

REPORT NUMBER: R&D-CAL-13-004

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

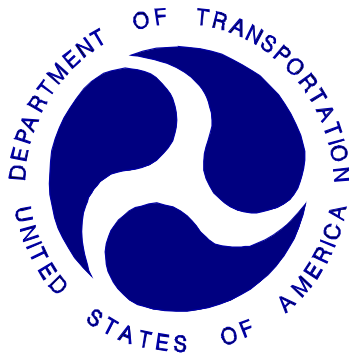
2013 Volvo XC60

90.1KPH, 15 DEGREE ANGLE, 35% OVERLAP

TEST DATE: 11/11/2013

NHTSA No: RD5910

**CALSPAN CORPORATION
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October 30, 2014

PREPARED FOR:

**U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Vehicle safety Research
1200 New Jersey Ave, SE
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FINAL REPORT ACCEPTANCE BY VEHICLE SAFETY RESEARCH, OFFICE OF
STRUCTURAL AND RESTRAINTS RESEARCH DIVISION

:

Date: _____

TOM, Vehicle Crash Testing
NHTSA, Office of Structures and Restraints Research

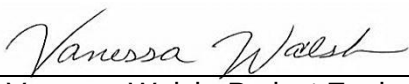
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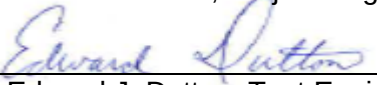
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16. Abstract A test was conducted in accordance with Task Order 0002 of Contract DTNH22-10-D-00155. The Test consisted of a Research Moving Deformable Barrier (RMDB) traveling at a target speed of 90.12 kph into a stationary 2013 Volvo XC60 SUV. The 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 November 11, 2013. The RMDB impact velocity was 89.76 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 464 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>140.15</td> <td>700</td> <td>465.83</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>-45.51</td> <td>52</td> <td>-42.03</td> </tr> <tr> <td>Neck Injury Criteria (Nij)</td> <td>N/A</td> <td>1</td> <td>0.29</td> <td>1</td> <td>0.25</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4,170</td> <td>1833.21</td> <td>2,620</td> <td>1190.84</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4,000</td> <td>-90.75</td> <td>2,520</td> <td>-322.06</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10,008</td> <td>-2476.44</td> <td>6,805</td> <td>-4013.17</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10,008</td> <td>-7695.92</td> <td>6,805</td> <td>-1868.97</td> </tr> </tbody> </table>					Measurement Description	Units	Driver ATD		Pass. ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)	N/A	700	140.15	700	465.83	Maximum Chest Compression	mm	63	-45.51	52	-42.03	Neck Injury Criteria (Nij)	N/A	1	0.29	1	0.25	Neck Tension	N	4,170	1833.21	2,620	1190.84	Neck Compression	N	4,000	-90.75	2,520	-322.06	Left Femur Force	N	10,008	-2476.44	6,805	-4013.17	Right Femur Force	N	10,008	-7695.92	6,805	-1868.97
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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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 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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SECTION 1
PURPOSE OF TEST

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

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.

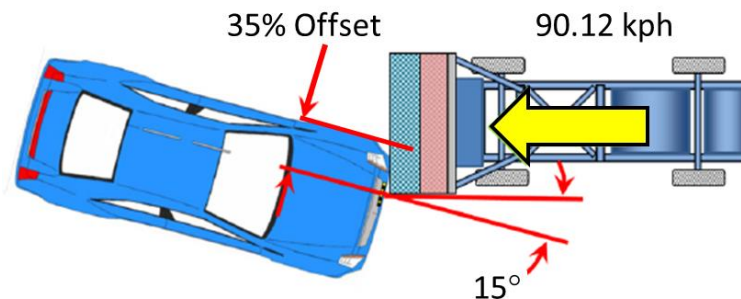
This test was conducted in accordance with the instructions set forth for a 15° angle, 35% offset moving barrier to vehicle impact, outlined in Contract No. DTNH22-10-D-00155, TO 0002. Data was obtained indicant of Federal Motor Vehicle Safety Standard FMVSS 208-Occupant Crash Protection, FMVSS 212 – 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 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

A 2013 Volvo XC60 SUV 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 2,153 kg (4,745.2 lbs), and the RMDB's mass was 2490.7 kg (5491 lbs). The test was conducted by Calspan Corporation on November 11, 2013.



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. 016) was seated in the left, front (P1 -Driver's) seating position and one 50% adult male THOR-NT adult male ATD (Serial No. 015) 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 airbag. 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 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

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Test Date: 11/11/2013

Two hundred and eighteen (218) 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 100% total windshield retention, with 100% 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 464 mm at C2 to the left of the vehicle's centerline. The maximum crush of the structural bumper beam was 437 mm at B3, 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:

- All pillars remained in good condition
- Windshield had cracks throughout
- Hood bent inwards

The driver ATD's visible contact points were:

- Head contacted the frontal and curtain airbag and the side head liner
- Torso contacted the frontal airbag
- Side Torso contacted the driver's door
- Knee contacted the knee bolster

The passenger ATD's visible contact points were:

- Head contacted the frontal airbag, center instrument panel, interior target bar and passenger door.
- Torso contacted the frontal airbag
- Knee contacted the glove box

SECTION 2 (CONTINUED) CRASH VEHICLE SUMMARY

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

Primary Impact Data

Measured Parameter	Units	Value
RMDB Velocity at Impact	kph	89.76
RMDB Test Weight	kg	2490.7
RMDB Maximum Static Crush	mm	394.9
Vehicle Test Weight	kg	2153
Actual Vehicle Angle	degrees	15
Vehicle Maximum Static Crush	mm	464
Vertical Offset from Target Point (+ down / - up)*	mm	-5
Lateral Offset from Target Point (+ left / - right)*	mm	8
Number of Data Channels		218
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: 016		THOR, S/N: 015	
Head Contact	Front and curtain airbag	A49-A51	Front airbag, center instrument panel, interior target bag & passenger door	A70-A72
Shoulder & Side Torso	Driver's Door	NA	Center instrument panel	NA
Upper Torso Contact	Front airbag	NA	Front airbag	NA
Lower Torso Contact	Front airbag	NA	None	NA
Left Knee Contact	Knee bolster	A28	Glove box	A52
Right Knee Contact	Knee bolster	A28	Glove box	A52

Data Anamolies:

- Driver Pelvis X Acceleration - Questionable Spike at 110ms
- Passenger Head CG X Acceleration - Questionable Data Throughout

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2013 Volvo XC60 NHTSA No.: RD5910
Test Program: Research and Development Left Oblique Offset Test Date: 11/11/2013

Driver: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head CG X	g	1000	9.02	-28.62
	Head CG Y	g	1000	21.99	-5.34
	Head CG Z	g	1000	33.51	-2.08
	Head Resultant	g	Compute	44.19	
	36 ms HIC		Compute	293.02	
	15 ms HIC		Compute	140.15	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	38.81	
	Head Rotational Velocity X	deg/s	60	927.52	-2015.54
	Head Rotational Velocity Y	deg/s	60	539.84	-2156.70
	Head Rotational Velocity Z	deg/s	60	2714.79	-823.67
	Head Rotational Velocity Resultant	deg/s	Compute	3497.50	
	Brain Injury Criteria		Compute	1.40	
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	136.92	-369.38
	UNLC Neck System Tension, FZ	N	1000	1833.21	
	UNLC Neck System Compression, FZ	N	1000		-90.75
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	3.55	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-11.54
	NIJ		Compute	0.29	
	On head acting through total neck section, FX	N	Thortest	151.52	-255.09
	On head acting through total neck section, FY	N	Thortest	645.82	-126.74
	On head acting through total neck section, FZ	N	Thortest	1847.99	-93.68
	On head acting through total neck section, MX	N-m	Thortest	67.86	-13.96
	On head acting through total neck section, MY	N-m	Thortest	18.56	-11.03
	On head acting through total neck section, MZ	N-m	Thortest	4.03	-40.94
	On head acting through O.C. joint only, FX	N	Thortest	48.43	-355.47
	On head acting through O.C. joint only, FZ	N	Thortest	1831.81	-153.03
	On head acting through O.C. joint only, MY	N-m	Thortest	3.55	-11.54
Chest	Upper Left IR-TRACC X - deflection	mm	Thortest	1.79	-17.93
	Upper Left IR-TRACC Y - deflection	mm	Thortest	5.05	-8.59
	Upper Left IR-TRACC Z - deflection	mm	Thortest	-0.00	-27.21
	Upper Left IR-TRACC D - deflection	mm	Thortest	1.95	-16.72
	Upper Right IR-TRACC X - deflection	mm	Thortest	0.05	-38.74
	Upper Right IR-TRACC Y - deflection	mm	Thortest	4.82	-7.94
	Upper Right IR-TRACC Z - deflection	mm	Thortest	18.67	-10.37
	Upper Right IR-TRACC D - deflection	mm	Thortest	0.05	-37.42
	Lower Left IR-TRACC X - deflection	mm	Thortest	0.52	-12.59
	Lower Left IR-TRACC Y - deflection	mm	Thortest	2.03	-13.78

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2013 Volvo XC60 NHTSA No.: RD5910
 Test Program: Research and Development Left Oblique Offset Test Date: 11/11/2013

Driver: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left IR-TRACC Z - deflection	mm	Thortest	0.19	-18.73
	Lower Left IR-TRACC D - deflection	mm	Thortest	0.64	-12.39
	Lower Right IR-TRACC X - deflection	mm	Thortest	-0.00	-47.27
	Lower Right IR-TRACC Y - deflection	mm	Thortest	2.22	-16.98
	Lower Right IR-TRACC Z - deflection	mm	Thortest	20.14	-4.12
	Lower Right IR-TRACC D - deflection	mm	Thortest	0.00	-45.51
	Chest CG Acceleration, 3 ms clip	g	Compute	N/A	
Abdomen	Lower Left IR-TRACC X - deflection	mm	Thortest	N/A	N/A
	Lower Left IR-TRACC Y - deflection	mm	Thortest	N/A	N/A
	Lower Left IR-TRACC Z - deflection	mm	Thortest	N/A	N/A
	Lower Left IR-TRACC D - deflection	mm	Thortest	N/A	N/A
	Left Viscous Criterion Based on X - deflection		Compute	N/A	
	Lower Right IR-TRACC X - deflection	mm	Thortest	N/A	N/A
	Lower Right IR-TRACC Y - deflection	mm	Thortest	N/A	N/A
	Lower Right IR-TRACC Z - deflection	mm	Thortest	N/A	N/A
	Lower Right IR-TRACC D - deflection	mm	Thortest	N/A	N/A
	Right Viscous Criterion Based on X - deflection		Compute	N/A	
Spine	Upper Spine (T1) AX	g	180	6.81	-34.06
	Upper Spine (T1) AY	g	180	31.65	-15.15
	Upper Spine (T1) AZ	g	180	11.67	-3.04
	Upper Spine (T1) Resultant	g	Compute	35.40	
	Middle Spine (T6) AX	g	180	13.17	-42.60
	Middle Spine (T6) AY	g	180	18.57	-7.83
	Middle Spine (T6) AZ	g	180	7.09	-13.14
	Middle Spine (T6) Resultant	g	Compute	43.25	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	78.68 ⁽¹⁾	
Acetabulum	Left FX force	N	600	904.18	-866.53
	Left FY force	N	600	538.17	-1020.44
	Left FZ force	N	600	1503.85	-23.27
	Left Acetabulum Resultant	N	Compute	1527.14	
	Right FX force	N	600	421.99	-4557.35
	Right FY force	N	600	203.16	-1788.01
	Right FZ force	N	600	784.71	-258.49
	Right Acetabulum Resultant	N	Compute	4825.34	
Anomalies					
(1) Questionable spike at 110 ms					

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver Legs

Test Vehicle: 2013 Volvo XC60 NHTSA No.: RD5910
Test Program: Research and Development Left Oblique Offset Test Date: 11/11/2013

Driver: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	1.87	-13.76
	Right Knee Displacement, DX	mm	180	1.77	-11.49
Femur	Left Femur Force, FZ	N	600	352.83	-2476.44
	Left Femur Moment, MX	N-m	600	29.32	-192.83
	Left Femur Moment, MY	N-m	600	62.77	-40.18
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	194.88	
	Right Femur Force, FZ	N	600	241.24	-7695.92
	Right Femur Moment, MX	N-m	600	22.79	-168.24
	Right Femur Moment, MY	N-m	600	77.03	-10.46
	Right Femur Res (MX / MY only, not MZ)	N-m	Compute	177.96	
Tibia	Left Upper Tibia, FZ	N	600	45.82	-840.62
	Left Upper Tibia, MY	N-m	600	41.85	-48.24
	Left Upper Tibia, Index		Compute	0.24	
	Right Upper Tibia, FZ	N	600	626.03	-1199.29
	Right Upper Tibia, MY	N-m	600	45.46	-97.32
	Right Upper Tibia, Index		Compute	1.01	
	Left Lower Tibia, FZ	N	600	154.91	-1604.51
	Left Lower Tibia, MY	N-m	600	22.68	-65.06
	Left Lower Tibia, Index		Compute	0.39	
	Right Lower Tibia, FZ	N	600	179.32	-1540.46
	Right Lower Tibia, MY	N-m	600	15.53	-84.68
	Right Lower Tibia, Index		Compute	1.07	
Ankle	Left Ankle Rotation, RX	Deg	180	18.78	-19.97
	Left Ankle Rotation, RY	Deg	180	25.48	-20.95
	Right Ankle Rotation, RX	Deg	180	1.33	-35.54
	Right Ankle Rotation, RY	Deg	180	-4.37	-20.65
Anomalies None					

SECTION 2 (CONTINUED)

PREMININARY INJURY SUMMARY: Right Front Passenger

Test Vehicle: 2013 Volvo XC60 NHTSA No.: RD5910
 Test Program: Research and Development Left Oblique Offset Test Date: 11/11/2013

Right Front Passenger: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head CG X	g	1000	64.61 ⁽²⁾	-11.46 ⁽²⁾
	Head CG Y	g	1000	24.73	-21.66
	Head CG Z	g	1000	25.29	-1.23
	Head Resultant	g	Compute	67.75 ⁽²⁾	
	36 ms HIC		Compute	1038.17 ⁽²⁾	
	15 ms HIC		Compute	465.83 ⁽²⁾	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	63.13 ⁽²⁾	
	Head Rotational Velocity X	deg/s	60	533.33	-1794.64
	Head Rotational Velocity Y	deg/s	60	1403.90	-1568.47
	Head Rotational Velocity Z	deg/s	60	3550.67	-2509.39
	Head Rotational Velocity Resultant	deg/s	Compute	3923.90	
	Brain Injury Criteria		Compute	1.60	
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	323.62	-86.09
	UNLC Neck System Tension, FZ	N	1000	1190.84	
	UNLC Neck System Compression, FZ	N	1000		-322.06
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	12.16	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-8.97
	NIJ		Compute	0.25	
	On head acting through total neck section, FX	N	Thortest	409.94	-222.75
	On head acting through total neck section, FY	N	Thortest	238.10	-144.51
	On head acting through total neck section, FZ	N	Thortest	1352.74	-74.85
	On head acting through total neck section, MX	N-m	Thortest	42.90	-22.85
	On head acting through total neck section, MY	N-m	Thortest	11.13	-22.52
	On head acting through total neck section, MZ	N-m	Thortest	20.48	-50.33
	On head acting through O.C. joint only, FX	N	Thortest	347.45	-201.04
	On head acting through O.C. joint only, FZ	N	Thortest	1199.87	-322.02
	On head acting through O.C. joint only, MY	N-m	Thortest	12.16	-8.97
Chest	Upper Left IR-TRACC X - deflection	mm	Thortest	0.03	-25.23
	Upper Left IR-TRACC Y - deflection	mm	Thortest	6.05	-9.22
	Upper Left IR-TRACC Z - deflection	mm	Thortest	14.41	-10.33
	Upper Left IR-TRACC D - deflection	mm	Thortest	0.04	-21.93
	Upper Right IR-TRACC X - deflection	mm	Thortest	0.19	-33.21
	Upper Right IR-TRACC Y - deflection	mm	Thortest	13.87	-6.09
	Upper Right IR-TRACC Z - deflection	mm	Thortest	14.49	-13.56
	Upper Right IR-TRACC D - deflection	mm	Thortest	0.21	-34.77
	Lower Left IR-TRACC X - deflection	mm	Thortest	2.20	-43.94
	Lower Left IR-TRACC Y - deflection	mm	Thortest	12.84	-1.08

SECTION 2 (CONTINUED)

PRELIMINARY INJURY SUMMARY: Right Front Passenger

Test Vehicle: 2013 Volvo XC60 NHTSA No.: RD5910
 Test Program: Research and Development Left Oblique Offset Test Date: 11/11/2013

Right Front Passenger: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left IR-TRACC Z - deflection	mm	Thortest	10.41	-9.56
	Lower Left IR-TRACC D - deflection	mm	Thortest	2.34	-42.03
	Lower Right IR-TRACC X - deflection	mm	Thortest	7.17	-18.99
	Lower Right IR-TRACC Y - deflection	mm	Thortest	8.07	-10.82
	Lower Right IR-TRACC Z - deflection	mm	Thortest	8.94	-19.13
	Lower Right IR-TRACC D - deflection	mm	Thortest	6.77	-15.58
	Chest CG Acceleration, 3 ms clip	g	Compute	N/A	
Abdomen	Lower Left IR-TRACC X - deflection	mm	Thortest	N/A	N/A
	Lower Left IR-TRACC Y - deflection	mm	Thortest	N/A	N/A
	Lower Left IR-TRACC Z - deflection	mm	Thortest	N/A	N/A
	Lower Left IR-TRACC D - deflection	mm	Thortest	N/A	N/A
	Left Viscous Criterion Based on X - deflection		Compute	N/A	
	Lower Right IR-TRACC X - deflection	mm	Thortest	N/A	N/A
	Lower Right IR-TRACC Y - deflection	mm	Thortest	N/A	N/A
	Lower Right IR-TRACC Z - deflection	mm	Thortest	N/A	N/A
	Lower Right IR-TRACC D - deflection	mm	Thortest	N/A	N/A
	Right Viscous Criterion Based on X - deflection		Compute	N/A	
Spine	Upper Spine (T1) AX	g	180	11.87	-23.11
	Upper Spine (T1) AY	g	180	32.32	-3.82
	Upper Spine (T1) AZ	g	180	26.65	-2.34
	Upper Spine (T1) Resultant	g	Compute	43.66	
	Middle Spine (T6) AX	g	180	7.02	-27.07
	Middle Spine (T6) AY	g	180	15.22	-1.79
	Middle Spine (T6) AZ	g	180	8.58	-6.33
	Middle Spine (T6) Resultant	g	Compute	29.47	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	57.91	
Acetabulum	Left FX force	N	600	2791.60	-2194.40
	Left FY force	N	600	327.10	-845.27
	Left FZ force	N	600	1264.94	-559.30
	Left Acetabulum Resultant	N	Compute	2950.18	
	Right FX force	N	600	1505.06	-448.03
	Right FY force	N	600	200.06	-1316.12
	Right FZ force	N	600	1346.22	-21.12
	Right Acetabulum Resultant	N	Compute	2305.04	
Anomalies					
(1) Questionable data throughout					

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

Test Vehicle: 2013 Volvo XC60 NHTSA No.: RD5910
Test Program: Research and Development Left Oblique Offset Test Date: 11/11/2013

Right Front Passenger: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	1.11	-3.03
	Right Knee Displacement, DX	mm	180	1.54	-1.85
Femur	Left Femur Force, FZ	N	600	371.05	-4013.17
	Left Femur Moment, MX	N-m	600	89.22	-265.96
	Left Femur Moment, MY	N-m	600	77.08	-22.69
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	266.40	
	Right Femur Force, FZ	N	600	299.24	-1868.97
	Right Femur Moment, MX	N-m	600	92.81	-194.66
	Right Femur Moment, MY	N-m	600	115.32	-21.76
	Right Femur Res (MX / MY only, not MZ)	N-m	Compute	220.54	
Tibia	Left Upper Tibia, FZ	N	600	35.27	-2374.40
	Left Upper Tibia, MY	N-m	600	39.05	-69.19
	Left Upper Tibia, Index		Compute	0.63	
	Right Upper Tibia, FZ	N	600	126.85	-1129.50
	Right Upper Tibia, MY	N-m	600	17.99	-60.00
	Right Upper Tibia, Index		Compute	0.58	
	Left Lower Tibia, FZ	N	600	48.63	-2878.64
	Left Lower Tibia, MY	N-m	600	15.63	-60.15
	Left Lower Tibia, Index		Compute	0.67	
	Right Lower Tibia, FZ	N	600	91.46	-1310.18
	Right Lower Tibia, MY	N-m	600	11.46	-40.76
	Right Lower Tibia, Index		Compute	0.67	
Ankle	Left Ankle Rotation, RX	Deg	180	25.35	-25.10
	Left Ankle Rotation, RY	Deg	180	8.23	-19.91
	Right Ankle Rotation, RX	Deg	180	28.56	-35.63
	Right Ankle Rotation, RY	Deg	180	-4.87	-23.54
Anomalies None					

SECTION 3 DATA SHEETS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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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
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9	Test Vehicle Summary of Results	3-25
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DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

VEHICLE INFORMATION

NHTSA No.	RD5910
Model Year	2013
Make	Volvo
Model	XC60
Body Style	Utility Vehicle
VIN	YV4952DZ9D2409747
Body Color	Dark Blue
Odometer Reading (km/mi)	32.2 km/ 20 mi
Engine Displacement. (L)	3.2
Type/No. Cylinders	I6
Engine Placement	Inline
Transmission Type	Automatic
Transmission Speeds	CVT
Overdrive	Yes
Final Drive	All-Wheel Drive
Roof Rack	No
Sunroof/T-Top	Yes
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes
All-Wheel Drive (AWD)	Yes
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	Volvo Car Corporation
Date of Manufacture	10/12

GVWR (kg)	2,429
GAWR Front (kg)	1,270
GAWR Rear (kg)	1,197

VEHICLE SEATING AND WEIGHT CAPACITY

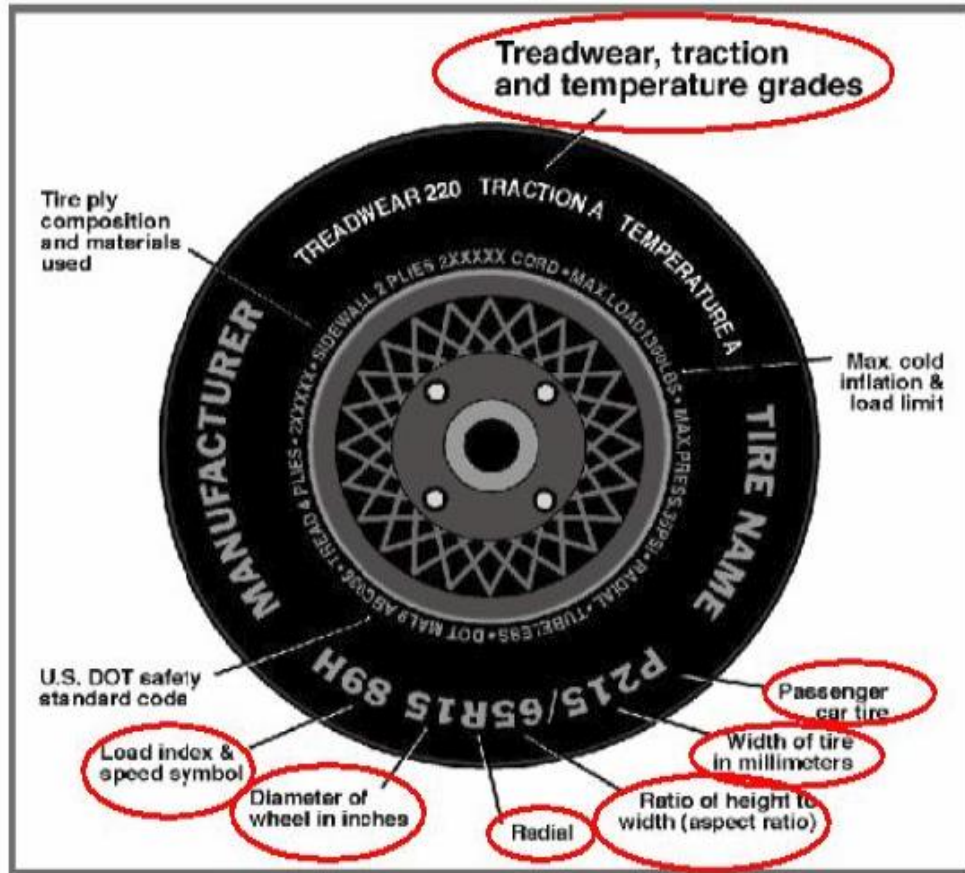
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	--	
Number of Occupants	2	3	--	5
Capacity Wt. (VCW) (kg)				430
Cargo Wt. (RCLW) (kg)				89.8

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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



Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	340	340
Recommended Tire Size	P235/60R18	P235/60R18
Tire Size on Vehicle	P235/60R18	P235/60R18
Tire Manufacturer	Michelin	Michelin
Tire Model	Latitude Tour HP	Latitude Tour HP
Treadwear	440	440
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 2 Steel, 1 Polyamide	2 Polyester, 2 Steel, 1 Polyamide
Load Index/Speed Symbol	103H	103H
Tire Material	Rubber	Rubber
DOT Safety Code Right	61XF8D9X3612	61XF8D9X3612
DOT Safety Code Left	61XF8D9X3612	61XF8D9X3612

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	565	378		609	478	
Right	kg	539	392		589	477	
Ratio	%	50.3%	41.1%		55.7%	44.3%	
Totals	kg	1104	770	1874	1198	955	2153

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1874.0
Weight of 2 P572E ATDs	kg	198.2
Rated Cargo/Luggage Weight (RCLW)	kg	89.8
Calculated Vehicle Target Weight (TVTW)	kg	2163.8

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	801	801	834	834	1139
As Tested	mm	788	789	802	803	1230
Post Test	mm	818	764	797	821	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2773
Total Vehicle Length at Left Side	mm	4537
Total Vehicle Length at Centerline	mm	4360
Total Vehicle Length at Right Side	mm	4537
Weight of Ballast in Cargo Area	kg	37.7
Weight of Vehicle Components Removed	kg	62
Amount of Stoddard Solvent in Fuel Tank	L	65.1

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

No components were removed in order to meet the required test weight.

Trunk carpeting, spare tire, jack, rear seats, and right rear tail light were removed to
Install data acquisition and onboard cameras.

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements		Pre-Test
1	Total Length	mm	4630
2	Total Width	mm	1826
3*	Bumper Top Height	mm	695
4*	Bumper Bottom Height	mm	608
5*	Longitudinal Member Top Height	mm	717
6	Distance Between Longitudinal Members	mm	1169
7	Longitudinal Member Width	mm	114
8*	Engine Top Height	mm	1069
9*	Engine Bottom Height	mm	377
10	Engine and Gearbox Width	mm	757
11	Front Bumper-Engine Distance	mm	398
12*	Front Shock Absorber Fixing Height	mm	1064
13*	Bonnet Leading Edge Height	mm	960
14	Front Shock Absorber Fixing Width	mm	1210
15	Front Bumper – Front Axle Distance	mm	917
16	Front Axle – A Pillar Distance	mm	528
17	A-Pillar – B-Pillar Distance	mm	1108
18	B-Pillar – Rear Axle Distance	mm	1133
19	B-Pillar – C-Pillar Distance	mm	921
20*	Roof Sill Bottom Height	mm	1545
21*	Roof Sill Top Height	mm	1649
22*	Floor Sill Bottom Height	mm	444
23*	Floor Sill Top Height	mm	541

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

DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

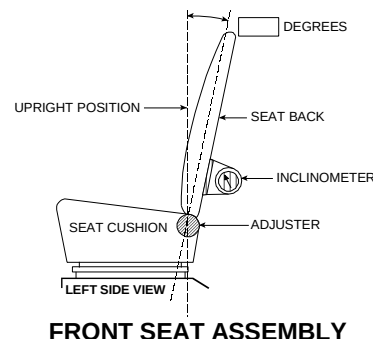
NHTSA No.: RD5910
 Test Date: 11/11/2013

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	18
Passenger Seat Back Angle	18

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.

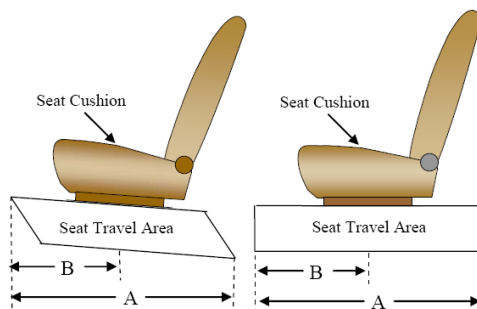
	Total Fore/Aft Travel	Placed in Position #
Driver Seat	310	155
Passenger Seat	284	142

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	Not Adjustable	
Passenger Seat	Not Adjustable	



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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

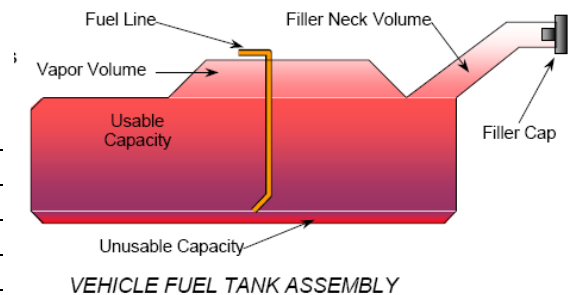
FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	70.0
Usable Capacity of "Optional Tank"	
93% of Usable Capacity	65.1
Actual Amount of Solvent Used	65.1
1/3 of Usable Capacity	23.3

FUEL PUMP

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

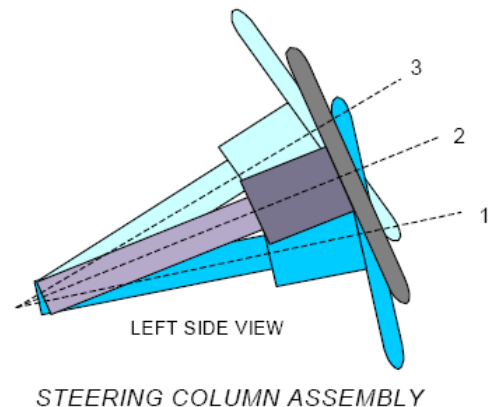
Fuel evacuated according to the specifications provided by the manufacturer in Form 1. Electric fuel pump operates when the ignition is in the 'on' position and the engine is running. The fuel filler neck is located above the right rear wheel.



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)



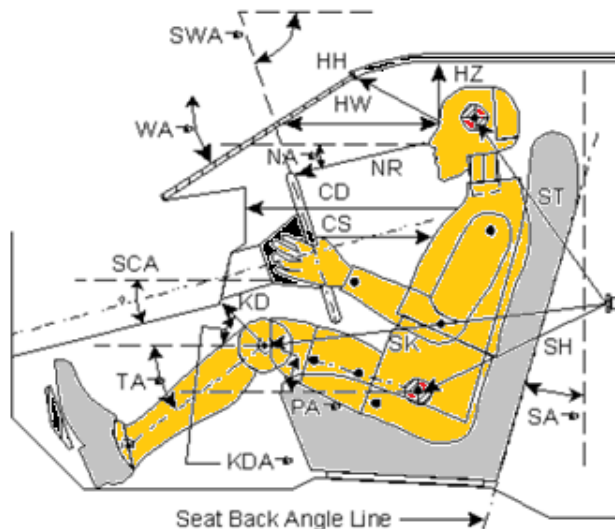
STEERING COLUMN POSITIONS

	Tilt (degrees)	Fore/Aft Position (mm)
Lowermost position No. 1	21.4	
Geometric center position No. 2	24.4	
Uppermost position No. 3	27.4	
Telescoping Steering Wheel Travel		48
Test Position	24.4	24

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



Code	Measurement Description	Driver (Serial # THOR 016)		Passenger (Serial # THOR 015)	
		Length (mm)	Angle(°)	Length (mm)	Angle (°)
WA°	Windshield Angle		-26.6		
SWA°	Steering Wheel Angle		24.6		
SCA°	Steering Column Angle		65.4		
SA°	Seat Back Angle (on headrest post)		18.0		18.0
HZ	Head to Roof (Z)	168	90	159	90
HH	Head to Header	414	17.1	426	16.6
HW	Head to Windshield	653	0	715	0
NR	Nose to Rim	517	-16.3	761	-30.5
CD	Chest to Dash	614		595	
CS	Chest to Steering Hub	356	0		
RA	Rim to Abdomen	191	0		
KDL	Left Knee to Dash	172	14.0	143	33.2
KDR	Right Knee to Dash	137	33.8	157	30.4
PA°	Pelvic Angle		24.4		22.4
TA°	Tibia Angle		-41.2		-39.0
SK	Striker to Knee	575	4.6	567	3.0
ST	Striker to Head	-59	84.5	-75	83.1
SH	Striker to H-Point	174	17.8	153	21.1
HAX°	Head Angle (X)		0.2		0.2
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)		-0.7		-1.0
TAY°	T6 Angle (Y)		21.1		19.6
LAX°	Lumbar Angle (X)		0.7		0.0
LAY°	Lumbar Angle (Y)		-0.9		1.9

DATA SHEET NO.3 (CONTINUED)
DUMMY CMM MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

Description	Units	Driver			Passenger		
		X	Y	Z	X	Y	Z
Striker	mm	1391	-796	876	1393	791	873
Head CG	mm	1363	-443	271	1351	440	259
Bridge of Nose	mm	1456	-365	261	1445	364	248
Tip of Nose	mm	1458	-366	300	1448	364	291
Shoulder Bolt	mm	1419	-569	537	1420	552	520
Tip of Chin	mm	1460	-366	394	1447	365	385
H-Point	mm	1596	-564	944	1579	561	942
Left Knee	mm	1990	-574	844	1990	291	852
Right Knee	mm	1997	-287	842	1993	518	853
Left Ankle	mm	2299	-572	1119	2311	256	1119
Right Ankle	mm	2318	-250	1118	2319	489	1112
Left Heel	mm	2318	-546	1254	2305	204	1247
Right Heel	mm	2329	-216	1251	2313	461	1249
Head Bolt 1 – Top Left	mm	1293	-398	230	1284	321	219
Head Bolt 2 – Lower Left	mm	1304	-389	314	1292	339	299
Head Bolt 3 – Top Right	mm	1295	-327	231	1282	393	217
Head Bolt 4 – Lower Right	mm	1305	-338	313	1291	384	302
Driver's Outboard Seat Anchor Bolt	mm	1906	-568	1169	1393	791	873
Outboard Head Restraint Post	mm	1200	-449	501	1200	458	489
Top of Head Restraint	mm	1243	-367	218	1227	364	216
Center of Steering Wheel	mm	1881	-372	554			

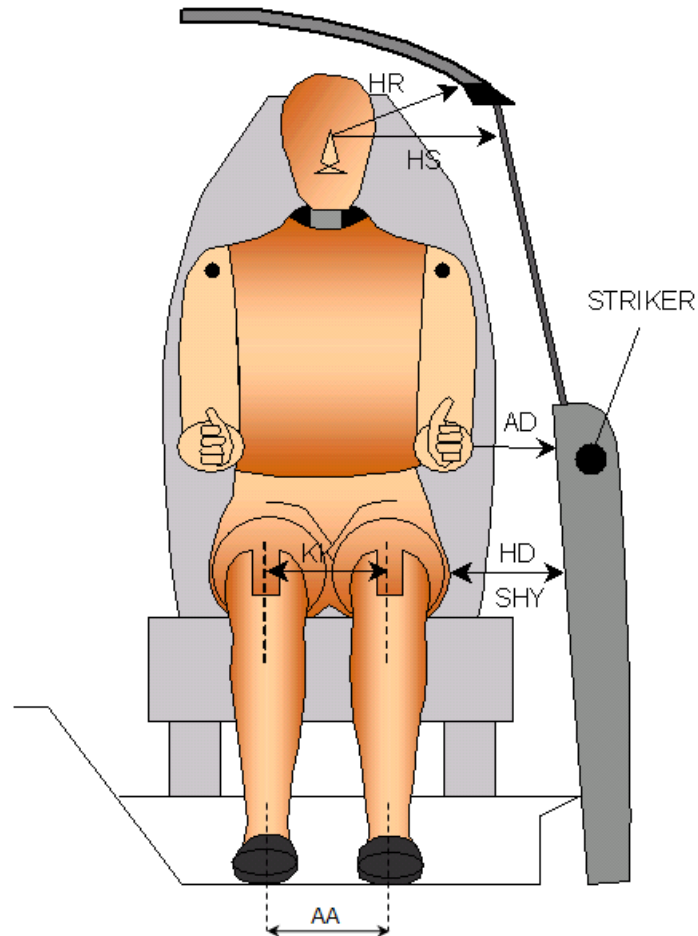
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

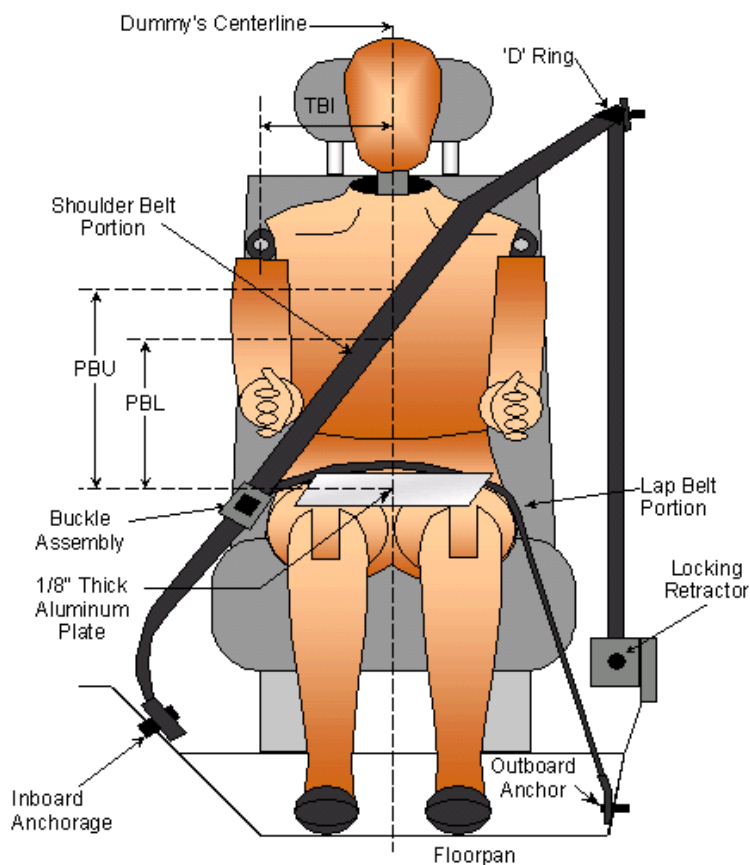


Code	Description	Units	Driver	Passenger
AD	Arm to Door	mm	53	53
HD	H-Point to Door	mm	126	136
HR	Head to Side Header	mm	208	208
HS	Head to Side Window	mm	345	345
KK	Knee to Knee	mm	338	272
SHY	Striker to H-Point (Y Direction)	mm	230	230
AA	Ankle to Ankle	mm	315	248

DATA SHEET NO. 5 SEAT BELT POSITIONING DATA

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	410	385
PBL — Top surface of reference to belt lower edge	mm	335	295

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	820	820
Lap Belt Length as measured on ATD	mm	525	510
Remainder of belt on reel	mm	855	870
Total belt length for continuous webbing systems	mm	2200	2200

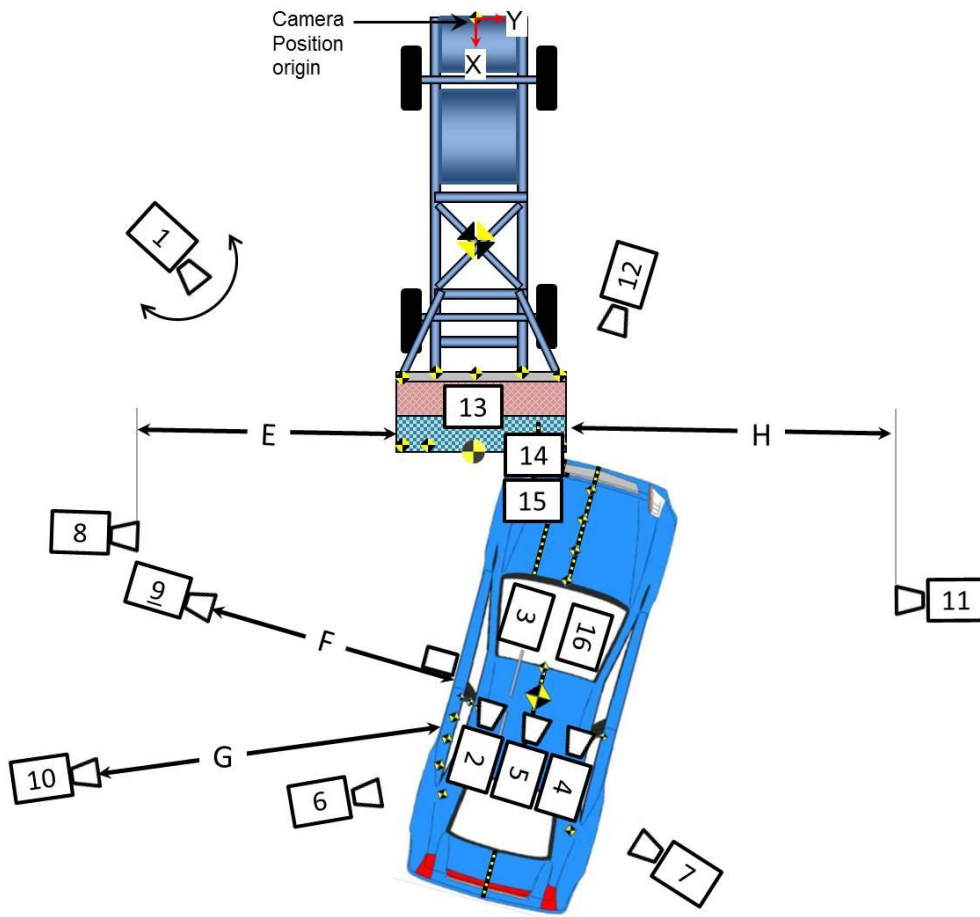
DATA SHEET NO. 6

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

HORIZONTAL LOCATION



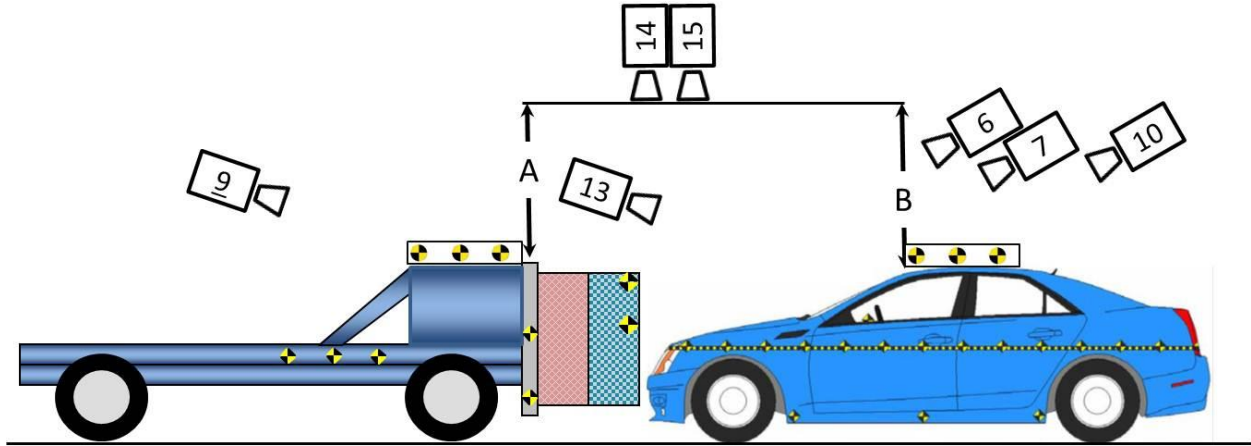
E	mm	6716
F	mm	7295
G	mm	9280
H	mm	6587

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

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

VERTICAL LOCATION



A	mm	4164
B	mm	3692

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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	7730	-214	1402	12.5	1000
3	Onboard Driver Lower Leg	3708	-491	459	6.5	1000
4	Onboard Driver Movement	8062	-933	1409	12.5	1000
5	Onboard Centerline	8316	-428	1399	12.5	1000
6	Driver Interaction	7553	2216	3663	24	1000
7	Passenger Interaction	11233	-8570	2526	50	1000
8	Target Vehicle Left Side Perpendicular (High)	4908	7740	1032	24-70	1000
9	Target Vehicle Driver Motion	6440	7461	1008	24	1000
10	Target Vehicle Passenger Motion	10271	8893	3416	50	1000
11	Target Vehicle Right Side	4746	-7812	977	24	1000
12	Target Vehicle Left Side (High)	1127	-2059	1231	28-70	1000
13	RMDB/Target Vehicle Interaction	4844	1018	4630	13	1000
14	Close-up Impact Point	6767	622	5341	28	1000
15	Overall Impact	4842	622	5341	14	1000

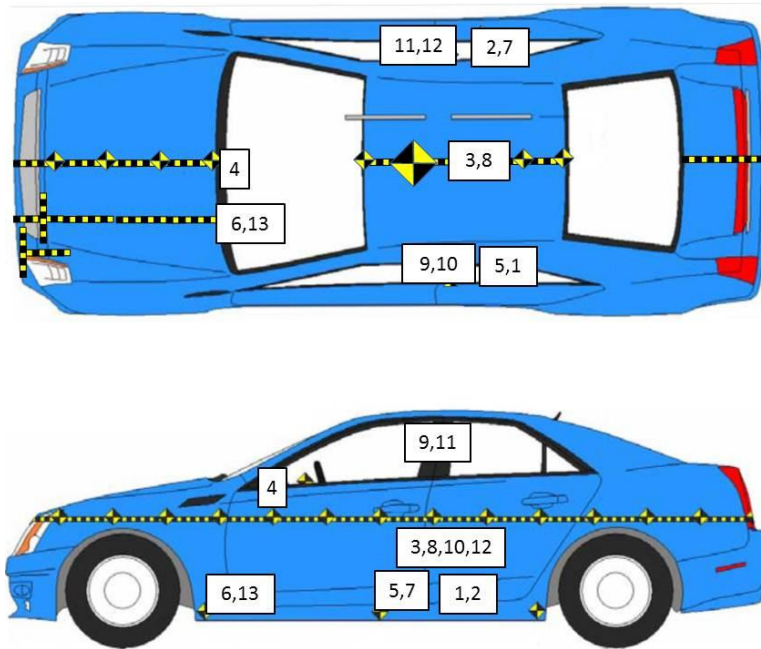
Reference Point: Center most rearward point of the RMDB when in contact with the target vehicle:

- +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 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Axes	Units	Measurements (mm)		
				X	Y	Z
1	Left Rear Sill	X,Y	mm	1299	-654	1243
2	Right Rear Sill	X,Y	mm	1288	658	1231
3	Vehicle CG	X,Y,Z	mm	1211	1	1124
4	Instrument Panel	X	mm	2204	-5	557
5	Driver Seat Track	X,Y,Z	mm	1308	-584	1273
6	Behind Brake Pedal	X,Y,Z	mm	2649	-360	987
7	Passenger Seat Track	X,Y,Z	mm	1326	580	1266
8	Angular Rate Sensors	X	mm	1182	1	1148
		Y	mm	1210	-22	1150
		Z	mm	1211	1	1124

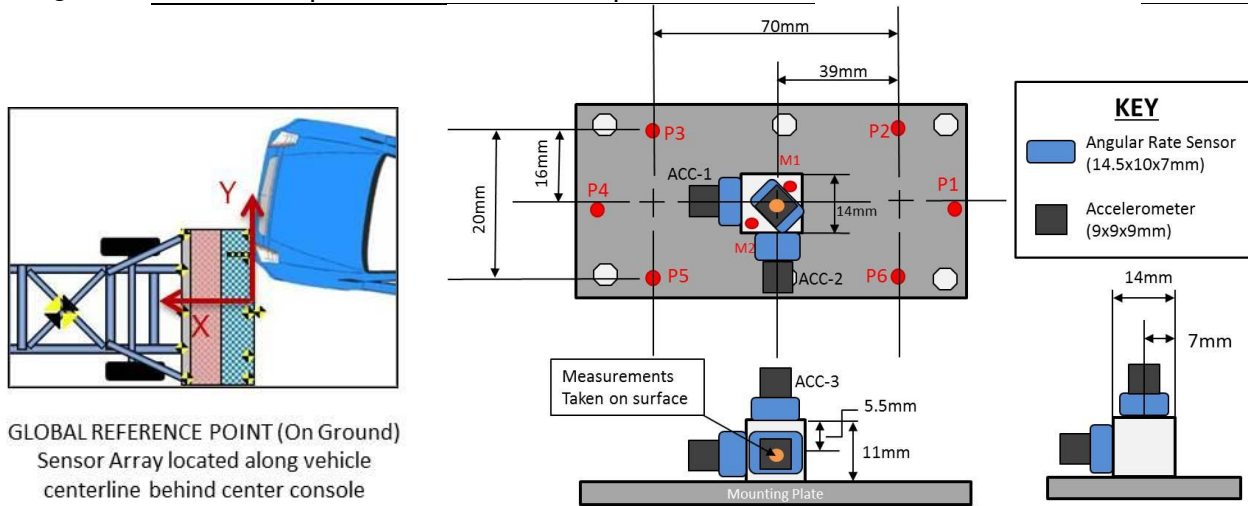
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +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 (CONTINUED) VEHICLE INSTRUMENTATION DATA

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013



VEHICLE COORDINATE SYSTEM					
No.	Accelerometer Location	Units	Measurements (mm)		
			X	Y	Z
ACC-1	Accelerometer CG – X Direction	mm	1182	1	1148
ACC-2	Accelerometer CG – Y Direction	mm	1210	-22	1150
ACC-3	Accelerometer CG – Z Direction	mm	1211	1	1124
M1	Mounting Bolt 1	mm	1213	-10	1140
M2	Mounting Bolt 2	mm	1202	1	1140
P1	Plate Point 1	mm	1258	1	1152
P2	Plate Point 2	mm	1247	-20	1153
P3	Plate Point 3	mm	1177	-21	1154
P4	Plate Point 4	mm	1166	-1	1153
P5	Plate Point 5	mm	1176	20	1153
P6	Plate Point 6	mm	1246	21	1152

GLOBAL COORDINATE SYSTEM*					
No.	Accelerometer Location	Units	Measurements (mm)		
			X	Y	Z
ACC-1	Accelerometer CG – X Direction	mm	-2373	1375	-439
ACC-2	Accelerometer CG – Y Direction	mm	-2344	1352	-437
ACC-3	Accelerometer CG – Z Direction	mm	-2343	1375	-463
M1	Mounting Bolt 1	mm	-2342	1365	-447
M2	Mounting Bolt 2	mm	-2353	1376	-447
P1	Plate Point 1	mm	-2297	1376	-434
P2	Plate Point 2	mm	-2308	1355	-434
P3	Plate Point 3	mm	-2378	1353	-433
P4	Plate Point 4	mm	-2389	1374	-433
P5	Plate Point 5	mm	-2378	1395	-434
P6	Plate Point 6	mm	-2308	1396	-435

*Global coordinate system is located at the front center of RMDB on the ground

DATA SHEET NO. 7 (CONTINUED)
VEHICLE INSTRUMENTATION DATA

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

VEHICLE INSTRUMENTATION DATA

Loc.	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Left Rear Sill	X	g	1.80	102.75	-39.39	39.55
		Y	g	25.74	43.85	-4.18	3.55
2	Right Rear Sill	X	g	3.35	89.50	-44.76	42.70
		Y	g	21.22	37.10	-5.74	10.95
3	Vehicle CG	X	g	4.06	91.15	-38.87	54.75
		Y	g	65.59	54.90	-35.87	59.60
		Z	g	40.30	55.25	-33.36	59.80
4	Instrument Panel	X	g	55.69	30.30	-98.27	25.45
5	Driver Seat Track	X	g	1.86	89.50	-49.29	40.00
		Y	g	25.30	44.30	-4.14	66.40
		Z	g	10.04	49.85	-11.48	64.05
6	Behind Brake Pedal	X	g	14.72	59.10	-95.62	40.45
		Y	g	76.29	40.65	-13.77	60.30
		Z	g	15.18	50.45	-21.56	39.50
7	Passenger Seat Track	X	g	3.21	91.25	-42.34	43.25
		Y	g	23.19	37.05	-6.05	10.80
		Z	g	5.24	40.80	-8.05	48.55
8	Angular Rate Sensors	X	deg/s	192.80	63.45	-696.40	49.40
		Y	deg/s	310.24	56.70	-869.06	48.95
		Z	deg/s	300.72	55.60	-121.09	59.60
9	Driver Shoulder Belt		N	4720.65	68.60	-60.92	194.50
10	Driver Lap Belt		N	3666.09	58.40	-3.62	10.80
11	Passenger Shoulder Belt		N	5170.26	58.05	-58.56	222.00
12	Passenger Lap Belt		N	5857.46	62.55	-7.78	10.15
13	Driver Floor Pan String Pot		mm	51.52	292.30	-34.80	60.55

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	*	V	9.10
2	Driver Air Bag Squib 2	*	V	14.10
3	Driver Curtain Airbag	*	V	10.60
4	Driver Torso Airbag	*	V	Did Not Fire
5	Driver Knee Airbag	*	V	
6	Driver Pretensioner	*	V	16.10
7	Passenger Air Bag Squib 1	*	V	9.10
8	Passenger Air Bag Squib 2	*	V	14.15
9	Passenger Curtain Airbag	*	V	Disabled
10	Passenger Torso Airbag	*	V	Disabled
11	Passenger Knee Airbag	*	V	N/A
12	Passenger Pretensioner	*	V	16.15

* The measurement indicates the time the voltage changed

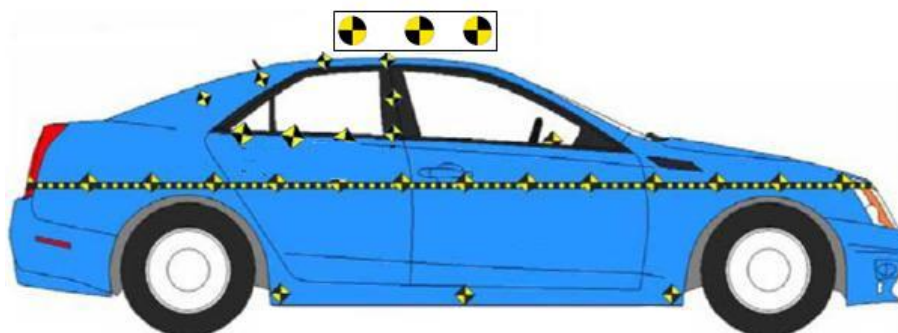
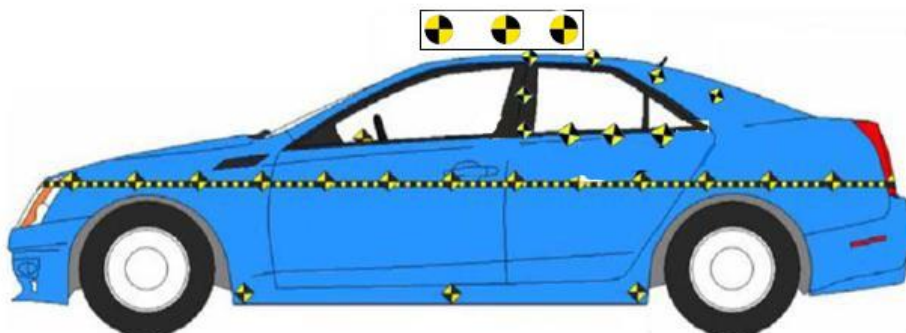
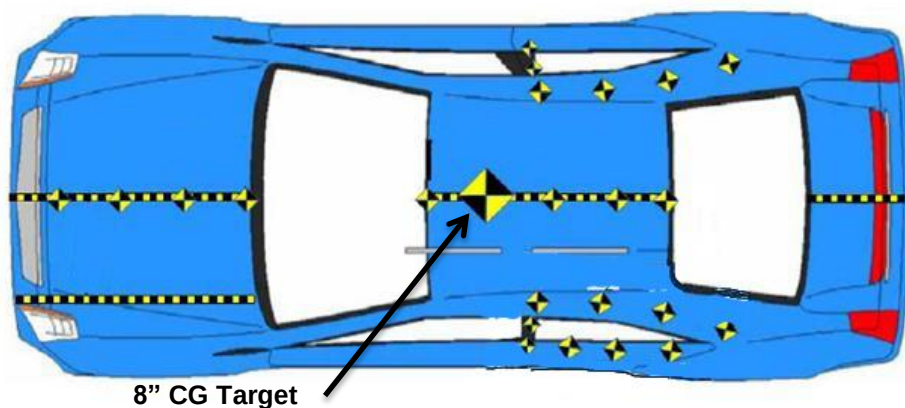
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

Item	Units	Value
A	mm	283

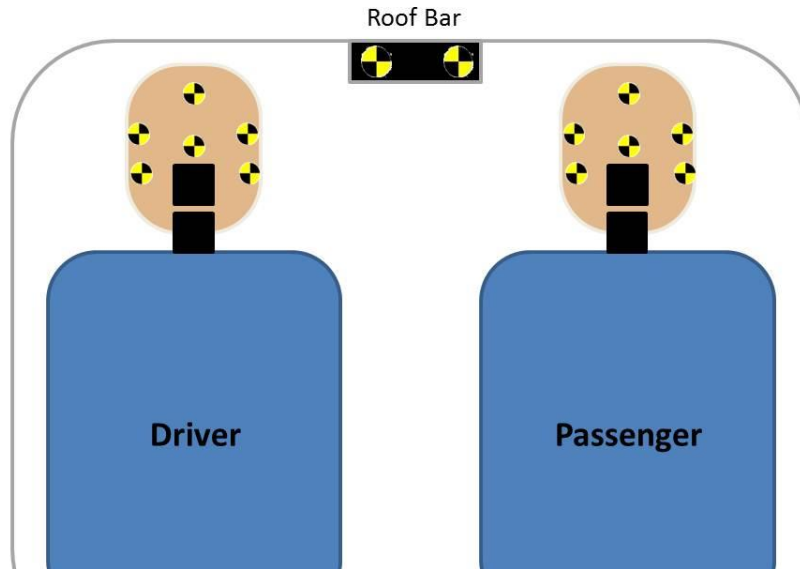
Note: All 6" targets on the vehicle are 450 mm apart.



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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



Point	Pre-Test		
	X	Y	Z
Roof Bar Driver	1829	-59	218
Roof Bar Passenger	1826	66	218

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

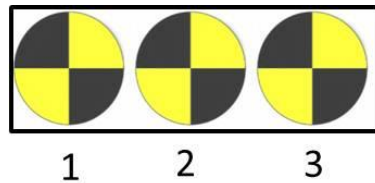
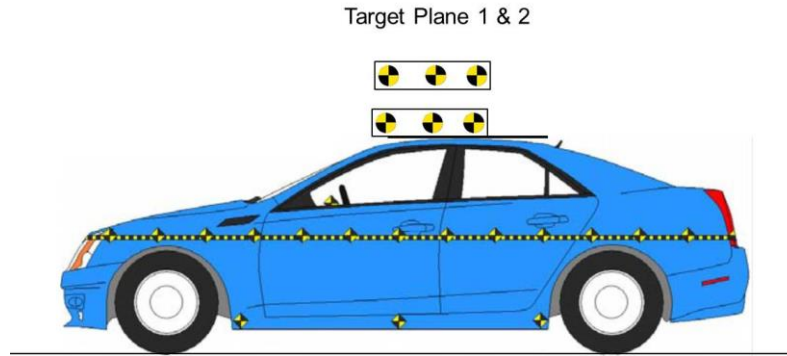
- +X – From the rear of the vehicle to the front of the vehicle
- +Y – From the left side of the vehicle to the right side of the vehicle
- +Z – From the top of the vehicle to the bottom of the vehicle

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

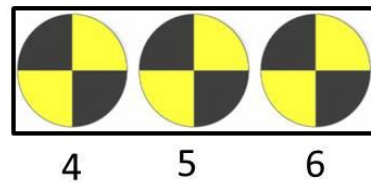
Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

OVERHEAD TARGET BARS



Vertical Target
Plane 1
(Driver's Side)



Vertical Target
Plane 2
(Passenger Side)

Target	Units	X	Y	Z
1	mm	1778	-516	-338
2	mm	1327	-510	-340
3	mm	876	-500	-341
4	mm	1800	533	-346
5	mm	1349	524	-346
6	mm	895	509	-341

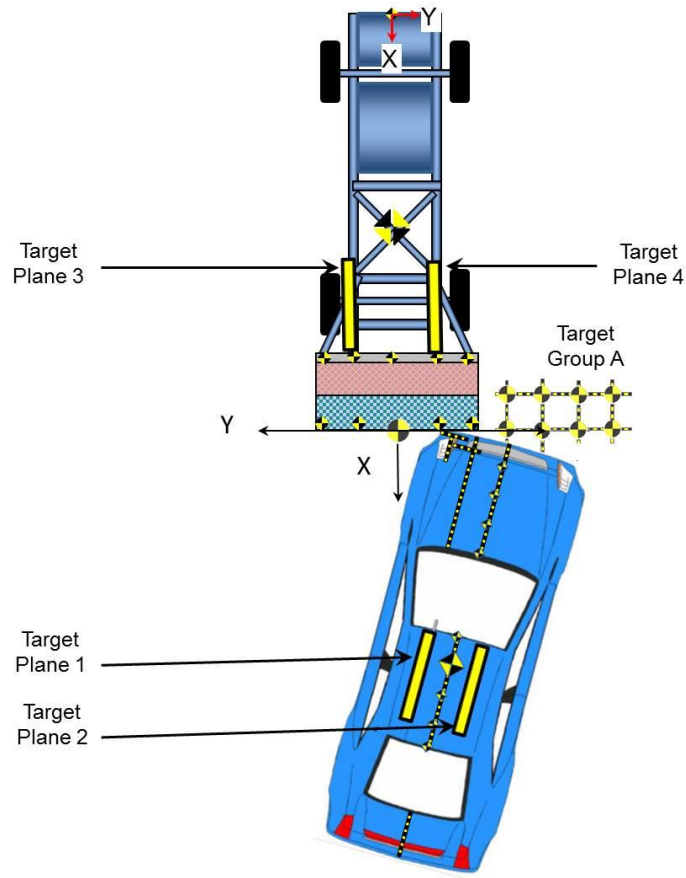
Reference point: 50mm above the center of the rear windshield (See appendix D for procedure to create coordinate system).

- +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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



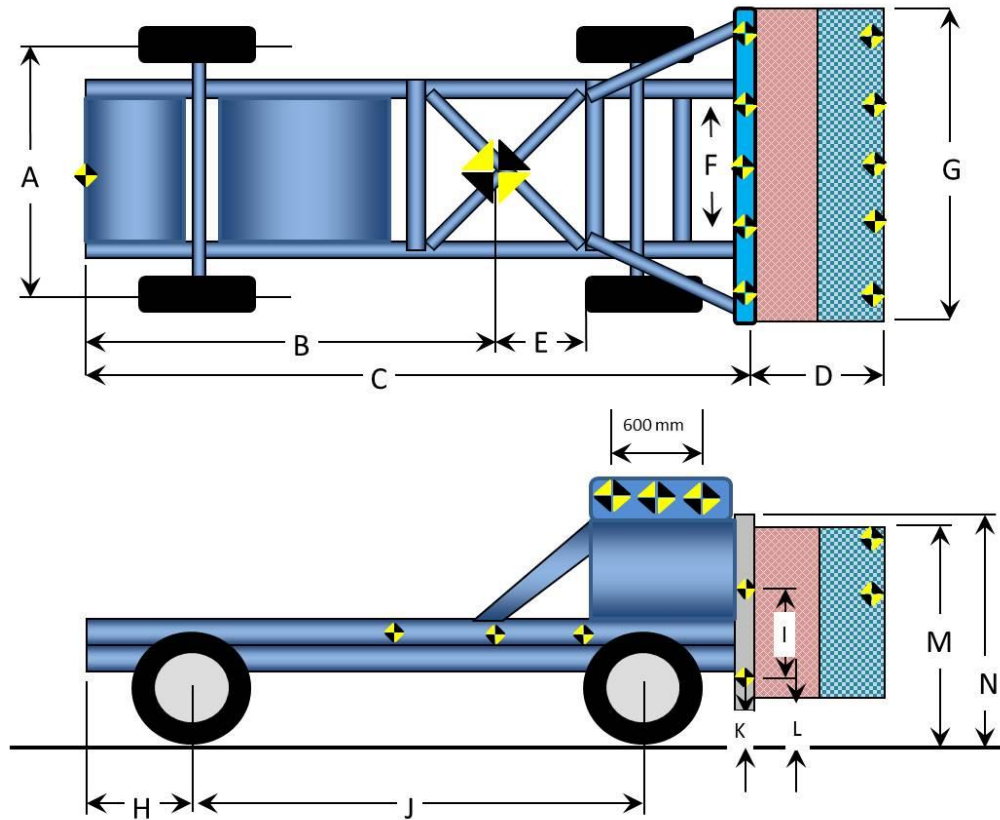
GROUND TARGET LOCATIONS

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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



Item	Units	Value	Item	Units	Value
A	mm	1930	H	mm	800
B	mm	2451	I	mm	450
C	mm	3995	J	mm	2555
D	mm	605	K	mm	77
E	mm	904	L	mm	71
F	mm	900	M	mm	1024
G	mm	2205	N	mm	1177

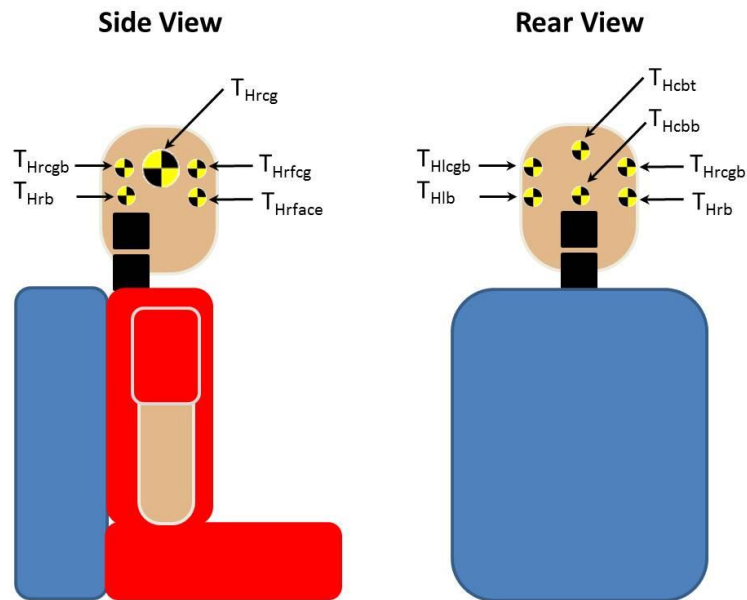
	Units	Front Axle	Rear Axle	Total
Left	kg	802.0	453.6	1255.6
Right	kg	807.4	427.7	1235.1
Ratio	%	65	35	100
Total	kg	1609.4	881.3	2490.7
CG Aft of Front Axle	mm			904

Note: All targets on the RMDB honeycomb are 450mm apart except target bars that are 300mm apart

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



Driver Dummy Head Targets (S/N 116)

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 _{Hlfcg}	mm	38
Distance between T _{Hlcbg} & T _{Hlcb}	mm	38
Distance between T _{Hlcb} & T _{Hlface}	mm	70
Distance between T _{Hlfcg} & T _{Hlface}	mm	70
Distance between T _{Hcgt} & T _{Hcbb}	mm	72

Passenger Dummy Head Targets (S/N 366)

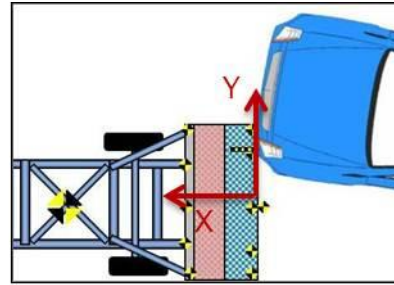
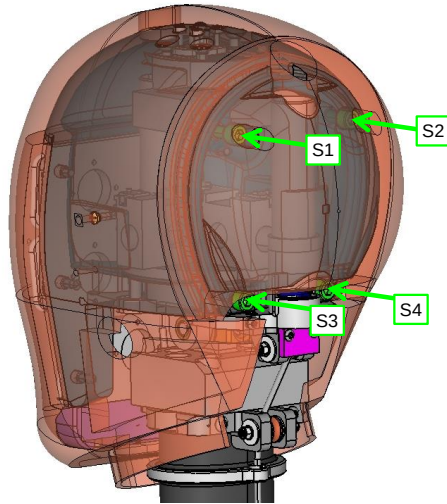
Measurement	Units	Value
Distance between T _{Hrcg} & T _{Hrfcg}	mm	38
Distance between T _{Hrcg} & T _{Hrcgb}	mm	38
Distance between T _{Hrcgb} & T _{Hrb}	mm	70
Distance between T _{Hrfcg} & T _{Hrface}	mm	70
Distance between T _{Hlcbg} & T _{Hlfcg}	mm	38
Distance between T _{Hlcbg} & T _{Hlcb}	mm	38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

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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



GLOBAL REFERENCE POINT (On Ground)
 Sensor Array located along vehicle
 centerline behind center console

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	-2261	975	-1357
S3	-2250	985	-1274
S2	-2259	1046	-1356
S4	-2249	1036	-1274

FRONT PASSENGER'S HEAD BOLT POINTS

Target	X	Y	Z
S1	-2271	1696	-1368
S3	-2263	1713	-1288
S2	-2272	1768	-1369
S4	-2264	1759	-1285

*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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	87
Passenger Dummy Accelerometers	81
Vehicle Structure Accelerometers	46
RMDB Cart Accelerometers	6
Total	218

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 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Right Front Passenger
Dummy Type/Serial No.	THOR016	THOR015
Lower Leg Type	LX	LX
Lower Leg Serial No.	LX0018/ LX0019	LX0038/LX0039
Head Contact	Frontal & curtain airbag, & side head liner	Frontal airbag, center instrument panel, interior target bar and passenger door
Upper Torso Contact	Frontal airbag	Frontal airbag
Side Torso Contact	Driver's door	Center instrument panel
Lower Torso Contact	None	None
Left Knee Contact	Knee Bolster	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 & Jammed	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	Remained in good condition	Y
Windshield Damage	Cracked throughout	Y
Window Damage	None	Y
Other Notable Effects	None	--

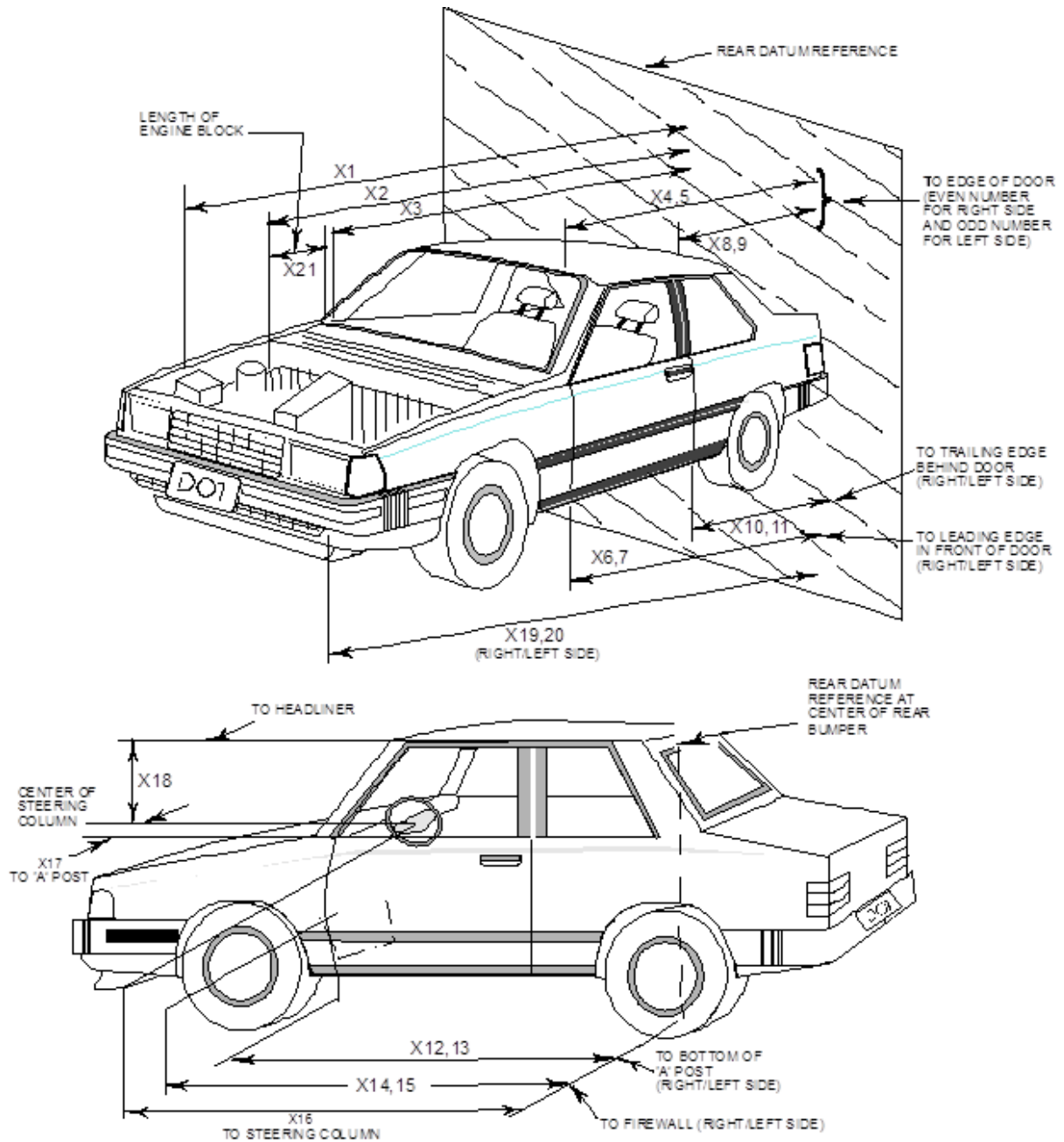
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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	No	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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



DATA SHEET NO. 11 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	3825	3527	298
2	Rear Surface of Vehicle (RSOV) to Front of Engine	mm	3427	3317	110
3	RSOV to Firewall	mm	2893	2797	96
4	RSOV to Upper Leading Edge of Right Door	mm	2380	2381	-1
5	RSOV to Upper Leading Edge of Left Door	mm	2377	2373	4
6	RSOV to Lower Leading Edge of Right Door	mm	2411	2413	-2
7	RSOV to Lower Leading Edge of Left Door	mm	2409	2359	49
8	RSOV to Upper Trailing Edge of Right Door	mm	1279	1281	-1
9	RSOV to Upper Trailing Edge of Left Door	mm	1278	1276	2
10	RSOV to Lower Trailing Edge of Right Door	mm	1365	1368	-3
11	RSOV to Lower Trailing Edge of Left Door	mm	1362	1353	9
12	RSOV to Bottom of "A" Post of Right Side	mm	2431	2432	-1
13	RSOV to Bottom of "A" Post of Left Side	mm	2432	2431	1
14	RSOV to Firewall, Right Side	mm	2979	2975	4
15	RSOV to Firewall, Left Side	mm	2974	2790	184
16	RSOV to Steering Column	mm	1881	1881	0
17	Center of Steering Column to "A" Post	mm	299	309	-9
18	Center of Steering Column to Headliner	mm	416	427	-11
19	RSOV to Right Side of Front Bumper	mm	3771	3803	-32
20	RSOV to Left Side of Front Bumper	mm	3772	UR*	UR*
21	Length of Engine Block	mm	513	522	-10
RD	RSOV to Right Side of Dash Panel	mm	2118	2117	2
CD	RSOV to Center of Dash Panel	mm	2063	2037	26
LD	RSOV to Left Side of Dash Panel	mm	2118	2094	23

UR = Unrecoverable data point

DATA SHEET NO. 12
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

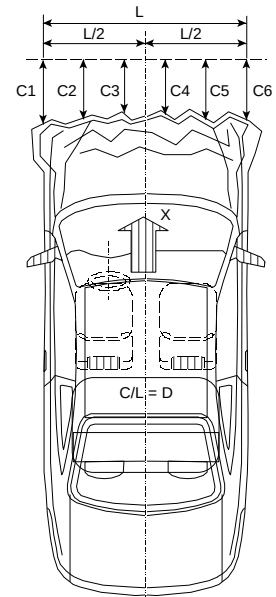
NHTSA No.: RD5910
Test Date: 11/11/2013

VEHICLE INFORMATION

VIN: YV4952DZ9D2409747 Wheelbase (mm): 2,773
Vehicle Size Category: Passenger Test Weight (kg): 2,153

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): 89.76
Velocity Change (kph): 89.76



CRUSH PROFILE

Collision Deformation Classification: 11FYEW4
Midpoint of Damage: C2
Damage Region Length (mm): 1166
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	3718	3435	283
C2	Crush zone 2 at left side	mm	3807	3343	464
C3	Crush zone 3 at left side	mm	3818	3514	304
C4	Crush zone 4 at right side	mm	3817	3655	162
C5	Crush zone 5 at right side	mm	3806	3764	42
C6	Crush zone 6 at right side	mm	3718	3781	-63
L	C1 to C6	mm	1166	1019	147

Crush Measurements: Bumper Cover Removed

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
B1	Bumper Beam 1 at left side	mm	3688	3387	-301
B2	Bumper Beam 2 at left side	mm	3691	3296	-395
B3	Bumper Beam 3 at left side	mm	3694	3258	-436
B4	Bumper Beam 4 at left side	mm	3703	3345	-358
B5	Bumper Beam 5 at right side	mm	3706	3426	-280
B6	Bumper Beam 6 at right side	mm	3703	3504	-199
B7	Bumper Beam 7 at right side	mm	3694	3573	-121
B8	Bumper Beam 8 at right side	mm	3694	3649	-45
B9	Bumper Beam 9 at right side	mm	3642	3683	41
L	B1 to B9	mm	1090	906	-184

DATA SHEET NO. 13
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

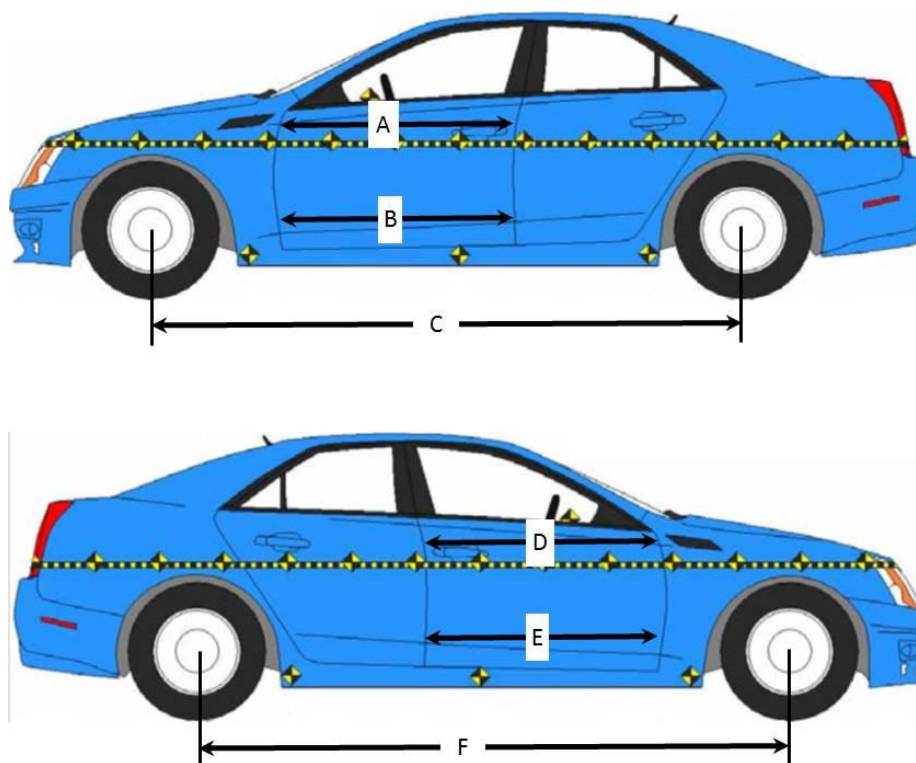
NHTSA No.: RD5910
 Test Date: 11/11/2013

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	933	924	-9
B	Left Side Lower	mm	911	898	-13
D	Right Side Upper	mm	932	932	0
E	Right Side Lower	mm	906	906	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2773	2556	-217
F	Right Side Wheelbase	mm	2773	2789	16



DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

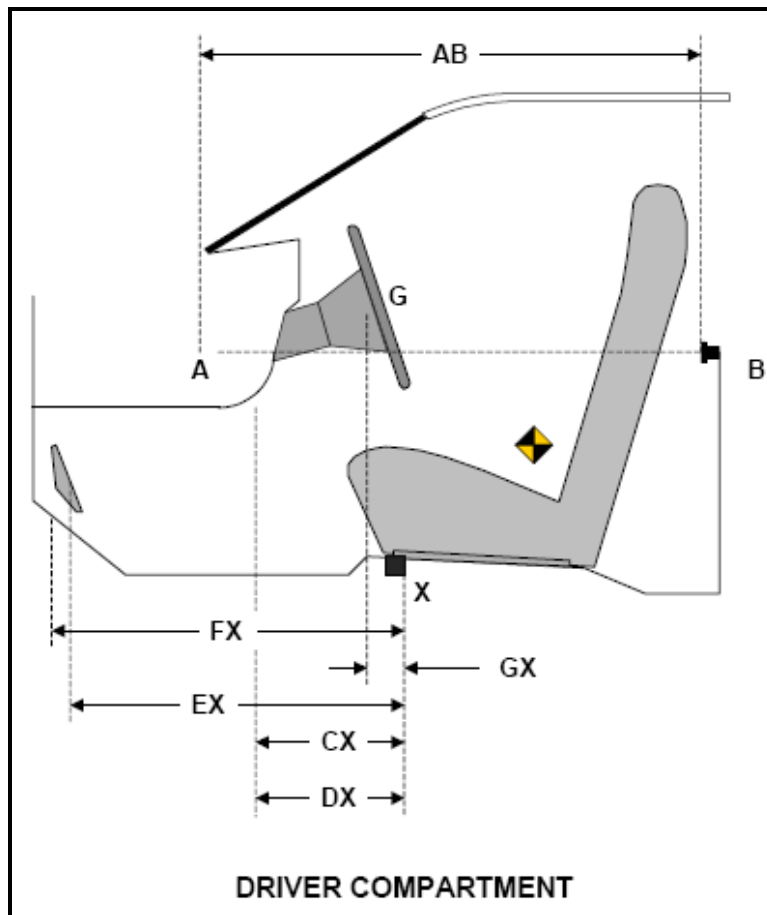
Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	755	753	-2
CX	Left Knee Bolster to X	mm	227	202	-25
DX	Right Knee Bolster to X	mm	210	198	-12
EX	Brake Pedal to X	mm	482	459	-23
FX	Foot Rest to X	mm	546	532	-15
GX	Center of Steering Column Wheel Hub to X	mm	-25	-17	8

X = Front of Seat Track (Stationary)

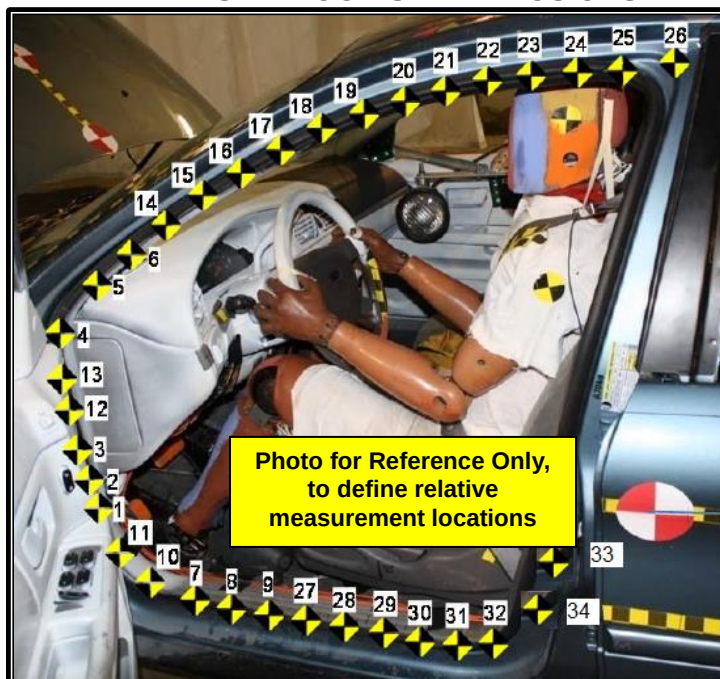


DATA SHEET NO.13 (CONTINUED) **VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

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	2281	-747	1074	2273	-724	1097	-8	23	23
2	2289	-750	1001	2276	-729	1023	-13	21	22
3	2285	-756	924	2269	-738	946	-16	18	22
4	2269	-756	624	2263	-740	645	-6	16	21
5	2261	-748	550	2257	-733	570	-4	15	20
6	2232	-731	478	2230	-719	496	-2	12	18
7	2187	-746	1145	2184	-724	1170	-3	22	25
8	2037	-745	1148	2035	-725	1170	-2	20	22
9	1888	-745	1149	1885	-728	1169	-3	17	20
10	2224	-745	1134	2222	-725	1159	-2	20	25
11	2258	-744	1110	2253	-723	1134	-5	21	24
12	2279	-756	822	2264	-743	843	-15	13	21
13	2274	-757	726	2263	-742	745	-11	15	19
14	2183	-717	426	2183	-704	443	0	13	17
15	2118	-703	385	2120	-690	400	2	13	15
16	2052	-690	348	2054	-676	363	2	14	15

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
17	1985	-677	314	1987	-663	327	2	14	13
18	1915	-663	280	1917	-650	293	2	13	13
19	1846	-650	251	1849	-638	262	3	12	11
20	1776	-638	222	1779	-627	234	3	11	12
21	1703	-627	199	1706	-616	210	3	11	11
22	1629	-617	178	1632	-607	190	3	10	12
23	1555	-610	162	1559	-600	173	4	10	11
24	1480	-604	150	1483	-595	161	3	9	11
25	1405	-600	142	1408	-591	153	3	9	11
26	1331	-601	139	1335	-594	150	4	7	11
27	1847	-744	1150	1844	-728	1169	-3	16	19
28	1805	-744	1150	1803	-728	1169	-2	16	19
29	1763	-744	1151	1761	-730	1168	-2	14	17
30	1721	-743	1151	1719	-731	1168	-2	12	17
31	1680	-745	1149	1677	-732	1165	-3	13	16
32	1641	-744	1134	1640	-733	1150	-1	11	16
33	1471	-746	924	1470	-737	937	0	9	13
34	1572	-745	1073	1570	-734	1088	-2	11	15

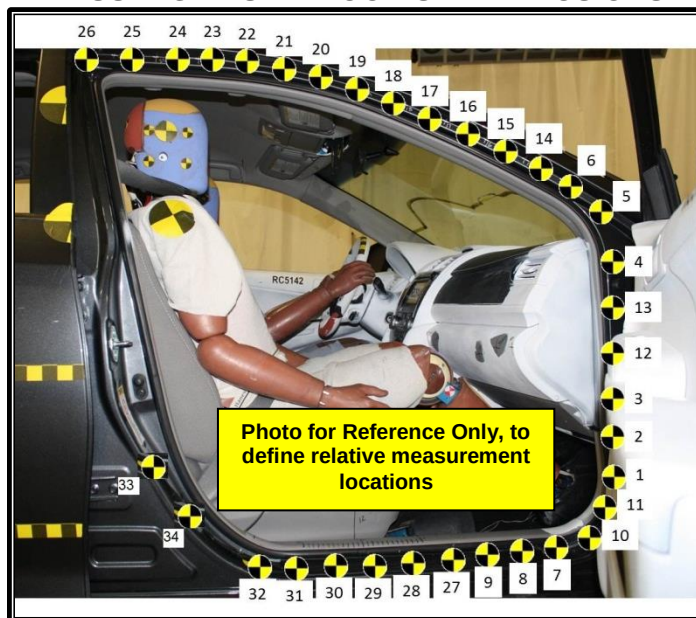
Note: See Appendix D for detailed procedure on how to measure the required door sill intrusions.

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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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	2280	743	1074	2281	775	1069	1	32	-5
2	2291	747	1000	2291	778	996	0	31	-4
3	2288	752	927	2287	781	922	-1	29	-5
4	2271	751	625	2271	774	621	0	23	-4
5	2264	743	550	2264	766	546	0	23	-4
6	2237	726	476	2237	747	472	0	21	-4
7	2190	743	1139	2191	776	1135	1	33	-4
8	2040	744	1143	2040	772	1140	0	28	-3
9	1890	745	1144	1890	769	1141	0	24	-3
10	2228	743	1127	2230	774	1125	2	31	-2
11	2260	742	1105	2261	774	1101	1	32	-4
12	2282	751	826	2281	779	822	-1	28	-4
13	2277	751	728	2276	777	723	-1	26	-5
14	2186	710	420	2186	729	417	0	19	-3
15	2122	696	379	2123	714	376	1	18	-3
16	2056	682	343	2057	699	340	1	17	-3

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
17	1990	671	308	1990	684	306	0	13	-2
18	1922	657	276	1923	671	273	1	14	-3
19	1852	645	247	1853	658	243	1	13	-4
20	1782	633	220	1784	645	217	2	12	-3
21	1712	621	197	1713	633	194	1	12	-3
22	1639	613	176	1641	623	174	2	10	-2
23	1565	605	160	1567	615	157	2	10	-3
24	1489	601	147	1490	609	146	1	8	-1
25	1412	597	138	1414	605	136	2	8	-2
26	1333	598	135	1334	605	134	1	7	-1
27	1849	745	1144	1849	768	1142	0	23	-2
28	1808	745	1145	1810	767	1143	2	22	-2
29	1770	745	1145	1770	766	1143	0	21	-2
30	1730	745	1146	1732	764	1144	2	19	-2
31	1691	745	1145	1692	765	1143	1	20	-2
32	1645	745	1128	1646	763	1127	1	18	-1
33	1474	745	924	1475	758	923	0	13	0
34	1583	744	1073	1584	758	1072	1	14	-1

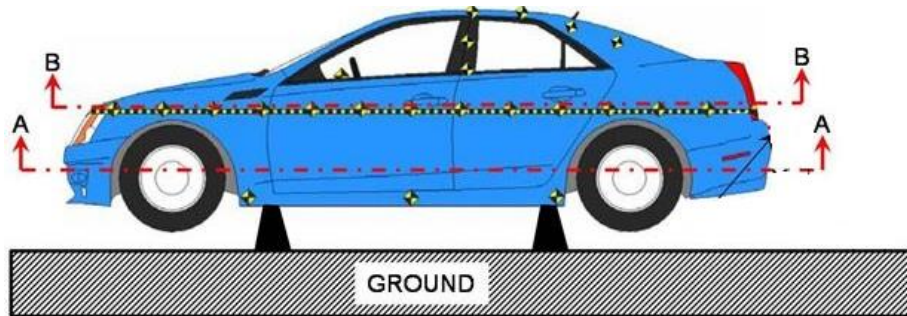
Note: See Appendix D for detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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	2495	932	1037	1	2491	967	1038
2	2410	917	1039	2	2413	950	1038
3	2270	907	1039	3	2225	935	1039
4	2101	907	1038	4	2077	933	1038
5	1940	907	1039	5	1931	930	1038
6	1742	906	1039	6	1679	923	1039
7	1579	903	1039	7	1527	918	1039
8	1452	901	1039	8	1433	915	1038
9	1342	898	1038	9	1393	913	1039
10	1205	894	1038	10	1327	908	1038
11	1052	889	1039	11	1148	900	1039
12	905	888	1038	12	1012	895	1038
13	769	891	1039	13	889	894	1038
14	661	899	1039	14	727	897	1038
15	575	905	1039	15	625	904	1039
16	-264	908	1039	16	580	906	1038
17	-328	891	1038	17	539	906	1039
18	-420	849	1039	18	-264	907	1039
19	-580	757	1038	19	-264	907	1039
20	-672	674	1038	20	-309	895	1038
21	-721	600	1039	21	-345	882	1038
22	-752	522	1039	22	-466	823	1039
23	-776	409	1038	23	-570	760	1039
24	-790	270	1039	24	-639	705	1038
25	-795	148	1038	25	-703	626	1038

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
26	-797	1	1039	26	-746	530	1039
27	-794	-157	1038	27	-778	381	1038
28	-784	-330	1039	28	-791	216	1039
29	-766	-448	1038	29	-793	78	1038
30	-698	-625	1038	30	-795	-18	1038
31	-644	-692	1038	31	-793	-142	1039
32	-550	-767	1038	32	-788	-272	1038
33	-443	-828	1038	33	-778	-374	1039
34	-369	-864	1038	34	-756	-486	1038
35	-303	-889	1038	35	-723	-581	1039
36	-254	-901	1038	36	-645	-692	1038
37	540	-908	1039	37	-527	-783	1038
38	638	-903	1039	38	-391	-856	1039
39	813	-892	1039	39	-325	-885	1038
40	1057	-891	1039	40	-257	-903	1039
41	1239	-896	1038	41	535	-908	1039
42	1396	-902	1039	42	578	-907	1039
43	1584	-906	1039	43	664	-902	1038
44	1703	-908	1039	44	800	-892	1038
45	1877	-910	1039	45	964	-888	1039
46	2008	-911	1039	46	1178	-890	1039
47	2211	-912	1038	47	1344	-893	1039
48	2382	-918	1039	48	1350	-898	1039
49	2460	-932	1039	49	1450	-897	1040
50	2494	-938	1039	50	1586	-898	1039
51	3310	-921	1039	51	1746	-897	1039
52	3396	-891	1039	52	1915	-895	1039
53	3476	-842	1038	53	2125	-890	1039
54	3559	-757	1039	54	2250	-871	1040
55	3630	-691	1038	55	2340	-877	1039
56	3675	-643	1039	56	2396	-903	1040
57	3742	-548	1038	57	2401	-920	1039
58	3800	-452	1038	58	2440	-915	1039
59	3812	-427	1039	59	2547	-871	1039
60	3806	-372	1039	60	2716	-844	1039
61	3814	-233	1039	61	2817	-836	1040
62	3818	-75	1038	62	2971	-833	1039
63	3817	107	1038	63	3062	-737	1040
64	3811	252	1038	64	3086	-590	1039
65	3805	363	1038	65	3209	-549	1038
66	3813	421	1038	66	3317	-467	1038

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
67	3777	488	1038	67	3365	-476	1039
68	3718	581	1038	68	3424	-486	1038
69	3661	657	1039	69	3420	-398	1038
70	3597	717	1038	70	3394	-311	1038
71	3494	814	1038	71	3358	-228	1039
72	3422	876	1038	72	3338	-174	1039
73	3361	908	1038	73	3378	-117	1038
74	3314	920	1039	74	3483	-19	1038
75	2495	932	1037	75	3578	159	1039
				76	3596	197	1038
				77	3665	279	1038
				78	3719	305	1038
				79	3732	304	1038
				80	3766	342	1039
				81	3781	412	1039
				82	3789	502	1038
				83	3789	584	1038
				84	3767	633	1038
				85	3739	685	1039
				86	3676	781	1038
				87	3601	891	1038
				88	3551	943	1039
				89	3506	975	1038
				90	3194	1022	1038
				91	3048	990	1038
				92	2880	965	1038

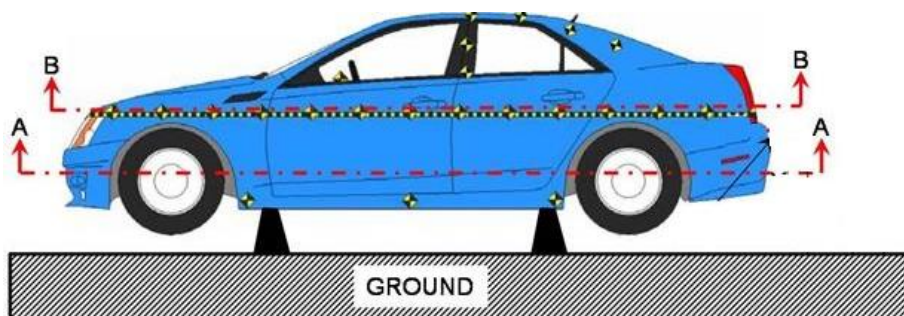
Note: See Appendix D for detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

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	3264	860	746	1	3181	936	745
2	3185	880	746	2	3084	954	745
3	3030	912	746	3	2949	974	745
4	2838	927	745	4	2814	975	745
5	2632	918	746	5	2653	961	745
6	2465	906	746	6	2495	944	745
7	2242	906	746	7	2380	932	746
8	1938	913	746	8	2220	933	745
9	1719	915	746	9	2027	934	745
10	1565	914	745	10	1870	934	746
11	1361	911	746	11	1748	932	745
12	1218	907	745	12	1689	931	745
13	1061	901	745	13	1592	929	745
14	855	897	744	14	1489	926	745
15	627	900	746	15	1371	922	745
16	436	906	746	16	1244	917	745
17	242	915	746	17	1078	910	746
18	2	913	745	18	923	904	745
19	-175	895	746	19	747	902	745
20	-234	888	745	20	584	903	745
21	-316	881	746	21	399	911	745
22	-404	861	746	22	273	916	745
23	-482	837	746	23	238	920	746
24	-567	782	745	24	238	920	746
25	-623	711	746	25	141	923	745

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
26	-651	640	745	26	19	921	746
27	-684	500	746	27	-105	912	745
28	-692	445	746	28	-247	892	746
29	-677	425	745	29	-370	869	746
30	-681	275	745	30	-520	817	747
31	-689	122	745	31	-623	707	746
32	-690	-48	746	32	-645	656	745
33	-684	-227	745	33	-687	486	745
34	-678	-420	745	34	-693	444	746
35	-694	-441	746	35	-679	429	745
36	-673	-558	745	36	-679	306	745
37	-652	-636	745	37	-688	145	746
38	-615	-720	745	38	-690	15	746
39	-522	-810	745	39	-689	-109	746
40	-406	-854	745	40	-683	-232	745
41	-235	-887	745	41	-676	-330	745
42	32	-913	745	42	-679	-426	746
43	293	-912	745	43	-692	-446	745
44	469	-906	745	44	-675	-541	746
45	557	-903	746	45	-650	-638	745
46	672	-902	745	46	-620	-711	745
47	861	-900	746	47	-521	-808	746
48	1068	-905	745	48	-386	-860	747
49	1275	-911	746	49	-250	-885	745
50	1447	-916	746	50	-56	-908	746
51	1620	-918	745	51	118	-916	745
52	1823	-918	746	52	245	-915	745
53	2004	-916	746	53	323	-911	745
54	2137	-914	746	54	410	-913	746
55	2295	-910	745	55	563	-905	746
56	2403	-909	746	56	815	-897	745
57	2560	-918	745	57	997	-897	746
58	2829	-931	746	58	1210	-901	746
59	3049	-911	746	59	1325	-903	746
60	3217	-875	745	60	1336	-914	746
61	3362	-827	745	61	1500	-913	746
62	3506	-736	746	62	1615	-913	746
63	3602	-621	746	63	1955	-905	746
64	3654	-543	746	64	2194	-897	747
65	3694	-482	746	65	2374	-893	746
66	3711	-421	745	66	2429	-887	746
67	3724	-246	746	67	2520	-932	746

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
68	3731	-139	745	68	2627	-992	746
69	3730	87	746	69	2687	-954	746
70	3723	216	745	70	2714	-893	746
71	3712	373	744	71	2792	-831	747
72	3698	471	746	72	2850	-767	746
73	3619	598	746	73	2981	-635	746
74	3532	711	746	74	2966	-515	745
75	3392	813	746	75	3088	-462	746
76	3302	849	745	76	3182	-390	745
				77	3207	-329	745
				78	3237	-259	745
				79	3226	-215	745
				80	3213	-156	745
				81	3274	-81	745
				82	3352	-24	746
				83	3412	42	745
				84	3478	146	745
				85	3525	261	746
				86	3552	328	745
				87	3612	328	746
				88	3633	382	745
				89	3729	372	746
				90	3744	405	745
				91	3720	485	746
				92	3385	509	745
				93	3308	681	745
				94	3329	810	746
				95	3248	921	746
				96	3110	948	746
				97	2960	973	745
				98	2797	974	745
				99	2645	960	746

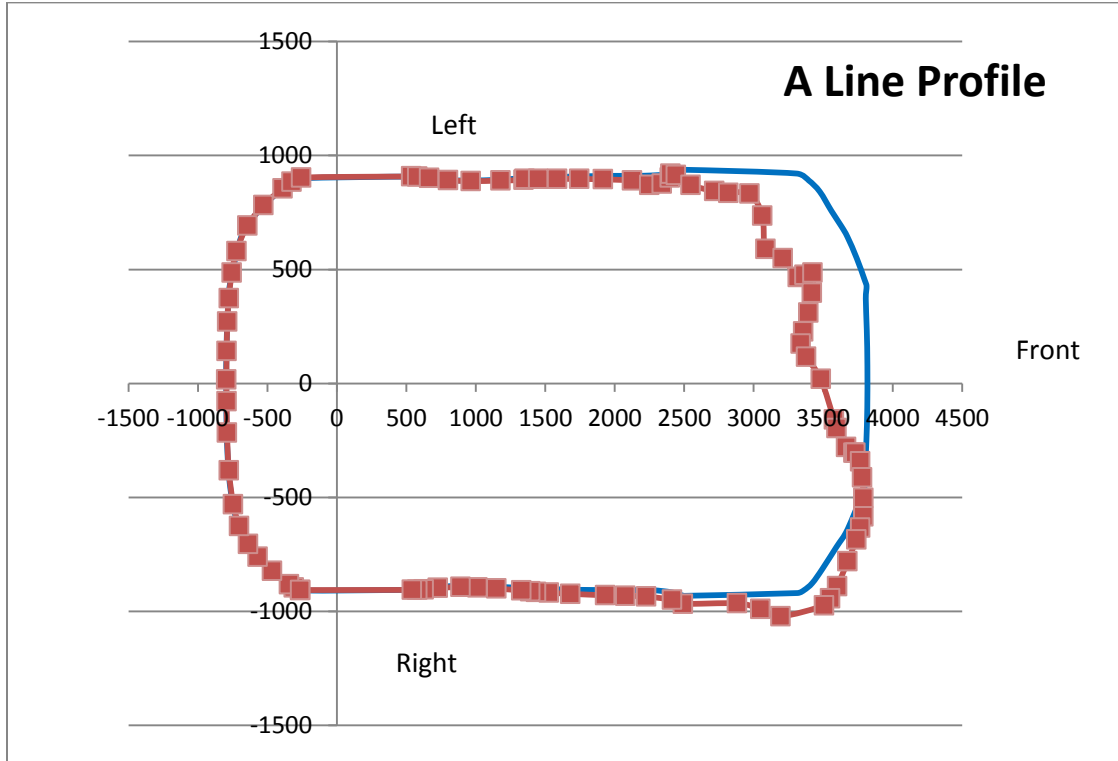
Note: See Appendix D for detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

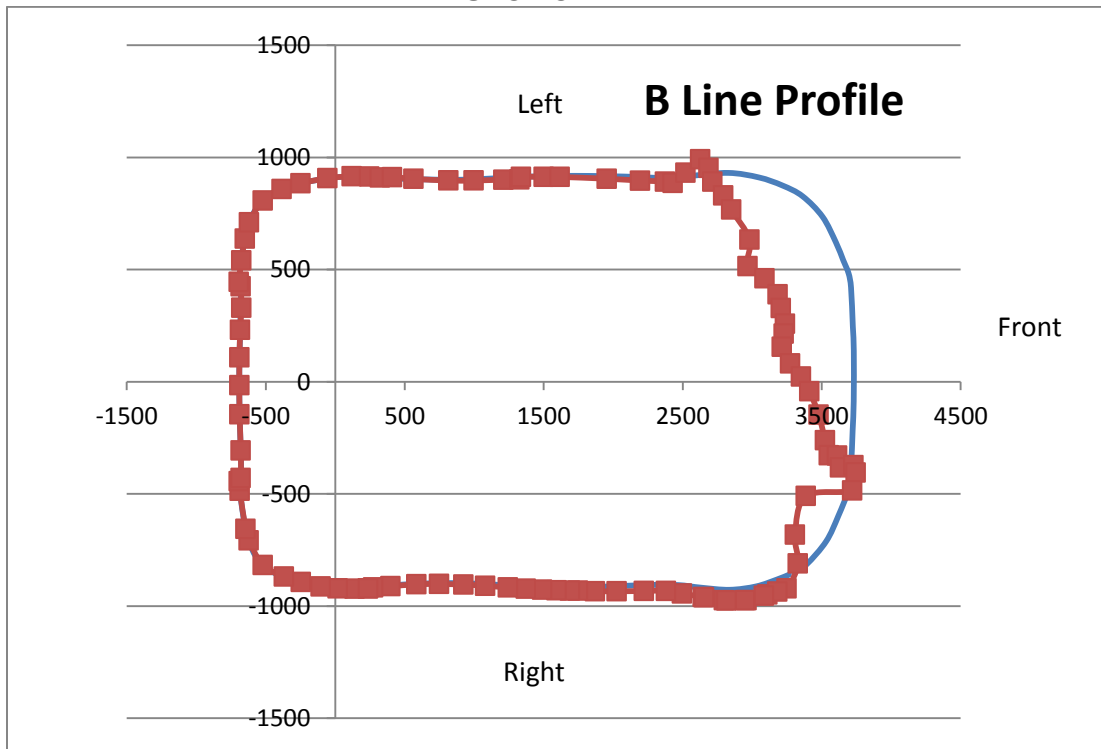
Test Vehicle: 2013 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A



SECTION B-B



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

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



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	3708	-549	1014	3411	-362	980	-297	187	-34
	B2	3713	-411	1012	3317	-266	958	-396	145	-54
	B3	3702	-275	1014	3260	-173	924	-442	102	-90
	B4	3710	-140	1014	3351	-74	935	-359	66	-79
	B5	3714	-1	1012	3435	37	941	-279	38	-71
	B6	3710	138	1013	3510	152	947	-200	14	-66
	B7	3699	276	1014	3580	271	952	-119	-5	-62
	B8	3715	412	1011	3670	376	956	-45	-36	-55
	B9	3708	545	1012	3739	491	961	31	-54	-51
Center Structural Bumper Beam	B1	3688	-547	1039	3387	-382	993	-301	165	-46
	B2	3691	-410	1036	3296	-285	966	-395	125	-70
	B3	3694	-272	1038	3258	-168	953	-436	104	-85
	B4	3703	-137	1039	3345	-67	960	-358	70	-79
	B5	3706	-2	1037	3426	41	964	-280	43	-73
	B6	3703	138	1036	3504	157	969	-199	19	-67
	B7	3694	274	1035	3573	274	972	-121	0	-63
	B8	3694	411	1039	3649	386	982	-45	-25	-57
	B9	3642	543	1041	3683	524	986	41	-19	-55
Upper Radiator Support	1	3605	-547	750	3086	-368	660	-519	179	-90
	2	3661	-410	750	3160	-252	670	-501	158	-80
	3	3662	-274	749	3190	-137	699	-472	137	-50
	4	3670	-139	747	3289	-82	669	-381	57	-78
	5	3674	0	746	3383	19	658	-291	19	-88
	6	3671	136	746	3468	125	649	-203	-11	-97
	7	3662	273	746	3531	245	631	-131	-28	-115
	8	3664	408	746	3571	375	623	-93	-33	-123
	9	3606	541	744	3550	519	632	-56	-22	-112

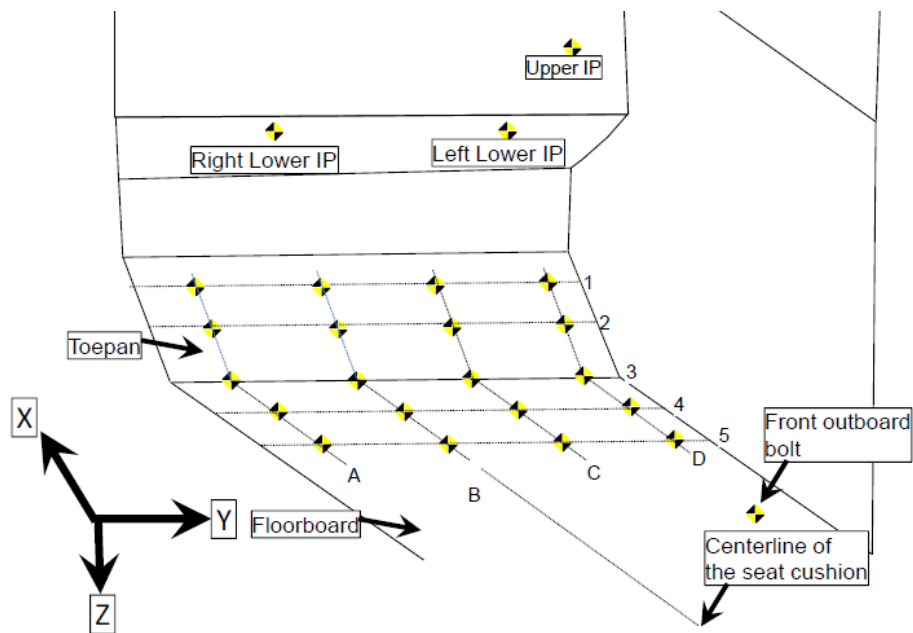
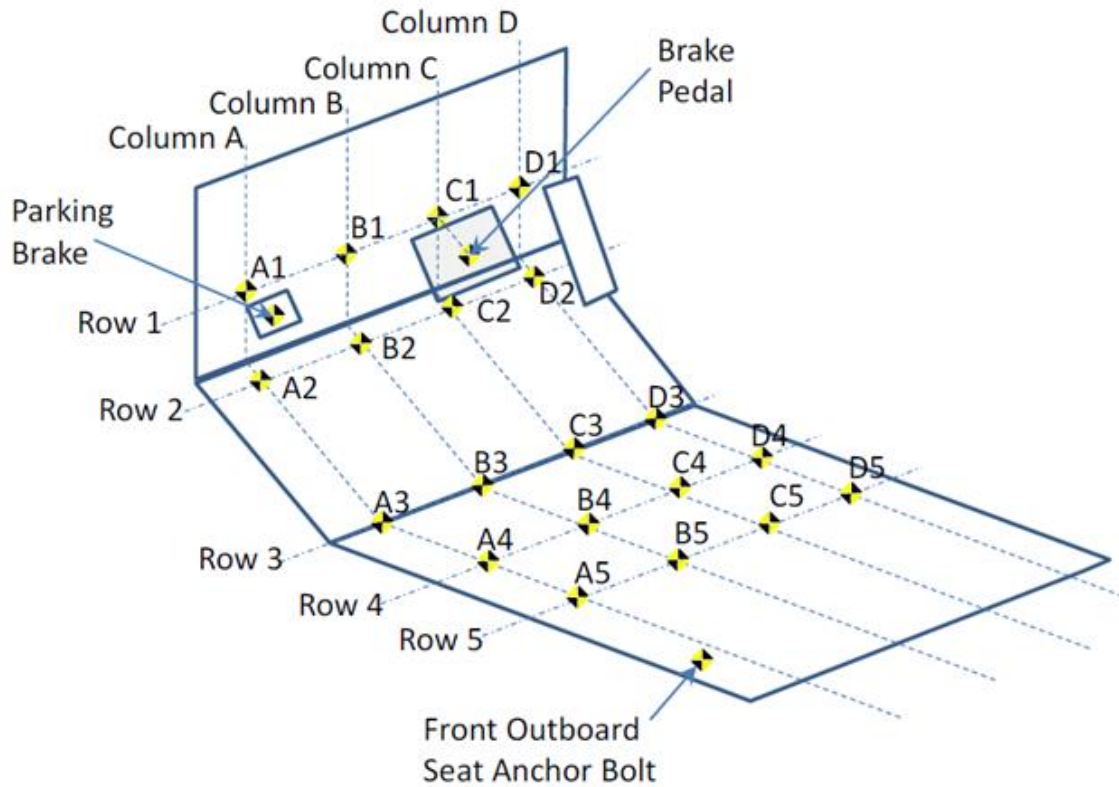
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



Note: See Appendix D for toe pan measuring procedure

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2013 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

DRIVER FLOOR PAN MEASUREMENTS

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2533	-573	1074	2497	-529	1074	-36	44	0
B1	2594	-473	1075	2552	-425	1067	-42	48	-8
C1	2612	-323	1074	2572	-278	1084	-40	45	10
D1	2608	-174	1075	2580	-129	1070	-28	45	-5
A2	2487	-576	1144	2461	-534	1148	-26	42	4
B2	2548	-475	1145	2519	-431	1143	-29	44	-2
C2	2577	-324	1145	2550	-283	1141	-27	41	-4
D2	2541	-174	1143	2518	-130	1143	-23	44	0
A3	2427	-576	1221	2410	-535	1231	-17	41	10
B3	2480	-473	1222	2460	-432	1226	-20	41	4
C3	2476	-322	1223	2454	-281	1222	-22	41	-1
D3	2456	-171	1222	2435	-128	1224	-21	43	2
A4	2356	-574	1278	2345	-535	1295	-11	39	17
B4	2357	-473	1276	2344	-435	1279	-13	38	3
C4	2356	-322	1279	2339	-281	1282	-17	41	3
D4	2356	-173	1272	2335	-135	1272	-21	38	0
A5	2258	-572	1280	2247	-536	1291	-11	36	11
B5	2257	-473	1276	2244	-438	1281	-13	35	5
C5	2255	-322	1279	2239	-286	1275	-16	36	-4
D5	2254	-173	1274	2232	-138	1269	-22	35	-5
Brake Pedal	2388	-323	1074	2358	-298	1065	-30	25	-9
Driver IP Left	2133	-520	763	2100	-506	772	-33	14	9
Driver IP Right	2116	-221	762	2096	-208	763	-20	13	1
DOLP	2148	-620	775	2131	-601	774	-17	19	-1
Steering Column	1881	-372	554	1881	-350	575	0	22	21
Front Outboard Bolt	1906	-568	1169	1898	-551	1184	-8	17	15
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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

PASSENGER FLOOR PAN MEASUREMENTS

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2614	216	1075	2597	264	1061	-17	48	-14
B1	2615	367	1073	2622	408	1075	7	41	2
C1	2575	505	1066	2580	544	1065	5	39	-1
D1	2488	616	1074	2492	651	1073	4	35	-1
A2	2560	214	1140	2552	261	1132	-8	47	-8
B2	2574	364	1143	2585	404	1145	11	40	2
C2	2521	516	1142	2528	554	1141	7	38	-1
D2	2454	620	1143	2458	656	1140	4	36	-3
A3	2470	218	1222	2471	263	1218	1	45	-4
B3	2471	365	1222	2483	404	1227	12	39	5
C3	2472	515	1220	2479	556	1220	7	41	0
D3	2390	616	1216	2395	651	1214	5	35	-2
A4	2368	214	1269	2377	257	1265	9	43	-4
B4	2368	365	1270	2378	403	1276	10	38	6
C4	2373	515	1274	2379	553	1274	6	38	0
D4	2365	627	1271	2371	655	1270	6	28	-1
A5	2269	215	1271	2286	251	1273	17	36	2
B5	2269	365	1274	2281	400	1278	12	35	4
C5	2271	515	1272	2279	550	1271	8	35	-1
D5	2268	613	1272	2275	649	1271	7	36	-1
Pass IP Left	2127	216	793	2126	240	791	-1	24	-2
Pass IP Right	2149	516	793	2147	541	794	-2	25	1
PORP	2146	617	773	2143	641	775	-3	24	2
Front Outboard Bolt	1907	567	1164	1913	590	1164	6	23	0

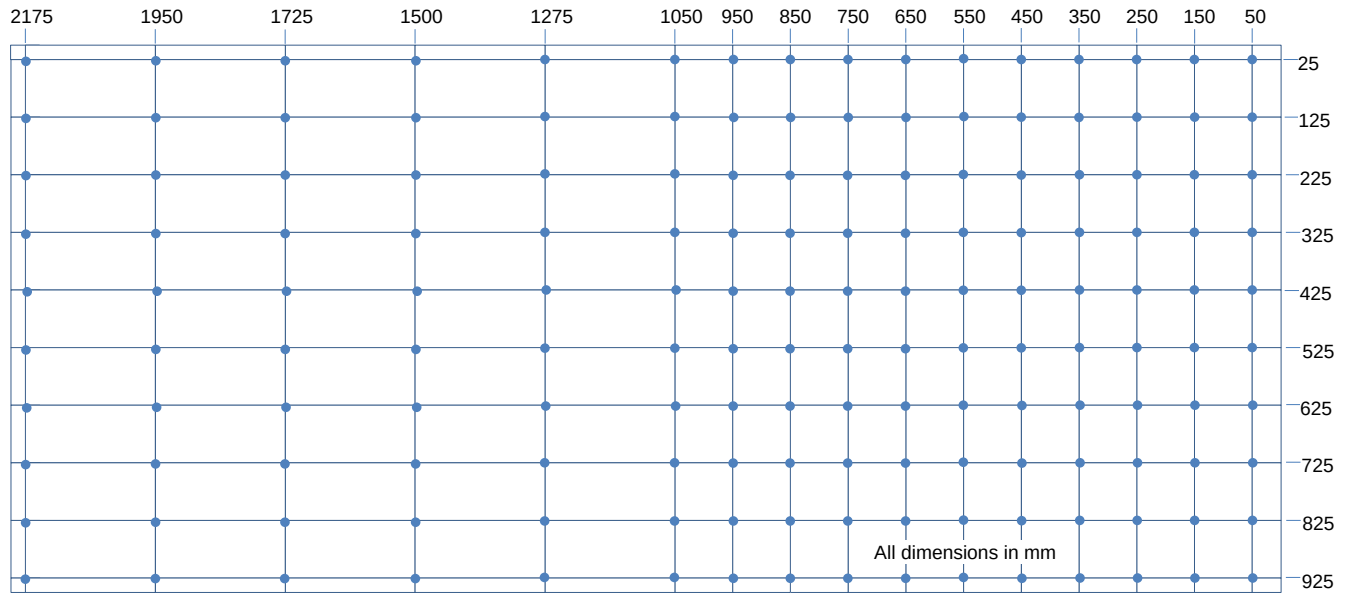
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

- +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 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013



	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
R10	-2.6	-2.3	-1.6	-0.9	-0.2	0.1	0.5	0.6	0.9	1.1	1.5	1.9	3.8	6.9	9.7	20.2
R9	-3.1	-2.5	-1.6	-1.1	-0.5	0.2	0.4	3.6	17.5	5.3	5.2	7.8	33.4	51.8	62.8	60.8
R8	-2.9	-2.3	-1.7	-1.1	-0.5	-0.1	0.4	3.4	19.2	51.3	59.1	42.4	81.2	120.4	131.1	116.6
R7	-2.9	-2.4	-1.9	-1.2	-0.6	0.1	0.4	0.5	3.7	54.0	86.4	93.3	125.8	144.6	158.6	149.1
R6	-2.9	-2.4	-2.0	-1.5	-0.6	0.0	0.3	0.9	14.4	35.3	86.6	136.1	188.9	190.3	188.1	194.8
R5	-3.2	-2.7	-1.8	-1.3	-0.6	0.0	0.3	24.2	33.3	16.6	20.3	335.6	394.9	345.0	270.9	199.4
R4	-3.0	-2.4	-1.9	-1.3	-0.6	0.1	4.3	49.9	51.0	22.7	8.3	312.1	338.9	301.8	236.2	170.5
R3	-3.1	-2.6	-1.9	-1.4	-0.7	0.2	7.0	61.3	62.3	25.5	7.1	44.6	263.1	241.9	195.8	168.1
R2	-3.1	-2.6	-2.0	-1.5	-0.9	-0.1	5.1	59.9	56.3	25.8	4.9	24.1	77.8	150.4	130.4	119.2
R1	-0.8	-1.3	-1.1	-0.5						28.9	9.0	5.9	5.8	8.1	45.8	43.0

*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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013

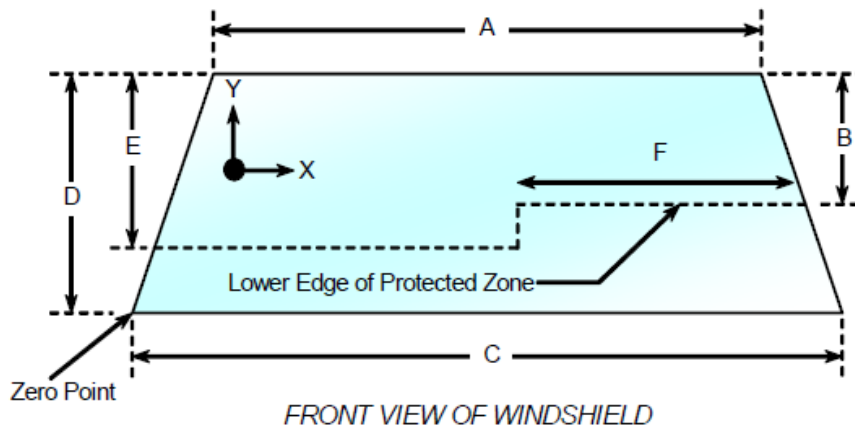
Please provide windshield mounting details. A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.

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	2263	2263	100%
Right Side	2263	2263	100%
Total	4526	4526	100%



Item	Units	Value
A	mm	1255
B	mm	564
C	mm	1490
D	mm	890
E	mm	617
F	mm	340

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 Volvo XC60 SUV
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
Test Date: 11/11/2013

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

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

Test Time: 11:21 AM

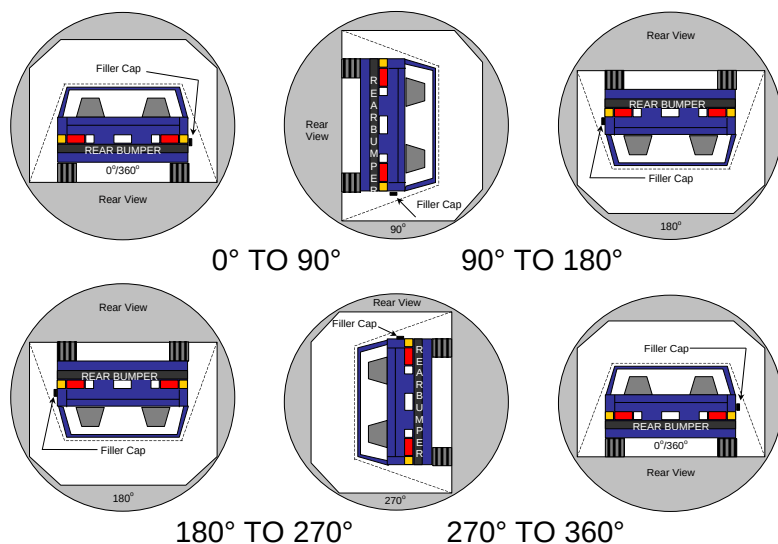
Stoddard Solvent Spillage Measurements

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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



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°	69	300	369
90° to 180°	62	300	362
180° to 270°	68	300	368
270° to 360°	71	300	371

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	

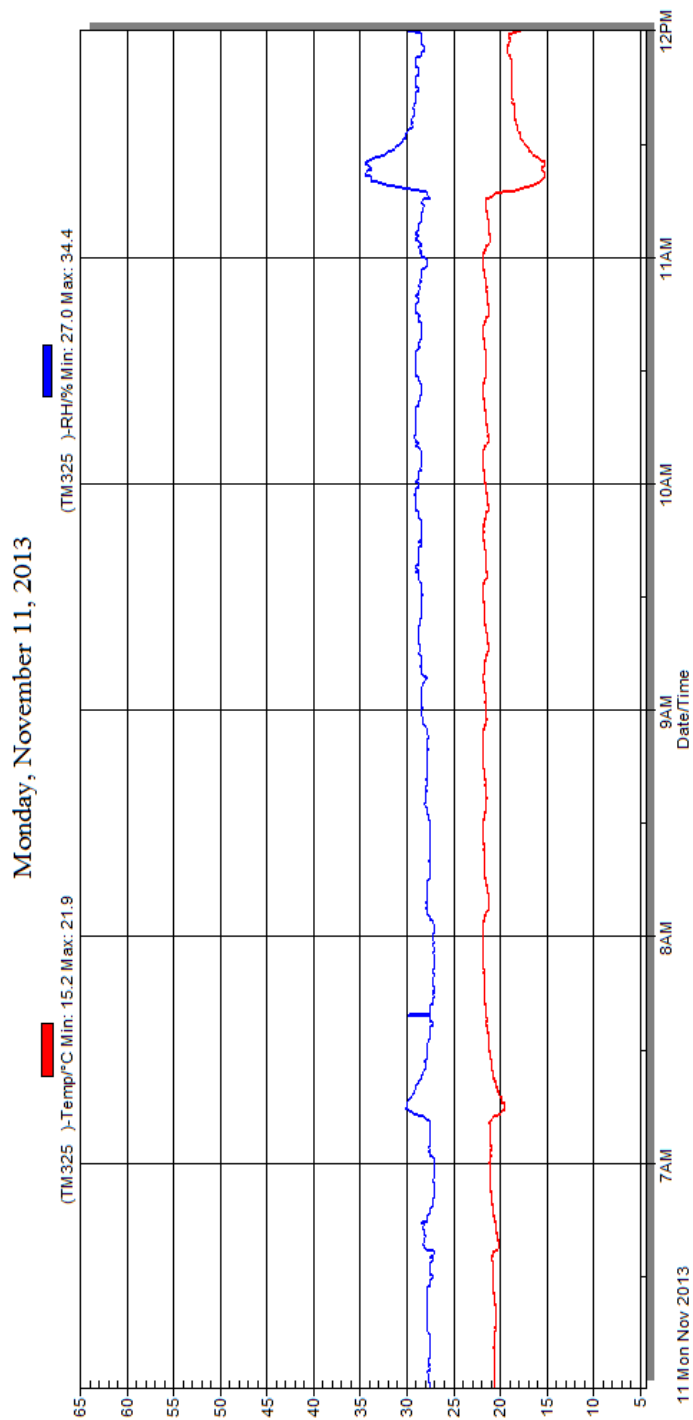
SOLVENT SPILLAGE LOCATION TABLE

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 Volvo XC60 SUV
 Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RD5910
 Test Date: 11/11/2013



Temperature Stabilization Chart/Data

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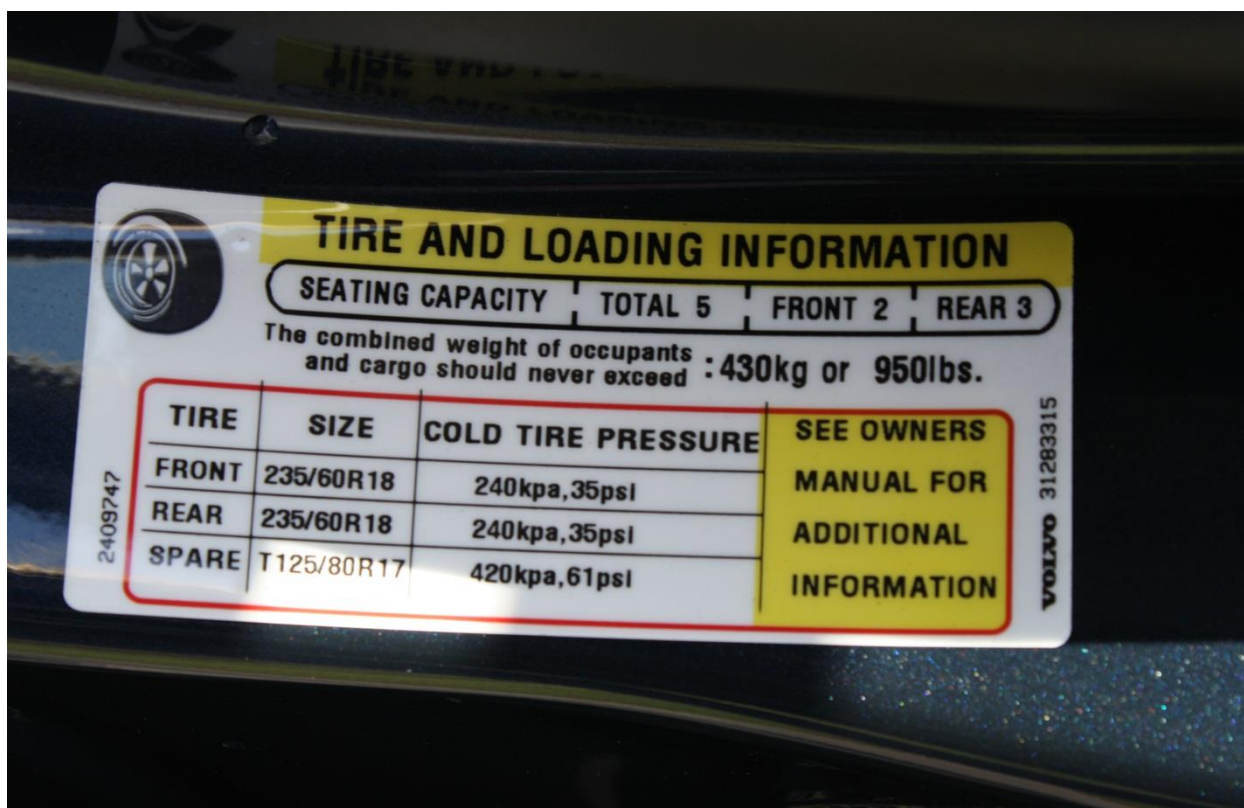
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No. 002 As Delivered Left Rear 3-4 View of Test Vehicle



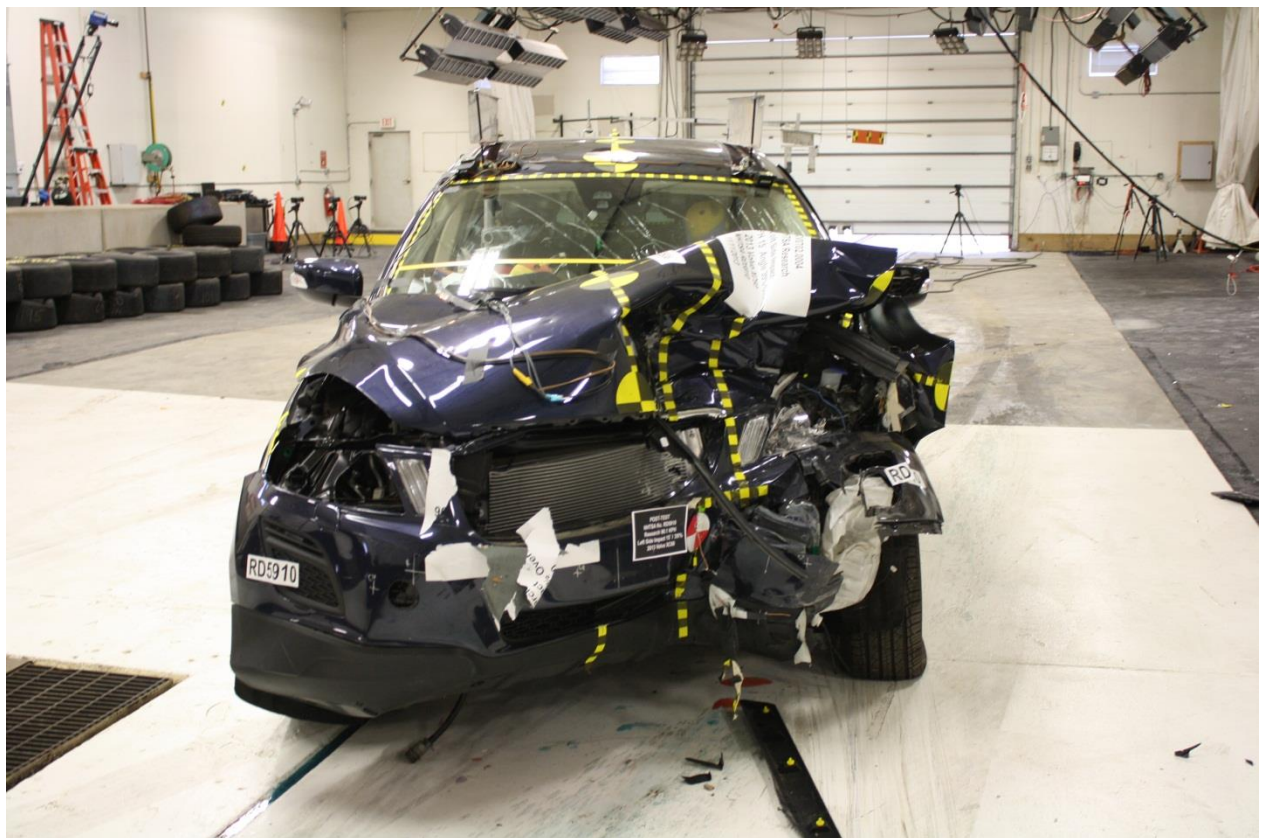
No. 003 Test Vehicle Certification Label



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. 007 Pre-Test Left Front 3-4 View of Test Vehicle



No. 008 Post-Test Left Front 3-4 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

VOLVO

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www.volvocars.us

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS COUNTRY: VOLVO SERIES
U.S. CANADIAN PARTS CONTENT: 1%
MAJOR SOURCES OF FOREIGN PARTS CONTENT:
BELGIUM: 25%
GERMANY: 20%
FOR THIS VEHICLE:
FINAL ASSEMBLY POINT: GHENT, BELGIUM
COUNTRY OF ORIGIN: GREAT BRITAIN
TRANSMISSION PARTS: JAPAN
ENGINE PARTS: GREAT BRITAIN
Note: Parts content does not include final assembly, distribution, or other non-parts costs.

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48 Month/50,000 Mile Limited Warranty Coverage
124 Month Corrosion Protection - "Unlimited Mileage"
Refer to Warranty Info Book for Specific Limitations
Volvo Increased Protection: Ask Your Volvo Retailer
About an Extended Service Contract

Make & Model: 2013 VOLVO S60L PHEV 4WD
Model Description: XC60 3.2 AWD

PERFORMANCE

3.2 Liter, 6 Cylinder, Alloy Engine w/DHC
Continuous Variable Valve Timing, Variable Intake
240 HP @ 6400 RPM and 236 lb-ft Torque @ 3200 RPM
ULEV II (Ultra Low Emissions Vehicle)
6 Speed Auto, Geartronic Trans. w/Adaptive DNT Logic
Fuel Independent Drive Suspension w/anti-dive geometry
Fully Independent Rear Multi-Link Suspension
Dynamic Stability Traction Control (DSTC)
Roll Stability Control (RSC)
Power Assisted Rack & Pinion Steering
Ventilated Disc Brakes w/Anti-Lock Braking System (ABS)
Electronic Brake Distribution & Assistance (EBDA/EBL)
Ready Alert Brakes (RAB)
18" Alloy Wheels with All-Season Tires

SAFETY & SECURITY

City Safety
Five 3-point safety belts w/ pretensioner technology
Front safety Belt w/ Auto Height Adj. & Force Limiters
Seat Belt Reminder for all seating positions
Unibody High Strength Steel Passenger Safety Cage
Inflatable Curtain Side Impact Head Protection Sys (IC)
Side Impact Protection System (SIPS) w/ Driver &
Front Passenger Dual Chamber Side Impact Airbags
Driver & Front Passenger Dual Stage Supplemental
Restraint System (AIRBAG)
Volvo Whiplash Protection System (WHIPS) in Driver &
Front Passenger Seats / 5 Padded Head Restraints
Adaptive Steering Wheel Column
Dual ISO-FIX (LATCH) Attachment System
Safe Approach & Home Safe Perimeter Lighting System
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Child Safety Locks in Rear Doors
Tire Pressure Monitoring System (TPMS)
Rear Foglight and LED Accent Tail Lights

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Bluetooth® Hands Free Phone Interface w/ Audio Streaming
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Integrated Roof Rails
40/20/40 Folding Rear Seats w/Folding Head Restraints
Flat Folding Rear Seats & Front Passenger Seat
Front Center Armrest & Storage Compartment w/2 Center
Console Cupholders & CD Storage
Rear Center Armrest w/2 Cupholders

Importers Suggested List Price P.O.E.: \$ 34,350.00
Complimentary Factory Scheduled Maintenance
For the first 3 Years OR 36,000 Miles

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Leather Seating Surfaces | Laminated Panoramic
Roof | Tinted Rear Windows | Power Passenger
Seat | Silver Roof Rails | Silver Side Decal |
Keyless Drive w/ Personal Car Communicator |
Accessory Prep Cable

XC60 PREMIER Price 2,950.00

Climate Package:
Heated Front & Rear Seats
Heated Windshield Washer Nozzles
Interior Air Quality System (IAQS)
Total Package Price 900.00

Electronically Controlled All Wheel Drive
With Instant Traction 2,000.00
Metallic Paint 550.00
Chrome Dual Tail Pipes 215.00
Destination Charge 895.00
VOLVO "On-Call" Road Assist
Total Suggested Retail Price: \$ 41,860.00

EPA DOT Fuel Economy and Environment Gasoline Vehicle

Fuel Economy

20 MPG
combined city/hwy

Small SUVs range from 16 to 32 mpg.
The best vehicle rates 112 MPG.

You spend \$1,650 more in fuel costs over 5 years
compared to the average new vehicle.

Annual fuel cost \$2,650

Fuel Economy & Greenhouse Gas Rating (tailpipe only) Smog Rating (tailpipe only)

5 (tailpipe only) **5** (tailpipe only)

This vehicle emits 437 grams CO2 per mile. The best emits 0 grams per mile (tailpipe only).
Producing and distributing fuel also creates emissions. Learn more at fuel-economy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 23 MPG and costs \$11,600 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$3.56 per gallon. MPG is miles per gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fuel-economy.gov
Calculate personalized estimates and compare vehicles

VEHICLE IDENTIFICATION
Type & Chassis: 186 409747
Model Year: 2013
Color: 488 Capstan Blue Metallic
VIN: YV48520D202409747

Part of Importation: Baltimore, MD
Delivered by: Truck
DELIVERY ADDRESS
WYNNIE VOLVO HMTN 7626
1010 W MERCURY BLVD.
HAMPTON, VA 23666

Environmental Performance

Protect the environment, choose vehicles with higher scores:

Global Warming Score 4 (Average new vehicle) 5 (Cleanest new vehicle)
Smog Score 5 (Average new vehicle) 5 (Cleanest new vehicle)

Using alternative fuels may improve scores. See www.DriveClean.ca.gov

Vehicle emissions are a primary contributor to global warming and smog. Scores are determined by the California Air Resources Board based on this vehicle's measured emissions. Please visit www.DriveClean.ca.gov for more information. AIR RESOURCES BOARD

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score ★★★★★
Based on the combined ratings of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.

Frontal Crash ★★★★★
Based on the risk of injury in a frontal impact.

Driver Passenger ★★★★★
Should ONLY be compared to other vehicles of similar size and weight.

Side Crash ★★★★★
Based on the risk of injury in a side impact.

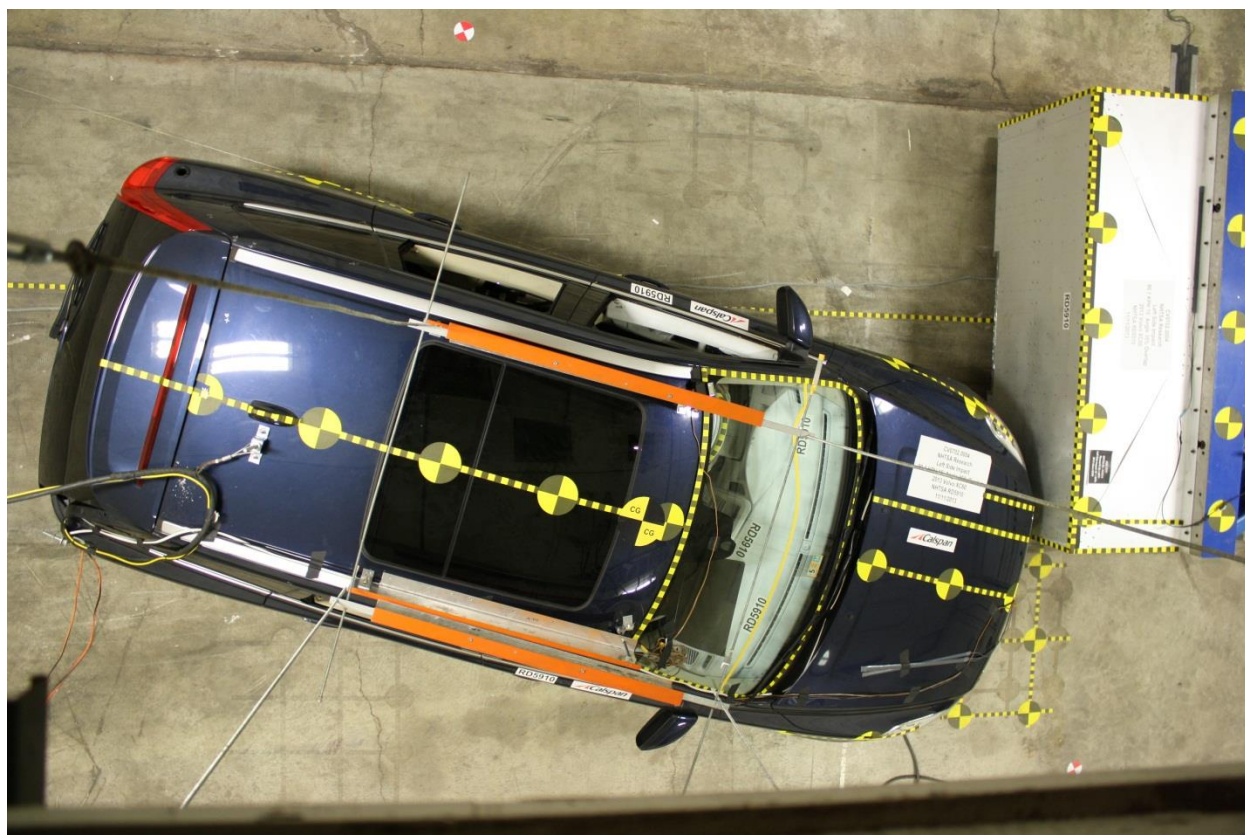
Front Seat ★★★★★
Rear Seat ★★★★★

Rollover ★★★★★
Based on the risk of rollover in a single vehicle crash.

Star ratings range from 1 to 5 stars (★★★★★), with 5 being the highest.
Source: National Highway Traffic Safety Administration (NHTSA)
www.safercar.gov or 1-888-327-4236

The price shown does not include Gasoline, License and Title Fees, State and Local Taxes and Dealer-installed Options and Accessories. The factory reserves the right to modify price, design and equipment without previous notice.

No. 021 Monroney Label Photograph



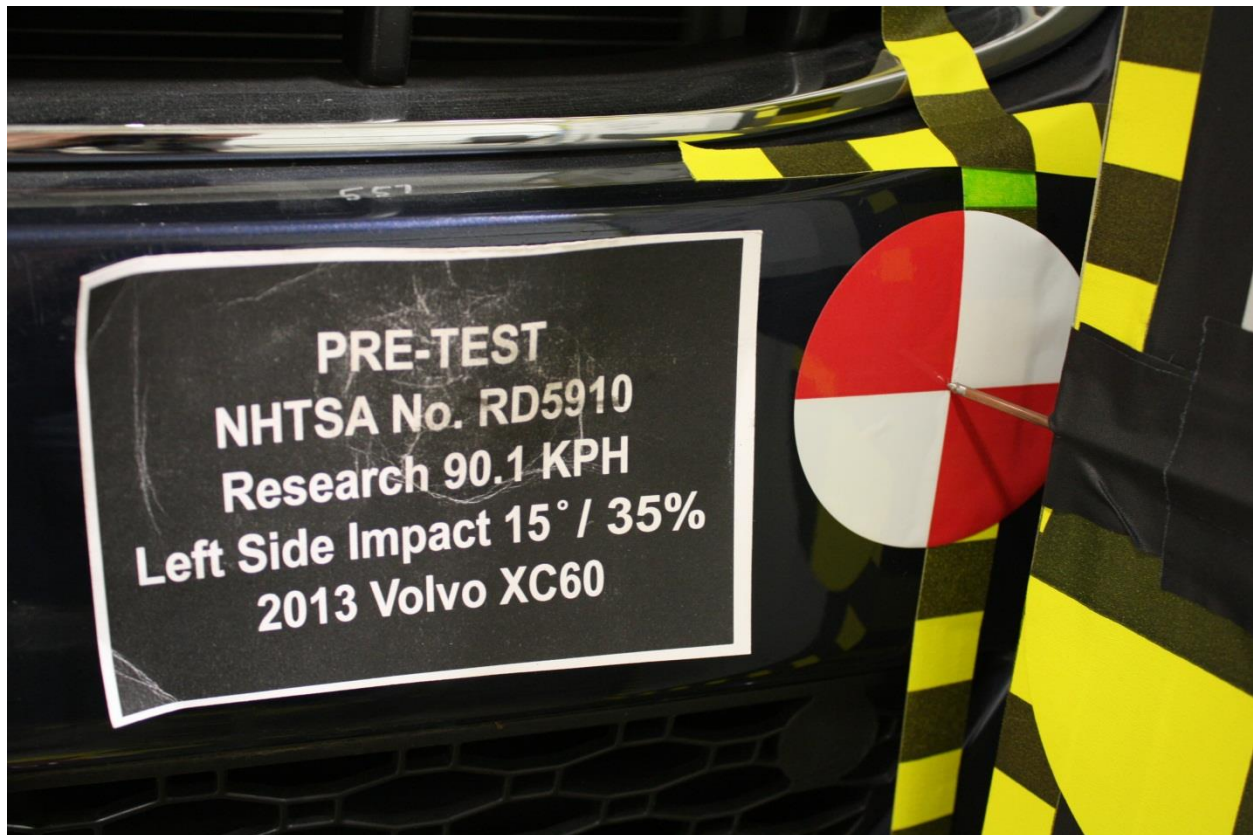
No. 022 Pre-Test Overhead View of RMDB against target vehicle at ideal Impact Point



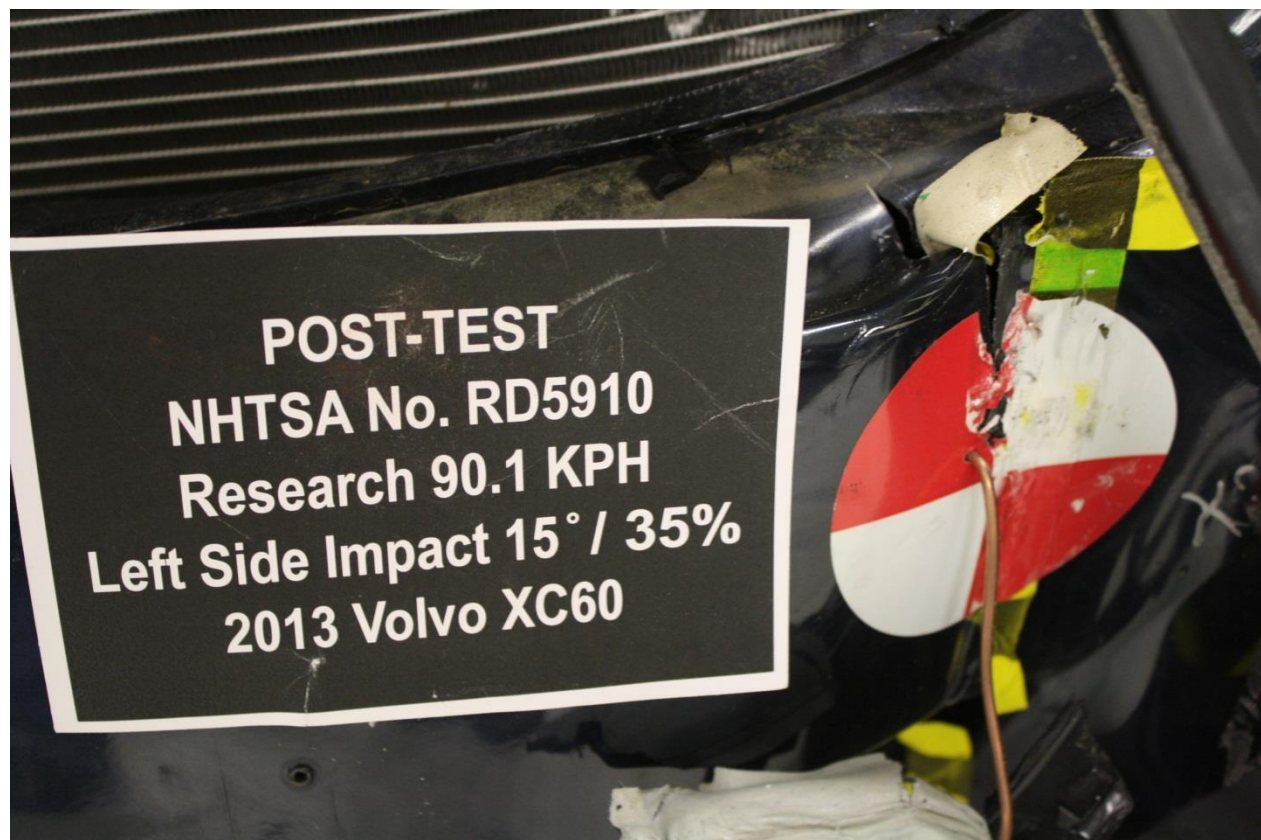
No. 023 Pre-Test Left Side View of RMDB against target vehicle at ideal Impact Point



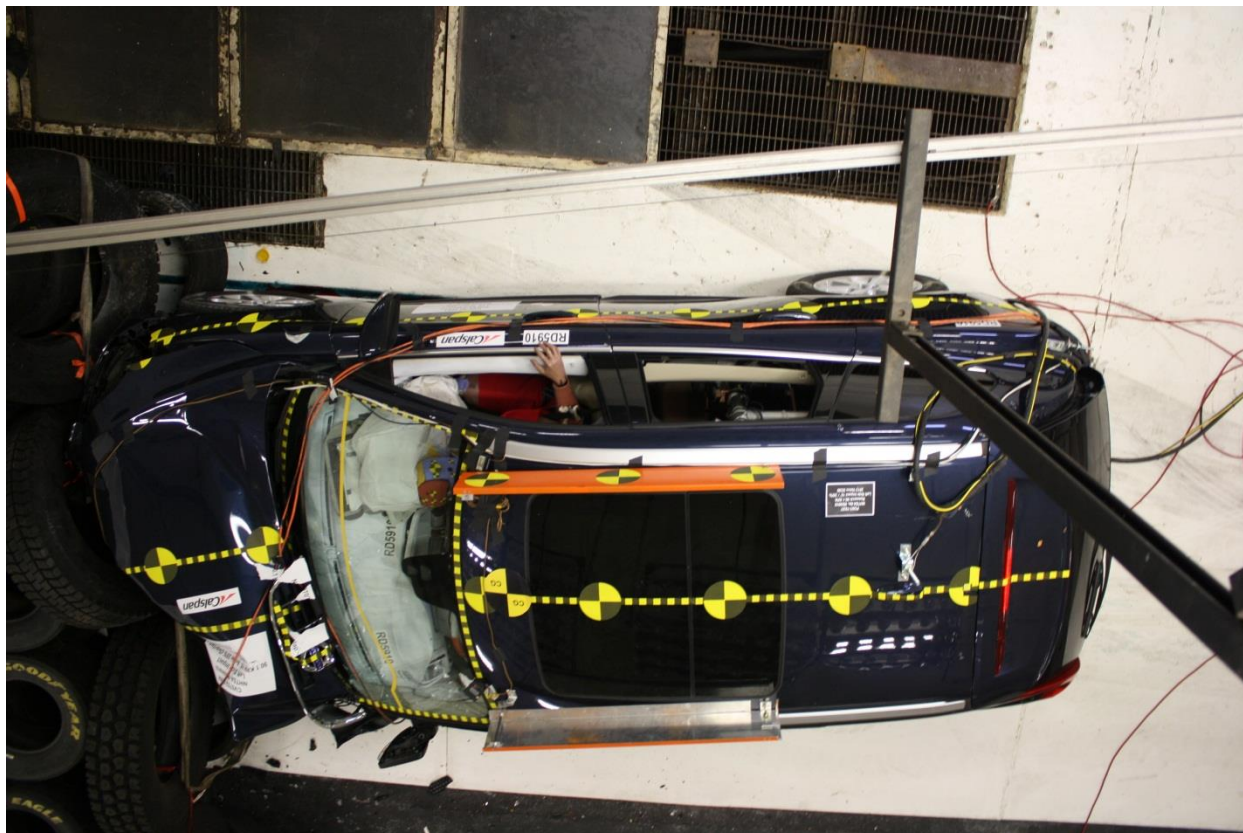
No. 024 Pre-Test Right Side View of RMDB against target vehicle at ideal Impact Point



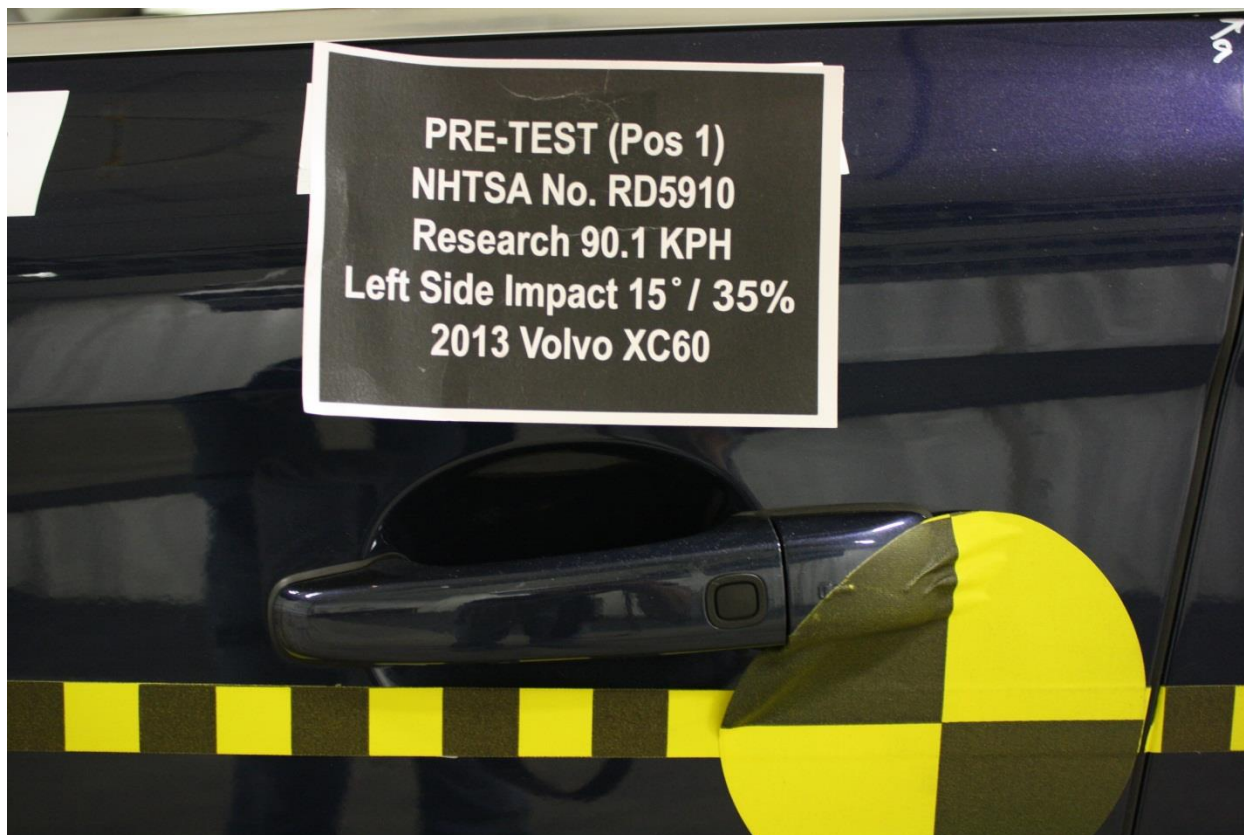
No. 025 Pre-Test Close-up View of Impact Point



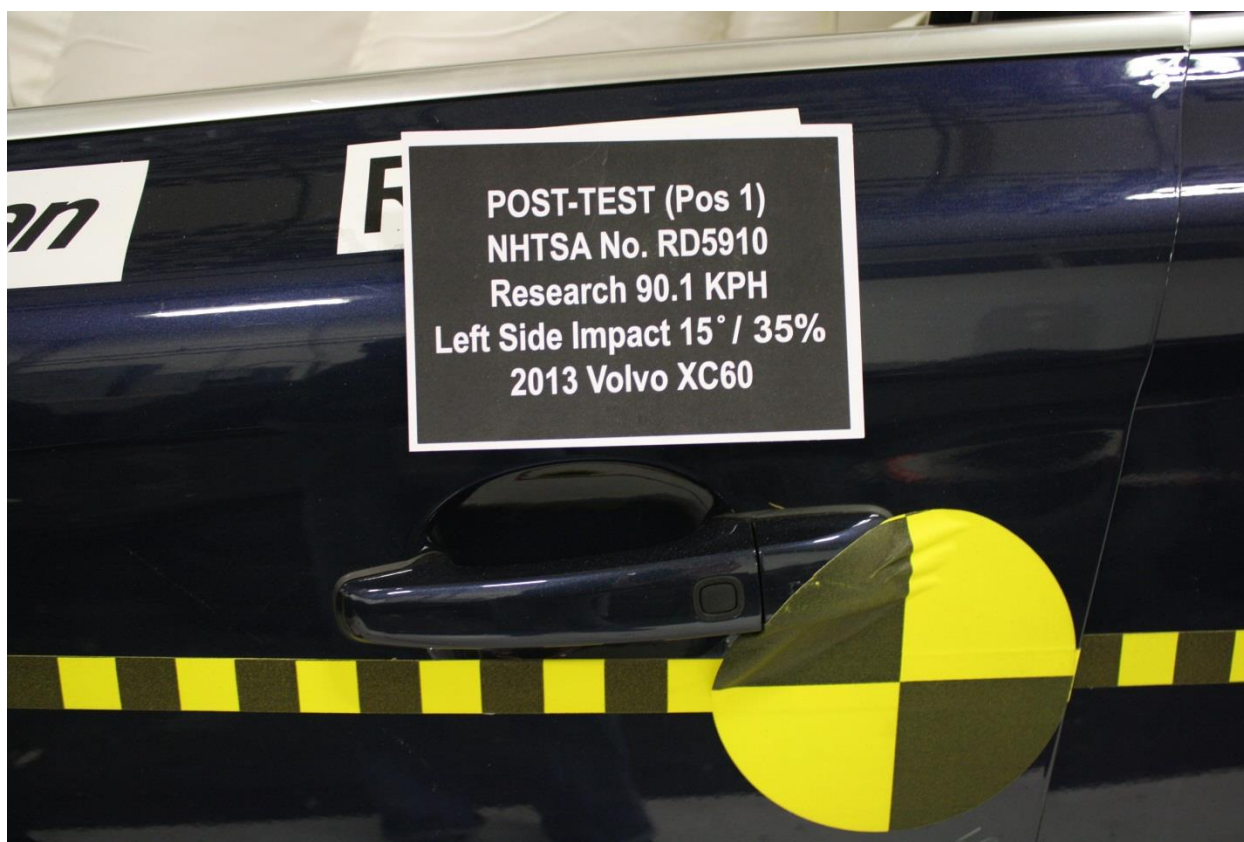
No. 026 Post-Test Close-up View of Impact Point



No. 027 Post-Test Vehicle Overhead View



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



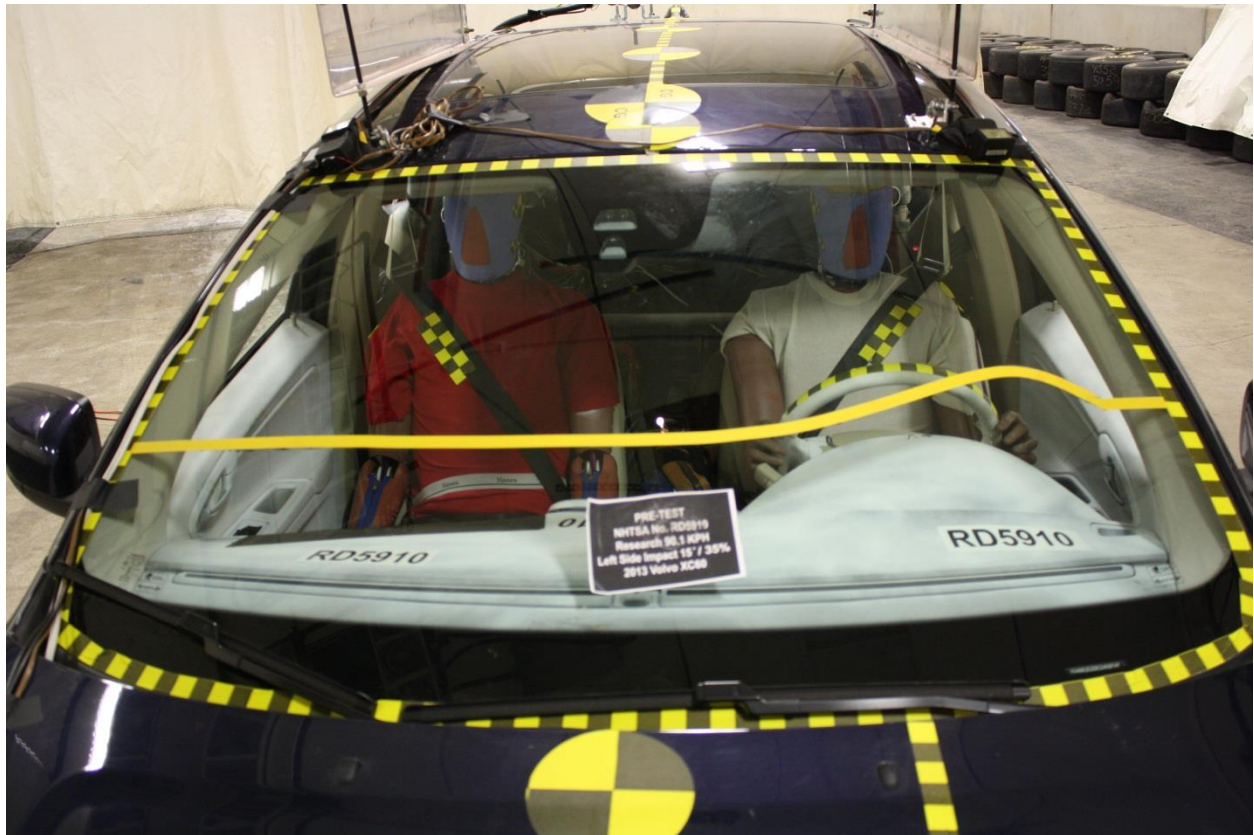
No. 029 Post-Test Close-up View of Driver Door Latch



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



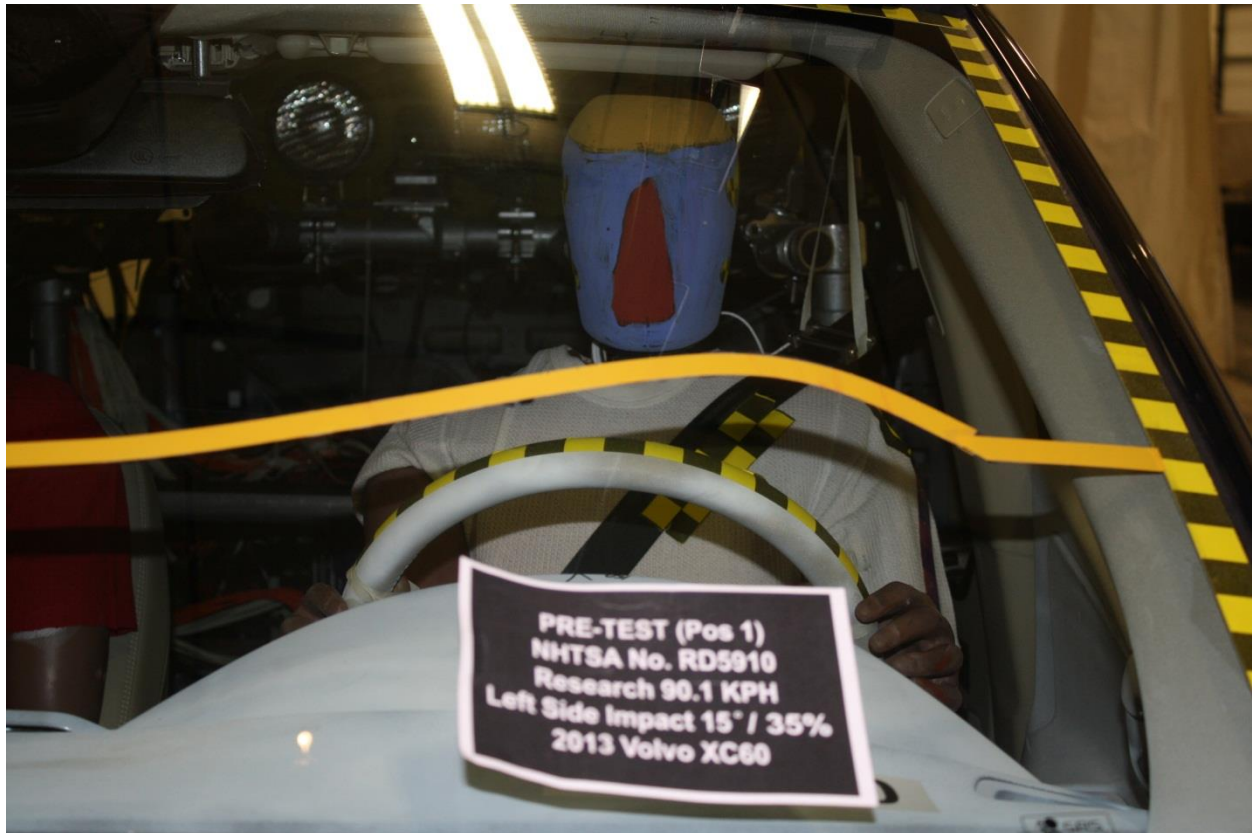
No. 049 Post-Test View of Driver Floor pan at Left sill level, w/o carpet



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



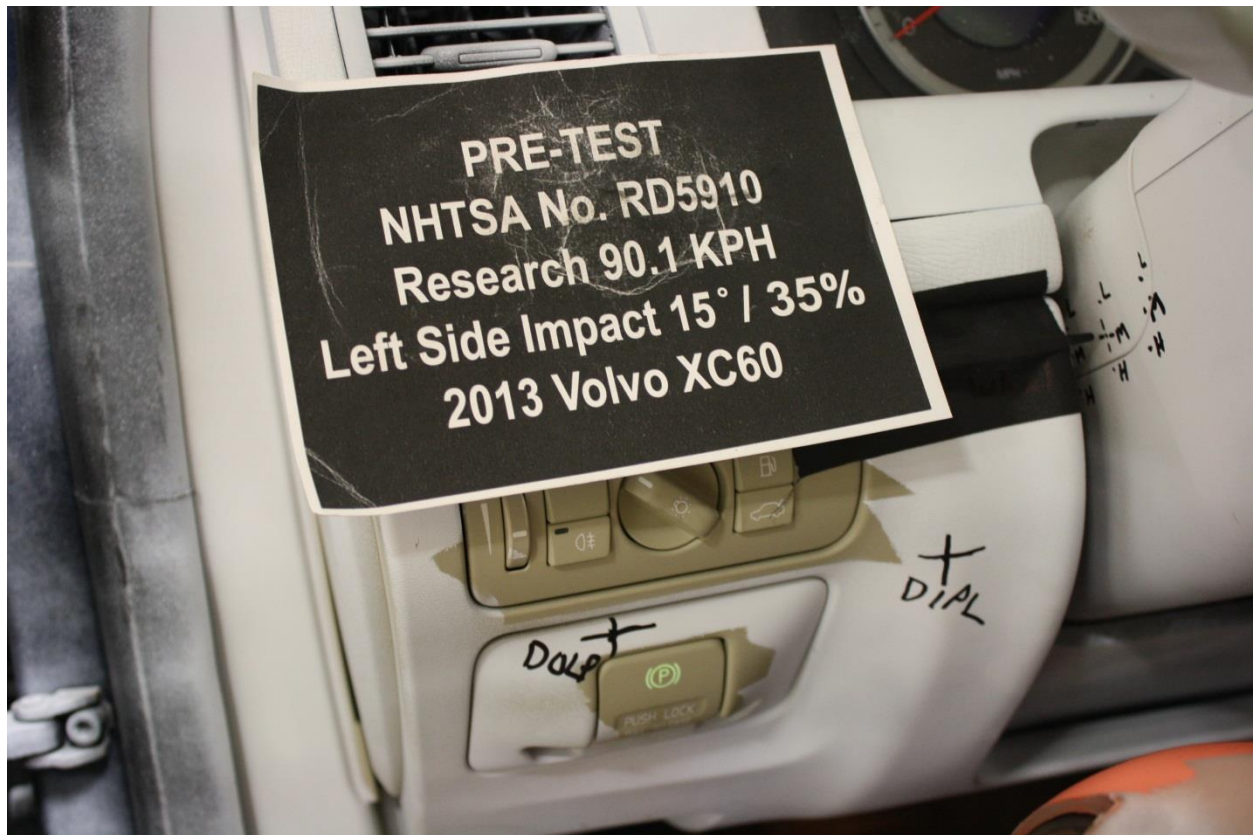
No. 059 Post-Test Right Side View of Driver and Interior



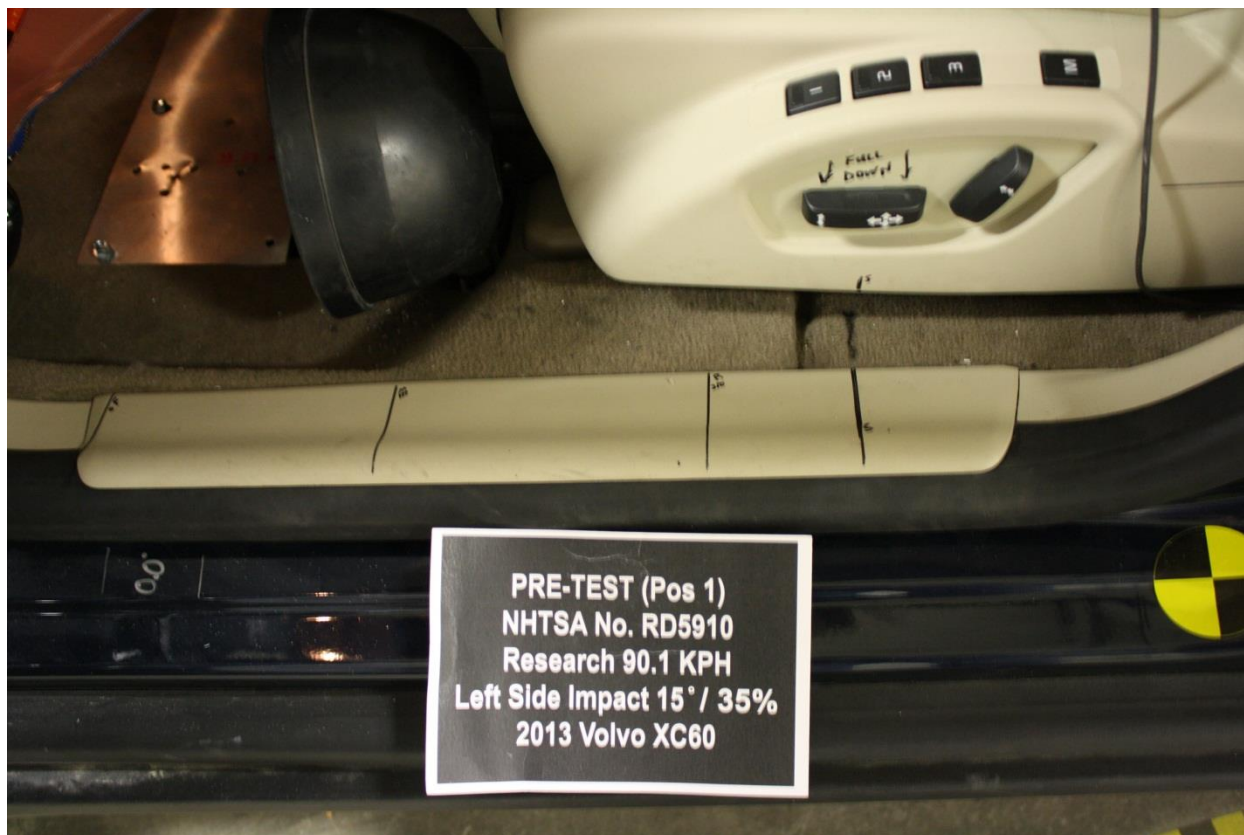
No. 060 Pre-Test View of Driver Door Clearance



No. 061 Post-Test View of Driver Door Clearance



No. 062 Pre-Test View of Parking Brake



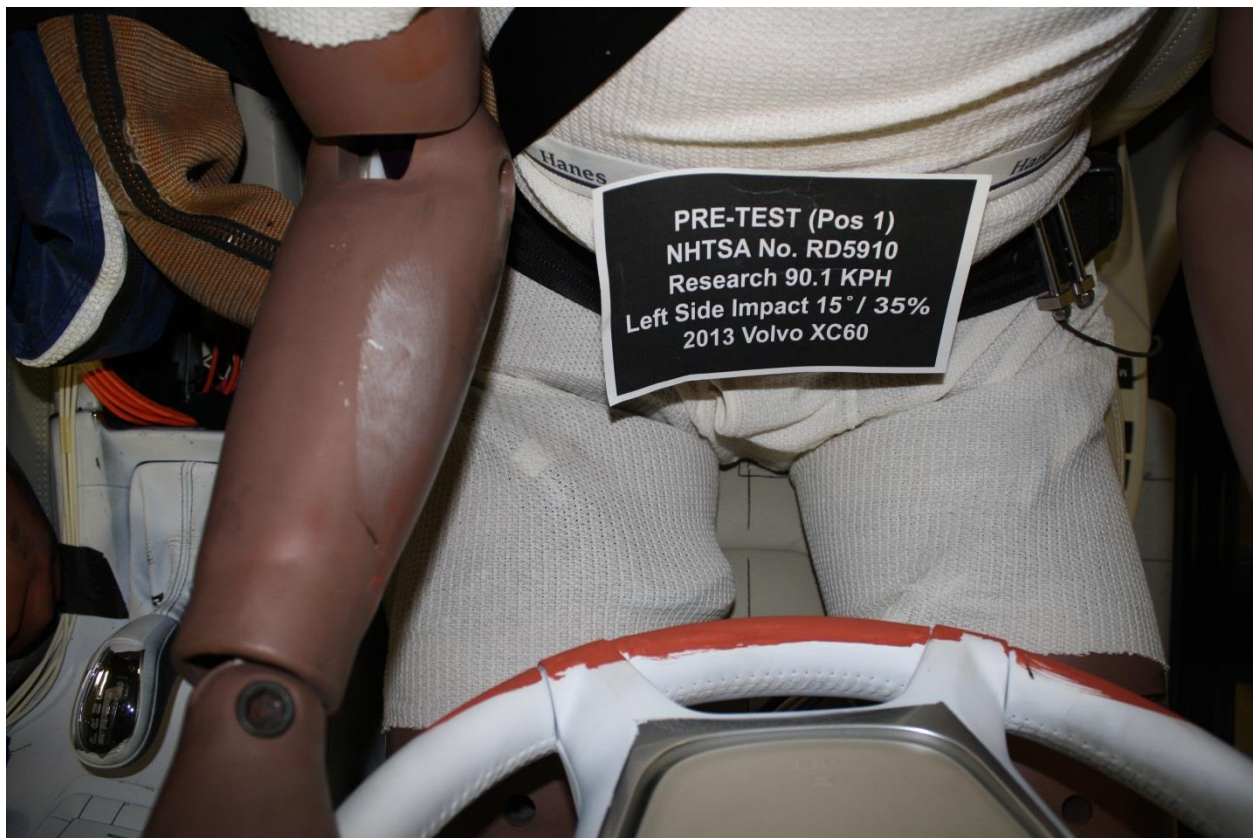
No. 063 Pre-Test Driver Seat Fore Aft Markings



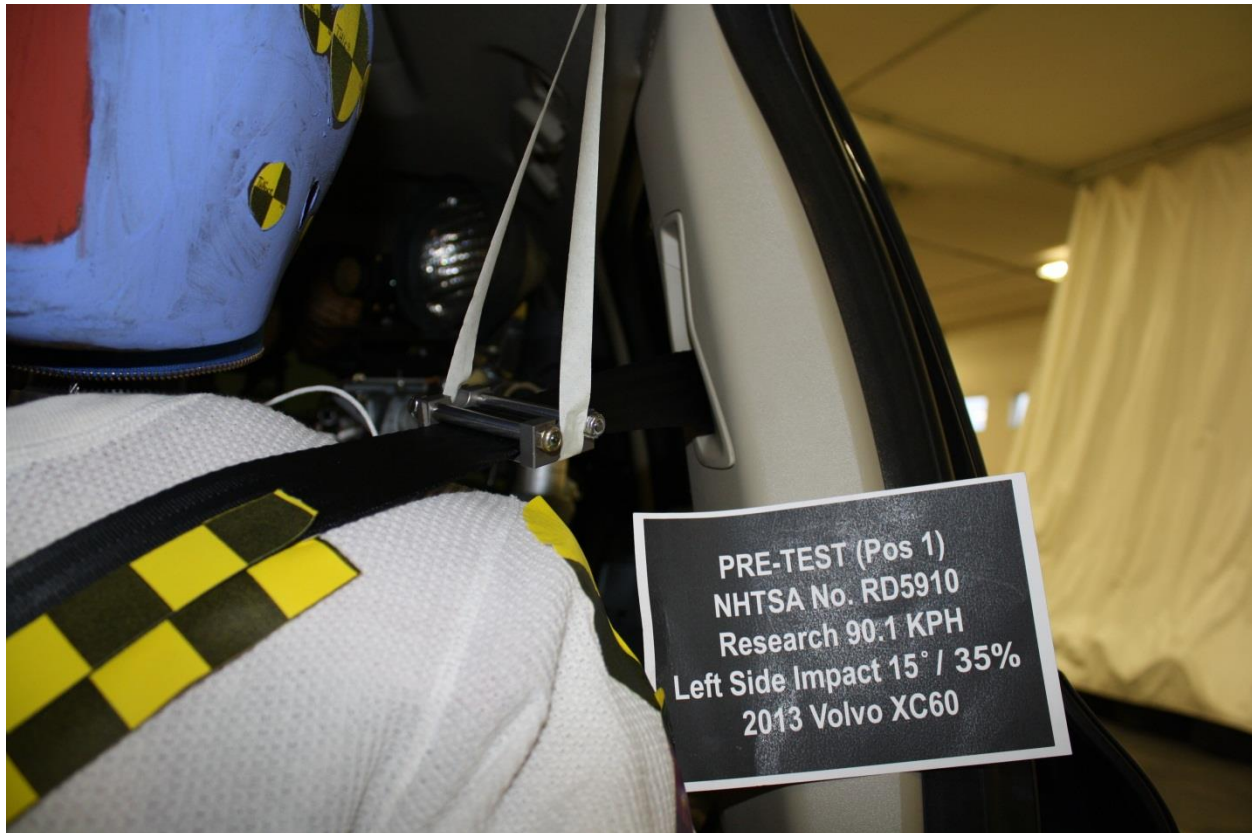
No. 064 Post-Test Driver Seat Fore Aft Markings



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



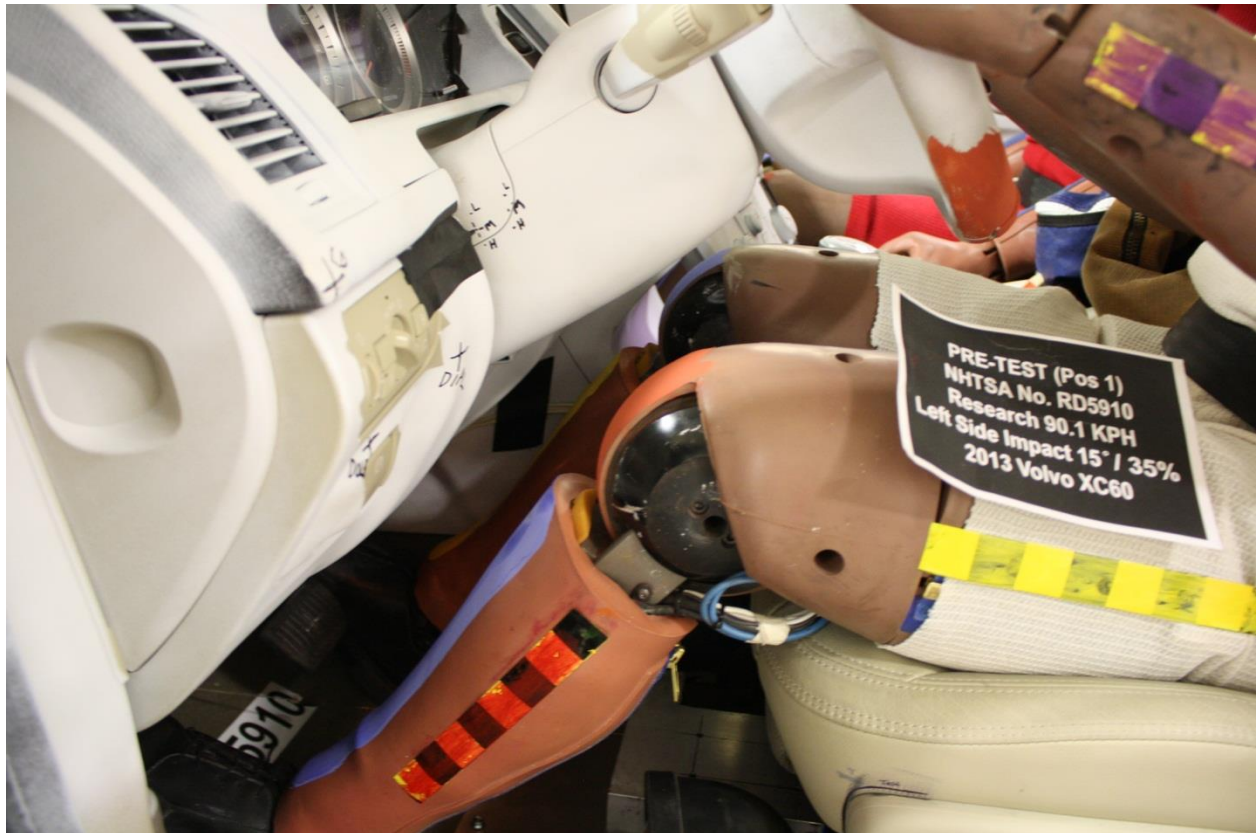
No. 070 Post-Test Driver Feet



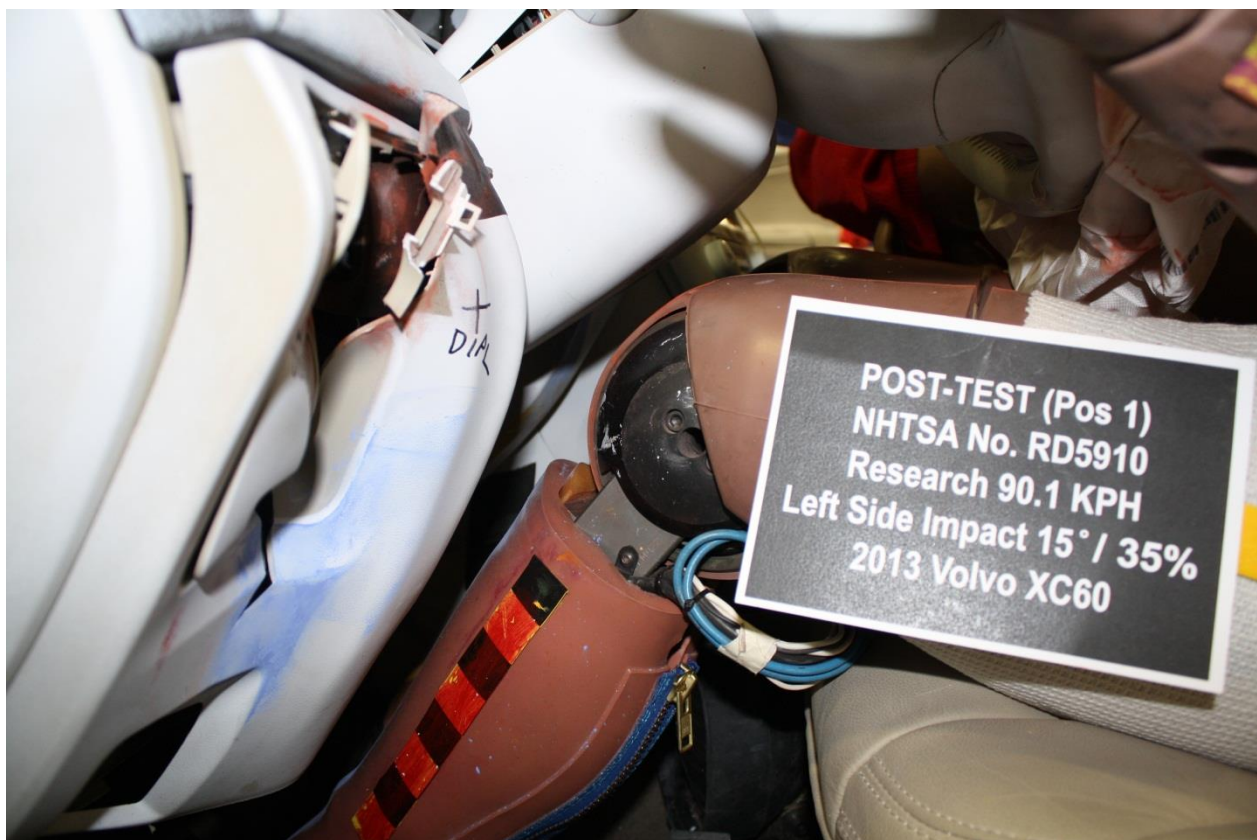
No. 071 Pre-Test View of Driver Right Knee and Bolster



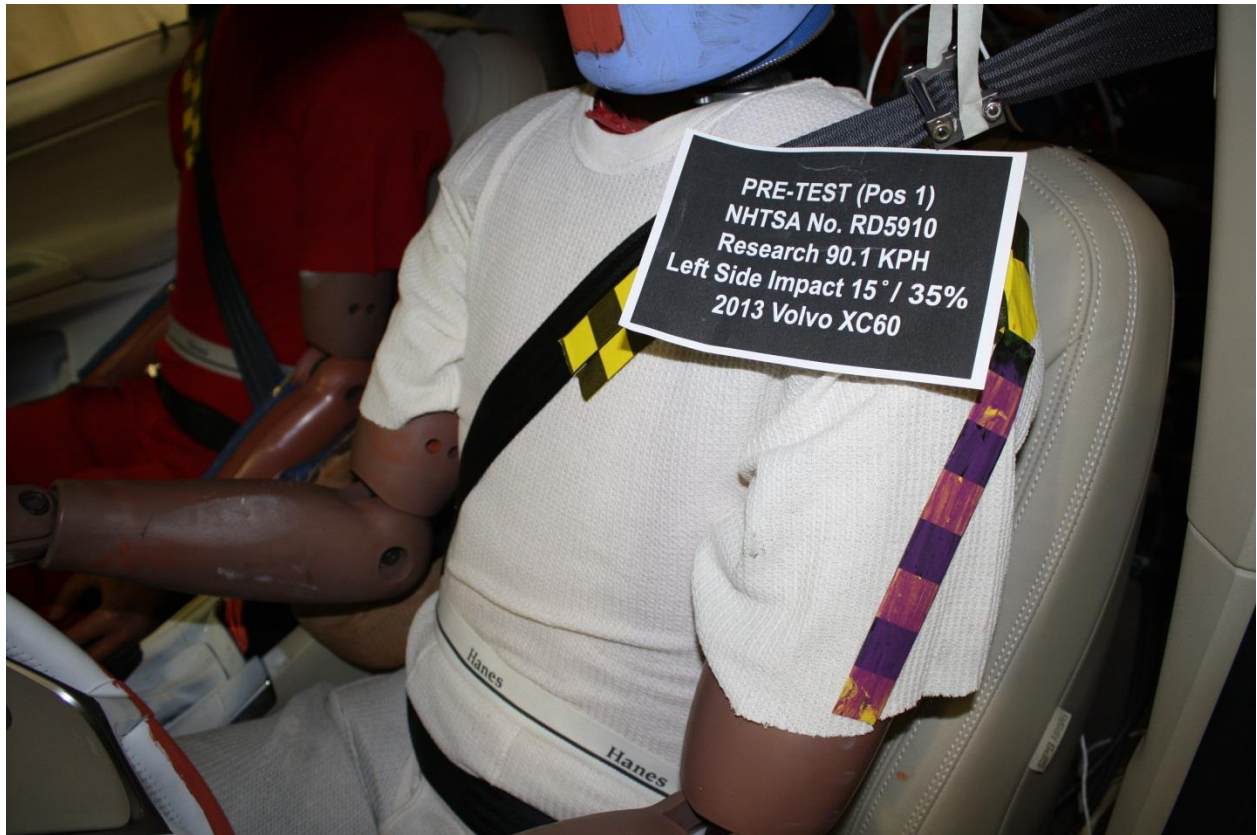
No. 072 Post-Test View of Driver Right Knee and Bolster



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



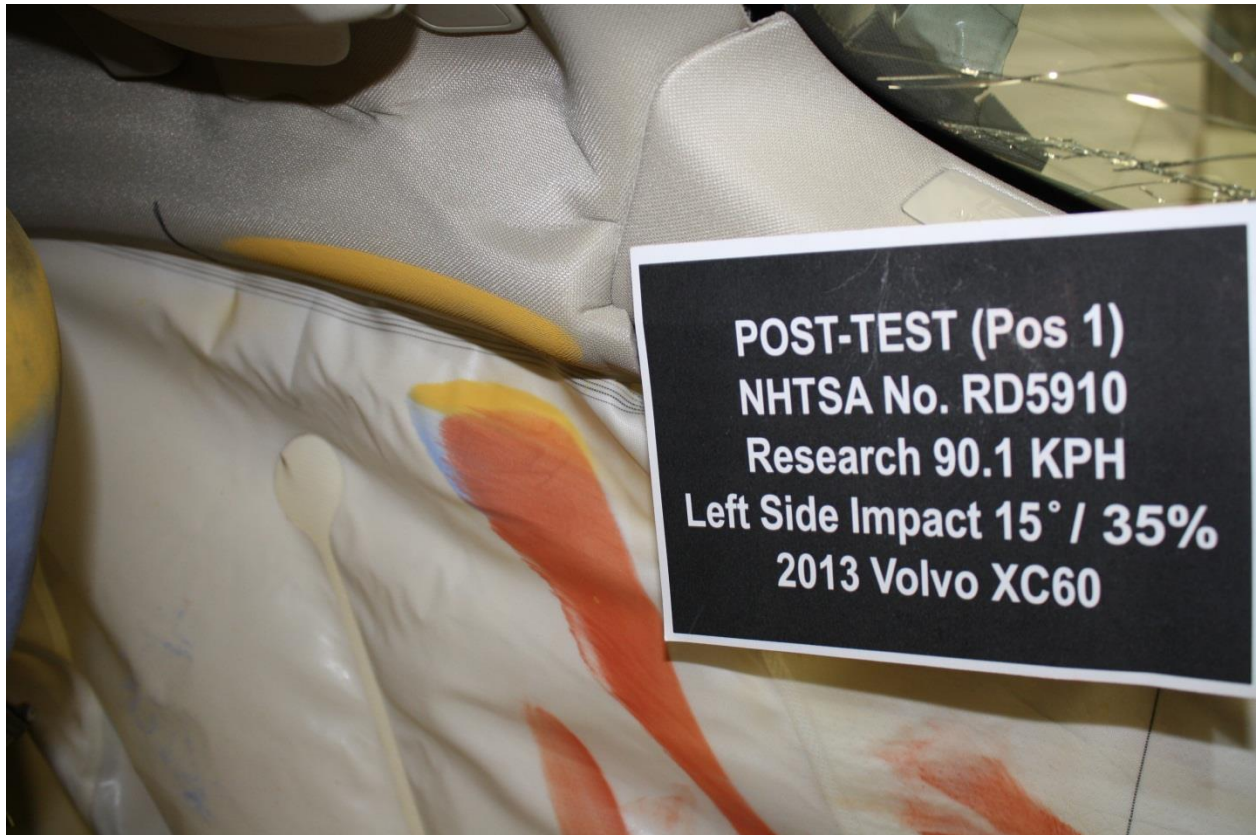
No. 078 Post-Test Left Side View of Steering Wheel set position



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



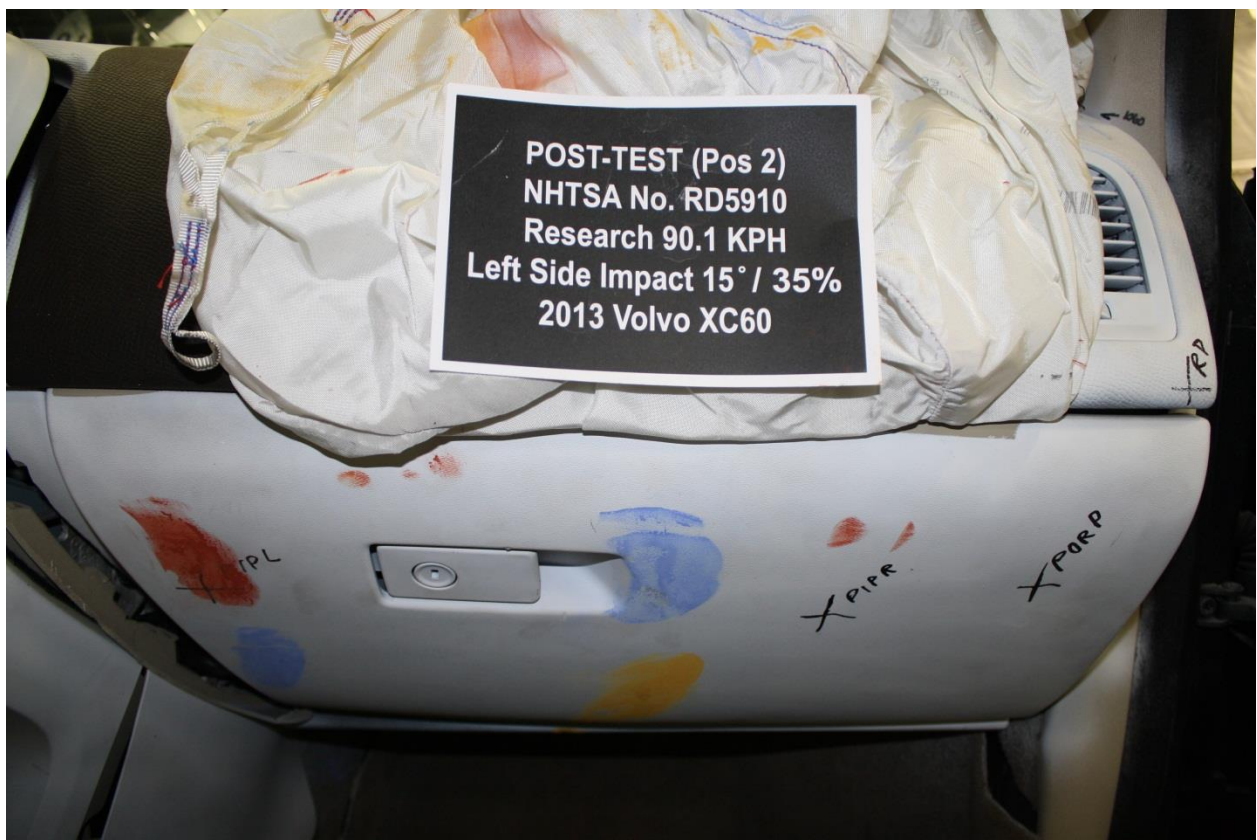
No. 081a Post-Test View of Driver Body Contact with Vehicle Interior - B

Photo Not Applicable

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



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



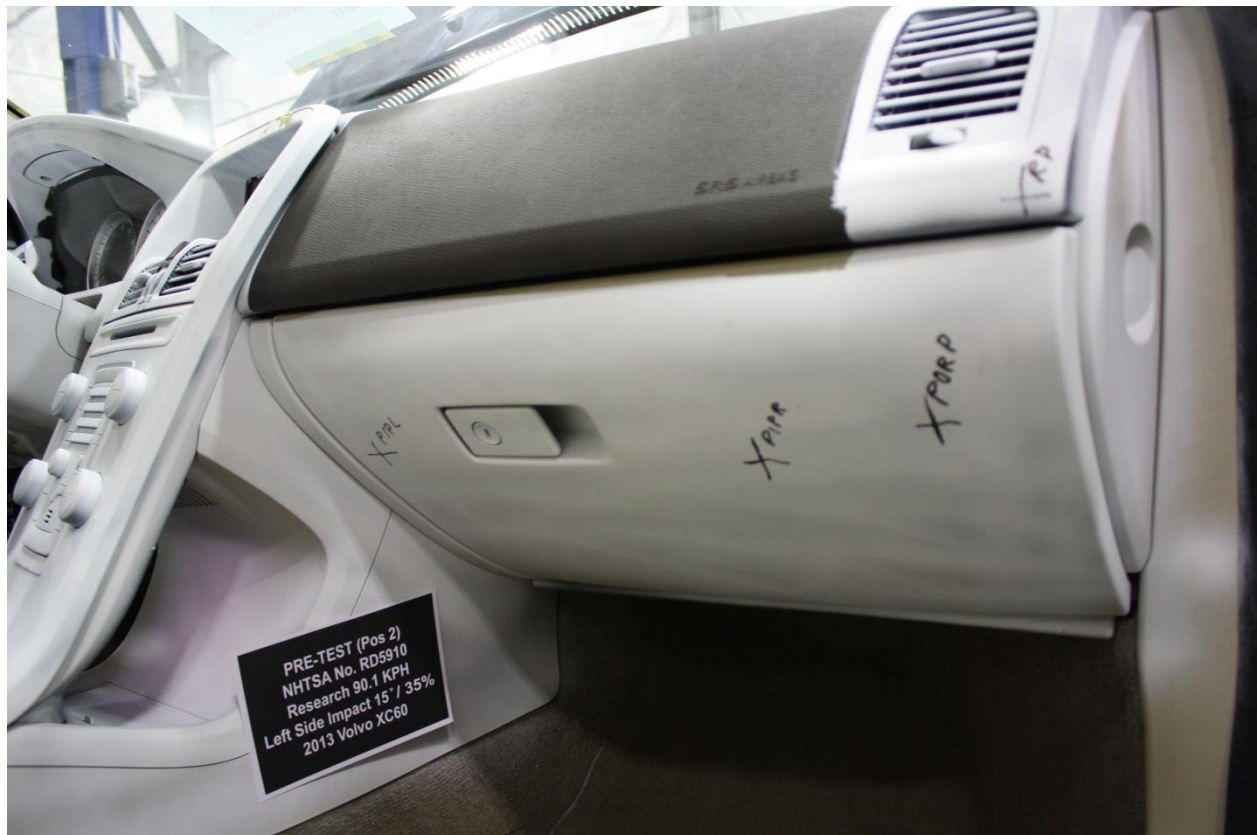
No. 083 Post-Test Overall View of Passenger Knee Bolsters



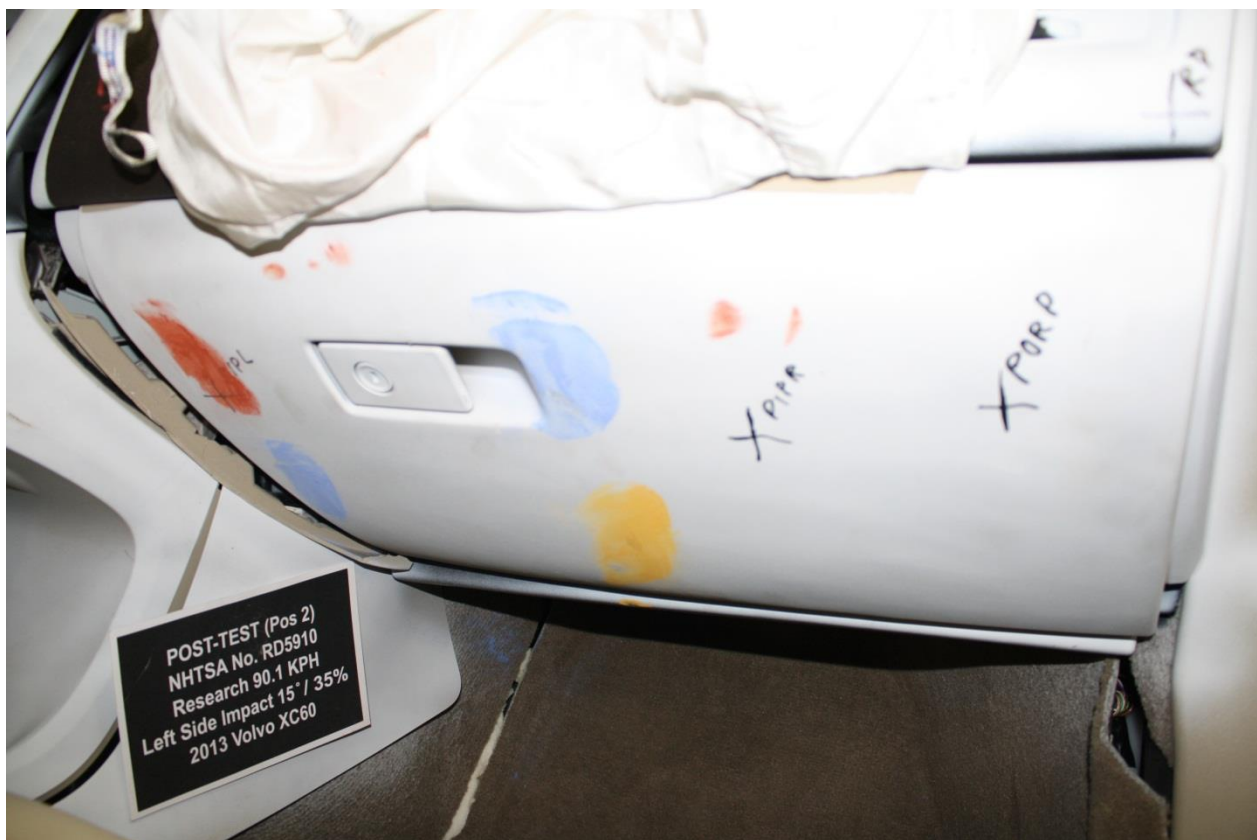
No. 084 Pre-Test Left Side View of Passenger Knee Bolsters



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 Right sill level, w/carpet



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



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



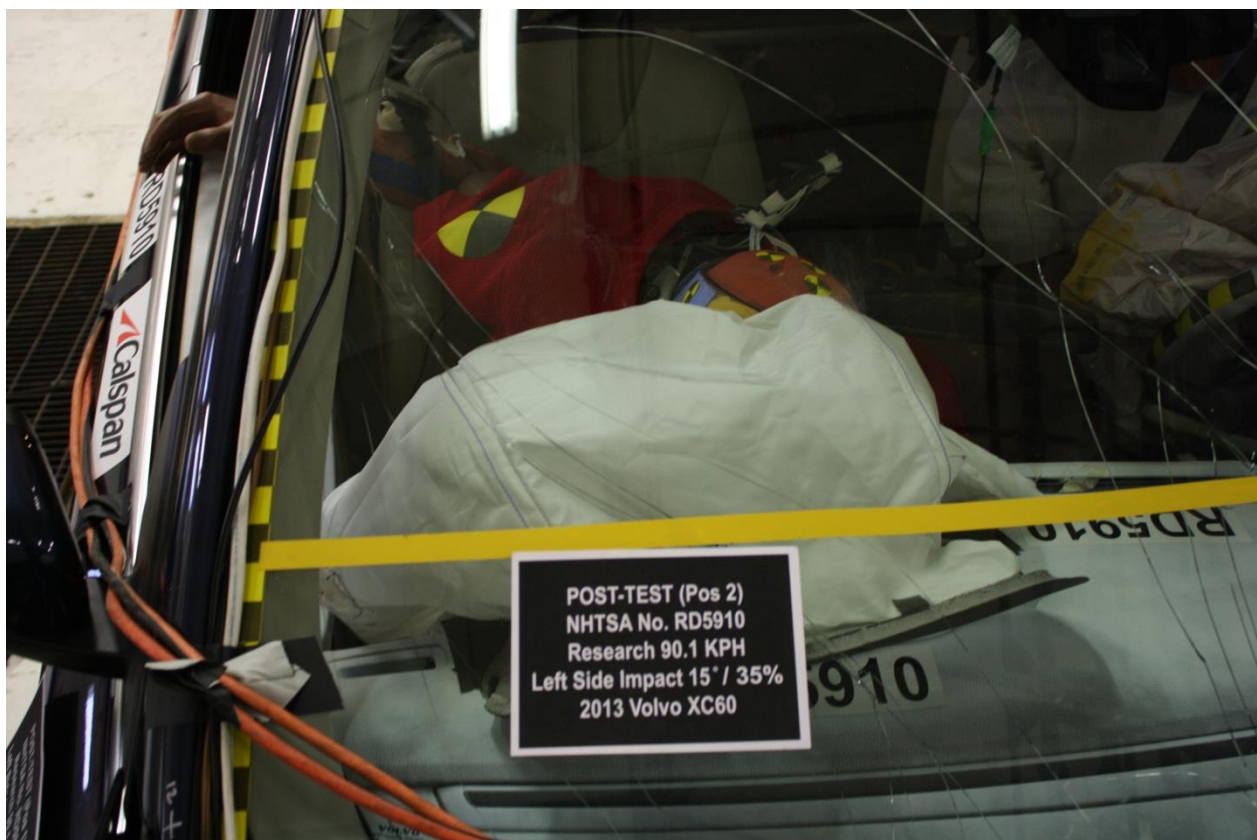
No. 094 Pre-Test View of Passenger Floor pan at Mid seat level, without carpet



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



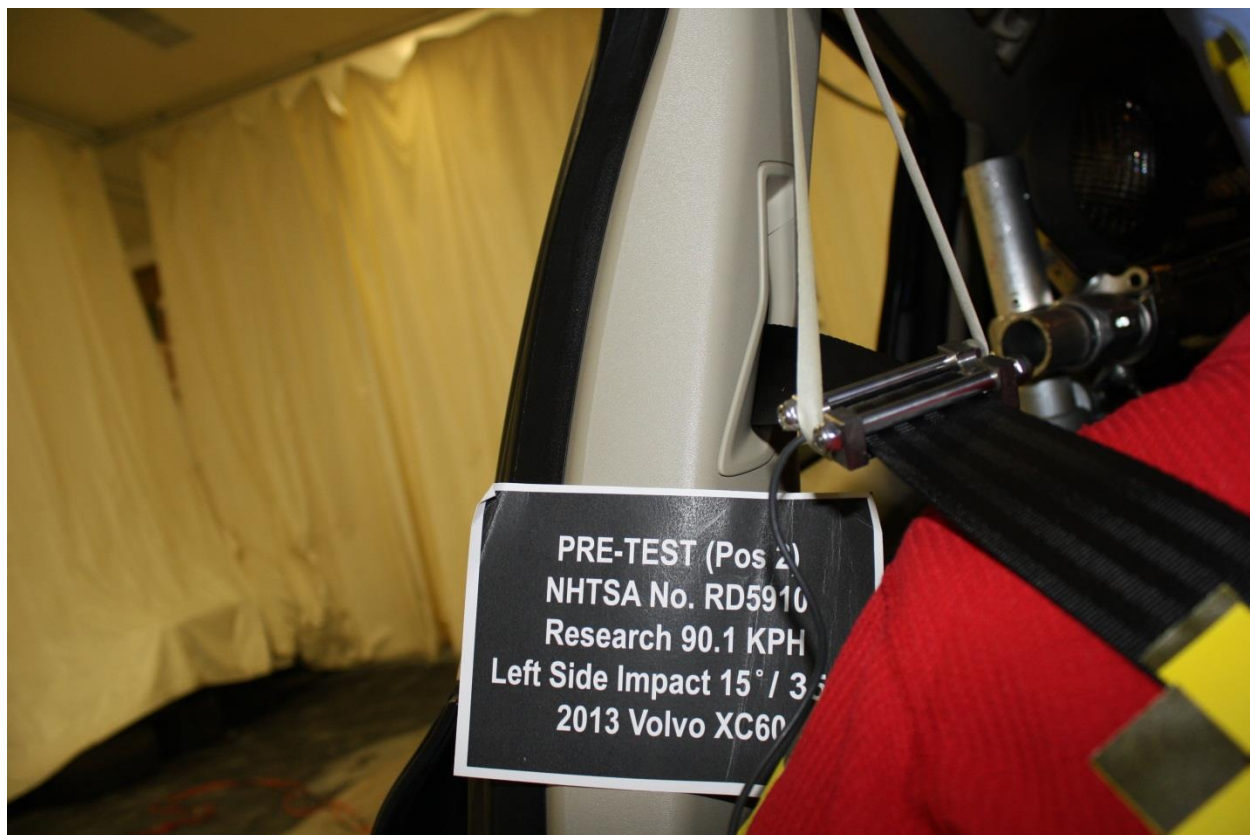
No. 107 Post-Test Passenger Seat Fore-Aft Markings



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



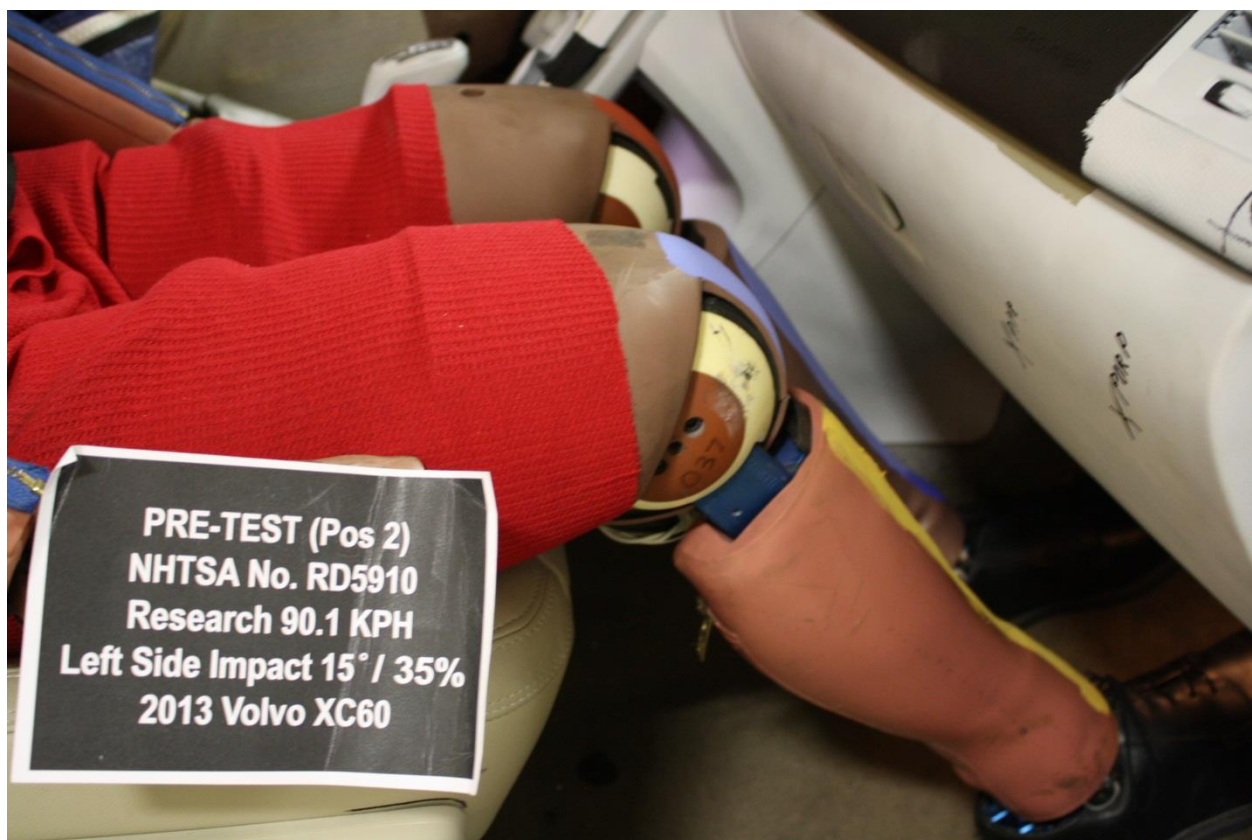
No. 111 Post-Test Passenger Adjustable D-ring



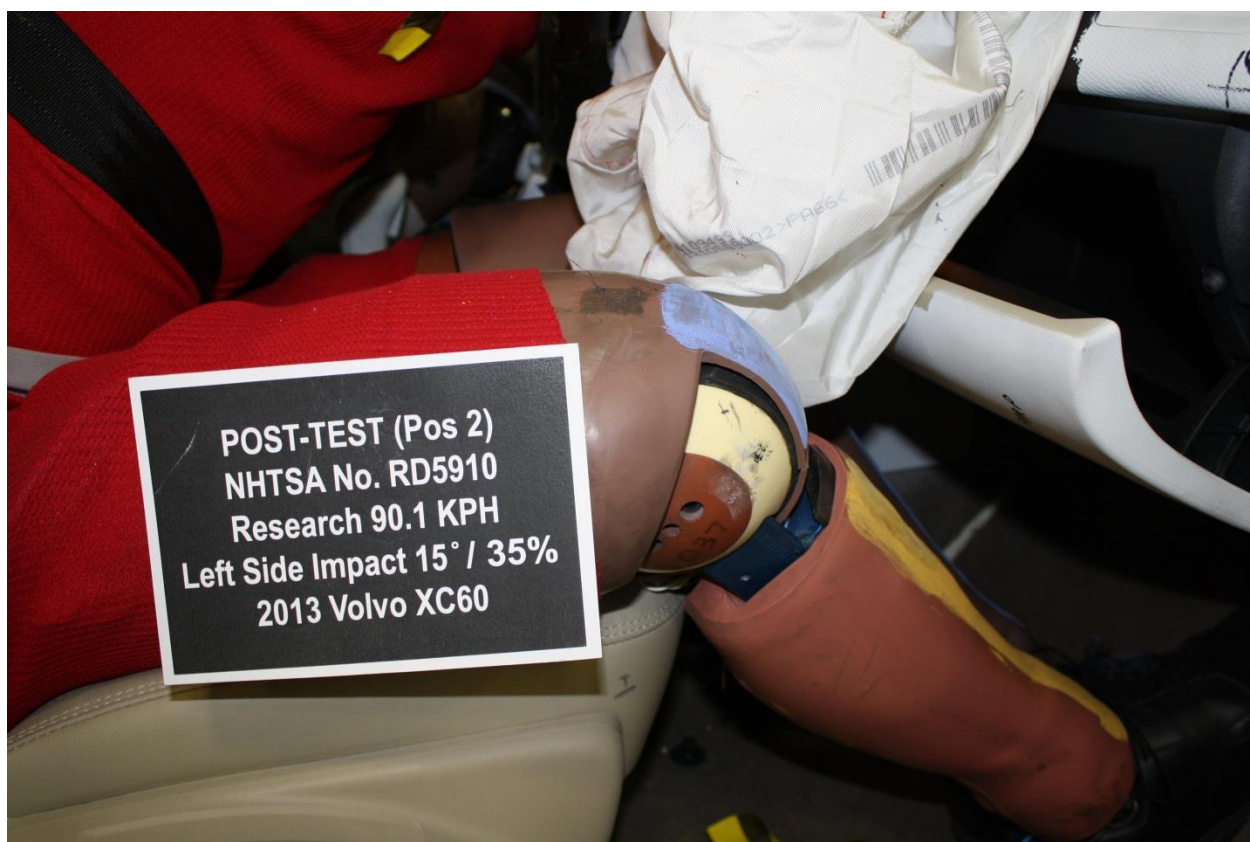
No. 112 Pre-Test View of Passenger Feet



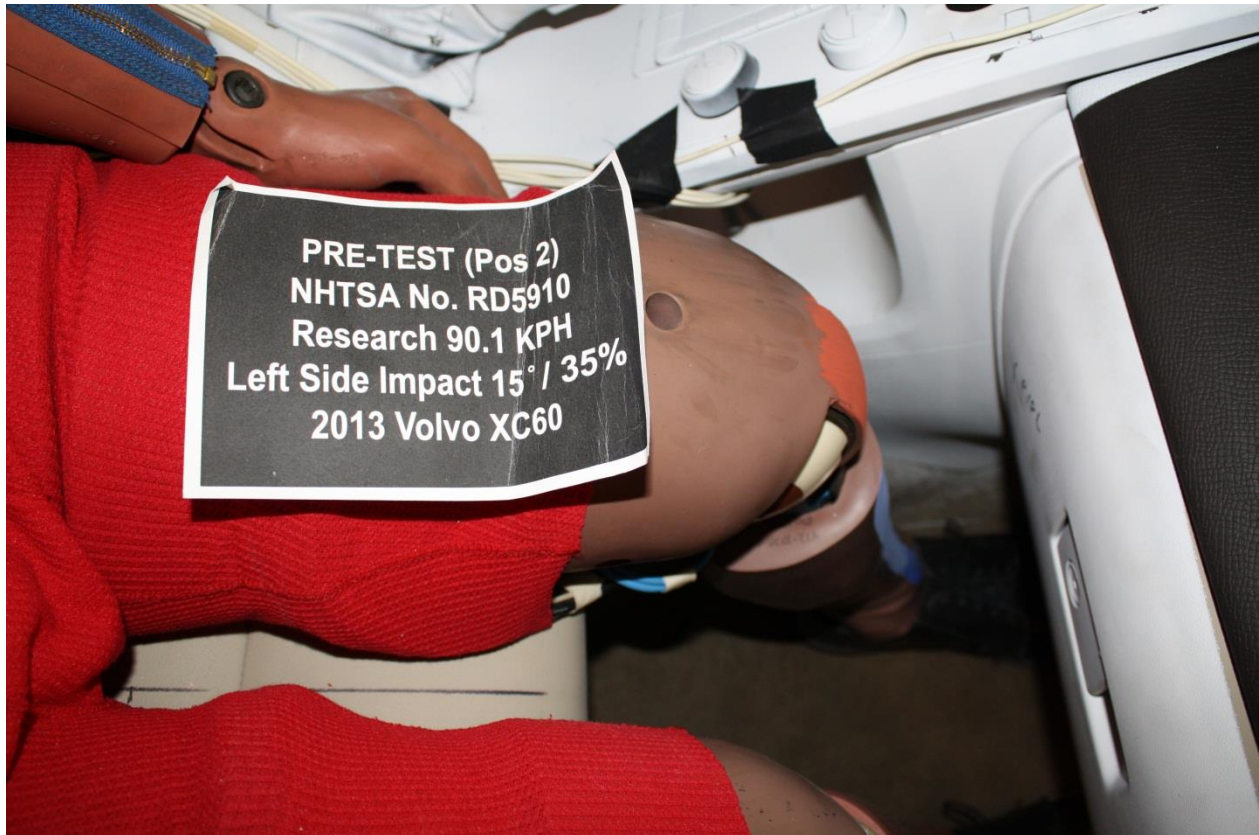
No. 113 Post-Test View of Passenger Feet



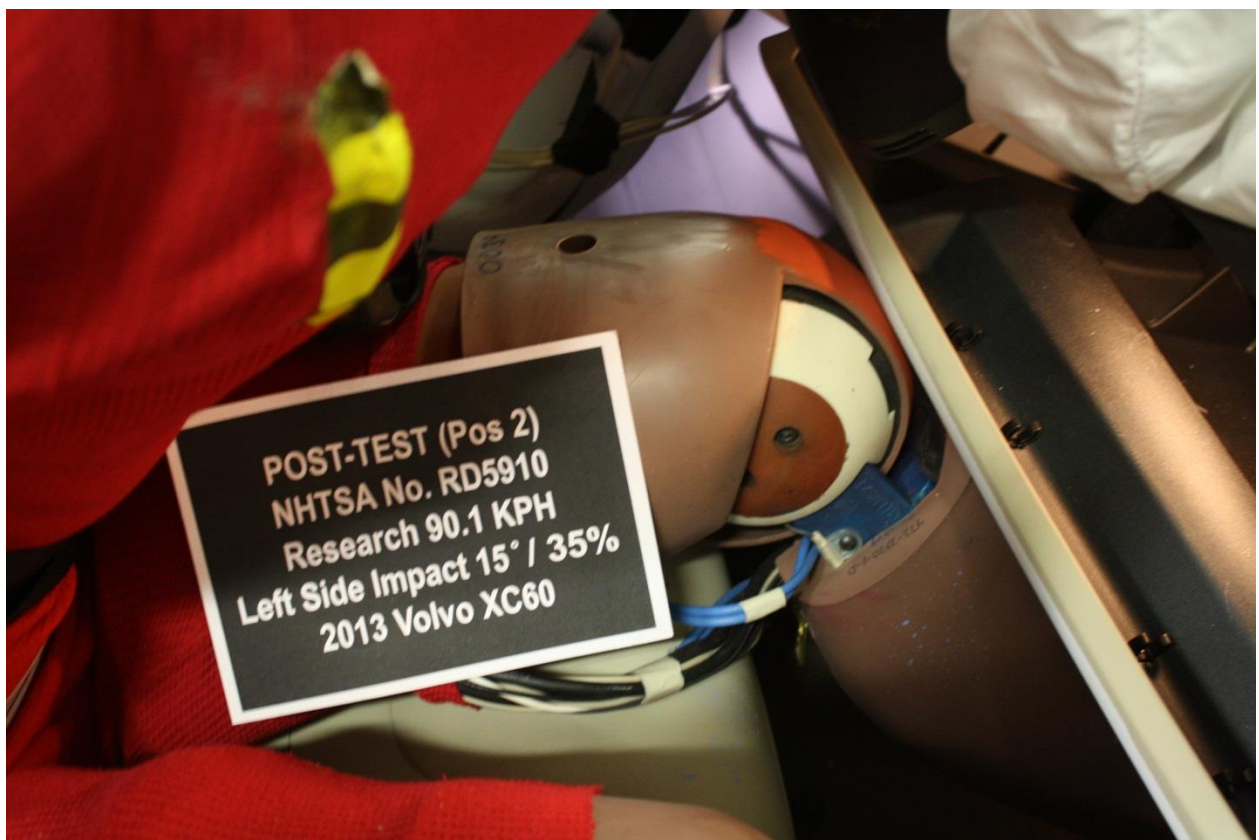
No. 114 Pre-Test View of Passenger Right Knee and Bolster



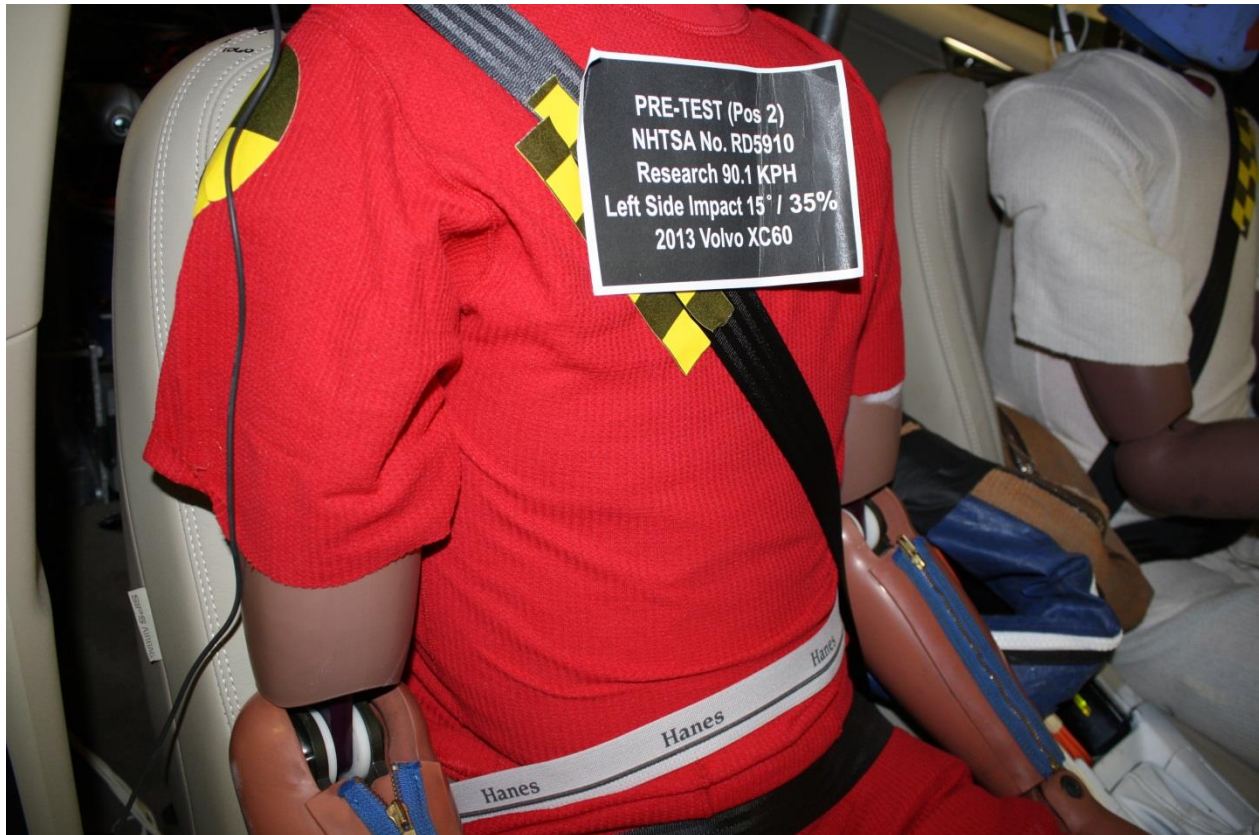
No. 115 Post-Test View of Passenger Right Knee and Bolster



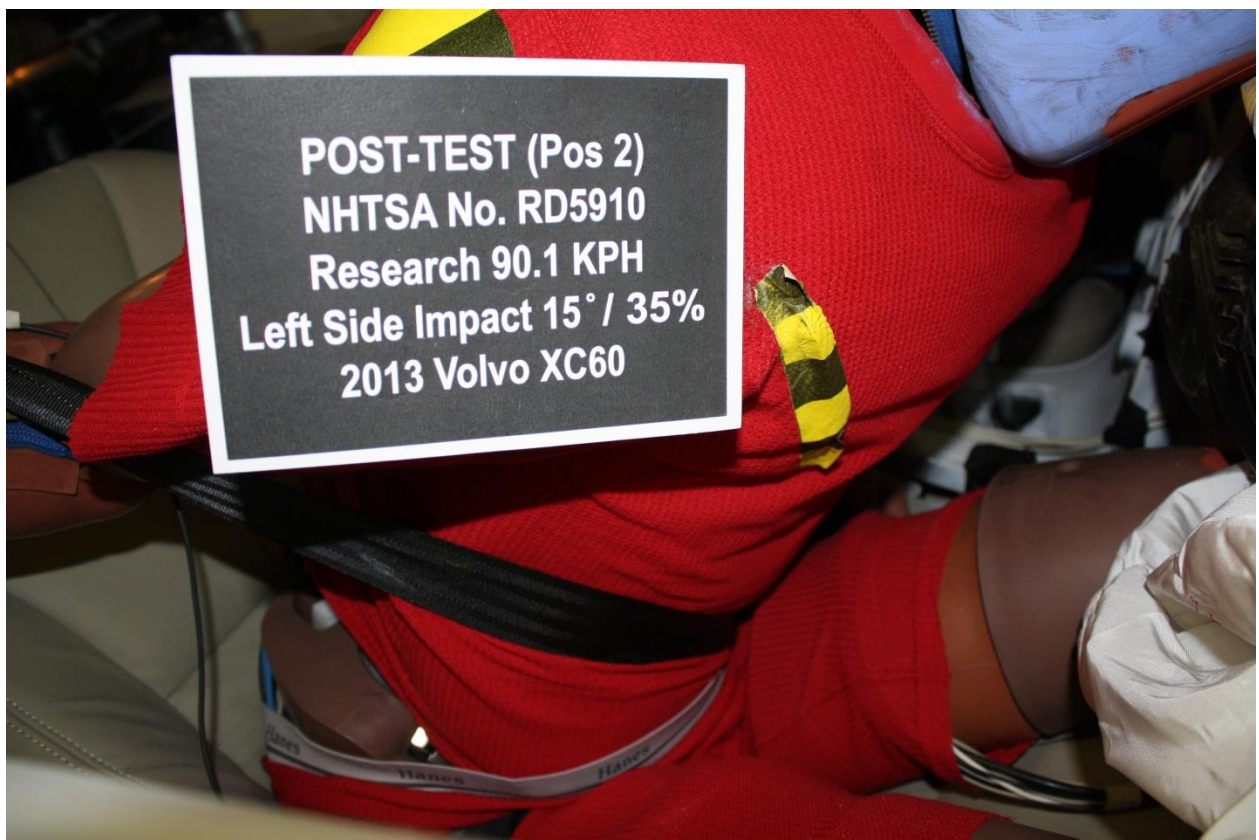
No. 116 Pre-Test View of Passenger Left Knee and Bolster



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



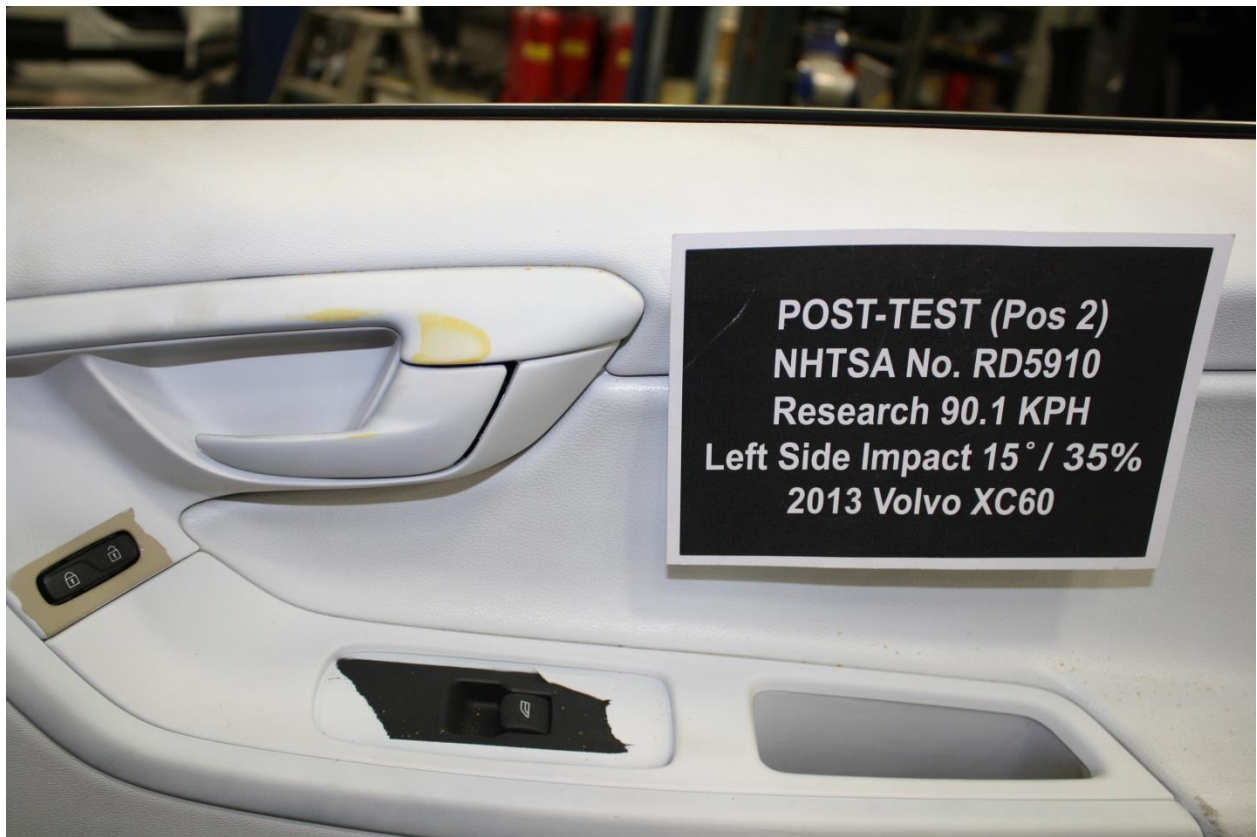
No. 120 Post-Test View of Passenger Head contact with Airbag – Front

Photo Not Applicable

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



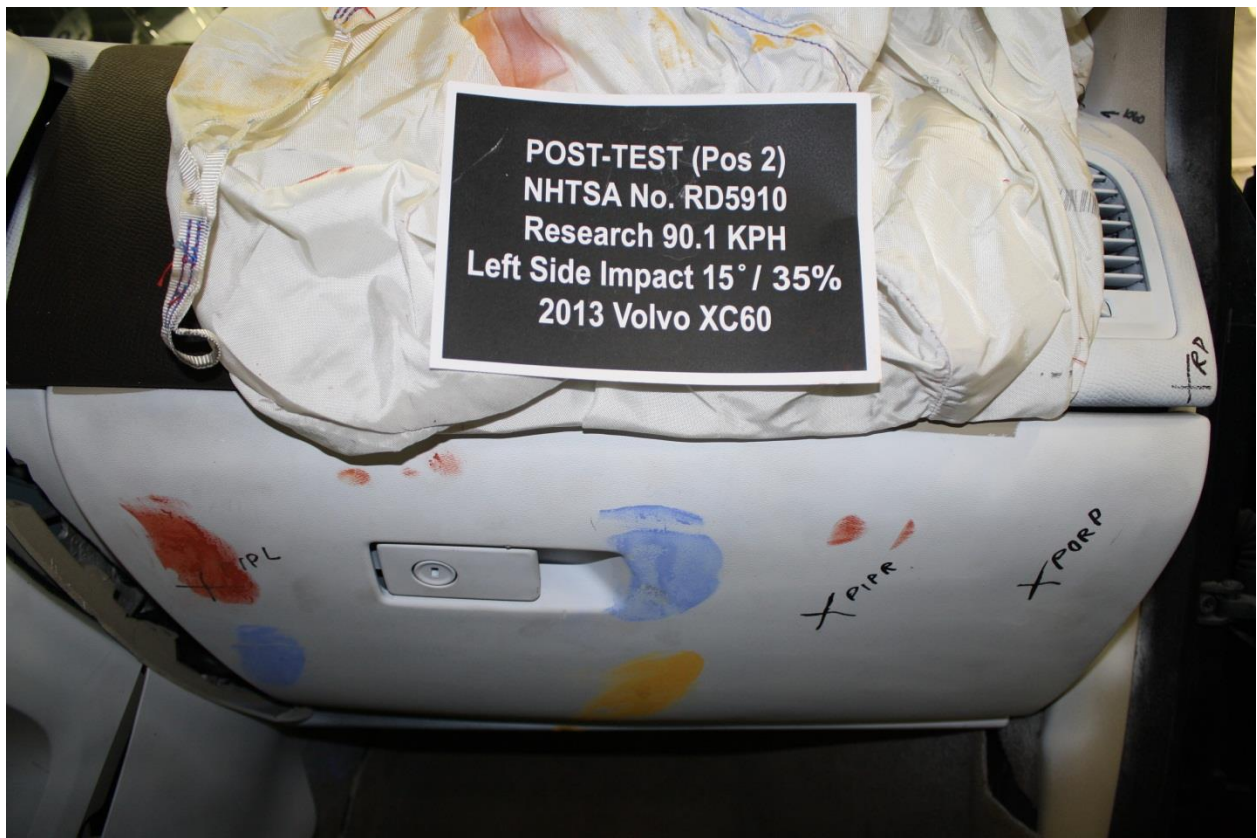
No. 121 Post-Test View of Passenger Head contact with Interior



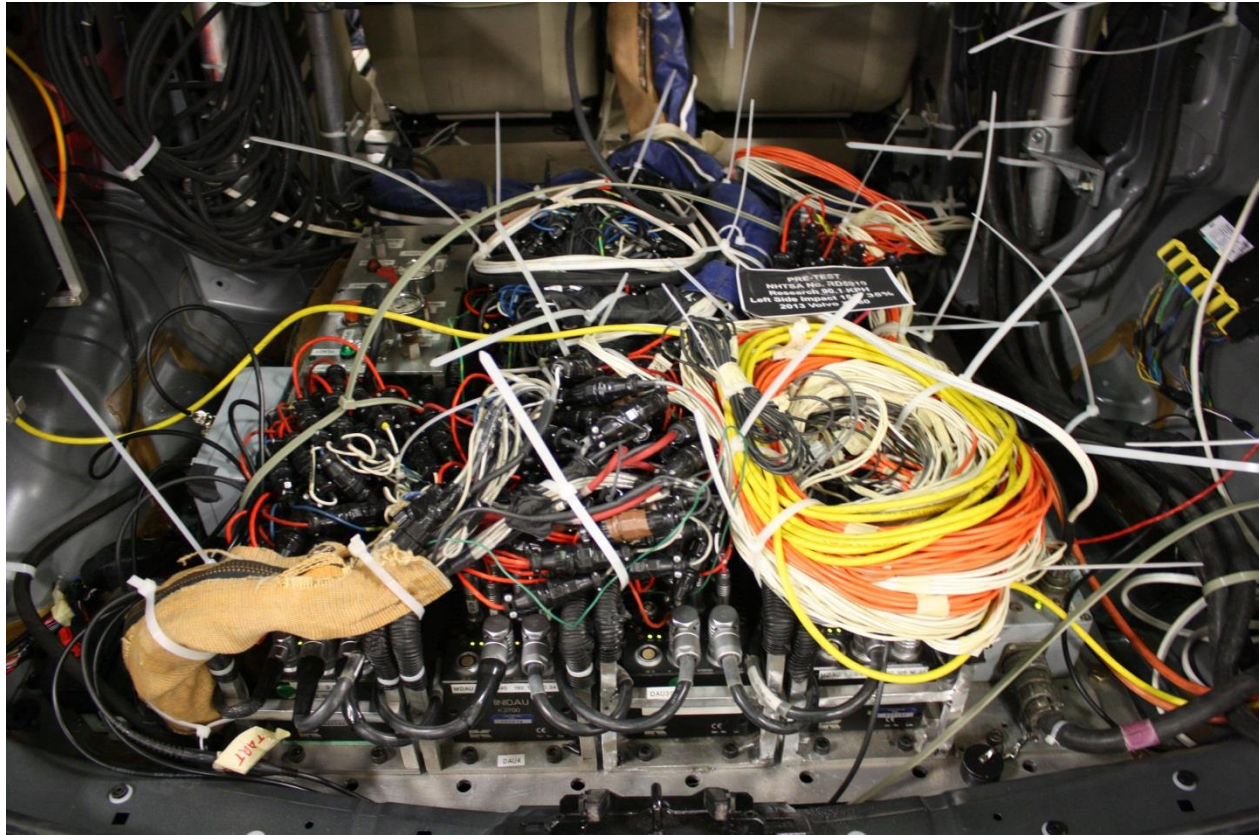
No. 121a Post-Test View of Passenger Head contact with Interior

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



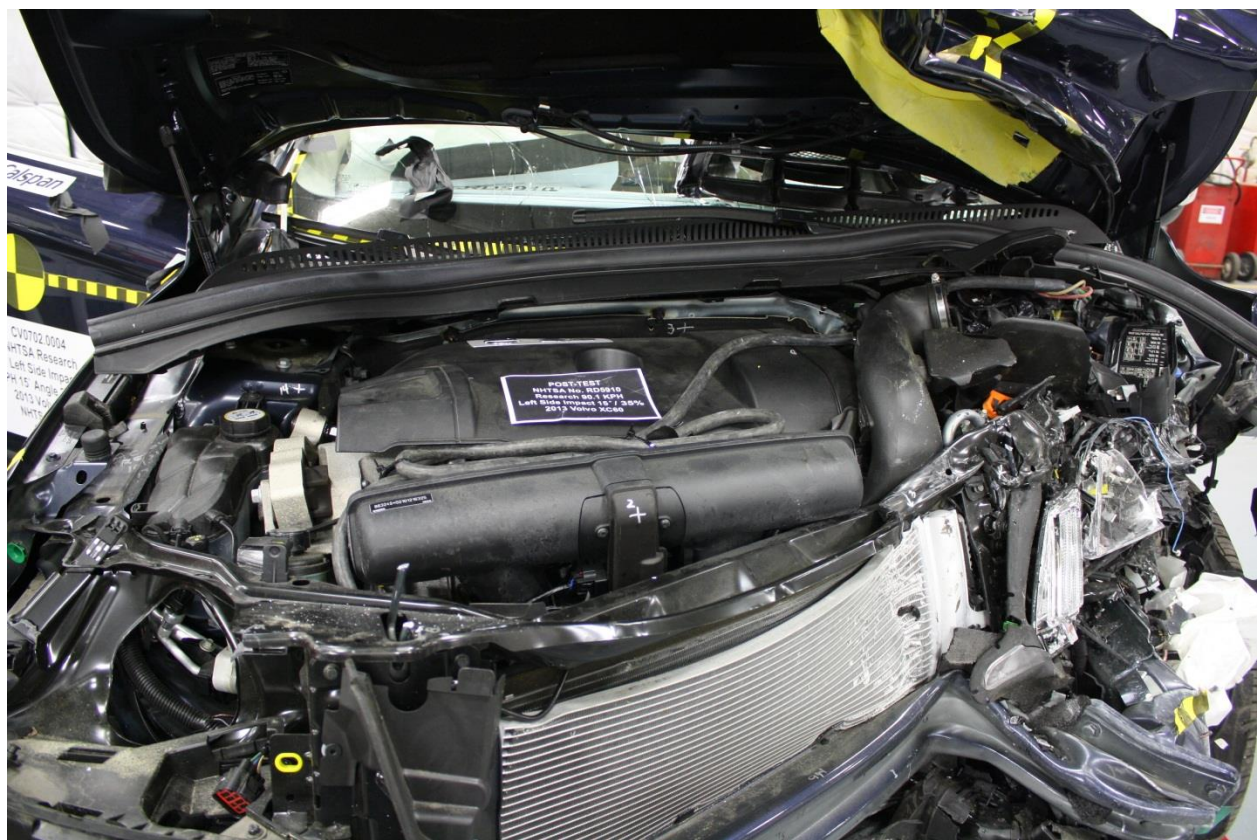
No. 125 Pre-Test View of Fuel Filler Cap



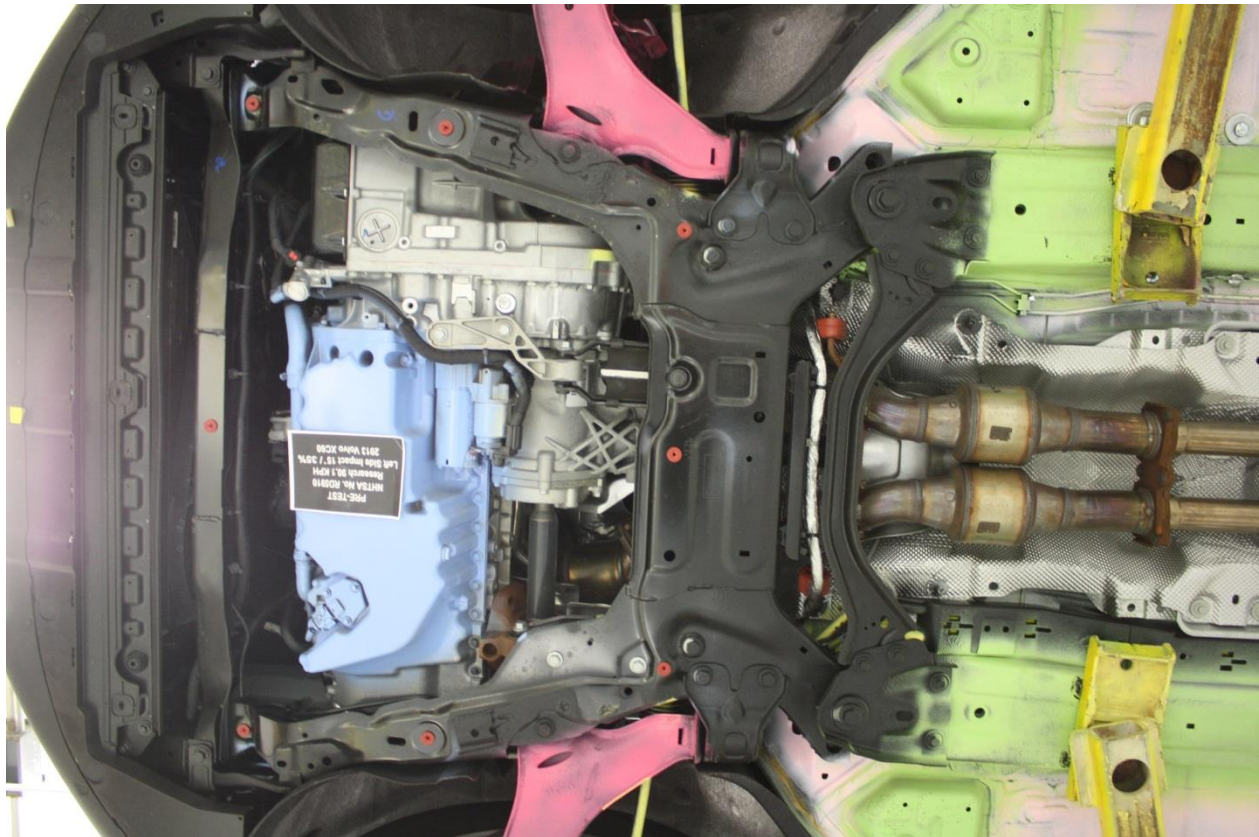
No. 126 Post-Test View of Fuel Filler Cap



No. 127 Pre-Test Engine Compartment View



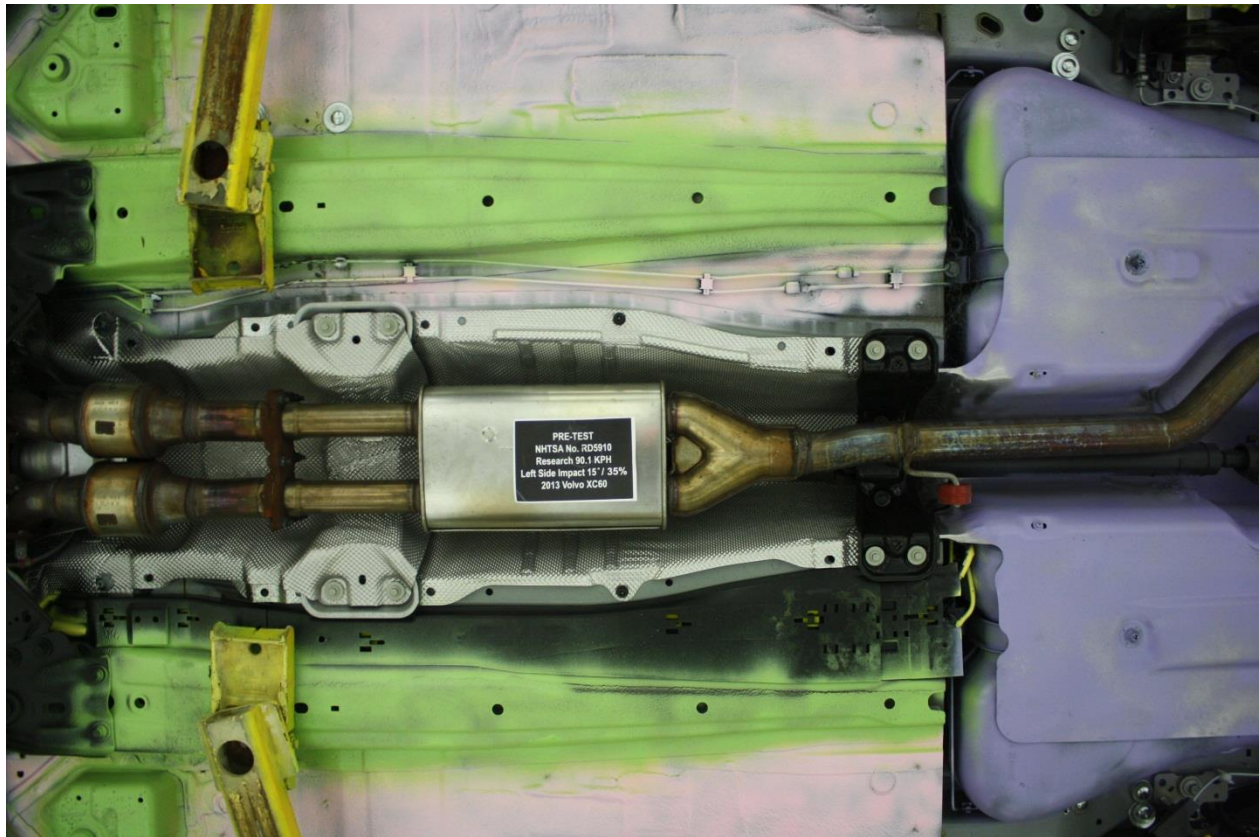
No. 128 Post-Test Engine Compartment View



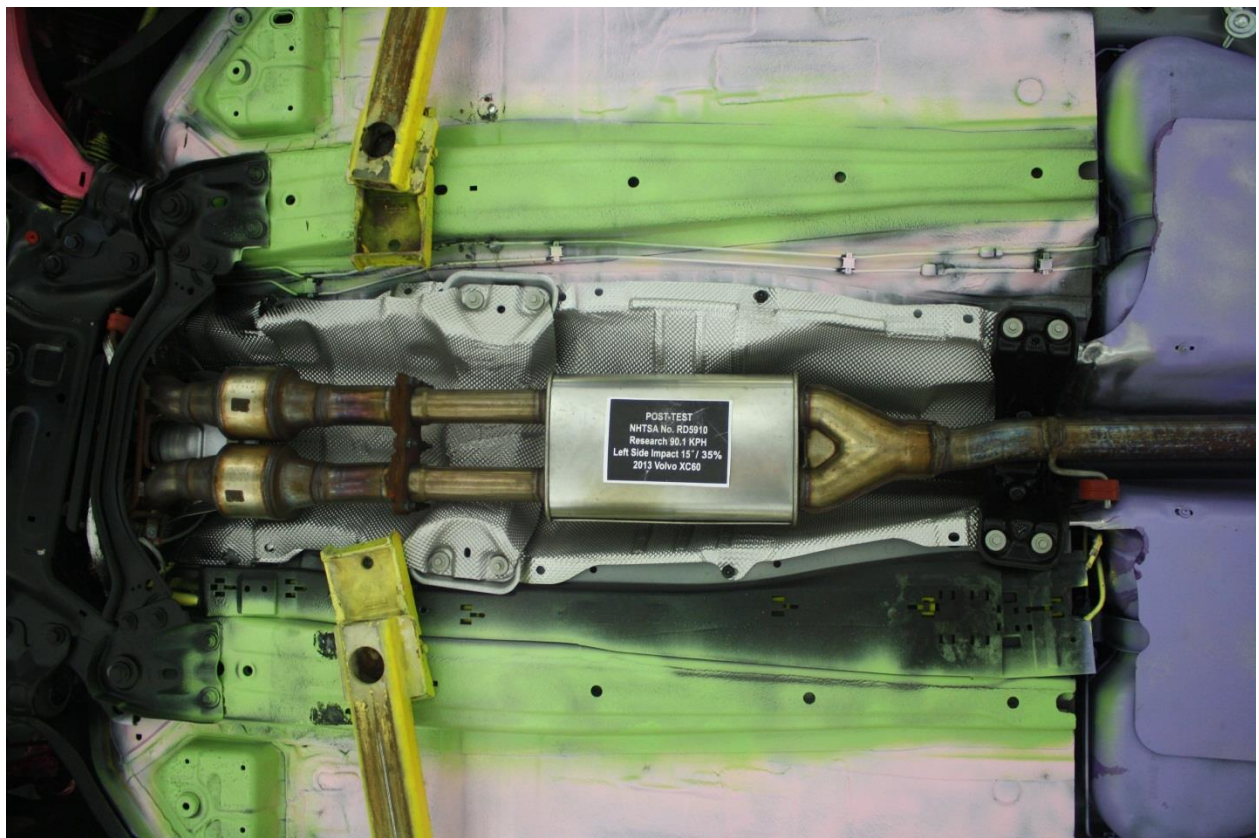
No. 129 Pre-Test View of Front Underbody (perpendicular to vehicle)



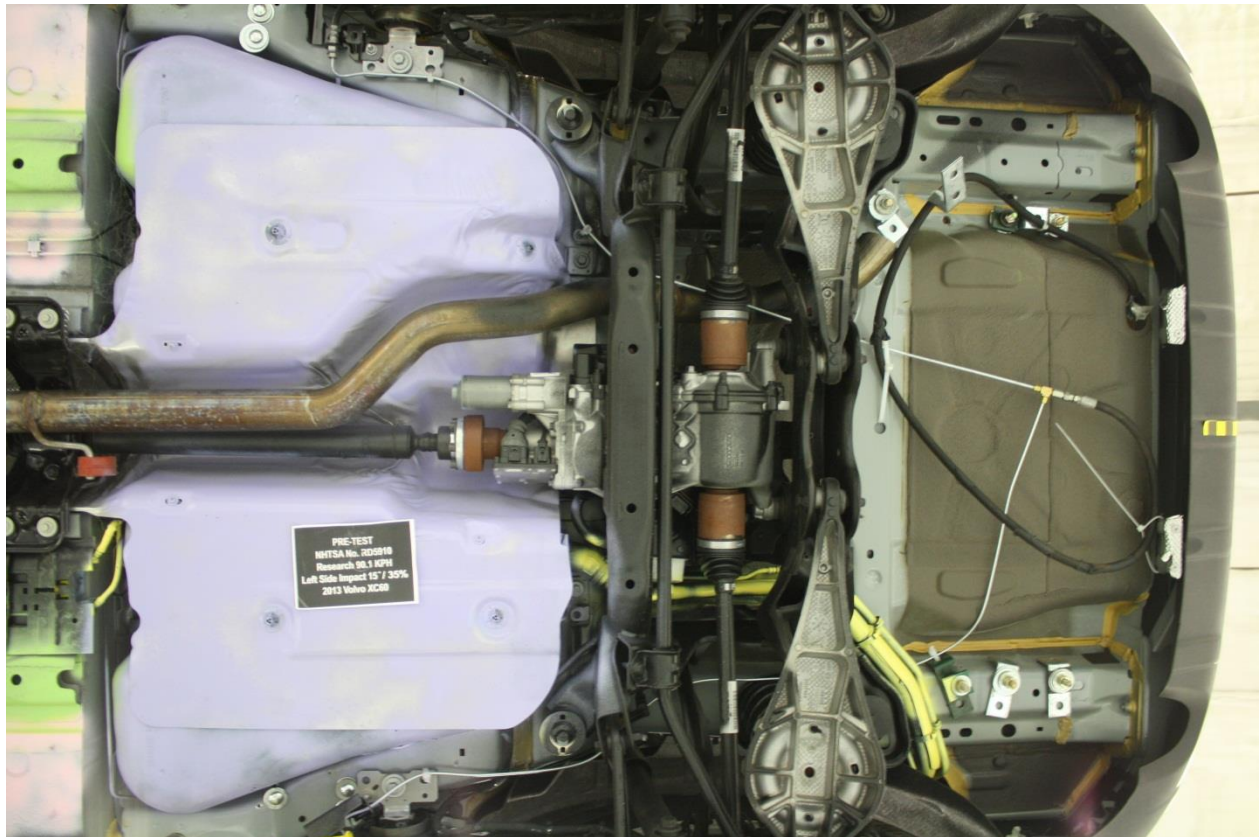
No. 130 Post-Test View of Front Underbody (perpendicular to vehicle)



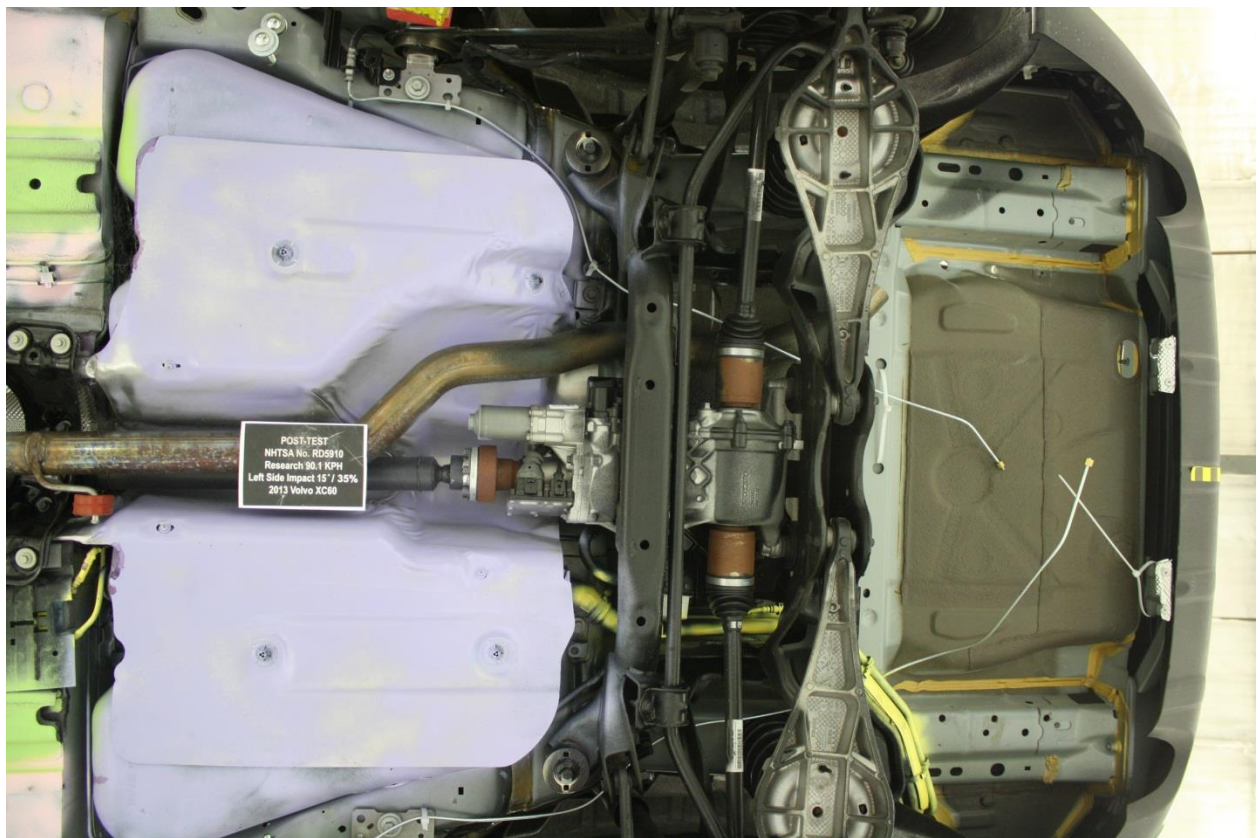
No. 131 Pre-Test View of Mid Underbody (perpendicular to vehicle)



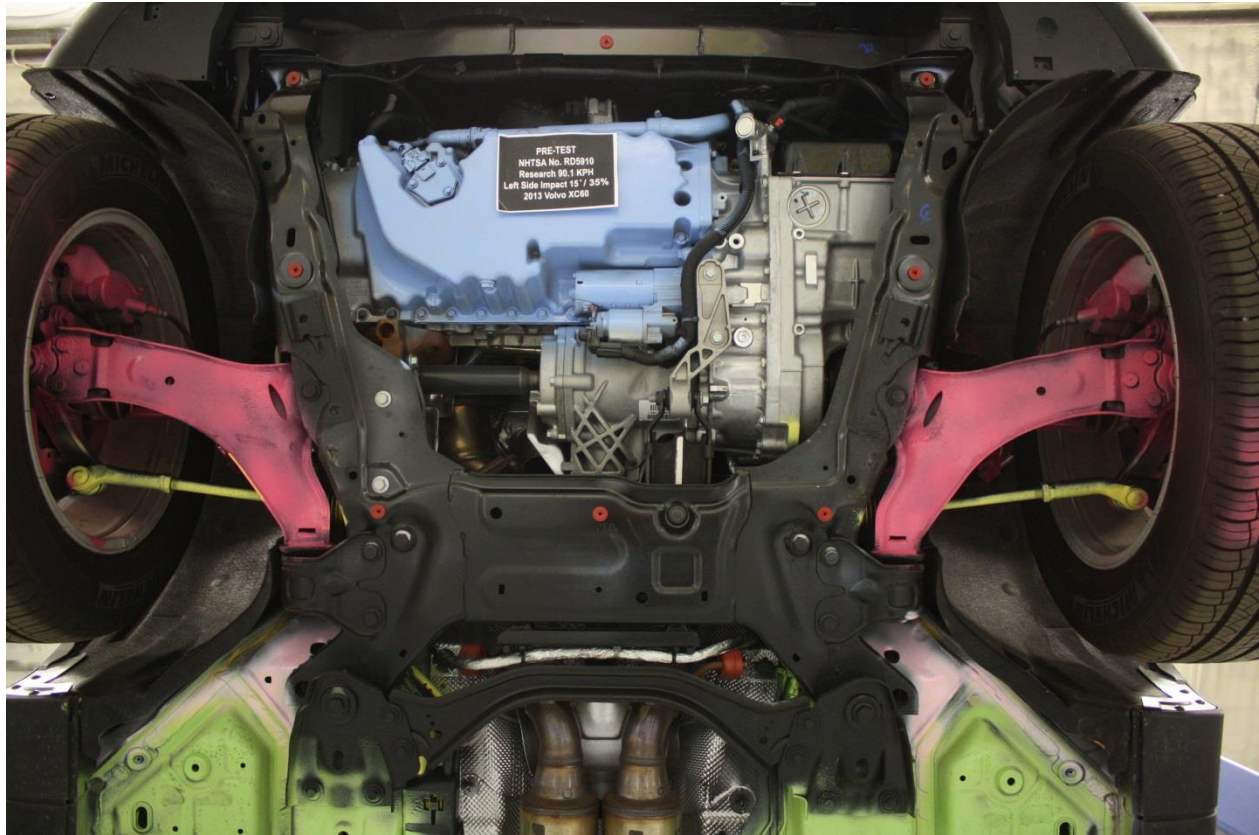
No. 132 Post-Test View of Mid Underbody (perpendicular to vehicle)



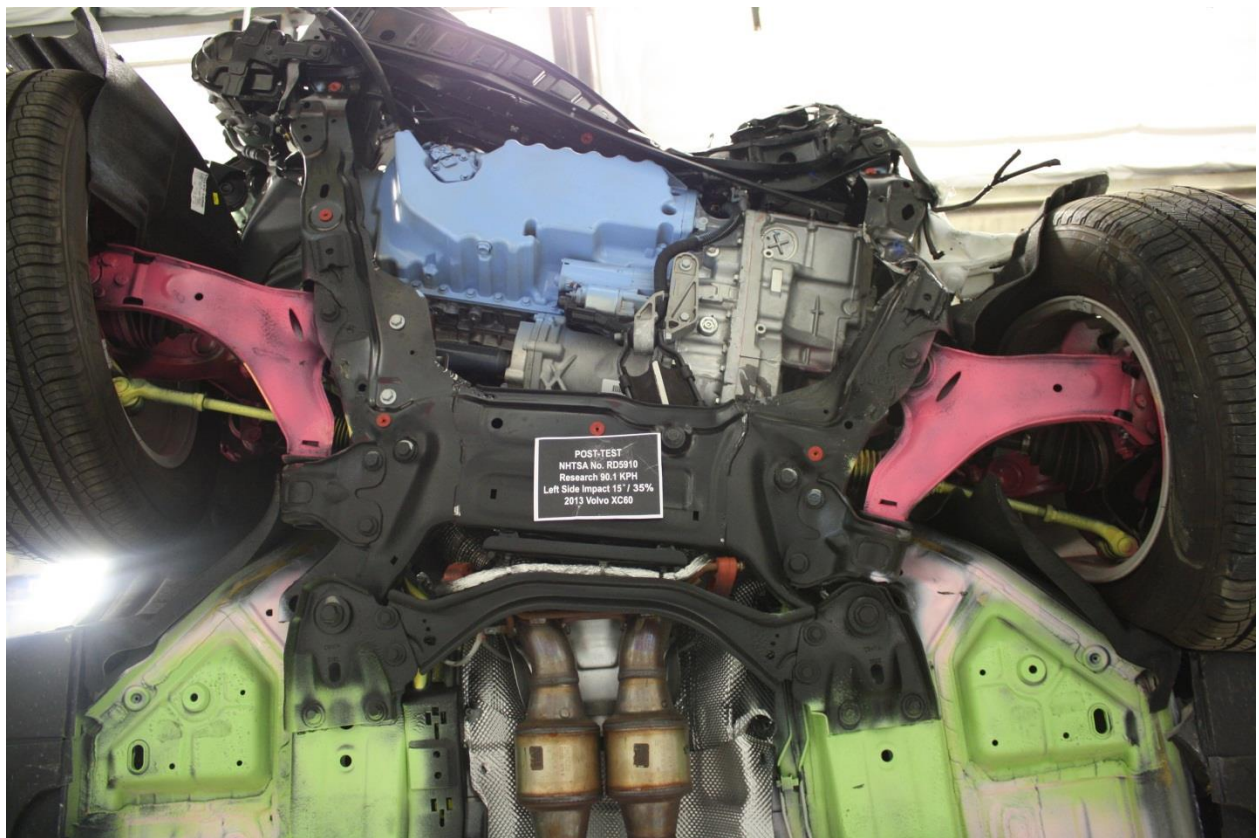
No. 133 Pre-Test View of Rear Underbody (perpendicular to vehicle)



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



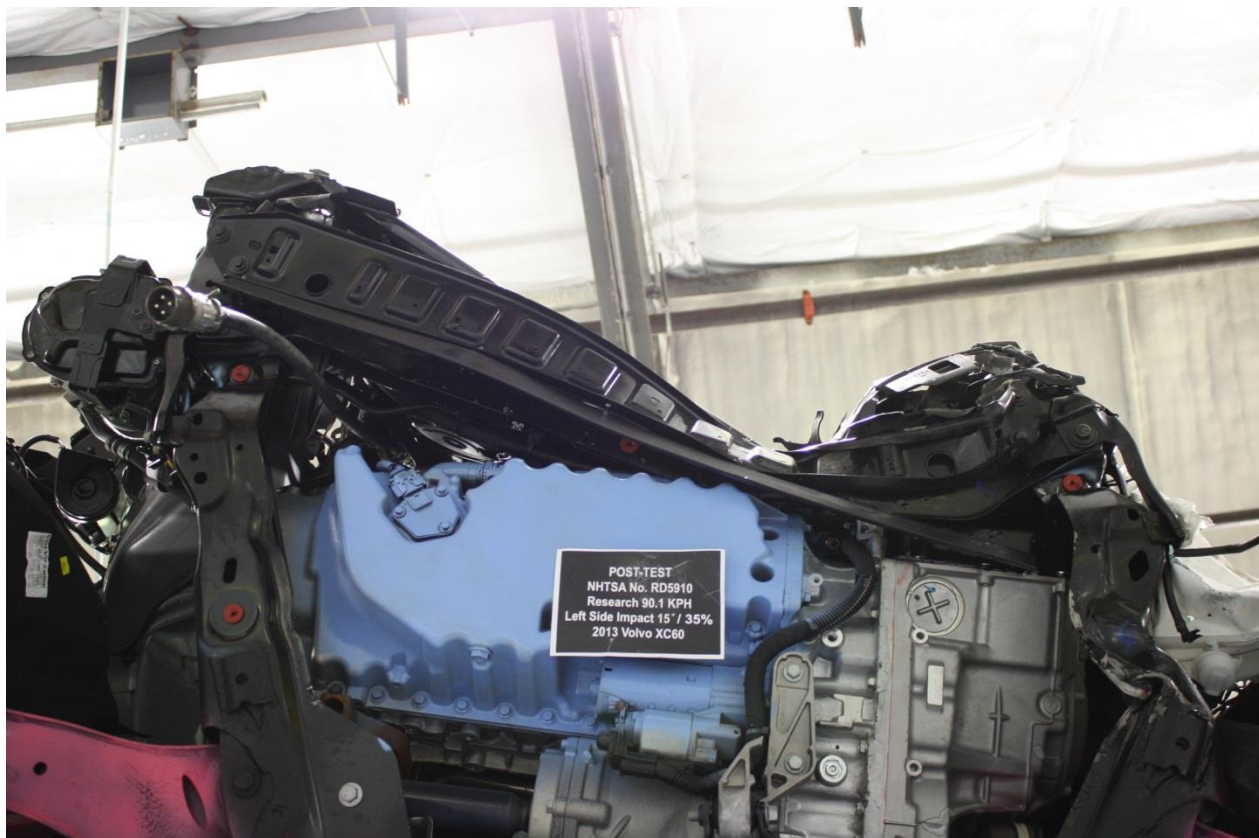
No. 135 Pre-Test View of Steering rack and or sway bar



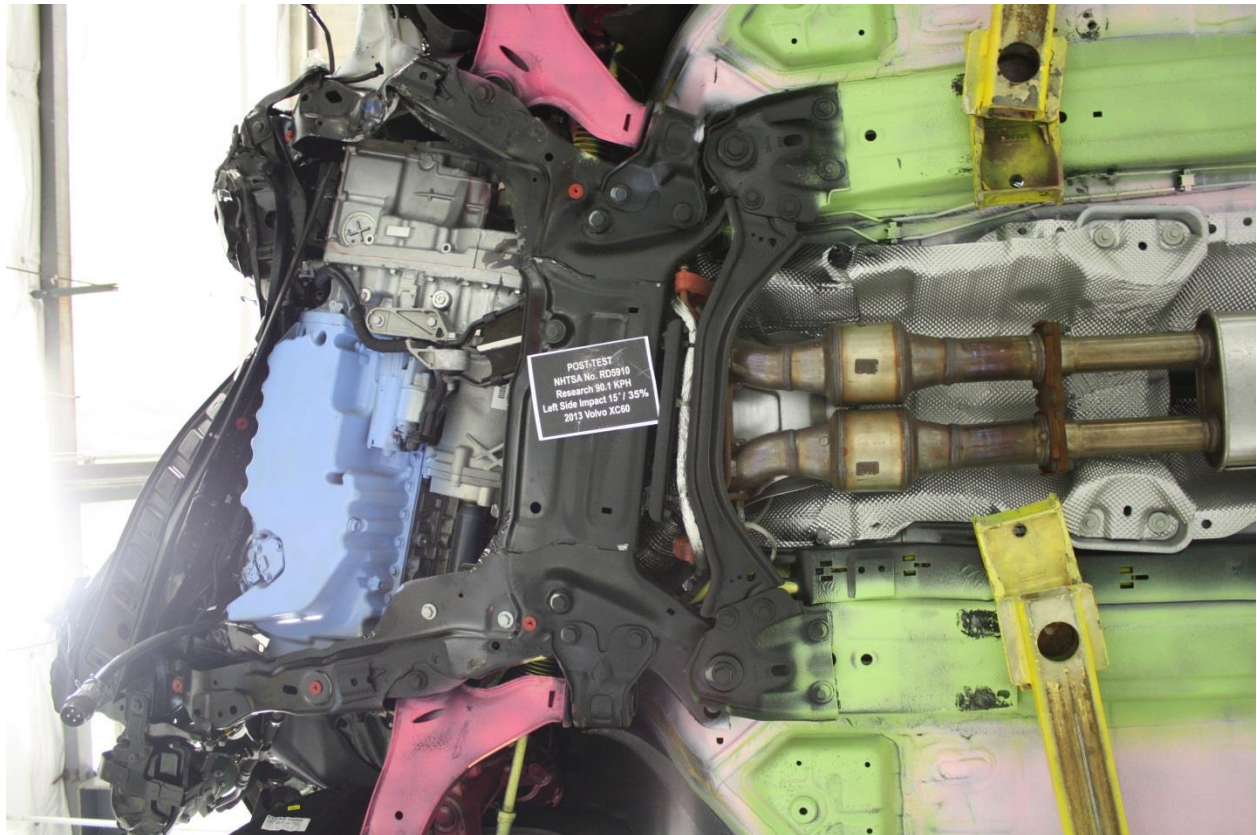
No. 136 Post-Test View of Steering rack and or sway bar



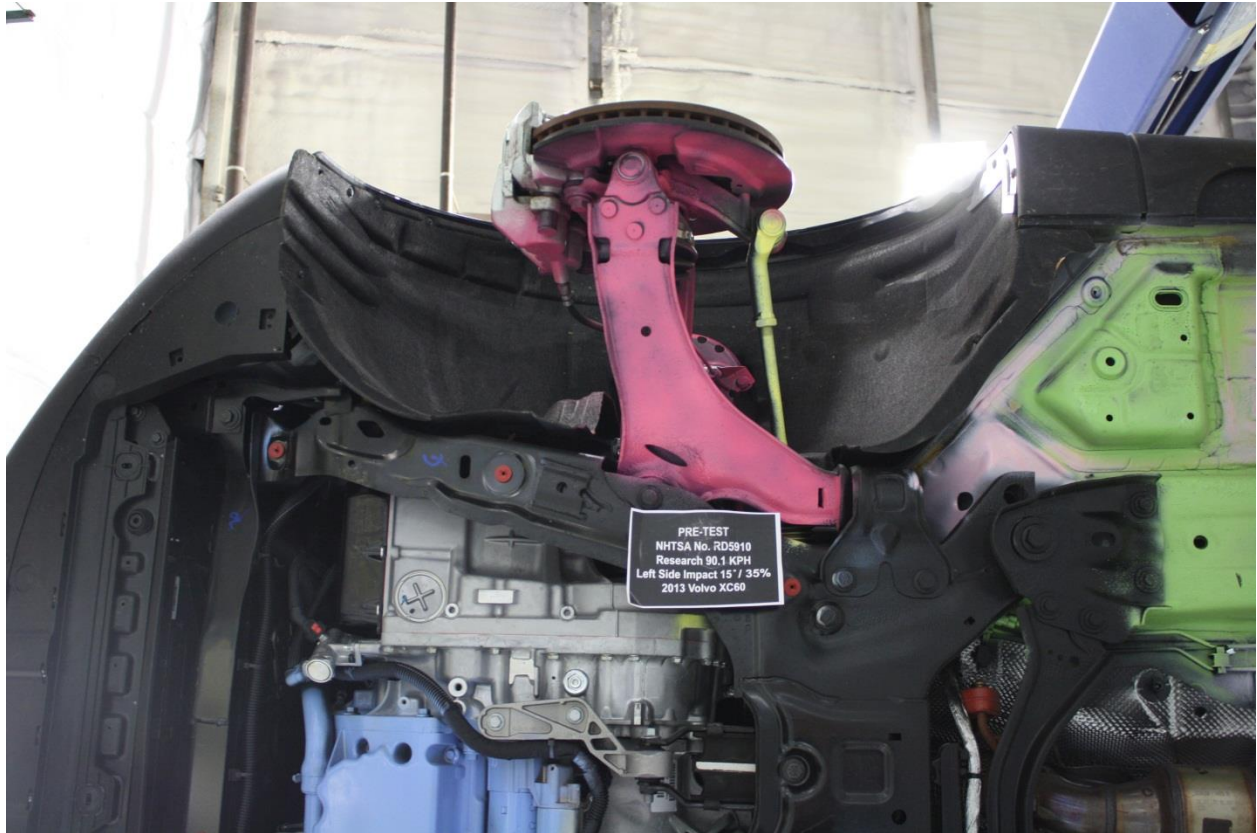
No. 137 Pre-Test Bumper to Rail Attachments and Crush Initiators



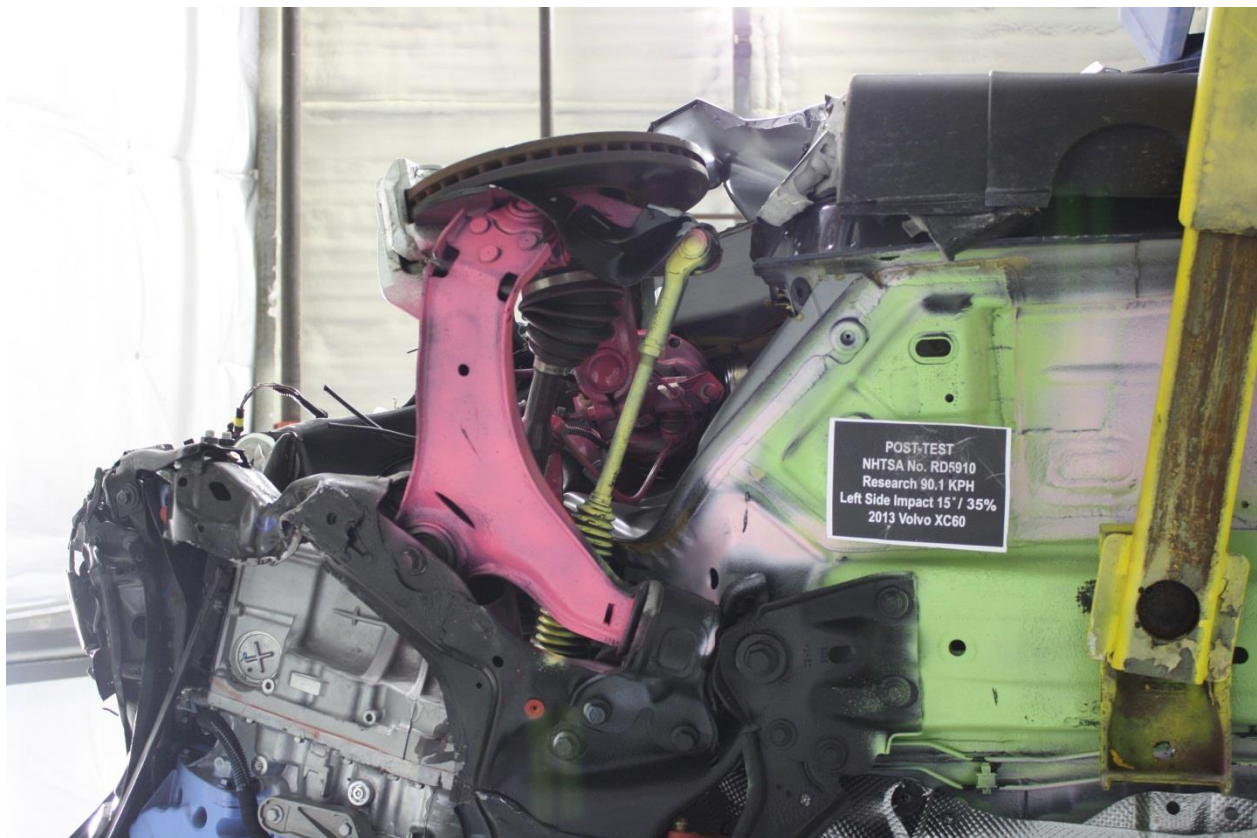
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No. 139 Post-Test View of Front Sub-Frame Deformation



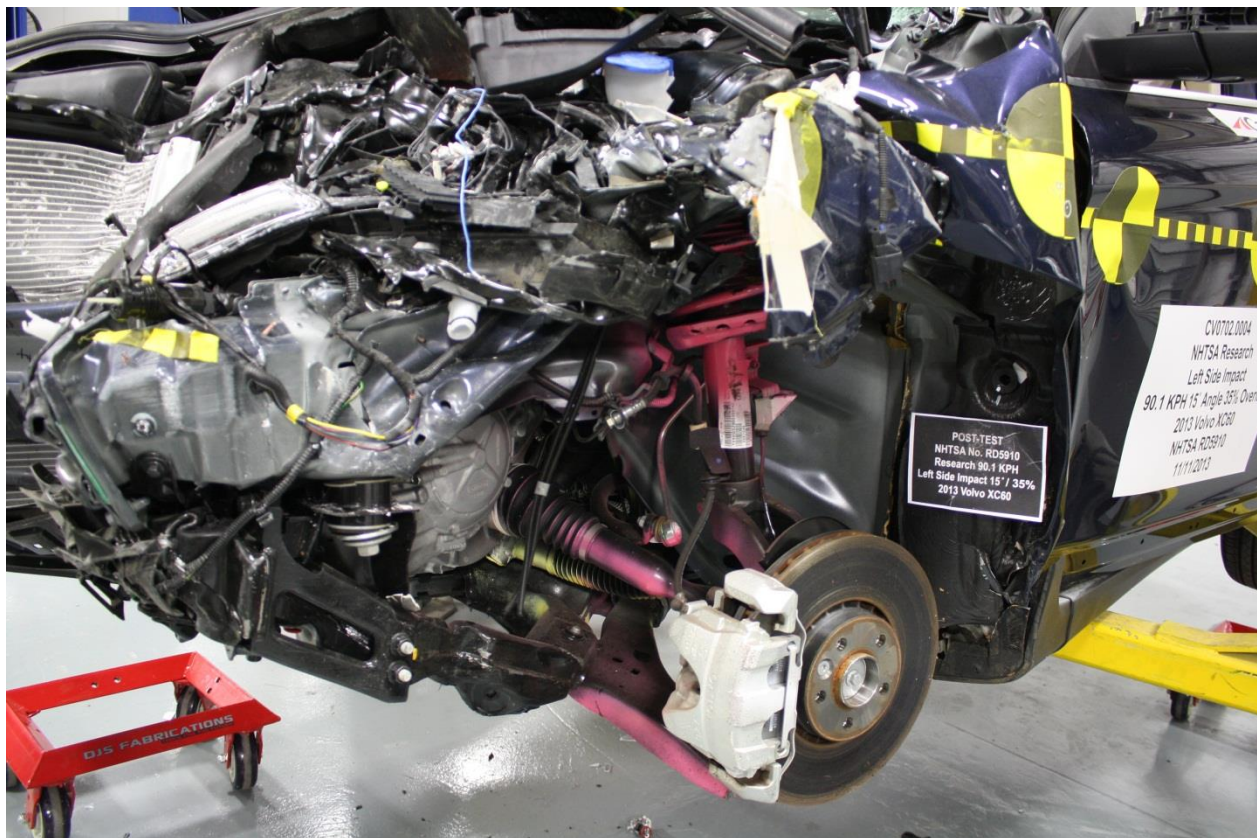
No. 140 Pre-Test Frame Rail with tire removed



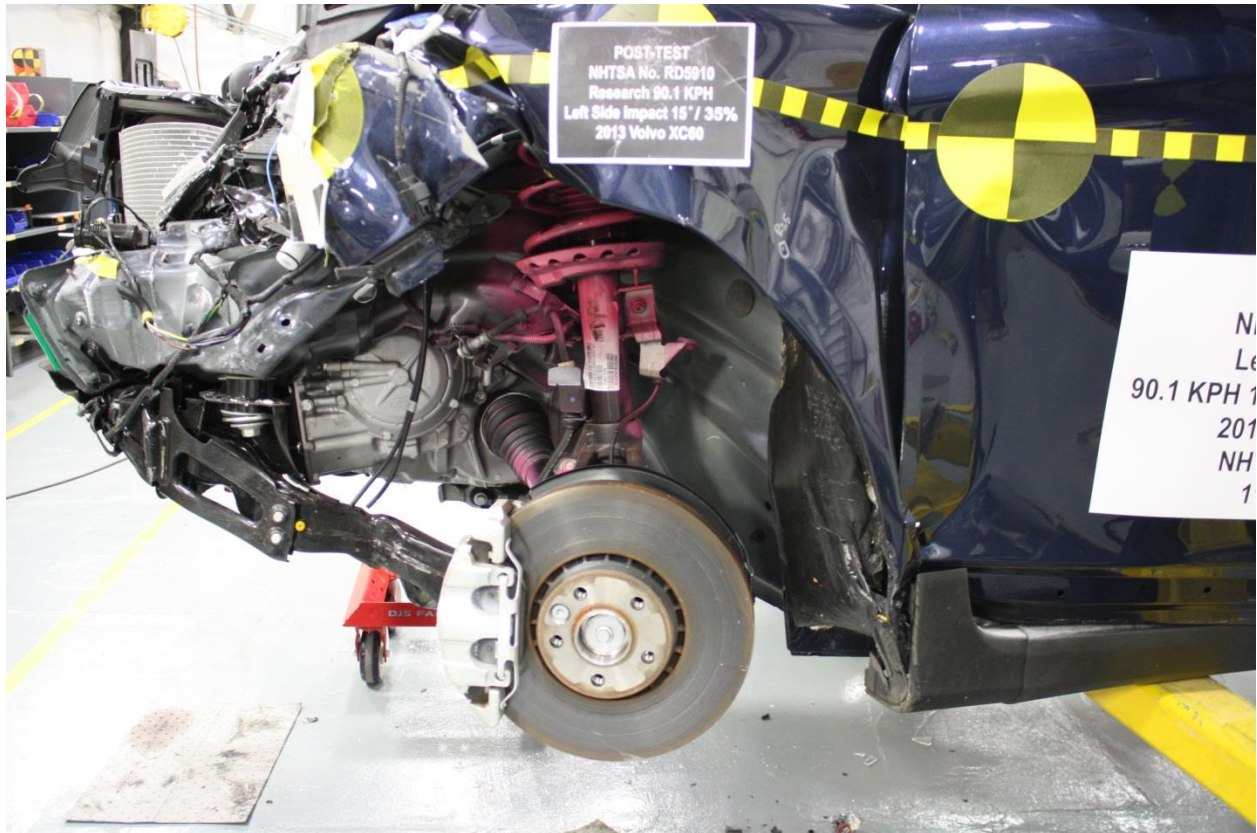
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No. 142 Pre-Test View of Front Driver Wheel Well w/ Tire Removed



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



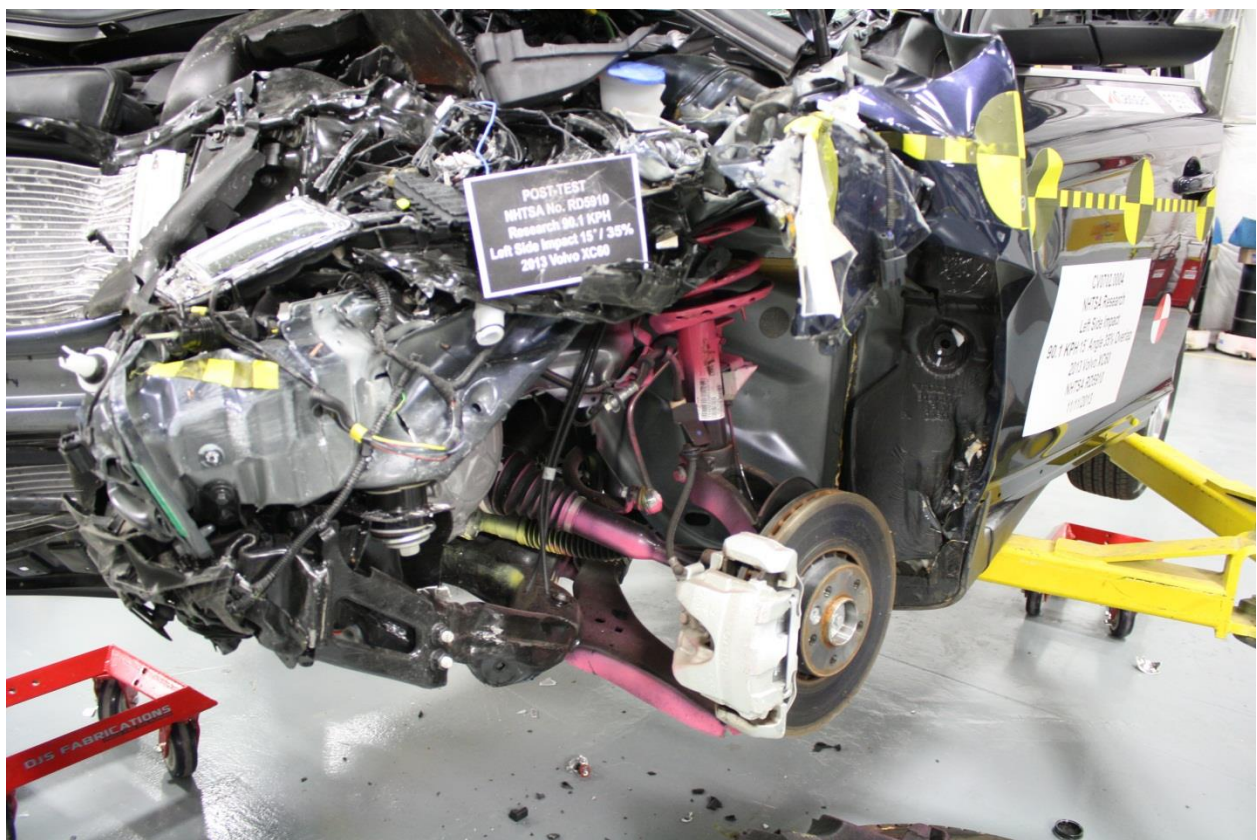
No. 144 Post-Test Side View of Front Driver Wheel Well w/ Tire Removed



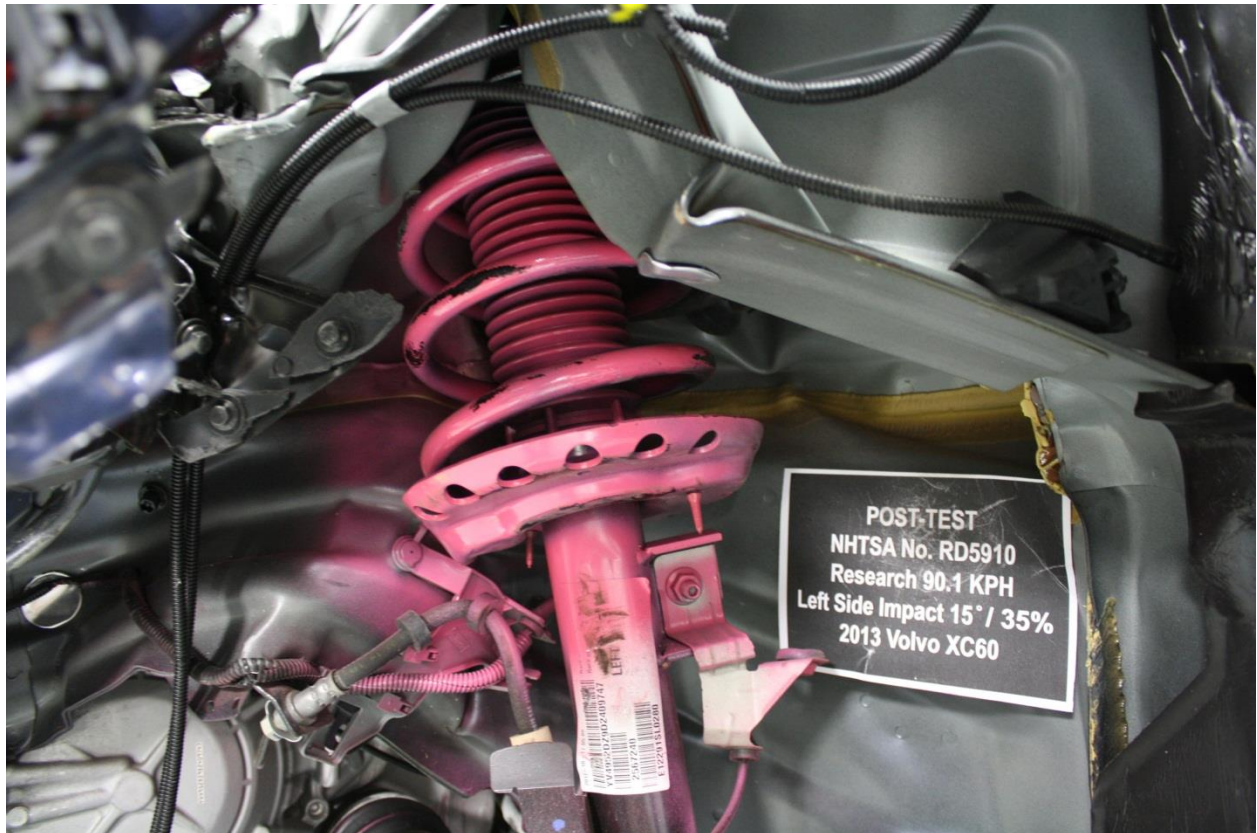
No. 145 Post-Test Right Side 3/4 Rear View of the Front Driver Wheel Well w/ Tire Removed



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



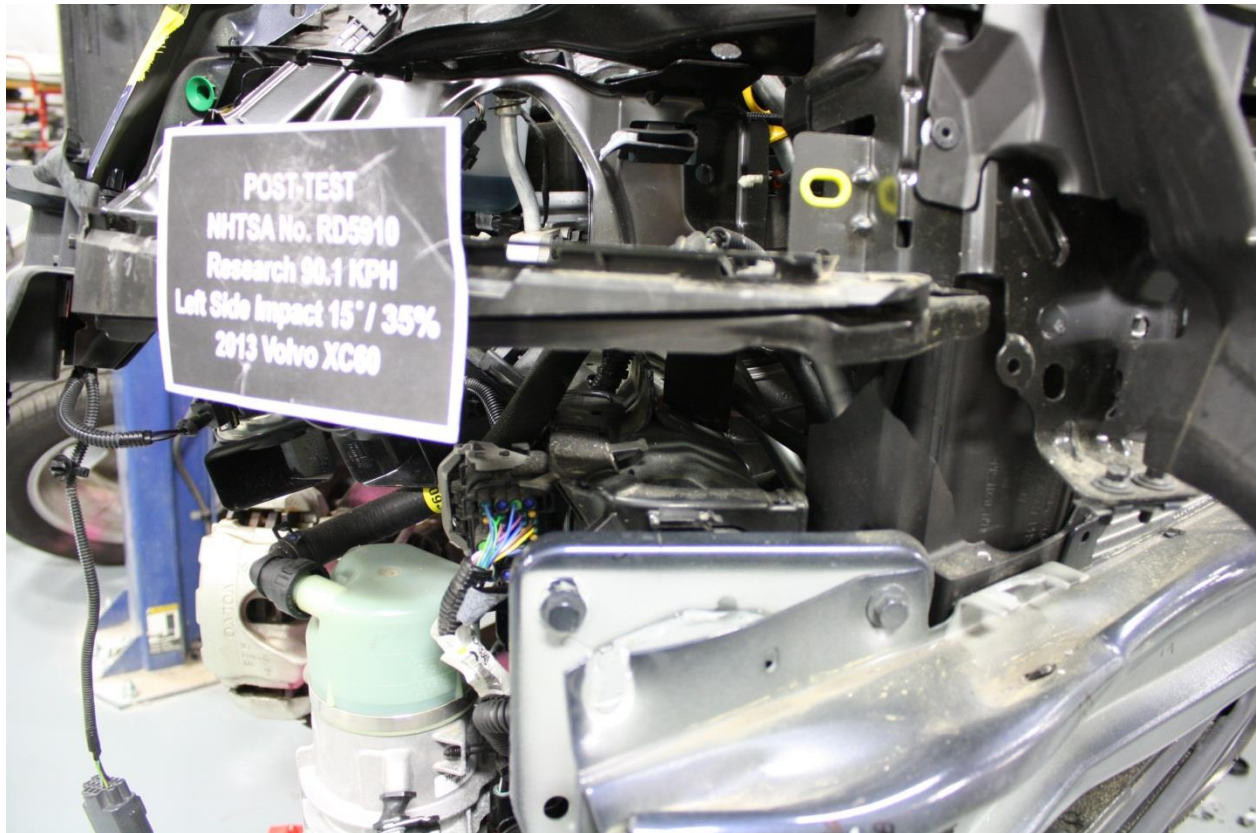
No. 149 Post-Test $\frac{3}{4}$ View of Front Passenger Wheel Well w/ Tire Removed



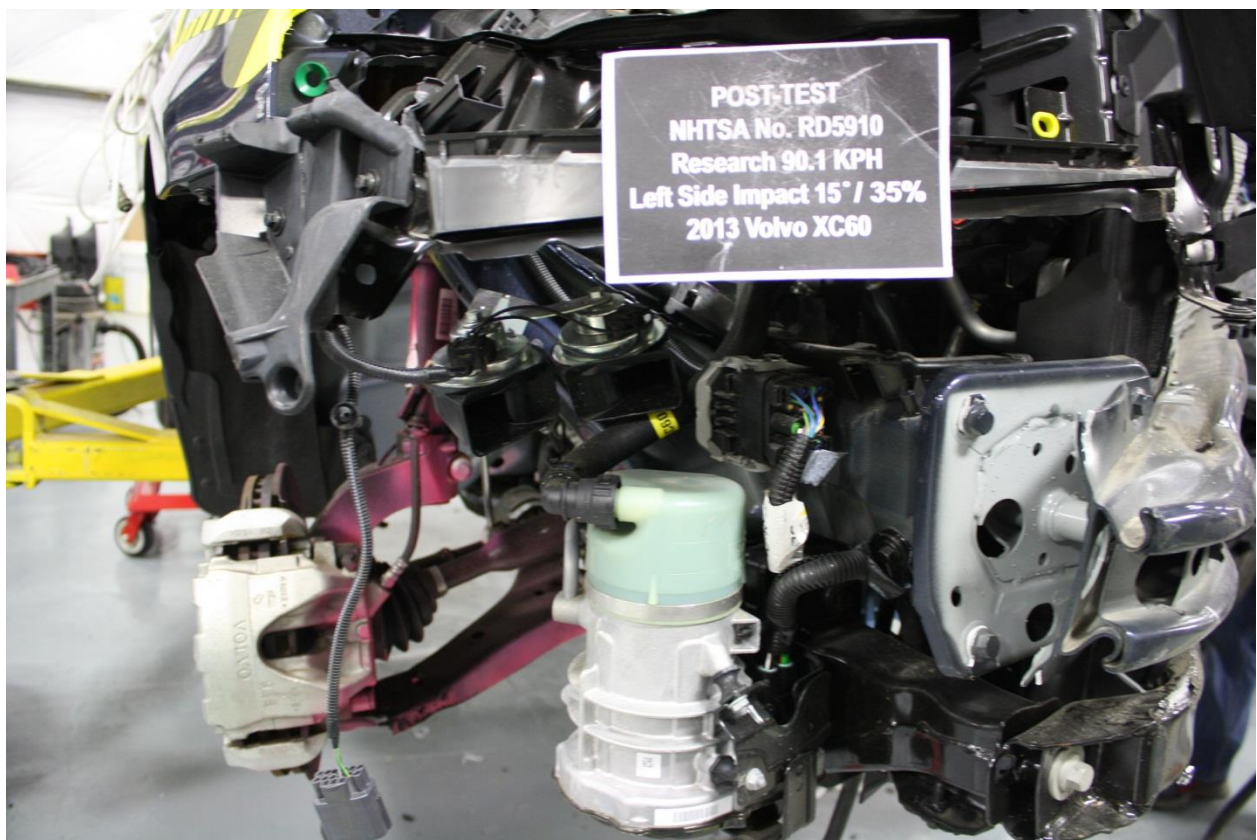
No. 150 Post-Test Side View of Front Passenger Wheel Well w/ Tire Removed



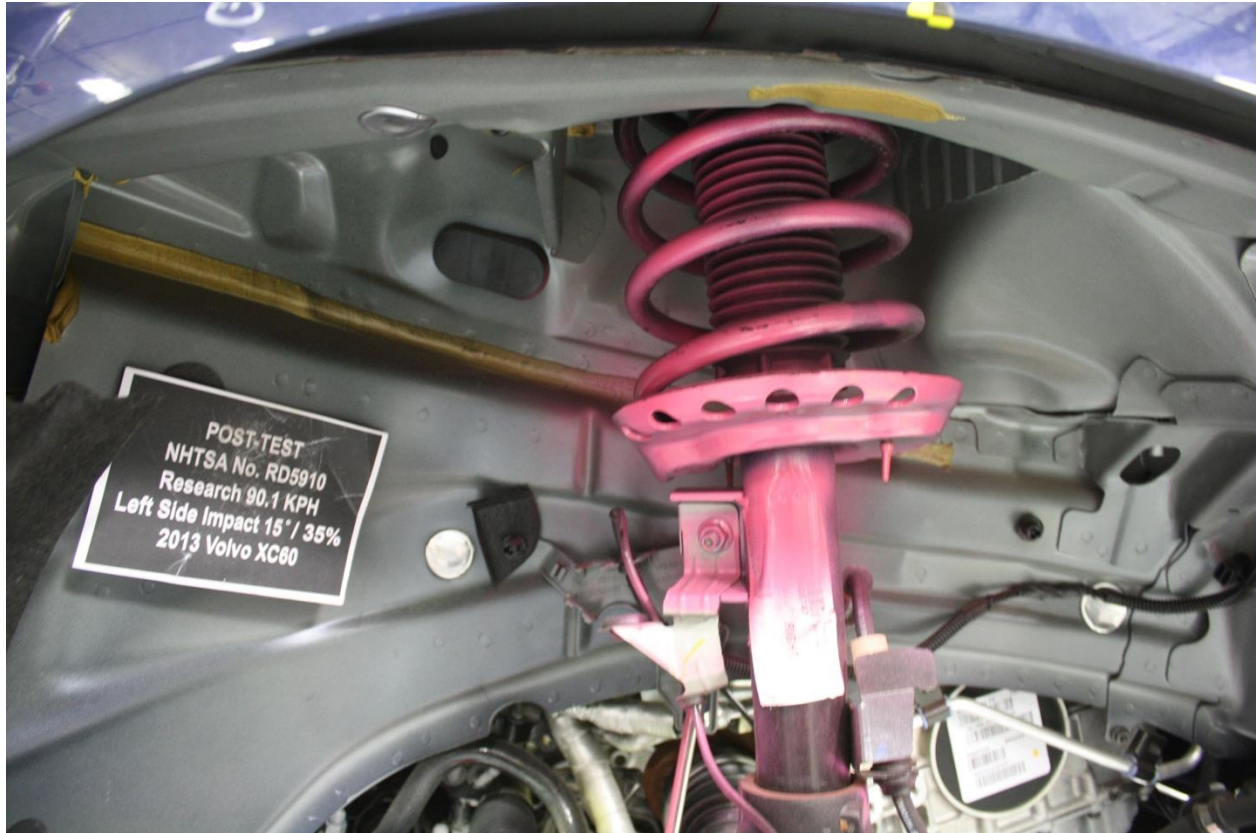
No. 151 Post-Test Right Side 3/4 Rear View of the Front Passenger Wheel Well w/ Tire Removed



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

Photo Not Applicable

No. 161 Post-Test View of Windshield Separation



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No. 163 Post-Test Left Side View of RMDB



No. 164 Pre-Test Right Side View of RMDB



No. 165 Post-Test Right Side View of RMDB



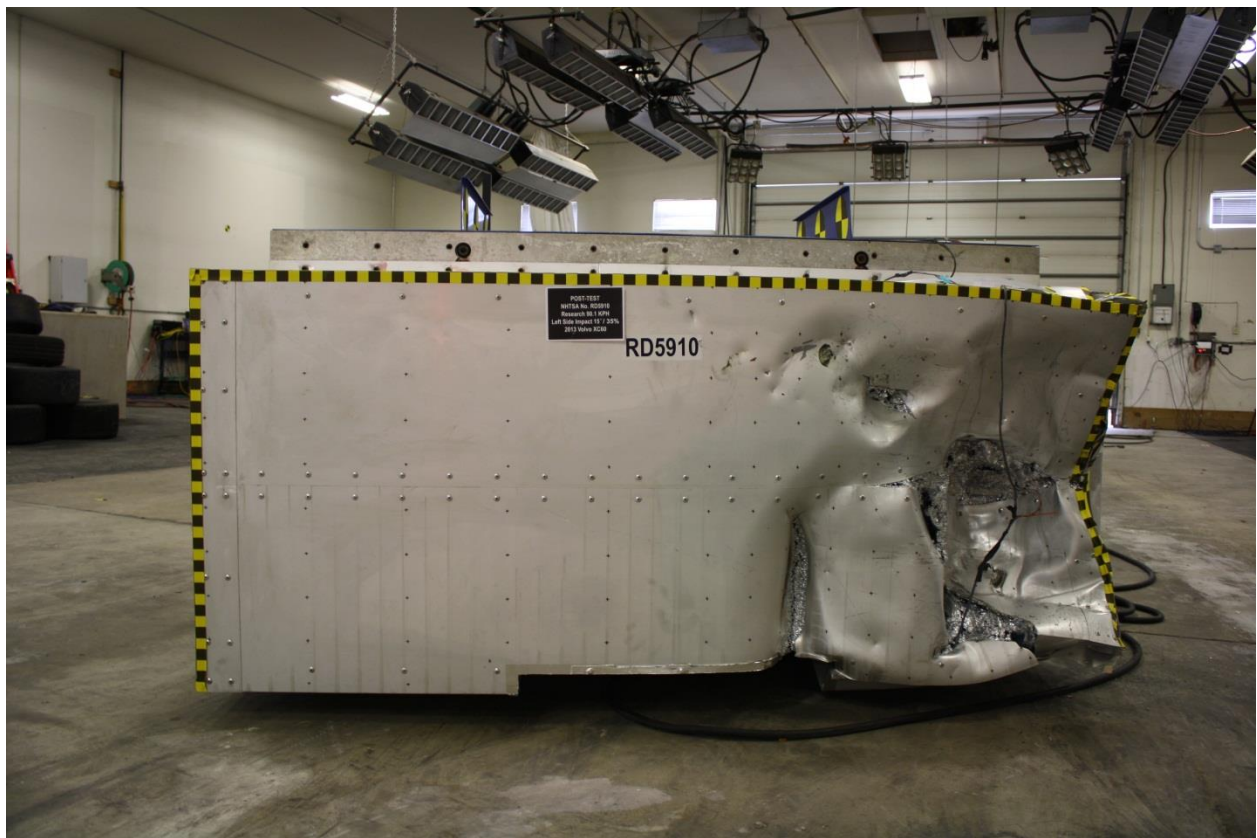
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No. 167 Post-Test Top View of RMDB



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



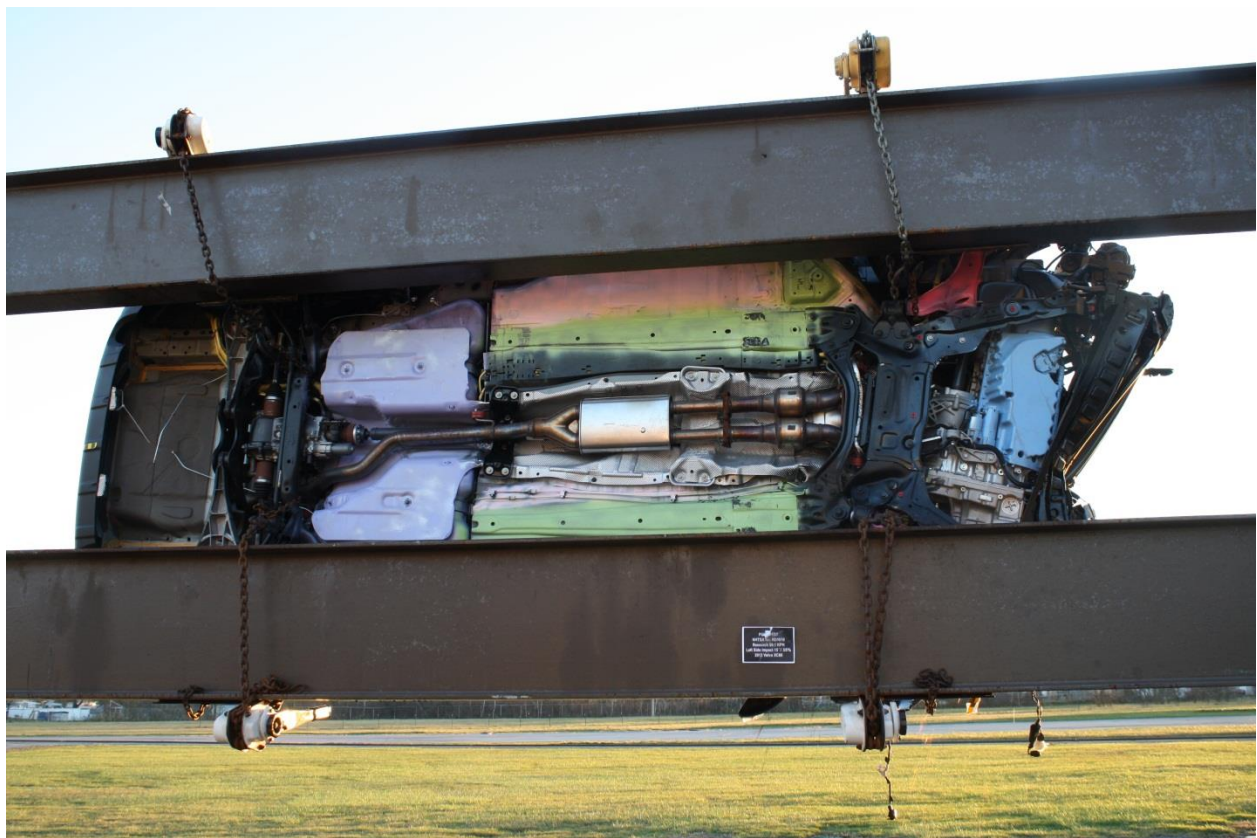
No. 180 Vehicle at 0 Degrees on Static Rollover Device



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

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VEHICLE & DUMMY RESPONSE DATA TRACES

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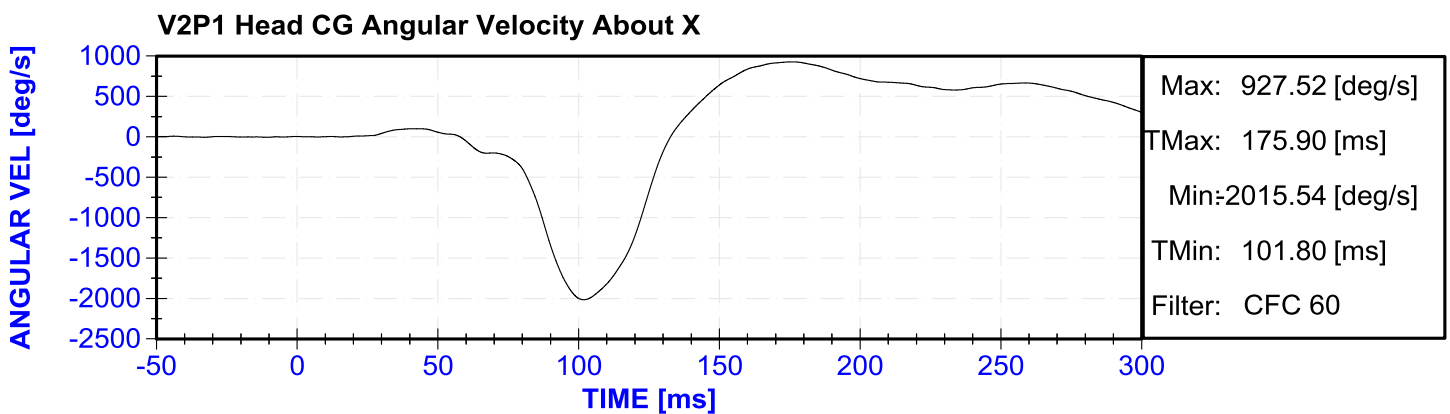
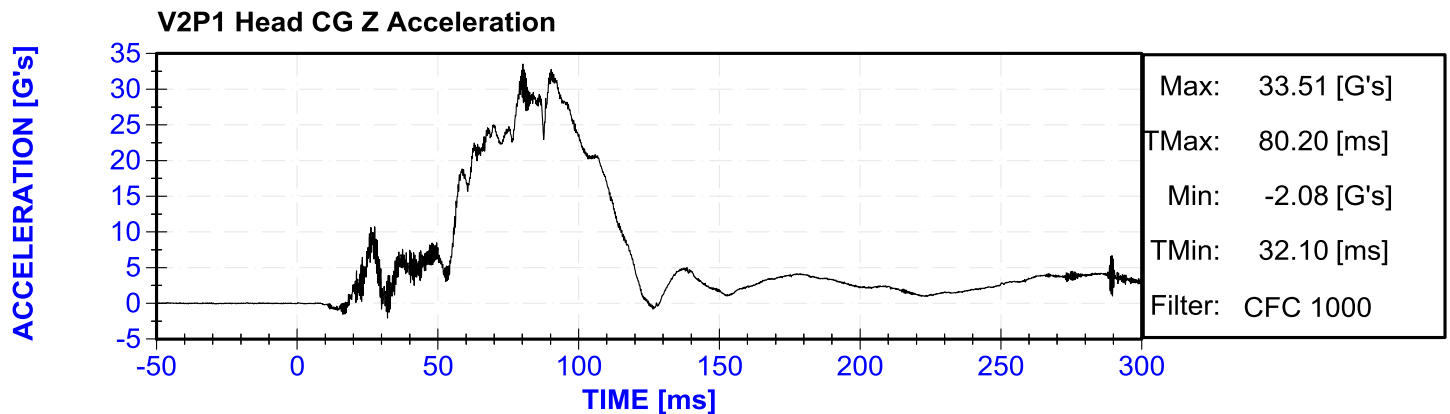
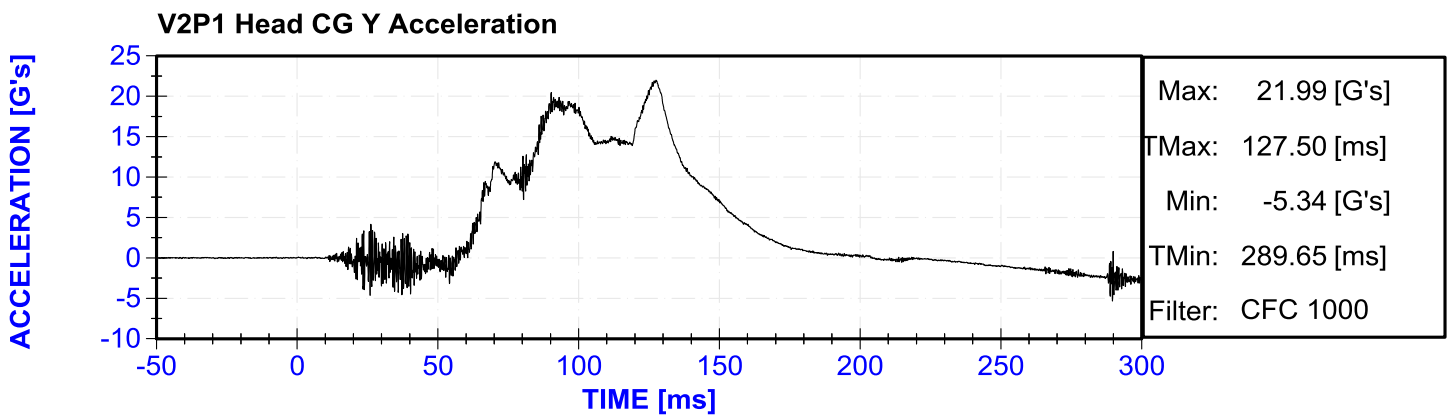
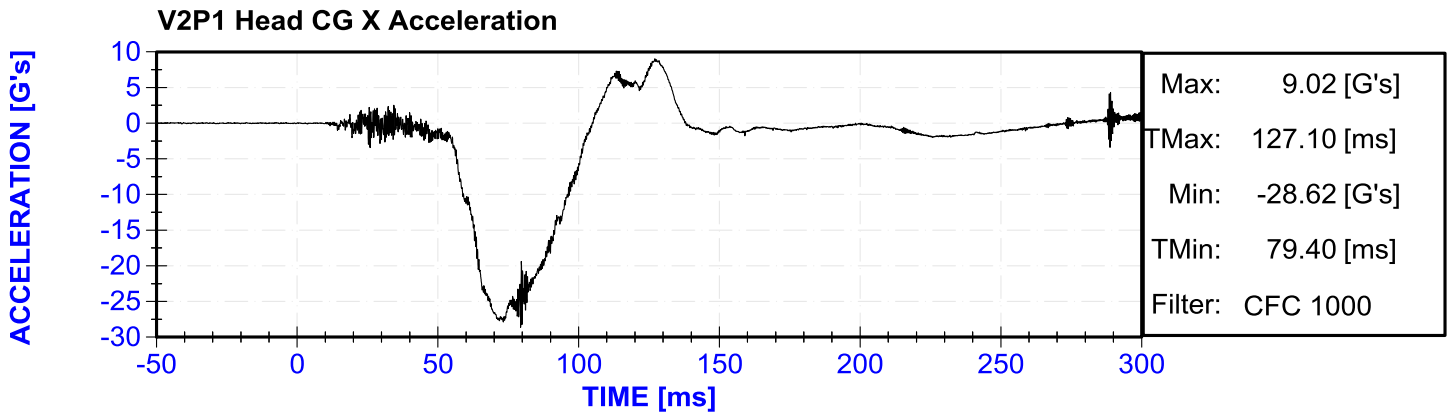
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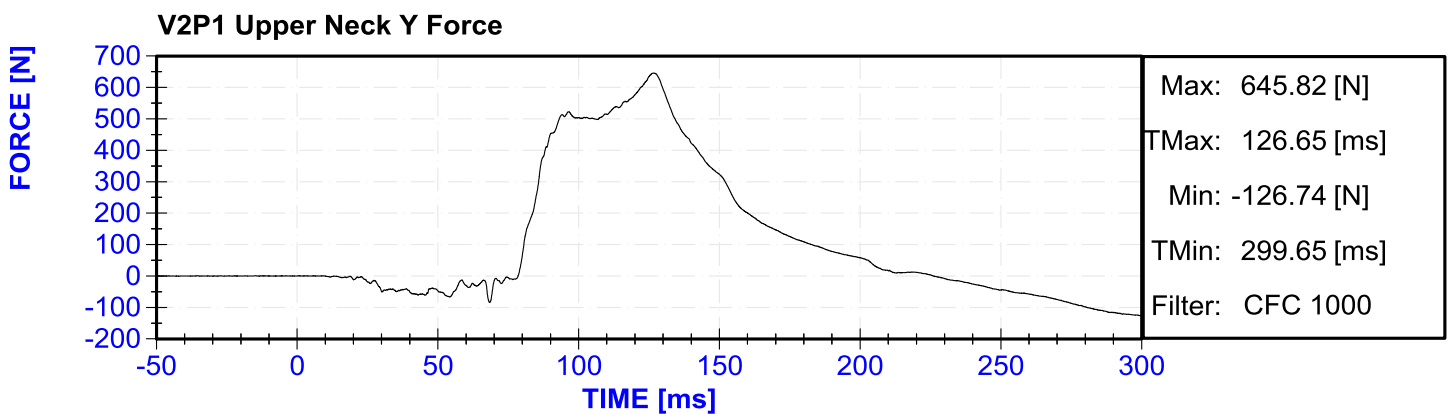
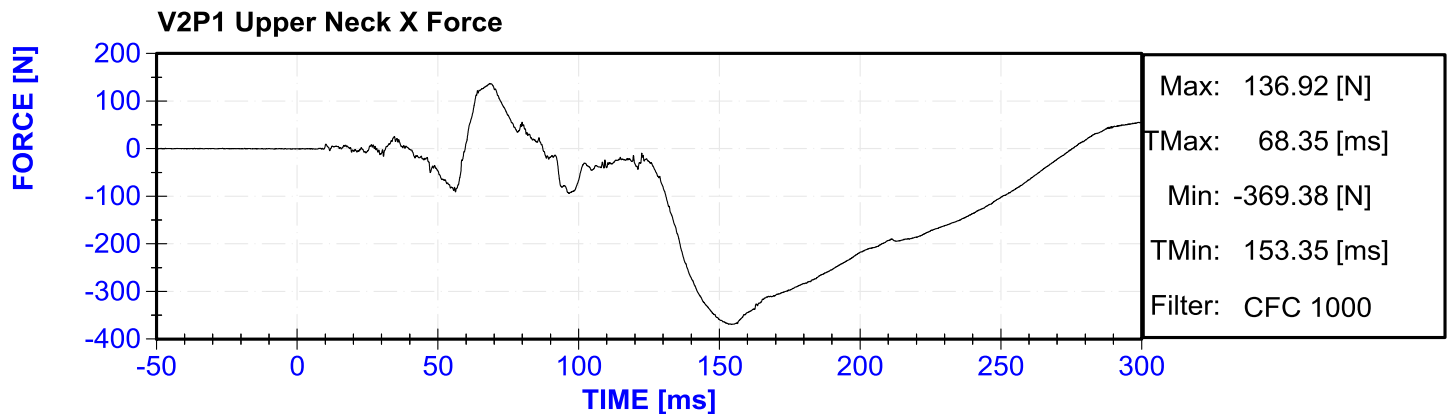
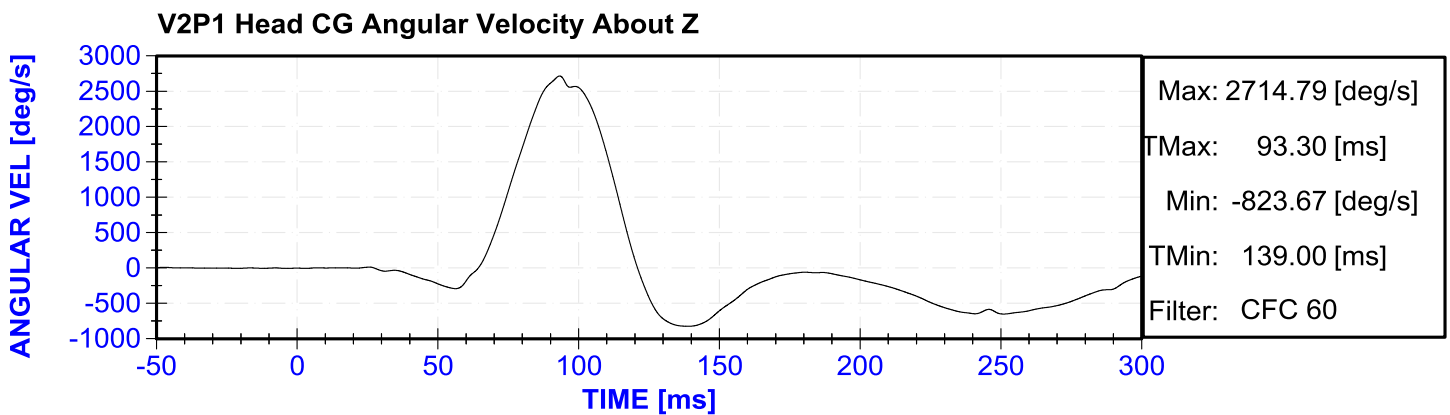
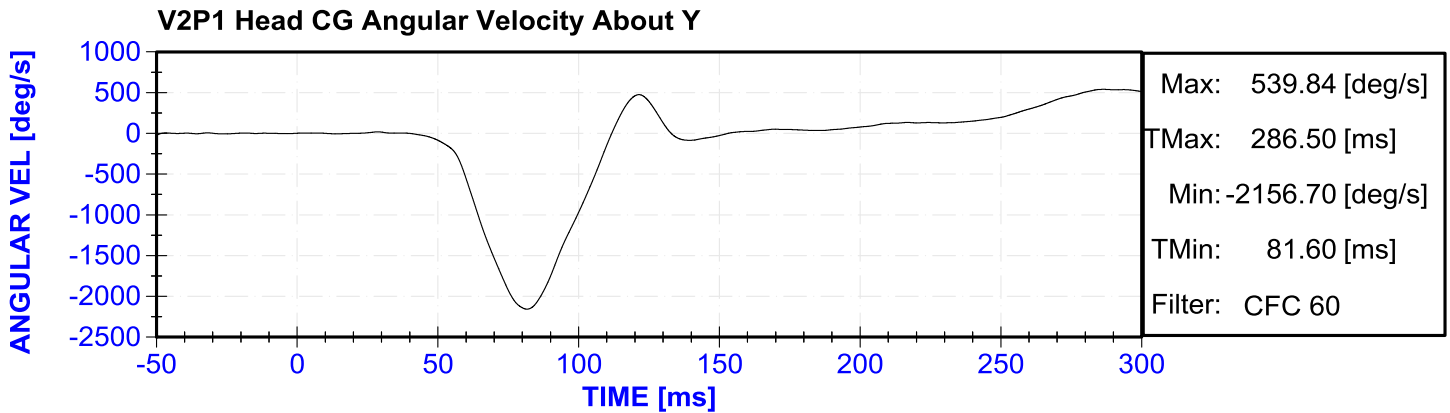
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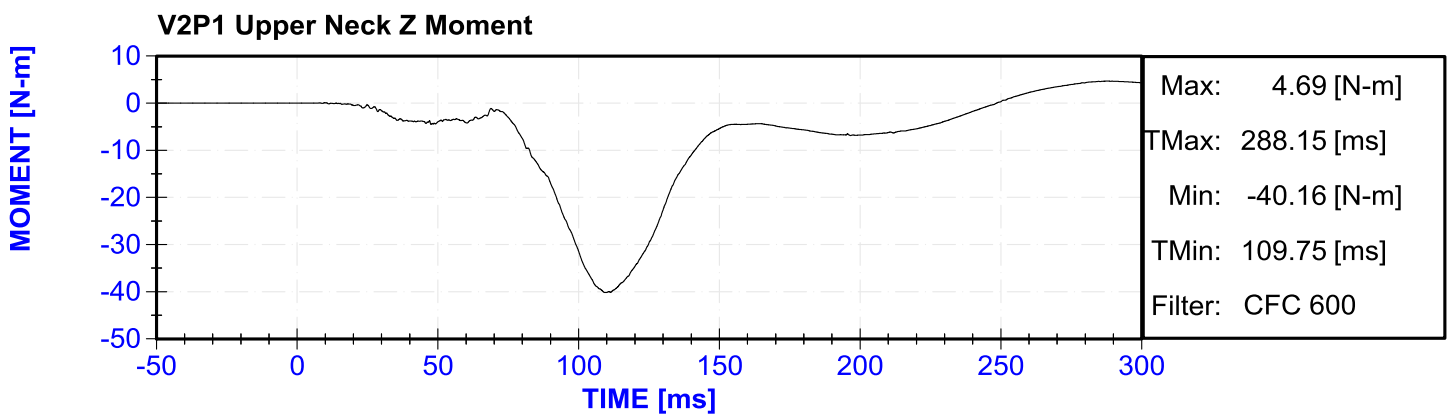
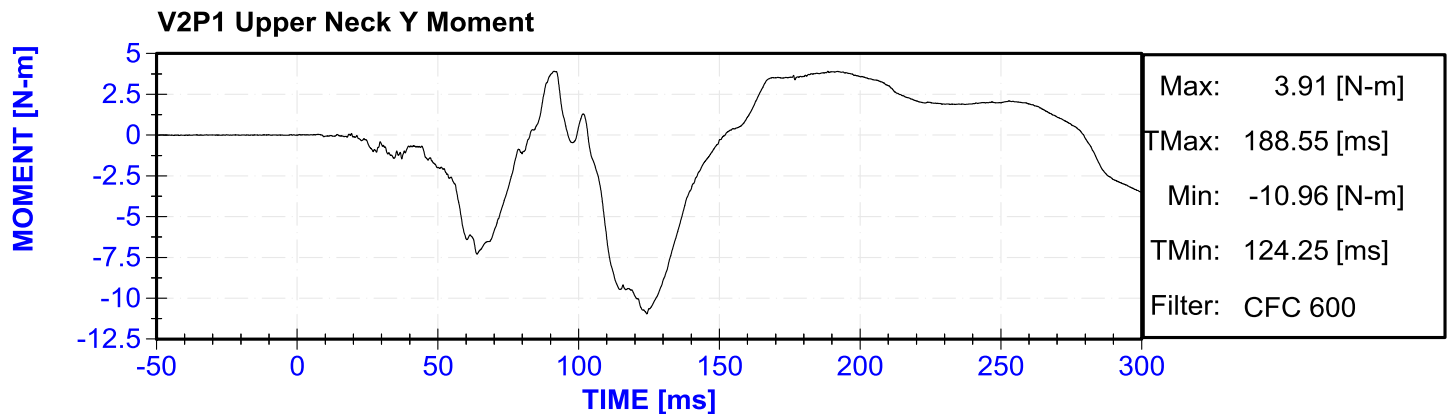
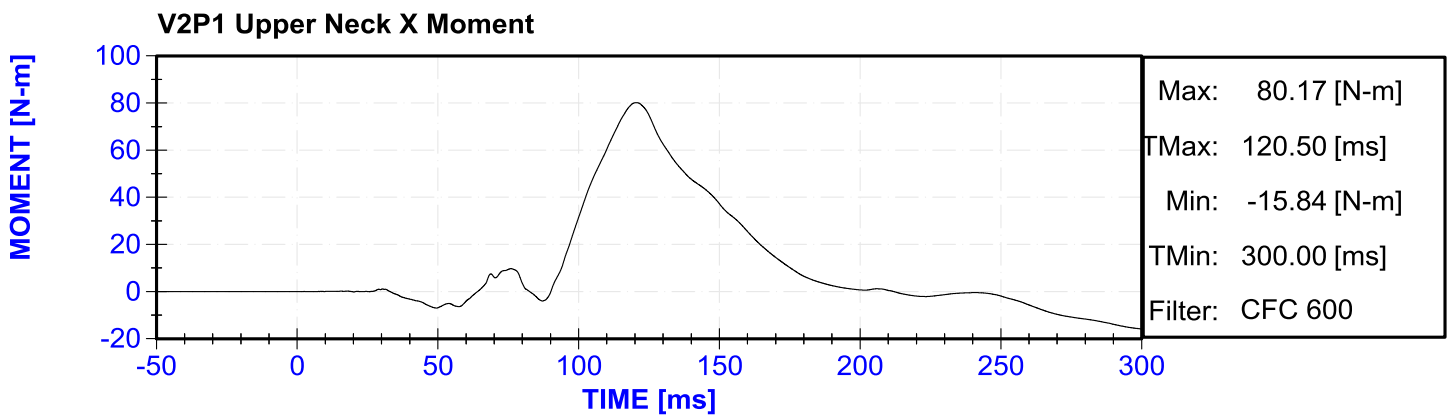
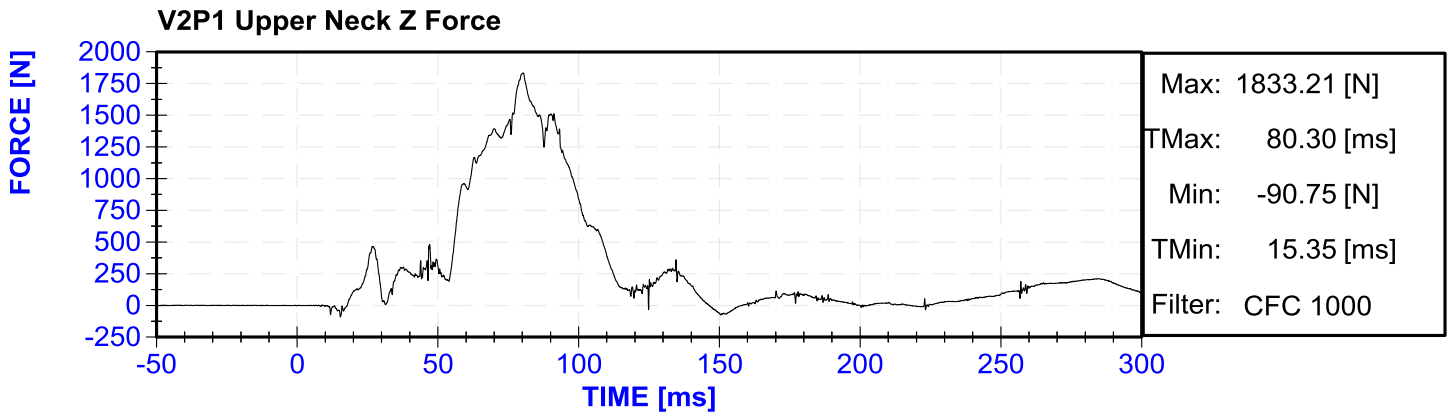
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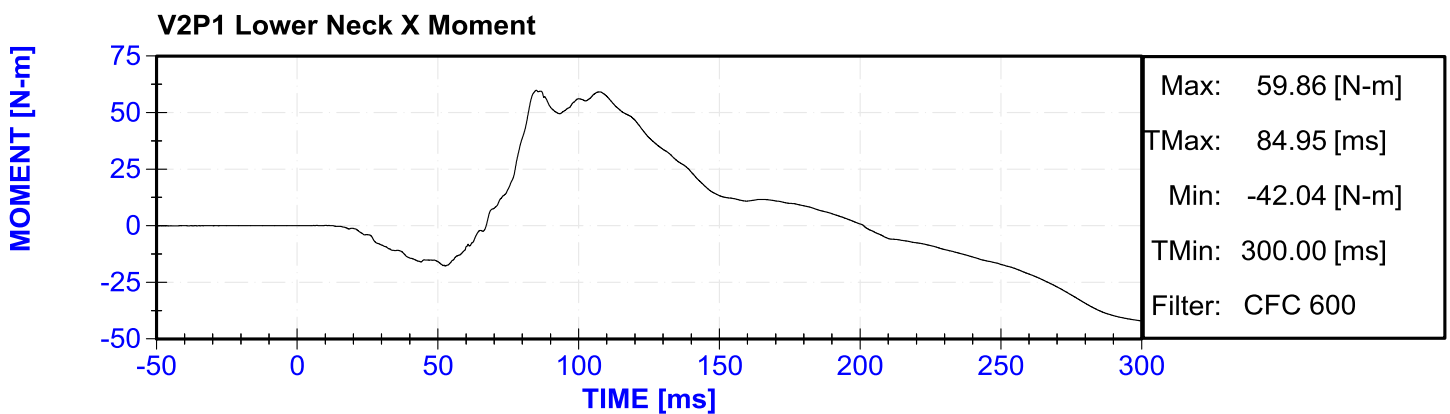
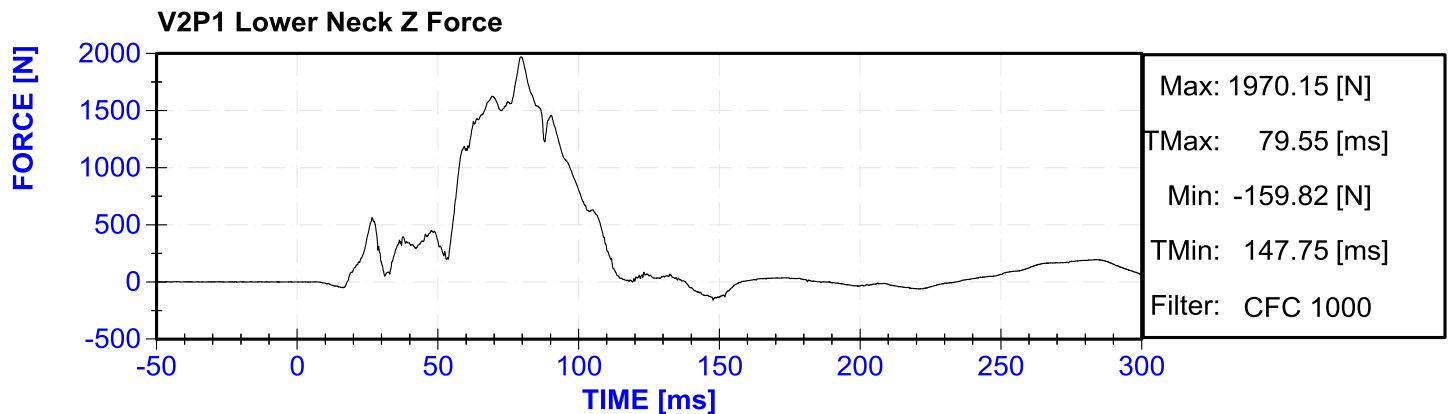
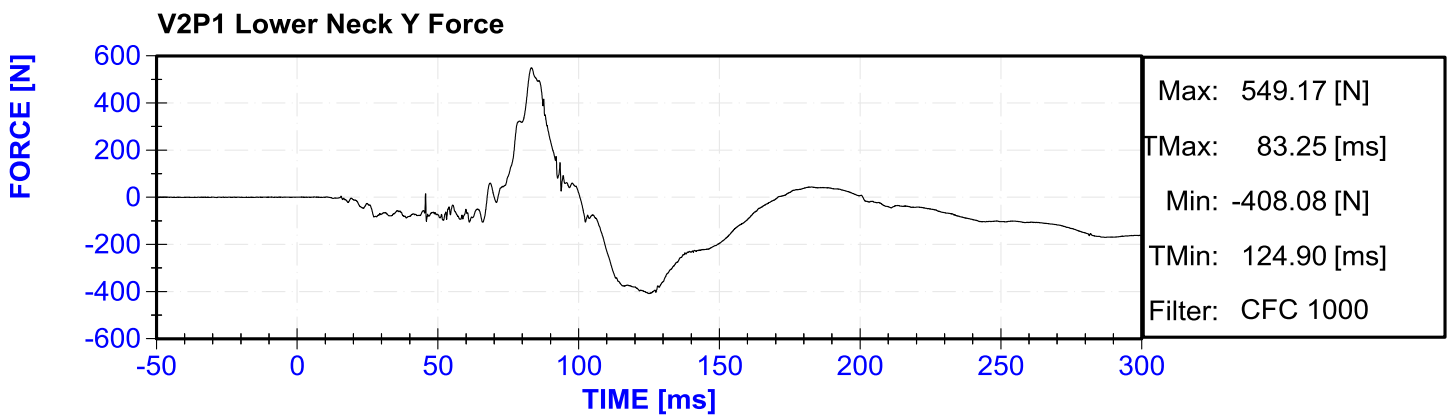
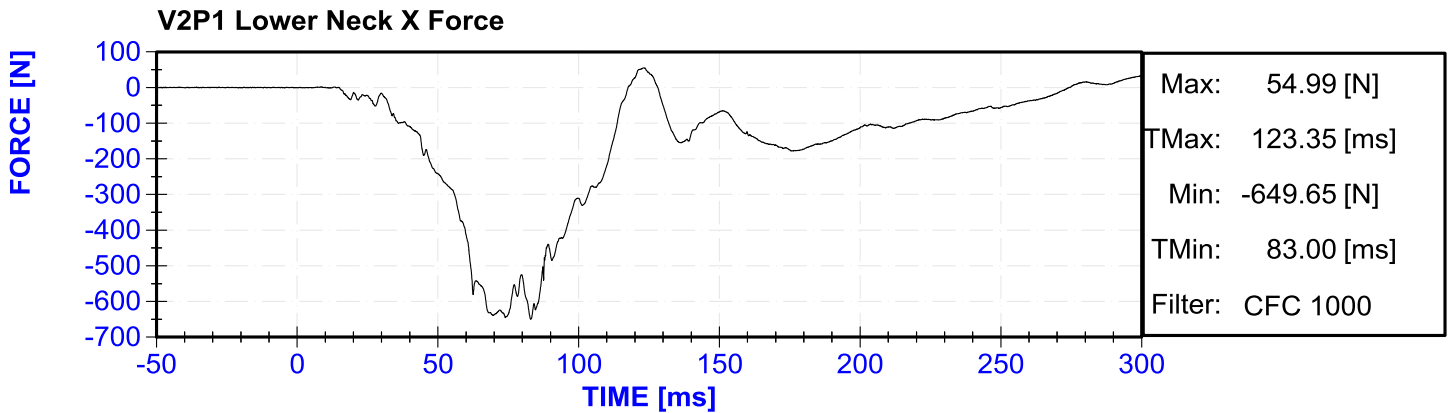
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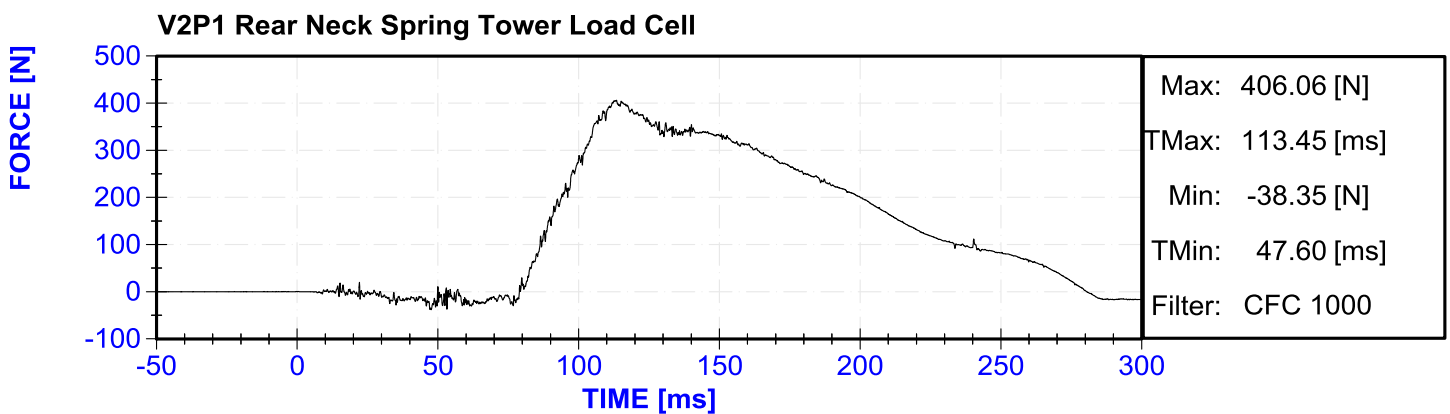
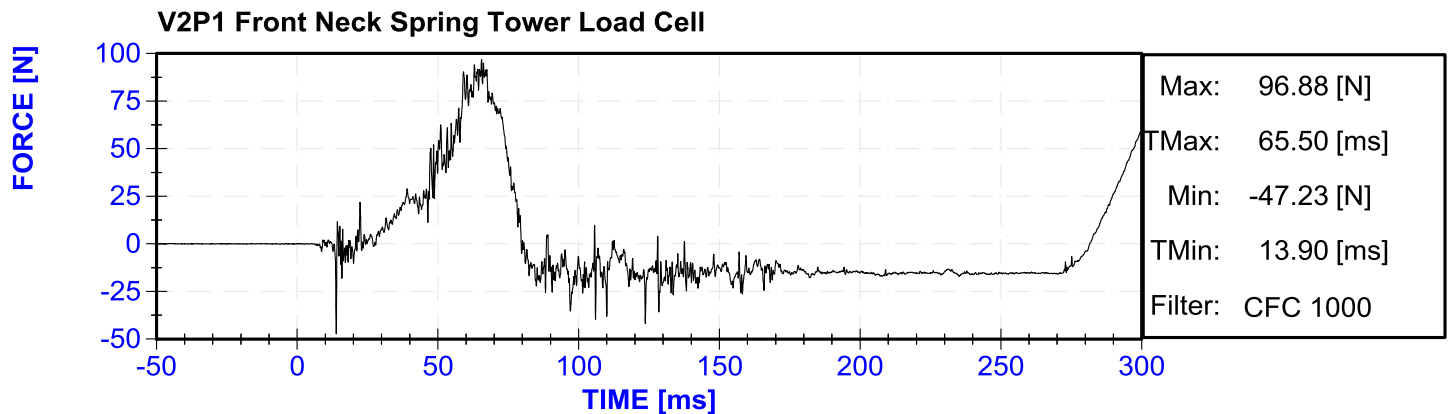
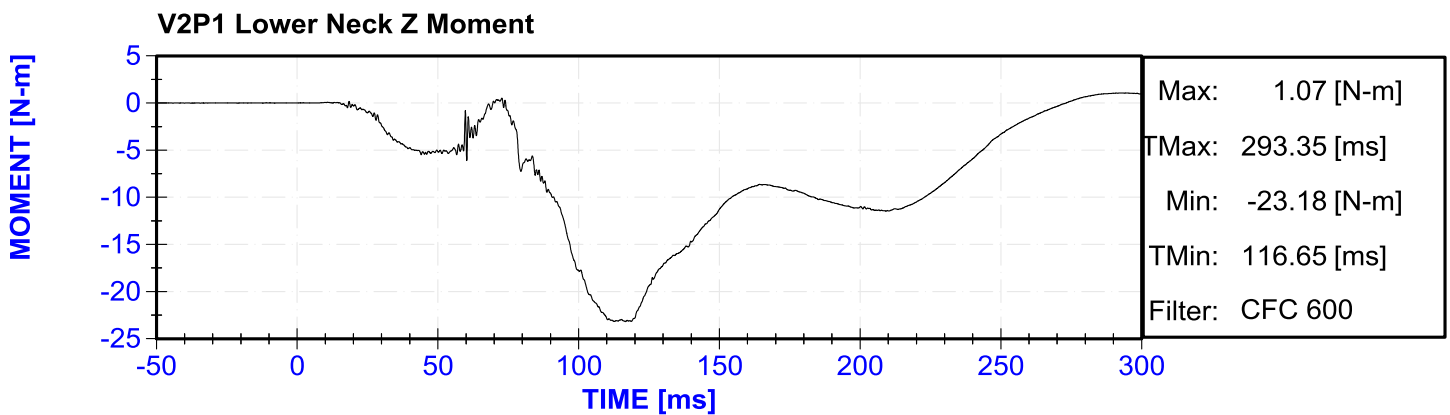
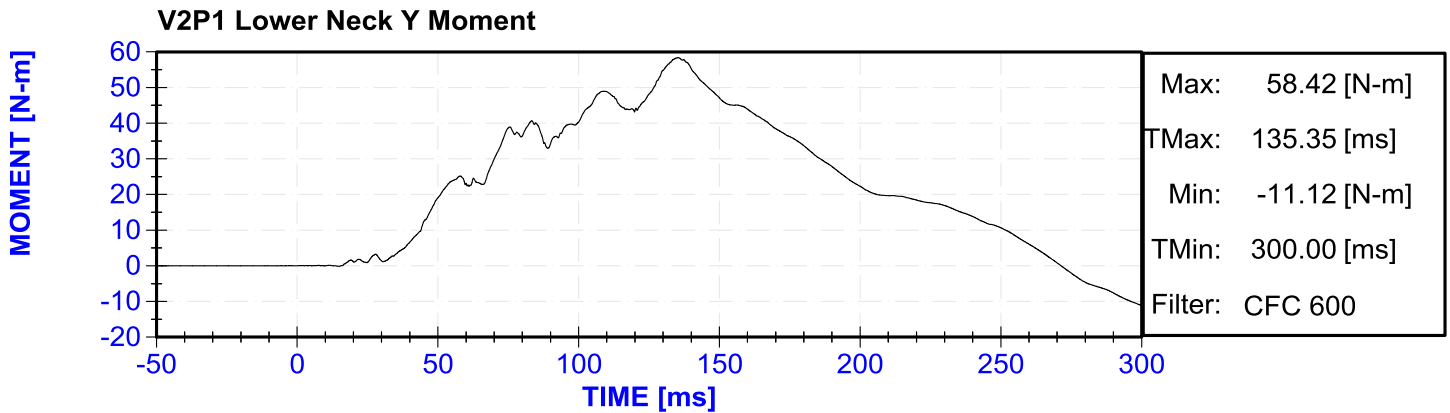
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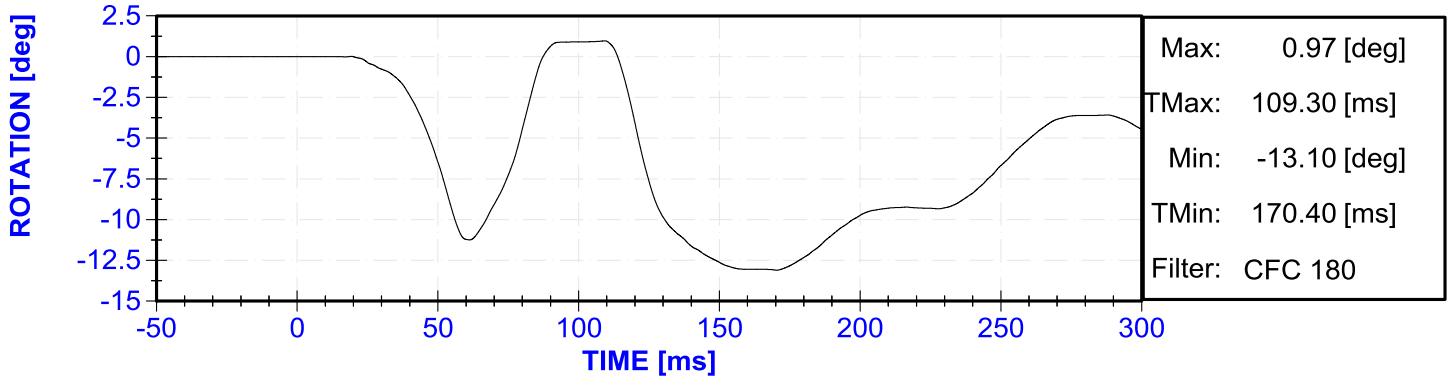




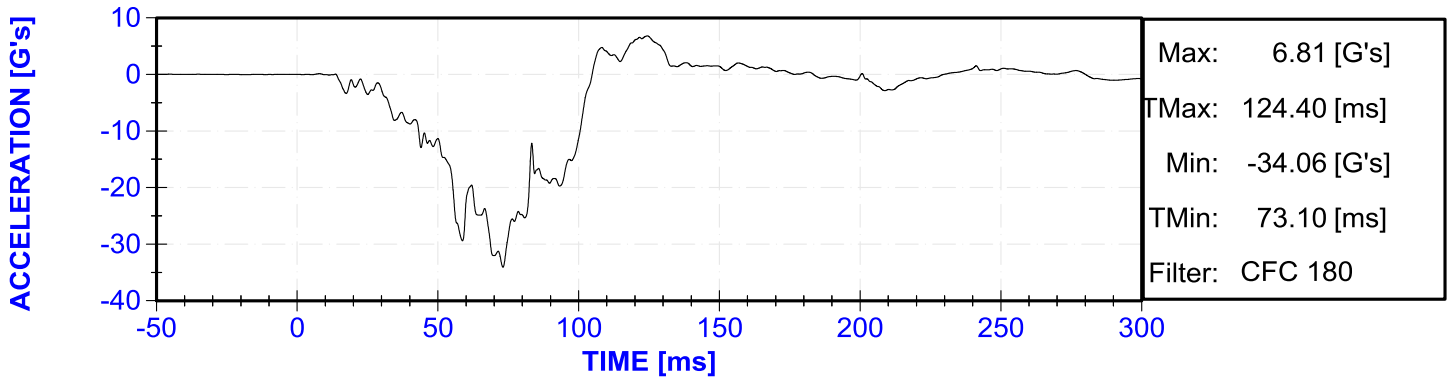




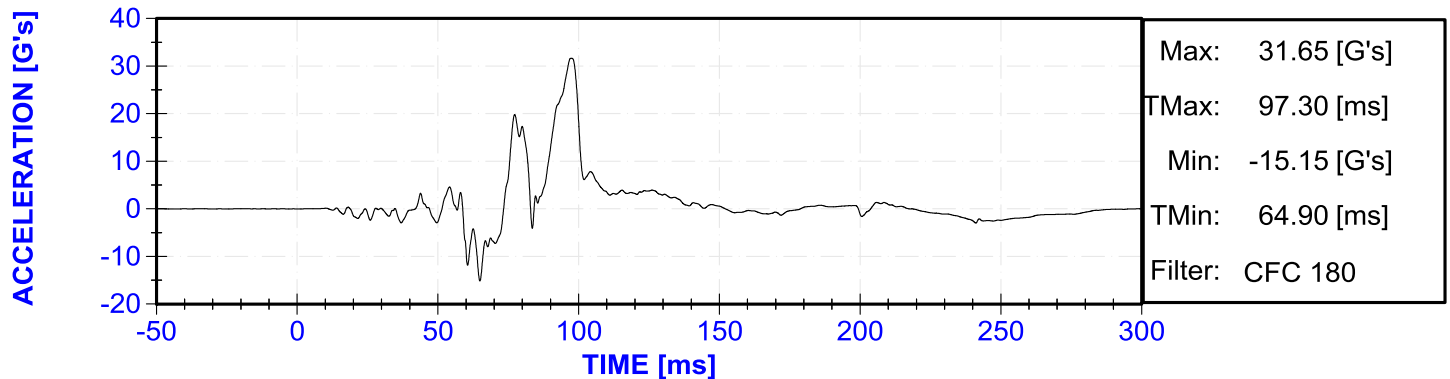
V2P1 Occipital Condyle Rotation Potentiometer



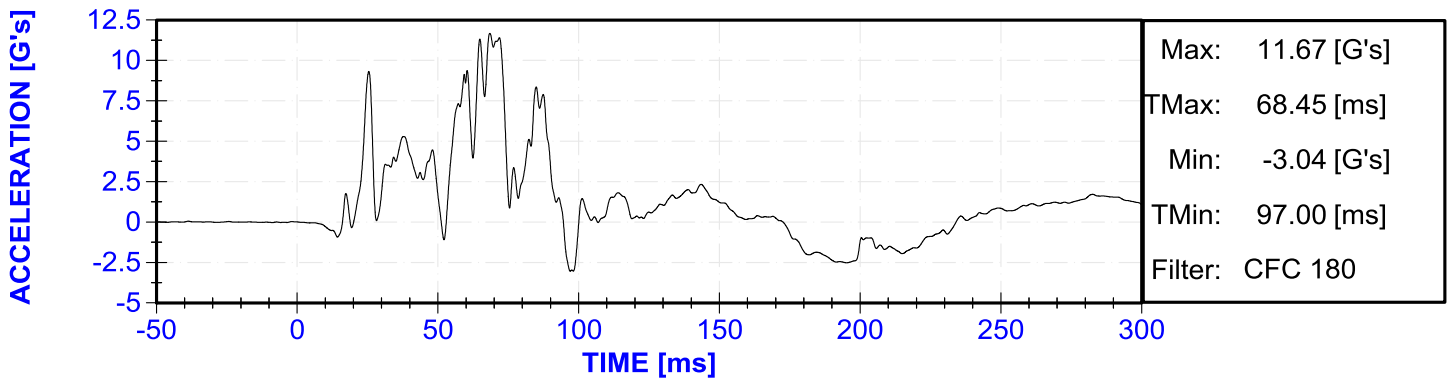
V2P1 T1 X Acceleration

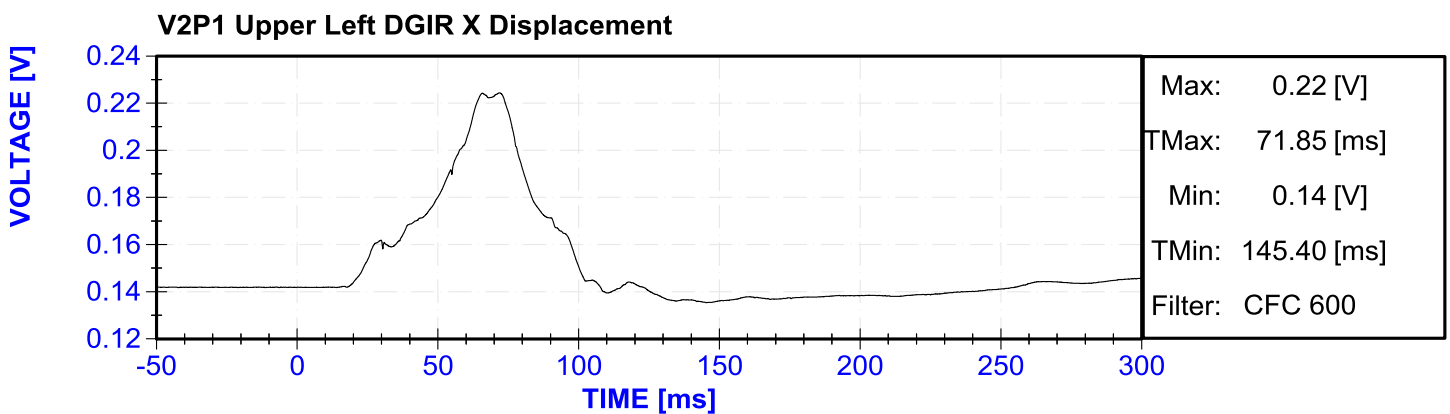
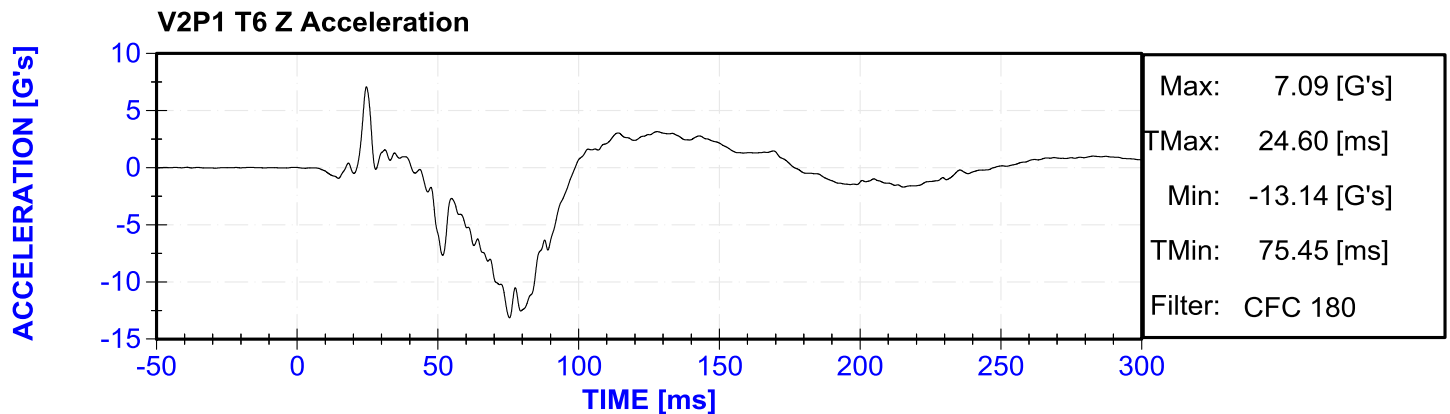
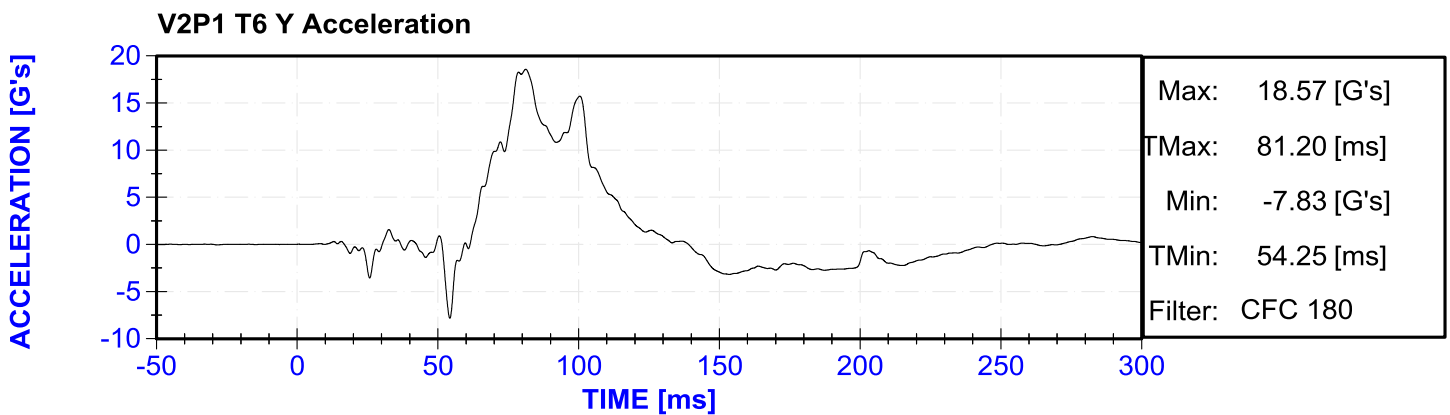
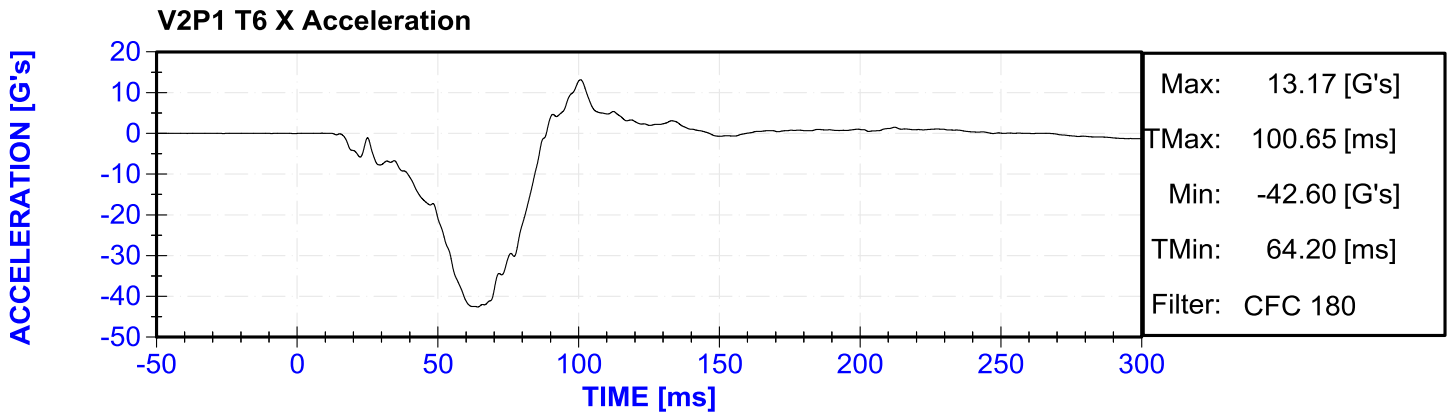


V2P1 T1 Y Acceleration

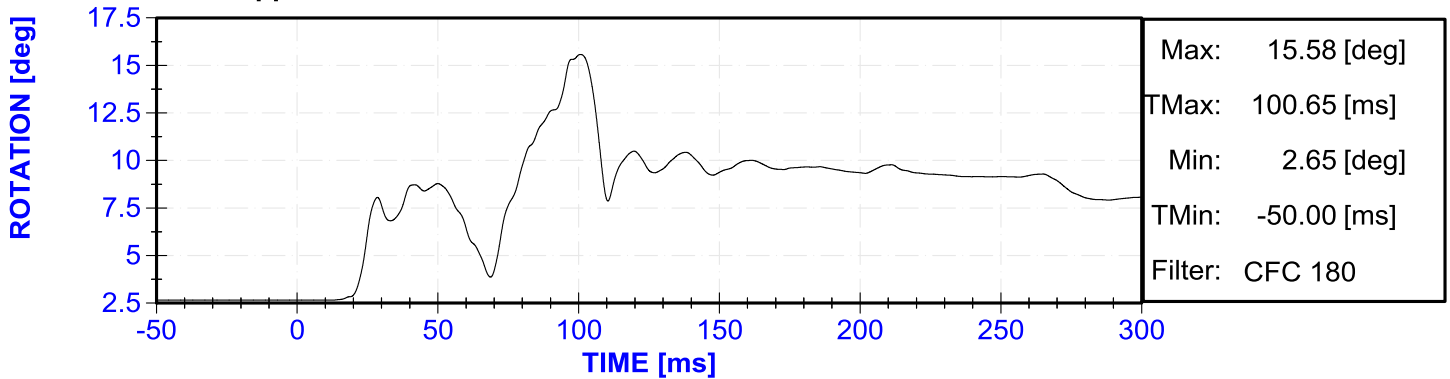


V2P1 T1 Z Acceleration

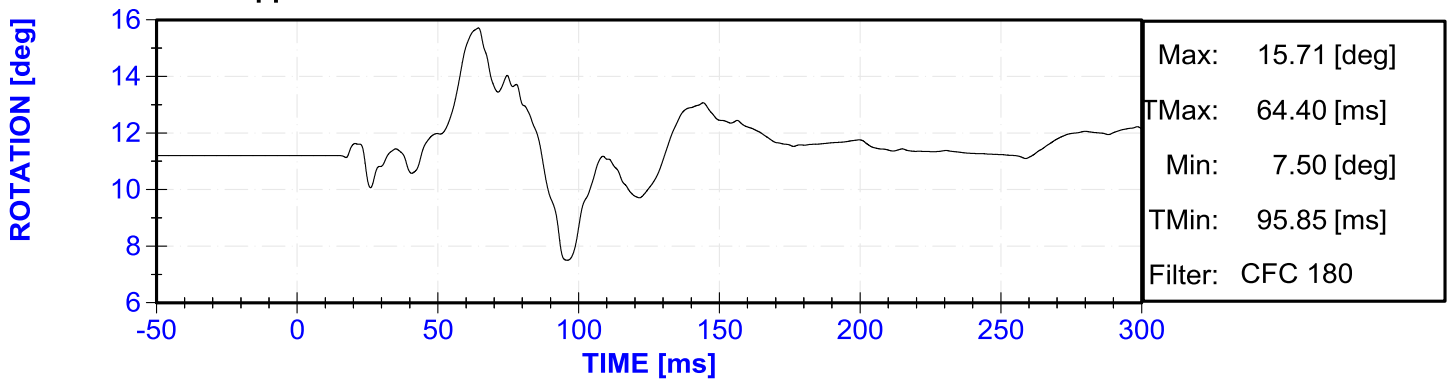




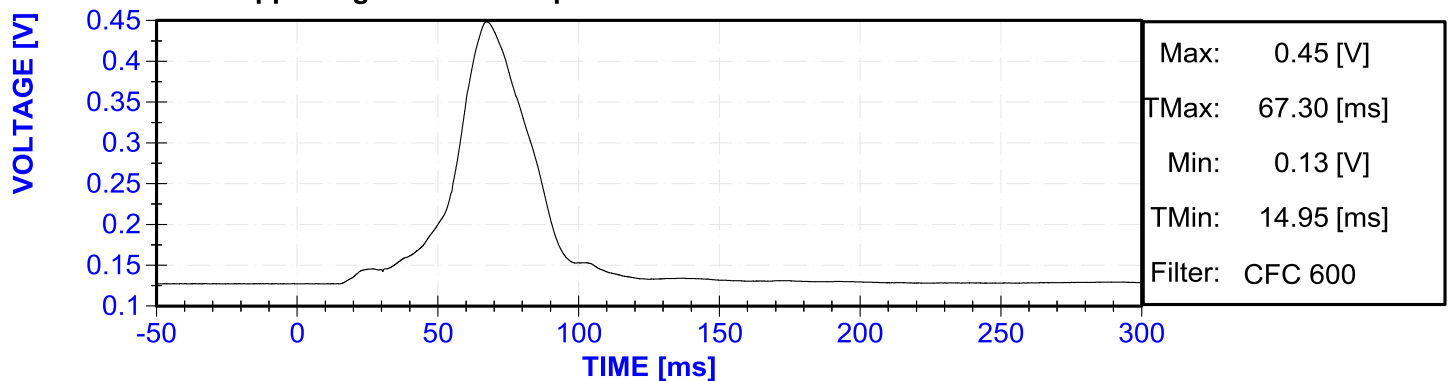
V2P1 Upper Left DGIR Y Rotation



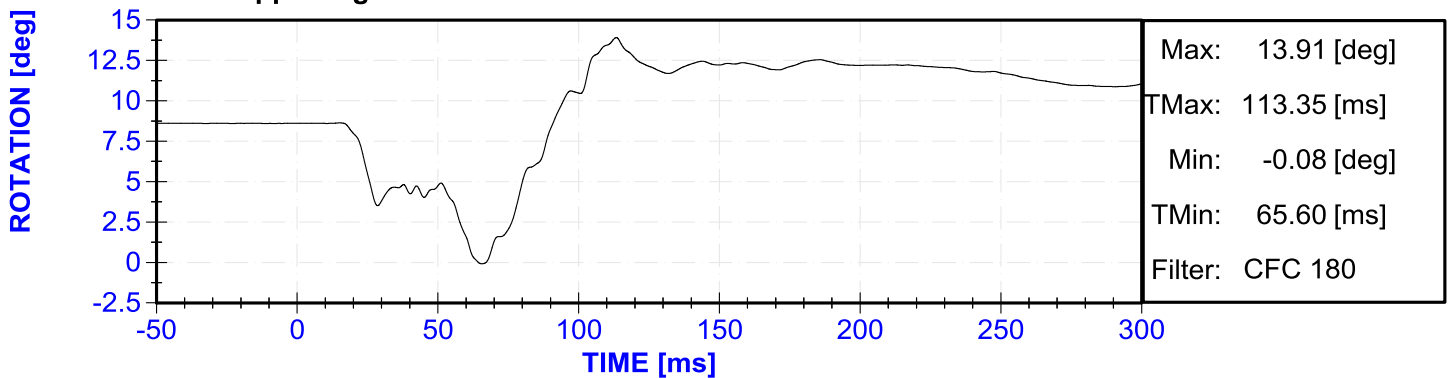
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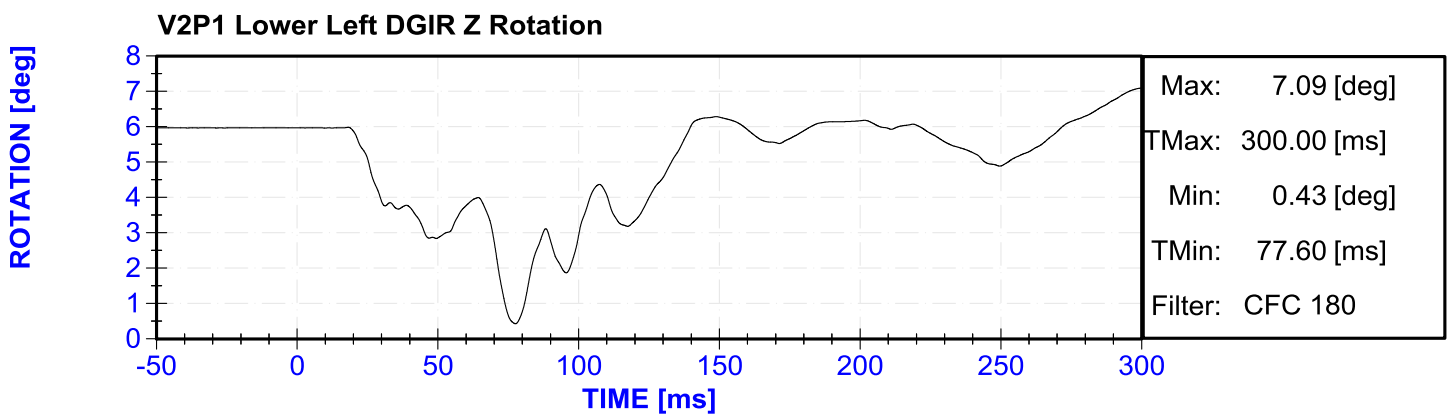
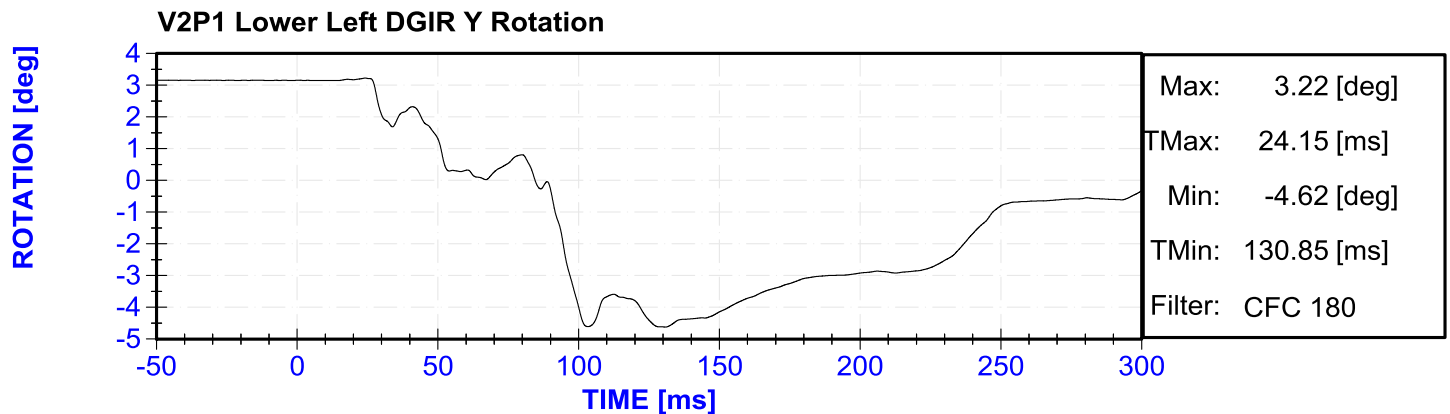
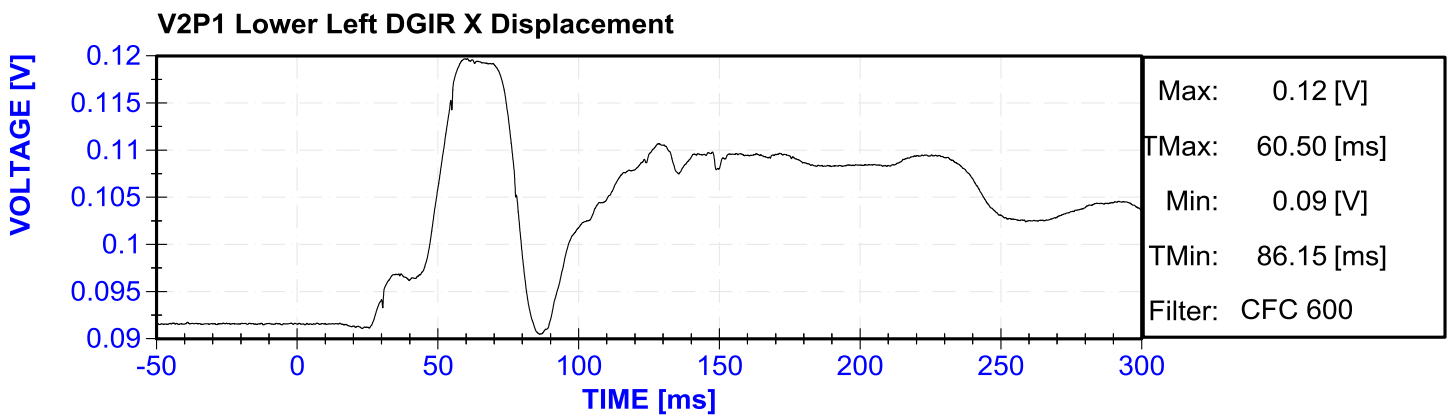
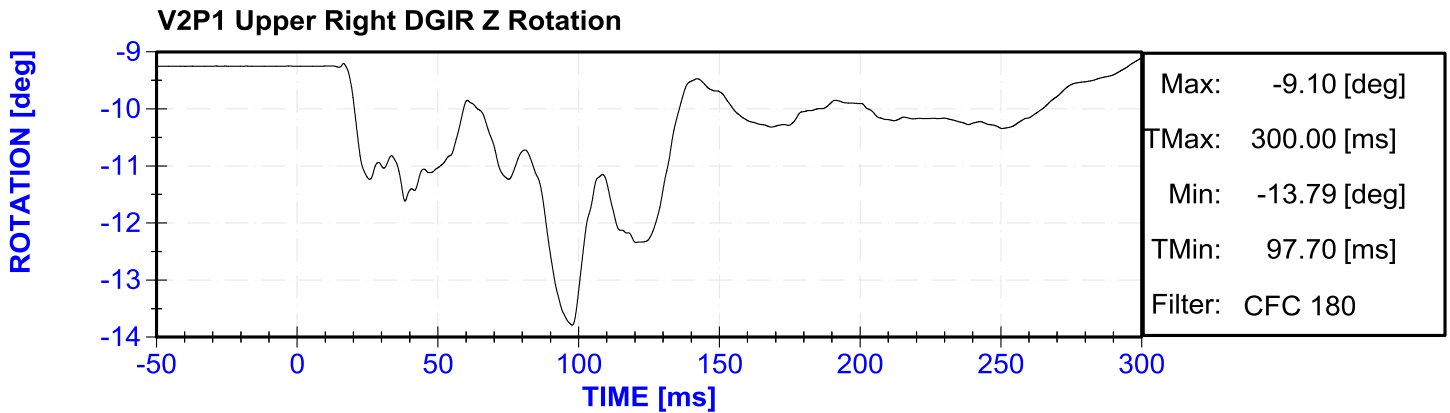


V2P1 Upper Right DGIR X Displacement

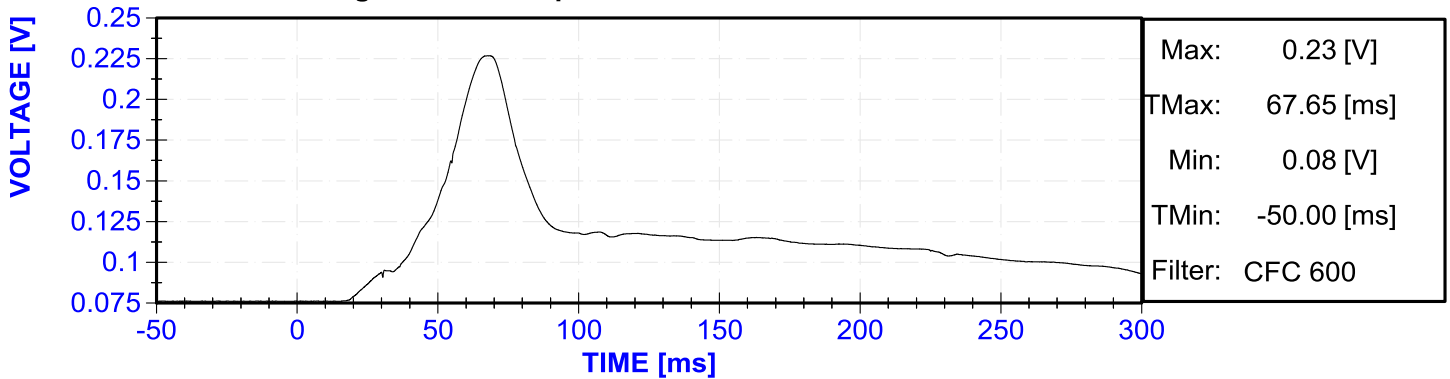


V2P1 Upper Right DGIR Y Rotation

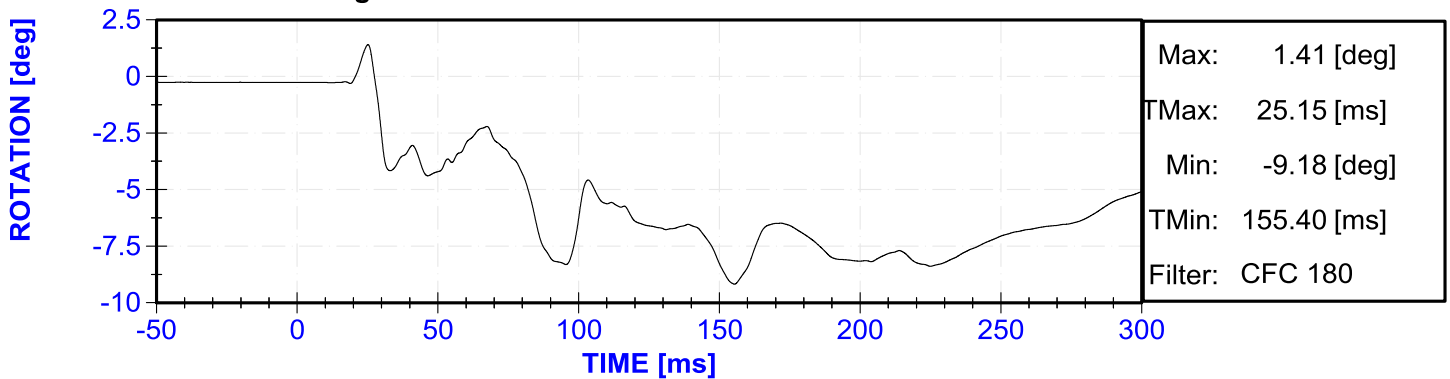




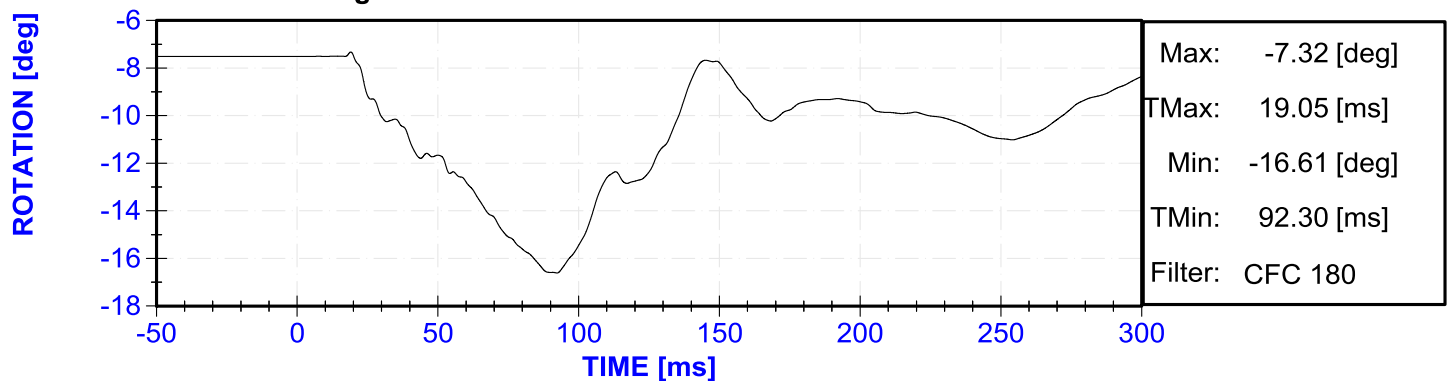
V2P1 Lower Right DGIR X Displacement



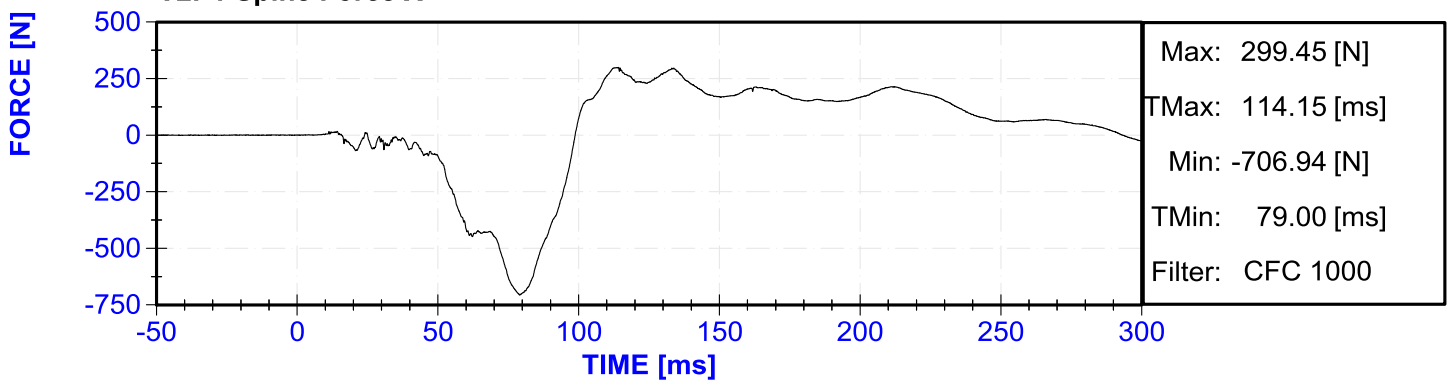
V2P1 Lower Right DGIR Y Rotation

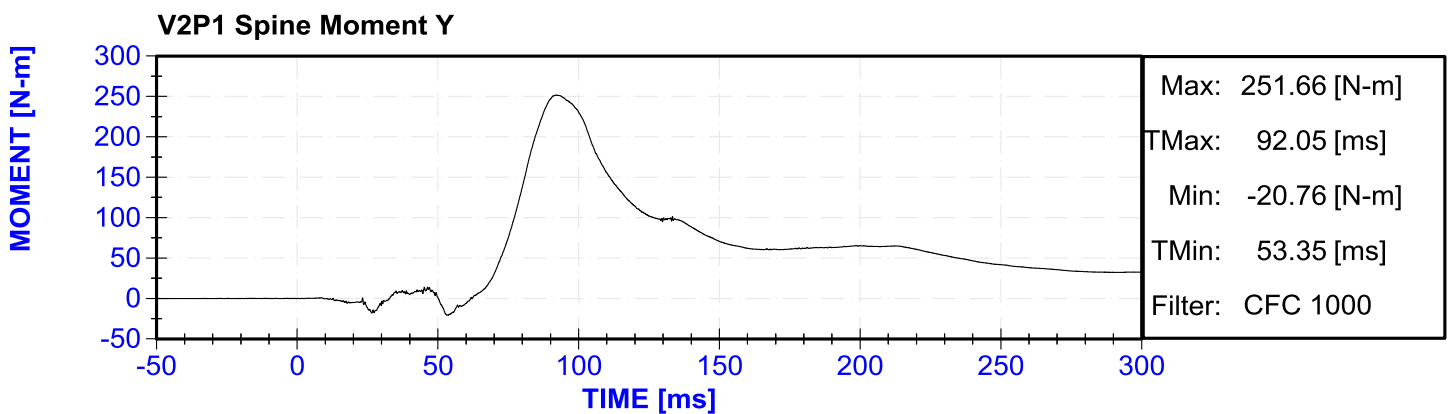
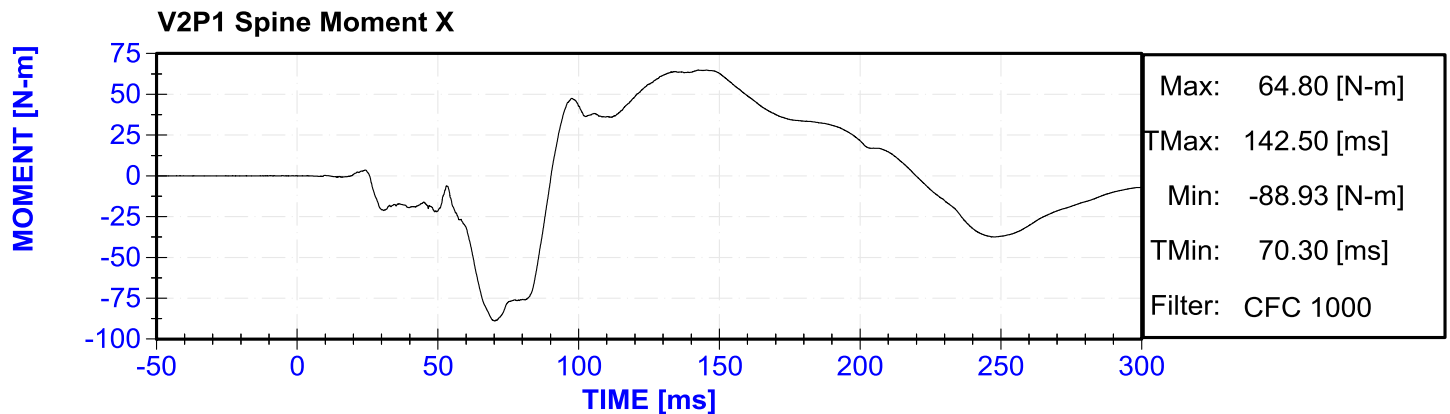
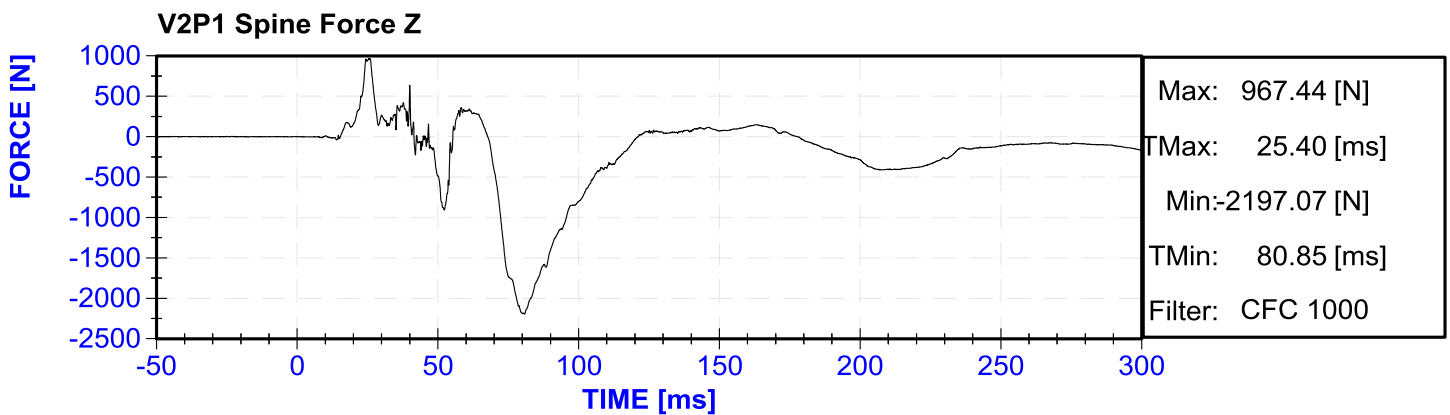
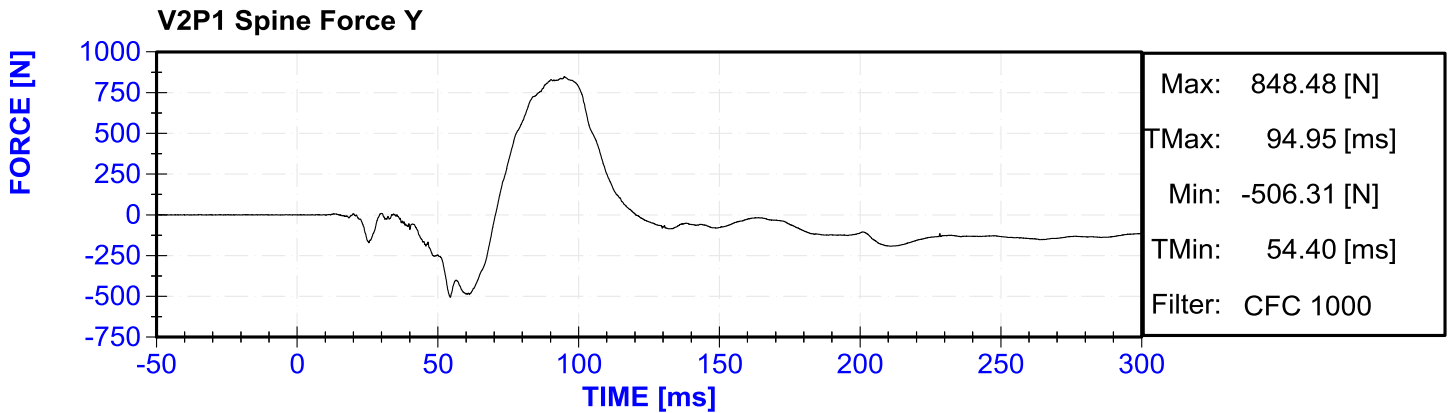


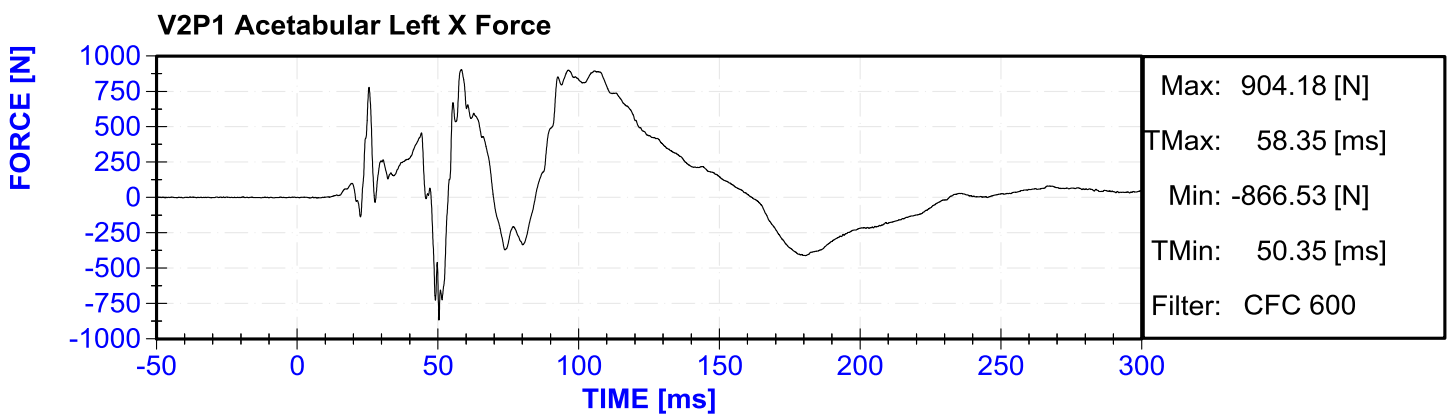
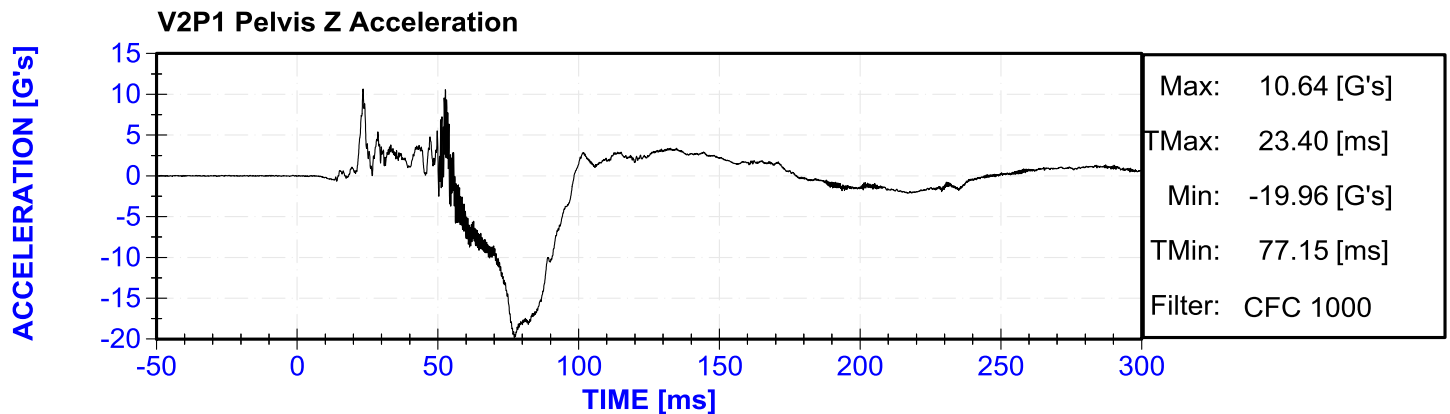
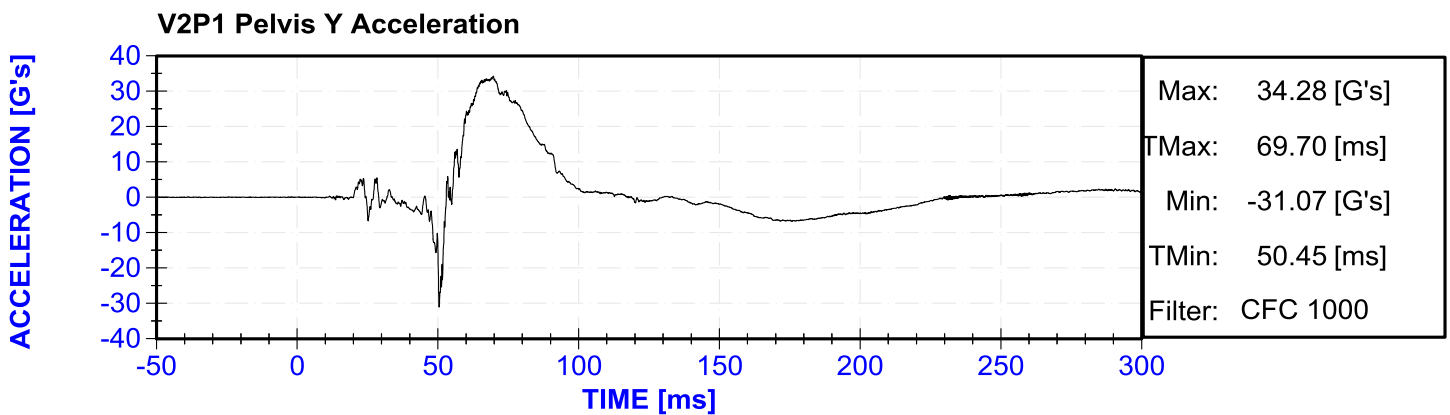
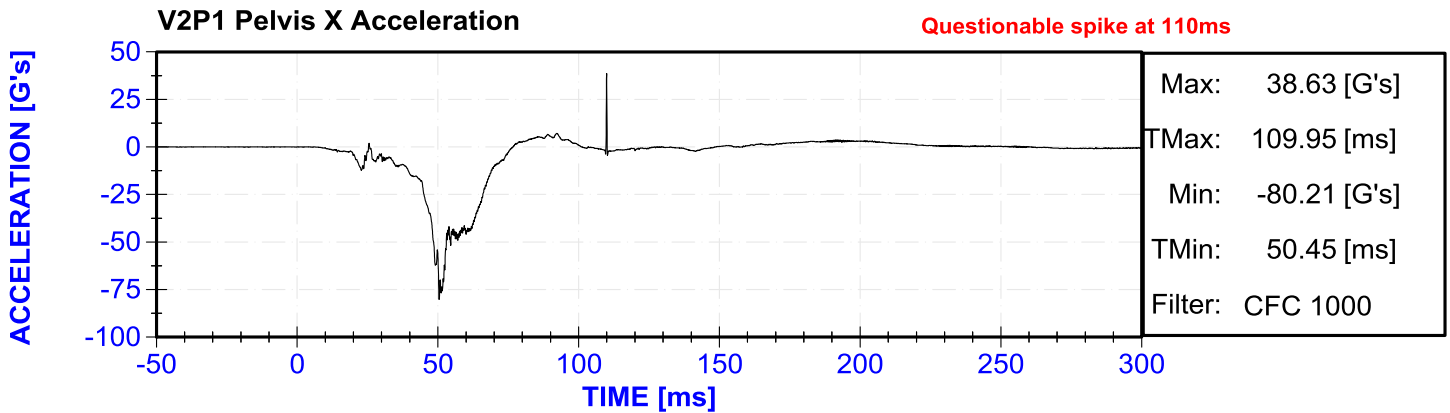
V2P1 Lower Right DGIR Z Rotation

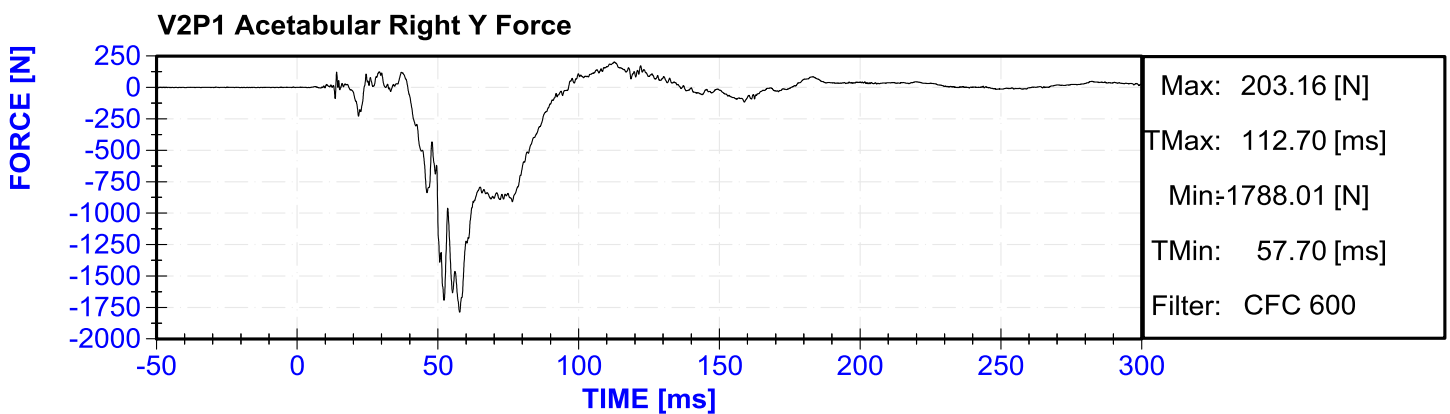
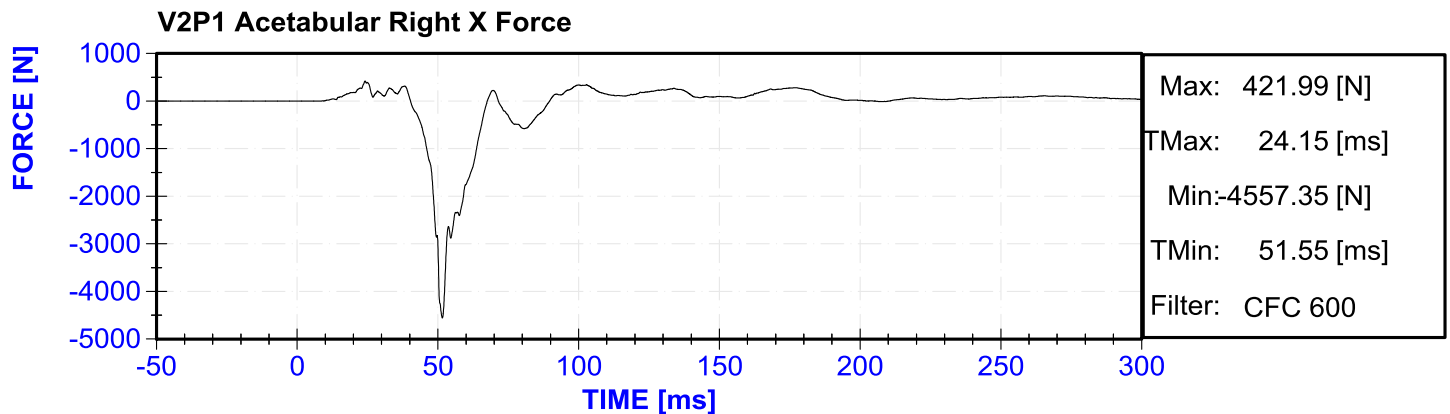
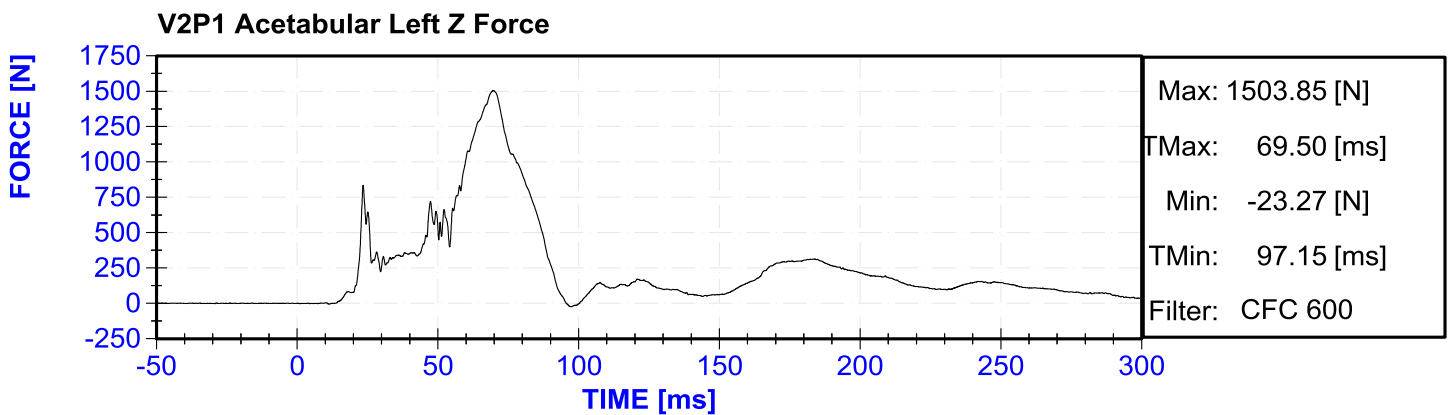
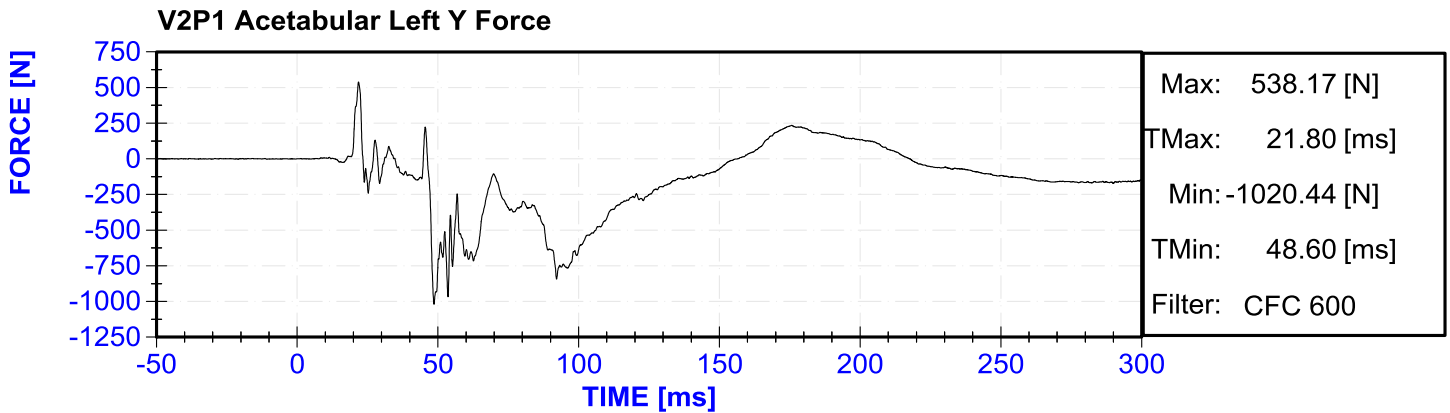


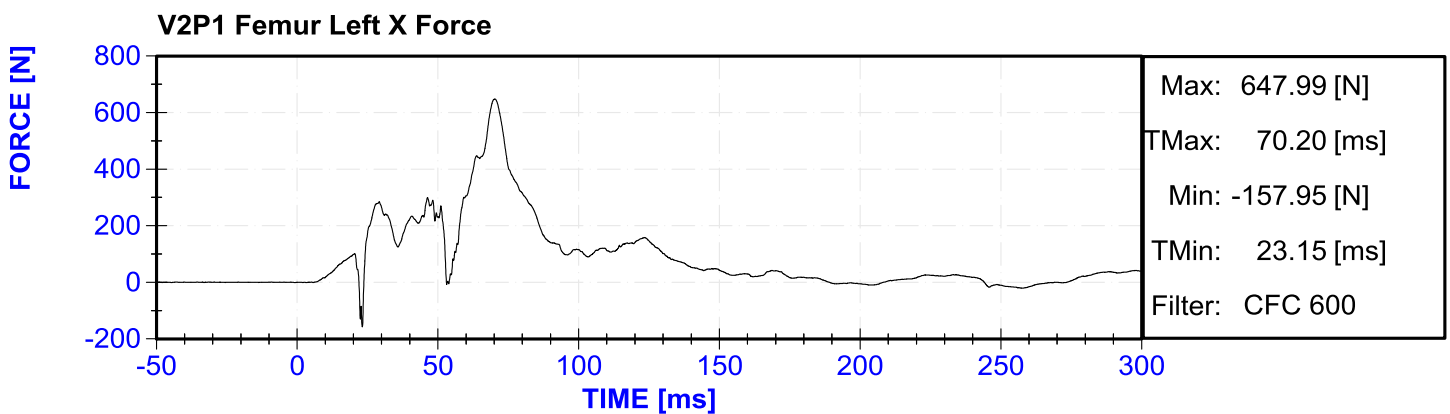
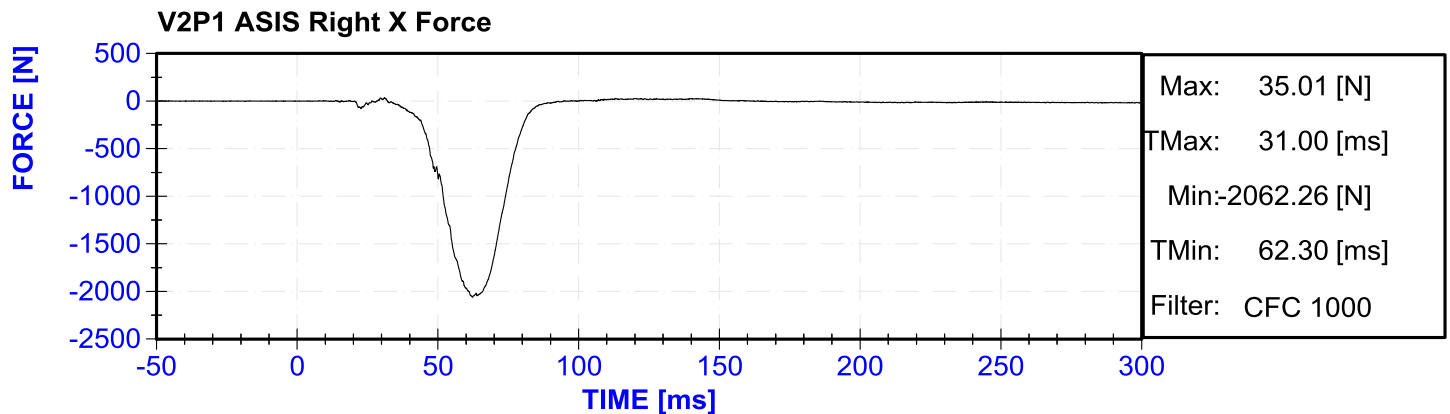
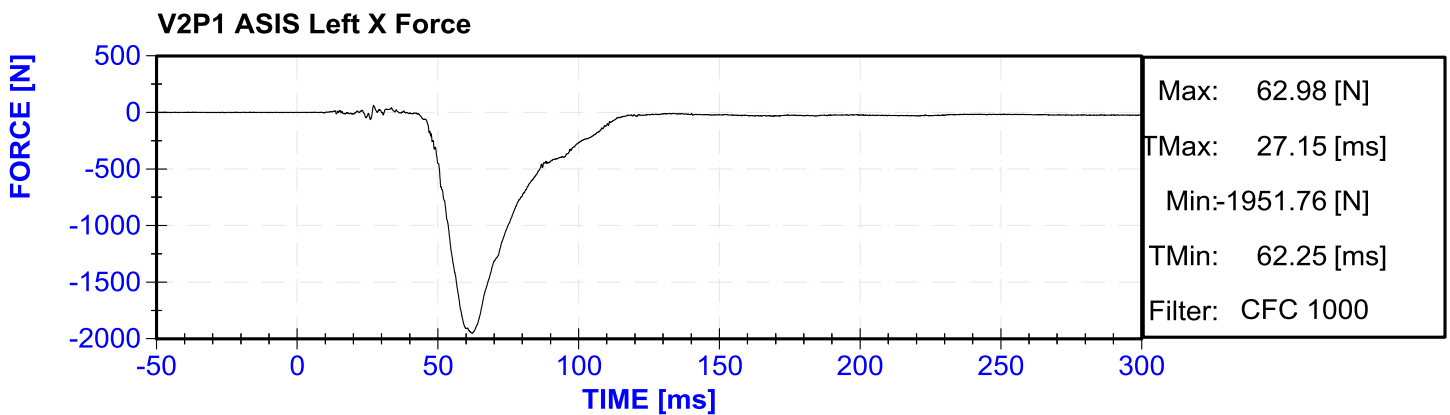
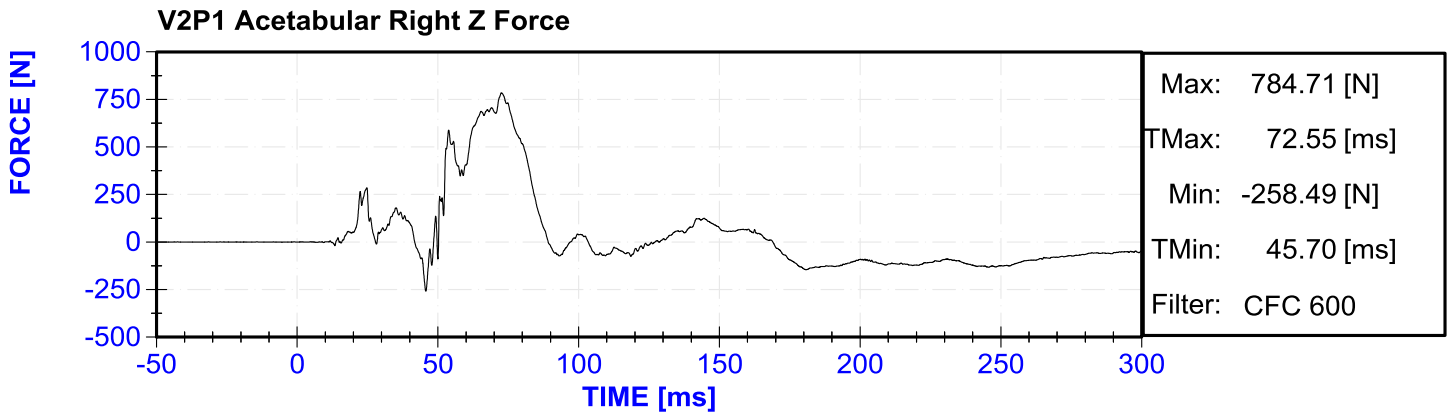
V2P1 Spine Force X

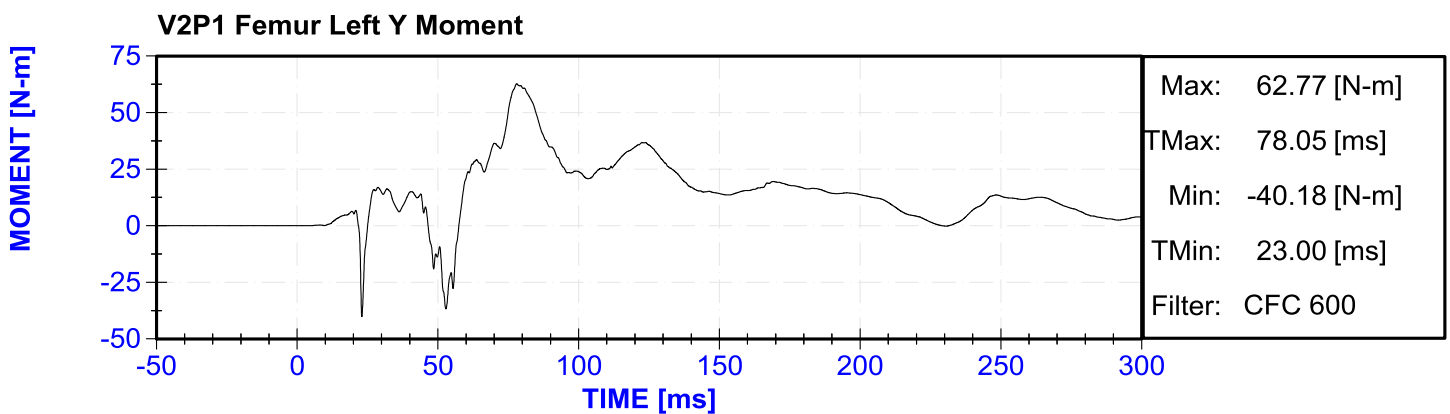
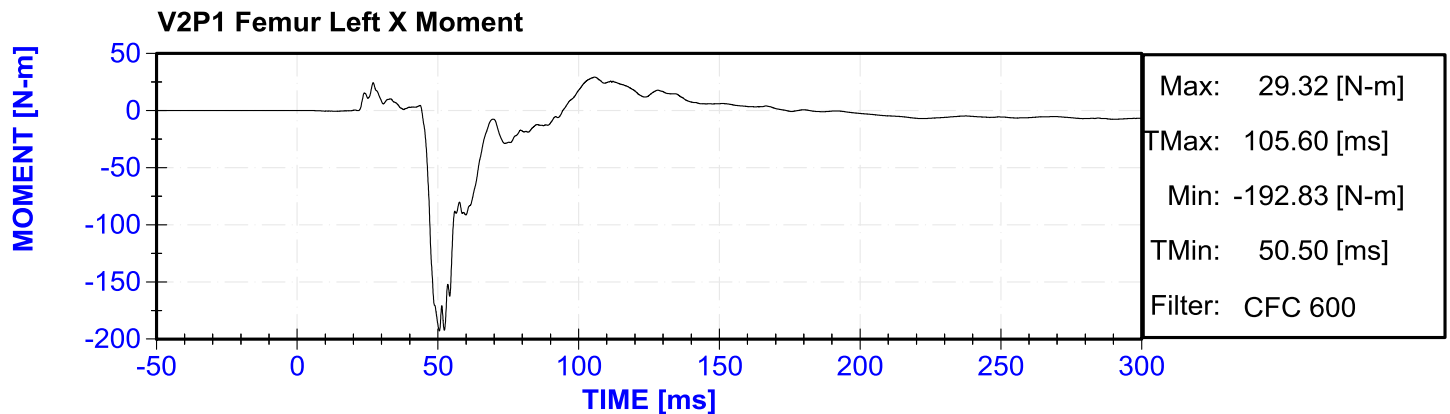
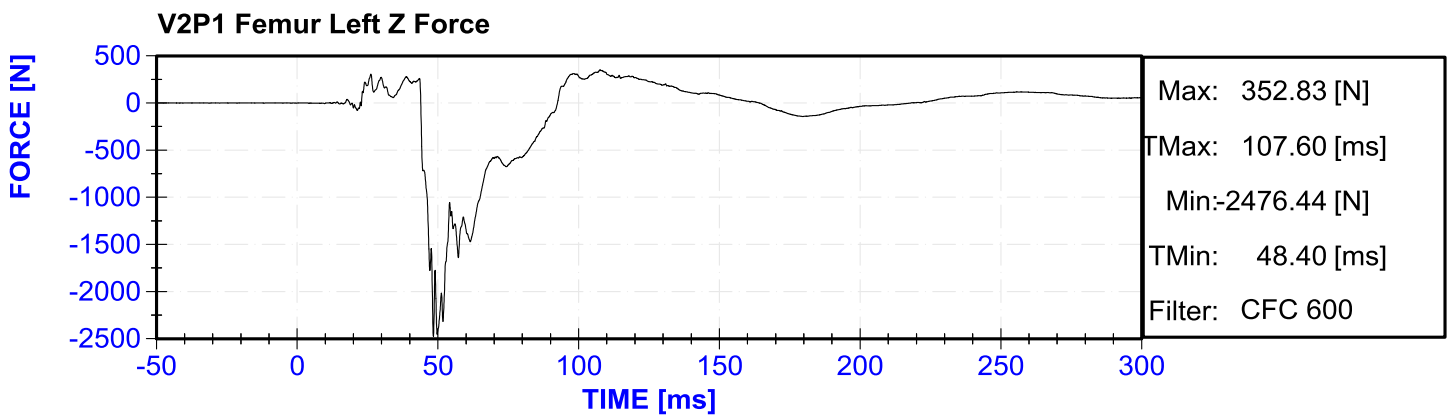
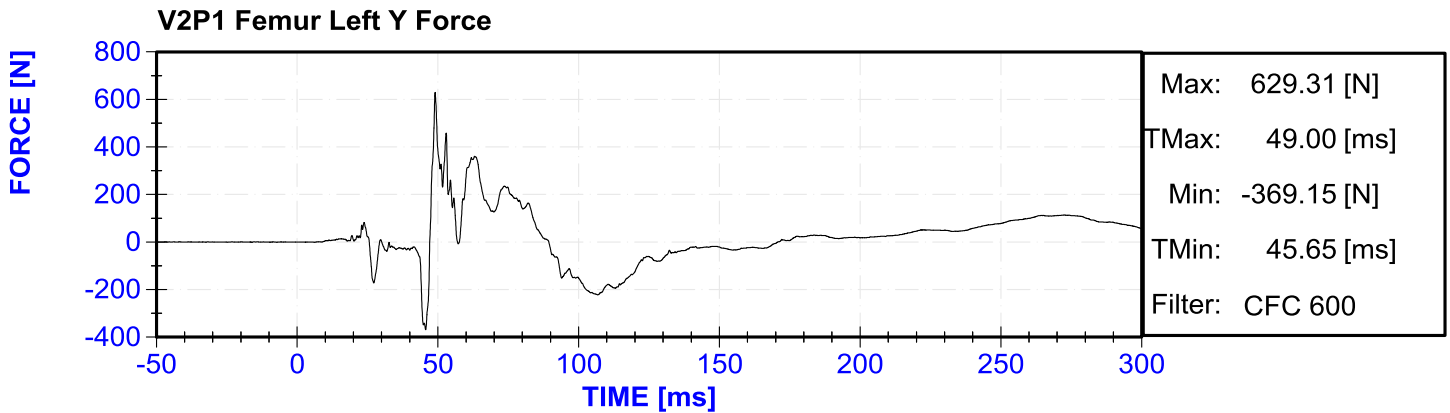


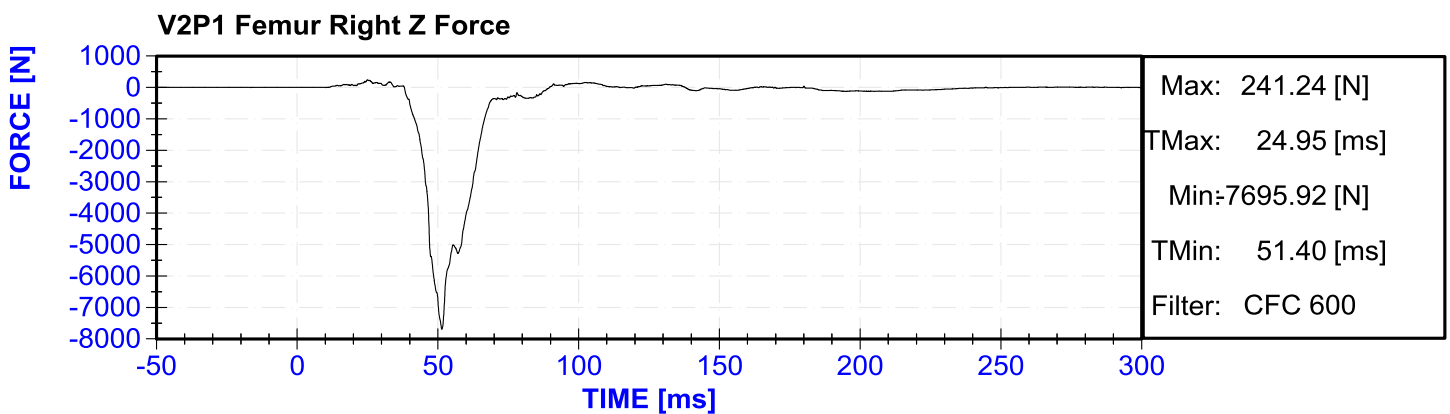
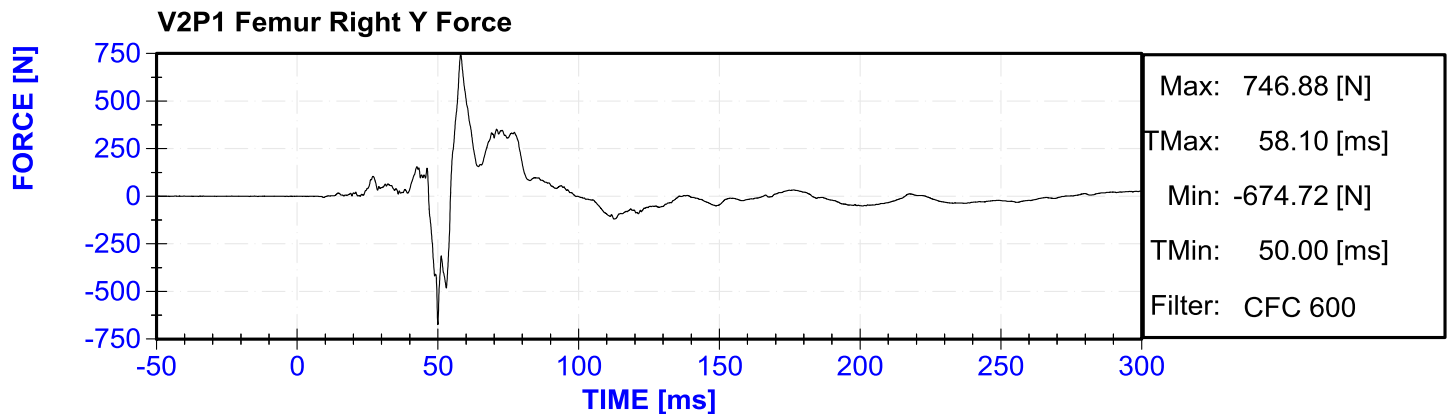
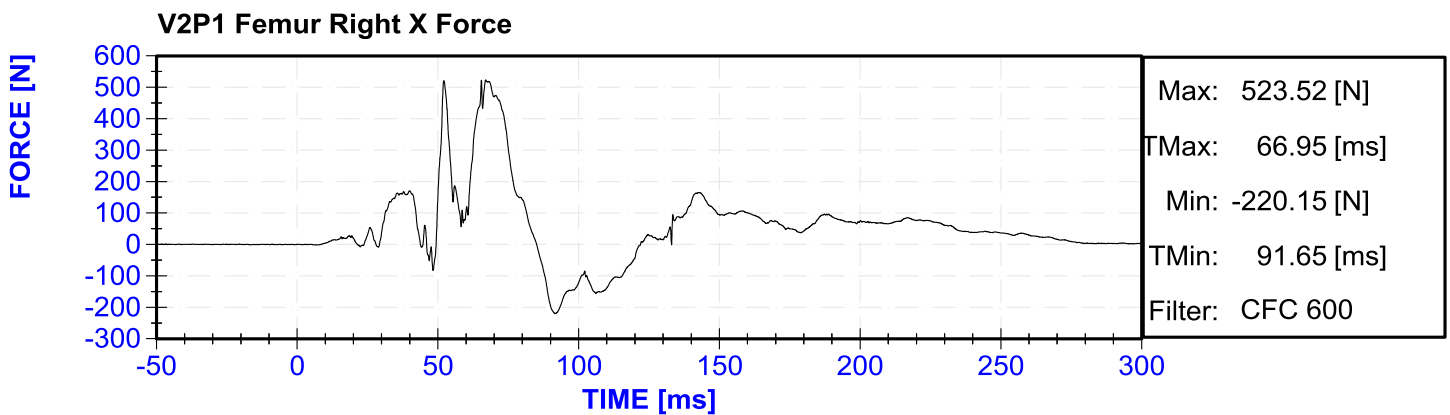
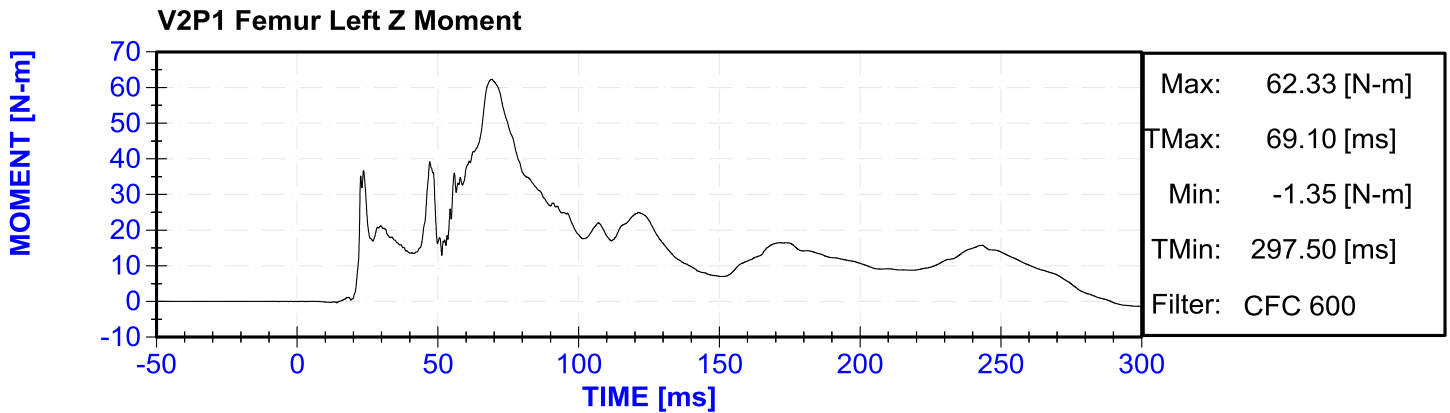


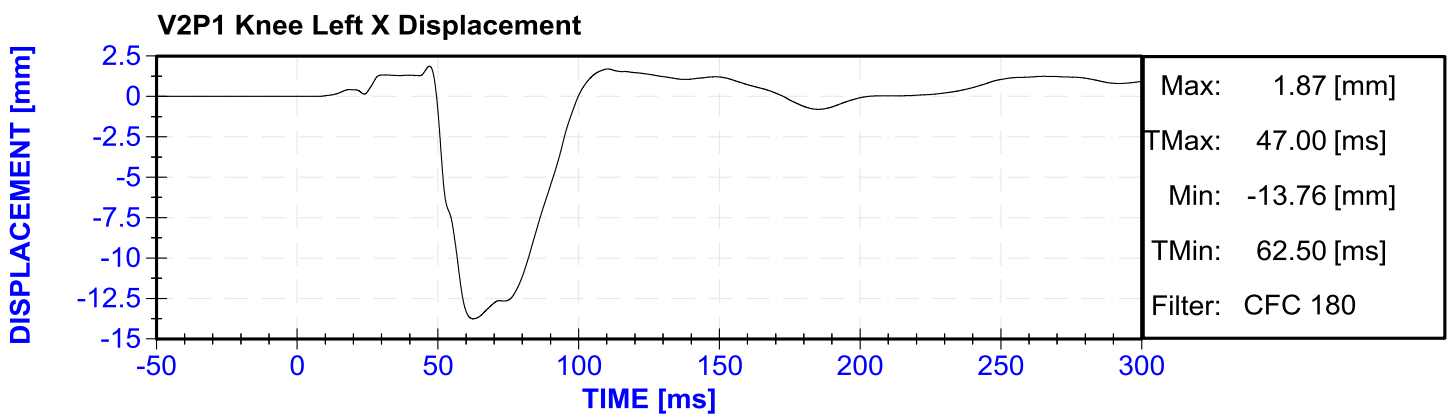
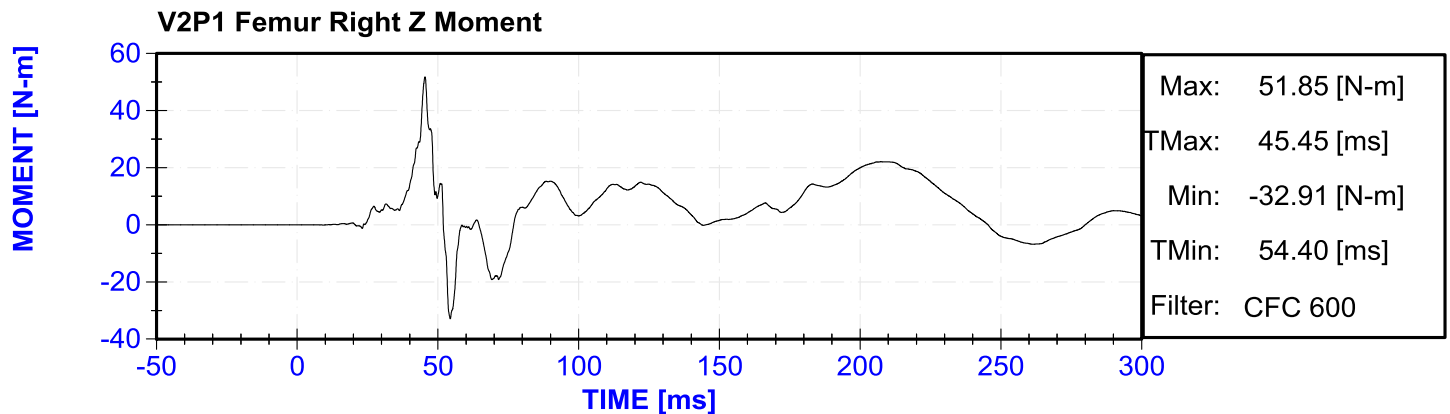
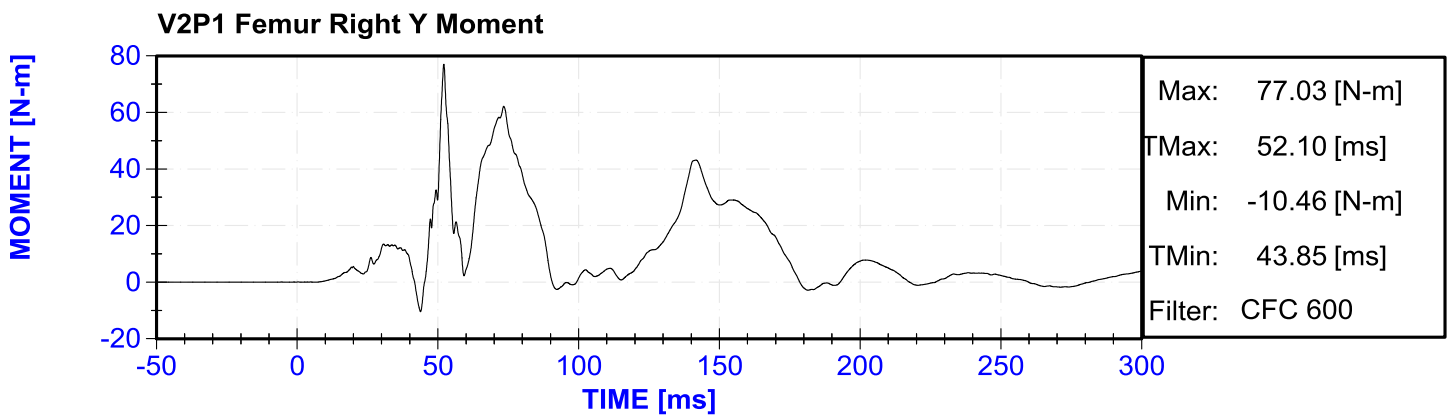
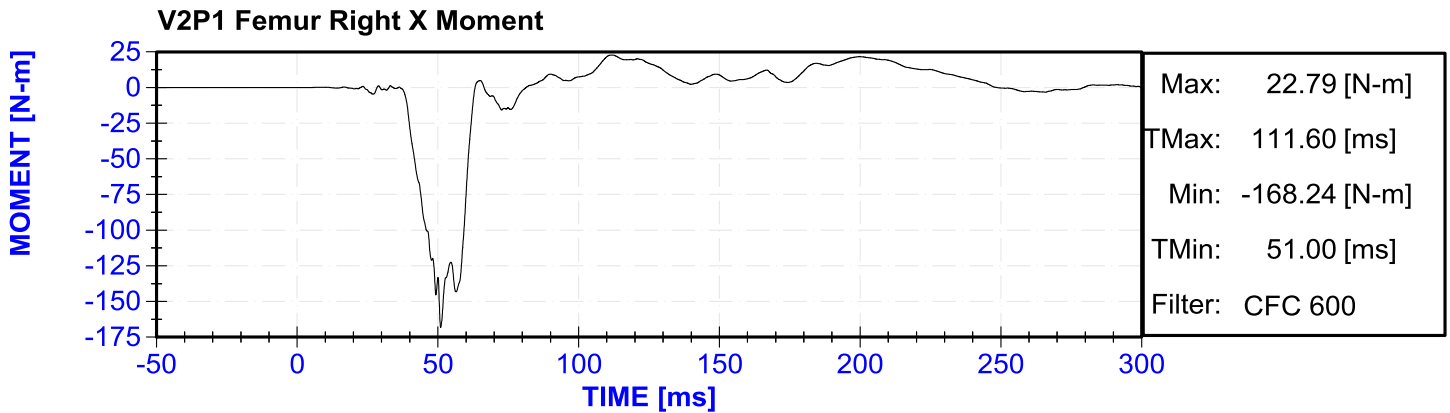


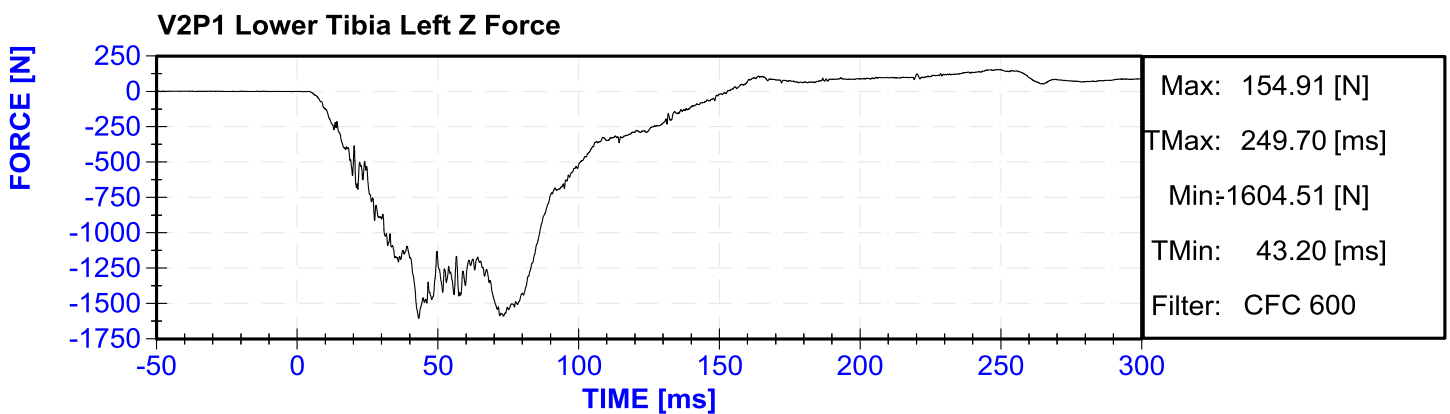
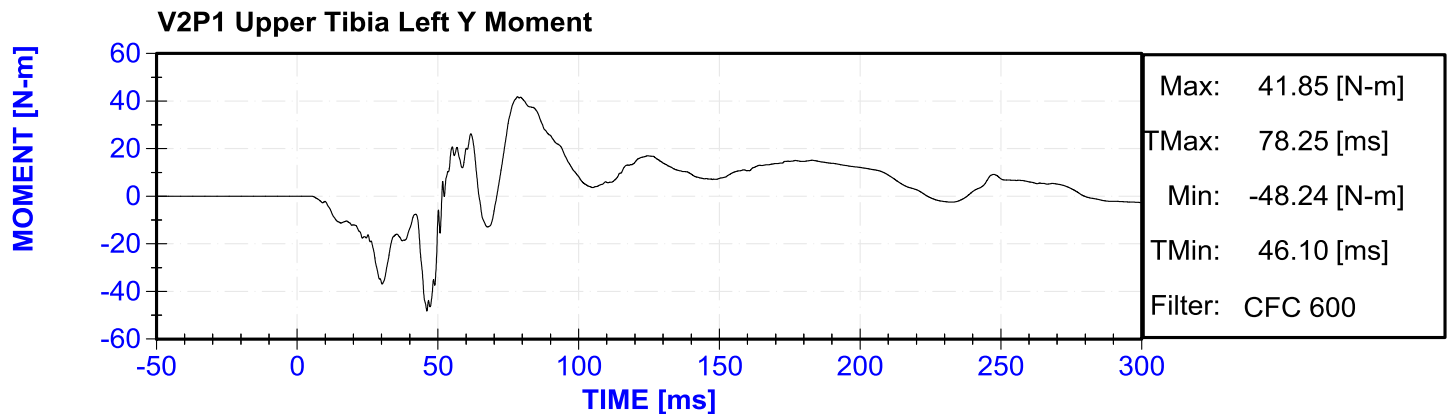
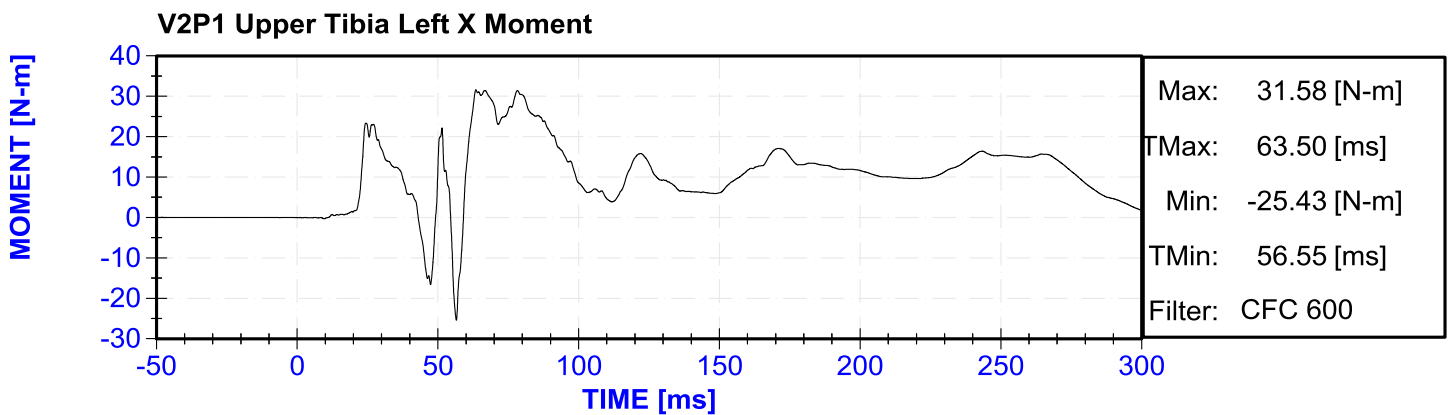
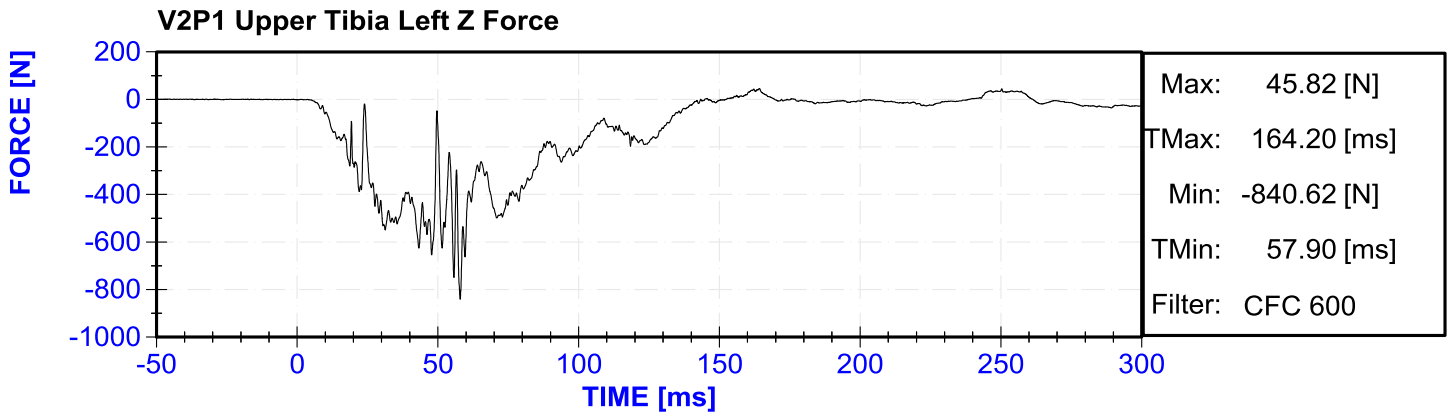


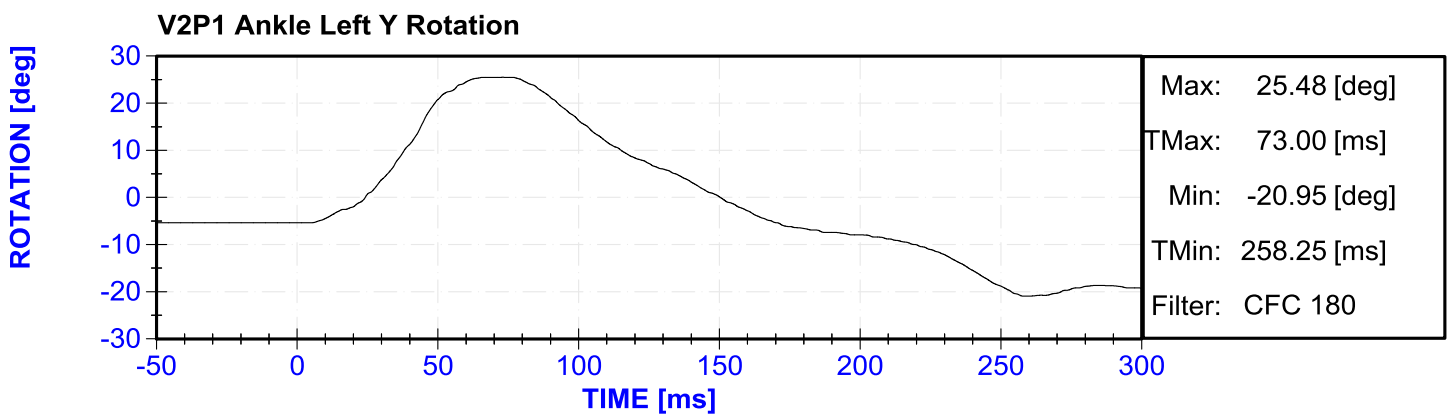
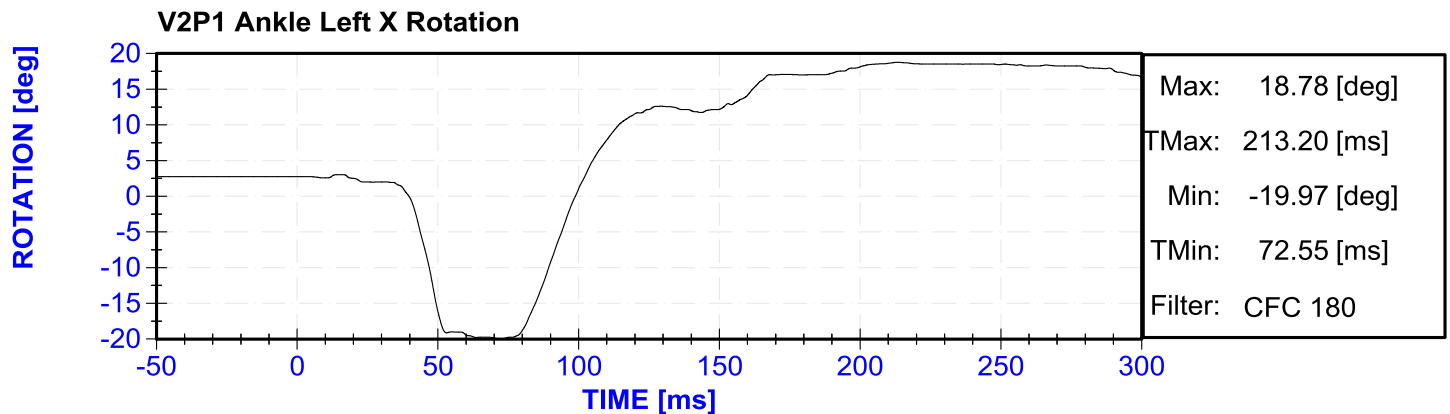
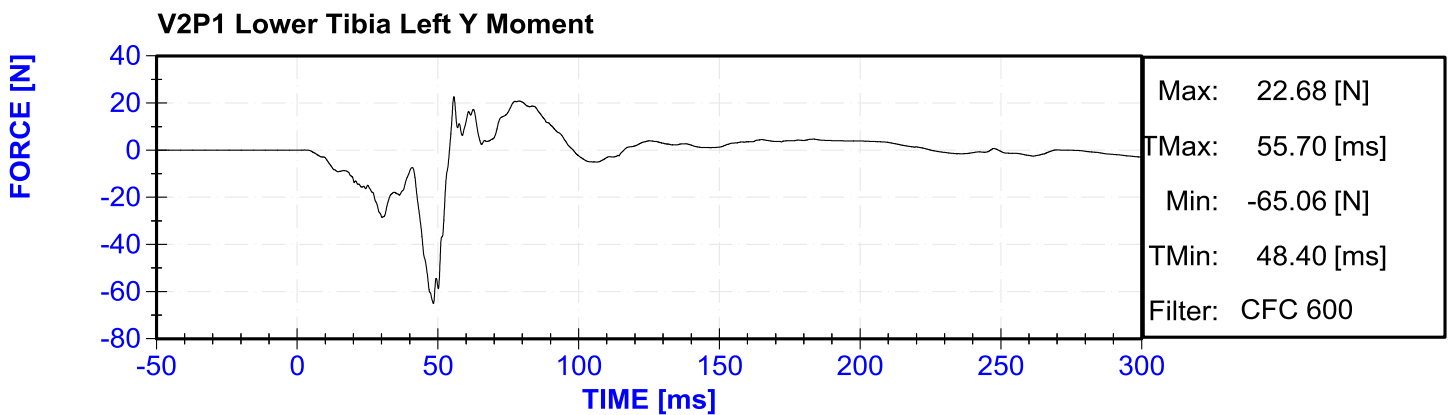
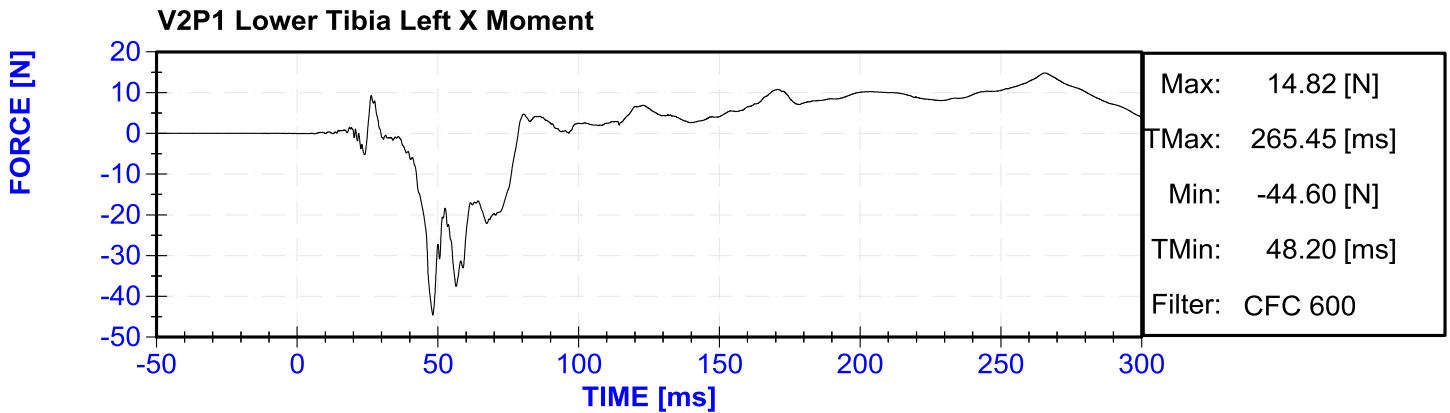


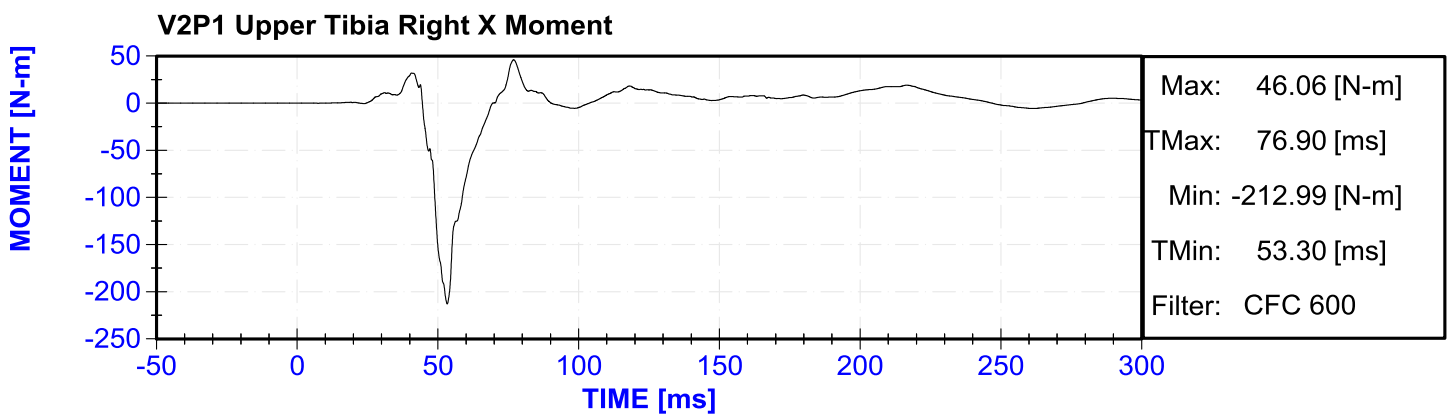
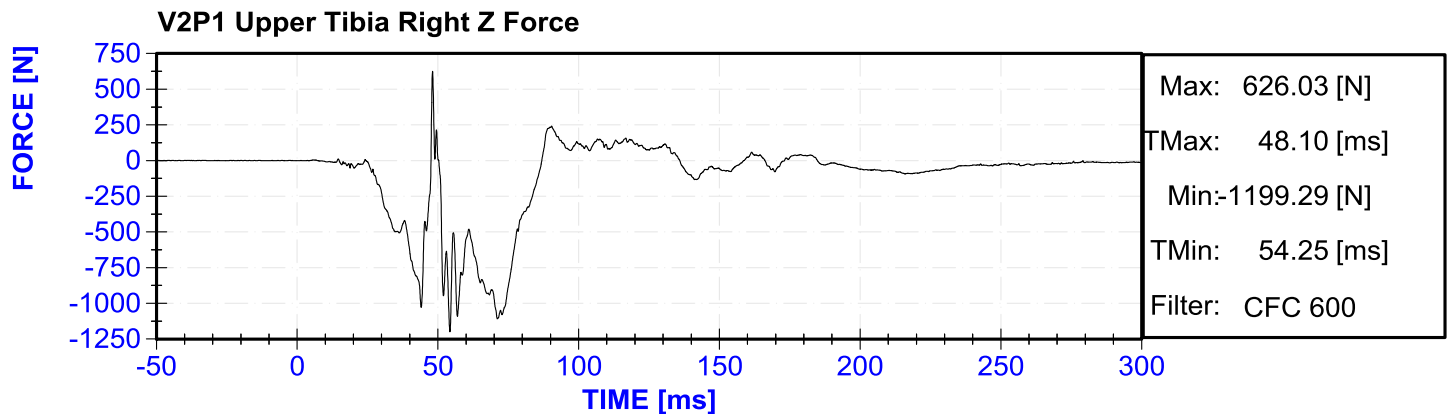
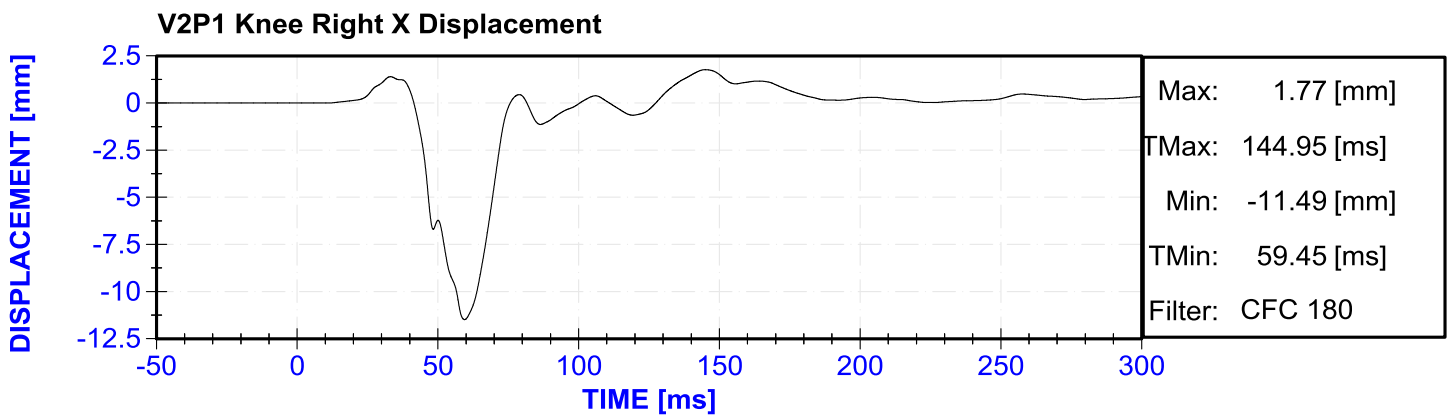
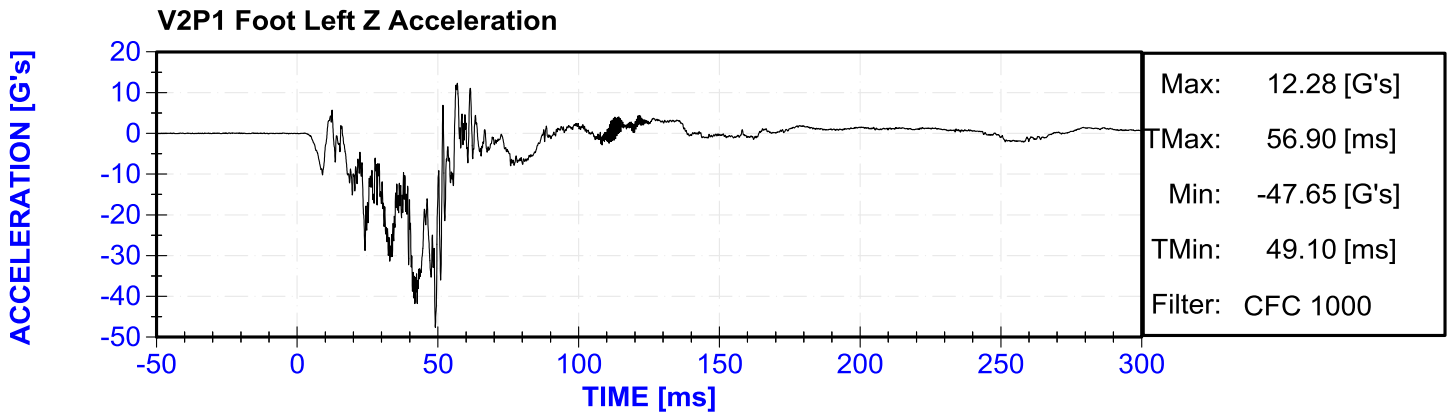


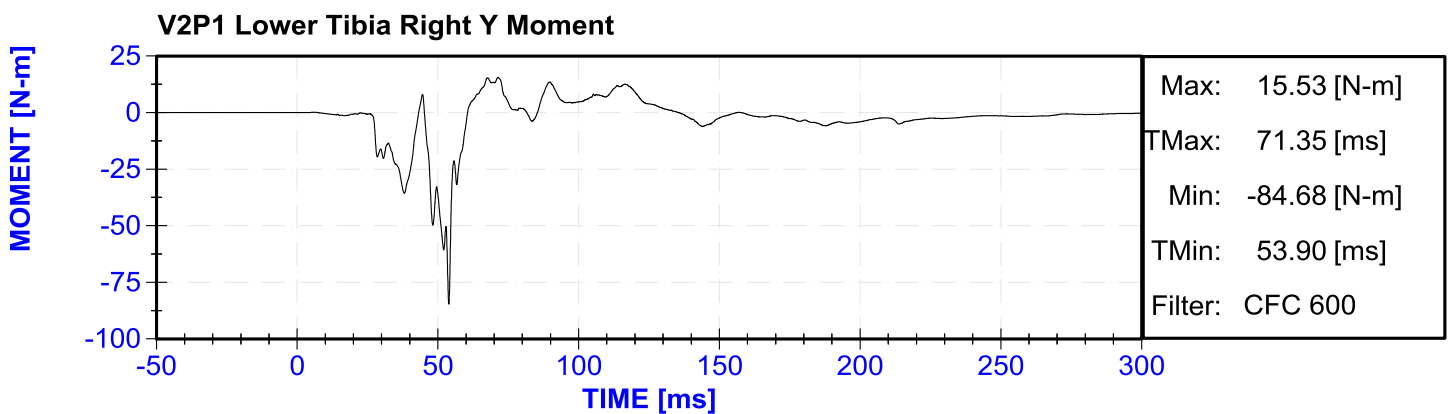
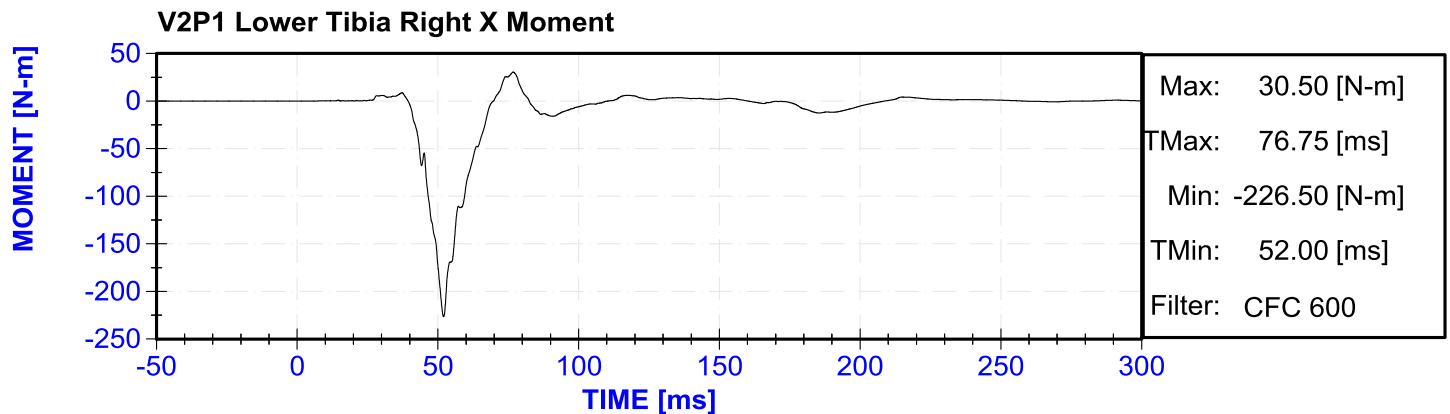
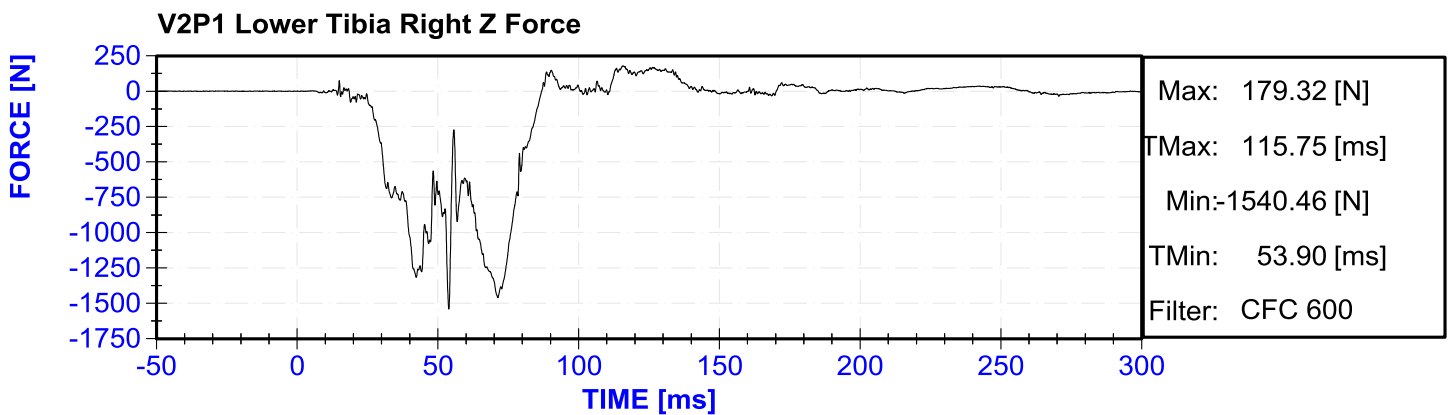
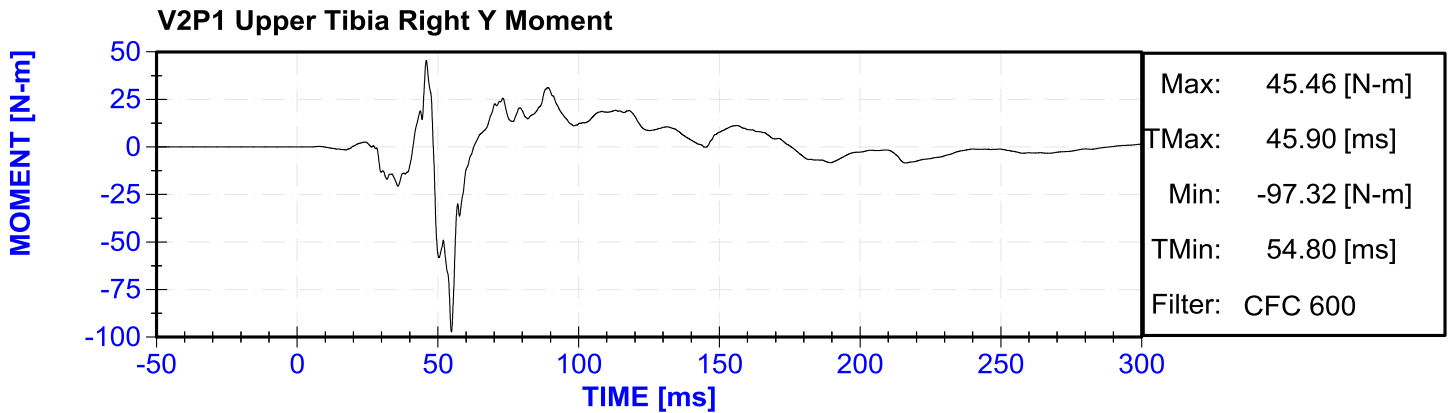


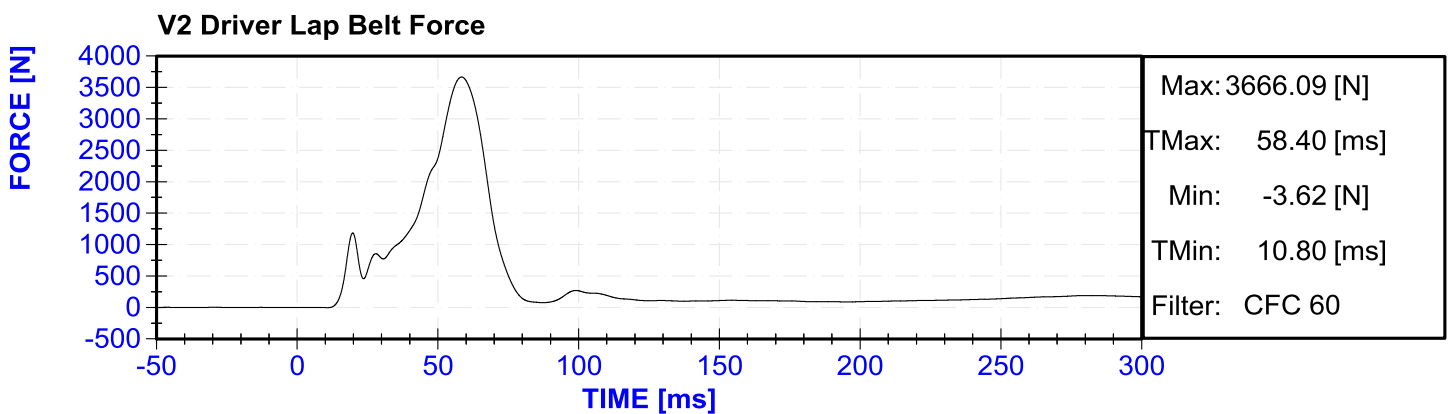
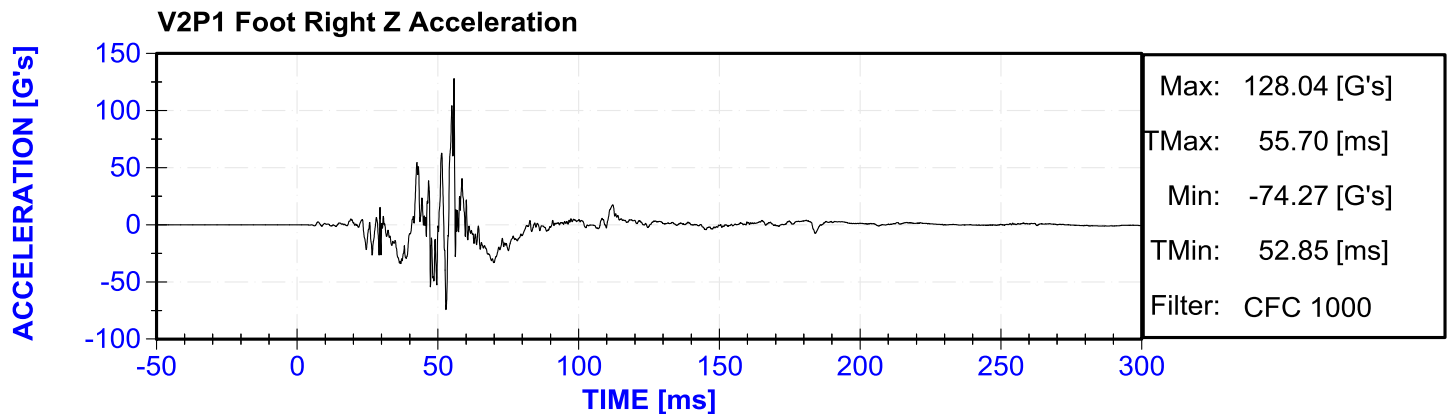
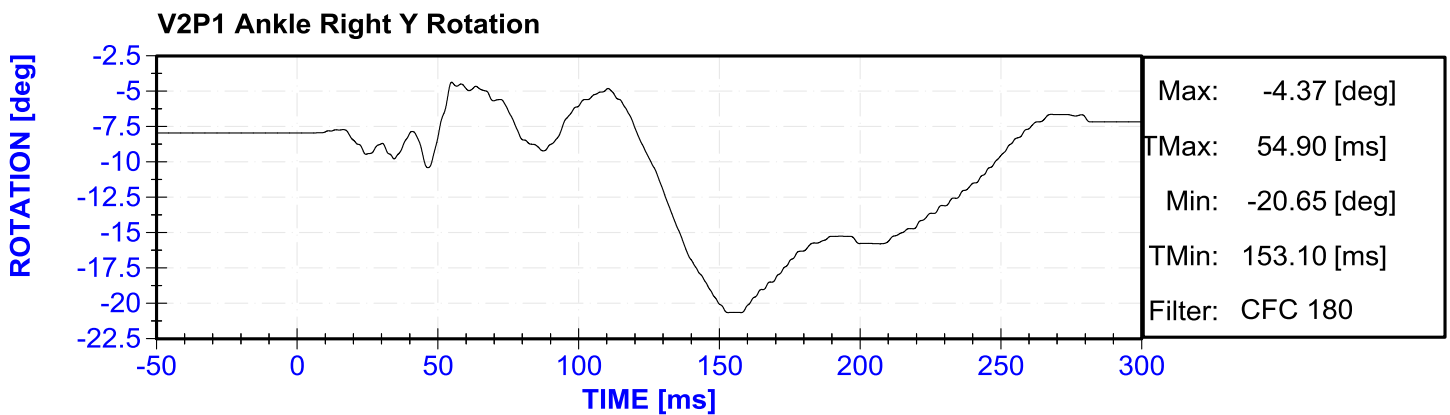
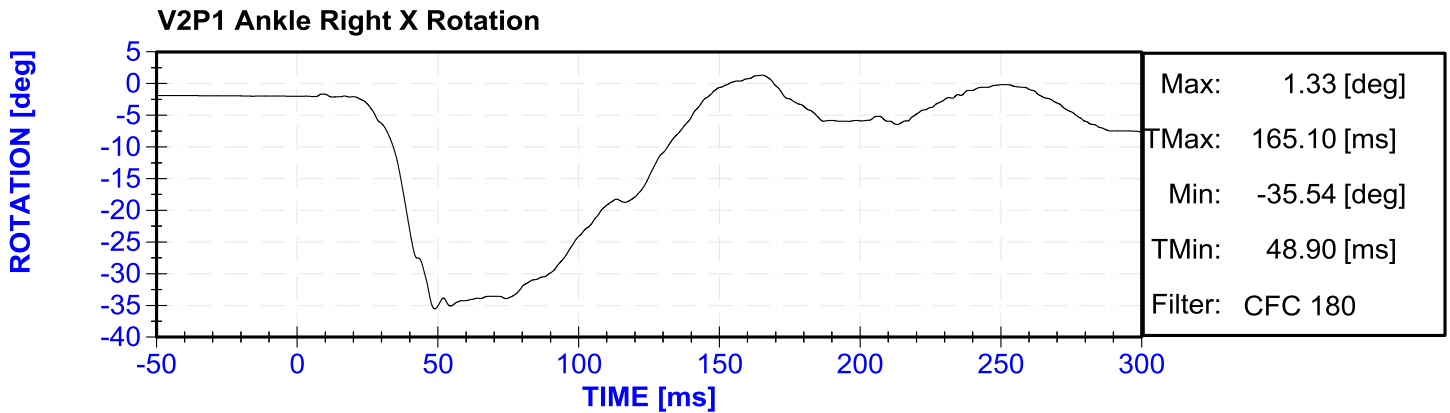




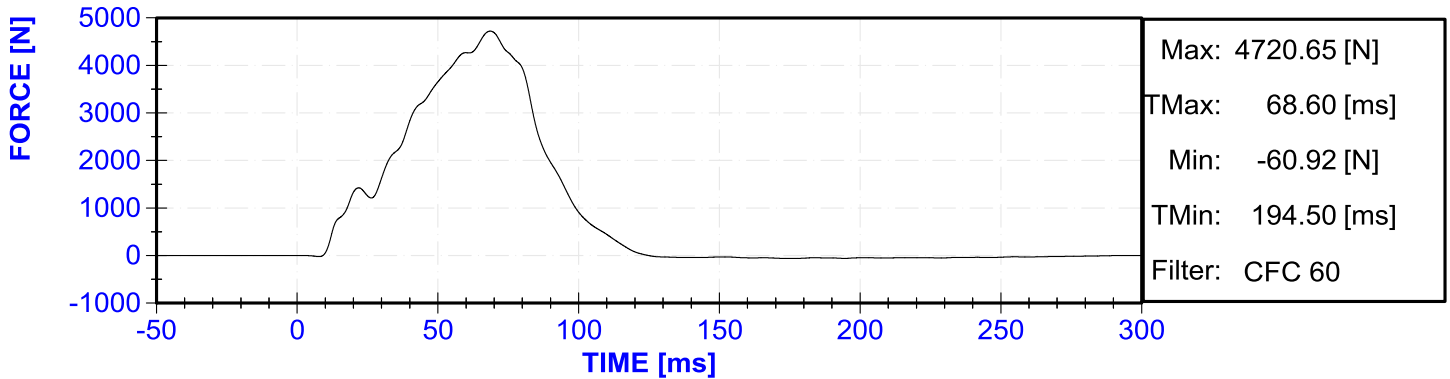




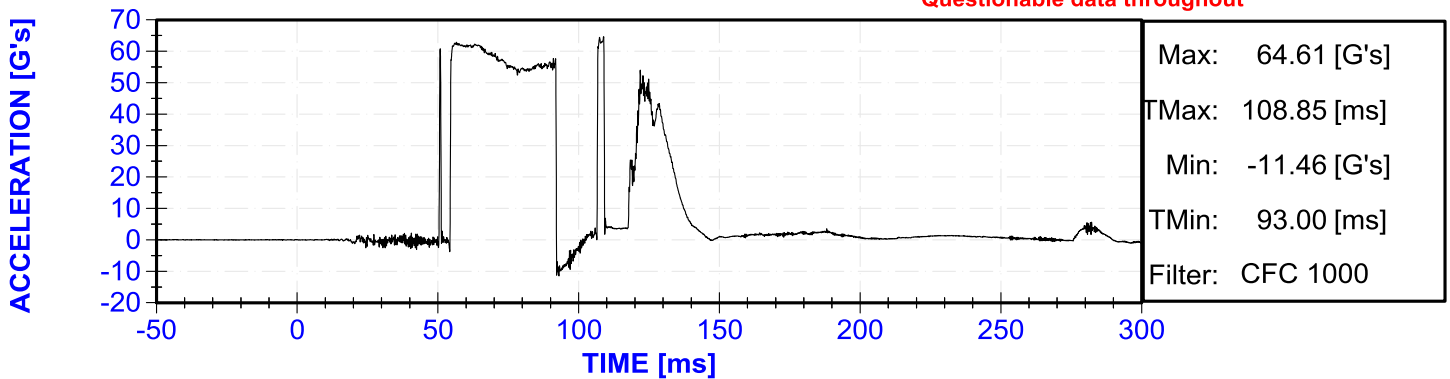




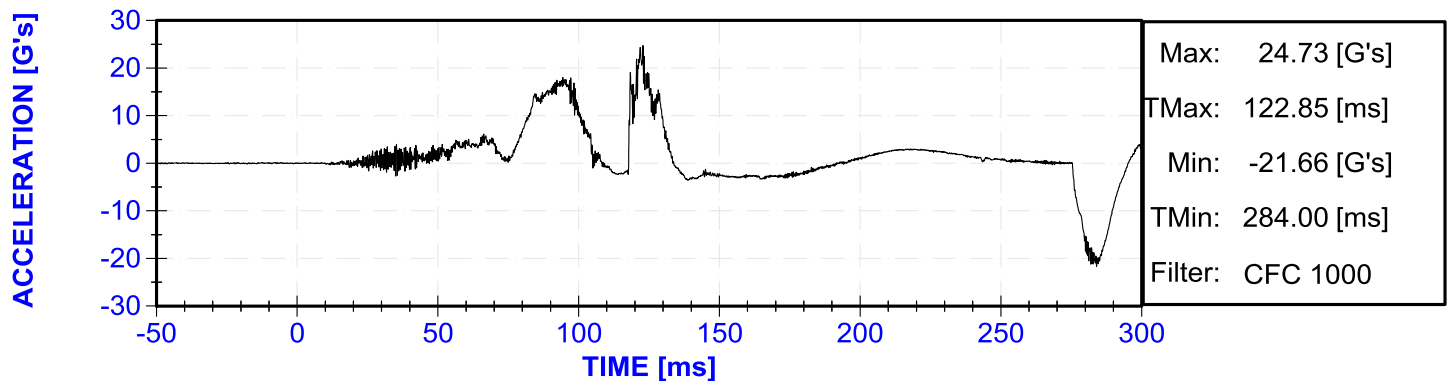
V2 Driver Shoulder Belt Force



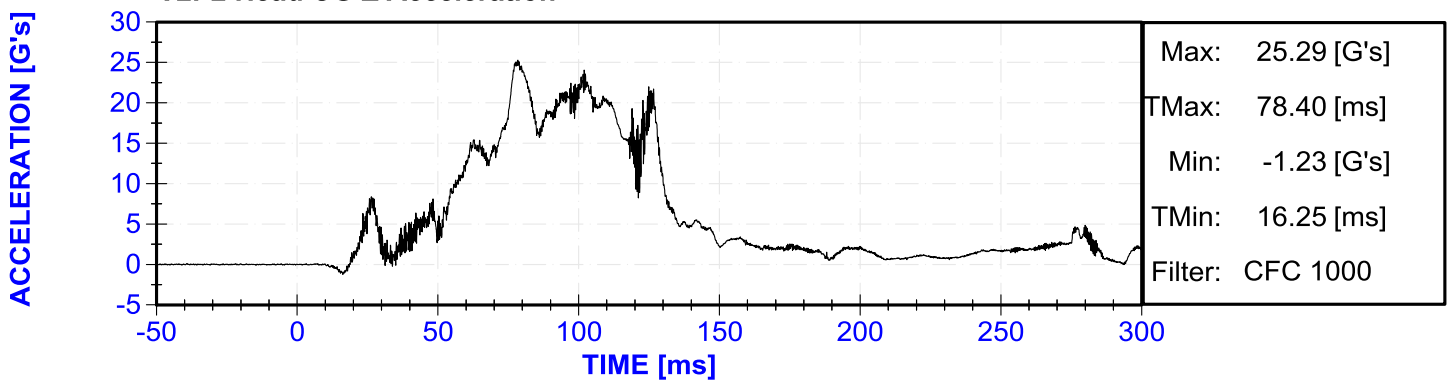
V2P2 Head CG X Acceleration

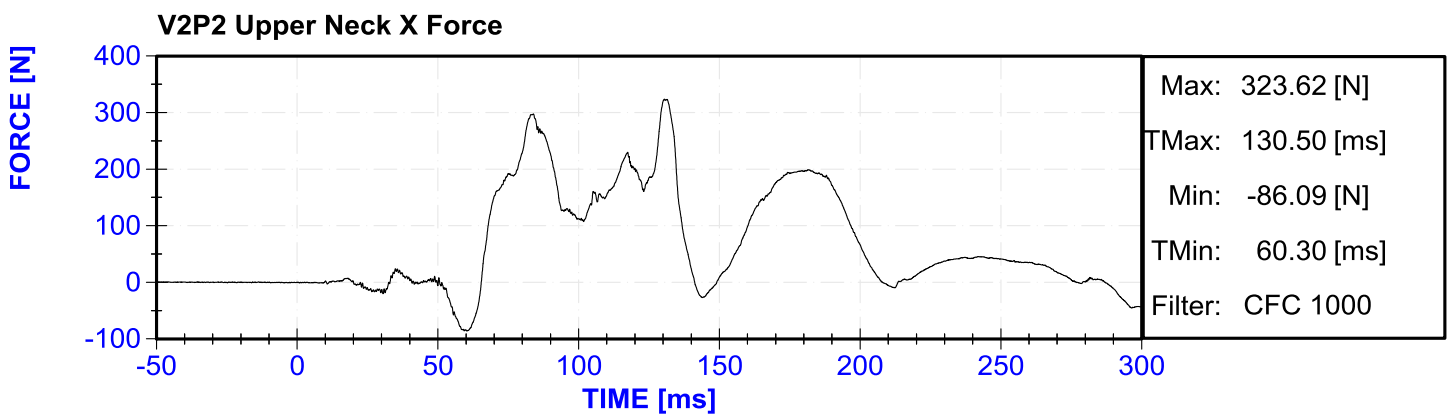
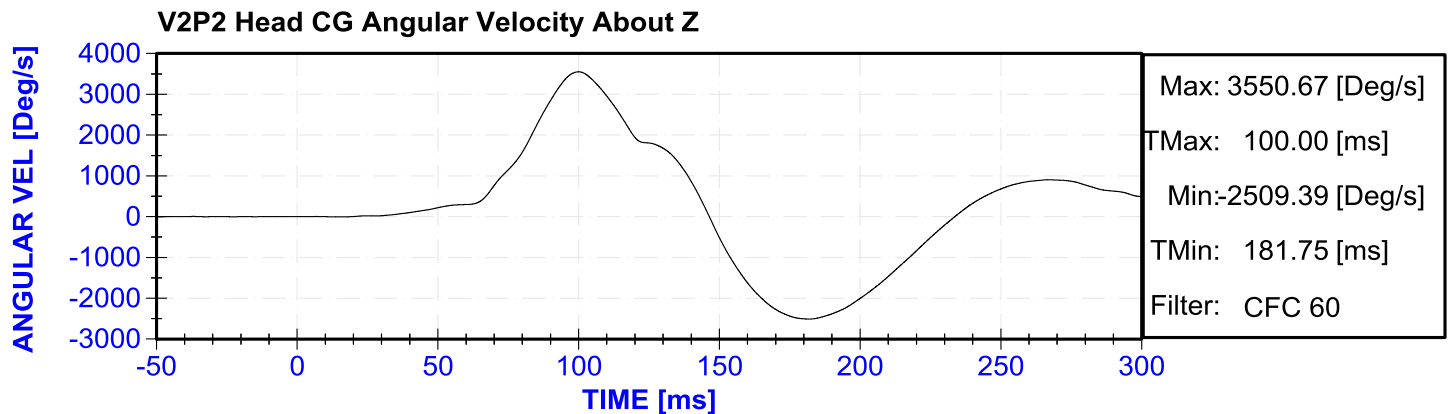
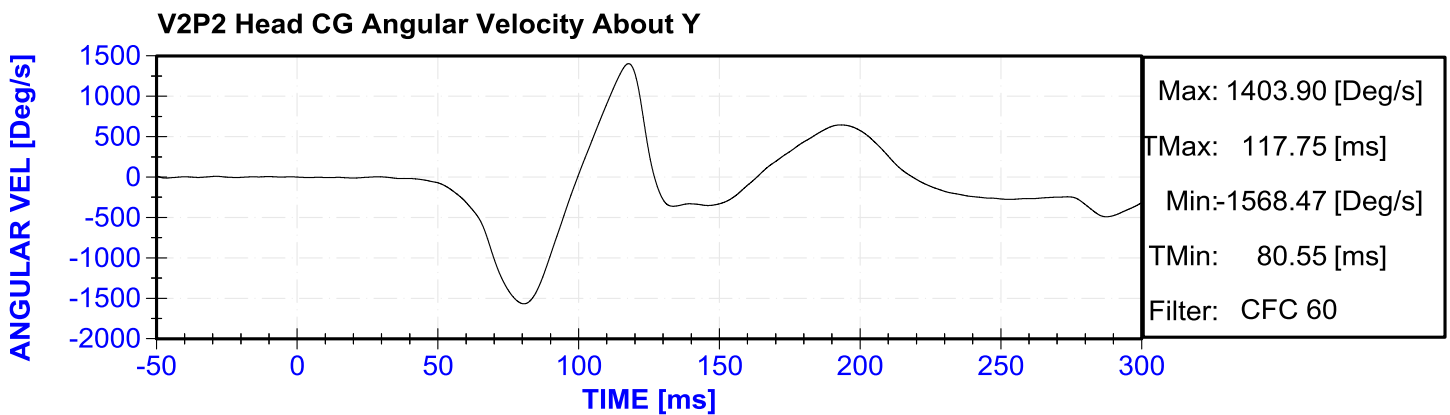
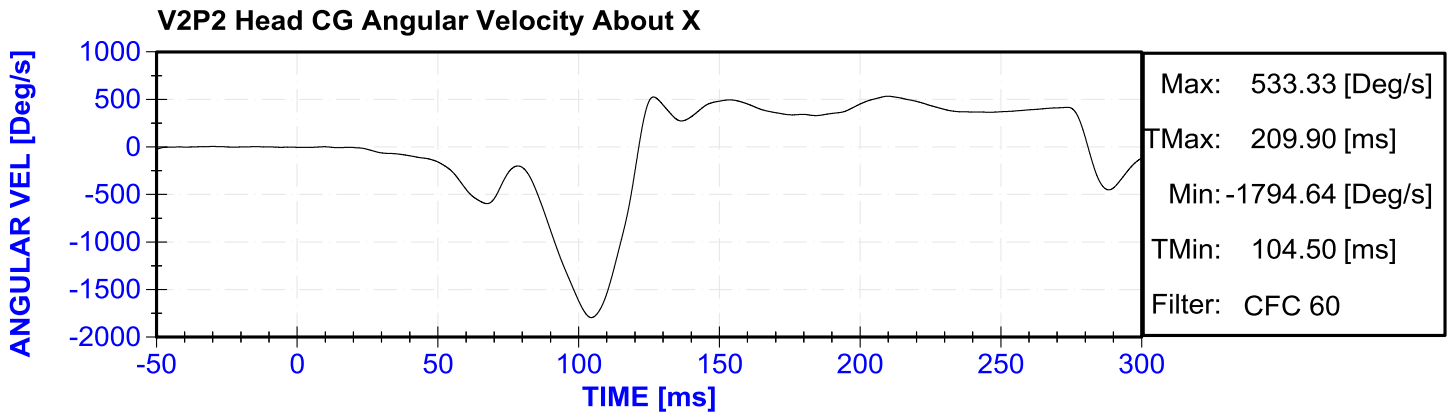


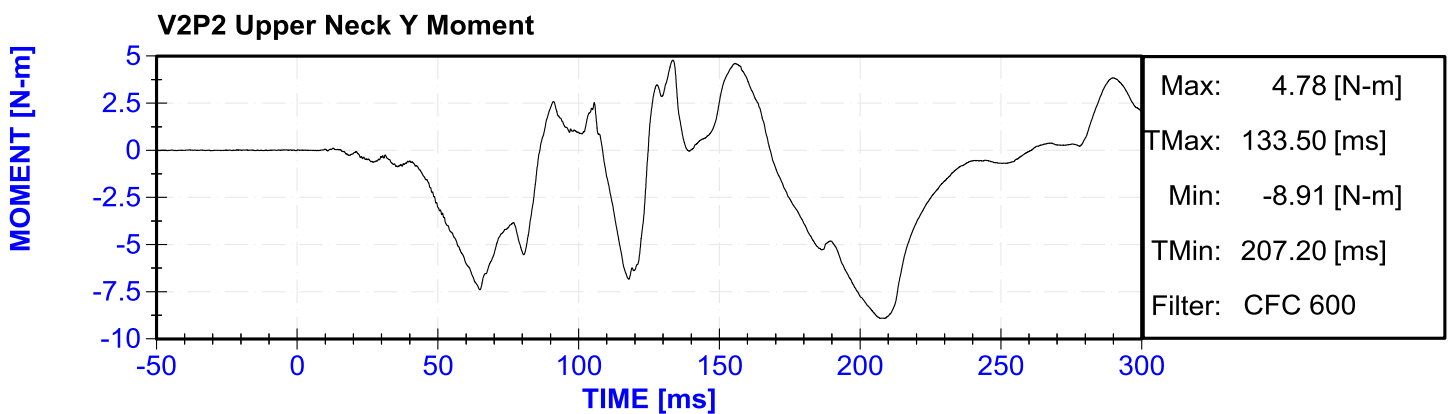
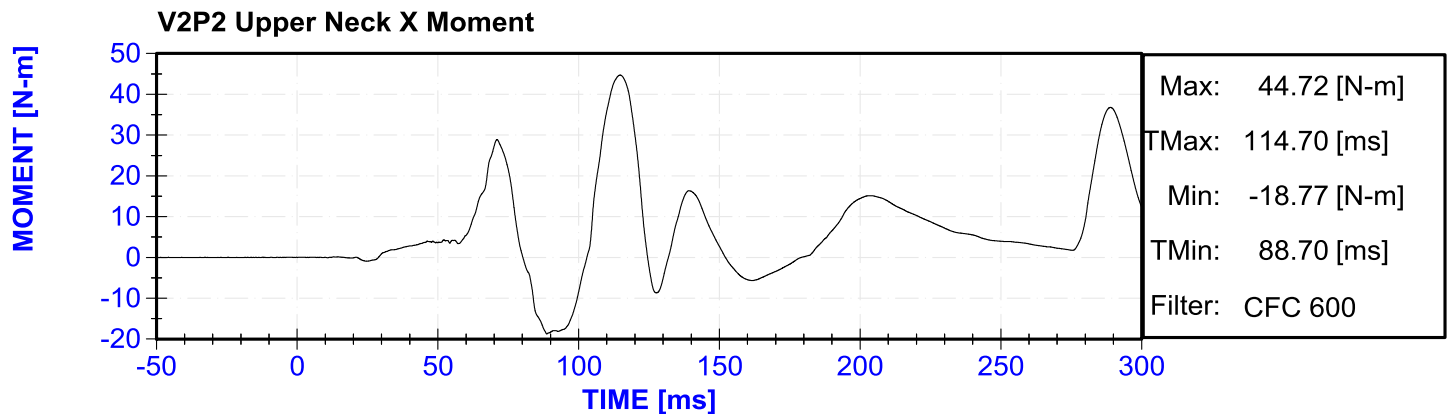
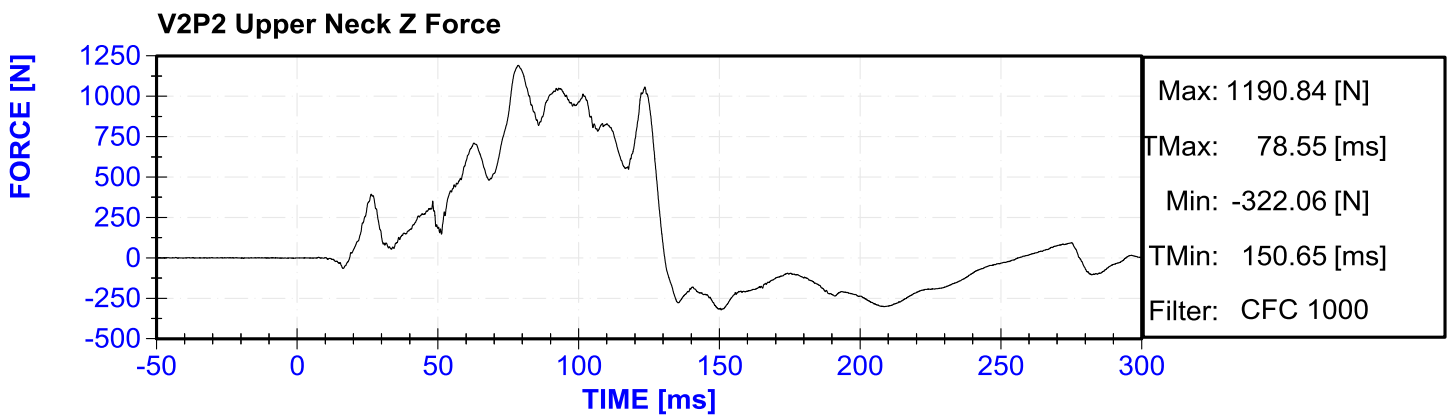
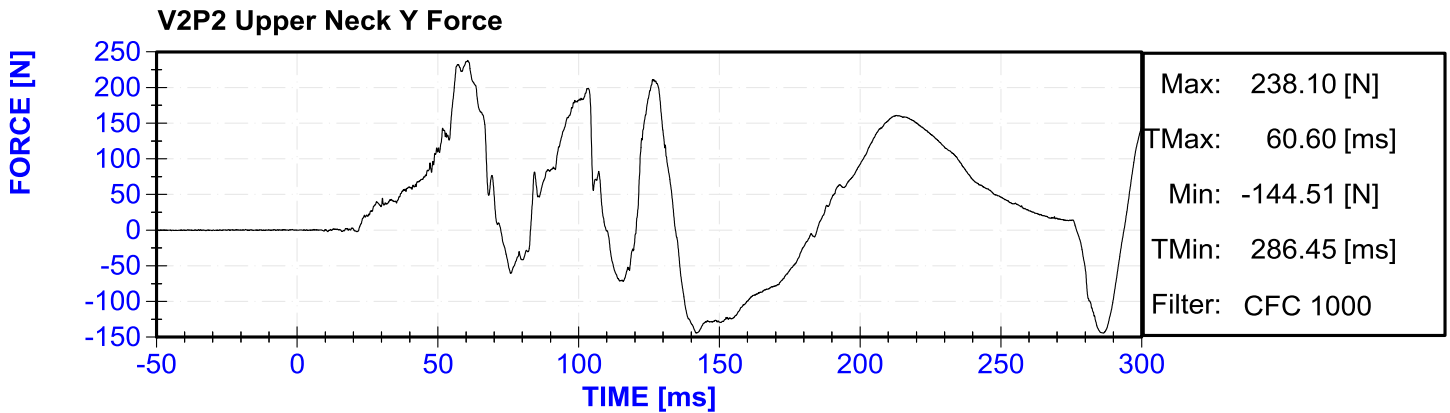
V2P2 Head CG Y Acceleration

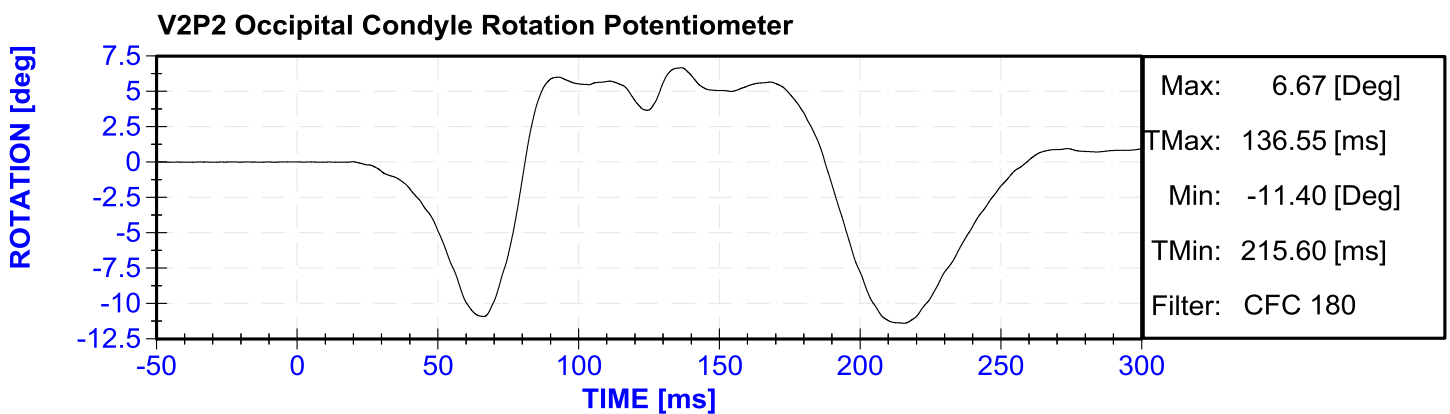
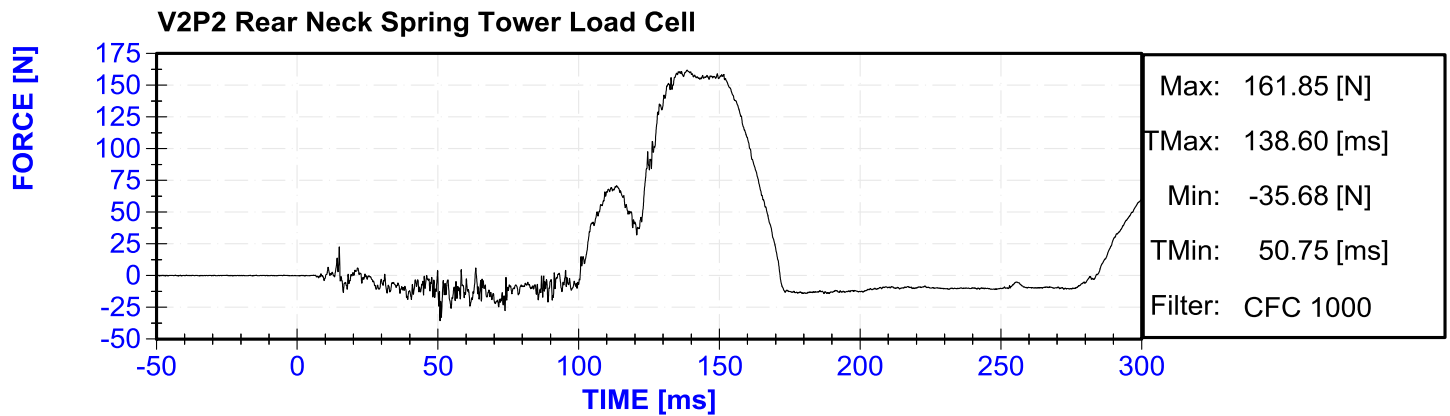
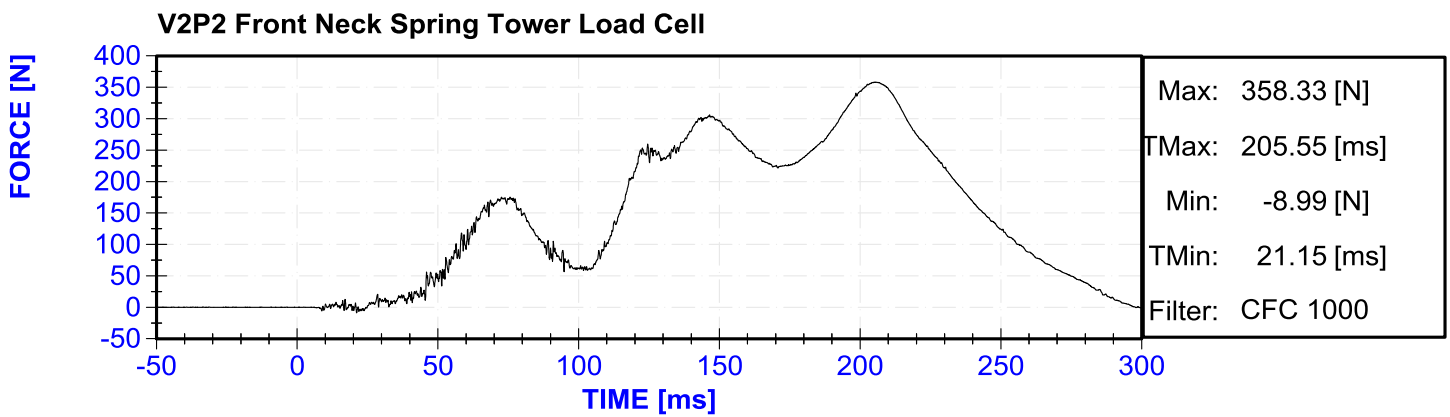
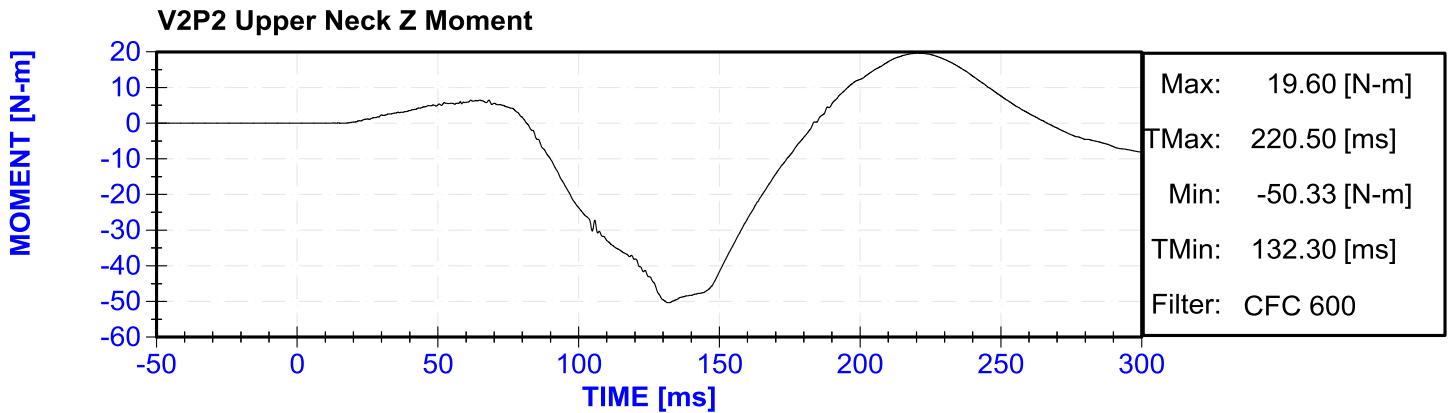


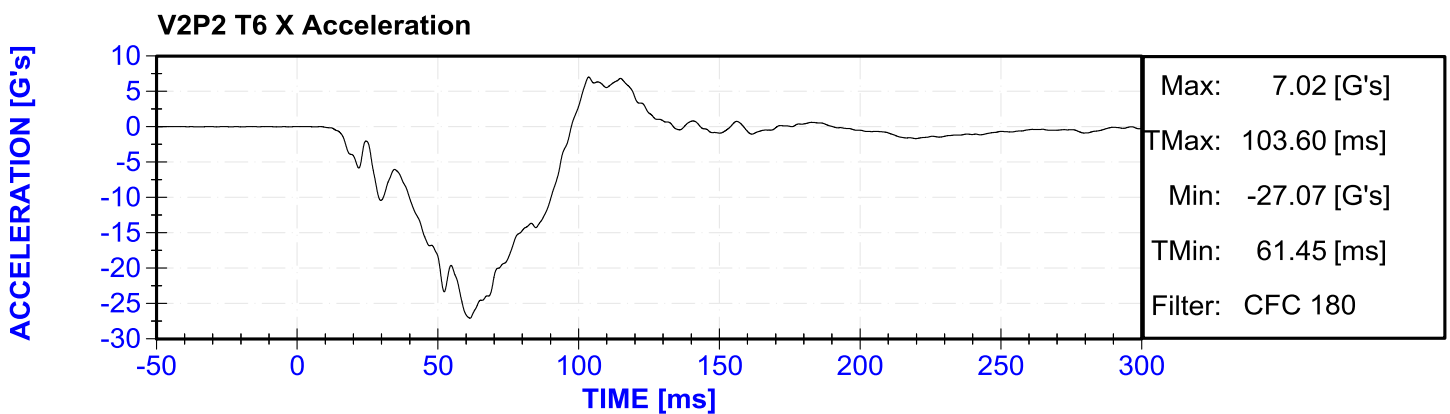
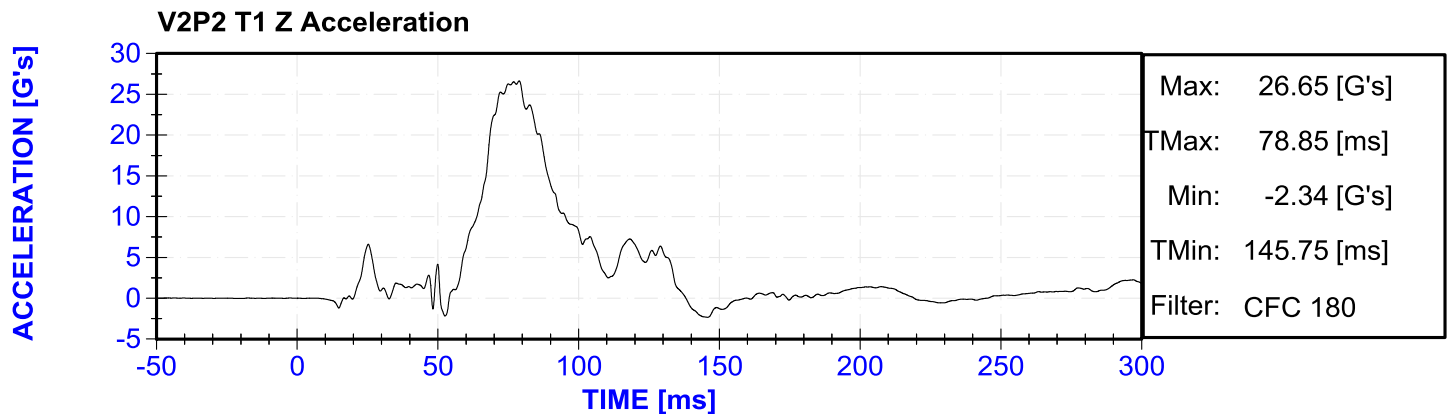
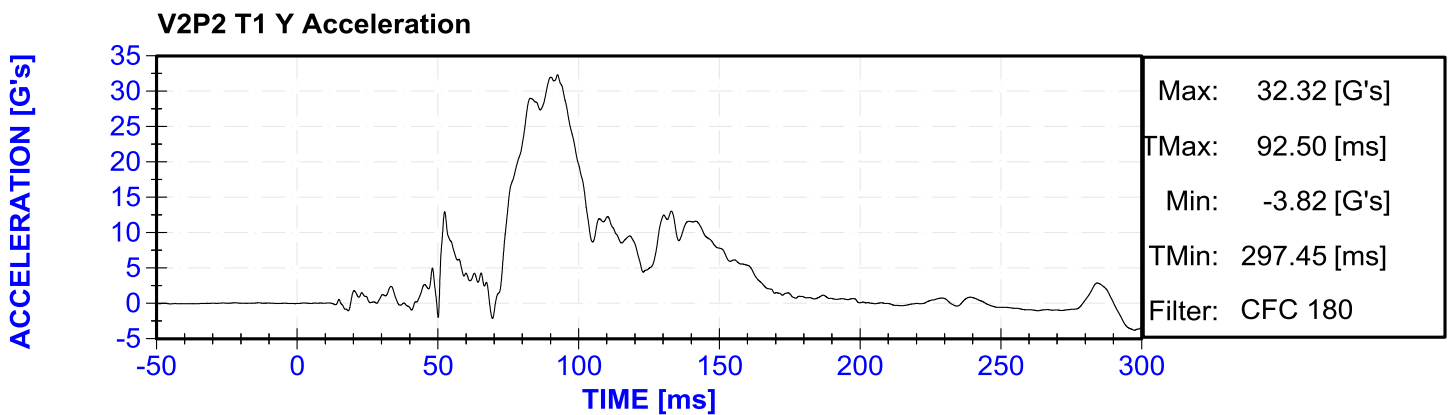
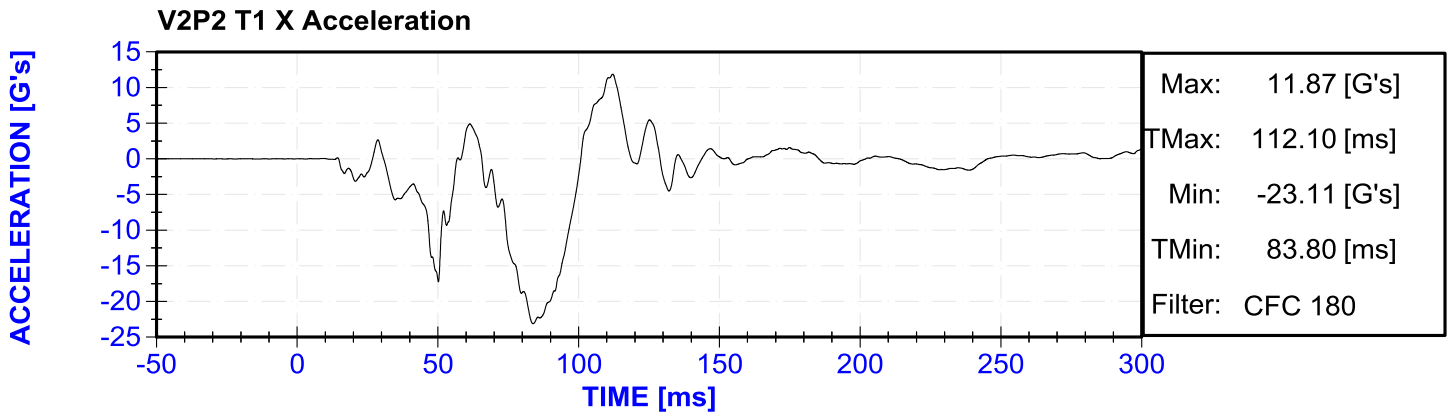
V2P2 Head CG Z Acceleration

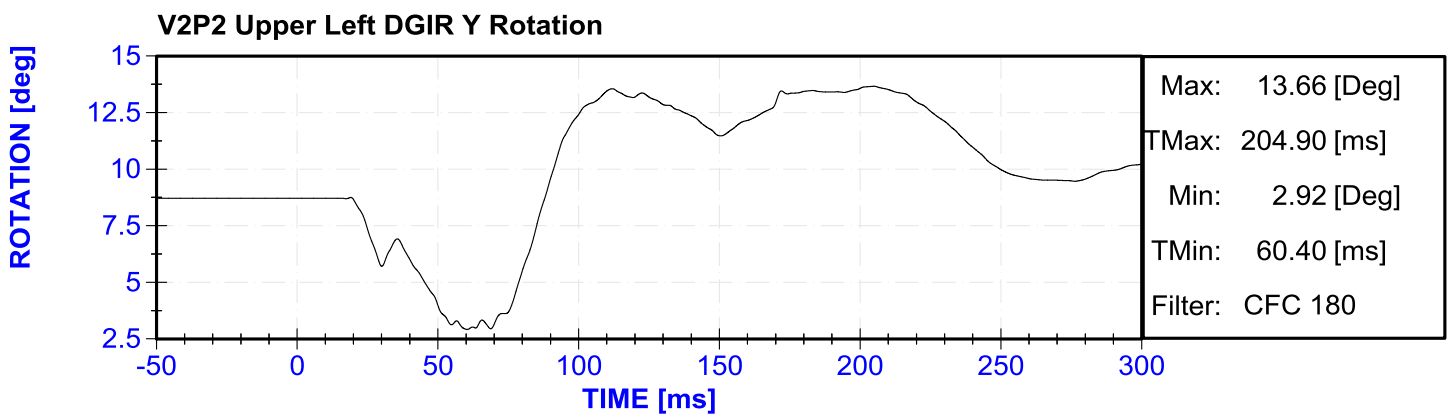
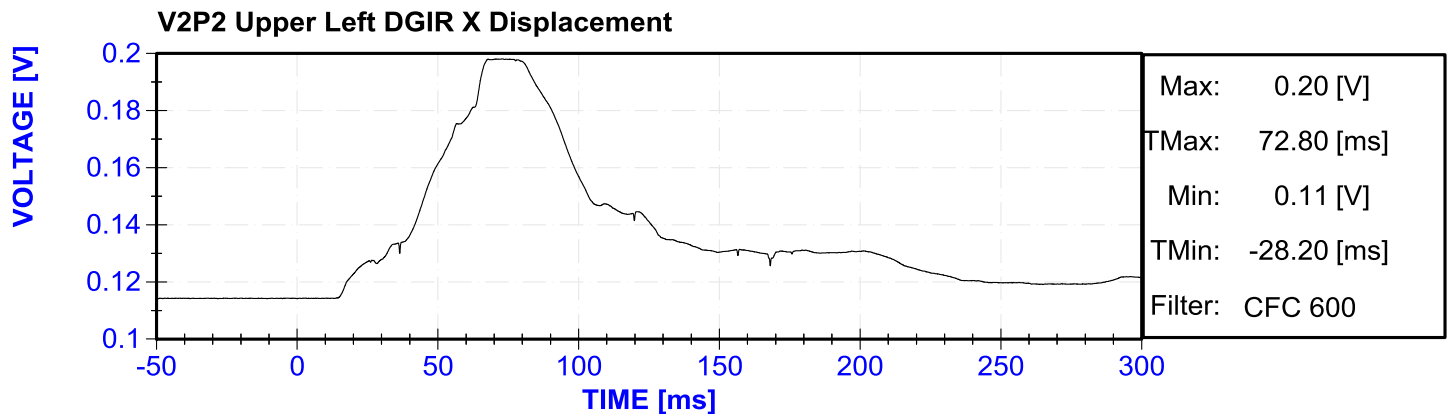
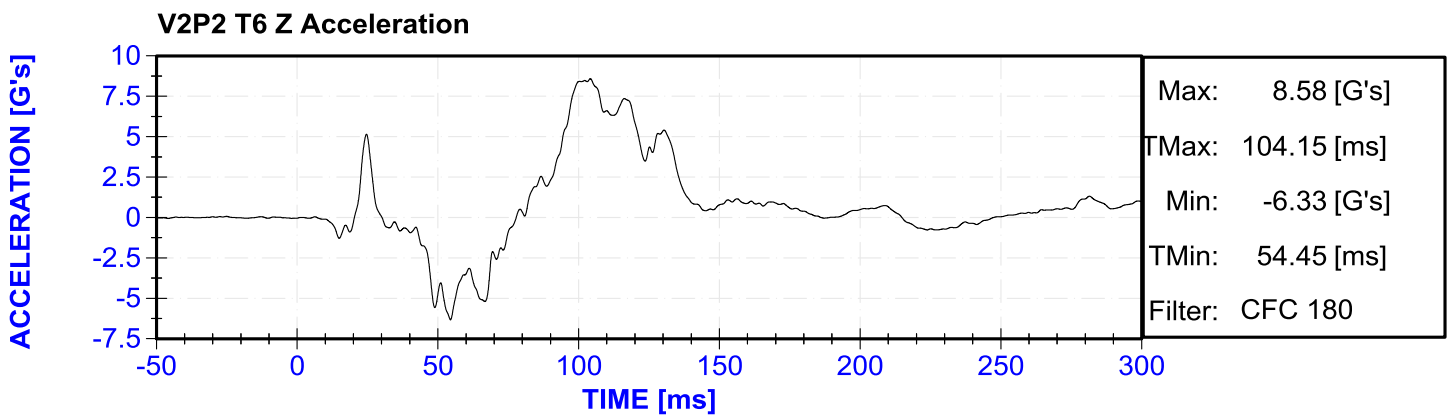
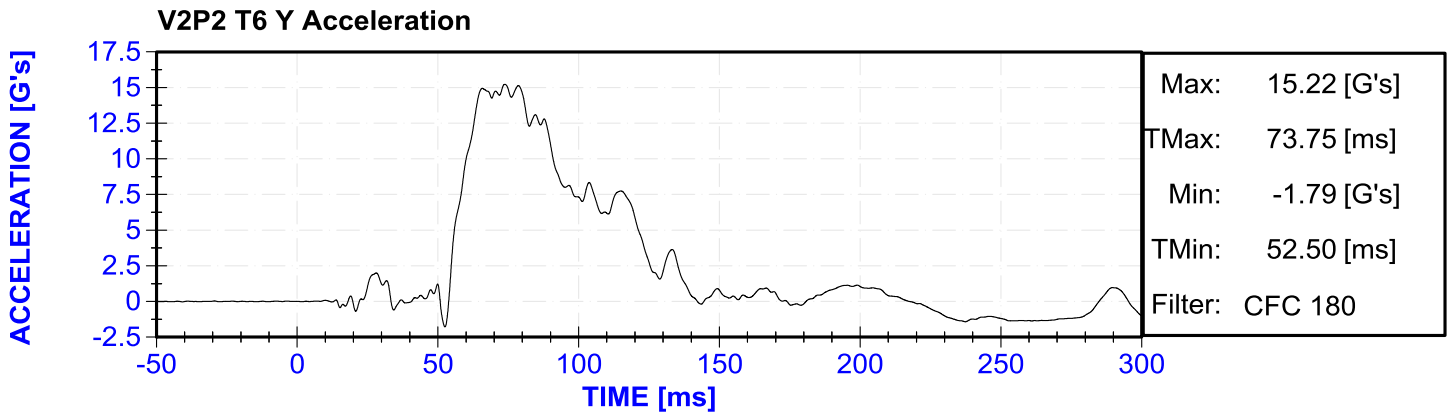


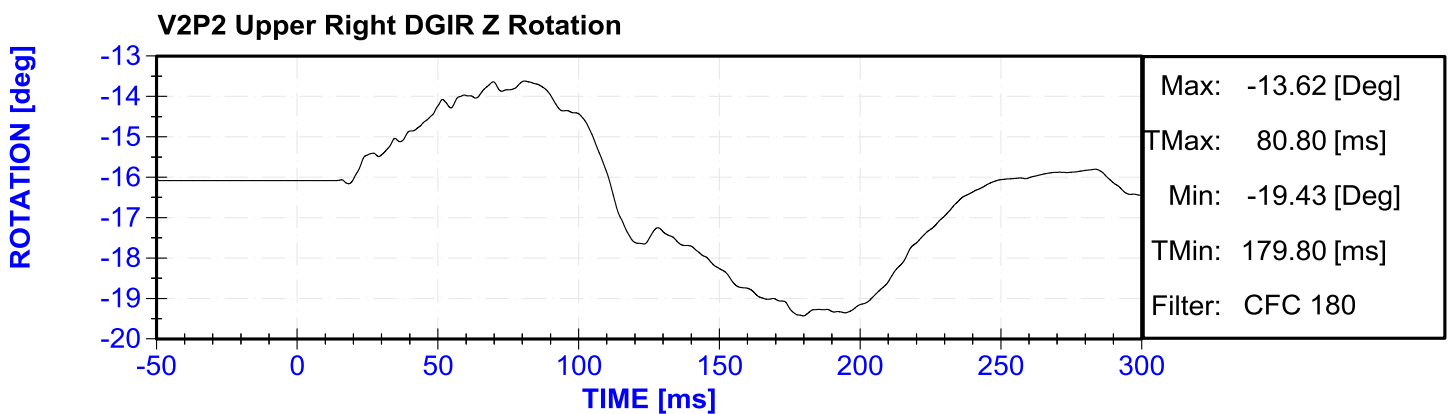
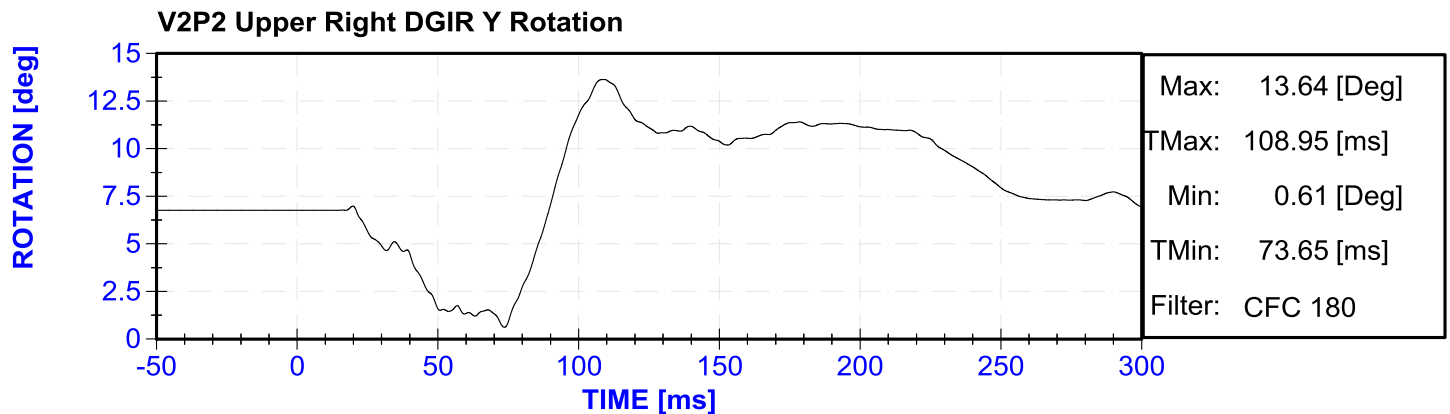
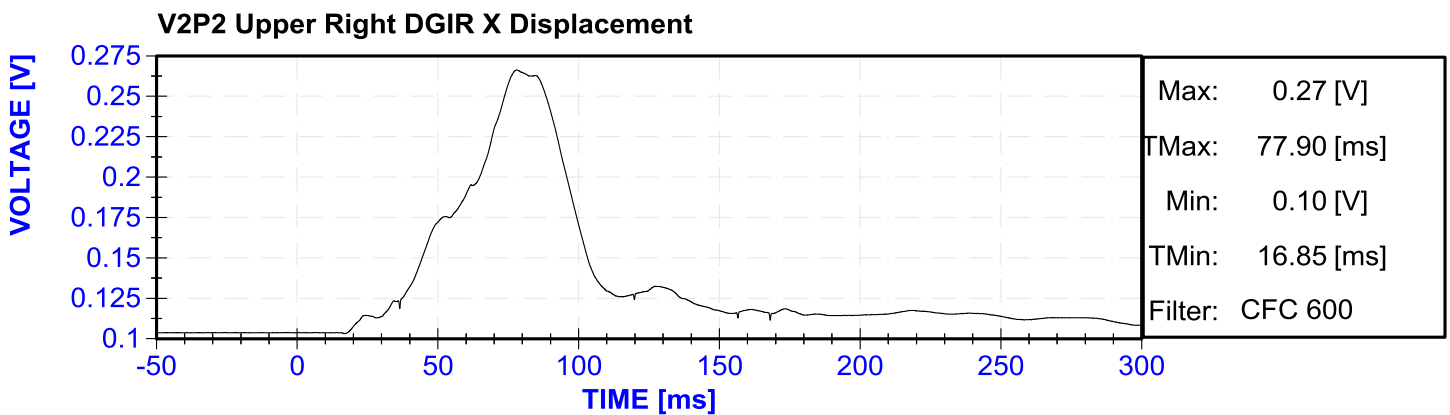
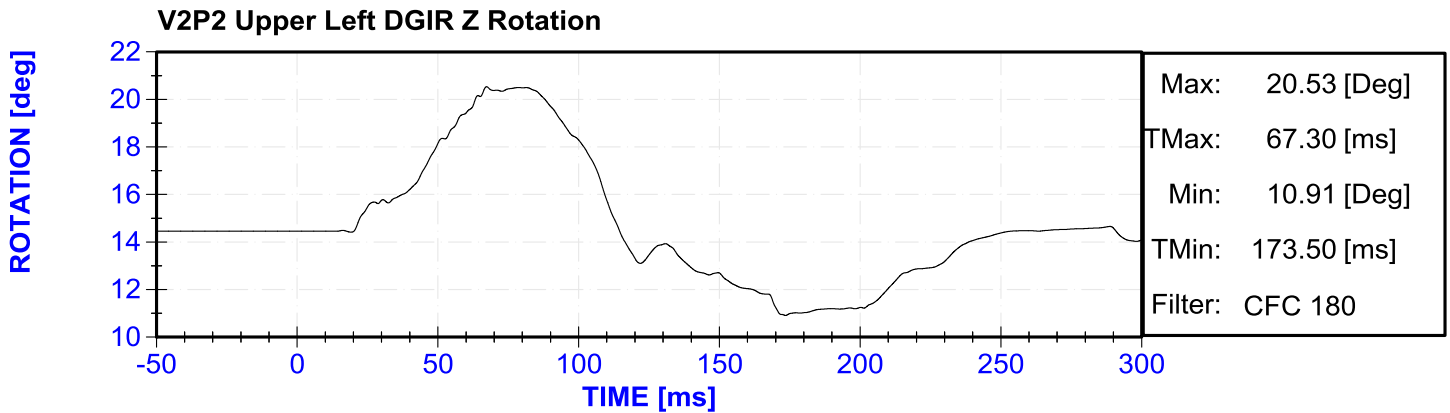




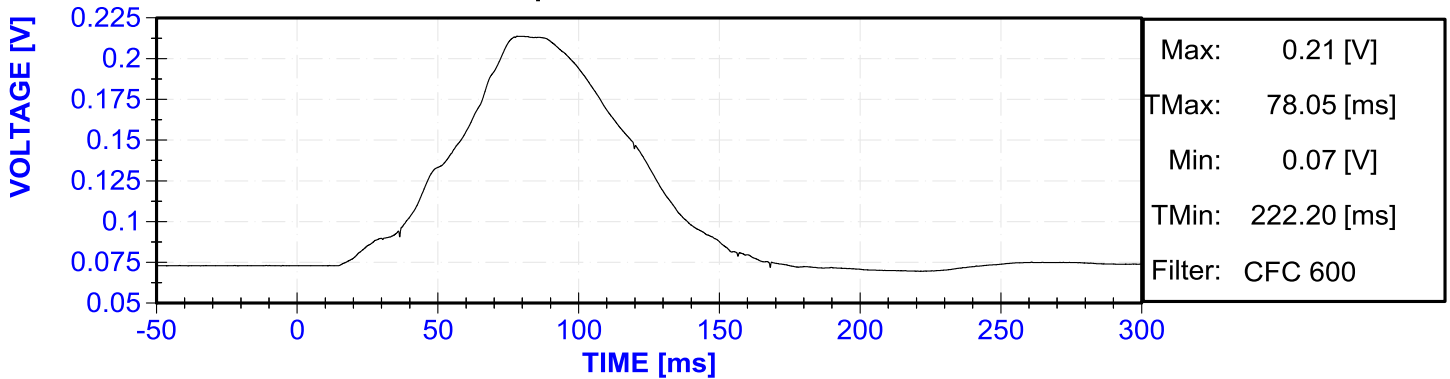




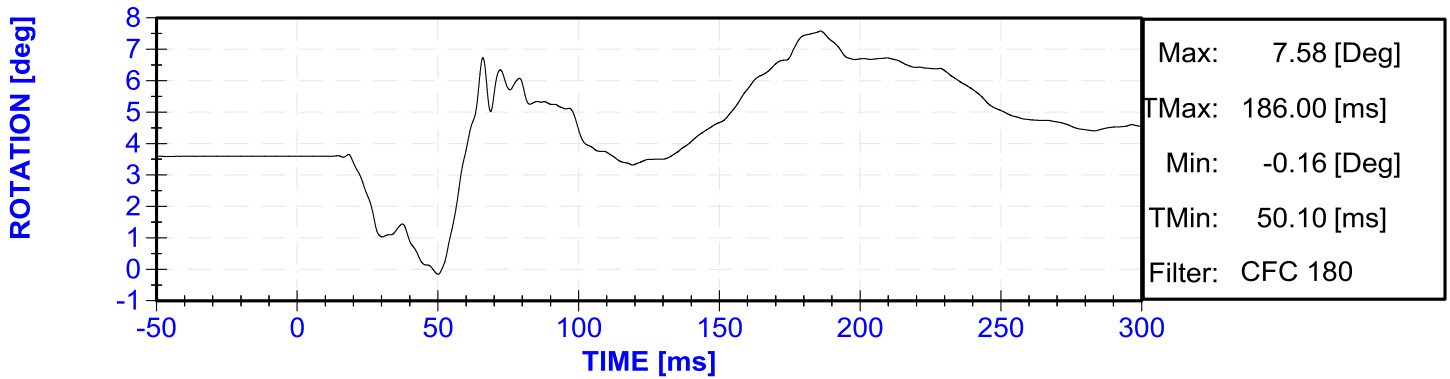




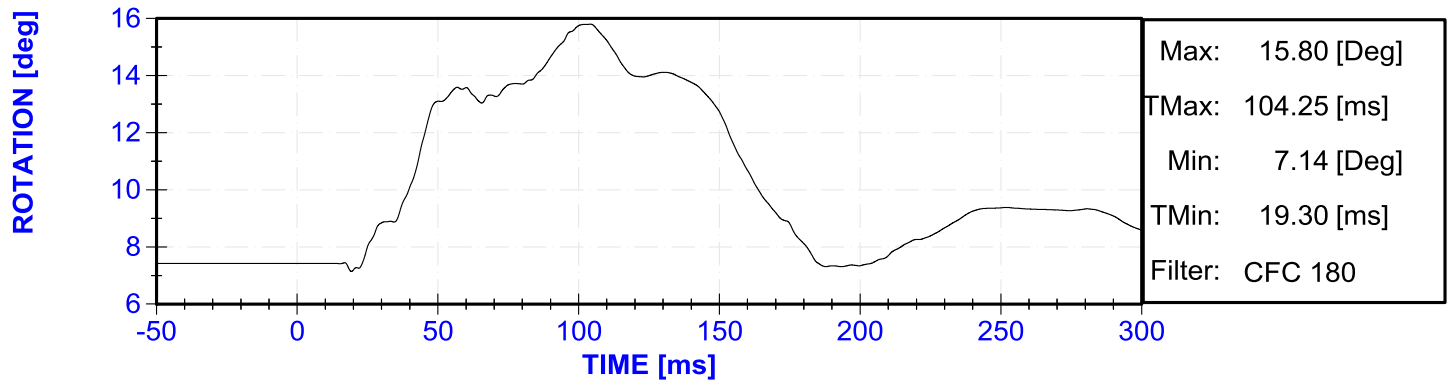
V2P2 Lower Left DGIR X Displacement



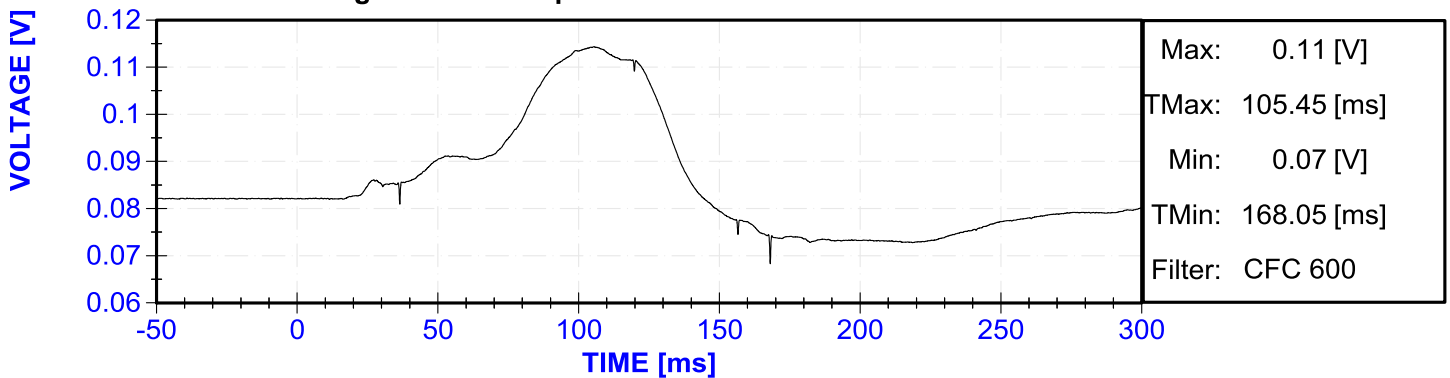
V2P2 Lower Left DGIR Y Rotation



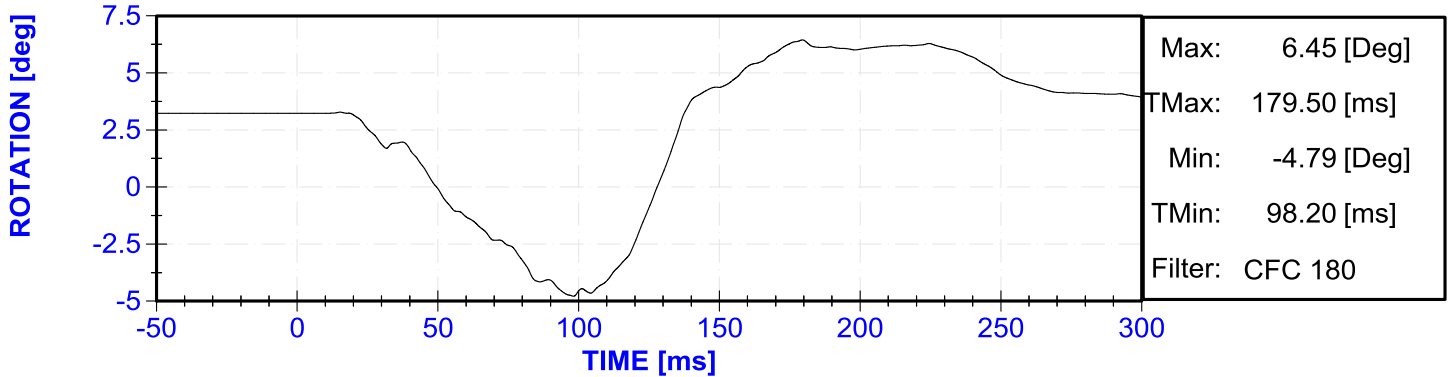
V2P2 Lower Left DGIR Z Rotation



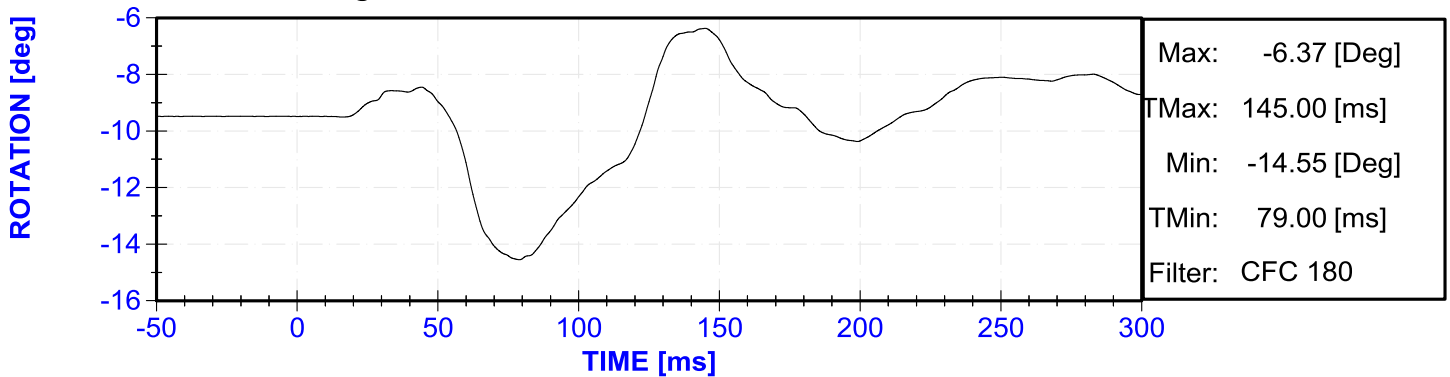
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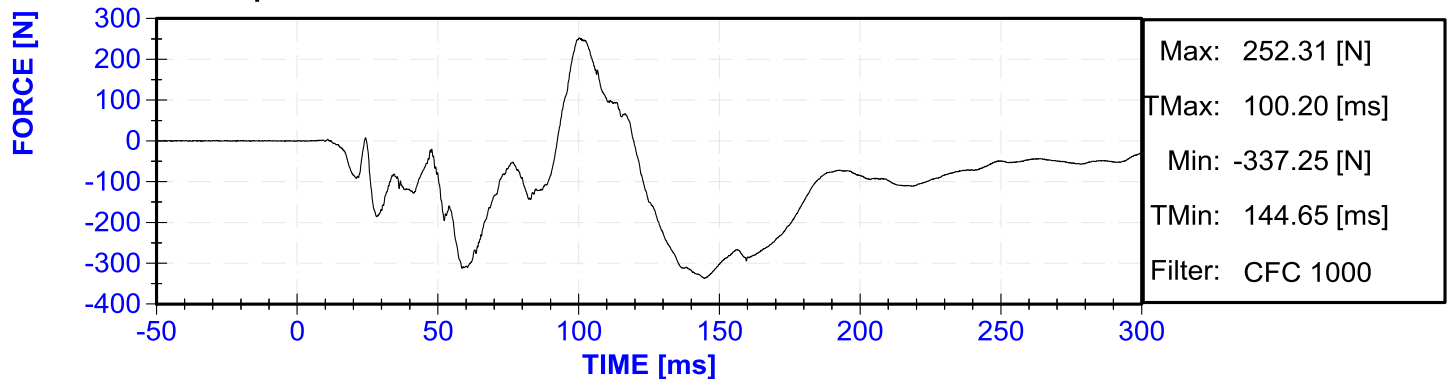
V2P2 Lower Right DGIR Y Rotation



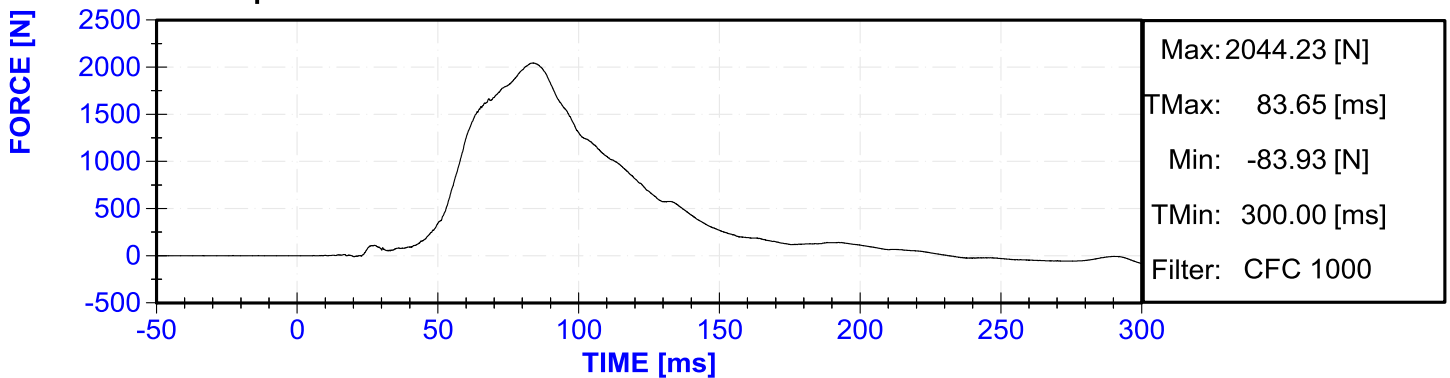
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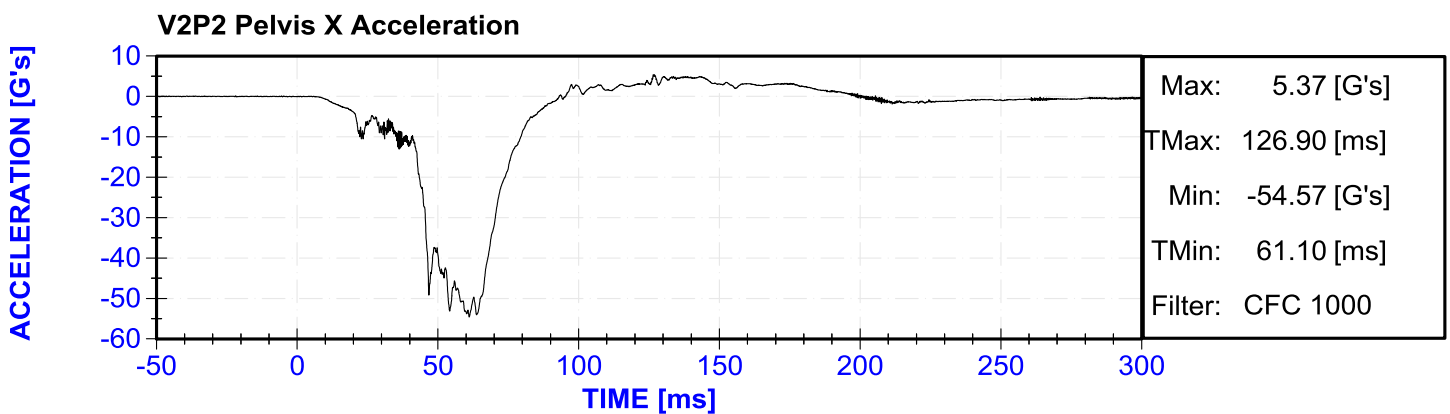
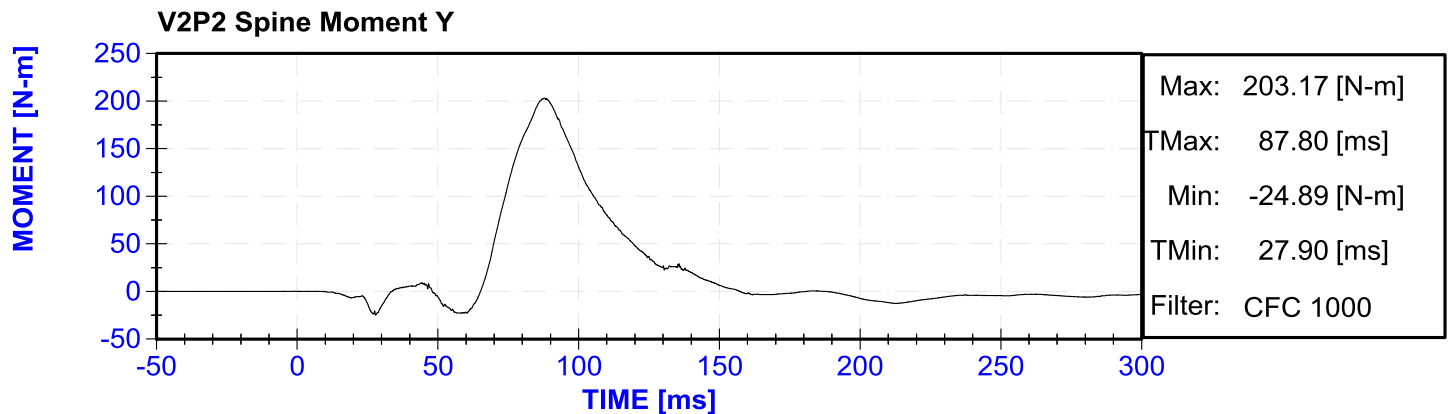
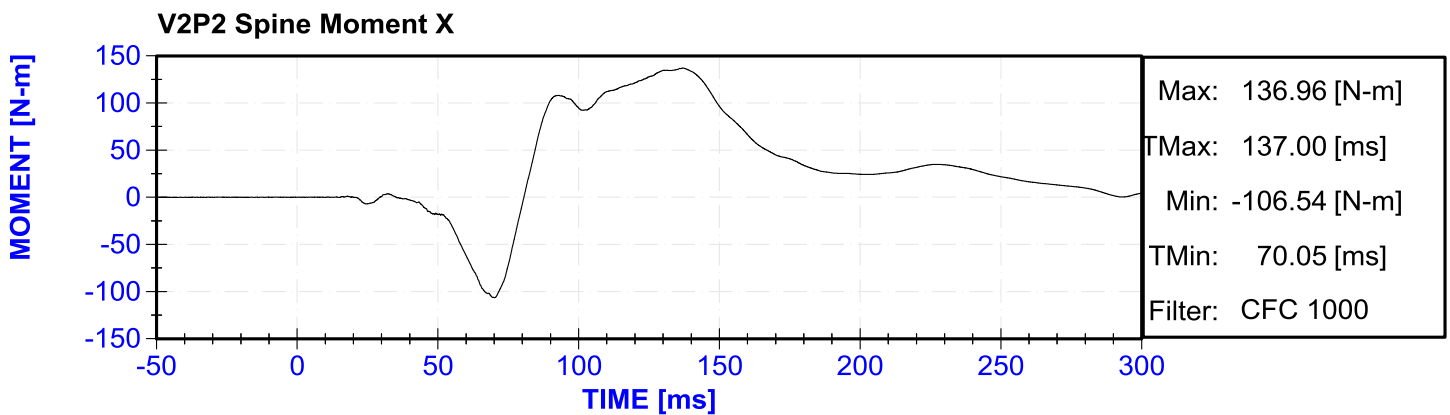
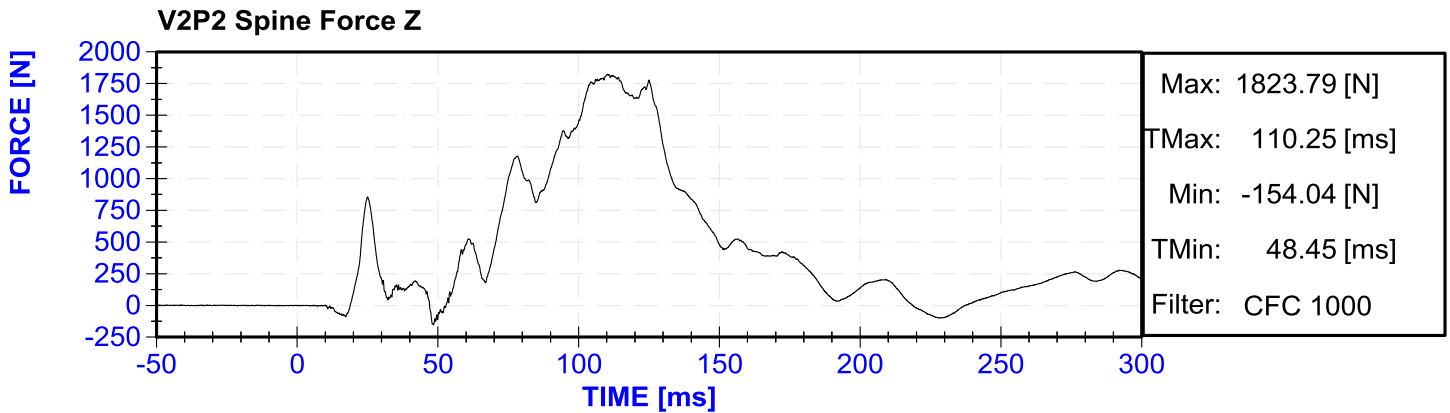


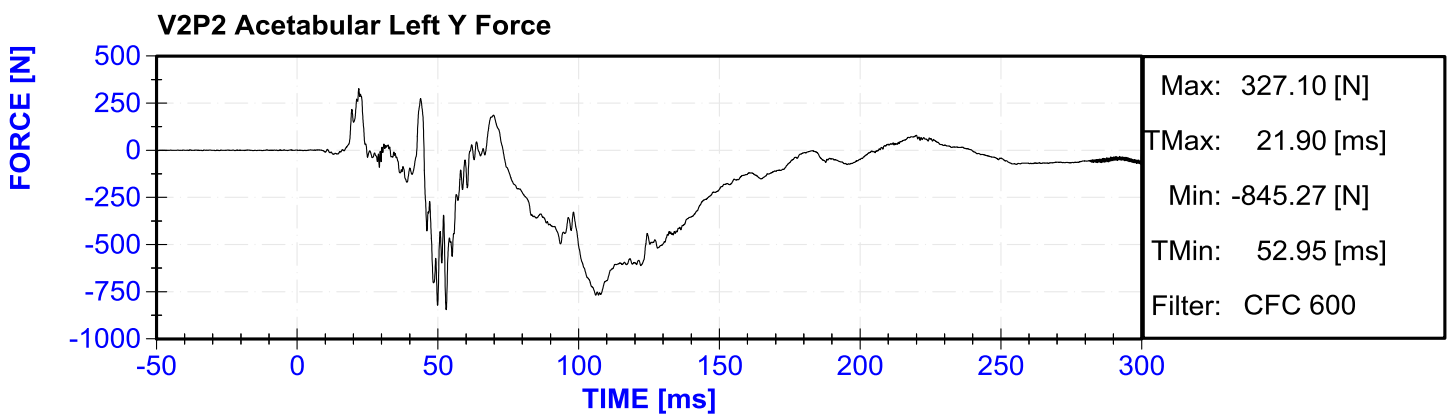
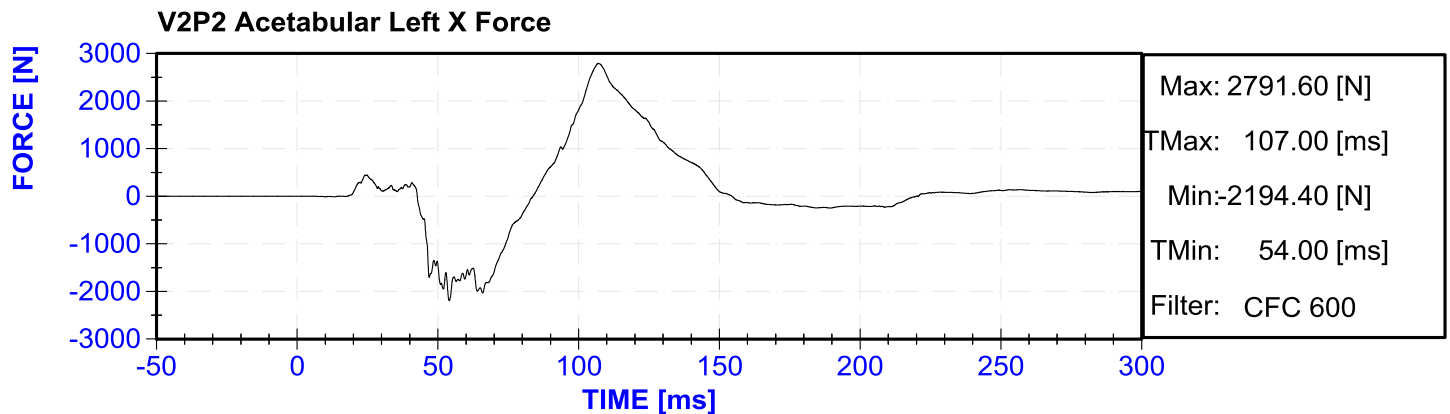
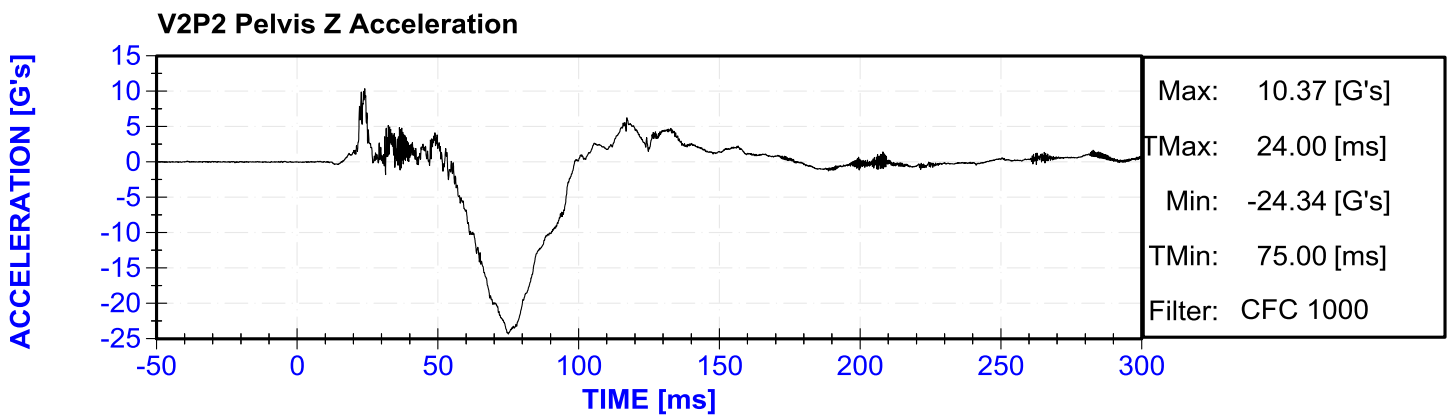
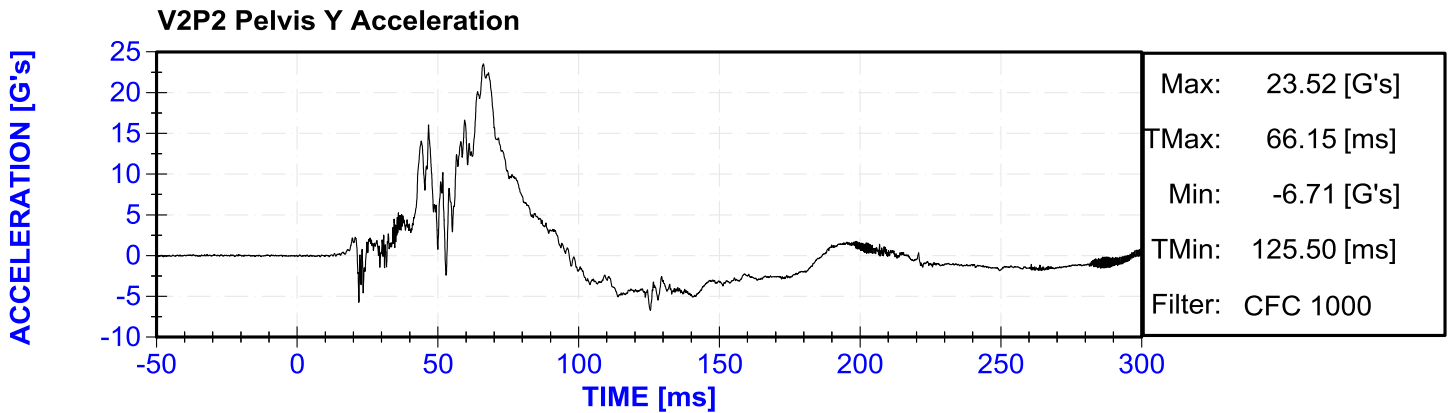
V2P2 Spine Force X

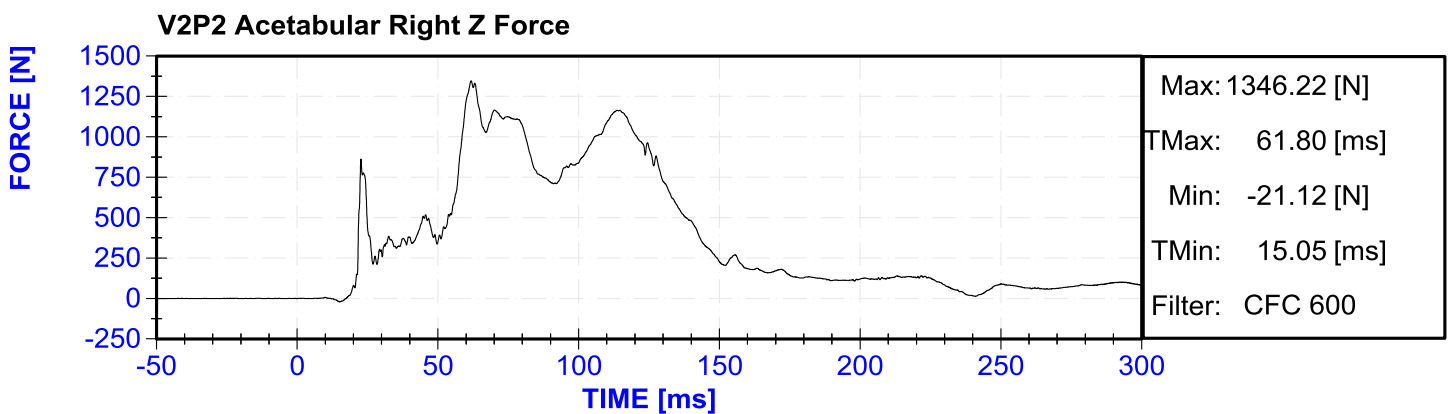
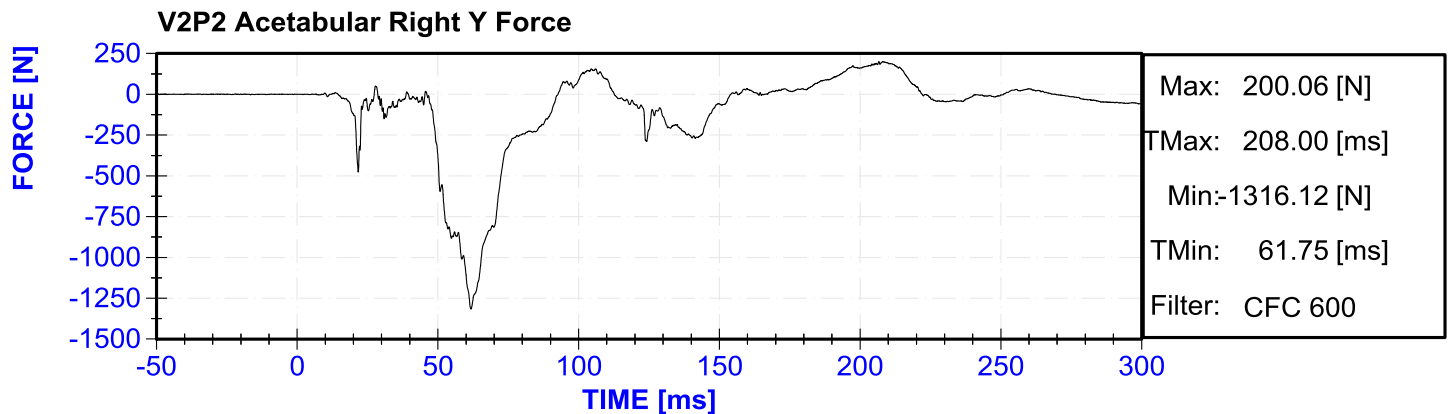
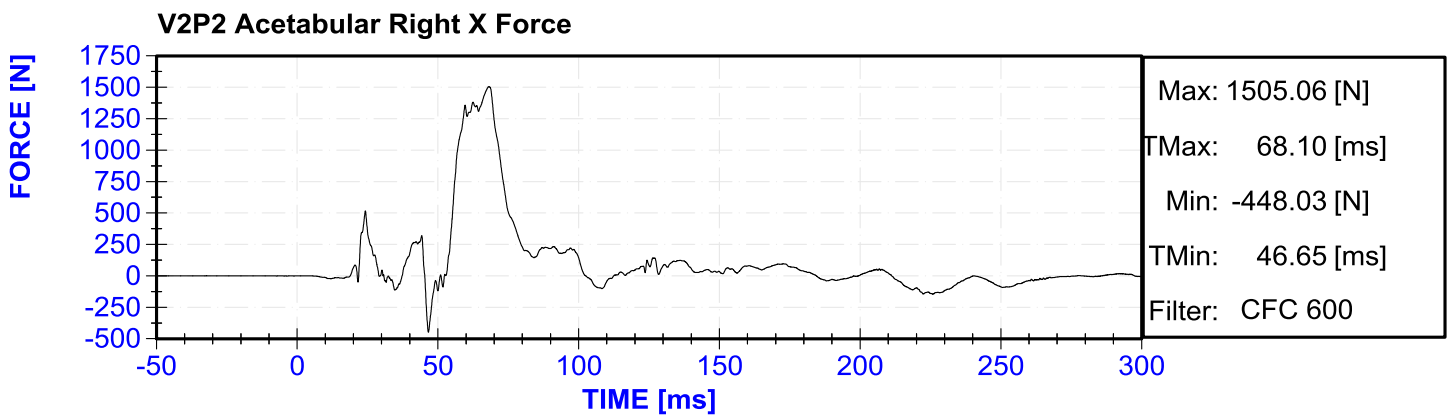
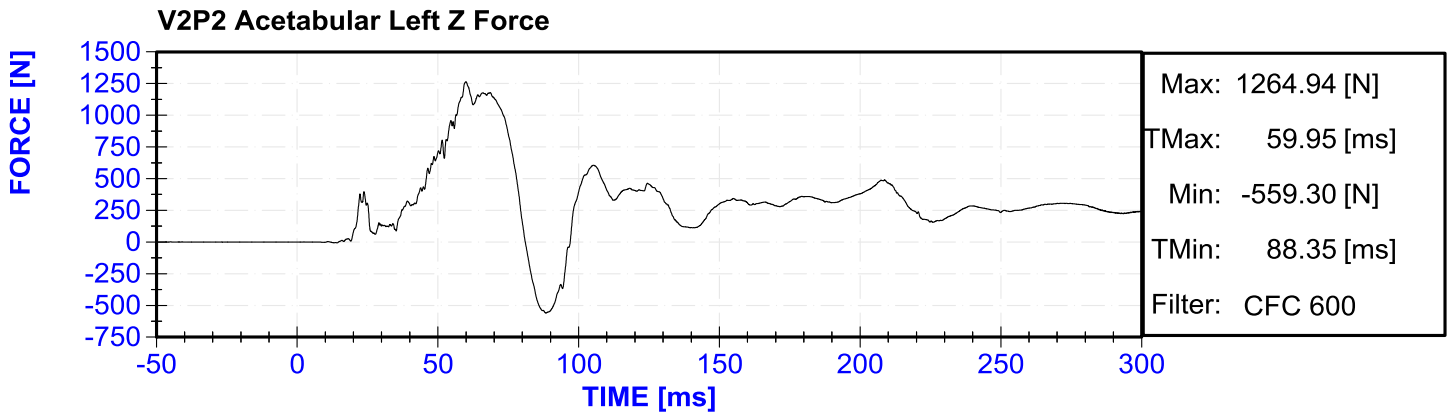


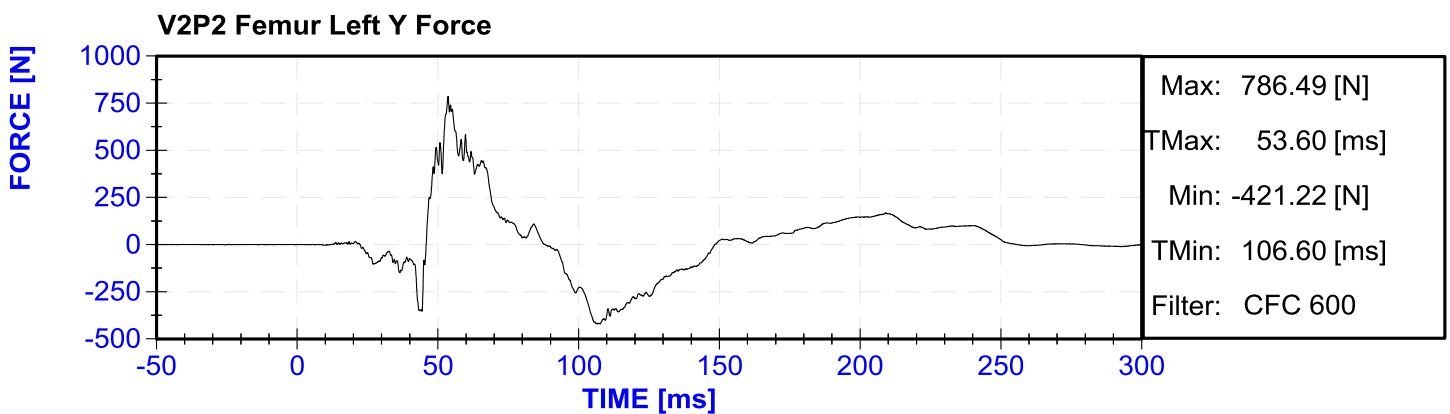
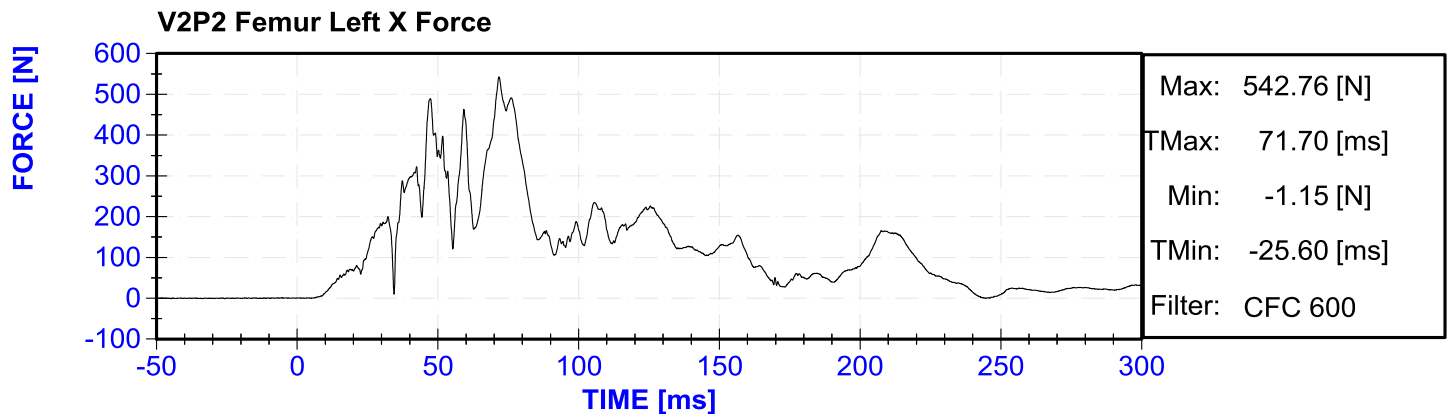
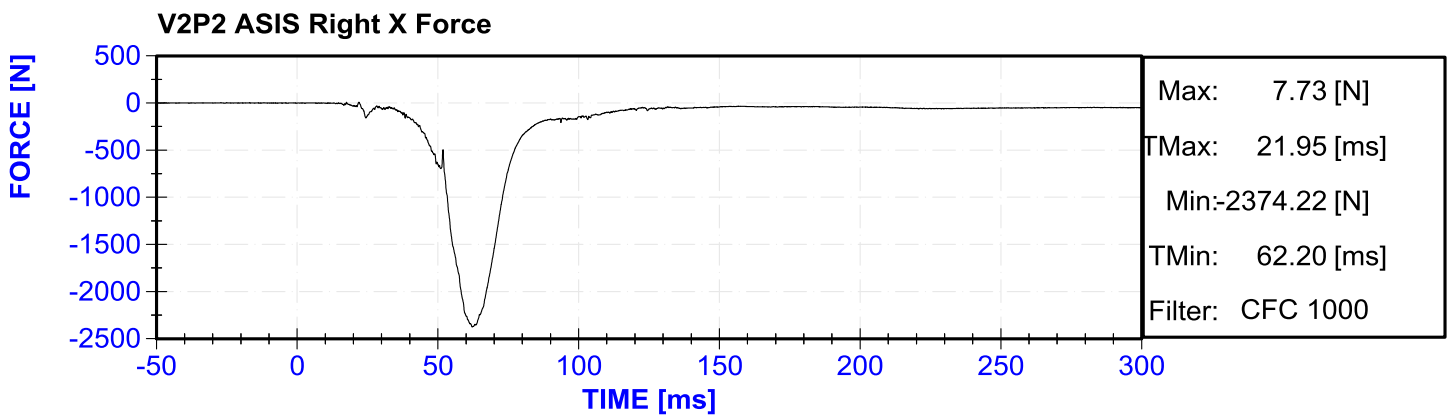
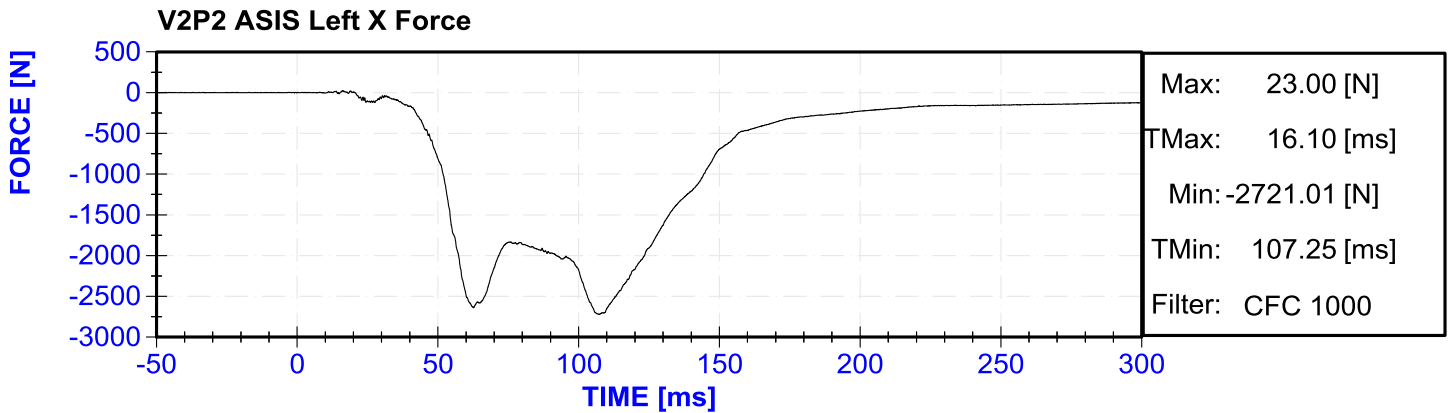
V2P2 Spine Force Y

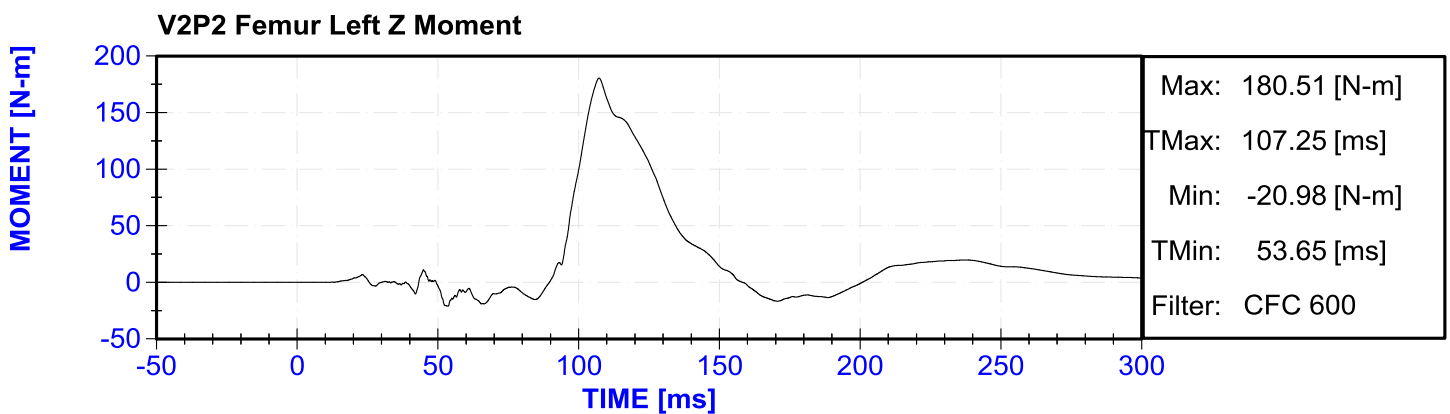
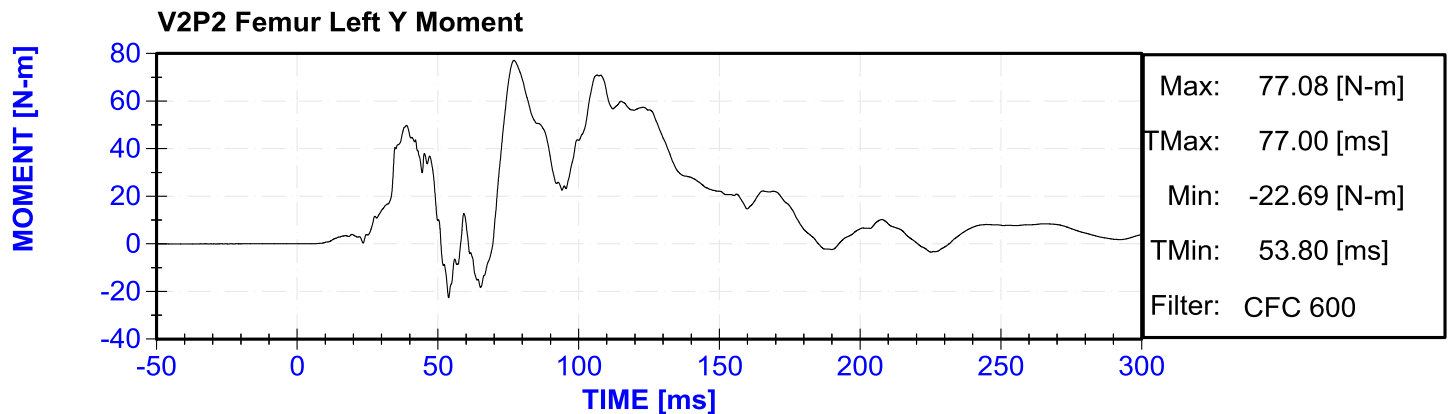
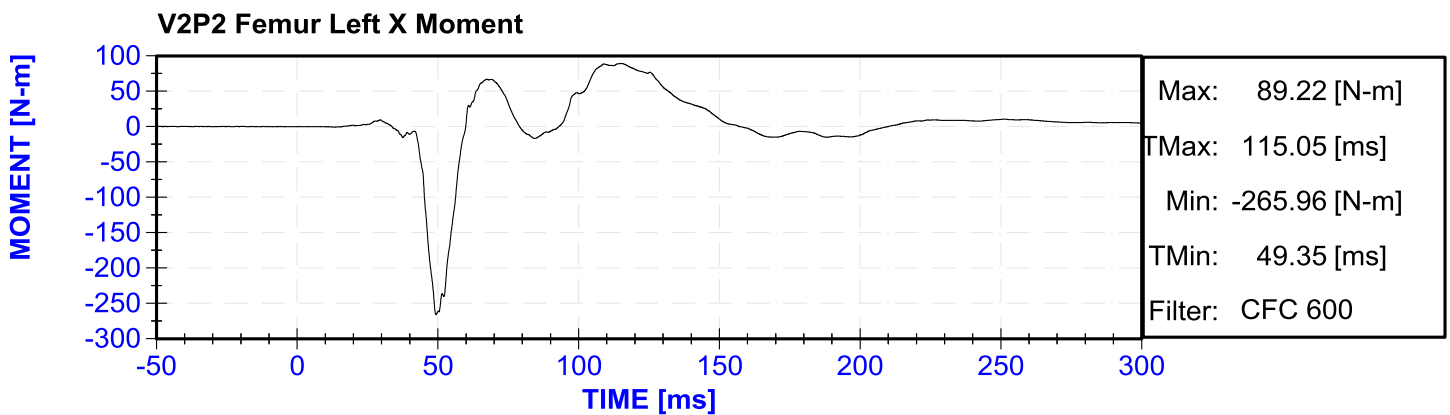
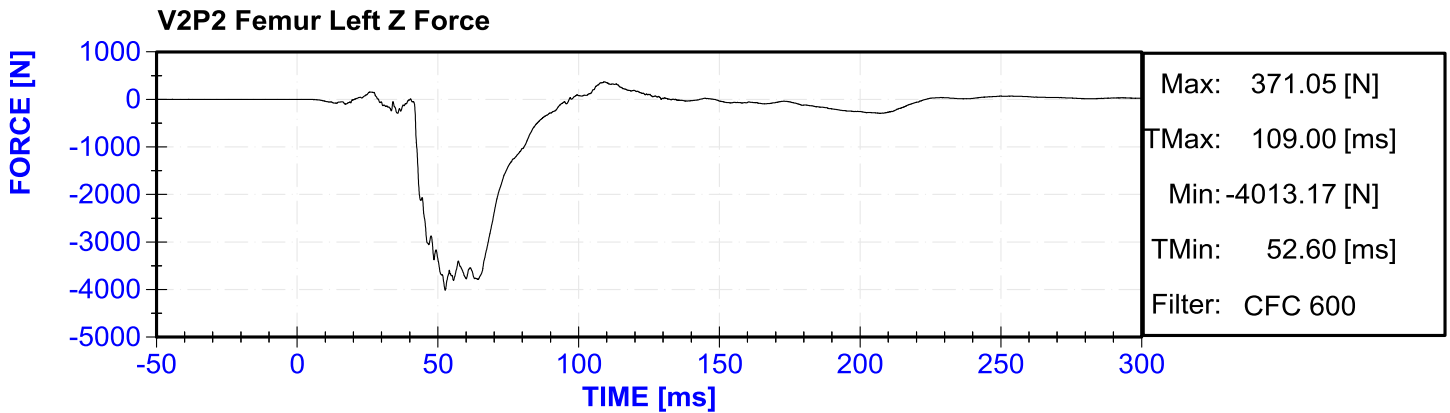


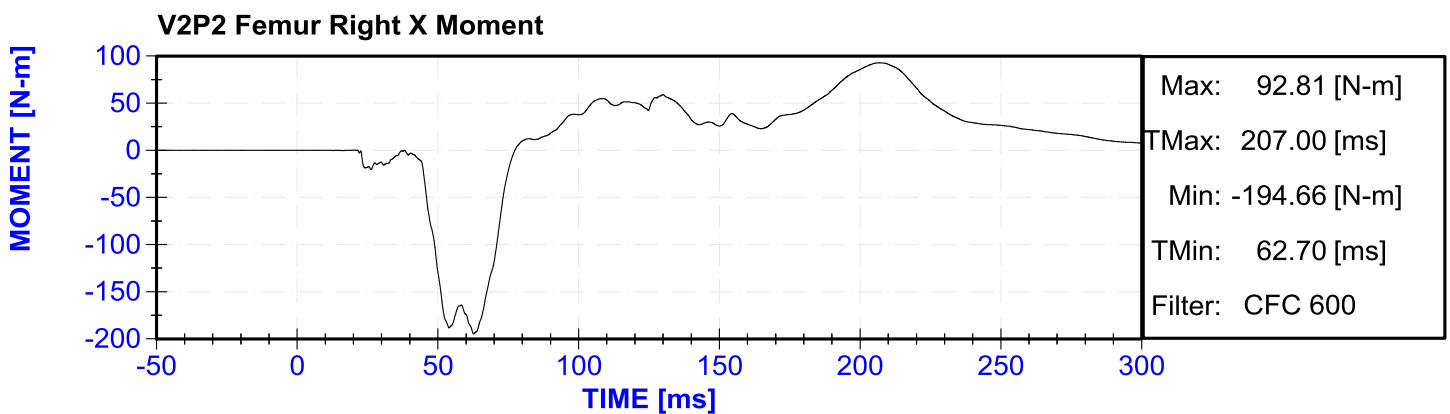
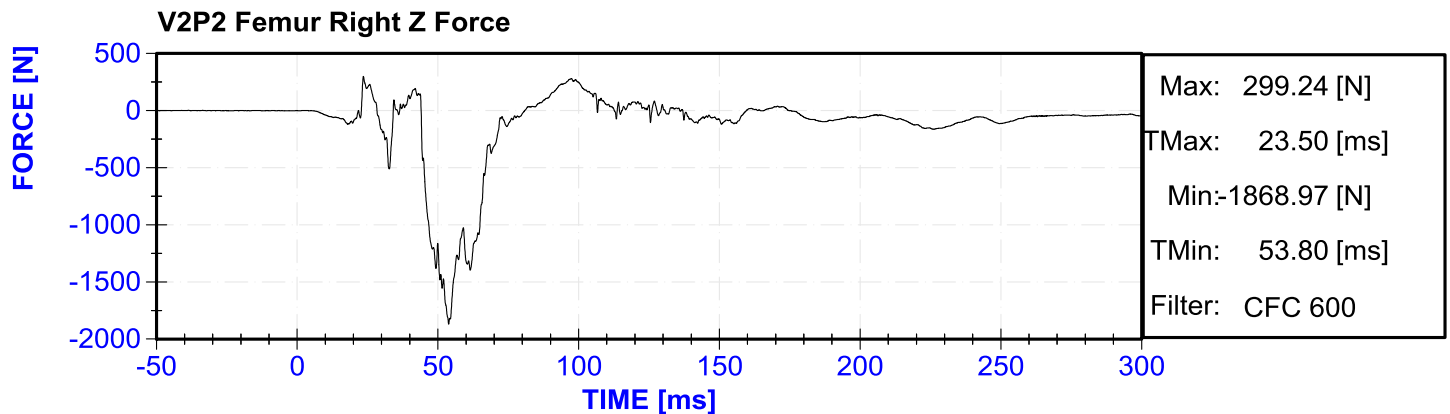
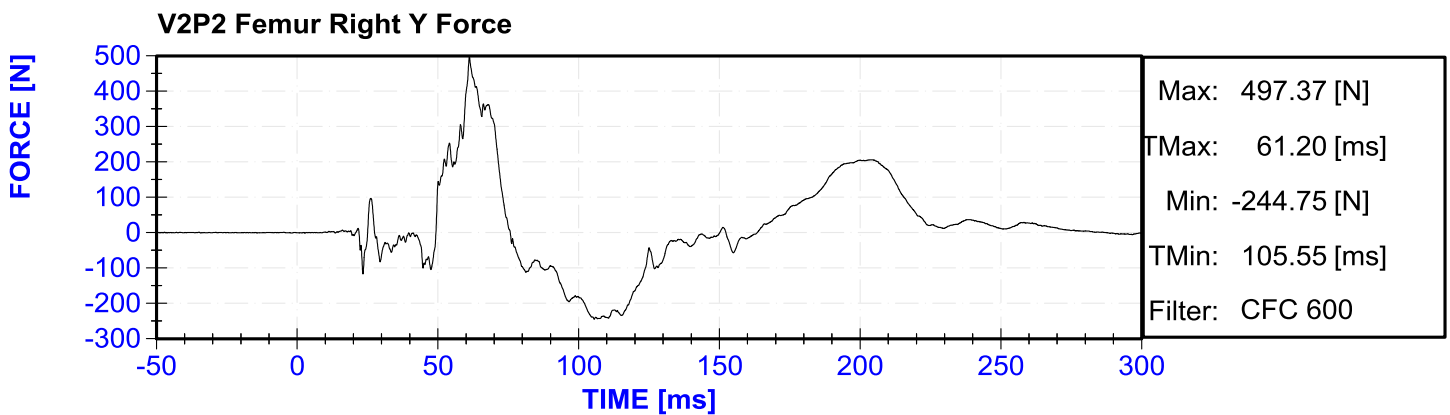
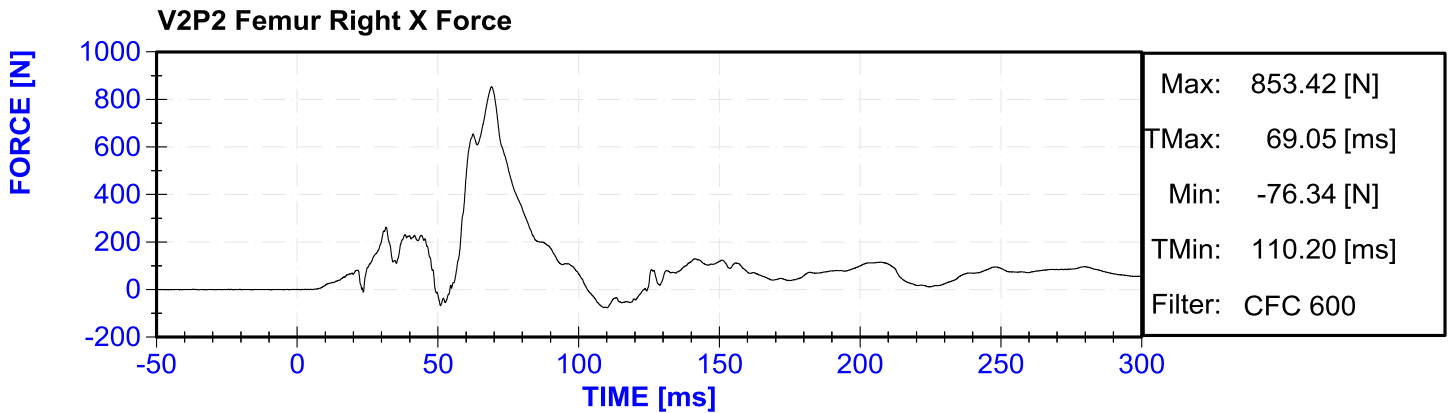


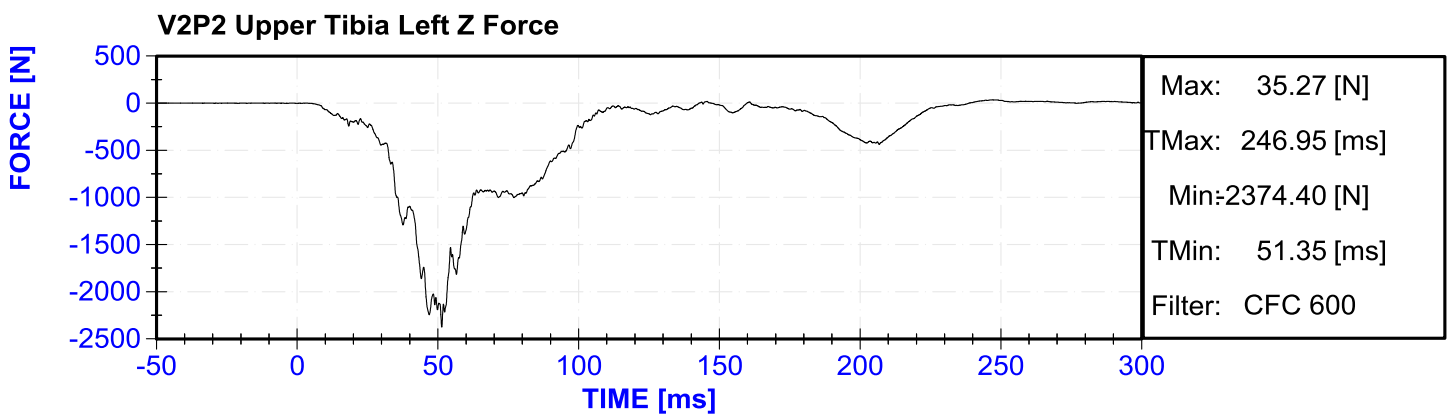
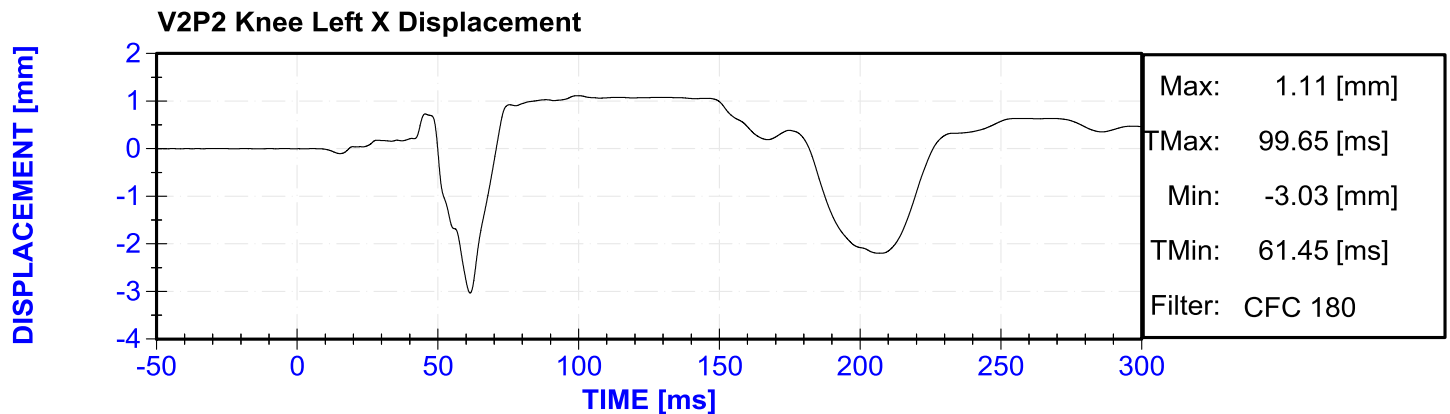
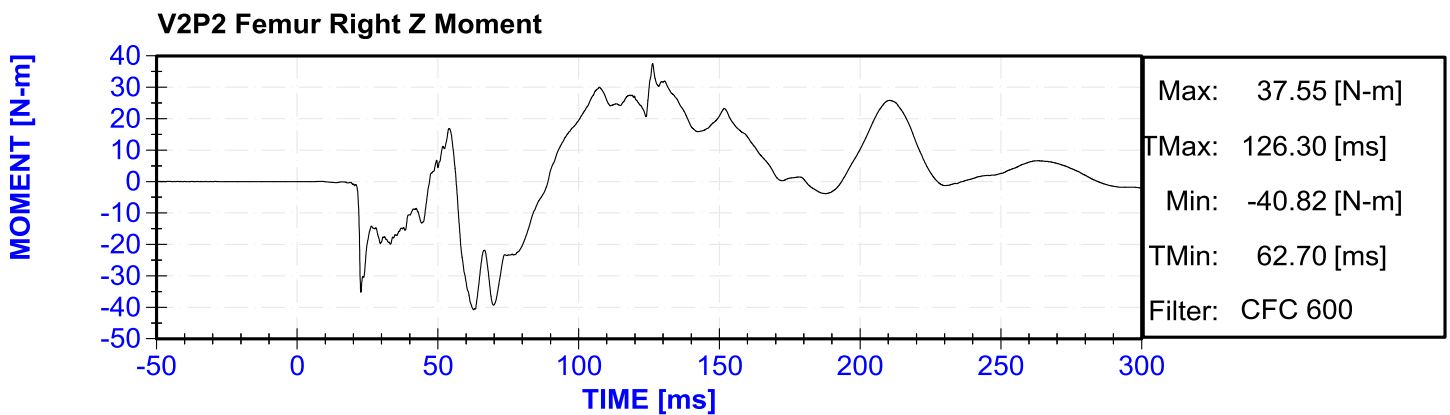
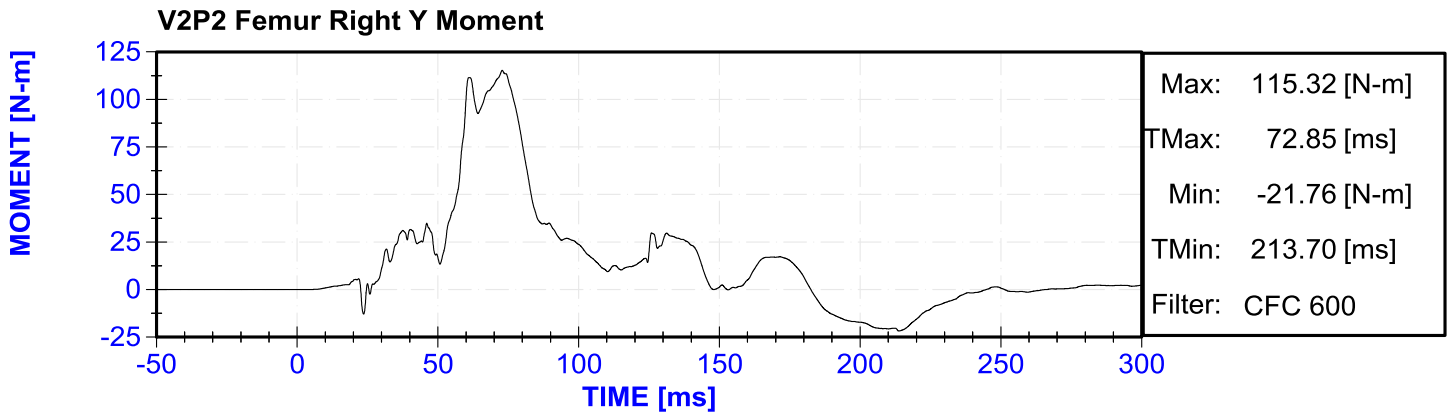


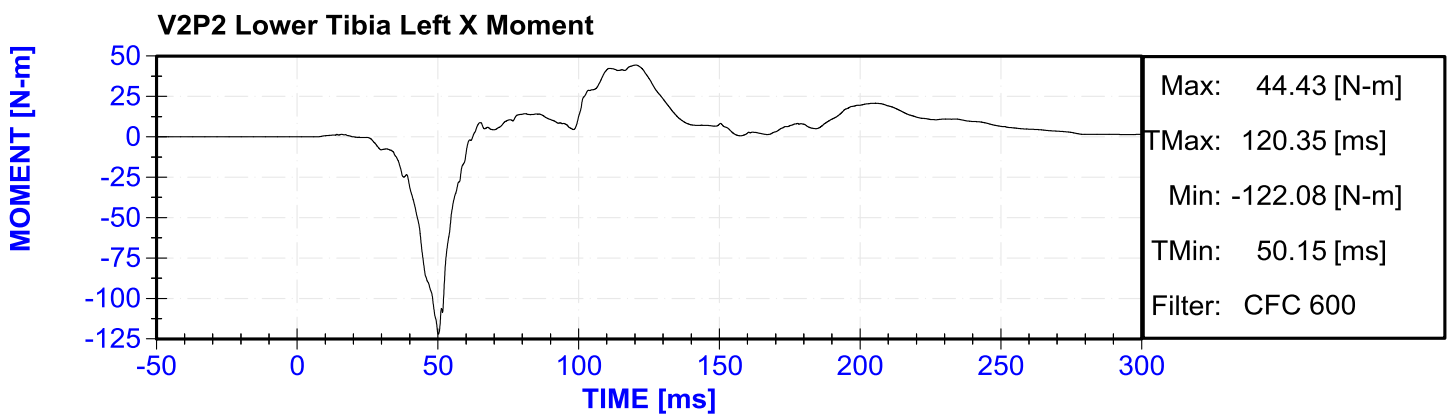
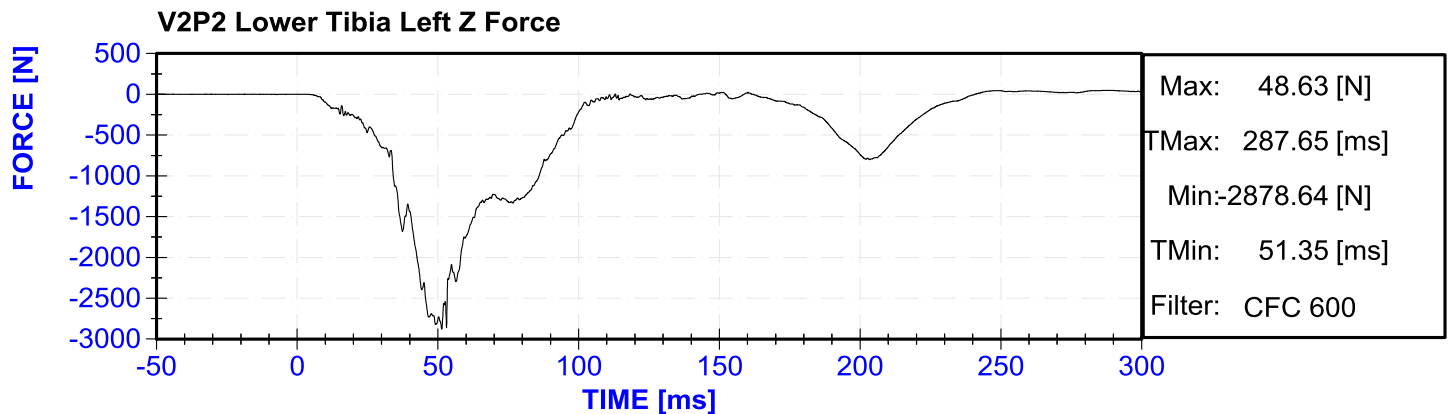
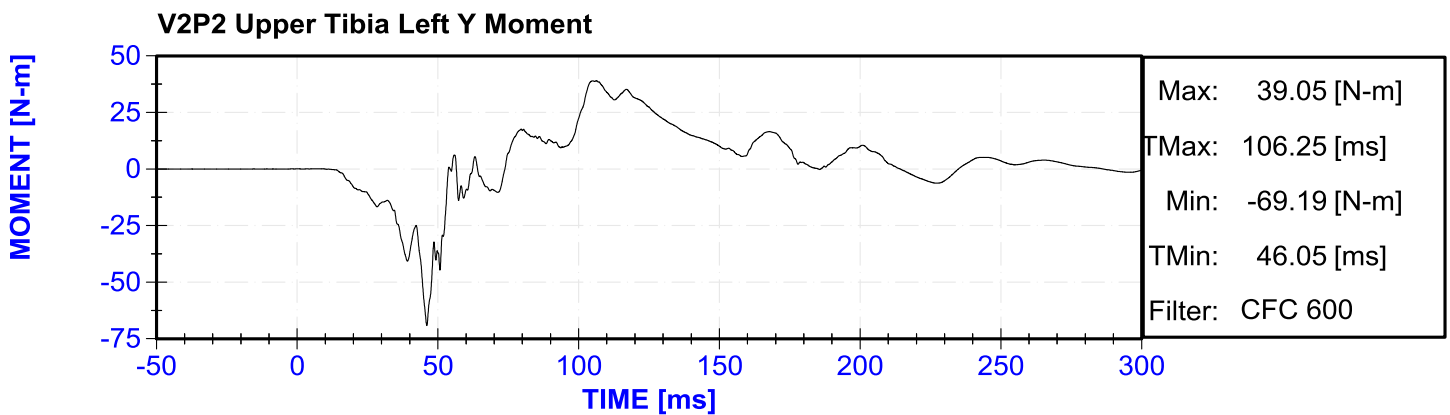
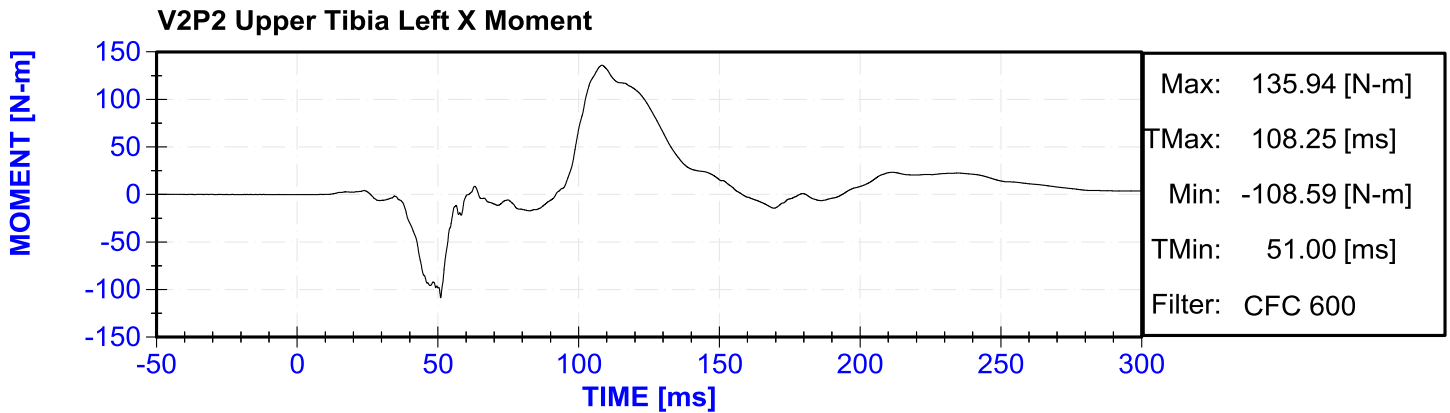


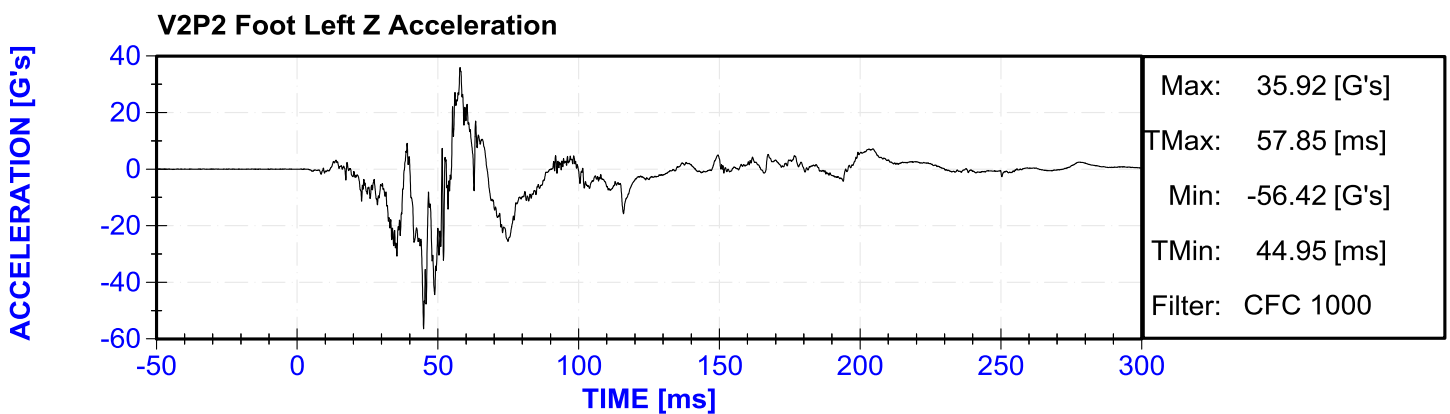
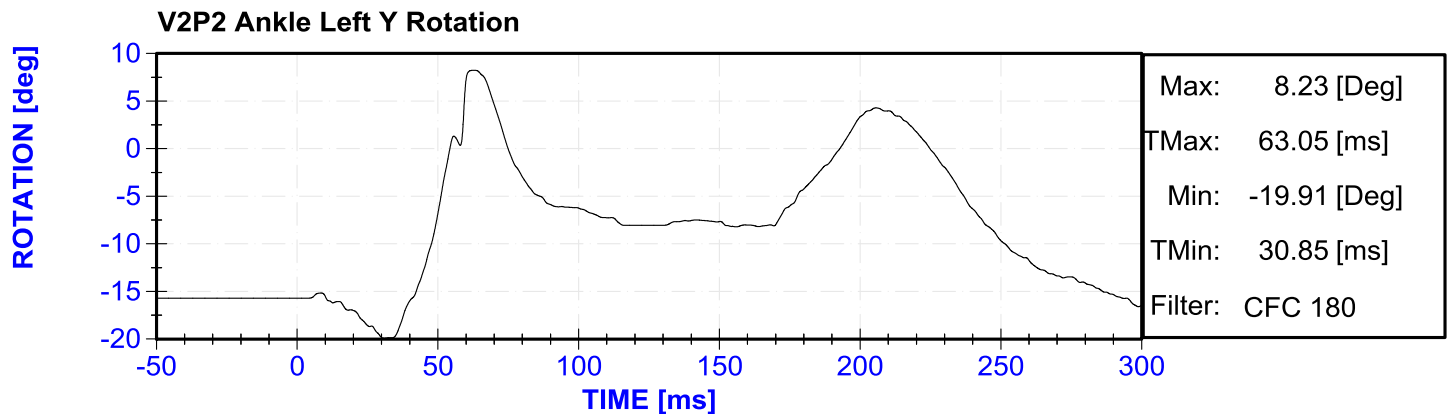
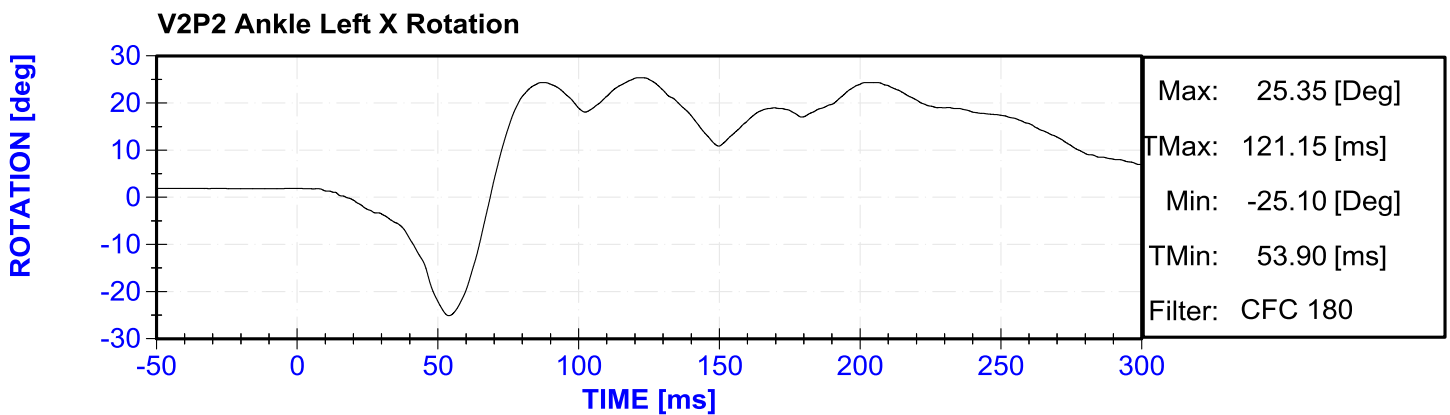
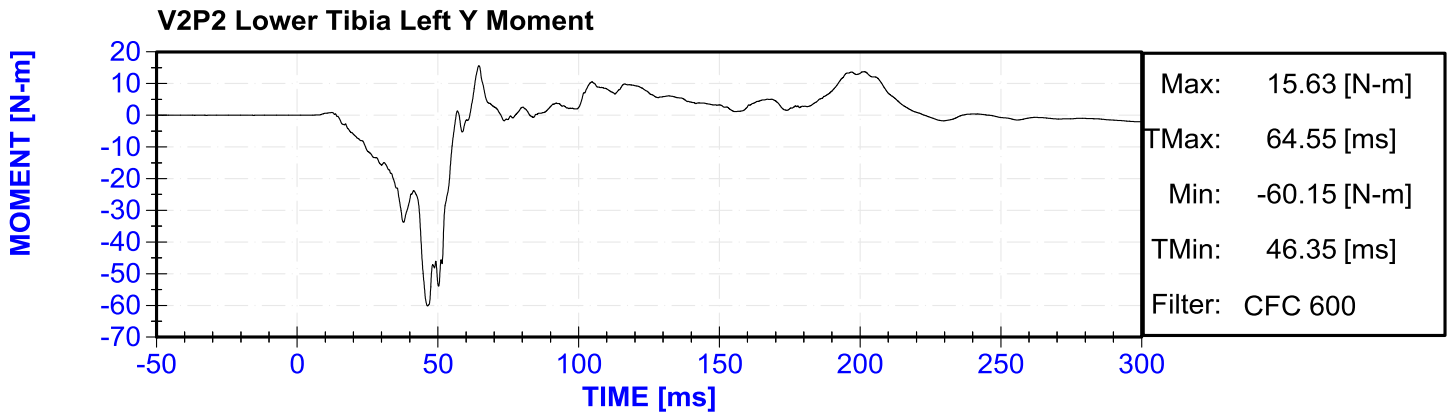


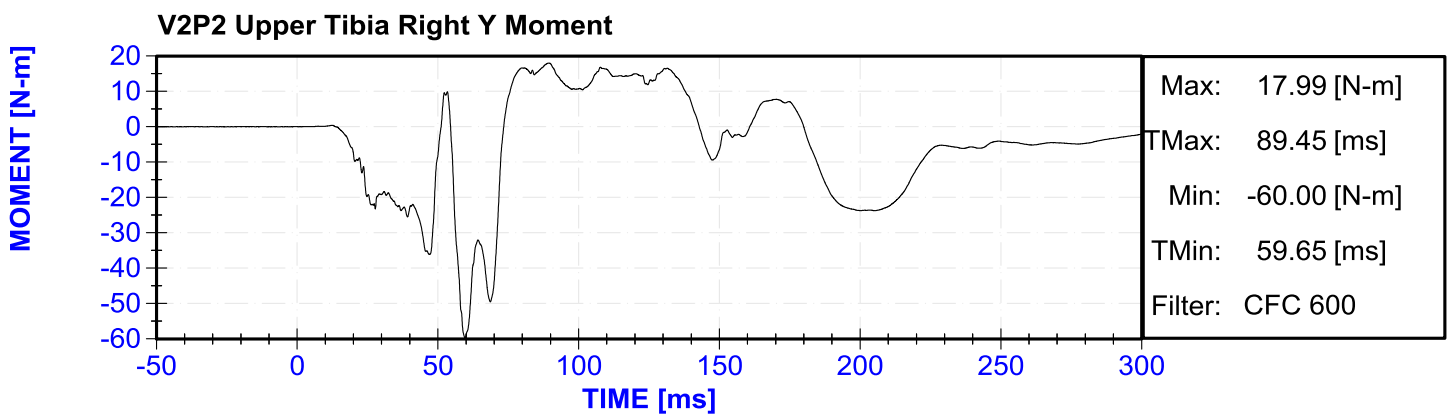
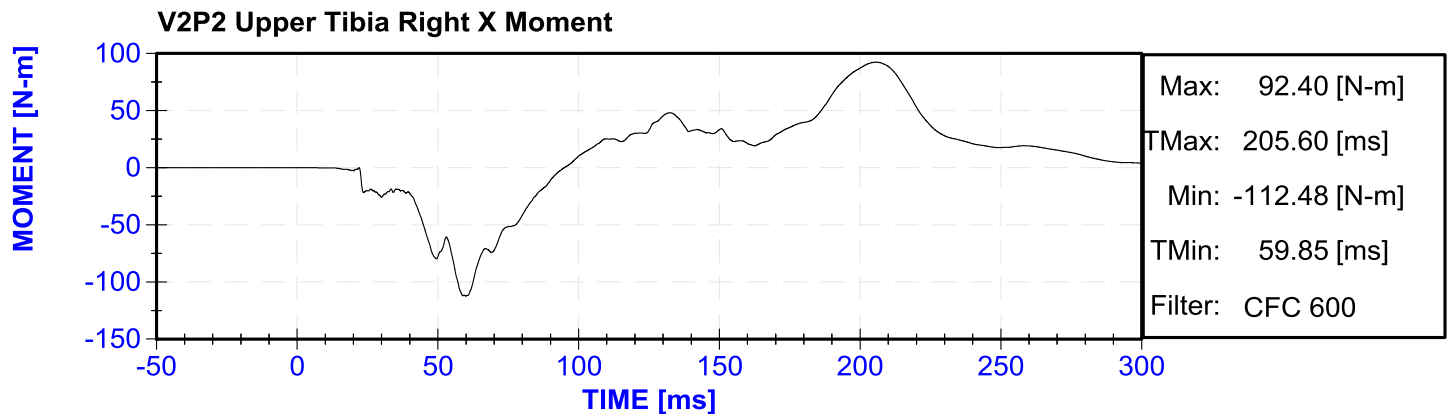
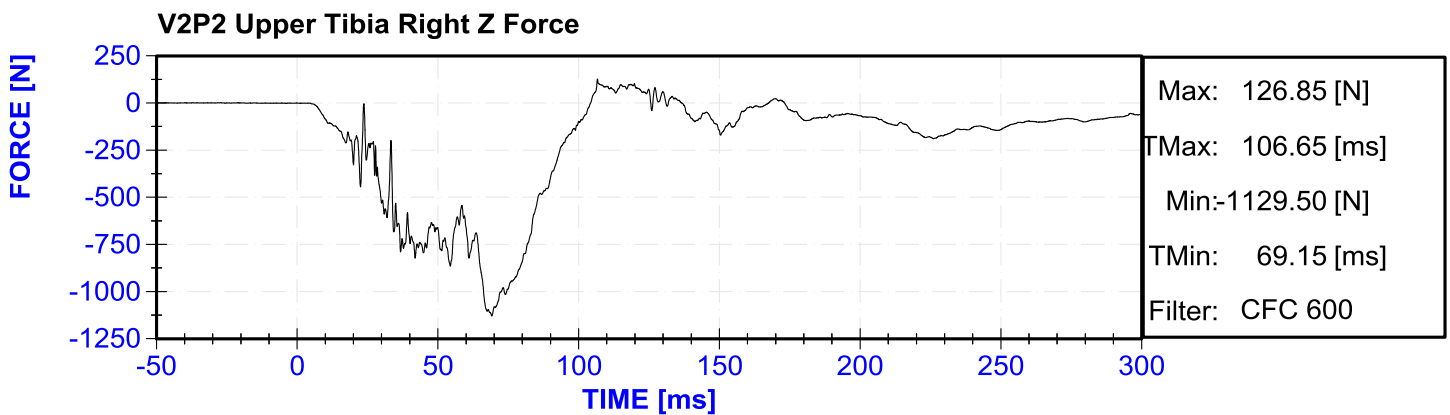
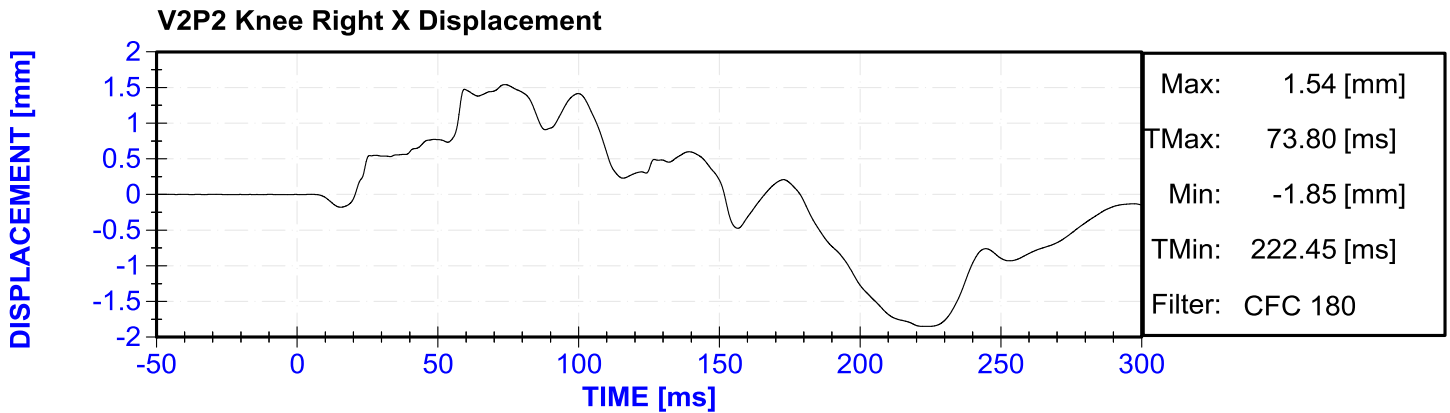


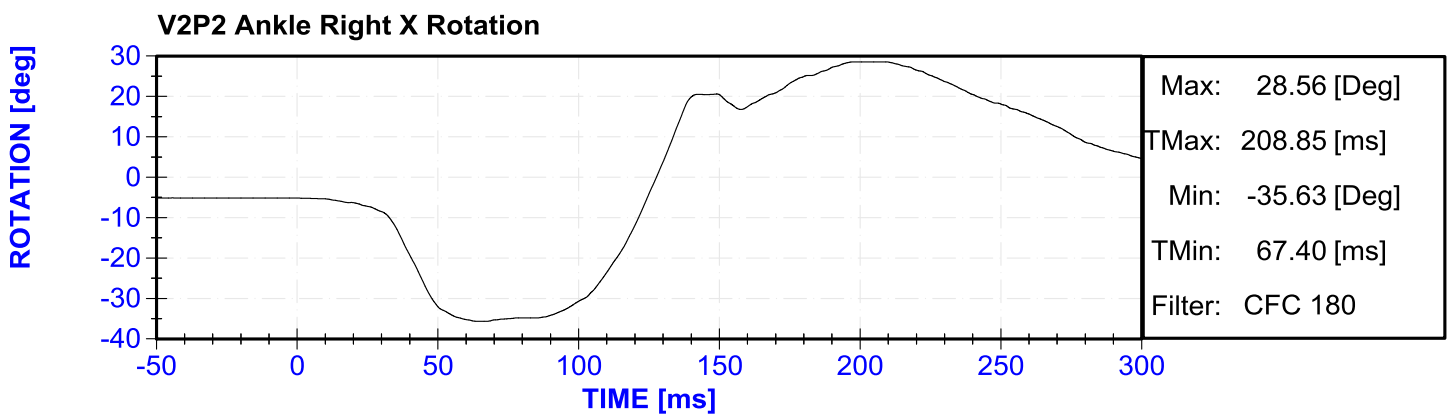
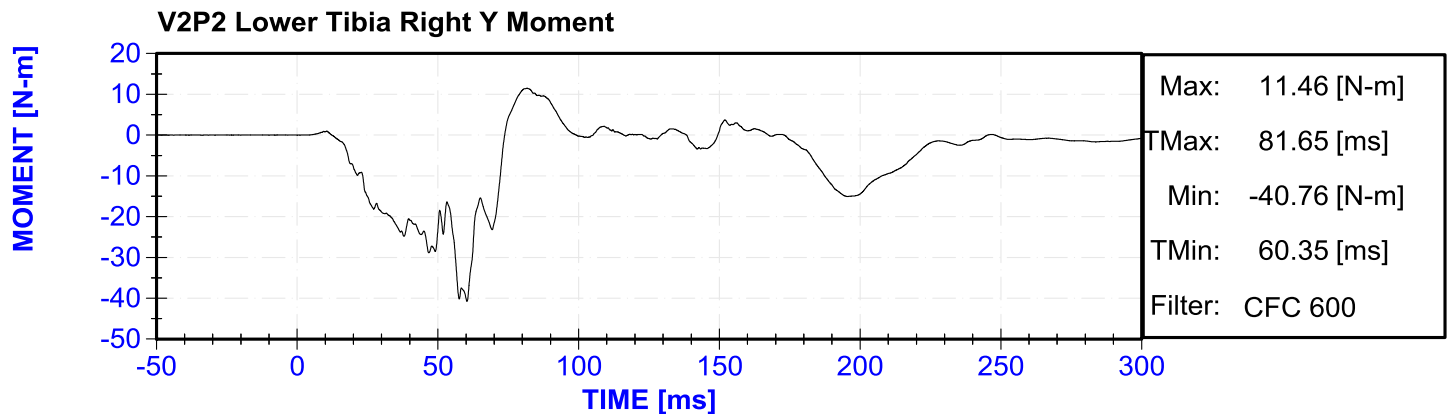
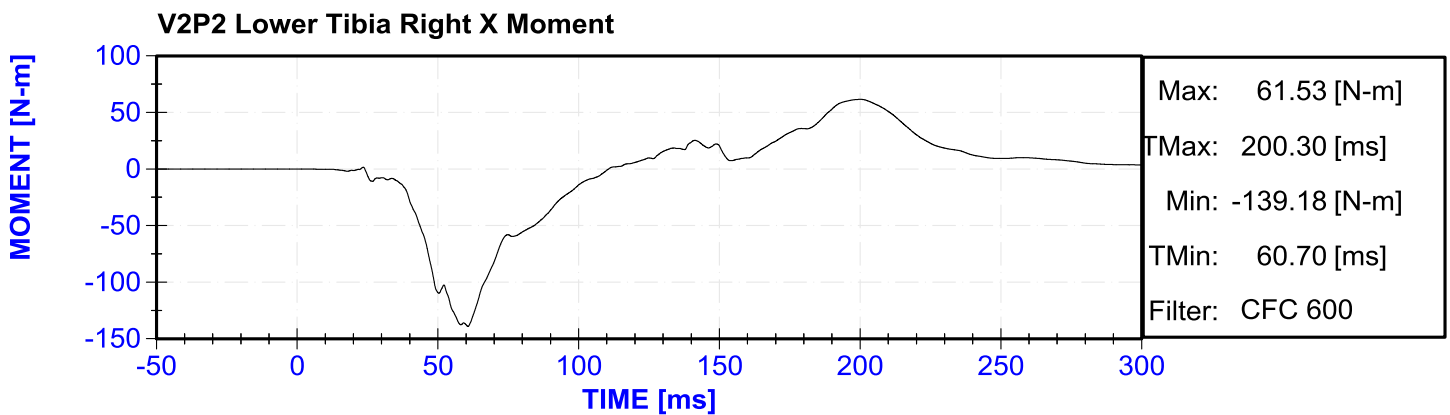
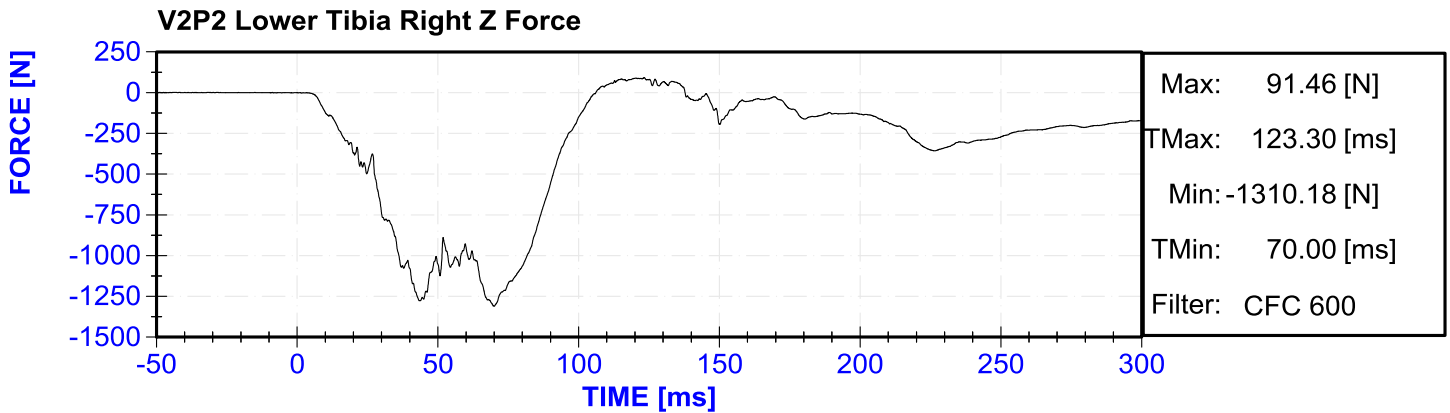


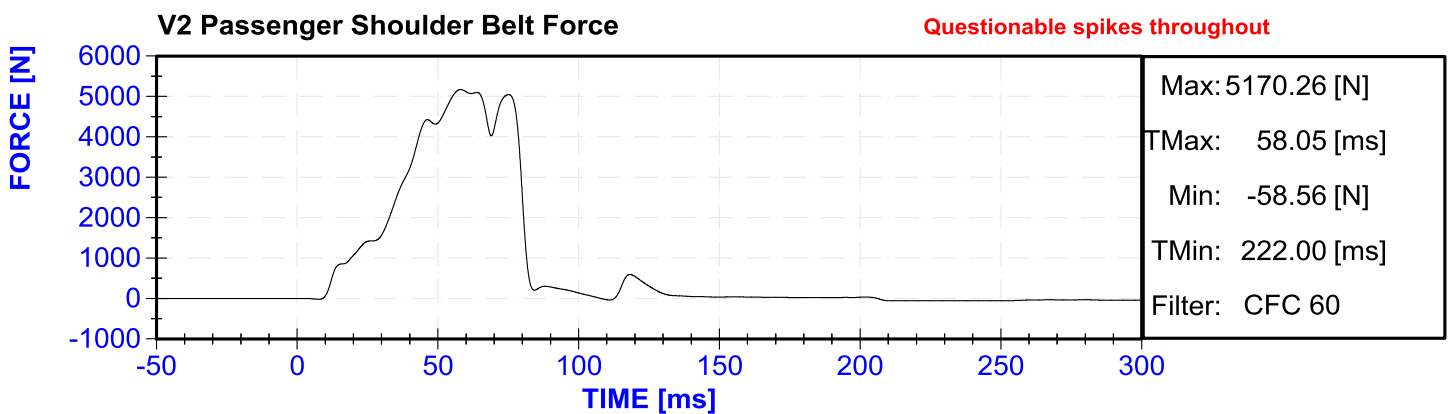
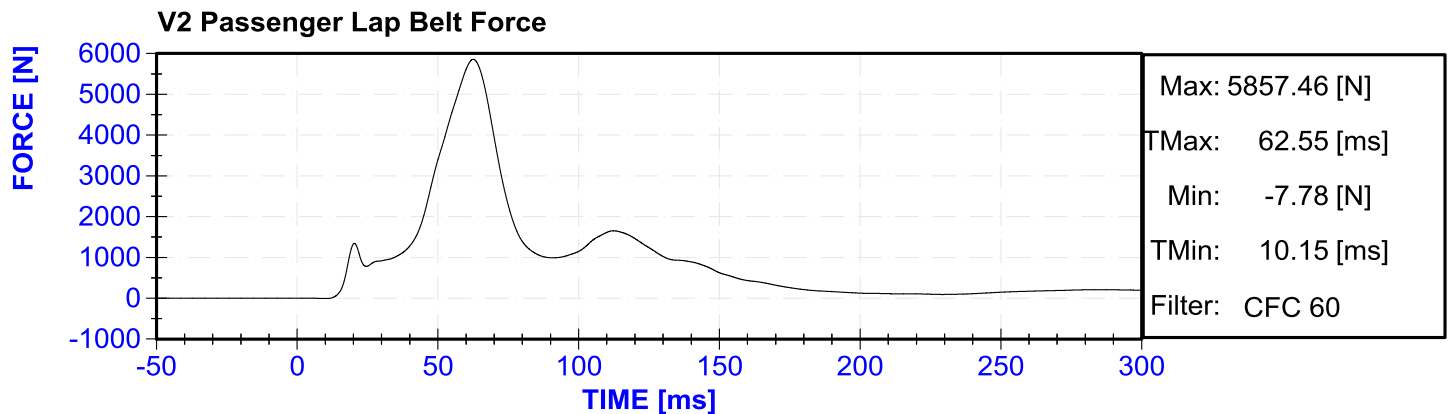
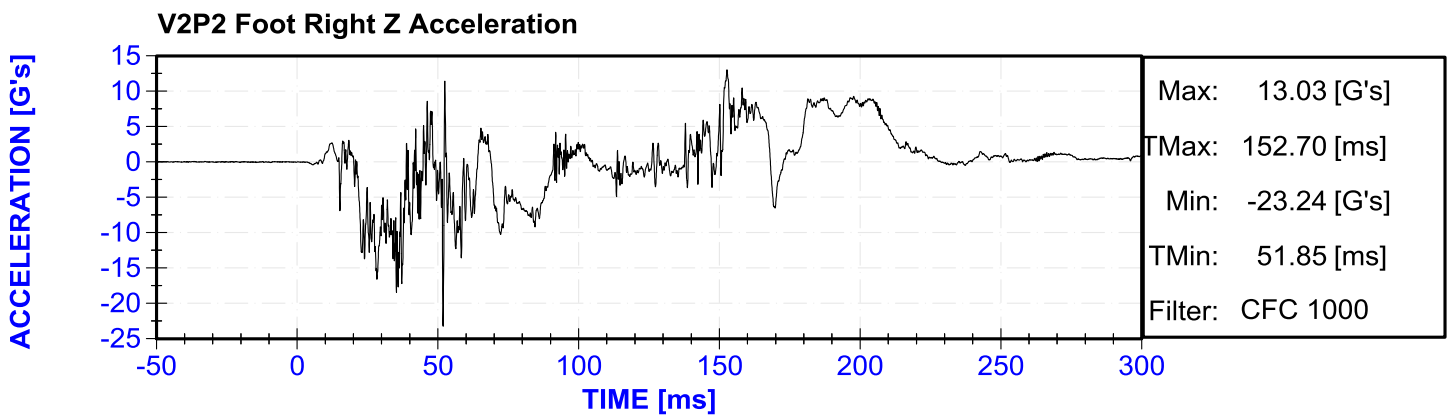
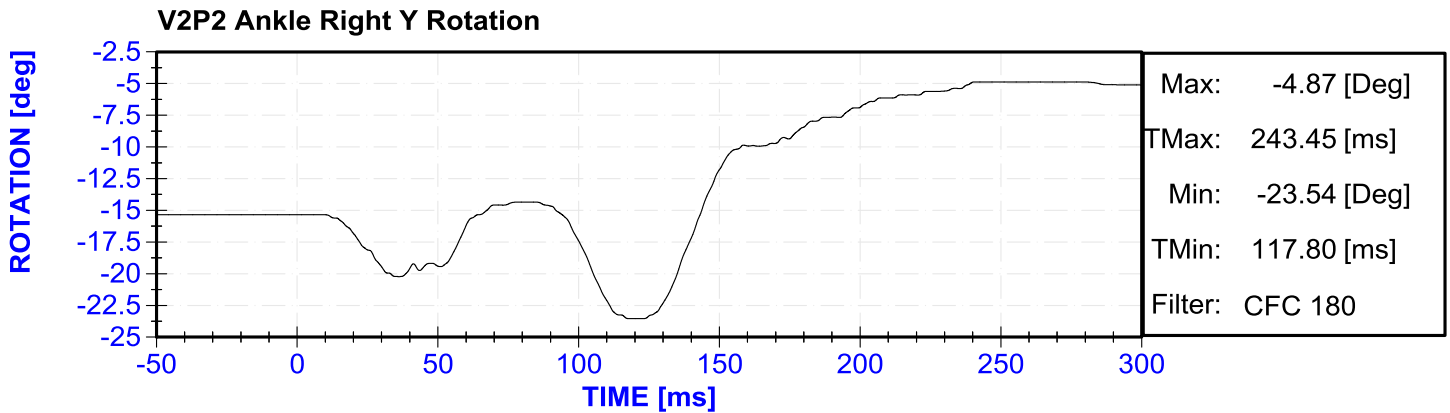


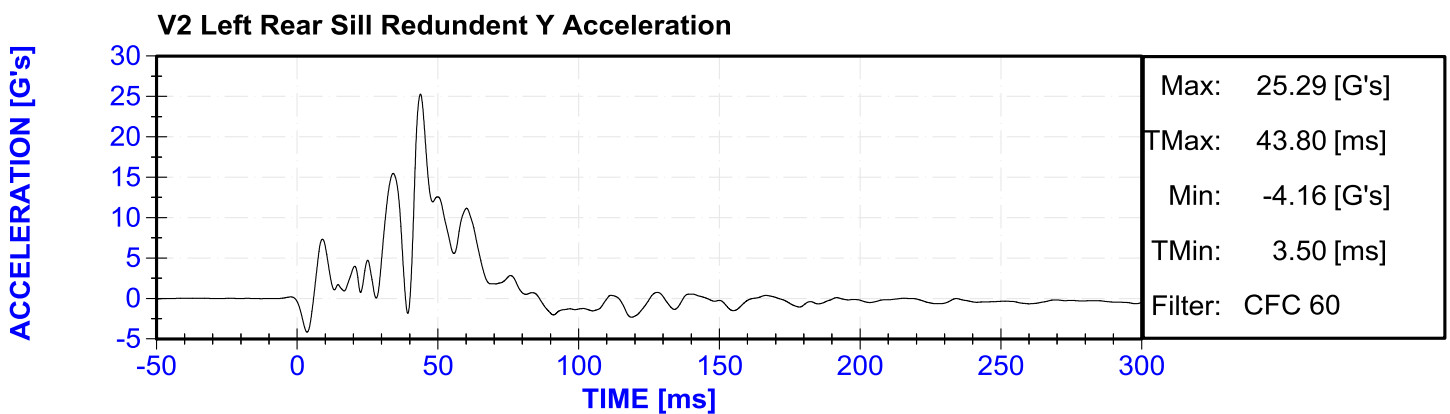
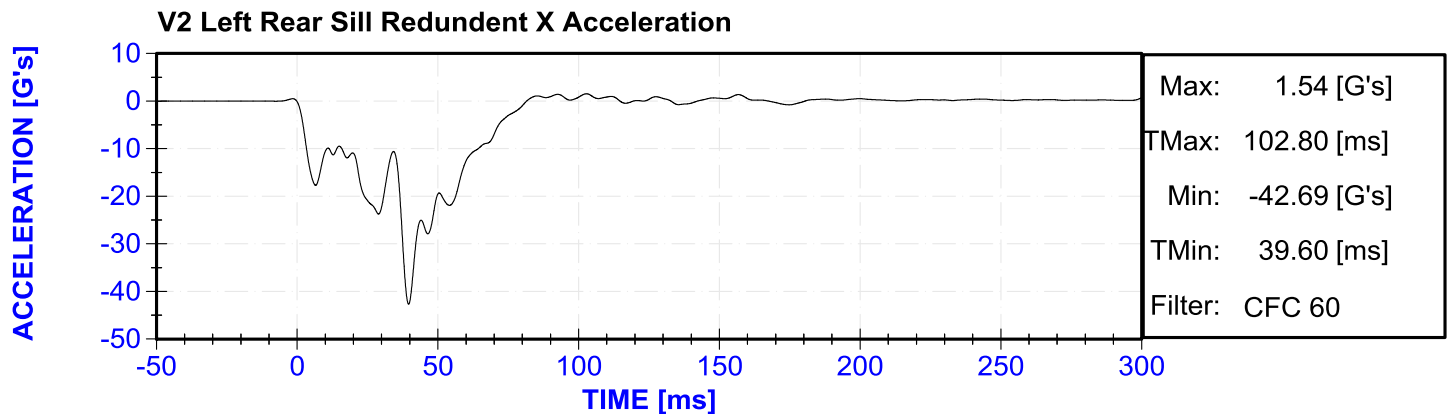
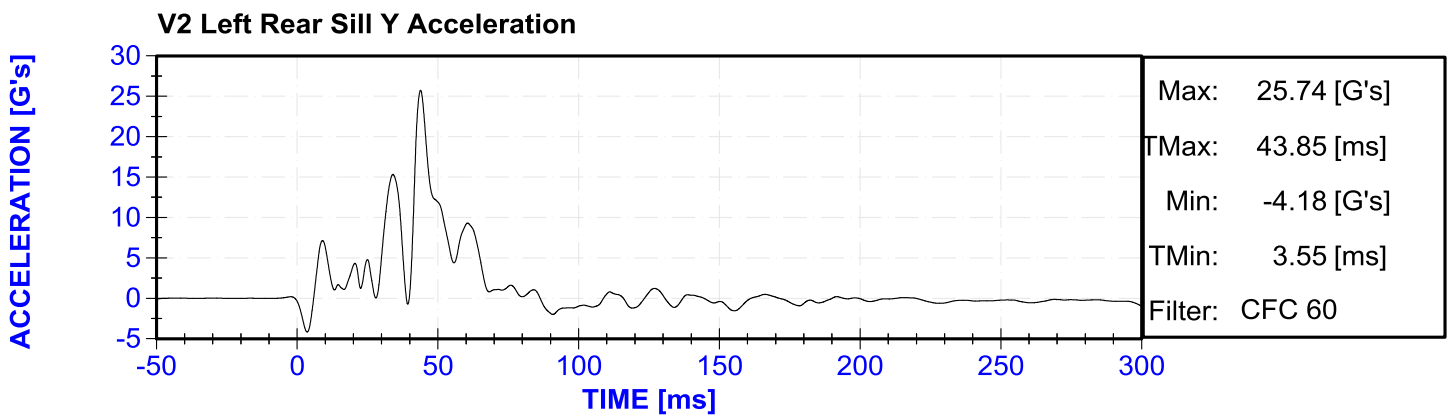
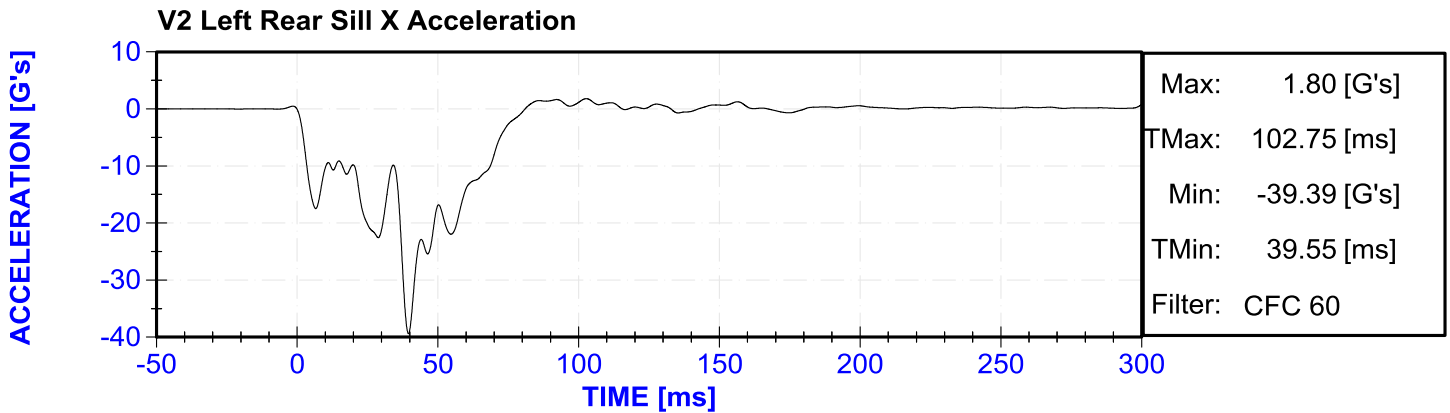


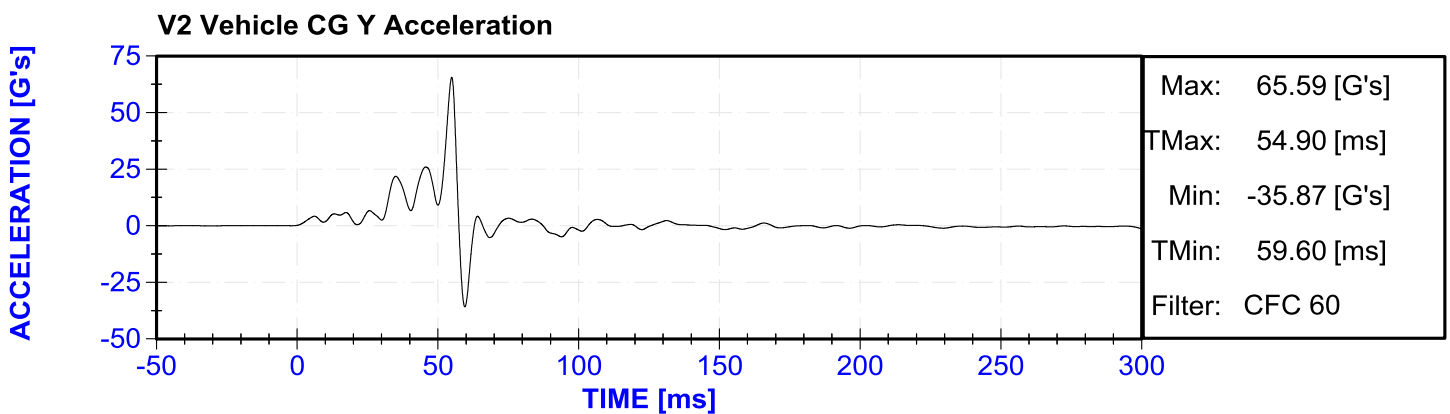
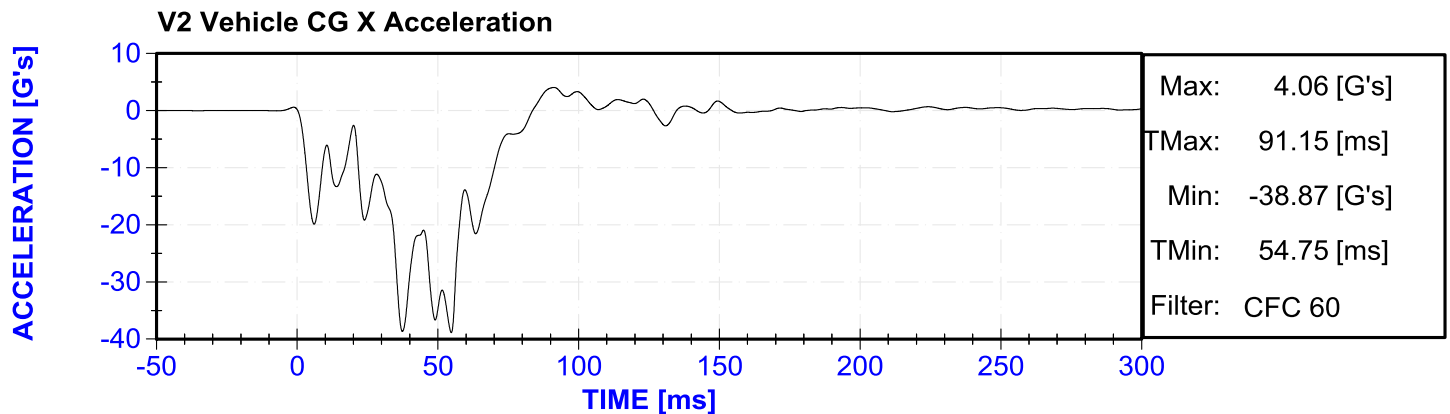
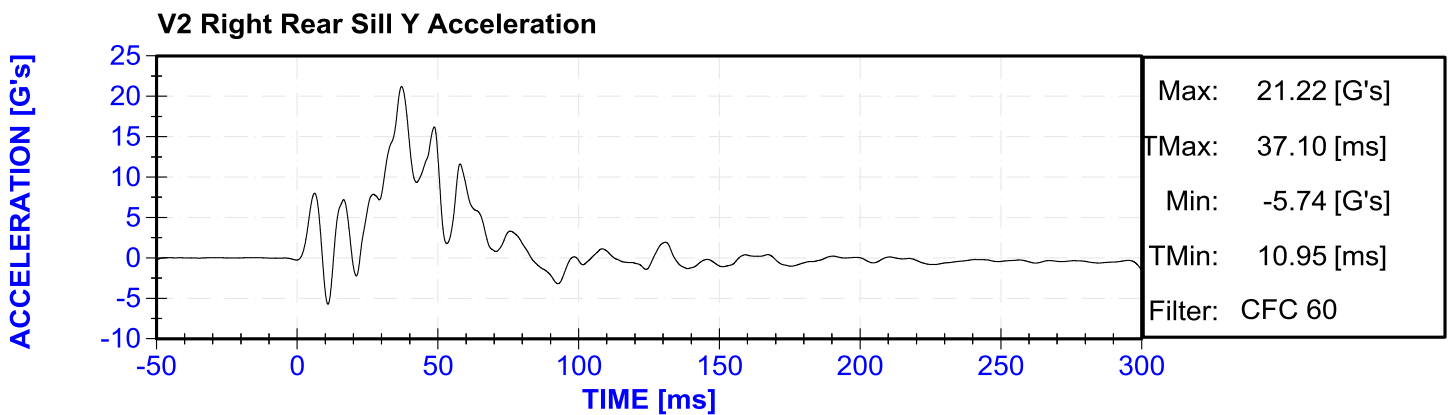
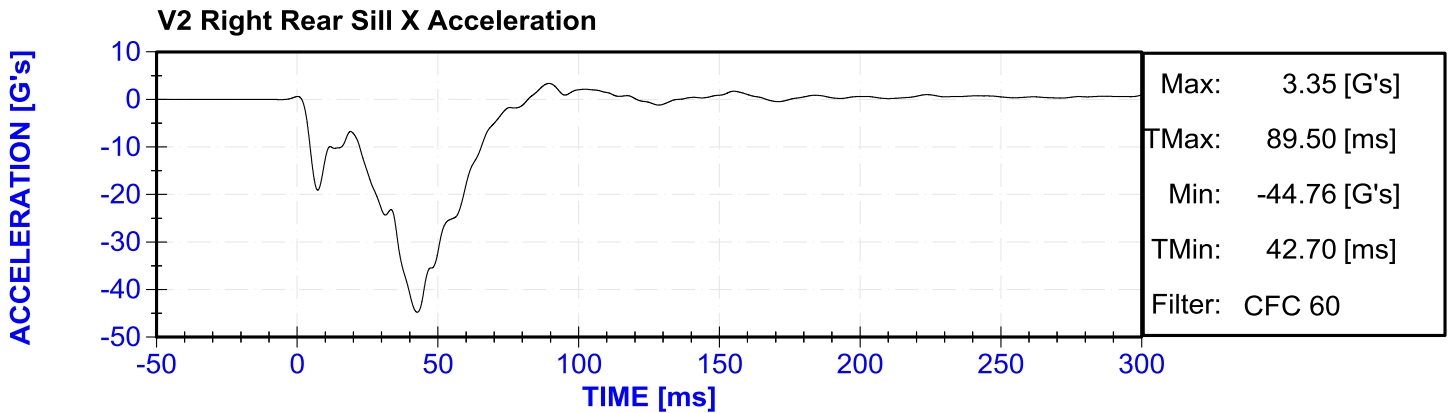




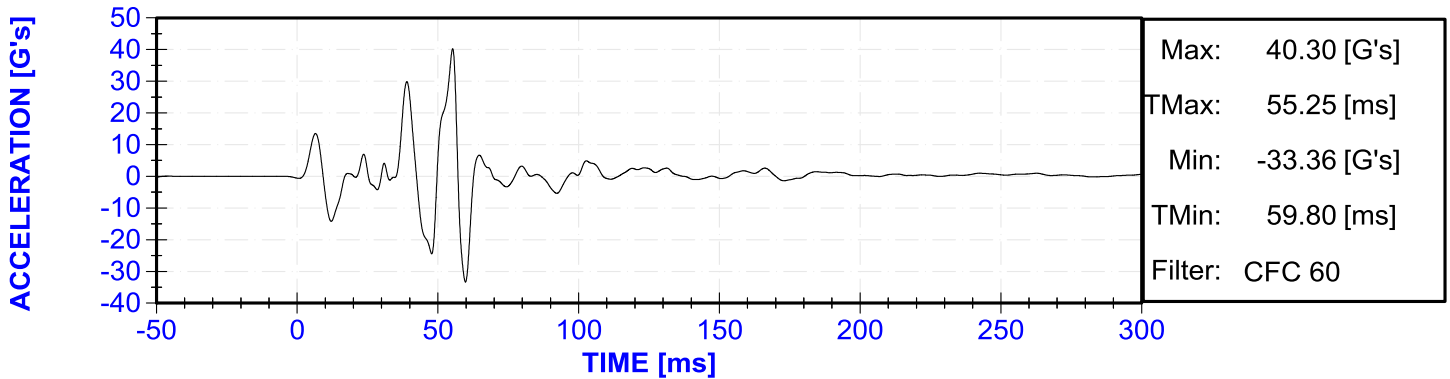




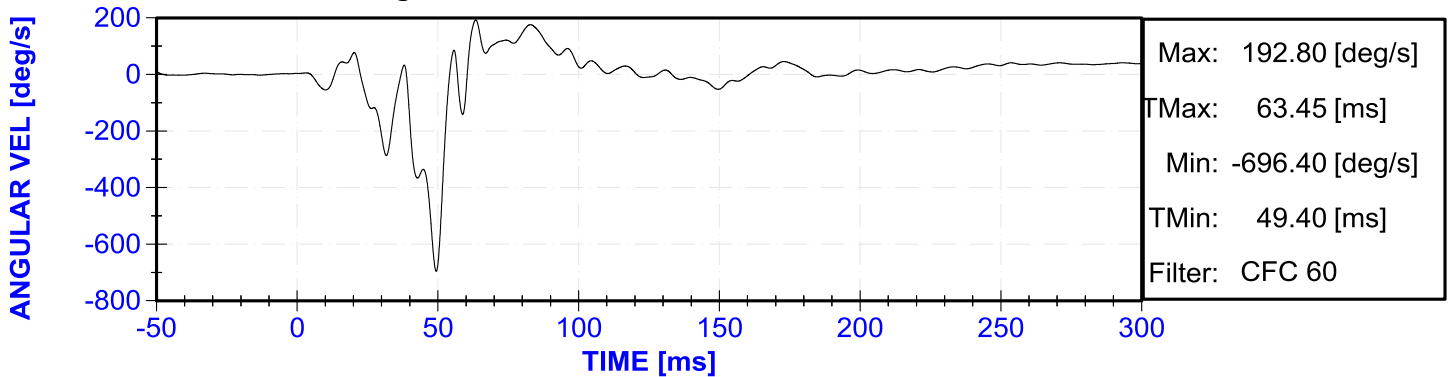




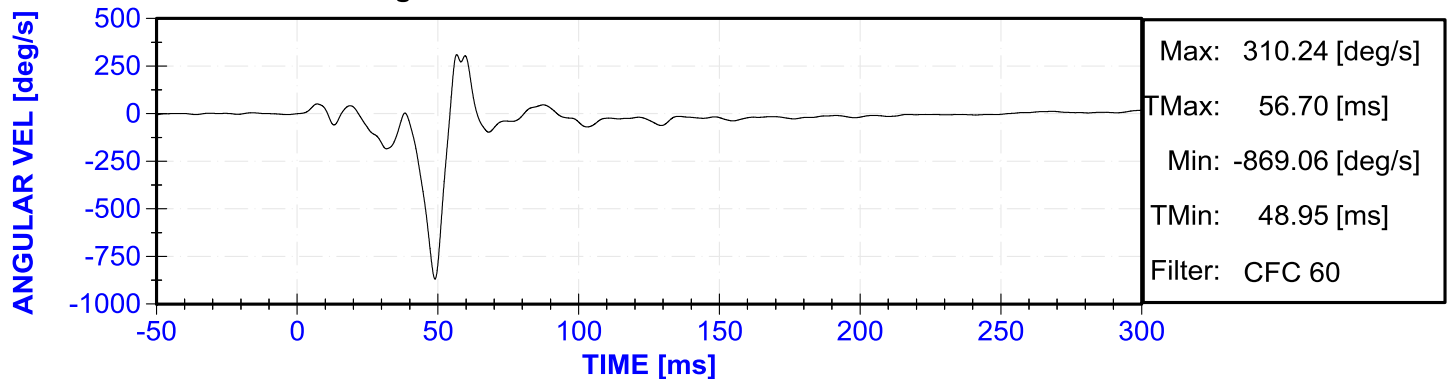
V2 Vehicle CG Z Acceleration



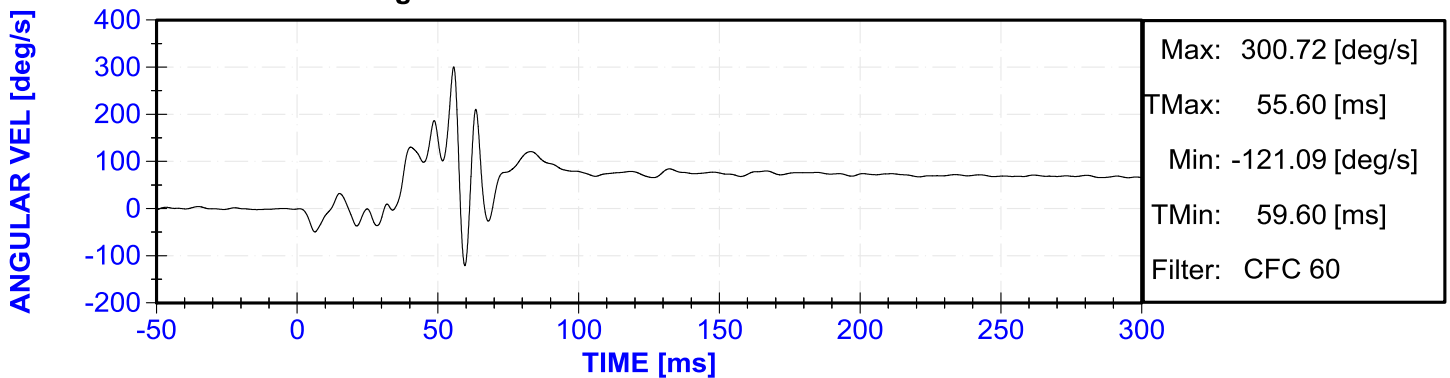
V2 Vehicle CG Angular Rate X



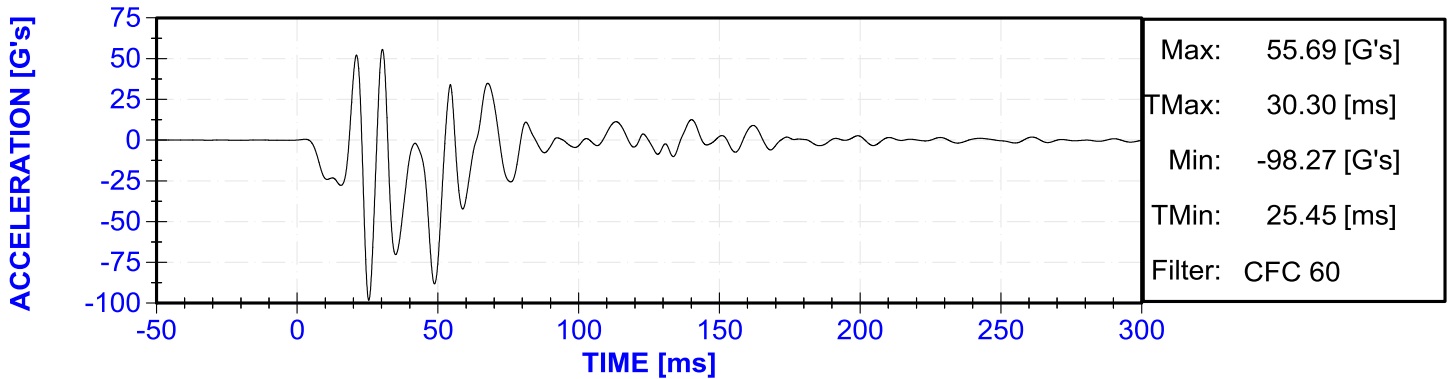
V2 Vehicle CG Angular Rate Y



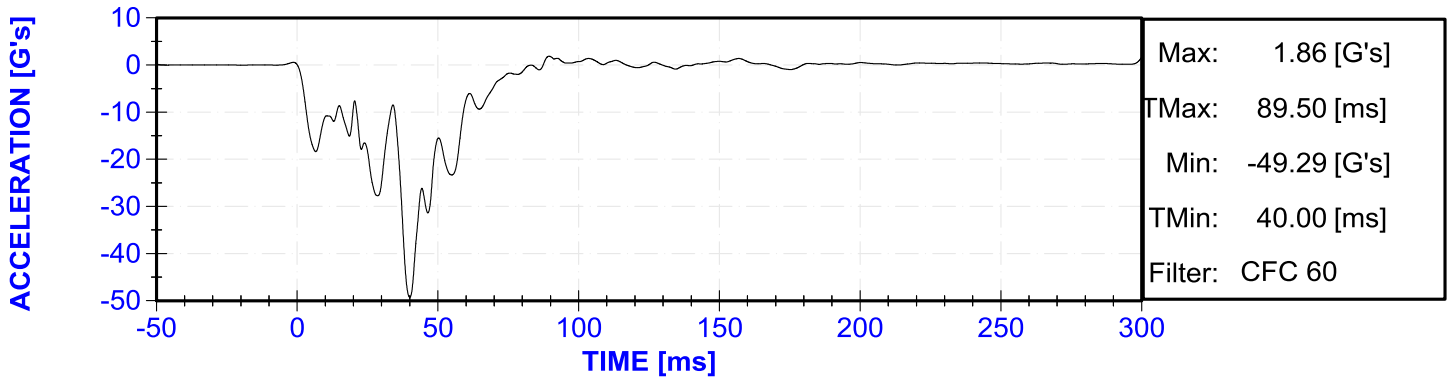
V2 Vehicle CG Angular Rate Z



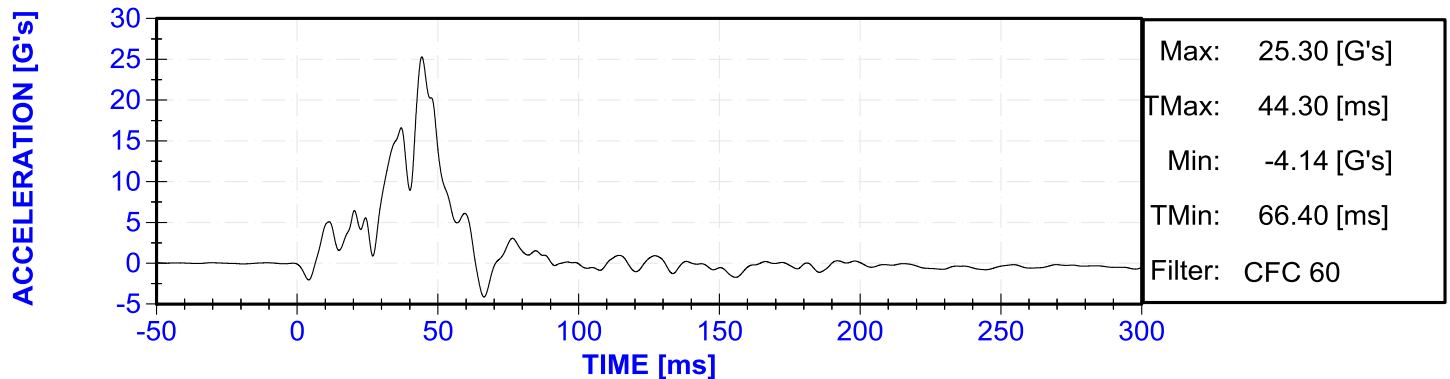
V2 Instrument Panel X Acceleration



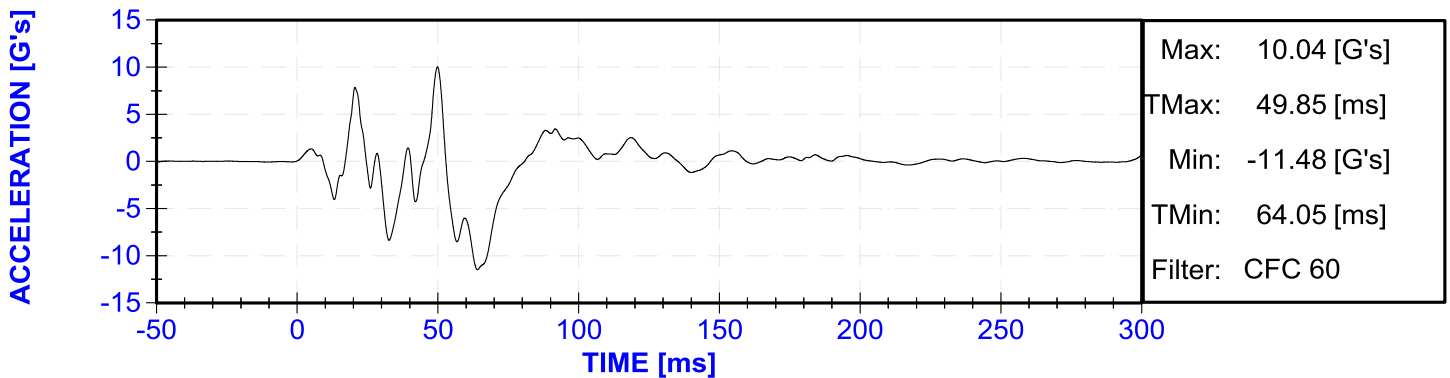
V2 Driver Seat Track X Acceleration



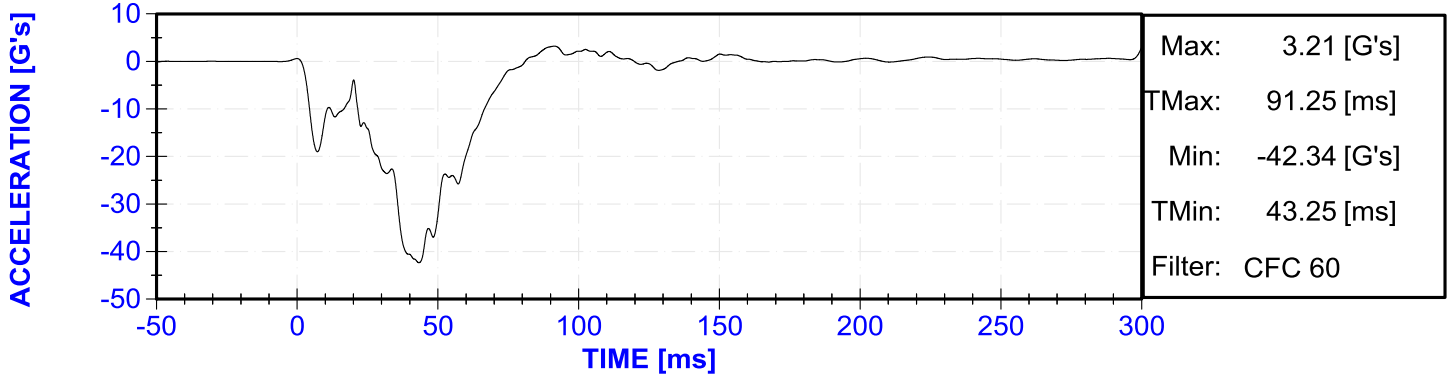
V2 Driver Seat Track Y Acceleration



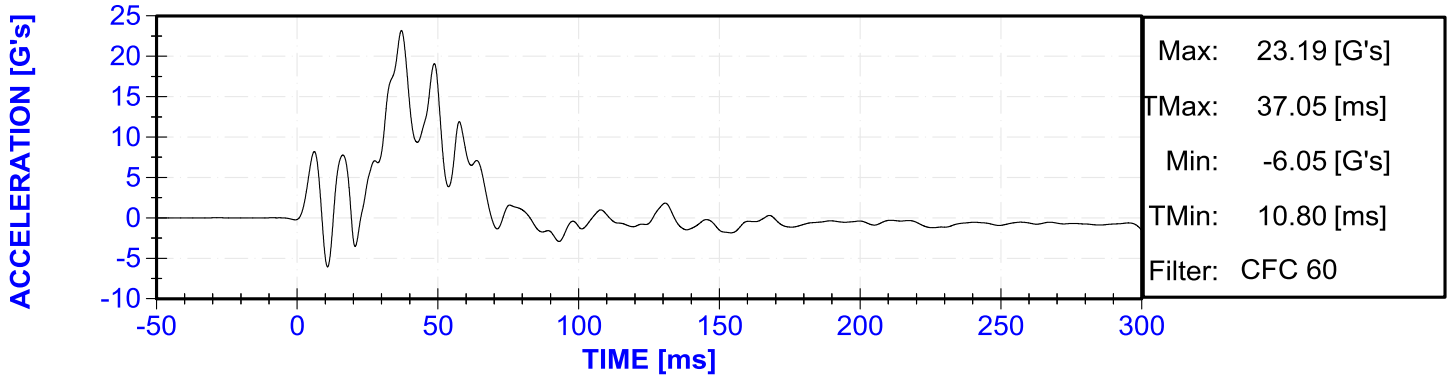
V2 Driver Seat Track Z Acceleration



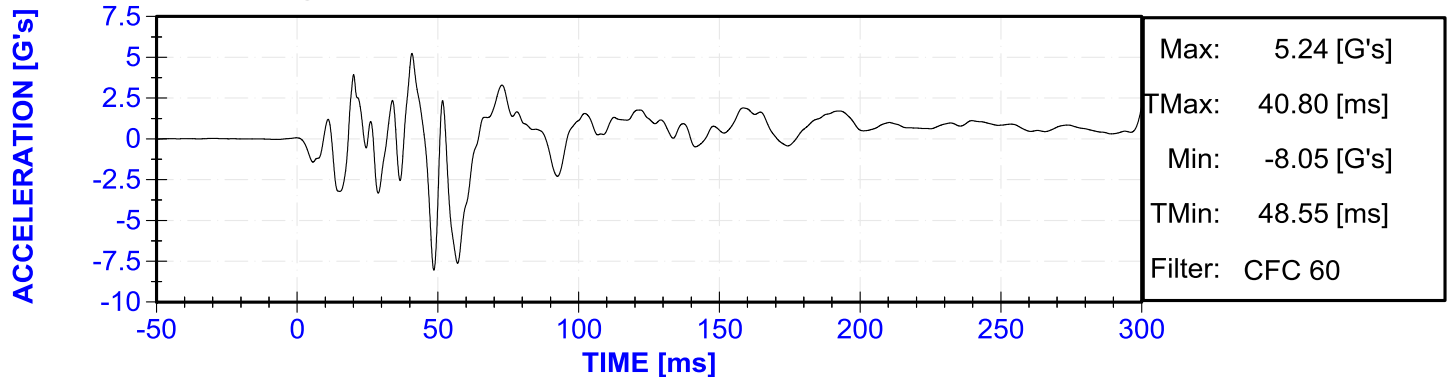
V2 Passenger Seat Track X Acceleration



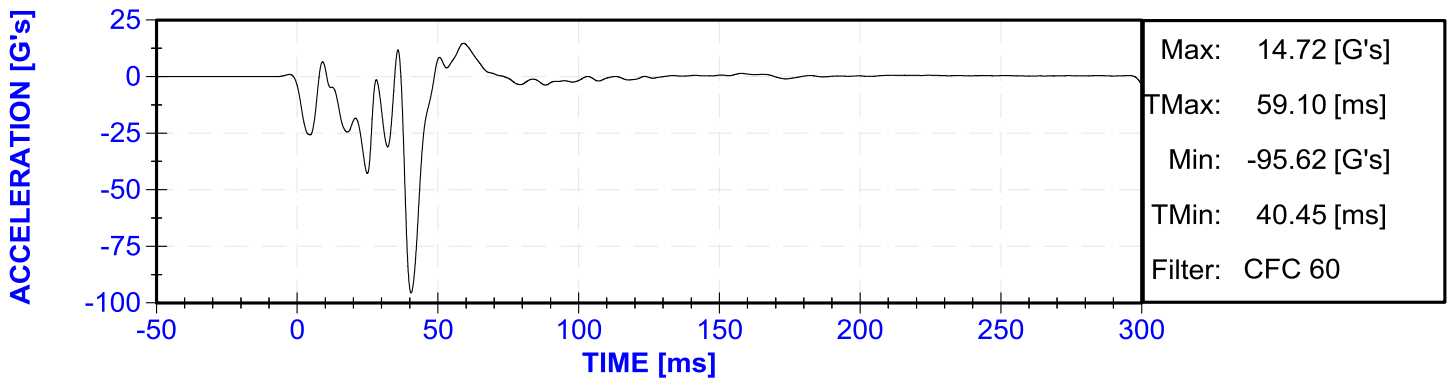
V2 Passenger Seat Track Y Acceleration



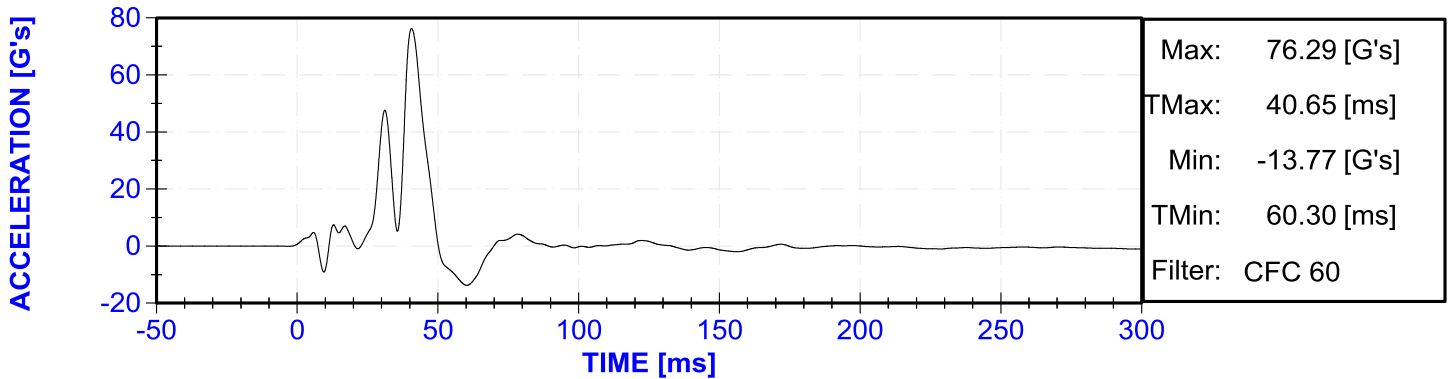
V2 Passenger Seat Track Z Acceleration



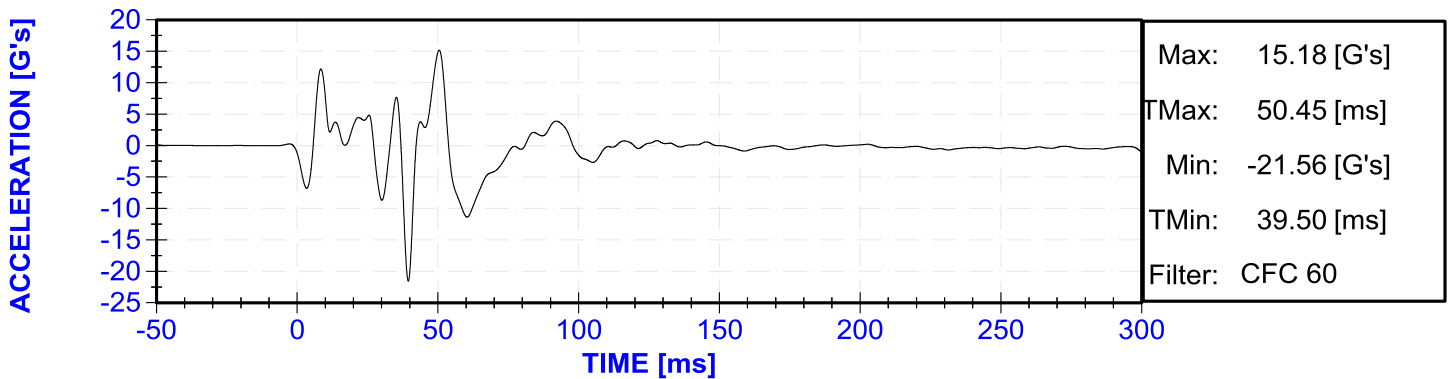
V2 Driver Floor Pan X Acceleration



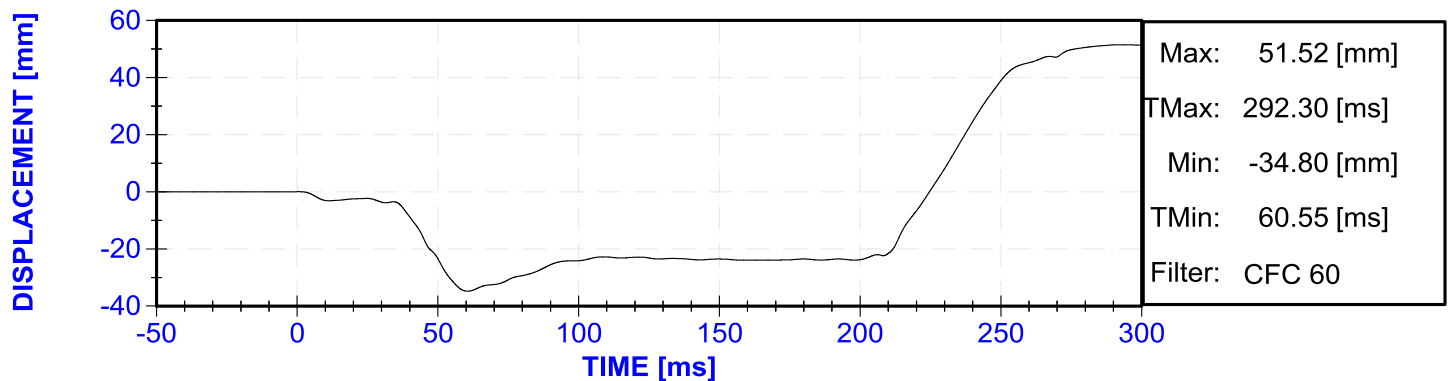
V2 Driver Floor Pan Y Acceleration



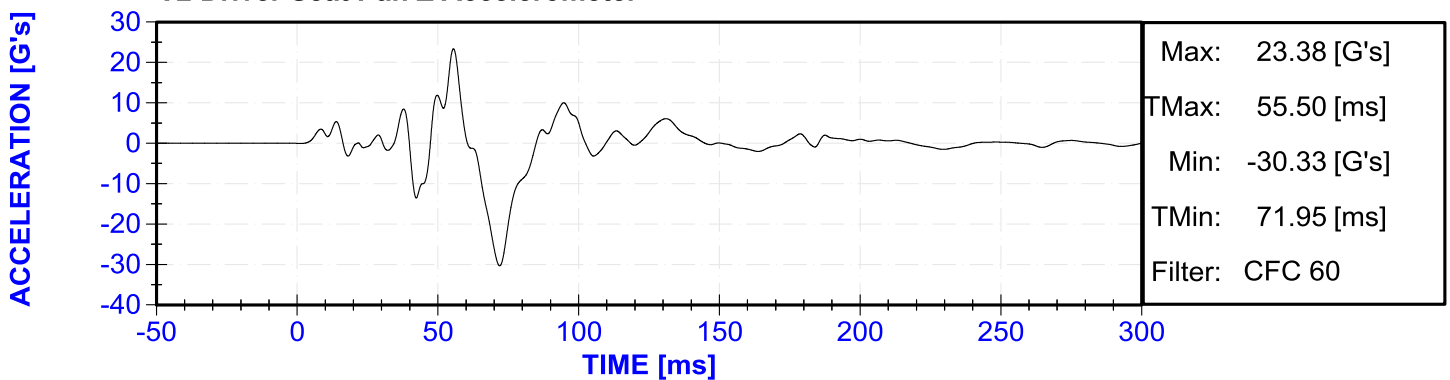
V2 Driver Floor Pan Z Acceleration



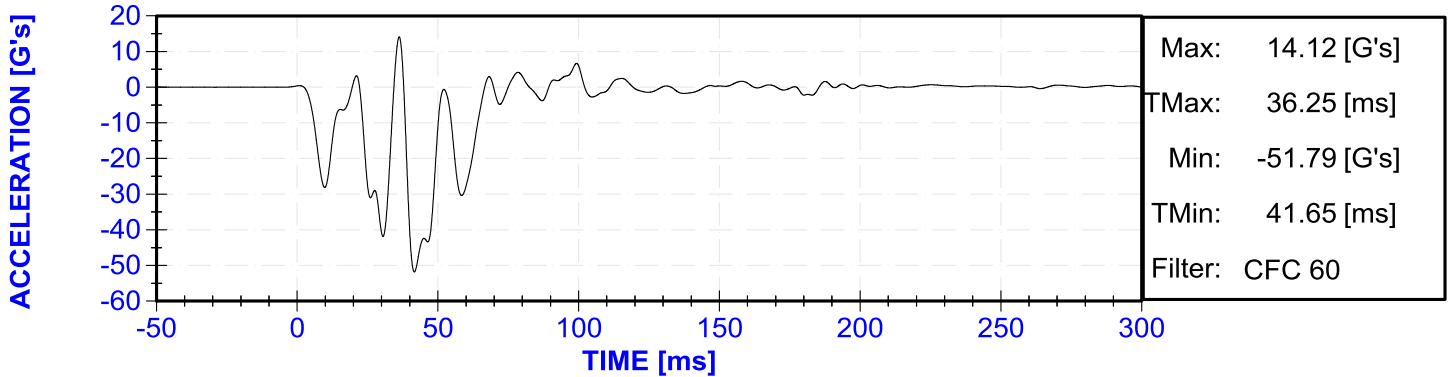
V2 Driver Floor Pan X Deflection



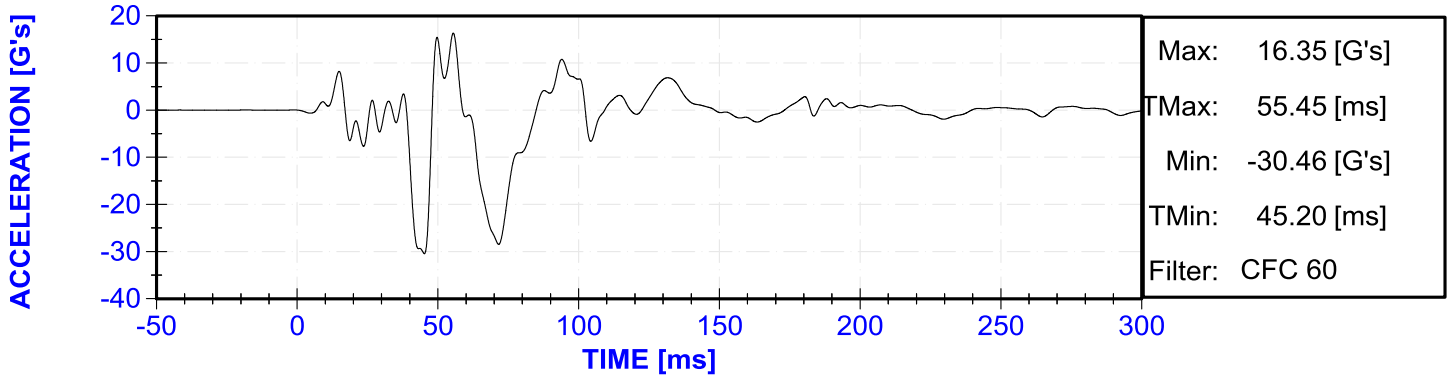
V2 Driver Seat Pan Z Accelerometer



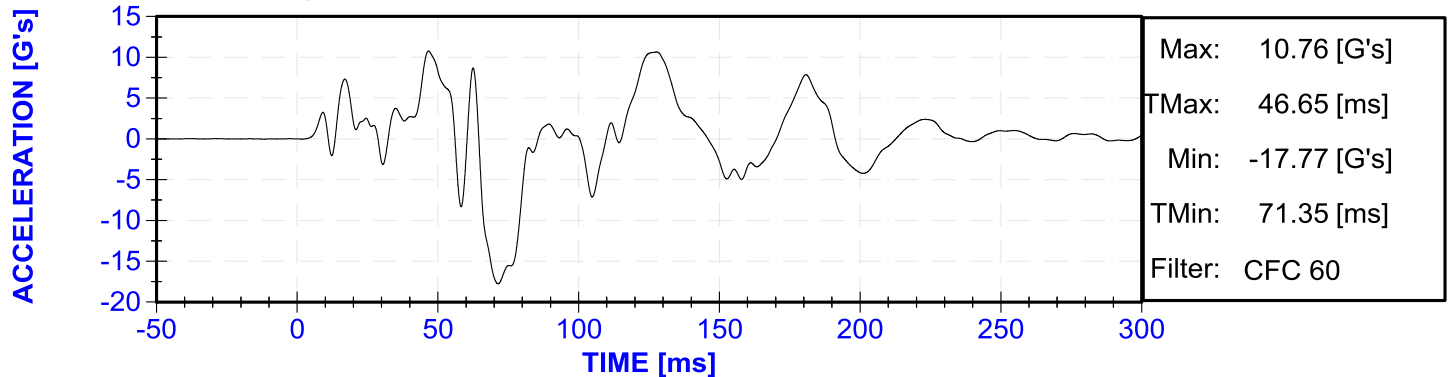
V2 Driver Seat Thigh Bar X Acceleration



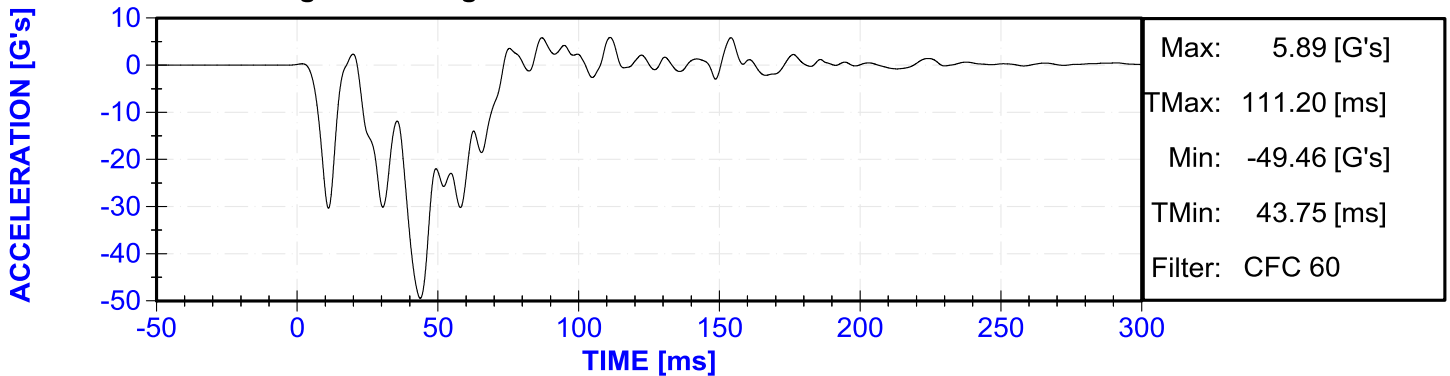
V2 Driver Seat Thigh Bar Z Acceleration



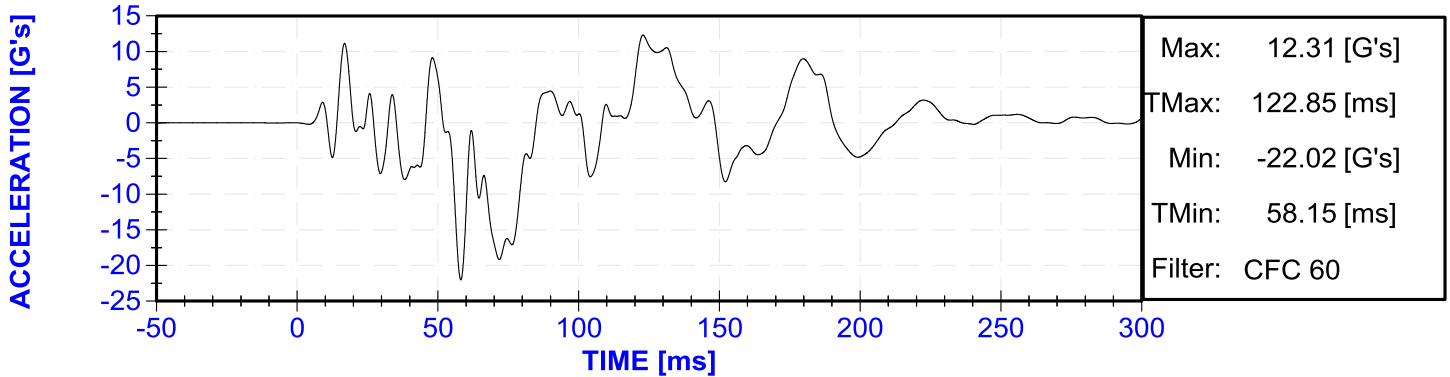
V2 Passenger Seat Pan Z Accelerometer



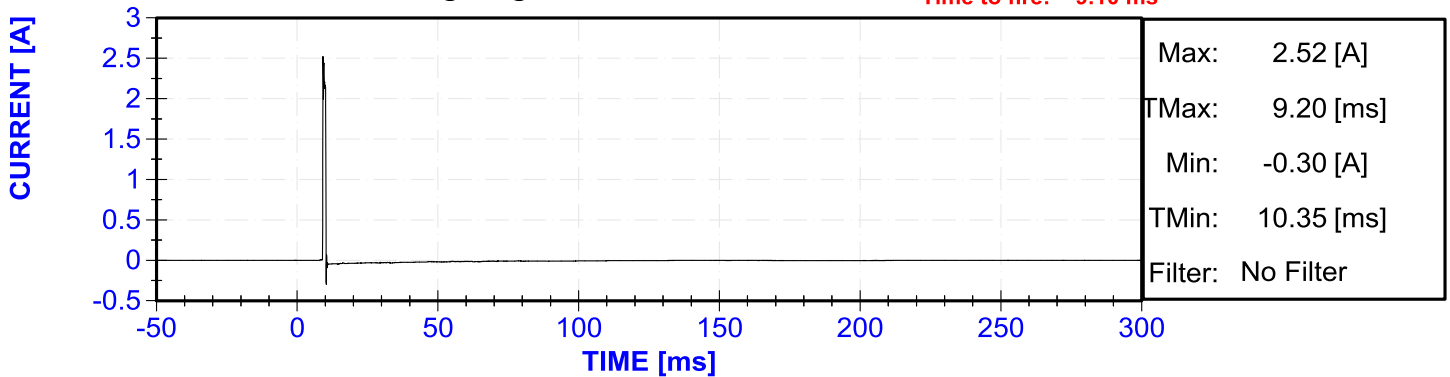
V2 Passenger Seat Thigh Bar X Accelerometer



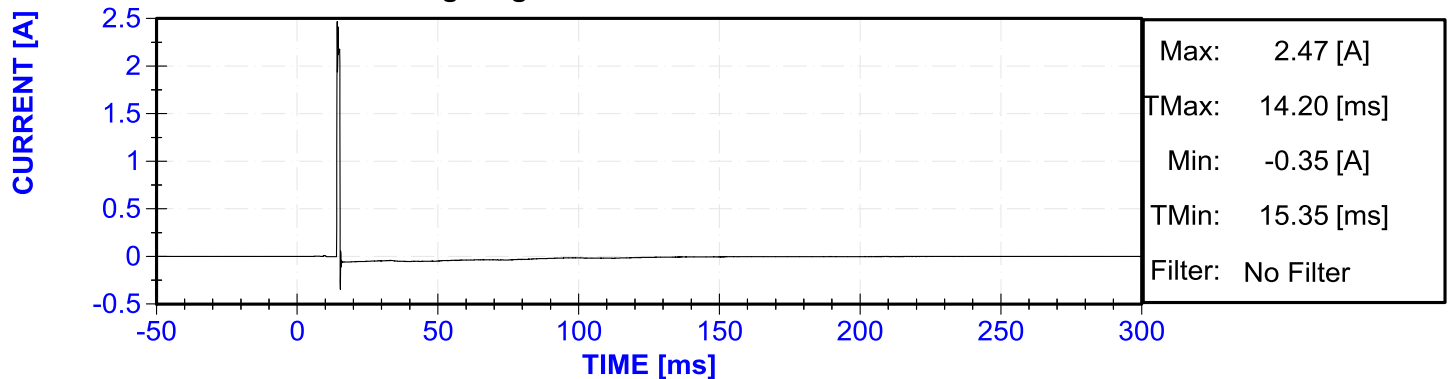
V2 Passenger Seat Thigh Bar Z Accelerometer



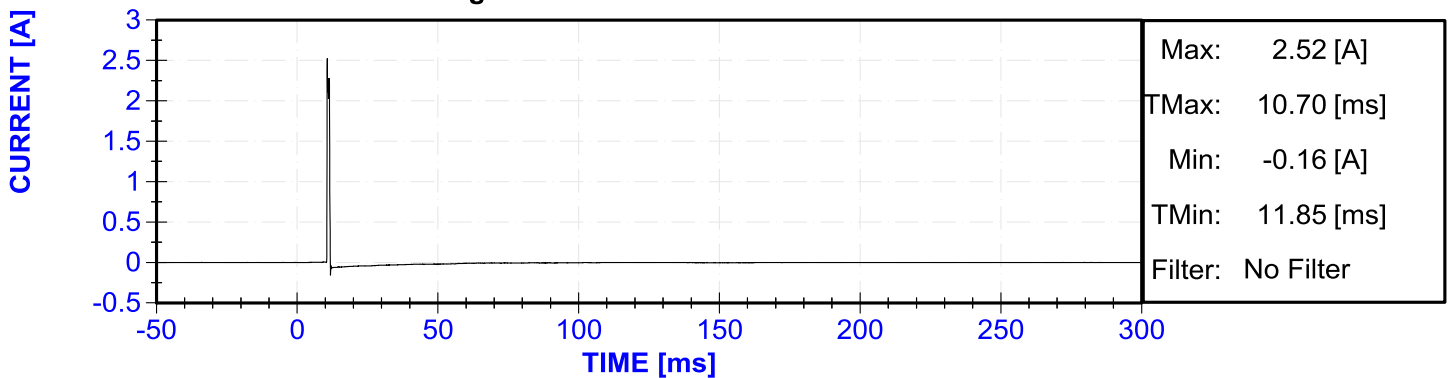
V2 Driver Front Airbag Stage 1 Monitor



V2 Driver Front Airbag Stage 2 Monitor

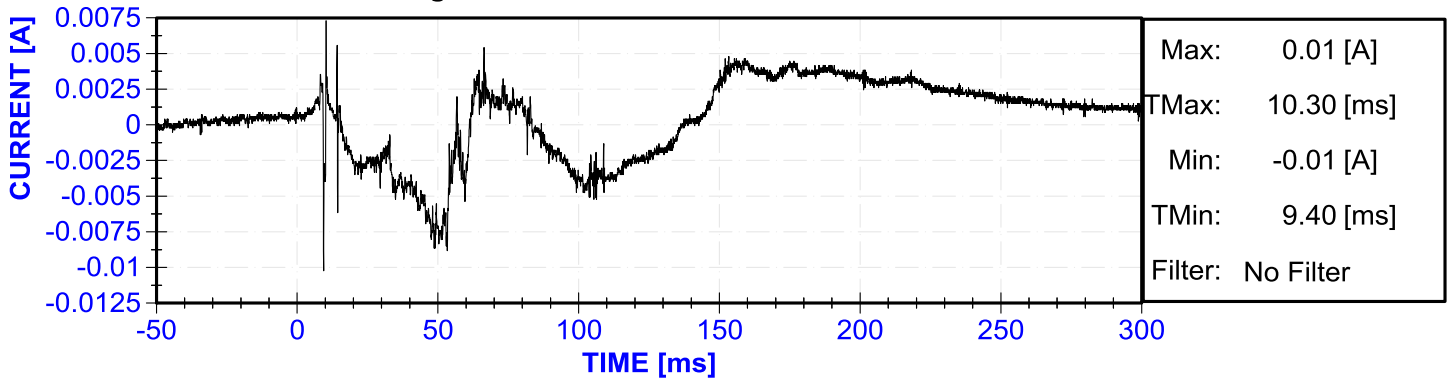


V2 Driver Curtain Airbag Monitor



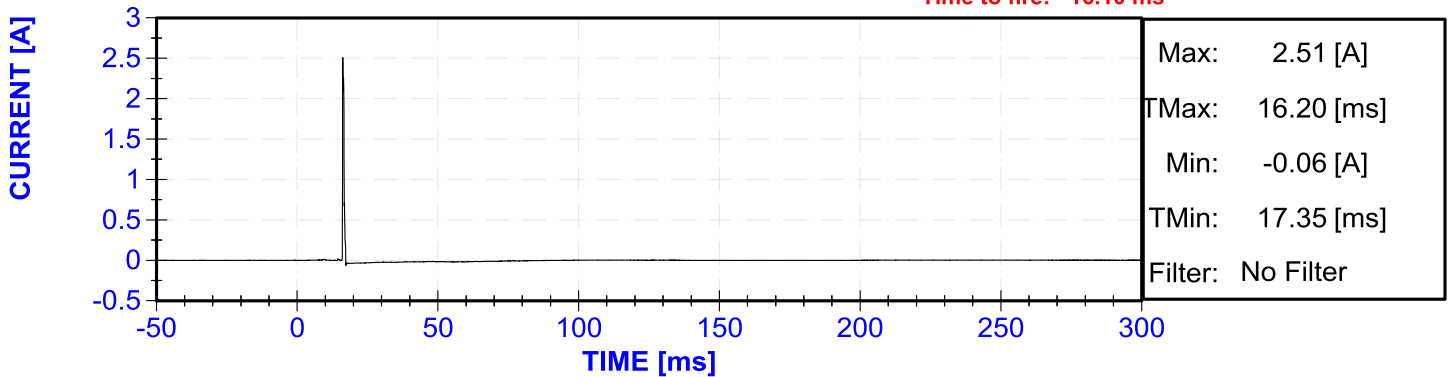
V2 Driver Seat Airbag Monitor

Did not fire



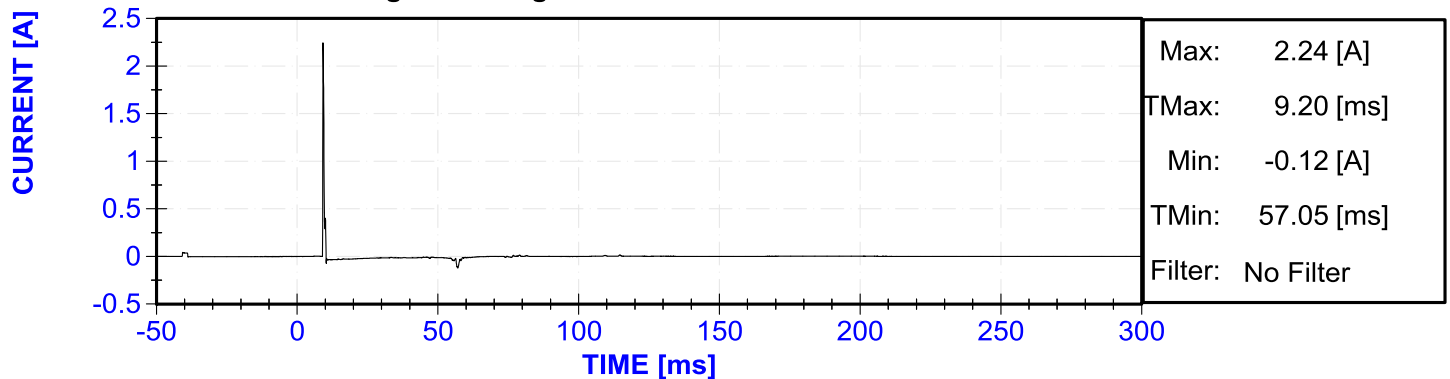
V2 Driver Anchor Pretensioner Monitor

Time to fire: 16.10 ms



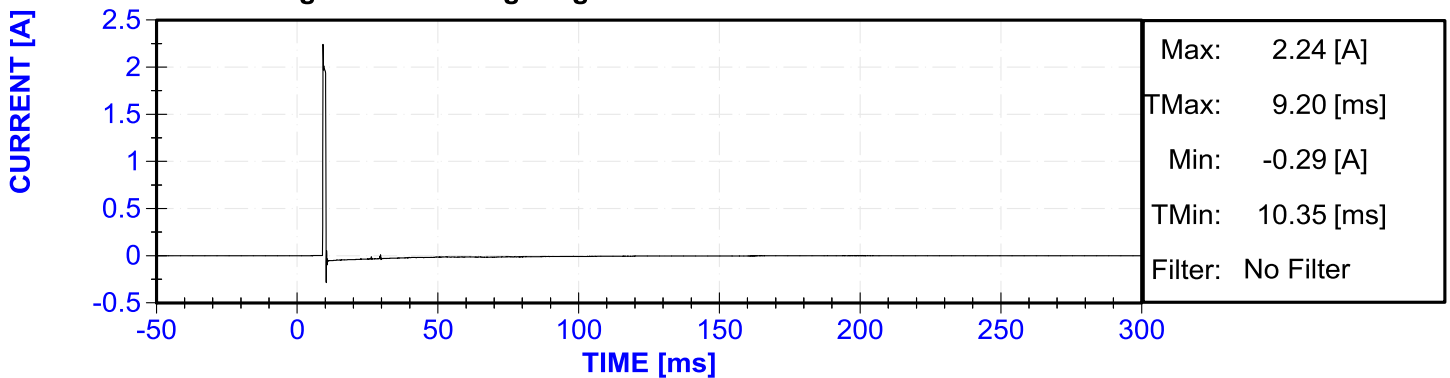
V2 Driver Steering Column Ignitor

Time to fire: 9.1 ms



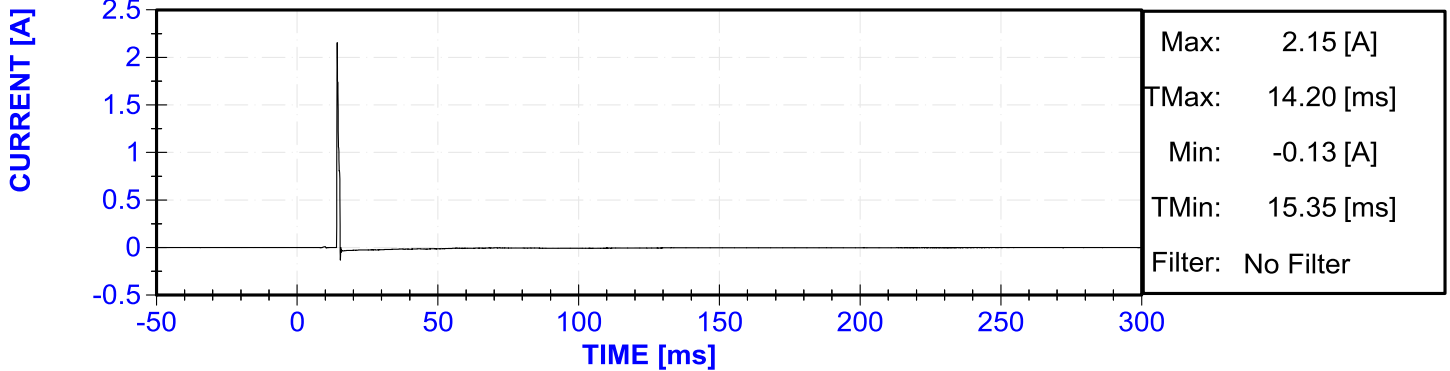
V2 Passenger Front Airbag Stage 1 Monitor

Time to fire: 9.10 ms



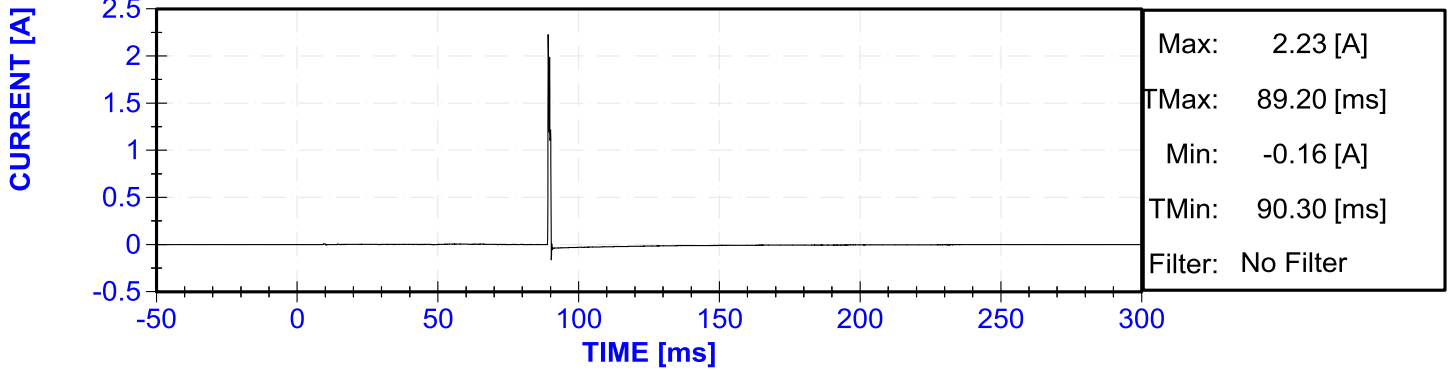
V2 Passenger Front Airbag Stage 2 Monitor

Time to fire: 14.15 ms



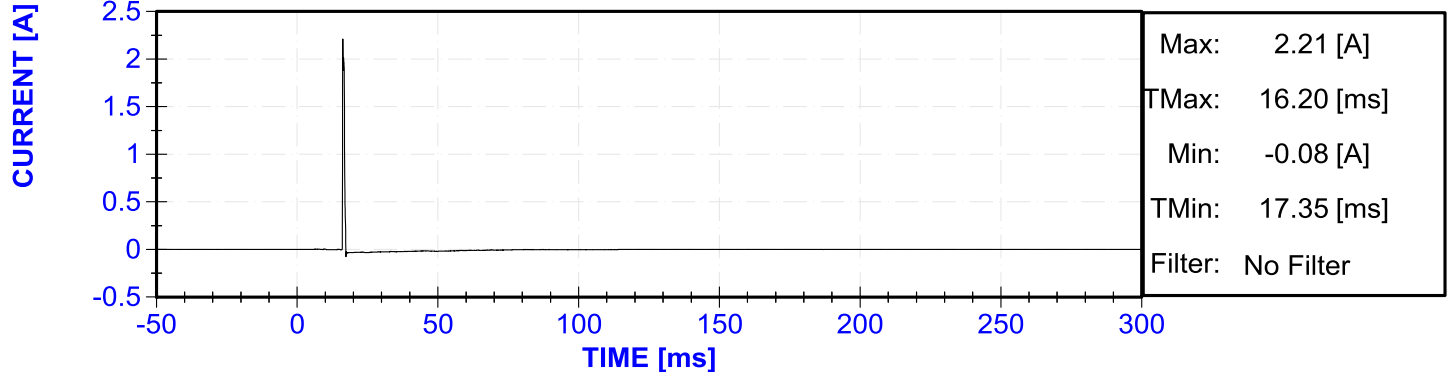
V2 Passenger Front Airbag Stage 3 Monitor

Time to fire: 89.10 ms

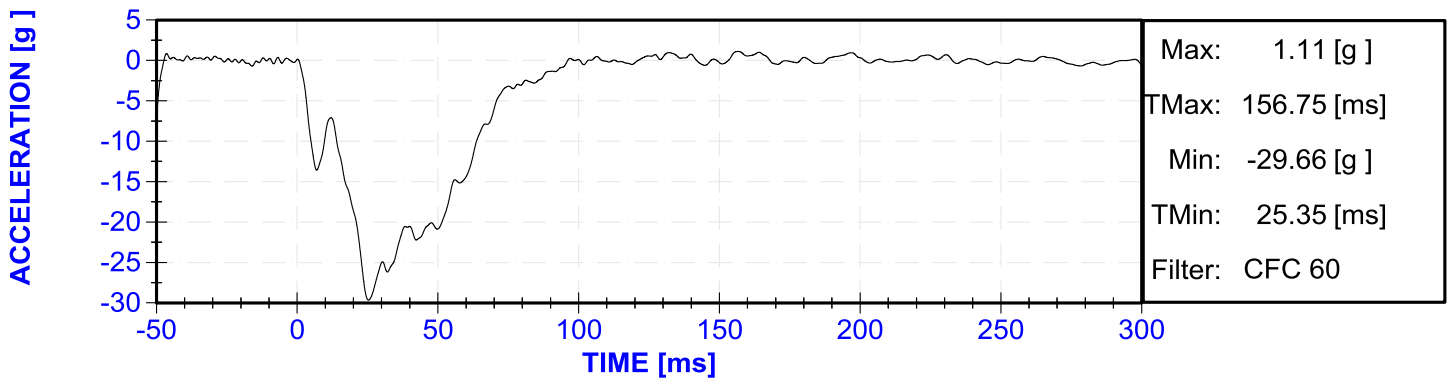


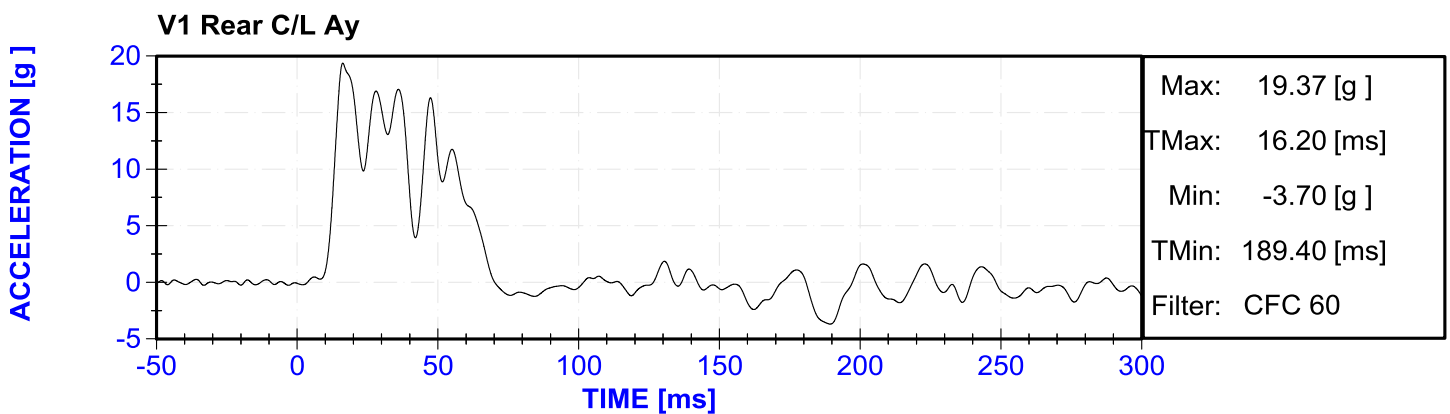
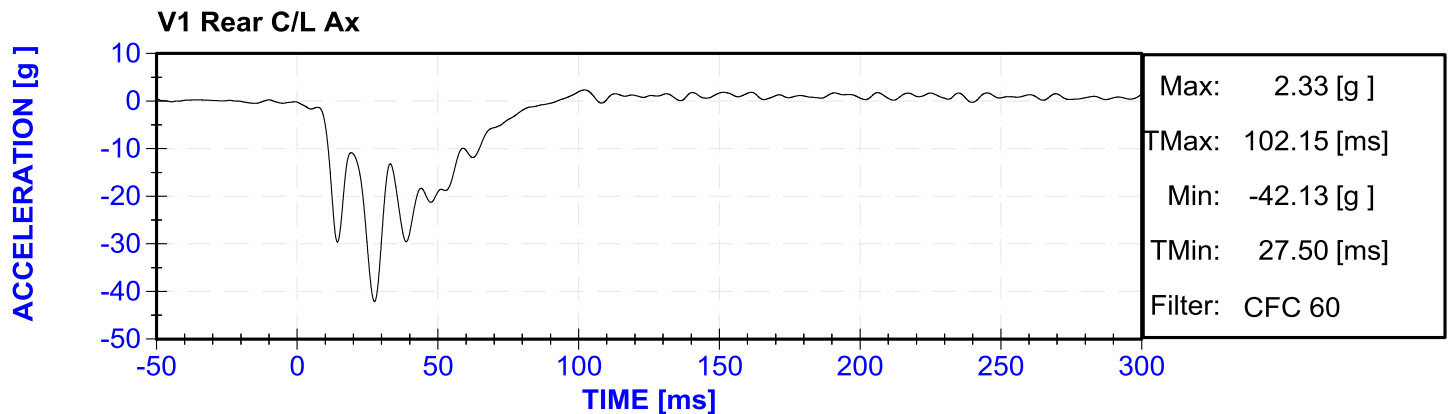
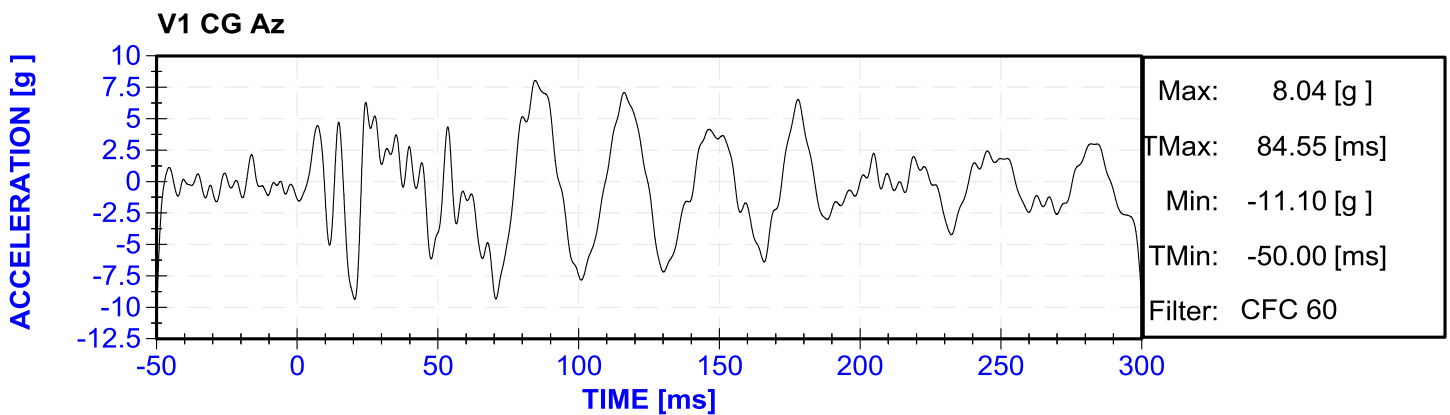
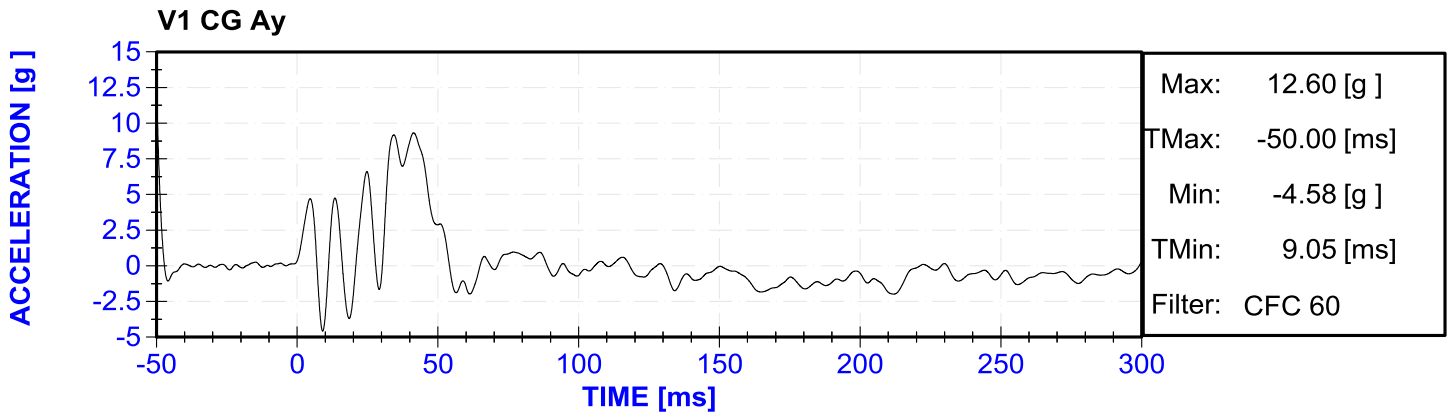
V2 Passenger Anchor Pretensioner Monitor

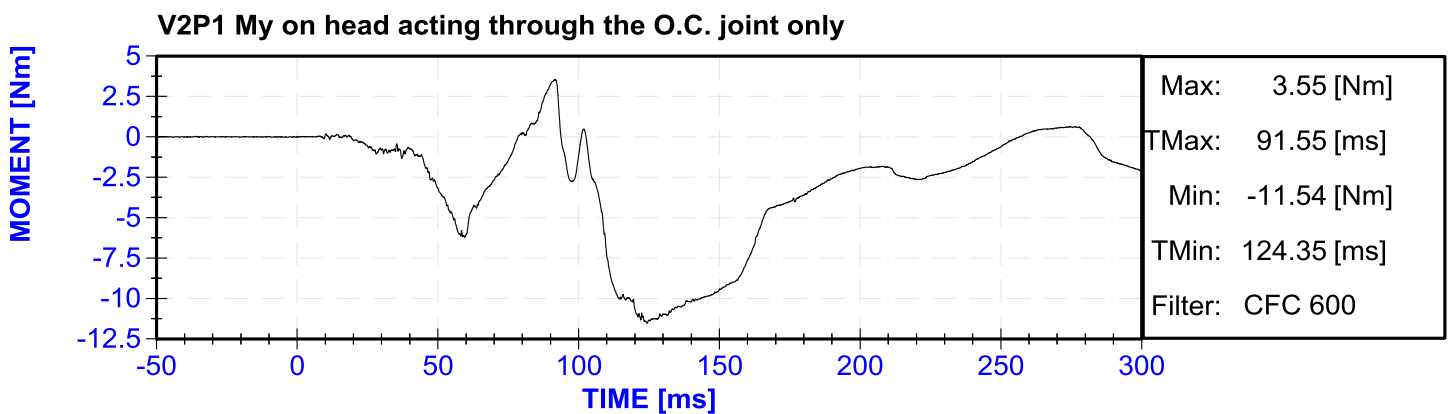
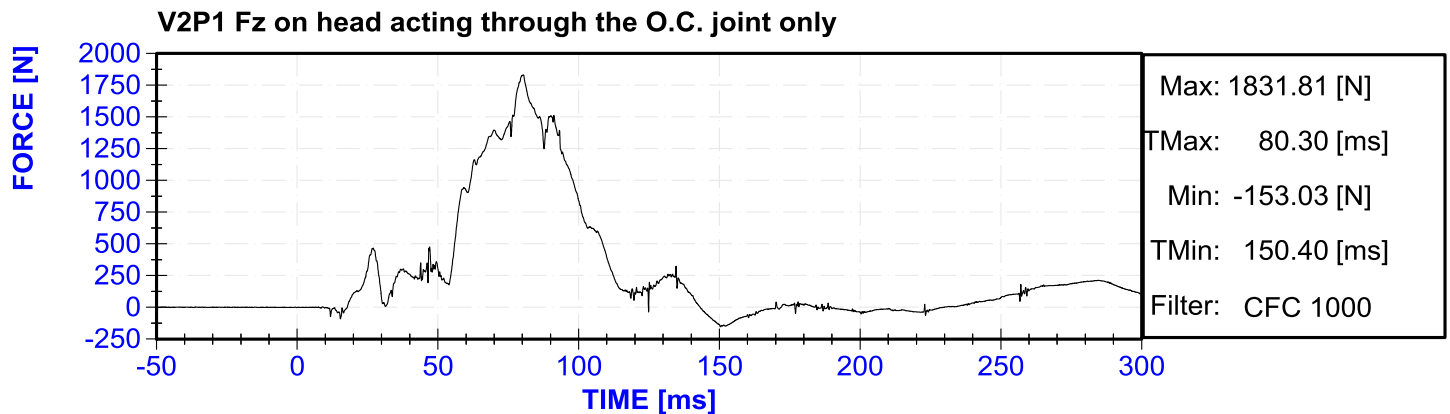
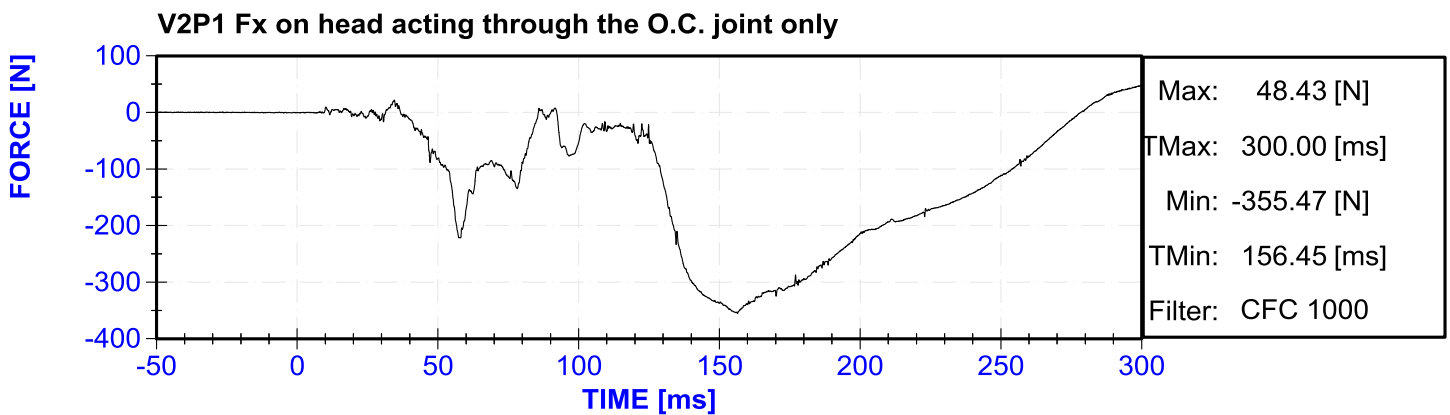
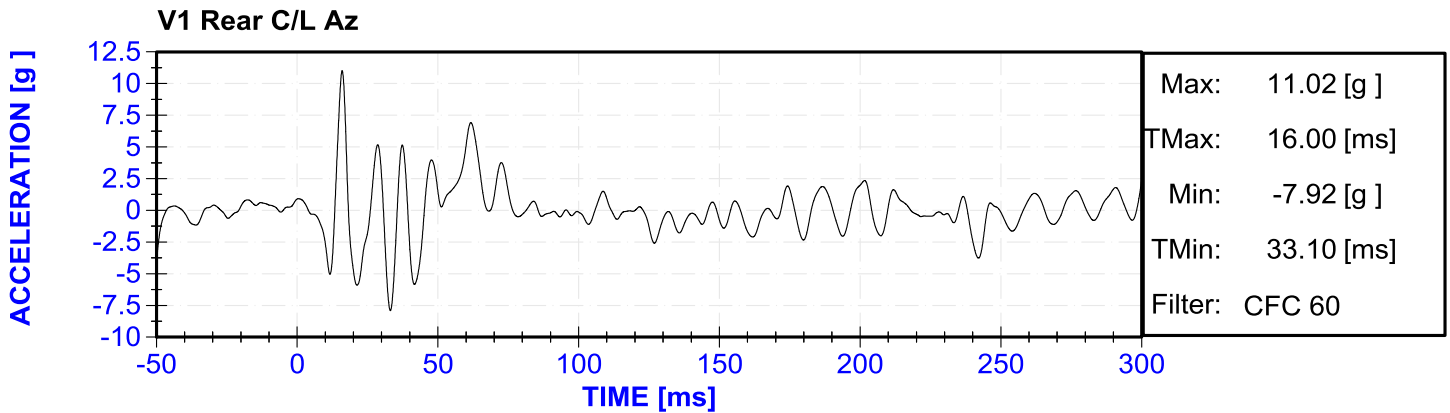
Time to fire: 16.15 ms



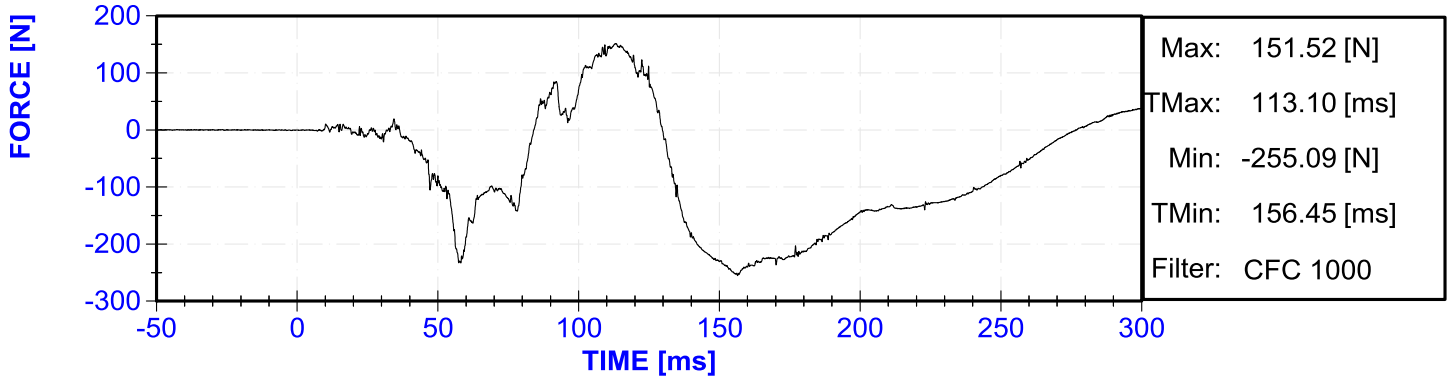
V1 CG Ax



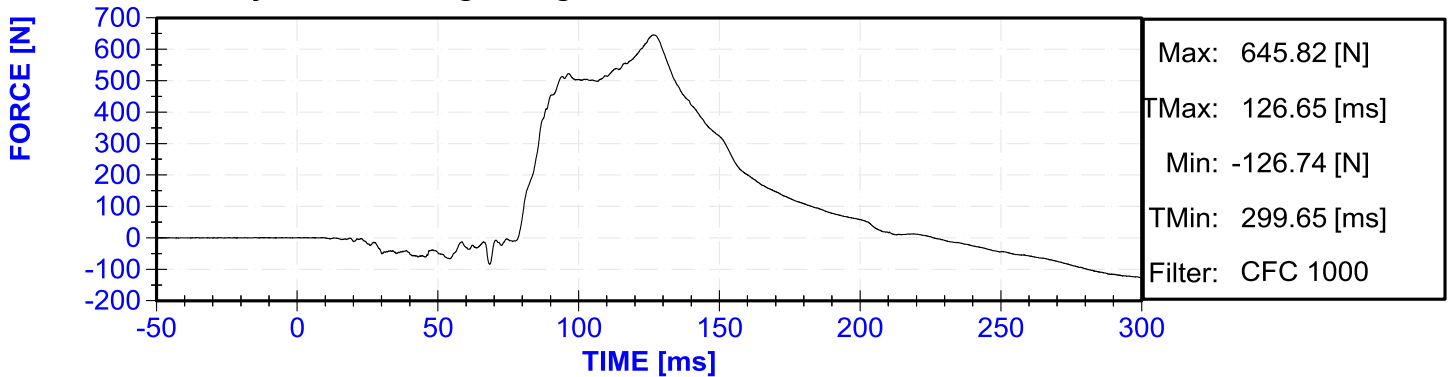




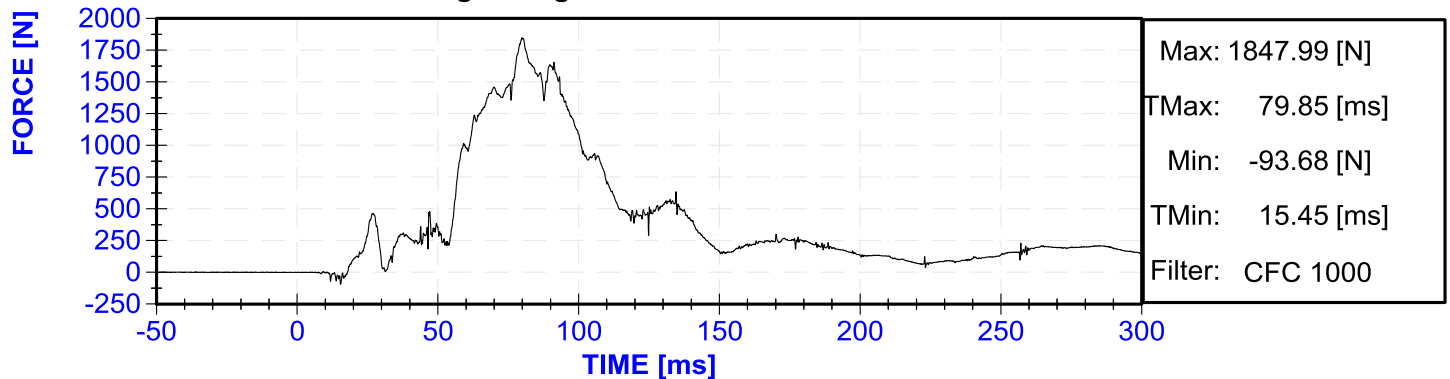
V2P1 Fx on head acting through the total neck section



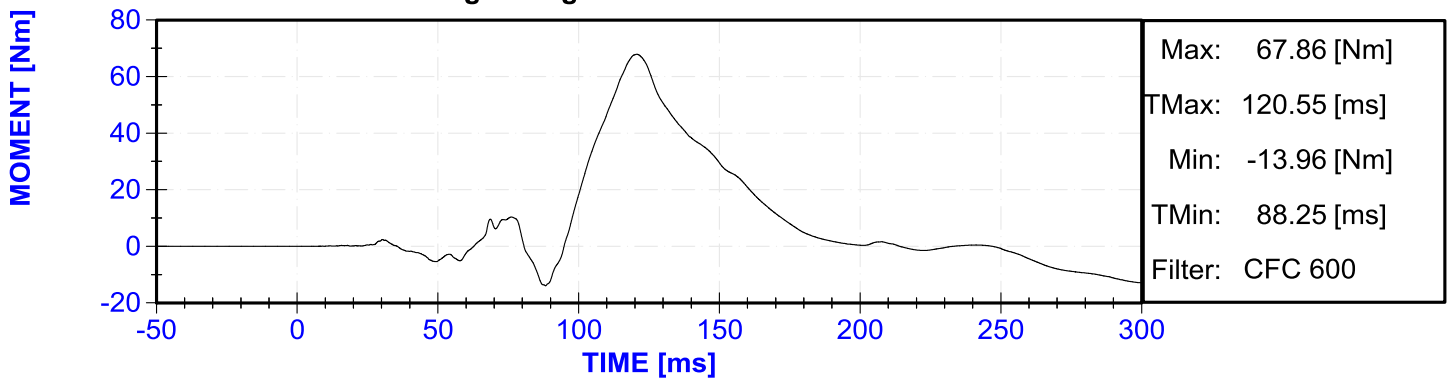
V2P1 Fy on head acting through the total neck section



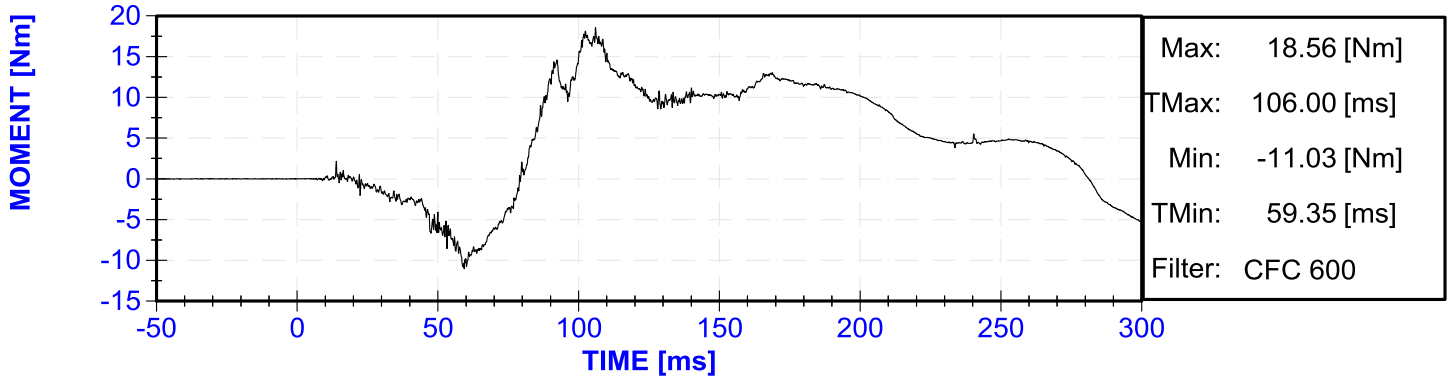
V2P1 Fz on head acting through the total neck section



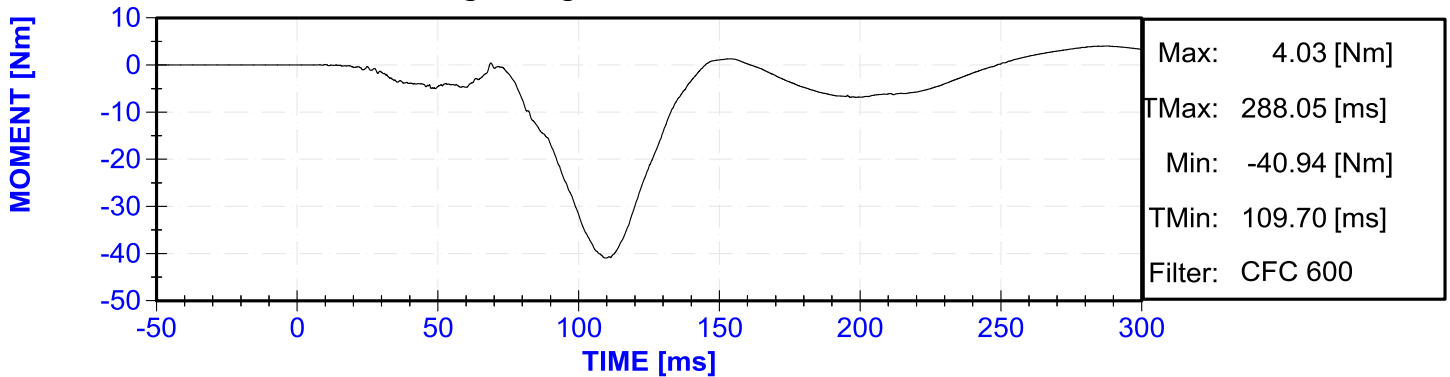
V2P1 Mx on head acting through the total neck section



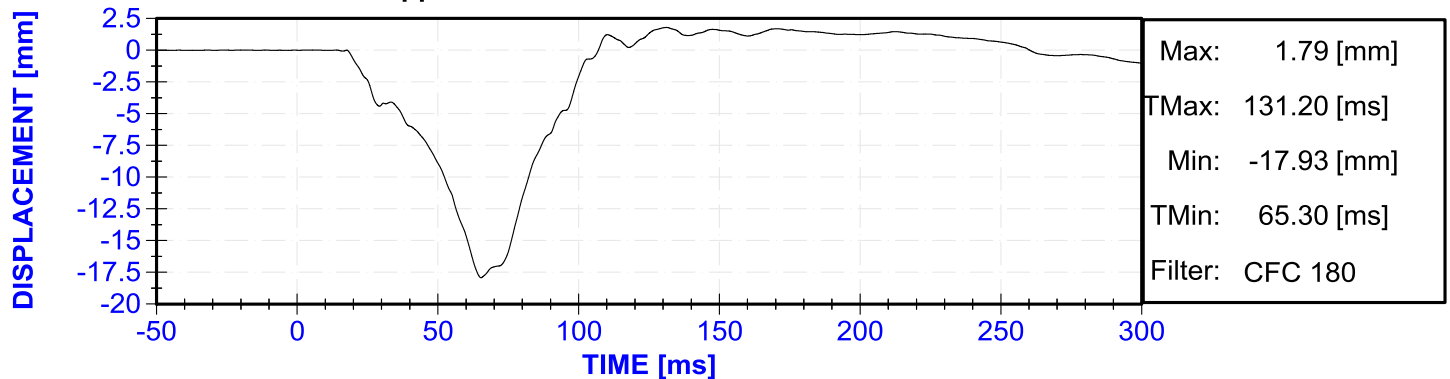
V2P1 My on head acting through the total neck section



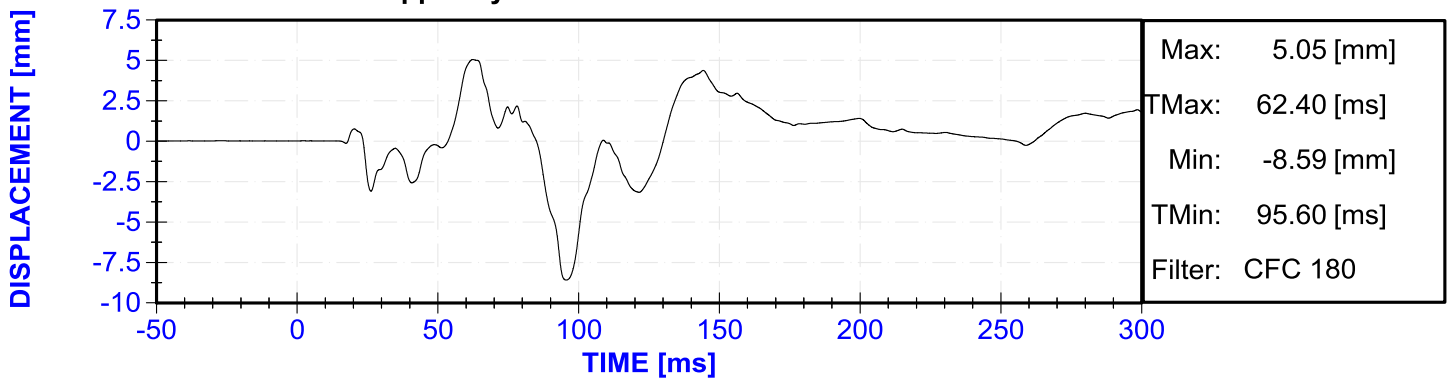
V2P1 Mz on head acting through the total neck section

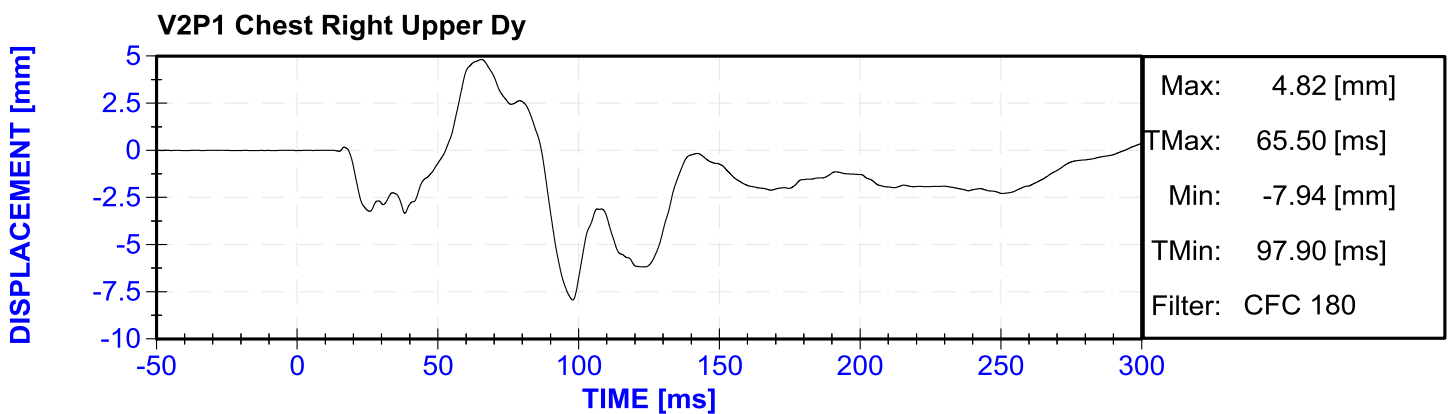
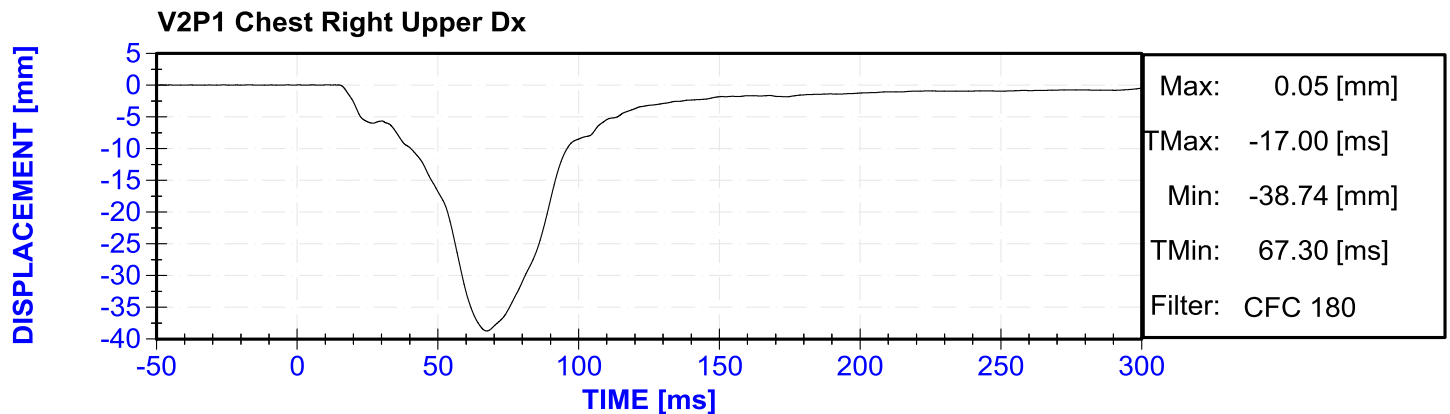
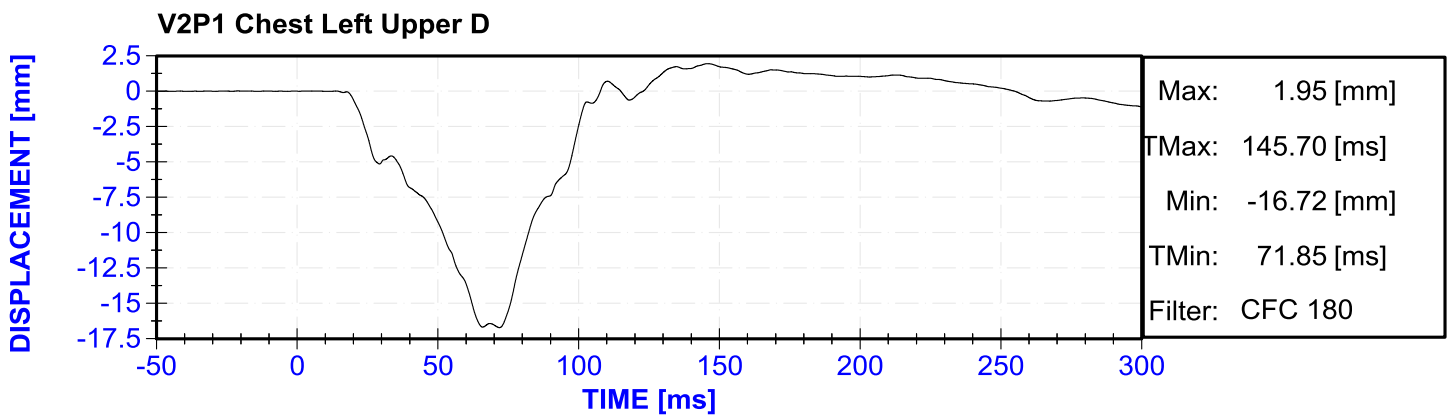
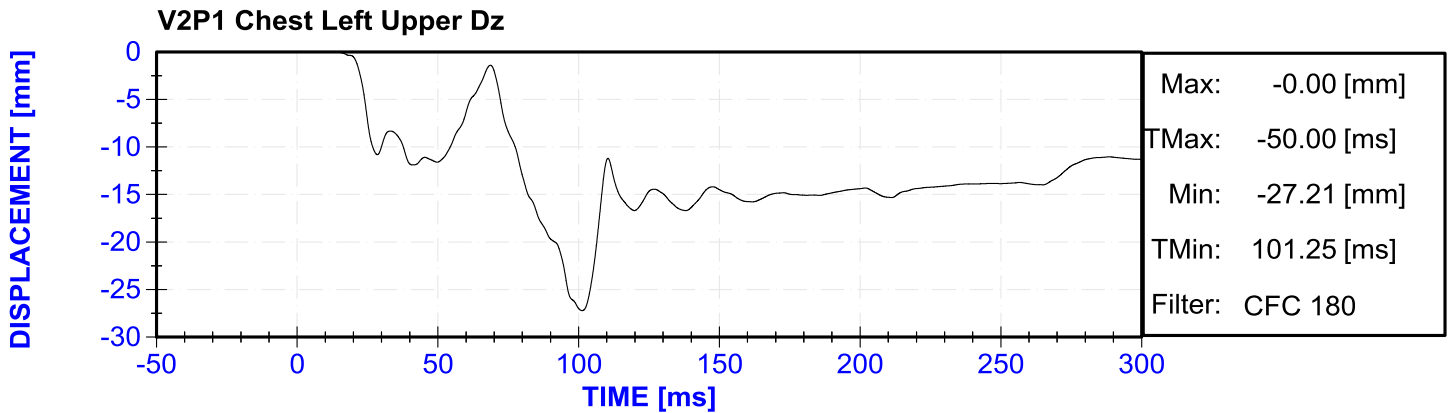


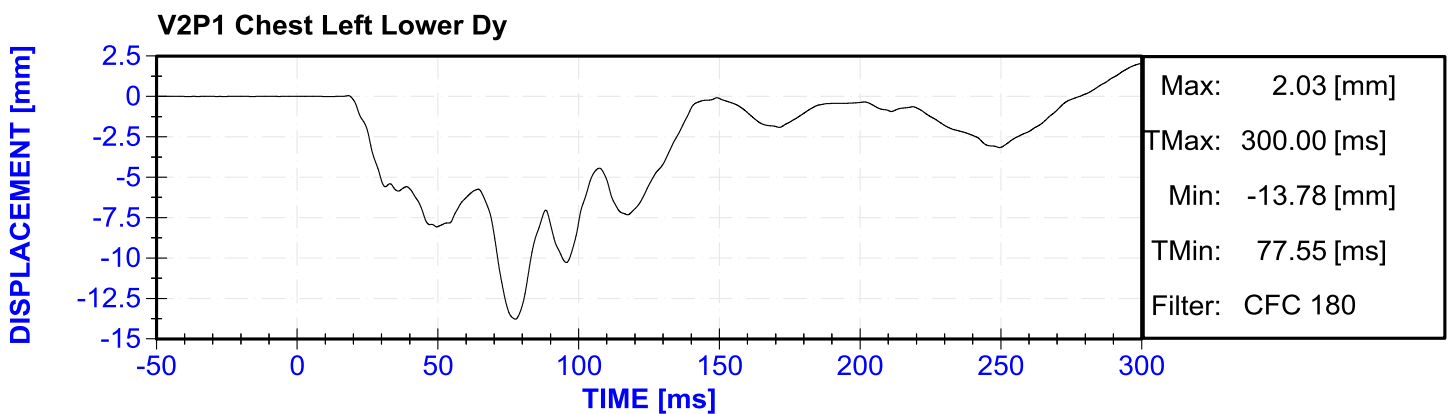
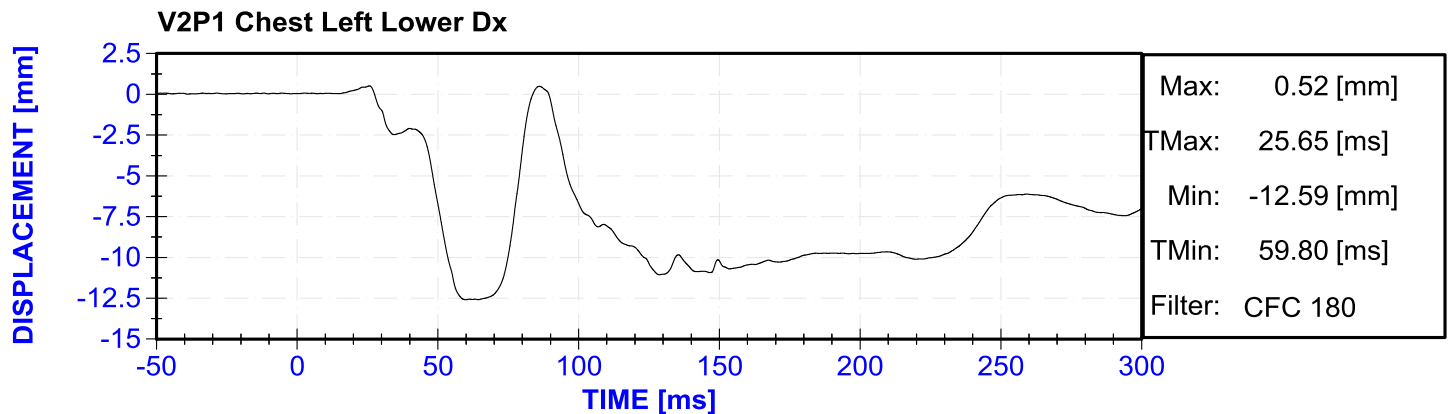
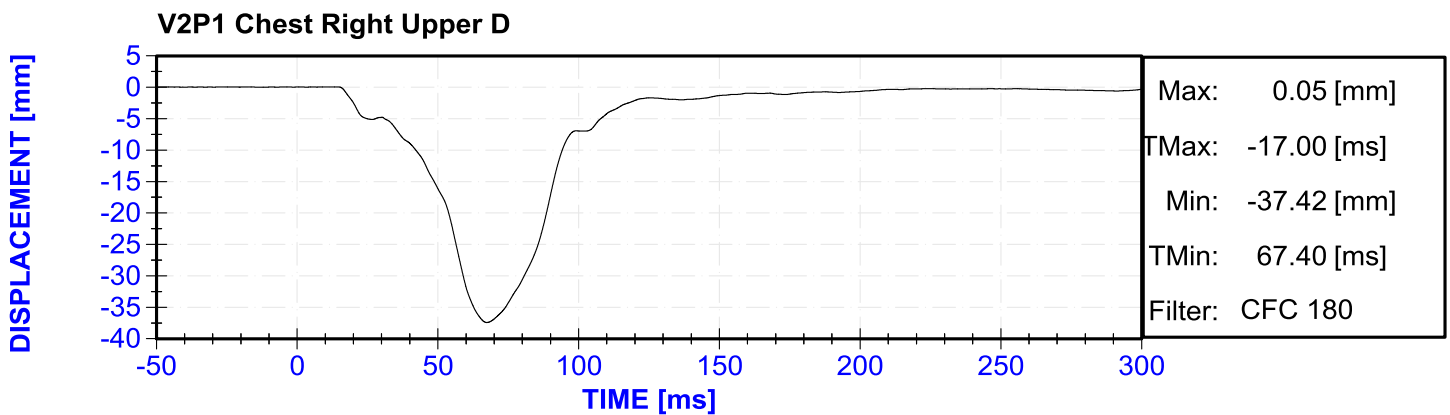
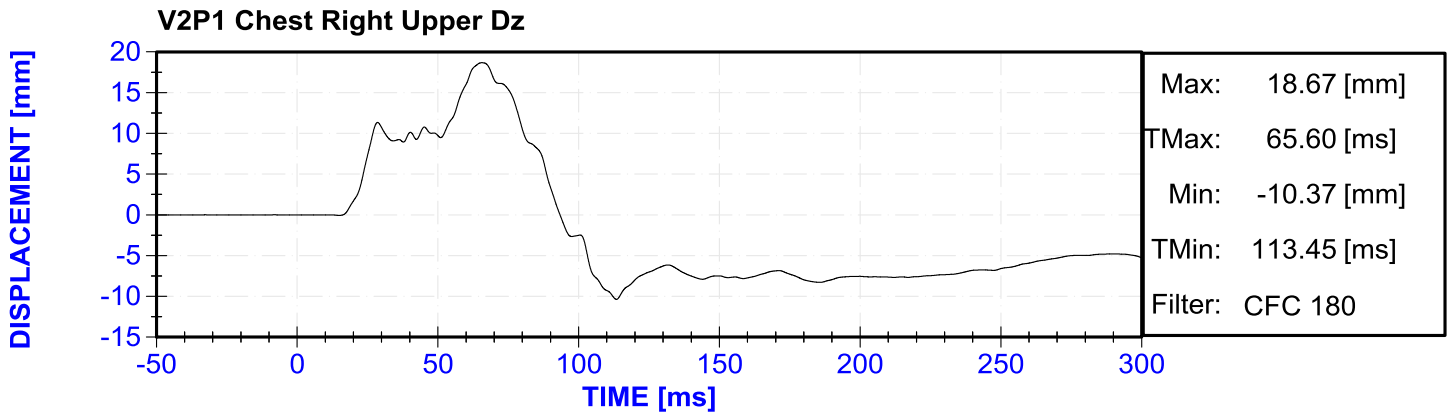
V2P1 Chest Left Upper Dx

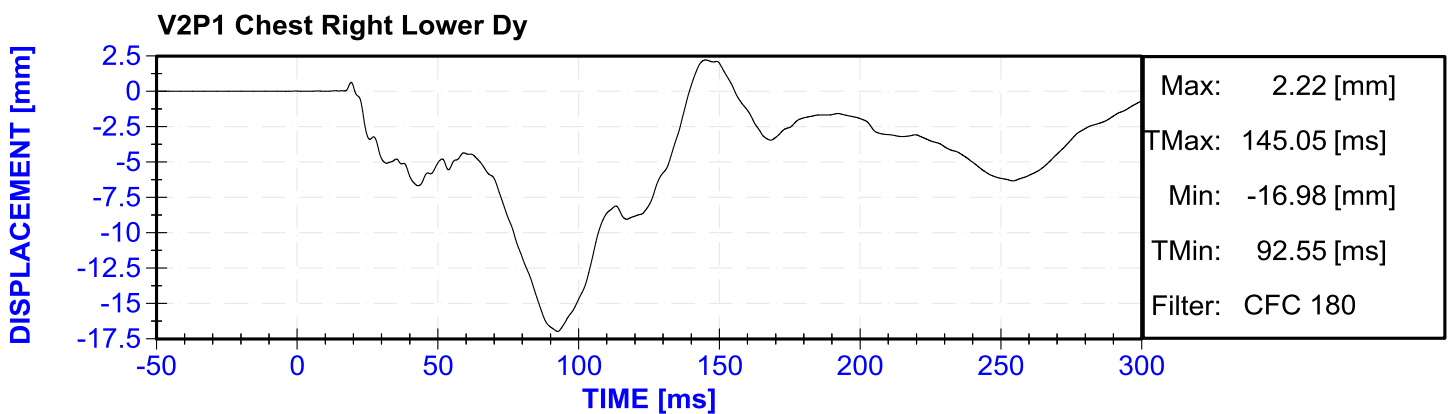
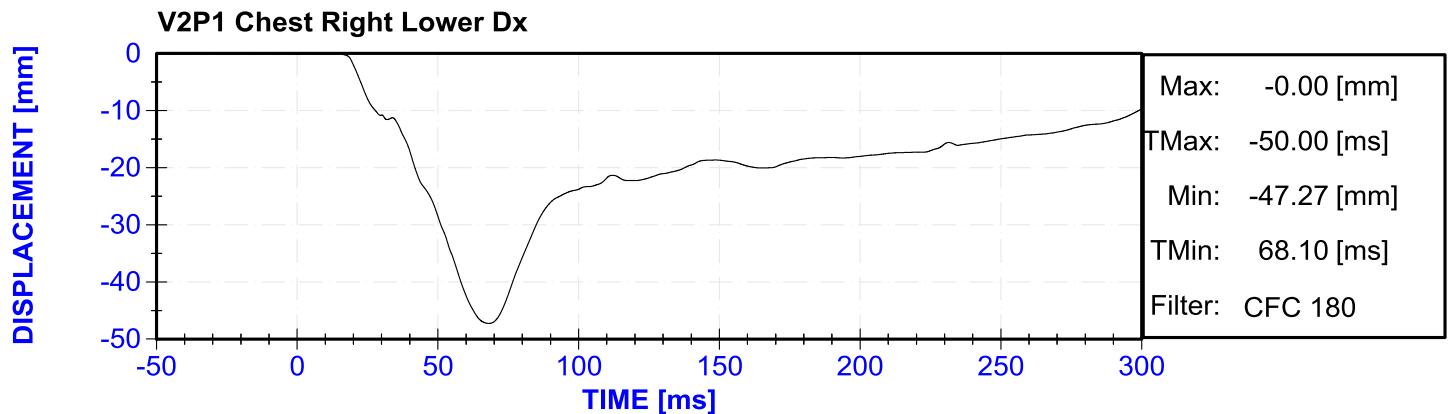
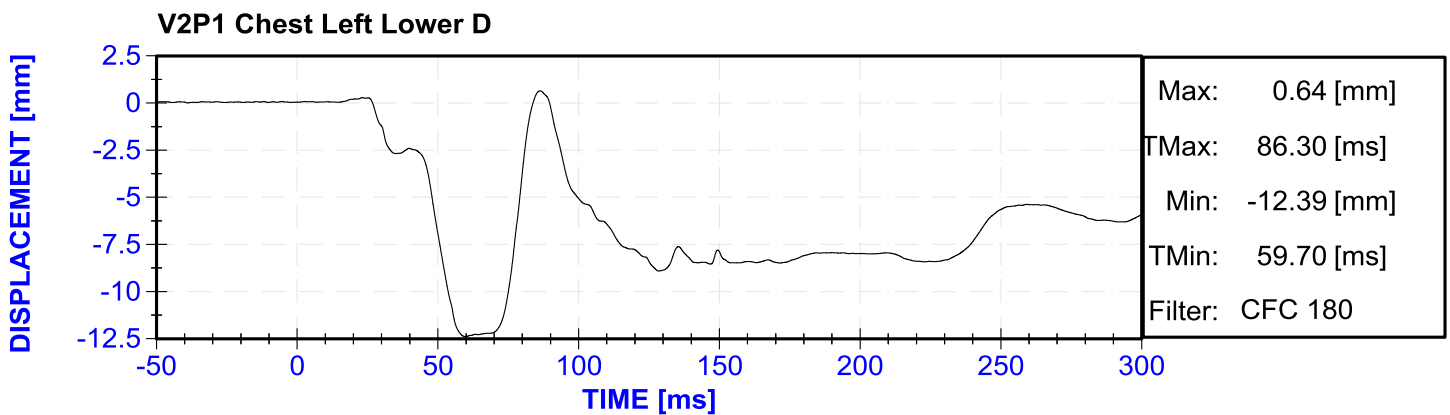
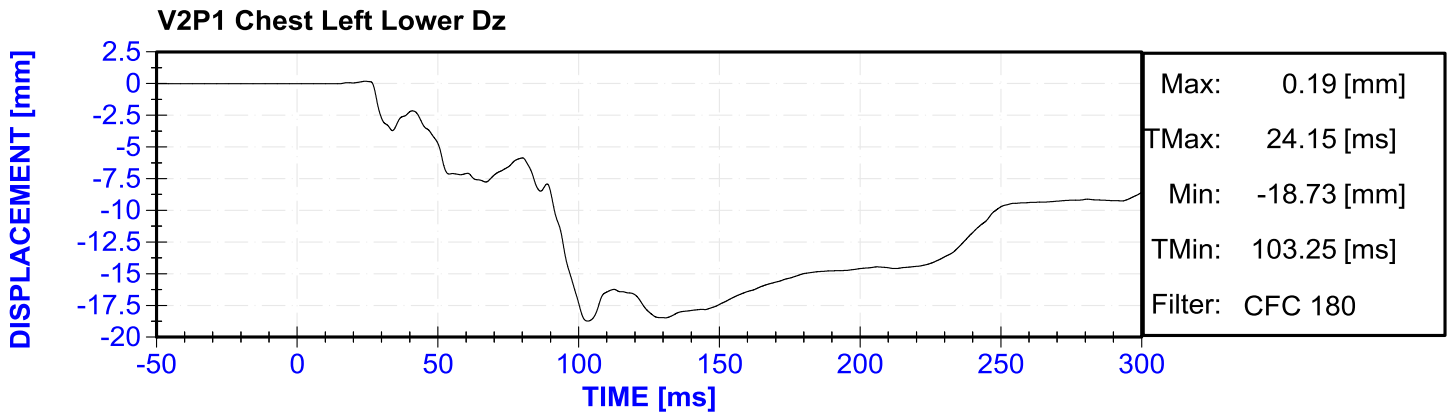


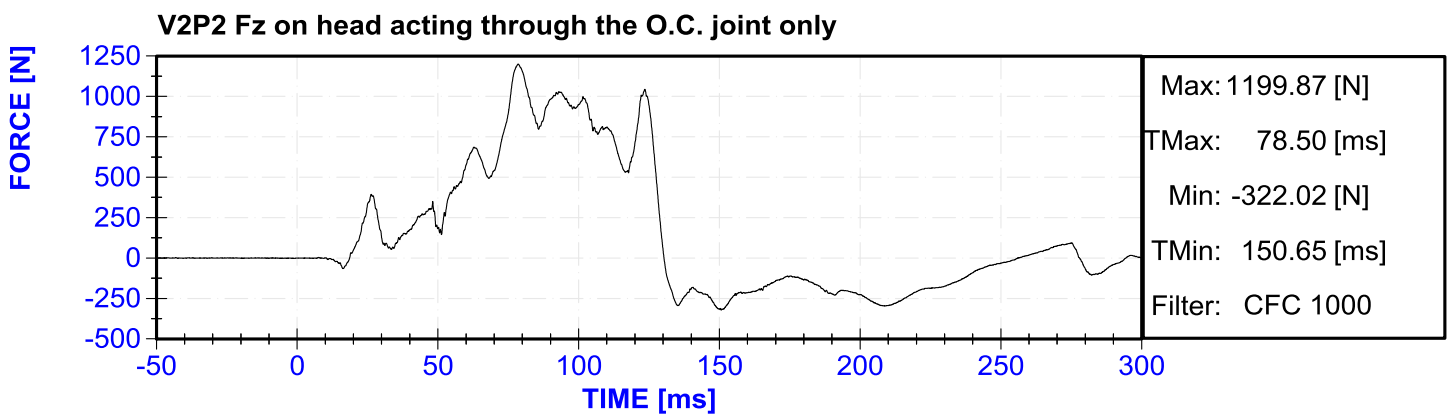
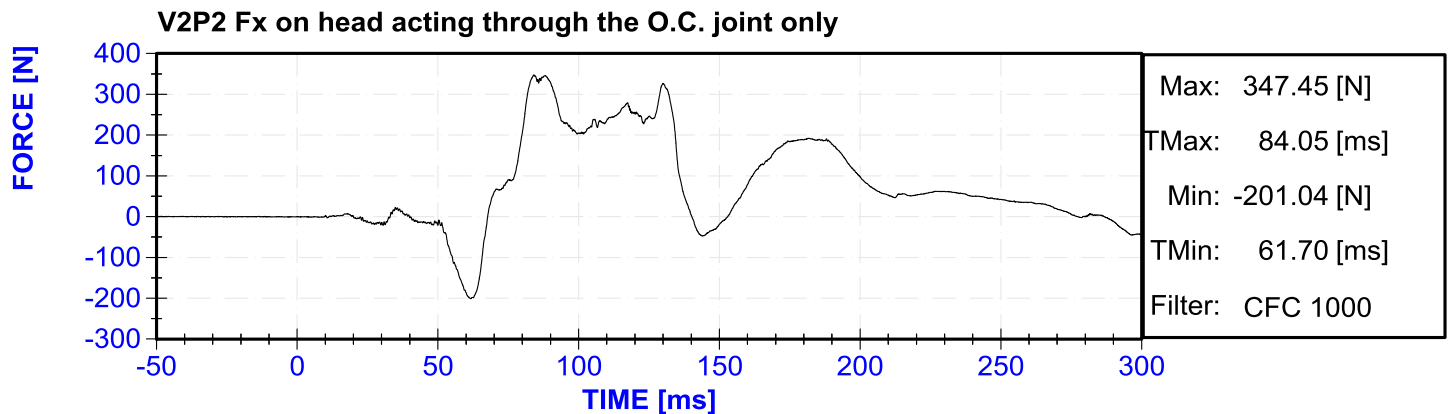
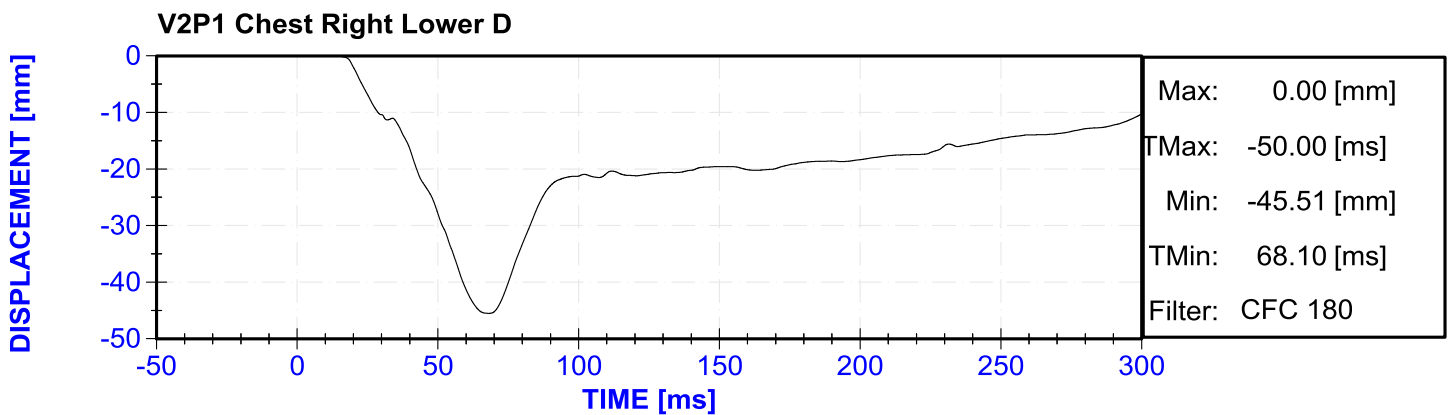
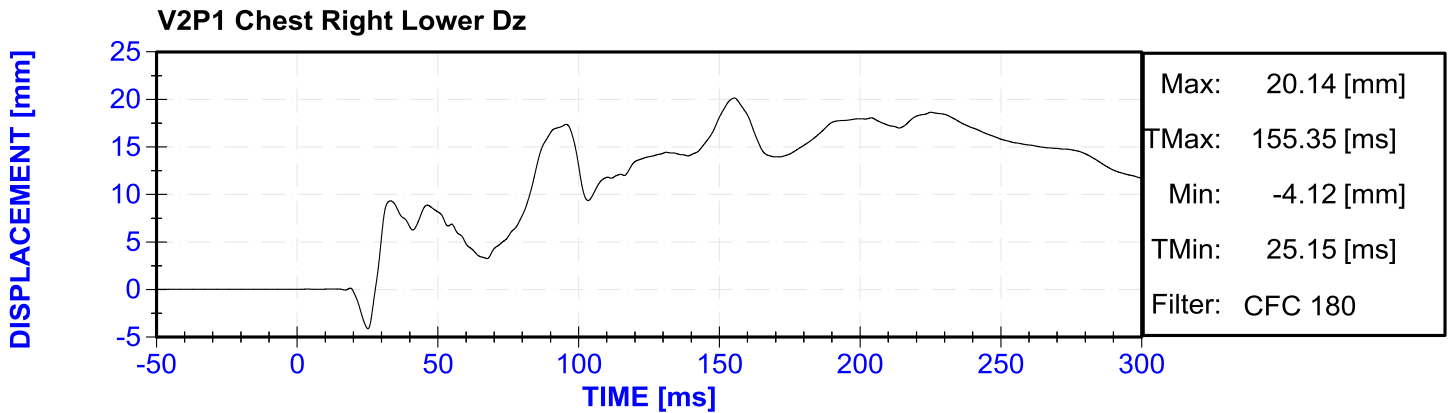
V2P1 Chest Left Upper Dy



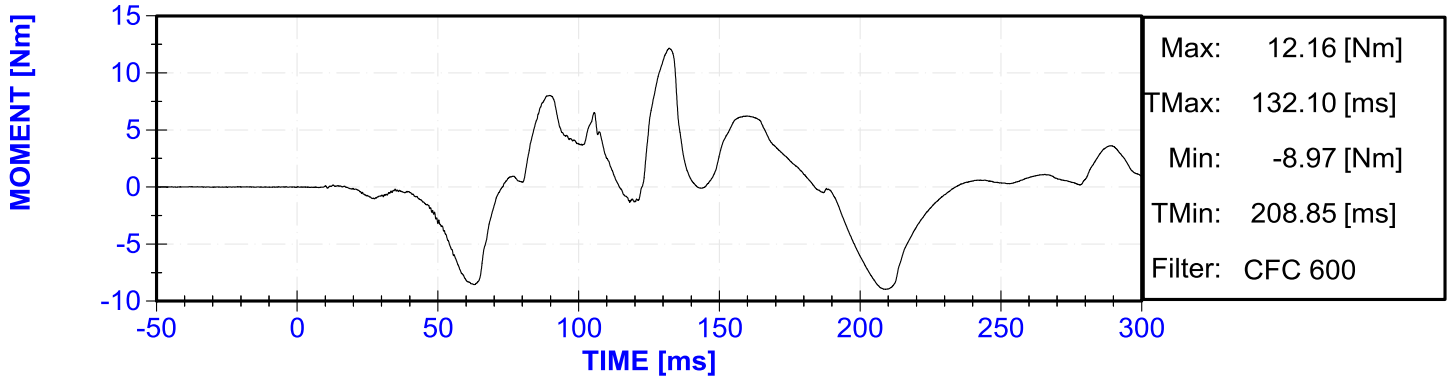




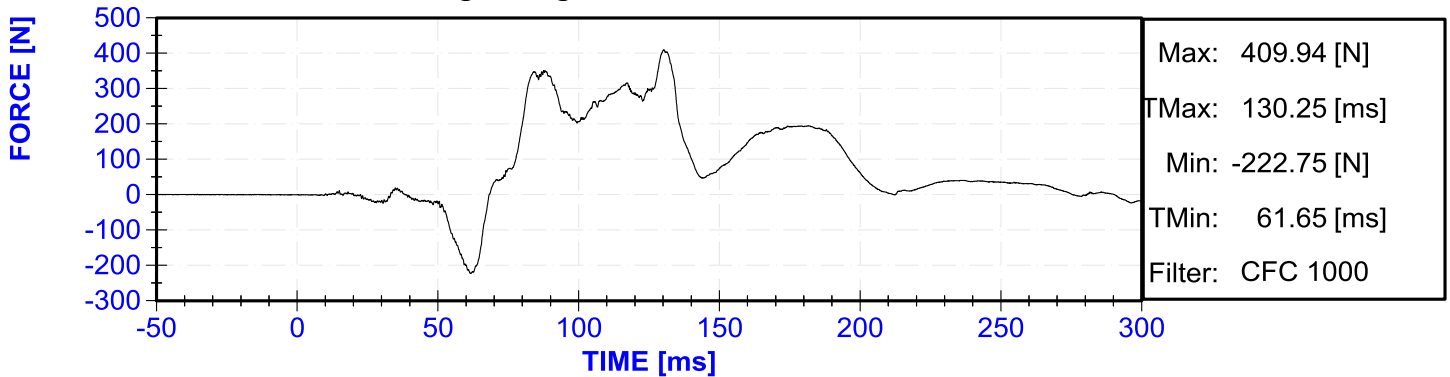




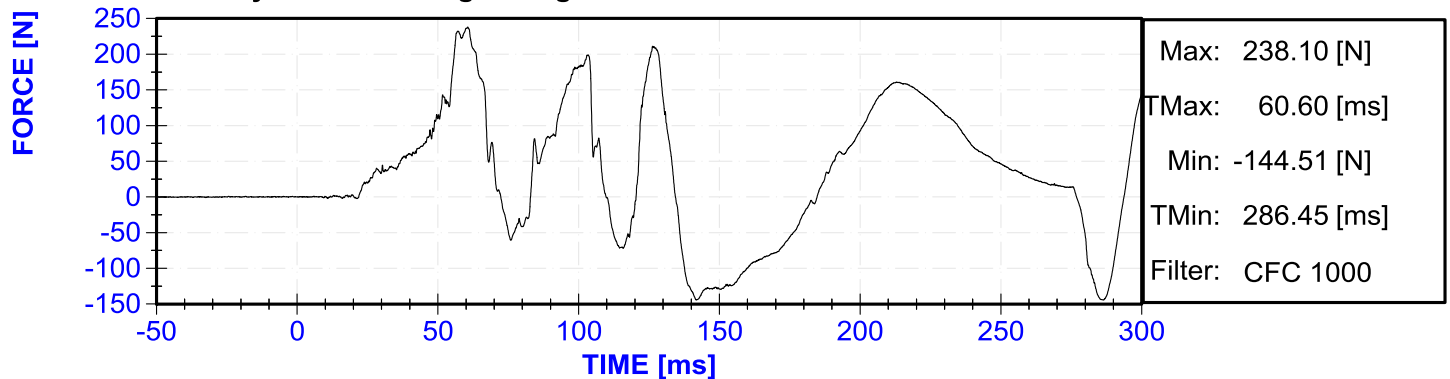
V2P2 My on head acting through the O.C. joint only



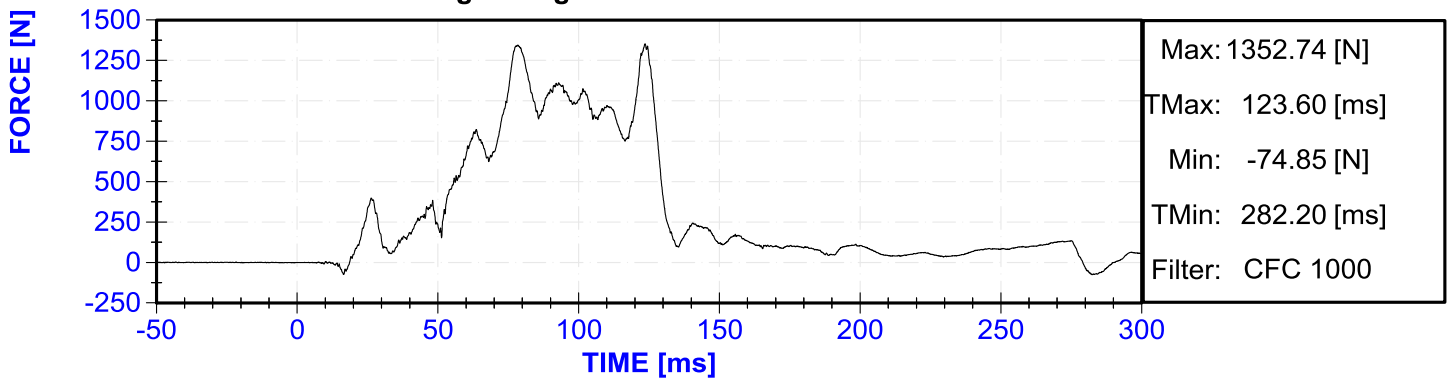
V2P2 Fx on head acting through the total neck section



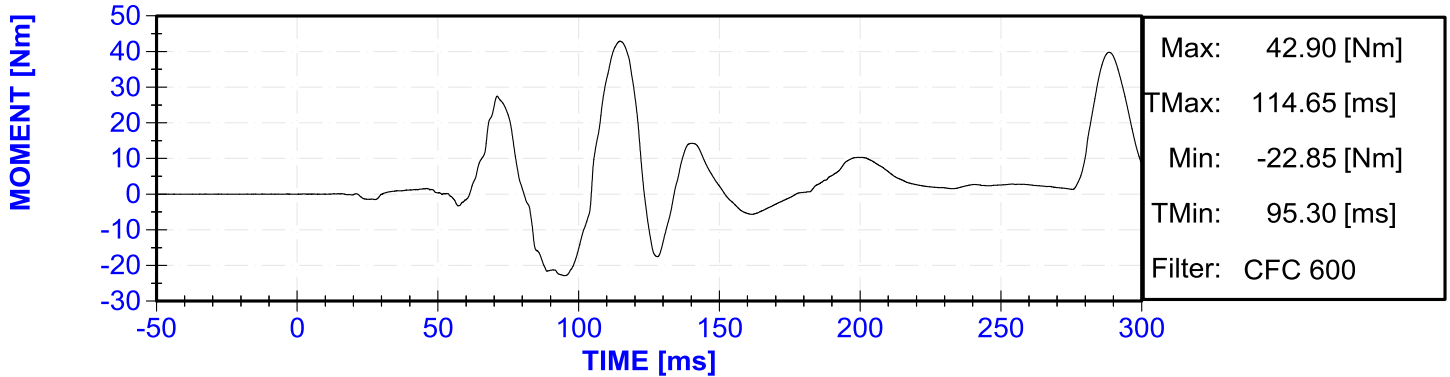
V2P2 Fy on head acting through the total neck section



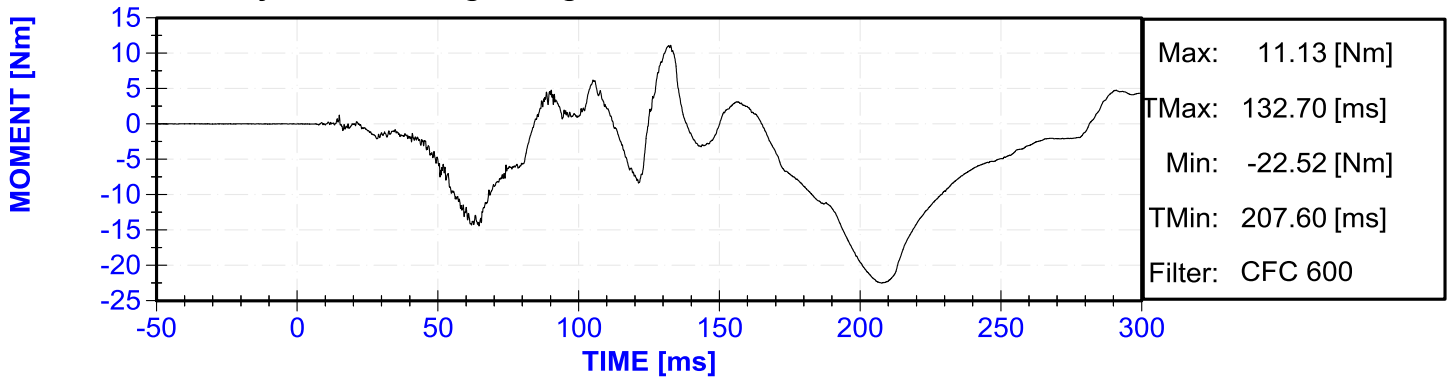
V2P2 Fz on head acting through the total neck section



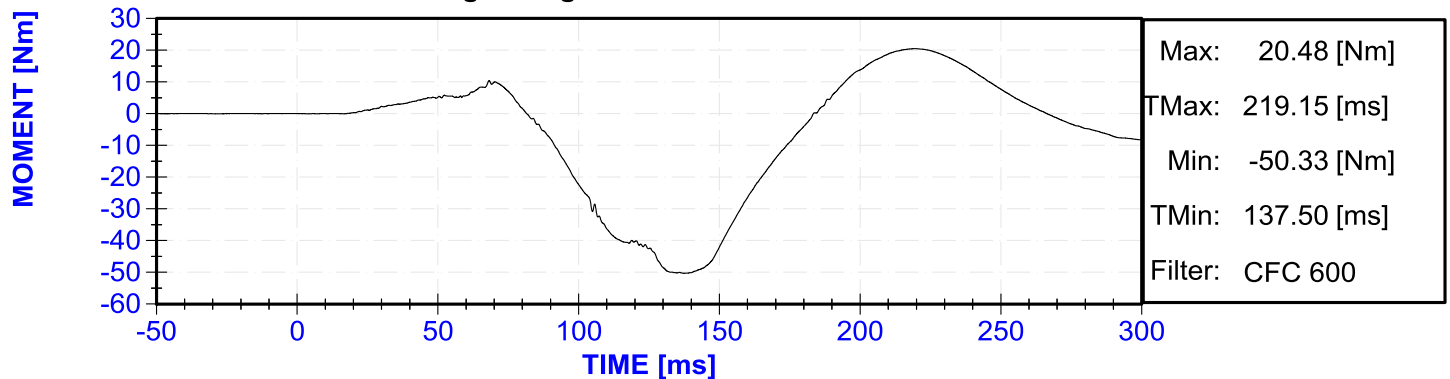
V2P2 Mx on head acting through the total neck section



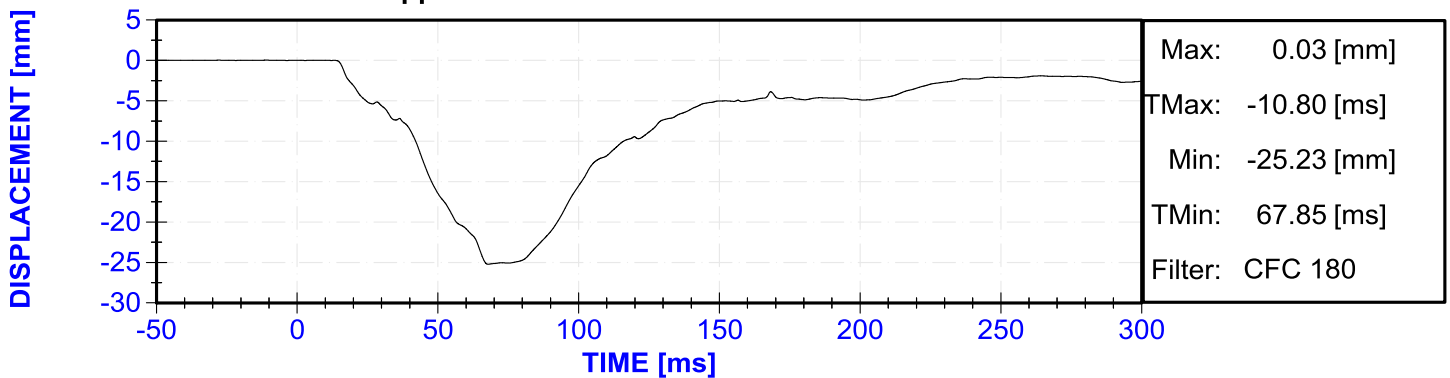
V2P2 My on head acting through the total neck section

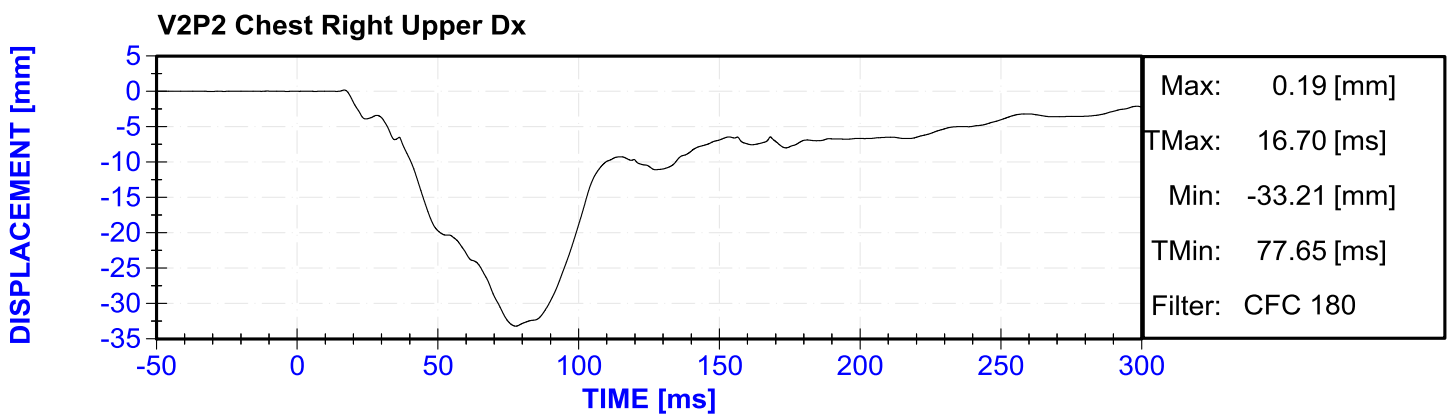
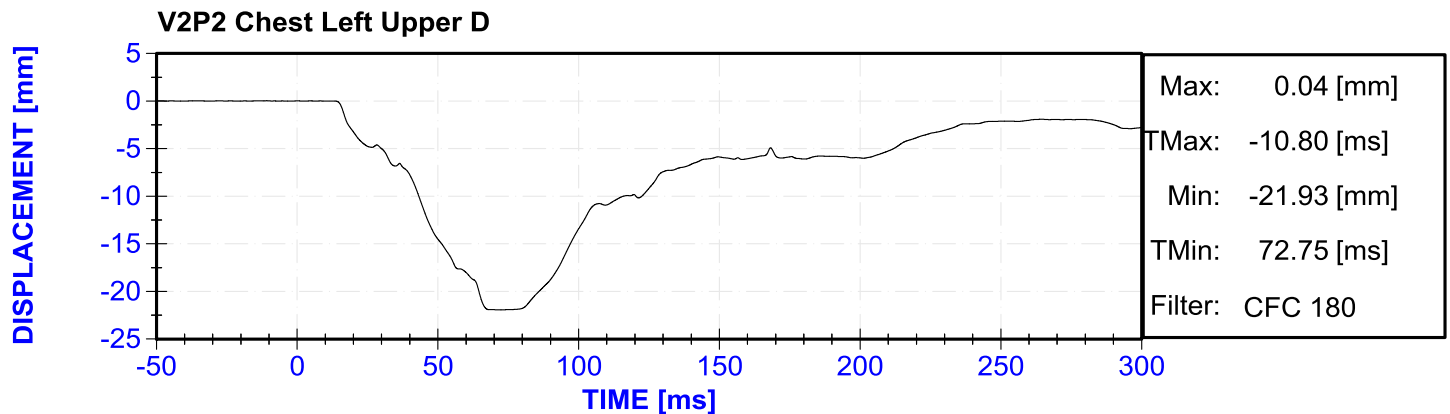
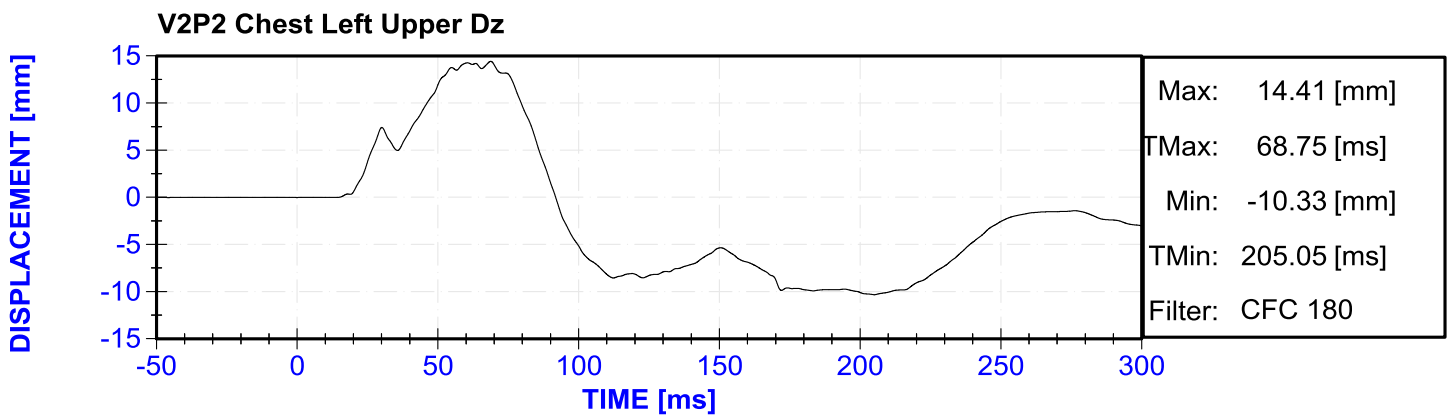
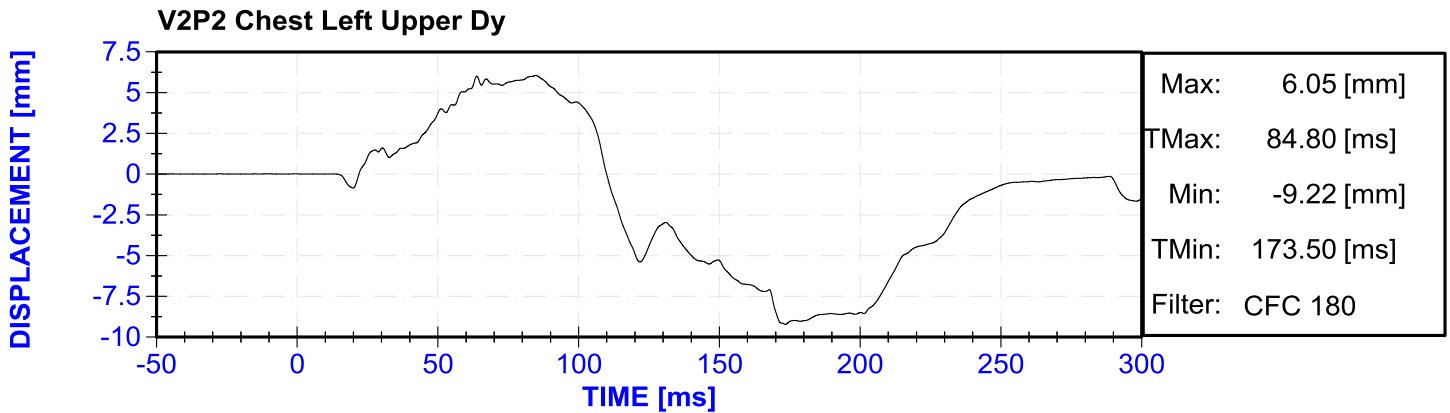


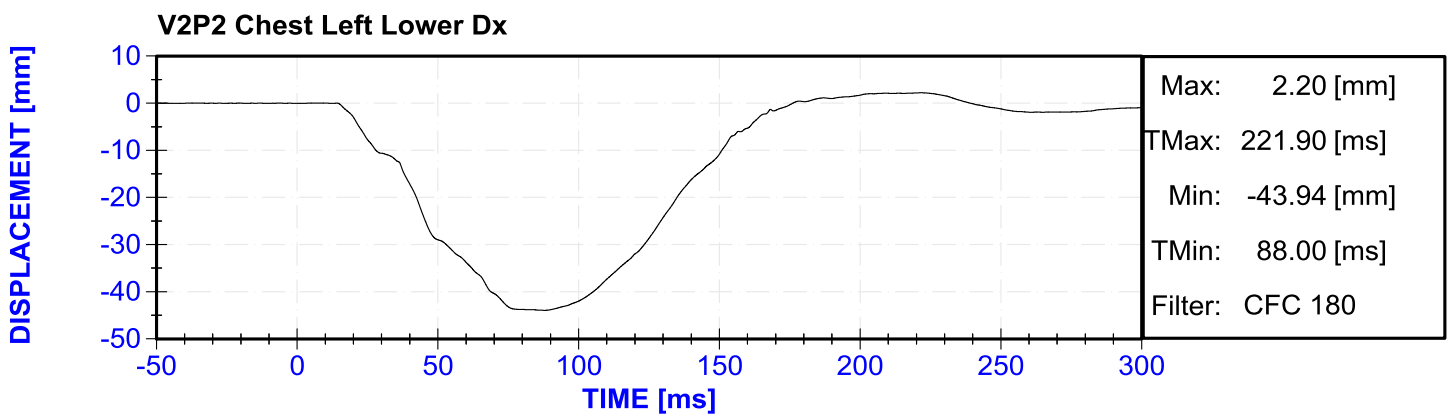
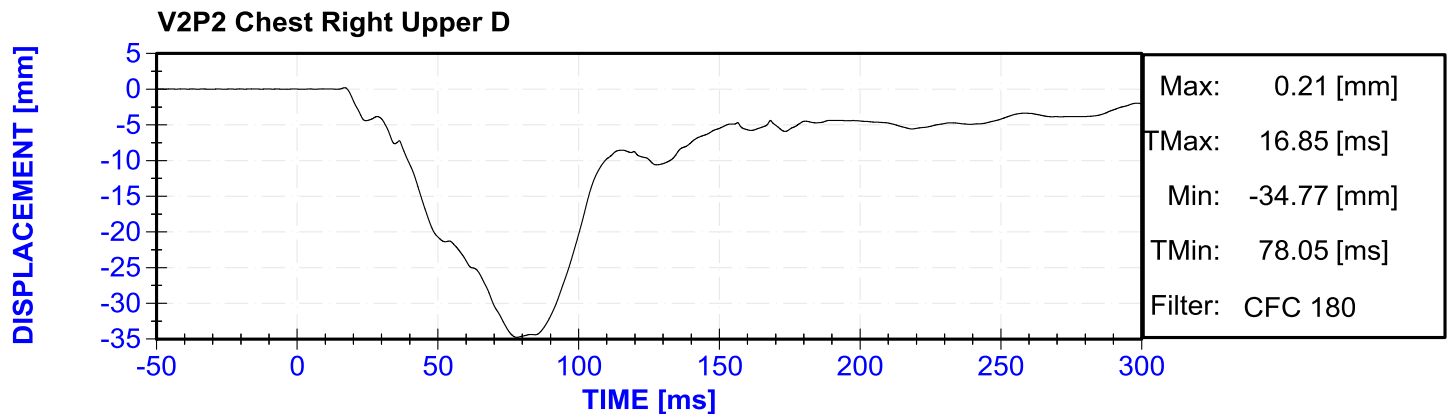
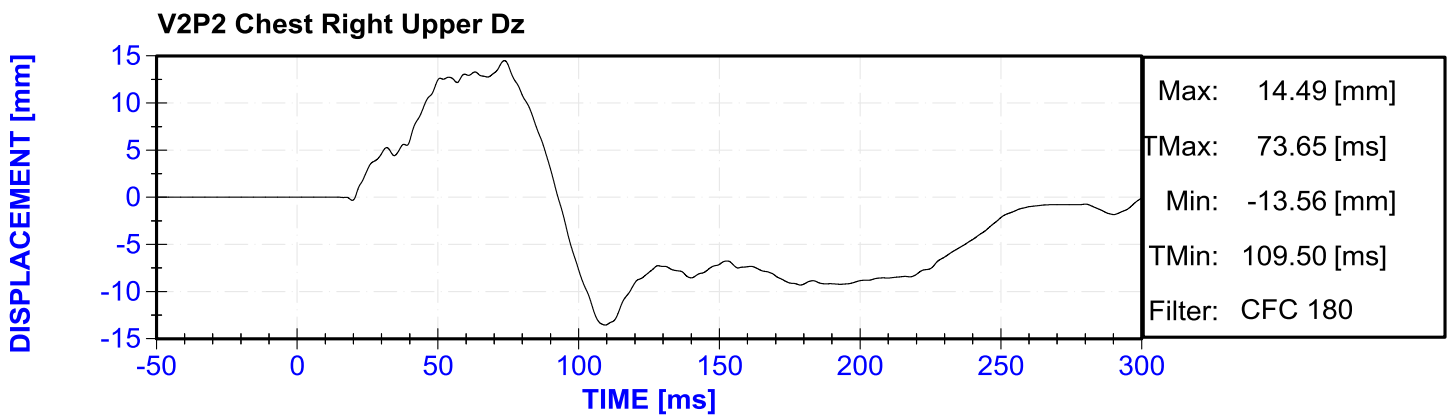
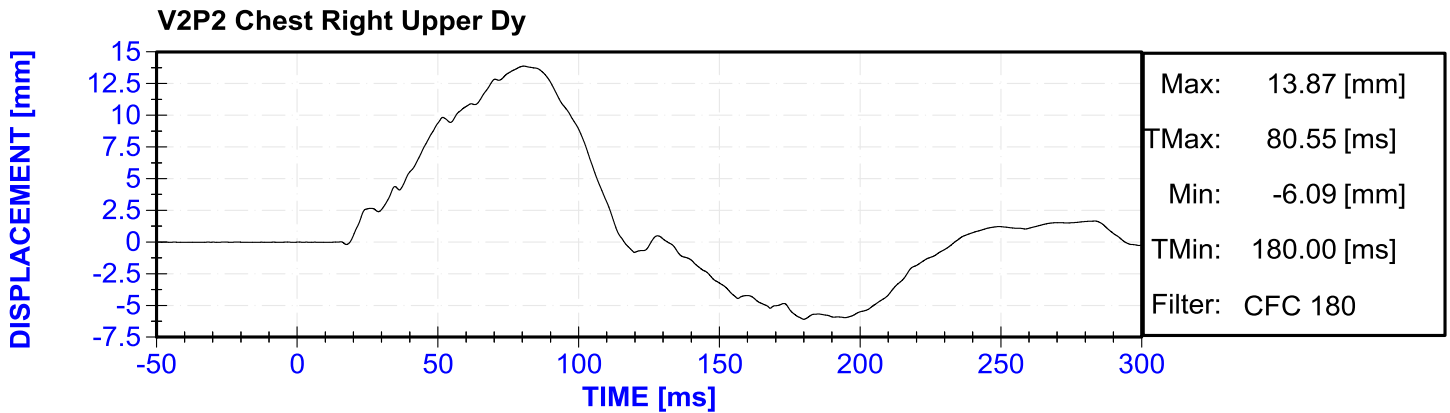
V2P2 Mz on head acting through the total neck section

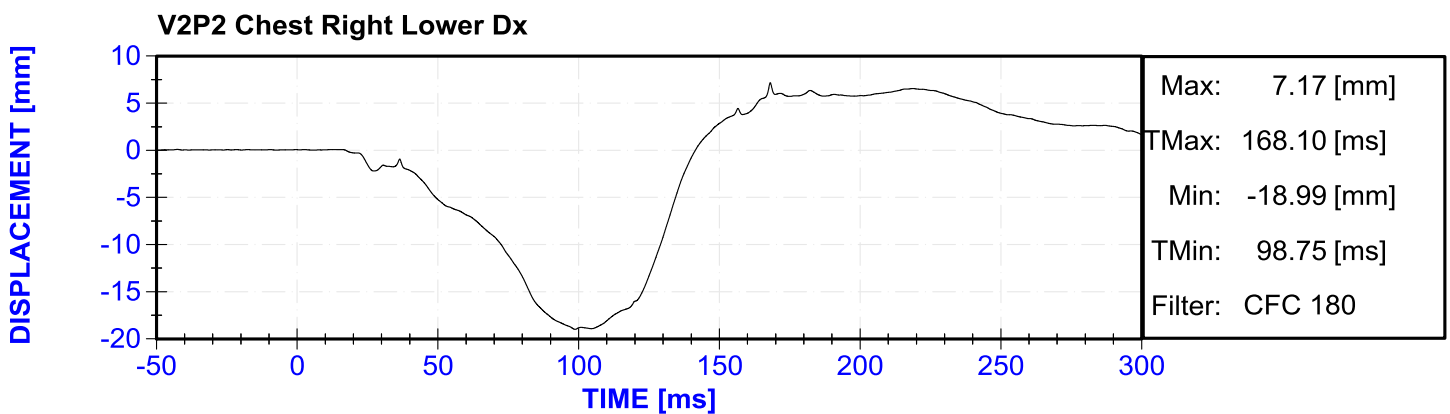
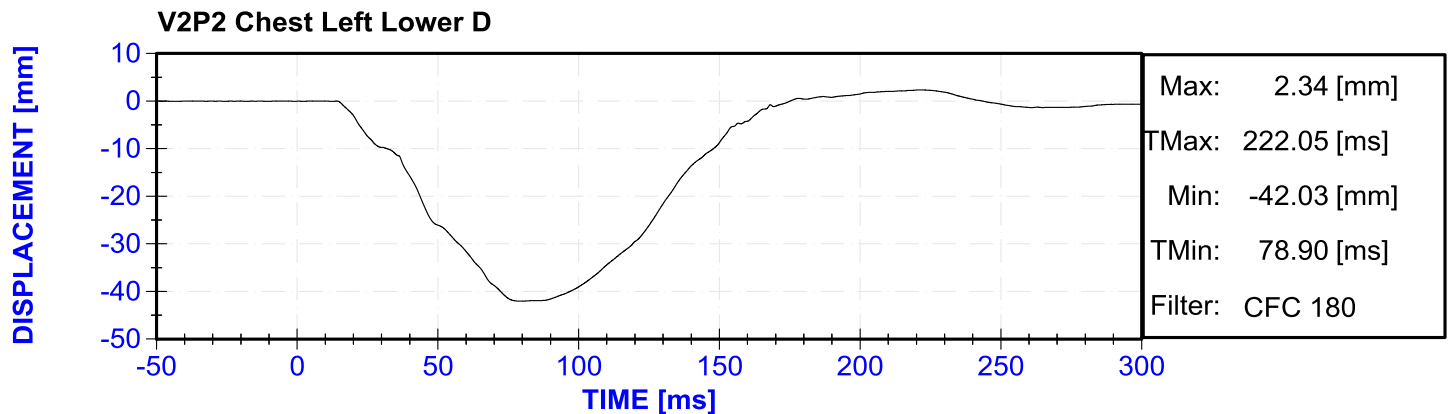
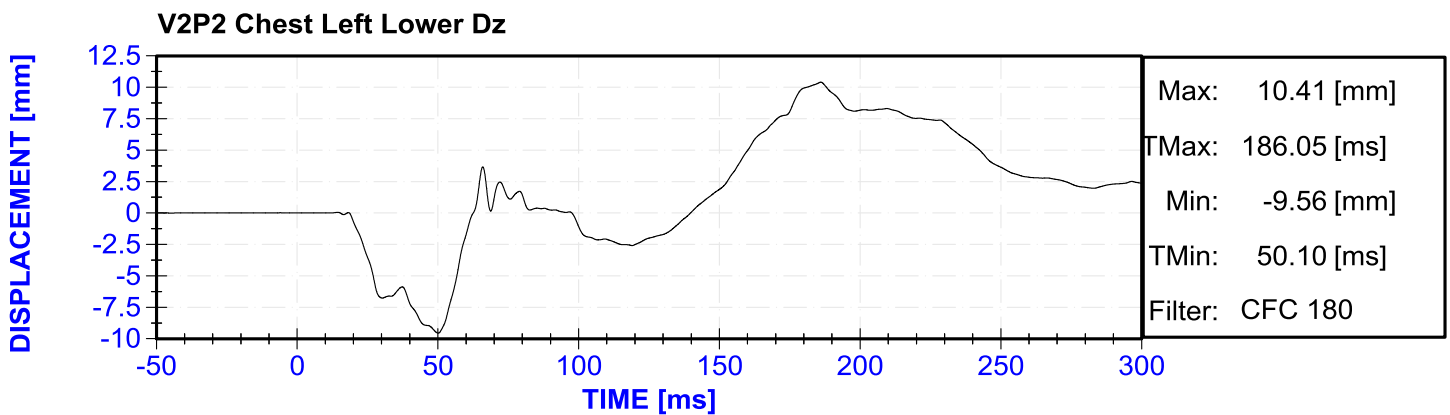
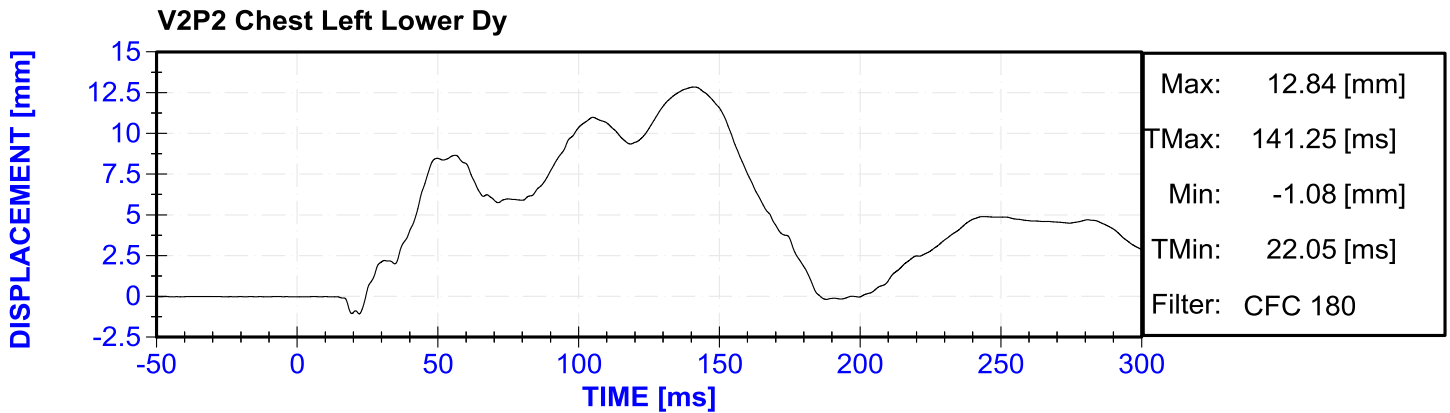


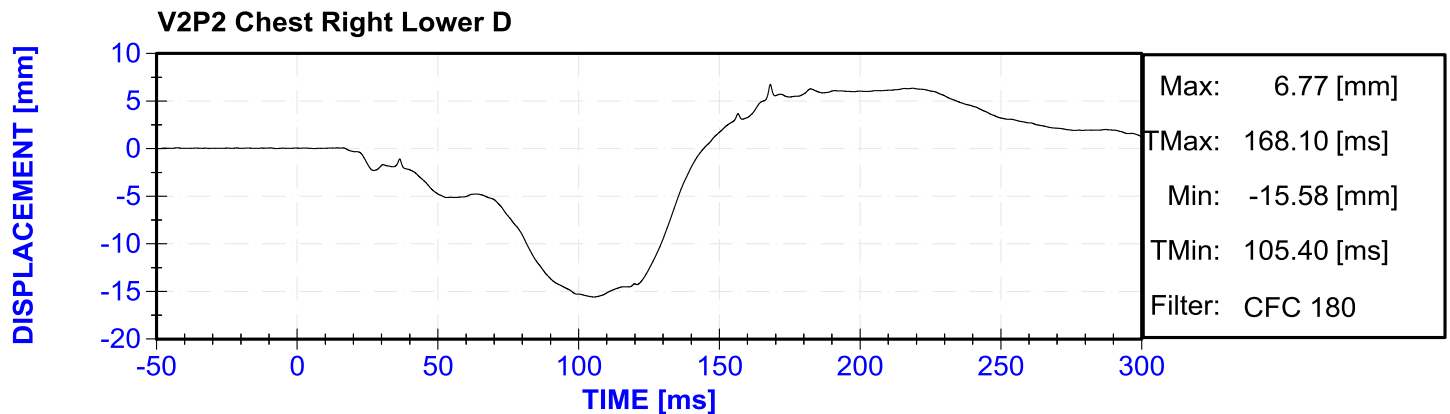
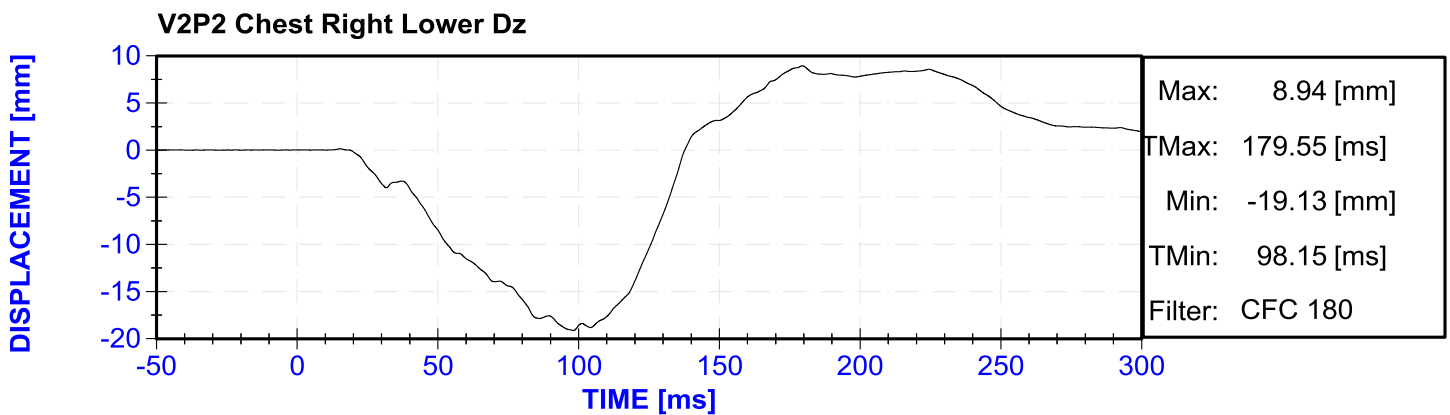
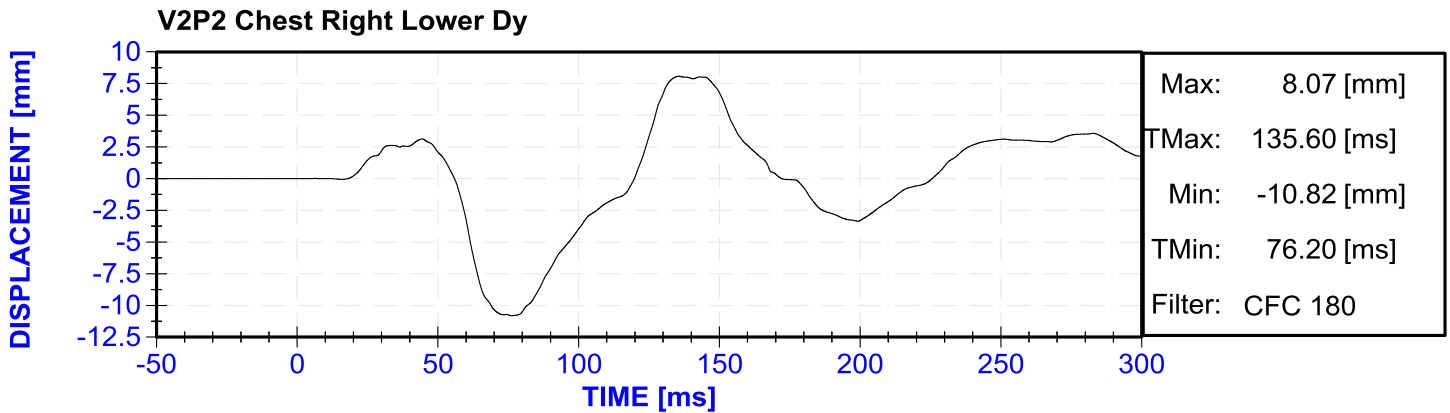
V2P2 Chest Left Upper Dx











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

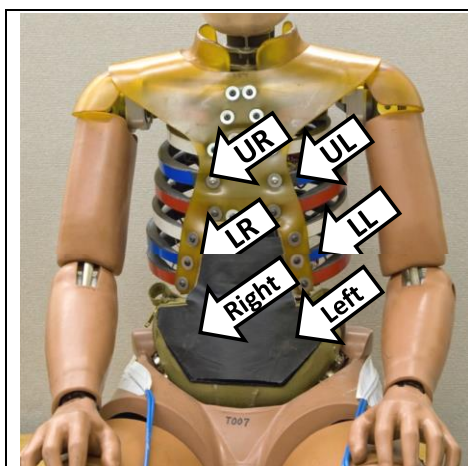


Figure 1. Manipulation to determine thoracic and abdominal IR-TRACC polarity.

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

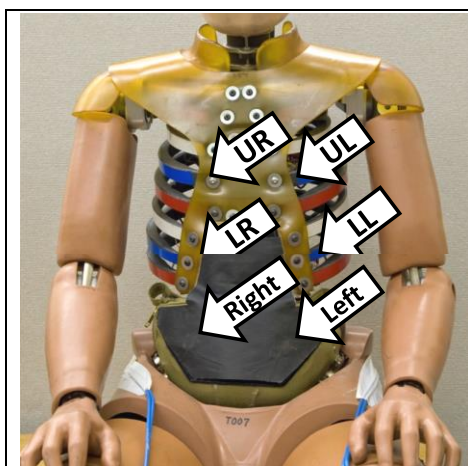


Figure 2. Manipulation to determine thoracic and abdominal IR-TRACC polarity.

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: 11/11/2013	
NHTSA Representative: James Saunders	
Inspection Reporter: Mary Geesey	
Witness(es):	
Inspection type (check one): ☒ PRE ☐ POST	
Dummy S/N: 0016	Legs S/N: LX019/LX018
Dummy Description: Thor NT 50th Male	
Date of last Certification or Inspection: 10/31/2013	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last certification:</u> RD0332 Dodge Dart RD5371 Honda Civic RE5507 Subaru Forester RD5910 Volvo XC60	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> - None	
<u>Physical evidence of damage:</u> See Report – Arm Tears, Pelvis Tears, Leg Tears	
<u>Anecdotal evidence of damage:</u> N/A	
<u>Equipment delivered to Borrower:</u> Thor 16 ATD 26 Accelerometers 3 Angular Rate Sensors 2 Skull Spring LC 1 Condyle Pot 1 Upper Neck LC 1 Lower 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 Font

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	Small tear in the insulation 

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 If N – indicate which interface (where plate/puck 1 attach to upper neck load cell):
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	

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

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
OTHER	 Tear to the left wrist area

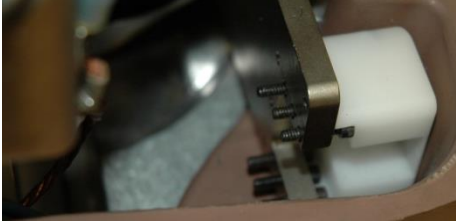
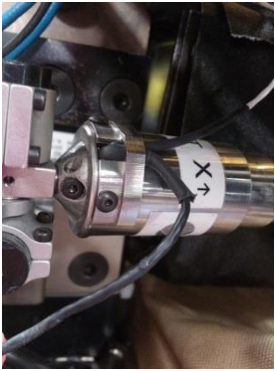


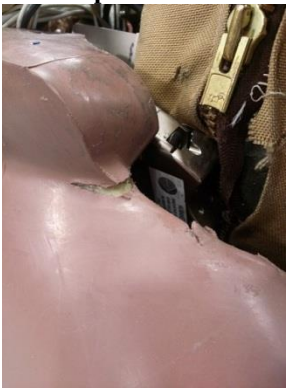
Inside left had has cuts

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 gimballs, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration  Bib has torn in the center of sternum
Y / N	Ribs securely attached to posterior spine
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)

OTHER	 Lower Neck LC Cable has been repaired where it passes through the upper rear spine box.  T6 X Accelerometer missing insulation at transducer. Electrical tape covers this.
ABDOMEN	
Y / N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper  Upper abdomen came held together with black tape
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  Abdomen bag has many broken stitches forming, but no tears occurring.  Both sides of the Abdomen Bag have torn where the stitches had broke

Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
Other	 Both lower abdomen IRTracc screws are inserted, but the IRTraccs are not installed.  Wire seems to have been pinched

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	 Rear of pelvis has torn flesh  Tears have formed to the front of the pelvis  Tears in the pelvis have gotten worse

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
Other	
LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached -Left ankle Y pot has intermittent failure in cable close to amp connector. –Repaired by cutting back cable and reinstalling on connector.
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 Numerous minor cuts  Zipper on right ankle is pulling away from the flesh – This became much worse during the RE5507 test. (See second photo)   Right knee has some nicks in the flesh

Other	 Damage to the metal of the right ankle
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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 tears around neck and at most seam ends as seen here on the front left shoulder.
OTHER	 Lifting strap torn

THOR Inspection Checklist

Date: 11/11/2013	
NHTSA Representative: James Saunders	
Inspection Reporter: Mary Geesey	
Witness(es):	
Inspection type (check one): ☐ PRE ☒ POST	
Dummy S/N: 0016	Legs S/N: LX019/LX018
Dummy Description: Thor NT 50th Male	
Date of last Certification or Inspection: 10/31/2013	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last inspection:</u> RD5910 Volvo XC60 <u>Since last certification:</u> RD0332 Dodge Dart RD5371 Honda Civic RE5507 Subaru Forester RD5910 Volvo XC60	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> - Pelvis X Acceleration – Questionable spike at 110ms. – Inspected physical and electrical aspects with no trouble arising during data live-view.	
<u>Physical evidence of damage:</u> See Report – Arm Tears, Pelvis Tears, Leg Tears	
<u>Anecdotal evidence of damage:</u> N/A	
<u>Equipment delivered to Borrower:</u> Thor 16 ATD 26 Accelerometers 3 Angular Rate Sensors 2 Skull Spring LC 1 Condyle Pot 1 Upper Neck LC 1 Lower 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 Font

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	Small tear in the insulation 

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 If N – indicate which interface (where plate/puck 1 attach to upper neck load cell):
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	

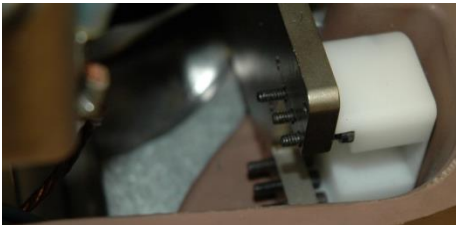
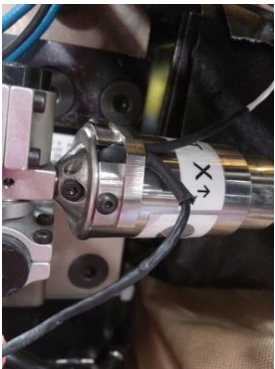
SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates  Debonding has occurred at bottom of thoracic spine rubber
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates  Debonding has occurred at bottom of lumbar spine rubber
Y / N	Lumbar spine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

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
OTHER	 Tear to the left wrist area

	 Inside left had has cuts	
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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 gimballs, spine	
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration	 Bib has torn in the center of sternum
Y / N	Ribs securely attached to posterior spine	
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)	

OTHER	 Lower Neck LC Cable has been repaired where it passes through the upper rear spine box.  T6 X Accelerometer missing insulation at transducer. Electrical tape covers this.
ABDOMEN	
Y / N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper  Upper abdomen came held together with black tape
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  Abdomen bag has many broken stitches forming, but no tears occurring.  Both sides of the Abdomen Bag have torn where the stitches had broke

Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
Other	 Both lower abdomen IRTracc screws are inserted, but the IRTraccs are not installed.  Wire seems to have been pinched

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	 Rear of pelvis has torn flesh  Tears have formed to the front of the pelvis  Tears in the pelvis have gotten worse

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
Other	

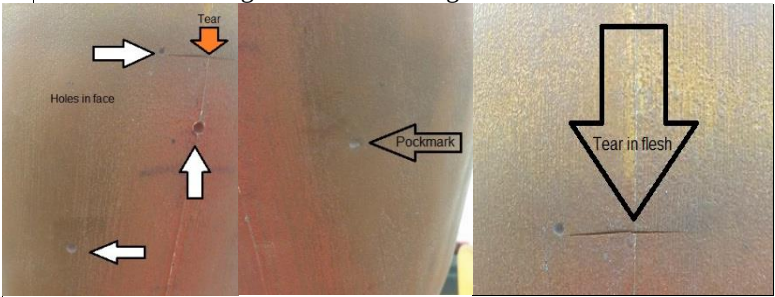
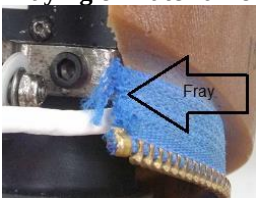
LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached -Left ankle Y pot has intermittent failure in cable close to amp connector. –Repaired by cutting back cable and reinstalling on connector.
Y / N	Achilles tendon provides resistance to dorsiflexion
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
Y / N	No cuts, tears, or scuffing of leg flesh Numerous minor cuts  Zipper on right ankle is pulling away from the flesh – This became much worse during the RE5507 test. (See second photo)   Right knee has some nicks in the flesh

Other	 Damage to the metal of the right ankle
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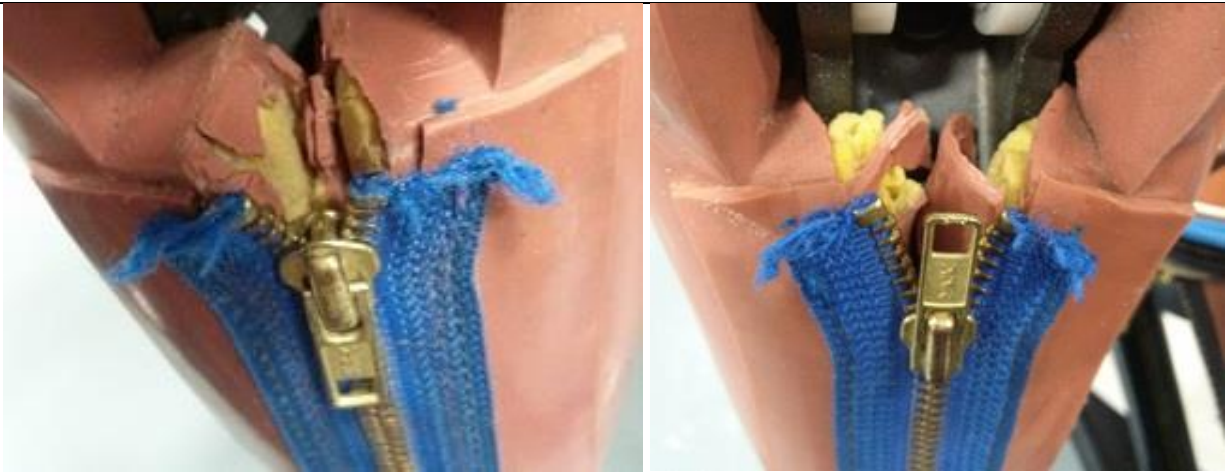
JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers
	 Jacket has tears around neck and at most seam ends as seen here on the front left shoulder.
OTHER	 Lifting strap torn

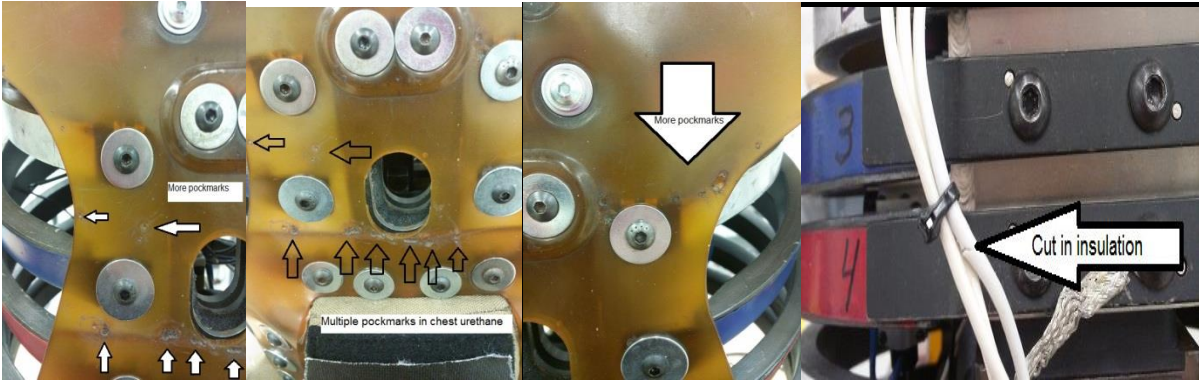
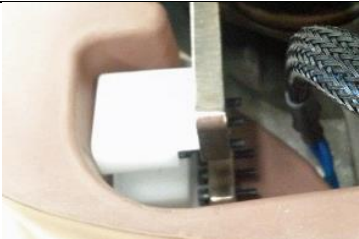
THOR Inspection Checklist

Date: 11/07/2013	
NHTSA Representative: James Saunders	
Inspection Reporter: Mary Geesey	
Witness(es):	
Inspection type (check one): ☒ PRE ☐ POST	
Dummy S/N: 0015	Legs S/N: LX0038/LX0039
Dummy Description: Thor NT 50th Male	
Date of last Certification or Inspection: 10/31/2013	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last inspection:</u> RE5507 Subaru Forester <u>Since last certification:</u> RD0332 Dodge Dart RD5371 Honda Civic RE5507 Subaru Forester	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> - Ankle left X rotation – Questionable data throughout – The Amp connector had a couple wires pull out during the test. Pins were repairs and retested okay.	
<u>Physical evidence of damage:</u> See report – Arm damage	
<u>Anecdotal evidence of damage:</u> N/A	
<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

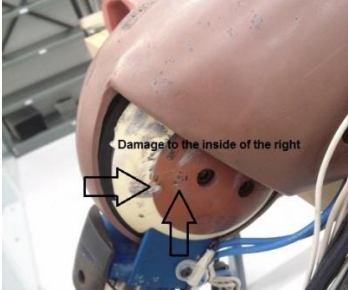
HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage  Thor has holes/pockmarks in his head skin, along with a tear
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / N	Head securely mounted to OC joint
OTHER	Fraying of material for zipper at the back of the head  Head CG Y Accelerometer wire damaged 

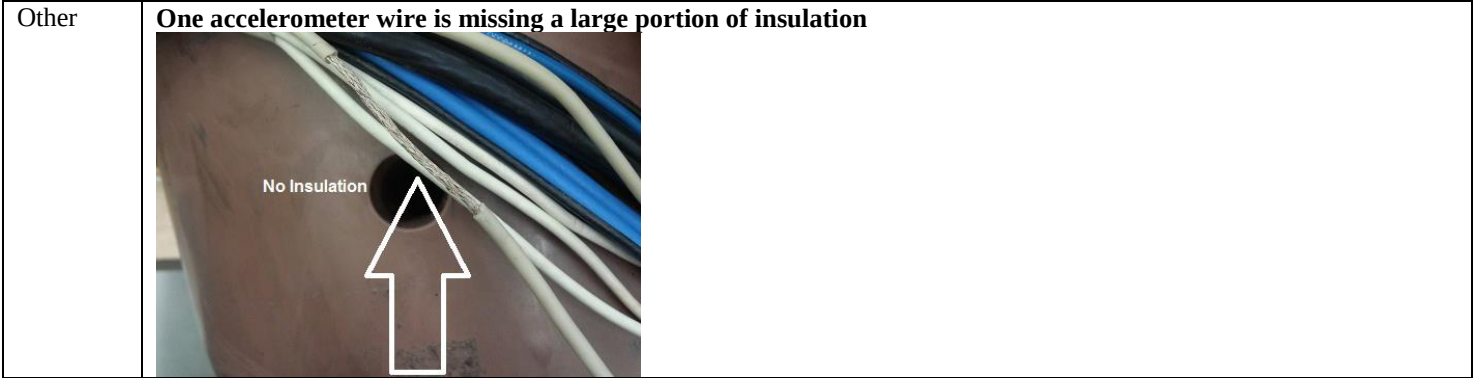
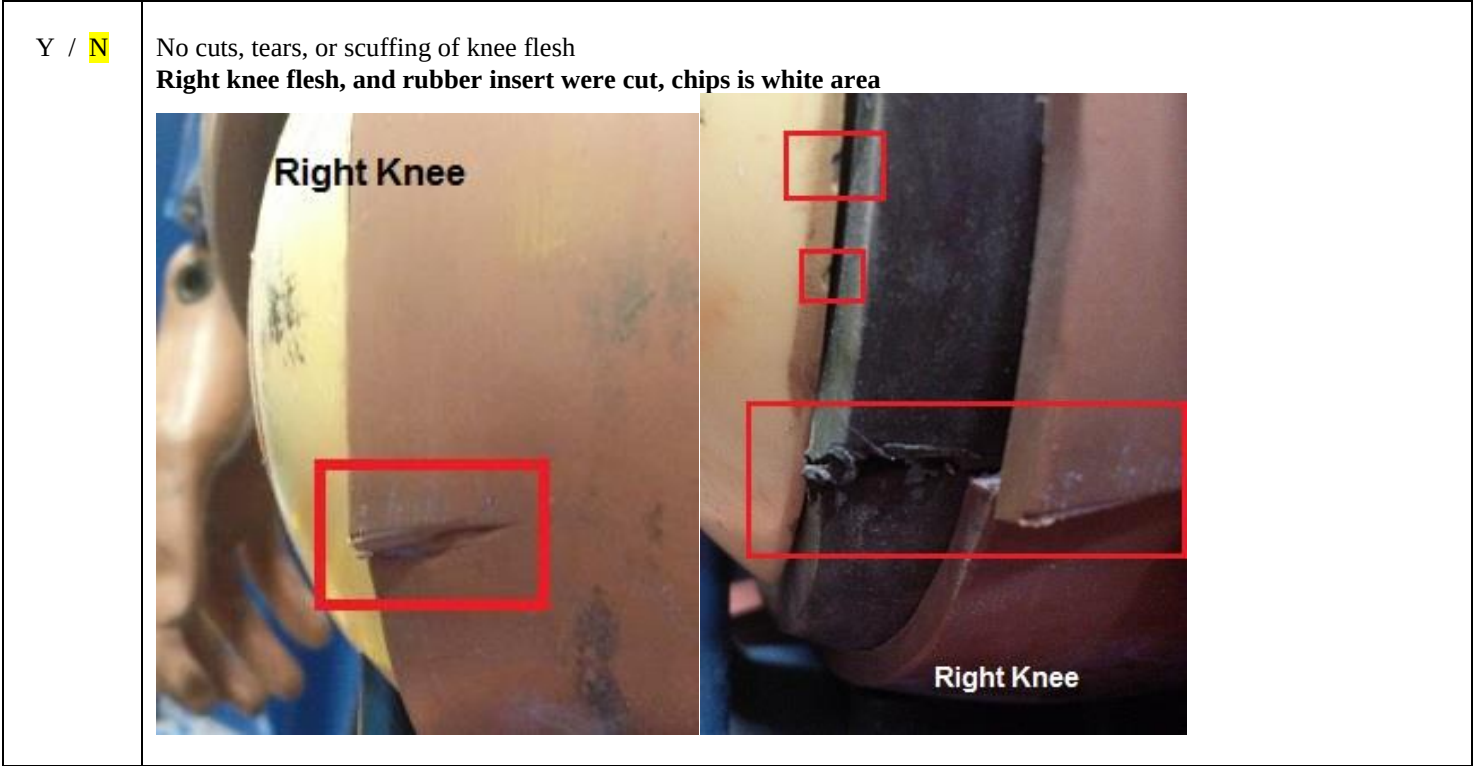
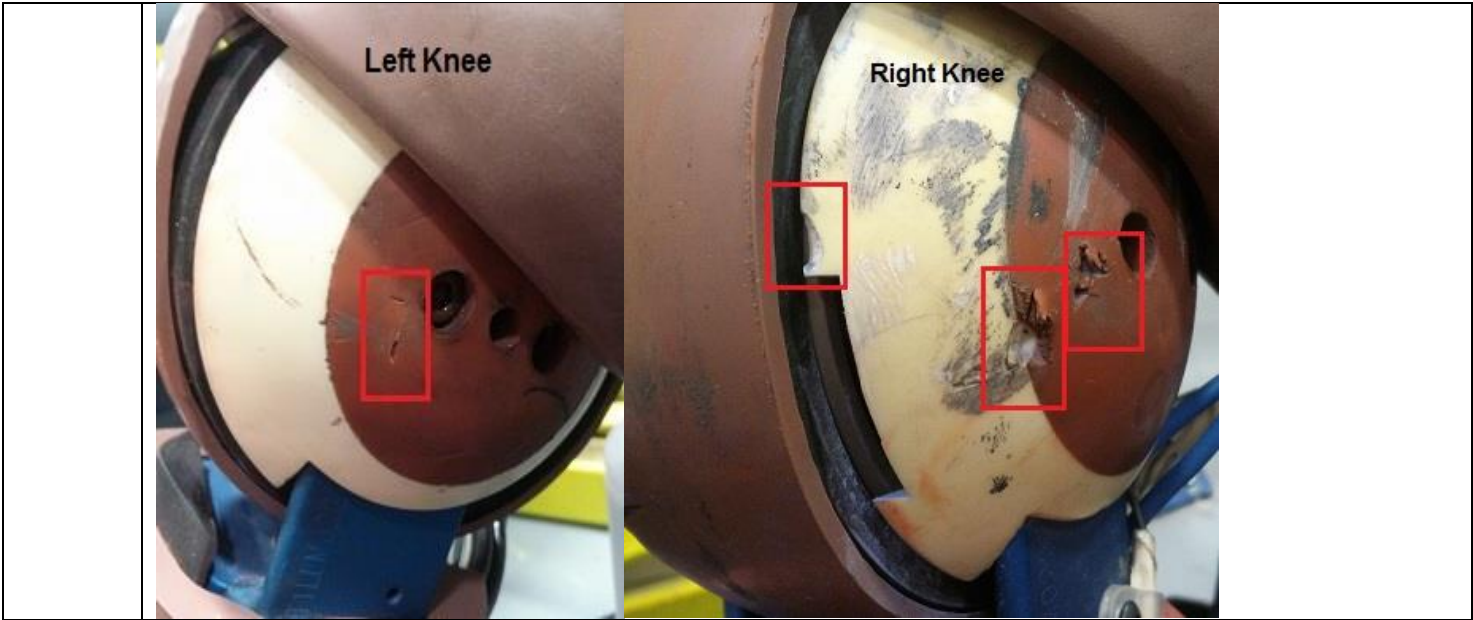
NECK	
Y / N	Neck cables slide freely through holes in neck plates
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates If N – indicate which interface (where plate/puck 1 attach to upper neck load cell):
Y / N	No evidence of 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
	THOR 0015 does not have a lower neck load cell
Y / N	Neck pitch change joint mechanism mating teeth are engaged
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	

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
OTHER	 Both left and right arms show signs of internal tearing

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
Y / N	Ribs securely attached to posterior spine
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)
OTHER	There are multiple pockmarks in the chest urethane, and at the back there is a cut in the insulation to one of the accelerometer wires  The images show four different views of the thorax assembly. The first three images show the chest urethane with multiple pockmarks indicated by arrows and labels. The fourth image shows a cut in the insulation of an accelerometer wire.
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
Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
Other	 Both lower abdomen IRTracc screws are inserted, but the IRTraccs are not installed.

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	Small tear in pelvis flesh on the left side 

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 Damage to the inside of the right knee  Some damage done to the outer left knee, inside right knee sustained more damage



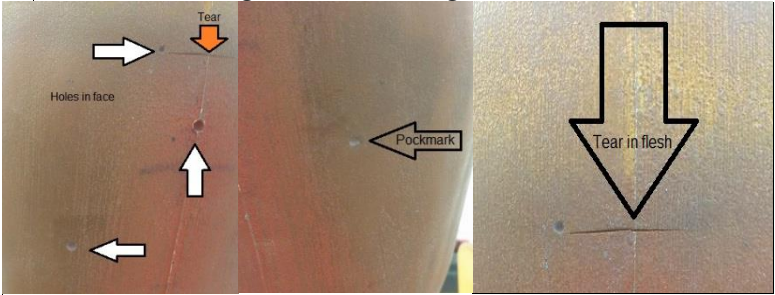
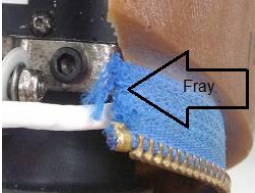
LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached
Y / N	Achilles tendon provides resistance to dorsiflexion
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
Y / N	No cuts, tears, or scuffing of leg flesh Right leg flesh shows separation at rear upper seam 
Other	

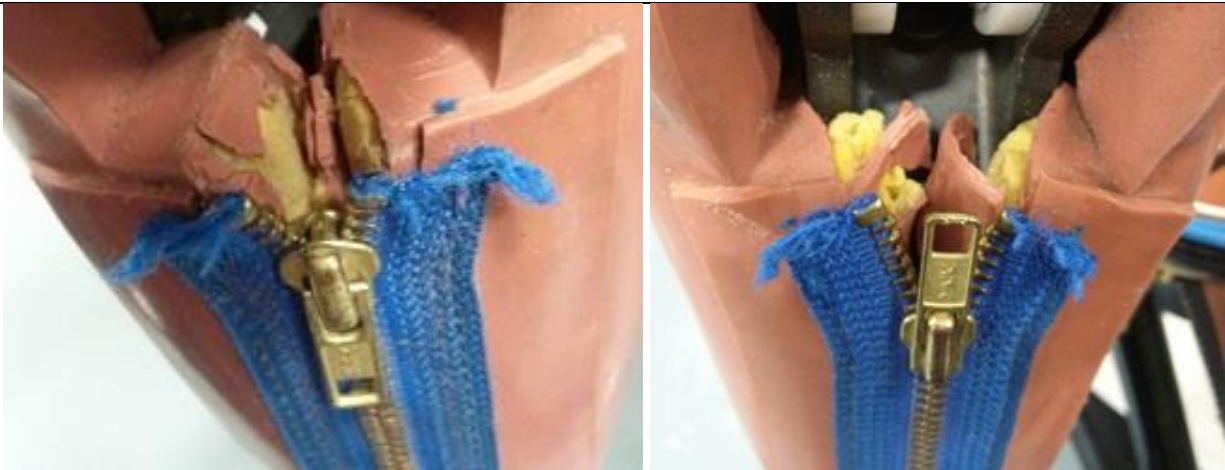
JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation One of the left rib stiffeners has damage to the outer coating that goes all the way around, also, the rib stiffeners were severely bent when we received 0015. 
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers Many of the seams of the jacket are coming undone, and there is a hole on the bottom left side along with stains all over the jacket. 

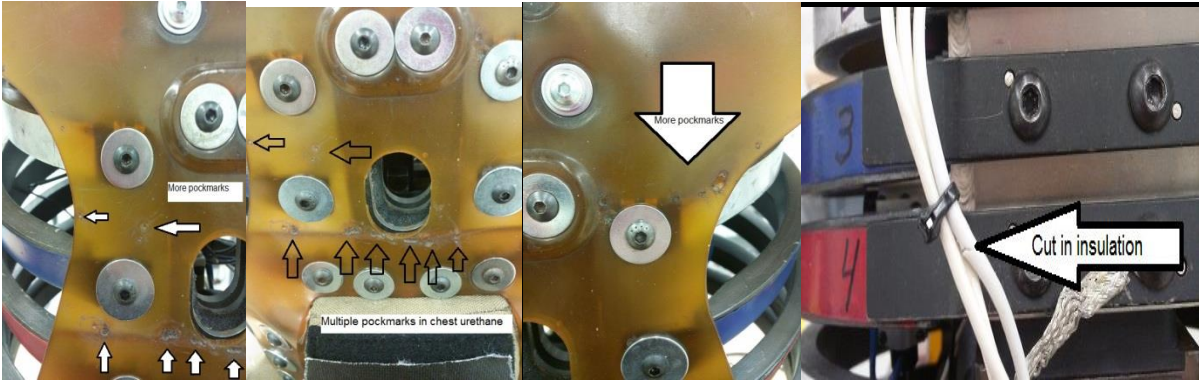
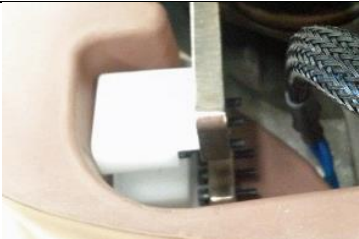
	
OTHER	

THOR Inspection Checklist

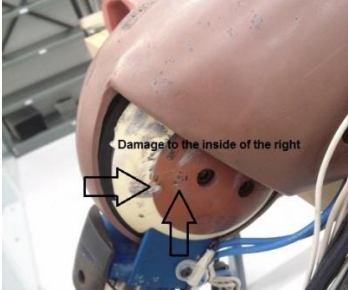
Date: 11/11/2013	
NHTSA Representative: James Saunders	
Inspection Reporter: Mary Geesey	
Witness(es):	
Inspection type (check one): ☐ PRE ☒ POST	
Dummy S/N: 0015	Legs S/N: LX0038/LX0039
Dummy Description: Thor NT 50th Male	
Date of last Certification or Inspection: 10/31/2013	
<u>Tests conducted since last full certification or inspection:</u> <u>Since last inspection:</u> RD5910 Volvo XC60 <u>Since last certification:</u> RD0332 Dodge Dart RD5371 Honda Civic RE5507 Subaru Forester RD5910 Volvo XC60	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> - Head CG X Acceleration – Questionable Data Throughout - Inspected physical and electrical aspects with no trouble arising during data live-view.	
<u>Physical evidence of damage:</u> See report – Leg damage	
<u>Anecdotal evidence of damage:</u> N/A	
<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

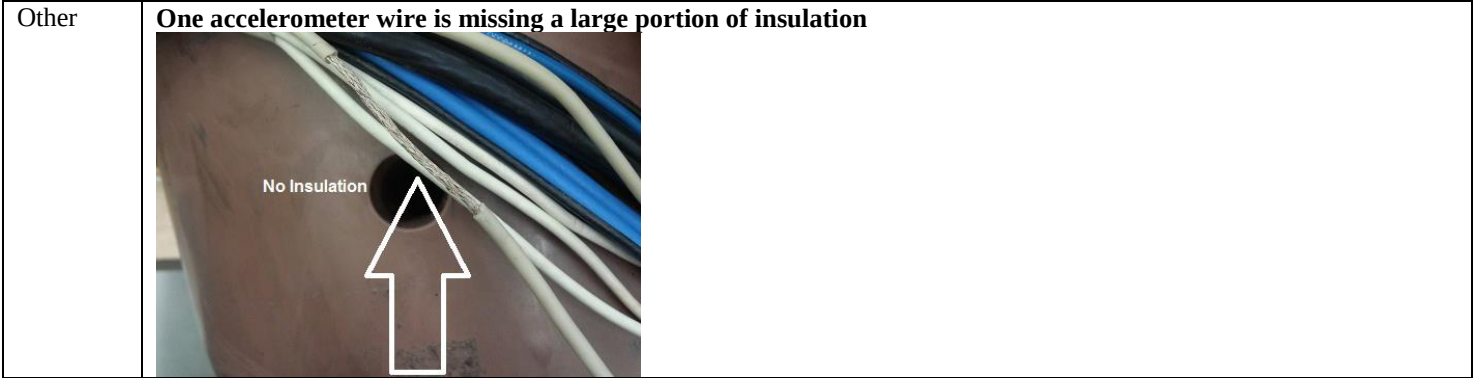
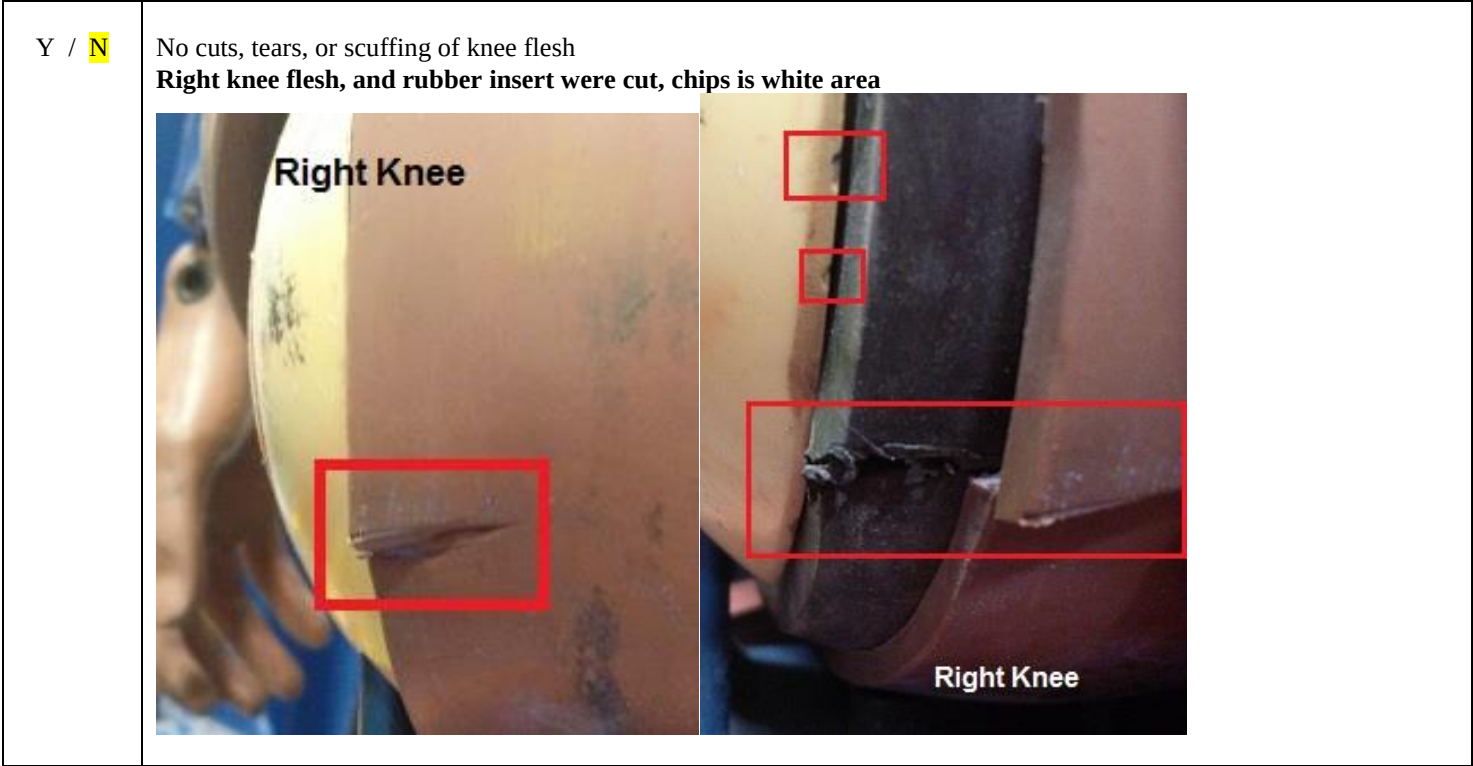
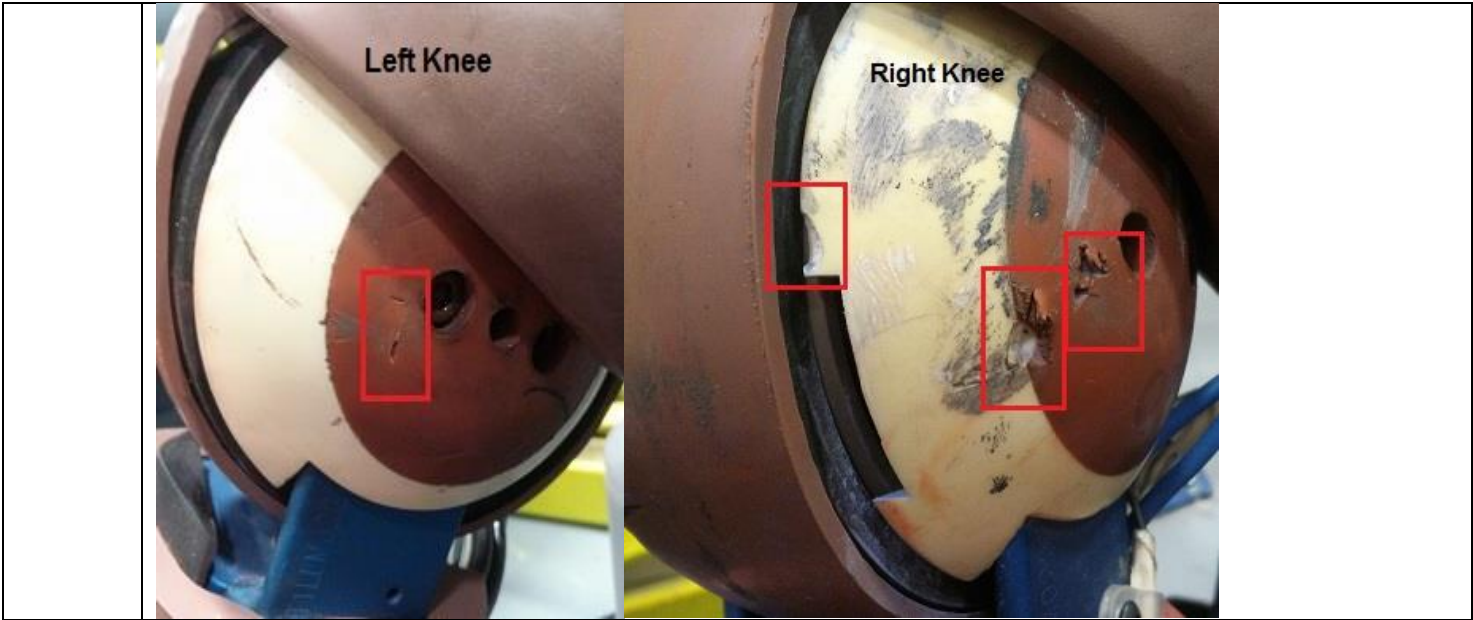
HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage  Thor has holes/pockmarks in his head skin, along with a tear
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / N	Head securely mounted to OC joint
OTHER	Fraying of material for zipper at the back of the head  Head CG Y Accelerometer wire damaged 

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 If N – indicate which interface (where plate/puck 1 attach to upper neck load cell):
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 THOR 0015 does not have a lower neck load cell
Y / N	Neck pitch change joint mechanism mating teeth are engaged
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	
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
OTHER	 Both left and right arms show signs of internal tearing

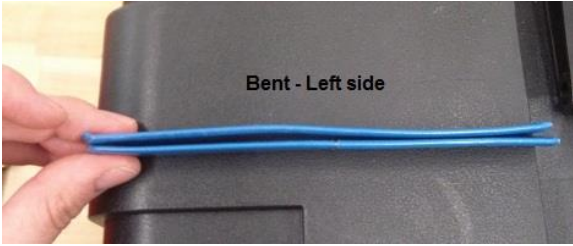
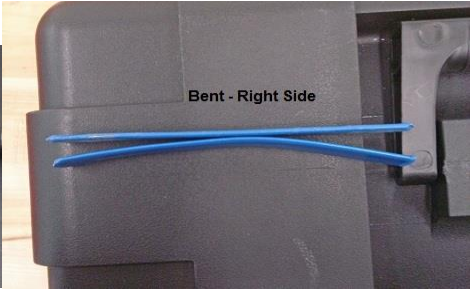
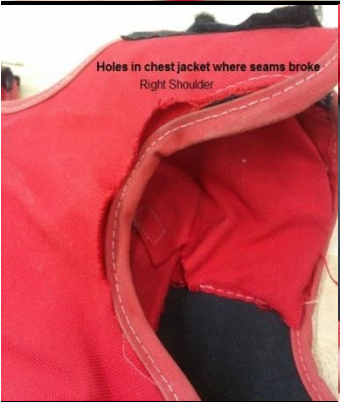
THORAX	
Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	CRUX anterior arms securely attached to anterior ribs
Y / N	CRUX posterior arms securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration
Y / N	Ribs securely attached to posterior spine
Y / N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners)
OTHER	There are multiple pockmarks in the chest urethane, and at the back there is a cut in the insulation to one of the accelerometer wires  The images show the following details: - Image 1: Chest urethane with pockmarks indicated by arrows and the label 'More pockmarks'. - Image 2: Chest urethane with pockmarks indicated by arrows and the label 'Multiple pockmarks in chest urethane'. - Image 3: Chest urethane with pockmarks indicated by an arrow and the label 'More pockmarks'. - Image 4: Accelerometer wire with a cut in the insulation indicated by an arrow and the label 'Cut in insulation'.
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
Y / N	Lower abdomen insert securely attached to spine
Y / N	Lower abdomen insert shows no evidence of permanent set
Other	 Both lower abdomen IRTracc screws are inserted, but the IRTraccs are not installed.

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	Small tear in pelvis flesh on the left side 

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 Damage to the inside of the right knee  Some damage done to the outer left knee, inside right knee sustained more damage



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 shows separation at rear upper seam  Abrasions to the right leg skin
Other	

JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation One of the left rib stiffeners has damage to the outer coating that goes all the way around, also, the rib stiffeners were severely bent when we received 0015.  Left Side Damage to the covering  Bent - Left side  Bent - Right Side
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers Many of the seams of the jacket are coming undone, and there is a hole on the bottom left side along with stains all over the jacket.  Stains Tear in material Hole  Seam coming undone  Seam coming undone  Seam coming undone at neck line  Holes in chest jacket where seams broke Right Shoulder  Hole on the bottom left of the chest jacket  Seam torn, material ripped
OTHER	

Test Data/Sensor Repair Notes

DUMMY CALIBRATIONS

50% ADULT MALE THOR016 DUMMY CALIBRATIONS

Summary of Thor 16 Certification Test Results

Reported by: Calspan

Technician: M. Goehle

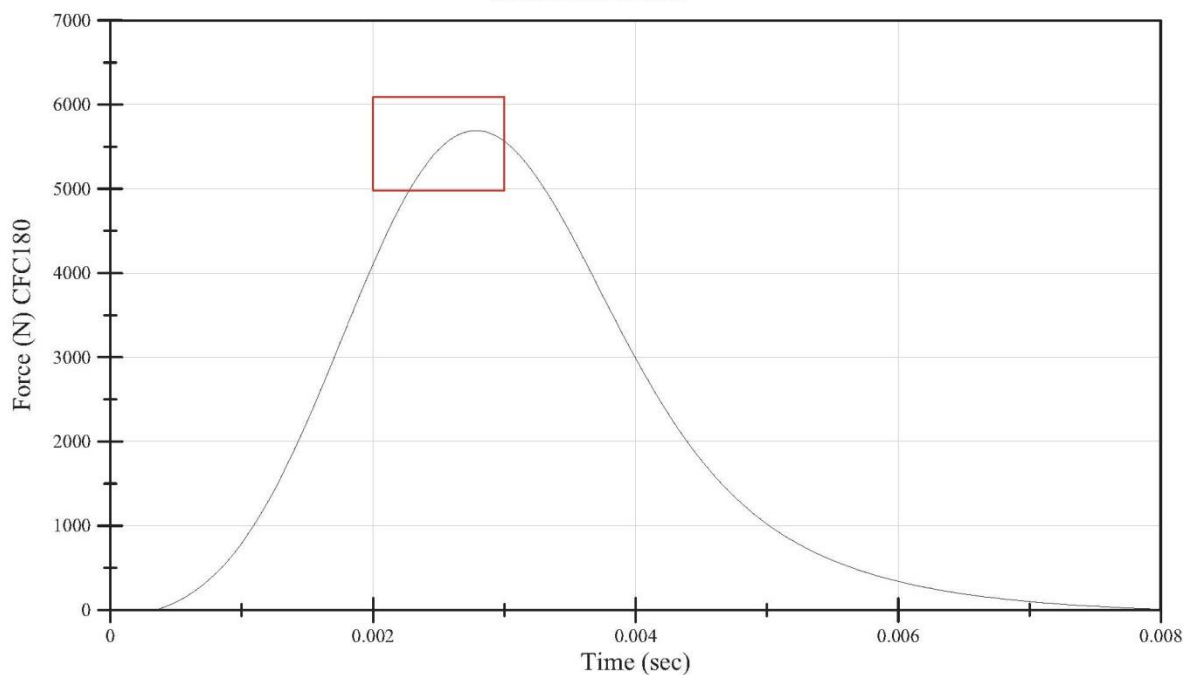
Date: 10/21/2013

Head Impact	Passed
Occipital Condyle Quasi-Static	Failed
Neck Left Lateral Flexion	Failed
Neck Right Lateral Flexion	Failed
Neck Flexion	Failed
Neck Extension	Failed
Upper Thorax	Failed
Lower Left Oblique Thorax	Failed
Lower Right Oblique Thorax	Failed
Upper Abdomen	Failed
Lower Abdomen	Failed
Left Femur	Passed
Right Femur	Passed
Left Knee	Passed
Right Knee	Passed
Left Foot Inversion	Passed
Left Foot Eversion	Passed
Left Heel of Foot	Failed
Left Ball of Foot	Failed
Right Foot Inversion	Failed
Right Foot Eversion	Passed
Right Heel of Foot	Passed
Right Ball of Foot	Passed

Certifications performed by VRTC
Instructed by NHTSA to use "as is"

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 1.98 m/s

THOR Head Impact Certification
Probe Force
Serial Number: T016

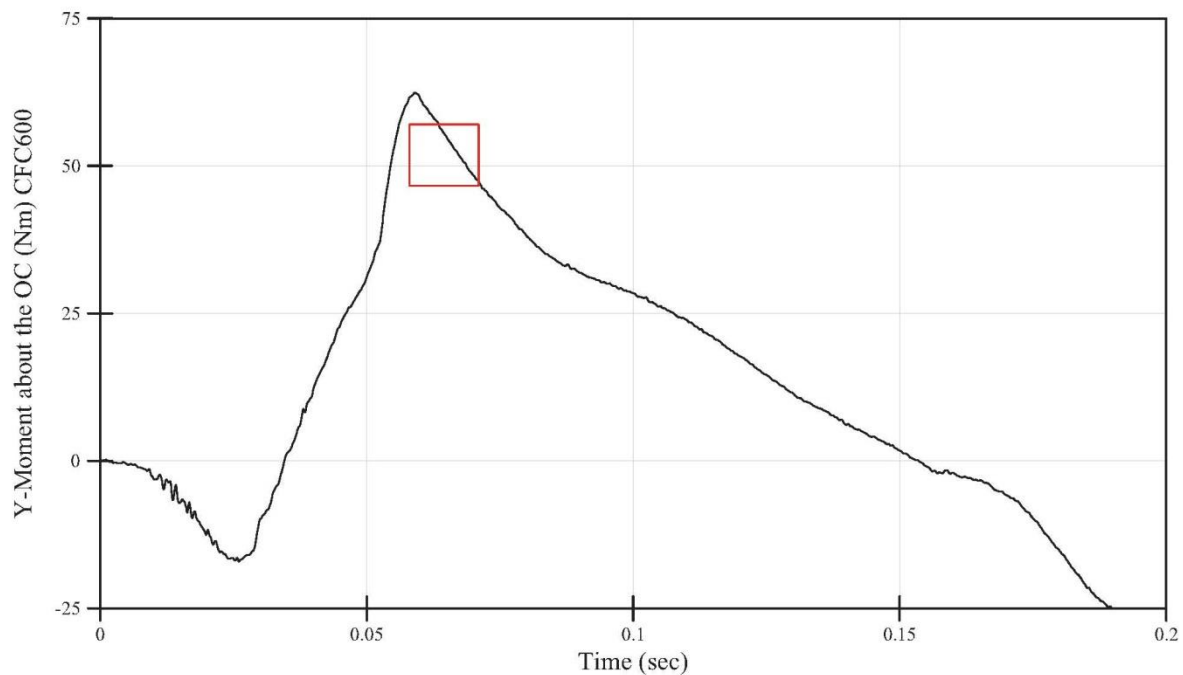


Software Version: 2.2

File Name: T016HEAD092513_01_DIADEMHeader_BINARYpp
09/25/2013 11:10:29.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.83 m/s

THOR Neck Flexion Certification
Y-Moment
Serial Number: T016



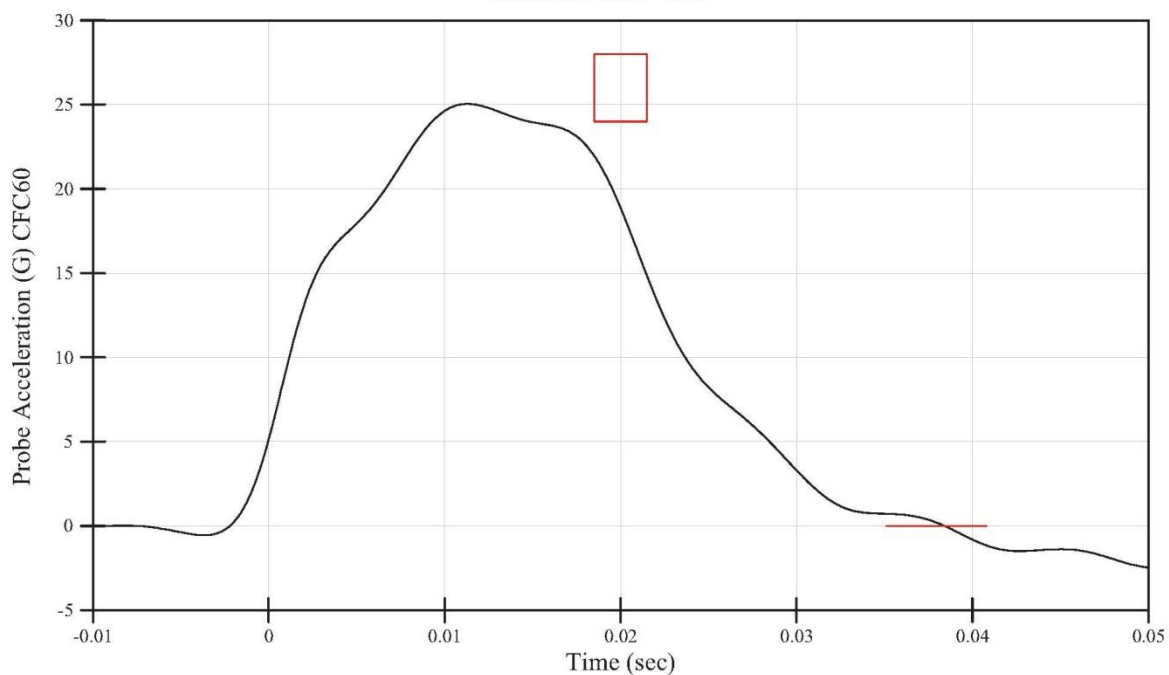
Software Version: 2.2

File Name: T016NECKFLEX092313_01_DIADEMHeader_BINARYpp
09/24/2013 07:01:32.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.83 m/s

THOR Neck Flexion Certification

Probe Acceleration
Serial Number: T016



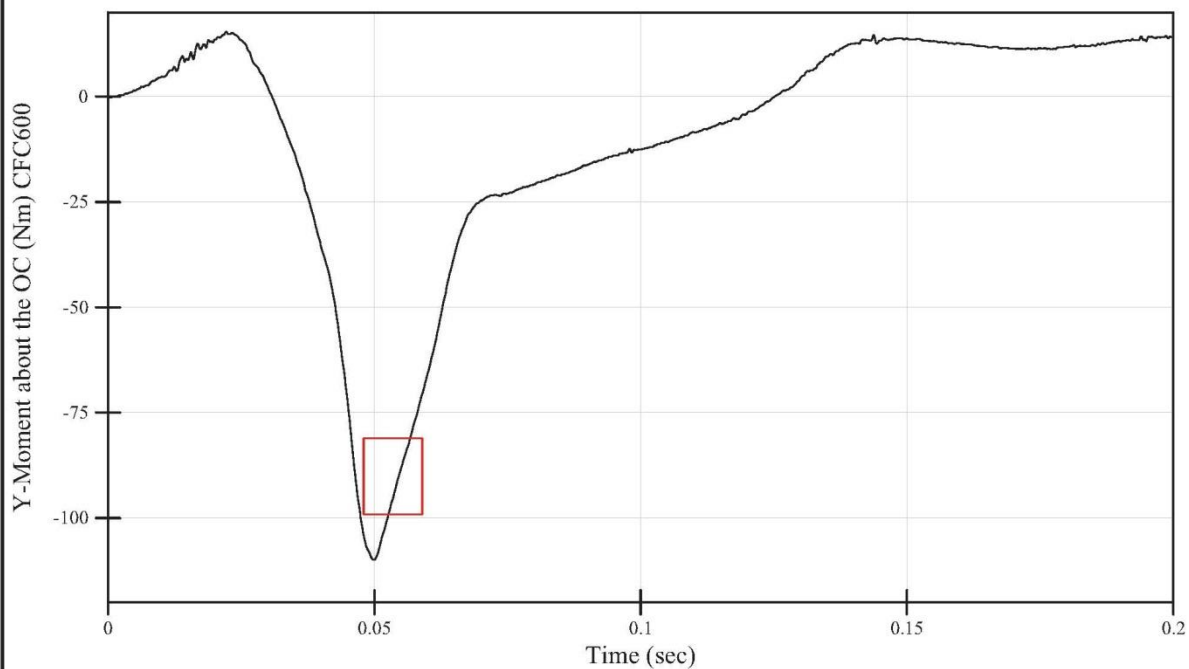
Software Version: 2.2

File Name: T016NECKFLEX092313_01_DiAdemHeader_BINARYpp
09/24/2013 07:01:32.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.73 m/s

THOR Neck Extension Certification

Y-Moment
Serial Number: T016

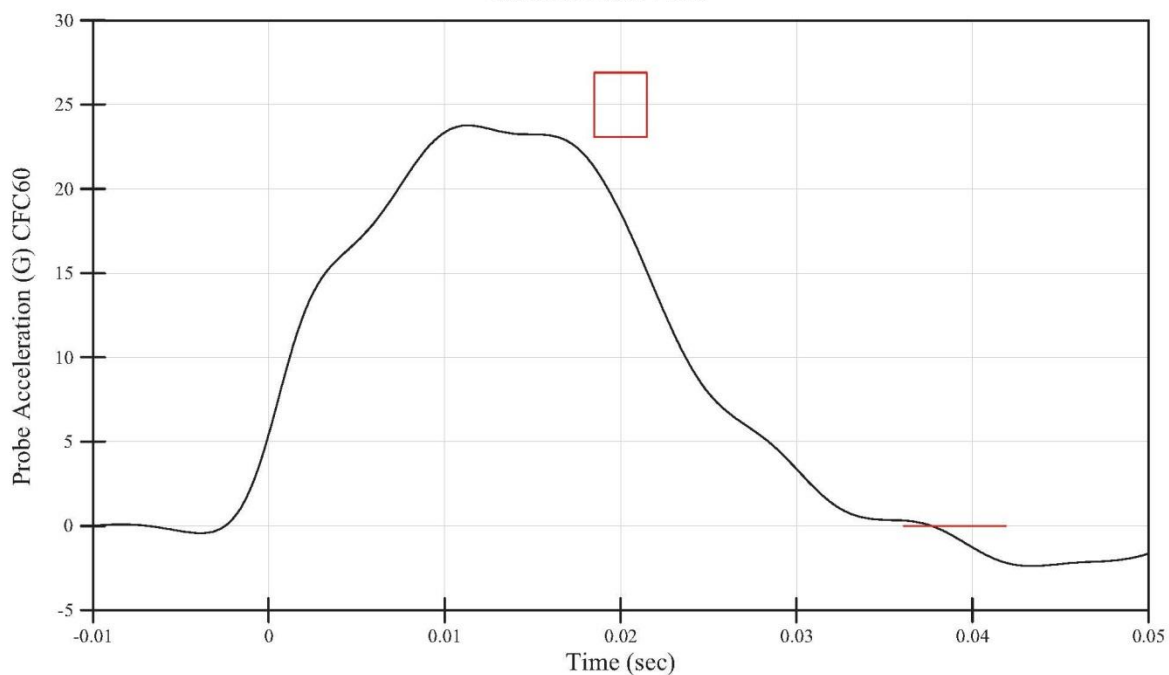


Software Version: 2.2

File Name: T016NECKEXT092413_01_DiAdemHeader_BINARYpp
09/24/2013 07:46:19.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.73 m/s

THOR Neck Extension Certification
Probe Acceleration
Serial Number: T016

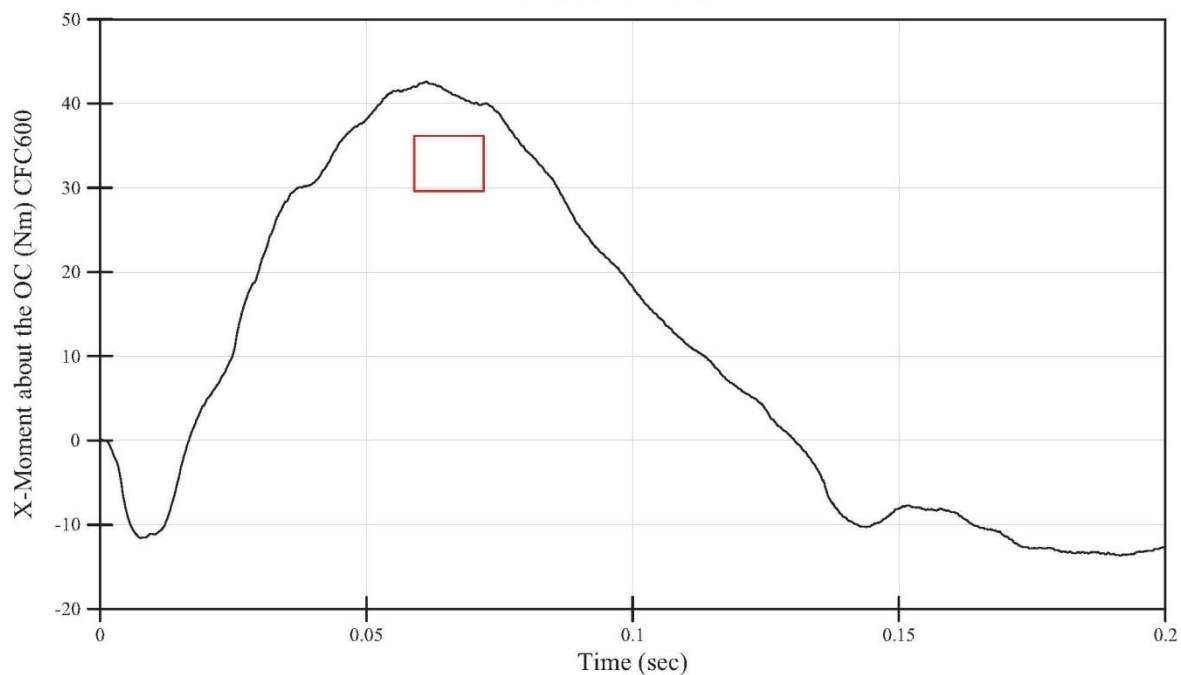


Software Version: 2.2

File Name: T016NECKEXT092413_01_DIAdemHeader_BINARYpp
09/24/2013 07:46:19.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.91 m/s

THOR Neck Left Lateral Flexion Certification
X-Moment
Serial Number: T016



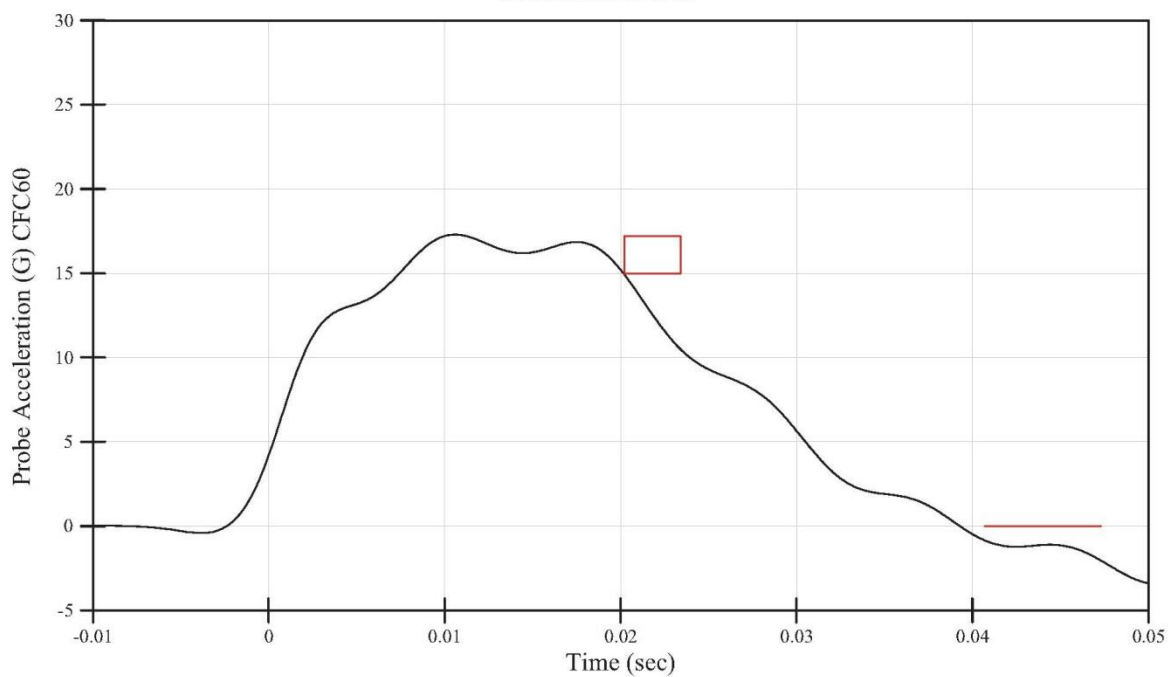
Software Version: 2.2

File Name: T016NECKLEFT092413_01_DIAdemHeader_BINARYpp
09/24/2013 08:59:19.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.91 m/s

THOR Neck Left Lateral Flexion Certification

Probe Acceleration
Serial Number: T016



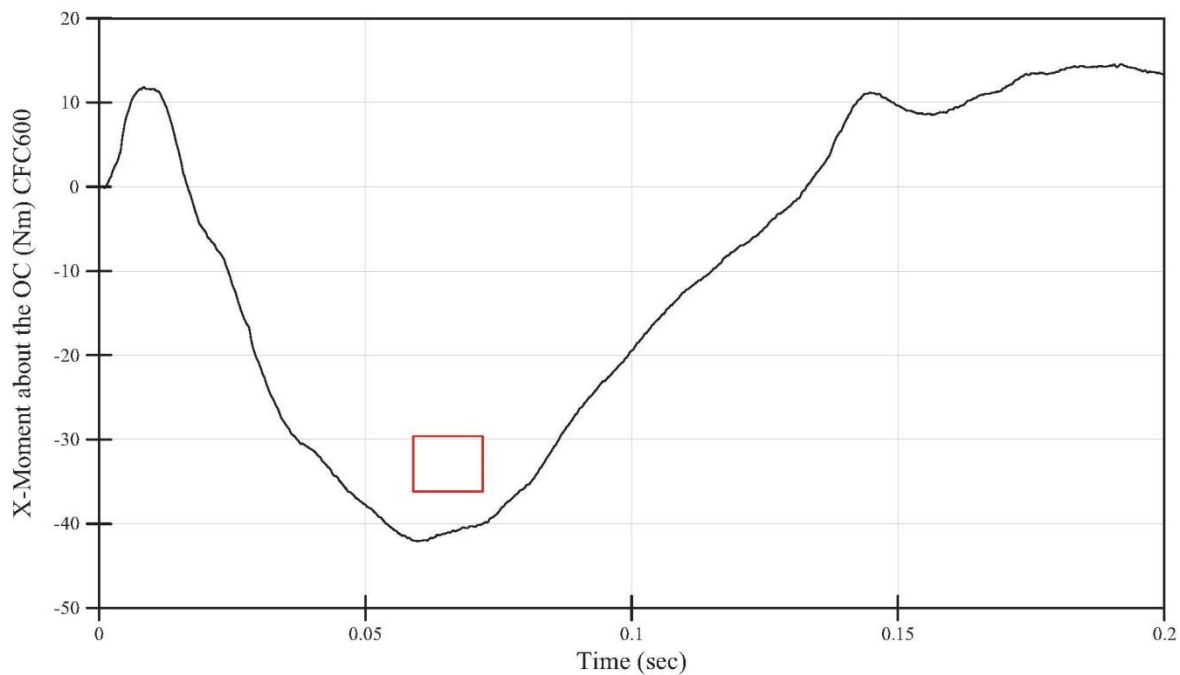
Software Version: 2.2

File Name: T016NECKLEFT092413_01_DiAdemHeader_BINARYpp
09/24/2013 08:59:19.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.94 m/s

THOR Neck Right Lateral Flexion Certification

X-Moment
Serial Number: T016



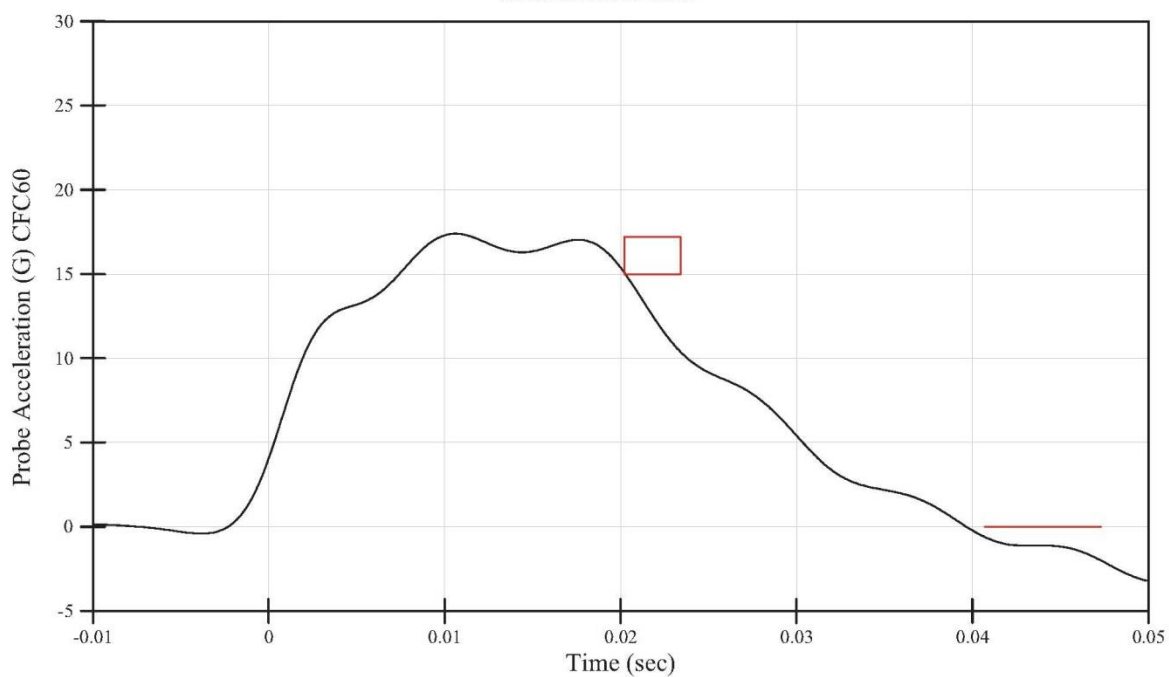
Software Version: 2.2

File Name: T016NECKRIGHT092413_01_DiAdemHeader_BINARYpp
09/24/2013 08:23:43.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.94 m/s

THOR Neck Right Lateral Flexion Certification

Probe Acceleration
Serial Number: T016



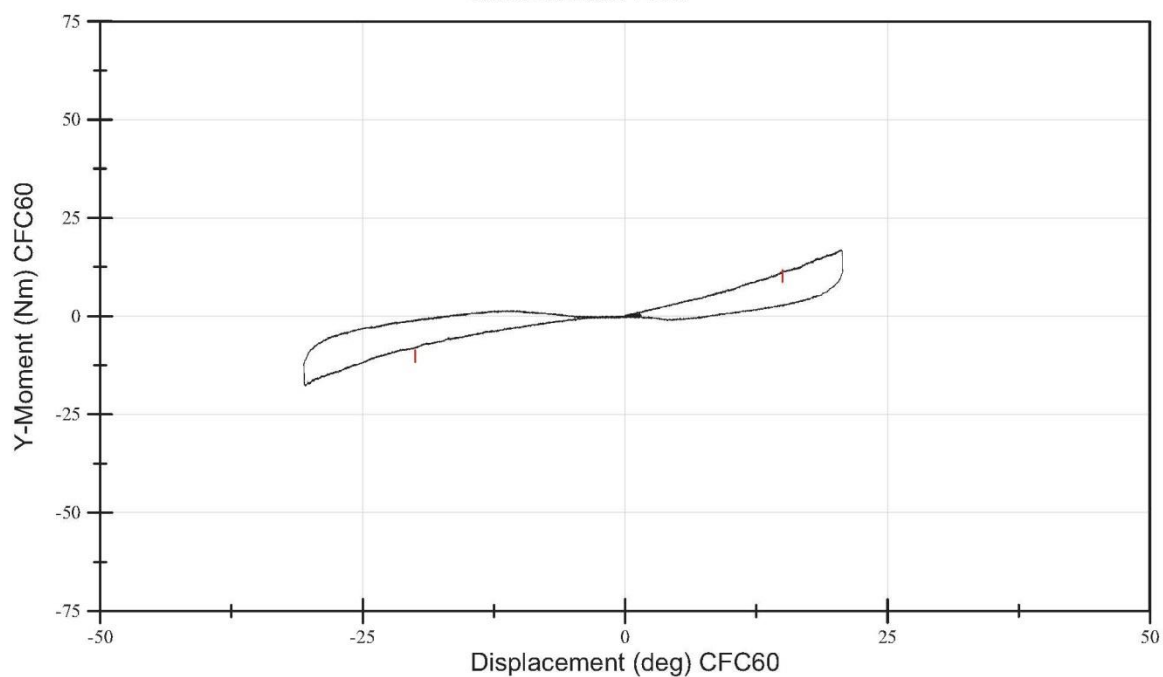
Software Version: 2.2

File Name: T016NECKRIGHT092413_01_DIADEMHeader_BINARYpp
09/24/2013 08:23:43.0000

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 0 m/s

THOR Occipital Condyle Quasi-Static Certification

Displacement vs. Torque
Serial Number: T016

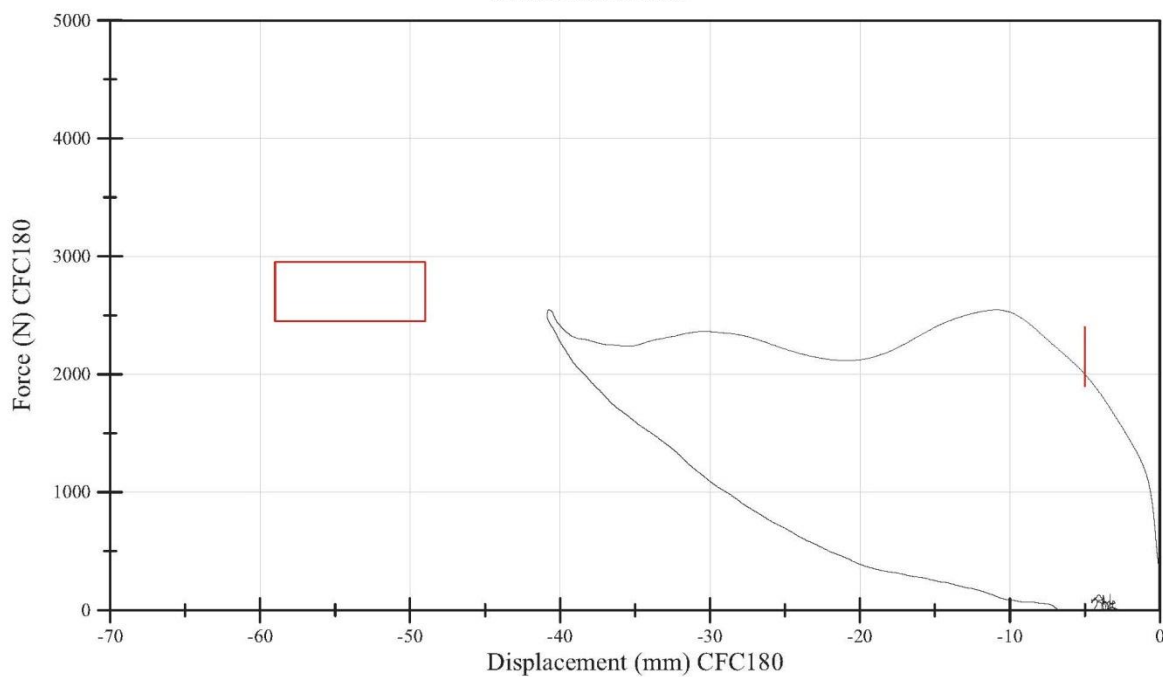


Software Version: 2.2

File Name: T016 OC 091813_01
09/19/2013 14:51:47.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 4.31 m/s

THOR Upper Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T016

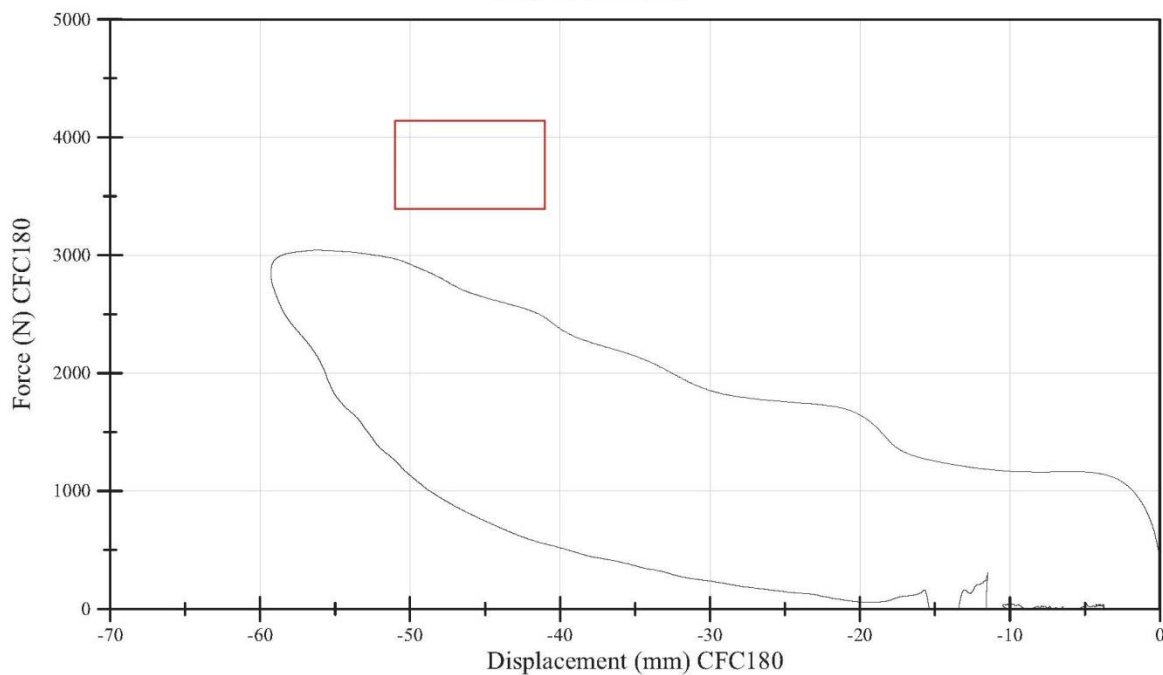


Software Version: 2.2

File Name: T016THORAXUPPER092513_01_DIAdemHeader_BINARYpp
09/25/2013 10:28:40.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 4.31 m/s

THOR Lower Left Oblique Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T016

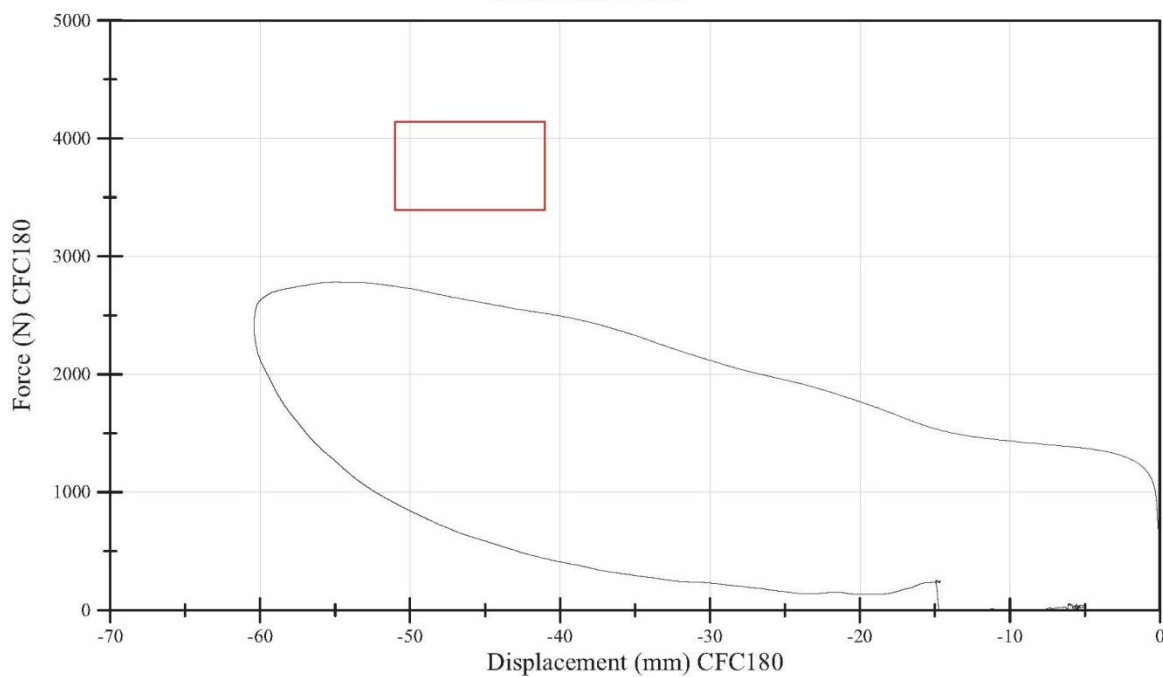


Software Version: 2.2

File Name: T016THORAXLEFT092513_01_DIAdemHeader_BINARYpp
09/25/2013 09:37:54.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 4.31 m/s

THOR Lower Right Oblique Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T016

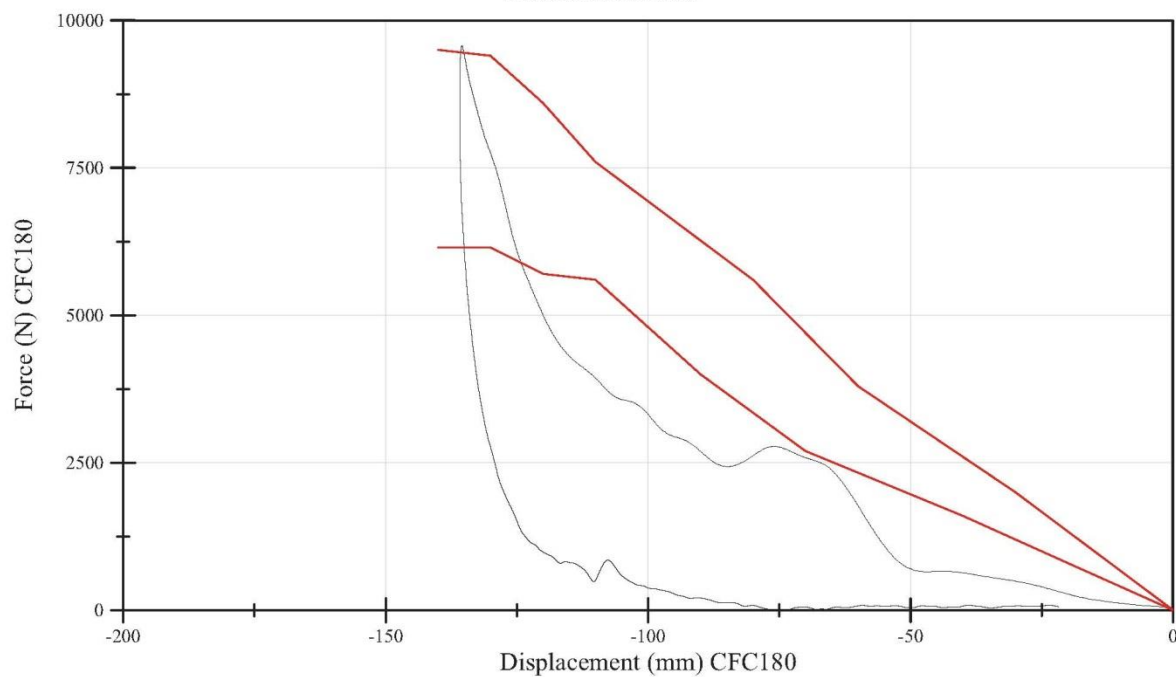


Software Version: 2.2

File Name: T016THORAXRIGHT092513_01_DIADEMHeader_BINARYpp
09/25/2013 09:39:26.0000

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 7.94 m/s

THOR Upper Abdomen Certification
Abdomen Displacement vs. Probe Force
Serial Number: T016

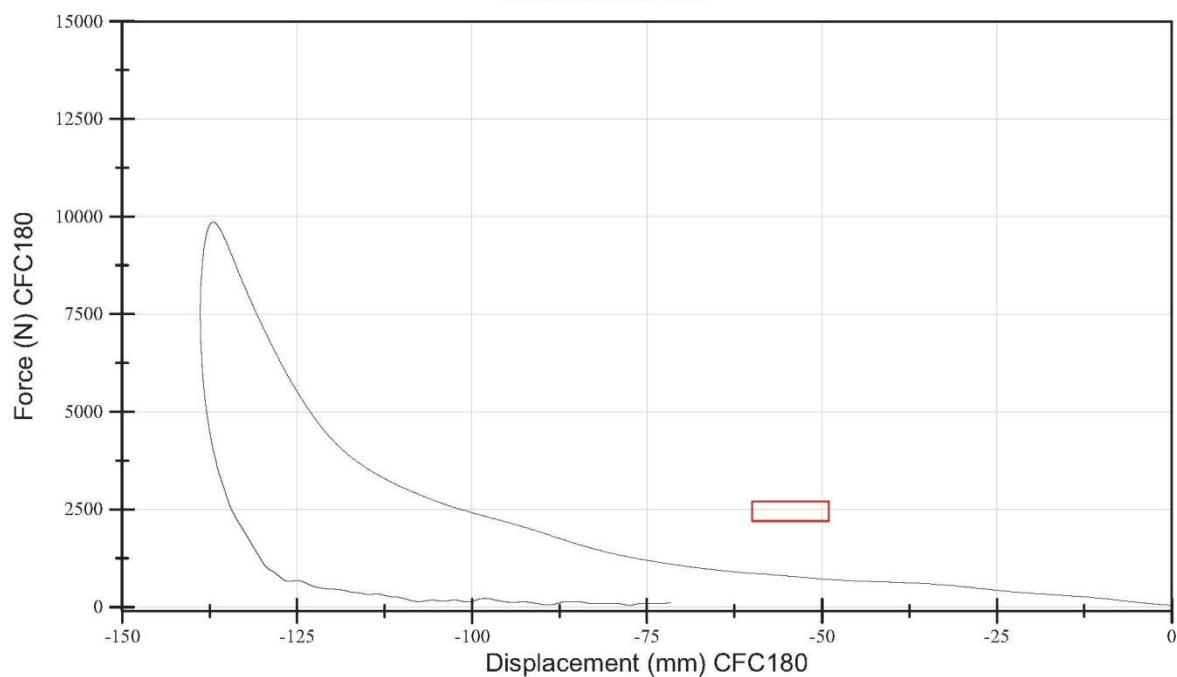


Software Version: 2.2

File Name: T016ABDOMENUPPER092413_01_DIADEMHeader_BINARYpp
09/24/2013 14:27:18.0000

Test Temperature: degrees
Relative Humidity: %
Test Velocity: m/s

THOR Lower Abdomen Certification
Lower Abdomen Deflection (via PENXG and T12XG) vs. Probe Force
Serial Number: 016



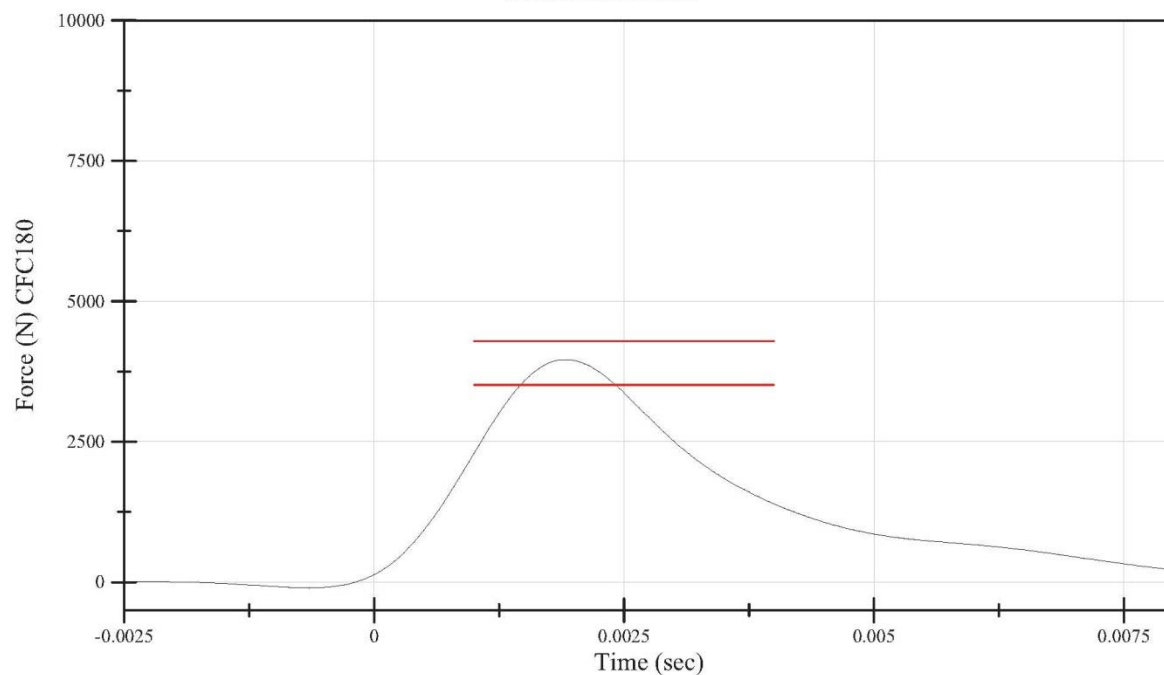
Software Version:

File Name: T016ABDOMENLOWER092413_01_DIAdemHeader_BINARYp

09/24/2013 13:10:11.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.55 m/s

THOR Left Femur Certification
Probe Force
Serial Number: T015



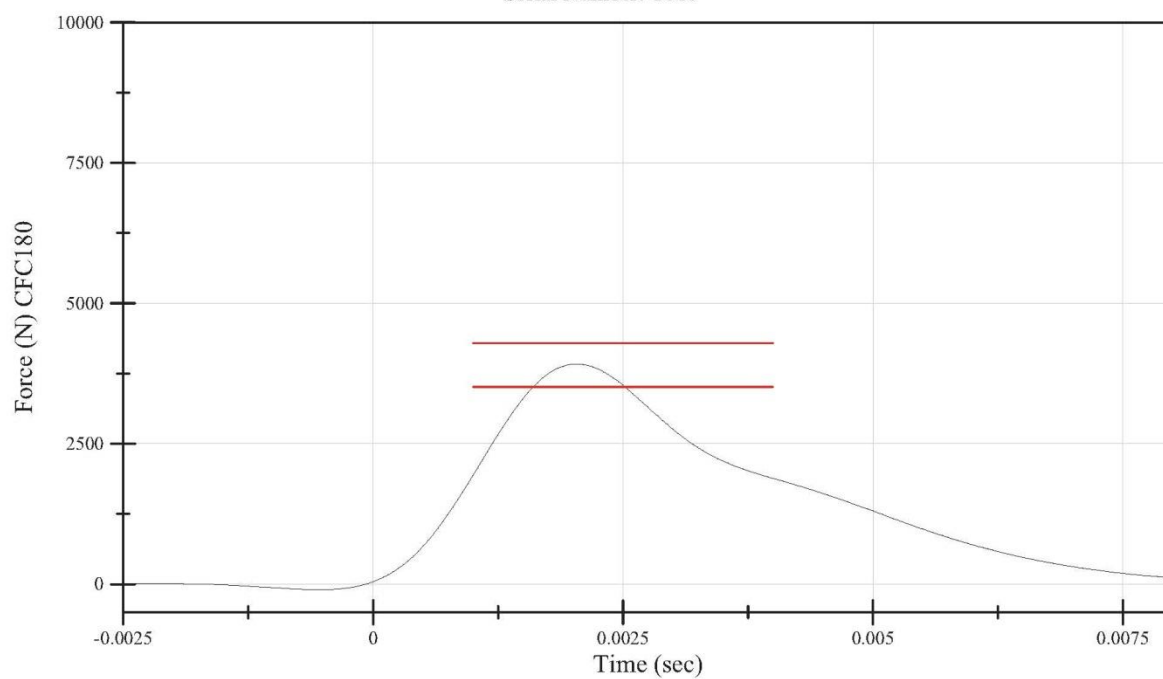
Software Version: 2.2

File Name: T016FEMURLEFT092613_01_DIAdemHeader_BINARYpp

09/26/2013 13:23:16.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.55 m/s

THOR Right Femur Certification
Probe Force
Serial Number: T015



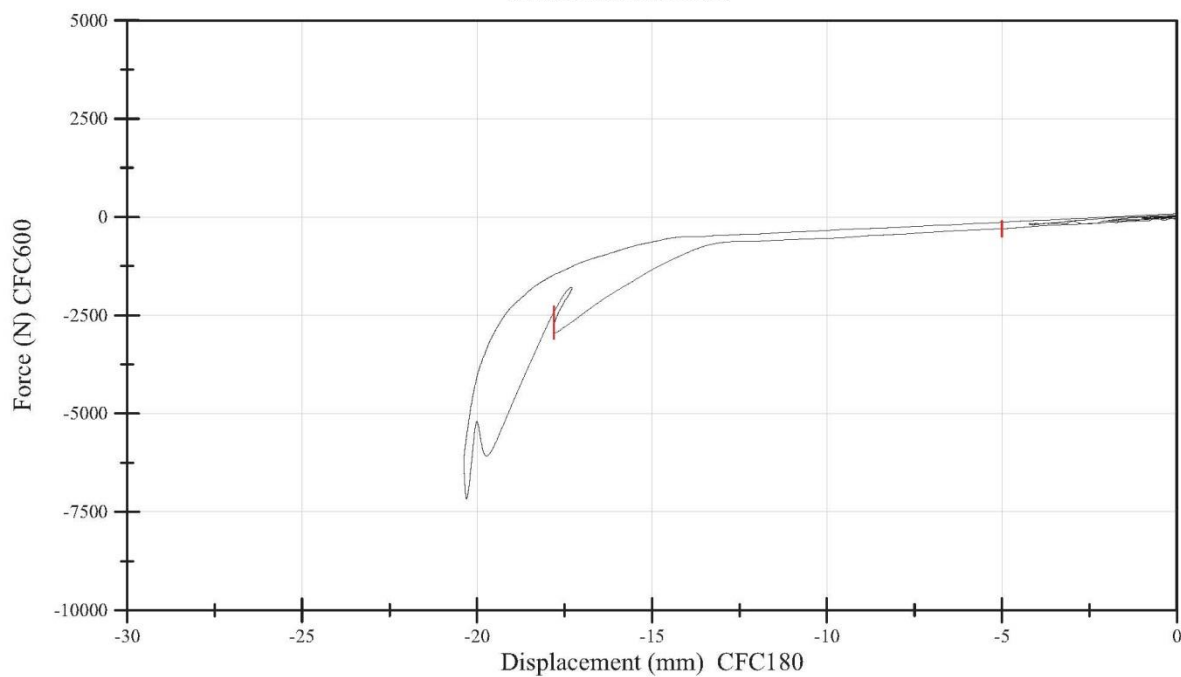
Software Version: 2.2

File Name: T016FEMURRIGHT092613_01_DIAdemHeader_BINARYpp
09/26/2013 13:25:13.0000

THOR 016 LEG CALIBRATIONS
LX0018/ LX0019

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.72 m/s

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

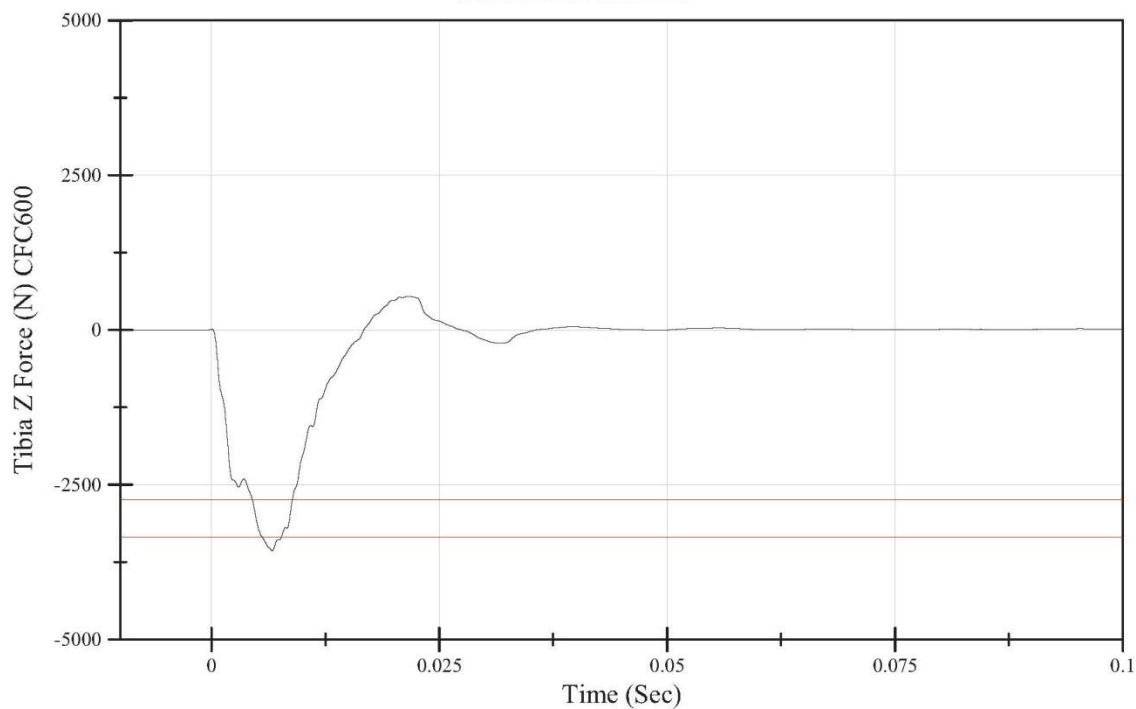


Software Version: 2.2

File Name: D2103665B_092613_01_DIADEMHeader_BINARYpp
09/26/2013 09:33:48.0000

Test Temperature: 70.4 degrees
Relative Humidity: 39.8%
Test Velocity: 4.00 m/s

THOR Left Foot Heel Certification Tibia Load Serial Number: LX0019

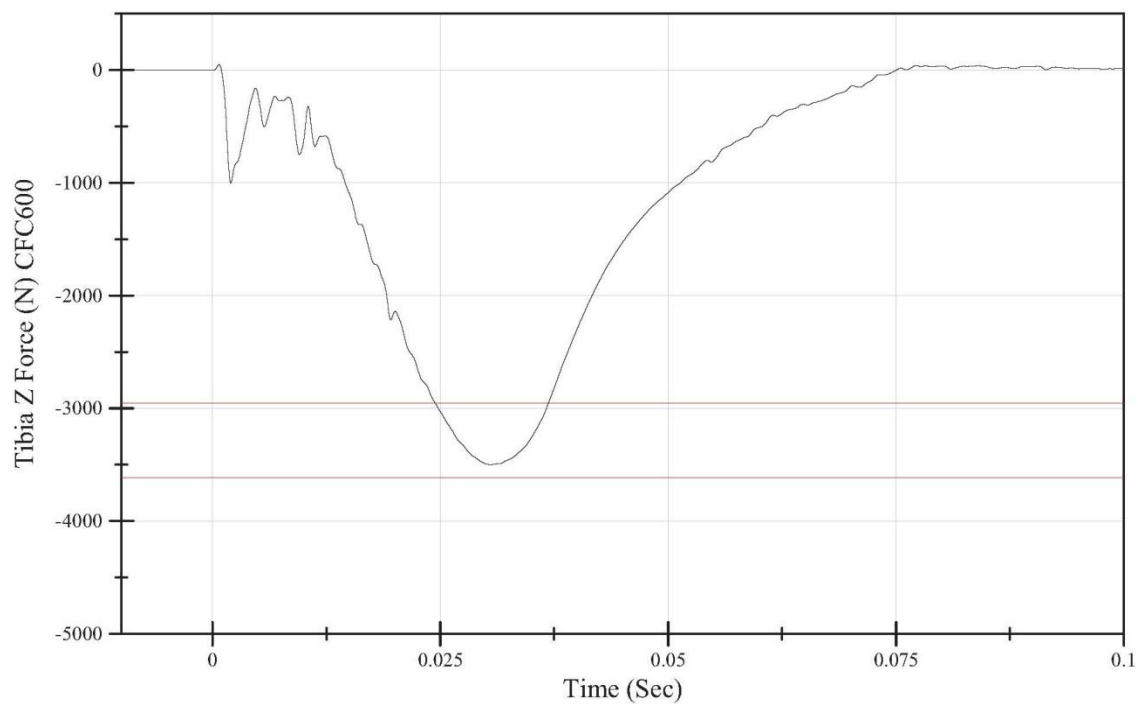


Software Version: 2.2

File Name: Heel_LX0019_2013_09_24 01 processed
09/24/2013 14:14:17.0000

Test Temperature: 70.8 degrees
Relative Humidity: 36.6%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0019

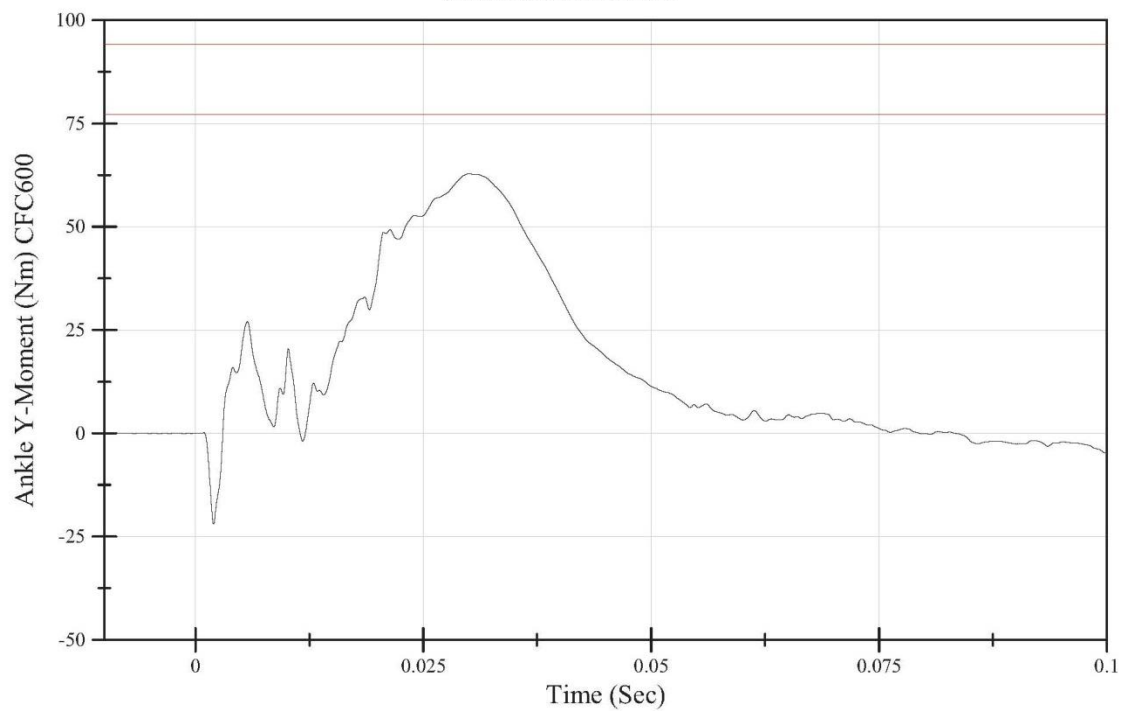


Software Version: 2.2

File Name: Ball_LX0019_2013_09_23 01 processed
09/24/2013 10:51:15.0000

Test Temperature: 70.8 degrees
Relative Humidity: 36.6%
Test Velocity: 5.03 m/s

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

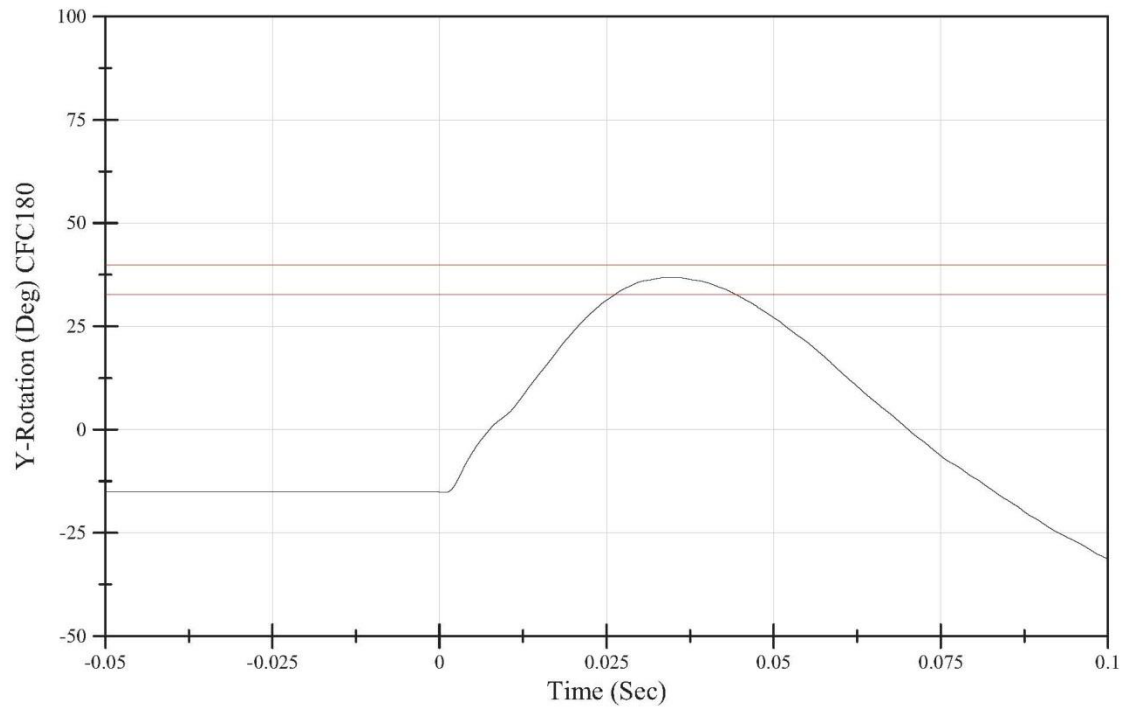


Software Version: 2.2

File Name: Ball_LX0019_2013_09_23 01 processed
09/24/2013 10:51:15.0000

Test Temperature: 70.8 degrees
Relative Humidity: 36.6%
Test Velocity: 5.03 m/s

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

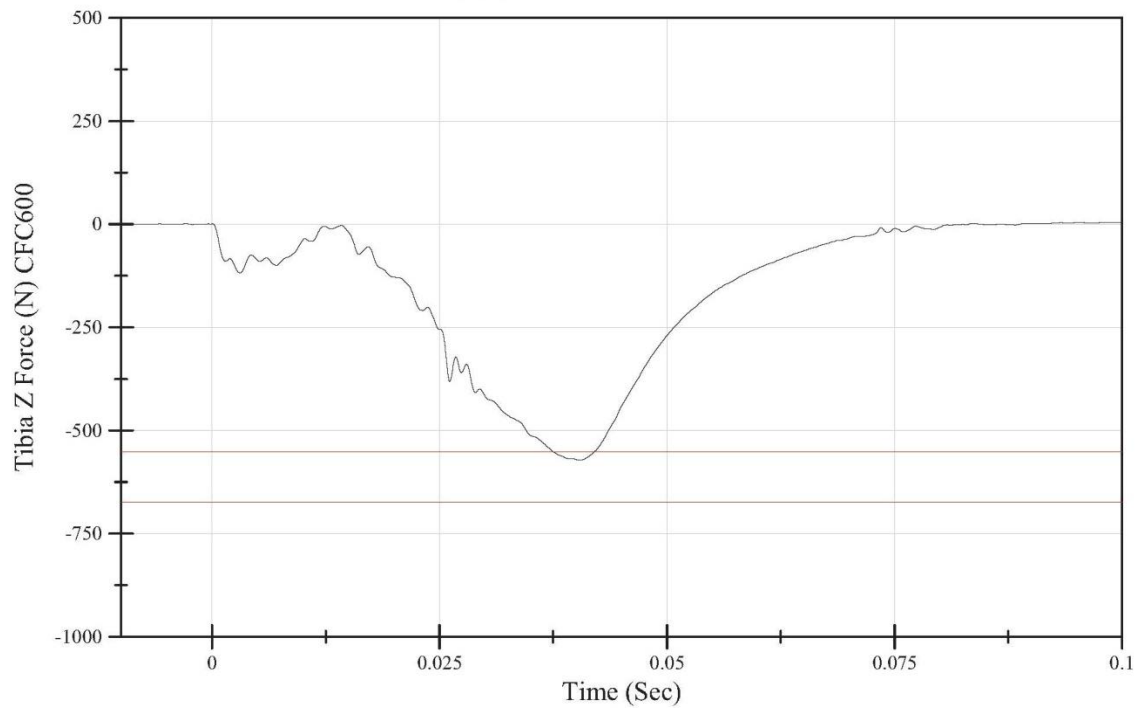


Software Version: 2.2

File Name: Ball_LX0019_2013_09_23 01 processed
09/24/2013 10:51:15.0000

Test Temperature: 71.1 degrees
Relative Humidity: 38.4%
Test Velocity: 1.98 m/s

THOR Left Foot Eversion Certification
Tibia Load
Serial Number: LX0019

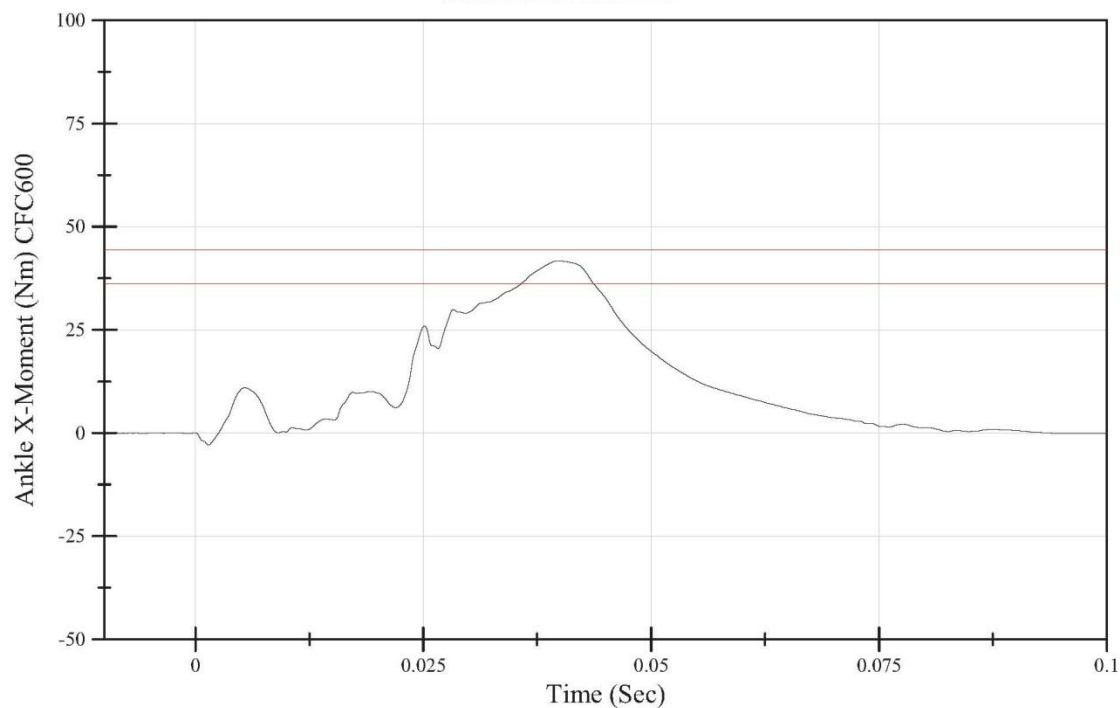


Software Version: 2.2

File Name: Ever_LX0019_2013_09_24 02 processed
09/24/2013 13:30:02.0000

Test Temperature: 71.1 degrees
Relative Humidity: 38.4%
Test Velocity: 1.98 m/s

THOR Left Foot Eversion Certification
Ankle Moment
Serial Number: LX0019

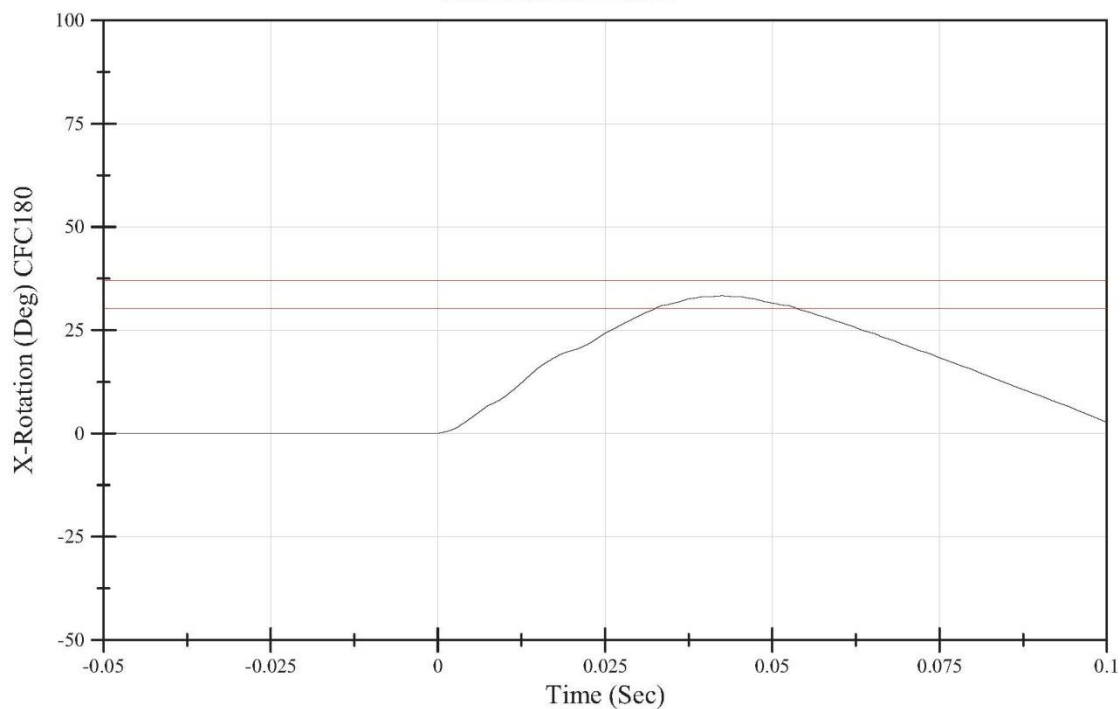


Software Version: 2.2

File Name: Ever_LX0019_2013_09_24 02 processed
09/24/2013 13:30:02.0000

Test Temperature: 71.1 degrees
Relative Humidity: 38.4%
Test Velocity: 1.98 m/s

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

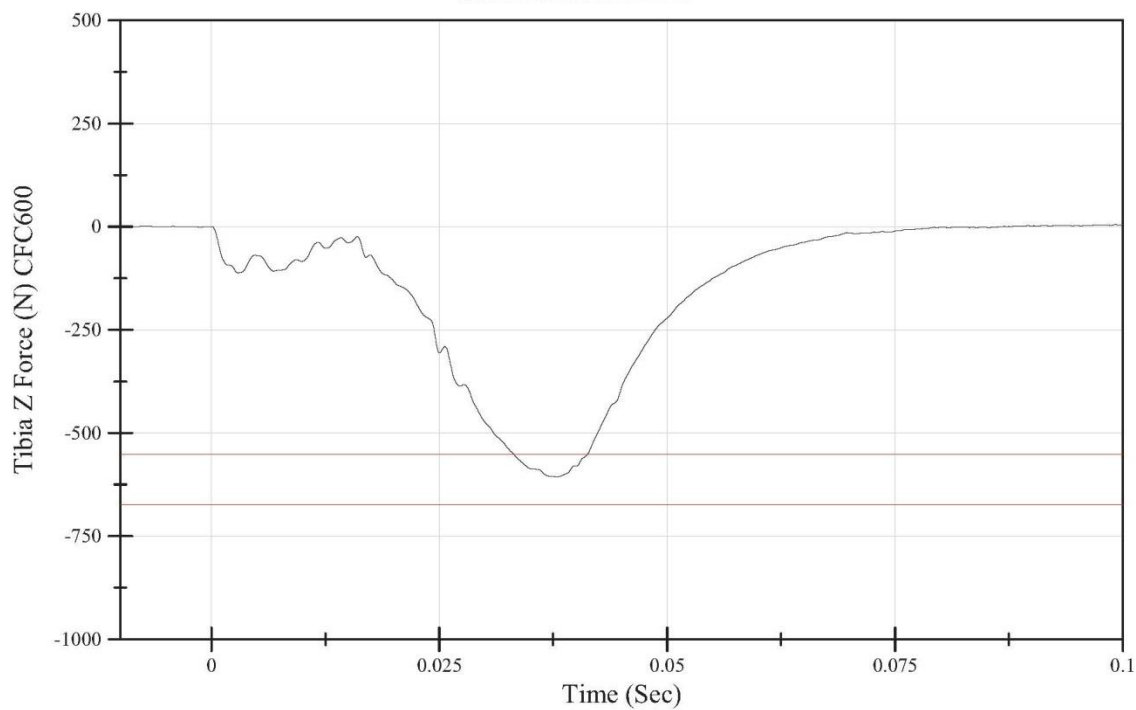


Software Version: 2.2

File Name: Ever_LX0019_2013_09_24 02 processed
09/24/2013 13:30:02.0000

Test Temperature: 70.7 degrees
Relative Humidity: 37.7%
Test Velocity: 1.95 m/s

THOR Left Foot Inversion Certification
Tibia Load
Serial Number: LX0019

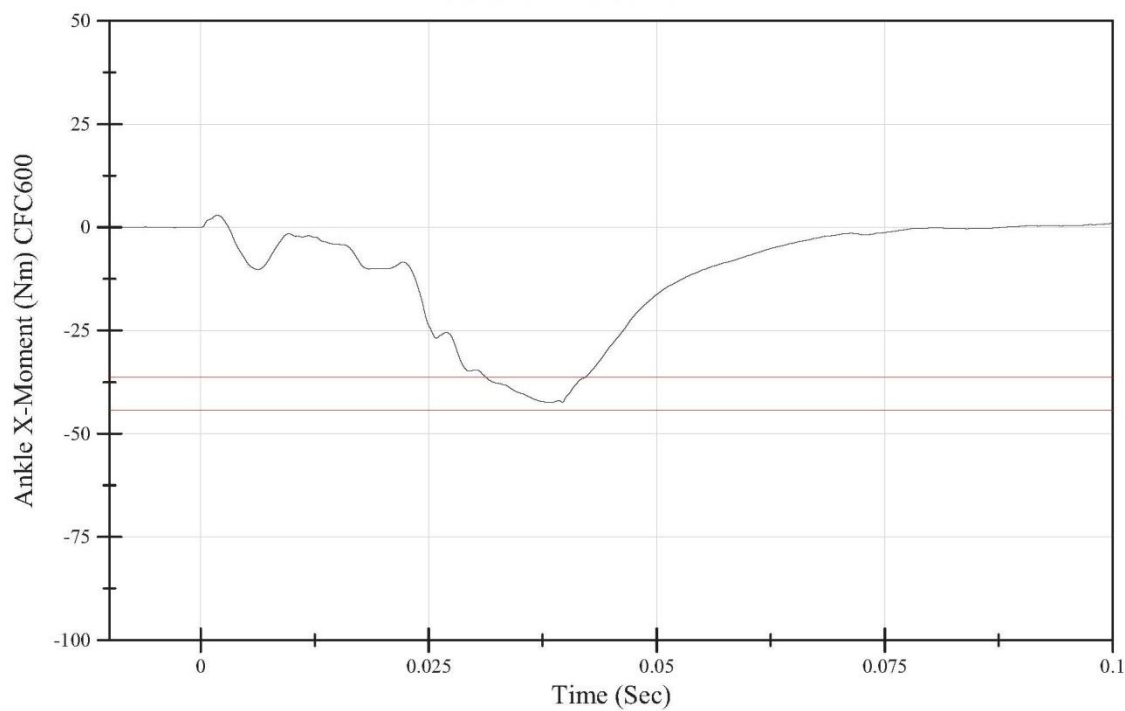


Software Version: 2.2

File Name: Inver_LX0019_2013_09_24 01 processed.dat
09/24/2013 12:25:35.0000

Test Temperature: 70.7 degrees
Relative Humidity: 37.7%
Test Velocity: 1.95 m/s

THOR Left Foot Inversion Certification
Ankle Moment
Serial Number: LX0019

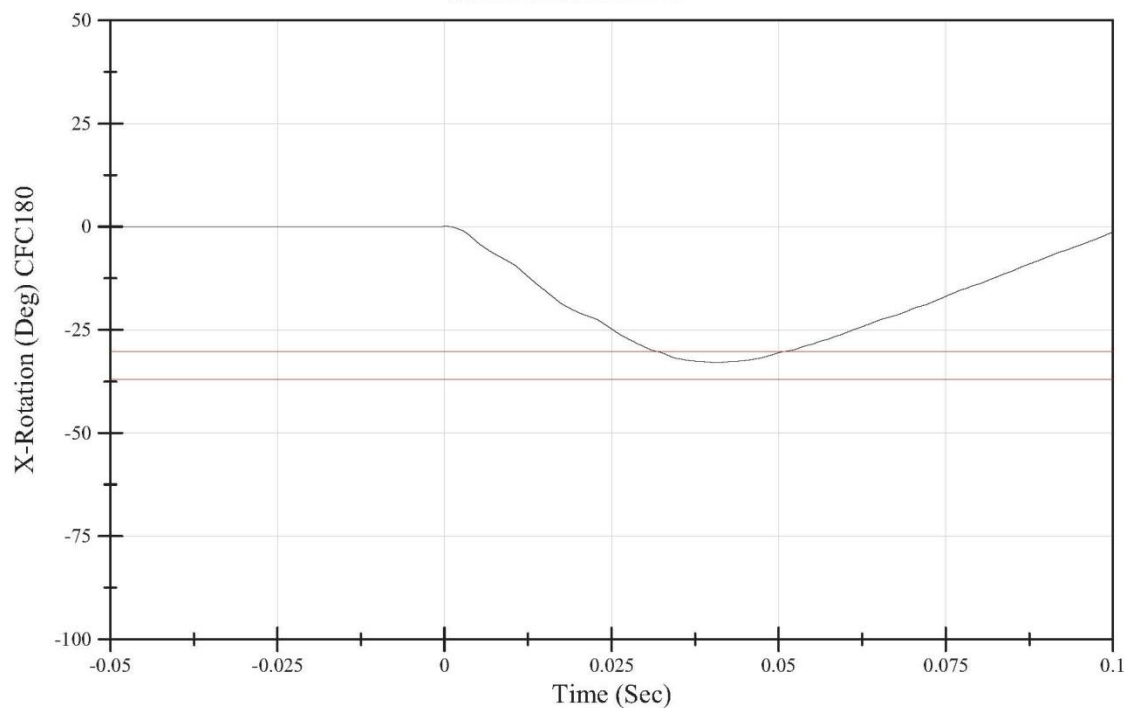


Software Version: 2.2

File Name: Inver_LX0019_2013_09_24 01 processed.dat
09/24/2013 12:25:35.0000

Test Temperature: 70.7 degrees
Relative Humidity: 37.7%
Test Velocity: 1.95 m/s

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

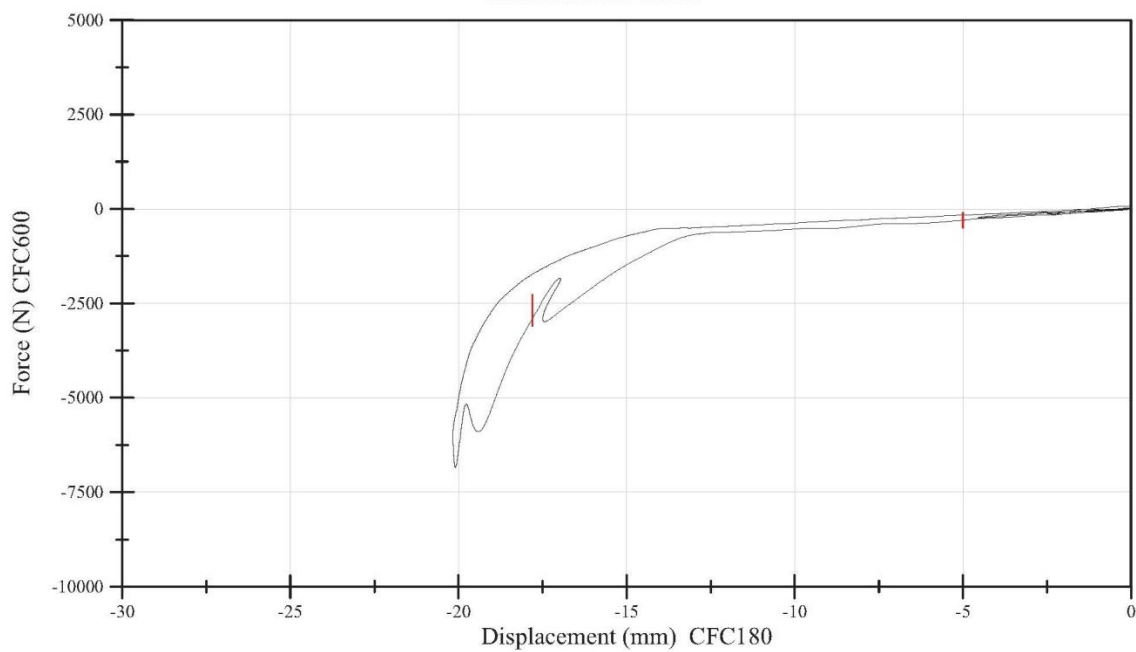


Software Version: 2.2

File Name: Inver_LX0019_2013_09_24 01 processed.dat
09/24/2013 12:25:35.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.72 m/s

THOR Right Knee Certification
Femur Force vs. Knee Displacement
Serial Number: LX0018

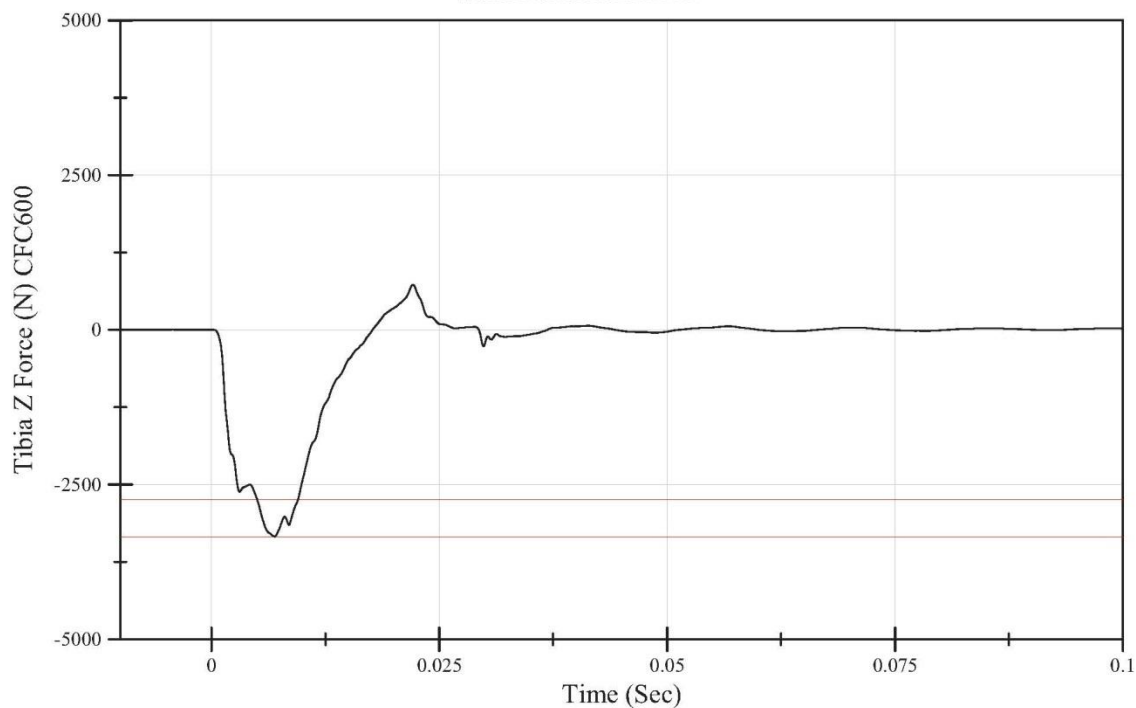


Software Version: 2.2

File Name: D2103657B_092613_01_DIADEMHeader_BINARYpp
09/26/2013 08:54:58.0000

Test Temperature: 70.2 degrees
Relative Humidity: 42.6%
Test Velocity: 4.03 m/s

THOR Right Foot Heel Certification
Tibia Load
Serial Number: LX0018

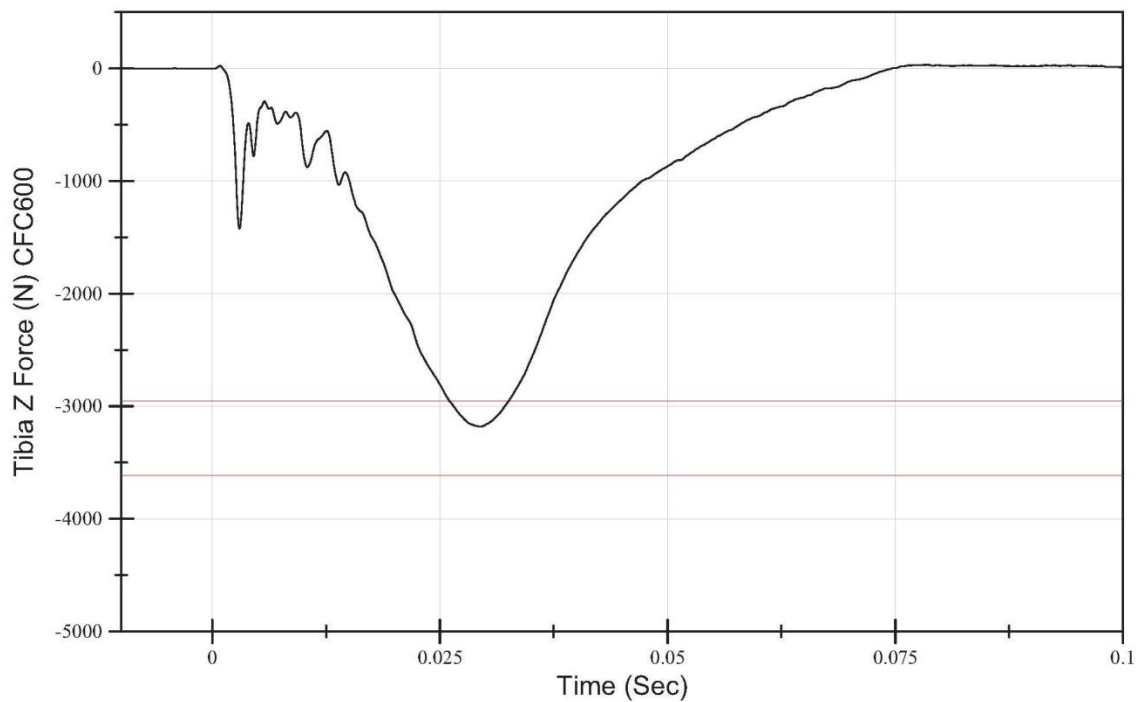


Software Version: 2.2

File Name: Heel_LX0018_2013_09_25 01 processed
09/25/2013 15:41:20.0000

Test Temperature: 70.7 degrees
Relative Humidity: 41.3%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0018

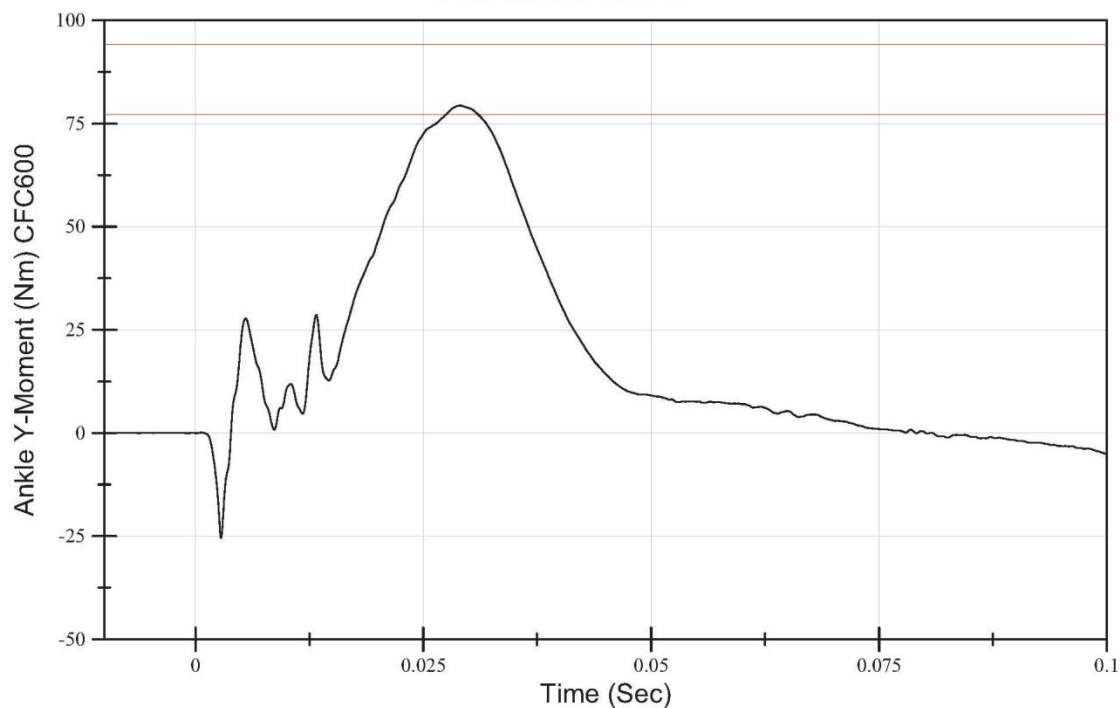


Software Version: 2.2

File Name: Ball_LX0018_2013_09_25 01 processed
09/25/2013 13:53:31.0000

Test Temperature: 70.7 degrees
Relative Humidity: 41.3%
Test Velocity: 5.03 m/s

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

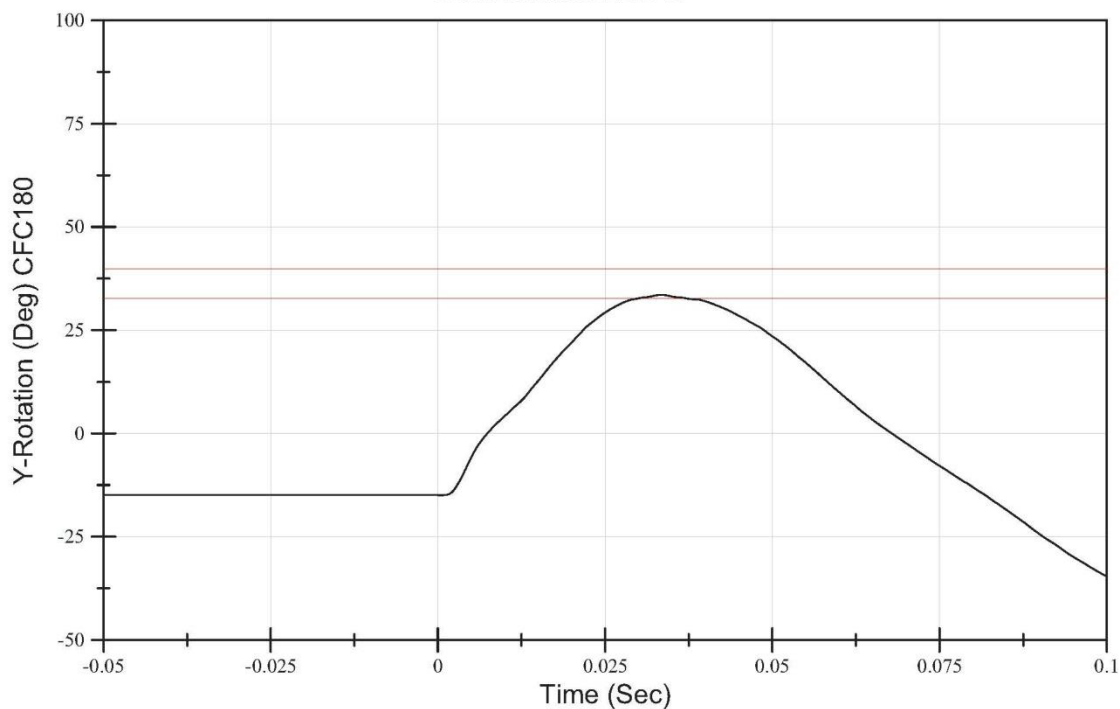


Software Version: 2.2

File Name: Ball_LX0018_2013_09_25 01 processed
09/25/2013 13:53:31.0000

Test Temperature: 70.7 degrees
Relative Humidity: 41.3%
Test Velocity: 5.03 m/s

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

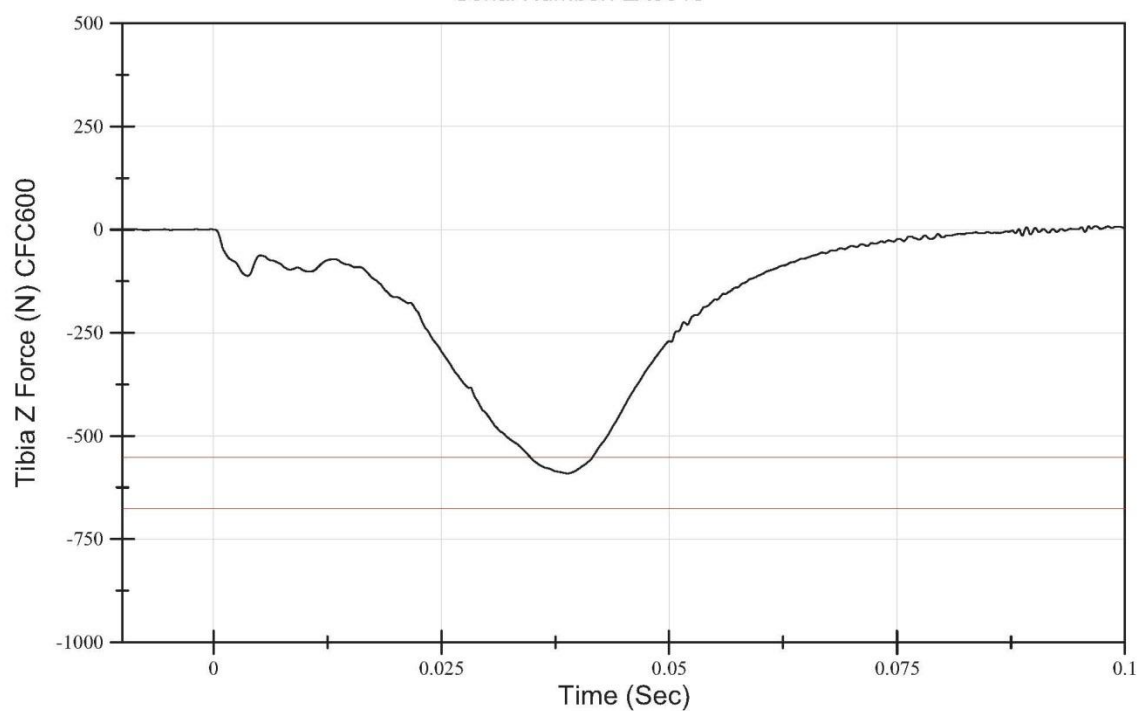


Software Version: 2.2

File Name: Ball_LX0018_2013_09_25 01 processed
09/25/2013 13:53:31.0000

Test Temperature: 70.2 degrees
Relative Humidity: 41.7%
Test Velocity: 1.96 m/s

THOR Right Foot Eversion Certification
Tibia Load
Serial Number: LX0018

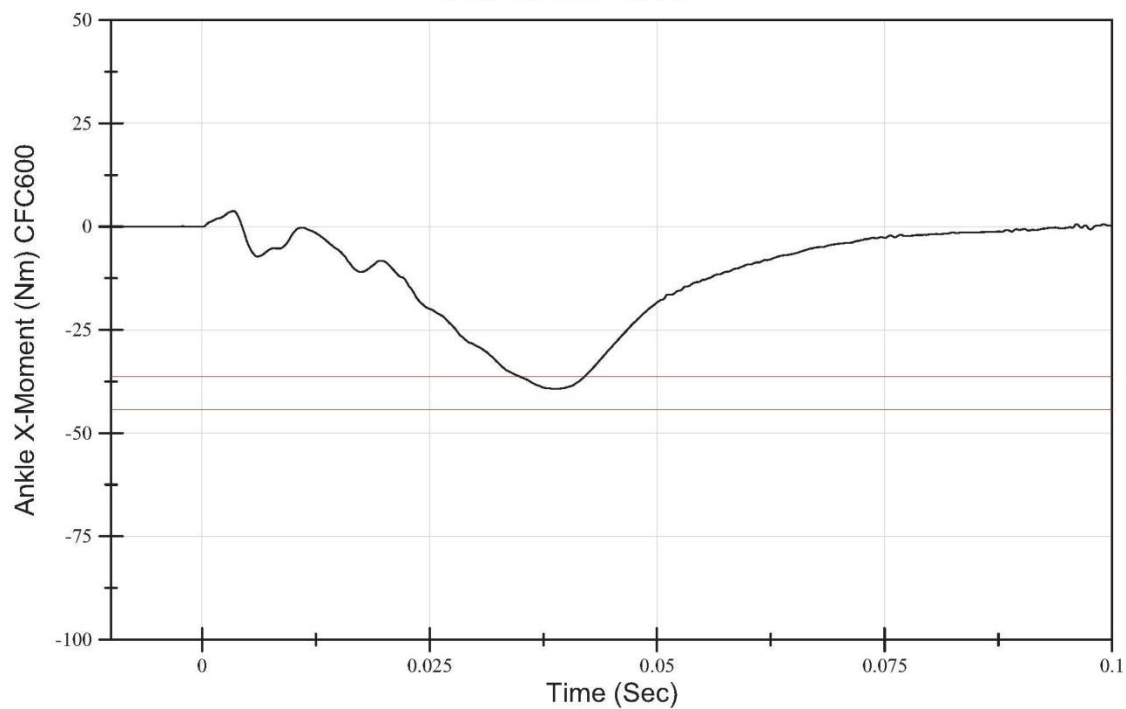


Software Version: 2.2

File Name: Ever_LX0018_2013_09_25 01
01/01/0000 00:00:00.0000

Test Temperature: 70.2 degrees
Relative Humidity: 41.7%
Test Velocity: 1.96 m/s

THOR Right Foot Eversion Certification
Ankle Moment
Serial Number: LX0018

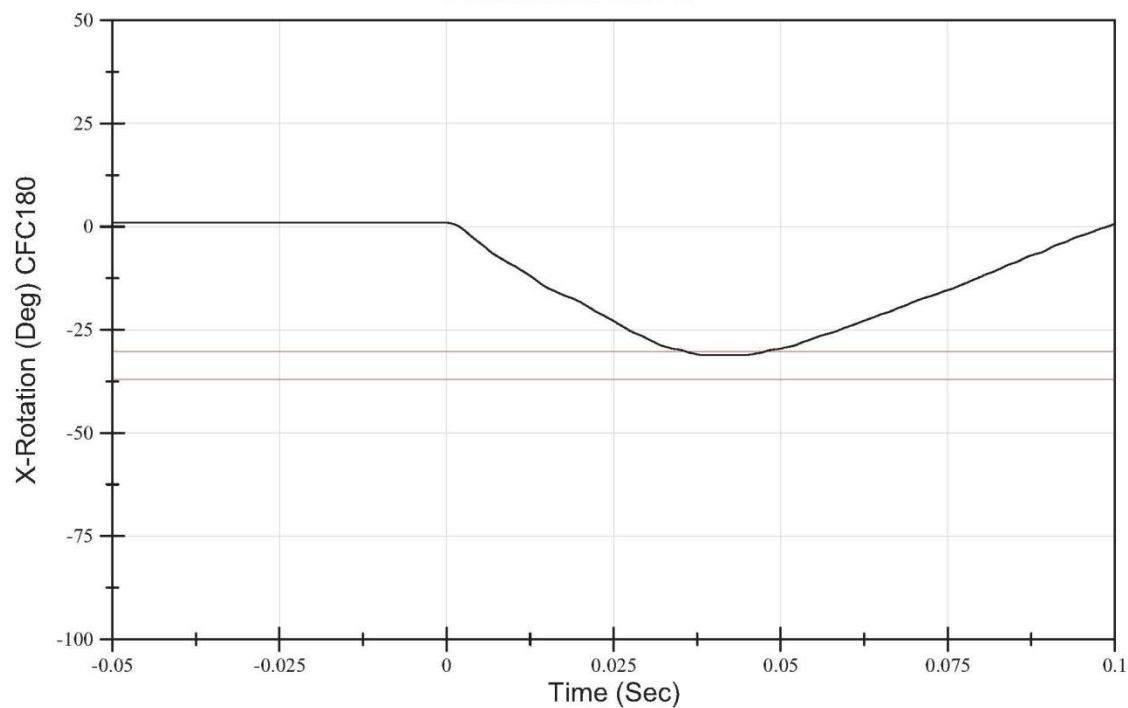


Software Version: 2.2

File Name: Ever_LX0018_2013_09_25 01
01/01/0000 00:00:00.0000

Test Temperature: 70.2 degrees
Relative Humidity: 41.7%
Test Velocity: 1.96 m/s

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

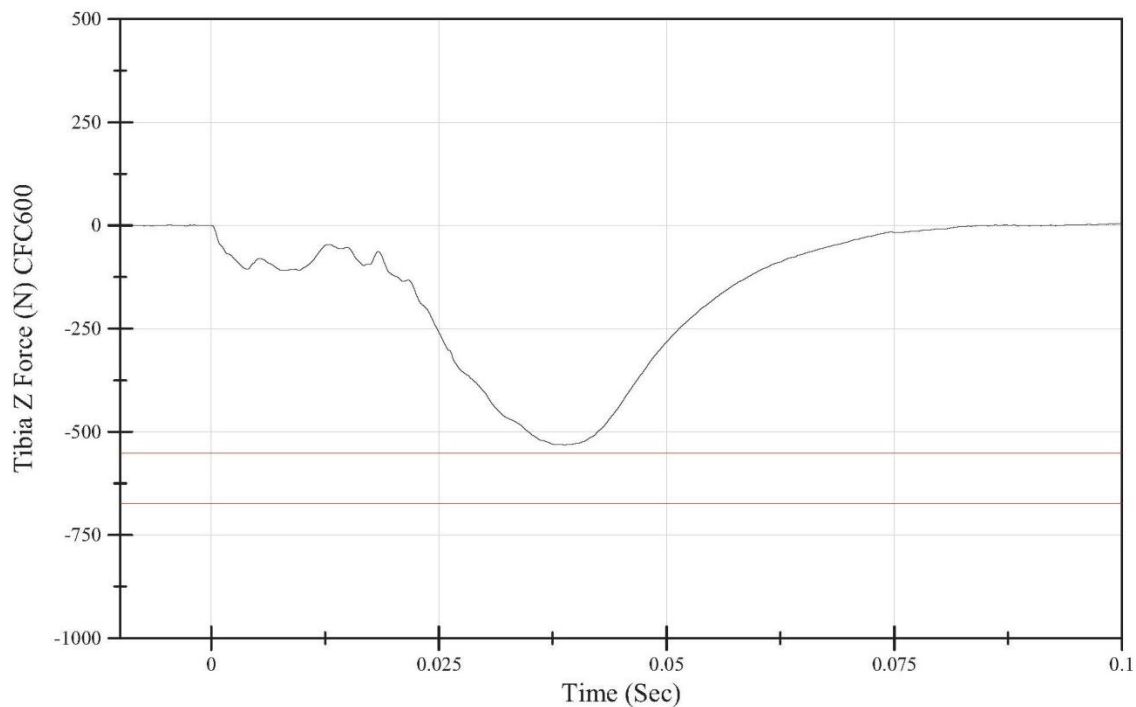


Software Version: 2.2

File Name: Ever_LX0018_2013_09_25 01
01/01/0000 00:00:00.0000

Test Temperature: 70.4 degrees
Relative Humidity: 41.7%
Test Velocity: 1.95 m/s

THOR Right Foot Inversion Certification
Tibia Load
Serial Number: LX0018



Software Version: 2.2

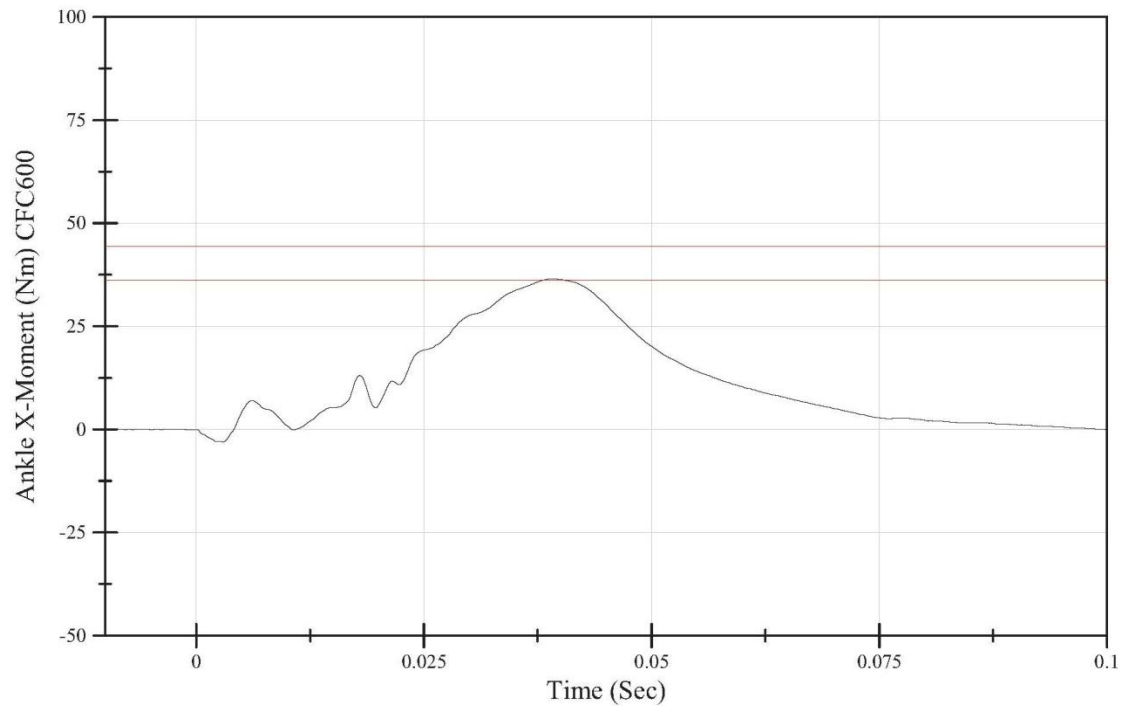
File Name: Inver_LX0018_2013_09_25 01 processed
09/25/2013 14:22:55.0000

Test Temperature: 70.4 degrees
Relative Humidity: 41.7%
Test Velocity: 1.95 m/s

THOR Right Foot Inversion Certification

Ankle Moment

Serial Number: LX0018



Software Version: 2.2

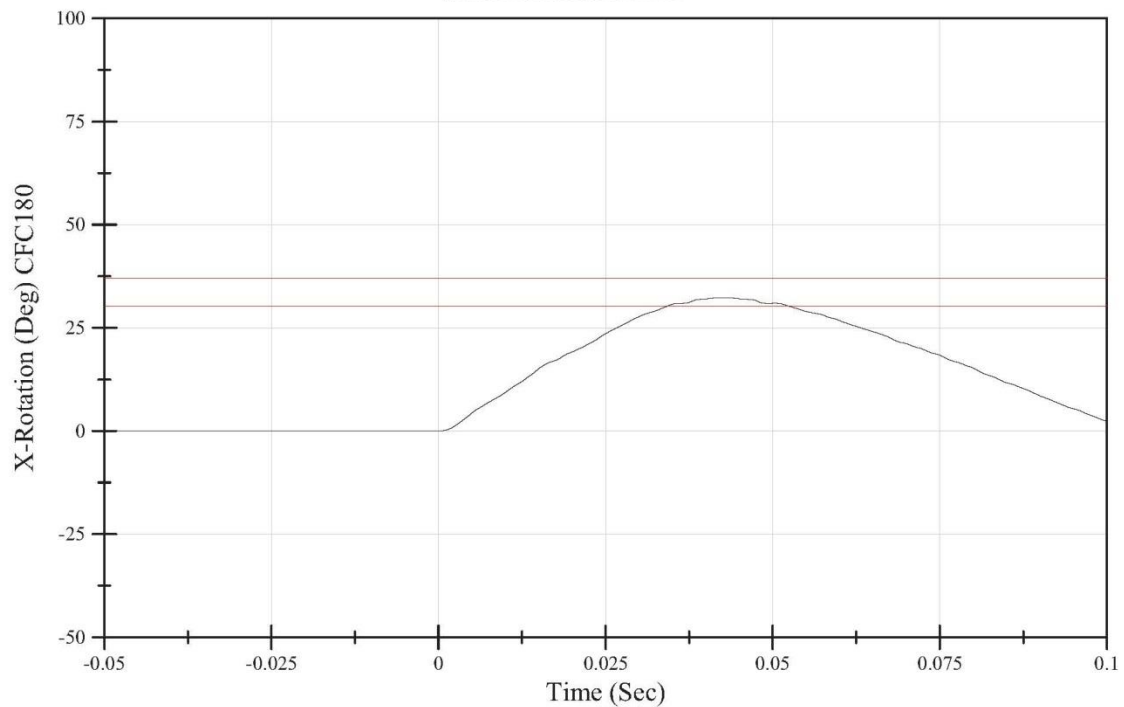
File Name: Inver_LX0018_2013_09_25 01 processed
09/25/2013 14:22:55.0000

Test Temperature: 70.4 degrees
Relative Humidity: 41.7%
Test Velocity: 1.95 m/s

THOR Right Foot Inversion Certification

Ankle X-Rotation

Serial Number: LX0018



Software Version: 2.2

File Name: Inver_LX0018_2013_09_25 01 processed
09/25/2013 14:22:55.0000

50% ADULT MALE THOR015 DUMMY CALIBRATIONS

Summary of Thor 15 Certification Test Results

Reported by: Calspan

Technician: M. Goehle

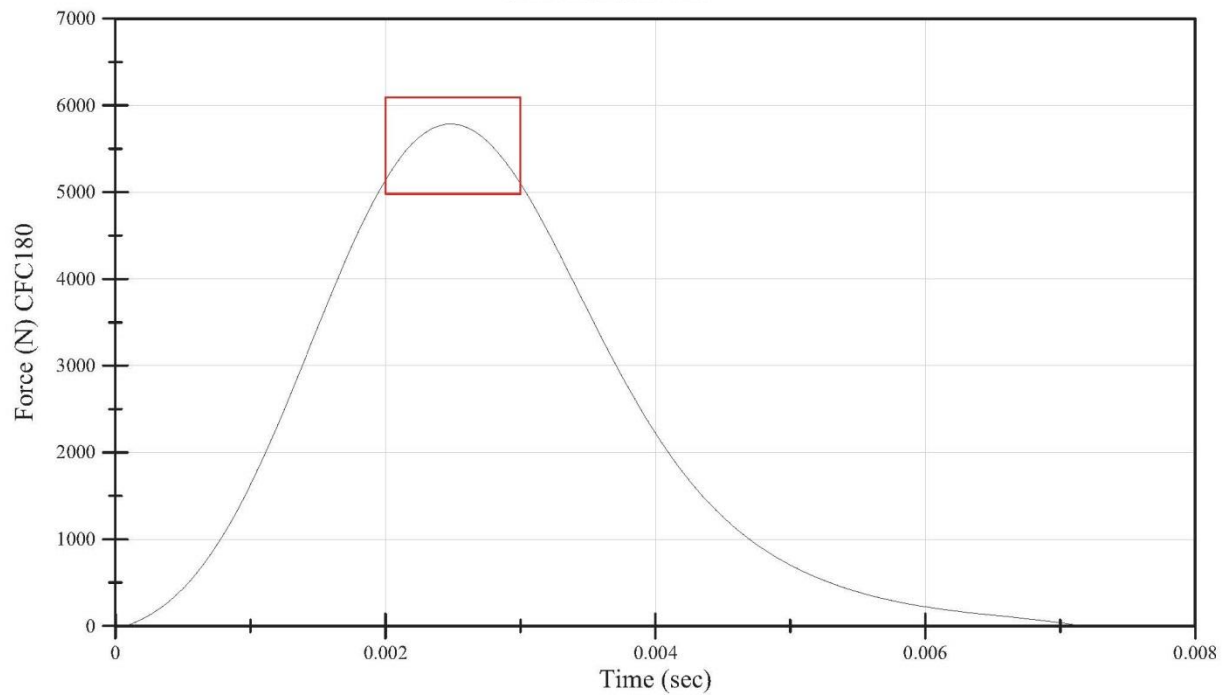
Date: 10/28/2013

Head Impact	Passed
Occipital Condyle Quasi-Static	Failed
Neck Left Lateral Flexion	Failed
Neck Right Lateral Flexion	Failed
Neck Flexion	Failed
Neck Extension	Failed
Upper Thorax	Failed
Lower Left Oblique Thorax	Failed
Lower Right Oblique Thorax	Failed
Upper Abdomen	Failed
Lower Abdomen	Failed
Left Femur	Passed
Right Femur	Passed
Left Knee	Passed
Right Knee	Passed
Left Foot Inversion	Passed
Left Foot Eversion	Passed
Left Heel of Foot	Failed
Left Ball of Foot	Failed
Right Foot Inversion	Failed
Right Foot Eversion	Passed
Right Heel of Foot	Passed
Right Ball of Foot	Passed

Certifications performed by VRTC

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 1.98 m/s

THOR Head Impact Certification
Probe Force
Serial Number: T015

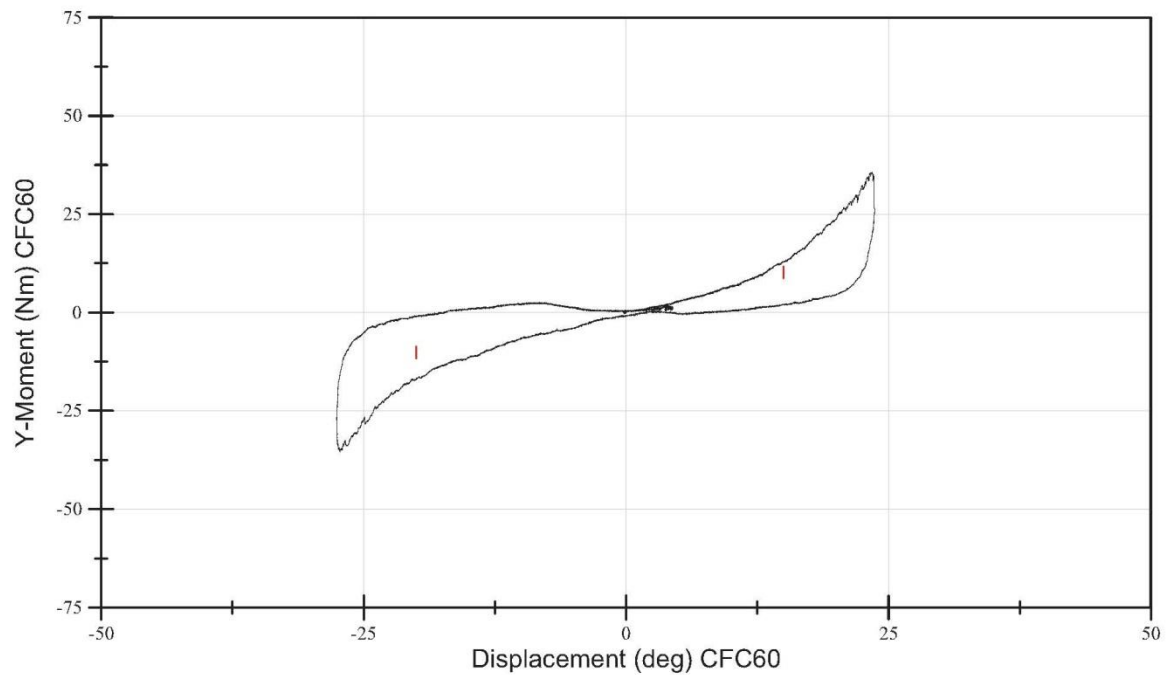


Software Version: 2.2

File Name: T015HEAD102113_01_DIADEMHeader_BINARYpp
10/21/2013 14:14:18.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 0 m/s

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

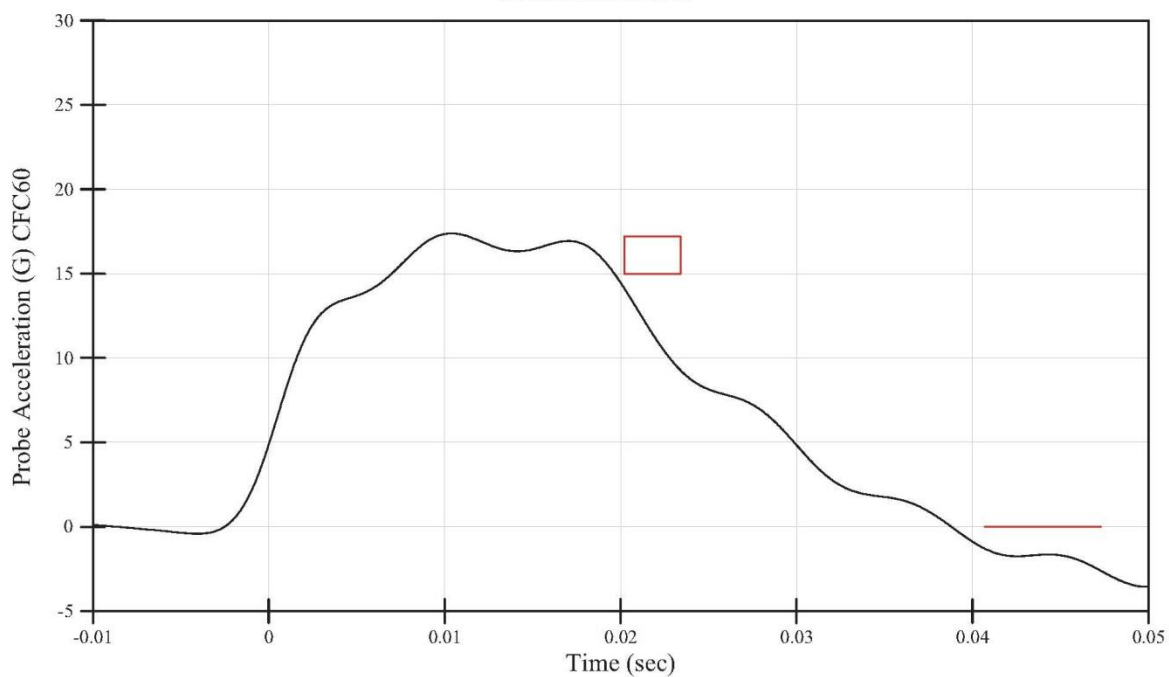


Software Version: 2.2

File Name: T015OC092513_01_DIADEMHeader_BINARYpp
09/25/2013 12:51:25.0000

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.90 m/s

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

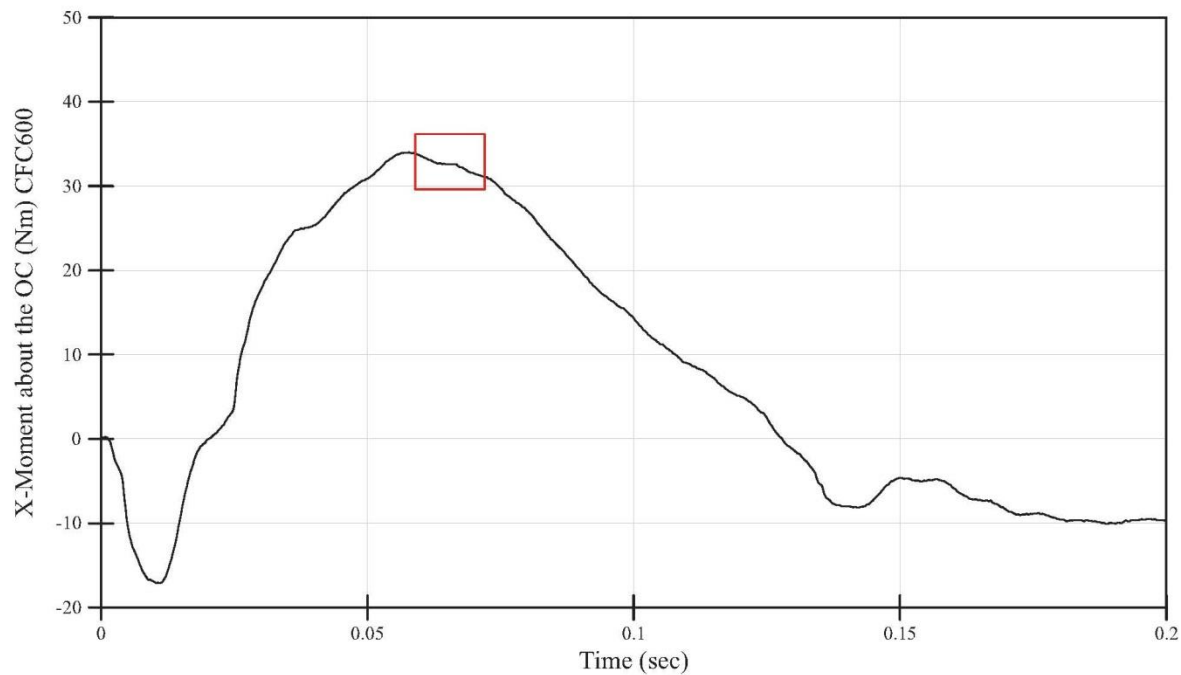


Software Version: 2.2

File Name: T015NECKLEFT093013_01_DIADEMHeader_BINARYpp
09/30/2013 13:01:45.0000

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.90 m/s

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

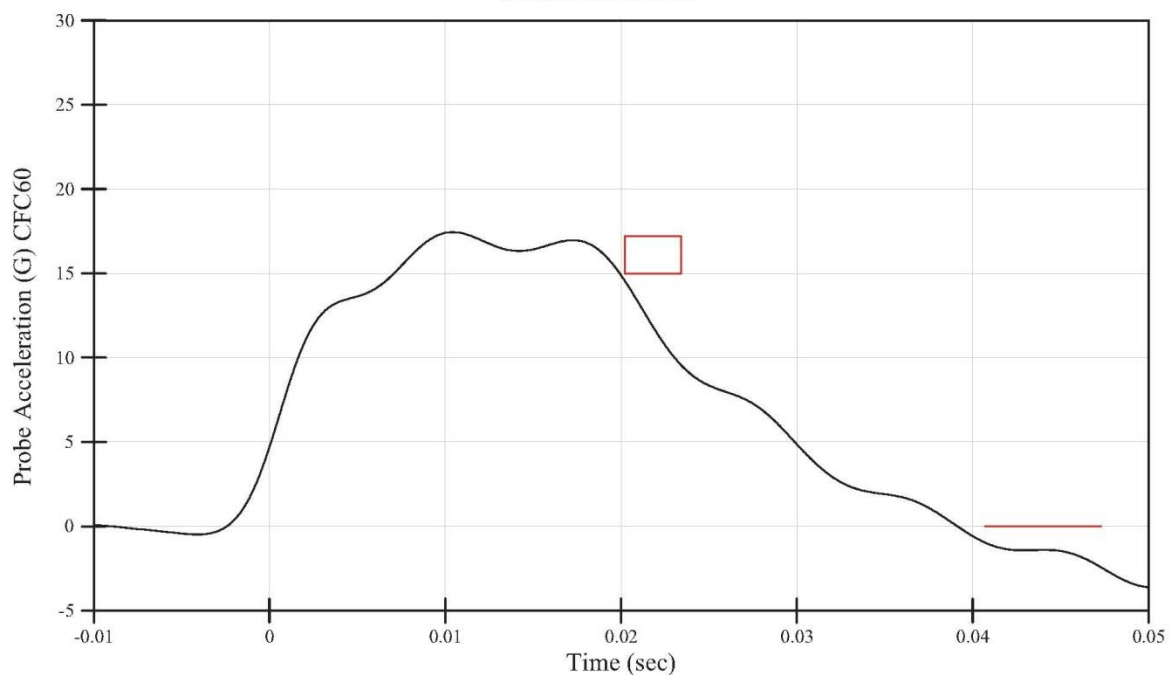


Software Version: 2.2

File Name: T015NECKLEFT093013_01_DIADEMHeader_BINARYpp
09/30/2013 13:01:45.0000

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.91 m/s

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

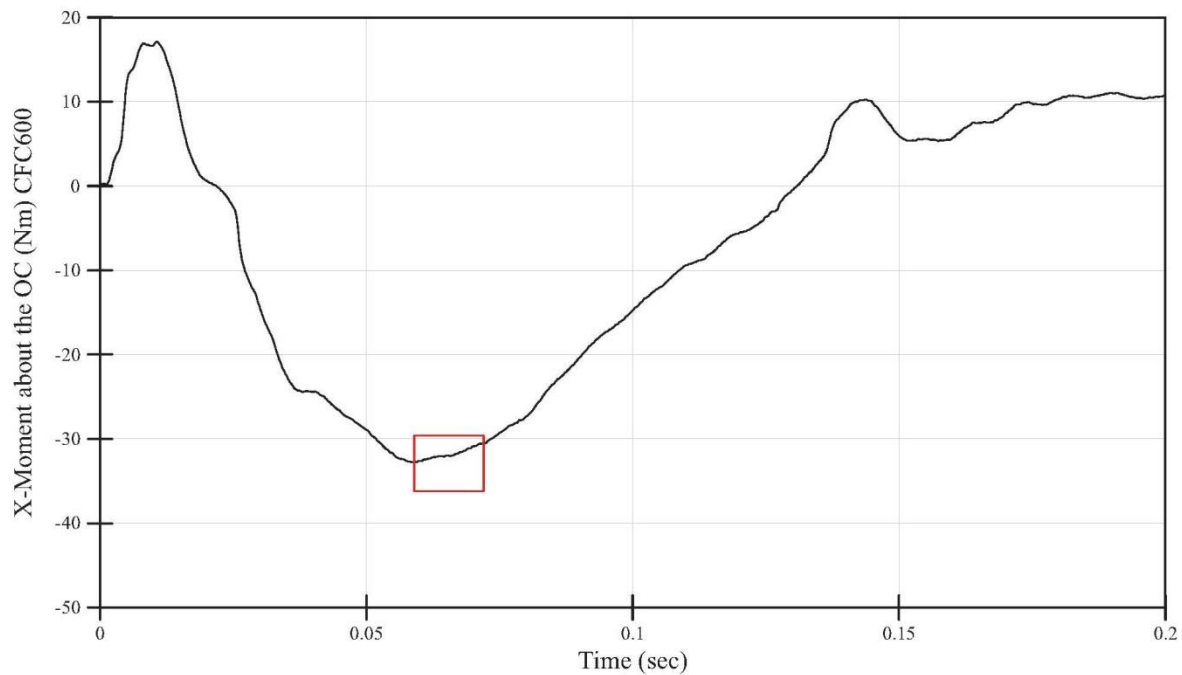


Software Version: 2.2

File Name: T015NECKRIGHT093013_01_DIAdemHeader_BINARYpp
09/30/2013 12:10:08.0000

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.91 m/s

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

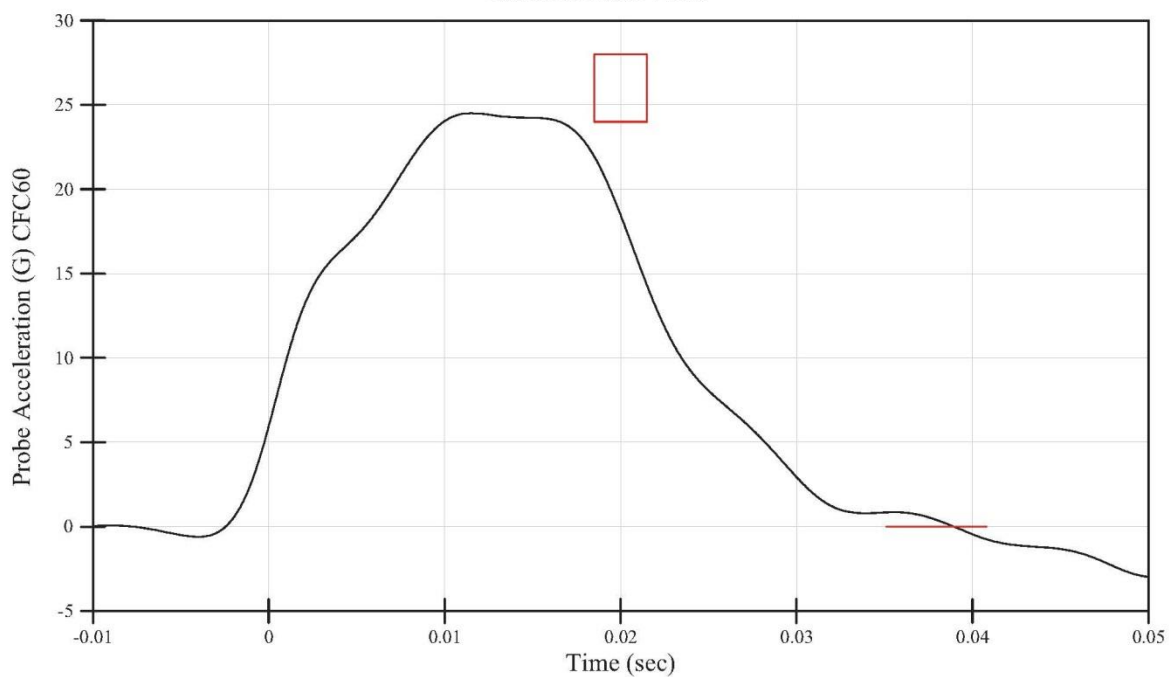


Software Version: 2.2

File Name: T015NECKRIGHT093013_01_DIAdemHeader_BINARYpp
09/30/2013 12:10:08.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 3.81 m/s

THOR Neck Flexion Certification
Probe Acceleration
Serial Number: T015

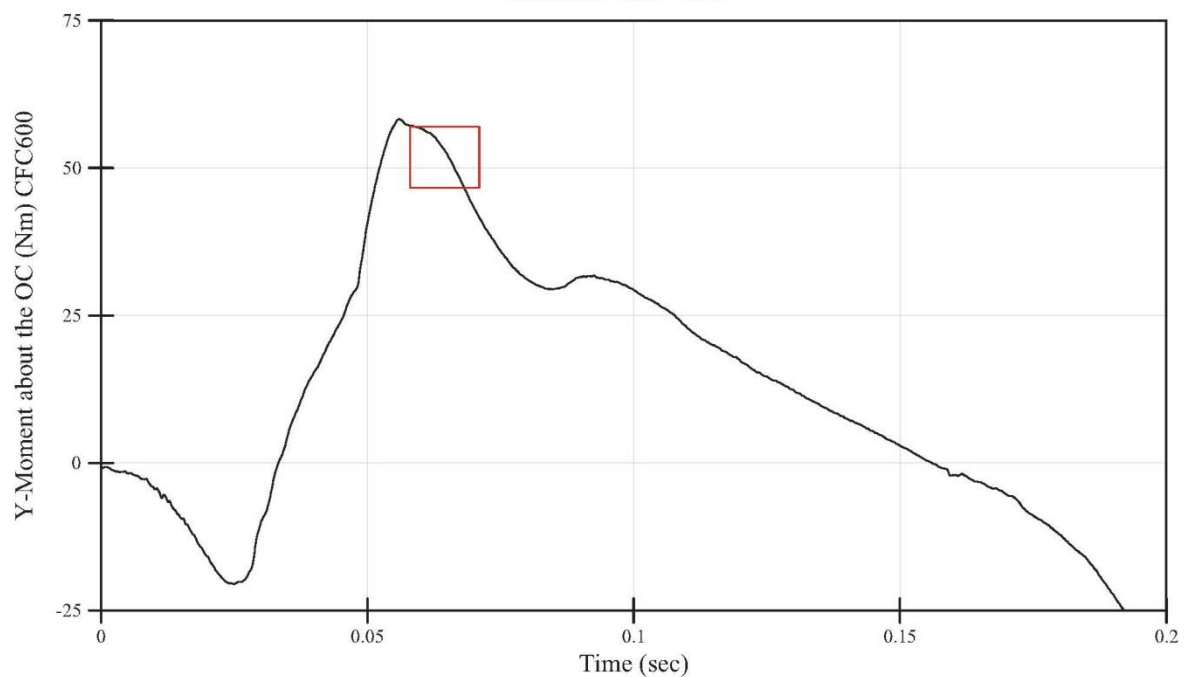


Software Version: 2.2

File Name: T015FLEX093013_01_DIADEMHeader_BINARYpp
09/30/2013 08:55:22.0000

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 3.81 m/s

THOR Neck Flexion Certification
Y-Moment
Serial Number: T015

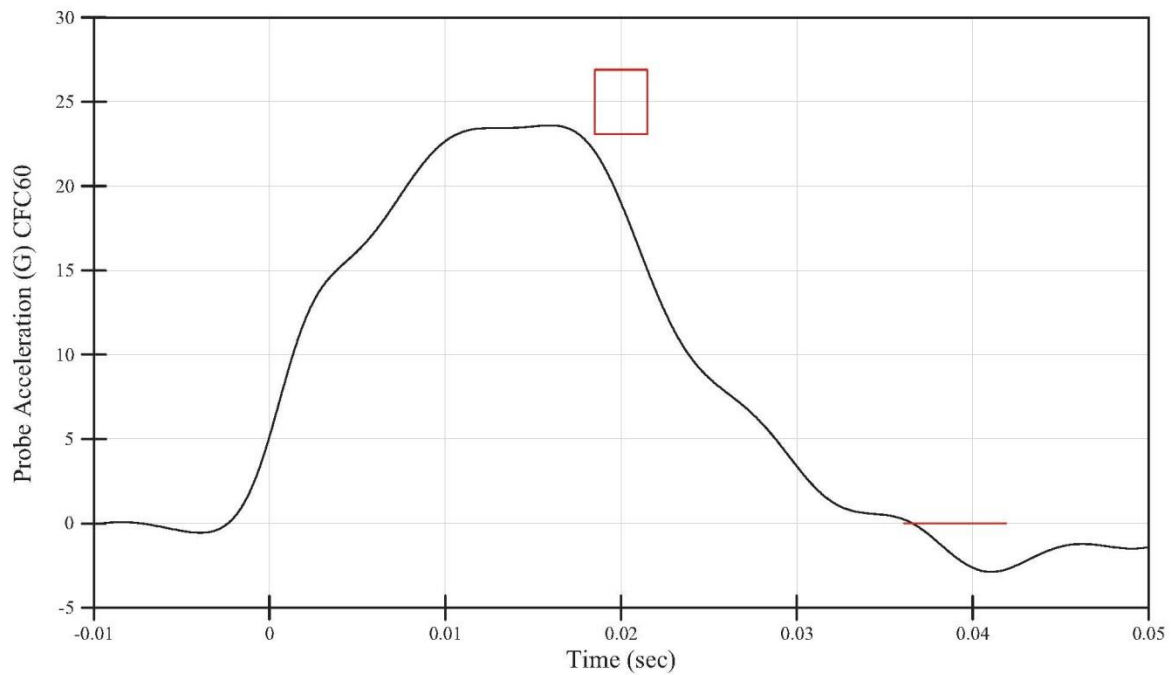


Software Version: 2.2

File Name: T015FLEX093013_01_DIADEMHeader_BINARYpp
09/30/2013 08:55:22.0000

Test Temperature: 70 degrees
Relative Humidity: 52%
Test Velocity: 3.68 m/s

THOR Neck Extension Certification
Probe Acceleration
Serial Number: T015

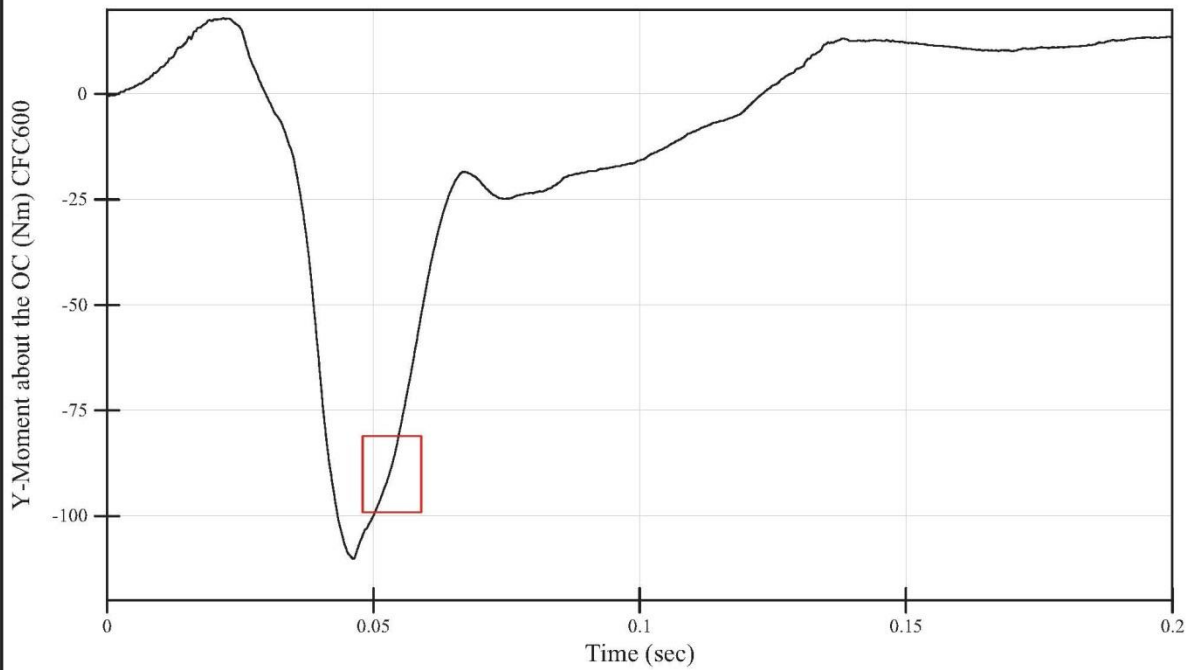


Software Version: 2.2

File Name: T015NECKEXT093013_01_DIAdemHeader_BINARYpp
09/30/2013 09:28:21.0000

Test Temperature: 70 degrees
Relative Humidity: 52%
Test Velocity: 3.68 m/s

THOR Neck Extension Certification
Y-Moment
Serial Number: T015

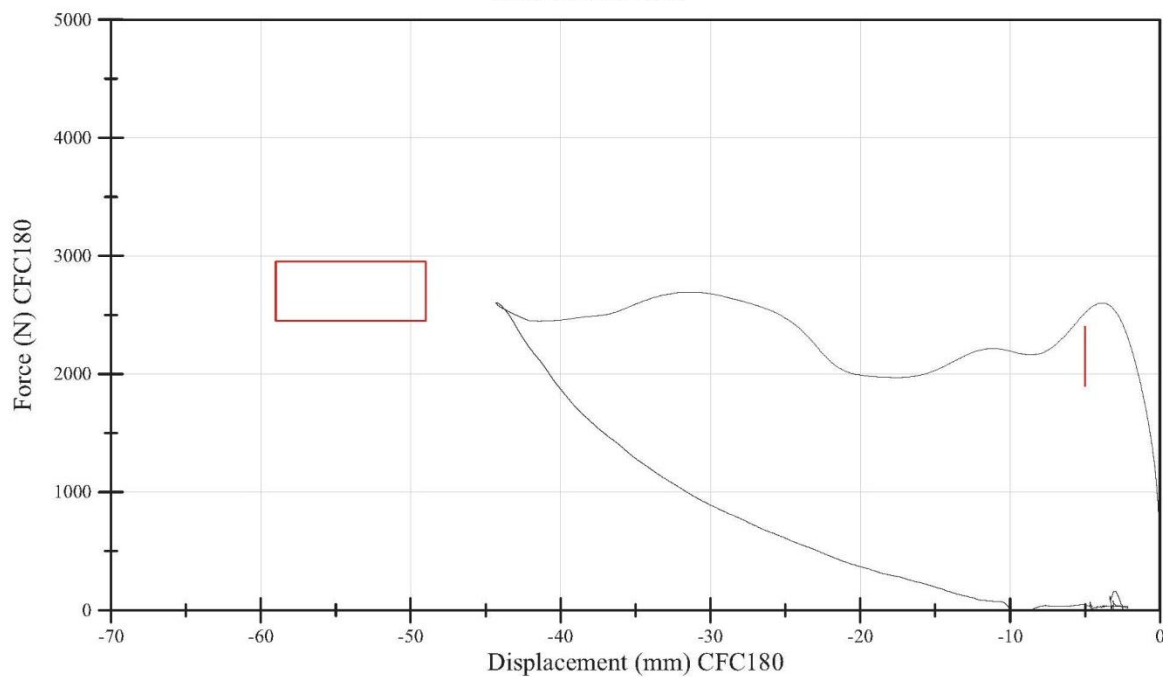


Software Version: 2.2

File Name: T015NECKEXT093013_01_DIAdemHeader_BINARYpp
09/30/2013 09:28:21.0000

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 4.31 m/s

THOR Upper Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T015

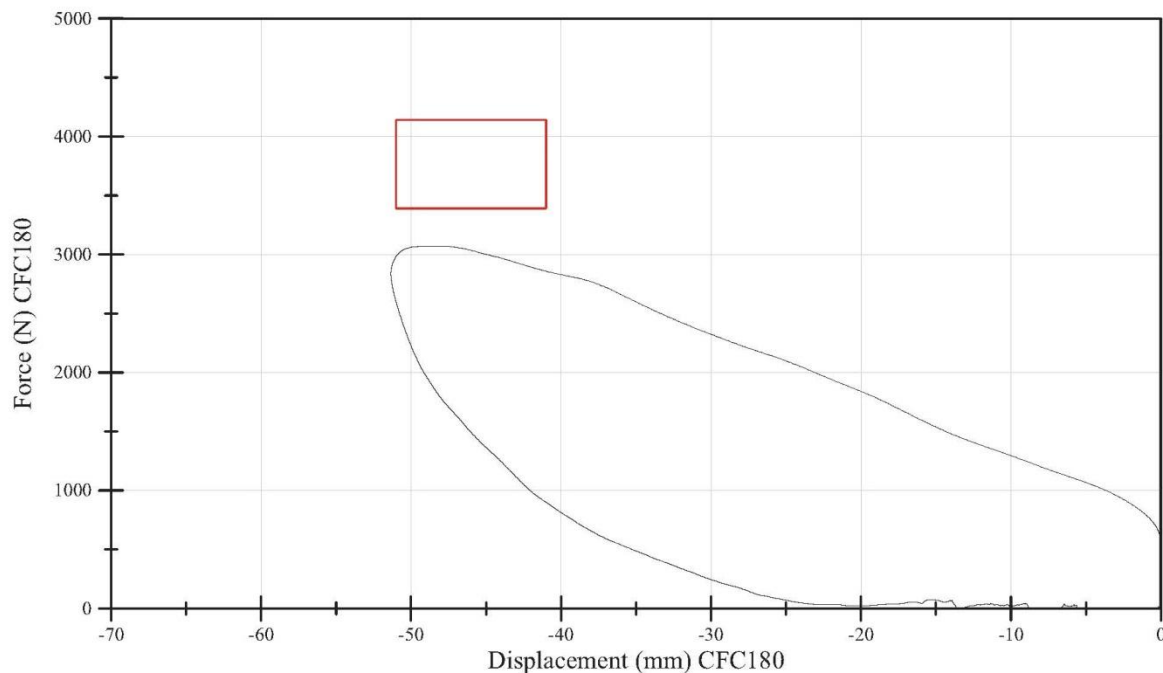


Software Version: 2.2

File Name: T015THORAXUPPER102113_01_DIADEMHeader_BINARYpp
10/21/2013 09:00:19.0000

Test Temperature: 72 degrees
Relative Humidity: 55%
Test Velocity: 4.27 m/s

THOR Lower Left Oblique Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T015

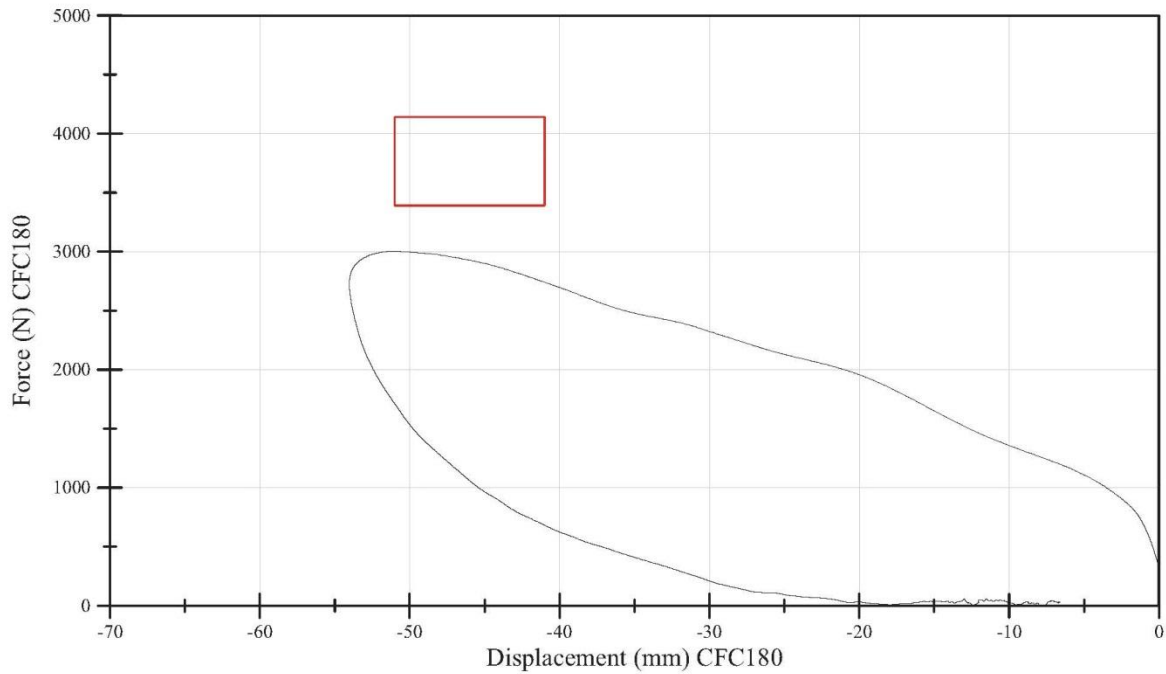


Software Version: 2.2

File Name: T015THORAXLEFT101713_01_DIADEMHeader_BINARYpp
10/17/2013 14:07:04.0000

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 4.31 m/s

THOR Lower Right Oblique Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T015

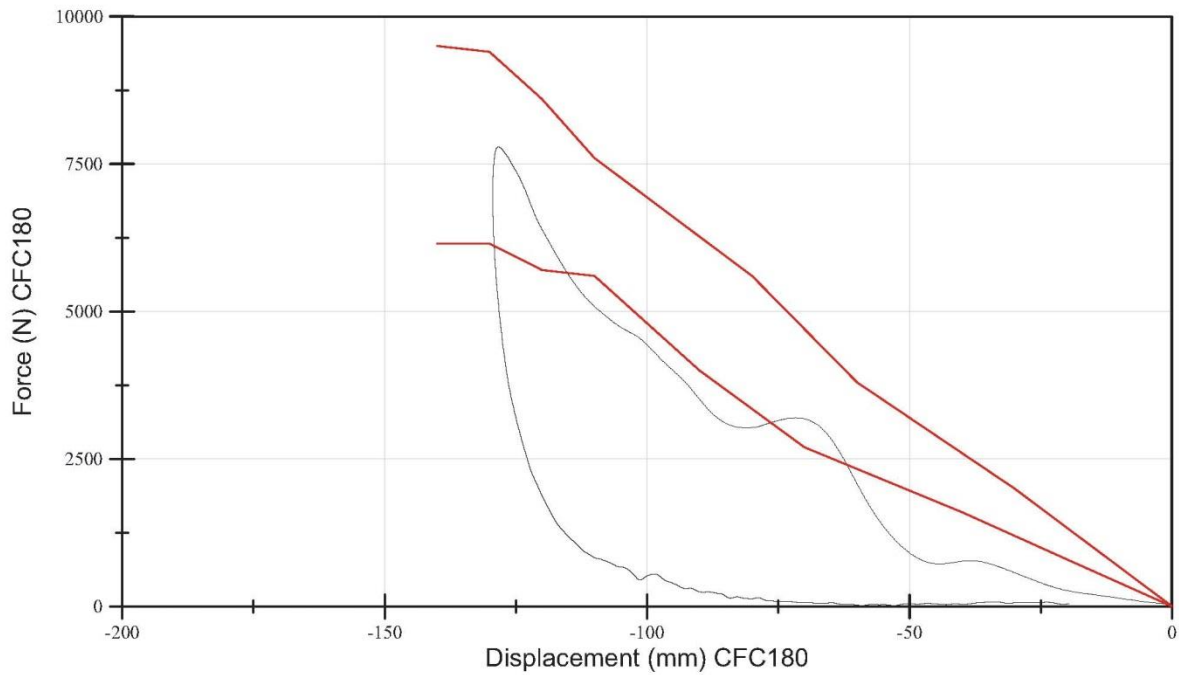


Software Version: 2.2

File Name: T015THORAXRIGHT100113_01_DIAdemHeader_BINARYpp
10/01/2013 08:29:25.0000

Test Temperature: 71 degrees
Relative Humidity: 51%
Test Velocity: 8.06 m/s

THOR Upper Abdomen Certification
Abdomen Displacement vs. Probe Force
Serial Number: T015

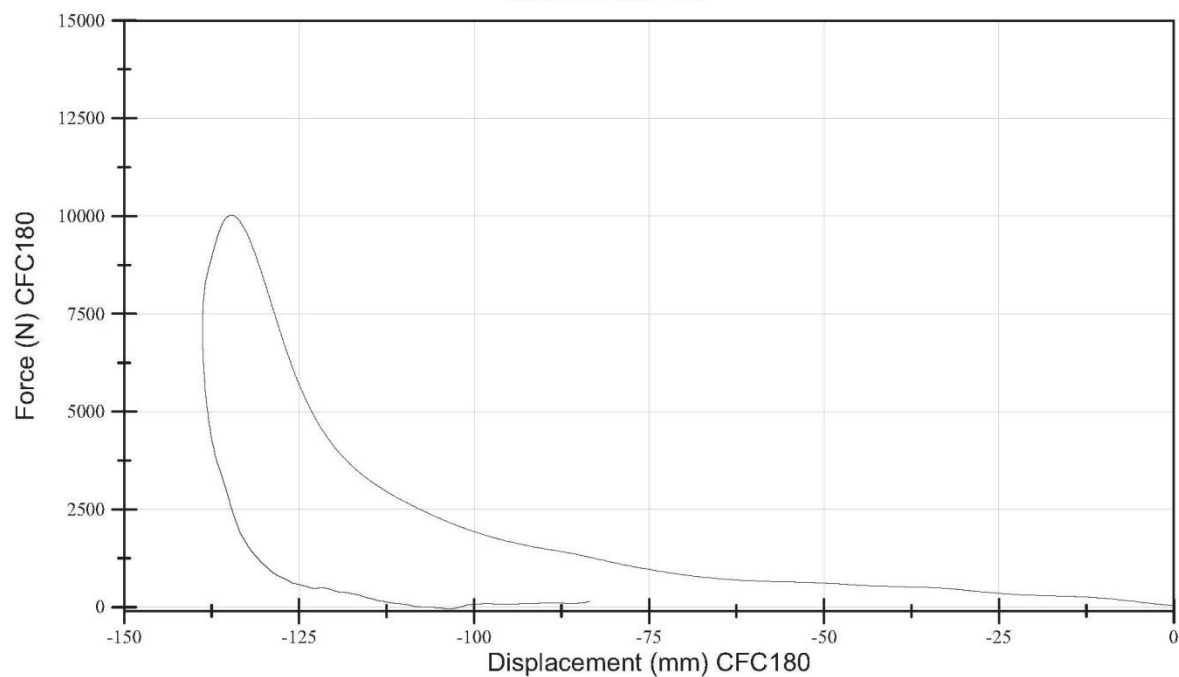


Software Version: 2.2

File Name: T015ABDOMENUPPER101713_01_DIAdemHeader_BINARYpp
10/17/2013 16:20:04.0000

Test Temperature: 71 degrees
Relative Humidity: 51%
Test Velocity: 6.1 m/s

THOR Lower Abdomen Certification
Lower Abdomen Deflection (via PENXG and T12XG) vs. Probe Force
Serial Number: 015



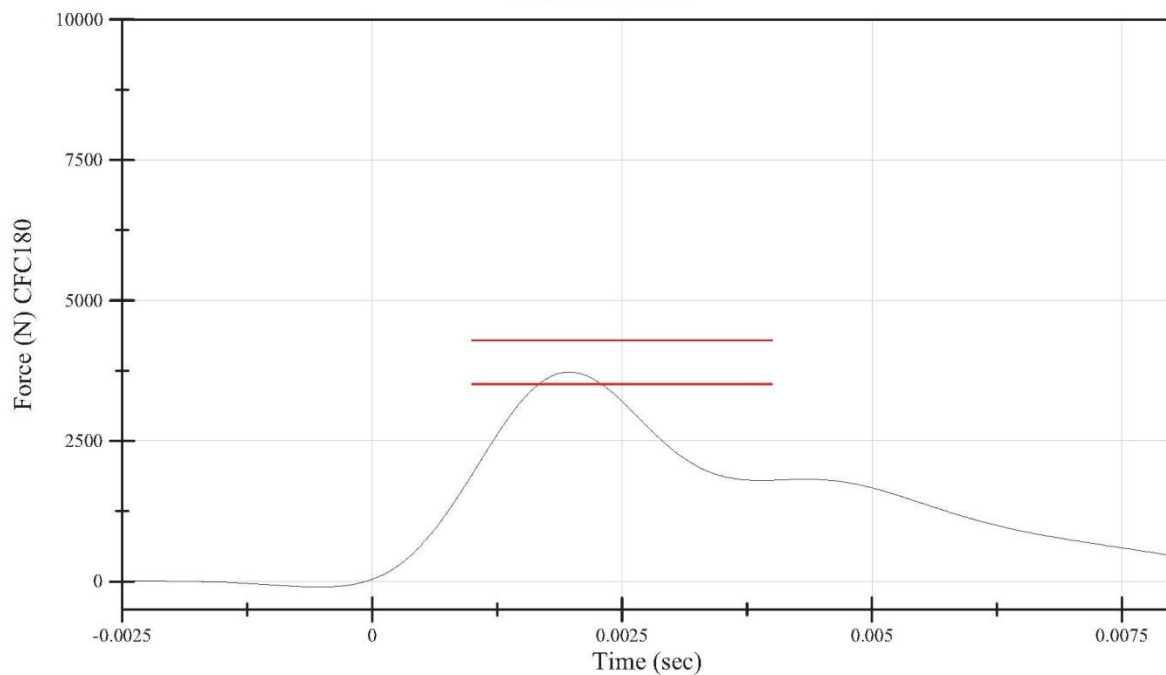
File Name: T015ABDOMENLOWER102113_01_DIADEMHeader_BINARY

Software Version:

01/01/0000 00:00:00.0000

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 2.58 m/s

THOR Left Femur Certification
Probe Force
Serial Number: T015



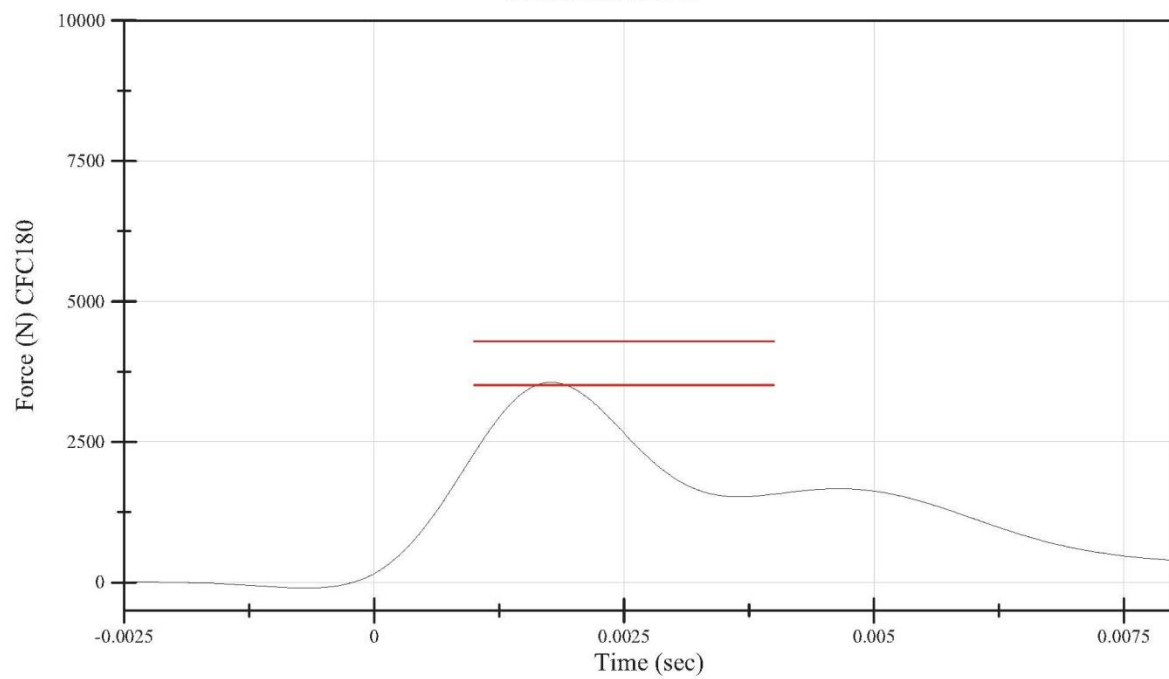
File Name: T015FEMURLEFT102213_01_DIADEMHeader_BINARYpp

Software Version: 2.2

10/22/2013 14:06:02.0000

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 2.58 m/s

THOR Right Femur Certification
Probe Force
Serial Number: T015



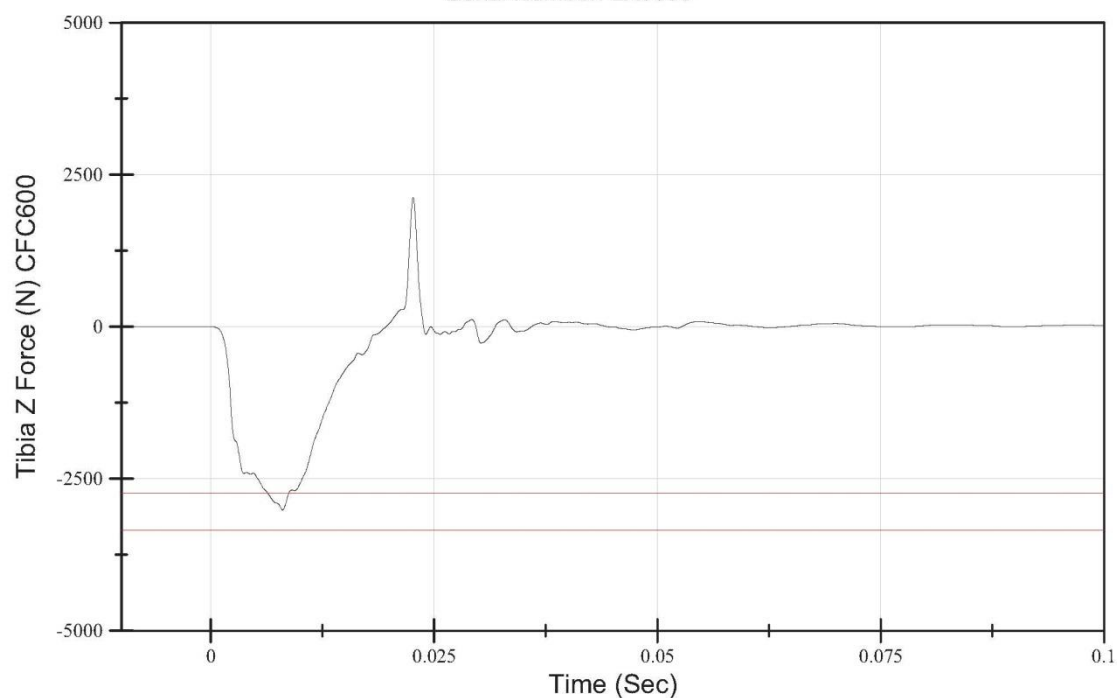
Software Version: 2.2

File Name: T015FEMURRIGHT102213_01_DIAdemHeader_BINARYpp
10/22/2013 14:07:36.0000

THOR 015 LEG CALIBRATIONS
LX0039 / LX0038

Test Temperature: 71.4 degrees
Relative Humidity: 35.9%
Test Velocity: 3.97 m/s

THOR Left Foot Heel Certification
Tibia Load
Serial Number: LX0039

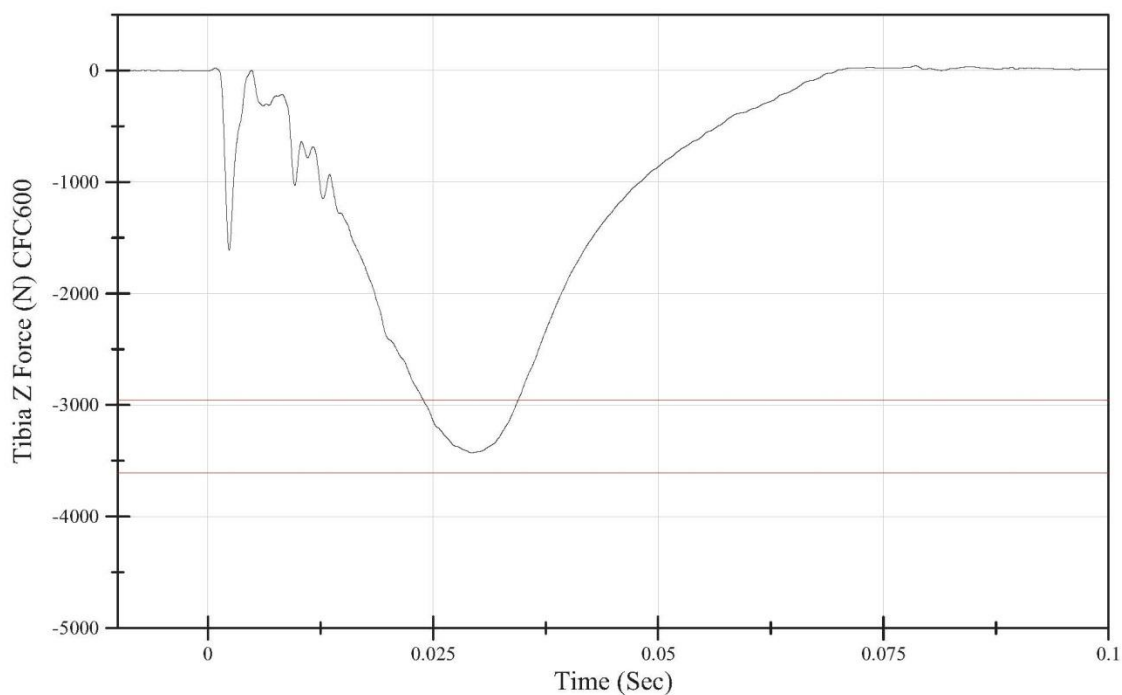


Software Version: 2.2

File Name: Heel_LX0039_2013_10_22 01 processed
10/22/2013 07:59:48.0000

Test Temperature: 70.2 degrees
Relative Humidity: 32.6%
Test Velocity: 5.03 m/s

THOR Left Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0039

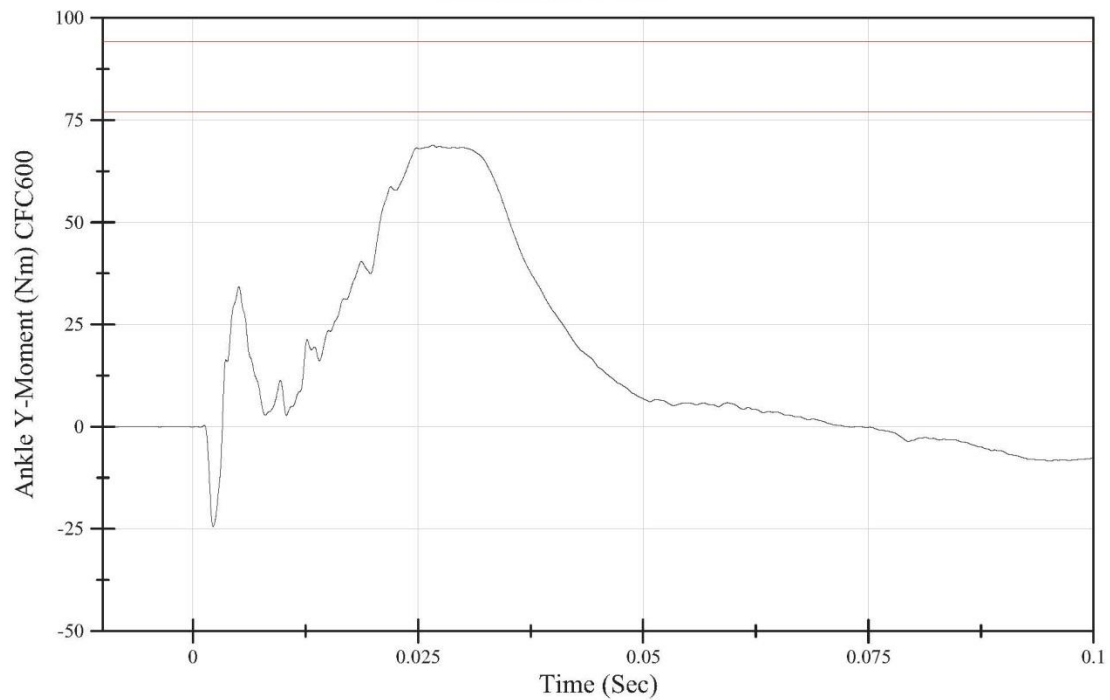


Software Version: 2.2

File Name: Ball_LX0039_2013_10_21 01 processed
10/29/2013 13:51:35.0000

Test Temperature: 70.2 degrees
Relative Humidity: 32.6%
Test Velocity: 5.03 m/s

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

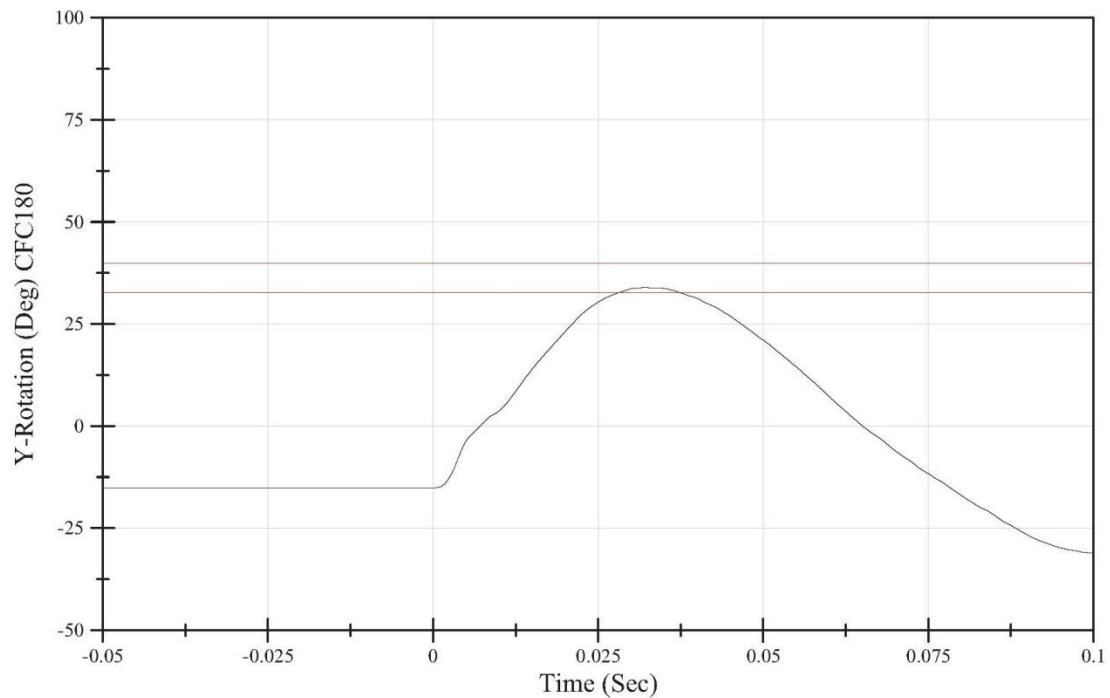


Software Version: 2.2

File Name: Ball_LX0039_2013_10_21 01 processed
10/29/2013 13:51:35.0000

Test Temperature: 70.2 degrees
Relative Humidity: 32.6%
Test Velocity: 5.03 m/s

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

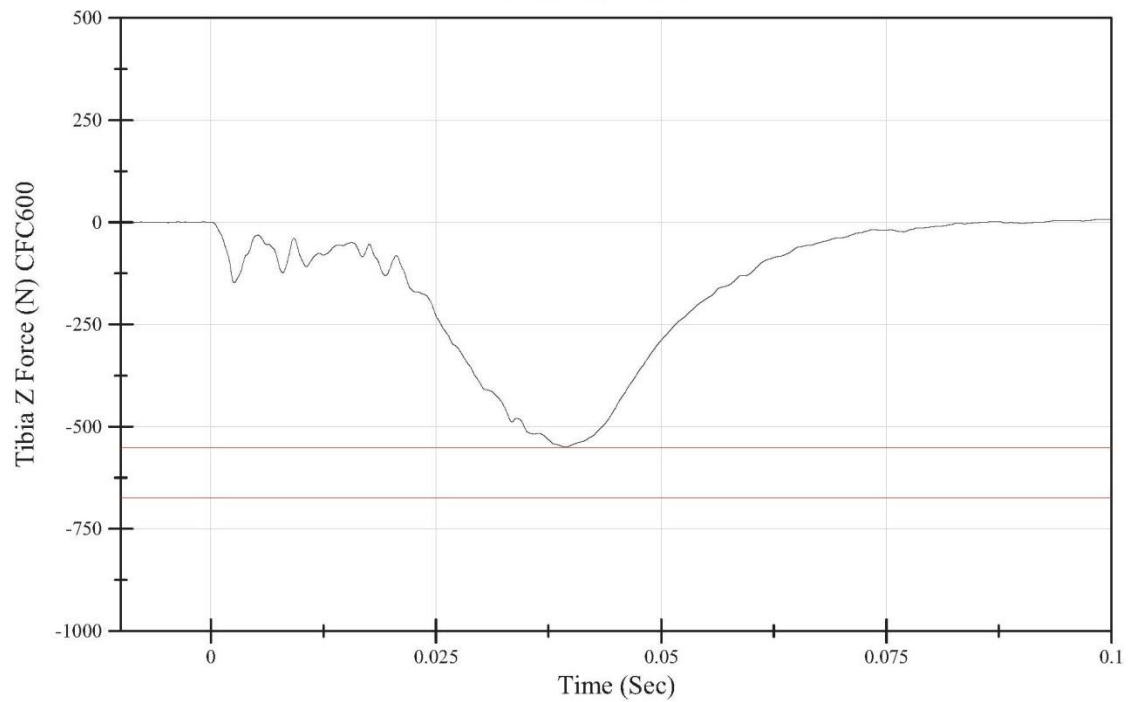


Software Version: 2.2

File Name: Ball_LX0039_2013_10_21 01 processed
10/29/2013 13:51:35.0000

Test Temperature: 71.3 degrees
Relative Humidity: 32.5%
Test Velocity: 1.96 m/s

THOR Left Foot Eversion Certification
Tibia Load
Serial Number: LX0039

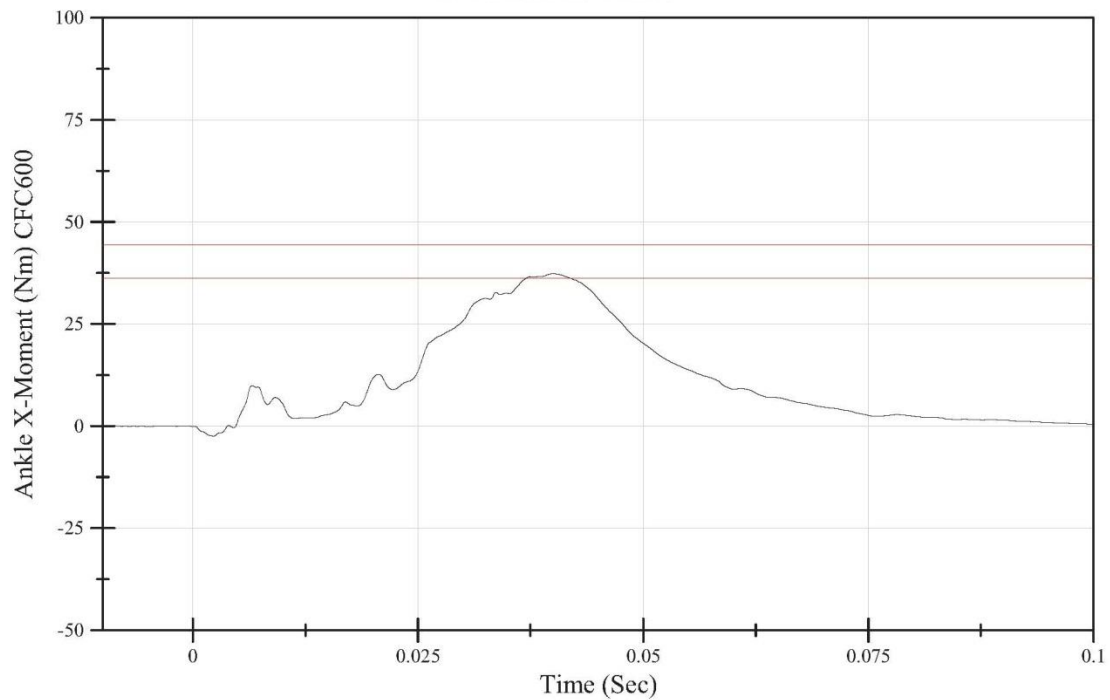


Software Version: 2.2

File Name: Ever_LX0039_2013_10_21 02 processed
10/21/2013 15:38:14.0000

Test Temperature: 71.3 degrees
Relative Humidity: 32.5%
Test Velocity: 1.96 m/s

THOR Left Foot Eversion Certification
Ankle Moment
Serial Number: LX0039

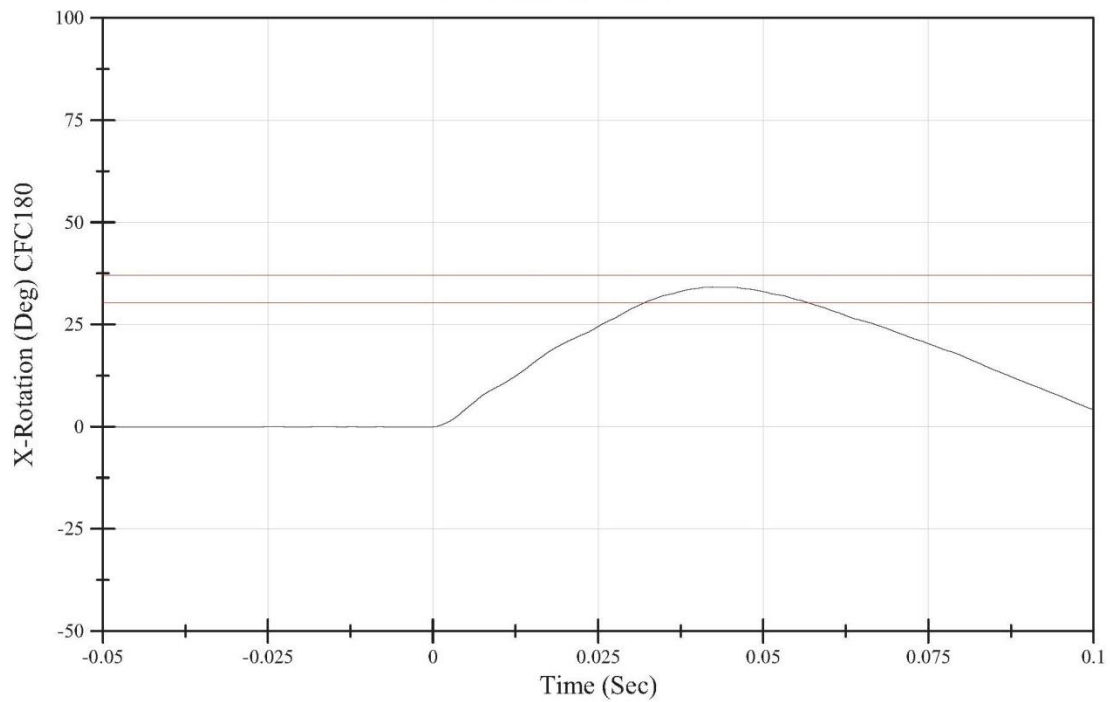


Software Version: 2.2

File Name: Ever_LX0039_2013_10_21 02 processed
10/21/2013 15:38:14.0000

Test Temperature: 71.3 degrees
Relative Humidity: 32.5%
Test Velocity: 1.96 m/s

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

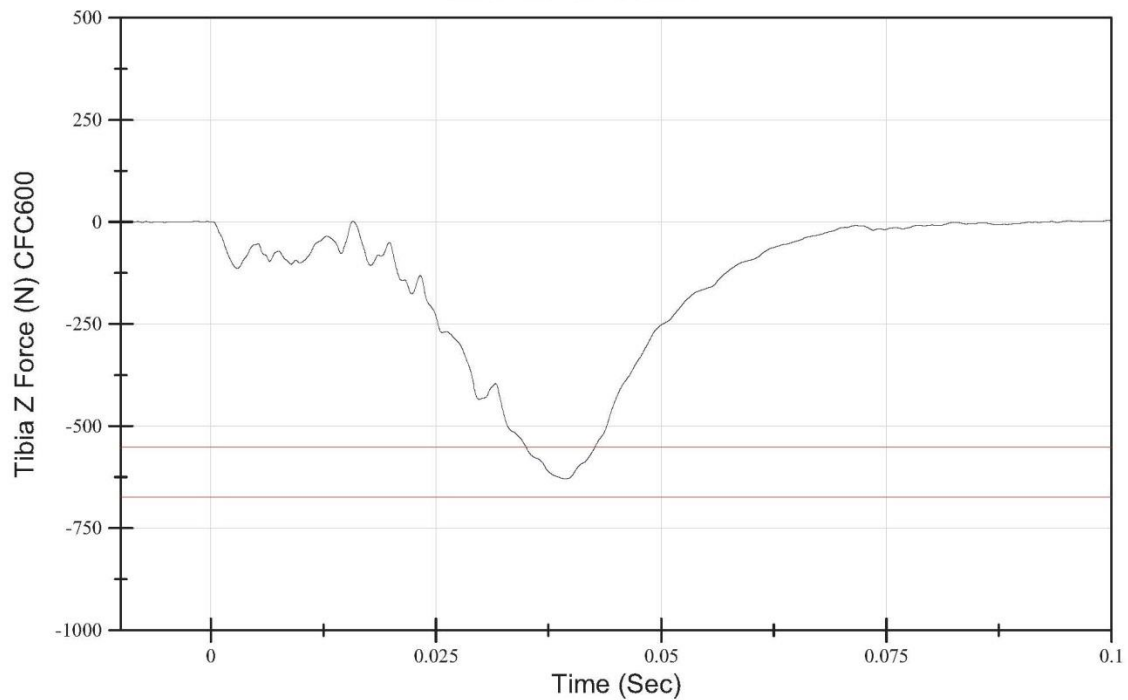


Software Version: 2.2

File Name: Ever_LX0039_2013_10_21 02 processed
10/21/2013 15:38:14.0000

Test Temperature: 70.7 degrees
Relative Humidity: 33.4%
Test Velocity: 1.95 m/s

THOR Left Foot Inversion Certification
Tibia Load
Serial Number: LX0039

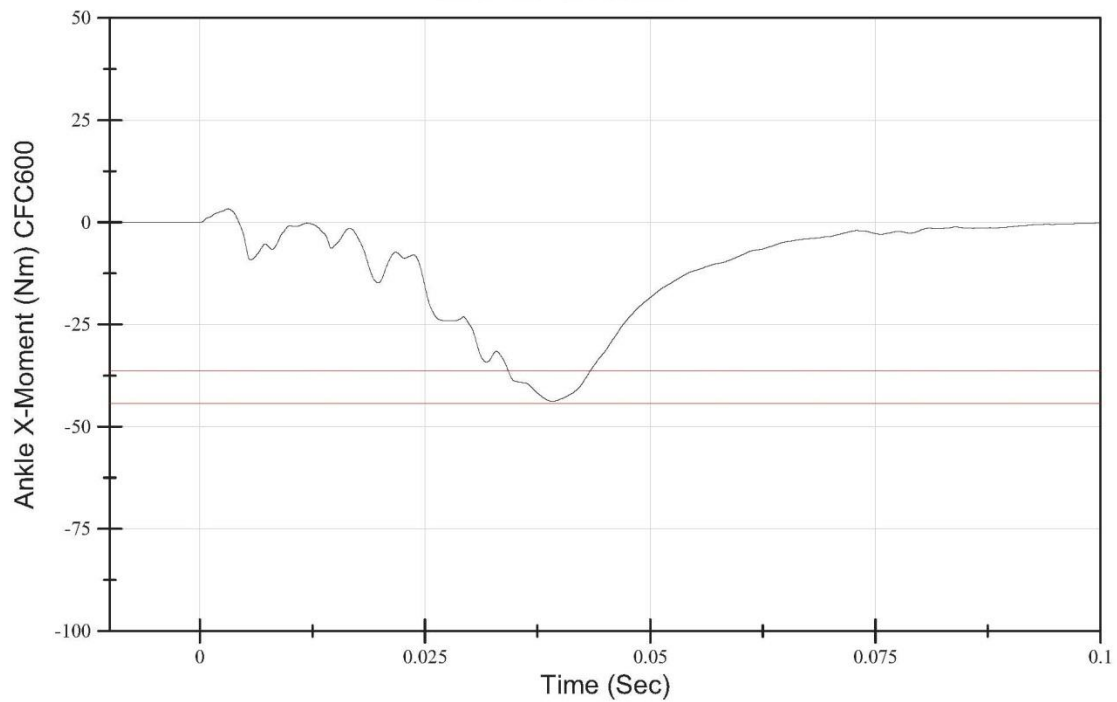


Software Version: 2.2

File Name: Inver_LX0039_2013_10_21 02 processed
10/21/2013 15:09:24.0000

Test Temperature: 70.7 degrees
Relative Humidity: 33.4%
Test Velocity: 1.95 m/s

THOR Left Foot Inversion Certification
Ankle Moment
Serial Number: LX0039

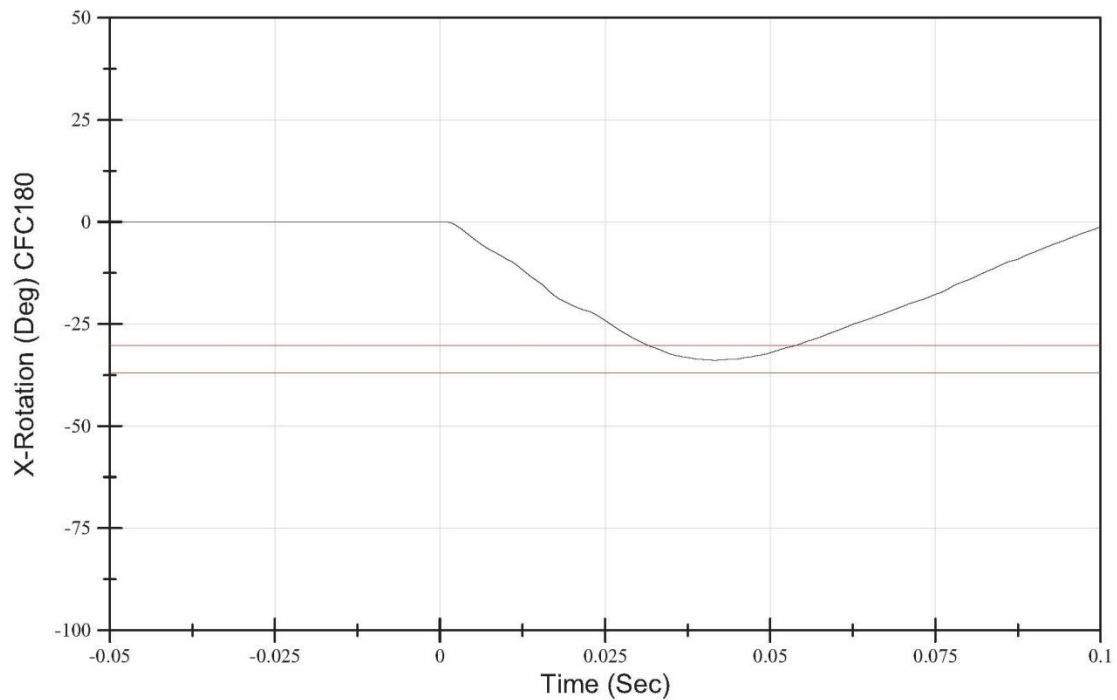


Software Version: 2.2

File Name: Inver_LX0039_2013_10_21 02 processed
10/21/2013 15:09:24.0000

Test Temperature: 70.7 degrees
Relative Humidity: 33.4%
Test Velocity: 1.95 m/s

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

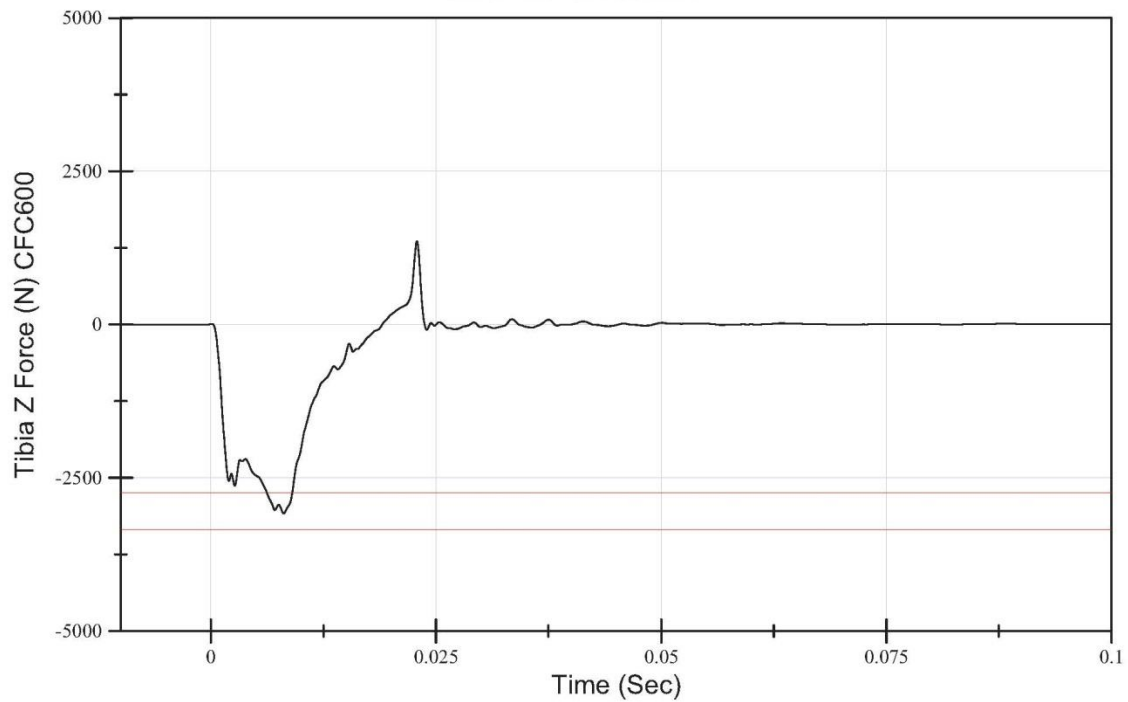


Software Version: 2.2

File Name: Inver_LX0039_2013_10_21 02 processed
10/21/2013 15:09:24.0000

Test Temperature: 71 degrees
Relative Humidity: 37.5%
Test Velocity: 4 m/s

THOR Right Foot Heel Certification
Tibia Load
Serial Number: LX0038

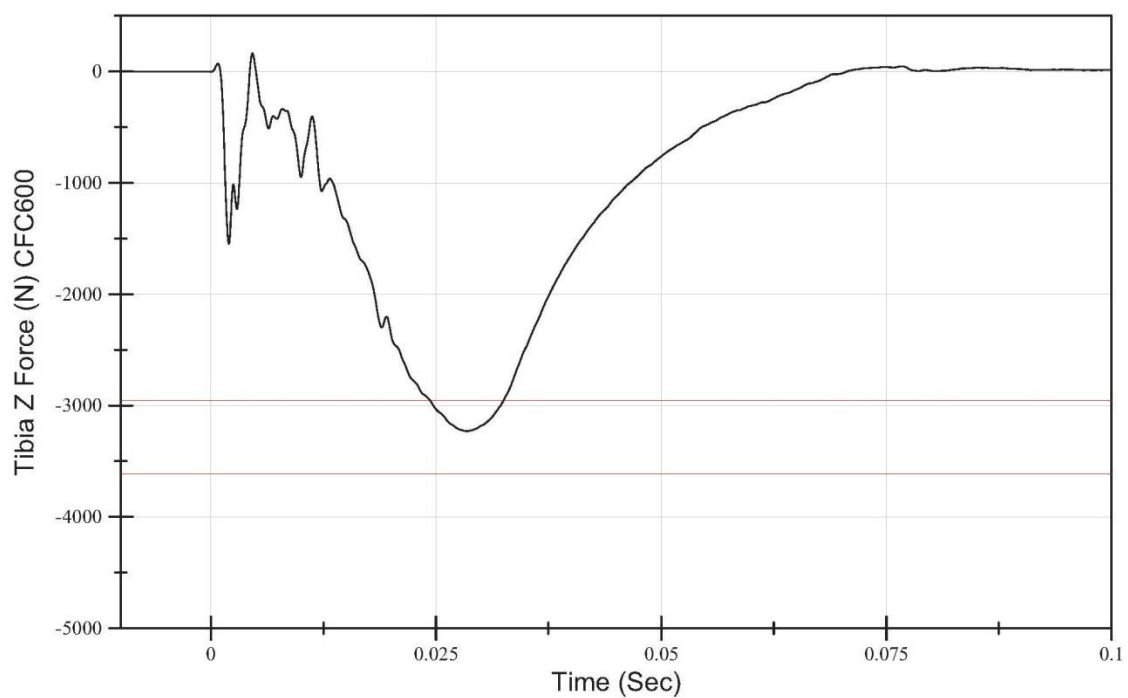


Software Version: 2.2

File Name: Heel_LX0038_2013_10_17 01 processed
10/17/2013 10:13:04.0000

Test Temperature: 68.9 degrees
Relative Humidity: 47%
Test Velocity: 5.03 m/s

THOR Right Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0038

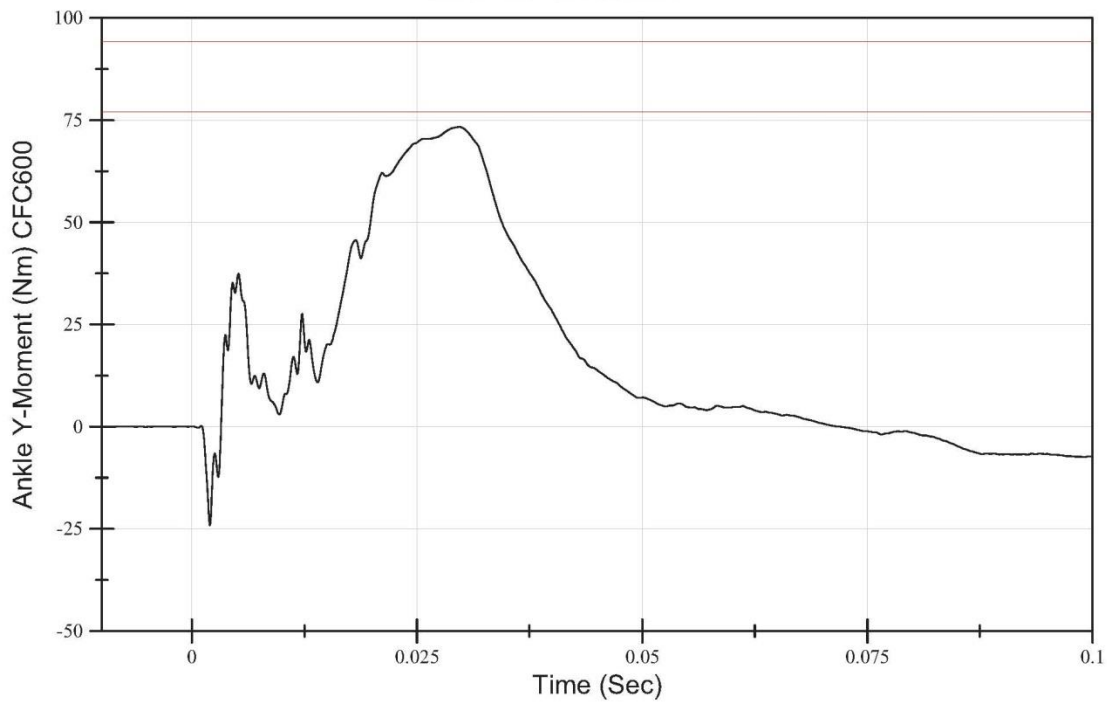


Software Version: 2.2

File Name: Ball_LX0038_2013_09_30 01 processed
09/30/2013 16:14:07.0000

Test Temperature: 68.9 degrees
Relative Humidity: 47%
Test Velocity: 5.03 m/s

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

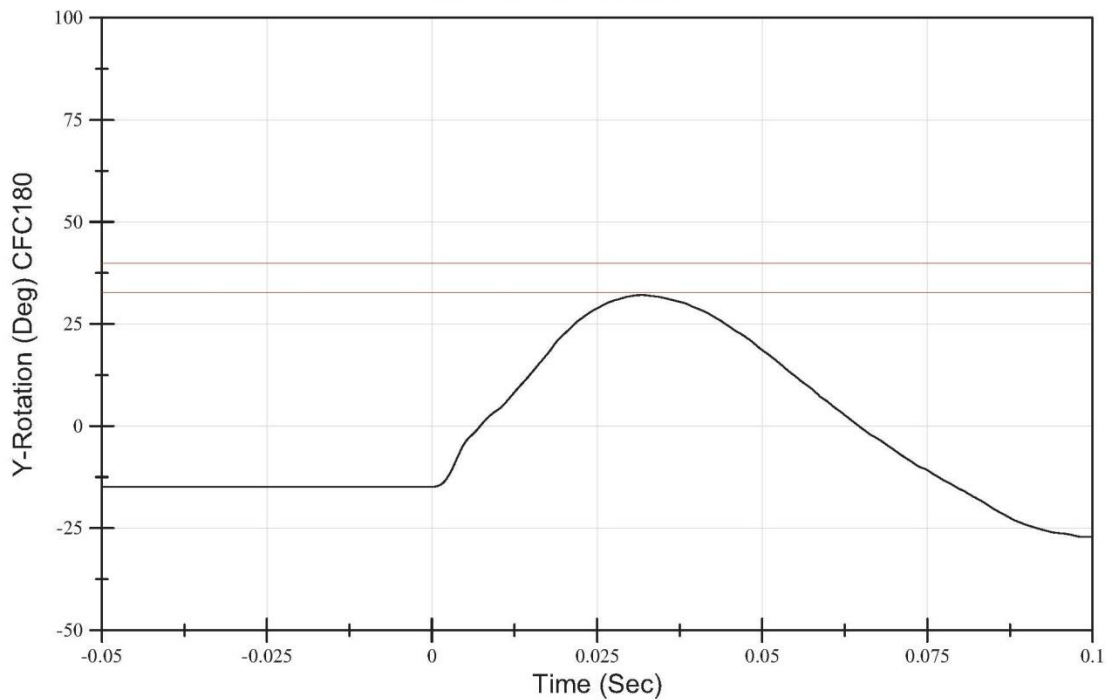


Software Version: 2.2

File Name: Ball_LX0038_2013_09_30 01 processed
09/30/2013 16:14:07.0000

Test Temperature: 68.9 degrees
Relative Humidity: 47%
Test Velocity: 5.03 m/s

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

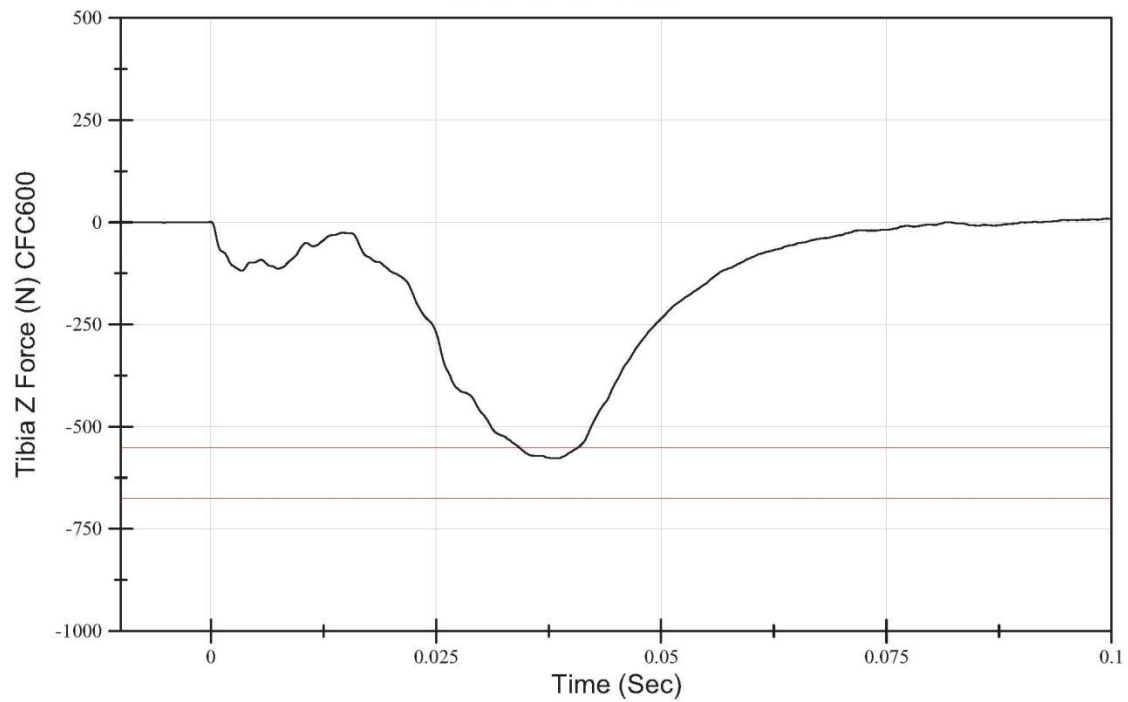


Software Version: 2.2

File Name: Ball_LX0038_2013_09_30 01 processed
09/30/2013 16:14:07.0000

Test Temperature: 69.2 degrees
Relative Humidity: 50.6%
Test Velocity: 1.95 m/s

THOR Right Foot Eversion Certification
Tibia Load
Serial Number: LX0038

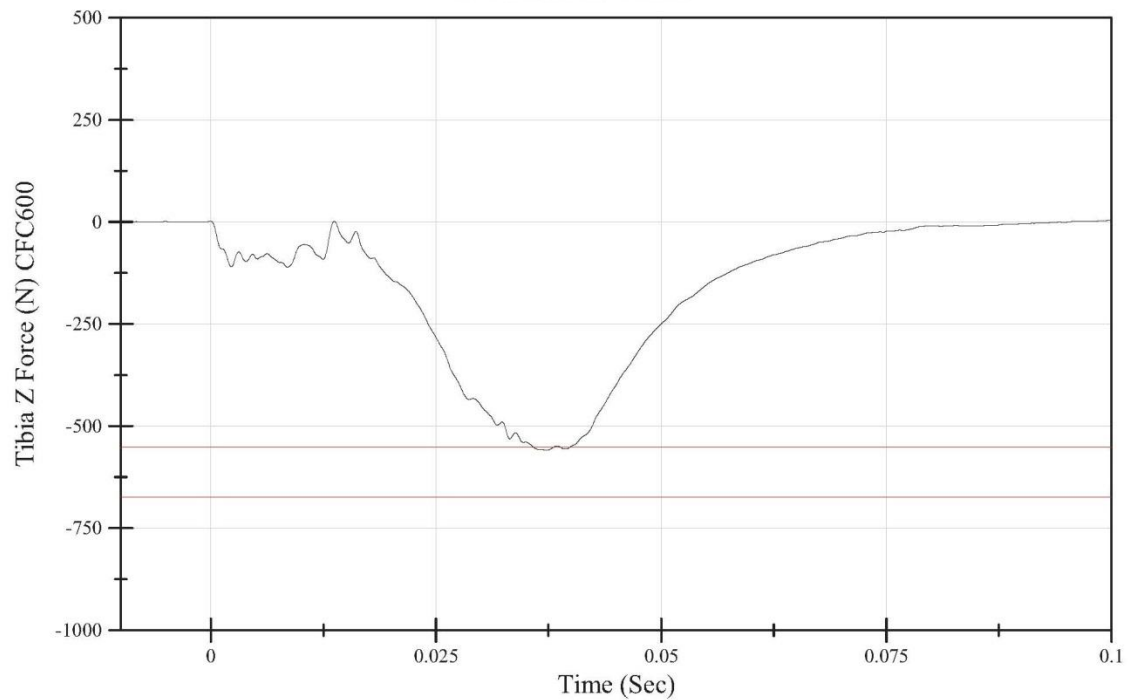


Software Version: 2.2

File Name: Ever_LX0038_2013_10_01 01 processed
10/01/2013 10:12:11.0000

Test Temperature: 69.2 degrees
Relative Humidity: 50.9%
Test Velocity: 1.96 m/s

THOR Right Foot Inversion Certification
Tibia Load
Serial Number: LX0038

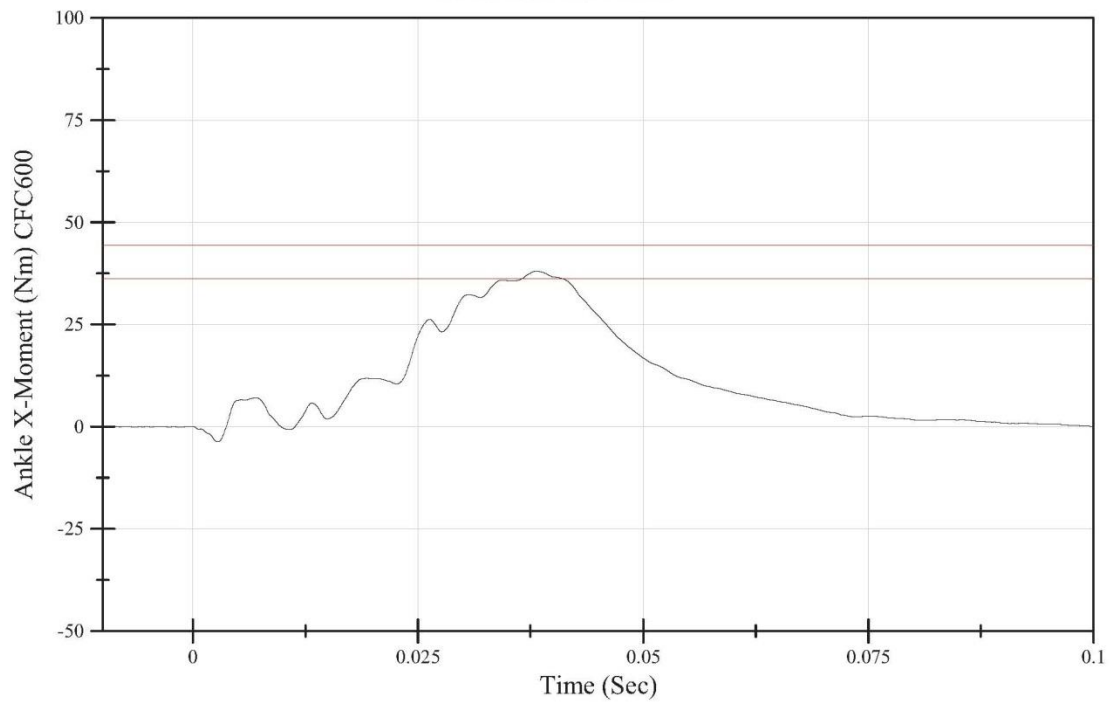


Software Version: 2.2

File Name: Inver_LX0038_2013_10_01 01 processed
10/01/2013 08:27:23.0000

Test Temperature: 69.2 degrees
Relative Humidity: 50.9%
Test Velocity: 1.96 m/s

THOR Right Foot Inversion Certification
Ankle Moment
Serial Number: LX0038

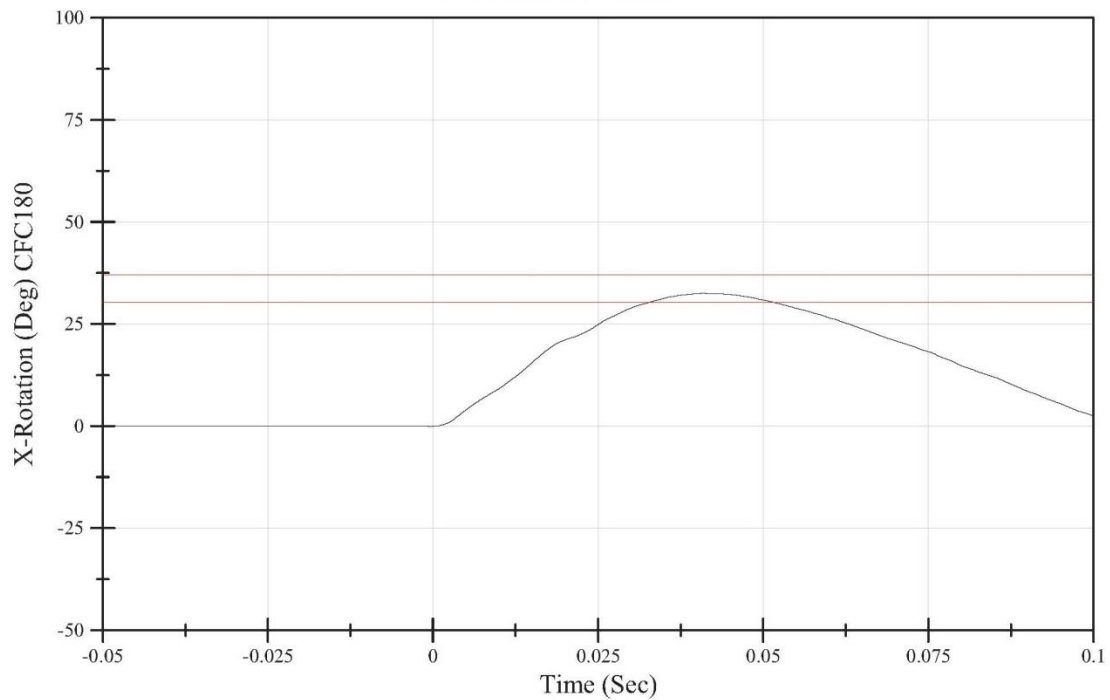


Software Version: 2.2

File Name: Inver_LX0038_2013_10_01 01 processed
10/01/2013 08:27:23.0000

Test Temperature: 69.2 degrees
Relative Humidity: 50.9%
Test Velocity: 1.96 m/s

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

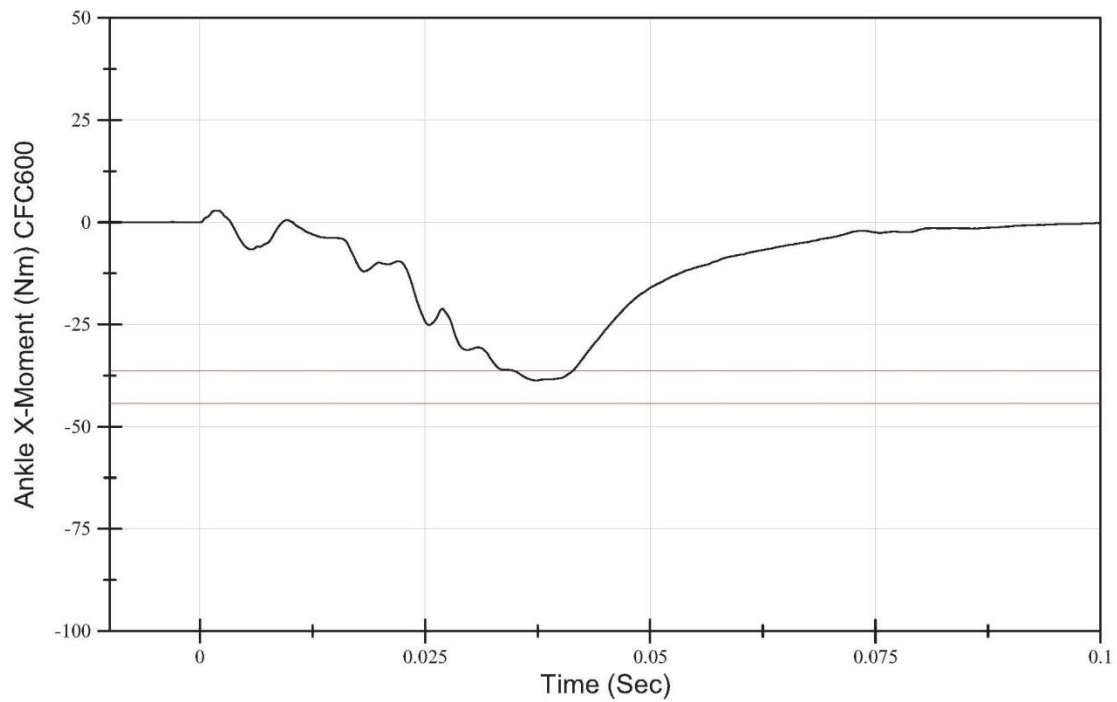


Software Version: 2.2

File Name: Inver_LX0038_2013_10_01 01 processed
10/01/2013 08:27:23.0000

Test Temperature: 69.2 degrees
Relative Humidity: 50.6%
Test Velocity: 1.95 m/s

THOR Right Foot Eversion Certification
Ankle Moment
Serial Number: LX0038

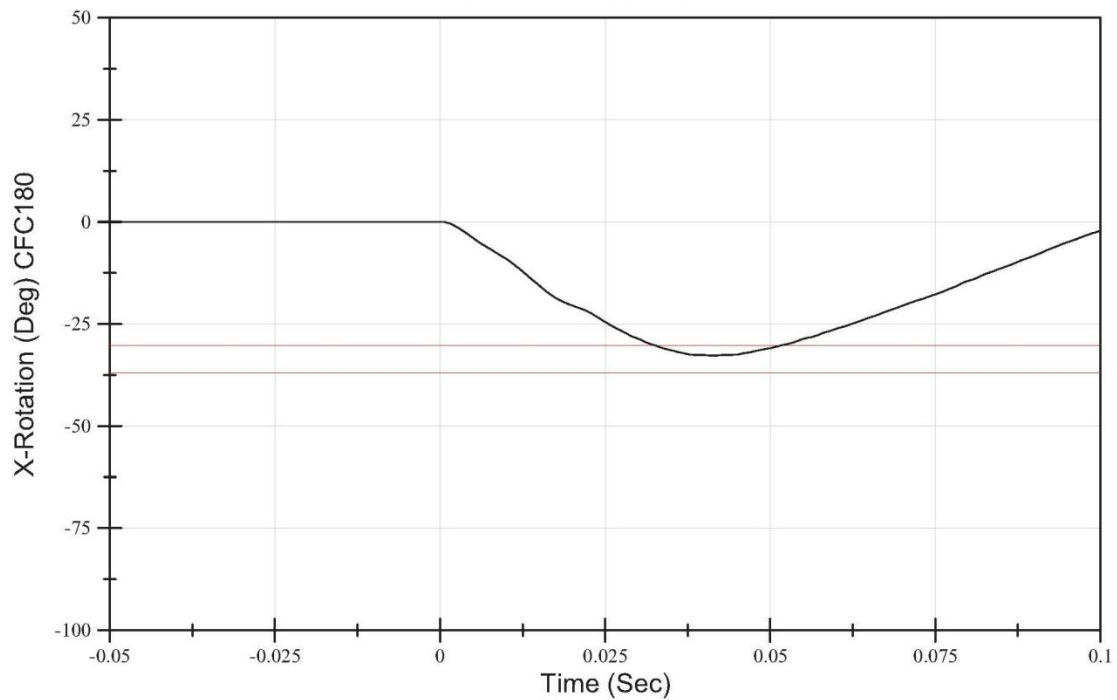


Software Version: 2.2

File Name: Ever_LX0038_2013_10_01 01 processed
10/01/2013 10:12:11.0000

Test Temperature: 69.2 degrees
Relative Humidity: 50.6%
Test Velocity: 1.95 m/s

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



Software Version: 2.2

File Name: Ever_LX0038_2013_10_01 01 processed
10/01/2013 10:12:11.0000

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

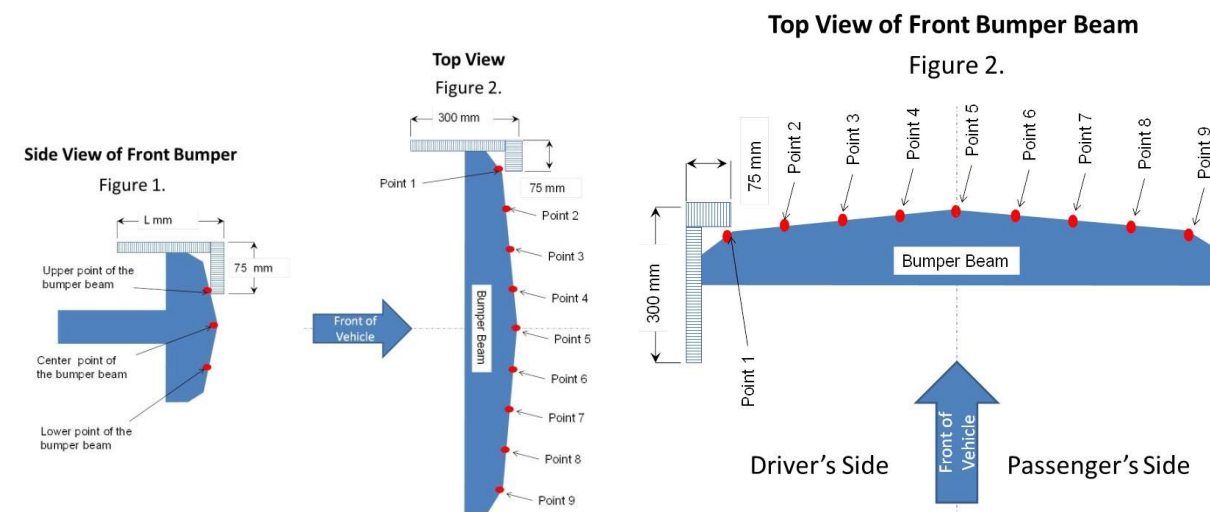
The Brake Pedal Reference Point is the x, y, and z location of the geometric center of the brake pedal pad (top surface) in the VCS.

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.

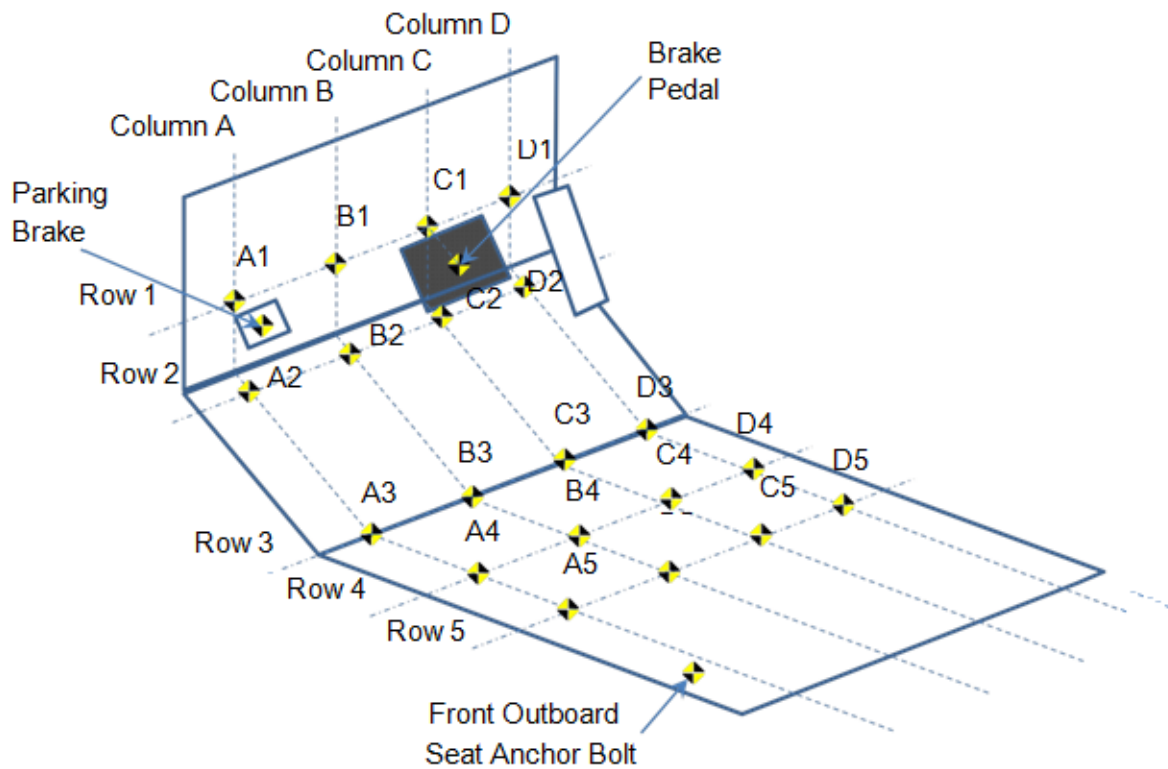
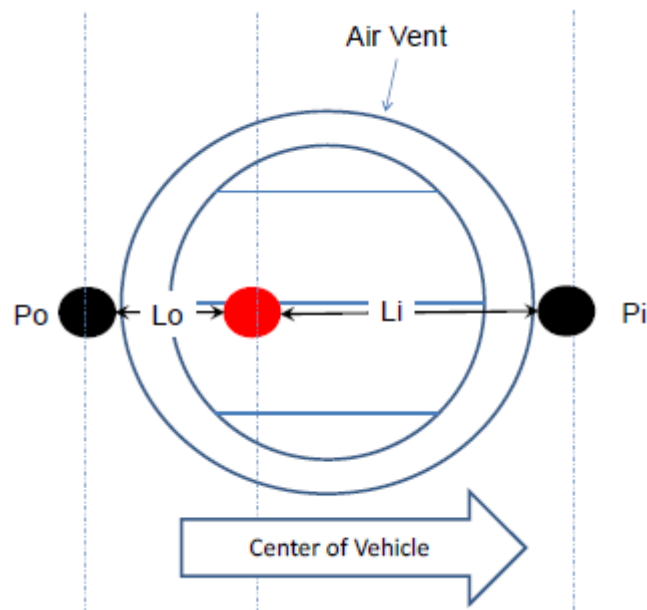


Figure 22: Lower interior intrusion measurements

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.

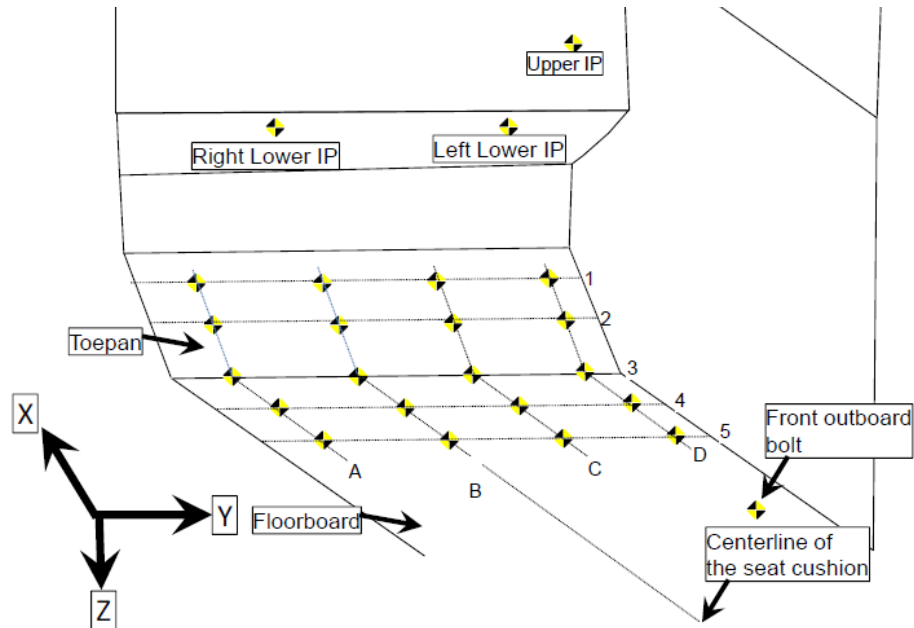


Figure 24: Passenger side lower interior measurements

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

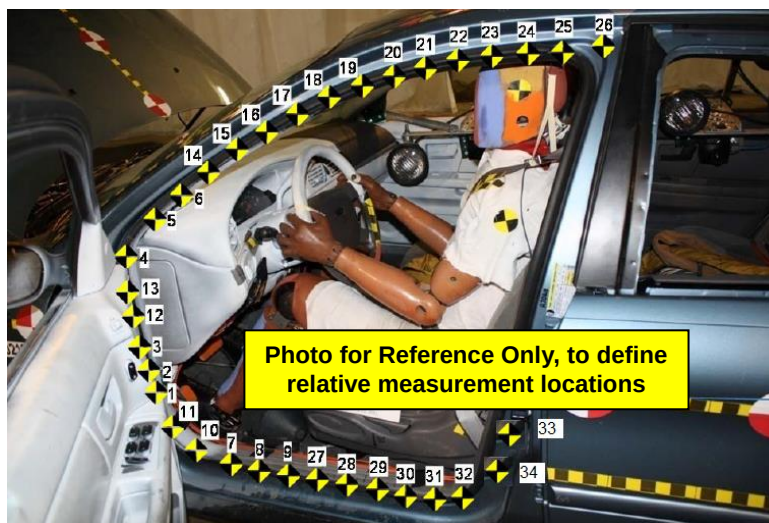


Figure 25: Driver Door Measurements

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.

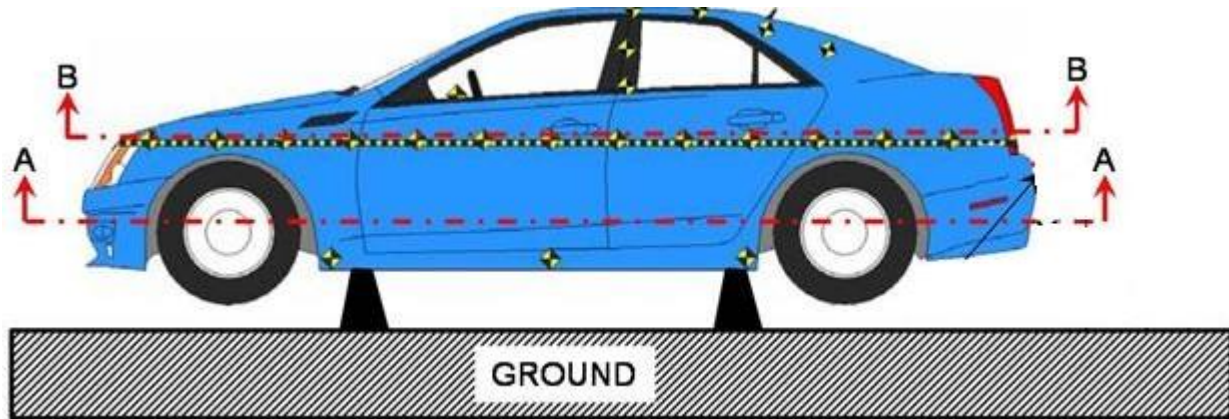


Figure 26: Pre-Test Vehicle Profile

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.

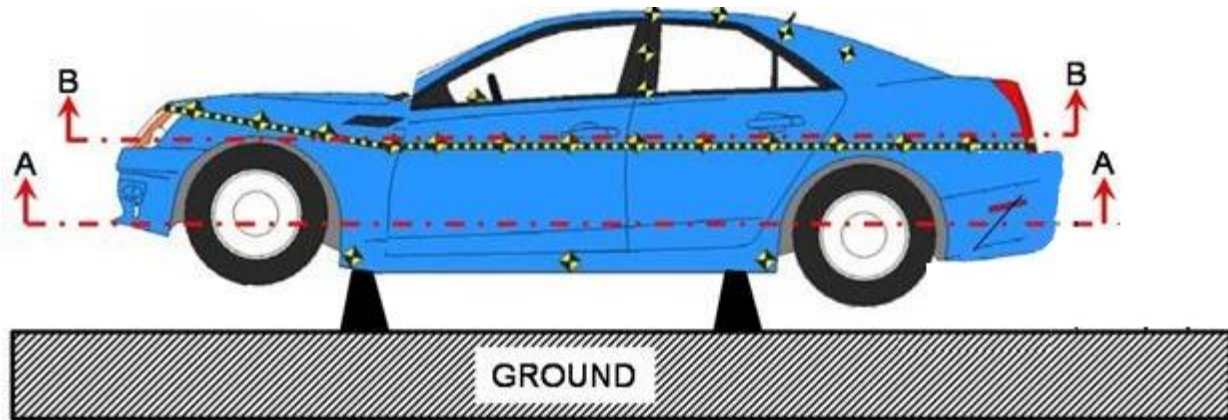
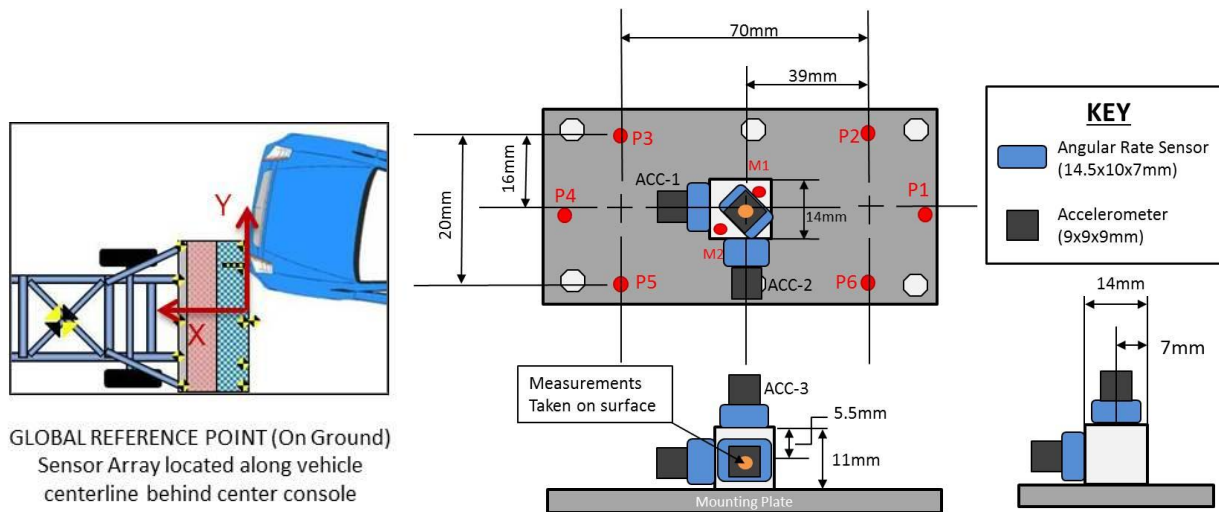


Figure 27: Post-Test Vehicle Profile

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 rear of RMDB
 - Positive Y is from the center of RMDB towards the left 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