving Barrier into a test vehicle is part of the Frontal Offset Test outlined in Contract No. DTNH22-10-D-00155, Task Order 0002. The purpose of this test is to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

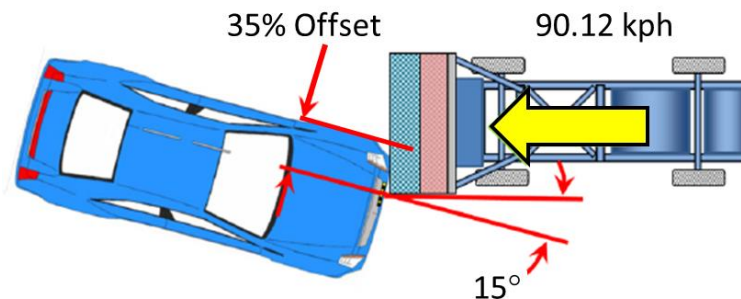
This test was conducted in accordance with the instructions set forth for a 15° angle, 35% offset moving barrier to vehicle impact, outlined in Contract No. DTNH22-10-D-00155, TO 0002. Data was obtained indicant of Federal Motor Vehicle Safety Standard FMVSS 208-Occupant Crash Protection, FMVSS 212 – Windshield Mounting, FMVSS 219 (partial) – Windshield Zone Intrusion, and FMVSS 301 – Fuel System Integrity, in addition to the requirements of Contract No. DTNH22-10-D-00155, TO 0002.

SECTION 2 SUMMARY OF TEST

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

A 2013 Hyundai Elantra four door sedan was impacted on the left front corner by a research moving deformable barrier (RMDB). This test vehicle was stationary and positioned at a target angle of 15° and at a target offset of 35% to the forward line of motion of the RMDB. The RMDB was towed down the test track in a full forward direction, without any crabbing, and at the targeted impact velocity of 90.12 kph (56.0 mph) into the test vehicle. The test vehicle's mass was 1,545.5 kg (3,406.3 lbs), and the RMDB's mass was 2490.2 kg (5490 lbs). The test was conducted by Calspan Corporation on July 15, 2014.



The test was documented by two (2) real time and fourteen (14) high-speed video cameras. Camera locations and other pertinent data are located in Data Sheet No. 6 of this report. Pre and post – test photographs of the test vehicle, RMDB, and test setup were taken using a digital still camera. Photographic documentation of the test is presented in Appendix A of this report.

One 50% adult male THOR-NT anthropomorphic test device (ATD) (Serial No. 015) was seated in the left, front (P1 -Driver's) seating position and one 50% adult male THOR-NT adult male ATD (Serial No. 016) was seated in the right front passenger seating position (P2). The driver and passenger were positioned according to instructions specified in laboratory test procedures FMVSS 208-14, "Occupant Crash Protection", TP208-14, July 27, 2006.

The driver was restrained with a 3 – point seat belt, a frontal, curtain, and torso airbags. The passenger was restrained with a 3 – point seat belt, and frontal airbag. The passenger's curtain and torso airbags were disabled.

SECTION 2 (CONTINUED)

SUMMARY OF TEST

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

Two hundred and thirty eight (238) channels of data from the two ATD's, test vehicle and RMDB were collected using Kayser – Threde and DTS data acquisition systems. Appendix B contains dummy data plots, as well as vehicle and RMDB response data plots.

There was 79.8% total windshield retention, with 59.7% and 100% retention on the left and right sides, respectively. There appeared to be no intrusion into the protected zone of the windshield during any portion of the impact event. The maximum static crush of the vehicle was 352 mm at C2 to the left of the vehicle's centerline. The maximum crush of the structural bumper beam was 434 mm at B2, to the left of the vehicle's centerline. Full vehicle measurements are presented in Section 3 of this report.

All four vehicle doors remained closed and latched during the test. All doors remained operational after the impact event.

Structure observations include the following:

- A-Pillar buckled during impact
- Windshield had cracks throughout with some separation
- Hood bent inwards and exposed part of the engine compartment

The driver ATD's visible contact points were:

- Head contacted the frontal and curtain airbag, side headliner and visor
- Torso contacted the frontal airbag, torso airbag, seatback, and driver's shoulder contacted the side door
- Knees contacted the knee bolster, and outside leg contacted the driver's door

The right front passenger ATD's visible contact points were:

- Head contacted the frontal airbag, visor, and head liner
- Torso contacted the frontal airbag
- Knees contacted the glove box

SECTION 2 (CONTINUED) CRASH VEHICLE SUMMARY

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

Primary Impact Data

Measured Parameter	Units	Value
RMDB Velocity at Impact	kph	89.89
RMDB Test Weight	kg	2490.2
RMDB Maximum Static Crush	mm	299
Vehicle Test Weight	kg	1545.5
Actual Vehicle Angle	degrees	15
Vehicle Maximum Static Crush	mm	434
Vertical Offset from Target Point (+ down / - up)*	mm	-22
Lateral Offset from Target Point (+ left / - right)*	mm	+8
Number of Data Channels		238
Number of Real-Time Cameras		2
Number of High-Speed Cameras		14

*Offsets are in relation to the vehicle coordinate system.

Dummy Contacts

	Driver	Picture Ref.	Passenger	Picture Ref.
Dummy Type	THOR, S/N: 015		THOR, S/N: 016	
Head Contact	Front & Curtain Airbags, Side Headliner, & Visor	A49-A51	Front Airbag, Visor, and Side Headliver	A70-A72
Left Shoulder Contact	Driver's Door	N/A	None	N/A
Upper Torso Contact	Front & Torso Airbag, and Seatback	N/A	Front Airbag	N/A
Lower Torso Contact	None	N/A	None	N/A
Left Knee Contact	Knee Bolster	A28	Glove Box	A52
Left Outside Leg Contact	Driver's Door	N/A	N/A	N/A
Right Knee Contact	Knee Bolster	A28	Glove Box	A52

Data Anamolies:

- Passenger Lower Neck Y Force, Questionable data after 36 ms

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2013 Hyundai Elantra NHTSA No.: RD0529
Test Program: Research and Development Left Oblique Offset Test Date: 7/15/2014

Driver: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head CG X	g	1000	13.35	-60.67
	Head CG Y	g	1000	29.48	-8.06
	Head CG Z	g	1000	37.15	-16.55
	Head Resultant	g	Compute	61.48	
	36 ms HIC		Compute	401.41	
	15 ms HIC		Compute	250.17	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	51.41	
	Head Rotational Velocity X	deg/s	60	1221.11	-167.35
	Head Rotational Velocity Y	deg/s	60	1013.66	-2661.67
	Head Rotational Velocity Z	deg/s	60	963.56	-892.49
	Head Rotational Velocity Resultant	deg/s	Compute	2806.23	
	Brain Injury Criteria		Compute	0.97	
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	224.04	-820.72
	UNLC Neck System Tension, FZ	N	1000	1907.33	
	UNLC Neck System Compression, FZ	N	1000		-310.04
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	1.25	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-35.25
	NIJ		Compute	0.36	
	On head acting through total neck section, FX	N	Thortest	106.80	-653.13
	On head acting through total neck section, FY	N	Thortest	72.28	-239.90
	On head acting through total neck section, FZ	N	Thortest	2096.67	-69.55
	On head acting through total neck section, MX	N-m	Thortest	14.66	-31.93
	On head acting through total neck section, MY	N-m	Thortest	43.18	-50.19
	On head acting through total neck section, MZ	N-m	Thortest	21.15	-6.77
	On head acting through O.C. joint only, FX	N	Thortest	163.91	-840.54
	On head acting through O.C. joint only, FZ	N	Thortest	1919.62	-352.92
	On head acting through O.C. joint only, MY	N-m	Thortest	1.25	-35.25
Chest	Upper Left IR-TRACC X - deflection	mm	Thortest	0.05	-40.28
	Upper Left IR-TRACC Y - deflection	mm	Thortest	9.52	-4.11
	Upper Left IR-TRACC Z - deflection	mm	Thortest	19.35	-18.70
	Upper Left IR-TRACC D - deflection	mm	Thortest	0.06	-39.27
	Upper Right IR-TRACC X - deflection	mm	Thortest	1.13	-49.46
	Upper Right IR-TRACC Y - deflection	mm	Thortest	8.26	-2.30
	Upper Right IR-TRACC Z - deflection	mm	Thortest	18.03	-15.30
	Upper Right IR-TRACC D - deflection	mm	Thortest	0.64	-48.17
	Lower Left IR-TRACC X - deflection	mm	Thortest	2.78	-11.09
	Lower Left IR-TRACC Y - deflection	mm	Thortest	7.85	-5.53

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2013 Hyundai Elantra NHTSA No.: RD0529

Test Program: Research and Development Left Oblique Offset Test Date: 7/15/2014

Driver: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left IR-TRACC Z - deflection	mm	Thortest	16.58	-1.63
	Lower Left IR-TRACC D - deflection	mm	Thortest	2.82	-11.51
	Lower Right IR-TRACC X - deflection	mm	Thortest	0.46	-53.92
	Lower Right IR-TRACC Y - deflection	mm	Thortest	0.42	-9.21
	Lower Right IR-TRACC Z - deflection	mm	Thortest	13.88	-6.41
	Lower Right IR-TRACC D - deflection	mm	Thortest	0.44	-51.54
	Chest CG Acceleration, 3 ms clip	g	Compute	45.76	
Abdomen	Lower Left IR-TRACC X - deflection	mm	Thortest	0.07	-53.65
	Lower Left IR-TRACC Y - deflection	mm	Thortest	0.05	-11.48
	Lower Left IR-TRACC Z - deflection	mm	Thortest	20.21	-1.86
	Lower Left IR-TRACC D - deflection	mm	Thortest	0.07	-54.35
	Left Viscous Criterion Based on X - deflection		Compute	0.46	
	Lower Right IR-TRACC X - deflection	mm	Thortest	9.92	-63.01
	Lower Right IR-TRACC Y - deflection	mm	Thortest	8.21	-11.23
	Lower Right IR-TRACC Z - deflection	mm	Thortest	24.25	-1.04
	Lower Right IR-TRACC D - deflection	mm	Thortest	9.70	-64.13
	Right Viscous Criterion Based on X - deflection		Compute	0.33	
Spine	Upper Spine (T1) AX	g	180	11.49	-61.40
	Upper Spine (T1) AY	g	180	33.67	-21.88
	Upper Spine (T1) AZ	g	180	37.46	-9.55
	Upper Spine (T1) Resultant	g	Compute	65.05	
	Middle Spine (T6) AX	g	180	10.32	-47.20
	Middle Spine (T6) AY	g	180	26.06	-3.84
	Middle Spine (T6) AZ	g	180	10.94	-10.40
	Middle Spine (T6) Resultant	g	Compute	48.39	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	91.02	
Acetabulum	Left FX force	N	600	1083.49	-1474.47
	Left FY force	N	600	517.03	-1002.69
	Left FZ force	N	600	1357.87	-974.18
	Left Acetabulum Resultant	N	Compute	1561.57	
	Right FX force	N	600	1113.48	-2867.79
	Right FY force	N	600	276.35	-2201.68
	Right FZ force	N	600	1765.45	-572.02
	Right Acetabulum Resultant	N	Compute	3518.07	
Anomalies					
None					

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver Legs

Test Vehicle: 2013 Hyundai Elantra NHTSA No.: RD0529
Test Program: Research and Development Left Oblique Offset Test Date: 7/15/2014

Driver: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	1.66	-12.11
	Right Knee Displacement, DX	mm	180	1.64	-14.99
Femur	Left Femur Force, FZ	N	600	839.85	-4391.95
	Left Femur Moment, MX	N-m	600	21.43	-223.34
	Left Femur Moment, MY	N-m	600	92.33	-137.48
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	225.41	
	Right Femur Force, FZ	N	600	316.41	-8116.91
	Right Femur Moment, MX	N-m	600	80.86	-136.00
	Right Femur Moment, MY	N-m	600	133.86	-36.44
	Right Femur Res (MX / MY only, not MZ)	N-m	Compute	151.80	
	Left Upper Tibia, FZ	N	600	17.85	-2083.72
	Left Upper Tibia, MY	N-m	600	66.06	-82.02
Tibia	Left Upper Tibia, Index		Compute	0.81	
	Right Upper Tibia, FZ	N	600	54.80	-2390.19
	Right Upper Tibia, MY	N-m	600	128.11	-46.25
	Right Upper Tibia, Index		Compute	0.84	
	Left Lower Tibia, FZ	N	600	165.94	-5079.95
	Left Lower Tibia, MY	N-m	600	104.33	-77.12
	Left Lower Tibia, Index		Compute	1.01	
	Right Lower Tibia, FZ	N	600	41.08	-3574.41
	Right Lower Tibia, MY	N-m	600	84.12	-77.11
	Right Lower Tibia, Index		Compute	0.90	
Ankle	Left Ankle Rotation, RX	Deg	180	23.62	-18.10
	Left Ankle Rotation, RY	Deg	180	37.55	-12.35
	Right Ankle Rotation, RX	Deg	180	9.30	-36.30
	Right Ankle Rotation, RY	Deg	180	11.30	-20.06
Anomalies					
None					

SECTION 2 (CONTINUED)

PRELIMINARY INJURY SUMMARY: Right Front Passenger

Test Vehicle: 2013 Hyundai Elantra NHTSA No.: RD0529

Test Program: Research and Development Left Oblique Offset Test Date: 7/15/2014

Right Front Passenger: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head CG X	g	1000	22.63	-23.28
	Head CG Y	g	1000	48.64	-6.90
	Head CG Z	g	1000	30.97	-5.18
	Head Resultant	g	Compute	51.13	
	36 ms HIC		Compute	469.92	
	15 ms HIC		Compute	249.37	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	49.45	
	Head Rotational Velocity X	deg/s	60	1007.21	-1558.13
	Head Rotational Velocity Y	deg/s	60	342.82	-764.32
	Head Rotational Velocity Z	deg/s	60	3091.81	-1600.99
	Head Rotational Velocity Resultant	deg/s	Compute	3340.15	
	Brain Injury Criteria		Compute	1.34	
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	430.46	-123.38
	UNLC Neck System Tension, FZ	N	1000	1378.09	
	UNLC Neck System Compression, FZ	N	1000		-102.98
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	21.99	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-11.93
	NIJ		Compute	0.28	
	On head acting through total neck section, FX	N	Thortest	514.58	-140.18
	On head acting through total neck section, FY	N	Thortest	282.82	-177.85
	On head acting through total neck section, FZ	N	Thortest	1542.40	-85.97
	On head acting through total neck section, MX	N-m	Thortest	11.91	-37.63
	On head acting through total neck section, MY	N-m	Thortest	22.93	-21.30
	On head acting through total neck section, MZ	N-m	Thortest	13.59	-35.39
	On head acting through O.C. joint only, FX	N	Thortest	499.23	-123.75
	On head acting through O.C. joint only, FZ	N	Thortest	1378.79	-113.08
	On head acting through O.C. joint only, MY	N-m	Thortest	21.99	-11.93
Chest	Upper Left IR-TRACC X - deflection	mm	Thortest	0.07	-25.90
	Upper Left IR-TRACC Y - deflection	mm	Thortest	4.19	-13.54
	Upper Left IR-TRACC Z - deflection	mm	Thortest	16.99	-11.17
	Upper Left IR-TRACC D - deflection	mm	Thortest	0.08	-27.13
	Upper Right IR-TRACC X - deflection	mm	Thortest	0.08	-22.12
	Upper Right IR-TRACC Y - deflection	mm	Thortest	5.69	-11.77
	Upper Right IR-TRACC Z - deflection	mm	Thortest	12.66	-8.28
	Upper Right IR-TRACC D - deflection	mm	Thortest	0.09	-21.76
	Lower Left IR-TRACC X - deflection	mm	Thortest	0.17	-41.93
	Lower Left IR-TRACC Y - deflection	mm	Thortest	11.63	-10.24

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Right Front Passenger

Test Vehicle: 2013 Hyundai Elantra NHTSA No.: RD0529

Test Program: Research and Development Left Oblique Offset Test Date: 7/15/2014

Right Front Passenger: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left IR-TRACC Z - deflection	mm	Thortest	9.56	-20.62
	Lower Left IR-TRACC D - deflection	mm	Thortest	1.35	-41.50
	Lower Right IR-TRACC X - deflection	mm	Thortest	3.74	-2.99
	Lower Right IR-TRACC Y - deflection	mm	Thortest	14.24	-19.09
	Lower Right IR-TRACC Z - deflection	mm	Thortest	22.27	-7.76
	Lower Right IR-TRACC D - deflection	mm	Thortest	3.80	-1.96
	Chest CG Acceleration, 3 ms clip	g	Compute	39.01	
Abdomen	Lower Left IR-TRACC X - deflection	mm	Thortest	0.33	-66.71
	Lower Left IR-TRACC Y - deflection	mm	Thortest	8.16	-4.38
	Lower Left IR-TRACC Z - deflection	mm	Thortest	4.18	-6.01
	Lower Left IR-TRACC D - deflection	mm	Thortest	0.34	-65.21
	Left Viscous Criterion Based on X - deflection		Compute	2.42	
	Lower Right IR-TRACC X - deflection	mm	Thortest	0.07	-44.01
	Lower Right IR-TRACC Y - deflection	mm	Thortest	8.37	-0.04
	Lower Right IR-TRACC Z - deflection	mm	Thortest	4.92	-0.80
	Lower Right IR-TRACC D - deflection	mm	Thortest	0.07	-43.80
	Right Viscous Criterion Based on X - deflection		Compute	0.45	
Spine	Upper Spine (T1) AX	g	180	7.00	-45.29
	Upper Spine (T1) AY	g	180	44.96	-6.40
	Upper Spine (T1) AZ	g	180	36.92	-4.94
	Upper Spine (T1) Resultant	g	Compute	59.22	
	Middle Spine (T6) AX	g	180	2.72	-31.76
	Middle Spine (T6) AY	g	180	32.31	-3.44
	Middle Spine (T6) AZ	g	180	14.02	-11.58
	Middle Spine (T6) Resultant	g	Compute	40.83	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	81.53	
Acetabulum	Left FX force	N	600	2777.15	-2249.76
	Left FY force	N	600	582.23	-971.06
	Left FZ force	N	600	1164.17	-565.39
	Left Acetabulum Resultant	N	Compute	2814.33	
	Right FX force	N	600	3770.81	-332.13
	Right FY force	N	600	678.92	-1247.61
	Right FZ force	N	600	2186.06	-544.56
	Right Acetabulum Resultant	N	Compute	3877.24	
Anomalies None					

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Right Front Passenger Legs

Test Vehicle: 2013 Hyundai Elantra NHTSA No.: RD0529
Test Program: Research and Development Left Oblique Offset Test Date: 7/15/2014

Right Front Passenger: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	1.70	-6.56
	Right Knee Displacement, DX	mm	180	1.30	-0.56
Femur	Left Femur Force, FZ	N	600	527.86	-4635.36
	Left Femur Moment, MX	N-m	600	106.44	-151.90
	Left Femur Moment, MY	N-m	600	100.89	-181.06
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	212.59	
	Right Femur Force, FZ	N	600	531.70	-969.61
	Right Femur Moment, MX	N-m	600	160.94	-187.26
	Right Femur Moment, MY	N-m	600	170.41	-79.04
	Right Femur Res (MX / MY only, not MZ)	N-m	Compute	191.46	
Tibia	Left Upper Tibia, FZ	N	600	152.49	-3548.28
	Left Upper Tibia, MY	N-m	600	30.62	-145.94
	Left Upper Tibia, Index		Compute	1.09	
	Right Upper Tibia, FZ	N	600	787.31	-3536.10
	Right Upper Tibia, MY	N-m	600	18.93	-127.29
	Right Upper Tibia, Index		Compute	0.95	
	Left Lower Tibia, FZ	N	600	179.37	-2829.77
	Left Lower Tibia, MY	N-m	600	122.14	-128.06
	Left Lower Tibia, Index		Compute	0.84	
	Right Lower Tibia, FZ	N	600	562.12	-2452.93
	Right Lower Tibia, MY	N-m	600	43.11	-96.66
	Right Lower Tibia, Index		Compute	0.98	
Ankle	Left Ankle Rotation, RX	Deg	180	22.70	-22.55
	Left Ankle Rotation, RY	Deg	180	-7.86	-50.60
	Right Ankle Rotation, RX	Deg	180	19.67	-38.71
	Right Ankle Rotation, RY	Deg	180	-7.85	-47.59
Anomalies					
None					

SECTION 3 DATA SHEETS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

Data Sheet No.		Page No.
1	General Test and Vehicle Parameter Data	3-2
2	Seat Adjustment, Fuel System, and Steering Wheel	3-6
3	Dummy Longitudinal Clearance Dimensions	3-8
4	Dummy Lateral Clearance Dimensions	3-10
5	Seat Belt Positioning Data	3-11
6	High-Speed Camera Locations and Data	3-12
7	Vehicle Instrumentation Data	3-15
8	Photographic Reference Target Locations	3-18
9	Test Vehicle Summary of Results	3-25
10	Post-Test Observations	3-26
11	Vehicle Profile Measurements	3-27
12	Accident Investigation Division Data	3-29
13	Vehicle Intrusion Measurements	3-30
14	RMDB Crush Measurements	3-47
15	Summary of FMVSS 212, 219 (Partial), and 301 Data	3-48
	Windshield Periphery Measurements	3-48
	Areas of Protected Zone Failures	3-48
	Fuel System Integrity Post Impact Data	3-49
16	FMVSS 301 Static Rollover Results	3-50
17	Dummy / Vehicle Temperature Stabilization	3-51

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE INFORMATION

NHTSA No.	RD0529
Model Year	2013
Make	Hyundai
Model	Elantra
Body Style	Four Door Sedan
VIN	5NPDH4AE4DH440923
Body Color	Silver
Odometer Reading (km/mi)	30.6 km / 19 mi
Engine Displacement. (L)	1.8
Type/No. Cylinders	I4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	6-Speed
Overdrive	Yes
Final Drive	Front Wheel Drive
Roof Rack	No
Sunroof/T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
Anti-Lock Brakes (ABS)	Yes
All-Wheel Drive (AWD)	No
Traction Control System (TCS)	Yes

VEHICLE OPTIONS

Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	No
Other Optional Feature	-
Driver Front Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	Yes
Driver Torso/Pelvis Airbag	No
Driver Pelvis Airbag	No
Driver Knee Airbag	No
Pass. Front Airbag	Yes
Pass. Curtain Airbag	Yes
Pass. Head/Torso Airbag	No
Pass. Torso Airbag	Yes
Pass. Torso/Pelvis Airbag	No
Pass. Pelvis Airbag	No
Pass. Knee Airbag	No
Driver Seat Belt Pretensioner	Yes
Pass. Seat Belt Pretensioner	Yes
Driver Load Limiter	Yes
Pass. Load Limiter	Yes
Other Safety Restraint	-

Does owner's manual provide instructions to turn off automatic door locks?

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Manufacturing Alabama, LLC
Date of Manufacture	Oct/25/13

GVWR (kg)	1720
GAWR Front (kg)	940
GAWR Rear (kg)	800

VEHICLE SEATING AND WEIGHT CAPACITY

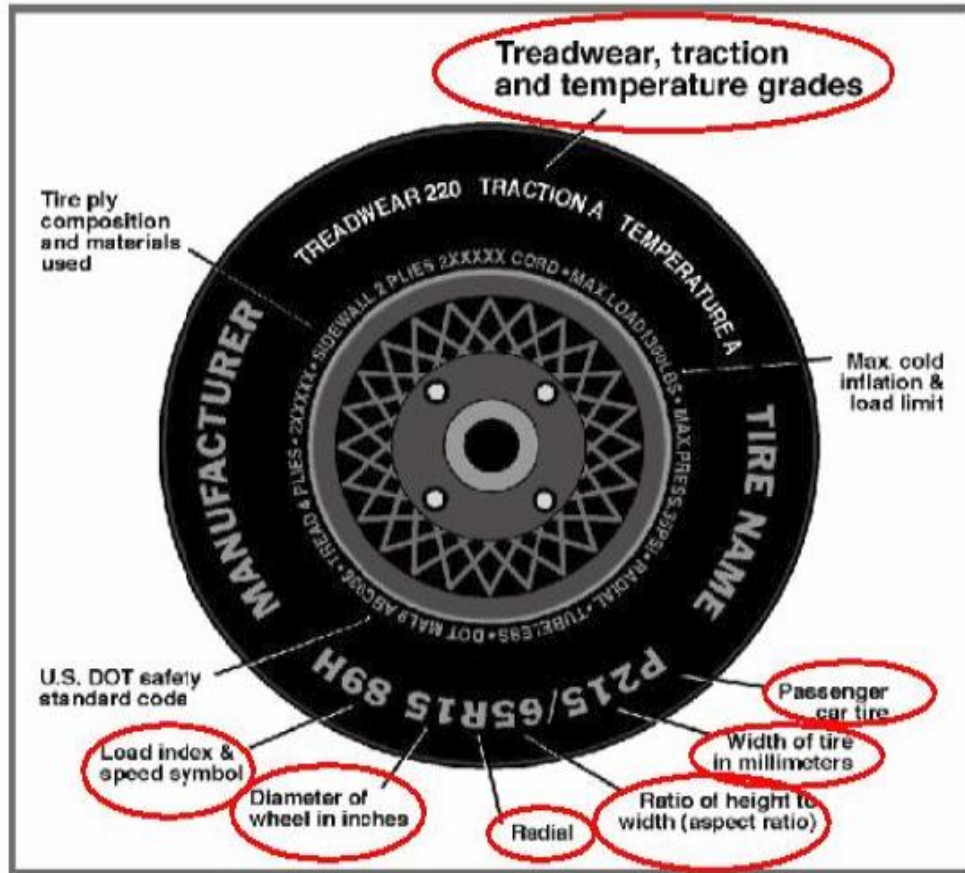
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	--	
Number of Occupants	2	3	--	5
Capacity Wt. (VCW) (kg)				385
Cargo Wt. (RCLW) (kg)				44.8

DATA SHEET NO. 1 (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

Collect items circled in red, tire manufacturer, and tire name.



Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	220	220
Recommended Tire Size	P205/55/R16	P205/55/R16
Tire Size on Vehicle	P205/55/R16	P205/55/R16
Tire Manufacturer	Hankook	Hankook
Tire Model	Optimo H426	Optimo H426
Treadwear	440	440
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index/Speed Symbol	89H	89H
Tire Material	Rubber	Rubber
DOT Safety Code Right	T7BCDLH3213	T7BCDLH3213
DOT Safety Code Left	T7BCDLH3313	T7BCDLH3213

DATA SHEET NO. 1 (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	403	239		439.5	353.5	
Right	kg	383	237		416	336.5	
Ratio	%	62%	38%		55%	45%	
Totals	kg	786	476	1262	855.5	690	1545.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1262
Weight of 2 P572E ATDs	kg	197.8
Rated Cargo/Luggage Weight (RCLW)	kg	44.8
Calculated Vehicle Target Weight (TVTW)	kg	1504.6

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	679	686	689	697	1019
As Tested	mm	660	669	642	654	1207
Post Test	mm	642	638	606	716	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2703
Total Vehicle Length at Left Side	mm	4364
Total Vehicle Length at Centerline	mm	4539
Total Vehicle Length at Right Side	mm	4369
Weight of Ballast in Cargo Area	kg	0
Weight of Vehicle Components Removed	kg	44
Amount of Stoddard Solvent in Fuel Tank	L	44.6

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk carpeting, inflator kit, tail light, rear seats, and muffler

DATA SHEET NO.1 (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements		Pre-Test
1	Total Length	mm	4539
2	Total Width	mm	1773
3*	Bumper Top Height	mm	559
4*	Bumper Bottom Height	mm	451
5*	Longitudinal Member Top Height	mm	556
6	Distance Between Longitudinal Members	mm	1052
7	Longitudinal Member Width	mm	74
8*	Engine Top Height	mm	900
9*	Engine Bottom Height	mm	220
10	Engine and Gearbox Width	mm	595
11	Front Bumper-Engine Distance	mm	427
12*	Front Shock Absorber Fixing Height	mm	881
13*	Bonnet Leading Edge Height	mm	706
14	Front Shock Absorber Fixing Width	mm	1339
15	Front Bumper – Front Axle Distance	mm	865
16	Front Axle – A Pillar Distance	mm	452
17	A-Pillar – B-Pillar Distance	mm	1143
18	B-Pillar – Rear Axle Distance	mm	1107
19	B-Pillar – C-Pillar Distance	mm	960
20*	Roof Sill Bottom Height	mm	1334
21*	Roof Sill Top Height	mm	1440
22*	Floor Sill Bottom Height	mm	242
23*	Floor Sill Top Height	mm	385

*Note: Height measurements are in reference to the ground.

DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

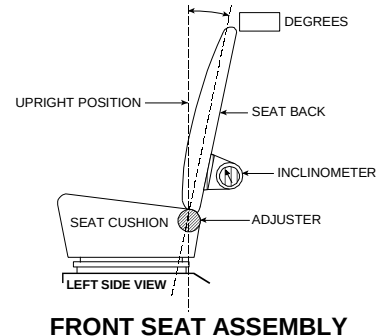
NHTSA No.: RD0529
 Test Date: 6/27/2014

NORMAL DESIGN RIDING POSITION

For adjustable driver and passenger seat backs. Please describe how to position the inclinometer to measure the seat back angle. Include description of the location of the adjustment latch detent, if applicable.

Driver seat: The driver seat back was positioned according to the Nominal Design Riding position listed in FORM 1

Passenger Seat: The passenger seat back was positioned according to the Nominal Design Riding position listed in FORM 1



	Deg.
Driver Seat Back Angle	4.4
Passenger Seat Back Angle	4.8

SEAT FORE/AFT POSITIONS

Describe the method used of determining seat fore/aft positions.

The driver's seat was positioned at its lowest position and at the mid-point of fore/aft travel.

The passenger's seat was positioned at the mid-point of fore/aft travel.

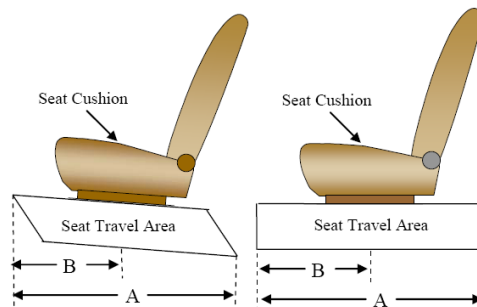
	Total Fore/Aft Travel	Placed in Position #
Driver Seat	23 (0-22) Detents	10
Passenger Seat	23 (0-22) Detents	11

SEAT BELT UPPER ANCHORAGES

Describe the method of positioning seat belt upper anchorages. Belt anchorages were moved along the full range of motion, and marked on the B-Pillar to their respective possible positions.

Photographic evidence can be found in Appendix A of this report. Zero is defined as the upper-most position.

	Total # of Positions	Placed in Position #
Driver Seat	4	0
Passenger Seat	4	0



DATA SHEET NO. 2 (CONTINUED)
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

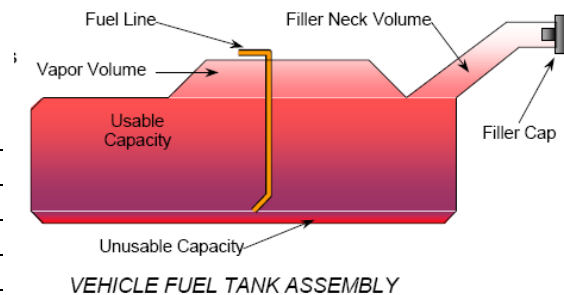
FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	48
Usable Capacity of "Optional Tank"	
93% of Usable Capacity	44.6
Actual Amount of Solvent Used	44.6
1/3 of Usable Capacity	15.8

FUEL PUMP

Describe the fuel system - what type of fuel pump, details about how it operates, etc.

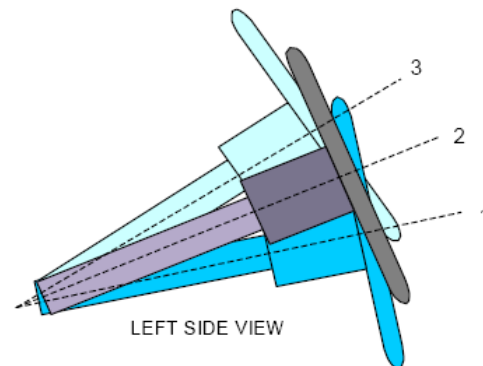
Fuel evacuated according to the specifications provided by the manufacturer in Form 1. Electric fuel pump operates when the ignition is in the 'on' position and the engine is running. The fuel filler neck is located above the left rear wheel.



STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. Describe how this measurement was taken.

The steering wheel was adjusted to the midpoint of tilt angle range and the midpoint of the telescoping travel (if applicable)



STEERING COLUMN ASSEMBLY

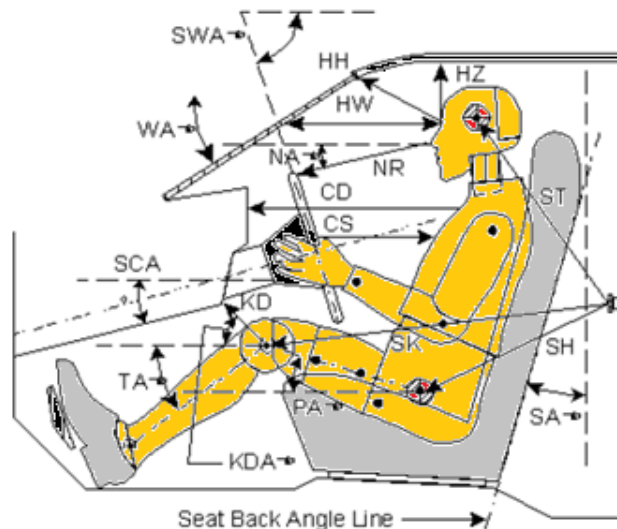
STEERING COLUMN POSITIONS

	Tilt (degrees)	Fore/Aft Position (mm)
Lowermost position No. 1	19.4	
Geometric center position No. 2	21.5	
Uppermost position No. 3	23.6	
Telescoping Steering Wheel Travel		40
Test Position	21.5	20

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



Code	Measurement Description	Driver (Serial # THOR 015)		Passenger (Serial # THOR 016)	
		Length (mm)	Angle(°)	Length (mm)	Angle (°)
WA°	Windshield Angle		-24		
SWA°	Steering Wheel Angle		22.1		
SCA°	Steering Column Angle		67.9		
SA°	Seat Back Angle (on headrest post)		5.0		4.7
HZ	Head to Roof (Z)	195	90	181	90
HH	Head to Header	449	16.2	458	12.8
HW	Head to Windshield	789	0	727	0
NR	Nose to Rim	547	14.3	805	-34.3
CD	Chest to Dash	622		643	
CS	Chest to Steering Hub	439	-5.1		
RA	Rim to Abdomen	256	0		
KDL	Left Knee to Dash	183	29.7	193	30.5
KDR	Right Knee to Dash	158	28.1	203	29.3
PA°	Pelvic Angle		24.8		24.1
TA°	Tibia Angle		39.2		-31.2
SK	Striker to Knee	605	-12.2	630	-16.9
ST	Striker to Head	412	-89.2	429	86.9
SH	Striker to H-Point	329	-51.3	330	-54.6
HAX°	Head Angle (X)		0.3		-0.3
HAY°	Head Angle (Y)		0.2		0.2
NAX°	Neck Angle (X)		N/A		N/A
NAY°	Neck Angle (Y)		N/A		N/A
TAX°	T6 Angle (X)		-2.2		0.6
TAY°	T6 Angle (Y)		20.6		16.4
LAX°	T1 (X)		1.7		1.9
LAY°	T1 (Y)		2.6		0.8

DATA SHEET NO.3 (CONTINUED)
DUMMY CMM MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

Description	Units	Driver			Passenger		
		X	Y	Z	X	Y	Z
Striker	mm	926	-771	582	928	770	581
Head CG	mm	951	-442	182	935	435	163
Bridge of Nose	mm	1043	-364	172	1029	361	155
Tip of Nose	mm	1043	-364	212	1030	359	193
Shoulder Bolt	mm	976	-552	435	1007	546	435
Tip of Chin	mm	1037	-361	310	1028	361	291
H-Point	mm	1163	-603	851	1149	597	861
Left Knee	mm	1548	-585	722	1561	291	768
Right Knee	mm	1568	-275	726	1561	510	775
Left Ankle	mm	1885	-616	972	1924	286	971
Right Ankle	mm	1897	-242	980	1930	485	972
Left Heel	mm	1905	-612	1109	1915	252	1105
Right Heel	mm	1904	-217	1104	1902	453	1107
Head Bolt 1 – Top Left	mm	881	-404	132	870	329	118
Head Bolt 2 – Lower Left	mm	887	-393	217	878	335	203
Head Bolt 3 – Top Right	mm	879	-334	132	867	391	118
Head Bolt 4 – Lower Right	mm	886	-343	217	877	384	203
Driver's Outboard Seat Anchor Bolt	mm	1448	-595	1047	1448	595	1044
Outboard Head Restraint Post	mm	820	-436	328	796	433	334
Top of Head Restraint	mm	878	-361	68	840	361	68
Center of Steering Wheel	mm	1511	-358	464			

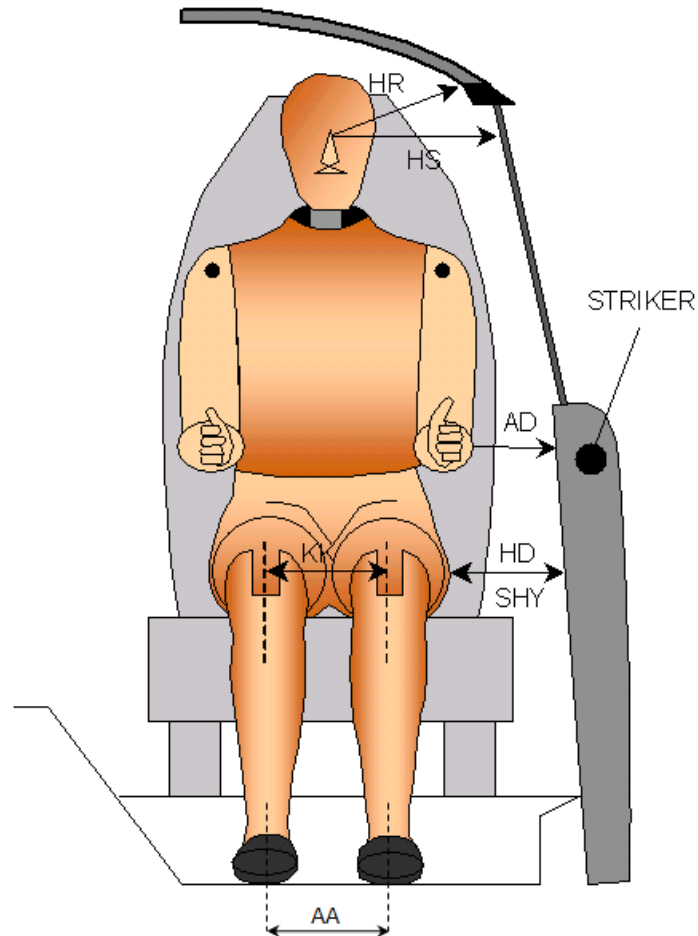
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

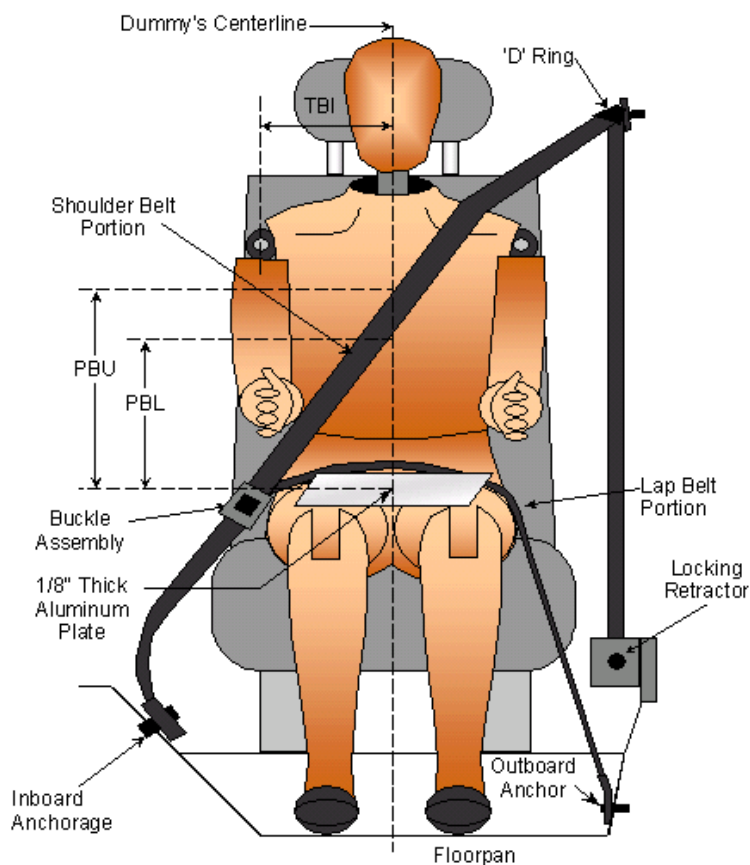


Code	Description	Units	Driver	Passenger
AD	Arm to Door	mm	156	40
HD	H-Point to Door	mm	124	136
HR	Head to Side Header	mm	207	204
HS	Head to Side Window	mm	325	320
KK	Knee to Knee	mm	360	270
SHY	Striker to H-Point (Y Direction)	mm	225	230
AA	Ankle to Ankle	mm	370	208

DATA SHEET NO. 5 SEAT BELT POSITIONING DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	380	380
PBL — Top surface of reference to belt lower edge	mm	300	300

BELT LENGTH DATA

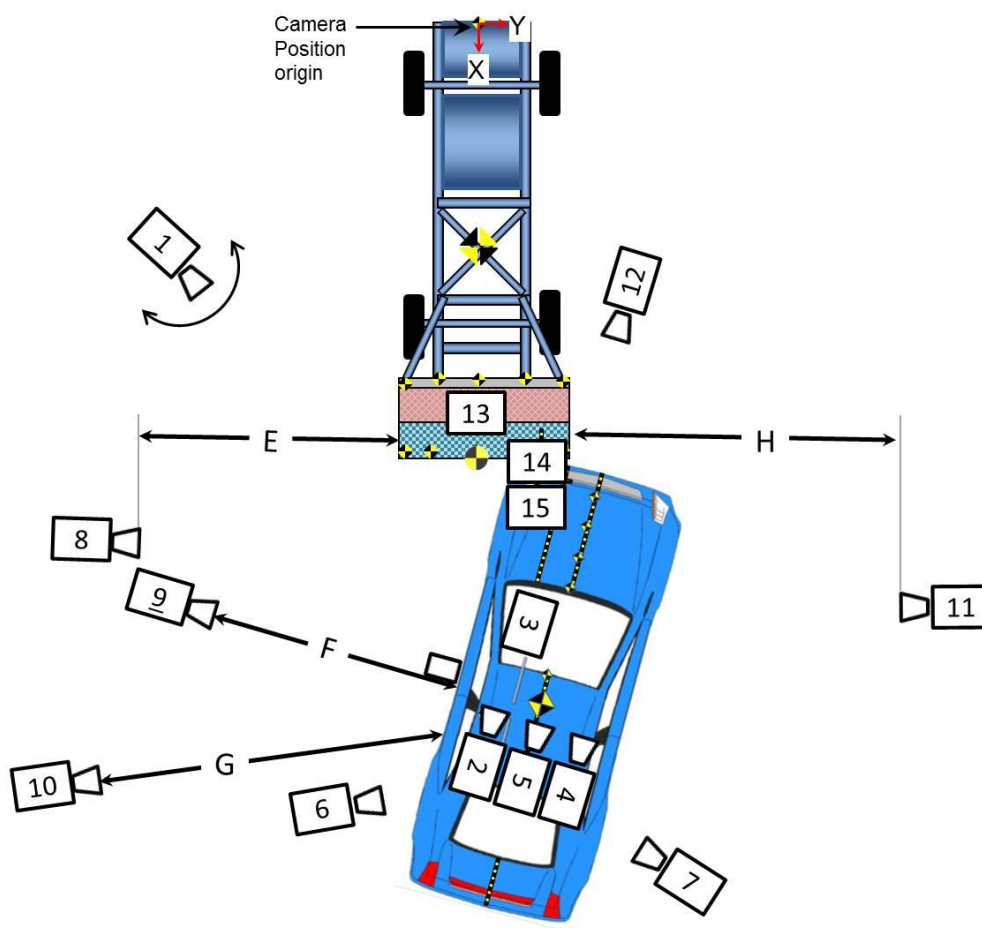
Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	785	810
Lap Belt Length as measured on ATD	mm	675	680
Remainder of belt on reel	mm	790	760
Total belt length for continuous webbing systems	mm	2250	2250

DATA SHEET NO. 6 **HIGH-SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

HORIZONTAL LOCATION



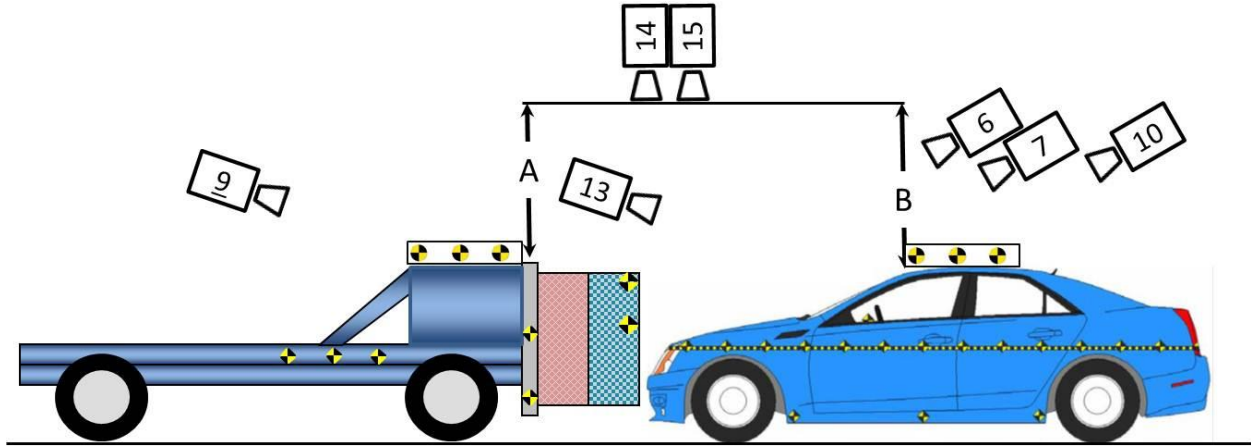
E	mm	6721
F	mm	7526
G	mm	9225
H	mm	6605

DATA SHEET NO. 6 (CONTINUED)
HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

VERTICAL LOCATION



A	mm	4069
B	mm	3806

DATA SHEET NO. 6 (CONTINUED)
HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

CAMERA LOCATIONS

No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side	--	--	--	Zoom	30
2	Onboard Passenger Movement	7662	-75	1258	12.5	1000
3	Onboard Driver Lower Leg	6362	-529	204	6.5	1000
4	Onboard Driver Movement	7791	-942	1258	12.5	1000
5	Onboard Centerline	7702	-554	1258	8	1000
6	Driver Interaction	7957	2535	3419	28	1000
7	Passenger Interaction	10957	-9153	2529	24-70	1000
8	Target Vehicle Left Side Perpendicular (High)	4839	7862	1174	24	1000
9	Target Vehicle Driver Motion	6310	7595	1128	24	1000
10	Target Vehicle Passenger Motion	9684	8798	2904	24-70	1000
11	Target Vehicle Right Side	4821	-7647	1246	24	1000
12	Target Vehicle Left Side (High)	656	-2814	1150	28	1000
13	RMDB/Target Vehicle Interaction	4824	993	4685	28	1000
14	Close-up Impact Point	6950	-561	5246	15	1000
15	Overall Impact	4501	-150	5246	15	1000

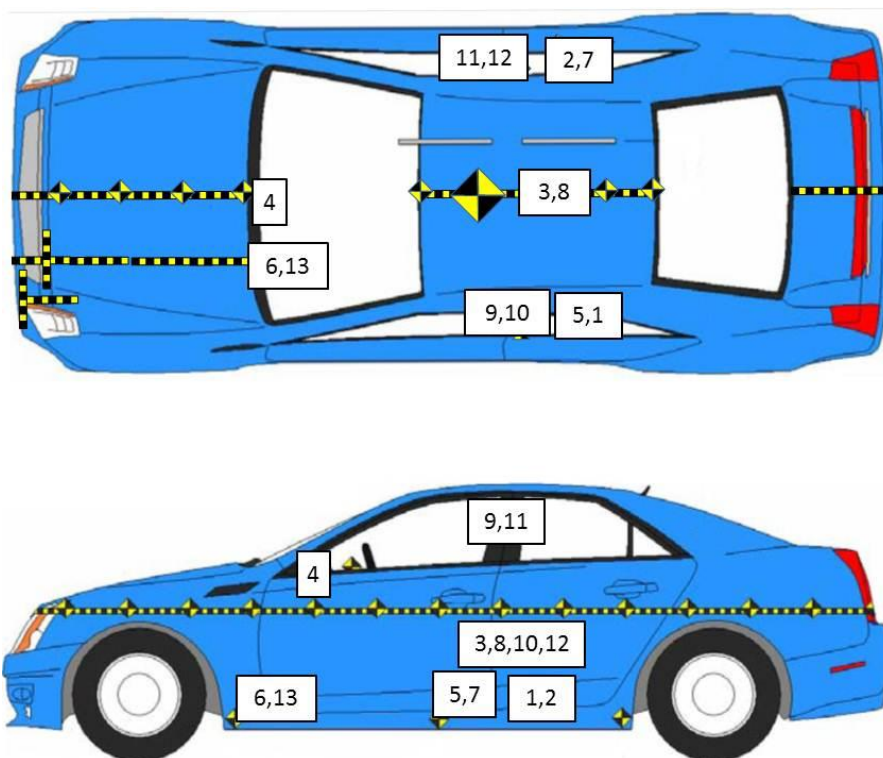
Reference Point: Center most rearward point of the RMDB when in contact with the target vehicle:

- +X – From back of RMDB to front of RMDB
- +Y – Right of monorail center
- +Z – Up from ground

DATA SHEET NO. 7 **VEHICLE INSTRUMENTATION DATA**

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Axes	Units	Measurements (mm)		
				X	Y	Z
1	Left Rear Sill	X,Y	mm	615	-725	1032
2	Right Rear Sill	X,Y	mm	629	724	1032
3	Vehicle CG	X,Y,Z	mm	802	1	1080
4	Instrument Panel	X	mm	1659	10	535
5	Driver Seat Track	X,Y,Z	mm	957	-602	1132
6	Behind Brake Pedal	X,Y,Z	mm	2225	-376	919
7	Passenger Seat Track	X,Y,Z	mm	954	602	1132
8	Angular Rate Sensors	X	mm	813	3	1087
		Y	mm	802	12	1086
		Z,	mm	802	1	1080

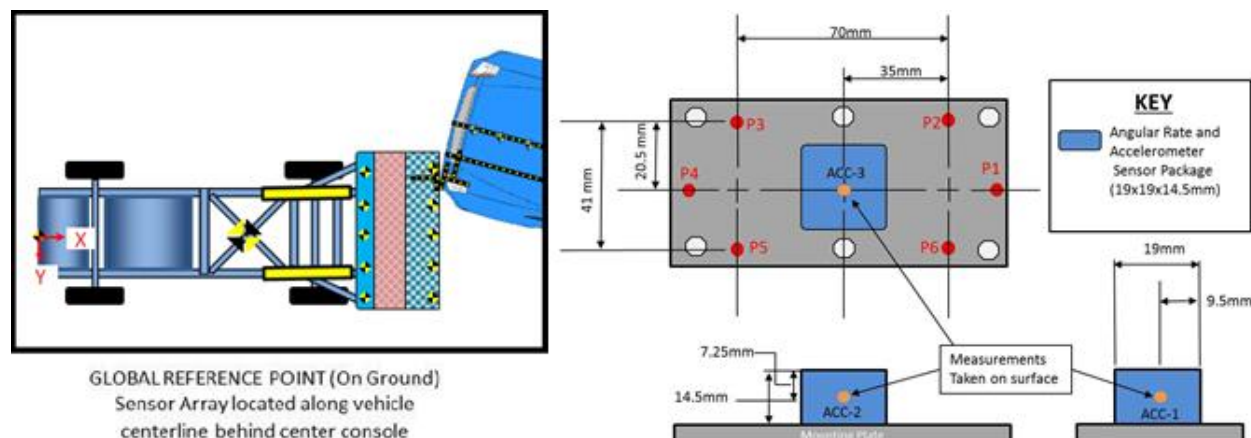
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO. 7 **VEHICLE INSTRUMENTATION DATA**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



VEHICLE COORDINATE SYSTEM					
No.	Accelerometer Location	Units	Measurements (mm)		
			X	Y	Z
ACC-1	Accelerometer CG – X Direction	mm	813	3	1087
ACC-2	Accelerometer CG – Y Direction	mm	802	12	1086
ACC-3	Accelerometer CG – Z Direction	mm	802	1	1080
M1	Mounting Bolt 1	mm	810	9	1081
M2	Mounting Bolt 2	mm	795	-7	1081
P1	Plate Point 1	mm	848	1	1095
P2	Plate Point 2	mm	837	-20	1095
P3	Plate Point 3	mm	768	-20	1095
P4	Plate Point 4	mm	756	0	1096
P5	Plate Point 5	mm	767	21	1095
P6	Plate Point 6	mm	837	22	1095

GLOBAL COORDINATE SYSTEM					
No.	Accelerometer Location	Units	Measurements (mm)		
			X	Y	Z
ACC-1	Accelerometer CG – X Direction	mm	7084	-723	-242
ACC-2	Accelerometer CG – Y Direction	mm	7096	-729	-243
ACC-3	Accelerometer CG – Z Direction	mm	7093	-719	-249
M1	Mounting Bolt 1	mm	7088	-728	-248
M2	Mounting Bolt 2	mm	7099	-709	-248
P1	Plate Point 1	mm	7049	-731	-234
P2	Plate Point 2	mm	7054	-708	-234
P3	Plate Point 3	mm	7122	-689	-234
P4	Plate Point 4	mm	7138	-706	-233
P5	Plate Point 5	mm	7133	-729	-234
P6	Plate Point 6	mm	7066	-748	-234

DATA SHEET NO. 7 (CONTINUED)
VEHICLE INSTRUMENTATION DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

VEHICLE INSTRUMENTATION DATA

Loc.	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Left Rear Sill	X	g	1.41	226.45	-35.60	33.55
		Y	g	20.38	40.85	-4.90	61.65
2	Right Rear Sill	X	g	2.22	141.25	-46.65	40.00
		Y	g	22.41	40.70	-5.72	66.00
3	Vehicle CG	X	g	4.00	80.05	-51.62	35.70
		Y	g	39.14	36.75	-6.49	81.65
		Z	g	77.03	37.00	-95.59	40.85
4	Instrument Panel	X	g	25.44	77.25	-71.26	49.85
5	Driver Seat Track	X	g	2.05	116.10	-36.17	34.70
		Y	g	29.37	47.30	-5.19	62.25
		Z	g	24.59	33.65	-12.36	80.55
6	Behind Brake Pedal	X	g	27.66	13.25	-174.59	29.65
		Y	g	34.68	33.90	-9.47	64.20
		Z	g	30.02	37.40	-30.68	44.90
7	Passenger Seat Track	X	g	1.79	119.85	-44.98	35.95
		Y	g	6.52	65.80	-29.75	39.60
		Z	g	16.71	37.80	-4.82	14.30
8	Angular Rate Sensors	X	Deg/s	173.96	61.85	-1233.21	38.75
		Y	Deg/s	1619.99	38.10	-161.60	60.00
		Z	Deg/s	36.02	28.70	-112.91	55.40
9	Driver Shoulder Belt		N	4162.19	49.25	-14.75	197.15
10	Driver Lap Belt		N	6198.72	54.60	-42.92	8.70
11	Passenger Shoulder Belt		N	3525.50	42.95	-19.87	12.35
12	Passenger Lap Belt		N	8958.09	59.95	-42.13	8.85
13	Driver Floor Pan String Pot		mm	0.07	1.20	-56.94	59.05

Note: See Appendix B for all additional vehicle channel data

TIME TO FIRE RESTRAINT TIMING

Loc.	Description	Axes	Units	Time to Fire (ms)
1	Driver Air Bag Squib 1	*	A	22.20
2	Driver Air Bag Squib 2	*	A	32.20
3	Driver Curtain Airbag	*	A	12.20
4	Driver Torso Airbag	*	A	32.20
5	Driver Knee Airbag	*	A	N/A
6	Driver Pretensioner	*	A	12.15
7	Passenger Air Bag Squib 1	*	A	12.20
8	Passenger Air Bag Squib 2	*	A	22.20
9	Passenger Curtain Airbag	*	A	Disabled
10	Passenger Torso Airbag	*	A	Disabled
11	Passenger Knee Airbag	*	A	N/A
12	Passenger Pretensioner	*	A	12.20

* The measurement indicates the time the voltage changed

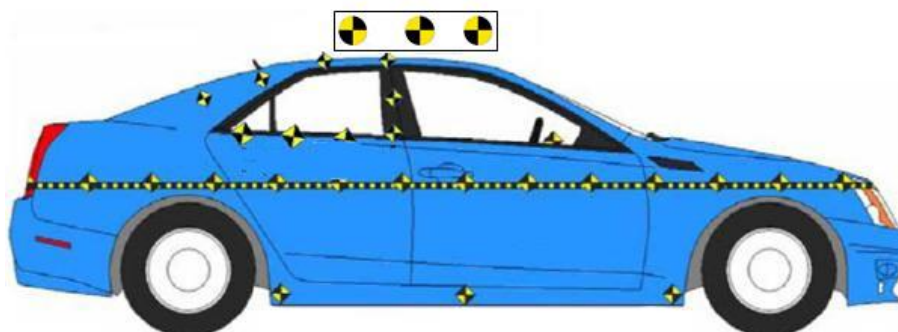
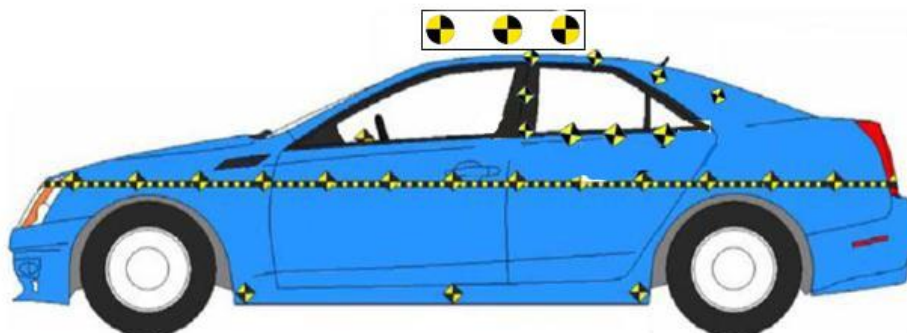
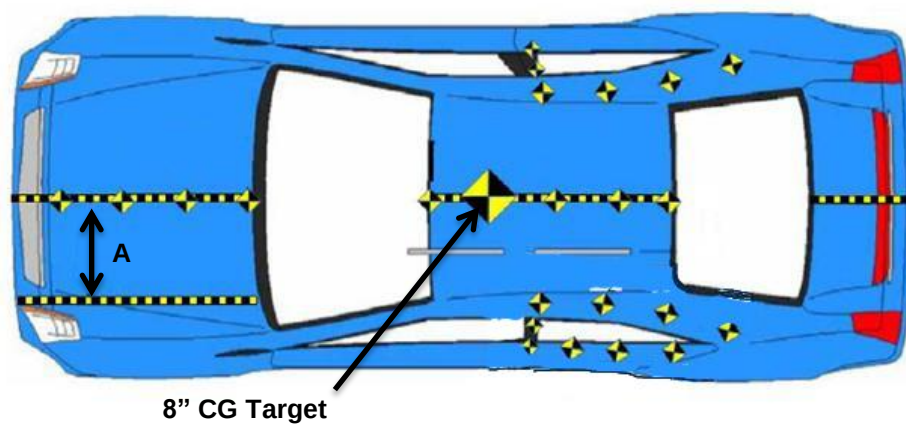
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

Item	Units	Value
A	mm	267

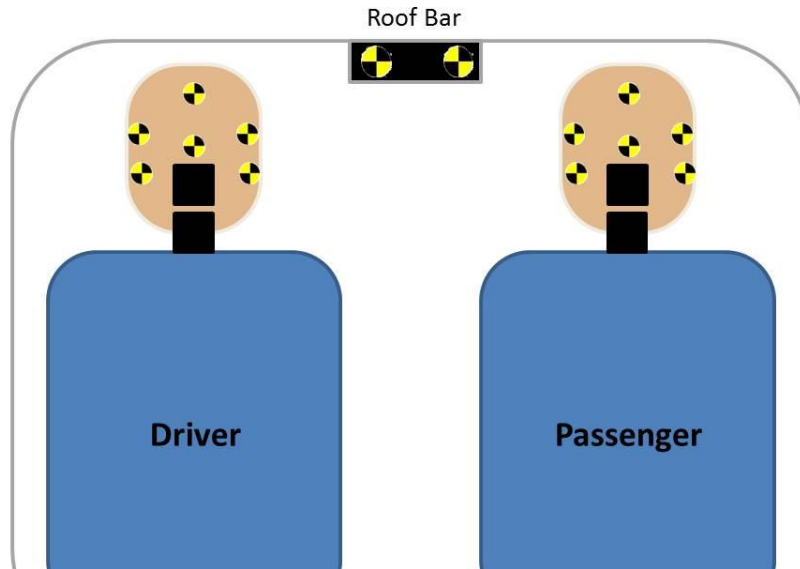
Note: All 6" targets on vehicle are 450 mm apart.



DATA SHEET NO. 8 (CONTINUED)
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



Point	Pre-Test		
	X	Y	Z
Roof Bar Driver	1444	-68	88
Roof Bar Passenger	1446	60	86

Reference point: 50mm above the center of the rear windshield (See appendix D for procedure to create coordinate system).

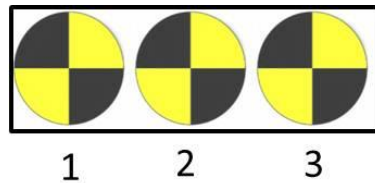
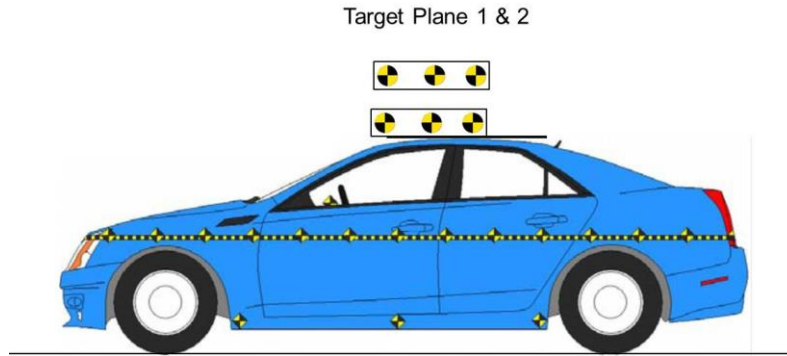
- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO. 8 (CONTINUED)
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

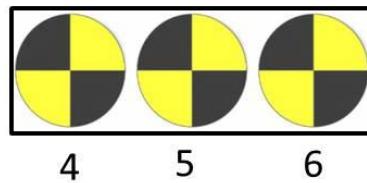
Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

OVERHEAD TARGET BARS



Vertical Target
Plane 1
(Driver's Side)



Vertical Target
Plane 2
(Passenger Side)

Target	Units	X	Y	Z
1	mm	1143	-387	-451
2	mm	689	-383	-451
3	mm	244	-367	-448
4	mm	1150	351	-439
5	mm	700	344	-442
6	mm	246	344	-440

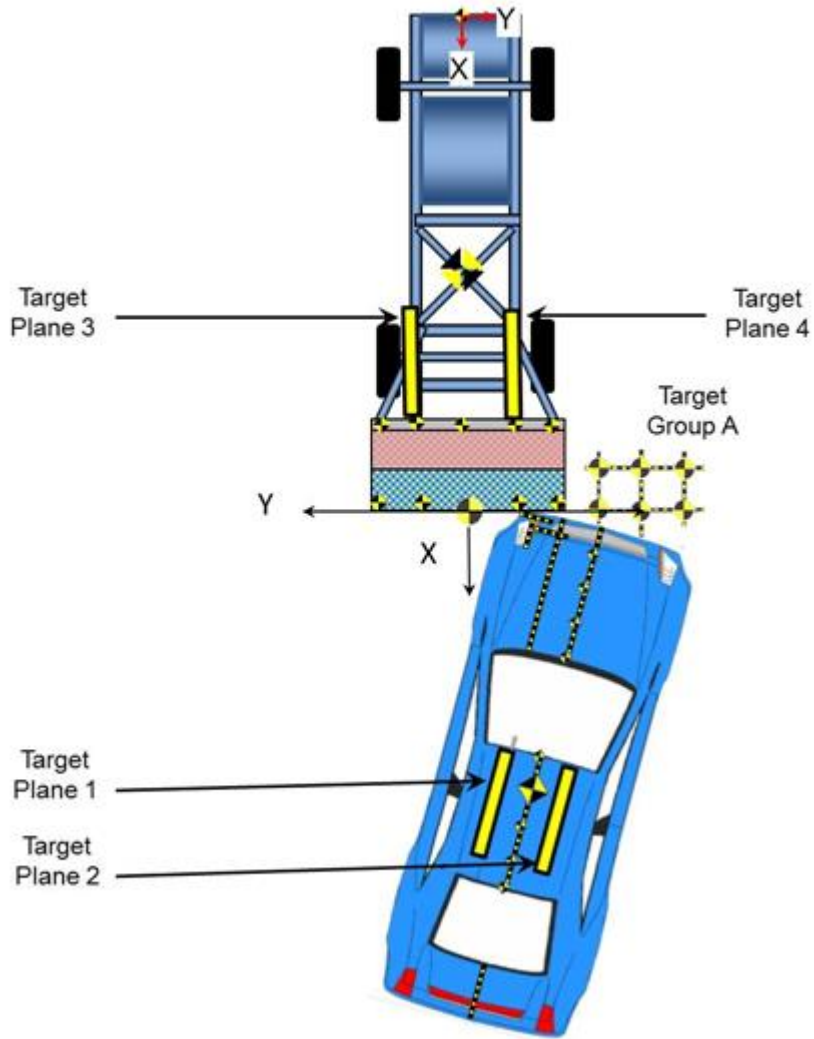
Reference point: 50mm above the center of the rear windshield (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO. 8 (CONTINUED)
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



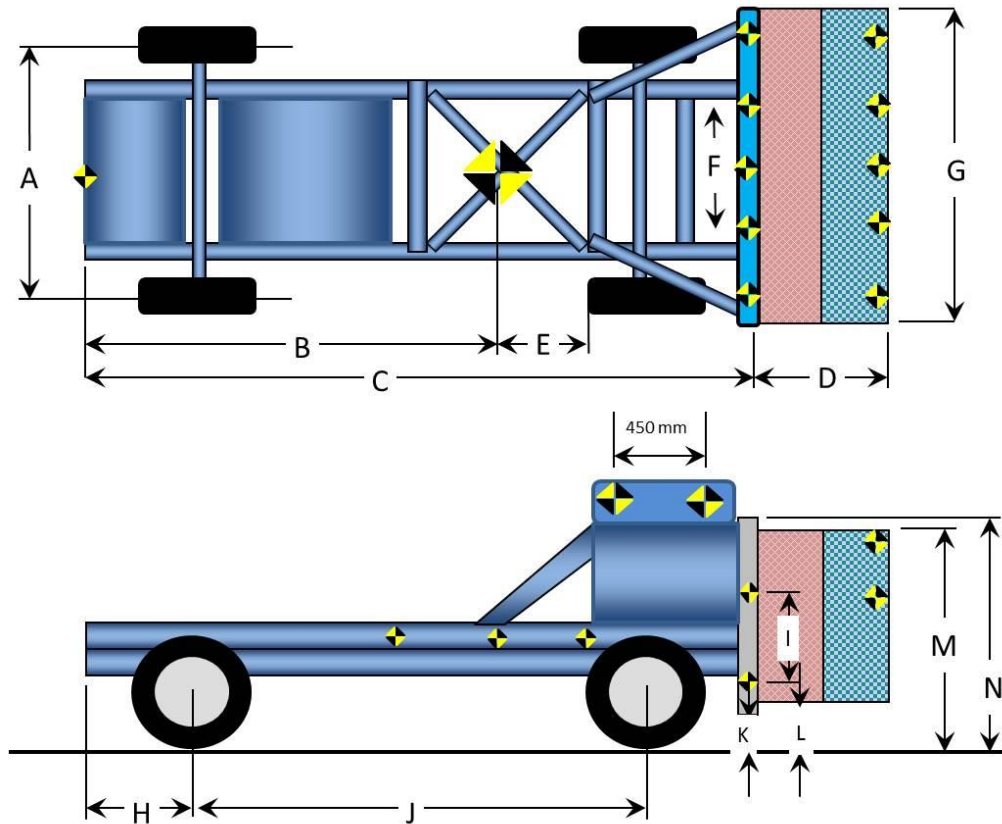
GROUND TARGET LOCATIONS

Target	Units	X	Y
1	mm	0	1411
2	mm	0	1861
3	mm	0	2311
4	mm	-450	1411
5	mm	-450	1861
6	mm	-450	2311

DATA SHEET NO. 8 (CONTINUED)
RMDB PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



Item	Units	Value	Item	Units	Value
A	mm	1930	H	mm	800
B	mm	2449	I	mm	450
C	mm	3995	J	mm	2555
D	mm	605	K	mm	77
E	mm	907	L	mm	71
F	mm	900	M	mm	1024
G	mm	2205	N	mm	1177

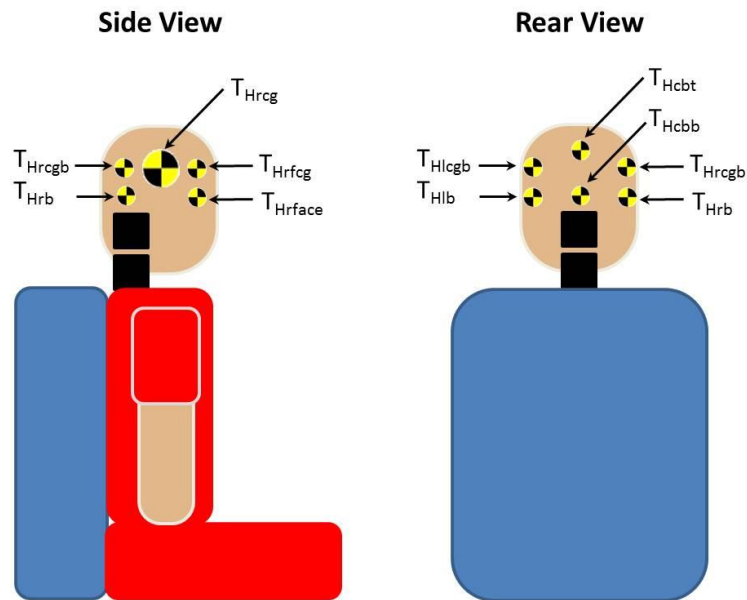
	Units	Front Axle	Rear Axle	Total
Left	kg	804.2	435	1239.2
Right	kg	801.5	449.5	1251
Ratio	%	64.5	35.5	100
Total	kg	1605.7	884.5	2490.2
CG Aft of Front Axle	mm			907

Note: All targets on the RMDB honeycomb are 450mm apart unless otherwise noted.

DATA SHEET NO. 8 (CONTINUED)
DUMMY PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



Driver Dummy Head Targets (S/N 016)

Measurement	Units	Value
Distance between T _{Hrcg} & T _{Hrfcg}	mm	38
Distance between T _{Hrcg} & T _{Hrcgb}	mm	38
Distance between T _{Hrcgb} & T _{Hrb}	mm	70
Distance between T _{Hrfcg} & T _{Hrface}	mm	70
Distance between T _{Hlcbg} & T _{Hlcb}	mm	38
Distance between T _{Hlcbg} & T _{Hlcb}	mm	38
Distance between T _{Hlcbg} & T _{Hlcb}	mm	70
Distance between T _{Hlcbg} & T _{Hlcb}	mm	70
Distance between T _{Hlcbg} & T _{Hlcb}	mm	70
Distance between T _{Hcgt} & T _{Hcbb}	mm	72

Passenger Dummy Head Targets (S/N 015)

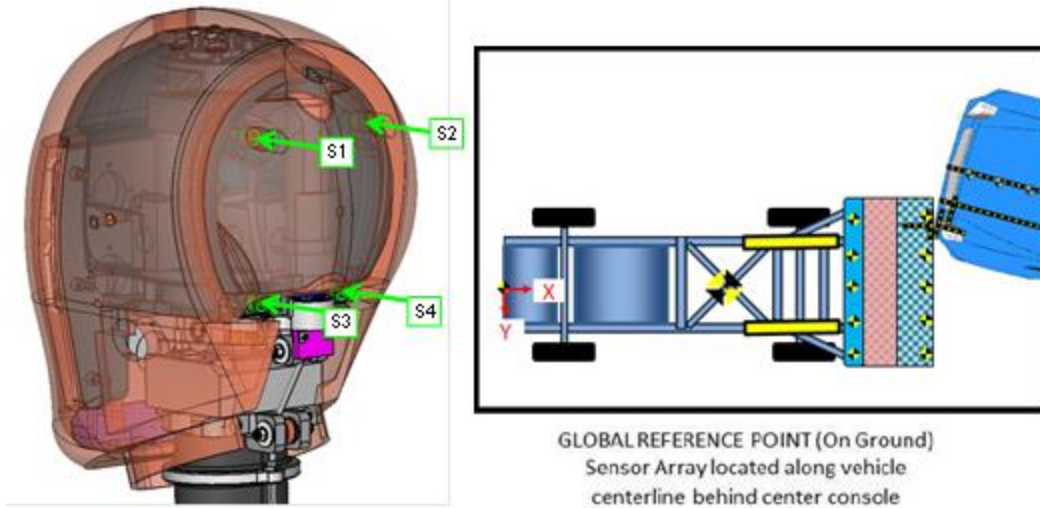
Measurement	Units	Value
Distance between T _{Hrcg} & T _{Hrfcg}	mm	38
Distance between T _{Hrcg} & T _{Hrcgb}	mm	38
Distance between T _{Hrcgb} & T _{Hrb}	mm	70
Distance between T _{Hrfcg} & T _{Hrface}	mm	70
Distance between T _{Hlcbg} & T _{Hlcb}	mm	38
Distance between T _{Hlcbg} & T _{Hlcb}	mm	38
Distance between T _{Hlcbg} & T _{Hlcb}	mm	70
Distance between T _{Hlcbg} & T _{Hlcb}	mm	70
Distance between T _{Hlcbg} & T _{Hlcb}	mm	70
Distance between T _{Hcgt} & T _{Hcbb}	mm	72

DATA SHEET NO. 8 (CONTINUED)
DUMMY PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

THOR HEAD BOLT MEASUREMENTS
GLOBAL COORDINATE SYSTEM
Rear of RMDB is the Origin



BOLT POINTS RELATIVE TO HEAD CG

Target	X	Y	Z
S1	-65.32	-35.43	-45.75
S2	-65.32	35.43	-45.75
S3	-60.16	-25.40	36.90
S4	-60.16	25.40	36.90

DRIVER'S HEAD BOLT POINTS

Target	X	Y	Z
S1	6913	-348	-1196
S3	6910	-360	-1112
S2	6933	-415	-1196
S4	6923	-408	-1112

FRONT PASSENGER HEAD BOLT POINTS

Target	X	Y	Z
S1	7113	-1053	-1211
S3	7107	-1061	-1125
S2	7132	-1113	-1211
S4	7121	-1108	-1126

**See Datasheet 3 for head bolt locations in reference to the vehicle coordinate system.*

DATA SHEET NO. 9
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	93
Passenger Dummy Accelerometers	93
Vehicle Structure Accelerometers	46
RMDB Cart Accelerometers	6
Total	238

CAMERA COVERAGE

Type of Camera	Number Used in this Test
High-Speed Vehicle Onboard	4
High-Speed Off-board	10
Real-Time Panning	2
Total	16

DATA SHEET NO. 10
POST TEST OBSERVATIONS

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Right Front Passenger
Dummy Type/Serial No.	THOR015	THOR016
Lower Leg Type	LX	LX
Lower Leg Serial No.	LX0038/LX0039	LX0018/ LX0019
Head Contact	Front & Curtain Airbag, Side headliner, & Visor	Front Airbag, Visor, Side Head Liner
Upper Torso Contact	Front & Torso Airbag, Seatback, Arm contacted driver's door	Front Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Bolster, outside leg contacted driver's door	Glove Box
Right Knee Contact	Knee Bolster	Glove Box

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Right Front Passenger
Locked/Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Closed & Operational	Closed & Operational
Rear Door Opening	Closed & Operational	Closed & Operational
Seat Track Shift (mm)	0	0
Seat Back Failure	No	No
Glazing Damage	None	None

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions	Photo Taken (Y/N)
Pillar Performance	A-Pillar Buckled during impact event	Y
Windshield Damage	Cracks throughout with some separation	Y
Window Damage	None	Y
Other Notable Effects	None	--

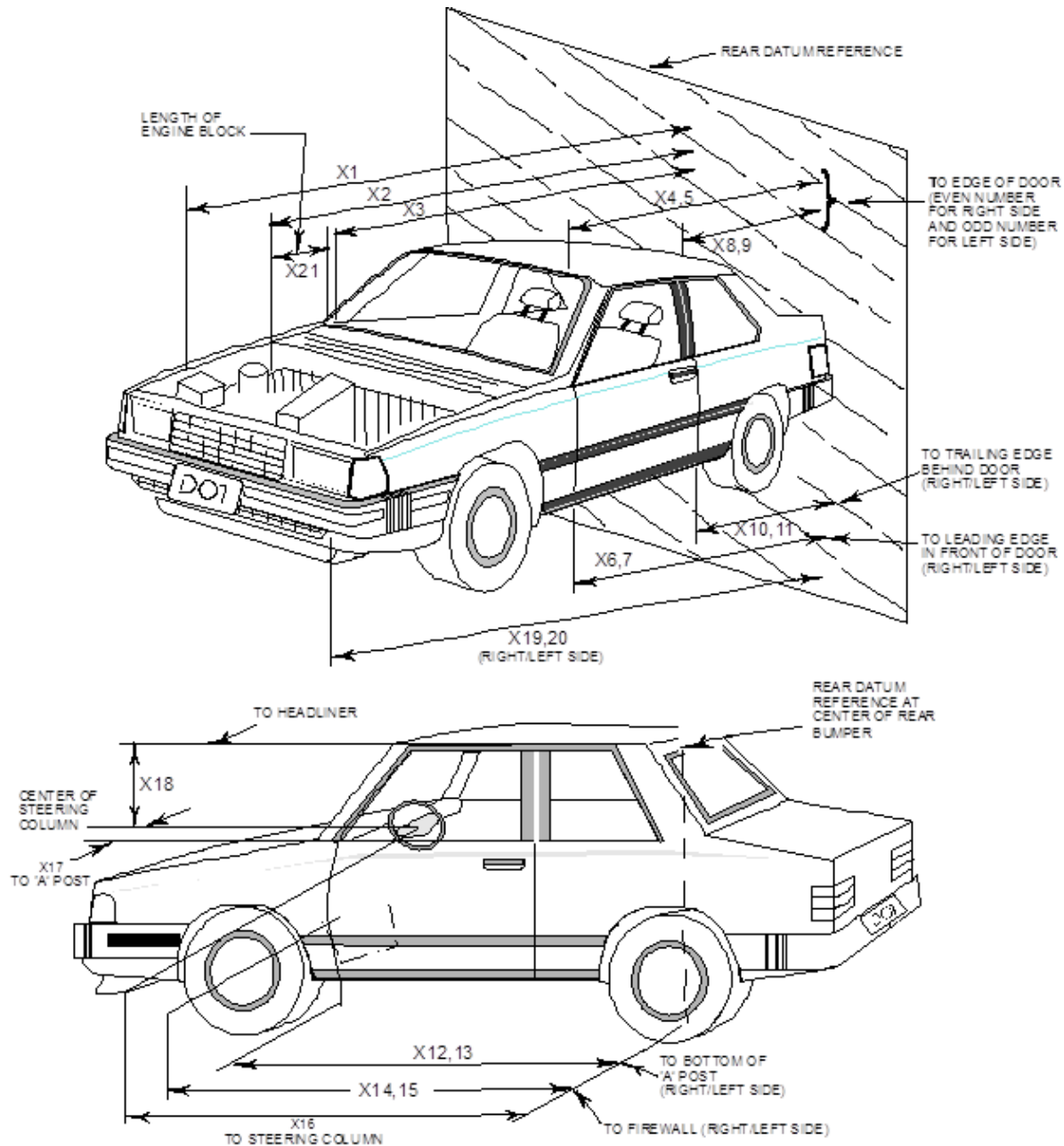
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver (Occupant 1)		Right Front Passenger (Occupant 2)	
	Installed	Deployed	Installed	Deployed
Front Airbag	Yes	Yes	Yes	Yes
Curtain Airbag	Yes	Yes	Yes	Disabled
Torso Airbag	Yes	Yes	Yes	Disabled
Knee Airbag	No	N/A	No	N/A
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes	Yes	Yes	Yes
Other				

DATA SHEET NO. 11 **VEHICLE PROFILE MEASUREMENTS**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



DATA SHEET NO. 11 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	3321	3067	254
2	Rear Surface of Vehicle (RSOV) to Front of Engine	mm	2894	2750	145
3	RSOV to Firewall	mm	2391	2287	104
4	RSOV to Upper Leading Edge of Right Door	mm	2011	2001	10
5	RSOV to Upper Leading Edge of Left Door	mm	2009	1991	19
6	RSOV to Lower Leading Edge of Right Door	mm	1995	1986	9
7	RSOV to Lower Leading Edge of Left Door	mm	1993	1980	13
8	RSOV to Upper Trailing Edge of Right Door	mm	871	861	10
9	RSOV to Upper Trailing Edge of Left Door	mm	867	857	11
10	RSOV to Lower Trailing Edge of Right Door	mm	885	875	10
11	RSOV to Lower Trailing Edge of Left Door	mm	882	871	11
12	RSOV to Bottom of "A" Post of Right Side	mm	2216	2205	11
13	RSOV to Bottom of "A" Post of Left Side	mm	2218	2170	48
14	RSOV to Firewall, Right Side	mm	2482	2480	2
15	RSOV to Firewall, Left Side	mm	2482	2190	292
16	RSOV to Steering Column	mm	1511	1462	48
17	Center of Steering Column to "A" Post	mm	275	256	19
18	Center of Steering Column to Headliner	mm	401	443	-42
19	RSOV to Right Side of Front Bumper	mm	3218	3241	-23
20	RSOV to Left Side of Front Bumper	mm	3214	2909	305
21	Length of Engine Block	mm	415	411	4
RD	RSOV to Right Side of Dash Panel	mm	1691	1692	-1
CD	RSOV to Center of Dash Panel	mm	1776	1726	50
LD	RSOV to Left Side of Dash Panel	mm	1691	1643	48

UR* = Unrecoverable Data Point

DATA SHEET NO. 12
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

VEHICLE INFORMATION

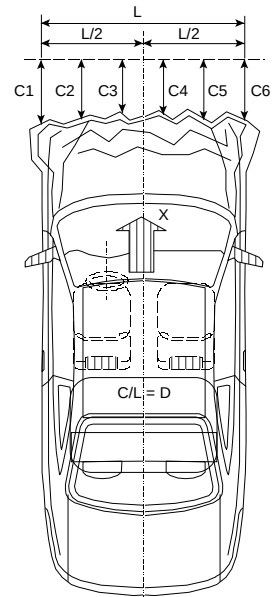
VIN: 5NPDH4AE4DH440923 Wheelbase (mm): 2703
Vehicle Size Category: Passenger Test Weight (kg): 1545.5

ACCELEROMETER DATA

Accelerometer Locations: As Described in Data Sheet No. 7
Cal. Procedure/Interval: Calspan Procedure / 6 month
Integration Algorithm: Trapezoidal
Linearity: > 99%
Impact Velocity (kph): 89.89
Velocity Change (kph): 89.89

CRUSH PROFILE

Collision Deformation Classification: 12FYEW2
Midpoint of Damage: C2
Damage Region Length (mm): 1049
Impact Mode: Frontal 15° Angle, 35% Left Offset



Crush Measurements: Bumper Cover

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	3196	2866	330
C2	Crush zone 2 at left side	mm	3290	2938	352
C3	Crush zone 3 at left side	mm	3316	3021	295
C4	Crush zone 4 at right side	mm	3317	3109	208
C5	Crush zone 5 at right side	mm	3293	3190	103
C6	Crush zone 6 at right side	mm	3201	3226	-25
L	C1 to C6	mm	1049	949	100

Crush Measurements: Bumper Cover Removed

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
B1	Bumper Beam 1 at left side	mm	3132	2716	-416
B2	Bumper Beam 2 at left side	mm	3162	2728	-434
B3	Bumper Beam 3 at left side	mm	3192	2817	-375
B4	Bumper Beam 4 at left side	mm	3210	2906	-304
B5	Bumper Beam 5 at right side	mm	3217	2981	-236
B6	Bumper Beam 6 at right side	mm	3212	3048	-164
B7	Bumper Beam 7 at right side	mm	3197	3107	-90
B8	Bumper Beam 8 at right side	mm	3169	3157	-12
B9	Bumper Beam 9 at right side	mm	3136	3201	65
L	B1 to B9	mm	1208	1040	168

DATA SHEET NO. 13
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

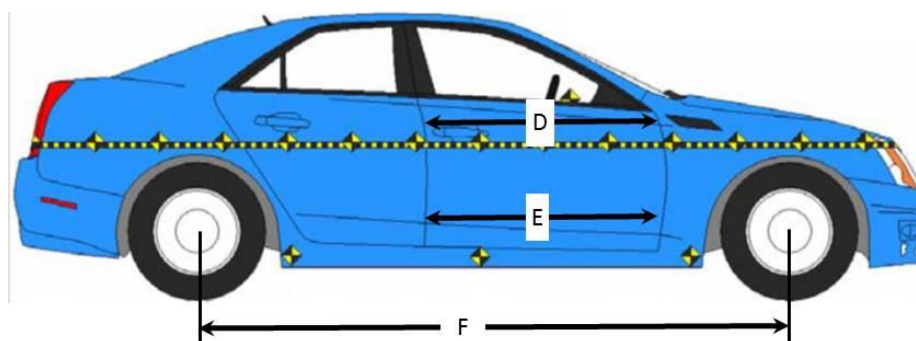
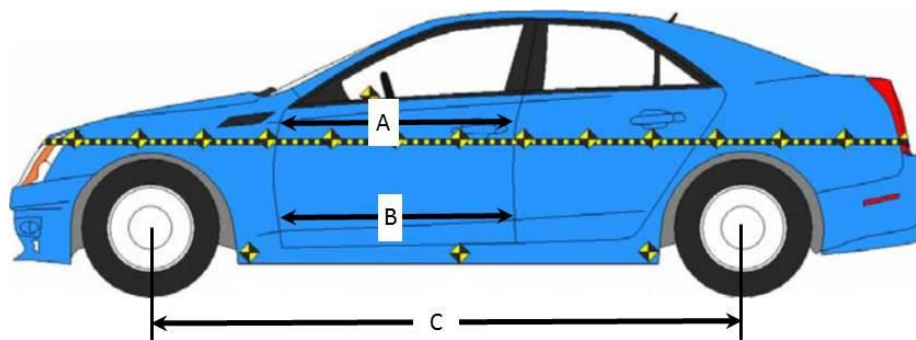
NHTSA No.: RD0529
 Test Date: 6/27/2014

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1050	1001	-49
B	Left Side Lower	mm	902	885	-17
D	Right Side Upper	mm	1050	1048	-2
E	Right Side Lower	mm	913	913	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2703	2496	-207
F	Right Side Wheelbase	mm	2703	2758	55



DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

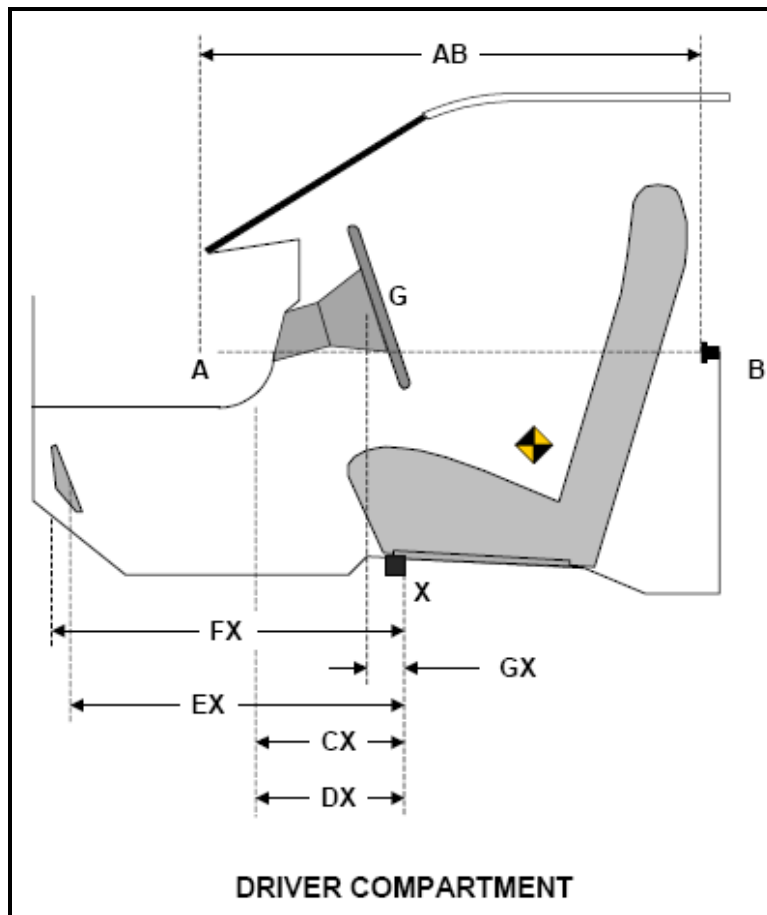
Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	880	874	-6
CX	Left Knee Bolster to X	mm	267	244	-23
DX	Right Knee Bolster to X	mm	252	221	-31
EX	Brake Pedal to X	mm	556	462	-94
FX	Foot Rest to X	mm	630	544	-86
GX	Center of Steering Column Wheel Hub to X	mm	62	18	-44

X = Front of Seat Track (Stationary)

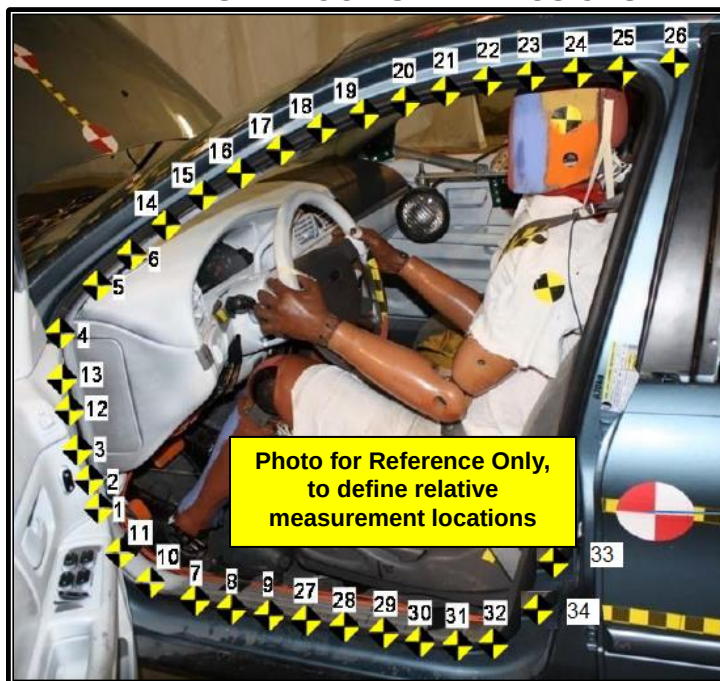


DATA SHEET NO.13 (CONTINUED) **VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

DRIVER SIDE DOOR SILL INTRUSIONS



Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	1894	-735	922	1871	-736	911	-23	-1	-11
2	1902	-731	843	1866	-736	836	-36	-5	-7
3	1902	-728	772	1859	-735	763	-43	-7	-9
4	1904	-722	472	1868	-741	460	-36	-19	-12
5	1900	-715	397	1873	-737	385	-27	-22	-12
6	1850	-699	323	1837	-712	305	-13	-13	-18
7	1803	-741	1009	1796	-734	1012	-7	7	3
8	1655	-739	1013	1652	-725	1012	-3	14	-1
9	1503	-739	1013	1501	-727	1011	-2	12	-2
10	1847	-739	994	1837	-726	992	-10	13	-2
11	1879	-738	964	1862	-732	959	-17	6	-5
12	1903	-723	670	1855	-739	660	-48	-16	-10
13	1903	-723	568	1857	-741	557	-46	-18	-11
14	1783	-689	288	1788	-695	270	5	-6	-18
15	1713	-681	257	1717	-689	242	4	-8	-15
16	1642	-672	226	1645	-677	213	3	-5	-13

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
17	1572	-662	198	1574	-669	185	2	-7	-13
18	1500	-653	170	1501	-657	160	1	-4	-10
19	1428	-643	146	1428	-647	136	0	-4	-10
20	1356	-634	124	1357	-636	116	1	-2	-8
21	1282	-624	106	1283	-628	98	1	-4	-8
22	1208	-618	91	1209	-621	85	1	-3	-6
23	1132	-613	80	1133	-616	75	1	-3	-5
24	1057	-610	71	1058	-612	67	1	-2	-4
25	983	-607	64	983	-609	62	0	-2	-2
26	899	-606	64	898	-609	62	-1	-3	-2
27	1451	-739	1013	1448	-728	1010	-3	11	-3
28	1398	-738	1012	1397	-728	1010	-1	10	-2
29	1345	-738	1011	1342	-728	1009	-3	10	-2
30	1292	-739	1007	1290	-729	1005	-2	10	-2
31	1241	-739	999	1239	-730	997	-2	9	-2
32	1197	-739	986	1194	-732	984	-3	7	-2
33	1024	-728	772	1021	-724	771	-3	4	-1
34	1097	-736	923	1093	-730	921	-3	5	-1

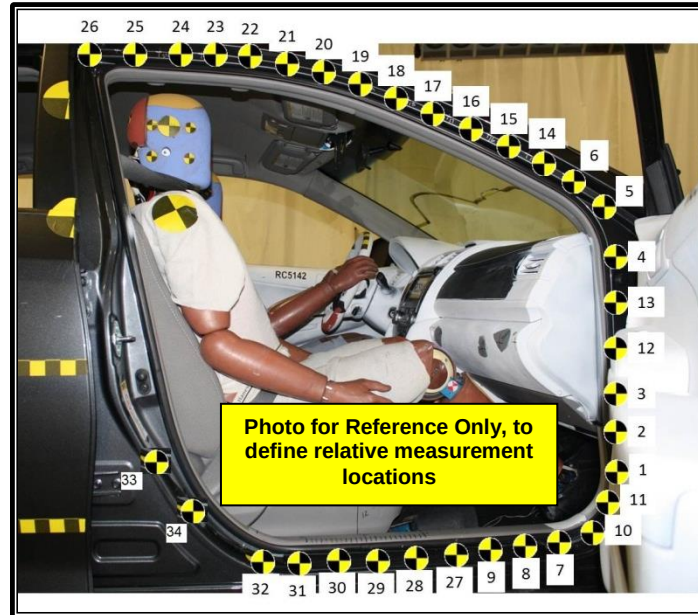
Note: See Appendix D for detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED) **VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

PASSENGER SIDE DOOR SILL INTRUSIONS



Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	1893	737	924	1891	754	927	-2	17	3
2	1902	733	847	1900	749	850	-2	16	3
3	1902	728	774	1900	744	777	-2	16	3
4	1904	723	473	1901	739	476	-3	16	3
5	1901	717	400	1898	733	403	-3	16	3
6	1855	702	324	1853	718	328	-2	16	4
7	1804	743	1004	1802	760	1008	-2	17	4
8	1656	740	1009	1654	755	1012	-2	15	3
9	1506	740	1009	1503	753	1011	-3	13	2
10	1850	741	989	1848	757	992	-2	16	3
11	1880	739	957	1878	756	960	-2	17	3
12	1903	724	674	1900	740	677	-3	16	3
13	1903	724	574	1901	740	577	-2	16	3
14	1768	688	278	1766	700	281	-2	12	3
15	1699	678	247	1697	687	251	-2	9	4
16	1629	669	217	1628	675	221	-1	6	4

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
17	1560	661	190	1560	665	193	0	4	3
18	1490	651	163	1489	653	167	-1	2	4
19	1420	642	139	1420	642	144	0	0	5
20	1349	633	118	1349	632	123	0	-1	5
21	1277	625	101	1277	624	105	0	-1	4
22	1202	617	87	1203	618	90	1	1	3
23	1126	612	76	1127	612	79	1	0	3
24	1050	609	68	1050	609	71	0	0	3
25	975	605	62	975	607	65	0	2	3
26	900	605	61	900	606	63	0	1	2
27	1453	740	1008	1451	752	1011	-2	12	3
28	1402	739	1008	1399	751	1011	-3	12	3
29	1352	739	1008	1349	750	1010	-3	11	2
30	1300	739	1005	1298	749	1008	-2	10	3
31	1251	738	998	1249	748	1001	-2	10	3
32	1197	739	984	1196	747	986	-1	8	2
33	1024	728	772	1022	733	774	-2	6	1
34	1098	736	921	1095	743	924	-2	7	2

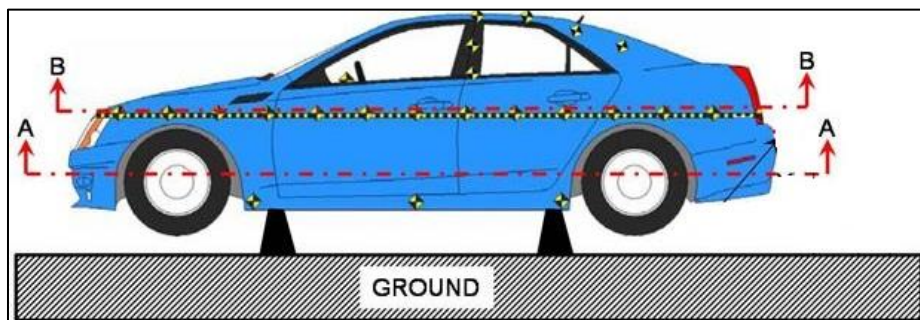
Note: See Appendix D for detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A



Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
1	2792	-876	891	1	2559	-721	895
2	2844	-864	891	2	2538	-625	893
3	2909	-846	892	3	2519	-587	893
4	2958	-806	891	4	2568	-405	892
5	3060	-689	892	5	2650	-410	893
6	3155	-591	892	6	2672	-356	893
7	3213	-497	891	7	2699	-291	892
8	3219	-470	892	8	2737	-207	892
9	3281	-341	892	9	2763	-137	891
10	3300	-261	892	10	2836	-49	892
11	3314	-135	892	11	2914	59	891
12	3319	-6	892	12	2937	108	891
13	3319	44	892	13	2967	183	891
14	3313	160	893	14	3092	278	891
15	3297	292	892	15	3137	392	890
16	3277	357	892	16	3181	487	890
17	3232	450	893	17	3208	570	889
18	3217	492	892	18	3034	584	889
19	3166	578	892	19	2945	618	888
20	3109	645	893	20	2887	688	888
21	3034	718	893	21	2842	764	888
22	2982	783	893	22	2802	814	887
23	2924	844	893	23	2772	925	887
24	2831	875	893	24	2622	937	886
25	2800	885	893	25	2461	928	886

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
26	2119	887	893	26	2371	918	893
27	2032	885	893	27	2255	903	892
28	1939	877	893	28	2113	905	892
29	1776	873	892	29	2023	909	892
30	1551	872	892	30	1958	904	892
31	1300	872	892	31	1760	894	892
32	1065	871	893	32	1602	891	892
33	897	871	893	33	1345	885	892
34	847	872	893	34	1152	881	892
35	684	872	892	35	965	877	892
36	491	874	893	36	830	876	892
37	337	878	892	37	642	875	891
38	209	886	893	38	434	875	893
39	98	888	892	39	249	881	893
40	-578	880	892	40	157	886	892
41	-765	851	893	41	85	883	892
42	-842	834	893	42	-580	880	892
43	-947	784	892	43	-681	866	892
44	-1042	697	893	44	-792	846	893
45	-1109	587	892	45	-864	829	893
46	-1148	486	893	46	-966	772	892
47	-1176	357	892	47	-1051	687	892
48	-1198	172	892	48	-1113	580	892
49	-1205	-1	892	49	-1148	489	892
50	-1201	-144	892	50	-1185	304	893
51	-1183	-313	892	51	-1201	145	892
52	-1168	-399	892	52	-1205	9	893
53	-1134	-526	893	53	-1202	-63	892
54	-1073	-650	893	54	-1194	-216	892
55	-981	-757	892	55	-1171	-382	892
56	-849	-831	892	56	-1137	-518	893
57	-712	-859	893	57	-1097	-611	892
58	-580	-879	892	58	-1020	-721	893
59	94	-887	892	59	-872	-823	892
60	148	-885	893	60	-774	-848	892
61	241	-880	893	61	-641	-871	892
62	435	-872	892	62	-581	-879	892
63	627	-871	892	63	89	-884	892
64	818	-871	892	64	169	-882	893
65	884	-871	893	65	321	-872	893
66	940	-873	892	66	604	-867	893

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
67	1095	-873	892	67	784	-866	892
68	1276	-873	893	68	875	-866	893
69	1479	-873	893	69	883	-870	892
70	1698	-873	893	70	1064	-875	892
71	1924	-877	892	71	1226	-879	893
72	2021	-884	892	72	1368	-884	892
73	2118	-887	892	73	1507	-884	892
74	2792	-876	891	74	1688	-881	892
				75	1878	-883	892
				76	2005	-889	892
				77	2019	-870	893
				78	2063	-864	892
				79	2169	-826	892
				80	2312	-795	893
				81	2462	-749	893
				82	2521	-759	892

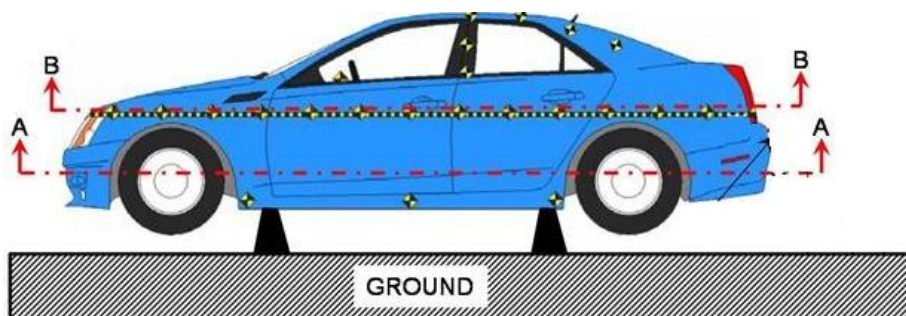
Note: See Appendix D for detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B



Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
1	2130	-859	618	1	2385	-483	618
2	2195	-865	617	2	2500	-435	619
3	2329	-879	618	3	2575	-431	618
4	2543	-872	618	4	2625	-406	619
5	2673	-831	617	5	2649	-497	619
6	2779	-797	618	6	2687	-478	619
7	2883	-771	617	7	2717	-445	619
8	2991	-675	618	8	2733	-337	619
9	3040	-578	618	9	2725	-156	618
10	3076	-462	618	10	2795	-70	617
11	3098	-427	618	11	2866	22	616
12	3120	-284	618	12	2930	133	617
13	3144	-154	618	13	2956	202	617
14	3153	-36	619	14	2981	327	616
15	3153	6	618	15	2993	386	616
16	3151	81	619	16	3001	471	615
17	3137	195	618	17	2688	739	613
18	3116	308	619	18	2686	808	613
19	3099	421	619	19	2750	839	613
20	3062	489	618	20	2644	877	612
21	3052	548	619	21	2463	912	612
22	3011	650	619	22	2268	903	611
23	2925	745	619	23	2100	885	611
24	2838	788	619	24	2029	880	618
25	2774	795	619	25	1987	881	618

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
26	2683	831	619	26	1828	886	618
27	2564	871	619	27	1631	886	618
28	2369	883	619	28	1483	885	618
29	2209	869	619	29	1324	883	618
30	2094	859	619	30	1004	881	618
31	2038	858	618	31	890	880	618
32	1912	862	618	32	805	879	618
33	1709	867	618	33	663	879	619
34	1489	870	619	34	486	877	618
35	1323	873	619	35	277	874	618
36	1120	876	619	36	80	871	619
37	962	878	619	37	-53	874	617
38	895	879	619	38	-143	880	618
39	785	878	618	39	-158	883	618
40	630	878	618	40	-262	883	618
41	489	877	618	41	-393	880	618
42	309	875	619	42	-524	861	618
43	119	873	618	43	-662	834	618
44	-92	884	619	44	-754	819	618
45	-271	886	619	45	-897	795	618
46	-436	880	619	46	-983	739	619
47	-579	854	618	47	-1060	590	618
48	-634	840	618	48	-1084	516	618
49	-769	818	619	49	-1079	489	618
50	-895	796	619	50	-1105	383	618
51	-948	776	619	51	-1118	311	618
52	-1030	664	619	52	-1120	198	618
53	-1077	543	619	53	-1125	53	618
54	-1086	514	619	54	-1125	-5	618
55	-1079	501	618	55	-1124	-88	618
56	-1107	395	619	56	-1120	-223	618
57	-1119	330	618	57	-1120	-318	618
58	-1119	243	619	58	-1093	-451	618
59	-1125	103	618	59	-1081	-495	619
60	-1127	-3	618	60	-1088	-515	619
61	-1125	-131	618	61	-1048	-625	618
62	-1121	-230	618	62	-1000	-719	618
63	-1121	-310	618	63	-953	-773	618
64	-1121	-323	619	64	-797	-813	618
65	-1104	-410	619	65	-661	-835	618
66	-1085	-483	619	66	-519	-864	618
67	-1081	-499	619	67	-323	-884	618

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
68	-1087	-516	619	68	-158	-884	618
69	-1060	-591	618	69	-150	-882	618
70	-1019	-683	618	70	-28	-875	619
71	-969	-756	619	71	140	-870	618
72	-901	-794	619	72	308	-872	618
73	-777	-815	619	73	488	-874	618
74	-614	-843	618	74	659	-875	619
75	-458	-874	618	75	824	-875	617
76	-287	-883	619	76	875	-875	619
77	-117	-881	618	77	881	-882	618
78	50	-871	618	78	971	-887	619
79	162	-870	619	79	1034	-889	618
80	231	-871	618	80	1119	-892	618
81	330	-873	618	81	1262	-895	618
82	463	-875	619	82	1438	-900	618
83	617	-876	618	83	1615	-904	618
84	779	-877	618	84	1801	-903	619
85	883	-877	618	85	1942	-892	618
86	984	-878	618	86	2010	-887	618
87	1156	-875	619	87	2002	-831	618
88	1330	-873	618	88	2072	-820	618
89	1512	-870	618	89	2147	-776	619
90	1703	-868	618	90	2217	-733	618
91	1897	-863	618	91	2273	-620	619
92	2023	-857	618	92	2313	-550	618
93	2091	-858	618	93	2338	-490	618
94	2130	-859	618				

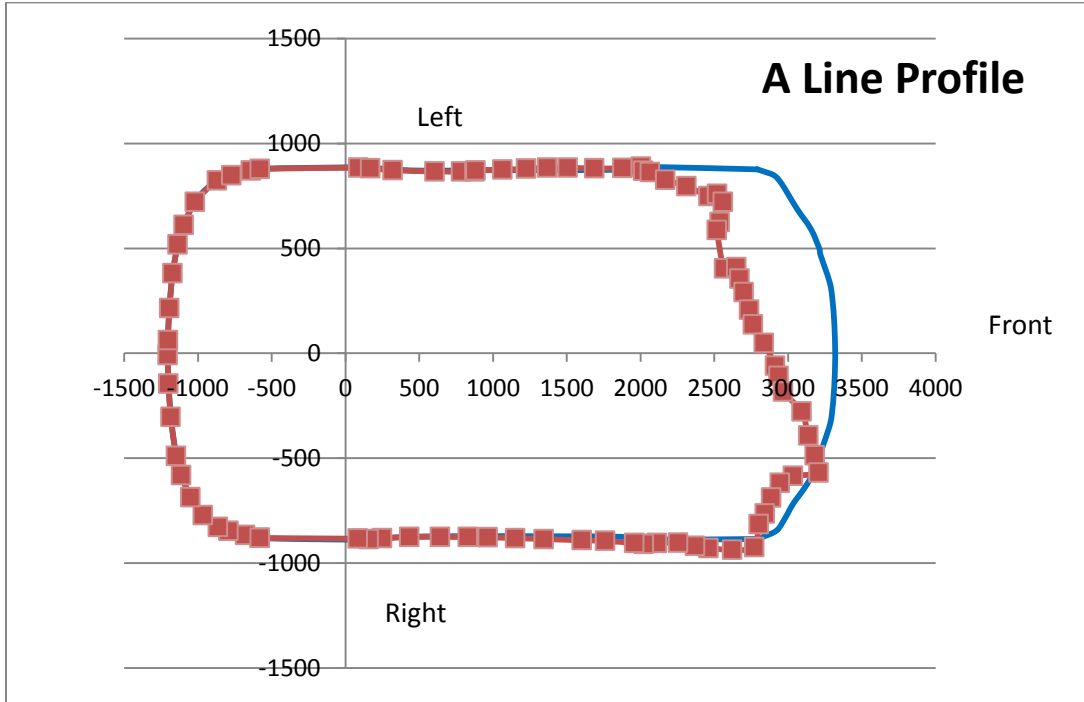
Note: See Appendix D for detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

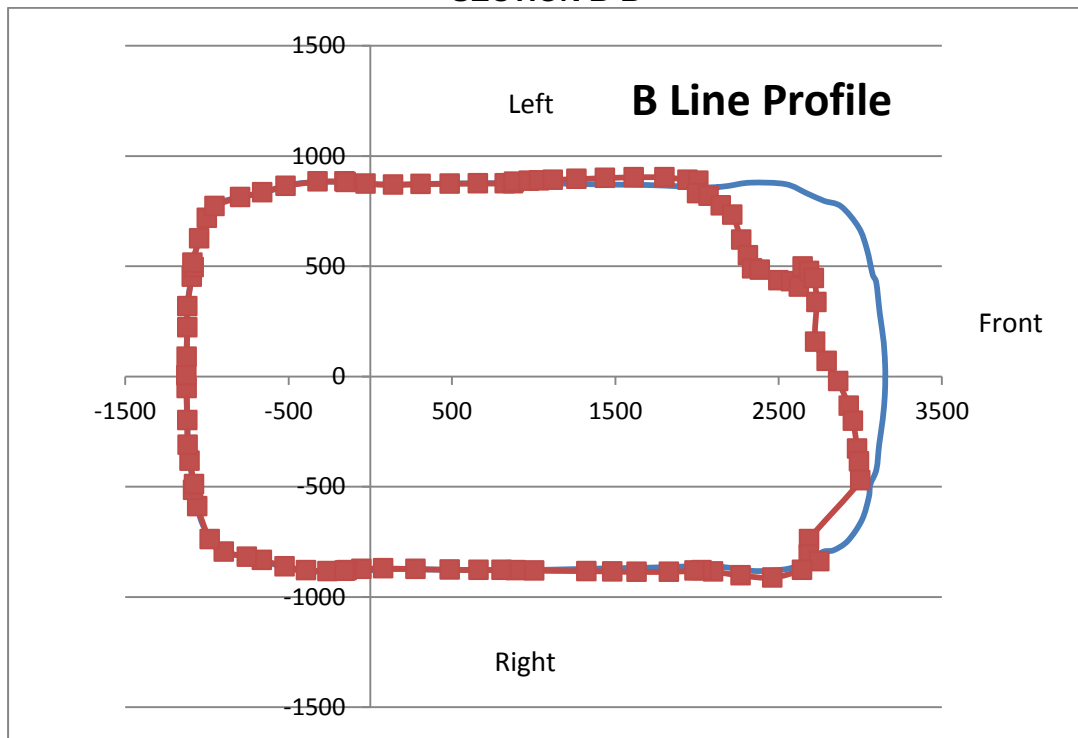
Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A



SECTION B-B



DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

STRUCTURAL BUMPER BEAM POINTS

	Point	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
		X	Y	Z	X	Y	Z	X	Y	Z
Redundant Structural Bumper Beam	B1	3131	-605	866	2717	-441	586	-414	164	-280
	B2	3169	-454	868	2738	-309	649	-431	145	-219
	B3	3198	-304	867	2831	-201	698	-367	103	-169
	B4	3215	-150	869	2918	-82	743	-297	68	-126
	B5	3223	-2	866	2995	39	784	-228	41	-82
	B6	3215	151	868	3061	170	826	-154	19	-42
	B7	3195	302	869	3117	307	863	-78	5	-6
	B8	3167	449	868	3163	446	896	-4	-3	28
	B9	3136	603	867	3210	592	930	74	-11	63
Center Structural Bumper Beam	B1	3132	-605	891	2716	-450	609	-416	155	-282
	B2	3162	-454	893	2728	-308	665	-434	146	-228
	B3	3192	-303	892	2817	-198	719	-375	105	-173
	B4	3210	-150	893	2906	-82	766	-304	68	-127
	B5	3217	-2	892	2981	40	807	-236	42	-85
	B6	3212	149	892	3048	168	847	-164	19	-45
	B7	3197	300	892	3107	303	885	-90	3	-7
	B8	3169	451	892	3157	444	919	-12	-7	27
	B9	3136	603	891	3201	590	953	65	-13	62
Upper Radiator Support	1	3060	-439	647	2513	-210	493	-547	229	-154
	2	3032	-328	619	2562	-112	470	-470	216	-149
	3	3023	-218	616	2658	-65	447	-365	153	-169
	4	3032	-109	621	2753	-7	443	-279	102	-178
	5	3021	1	619	2800	92	461	-221	91	-158
	6	3031	111	619	2863	179	498	-168	68	-121
	7	3029	220	623	2907	270	538	-122	50	-85
	8	3032	329	618	2958	362	568	-74	33	-50
	9	3059	438	641	3024	436	621	-35	-2	-20

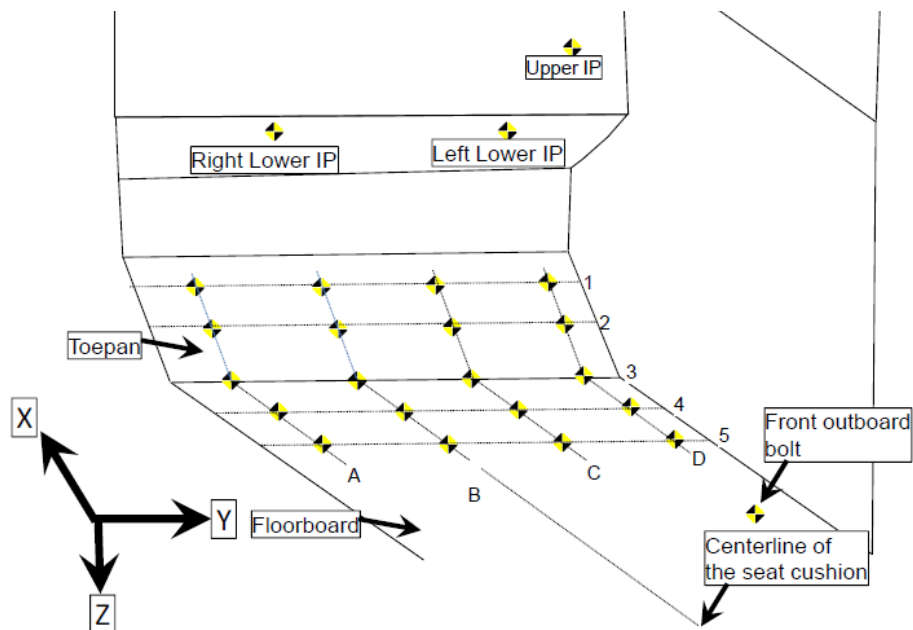
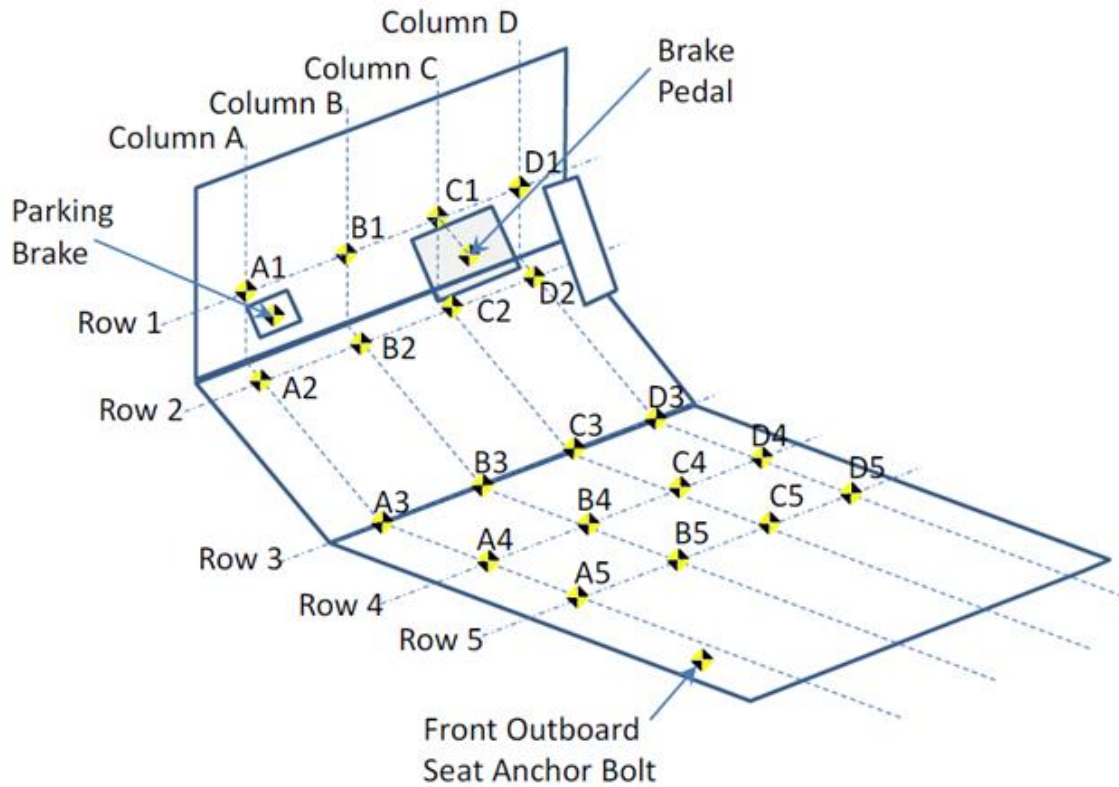
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO.13 (CONTINUED) **VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



Note: See Appendix D for toe pan measuring procedure

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

DRIVER FLOOR PAN MEASUREMENTS

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2102	-583	921	2006	-540	907	-96	43	-14
B1	2216	-481	922	2074	-411	884	-142	70	-38
C1	2215	-332	922	2095	-278	883	-120	54	-39
D1	2216	-185	921	2139	-150	885	-77	35	-36
A2	2113	-581	1001	2054	-546	978	-59	35	-23
B2	2180	-480	1003	2104	-438	953	-76	42	-50
C2	2201	-331	1003	2122	-293	955	-79	38	-48
D2	2195	-182	1004	2148	-158	968	-47	24	-36
A3	2029	-582	1094	2016	-554	1086	-13	28	-8
B3	2021	-482	1096	1998	-452	1077	-23	30	-19
C3	2011	-334	1093	1979	-307	1080	-32	27	-13
D3	2029	-181	1095	2003	-161	1086	-26	20	-9
A4	1931	-583	1135	1925	-558	1134	-6	25	-1
B4	1930	-484	1130	1922	-458	1134	-8	26	4
C4	1930	-331	1134	1913	-308	1140	-17	23	6
D4	1930	-182	1119	1911	-158	1127	-19	24	8
A5	1831	-583	1148	1824	-560	1150	-7	23	2
B5	1832	-482	1140	1823	-462	1153	-9	20	13
C5	1828	-332	1140	1816	-313	1142	-12	19	2
D5	1830	-181	1138	1816	-162	1146	-14	19	8
Brake Pedal	2004	-334	921	1907	-334	883	-97	0	-38
Driver IP Left	1716	-506	636	1688	-517	635	-28	-11	-1
Driver IP Right	1701	-206	637	1665	-231	635	-36	-25	-2
DOLP	1702	-607	621	1662	-613	618	-40	-6	-3
Steering Column	1511	-358	464	1462	-412	502	-49	-54	38
Front Outboard Bolt	1448	-595	1047	1444	-585	1044	-4	10	-3
Emergency Brake									

Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

PASSENGER FLOOR PAN MEASUREMENTS

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2225	211	920	2197	233	904	-28	22	-16
B1	2226	361	918	2216	382	908	-10	21	-10
C1	2179	510	919	2175	532	914	-4	22	-5
D1	2110	612	919	2106	635	919	-4	23	0
A2	2174	210	1003	2164	229	994	-10	19	-9
B2	2175	360	1003	2170	379	996	-5	19	-7
C2	2161	511	1004	2156	533	1000	-5	22	-4
D2	2093	611	1001	2090	634	1001	-3	23	0
A3	2021	211	1094	2025	235	1099	4	24	5
B3	2013	359	1095	2012	377	1095	-1	18	0
C3	2020	514	1096	2018	533	1094	-2	19	-2
D3	2022	611	1095	2021	630	1095	-1	19	0
A4	1922	212	1132	1924	232	1133	2	20	1
B4	1921	361	1132	1923	380	1132	2	19	0
C4	1922	509	1132	1920	526	1130	-2	17	-2
D4	1919	612	1134	1918	629	1134	-1	17	0
A5	1821	209	1133	1823	226	1134	2	17	1
B5	1824	360	1136	1824	376	1138	0	16	2
C5	1823	511	1139	1820	527	1138	-3	16	-1
D5	1822	611	1145	1819	628	1139	-3	17	-6
Pass IP Left	1703	208	648	1700	206	649	-3	-2	1
Pass IP Right	1726	508	647	1727	505	653	1	-3	6
PORP	1703	611	621	1704	611	631	1	0	10
Front Outboard Bolt	1448	595	1044	1448	606	1045	0	11	1

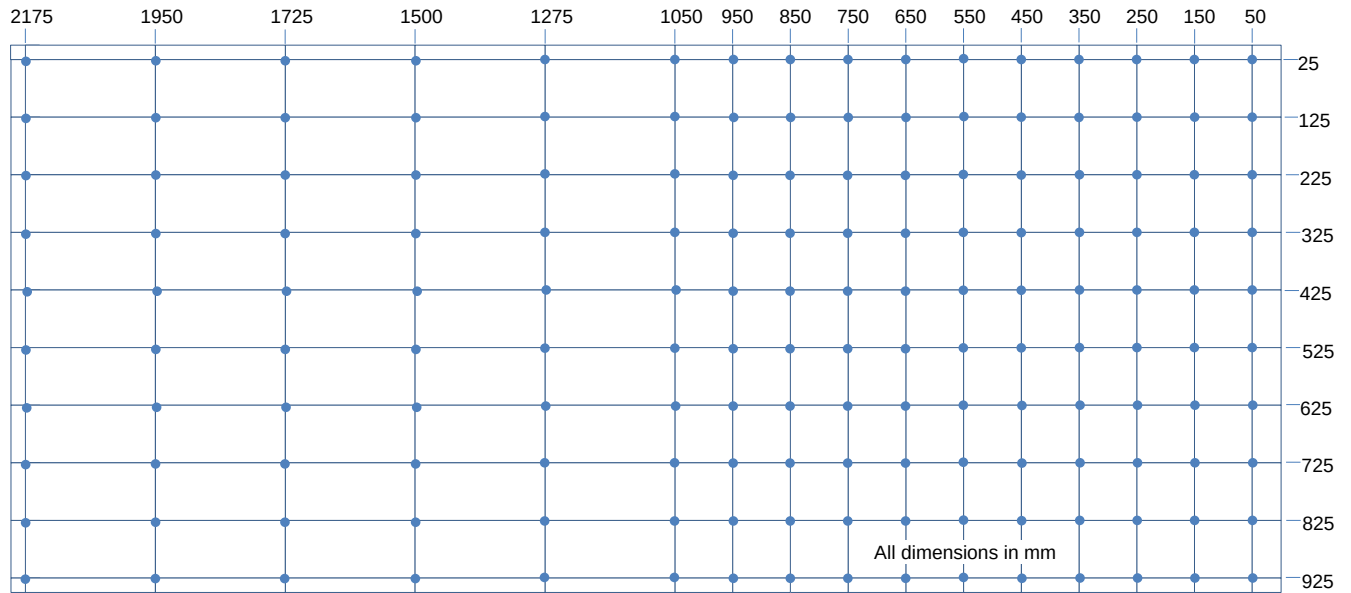
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO.14 **RMDB CRUSH MEASUREMENTS**

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014



	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
R10	-0.6	-1.0	-1.0	-1.0	-1.1	-1.2	-1.1	-1.2	-1.3	-1.4	-1.6	-1.7	-1.8	-2.0	-1.9	-2.2
R9	-0.7	-0.9	-0.7	-0.7	-0.9	-0.9	-0.9	-0.9	-0.9	-0.9	-0.6	0.0	0.2	0.3	0.6	0.9
R8	-0.4	-0.4	-0.6	-0.5	-0.6	-0.7	-0.6	-0.5	10.2	16.5	17.5	13.2	12.8	4.4	3.6	10.3
R7	-0.2	-0.2	-0.3	-0.3	-0.4	-0.4	-0.3	2.8	8.9	35.4	44.6	49.4	35.7	17.6	14.8	56.2
R6	0.2	0.1	-0.3	-0.2	-0.1	-0.2	-0.1	0.3	6.8	36.7	45.7	51.3	38.1	36.7	52.0	115.2
R5	0.4	0.2	0.4	0.4	0.1	0.1	0.2	0.2	23.3	11.2	38.6	109.5	187.0	268.3	299.0	292.5
R4	1.0	0.9	0.7	0.8	0.6	0.6	0.6	3.6	105.0	46.8	23.6	83.9	166.4	247.5	266.2	269.2
R3	1.1	1.2	1.1	1.0	0.9	0.9	0.8	11.3	162.3	90.5	60.0	45.3	130.9	234.6	261.0	244.3
R2	0.1	1.6	1.4	1.3	1.2	1.2	1.2	19.9	193.5	122.5	67.5	31.1	96.3	178.1	232.5	250.0
R1	2.2	1.9	1.8	1.8						137.0	64.8	26.8	61.3	130.9	147.9	167.0

*Barrier was cut to accommodate the rail, therefore these points were un-measurable.

DATA SHEET NO. 15
SUMMARY OF FMVSS 212, 219 (PARTIAL), AND 301 DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014

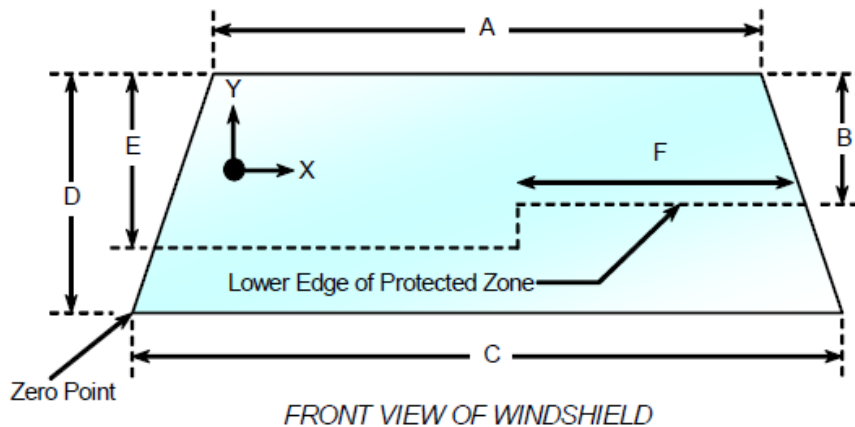
Please provide windshield mounting details. A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

The standard requires that the post-test retention measurement be a minimum of 75% of the pre-test total periphery measurement for vehicles not equipped with occupant passive restraints and 50% for each side of the windshield for vehicles which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 21°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2220	1325	59.7%
Right Side	2220	2220	100%
Total	4440	3545	79.8%



Item	Units	Value
A	mm	1210
B	mm	543
C	mm	1410
D	mm	910
E	mm	552
F	mm	460

AREAS OF PROTECTED ZONE FAILURES

A. Provide coordinates of the area that the protected zone was penetrated more than .25 inches by a vehicle component other than one that is normally in contact with the windshield.

- No penetration

X	Y

B. Provide coordinates of the area beneath the protected zone that the inner surface of the windshield was penetrated by a vehicle component.

- No Penetration

X	Y

DATA SHEET NO. 15 (CONTINUED)
SUMMARY OF FMVSS 212, 219 (PARTIAL), AND 301 DATA

Test Vehicle: 2013 Hyundai Elantra four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
Test Date: 6/27/2014

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Ambient Temperature at Test Vehicle Time of Impact: 21° C

Test Time: 4:26 PM

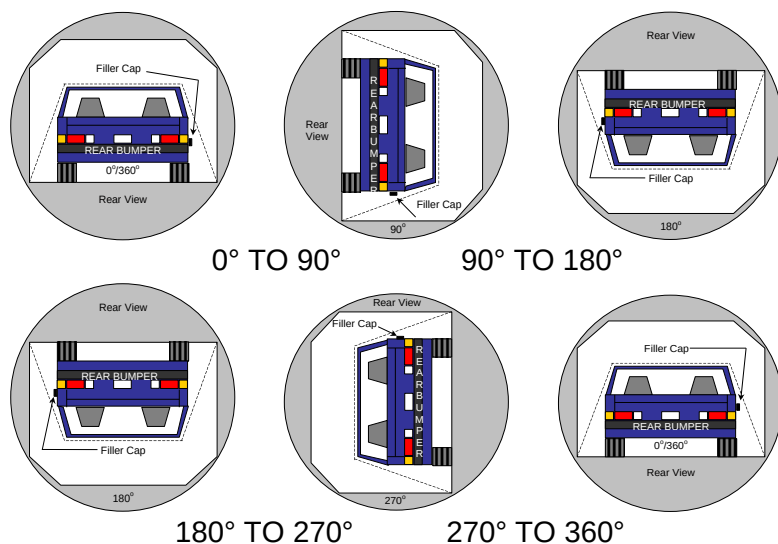
Stoddard Solvent Spillage Measurements

A.	From impact until vehicle motion ceases: (Maximum allowable = 1 oz.)	<u>0</u>	oz
B.	For the 5-minute period after motion ceases: (Maximum allowable = 5 oz.)	<u>0</u>	oz
C.	For the following 25 minutes: (Maximum allowable = 1 oz./minute)	<u>0</u>	oz
D.	Spillage	<u>0</u>	oz

DATA SHEET NO. 16 **FMVSS 301 STATIC ROLLOVER RESULTS**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.

2. The position hold time at each position is 300 seconds (minimum).

3. Details of Stoddard Solvent spillage: None

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	67	300	367
90° to 180°	63	300	363
180° to 270°	62	300	362
270° to 360°	68	300	368

FMVSS 301 SPILLAGE TABLE

Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

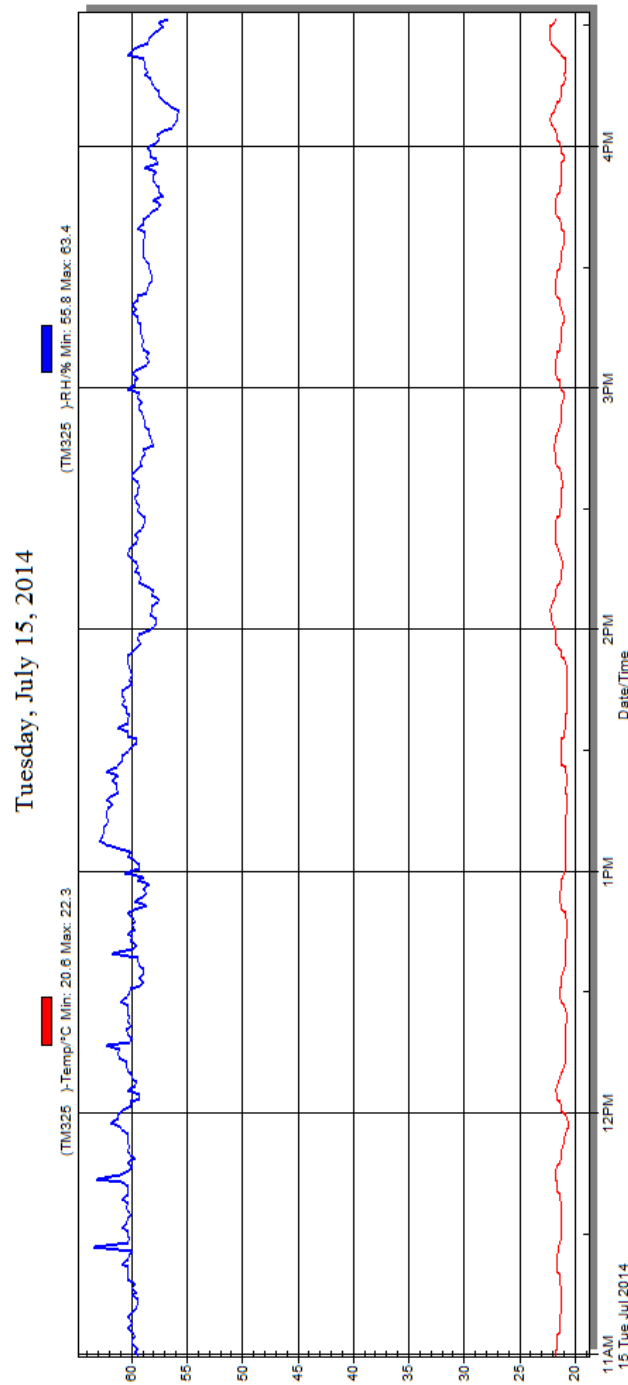
SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

DATA SHEET NO. 17 **DUMMY/VEHICLE TEMPERATURE STABILIZATION**

Test Vehicle: 2013 Hyundai Elantra four door sedan
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD0529
 Test Date: 6/27/2014



Temperature Stabilization Chart/Data

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS		
No.	Description	Page
1	As Delivered Right Front 3-4 View of Test Vehicle	A-9
2	As Delivered Left Rear 3-4 View of Test Vehicle	A-9
3	Test Vehicle Certification Label	A-10
4	Test Vehicle Tire Placard	A-10
5	Pre-Test Front View of Test Vehicle	A-11
6	Post-Test Front View of Test Vehicle	A-11
7	Pre-Test Left Front 3-4 View of Test Vehicle	A-12
8	Post-Test Left Front 3-4 View of Test Vehicle	A-12
9	Pre-Test Left Side View of Test Vehicle	A-13
10	Post-Test Left Side View of Test Vehicle	A-13
11	Pre-Test Left Rear 3-4 View of Test Vehicle	A-14
12	Post-Test Left Rear 3-4 View of Test Vehicle	A-14
13	Pre-Test Rear View of Test Vehicle	A-15
14	Post-Test Rear View of Test Vehicle	A-15
15	Pre-Test Right Rear 3-4 View of Test Vehicle	A-16
16	Post-Test Right Rear 3-4 View of Test Vehicle	A-16
17	Pre-Test Right Side View of Test Vehicle	A-17
18	Post-Test Right Side View of Test Vehicle	A-17
19	Pre-Test Right Front 3-4 View of Test Vehicle	A-18
20	Post-Test Right Front 3-4 View of Test Vehicle	A-18
21	Monroney Label Photograph	A-19
22	Pre-Test Overhead View of RMDB against target vehicle at ideal Impact Point	A-19
23	Pre-Test Left Side View of RMDB against target vehicle at ideal Impact Point	A-20
24	Pre-Test Right Side View of RMDB against target vehicle at ideal Impact Point	A-20
25	Pre-Test Close-up View of Impact Point	A-21
26	Post-Test Close-up View of Impact Point	A-21
27	Post-Test Vehicle Overhead View	A-22
28	Pre-Test Close-up View of Driver Door Latch	A-23
29	Post-Test Close-up View of Driver Door Latch	A-23
30	Pre-Test Close-up View of Passenger Door Latch	A-24

TABLE OF PHOTOGRAPHS (Continued)		
No.	Description	Page
31	Post-Test Close-up View of Passenger Door Latch	A-24
32	Pre-Test Windshield View	A-25
33	Post-Test Windshield View	A-25
34	Pre-Test View of Driver Inner Door Panel	A-26
35	Post-Test View of Driver Inner Door Panel	A-26
36	Pre-Test View of Passenger Inner Door Panel	A-27
37	Post-Test View of Passenger Inner Door Panel	A-27
38	Pre-Test Overall View of Driver Knee Bolsters	A-28
39	Post-Test Overall View of Driver Knee Bolsters	A-28
40	Pre-Test Left Side View of Driver Knee Bolsters	A-29
41	Post-Test Left Side View of Driver Knee Bolsters	A-29
42	Pre-Test Right Side View of Driver Knee Bolsters	A-30
43	Post-Test Right Side View of Driver Knee Bolsters	A-30
44	Pre-Test View of Driver Floor pan at Left sill level, w/carpet	A-31
45	Post-Test View of Driver Floor pan at Left sill level, w/carpet	A-31
46	Pre-Test View of Driver Floor pan at Mid seat level, w/carpet	A-32
47	Post-Test view of Driver Floor pan at Mid seat level, w/carpet	A-32
48	Pre-Test View of Driver Floor pan at Left sill level, w/o carpet	A-33
49	Post-Test View of Driver Floor pan at Left sill level, w/o carpet	A-33
50	Pre-Test View of Driver Floor pan at Mid seat level, w/o carpet	A-34
51	Post-Test view of Driver Floor pan at Mid seat level, w/o carpet	A-34
52	Pre-Test Driver Front Windshield View	A-35
53	Post-Test Driver Front Windshield View	A-35
54	Pre-Test Left Side View of Driver and Interior	A-36
55	Post-Test Left Side View of Driver and Interior	A-36
56	Pre-Test Left Side Driver Window View	A-37
57	Post-Test Left Side Driver Window View	A-37
58	Pre-Test Right Side View of Driver and Interior	A-38
59	Post-Test Right Side View of Driver and Interior	A-38
60	Pre-Test View of Driver Door Clearance	A-39

TABLE OF PHOTOGRAPHS (Continued)		
No.	Description	Page
61	Post-Test View of Driver Door Clearance	A-39
62	Pre-Test View of Parking Brake	A-40
63	Pre-Test Driver Seat Fore Aft Markings	A-41
64	Post-Test Driver Seat Fore Aft Markings	A-41
65	Pre-Test Driver Seat Back Markings	A-42
66	Pre-Test Overhead View of Driver Thighs on Seat	A-42
67	Pre-Test Driver Adjustable D-ring	A-43
68	Post-Test Driver Adjustable D-ring	A-43
69	Pre-Test Driver Feet	A-44
70	Post-Test Driver Feet	A-44
71	Pre-Test View of Driver Right Knee and Bolster	A-45
72	Post-Test View of Driver Right Knee and Bolster	A-45
73	Pre-Test View of Driver Left Knee and Bolster	A-46
74	Post-Test View of Driver Left Knee and Bolster	A-46
75	Pre-Test View of Driver Abdomen	A-47
76	Post-Test View of Driver Abdomen	A-47
77	Pre-Test Left Side View of Steering Wheel set position	A-48
78	Post-Test Left Side View of Steering Wheel set position	A-48
79	Post-Test View of Driver Head Contact with Airbag – Front	A-49
80	Post-Test View of Driver Head Contact with Airbag – Curtain	A-49
81	Post-Test View of Driver Head Contact with Vehicle Interior – A	A-50
81a	Post-Test View of Driver Head Contact with Vehicle Interior – B	A-50
81b	Post-Test View of Driver Head Contact with Vehicle Interior – C	A-51
82	Pre-Test Overall View of Passenger Knee Bolsters	A-52
83	Post-Test Overall View of Passenger Knee Bolsters	A-52
84	Pre-Test Left Side View of Passenger Knee Bolsters	A-53
85	Post-Test Left Side View of Passenger Knee Bolsters	A-53
86	Pre-Test Right Side View of Passenger Knee Bolsters	A-54
87	Post-Test Right Side View of Passenger Knee Bolsters	A-54
88	Pre-Test View of Passenger Floor pan at Left sill level, w/carpet	A-55

TABLE OF PHOTOGRAPHS (Continued)		
No.	Description	Page
89	Post-Test View of Passenger Floor pan at Left sill level, w/carpet	A-55
90	Pre-Test View of Passenger Floor pan at Mid seat level, w/carpet	A-56
91	Post-Test view of Passenger Floor pan at Mid seat level, w/carpet	A-56
92	Pre-Test View of Passenger Floor pan at Left sill level, w/o carpet	A-57
93	Post-Test View of Passenger Floor pan at Left sill level, w/o carpet	A-57
94	Pre-Test View of Passenger Floor pan at Mid seat level, w/o carpet	A-58
95	Post-Test view of Passenger Floor pan at Mid seat level, w/o carpet	A-58
96	Pre-Test Passenger Front Close-up View, Windshield	A-59
97	Post-Test Passenger Front Close-up View, Windshield	A-59
98	Pre-Test Left Side Passenger and Interior View	A-60
99	Post-Test Left Side Passenger and Interior View	A-60
100	Pre-Test Right Side Passenger Window View	A-61
101	Post-Test Right Side Passenger Window View	A-61
102	Pre-Test Right Side Passenger and Interior View	A-62
103	Post-Test Right Side Passenger and Interior View	A-62
104	Pre-Test View of Passenger Door Clearance	A-63
105	Post-Test View of Passenger Door Clearance	A-63
106	Pre-Test Passenger Seat Fore-Aft Markings	A-64
107	Post-Test Passenger Seat Fore-Aft Markings	A-64
108	Pre-Test Passenger Seat Back Markings	A-65
109	Pre-Test Overhead View of Passenger Thighs on seat	A-65
110	Pre-Test Passenger Adjustable D-ring	A-66
111	Post-Test Passenger Adjustable D-ring	A-66
112	Pre-Test View of Passenger Feet	A-67
113	Post-Test View of Passenger Feet	A-67
114	Pre-Test View of Passenger Right Knee and Bolster	A-68
115	Post-Test View of Passenger Right Knee and Bolster	A-68
116	Pre-Test View of Passenger Left Knee and Bolster	A-69
117	Post-Test View of Passenger Left Knee and Bolster	A-69
118	Pre-Test View of Passenger Abdomen	A-70

TABLE OF PHOTOGRAPHS (Continued)		
No.	Description	Page
119	Post-Test View of Passenger Abdomen	A-70
120	Post-Test View of Passenger Head contact with Airbag – Front	A-71
120a	Post-Test View of Passenger Head contact with Airbag – Curtain	A-71
121	Post-Test View of Passenger Head contact with Interior – A	A-72
121a	Post-Test View of Passenger Head contact with Interior – B	A-72
121b	Post-Test View of Passenger Head contact with Interior – C	A-73
122	Post-Test Passenger Contact With Glovebox	A-73
123	Pre-Test Ballast Locations	A-74
124	Post-Test Speed Trap Readout	A-74
125	Pre-Test View of Fuel Filler Cap	A-75
126	Post-Test View of Fuel Filler Cap	A-75
127	Pre-Test Engine Compartment View	A-76
128	Post-Test Engine Compartment View	A-76
129	Pre-Test View of Front Underbody (perpendicular to vehicle)	A-77
130	Post-Test View of Front Underbody (perpendicular to vehicle)	A-77
131	Pre-Test View of Mid Underbody (perpendicular to vehicle)	A-78
132	Post-Test View of Mid Underbody (perpendicular to vehicle)	A-78
133	Pre-Test View of Rear Underbody (perpendicular to vehicle)	A-79
134	Post-Test View of Rear Underbody (perpendicular to vehicle)	A-79
135	Pre-Test View of Steering rack and or sway bar	A-80
136	Post-Test View of Steering rack and or sway bar	A-80
137	Pre-Test Bumper to Rail Attachments and Crush Initiators	A-81
138	Post-Test Bumper to Rail Attachments and Crush Initiators	A-82
139	Post-Test View of Front Sub-Frame Deformation	A-82
140	Pre-Test Frame Rail with tire removed	A-83
141	Post-Test Frame Rail with tire removed	A-83
142	Pre-Test View of Front Driver Wheel Well with tire removed	A-84
143	Post-Test ¾ View of Front Driver Wheel Well w/ tire removed	A-84
144	Post-Test Side View of Front Driver Wheel Well w/ tire removed	A-85
145	Post-Test Right Side 3/4 Rear View of the Front Driver Wheel Well w/ tire removed	A-85

TABLE OF PHOTOGRAPHS (Continued)		
No.	Description	Page
146	Post-Test Looking Down at the Front Driver Shotgun	A-86
147	Post-Test Right Side ¾ View of Front Driver Shotgun	A-86
148	Post-Test Front Driver Close up View of Suspension w/ tire removed	A-87
149	Post-Test ¾ View of Front Passenger Wheel Well w/ tire removed	A-87
150	Post-Test Side View of Front Passenger Wheel Well w/ tire removed	A-88
151	Post-Test Right Side 3/4 Rear View of the Front Passenger Wheel Well w/ tire removed	A-88
152	Post-Test Looking Down at the Front Passenger Shotgun	A-89
153	Post-Test Right Side ¾ View of Front Passenger Shotgun	A-89
154	Post-Test Front Passenger Close up View of Suspension w/ tire removed	A-90
155	Post-Test View of Door Sill with door open-Struck Side	A-90
156	Post-Test View of Deformation of A pillar-Struck Side	A-91
157	Post-Test View of Deformation of B pillar-Struck Side	A-91
158	Post-Test View of Deformation of C pillar-Struck Side	A-92
159	Post-Test View of Wheel and/or Tire Deformation-Struck Side	A-92
160	Post-Test View of Deformation of Rocker or Post-Struck Side	A-93
161	Post-Test View of Windshield Separation	A-93
162	Pre-Test Left Side View of RMDB	A-94
163	Post-Test Left Side View of RMDB	A-94
164	Pre-Test Right Side View of RMDB	A-95
165	Post-Test Right Side View of RMDB	A-95
166	Pre-Test Top View of RMDB	A-96
167	Post-Test Top View of RMDB	A-96
168	Pre-Test Front View of RMDB	A-97
169	Post-Test Front View of RMDB	A-97
170	Pre-Test RMDB & Vehicle, Right Side	A-98
171	Post-Test RMDB & Vehicle, Right Side	A-98
172	Pre-Test RMDB & Vehicle, Left Side	A-99
173	Post-Test RMDB & Vehicle, Left Side	A-99
174	Pre-Test RMDB & Vehicle, Top View	A-100
175	Post-Test RMDB & Vehicle, Top View	A-100

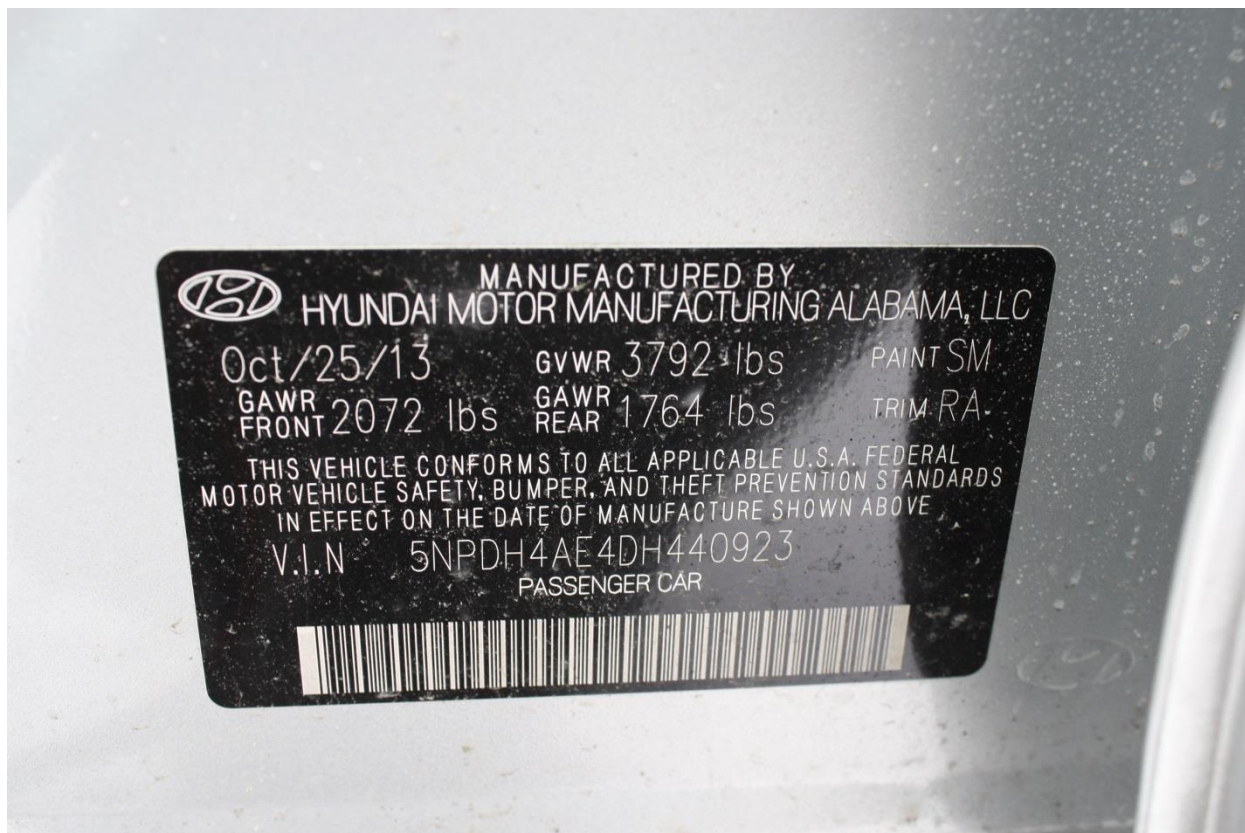
TABLE OF PHOTOGRAPHS (Continued)		
No.	Description	Page
176	Pre-Test RMDB & Vehicle, Rear View	A-101
177	Post-Test RMDB & Vehicle, Rear View	A-101
178	Pre-Test RMDB & Vehicle, Front View	A-102
179	Post-Test RMDB & Vehicle, Front View	A-102
180	Vehicle at 0 Degrees on Static Rollover Device	A-103
181	Vehicle at 90 Degrees on Static Rollover Device	A-103
182	Vehicle at 180 Degrees on Static Rollover Device	A-104
183	Vehicle at 270 Degrees on Static Rollover Device	A-104
184	Vehicle at 360 Degrees on Static Rollover Device	A-105
185	Impact Photo	A-105



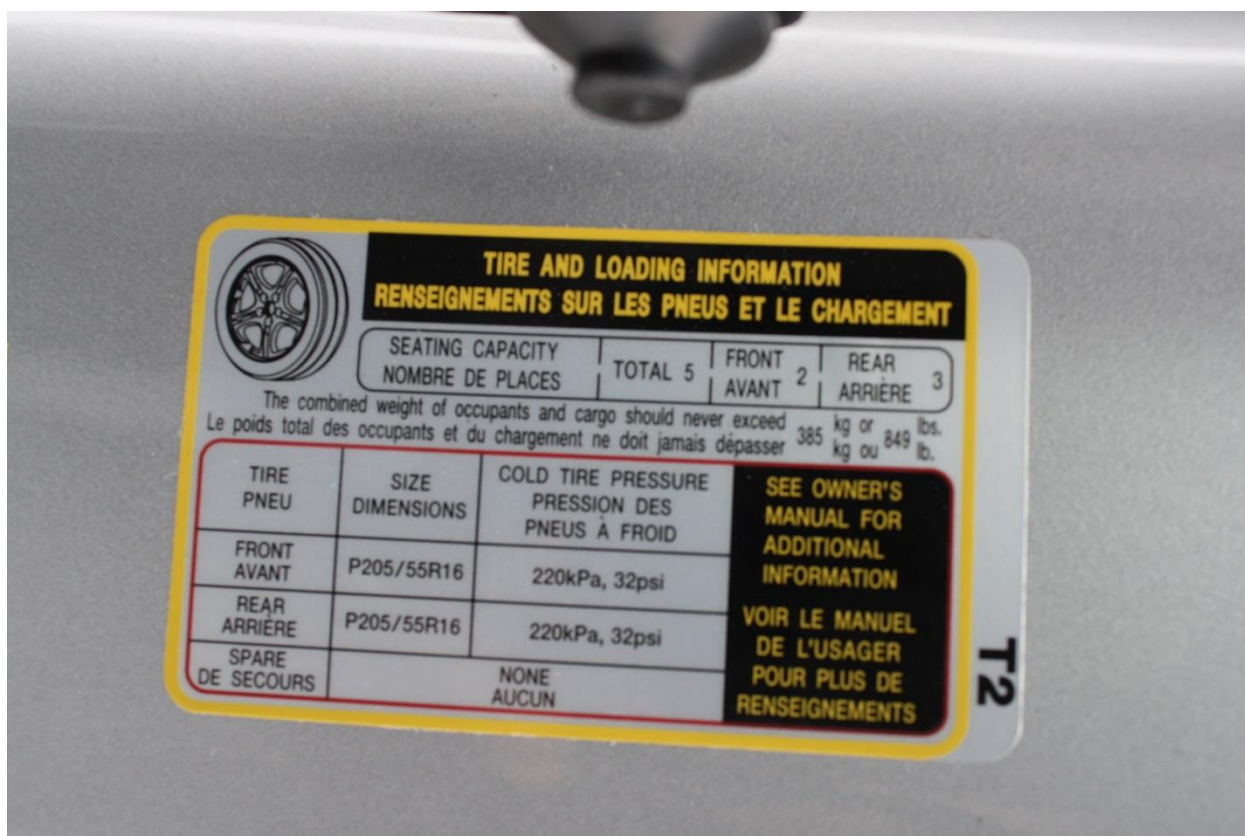
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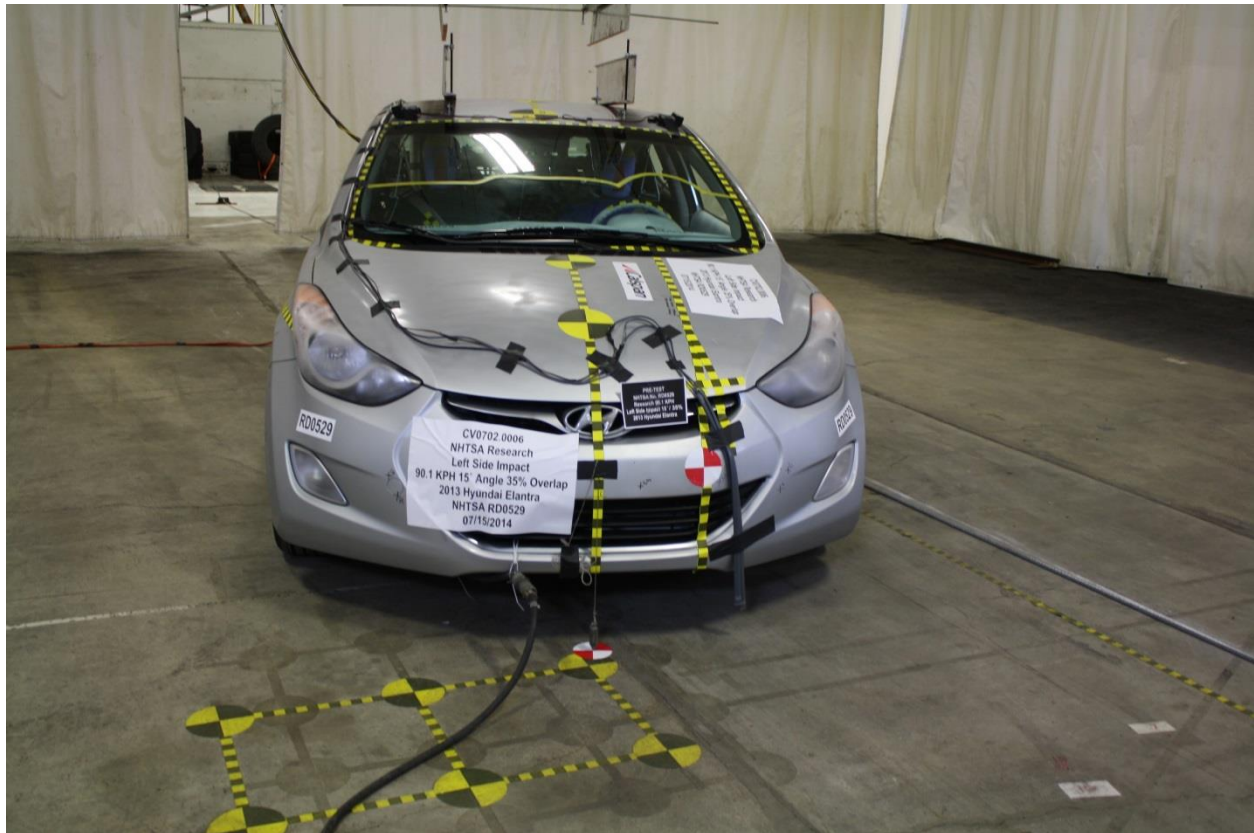
No. 002 As Delivered Left Rear 3-4 View of Test Vehicle



No. 003 Test Vehicle Certification Label



No. 004 Test Vehicle Tire Placard



No. 005 Pre-Test Front View of Test Vehicle



No. 006 Post-Test Front View of Test Vehicle





No. 009 Pre-Test Left Side View of Test Vehicle



No. 010 Post-Test Left Side View of Test Vehicle



No. 011 Pre-Test Left Rear 3-4 View of Test Vehicle



No. 012 Post-Test Left Rear 3-4 View of Test Vehicle



No. 013 Pre-Test Rear View of Test Vehicle



No. 014 Post-Test Rear View of Test Vehicle



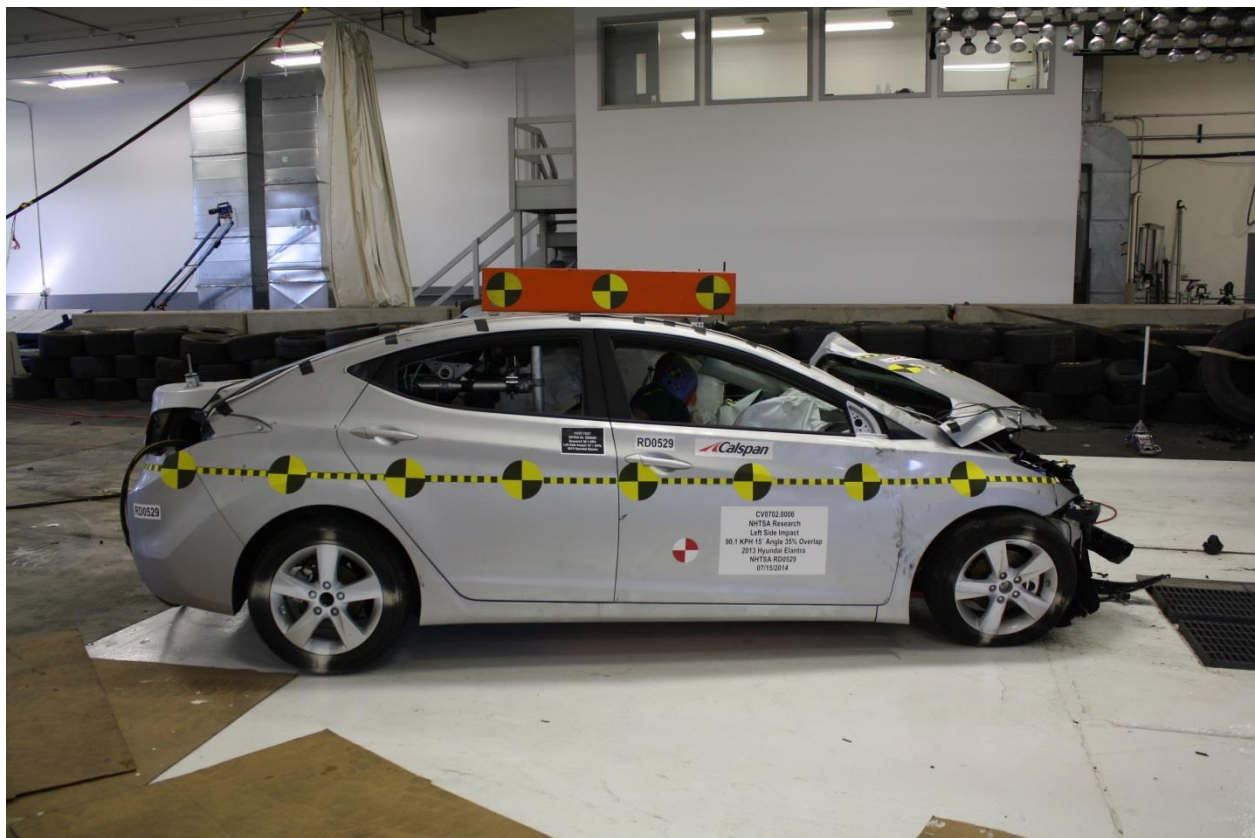
No. 015 Pre-Test Right Rear 3-4 View of Test Vehicle



No. 016 Post-Test Right Rear 3-4 View of Test Vehicle



No. 017 Pre-Test Right Side View of Test Vehicle



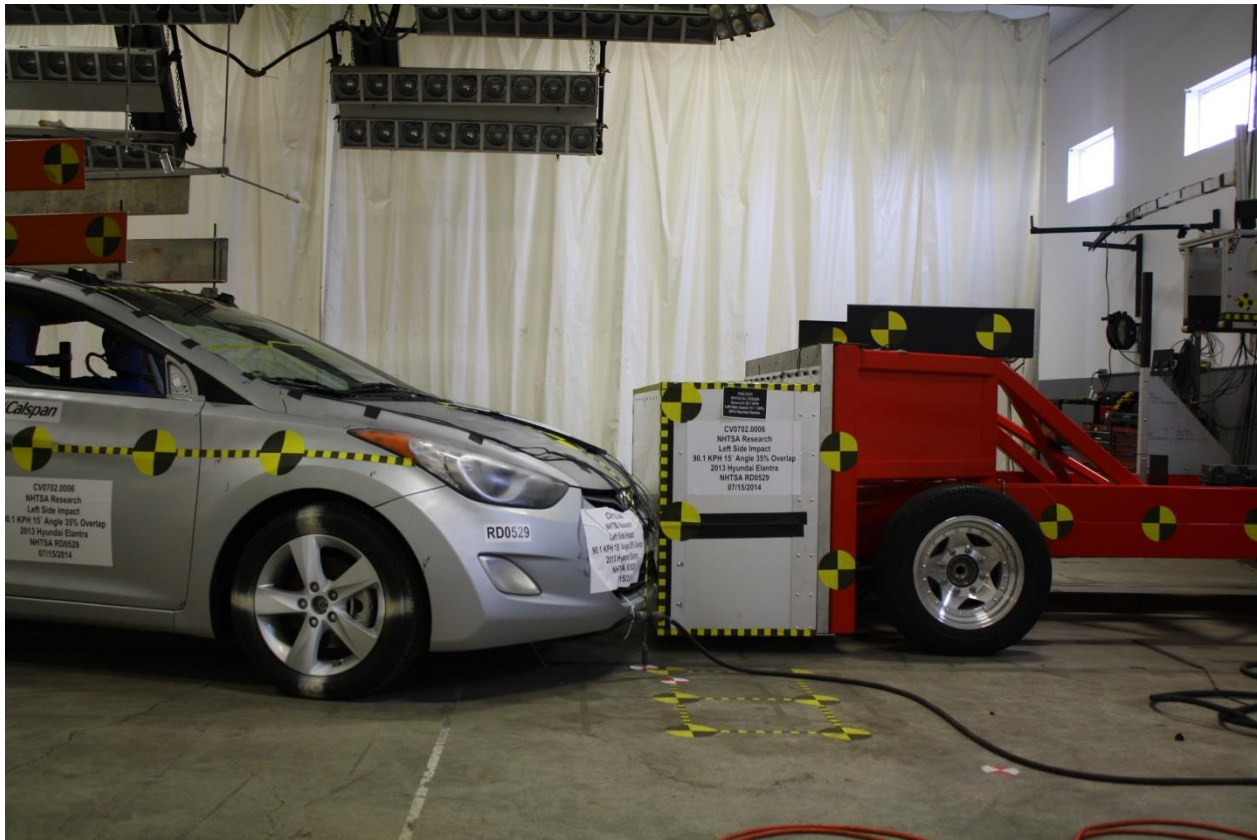
No. 018 Post-Test Right Side View of Test Vehicle



No. 019 Pre-Test Right Front 3-4 View of Test Vehicle



No. 020 Post-Test Right Front 3-4 View of Test Vehicle



No. 023 Pre-Test Left Side View of RMDB against target vehicle at ideal Impact Point



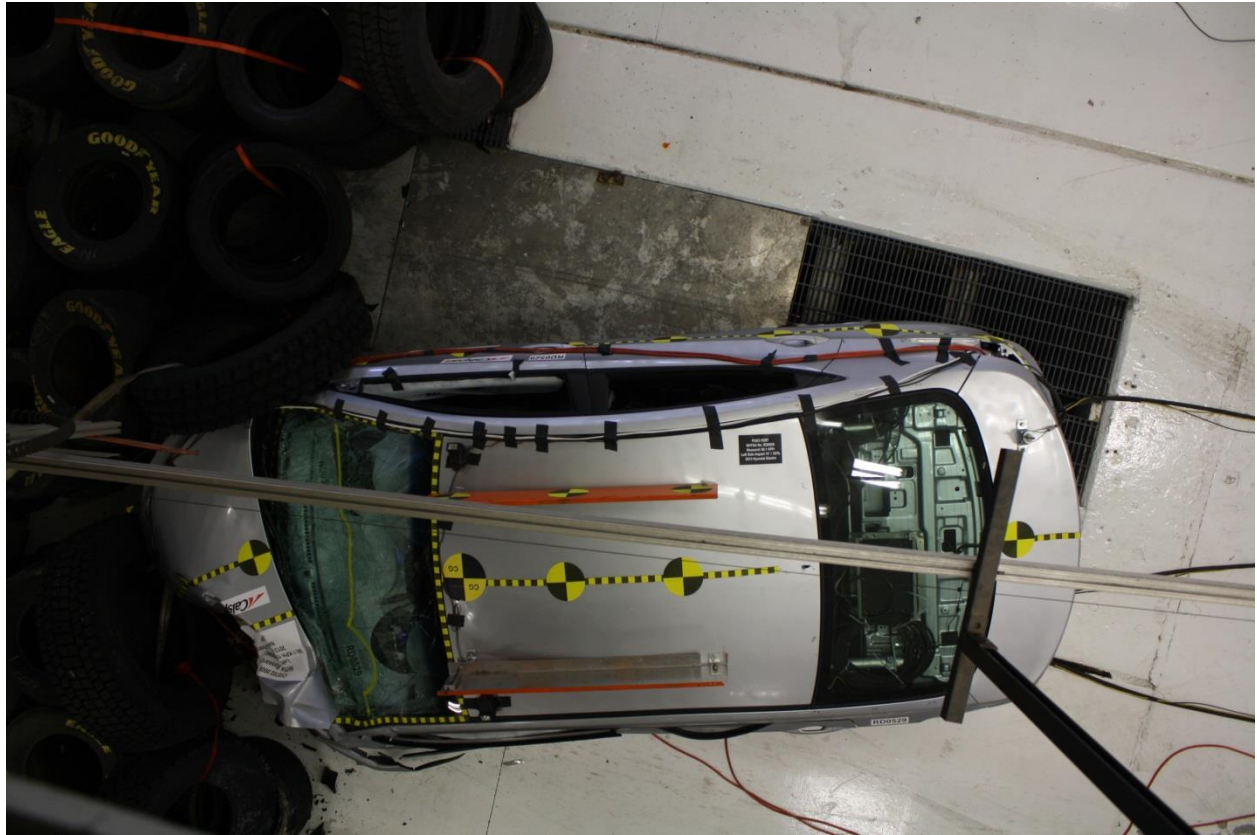
No. 024 Pre-Test Right Side View of RMDB against target vehicle at ideal Impact Point



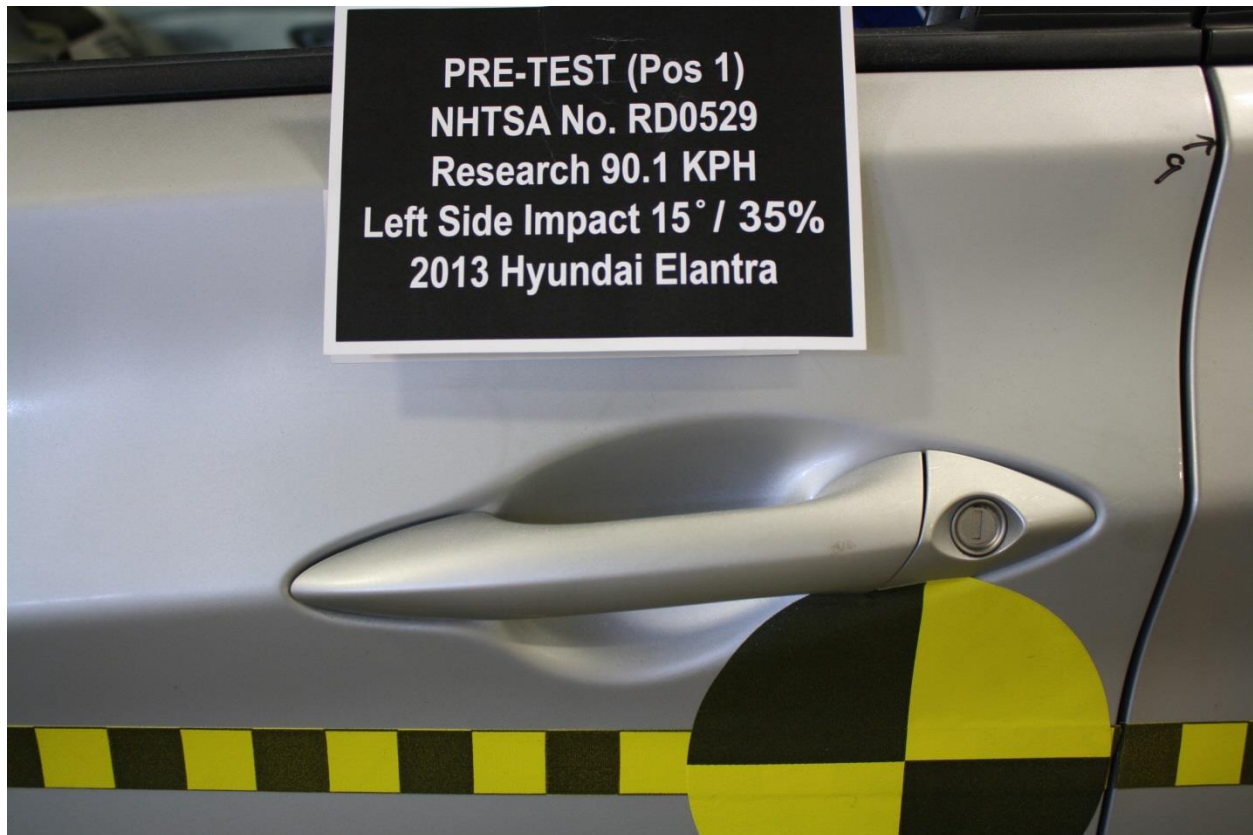
No. 025 Pre-Test Close-up View of Impact Point



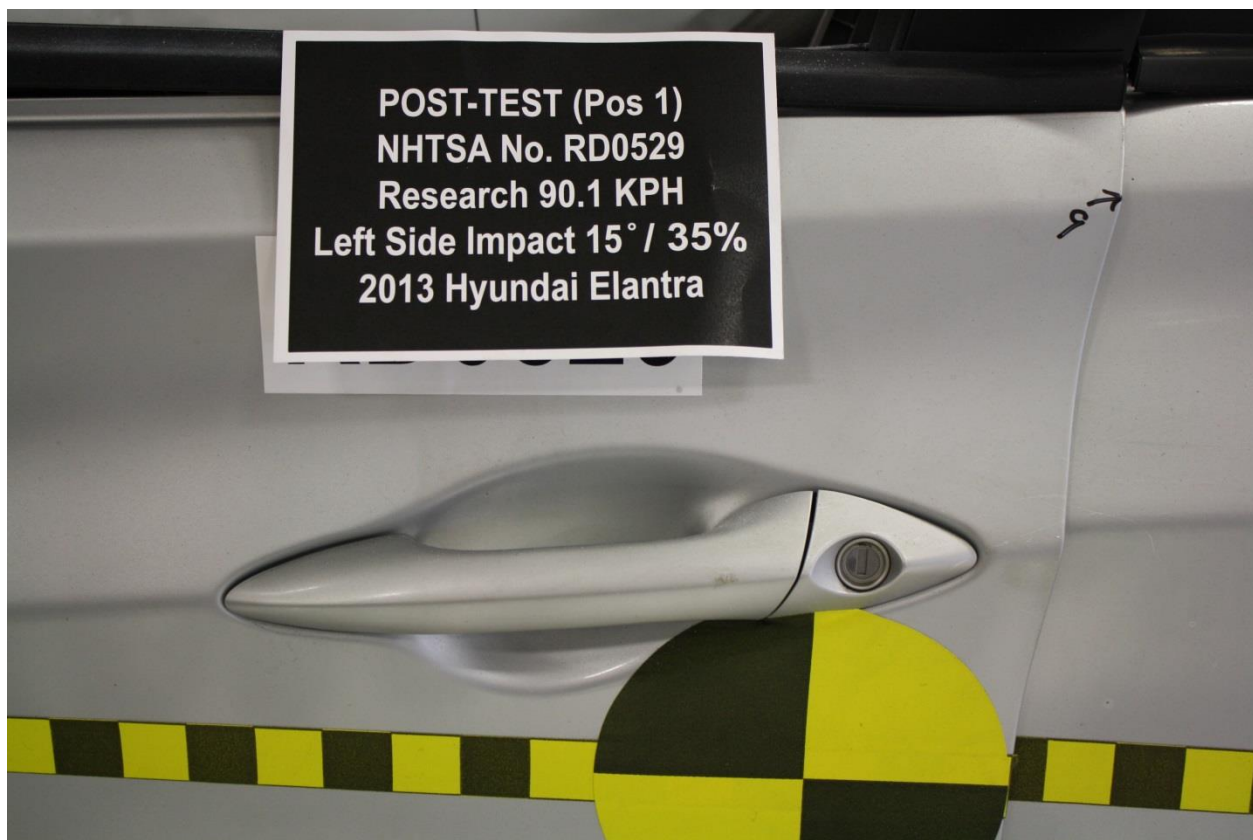
No. 026 Post-Test Close-up View of Impact Point



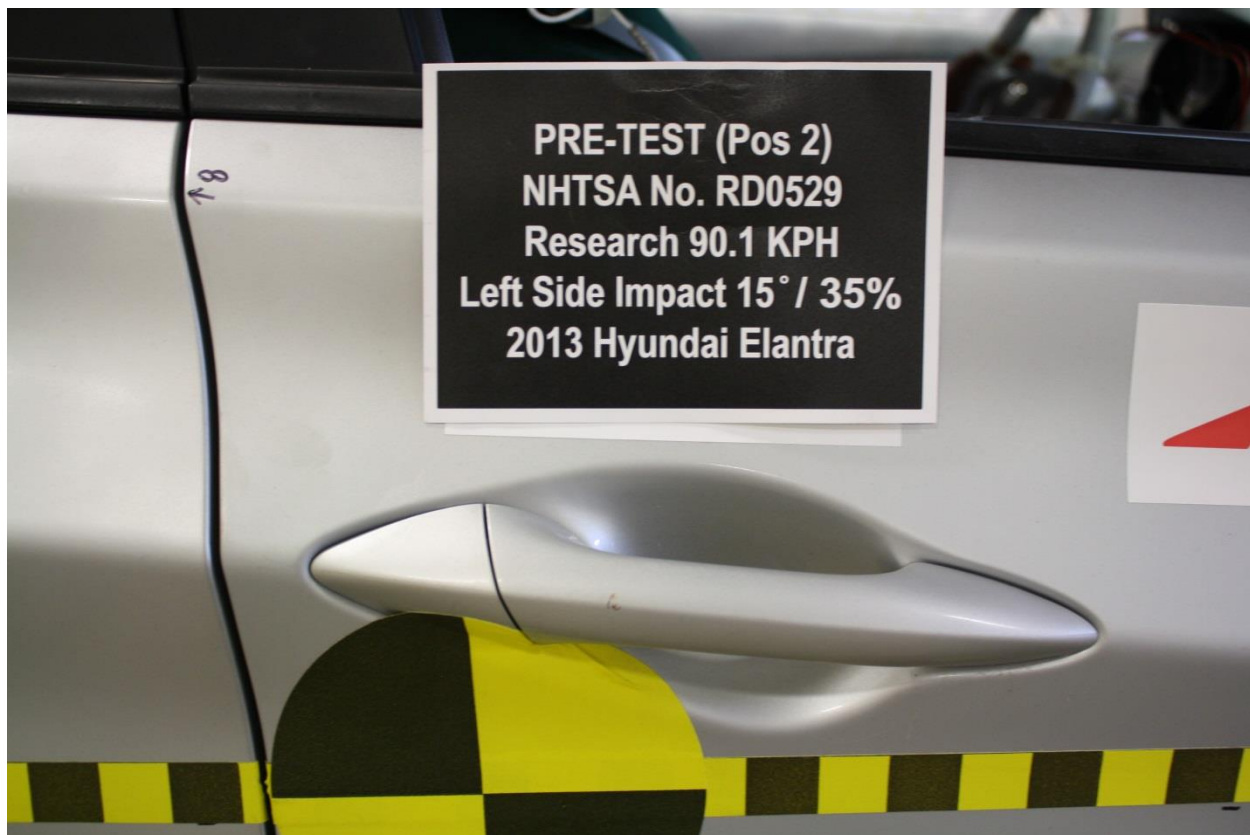
No. 027 Post-Test Vehicle Overhead View



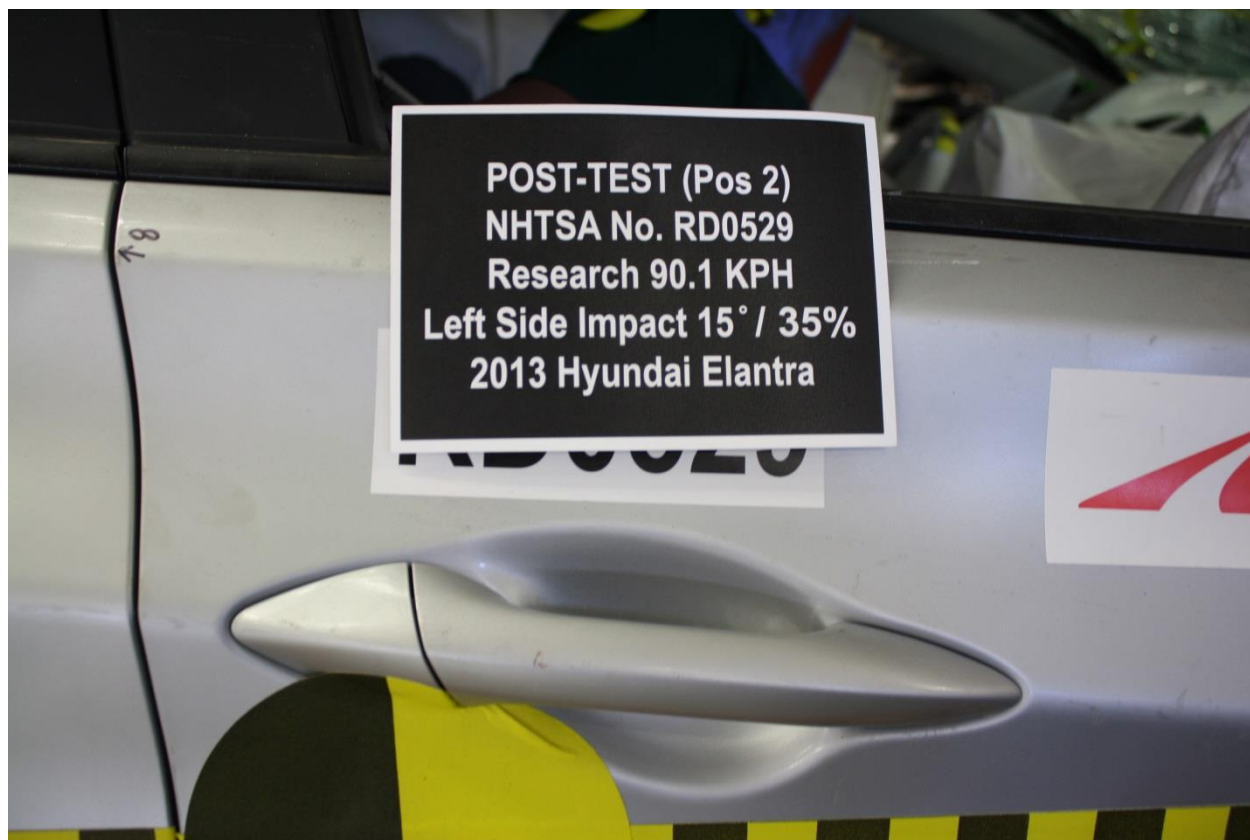
No. 028 Pre-Test Close-up View of Driver Door Latch



No. 029 Post-Test Close-up View of Driver Door Latch



No. 030 Pre-Test Close-up View of Passenger Door Latch



No. 031 Post-Test Close-up View of Passenger Door Latch



No. 032 Pre-Test Windshield View



No. 033 Post-Test Windshield View



No. 034 Pre-Test View of Driver Inner Door Panel



No. 035 Post-Test View of Driver Inner Door Panel



No. 036 Pre-Test View of Passenger Inner Door Panel



No. 037 Post-Test View of Passenger Inner Door Panel



No. 038 Pre-Test Overall View of Driver Knee Bolsters



No. 039 Post-Test Overall View of Driver Knee Bolsters



No. 040 Pre-Test Left Side View of Driver Knee Bolsters



No. 041 Post-Test Left Side View of Driver Knee Bolsters



No. 042 Pre-Test Right Side View of Driver Knee Bolsters



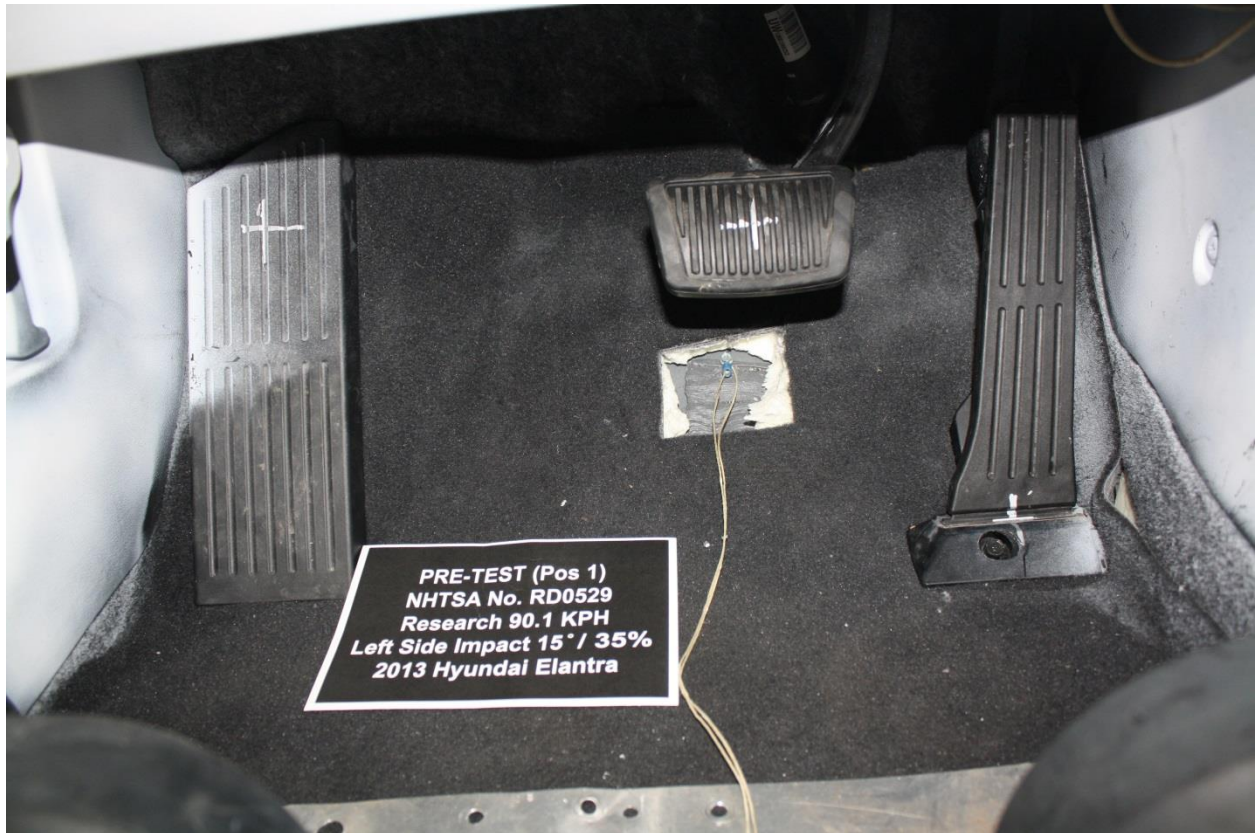
No. 043 Post-Test Right Side View of Driver Knee Bolsters



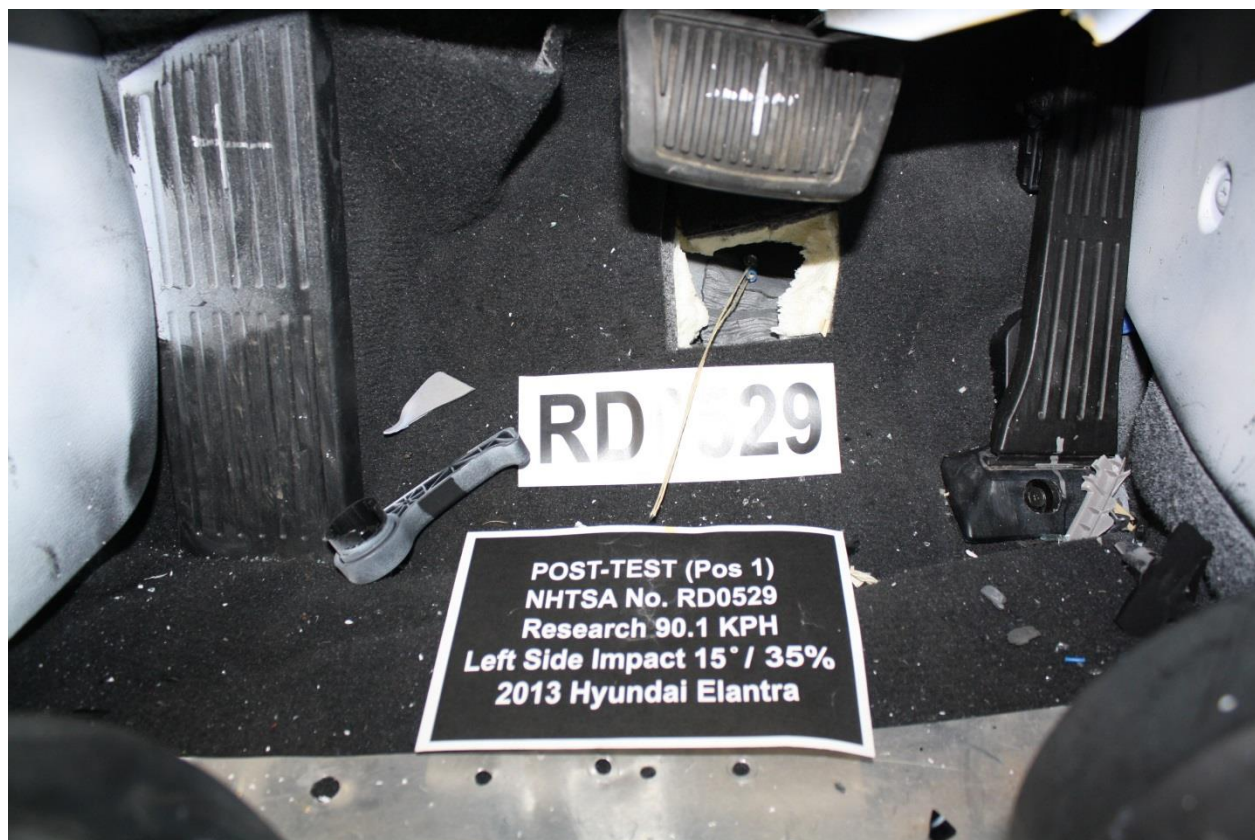
No. 044 Pre-Test View of Driver Floor pan at Left sill level, w/carpet



No. 045 Post-Test View of Driver Floor pan at Left sill level, w/carpet



No. 046 Pre-Test View of Driver Floor pan at Mid seat level, w/carpet



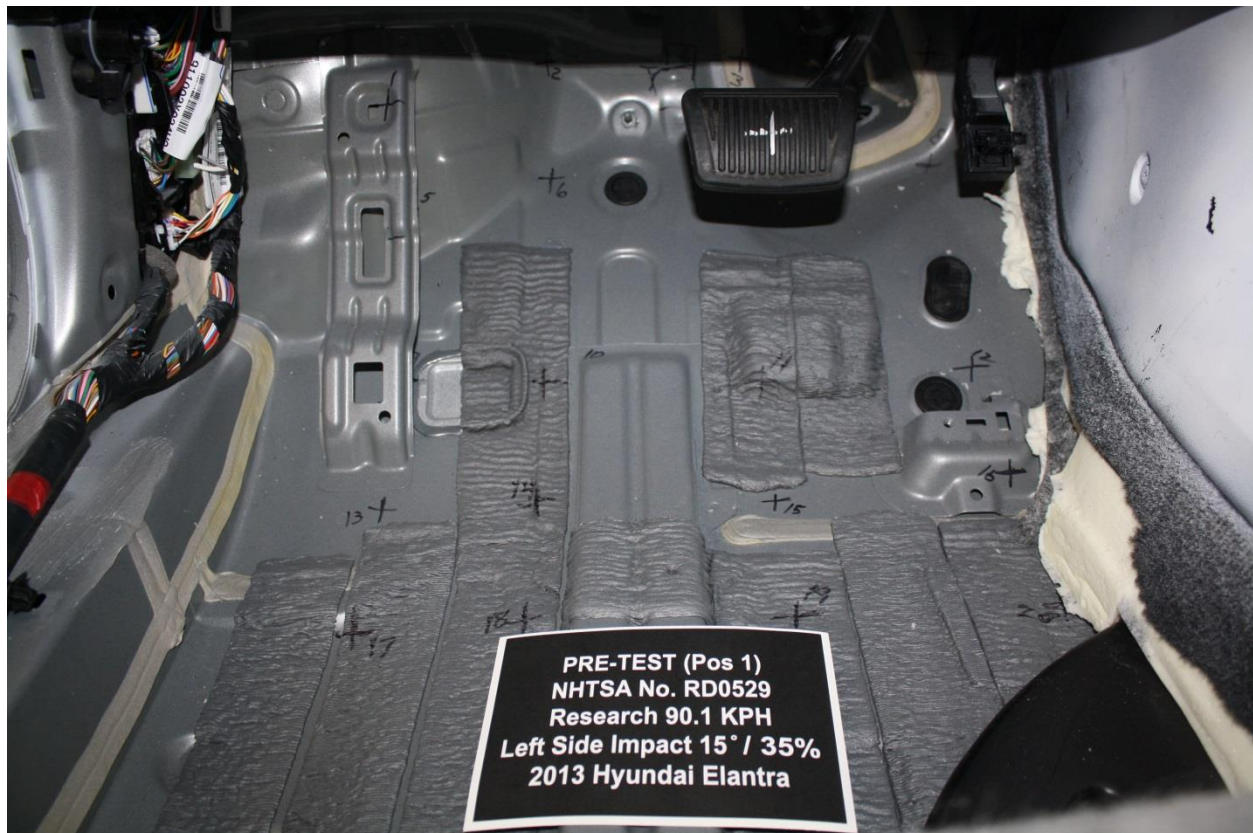
No. 047 Post-Test view of Driver Floor pan at Mid seat level, w/carpet



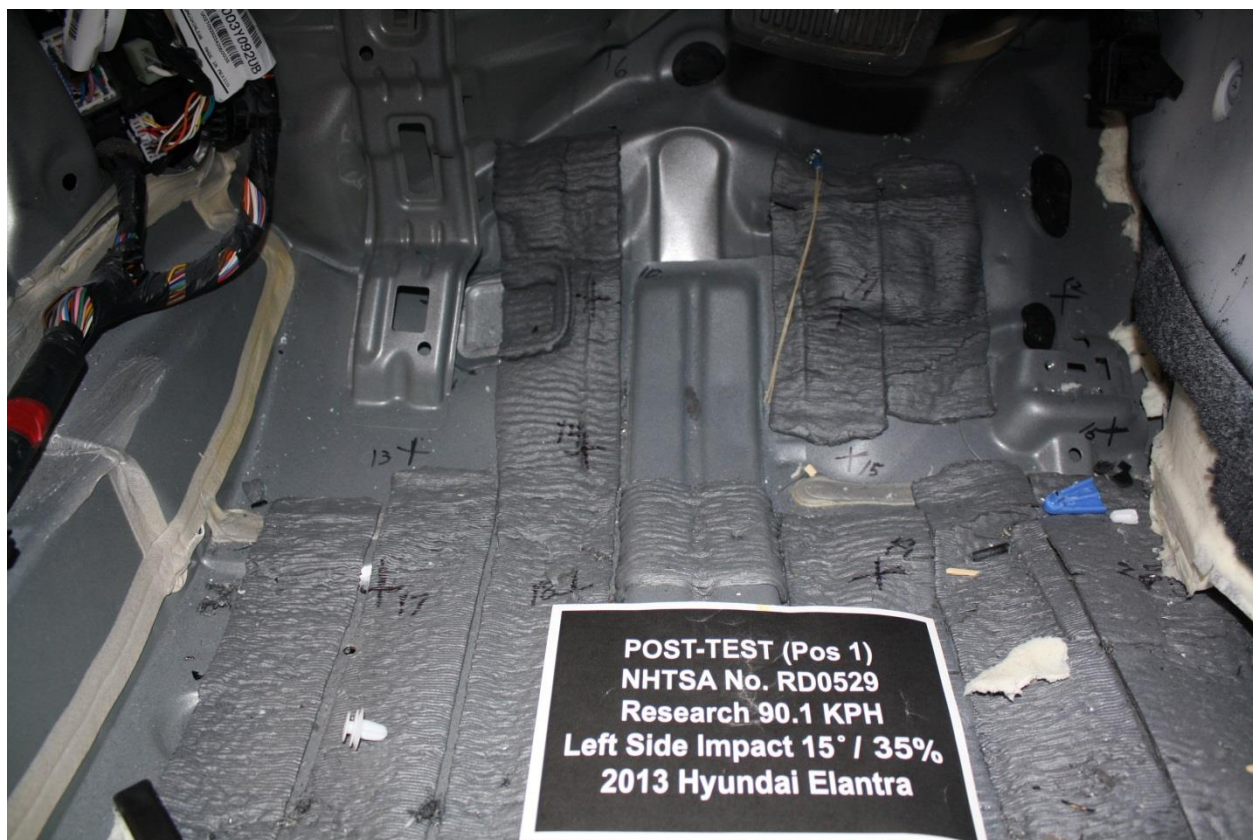
No. 048 Pre-Test View of Driver Floor pan at Left sill level, w/o carpet



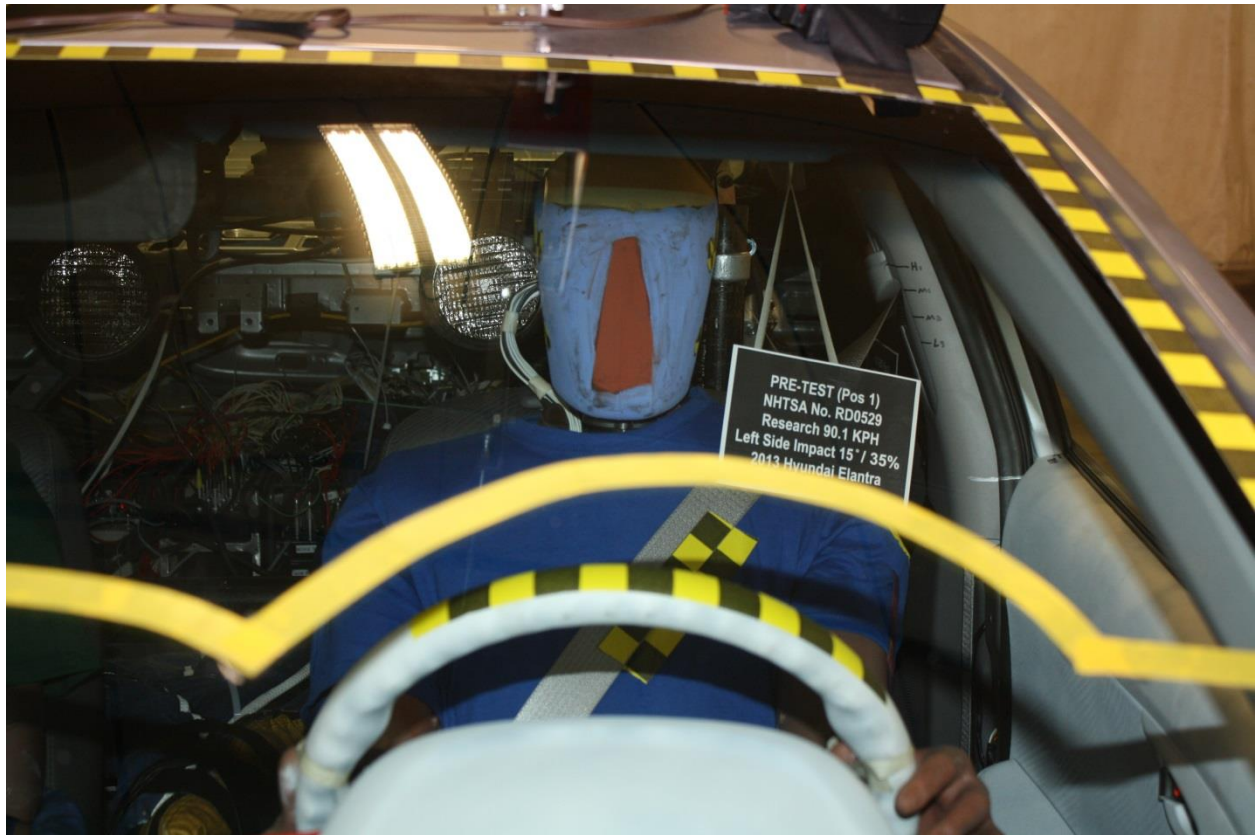
No. 049 Post-Test View of Driver Floor pan at Left sill level, w/o carpet



No. 050 Pre-Test View of Driver Floor pan at Mid seat level, w/o carpet



No. 051 Post-Test view of Driver Floor pan at Mid seat level, w/o carpet



No. 052 Pre-Test Driver Front Windshield View



No. 053 Post-Test Driver Front Windshield View



No. 054 Pre-Test Left Side View of Driver and Interior



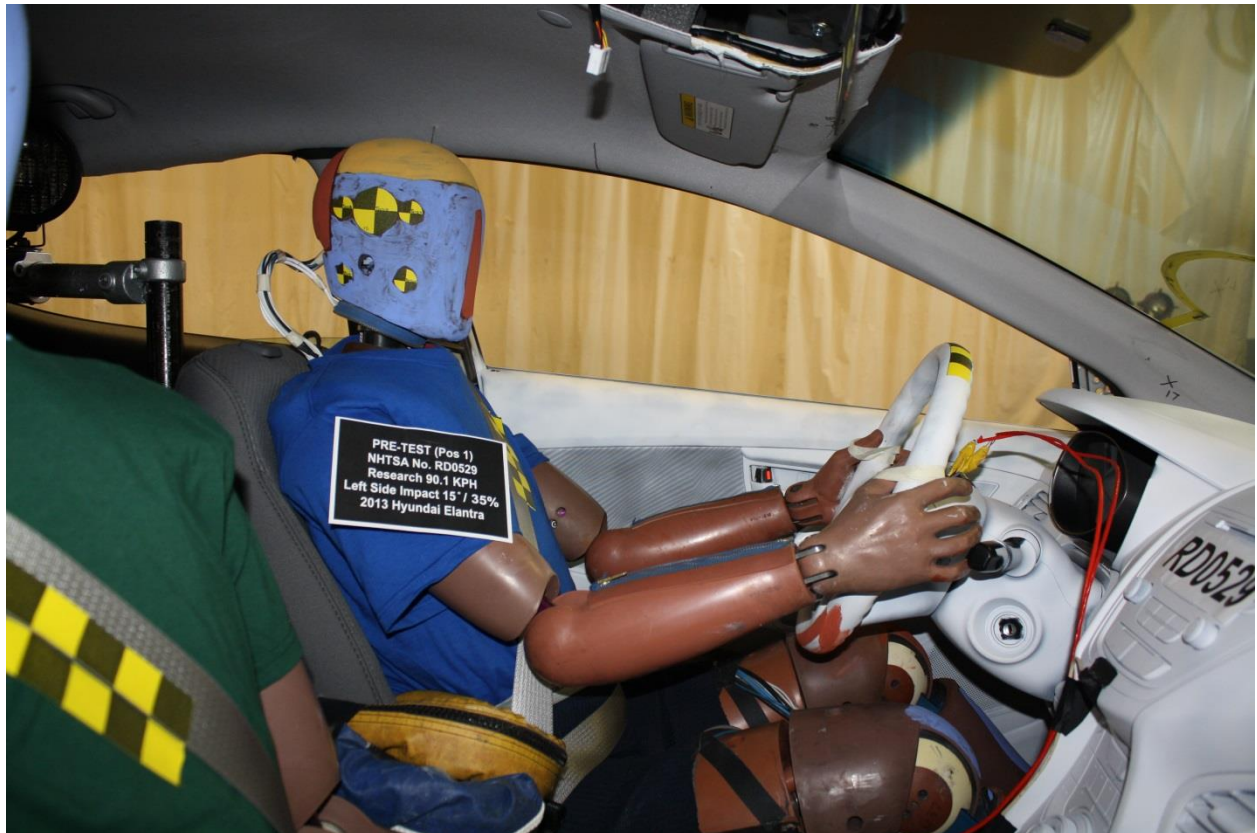
No. 055 Post-Test Left Side View of Driver and Interior



No. 056 Pre-Test Left Side Driver Window View



No. 057 Post-Test Left Side Driver Window View



No. 058 Pre-Test Right Side View of Driver and Interior



No. 059 Post-Test Right Side View of Driver and Interior



No. 060 Pre-Test View of Driver Door Clearance



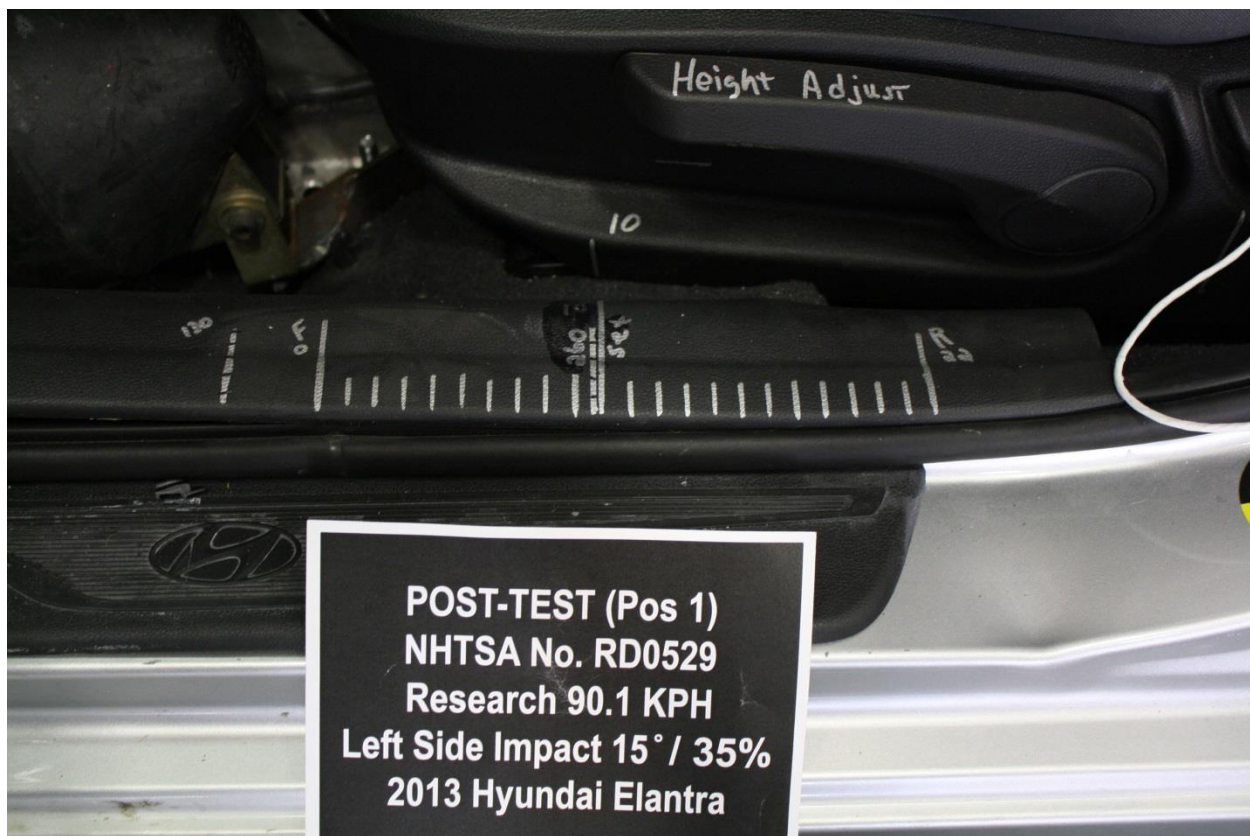
No. 061 Post-Test View of Driver Door Clearance



No. 062 Pre-Test View of Parking Brake



No. 063 Pre-Test Driver Seat Fore Aft Markings



No. 064 Post-Test Driver Seat Fore Aft Markings



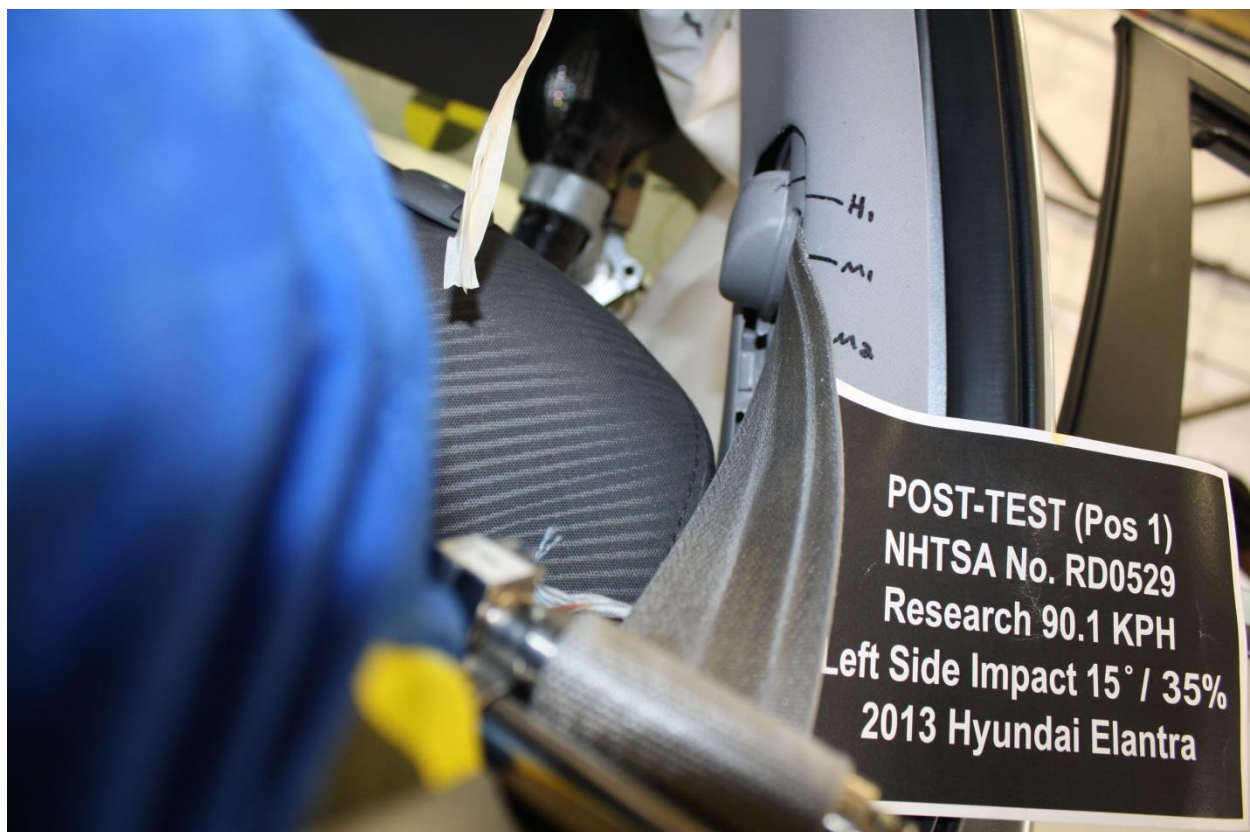
No. 065 Pre-Test Driver Seat Back Markings



No. 066 Pre-Test Overhead View of Driver Thighs on Seat



No. 067 Pre-Test Driver Adjustable D-Ring



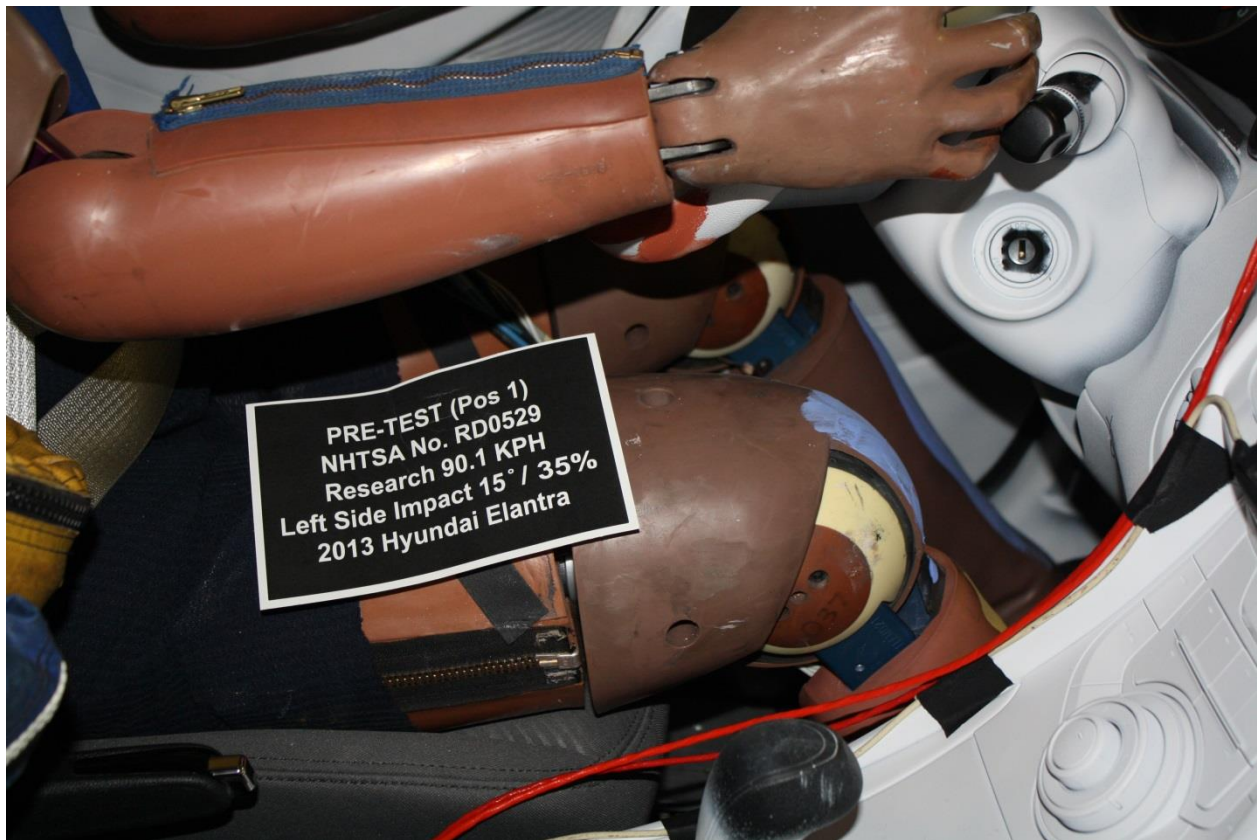
No. 068 Post-Test Driver Adjustable D-Ring



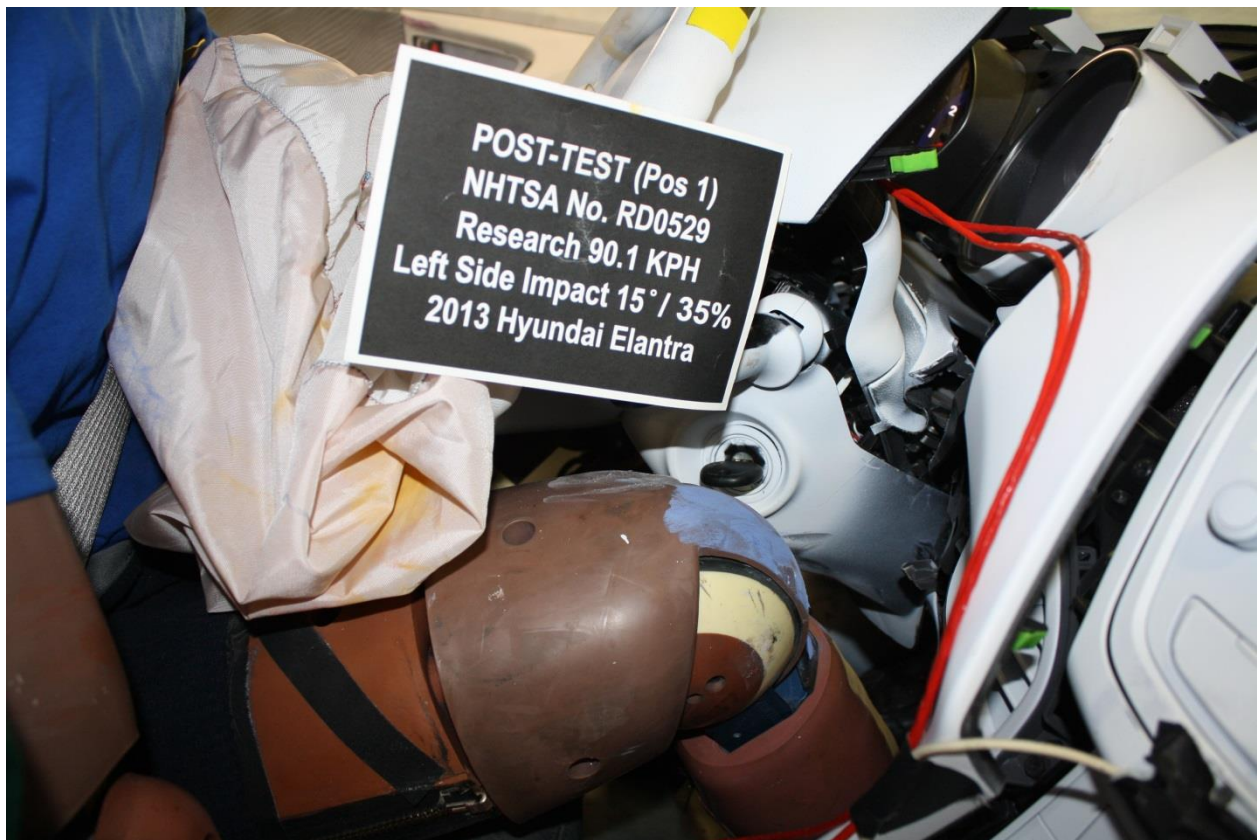
No. 069 Pre-Test Driver Feet



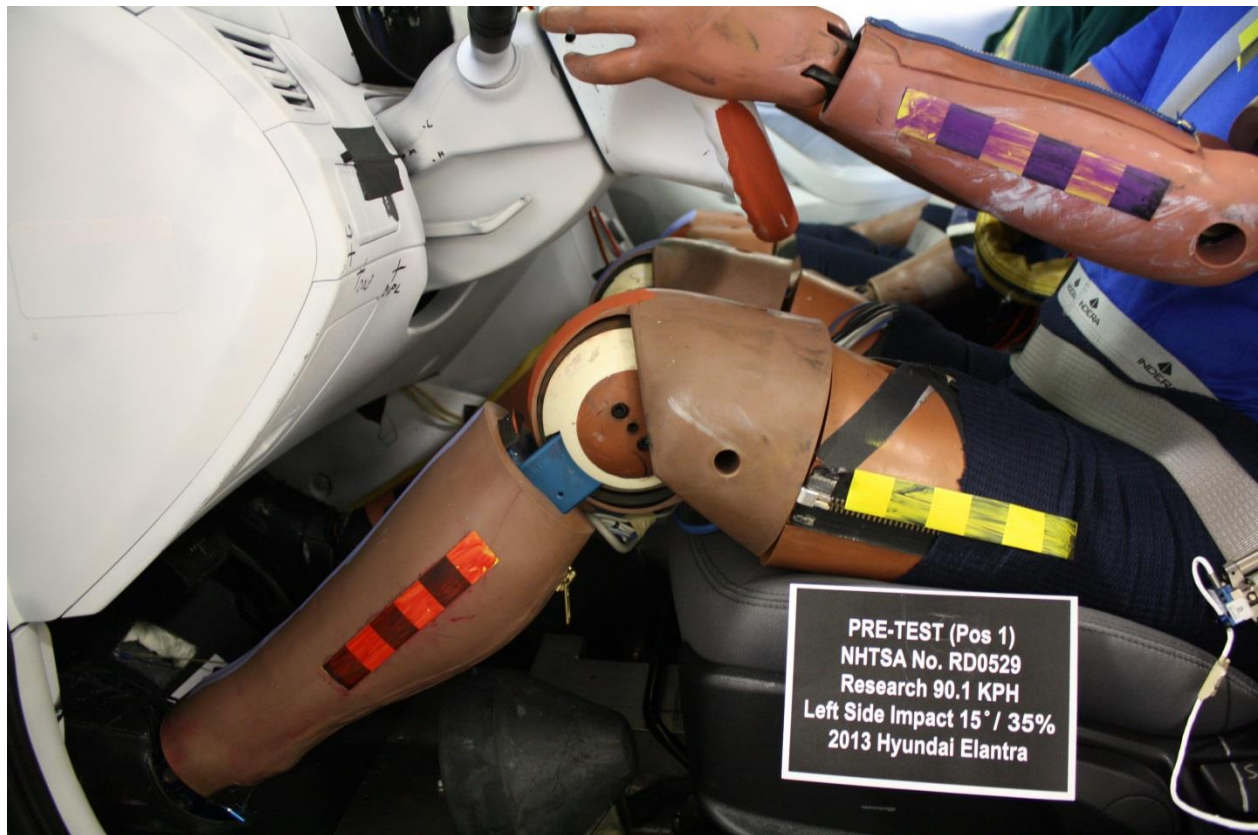
No. 070 Post-Test Driver Feet



No. 071 Pre-Test View of Driver Right Knee and Bolster



No. 072 Post-Test View of Driver Right Knee and Bolster



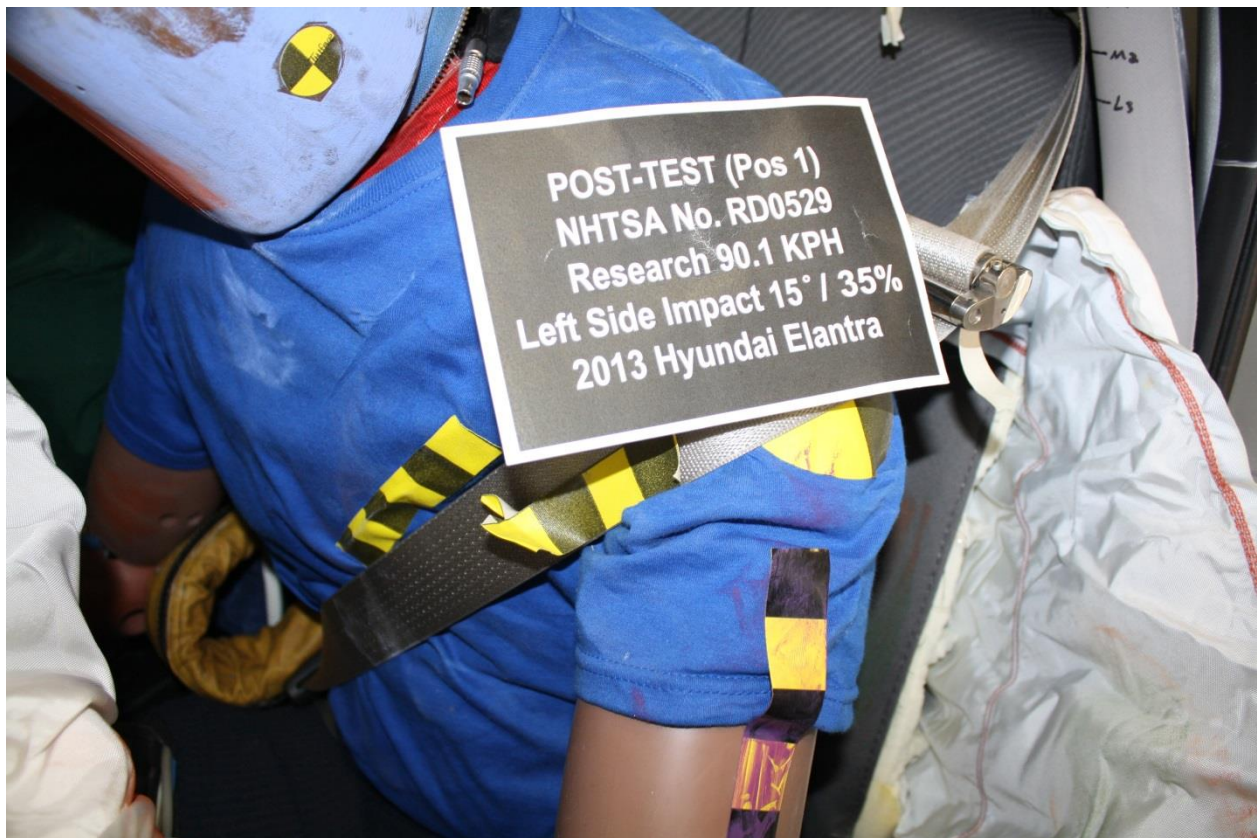
No. 073 Pre-Test View of Driver Left Knee and Bolster



No. 074 Post-Test View of Driver Left Knee and Bolster



No. 075 Pre-Test View of Driver Abdomen



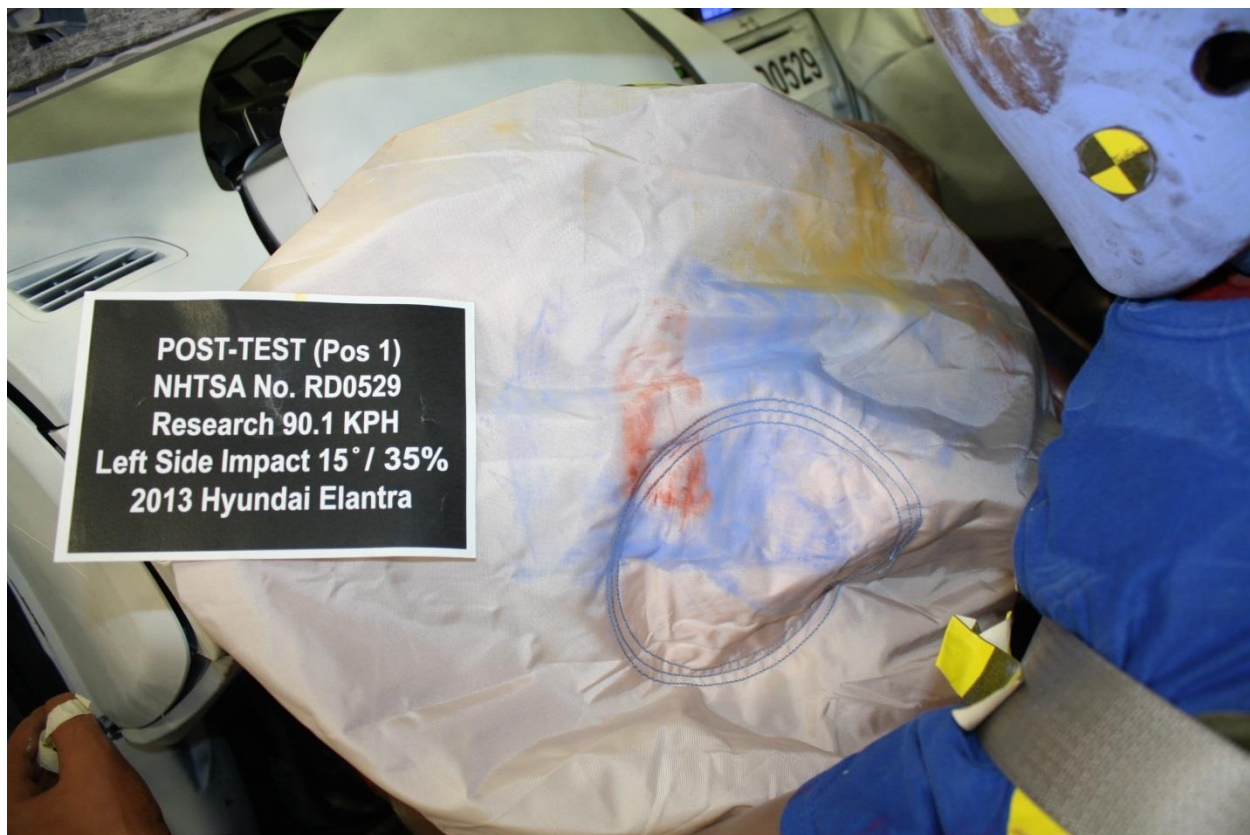
No. 076 Post-Test View of Driver Abdomen



No. 077 Pre-Test Left Side View of Steering Wheel set position



No. 078 Post-Test Left Side View of Steering Wheel set position



No. 079 Post-Test View of Driver Head Contact with Front Airbag



No. 080 Post-Test View of Driver Head Contact with Curtain Airbag



No. 081 Post-Test View of Driver Head Contact with Vehicle Interior – A



No. 081a Post-Test View of Driver Body Contact with Vehicle Interior - B



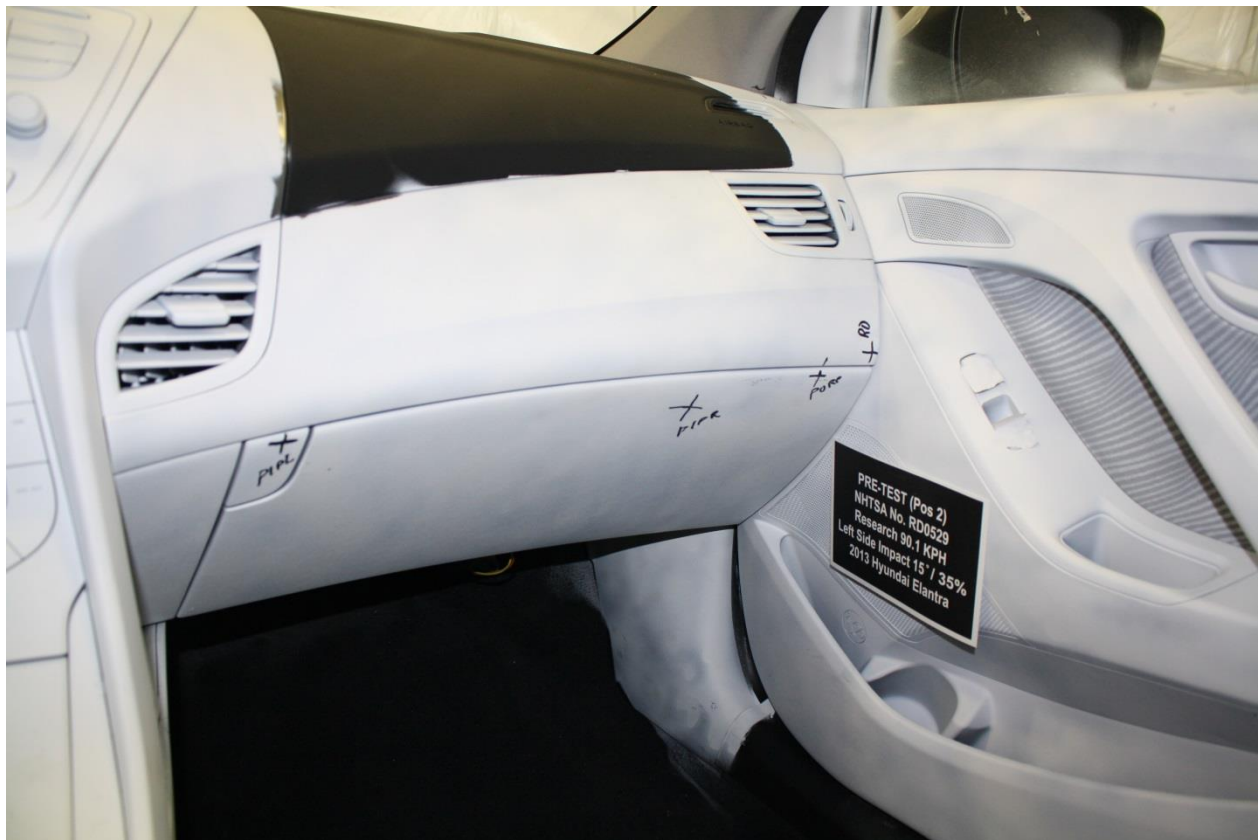
No. 081b Post-Test View of Driver Body Contact with Vehicle Interior - C



No. 082 Pre-Test Overall View of Passenger Knee Bolsters



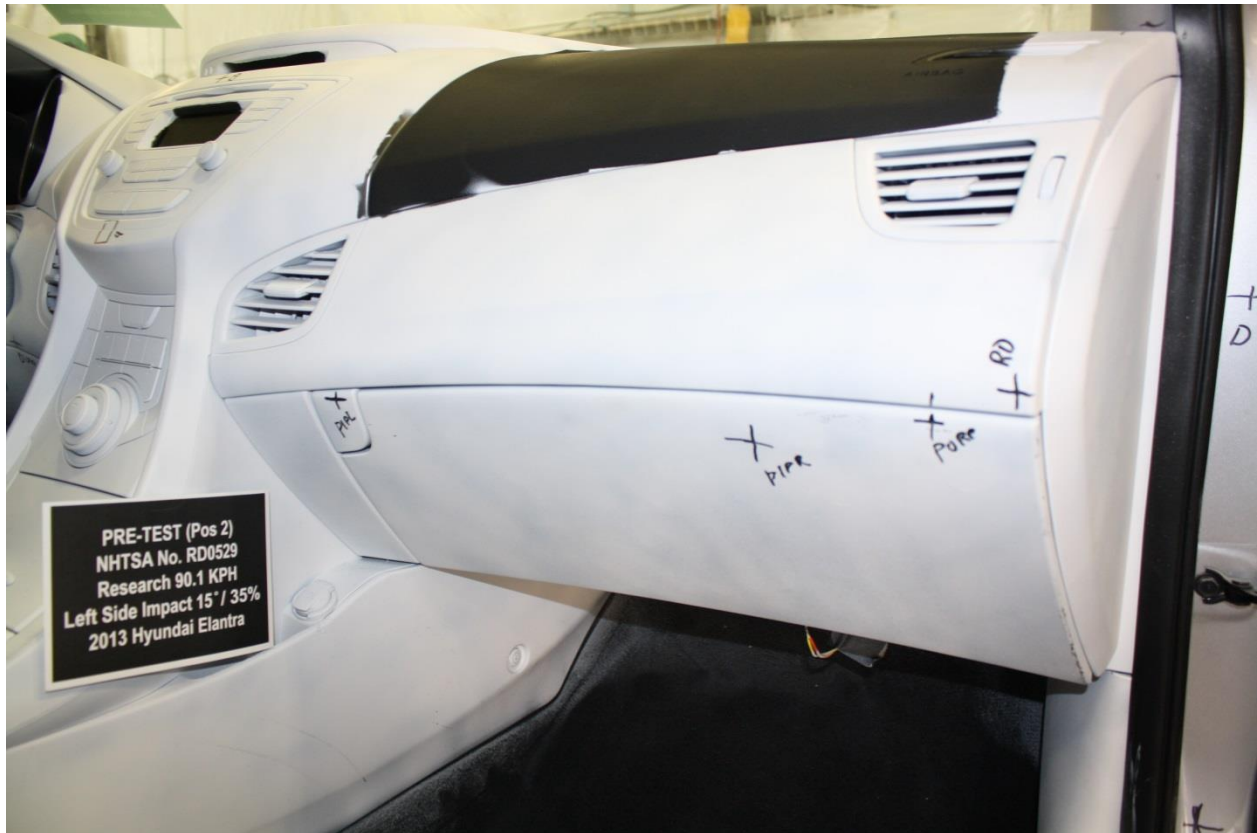
No. 083 Post-Test Overall View of Passenger Knee Bolsters



No. 084 Pre-Test Left Side View of Passenger Knee Bolsters



No. 085 Post-Test Left Side View of Passenger Knee Bolsters



No. 086 Pre-Test Right Side View of Passenger Knee Bolsters



No. 087 Post-Test Right Side View of Passenger Knee Bolsters



No. 088 Pre-Test View of Passenger Floor pan at Left sill level, w/carpet



No. 089 Post-Test View of Passenger Floor pan at Left sill level, w/carpet



No. 090 Pre-Test View of Passenger Floor pan at Mid seat level, w/carpet



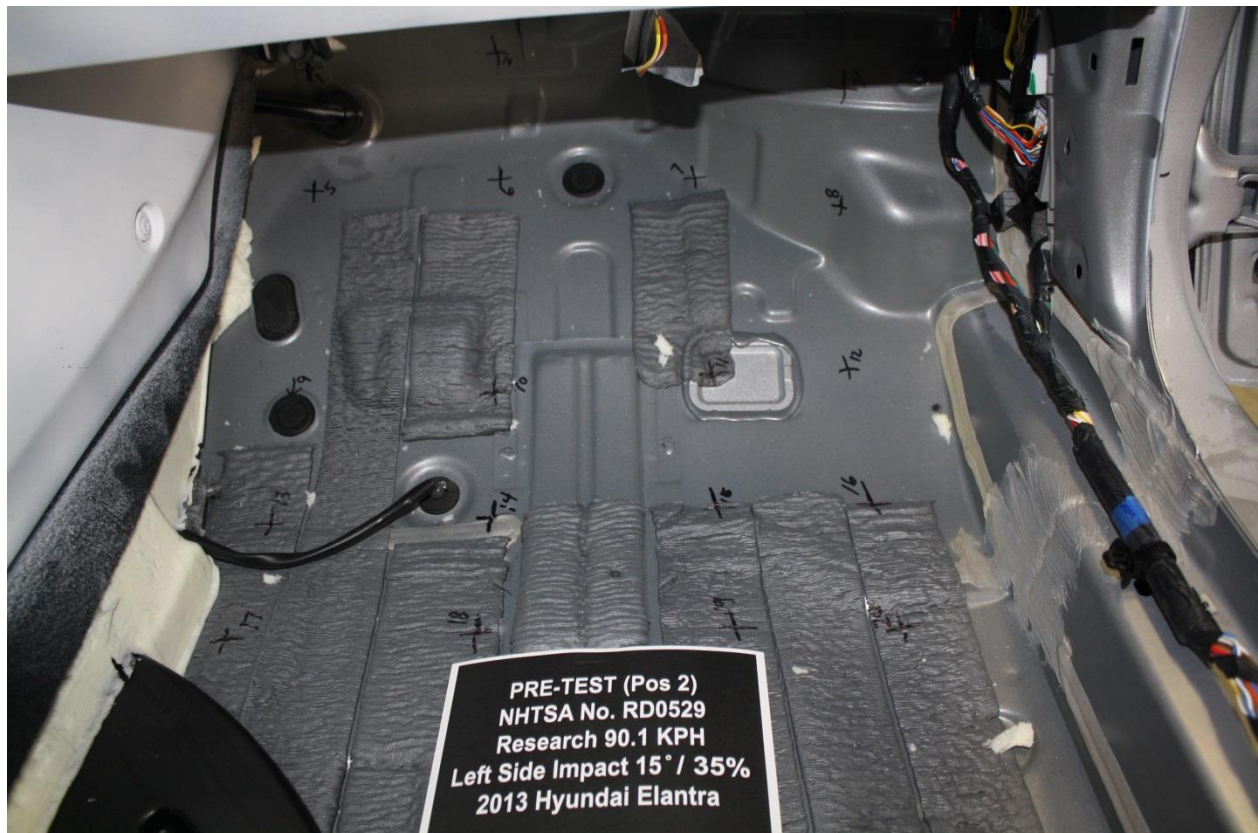
No. 091 Post-Test view of Passenger Floor pan at Mid seat level, w/carpet



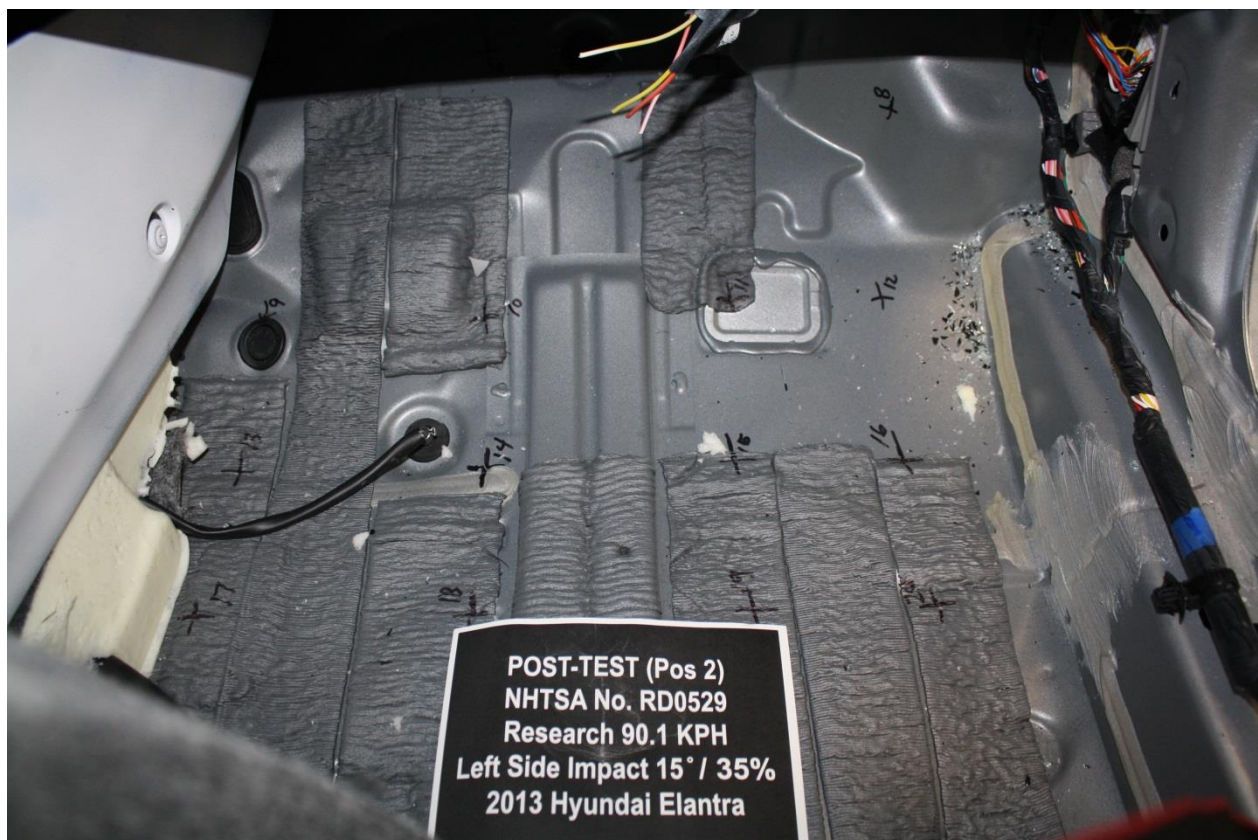
No. 092 Pre-Test View of Passenger Floor pan at Left sill level, w/o carpet



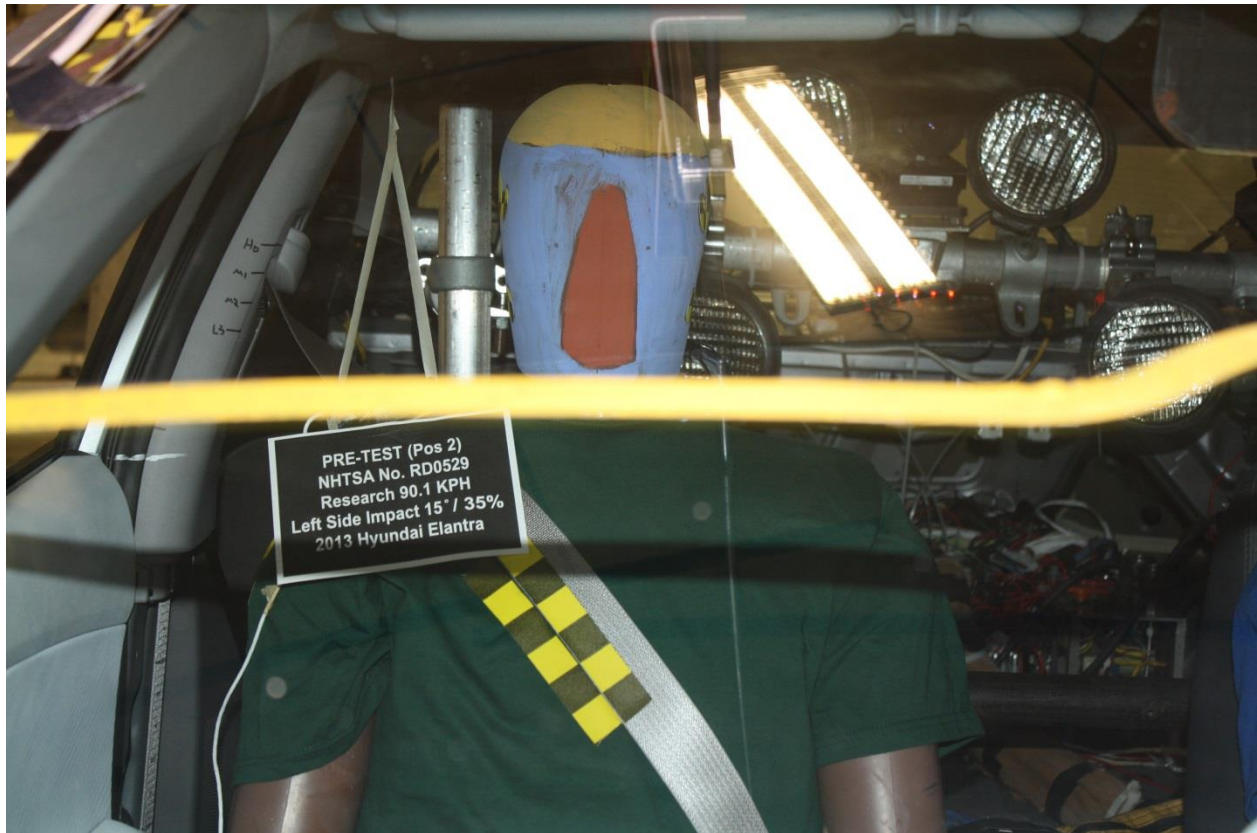
No. 093 Post-Test View of Passenger Floor pan at Left sill level, w/o carpet



No. 094 Pre-Test View of Passenger Floor pan at Mid seat level, without carpet



No. 095 Post-Test view of Passenger Floor pan at Mid seat level, wo carpet



No. 096 Pre-Test Passenger Front Close-up View, Windshield



No. 097 Post-Test Passenger Front Close-up View, Windshield



No. 098 Pre-Test Left Side Passenger and Interior View



No. 099 Post-Test Left Side Passenger and Interior View



No. 100 Pre-Test Right Side Passenger Window View



No. 101 Post-Test Right Side Passenger Window View



No. 102 Pre-Test Right Side Passenger and Interior View



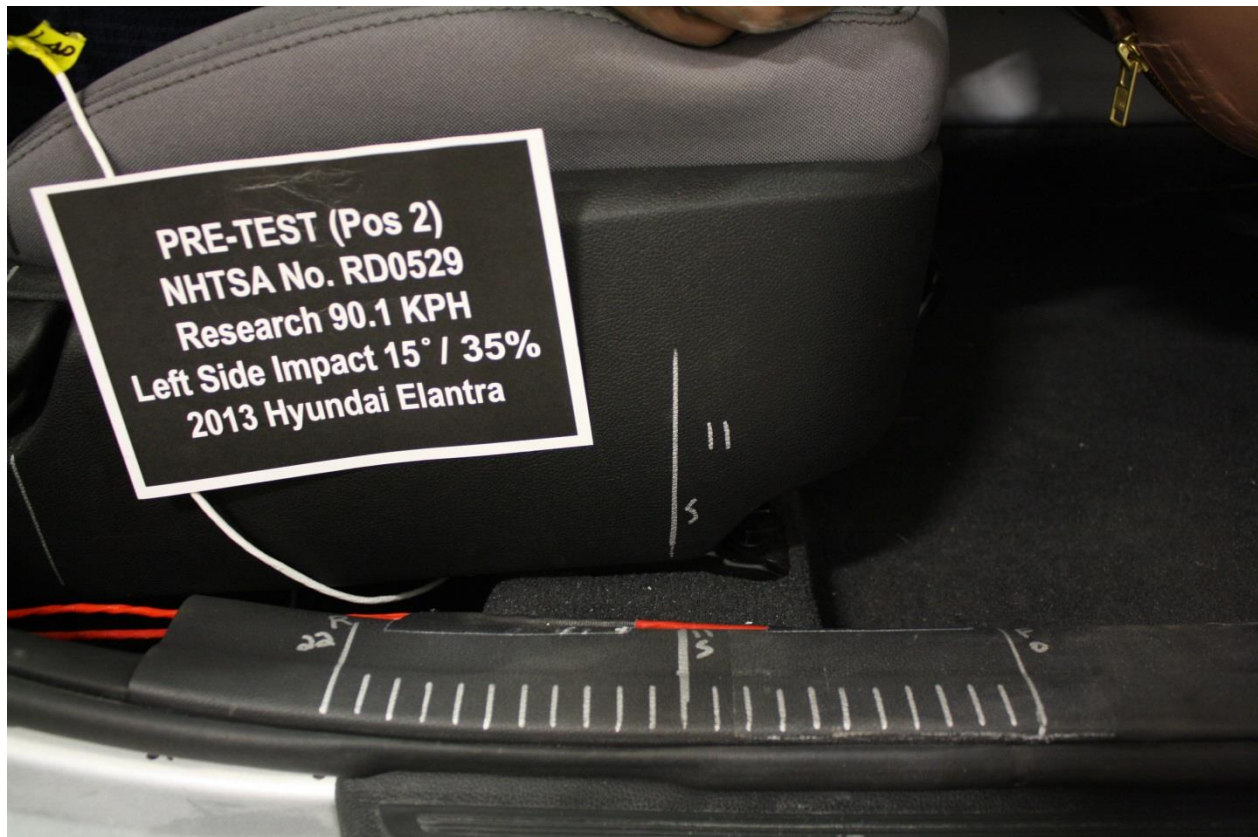
No. 103 Post-Test Right Side Passenger and Interior View



No. 104 Pre-Test View of Passenger Door Clearance



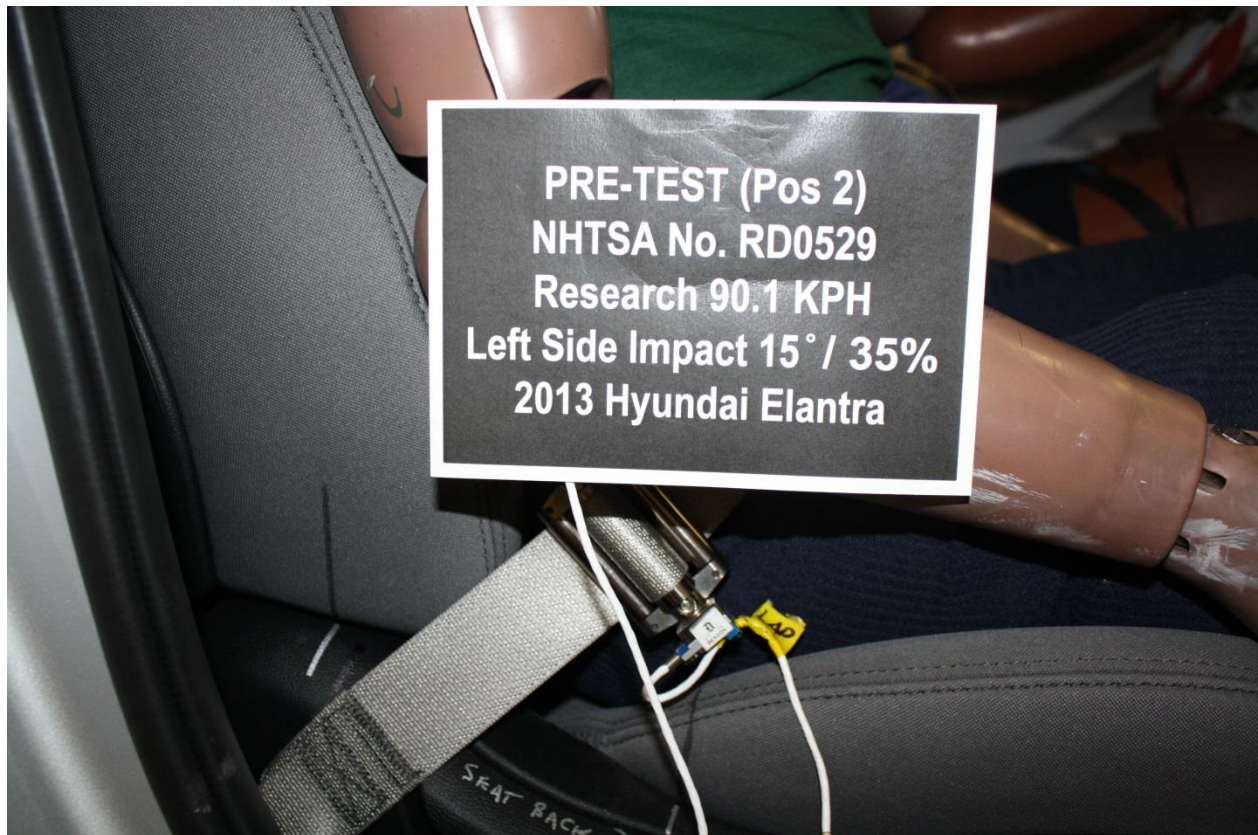
No. 105 Post-Test View of Passenger Door Clearance



No. 106 Pre-Test Passenger Seat Fore-Aft Markings



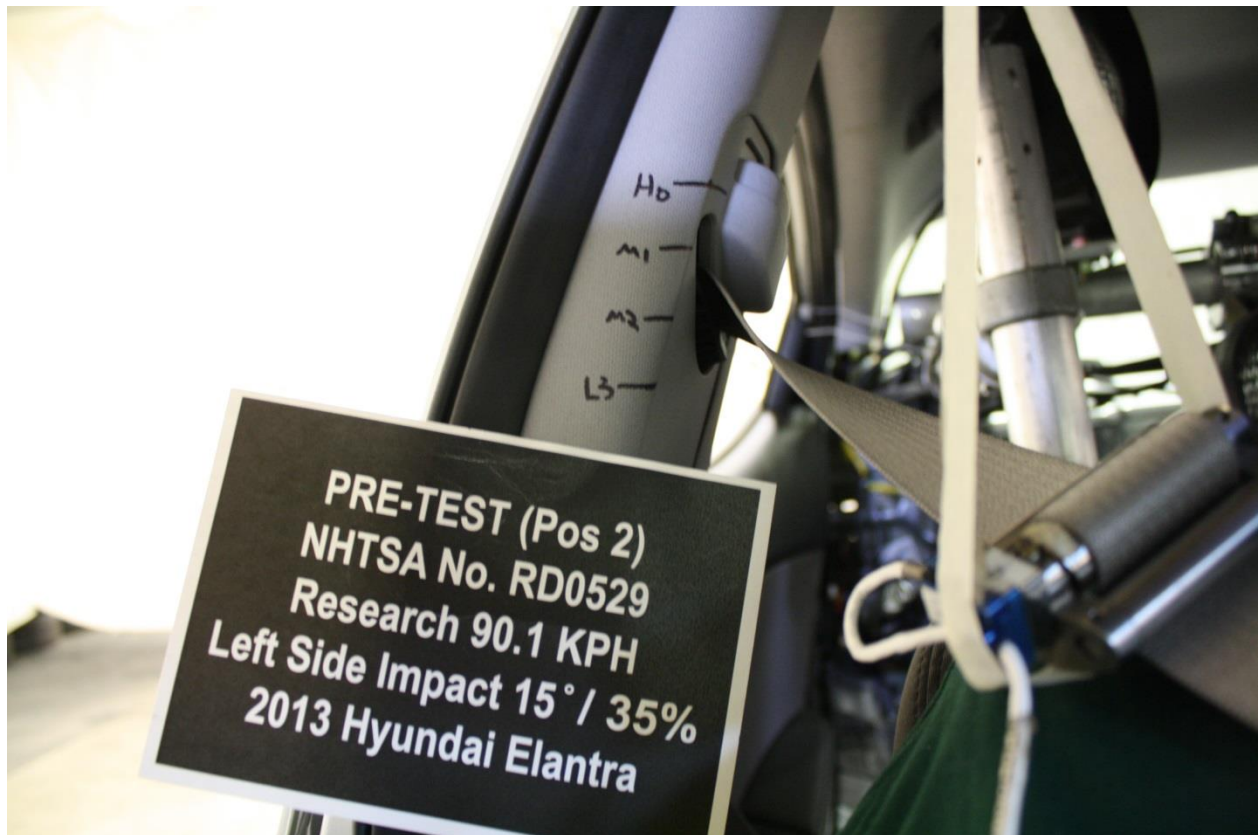
No. 107 Post-Test Passenger Seat Fore-Aft Markings



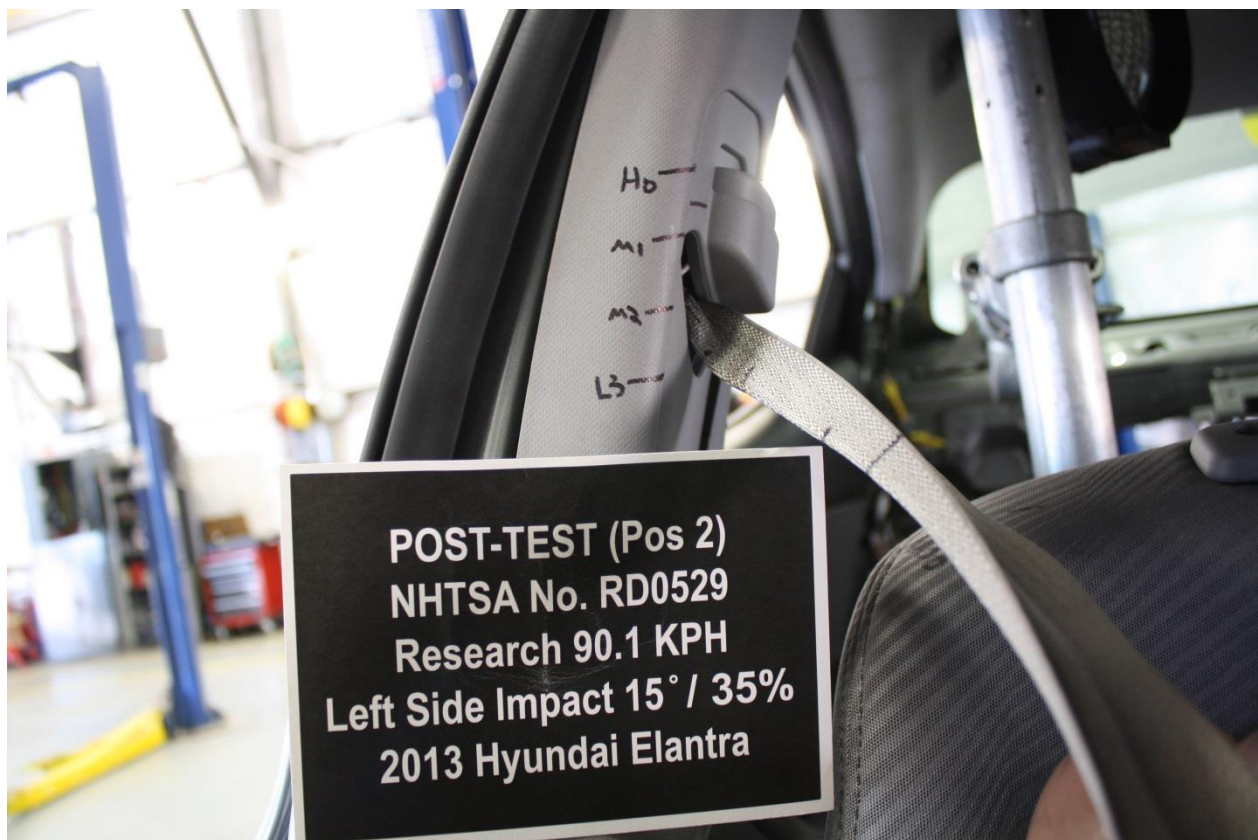
No. 108 Pre-Test Passenger Seat Back Markings



No. 109 Pre-Test Overhead View of Passenger Thighs on seat



No. 110 Pre-Test Passenger Adjustable D-ring



No. 111 Post-Test Passenger Adjustable D-ring



No. 112 Pre-Test View of Passenger Feet



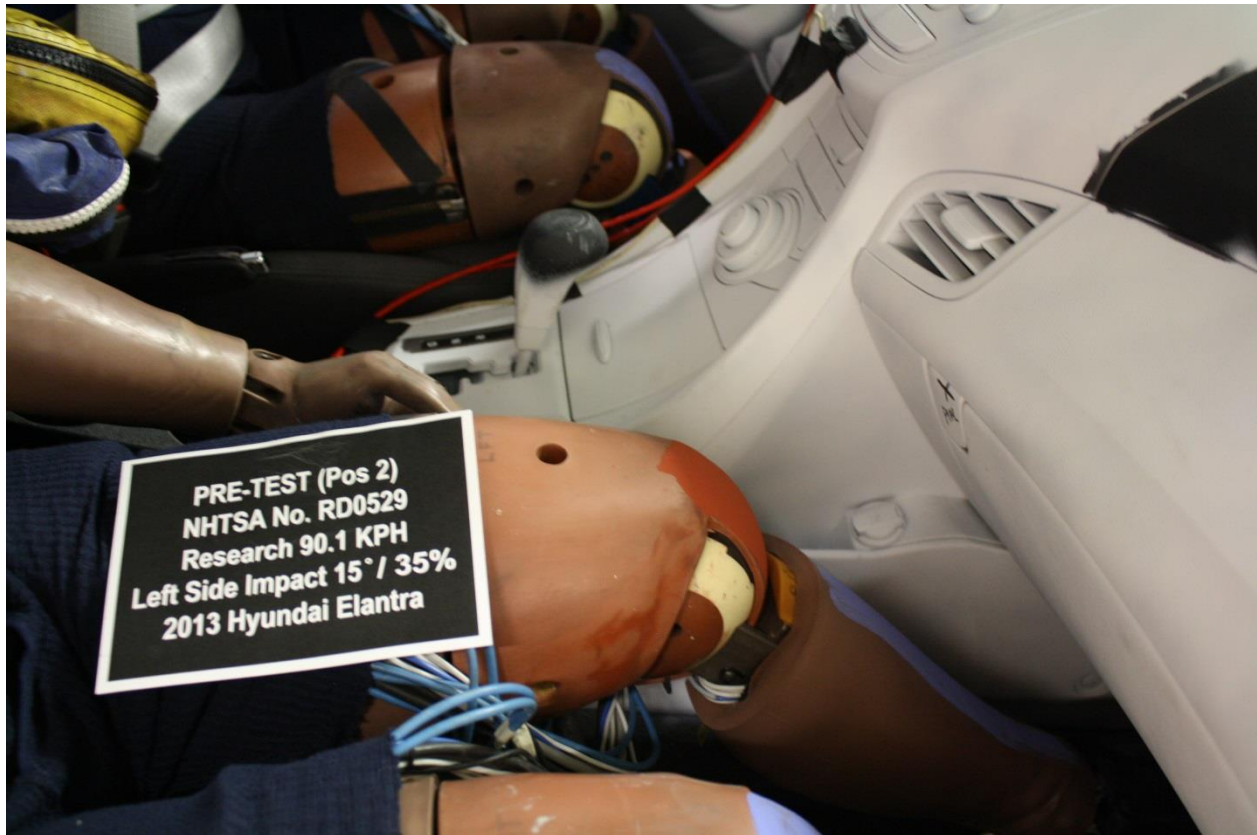
No. 113 Post-Test View of Passenger Feet



No. 114 Pre-Test View of Passenger Right Knee and Bolster



No. 115 Post-Test View of Passenger Right Knee and Bolster



No. 116 Pre-Test View of Passenger Left Knee and Bolster



No. 117 Post-Test View of Passenger Left Knee and Bolster



No. 118 Pre-Test View of Passenger Abdomen



No. 119 Post-Test View of Passenger Abdomen



No. 120 Post-Test View of Passenger Head contact with Airbag – Front

Photo Not Applicable

No. 120a Post-Test View of Passenger Head contact with Airbag - Curtain



No. 121 Post-Test View of Passenger Head contact with Interior



No. 121a Post-Test View of Passenger Head contact with Interior

Photo Not Applicable

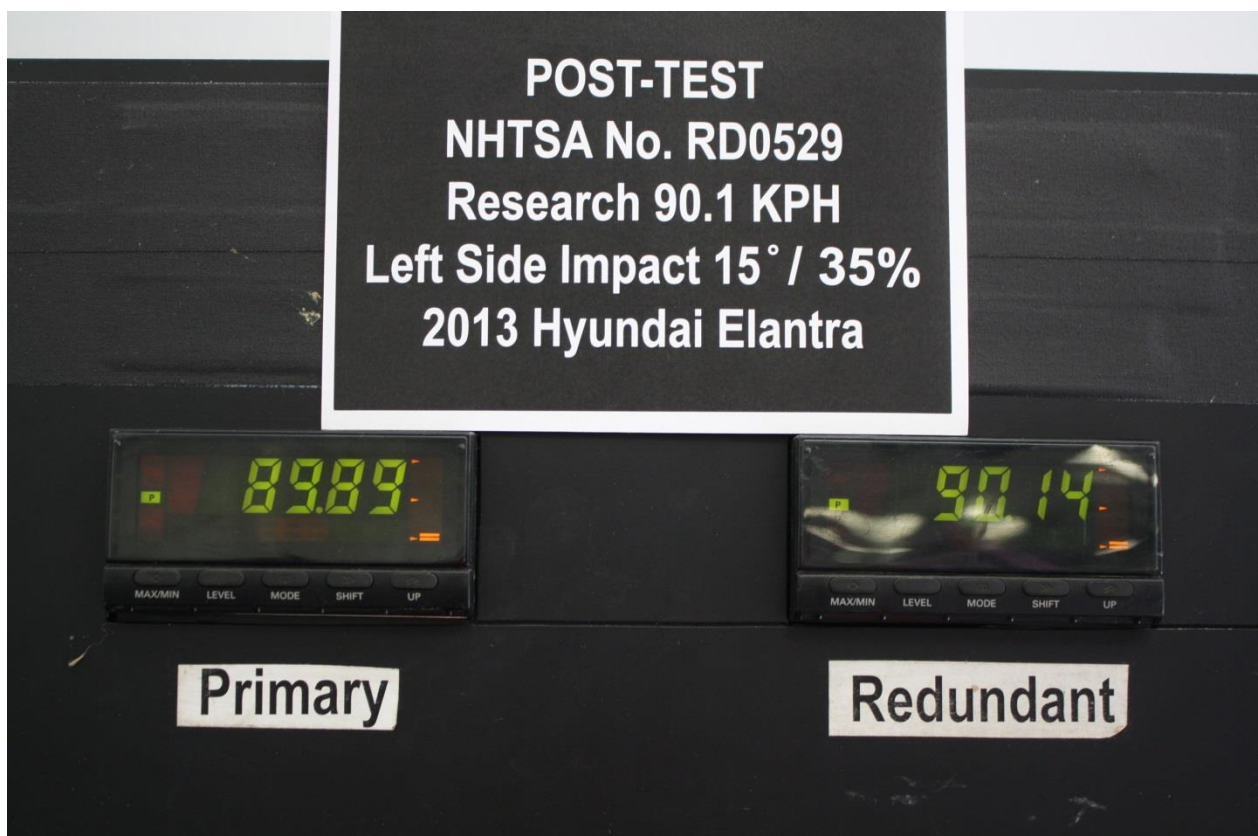
No. 121b Post-Test View of Passenger Head contact with Interior



No. 122 Post-Test Passenger Contact With Glovebox



No. 123 Pre-Test Ballast Locations



No. 124 Post-Test Speed Trap Readout



No. 125 Pre-Test View of Fuel Filler Cap



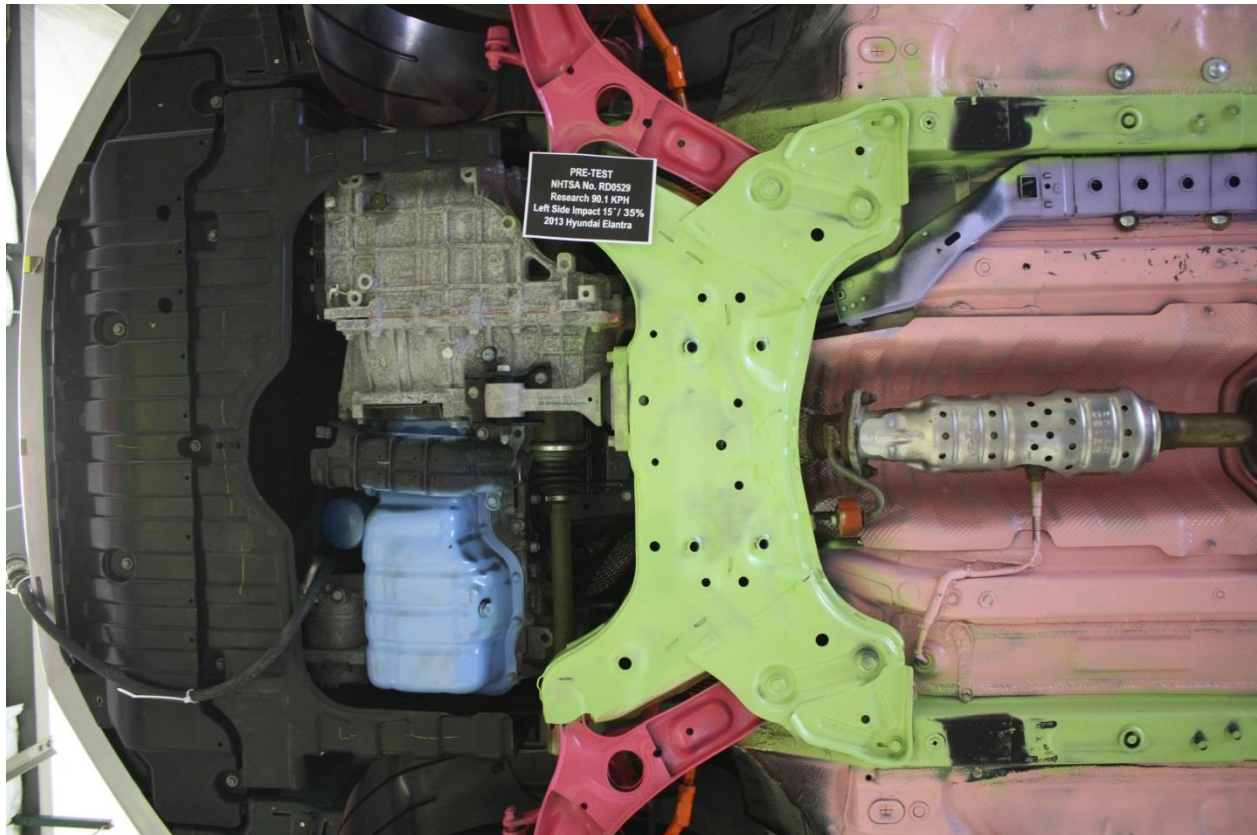
No. 126 Post-Test View of Fuel Filler Cap



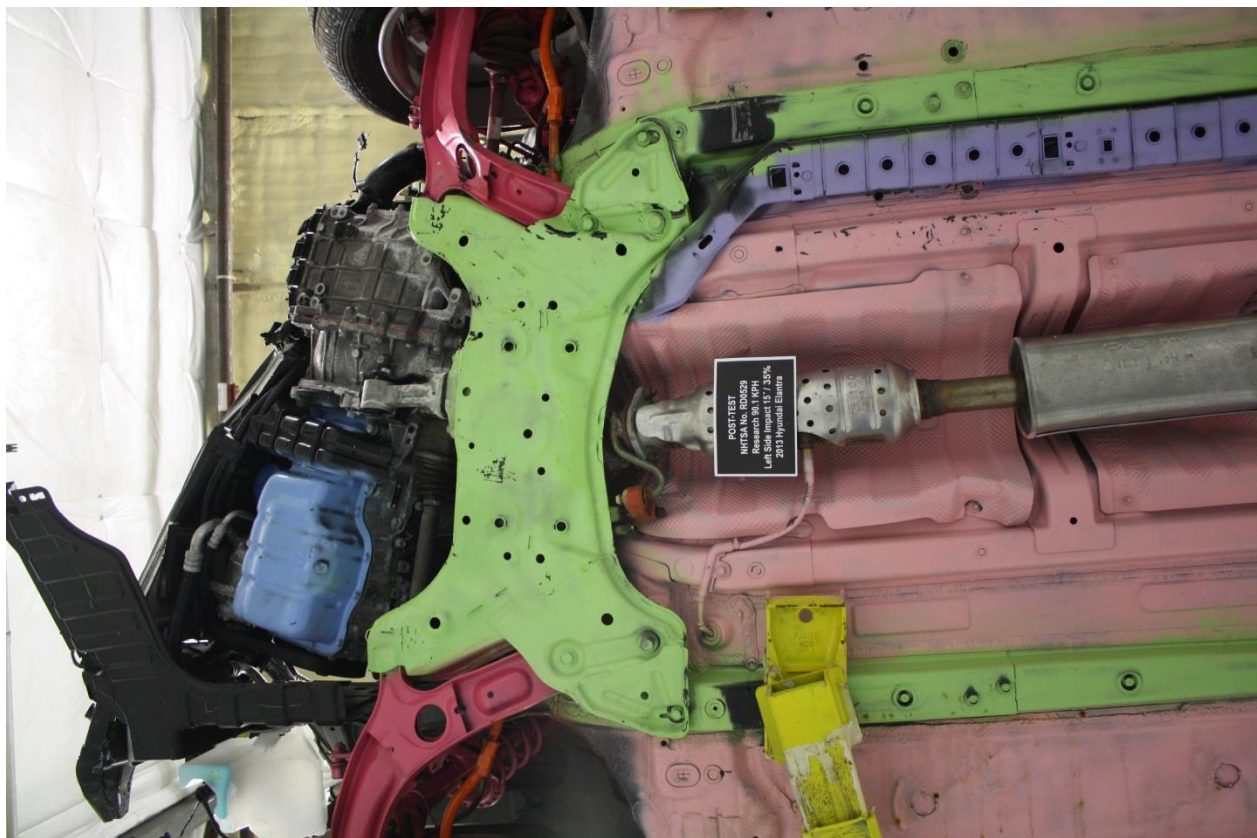
No. 127 Pre-Test Engine Compartment View



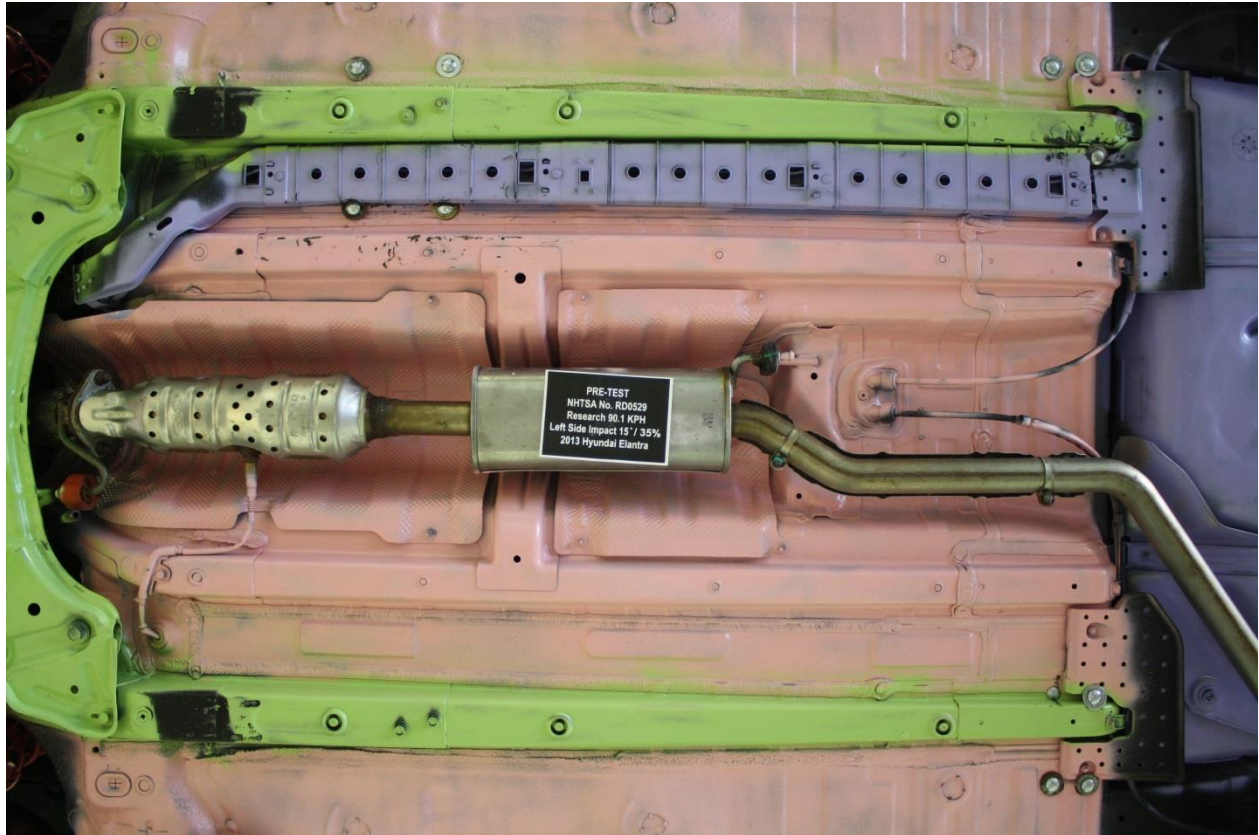
No. 128 Post-Test Engine Compartment View



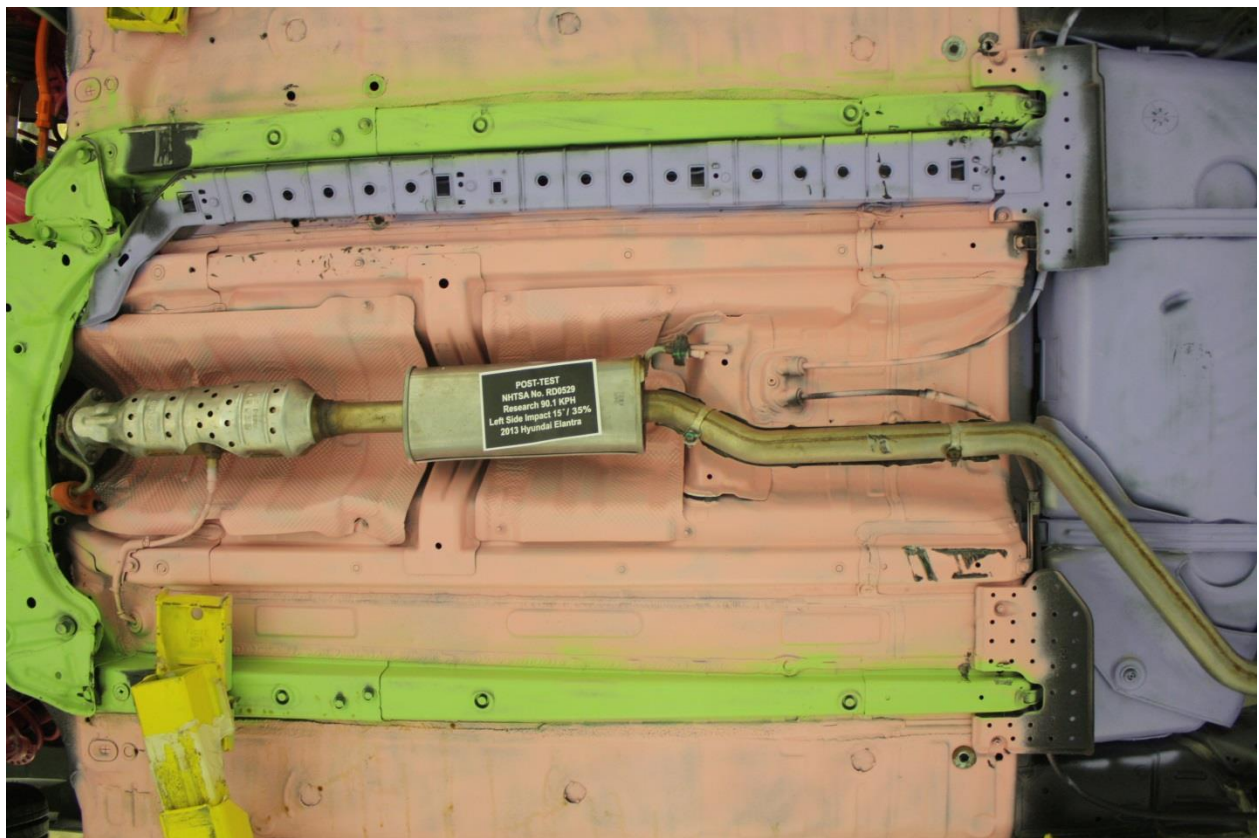
No. 129 Pre-Test View of Front Underbody (perpendicular to vehicle)



No. 130 Post-Test View of Front Underbody (perpendicular to vehicle)



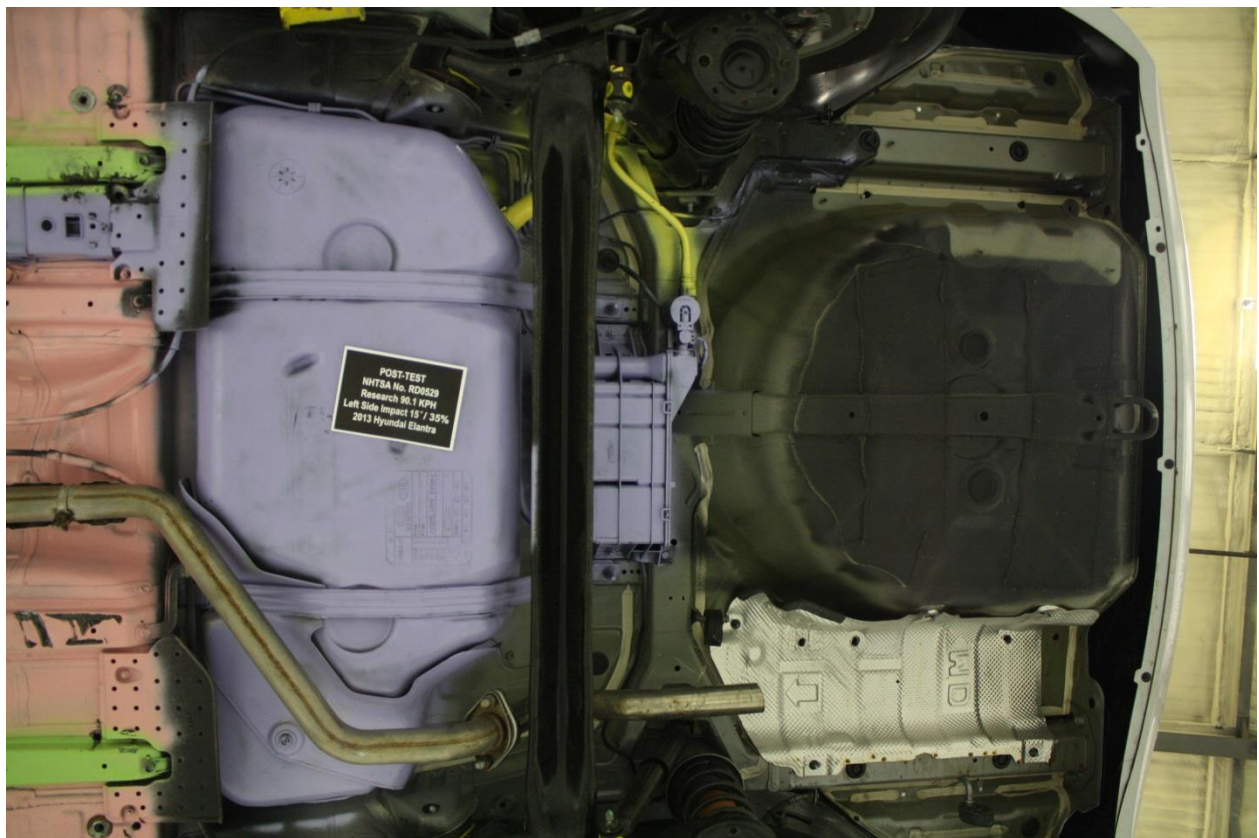
No. 131 Pre-Test View of Mid Underbody (perpendicular to vehicle)



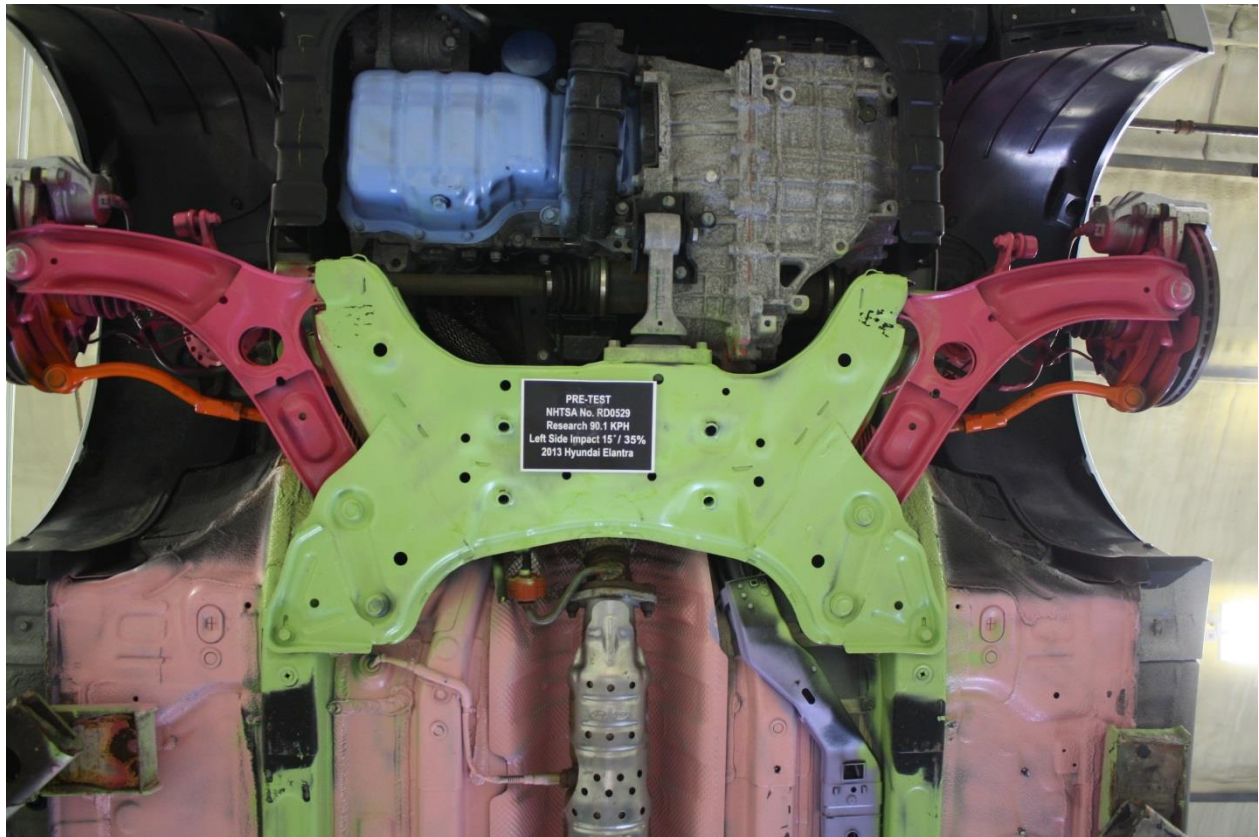
No. 132 Post-Test View of Mid Underbody (perpendicular to vehicle)



No. 133 Pre-Test View of Rear Underbody (perpendicular to vehicle)



No. 134 Post-Test View of Rear Underbody (perpendicular to vehicle)



No. 135 Pre-Test View of Steering rack and or sway bar



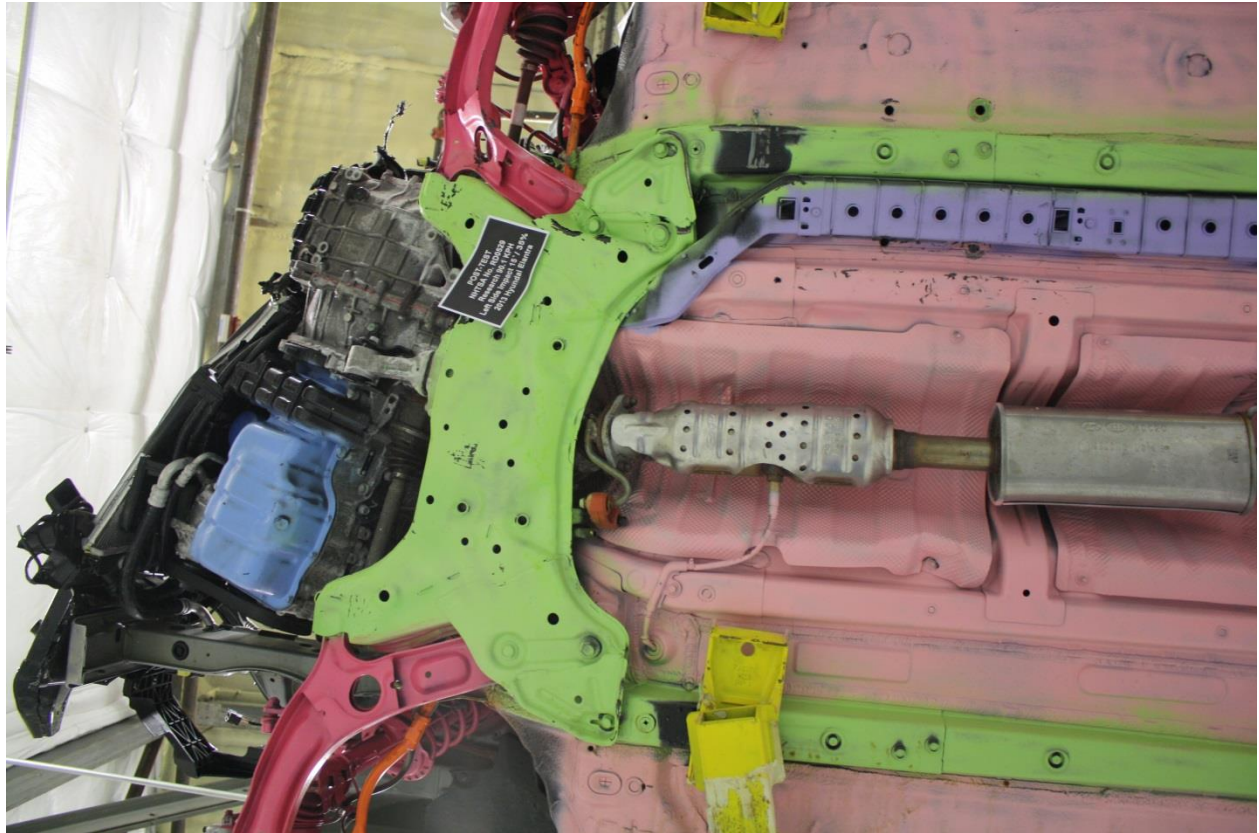
No. 136 Post-Test View of Steering rack and or sway bar

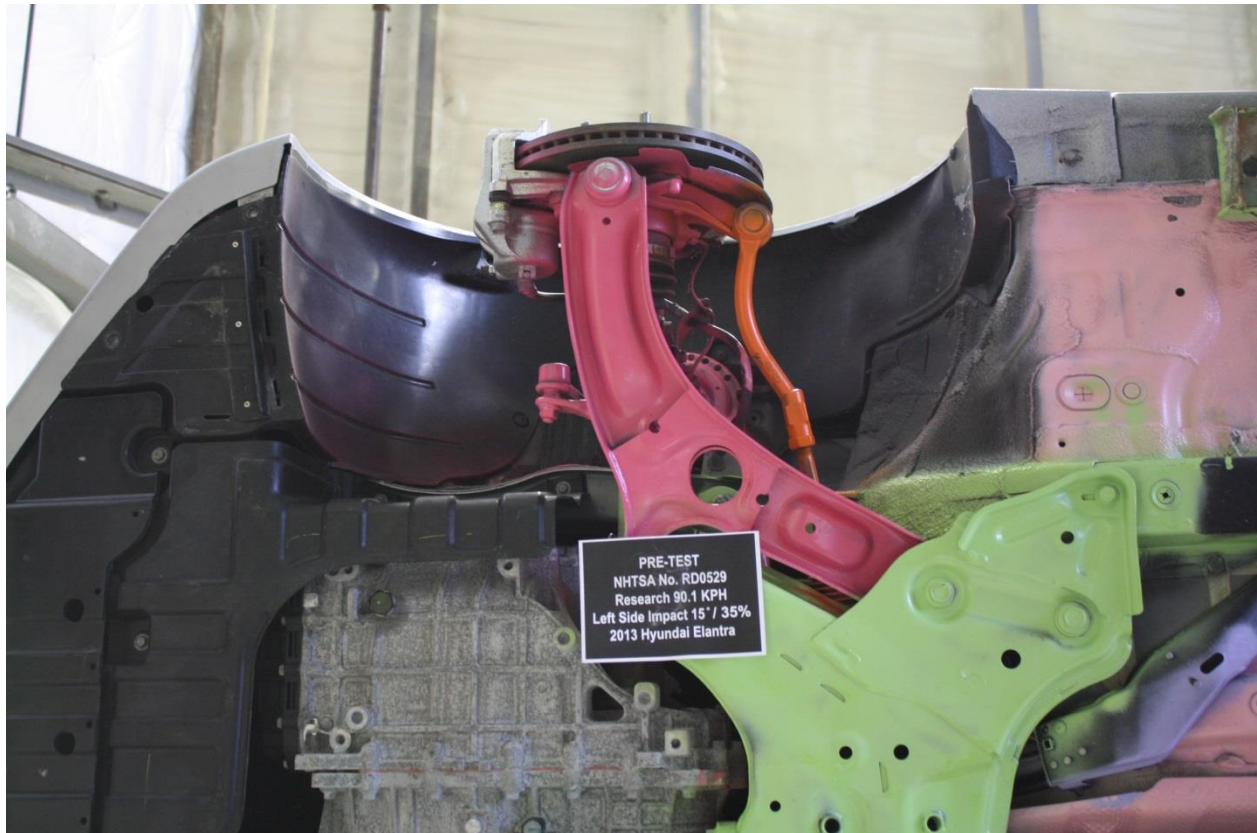


No. 137 Pre-Test Bumper to Rail Attachments and Crush Initiators



No. 138 Post-Test Bumper to Rail Attachments and Crush Initiators





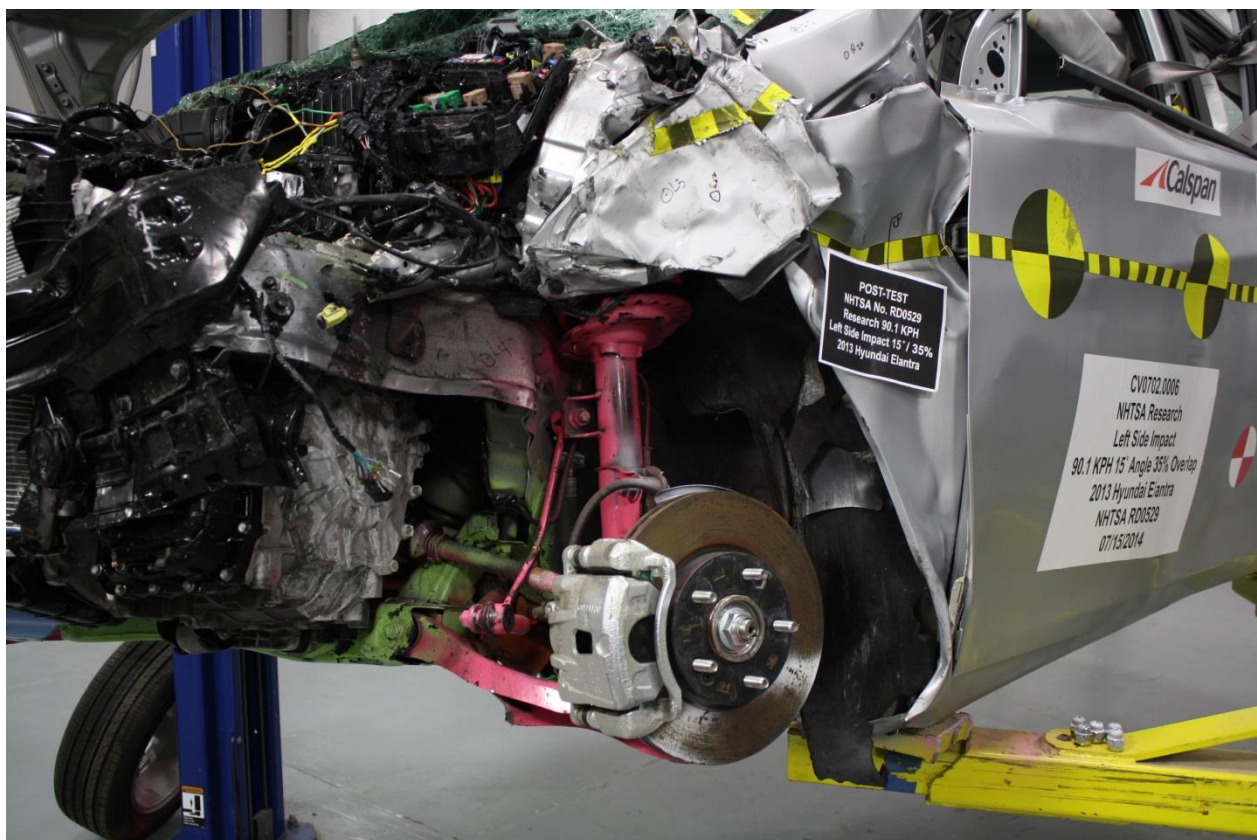
No. 140 Pre-Test Frame Rail with tire removed



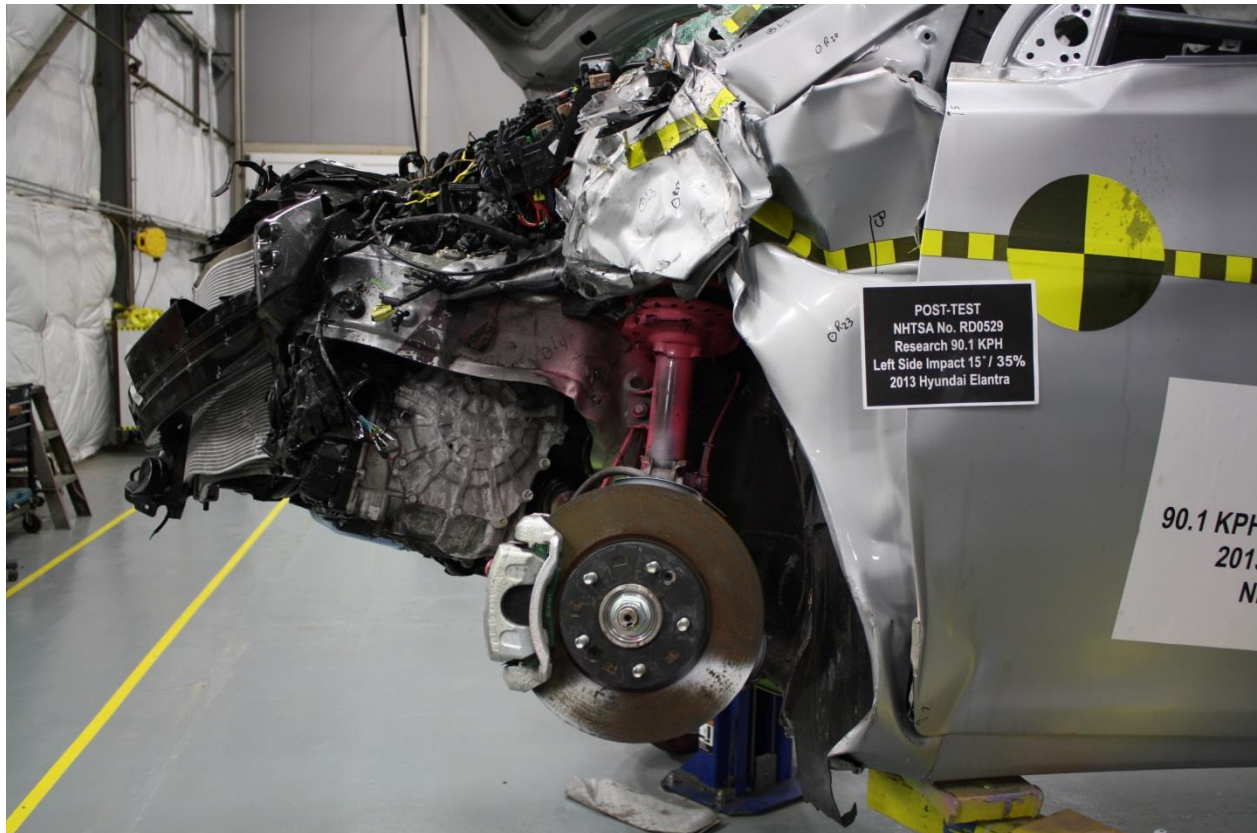
No. 141 Post-Test Frame Rail with tire removed



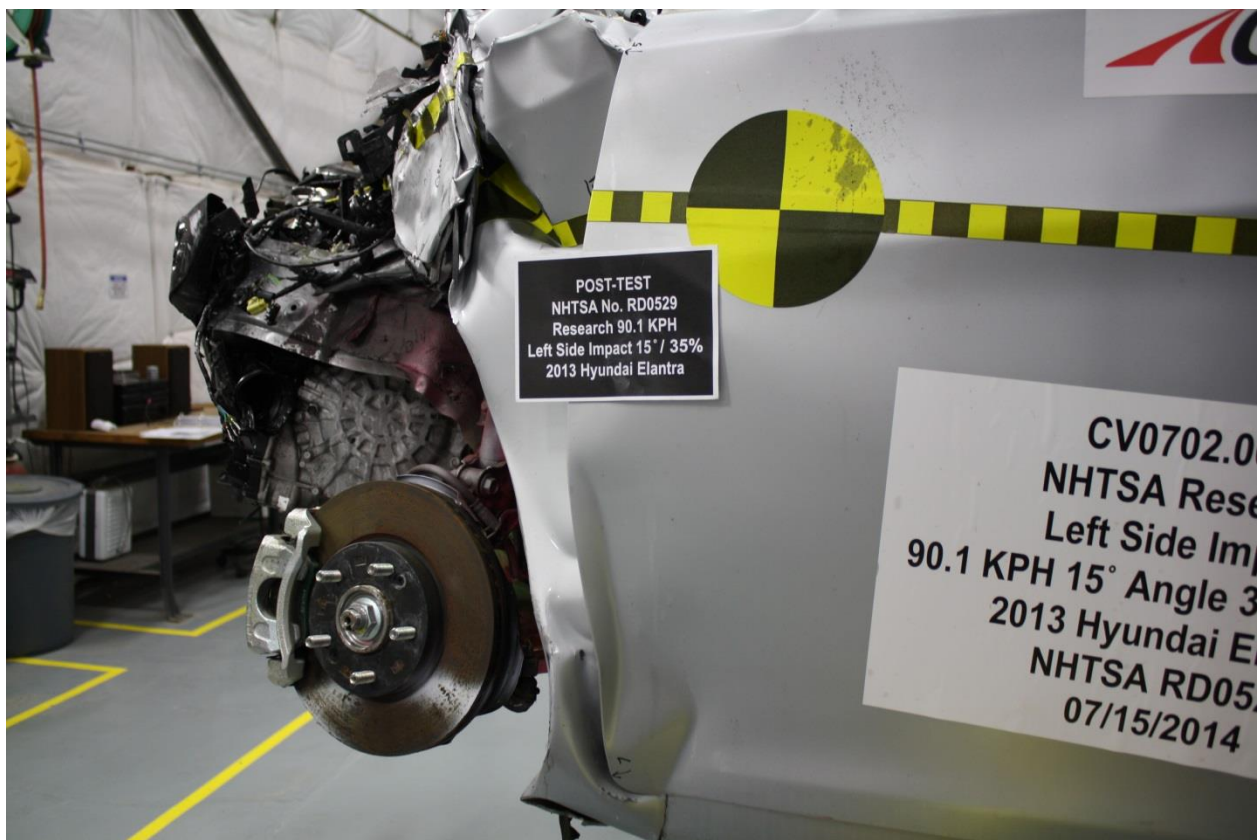
No. 142 Pre-Test View of Front Driver Wheel Well w/ Tire Removed



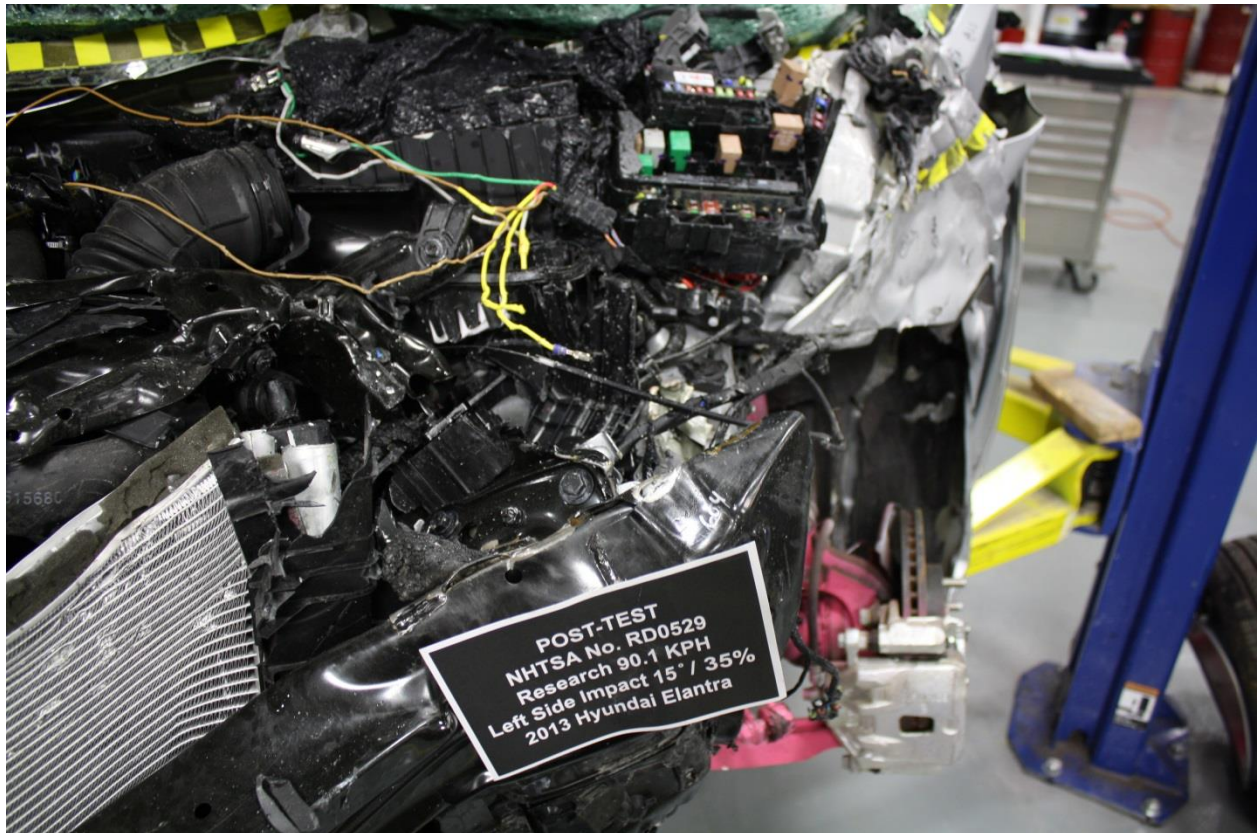
No. 143 Post-Test $\frac{3}{4}$ View of Front Driver Wheel Well w/ Tire Removed



No. 144 Post-Test Side View of Front Driver Wheel Well w/ Tire Removed



No. 145 Post-Test Right Side 3/4 Rear View of the Front Driver Wheel Well w/ Tire Removed



No. 146 Post-Test Looking Down at the Front Driver Shotgun



No. 147 Post-Test Right Side $\frac{3}{4}$ View of Front Driver Shotgun



No. 148 Post-Test Front Driver Close up View of Suspension w/ Tire Removed



No. 149 Post-Test $\frac{3}{4}$ View of Front Passenger Wheel Well w/ Tire Removed



No. 150 Post-Test Side View of Front Passenger Wheel Well w/ Tire Removed



No. 151 Post-Test Right Side 3/4 Rear View of the Front Passenger Wheel Well w/ Tire Removed



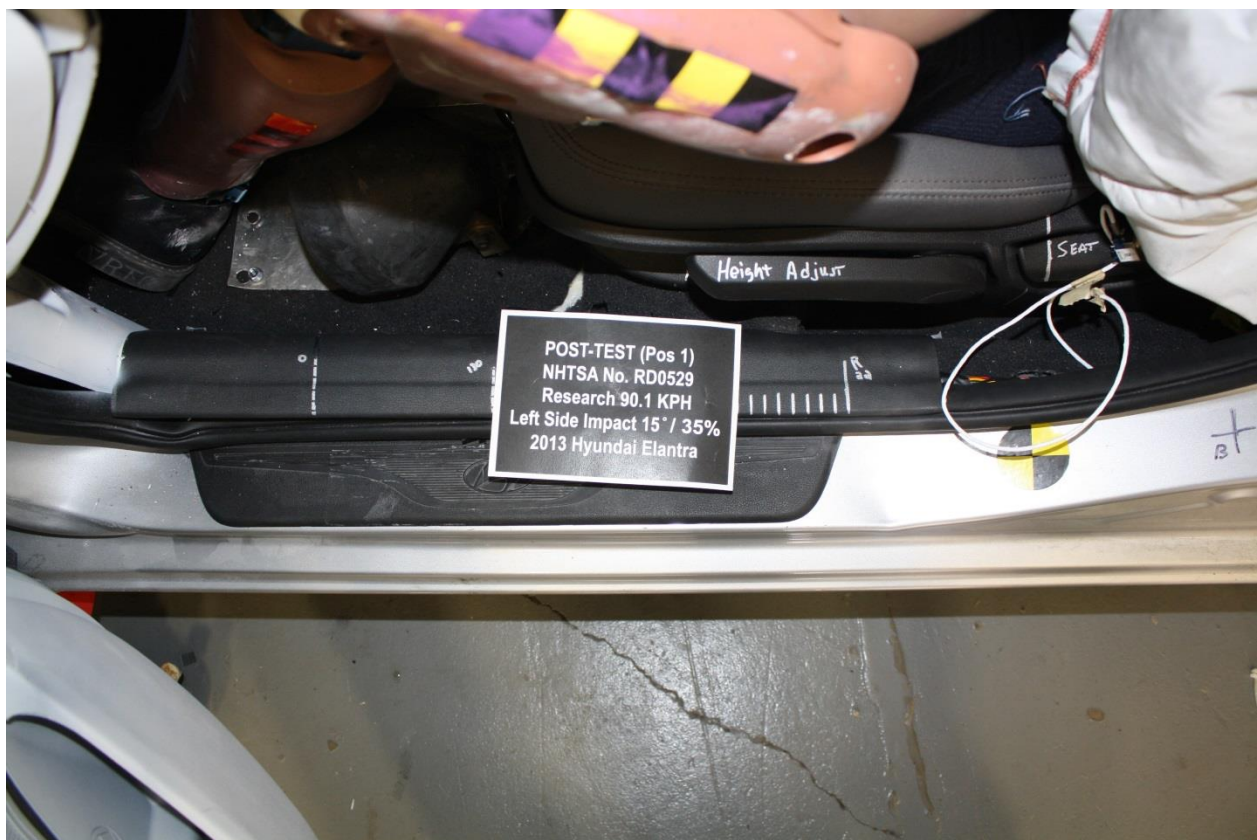
No. 152 Post-Test Looking Down at the Front Passenger Shotgun



No. 153 Post-Test Right Side $\frac{3}{4}$ View of Front Passenger Shotgun



No. 154 Post-Test Front Passenger Close up View of Suspension w/ Tire Removed



No. 155 Post-Test View of Door Sill with Door Open- Struck Side



No. 156 Post-Test View of Deformation of A pillar-Struck Side



No. 157 Post-Test View of Deformation of B pillar-Struck Side



No. 158 Post-Test View of Deformation of C pillar-Struck Side



No. 159 Post-Test View of Wheel and/or Tire Deformation-Struck Side



No. 160 Post-Test View of Deformation of Rocker or Post-Struck Side



No. 161 Post-Test View of Windshield Separation



No. 162 Pre-Test Left Side View of RMD



No. 163 Post-Test Left Side View of RMD



No. 164 Pre-Test Right Side View of RMDB



No. 165 Post-Test Right Side View of RMDB



No. 166 Pre-Test Top View of RMDB



No. 167 Post-Test Top View of RMDB



No. 168 Pre-Test Front View of RMDB



No. 169 Post-Test Front View of RMDB



No. 170 Pre-Test RMDB & Vehicle, Right Side



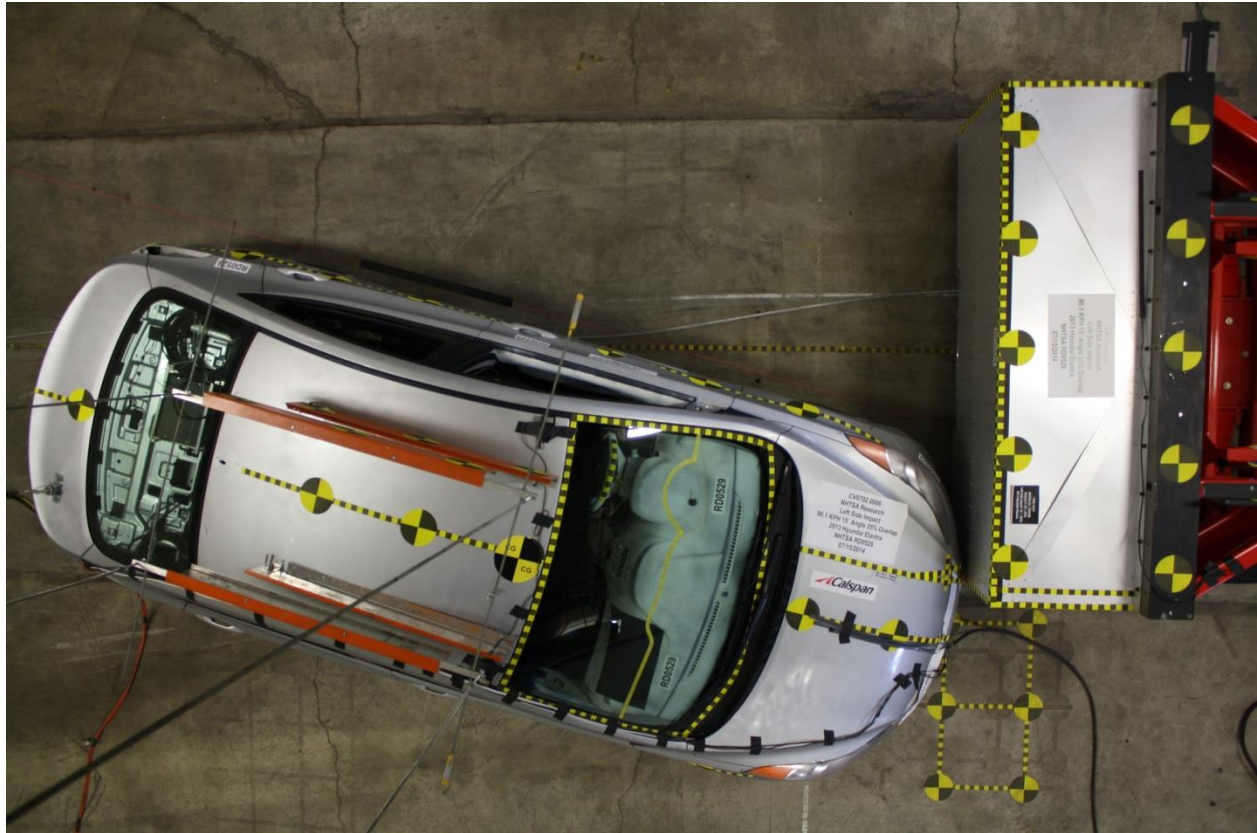
No. 171 Post-Test RMDB & Vehicle, Right Side



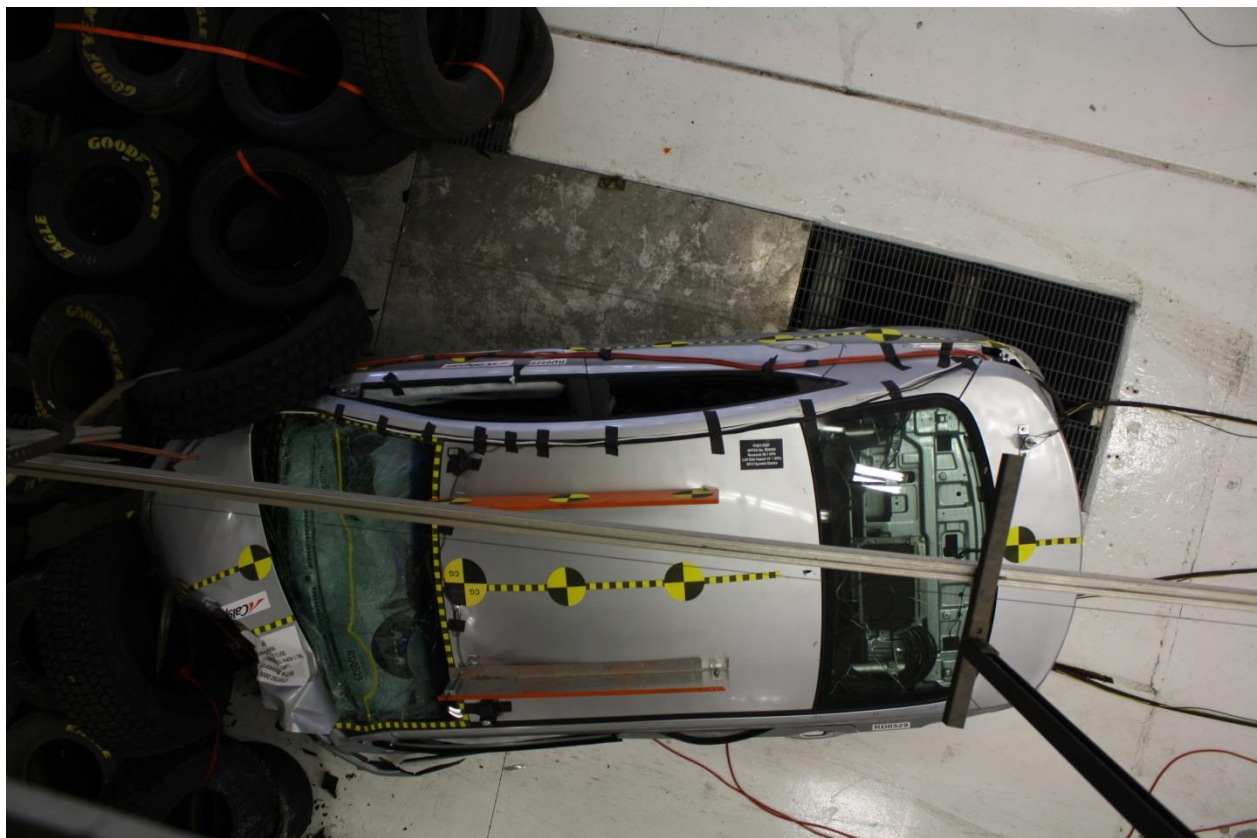
No. 172 Pre-Test RMDB & Vehicle, Left Side



No. 173 Post-Test RMDB & Vehicle, Left Side



No. 174 Pre-Test RMDB & Vehicle, Top View



No. 175 Post-Test RMDB & Vehicle, Top View



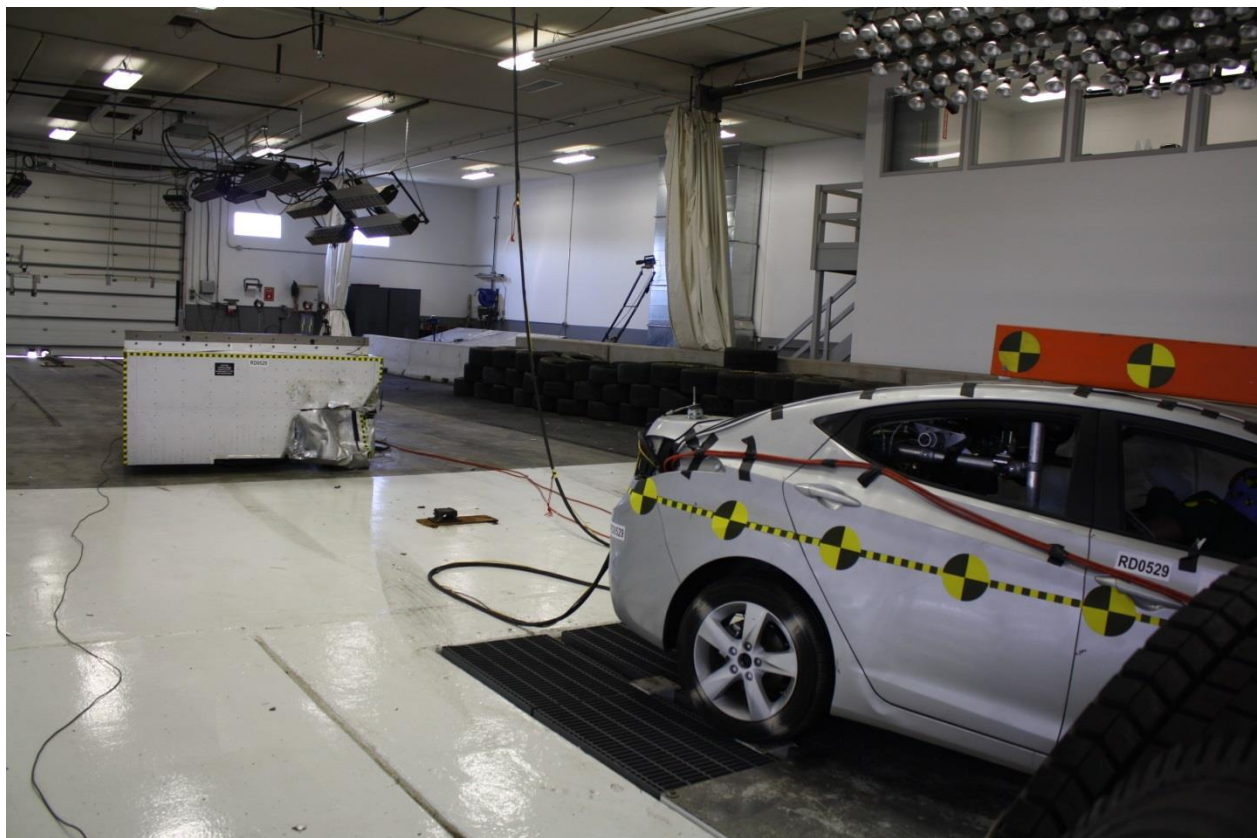
No. 176 Pre-Test RMDB & Vehicle, Rear View



No. 177 Post-Test RMDB & Vehicle, Rear View



No. 178 Pre-Test RMDB & Vehicle, Front View



No. 179 Post-Test RMDB & Vehicle, Front View



No. 180 Vehicle at 0 Degrees on Static Rollover Device



No. 181 Vehicle at 90 Degrees on Static Rollover Device



No. 182 Vehicle at 180 Degrees on Static Rollover Device



No. 183 Vehicle at 270 Degrees on Static Rollover Device



No. 184 Vehicle at 360 Degrees on Static Rollover Device



No. 185 Impact Photo

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

Table of Data Plots

No.	Description	Page
Plot 1	V2P1 Head CG X Acceleration	B-8
Plot 2	V2P1 Head CG Y Acceleration	B-8
Plot 3	V2P1 Head CG Z Acceleration	B-8
Plot 4	V2P1 Head CG Angular Velocity About X	B-8
Plot 5	V2P1 Head CG Angular Velocity About Y	B-9
Plot 6	V2P1 Head CG Angular Velocity About Z	B-9
Plot 7	V2P1 Upper Neck X Force	B-9
Plot 8	V2P1 Upper Neck Y Force	B-9
Plot 9	V2P1 Upper Neck Z Force	B-10
Plot 10	V2P1 Upper Neck X Moment	B-10
Plot 11	V2P1 Upper Neck Y Moment	B-10
Plot 12	V2P1 Upper Neck Z Moment	B-10
Plot 13	V2P1 Lower Neck X Force	B-11
Plot 14	V2P1 Lower Neck Y Force	B-11
Plot 15	V2P1 Lower Neck Z Force	B-11
Plot 16	V2P1 Lower Neck X Moment	B-11
Plot 17	V2P1 Lower Neck Y Moment	B-12
Plot 18	V2P1 Lower Neck Z Moment	B-12
Plot 19	V2P1 Front Neck Spring Tower Load Cell	B-12
Plot 20	V2P1 Rear Neck Spring Tower Load Cell	B-12
Plot 21	V2P1 Occipital Condyle Rotation Potentiometer	B-13
Plot 22	V2P1 T1 X Acceleration	B-13
Plot 23	V2P1 T1 Y Acceleration	B-13
Plot 24	V2P1 T1 Z Acceleration	B-13
Plot 25	V2P1 T6 X Acceleration	B-14
Plot 26	V2P1 T6 Y Acceleration	B-14
Plot 27	V2P1 T6 Z Acceleration	B-14
Plot 28	V2P1 Upper Left DGIR X Displacement	B-14
Plot 29	V2P1 Upper Left DGIR Y Rotation	B-15
Plot 30	V2P1 Upper Left DGIR Z Rotation	B-15
Plot 31	V2P1 Upper Right DGIR X Displacement	B-15
Plot 32	V2P1 Upper Right DGIR Y Rotation	B-15
Plot 33	V2P1 Upper Right DGIR Z Rotation	B-16
Plot 34	V2P1 Lower Left DGIR X Displacement	B-16
Plot 35	V2P1 Lower Left DGIR Y Rotation	B-16
Plot 36	V2P1 Lower Left DGIR Z Rotation	B-16
Plot 37	V2P1 Lower Right DGIR X Displacement	B-17
Plot 38	V2P1 Lower Right DGIR Y Rotation	B-17
Plot 39	V2P1 Lower Right DGIR Z Rotation	B-17
Plot 40	V2P1 Abdomen Left DGIR X Displacement	B-17
Plot 41	V2P1 Abdomen Left DGIR Y Rotation	B-18
Plot 42	V2P1 Abdomen Left DGIR Z Rotation	B-18
Plot 43	V2P1 Abdomen Right DGIR X Displacement	B-18
Plot 44	V2P1 Abdomen Right DGIR Y Rotation	B-18
Plot 45	V2P1 Abdomen Right DGIR Z Rotation	B-19
Plot 46	V2P1 Spine Force X	B-19
Plot 47	V2P1 Spine Force Y	B-19
Plot 48	V2P1 Spine Force Z	B-19
Plot 49	V2P1 Spine Moment X	B-20
Plot 50	V2P1 Spine Moment Y	B-20
Plot 51	V2P1 Pelvis X Acceleration	B-20
Plot 52	V2P1 Pelvis Y Acceleration	B-20
Plot 53	V2P1 Pelvis Z Acceleration	B-21
Plot 54	V2P1 Acetabular Left X Force	B-21
Plot 55	V2P1 Acetabular Left Y Force	B-21
Plot 56	V2P1 Acetabular Left Z Force	B-21
Plot 57	V2P1 Acetabular Right X Force	B-22

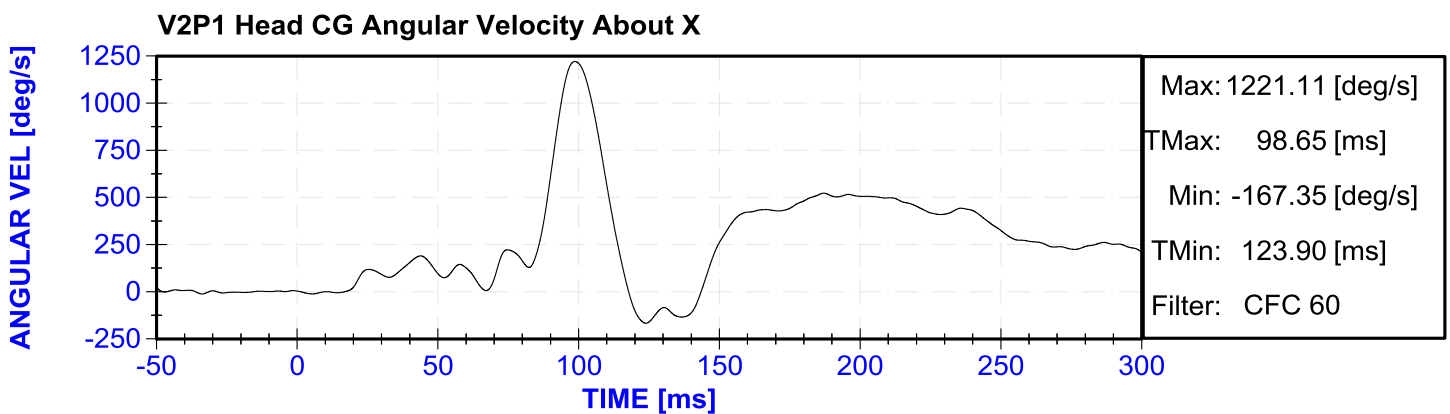
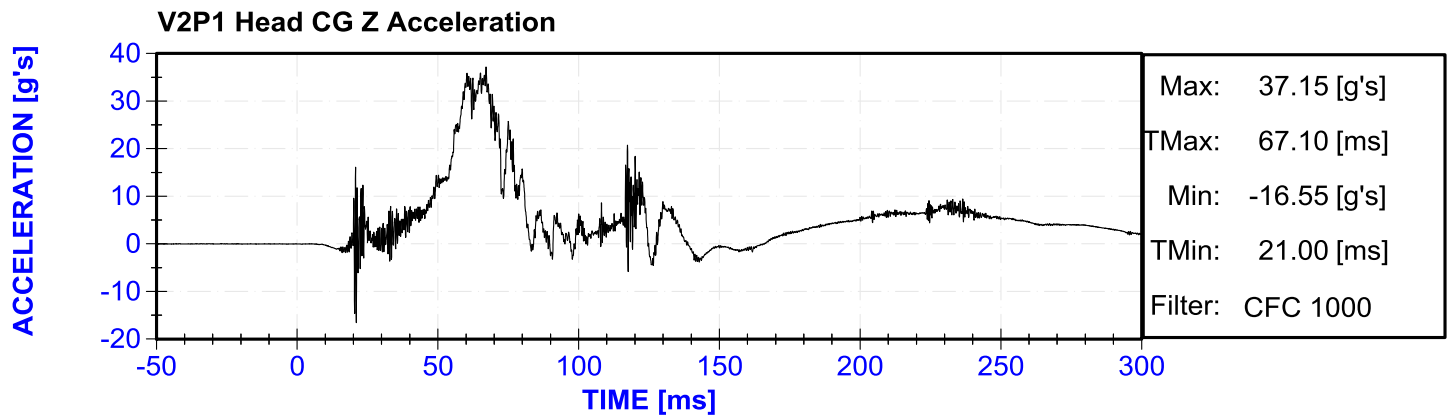
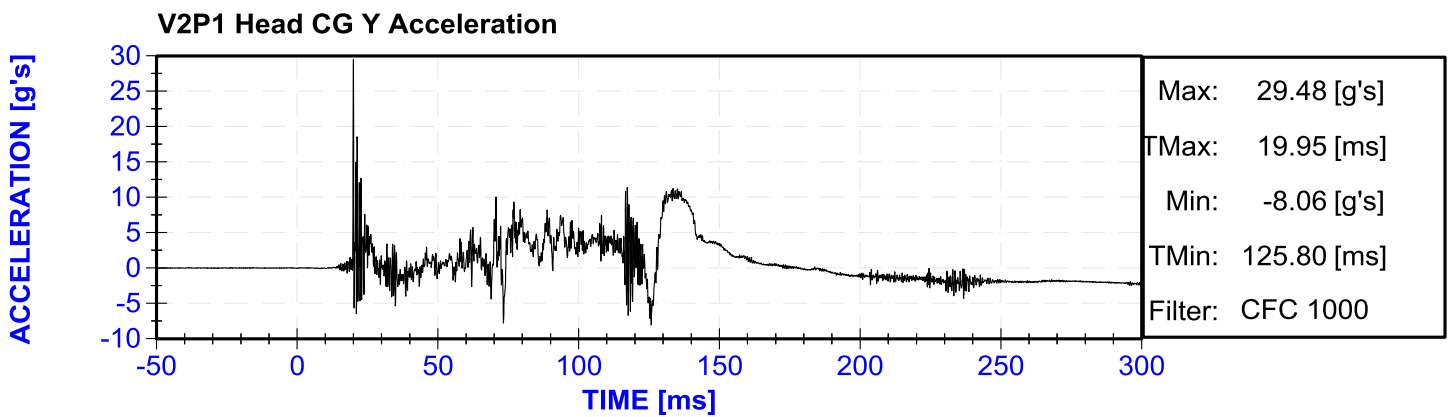
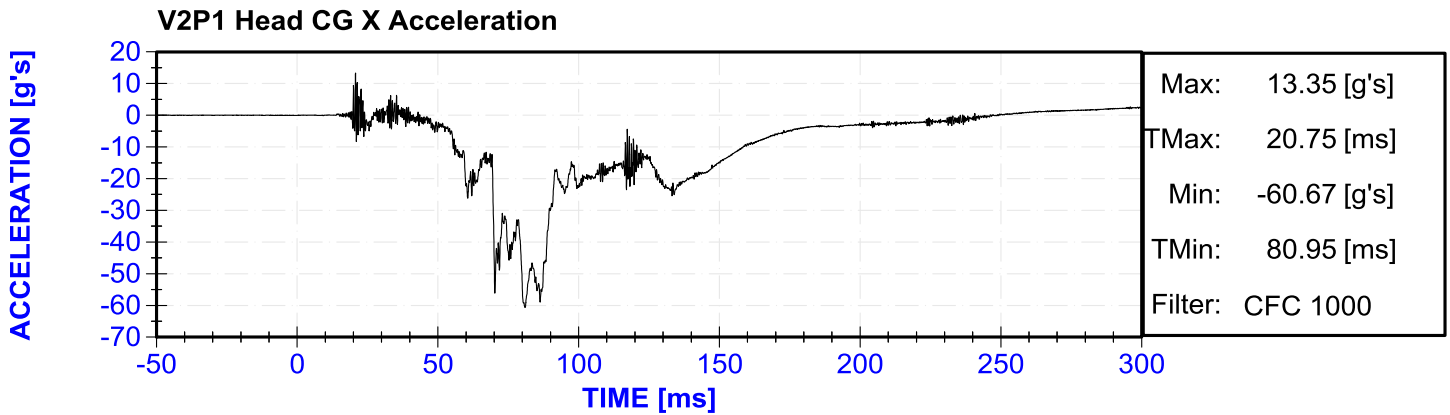
Plot 58	V2P1 Acetabular Right Y Force	B-22
Plot 59	V2P1 Acetabular Right Z Force	B-22
Plot 60	V2P1 ASIS Left X Force	B-22
Plot 61	V2P1 ASIS Right X Force	B-23
Plot 62	V2P1 Femur Left X Force	B-23
Plot 63	V2P1 Femur Left Y Force	B-23
Plot 64	V2P1 Femur Left Z Force	B-23
Plot 65	V2P1 Femur Left X Moment	B-24
Plot 66	V2P1 Femur Left Y Moment	B-24
Plot 67	V2P1 Femur Left Z Moment	B-24
Plot 68	V2P1 Femur Right X Force	B-24
Plot 69	V2P1 Femur Right Y Force	B-25
Plot 70	V2P1 Femur Right Z Force	B-25
Plot 71	V2P1 Femur Right X Moment	B-25
Plot 72	V2P1 Femur Right Y Moment	B-25
Plot 73	V2P1 Femur Right Z Moment	B-26
Plot 74	V2P1 Knee Left X Displacement	B-26
Plot 75	V2P1 Upper Tibia Left Z Force	B-26
Plot 76	V2P1 Upper Tibia Left X Moment	B-26
Plot 77	V2P1 Upper Tibia Left Y Moment	B-27
Plot 78	V2P1 Lower Tibia Left Z Force	B-27
Plot 79	V2P1 Lower Tibia Left X Moment	B-27
Plot 80	V2P1 Lower Tibia Left Y Moment	B-27
Plot 81	V2P1 Ankle Left X Rotation	B-28
Plot 82	V2P1 Ankle Left Y Rotation	B-28
Plot 83	V2P1 Foot Left Z Acceleration	B-28
Plot 84	V2P1 Knee Right X Displacement	B-28
Plot 85	V2P1 Upper Tibia Right Z Force	B-29
Plot 86	V2P1 Upper Tibia Right X Moment	B-29
Plot 87	V2P1 Upper Tibia Right Y Moment	B-29
Plot 88	V2P1 Lower Tibia Right Z Force	B-29
Plot 89	V2P1 Lower Tibia Right X Moment	B-30
Plot 90	V2P1 Lower Tibia Right Y Moment	B-30
Plot 91	V2P1 Ankle Right X Rotation	B-30
Plot 92	V2P1 Ankle Right Y Rotation	B-30
Plot 93	V2P1 Foot Right Z Acceleration	B-31
Plot 94	V2 Driver Lap Belt Force	B-31
Plot 95	V2 Driver Shoulder Belt Upper Force	B-31
Plot 96	V2 Driver Shoulder Belt Displacement	B-31
Plot 97	V2P2 Head CG X Acceleration	B-32
Plot 98	V2P2 Head CG Y Acceleration	B-32
Plot 99	V2P2 Head CG Z Acceleration	B-32
Plot 100	V2P2 Head CG Angular Velocity About X	B-32
Plot 101	V2P2 Head CG Angular Velocity About Y	B-33
Plot 102	V2P2 Head CG Angular Velocity About Z	B-33
Plot 103	V2P2 Upper Neck X Force	B-33
Plot 104	V2P2 Upper Neck Y Force	B-33
Plot 105	V2P2 Upper Neck Z Force	B-34
Plot 106	V2P2 Upper Neck X Moment	B-34
Plot 107	V2P2 Upper Neck Y Moment	B-34
Plot 108	V2P2 Upper Neck Z Moment	B-34
Plot 109	V2P2 Lower Neck X Force	B-35
Plot 110	V2P2 Lower Neck Y Force	B-35
Plot 111	V2P2 Lower Neck Z Force	B-35
Plot 112	V2P2 Lower Neck X Moment	B-35
Plot 113	V2P2 Lower Neck Y Moment	B-36
Plot 114	V2P2 Lower Neck Z Moment	B-36
Plot 115	V2P2 Front Neck Spring Tower Load Cell	B-36
Plot 116	V2P2 Rear Neck Spring Tower Load Cell	B-36

Plot 117	V2P2 Occipital Condyle Rotation Potentiometer	B-37
Plot 118	V2P2 T1 X Acceleration	B-37
Plot 119	V2P2 T1 Y Acceleration	B-37
Plot 120	V2P2 T1 Z Acceleration	B-37
Plot 121	V2P2 T6 X Acceleration	B-38
Plot 122	V2P2 T6 Y Acceleration	B-38
Plot 123	V2P2 T6 Z Acceleration	B-38
Plot 124	V2P2 Upper Left DGIR X Displacement	B-38
Plot 125	V2P2 Upper Left DGIR Y Rotation	B-39
Plot 126	V2P2 Upper Left DGIR Z Rotation	B-39
Plot 127	V2P2 Upper Right DGIR X Displacement	B-39
Plot 128	V2P2 Upper Right DGIR Y Rotation	B-39
Plot 129	V2P2 Upper Right DGIR Z Rotation	B-40
Plot 130	V2P2 Lower Left DGIR X Displacement	B-40
Plot 131	V2P2 Lower Left DGIR Y Rotation	B-40
Plot 132	V2P2 Lower Left DGIR Z Rotation	B-40
Plot 133	V2P2 Lower Right DGIR X Displacement	B-41
Plot 134	V2P2 Lower Right DGIR Y Rotation	B-41
Plot 135	V2P2 Lower Right DGIR Z Rotation	B-41
Plot 136	V2P2 Abdomen Left DGIR X Displacement	B-41
Plot 137	V2P2 Abdomen Left DGIR Y Rotation	B-42
Plot 138	V2P2 Abdomen Left DGIR Z Rotation	B-42
Plot 139	V2P2 Abdomen Right DGIR X Displacement	B-42
Plot 140	V2P2 Abdomen Right DGIR Y Rotation	B-42
Plot 141	V2P2 Abdomen Right DGIR Z Rotation	B-43
Plot 142	V2P2 Spine Force X	B-43
Plot 143	V2P2 Spine Force Y	B-43
Plot 144	V2P2 Spine Force Z	B-43
Plot 145	V2P2 Spine Moment X	B-44
Plot 146	V2P2 Spine Moment Y	B-44
Plot 147	V2P2 Pelvis X Acceleration	B-44
Plot 148	V2P2 Pelvis Y Acceleration	B-44
Plot 149	V2P2 Pelvis Z Acceleration	B-45
Plot 150	V2P2 Acetabular Left X Force	B-45
Plot 151	V2P2 Acetabular Left Y Force	B-45
Plot 152	V2P2 Acetabular Left Z Force	B-45
Plot 153	V2P2 Acetabular Right X Force	B-46
Plot 154	V2P2 Acetabular Right Y Force	B-46
Plot 155	V2P2 Acetabular Right Z Force	B-46
Plot 156	V2P2 ASIS Left X Force	B-46
Plot 157	V2P2 ASIS Right X Force	B-47
Plot 158	V2P2 Femur Left X Force	B-47
Plot 159	V2P2 Femur Left Y Force	B-47
Plot 160	V2P2 Femur Left Z Force	B-47
Plot 161	V2P2 Femur Left X Moment	B-48
Plot 162	V2P2 Femur Left Y Moment	B-48
Plot 163	V2P2 Femur Left Z Moment	B-48
Plot 164	V2P2 Femur Right X Force	B-48
Plot 165	V2P2 Femur Right Y Force	B-49
Plot 166	V2P2 Femur Right Z Force	B-49
Plot 167	V2P2 Femur Right X Moment	B-49
Plot 168	V2P2 Femur Right Y Moment	B-49
Plot 169	V2P2 Femur Right Z Moment	B-50
Plot 170	V2P2 Knee Left X Displacement	B-50
Plot 171	V2P2 Upper Tibia Left Z Force	B-50
Plot 172	V2P2 Upper Tibia Left X Moment	B-50
Plot 173	V2P2 Upper Tibia Left Y Moment	B-51
Plot 174	V2P2 Lower Tibia Left Z Force	B-51
Plot 175	V2P2 Lower Tibia Left X Moment	B-51

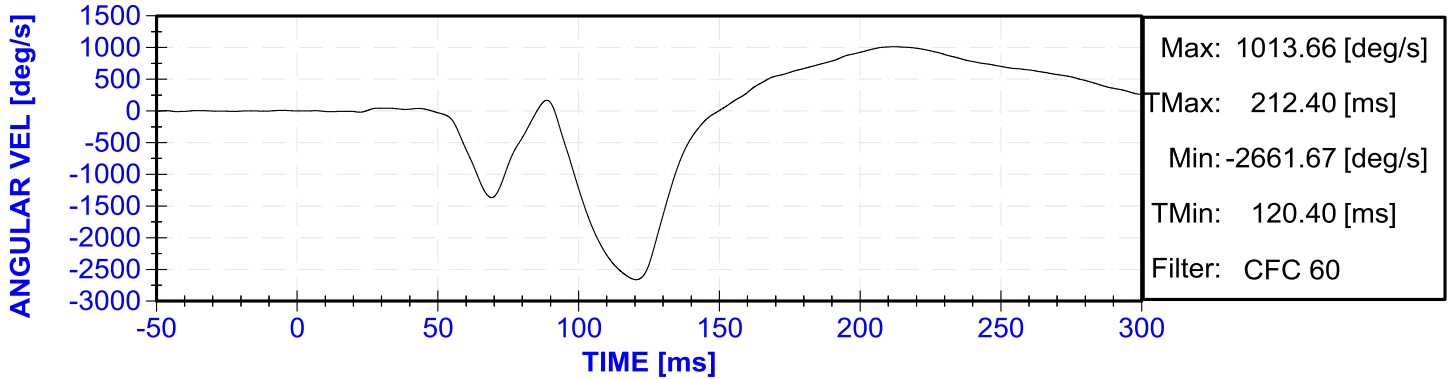
Plot 176	V2P2 Lower Tibia Left Y Moment	B-51
Plot 177	V2P2 Ankle Left X Rotation	B-52
Plot 178	V2P2 Ankle Left Y Rotation	B-52
Plot 179	V2P2 Foot Left Z Acceleration	B-52
Plot 180	V2P2 Knee Right X Displacement	B-52
Plot 181	V2P2 Upper Tibia Right Z Force	B-53
Plot 182	V2P2 Upper Tibia Right X Moment	B-53
Plot 183	V2P2 Upper Tibia Right Y Moment	B-53
Plot 184	V2P2 Lower Tibia Right Z Force	B-53
Plot 185	V2P2 Lower Tibia Right X Moment	B-54
Plot 186	V2P2 Lower Tibia Right Y Moment	B-54
Plot 187	V2P2 Ankle Right X Rotation	B-54
Plot 188	V2P2 Ankle Right Y Rotation	B-54
Plot 189	V2P2 Foot Right Z Acceleration	B-55
Plot 190	V2 Passenger Lap Belt Force	B-55
Plot 191	V2 Passenger Shoulder Belt Upper Force	B-55
Plot 192	V2 Left Rear Sill X Acceleration	B-55
Plot 193	V2 Left Rear Sill Y Acceleration	B-56
Plot 194	V2 Left Rear Sill Redundant X Acceleration	B-56
Plot 195	V2 Left Rear Sill Redundant Y Acceleration	B-56
Plot 196	V2 Right Rear Sill X Acceleration	B-56
Plot 197	V2 Right Rear Sill Y Acceleration	B-57
Plot 198	V2 Vehicle CG X Acceleration	B-57
Plot 199	V2 Vehicle CG Y Acceleration	B-57
Plot 200	V2 Vehicle CG Z Acceleration	B-57
Plot 201	V2 Vehicle CG Angular Rate X	B-58
Plot 202	V2 Vehicle CG Angular Rate Y	B-58
Plot 203	V2 Vehicle CG Angular Rate Z	B-58
Plot 204	V2 Instrument Panel X Acceleration	B-58
Plot 205	V2 Driver Seat Track X Acceleration	B-59
Plot 206	V2 Driver Seat Track Y Acceleration	B-59
Plot 207	V2 Driver Seat Track Z Acceleration	B-59
Plot 208	V2 Passenger Seat Track X Acceleration	B-59
Plot 209	V2 Passenger Seat Track Y Acceleration	B-60
Plot 210	V2 Passenger Seat Track Z Acceleration	B-60
Plot 211	V2 Driver Floor Pan X Acceleration	B-60
Plot 212	V2 Driver Floor Pan Y Acceleration	B-60
Plot 213	V2 Driver Floor Pan Z Acceleration	B-61
Plot 214	V2 Driver Floor Pan X Deflection	B-61
Plot 215	V2 Driver Seat Pan Z Acceleration	B-61
Plot 216	V2 Driver Seat Thigh Bar X Acceleration	B-61
Plot 217	V2 Passenger Seat Pan Z Acceleration	B-62
Plot 218	V2 Passenger Seat Thigh Bar X Acceleration	B-62
Plot 219	V2 Driver Front Airbag Stage 1 Current	B-62
Plot 220	V2 Driver Front Airbag Stage 2 Current	B-62
Plot 221	V2 Driver Anchor Pretensioner Current	B-63
Plot 222	V2 Driver Curtain Airbag Current	B-63
Plot 223	V2 Driver Seat Torso Airbag Current	B-63
Plot 224	V2 Driver Retractor Pretensioner 1 Current	B-63
Plot 225	V2 Driver Retractor Pretensioner 2 Current	B-64
Plot 226	V2 Passenger Front Airbag Stage 1 Current	B-64
Plot 227	V2 Passenger Front Airbag Stage 2 Current	B-64
Plot 228	V2 Passenger Retractor Pretensioner 1 Current	B-64
Plot 229	V2 Passenger Anchor Pretensioner Current	B-65
Plot 230	V1 Cart CG X Acceleration	B-65
Plot 231	V1 Cart CG Y Acceleration	B-65
Plot 232	V1 Cart CG Z Acceleration	B-65
Plot 233	V1 Cart Rear C/L X Acceleration	B-66
Plot 234	V1 Cart Rear C/L Y Acceleration	B-66

Plot 235	V1 Cart Rear C/L Z Acceleration	B-66
Plot 236	V2P1 Fx on head acting through the O.C. joint only	B-66
Plot 237	V2P1 Fz on head acting through the O.C. joint only	B-67
Plot 238	V2P1 My on head acting through the O.C. joint only	B-67
Plot 239	V2P1 Fx on head acting through the total neck section	B-67
Plot 240	V2P1 Fy on head acting through the total neck section	B-67
Plot 241	V2P1 Fz on head acting through the total neck section	B-68
Plot 242	V2P1 Mx on head acting through the total neck section	B-68
Plot 243	V2P1 My on head acting through the total neck section	B-68
Plot 244	V2P1 Mz on head acting through the total neck section	B-68
Plot 245	V2P1 Chest Left Upper Dx	B-69
Plot 246	V2P1 Chest Left Upper Dy	B-69
Plot 247	V2P1 Chest Left Upper Dz	B-69
Plot 248	V2P1 Chest Left Upper D	B-69
Plot 249	V2P1 Chest Right Upper Dx	B-70
Plot 250	V2P1 Chest Right Upper Dy	B-70
Plot 251	V2P1 Chest Right Upper Dz	B-70
Plot 252	V2P1 Chest Right Upper D	B-70
Plot 253	V2P1 Chest Left Lower Dx	B-71
Plot 254	V2P1 Chest Left Lower Dy	B-71
Plot 255	V2P1 Chest Left Lower Dz	B-71
Plot 256	V2P1 Chest Left Lower D	B-71
Plot 257	V2P1 Chest Right Lower Dx	B-72
Plot 258	V2P1 Chest Right Lower Dy	B-72
Plot 259	V2P1 Chest Right Lower Dz	B-72
Plot 260	V2P1 Chest Right Lower D	B-72
Plot 261	V2P1 Abdomen Left Lower Dx	B-73
Plot 262	V2P1 Abdomen Left Lower Dy	B-73
Plot 263	V2P1 Abdomen Left Lower Dz	B-73
Plot 264	V2P1 Abdomen Left Lower D	B-73
Plot 265	V2P1 Abdomen Right Lower Dx	B-74
Plot 266	V2P1 Abdomen Right Lower Dy	B-74
Plot 267	V2P1 Abdomen Right Lower Dz	B-74
Plot 268	V2P1 Abdomen Right Lower D	B-74
Plot 269	V2P2 Fx on head acting through the O.C. joint only	B-75
Plot 270	V2P2 Fz on head acting through the O.C. joint only	B-75
Plot 271	V2P2 My on head acting through the O.C. joint only	B-75
Plot 272	V2P2 Fx on head acting through the total neck section	B-75
Plot 273	V2P2 Fy on head acting through the total neck section	B-76
Plot 274	V2P2 Fz on head acting through the total neck section	B-76
Plot 275	V2P2 Mx on head acting through the total neck section	B-76
Plot 276	V2P2 My on head acting through the total neck section	B-76
Plot 277	V2P2 Mz on head acting through the total neck section	B-77
Plot 278	V2P2 Chest Left Upper Dx	B-77
Plot 279	V2P2 Chest Left Upper Dy	B-77
Plot 280	V2P2 Chest Left Upper Dz	B-77
Plot 281	V2P2 Chest Left Upper D	B-78
Plot 282	V2P2 Chest Right Upper Dx	B-78
Plot 283	V2P2 Chest Right Upper Dy	B-78
Plot 284	V2P2 Chest Right Upper Dz	B-78
Plot 285	V2P2 Chest Right Upper D	B-79
Plot 286	V2P2 Chest Left Lower Dx	B-79
Plot 287	V2P2 Chest Left Lower Dy	B-79
Plot 288	V2P2 Chest Left Lower Dz	B-79
Plot 289	V2P2 Chest Left Lower D	B-80
Plot 290	V2P2 Chest Right Lower Dx	B-80
Plot 291	V2P2 Chest Right Lower Dy	B-80
Plot 292	V2P2 Chest Right Lower Dz	B-80
Plot 293	V2P2 Chest Right Lower D	B-81

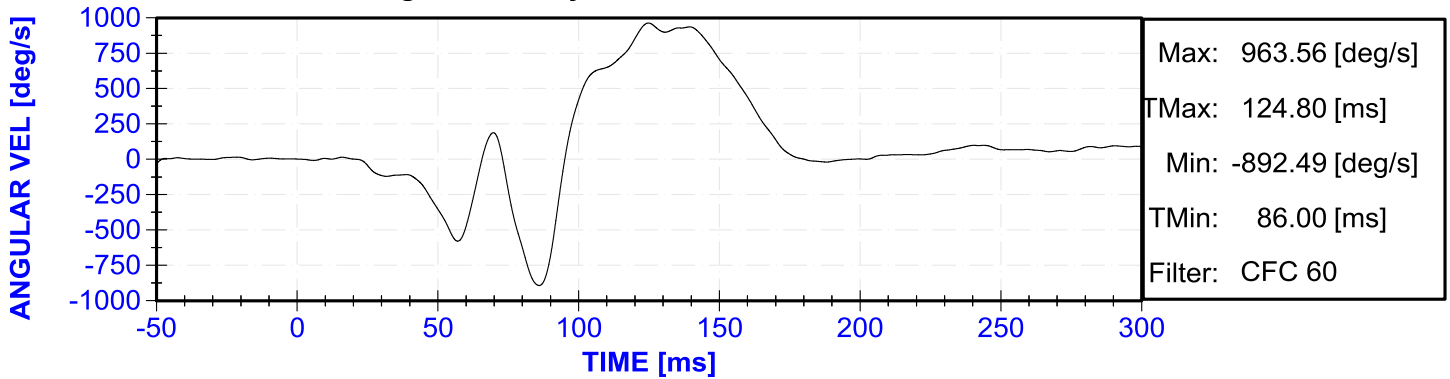
Plot 294	V2P2 Abdomen Left Lower Dx	B-81
Plot 295	V2P2 Abdomen Left Lower Dy	B-81
Plot 296	V2P2 Abdomen Left Lower Dz	B-81
Plot 297	V2P2 Abdomen Left Lower D	B-82
Plot 298	V2P2 Abdomen Right Lower Dx	B-82
Plot 299	V2P2 Abdomen Right Lower Dy	B-82
Plot 300	V2P2 Abdomen Right Lower Dz	B-82
Plot 301	V2P2 Abdomen Right Lower D	B-83



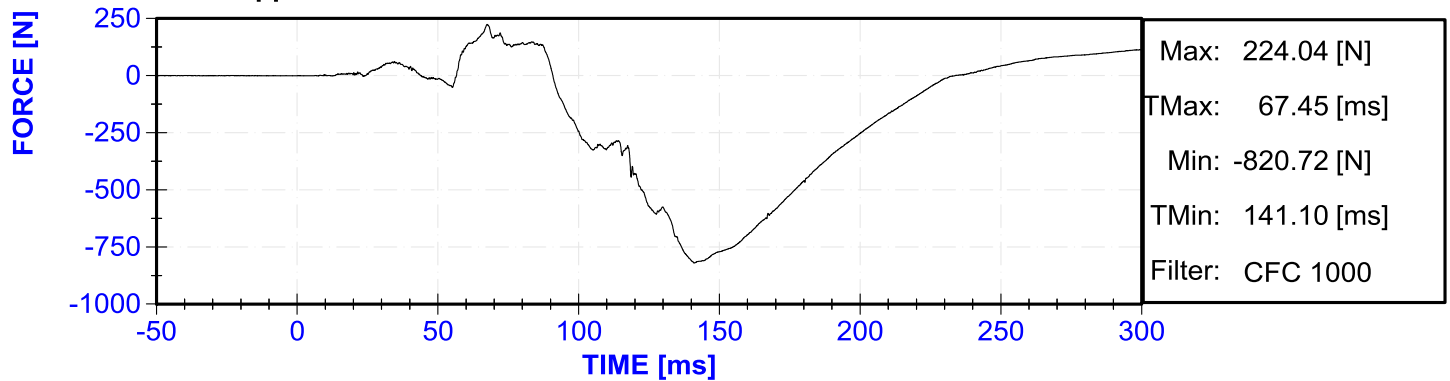
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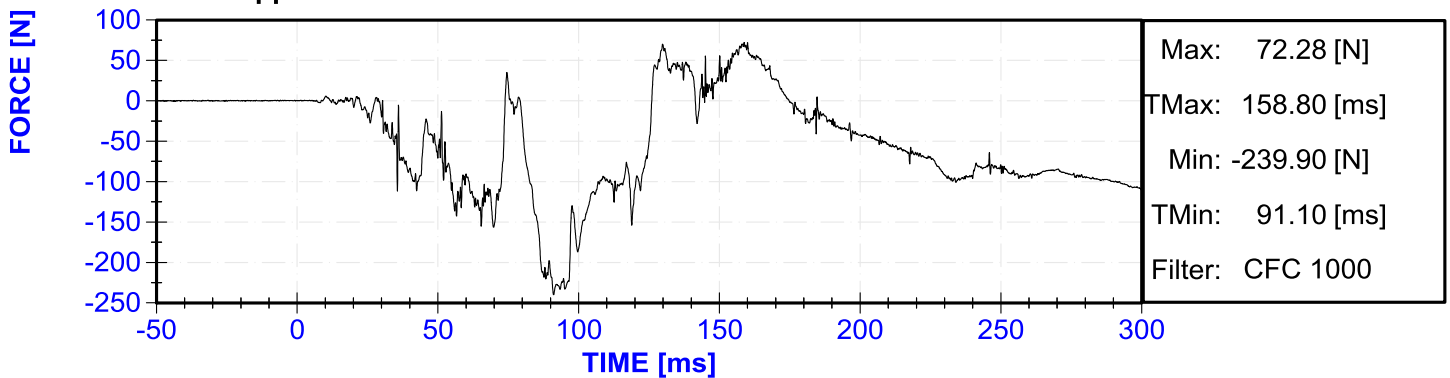
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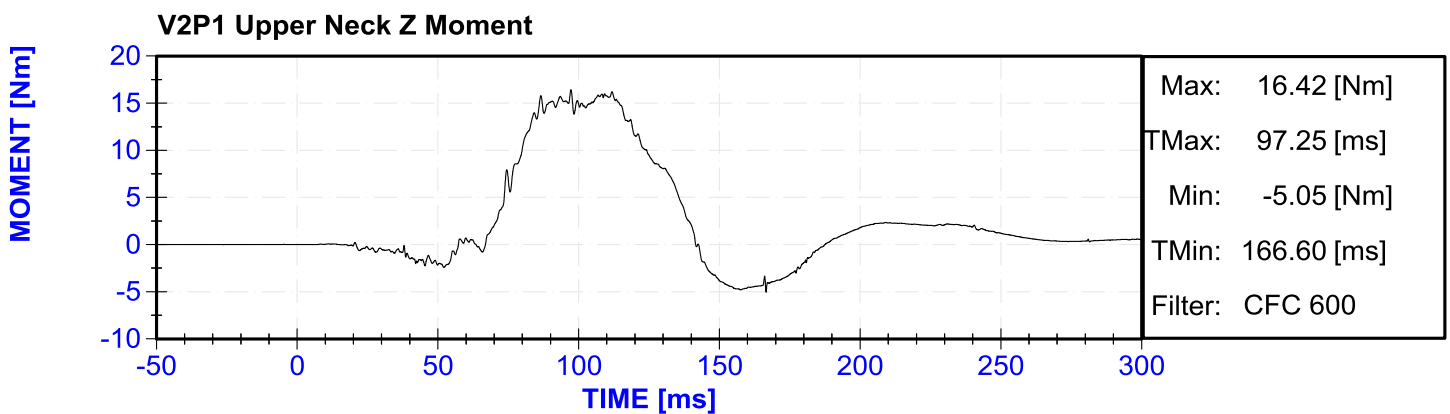
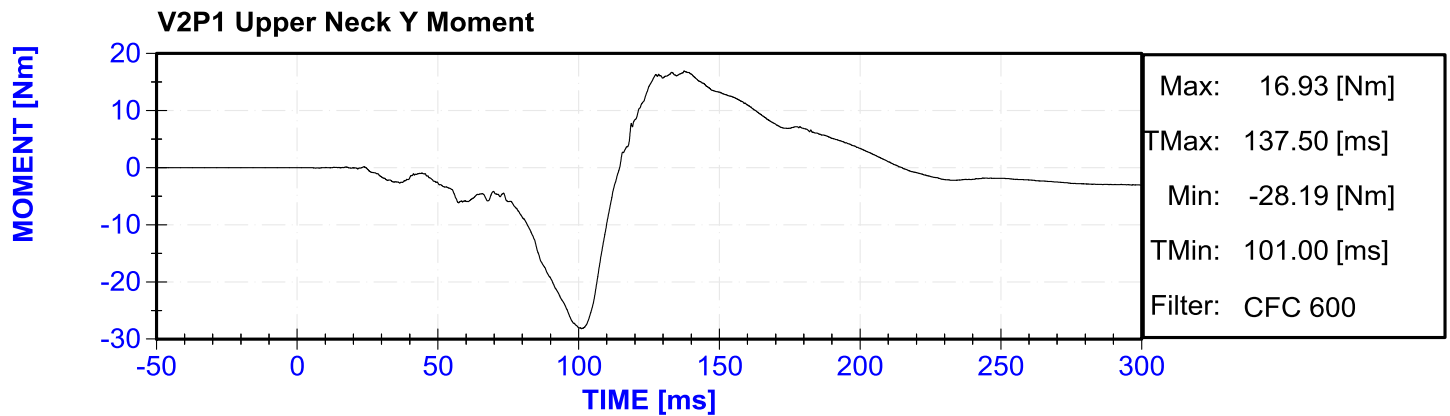
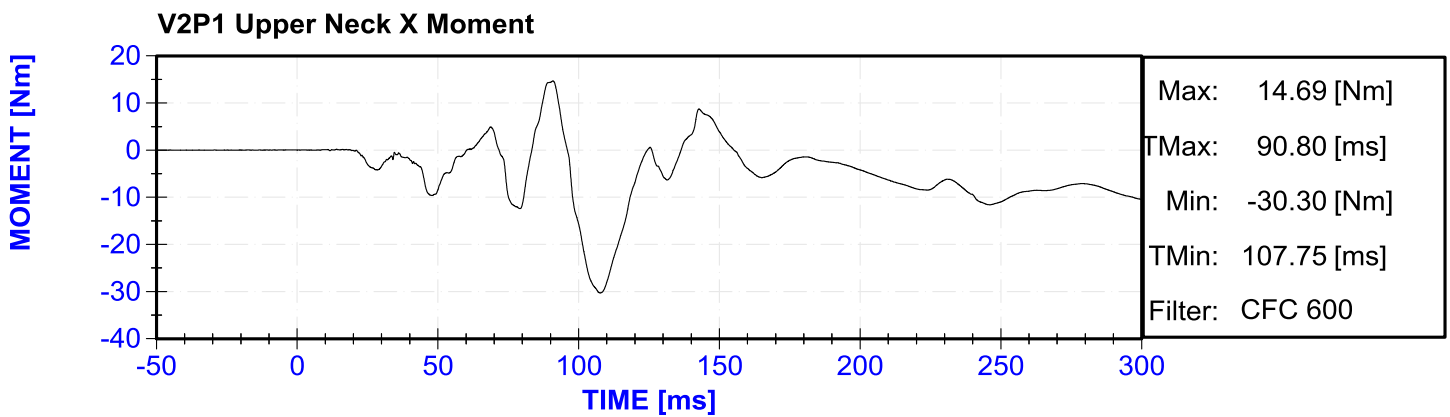
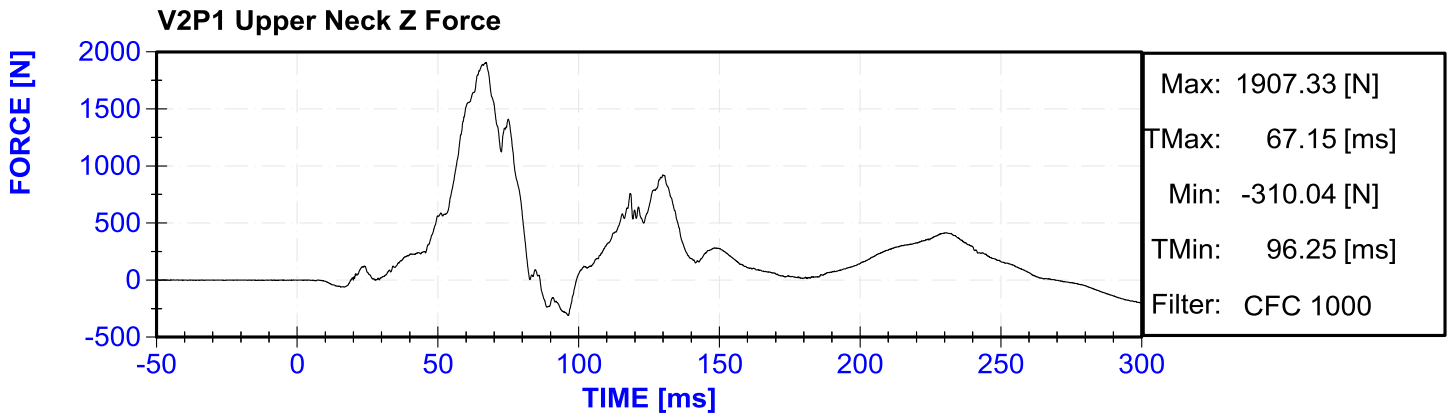


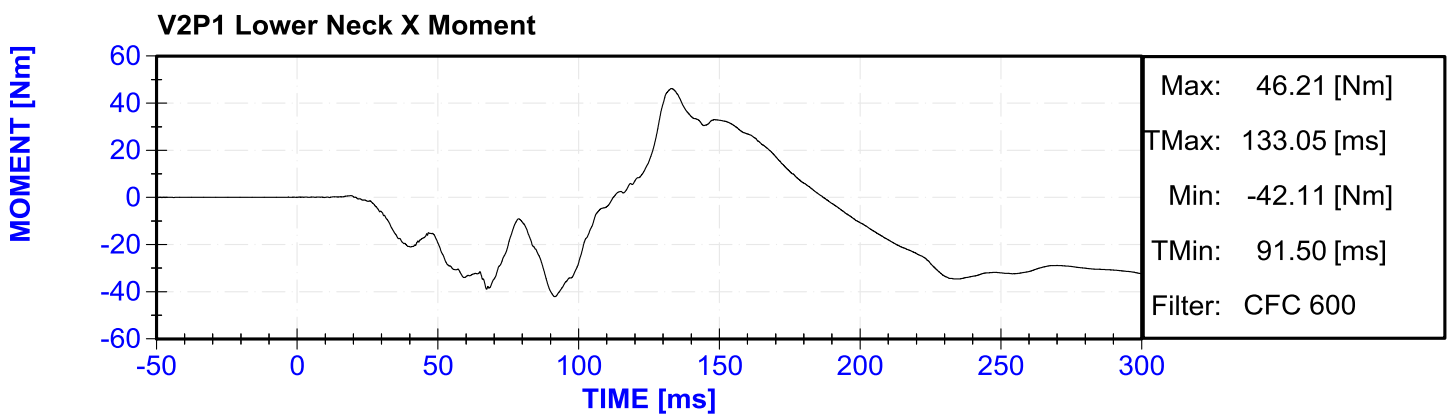
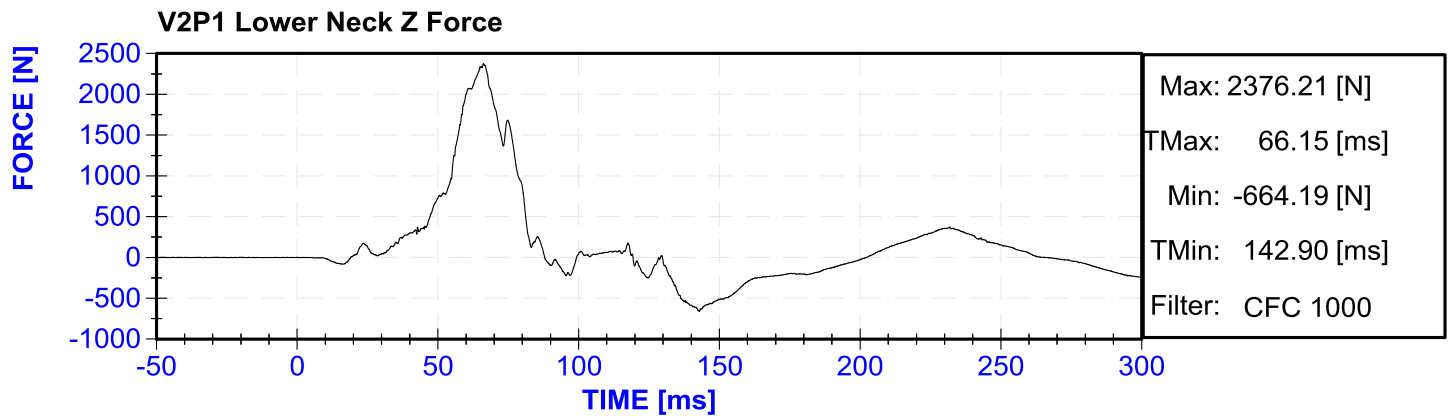
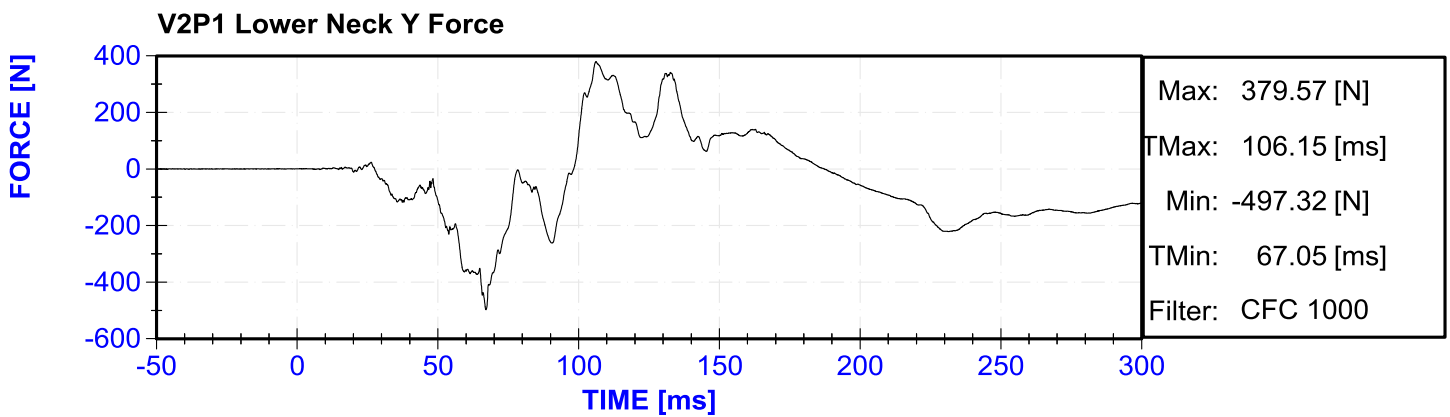
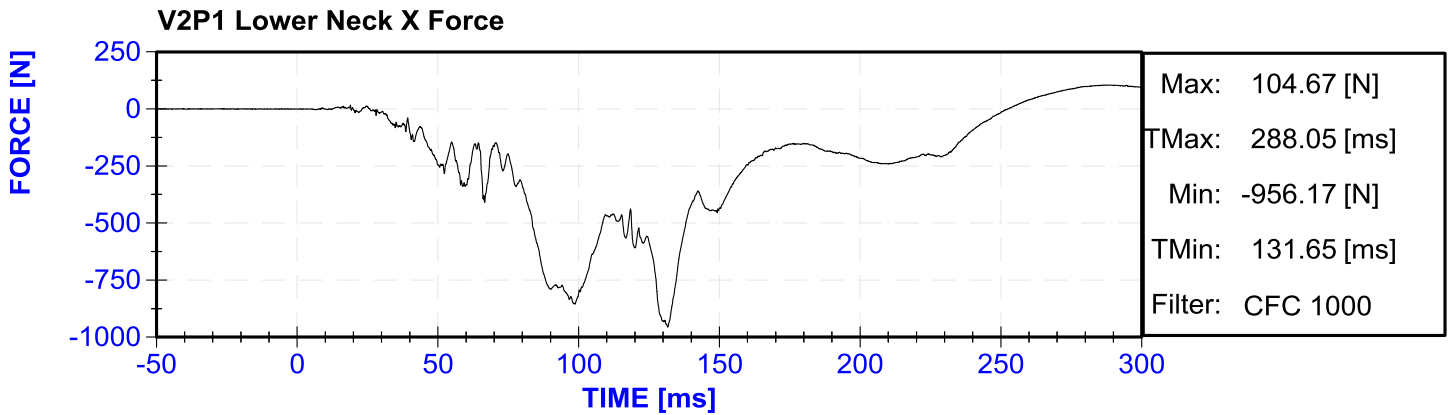
V2P1 Upper Neck X Force

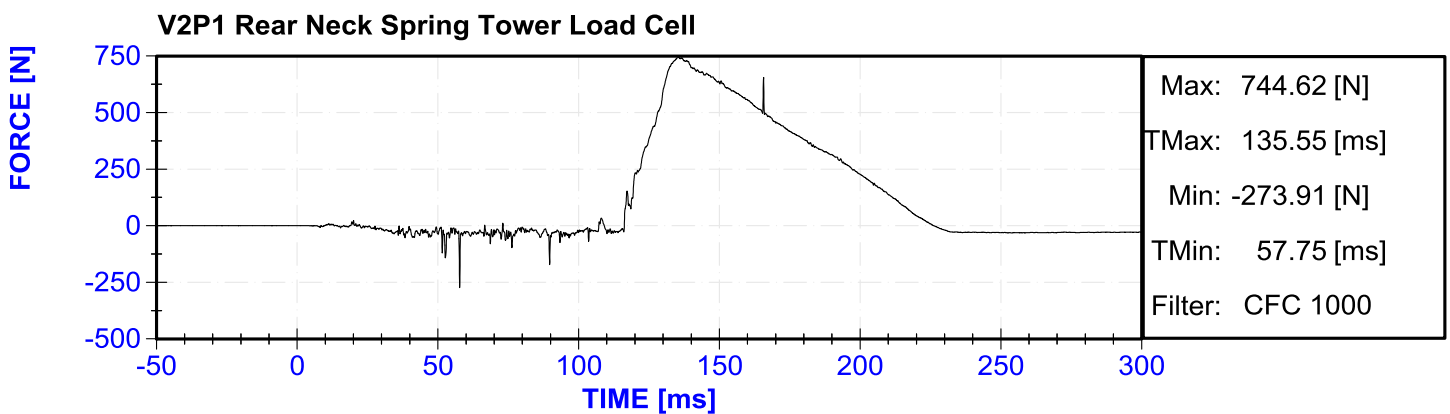
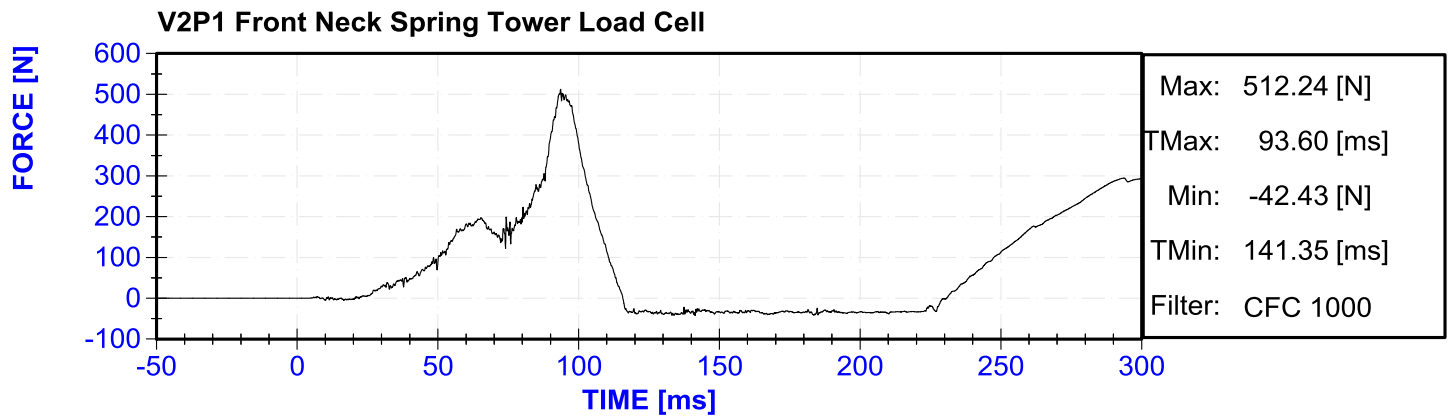
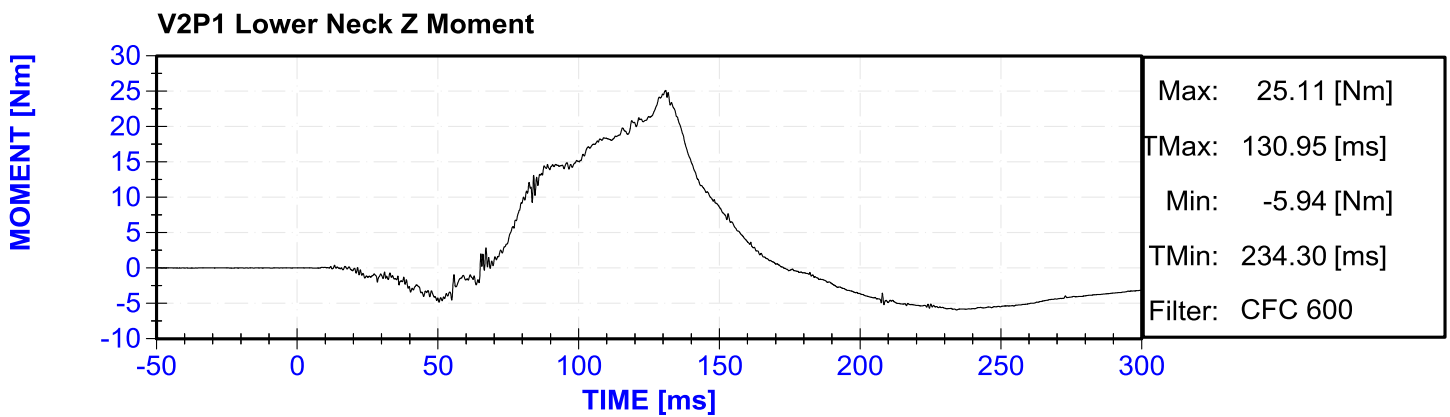
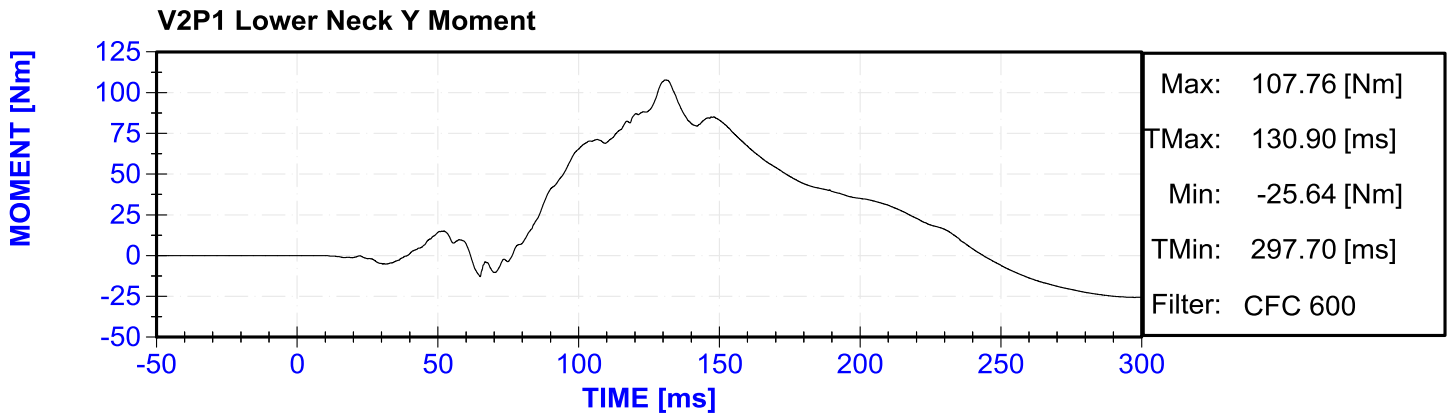


V2P1 Upper Neck Y Force

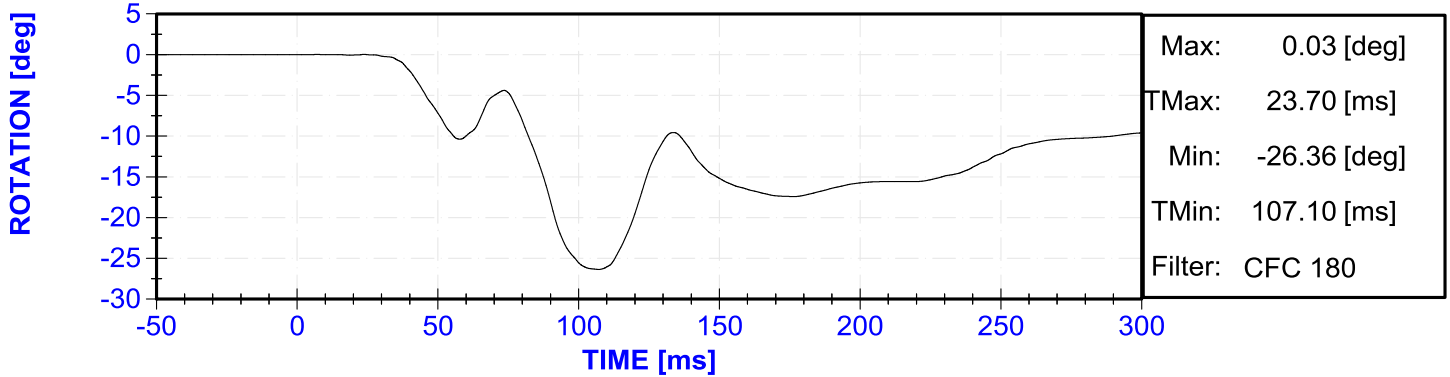




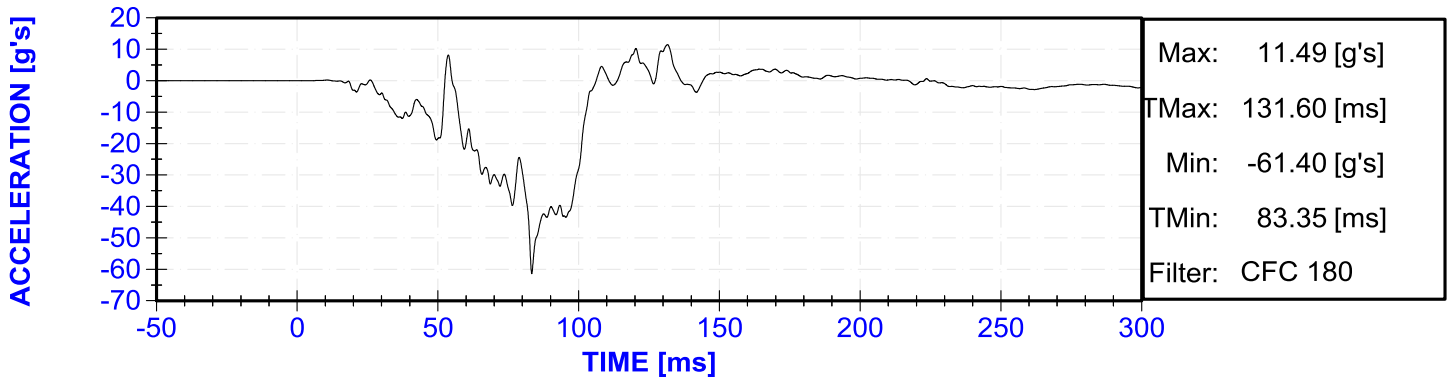




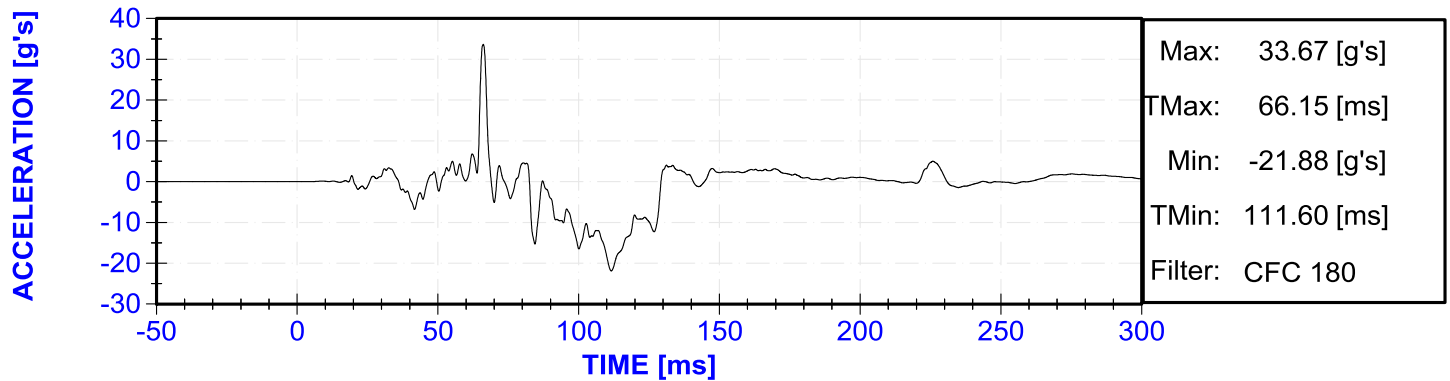
V2P1 Occipital Condyle Rotation Potentiometer



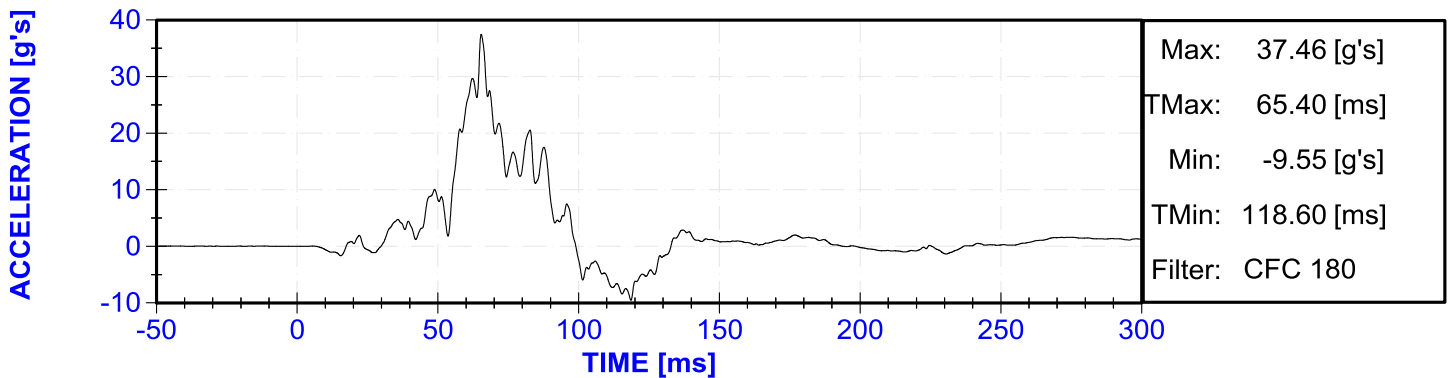
V2P1 T1 X Acceleration

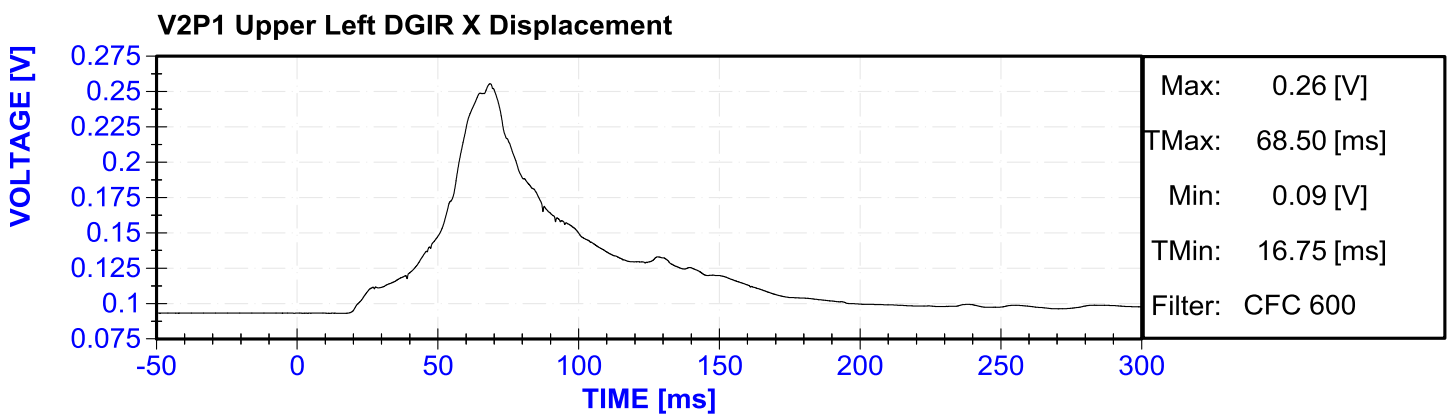
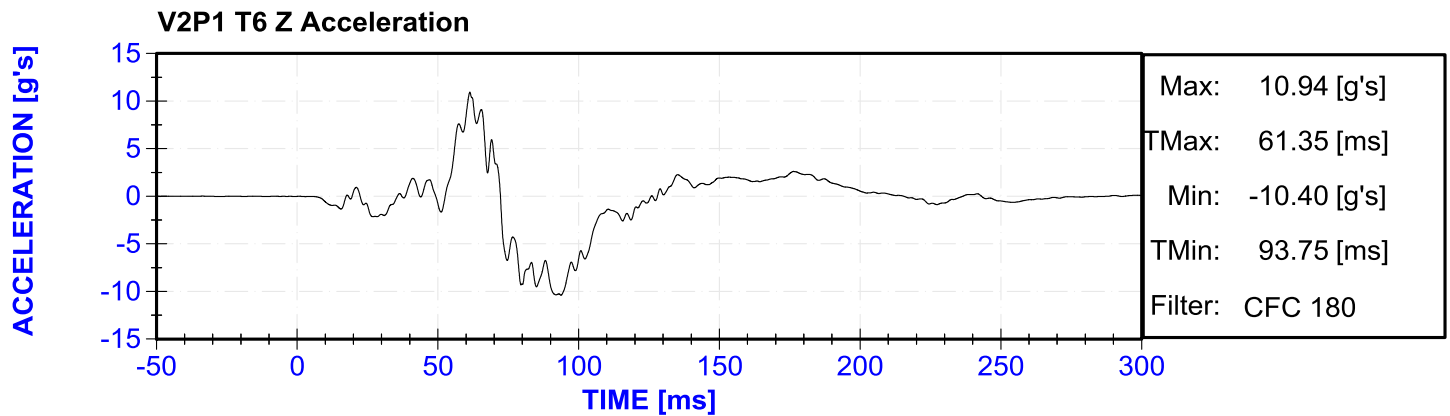
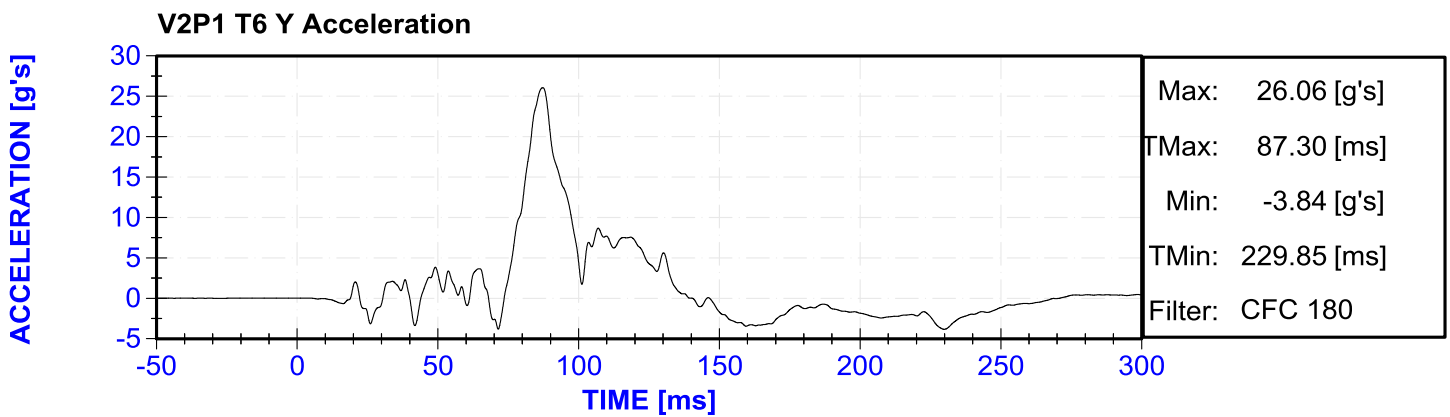
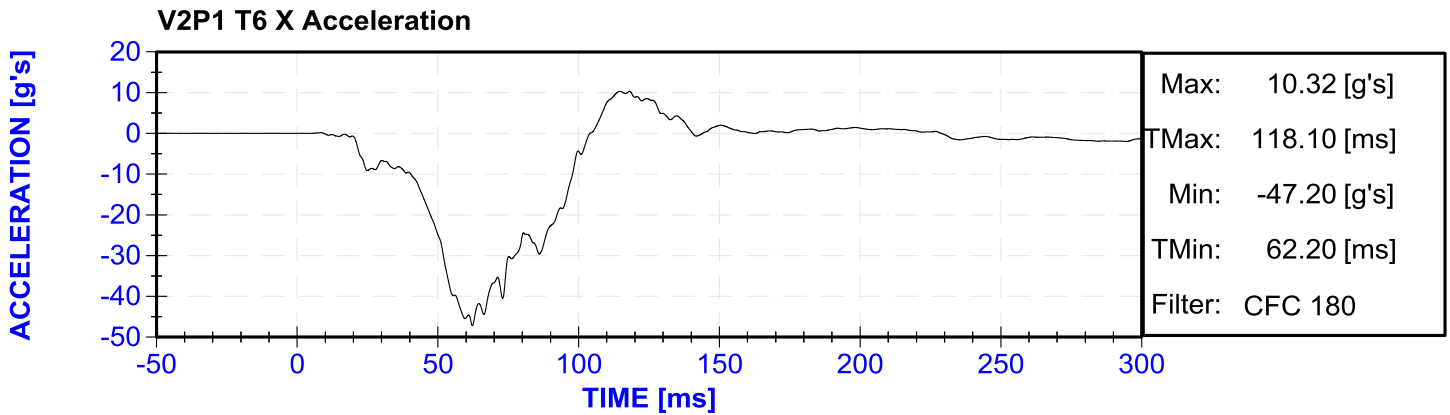


V2P1 T1 Y Acceleration

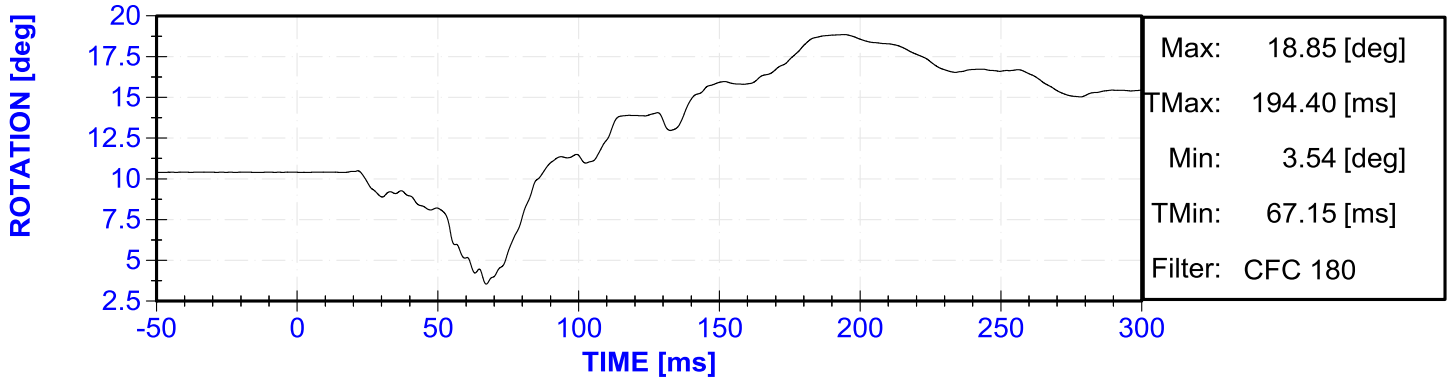


V2P1 T1 Z Acceleration

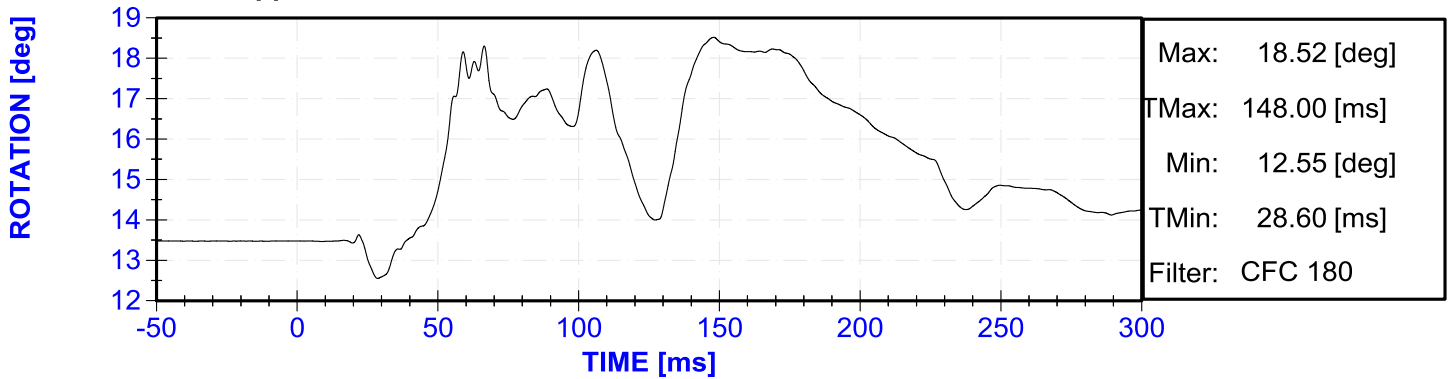




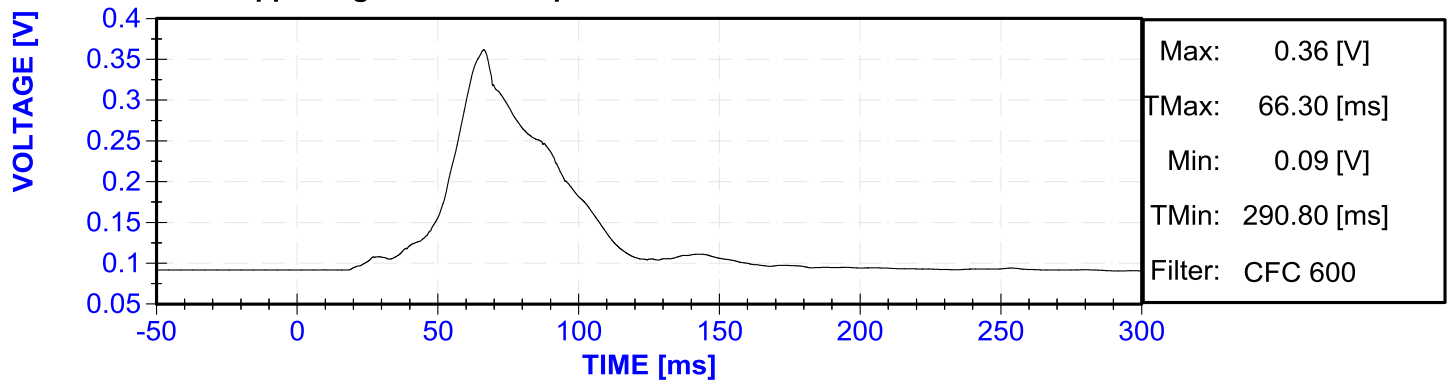
V2P1 Upper Left DGIR Y Rotation



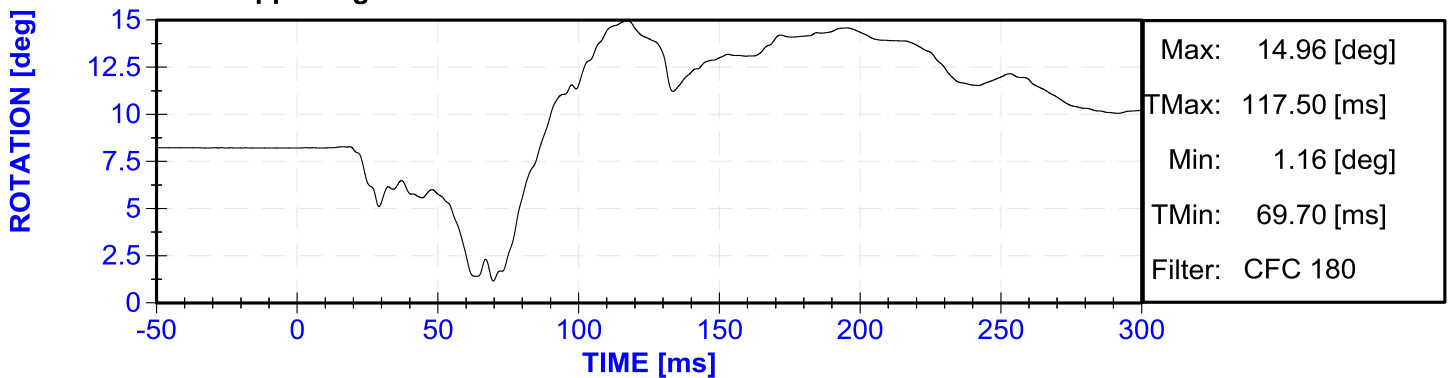
V2P1 Upper Left DGIR Z Rotation



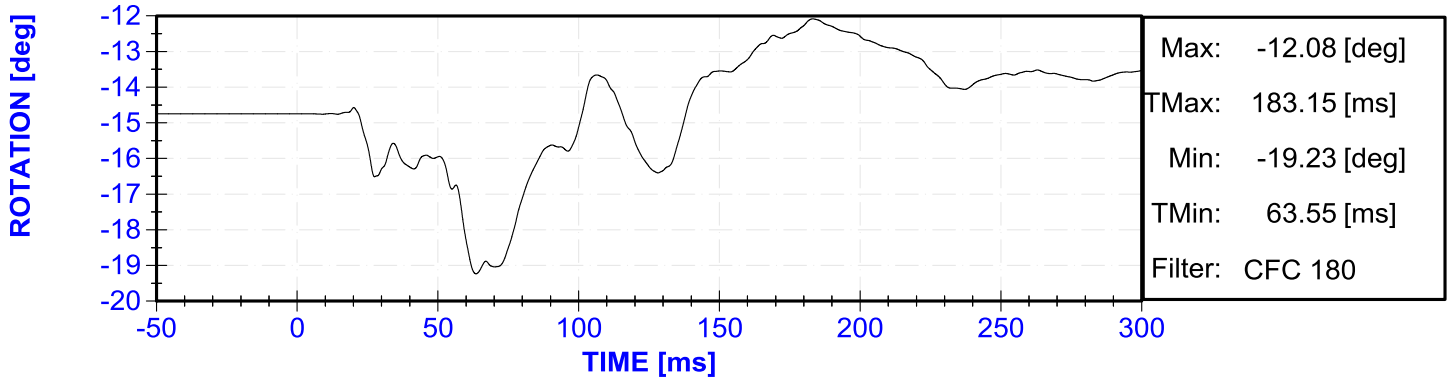
V2P1 Upper Right DGIR X Displacement



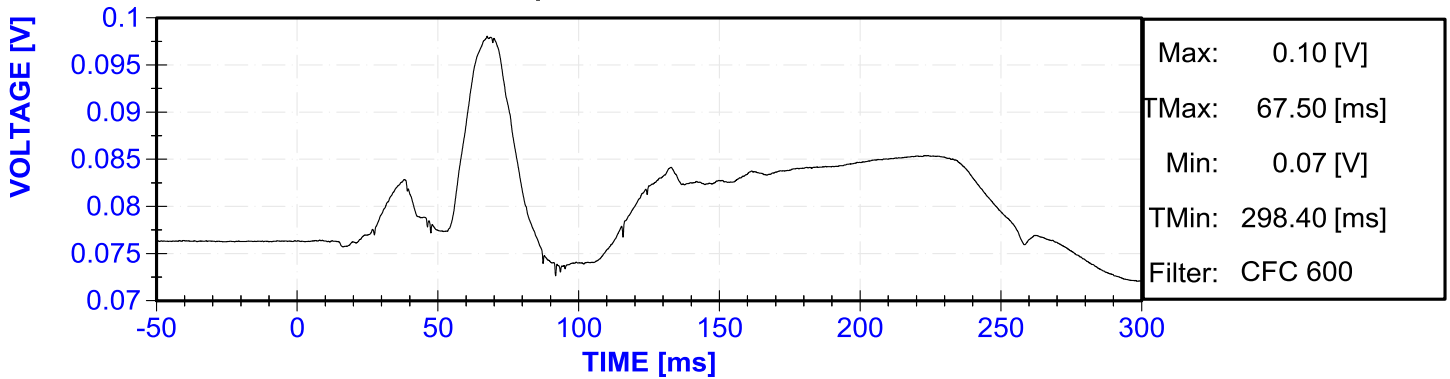
V2P1 Upper Right DGIR Y Rotation



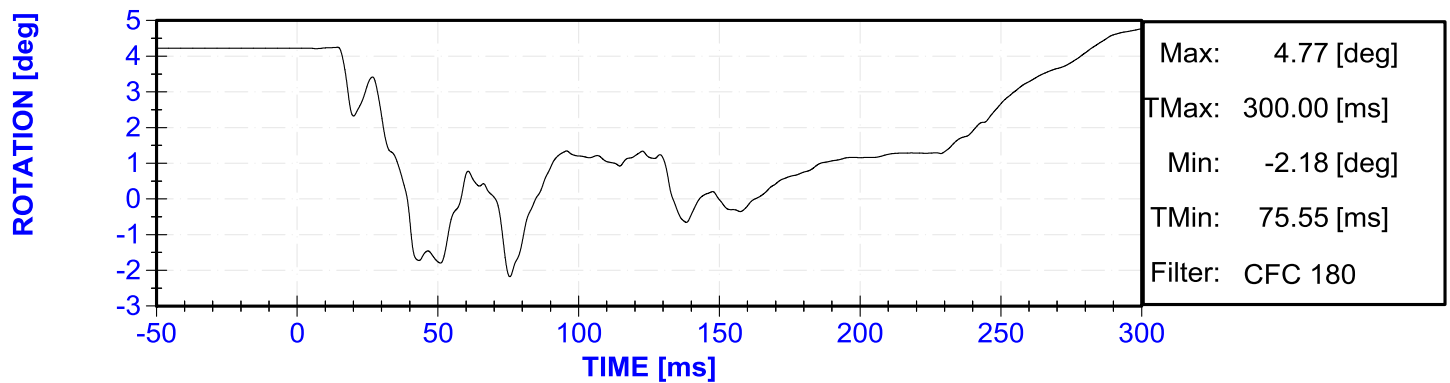
V2P1 Upper Right DGIR Z Rotation



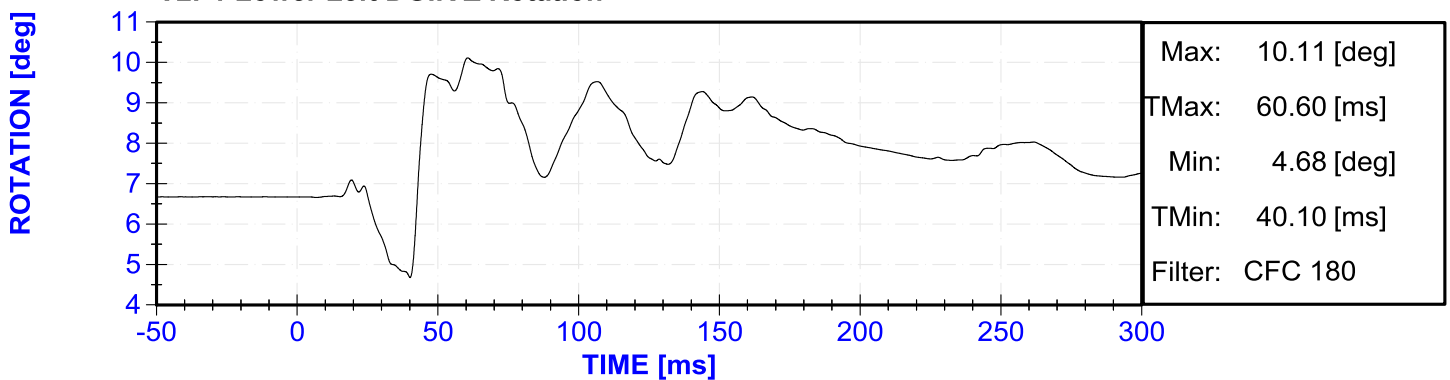
V2P1 Lower Left DGIR X Displacement



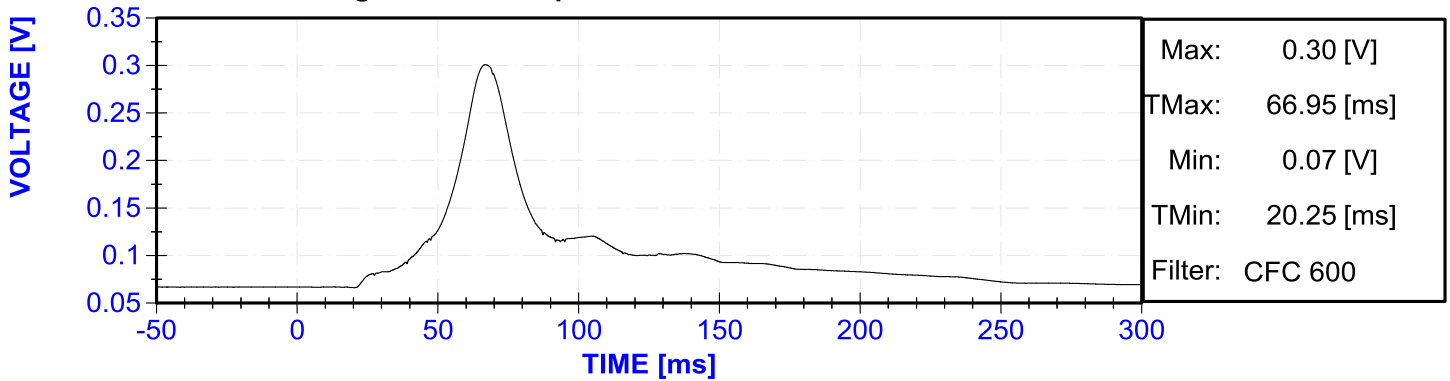
V2P1 Lower Left DGIR Y Rotation



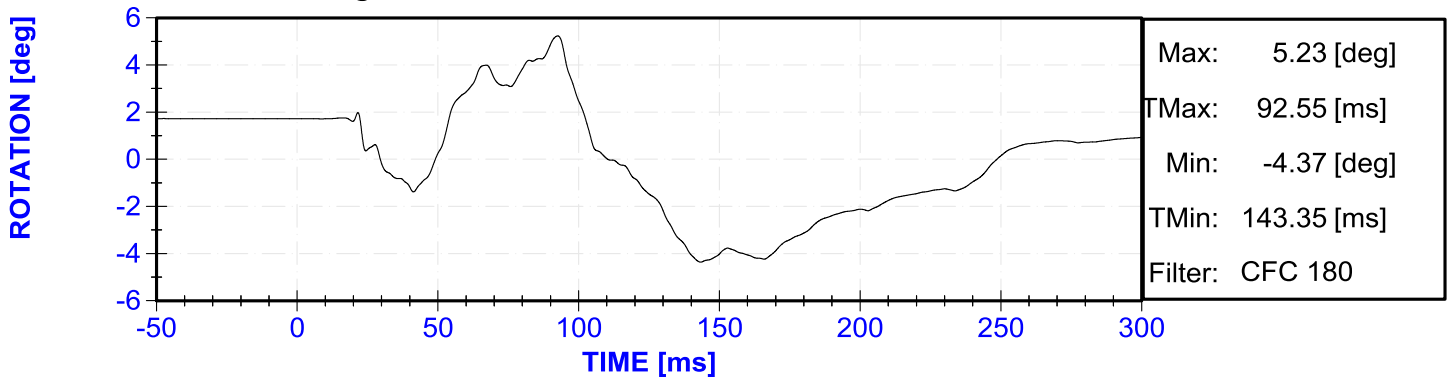
V2P1 Lower Left DGIR Z Rotation



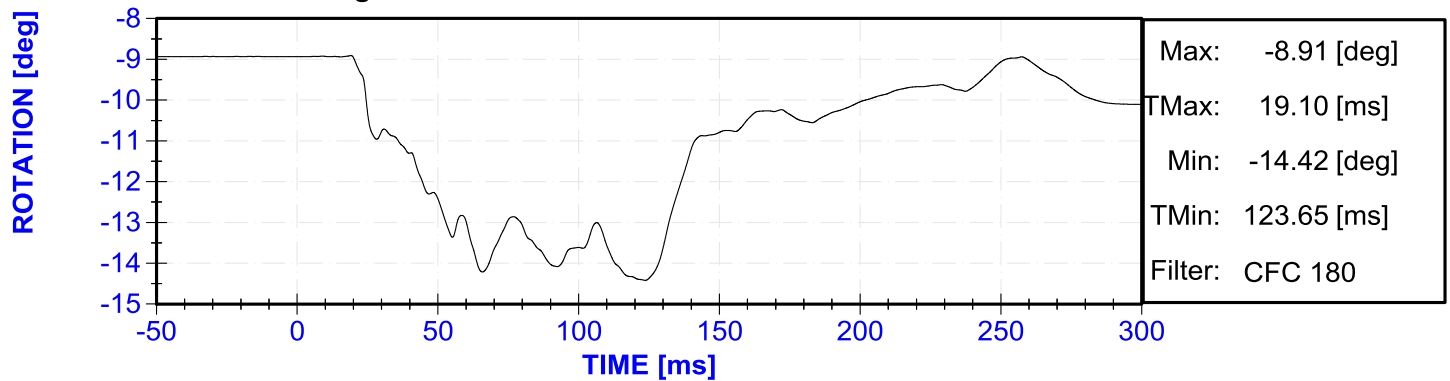
V2P1 Lower Right DGIR X Displacement



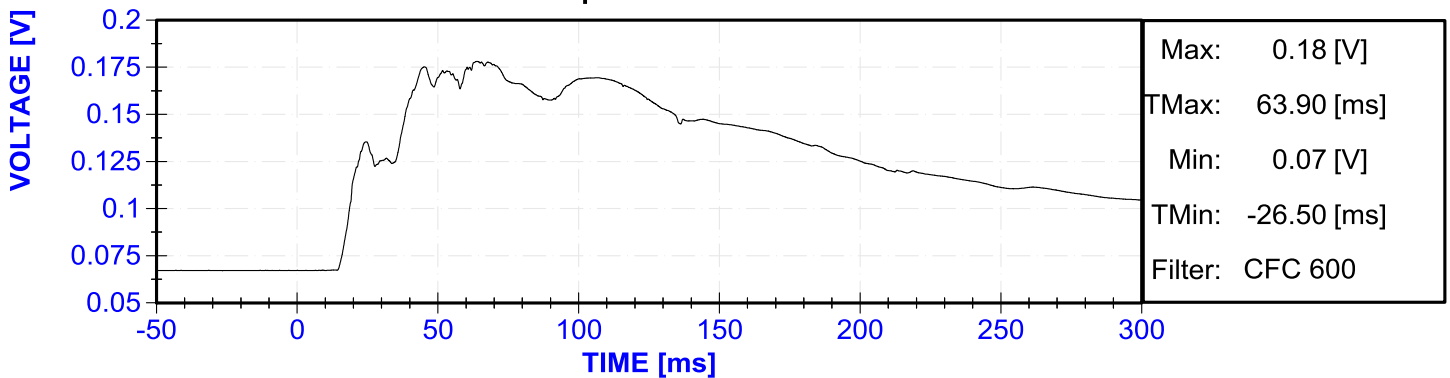
V2P1 Lower Right DGIR Y Rotation



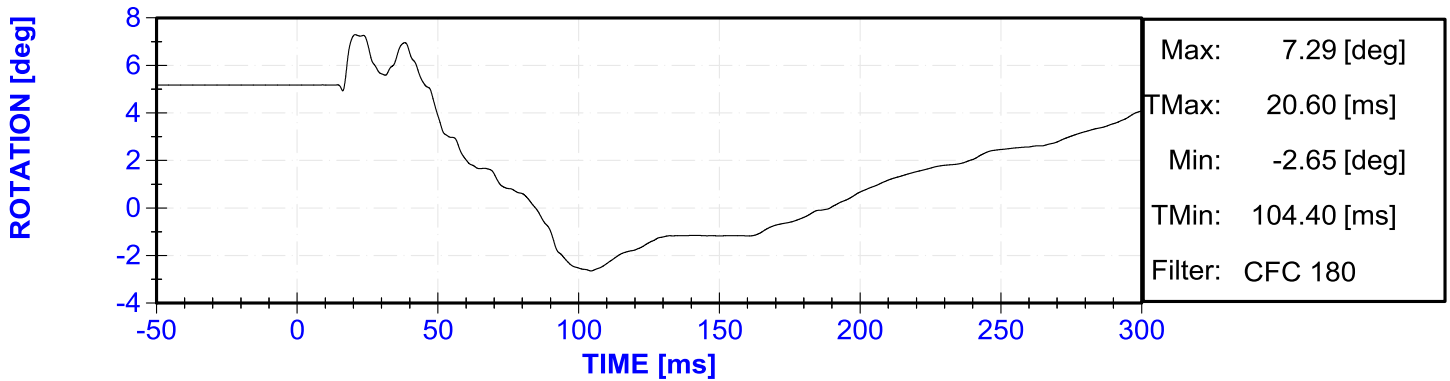
V2P1 Lower Right DGIR Z Rotation



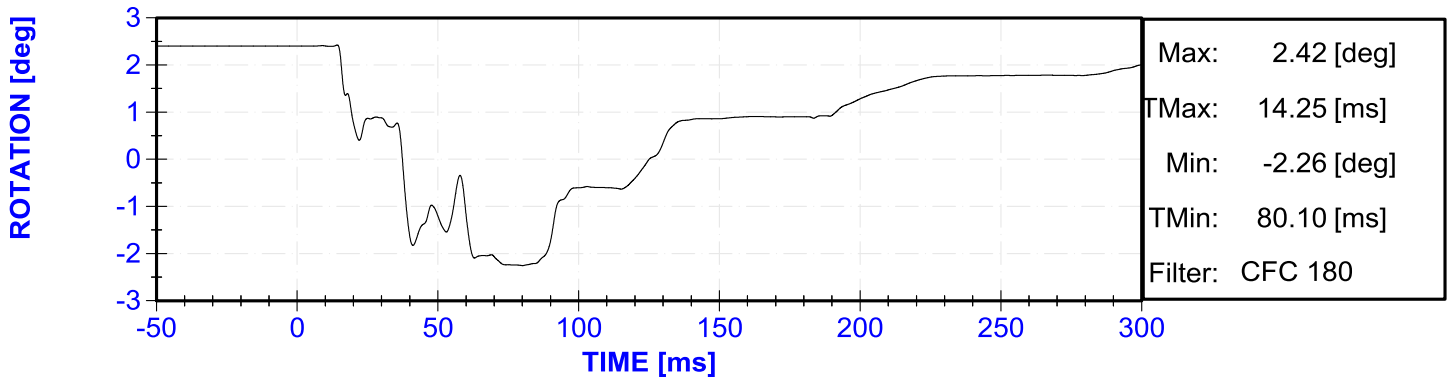
V2P1 Abdomen Left DGIR X Displacement



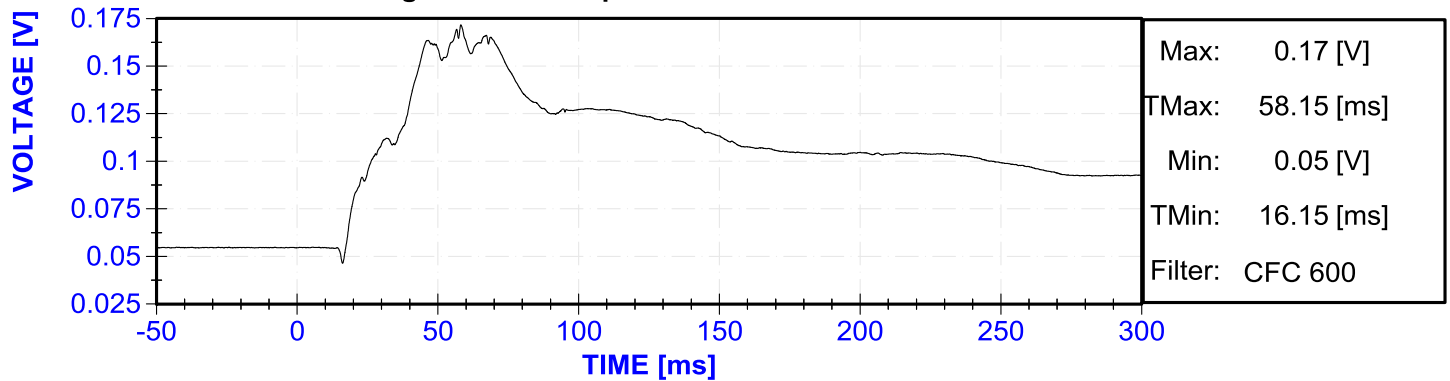
V2P1 Abdomen Left DGIR Y Rotation



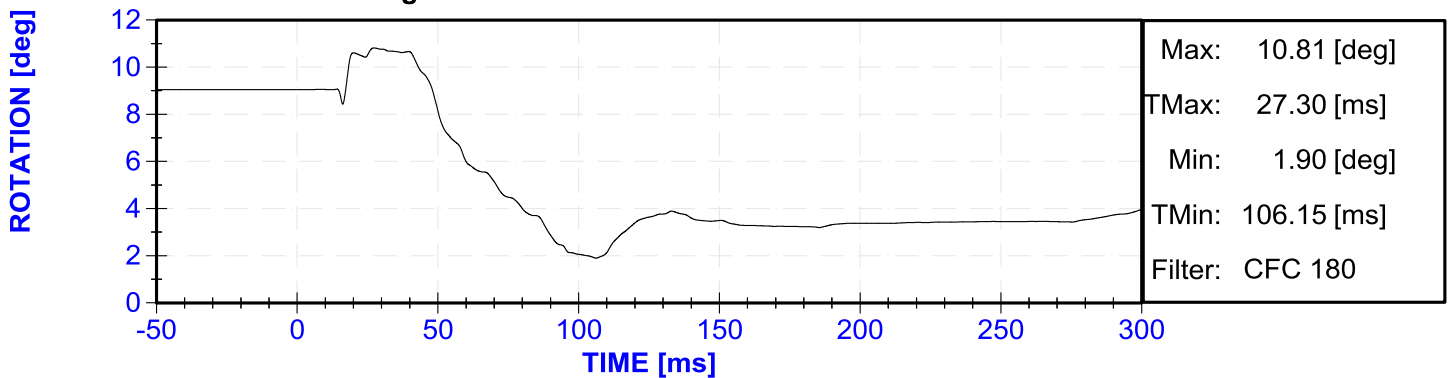
V2P1 Abdomen Left DGIR Z Rotation



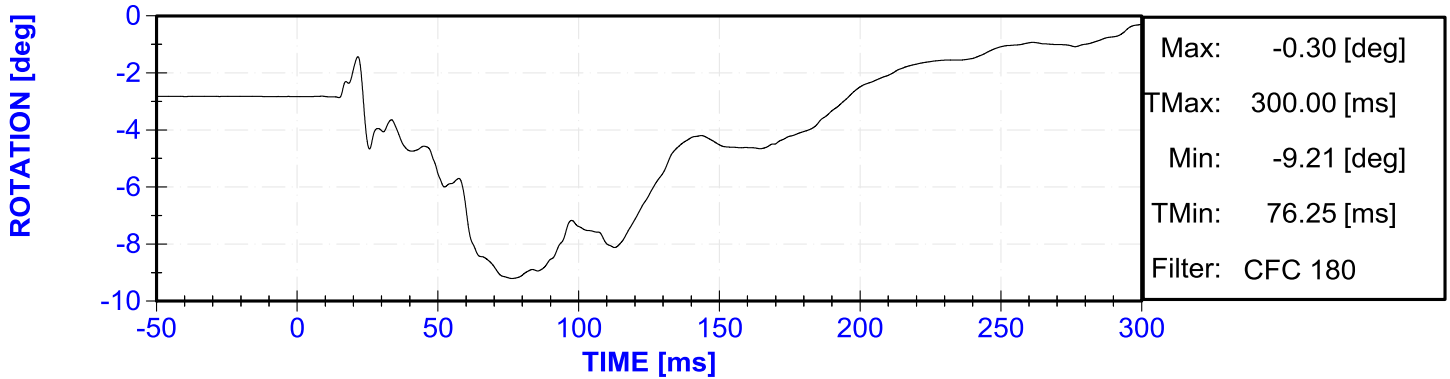
V2P1 Abdomen Right DGIR X Displacement



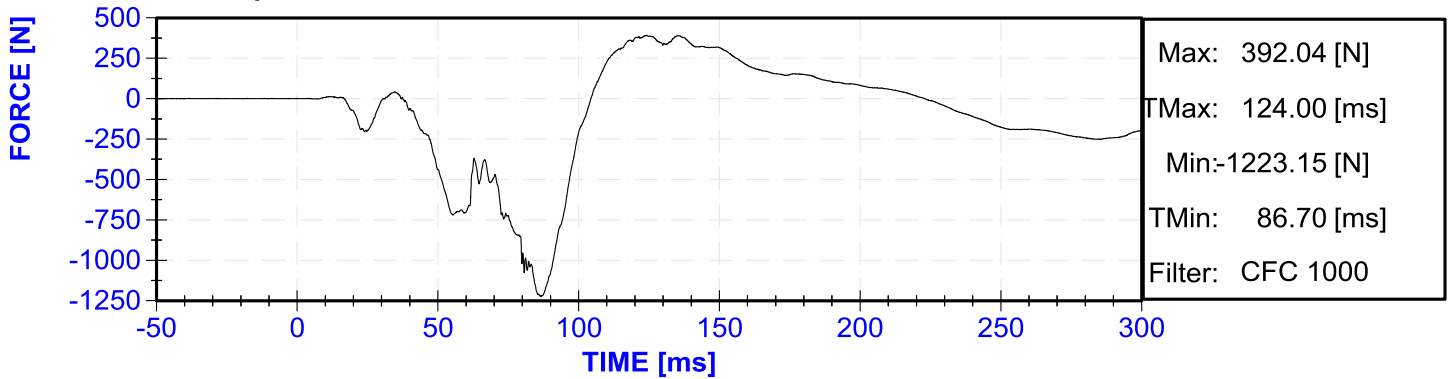
V2P1 Abdomen Right DGIR Y Rotation



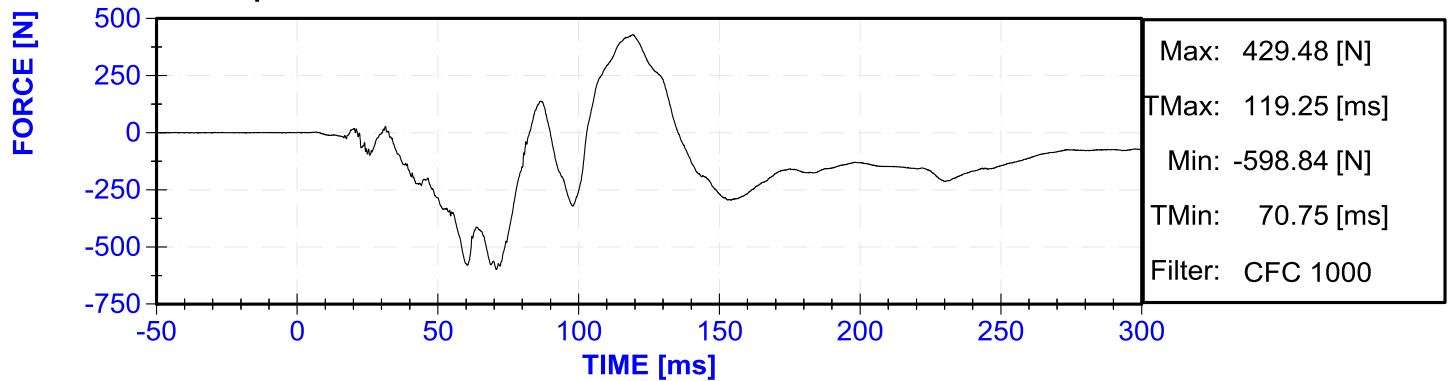
V2P1 Abdomen Right DGIR Z Rotation



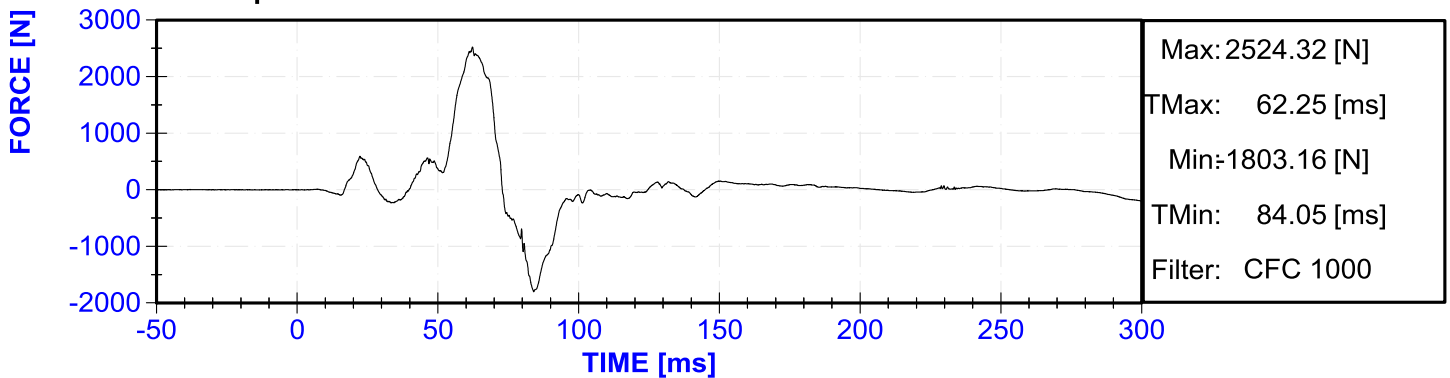
V2P1 Spine Force X

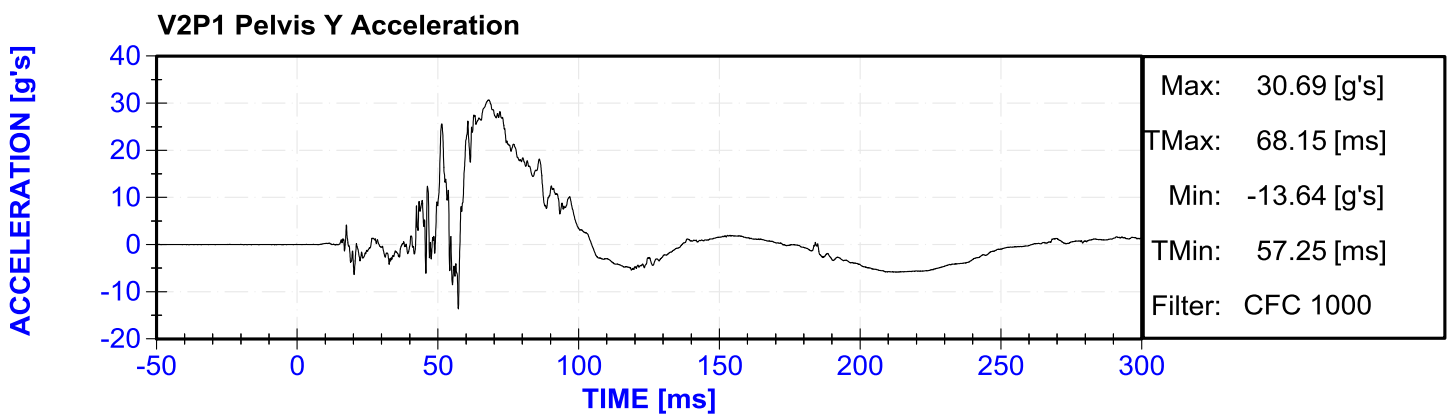
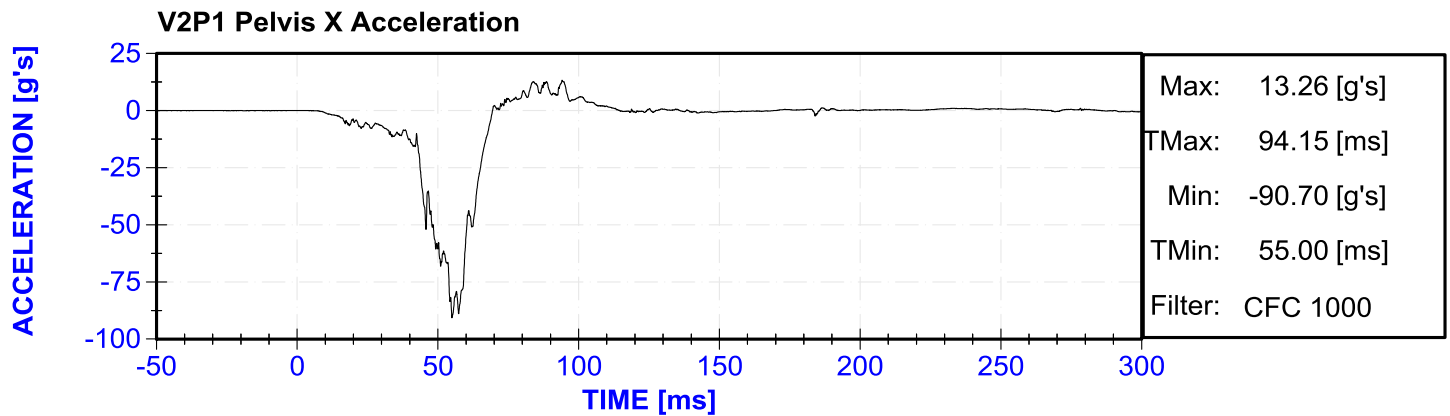
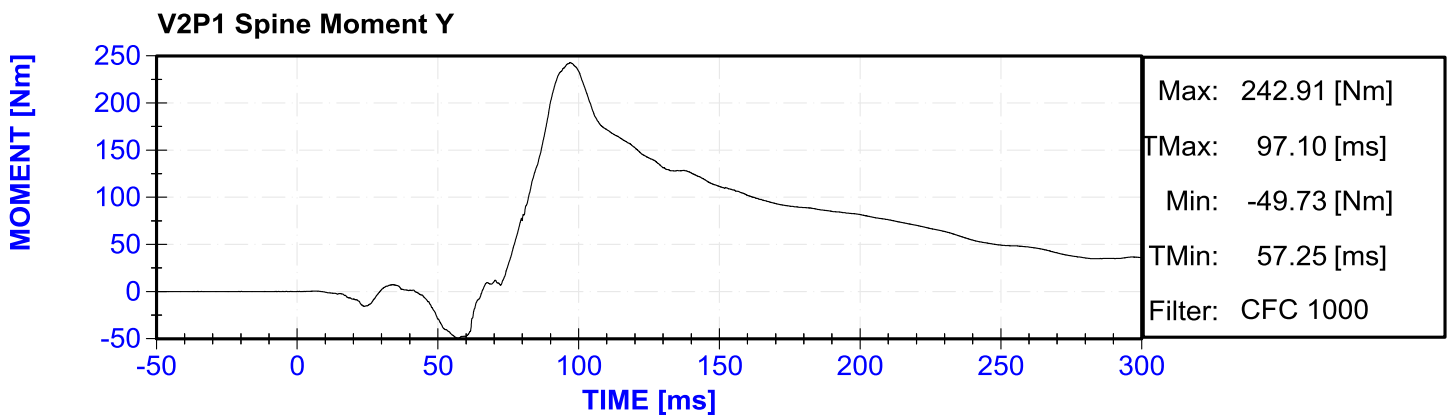
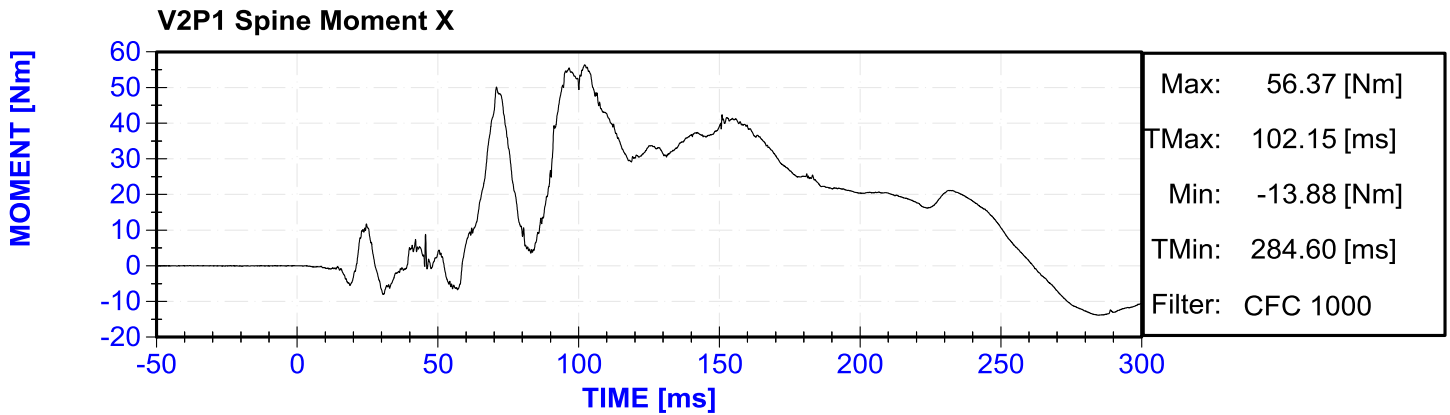


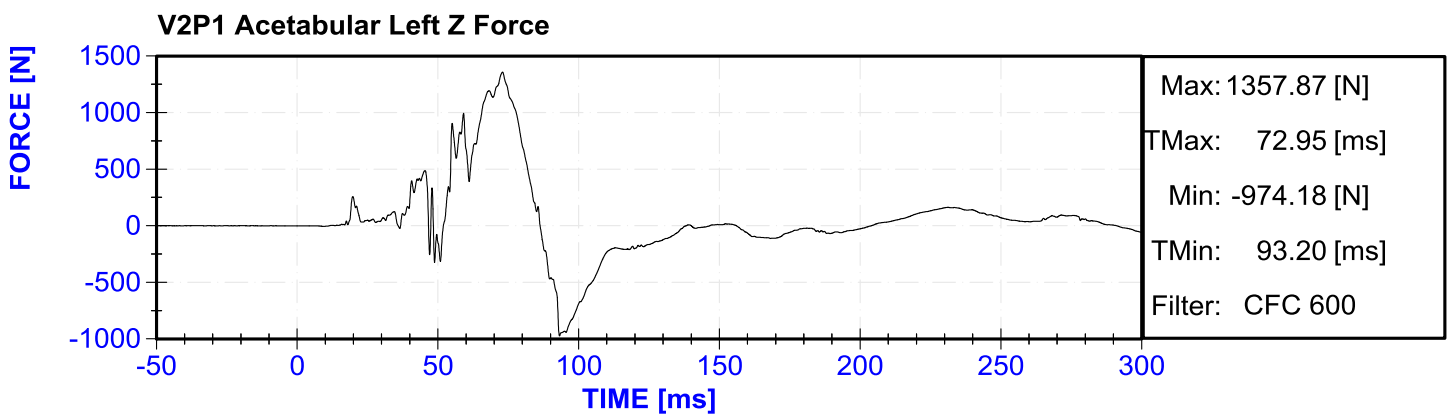
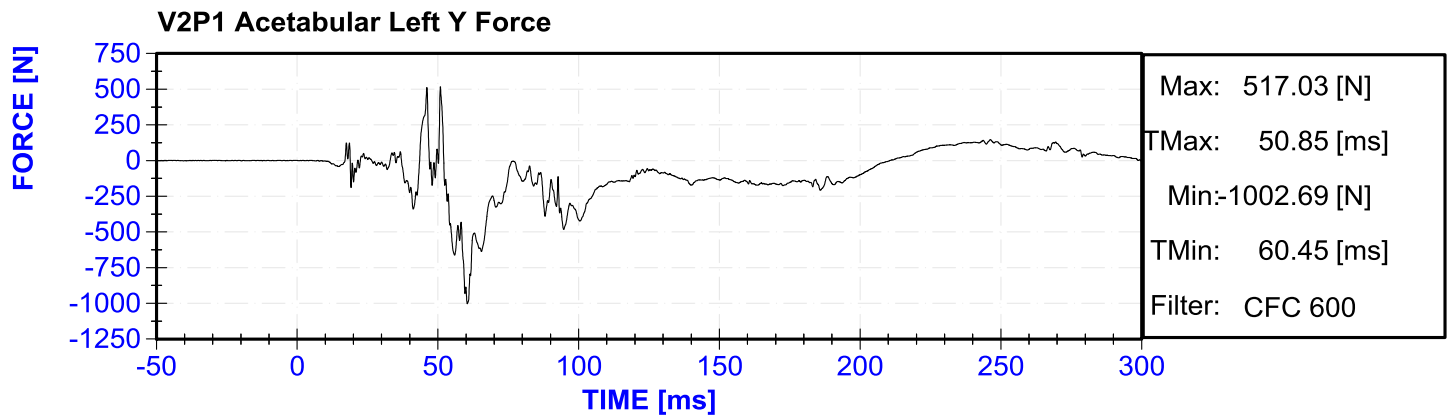
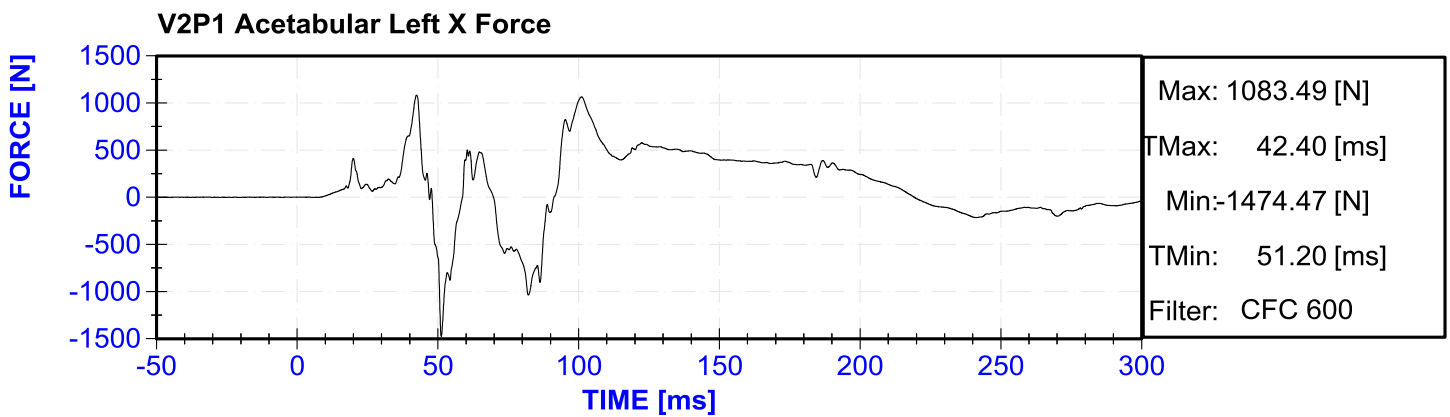
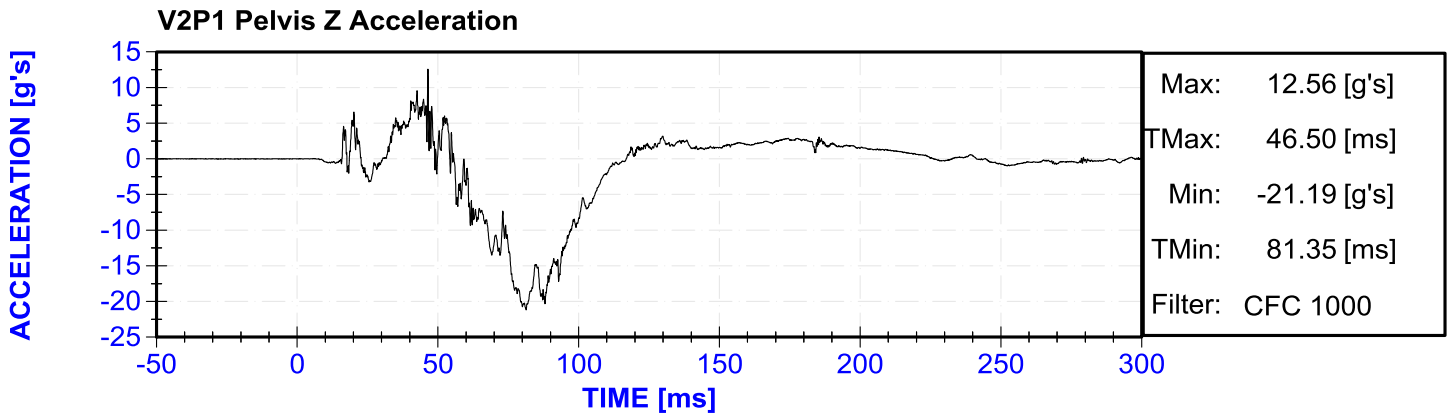
V2P1 Spine Force Y



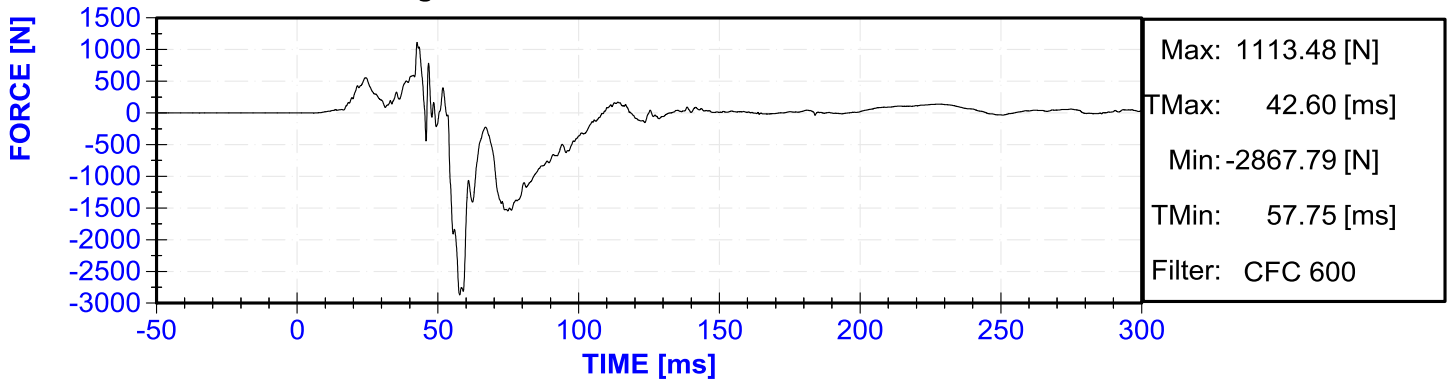
V2P1 Spine Force Z



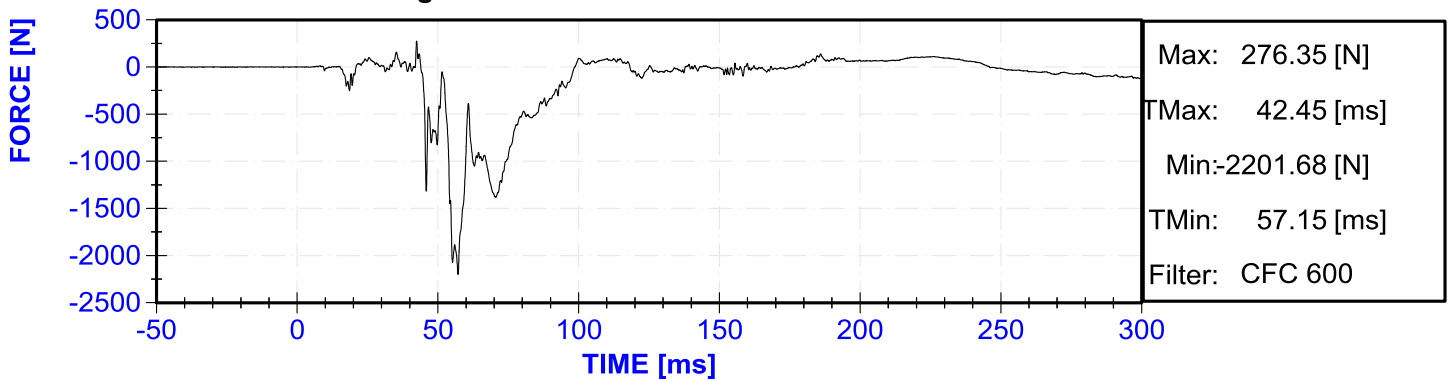




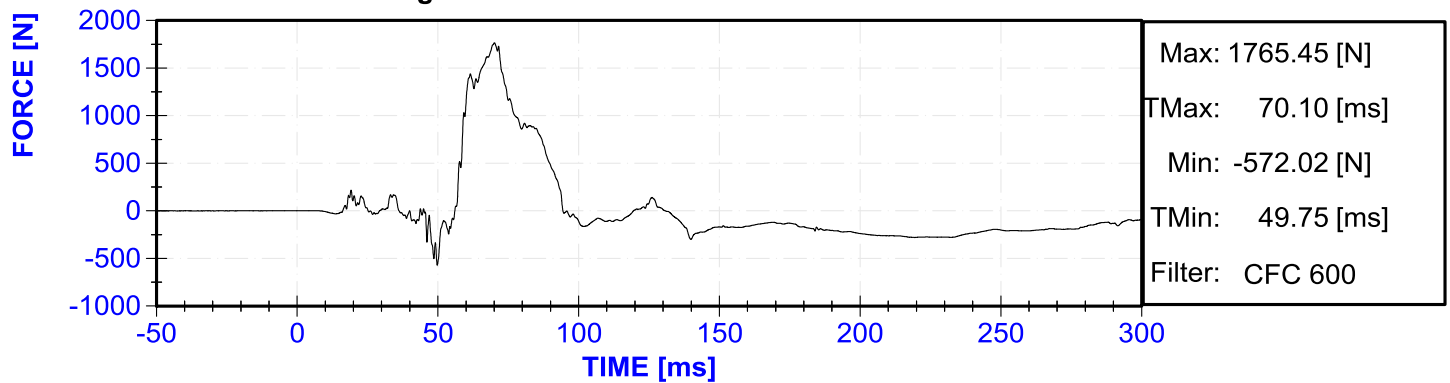
V2P1 Acetabular Right X Force



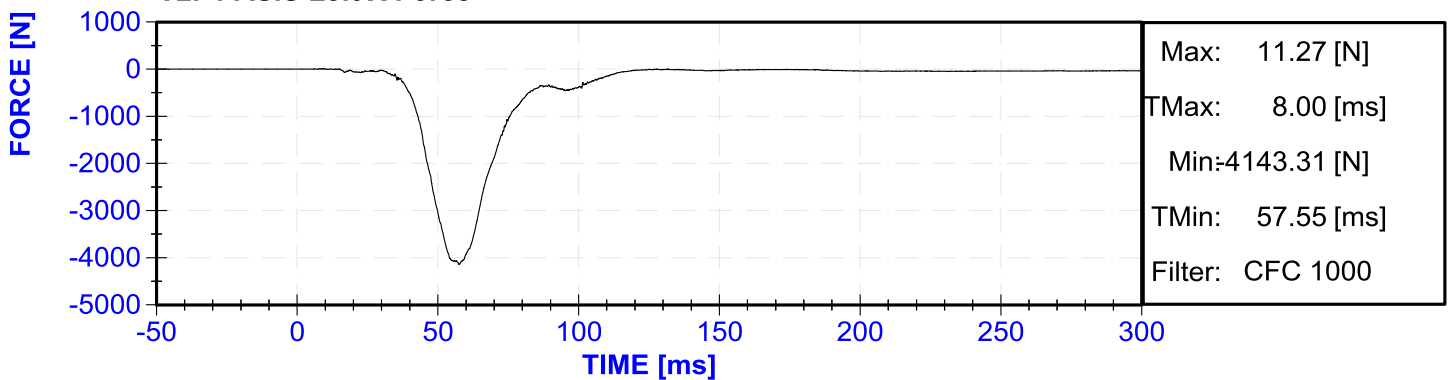
V2P1 Acetabular Right Y Force

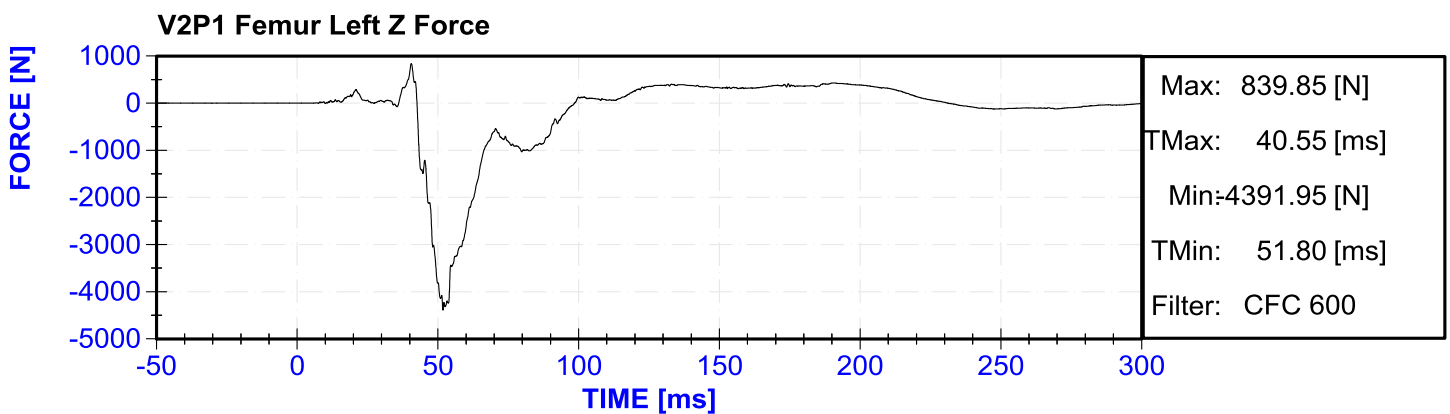
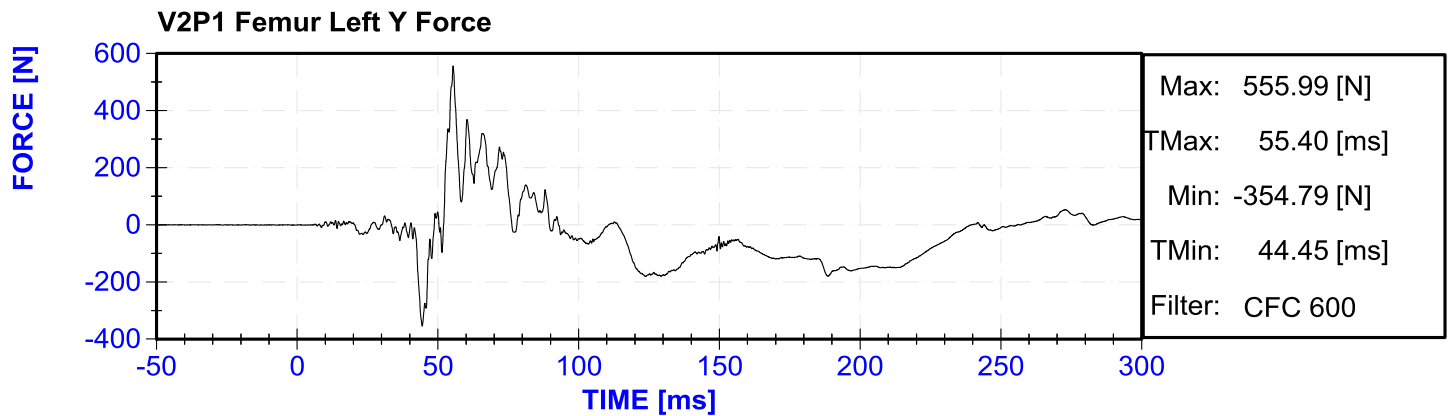
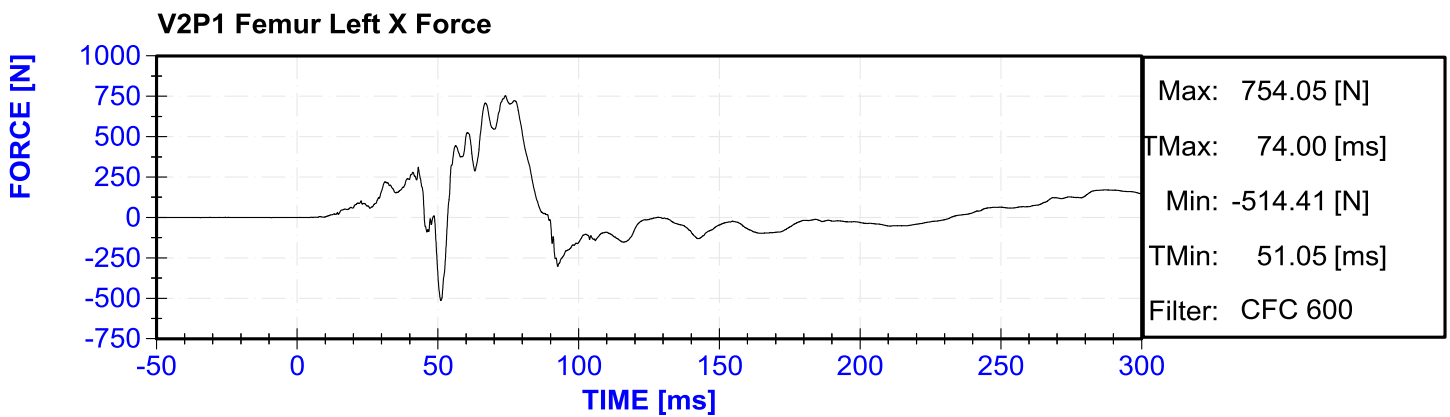
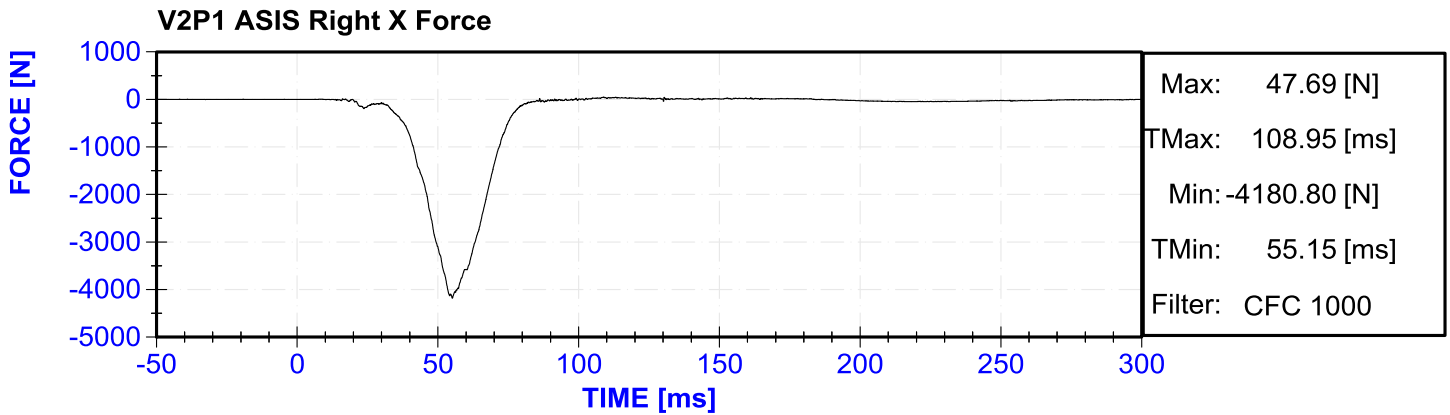


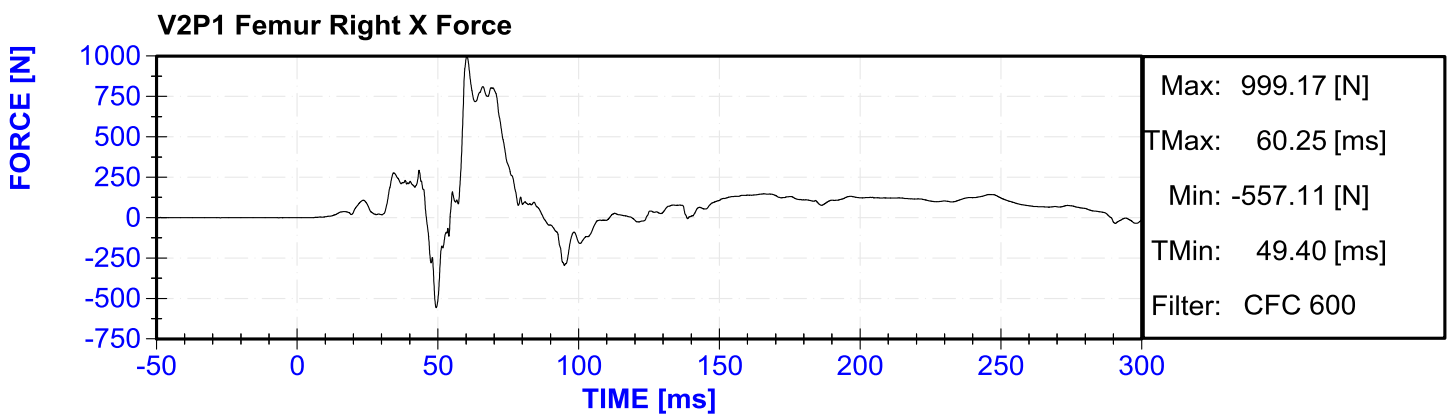
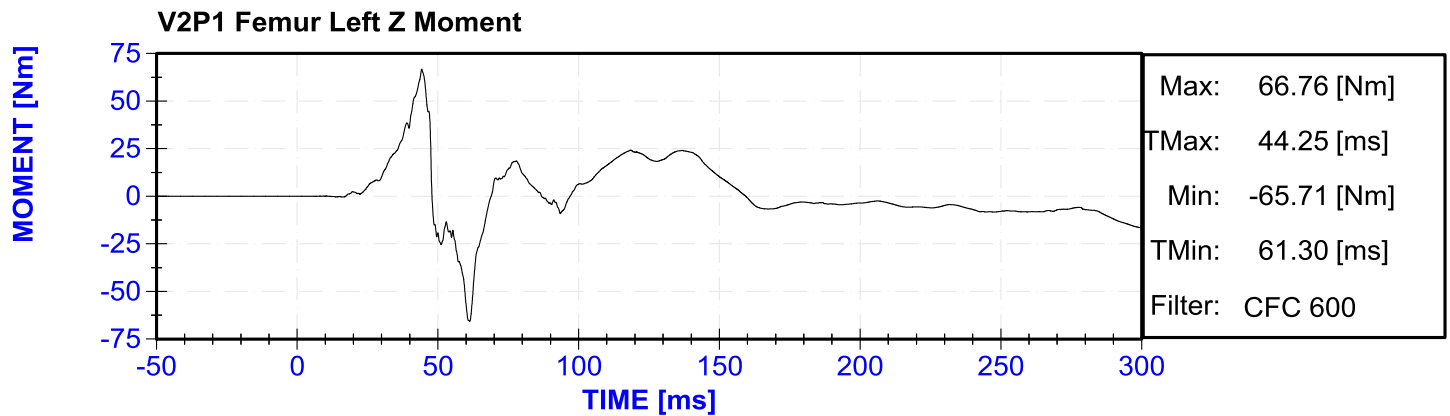
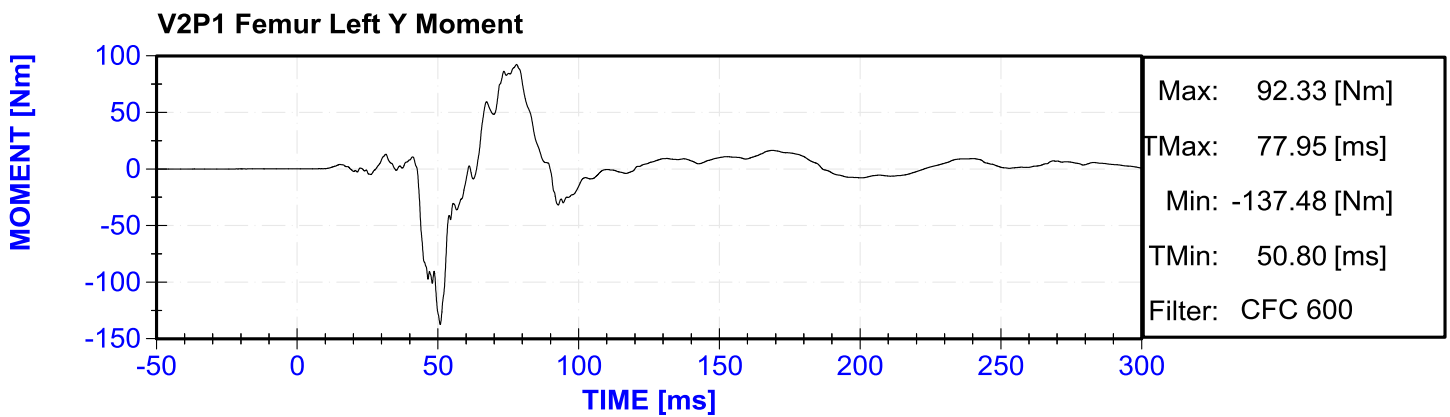
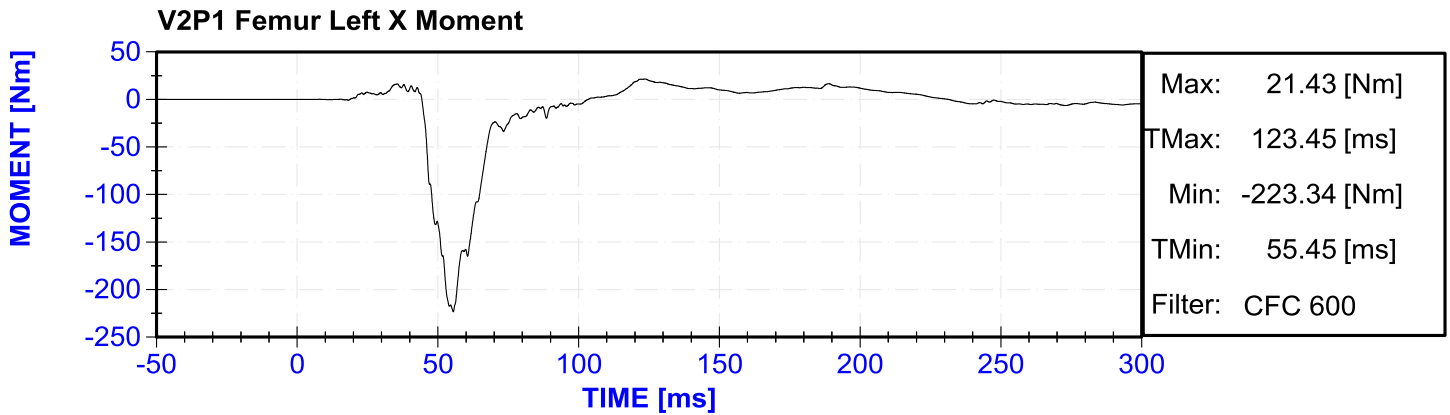
V2P1 Acetabular Right Z Force

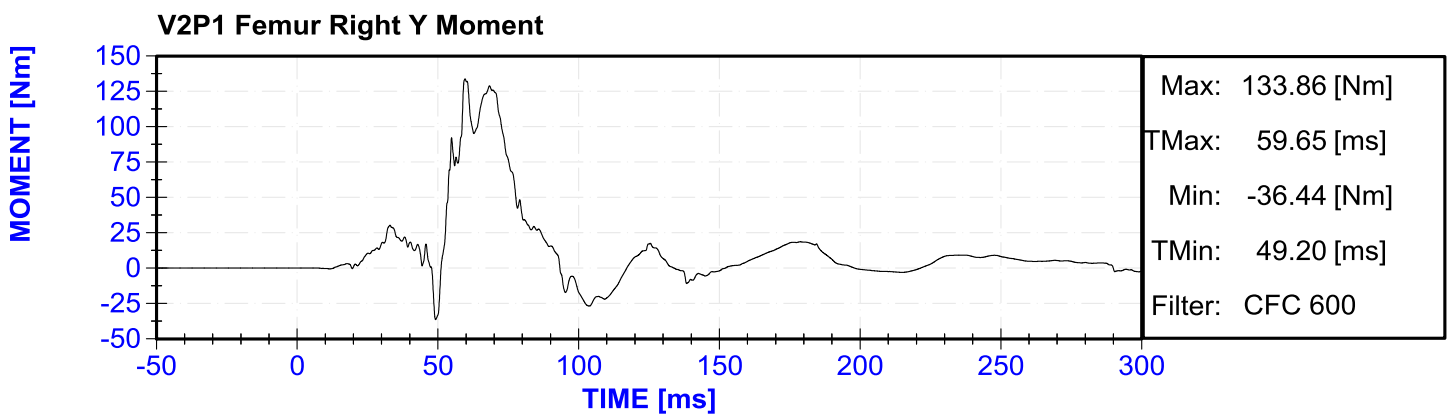
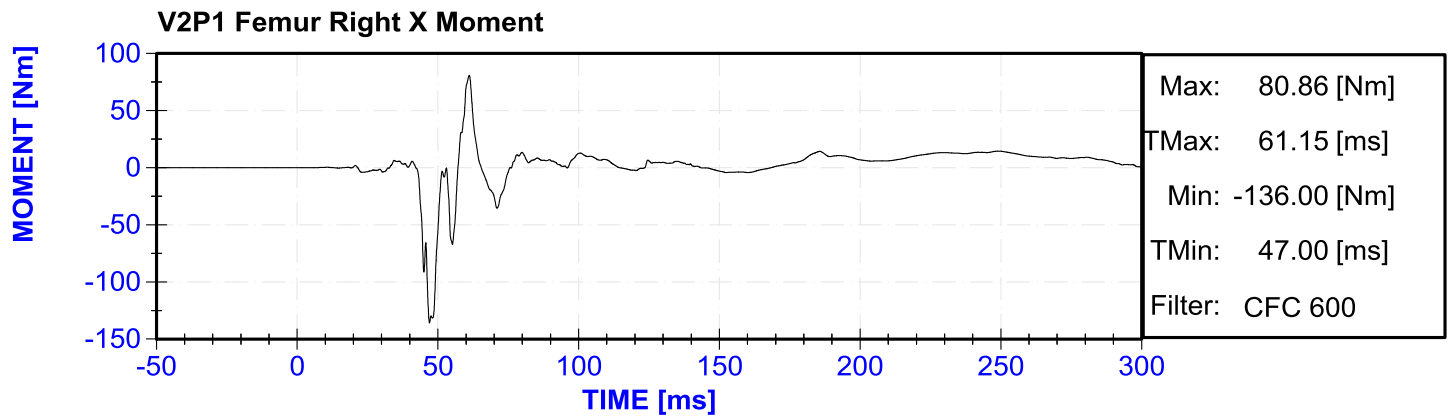
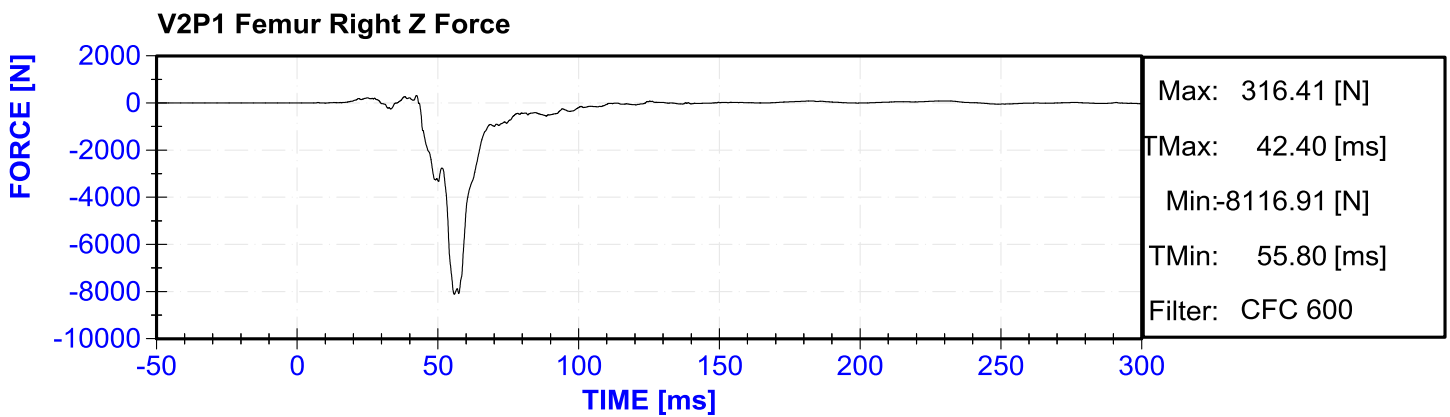
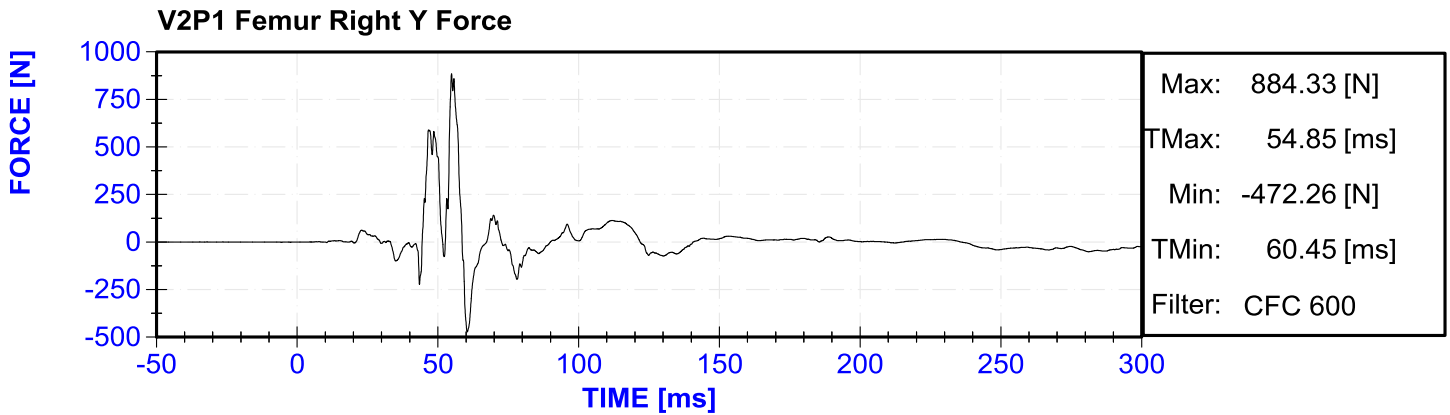


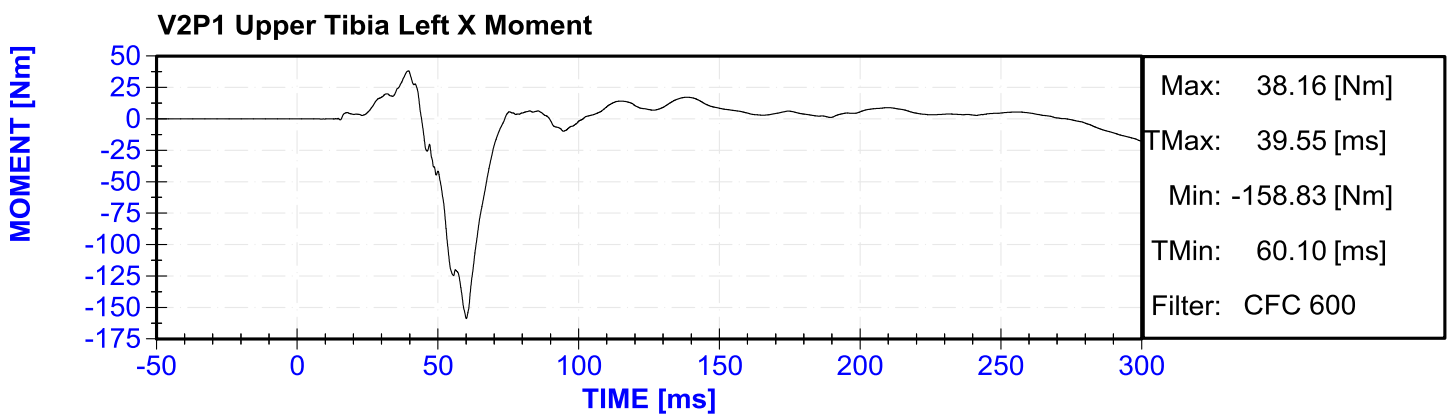
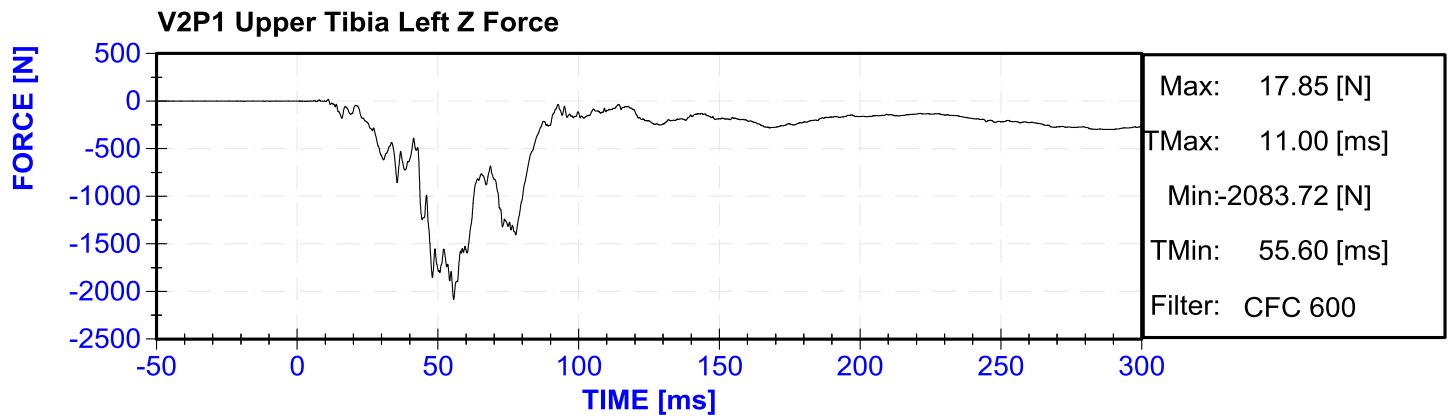
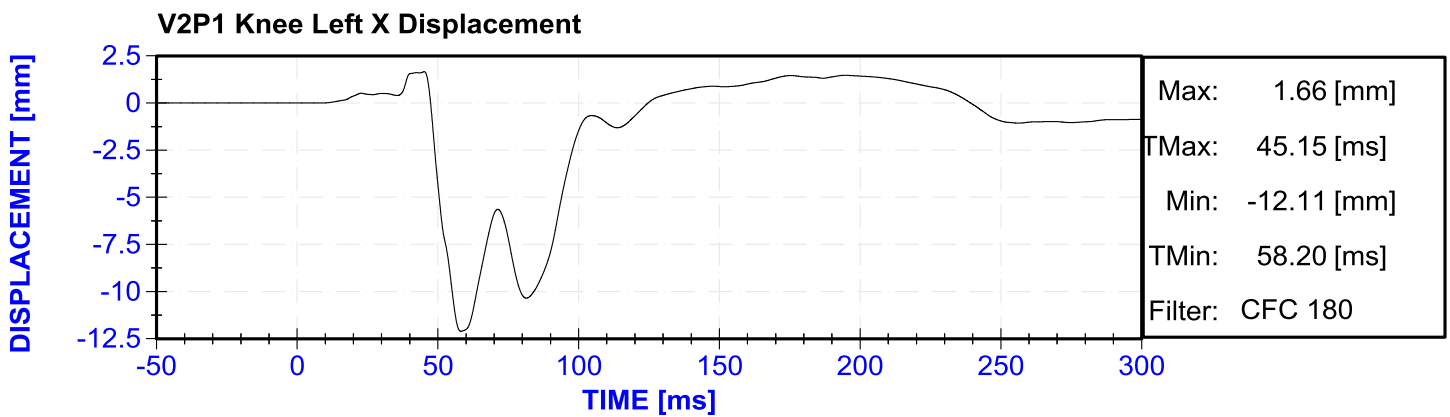
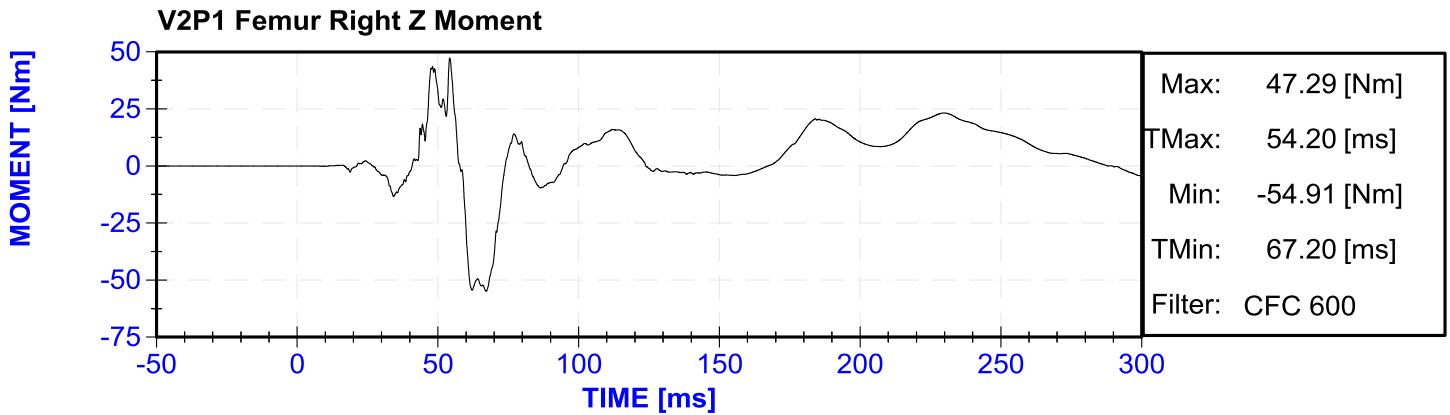
V2P1 ASIS Left X Force



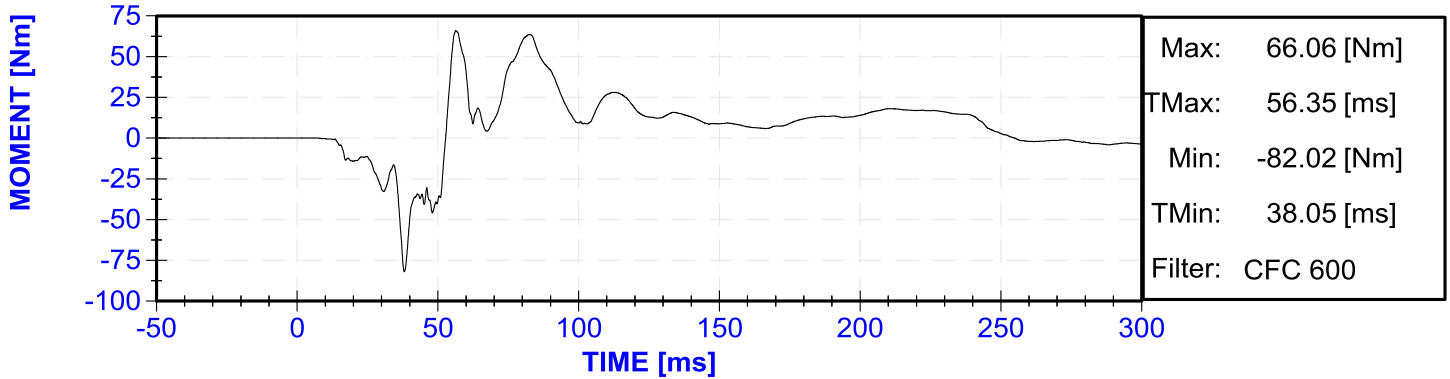




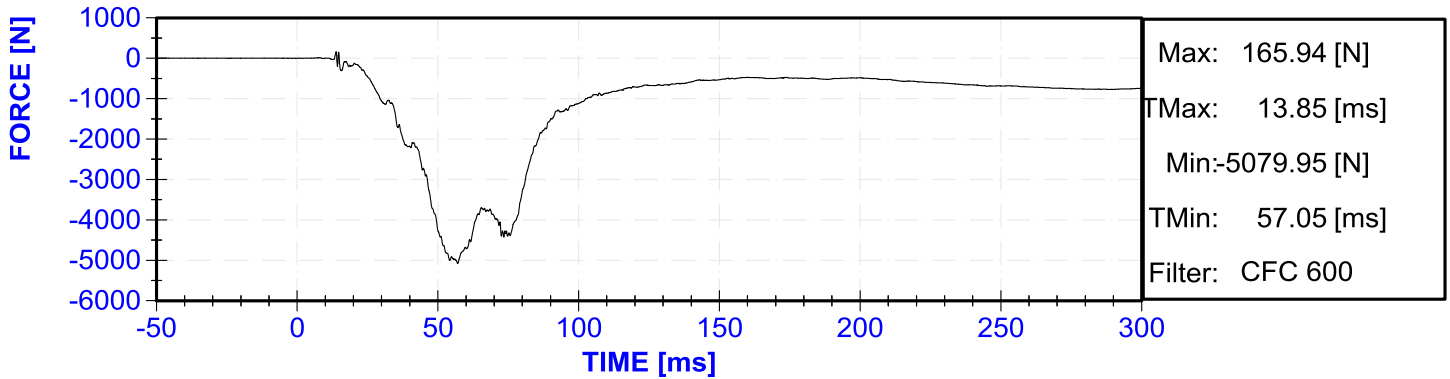




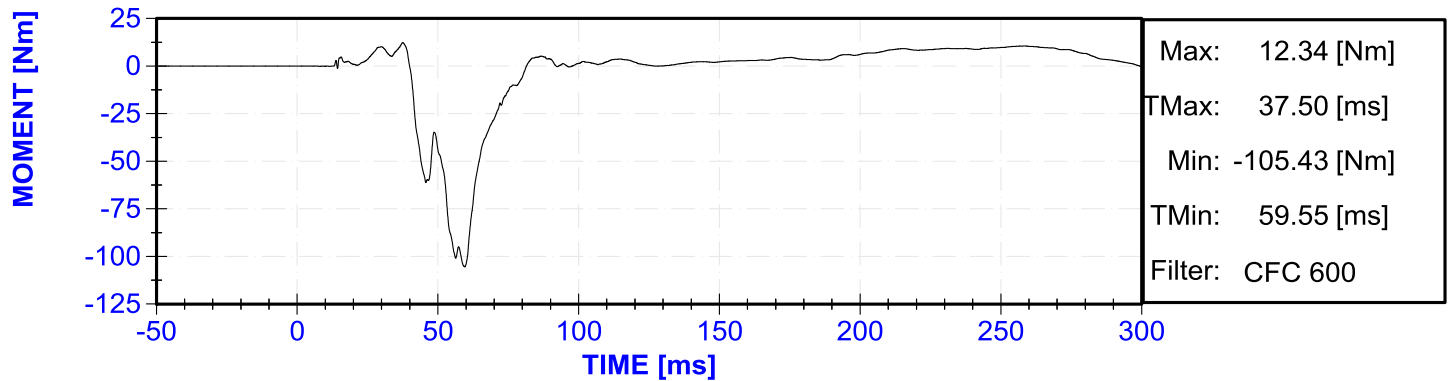
V2P1 Upper Tibia Left Y Moment



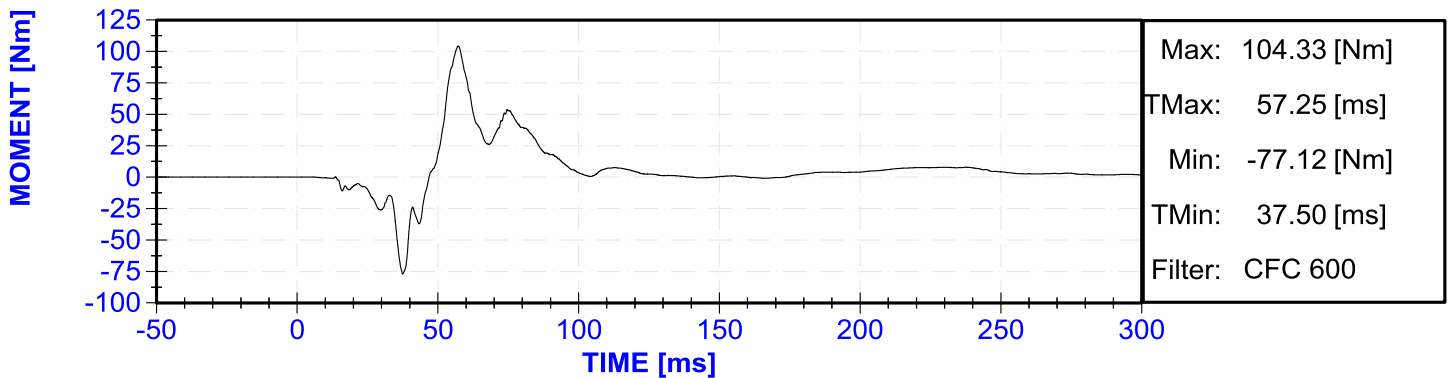
V2P1 Lower Tibia Left Z Force



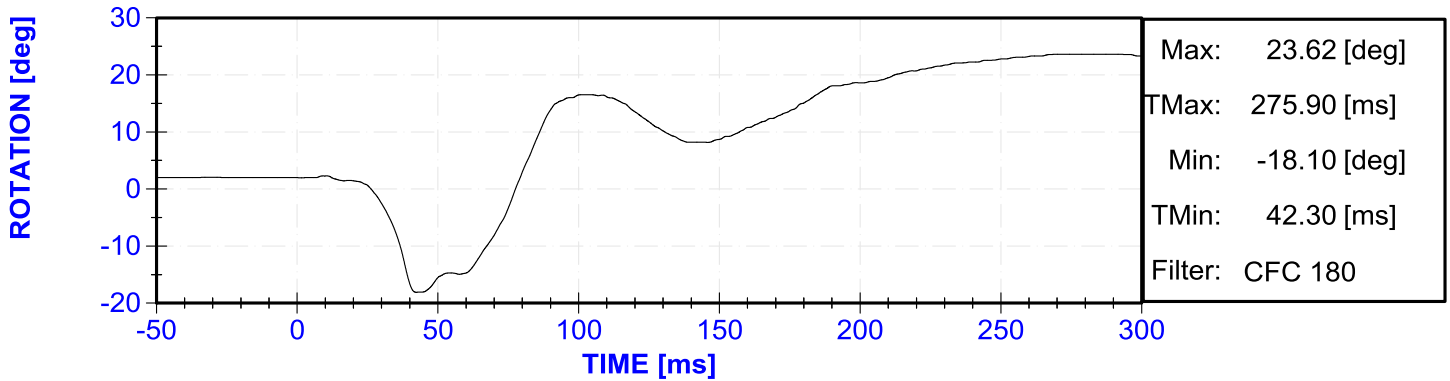
V2P1 Lower Tibia Left X Moment



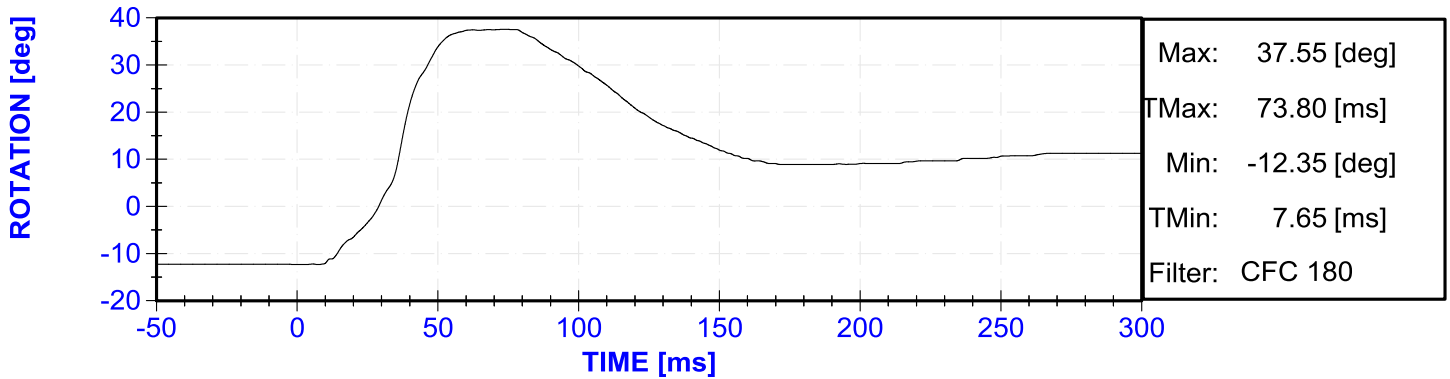
V2P1 Lower Tibia Left Y Moment



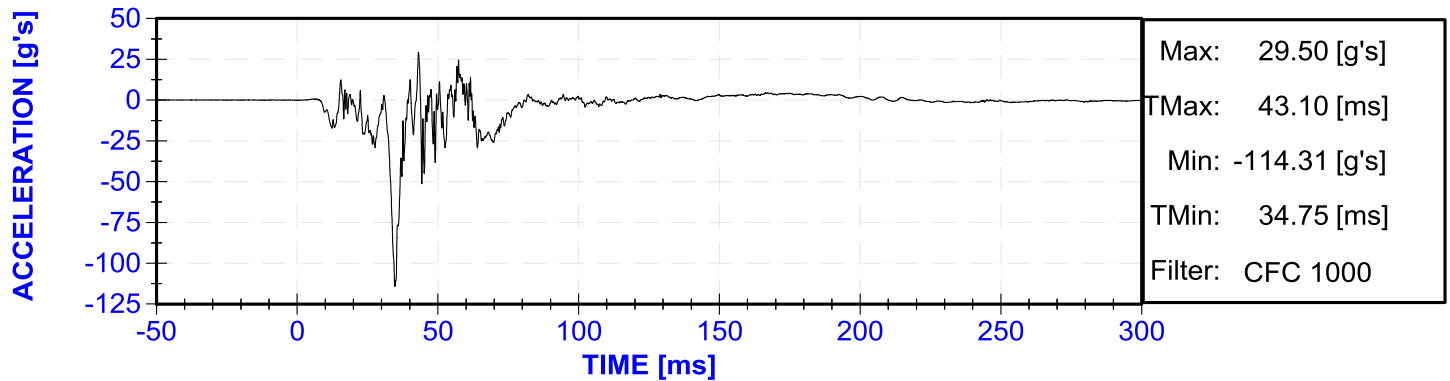
V2P1 Ankle Left X Rotation



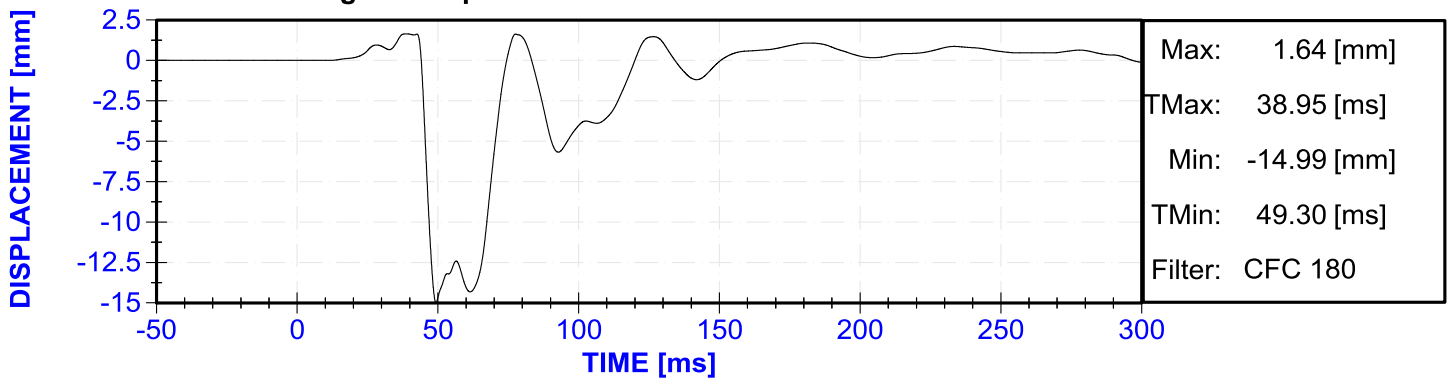
V2P1 Ankle Left Y Rotation



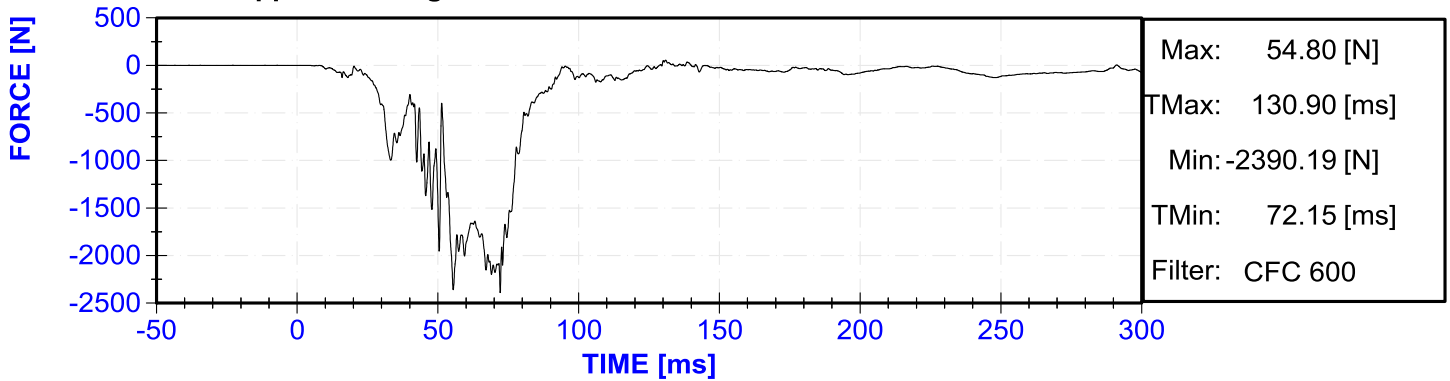
V2P1 Foot Left Z Acceleration



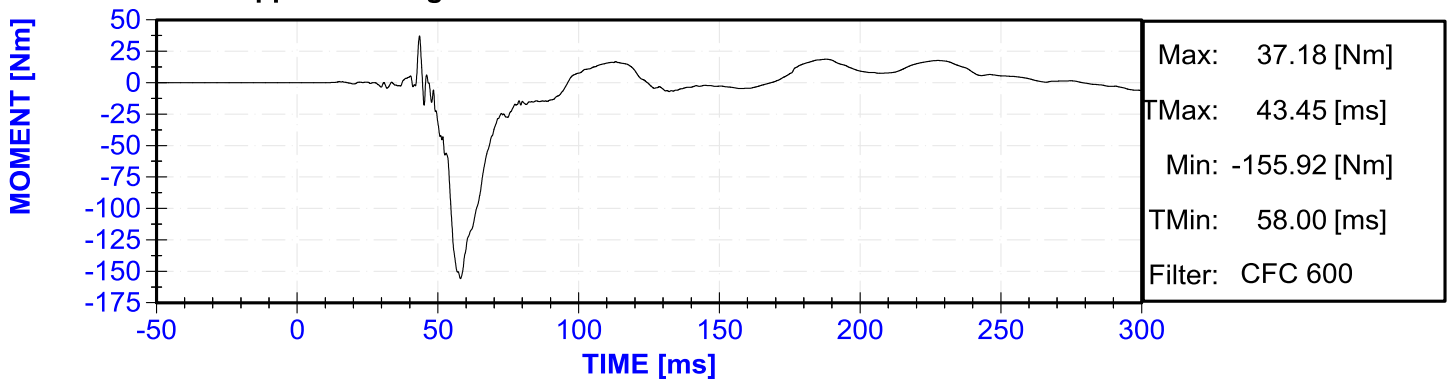
V2P1 Knee Right X Displacement



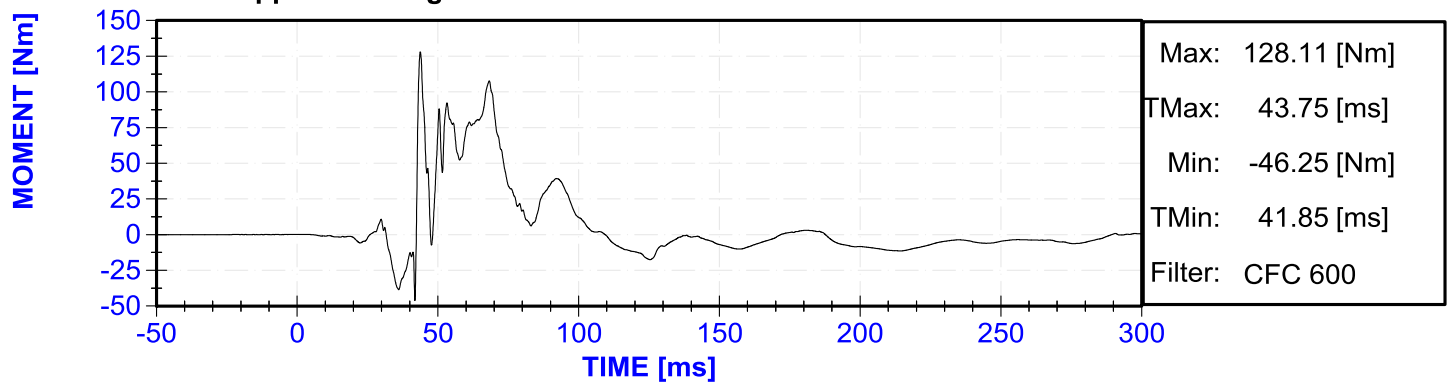
V2P1 Upper Tibia Right Z Force



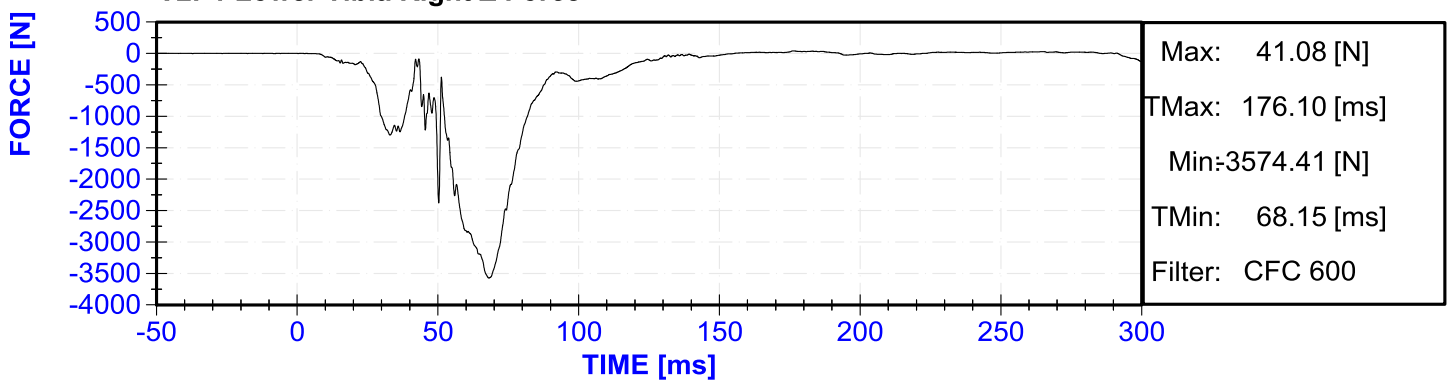
V2P1 Upper Tibia Right X Moment



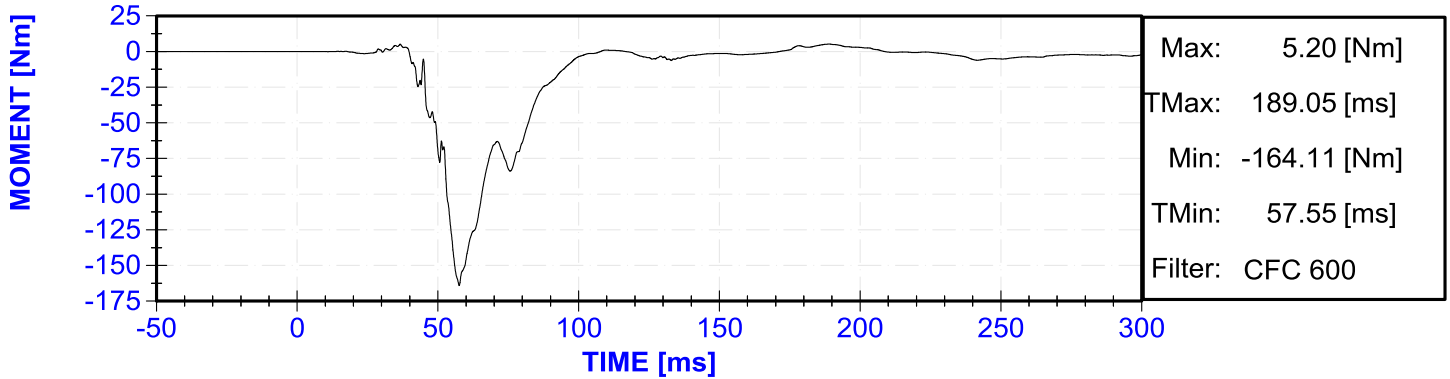
V2P1 Upper Tibia Right Y Moment



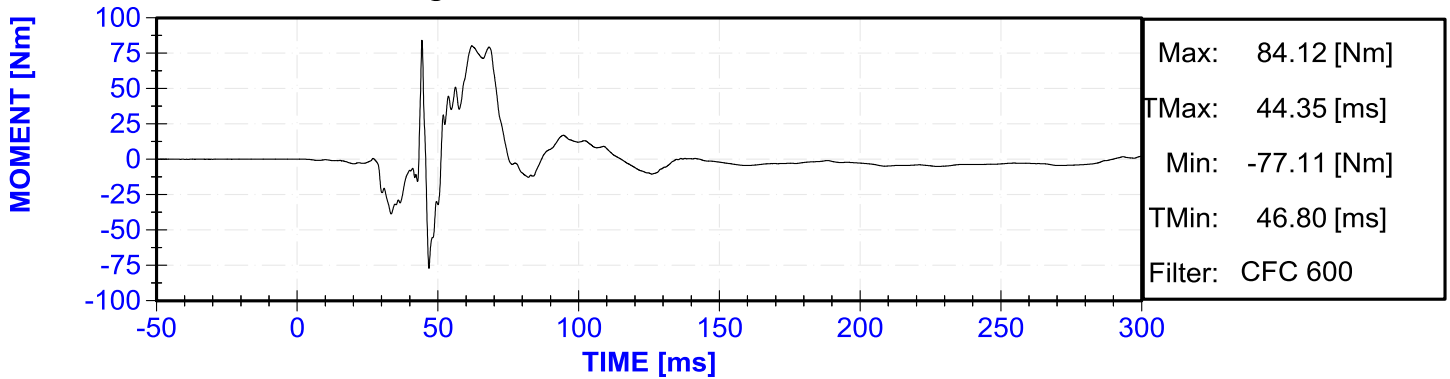
V2P1 Lower Tibia Right Z Force



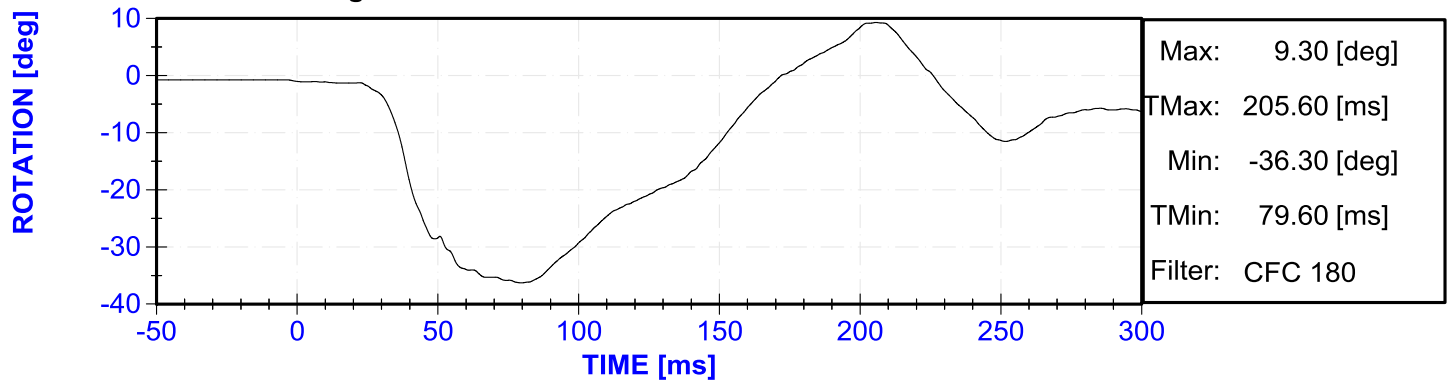
V2P1 Lower Tibia Right X Moment



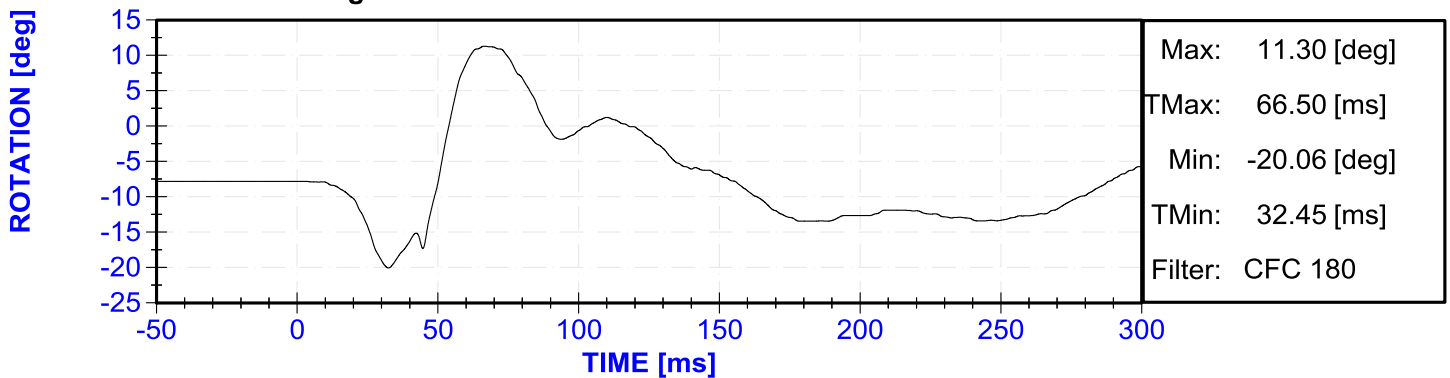
V2P1 Lower Tibia Right Y Moment



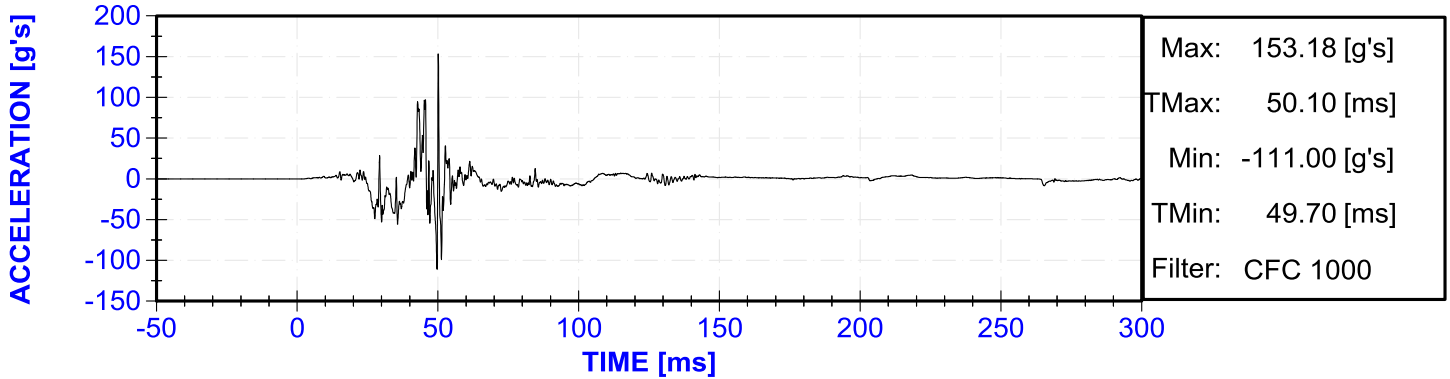
V2P1 Ankle Right X Rotation



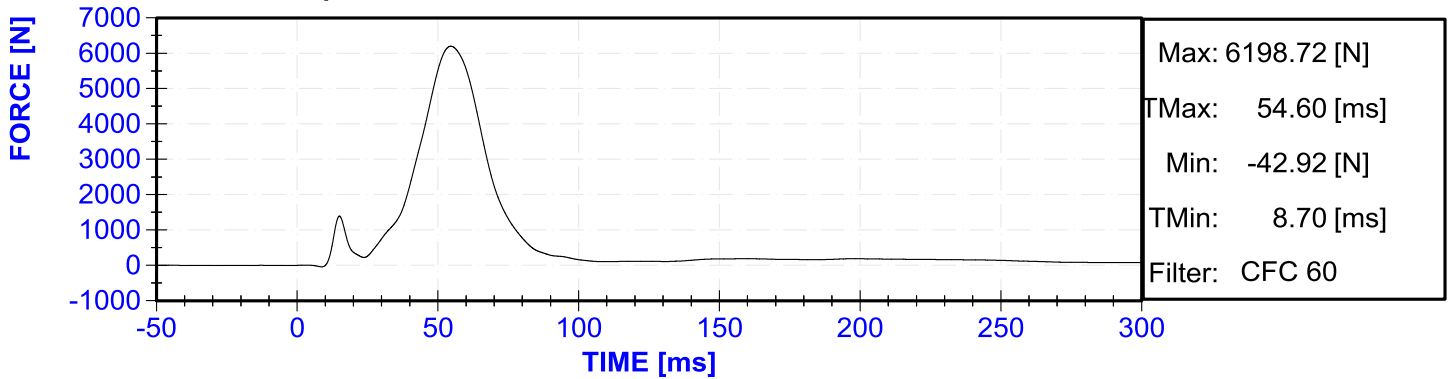
V2P1 Ankle Right Y Rotation



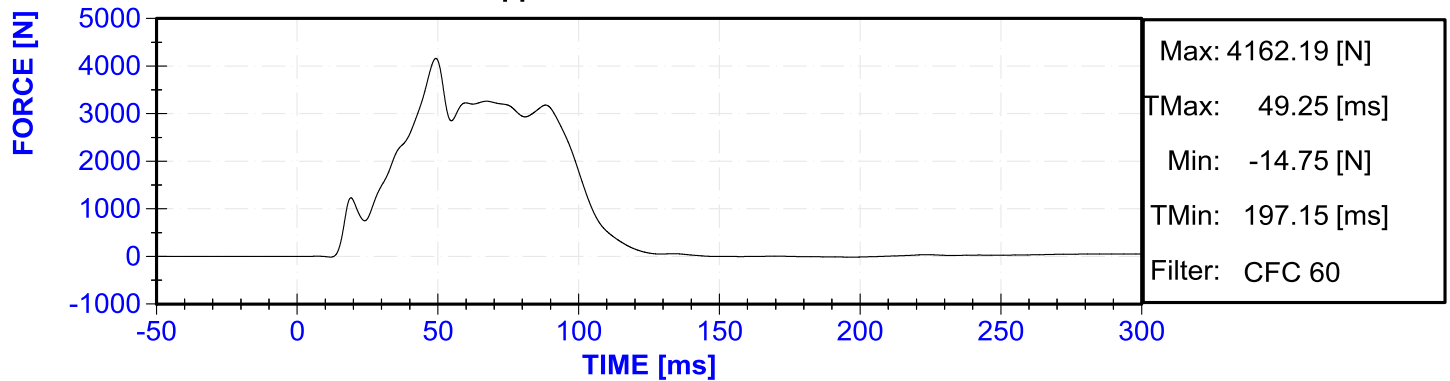
V2P1 Foot Right Z Acceleration



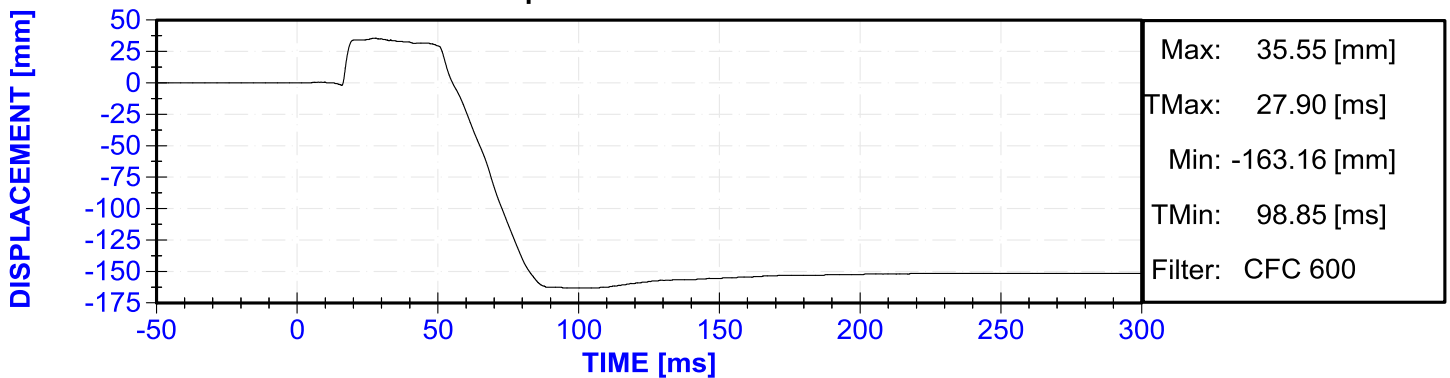
V2 Driver Lap Belt Force

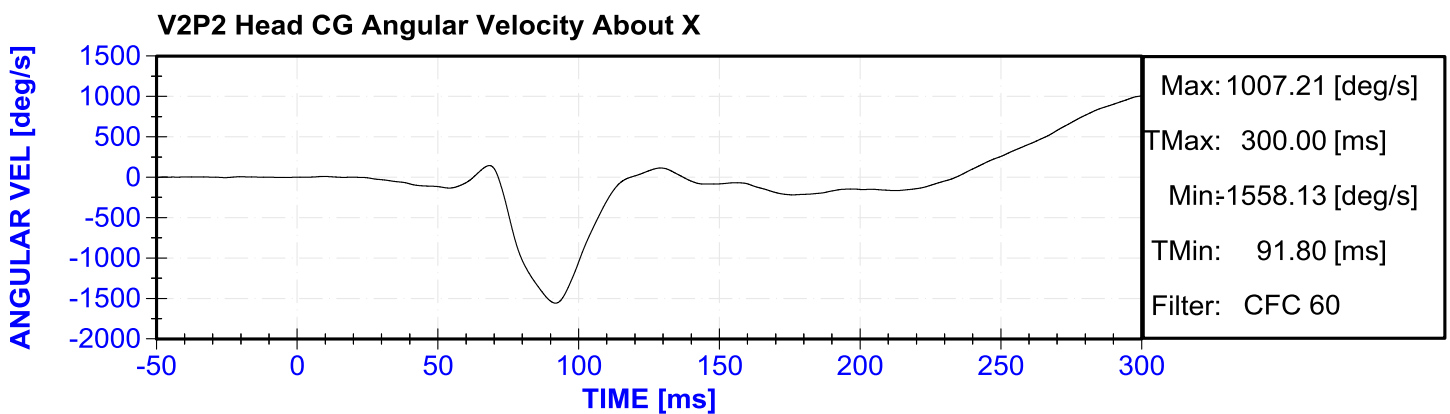
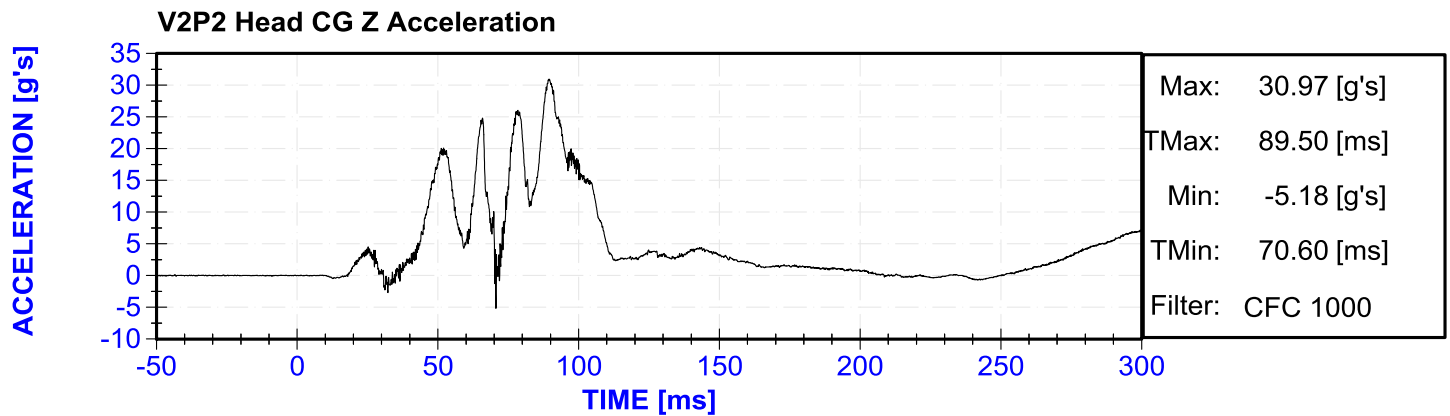
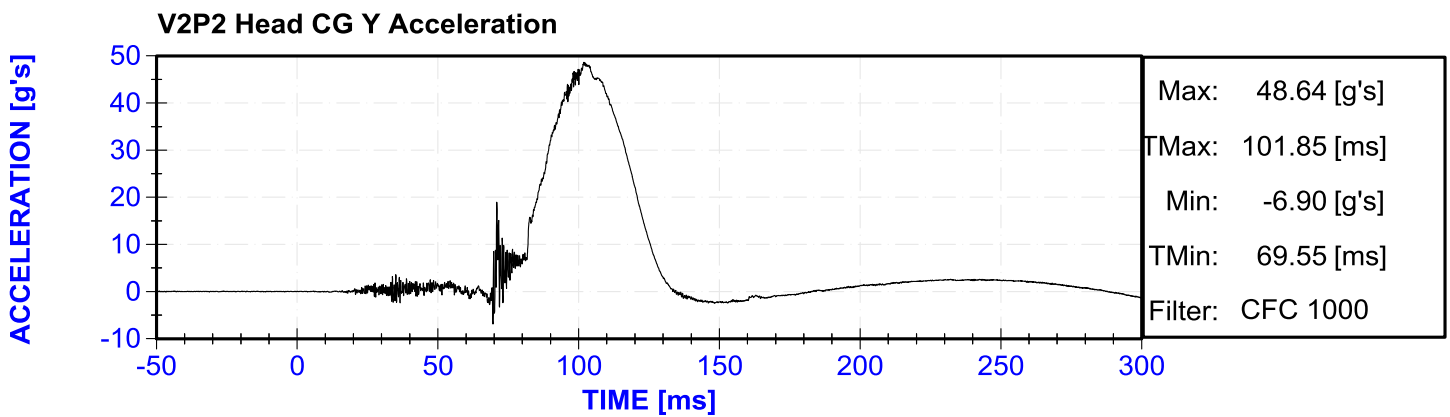
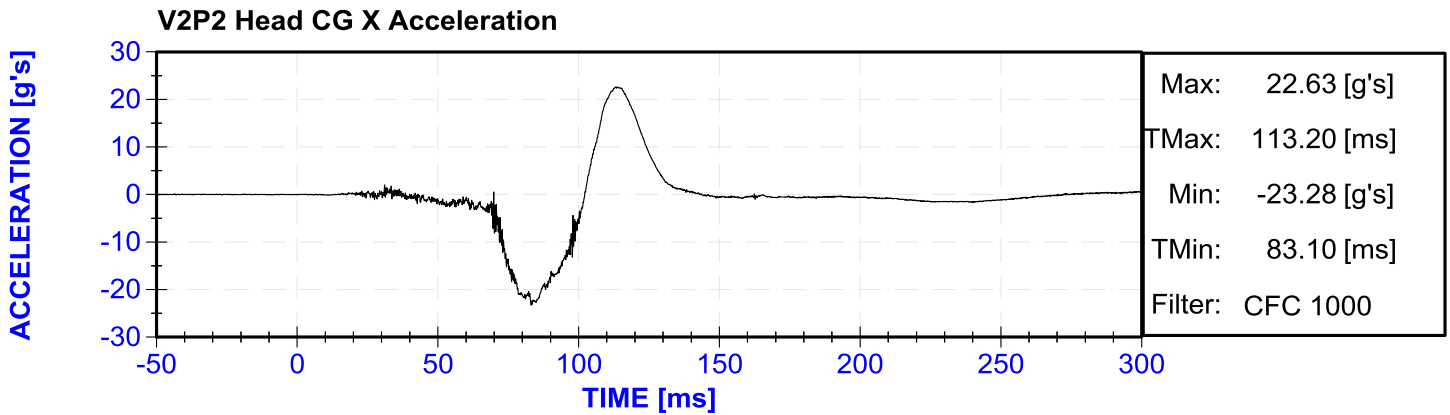


V2 Driver Shoulder Belt Upper Force

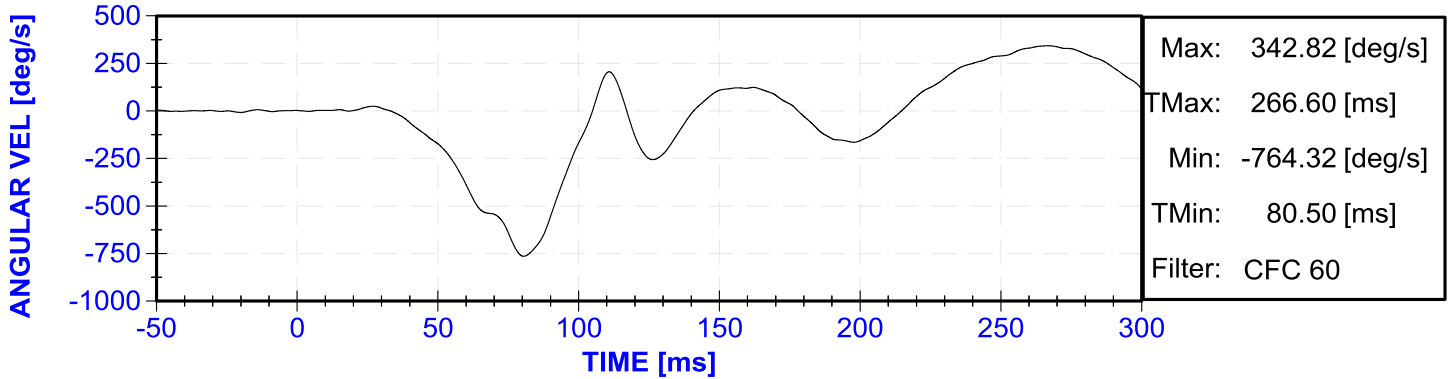


V2 Driver Shoulder Belt Displacement

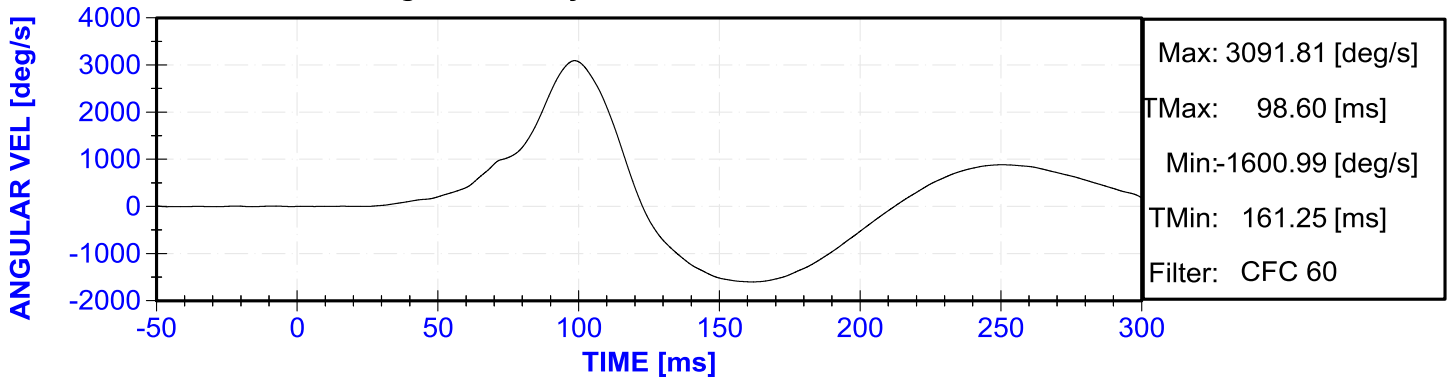




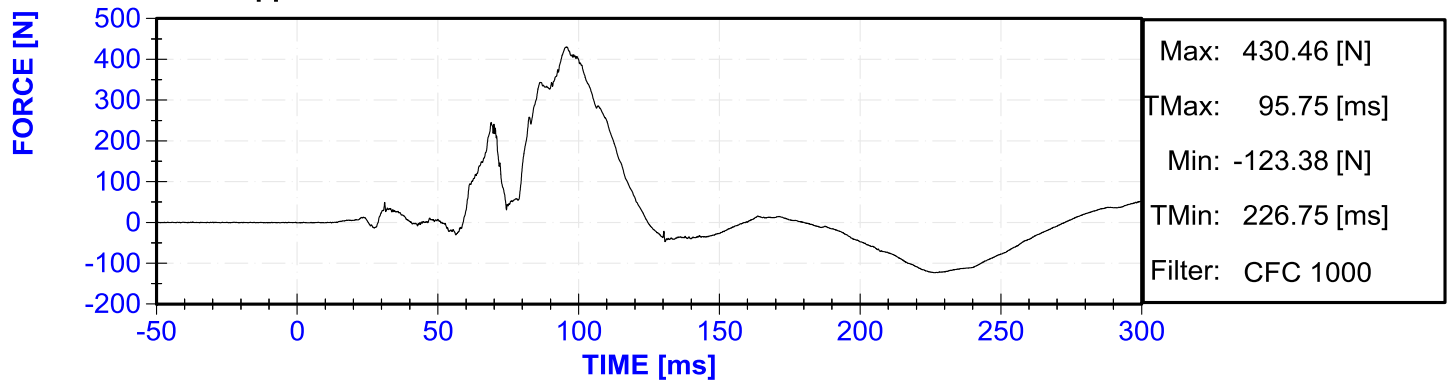
V2P2 Head CG Angular Velocity About Y



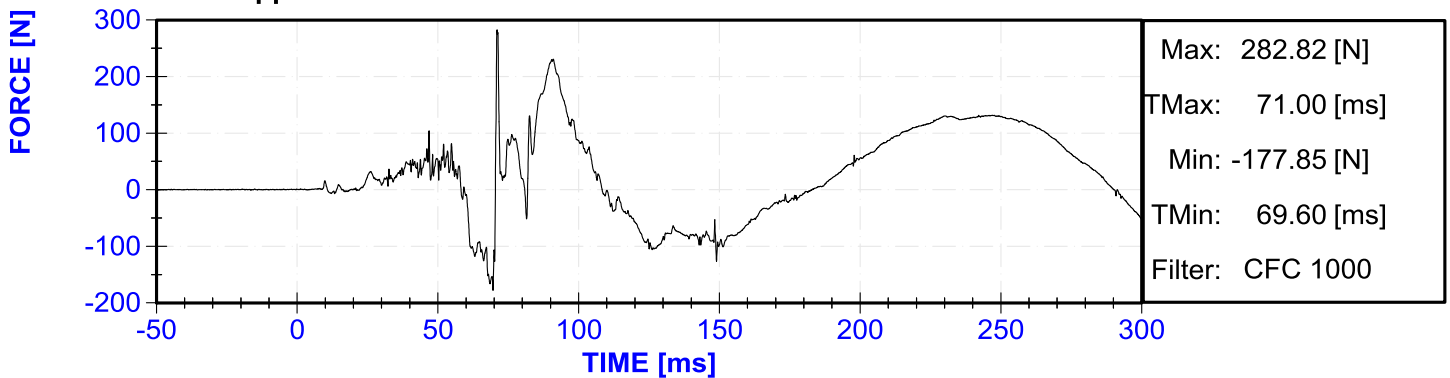
V2P2 Head CG Angular Velocity About Z

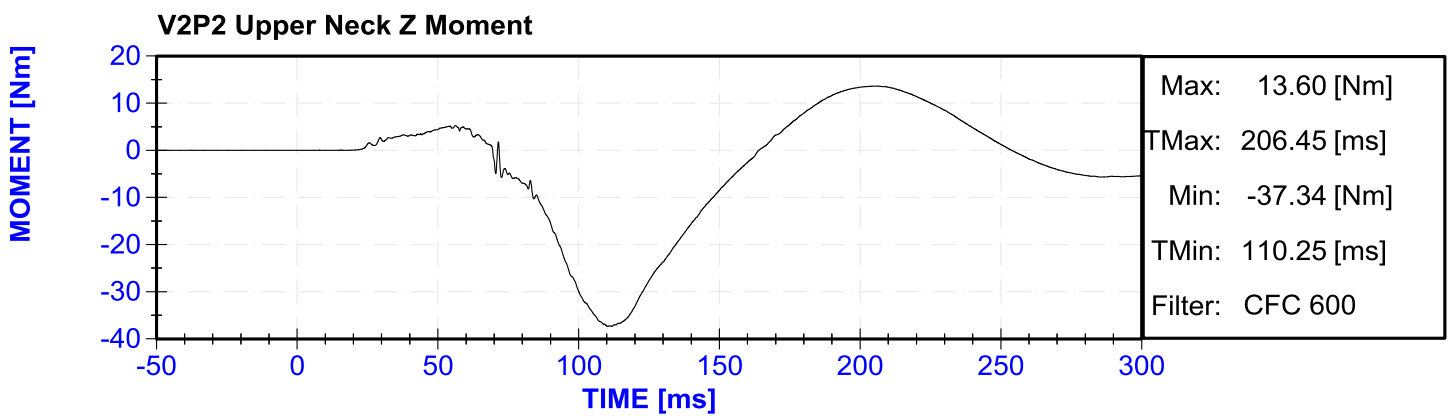
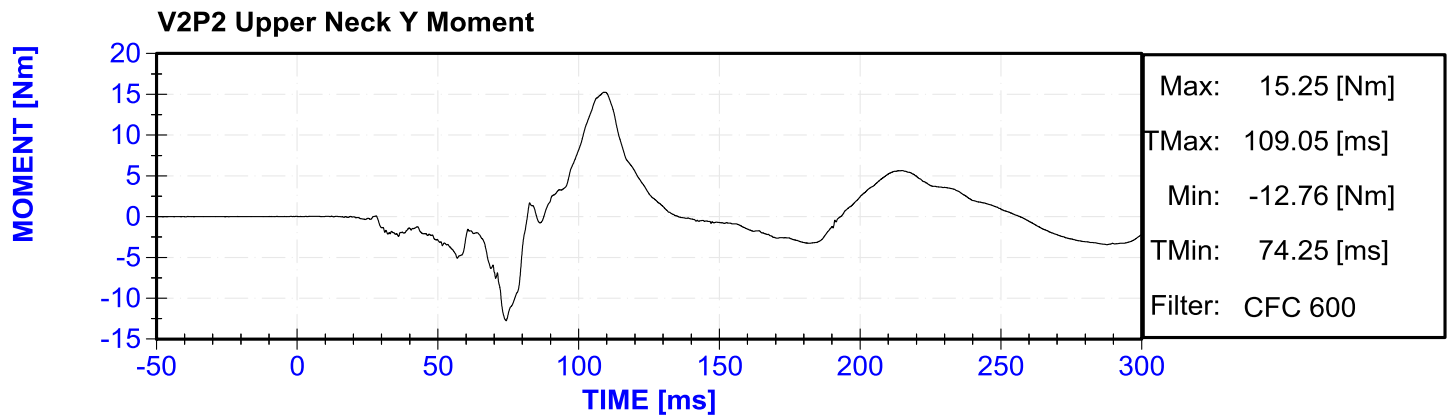
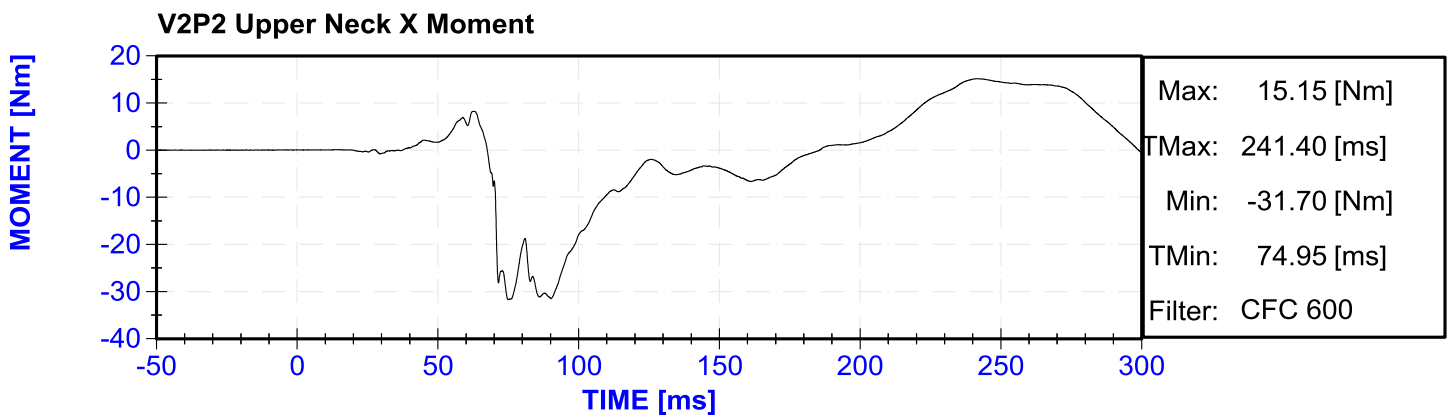
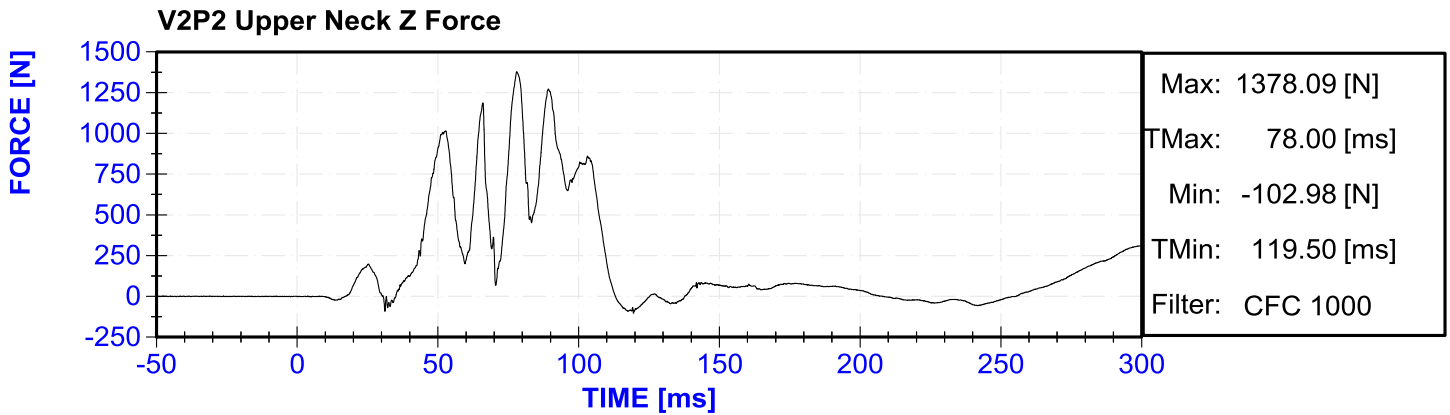


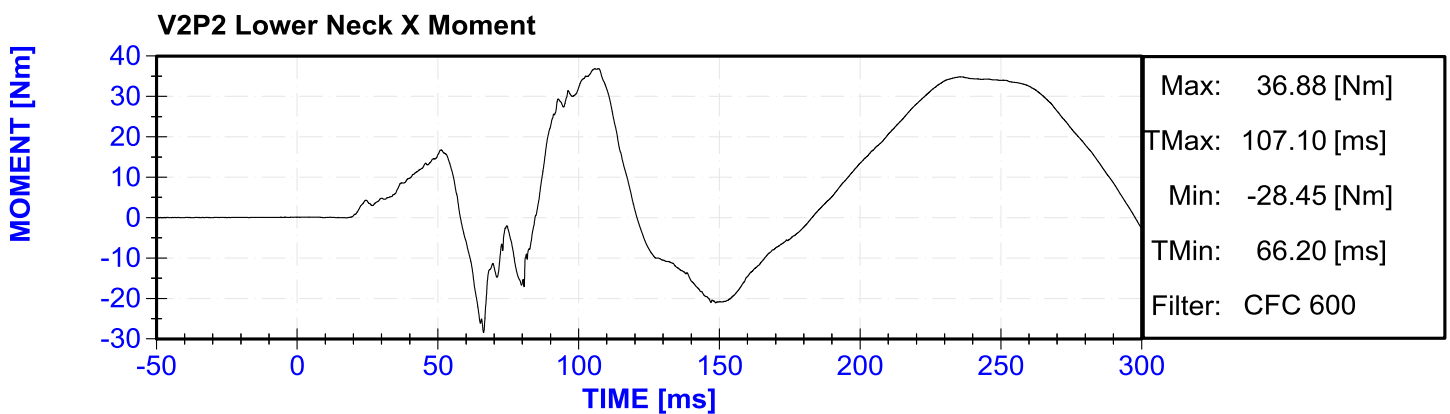
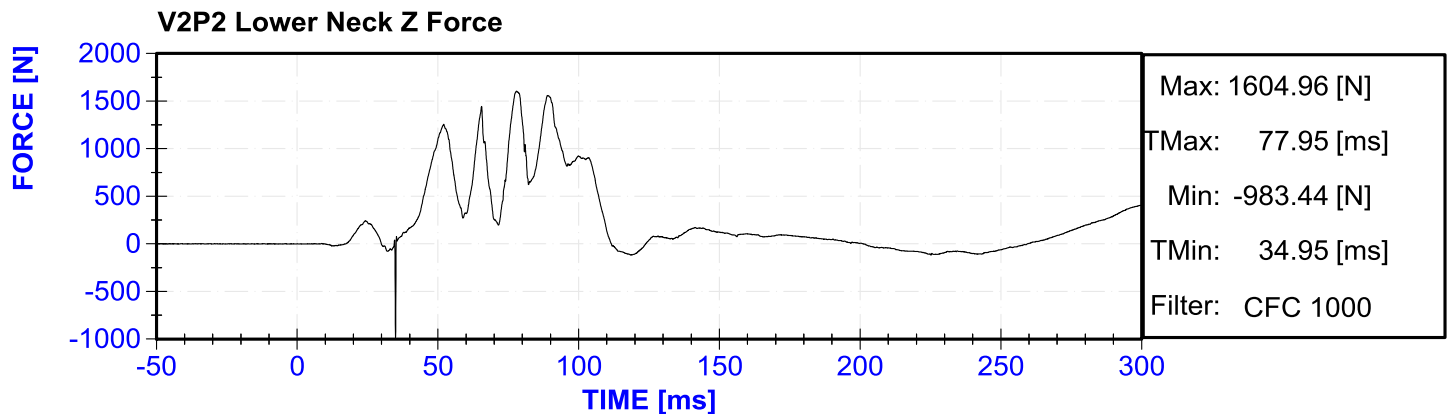
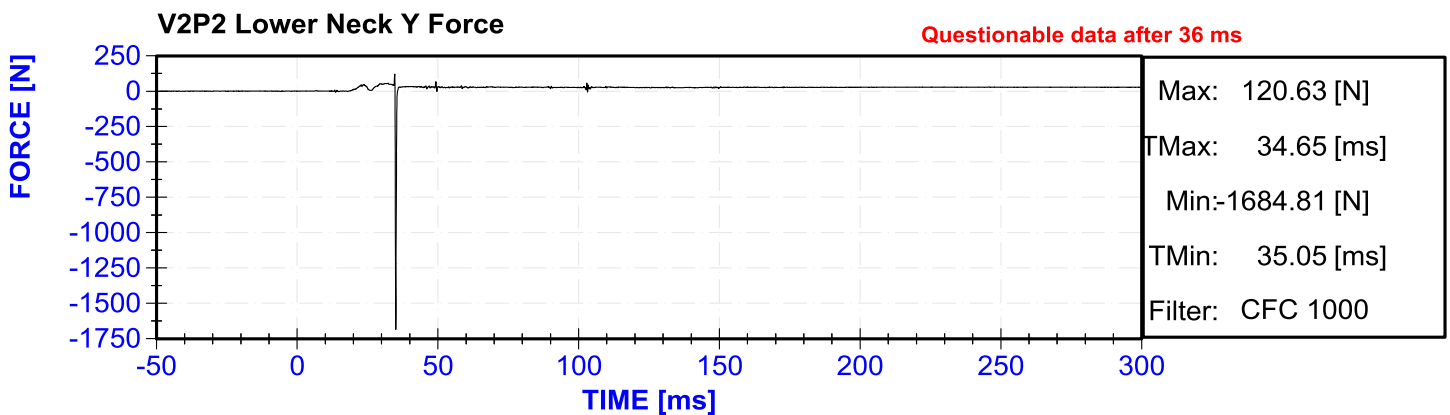
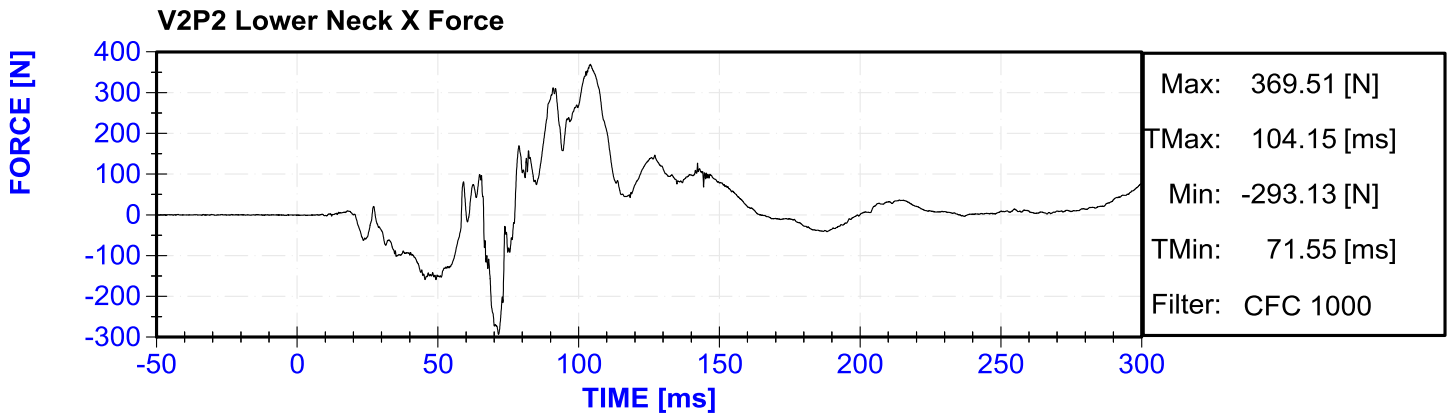
V2P2 Upper Neck X Force

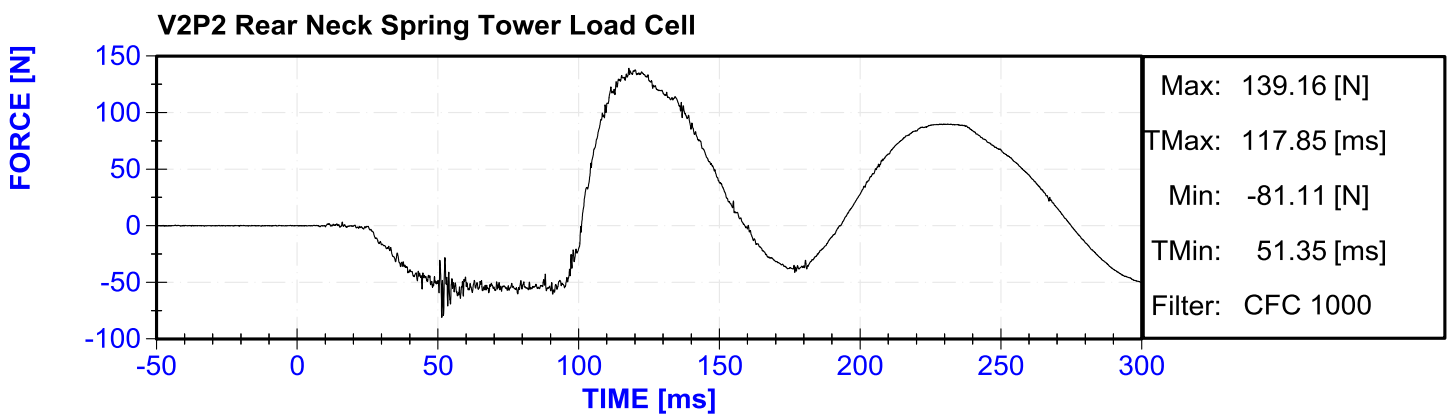
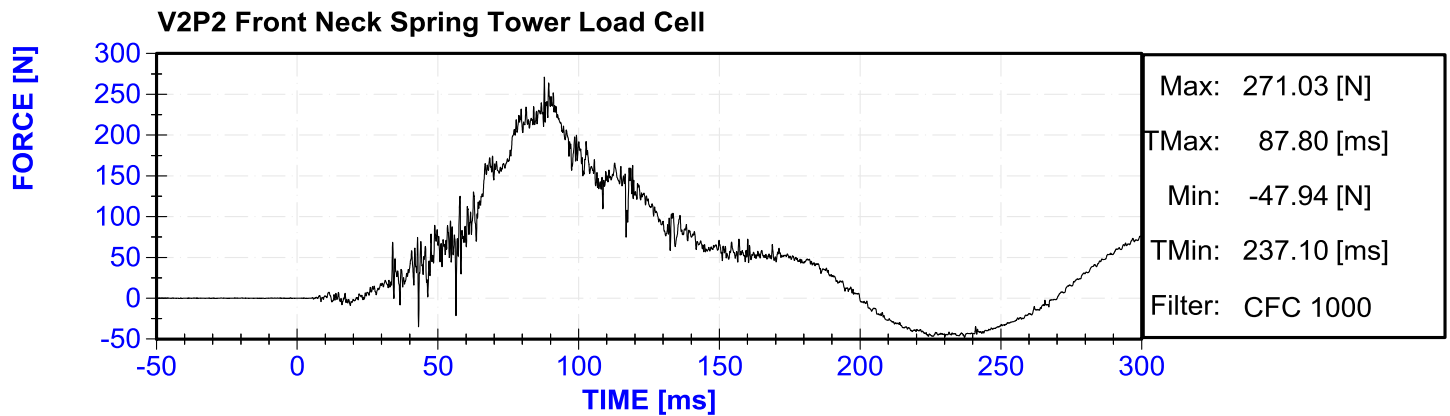
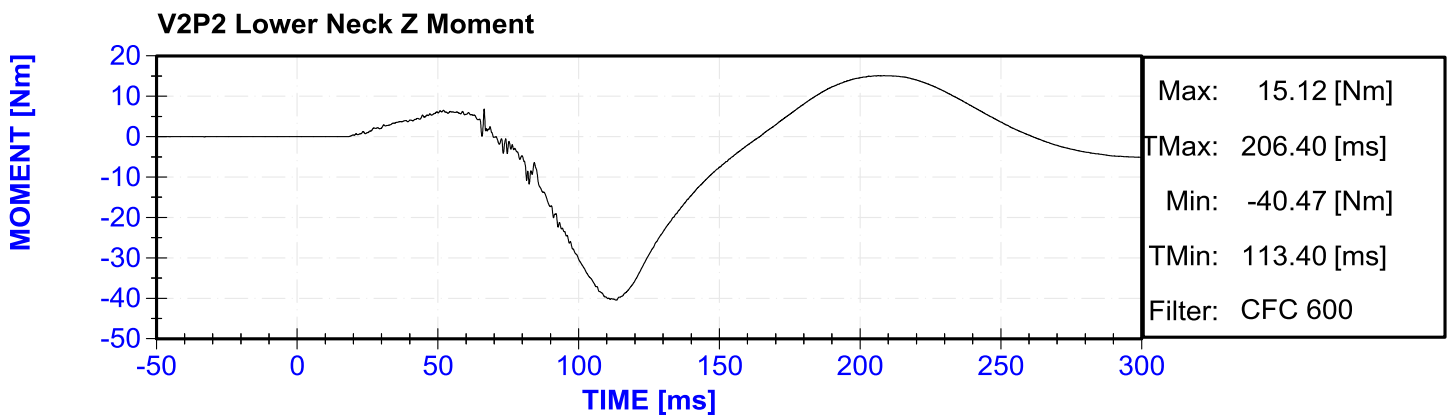
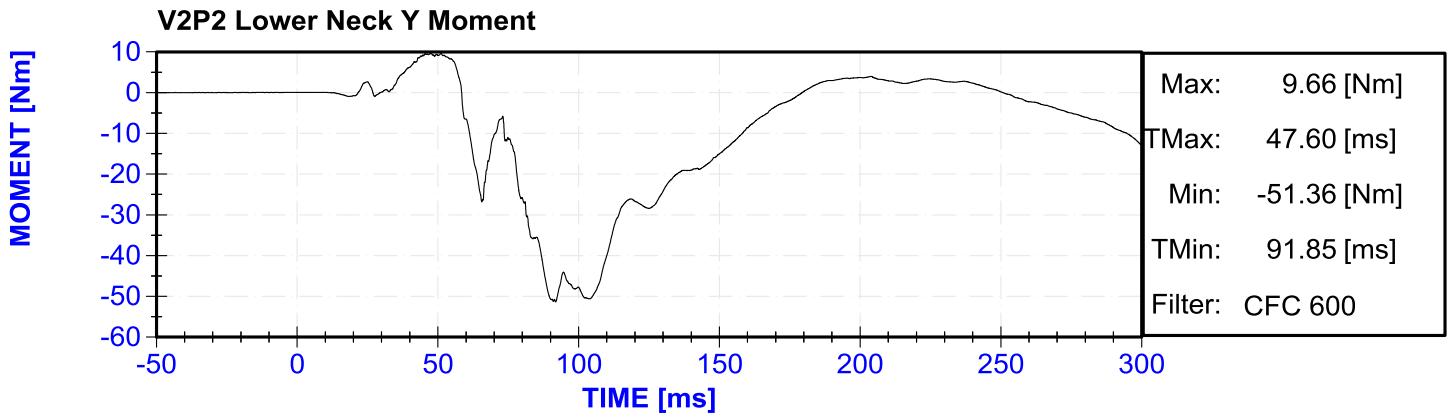


V2P2 Upper Neck Y Force

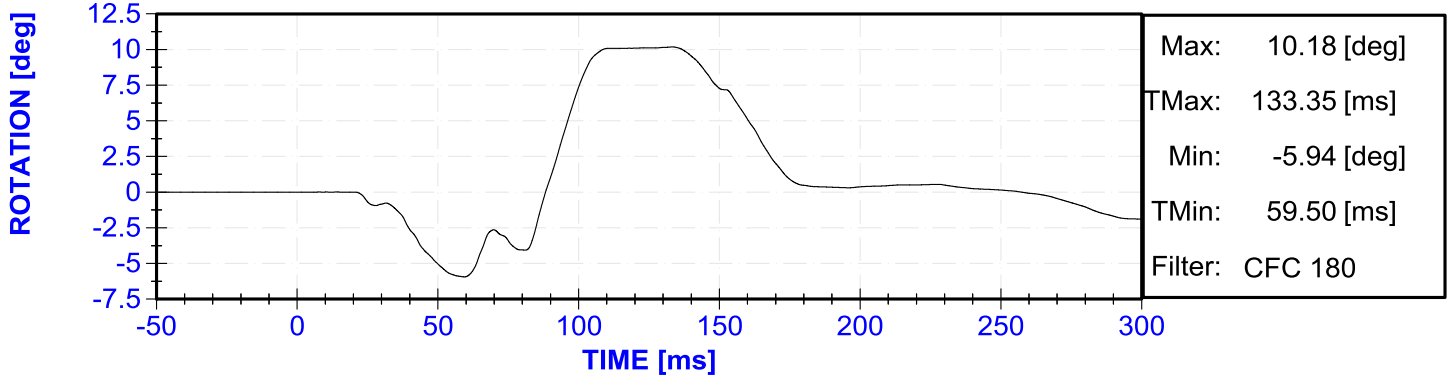




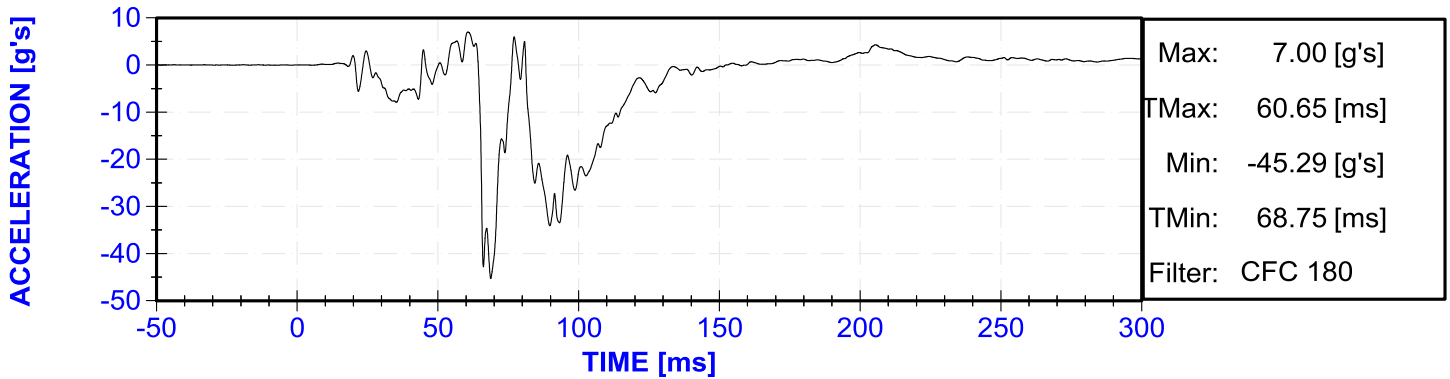




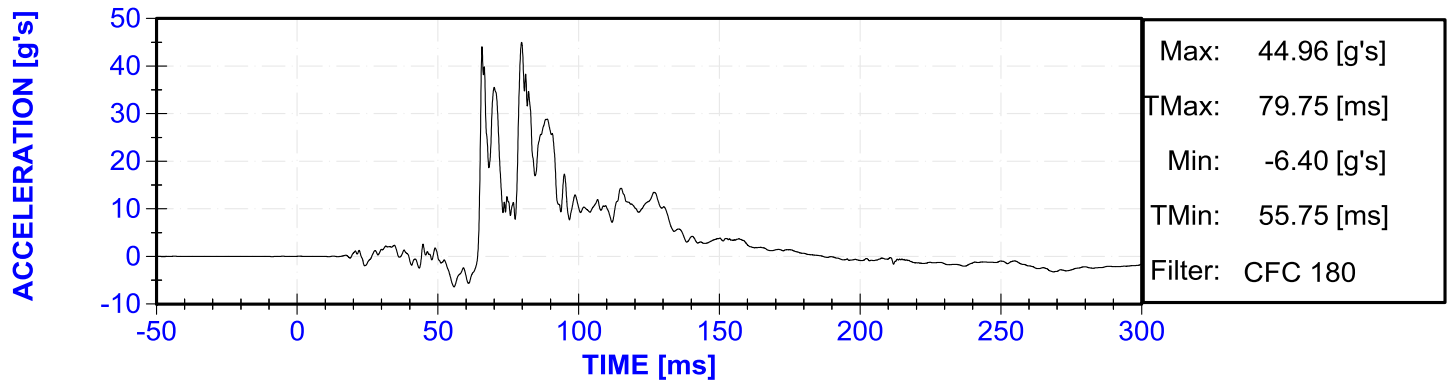
V2P2 Occipital Condyle Rotation Potentiometer



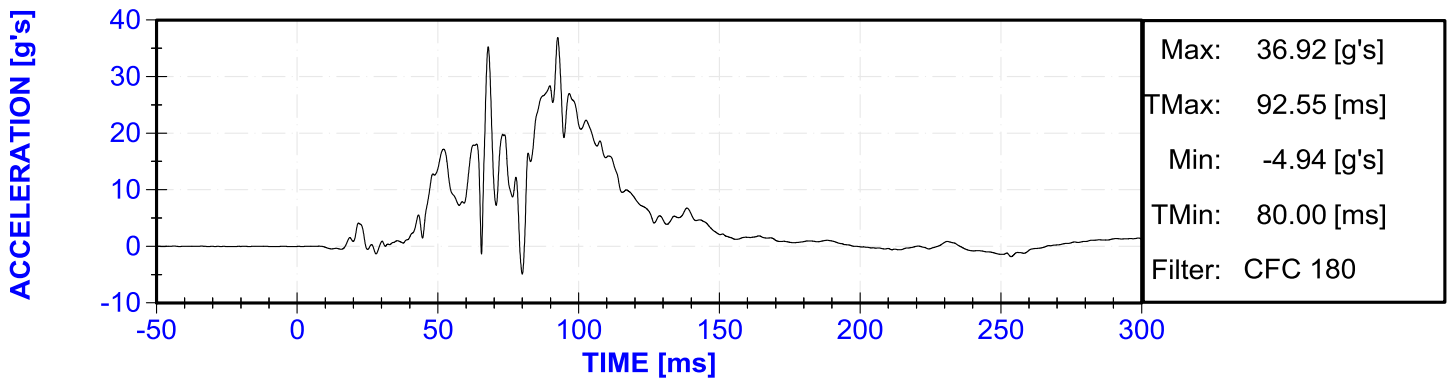
V2P2 T1 X Acceleration

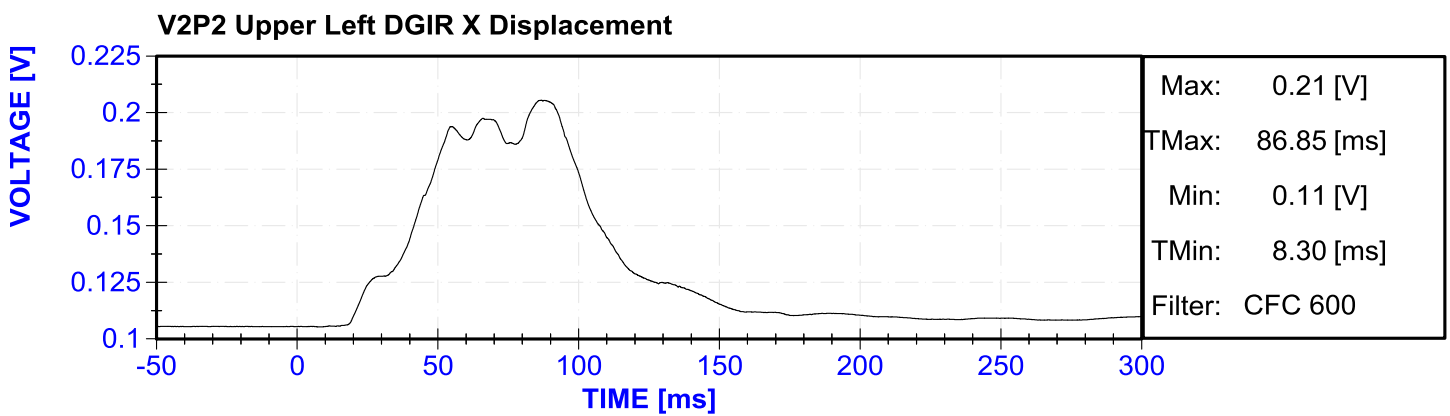
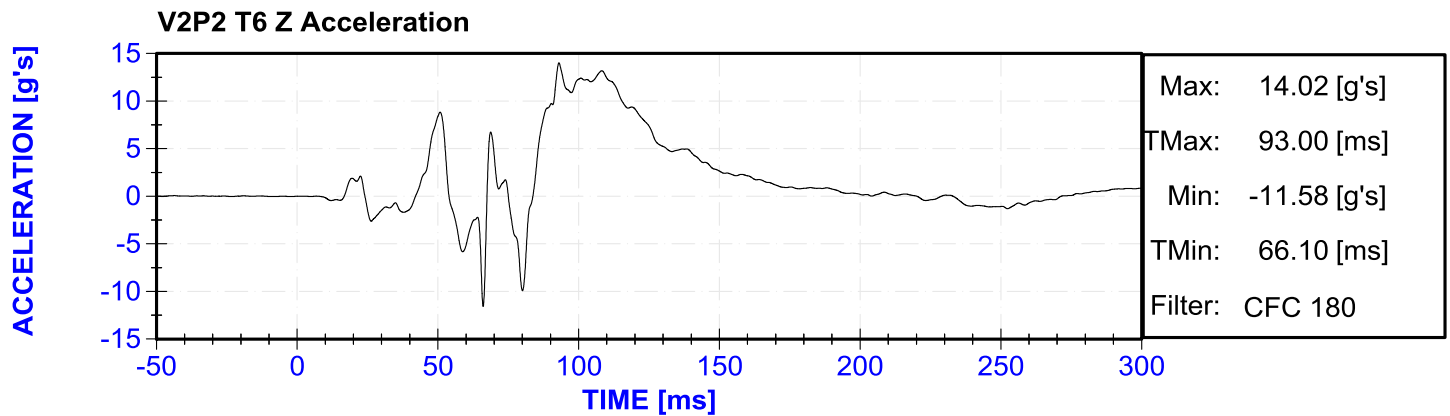
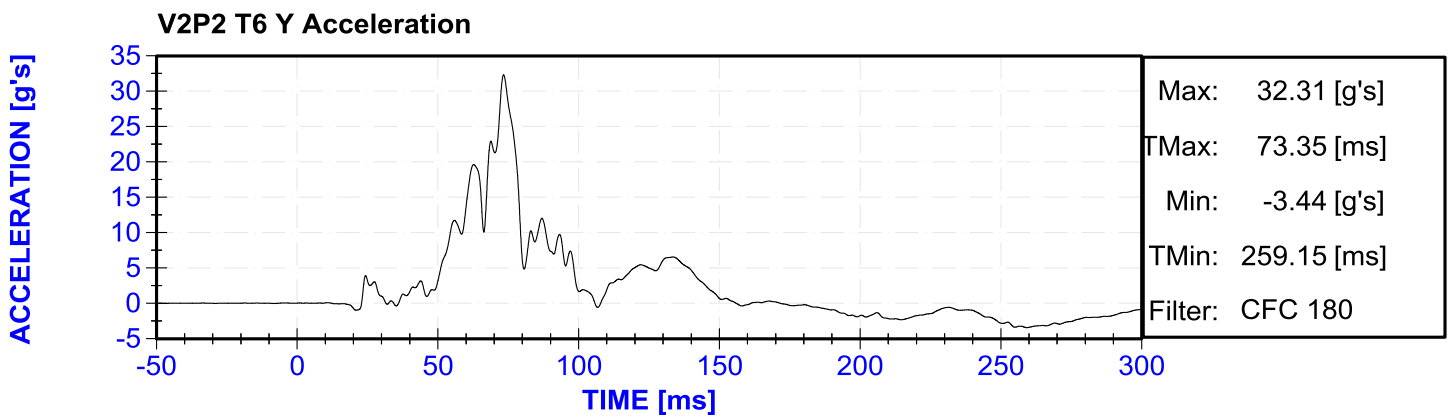
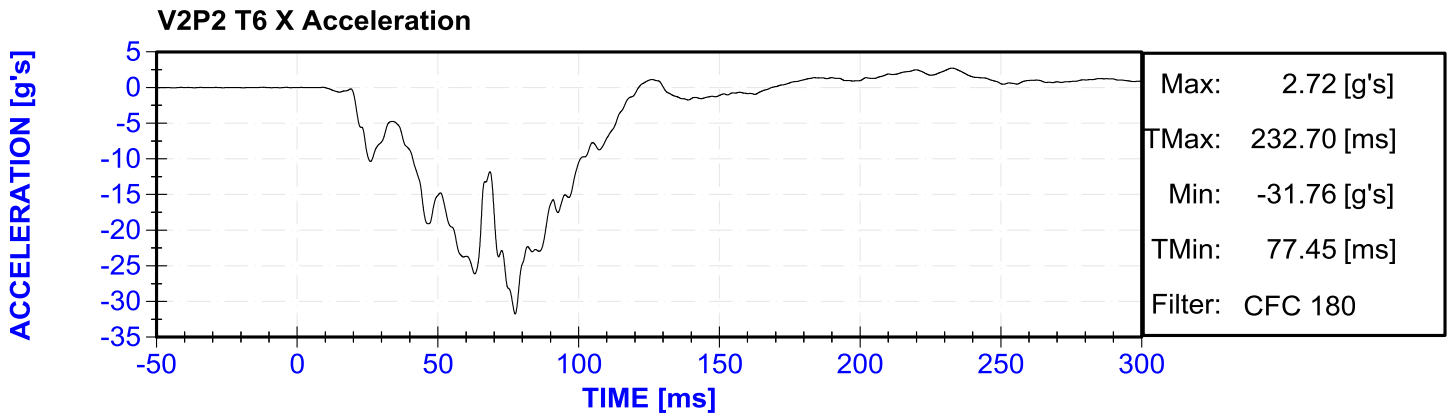


V2P2 T1 Y Acceleration

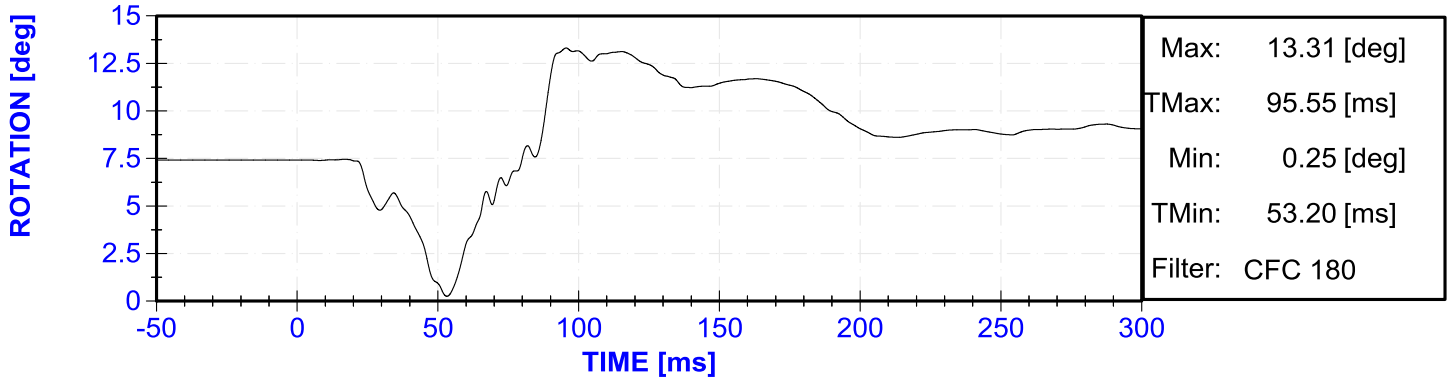


V2P2 T1 Z Acceleration

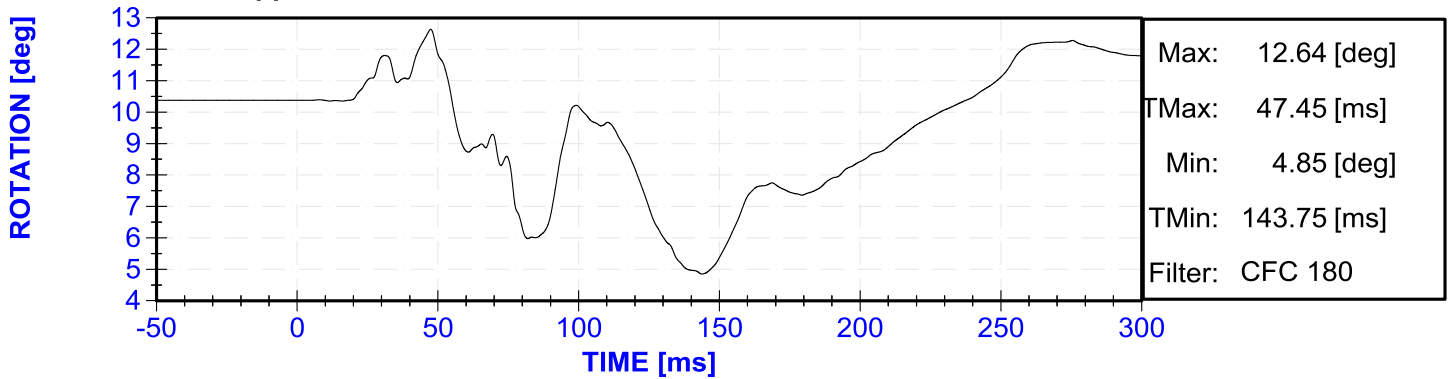




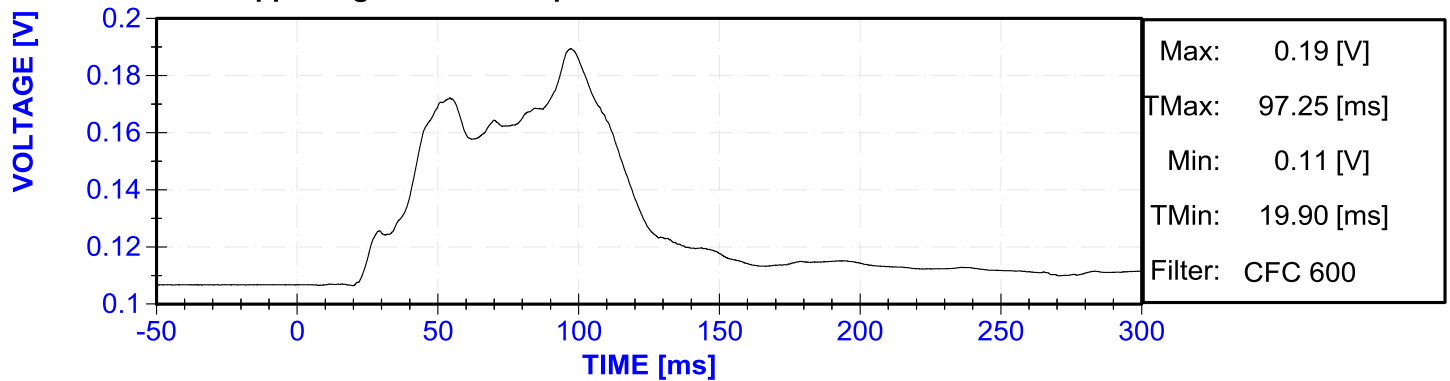
V2P2 Upper Left DGIR Y Rotation



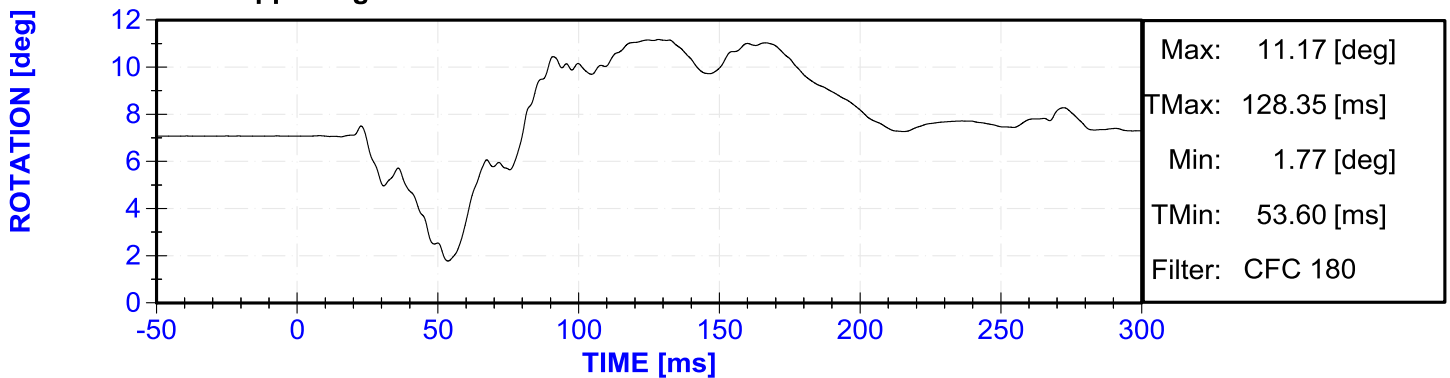
V2P2 Upper Left DGIR Z Rotation



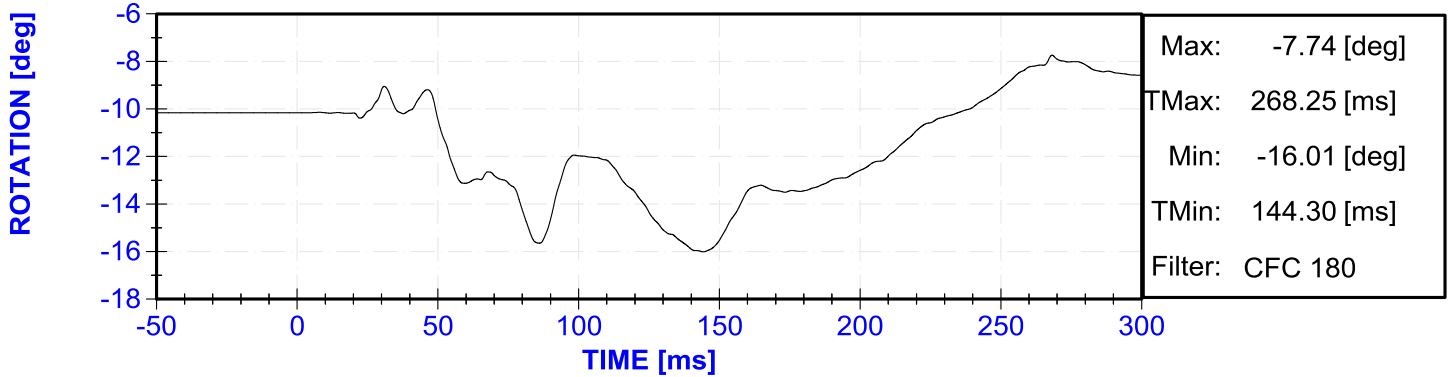
V2P2 Upper Right DGIR X Displacement



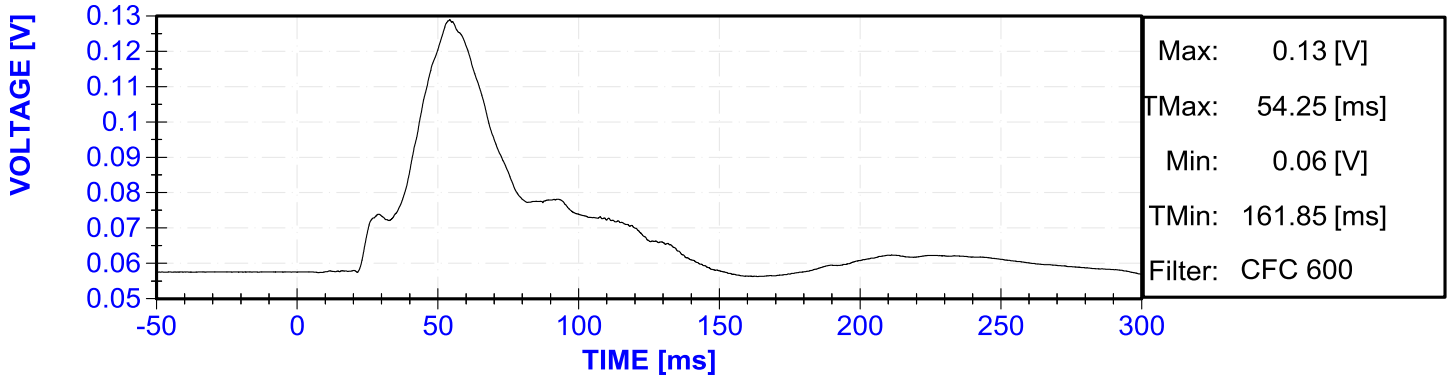
V2P2 Upper Right DGIR Y Rotation



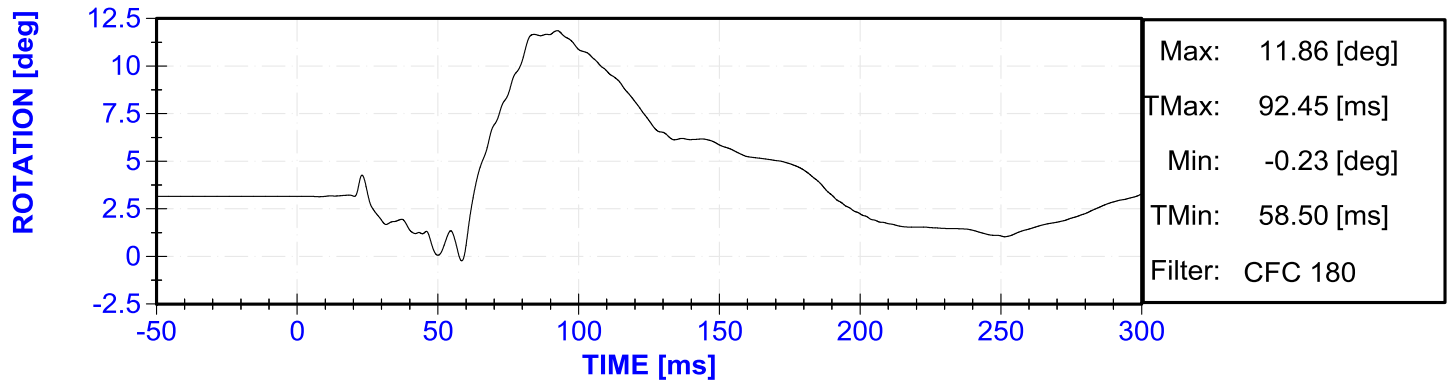
V2P2 Upper Right DGIR Z Rotation



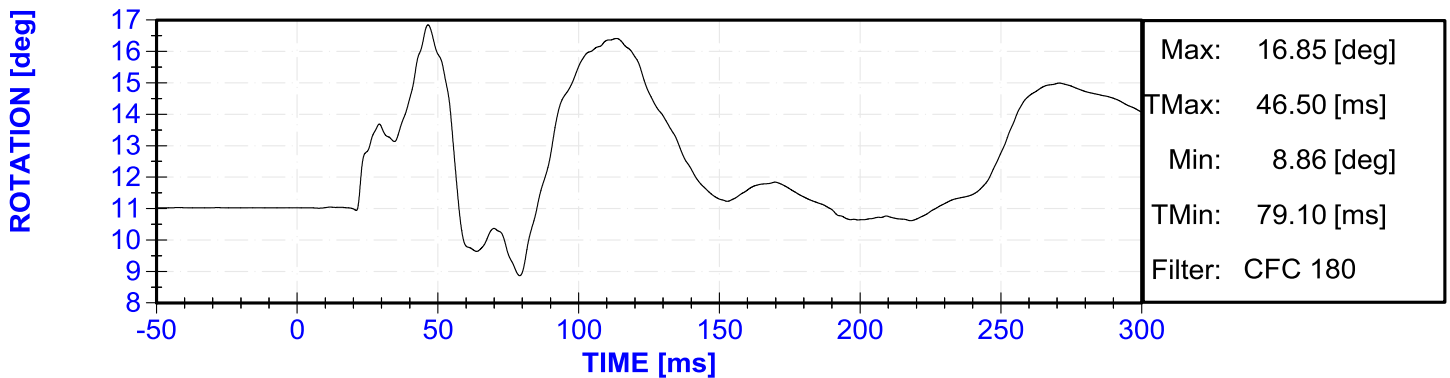
V2P2 Lower Left DGIR X Displacement



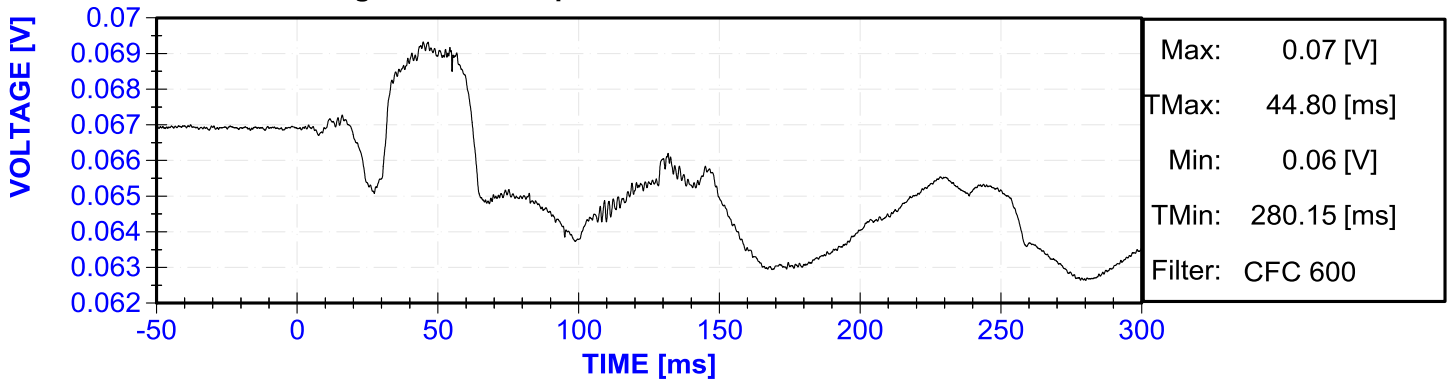
V2P2 Lower Left DGIR Y Rotation



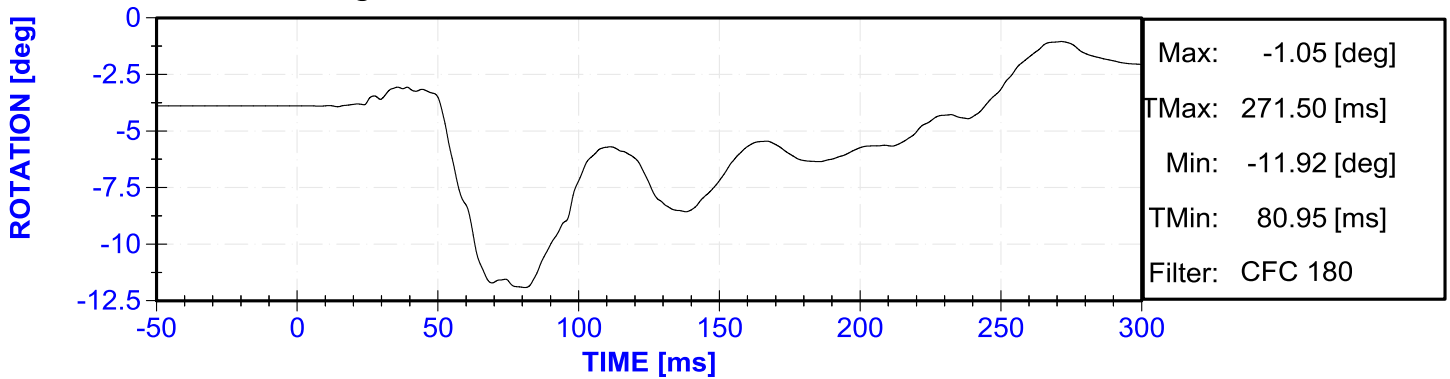
V2P2 Lower Left DGIR Z Rotation



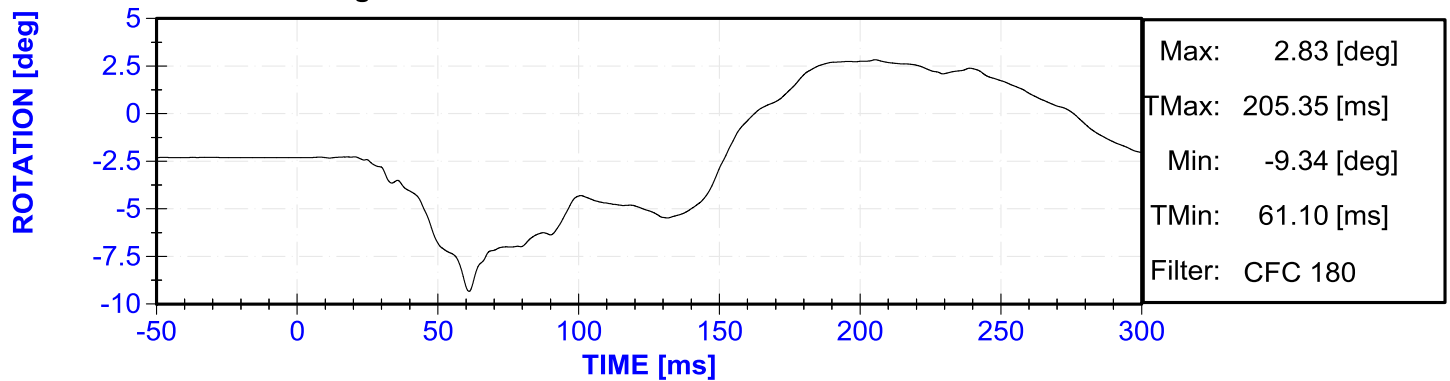
V2P2 Lower Right DGIR X Displacement



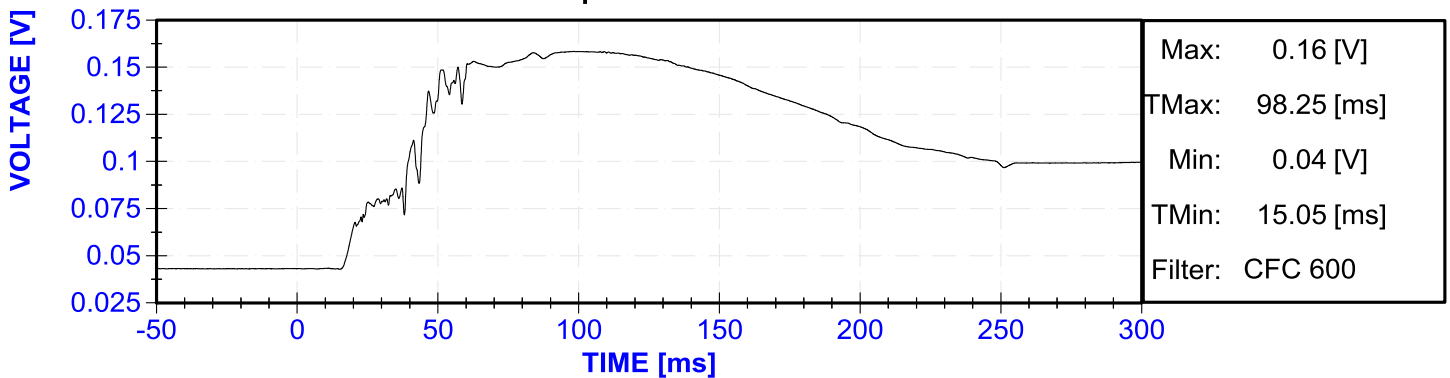
V2P2 Lower Right DGIR Y Rotation



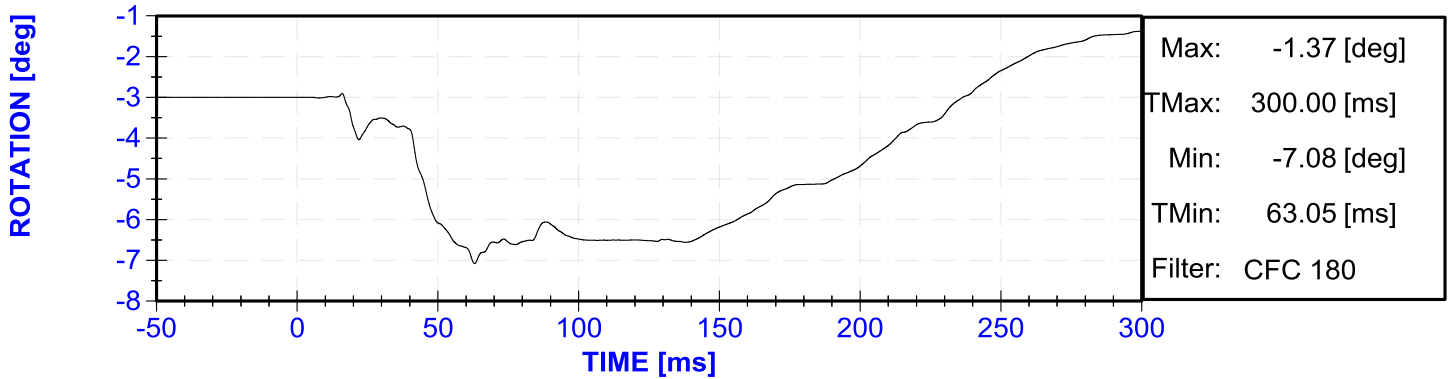
V2P2 Lower Right DGIR Z Rotation



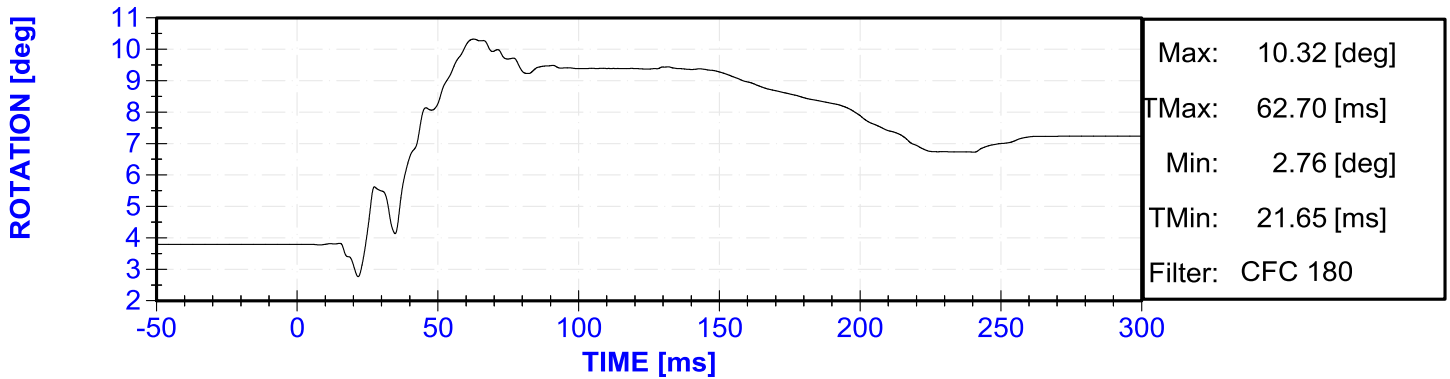
V2P2 Abdomen Left DGIR X Displacement



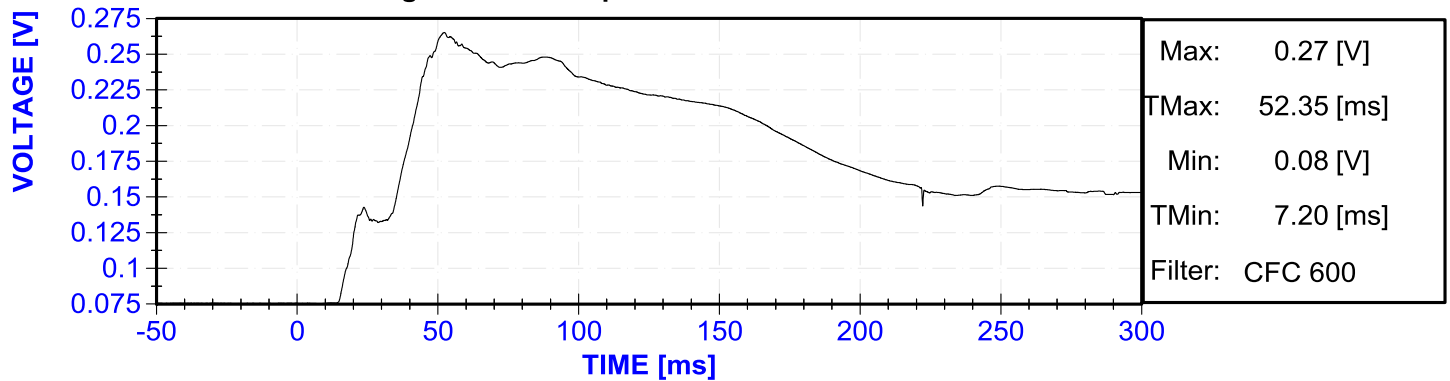
V2P2 Abdomen Left DGIR Y Rotation



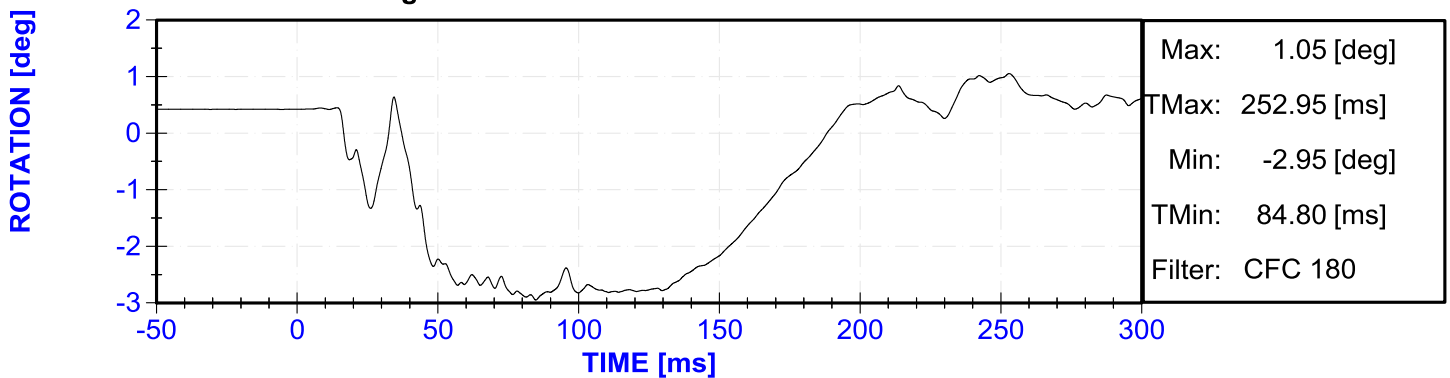
V2P2 Abdomen Left DGIR Z Rotation



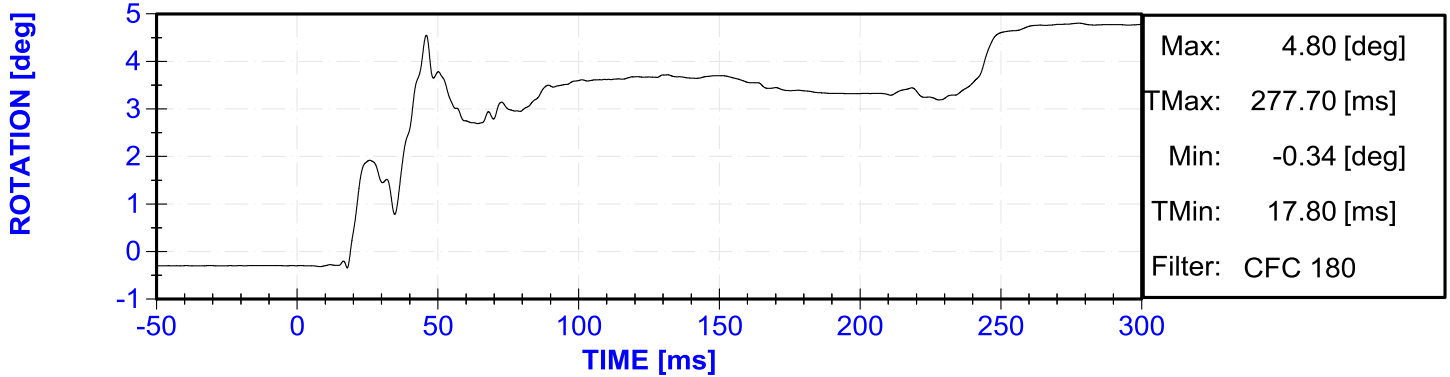
V2P2 Abdomen Right DGIR X Displacement



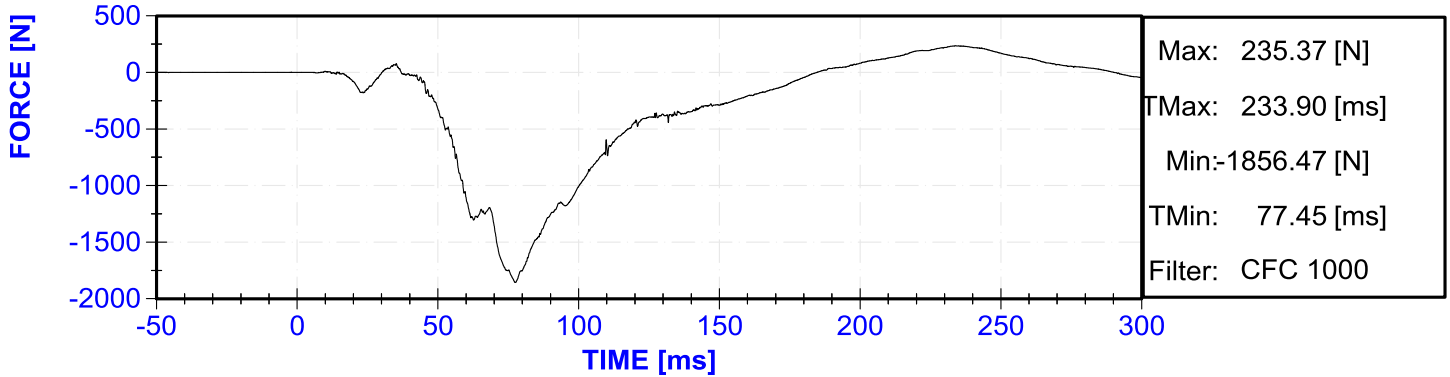
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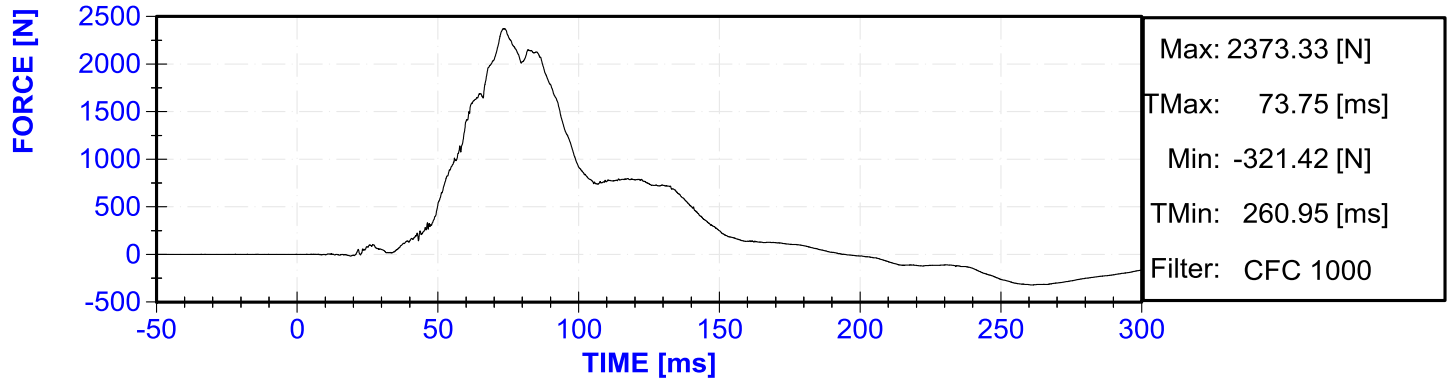
V2P2 Abdomen Right DGIR Z Rotation



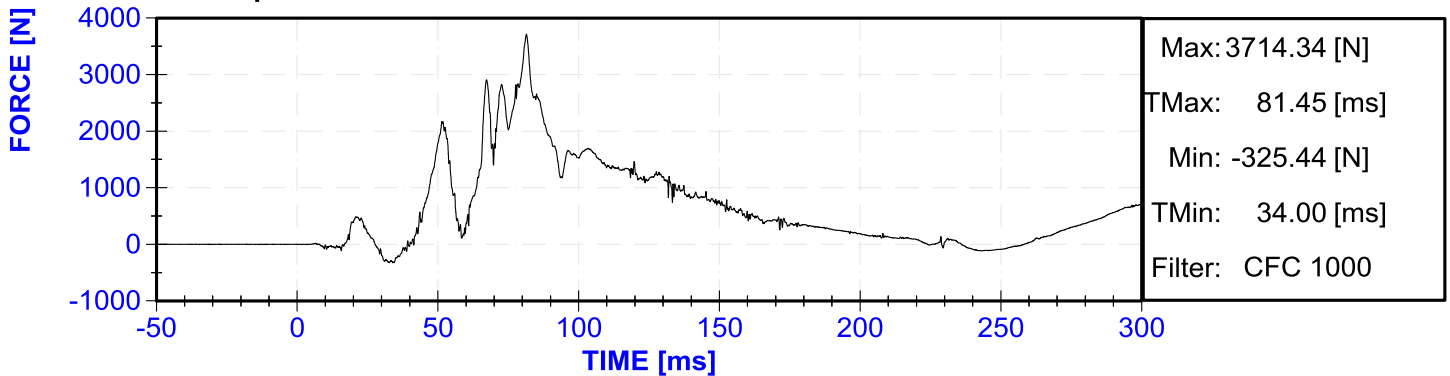
V2P2 Spine Force X

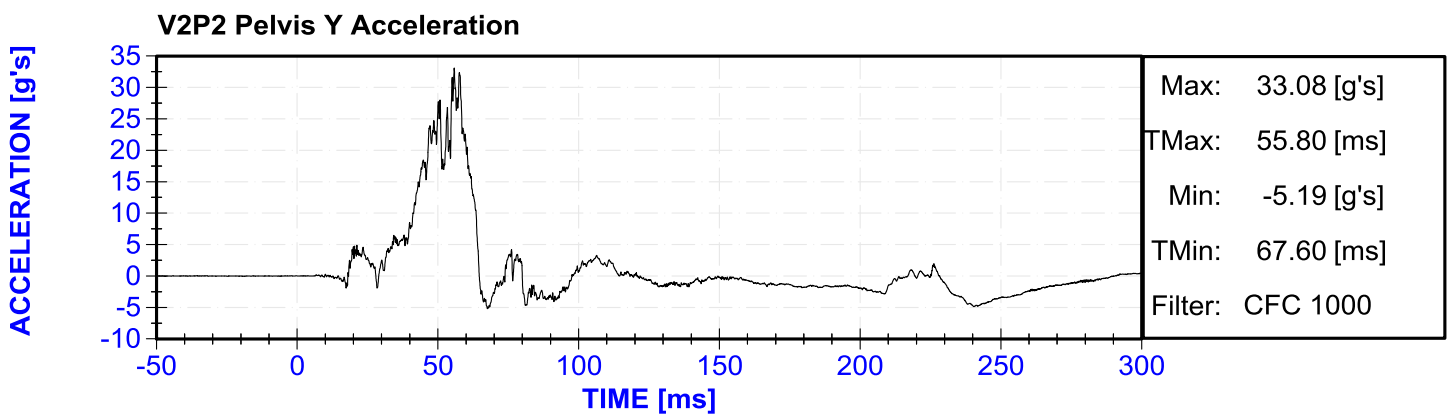
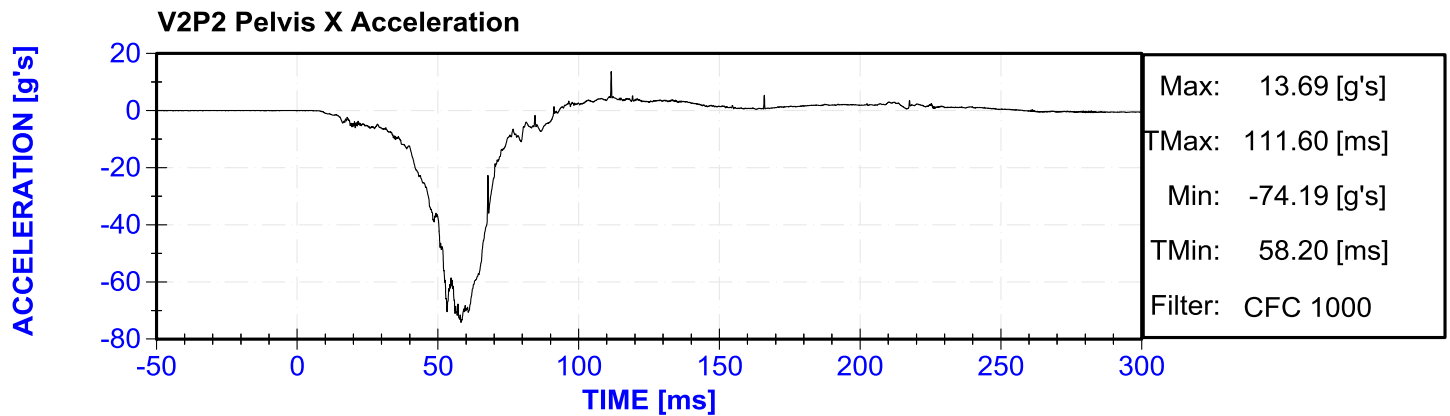
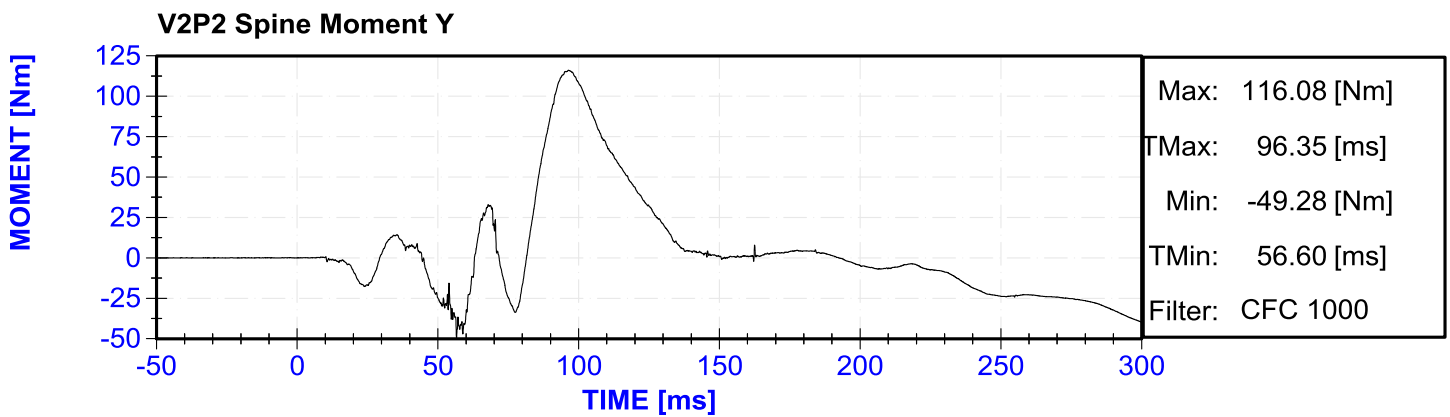
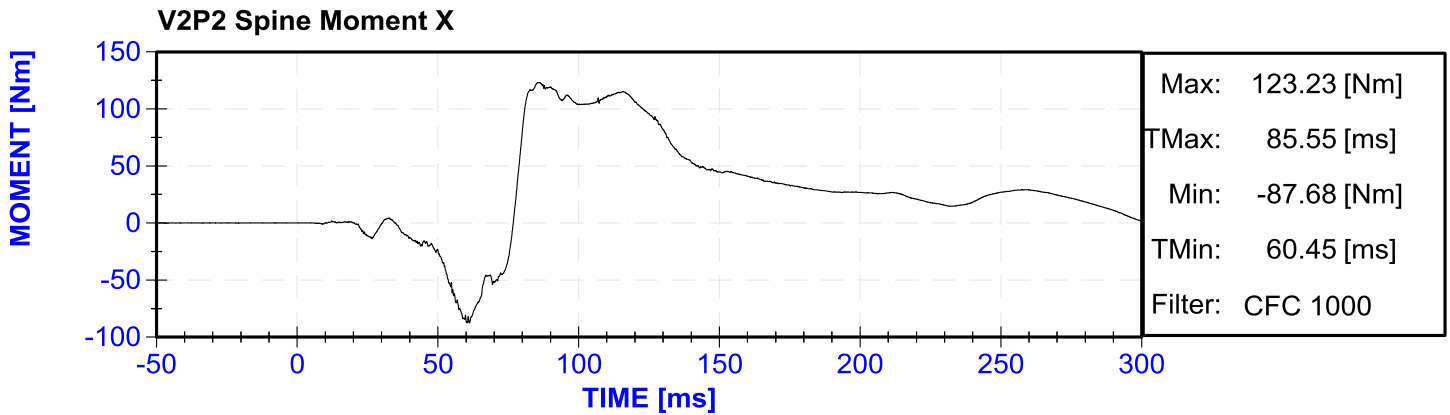


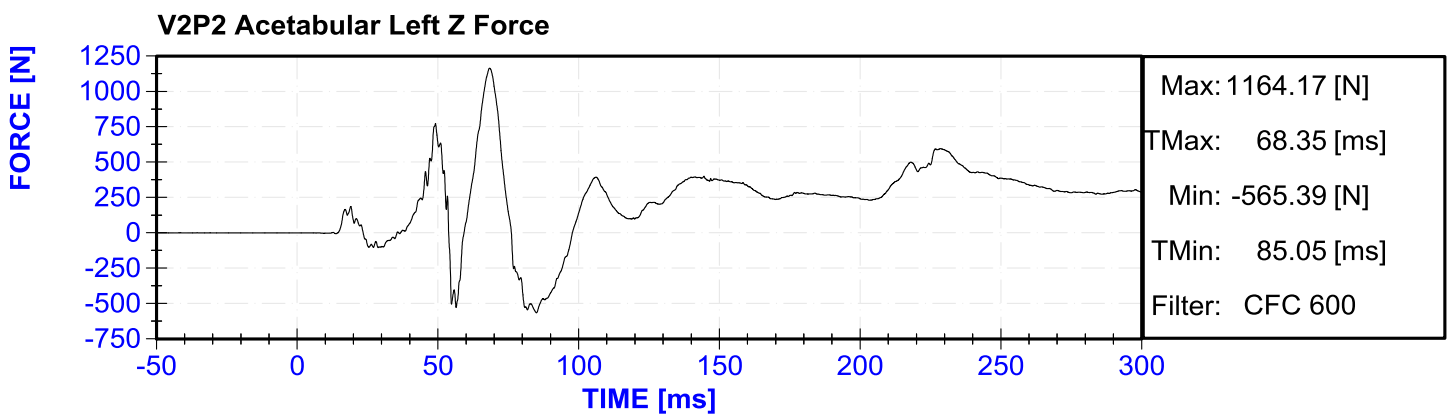
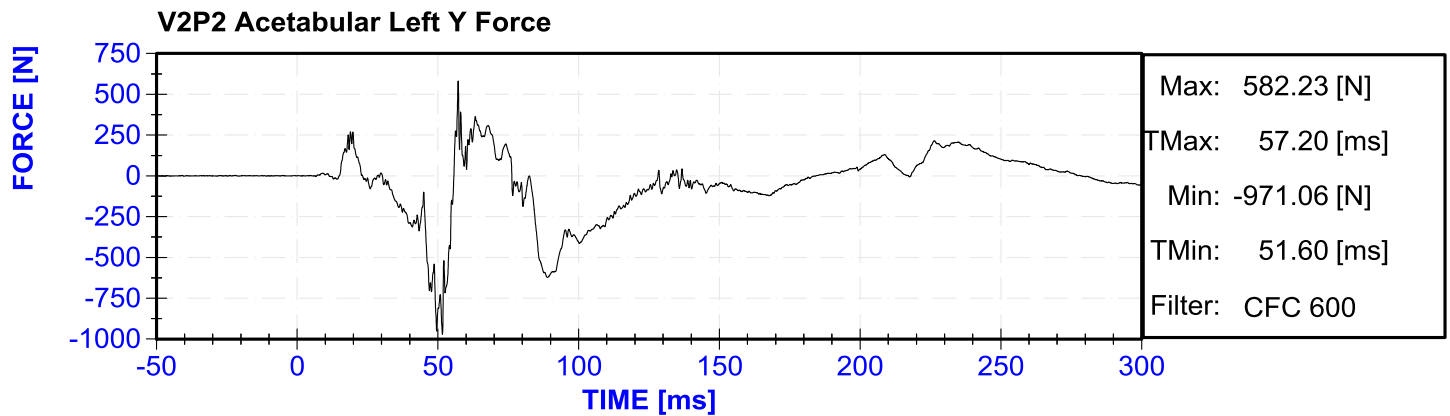
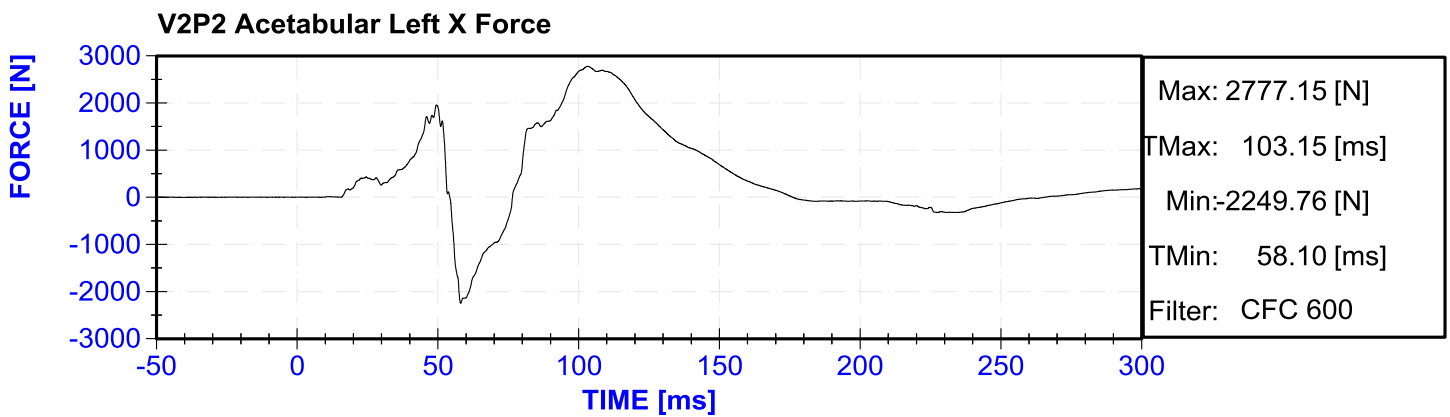
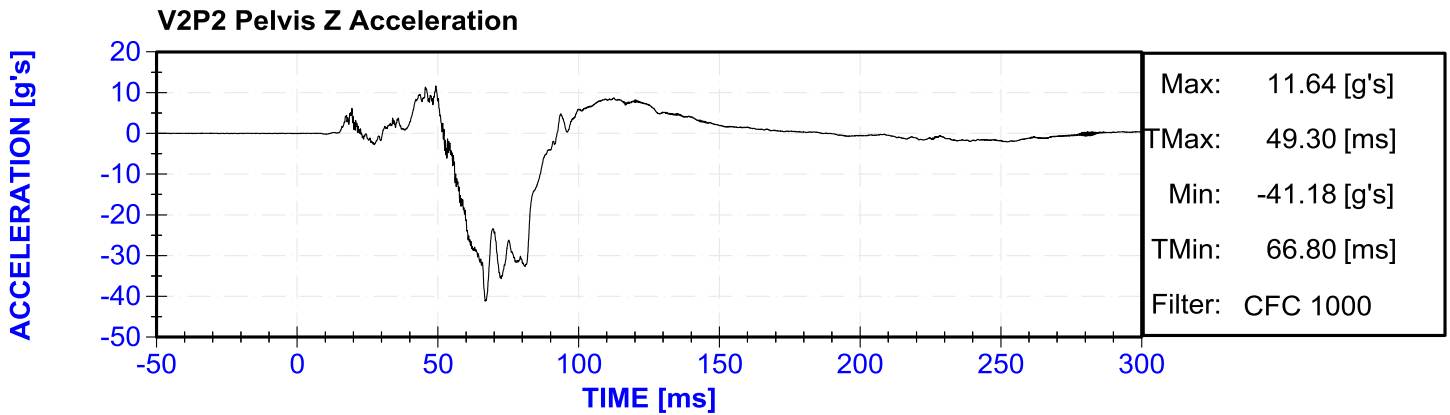
V2P2 Spine Force Y

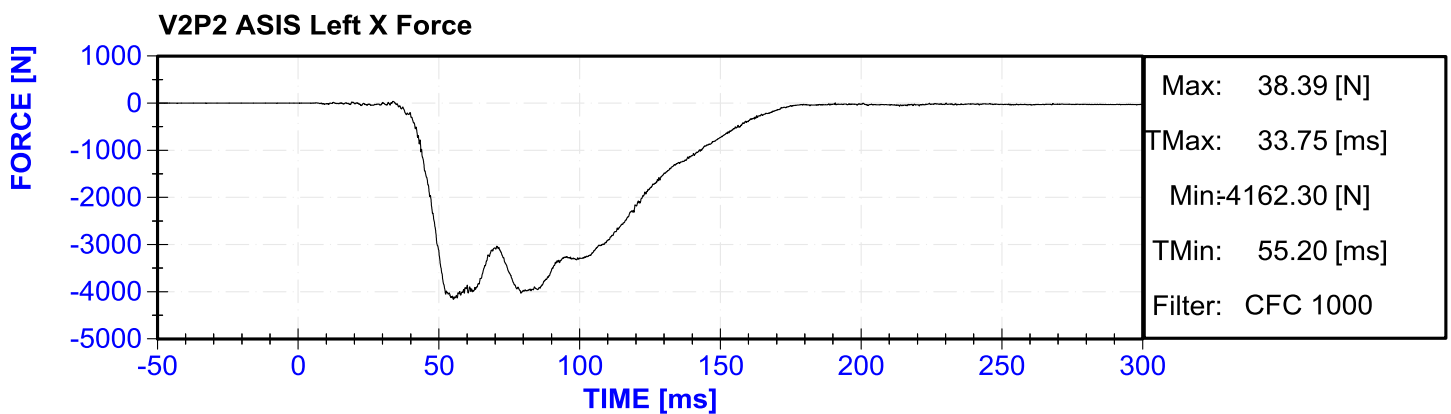
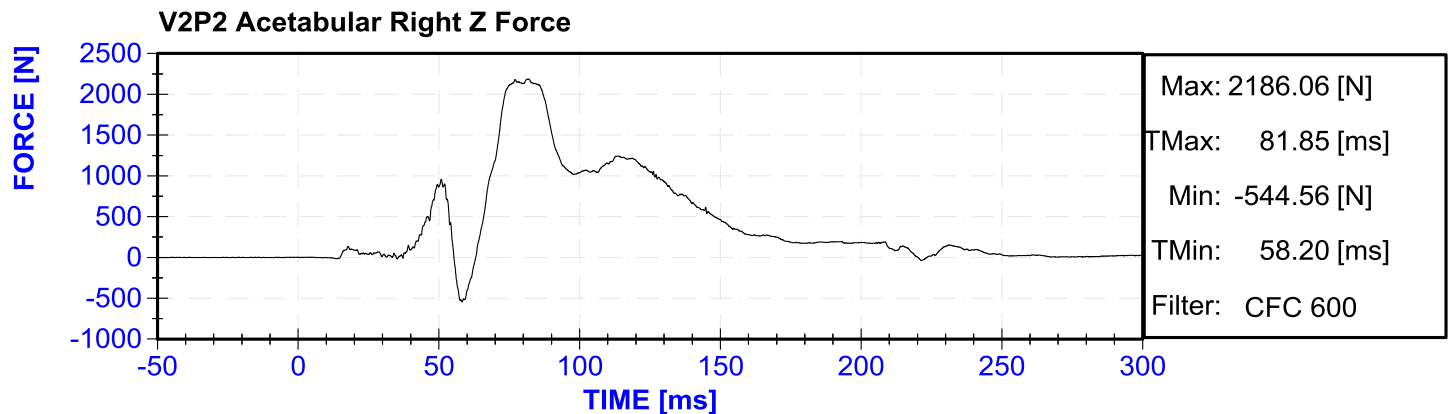
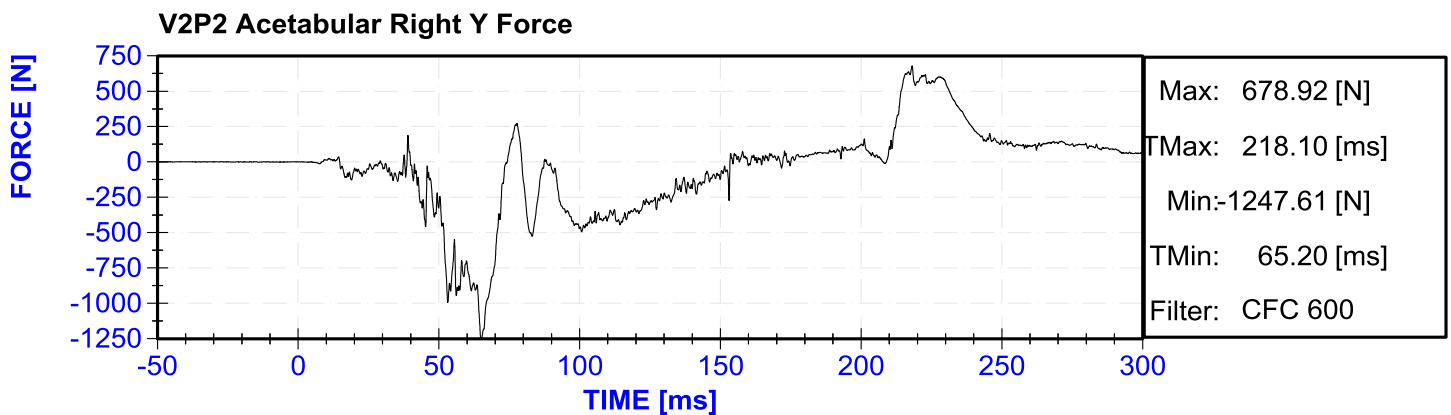
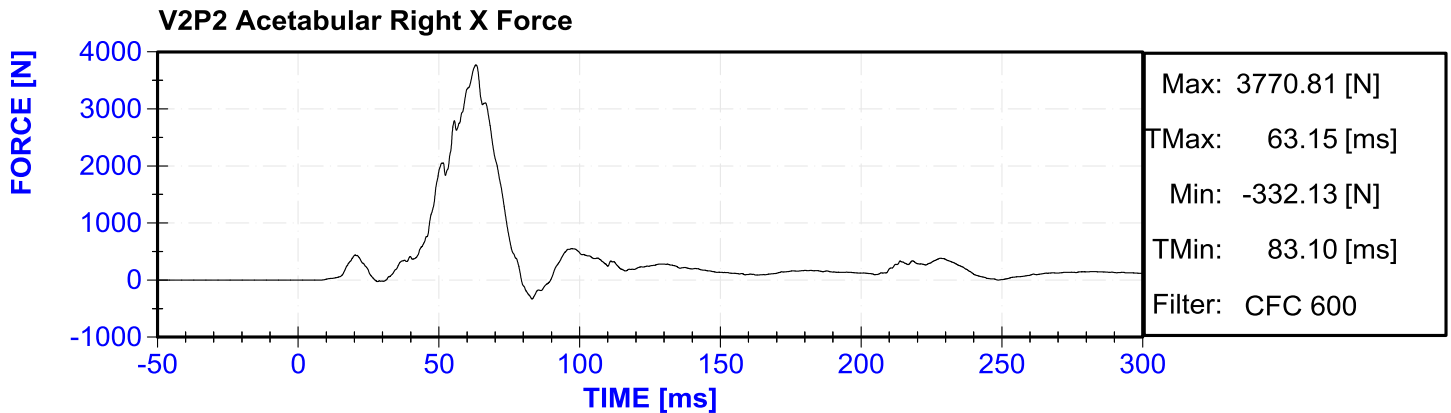


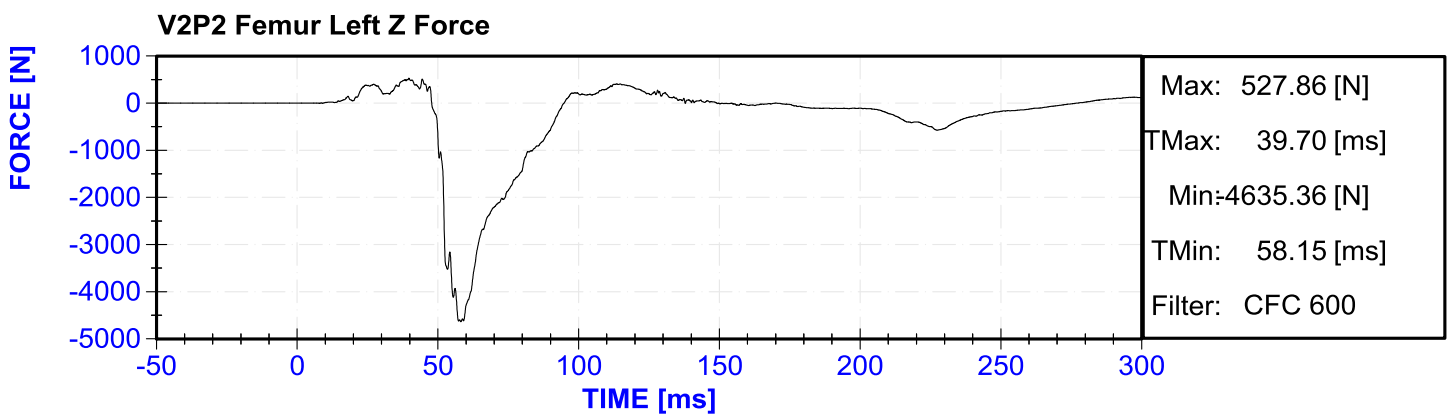
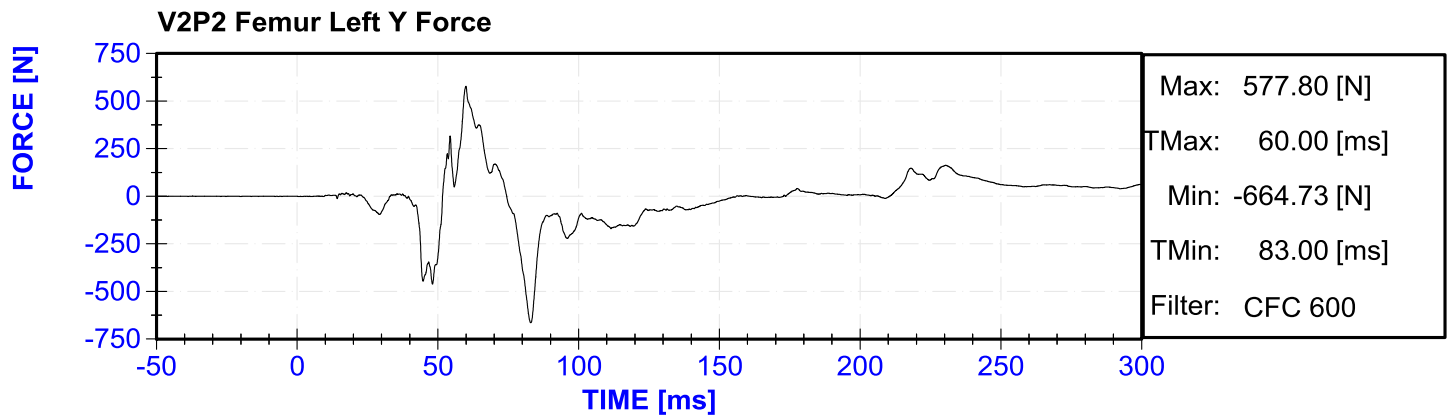
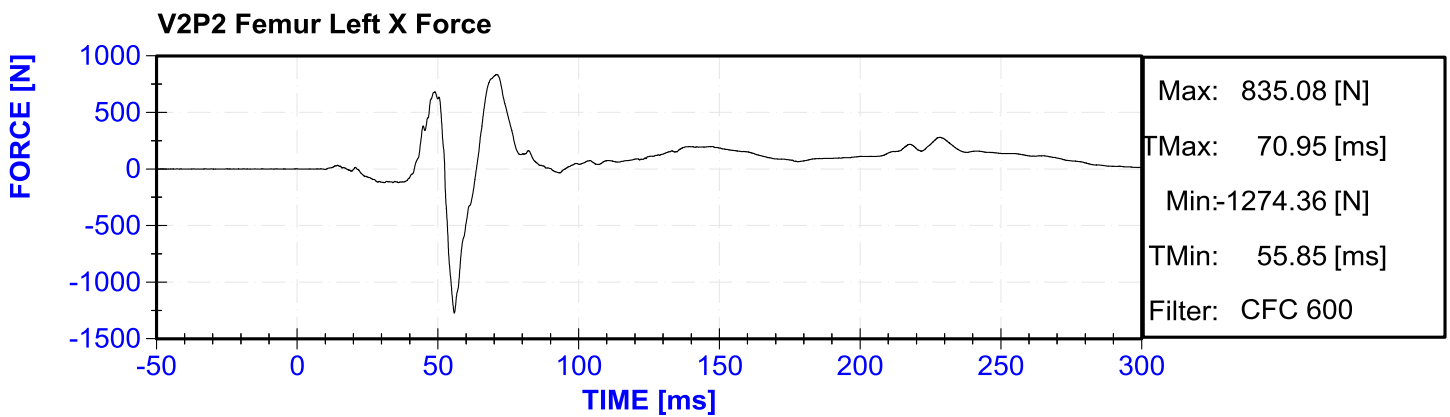
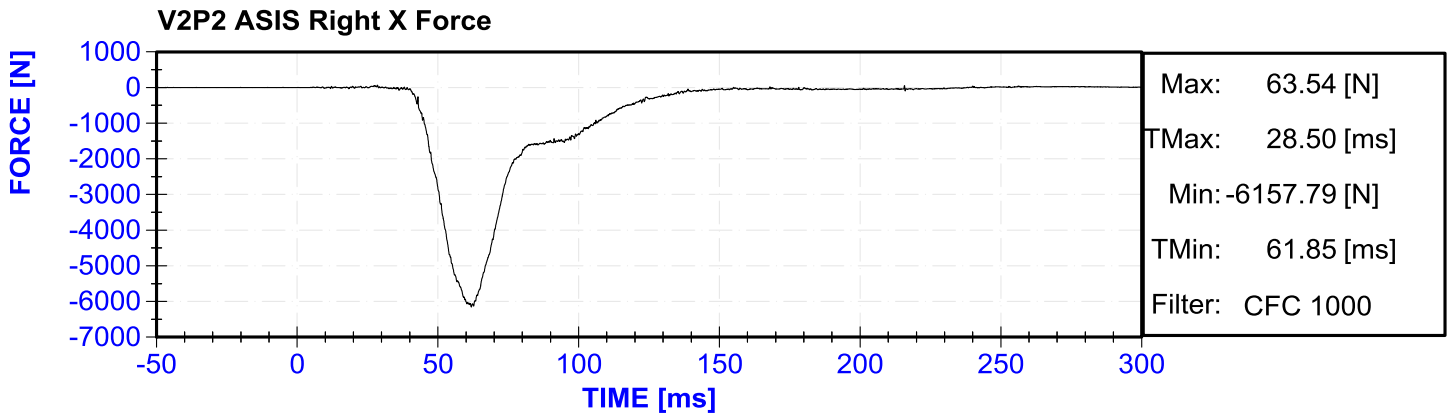
V2P2 Spine Force Z

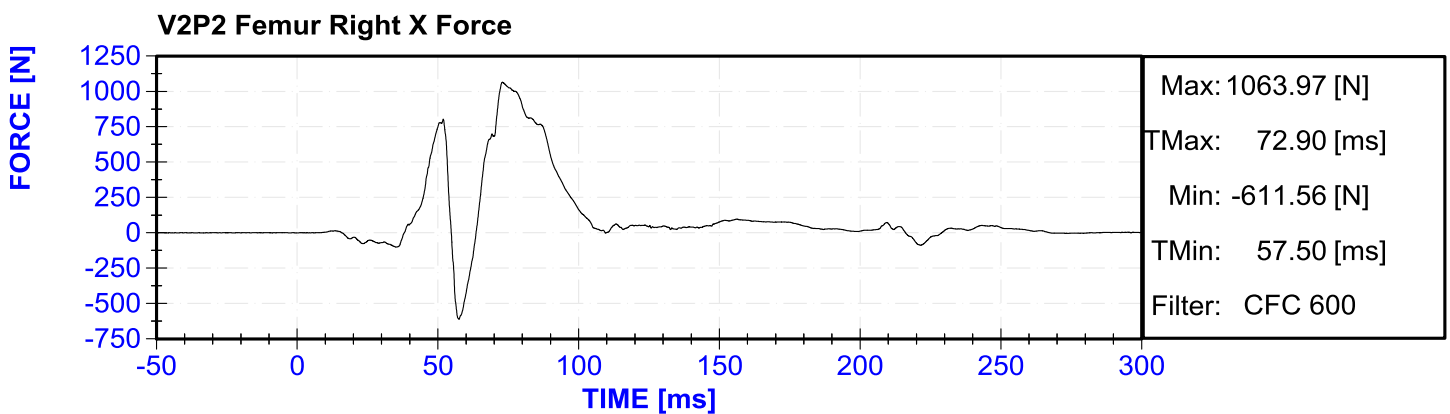
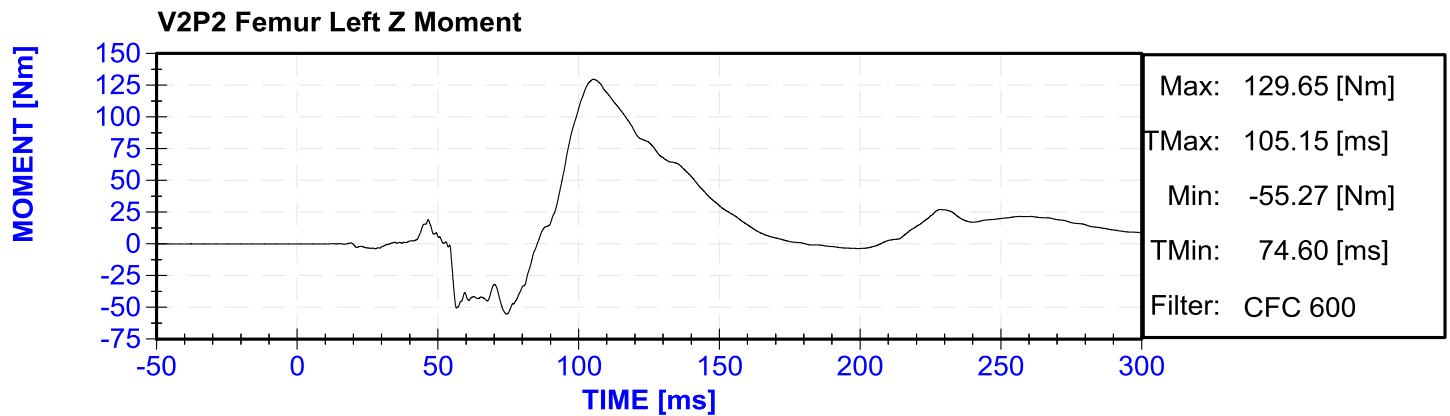
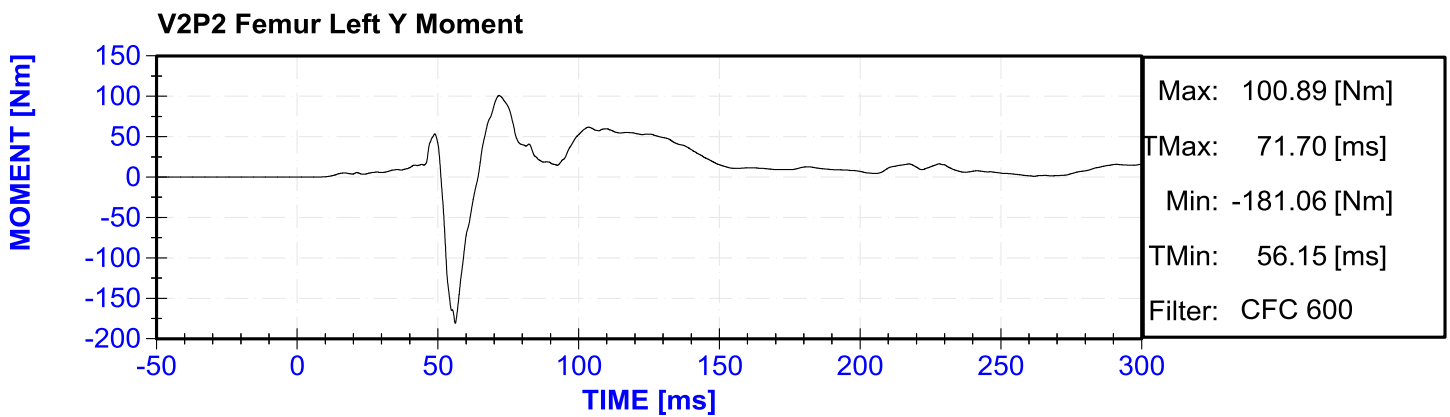
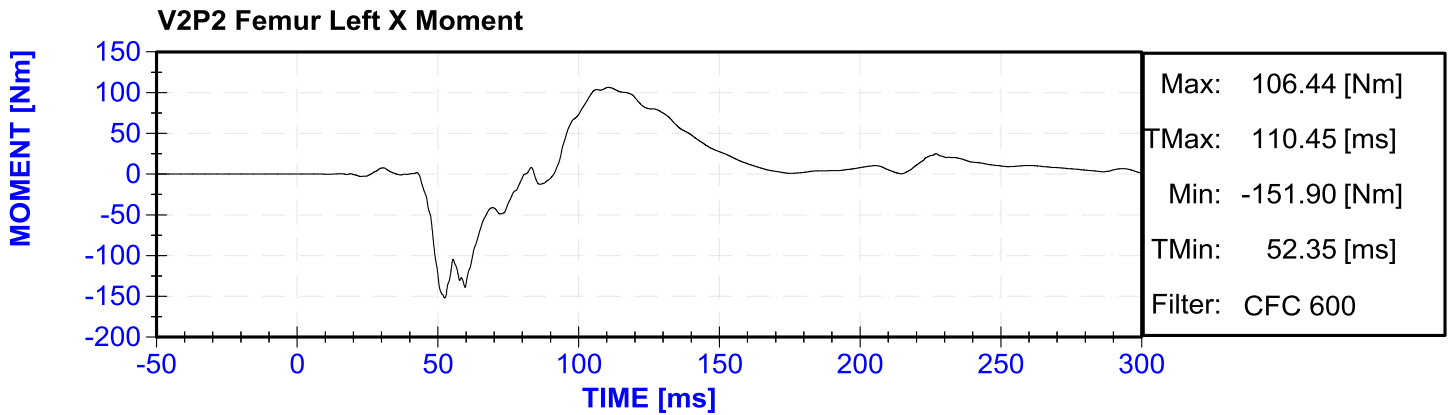


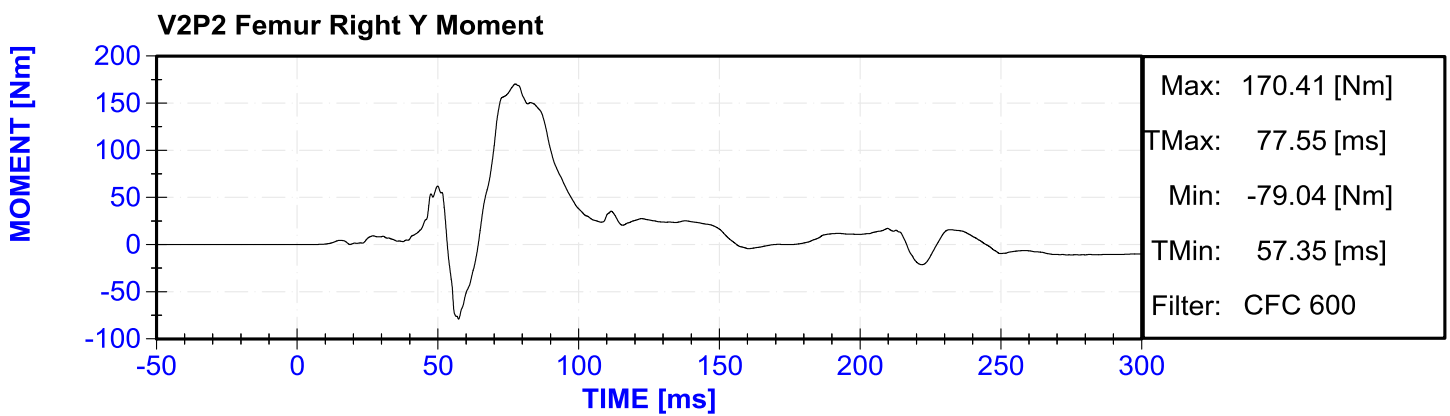
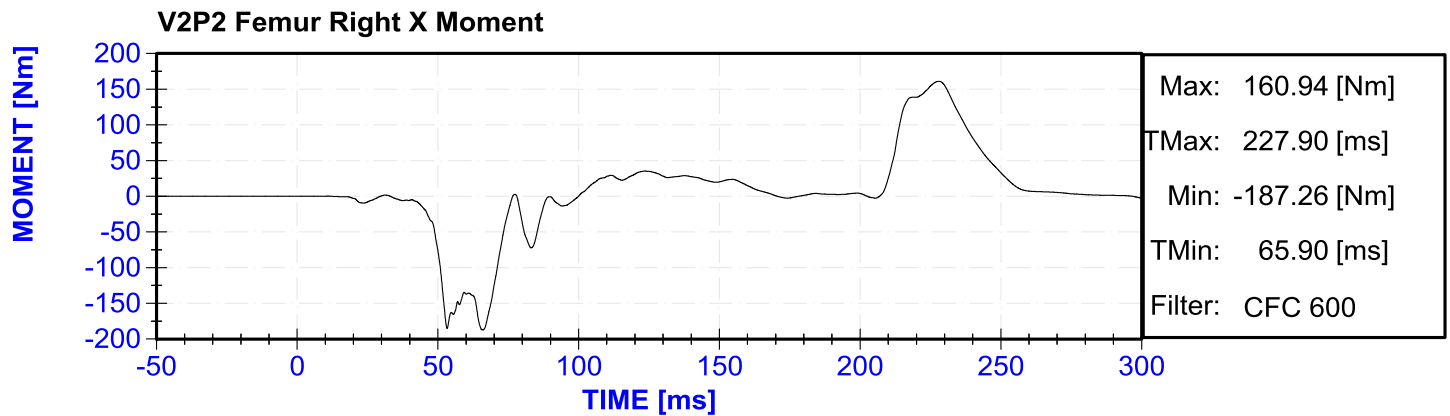
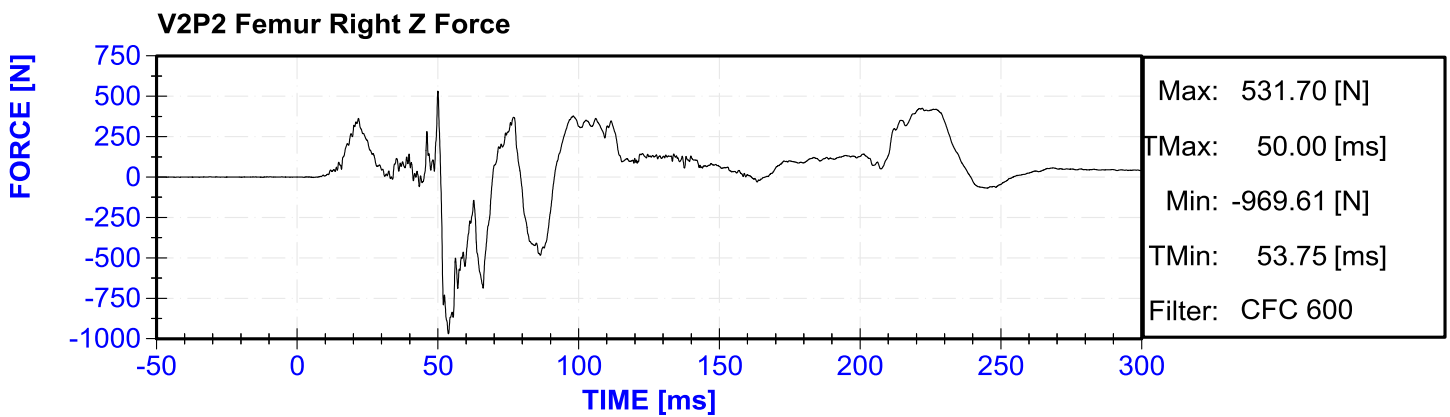
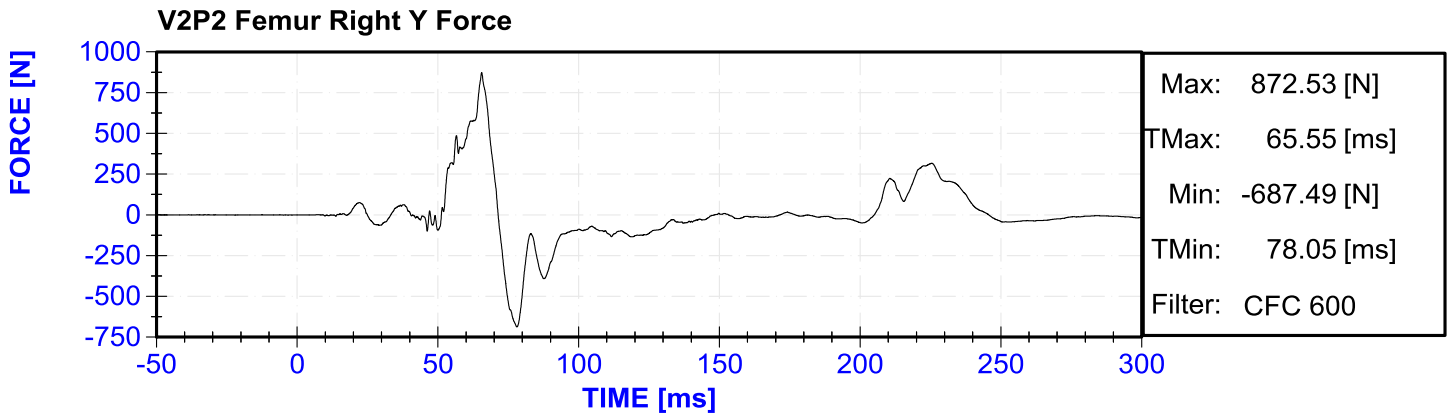




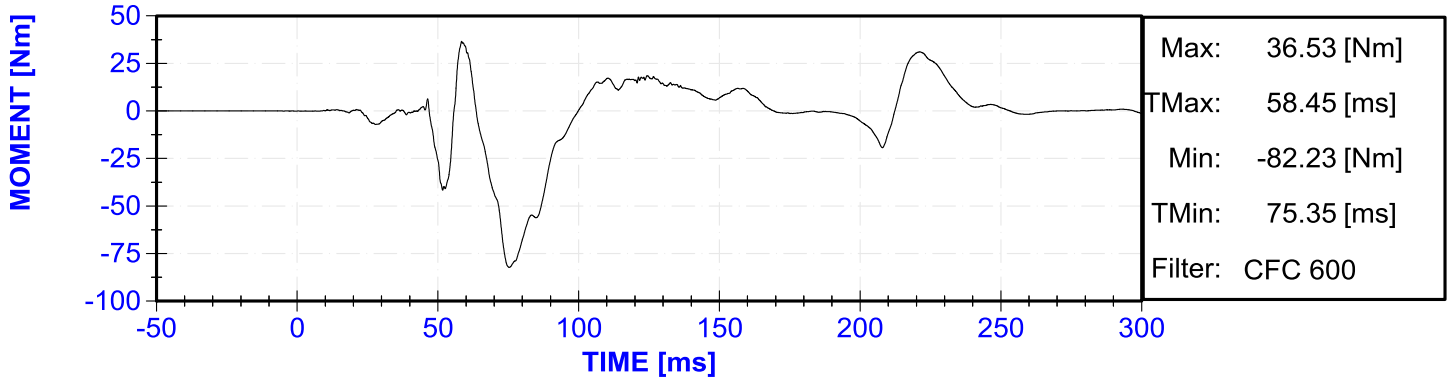




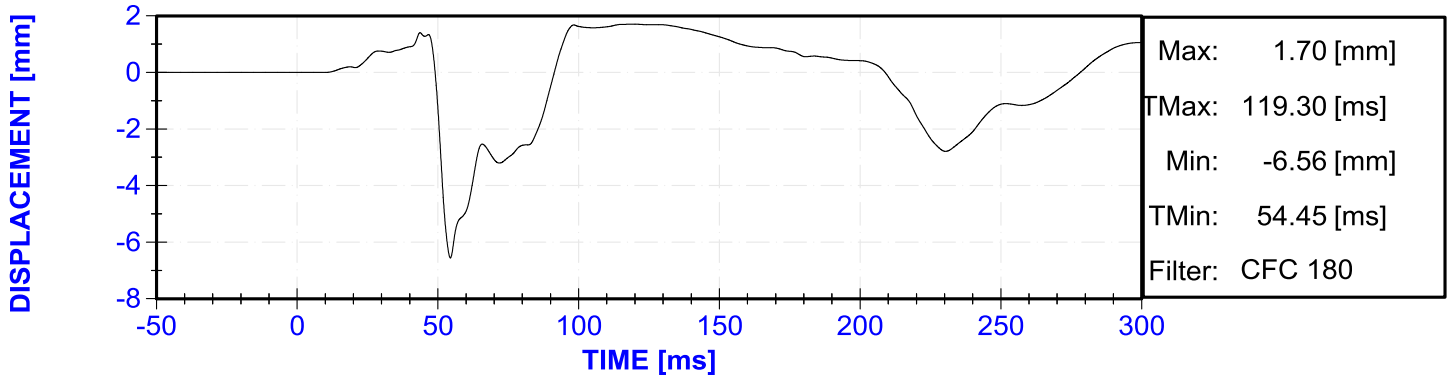




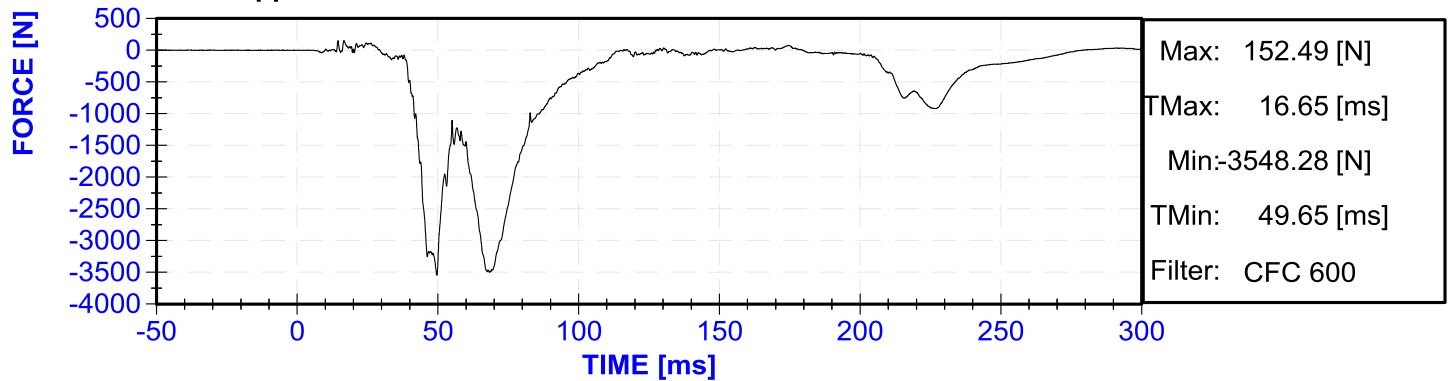
V2P2 Femur Right Z Moment



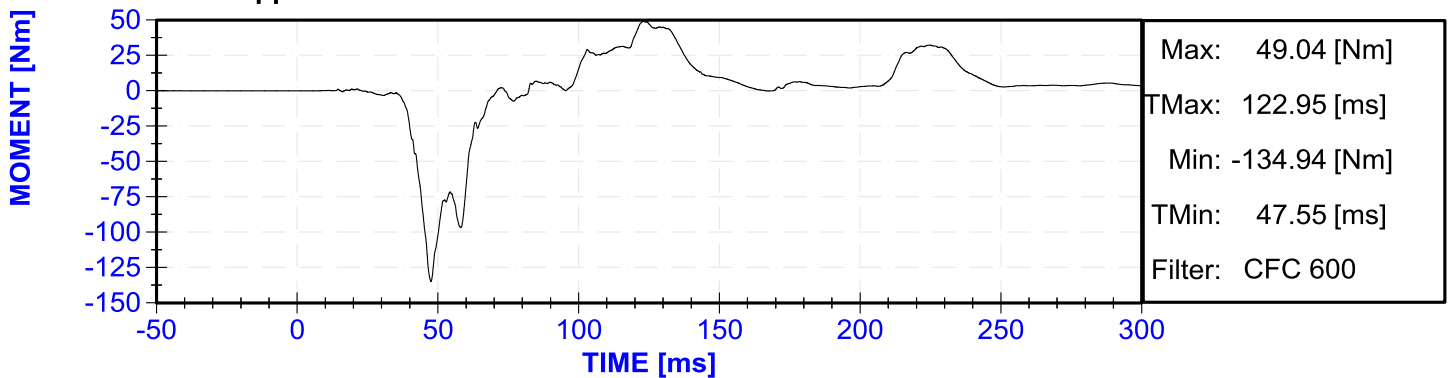
V2P2 Knee Left X Displacement



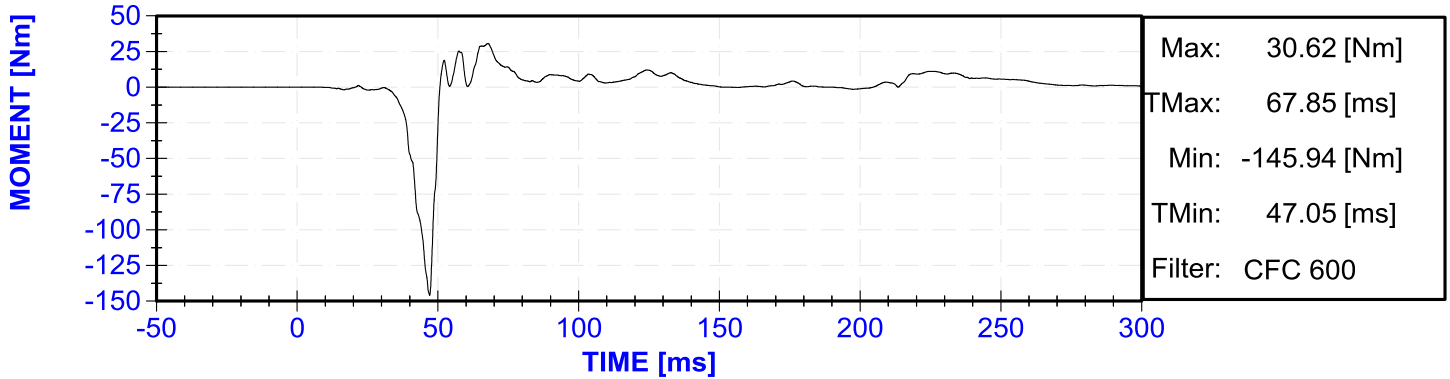
V2P2 Upper Tibia Left Z Force



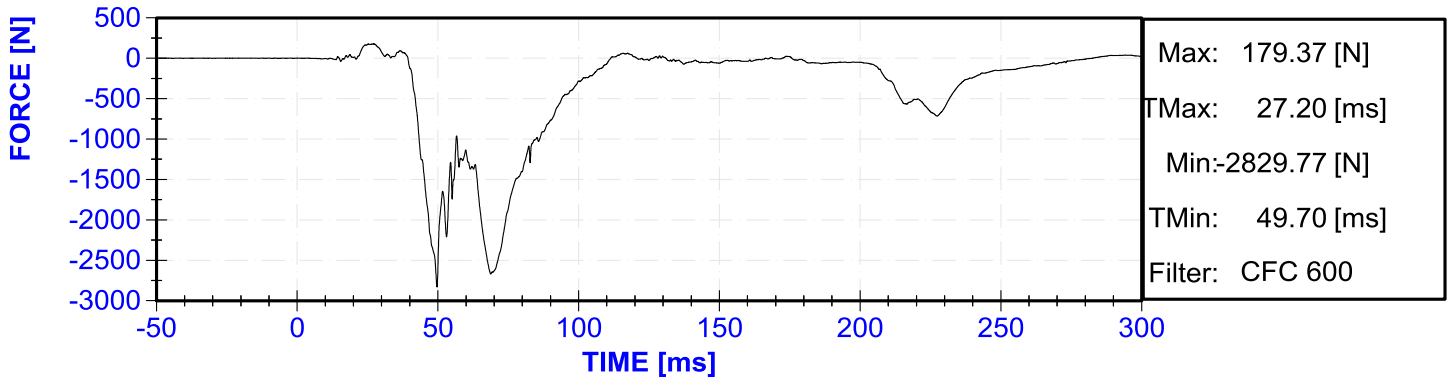
V2P2 Upper Tibia Left X Moment



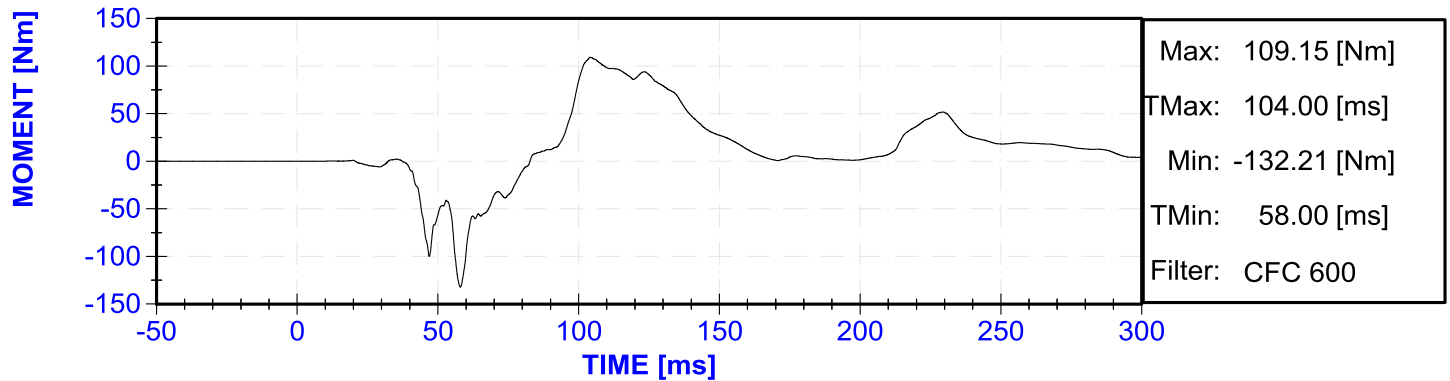
V2P2 Upper Tibia Left Y Moment



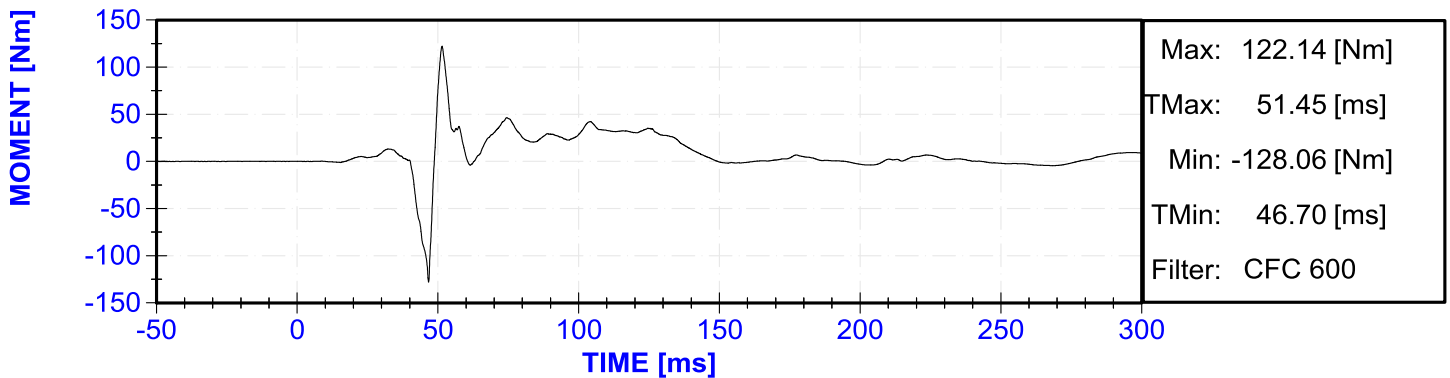
V2P2 Lower Tibia Left Z Force

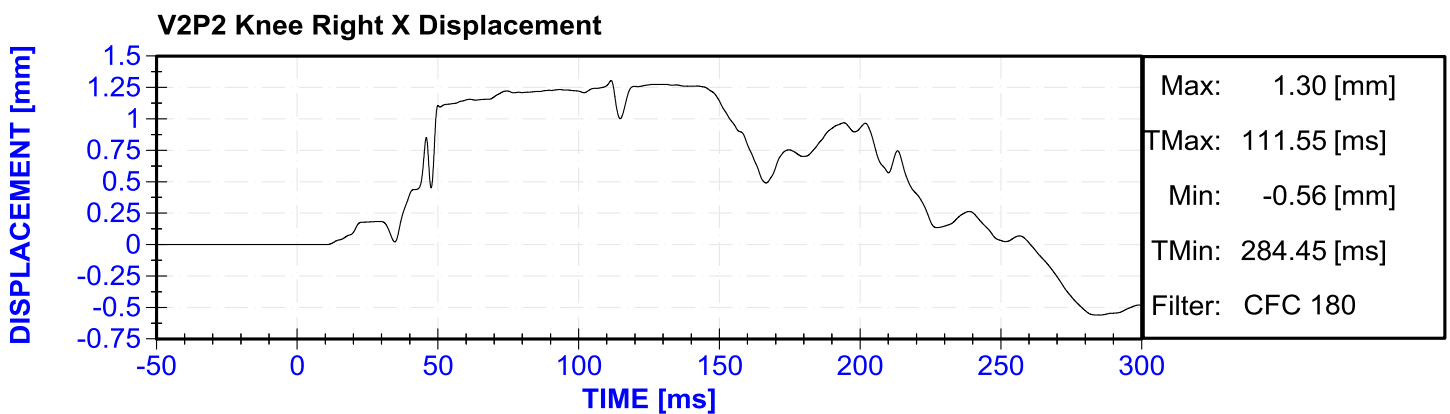
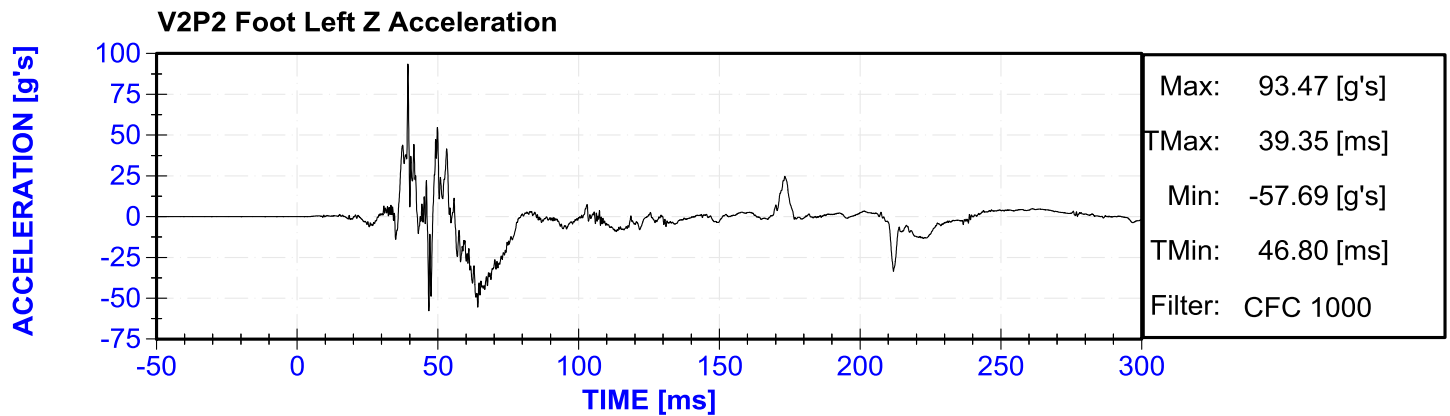
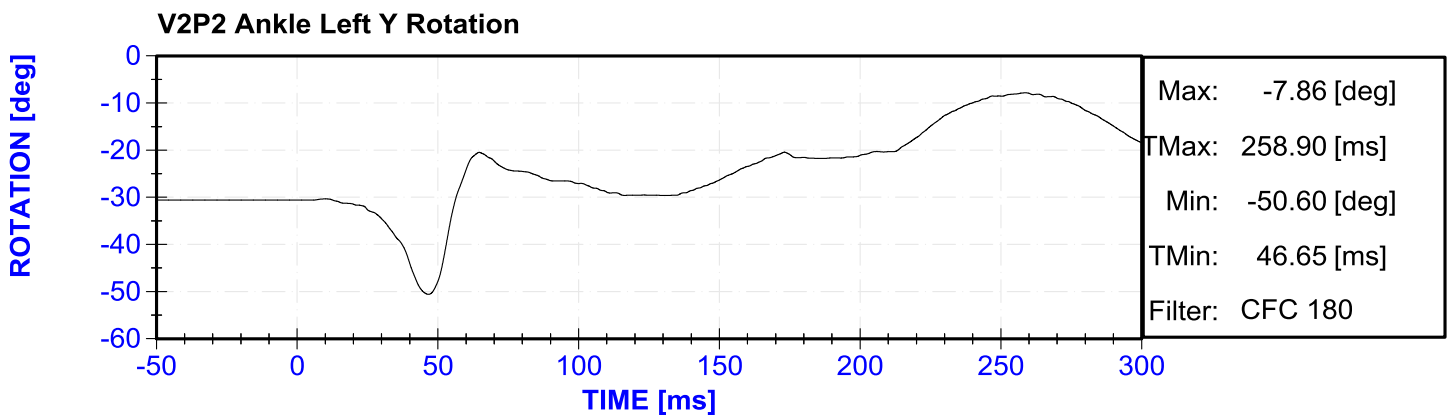
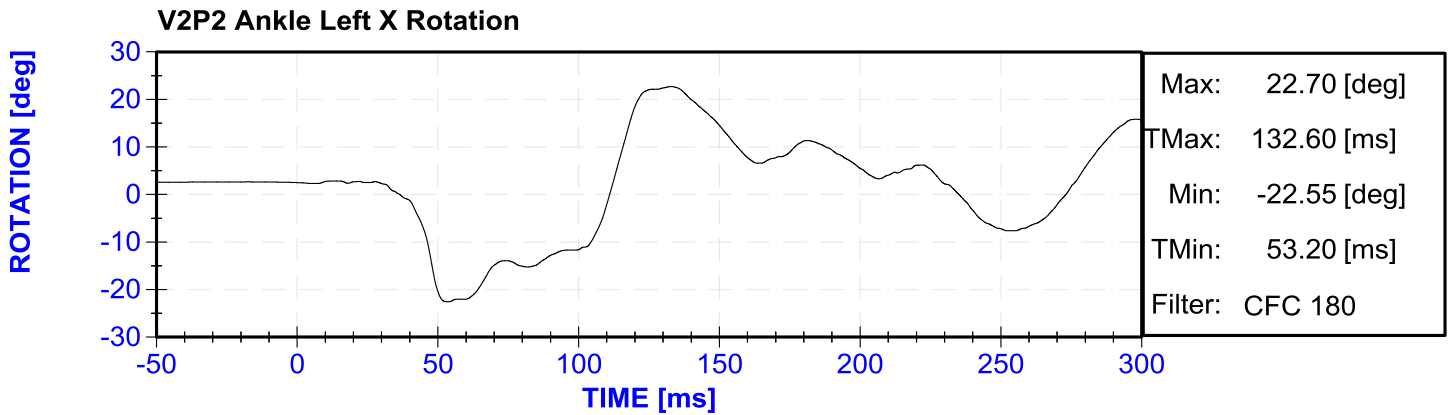


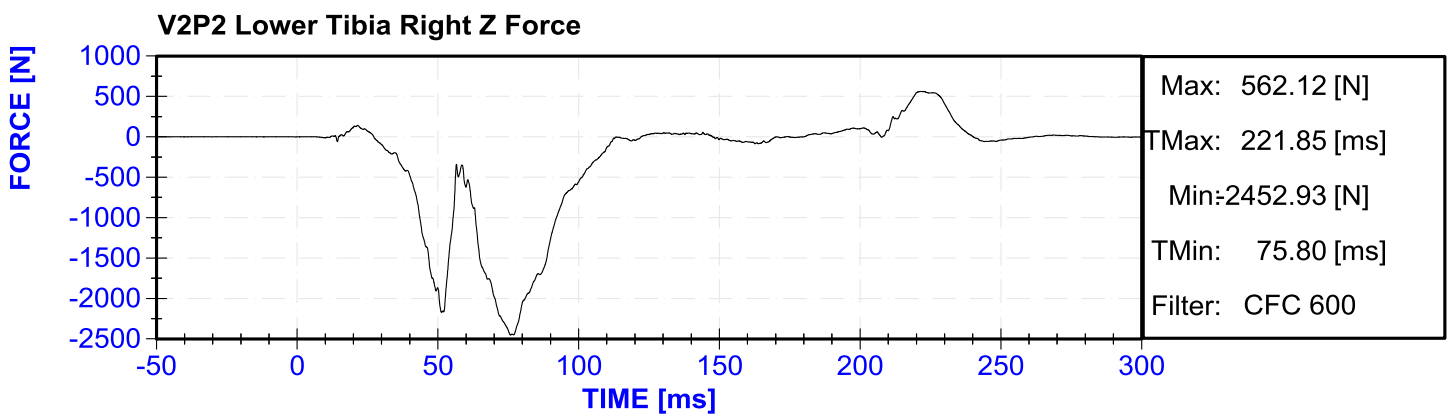
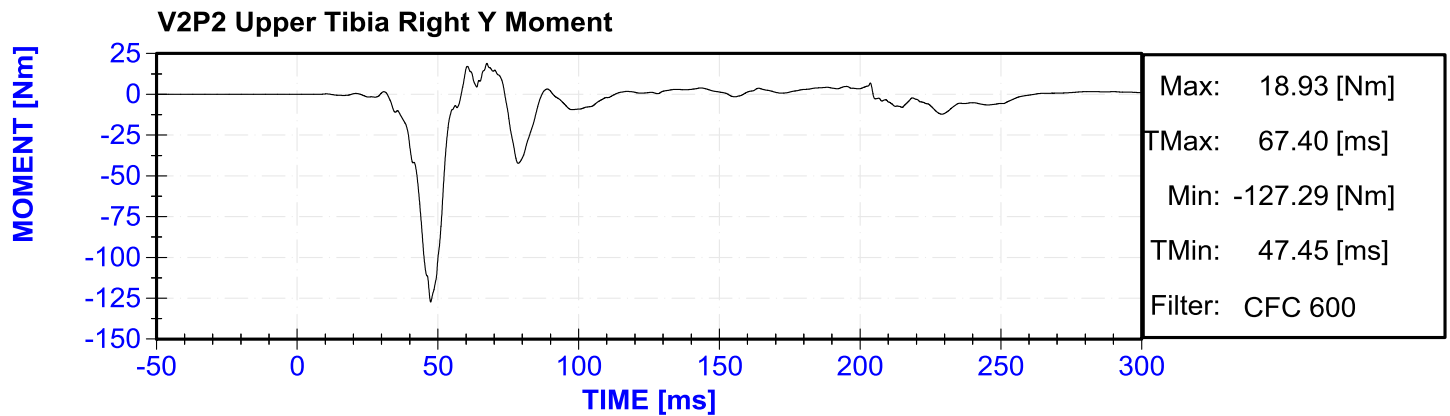
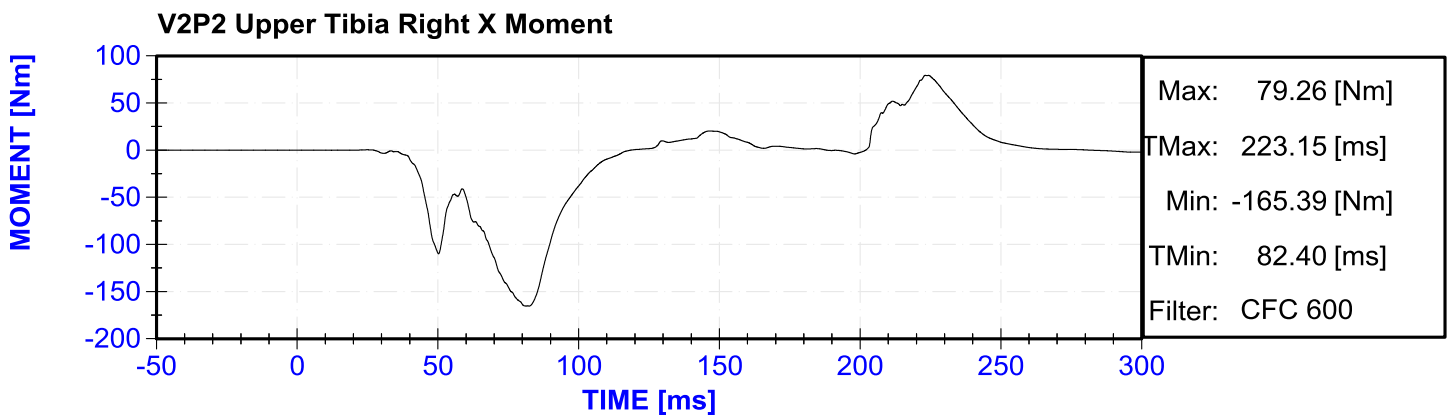
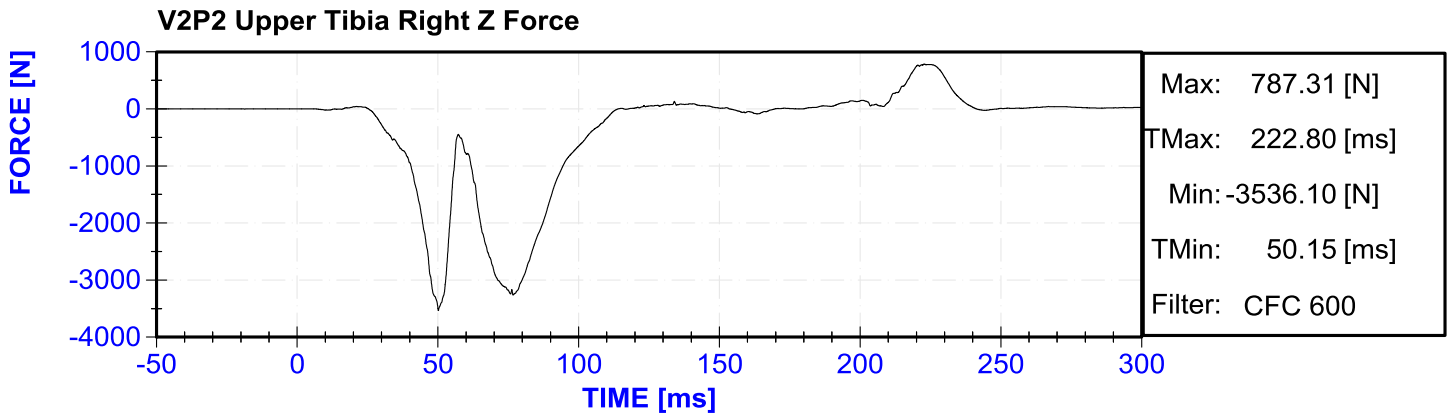
V2P2 Lower Tibia Left X Moment

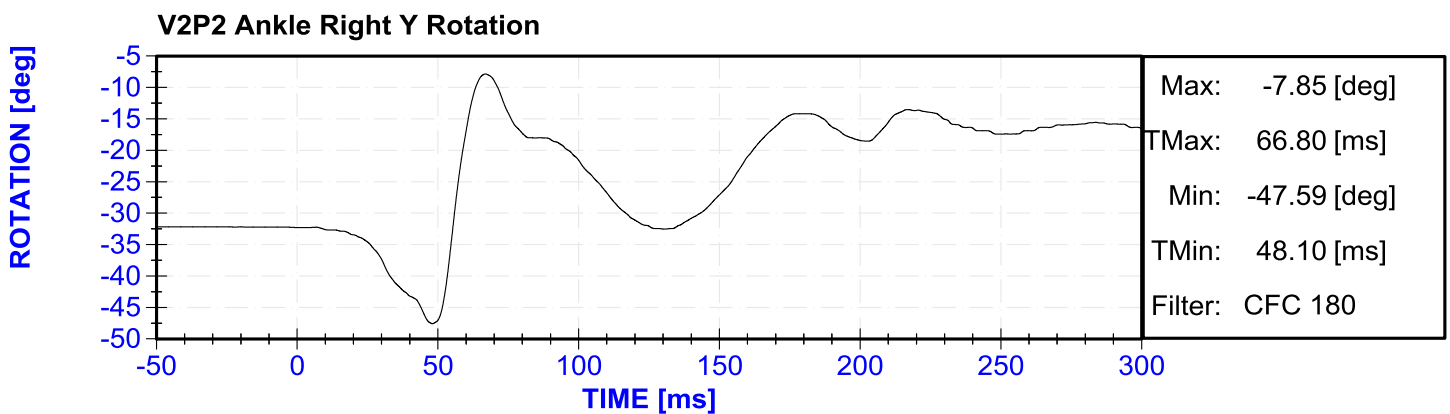
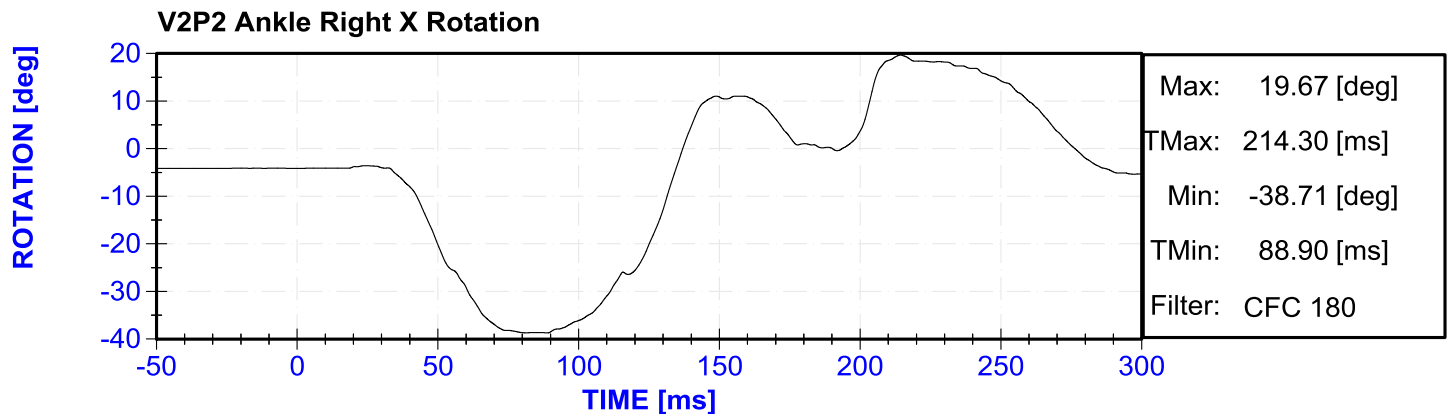
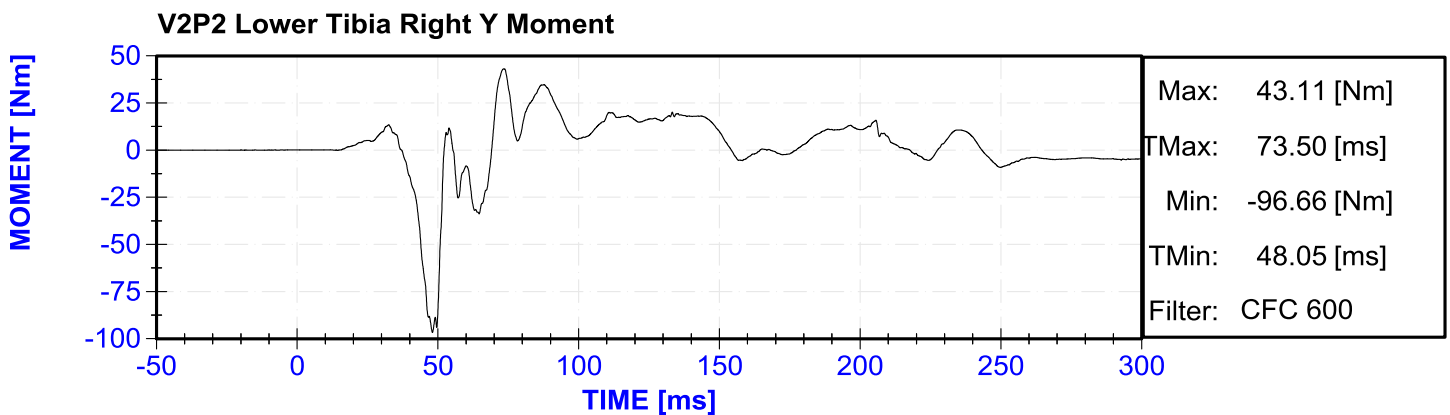
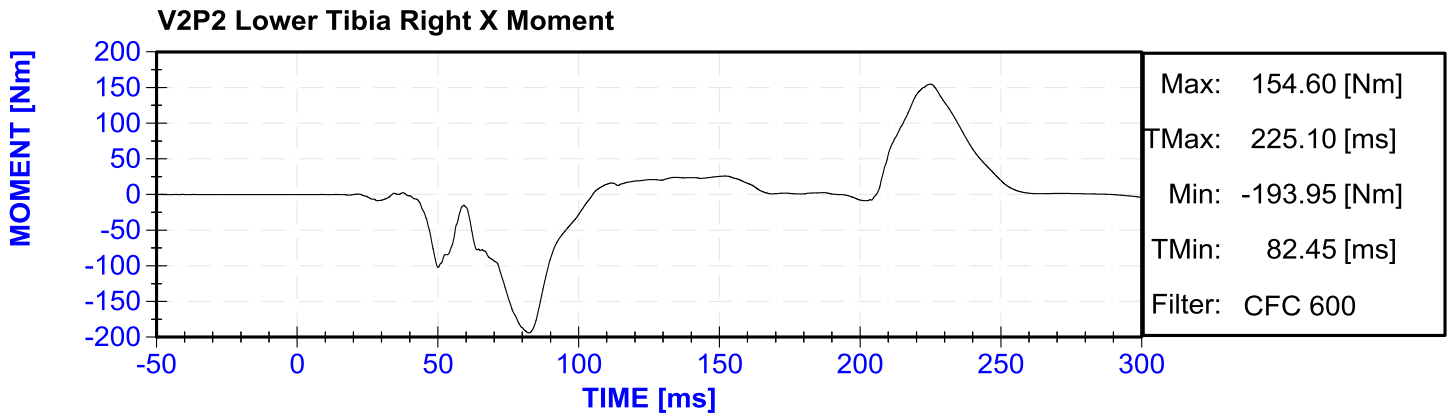


V2P2 Lower Tibia Left Y Moment

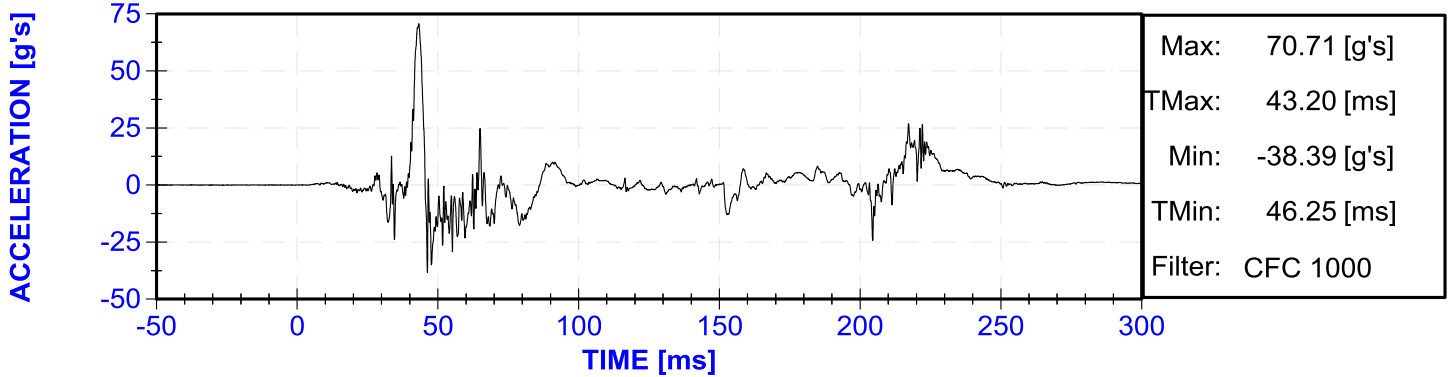




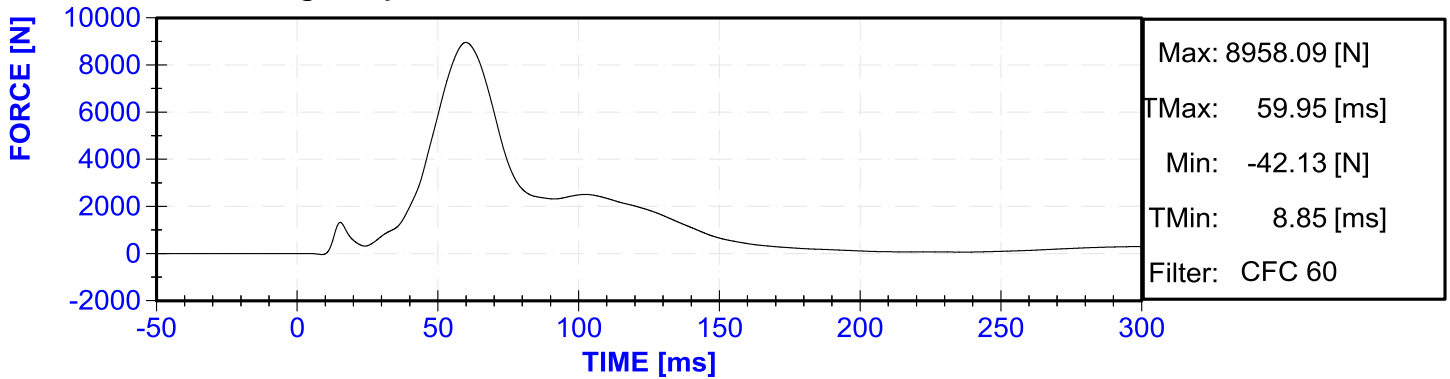




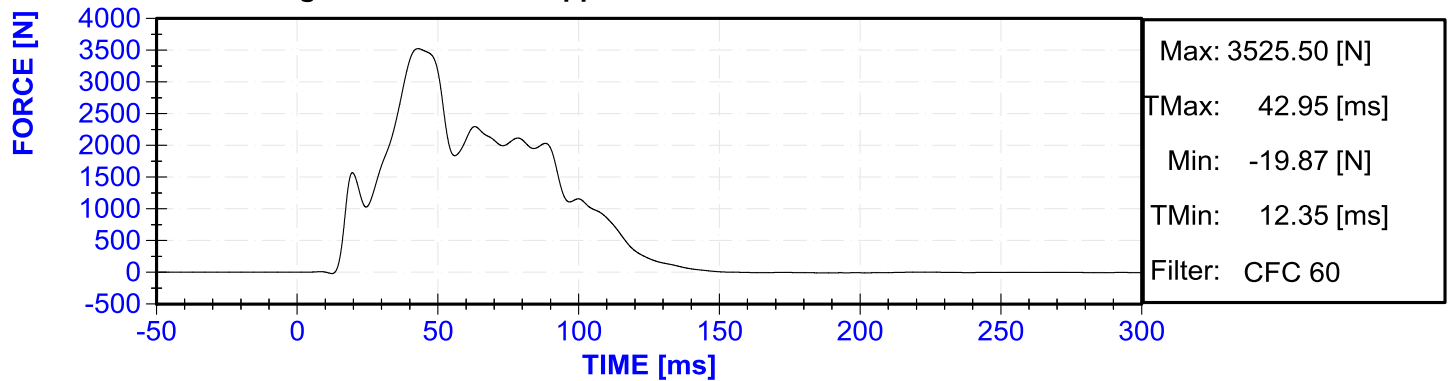
V2P2 Foot Right Z Acceleration



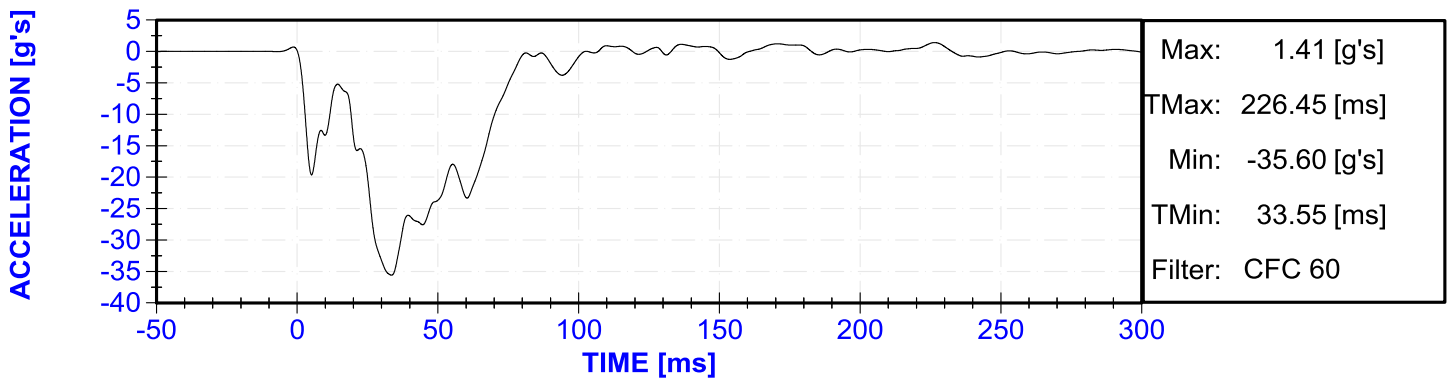
V2 Passenger Lap Belt Force



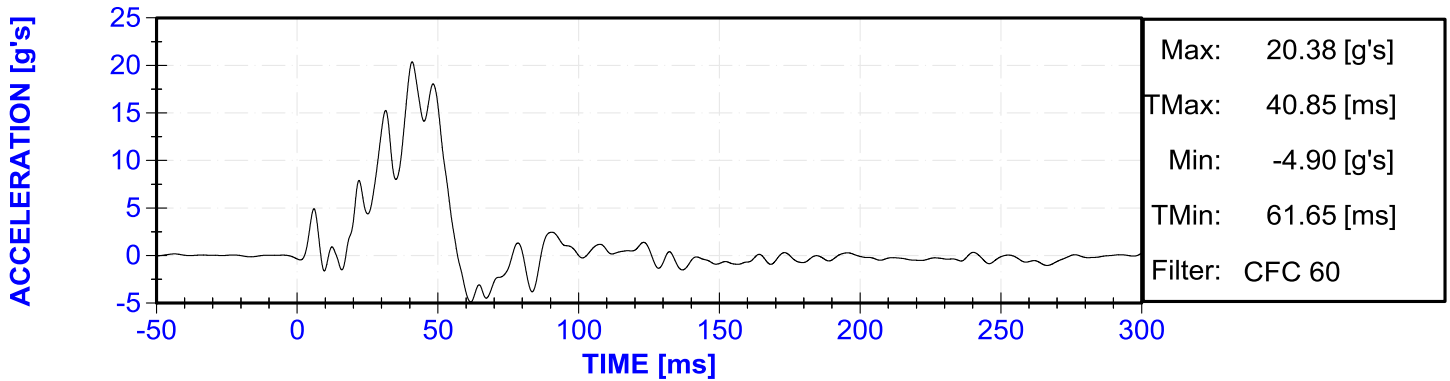
V2 Passenger Shoulder Belt Upper Force



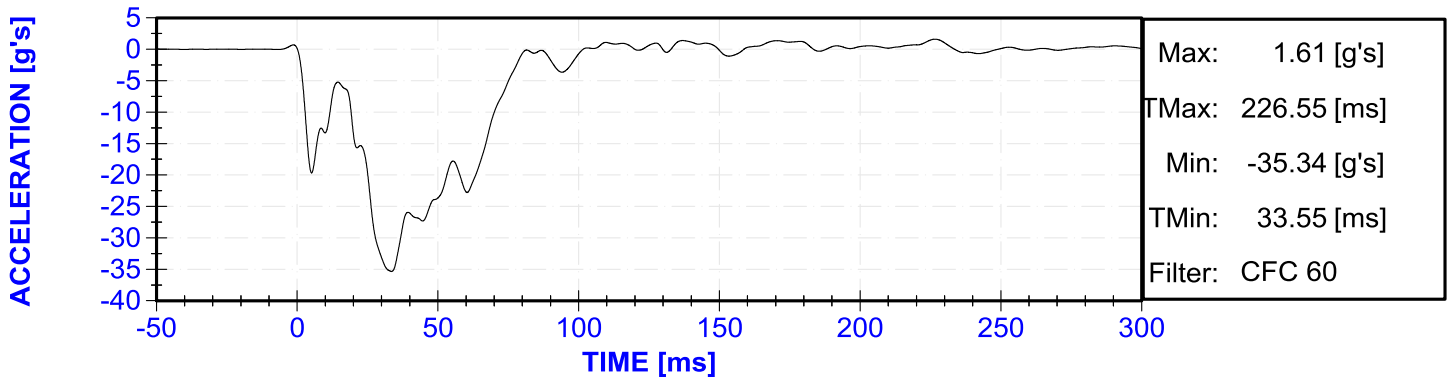
V2 Left Rear Sill X Acceleration



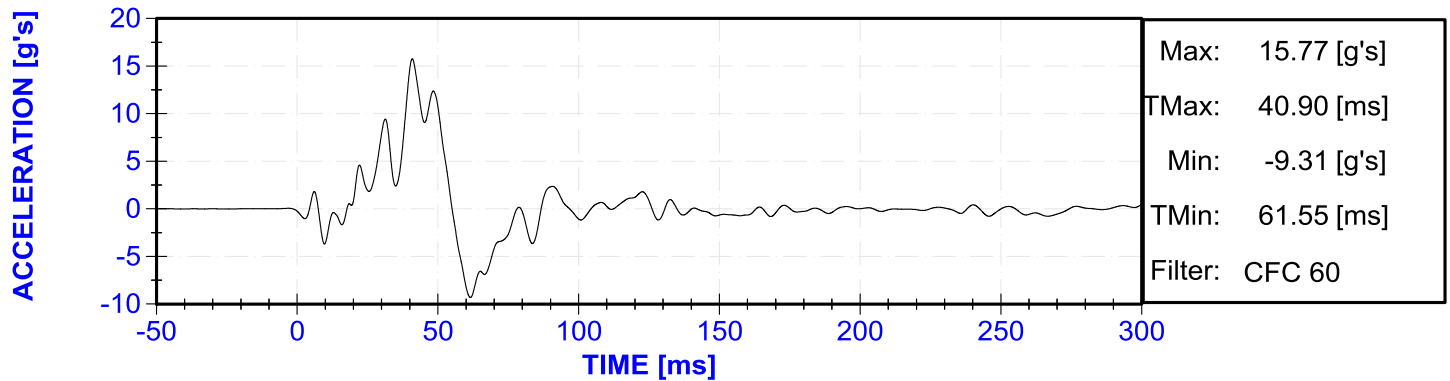
V2 Left Rear Sill Y Acceleration



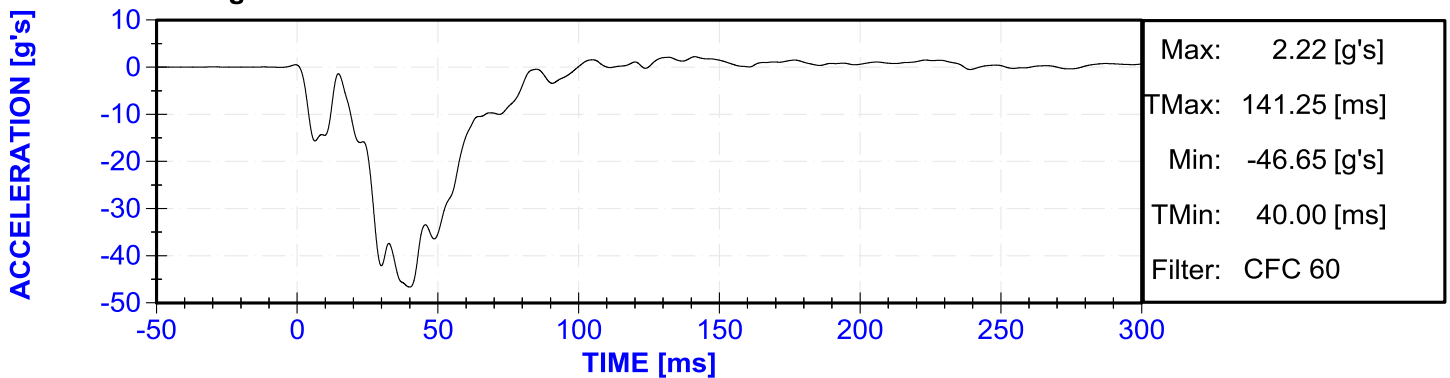
V2 Left Rear Sill Redundant X Acceleration



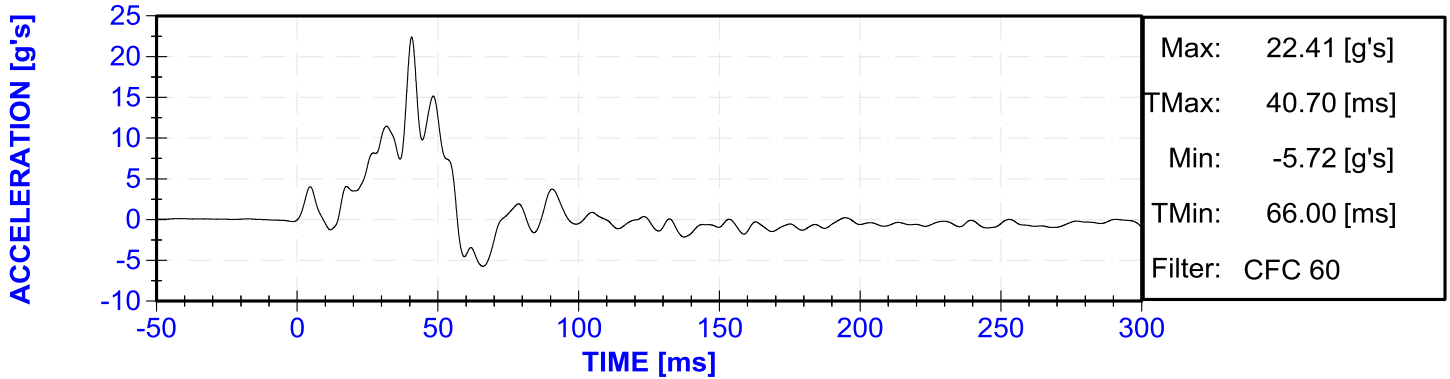
V2 Left Rear Sill Redundant Y Acceleration



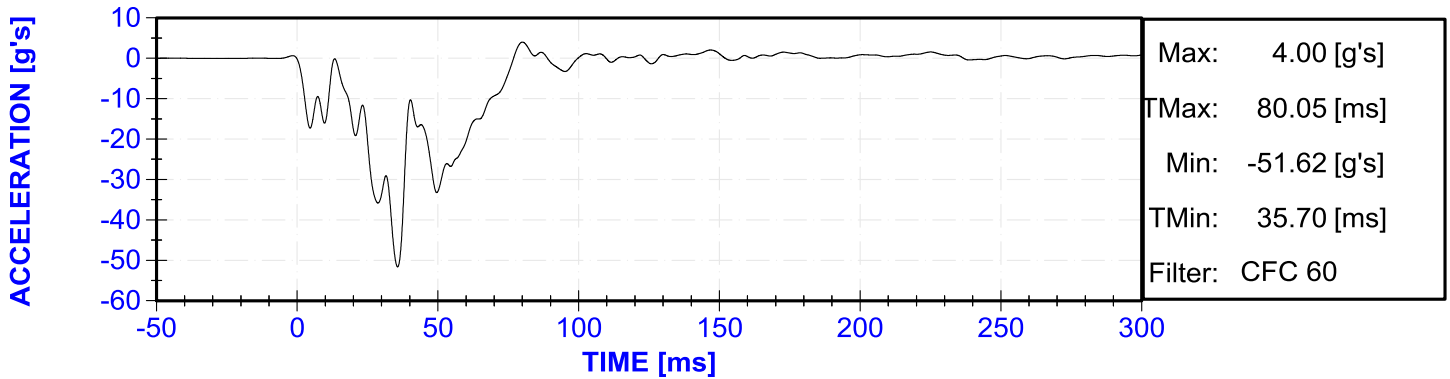
V2 Right Rear Sill X Acceleration



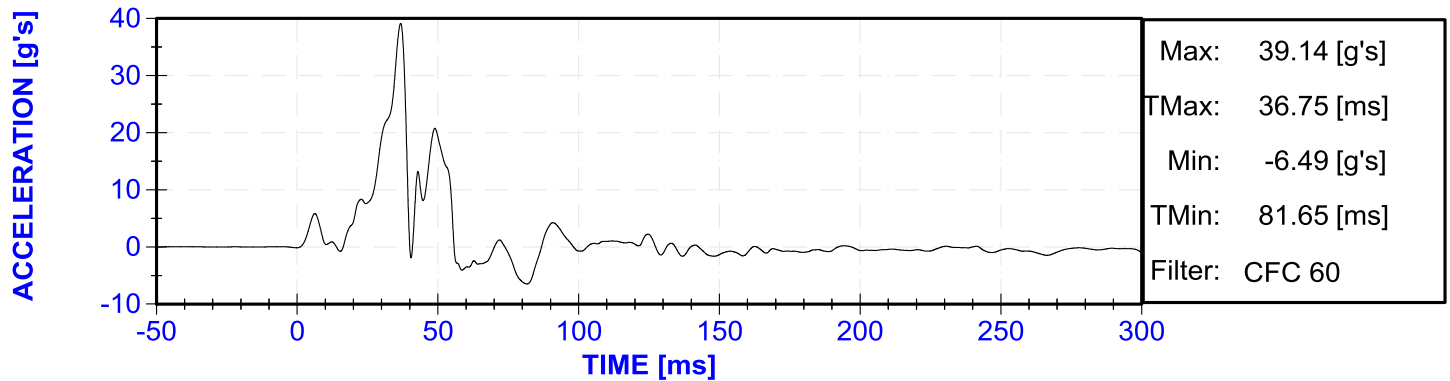
V2 Right Rear Sill Y Acceleration



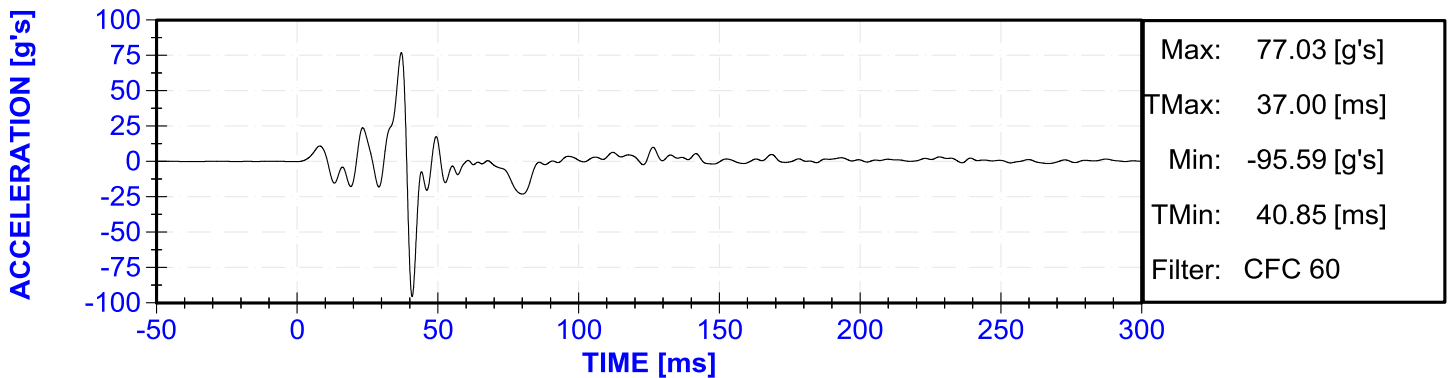
V2 Vehicle CG X Acceleration

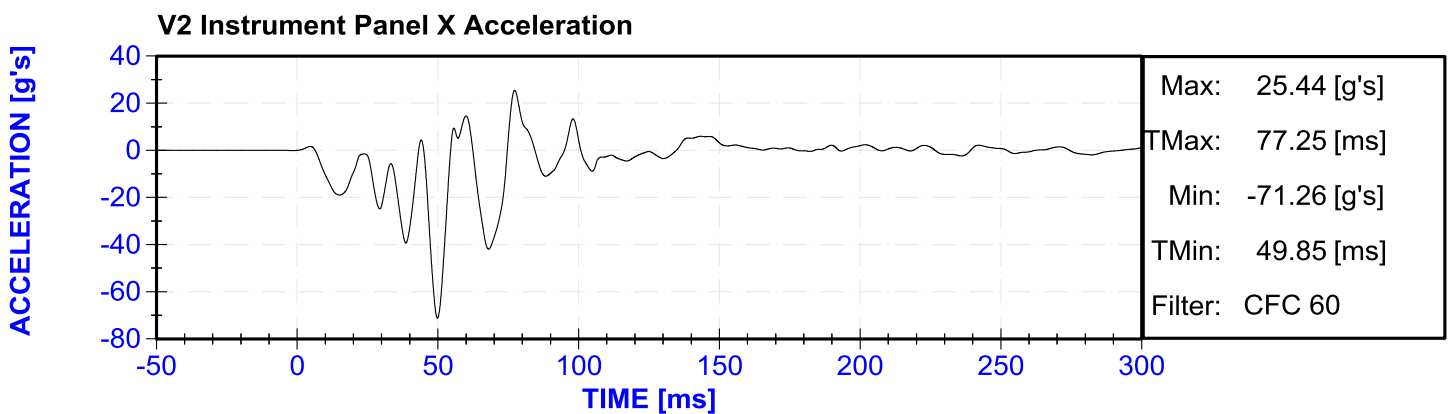
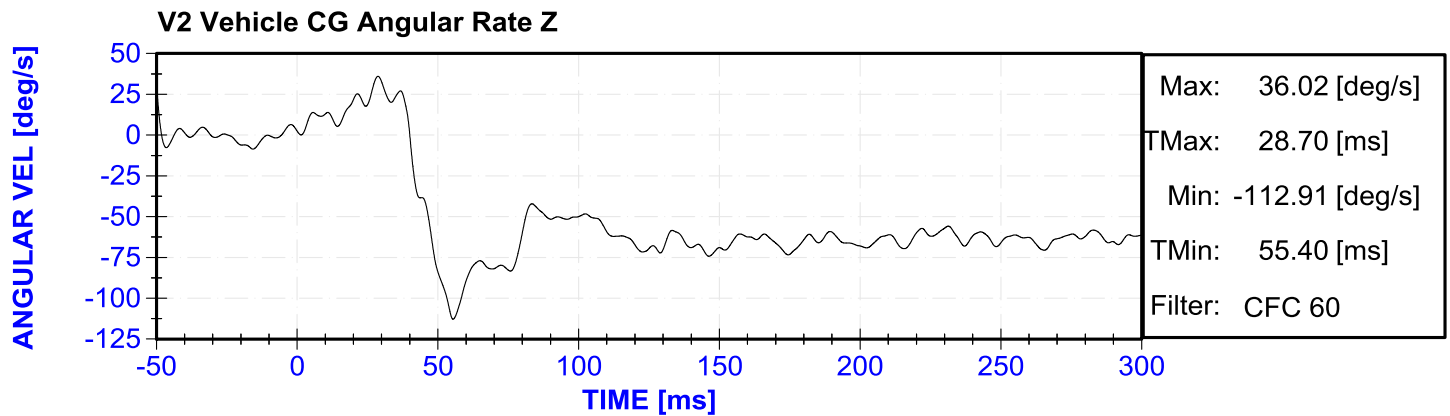
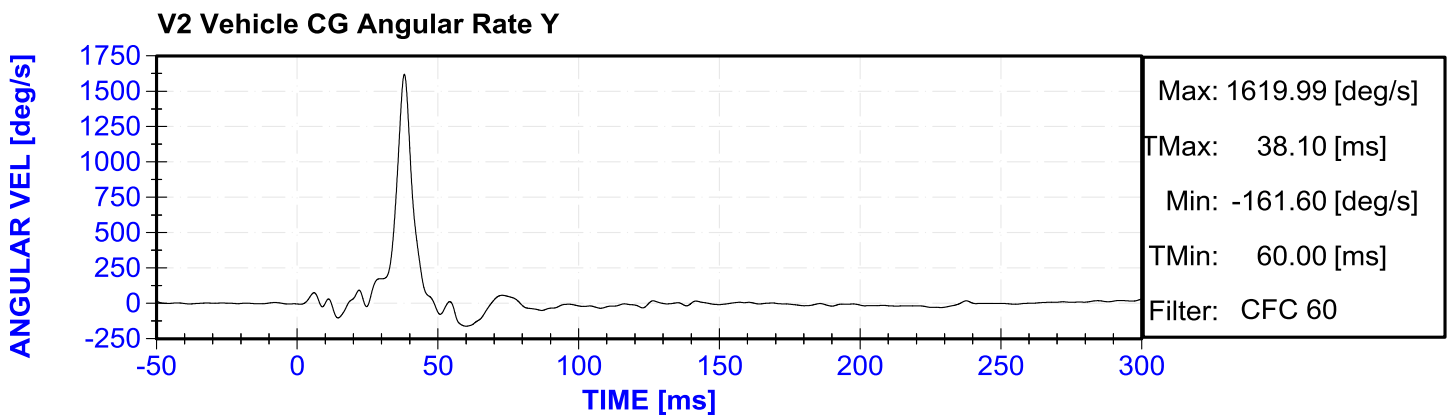
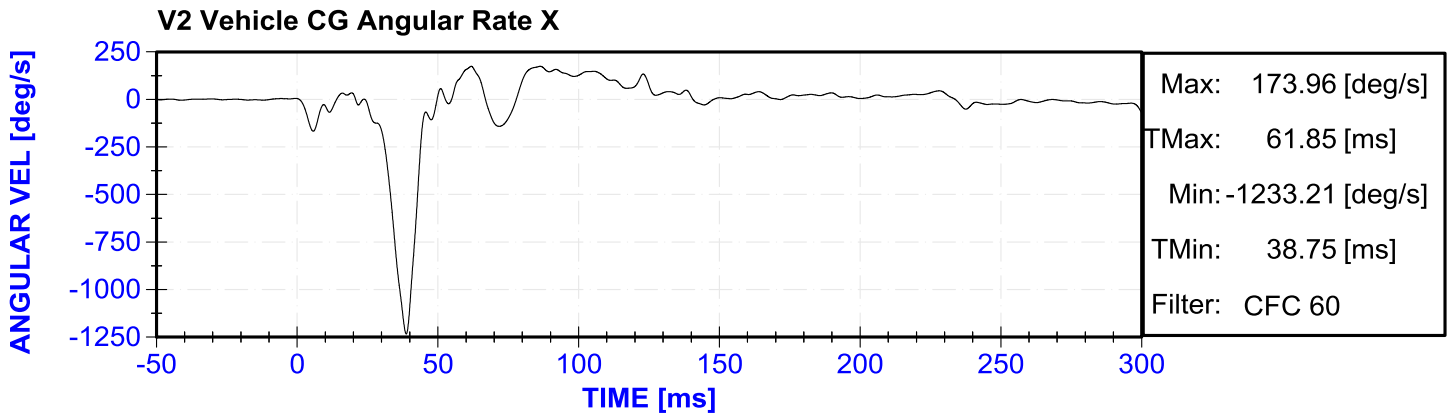


V2 Vehicle CG Y Acceleration

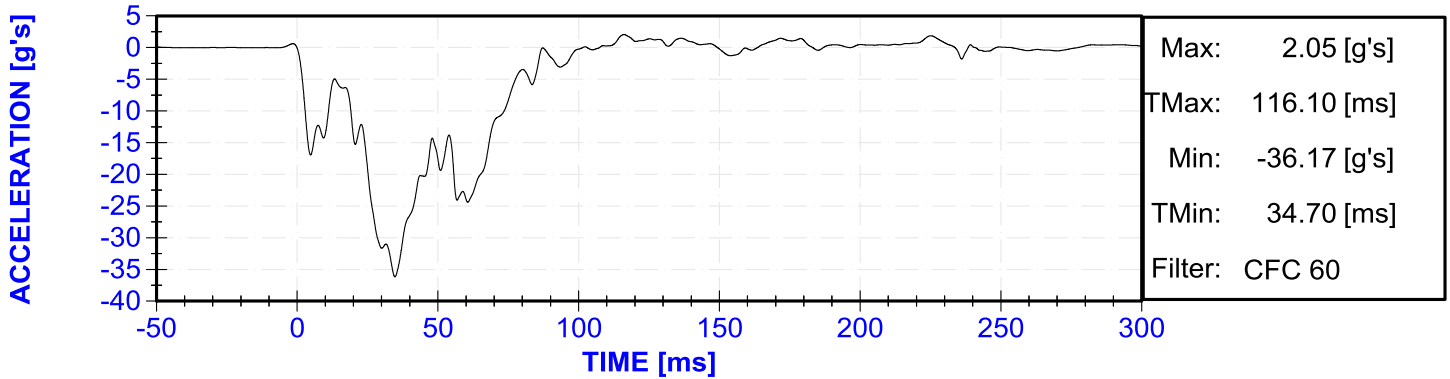


V2 Vehicle CG Z Acceleration

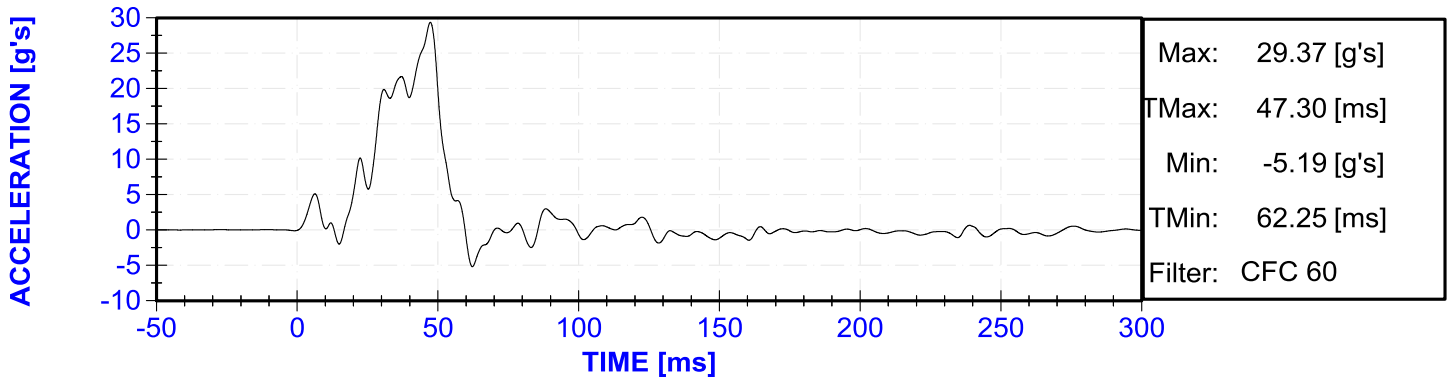




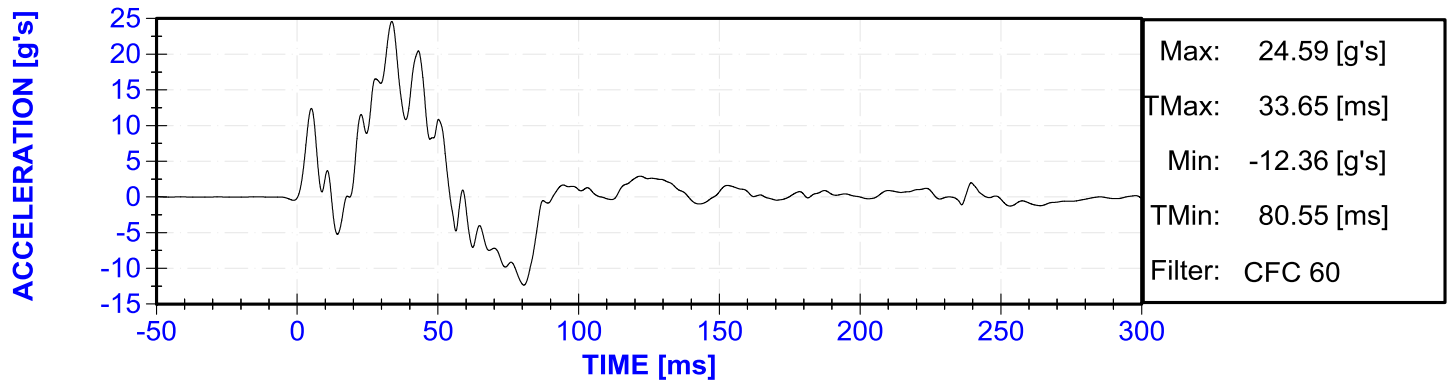
V2 Driver Seat Track X Acceleration



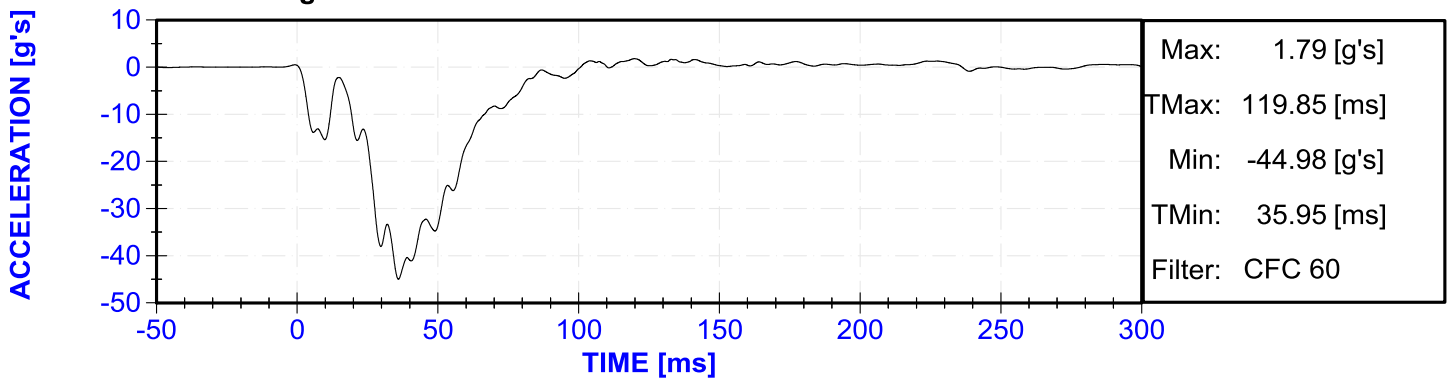
V2 Driver Seat Track Y Acceleration



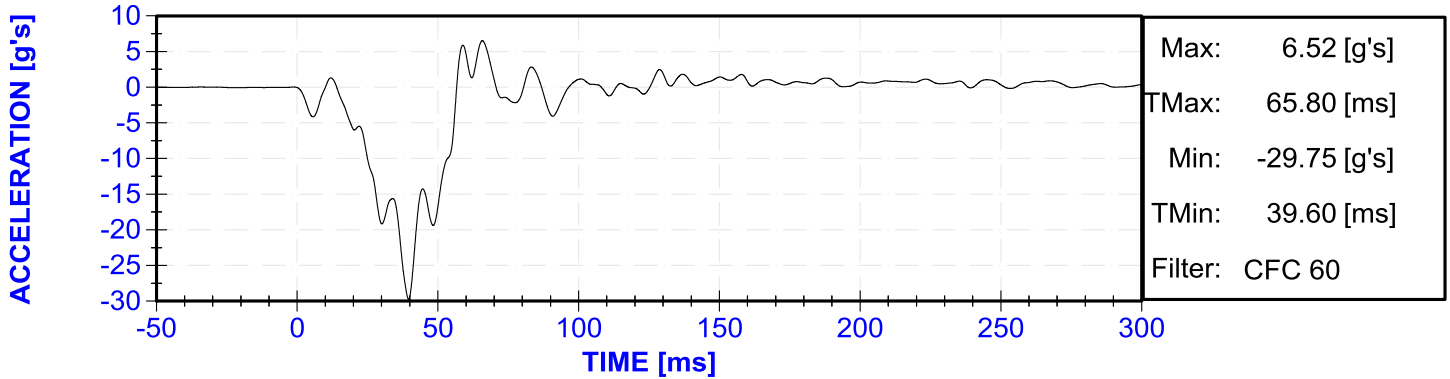
V2 Driver Seat Track Z Acceleration



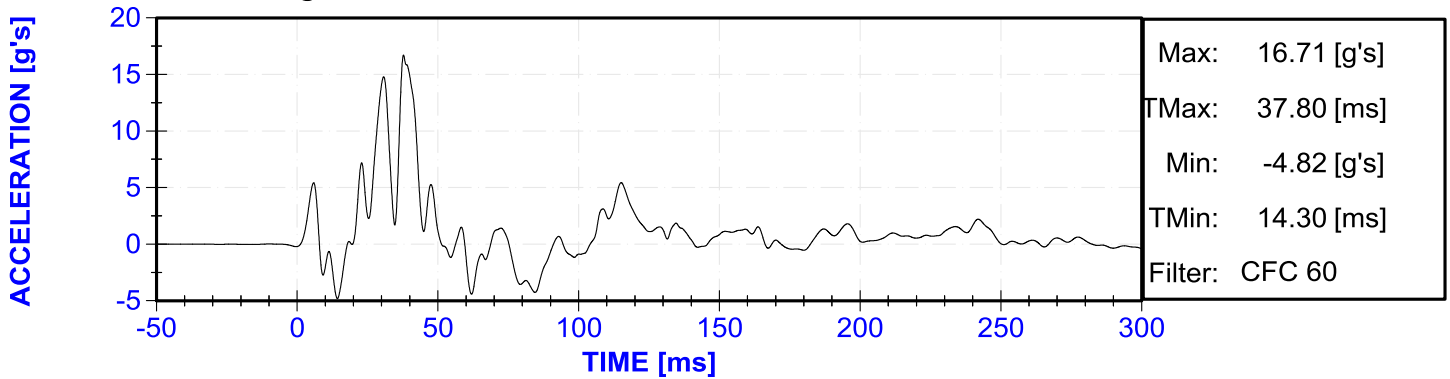
V2 Passenger Seat Track X Acceleration



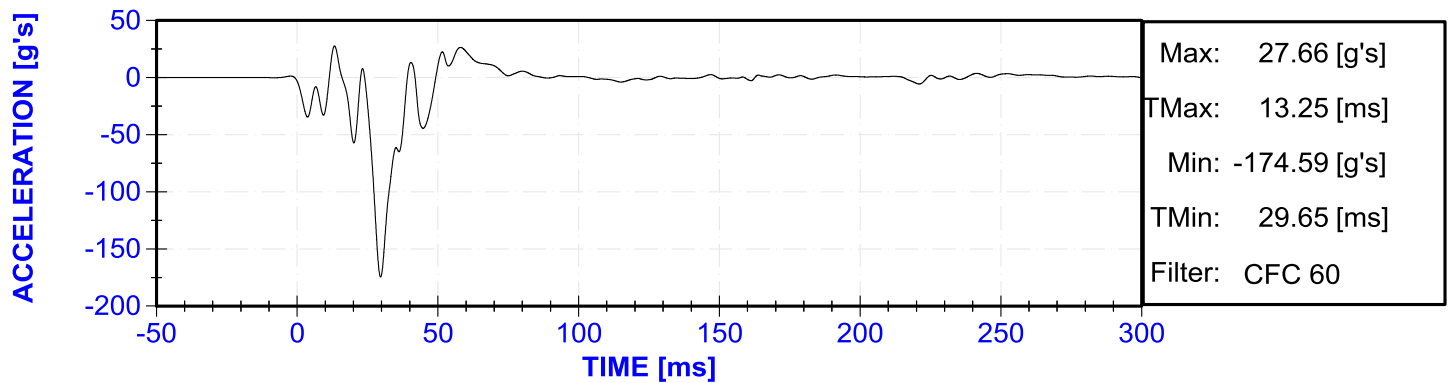
V2 Passenger Seat Track Y Acceleration



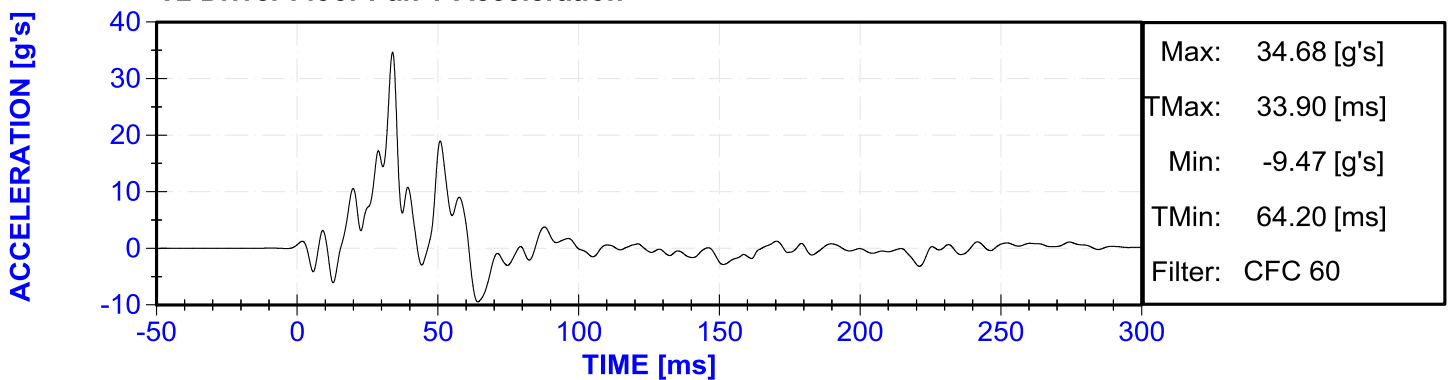
V2 Passenger Seat Track Z Acceleration



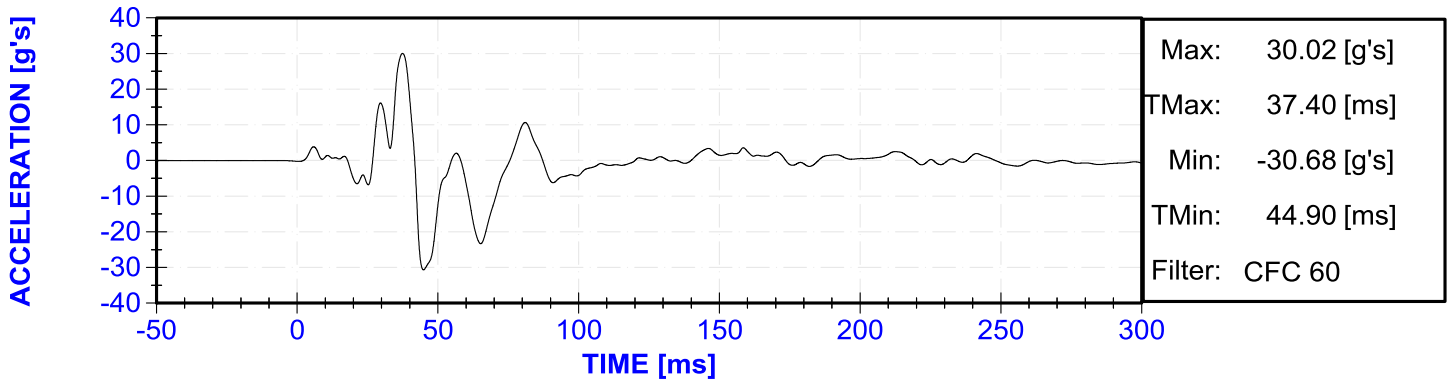
V2 Driver Floor Pan X Acceleration



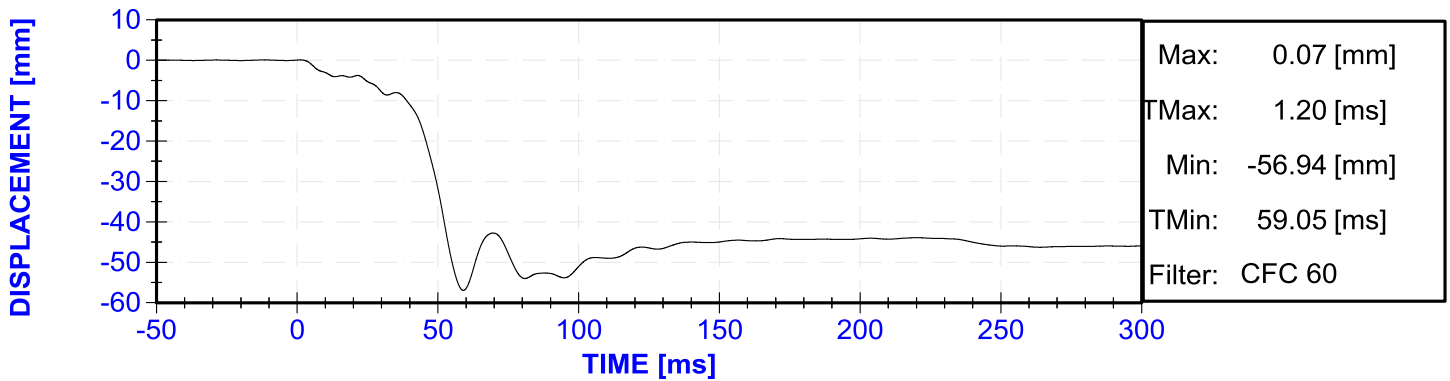
V2 Driver Floor Pan Y Acceleration



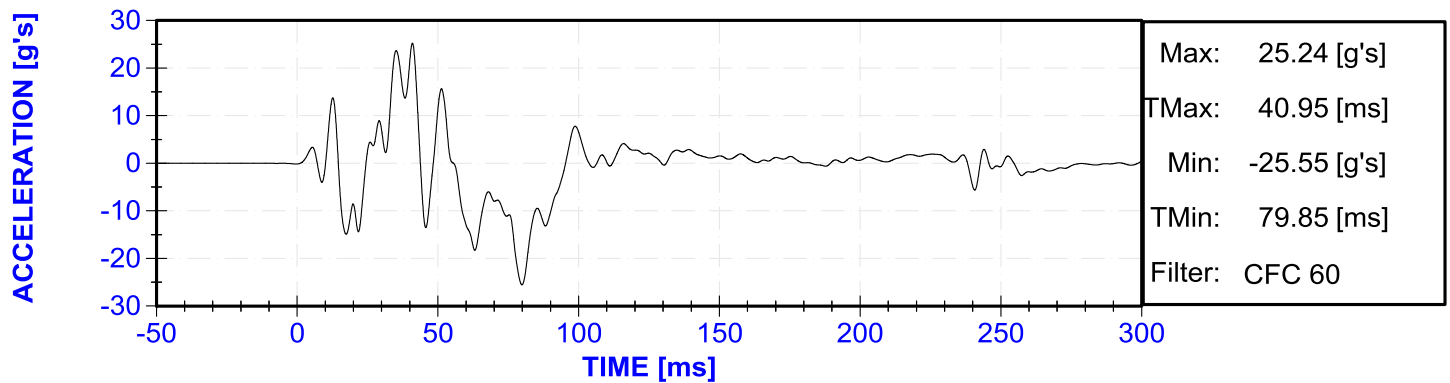
V2 Driver Floor Pan Z Acceleration



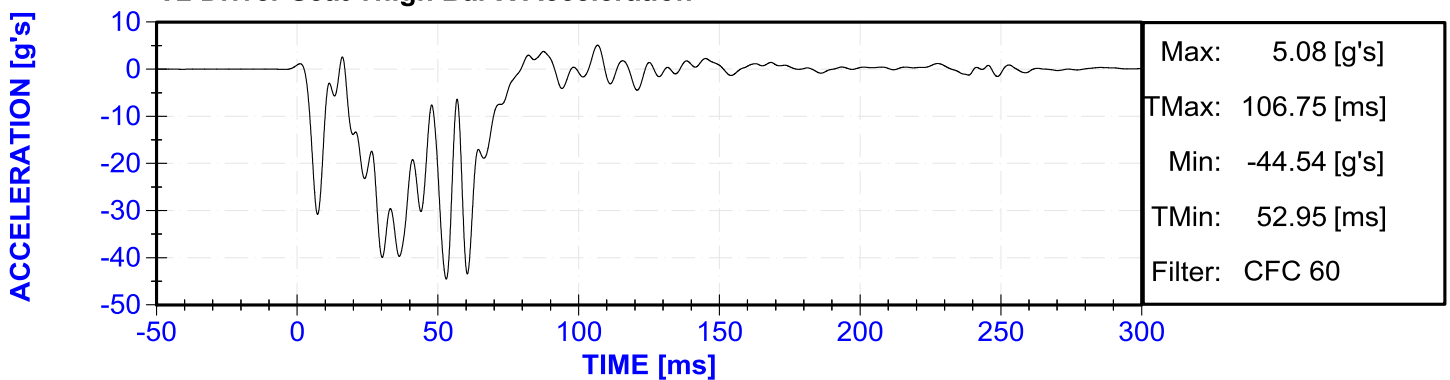
V2 Driver Floor Pan X Deflection



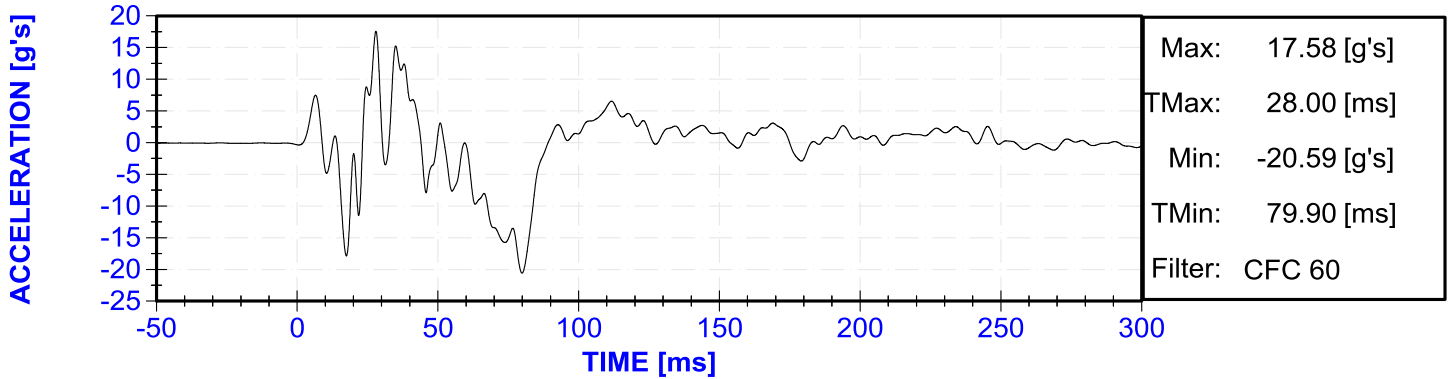
V2 Driver Seat Pan Z Acceleration



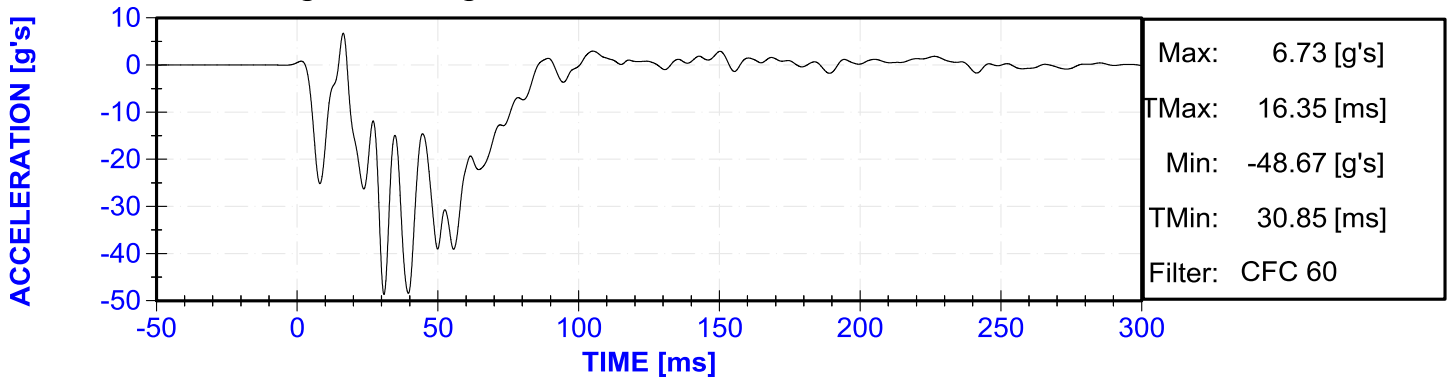
V2 Driver Seat Thigh Bar X Acceleration



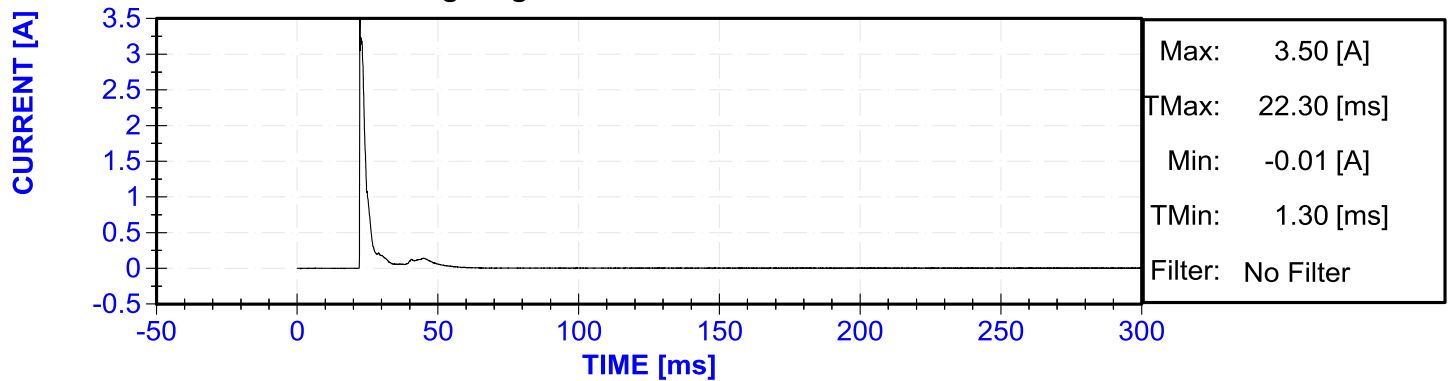
V2 Passenger Seat Pan Z Acceleration



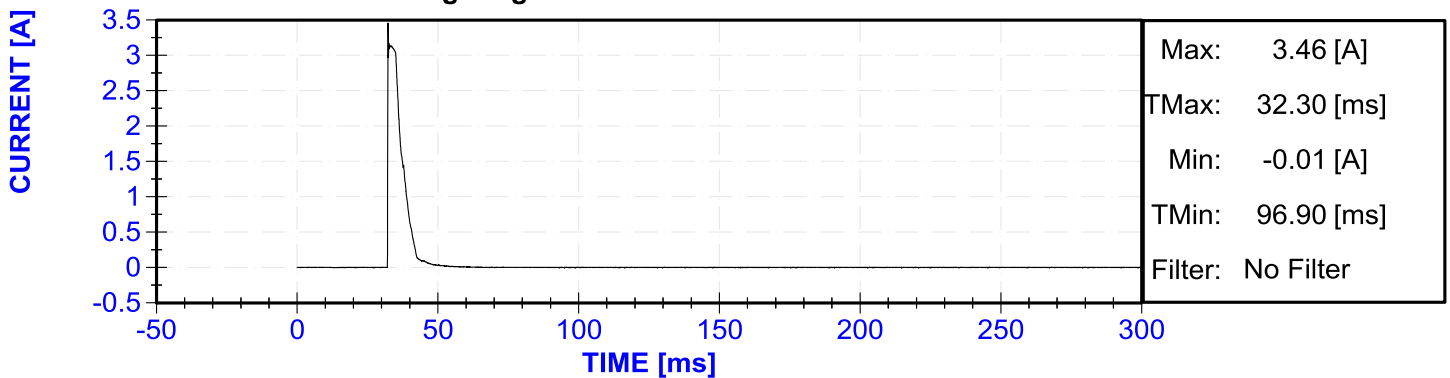
V2 Passenger Seat Thigh Bar X Acceleration

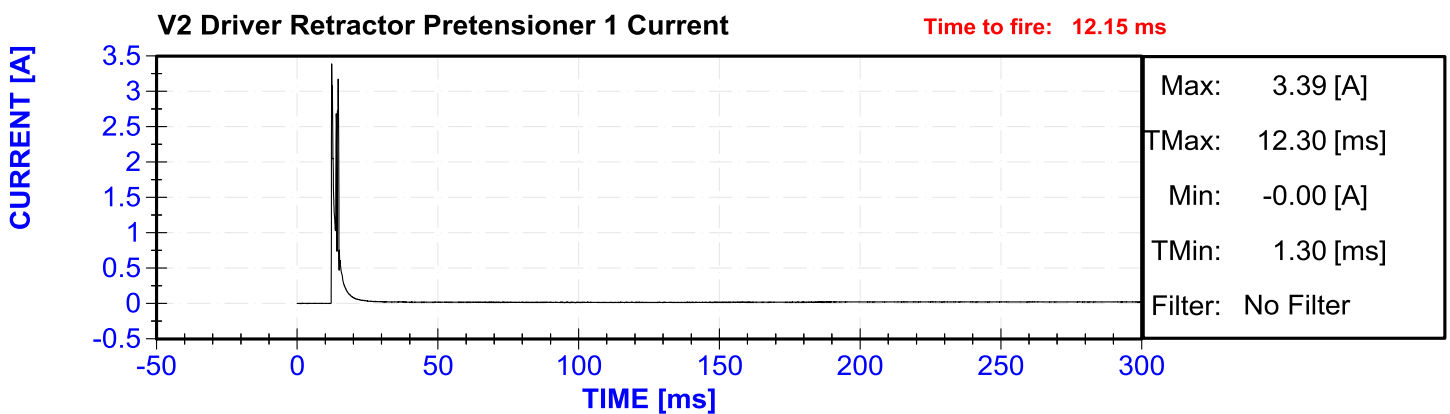
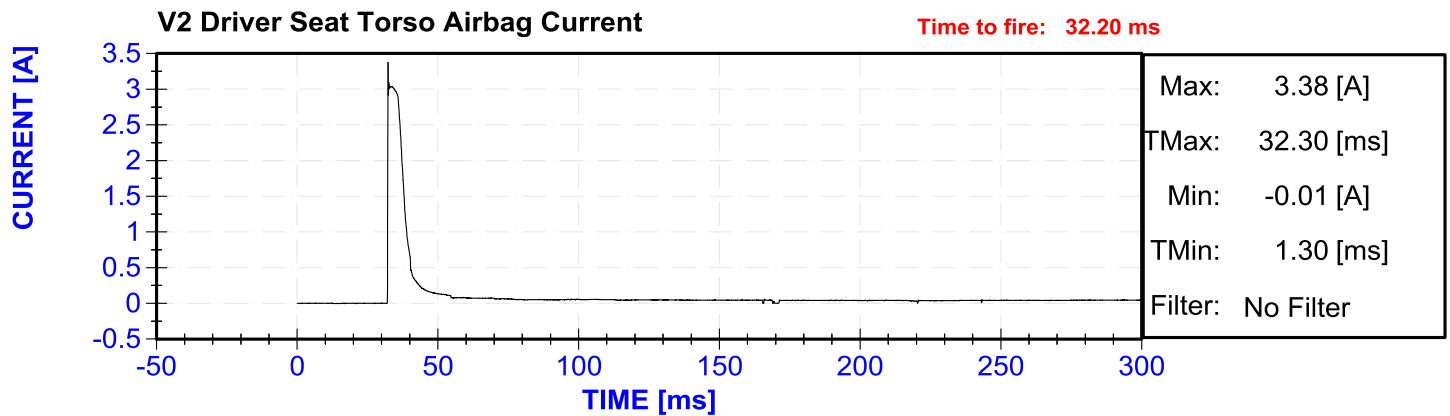
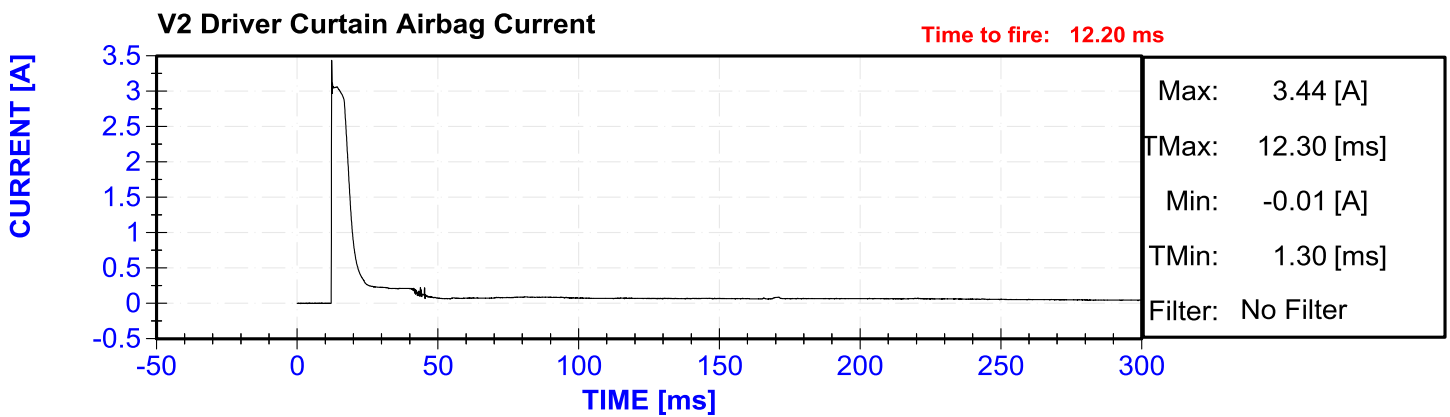
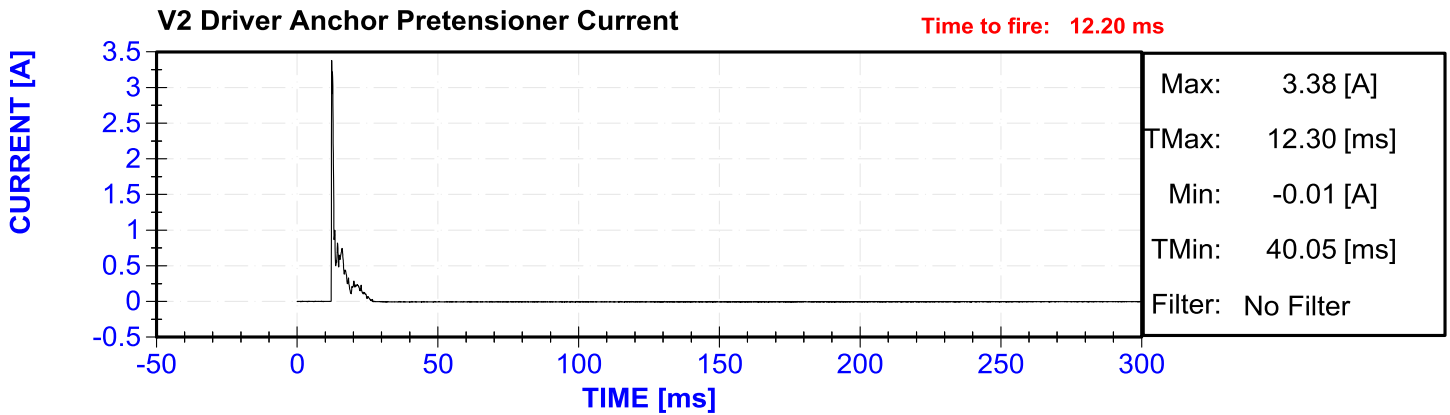


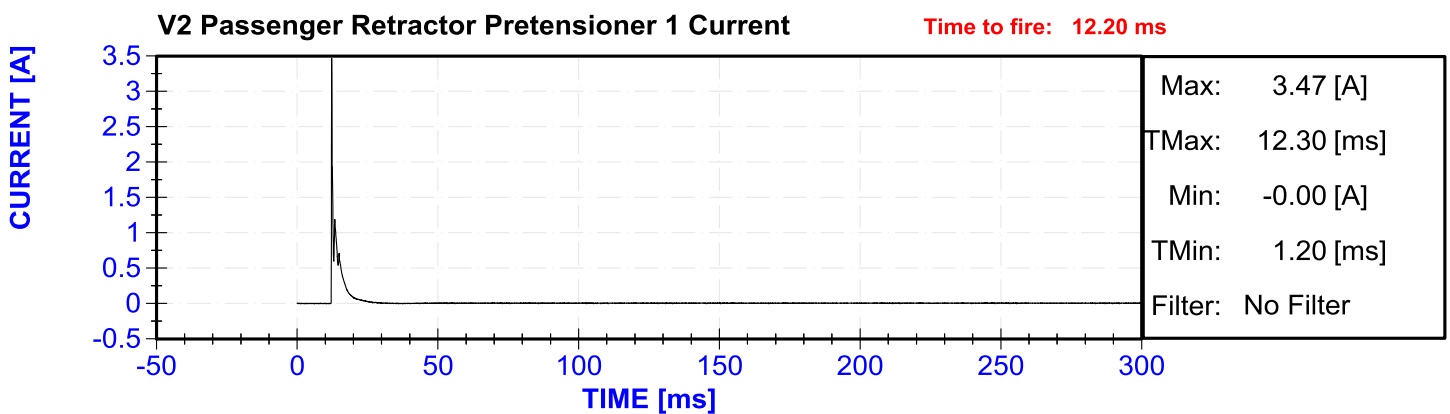
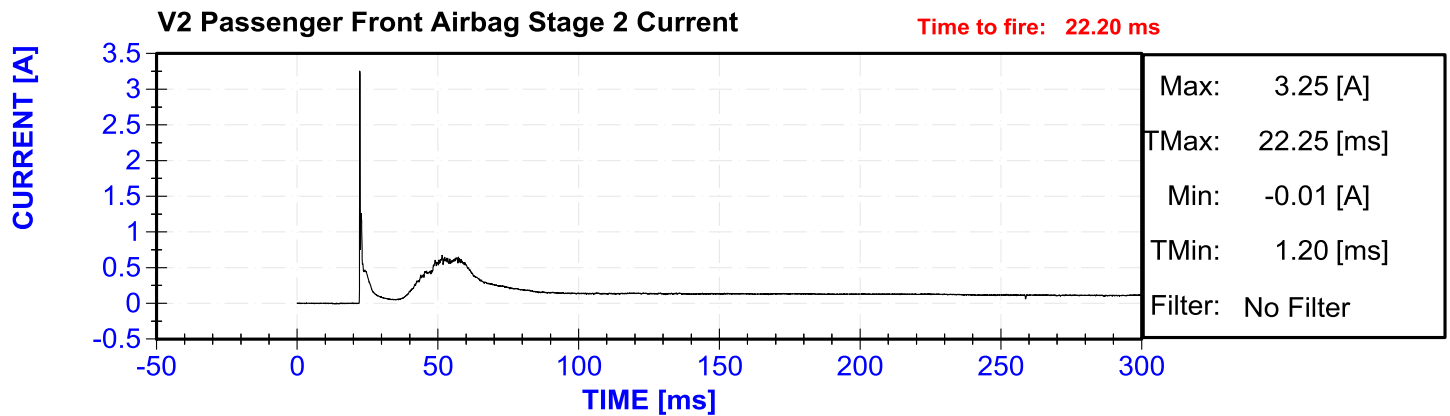
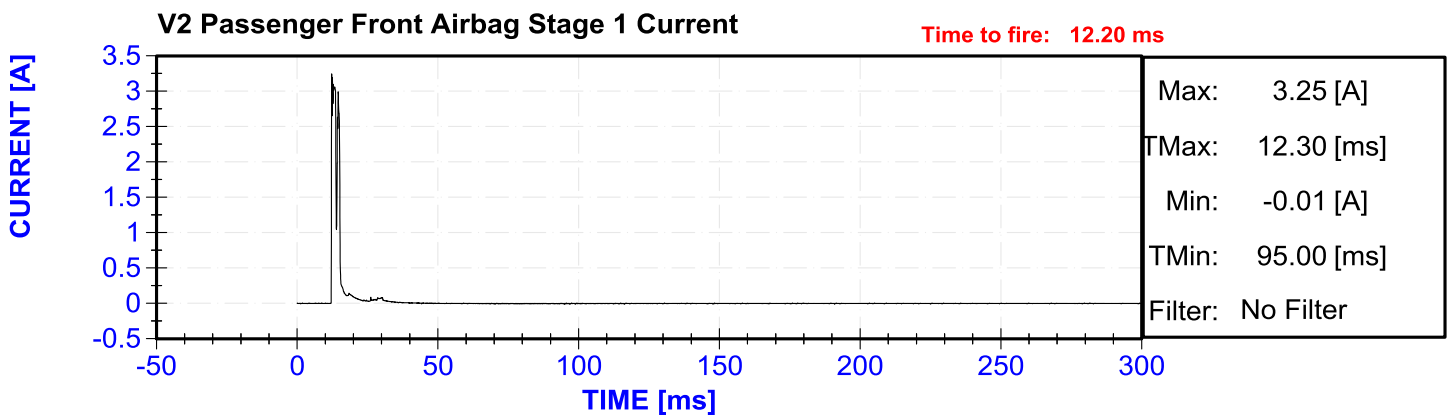
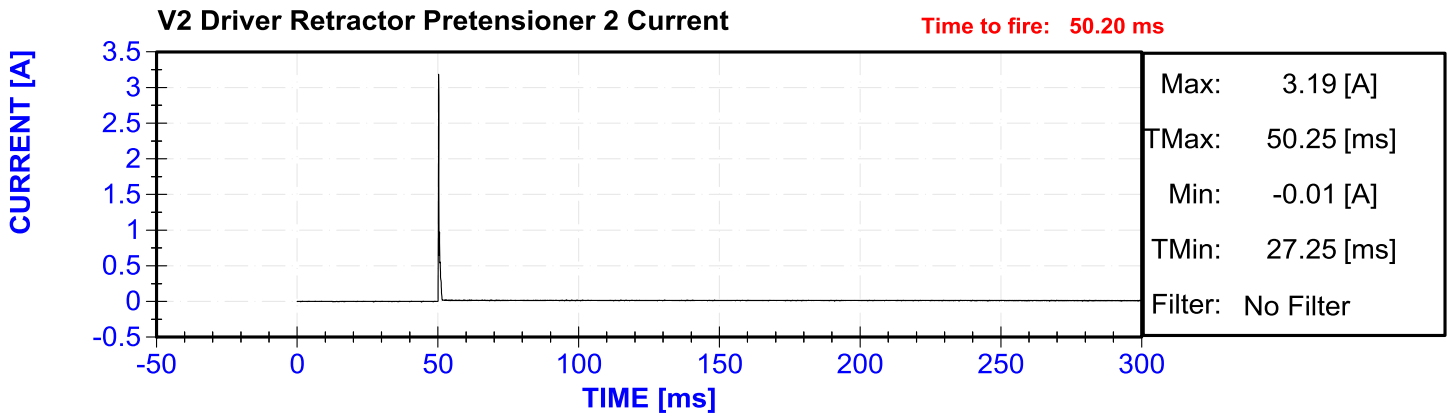
V2 Driver Front Airbag Stage 1 Current



V2 Driver Front Airbag Stage 2 Current



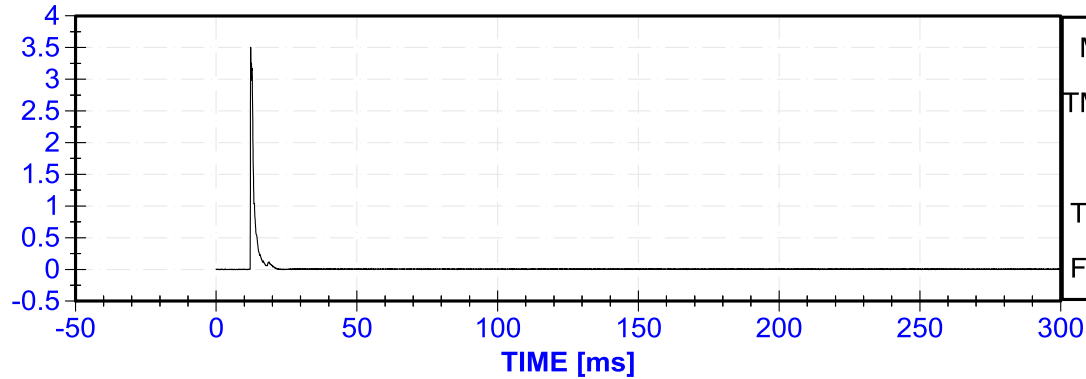




V2 Passenger Anchor Pretensioner Current

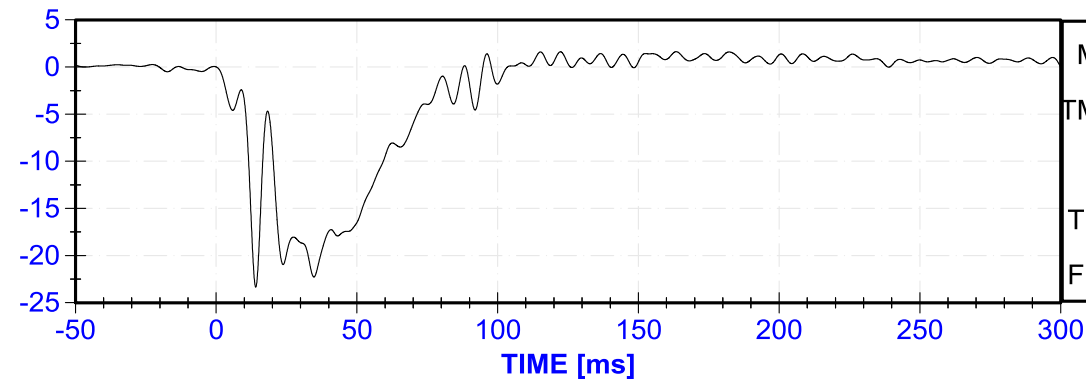
Time to fire: 12.15 ms

CURRENT [A]



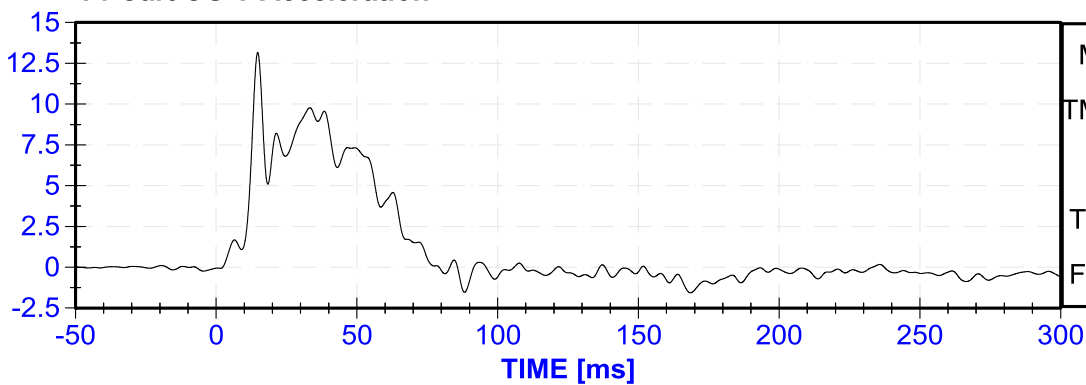
V1 Cart CG X Acceleration

ACCELERATION [g's]



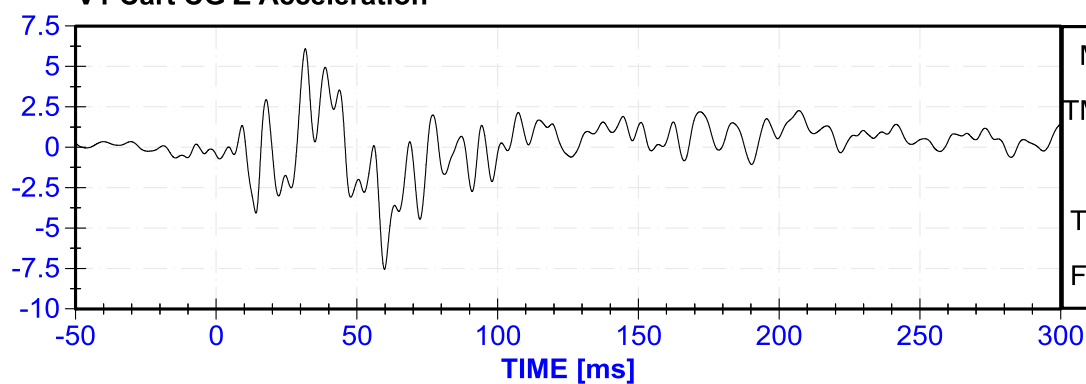
V1 Cart CG Y Acceleration

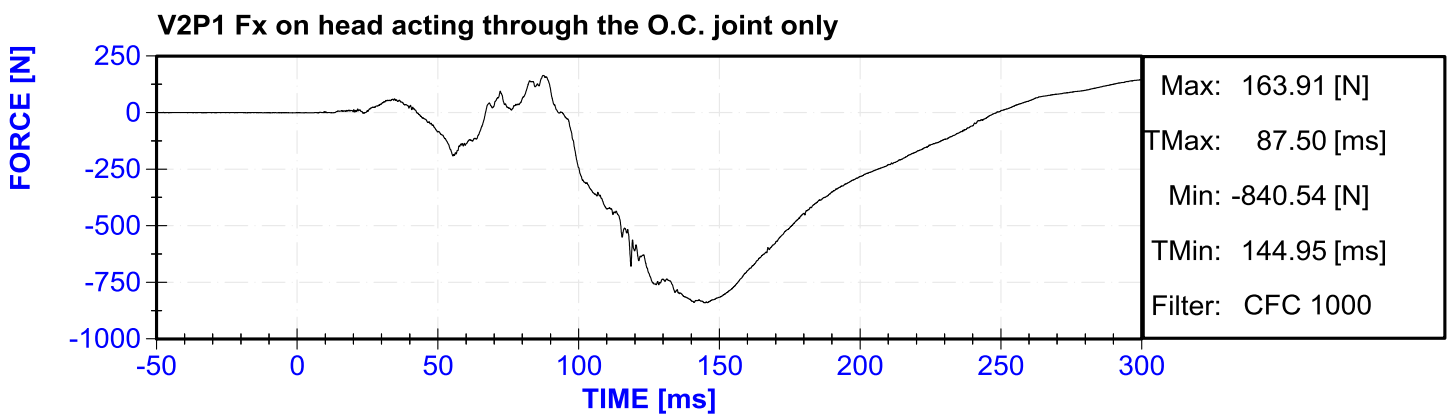
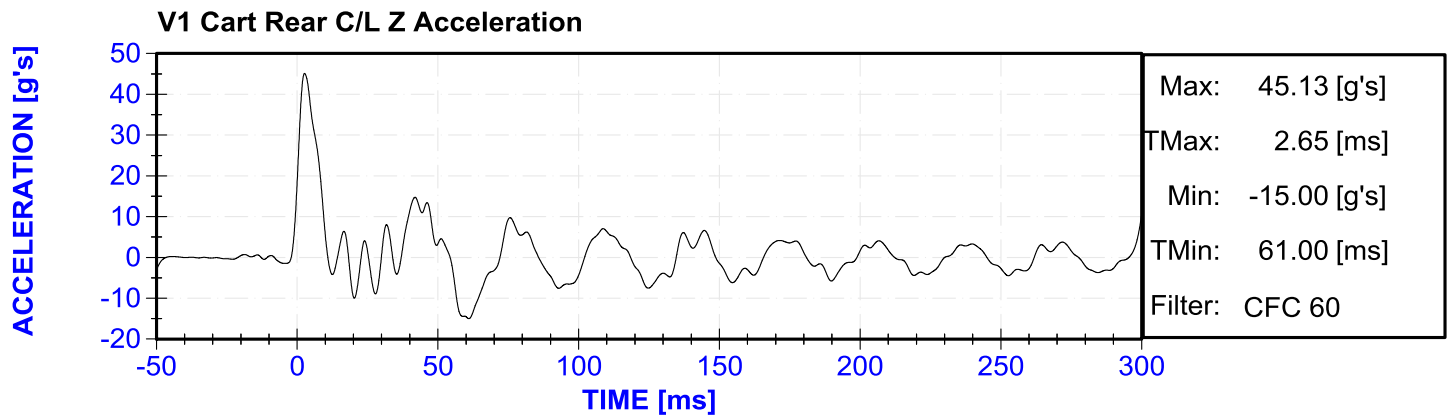
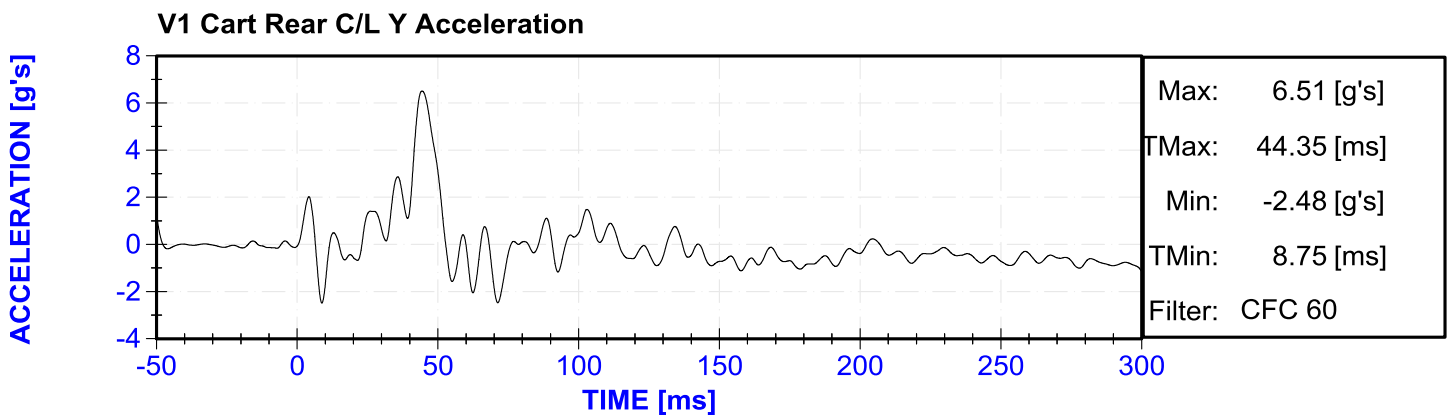
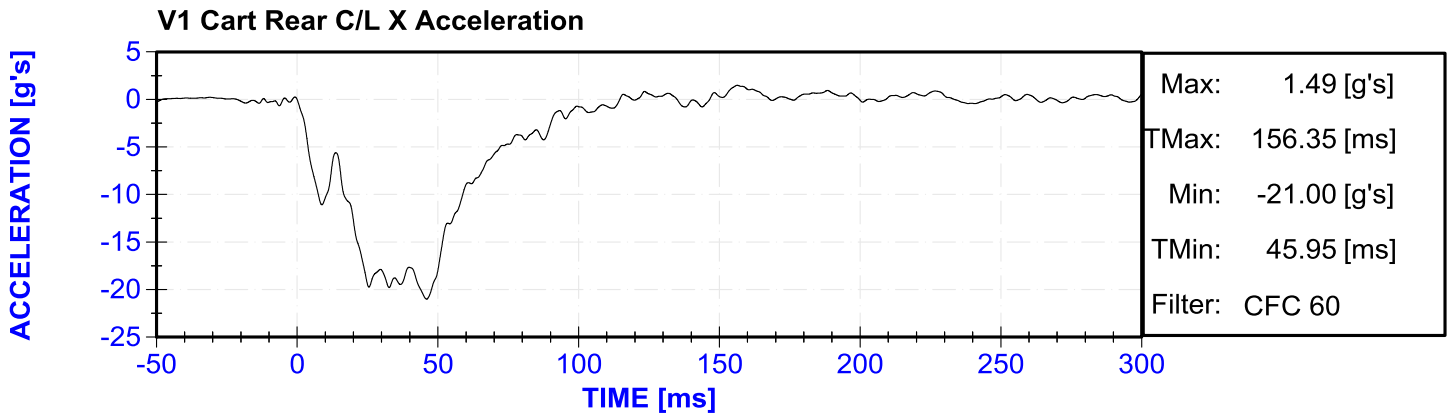
ACCELERATION [g's]



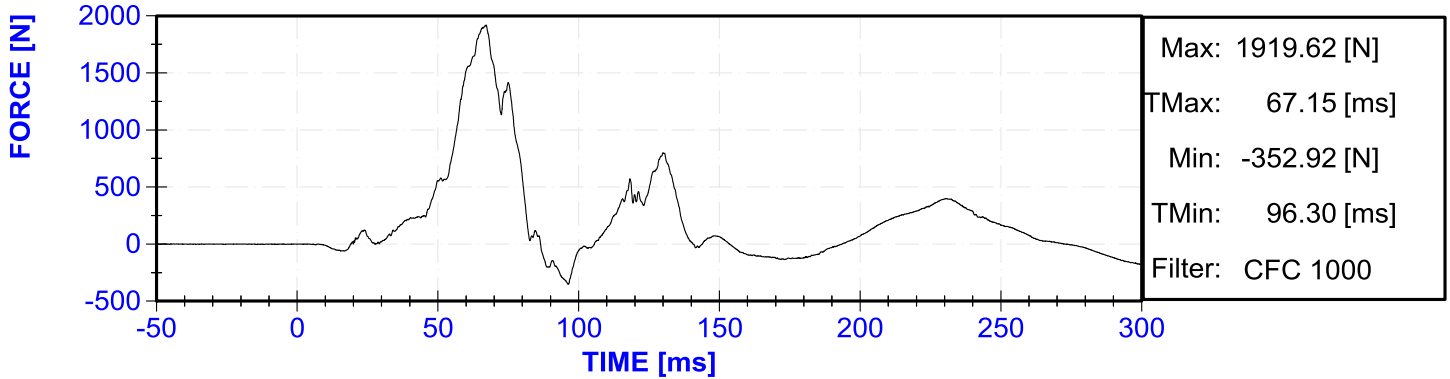
V1 Cart CG Z Acceleration

ACCELERATION [g's]

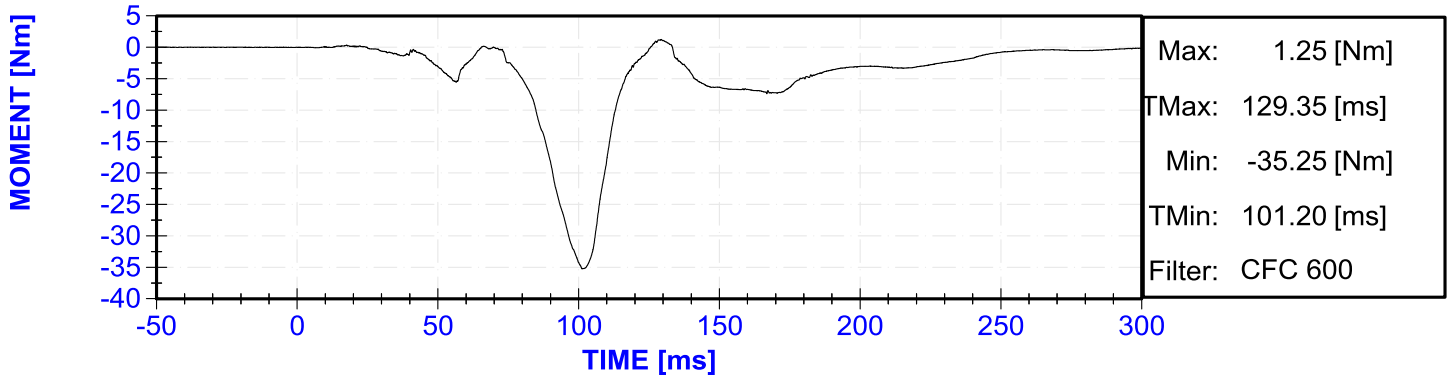




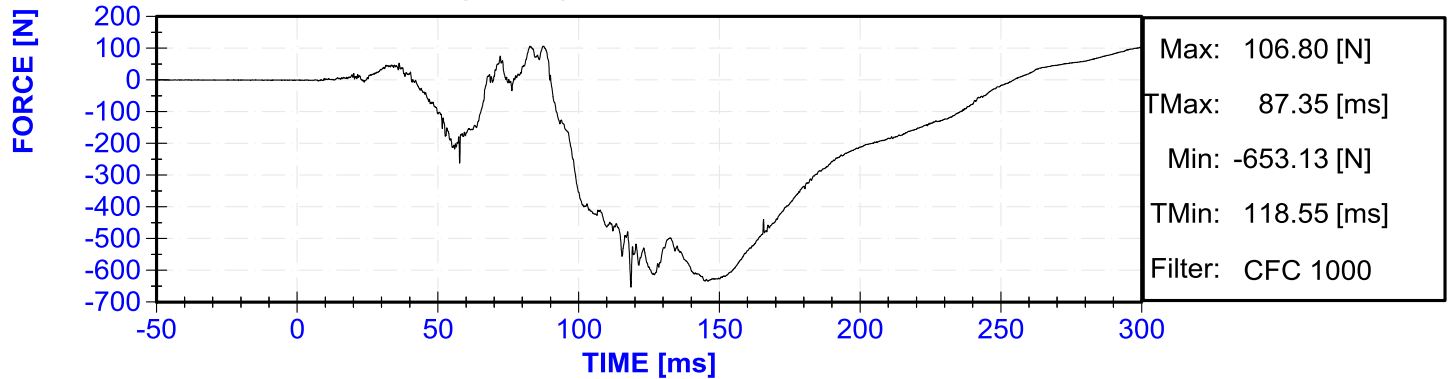
V2P1 Fz on head acting through the O.C. joint only



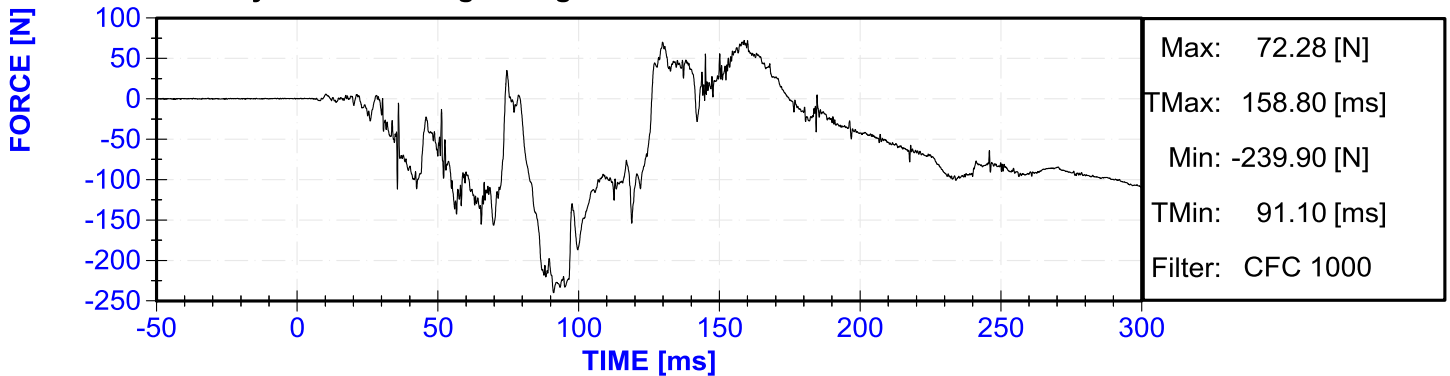
V2P1 My on head acting through the O.C. joint only



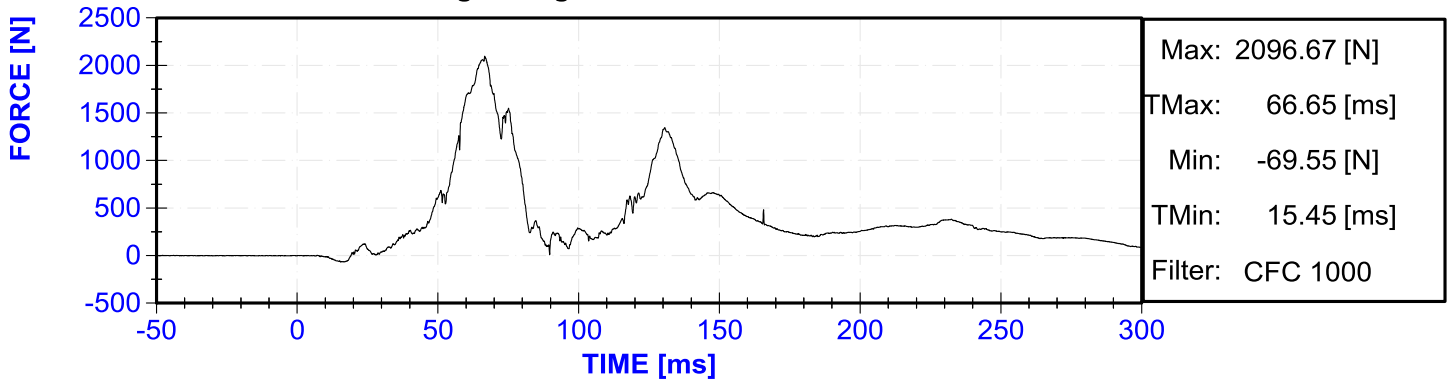
V2P1 Fx on head acting through the total neck section



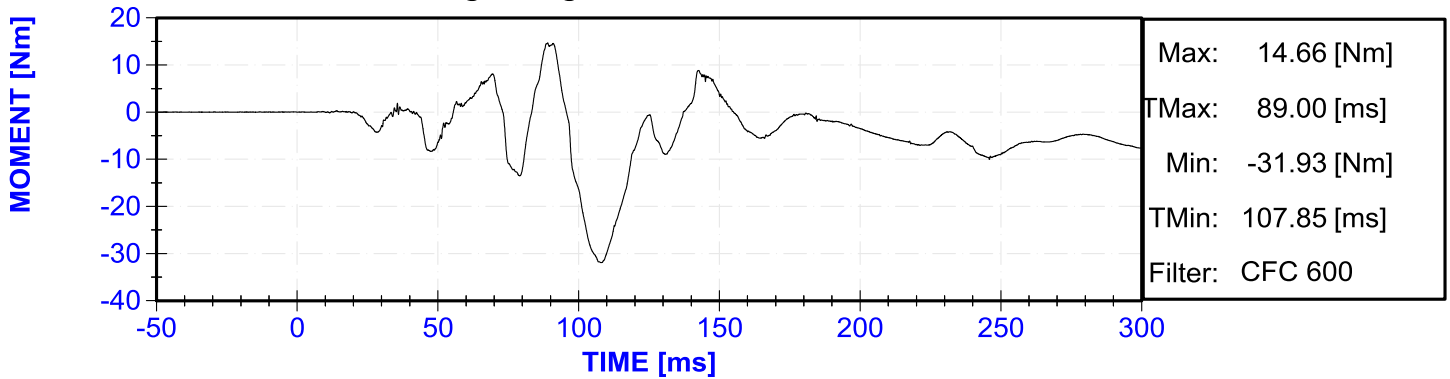
V2P1 Fy on head acting through the total neck section



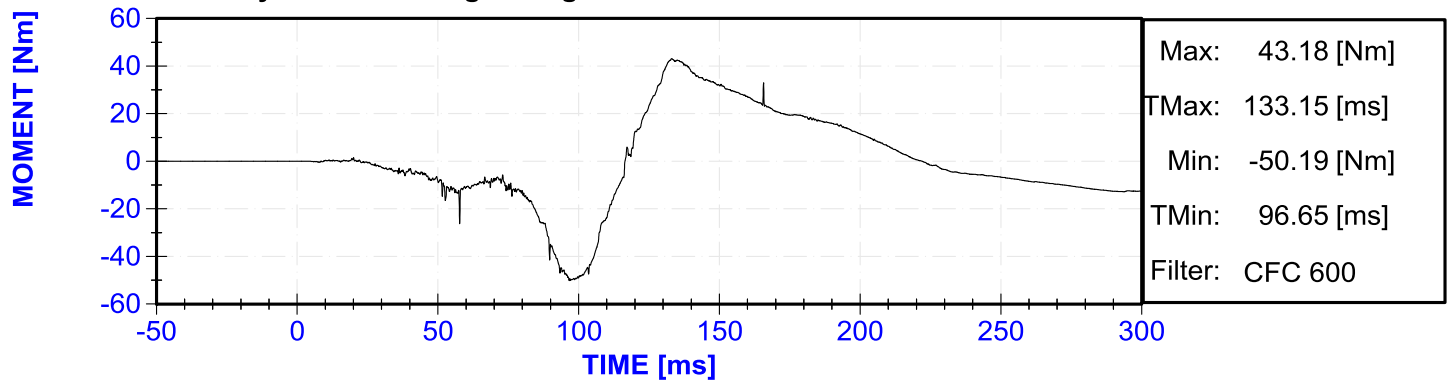
V2P1 Fz on head acting through the total neck section



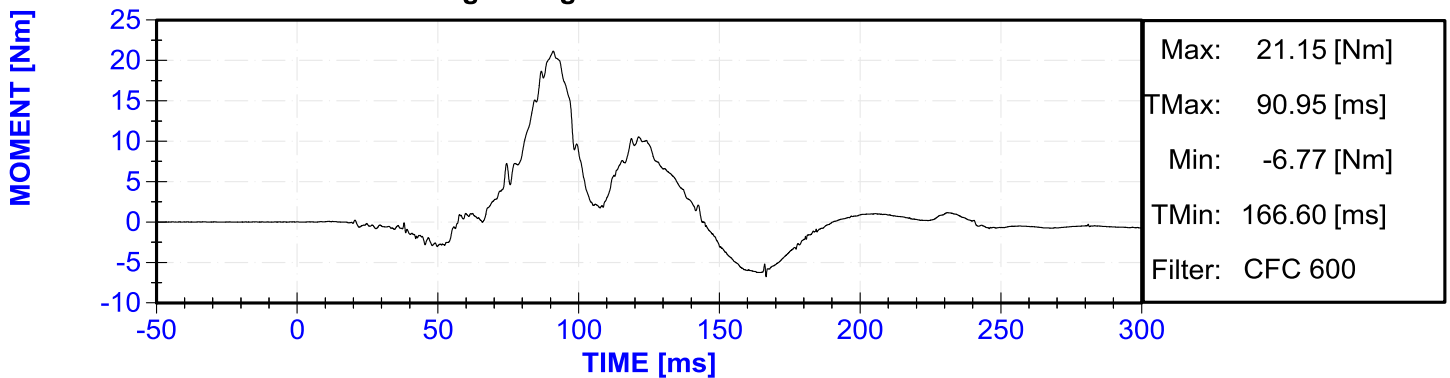
V2P1 Mx on head acting through the total neck section

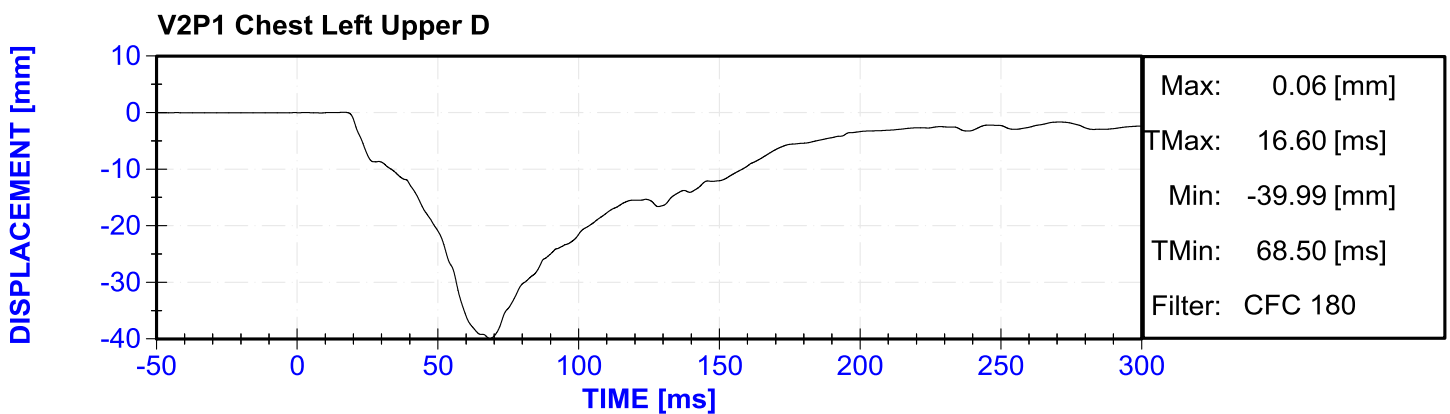
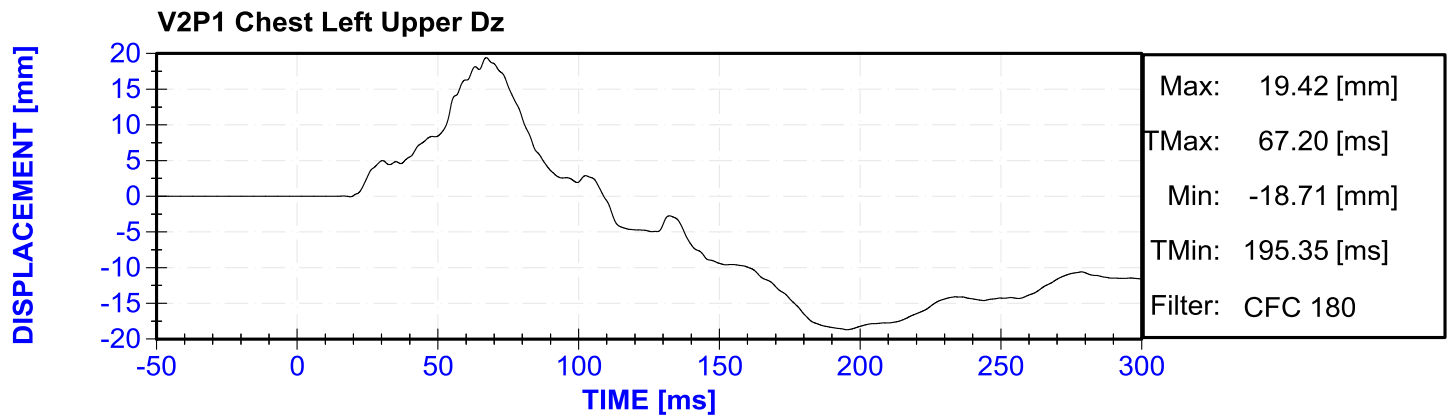
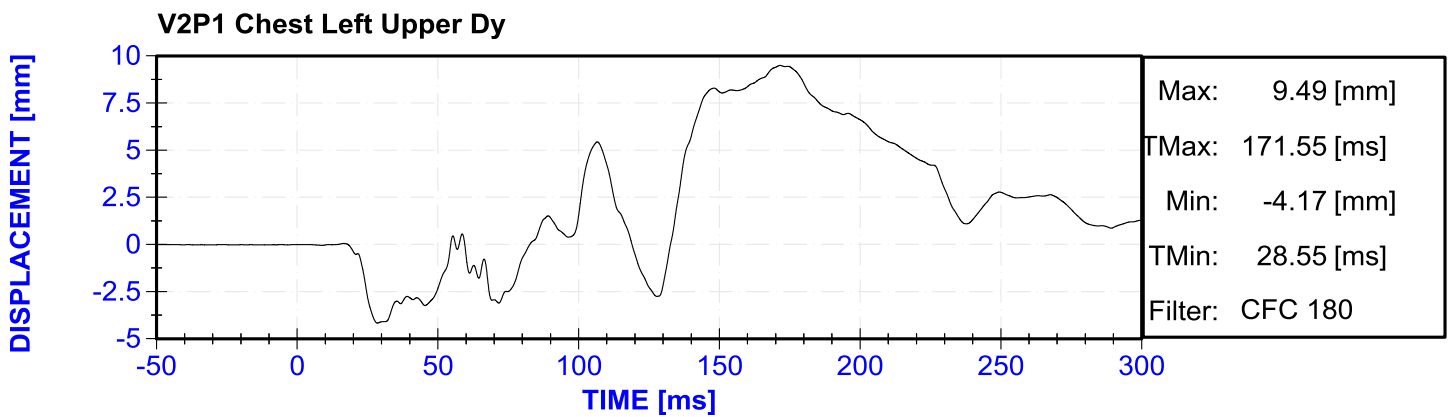
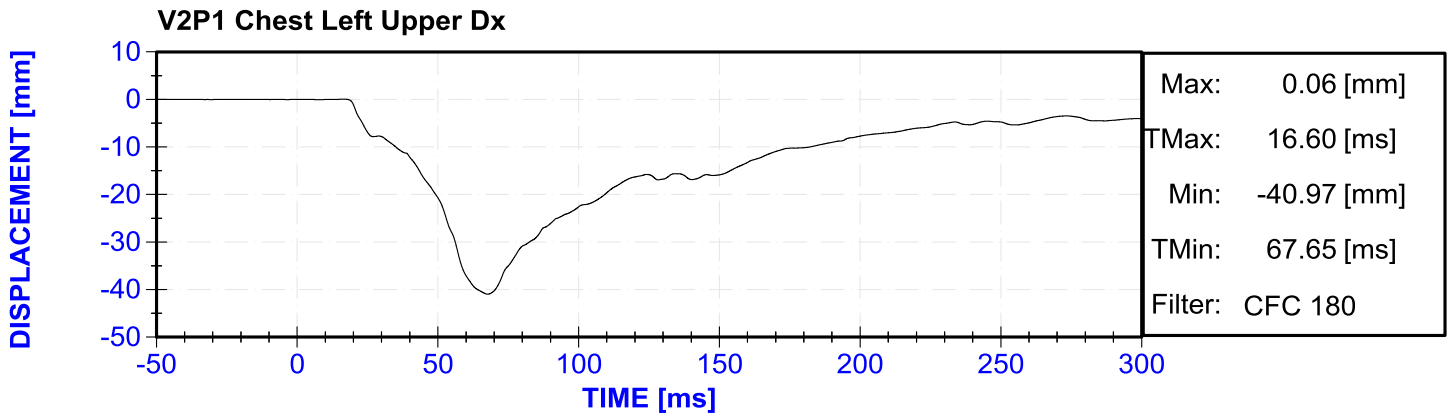


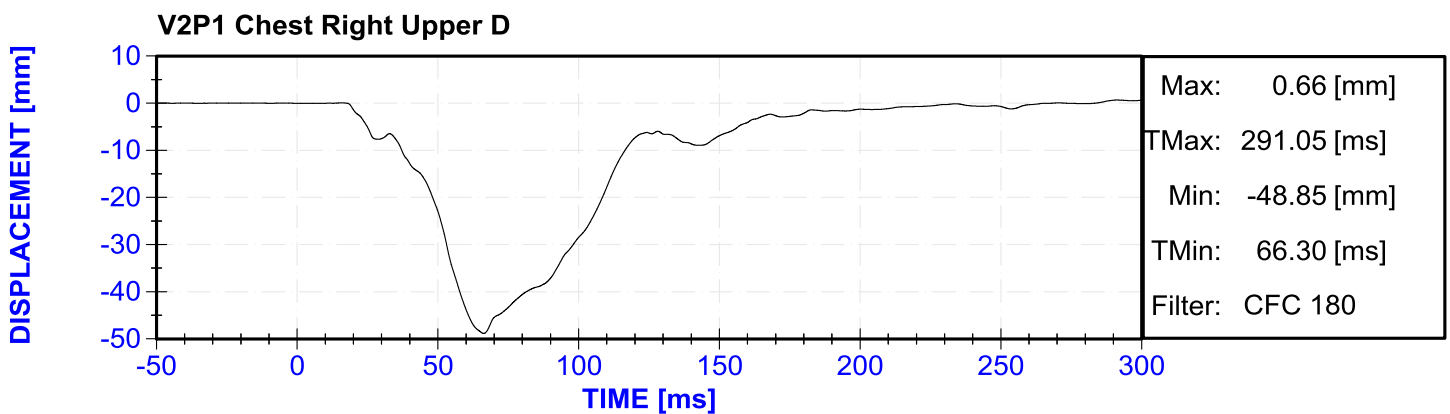
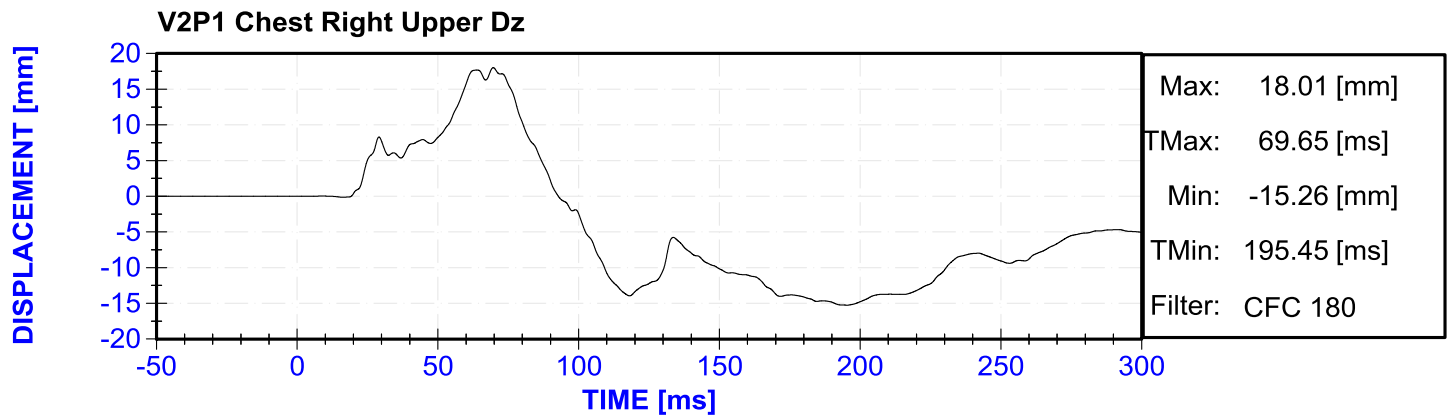
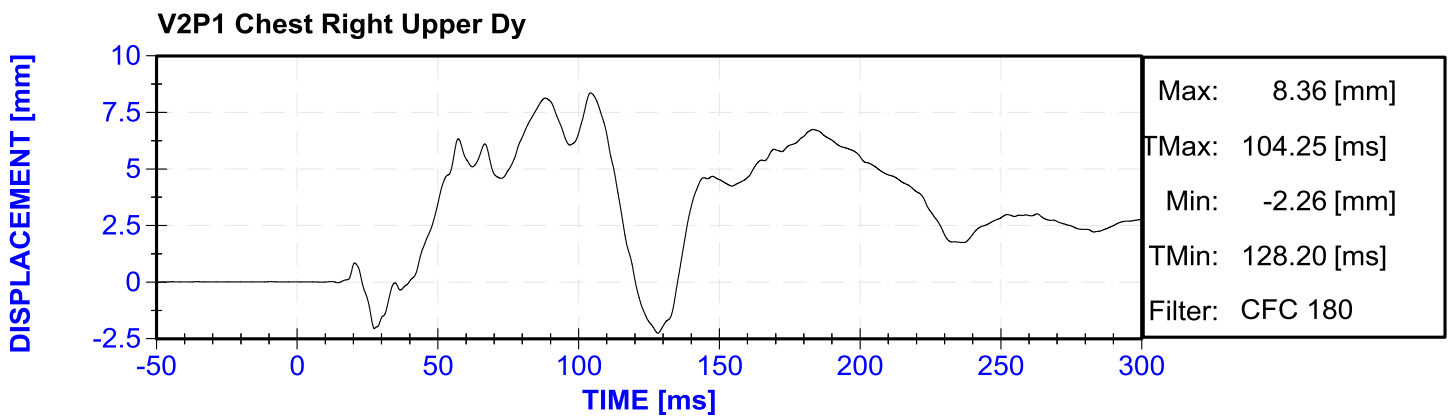
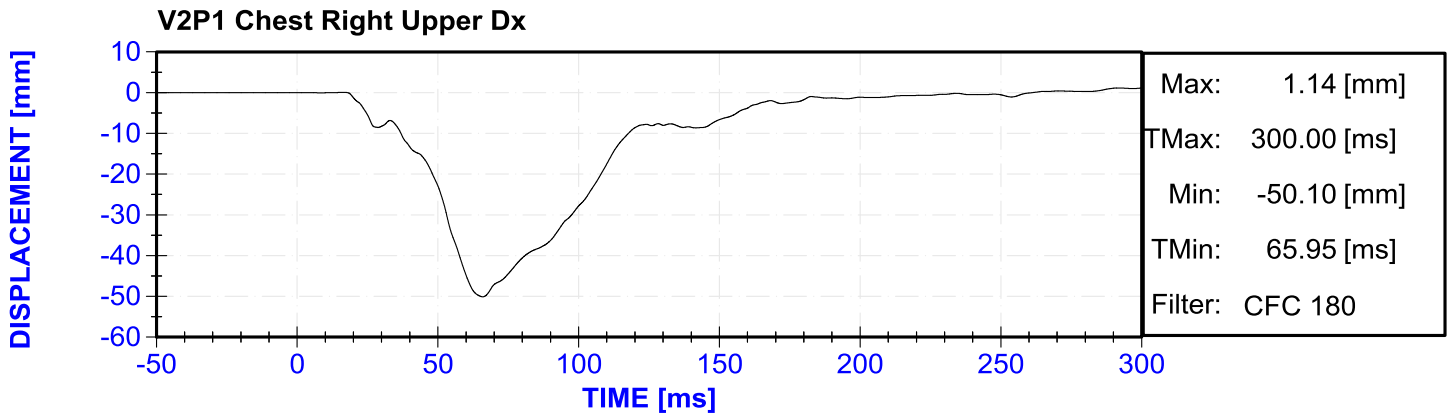
V2P1 My on head acting through the total neck section



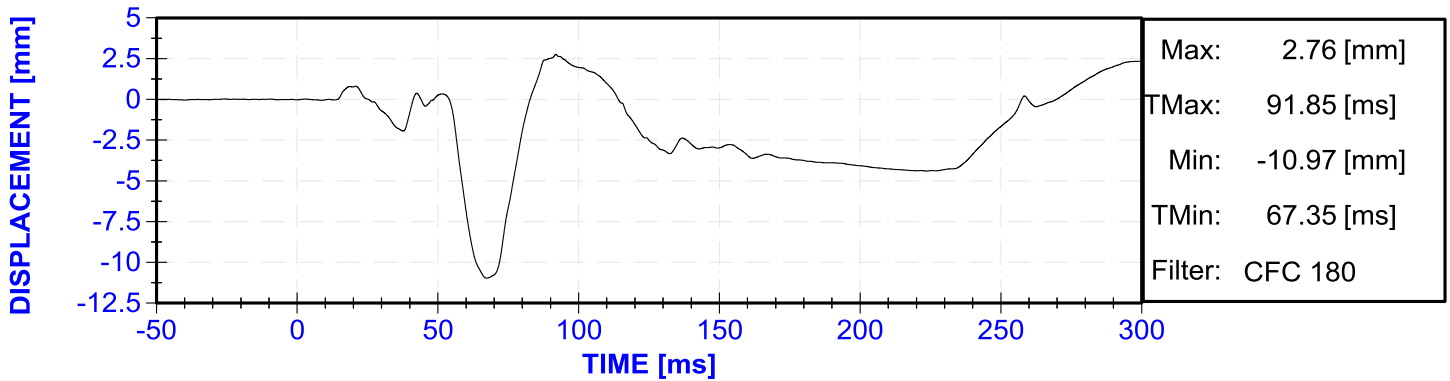
V2P1 Mz on head acting through the total neck section



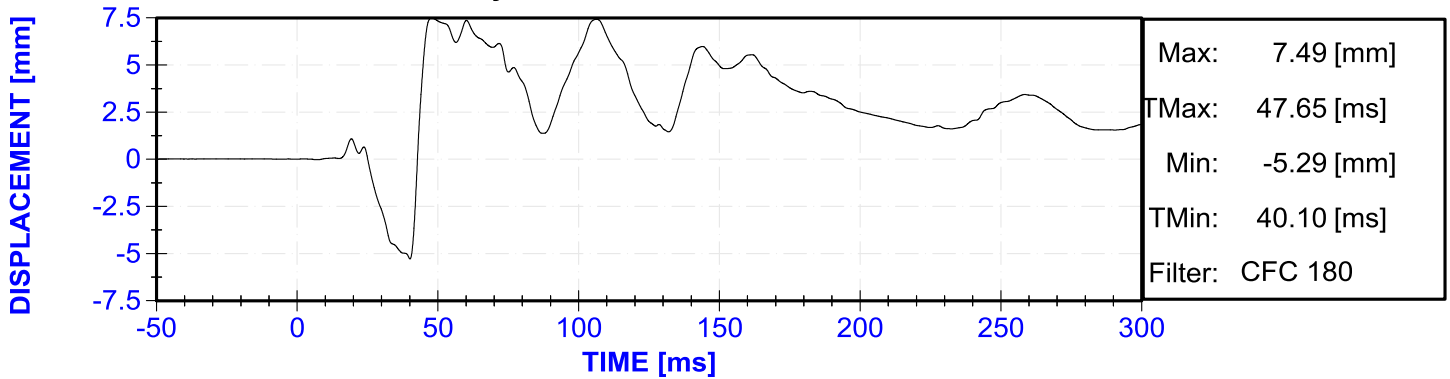




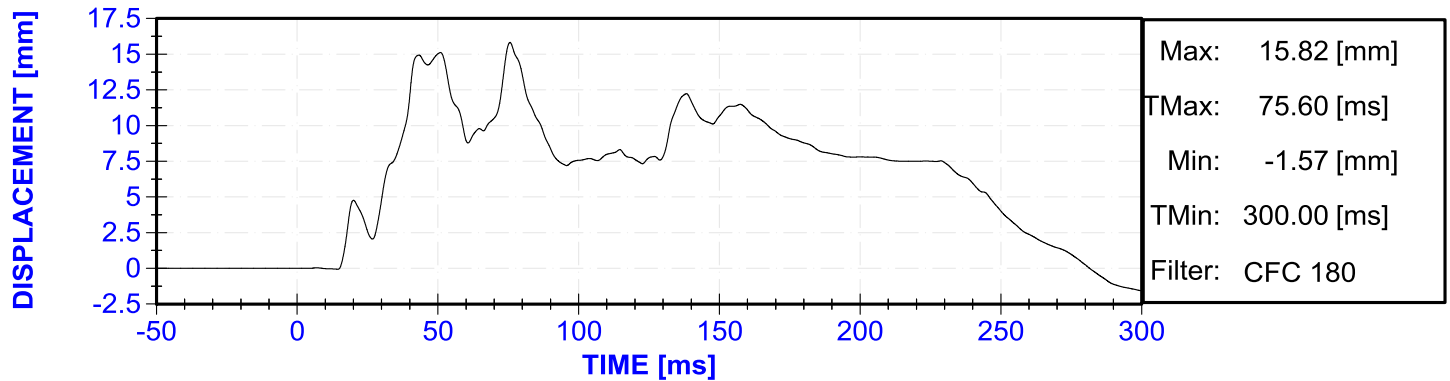
V2P1 Chest Left Lower Dx



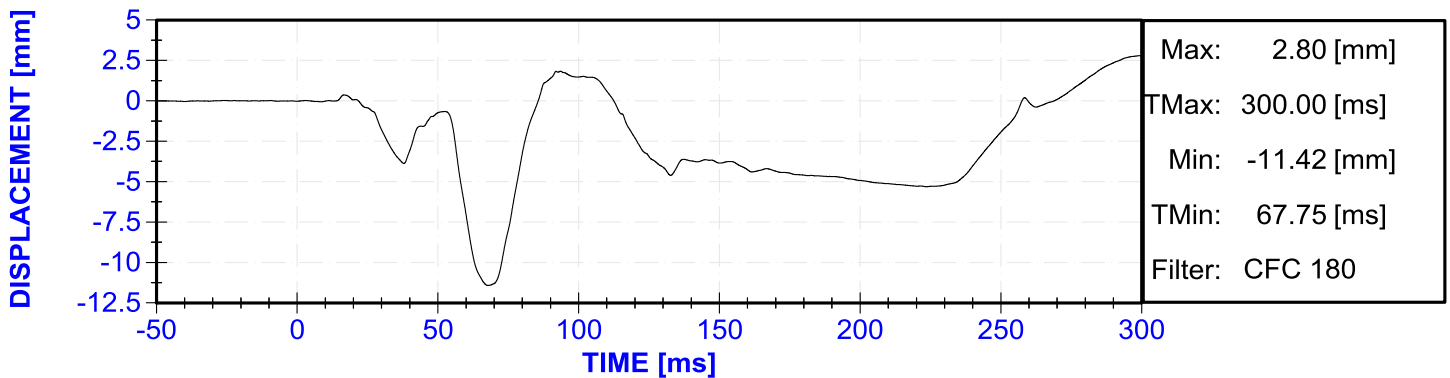
V2P1 Chest Left Lower Dy

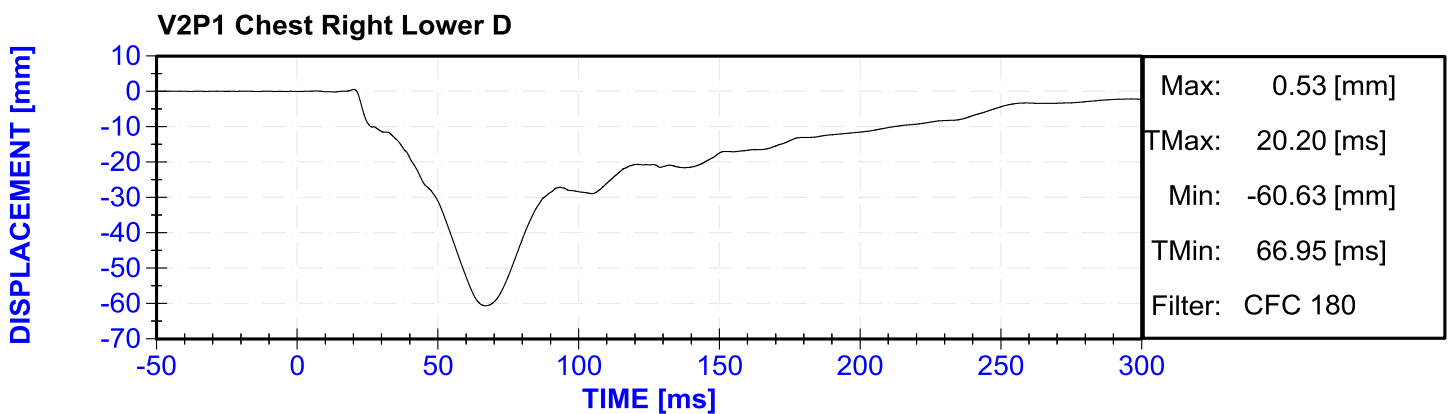
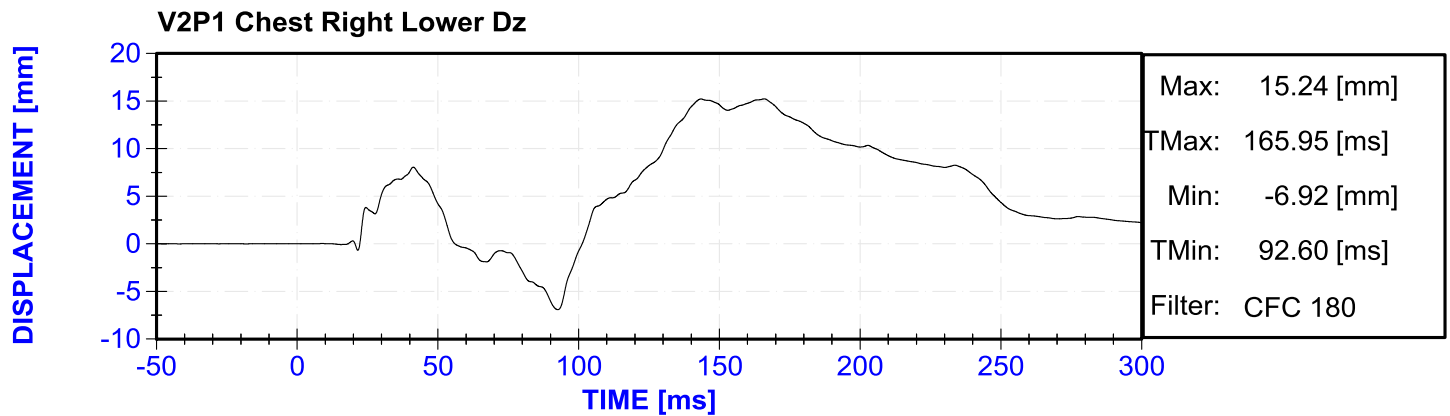
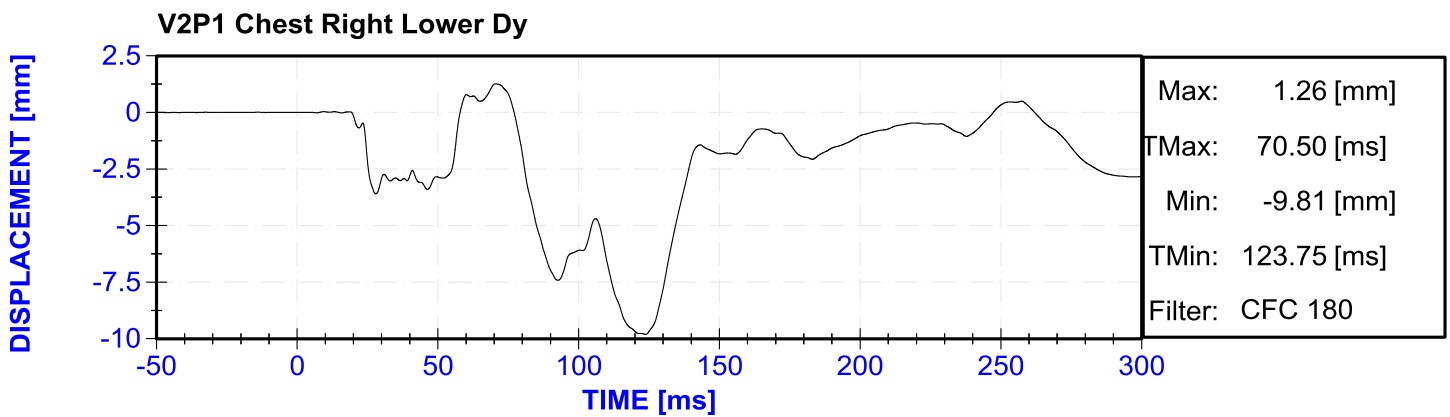
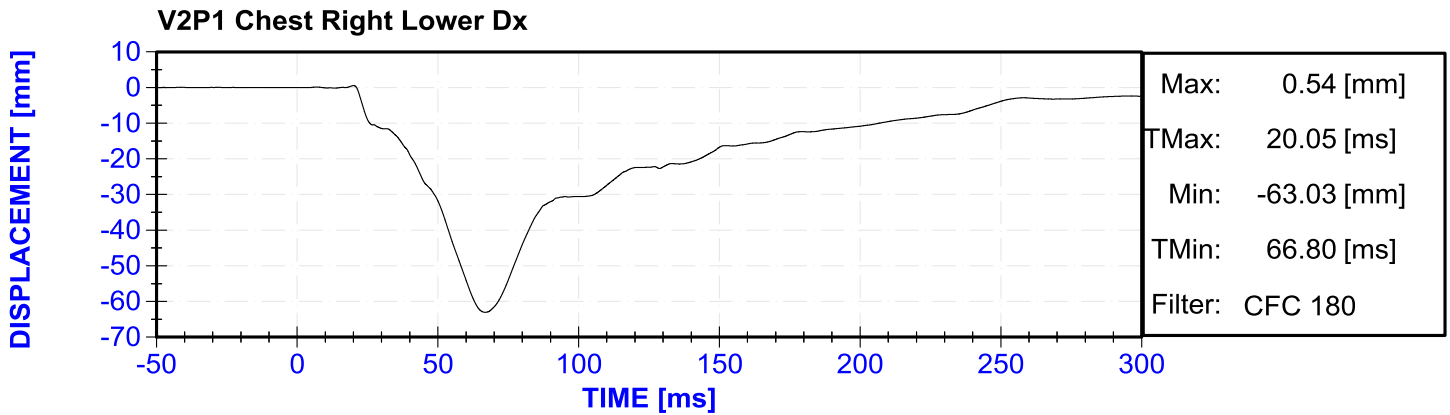


V2P1 Chest Left Lower Dz

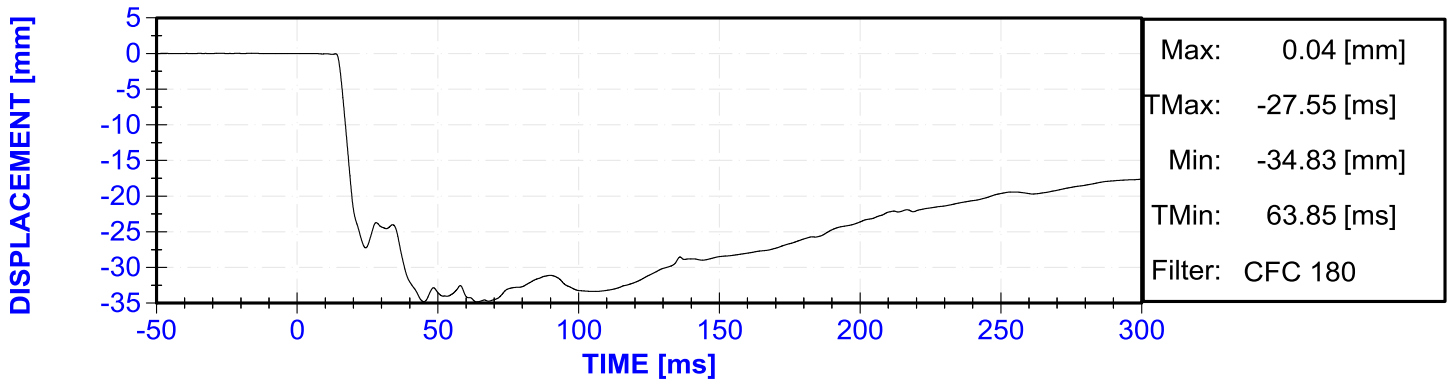


V2P1 Chest Left Lower D

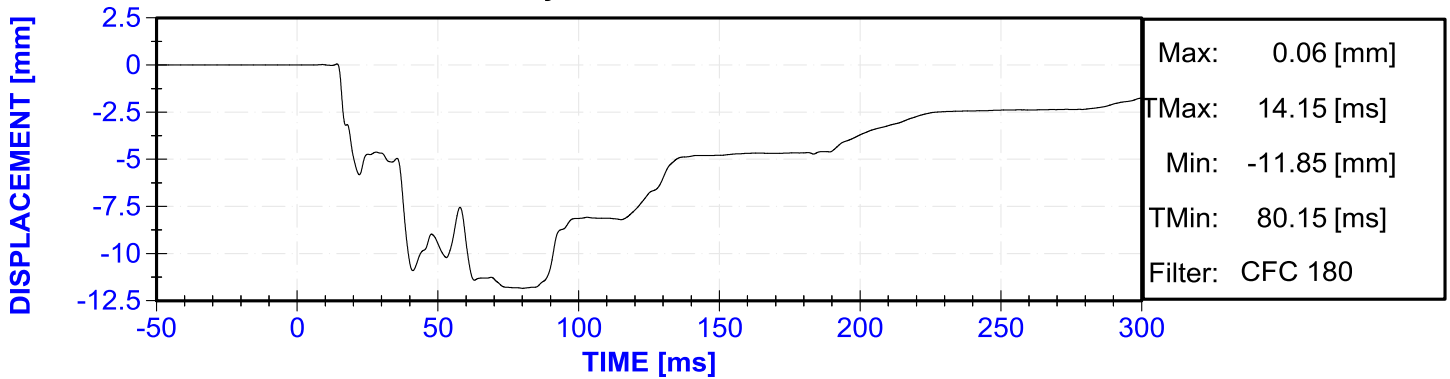




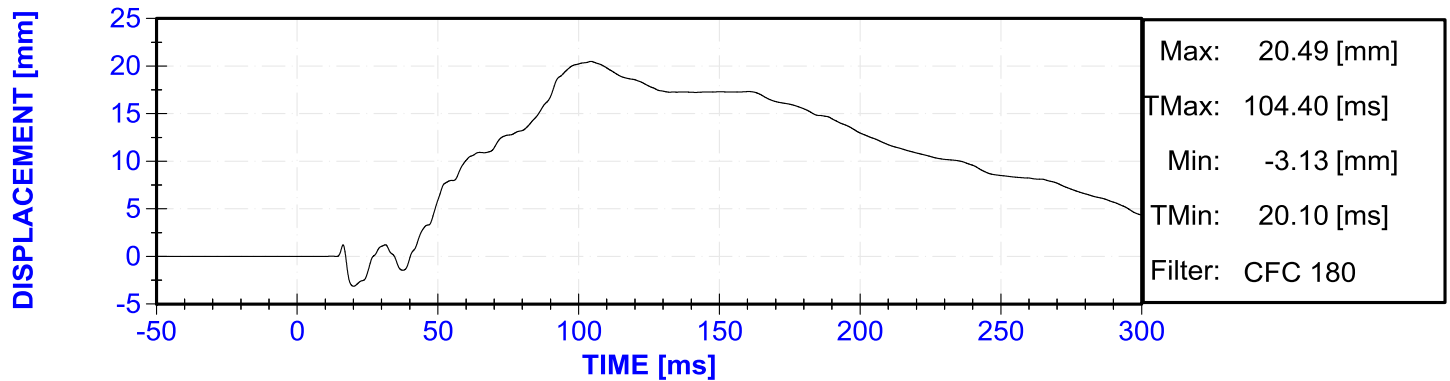
V2P1 Abdomen Left Lower Dx



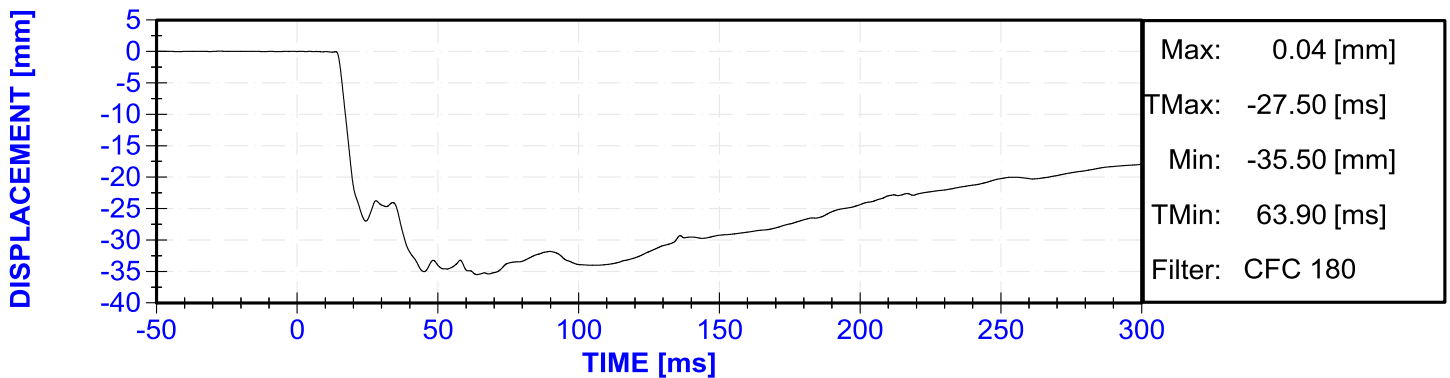
V2P1 Abdomen Left Lower Dy



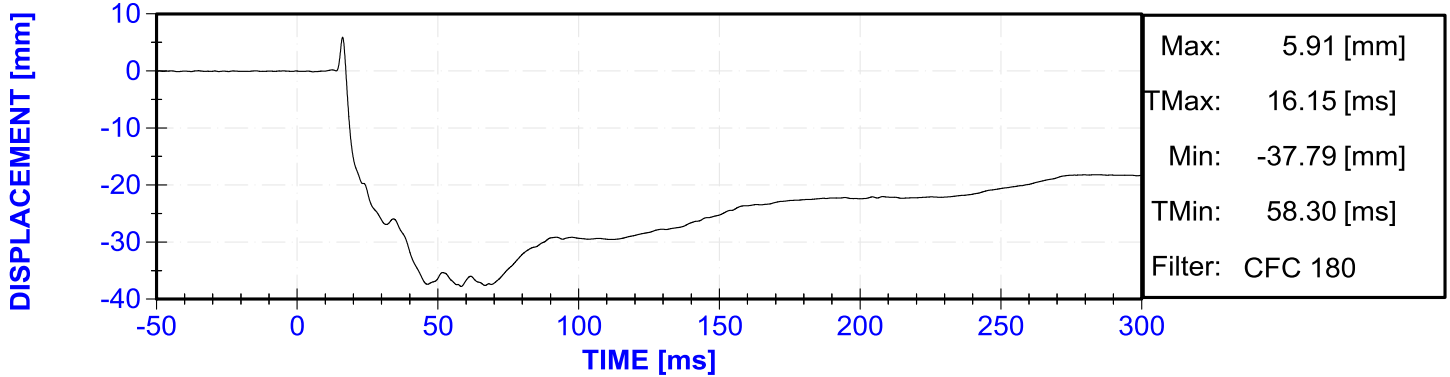
V2P1 Abdomen Left Lower Dz



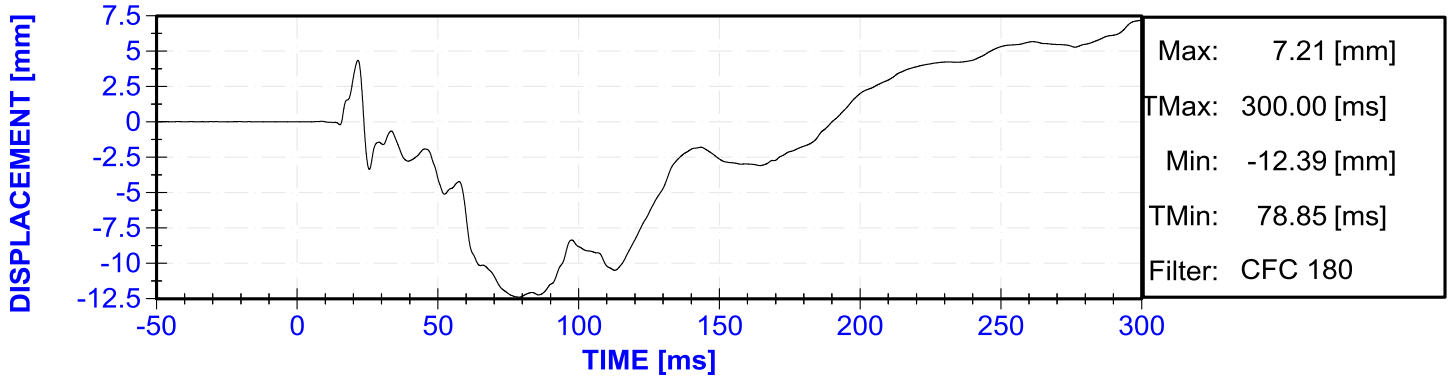
V2P1 Abdomen Left Lower D



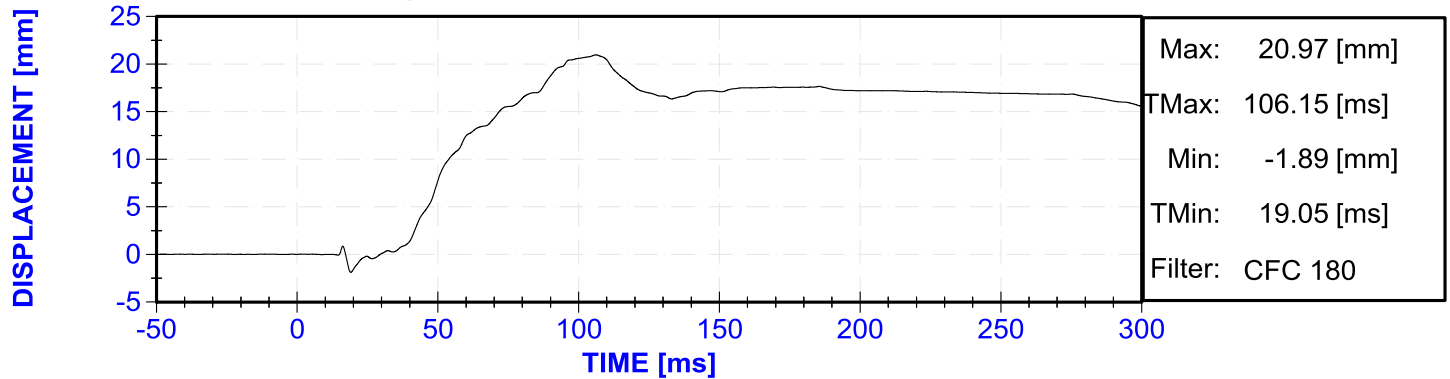
V2P1 Abdomen Right Lower Dx



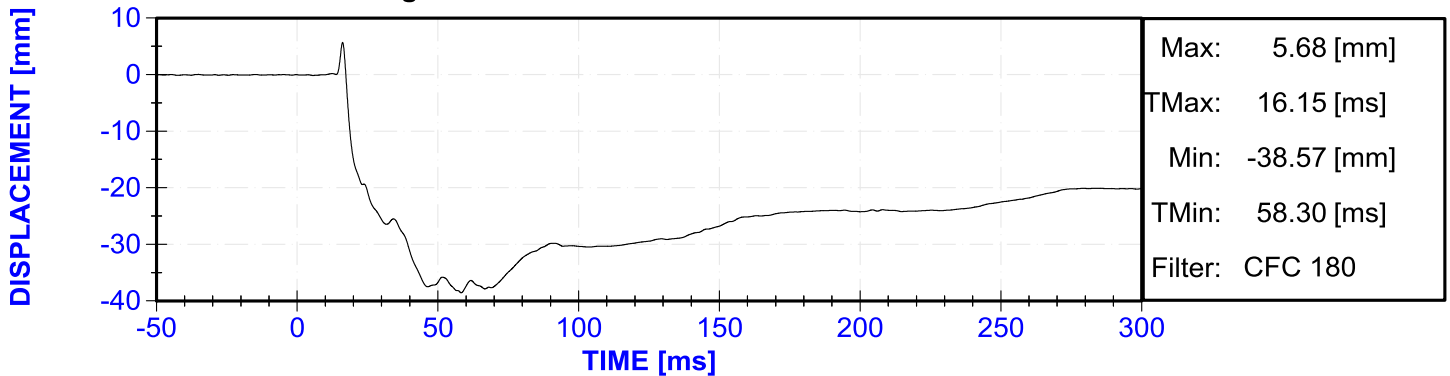
V2P1 Abdomen Right Lower Dy



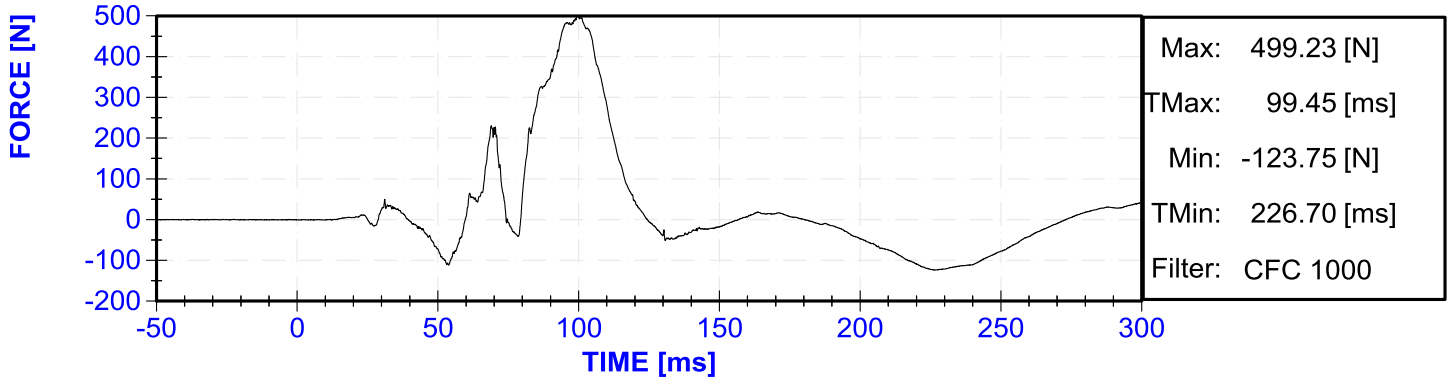
V2P1 Abdomen Right Lower Dz



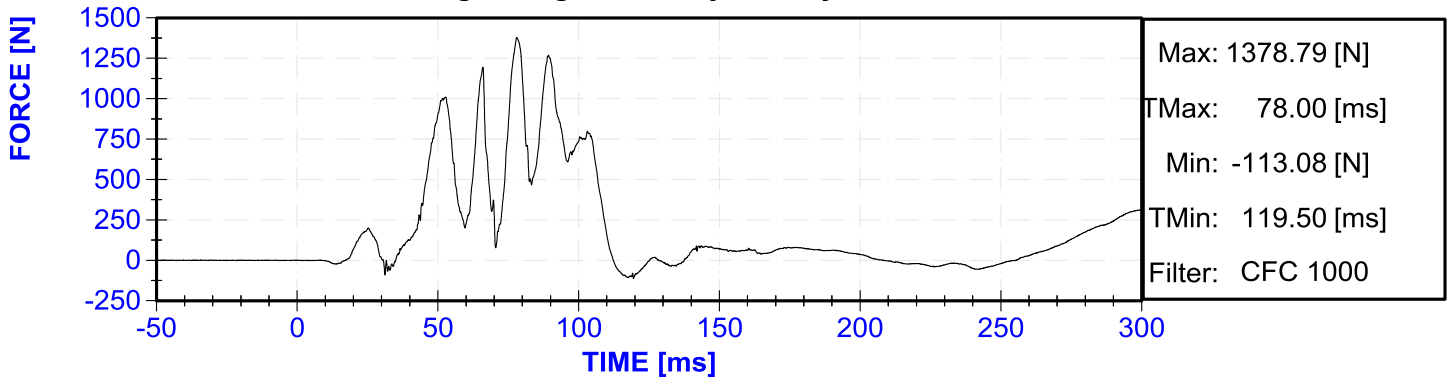
V2P1 Abdomen Right Lower D



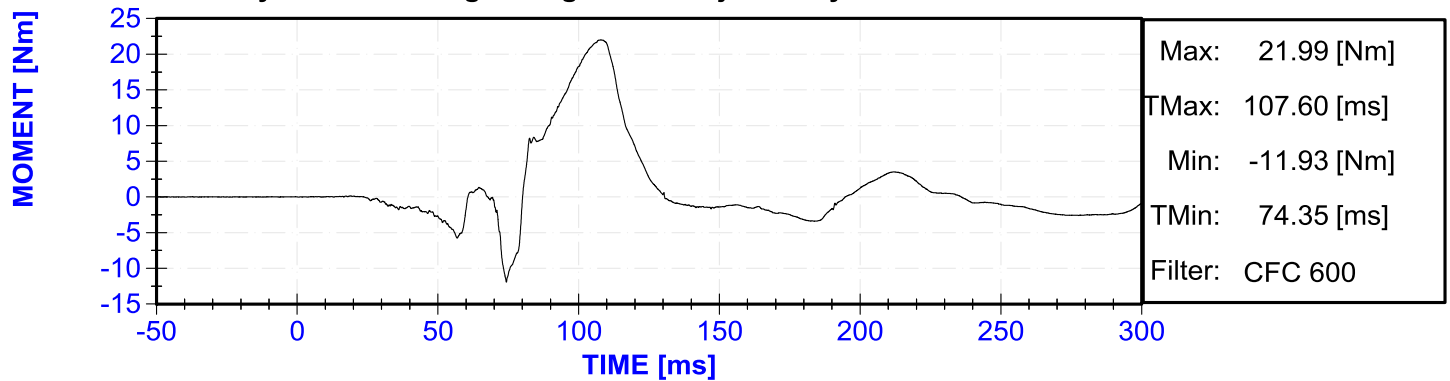
V2P2 Fx on head acting through the O.C. joint only



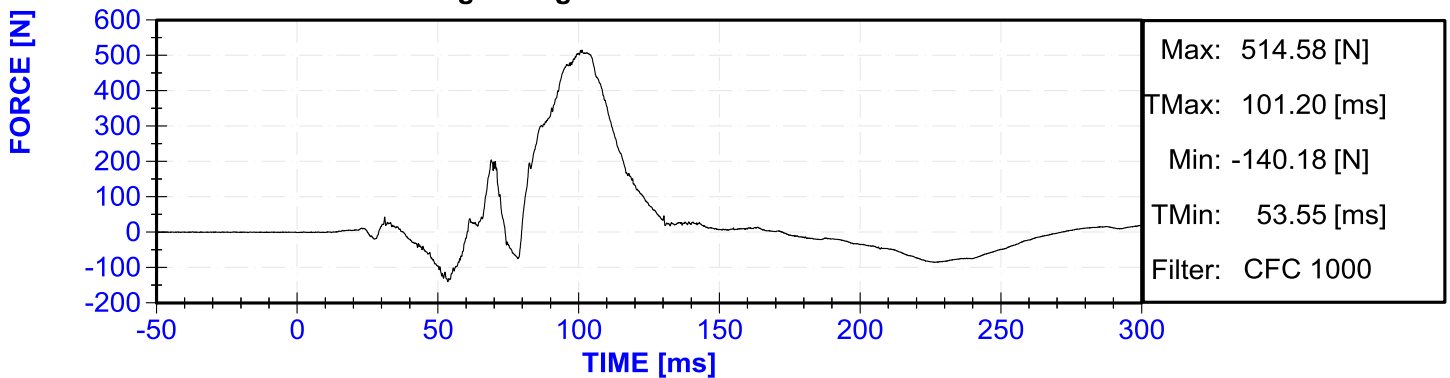
V2P2 Fz on head acting through the O.C. joint only



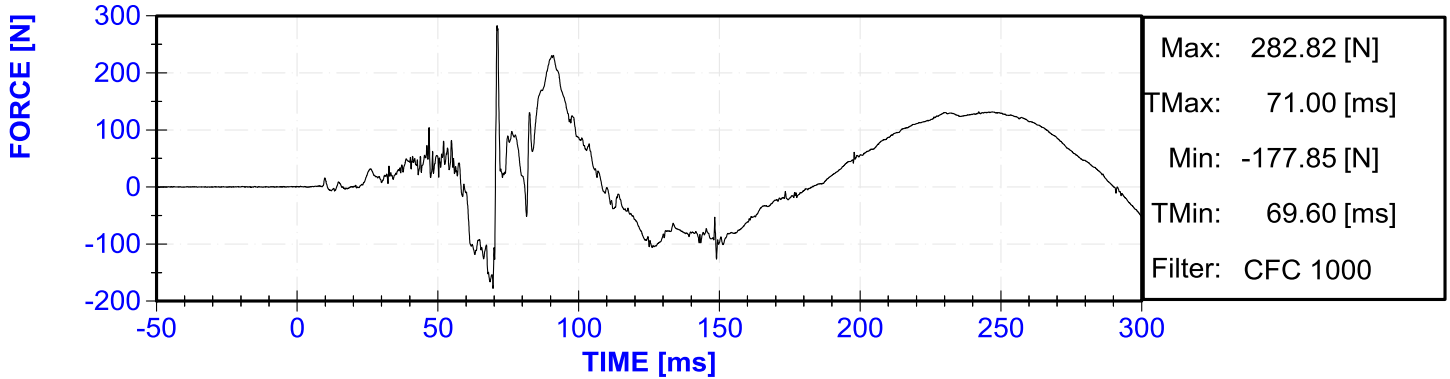
V2P2 My on head acting through the O.C. joint only



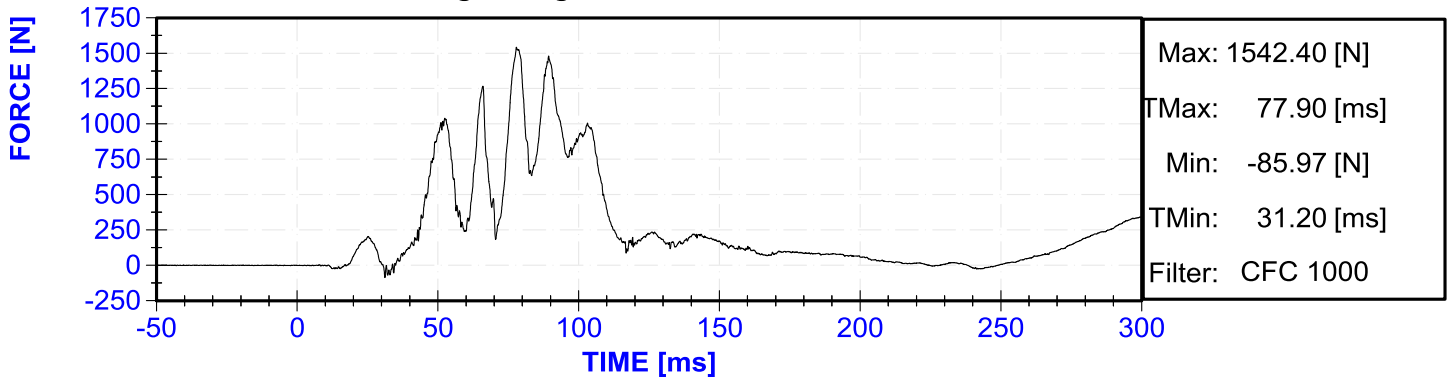
V2P2 Fx on head acting through the total neck section



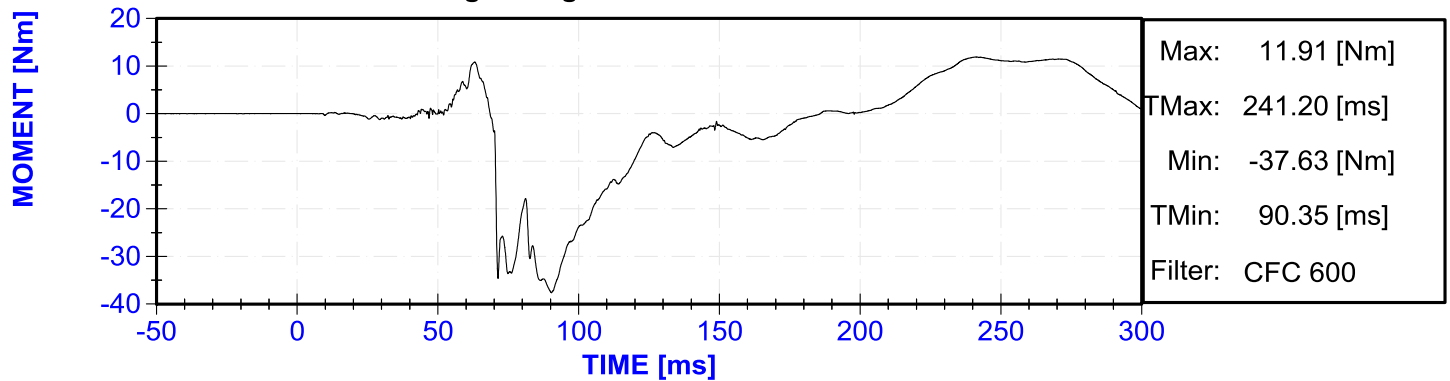
V2P2 Fy on head acting through the total neck section



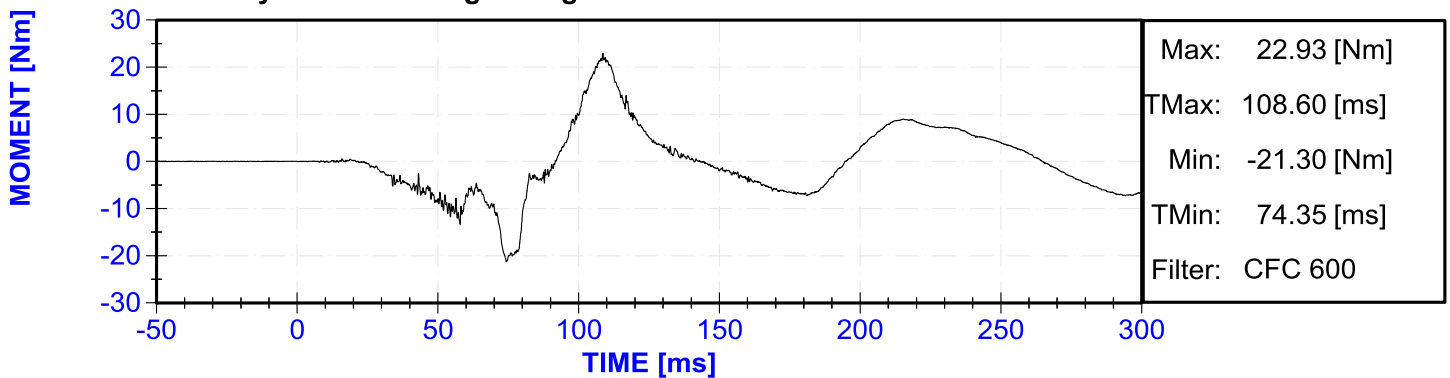
V2P2 Fz on head acting through the total neck section



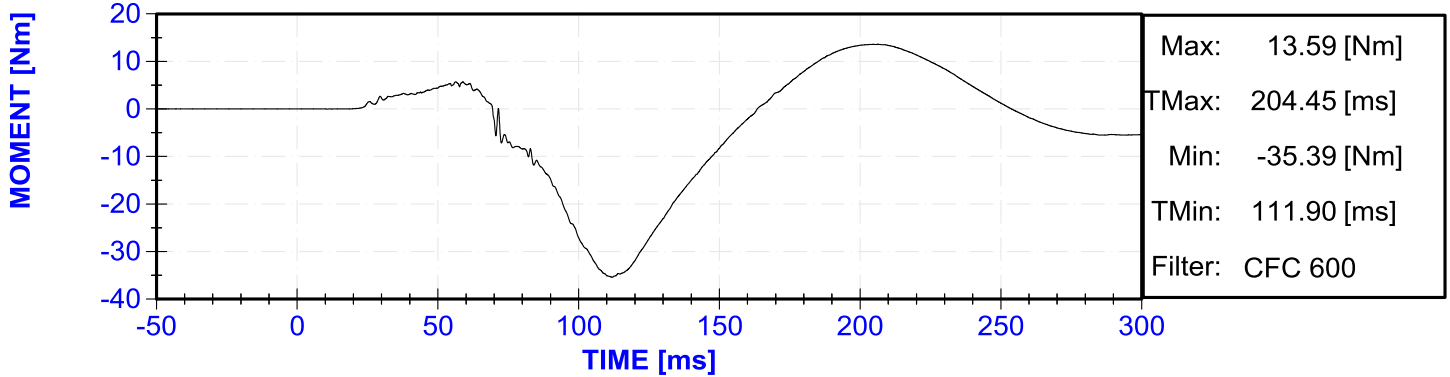
V2P2 Mx on head acting through the total neck section



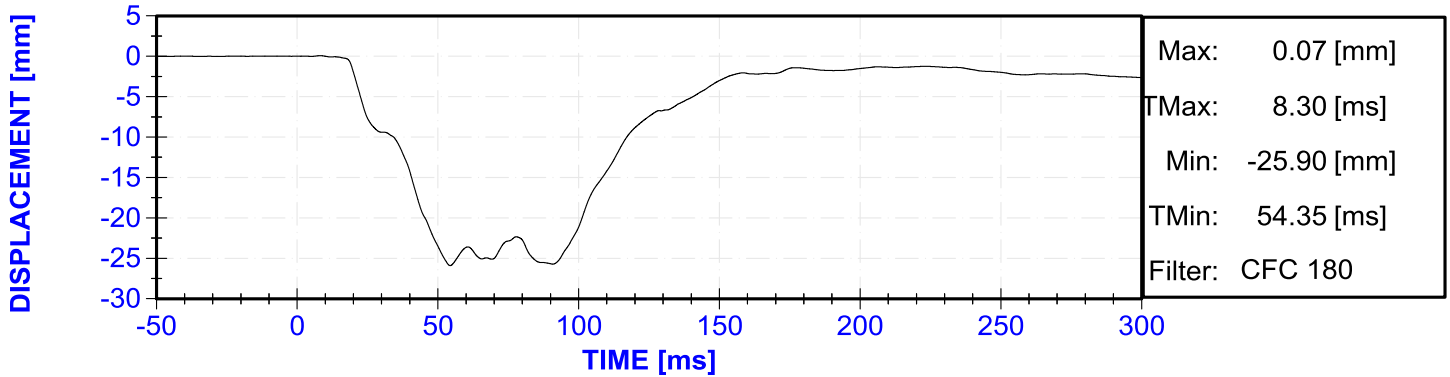
V2P2 My on head acting through the total neck section



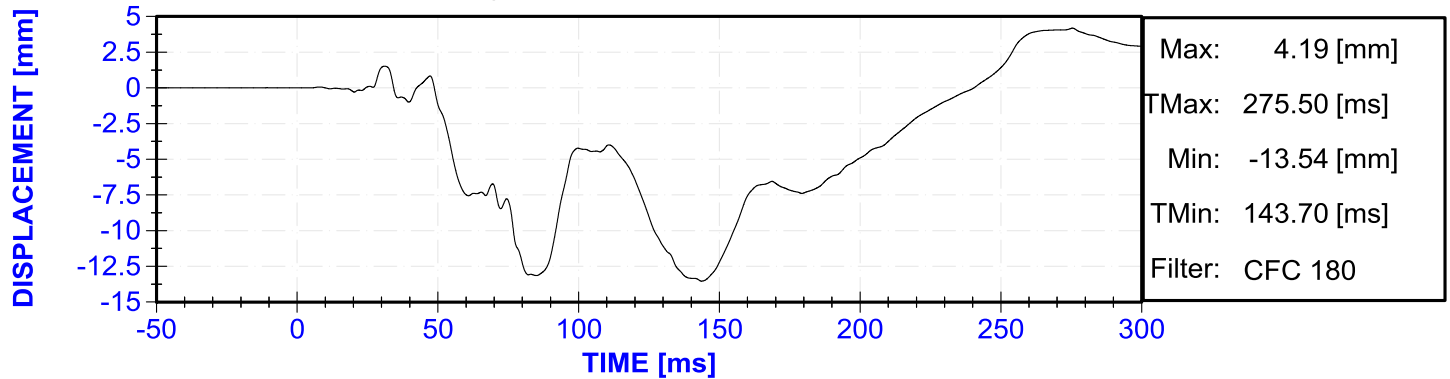
V2P2 Mz on head acting through the total neck section



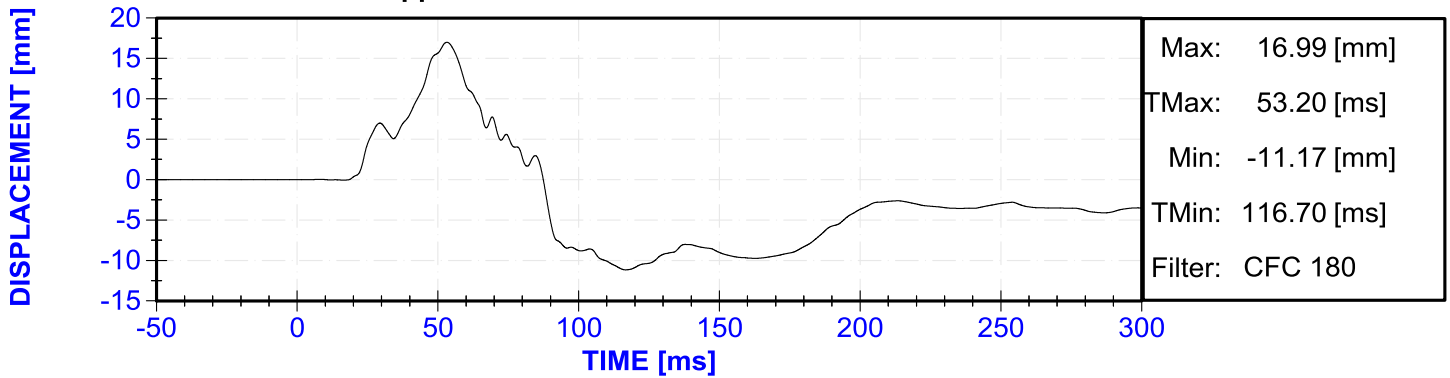
V2P2 Chest Left Upper Dx



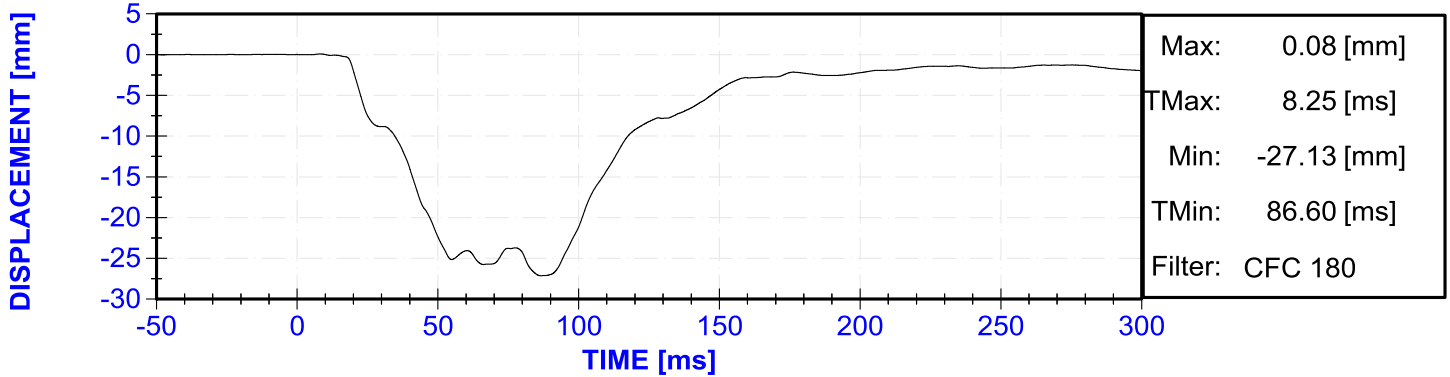
V2P2 Chest Left Upper Dy



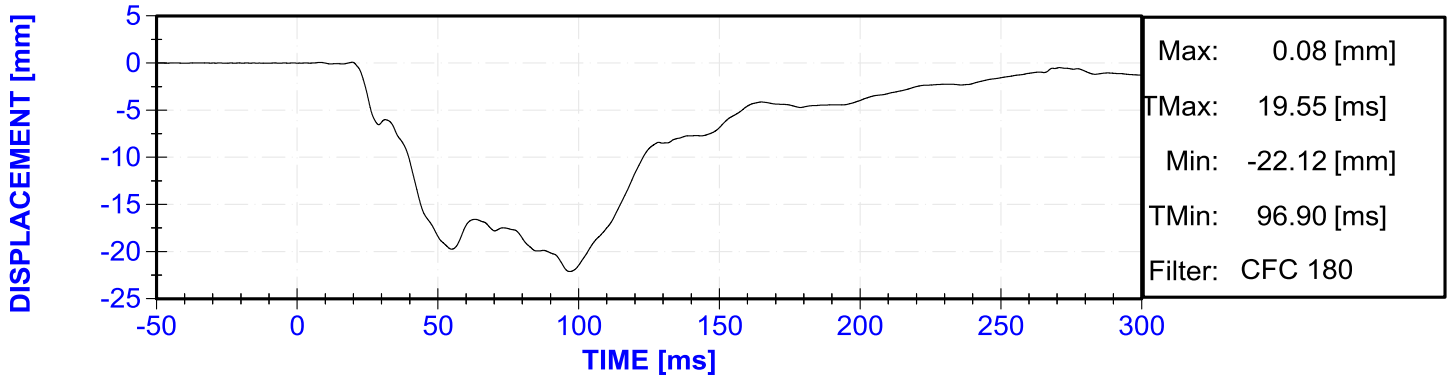
V2P2 Chest Left Upper Dz



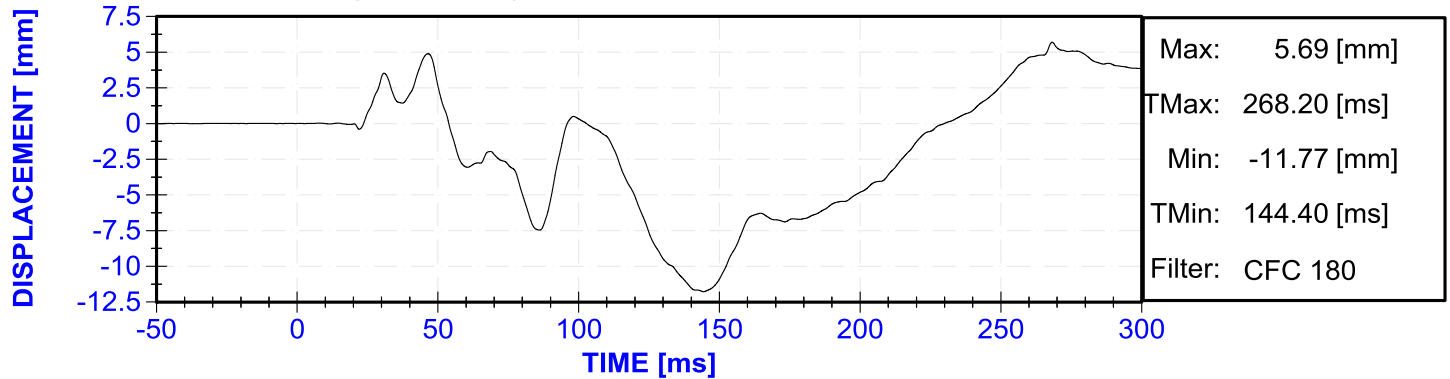
V2P2 Chest Left Upper D



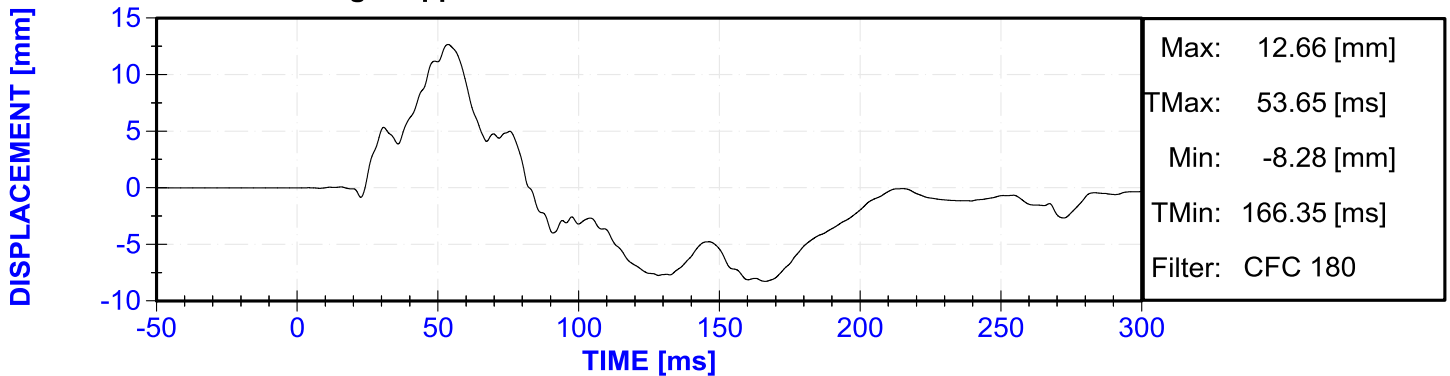
V2P2 Chest Right Upper Dx



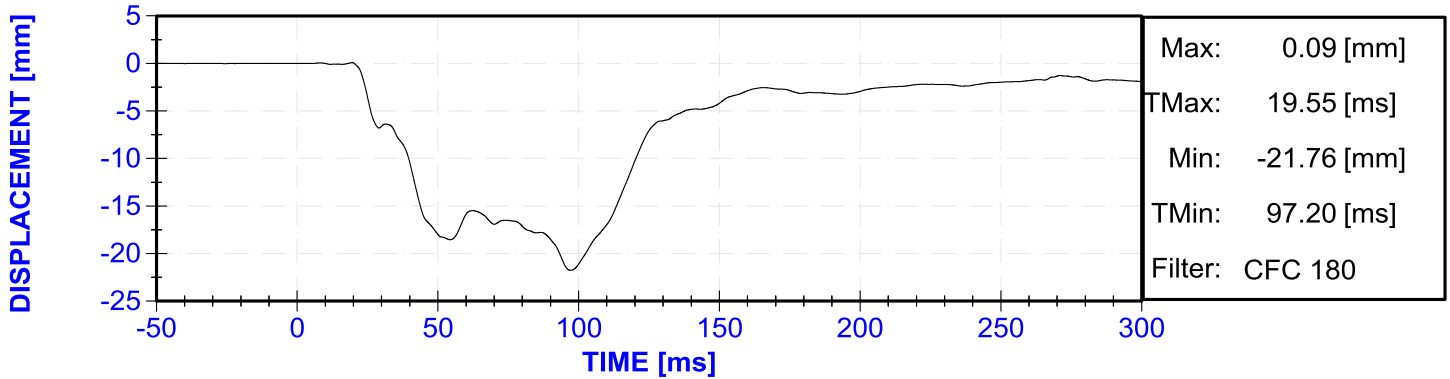
V2P2 Chest Right Upper Dy



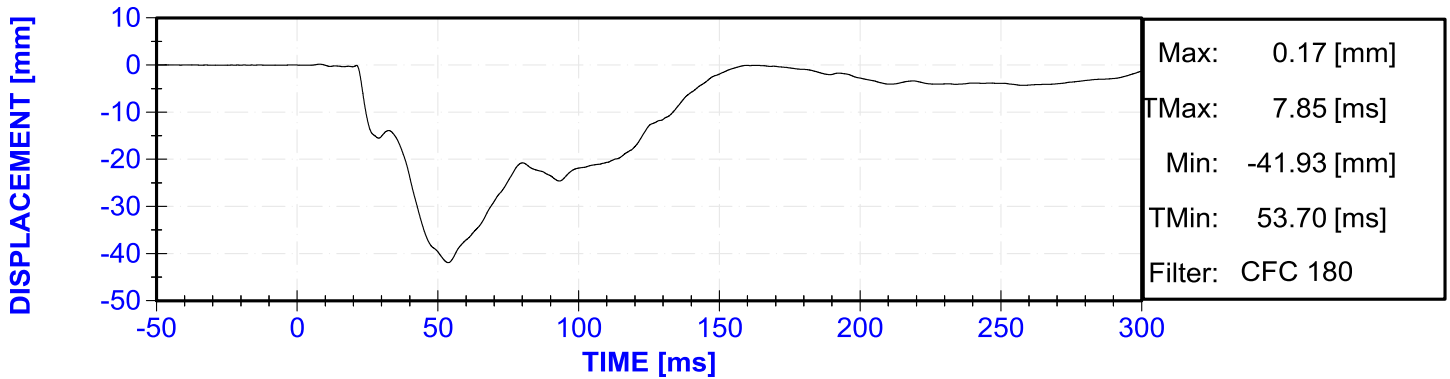
V2P2 Chest Right Upper Dz



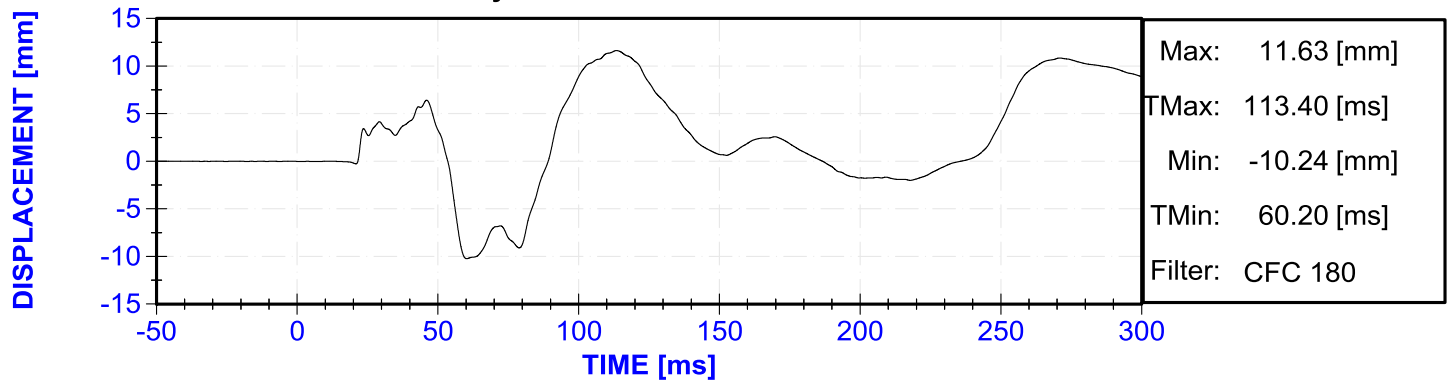
V2P2 Chest Right Upper D



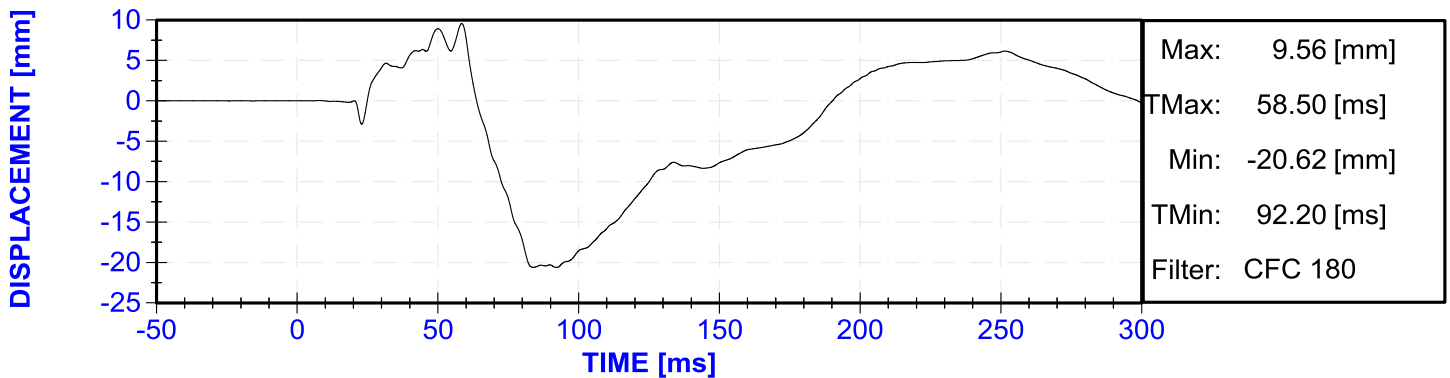
V2P2 Chest Left Lower Dx



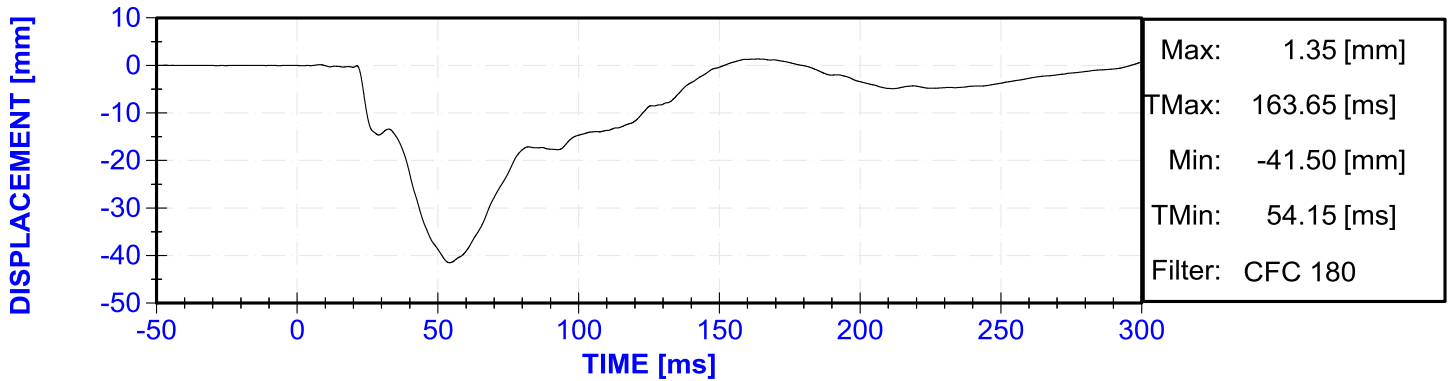
V2P2 Chest Left Lower Dy



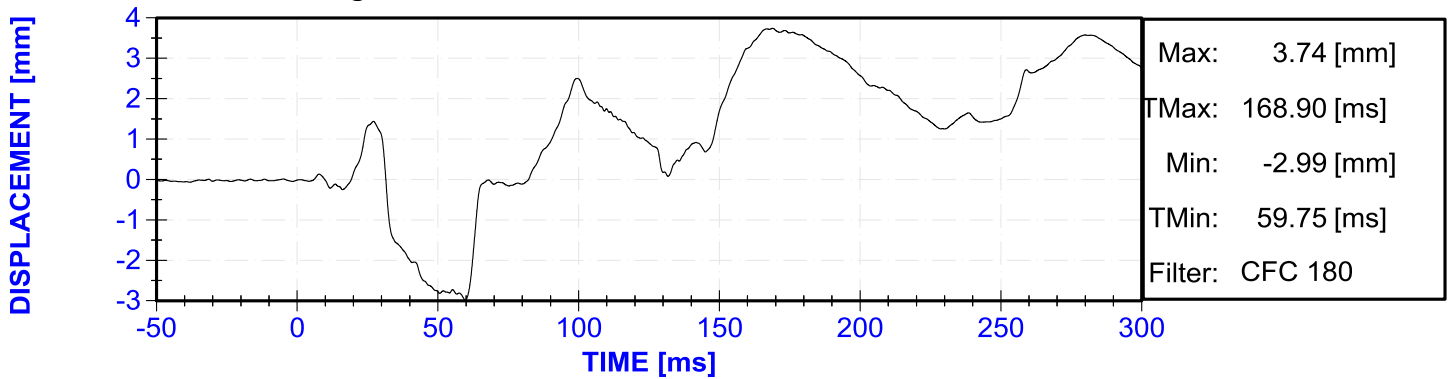
V2P2 Chest Left Lower Dz



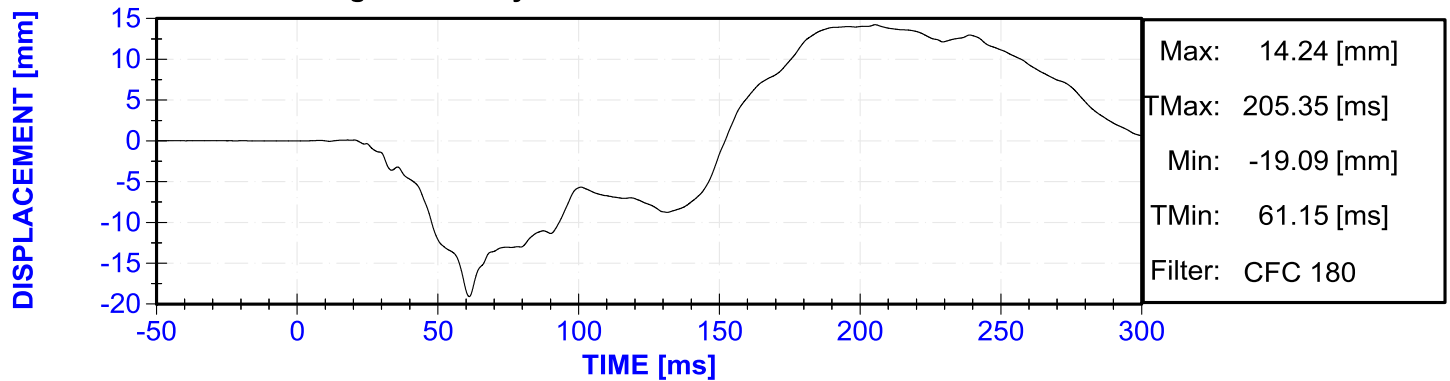
V2P2 Chest Left Lower D



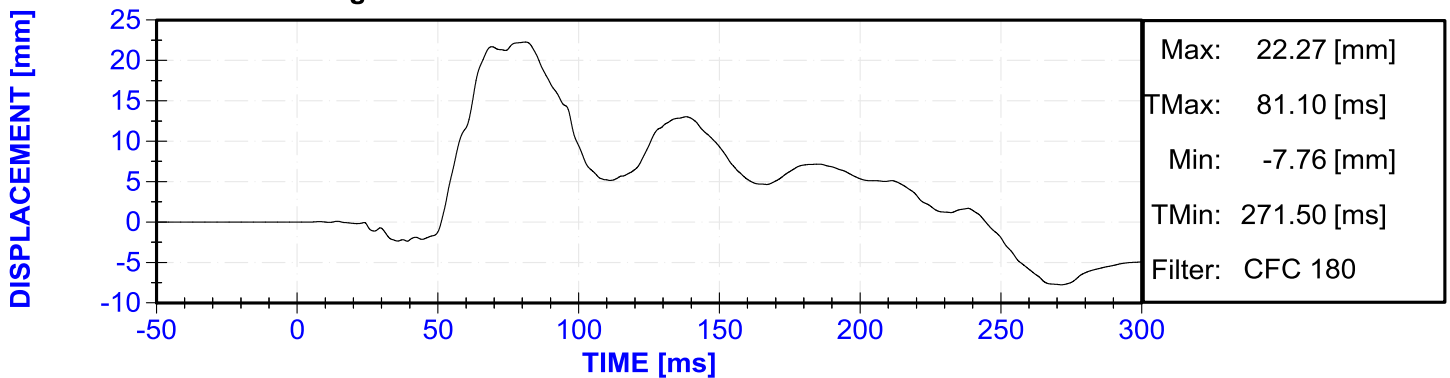
V2P2 Chest Right Lower Dx



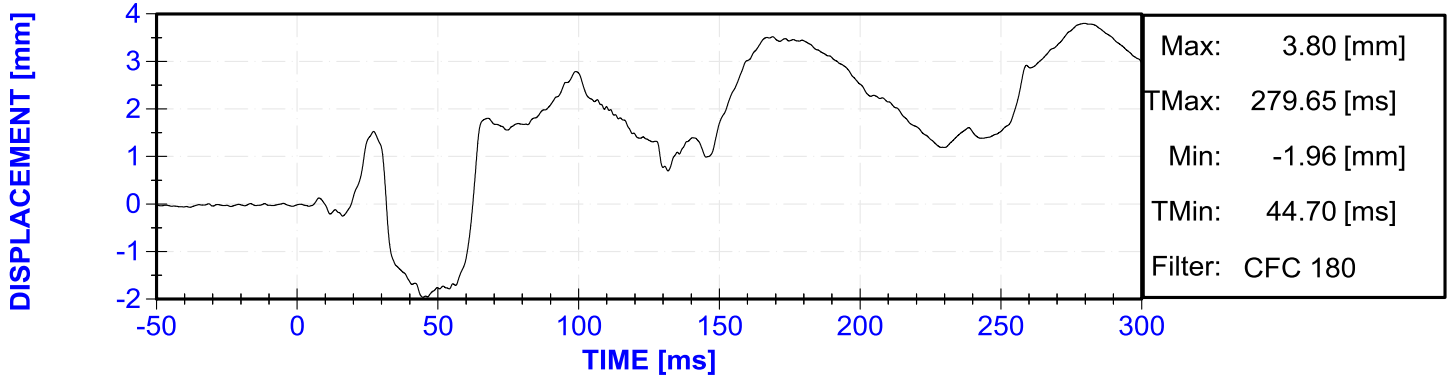
V2P2 Chest Right Lower Dy



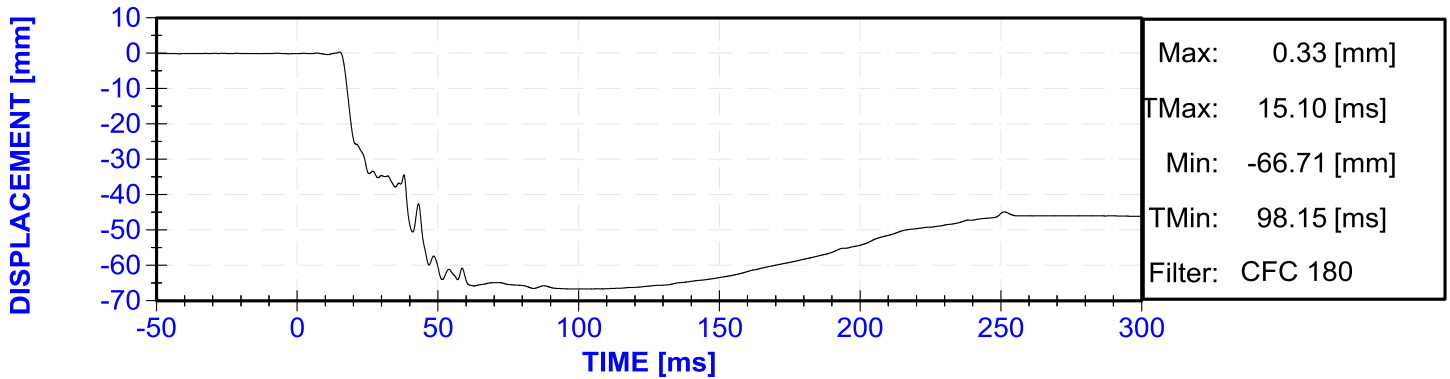
V2P2 Chest Right Lower Dz



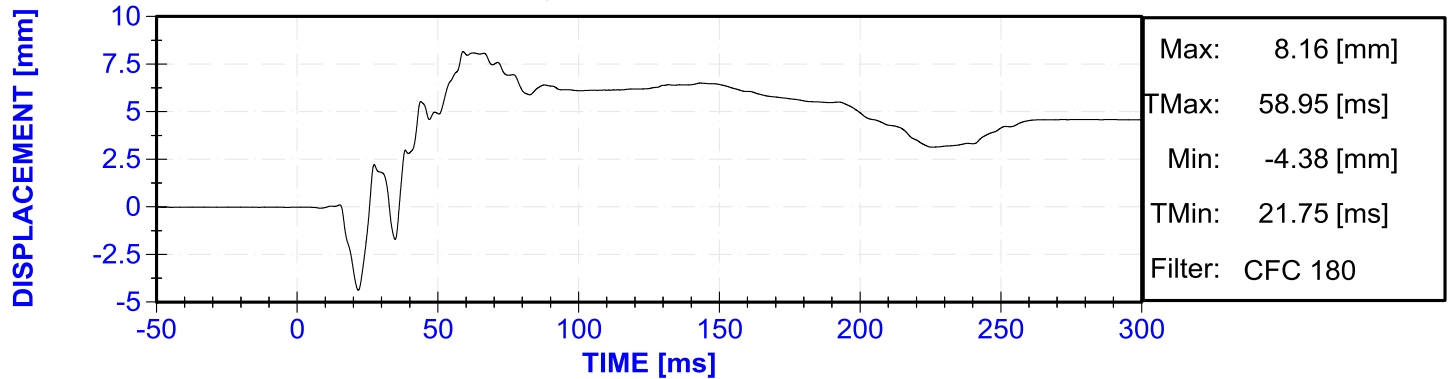
V2P2 Chest Right Lower D



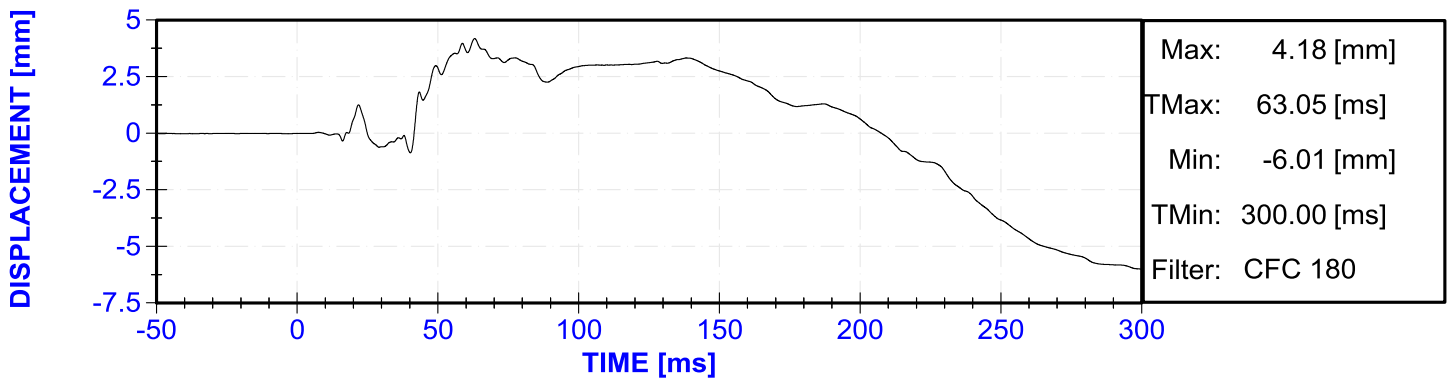
V2P2 Abdomen Left Lower Dx



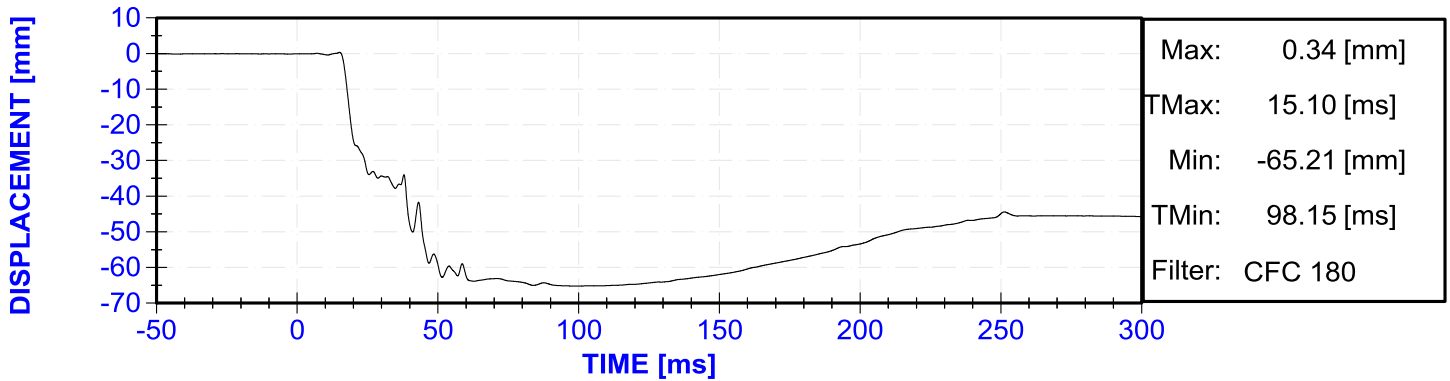
V2P2 Abdomen Left Lower Dy



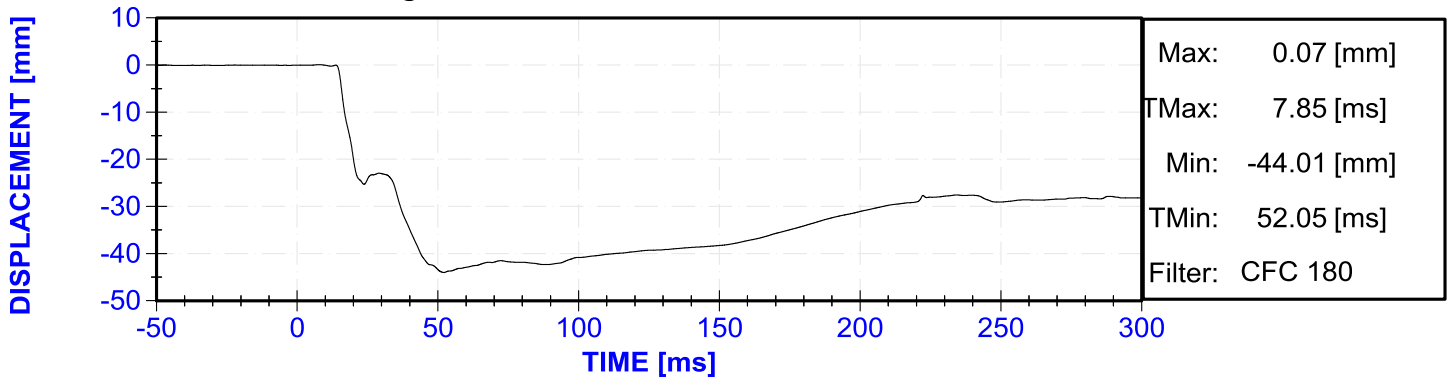
V2P2 Abdomen Left Lower Dz



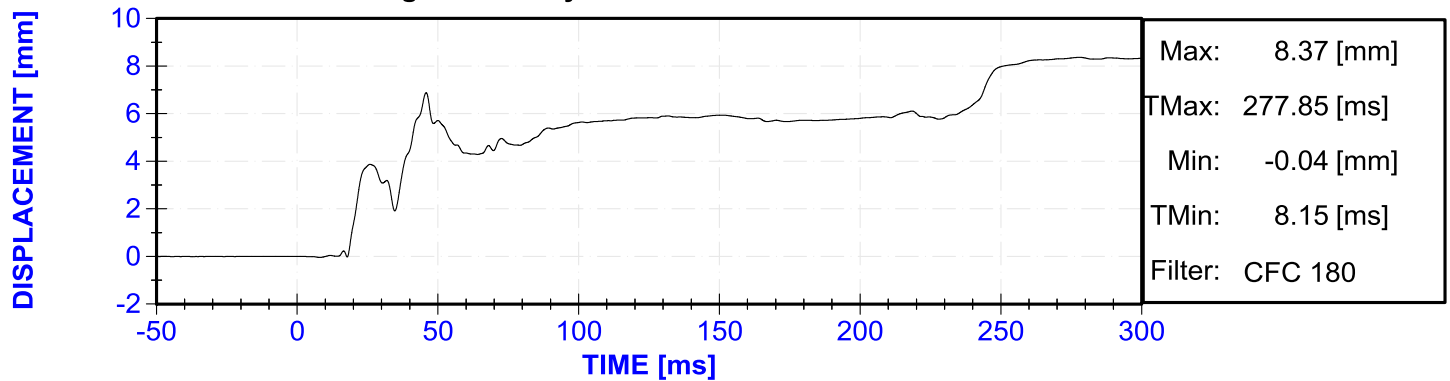
V2P2 Abdomen Left Lower D



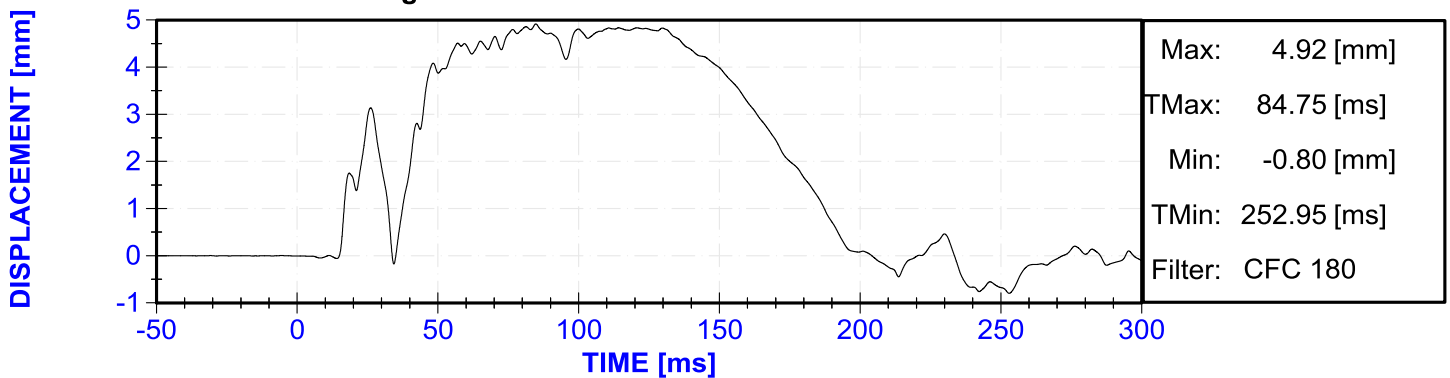
V2P2 Abdomen Right Lower Dx

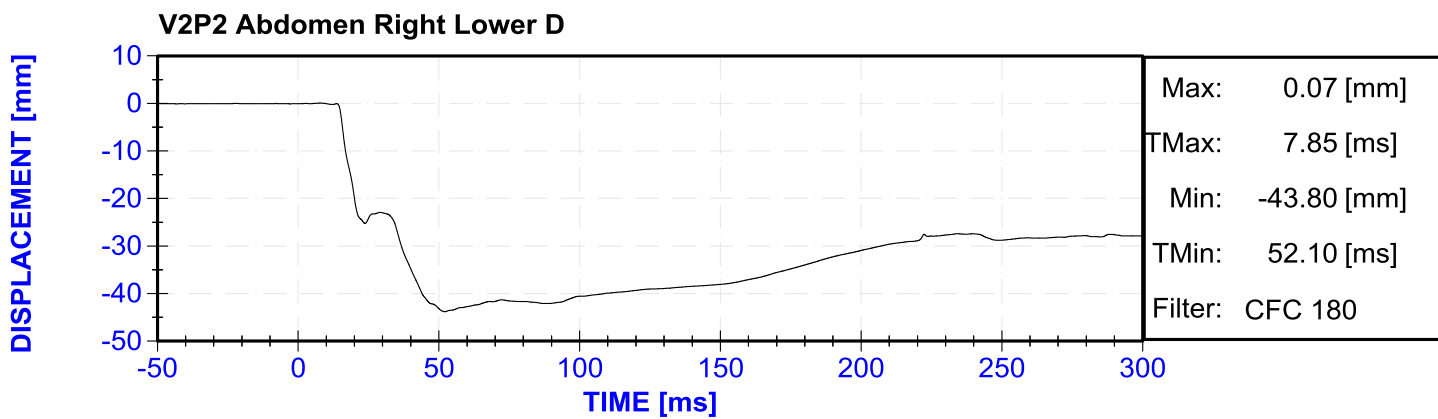


V2P2 Abdomen Right Lower Dy



V2P2 Abdomen Right Lower Dz





APPENDIX C

PART 572 E/O DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA SHEETS

Table C-1: Dummy Information

TYPE	DESCRIPTION	SERIAL NUMBER
THOR TK	50 TH Male	016
THOR TK	50 TH Male	015

Table C-2: Ankle Offset Files

THOR – TK S/N: 016					
LFTX	LFTY	LFTZ	RFTX	RFTY	RFTZ
Left Ankle X Rotation	Left Ankle Y Rotation	Left Ankle Z Rotation	Right Ankle X Rotation	Right Ankle Y Rotation	Right Ankle Z Rotation
-0.281010	13.9793		-0.926255	17.6868	
THOR – TK S/N: 015					
LFTX	LFTY	LFTZ	RFTX	RFTY	RFTZ
Left Ankle X Rotation	Left Ankle Y Rotation	Left Ankle Z Rotation	Right Ankle X Rotation	Right Ankle Y Rotation	Right Ankle Z Rotation
.762525	14.9331		-1.31005	13.7803	

Table C- 3: THOR Dummies Initial Set-Up Information

THOR – TK S/N: 016								
Sensor	Manufacturer	Serial #	Capacity	Units (M)	Range	CFC	Sensitivity (mv/V/EU)	Initial Offset (EU)
HEAD CG X	Endevco	AC-P74956	2000	g	2000	1000	0.01851	0.415576
HEAD CG Y	Endevco	AC-P51933	2000	g	2000	1000	0.01927	0
HEAD CG Z	Endevco	AC-P52069	2000	g	2000	1000	0.01904	0
HDCG Wx	DTS	ARS-5928	18000	deg/s	18000	1000	0.09340	-47.3992
HDCG Wy	DTS	ARS-5950	18000	deg/s	18000	1000	0.09373	-82.2398
HDCG Wz	DTS	ARS-5990	18000	deg/s	18000	1000	0.09396	-27.7157
NEKU Fx	Denton	LC-3454J-76Fx	8896	N	8896	1000	0.000231531	-1.74156
NEKU Fy	Denton	LC-3454J-76Fy	8896	N	8896	1000	0.000233790	-1.73876
NEKU Fz	Denton	LC-3454J-76Fz	13345	N	13345	1000	0.000088380	-7.82127
NEKU Mx	Denton	LC-3454J-76Mx	282	N-m	282	600	0.006027005	0
NEKU My	Denton	LC-3454J-76My	282	N-m	282	600	0.005967528	-0.165369
NEKU Mz	Denton	LC-3454J-76Mz	282	N-m	282	600	0.009944701	-0.0552506
NEKL Fx	Denton	LC-DM4552FX	13345	N	13345	1000	0.000170802	0
NEKL Fy	Denton	LC-DM4552FY	13345	N	13345	1000	0.000170203	0
NEKL Fz	Denton	LC-DM4552FZ	13345	N	13345	1000	0.000071152	0
NEKL Mx	Denton	LC-DM4552MX	452	N-m	452	600	0.004108075	-0.0885175
NEKL My	Denton	LC-DM4552MY	452	N-m	452	600	0.004134627	-0.0885933
NEKL Mz	Denton	LC-DM4552MZ	226	N-m	226	600	0.006758431	0
NKCF Fz	Denton	LC-6005J-77Fz	4448	N	4448	1000	0.000850317	-0.871135

THOR – TK (Continued)

S/N: 016

Sensor	Manufacturer	Serial #	Capacity	Units (M)	Range	CFC	Sensitivity (mv/V/EU)	Initial Offset (EU)
NKCR Fz	Denton	LC-6005J-78Fz	4448	N	4448	1000	0.000862839	0
HDOT RDy	Sfernice	DS-007	180	deg	160	180	3.045	0.0328407
SPNU Ax	Endevco	AC-P64099	2000	g	2000	180	0.02212	-0.821963
SPNU Ay	Endevco	AC-P58838	2000	g	2000	180	0.01904	-0.404008
SPNU Az	Entran	AC-02I02I05-F14	2000	g	2000	180	0.02184	0
SPNM Ax	Endevco	AC-P64002	2000	g	2000	180	0.01993	0.41813
SPNM Ay	Endevco	AC-P58735	2000	g	2000	180	0.01954	0.39367
SPNM Az	Entran	AC-03D03D16-F12	2000	g	2000	180	0.02265	0
CHLU Dx	Humanetics	DS-DM1151	3.3	V	3.3	600	Raw	0.144062
CHLU Ry	Humanetics	DS-DJ4106	180	deg	160	180	3.074	0
CHLU Rz	Humanetics	DS-DJ4108	180	deg	160	180	2.995	0.033389
CHRU Dx	Humanetics	DS-DI4716	3.3	V	3.3	600	Raw	0.125521
CHRU Ry	Humanetics	DS-DI2381	180	deg	160	180	3.029	0
CHRU Rz	Humanetics	DS-DI2380	180	deg	160	180	3.064	0
CHLL Dx	Humanetics	DS-DM1152	3.3	V	3.3	600	Raw	0.0989583
CHLL Ry	Humanetics	DS-DI7903	180	deg	160	180	2.997	0
CHLL Rz	Humanetics	DS-DJ0023	180	deg	160	180	3.065	-0.0326264
CHRL Dx	Humanetics	DS-DI4717	3.3	V	3.3	600	Raw	0.08
CHRL Ry	Humanetics	DS-DI2385	180	deg	160	180	2.584	0.0322497
CHRL Rz	Humanetics	DS-DI2384	180	deg	160	180	3.007	0
SPNL Fx	Denton	LC-92Fx	13345	N	13345	1000	0.000137463	2.60741
SPNL Fy	Denton	LC-92Fy	13345	N	13345	1000	0.000138198	-2.61227
SPNL Fz	Denton	LC-92Fz	17793	N	13345	1000	0.000052639	-5.21904
SPNL Mx	Denton	LC-92Mx	678	N-m	678	1000	0.002164893	0
SPNL My	Denton	LC-92My	904	N-m	904	1000	0.001775128	2.68257
PVCG Ax	Endevco	AC-P64087	2000	g	2000	1000	0.02017	0
PVCG Ay	Endevco	AC-P50065	2000	g	2000	1000	0.01704	0
PVCG Az	Endevco	AC-P64123	2000	g	2000	1000	0.01961	-0.392265
PVAL Fx	Humanetics	LC-84Fx	22241	N	22241	600	0.0001229300	8.70164
PVAL Fy	Humanetics	LC-84Fy	13345	N	13345	600	0.0000607883	0
PVAL Fz	Humanetics	LC-84Fz	13345	N	13345	600	0.0001661788	0
PVAR Fx	Humanetics	LC-77Fx	22241	N	22241	600	0.0001216936	-4.34865
PVAR Fy	Humanetics	LC-77Fy	13345	N	13345	600	0.0000598142	0
PVAR Fz	Humanetics	LC-77Fz	13345	N	13345	600	0.0001651371	2.61043
PILL Fx	Humanetics	LC-DI4774 Fx	13000	N	13000	600	0.000067785	5.07945
PILR Fx	Humanetics	LC-DI4775 Fx	13000	N	13000	600	0.000067854	12.7074
FMRL Fx	Humanetics	LC-108Fx	15000	N	15000	600	0.0001449	0
FMRL Fy	Humanetics	LC-108Fy	15000	N	15000	600	0.0001457	2.93308
FMRL Fz	Humanetics	LC-108Fz	15000	N	15000	600	0.0000750	-2.9304
FMRL Mx	Humanetics	LC-108Mx	350	N-m	350	600	0.0065318	-0.0686534
FMRL My	Humanetics	LC-108My	350	N-m	350	600	0.0065158	13.0026
FMRL Mz	Humanetics	LC-108Mz	350	N-m	350	600	0.0093691	-0.0684191
KNEL Dx	Space Age	DS-D2103665B	30	mm	20	180	23.87593	0.00418832
TBLU Fz	Denton	LC-4509J-110Fz	11120	N	11120	600	0.0000923	-6.52665
TBLU Mx	Denton	LC-4509J-110Mx	395	N-m	395	600	0.0073903	-0.0773214
TBLU My	Denton	LC-4509J-110My	395	N-m	395	600	0.0073054	0
TBLL Fz	Denton	LC-76Fz	11120	N	11120	600	0.0000948	-6.52486

THOR – TK (Continued) S/N: 016								
Sensor	Manufacturer	Serial #	Capacity	Units (M)	Range	CFC	Sensitivity (mv/V/EU)	Initial Offset (EU)
TBLL Mx	Denton	LC-76Mx	395	N	395	600	0.0074420	0
TBLL My	Denton	LC-76My	395	N	395	600	0.0073706	-0.0775281
ANKL Rx	Contelec	DS-001x	180	deg	150	180	3.20532	-0.28101
ANKL Ry	Contelec	DS-002y	180	deg	150	180	3.16119	13.9793
FOTL Az	Endevco	AC-J19244	2000	g	2000	1000	0.02590	2.36388
FMRR Fx	Humanetics	LC-DJ1045Fx	15000	N	15000	600	0.0001450	-2.9347
FMRR Fy	Humanetics	LC-DJ1045Fy	15000	N	15000	600	0.0001452	-2.93066
FMRR Fz	Humanetics	LC-DJ1045Fz	15000	N	15000	600	0.0000732	0
FMRR Mx	Humanetics	LC-DJ1045Mx	350	N-m	350	600	0.0065293	-0.0683731
FMRR My	Humanetics	LC-DJ1045My	350	N-m	350	600	0.0065638	0.0686265
FMRR Mz	Humanetics	LC-DJ1045Mz	350	N-m	350	600	0.0088260	0
KNER Dx	Space Age	DS-D2103657B	30	mm	20	180	24.06200	0.00415593
TBRU Fz	Denton	LC-4509J-107Fz	11120	N	11120	600	0.0000923	-6.52665
TBRU Mx	Denton	LC-4509J-107Mx	395	N-m	395	600	0.0073875	-0.0773507
TBRU My	Denton	LC-4509J-107My	395	N-m	395	600	0.0073329	0
TBRL Fz	Denton	LC-75Fz	11120	N	11120	600	0.0000958	0
TBRL Mx	Denton	LC-75Mx	395	N-m	395	600	0.0072968	0.0774273
TBRL My	Denton	LC-75My	395	N-m	395	600	0.0073137	0
ANKR Rx	Contelec	DS-004X	180	deg	150	180	3.16542	-0.92625
ANKR Ry	Contelec	DS-0534Y	180	deg	150	180	3.17825	17.6868
FOTR Az	Endevco	AC-P74773	2000	g	2000	1000	0.01818	-0.392896

THOR – TK S/N: 015								
Sensor	Manufacturer	Serial #	Capacity	Units (M)	Range	CFC	Sensitivity (mv/V/EU)	Initial Offset (EU)
HEAD CG X	Endevco	P63926	2000	g	2000	1000	0.01887	0
HEAD CG Y	Endevco	P64084	2000	g	2000	1000	0.02366	-1.95673
HEAD CG Z	Endevco	P51732	2000	g	2000	1000	0.01901	-0.404645
HDCG Wx	DTS	ARS4727	18000	deg/s	18000	1000	0.09212	-98.9425
HDCG Wy	DTS	ARS4712	18000	deg/s	18000	1000	0.09309	-11.7494
HDCG Wz	DTS	ARS4714	18000	deg/s	18000	1000	0.09443	-14.892
NEKU Fx	Denton	77	8896	N	8896	1000	0.000231857	-5.6069
NEKU Fy	Denton	77	8896	N	8896	1000	0.000228428	-0.875549
NEKU Fz	Denton	77	13345	N	13345	1000	0.000086454	2.31337
NEKU Mx	Denton	77	282	N-m	282	600	0.005888226	-0.0509491
NEKU My	Denton	77	282	N-m	282	600	0.005997267	-0.0333485
NEKU Mz	Denton	77	282	N-m	282	600	0.009965588	0.100345
NKCF Fz	Denton	LC-6005J-77Fz	80	N	4448	1000	0.000868639	0
NKCR Fz	Denton	LC-6005J-78Fz	75	N	4448	1000	0.000709137	0
HDOT RDy	Humanetics	DS-007	160	deg	160	180	3.036	0
SPNU Ax	Endevco	AC-P64099	2000	g	2000	180	0.01736	0
SPNU Ay	Entran	AC-P58838	2000	g	2000	180	0.02330	-1.18124
SPNU Az	Endevco	AC-02I02I05-F14	2000	g	2000	180	0.01914	0
SPNM Ax	Endevco	AC-P64002	2000	g	2000	180	0.01819	0.39268

THOR – TK (Continued)

S/N: 015

Sensor	Manufacturer	Serial #	Capacity	Units (M)	Range	CFC	Sensitivity (mv/V/EU)	Initial Offset (EU)
SPNM Ay	Endevco	P58717	2000	g	2000	180	0.01797	0
SPNM Az	Endevco	P63843	2000	g	2000	180	0.02361	-0.784351
CHLU Dx	Humanetics	DK3867	3.3	V	3.3	600	Raw	0.112292
CHLU Ry	Humanetics	DJ5448	180	deg	160	180	3.074	-0.0325309
CHLU Rz	Humanetics	DJ5449	180	deg	160	180	3.042	0
CHRU Dx	Humanetics	DK3868	3.3	V	3.3	600	Raw	0.10875
CHRU Ry	Humanetics	DJ5451	180	deg	160	180	3.045	0
CHRU Rz	Humanetics	DJ5450	180	deg	160	180	3.032	0
CHLL Dx	Humanetics	DI4718	3.3	V	3.3	600	Raw	0.0783333
CHLL Ry	Humanetics	DI2386	180	deg	160	180	2.958	0
CHLL Rz	Humanetics	DI6129	180	deg	160	180	3.053	0.0327547
CHRL Dx	Humanetics	DJ2614	3.3	V	3.3	600	Raw	0.0870833
CHRL Ry	Humanetics	DJ4107	180	deg	160	180	2.978	0.0335796
CHRL Rz	Humanetics	DJ4109	180	deg	160	180	3.045	0
SPNL Fx	Denton	125	13345	N	13345	1000	0.000142439	-2.80822
SPNL Fy	Denton	125	13345	N	13345	1000	0.000142551	0.701503
SPNL Fz	Denton	125	17793	N	13345	1000	0.000061260	4.89716
SPNL Mx	Denton	125	678	N-m	678	1000	0.002138341	-0.420887
SPNL My	Denton	125	904	N-m	904	1000	0.001834428	0.272565
PVCG Ax	Endevco	P51294	2000	g	2000	1000	0.02201	0
PVCG Ay	Endevco	P63857	2000	g	2000	1000	0.02371	1.57668
PVCG Az	Endevco	P59011	2000	g	2000	1000	0.01781	0
PVAL Fx	Humanetics	83	22241	N	22241	600	0.0001206055	9.12061
PVAL Fy	Humanetics	83	13345	N	13345	600	0.0000591322	15.2284
PVAL Fz	Humanetics	83	13345	N	13345	600	0.0001630614	-5.51941
PVAR Fx	Humanetics	79	22241	N	22241	600	0.0001206190	-9.94868
PVAR Fy	Humanetics	79	13345	N	13345	600	0.0000595968	-6.71141
PVAR Fz	Humanetics	79	13345	N	13345	600	0.0001636234	2.44464
PILL Fx	Humanetics	DJ5524	13000	N	13000	600	0.000070654	-10.1641
PILR Fx	Humanetics	77	13000	N	13000	600	0.000068416	-7.62598
FMRL Fx	Humanetics	DM4951	15000	N	15000	600	0.000142057	-2.93309
FMRL Fy	Humanetics	DM4951	15000	N	15000	600	0.000142086	-2.9325
FMRL Fz	Humanetics	DM4951	15000	N	15000	600	0.000071741	5.86907
FMRL Mx	Humanetics	DM4951	350	N-m	350	600	0.006425656	-0.137116
FMRL My	Humanetics	DM4951	350	N-m	350	600	0.006432760	-0.0684821
FMRL Mz	Humanetics	DM4951	350	N-m	350	600	0.009035044	0
KNEL Dx	Space Age	C2102639B	30	mm	20	180	24.03214	0.00832219
TBLU Fz	Denton	106	11120	N	11120	600	0.00009360	-6.52776
TBLU Mx	Denton	106	395	N-m	395	600	0.00741550	-0.155003
TBLU My	Denton	106	395	N-m	395	600	0.00742091	0
TBLL Fz	Denton	139	11120	N	11120	600	0.00009648	4.34585

THOR – TK (Continued) S/N: 015								
Sensor	Manufacturer	Serial #	Capacity	Units (M)	Range	CFC	Sensitivity (mv/V/EU)	Initial Offset (EU)
TBLL Mx	Denton	139	395	N	395	600	0.00749952	-0.0775243
TBLL My	Denton	139	395	N	395	600	0.00754555	-0.077502
ANKL Rx	Contelec	7921-0382	180	deg	150	180	3.18215	0.762525
ANKL Ry	Contelec	7921-0386	180	deg	150	180	3.17717	14.9331
FOTL Az	Endevco	J27525	2000	g	2000	1000	0.02143	6.36321
FMRR Fx	Humanetics	DM4950	15000	N	15000	600	0.000141110	0
FMRR Fy	Humanetics	DM4950	15000	N	15000	600	0.000141643	0
FMRR Fz	Humanetics	DM4950	15000	N	15000	600	0.000071653	-8.79589
FMRR Mx	Humanetics	DM4950	350	N-m	350	600	0.006388454	0.0686546
FMRR My	Humanetics	DM4950	350	N-m	350	600	0.006411979	-0.136805
FMRR Mz	Humanetics	DM4950	350	N-m	350	600	0.008857852	0
KNER Dx	Space Age	I1807966B	30	mm	20	180	23.38064	0
TBRU Fz	Denton	88	11120	N	11120	600	0.00009280	-4.34511
TBRU Mx	Denton	88	395	N-m	395	600	0.00726490	0
TBRU My	Denton	88	395	N-m	395	600	0.00725530	0
TBRL Fz	Denton	140	11120	N	11120	600	0.00009658	0
TBRL Mx	Denton	140	395	N-m	395	600	0.00760594	0
TBRL My	Denton	140	395	N-m	395	600	0.00764658	0
ANKR Rx	Contelec	7921-0385	180	deg	150	180	3.18522	-1.31005
ANKR Ry	Contelec	7921-0383	180	deg	150	180	3.18949	13.7803
FOTR Az	Endevco	P58616	2000	g	2000	1000	0.01995	0

Table C-4: THOR Dummy Initial Set-Up Information (IR-TRACC)

THOR – TK S/N: 016			
Sensor	IR-TRACC Exponent	IR-TRACC Slope	IR-TRACC Intercept
CHLU Dx	-0.54440	26.4269	N/A
CHRU Dx	-0.4872	31.6935	N/A
CHLL Dx	-0.49197	31.3308	N/A
CHRL Dx	-0.4865	30.3707	N/A
ABDL Dx	N/A	N/A	N/A
ABDR Dx	N/A	N/A	N/A
THOR – TK S/N: 015			
Sensor	IR-TRACC Exponent	IR-TRACC Slope	IR-TRACC Intercept
CHLU Dx	-0.5268	28.0630	N/A
CHRU Dx	-0.4888	31.4311	N/A
CHLL Dx	-0.4500	34.0200	N/A
CHRL Dx	-0.4647	34.5897	N/A
ABDL Dx	N/A	N/A	N/A
ABDR Dx	N/A	N/A	N/A

Table 5 – THOR IR-TRACC Polarity

In order to reduce the risk of damage to instrumentation, it is recommended that the 3D IR-TRACC units are not disconnected from the rib cage to conduct the polarity test. An alternate procedure for checking the IR-TRACC polarity is described below.

1. Using the data acquisition system control software, open a live view of each channel. If possible, view the DX, RY, and RZ components of a given quadrant simultaneously.
2. Record the initial reading of each channel
3. Perform the following motions on each of the four rib attachment locations and two abdomen attachment locations (specified by the hexagonal bolt attaching the blue ribs).
 - a. DX: Push inward (front-to-back). The IR-TRACC tube voltage should increase.
 - b. RY: Push downward (head-to-pelvis). The Y-axis potentiometer reading should decrease.
 - c. RZ: Push rightward (left-to-right). The Z-axis potentiometer should increase.
4. Record the final reading of each channel
5. If the “Measured” value (increase or decrease) does not match the “Expected” value, the polarity of the channel must be inverted.

THOR 016

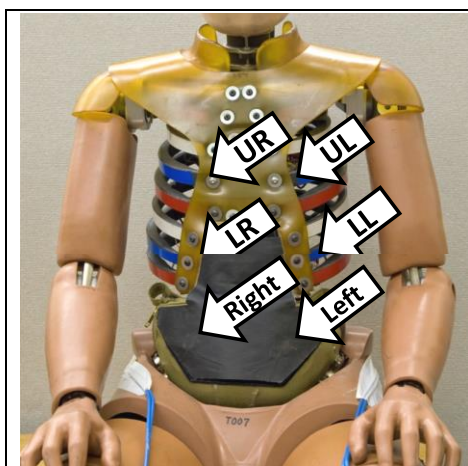


Figure 1. Manipulation to determine thoracic and abdominal IR-TRACC polarity.

Channel	Motion
DX	Push inward
RY	Push upward
RZ	Push rightward

Upper Right Thorax				Upper Left Thorax			
Channel	Initial Value	Expected Polarity	Recorded Polarity	Channel	Initial Value	Expected Polarity	Recorded Polarity
DX (V)	0.12625	+	+	DX (V)	0.14208	+	+
RY (Deg)	8.1864	+	+	RY (Deg)	3.5479	+	+
RZ (Deg)	-8.7763	+	+	RZ (Deg)	11.9783	+	+
Lower Right Thorax				Lower Left Thorax			
Channel	Initial Value	Expected Polarity	Recorded Polarity	Channel	Initial Value	Expected Polarity	Recorded Polarity
DX (V)	0.07354	+	+	DX (V)	0.08948	+	+
RY (Deg)	0.77097	+	+	RY (Deg)	3.7068	+	+
RZ (Deg)	-6.8798	+	+	RZ (Deg)	7.1676	+	+
Abdomen Right				Abdomen Left			
Channel	Initial Value	Expected Polarity	Recorded Polarity	Channel	Initial Value	Expected Polarity	Recorded Polarity
DX (V)	N/A	+	N/A	DX (V)	N/A	+	N/A
RY (Deg)	N/A	+	N/A	RY (Deg)	N/A	+	N/A
RZ (Deg)	N/A	+	N/A	RZ (Deg)	N/A	+	N/A

THOR 015

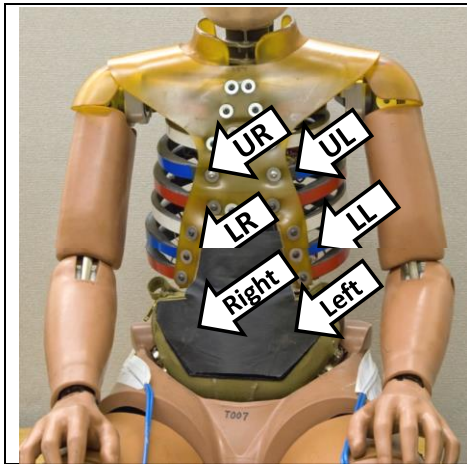


Figure 2. Manipulation to determine thoracic and abdominal IR-TRACC polarity.

Channel	Motion
DX	Push inward
RY	Push upward
RZ	Push rightward

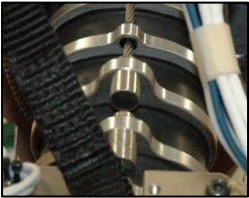
Upper Right Thorax				Upper Left Thorax			
Channel	Initial Value	Expected Polarity	Recorded Polarity	Channel	Initial Value	Expected Polarity	Recorded Polarity
DX (V)	0.10823	+	+	DX (V)	0.11271	+	+
RY (Deg)	6.54762	+	+	RY (Deg)	8.5546	+	+
RZ (Deg)	-16.135	+	+	RZ (Deg)	14.2536	+	+
Lower Right Thorax				Lower Left Thorax			
Channel	Initial Value	Expected Polarity	Recorded Polarity	Channel	Initial Value	Expected Polarity	Recorded Polarity
DX (V)	0.07854	+	+	DX (V)	0.07073	+	+
RY (Deg)	3.8564	+	+	RY (Deg)	4.5322	+	+
RZ (Deg)	-9.8420	+	+	RZ (Deg)	6.39228	+	+
Abdomen Right				Abdomen Left			
Channel	Initial Value	Expected Polarity	Recorded Polarity	Channel	Initial Value	Expected Polarity	Recorded Polarity
DX (V)	N/A	+	N/A	DX (V)	N/A	+	N/A
RY (Deg)	N/A	+	N/A	RY (Deg)	N/A	+	N/A
RZ (Deg)	N/A	+	N/A	RZ (Deg)	N/A	+	N/A

THOR Inspection Checklist

Date: 07/11/2014	
NHTSA Representative: James Saunders	
Inspection Reporter: Rick Weil, Mary Geesey	
Inspection type (check one): ☒ Pre-Test ☐ Post-Test	
Dummy S/N: 0015	Legs S/N: LX0038/LX0039
Dummy Description: THOR NT 50th Male	
Date of last Certification: Certification performed in May 2014	
<u>Tests conducted since last full certification or inspection:</u> Since last inspection: R20145372 – Honda Accord Since last certification: R20145400 – Mazda 3 R20145401 – Mazda CX-5 CAL2712 - Research Vehicle 2712 R20145372 – Honda Accord R20144143 – 2014 Toyota Camry R20145373 – Honda Odyssey	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> 11ACTBRI00THFOZP, Acetabular Right Z Force, Channel failed., SN:LC-87 Fz – Repaired broken +SIG wire found 6” from the connector. 11KNSLLE00THDSXP, Knee Left X Displacement, Questionable magnitude (Possible failure), SN:DS-D2103665B – Repaired broken –SIG wire at thigh splice 11KNSLRI00THDSXP, Knee Right X Displacement, Possible failure, SN:DS- D2103657B – Could not duplicate issue, replaced adapter to be safe.	
<u>Physical evidence of damage:</u> See Report – Light scuffing, right leg	
<u>Anecdotal evidence of damage:</u> None	
<u>Equipment delivered to Borrower:</u> THOR 0015 ATD 26 Accelerometers 3 Angular Rate Sensors 2 Skull Spring LC 1 Condyle Pot 1 Upper Neck LC 4 IRTraccs 8 Rotational Pots 1 Spine LC 2 Acetabulum LC 2 ASIS LC 2 Femur LC	<i>Continued</i> 2 LX Leg Assemblies 2 Upper Tibia LC 2 Lower Tibia LC 6 Ank1e Potentiometers 2 Knee Sliders 1 Neck Skin 1 Neck Foam 1 Tiltview Interface Cable 4 Tilt Sensors 1 H-Point Tool 1 Tool Box 1 Laptop 1 LX Zeroing Bracket

Note: New Damage is Noted in Red

HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage Horizontal cut in face flesh goes all the way through 
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / N	Head securely mounted to OC joint
OTHER	

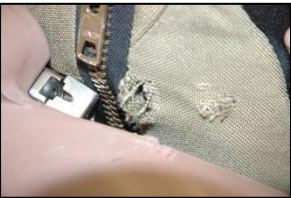
NECK	
Y / N	Neck cables slide freely through holes in neck plates
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates
Y / N	No evidence of debonding or permanent compression in neck soft stop assemblies
Y / N	Neck securely attached to upper neck load cell
Y / N	Neck securely attached to lower neck load cell
Y / N	Neck pitch change joint mechanism mating teeth are engaged
OTHER	Rear upper neck stop is missing rubber 

SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact
Y / N	Clavicles securely attached to sternum and shoulder
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops Left softstop is missing. 
OTHER	Right hand has a cut. 

SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates
Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	

THORAX

Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	IRTRACC securely attached to anterior ribs
Y / N	IRTRACC securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration
Y / N	Ribs securely attached to posterior spine
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)
OTHER	Hole in chest damper foam on the left side  Right lower Dx IRTRACC cable broke at front end. Test data (300ms) was not affected. IRTRACC swapped with left lower tube per Dan/James' email approval on 6/26/14.  IRTRACC Replaced and is functional

ABDOMEN	
Y / N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper
Y / N	Upper abdomen insert securely attached to spine
Y / N	Upper abdomen insert shows no evidence of permanent set
Y / N	No evidence of tearing, cuts, or broken stitches in lower abdomen bag and zipper Holes on both sides of lower abdomen bag 
Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
OTHER	Lower right abdomen IRTRACC Y-Axis potentiometer cable has detached. 

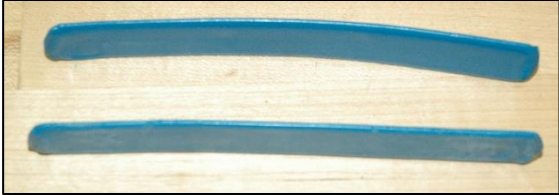
PELVIS	
Y / N	Pelvis flesh fits securely over pelvis bones
Y / N	H-point tool fits securely into hole on both sides of pelvis
OTHER	Multiple cuts and pitting in pelvis flesh

	
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FEMUR	
Y / N	Acetabular load cells firmly attached
Y / N	Femur load cells firmly attached
Y / N	No evidence of deformation of knee slider bump stop
Y / N	No cuts, tears, or scuffing of knee flesh Knees are scuffed
	 Right knee flesh is torn. 
OTHER	

LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached
Y / N	Achilles tendon provides resistance to dorsiflexion
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
Y / N	No cuts, tears, or scuffing of leg flesh Right leg flesh is torn at zipper attachment.
	 Right leg flesh is much more torn after CAL2712. Repair was made with Gaffer's tape.   Right leg scuffing

		
OTHER		

JACKET		
Y / N	Rib stiffeners show no sign of permanent deformation Note: Bent, but can be corrected 	
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers Multiple holes, tears in lining, frayed seams, back foam insert is falling apart 	
OTHER		

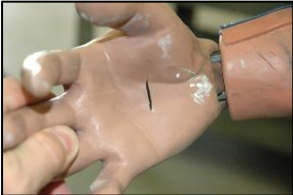
THOR Inspection Checklist

Date: 07/15/2014	
NHTSA Representative: James Saunders	
Inspection Reporter: Mary Geesey	
Inspection type (check one): ☐ Pre-Test ☒ Post-Test	
Dummy S/N: 0015	Legs S/N: LX0038/LX0039
Dummy Description: THOR NT 50th Male	
Date of last Certification: Certification performed in May 2014	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last inspection:</u> RD0529 – Hyundai Elantra <u>Since last certification:</u> R20145400 – Mazda 3 R20145401 – Mazda CX-5 CAL2712 - Research Vehicle 2712 R20145372 – Honda Accord R20144143 – 2014 Toyota Camry R20145373 – Honda Odyssey RD0529 – Hyundai Elantra	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> -None New	
<u>Physical evidence of damage:</u> See Report – Light scuffing, right leg	
<u>Anecdotal evidence of damage:</u> None	
<u>Equipment delivered to Borrower:</u> THOR 0015 ATD 26 Accelerometers 3 Angular Rate Sensors 2 Skull Spring LC 1 Condyle Pot 1 Upper Neck LC 4 IRTraccs 8 Rotational Pots 1 Spine LC 2 Acetabulum LC 2 ASIS LC 2 Femur LC	<i>Continued</i> 2 LX Leg Assemblies 2 Upper Tibia LC 2 Lower Tibia LC 6 Ank1e Potentiometers 2 Knee Sliders 1 Neck Skin 1 Neck Foam 1 Tiltview Interface Cable 4 Tilt Sensors 1 H-Point Tool 1 Tool Box 1 Laptop 1 LX Zeroing Bracket

Note: New Damage is Noted in Red

HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage Horizontal cut in face flesh goes all the way through 
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / N	Head securely mounted to OC joint
OTHER	

NECK	
Y / N	Neck cables slide freely through holes in neck plates
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates
Y / N	No evidence of debonding or permanent compression in neck soft stop assemblies
Y / N	Neck securely attached to upper neck load cell
Y / N	Neck securely attached to lower neck load cell
Y / N	Neck pitch change joint mechanism mating teeth are engaged
OTHER	Rear upper neck stop is missing rubber 

SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact
Y / N	Clavicles securely attached to sternum and shoulder
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops Left softstop is missing. 
OTHER	Right hand has a cut. 

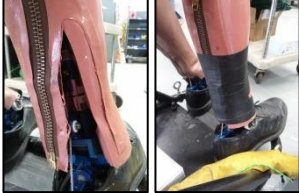
SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates
Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	

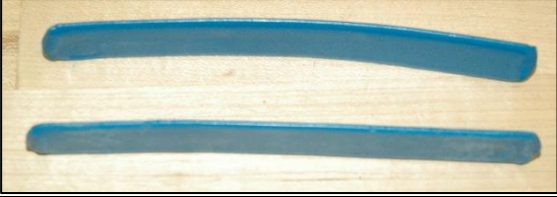
THORAX	
Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	IRTRACC securely attached to anterior ribs
Y / N	IRTRACC securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration
Y / N	Ribs securely attached to posterior spine
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)
OTHER	Hole in chest damper foam on the left side  Right lower Dx IRTRACC cable broke at front end. Test data (300ms) was not affected. IRTRACC swapped with left lower tube per Dan/James' email approval on 6/26/14.  IRTRACC Replaced and is functional

ABDOMEN	
Y / N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper
Y / N	Upper abdomen insert securely attached to spine
Y / N	Upper abdomen insert shows no evidence of permanent set
Y / N	No evidence of tearing, cuts, or broken stitches in lower abdomen bag and zipper Holes on both sides of lower abdomen bag 
Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
OTHER	Lower right abdomen IRTRACC Y-Axis potentiometer cable insulation has detached. 

PELVIS	
Y / N	Pelvis flesh fits securely over pelvis bones
Y / N	H-point tool fits securely into hole on both sides of pelvis
OTHER	Multiple cuts and pitting in pelvis flesh  Cuts on the right side of pelvis, pitting on left side of pelvis and hole on the inside right side of pelvis all worsening: 

FEMUR	
Y / N	Acetabular load cells firmly attached
Y / N	Femur load cells firmly attached
Y / N	No evidence of deformation of knee slider bump stop
Y / N	No cuts, tears, or scuffing of knee flesh Knees are scuffed  Right knee flesh is torn.  Right knee insert has been cut all the way through: 
OTHER	

LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached
Y / N	Achilles tendon provides resistance to dorsiflexion
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
Y / N	No cuts, tears, or scuffing of leg flesh Right leg flesh is torn at zipper attachment.  Right leg flesh is much more torn after CAL2712. Repair was made with Gaffer's tape.  Right leg scuffing  Right leg flesh has multiple small cuts:  Left leg zipper is pulling away from leg flesh: 
OTHER	

JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation Note: Bent, but can be corrected 
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers Multiple holes, tears in lining, frayed seams, back foam insert is falling apart  Holes forming in jacket: 
OTHER	

THOR Inspection Checklist

Date: 07-11-2014	
NHTSA Representative: James Saunders	
Inspection Reporter: Rick Weil, Mary Geesey	
Inspection type (check one): ☒ Pre-Test ☐ Post-Test	
Dummy S/N: 0016	Legs S/N: LX0019/LX0018
Dummy Description: THOR NT 50th Male	
Date of last Certification: Certification performed in June 2014	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last inspection:</u> R20145372 – Honda Accord <u>Since last certification:</u> R20145400 – Mazda 3 R20145401 – Mazda CX-5 CAL2712 - Research Vehicle 2712 R20145372 – Honda Accord R20144143 – 2014 Toyota Camry R201445373 – Honda Odyssey	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> None	
<u>Physical evidence of damage:</u> None – need to add	
<u>Anecdotal evidence of damage:</u> None	
<u>Equipment delivered to Borrower:</u> THOR 0016 ATD 26 Accelerometers 3 Angular Rate Sensors 2 Skull Spring LC 1 Condyle Pot 1 Upper Neck LC 4 IRTraccs 8 Rotational Pots 1 Spine LC 2 Acetabulum LC 2 ASIS LC 2 Femur LC	<i>Continued</i> 2 LX Leg Assemblies 2 Upper Tibia LC 2 Lower Tibia LC 6 Ank1e Potentiometers 2 Knee Sliders 1 Neck Skin 1 Neck Foam 1 Tiltview Interface Cable 4 Tilt Sensors 1 H-Point Tool 1 Tool Box 1 Laptop

Note: New Damage is Noted in Red

HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / N	Head securely mounted to OC joint
OTHER	

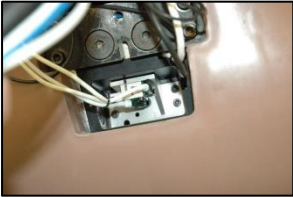
NECK	
Y / N	Neck cables slide freely through holes in neck plates
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates
Y / N	No evidence of debonding or permanent compression in neck soft stop assemblies
Y / N	Neck securely attached to upper neck load cell
Y / N	Neck securely attached to lower neck load cell
Y / N	Neck pitch change joint mechanism mating teeth are engaged
OTHER	

SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact Both shoulder pads are torn. We used Gaffer's tape to prevent further damage.  More nick damage found to urethane shoulder pads
Y / N	Clavicles securely attached to sternum and shoulder
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops
OTHER	

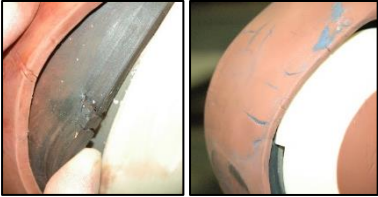
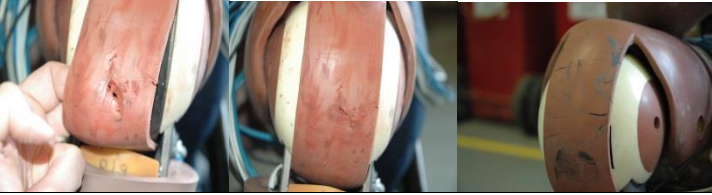
SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates
Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	

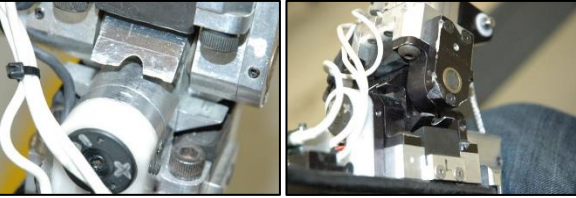
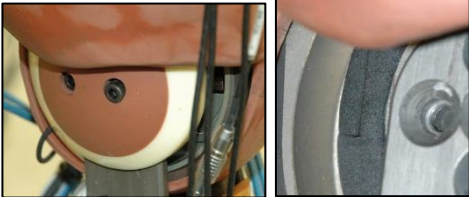
THORAX	
Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	CRUX anterior arms securely attached to anterior ribs
Y / N	CRUX posterior arms securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration Bib is still torn in the center near clavicle attachment.
	
Y / N	Ribs securely attached to posterior spine
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)
OTHER	T6 Accelerometer cable is torn at accelerometer.
	

ABDOMEN	
Y / N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper
Y / N	Upper abdomen insert securely attached to spine
Y / N	Upper abdomen insert shows no evidence of permanent set
Y / N	No evidence of tearing, cuts, or broken stitches in lower abdomen bag and zipper Lower abdomen bag has a number of ribs and tears.
	
Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
OTHER	

PELVIS	
Y / N	Pelvis flesh fits securely over pelvis bones
Y / N	H-point tool fits securely into hole on both sides of pelvis
OTHER	Pelvis Instrumentation protective cover is missing.
	

FEMUR	
Y / N	Acetabular load cells firmly attached
Y / N	Femur load cells firmly attached
Y / N	No evidence of deformation of knee slider bump stop
Y / N	No cuts, tears, or scuffing of knee flesh

	Knees are both cut. Left insert is slightly cut.  More knee cuts found with damage going all the way through. No new damage to inserts 
OTHER	

LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached Ankle assemblies are both marked up but functional. 
Y / N	Achilles tendon provides resistance to dorsiflexion
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
Y / N	No cuts, tears, or scuffing of leg flesh Right tibia flesh has mild scuffing. 
OTHER	Inside left and right knee covers were swapped resulting in permanent markings in the rear knee stops. I  swapped.

JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers Jacket has a number of tears throughout.
OTHER	

THOR Inspection Checklist

Date: 07-15-2014	
NHTSA Representative: James Saunders	
Inspection Reporter: Rick Weil, Mary Geesey	
Inspection type (check one): ☐ Pre-Test ☒ Post-Test	
Dummy S/N: 0016	Legs S/N: LX0019/LX0018
Dummy Description: THOR NT 50th Male	
Date of last Certification: Certification performed in June 2014	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last inspection:</u> RD0529 – 2013 Hyundai Elantra <u>Since last certification:</u> R20145400 – Mazda 3 R20145401 – Mazda CX-5 CAL2712 - Research Vehicle 2712 R20145372 – Honda Accord R20144143 – 2014 Toyota Camry R201445373 – Honda Odyssey RD0529 – 2013 Hyundai Elantra	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> - 13NECKLO00THFOYP, Lower Neck Y Force, Questionable data after 36 ms, SN:LC-85 Fy – Found broken wire for –Exe and repaired.	
<u>Physical evidence of damage:</u> None	
<u>Anecdotal evidence of damage:</u> None	
<u>Equipment delivered to Borrower:</u> THOR 0016 ATD 26 Accelerometers 3 Angular Rate Sensors 2 Skull Spring LC 1 Condyle Pot 1 Upper Neck LC 4 IRTraccs 8 Rotational Pots 1 Spine LC 2 Acetabulum LC 2 ASIS LC 2 Femur LC	<i>Continued</i> 2 LX Leg Assemblies 2 Upper Tibia LC 2 Lower Tibia LC 6 Ank1e Potentiometers 2 Knee Sliders 1 Neck Skin 1 Neck Foam 1 Tiltview Interface Cable 4 Tilt Sensors 1 H-Point Tool 1 Tool Box 1 Laptop

Note: New Damage is Noted in Red

HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / N	Head securely mounted to OC joint
OTHER	

NECK	
Y / N	Neck cables slide freely through holes in neck plates
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates
Y / N	No evidence of debonding or permanent compression in neck soft stop assemblies
Y / N	Neck securely attached to upper neck load cell
Y / N	Neck securely attached to lower neck load cell
Y / N	Neck pitch change joint mechanism mating teeth are engaged
OTHER	

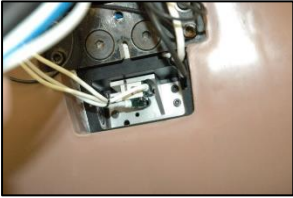
SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact Both shoulder pads are torn. We used Gaffer's tape to prevent further damage.  More nick damage found to urethane shoulder pads
Y / N	Clavicles securely attached to sternum and shoulder
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops
OTHER	

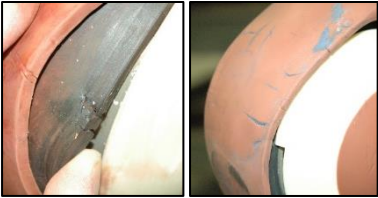
SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates
Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	

THORAX	
Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	CRUX anterior arms securely attached to anterior ribs
Y / N	CRUX posterior arms securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration Bib is still torn in the center near clavicle attachment.

		
Y / N	Ribs securely attached to posterior spine	
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)	
OTHER	T6 Accelerometer cable is torn at accelerometer. 	

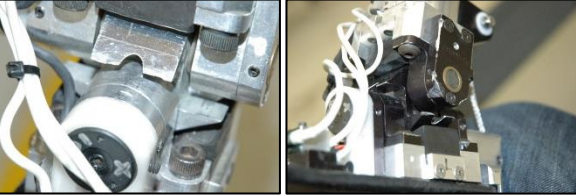
ABDOMEN		
Y / N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper	
Y / N	Upper abdomen insert securely attached to spine	
Y / N	Upper abdomen insert shows no evidence of permanent set	
Y / N	No evidence of tearing, cuts, or broken stitches in lower abdomen bag and zipper Lower abdomen bag has a number of ribs and tears. 	
Y / N	Lower abdomen insert securely attached to spine	
Y / N	Lower abdomen insert shows no evidence of permanent set	
OTHER		

PELVIS		
Y / N	Pelvis flesh fits securely over pelvis bones	
Y / N	H-point tool fits securely into hole on both sides of pelvis	
OTHER	Pelvis Instrumentation protective cover is missing. 	

FEMUR		
Y / N	Acetabular load cells firmly attached	
Y / N	Femur load cells firmly attached	
Y / N	No evidence of deformation of knee slider bump stop	
Y / N	No cuts, tears, or scuffing of knee flesh Knees are both cut. Left insert is slightly cut. 	
	More knee cuts found with damage going all the way through. No new damage to inserts	

		
OTHER		

LOWER EXTREMITY (LX)

Y / N	Rotational potentiometers in ankle securely attached Ankle assemblies are both marked up but functional.	
Y / N	Achilles tendon provides resistance to dorsiflexion	
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops	
Y / N	No cuts, tears, or scuffing of leg flesh - Right tibia flesh has mild scuffing.	
OTHER	Inside left and right knee covers were swapped resulting in permanent markings in the rear knee stops. I swapped.	

JACKET

Y / N	Rib stiffeners show no sign of permanent deformation	
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers Jacket has a number of tears throughout.	
OTHER		

Test Data/Sensor Repair Notes

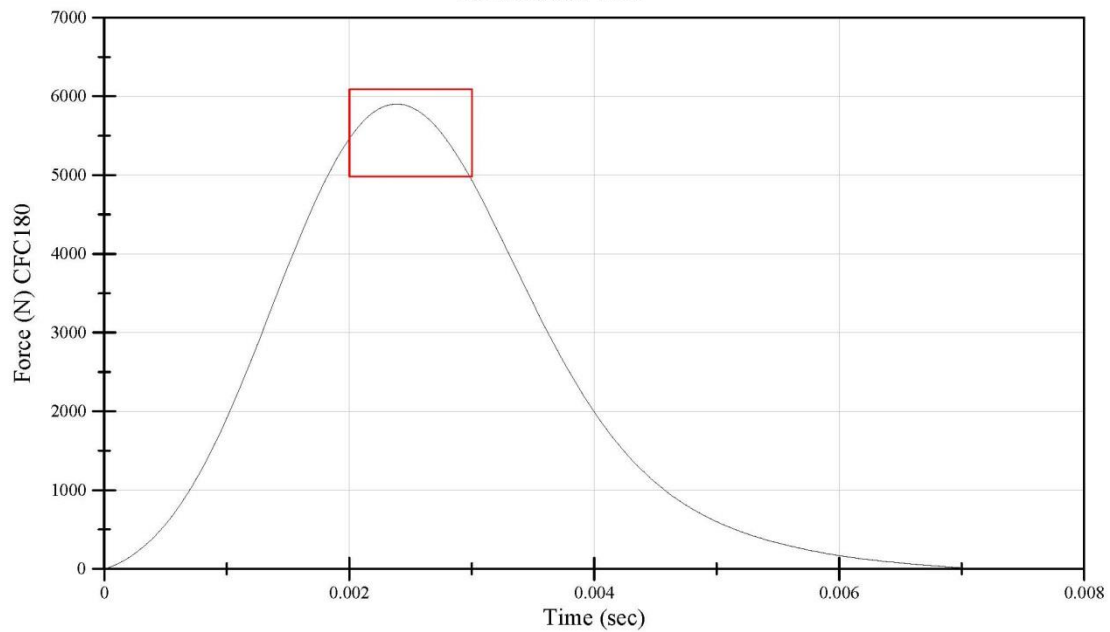
DUMMY CALIBRATIONS

50% ADULT MALE THOR016 DUMMY CALIBRATIONS

Test Temperature: 71 degrees
Relative Humidity: 38%
Test Velocity: 1.99 m/s

THOR Head Impact Certification

Probe Force
Serial Number: T016



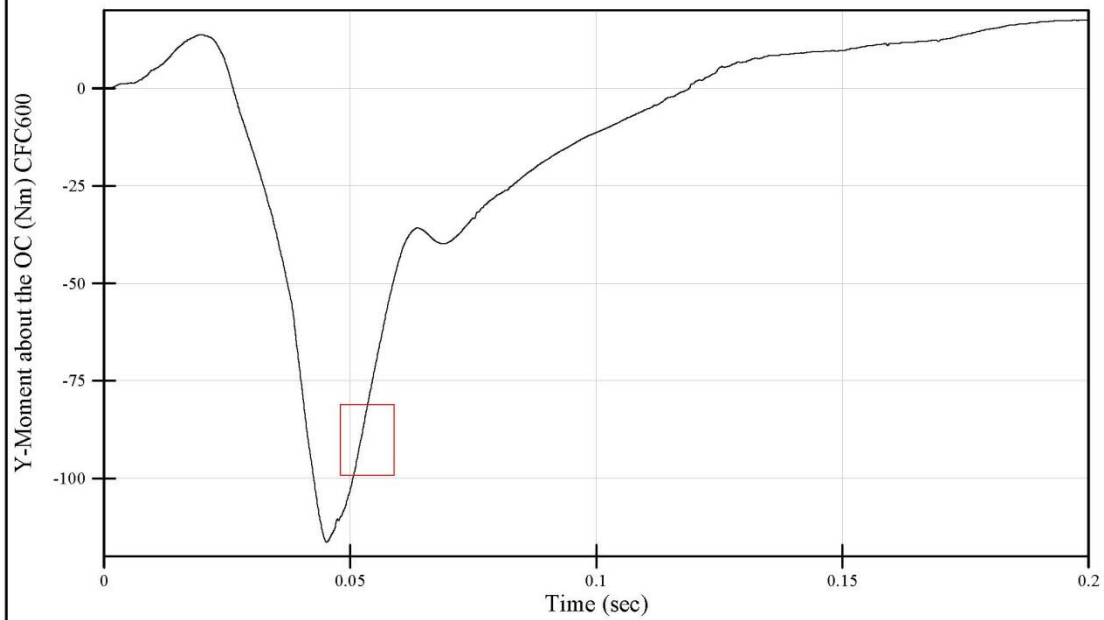
Software Version: 2.4

File Name: T016Head140617_01_DIAdemHeader_BINARYprocessed
06/17/2014 14:50:56.0000

Test Temperature: 70.9 degrees
Relative Humidity: 51%
Test Velocity: 3.65 m/s

THOR Neck Extension Certification

Y-Moment
Serial Number: T0016



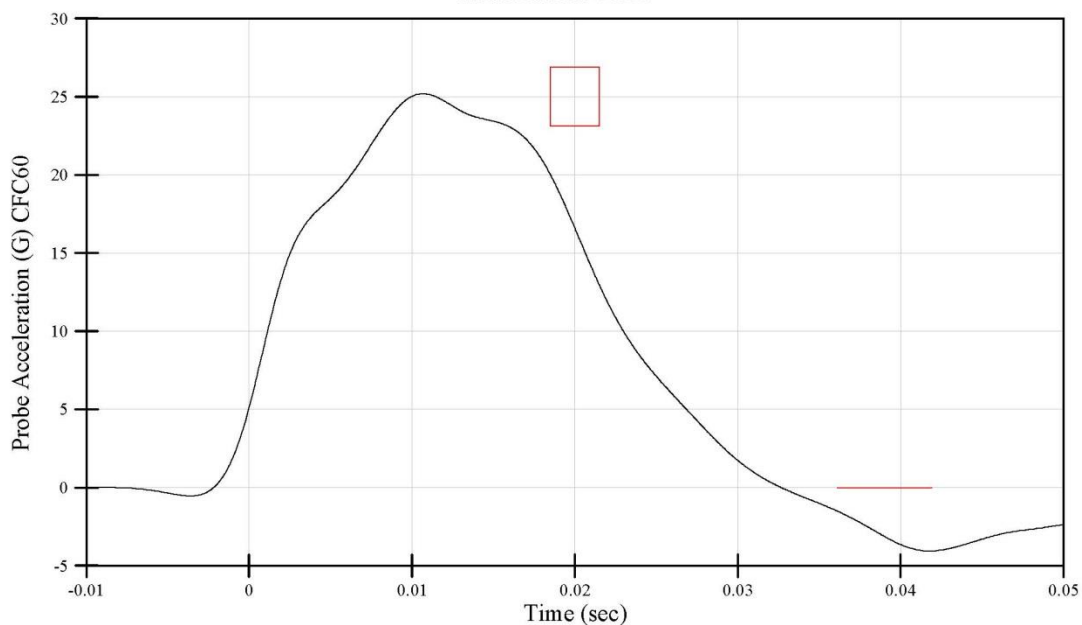
Software Version: 2.4

File Name: T016NeckExtension140616-01_Processed2
06/16/2014 10:56:25.0000

Test Temperature: 70.9 degrees
Relative Humidity: 51%
Test Velocity: 3.65 m/s

THOR Neck Extension Certification

Probe Acceleration
Serial Number: T0016



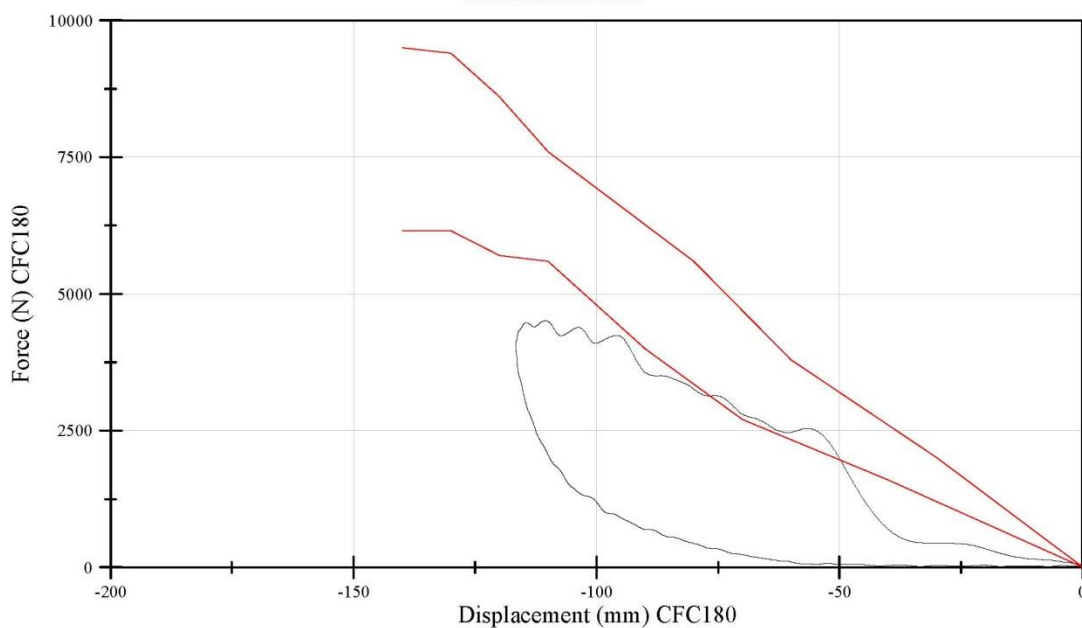
Software Version: 2.4

File Name: T016NeckExtension140616-01_Processed2
06/16/2014 10:56:25.0000

Test Temperature: 70.5 degrees
Relative Humidity: 51%
Test Velocity: 6.68 m/s

THOR Upper Abdomen Certification

Abdomen Displacement vs. Probe Force
Serial Number: T016

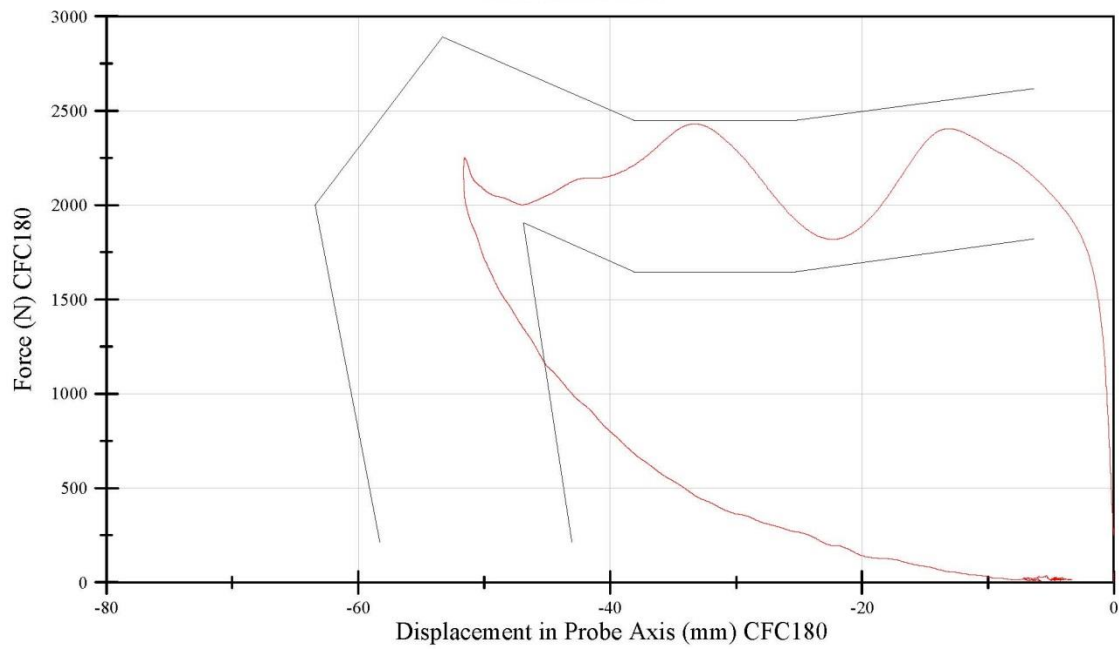


Software Version: 2.4

File Name: T016UpperAbdomen140610-01_Processed
06/10/2014 15:54:17.0000

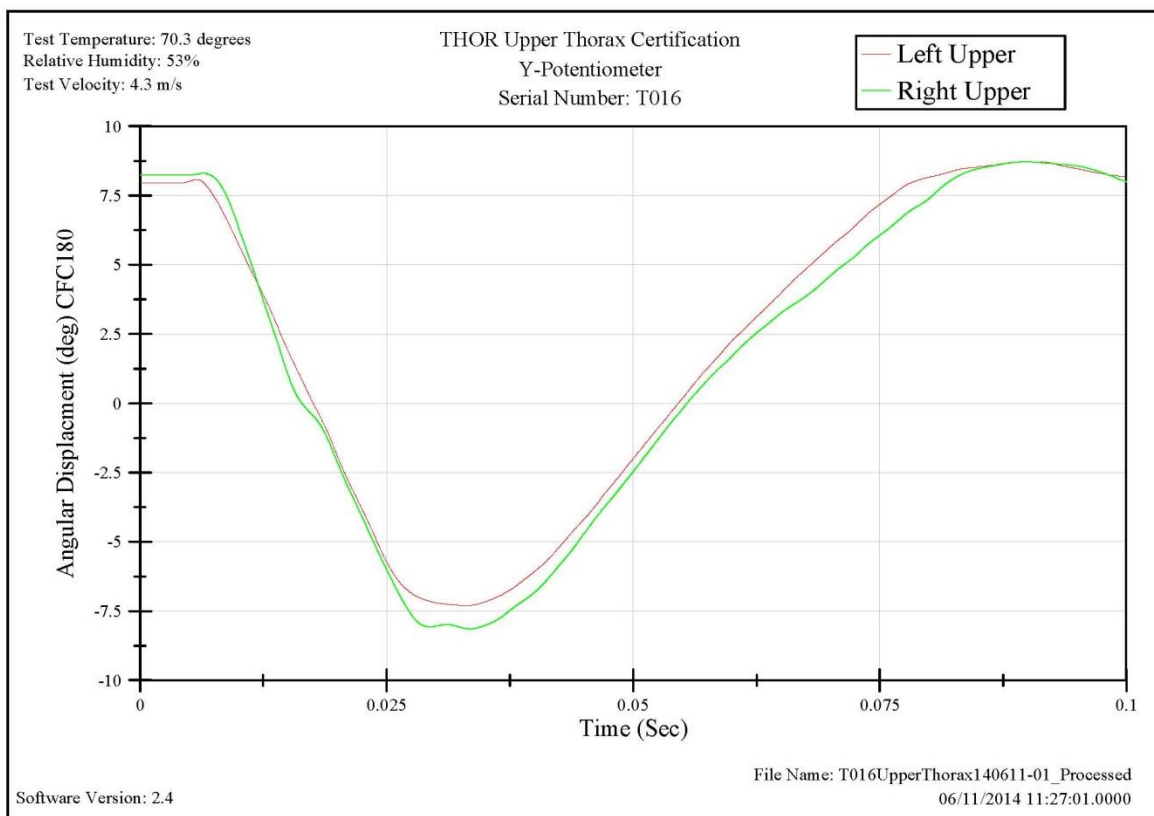
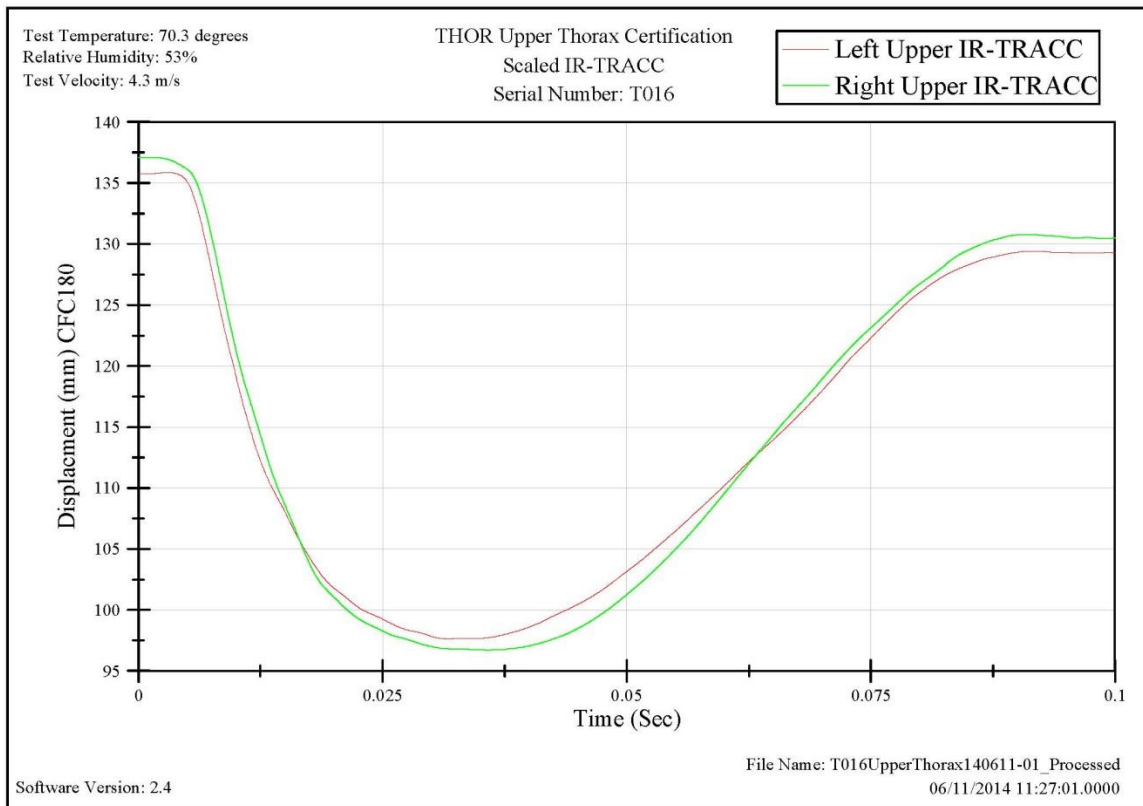
Test Temperature: 70.3 degrees
Relative Humidity: 53%
Test Velocity: 4.3 m/s

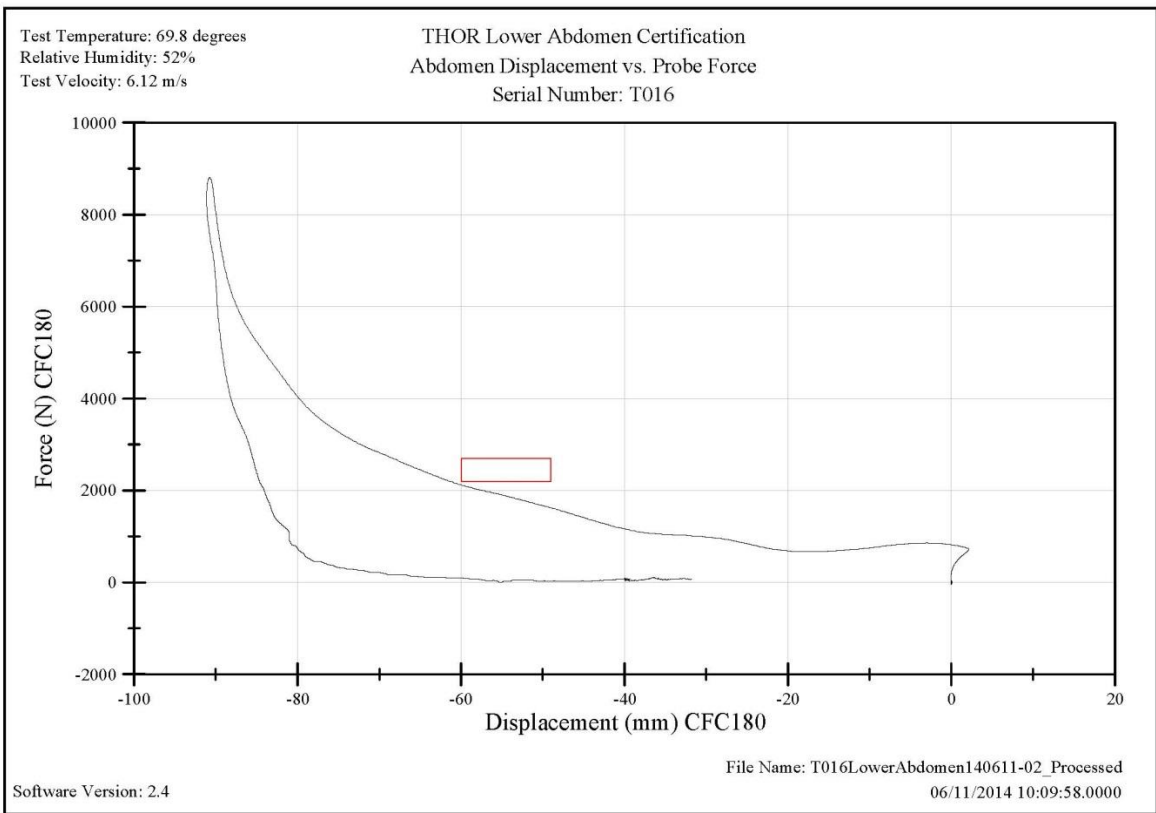
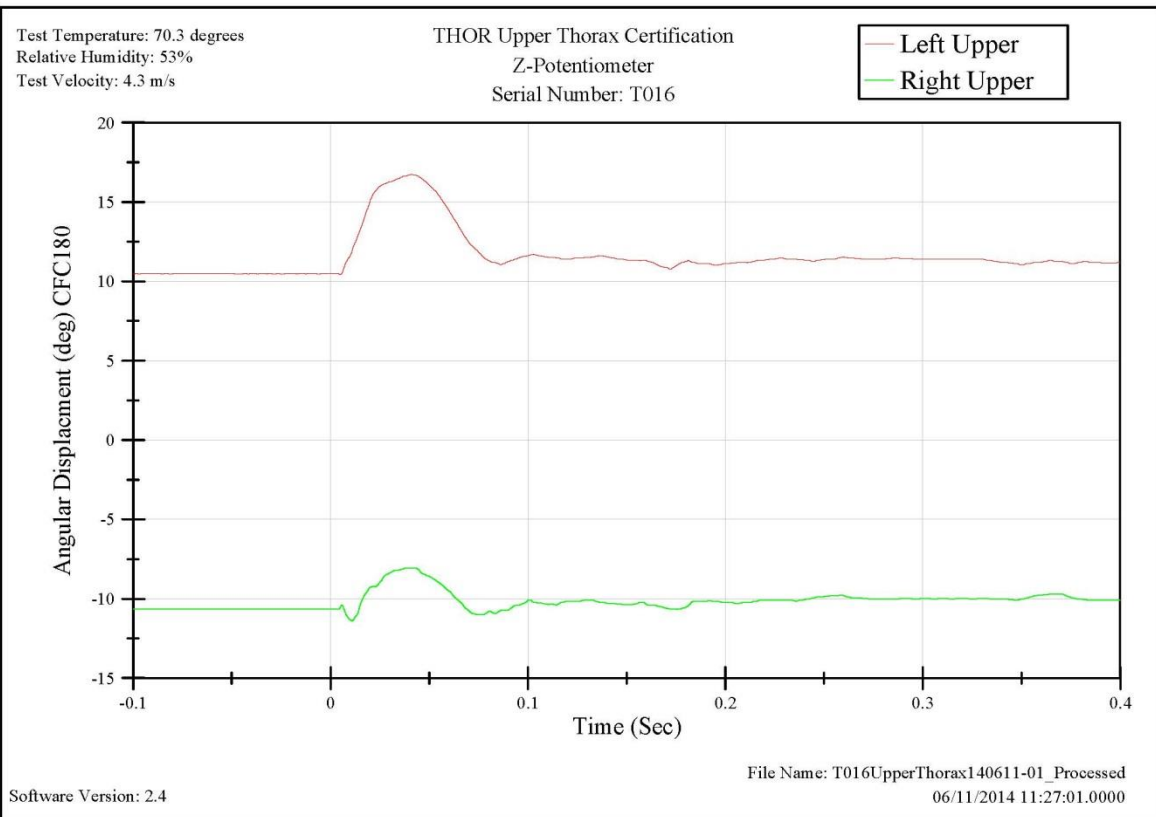
THOR Upper Thorax Certification
Thorax Response With Kroell Corridor
Serial Number: T016

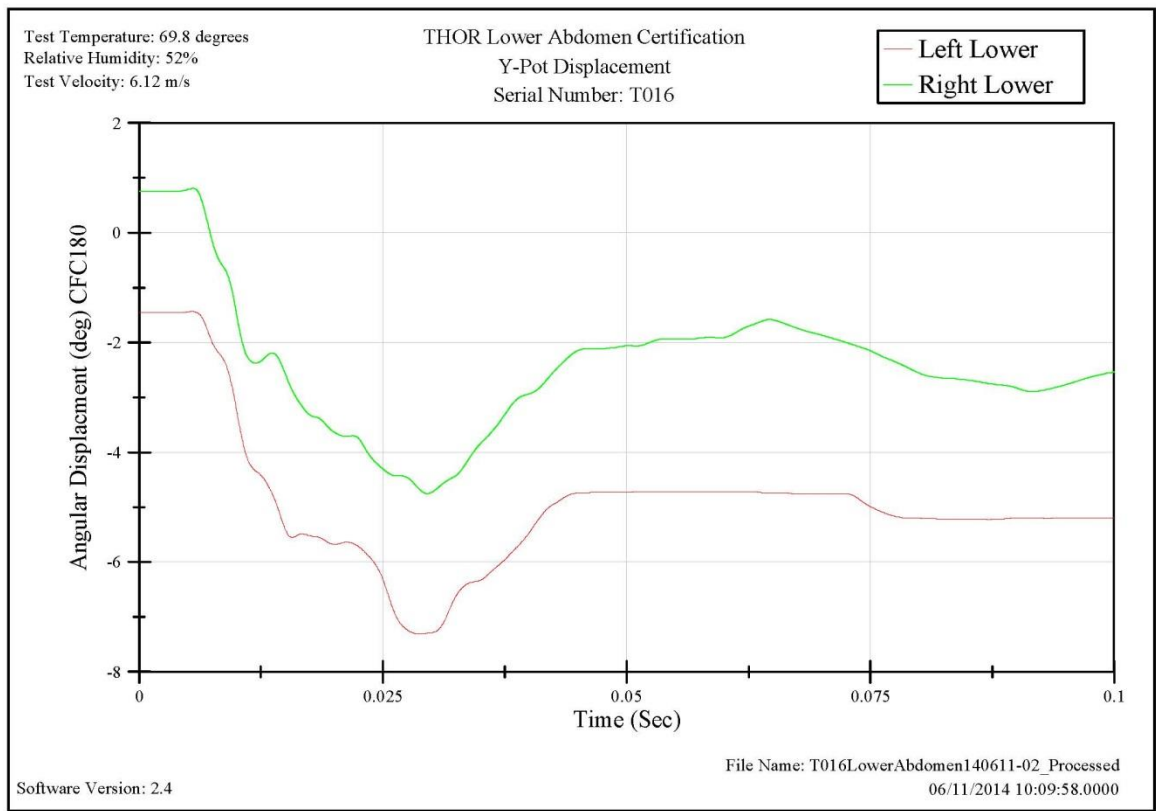
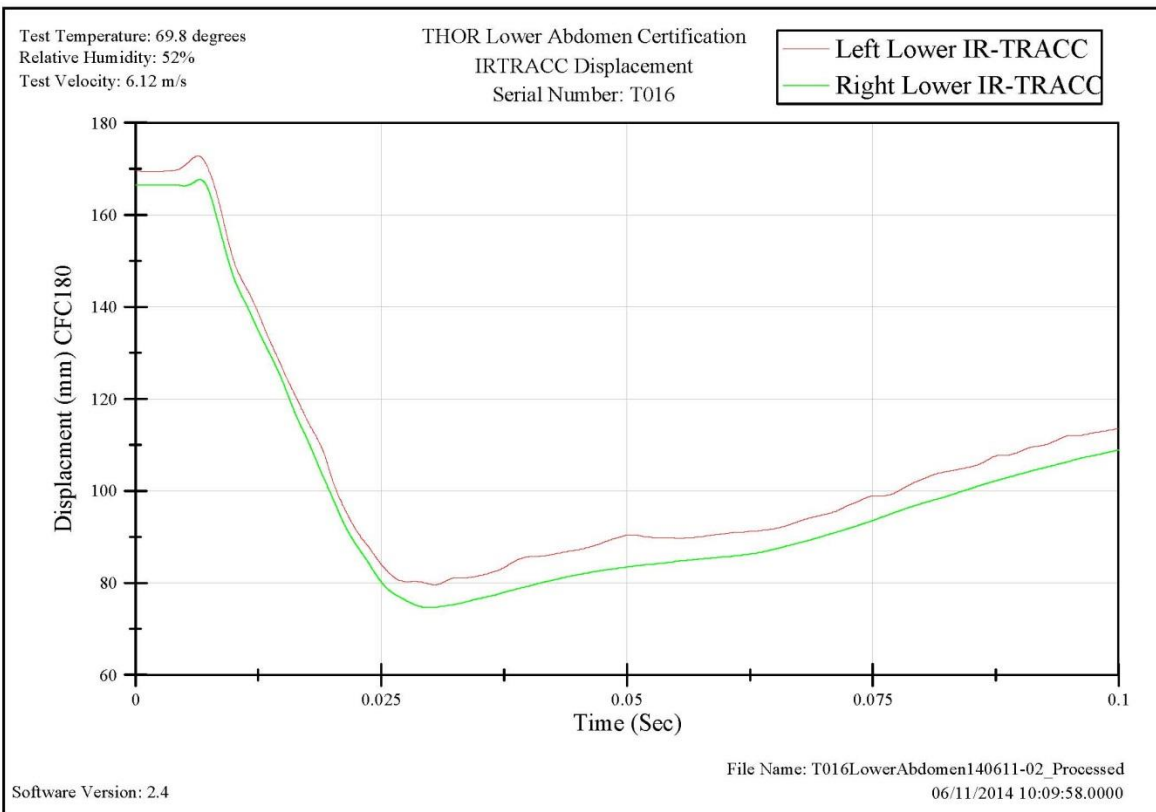


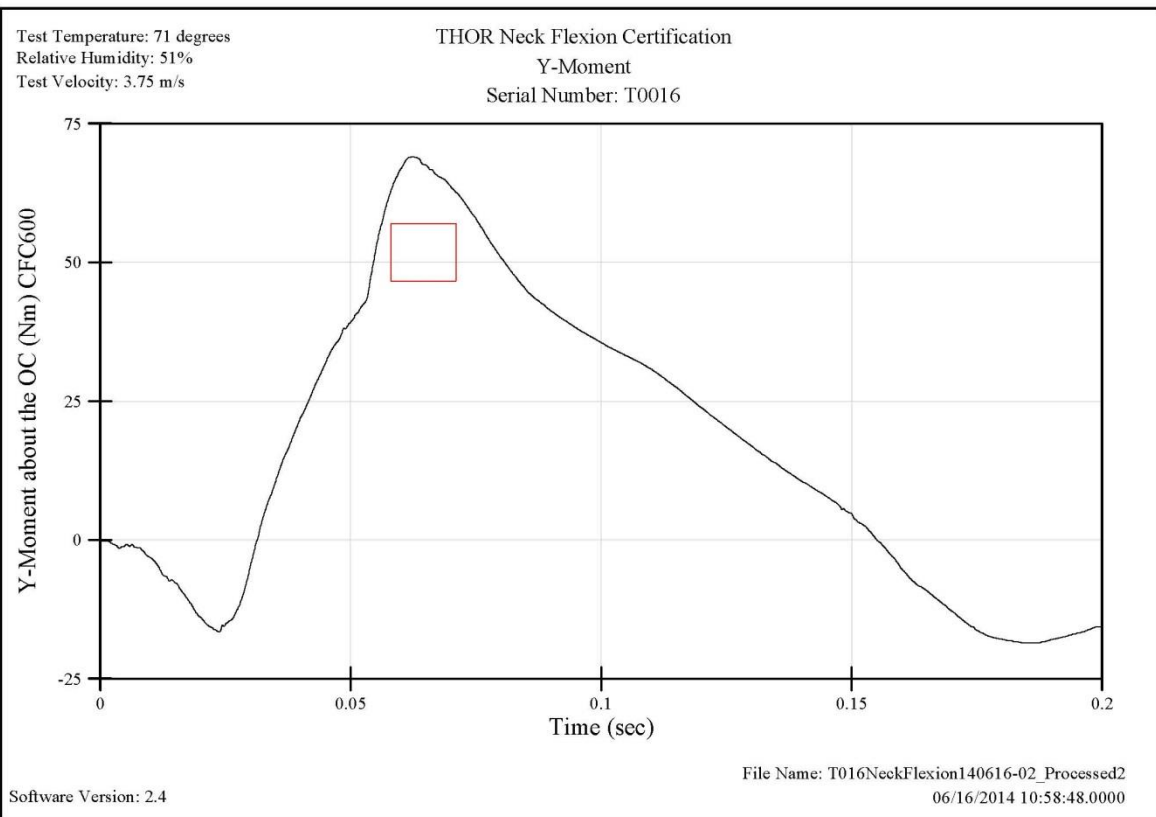
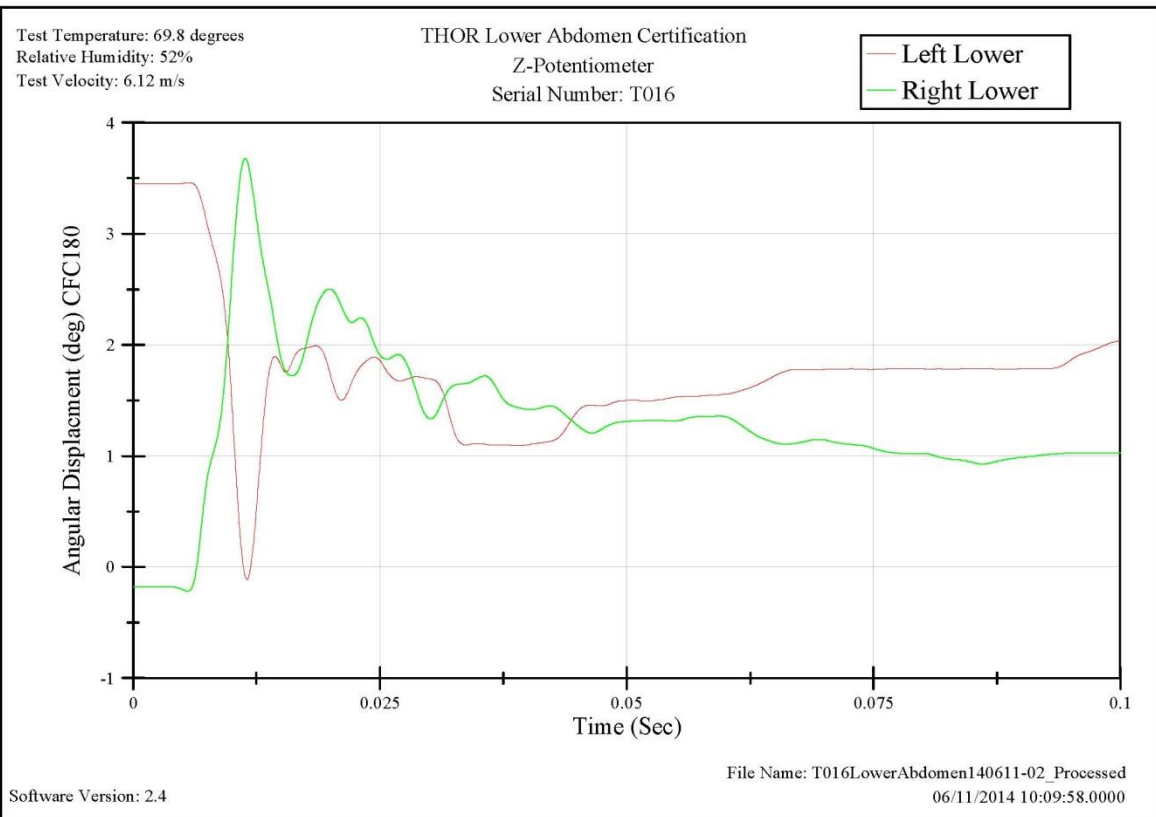
Software Version: 2.4

File Name: T016UpperThorax140611-01_Processed
06/11/2014 11:27:01.0000



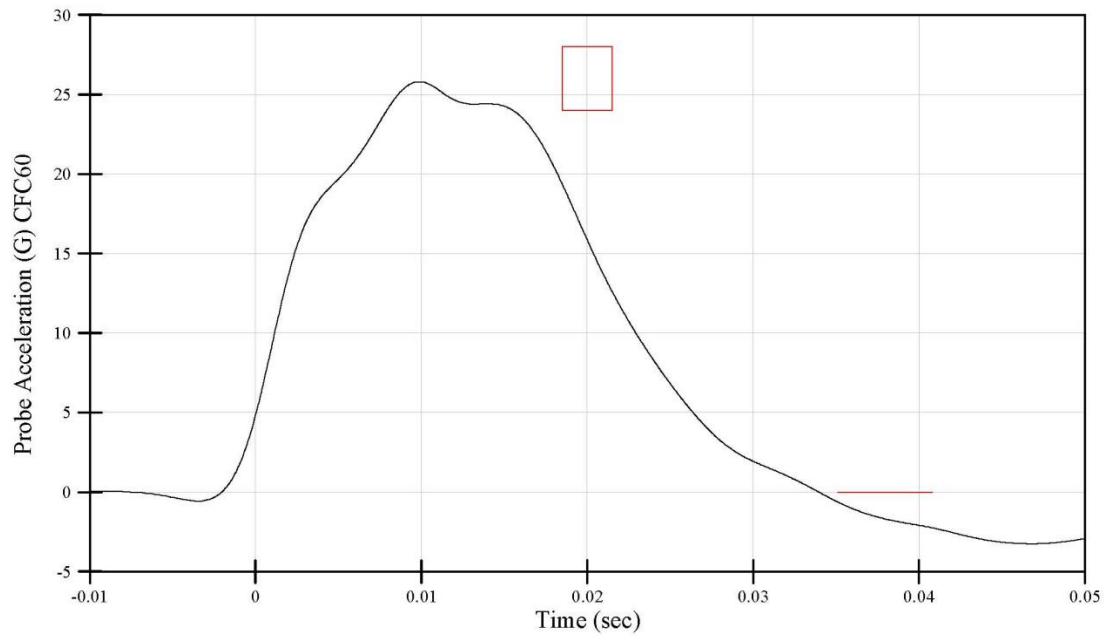






Test Temperature: 71 degrees
Relative Humidity: 51%
Test Velocity: 3.75 m/s

THOR Neck Flexion Certification
Probe Acceleration
Serial Number: T0016

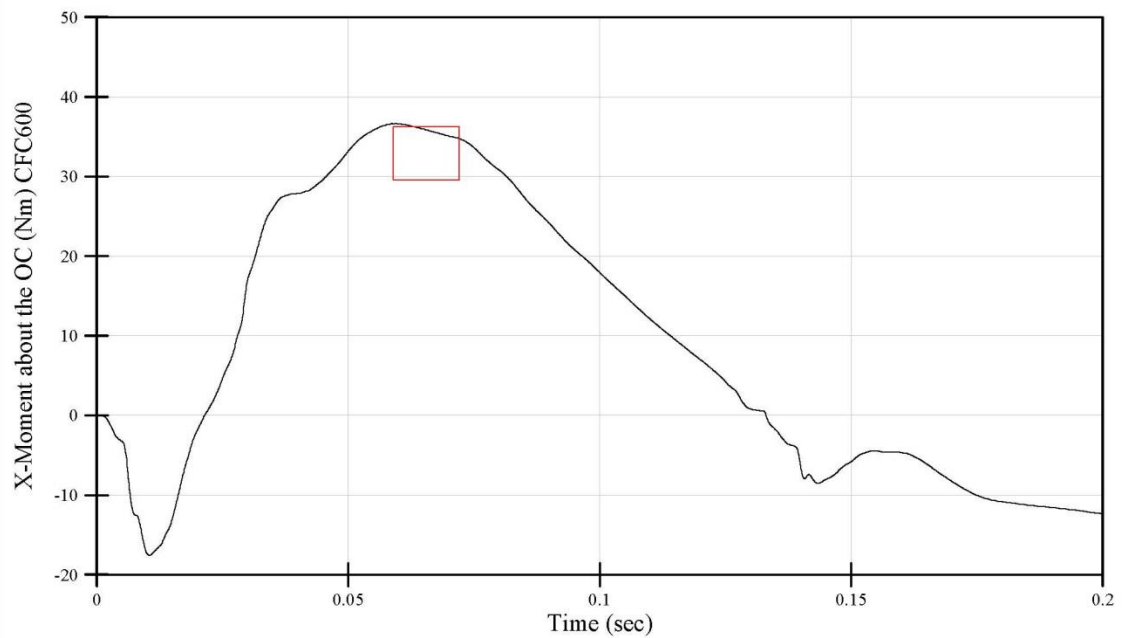


Software Version: 2.4

File Name: T016NeckFlexion140616-02_Processed2
06/16/2014 10:58:48.0000

Test Temperature: 70.4 degrees
Relative Humidity: 52%
Test Velocity: 2.86 m/s

THOR Neck Left Lateral Flexion Certification
X-Moment
Serial Number: T0016



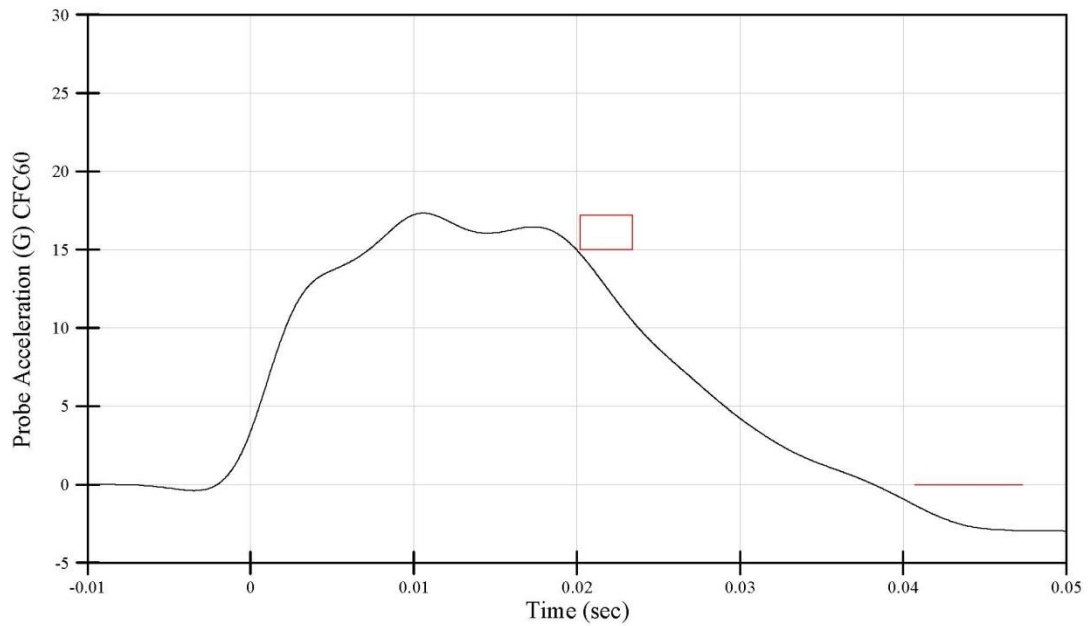
Software Version: 2.4

File Name: T016NeckLeftLateral140616-01_Processed
06/16/2014 11:07:30.0000

Test Temperature: 70.4 degrees
Relative Humidity: 52%
Test Velocity: 2.86 m/s

THOR Neck Left Lateral Flexion Certification

Probe Acceleration
Serial Number: T0016



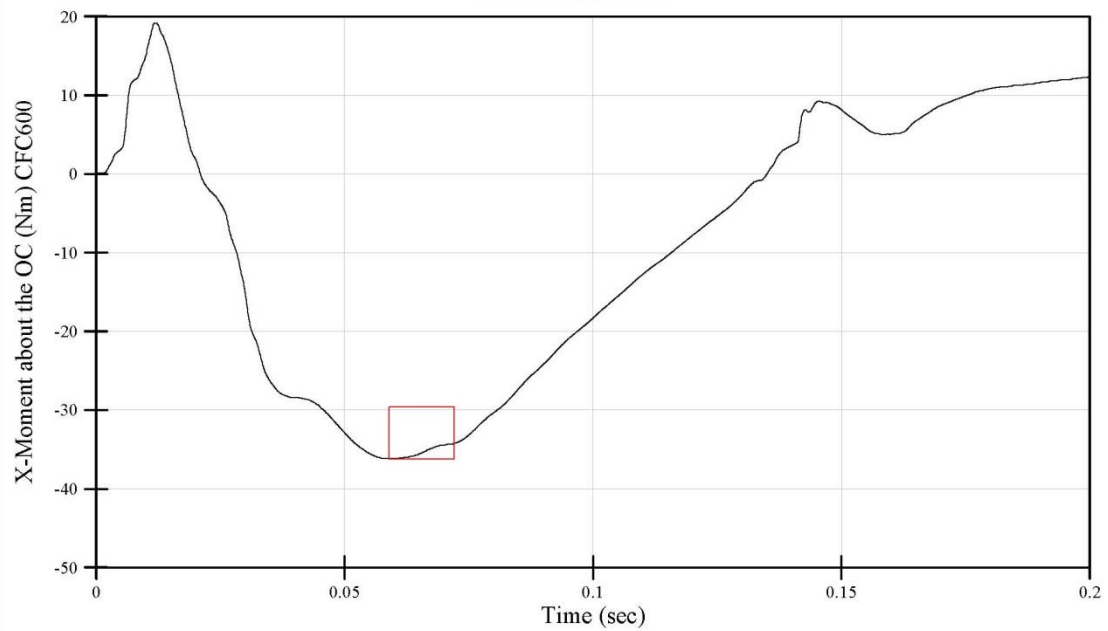
Software Version: 2.4

File Name: T016NeckLeftLateral140616-01_Processed
06/16/2014 11:07:30.0000

Test Temperature: 70.3 degrees
Relative Humidity: 53%
Test Velocity: 2.86 m/s

THOR Neck Right Lateral Flexion Certification

X-Moment
Serial Number: T0016



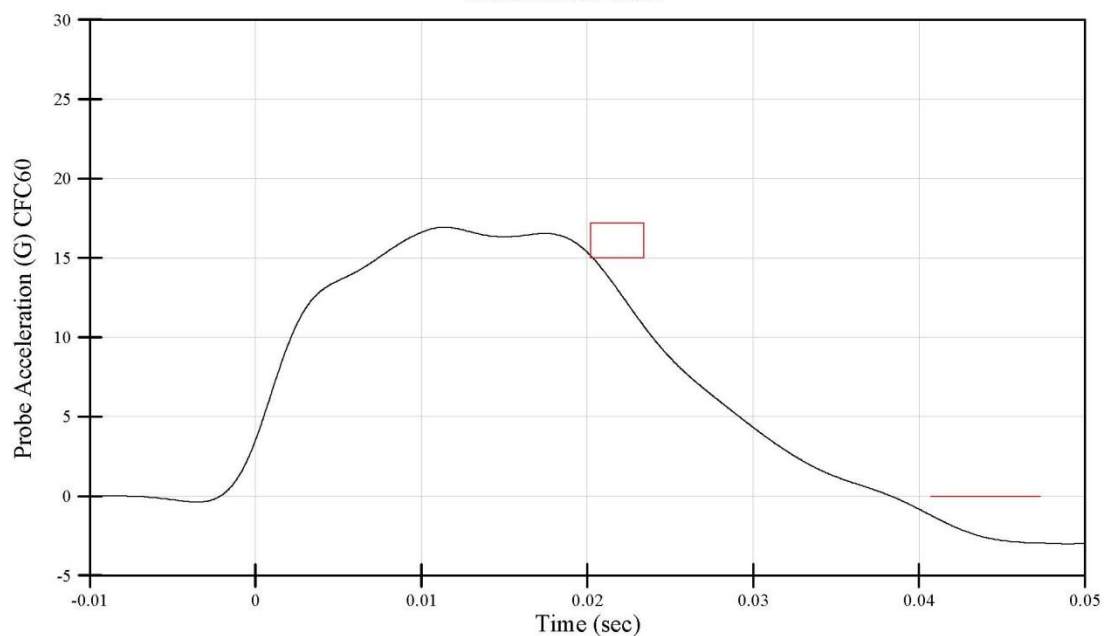
Software Version: 2.4

File Name: T016NeckRightLateral140616-01_Processed
06/16/2014 11:37:51.0000

Test Temperature: 70.3 degrees
Relative Humidity: 53%
Test Velocity: 2.86 m/s

THOR Neck Right Lateral Flexion Certification

Probe Acceleration
Serial Number: T0016



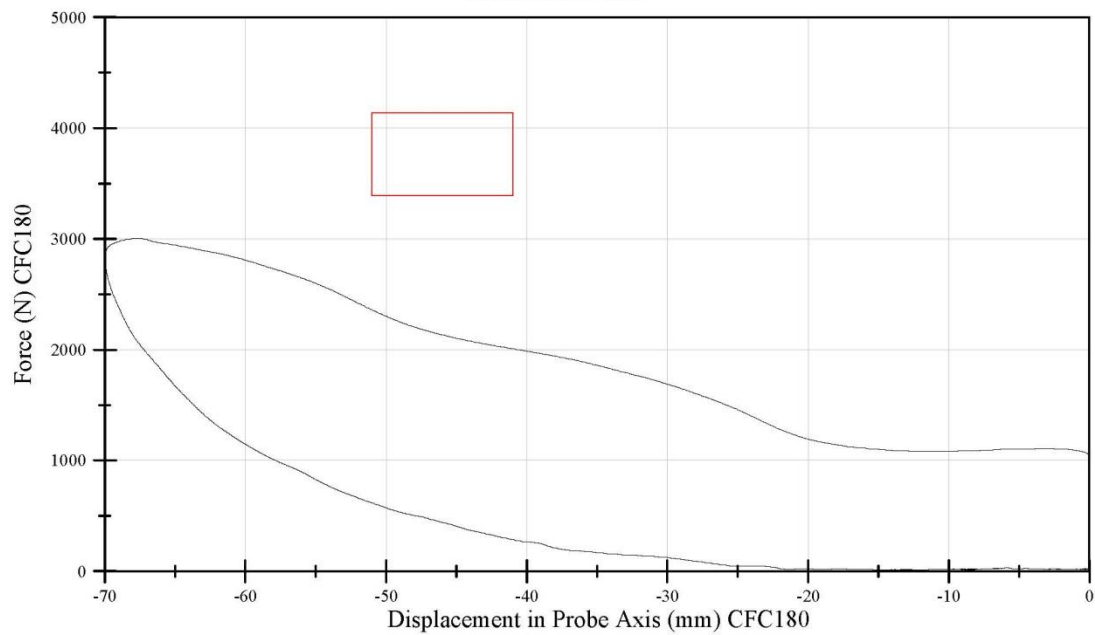
Software Version: 2.4

File Name: T016NeckRightLateral140616-01_Processed
06/16/2014 11:37:51.0000

Test Temperature: 70.5 degrees
Relative Humidity: 51%
Test Velocity: 4.27 m/s

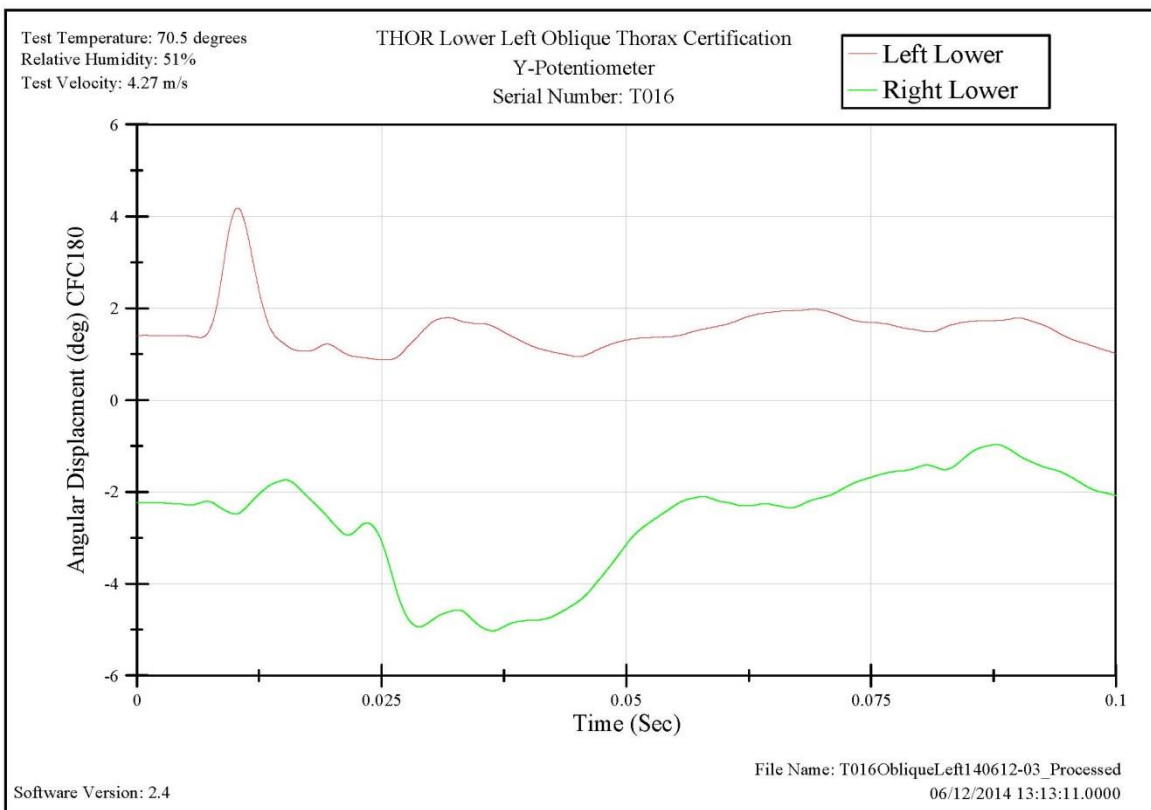
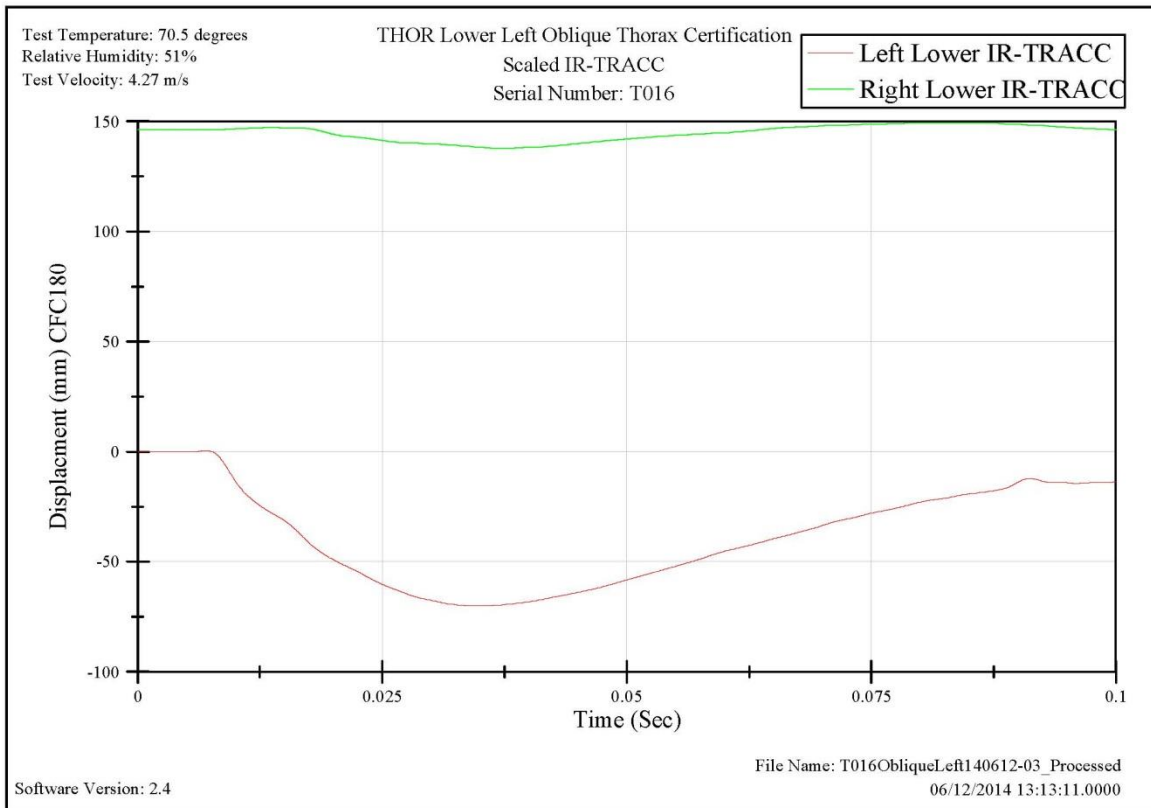
THOR Lower Left Oblique Thorax Certification

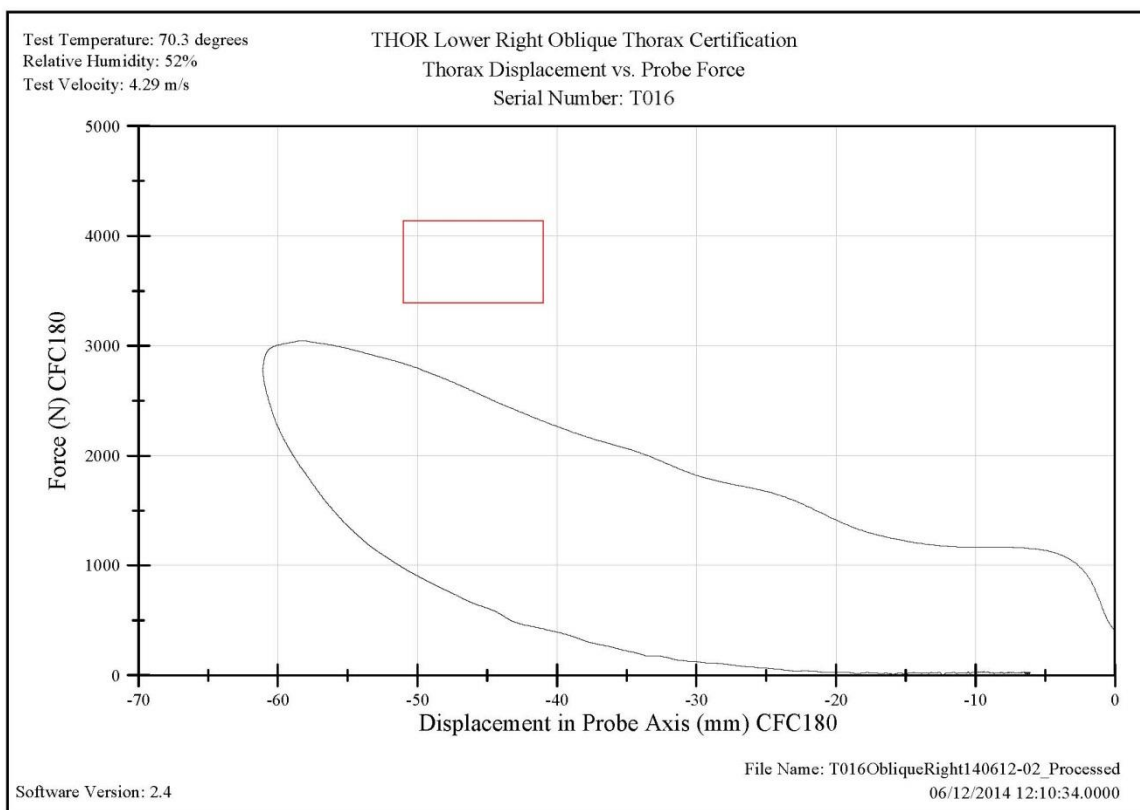
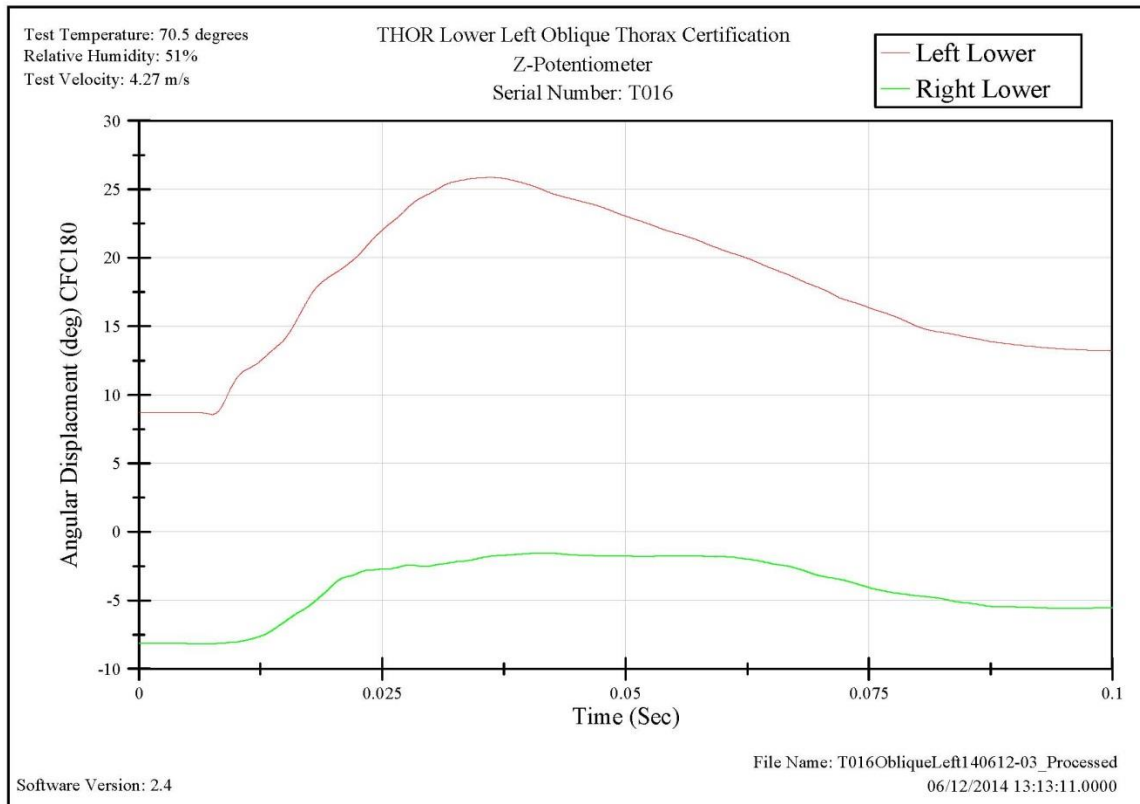
Thorax Displacement vs. Probe Force
Serial Number: T016

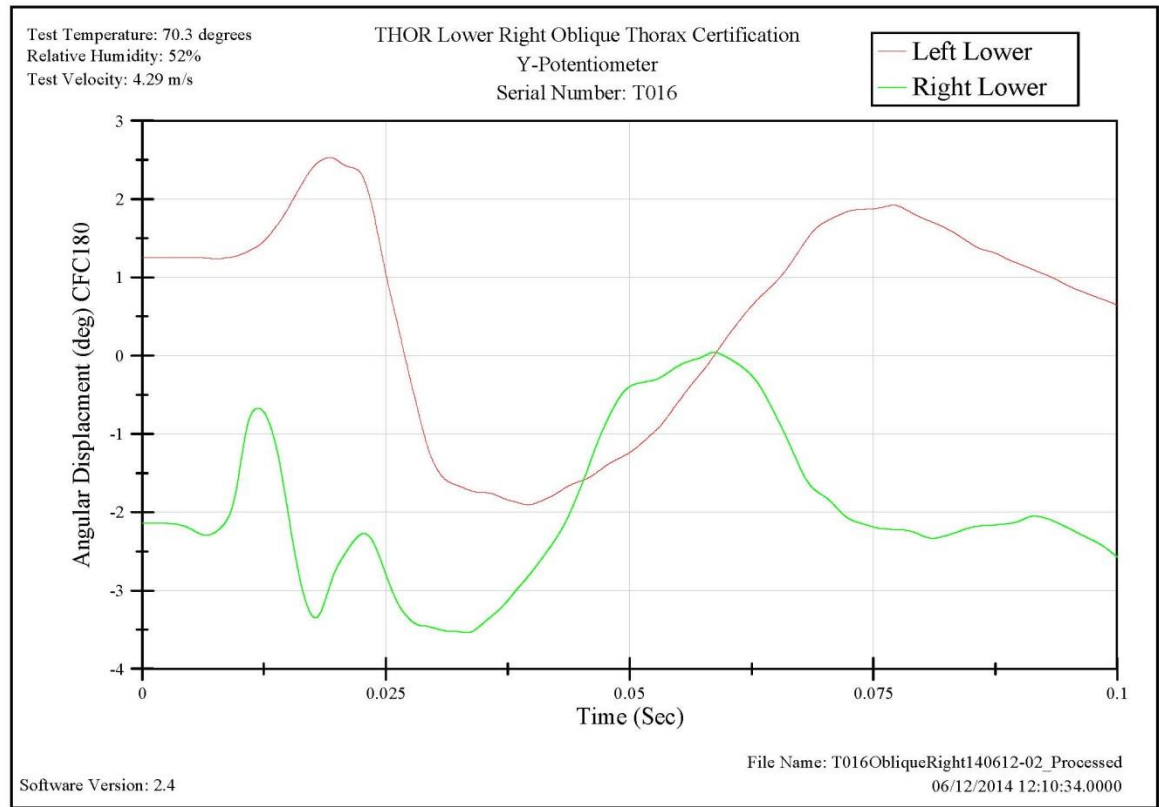
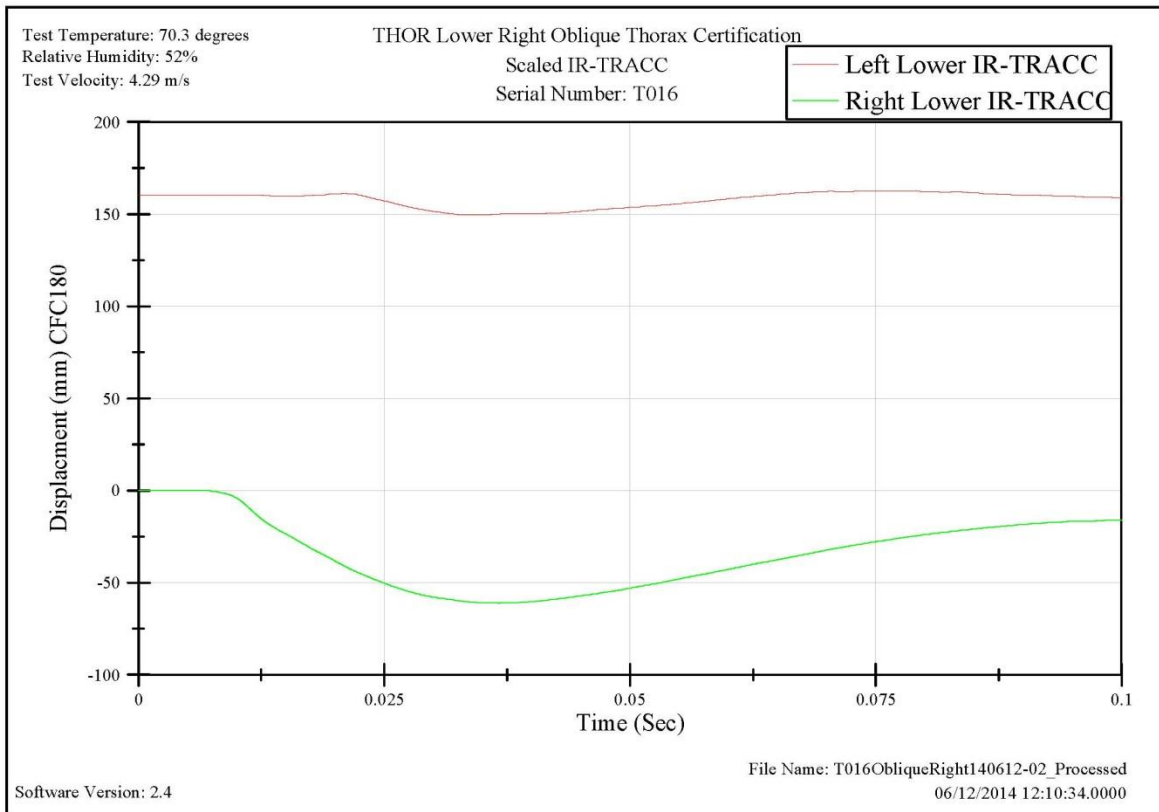


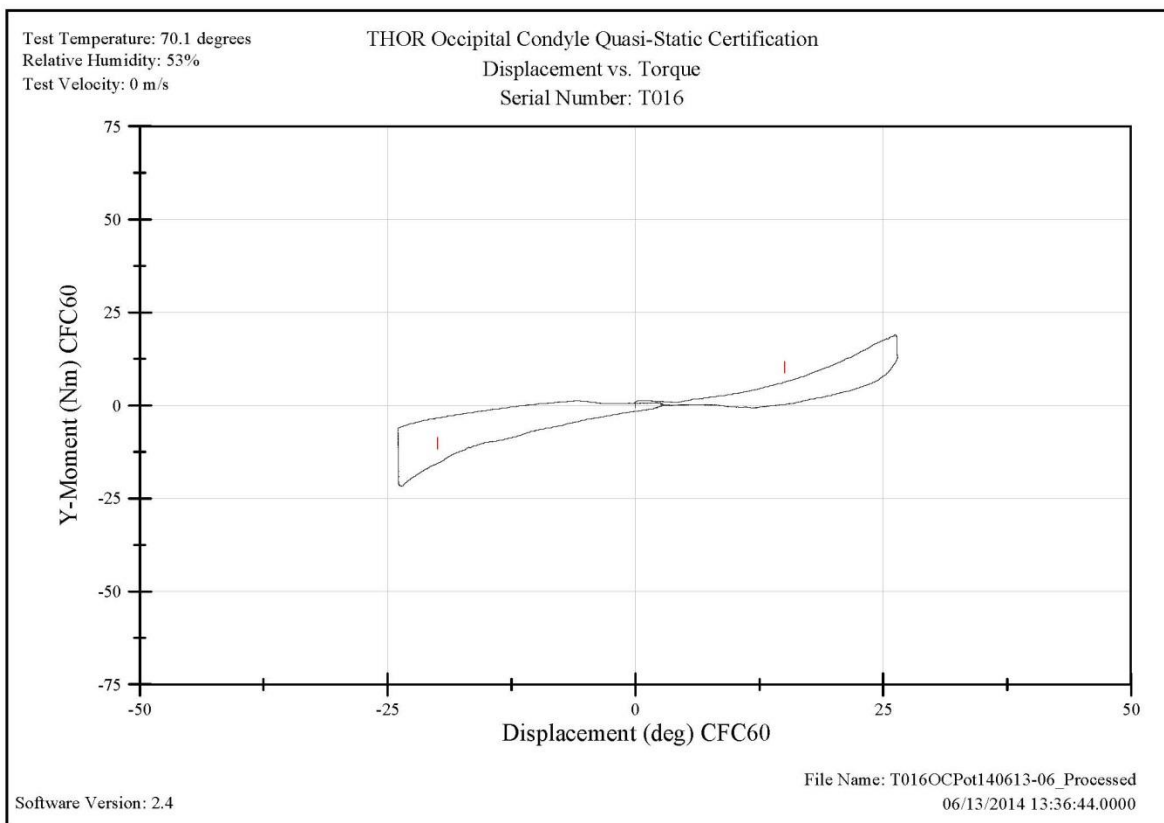
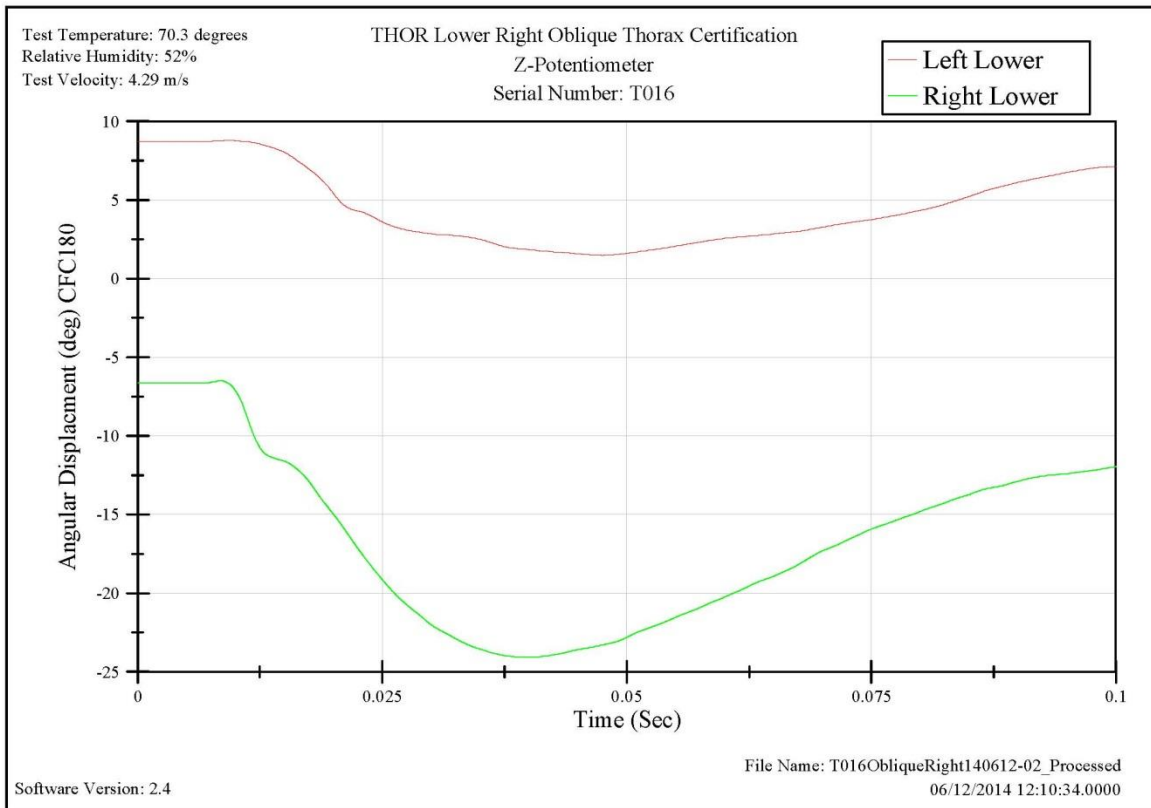
Software Version: 2.4

File Name: T016ObliqueLeft140612-03_Processed
06/12/2014 13:13:11.0000



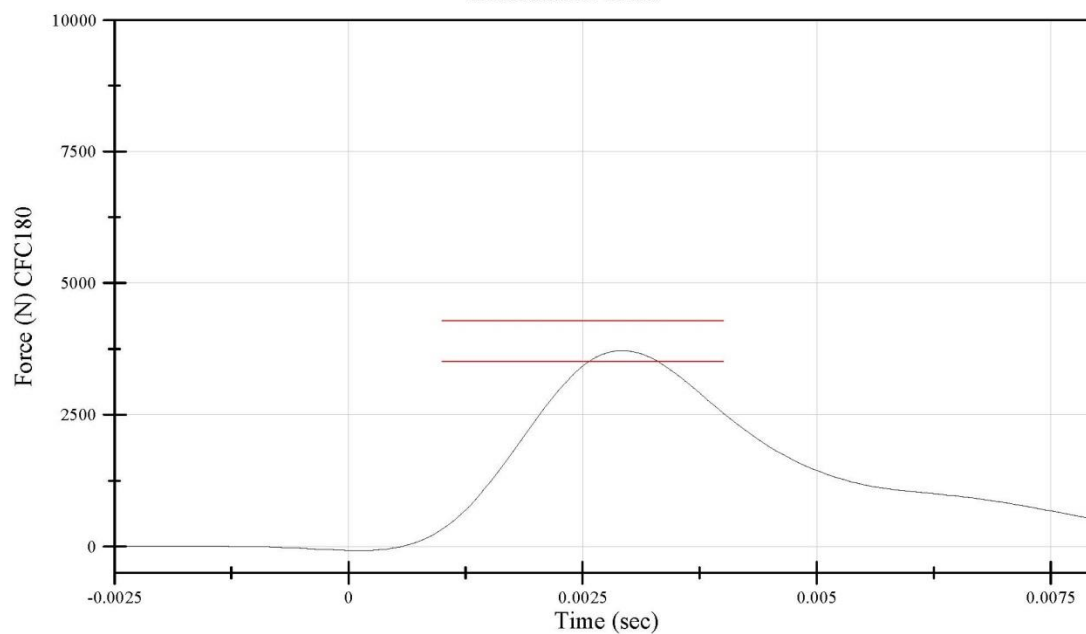






Test Temperature: 70.6 degrees
Relative Humidity: 52%
Test Velocity: 2.59 m/s

THOR Left Femur Certification
Probe Force
Serial Number: T0016

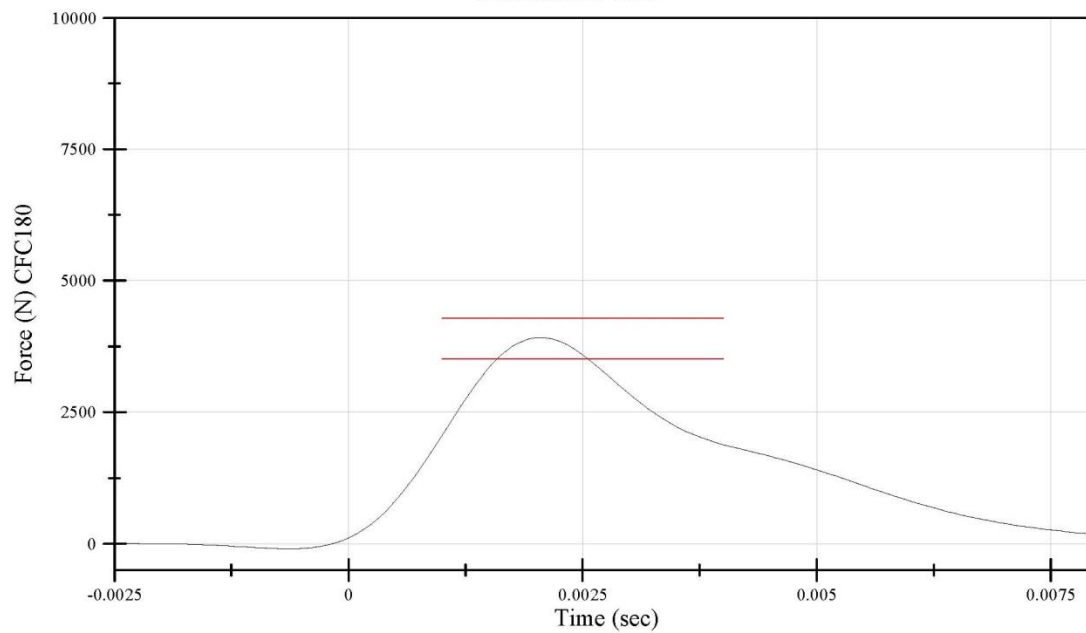


Software Version: 2.4

File Name: T016LeftKnee140613-03_Processed
06/16/2014 08:24:42.0000

Test Temperature: 70.3 degrees
Relative Humidity: 52%
Test Velocity: 2.59 m/s

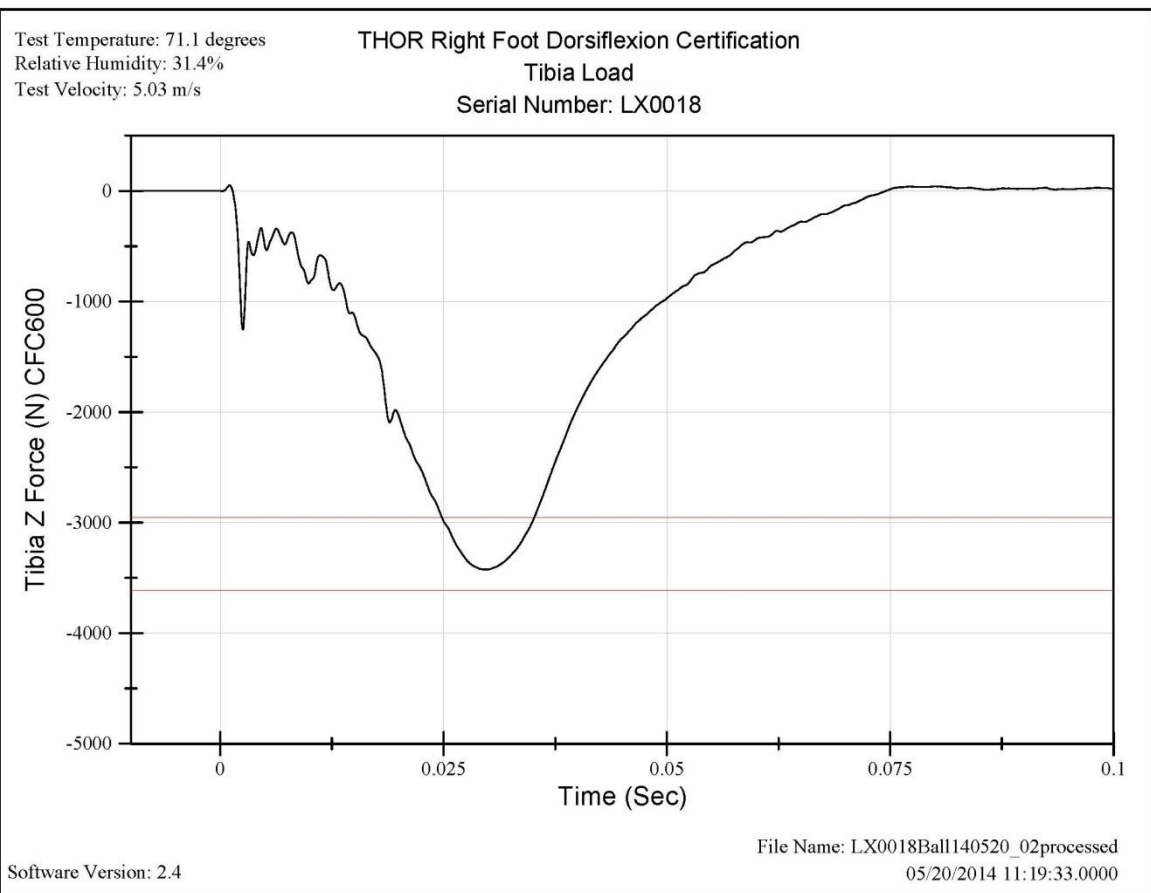
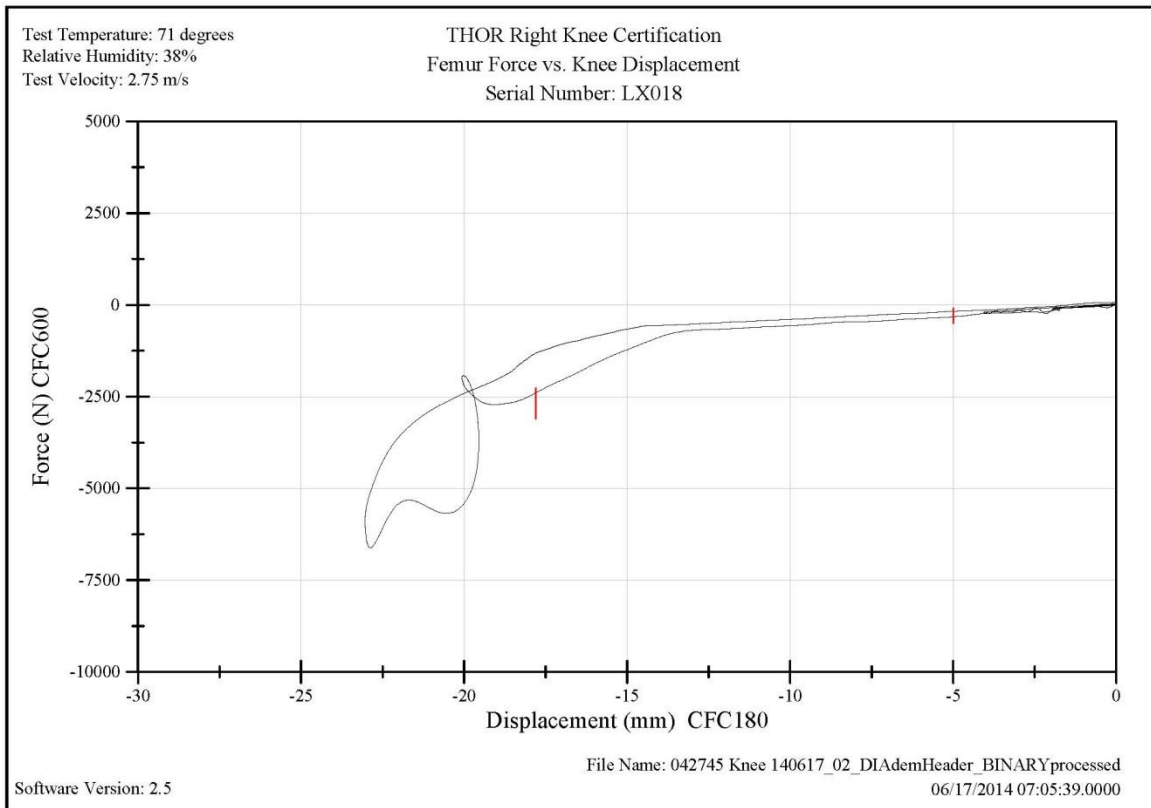
THOR Right Femur Certification
Probe Force
Serial Number: T016



Software Version: 2.4

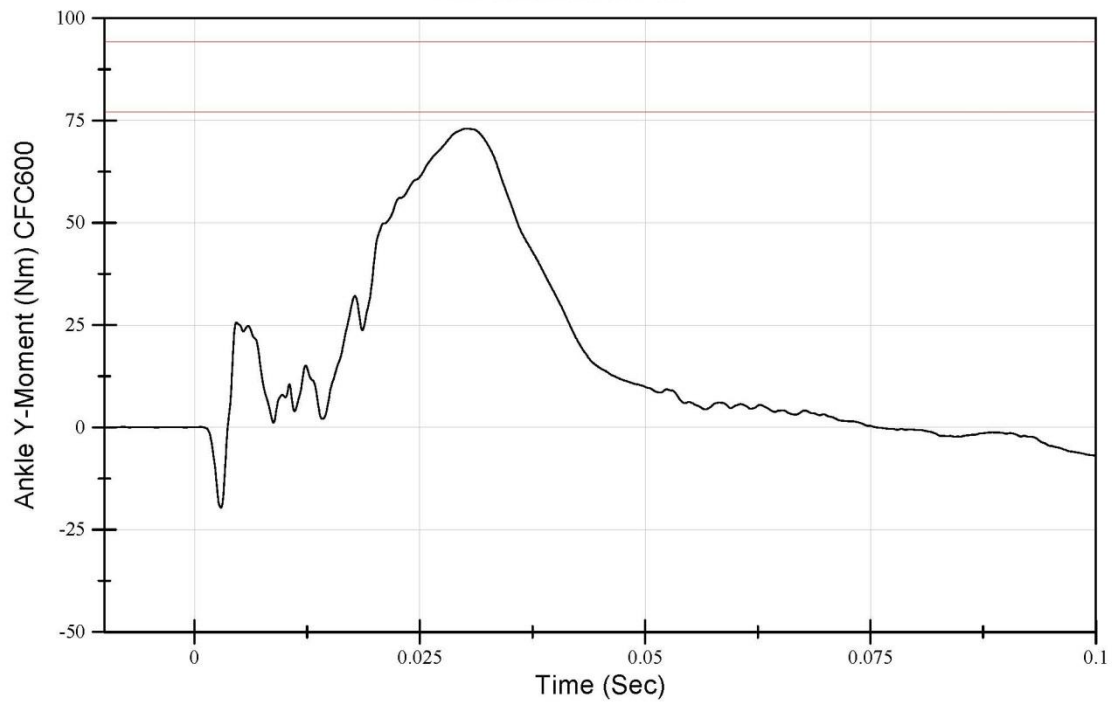
File Name: T016RightKnee140613-01_Processed
06/13/2014 16:14:24.0000

THOR 016 LEG CALIBRATIONS
LX0018/ LX0019



Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0018

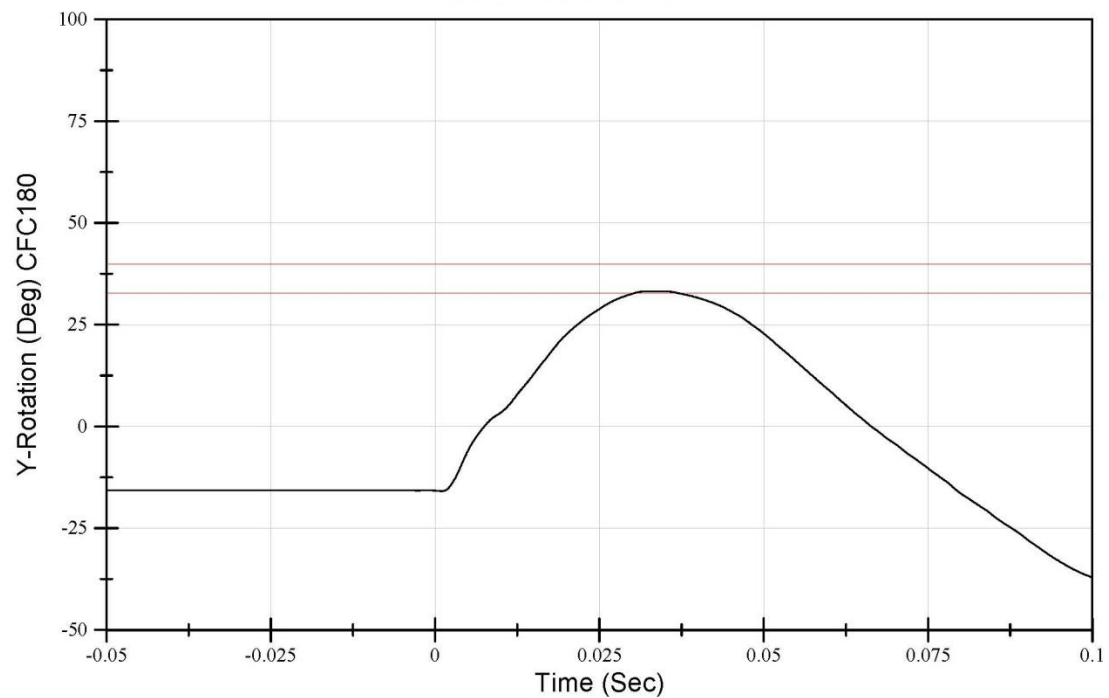


Software Version: 2.4

File Name: LX0018Ball140520_02processed
05/20/2014 11:19:33.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0018

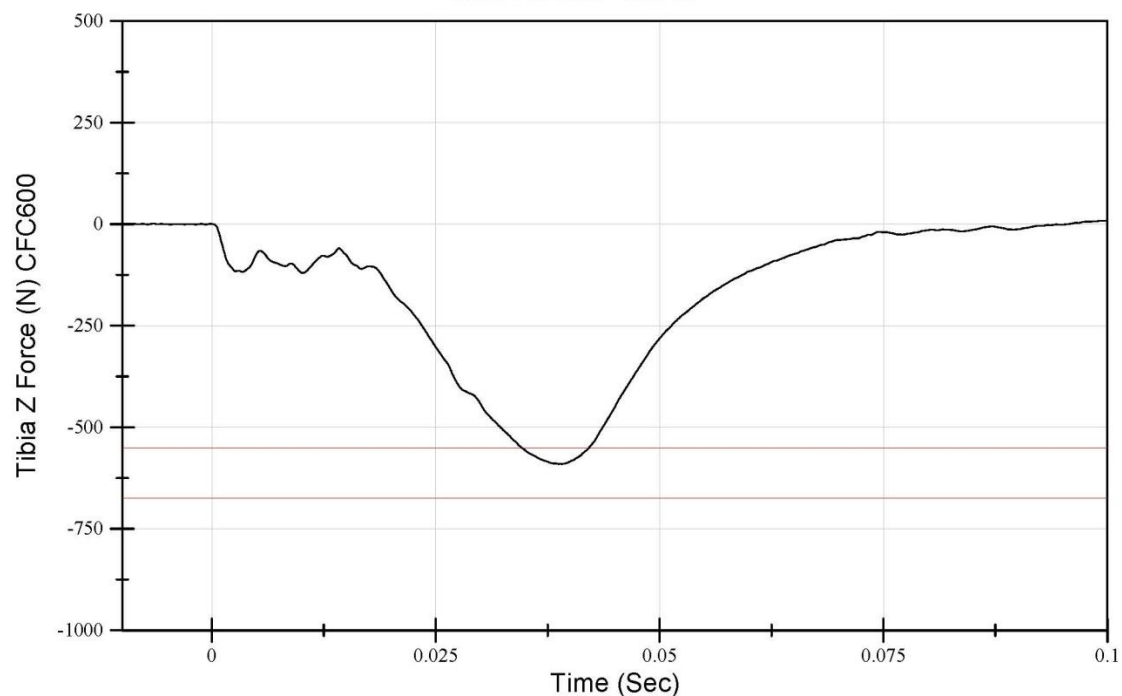


Software Version: 2.4

File Name: LX0018Ball140520_02processed
05/20/2014 11:19:33.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 2 m/s

THOR Right Foot Eversion Certification
Tibia Load
Serial Number: LX0018

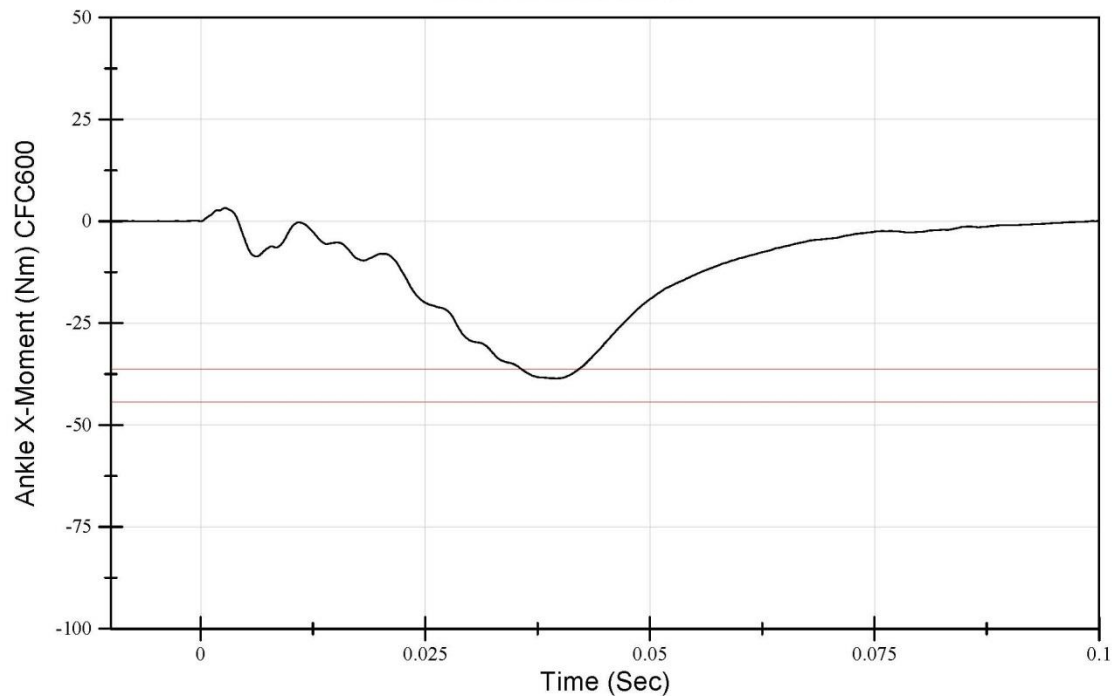


Software Version: 2.4

File Name: LX0018Eversion140520_01processed
05/20/2014 10:15:43.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 2 m/s

THOR Right Foot Eversion Certification
Ankle Moment
Serial Number: LX0018

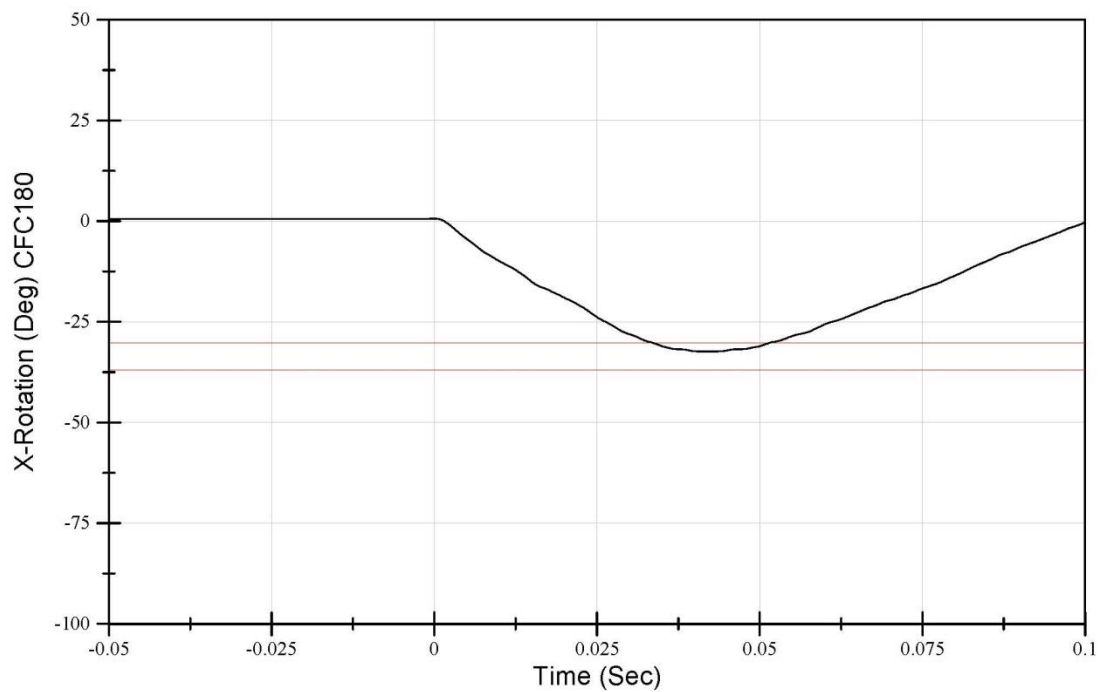


Software Version: 2.4

File Name: LX0018Eversion140520_01processed
05/20/2014 10:15:43.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 2 m/s

THOR Right Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0018

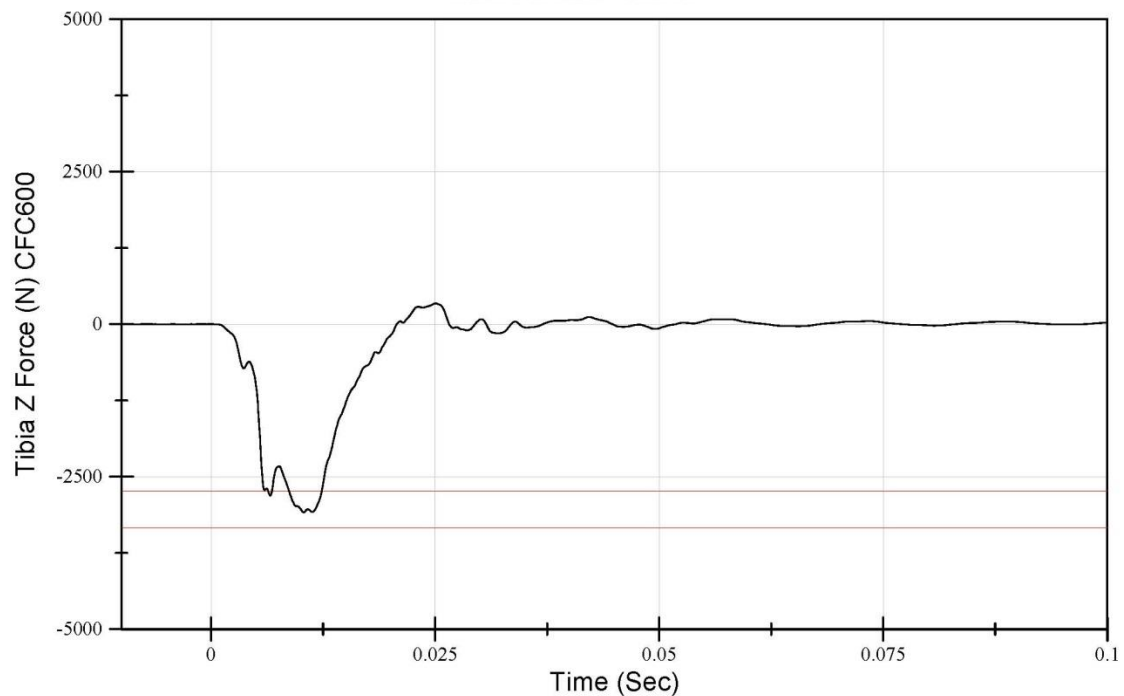


Software Version: 2.4

File Name: LX0018Eversion140520_01processed
05/20/2014 10:15:43.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 3.94 m/s

THOR Right Foot Heel Certification
Tibia Load
Serial Number: LX0018

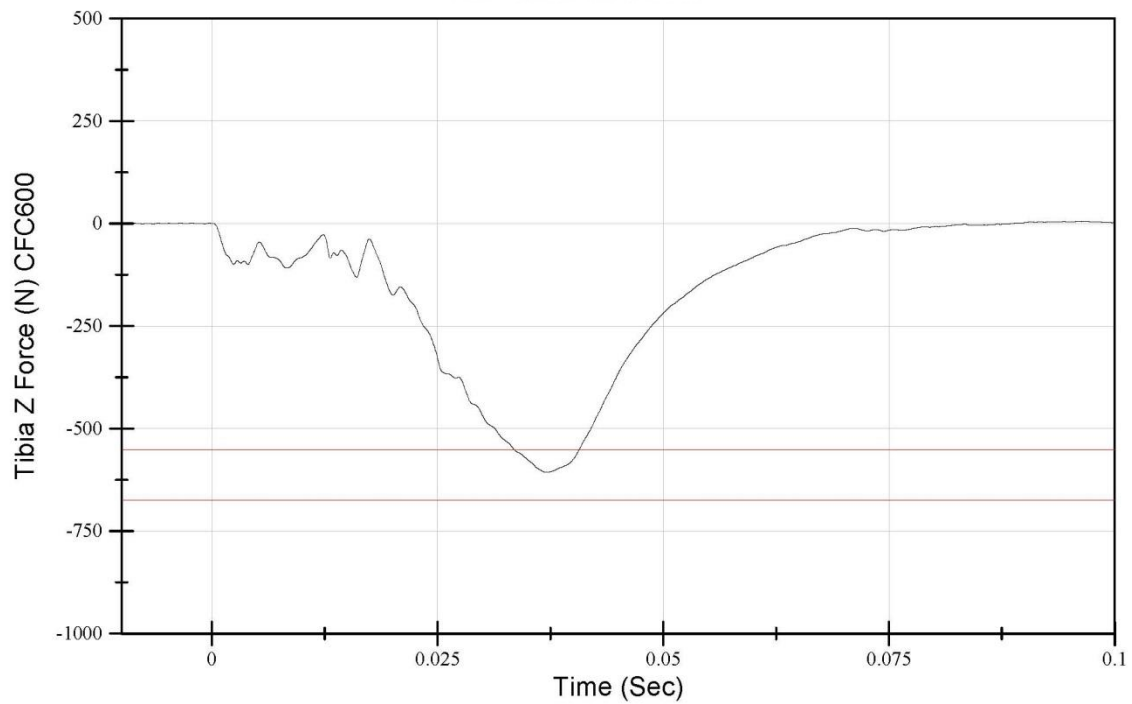


Software Version: 2.4

File Name: LX0018Heel140520_01processed
05/20/2014 12:59:01.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 2 m/s

THOR Right Foot Inversion Certification
Tibia Load
Serial Number: LX0018

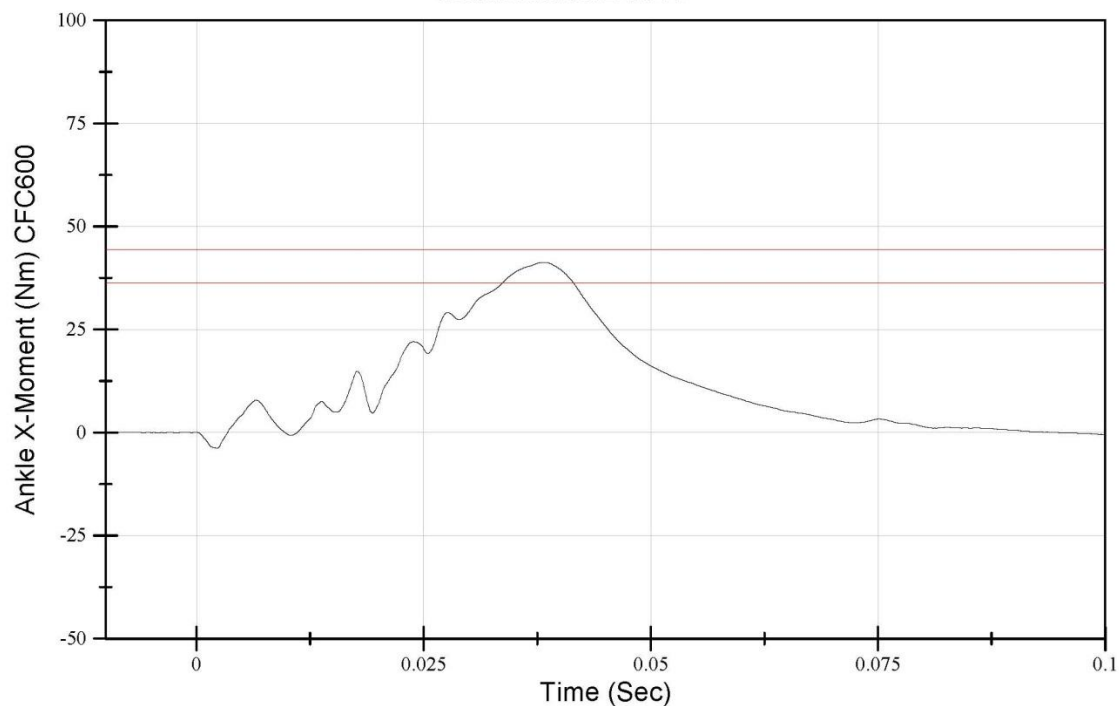


Software Version: 2.4

File Name: LX0018Inversion140520_04processed
05/20/2014 09:27:22.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 2 m/s

THOR Right Foot Inversion Certification
Ankle Moment
Serial Number: LX0018

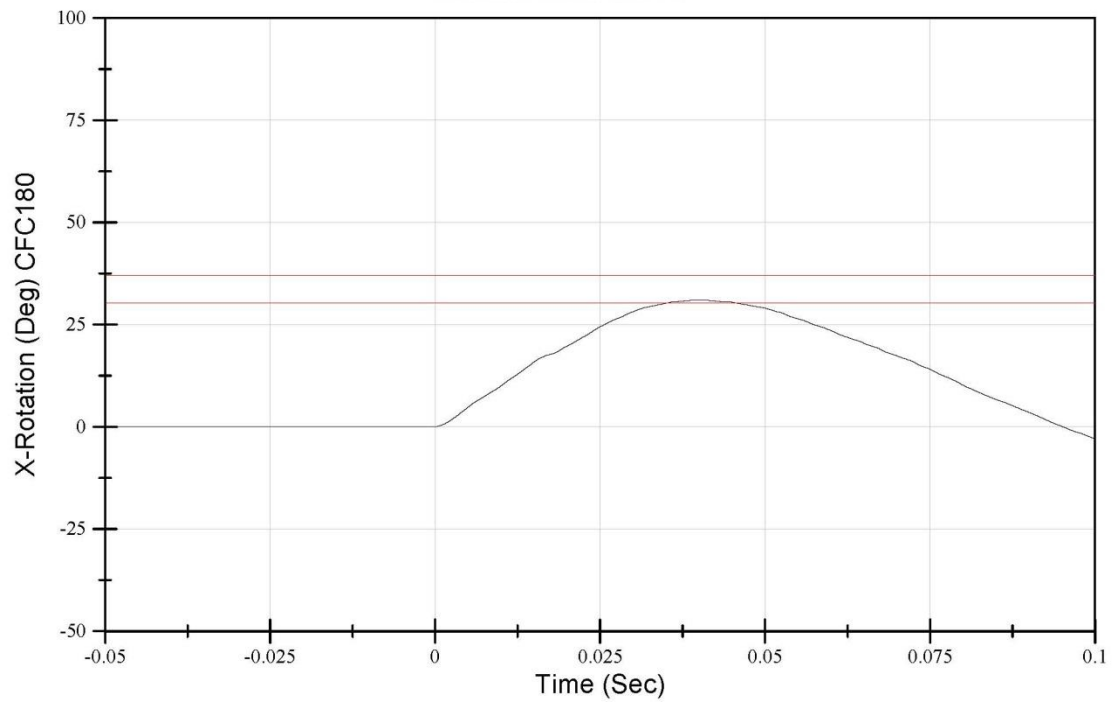


Software Version: 2.4

File Name: LX0018Inversion140520_04processed
05/20/2014 09:27:22.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 2 m/s

THOR Right Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0018

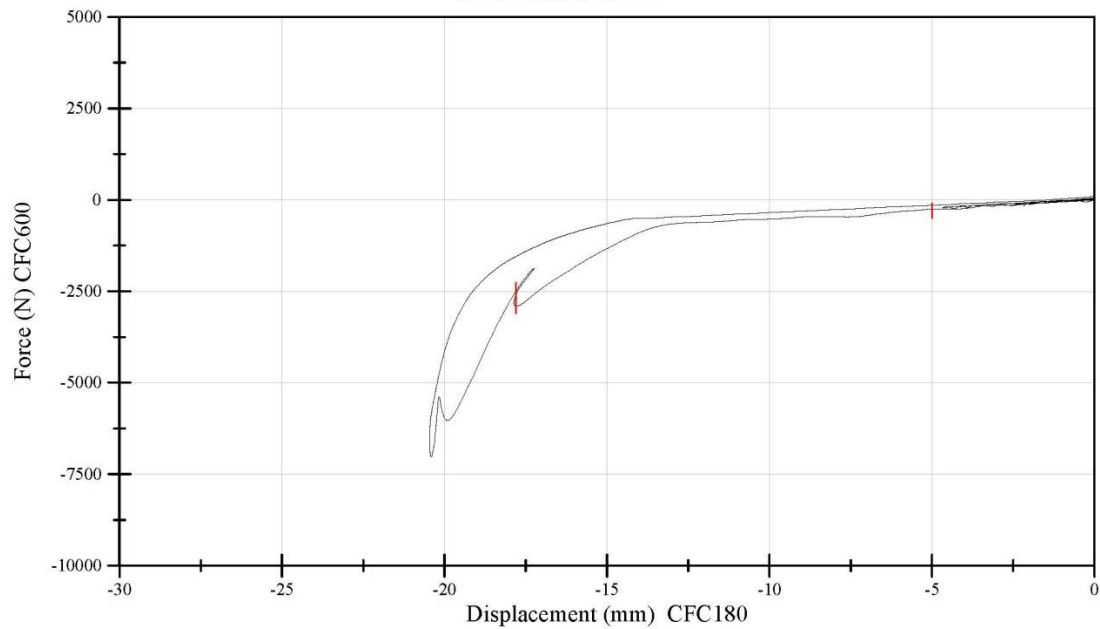


Software Version: 2.4

File Name: LX0018Inversion140520_04processed
05/20/2014 09:27:22.0000

Test Temperature: 71 degrees
Relative Humidity: 38%
Test Velocity: 2.75 m/s

THOR Left Knee Certification
Femur Force vs. Knee Displacement
Serial Number: LX0019

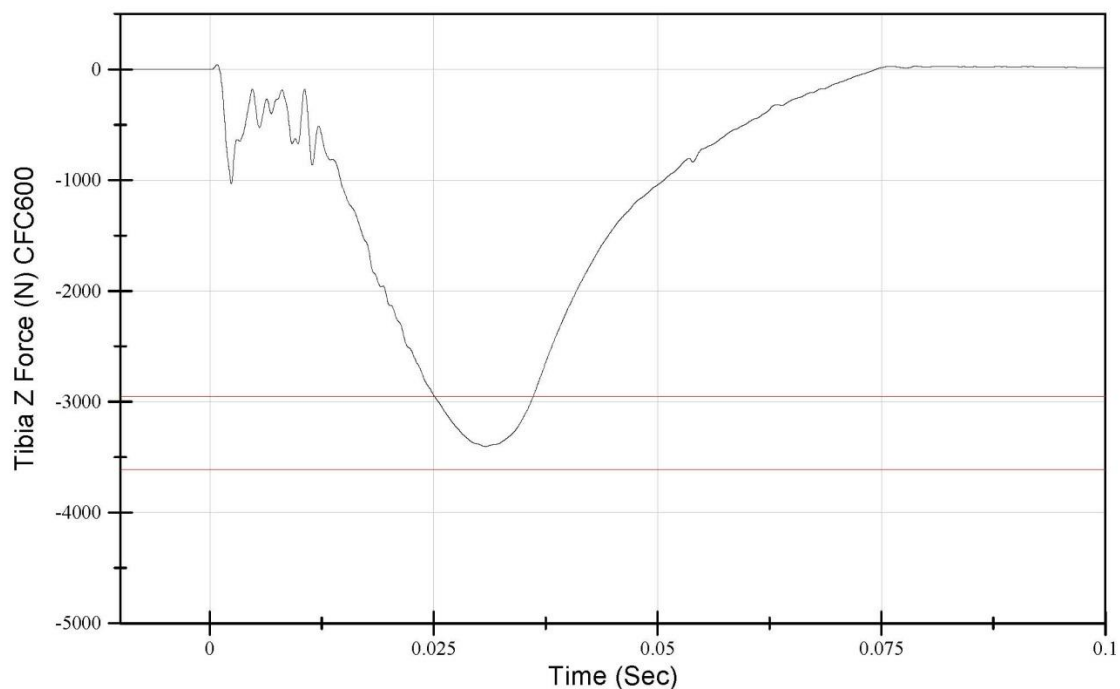


Software Version: 2.5

File Name: 13074235Knee140617_01_DIADEMHeader_BINARYprocessed
06/17/2014 10:50:02.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0019

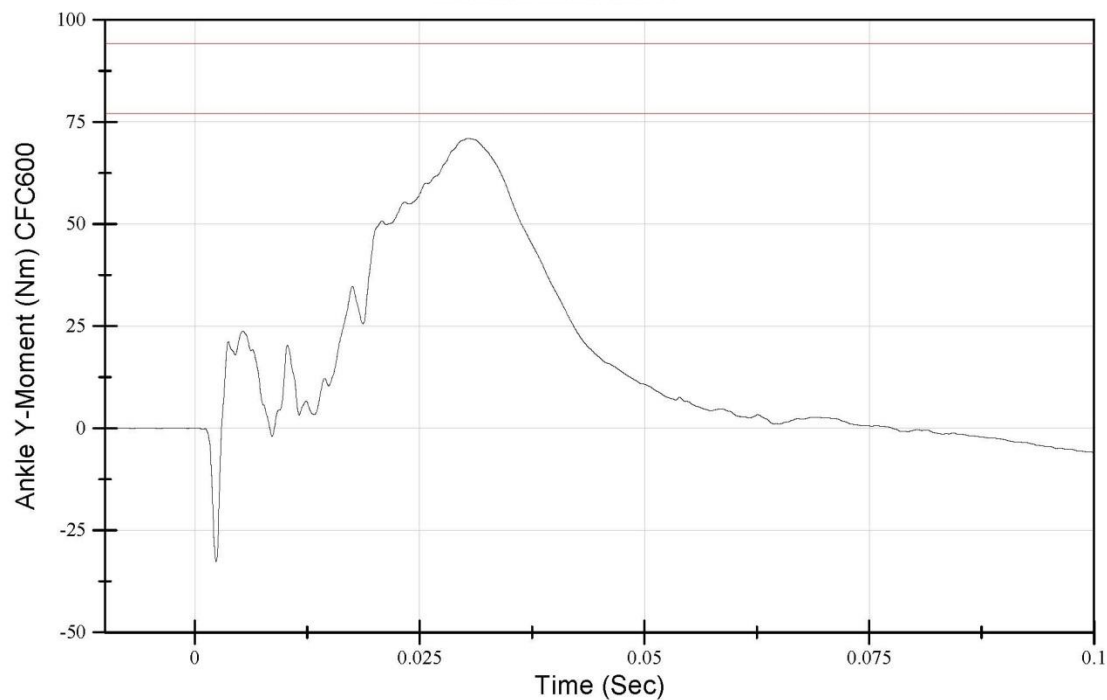


Software Version: 2.4

File Name: LX0019Ball140521_03processed
05/21/2014 13:20:28.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0019

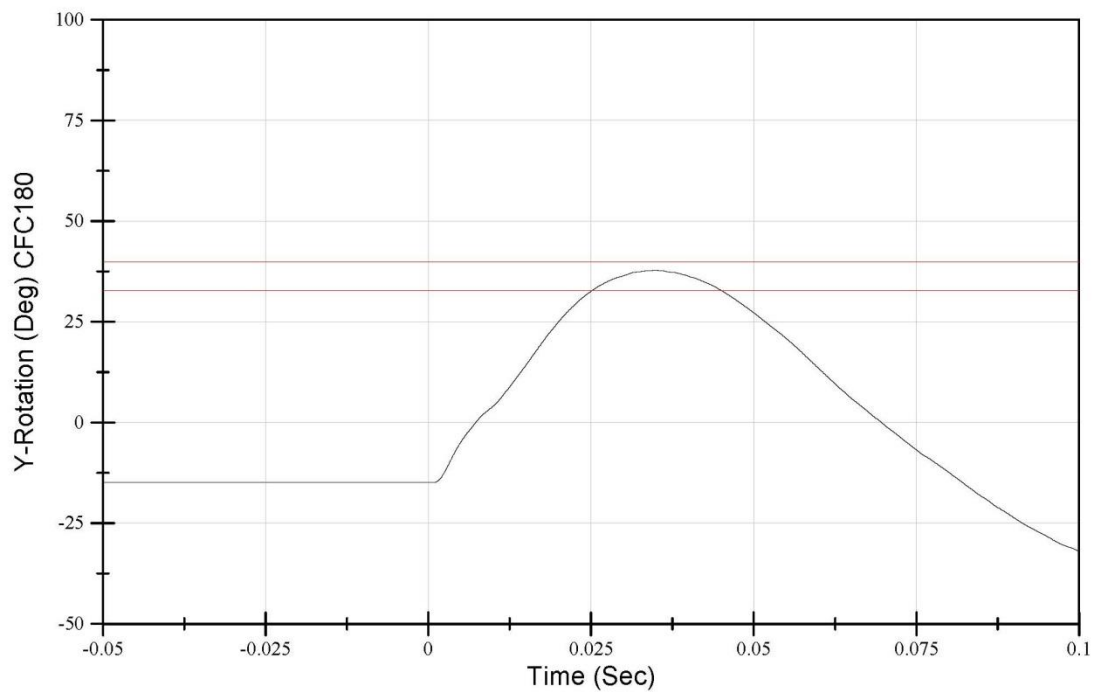


Software Version: 2.4

File Name: LX0019Ball140521_03processed
05/21/2014 13:20:28.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0019

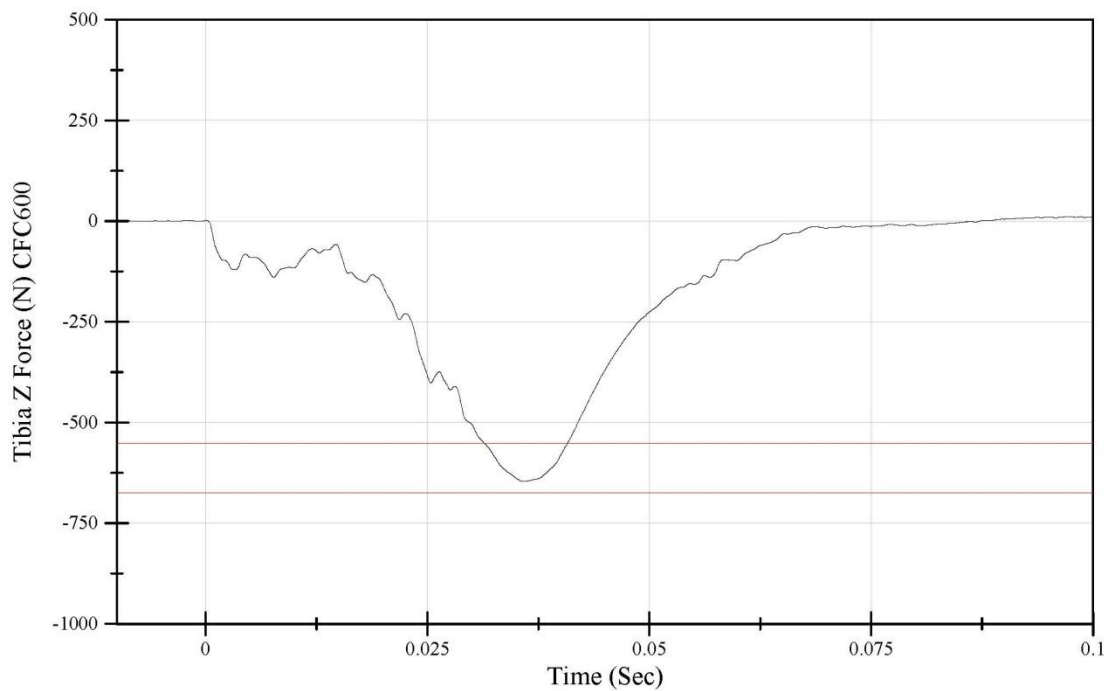


Software Version: 2.4

File Name: LX0019Ball140521_03processed
05/21/2014 13:20:28.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 1.97 m/s

THOR Left Foot Eversion Certification
Tibia Load
Serial Number: LX0019

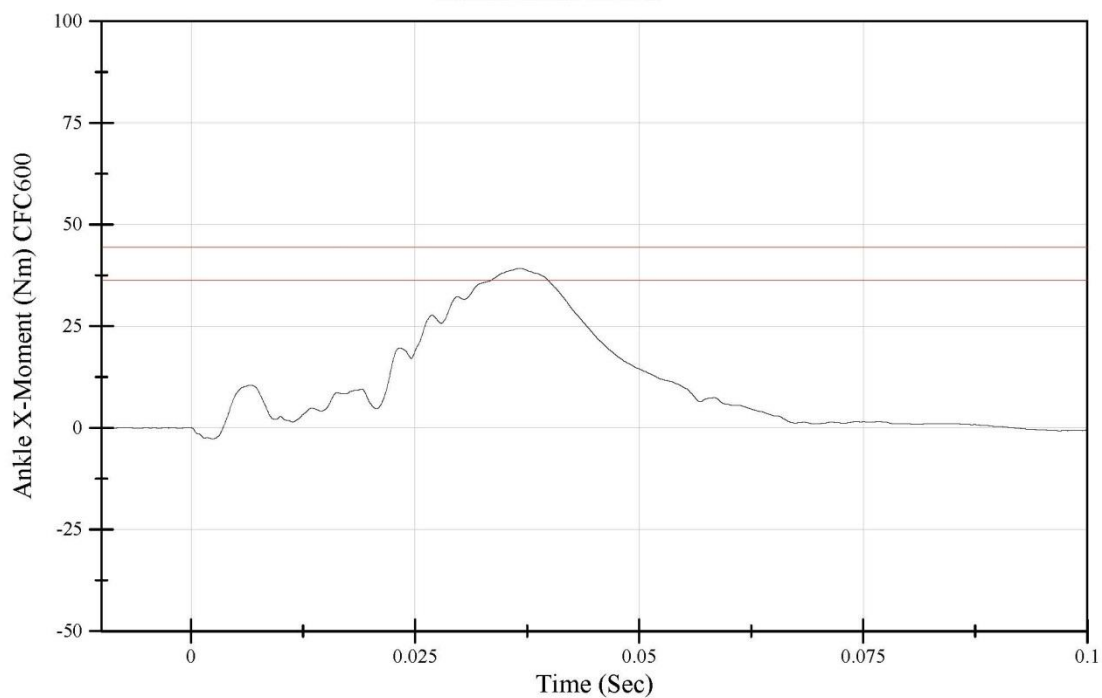


Software Version: 2.4

File Name: LX0019Eversion140521_02processed
05/21/2014 09:58:27.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 1.97 m/s

THOR Left Foot Eversion Certification
Ankle Moment
Serial Number: LX0019

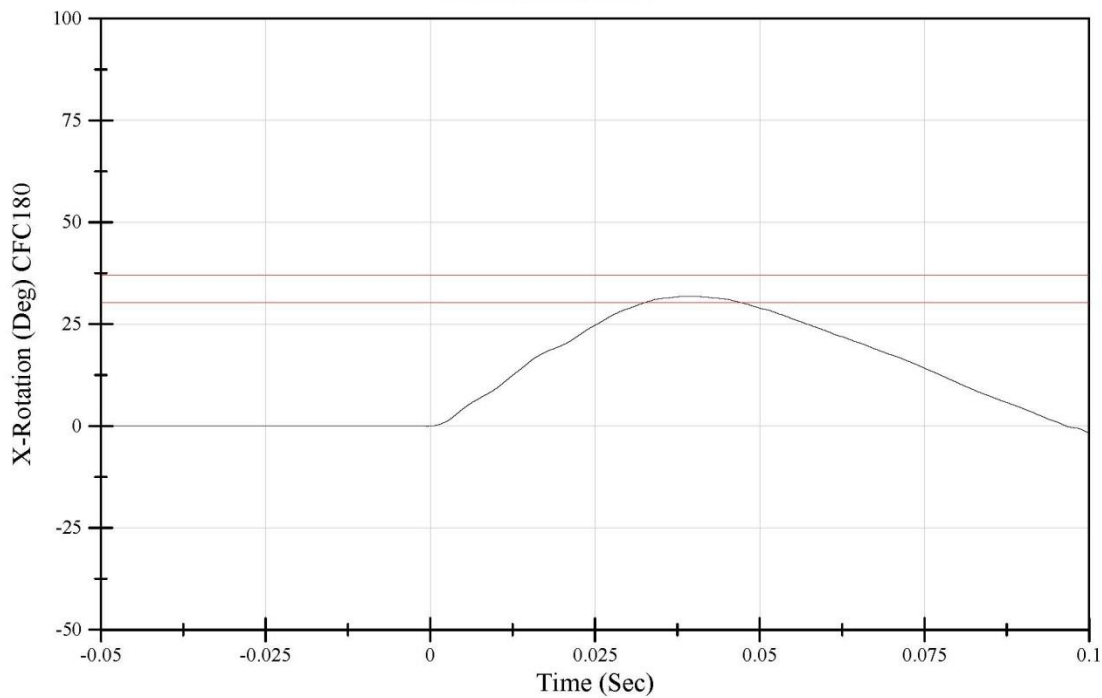


Software Version: 2.4

File Name: LX0019Eversion140521_02processed
05/21/2014 09:58:27.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 1.97 m/s

THOR Left Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0019

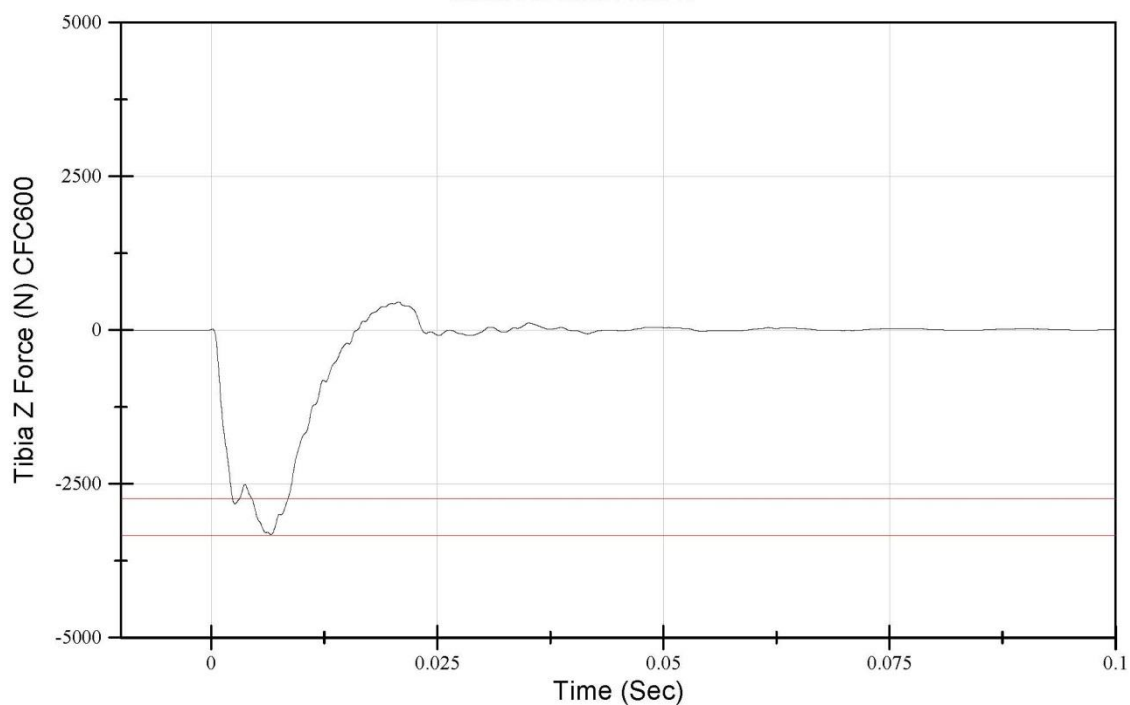


Software Version: 2.4

File Name: LX0019Eversion140521_02processed
05/21/2014 09:58:27.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 4 m/s

THOR Left Foot Heel Certification
Tibia Load
Serial Number: LX0019

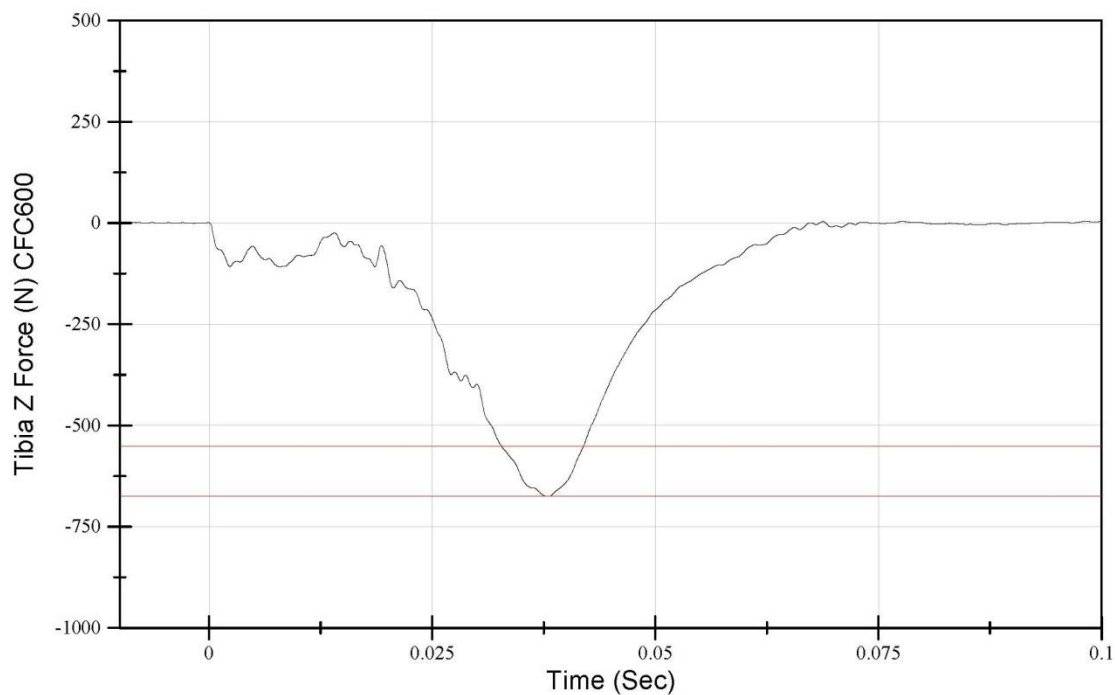


Software Version: 2.4

File Name: LX0019Heel140521_01processed
05/21/2014 14:19:36.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 1.96 m/s

THOR Left Foot Inversion Certification
Tibia Load
Serial Number: LX0019

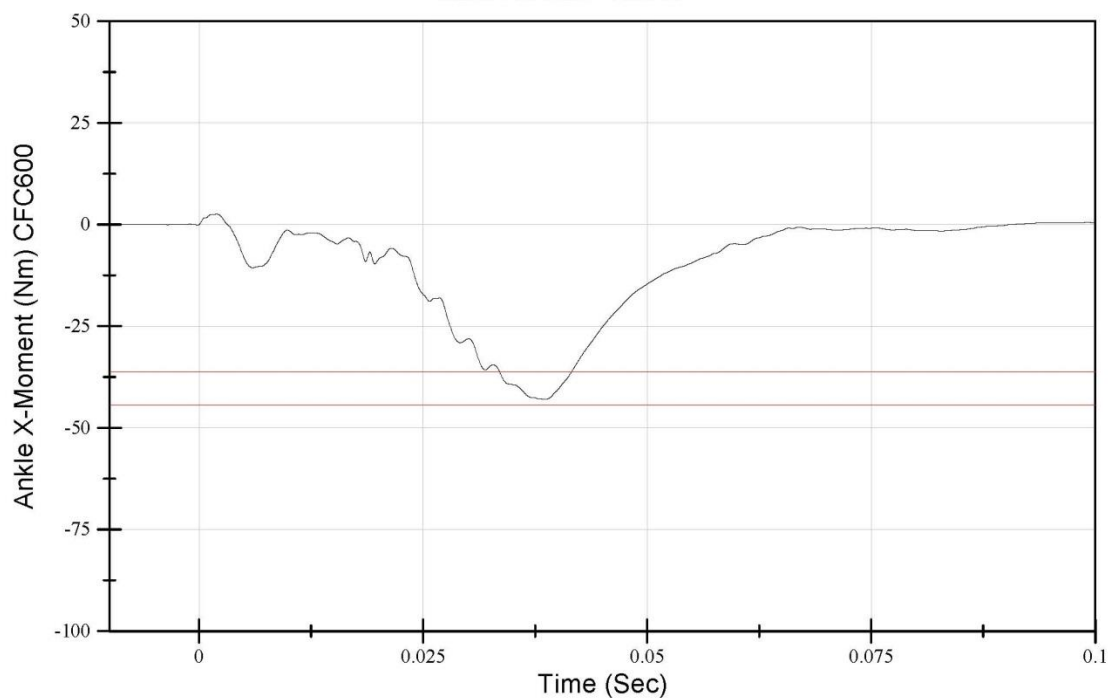


Software Version: 2.4

File Name: LX0019Inversion140521_03processed
05/21/2014 08:53:35.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 1.96 m/s

THOR Left Foot Inversion Certification
Ankle Moment
Serial Number: LX0019

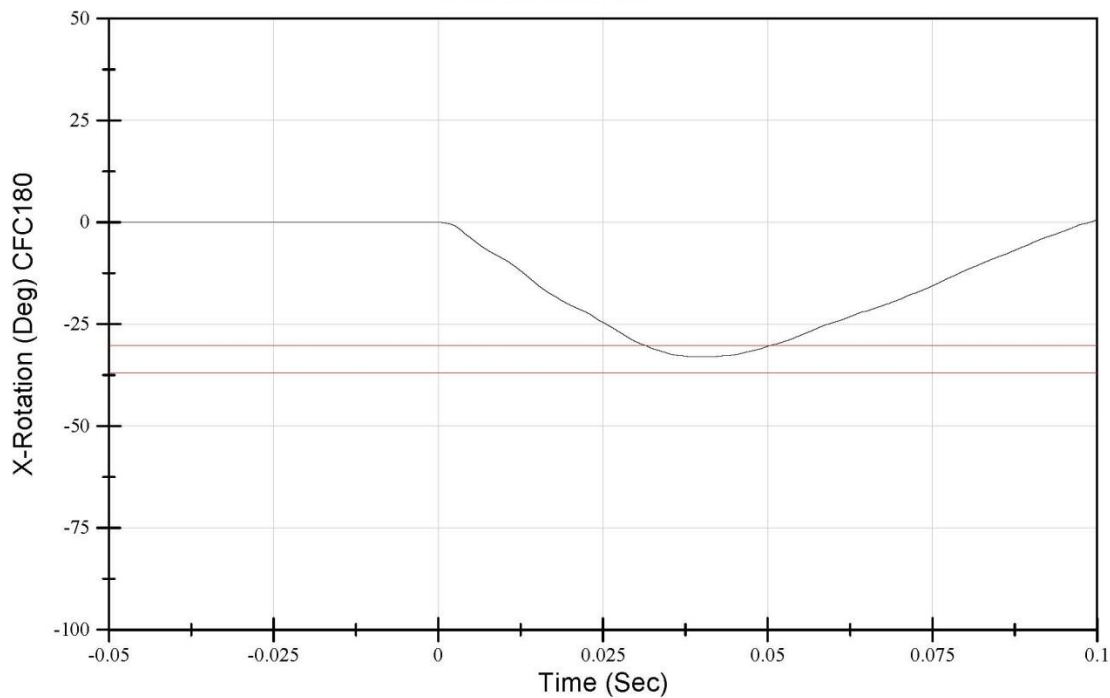


Software Version: 2.4

File Name: LX0019Inversion140521_03processed
05/21/2014 08:53:35.0000

Test Temperature: 71.1 degrees
Relative Humidity: 31.4%
Test Velocity: 1.96 m/s

THOR Left Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0019



Software Version: 2.4

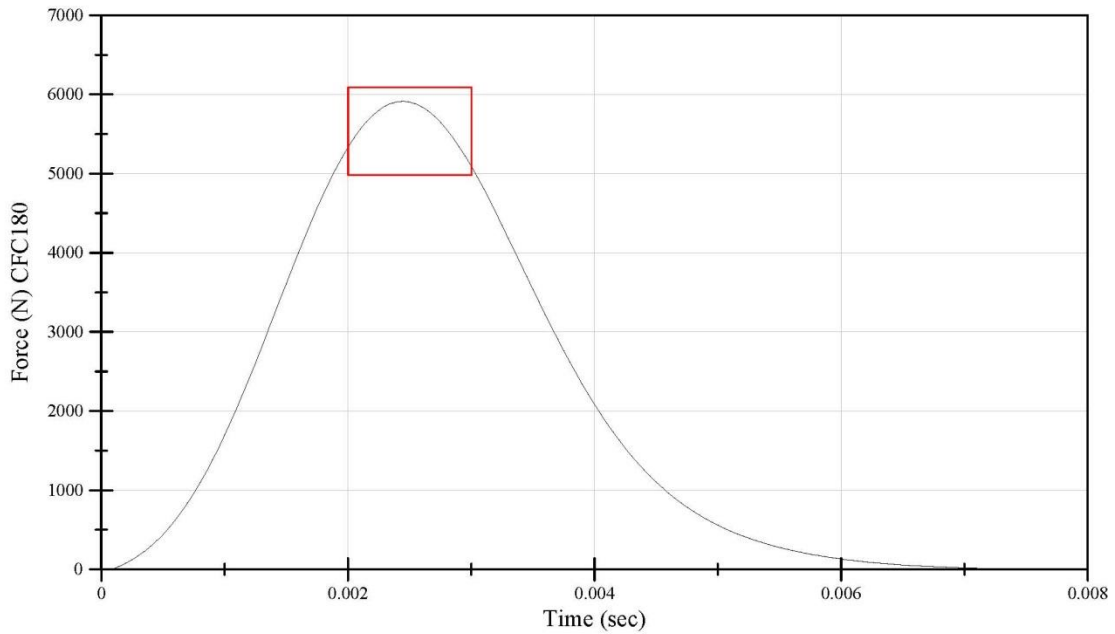
File Name: LX0019Inversion140521_03processed
05/21/2014 08:53:35.0000

50% ADULT MALE THOR015 DUMMY CALIBRATIONS

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 1.98 m/s

THOR Head Impact Certification

Probe Force
Serial Number: T015



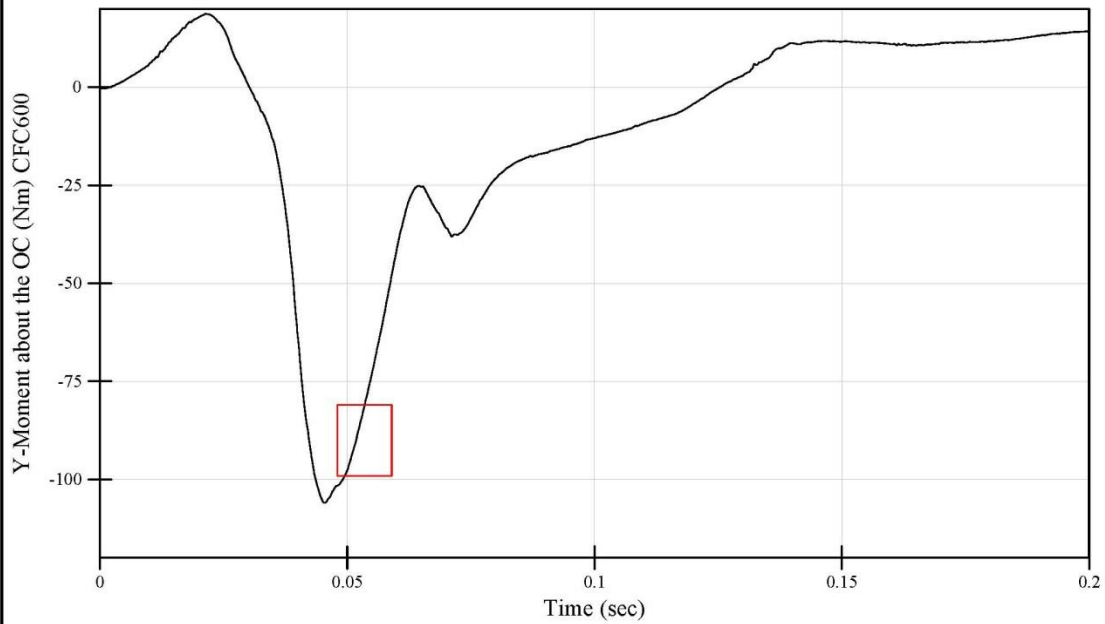
Software Version: 2.4

File Name: T015Head051914_01_DIAdemHeader_BINARYpatrick
05/19/2014 14:31:34.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 3.66 m/s

THOR Neck Extension Certification

Y-Moment
Serial Number: T015

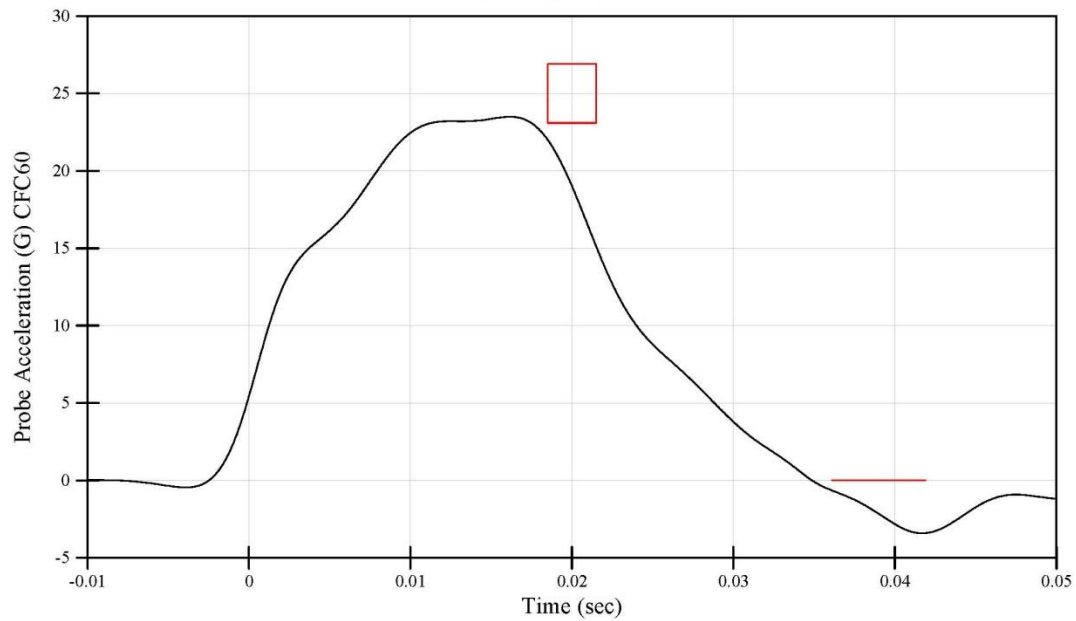


Software Version: 2.4

File Name: T015NeckExtension051914_02_DIAdemHeader_BINARYpatrick
05/19/2014 08:49:38.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 3.66 m/s

THOR Neck Extension Certification
Probe Acceleration
Serial Number: T015

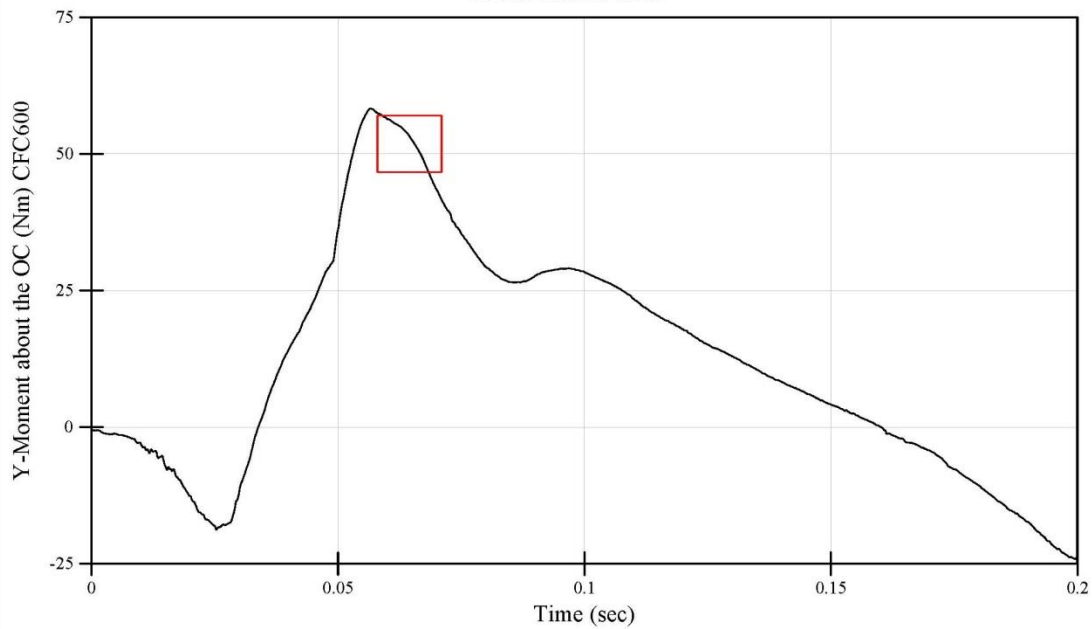


Software Version: 2.4

File Name: T015NeckExtension051914_02_DIAdemHeader_BINARYpatrick
05/19/2014 08:49:38.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 3.78 m/s

THOR Neck Flexion Certification
Y-Moment
Serial Number: T015

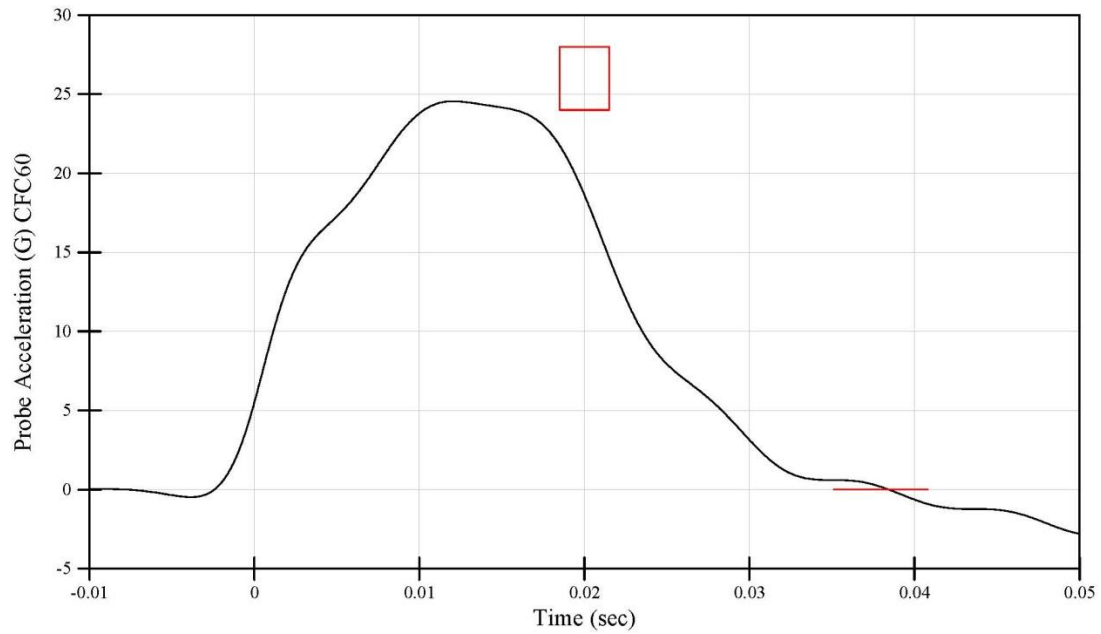


Software Version: 2.4

File Name: T015NeckFlexion051914_02_DIAdemHeader_BINARYpatrick
05/19/2014 08:24:12.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 3.78 m/s

THOR Neck Flexion Certification
Probe Acceleration
Serial Number: T015

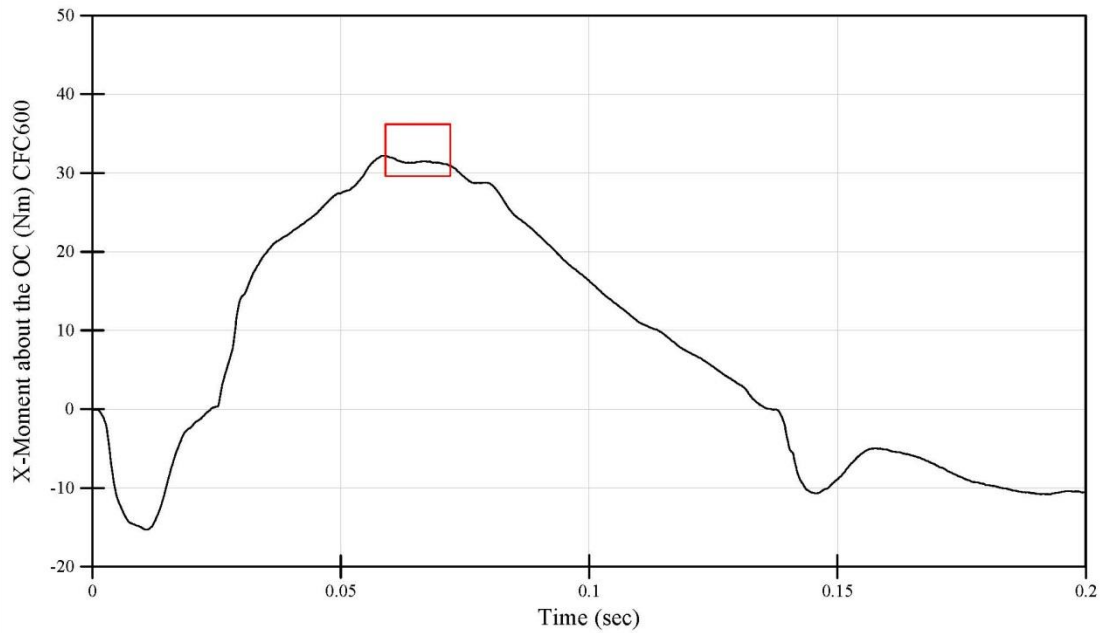


Software Version: 2.4

File Name: T015NeckFlexion051914_02_DIAdemHeader_BINARYpatrick
05/19/2014 08:24:12.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 2.88 m/s

THOR Neck Left Lateral Flexion Certification
X-Moment
Serial Number: T015

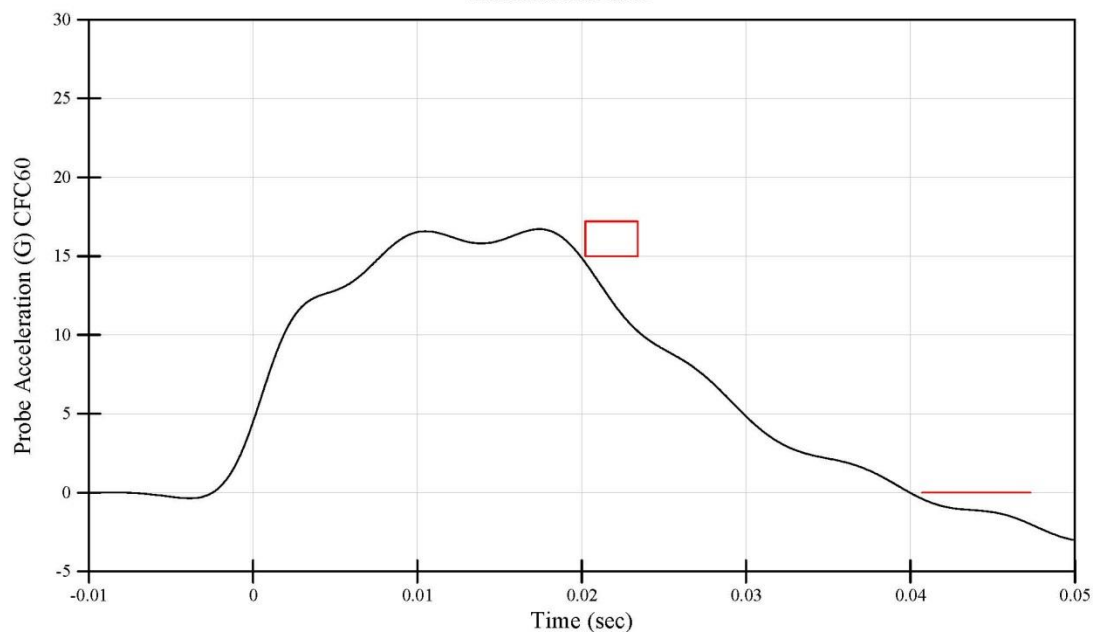


Software Version: 2.4

File Name: T015NeckLeft051914_02_DIAdemHeader_BINARYpatrick
05/19/2014 10:02:58.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 2.88 m/s

THOR Neck Left Lateral Flexion Certification
Probe Acceleration
Serial Number: T015

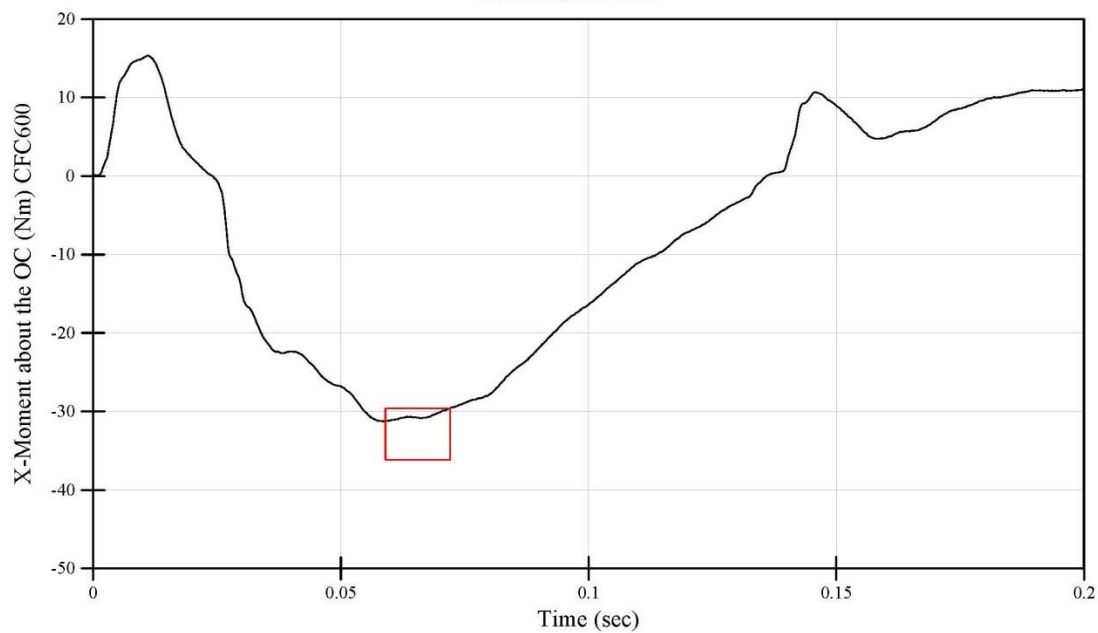


Software Version: 2.4

File Name: T015NeckLeft051914_02_DIADEMHeader_BINARYpatrick
05/19/2014 10:02:58.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 2.87 m/s

THOR Neck Right Lateral Flexion Certification
X-Moment
Serial Number: T015



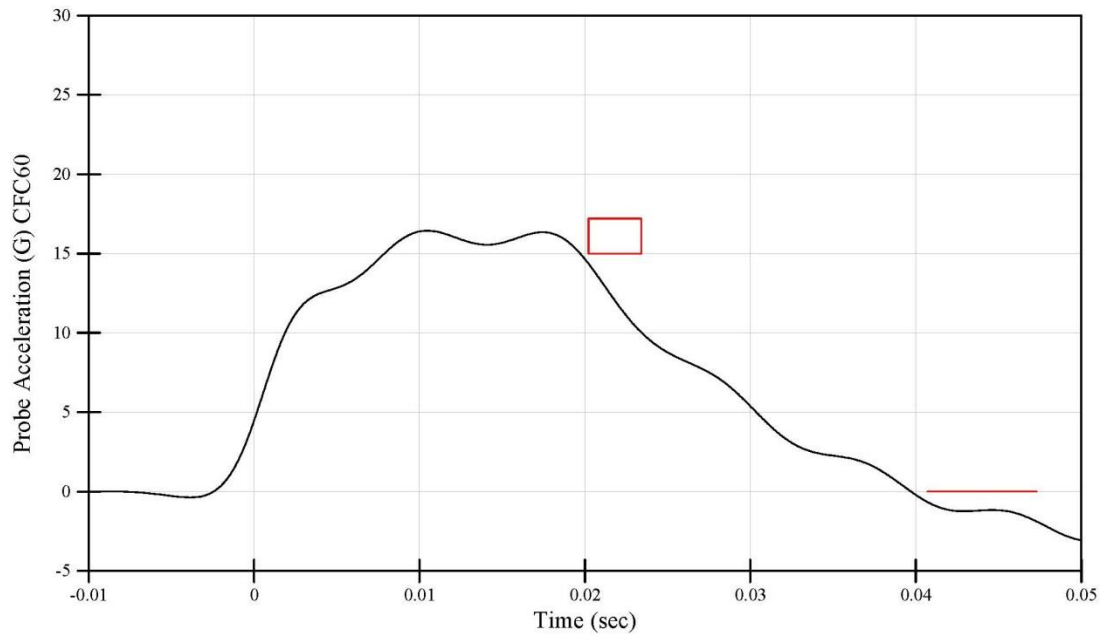
Software Version: 2.4

File Name: T015NeckRight051914_02_DIADEMHeader_BINARYpatrick
05/19/2014 09:29:56.0000

Test Temperature: 71 degrees
Relative Humidity: 31%
Test Velocity: 2.87 m/s

THOR Neck Right Lateral Flexion Certification

Probe Acceleration
Serial Number: T015

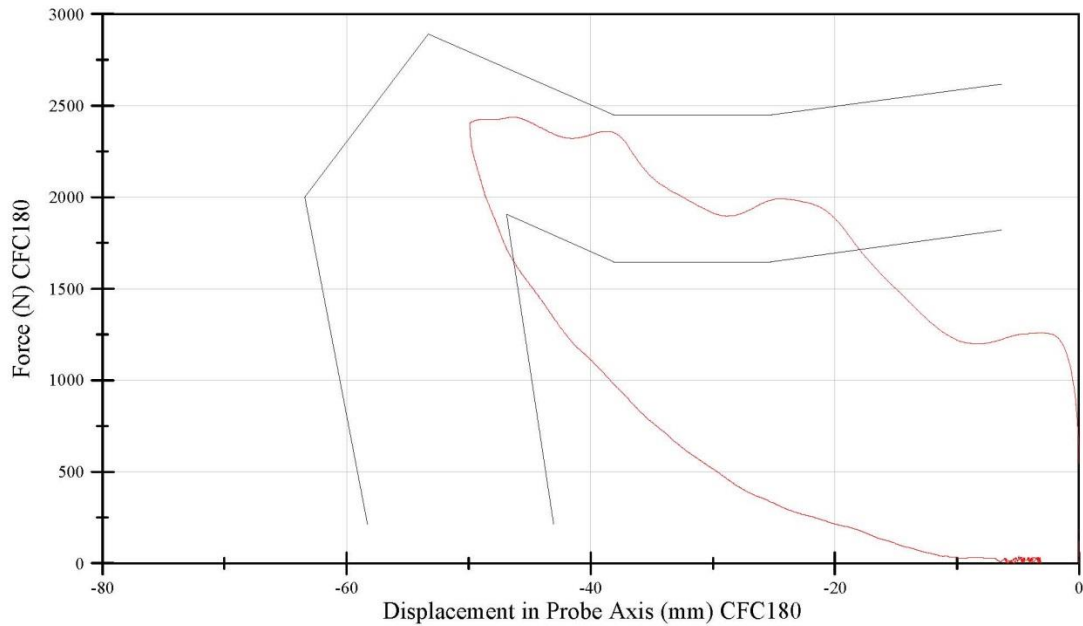


Software Version: 2.4

File Name: T015NeckRight051914_02_DIADEMHeader_BINARYpatrick
05/19/2014 09:29:56.0000

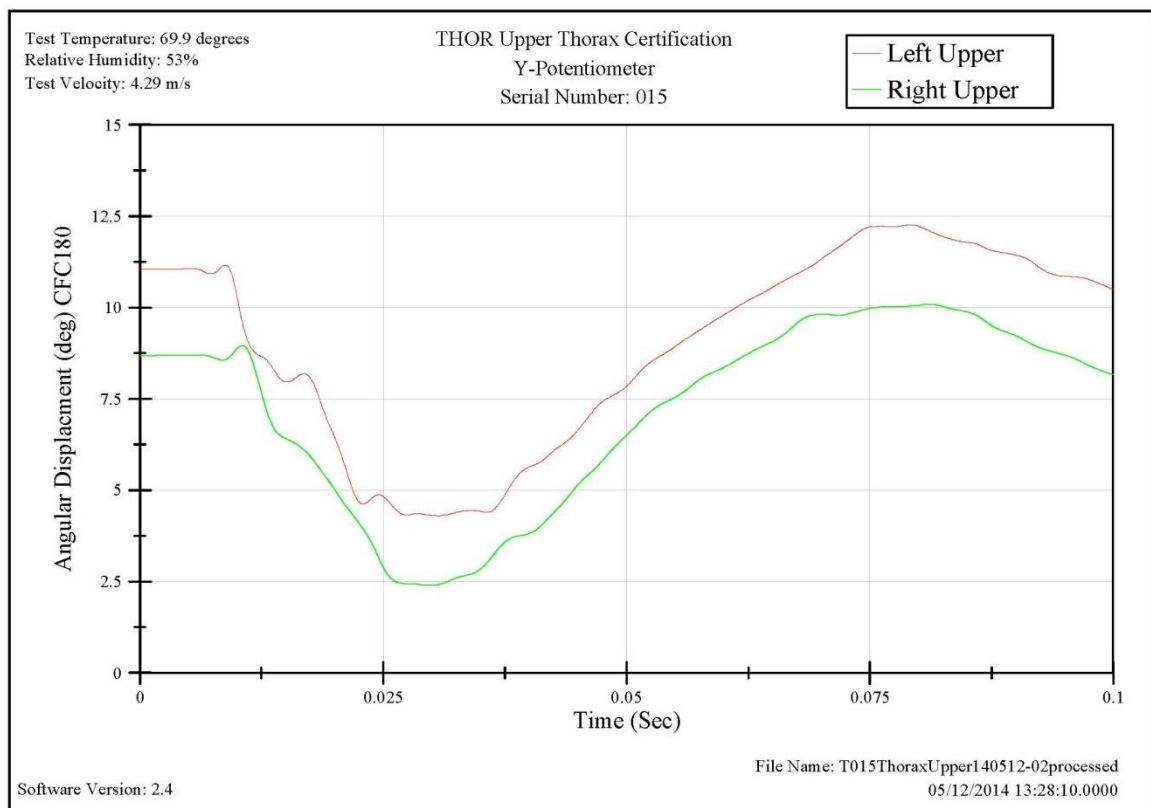
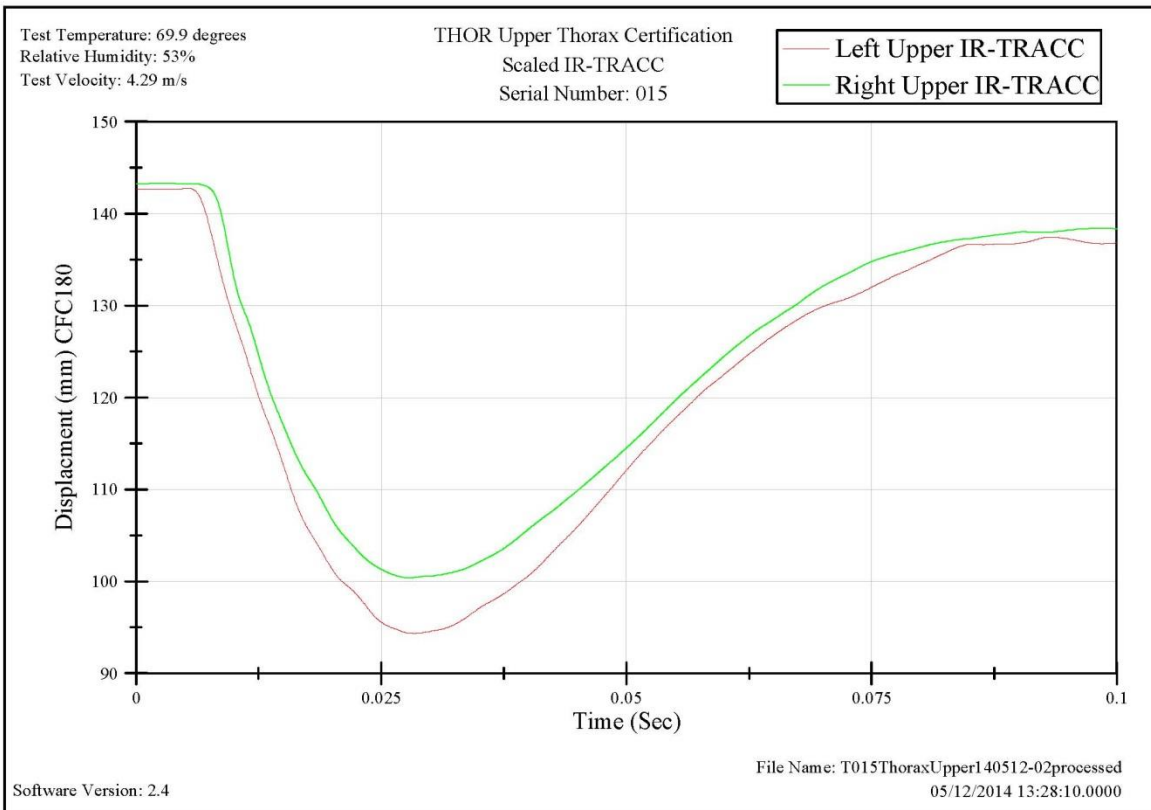
Test Temperature: 69.9 degrees
Relative Humidity: 53%
Test Velocity: 4.29 m/s

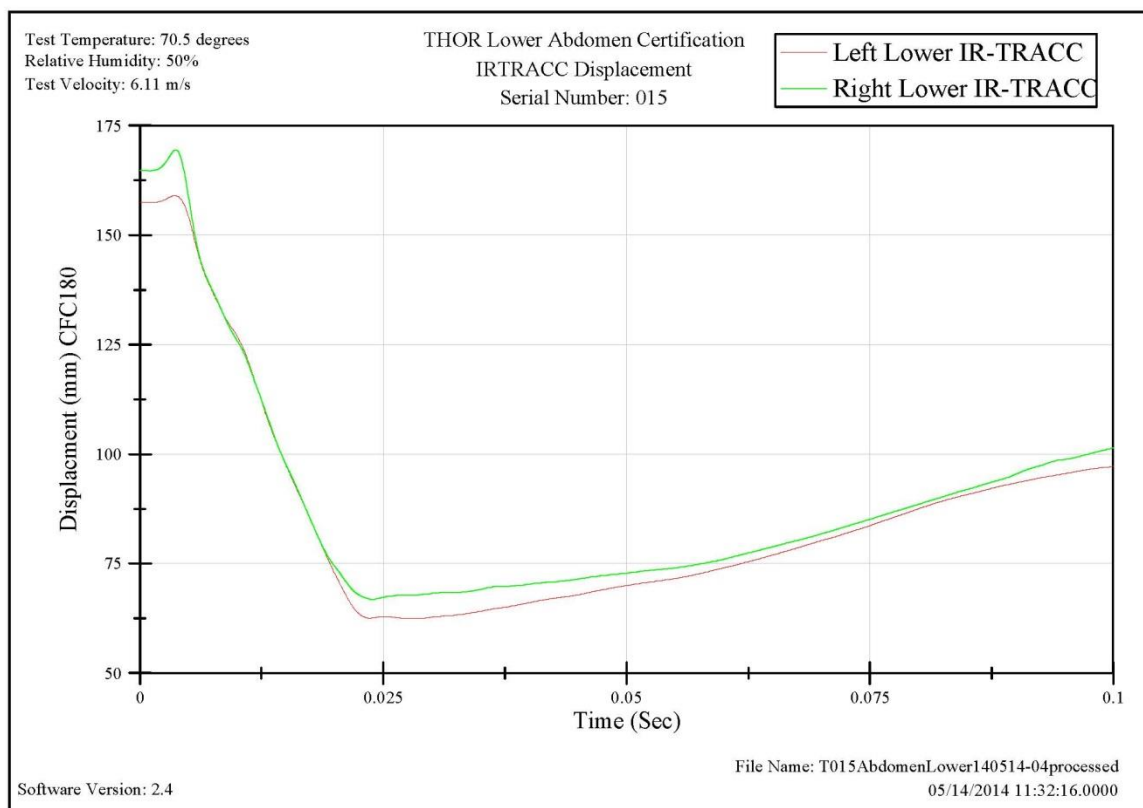
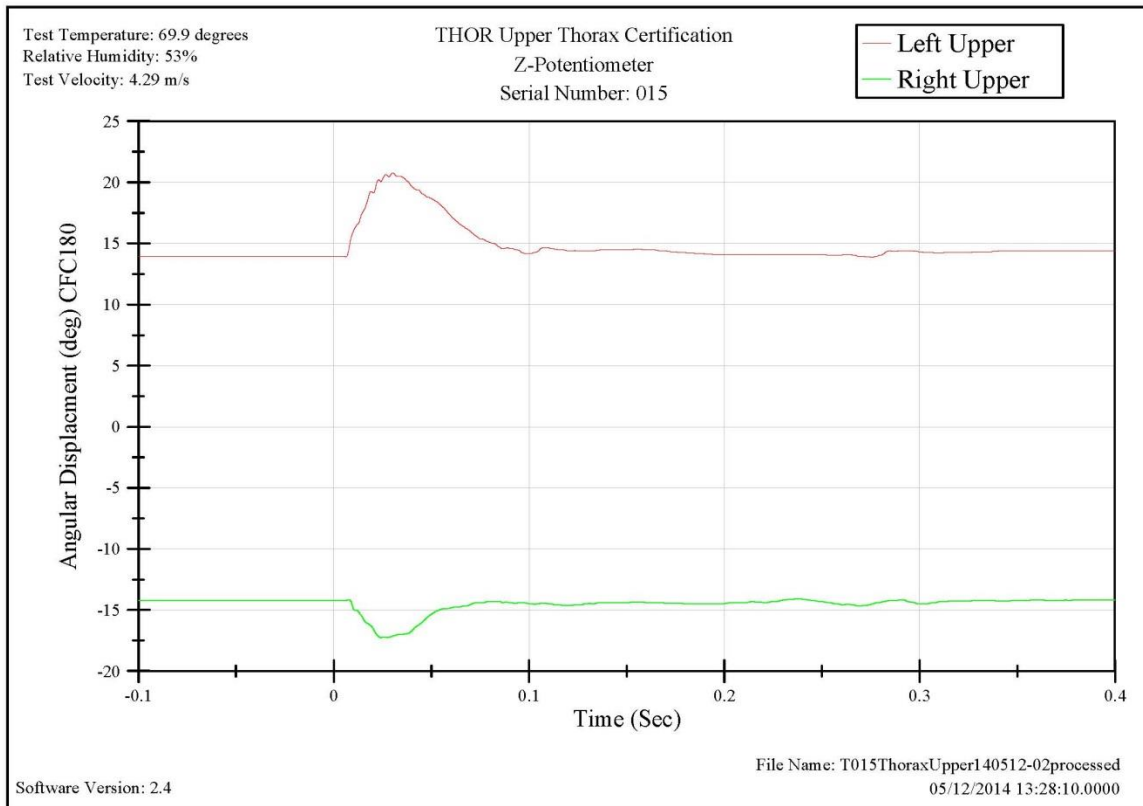
THOR Upper Thorax Certification Thorax Response With Kroell Corridor Serial Number: 015

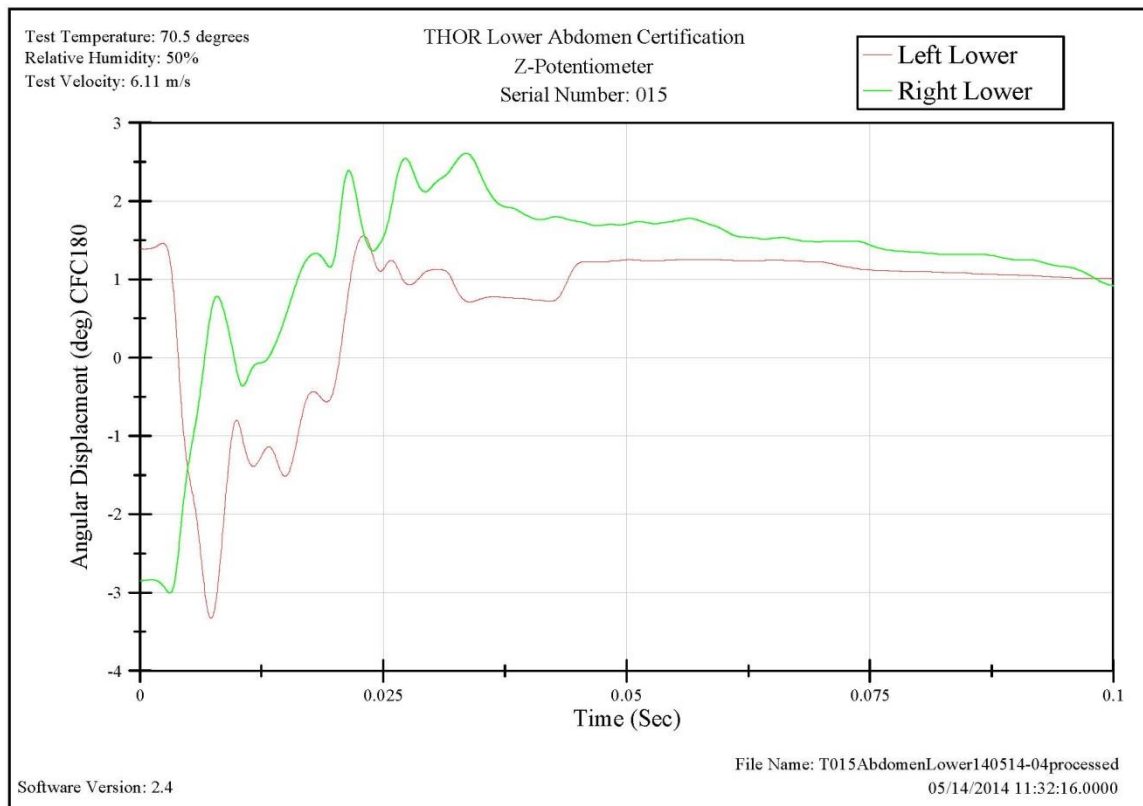
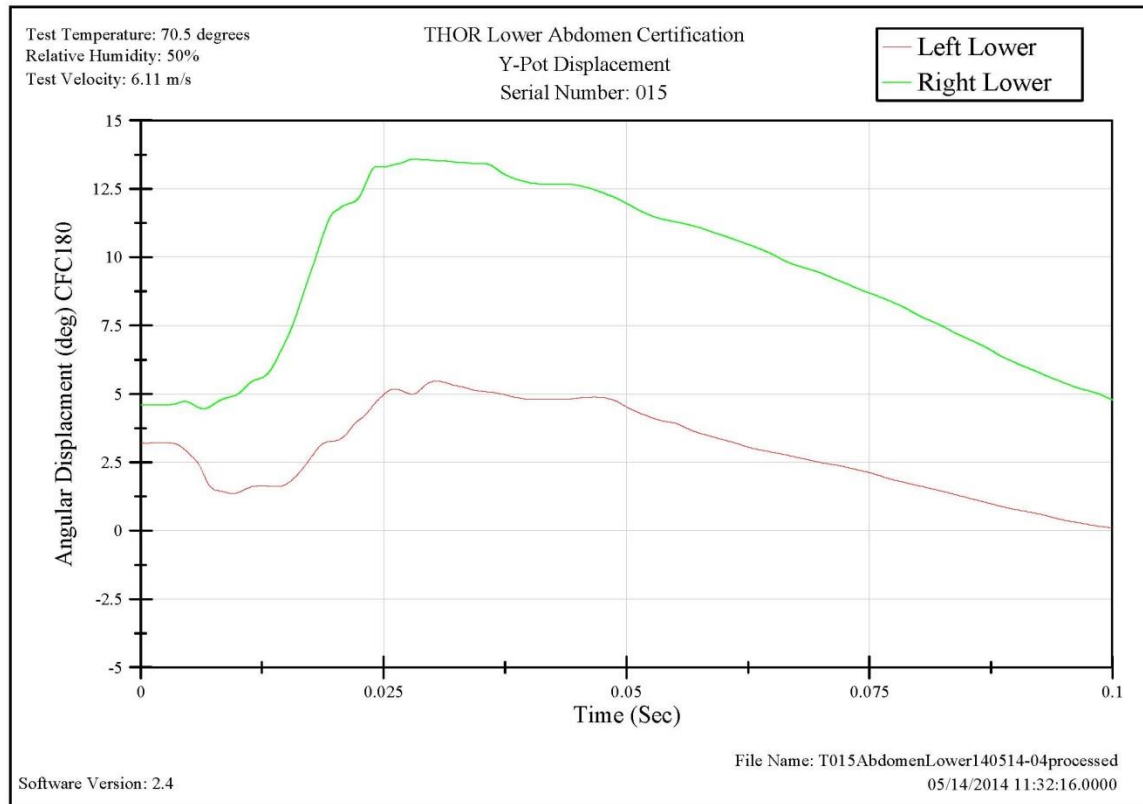


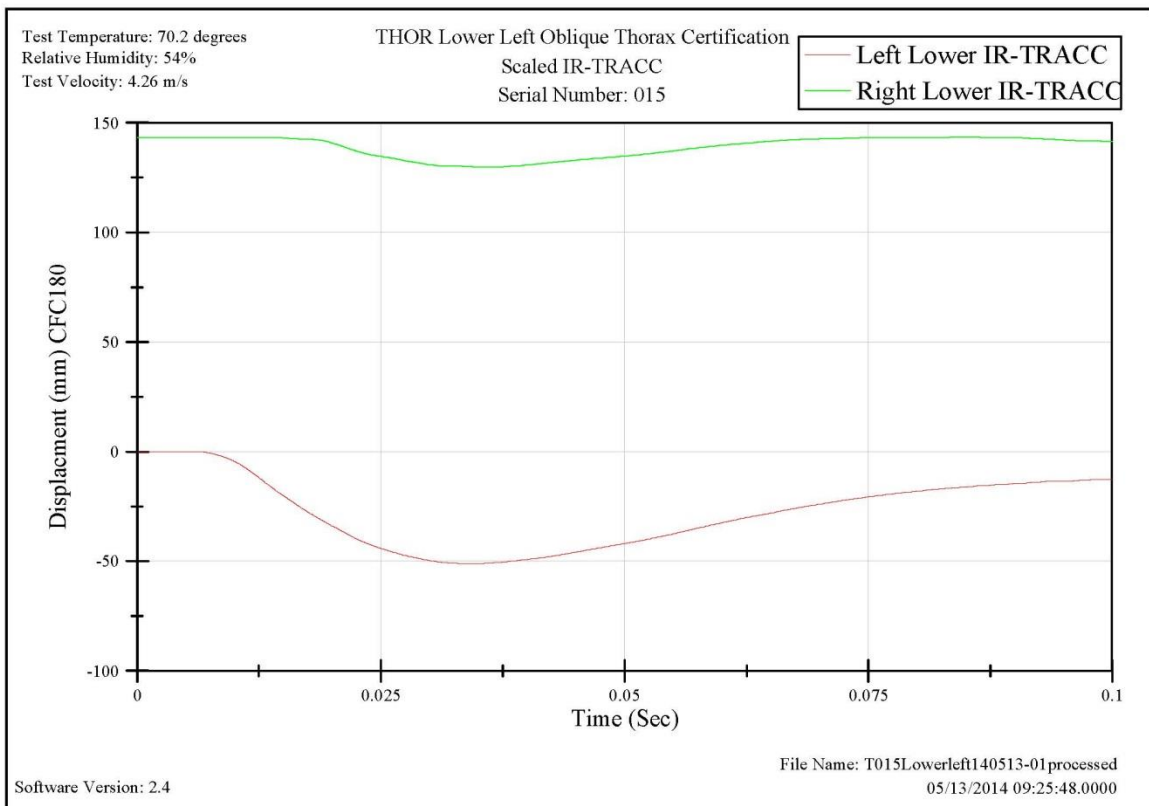
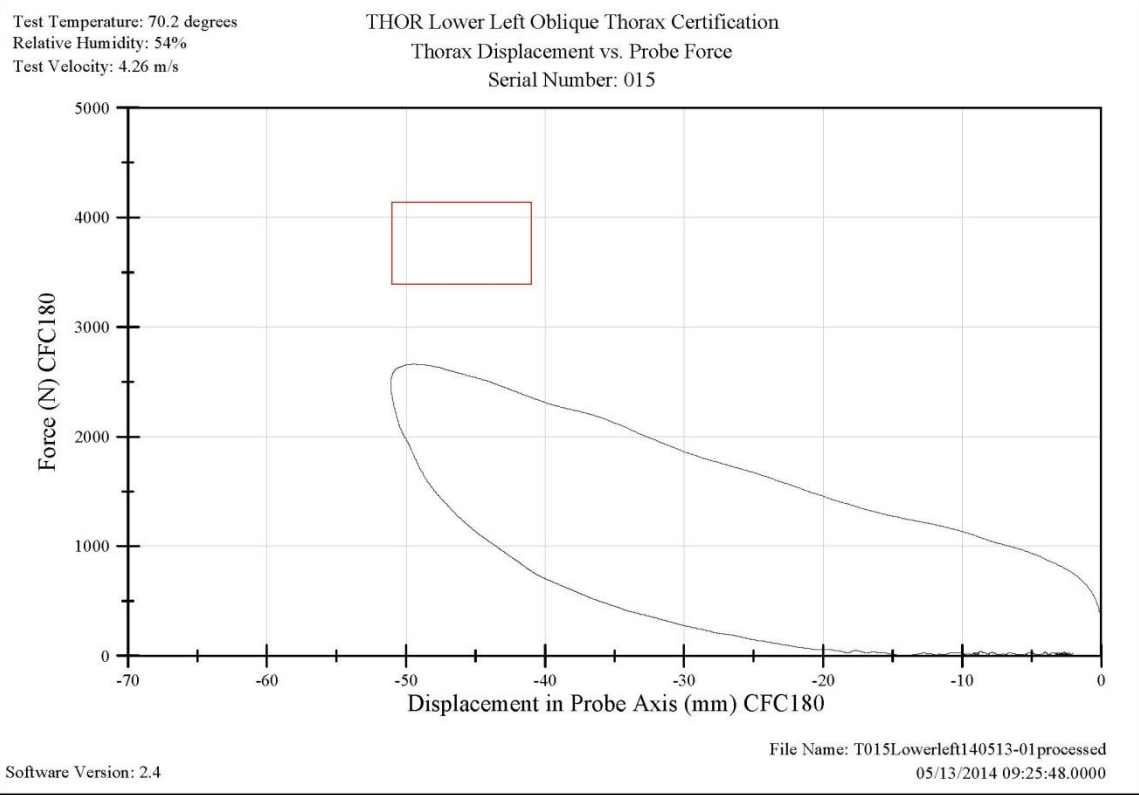
Software Version: 2.4

File Name: T015ThoraxUpper140512-02processed
05/12/2014 13:28:10.0000



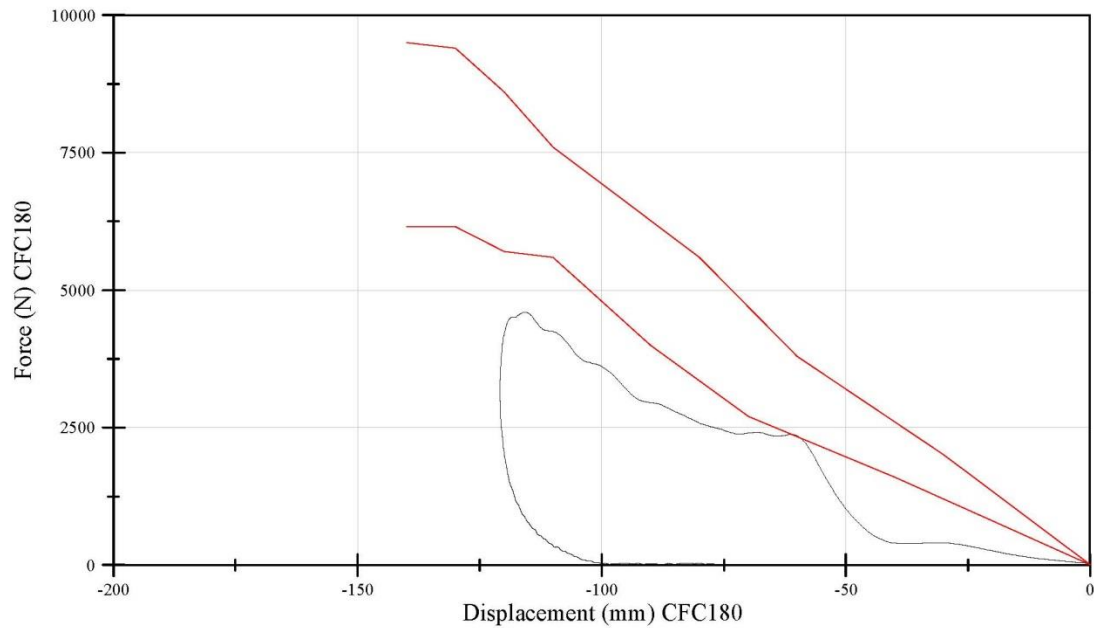






Test Temperature: 68.9 degrees
Relative Humidity: 51%
Test Velocity: 6.64 m/s

THOR Upper Abdomen Certification
Abdomen Displacement vs. Probe Force
Serial Number: 015

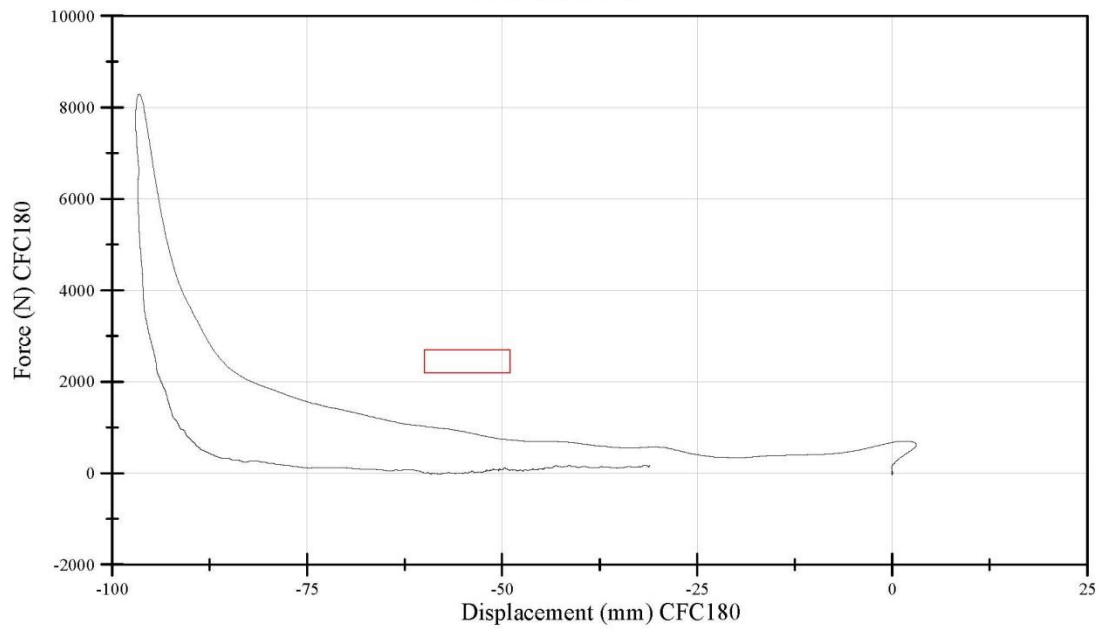


Software Version: 2.4

File Name: THFR-04
05/08/2014 14:50:17.0000

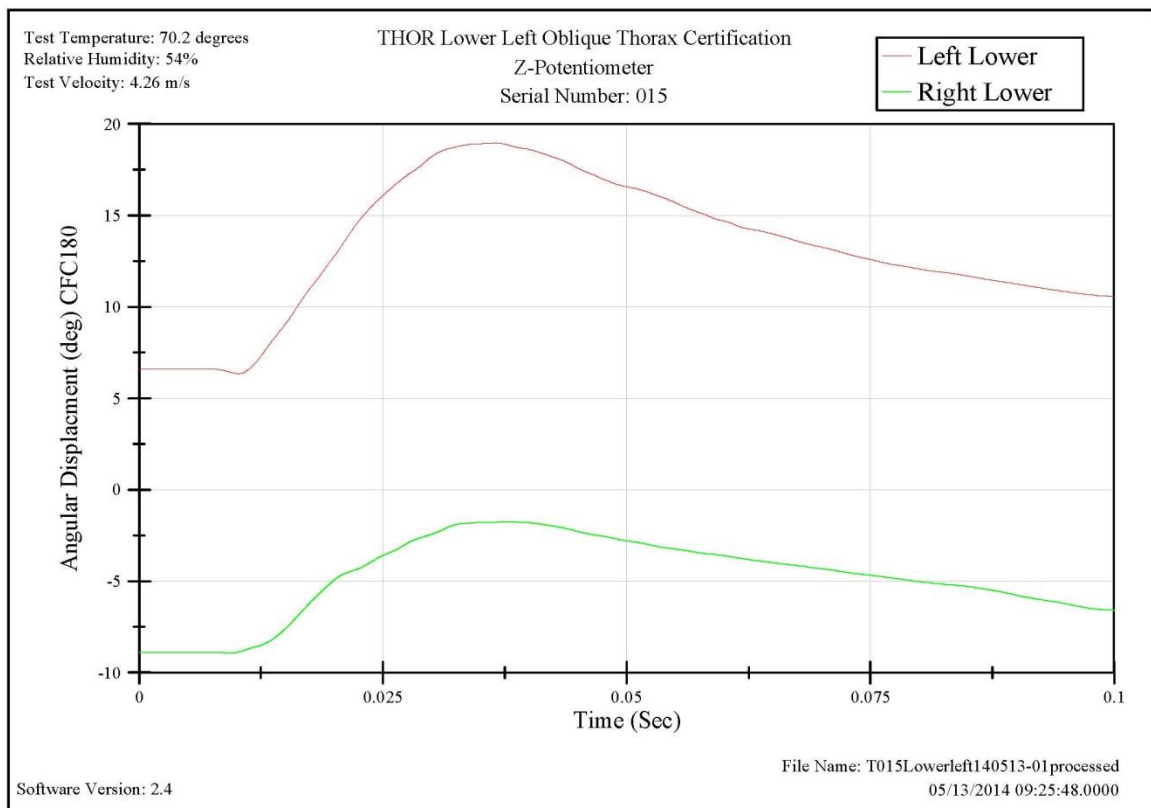
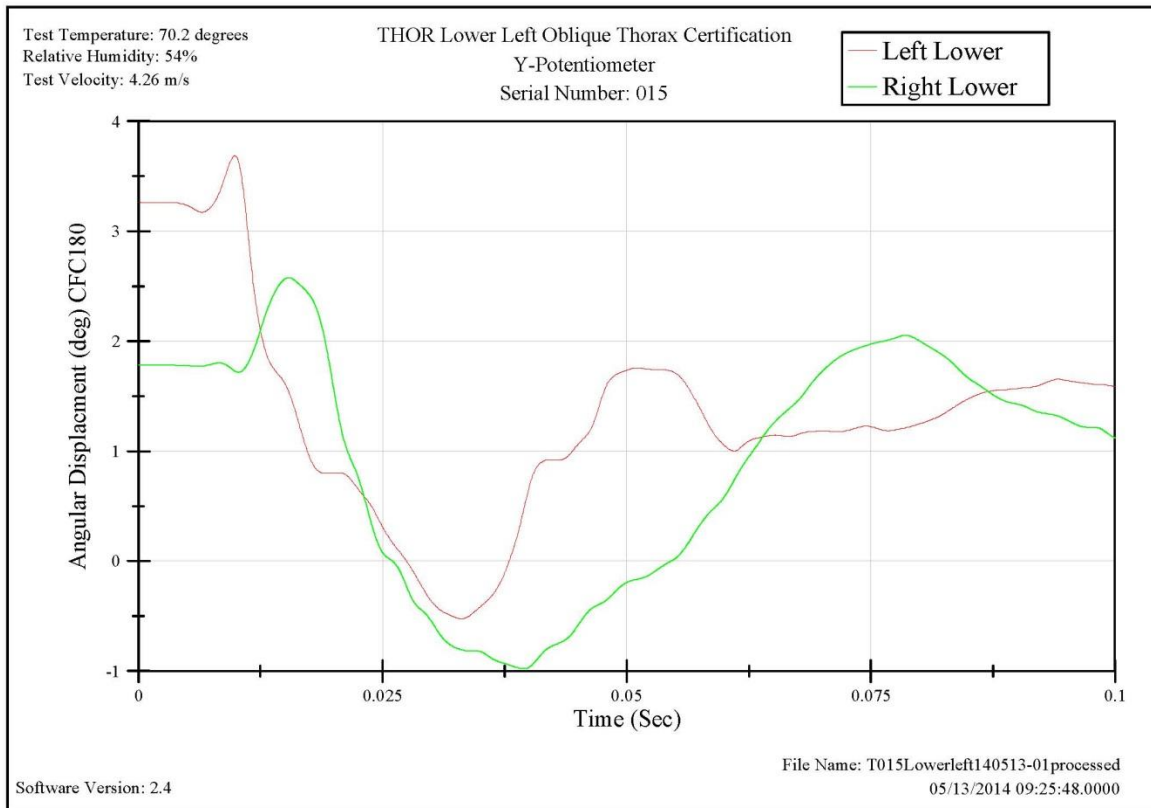
Test Temperature: 70.5 degrees
Relative Humidity: 50%
Test Velocity: 6.11 m/s

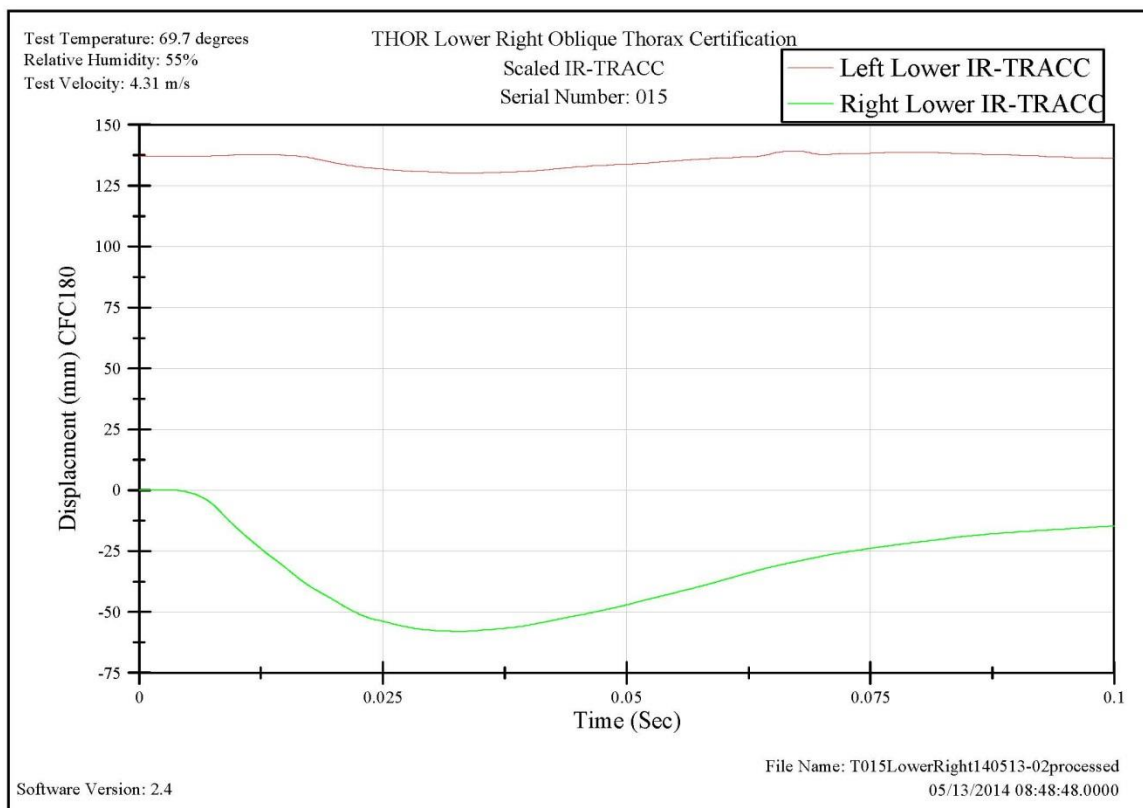
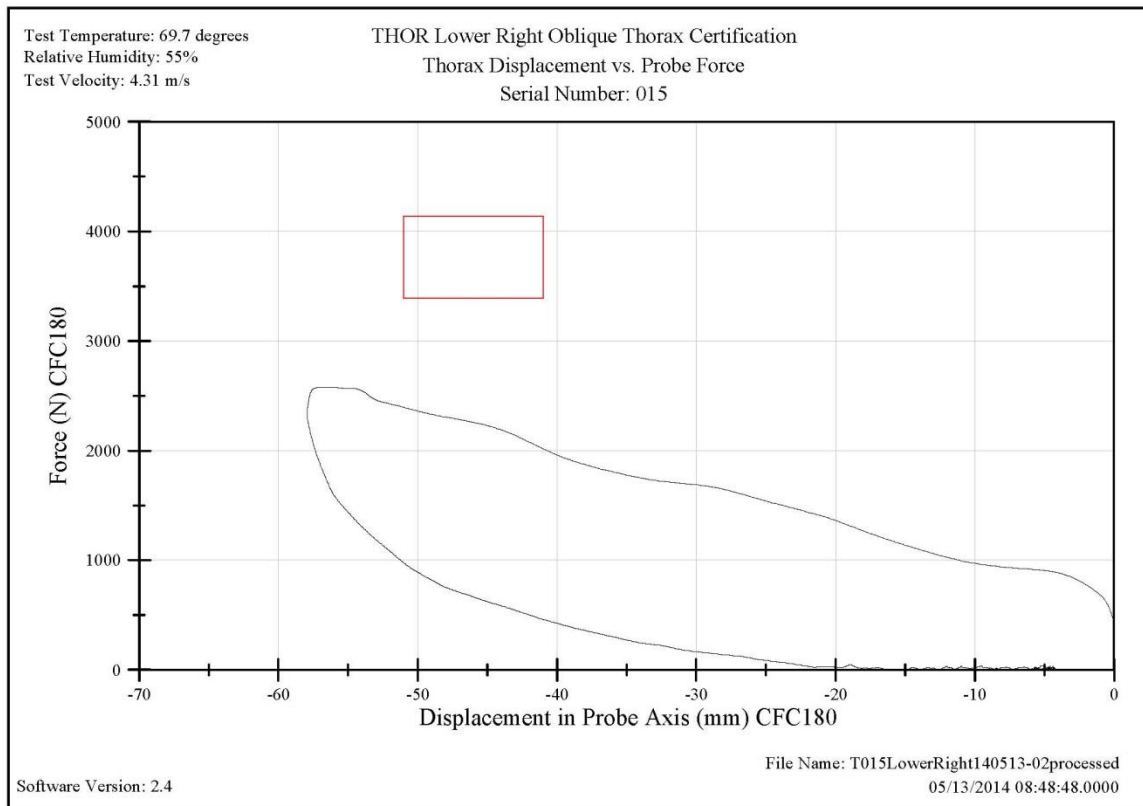
THOR Lower Abdomen Certification
Abdomen Displacement vs. Probe Force
Serial Number: 015

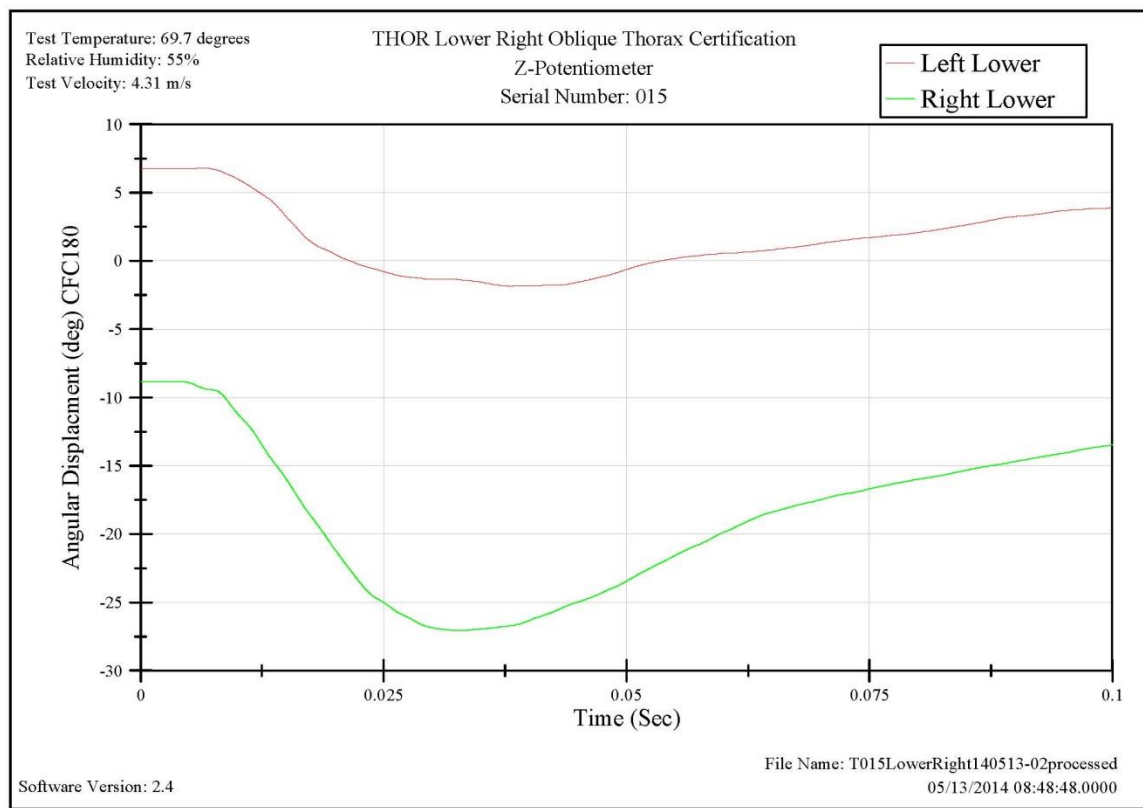
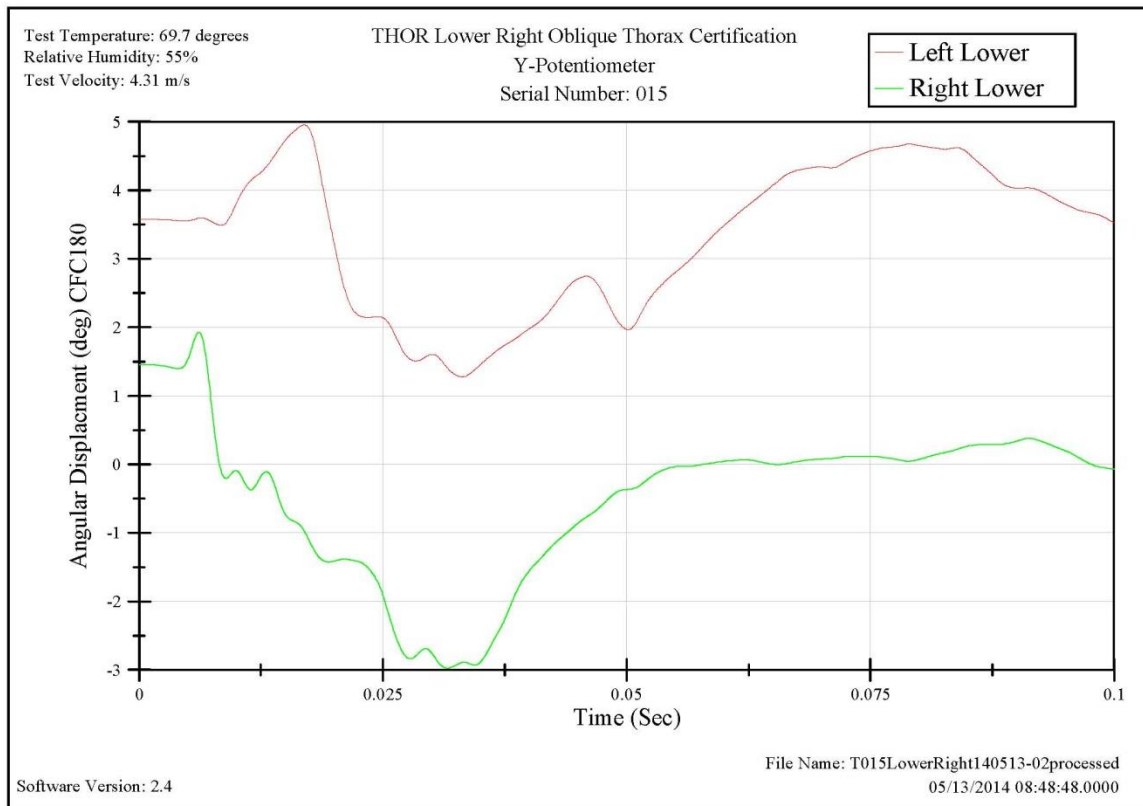


Software Version: 2.4

File Name: T015AbdomenLower140514-04processed
05/14/2014 11:32:16.0000

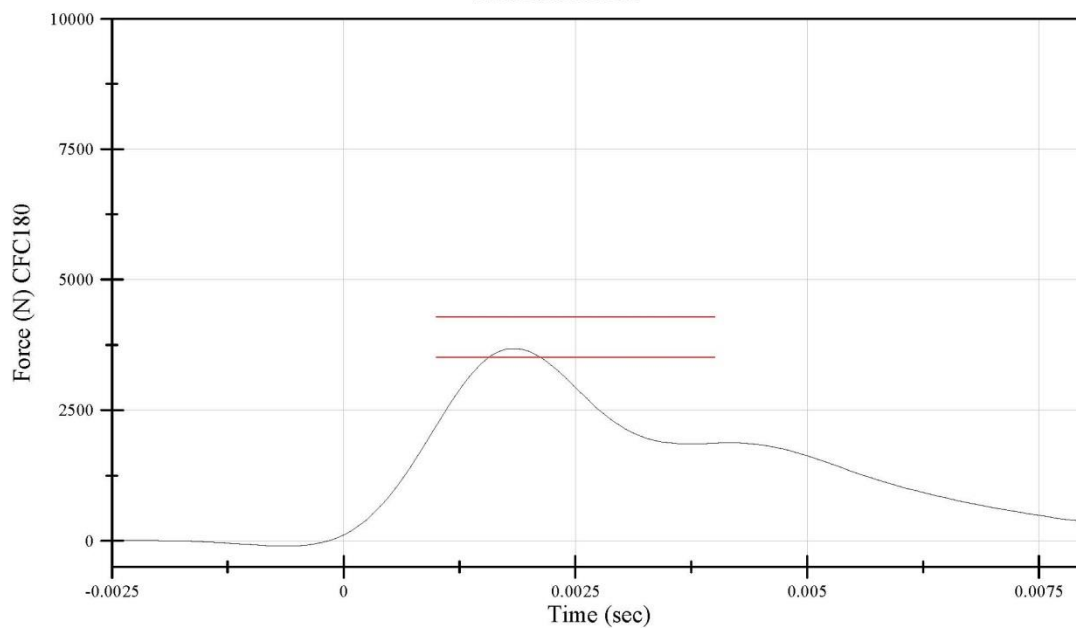






Test Temperature: 69.9 degrees
Relative Humidity: 53%
Test Velocity: 2.65 m/s

THOR Left Femur Certification
Probe Force
Serial Number: 015

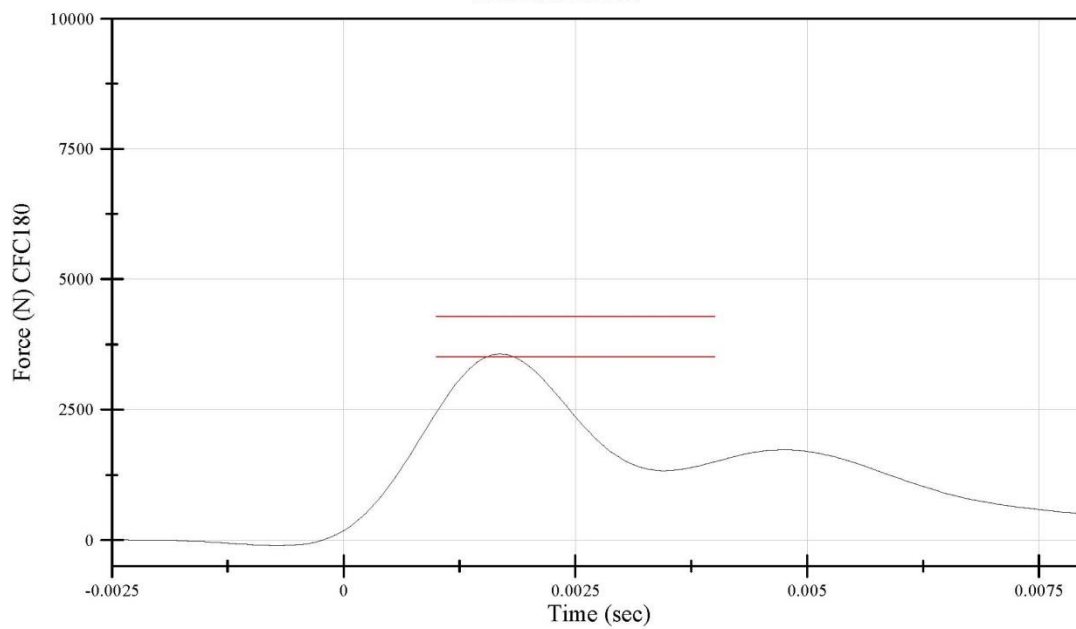


Software Version: 2.4

File Name: T015LeftKnee140514-02 time correctedprocessed
05/14/2014 15:13:25.0000

Test Temperature: 71.6 degrees
Relative Humidity: 50%
Test Velocity: 2.62 m/s

THOR Right Femur Certification
Probe Force
Serial Number: 015

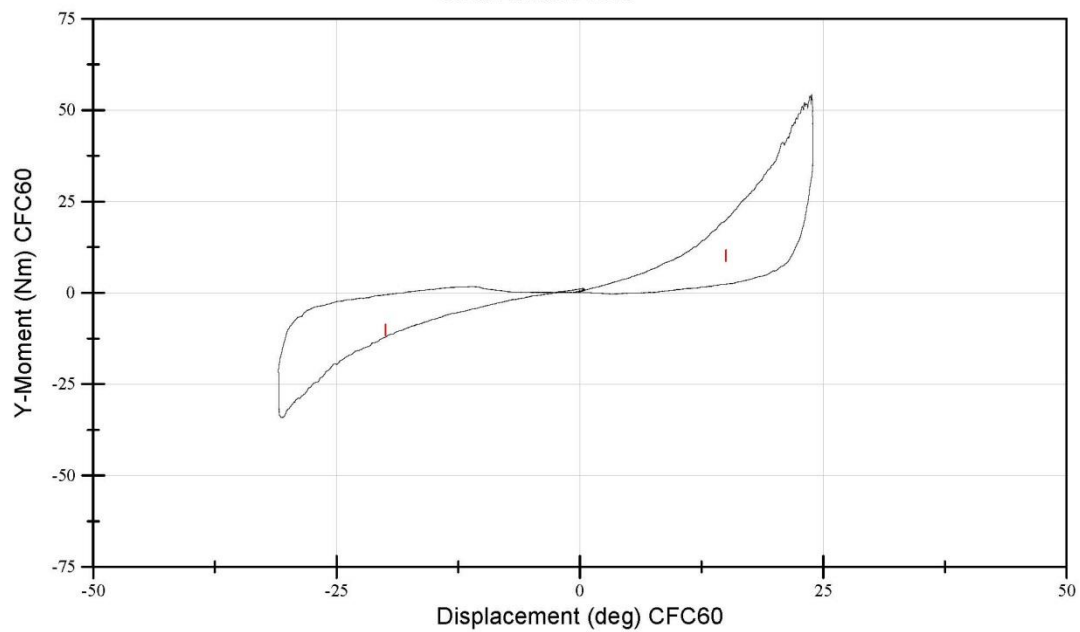


Software Version: 2.4

File Name: T015RightKnee140514-01processed
05/14/2014 15:28:10.0000

Test Temperature: 71 degrees
Relative Humidity: 35%
Test Velocity: 0 m/s

THOR Occipital Condyle Quasi-Static Certification
Displacement vs. Torque
Serial Number: T015



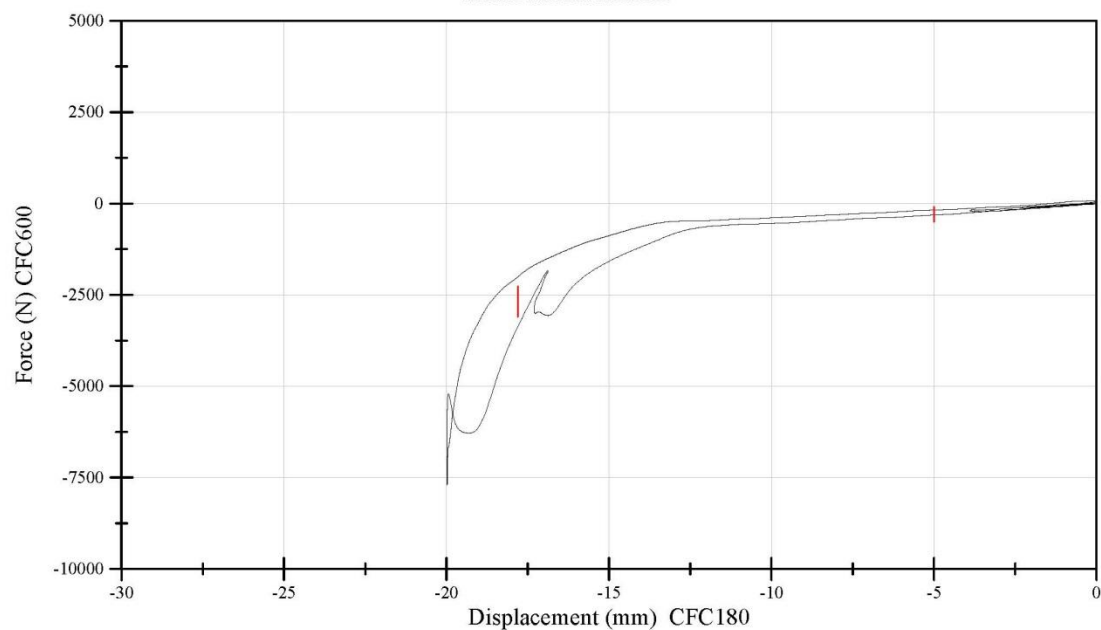
Software Version: 2.4

File Name: T015OC050814_01_DIADEMHeader_BINARYpatrick
05/08/2014 08:51:05.0000

THOR 015 LEG CALIBRATIONS
LX0039 / LX0038

Test Temperature: 71.6 degrees
Relative Humidity: 31.8%
Test Velocity: 2.78 m/s

THOR Knee Certification
Femur Force vs. Knee Displacement
Serial Number: LX0038

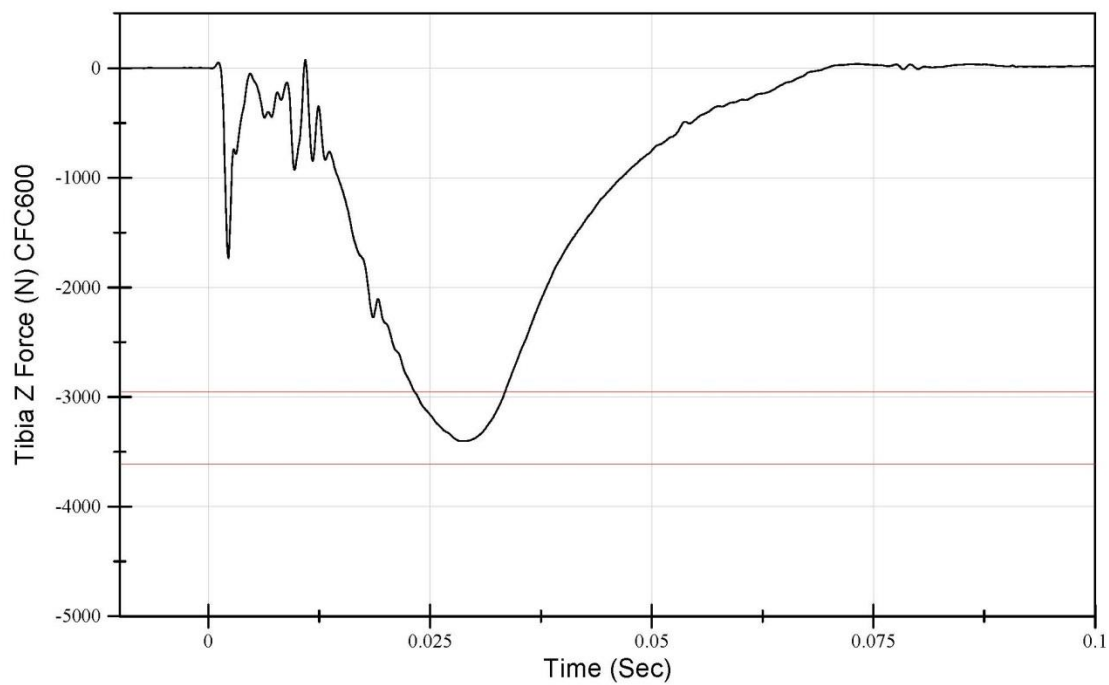


Software Version: 2.4

File Name: I1807966BKnee140424_01_DIADEMHeader_BINARYprocessed
04/24/2014 11:40:26.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0038

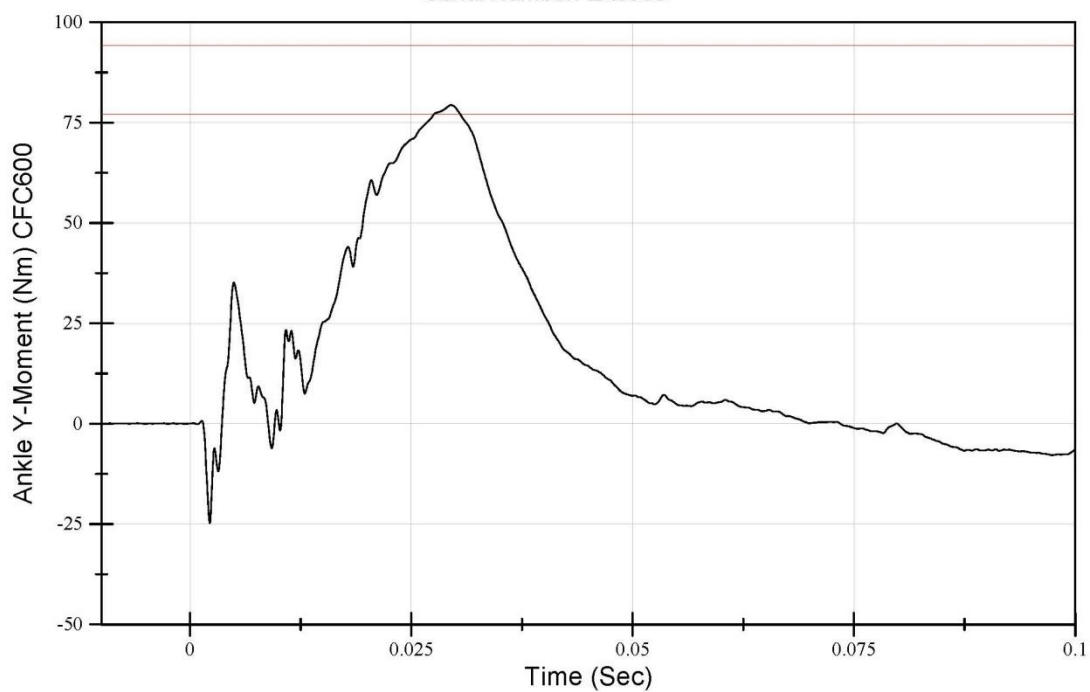


Software Version: 2.4

File Name: LX0038Ball140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 11:20:29.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0038

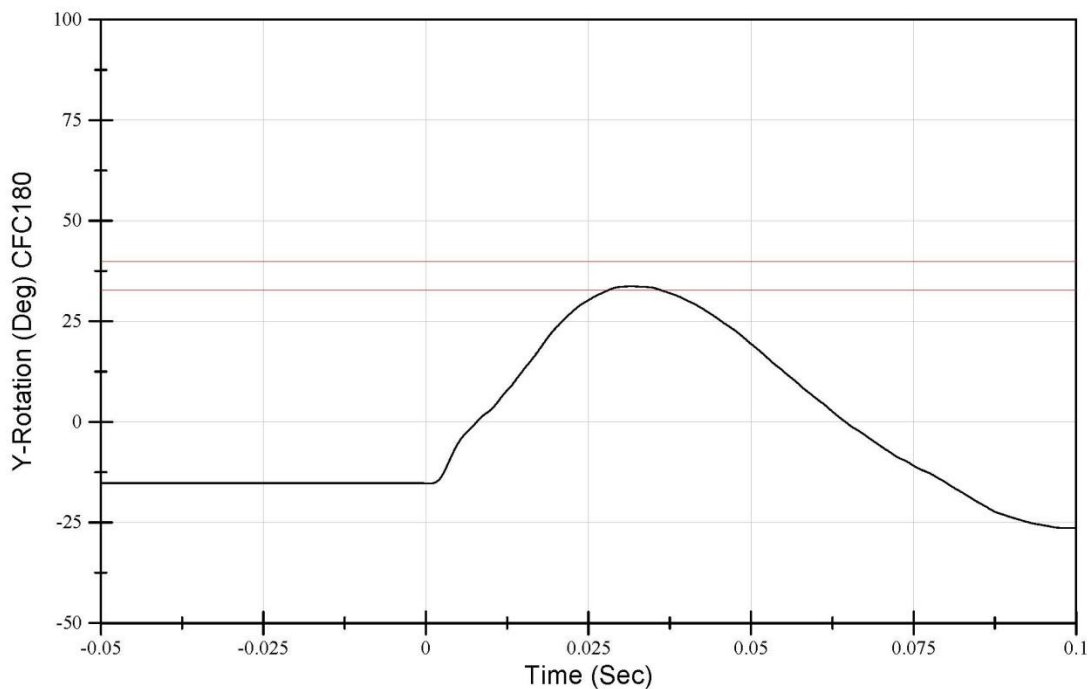


Software Version: 2.4

File Name: LX0038Ball140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 11:20:29.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0038

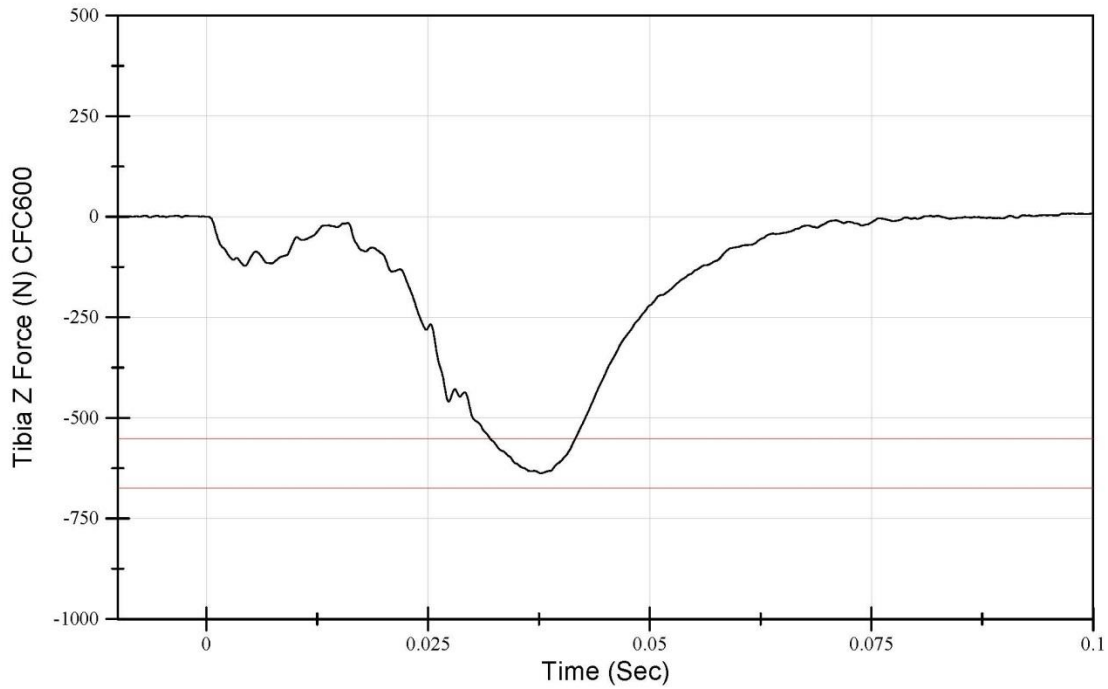


Software Version: 2.4

File Name: LX0038Ball140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 11:20:29.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 2 m/s

THOR Right Foot Eversion Certification
Tibia Load
Serial Number: LX0038

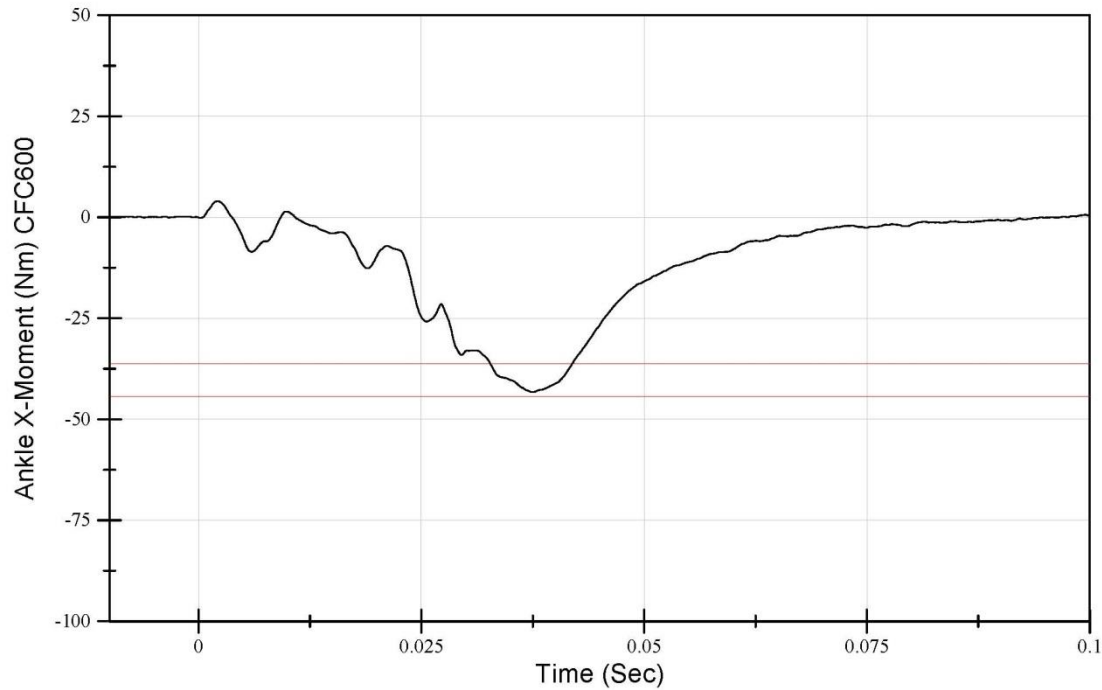


Software Version: 2.4

File Name: LX0038Eversion140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 10:22:49.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 2 m/s

THOR Right Foot Eversion Certification
Ankle Moment
Serial Number: LX0038

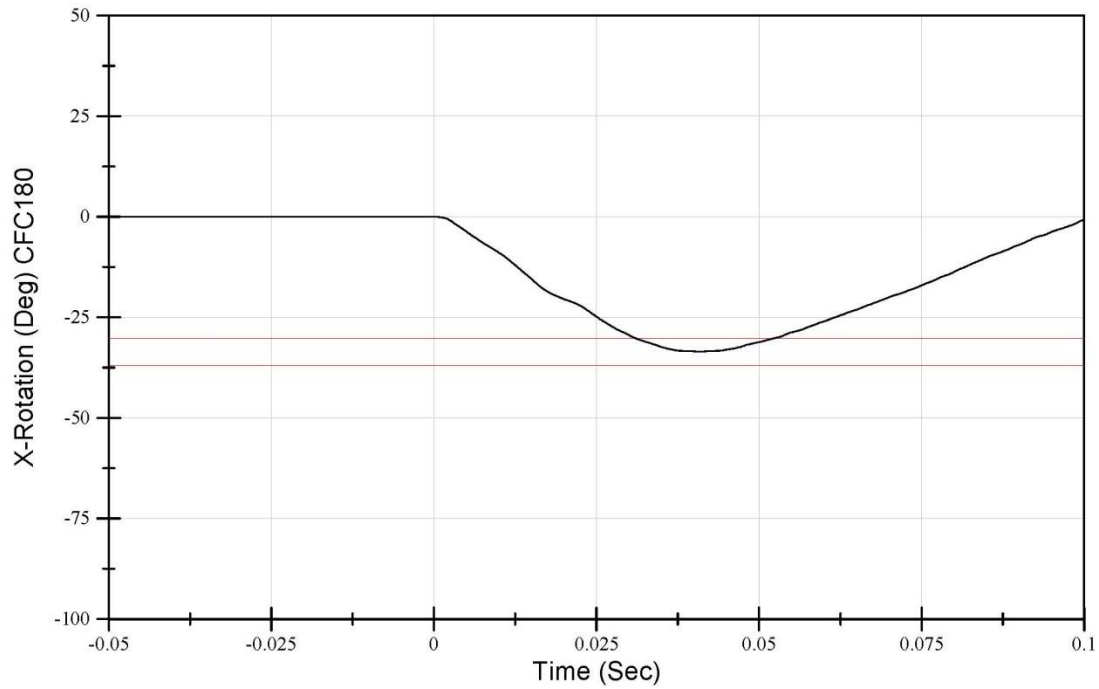


Software Version: 2.4

File Name: LX0038Eversion140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 10:22:49.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 2 m/s

THOR Right Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0038

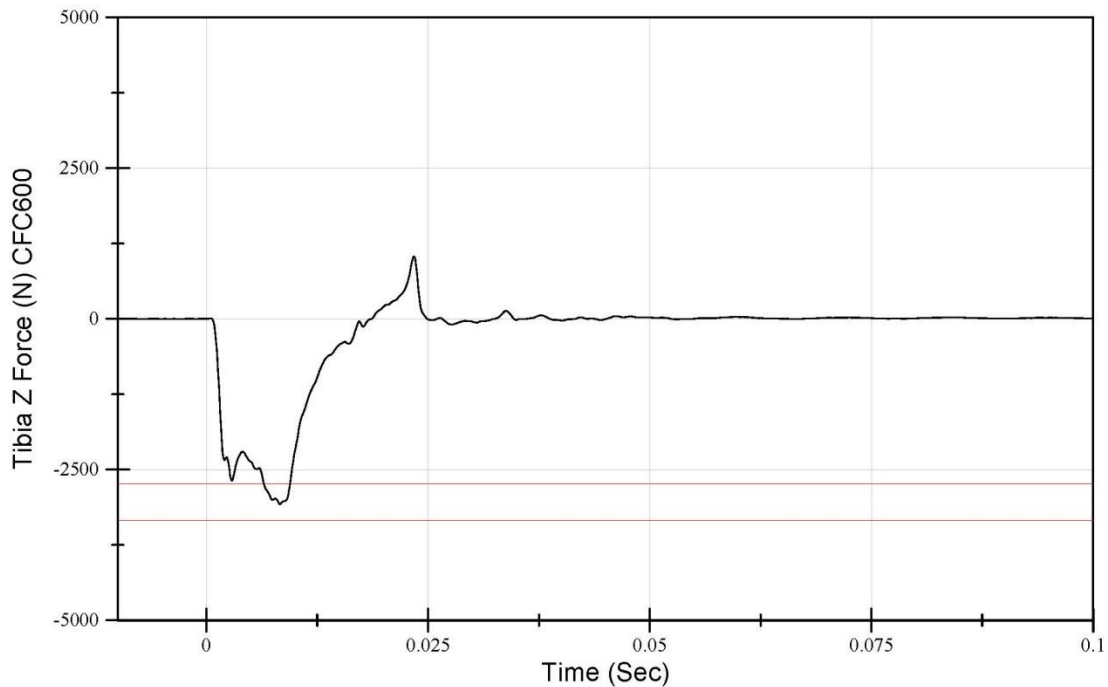


Software Version: 2.4

File Name: LX0038Eversion140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 10:22:49.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 4.03 m/s

THOR Right Foot Heel Certification
Tibia Load
Serial Number: LX0038

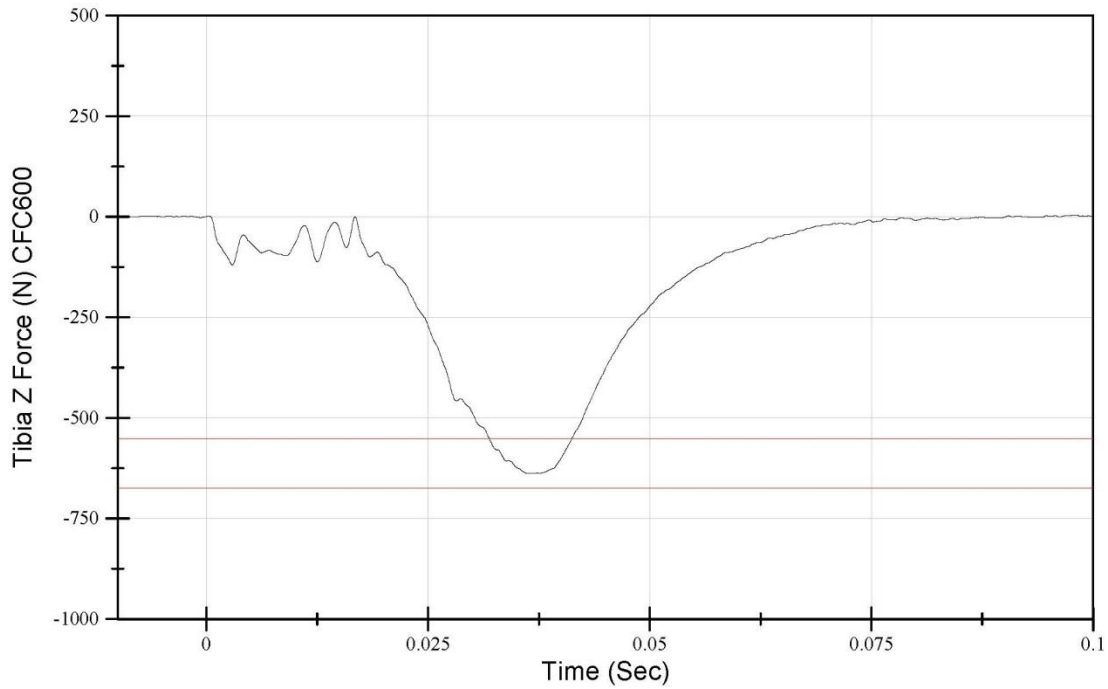


Software Version: 2.4

File Name: LX0038Heel140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 13:15:18.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 2 m/s

THOR Right Foot Inversion Certification
Tibia Load
Serial Number: LX0038

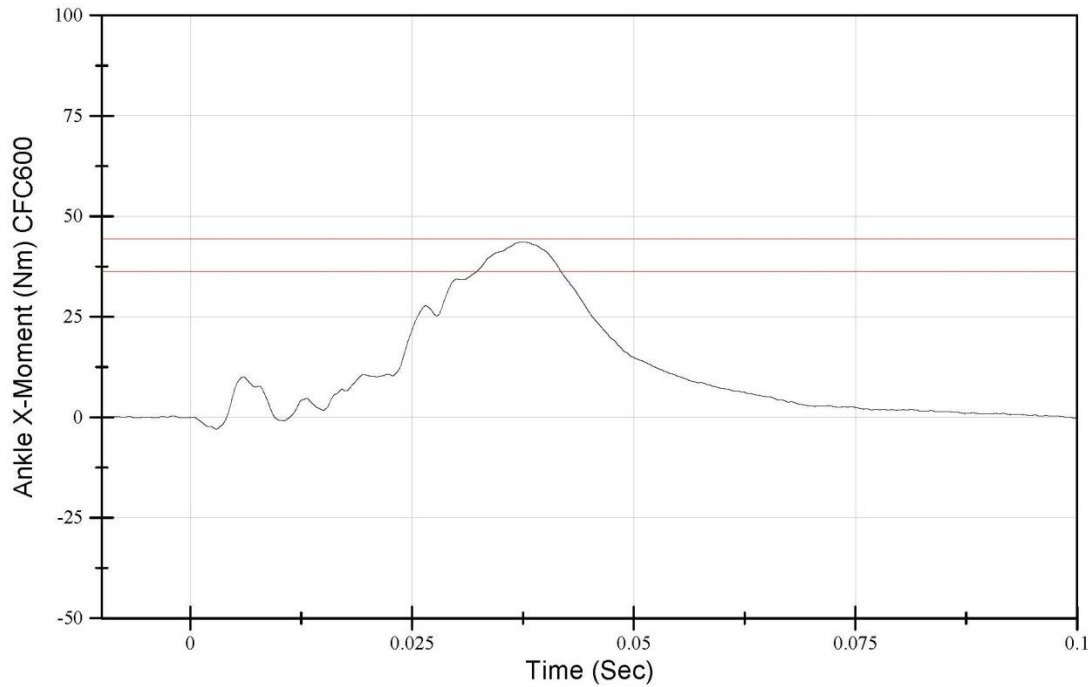


Software Version: 2.4

File Name: LX0038Inversion140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 09:52:27.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 2 m/s

THOR Right Foot Inversion Certification
Ankle Moment
Serial Number: LX0038

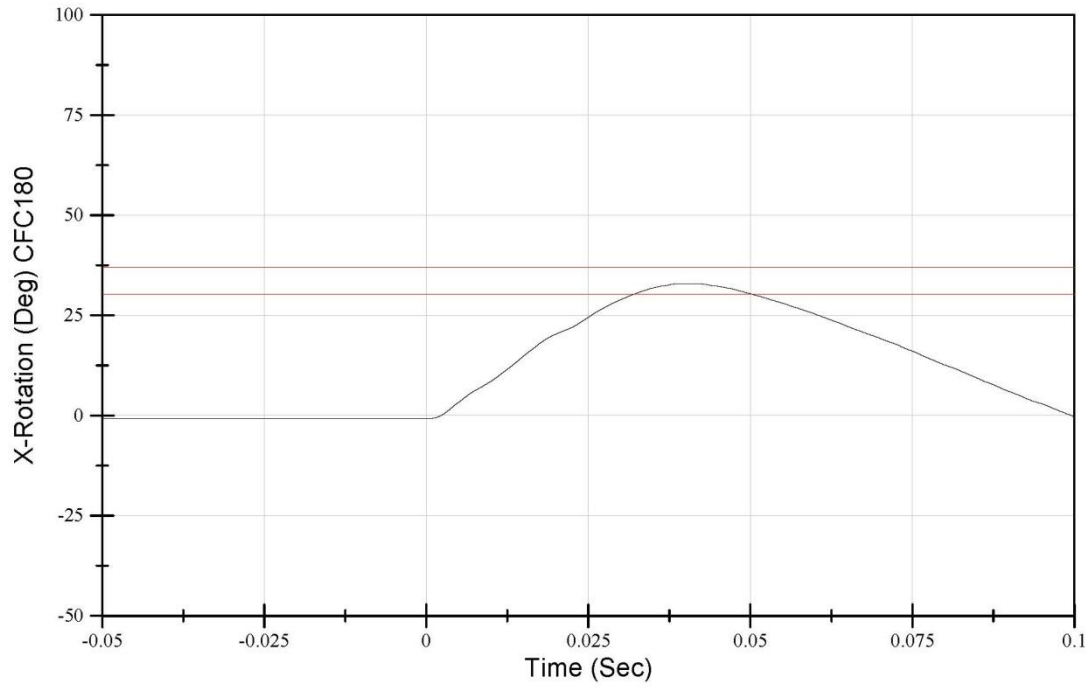


Software Version: 2.4

File Name: LX0038Inversion140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 09:52:27.0000

Test Temperature: 71.2 degrees
Relative Humidity: 32%
Test Velocity: 2 m/s

THOR Right Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0038

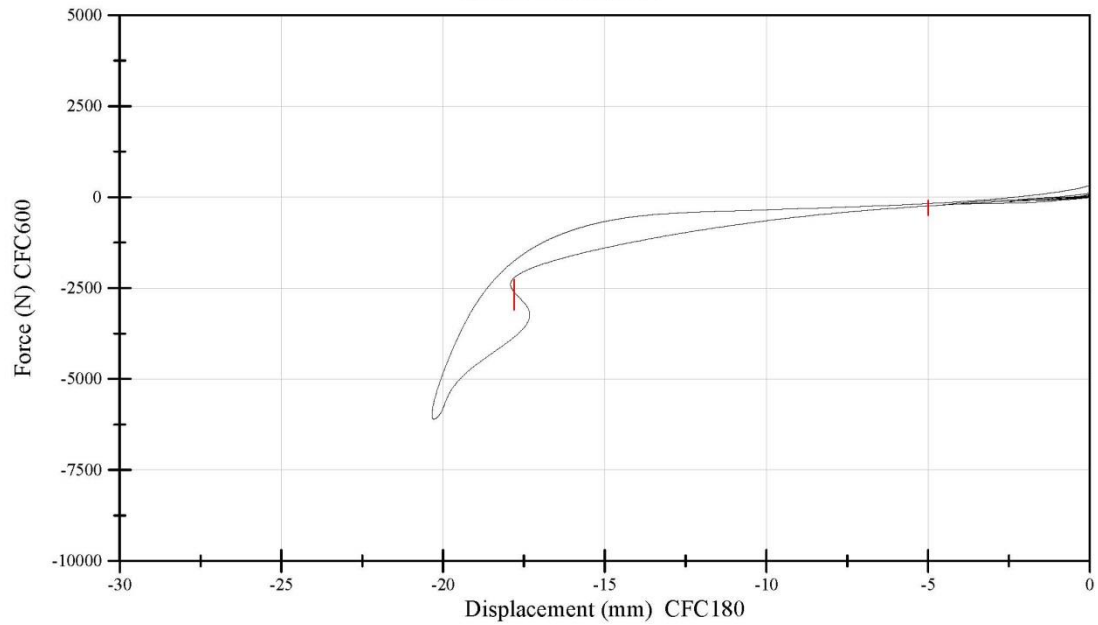


Software Version: 2.4

File Name: LX0038Inversion140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 09:52:27.0000

Test Temperature: 71.6 degrees
Relative Humidity: 31.8%
Test Velocity: 2.78 m/s

THOR Left Knee Certification
Femur Force vs. Knee Displacement
Serial Number: LX0039

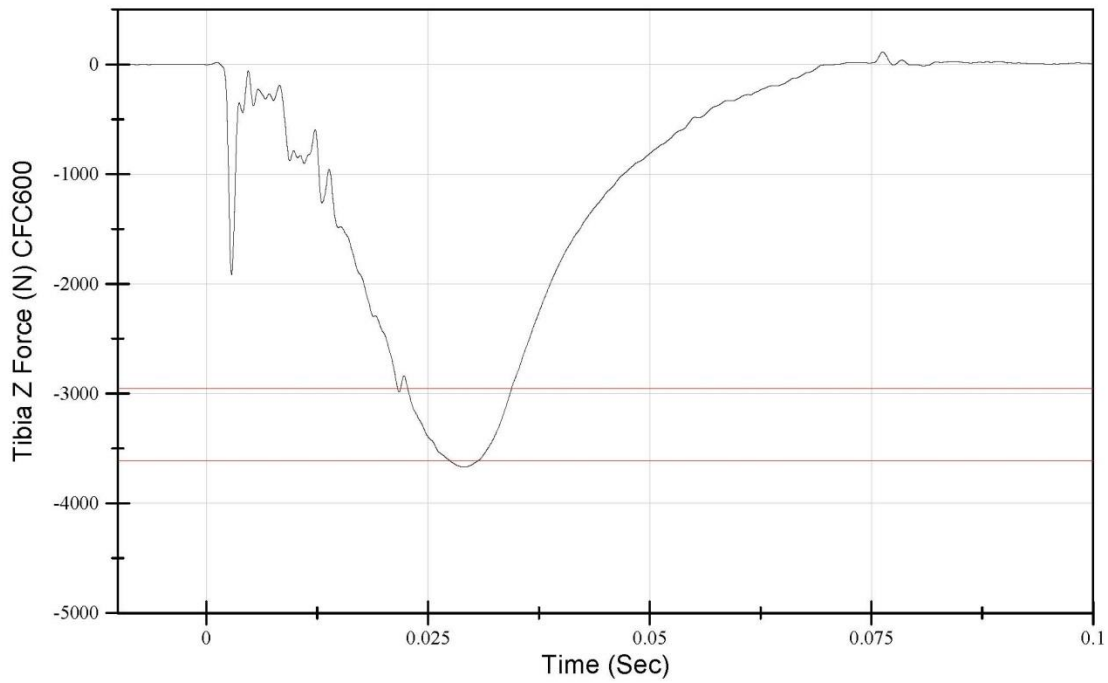


Software Version: 2.4

File Name: C2102639BKnee140424_01_DIADEMHeader_BINARYISOprocessed
04/24/2014 10:59:41.0000

Test Temperature: 70.4 degrees
Relative Humidity: 30.1%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0039

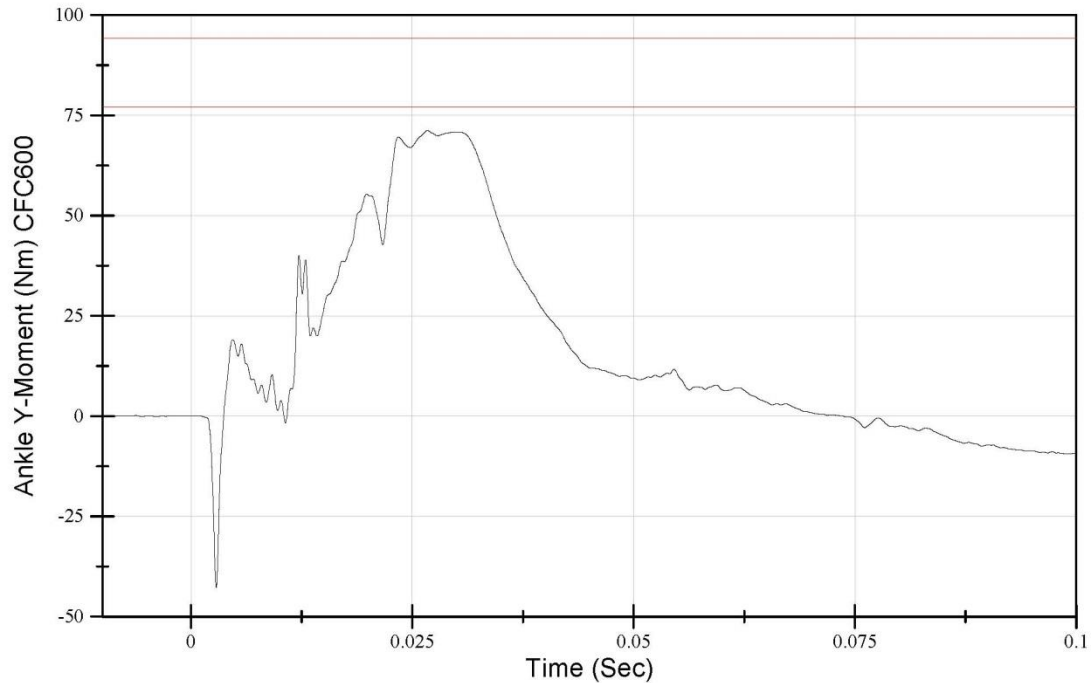


Software Version: 2.4

File Name: LX0039Ball140422_01_DIADEMHeader_BINARYprocessed
04/22/2014 15:55:44.0000

Test Temperature: 70.4 degrees
Relative Humidity: 30.1%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0039

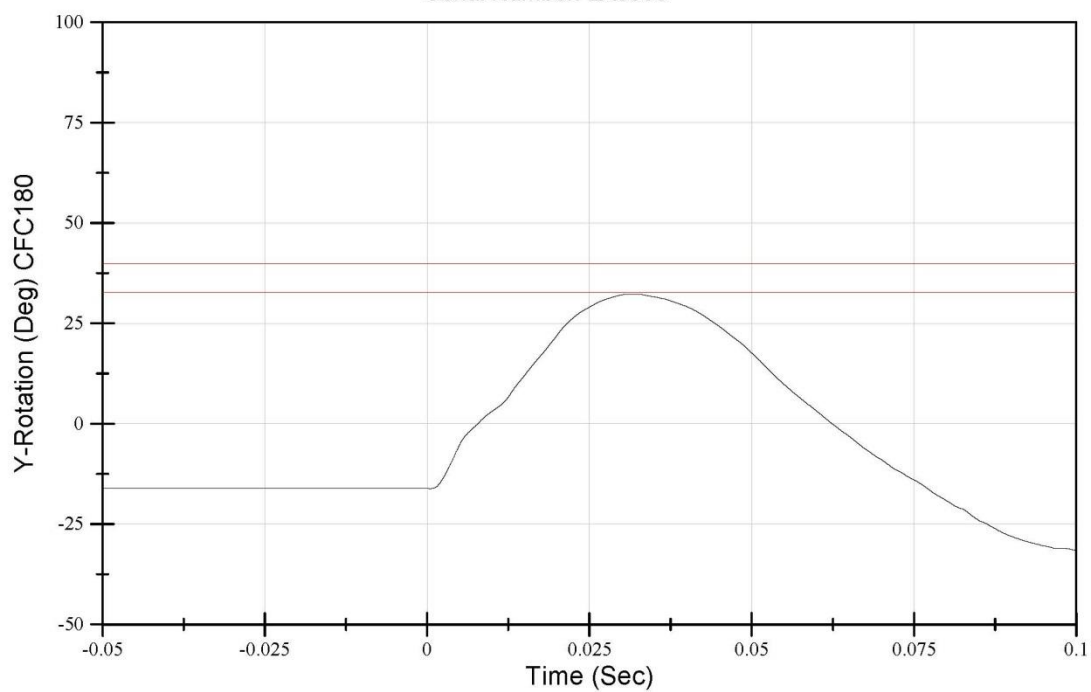


Software Version: 2.4

File Name: LX0039Ball140422_01_DIADEMHeader_BINARYprocessed
04/22/2014 15:55:44.0000

Test Temperature: 70.4 degrees
Relative Humidity: 30.1%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0039

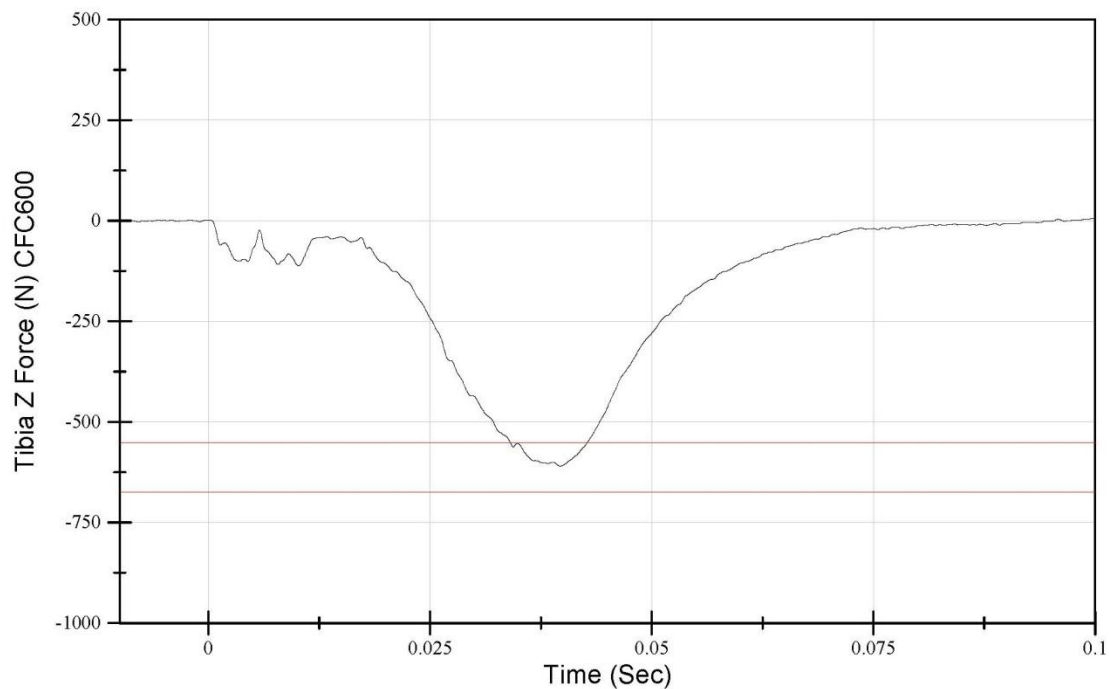


Software Version: 2.4

File Name: LX0039Ball140422_01_DIADEMHeader_BINARYprocessed
04/22/2014 15:55:44.0000

Test Temperature: 71.2 degrees
Relative Humidity: 30.4%
Test Velocity: 2 m/s

THOR Left Foot Eversion Certification
Tibia Load
Serial Number: LX0039

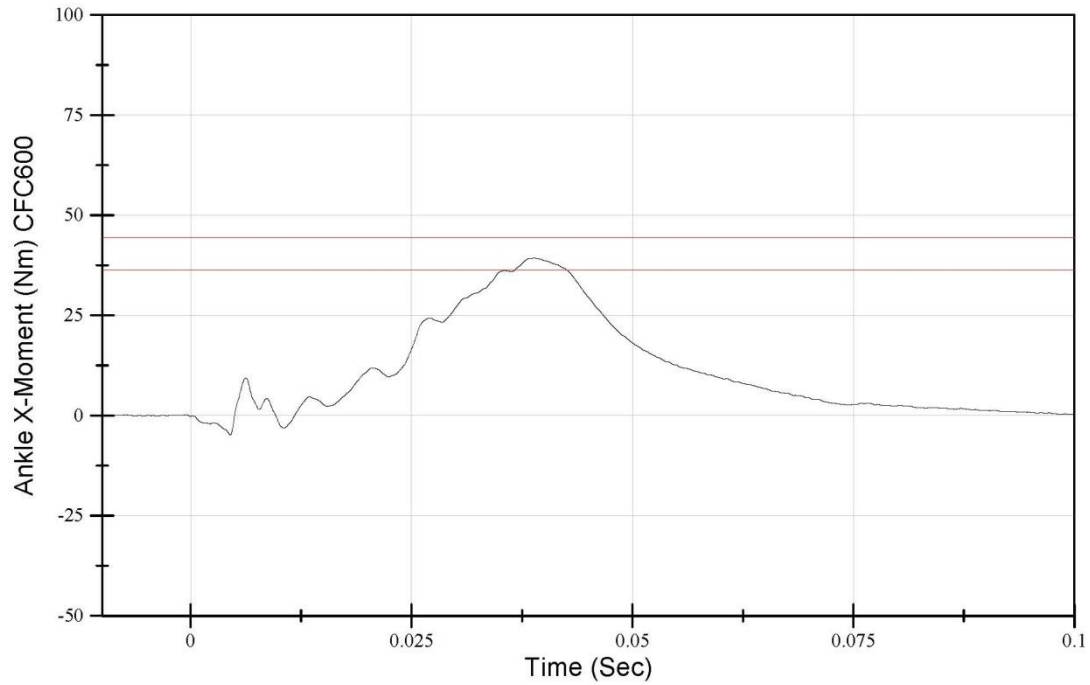


Software Version: 2.4

File Name: LX0039Eversion140422_01_DIADEMHeader_BINARYprocessed
04/22/2014 15:14:32.0000

Test Temperature: 71.2 degrees
Relative Humidity: 30.4%
Test Velocity: 2 m/s

THOR Left Foot Eversion Certification
Ankle Moment
Serial Number: LX0039

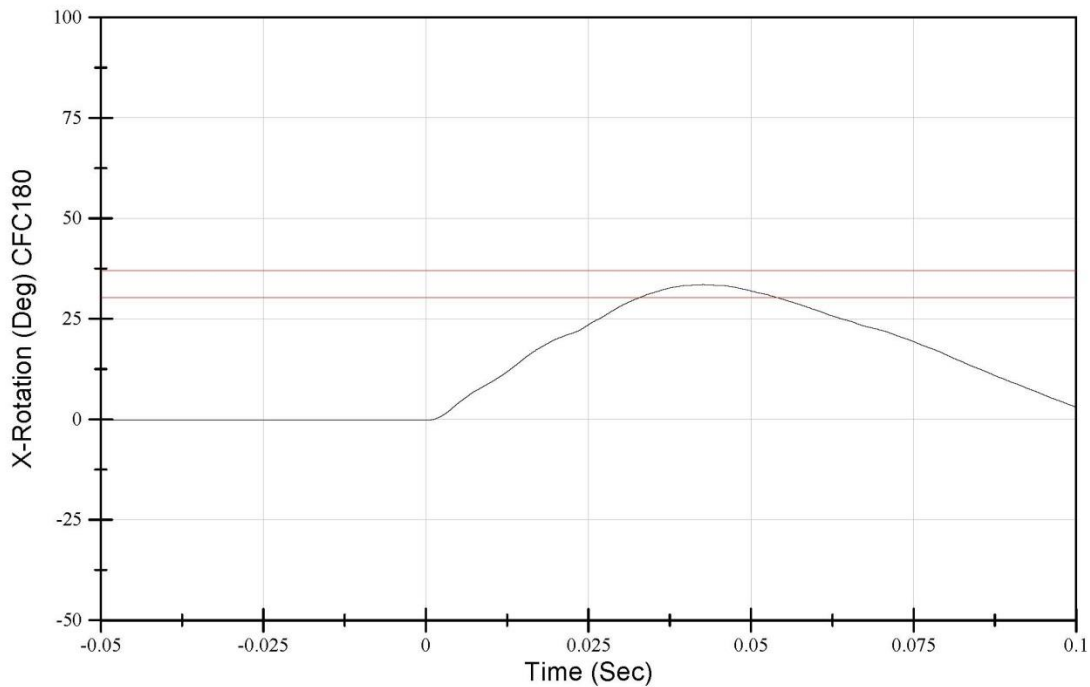


Software Version: 2.4

File Name: LX0039Eversion140422_01_DIADEMHeader_BINARYprocessed
04/22/2014 15:14:32.0000

Test Temperature: 71.2 degrees
Relative Humidity: 30.4%
Test Velocity: 2 m/s

THOR Left Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0039

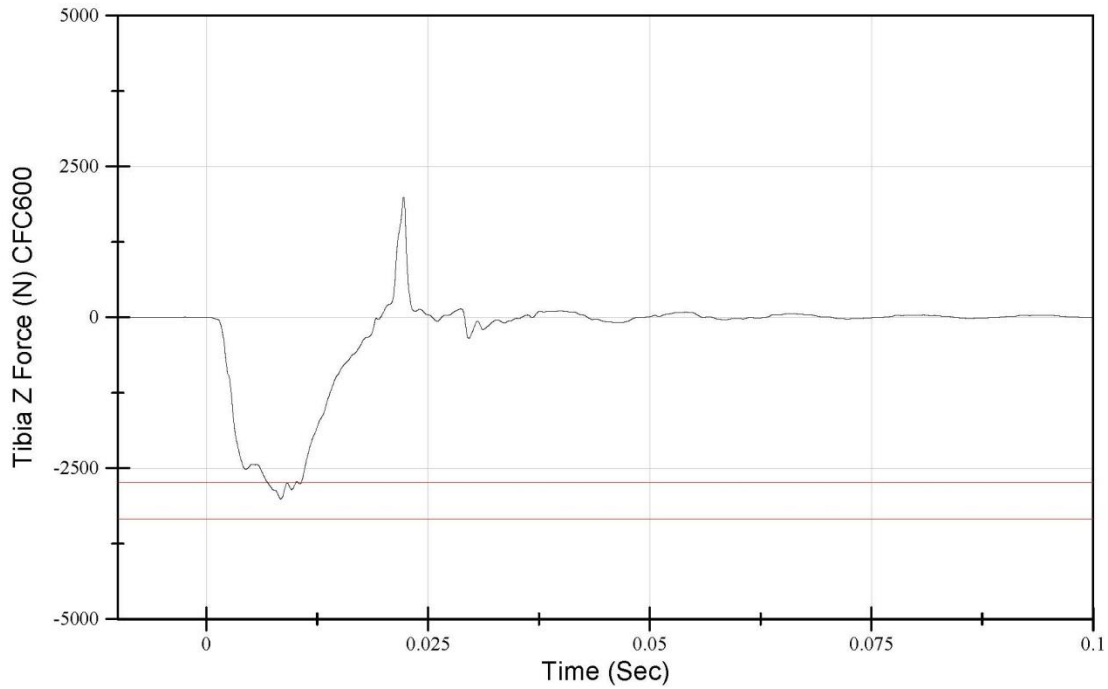


Software Version: 2.4

File Name: LX0039Eversion140422_01_DIADEMHeader_BINARYprocessed
04/22/2014 15:14:32.0000

Test Temperature: 71 degrees
Relative Humidity: 32%
Test Velocity: 4.03 m/s

THOR Left Foot Heel Certification
Tibia Load
Serial Number: LX0039

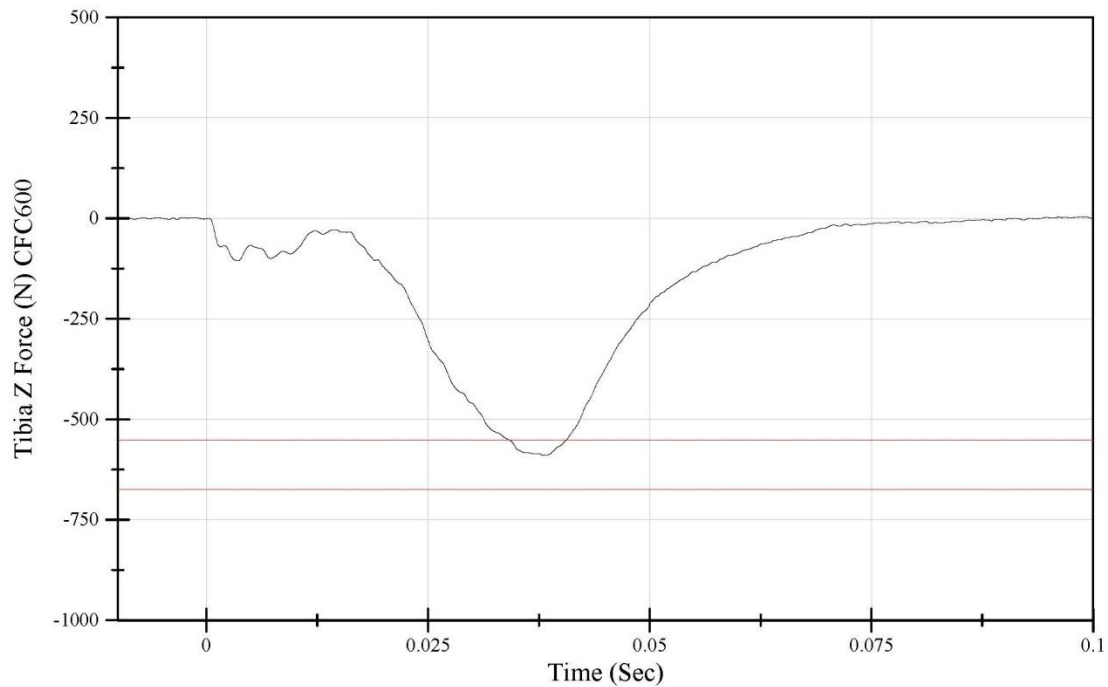


Software Version: 2.4

File Name: LX0039Heel140423_01_DIADEMHeader_BINARYprocessed
04/23/2014 07:47:37.0000

Test Temperature: 71.2 degrees
Relative Humidity: 3.4%
Test Velocity: 2 m/s

THOR Left Foot Inversion Certification
Tibia Load
Serial Number: LX0039

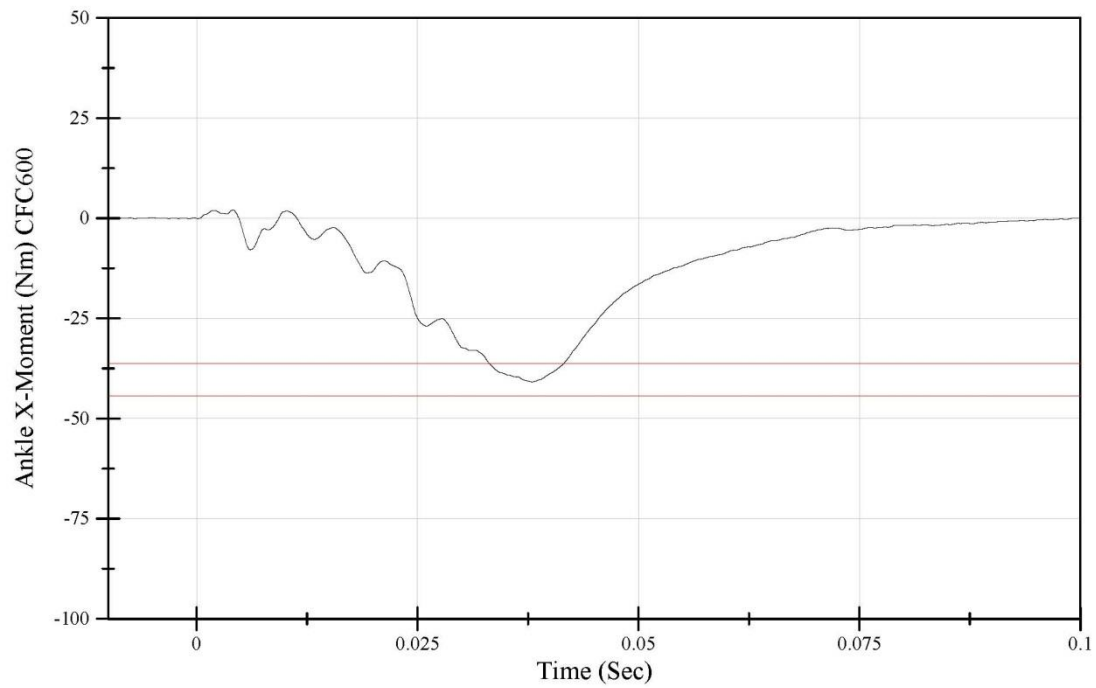


Software Version: 2.4

File Name: LX0039Inversion140422_01_DIADEMHeader_BINARYISOprocessed
04/22/2014 14:28:41.0000

Test Temperature: 71.2 degrees
Relative Humidity: 3.4%
Test Velocity: 2 m/s

THOR Left Foot Inversion Certification
Ankle Moment
Serial Number: LX0039

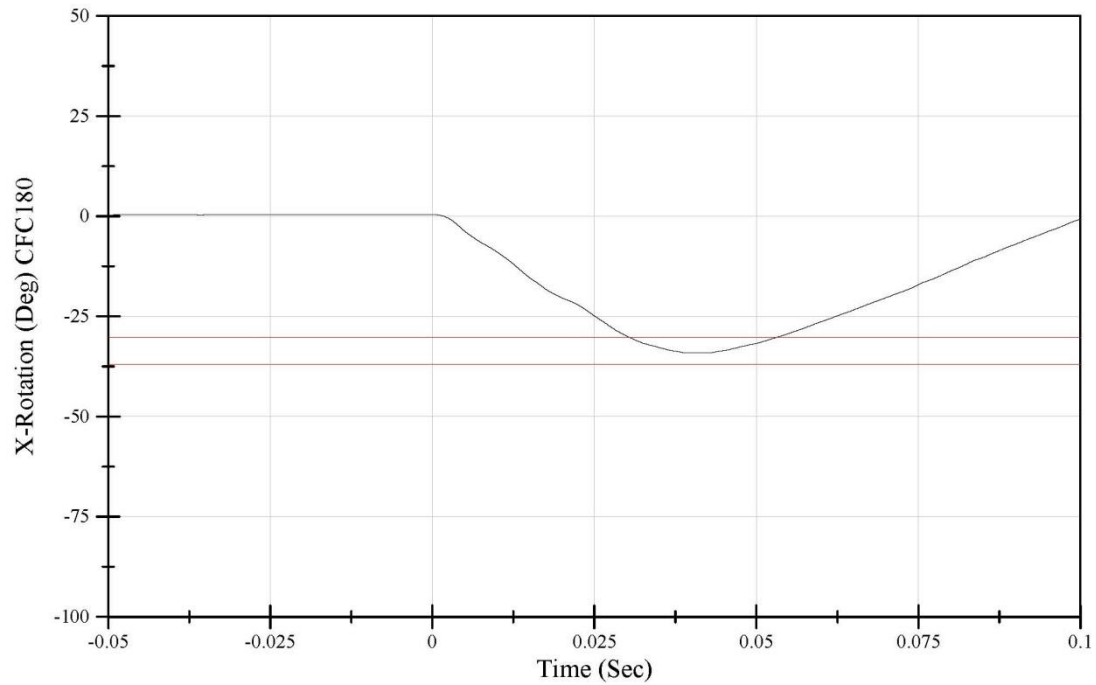


Software Version: 2.4

File Name: LX0039Inversion140422_01_DIADEMHeader_BINARYISOprocessed
04/22/2014 14:28:41.0000

Test Temperature: 71.2 degrees
Relative Humidity: 3.4%
Test Velocity: 2 m/s

THOR Left Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0039



Software Version: 2.4

File Name: LX0039Inversion140422_01_DIADEMHeader_BINARYISOprocessed
04/22/2014 14:28:41.0000

APPENDIX D:
CMM MEASUREMENT PROCEDURES

Vehicle Coordinate System

The origin point of the VCS is a point 50 mm forward of the rear window glass or hatchback door onto the roof of the vehicle along the vehicle's lateral centerline. The ground is not used as a reference.

The following procedure was used to create the Vehicle Coordinate System (VCS):

- 1) Place the As Delivered vehicle on a flat surface.
- 2) Measure the width of the vehicle at the rear of the vehicle to establish a first center point.
- 3) Measure the width of the vehicle at the front of the vehicle to establish a second center point.
- 4) Using a vertical laser beam, connect the two points to establish the lateral centerline of the vehicle.
- 5) Establish a point 50 mm from the edge of the rear window glass or rear hatchback door frame at the intersection of the roof onto the roof to establish the VCS origin point.
- 6) Construct a line perpendicular to the lateral centerline of the vehicle from VCS origin point towards the C-pillar. Mark a point along this line that is on the C-pillar at the body crease line between the roof and pillar geometry. This will be reference point #2.
- 7) Construct another perpendicular line in the opposite direction from the lateral centerline of the vehicle that is the same distance from the centerline as reference point #2. This will be reference point #3.
- 8) The VCS origin point is defined as the following:
 - Positive X is from the VCS origin point to the front of the vehicle
 - Positive Y is from the driver side of the vehicle to the passenger side of the vehicle
 - Positive Z is from the VCS origin point of the vehicle to the bottom of the vehicle

Steering Column Reference Point

The Steering Column Reference point is the x, y, and z location of the geometric center of the steering wheel in the VCS.

Brake Pedal Reference Point

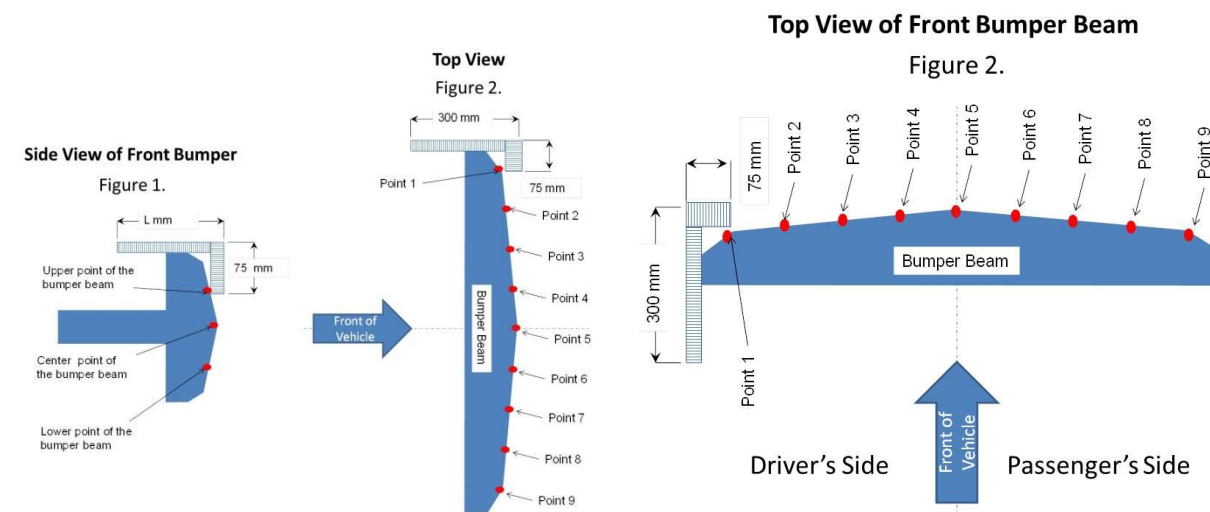
The Brake Pedal Reference Point is the x, y, and z location of the geometric center of the brake pedal pad (top surface) in the VCS.

Floor Reference Point

The Floor Reference Point is the x, y, and z location of the floor in the VCS. Use the following procedure to determine the Floor Reference Point:

1. If the vehicle has an accelerator pedal with fore-aft adjustment, adjust the pedal to its forward most position
2. Locate the centerline of the top surface of the bottom of the accelerator pedal (CLAP)
3. Remove floor mats
4. Project a vertical line down from the CLAP point until contact is made to the floor. This point is the Floor Reference Point

Pre and Post Bumper Beam and Radiator Support Measurement



Find the vertical center of the bumper beam using the following procedure (Reference Figure 1).

- 1) Position a square above the bumper beam at the centerline of the vehicle such that the plane of the square is aligned with the longitudinal axis of the vehicle and the "L mm" part of the square is parallel to the ground.
- 2) Move the square toward the ground until it contacts the bumper beam.
- 3) Move the square toward the rear of the vehicle until it contacts the bumper beam. The point where the 75 mm part of the square contacts the bumper beam is the Upper point of the bumper beam.
- 4) Perform the same procedure for the lower part of the bumper beam. The point where the 75 mm part of the square contacts the bumper beam is the Lower point of the bumper beam.
- 5) The center point of the bumper beam is half the distance between the Upper and Lower points of the bumper beam.
- 6) Transpose the lateral center of the bumper beam up onto the top of the upper radiator support.
- 7) Mark the center of the upper radiator support along its forward leading edge. If the radiator support is not flat this mark is made along the top edge.
- 8) Mark enough points along this edge to define its profile.

Pre and Post Driver Left Lower Instrument Panel

The left lower instrument panel (knee bolster) lateral coordinates are defined by adding 15 cm from the steering column reference lateral coordinate, respectively. The vertical coordinate is defined as 45 cm above the height of the floor reference point. If the panel or knee bolster loosens or breaks away in the crash, the post-crash measurements are taken by pressing and holding the panel against the underlying structure.

Create a floor vehicle coordinate system on the floor at the location of this measurement.

Pre and Post Driver Right Lower Instrument Panel

The left lower instrument panel (knee bolster) lateral coordinates are defined by subtracting 15 cm from the steering column reference lateral coordinate, respectively. The vertical coordinate is defined as 45 cm above the height of the floor reference point. If the panel or knee bolster loosens or breaks away in the crash, the post-crash measurements are taken by pressing and holding the panel against the underlying structure.

Pre and Post Brake Pedal (Figure 22)

If the brake pedal is constructed so that it dangles loosely after the crash, the brake pedal is pushed straight forward against the toe pan/floor pan and held there to take the post-crash measurement. If the pedal drops away entirely, no post-crash measurement is taken.

Pre and Post Driver Toe pan and Floor Board (Figure 22)

DRIVER POINT A1

The vertical coordinate for the A1 measurement location is the vertical of the brake pedal reference. The lateral coordinate of the A1 is obtained by subtracting 25 cm from the brake pedal reference lateral coordinate.

DRIVER POINT B1

The vertical coordinate for the B1 location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the B1 is obtained by subtracting 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT C1

The vertical coordinate for the C1 location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the C1 is obtained by subtracting 0 cm from the brake pedal reference lateral coordinate.

DRIVER POINT D1

The vertical coordinate for the D1 location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the D1 is obtained by adding 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT A2

The vertical coordinate of the A2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference and the vertical coordinate of the floor reference. The lateral coordinate of the A2 is obtained by subtracting 25 cm from the brake pedal reference lateral coordinate.

DRIVER POINT B2

The vertical coordinate of the B2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference the vertical coordinate of the floor reference. The lateral coordinate of the B2 is obtained by subtracting 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT C2

The vertical coordinate of the C2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference and the vertical coordinate of the floor reference. The lateral coordinate of the C2 is obtained by subtracting 0 cm from the brake pedal reference lateral coordinate.

DRIVER POINT D2

The vertical coordinate of the D2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference and the vertical coordinate of the floor reference. The lateral coordinate of the D2 is obtained by adding 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT A3

The vertical coordinate of the A3 measurement location is obtained by subtracting 1 cm from the floor reference. The lateral coordinate of the A3 is obtained by subtracting 25 cm from the brake pedal reference lateral coordinate.

DRIVER POINT B3

The vertical coordinate of the B3 measurement location is obtained by subtracting 1 cm from the floor reference. The lateral coordinate of the B3 is obtained by subtracting 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT C3

The vertical coordinate of the C3 measurement location is obtained by subtracting 1 cm from the floor reference. The lateral coordinate of the C3 is obtained by subtracting 0 cm from the brake pedal reference lateral coordinate.

DRIVER POINT D3

The vertical coordinate of the D3 measurement location is obtained by subtracting 1 cm from the floor reference. The lateral coordinate of the D3 is obtained by adding 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT A4

The longitudinal coordinate of the A4 measurement location is obtained by subtracting 10 cm from the D3 reference. The lateral coordinate of the A4 is obtained by subtracting 25 cm from the brake pedal reference lateral coordinate.

DRIVER POINT B4

The longitudinal coordinate of the B4 measurement location is obtained by subtracting 10 cm from the D3 reference. The lateral coordinate of the B4 is obtained by subtracting 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT C4

The longitudinal coordinate of the C4 measurement location is obtained by subtracting 10 cm from the D3 reference. The lateral coordinate of the C4 is obtained by subtracting 0 cm from the brake pedal reference lateral coordinate.

DRIVER POINT D4

The longitudinal coordinate of the D4 measurement location is obtained by subtracting 10 cm from the D3 reference. The lateral coordinate of the D4 is obtained by adding 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT A5

The longitudinal coordinate of the A5 measurement location is obtained by subtracting 10 cm from the A4 reference. The lateral coordinate of the A5 is obtained by subtracting 25 cm from the brake pedal reference lateral coordinate.

DRIVER POINT B5

The longitudinal coordinate of the B5 measurement location is obtained by subtracting 10 cm from the B4 reference. The lateral coordinate of the B5 is obtained by subtracting 15 cm from the brake pedal reference lateral coordinate.

DRIVER POINT C5

The longitudinal coordinate of the C5 measurement location is obtained by subtracting 10 cm from the C4 reference. The lateral coordinate of the C5 is obtained by subtracting 0 cm from the brake pedal reference lateral coordinate.

DRIVER POINT D5

The longitudinal coordinate of the D5 measurement location is obtained by subtracting 10 cm from the D4 reference. The lateral coordinate of the D5 is obtained by adding 15 cm from the brake pedal reference lateral coordinate.

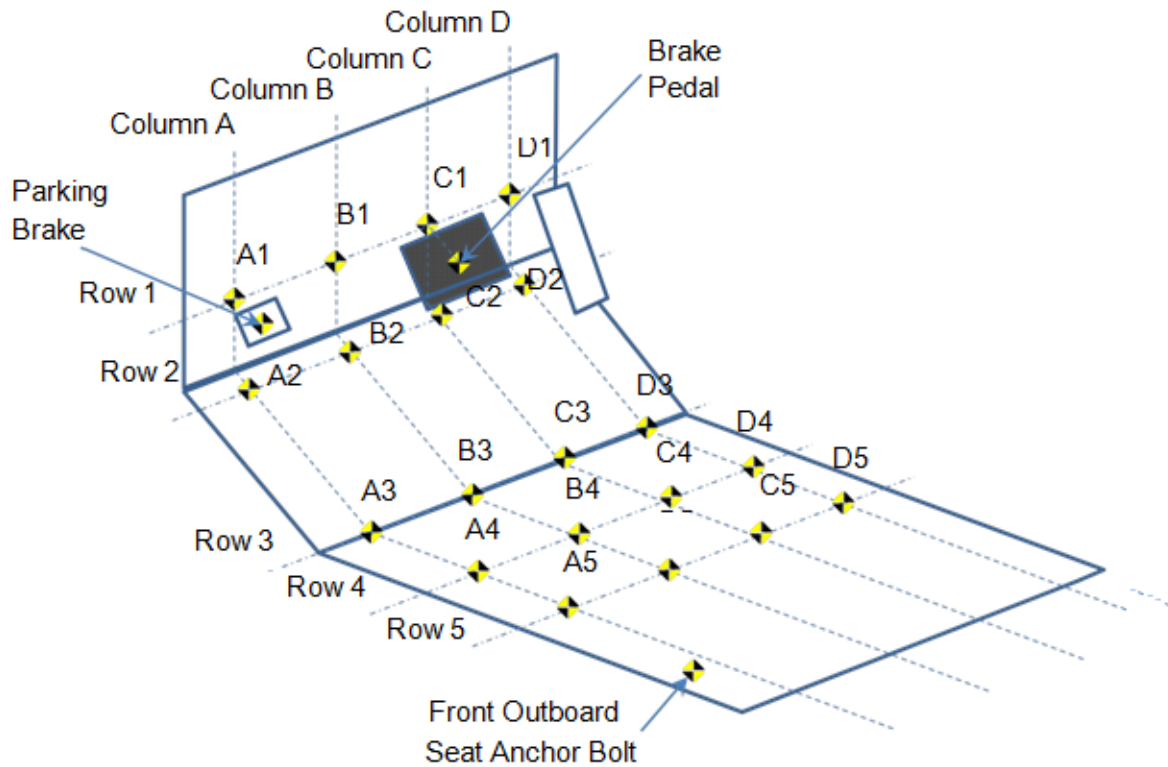
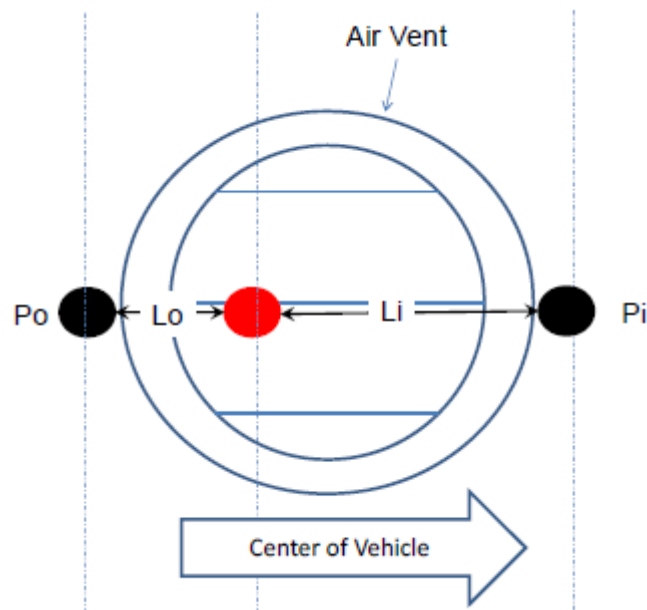


Figure 22: Lower interior intrusion measurements

Driver Upper Dash

The upper dash point is obtained by subtracting 25 cm from the lateral coordinate of the steering column reference lateral coordinate. This defines a line of points on the edge of the upper dash. The upper dash point is located on the rearward most (toward the rear of the vehicle) point on this line. This point must be located at least 30 cm above the brake pedal reference point to ensure a vertical location high enough to represent a location that could be contacted by the driver's upper body or head. If the rearward most point is less than 30 cm above the brake pedal reference point, the upper dash point is located at this 30 cm reference location.

There may be instances when the upper dash point is located on a “soft component” such as an air vent or control knob (Figure 23). To measure a more robust structure, the upper dash point is replaced with two additional points, and the weighted average of their coordinates is used to represent the deformation of a point at the original location (Equation 1). Each new point is determined by moving inboard/outboard to a location that is just off of the soft component.



$$dp = \frac{L_i}{L_o + L_i} [X_o, Y_o, Z_o] + \frac{L_o}{L_o + L_i} [X_o, Y_o, Z_o]$$

Figure 23: Equation for Measuring Soft Component Driver Upper Dash Point

Passenger Left Lower Instrument Panel

The left lower instrument panel (knee bolster) lateral coordinates are defined by adding 15 cm from the center passenger seat reference lateral coordinate, respectively. The vertical coordinate is defined as 45 cm above the height of the floor (without floor mats). If the panel or knee bolster loosens or breaks away in the crash, the post-crash measurements are taken by pressing and holding the panel against the underlying structure.

Create a floor vehicle coordinate system on the floor at the location of this measurement.

Passenger Right Lower Instrument Panel

The left lower instrument panel (knee bolster) lateral coordinates are defined by subtracting 15 cm from the center passenger seat reference lateral coordinate, respectively. The vertical coordinate is defined as 45 cm above the height of the floor (without floor mats). If the panel or knee bolster loosens or breaks away in the crash, the post-crash measurements are taken by pressing and holding the panel against the underlying structure.

Passenger Toe pan and Floor Board (Figure 24)

PASSENGER POINT A1

The vertical coordinate for the A1 measurement location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the A1 is obtained by subtracting 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT B1

The vertical coordinate for the B1 location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the B1 is obtained by subtracting 0 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT C1

The vertical coordinate for the C1 location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the C1 is obtained by adding 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT D1

The vertical coordinate for the D1 location is the vertical coordinate of the brake pedal reference. The lateral coordinate of the D1 is obtained by adding 25 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT A2

The vertical coordinate of the A2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference and the vertical coordinate of the floor reference. The lateral coordinate of the A2 is obtained by subtracting 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT B2

The vertical coordinate of the B2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference the vertical coordinate of the floor reference. The lateral coordinate of the B2 is obtained by subtracting 0 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT C2

The vertical coordinate of the C2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference and the vertical coordinate of the floor reference. The lateral coordinate of the C2 is obtained by adding 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT D2

The vertical coordinate of the C2 measurement location is obtained by adding half the distance between the vertical coordinate of the brake pedal reference and the vertical coordinate of the floor reference. The lateral coordinate of the D2 is obtained by adding 25 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT A3

The vertical coordinate of the A3 measurement location is obtained by subtracting 1 cm from the driver's floor reference. The lateral coordinate of the A3 is obtained by subtracting 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT B3

The vertical coordinate of the B3 measurement location is obtained by subtracting 1 cm from the driver's floor reference. The lateral coordinate of the B3 is obtained by subtracting 0 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT C3

The vertical coordinate of the C3 measurement location is obtained by subtracting 1 cm from the driver's floor reference. The lateral coordinate of the C3 is obtained by adding 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT D3

The vertical coordinate of the D3 measurement location is obtained by subtracting 1 cm from the driver's floor reference. The lateral coordinate of the D3 is obtained by adding 25 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT A4

The longitudinal coordinate of the A4 measurement location is obtained by subtracting 10 cm from the A3 reference. The lateral coordinate of the A4 is obtained by subtracting 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT B4

The longitudinal coordinate of the B4 measurement location is obtained by subtracting 10 cm from the A3 reference. The lateral coordinate of the B4 is obtained by subtracting 0 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT C4

The longitudinal coordinate of the C4 measurement location is obtained by subtracting 10 cm from the A3 reference. The lateral coordinate of the C4 is obtained by adding 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT D4

The longitudinal coordinate of the D4 measurement location is obtained by subtracting 10 cm from the A3 reference. The lateral coordinate of the D4 is obtained by adding 25 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT A5

The longitudinal coordinate of the A5 measurement location is obtained by subtracting 10 cm from the A4 reference. The lateral coordinate of the A5 is obtained by subtracting 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT B5

The longitudinal coordinate of the B5 measurement location is obtained by subtracting 10 cm from the B4 reference. The lateral coordinate of the B5 is obtained by subtracting 0 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT C5

The longitudinal coordinate of the C5 measurement location is obtained by subtracting 10 cm from the C4 reference. The lateral coordinate of the C5 is obtained by adding 15 cm from the center passenger seat reference lateral coordinate.

PASSENGER POINT D5

The longitudinal coordinate of the D5 measurement location is obtained by subtracting 10 cm from the D4 reference. The lateral coordinate of the D5 is obtained by adding 25 cm from the center passenger seat reference lateral coordinate.

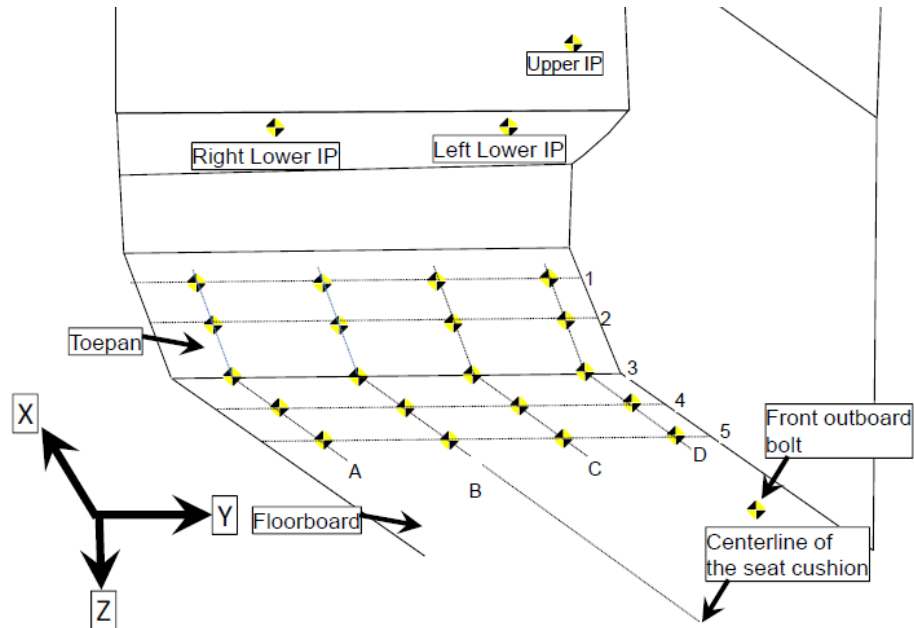


Figure 24: Passenger side lower interior measurements

Passenger Upper Dash

The upper dash point is obtained by adding 25 cm from the lateral coordinate of the center passenger seat reference lateral coordinate. This defines a line of points on the edge of the upper dash. The upper dash point is located on the rearward most (toward the rear of the vehicle) point on this line. This point must be located at least 30 cm above the brake pedal reference point to ensure a vertical location high enough to represent a location that could be contacted by the driver's upper body or head. If the rearward most point is less than 30 cm above the brake pedal reference point, the upper dash point is located at this 30 cm reference location.

There may be instances when the upper dash point is located on a "soft component" such as an air vent or control knob (Figure 23). To measure a more robust structure, the upper dash point is replaced with two additional points, and the weighted average of their coordinates is used to represent the deformation of a point at the original location (Equation 1). Each new point is determined by moving inboard/outboard to a location that is just off of the soft component.

Driver Door Measurements (Figure 25)

Mark the following points on the inner most surface of the door opening, typically on the pinch weld.

- 1) **Point 1:** The vertical coordinates of this point is obtained by subtracting 0 cm from the brake pedal reference point.
- 2) **Point 2:** The vertical coordinates of this point is obtained by subtracting 7.5 cm from the brake pedal reference point.
- 3) **Point 3:** The vertical coordinates of this point is obtained by subtracting 15 cm from the brake pedal reference point
- 4) **Point 4:** The vertical coordinates of this point is obtained by subtracting 45 cm from the brake pedal reference point.
- 5) **Point 5:** The vertical coordinates of this point is obtained by subtracting 52.5 cm from the brake pedal reference point).
- 6) **Point 6:** The vertical coordinates of this point is obtained by subtracting 60 cm from the brake pedal reference point
- 7) **Point 7:** The longitudinal coordinates of this point is obtained by subtracting 20 cm from the brake pedal reference point. If the 20 cm point is forward of the actual door frame, this point is located 5 cm rearward of lower hinge pillar point.
- 8) **Point 8:** The longitudinal coordinates of this point is obtained by subtracting 35 cm from the brake pedal reference point.
- 9) **Point 9:** The longitudinal coordinates of this point is obtained by subtracting 50 cm from the brake pedal reference point.
- 10) **Point 10 and 11:** Mark 2 evenly spaced points between points 1 and 7
- 11) **Point 12 and 13:** Mark 2 evenly spaced points between points 3 and 4
- 12) **Point 26:** Mark a point at the intersection of the roof rail and the start of the B-pillar
- 13) **Points 14-25:** Mark 12 evenly spaced points between points 6 and 26
- 14) **Point 32:** Mark a point at the intersection of the lower sill and the start of the B-pillar
- 15) **Points 27-31:** Mark 5 evenly spaced points between points 9 and 32
- 16) **Point 33:** Subtract 150mm from the vertical coordinate of the brake pedal reference point
- 17) **Point 34:** Subtract 0mm from the vertical coordinate of the brake pedal reference point

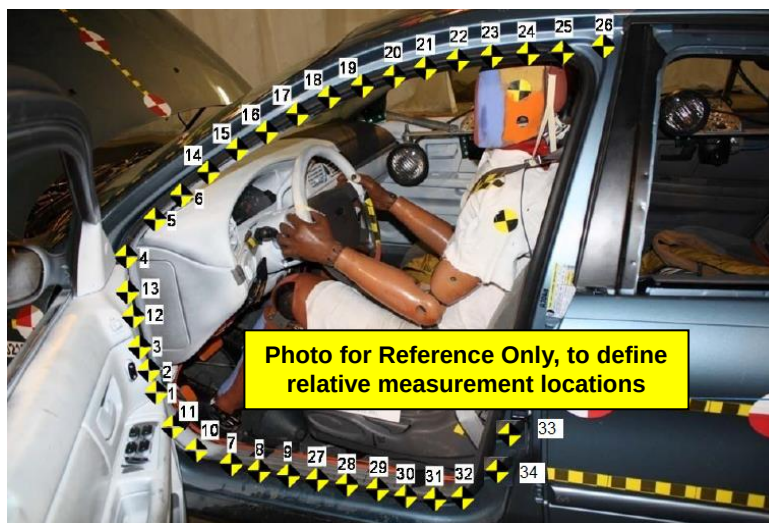


Figure 25: Driver Door Measurements

Passenger Door Measurements

Perform the same procedure as the driver door on the passenger side.

Pre-Test Exterior Profile

- 1) Expose the front bumper beam.
- 2) At the lateral center of the bumper beam, measure and mark the center of the front bumper beam (along front face of beam).
- 3) Using this Z coordinate, mark and measure enough points around the complete circumference of the vehicle to establish cross section A-A.
- 4) Transpose the lateral center of the bumper beam up onto the top of the upper radiator support.
- 5) Mark the center of the upper radiator support along its forward leading edge.
- 6) Using this Z coordinate, mark and measure enough points around the complete circumference of the vehicle to establish cross section B-B.

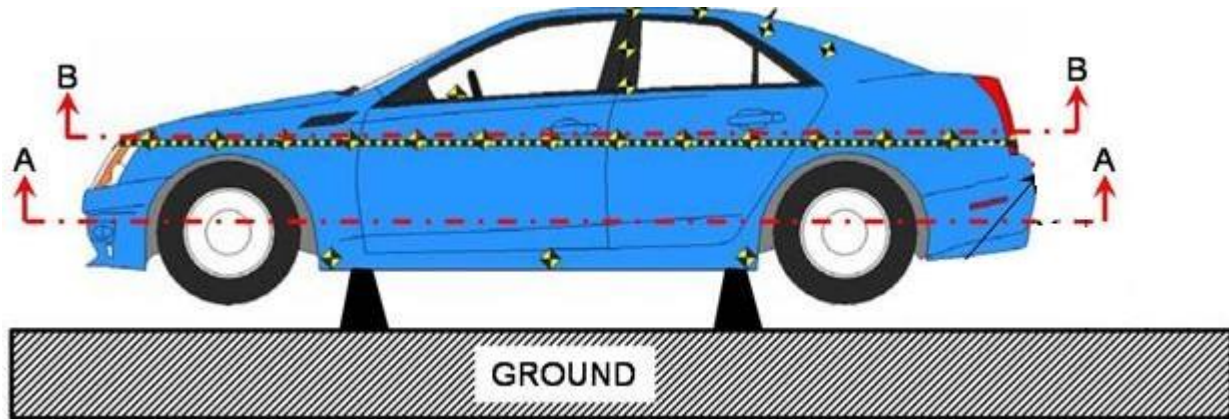


Figure 26: Pre-Test Vehicle Profile

Post-Test Exterior Profile

- 1) Remove bumper cover
- 2) Using the vehicle's origin reference point leap into vehicle's coordinate system.
- 3) Using the pre-Test z-value at section A-A which was recorded from VCS origin, take measurements at this z-distance around the circumference of the vehicle.
- 4) Using the pre-Test z-value at section B-B that was recorded from VCS origin, take measurements at this z-distance around the circumference of the vehicle.

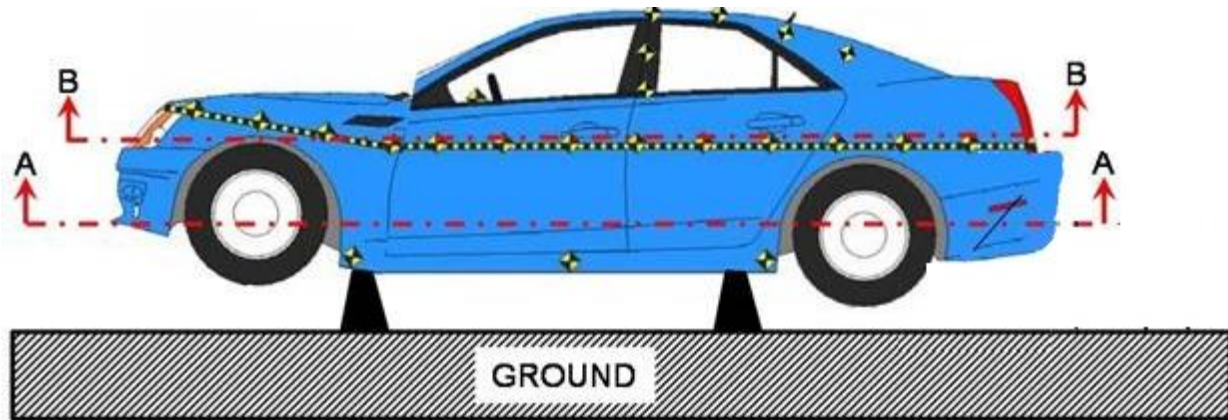
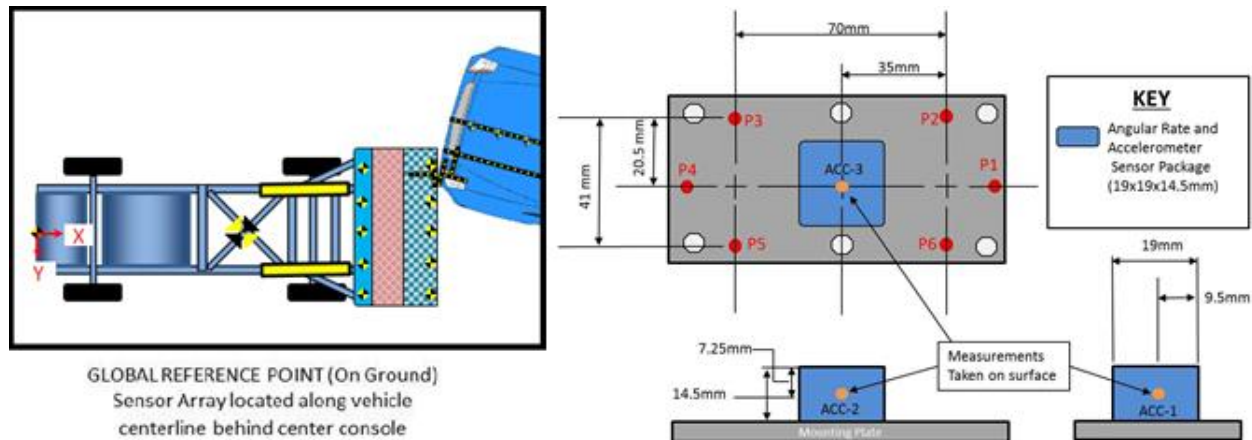


Figure 27: Post-Test Vehicle Profile

Pre and Post Honeycomb Requirements

The contractor shall take pre-and post-crush measurements of the honeycomb while attached to the barrier. These measurements shall be documented in the appropriate datasheet. Also, the contractor shall take pre-and post-Test pictures of the left and right side, top, and front view of the honeycomb while attached to the barrier.

Angular Rate Sensor Mounting & Dimensions:



- 1) Make sure the vehicle is in the **LVC** condition by placing jacks under each jack point and leveling the sill as previously described.
- 2) The ARS sensors and vehicle CG accelerometers were installed directly behind the center console on the floor board using the above pictured mounting block.
- 3) The block was mounted at the longitudinal centerline such that the x, y, and z axis of the block align with the vehicle coordinate system.
 - a. P1 and P4 were placed along the lateral centerline of the vehicle
 - b. P4 is mounted toward the front of the vehicle
 - c. The mounting plate is parallel to the horizontal plan of the vehicle coordinate system

Note: the block shall not move relative to the vehicle during the test

- 4) CMM each position alignment point (P1-P6) while the vehicle is level.
- 5) CMM the middle of the top surface of each direction of the CG accelerometer while the vehicle is level. (ie. Accelerometer CGx will be taken on the surface in the x-direction)
- 6) Transport the vehicle to test area and align with the RMDB barrier
- 7) Once vehicle is aligned with the barrier and all dummies are positioned, create a global coordinate system on the ground (GCS). The origin of the GCS is located at the front most point at the centerline of the RMDB.
 - Positive X is from the GCS origin point to the front of RMDB
 - Positive Y is from the center of RMDB towards the right of RMDB when looking from the back of the RMDB
 - Positive Z is from the GCS origin point downward into the ground
- 8) Measure and record all points described above