REPORT NUMBER: R&D-CAL-13-005

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

2012 Volvo S60 four door sedan

90.1KPH, 15 DEGREE ANGLE, 35% OVERLAP

TEST DATE: 1/06/2014

NHTSA No: RC5911

CALSPAN CORPORATION
TRANSPORTATION TEST OPERATIONS
P.O. BOX 400
BUFFALO, NEW YORK 14225

FINAL REPORT SUBMITTED:

October 29, 2014

PREPARED FOR:

U. S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Vehicle safety Research
1200 New Jersey Ave, SE
Room W46-446
Washington, DC 20590

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Prepared by: Vanessa Walsh, Project Engineer Date: October 29, 2014

Approved by: Edward J. Dutton, Test Engineer Director
Transportation Test Operations Date: October 29, 2014

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

Date: _____

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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 2012 Volvo S60 four door sedan. The struck vehicle was positioned 15 degrees relative to the moving barrier and impacted 35% of the left side of the vehicle. The test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The test was conducted at the Calspan Corporation's Transportation Test Operation's facility in Buffalo, New York on January 6, 2014. The RMDB impact velocity was 90.04 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 423 mm. The test vehicle's performance was as follows:

Measurement Description	Units	Driver ATD		Pass. ATD	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC_{15})	N/A	700	151.43	700	222.77
Maximum Chest Compression	mm	63	-36.54	52	-30.88
Neck Injury Criteria (Nij)	N/A	1	0.29	1	0.22
Neck Tension	N	4,170	1819.77	2,620	1103.50
Neck Compression	N	4,000	-93.70	2,520	-434.11
Left Femur Force	N	10,008	-3574.20	6,805	-5641.22
Right Femur Force	N	10,008	-8080.42	6,805	-1371.96

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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.

Prepared by: Vanessa Walsh, Project Engineer — Date: October 29, 2014

Approved by: Edward J. Dutton, Test Engineer Director, Transportation Test Operations — Date: October 29, 2014

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SECTION 1
PURPOSE OF TEST

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

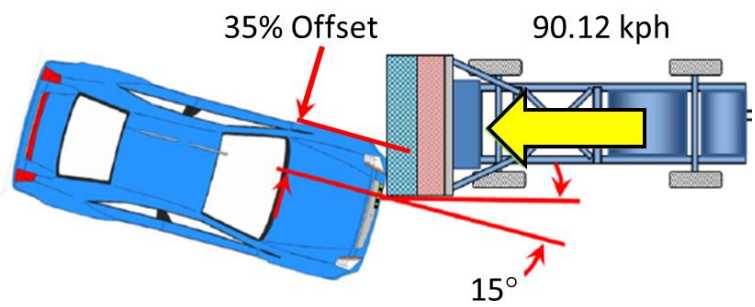
This 90.12 kph (56 mph) Moving Barrier into a test vehicle is part of the Frontal Offset Test outlined in Contract No. DTNH22-10-D-00155, Task Order 0002. The purpose of this test is to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

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

SECTION 2
SUMMARY OF TEST

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

A 2012 Volvo S60 four door sedan was impacted on the left front corner by a research moving deformable barrier (RMDB). This test vehicle was stationary and positioned at a target angle of 15° and at a target offset of 35% to the forward line of motion of the RMDB. The RMDB was towed down the test track in a full forward direction, without any crabbing, and at the targeted impact velocity of 90.12 kph (56.0 mph) into the test vehicle. The test vehicle's mass was 1,936 kg (4,266.9 lbs), and the RMDB's mass was 2490.7 kg (5491 lbs). The test was conducted by Calspan Corporation on January 6, 2014.



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

One 50% adult male THOR-NT anthropomorphic test device (ATD) (Serial No. 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.

Two hundred and twenty one (221) 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 290 mm at C2 to the left of the vehicle's centerline. The maximum crush of the structural bumper beam was 423 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:

- A-Pillar slightly buckled slightly
- Windshield had cracks throughout with a small tear
- Hood bent inwards and exposed part of the engine compartment

The driver ATD's visible contact points were:

- Head contacted the frontal and curtain airbag
- Torso contacted the frontal airbag, curtain airbag
- Side torso and arm 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, and A-Pillar
- Torso contacted the frontal airbag
- Knee contacted the glove box

SECTION 2 (CONTINUED)
CRASH VEHICLE SUMMARY

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

Primary Impact Data

Measured Parameter	Units	Value
RMDB Velocity at Impact	kph	90.04
RMDB Test Weight	kg	2490.7
RMDB Maximum Static Crush	mm	382
Vehicle Test Weight	kg	1936
Actual Vehicle Angle	degrees	15
Vehicle Maximum Static Crush	mm	423
Vertical Offset from Target Point (+ down / - up)*	mm	-16
Lateral Offset from Target Point (+ left / - right)*	mm	+13
Number of Data Channels		221
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 & Curtain Airbags & Side Headliner	A49-A51	Front Airbag, Center Instrument Panel, Visor, and A-Pillar	A70-A72
Upper Torso Contact	Front Airbag, Side Torso & Arm contacted driver's door	NA	Front Airbag	NA
Lower Torso Contact	None	NA	None	NA
Left Knee Contact	Knee Bolster	A28	Glove Box	A52
Right Knee Contact	Knee Bolster	A28	Glove Box	A52

Data Anamolies:

- None

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2013 Research Volvo S60 NHTSA No.: RC5911
Test Program: Research and Development Left Oblique Offset Test Date: 01/06/2014

Driver: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head CG X	g	1000	9.33	-32.73
	Head CG Y	g	1000	42.79	-5.38
	Head CG Z	g	1000	36.78	-3.91
	Head Resultant	g	Compute	47.48	
	36 ms HIC		Compute	317.22	
	15 ms HIC		Compute	151.43	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	43.04	
	Head Rotational Velocity X	deg/s	60	579.89	-1824.46
	Head Rotational Velocity Y	deg/s	60	944.43	-1707.64
	Head Rotational Velocity Z	deg/s	60	2053.40	-1090.98
	Head Rotational Velocity Resultant	deg/s	Compute	2924.17	
	Brain Injury Criteria		Compute	1.10	
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	81.81	-348.65
	UNLC Neck System Tension, FZ	N	1000	1819.77	
	UNLC Neck System Compression, FZ	N	1000		-93.70
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	10.53	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-10.53
	NIJ		Compute	0.29	
	On head acting through total neck section, FX	N	Thortest	496.86	-344.00
	On head acting through total neck section, FY	N	Thortest	603.20	-603.20
	On head acting through total neck section, FZ	N	Thortest	2033.02	-1721.21
	On head acting through total neck section, MX	N-m	Thortest	66.46	-68.10
	On head acting through total neck section, MY	N-m	Thortest	39.36	-11.81
	On head acting through total neck section, MZ	N-m	Thortest	29.02	-31.00
	On head acting through O.C. joint only, FX	N	Thortest	347.37	-341.40
	On head acting through O.C. joint only, FZ	N	Thortest	1819.67	-603.20
	On head acting through O.C. joint only, MY	N-m	Thortest	10.53	-10.53
Chest	Upper Left IR-TRACC X - deflection	mm	Thortest	1.79	-11.57
	Upper Left IR-TRACC Y - deflection	mm	Thortest	3.34	-9.70
	Upper Left IR-TRACC Z - deflection	mm	Thortest	4.42	-19.69
	Upper Left IR-TRACC D - deflection	mm	Thortest	1.06	-11.14
	Upper Right IR-TRACC X - deflection	mm	Thortest	0.37	-36.25
	Upper Right IR-TRACC Y - deflection	mm	Thortest	4.04	-10.11
	Upper Right IR-TRACC Z - deflection	mm	Thortest	22.68	-7.84
	Upper Right IR-TRACC D - deflection	mm	Thortest	0.34	-34.50
	Lower Left IR-TRACC X - deflection	mm	Thortest	4.61	-8.85
	Lower Left IR-TRACC Y - deflection	mm	Thortest	0.00	-30.60

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2013 Research Volvo S60 NHTSA No.: RC5911

Test Program: Research and Development Left Oblique Offset Test Date: 01/06/2014

Driver: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left IR-TRACC Z - deflection	mm	Thortest	1.62	-18.58
	Lower Left IR-TRACC D - deflection	mm	Thortest	4.58	-6.08
	Lower Right IR-TRACC X - deflection	mm	Thortest	0.04	-39.08
	Lower Right IR-TRACC Y - deflection	mm	Thortest	1.14	-28.73
	Lower Right IR-TRACC Z - deflection	mm	Thortest	0.30	-17.33
	Lower Right IR-TRACC D - deflection	mm	Thortest	0.04	-36.54
	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	9.50	-66.42
	Upper Spine (T1) AY	g	180	69.56	-20.25
	Upper Spine (T1) AZ	g	180	20.03	-9.54
	Upper Spine (T1) Resultant	g	Compute	96.84	
	Middle Spine (T6) AX	g	180	14.78	-43.01
	Middle Spine (T6) AY	g	180	52.10	-10.99
	Middle Spine (T6) AZ	g	180	7.47	-12.72
	Middle Spine (T6) Resultant	g	Compute	52.71	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	77.90	
Acetabulum	Left FX force	N	600	1459.96	-1135.01
	Left FY force	N	600	566.89	-1431.49
	Left FZ force	N	600	1902.01	-389.05
	Left Acetabulum Resultant	N	Compute	2172.22	
	Right FX force	N	600	766.88	-3545.44
	Right FY force	N	600	277.16	-1693.24
	Right FZ force	N	600	656.91	-378.00
	Right Acetabulum Resultant	N	Compute	3933.44	

Anomalies

None

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver Legs

Test Vehicle: 2013 Research Volvo S60 NHTSA No.: RC5911
Test Program: Research and Development Left Oblique Offset Test Date: 01/06/2014

Driver: Thor Serial No. 016 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	2.00	-15.47
	Right Knee Displacement, DX	mm	180	2.11	-16.07
Femur	Left Femur Force, FZ	N	600	589.32	-3574.20
	Left Femur Moment, MX	N-m	600	36.58	-164.48
	Left Femur Moment, MY	N-m	600	74.51	-77.62
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	169.56	
	Right Femur Force, FZ	N	600	282.72	-8080.42
	Right Femur Moment, MX	N-m	600	27.99	-132.31
	Right Femur Moment, MY	N-m	600	83.00	-16.95
	Right Femur Res (MX / MX only, not MZ)	N-m	Compute	149.50	
Tibia	Left Upper Tibia, FZ	N	600	70.46	-887.73
	Left Upper Tibia, MY	N-m	600	55.65	-55.84
	Left Upper Tibia, Index		Compute	0.33	
	Right Upper Tibia, FZ	N	600	291.94	-2095.63
	Right Upper Tibia, MY	N-m	600	65.36	-80.24
	Right Upper Tibia, Index		Compute	0.72	
	Left Lower Tibia, FZ	N	600	127.74	-1861.95
	Left Lower Tibia, MY	N-m	600	32.79	-65.87
	Left Lower Tibia, Index		Compute	0.38	
	Right Lower Tibia, FZ	N	600	92.58	-3675.58
	Right Lower Tibia, MY	N-m	600	67.02	-180.37
	Right Lower Tibia, Index		Compute	0.99	
Ankle	Left Ankle Rotation, RX	Deg	180	19.57	-9.29
	Left Ankle Rotation, RY	Deg	180	26.96	-14.58
	Right Ankle Rotation, RX	Deg	180	-2.35	-37.71
	Right Ankle Rotation, RY	Deg	180	7.48	-15.51

Anomalies
None

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

Test Vehicle: 2013 Research Volvo S60 NHTSA No.: RC5911

Test Program: Research and Development Left Oblique Offset Test Date: 01/06/2014

Right Front Passenger: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head CG X	g	1000	58.61	-20.30
	Head CG Y	g	1000	28.80	-13.24
	Head CG Z	g	1000	25.99	-1.56
	Head Resultant	g	Compute	67.95	
	36 ms HIC		Compute	222.77	
	15 ms HIC		Compute	222.77	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	55.51	
	Head Rotational Velocity X	deg/s	60	797.23	-1207.53
	Head Rotational Velocity Y	deg/s	60	1719.81	-1379.38
	Head Rotational Velocity Z	deg/s	60	3248.83	-2125.65
	Head Rotational Velocity Resultant	deg/s	Compute	3544.68	
	Brain Injury Criteria		Compute	1.46	
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	375.90	-80.33
	UNLC Neck System Tension, FZ	N	1000	1103.50	
	UNLC Neck System Compression, FZ	N	1000		-434.11
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	14.06	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-14.06
	NIJ		Compute	0.22	
	On head acting through total neck section, FX	N	Thortest	585.12	-251.70
	On head acting through total neck section, FY	N	Thortest	226.31	-226.31
	On head acting through total neck section, FZ	N	Thortest	1445.76	-1114.69
	On head acting through total neck section, MX	N-m	Thortest	26.73	-32.93
	On head acting through total neck section, MY	N-m	Thortest	22.05	-25.90
	On head acting through total neck section, MZ	N-m	Thortest	48.74	-48.65
	On head acting through O.C. joint only, FX	N	Thortest	492.38	-255.49
	On head acting through O.C. joint only, FZ	N	Thortest	1087.84	-437.89
	On head acting through O.C. joint only, MY	N-m	Thortest	14.06	-14.06
Chest	Upper Left IR-TRACC X - deflection	mm	Thortest	0.02	-33.57
	Upper Left IR-TRACC Y - deflection	mm	Thortest	9.12	-8.62
	Upper Left IR-TRACC Z - deflection	mm	Thortest	14.24	-7.25
	Upper Left IR-TRACC D - deflection	mm	Thortest	0.02	-30.88
	Upper Right IR-TRACC X - deflection	mm	Thortest	0.62	-12.26
	Upper Right IR-TRACC Y - deflection	mm	Thortest	8.85	-7.58
	Upper Right IR-TRACC Z - deflection	mm	Thortest	3.83	-16.44
	Upper Right IR-TRACC D - deflection	mm	Thortest	0.64	-13.45
	Lower Left IR-TRACC X - deflection	mm	Thortest	0.11	-30.19
	Lower Left IR-TRACC Y - deflection	mm	Thortest	13.43	-0.62

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

Test Vehicle: 2013 Research Volvo S60 NHTSA No.: RC5911
Test Program: Research and Development Left Oblique Offset Test Date: 01/06/2014

Passenger: Thor Serial No. 0015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left IR-TRACC Z - deflection	mm	Thortest	5.80	-9.36
	Lower Left IR-TRACC D - deflection	mm	Thortest	0.10	-28.46
	Lower Right IR-TRACC X - deflection	mm	Thortest	3.41	-14.53
	Lower Right IR-TRACC Y - deflection	mm	Thortest	7.53	-11.34
	Lower Right IR-TRACC Z - deflection	mm	Thortest	3.14	-12.88
	Lower Right IR-TRACC D - deflection	mm	Thortest	3.66	-11.22
	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	5.06	-21.58
	Upper Spine (T1) AY	g	180	40.81	-6.77
	Upper Spine (T1) AZ	g	180	23.09	-1.37
	Upper Spine (T1) Resultant	g	Compute	47.43	
	Middle Spine (T6) AX	g	180	9.63	-25.30
	Middle Spine (T6) AY	g	180	17.01	-3.84
	Middle Spine (T6) AZ	g	180	12.63	-6.68
	Middle Spine (T6) Resultant	g	Compute	29.59	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	81.10	
Acetabulum	Left FX force	N	600	2398.01	-3157.52
	Left FY force	N	600	772.33	-958.14
	Left FZ force	N	600	1604.35	-862.98
	Left Acetabulum Resultant	N	Compute	3541.54	
	Right FX force	N	600	3261.12	-686.76
	Right FY force	N	600	208.78	-1141.84
	Right FZ force	N	600	1612.49	-25.82
	Right Acetabulum Resultant	N	Compute	3506.49	

Anomalies

None

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

Test Vehicle: 2013 Research Volvo S60 NHTSA No.: RC5911
Test Program: Research and Development Left Oblique Offset Test Date: 01/06/2014

Right Front Passenger: Thor Serial No. 015 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	1.35	-4.99
	Right Knee Displacement, DX	mm	180	1.47	-1.85
Femur	Left Femur Force, FZ	N	600	504.65	-5641.22
	Left Femur Moment, MX	N-m	600	84.86	-108.11
	Left Femur Moment, MY	N-m	600	95.46	-50.74
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	118.68	
	Right Femur Force, FZ	N	600	1046.46	-1371.96
	Right Femur Moment, MX	N-m	600	84.91	-193.18
	Right Femur Moment, MY	N-m	600	109.48	-34.05
	Right Femur Res (MX / MX only, not MZ)	N-m	Compute	203.11	
Tibia	Left Upper Tibia, FZ	N	600	74.31	-2248.14
	Left Upper Tibia, MY	N-m	600	37.59	-63.16
	Left Upper Tibia, Index		Compute	0.64	
	Right Upper Tibia, FZ	N	600	176.32	-1415.20
	Right Upper Tibia, MY	N-m	600	28.22	-79.76
	Right Upper Tibia, Index		Compute	0.71	
	Left Lower Tibia, FZ	N	600	126.35	-3309.81
	Left Lower Tibia, MY	N-m	600	13.83	-62.16
	Left Lower Tibia, Index		Compute	0.65	
	Right Lower Tibia, FZ	N	600	124.84	-1837.87
	Right Lower Tibia, MY	N-m	600	4.83	-70.63
	Right Lower Tibia, Index		Compute	0.71	
Ankle	Left Ankle Rotation, RX	Deg	180	30.71	0.98
	Left Ankle Rotation, RY	Deg	180	9.80	-30.58
	Right Ankle Rotation, RX	Deg	180	24.69	-35.16
	Right Ankle Rotation, RY	Deg	180	-9.70	-24.54

Anomalies
None

SECTION 3
DATA SHEETS

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

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2	Seat Adjustment, Fuel System, and Steering Wheel	3-6
3	Dummy Longitudinal Clearance Dimensions	3-8
4	Dummy Lateral Clearance Dimensions	3-10
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15	Summary of FMVSS 212, 219 (Partial), and 301 Data	3-48
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DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

VEHICLE INFORMATION

NHTSA No.	RC5911
Model Year	2012
Make	Volvo
Model	S60 T5
Body Style	Four Door Sedan
VIN	YV1622FS1C2081747
Body Color	White
Odometer Reading (km/mi)	33136 km / 20590 mi
Engine Displacement. (L)	2.5
Type/No. Cylinders	I5
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	6-Speed
Overdrive	Yes
Final Drive	Front 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)	No
Traction Control System (TCS)	Yes

VEHICLE OPTIONS

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

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Volvo Car Corporation
Date of Manufacture	06/11

GVWR (kg)	2091
GAWR Front (kg)	1170
GAWR Rear (kg)	980

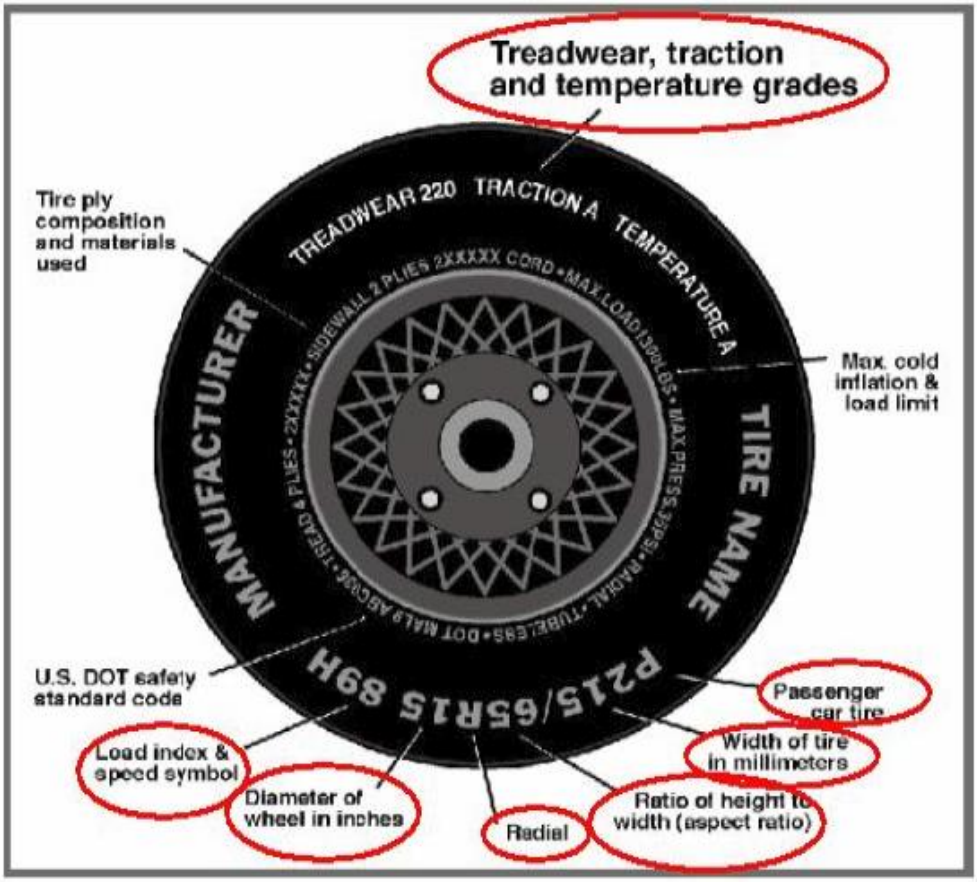
VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	--	
Number of Occupants	2	3	--	5
Capacity Wt. (VCW) (kg)				465
Cargo Wt. (RCLW) (kg)				124.8

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

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

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



Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	340	340
Cold Pressure (kPa)	260	260
Recommended Tire Size	P215/50R17	P215/50R17
Tire Size on Vehicle	P215/50R17	P215/50R17
Tire Manufacturer	Michelin	Michelin
Tire Model	Primacy MXM4	Primacy MXM4
Treadwear	500	500
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	95V	95V
Tire Material	Rubber	Rubber
DOT Safety Code Right	F338005X1811	F338005X1811
DOT Safety Code Left	F338005X1811	F338005X1811

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

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	503	313		562	412	
Right	kg	510	296		516	446	
Ratio	%	62%	38%		55.6%	44.4%	
Totals	kg	1013	609	1622	1078	858	1936

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1622.0
Weight of 2 P572E ATDs	kg	197.8
Rated Cargo/Luggage Weight (RCLW)	kg	125.0
Calculated Vehicle Target Weight (TVTW)	kg	1944.8

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	700	704	709	713	1043
As Tested	mm	687	693	666	668	1231
Post Test	mm	759	698	650	682	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2778
Total Vehicle Length at Left Side	mm	4501
Total Vehicle Length at Centerline	mm	4629
Total Vehicle Length at Right Side	mm	4507
Weight of Ballast in Cargo Area	kg	47
Weight of Vehicle Components Removed	kg	40
Amount of Stoddard Solvent in Fuel Tank	L	62.1

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk carpeting, jack, tail light, and rear seats were removed.

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

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements		Pre-Test
1	Total Length	mm	4629
2	Total Width	mm	1822
3*	Bumper Top Height	mm	587
4*	Bumper Bottom Height	mm	465
5*	Longitudinal Member Top Height	mm	650
6	Distance Between Longitudinal Members	mm	1168
7	Longitudinal Member Width	mm	115
8*	Engine Top Height	mm	870
9*	Engine Bottom Height	mm	249
10	Engine and Gearbox Width	mm	580
11	Front Bumper-Engine Distance	mm	548
12*	Front Shock Absorber Fixing Height	mm	944
13*	Bonnet Leading Edge Height	mm	835
14	Front Shock Absorber Fixing Width	mm	1178
15	Front Bumper – Front Axle Distance	mm	937
16	Front Axle – A Pillar Distance	mm	529
17	A-Pillar – B-Pillar Distance	mm	1097
18	B-Pillar – Rear Axle Distance	mm	1149
19	B-Pillar – C-Pillar Distance	mm	1042
20*	Roof Sill Bottom Height	mm	1372
21*	Roof Sill Top Height	mm	1471
22*	Floor Sill Bottom Height	mm	320
23*	Floor Sill Top Height	mm	431

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

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

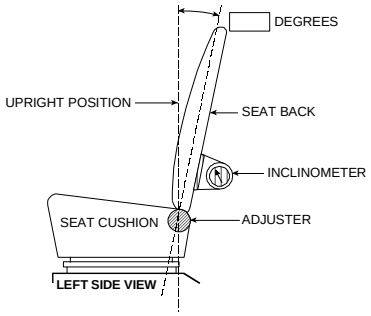
Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

NORMAL DESIGN RIDING POSITION

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

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

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



FRONT SEAT ASSEMBLY

	Deg.
Driver Seat Back Angle	12.0
Passenger Seat Back Angle	12.0

SEAT FORE/AFT POSITIONS

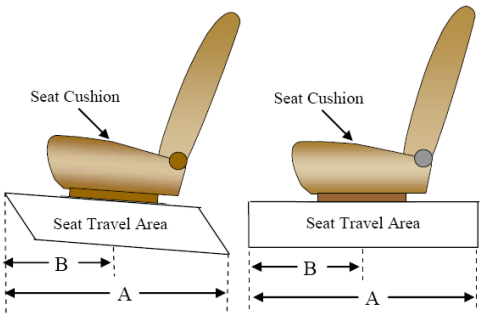
Describe the method used of determining seat fore/aft positions.
The driver's seat was positioned at its lowest postion and at the mid-point of fore/aft travel.
The passenger's seat was positioned at the mid-point of fore/aft travel.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	298	149
Passenger Seat	225	113

SEAT BELT UPPER ANCHORAGES

Describe the method of positioning seat belt upper anchorages. Belt anchorages were moved along the full range of motion, and marked on the B-Pillar to their respective possible positions. Photographic evidence can be found in Appendix A of this report. Zero is defined as the upper-most position.

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



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

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

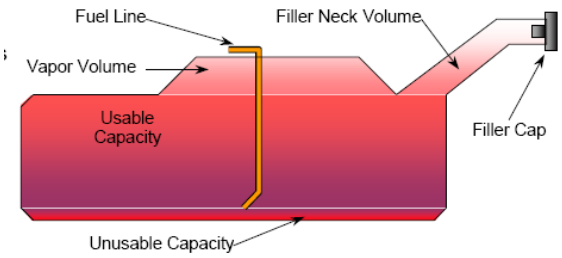
FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	66.8
Usable Capacity of "Optional Tank"	
93% of Usable Capacity	62.1
Actual Amount of Solvent Used	62.1
1/3 of Usable Capacity	22.3

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.

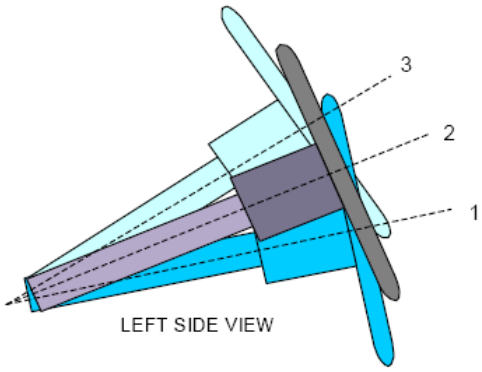


VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

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

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



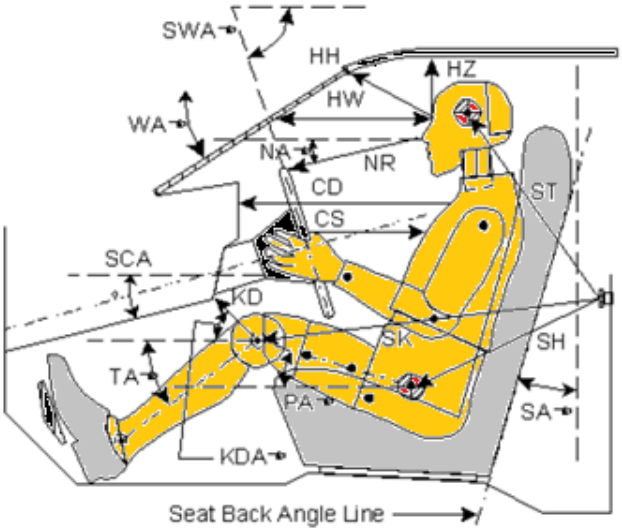
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

	Tilt (degrees)	Fore/Aft Position (mm)
Lowermost position No. 1	20.2	
Geometric center position No. 2	23.1	
Uppermost position No. 3	26.0	
Telescoping Steering Wheel Travel		48
Test Position	23.1	24

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



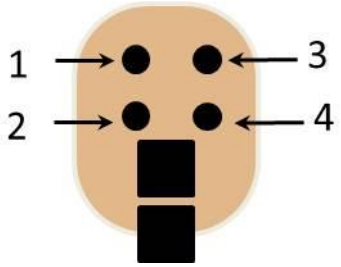
Code	Measurement Description	Driver (Serial # THOR 016)		Passenger (Serial # THOR 015)	
		Length (mm)	Angle(°)	Length (mm)	Angle (°)
WAº	Windshield Angle		-26.0		
SWAº	Steering Wheel Angle		23.1		
SCAº	Steering Column Angle		66.9		
SAº	Seat Back Angle (on headrest post)		12.0		12.0
HZ	Head to Roof (Z)	147	90	146	90
HH	Head to Header	399	15.1	420	15.9
HW	Head to Windshield	647	0	663	0
NR	Nose to Rim	483	20.4	723	-33
CD	Chest to Dash	603		602	
CS	Chest to Steering Hub	323	0		
RA	Rim to Abdomen	180	0		
KDL	Left Knee to Dash	193	17.8	203	31.5
KDR	Right Knee to Dash	164	29.5	207	30.8
PAº	Pelvic Angle		24.2		23.2
TAº	Tibia Angle		-39.3		-37.0
SK	Striker to Knee	546	-3.2	521	0
ST	Striker to Head	-47	85.4	-68	83.3
SH	Striker to H-Point	166	-29.8	120	-42.5
HAX˚	Head Angle (X)		0.2		0.0
HAY˚	Head Angle (Y)		0.0		-0.2
NAX˚	Neck Angle (X)		N/A		N/A
NAY˚	Neck Angle (Y)		N/A		N/A
TAX˚	T6 Angle (X)		-2.1		-1.3
TAY˚	T6 Angle (Y)		20.1		17.2
LAX˚	T1Angle (X)		0.5		0.1
LAY˚	T1 Angle (Y)		-2.0		-1.8

DATA SHEET NO.3 (CONTINUED)
DUMMY CMM MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

HEAD BOLT LOCATIONS



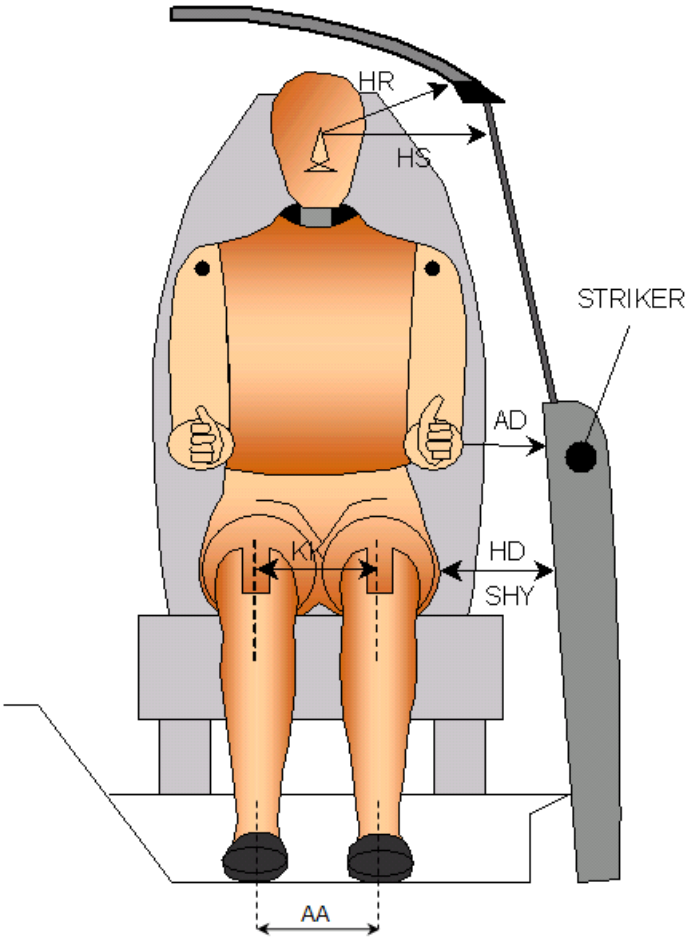
Description	Units	Driver			Passenger		
		X	Y	Z	X	Y	Z
Striker	mm	912	-792	756	915	785	755
Head CG	mm	899	-454	181	879	436	182
Bridge of Nose	mm	995	-377	177	977	365	174
Tip of Nose	mm	994	-379	215	978	368	212
Shoulder Bolt	mm	944	-577	439	924	555	447
Tip of Chin	mm	990	-377	315	975	368	313
H-Point	mm	1112	-628	861	1067	615	875
Left Knee	mm	1492	-585	735	1468	305	768
Right Knee	mm	1494	-296	742	1468	524	770
Left Ankle	mm	1809	-589	1003	1822	294	989
Right Ankle	mm	1830	-257	999	1822	500	995
Left Heel	mm	1828	-575	1136	1817	264	1127
Right Heel	mm	1843	-219	1130	1823	467	1130
Head Bolt 1 – Top Left	mm	832	-408	140	817	312	142
Head Bolt 2 – Lower Left	mm	842	-399	223	824	329	225
Head Bolt 3 – Top Right	mm	829	-337	138	810	381	141
Head Bolt 4 – Lower Right	mm	841	-351	226	820	378	225
Driver's Outboard Seat Anchor Bolt	mm	1418	-576	1066	915	785	755
Outboard Head Restraint Post	mm	718	-456	423	682	451	432
Top of Head Restraint	mm	749	-375	132	714	360	137
Center of Steering Wheel	mm	1382	-377	483			

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

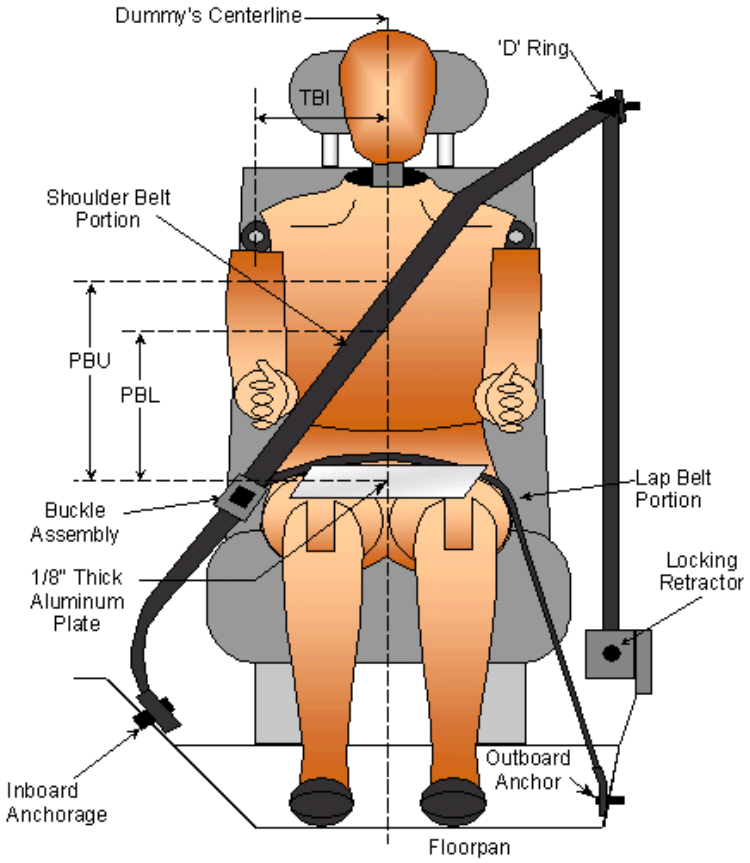
Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



Code	Description	Units	Driver	Passenger
AD	Arm to Door	mm	112	63
HD	H-Point to Door	mm	128	138
HR	Head to Side Header	mm	185	190
HS	Head to Side Window	mm	330	335
KK	Knee to Knee	mm	335	270
SHY	Striker to H-Point (Y Direction)	mm	230	230
AA	Ankle to Ankle	mm	329	200

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of reference to belt upper edge	mm	410	400
PBL — Top surface of reference to belt lower edge	mm	320	310

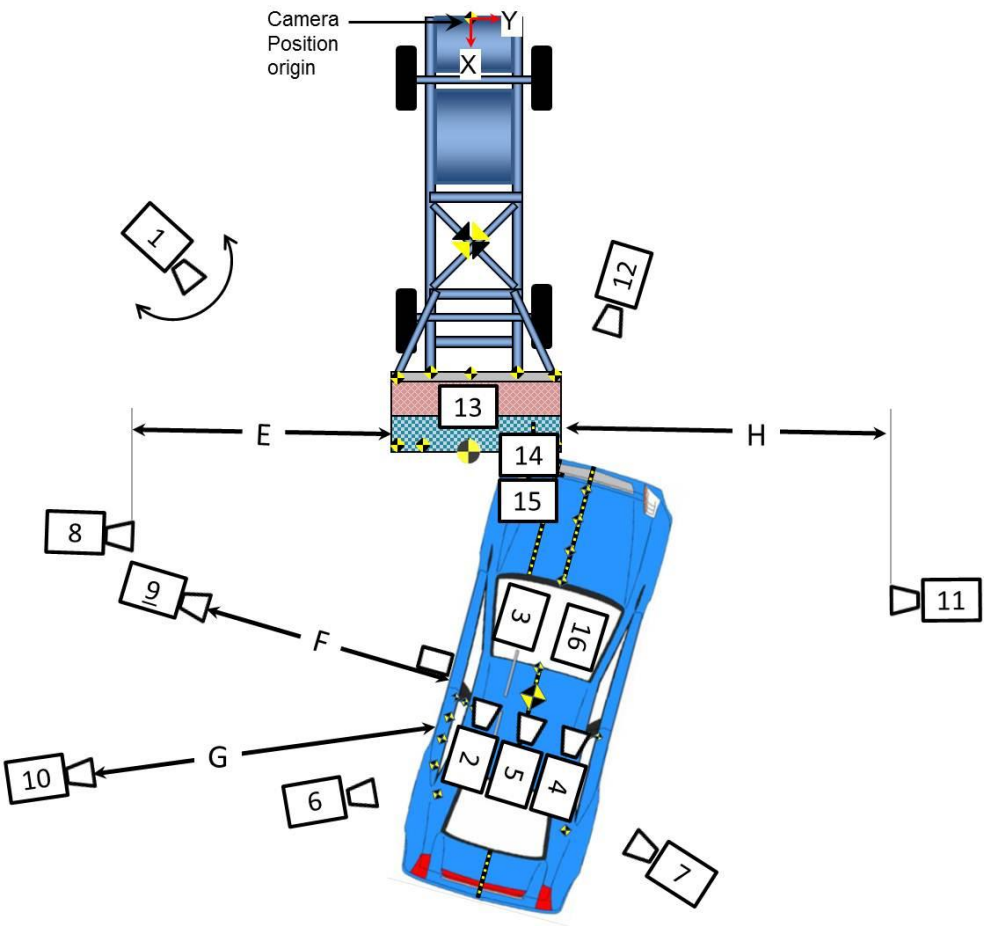
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	925	850
Lap Belt Length as measured on ATD	mm	510	500
Remainder of belt on reel	mm	1065	1100
Total belt length for continuous webbing systems	mm	2500	2450

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

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

HORIZONTAL LOCATION

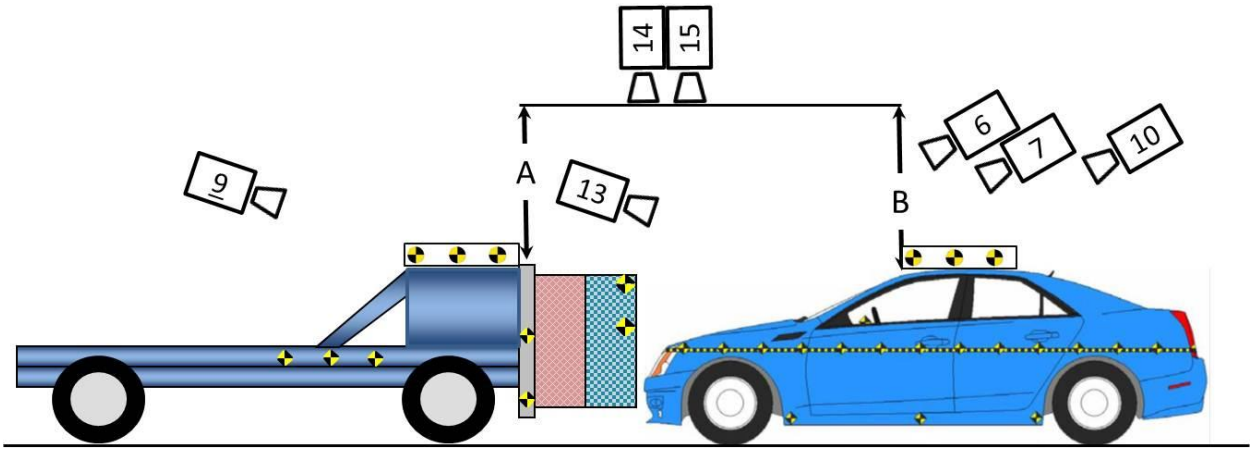


E	mm	6704
F	mm	7449
G	mm	9002
H	mm	6718

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

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

VERTICAL LOCATION



A	mm	4164
B	mm	3870

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

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

CAMERA LOCATIONS

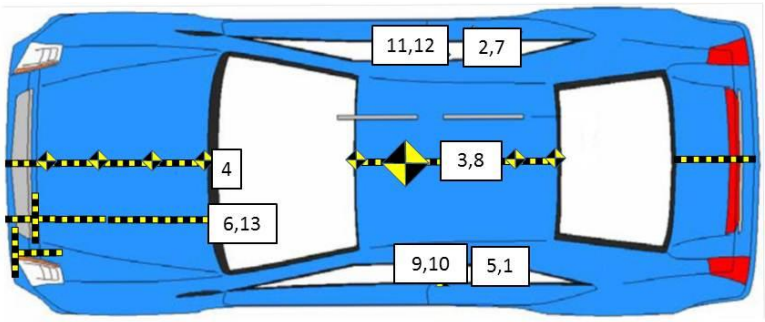
No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side	--	--	--	Zoom	30
2	Onboard Passenger Movement	7717	-169	1191	12.5	1000
3	Onboard Driver Lower Leg	6319	-578	226	6.5	1000
4	Onboard Driver Movement	7802	-761	1204	12.5	1000
5	Onboard Centerline	7916	-362	1242	12.5	1000
6	Driver Interaction	7553	2216	3663	24	1000
7	Passenger Interaction	11197	-8985	2561	50	1000
8	Target Vehicle Left Side Perpendicular (High)	4864	7807	1106	24-70	1000
9	Target Vehicle Driver Motion	5808	7621	1130	24	1000
10	Target Vehicle Passenger Motion	10416	8957	3421	50	1000
11	Target Vehicle Right Side	4864	-7821	1246	24	1000
12	Target Vehicle Left Side (High)	841	2202	1124	28-70	1000
13	RMDB/Target Vehicle Interaction	4844	1018	4630	13	1000
14	Close-up Impact Point	6767	662	5341	28	1000
15	Overall Impact	4842	662	5341	14	1000

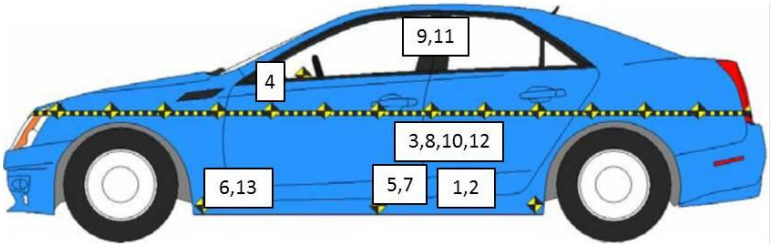
Reference Point: Center most rearward point of the RMDB when in contact with the target vehicle:

+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:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Axes	Units	Measurements (mm)		
				X	Y	Z
1	Left Rear Sill	X,Y	mm	838	-660	1108
2	Right Rear Sill	X,Y	mm	825	658	1106
3	Vehicle CG	X,Y,Z	mm	714	1	996
4	Instrument Panel	X	mm	1582	152	551
5	Driver Seat Track	X,Y,Z	mm	839	-578	1154
6	Behind Brake Pedal	X,Y,Z	mm	2161	-354	875
7	Passenger Seat Track	X,Y,Z	mm	837	576	1156
8	Angular Rate Sensor	X	mm	686	3	1022
	Angular Rate Sensor	Y	mm	732	-6	1019
	Angular Rate Sensor	Z,	mm	714	1	996

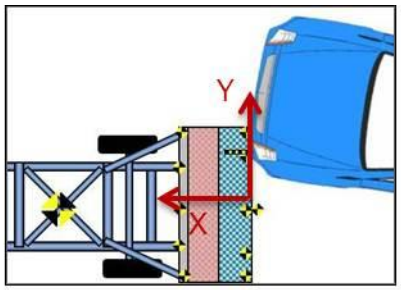
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

+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

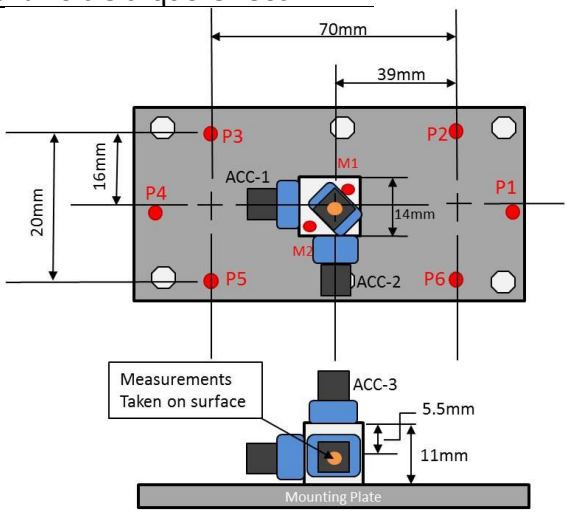
DATA SHEET NO. 7 (CONTINUED)
VEHICLE INSTRUMENTATION DATA

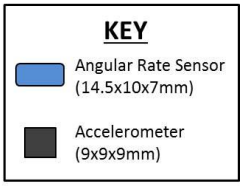
Test Vehicle: 2012 Volvo S60 four door sedan — NHTSA No.: RC5911

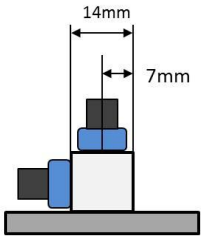
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset — Test Date: 1/6/2014



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







VEHICLE COORDINATE SYSTEM					
No.	Accelerometer Location	Units	Measurements (mm)		
			X	Y	Z
ACC-1	Accelerometer CG – X Direction	mm	686	3	1022
ACC-2	Accelerometer CG – Y Direction	mm	732	-6	1019
ACC-3	Accelerometer CG – Z Direction	mm	714	1	996
M1	Mounting Bolt 1	mm	717	-10	1013
M2	Mounting Bolt 2	mm	707	1	1013
P1	Plate Point 1	mm	762	-1	1025
P2	Plate Point 2	mm	751	-22	1025
P3	Plate Point 3	mm	681	-20	1026
P4	Plate Point 4	mm	670	1	1027
P5	Plate Point 5	mm	682	21	1026
P6	Plate Point 6	mm	752	20	1025

GLOBAL COORDINATE SYSTEM*					
No.	Accelerometer Location	Units	Measurements (mm)		
			X	Y	Z
ACC-1	Accelerometer CG – X Direction	mm	-2374	1363	-353
ACC-2	Accelerometer CG – Y Direction	mm	-2328	1355	-356
ACC-3	Accelerometer CG – Z Direction	mm	-2345	1361	-378
M1	Mounting Bolt 1	mm	-2342	1351	-362
M2	Mounting Bolt 2	mm	-2353	1362	-362
P1	Plate Point 1	mm	-2297	1359	-350
P2	Plate Point 2	mm	-2308	1339	-350
P3	Plate Point 3	mm	-2378	1340	-348
P4	Plate Point 4	mm	-2389	1361	-348
P5	Plate Point 5	mm	-2377	1382	-349
P6	Plate Point 6	mm	-2308	1380	-350

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

DATA SHEET NO. 7 (CONTINUED)
VEHICLE INSTRUMENTATION DATA

Test Vehicle: 2012 Volvo S60 four door sedan
NHTSA No.: RC5911
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
Test Date: 1/6/2014

VEHICLE INSTRUMENTATION DATA

Loc.	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Left Rear Sill	X	g	2.04	149.55	-47.75	41.10
		Y	g	17.18	44.30	-4.58	12.05
2	Right Rear Sill	X	g	3.58	109.25	-45.67	40.80
		Y	g	25.40	39.20	-2.99	111.50
3	Vehicle CG	X	g	3.12	107.75	-50.94	39.85
		Y	g	34.87	56.50	-6.39	50.35
		Z	g	34.37	40.70	-26.56	61.75
4	Instrument Panel	X	g	42.90	20.20	-77.64	49.20
5	Driver Seat Track	X	g	2.30	100.85	-57.67	41.55
		Y	g	26.97	42.75	-5.23	17.25
		Z	g	26.55	44.50	-24.40	39.90
6	Behind Brake Pedal	X	g	14.69	57.70	-80.45	40.35
		Y	g	50.53	40.85	-10.75	64.20
		Z	g	15.97	7.70	-24.97	47.95
7	Passenger Seat Track	X	g	3.84	108.45	-48.42	40.75
		Y	g	29.17	38.75	-22.04	21.00
		Z	g	12.92	42.75	-9.55	36.80
8	Angular Rate Sensors	X	Deg/s	144.89	105.35	1018.40	50.45
		Y	Deg/s	146.35	83.60	-591.93	48.20
		Z	Deg/s	130.69	79.00	-502.86	55.15
9	Driver Shoulder Belt		N	5500.87	63.15	-26.18	8.80
10	Driver Lap Belt		N	5877.96	58.95	-2.30	-50.00
11	Passenger Shoulder Belt		N	4449.57	87.50	-27.15	252.35
12	Passenger Lap Belt		N	7483.45	65.15	-22.58	12.10
13	Driver Floor Pan String Pot		mm	0.09	1.65	-21.73	52.55

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	8.95
2	Driver Air Bag Squib 2	*	V	13.95
3	Driver Curtain Airbag	*	V	13.40
4	Driver Torso Airbag	*	V	68.45
5	Driver Knee Airbag	*	V	N/A
6	Driver Pretensioner	*	V	8.45
7	Passenger Air Bag Squib 1	*	V	8.95
8	Passenger Air Bag Squib 2	*	V	18.95
9	Passenger Curtain Airbag	*	V	Disabled
10	Passenger Torso Airbag	*	V	Disabled
11	Passenger Knee Airbag	*	V	N/A
12	Passenger Pretensioner	*	V	16.45

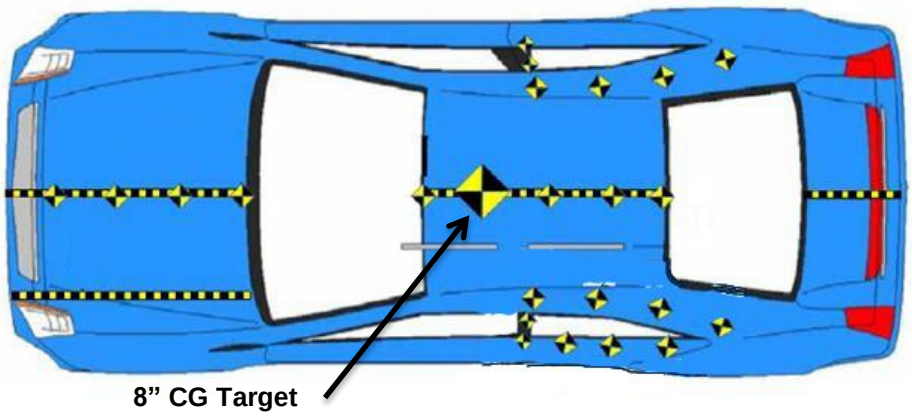
* The measurement indicates the time the voltage changed

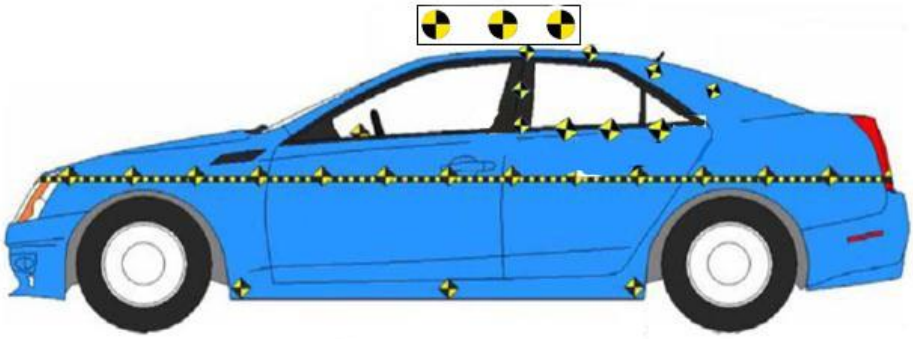
DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

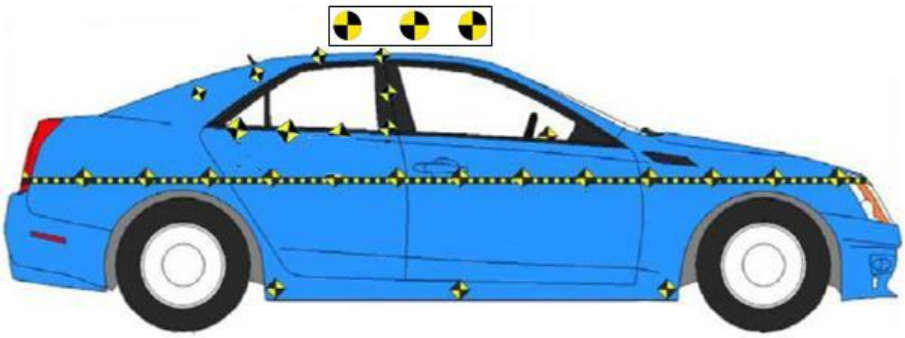
Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

Item	Units	Value
A	mm	274

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

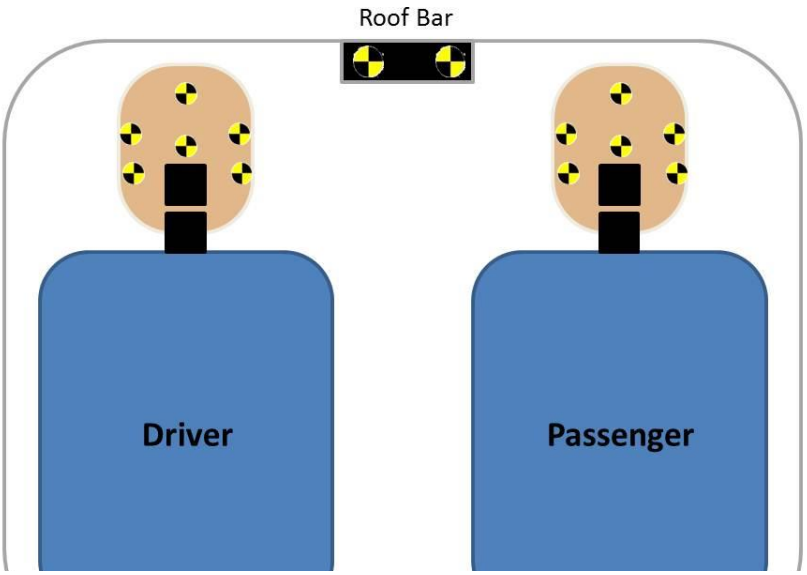






DATA SHEET NO. 8 (CONTINUED)
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



Point	Pre-Test		
	X	Y	Z
Roof Bar Driver	1357	-71	162
Roof Bar Passenger	1362	54	162

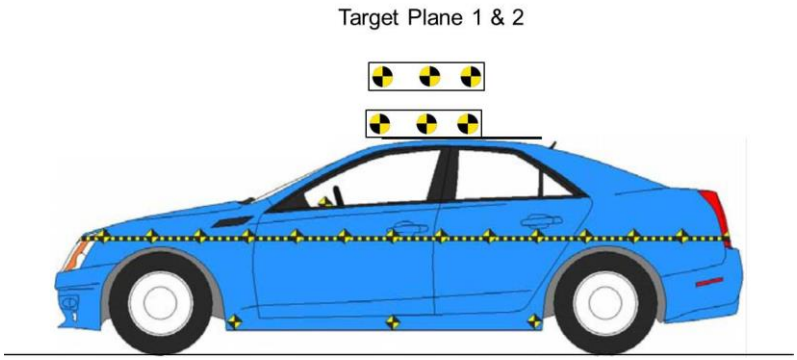
Reference point: 50mm above the center of the rear windshield (See appendix D for procedure to create coordinate system).

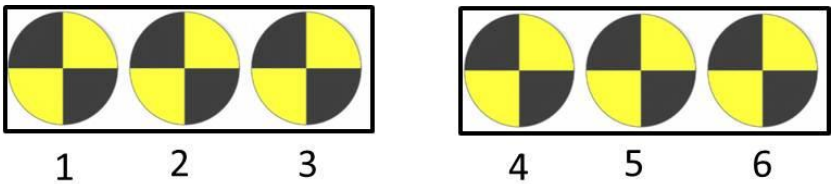
+X – From the rear of the vehicle to the front of the vehicle
+Y – From the left side of the vehicle to the right side of the vehicle
+Z – From the top of the vehicle to the bottom of the vehicle

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

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

OVERHEAD TARGET BARS





Vertical Target Plane 1 (Driver's Side)

Vertical Target Plane 2 (Passenger Side)

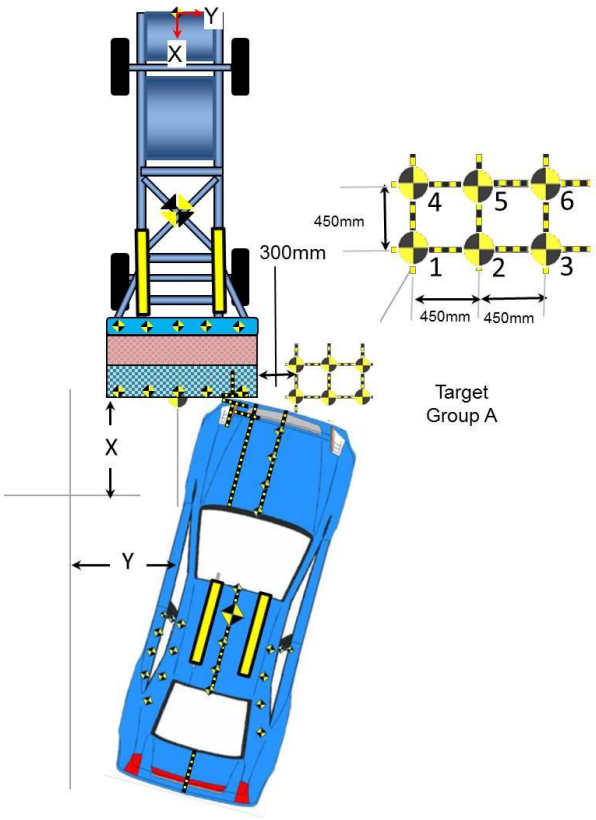
Target	Units	X	Y	Z
1	mm	1383	-487	-396
2	mm	929	-498	-401
3	mm	476	-501	-402
4	mm	1386	502	-395
5	mm	934	502	-397
6	mm	484	499	-396

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

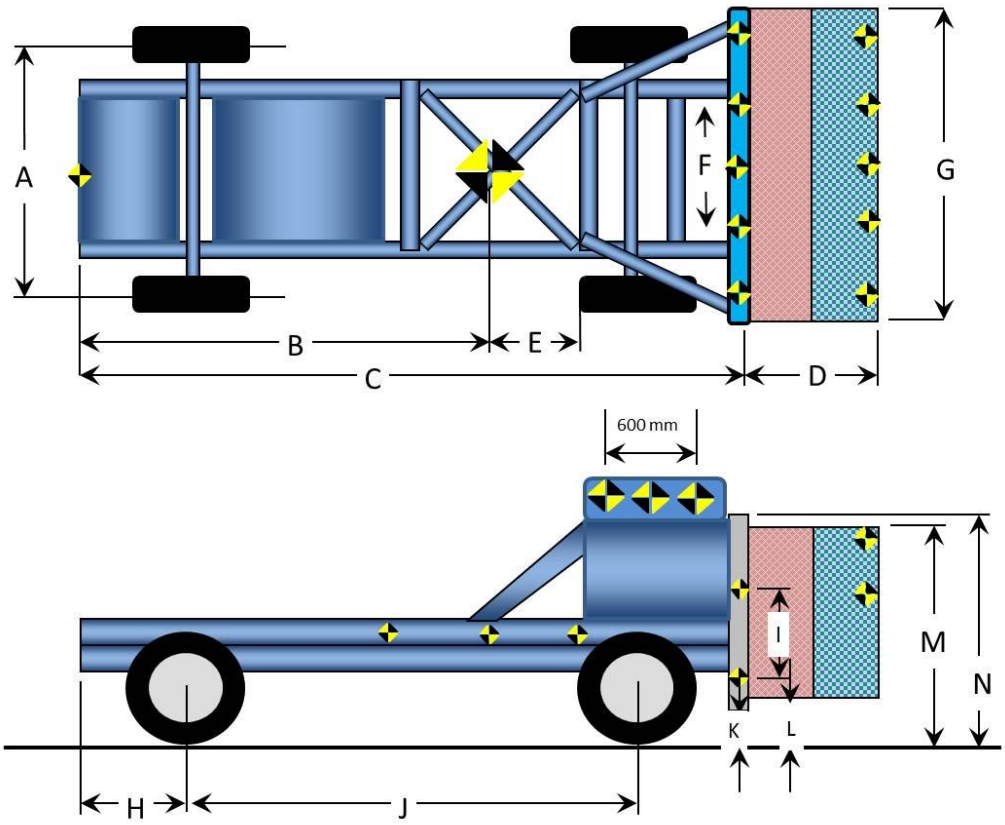
Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014



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:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



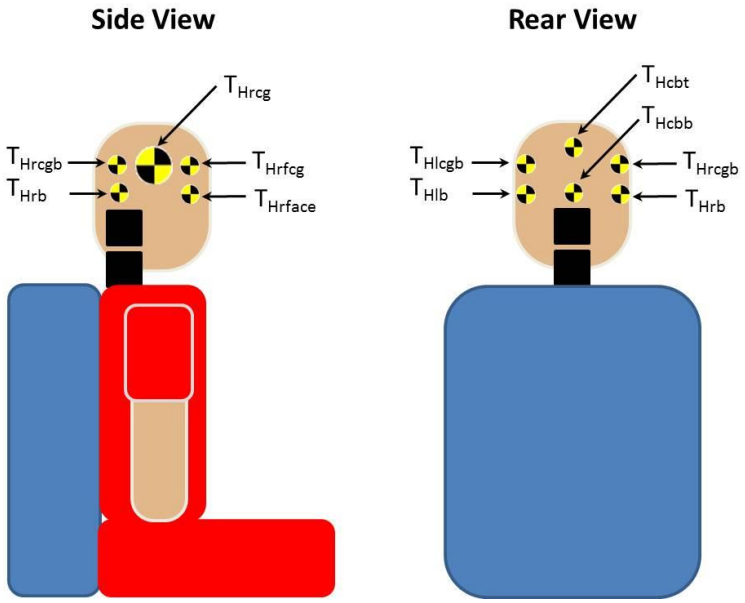
Item	Units	Value	Item	Units	Value
A	mm	1930	H	mm	800
B	mm	2451	I	mm	450
C	mm	3995	J	mm	2555
D	mm	605	K	mm	77
E	mm	904	L	mm	71
F	mm	900	M	mm	1024
G	mm	2205	N	mm	1177

	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

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

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



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_{Hlcg} & T_{Hlfcg}	mm	38
Distance between T_{Hlcg} & T_{Hlcgb}	mm	38
Distance between T_{Hlcgb} & T_{Hlb}	mm	70
Distance between T_{Hlfcg} & T_{Hlface}	mm	70
Distance between T_{Hcbt} & T_{Hcbb}	mm	72

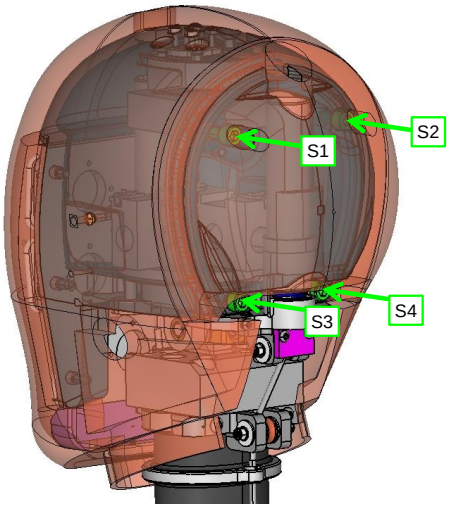
Passenger Dummy Head Targets (S/N 366)

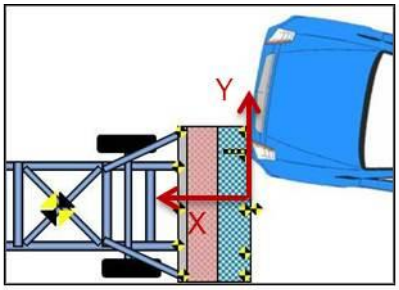
Measurement	Units	Value
Distance between T_{Hrcg} & T_{Hrfcg}	mm	38
Distance between T_{Hrcg} & T_{Hrcgb}	mm	38
Distance between T_{Hrcgb} & T_{Hrb}	mm	70
Distance between T_{Hrfcg} & T_{Hrface}	mm	70
Distance between T_{Hlcg} & T_{Hlfcg}	mm	38
Distance between T_{Hlcg} & T_{Hlcgb}	mm	38
Distance between T_{Hlcgb} & T_{Hlb}	mm	70
Distance between T_{Hlfcg} & T_{Hlface}	mm	70
Distance between T_{Hcbt} & T_{Hcbb}	mm	72

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

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

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 HEAD BOLT POINTS

Target	X	Y	Z
S1	-2228	952	-1235
S3	-2218	961	-1152
S2	-2219	1009	-1149
S4	-2230	1024	-1237

FRONT PASSENGER HEAD BOLT POINTS

Target	X	Y	Z
S1	-2242	1673	-1233
S3	-2236	1689	-1149
S2	-2249	1742	-1234
S4	-2240	1739	-1150

**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:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Accelerometers	87
Passenger Dummy Accelerometers	81
Vehicle Structure Accelerometers	47
RMDB Cart Accelerometers	6
Total	221

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: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

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	LX
Head Contact	Front & Curtain Airbags & Side Headliner	Front Airbag, center instrument panel, visor and A-Pillar
Upper Torso Contact	Front Airbag, Side Torso & Arm contacted driver's door	Front Airbag
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	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

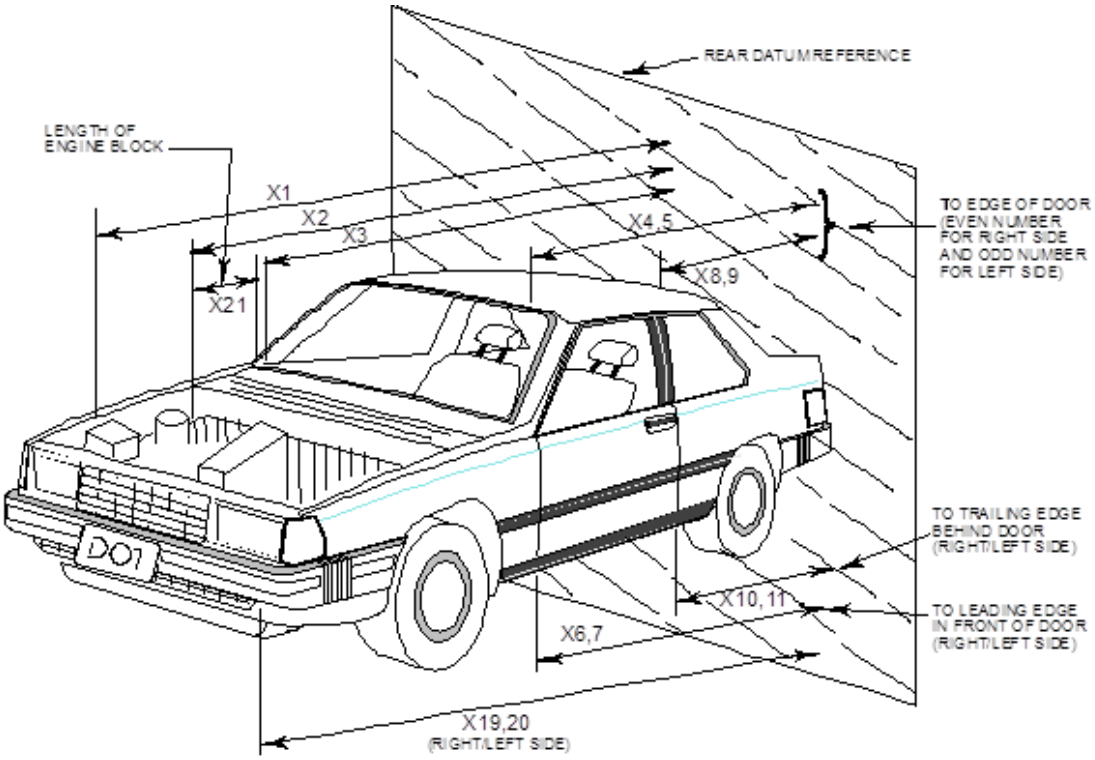
Critical Areas of Performance	Observations and Conclusions	Photo Taken (Y/N)
Pillar Performance	A-Pillar slightly buckled	Y
Windshield Damage	Cracks throughout with a small tear	Y
Window Damage	None	Y
Other Notable Effects	None	--

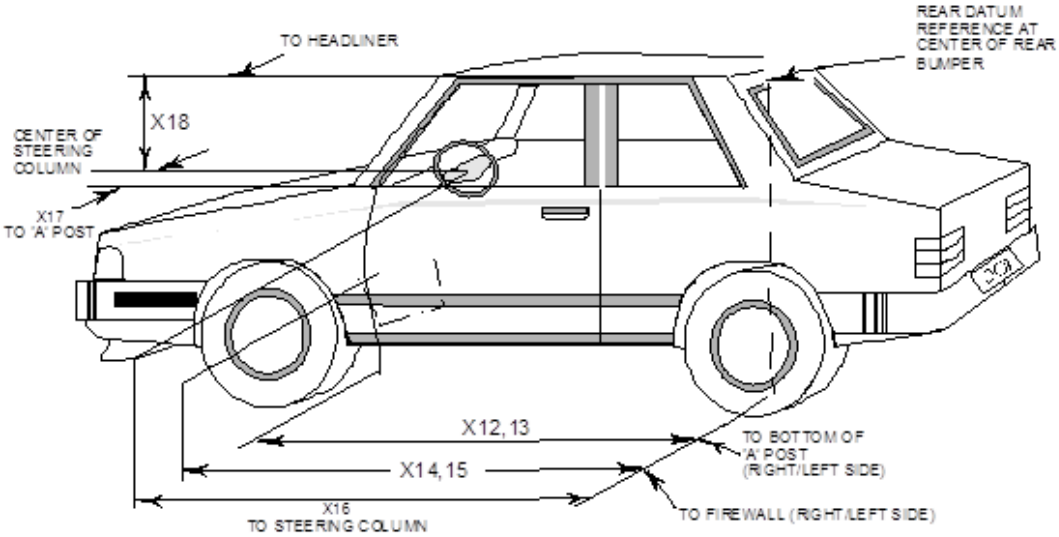
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 11
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014





DATA SHEET NO. 11 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	3360	3195	164
2	Rear Surface of Vehicle (RSOV) to Front of Engine	mm	2812	2742	70
3	RSOV to Firewall	mm	2401	2322	79
4	RSOV to Upper Leading Edge of Right Door	mm	1895	1896	-1
5	RSOV to Upper Leading Edge of Left Door	mm	1898	1884	13
6	RSOV to Lower Leading Edge of Right Door	mm	1893	1897	-3
7	RSOV to Lower Leading Edge of Left Door	mm	1895	1878	17
8	RSOV to Upper Trailing Edge of Right Door	mm	798	800	-2
9	RSOV to Upper Trailing Edge of Left Door	mm	802	789	13
10	RSOV to Lower Trailing Edge of Right Door	mm	860	862	-2
11	RSOV to Lower Trailing Edge of Left Door	mm	862	844	18
12	RSOV to Bottom of “A” Post of Right Side	mm	1872	1873	-1
13	RSOV to Bottom of “A” Post of Left Side	mm	1876	1870	6
14	RSOV to Firewall, Right Side	mm	2359	2357	1
15	RSOV to Firewall, Left Side	mm	2361	2214	147
16	RSOV to Steering Column	mm	1382	1419	-38
17	Center of Steering Column to “A” Post	mm	282	285	-3
18	Center of Steering Column to Headliner	mm	407	403	3
19	RSOV to Right Side of Front Bumper	mm	3270	3320	-50
20	RSOV to Left Side of Front Bumper	mm	3268	2973	296
21	Length of Engine Block	mm	381	381	0
RD	RSOV to Right Side of Dash Panel	mm	1637	1634	3
CD	RSOV to Center of Dash Panel	mm	1586	1559	27
LD	RSOV to Left Side of Dash Panel	mm	1635	1600	35

DATA SHEET NO. 12
ACCIDENT INVESTIGATION DIVISION DATA

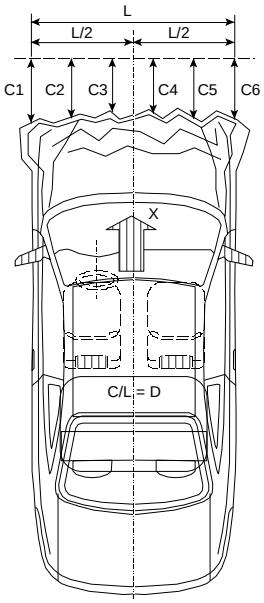
Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

VEHICLE INFORMATION

VIN:	YV1622FS1C2081747	Wheelbase (mm):	2778
Vehicle Size Category:	Passenger	Test Weight (kg):	1936

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):	90.09
Velocity Change (kph):	90.09



CRUSH PROFILE

Collision Deformation Classification:	11LFEW3
Midpoint of Damage:	C2
Damage Region Length (mm):	1171
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	3216	2932	284
C2	Crush zone 2 at left side	mm	3337	3047	290
C3	Crush zone 3 at left side	mm	3355	3146	209
C4	Crush zone 4 at right side	mm	3355	3231	124
C5	Crush zone 5 at right side	mm	3338	3305	33
C6	Crush zone 6 at right side	mm	3216	3307	-91
L	C1 to C6	mm	1171	1154	17

Crush Measurements: Bumper Cover Removed

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
B1	Bumper Beam 1 at left side	mm	3195	2919	-276
B2	Bumper Beam 2 at left side	mm	3200	2805	-395
B3	Bumper Beam 3 at left side	mm	3204	2782	-422
B4	Bumper Beam 4 at left side	mm	3213	2858	-355
B5	Bumper Beam 5 at right side	mm	3216	2937	-279
B6	Bumper Beam 6 at right side	mm	3213	3012	-201
B7	Bumper Beam 7 at right side	mm	3203	3083	-120
B8	Bumper Beam 8 at right side	mm	3200	3157	-43
B9	Bumper Beam 9 at right side	mm	3194	3227	33
L	B1 to B9	mm	1068	834	-234

DATA SHEET NO. 13
VEHICLE INTRUSION MEASUREMENTS

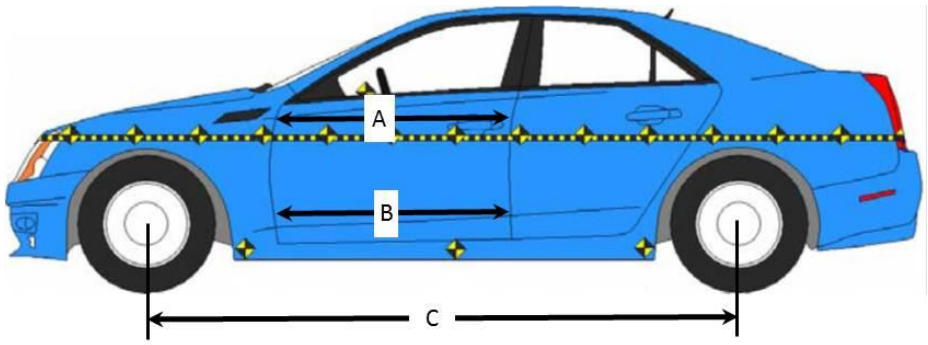
Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

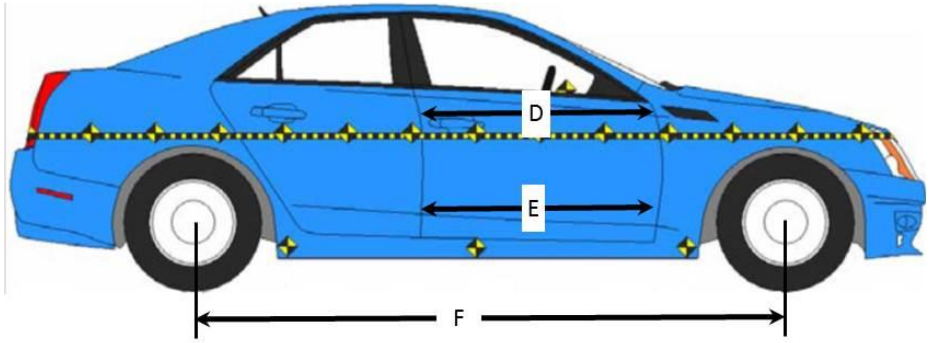
DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	925	902	-23
B	Left Side Lower	mm	853	841	-12
D	Right Side Upper	mm	927	927	0
E	Right Side Lower	mm	850	850	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2778	2643	-135
F	Right Side Wheelbase	mm	2778	2792	14





DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

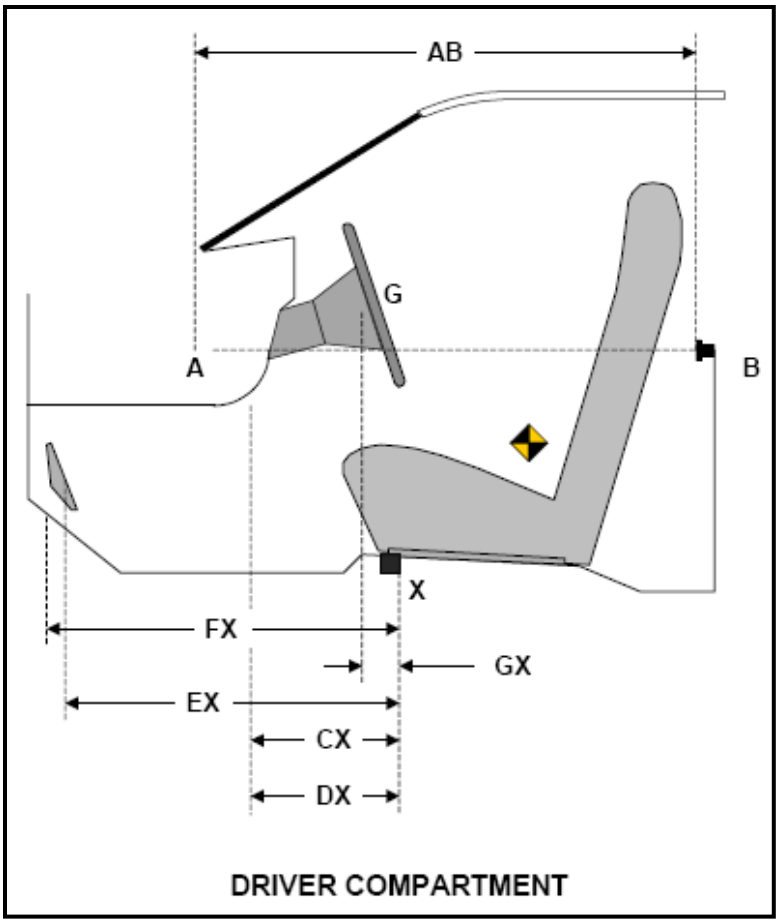
Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	763	765	2
CX	Left Knee Bolster to X	mm	232	204	-28
DX	Right Knee Bolster to X	mm	211	198	-13
EX	Brake Pedal to X	mm	476	460	-16
FX	Foot Rest to X	mm	552	535	-17
GX	Center of Steering Column Wheel Hub to X	mm	-36	11	48

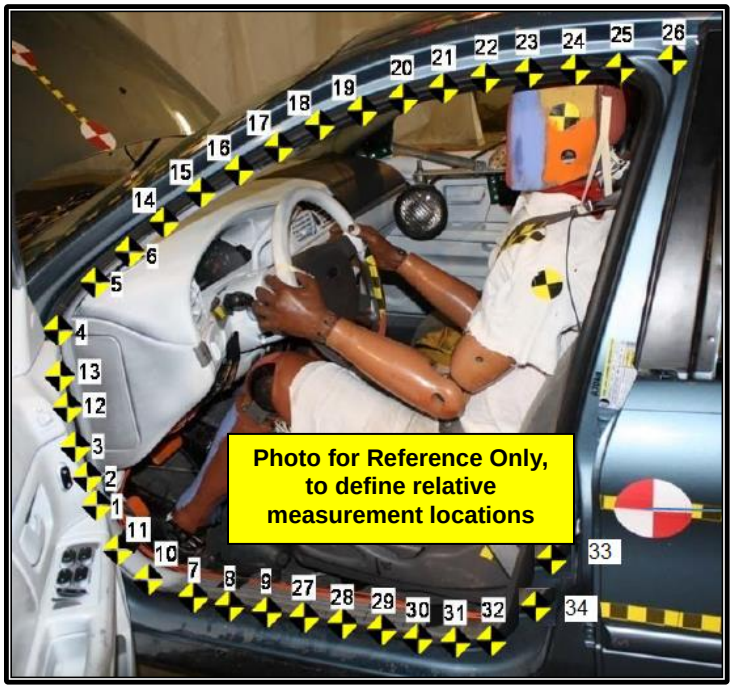
X = Front of Seat Track (Stationary)



DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

DRIVER SIDE DOOR SILL INTRUSIONS



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

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

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	1791	-746	954	1777	-731	980	-14	15	26
2	1800	-750	882	1781	-734	907	-19	16	25
3	1796	-755	806	1772	-740	832	-24	15	26
4	1783	-755	507	1763	-741	529	-20	14	22
5	1765	-744	434	1752	-731	455	-13	13	21
6	1709	-724	360	1702	-712	377	-7	12	17
7	1695	-746	1024	1689	-729	1051	-6	17	27
8	1545	-747	1026	1540	-731	1049	-5	16	23
9	1394	-747	1026	1388	-734	1045	-6	13	19
10	1737	-746	1015	1730	-730	1043	-7	16	28
11	1772	-745	990	1761	-731	1017	-11	14	27
12	1792	-756	709	1765	-743	733	-27	13	24
13	1788	-756	609	1761	-742	632	-27	14	23
14	1656	-710	319	1651	-700	330	-5	10	11
15	1596	-697	285	1596	-682	292	0	15	7
16	1534	-684	254	1536	-673	260	2	11	6

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

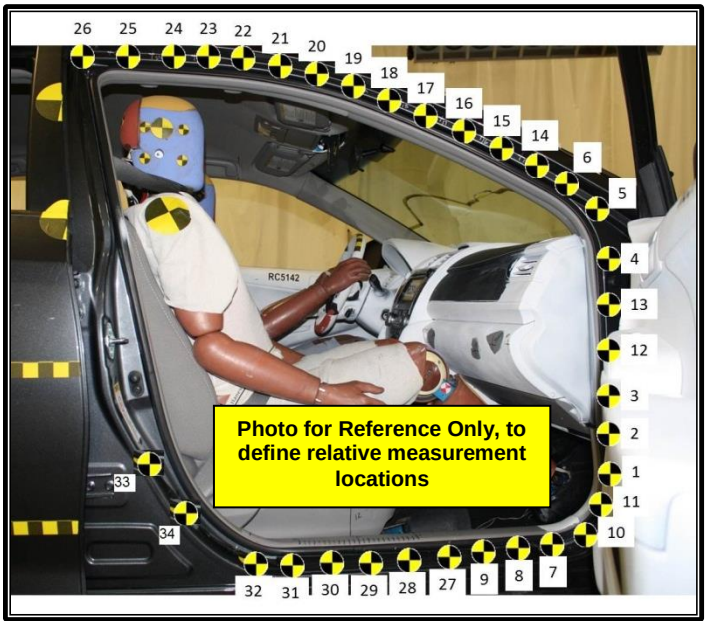
Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
17	1473	-671	226	1475	-662	231	2	9	5
18	1410	-657	200	1412	-650	202	2	7	2
19	1345	-646	175	1349	-639	175	4	7	0
20	1280	-634	154	1284	-628	155	4	6	1
21	1213	-623	135	1218	-619	138	5	4	3
22	1146	-615	119	1150	-610	124	4	5	5
23	1078	-607	106	1081	-603	112	3	4	6
24	1009	-600	95	1012	-595	102	3	5	7
25	940	-595	87	942	-592	95	2	3	8
26	868	-593	81	870	-589	91	2	4	10
27	1353	-746	1026	1347	-735	1044	-6	11	18
28	1312	-746	1026	1306	-735	1043	-6	11	17
29	1271	-747	1025	1265	-736	1042	-6	11	17
30	1230	-746	1025	1225	-737	1041	-5	9	16
31	1191	-747	1022	1186	-738	1038	-5	9	16
32	1157	-748	1010	1151	-739	1023	-6	9	13
33	989	-746	806	986	-742	820	-3	4	14
34	1098	-746	957	1093	-740	971	-5	6	14

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: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

PASSENGER SIDE DOOR SILL INTRUSIONS



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

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

Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	1790	739	956	1786	770	958	-4	31	2
2	1800	743	879	1797	773	881	-3	30	2
3	1797	748	808	1793	777	808	-4	29	0
4	1784	746	509	1780	770	510	-4	24	1
5	1766	735	432	1763	758	433	-3	23	1
6	1710	716	358	1707	735	360	-3	19	2
7	1696	739	1021	1692	770	1023	-4	31	2
8	1545	740	1023	1542	766	1024	-3	26	1
9	1396	739	1023	1394	762	1024	-2	23	1
10	1738	740	1012	1736	771	1013	-2	31	1
11	1773	739	987	1770	770	988	-3	31	1
12	1793	749	710	1789	775	711	-4	26	1
13	1789	748	609	1785	773	609	-4	25	0
14	1658	702	318	1655	719	319	-3	17	1
15	1599	688	285	1598	704	287	-1	16	2
16	1538	675	255	1537	690	256	-1	15	1

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

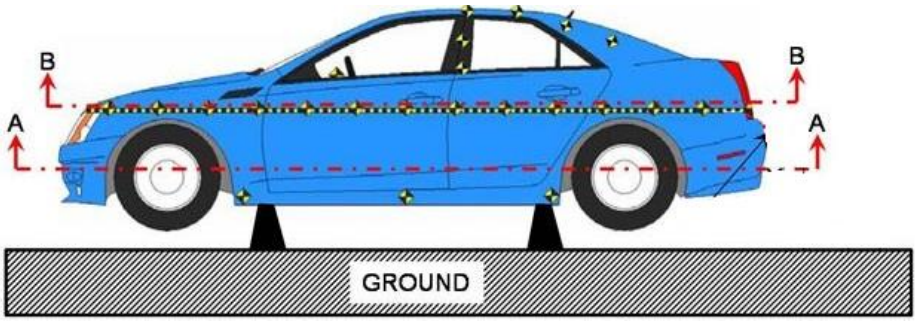
Point	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
17	1476	662	226	1475	676	227	-1	14	1
18	1413	649	199	1412	661	200	-1	12	1
19	1349	637	175	1348	647	176	-1	10	1
20	1283	625	153	1283	634	155	0	9	2
21	1217	615	134	1216	623	136	-1	8	2
22	1150	606	118	1149	613	120	-1	7	2
23	1081	598	105	1081	605	106	0	7	1
24	1012	591	94	1012	597	96	0	6	2
25	942	587	85	942	592	87	0	5	2
26	868	583	80	868	589	82	0	6	2
27	1356	739	1023	1354	761	1024	-2	22	1
28	1317	740	1023	1314	760	1024	-3	20	1
29	1277	740	1022	1274	759	1024	-3	19	2
30	1236	740	1022	1233	759	1024	-3	19	2
31	1195	740	1020	1192	757	1022	-3	17	2
32	1157	740	1005	1155	756	1007	-2	16	2
33	989	739	806	986	749	807	-3	10	1
34	1099	740	956	1097	754	957	-3	14	2

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

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan NHTSA No.: RC5911
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset Test Date: 1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A



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

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

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
1	2050	-907	931	1	2617	-655	931
2	2778	-896	931	2	2614	-552	931
3	2831	-887	931	3	2688	-497	931
4	2912	-858	931	4	2811	-439	931
5	2973	-831	931	5	2889	-407	931
6	2999	-818	931	6	2953	-404	931
7	3061	-773	931	7	2910	-339	931
8	3120	-714	931	8	2782	-171	930
9	3176	-643	931	9	2806	-62	931
10	3215	-587	931	10	2888	63	931
11	3258	-518	931	11	2998	221	931
12	3285	-454	931	12	3063	323	931
13	3328	-401	930	13	3149	415	931
14	3337	-350	931	14	3253	563	930
15	3351	-236	932	15	3143	636	931
16	3357	-21	932	16	2978	687	931
17	3358	-2	932	17	2965	748	930
18	3357	69	932	18	2777	885	931
19	3356	118	932	19	2722	979	930
20	3352	234	931	20	2614	988	930
21	3343	315	932	21	2489	968	930
22	3330	397	932	22	2284	938	931
23	3286	452	931	23	2057	936	931
24	3261	508	932	24	1969	931	930
25	3216	585	932	25	1930	928	931

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
26	3129	702	933	26	1761	919	932
27	3048	781	931	27	1589	918	931
28	2944	845	932	28	1372	917	932
29	2826	889	932	29	1203	915	932
30	2777	897	932	30	1060	912	932
31	2063	901	931	31	900	908	931
32	1998	901	932	32	763	902	932
33	1927	896	931	33	571	896	931
34	1689	892	931	34	391	890	932
35	1457	895	931	35	210	888	932
36	1169	897	931	36	115	891	932
37	957	895	932	37	11	894	931
38	829	892	931	38	-766	861	931
39	653	888	932	39	-766	861	931
40	414	881	932	40	-828	841	931
41	200	879	932	41	-955	799	931
42	109	883	932	42	-1056	759	932
43	6	888	932	43	-1161	677	931
44	-721	869	932	44	-1213	565	931
45	-765	857	932	45	-1241	449	931
46	-797	854	932	46	-1258	233	932
47	-915	813	932	47	-1263	82	931
48	-1036	765	932	48	-1264	-1	932
49	-1148	685	931	49	-1266	-63	933
50	-1209	573	932	50	-1263	-223	931
51	-1238	473	931	51	-1257	-345	931
52	-1258	305	932	52	-1244	-452	932
53	-1263	164	931	53	-1226	-541	931
54	-1264	0	932	54	-1183	-642	931
55	-1263	-140	930	55	-1137	-702	931
56	-1256	-336	931	56	-1029	-774	932
57	-1240	-479	931	57	-911	-821	931
58	-1190	-626	932	58	-798	-860	931
59	-1114	-722	932	59	-728	-880	931
60	-928	-815	931	60	4	-903	932
61	-809	-856	932	61	89	-900	932
62	-775	-868	931	62	248	-891	932
63	-719	-882	932	63	415	-891	931
64	8	-899	932	64	654	-895	931
65	84	-897	932	65	843	-897	931
66	166	-891	931	66	864	-901	931

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (Continued)

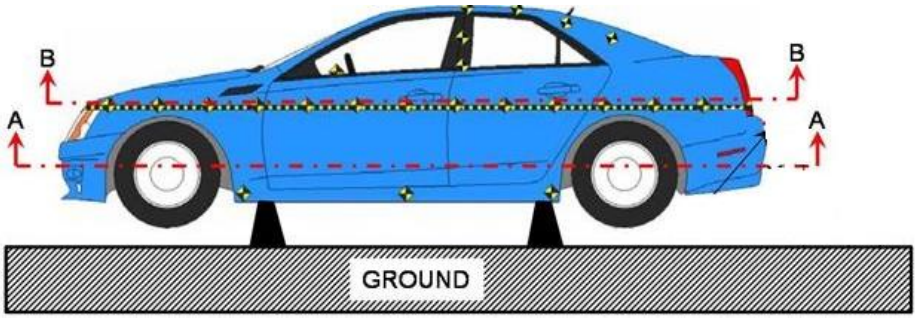
Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
67	364	-890	931	67	967	-901	932
68	562	-894	932	68	1146	-900	932
69	776	-900	931	69	1295	-898	932
70	911	-902	932	70	1377	-897	931
71	1153	-905	932	71	1554	-892	931
72	1392	-904	931	72	1723	-887	932
73	1650	-900	931	73	1861	-885	931
74	1866	-899	932	74	1915	-879	931
75	1993	-907	931	75	1945	-917	932
				76	1967	-938	931
				77	2025	-853	932
				78	2094	-848	932
				79	2263	-822	932
				80	2480	-788	932
				81	2562	-872	931
				82	2600	-879	932
				83	2627	-772	932
				84	2622	-669	931

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: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B



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

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

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
1	2004	-896	641	1	2631	-527	641
2	2132	-898	641	2	2535	-353	641
3	2215	-901	641	3	2593	-276	641
4	2332	-904	641	4	2613	-147	641
5	2438	-903	641	5	2729	-84	641
6	2569	-883	641	6	2880	27	641
7	2687	-851	642	7	2979	140	641
8	2808	-815	641	8	3053	290	641
9	2897	-781	641	9	3115	363	641
10	2996	-706	641	10	3156	439	640
11	3061	-639	641	11	3159	490	640
12	3133	-550	642	12	3170	625	641
13	3213	-389	642	13	3137	672	640
14	3256	-205	641	14	3055	765	640
15	3270	0	642	15	2963	830	641
16	3264	150	642	16	2850	864	641
17	3240	305	642	17	2731	881	641
18	3167	483	642	18	2537	928	641
19	3097	609	642	19	2370	940	641
20	3030	672	642	20	2184	932	641
21	2910	776	642	21	1971	925	641
22	2772	822	642	22	1878	918	640
23	2629	868	642	23	1866	918	641
24	2477	900	642	24	1710	919	641
25	2378	905	643	25	1526	922	642

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B (Continued)

Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
26	2259	900	641	26	1340	923	642
27	2101	893	642	27	1152	922	642
28	1960	890	642	28	1002	920	642
29	1765	893	642	29	819	916	641
30	1558	899	642	30	590	910	641
31	1346	904	642	31	368	902	642
32	1158	906	642	32	158	899	642
33	950	907	642	33	-24	899	641
34	855	905	642	34	-159	902	642
35	779	904	642	35	-225	905	642
36	610	900	642	36	-251	902	641
37	421	894	641	37	-251	902	641
38	239	891	642	38	-348	905	642
39	71	891	642	39	-451	900	641
40	-152	892	642	40	-590	879	642
41	-338	898	642	41	-683	860	641
42	-559	877	642	42	-772	843	641
43	-772	834	642	43	-855	825	642
44	-784	840	642	44	-949	802	641
45	-890	815	642	45	-981	794	641
46	-965	796	642	46	-1043	739	641
47	-983	790	641	47	-1101	645	641
48	-1045	732	642	48	-1125	584	641
49	-1103	635	641	49	-1122	543	642
50	-1124	581	642	50	-1141	452	641
51	-1122	549	642	51	-1159	344	642
52	-1129	511	642	52	-1148	246	641
53	-1153	382	642	53	-1149	118	641
54	-1163	307	641	54	-1152	1	641
55	-1139	226	641	55	-1151	-86	641
56	-1146	80	641	56	-1146	-225	642
57	-1148	-3	642	57	-1164	-312	642
58	-1145	-114	641	58	-1144	-443	642
59	-1146	-263	642	59	-1125	-540	641
60	-1163	-308	642	60	-1127	-581	641
61	-1145	-435	642	61	-1084	-682	641
62	-1123	-546	642	62	-1028	-760	641
63	-1125	-557	642	63	-996	-790	641
64	-1126	-584	642	64	-851	-828	641
65	-1090	-670	641	65	-677	-867	642
66	-1025	-762	642	66	-494	-901	641
67	-976	-798	641	67	-316	-910	641

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION B-B (Continued)

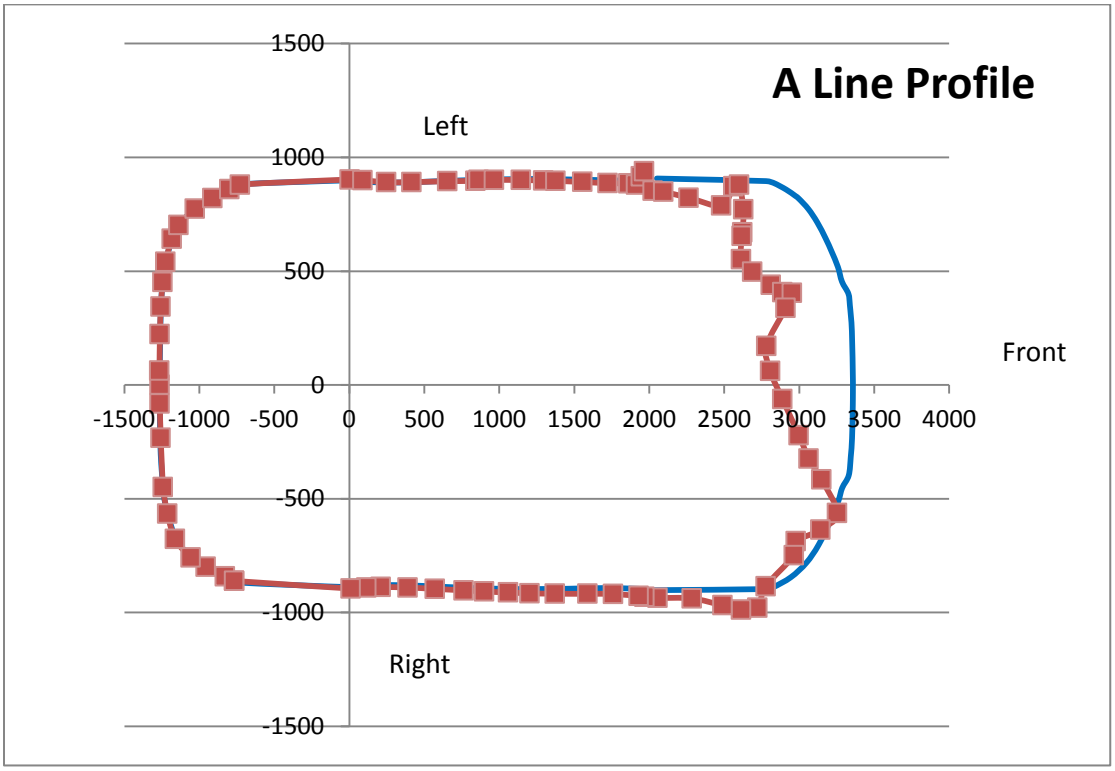
Point	Pre-Test			Point	Post-Test		
	X	Y	Z		X	Y	Z
68	-883	-822	642	68	-108	-905	642
69	-772	-848	642	69	-85	-906	641
70	-636	-875	642	70	36	-904	641
71	-506	-899	642	71	193	-902	641
72	-373	-910	642	72	377	-902	642
73	-213	-907	641	73	604	-905	642
74	-104	-904	642	74	776	-907	641
75	-56	-902	641	75	837	-908	641
76	166	-902	641	76	847	-917	641
77	384	-903	641	77	941	-918	642
78	577	-908	641	78	1074	-904	642
79	780	-913	642	79	1177	-912	642
80	915	-915	642	80	1288	-909	641
81	1117	-915	642	81	1463	-902	642
82	1279	-913	642	82	1628	-894	642
83	1473	-909	641	83	1765	-886	641
84	1625	-905	642	84	1876	-881	641
85	1767	-900	641	85	1899	-906	641
86	1896	-897	642	86	1965	-951	641
87	1986	-897	641	87	2059	-999	641
				88	2112	-1015	641
				89	2157	-953	641
				90	2186	-772	642
				91	2259	-822	641
				92	2307	-799	641
				93	2329	-728	641
				94	2526	-593	642
				95	2574	-623	641
				96	2617	-587	641

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

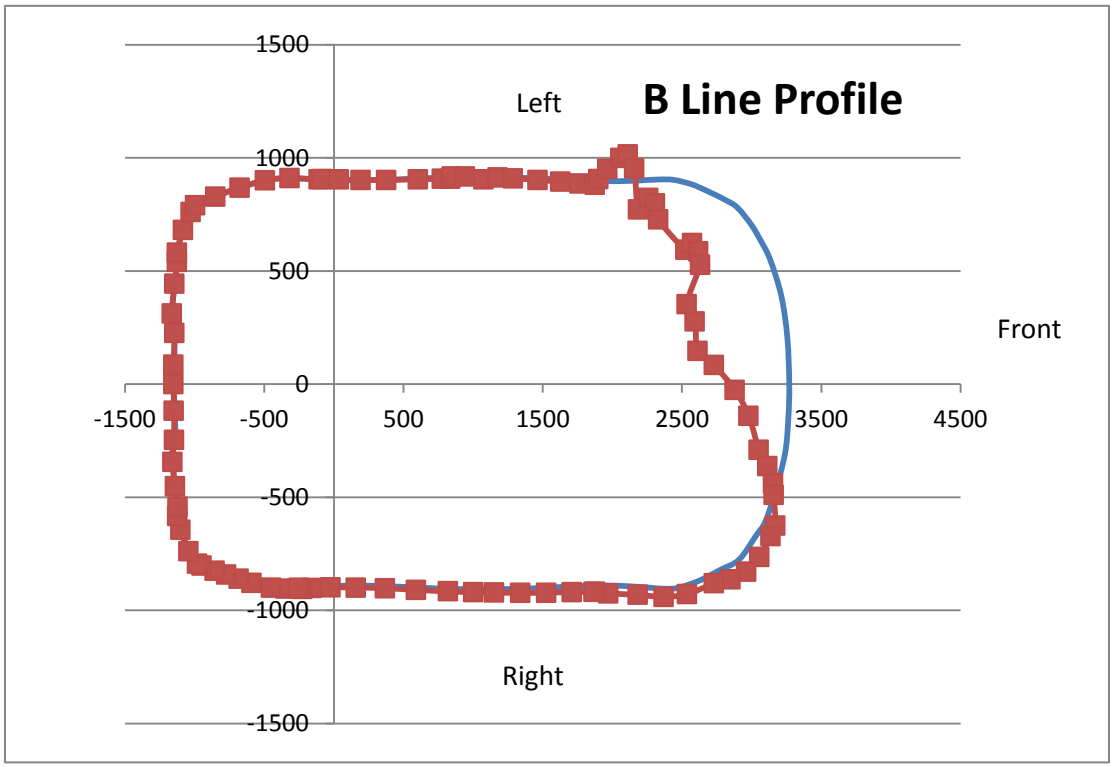
DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A



SECTION B-B



DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014

STRUCTURAL BUMPER BEAM POINTS

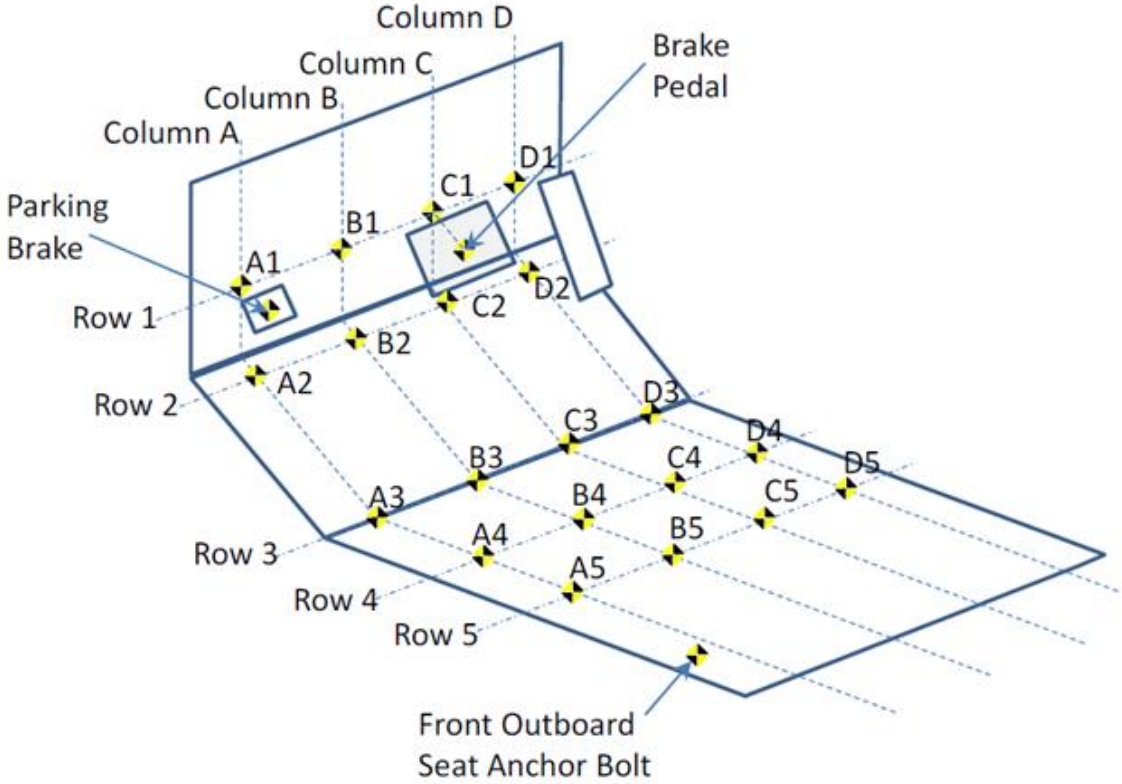
	Point	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
		X	Y	Z	X	Y	Z	X	Y	Z
Redundant Structural Bumper Beam	B1	3218	-534	906	2931	-299	851	-287	235	-55
	B2	3222	-401	907	2814	-238	841	-408	163	-66
	B3	3215	-268	906	2779	-155	823	-436	113	-83
	B4	3223	-136	906	2863	-53	835	-360	83	-71
	B5	3225	0	905	2944	55	842	-281	55	-63
	B6	3223	132	906	3019	166	848	-204	34	-58
	B7	3213	269	907	3090	282	855	-123	13	-52
	B8	3222	402	906	3174	386	861	-48	-16	-45
	B9	3218	534	905	3245	497	867	27	-37	-38
Center Structural Bumper Beam	B1	3195	-534	930	2919	-325	854	-276	209	-76
	B2	3200	-404	931	2805	-263	851	-395	141	-80
	B3	3204	-268	931	2782	-159	853	-422	109	-78
	B4	3213	-135	930	2858	-49	859	-355	86	-71
	B5	3216	-2	930	2937	58	866	-279	60	-64
	B6	3213	132	930	3012	169	873	-201	37	-57
	B7	3203	269	930	3083	285	880	-120	16	-50
	B8	3200	402	928	3157	397	884	-43	-5	-44
	B9	3194	534	936	3227	509	893	33	-25	-43
Upper Radiator Support	1	3205	-324	650	2893	-242	680	-312	82	30
	2	3214	-245	646	2915	-181	693	-299	64	47
	3	3225	-163	643	2981	-121	649	-244	42	6
	4	3237	-83	643	3026	-52	641	-211	31	-2
	5	3231	0	641	3056	23	627	-175	23	-14
	6	3235	82	641	3092	97	616	-143	15	-25
	7	3225	163	643	3116	174	605	-109	11	-38
	8	3215	243	645	3136	253	595	-79	10	-50
	9	3206	322	648	3158	330	589	-48	8	-59

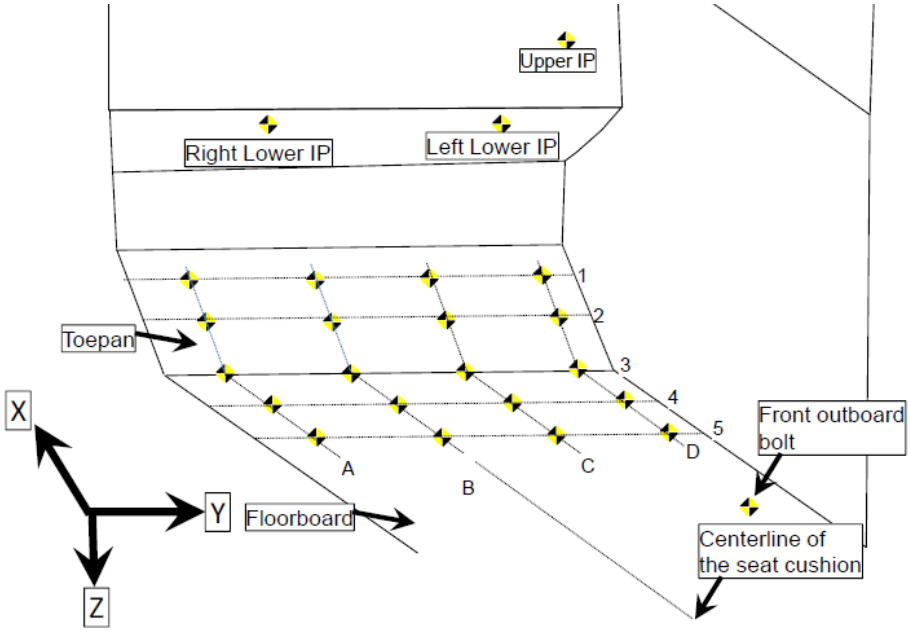
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

+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:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014





Note: See Appendix D for toe pan measuring procedure

DATA SHEET NO.13 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

DRIVER FLOOR PAN MEASUREMENTS

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2042	-576	955	2006	-538	959	-36	38	4
B1	2105	-471	957	2063	-431	956	-42	40	-1
C1	2118	-322	956	2069	-290	966	-49	32	10
D1	2120	-174	956	2092	-136	958	-28	38	2
A2	1997	-574	1027	1969	-540	1035	-28	34	8
B2	2059	-472	1027	2027	-435	1030	-32	37	3
C2	2084	-324	1027	2040	-290	1022	-44	34	-5
D2	2050	-175	1026	2023	-135	1029	-27	40	3
A3	1936	-573	1108	1917	-541	1123	-19	32	15
B3	1986	-473	1107	1960	-438	1115	-26	35	8
C3	1979	-324	1108	1956	-289	1117	-23	35	9
D3	1959	-173	1107	1933	-136	1112	-26	37	5
A4	1860	-572	1159	1848	-542	1184	-12	30	25
B4	1859	-474	1157	1844	-443	1169	-15	31	12
C4	1860	-322	1161	1840	-290	1156	-20	32	-5
D4	1858	-173	1153	1836	-144	1152	-22	29	-1
A5	1761	-575	1160	1748	-548	1177	-13	27	17
B5	1759	-473	1155	1743	-446	1168	-16	27	13
C5	1758	-323	1157	1740	-296	1165	-18	27	8
D5	1757	-173	1151	1735	-146	1148	-22	27	-3
Brake Pedal	1895	-324	957	1868	-316	951	-27	8	-6
Driver IP Left	1650	-527	648	1612	-508	666	-38	19	18
Driver IP Right	1630	-229	648	1607	-210	652	-23	19	4
DOLP	1660	-627	655	1631	-605	665	-29	22	10
Steering Column	1382	-377	483	1419	-358	486	37	19	3
Front Outboard Bolt	1418	-576	1066	1408	-561	1080	-10	15	14
Emergency Brake	2042	-576	955	2006	-538	959	-36	38	4

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: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset
NHTSA No.: RC5911
Test Date: 1/6/2014

PASSENGER FLOOR PAN MEASUREMENTS

Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2124	219	959	2107	264	957	-17	45	-2
B1	2127	369	957	2127	409	963	0	40	6
C1	2072	518	955	2074	554	960	2	36	5
A2	1990	619	957	1990	653	960	0	34	3
B2	2078	216	1026	2060	264	1023	-18	48	-3
C2	2084	369	1028	2090	409	1036	6	40	8
A3	2027	517	1026	2030	555	1030	3	38	4
B3	1962	619	1026	1962	655	1028	0	36	2
C3	1975	217	1107	1971	265	1106	-4	48	-1
A4	1979	370	1109	1986	409	1118	7	39	9
B4	1978	515	1107	1981	554	1112	3	39	5
C4	1892	616	1107	1892	653	1111	0	37	4
A5	1876	217	1153	1887	254	1166	11	37	13
B5	1877	368	1154	1884	404	1162	7	36	8
C5	1876	519	1155	1879	556	1159	3	37	4
Pass IP Left	1879	617	1156	1879	654	1159	0	37	3
Pass IP Right	1777	216	1154	1787	250	1167	10	34	13
PORP	1776	367	1156	1782	401	1164	6	34	8
Front Outboard Bolt	1778	515	1154	1781	550	1159	3	35	5

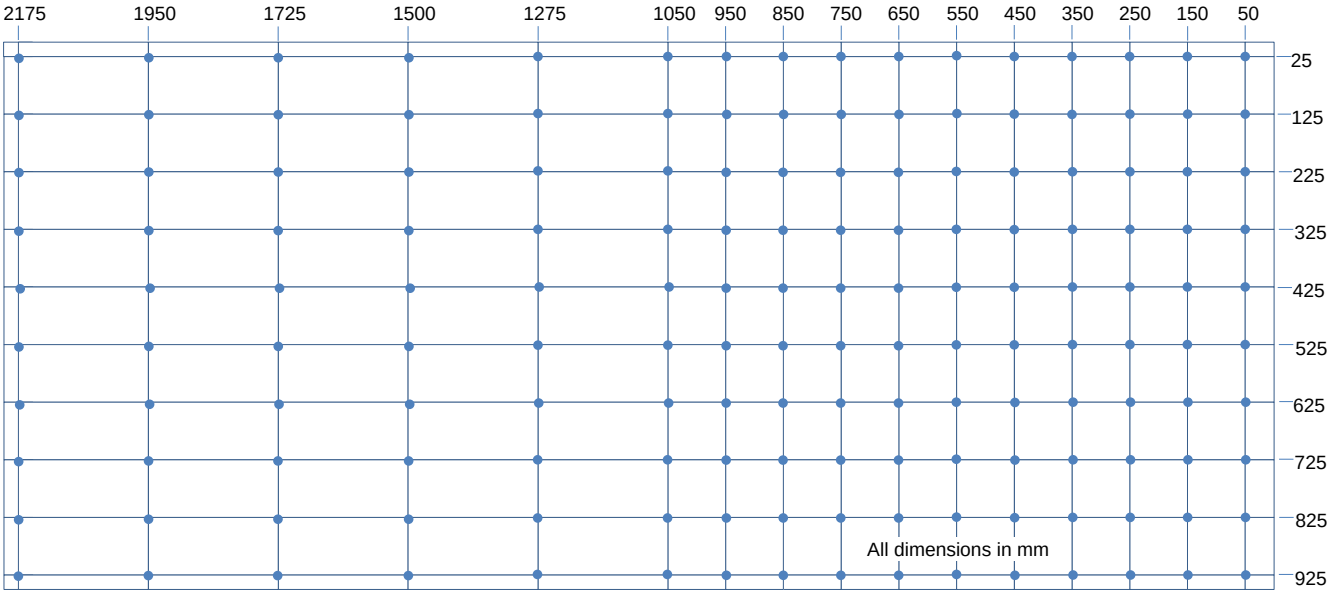
Reference point: Rear most center of the top of rear window (See appendix D for procedure to create coordinate system).

+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: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014



	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16
R10	0.4	0.3	0.4	0.4	0.4	0.3	0.4	0.3	0.4	1.3	1.1	0.7	0.5	0.5	0.4	2.1
R9	0.2	0.4	0.6	0.4	0.3	0.3	0.4	0.4	0.5	1.0	3.3	2.1	2.3	2.3	2.4	4.7
R8	0.4	0.7	0.4	0.5	0.3	0.2	1.2	0.6	11.2	33.5	27.1	25.3	22.6	5.7	5.0	14.6
R7	0.6	0.7	0.5	0.4	0.3	0.3	3.4	0.7	45.6	108.4	86.1	38.3	30.5	19.9	26.7	62.7
R6	0.5	0.7	0.4	0.2	0.4	0.3	0.5	5.1	4.0	21.7	104.0	101.2	86.0	89.3	89.9	113.6
R5	0.5	0.5	0.7	0.6	0.5	0.5	0.7	18.0	47.0	11.6	58.1	130.0	382.0	285.2	202.8	193.6
R4	0.8	1.1	0.9	0.8	0.7	0.8	0.8	35.4	79.8	45.4	39.3	85.1	371.9	284.0	188.6	228.1
R3	0.9	1.0	1.1	0.8	0.8	0.9	2.2	57.5	119.7	74.5	18.7	46.5	137.0	244.7	207.0	239.1
R2	-0.4	1.3	1.2	1.1	0.8	0.8	3.5	77.3	147.8	94.0	23.5	-16.0	99.4	188.8	203.9	216.9
R1	0.9	1.3	1.2	0.4						108.3	31.9	16.2	37.0	34.8	163.5	193.0

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

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

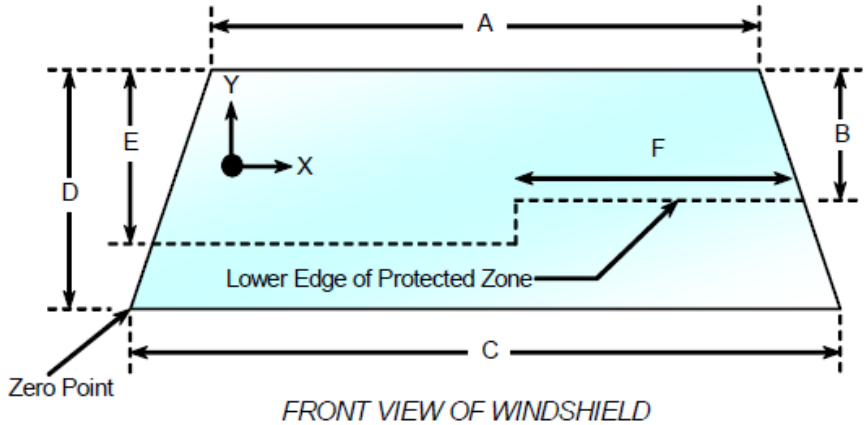
Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

Please provide windshield mounting details. A 0.8 mm trim surrounds the top and side of windshield while a plastic shroud is on the bottom.
The standard requires that the post-test retention measurement be a minimum of 75% of the pre-test total periphery measurement for vehicles not equipped with occupant passive restraints and 50% for each side of the windshield for vehicles which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 21°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2210	2210	100%
Right Side	2210	2210	100%
Total	4419	4419	100%



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1225
B	mm	500
C	mm	1430
D	mm	882
E	mm	550
F	mm	410

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:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

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

Test Time: 2:33 PM

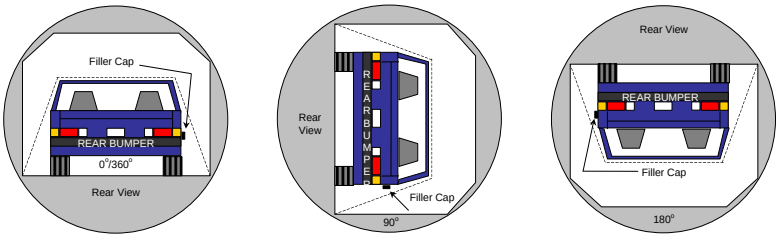
Stoddard Solvent Spillage Measurements

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

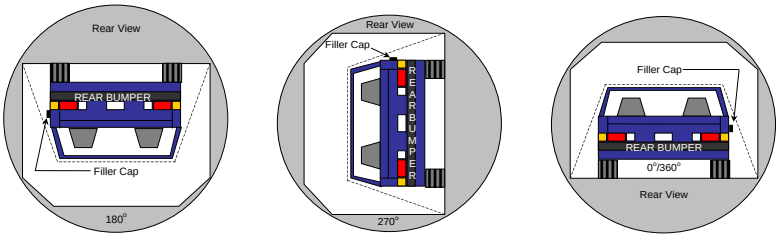
DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2012 Volvo S60 four door sedan
Test Program: R&D 90.1kph, 15° / 35% Left Oblique Offset

NHTSA No.: RC5911
Test Date: 1/6/2014



0° TO 90° 90° TO 180°



180° TO 270° 270° TO 360°

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°	65	300	365
180° to 270°	63	300	363
270° to 360°	68	300	368

FMVSS 301 SPILLAGE TABLE

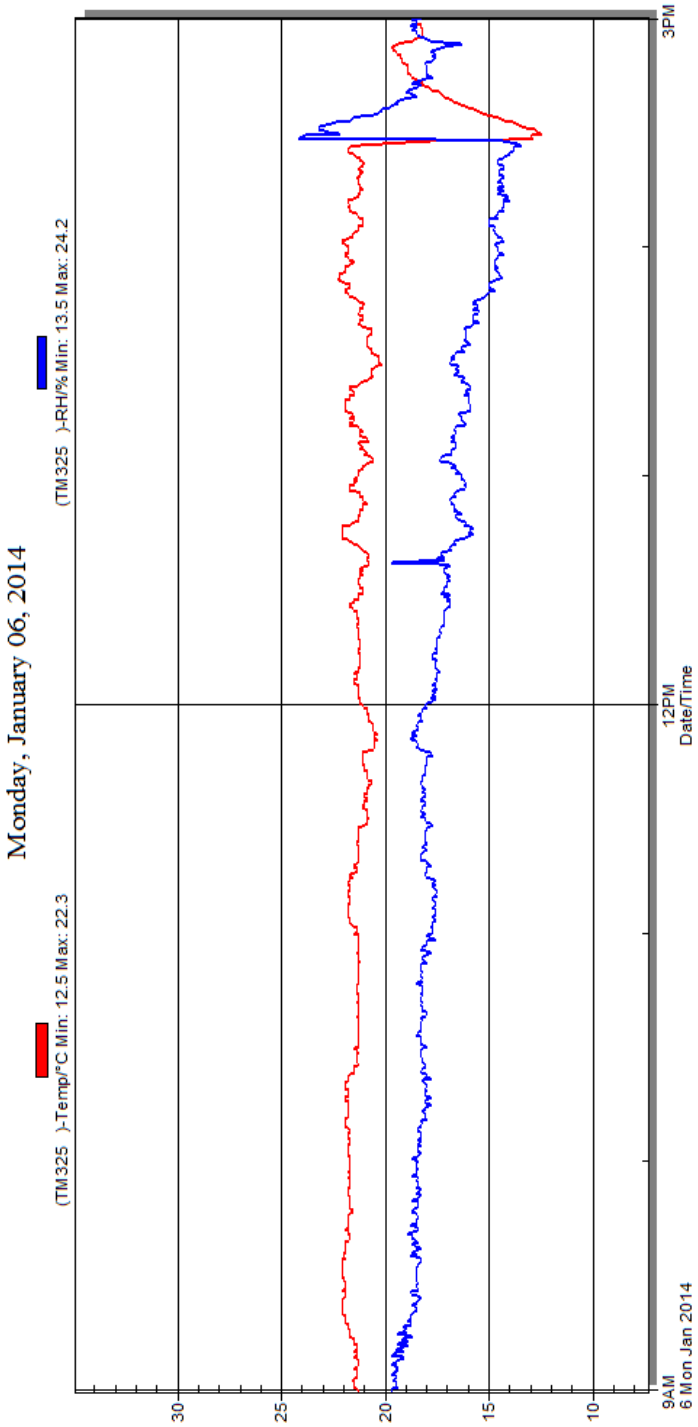
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eighth Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

SOLVENT SPILLAGE LOCATION TABLE

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

DATA SHEET NO. 17
DUMMY/VEHICLE TEMPERATURE STABILIZATION

Test Vehicle:	2012 Volvo S60 four door sedan	NHTSA No.:	RC5911
Test Program:	R&D 90.1kph, 15° / 35% Left Oblique Offset	Test Date:	1/6/2014



Temperature Stabilization Chart/Data

APPENDIX A

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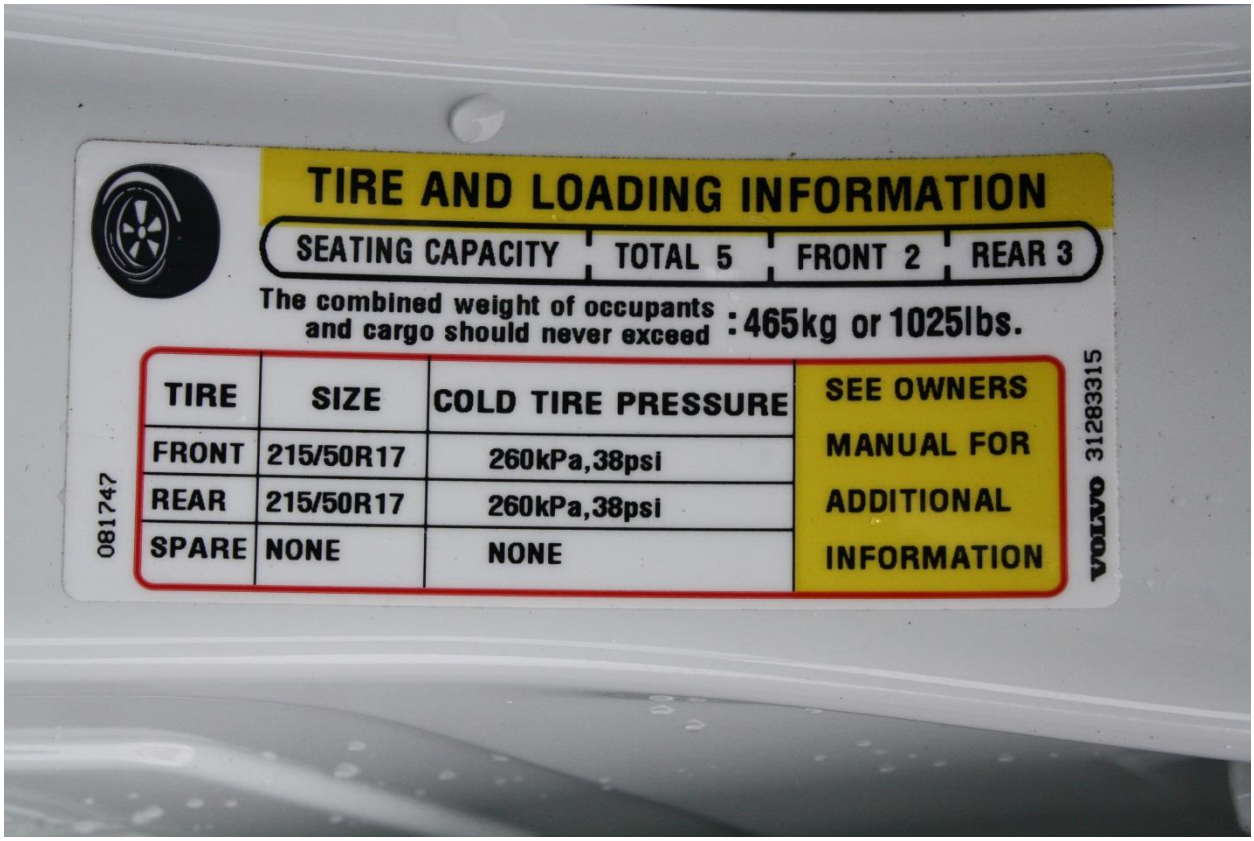
No. 001 As Delivered Right Front 3-4 View of Test Vehicle

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

No. 003 Test Vehicle Certification Label



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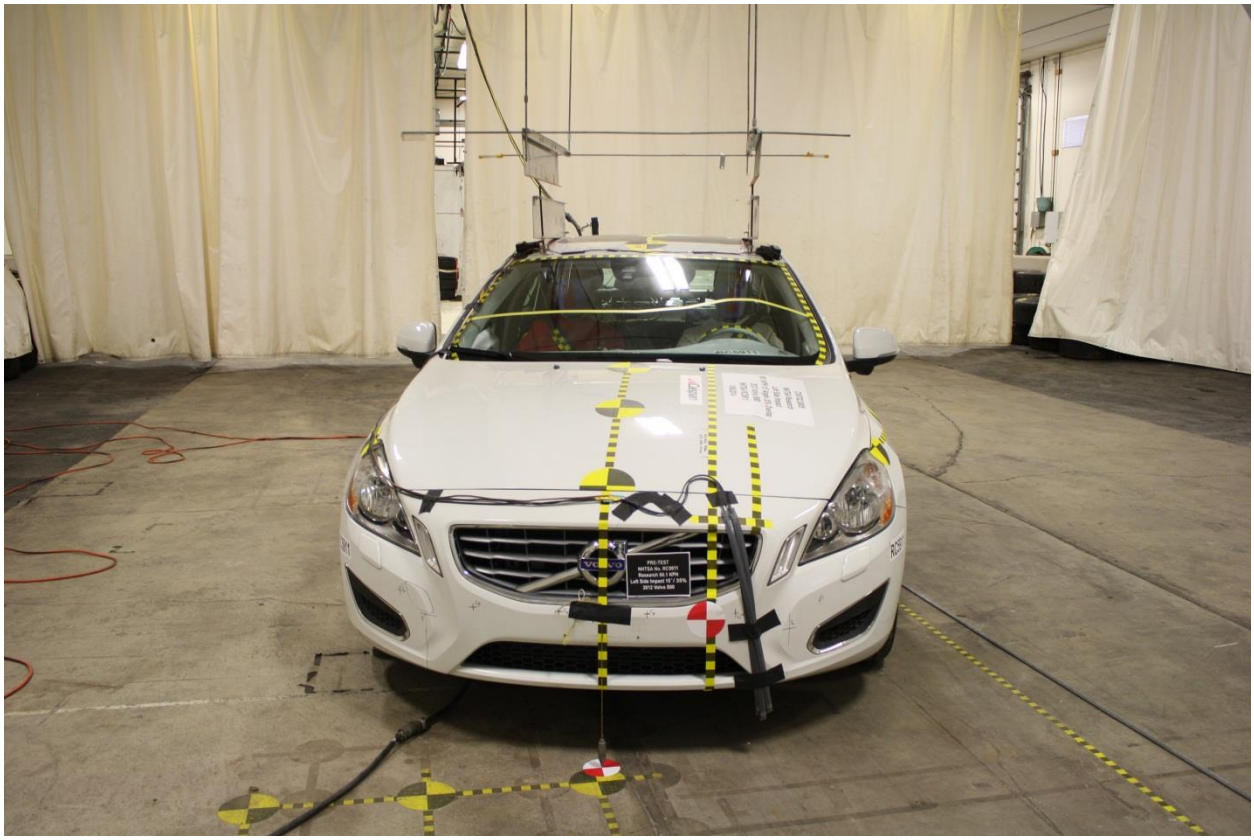
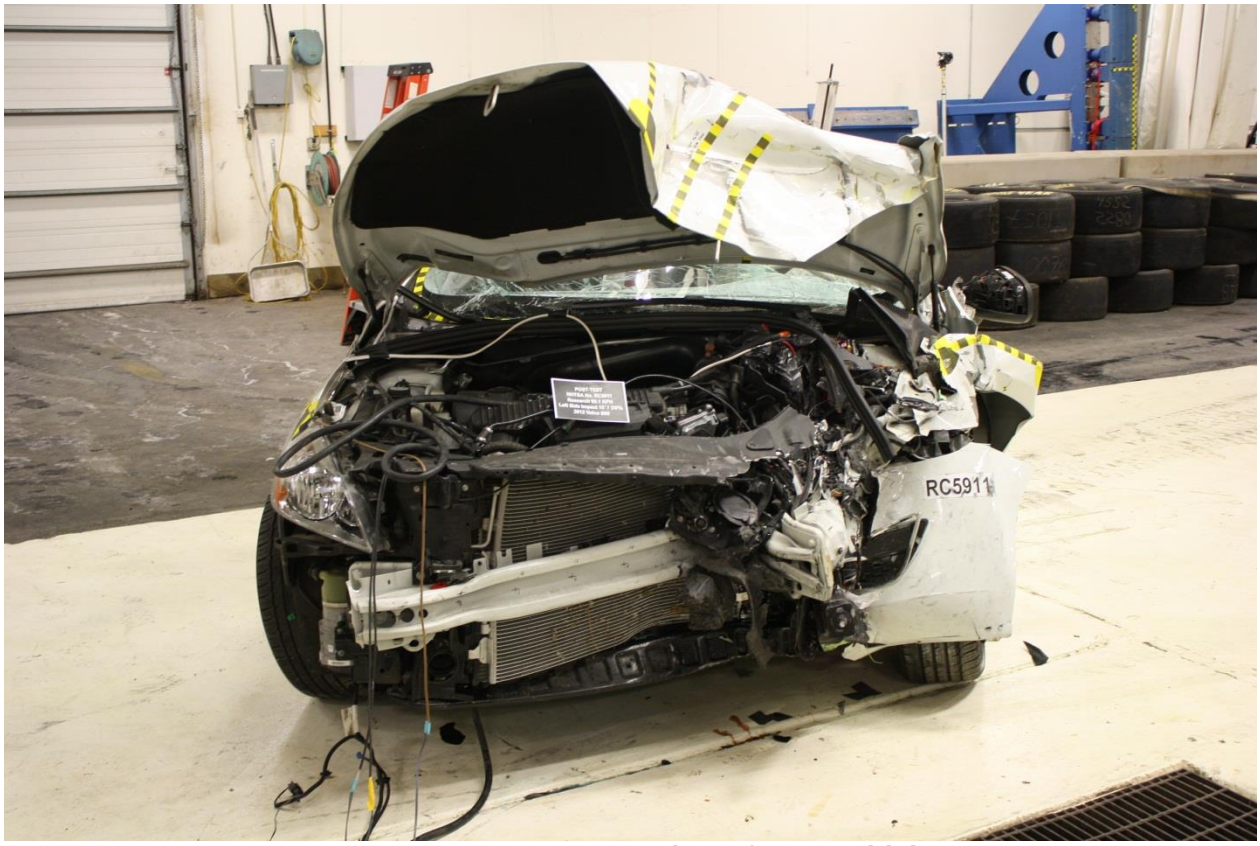
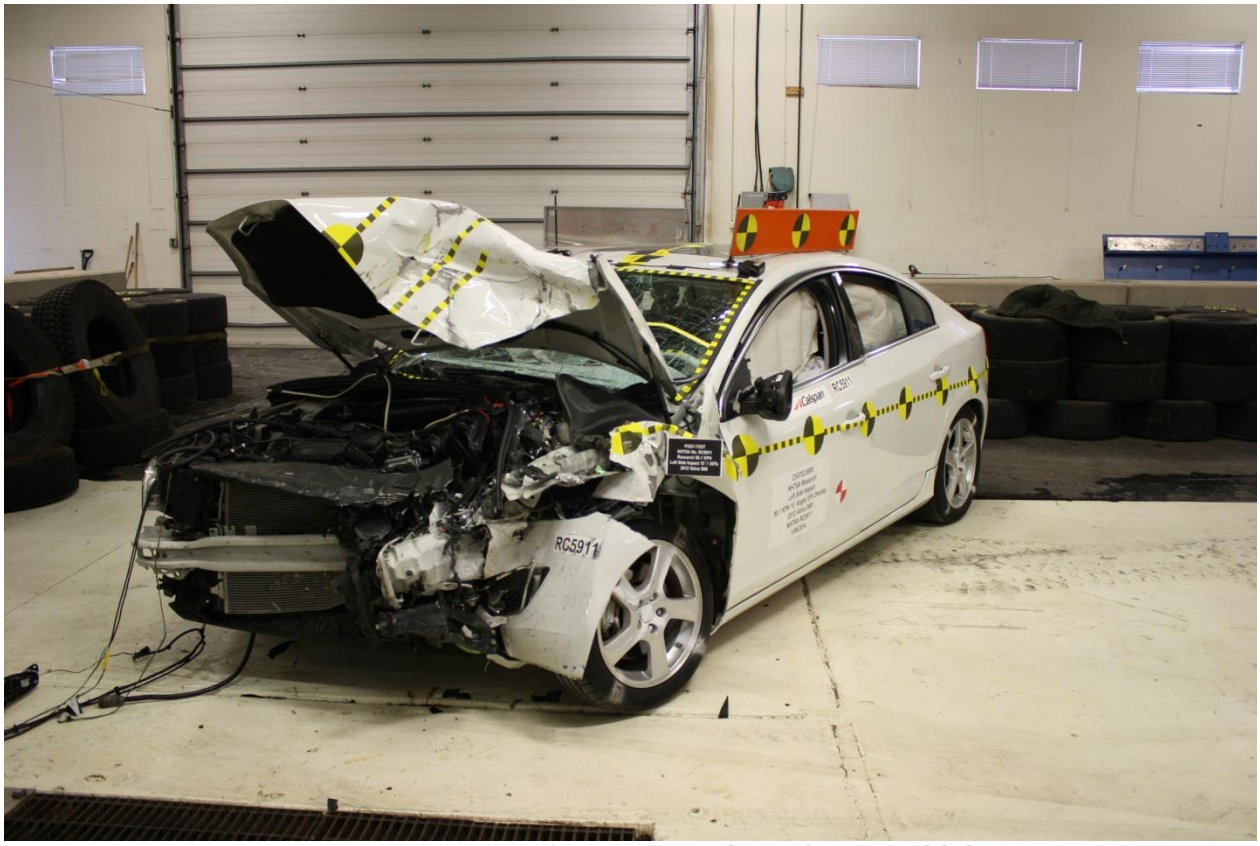


No. 005 Pre-Test Front View of Test Vehicle

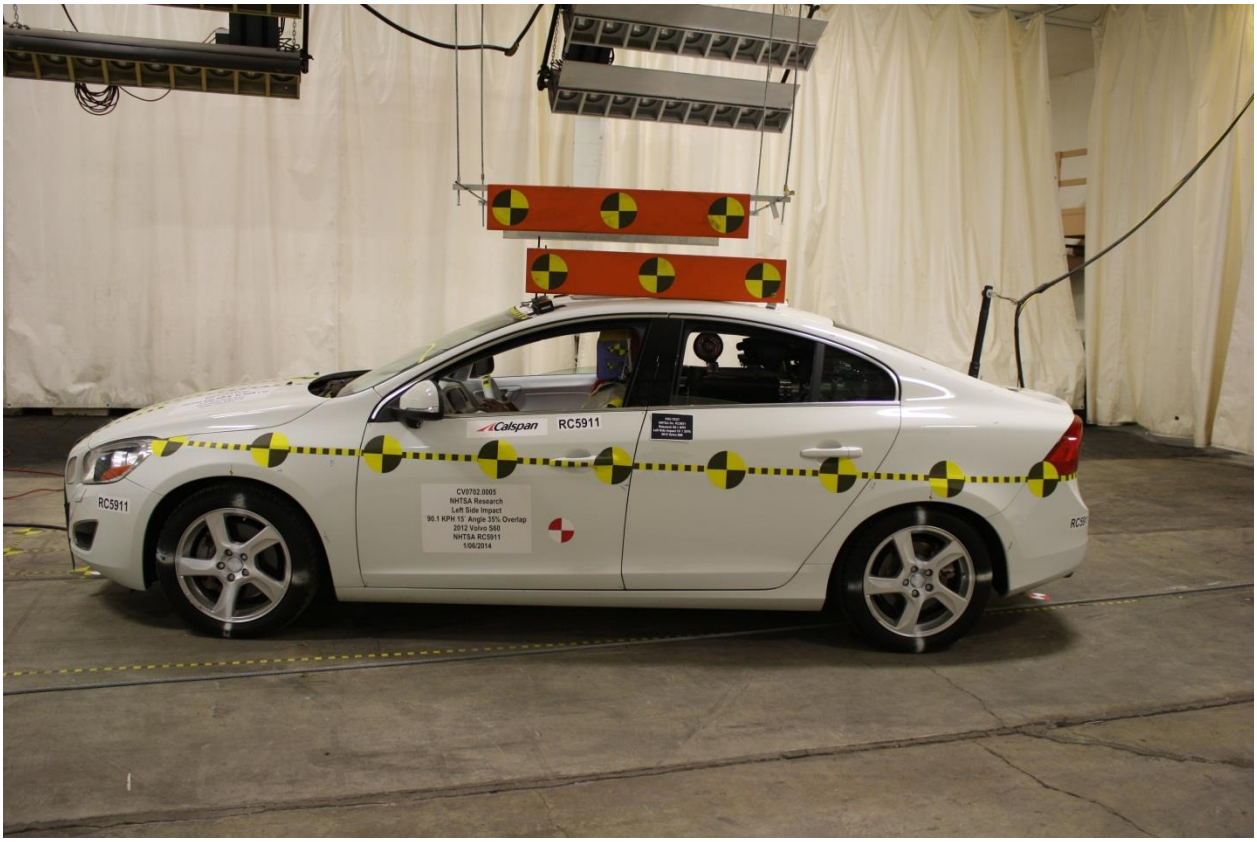


No. 006 Post-Test Front View of Test Vehicle

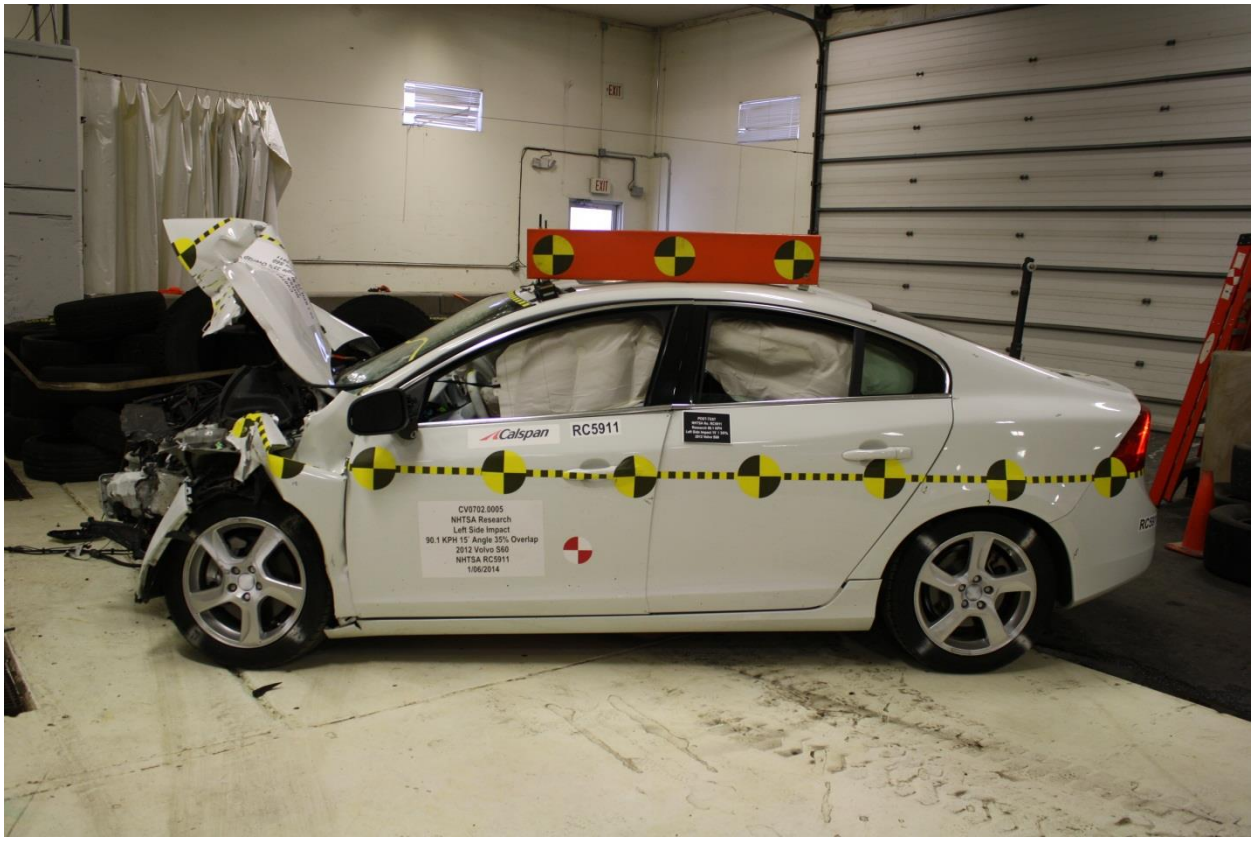
No. 007 Pre-Test Left Front 3-4 View of Test Vehicle



No. 008 Post-Test Left Front 3-4 View of Test Vehicle



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

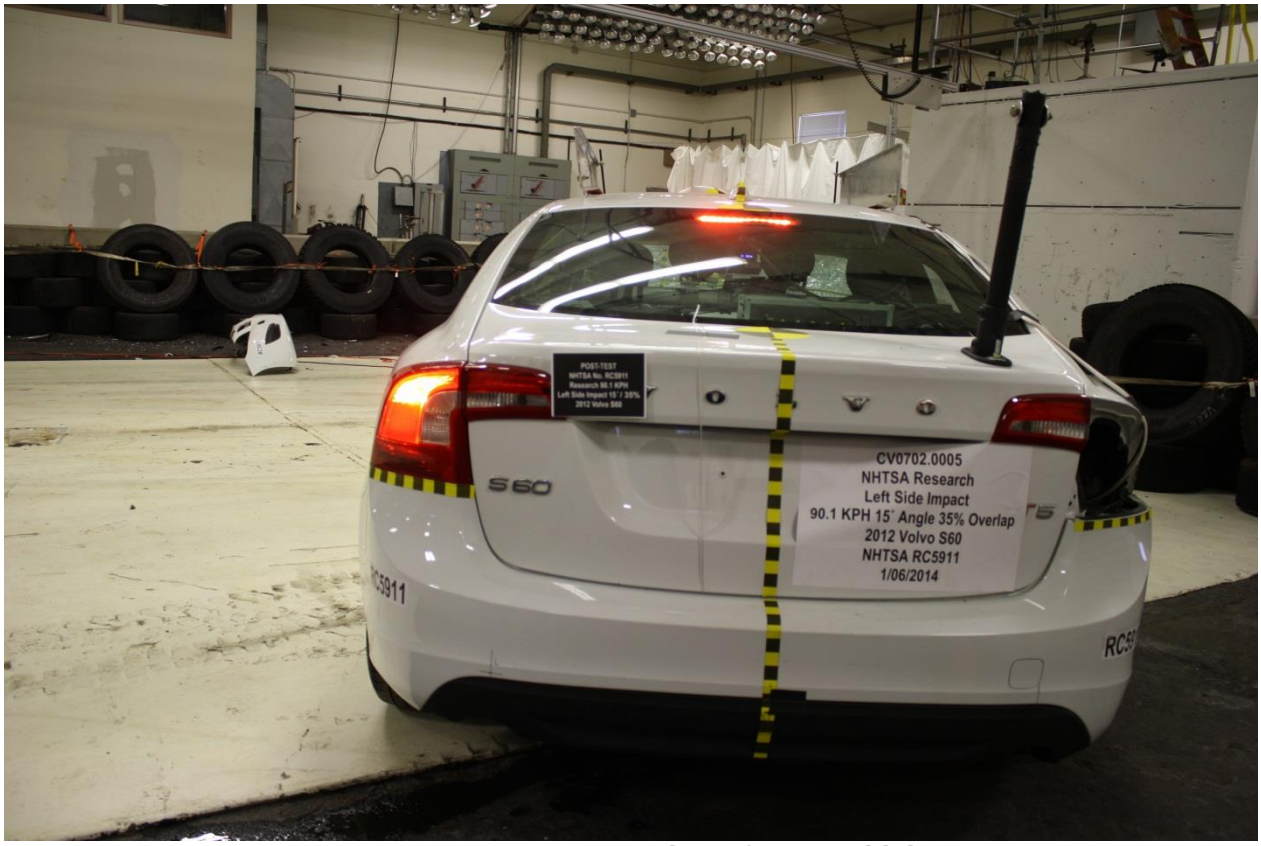


No. 010 Post-Test Left Side View of Test Vehicle

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

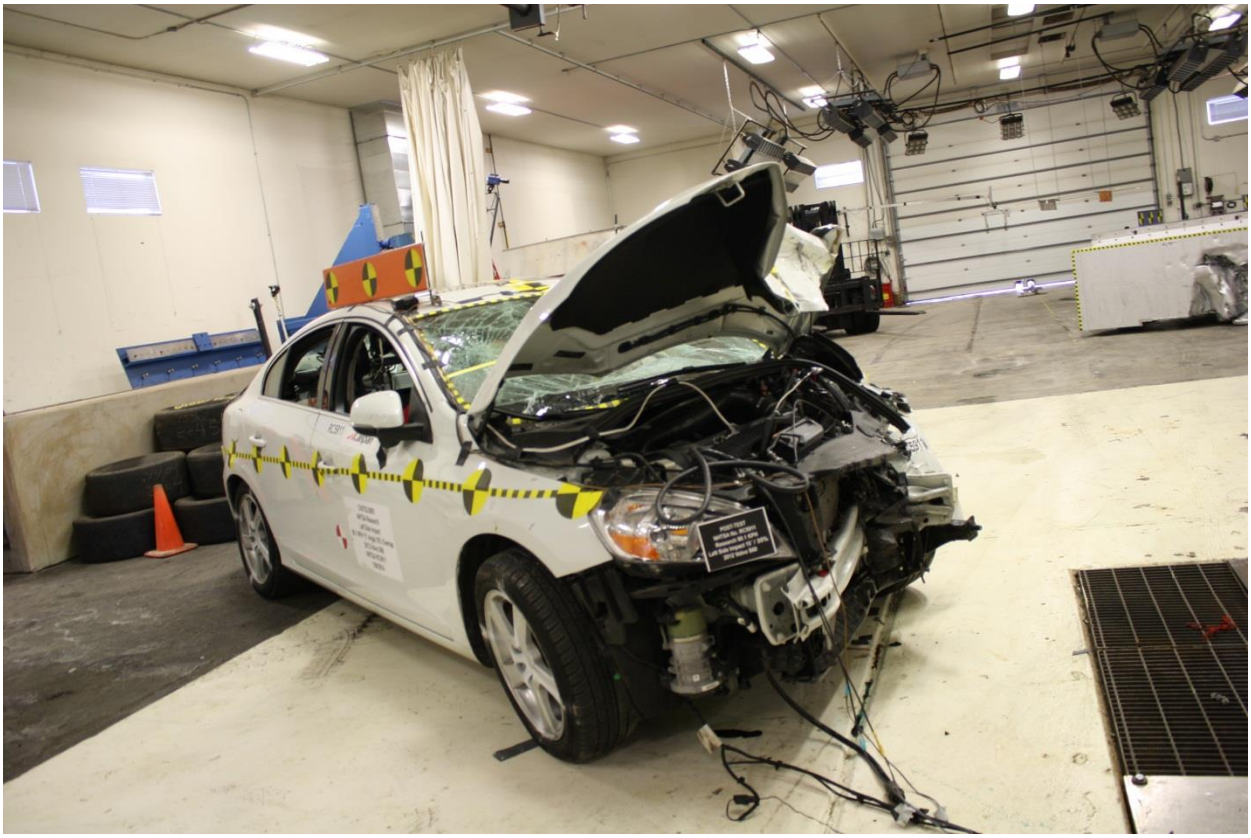
No. 015 Pre-Test Right Rear 3-4 View of Test Vehicle

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

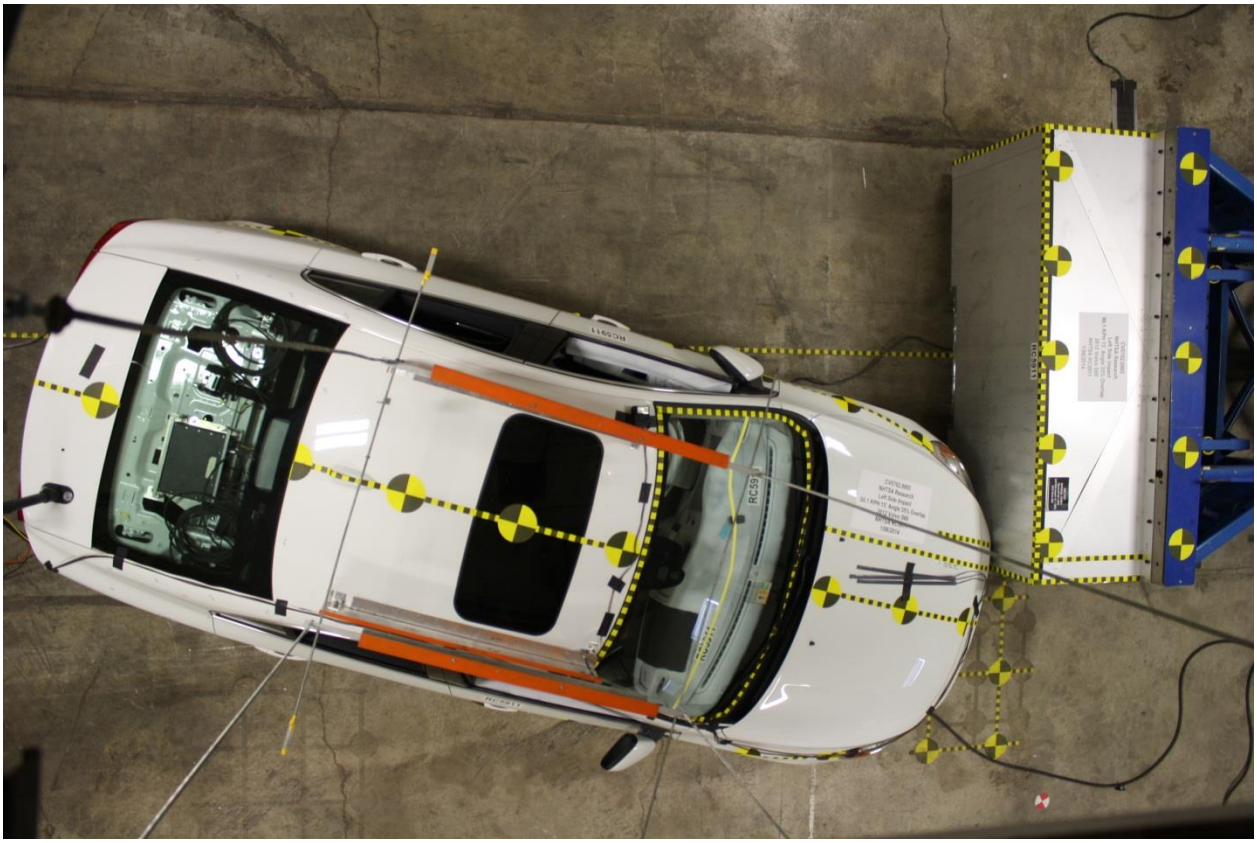
No. 019 Pre-Test Right Front 3-4 View of Test Vehicle



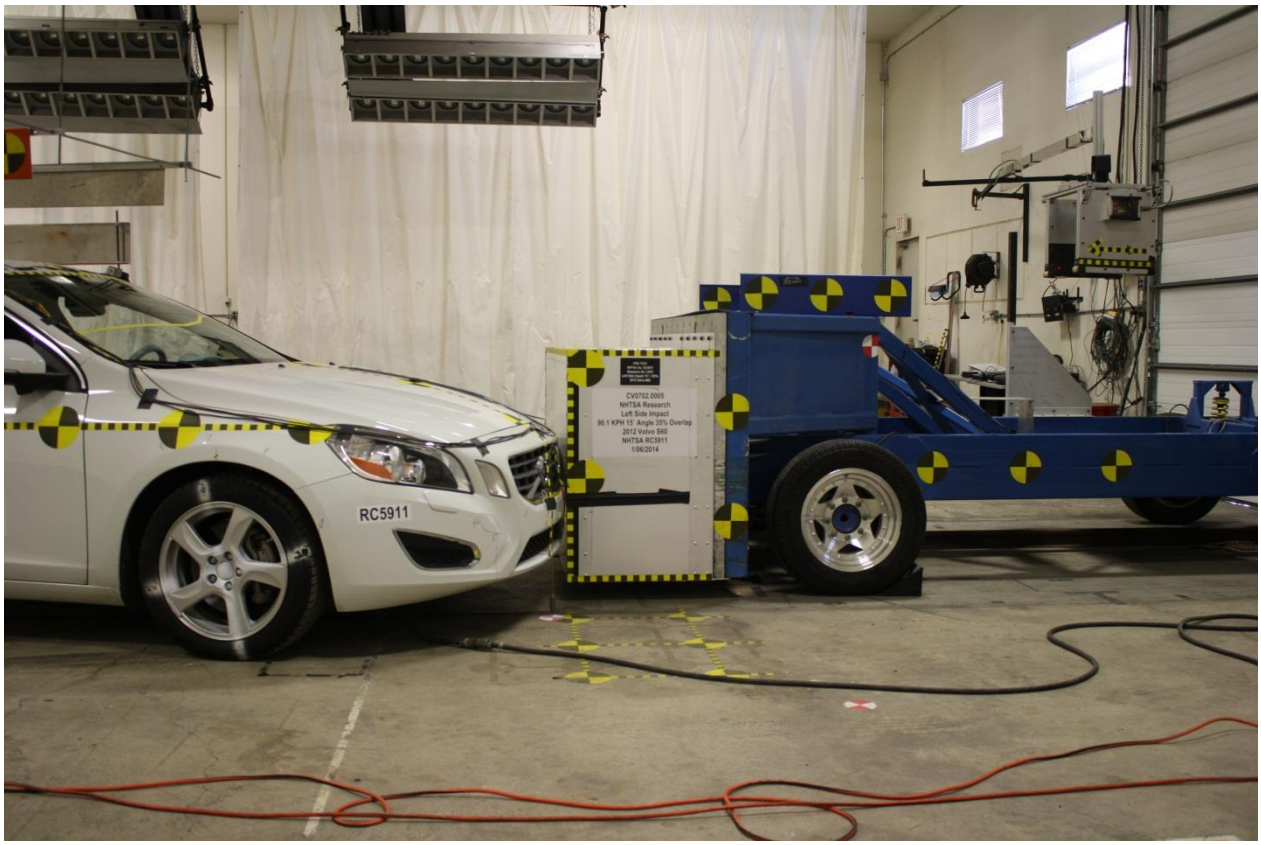
No. 020 Post-Test Right Front 3-4 View of Test Vehicle

Photo Not Applicable

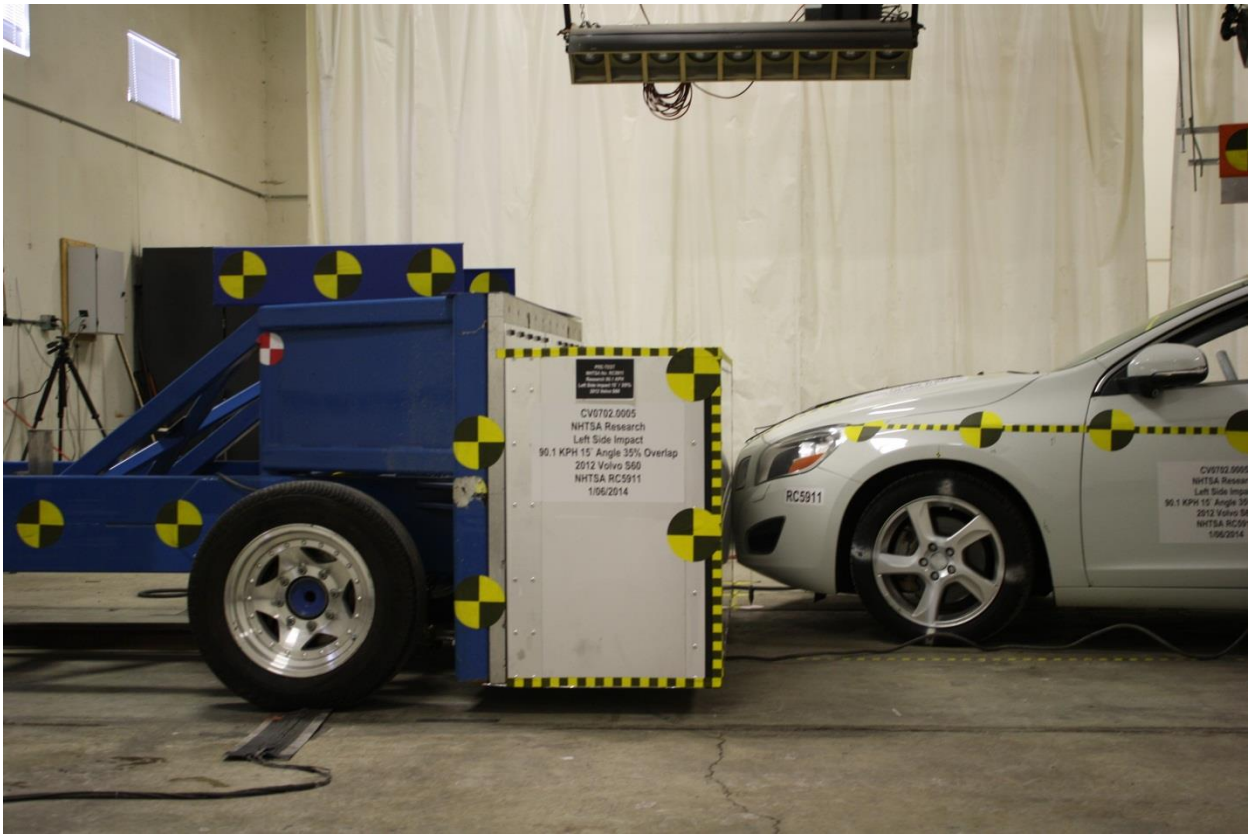
No. 021 Monroney Label Photograph



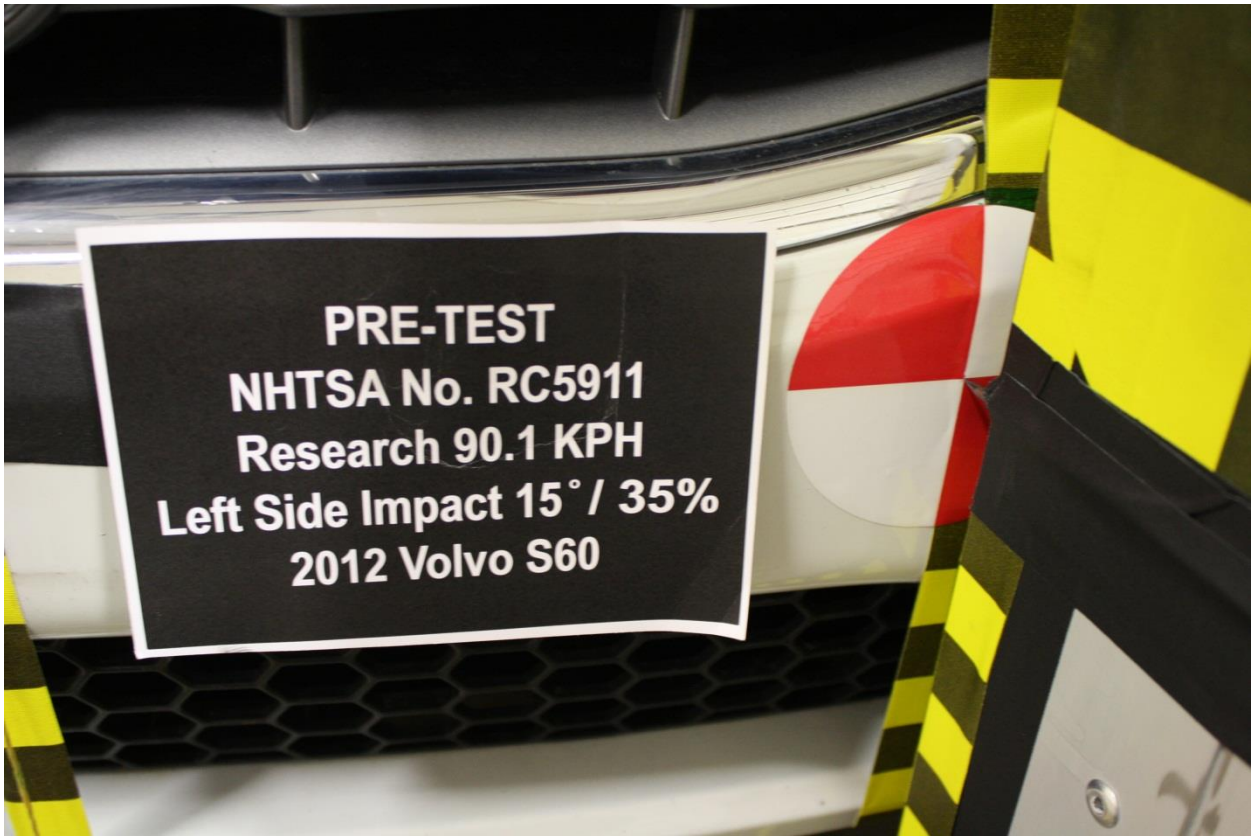
No. 022 Pre-Test Overhead View of RMDB against target vehicle at ideal Impact Point



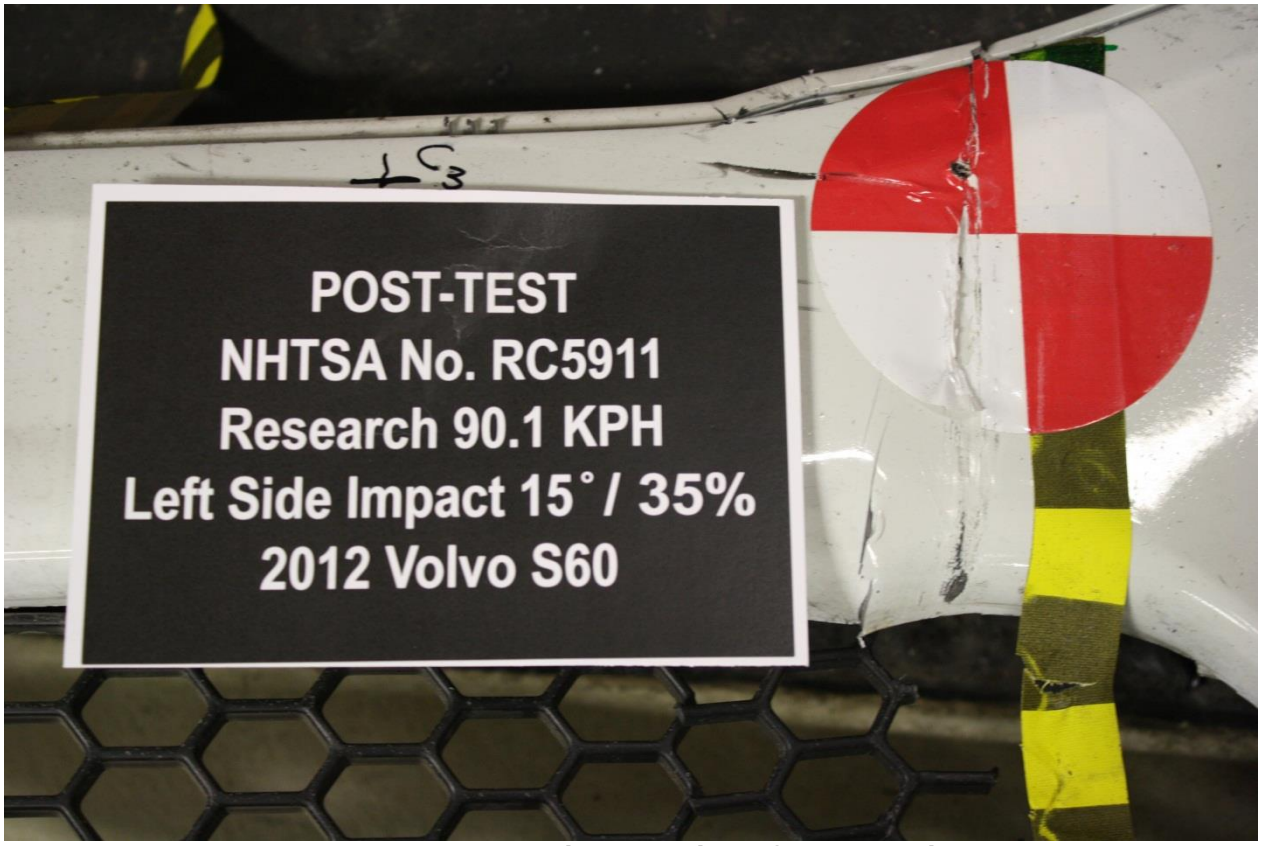
No. 023 Pre-Test Left Side View of RMDB against target vehicle at ideal Impact Point



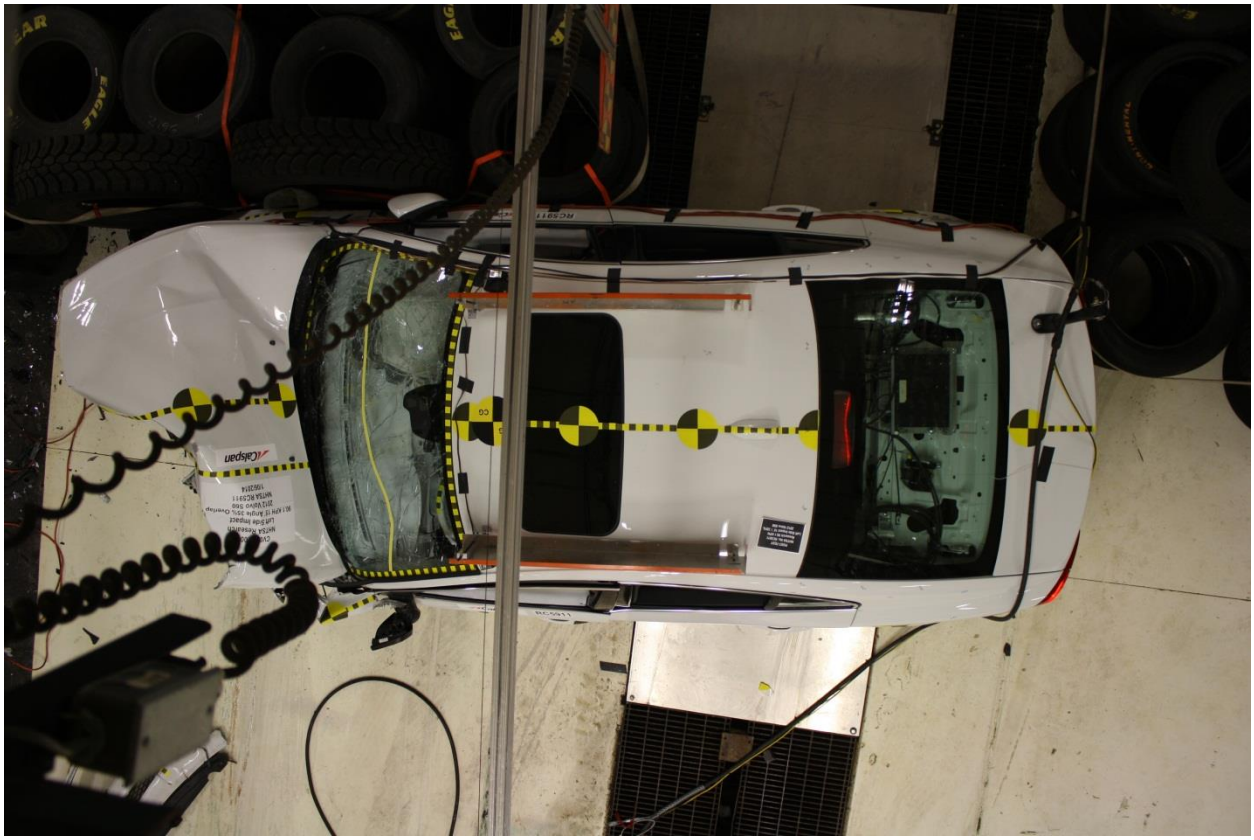
No. 024 Pre-Test Right Side View of RMDB against target vehicle at ideal Impact Point



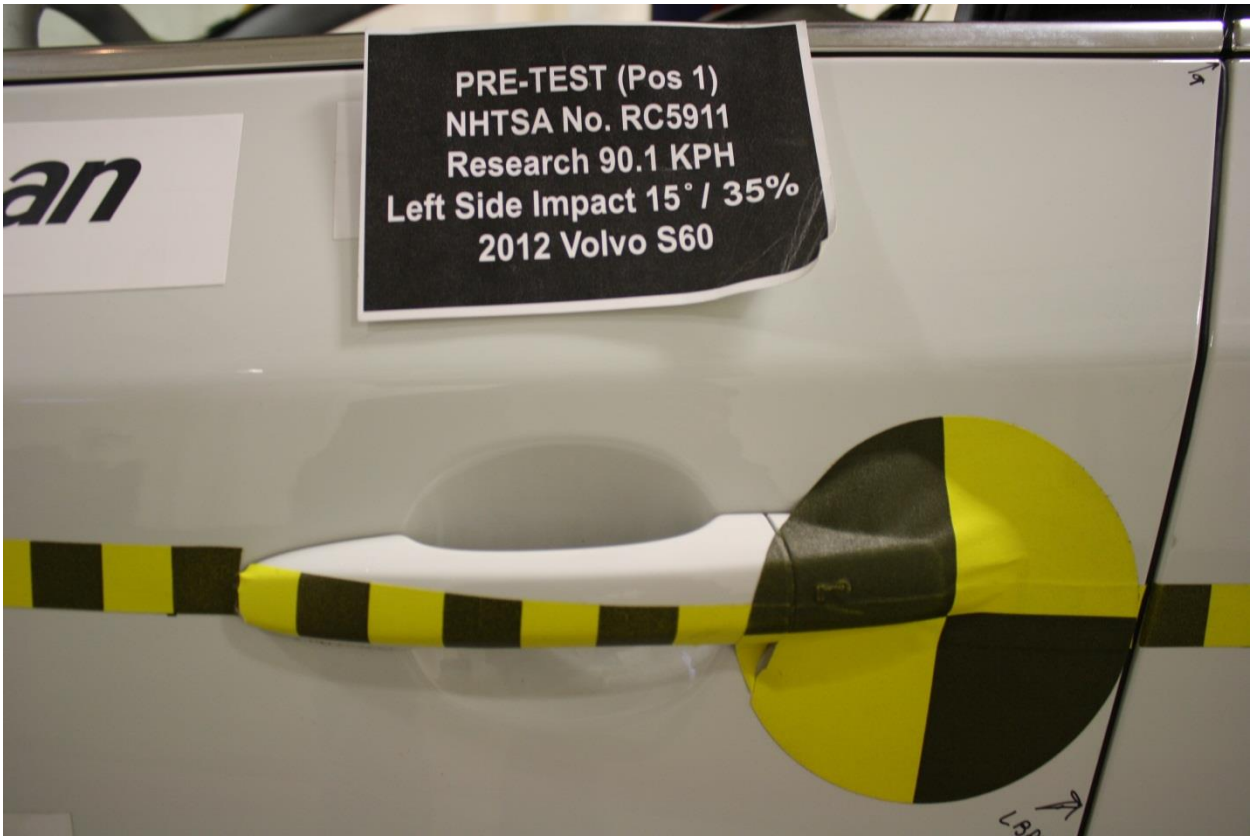
No. 025 Pre-Test Close-up View of Impact Point



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

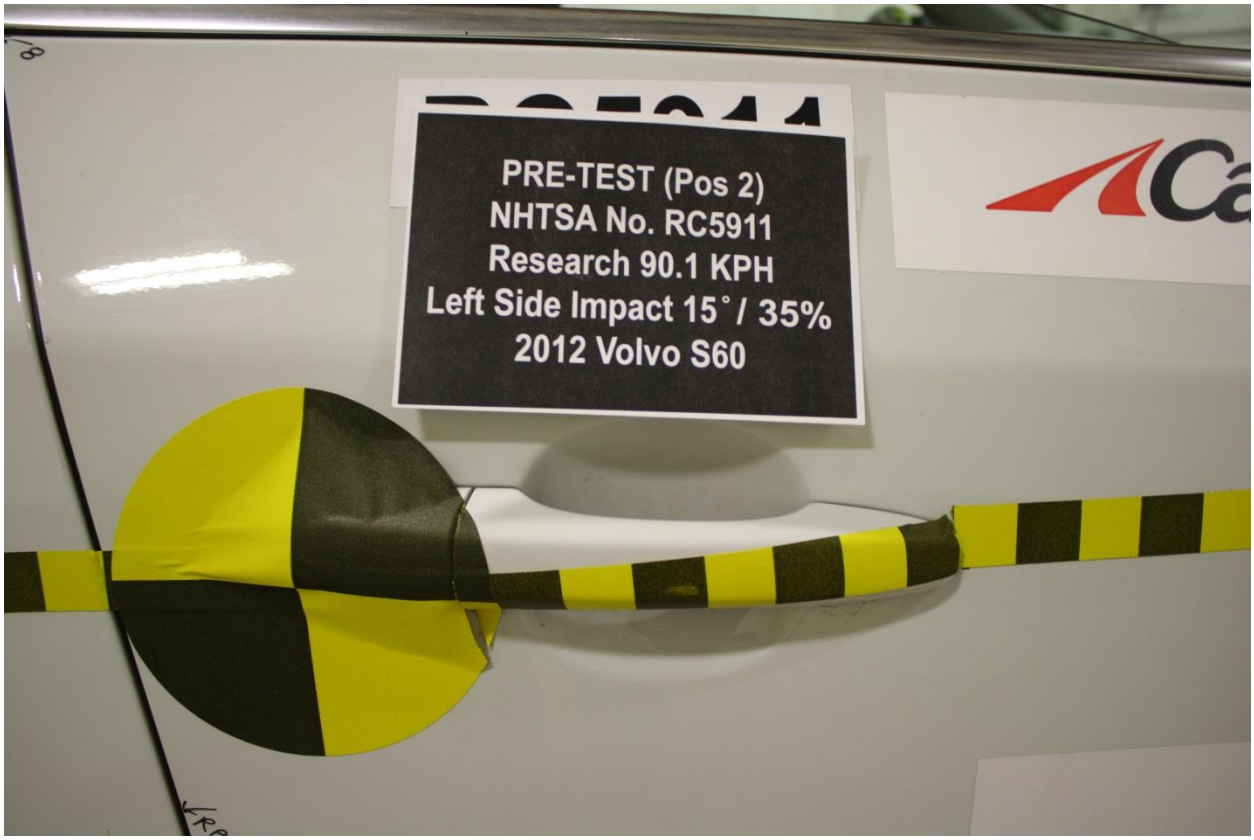


No. 027 Post-Test Vehicle Overhead View

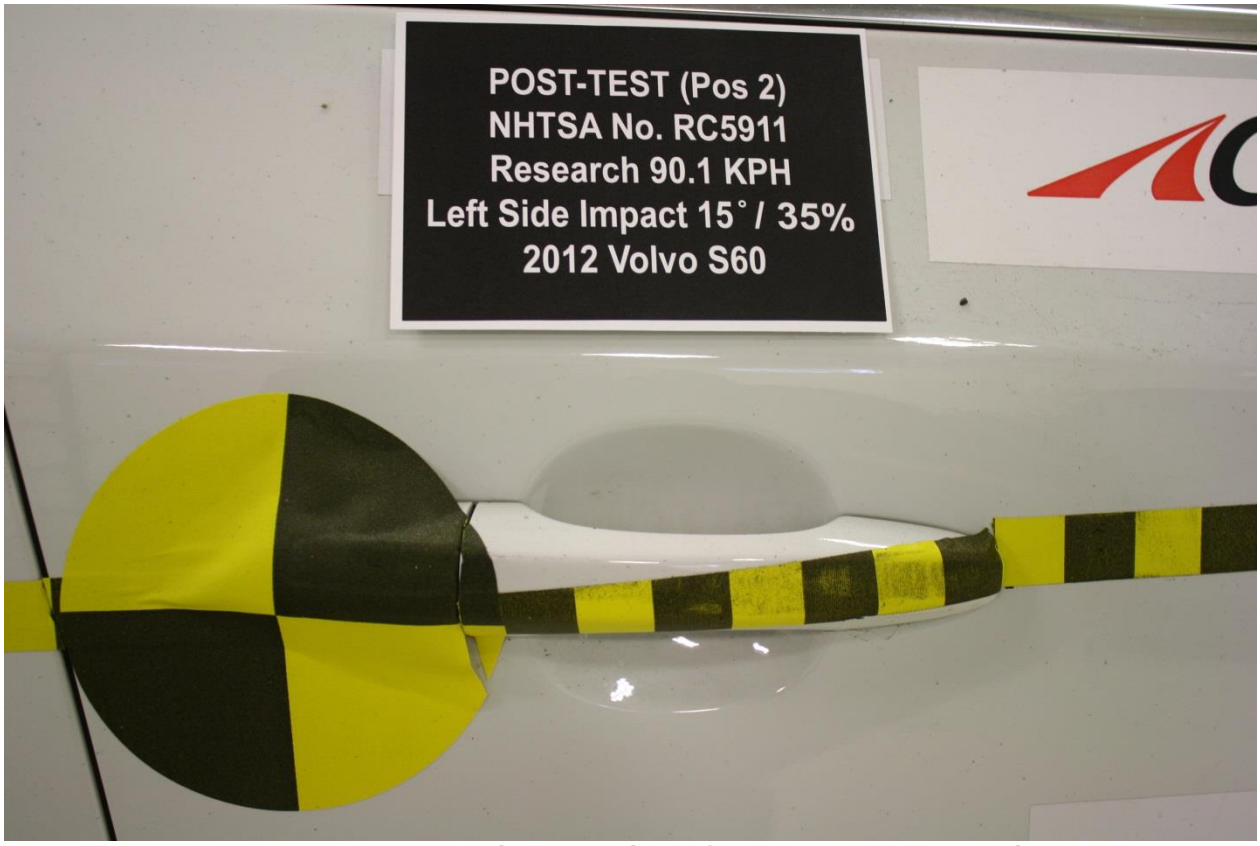


No. 028 Pre-Test Close-up View of Driver Door Latch

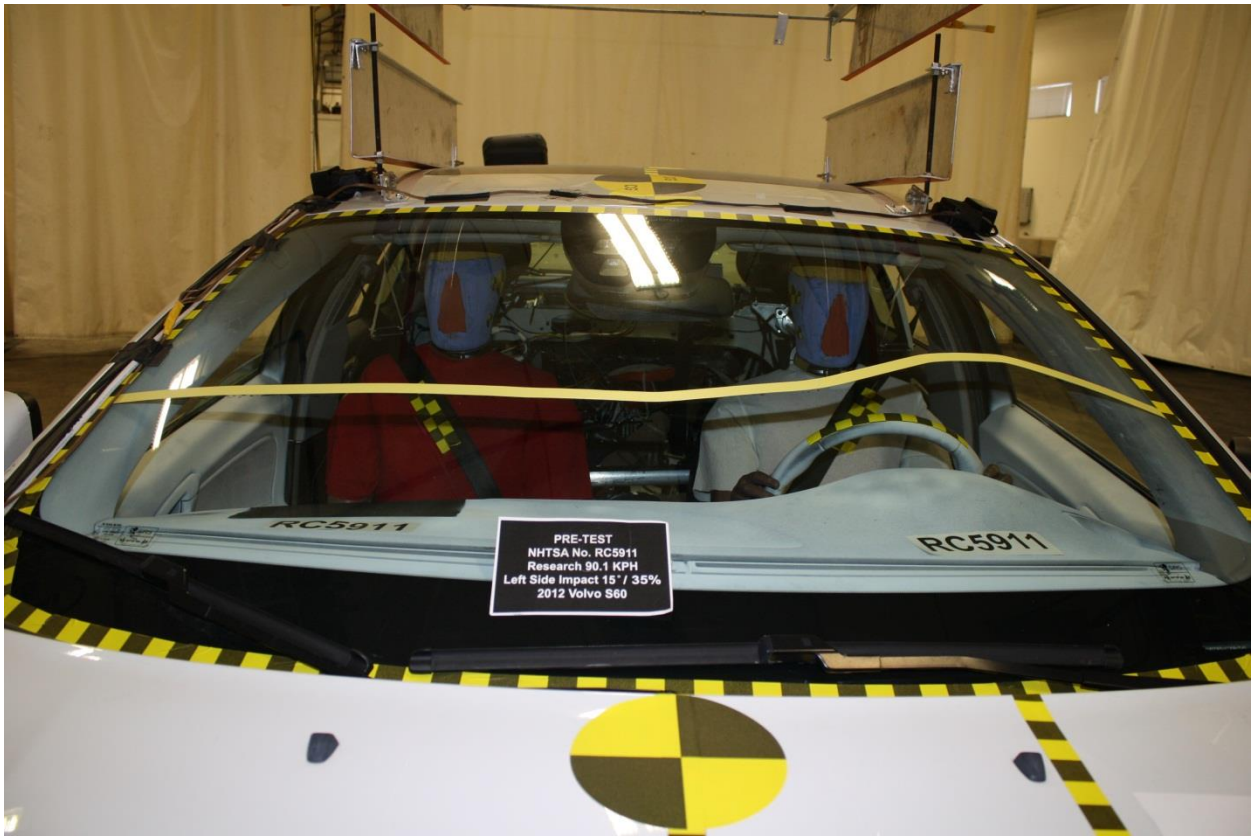
No. 029 Post-Test Close-up View of Driver Door Latch



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

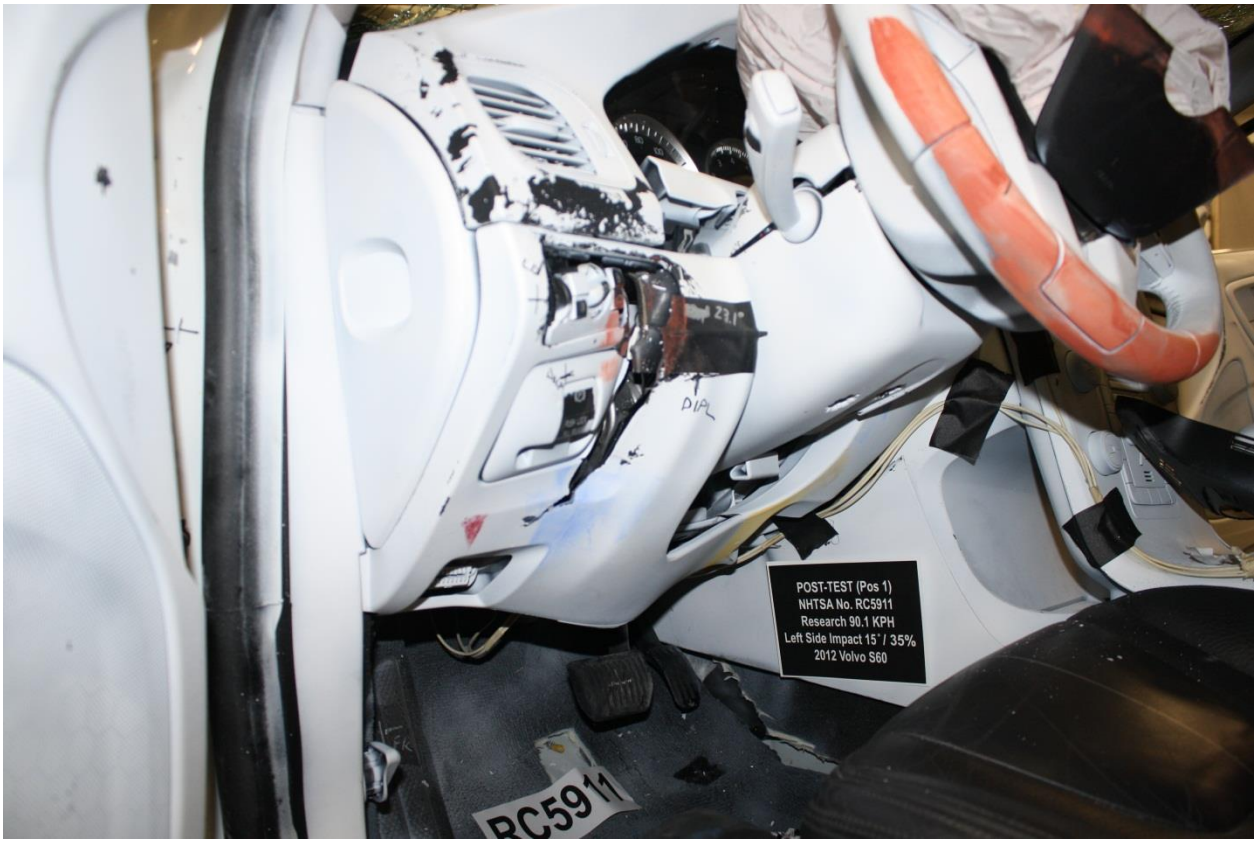
No. 036 Pre-Test View of Passenger Inner Door Panel

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

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

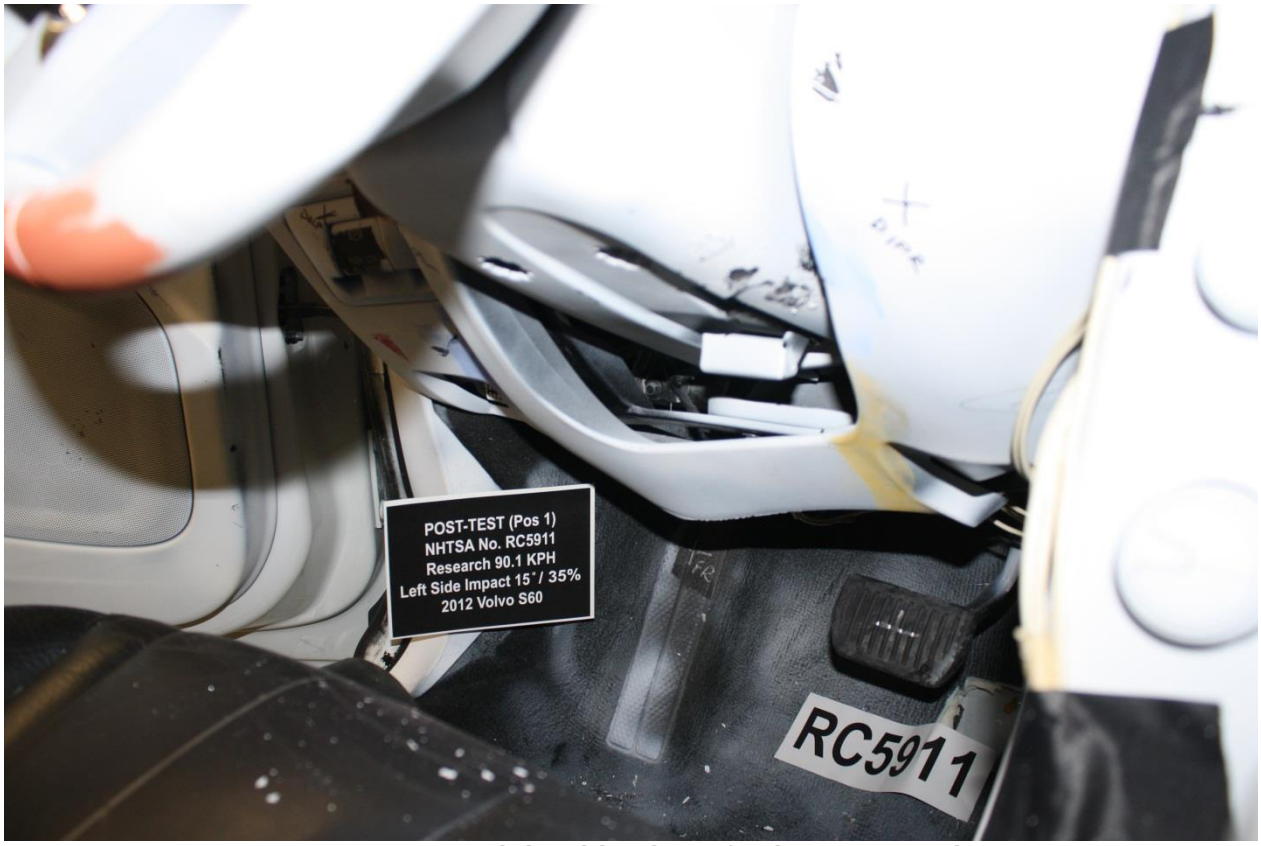
No. 039 Post-Test Overall View of Driver Knee Bolsters

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



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

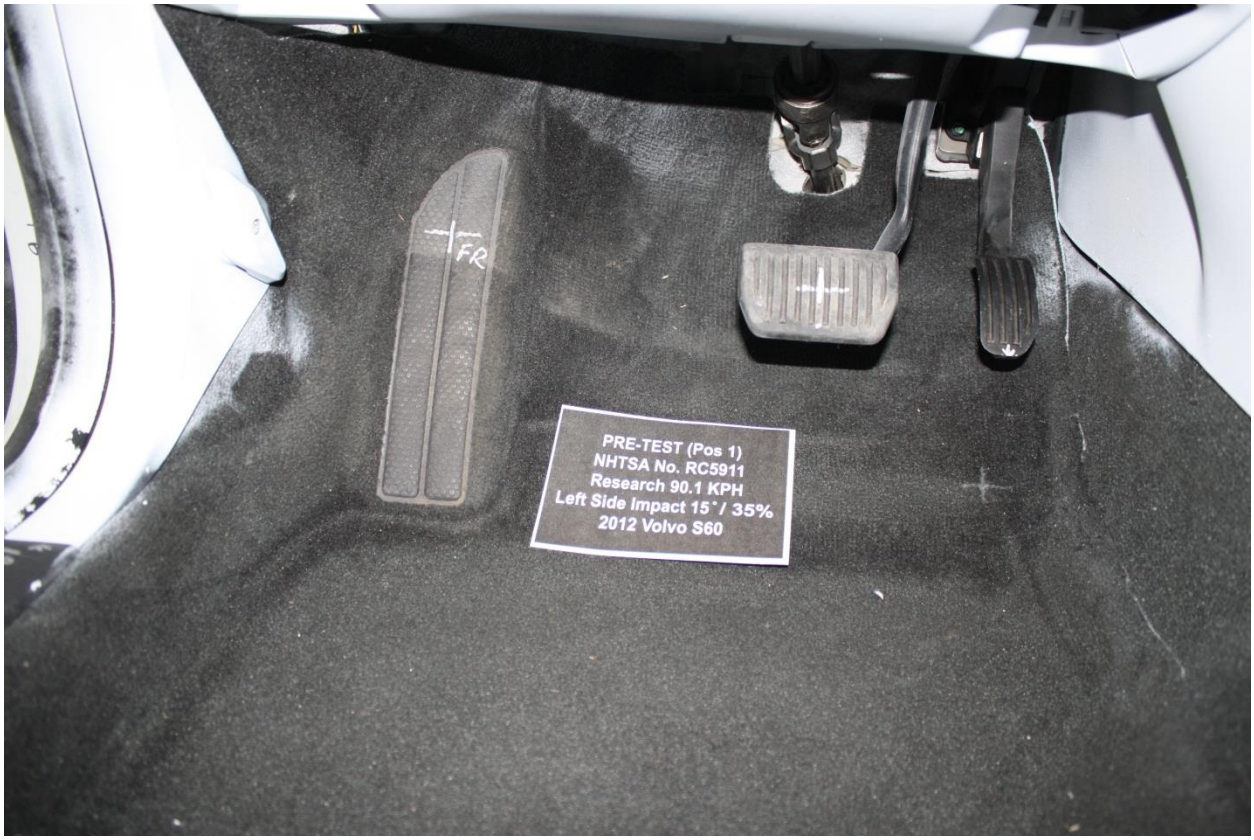
No. 042 Pre-Test Right Side View of Driver Knee Bolsters



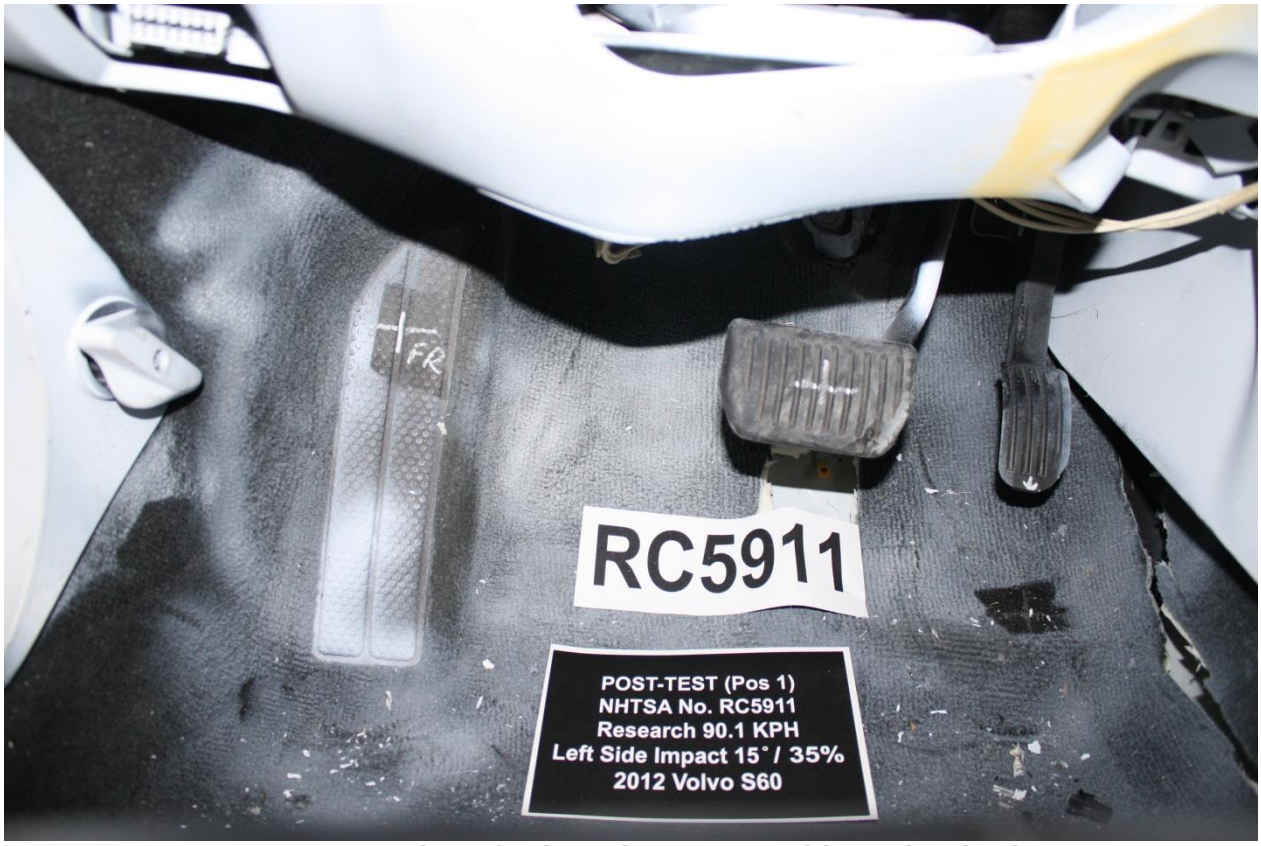
No. 043 Post-Test Right Side View of Driver Knee Bolsters

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

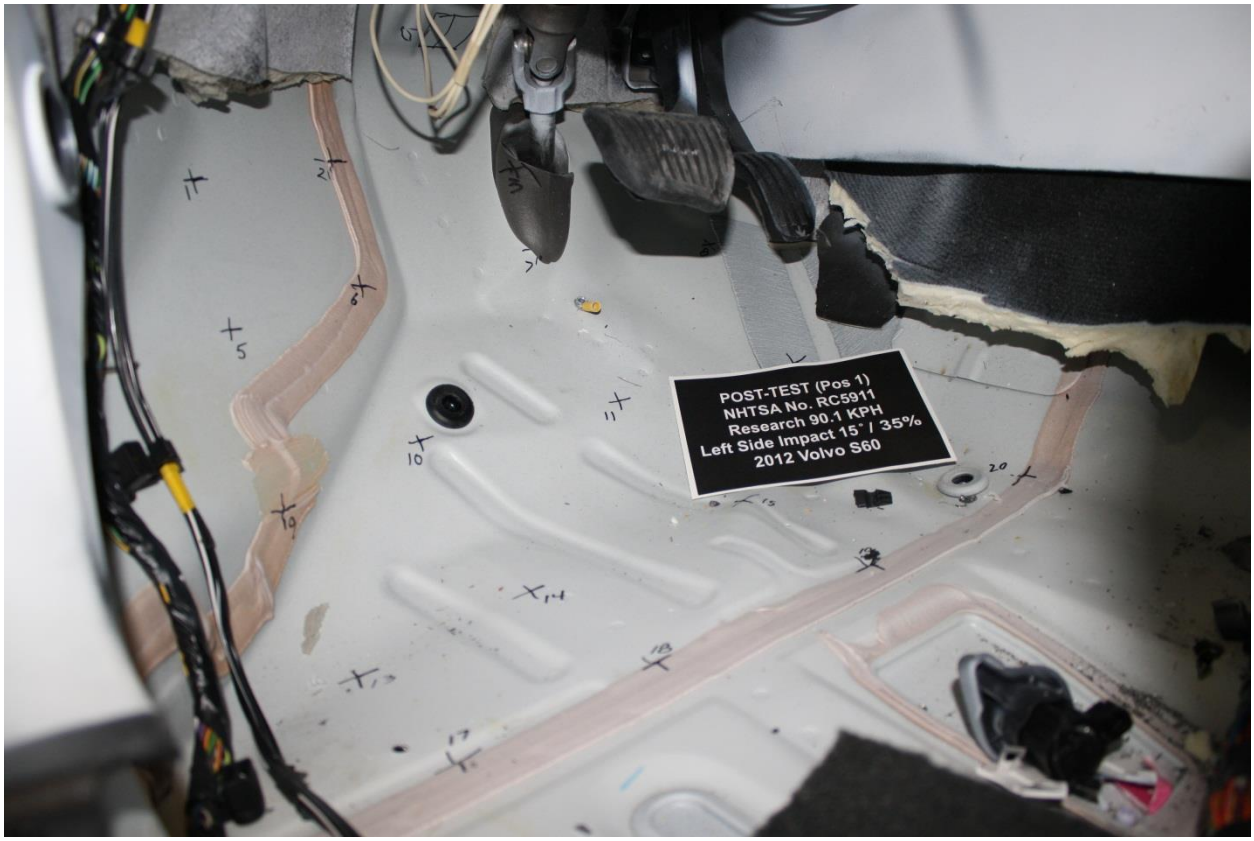


No. 046 Pre-Test View of Driver Floor pan at Mid seat level, w/carpet

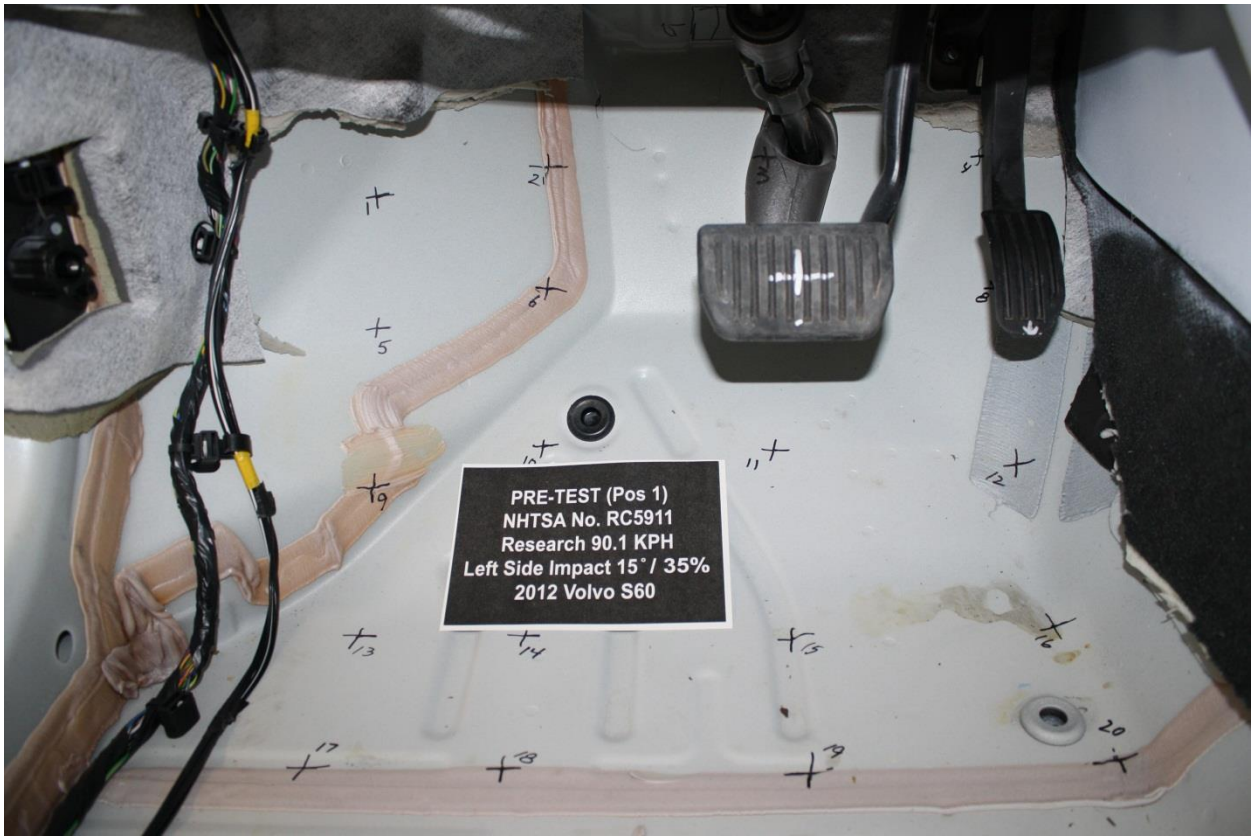


No. 047 Post-Test view of Driver Floor pan at Mid seat level, w/carpet

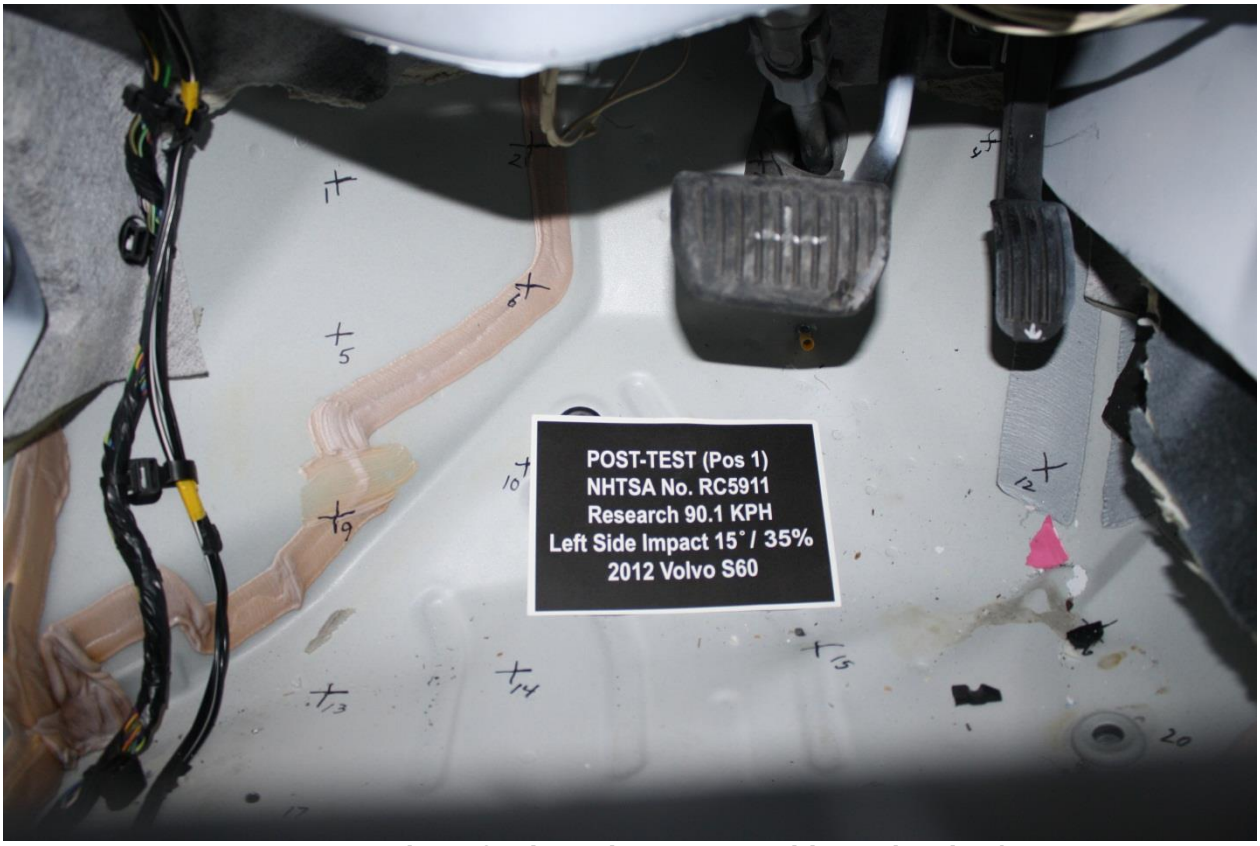
No. 048 Pre-Test View of Driver Floor pan at Left sill level, w/o carpet



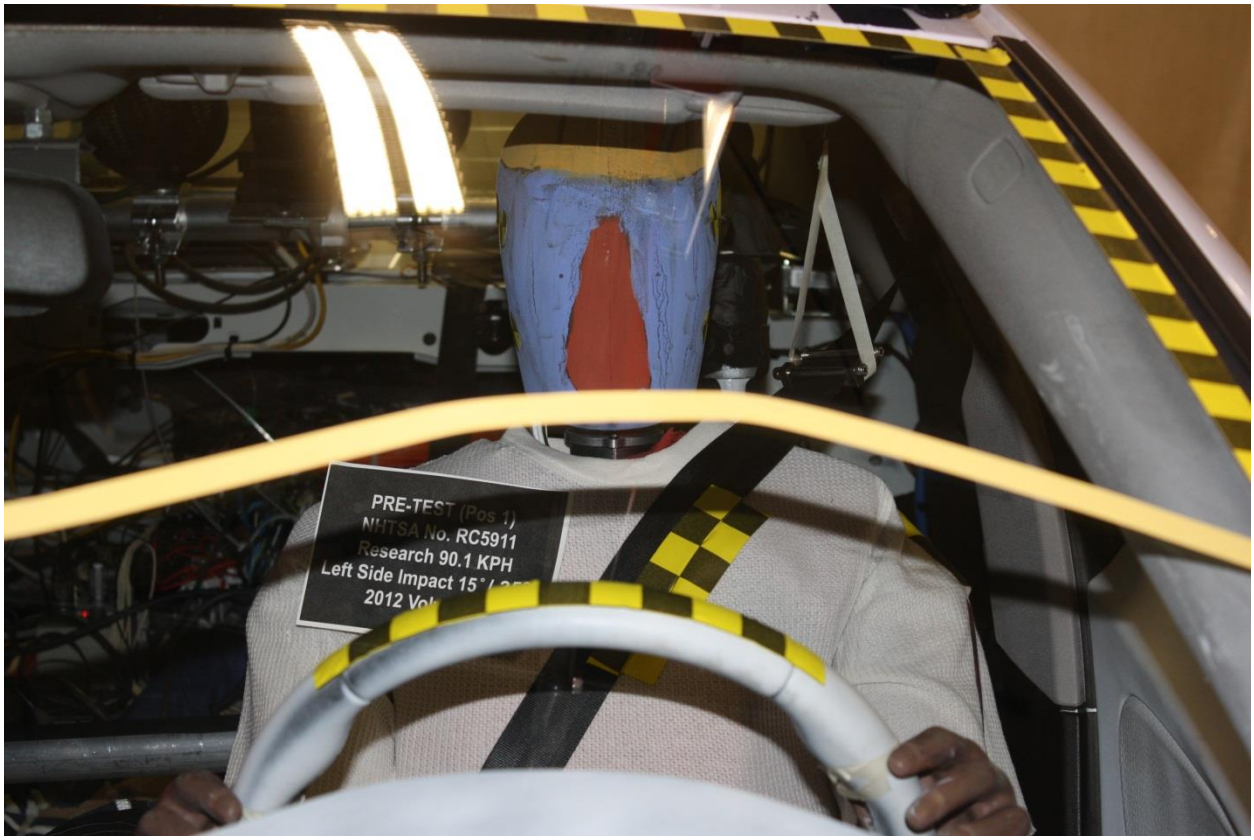
No. 049 Post-Test View of Driver Floor pan at Left sill level, w/o carpet



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

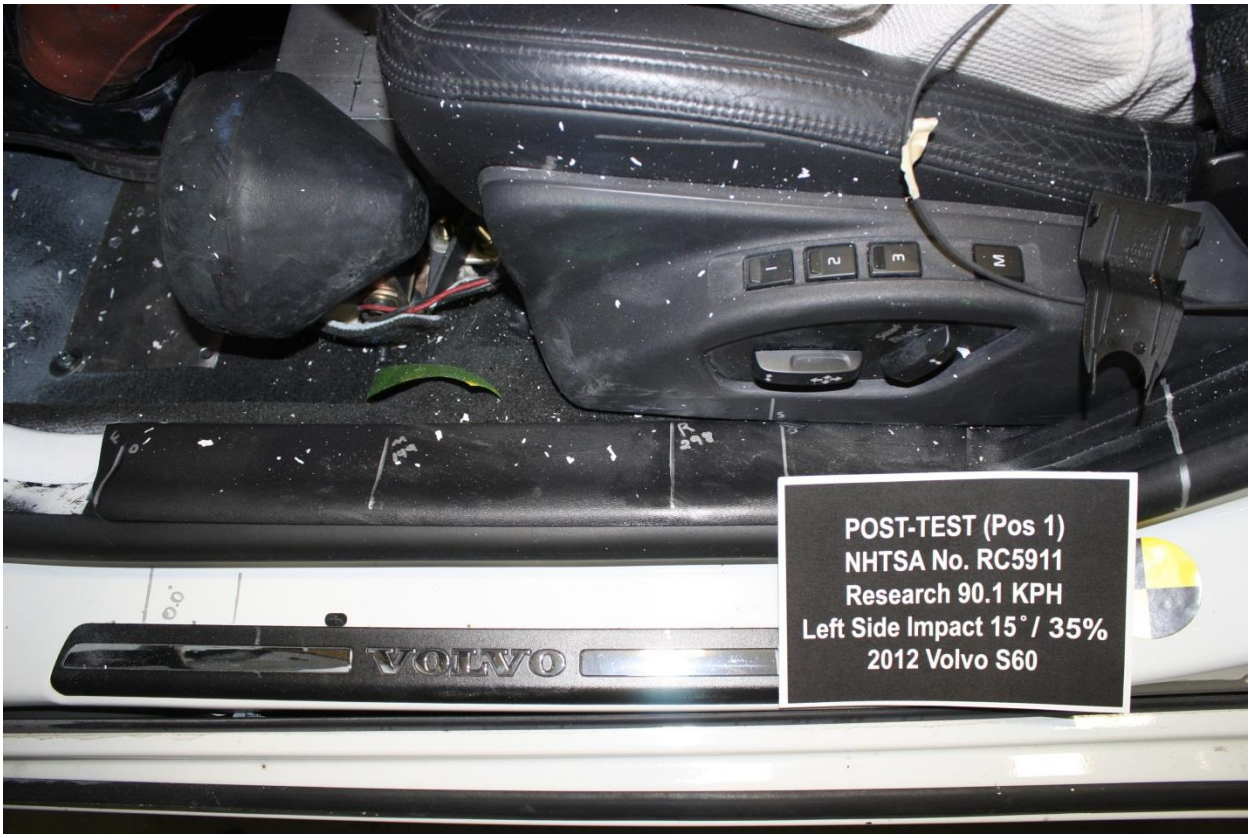
No. 059 Post-Test Right Side View of Driver and Interior

No. 060 Pre-Test View of Driver Door Clearance

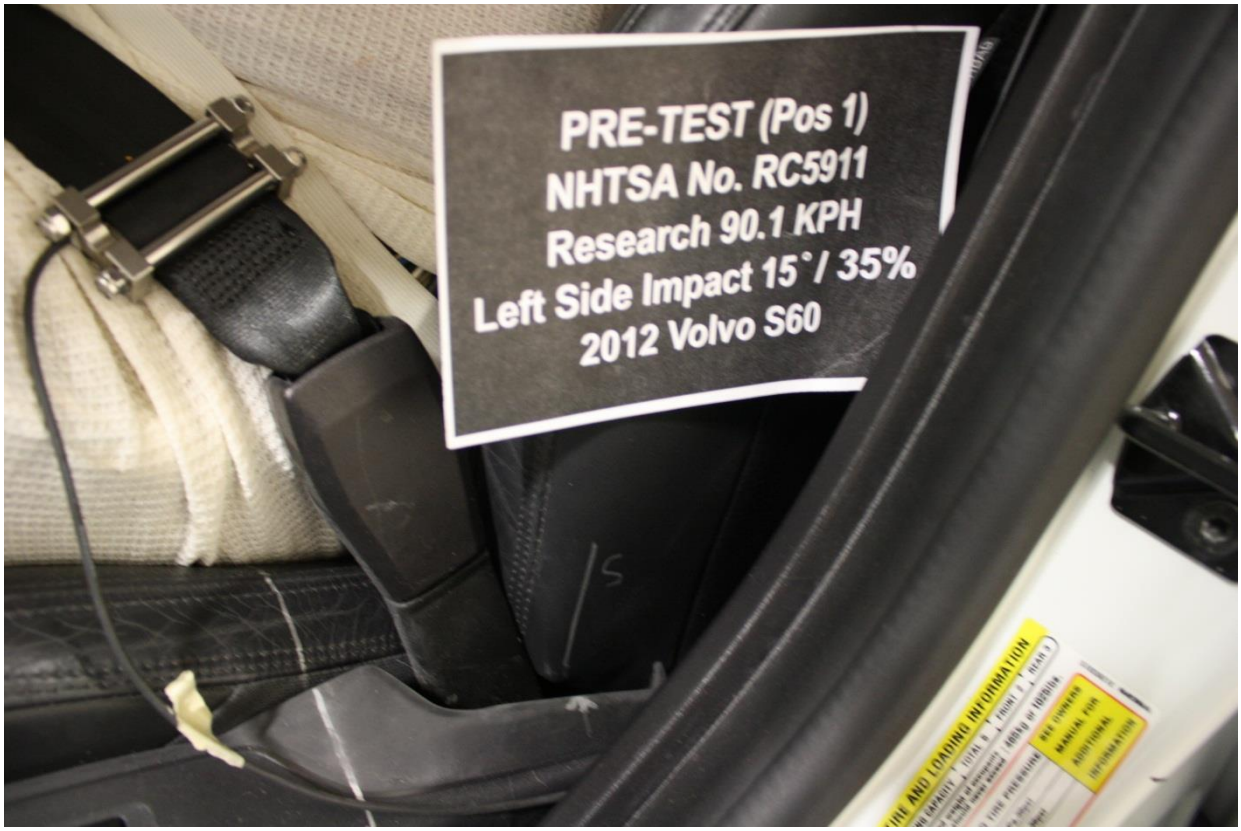
No. 061 Post-Test View of Driver Door Clearance

No. 062 Pre-Test View of Parking Brake

No. 063 Pre-Test Driver Seat Fore Aft Markings

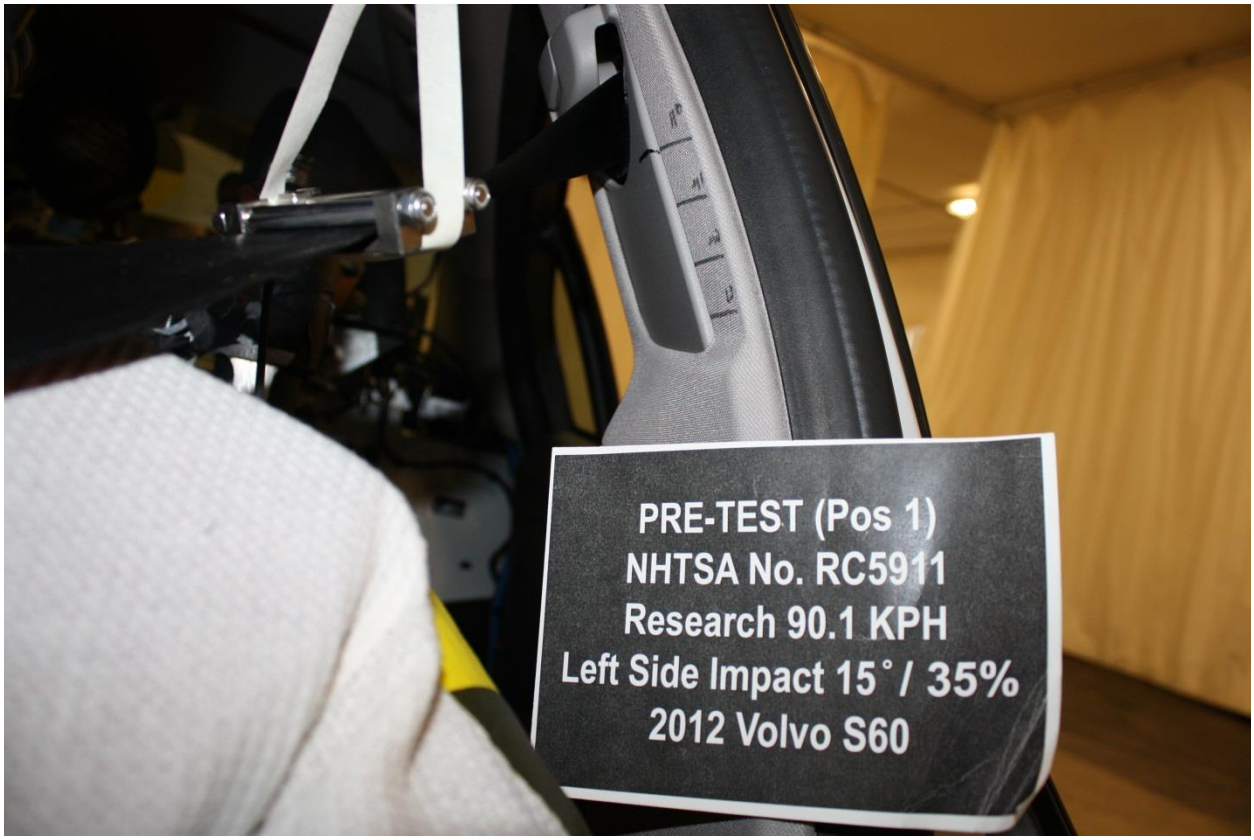


No. 064 Post-Test Driver Seat Fore Aft Markings – PLASTIC MOVED NOT SEAT



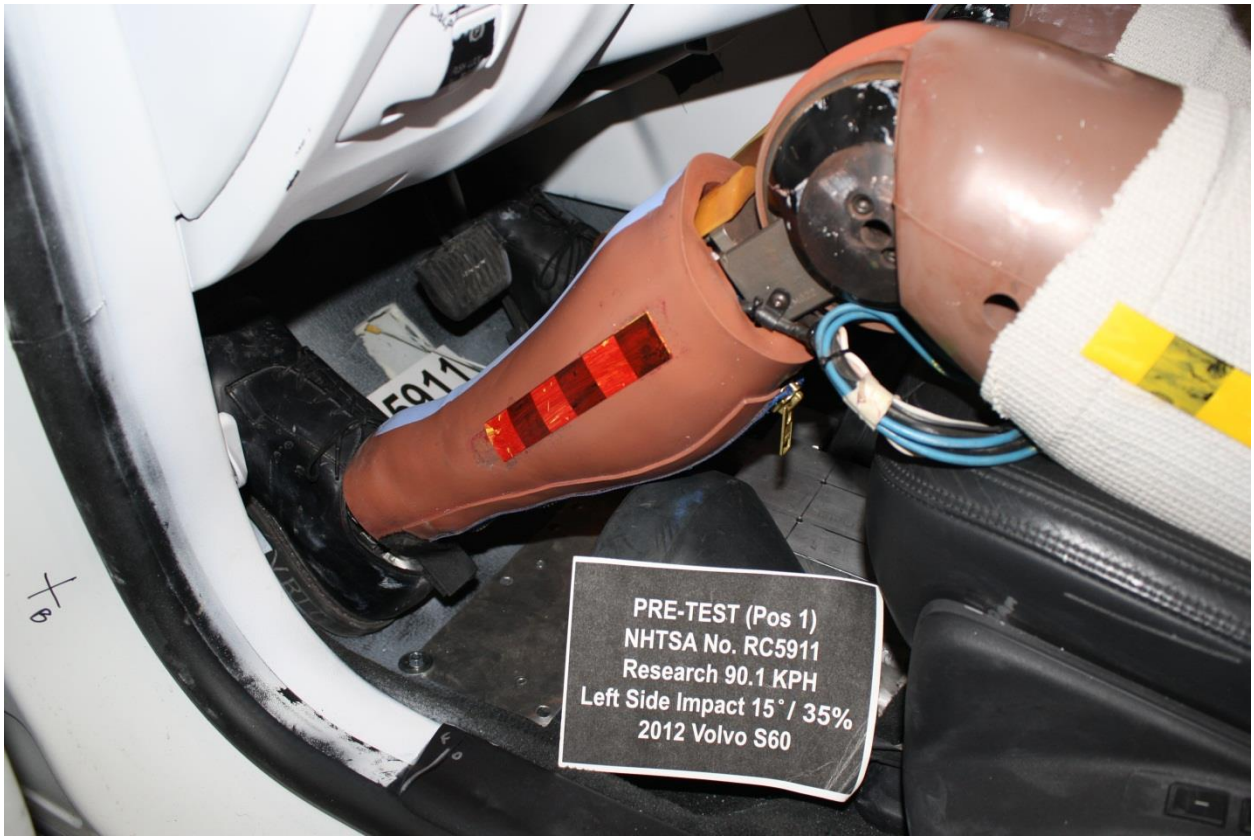
No. 065 Pre-Test Driver Seat Back Markings

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

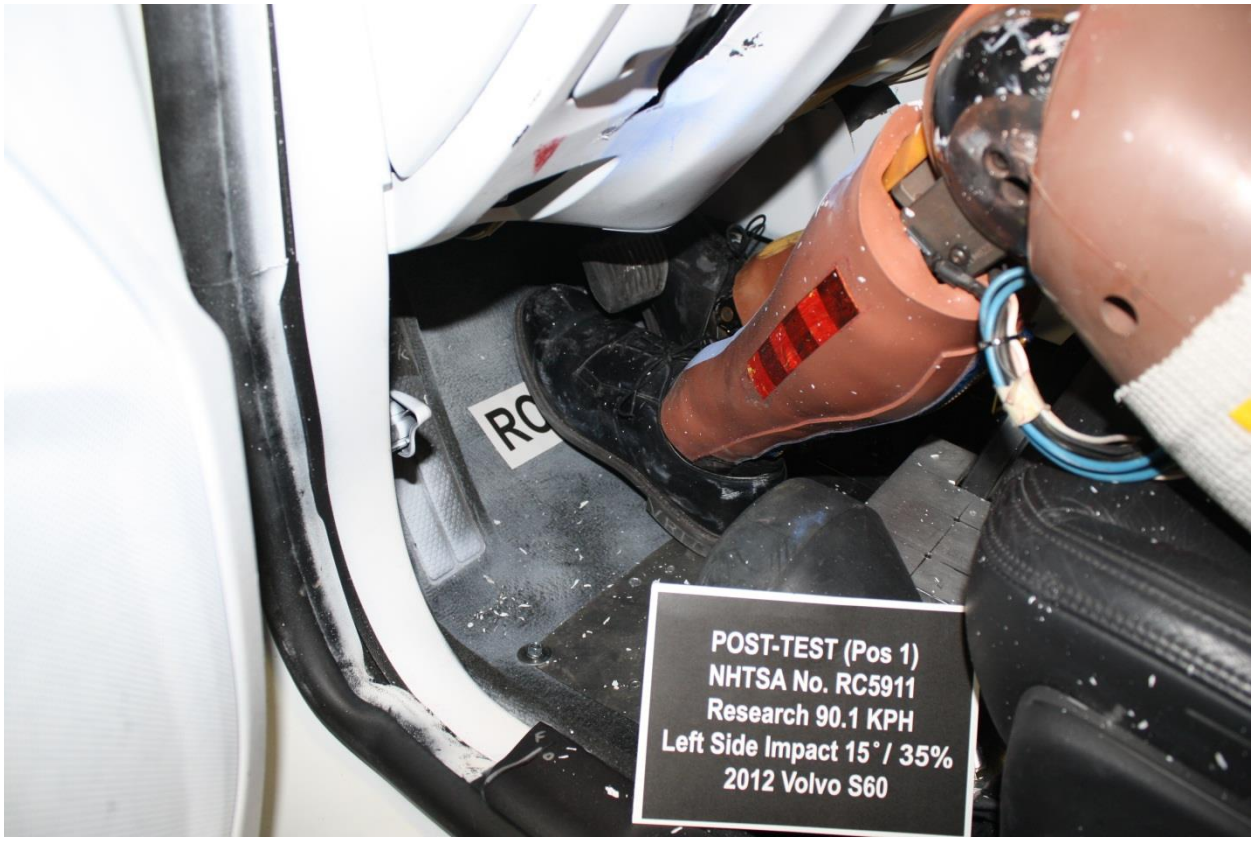


No. 067 Pre-Test Driver Adjustable D-Ring

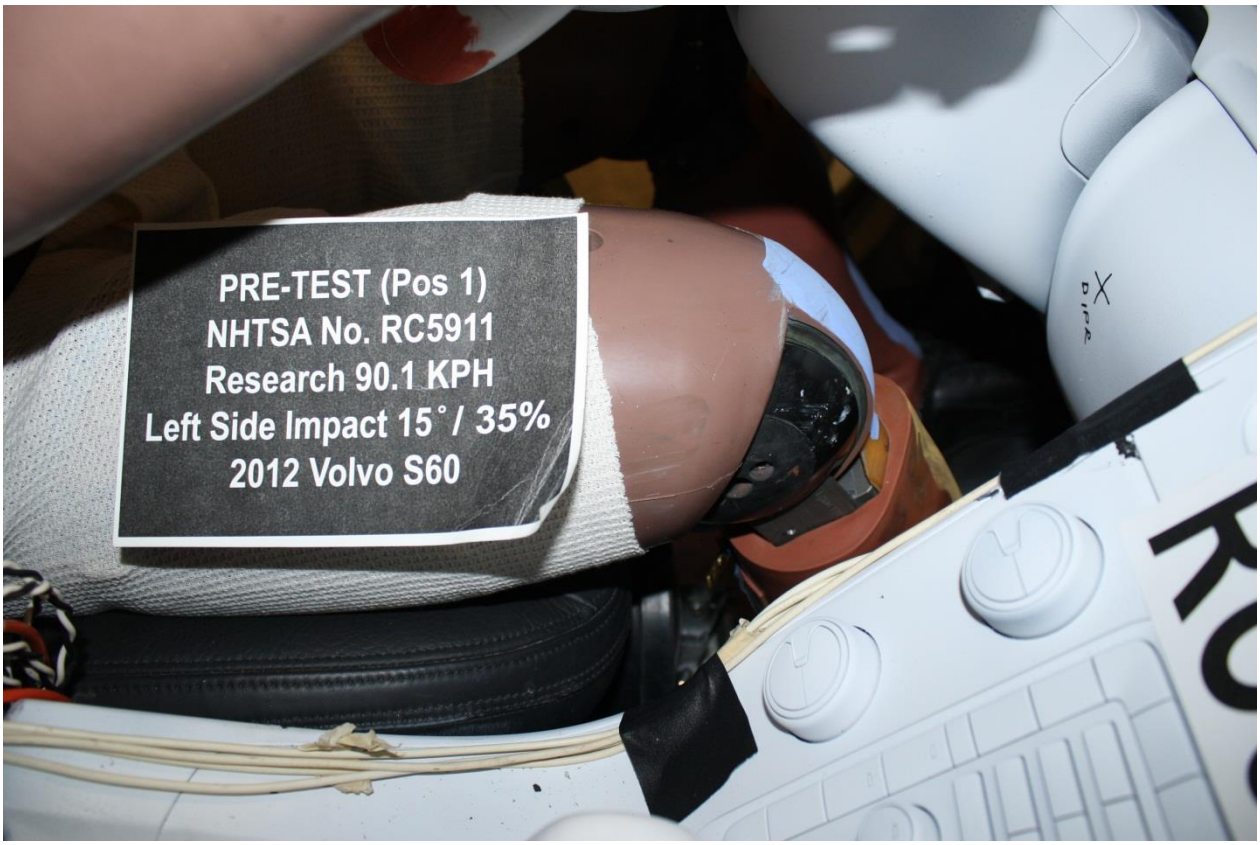
No. 068 Post-Test Driver Adjustable D-Ring



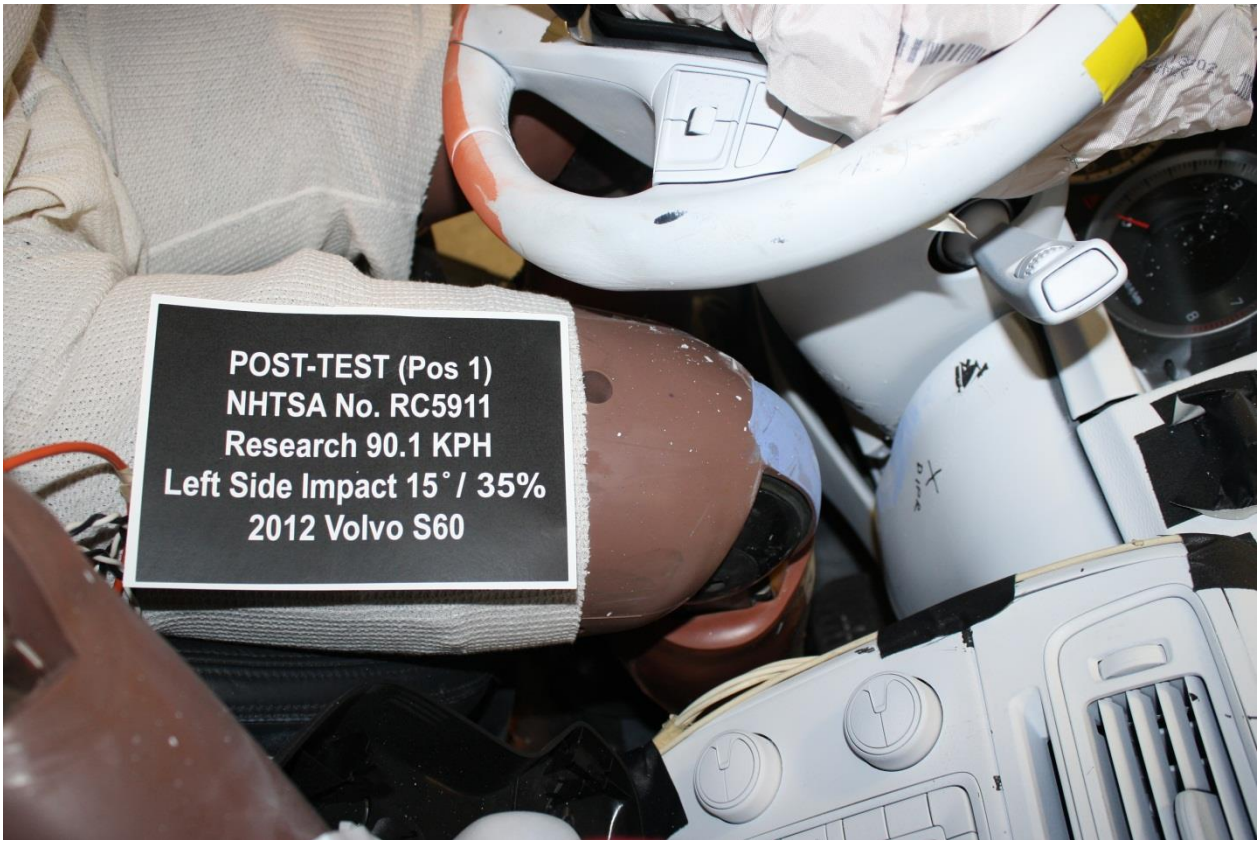
No. 069 Pre-Test Driver Feet



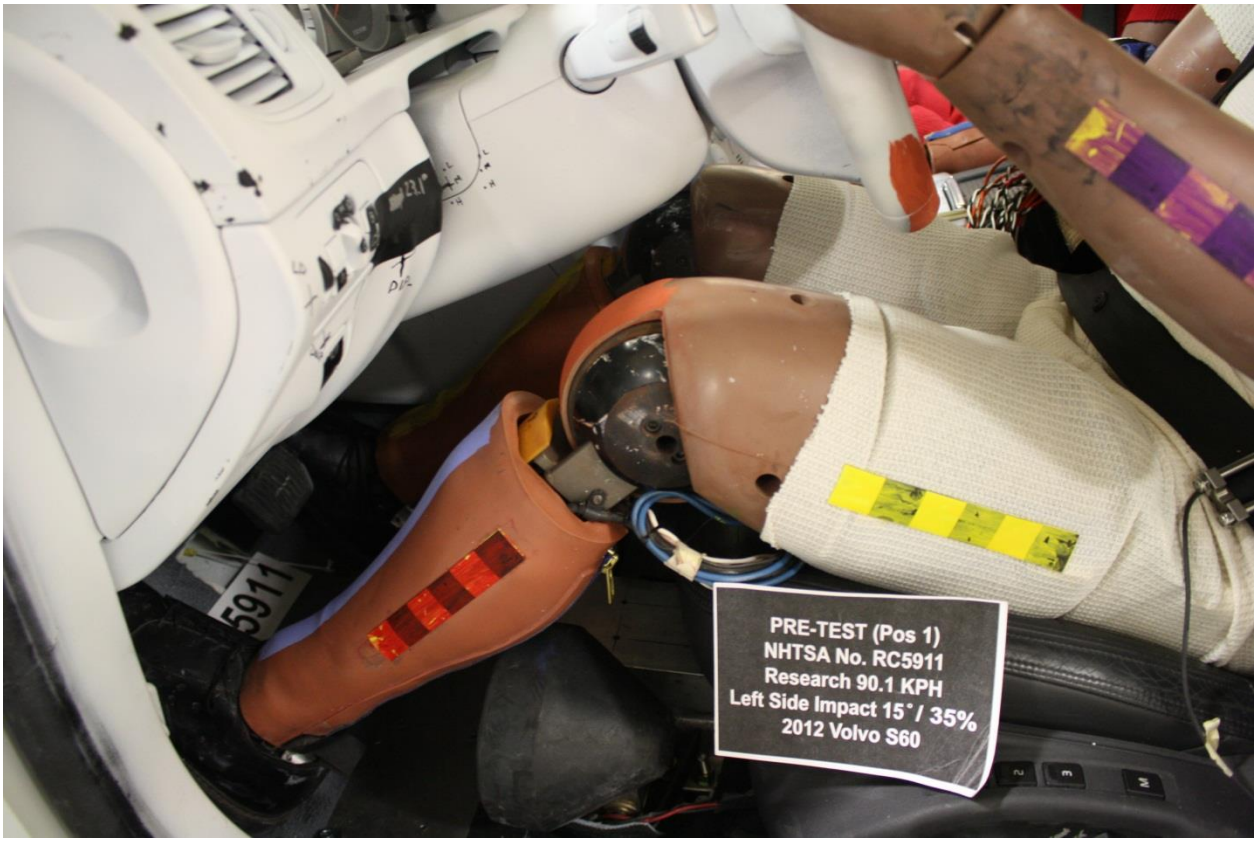
No. 070 Post-Test Driver Feet



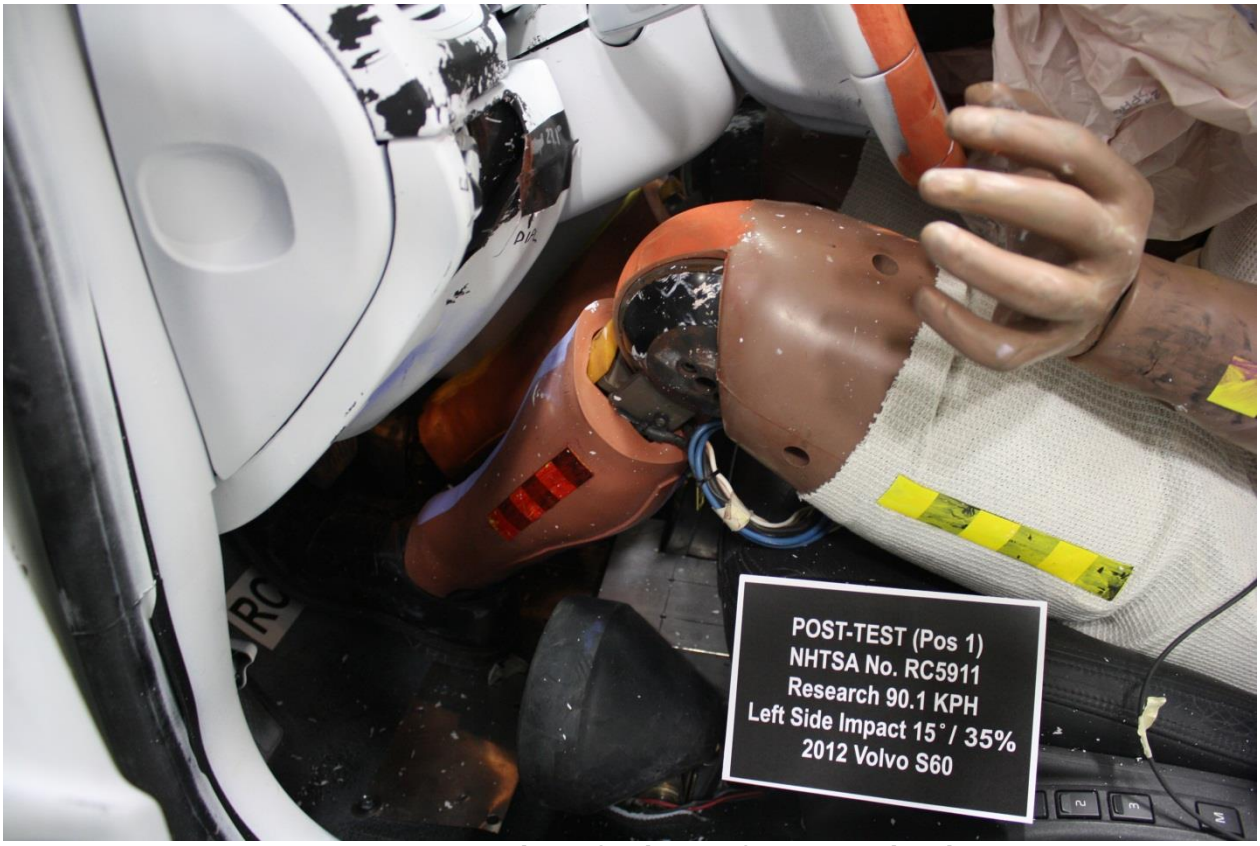
No. 071 Pre-Test View of Driver Right Knee and Bolster



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

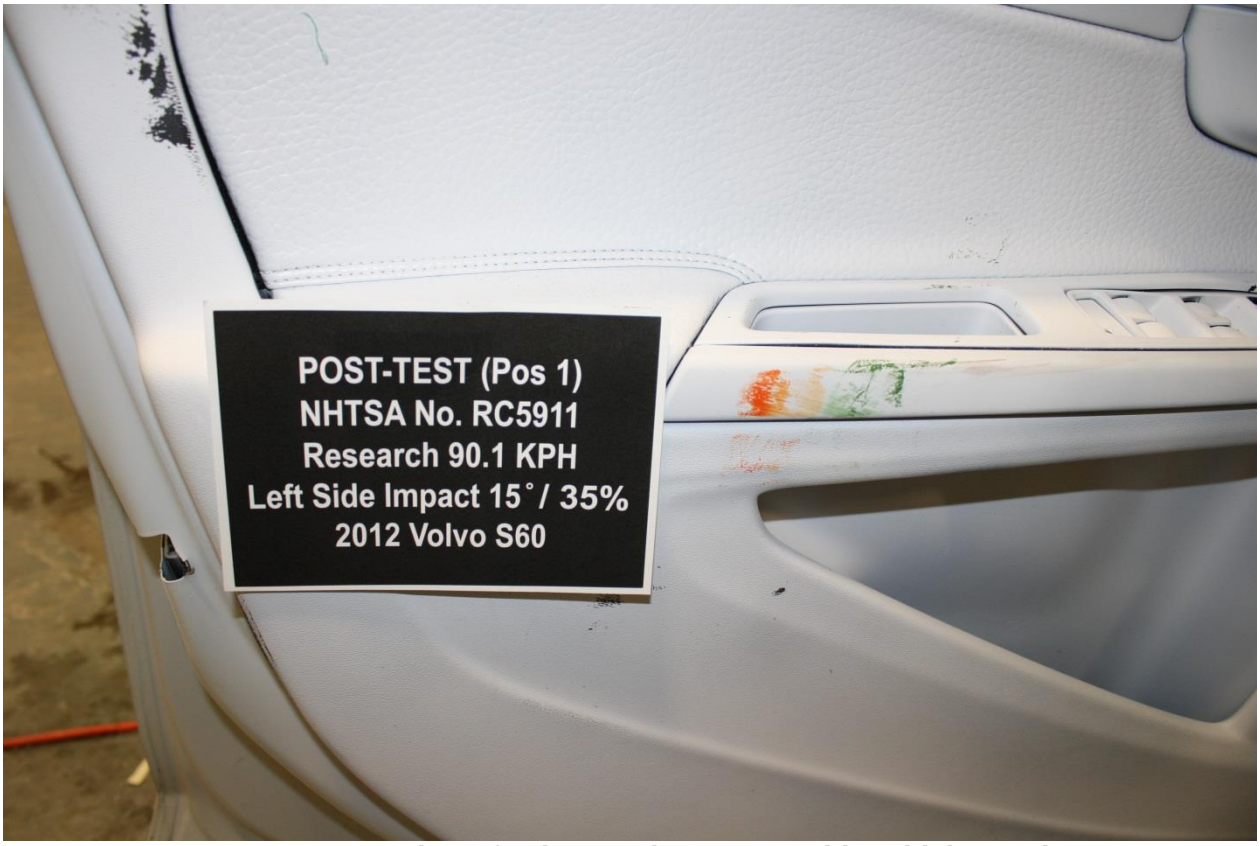
No. 078 Post-Test Left Side View of Steering Wheel set position

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

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

Photo Not Applicable

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



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

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

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

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

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

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

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

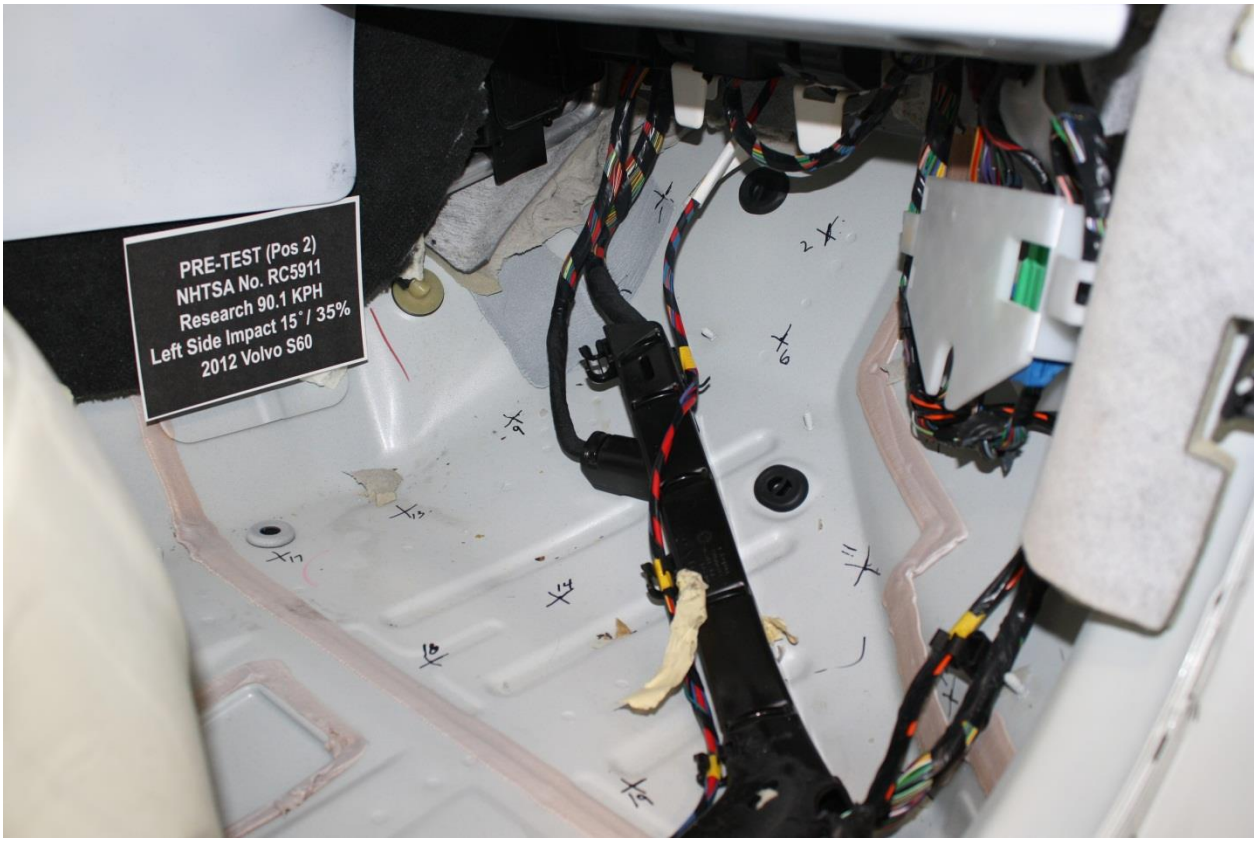
No. 087 Post-Test Right Side View of Passenger Knee Bolsters

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

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

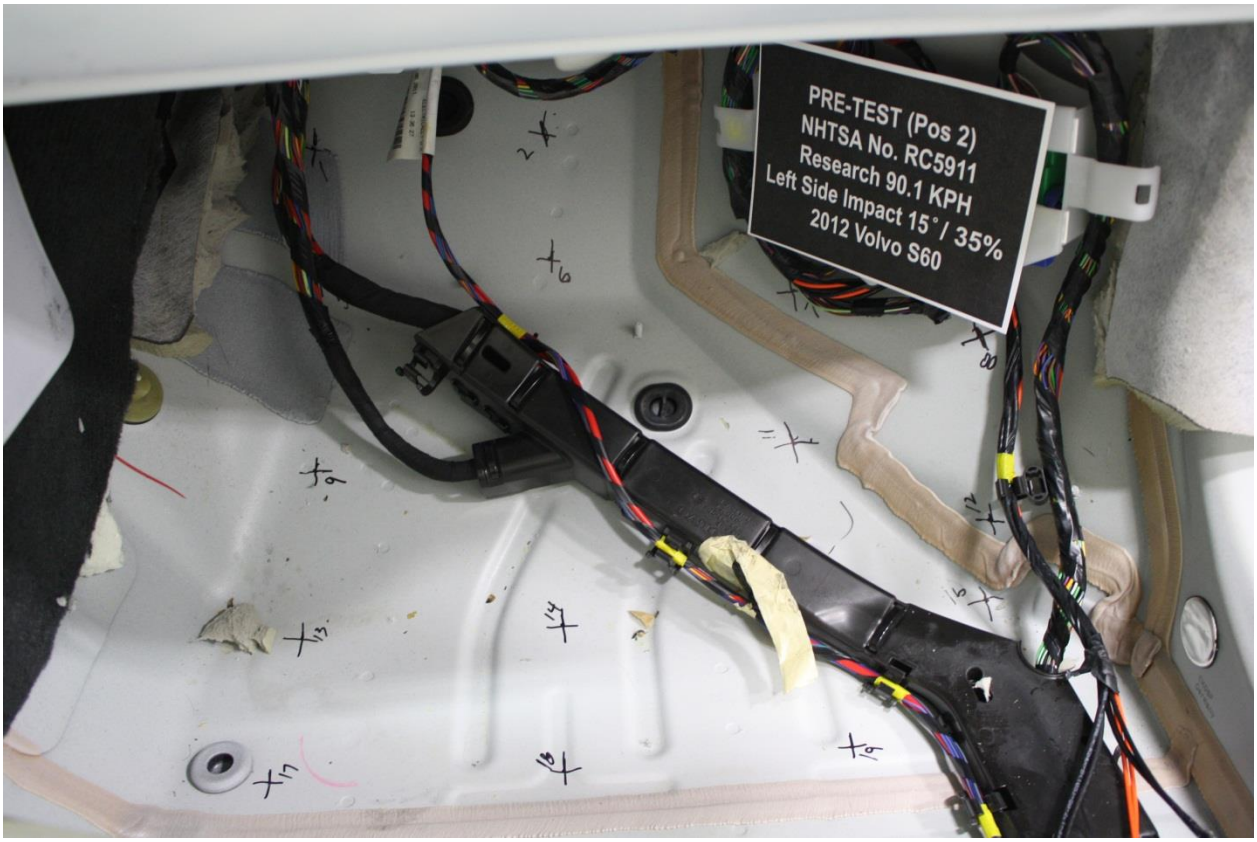
No. 090 Pre-Test View of Passenger Floor pan at Mid seat level, w/carpet

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

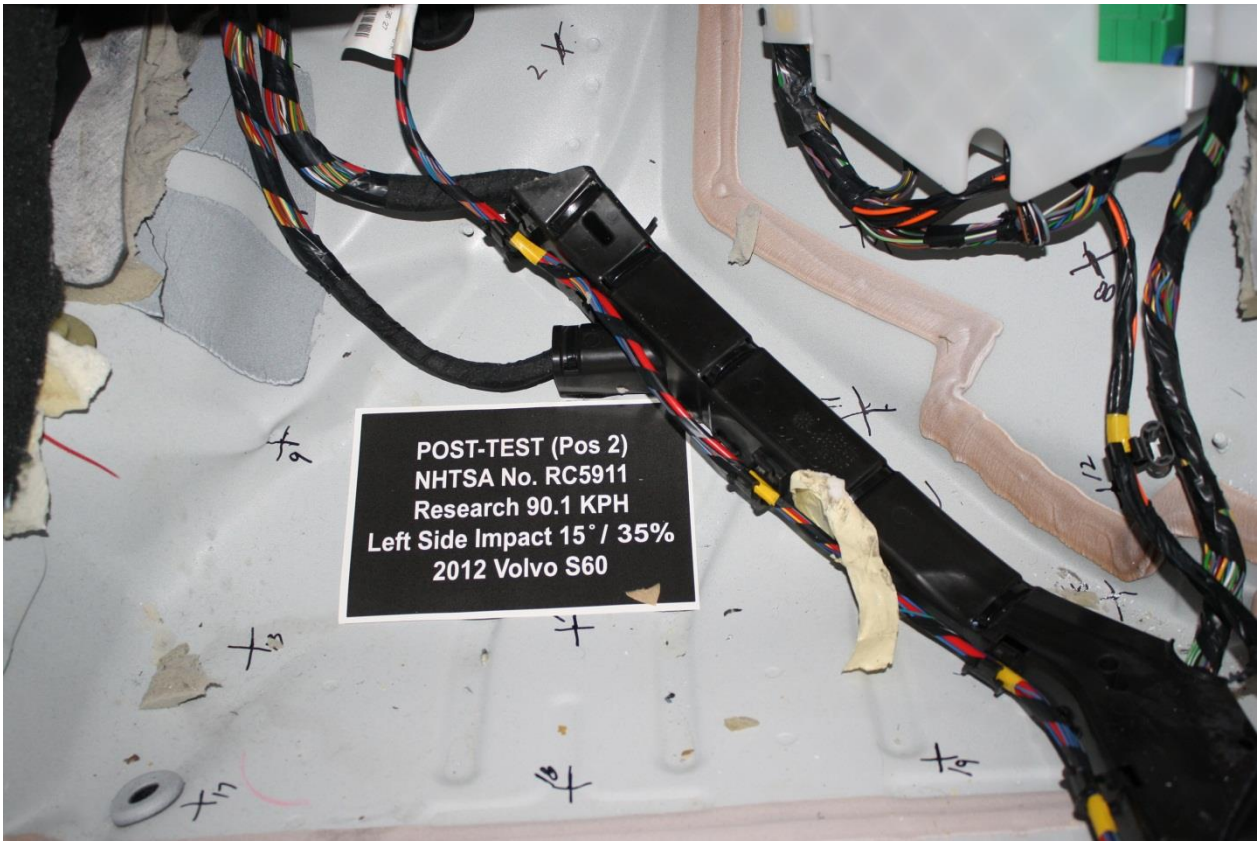


No. 092 Pre-Test View of Passenger Floor pan at Left sill level, w/o carpet

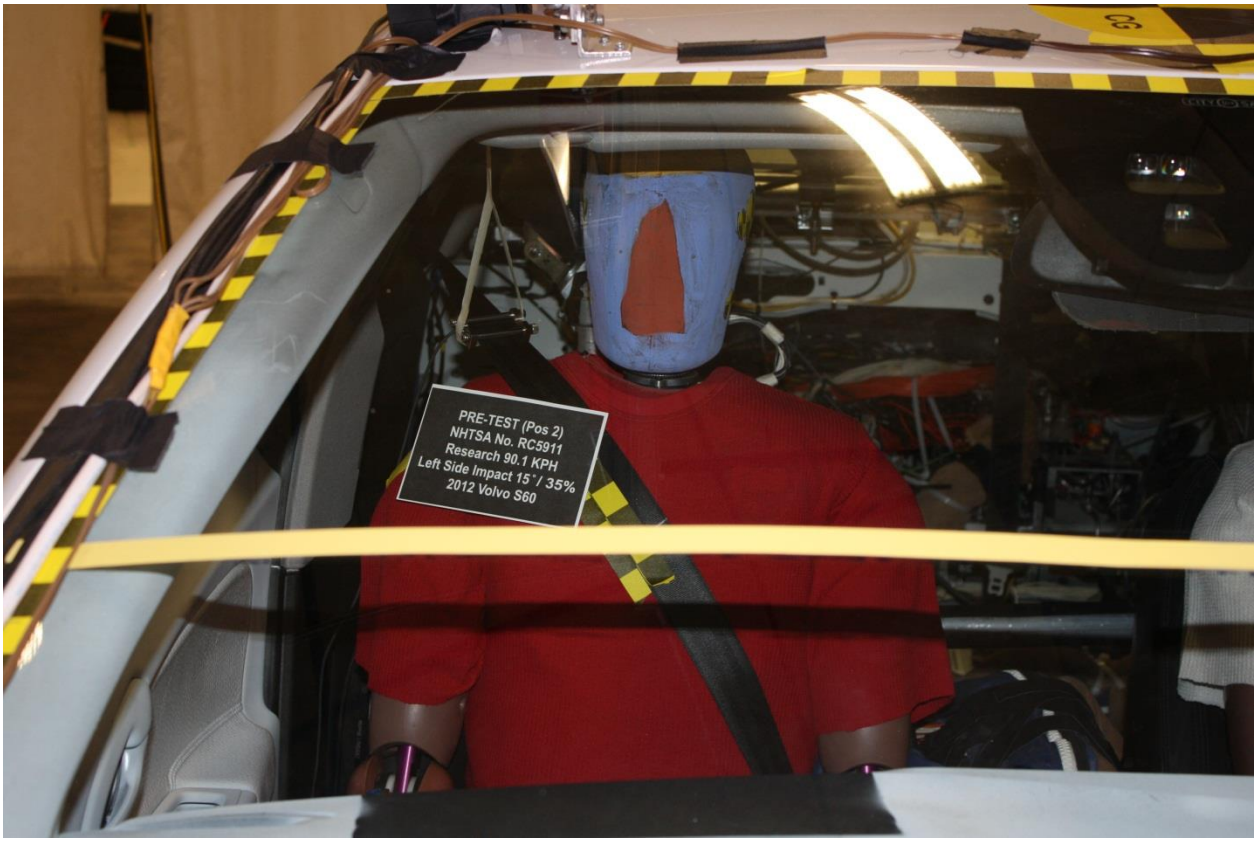
No. 093 Post-Test View of Passenger Floor pan at Left sill level, w/o carpet



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



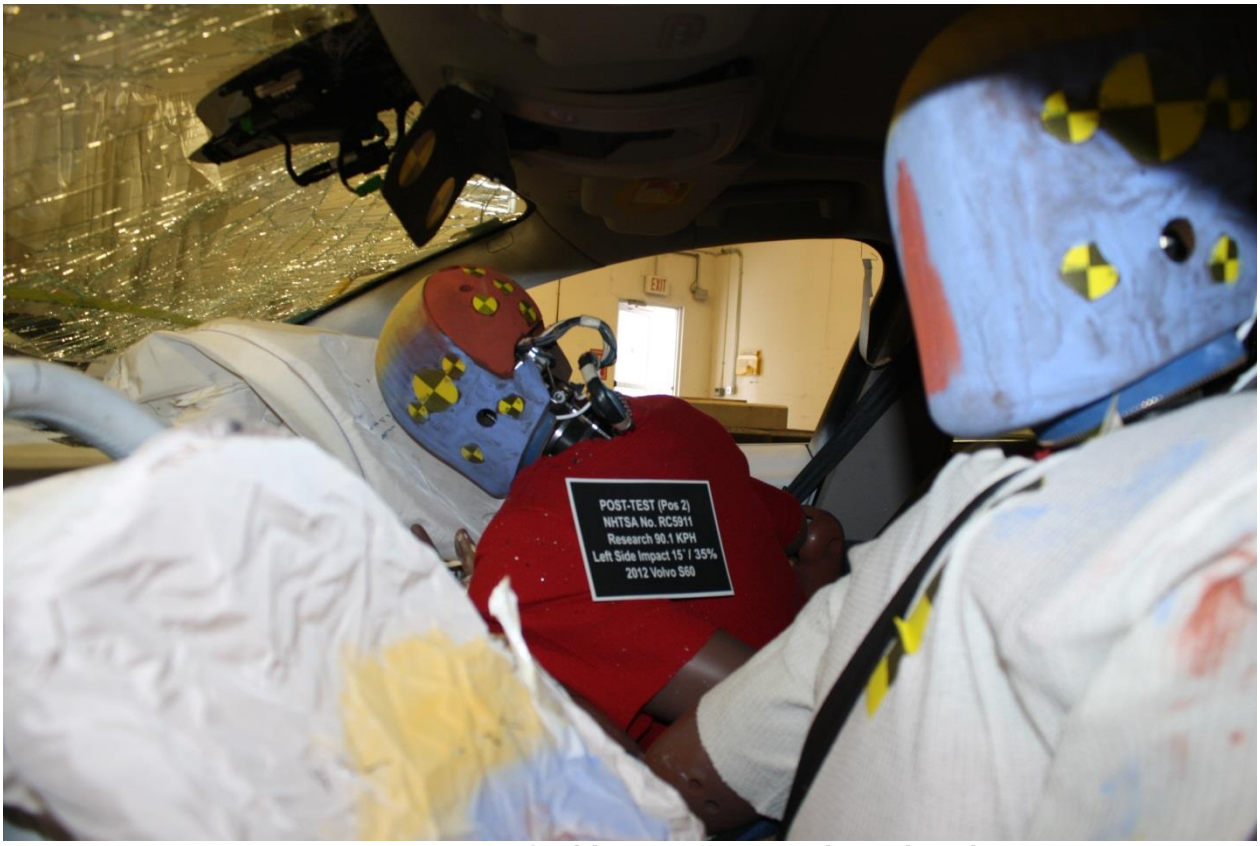
No. 095 Post-Test view of Passenger Floor pan at Mid seat level, wo carpet



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

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

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



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

No. 100 Pre-Test Right Side Passenger Window View

No. 101 Post-Test Right Side Passenger Window View

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

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

No. 104 Pre-Test View of Passenger Door Clearance

No. 105 Post-Test View of Passenger Door Clearance

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

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

No. 108 Pre-Test Passenger Seat Back Markings

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

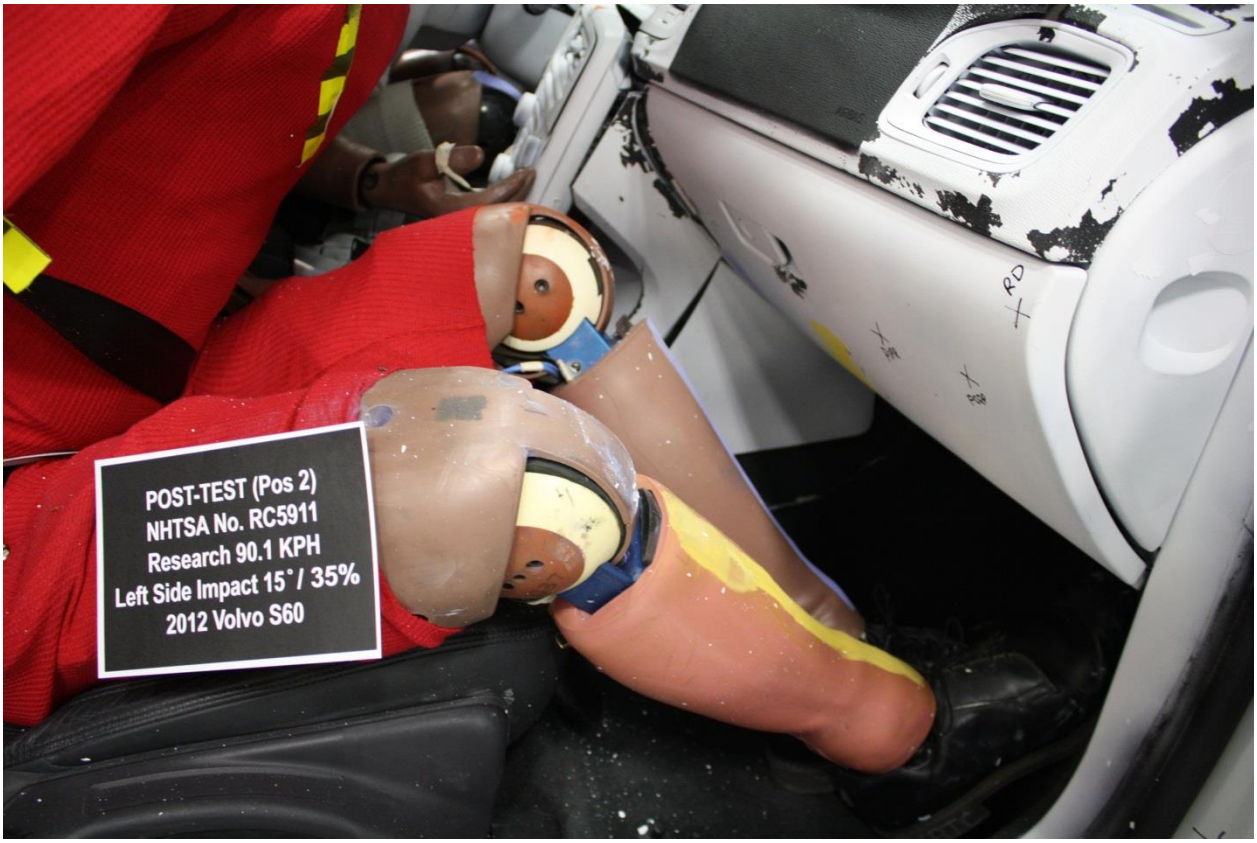
No. 110 Pre-Test Passenger Adjustable D-ring

No. 111 Post-Test Passenger Adjustable D-ring

No. 112 Pre-Test View of Passenger Feet

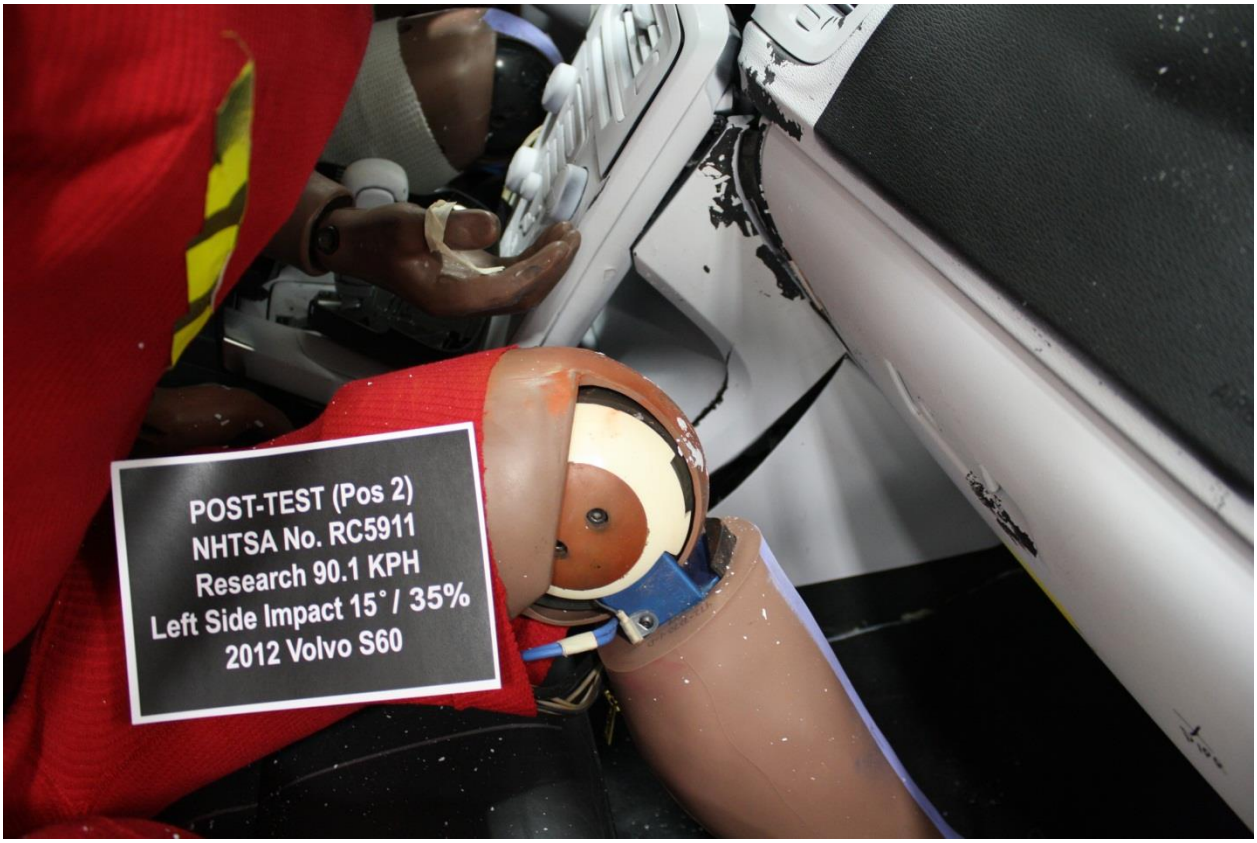
No. 113 Post-Test View of Passenger Feet

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

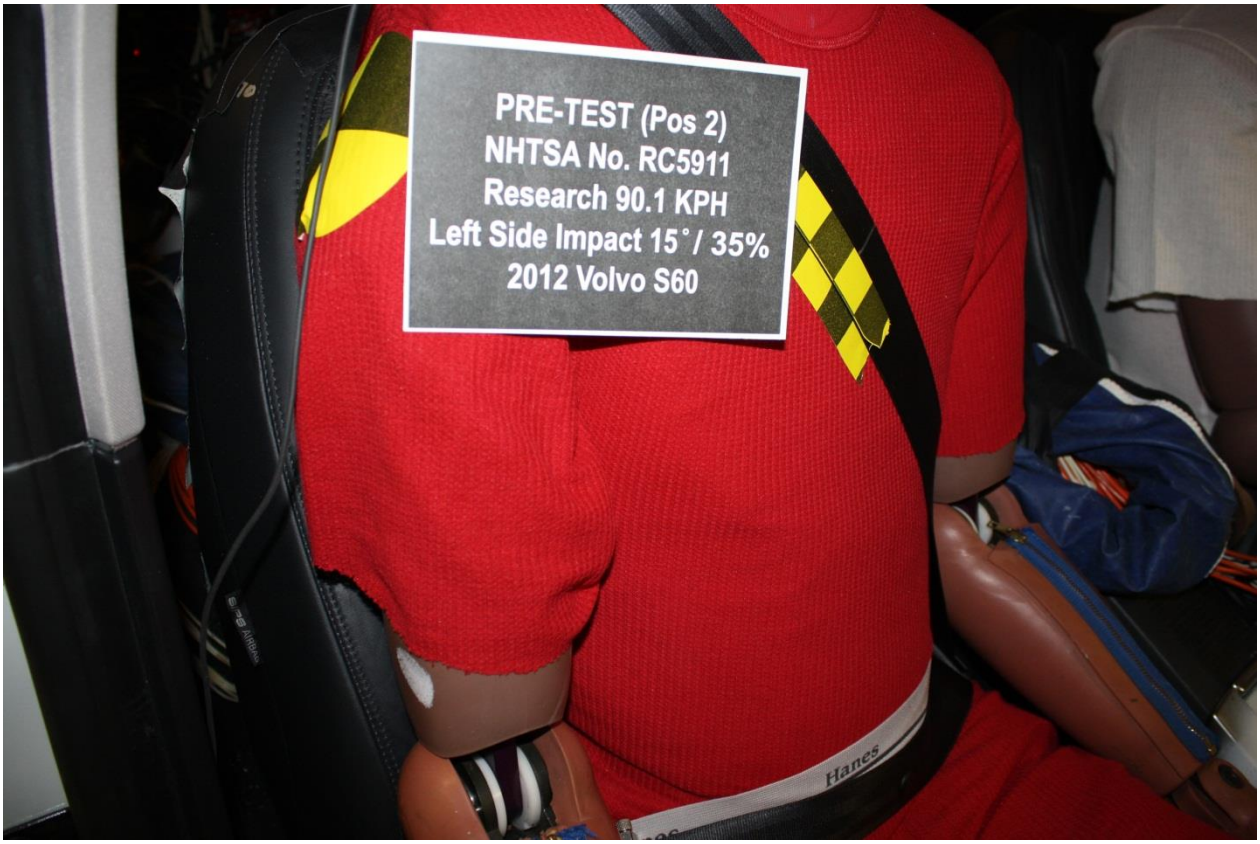


No. 115 Post-Test View of Passenger Right Knee and Bolster

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



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



No. 118 Pre-Test View of Passenger Abdomen

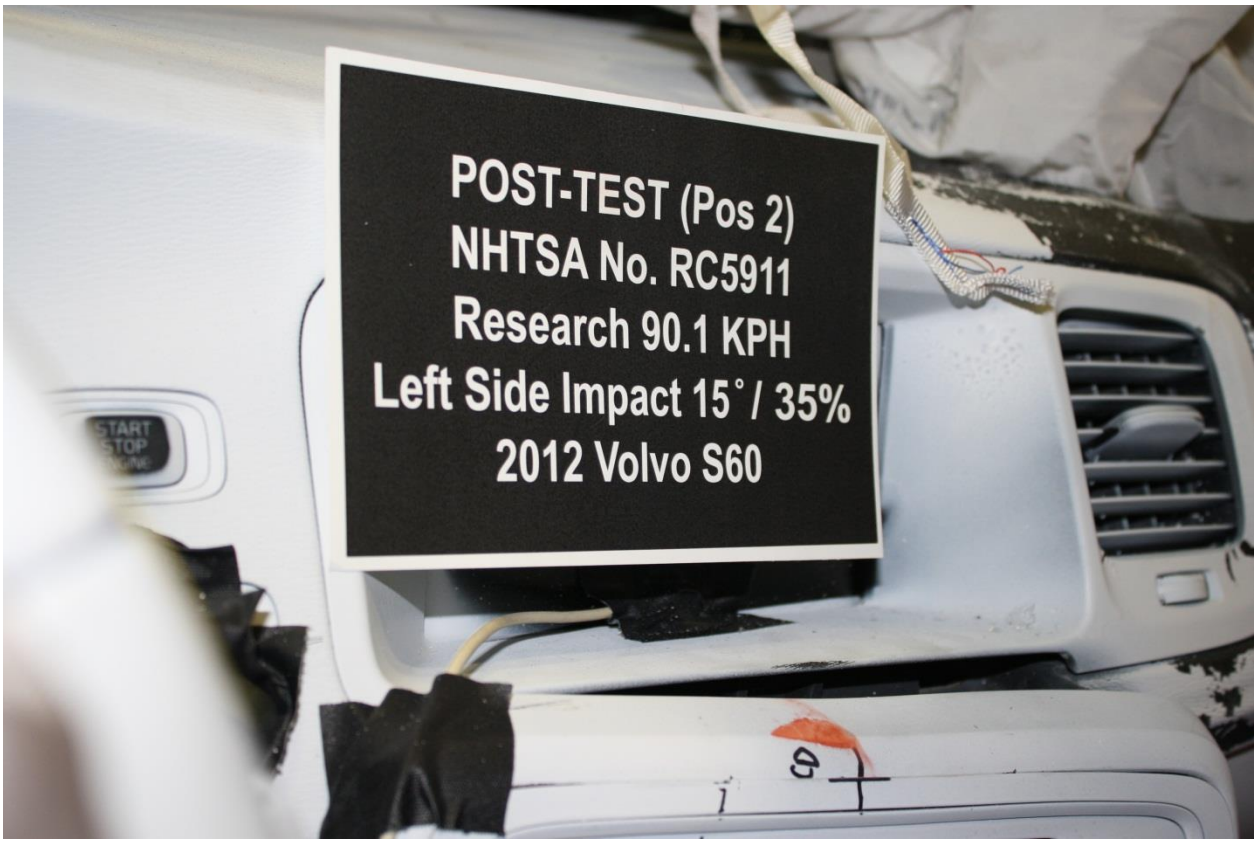
No. 119 Post-Test View of Passenger Abdomen

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

Photo Not Applicable

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

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

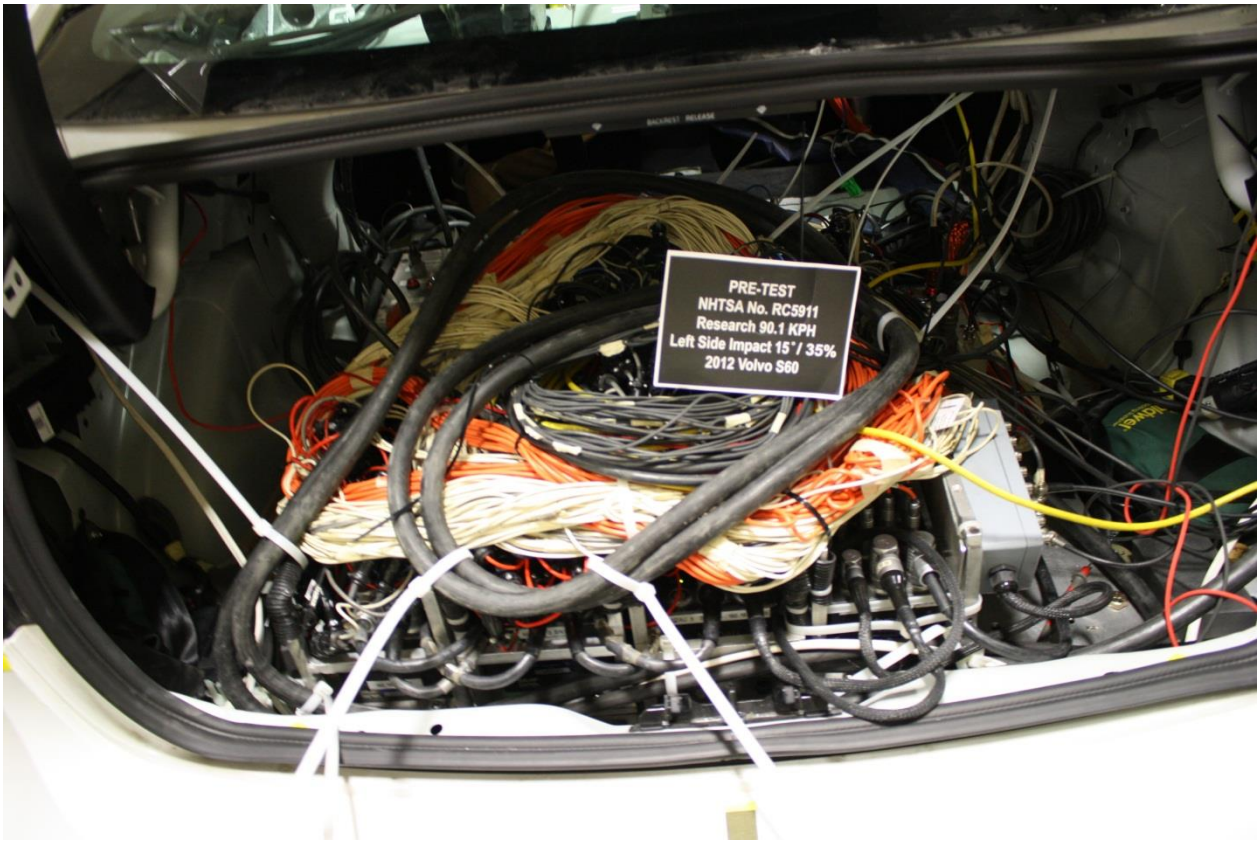


No. 121a Post-Test View of Passenger Head contact with Interior

Photo Not Applicable

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

No. 122 Post-Test Passenger Contact With Glovebox

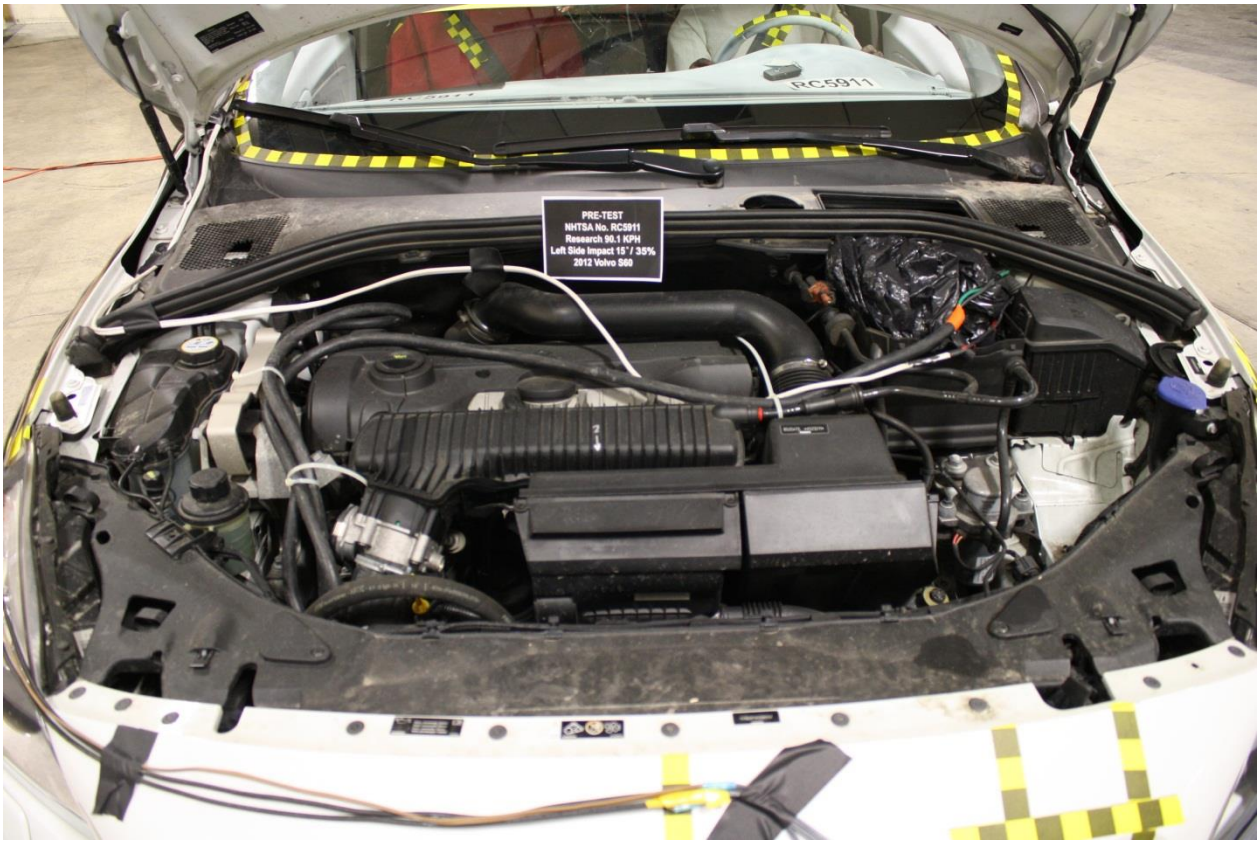


No. 123 Pre-Test Ballast Locations

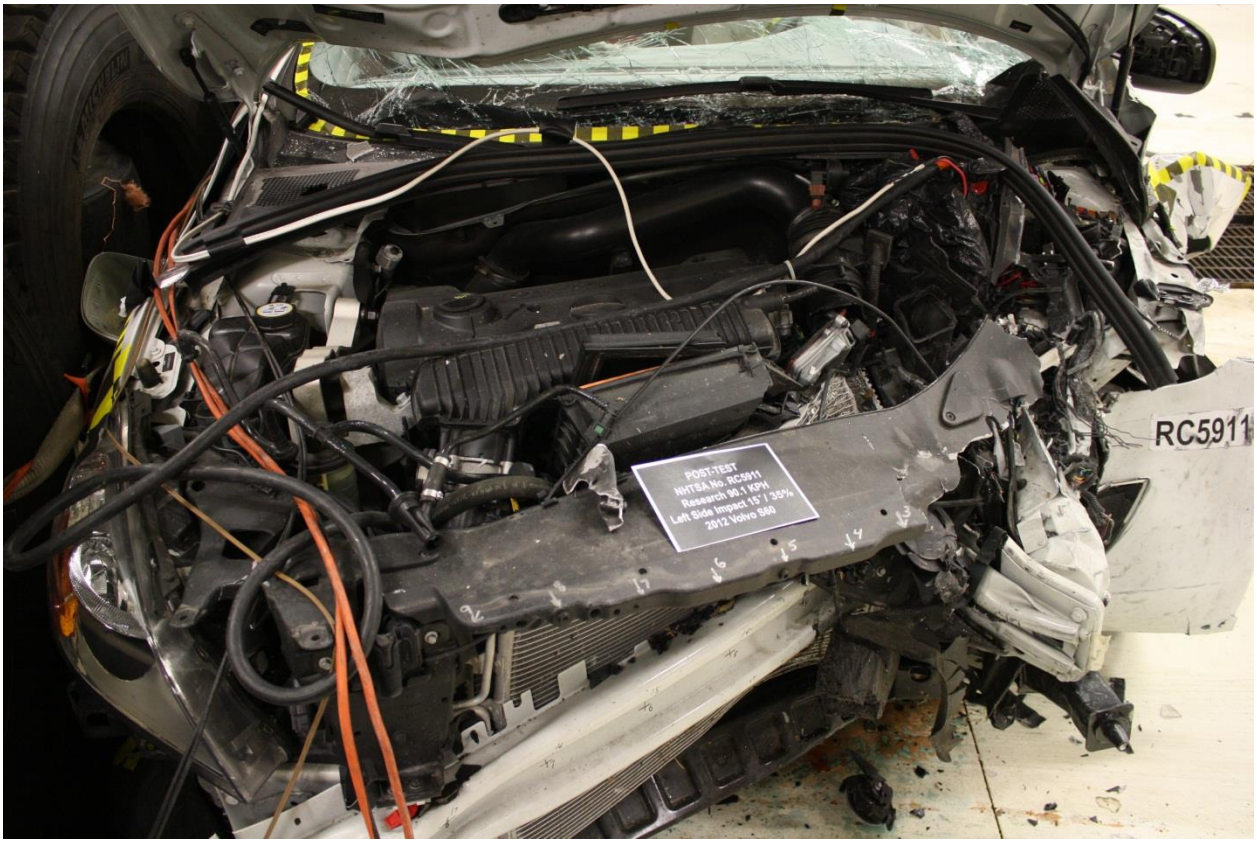
No. 124 Post-Test Speed Trap Readout

No. 125 Pre-Test View of Fuel Filler Cap

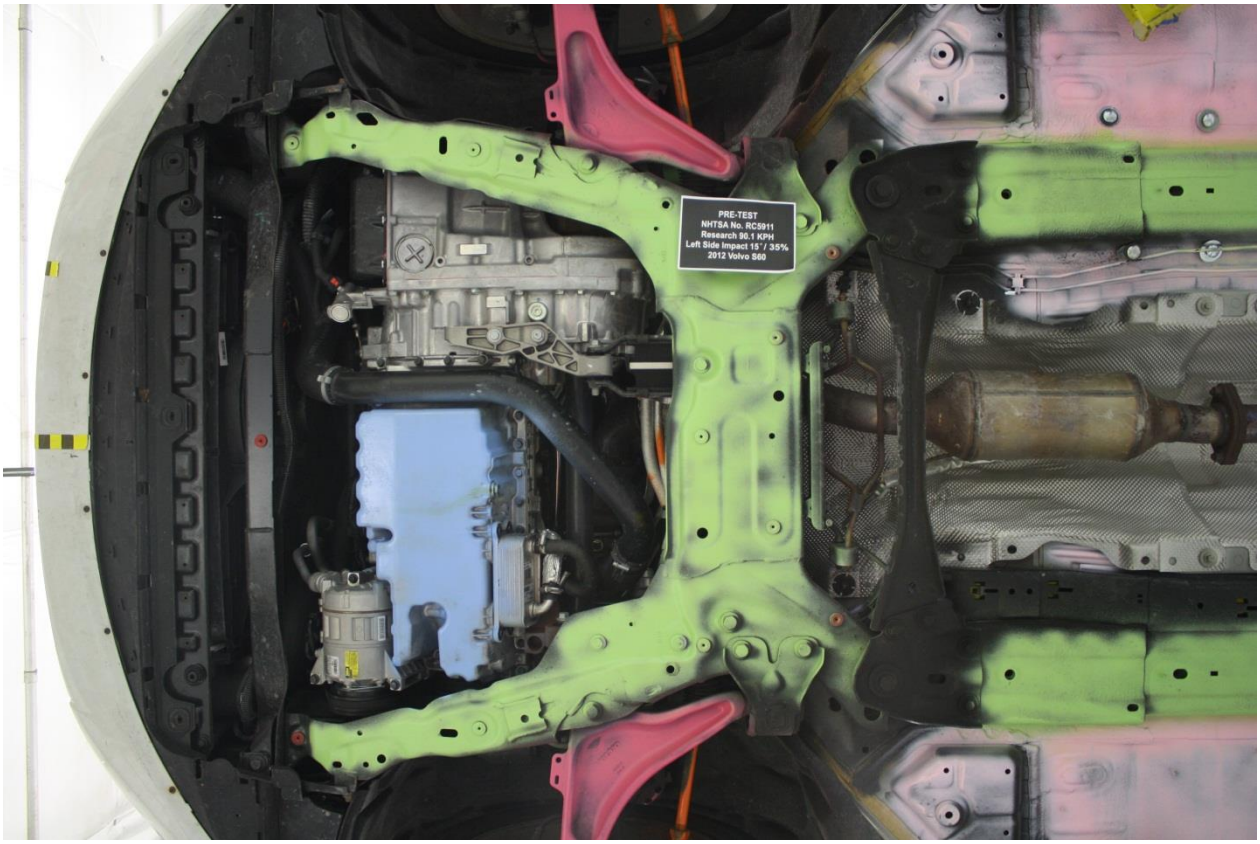
No. 126 Post-Test View of Fuel Filler Cap



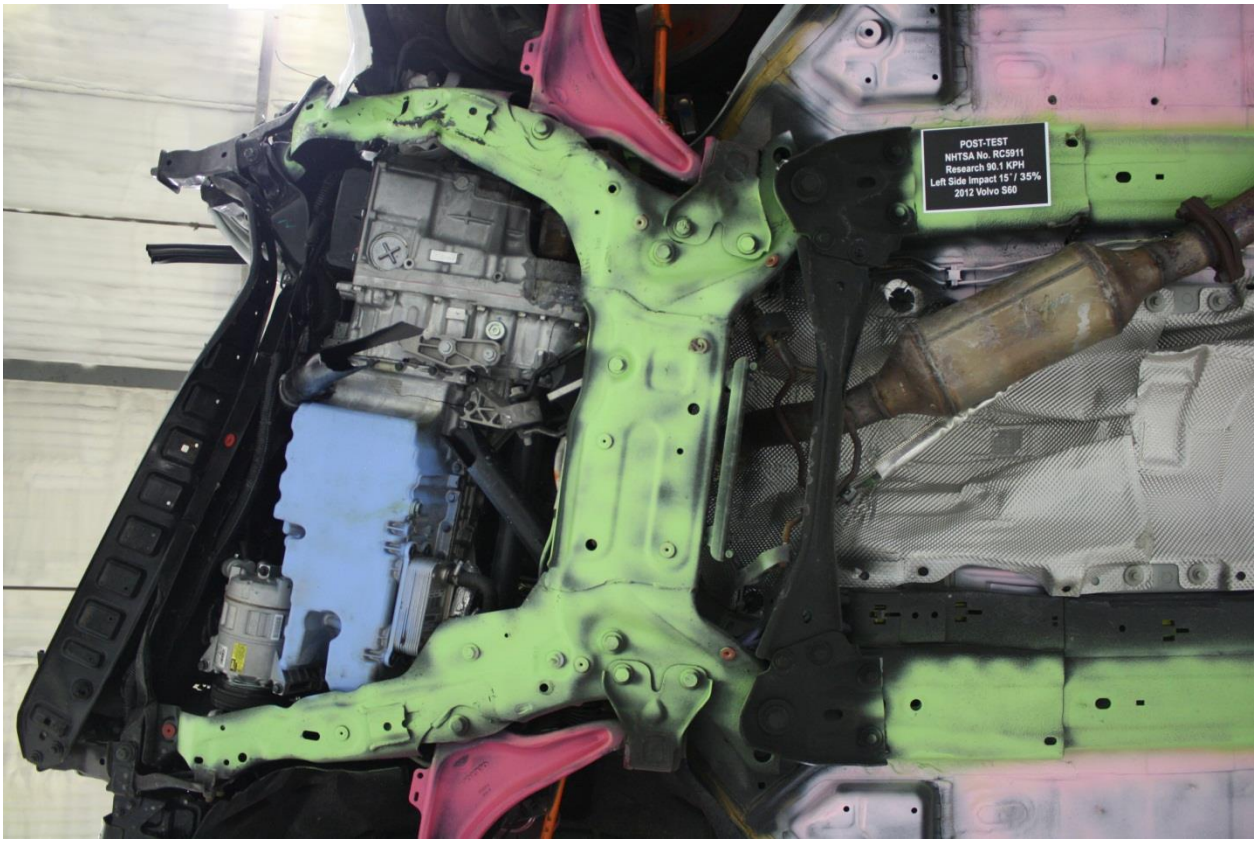
No. 127 Pre-Test Engine Compartment View



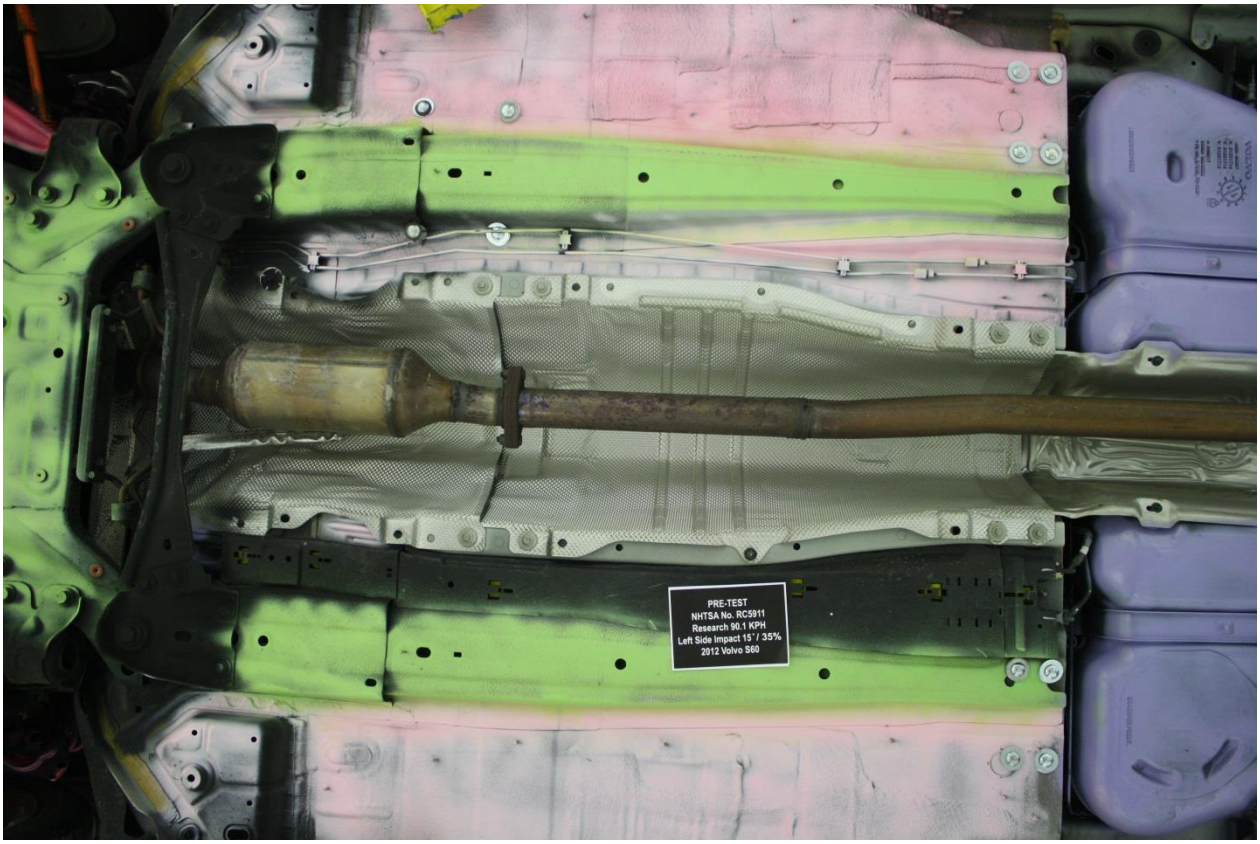
No. 128 Post-Test Engine Compartment View



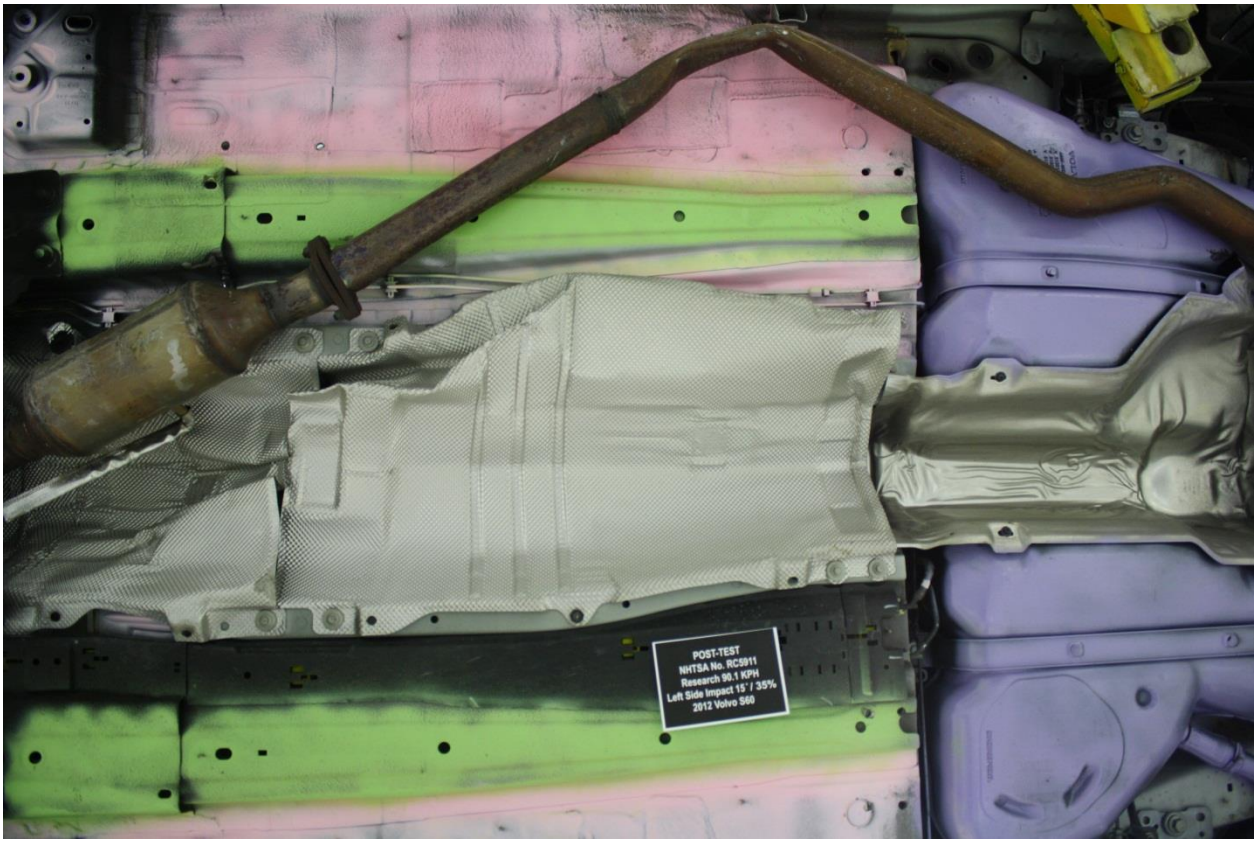
No. 129 Pre-Test View of Front Underbody (perpendicular to vehicle)



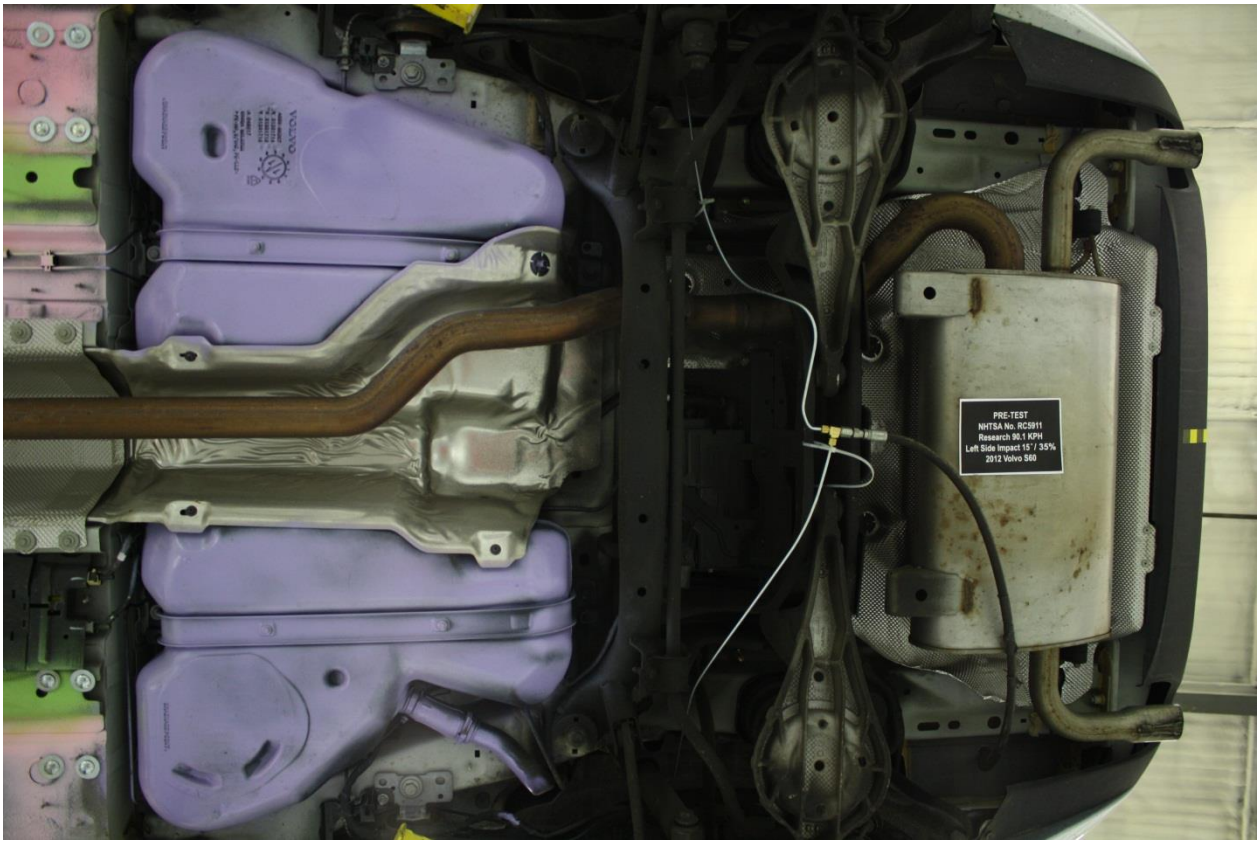
No. 130 Post-Test View of Front Underbody (perpendicular to vehicle)



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

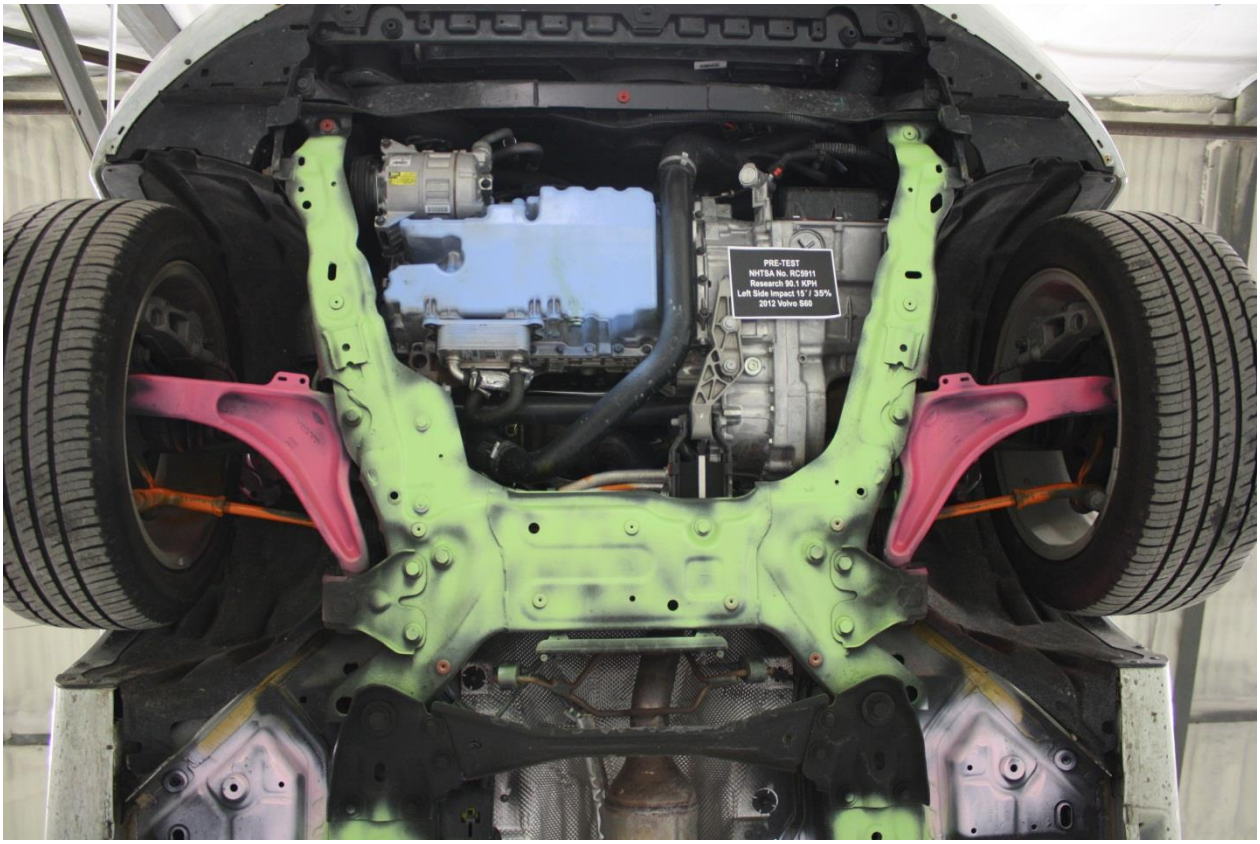


No. 132 Post-Test View of Mid Underbody (perpendicular to vehicle)



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

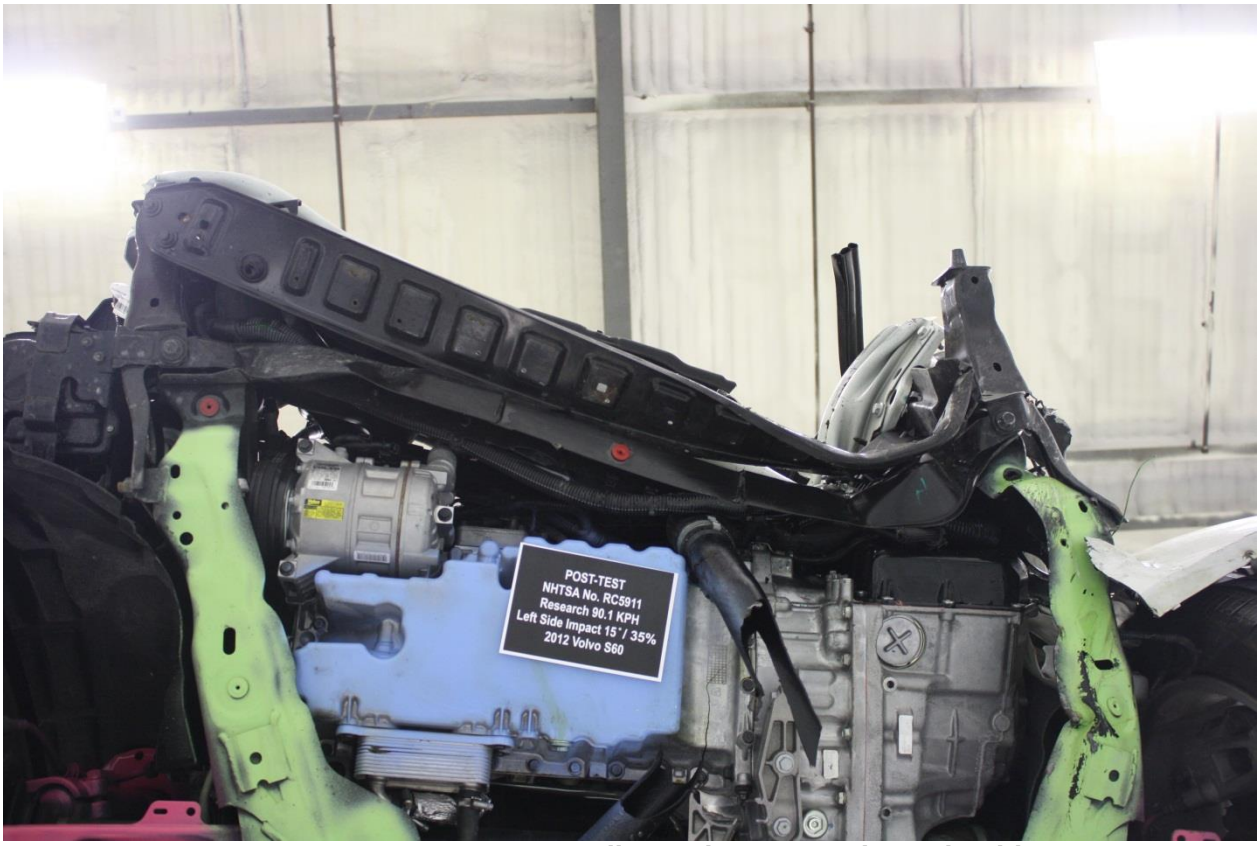
No. 134 Post-Test View of Rear Underbody (perpendicular to vehicle)



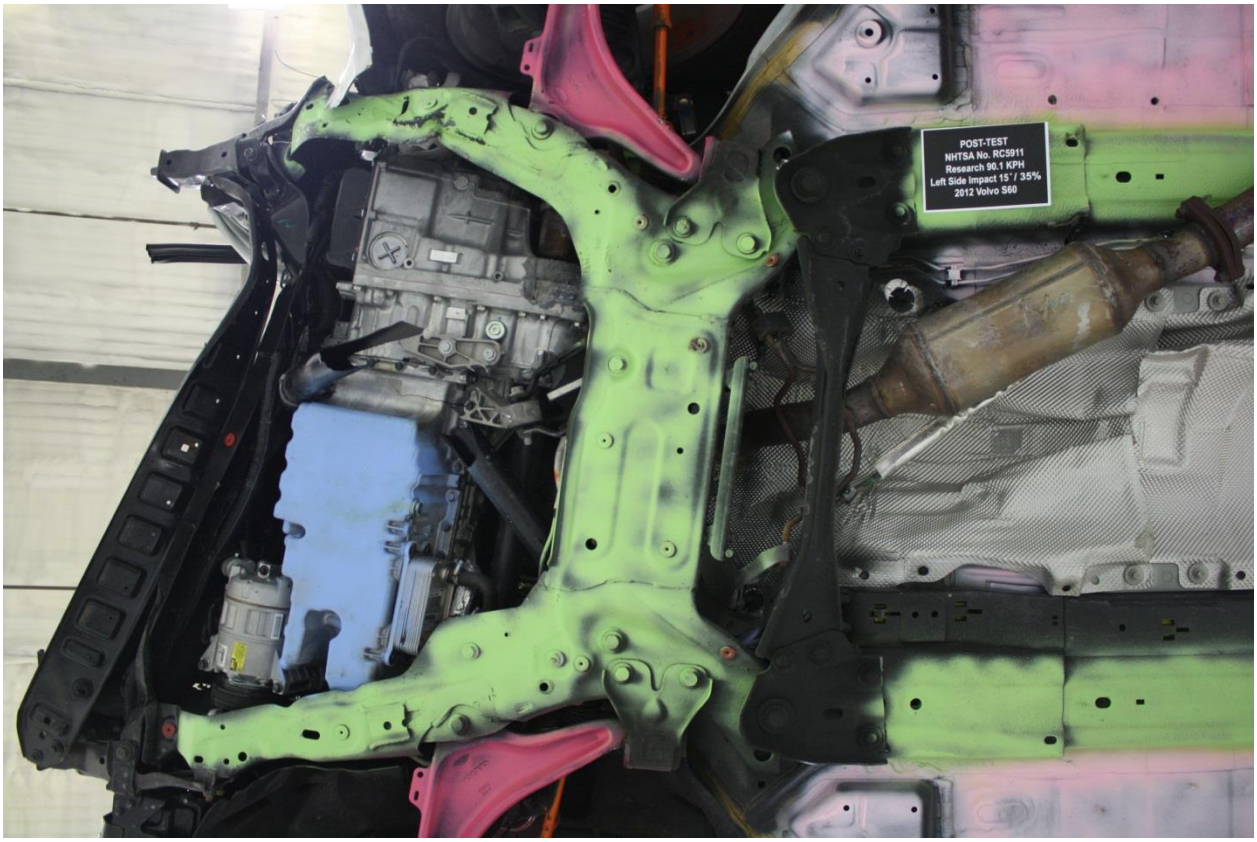
No. 135 Pre-Test View of Steering rack and or sway bar

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

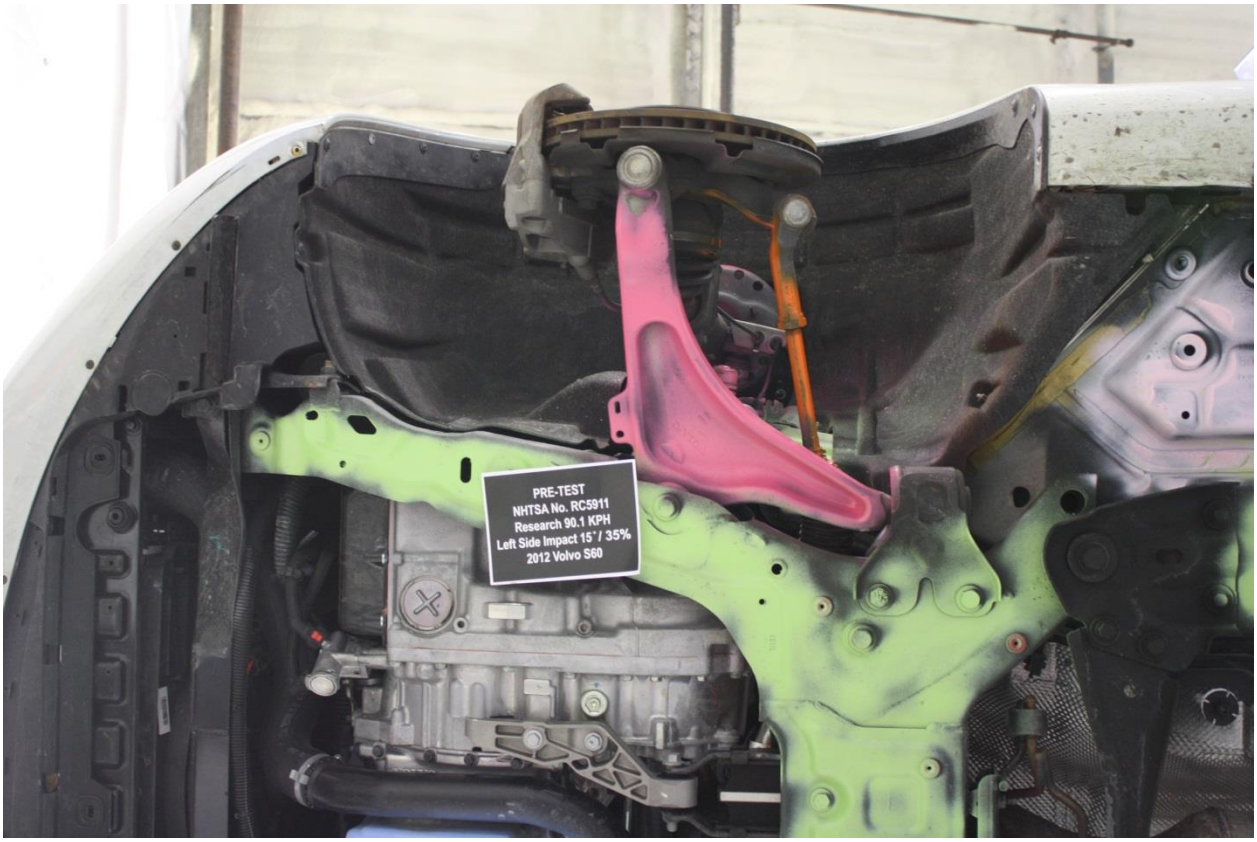
No. 137 Pre-Test Bumper to Rail Attachments and Crush Initiators



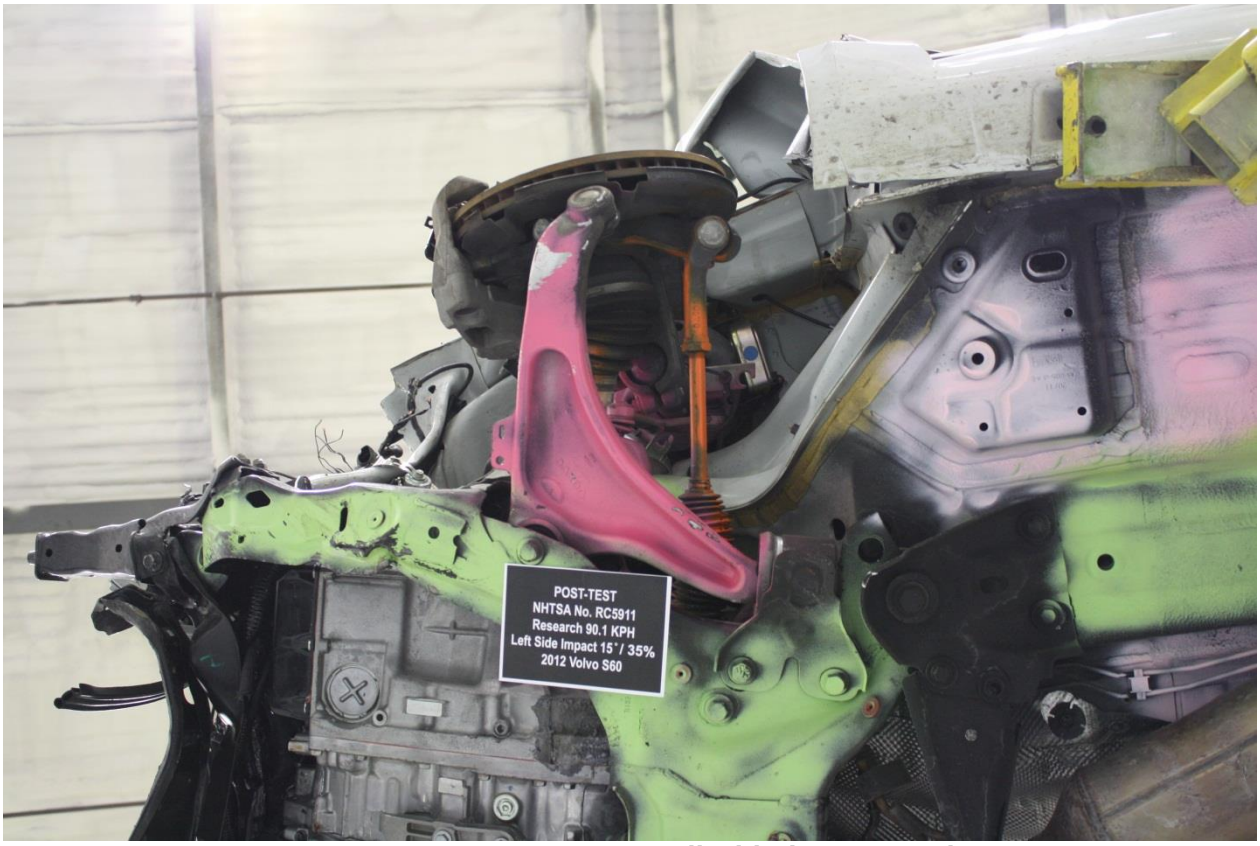
No. 138 Post-Test Bumper to Rail Attachments and Crush Initiators



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



No. 140 Pre-Test Frame Rail with tire removed



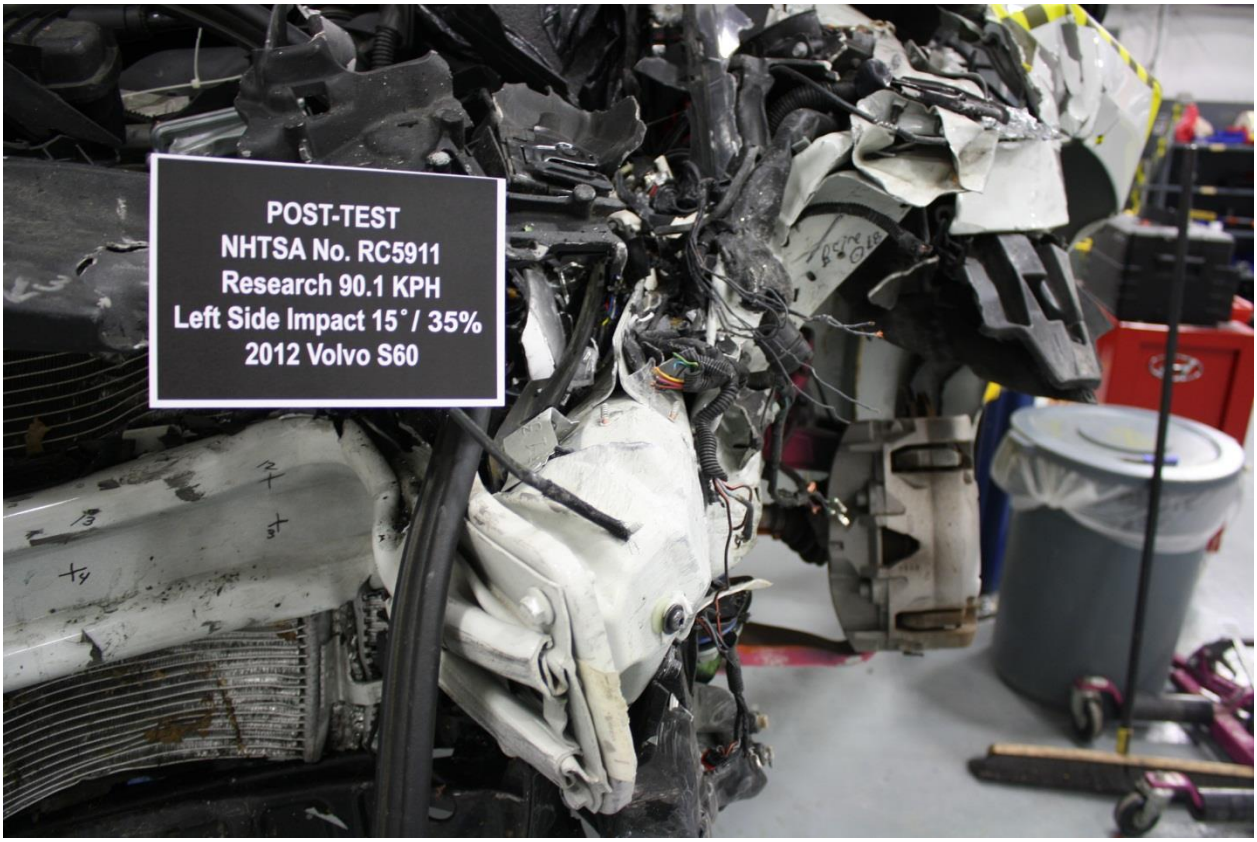
No. 141 Post-Test Frame Rail with tire removed

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

No. 143 Post-Test ¾ View of Front Driver Wheel Well w/ Tire Removed

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

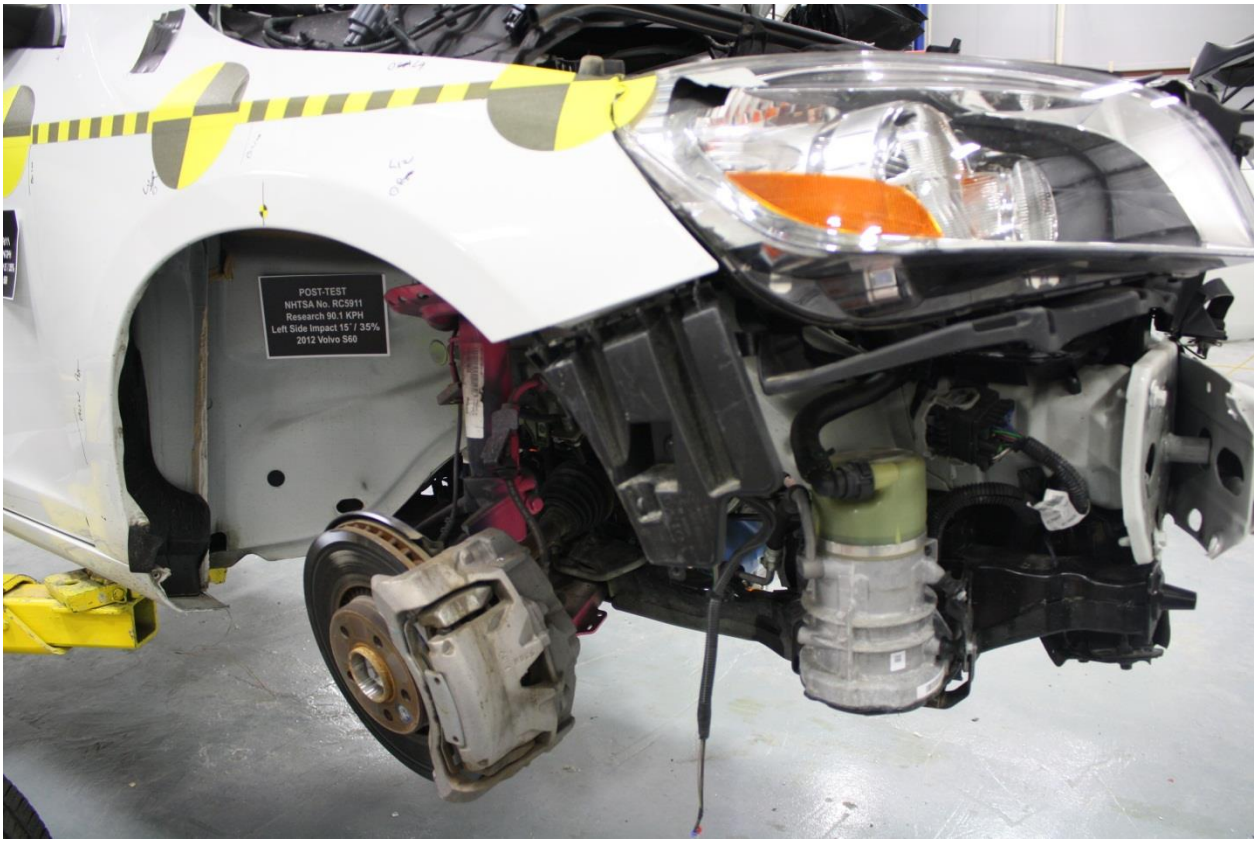
No. 145 Post-Test Right Side 3/4 Rear View of the Front Driver Wheel Well w/ Tire Removed



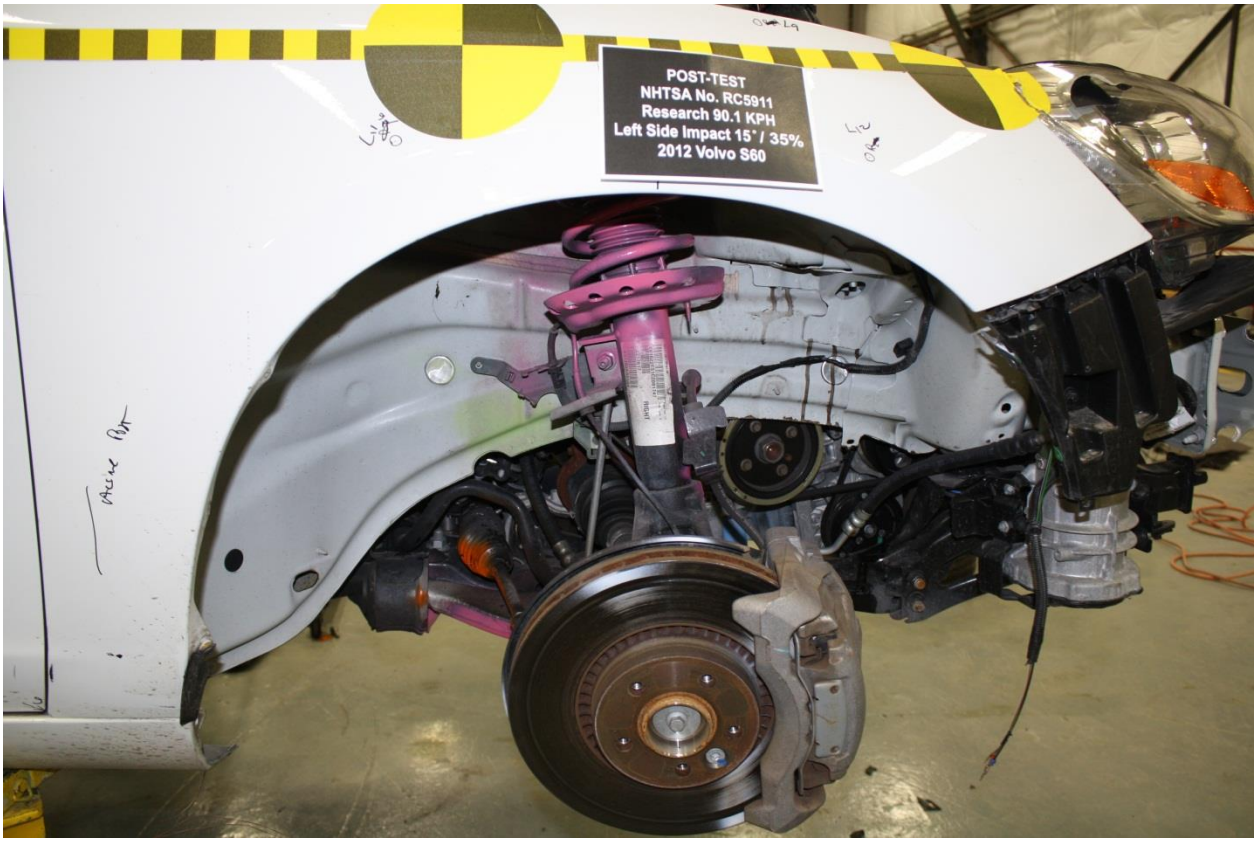
No. 146 Post-Test Looking Down at the Front Driver Shotgun

No. 147 Post-Test Right Side ¾ View of Front Driver Shotgun

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

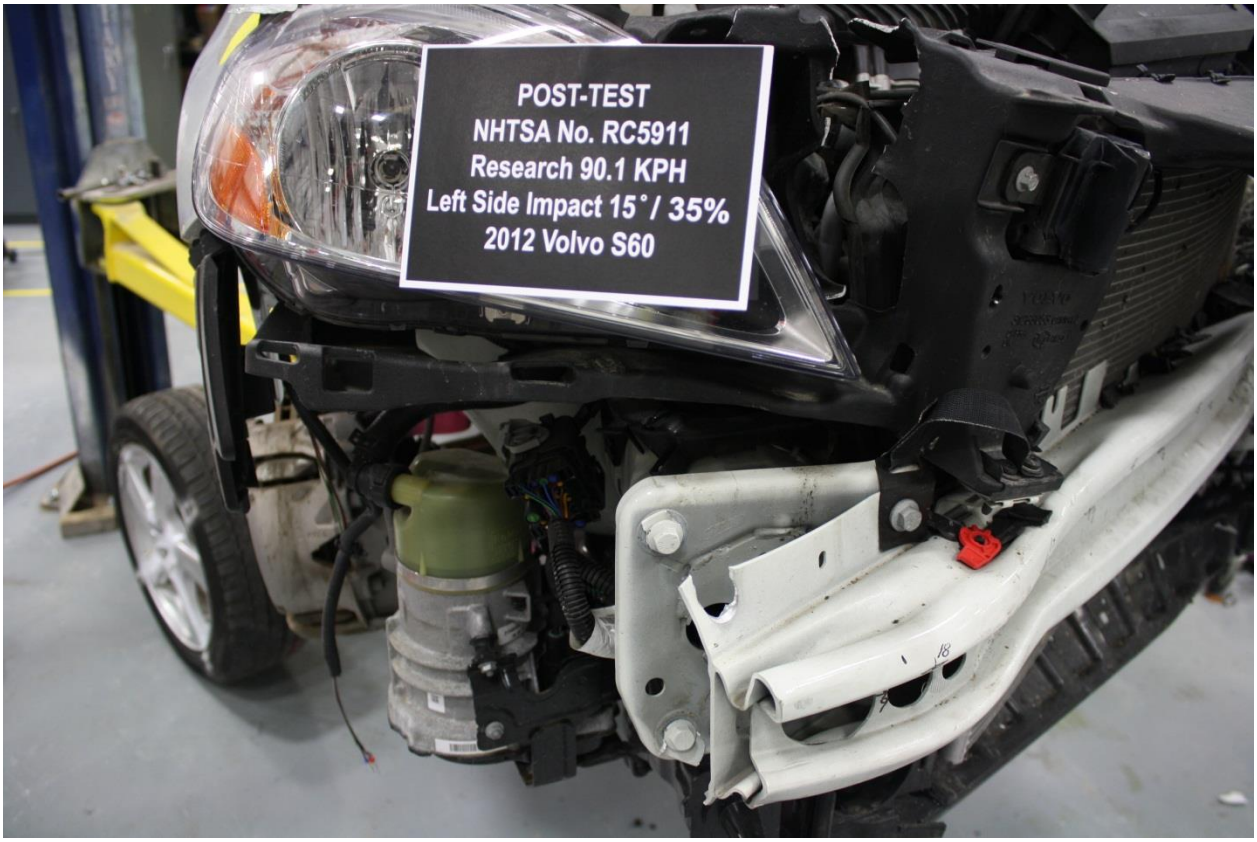


No. 149 Post-Test ¾ View of Front Passenger Wheel Well w/ Tire Removed



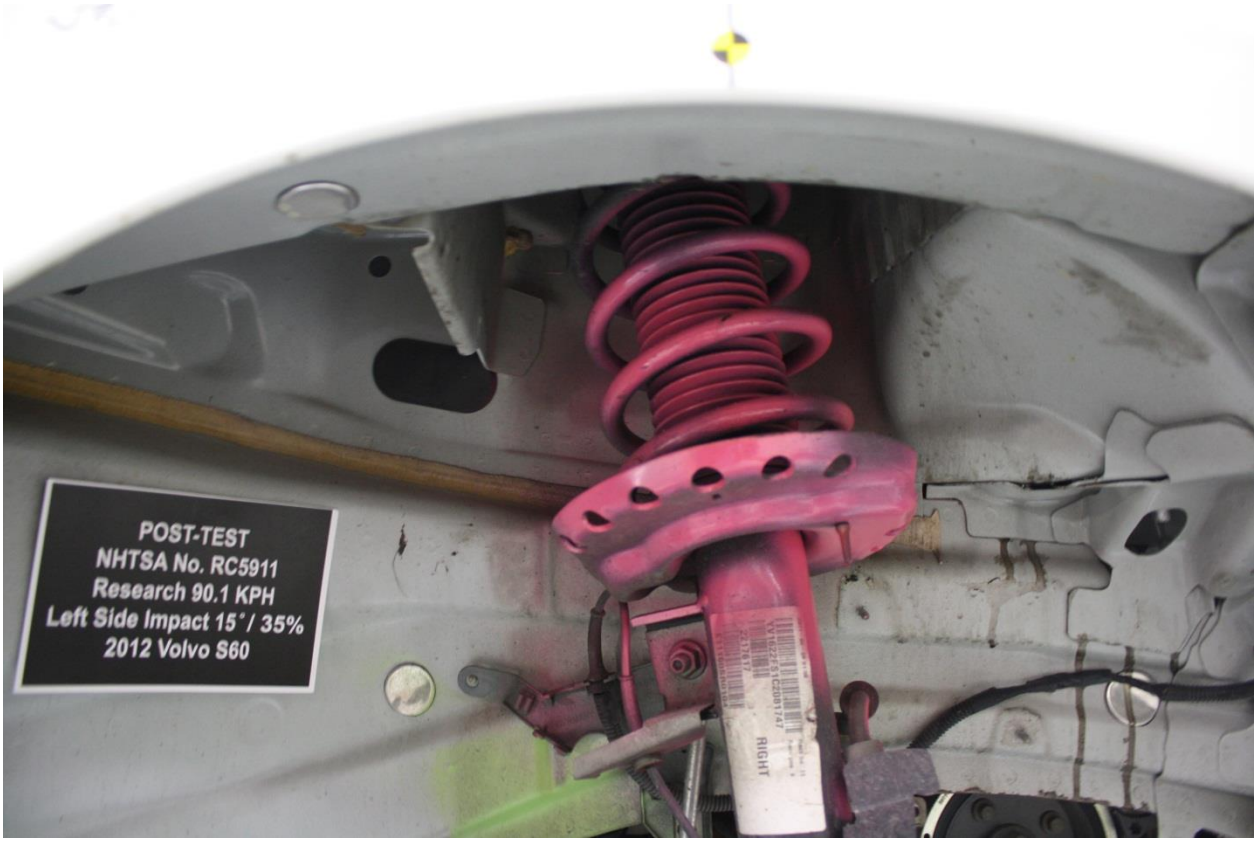
No. 150 Post-Test Side View of Front Passenger Wheel Well w/ Tire Removed

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 ¾ View of Front Passenger Shotgun



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

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

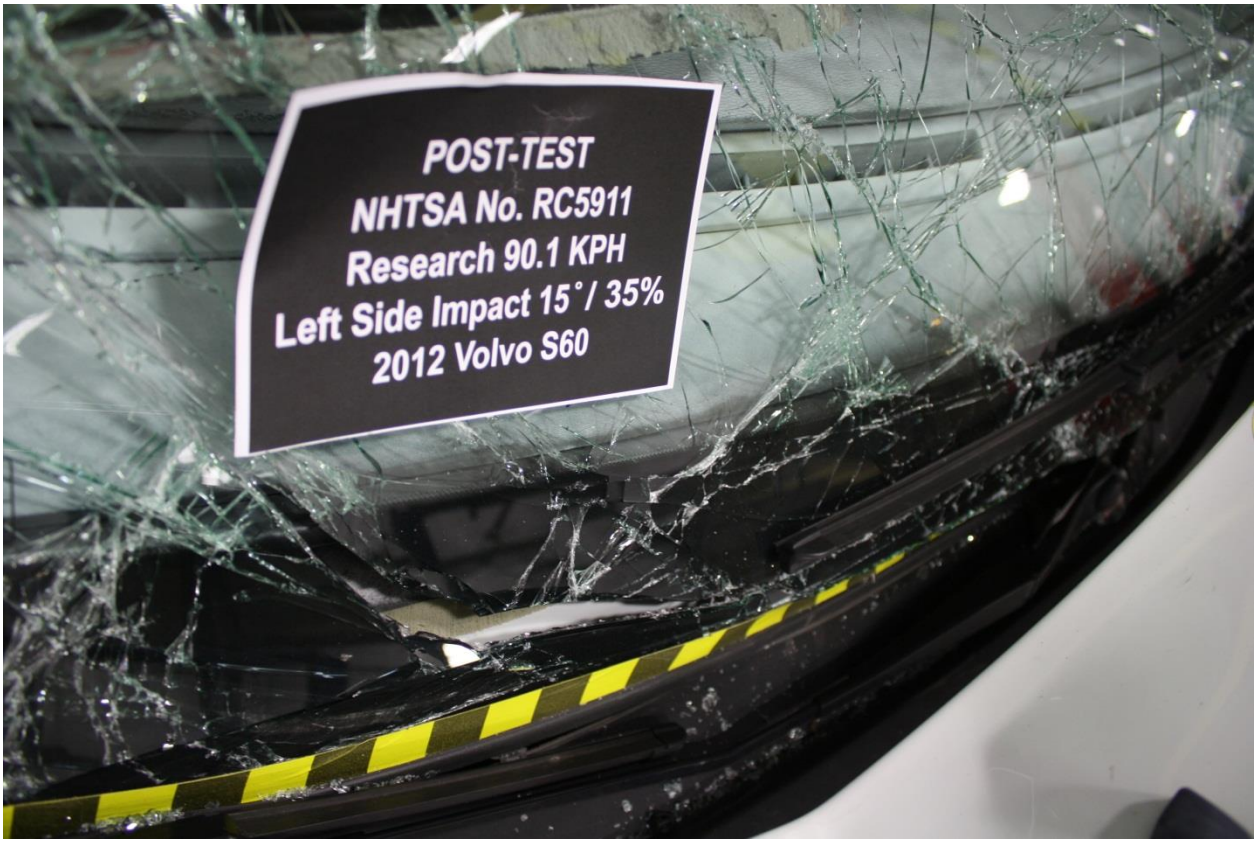
No. 156 Post-Test View of Deformation of A pillar-Struck Side

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

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

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

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



No. 161 Post-Test View of Windshield Separation

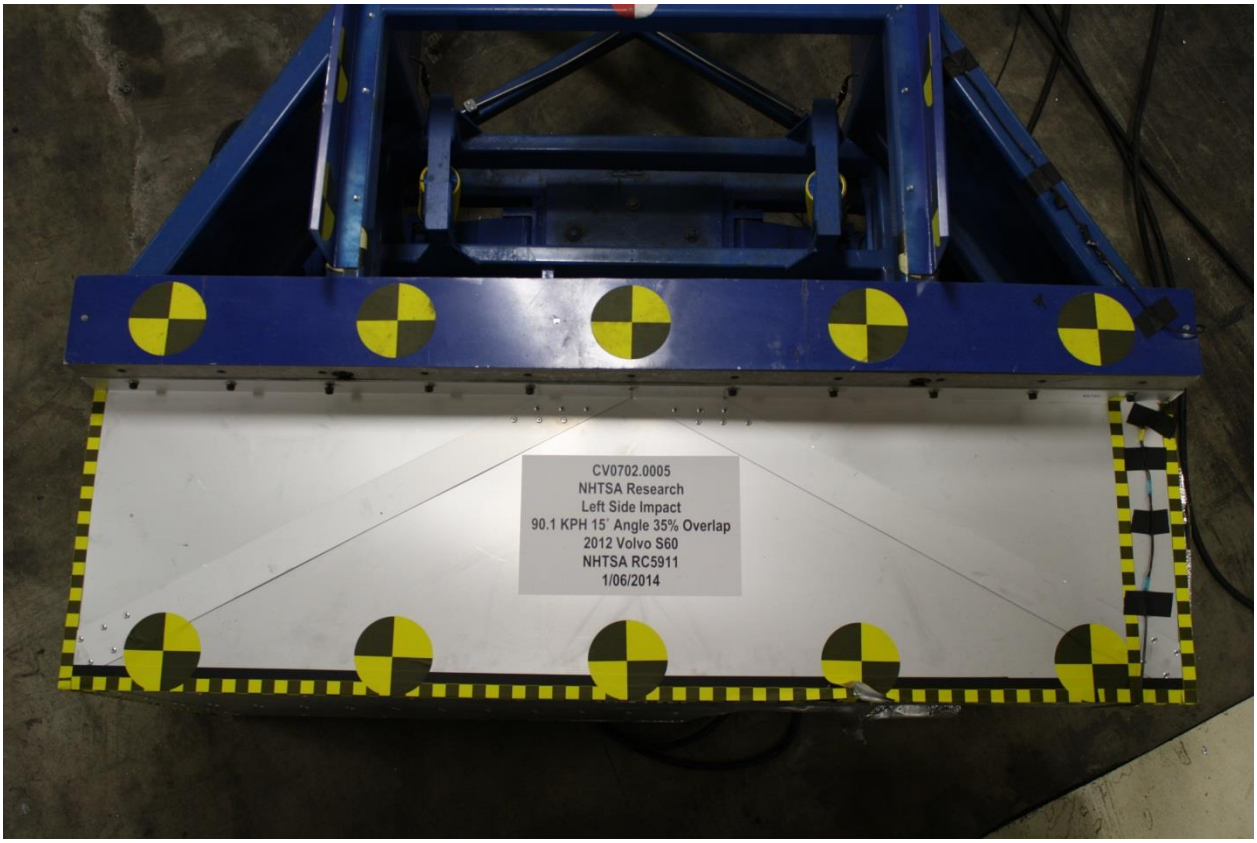
No. 162 Pre-Test Left Side View of RMDB

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

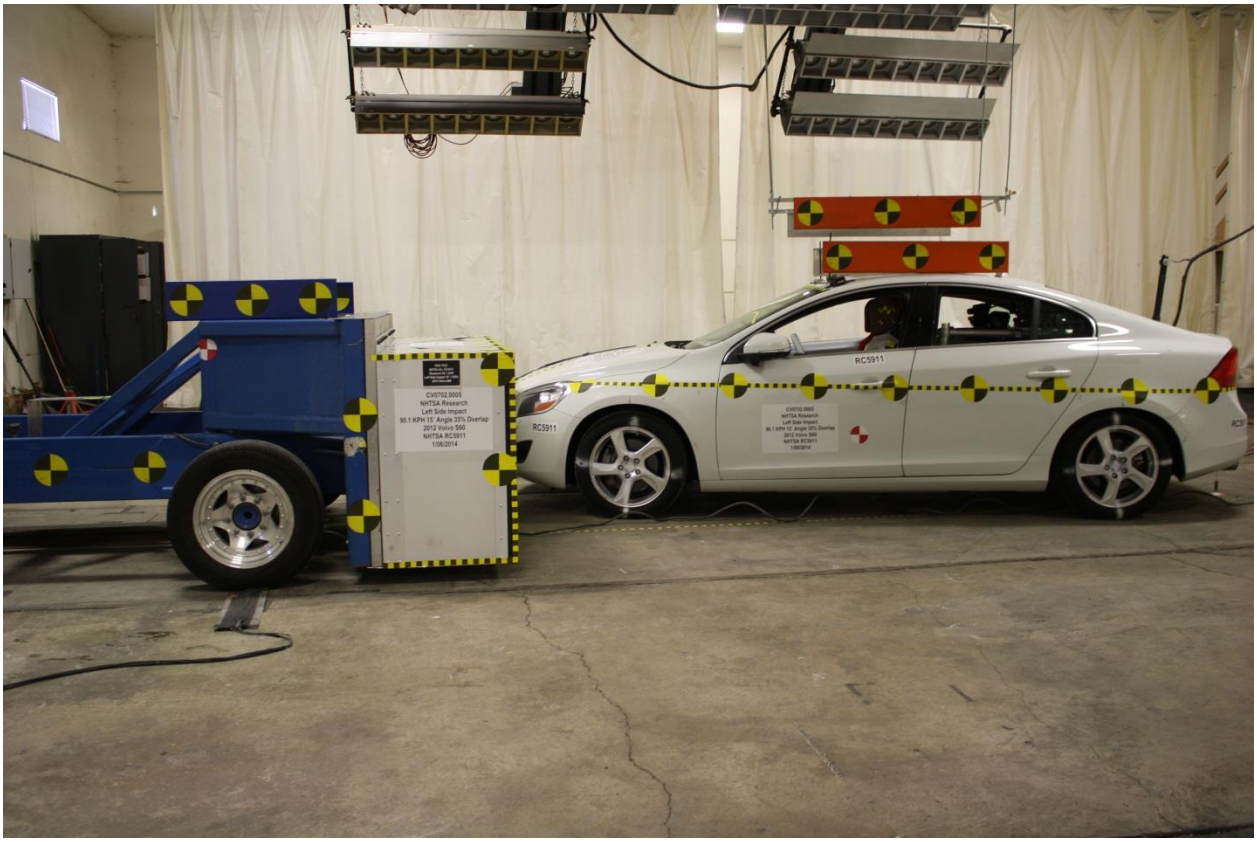
No. 166 Pre-Test Top View of RMDB



No. 167 Post-Test Top View of RMDB

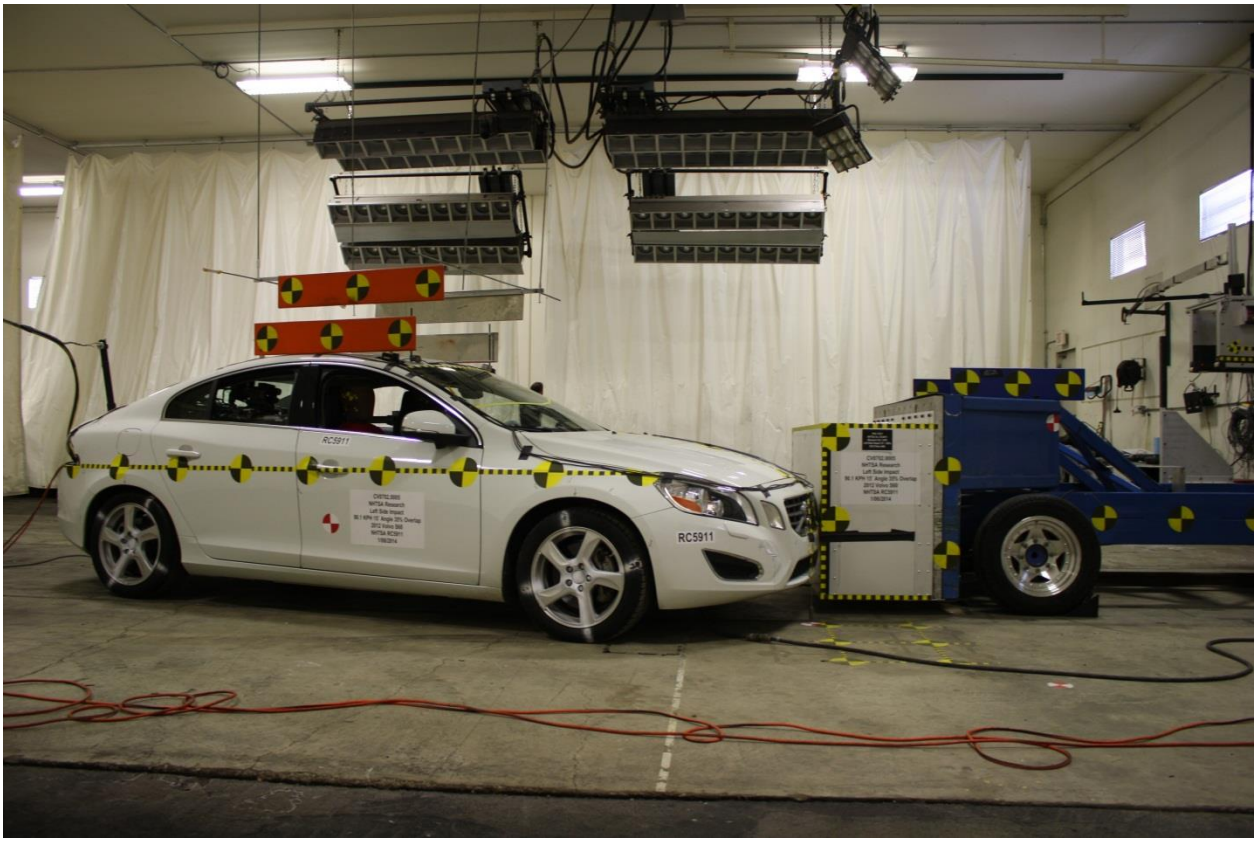
No. 168 Pre-Test Front View of RMDB

No. 169 Post-Test Front View of RMDB

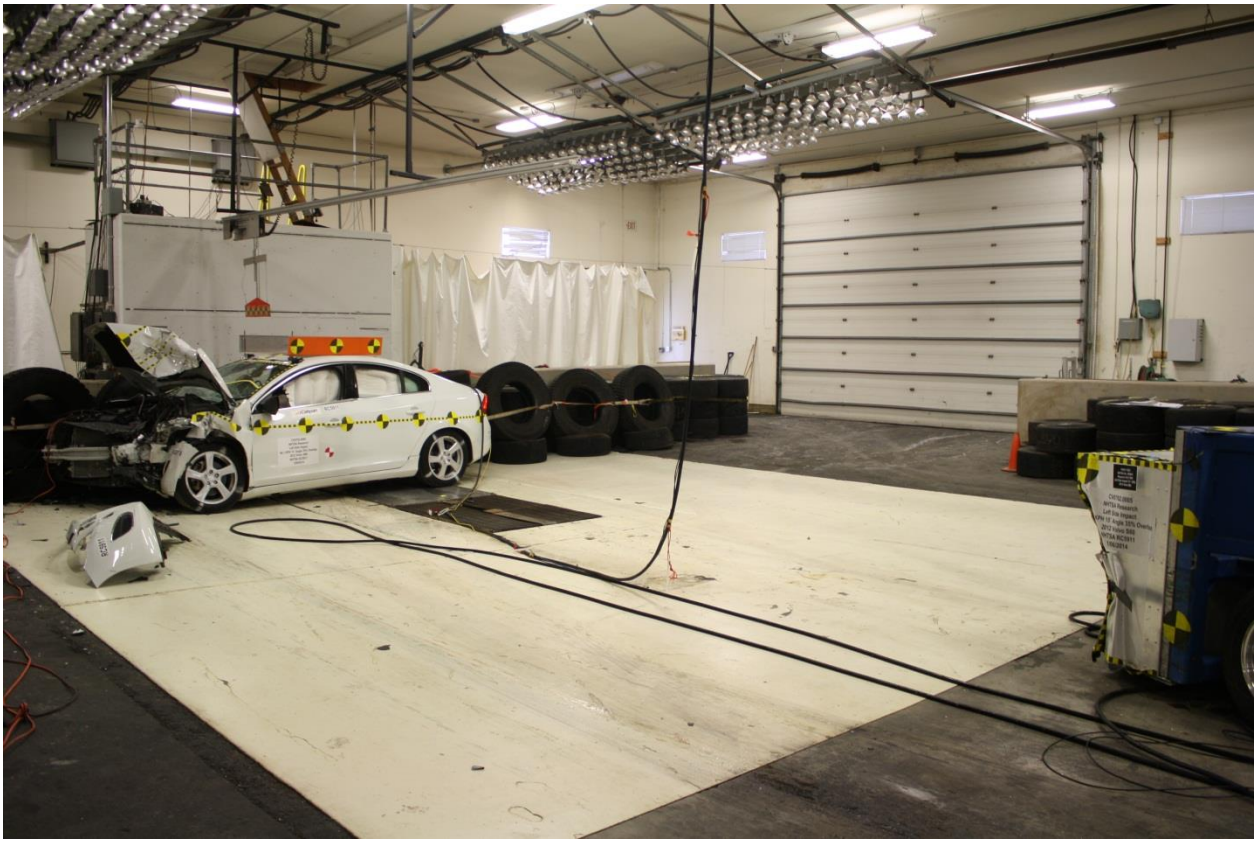


No. 170 Pre-Test RMDB & Vehicle, Right Side

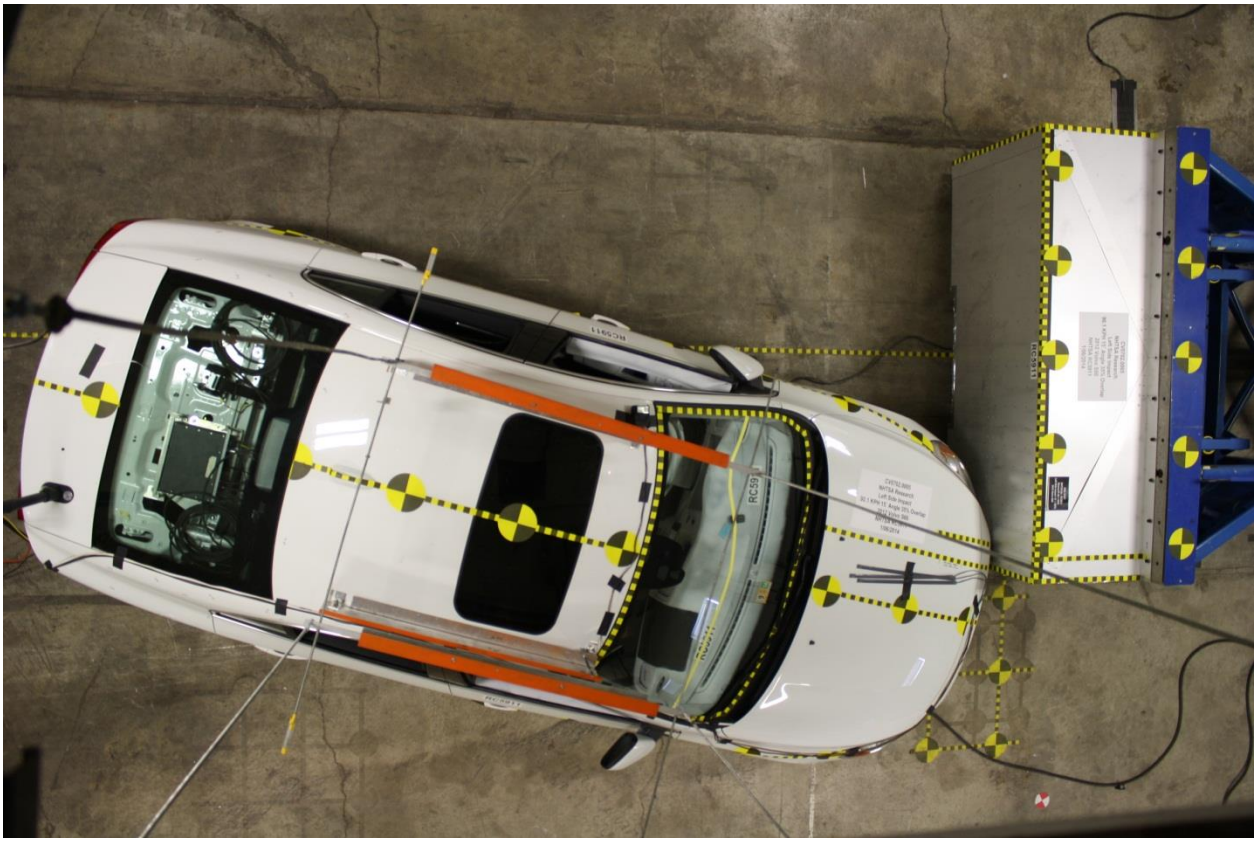
No. 171 Post-Test RMDB & Vehicle, Right Side



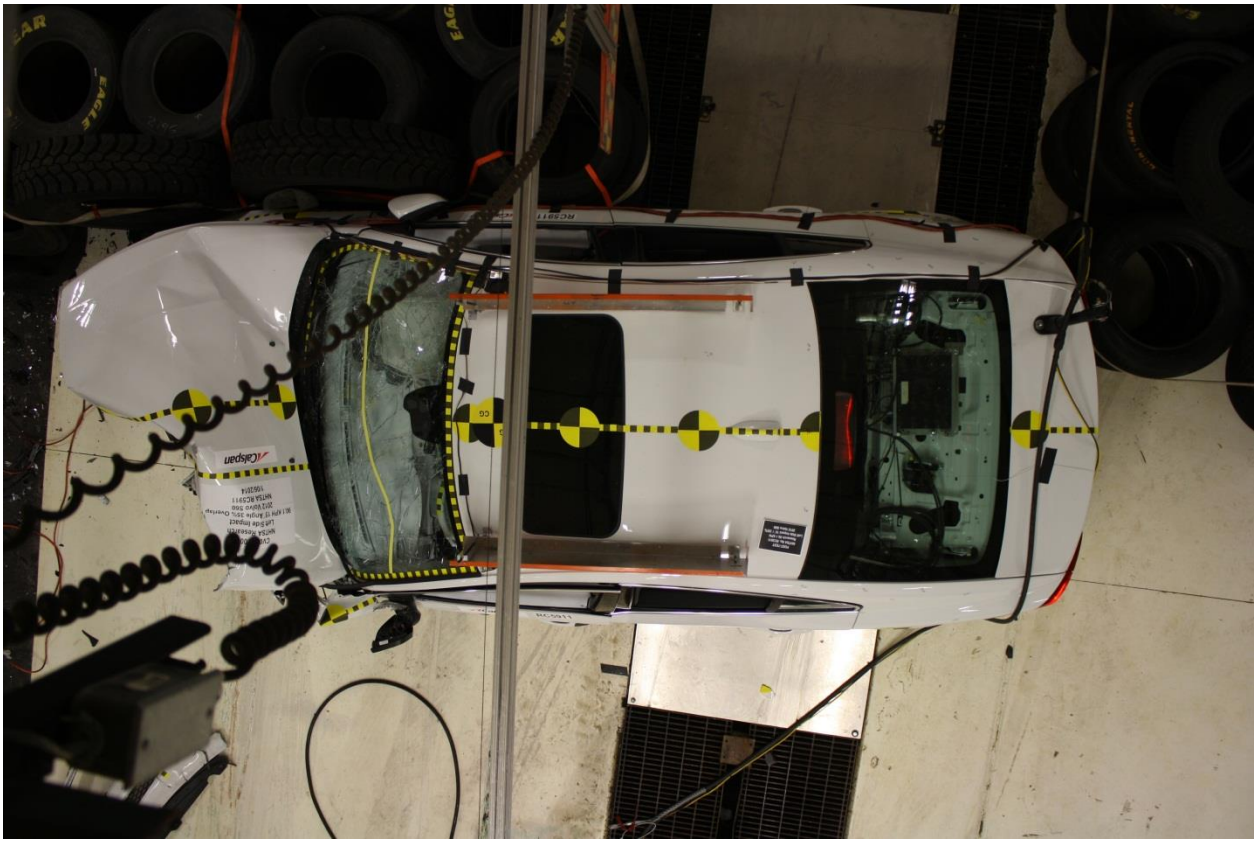
No. 172 Pre-Test RMDB & Vehicle, Left Side



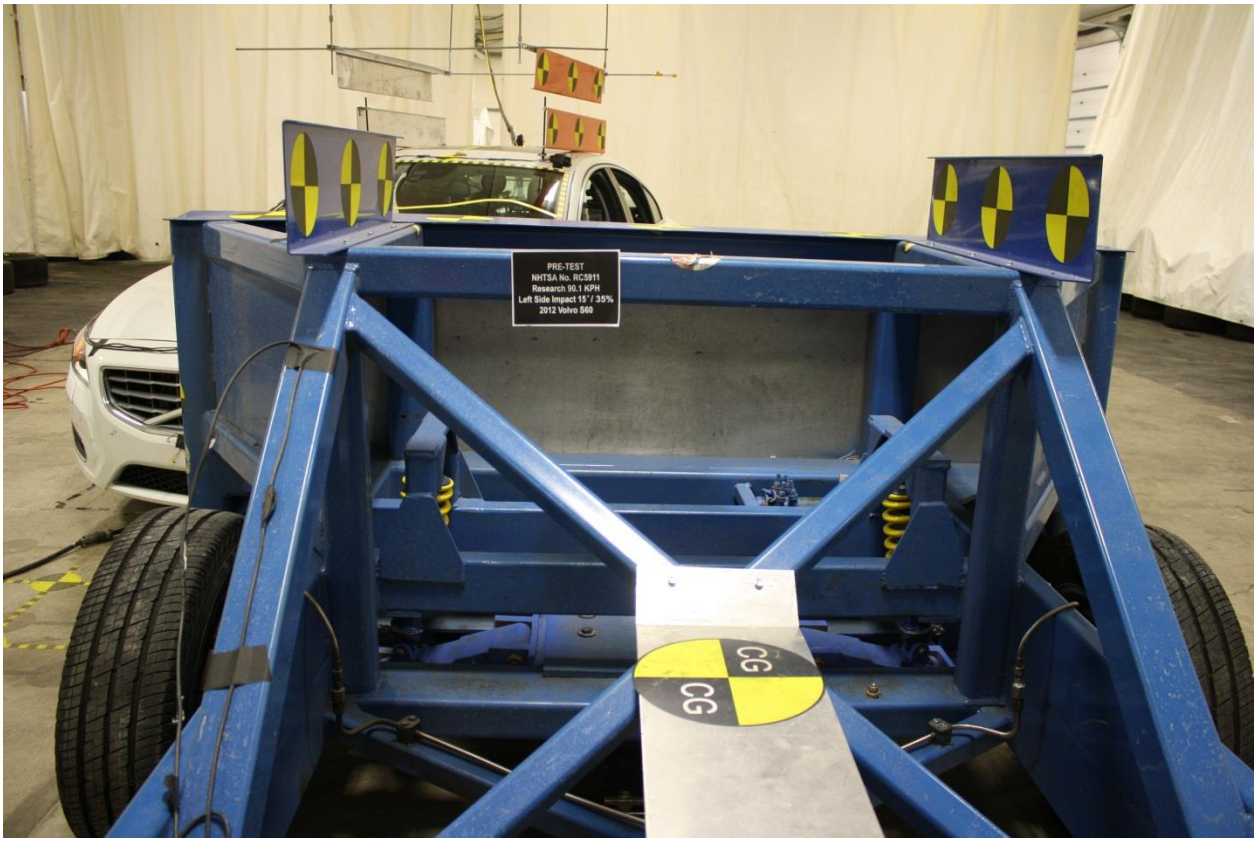
No. 173 Post-Test RMDB & Vehicle, Left Side



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



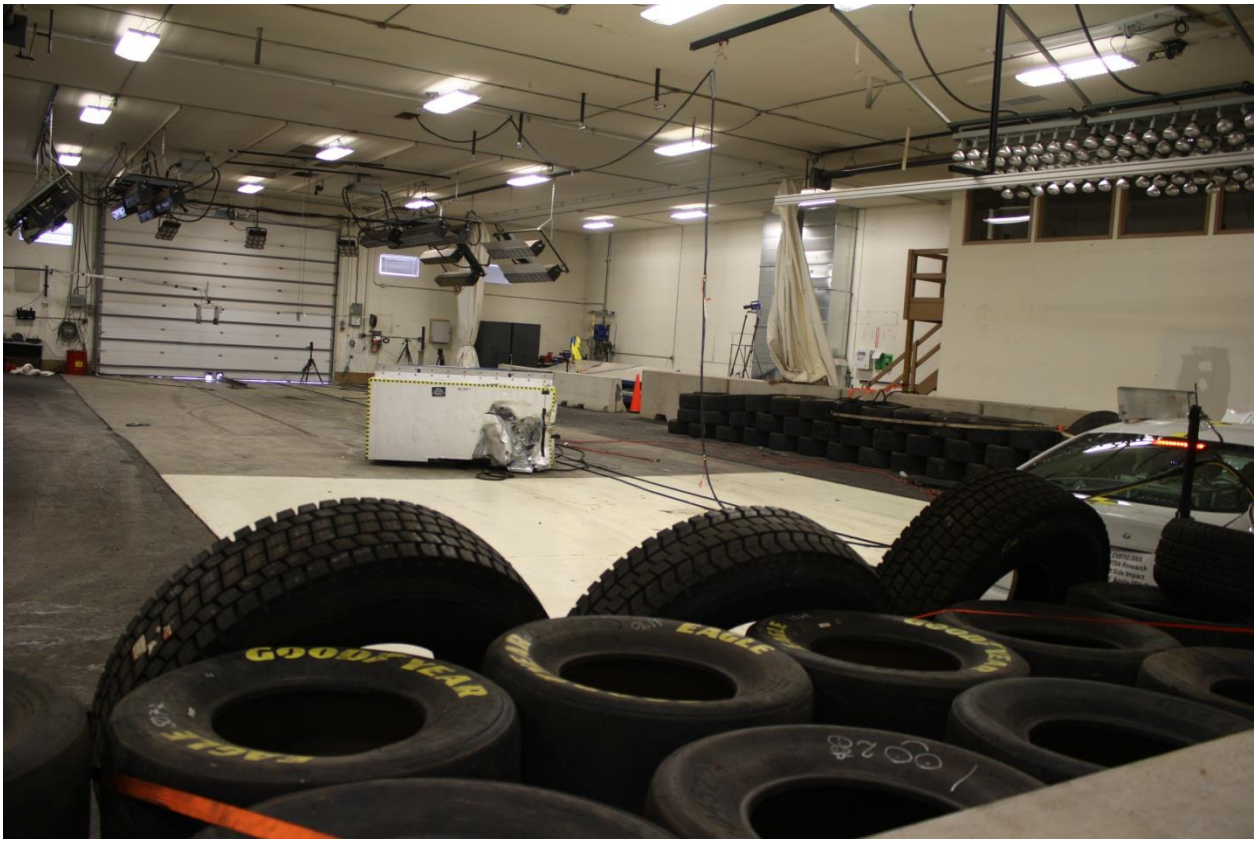
No. 175 Post-Test RMDB & Vehicle, Top View



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

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

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



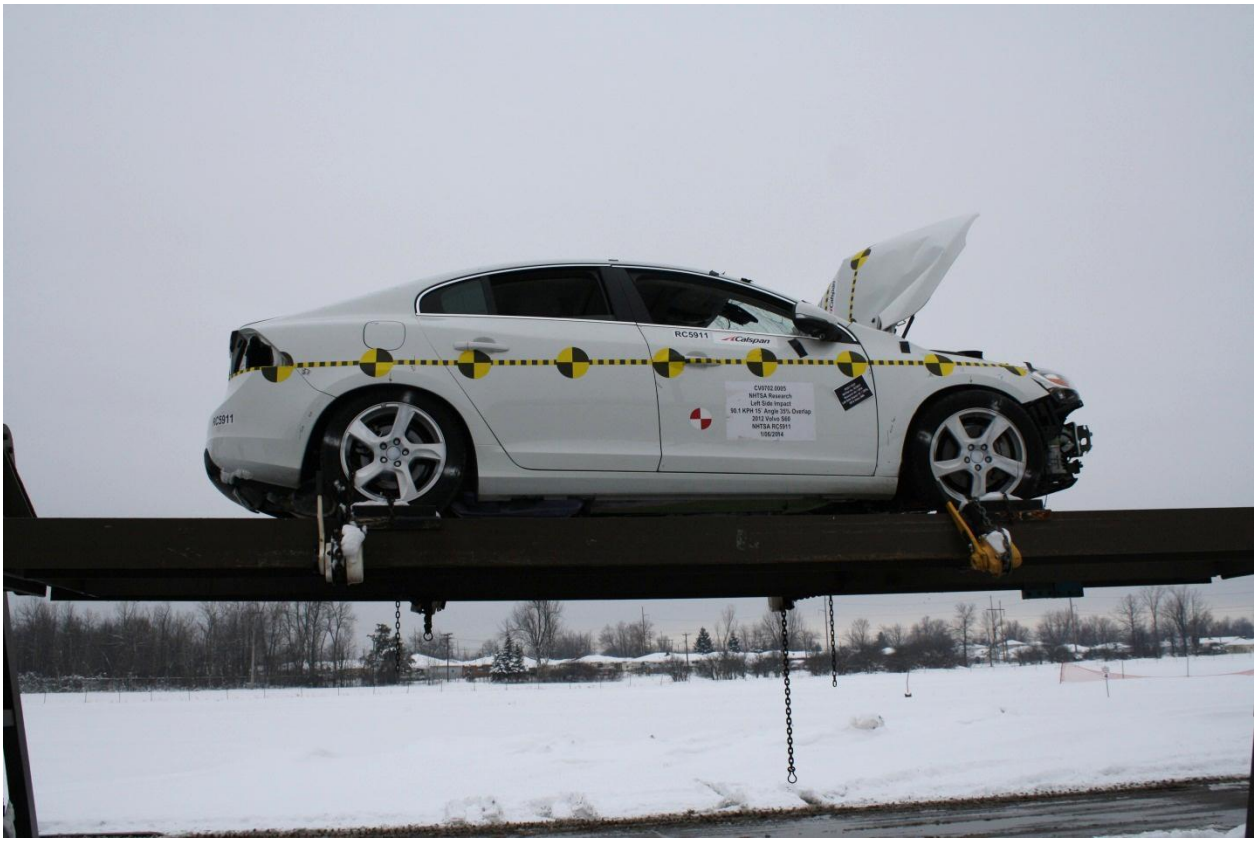
No. 179 Post-Test RMDB & Vehicle, Front View

No. 180 Vehicle at 0 Degrees on Static Rollover Device

No. 181 Vehicle at 90 Degrees on Static Rollover Device

No. 182 Vehicle at 180 Degrees on Static Rollover Device

No. 183 Vehicle at 270 Degrees on Static Rollover Device



No. 184 Vehicle at 360 Degrees on Static Rollover Device

No. 185 Impact Photo

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

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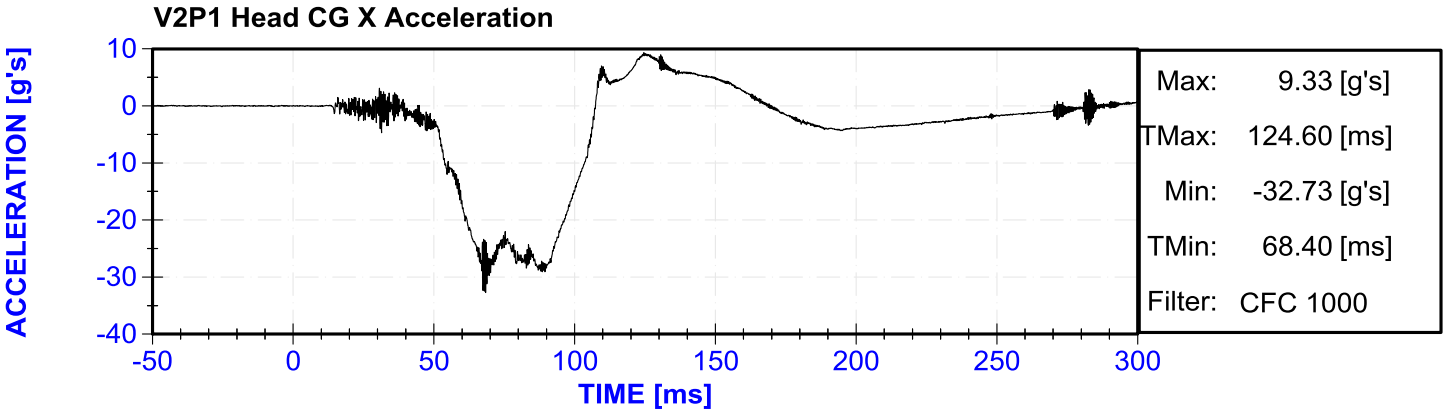
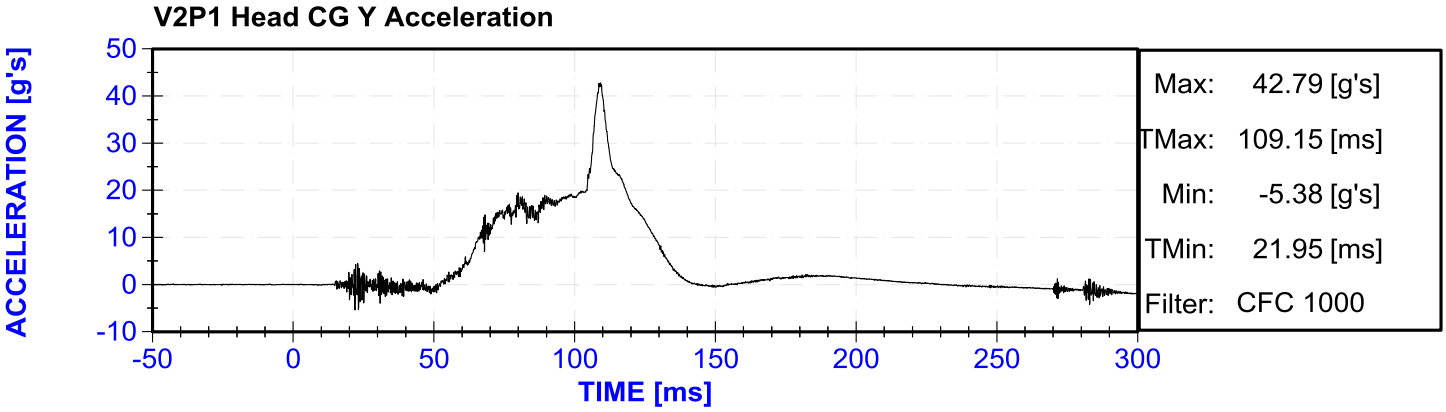
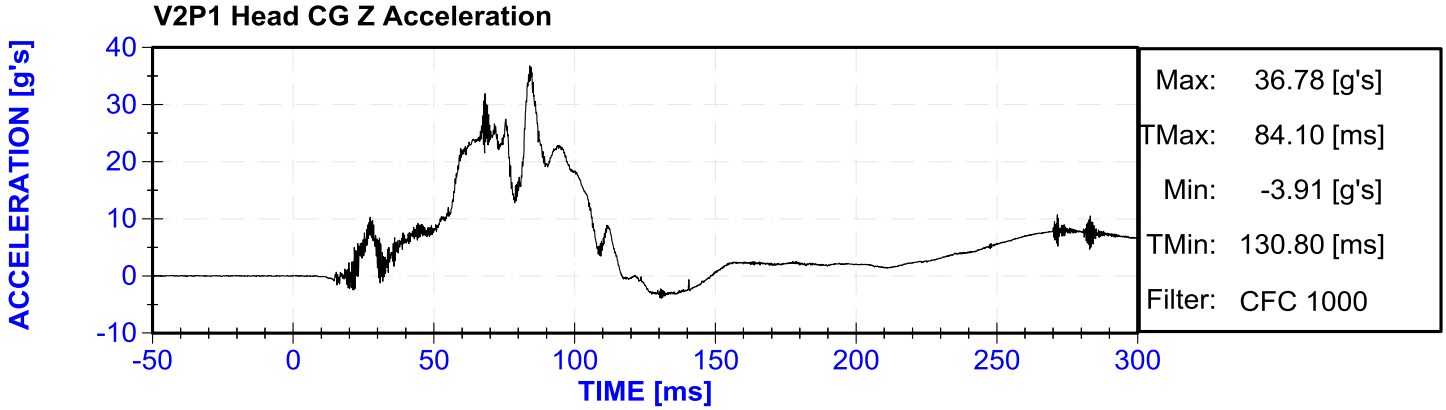
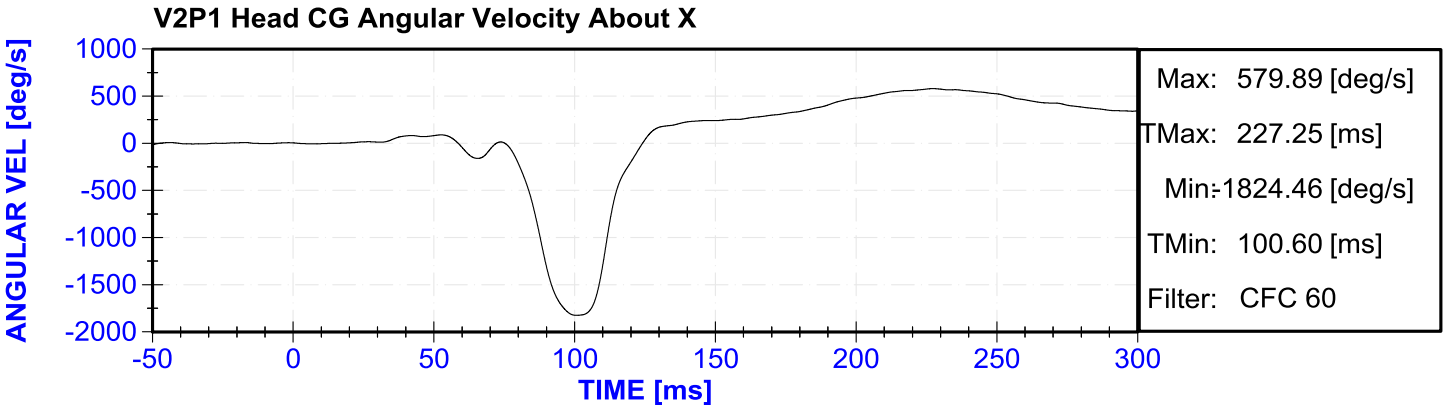
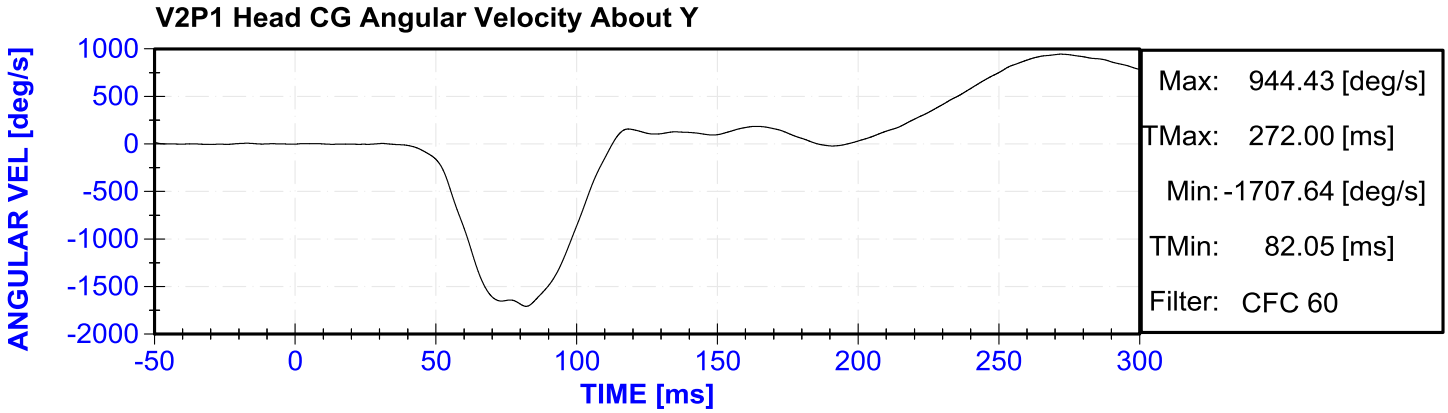
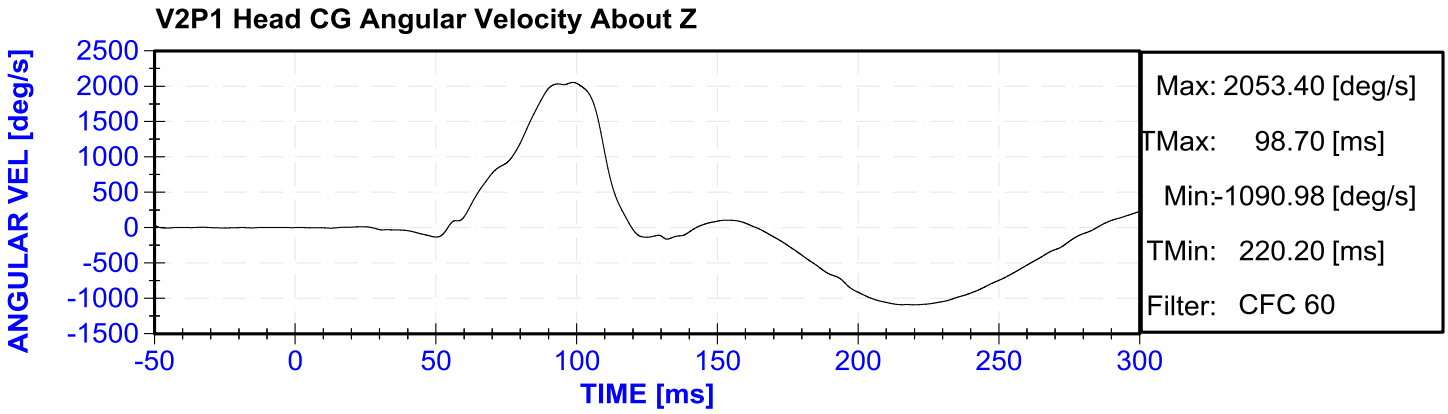

V2P1 Head CG X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 9.33 [g's]
TMax: 124.60 [ms]
Min: -32.73 [g's]
TMin: 68.40 [ms]
Filter: CFC 1000

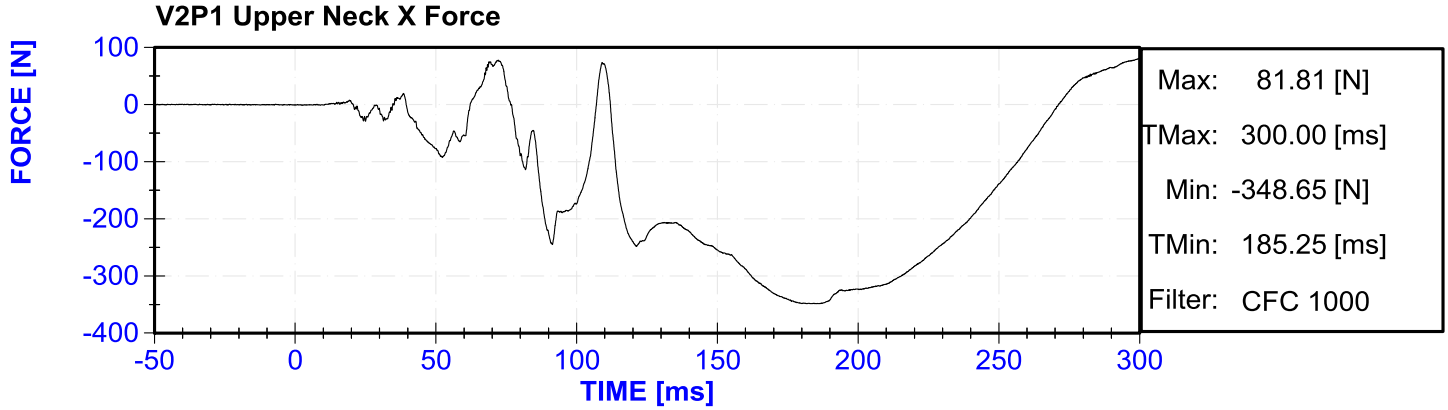

V2P1 Head CG Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 42.79 [g's]
TMax: 109.15 [ms]
Min: -5.38 [g's]
TMin: 21.95 [ms]
Filter: CFC 1000

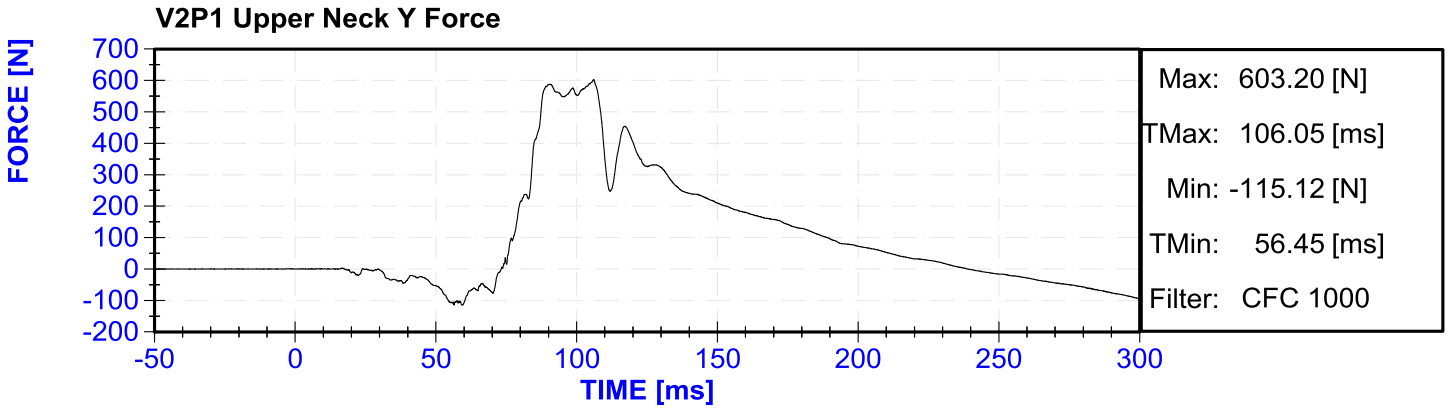

V2P1 Head CG Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 36.78 [g's]
TMax: 84.10 [ms]
Min: -3.91 [g's]
TMin: 130.80 [ms]
Filter: CFC 1000

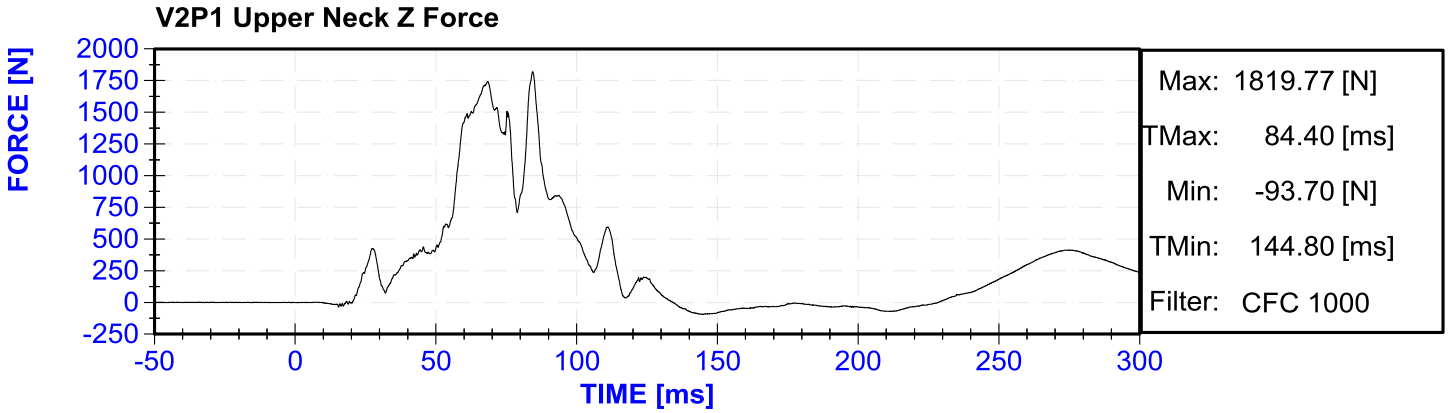

V2P1 Head CG Angular Velocity About X
ANGULAR VEL [deg/s]
TIME [ms]
Max: 579.89 [deg/s]
TMax: 227.25 [ms]
Min: -1824.46 [deg/s]
TMin: 100.60 [ms]
Filter: CFC 60

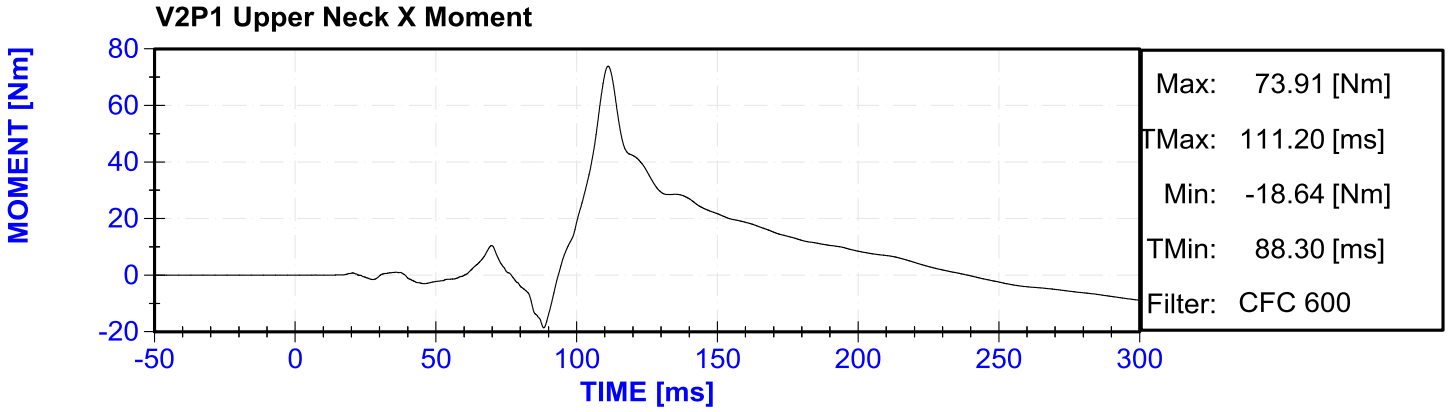

V2P1 Head CG Angular Velocity About Y
ANGULAR VEL [deg/s]
1000
500
0
-500
-1000
-1500
-2000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 944.43 [deg/s]
TMax: 272.00 [ms]
Min: -1707.64 [deg/s]
TMin: 82.05 [ms]
Filter: CFC 60

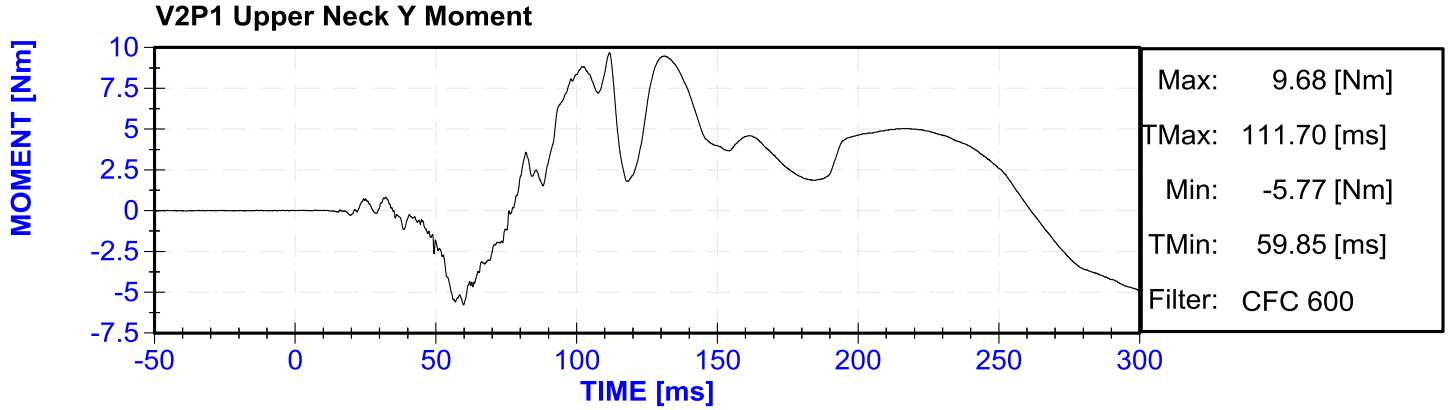

V2P1 Head CG Angular Velocity About Z
ANGULAR VEL [deg/s]
2500
2000
1500
1000
500
0
-500
-1000
-1500
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 2053.40 [deg/s]
TMax: 98.70 [ms]
Min: -1090.98 [deg/s]
TMin: 220.20 [ms]
Filter: CFC 60

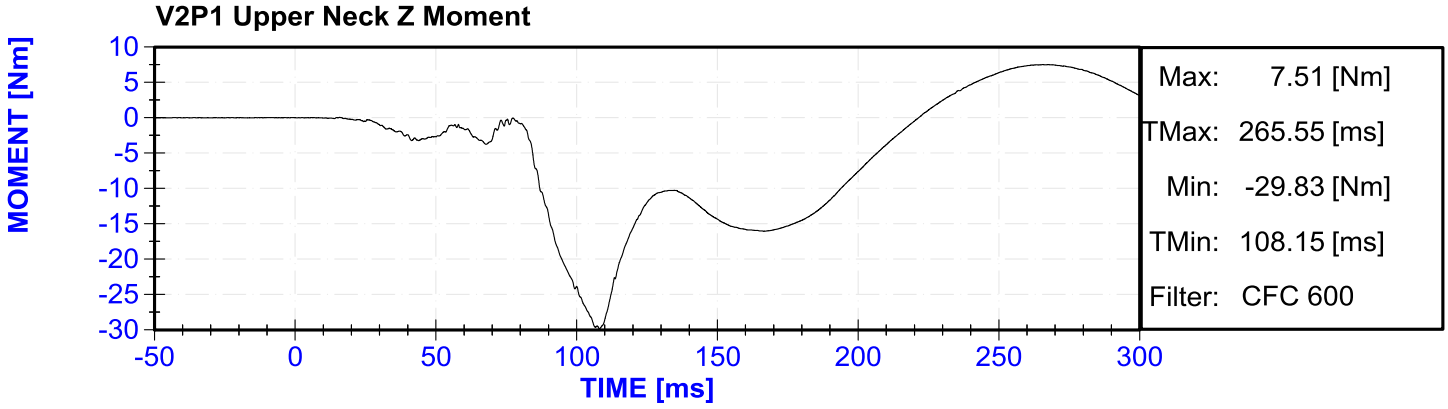

V2P1 Upper Neck X Force
FORCE [N]
100
0
-100
-200
-300
-400
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 81.81 [N]
TMax: 300.00 [ms]
Min: -348.65 [N]
TMin: 185.25 [ms]
Filter: CFC 1000

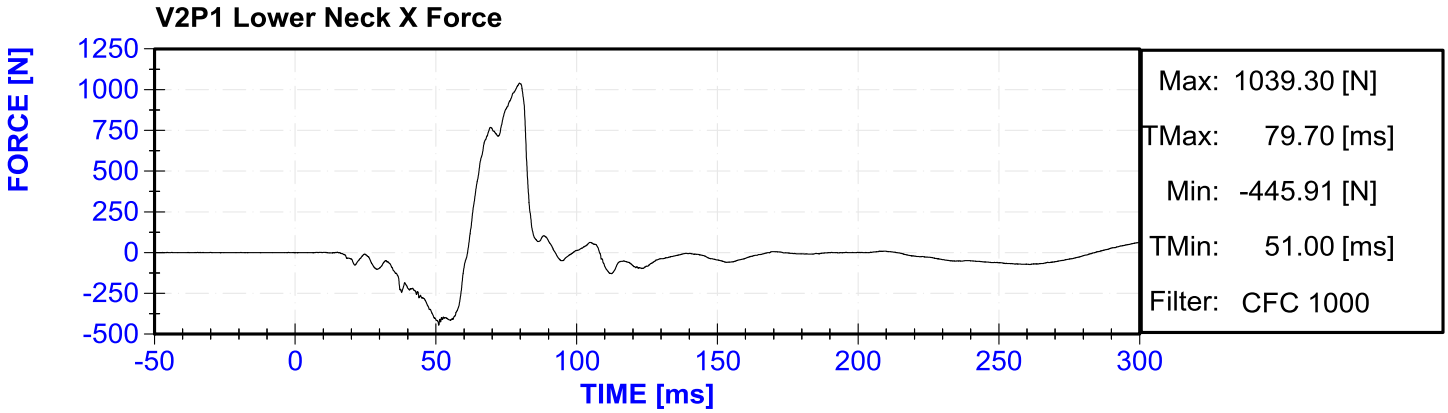

V2P1 Upper Neck Y Force
FORCE [N]
700
600
500
400
300
200
100
0
-100
-200
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 603.20 [N]
TMax: 106.05 [ms]
Min: -115.12 [N]
TMin: 56.45 [ms]
Filter: CFC 1000

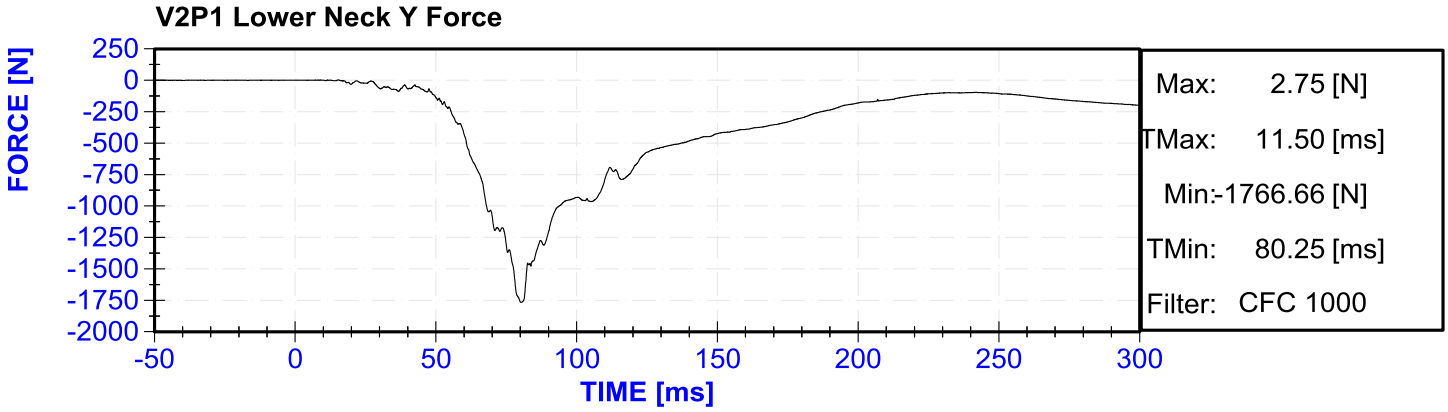

V2P1 Upper Neck Z Force
FORCE [N]
2000
1750
1500
1250
1000
750
500
250
0
-250
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1819.77 [N]
TMax: 84.40 [ms]
Min: -93.70 [N]
TMin: 144.80 [ms]
Filter: CFC 1000

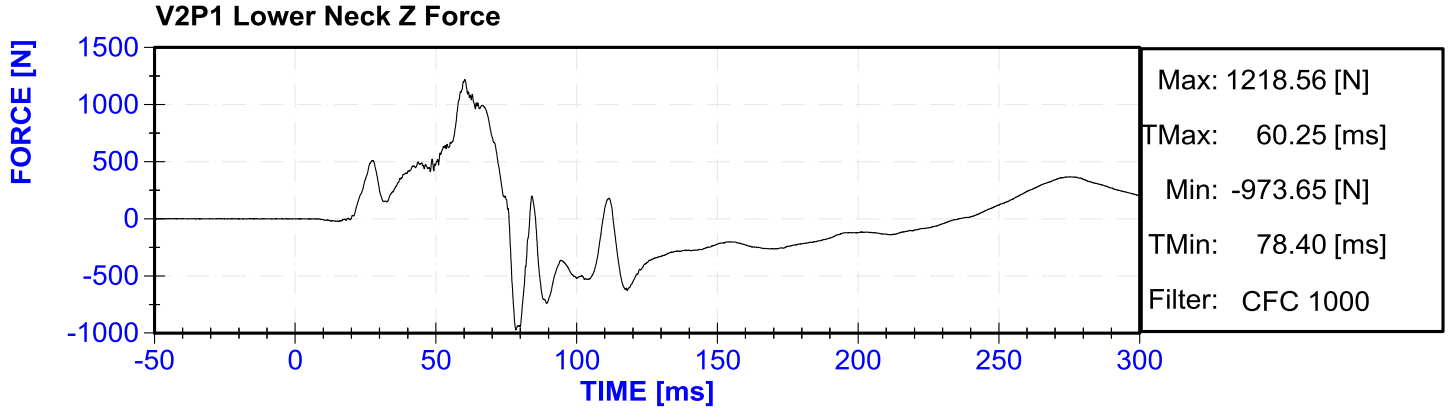

V2P1 Upper Neck X Moment
MOMENT [Nm]
80
60
40
20
0
-20
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 73.91 [Nm]
TMax: 111.20 [ms]
Min: -18.64 [Nm]
TMin: 88.30 [ms]
Filter: CFC 600

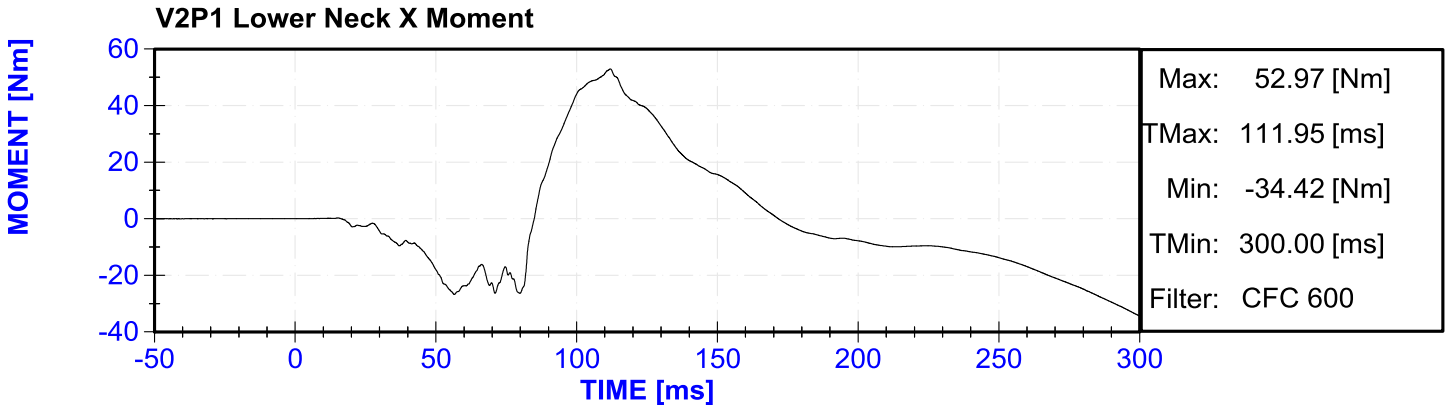

V2P1 Upper Neck Y Moment
MOMENT [Nm]
10
7.5
5
2.5
0
-2.5
-5
-7.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 9.68 [Nm]
TMax: 111.70 [ms]
Min: -5.77 [Nm]
TMin: 59.85 [ms]
Filter: CFC 600


V2P1 Upper Neck Z Moment
MOMENT [Nm]
10
5
0
-5
-10
-15
-20
-25
-30
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 7.51 [Nm]
TMax: 265.55 [ms]
Min: -29.83 [Nm]
TMin: 108.15 [ms]
Filter: CFC 600

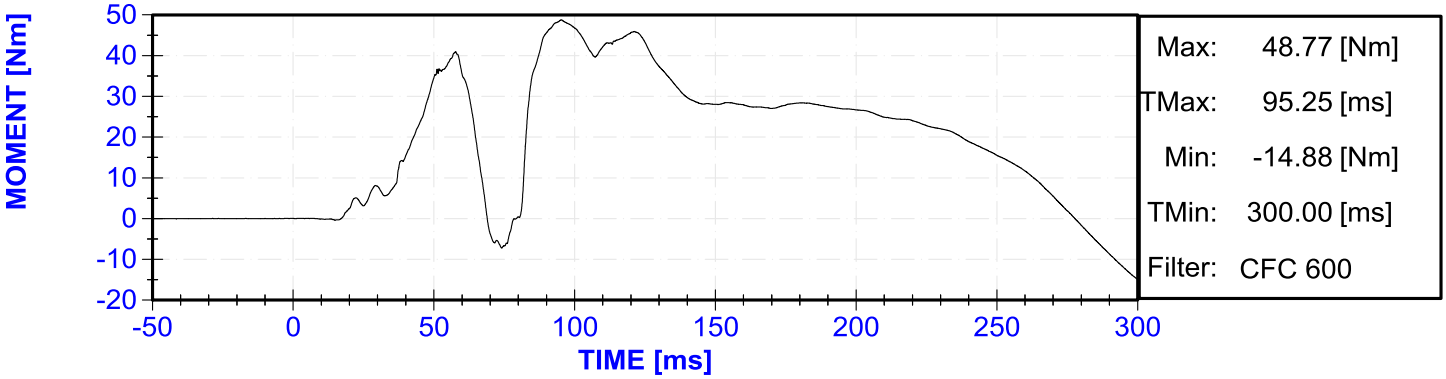

V2P1 Lower Neck X Force
FORCE [N]
TIME [ms]
Max: 1039.30 [N]
TMax: 79.70 [ms]
Min: -445.91 [N]
TMin: 51.00 [ms]
Filter: CFC 1000


V2P1 Lower Neck Y Force
FORCE [N]
TIME [ms]
Max: 2.75 [N]
TMax: 11.50 [ms]
Min:-1766.66 [N]
TMin: 80.25 [ms]
Filter: CFC 1000

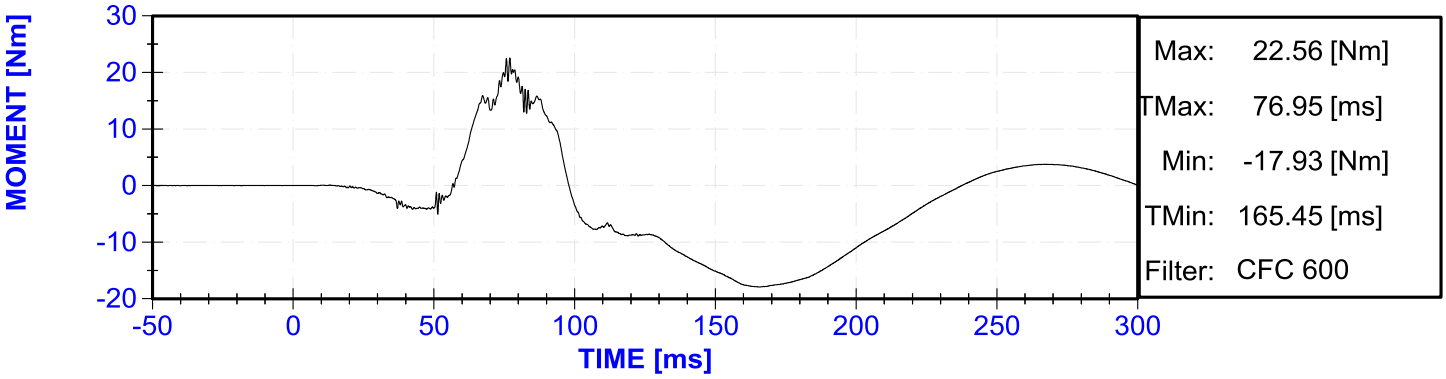

V2P1 Lower Neck Z Force
FORCE [N]
TIME [ms]
Max: 1218.56 [N]
TMax: 60.25 [ms]
Min: -973.65 [N]
TMin: 78.40 [ms]
Filter: CFC 1000


V2P1 Lower Neck X Moment
MOMENT [Nm]
TIME [ms]
Max: 52.97 [Nm]
TMax: 111.95 [ms]
Min: -34.42 [Nm]
TMin: 300.00 [ms]
Filter: CFC 600

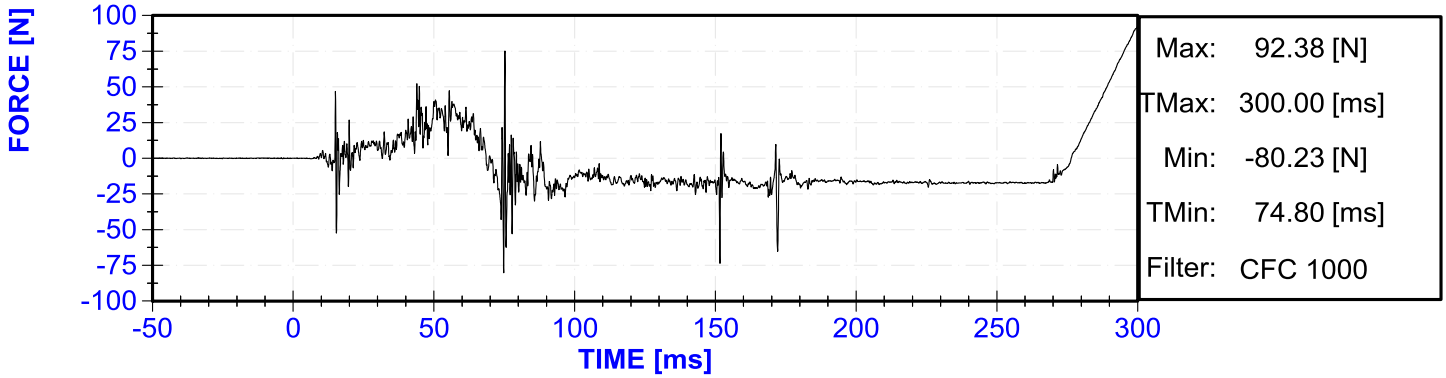
V2P1 Lower Neck Y Moment



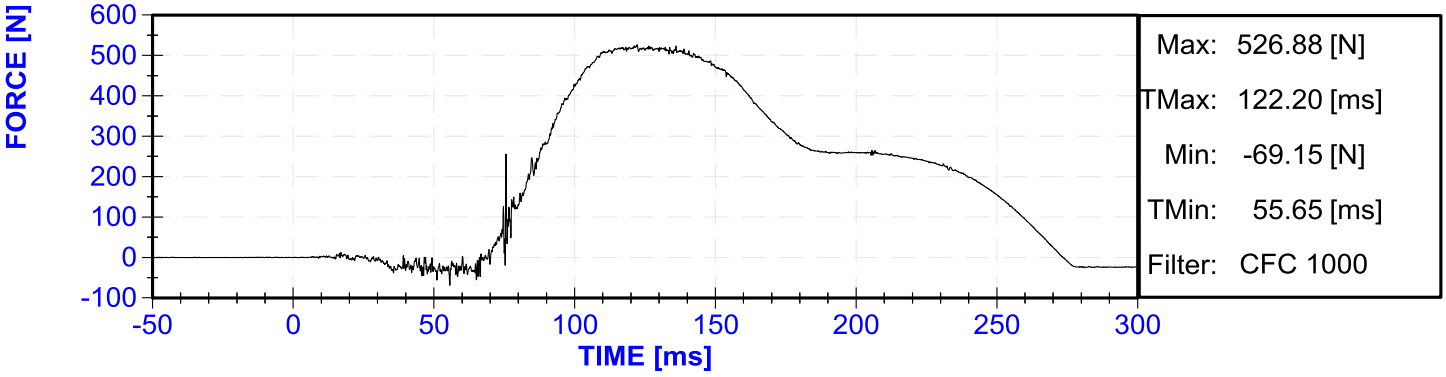
V2P1 Lower Neck Z Moment

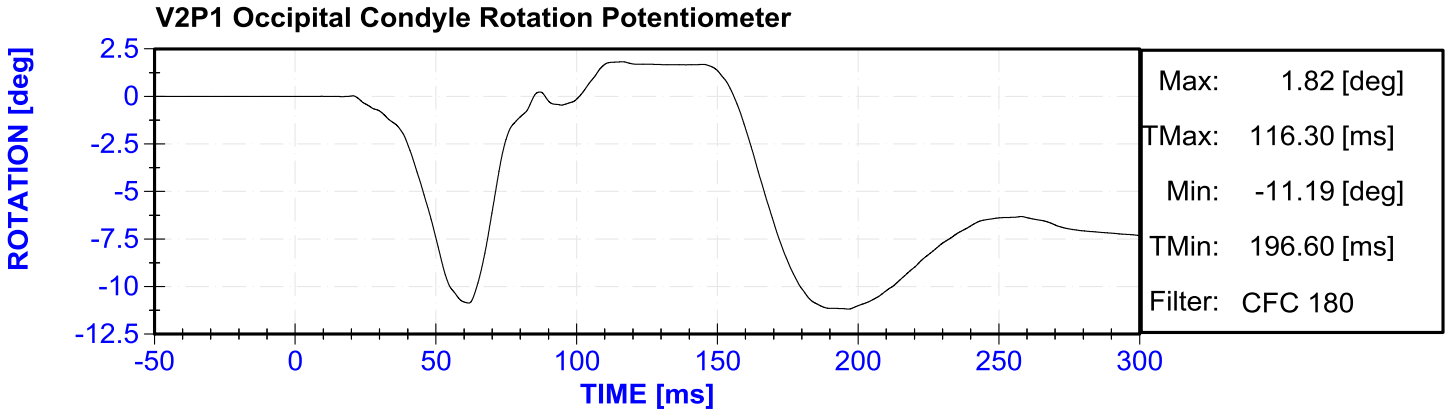


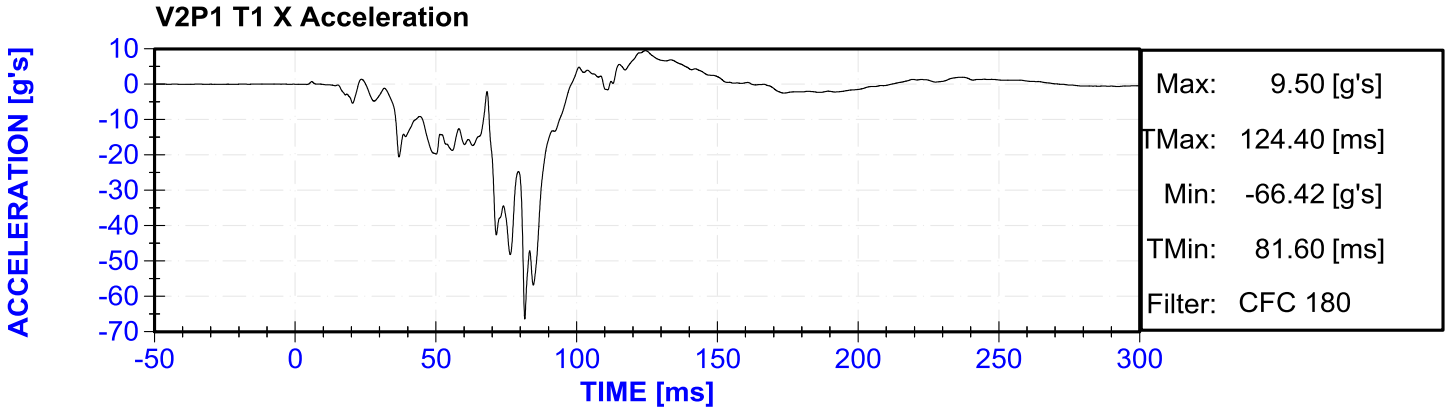
V2P1 Front Neck Spring Tower Load Cell

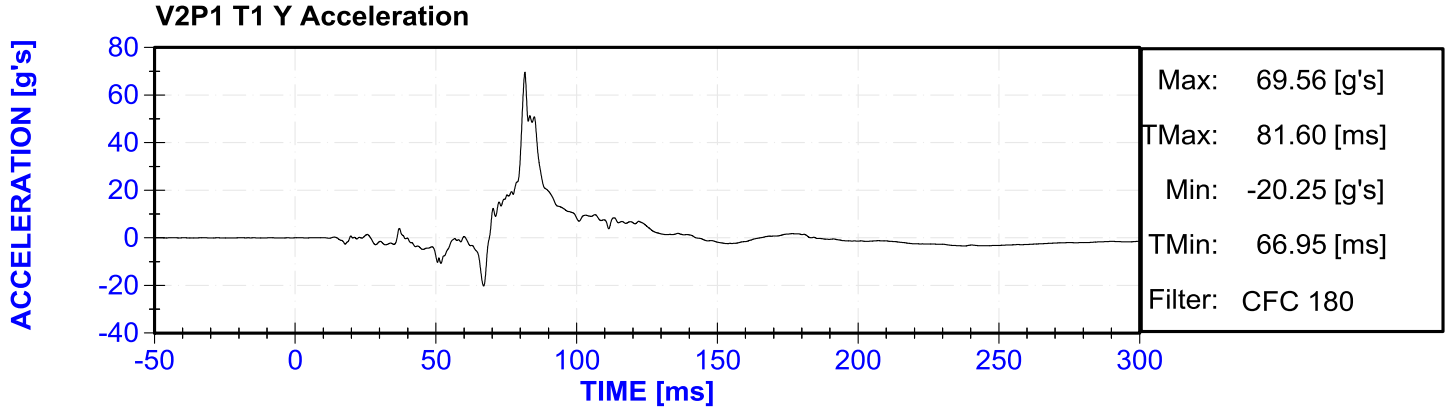


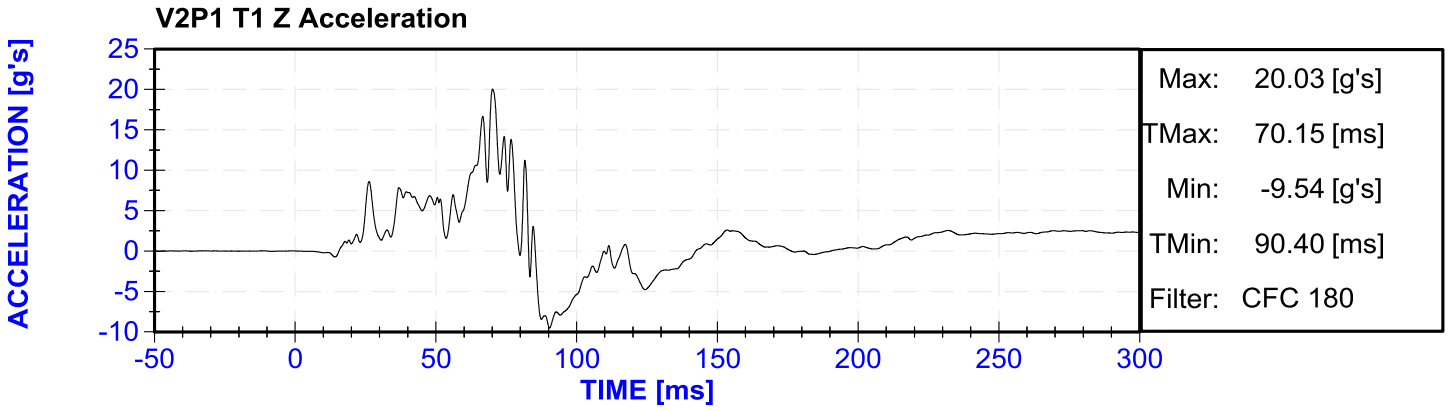
V2P1 Rear Neck Spring Tower Load Cell



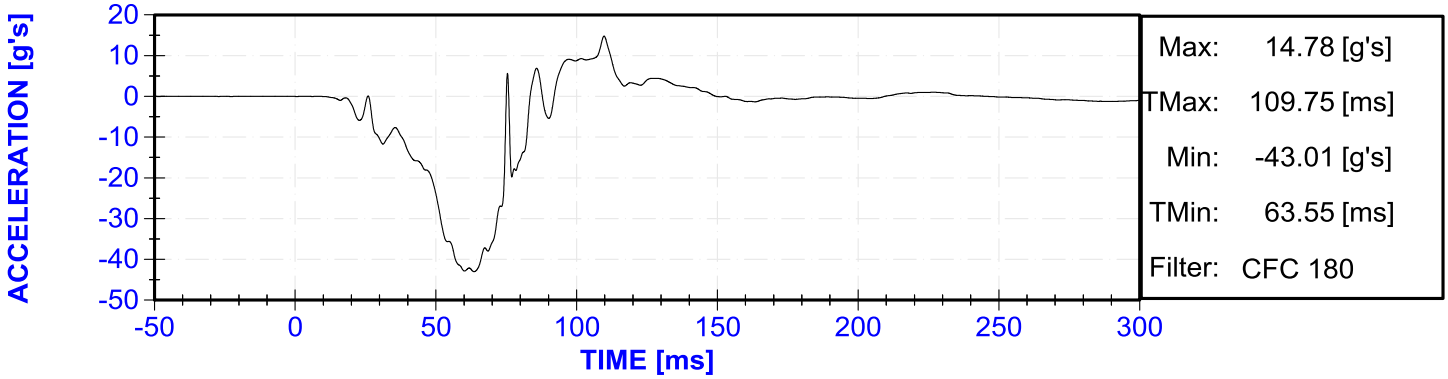

V2P1 Occipital Condyle Rotation Potentiometer
ROTATION [deg]
2.5
0
-2.5
-5
-7.5
-10
-12.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1.82 [deg]
TMax: 116.30 [ms]
Min: -11.19 [deg]
TMin: 196.60 [ms]
Filter: CFC 180


V2P1 T1 X Acceleration
ACCELERATION [g's]
10
0
-10
-20
-30
-40
-50
-60
-70
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 9.50 [g's]
TMax: 124.40 [ms]
Min: -66.42 [g's]
TMin: 81.60 [ms]
Filter: CFC 180

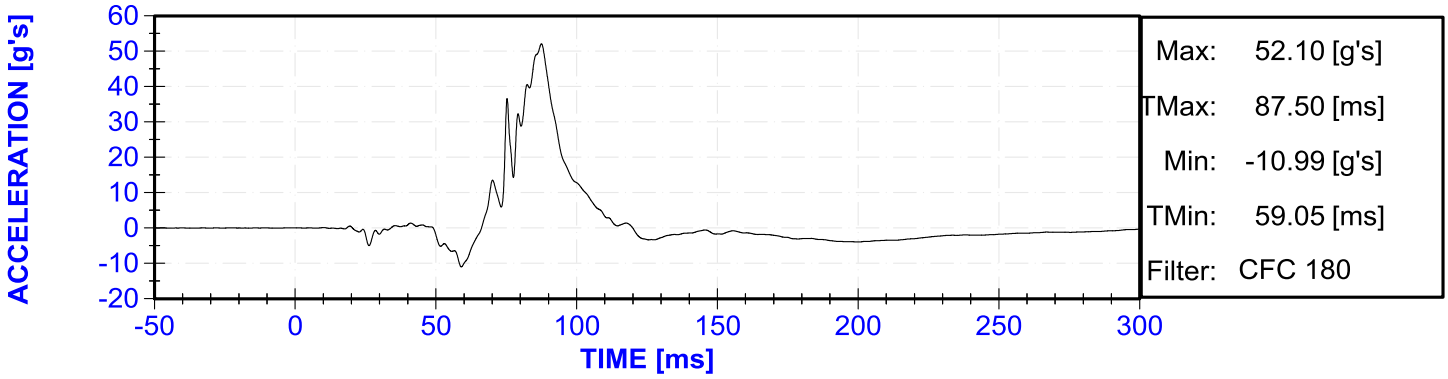

V2P1 T1 Y Acceleration
ACCELERATION [g's]
80
60
40
20
0
-20
-40
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 69.56 [g's]
TMax: 81.60 [ms]
Min: -20.25 [g's]
TMin: 66.95 [ms]
Filter: CFC 180


V2P1 T1 Z Acceleration
ACCELERATION [g's]
25
20
15
10
5
0
-5
-10
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 20.03 [g's]
TMax: 70.15 [ms]
Min: -9.54 [g's]
TMin: 90.40 [ms]
Filter: CFC 180

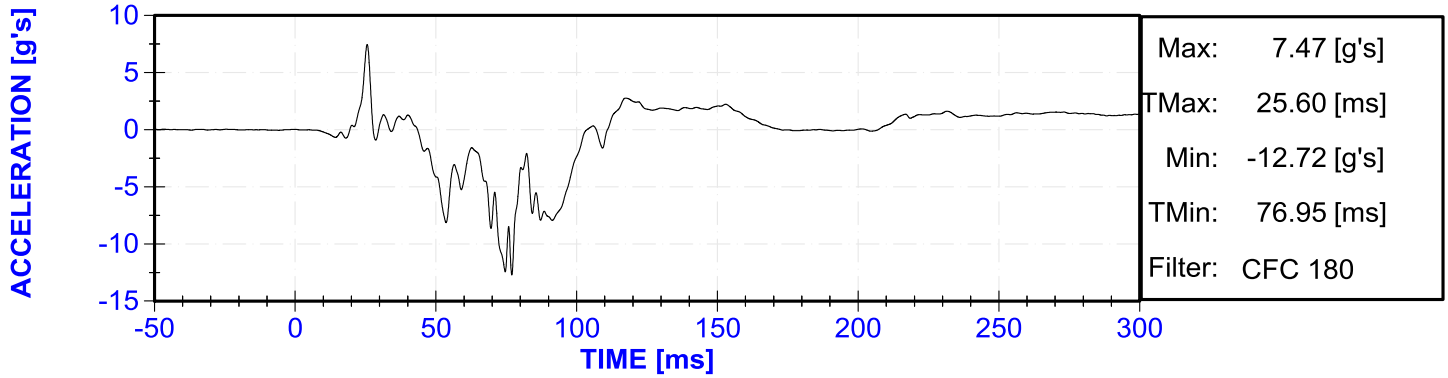
V2P1 T6 X Acceleration



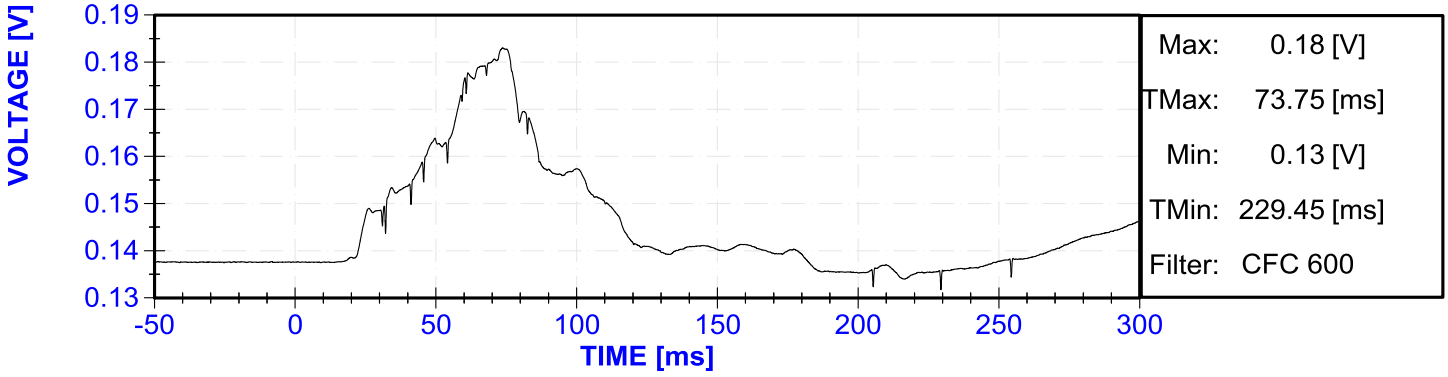
V2P1 T6 Y Acceleration

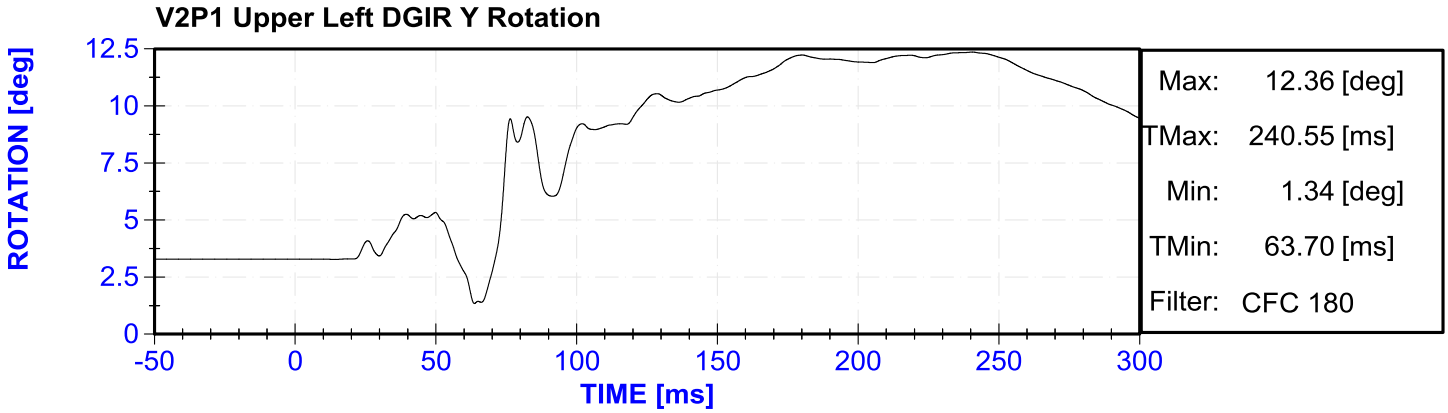


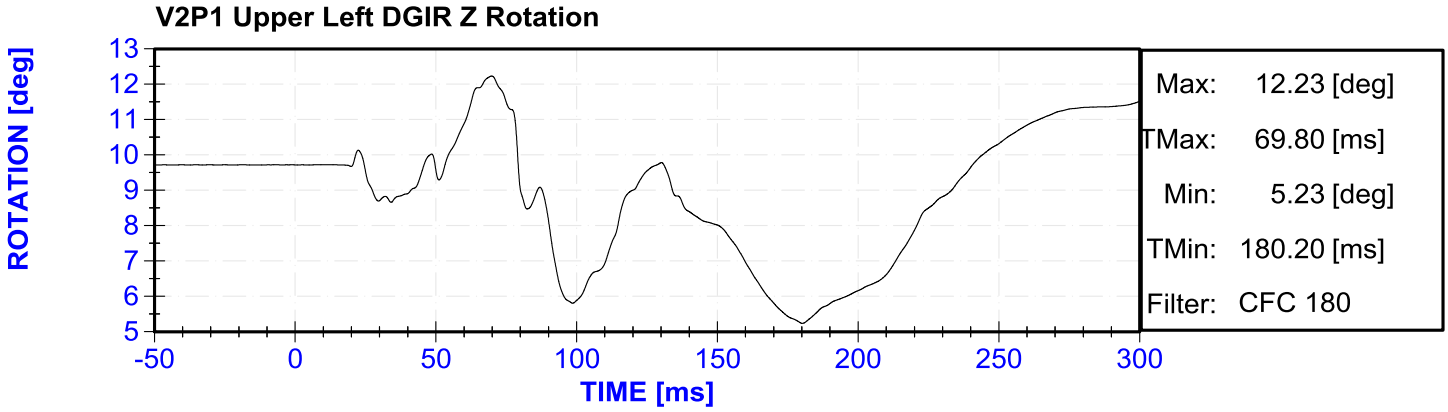
V2P1 T6 Z Acceleration

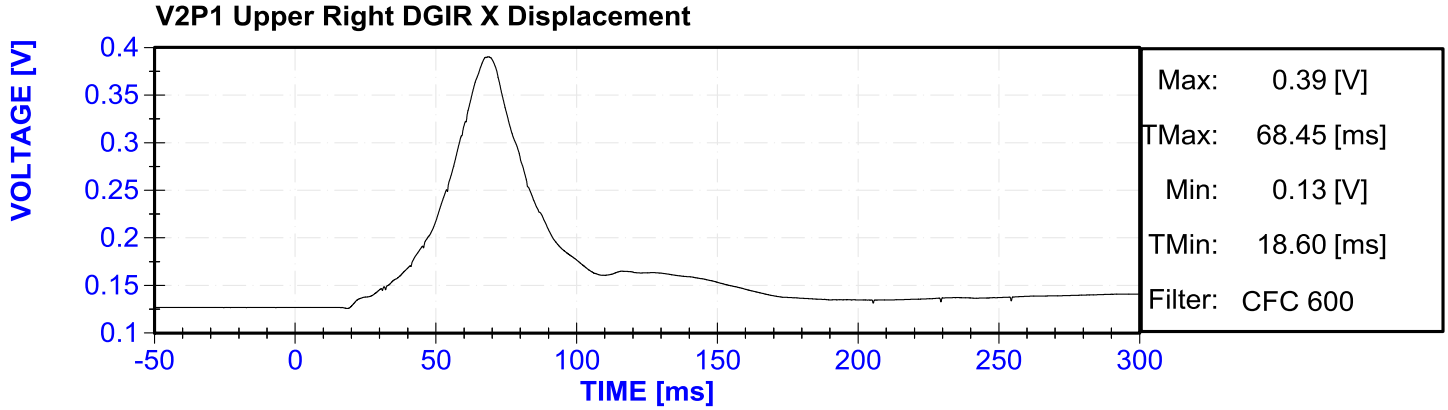


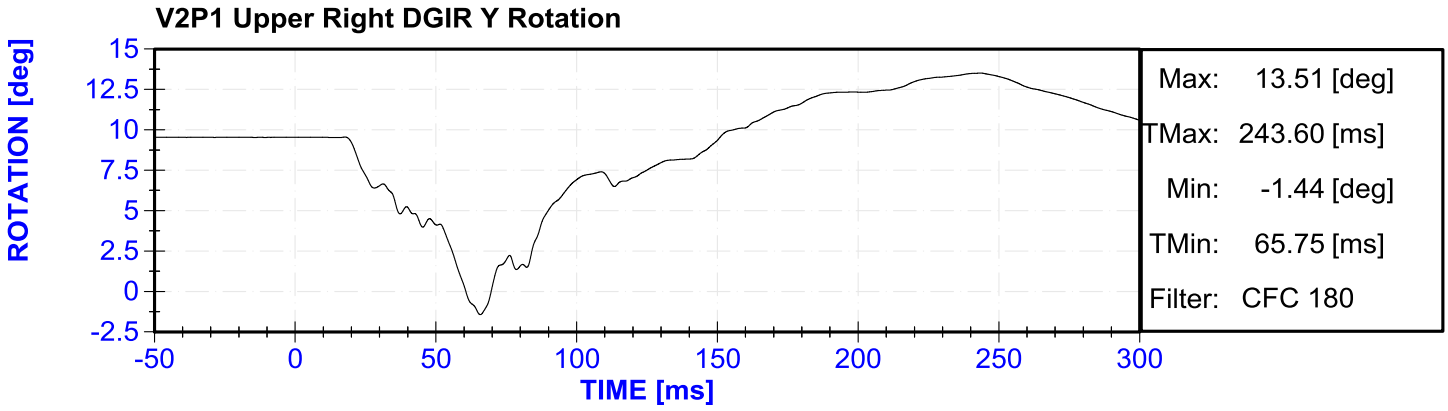
V2P1 Upper Left DGIR X Displacement

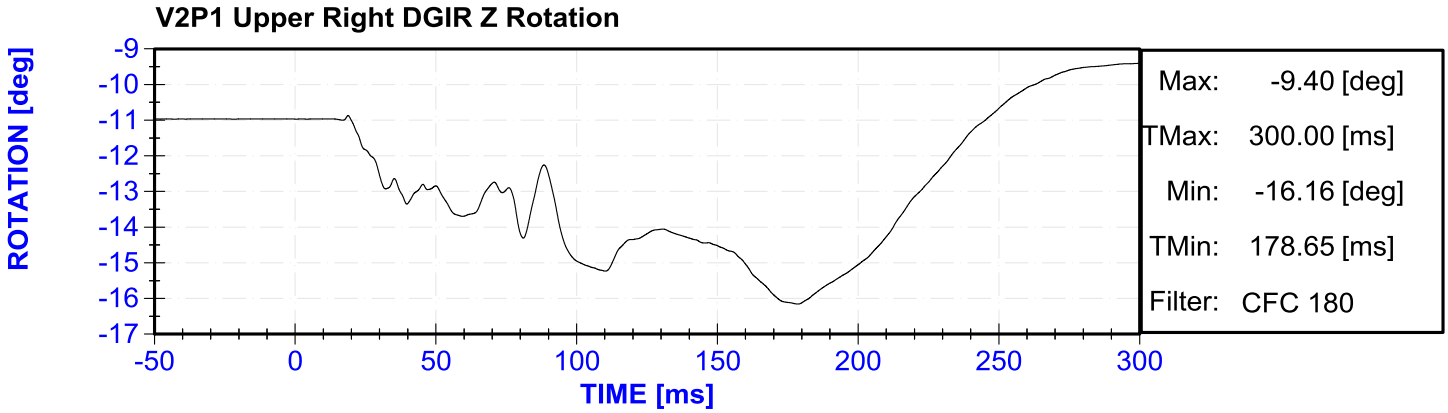


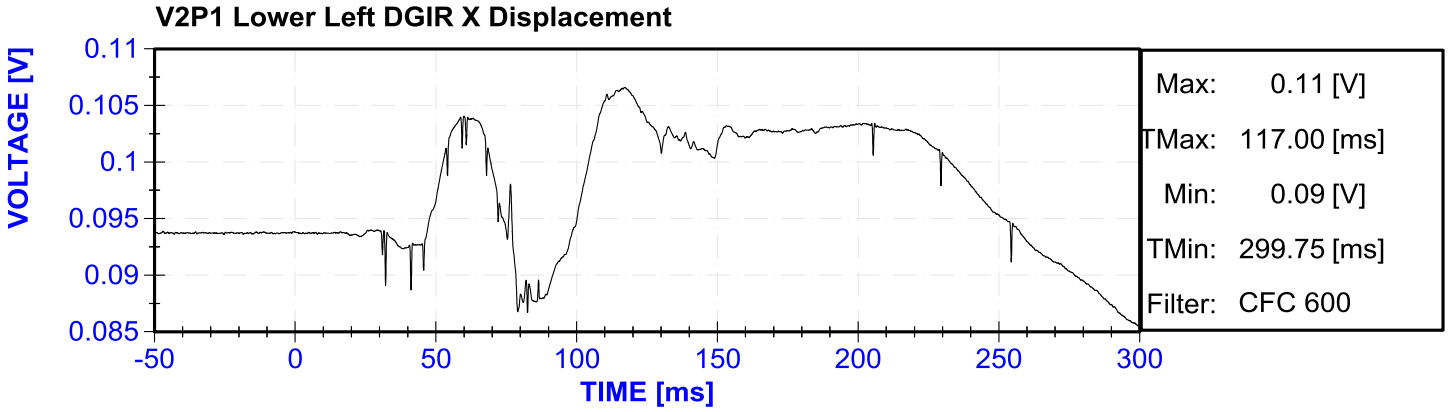

V2P1 Upper Left DGIR Y Rotation
ROTATION [deg]
TIME [ms]
Max: 12.36 [deg]
TMax: 240.55 [ms]
Min: 1.34 [deg]
TMin: 63.70 [ms]
Filter: CFC 180

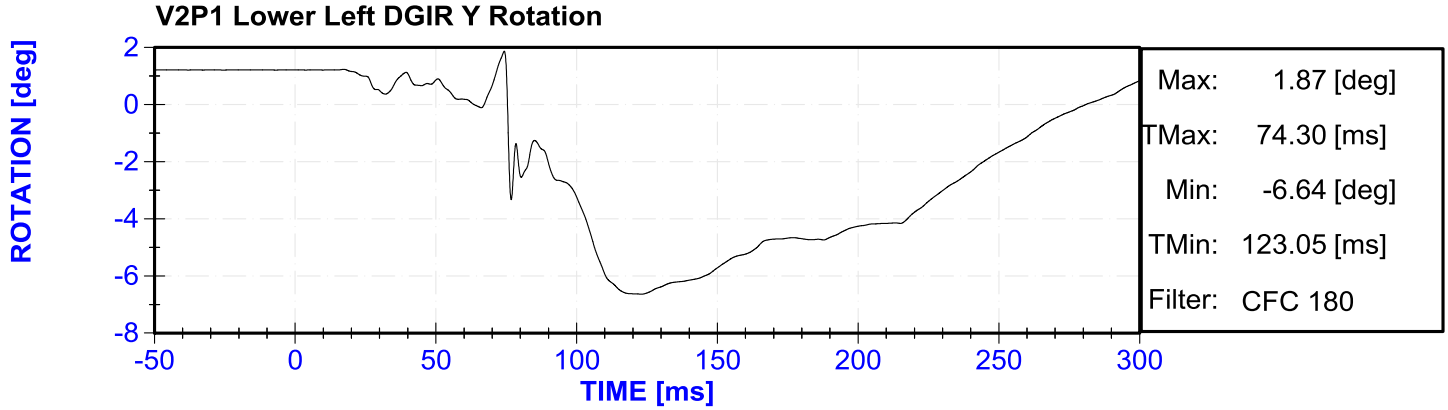

V2P1 Upper Left DGIR Z Rotation
ROTATION [deg]
TIME [ms]
Max: 12.23 [deg]
TMax: 69.80 [ms]
Min: 5.23 [deg]
TMin: 180.20 [ms]
Filter: CFC 180

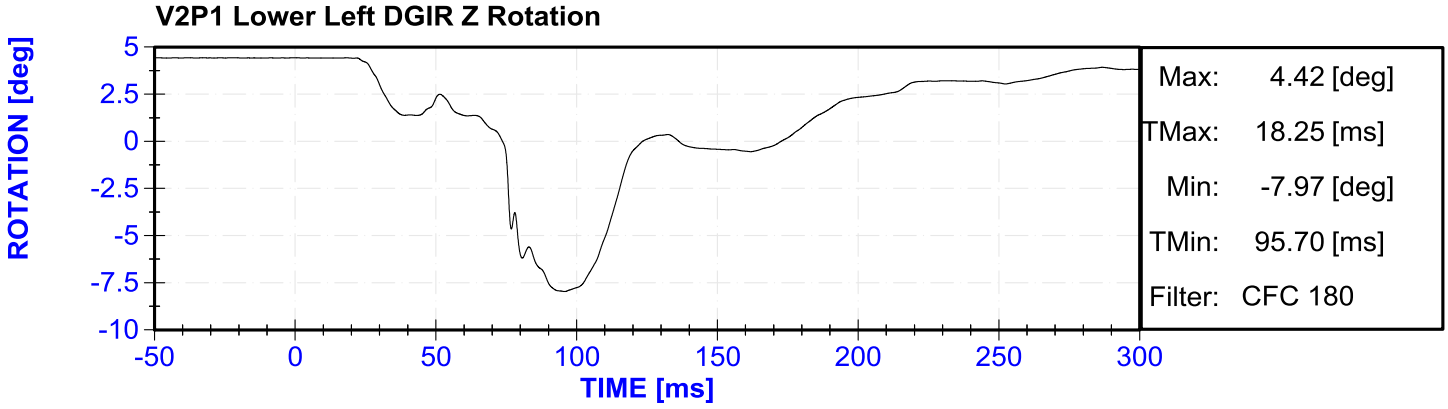

V2P1 Upper Right DGIR X Displacement
VOLTAGE [V]
TIME [ms]
Max: 0.39 [V]
TMax: 68.45 [ms]
Min: 0.13 [V]
TMin: 18.60 [ms]
Filter: CFC 600

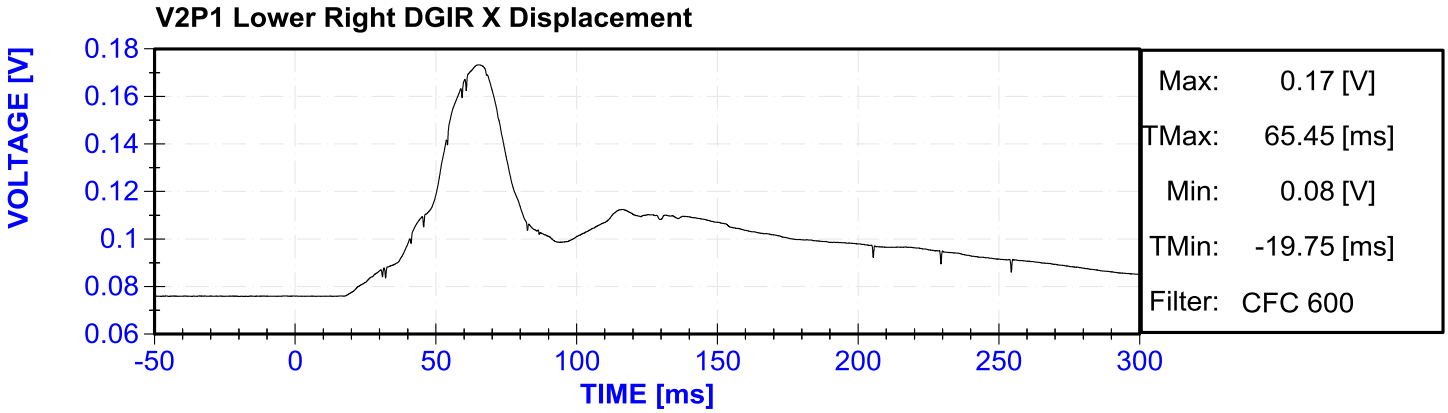

V2P1 Upper Right DGIR Y Rotation
ROTATION [deg]
TIME [ms]
Max: 13.51 [deg]
TMax: 243.60 [ms]
Min: -1.44 [deg]
TMin: 65.75 [ms]
Filter: CFC 180

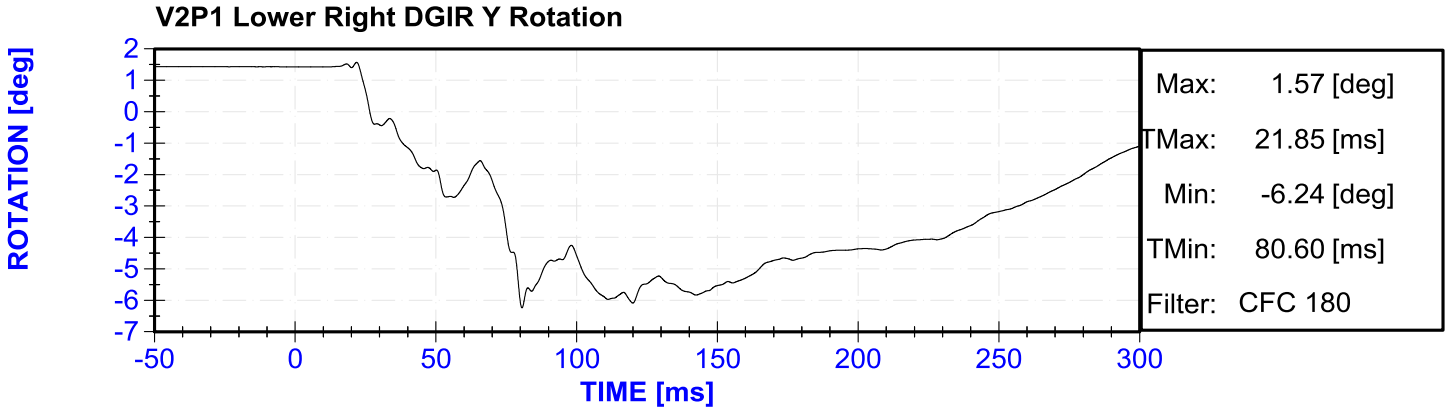

V2P1 Upper Right DGIR Z Rotation
ROTATION [deg]
-9
-10
-11
-12
-13
-14
-15
-16
-17
-50
0
50
100
150
200
250
300
TIME [ms]
Max: -9.40 [deg]
TMax: 300.00 [ms]
Min: -16.16 [deg]
TMin: 178.65 [ms]
Filter: CFC 180

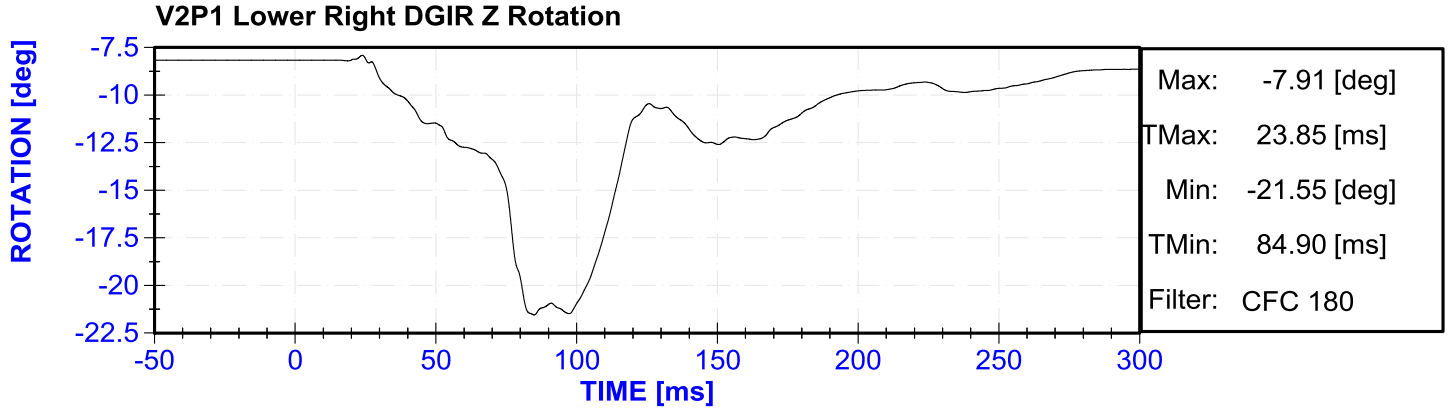

V2P1 Lower Left DGIR X Displacement
VOLTAGE [V]
0.11
0.105
0.1
0.095
0.09
0.085
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 0.11 [V]
TMax: 117.00 [ms]
Min: 0.09 [V]
TMin: 299.75 [ms]
Filter: CFC 600

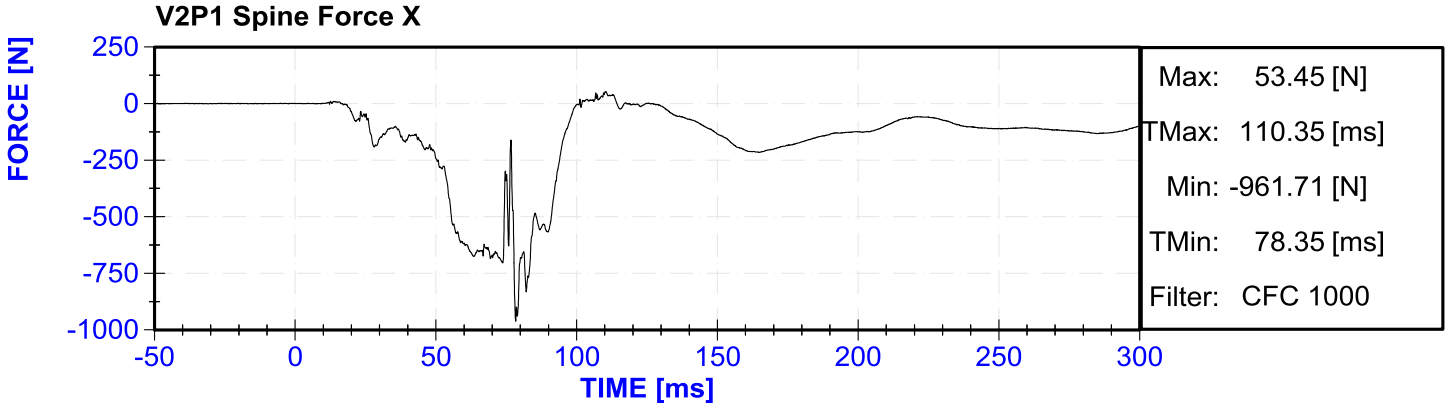

V2P1 Lower Left DGIR Y Rotation
ROTATION [deg]
2
0
-2
-4
-6
-8
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1.87 [deg]
TMax: 74.30 [ms]
Min: -6.64 [deg]
TMin: 123.05 [ms]
Filter: CFC 180

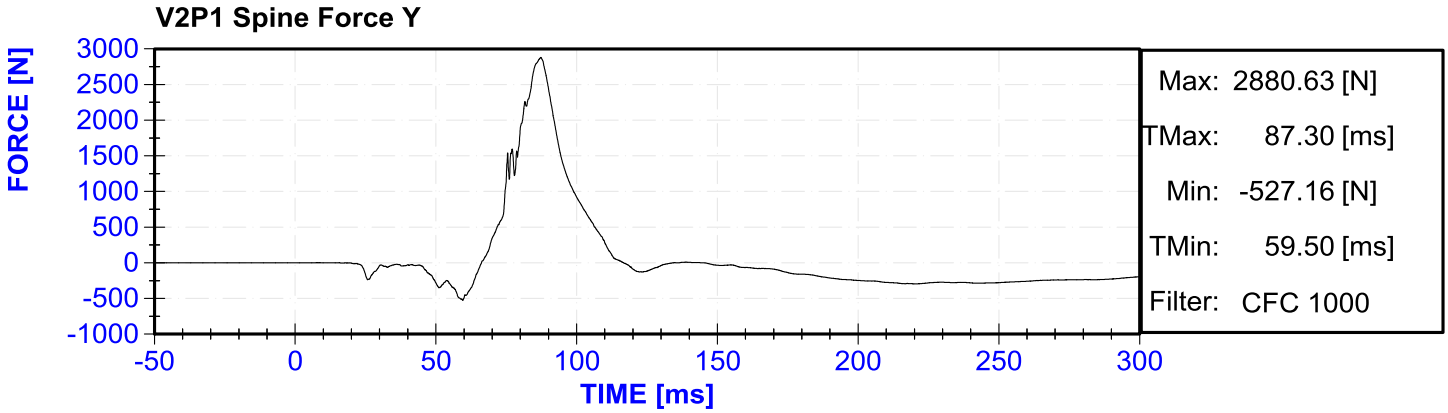

V2P1 Lower Left DGIR Z Rotation
ROTATION [deg]
5
2.5
0
-2.5
-5
-7.5
-10
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 4.42 [deg]
TMax: 18.25 [ms]
Min: -7.97 [deg]
TMin: 95.70 [ms]
Filter: CFC 180

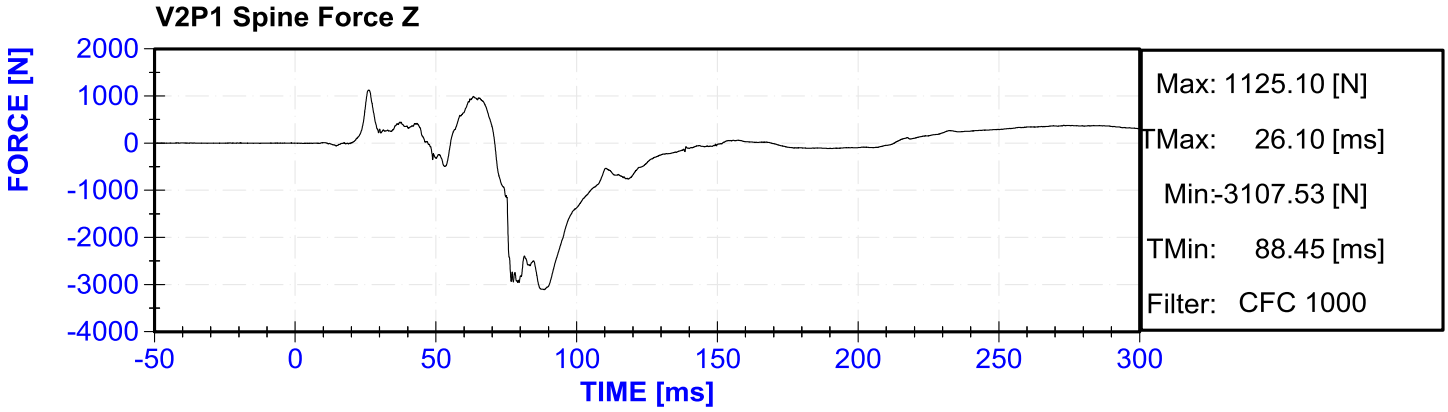

V2P1 Lower Right DGIR X Displacement
VOLTAGE [V]
0.18
0.16
0.14
0.12
0.1
0.08
0.06
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 0.17 [V]
TMax: 65.45 [ms]
Min: 0.08 [V]
TMin: -19.75 [ms]
Filter: CFC 600

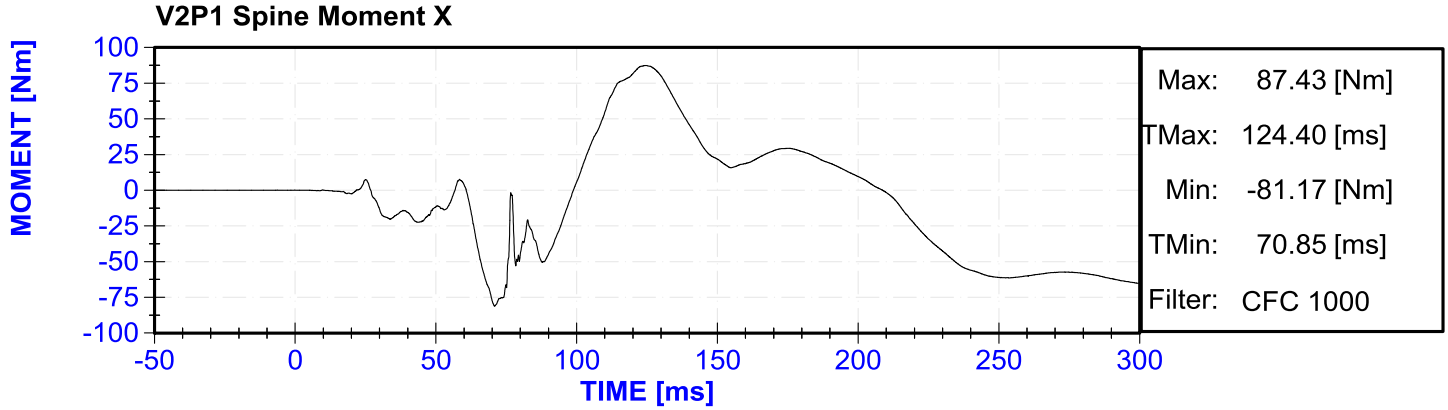

V2P1 Lower Right DGIR Y Rotation
ROTATION [deg]
2
1
0
-1
-2
-3
-4
-5
-6
-7
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1.57 [deg]
TMax: 21.85 [ms]
Min: -6.24 [deg]
TMin: 80.60 [ms]
Filter: CFC 180

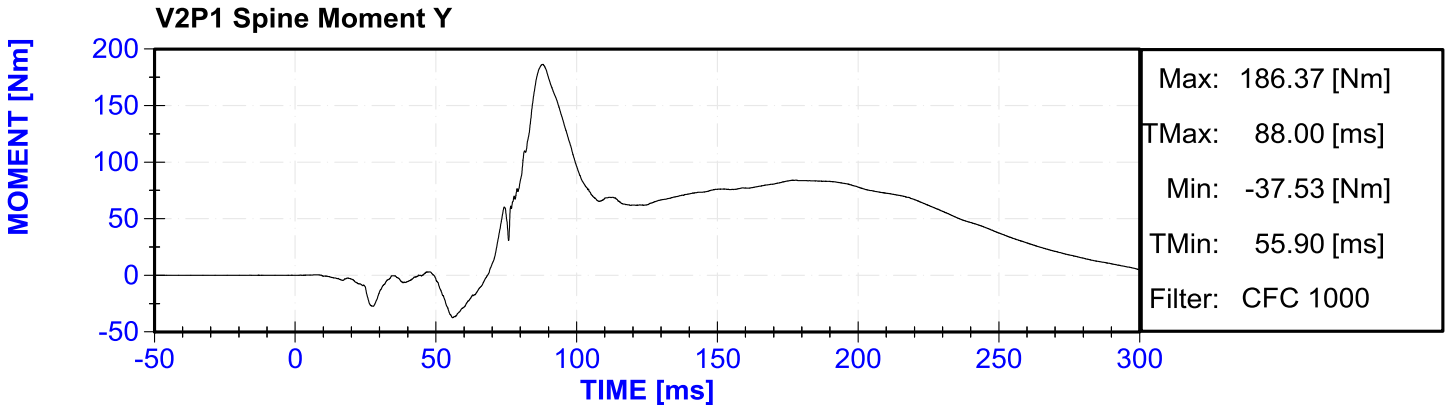

V2P1 Lower Right DGIR Z Rotation
ROTATION [deg]
-7.5
-10
-12.5
-15
-17.5
-20
-22.5
-50
0
50
100
150
200
250
300
TIME [ms]
Max: -7.91 [deg]
TMax: 23.85 [ms]
Min: -21.55 [deg]
TMin: 84.90 [ms]
Filter: CFC 180


V2P1 Spine Force X
FORCE [N]
250
0
-250
-500
-750
-1000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 53.45 [N]
TMax: 110.35 [ms]
Min: -961.71 [N]
TMin: 78.35 [ms]
Filter: CFC 1000

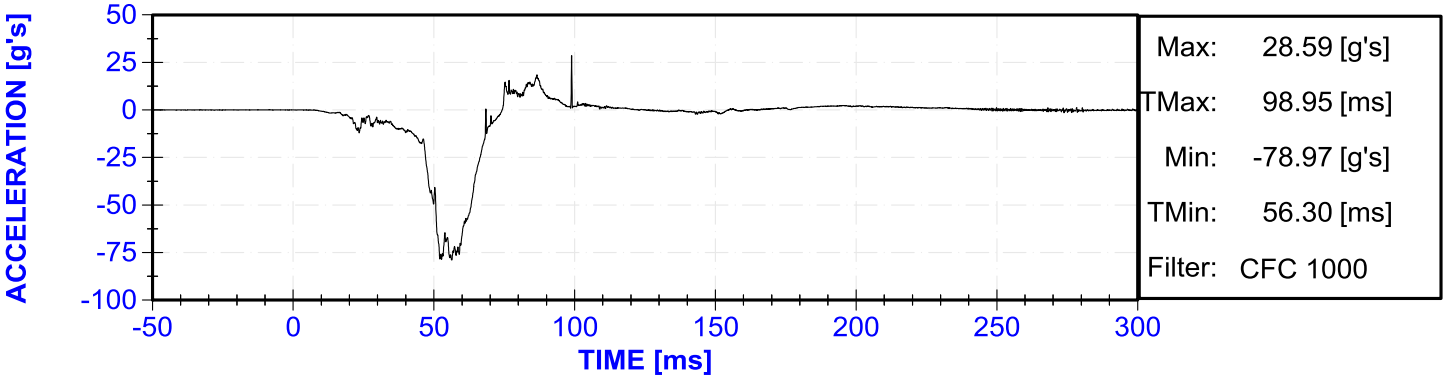

V2P1 Spine Force Y
FORCE [N]
TIME [ms]
Max: 2880.63 [N]
TMax: 87.30 [ms]
Min: -527.16 [N]
TMin: 59.50 [ms]
Filter: CFC 1000


V2P1 Spine Force Z
FORCE [N]
TIME [ms]
Max: 1125.10 [N]
TMax: 26.10 [ms]
Min:-3107.53 [N]
TMin: 88.45 [ms]
Filter: CFC 1000

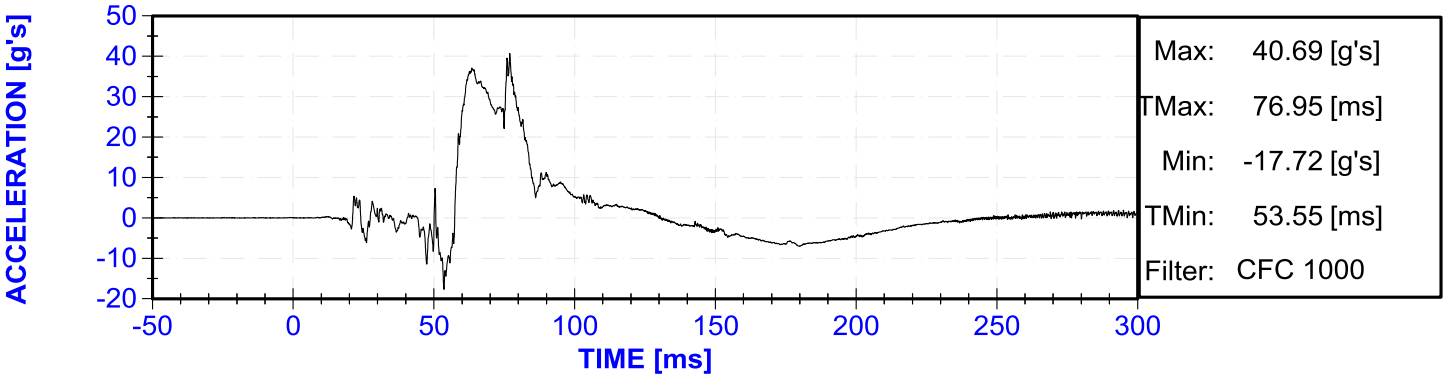

V2P1 Spine Moment X
MOMENT [Nm]
TIME [ms]
Max: 87.43 [Nm]
TMax: 124.40 [ms]
Min: -81.17 [Nm]
TMin: 70.85 [ms]
Filter: CFC 1000


V2P1 Spine Moment Y
MOMENT [Nm]
TIME [ms]
Max: 186.37 [Nm]
TMax: 88.00 [ms]
Min: -37.53 [Nm]
TMin: 55.90 [ms]
Filter: CFC 1000

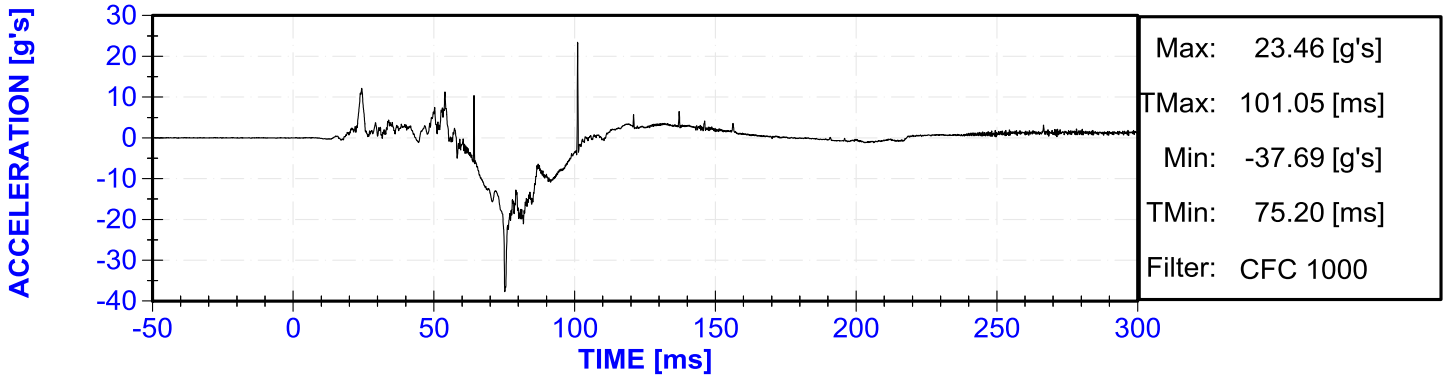
V2P1 Pelvis X Acceleration



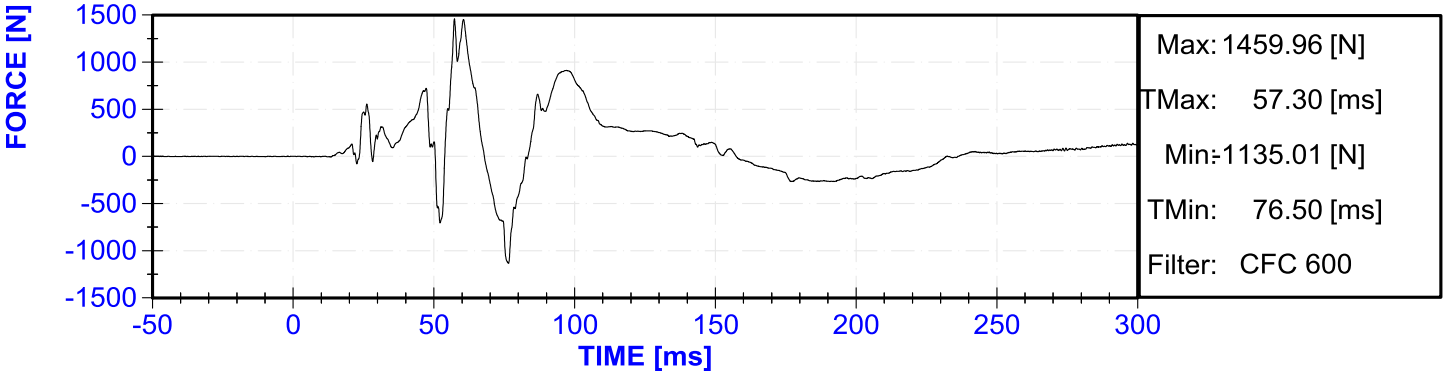
V2P1 Pelvis Y Acceleration



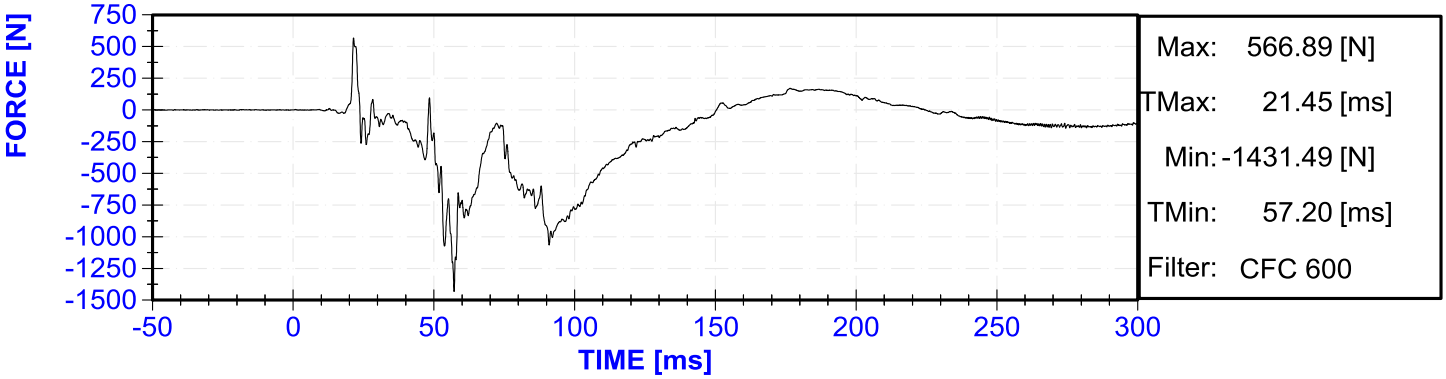
V2P1 Pelvis Z Acceleration



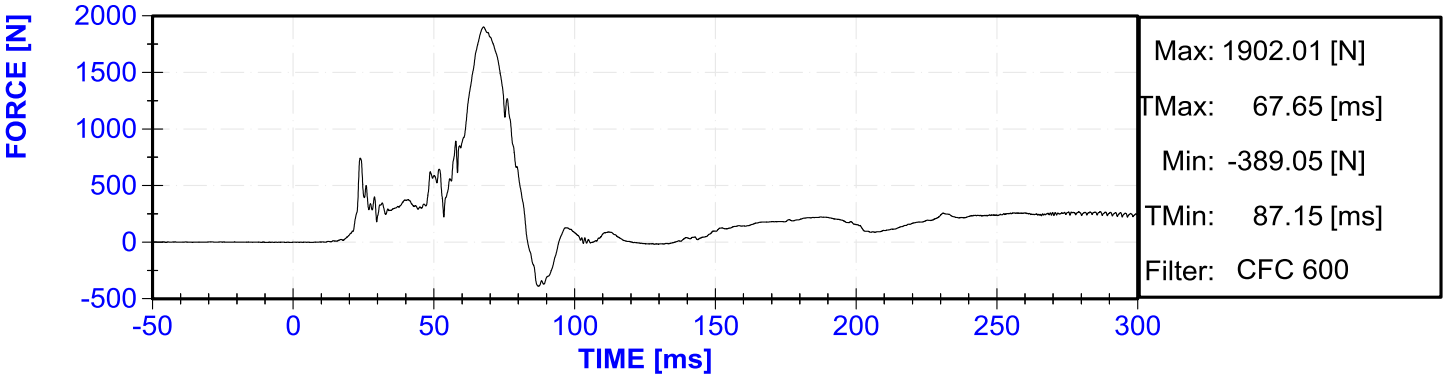
V2P1 Acetabular Left X Force



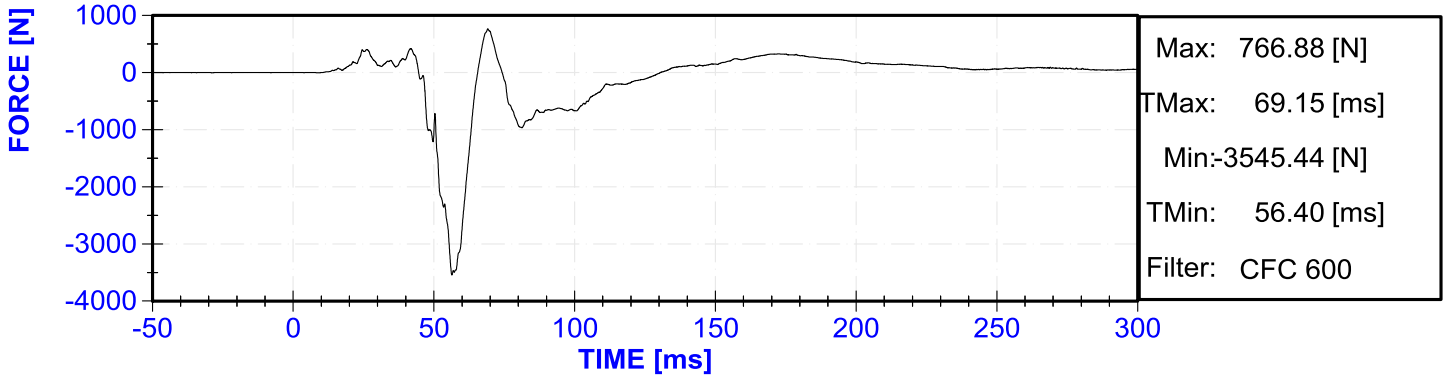
V2P1 Acetabular Left Y Force



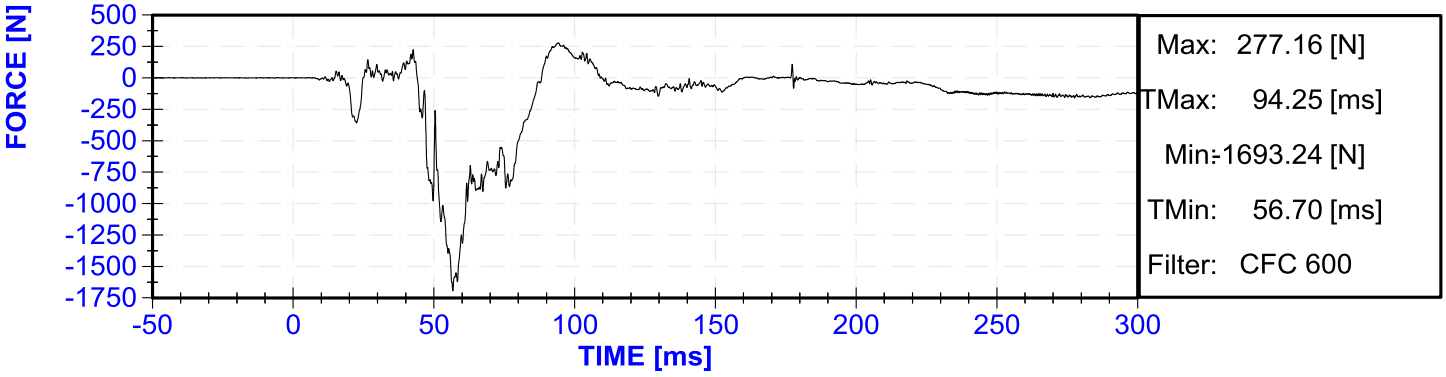
V2P1 Acetabular Left Z Force

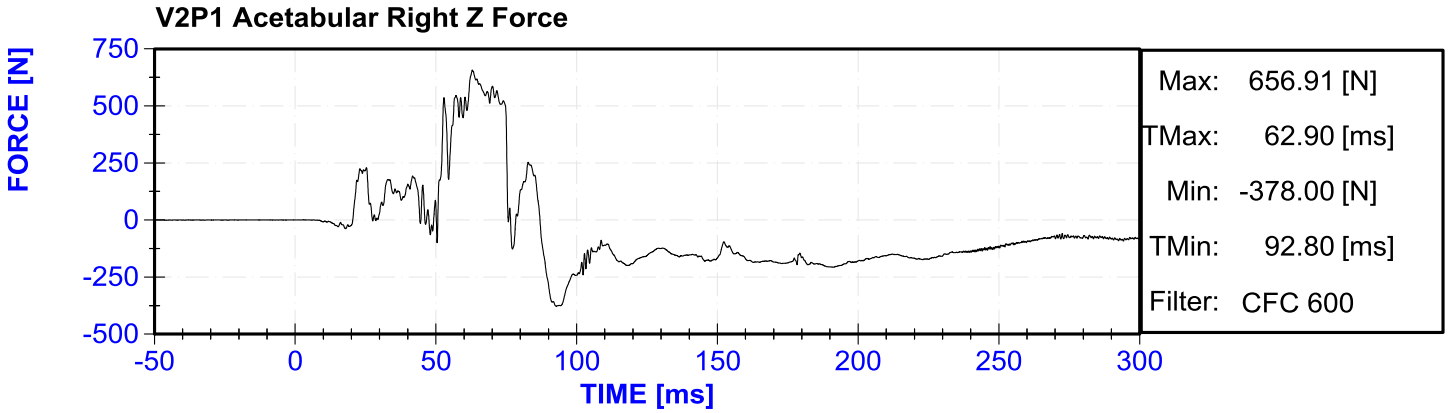


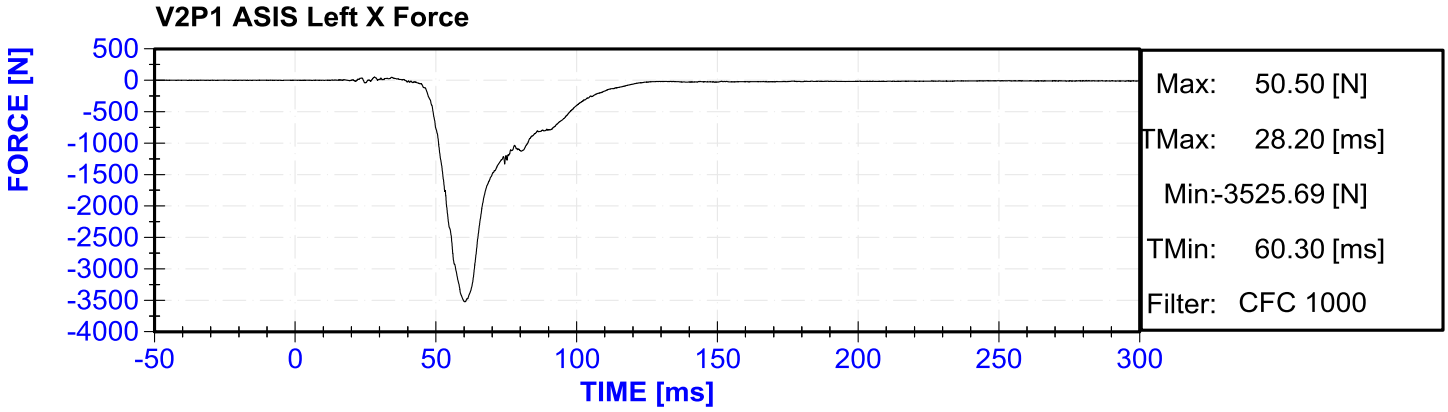
V2P1 Acetabular Right X Force

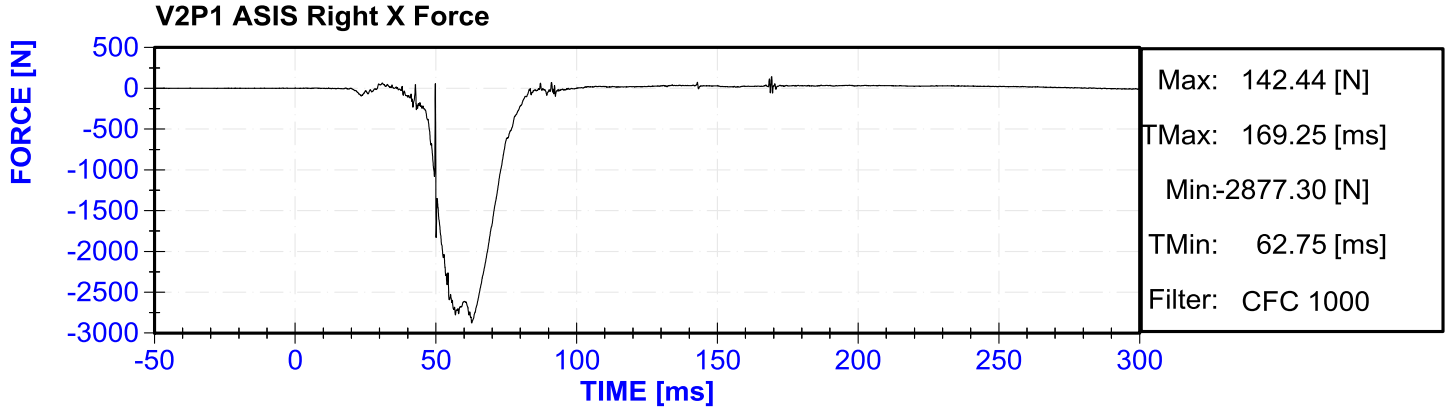


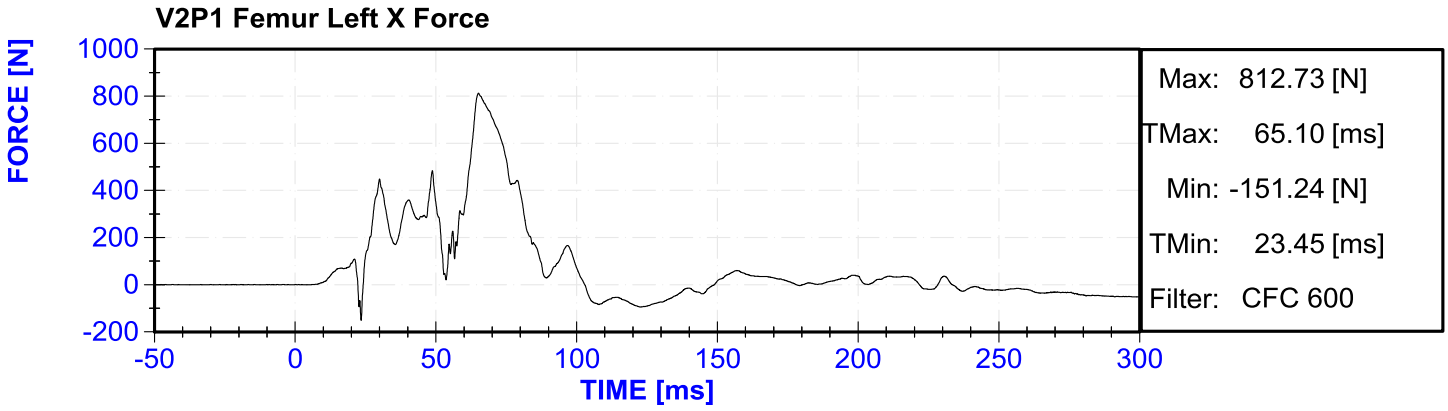
V2P1 Acetabular Right Y Force

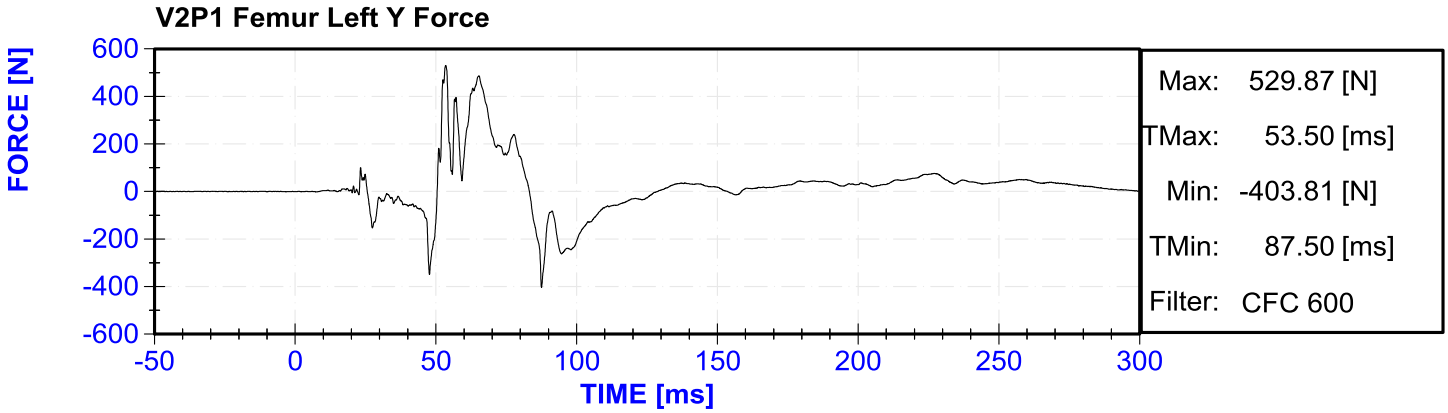


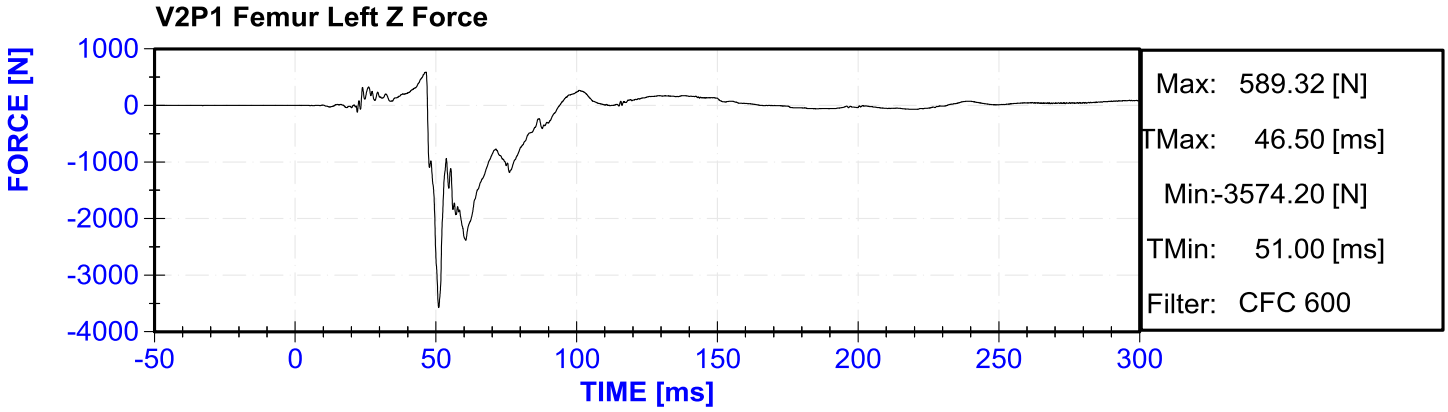

V2P1 Acetabular Right Z Force
FORCE [N]
TIME [ms]
Max: 656.91 [N]
TMax: 62.90 [ms]
Min: -378.00 [N]
TMin: 92.80 [ms]
Filter: CFC 600

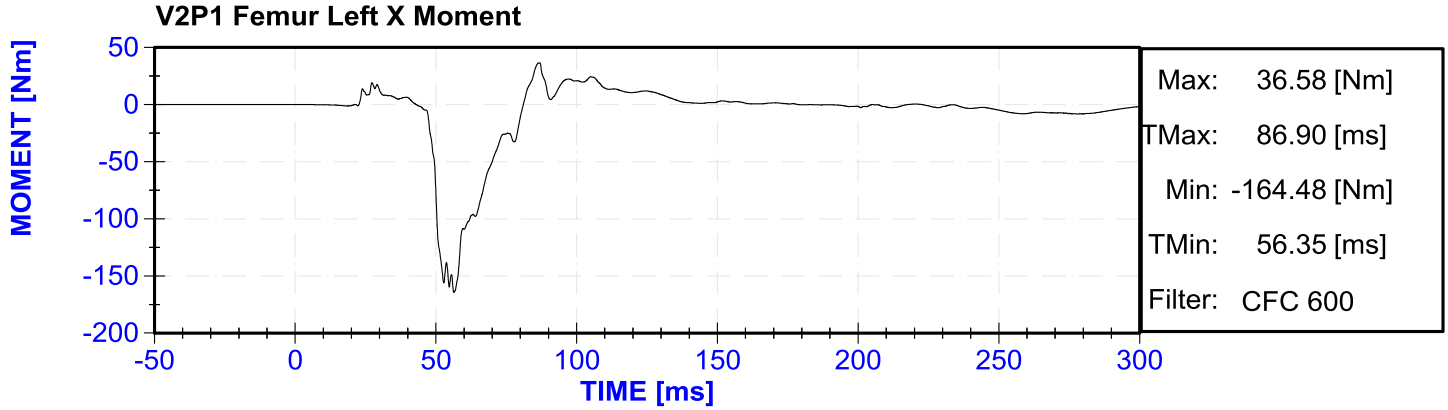

V2P1 ASIS Left X Force
FORCE [N]
TIME [ms]
Max: 50.50 [N]
TMax: 28.20 [ms]
Min:-3525.69 [N]
TMin: 60.30 [ms]
Filter: CFC 1000

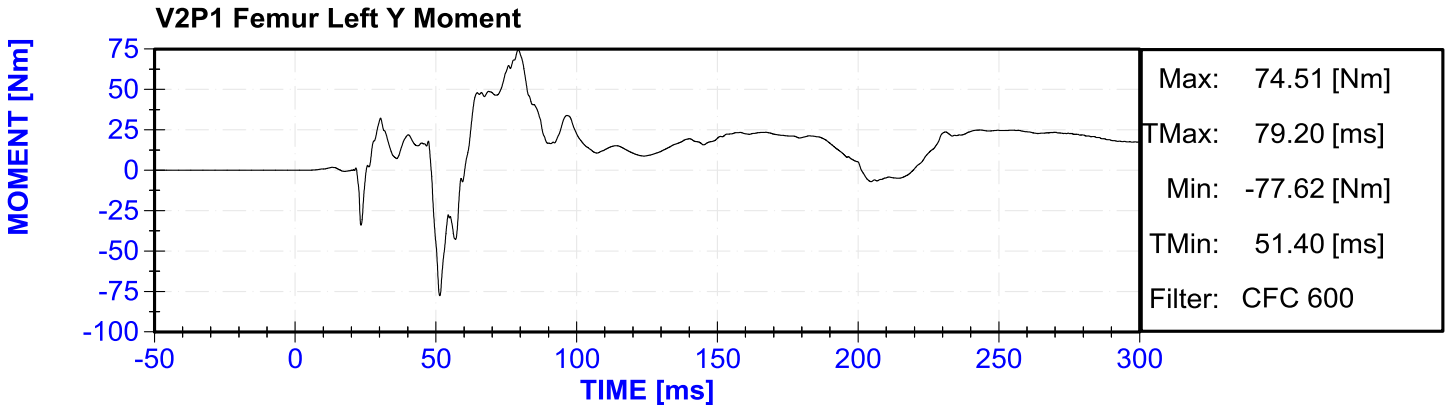

V2P1 ASIS Right X Force
FORCE [N]
TIME [ms]
Max: 142.44 [N]
TMax: 169.25 [ms]
Min:-2877.30 [N]
TMin: 62.75 [ms]
Filter: CFC 1000

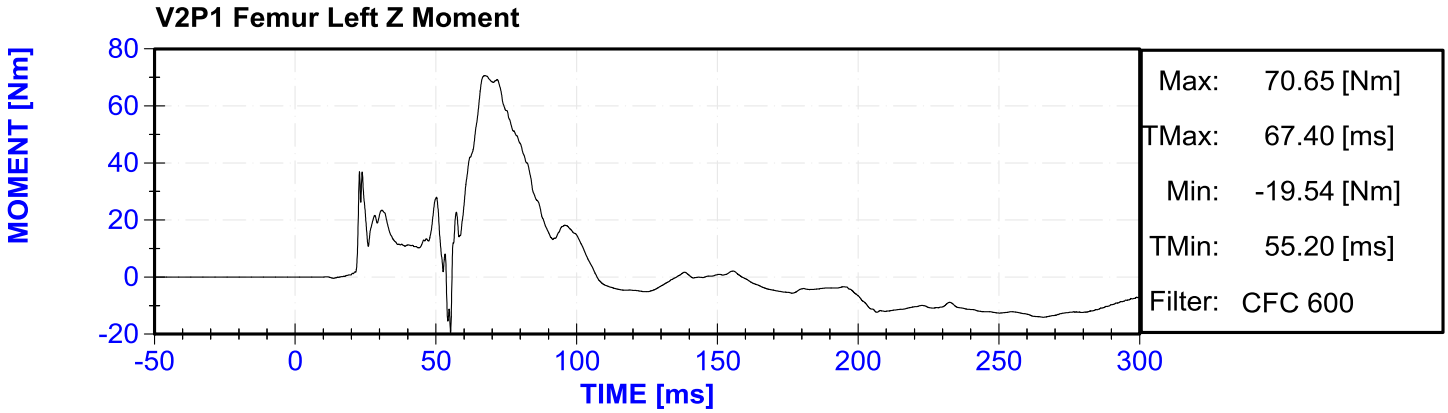

V2P1 Femur Left X Force
FORCE [N]
TIME [ms]
Max: 812.73 [N]
TMax: 65.10 [ms]
Min: -151.24 [N]
TMin: 23.45 [ms]
Filter: CFC 600

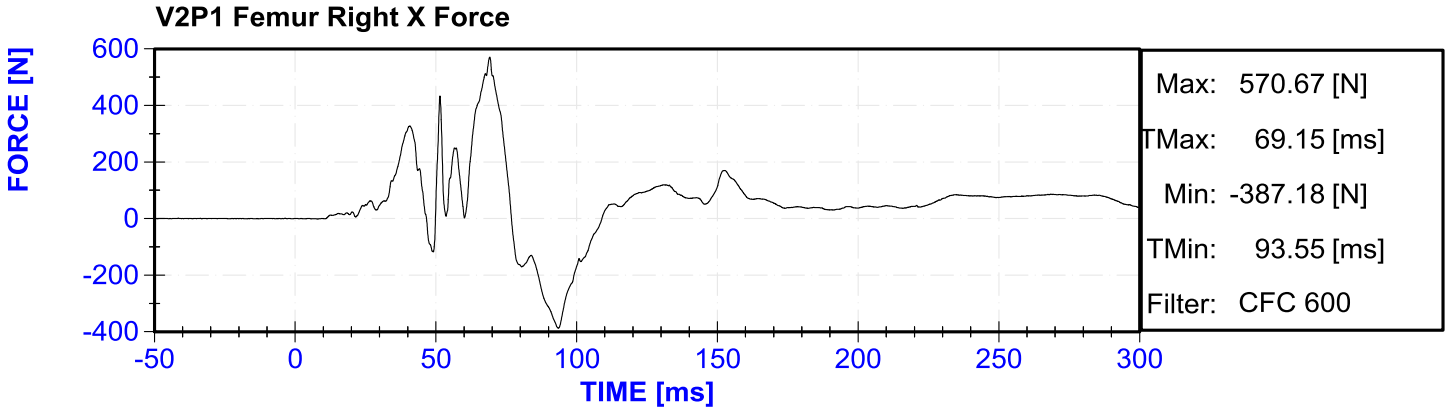

V2P1 Femur Left Y Force
FORCE [N]
600
400
200
0
-200
-400
-600
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 529.87 [N]
TMax: 53.50 [ms]
Min: -403.81 [N]
TMin: 87.50 [ms]
Filter: CFC 600

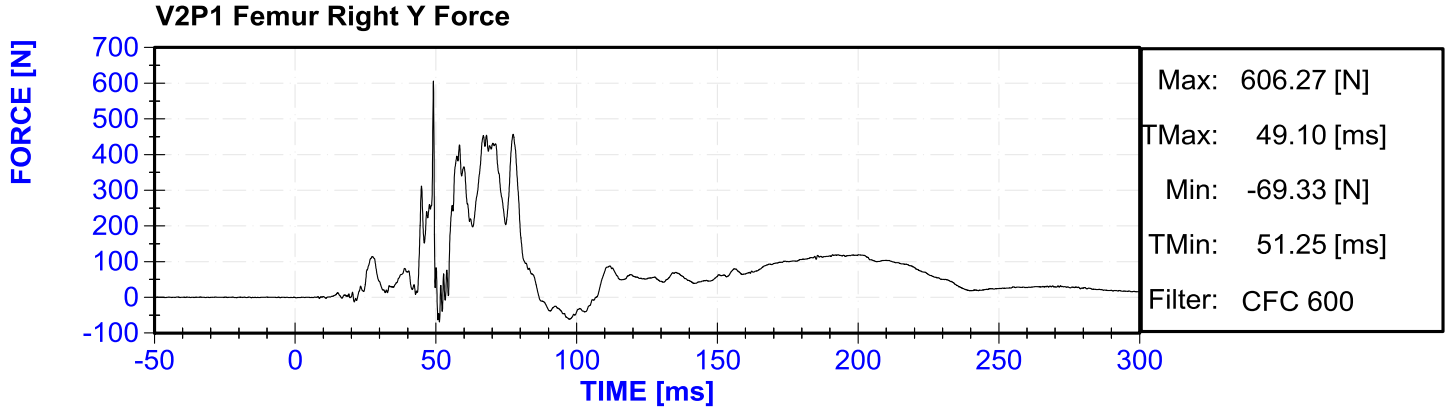

V2P1 Femur Left Z Force
FORCE [N]
1000
0
-1000
-2000
-3000
-4000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 589.32 [N]
TMax: 46.50 [ms]
Min:-3574.20 [N]
TMin: 51.00 [ms]
Filter: CFC 600

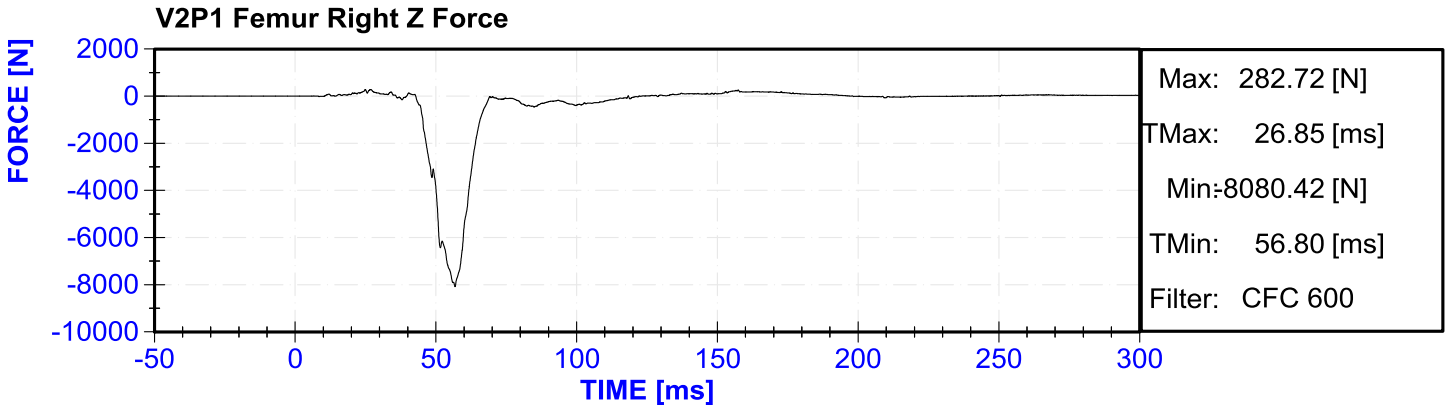

V2P1 Femur Left X Moment
MOMENT [Nm]
50
0
-50
-100
-150
-200
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 36.58 [Nm]
TMax: 86.90 [ms]
Min: -164.48 [Nm]
TMin: 56.35 [ms]
Filter: CFC 600

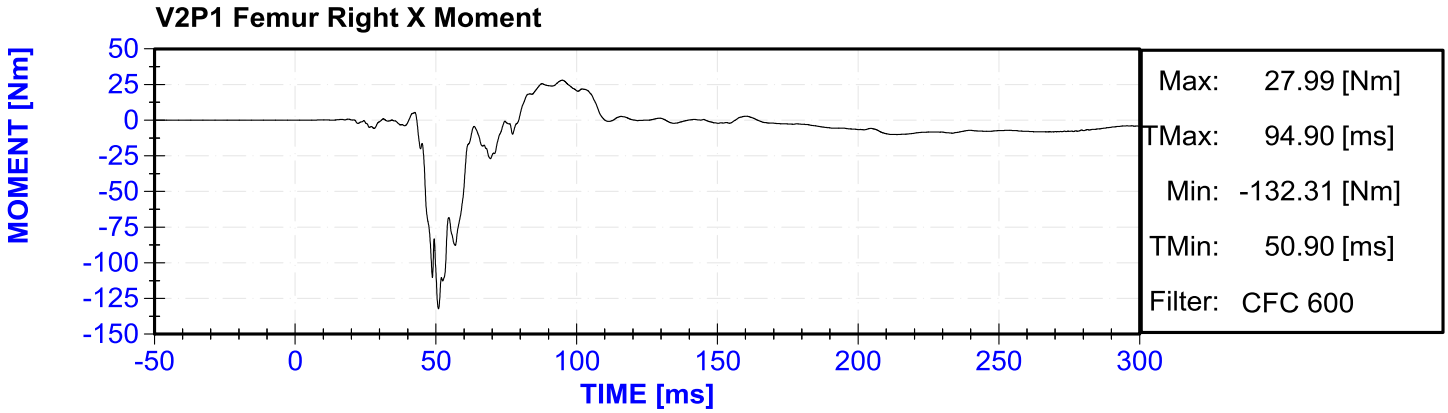

V2P1 Femur Left Y Moment
MOMENT [Nm]
75
50
25
0
-25
-50
-75
-100
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 74.51 [Nm]
TMax: 79.20 [ms]
Min: -77.62 [Nm]
TMin: 51.40 [ms]
Filter: CFC 600

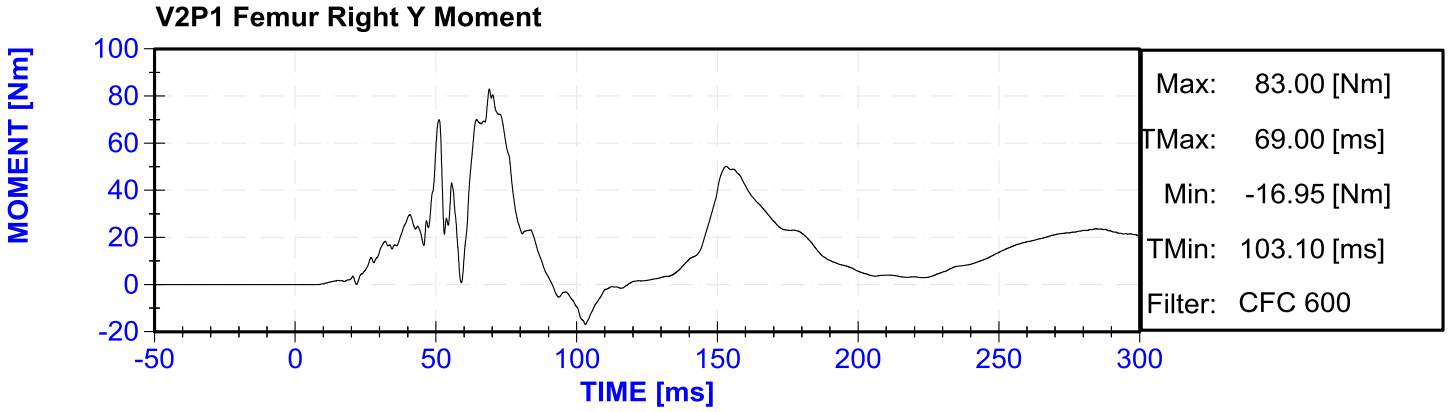

V2P1 Femur Left Z Moment
MOMENT [Nm]
TIME [ms]
Max: 70.65 [Nm]
TMax: 67.40 [ms]
Min: -19.54 [Nm]
TMin: 55.20 [ms]
Filter: CFC 600

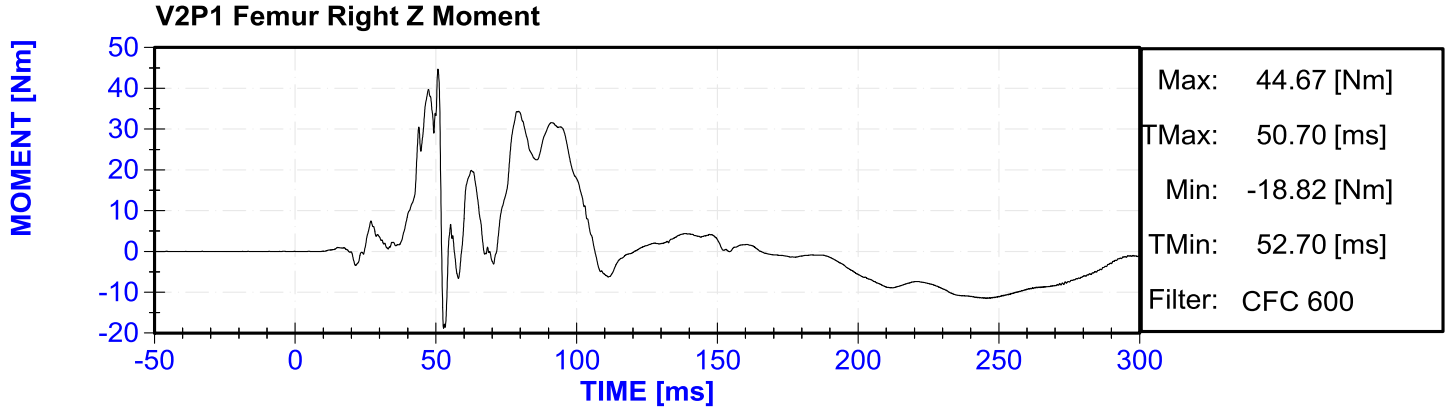

V2P1 Femur Right X Force
FORCE [N]
TIME [ms]
Max: 570.67 [N]
TMax: 69.15 [ms]
Min: -387.18 [N]
TMin: 93.55 [ms]
Filter: CFC 600

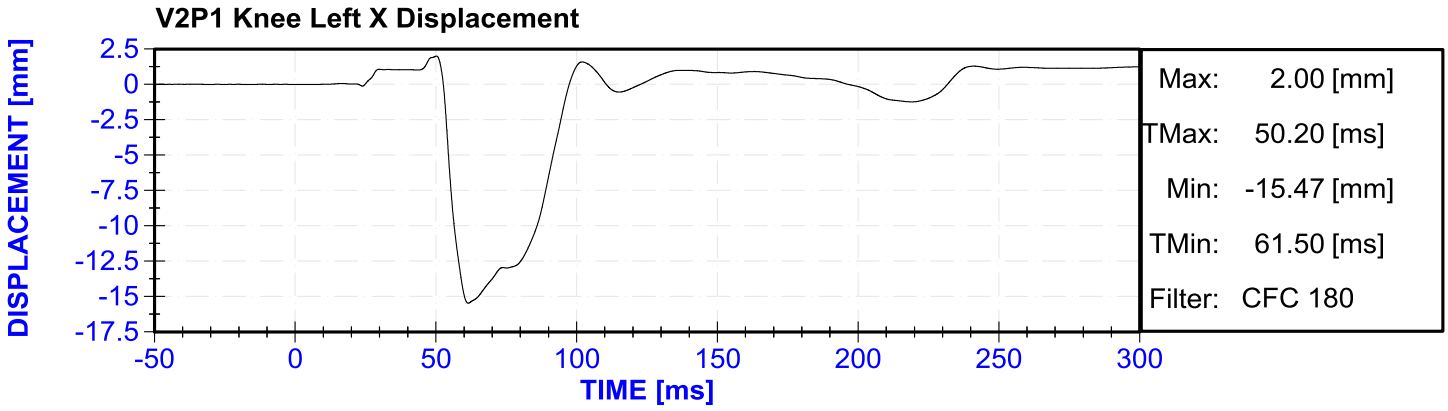

V2P1 Femur Right Y Force
FORCE [N]
TIME [ms]
Max: 606.27 [N]
TMax: 49.10 [ms]
Min: -69.33 [N]
TMin: 51.25 [ms]
Filter: CFC 600

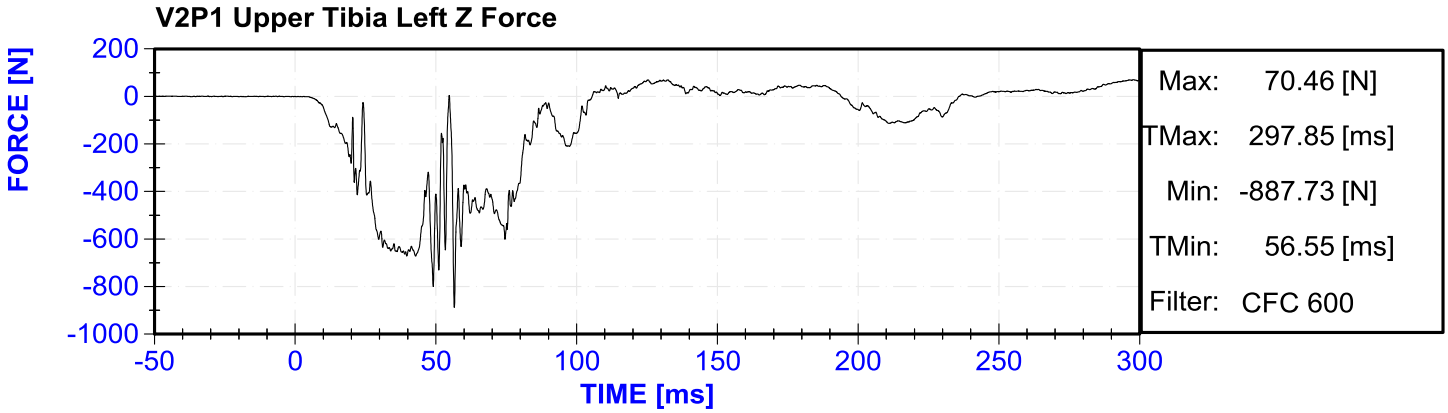

V2P1 Femur Right Z Force
FORCE [N]
TIME [ms]
Max: 282.72 [N]
TMax: 26.85 [ms]
Min: -8080.42 [N]
TMin: 56.80 [ms]
Filter: CFC 600

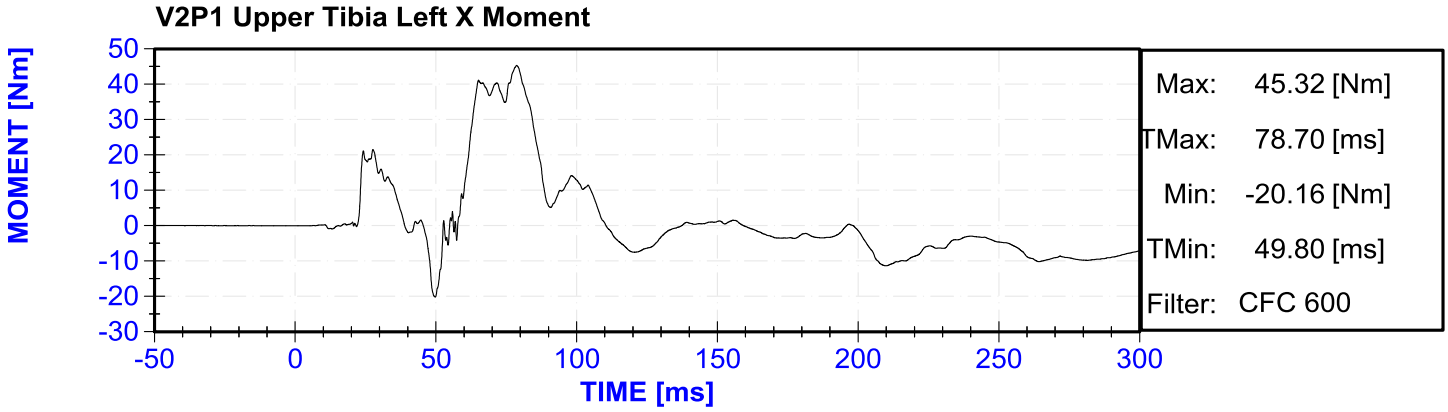

V2P1 Femur Right X Moment
MOMENT [Nm]
TIME [ms]
Max: 27.99 [Nm]
TMax: 94.90 [ms]
Min: -132.31 [Nm]
TMin: 50.90 [ms]
Filter: CFC 600

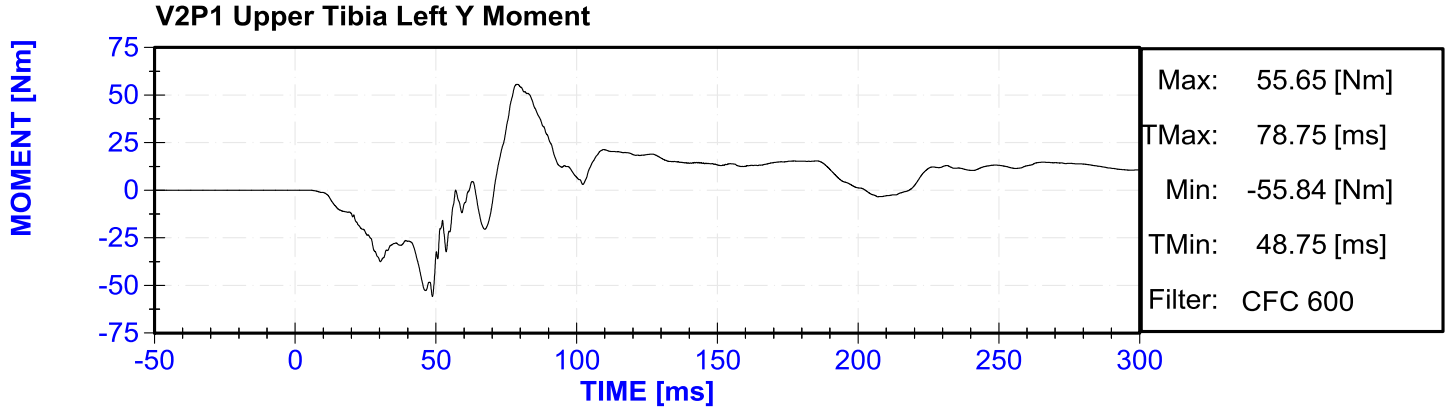

V2P1 Femur Right Y Moment
MOMENT [Nm]
TIME [ms]
Max: 83.00 [Nm]
TMax: 69.00 [ms]
Min: -16.95 [Nm]
TMin: 103.10 [ms]
Filter: CFC 600

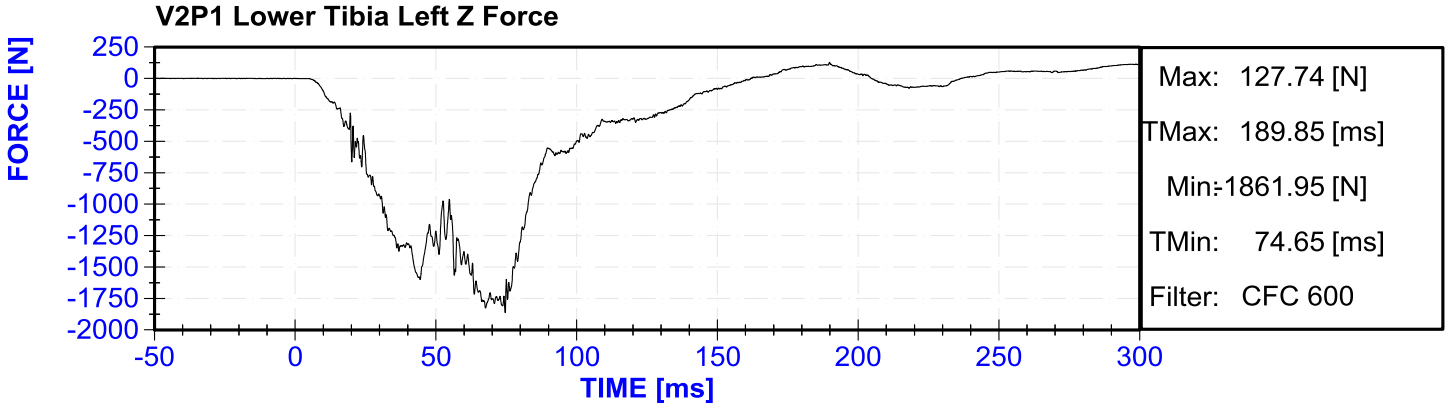

V2P1 Femur Right Z Moment
MOMENT [Nm]
TIME [ms]
Max: 44.67 [Nm]
TMax: 50.70 [ms]
Min: -18.82 [Nm]
TMin: 52.70 [ms]
Filter: CFC 600

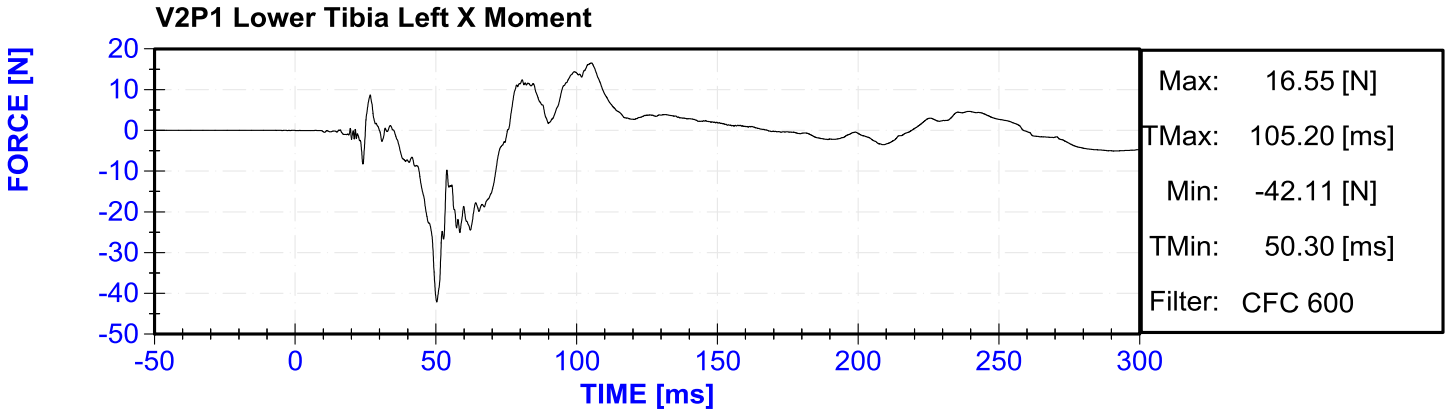

V2P1 Knee Left X Displacement
DISPLACEMENT [mm]
TIME [ms]
Max: 2.00 [mm]
TMax: 50.20 [ms]
Min: -15.47 [mm]
TMin: 61.50 [ms]
Filter: CFC 180

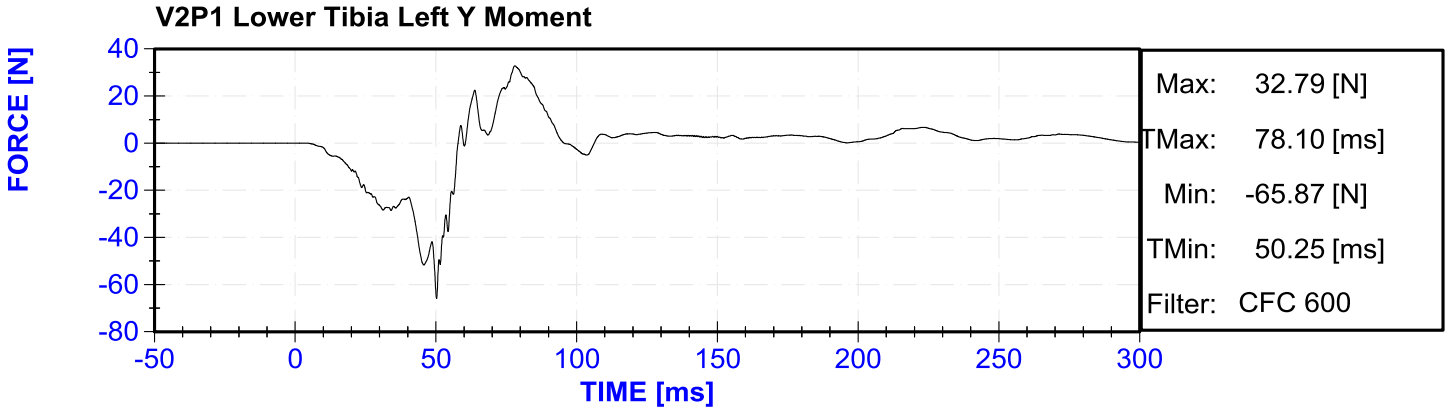

V2P1 Upper Tibia Left Z Force
FORCE [N]
TIME [ms]
Max: 70.46 [N]
TMax: 297.85 [ms]
Min: -887.73 [N]
TMin: 56.55 [ms]
Filter: CFC 600

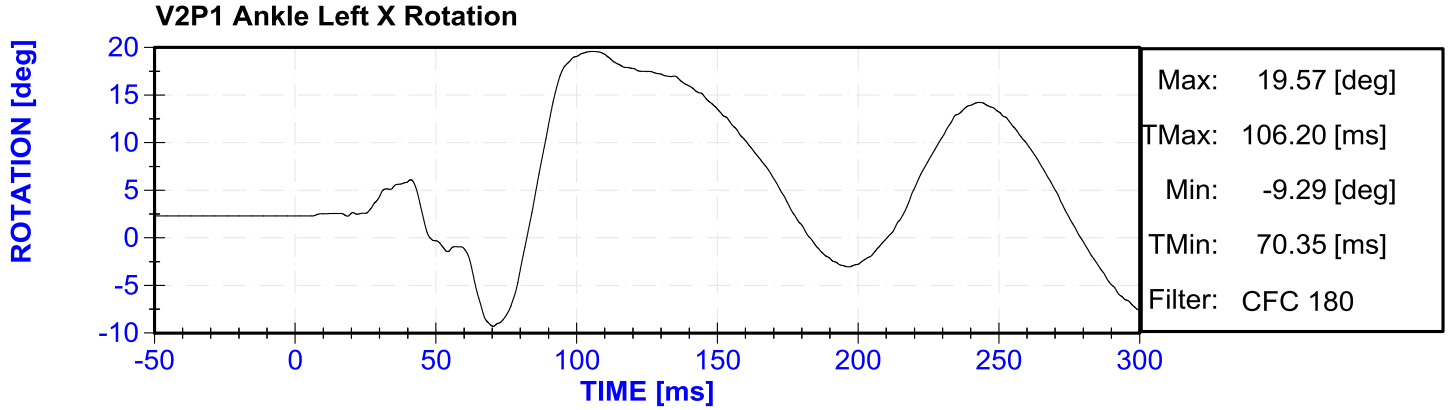

V2P1 Upper Tibia Left X Moment
MOMENT [Nm]
TIME [ms]
Max: 45.32 [Nm]
TMax: 78.70 [ms]
Min: -20.16 [Nm]
TMin: 49.80 [ms]
Filter: CFC 600

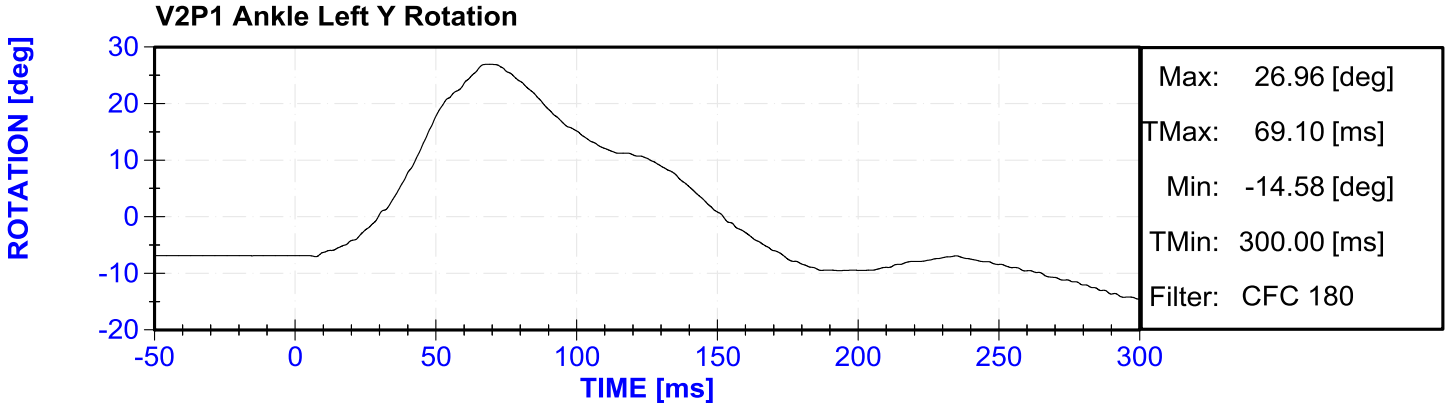

V2P1 Upper Tibia Left Y Moment
MOMENT [Nm]
TIME [ms]
Max: 55.65 [Nm]
TMax: 78.75 [ms]
Min: -55.84 [Nm]
TMin: 48.75 [ms]
Filter: CFC 600

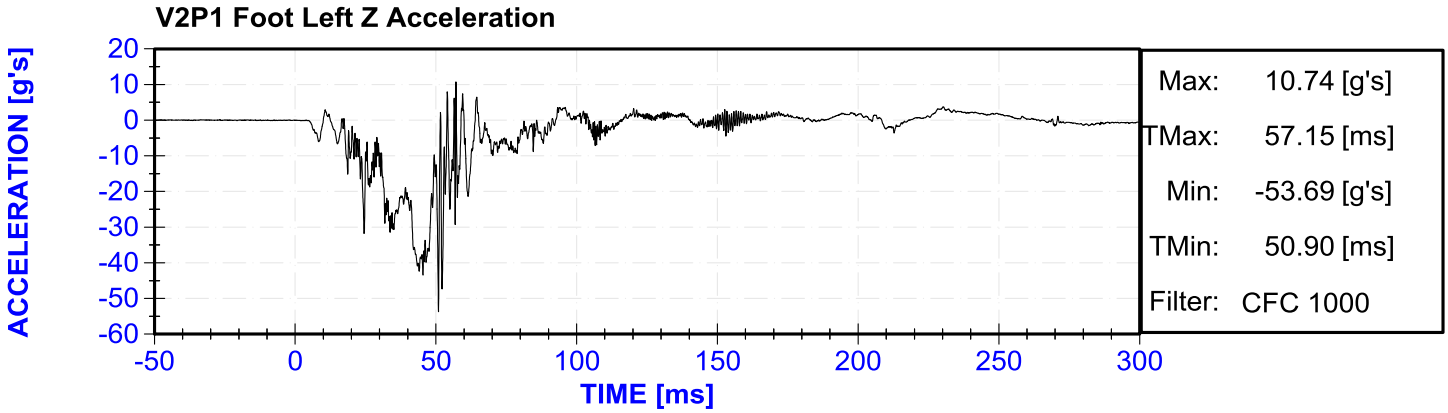

V2P1 Lower Tibia Left Z Force
FORCE [N]
TIME [ms]
Max: 127.74 [N]
TMax: 189.85 [ms]
Min: -1861.95 [N]
TMin: 74.65 [ms]
Filter: CFC 600

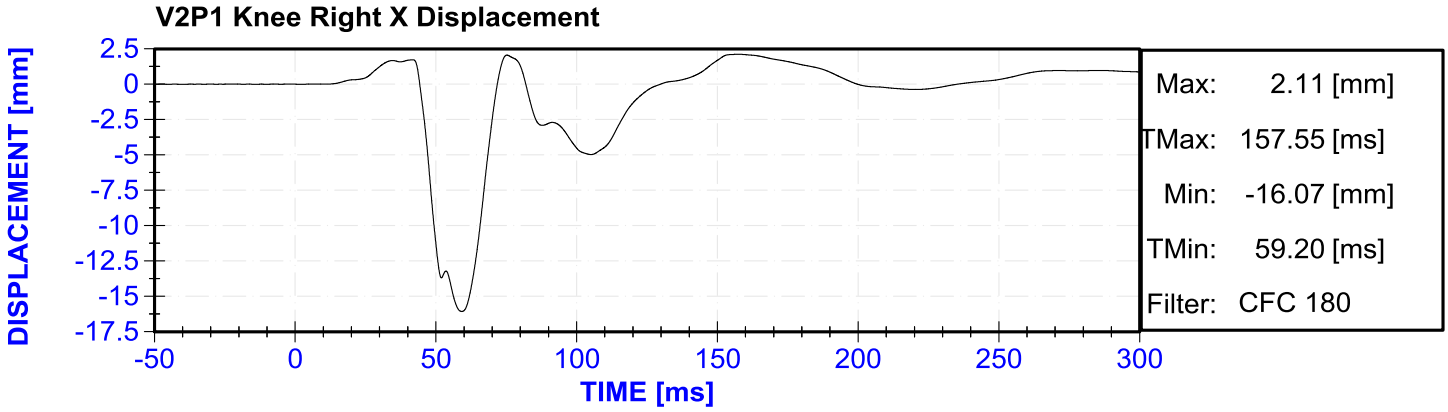

V2P1 Lower Tibia Left X Moment
FORCE [N]
TIME [ms]
Max: 16.55 [N]
TMax: 105.20 [ms]
Min: -42.11 [N]
TMin: 50.30 [ms]
Filter: CFC 600

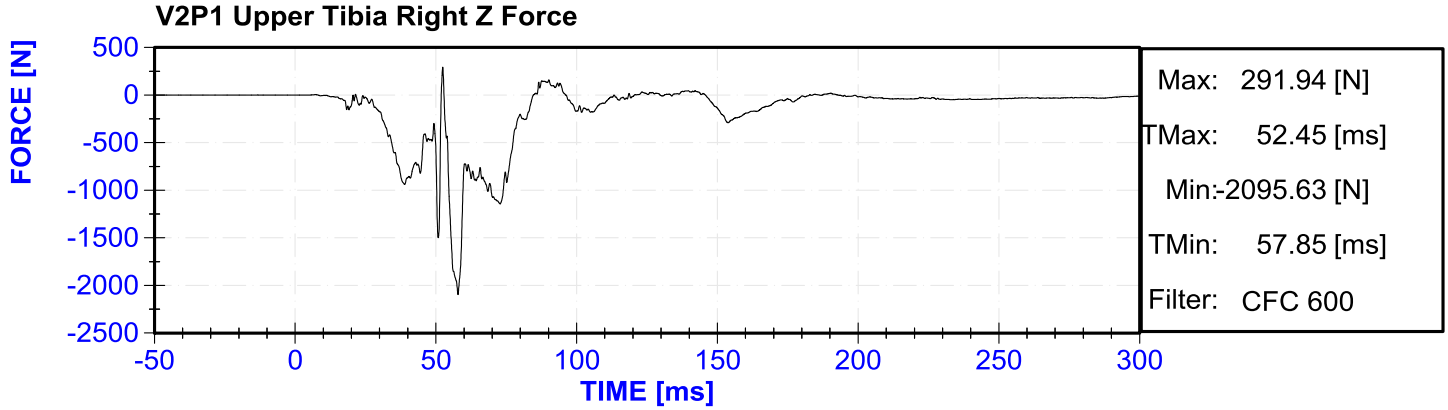

V2P1 Lower Tibia Left Y Moment
FORCE [N]
TIME [ms]
Max: 32.79 [N]
TMax: 78.10 [ms]
Min: -65.87 [N]
TMin: 50.25 [ms]
Filter: CFC 600

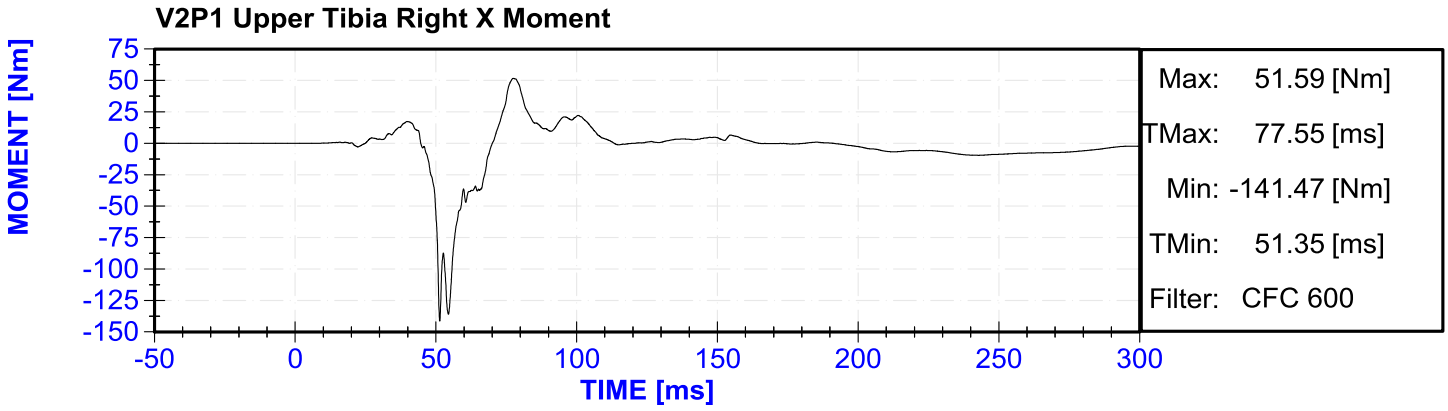

V2P1 Ankle Left X Rotation
ROTATION [deg]
TIME [ms]
Max: 19.57 [deg]
TMax: 106.20 [ms]
Min: -9.29 [deg]
TMin: 70.35 [ms]
Filter: CFC 180


V2P1 Ankle Left Y Rotation
ROTATION [deg]
TIME [ms]
Max: 26.96 [deg]
TMax: 69.10 [ms]
Min: -14.58 [deg]
TMin: 300.00 [ms]
Filter: CFC 180

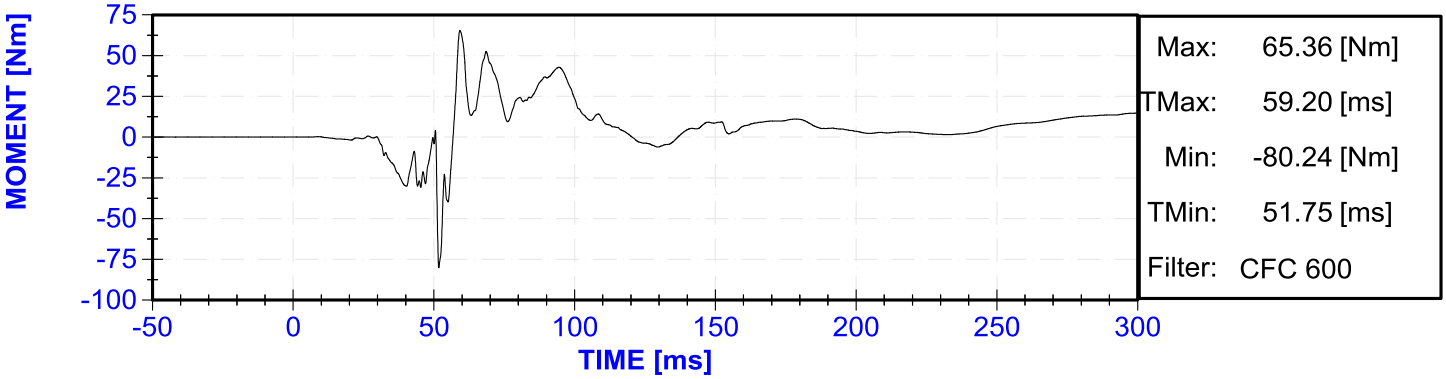

V2P1 Foot Left Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 10.74 [g's]
TMax: 57.15 [ms]
Min: -53.69 [g's]
TMin: 50.90 [ms]
Filter: CFC 1000


V2P1 Knee Right X Displacement
DISPLACEMENT [mm]
TIME [ms]
Max: 2.11 [mm]
TMax: 157.55 [ms]
Min: -16.07 [mm]
TMin: 59.20 [ms]
Filter: CFC 180

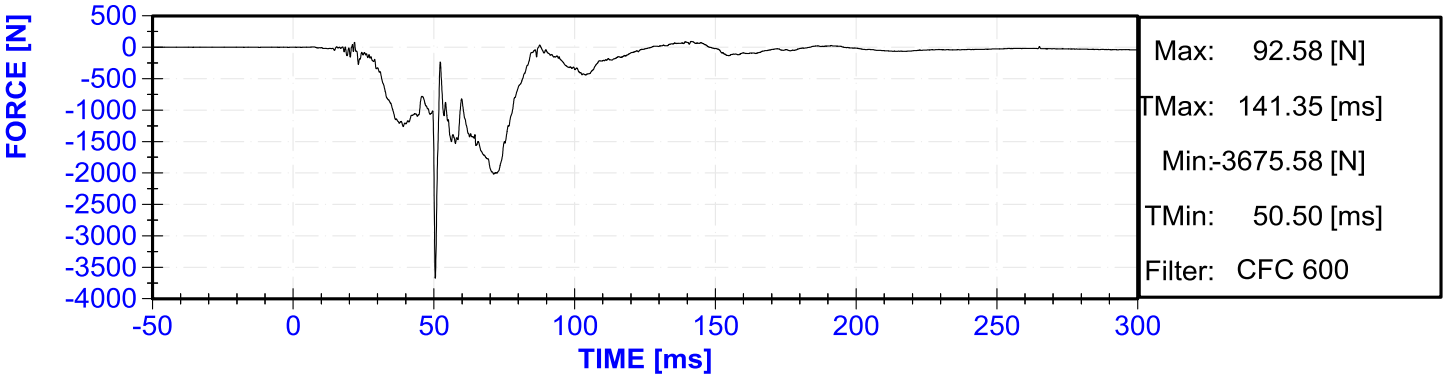

V2P1 Upper Tibia Right Z Force
FORCE [N]
TIME [ms]
Max: 291.94 [N]
TMax: 52.45 [ms]
Min:-2095.63 [N]
TMin: 57.85 [ms]
Filter: CFC 600


V2P1 Upper Tibia Right X Moment
MOMENT [Nm]
TIME [ms]
Max: 51.59 [Nm]
TMax: 77.55 [ms]
Min: -141.47 [Nm]
TMin: 51.35 [ms]
Filter: CFC 600

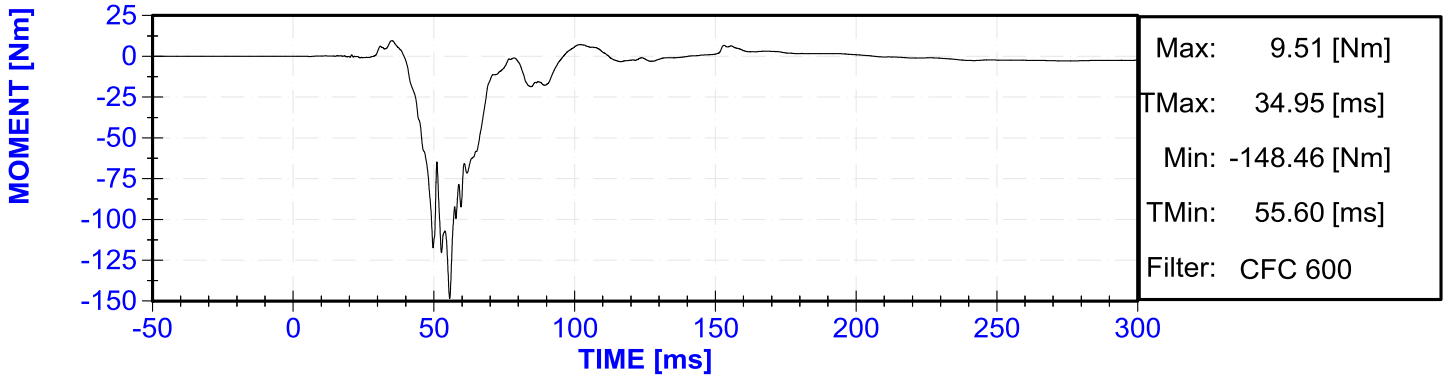
V2P1 Upper Tibia Right Y Moment



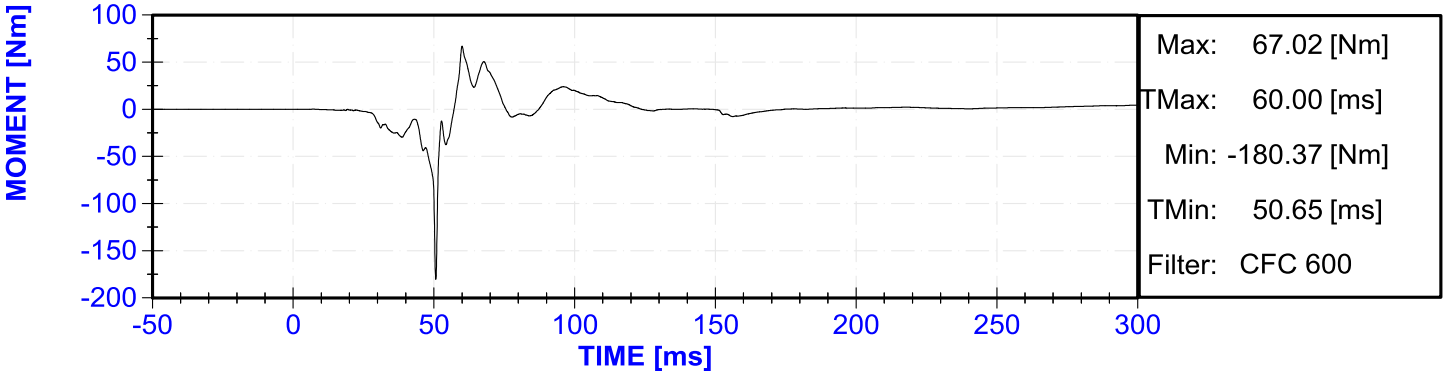
V2P1 Lower Tibia Right Z Force

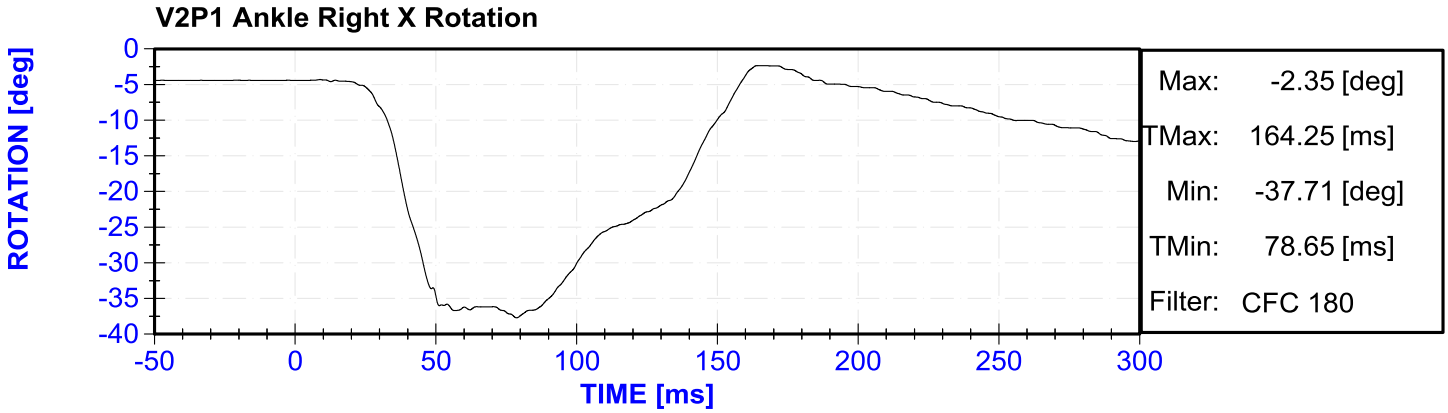


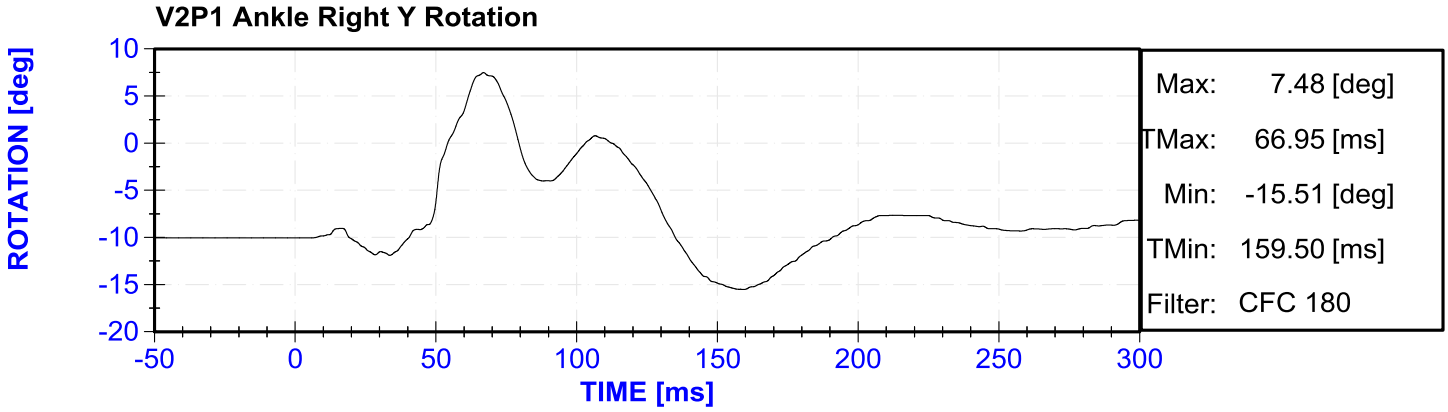
V2P1 Lower Tibia Right X Moment

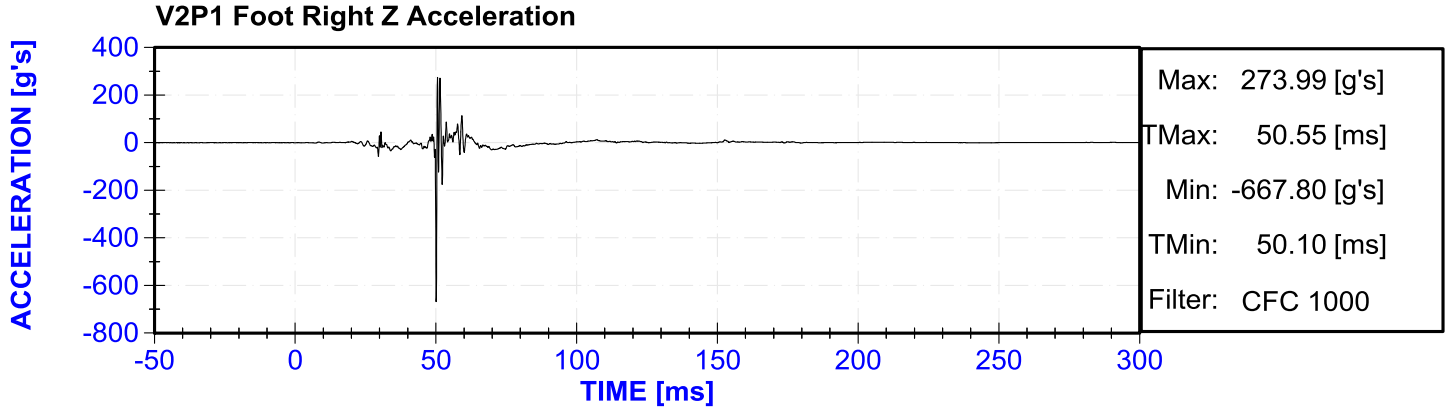


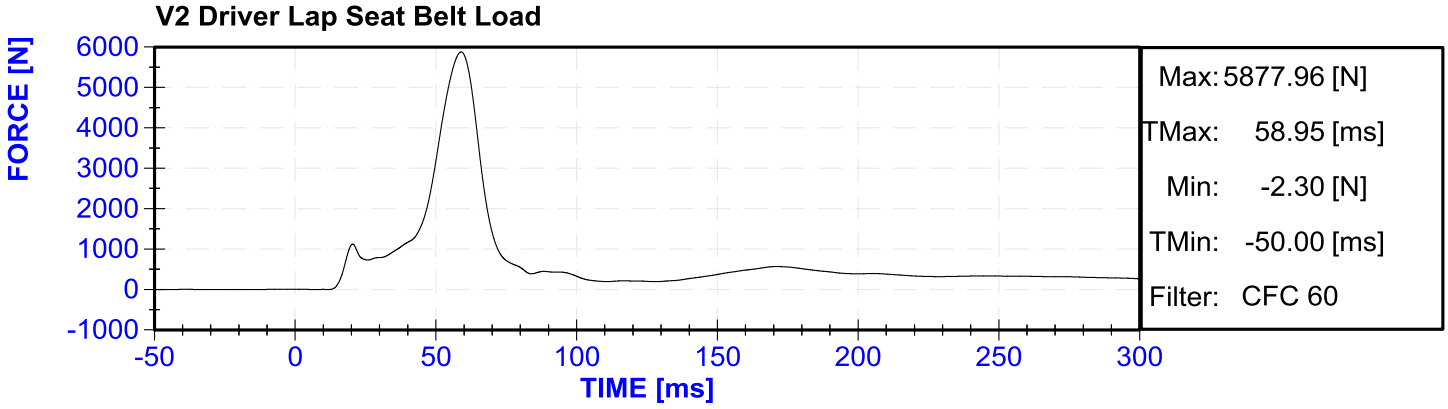
V2P1 Lower Tibia Right Y Moment



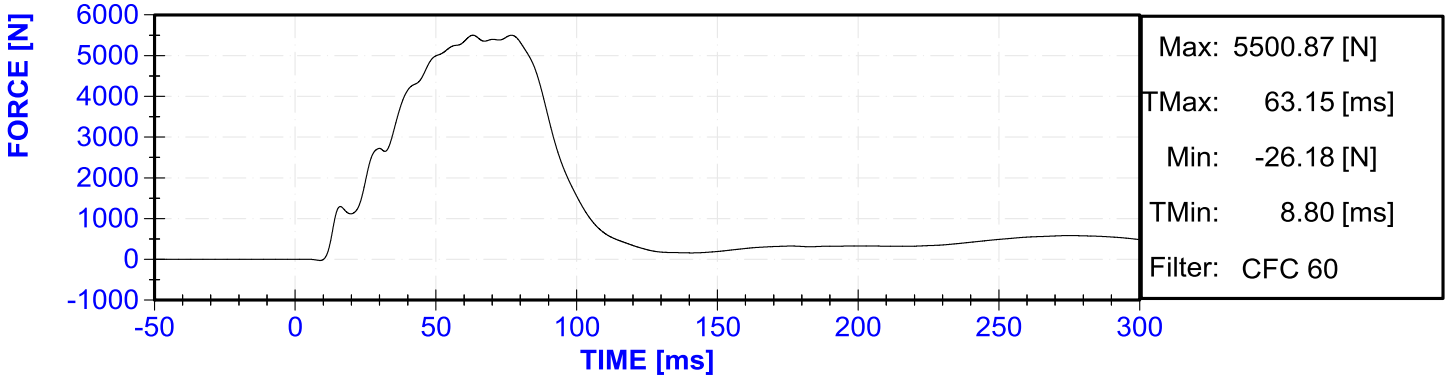

V2P1 Ankle Right X Rotation
ROTATION [deg]
TIME [ms]
Max: -2.35 [deg]
TMax: 164.25 [ms]
Min: -37.71 [deg]
TMin: 78.65 [ms]
Filter: CFC 180


V2P1 Ankle Right Y Rotation
ROTATION [deg]
TIME [ms]
Max: 7.48 [deg]
TMax: 66.95 [ms]
Min: -15.51 [deg]
TMin: 159.50 [ms]
Filter: CFC 180

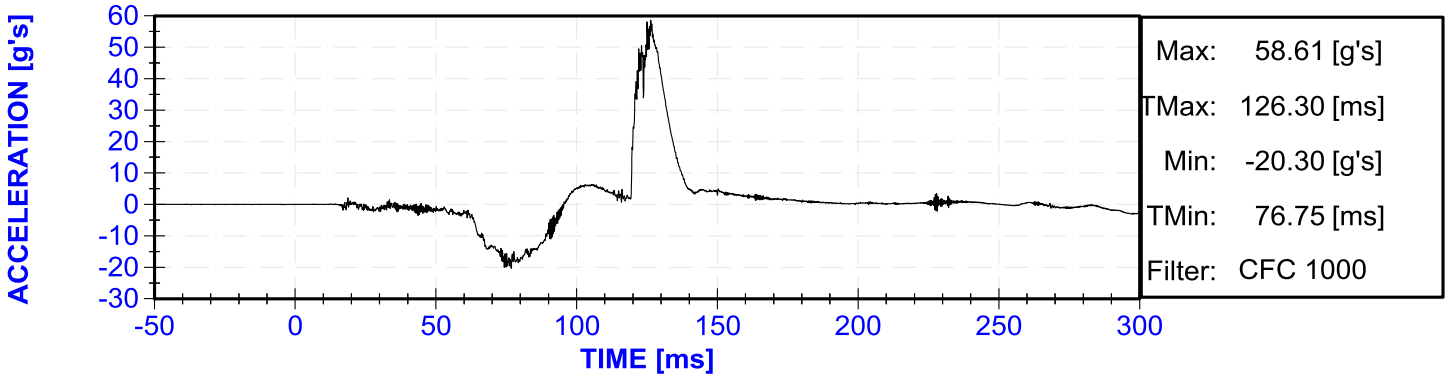

V2P1 Foot Right Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 273.99 [g's]
TMax: 50.55 [ms]
Min: -667.80 [g's]
TMin: 50.10 [ms]
Filter: CFC 1000


V2 Driver Lap Seat Belt Load
FORCE [N]
TIME [ms]
Max: 5877.96 [N]
TMax: 58.95 [ms]
Min: -2.30 [N]
TMin: -50.00 [ms]
Filter: CFC 60

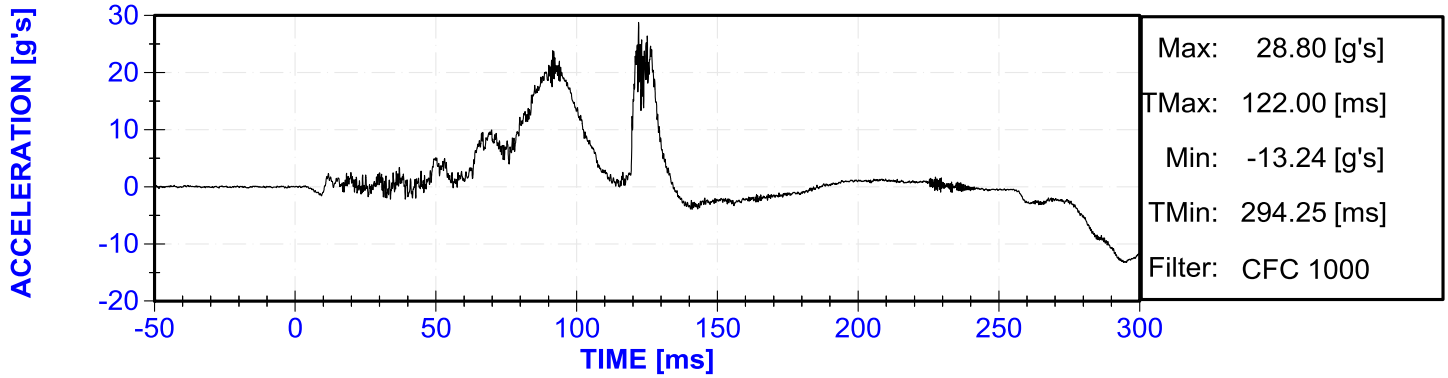
V2 Driver Shoulder Seat Belt Load



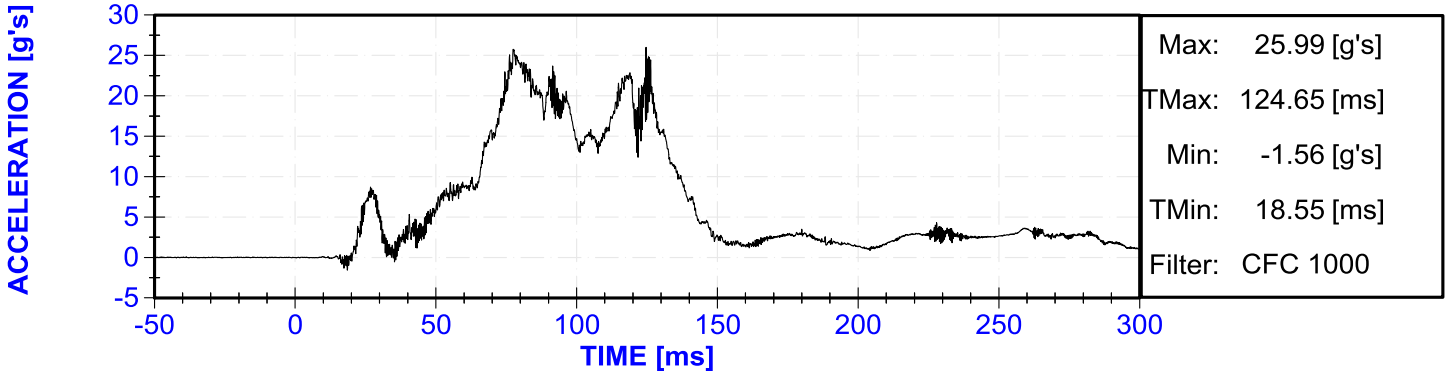
V2P2 Head CG X Acceleration

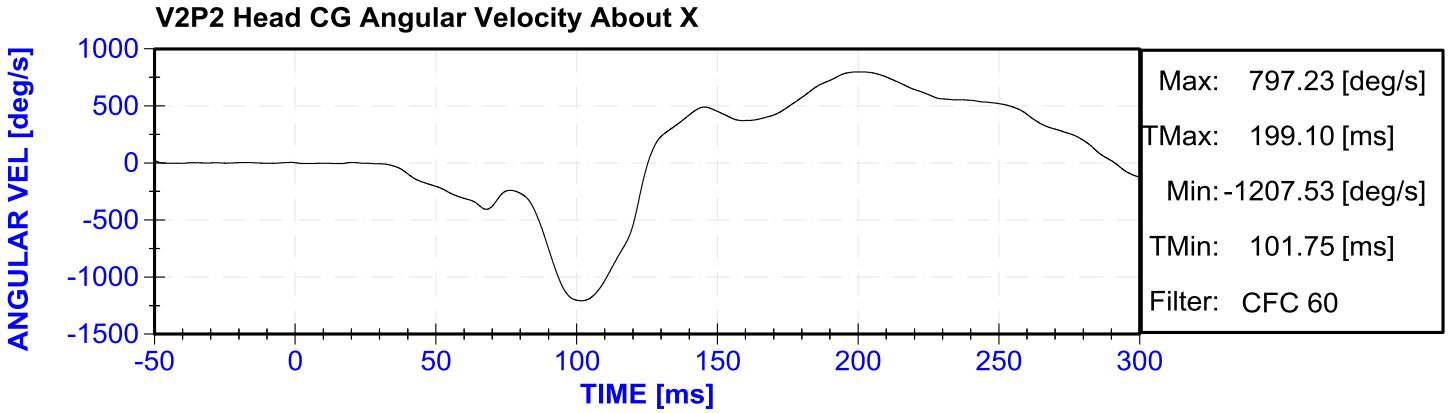


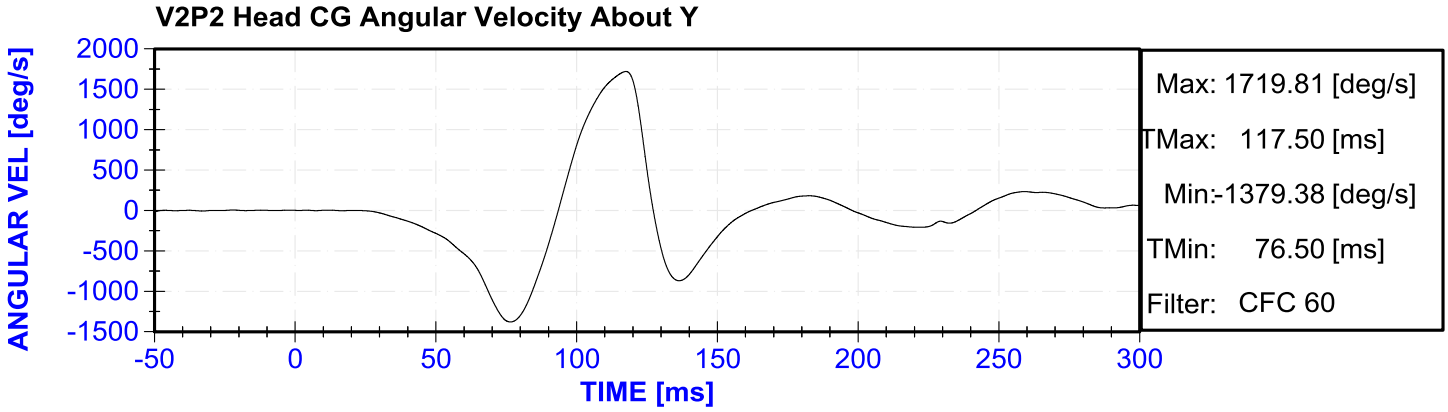
V2P2 Head CG Y Acceleration

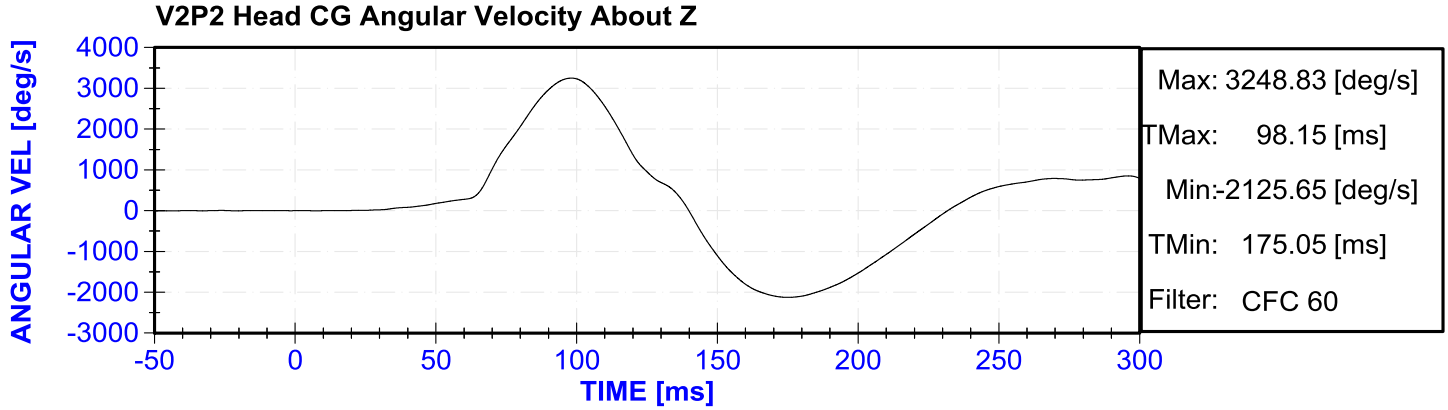


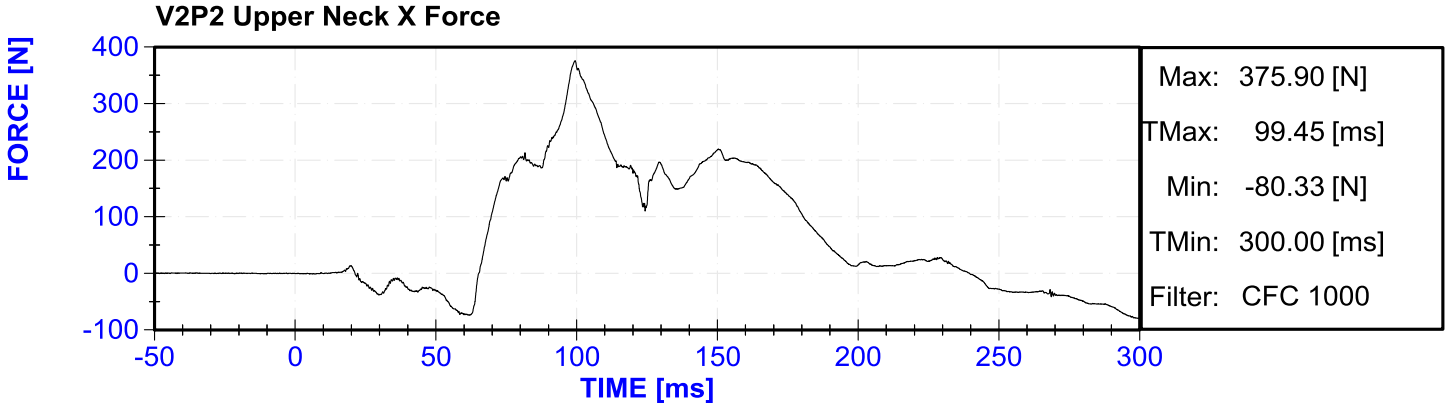
V2P2 Head CG Z Acceleration

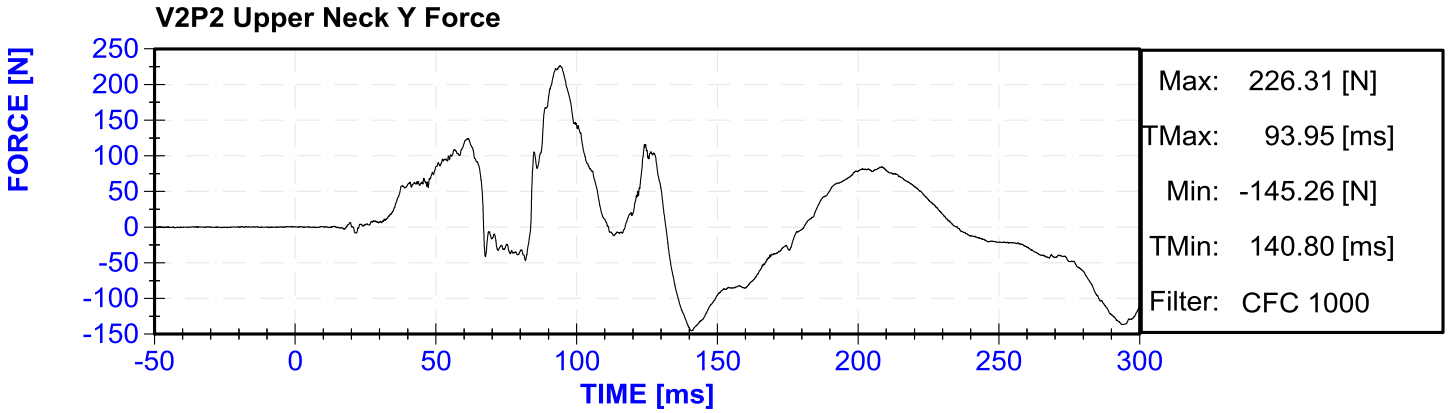


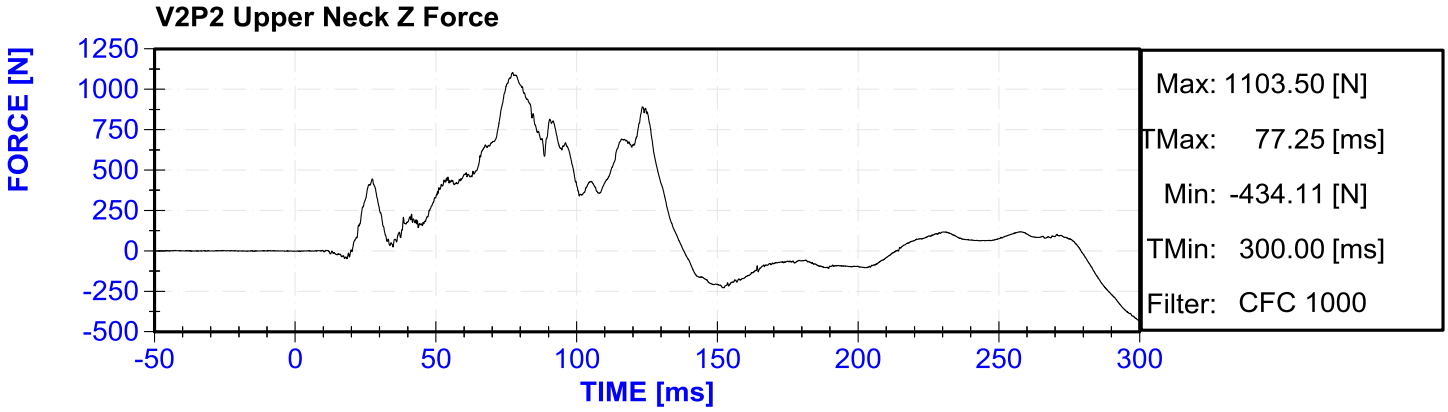

V2P2 Head CG Angular Velocity About X
ANGULAR VEL [deg/s]
1000
500
0
-500
-1000
-1500
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 797.23 [deg/s]
TMax: 199.10 [ms]
Min: -1207.53 [deg/s]
TMin: 101.75 [ms]
Filter: CFC 60

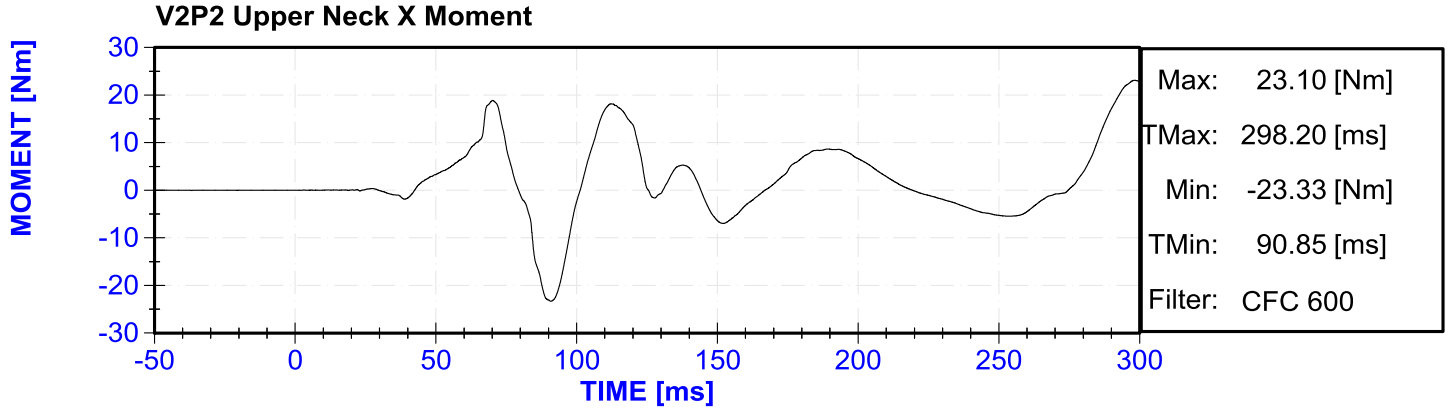

V2P2 Head CG Angular Velocity About Y
ANGULAR VEL [deg/s]
2000
1500
1000
500
0
-500
-1000
-1500
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 1719.81 [deg/s]
TMax: 117.50 [ms]
Min: -1379.38 [deg/s]
TMin: 76.50 [ms]
Filter: CFC 60

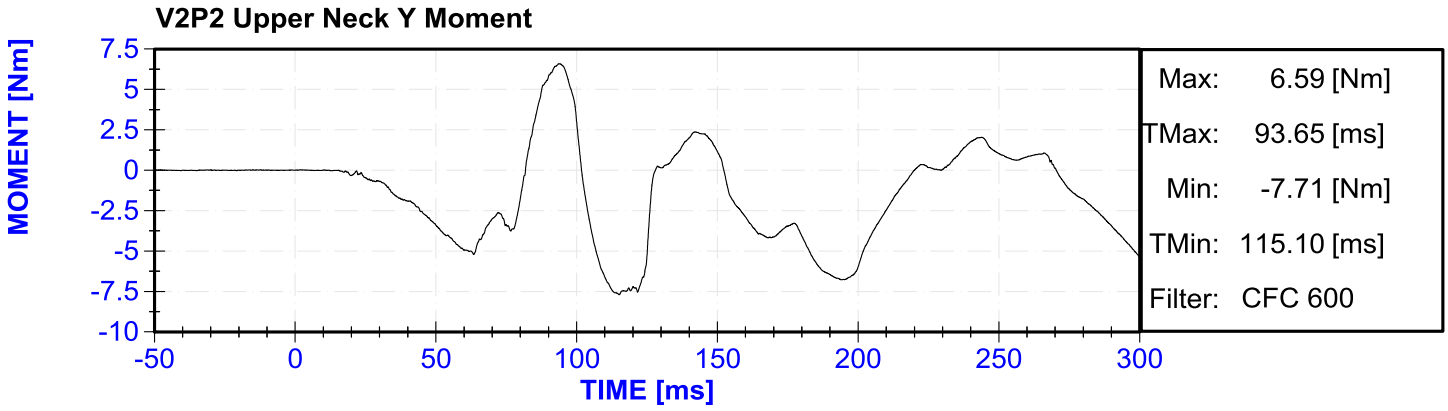

V2P2 Head CG Angular Velocity About Z
ANGULAR VEL [deg/s]
4000
3000
2000
1000
0
-1000
-2000
-3000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 3248.83 [deg/s]
TMax: 98.15 [ms]
Min: -2125.65 [deg/s]
TMin: 175.05 [ms]
Filter: CFC 60


V2P2 Upper Neck X Force
FORCE [N]
400
300
200
100
0
-100
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 375.90 [N]
TMax: 99.45 [ms]
Min: -80.33 [N]
TMin: 300.00 [ms]
Filter: CFC 1000

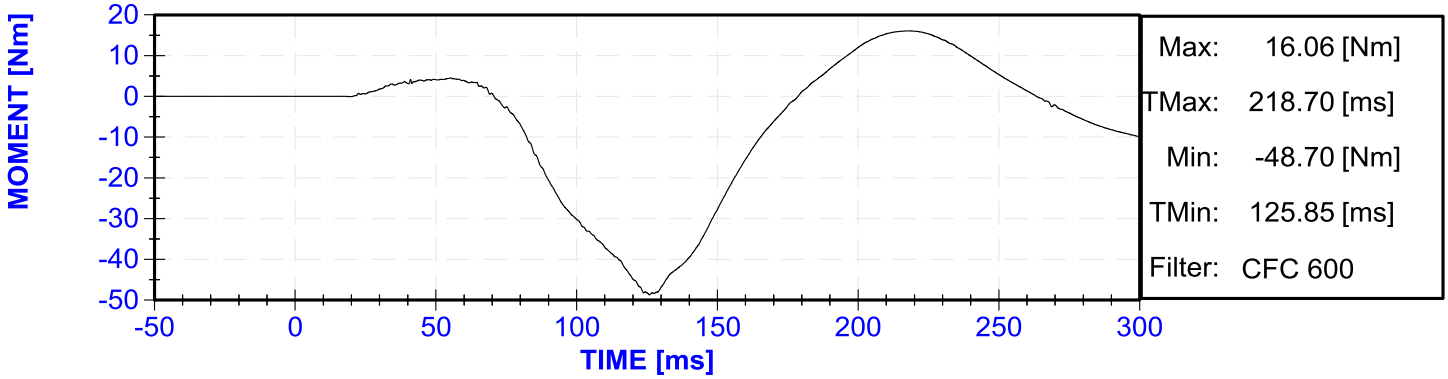

V2P2 Upper Neck Y Force
FORCE [N]
TIME [ms]
Max: 226.31 [N]
TMax: 93.95 [ms]
Min: -145.26 [N]
TMin: 140.80 [ms]
Filter: CFC 1000


V2P2 Upper Neck Z Force
FORCE [N]
TIME [ms]
Max: 1103.50 [N]
TMax: 77.25 [ms]
Min: -434.11 [N]
TMin: 300.00 [ms]
Filter: CFC 1000

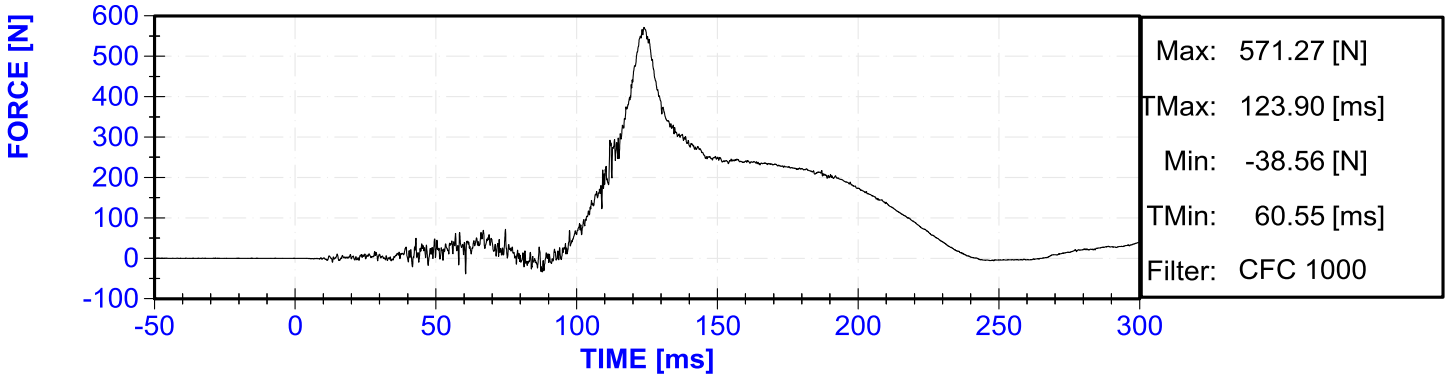

V2P2 Upper Neck X Moment
MOMENT [Nm]
TIME [ms]
Max: 23.10 [Nm]
TMax: 298.20 [ms]
Min: -23.33 [Nm]
TMin: 90.85 [ms]
Filter: CFC 600


V2P2 Upper Neck Y Moment
MOMENT [Nm]
TIME [ms]
Max: 6.59 [Nm]
TMax: 93.65 [ms]
Min: -7.71 [Nm]
TMin: 115.10 [ms]
Filter: CFC 600

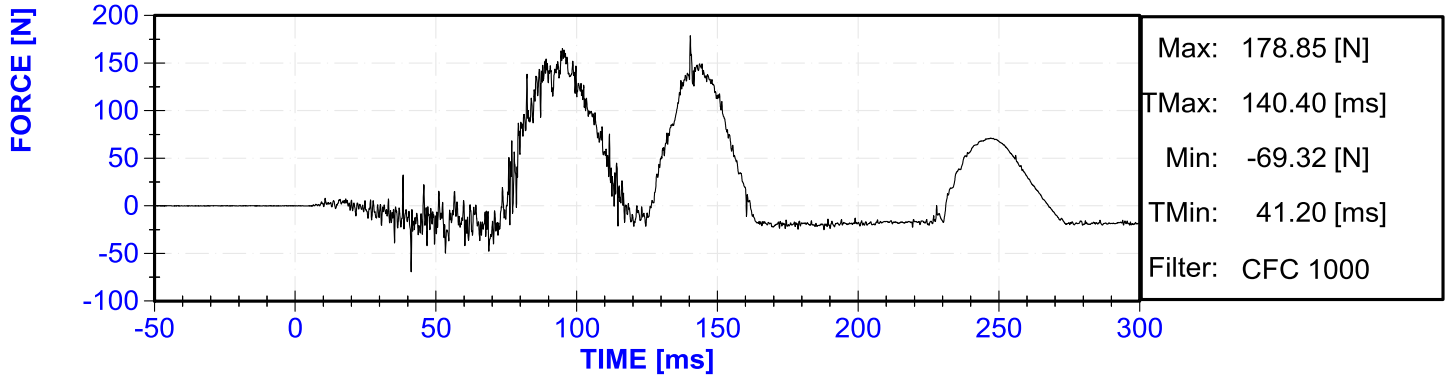
V2P2 Upper Neck Z Moment



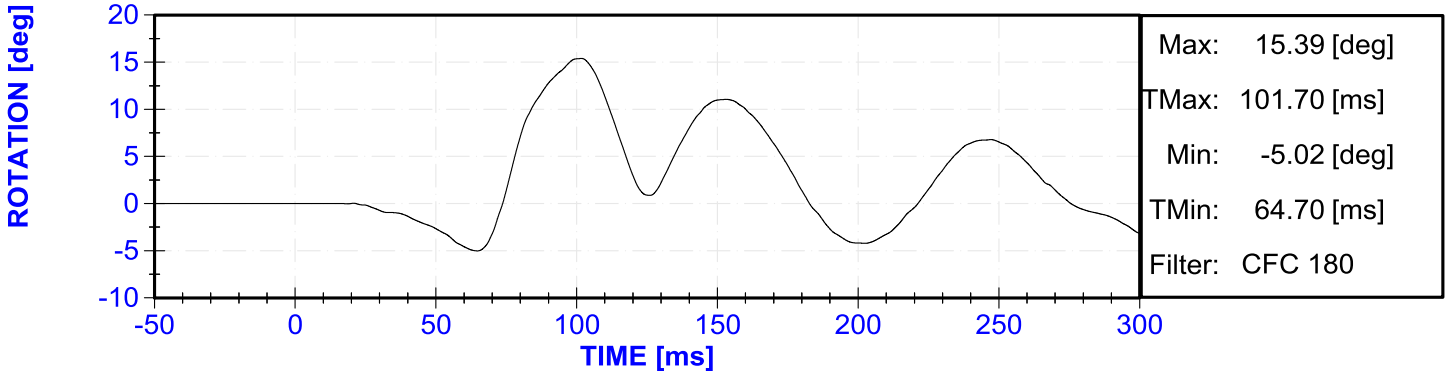
V2P2 Front Neck Spring Tower Load Cell

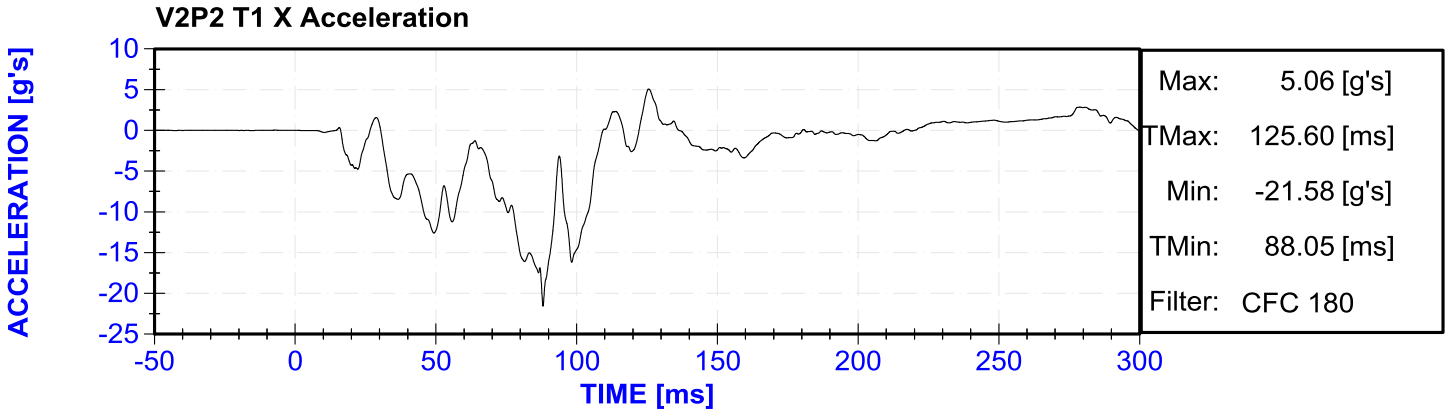


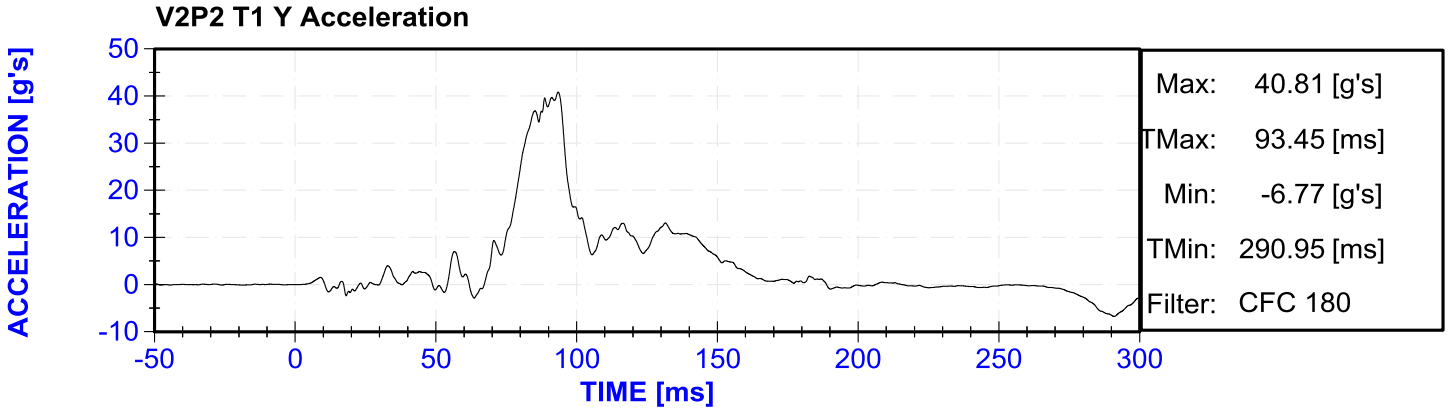
V2P2 Rear Neck Spring Tower Load Cell

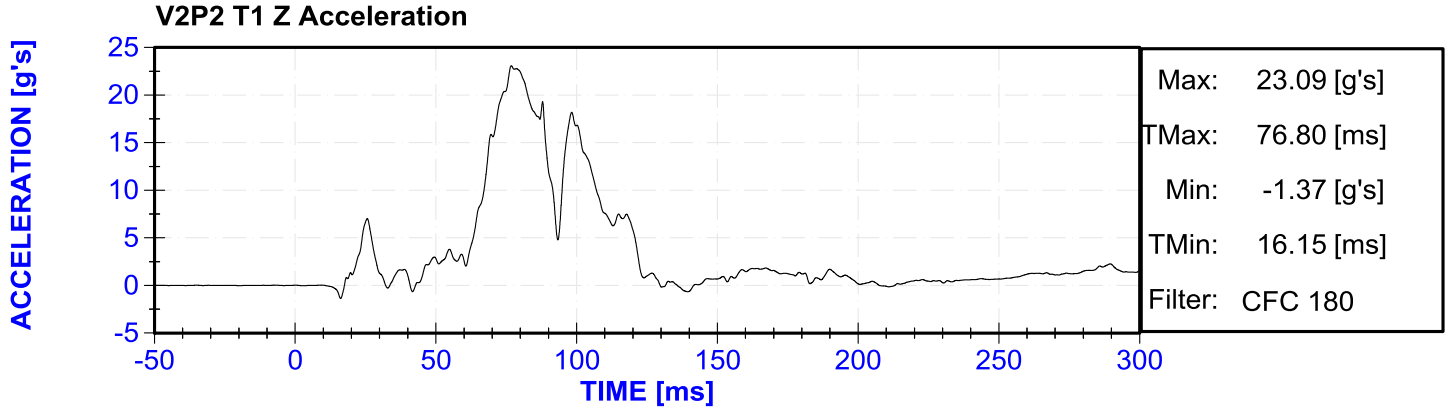


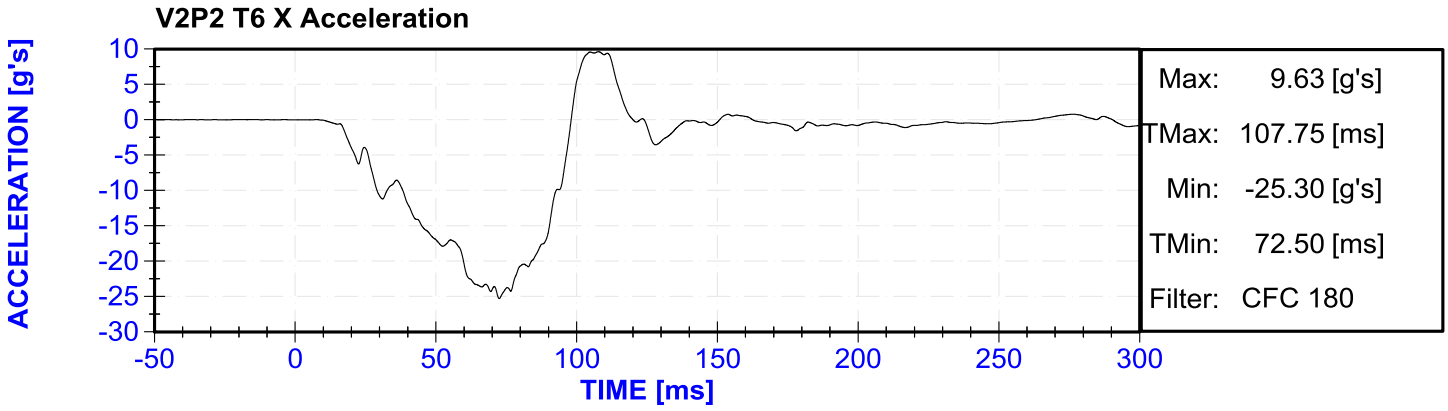
V2P2 Occipital Condyle Rotation Potentiometer



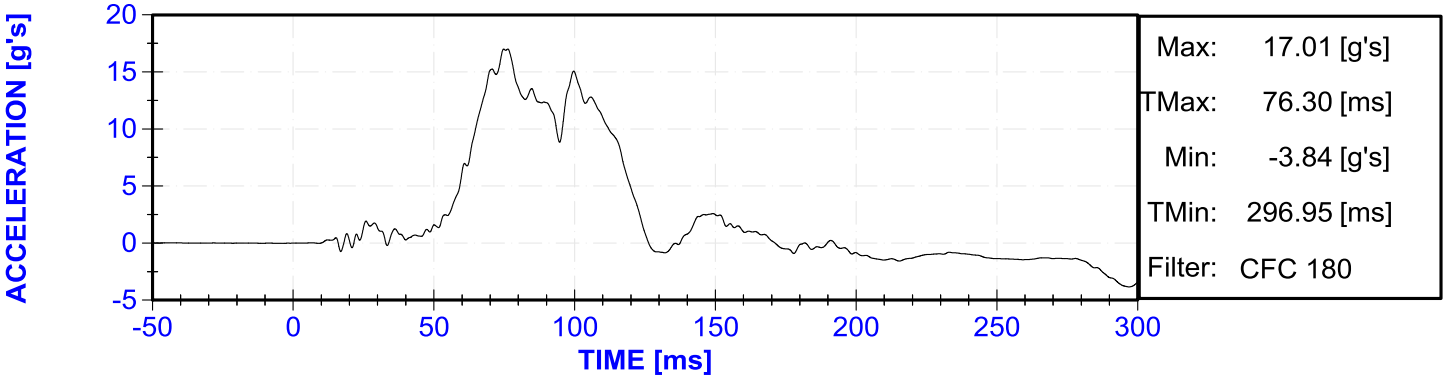

V2P2 T1 X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 5.06 [g's]
TMax: 125.60 [ms]
Min: -21.58 [g's]
TMin: 88.05 [ms]
Filter: CFC 180


V2P2 T1 Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 40.81 [g's]
TMax: 93.45 [ms]
Min: -6.77 [g's]
TMin: 290.95 [ms]
Filter: CFC 180

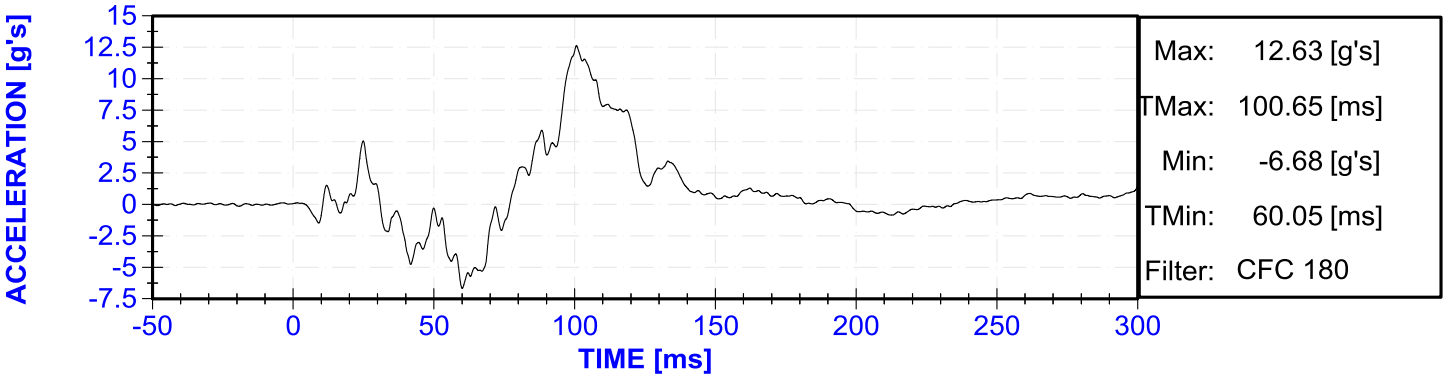

V2P2 T1 Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 23.09 [g's]
TMax: 76.80 [ms]
Min: -1.37 [g's]
TMin: 16.15 [ms]
Filter: CFC 180


V2P2 T6 X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 9.63 [g's]
TMax: 107.75 [ms]
Min: -25.30 [g's]
TMin: 72.50 [ms]
Filter: CFC 180

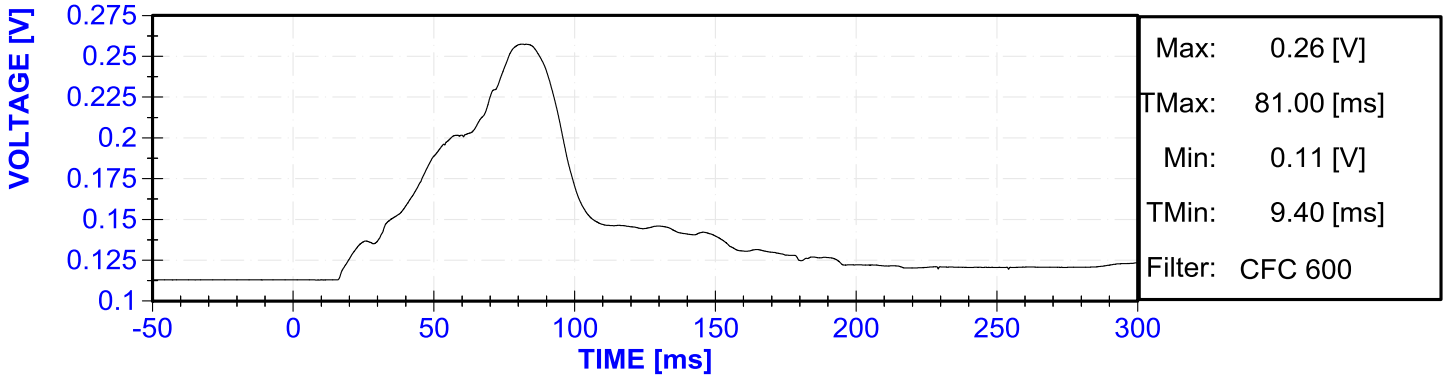
V2P2 T6 Y Acceleration



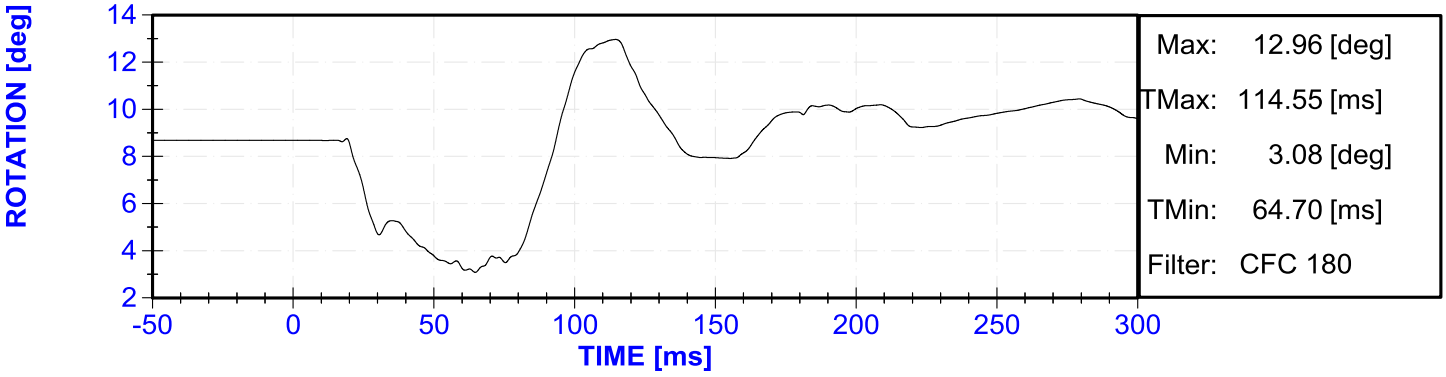
V2P2 T6 Z Acceleration

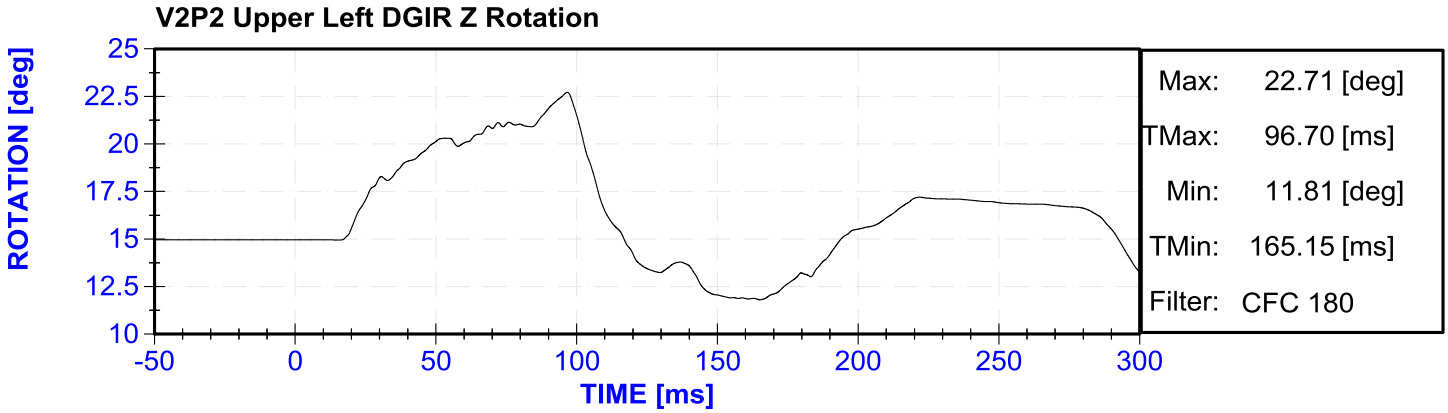


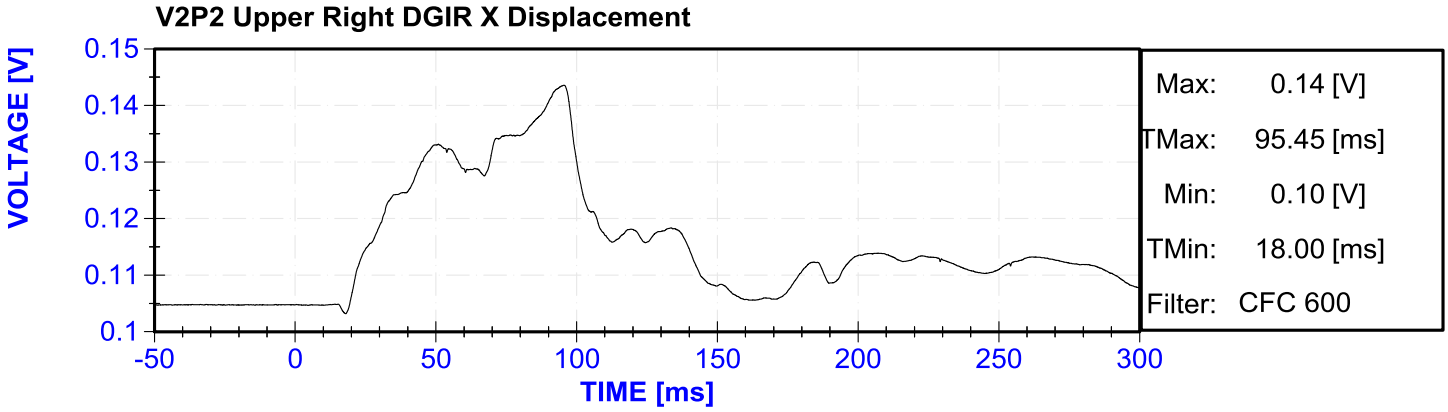
V2P2 Upper Left DGIR X Displacement

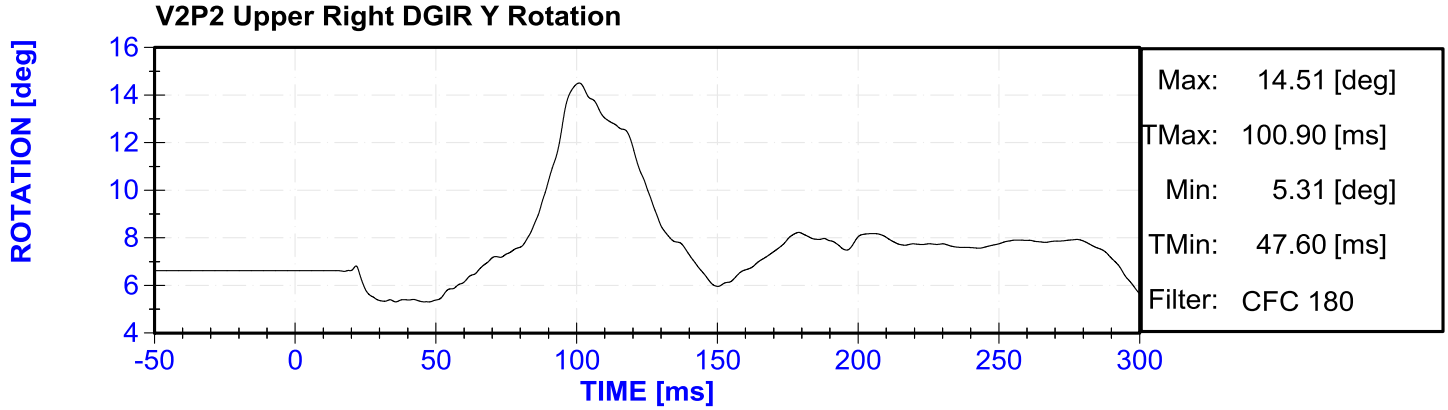


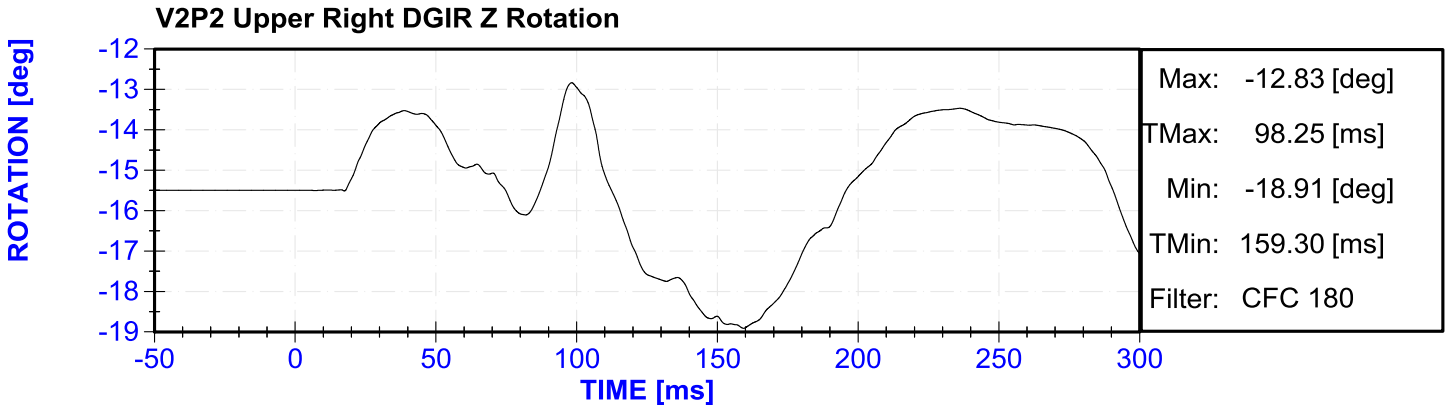
V2P2 Upper Left DGIR Y Rotation

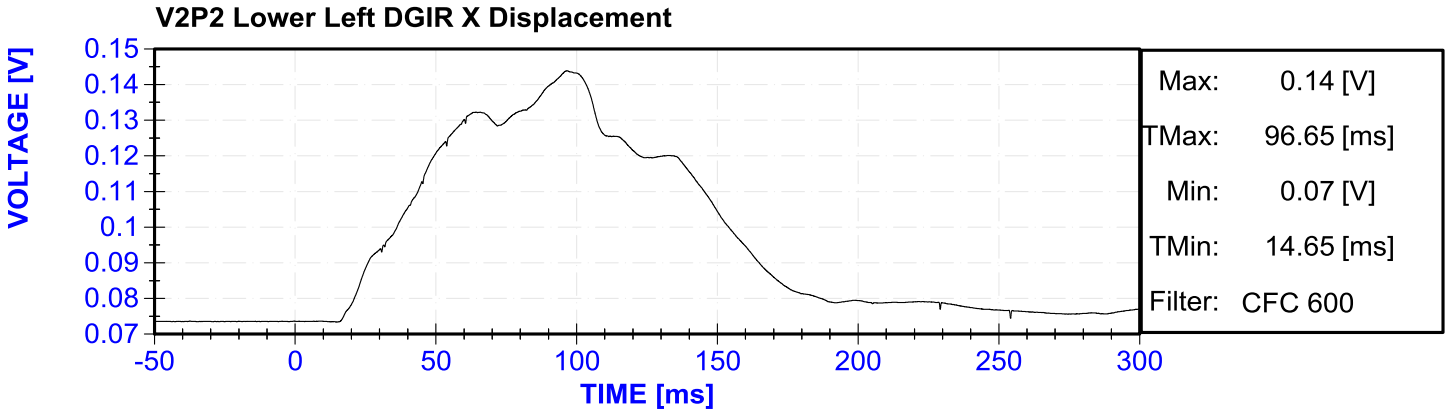


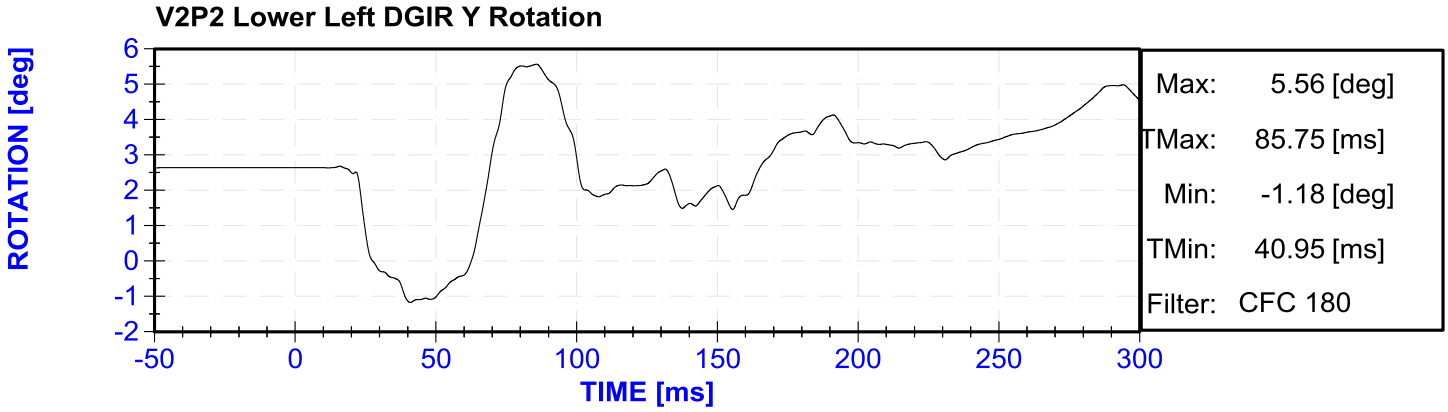

V2P2 Upper Left DGIR Z Rotation
ROTATION [deg]
TIME [ms]
Max: 22.71 [deg]
TMax: 96.70 [ms]
Min: 11.81 [deg]
TMin: 165.15 [ms]
Filter: CFC 180

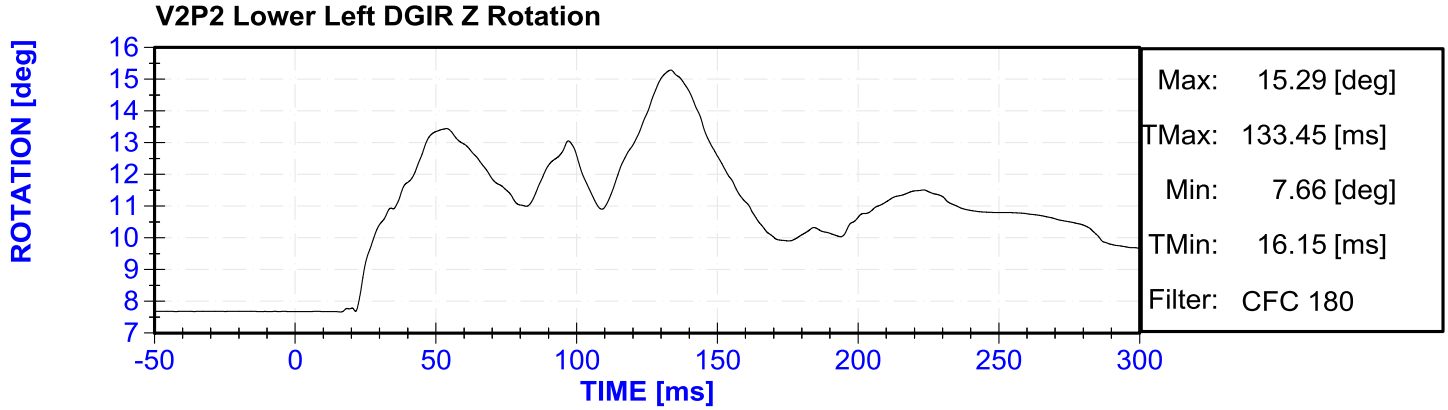

V2P2 Upper Right DGIR X Displacement
VOLTAGE [V]
TIME [ms]
Max: 0.14 [V]
TMax: 95.45 [ms]
Min: 0.10 [V]
TMin: 18.00 [ms]
Filter: CFC 600

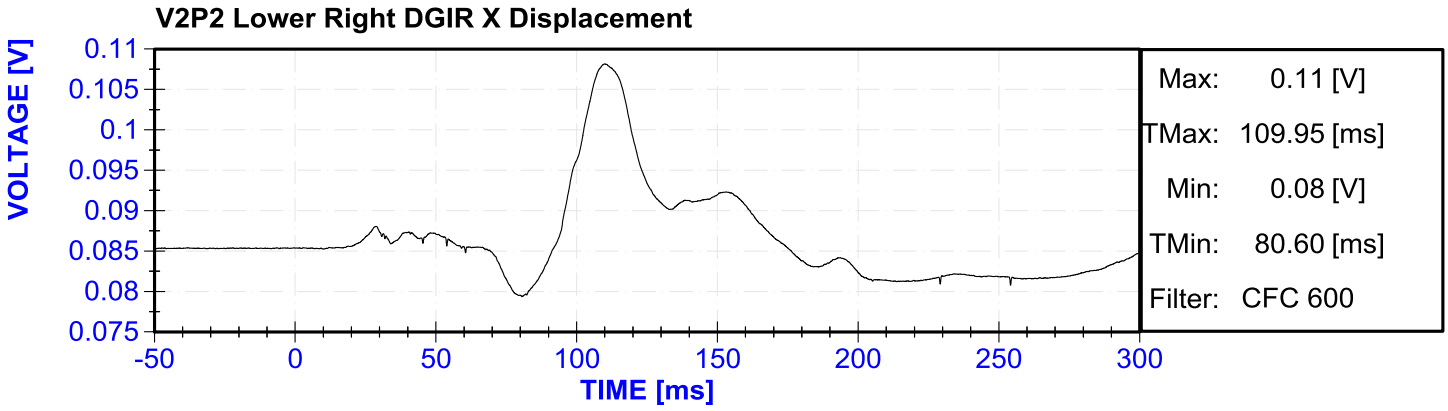

V2P2 Upper Right DGIR Y Rotation
ROTATION [deg]
TIME [ms]
Max: 14.51 [deg]
TMax: 100.90 [ms]
Min: 5.31 [deg]
TMin: 47.60 [ms]
Filter: CFC 180

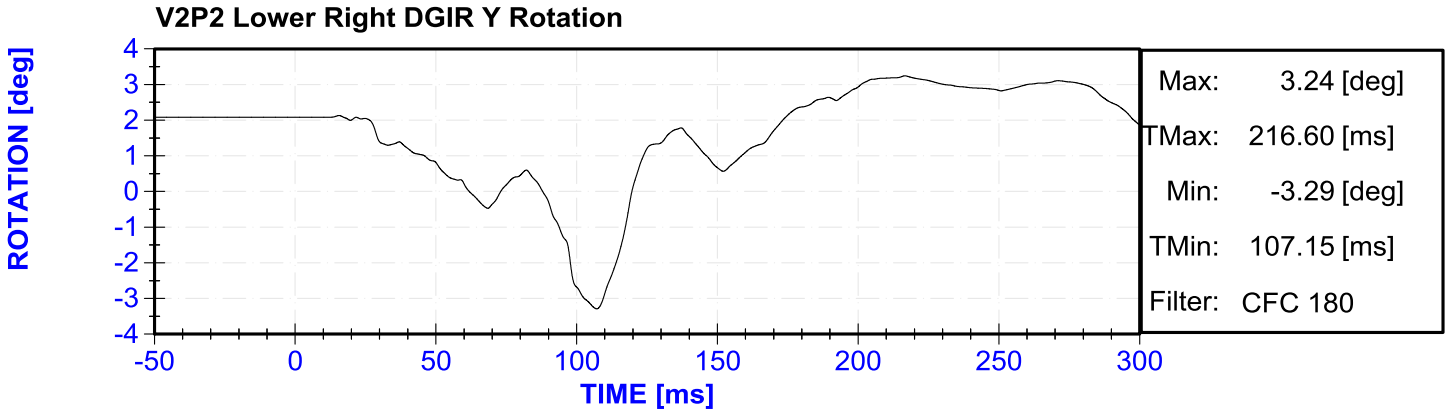

V2P2 Upper Right DGIR Z Rotation
ROTATION [deg]
TIME [ms]
Max: -12.83 [deg]
TMax: 98.25 [ms]
Min: -18.91 [deg]
TMin: 159.30 [ms]
Filter: CFC 180

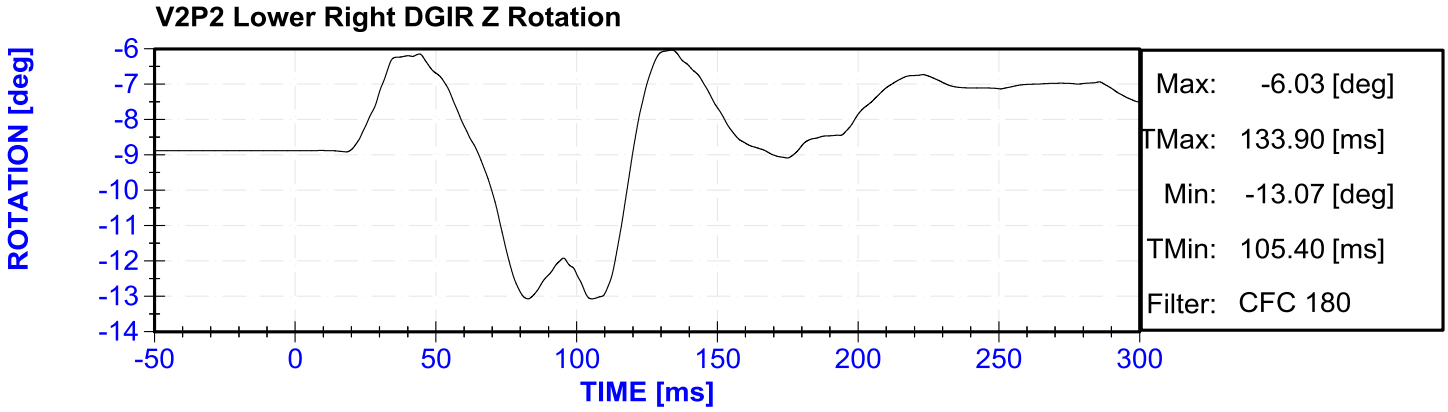

V2P2 Lower Left DGIR X Displacement
VOLTAGE [V]
TIME [ms]
Max: 0.14 [V]
TMax: 96.65 [ms]
Min: 0.07 [V]
TMin: 14.65 [ms]
Filter: CFC 600

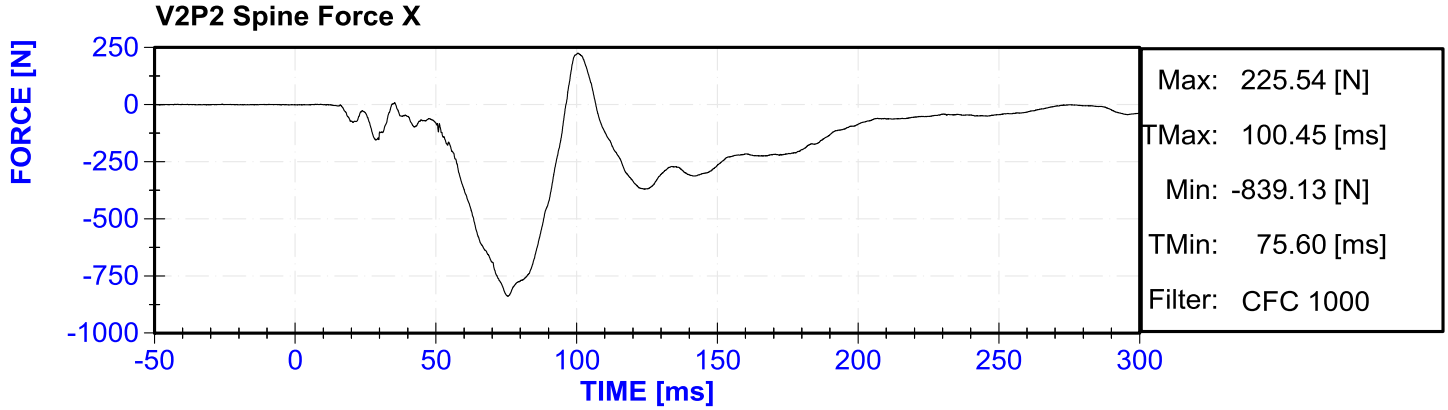

V2P2 Lower Left DGIR Y Rotation
ROTATION [deg]
TIME [ms]
Max: 5.56 [deg]
TMax: 85.75 [ms]
Min: -1.18 [deg]
TMin: 40.95 [ms]
Filter: CFC 180

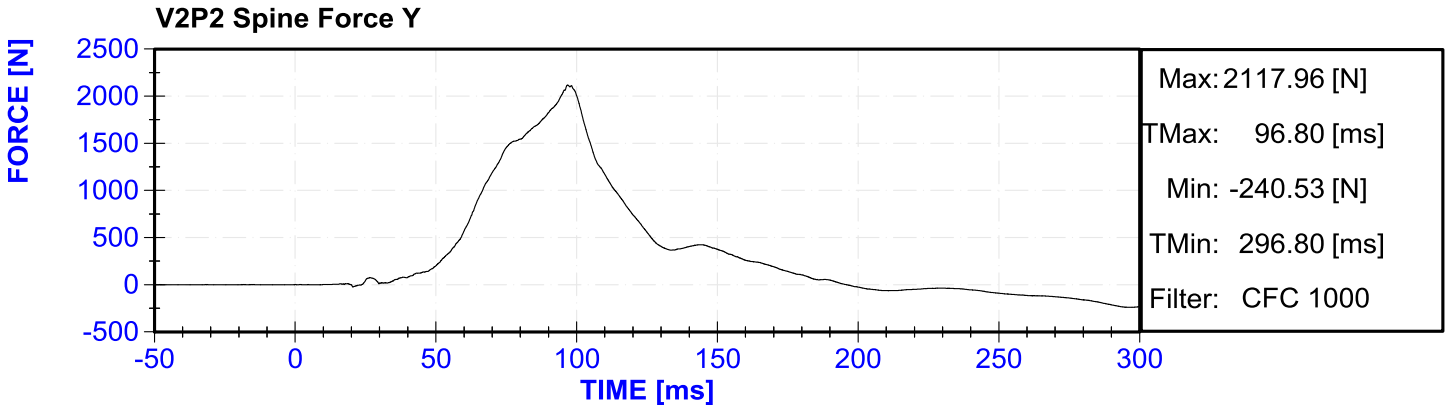

V2P2 Lower Left DGIR Z Rotation
ROTATION [deg]
TIME [ms]
Max: 15.29 [deg]
TMax: 133.45 [ms]
Min: 7.66 [deg]
TMin: 16.15 [ms]
Filter: CFC 180

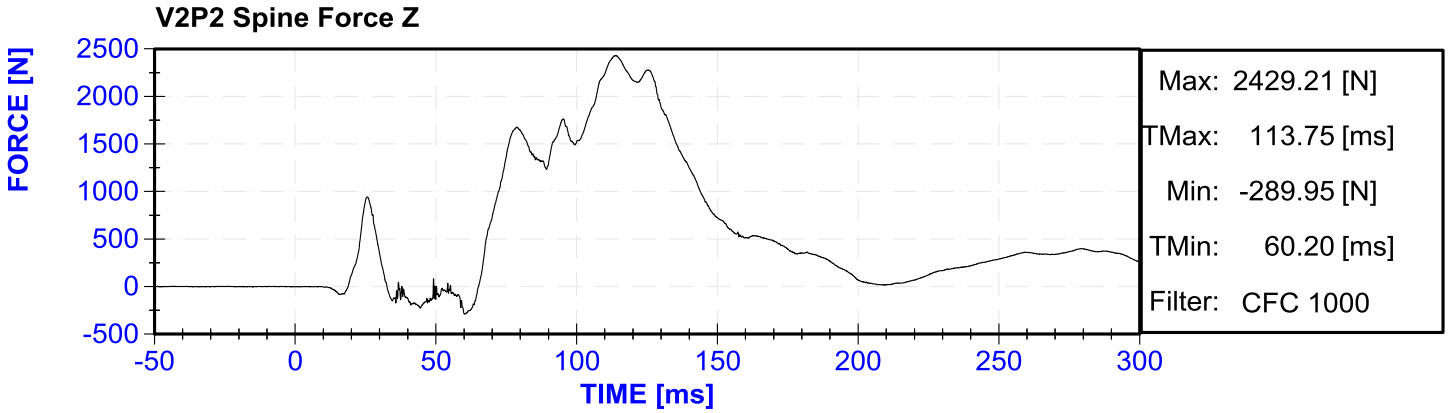

V2P2 Lower Right DGIR X Displacement
VOLTAGE [V]
TIME [ms]
Max: 0.11 [V]
TMax: 109.95 [ms]
Min: 0.08 [V]
TMin: 80.60 [ms]
Filter: CFC 600

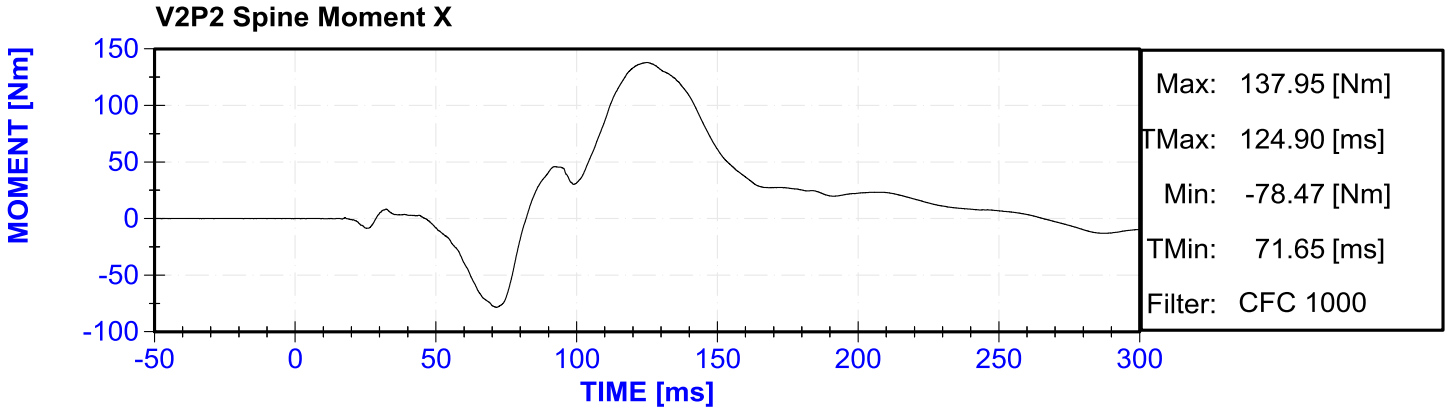

V2P2 Lower Right DGIR Y Rotation
ROTATION [deg]
TIME [ms]
Max: 3.24 [deg]
TMax: 216.60 [ms]
Min: -3.29 [deg]
TMin: 107.15 [ms]
Filter: CFC 180

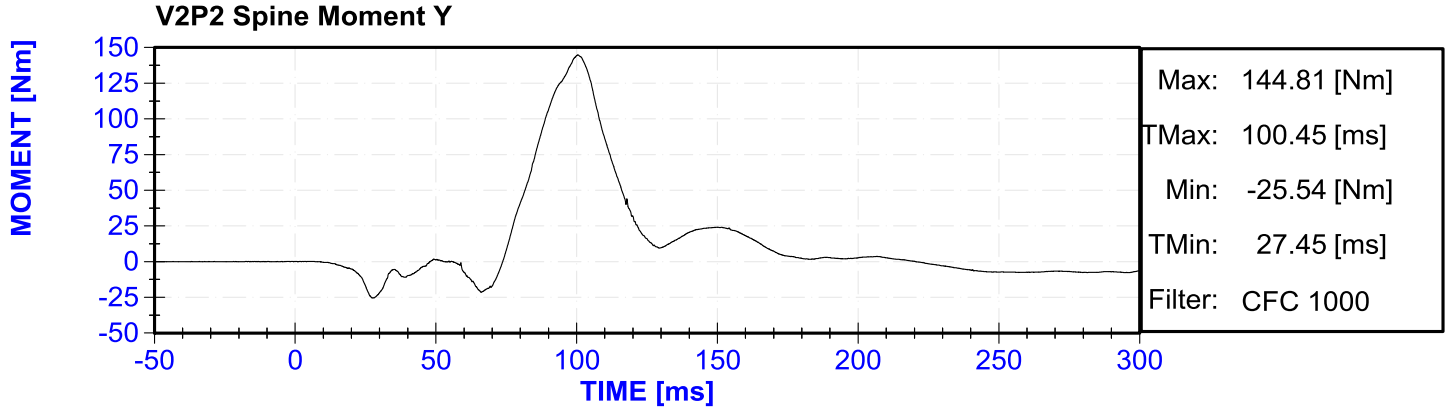

V2P2 Lower Right DGIR Z Rotation
ROTATION [deg]
TIME [ms]
Max: -6.03 [deg]
TMax: 133.90 [ms]
Min: -13.07 [deg]
TMin: 105.40 [ms]
Filter: CFC 180

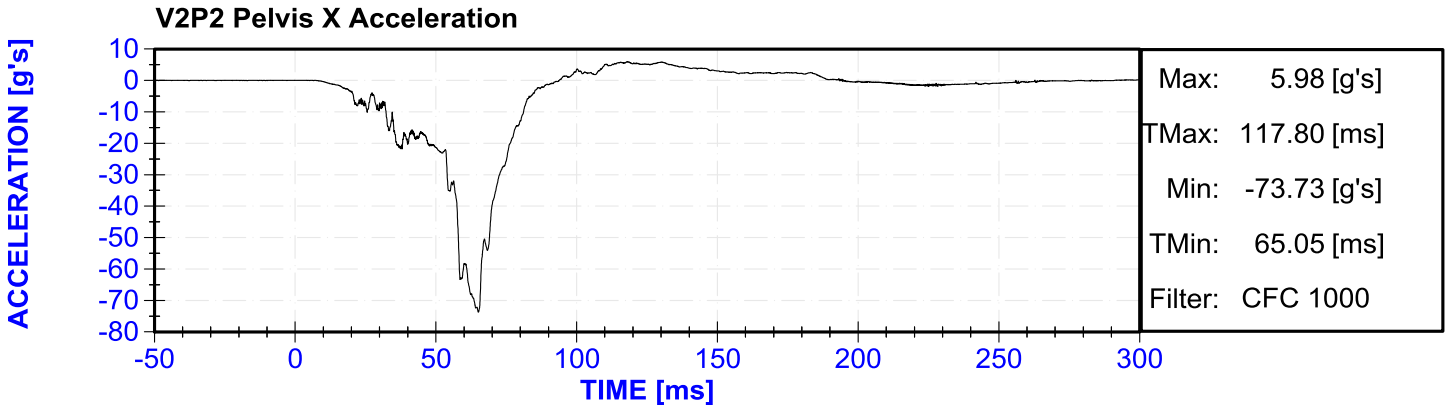

V2P2 Spine Force X
FORCE [N]
TIME [ms]
Max: 225.54 [N]
TMax: 100.45 [ms]
Min: -839.13 [N]
TMin: 75.60 [ms]
Filter: CFC 1000

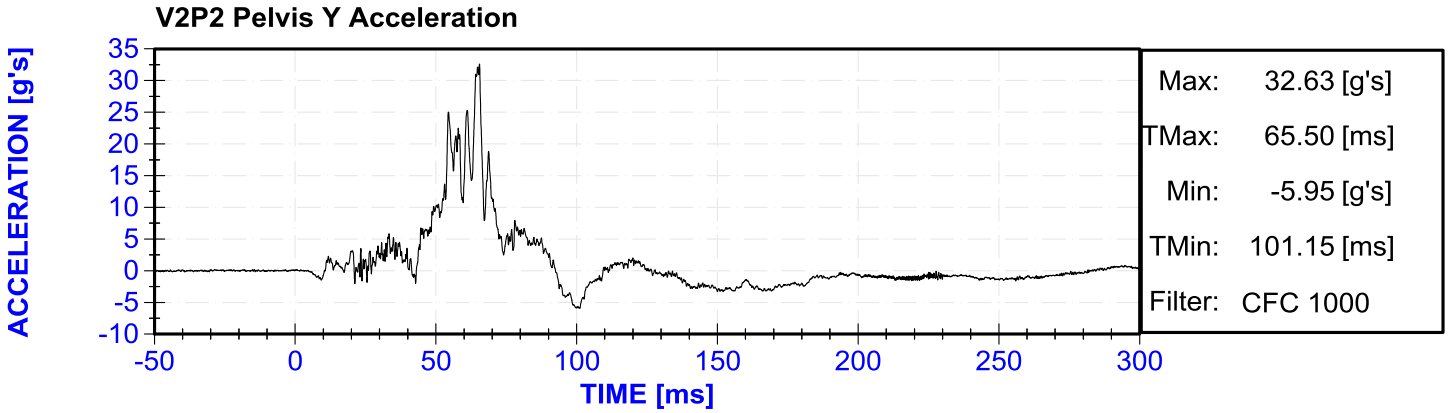

V2P2 Spine Force Y
FORCE [N]
TIME [ms]
Max: 2117.96 [N]
TMax: 96.80 [ms]
Min: -240.53 [N]
TMin: 296.80 [ms]
Filter: CFC 1000

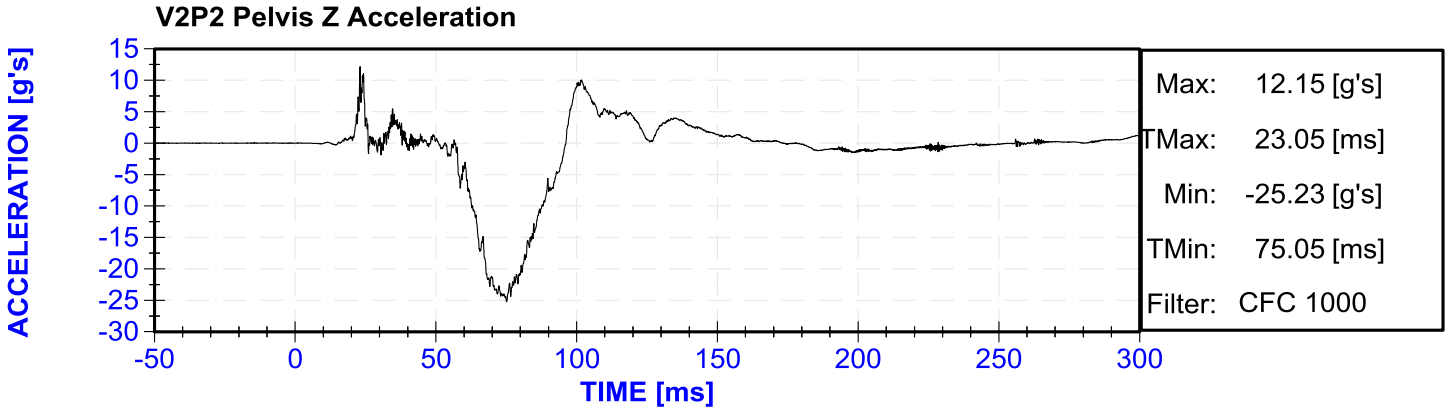

V2P2 Spine Force Z
FORCE [N]
TIME [ms]
Max: 2429.21 [N]
TMax: 113.75 [ms]
Min: -289.95 [N]
TMin: 60.20 [ms]
Filter: CFC 1000

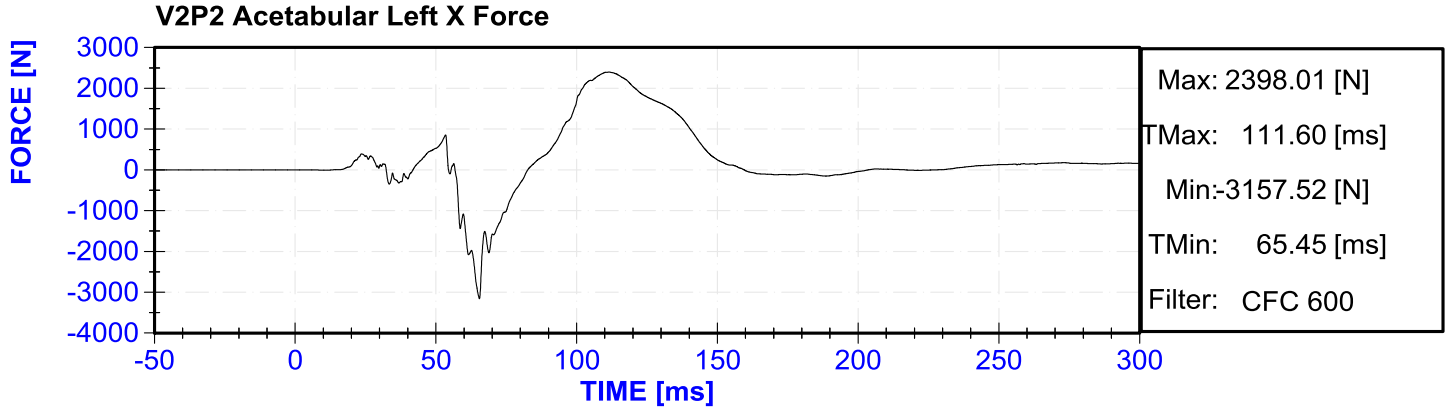

V2P2 Spine Moment X
MOMENT [Nm]
TIME [ms]
Max: 137.95 [Nm]
TMax: 124.90 [ms]
Min: -78.47 [Nm]
TMin: 71.65 [ms]
Filter: CFC 1000

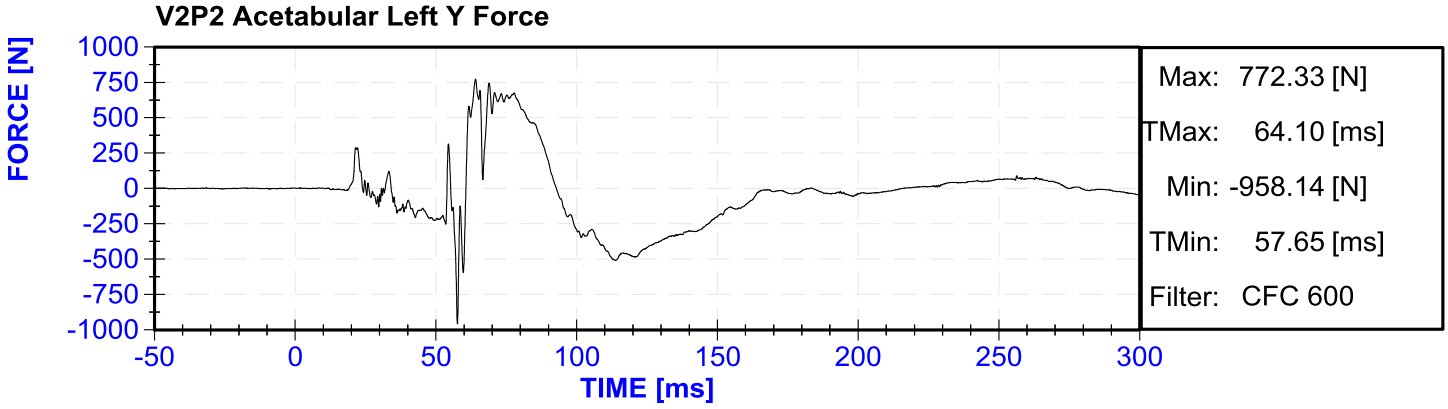

V2P2 Spine Moment Y
MOMENT [Nm]
TIME [ms]
Max: 144.81 [Nm]
TMax: 100.45 [ms]
Min: -25.54 [Nm]
TMin: 27.45 [ms]
Filter: CFC 1000


V2P2 Pelvis X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 5.98 [g's]
TMax: 117.80 [ms]
Min: -73.73 [g's]
TMin: 65.05 [ms]
Filter: CFC 1000

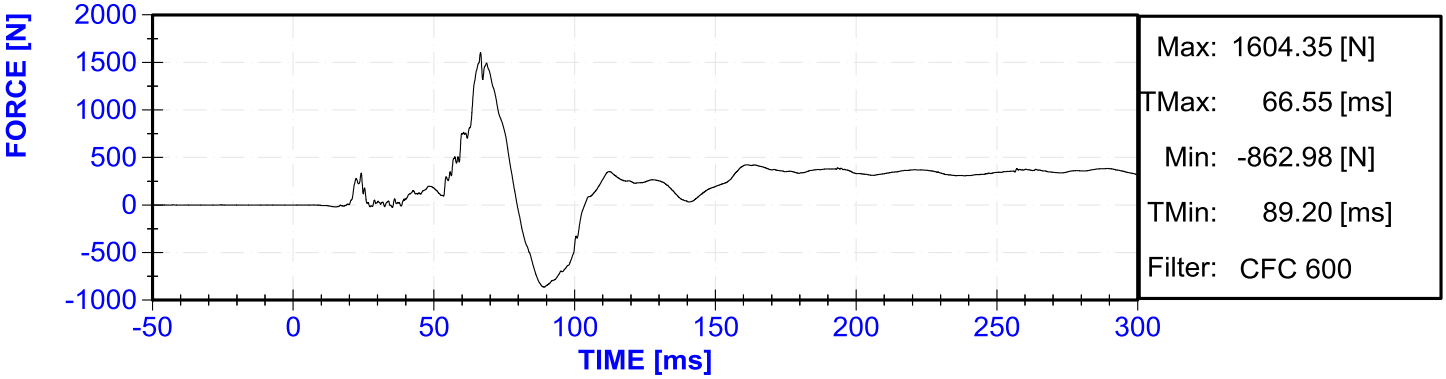

V2P2 Pelvis Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 32.63 [g's]
TMax: 65.50 [ms]
Min: -5.95 [g's]
TMin: 101.15 [ms]
Filter: CFC 1000


V2P2 Pelvis Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 12.15 [g's]
TMax: 23.05 [ms]
Min: -25.23 [g's]
TMin: 75.05 [ms]
Filter: CFC 1000

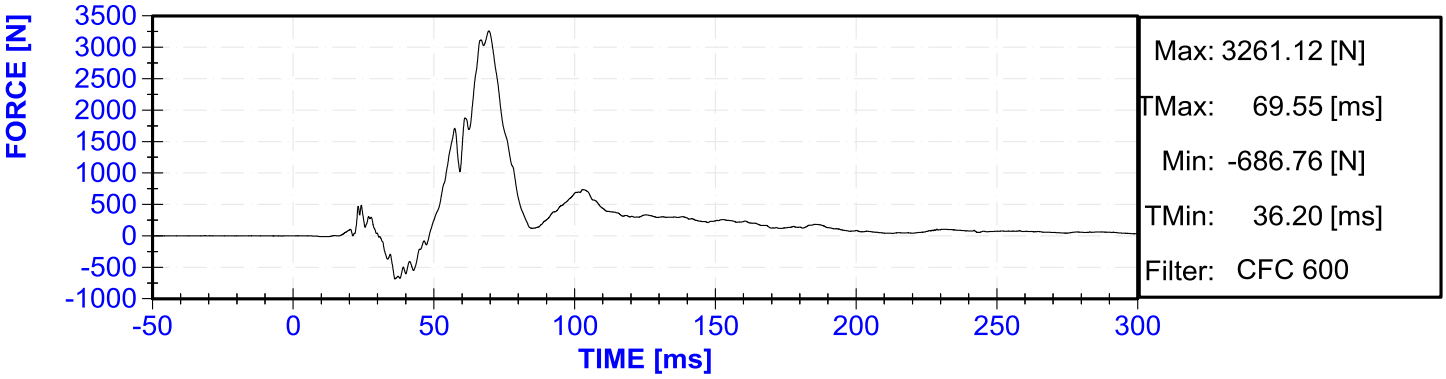

V2P2 Acetabular Left X Force
FORCE [N]
TIME [ms]
Max: 2398.01 [N]
TMax: 111.60 [ms]
Min:-3157.52 [N]
TMin: 65.45 [ms]
Filter: CFC 600


V2P2 Acetabular Left Y Force
FORCE [N]
TIME [ms]
Max: 772.33 [N]
TMax: 64.10 [ms]
Min: -958.14 [N]
TMin: 57.65 [ms]
Filter: CFC 600

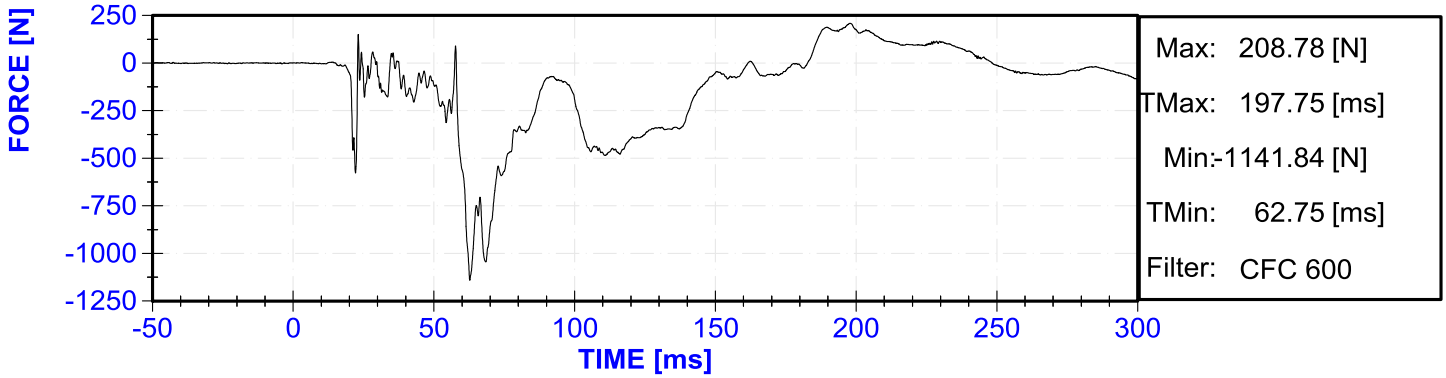
V2P2 Acetabular Left Z Force



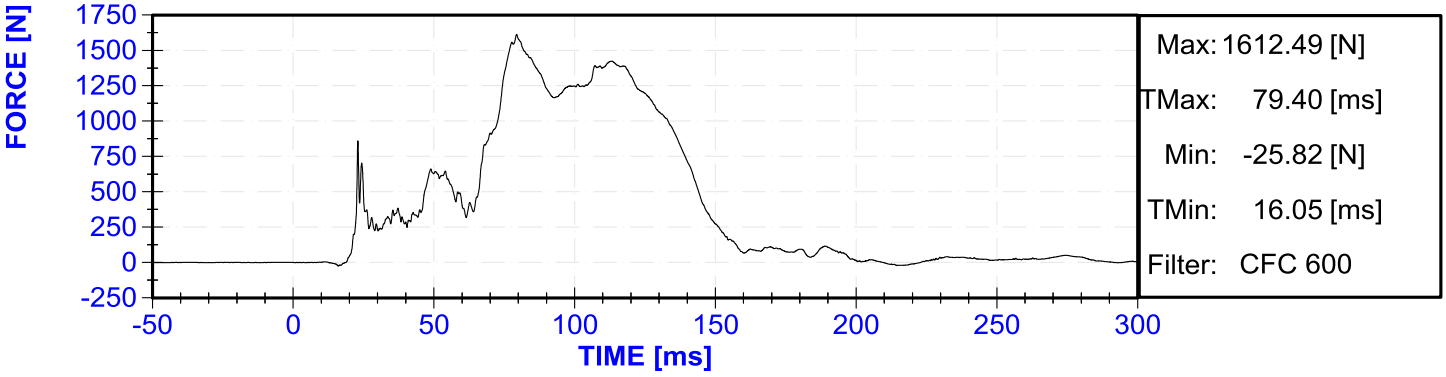
V2P2 Acetabular Right X Force

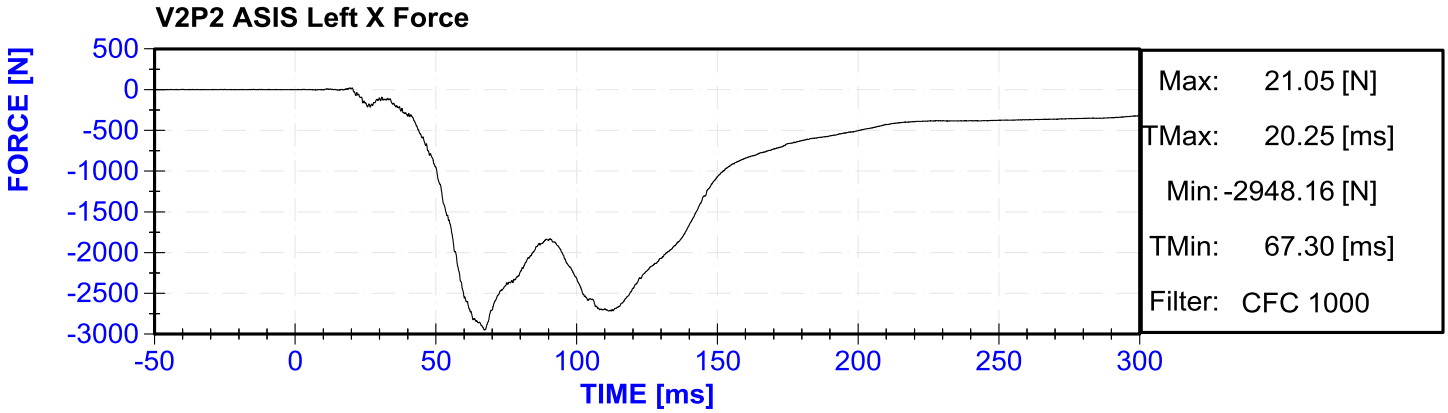


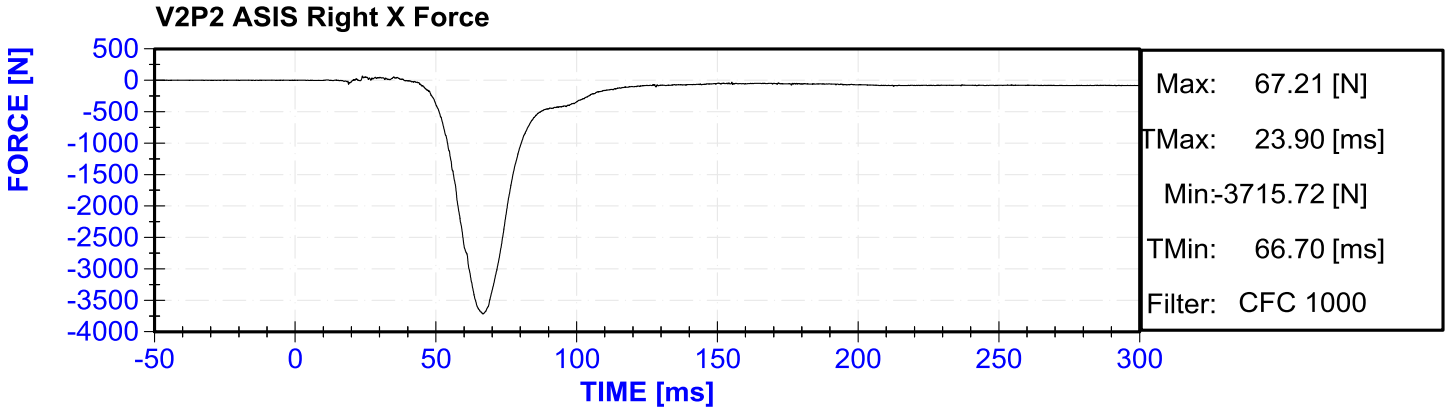
V2P2 Acetabular Right Y Force

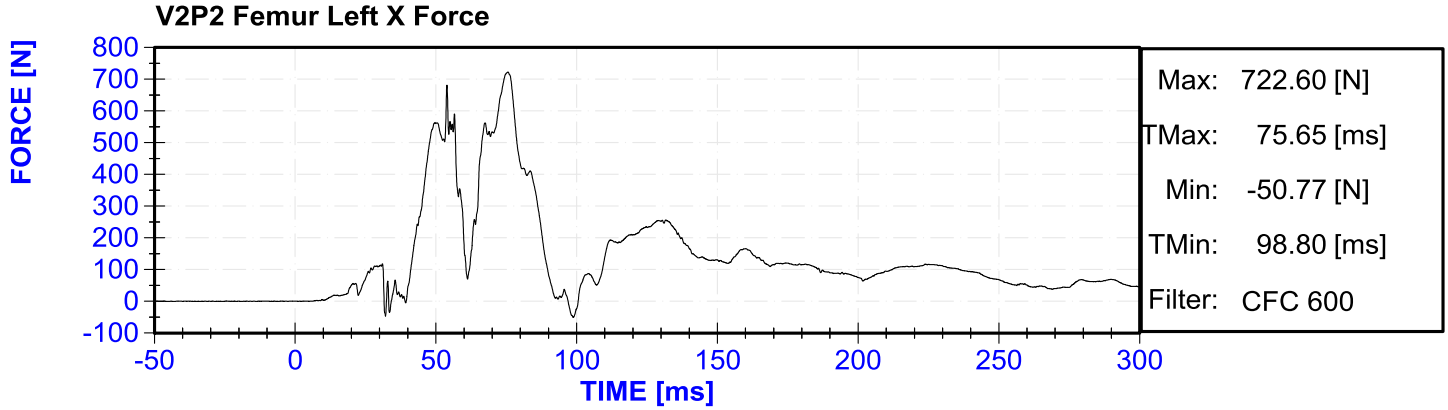


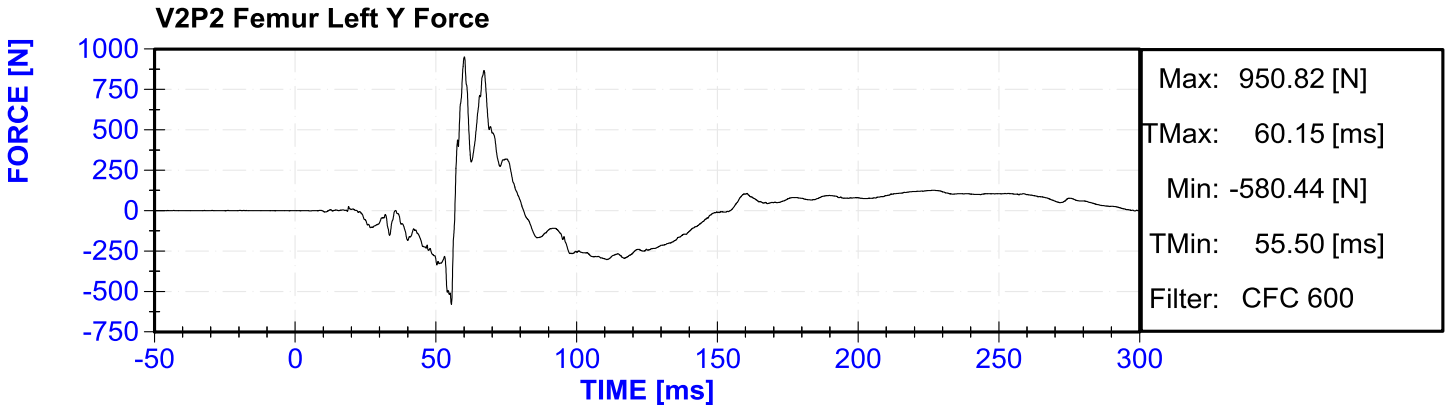
V2P2 Acetabular Right Z Force

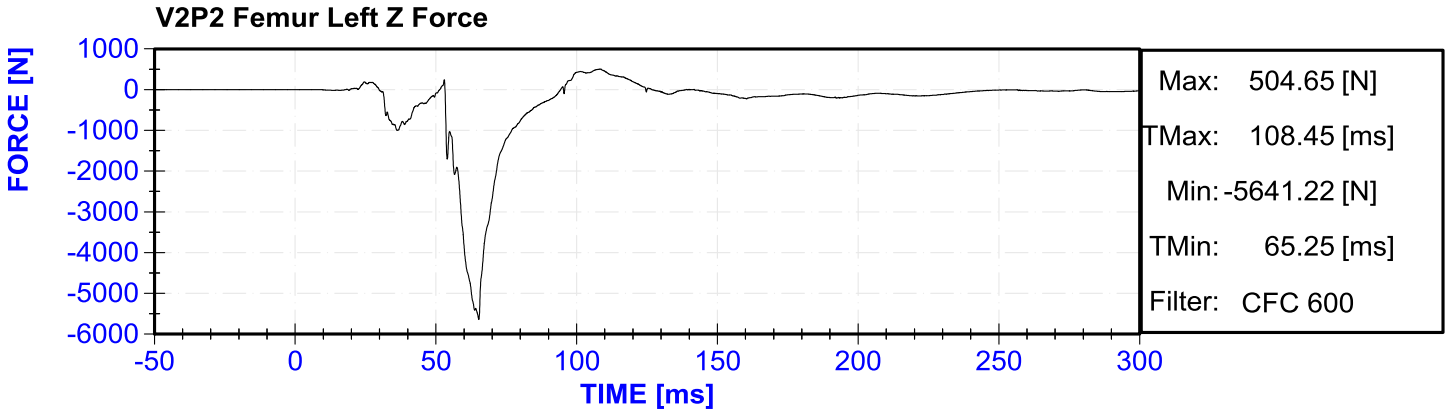


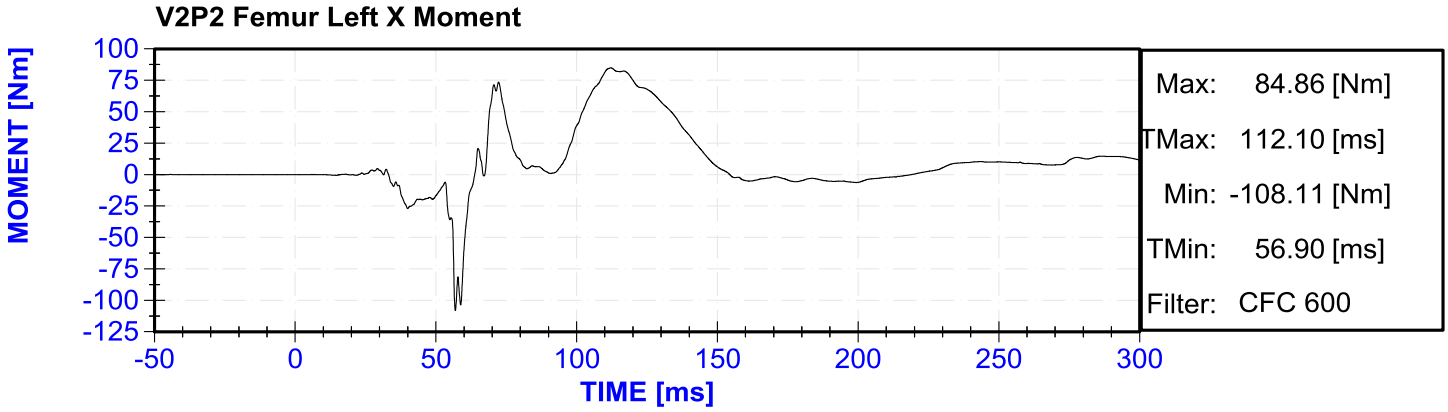

V2P2 ASIS Left X Force
FORCE [N]
TIME [ms]
Max: 21.05 [N]
TMax: 20.25 [ms]
Min: -2948.16 [N]
TMin: 67.30 [ms]
Filter: CFC 1000

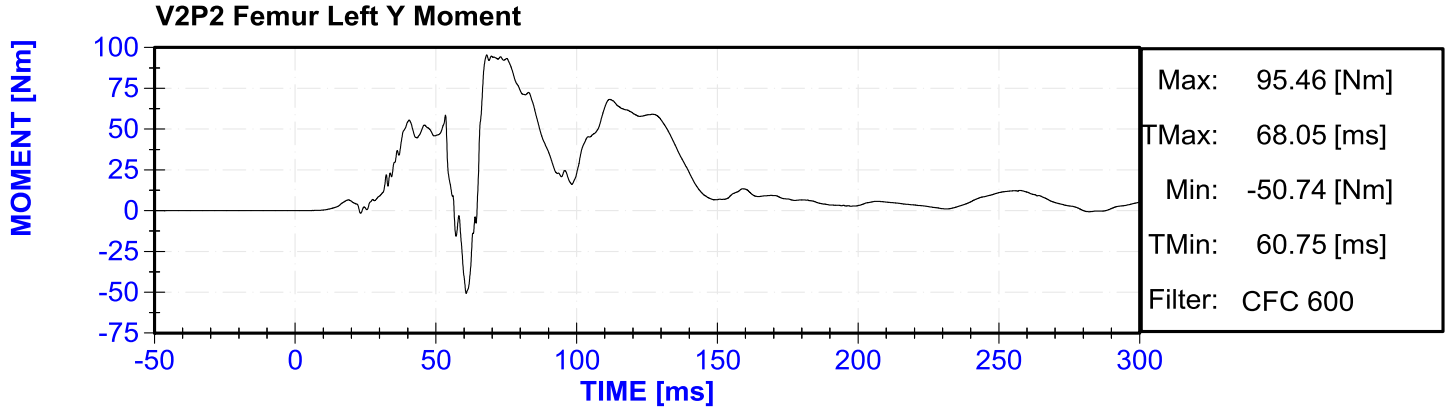

V2P2 ASIS Right X Force
FORCE [N]
TIME [ms]
Max: 67.21 [N]
TMax: 23.90 [ms]
Min: -3715.72 [N]
TMin: 66.70 [ms]
Filter: CFC 1000

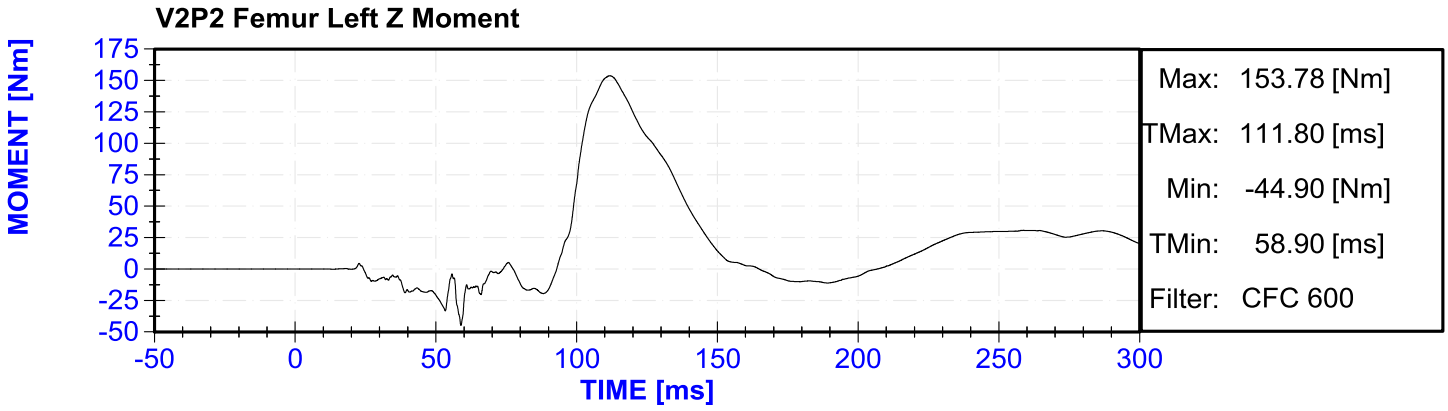

V2P2 Femur Left X Force
FORCE [N]
TIME [ms]
Max: 722.60 [N]
TMax: 75.65 [ms]
Min: -50.77 [N]
TMin: 98.80 [ms]
Filter: CFC 600


V2P2 Femur Left Y Force
FORCE [N]
TIME [ms]
Max: 950.82 [N]
TMax: 60.15 [ms]
Min: -580.44 [N]
TMin: 55.50 [ms]
Filter: CFC 600

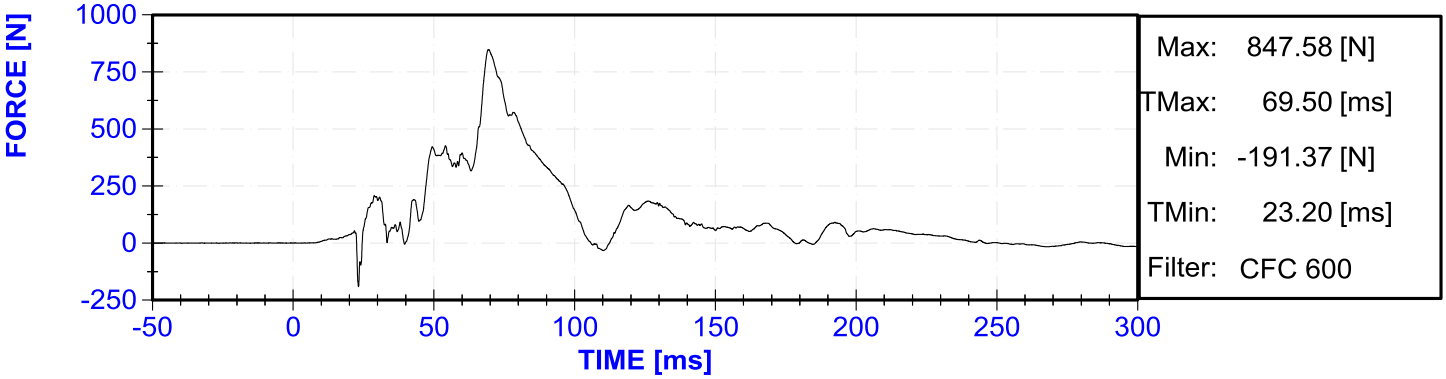

V2P2 Femur Left Z Force
FORCE [N]
1000
0
-1000
-2000
-3000
-4000
-5000
-6000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 504.65 [N]
TMax: 108.45 [ms]
Min: -5641.22 [N]
TMin: 65.25 [ms]
Filter: CFC 600


V2P2 Femur Left X Moment
MOMENT [Nm]
100
75
50
25
0
-25
-50
-75
-100
-125
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 84.86 [Nm]
TMax: 112.10 [ms]
Min: -108.11 [Nm]
TMin: 56.90 [ms]
Filter: CFC 600

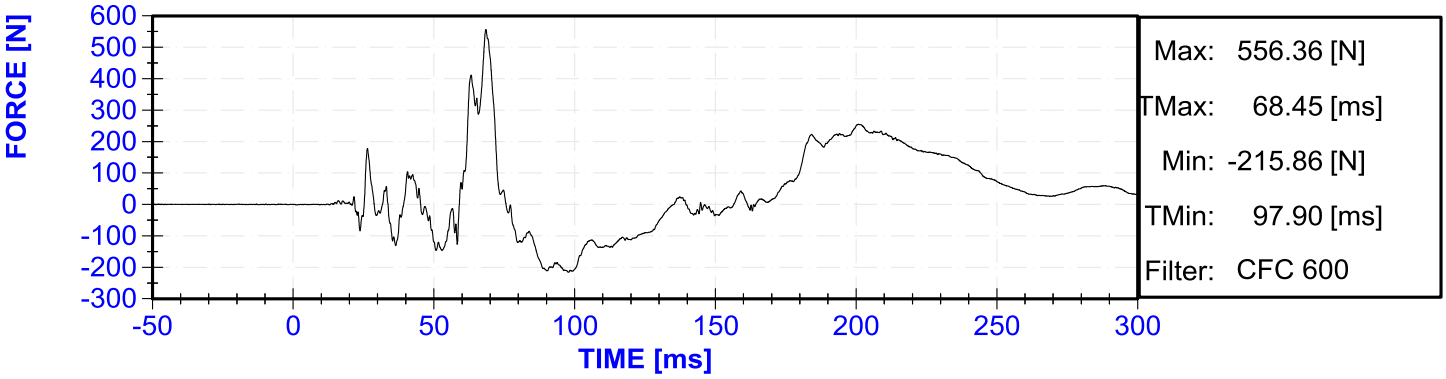

V2P2 Femur Left Y Moment
MOMENT [Nm]
100
75
50
25
0
-25
-50
-75
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 95.46 [Nm]
TMax: 68.05 [ms]
Min: -50.74 [Nm]
TMin: 60.75 [ms]
Filter: CFC 600


V2P2 Femur Left Z Moment
MOMENT [Nm]
175
150
125
100
75
50
25
0
-25
-50
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 153.78 [Nm]
TMax: 111.80 [ms]
Min: -44.90 [Nm]
TMin: 58.90 [ms]
Filter: CFC 600

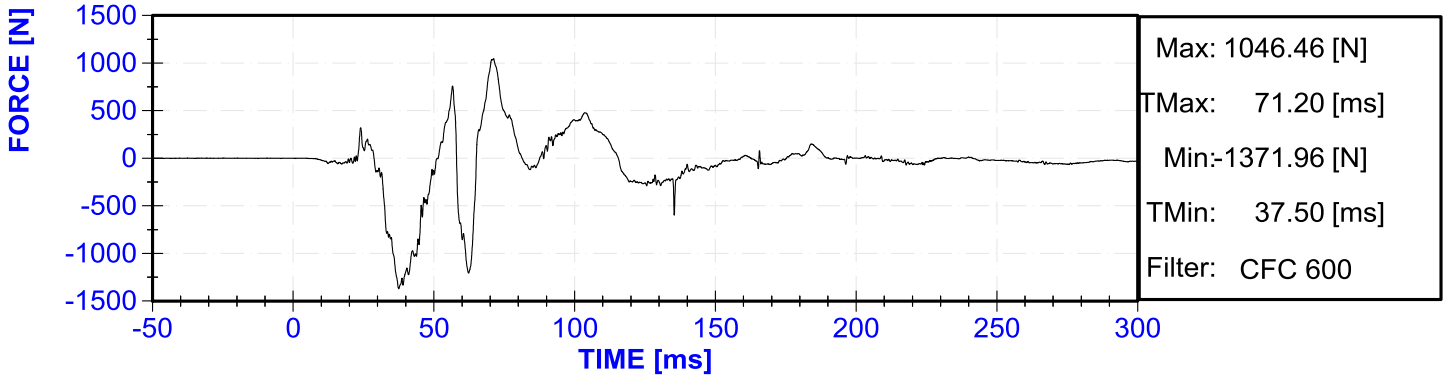
V2P2 Femur Right X Force



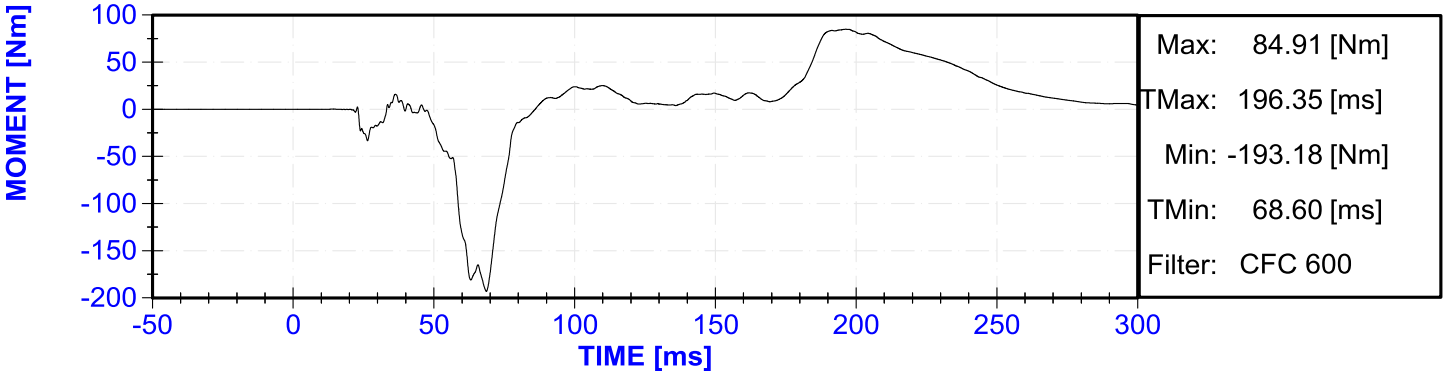
V2P2 Femur Right Y Force

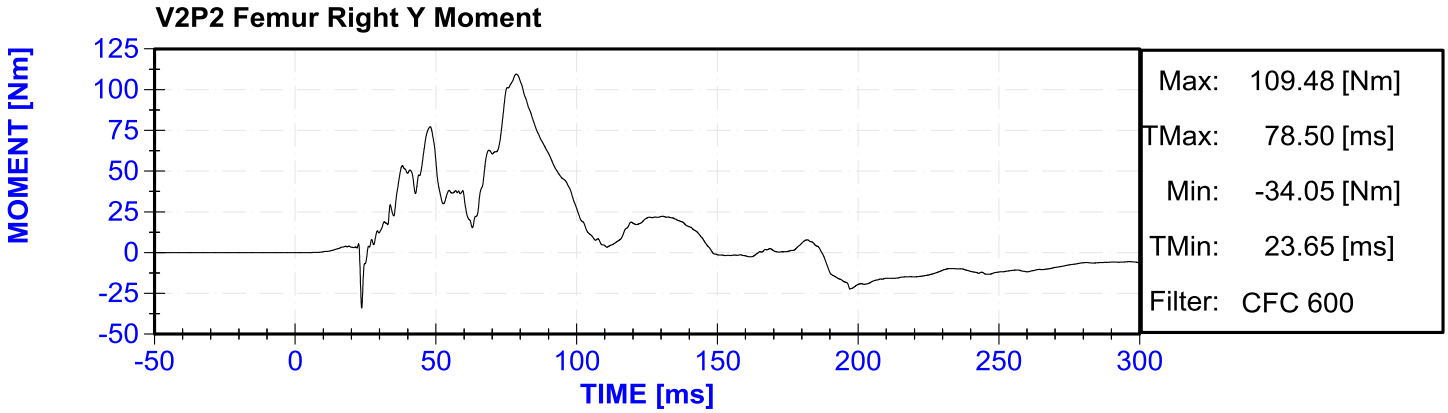


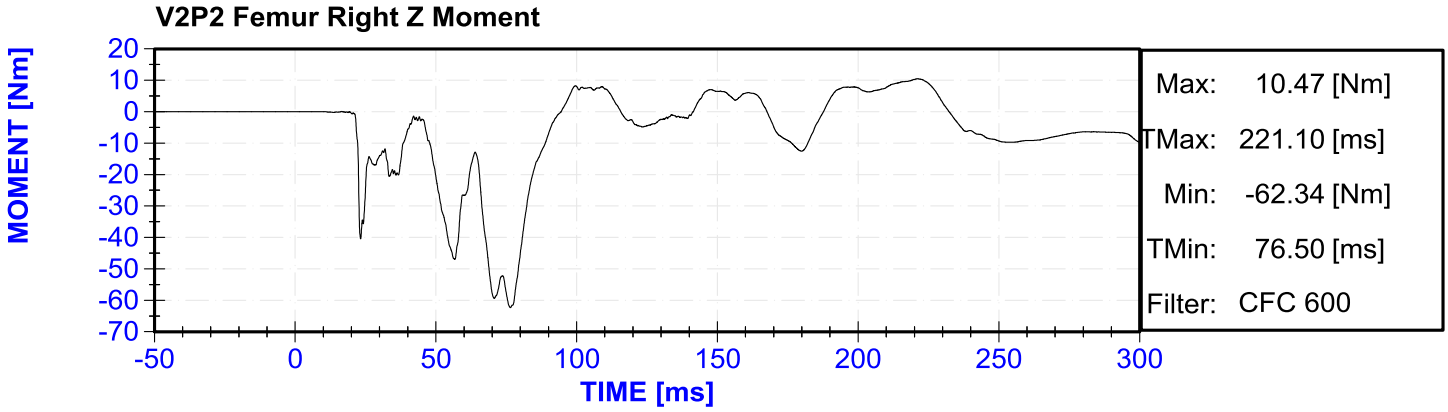
V2P2 Femur Right Z Force

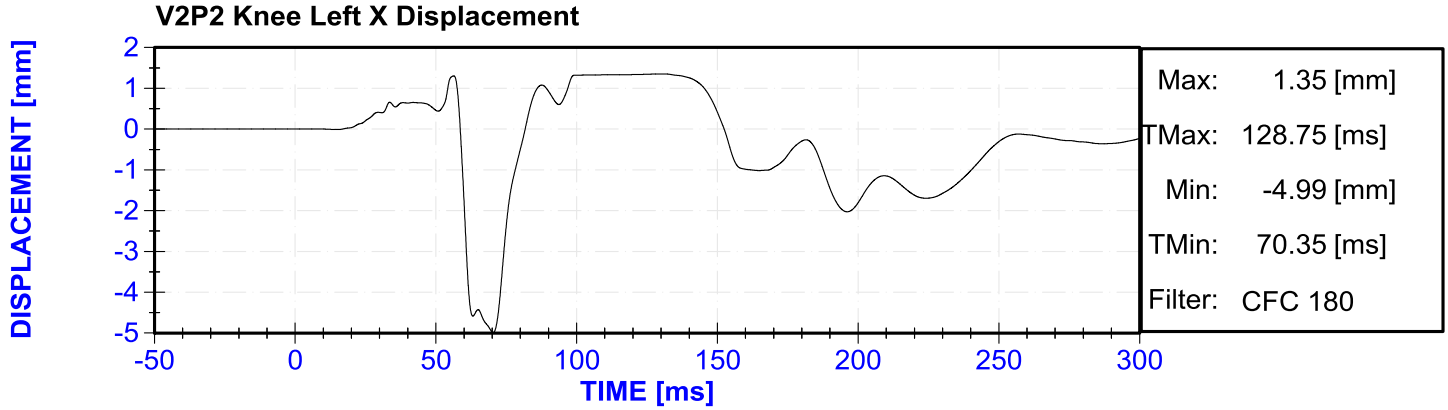


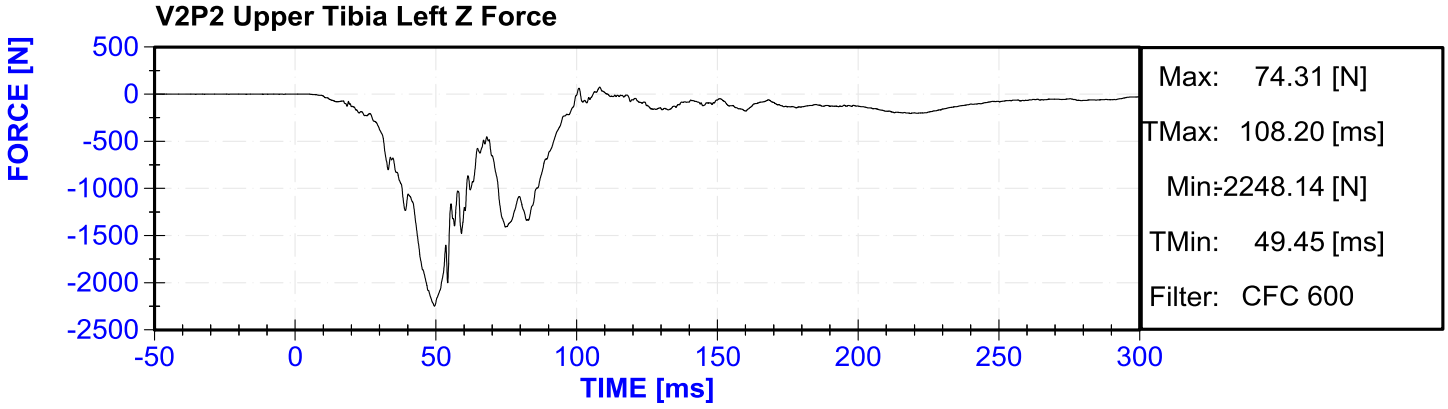
V2P2 Femur Right X Moment

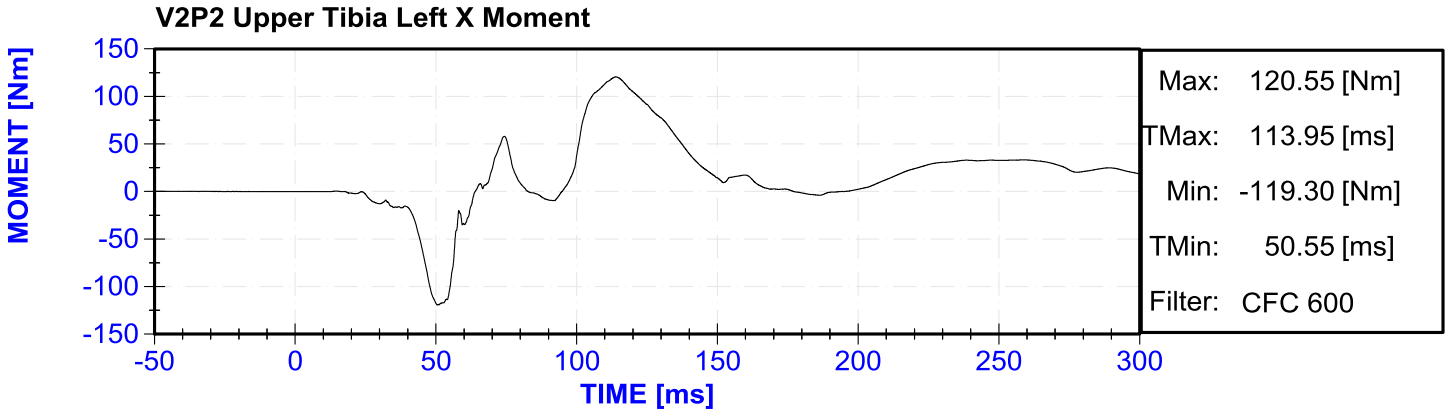


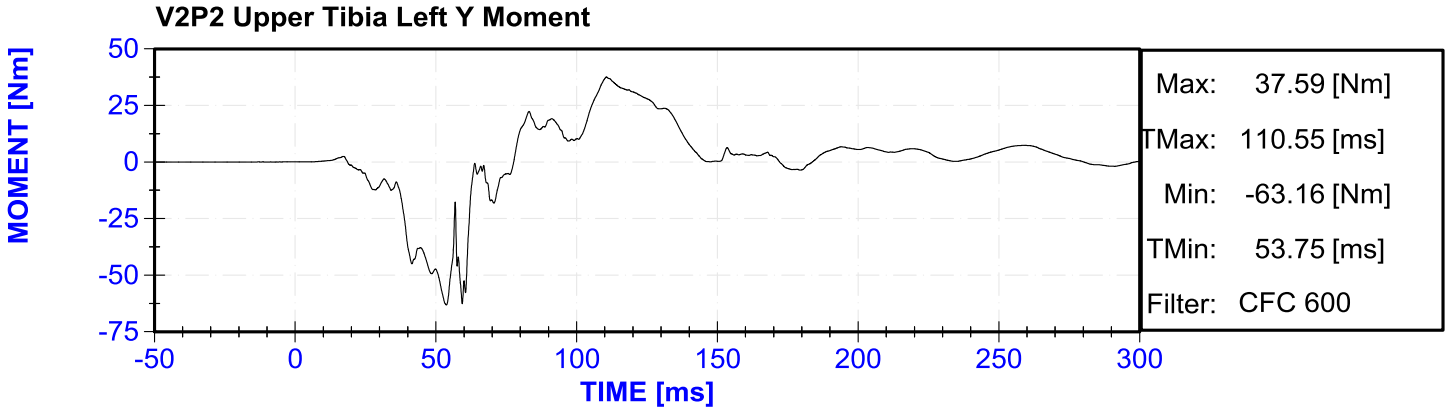

V2P2 Femur Right Y Moment
MOMENT [Nm]
TIME [ms]
Max: 109.48 [Nm]
TMax: 78.50 [ms]
Min: -34.05 [Nm]
TMin: 23.65 [ms]
Filter: CFC 600

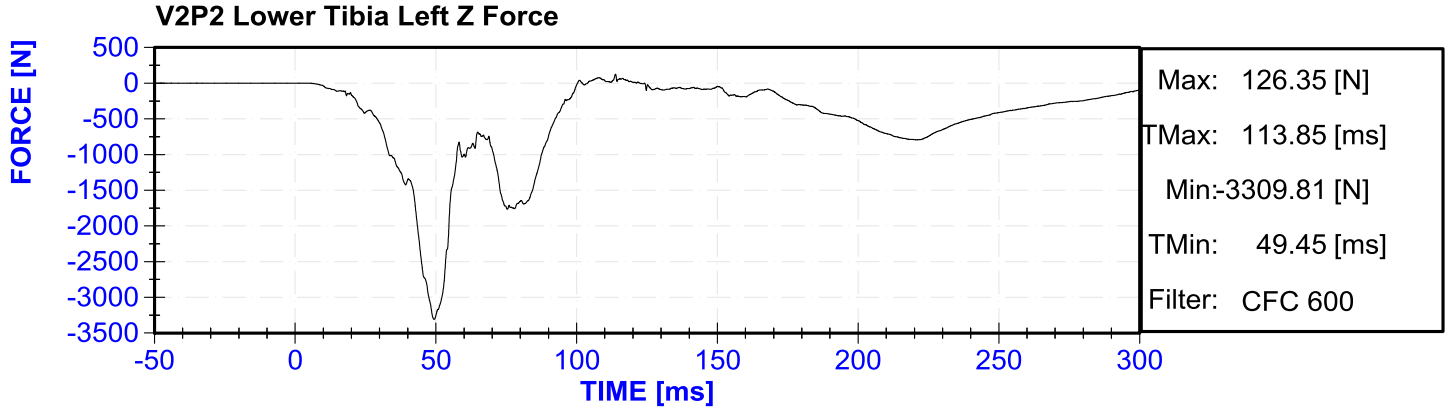

V2P2 Femur Right Z Moment
MOMENT [Nm]
TIME [ms]
Max: 10.47 [Nm]
TMax: 221.10 [ms]
Min: -62.34 [Nm]
TMin: 76.50 [ms]
Filter: CFC 600

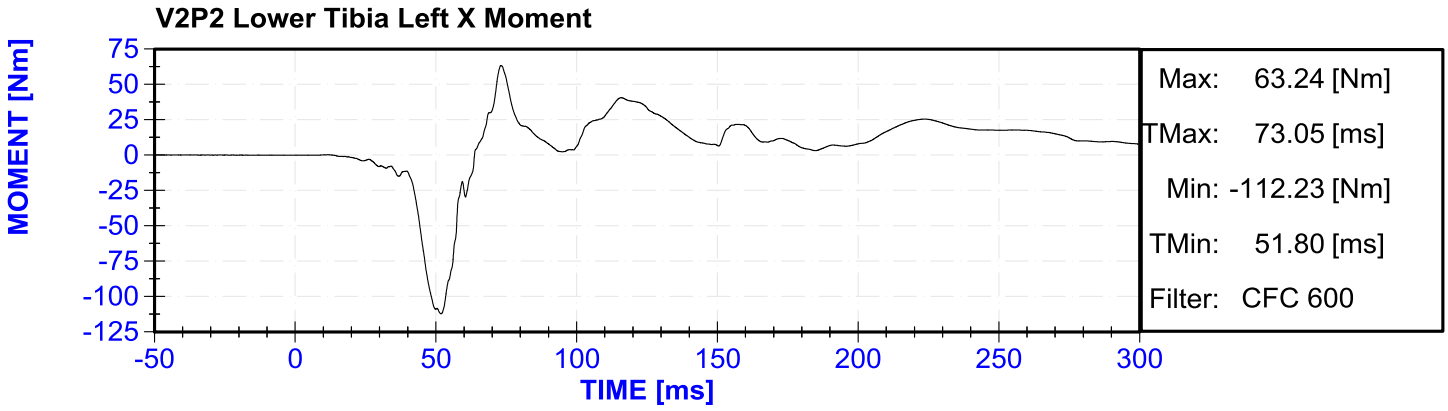

V2P2 Knee Left X Displacement
DISPLACEMENT [mm]
TIME [ms]
Max: 1.35 [mm]
TMax: 128.75 [ms]
Min: -4.99 [mm]
TMin: 70.35 [ms]
Filter: CFC 180

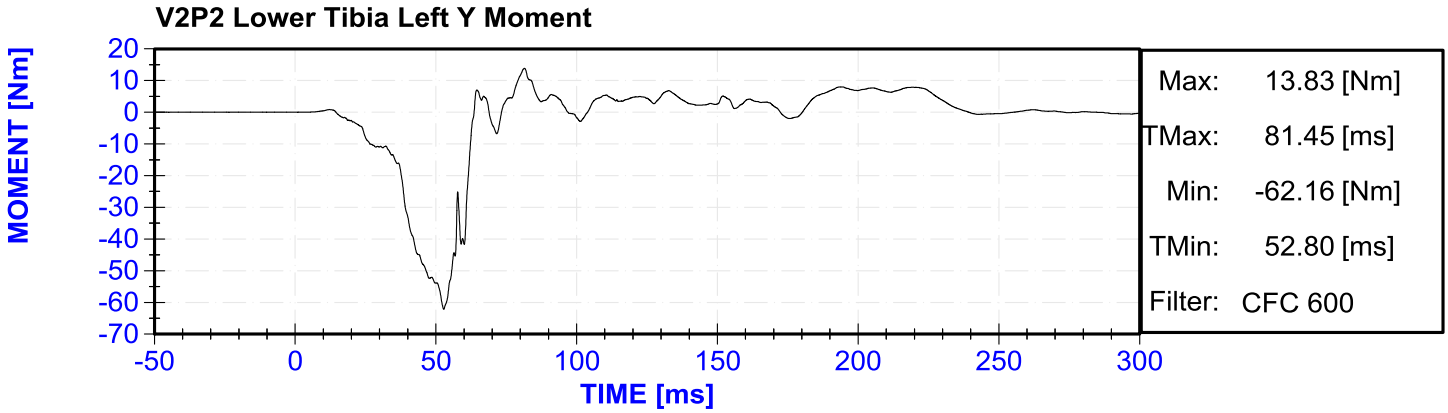

V2P2 Upper Tibia Left Z Force
FORCE [N]
TIME [ms]
Max: 74.31 [N]
TMax: 108.20 [ms]
Min: -2248.14 [N]
TMin: 49.45 [ms]
Filter: CFC 600

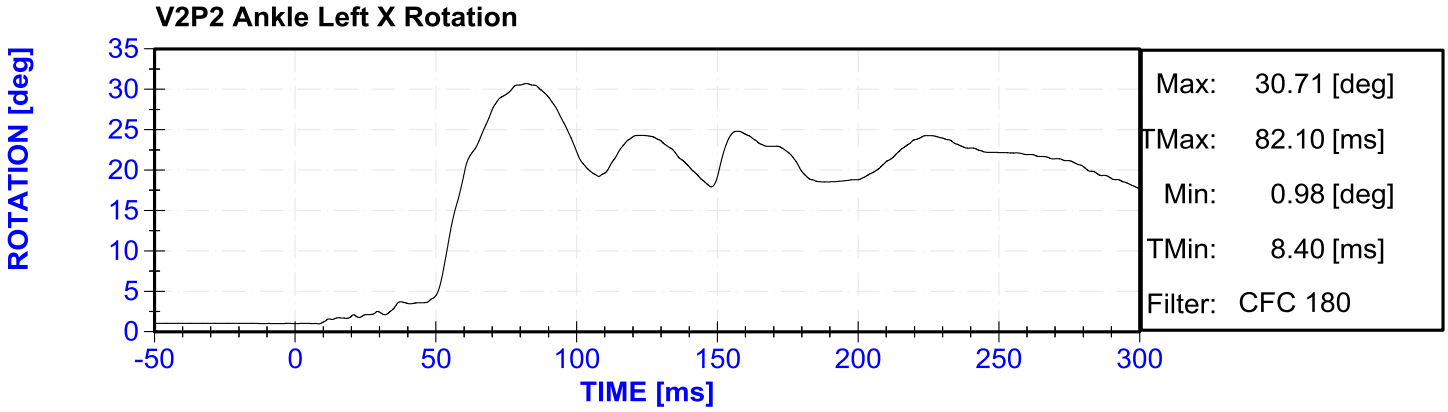

V2P2 Upper Tibia Left X Moment
MOMENT [Nm]
TIME [ms]
Max: 120.55 [Nm]
TMax: 113.95 [ms]
Min: -119.30 [Nm]
TMin: 50.55 [ms]
Filter: CFC 600

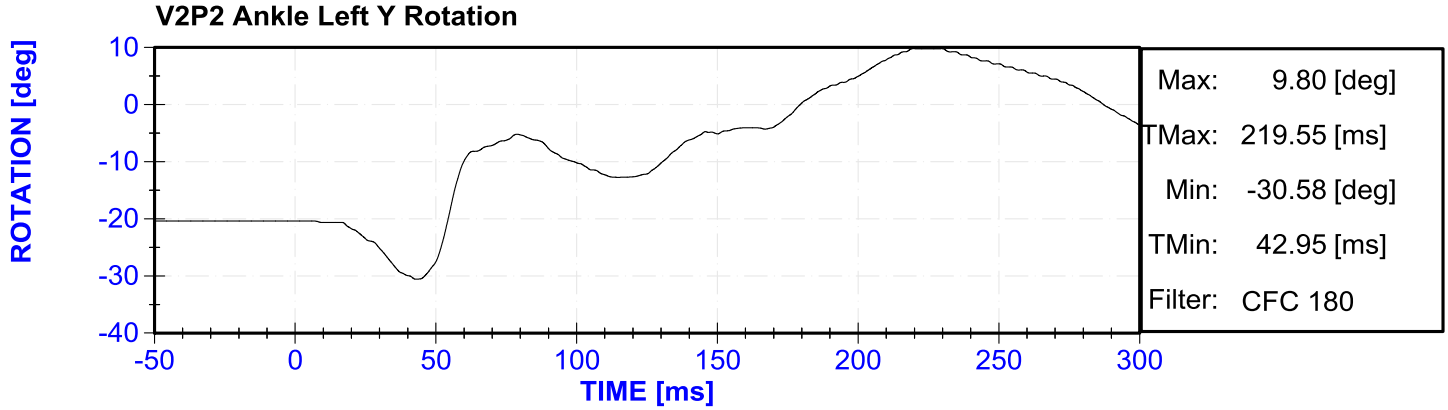

V2P2 Upper Tibia Left Y Moment
MOMENT [Nm]
TIME [ms]
Max: 37.59 [Nm]
TMax: 110.55 [ms]
Min: -63.16 [Nm]
TMin: 53.75 [ms]
Filter: CFC 600

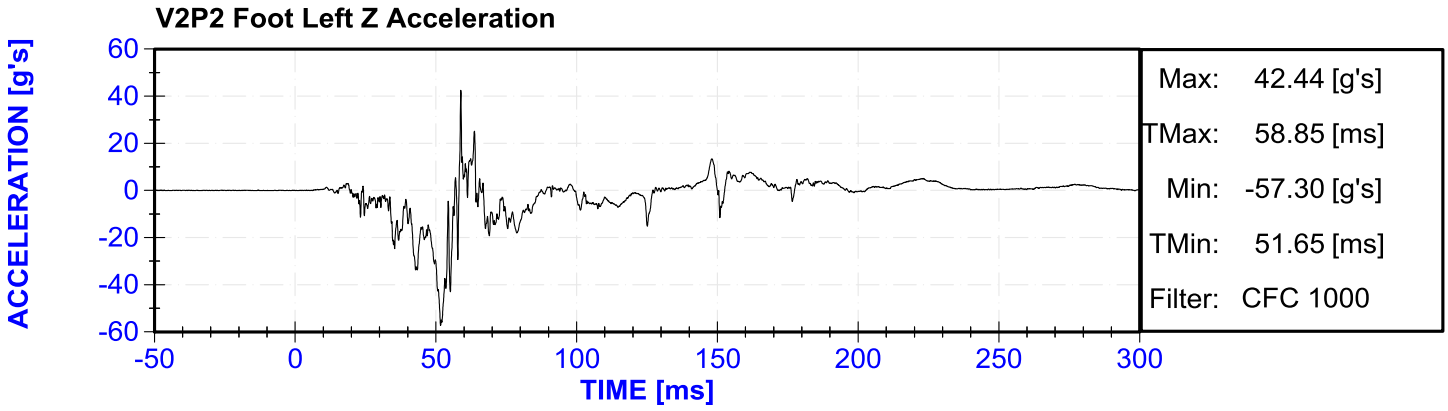

V2P2 Lower Tibia Left Z Force
FORCE [N]
TIME [ms]
Max: 126.35 [N]
TMax: 113.85 [ms]
Min:-3309.81 [N]
TMin: 49.45 [ms]
Filter: CFC 600

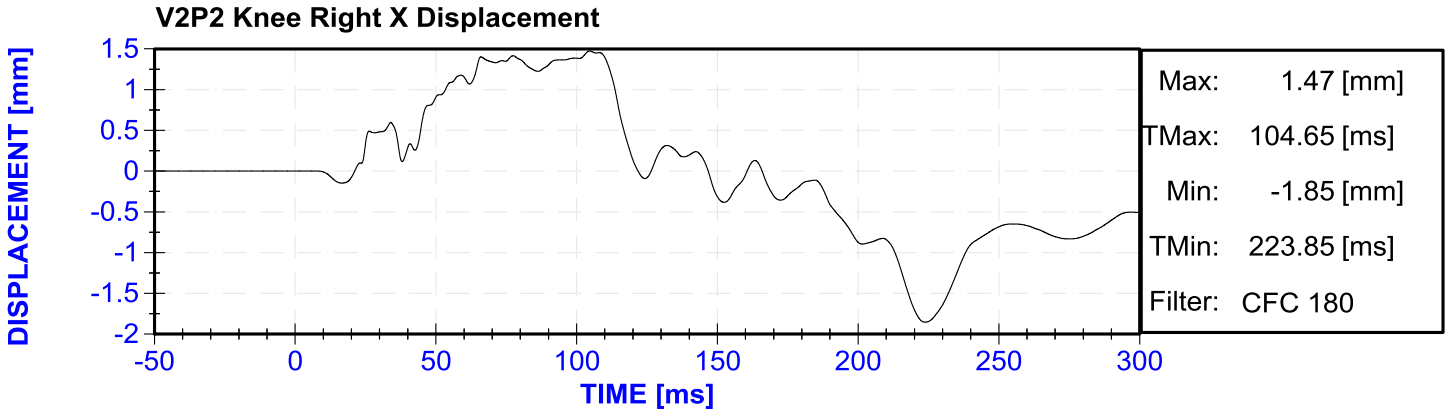

V2P2 Lower Tibia Left X Moment
MOMENT [Nm]
TIME [ms]
Max: 63.24 [Nm]
TMax: 73.05 [ms]
Min: -112.23 [Nm]
TMin: 51.80 [ms]
Filter: CFC 600

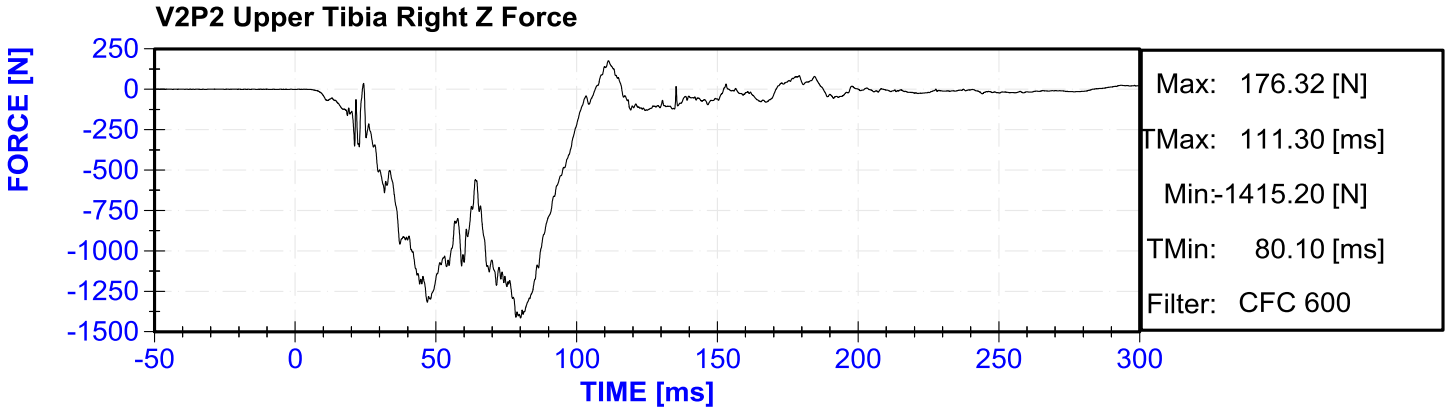

V2P2 Lower Tibia Left Y Moment
MOMENT [Nm]
TIME [ms]
Max: 13.83 [Nm]
TMax: 81.45 [ms]
Min: -62.16 [Nm]
TMin: 52.80 [ms]
Filter: CFC 600

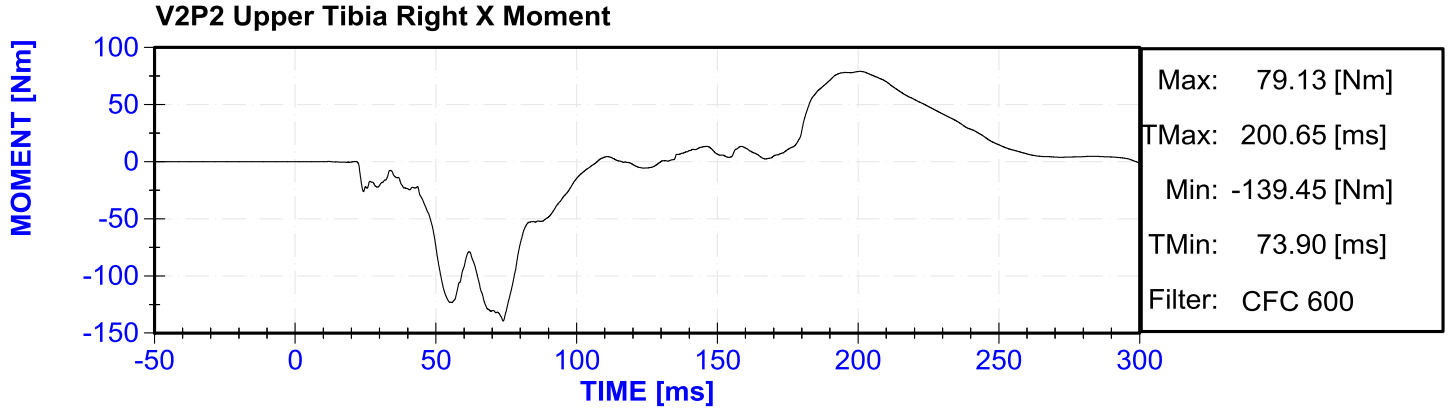

V2P2 Ankle Left X Rotation
ROTATION [deg]
TIME [ms]
Max: 30.71 [deg]
TMax: 82.10 [ms]
Min: 0.98 [deg]
TMin: 8.40 [ms]
Filter: CFC 180

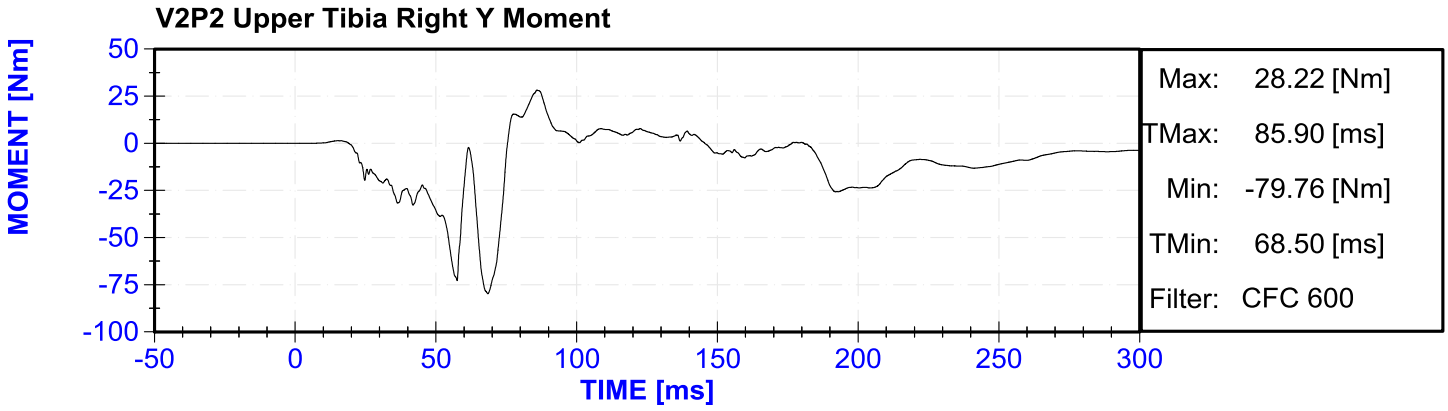

V2P2 Ankle Left Y Rotation
ROTATION [deg]
TIME [ms]
Max: 9.80 [deg]
TMax: 219.55 [ms]
Min: -30.58 [deg]
TMin: 42.95 [ms]
Filter: CFC 180

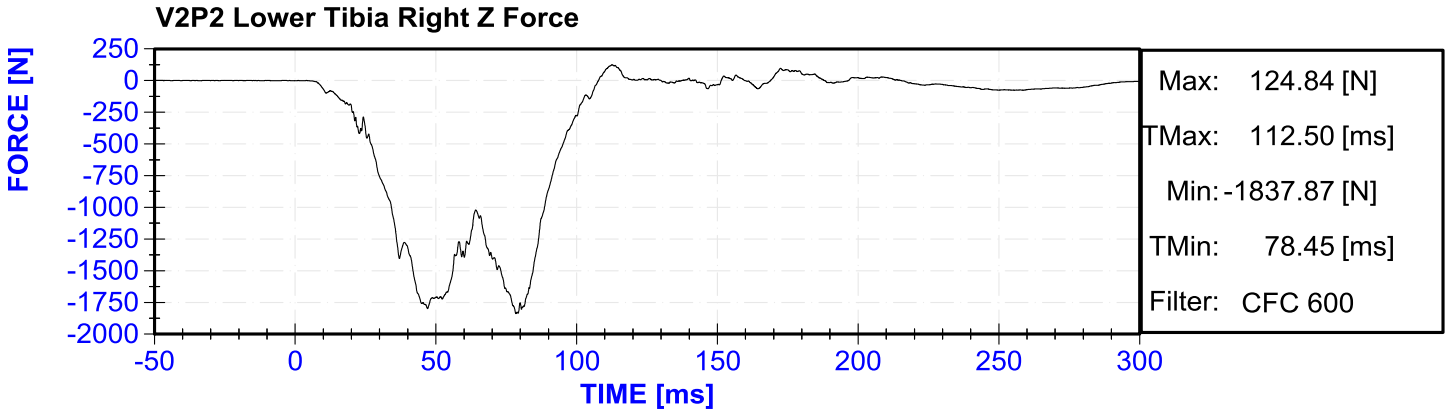

V2P2 Foot Left Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 42.44 [g's]
TMax: 58.85 [ms]
Min: -57.30 [g's]
TMin: 51.65 [ms]
Filter: CFC 1000

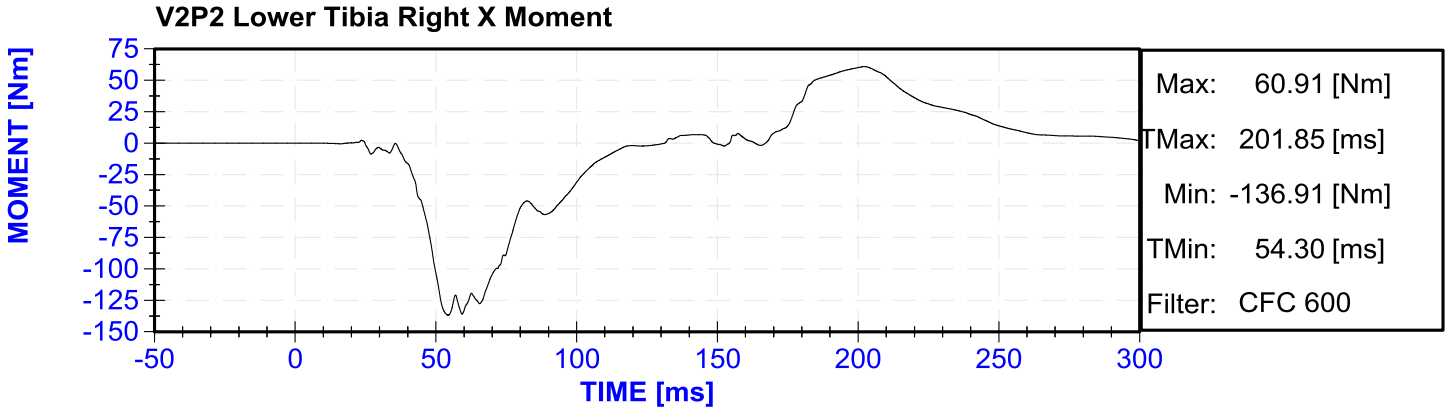

V2P2 Knee Right X Displacement
DISPLACEMENT [mm]
TIME [ms]
Max: 1.47 [mm]
TMax: 104.65 [ms]
Min: -1.85 [mm]
TMin: 223.85 [ms]
Filter: CFC 180

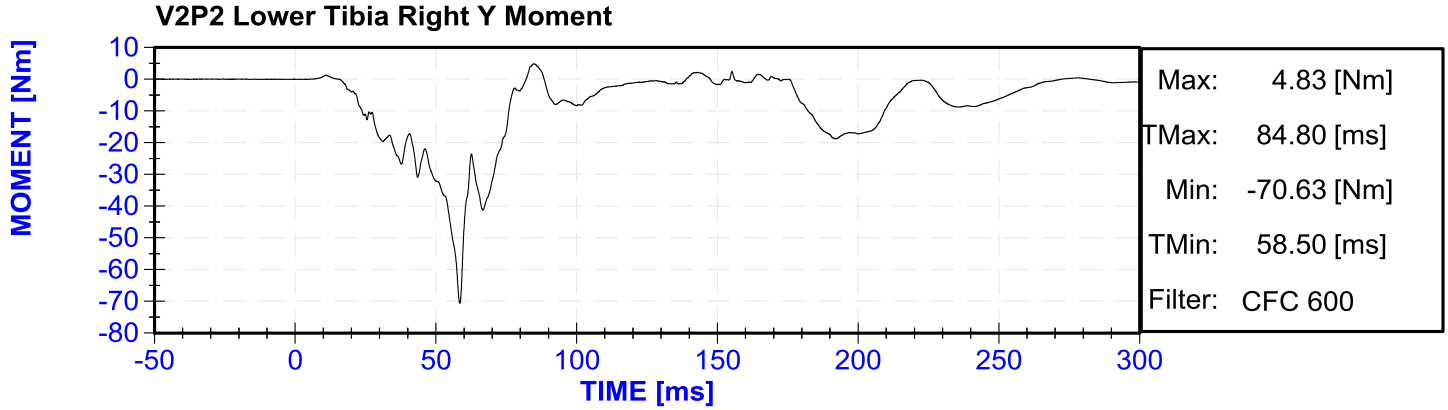

V2P2 Upper Tibia Right Z Force
FORCE [N]
TIME [ms]
Max: 176.32 [N]
TMax: 111.30 [ms]
Min:-1415.20 [N]
TMin: 80.10 [ms]
Filter: CFC 600

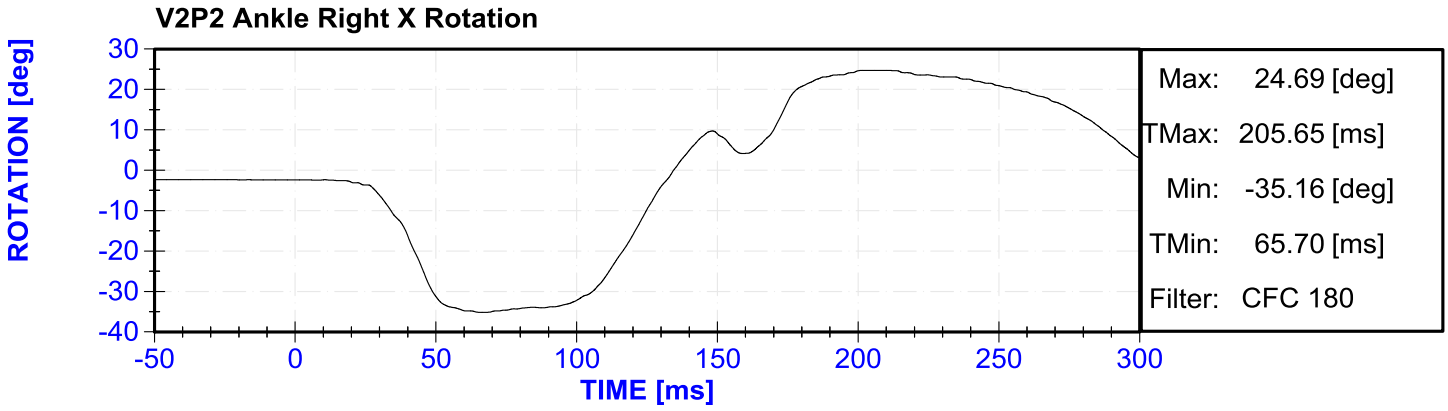

V2P2 Upper Tibia Right X Moment
MOMENT [Nm]
TIME [ms]
Max: 79.13 [Nm]
TMax: 200.65 [ms]
Min: -139.45 [Nm]
TMin: 73.90 [ms]
Filter: CFC 600

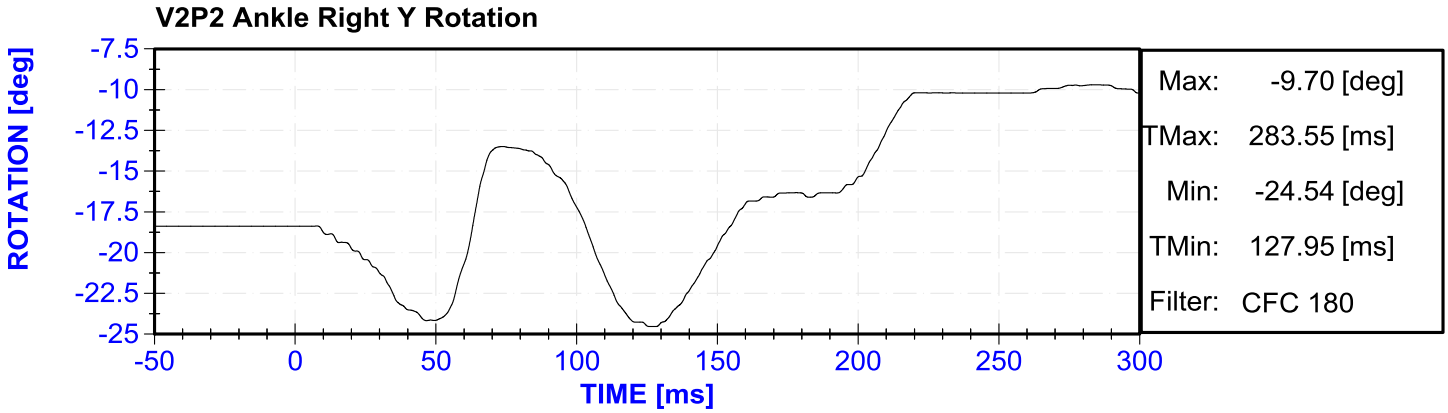

V2P2 Upper Tibia Right Y Moment
MOMENT [Nm]
TIME [ms]
Max: 28.22 [Nm]
TMax: 85.90 [ms]
Min: -79.76 [Nm]
TMin: 68.50 [ms]
Filter: CFC 600

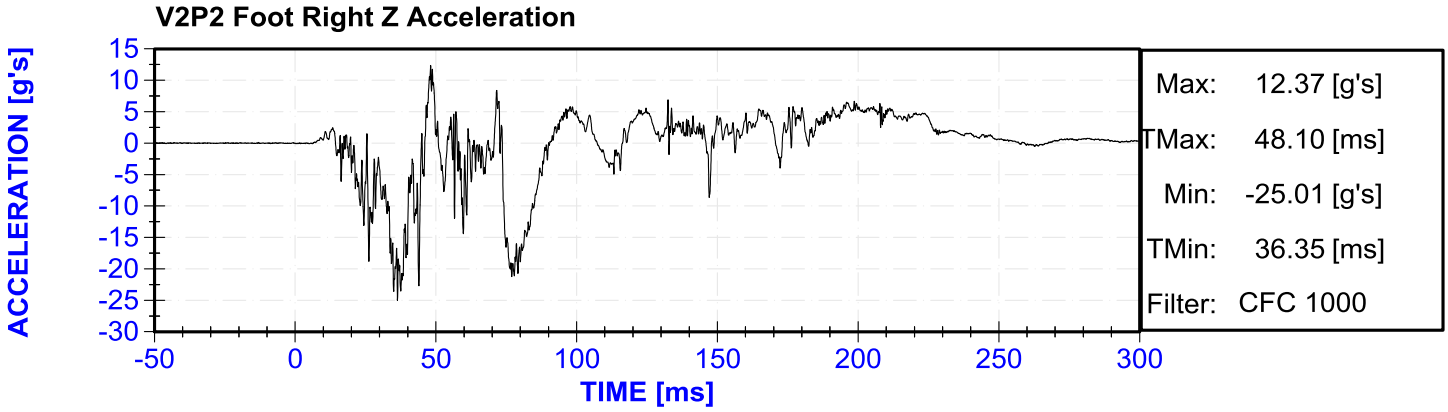

V2P2 Lower Tibia Right Z Force
FORCE [N]
TIME [ms]
Max: 124.84 [N]
TMax: 112.50 [ms]
Min: -1837.87 [N]
TMin: 78.45 [ms]
Filter: CFC 600

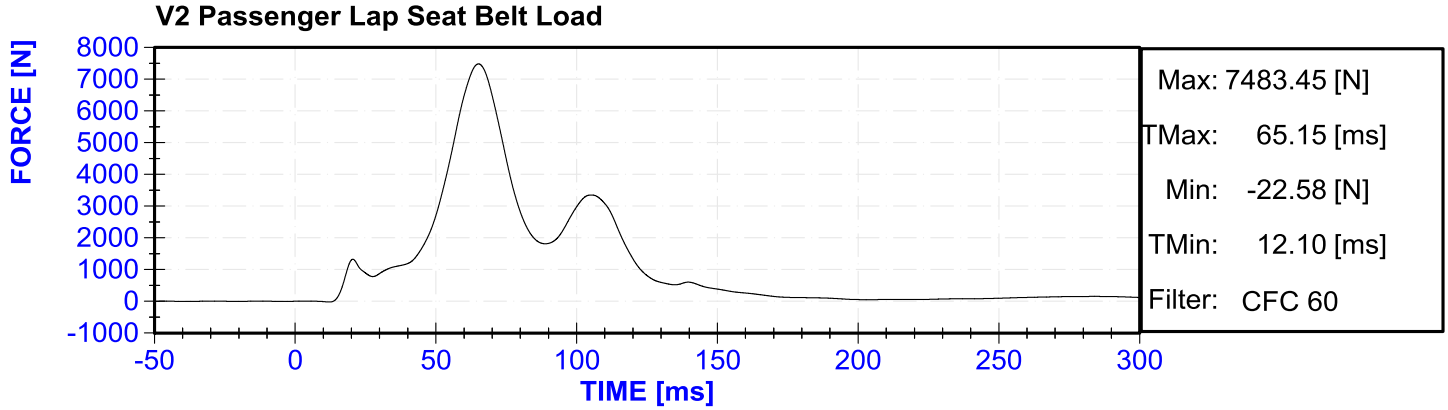

V2P2 Lower Tibia Right X Moment
MOMENT [Nm]
TIME [ms]
Max: 60.91 [Nm]
TMax: 201.85 [ms]
Min: -136.91 [Nm]
TMin: 54.30 [ms]
Filter: CFC 600

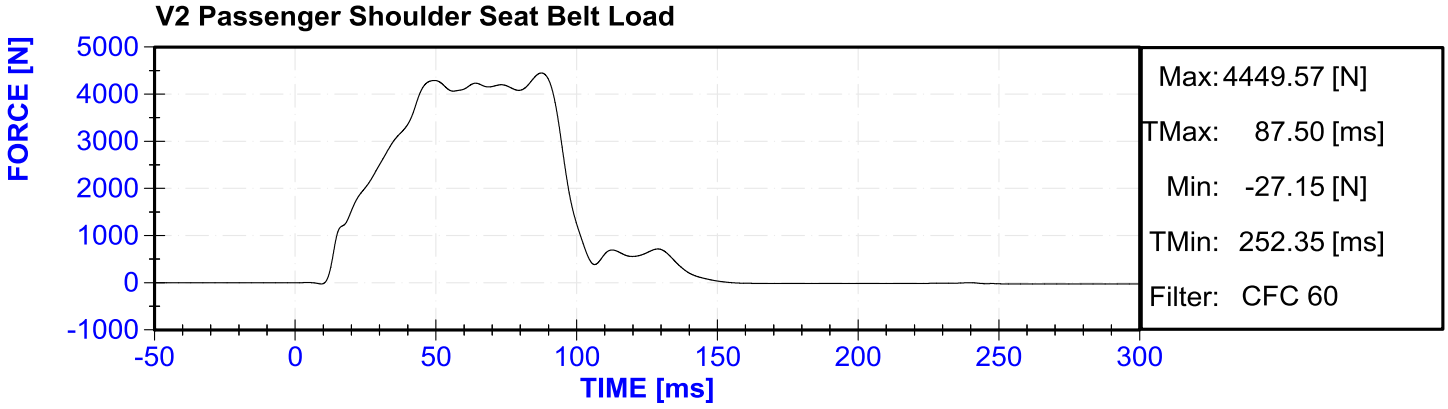

V2P2 Lower Tibia Right Y Moment
MOMENT [Nm]
TIME [ms]
Max: 4.83 [Nm]
TMax: 84.80 [ms]
Min: -70.63 [Nm]
TMin: 58.50 [ms]
Filter: CFC 600


V2P2 Ankle Right X Rotation
ROTATION [deg]
TIME [ms]
Max: 24.69 [deg]
TMax: 205.65 [ms]
Min: -35.16 [deg]
TMin: 65.70 [ms]
Filter: CFC 180

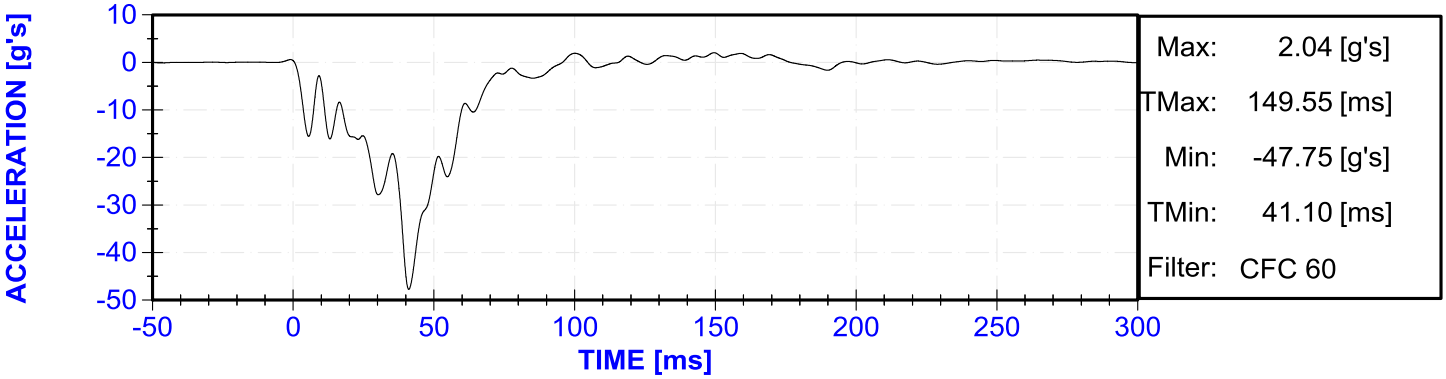

V2P2 Ankle Right Y Rotation
ROTATION [deg]
-7.5
-10
-12.5
-15
-17.5
-20
-22.5
-25
-50
0
50
100
150
200
250
300
TIME [ms]
Max: -9.70 [deg]
TMax: 283.55 [ms]
Min: -24.54 [deg]
TMin: 127.95 [ms]
Filter: CFC 180


V2P2 Foot Right Z Acceleration
ACCELERATION [g's]
15
10
5
0
-5
-10
-15
-20
-25
-30
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 12.37 [g's]
TMax: 48.10 [ms]
Min: -25.01 [g's]
TMin: 36.35 [ms]
Filter: CFC 1000

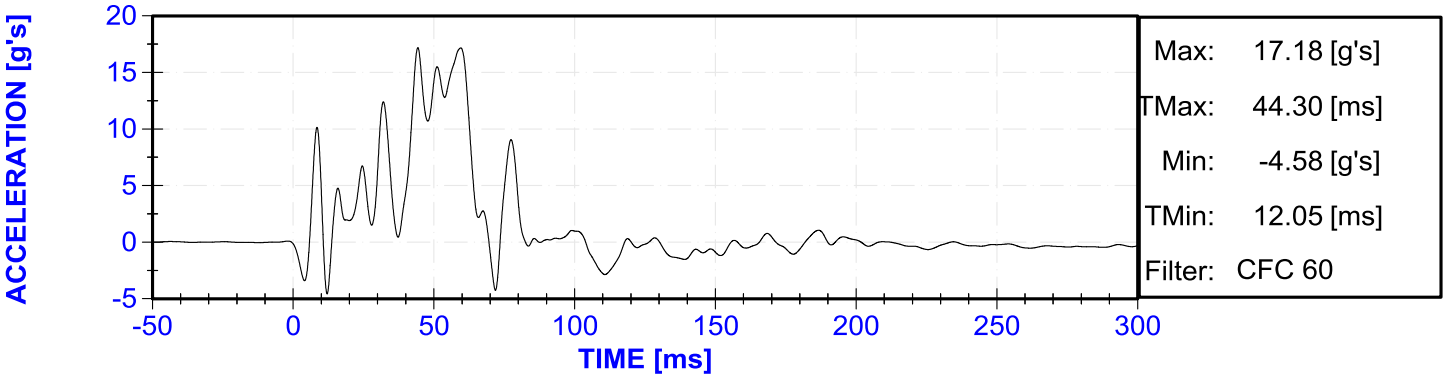

V2 Passenger Lap Seat Belt Load
FORCE [N]
8000
7000
6000
5000
4000
3000
2000
1000
0
-1000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 7483.45 [N]
TMax: 65.15 [ms]
Min: -22.58 [N]
TMin: 12.10 [ms]
Filter: CFC 60


V2 Passenger Shoulder Seat Belt Load
FORCE [N]
5000
4000
3000
2000
1000
0
-1000
-50
0
50
100
150
200
250
300
TIME [ms]
Max: 4449.57 [N]
TMax: 87.50 [ms]
Min: -27.15 [N]
TMin: 252.35 [ms]
Filter: CFC 60

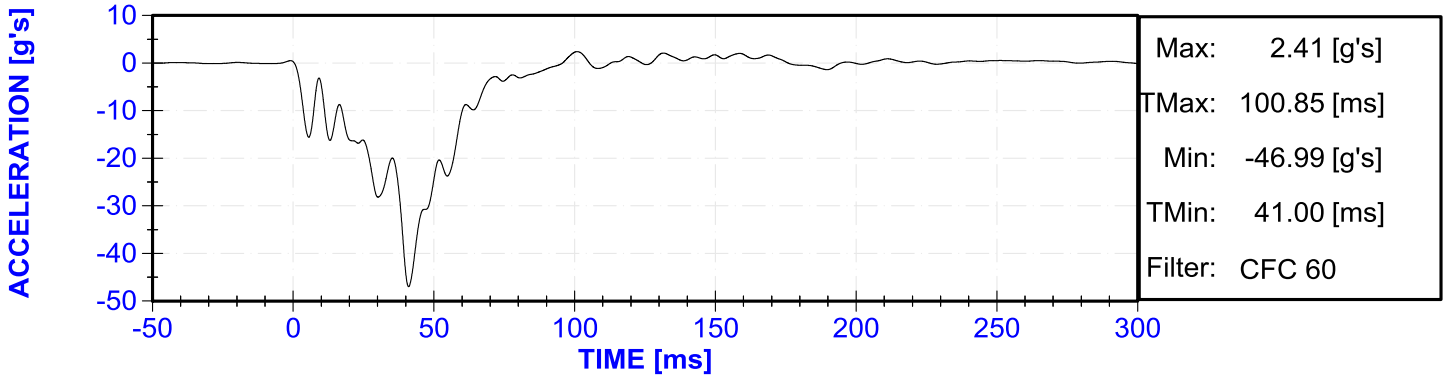
V2 Left Rear Sill X Acceleration



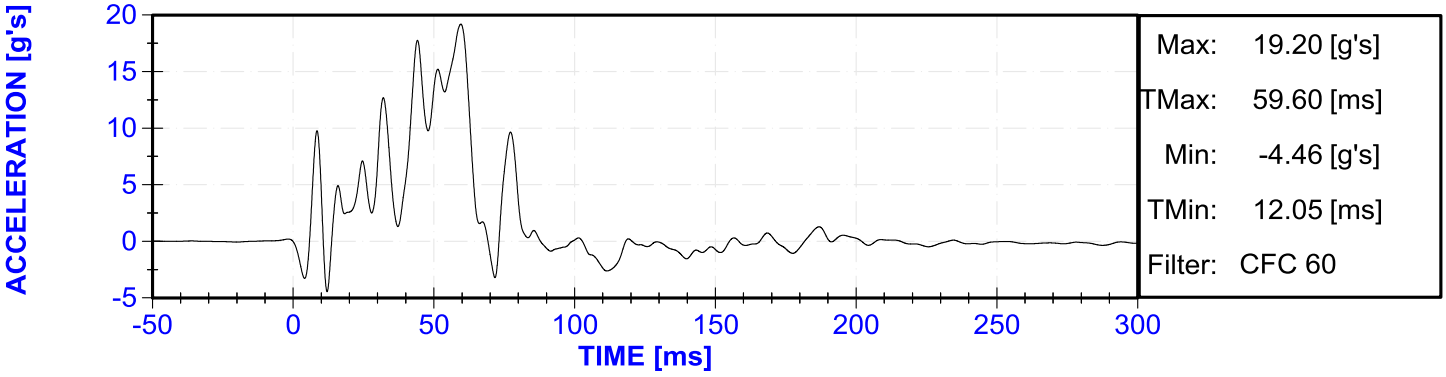
V2 Left Rear Sill Y Acceleration

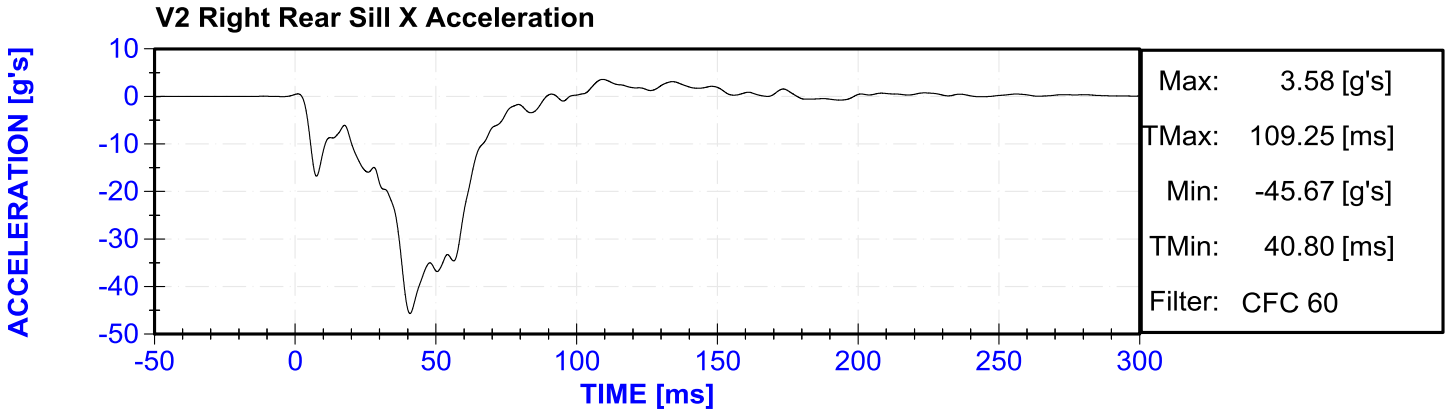


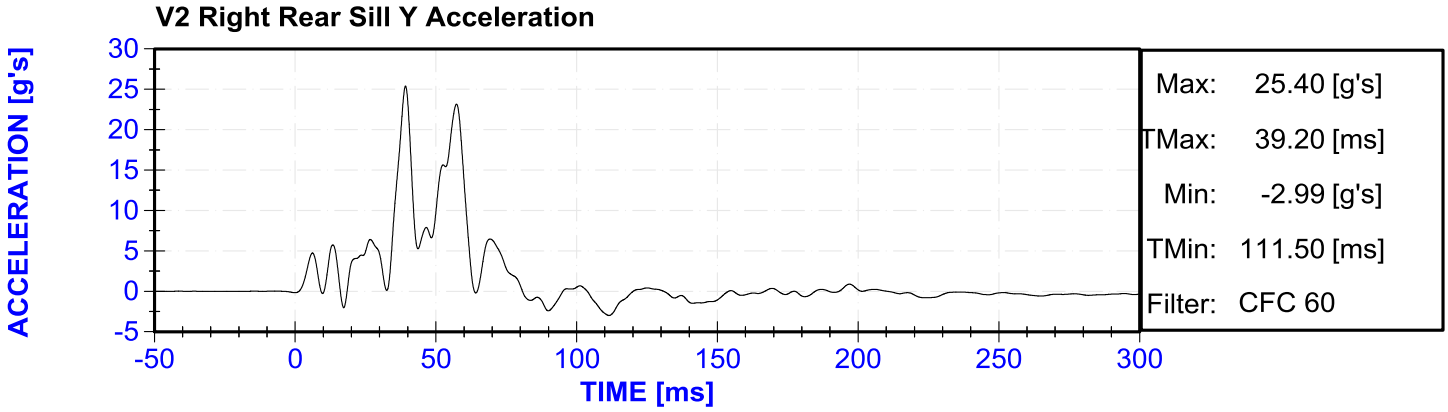
V2 Left Rear Sill Redundent X Acceleration

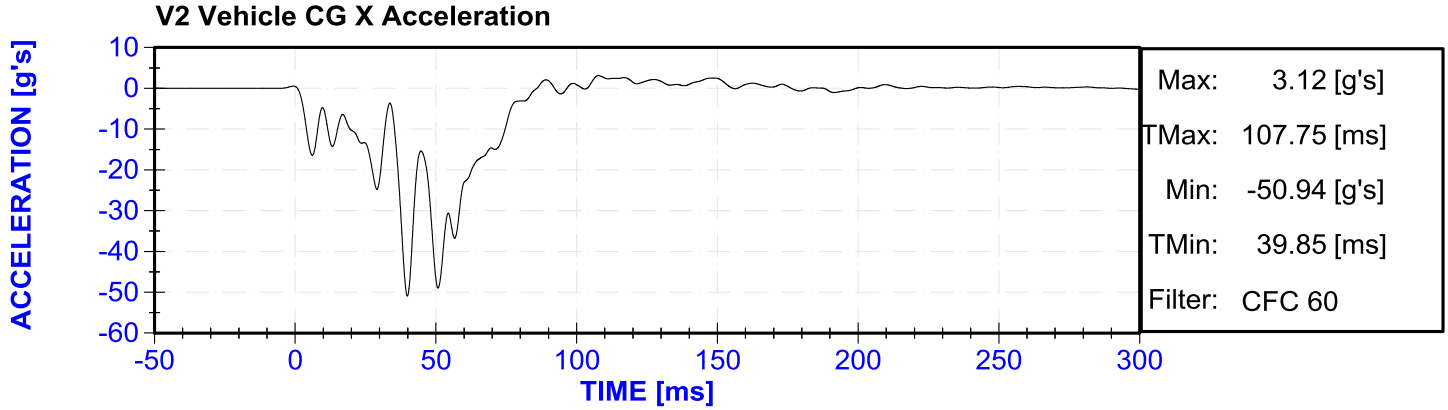


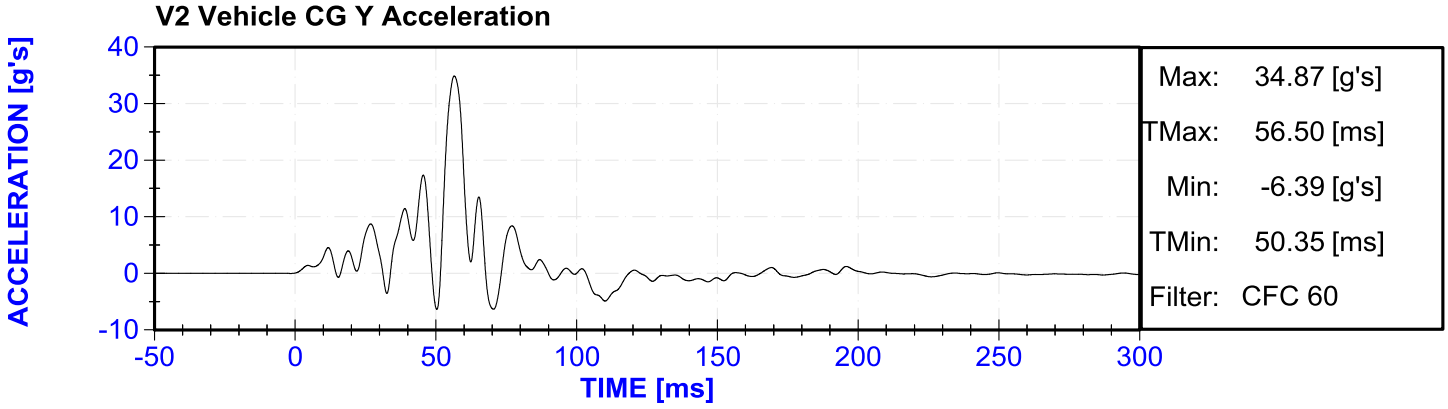
V2 Left Rear Sill Redundent Y Acceleration

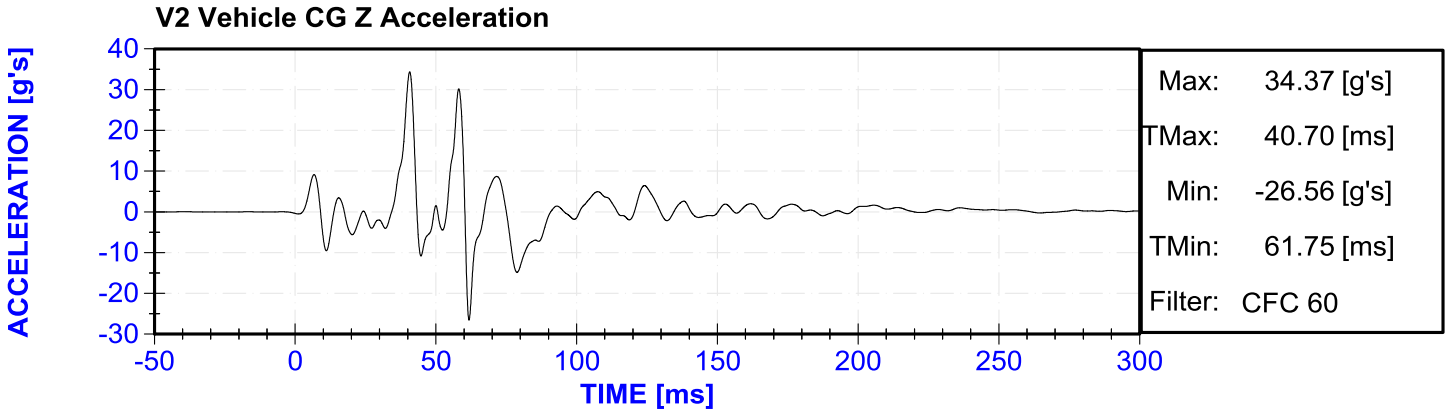


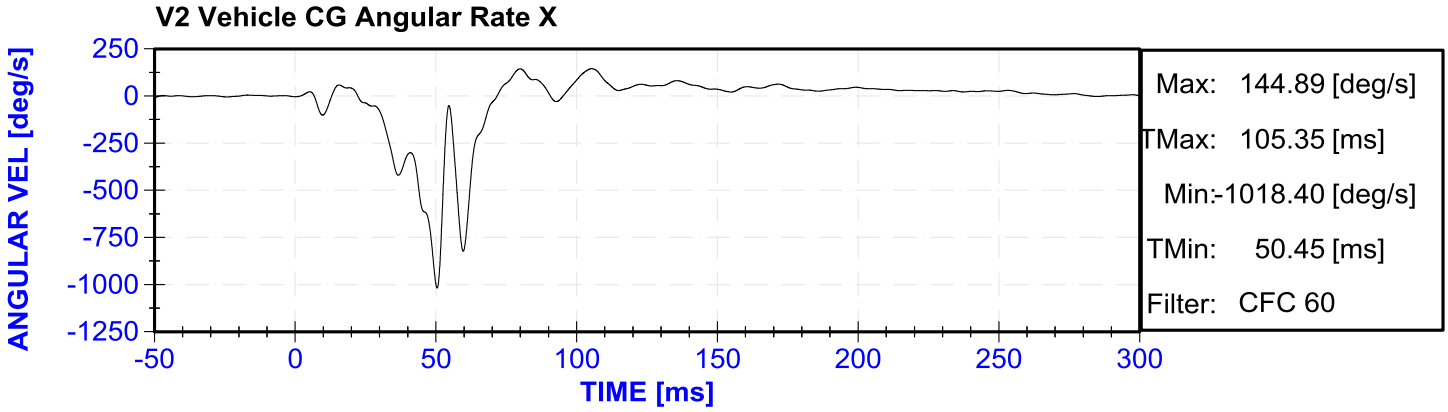

V2 Right Rear Sill X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 3.58 [g's]
TMax: 109.25 [ms]
Min: -45.67 [g's]
TMin: 40.80 [ms]
Filter: CFC 60

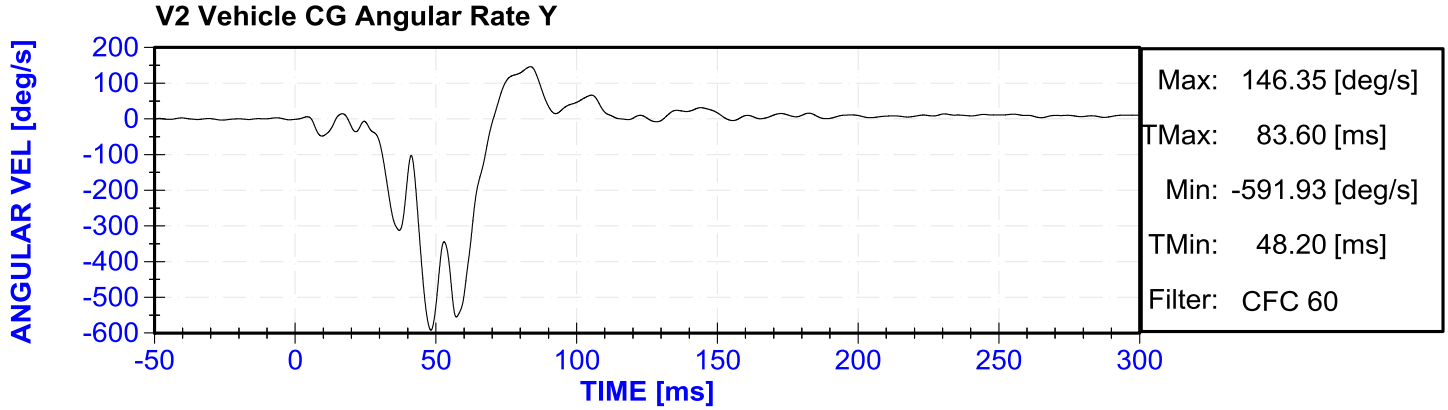

V2 Right Rear Sill Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 25.40 [g's]
TMax: 39.20 [ms]
Min: -2.99 [g's]
TMin: 111.50 [ms]
Filter: CFC 60

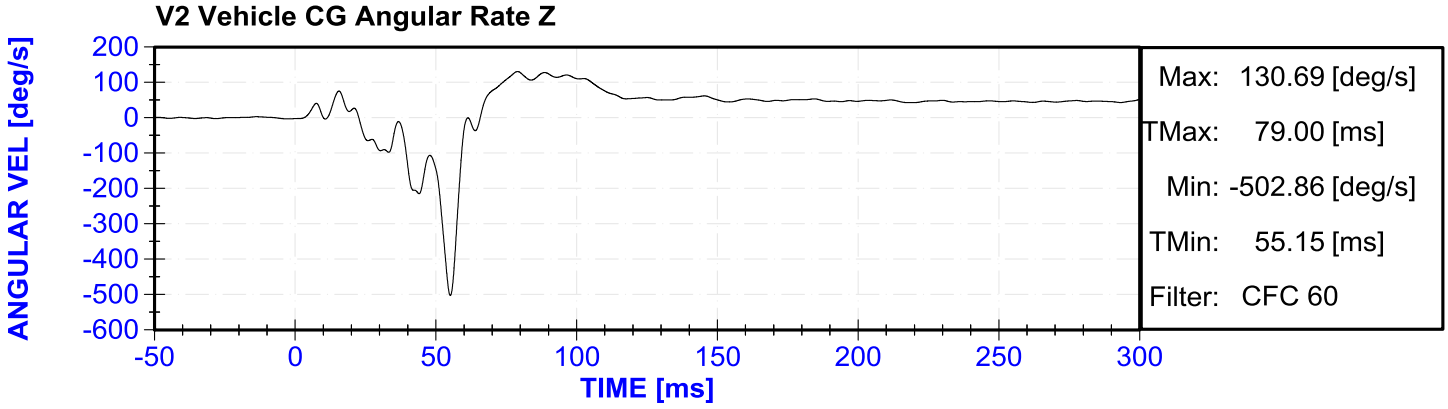

V2 Vehicle CG X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 3.12 [g's]
TMax: 107.75 [ms]
Min: -50.94 [g's]
TMin: 39.85 [ms]
Filter: CFC 60


V2 Vehicle CG Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 34.87 [g's]
TMax: 56.50 [ms]
Min: -6.39 [g's]
TMin: 50.35 [ms]
Filter: CFC 60

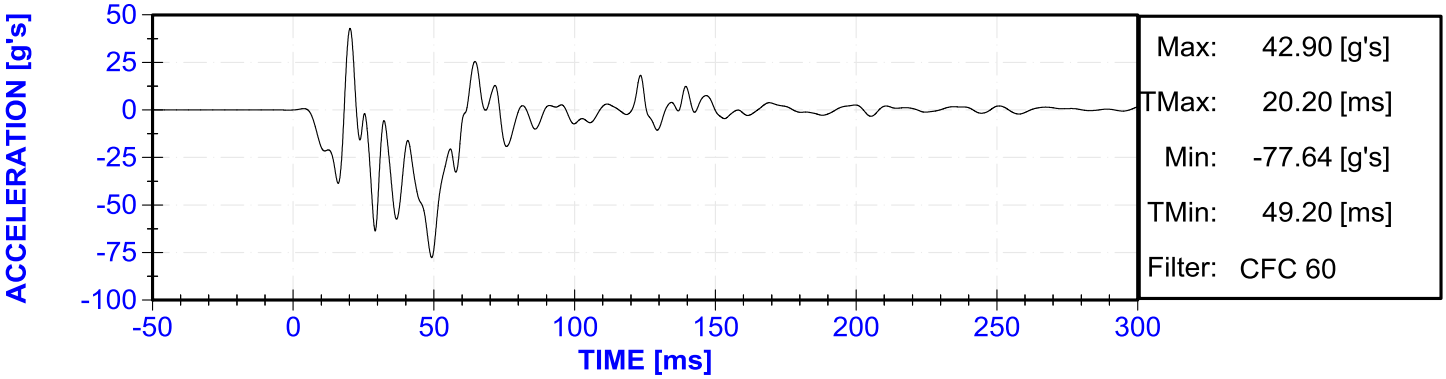

V2 Vehicle CG Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 34.37 [g's]
TMax: 40.70 [ms]
Min: -26.56 [g's]
TMin: 61.75 [ms]
Filter: CFC 60


V2 Vehicle CG Angular Rate X
ANGULAR VEL [deg/s]
TIME [ms]
Max: 144.89 [deg/s]
TMax: 105.35 [ms]
Min:-1018.40 [deg/s]
TMin: 50.45 [ms]
Filter: CFC 60

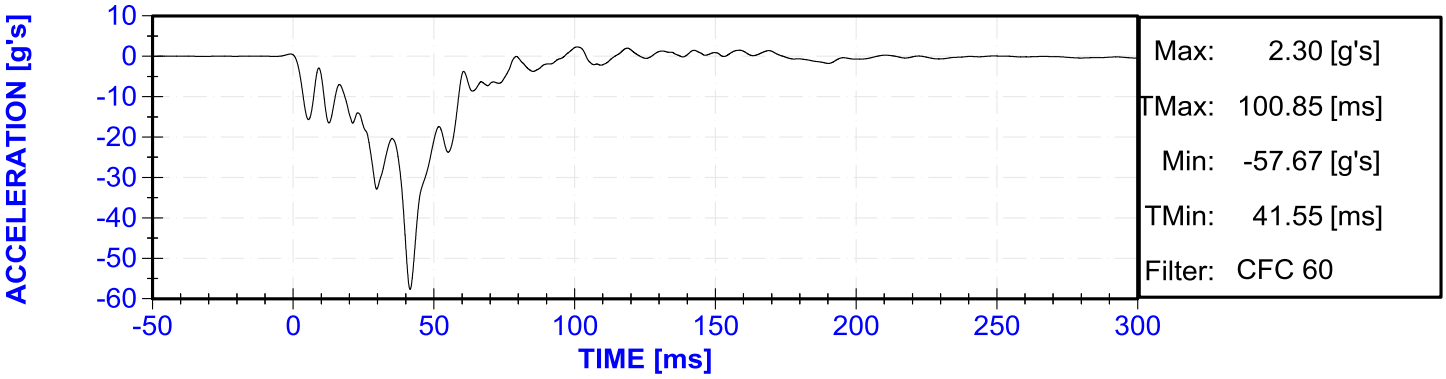

V2 Vehicle CG Angular Rate Y
ANGULAR VEL [deg/s]
TIME [ms]
Max: 146.35 [deg/s]
TMax: 83.60 [ms]
Min: -591.93 [deg/s]
TMin: 48.20 [ms]
Filter: CFC 60


V2 Vehicle CG Angular Rate Z
ANGULAR VEL [deg/s]
TIME [ms]
Max: 130.69 [deg/s]
TMax: 79.00 [ms]
Min: -502.86 [deg/s]
TMin: 55.15 [ms]
Filter: CFC 60

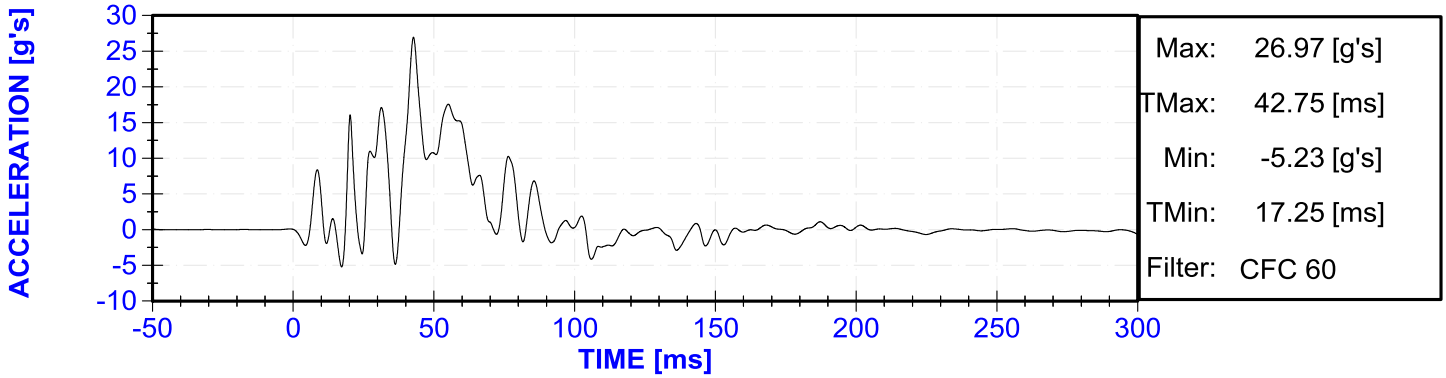
V2 Instrument Panel X Acceleration



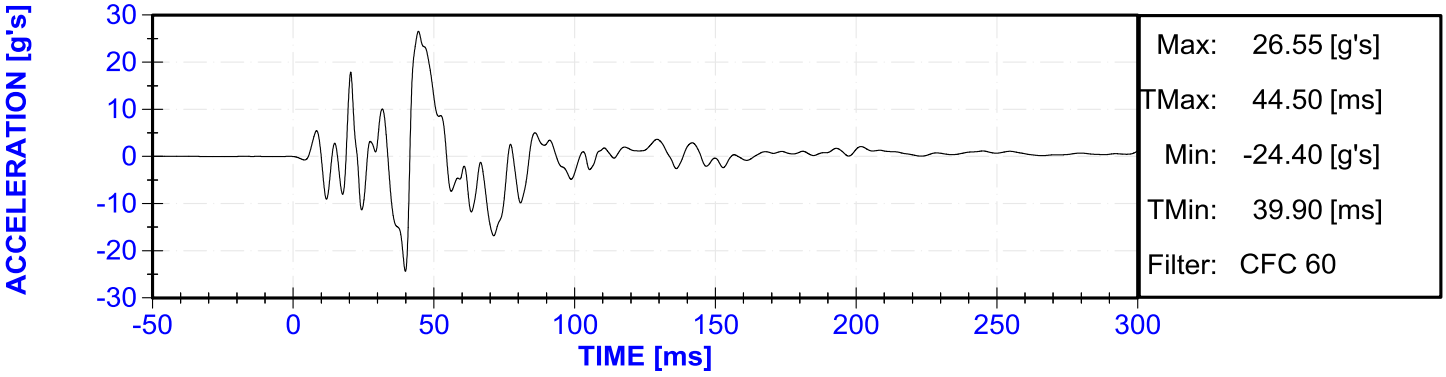
V2 Driver Seat Track X Acceleration



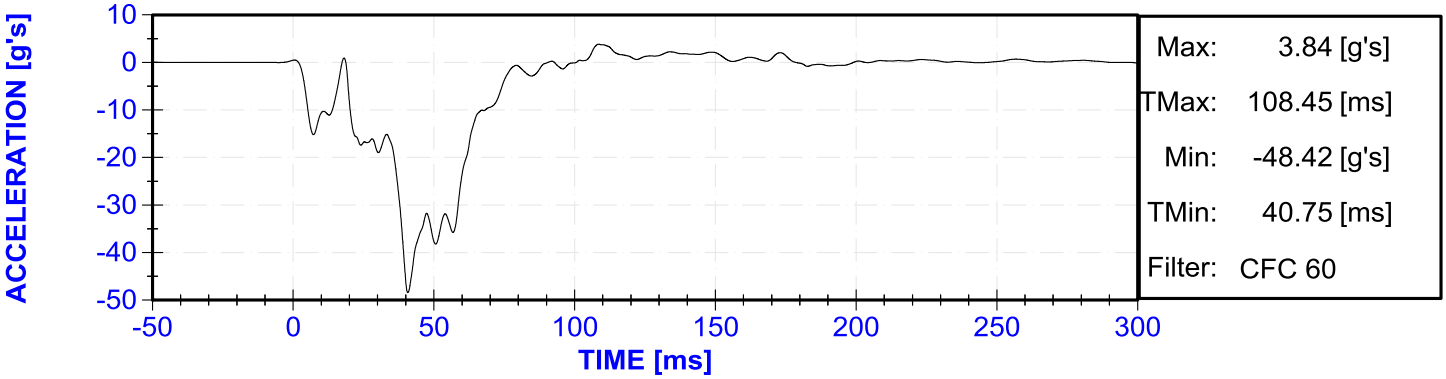
V2 Driver Seat Track Y Acceleration



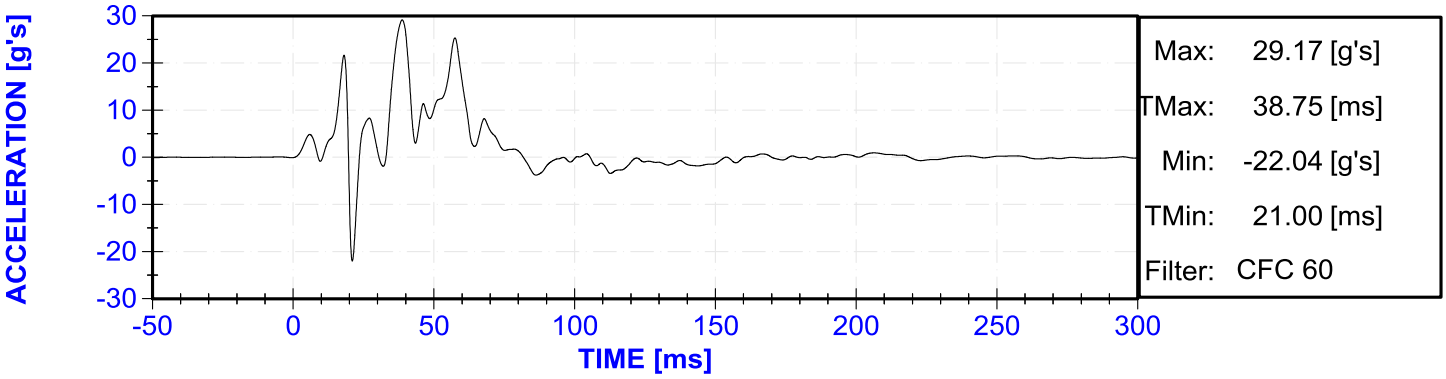
V2 Driver Seat Track Z Acceleration



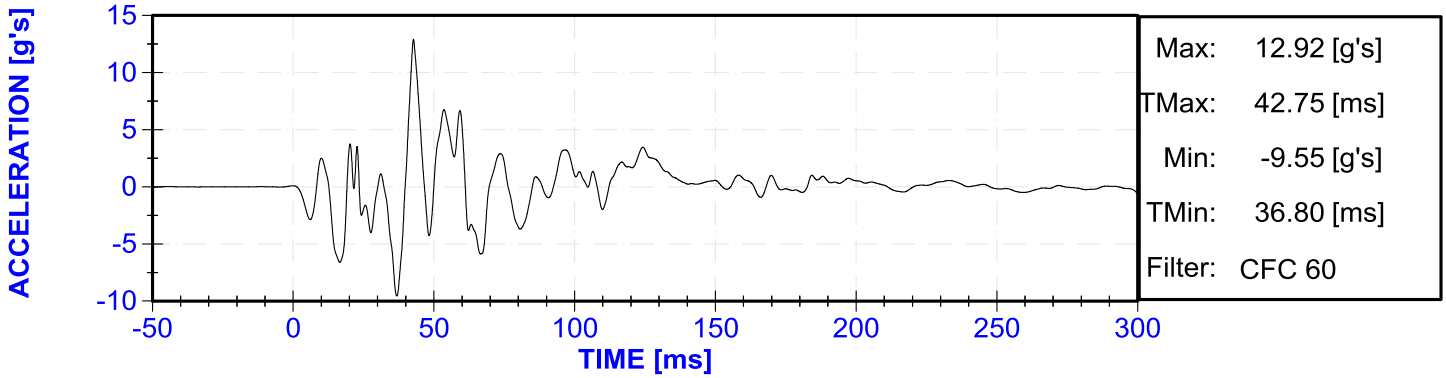
V2 Passenger Seat Track X Acceleration



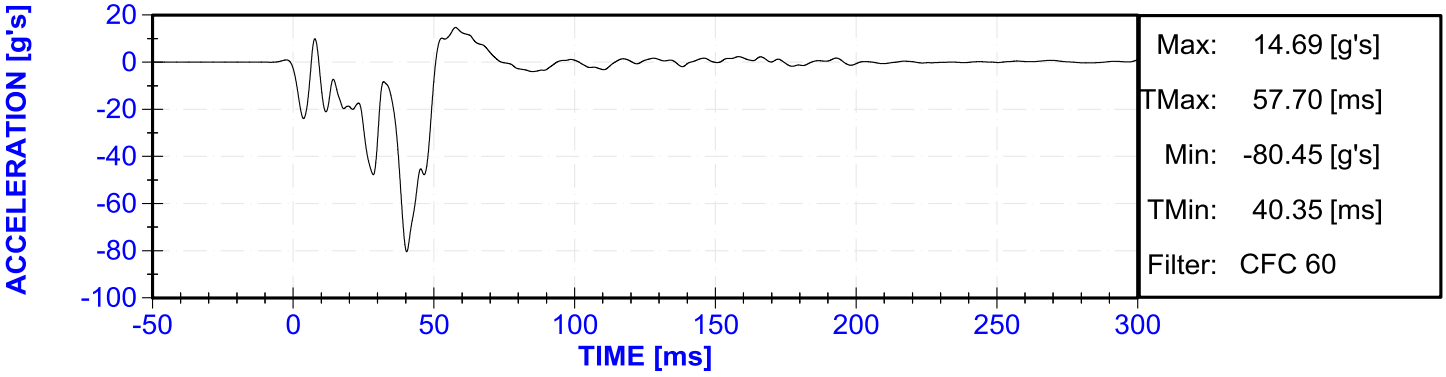
V2 Passenger Seat Track Y Acceleration



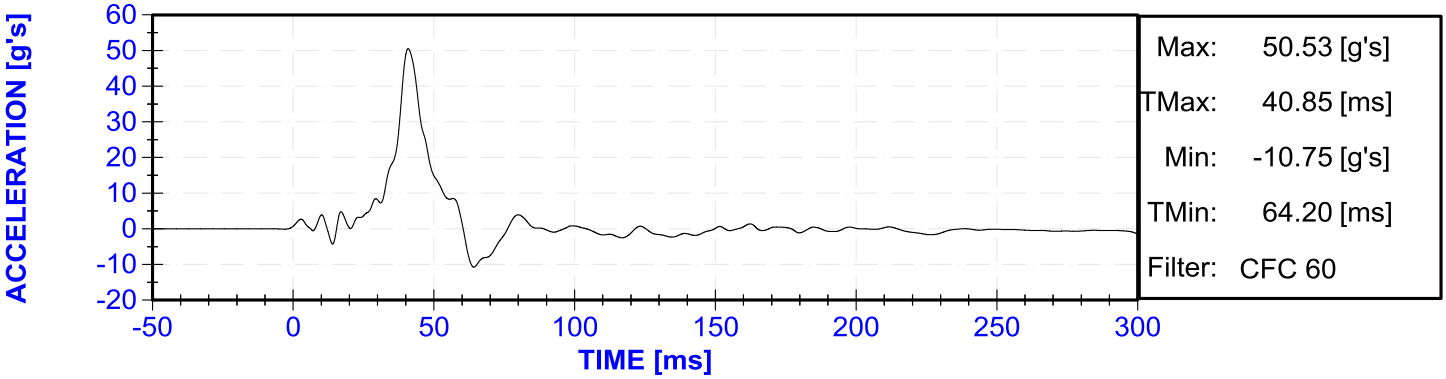
V2 Passenger Seat Track Z Acceleration



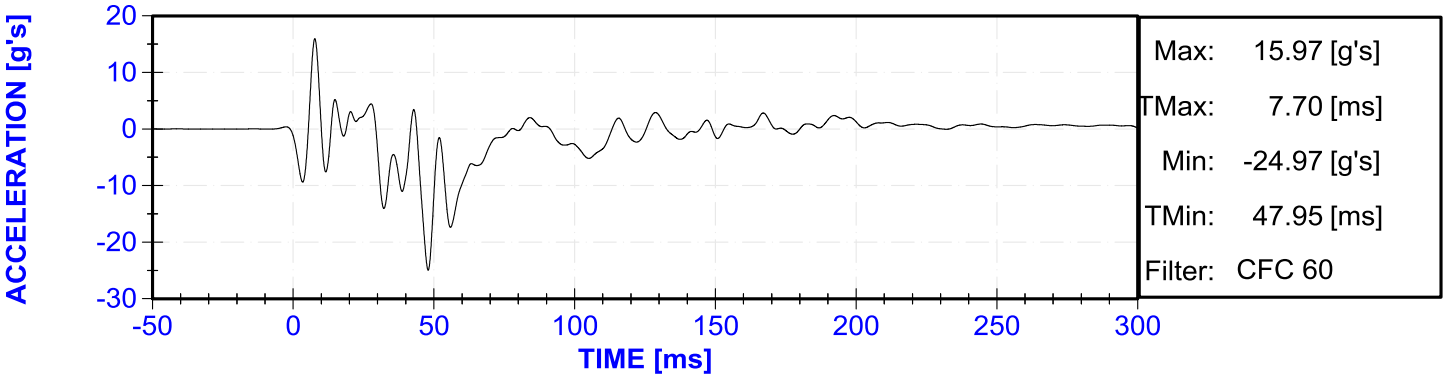
V2 Driver Floor Pan X Acceleration



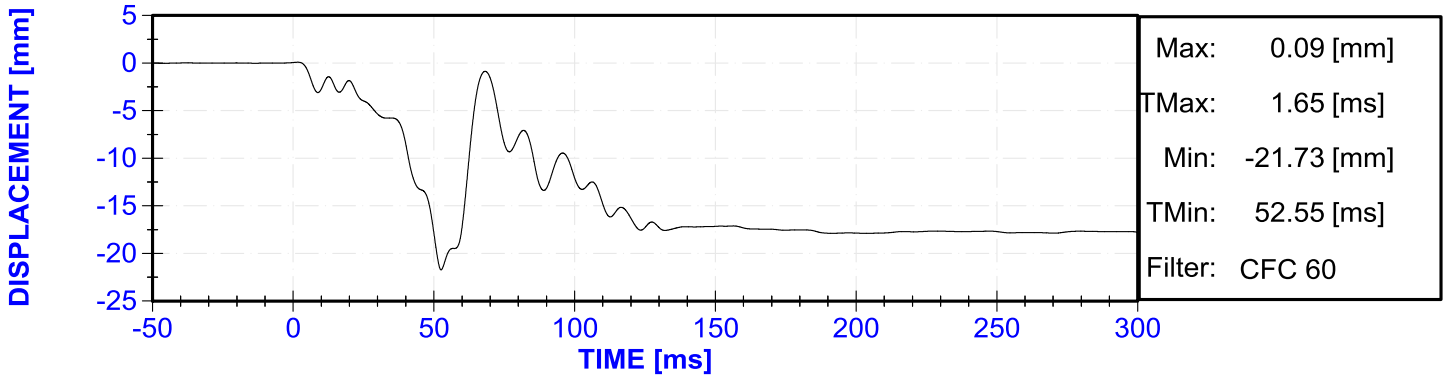
V2 Driver Floor Pan Y Acceleration



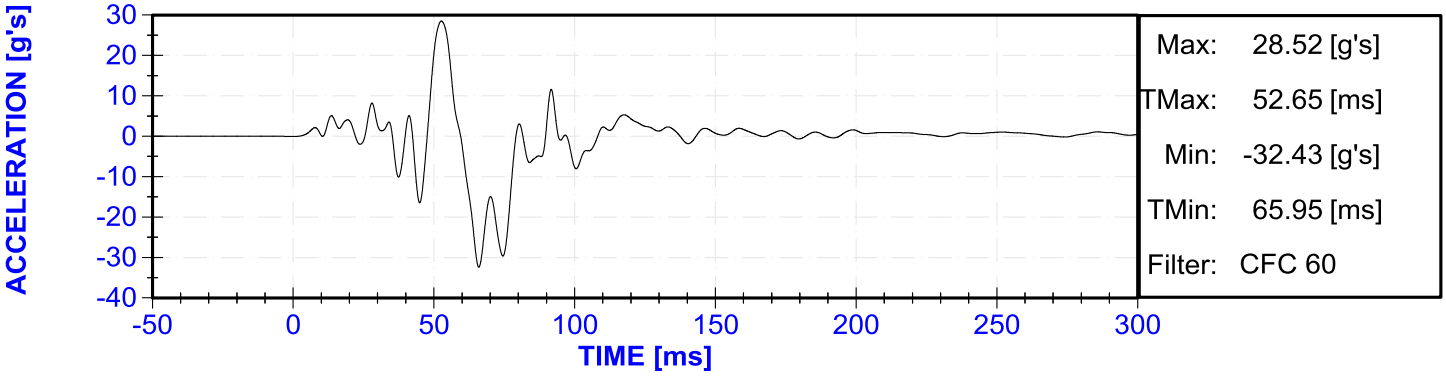
V2 Driver Floor Pan Z Acceleration



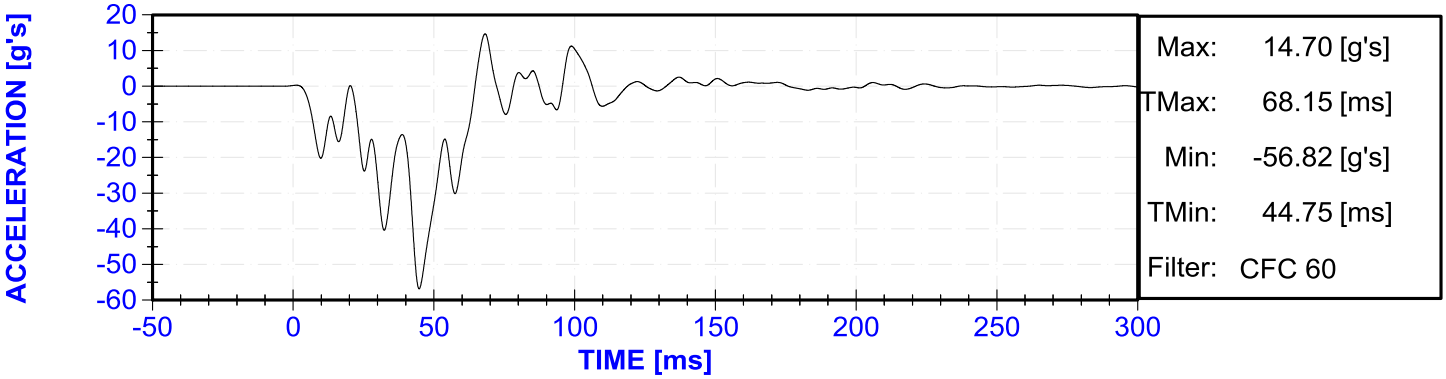
V2 Driver Floor Pan X Deflection



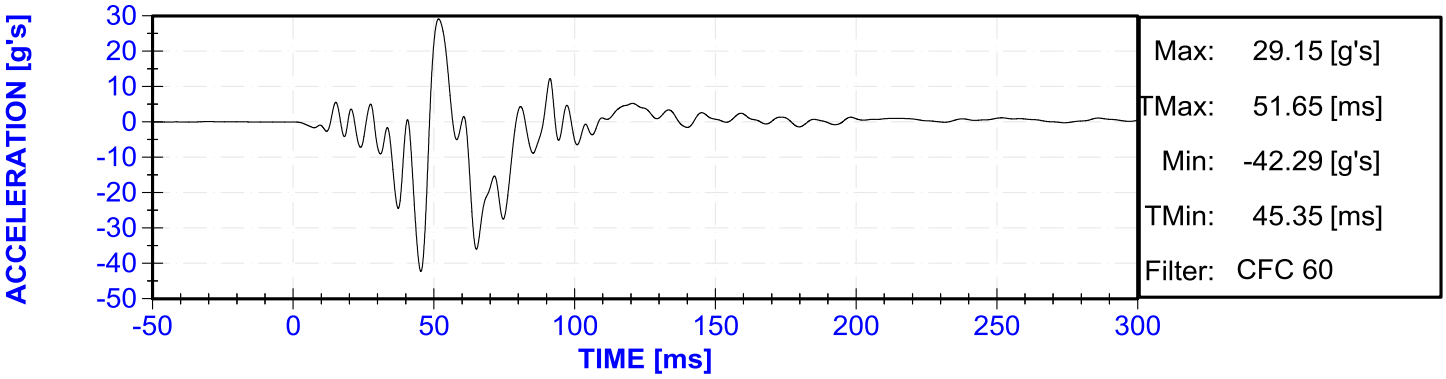
V2 Driver Seat Pan Z Accelerometer



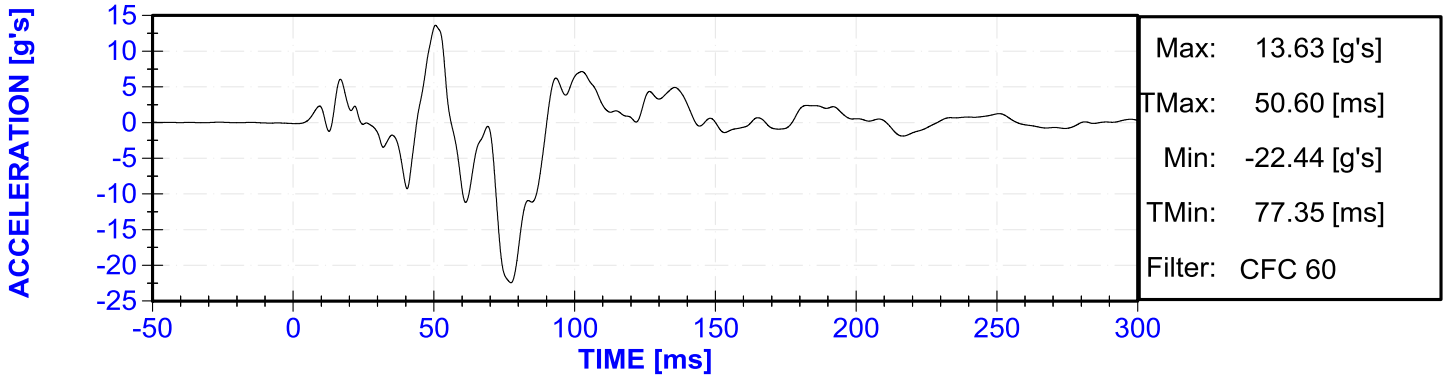
V2 Driver Seat Thigh Bar X Acceleration



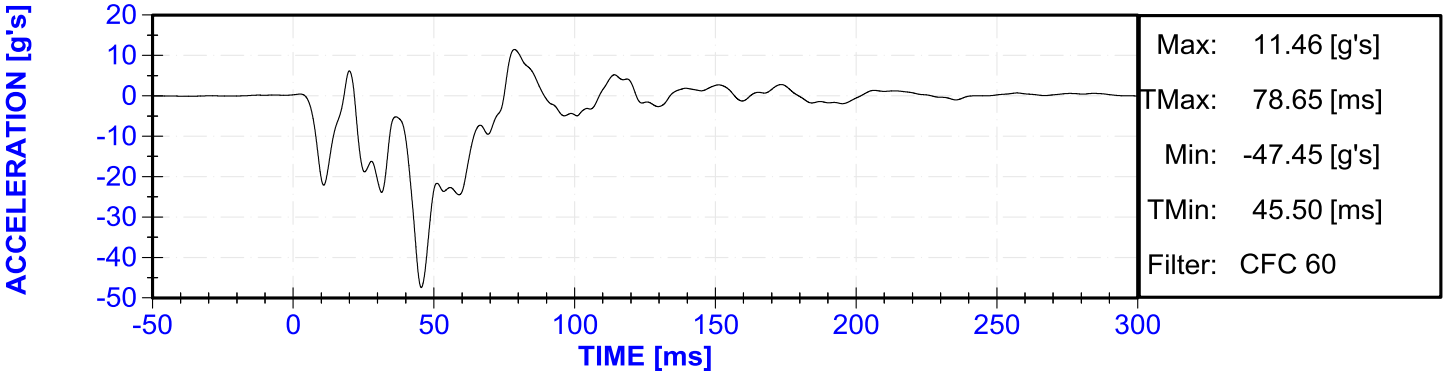
V2 Driver Seat Thigh Bar Z Acceleration



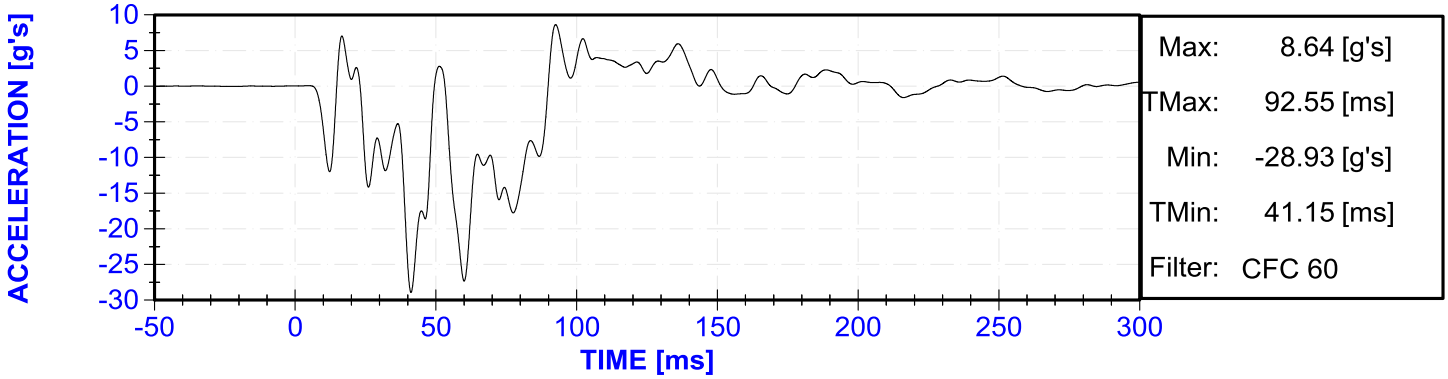
V2 Passenger Seat Pan Z Accelerometer



V2 Passenger Seat Thigh Bar X Accelerometer

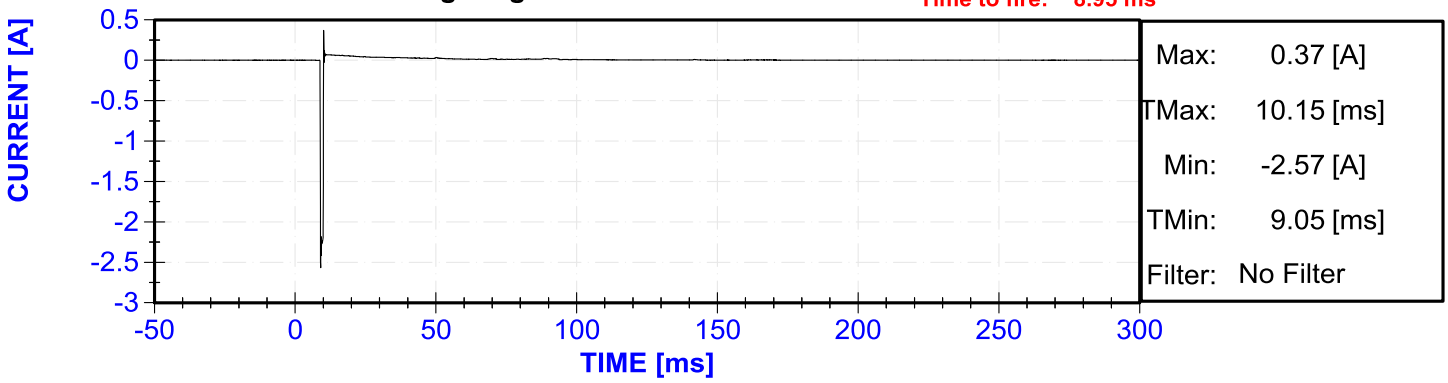


V2 Passenger Seat Thigh Bar Z Accelerometer



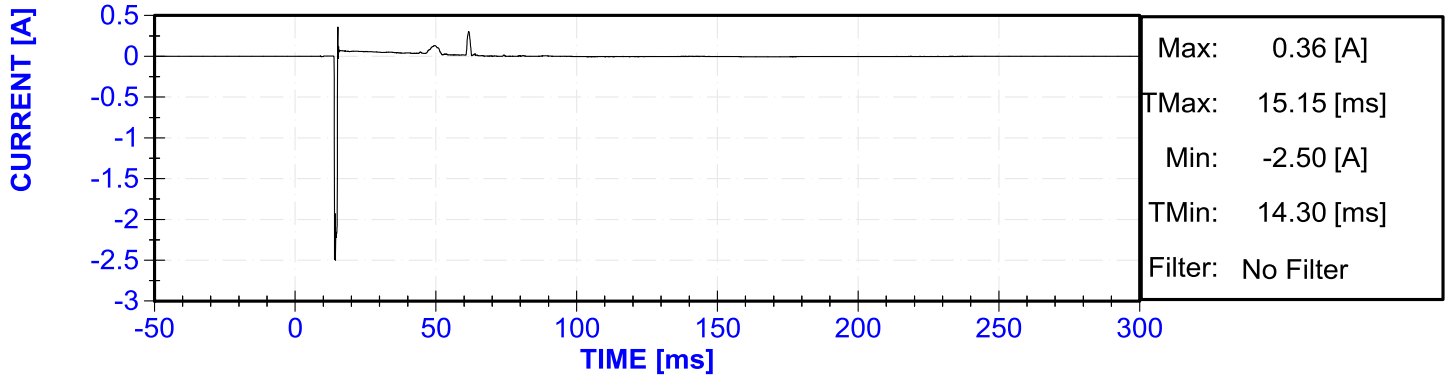
V2 Driver Front Airbag Stage 1 Monitor

Time to fire: 8.95 ms



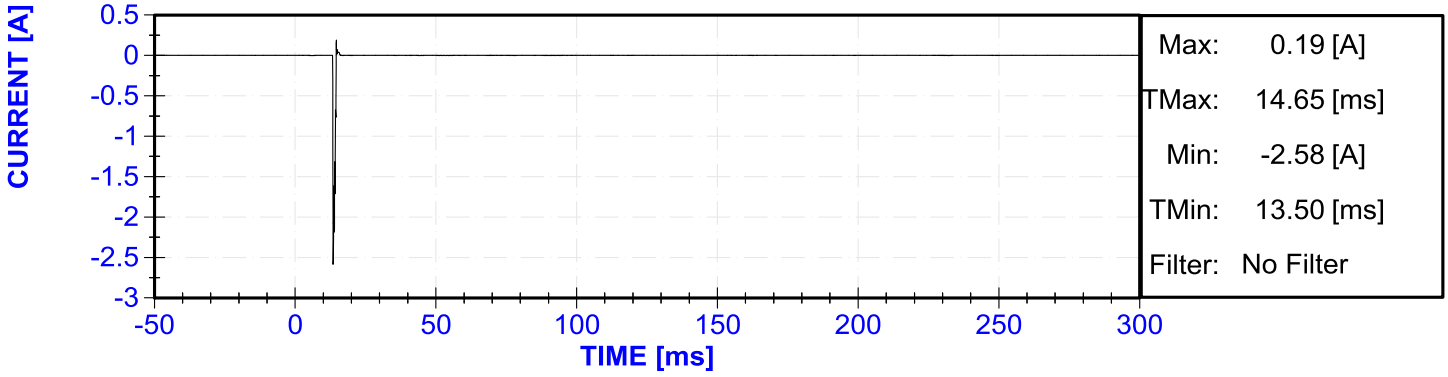
V2 Driver Front Airbag Stage 2 Monitor

Time to fire: 13.95 ms



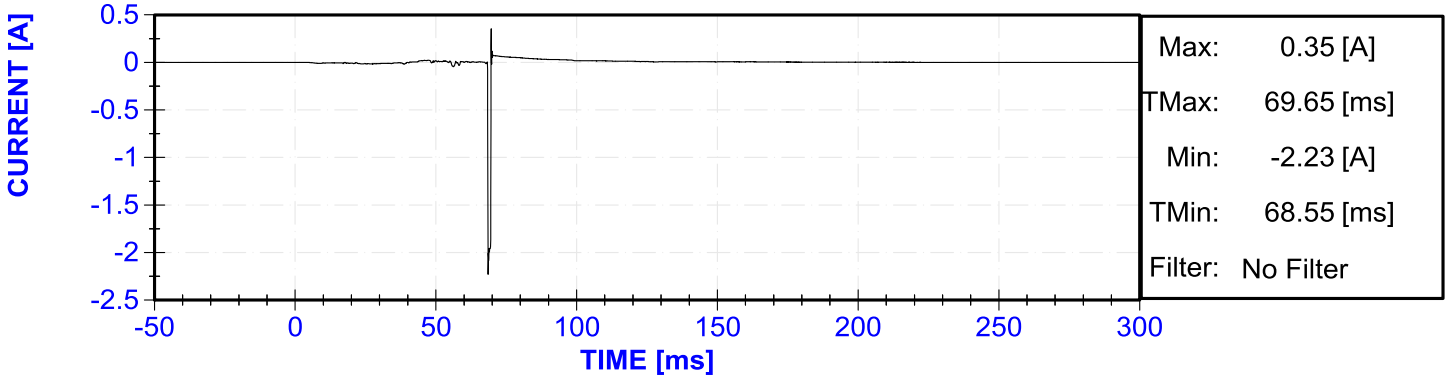
V2 Driver Curtain Airbag Monitor

Time to fire: 13.40 ms



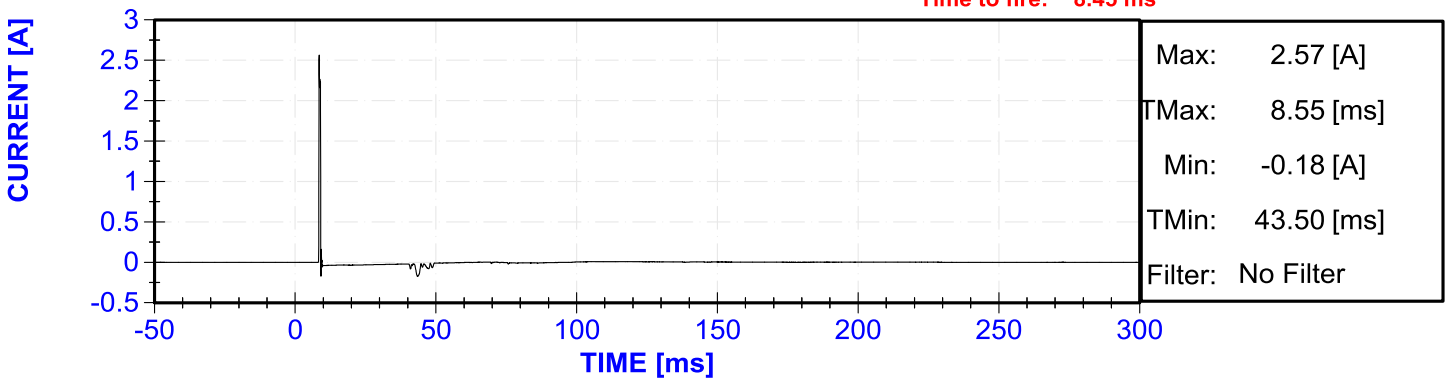
V2 Driver Seat Airbag Monitor

Time to fire: 68.45 ms



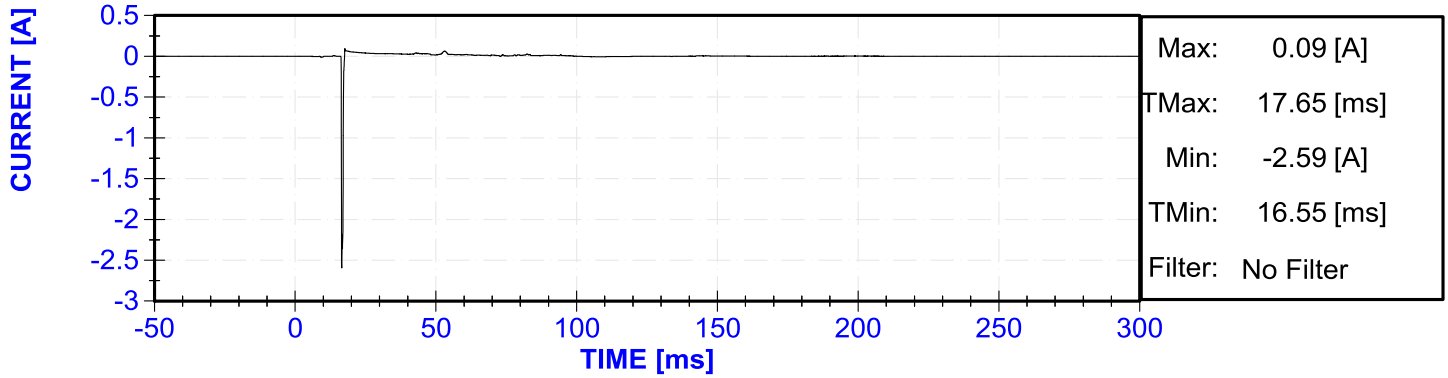
V2 Driver Retractor Pretensioner Monitor

Time to fire: 8.45 ms



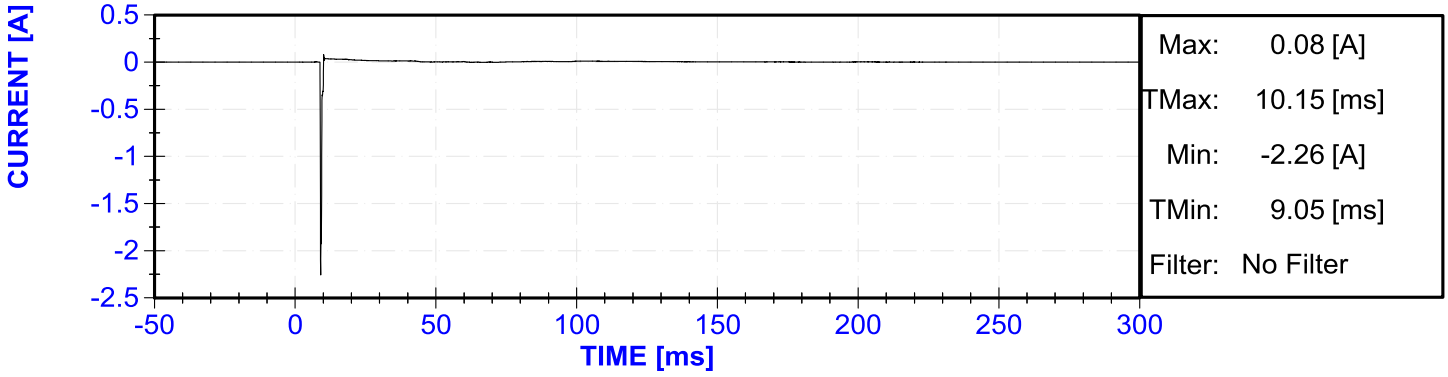
V2 Driver Anchor Pretensioner Monitor

Time to fire: 16.45 ms



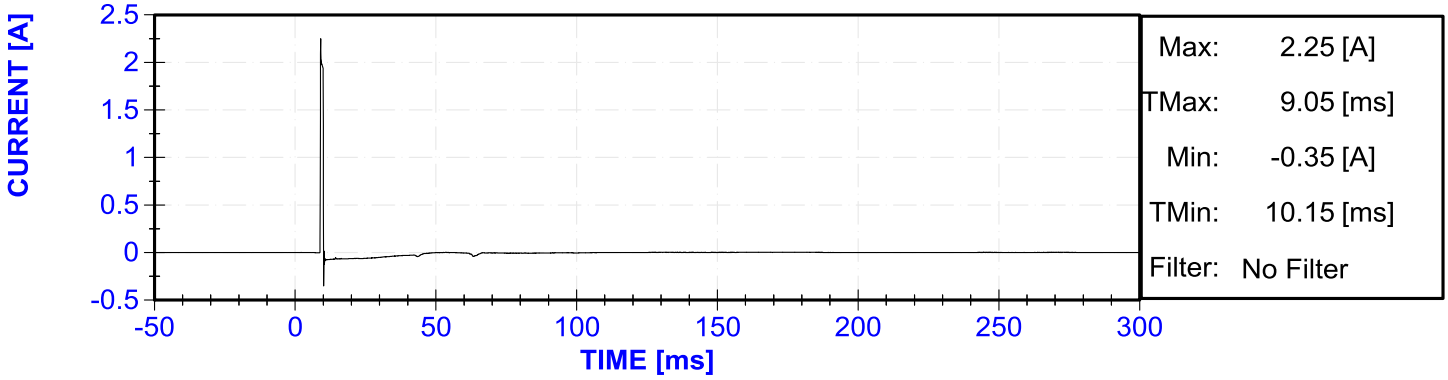
V2 Driver Steering Column Squib Monitor

Time to fire: 8.95 ms



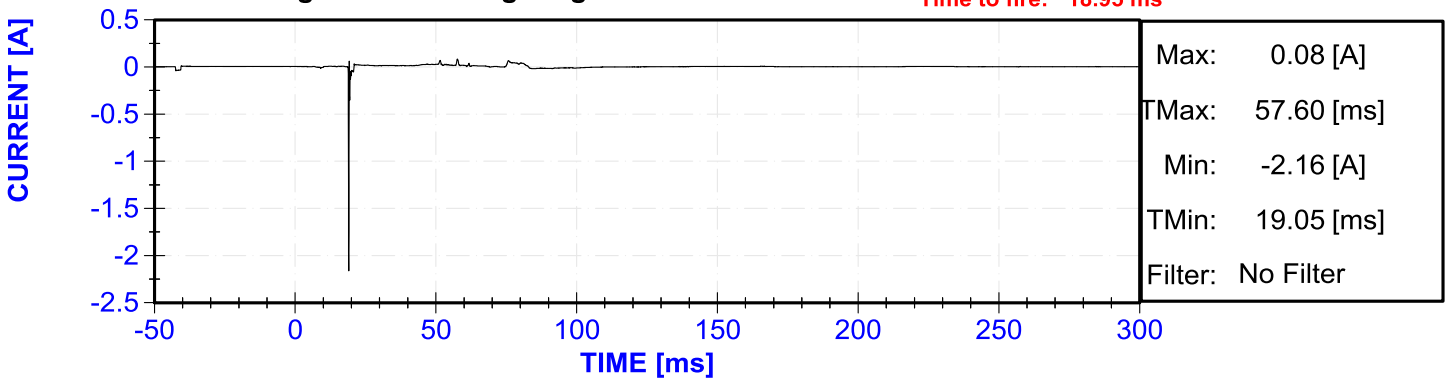
V2 Passenger Front Airbag Stage 1 Monitor

Time to fire: 8.95 ms



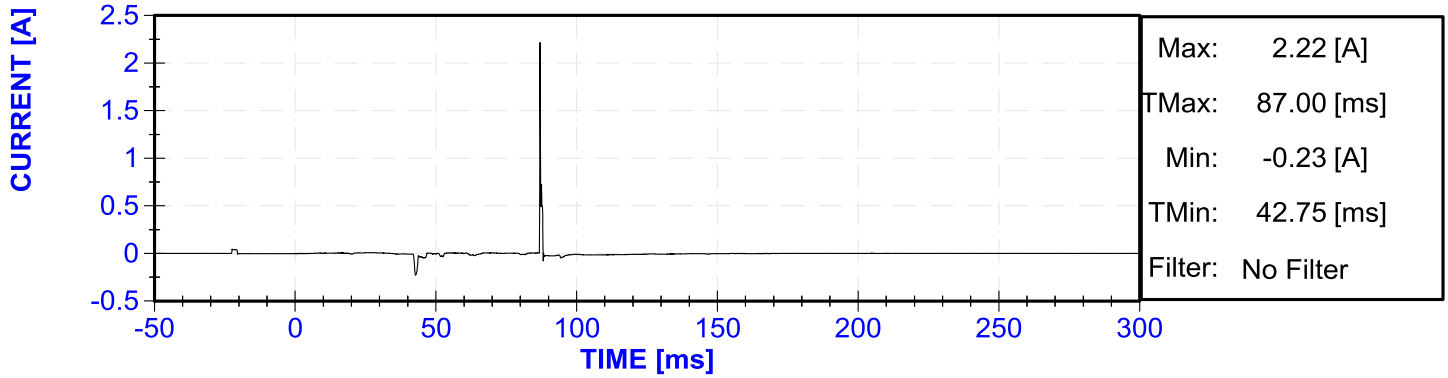
V2 Passenger Front Airbag Stage 2 Monitor

Time to fire: 18.95 ms



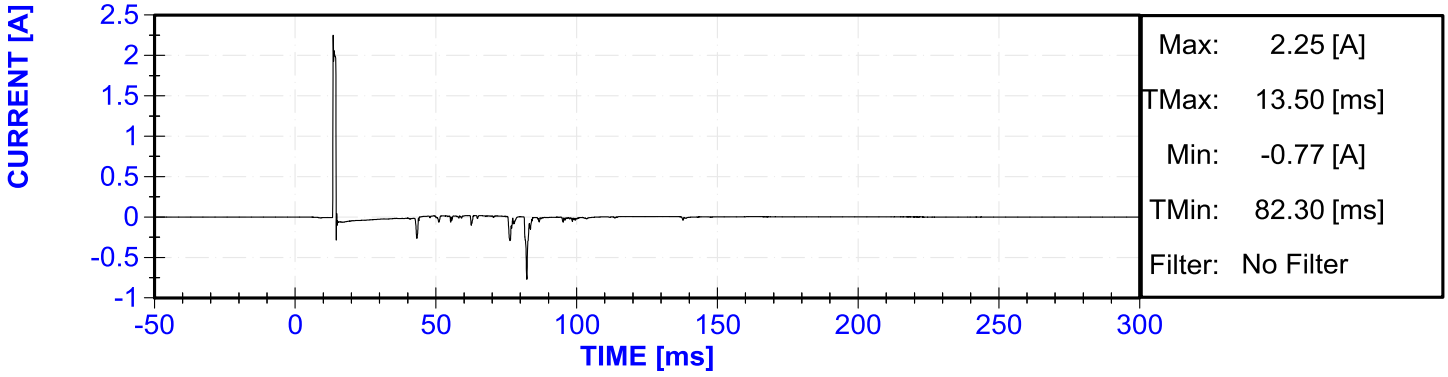
V2 Passenger Front Airbag Stage 3 Monitor

Time to fire: 86.90 ms



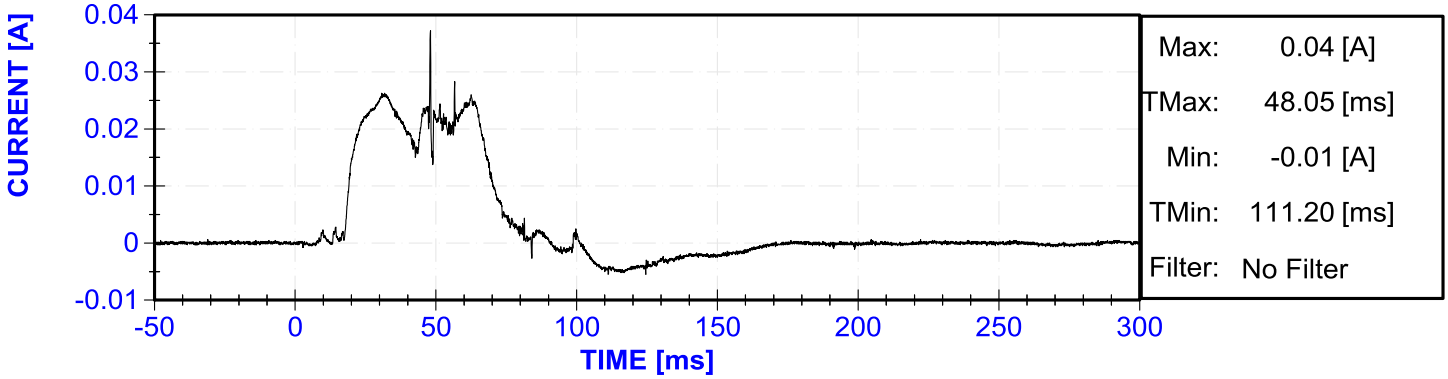
V2 Passenger Curtain Airbag Monitor

Time to fire: 13.45 ms



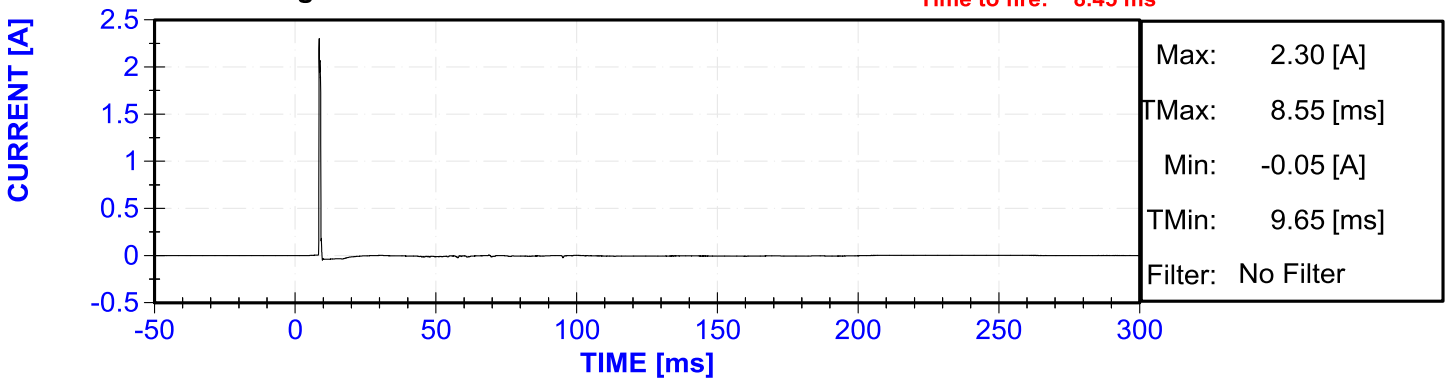
V2 Passenger Seat Airbag Monitor

Did not fire



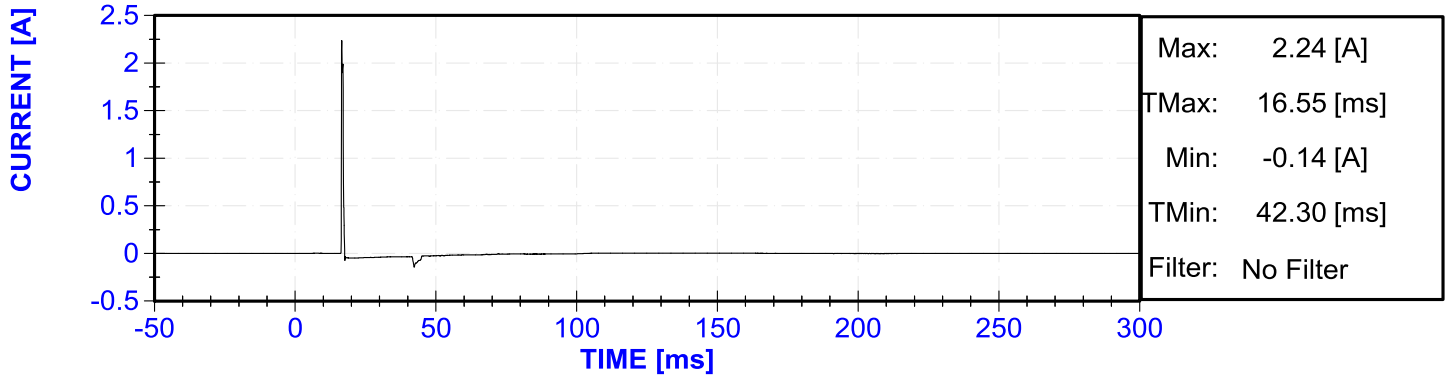
V2 Passenger Retractor Pretensioner Monitor

Time to fire: 8.45 ms

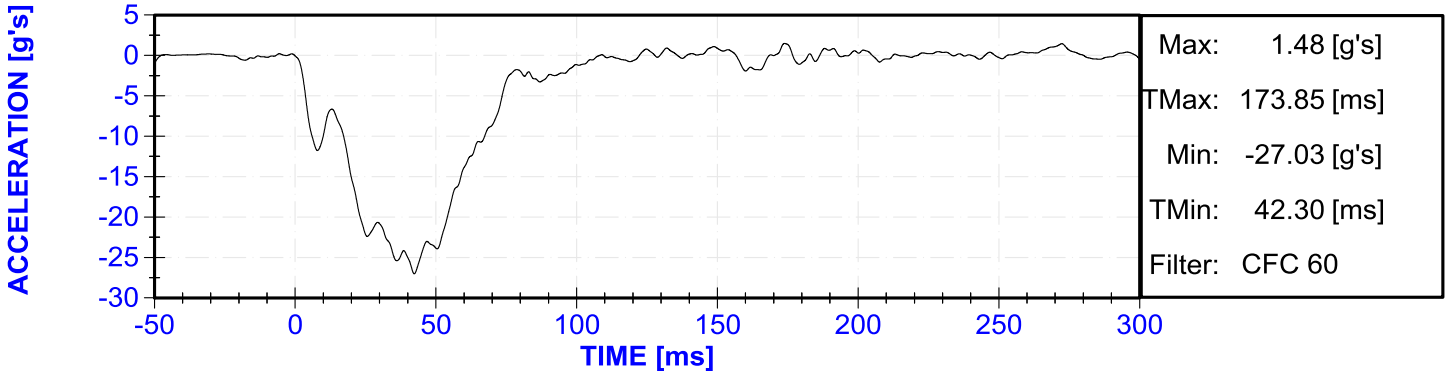


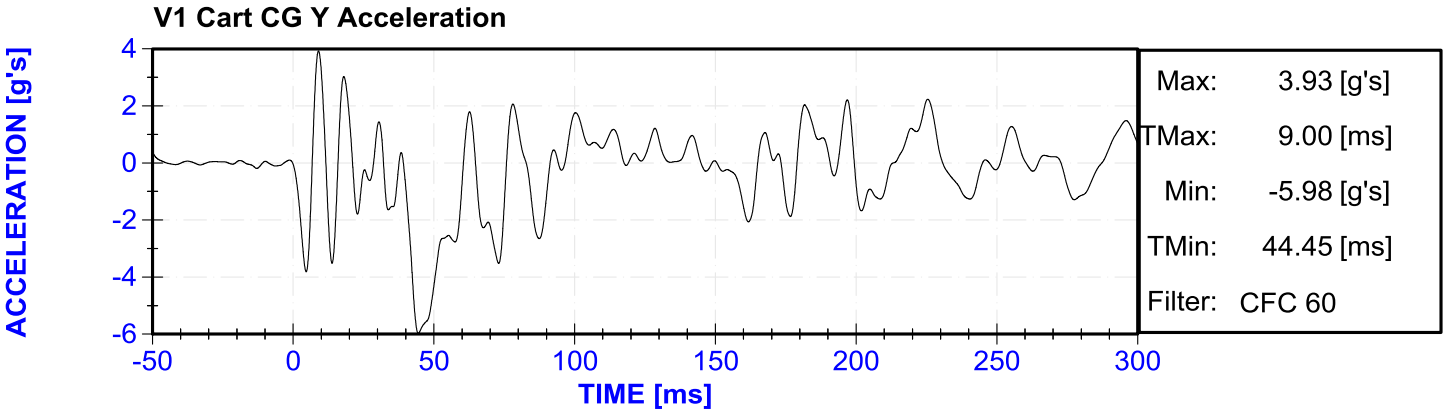
V2 Passenger Anchor Pretensioner Monitor

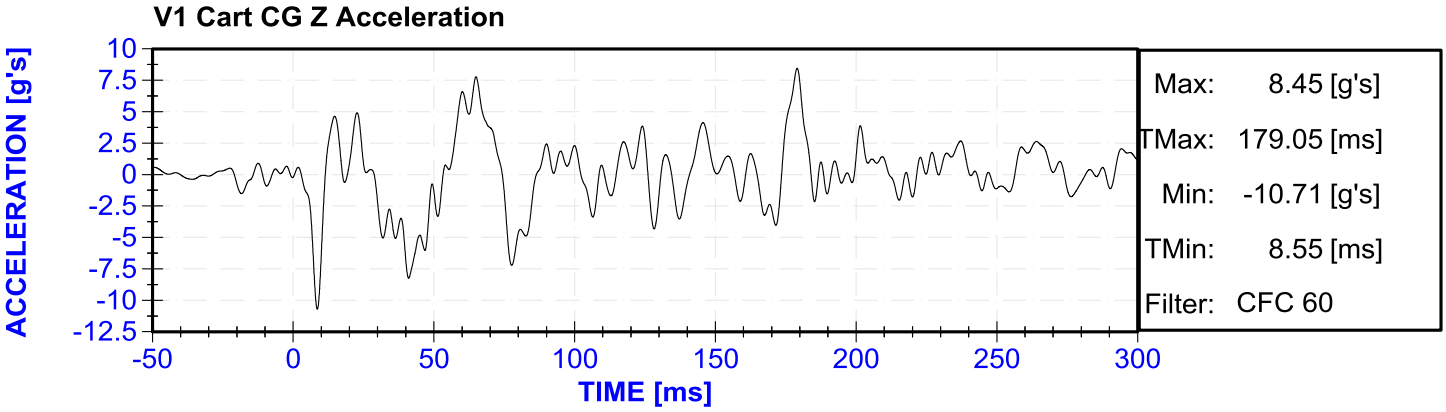
Time to fire: 16.45 ms

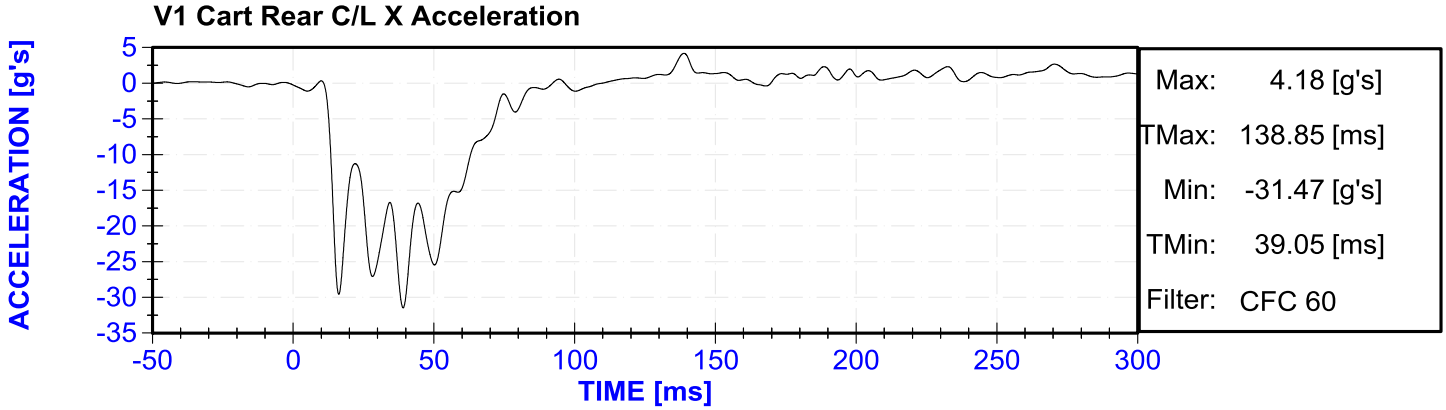


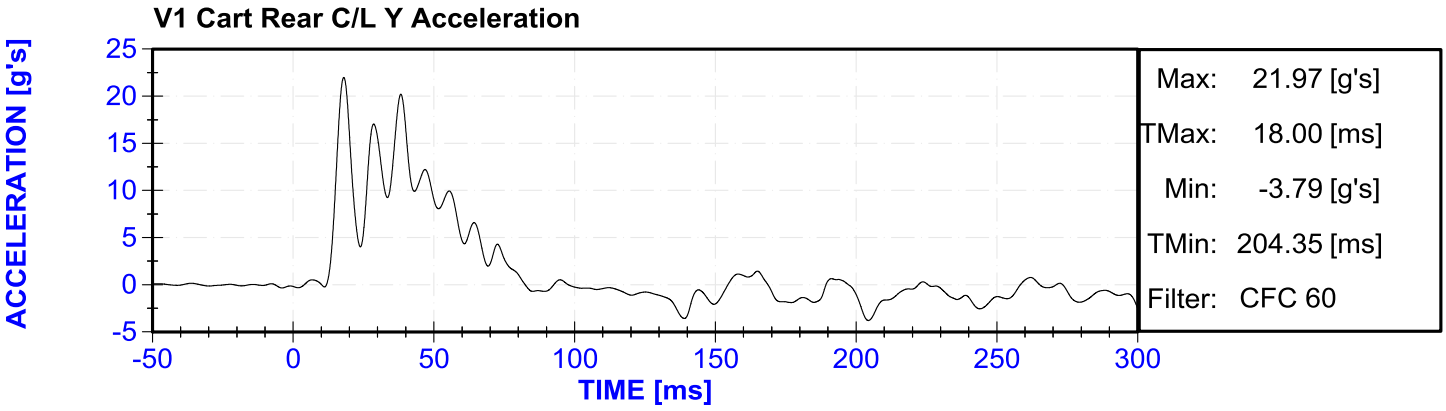
V1 Cart CG X Acceleration



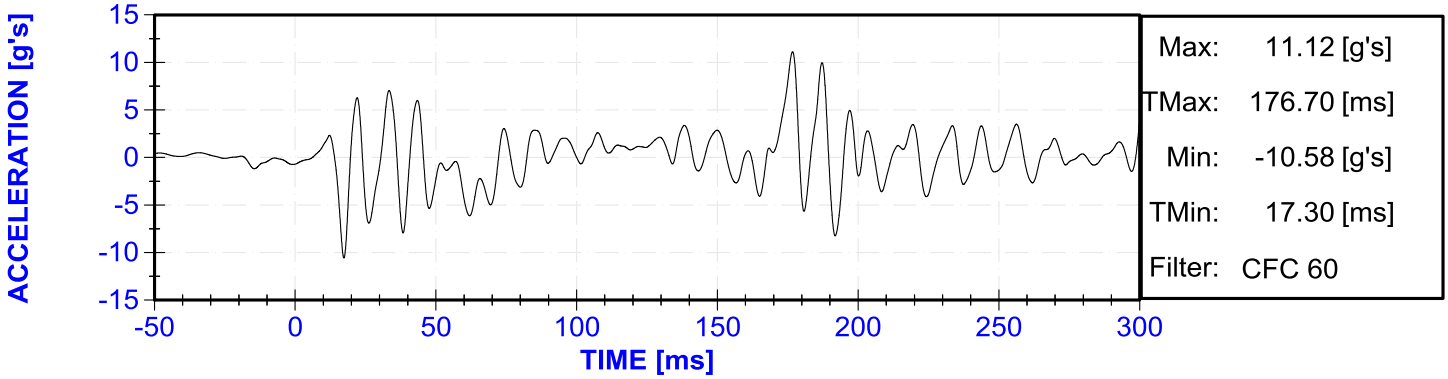

V1 Cart CG Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 3.93 [g's]
TMax: 9.00 [ms]
Min: -5.98 [g's]
TMin: 44.45 [ms]
Filter: CFC 60


V1 Cart CG Z Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 8.45 [g's]
TMax: 179.05 [ms]
Min: -10.71 [g's]
TMin: 8.55 [ms]
Filter: CFC 60

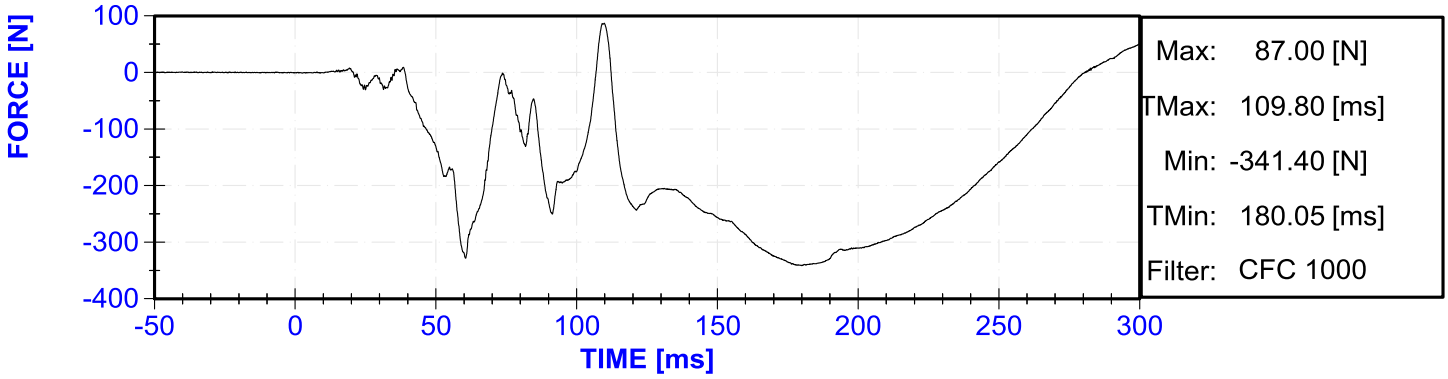

V1 Cart Rear C/L X Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 4.18 [g's]
TMax: 138.85 [ms]
Min: -31.47 [g's]
TMin: 39.05 [ms]
Filter: CFC 60


V1 Cart Rear C/L Y Acceleration
ACCELERATION [g's]
TIME [ms]
Max: 21.97 [g's]
TMax: 18.00 [ms]
Min: -3.79 [g's]
TMin: 204.35 [ms]
Filter: CFC 60

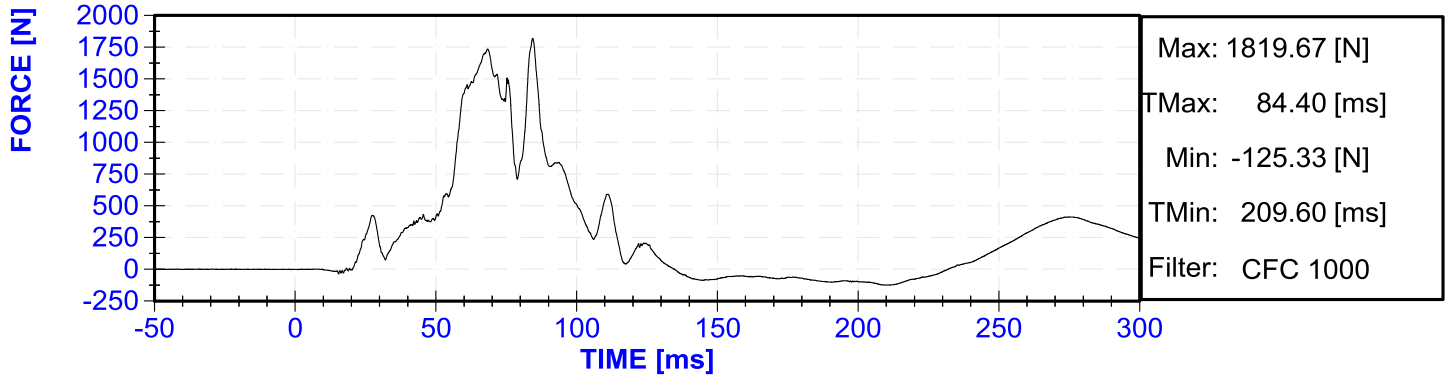
V1 Cart Rear C/L Z Acceleration



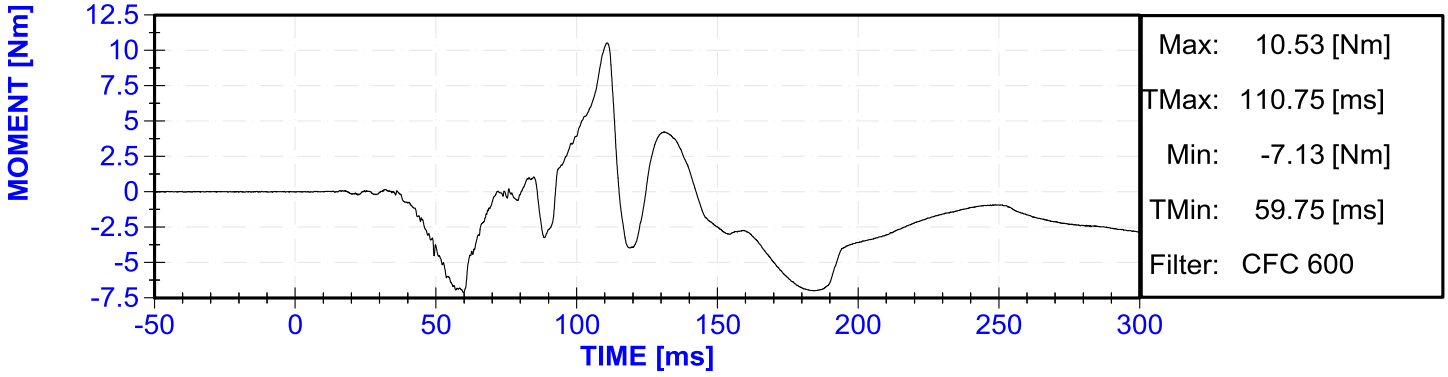
V2P1 Fx on head acting through the O.C. joint only



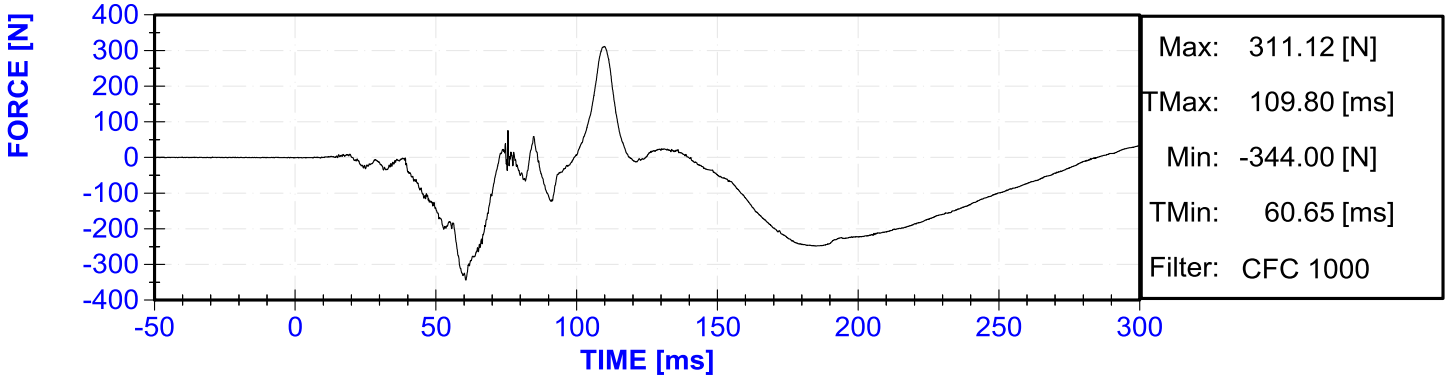
V2P1 Fz on head acting through the O.C. joint only



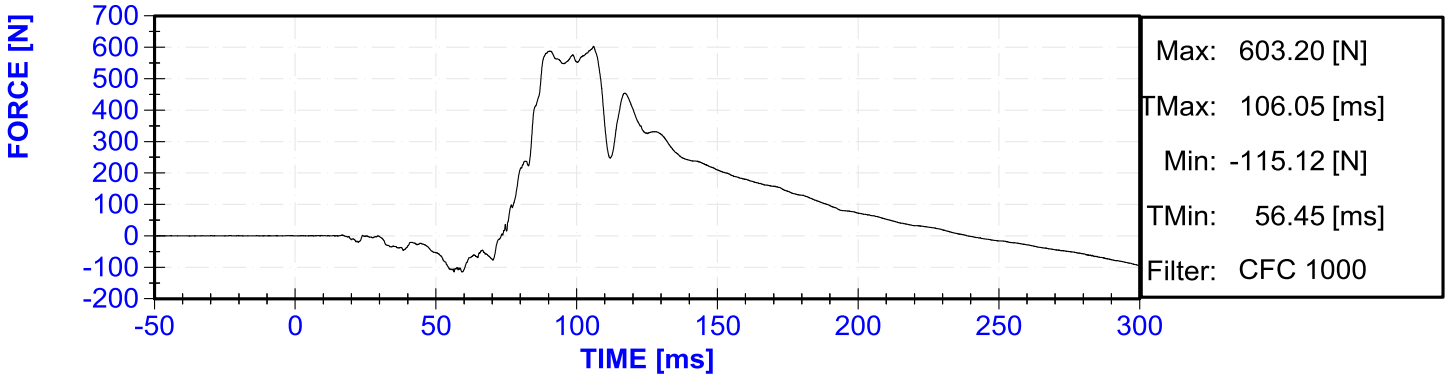
V2P1 My on head acting through the O.C. joint only



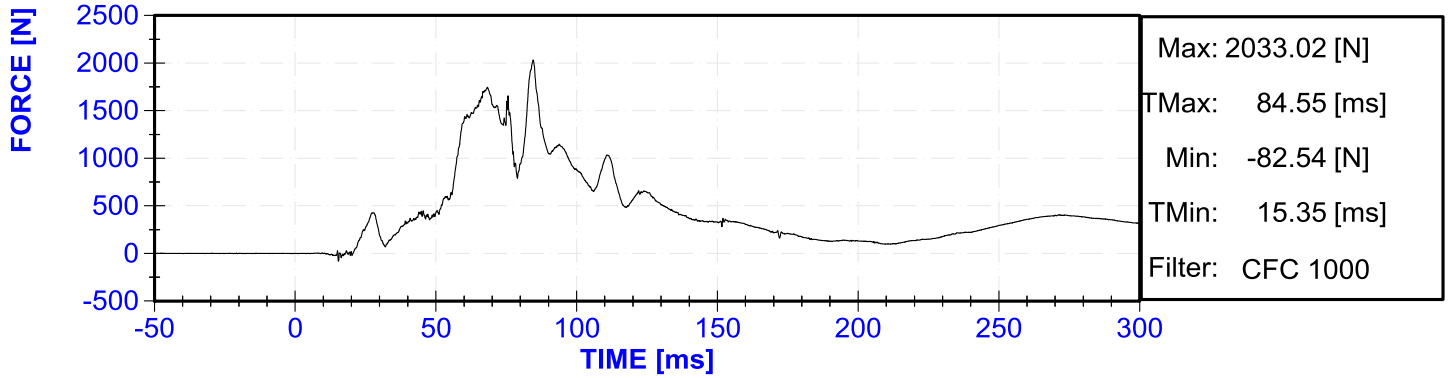
V2P1 Fx on head acting through the total neck section



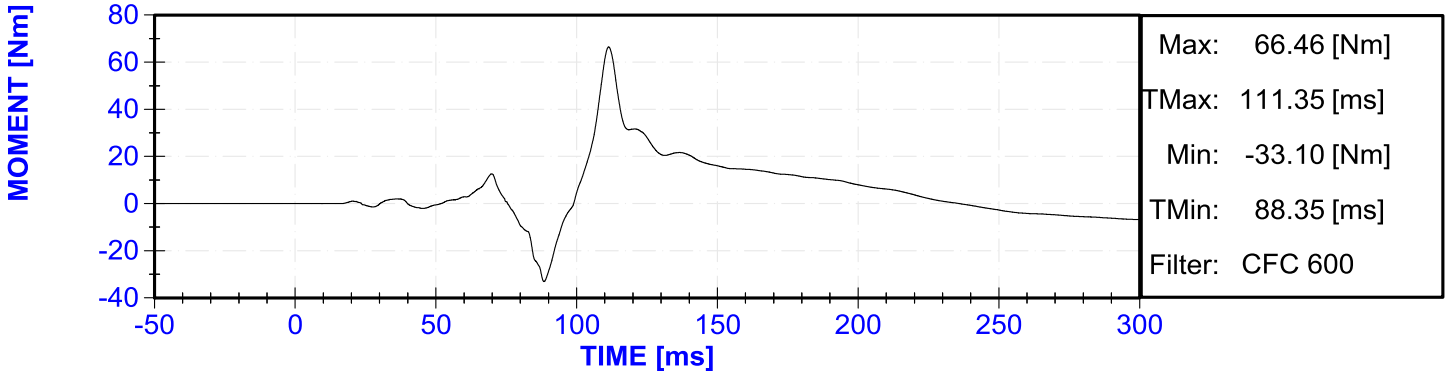
V2P1 Fy on head acting through the total neck section



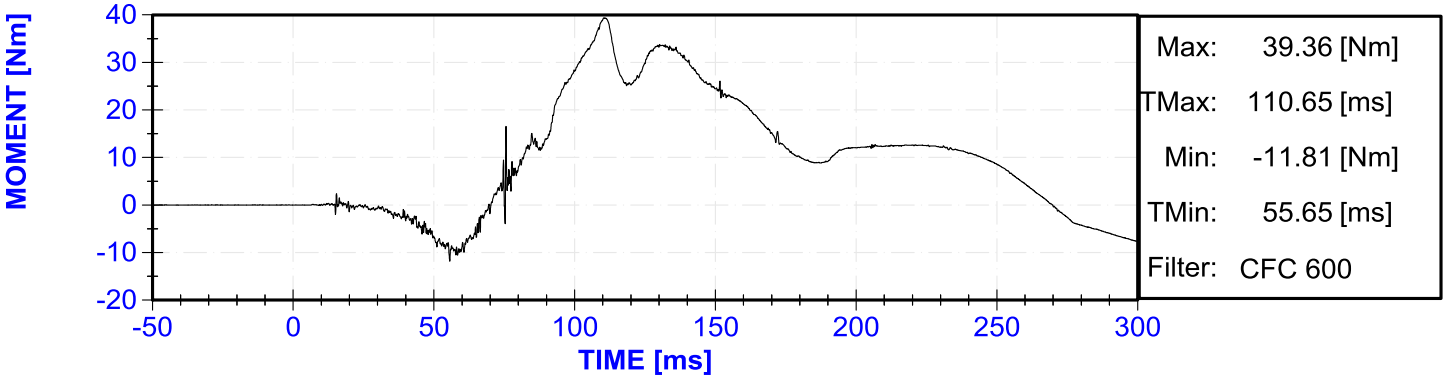
V2P1 Fz on head acting through the total neck section



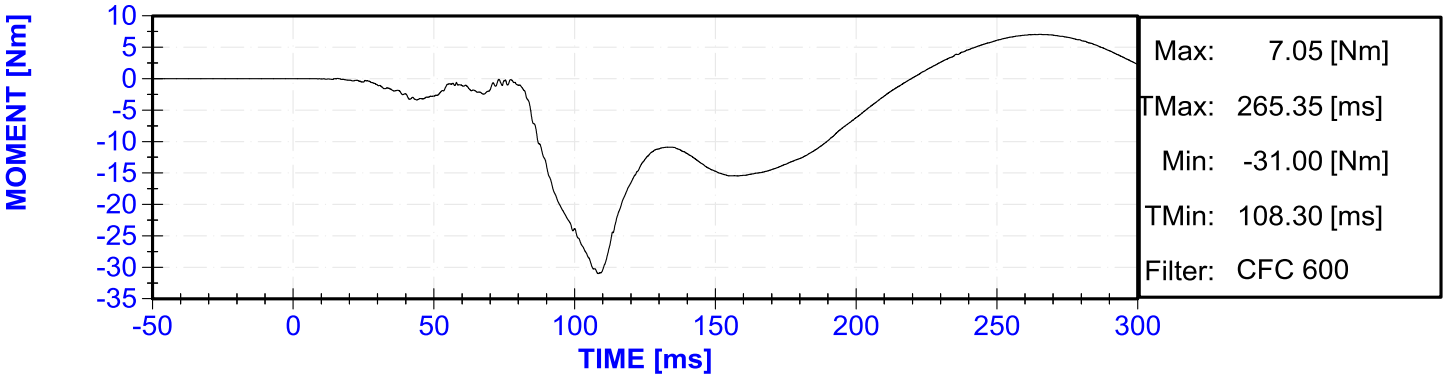
V2P1 Mx on head acting through the total neck section



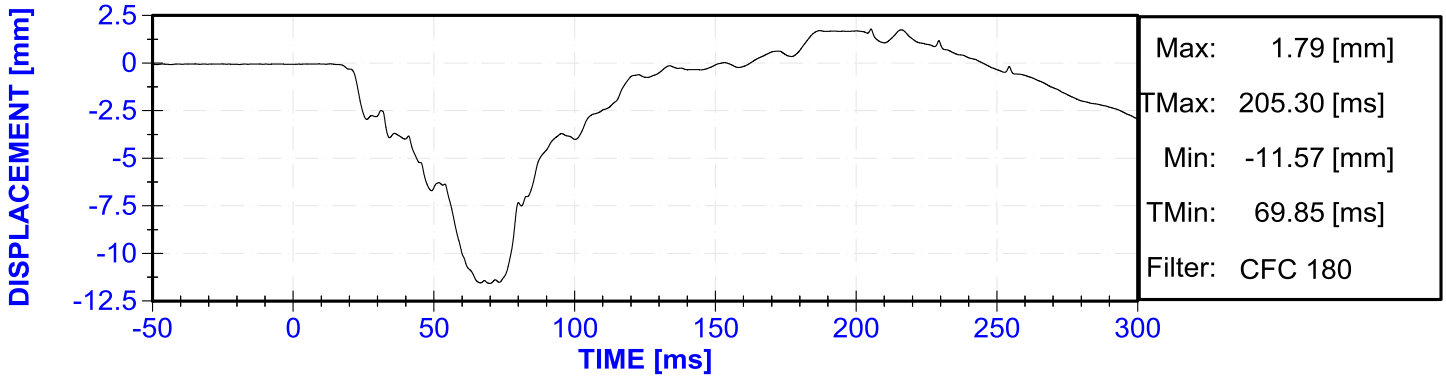
V2P1 My on head acting through the total neck section



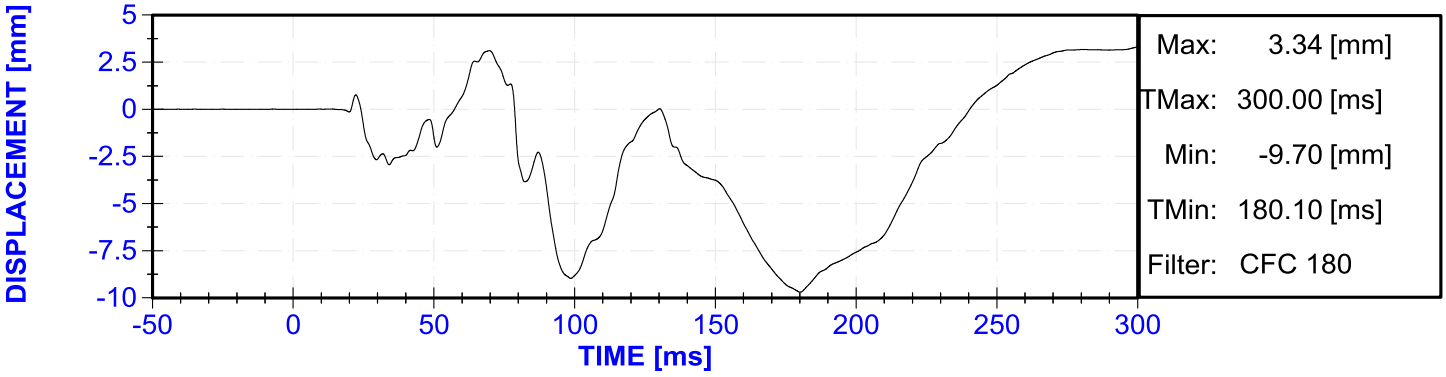
V2P1 Mz on head acting through the total neck section



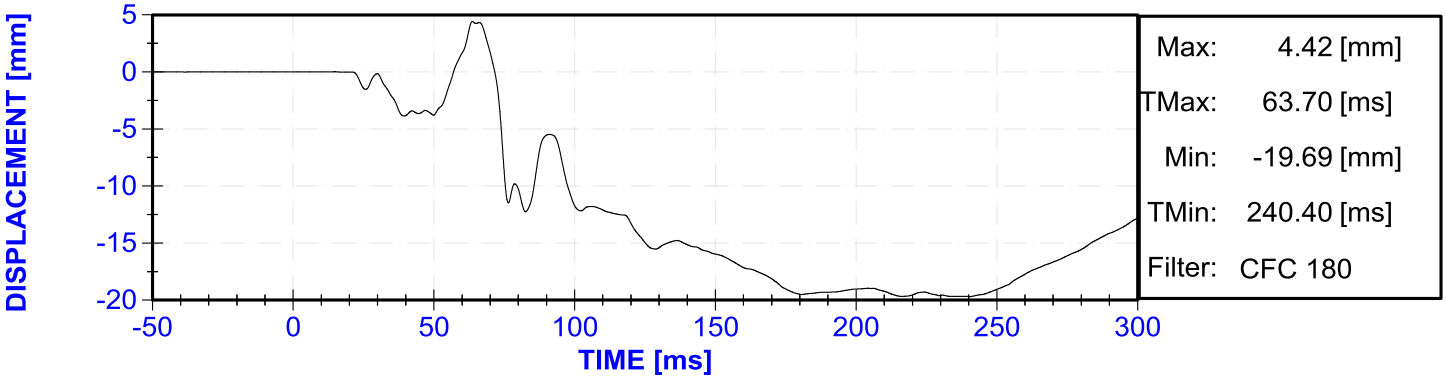
V2P1 Chest Left Upper Dx



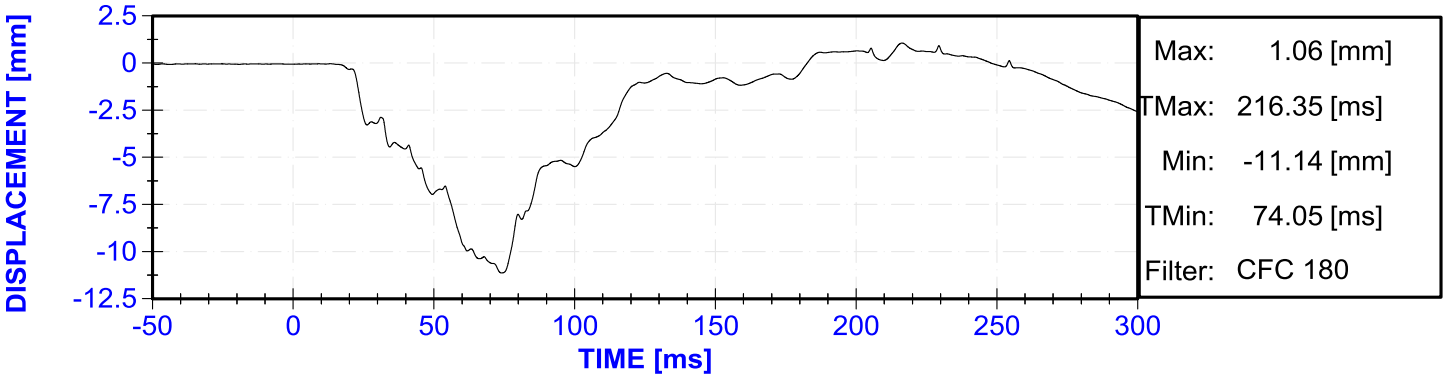
V2P1 Chest Left Upper Dy



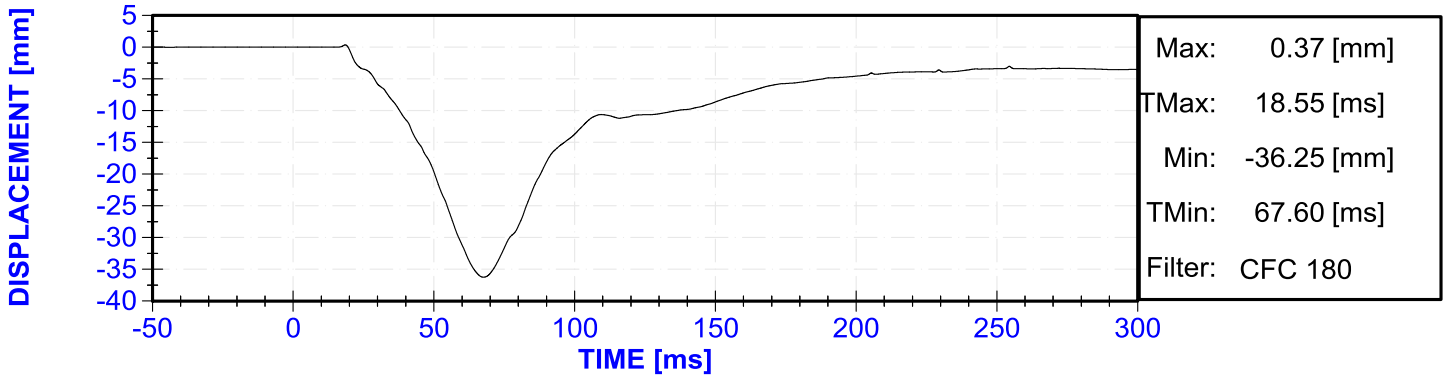
V2P1 Chest Left Upper Dz



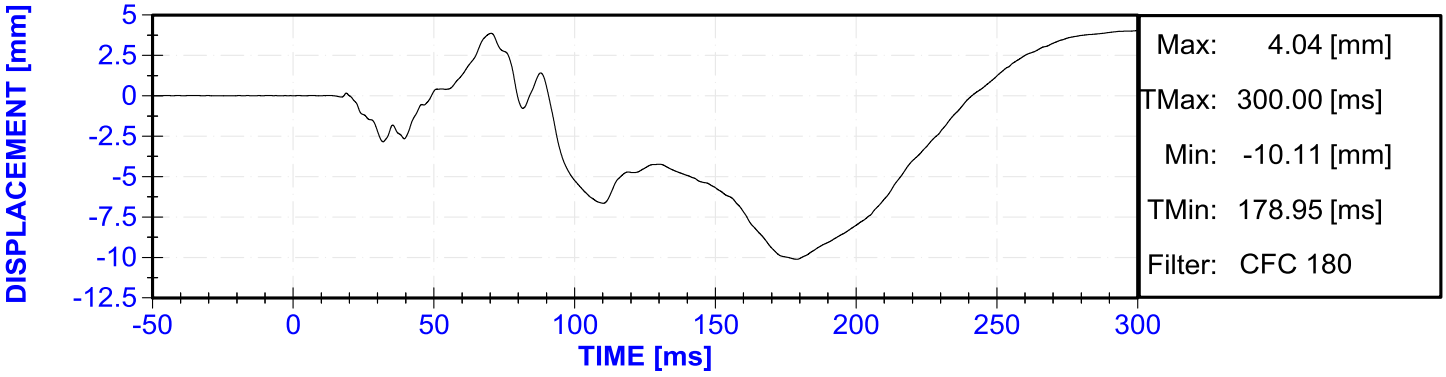
V2P1 Chest Left Upper D

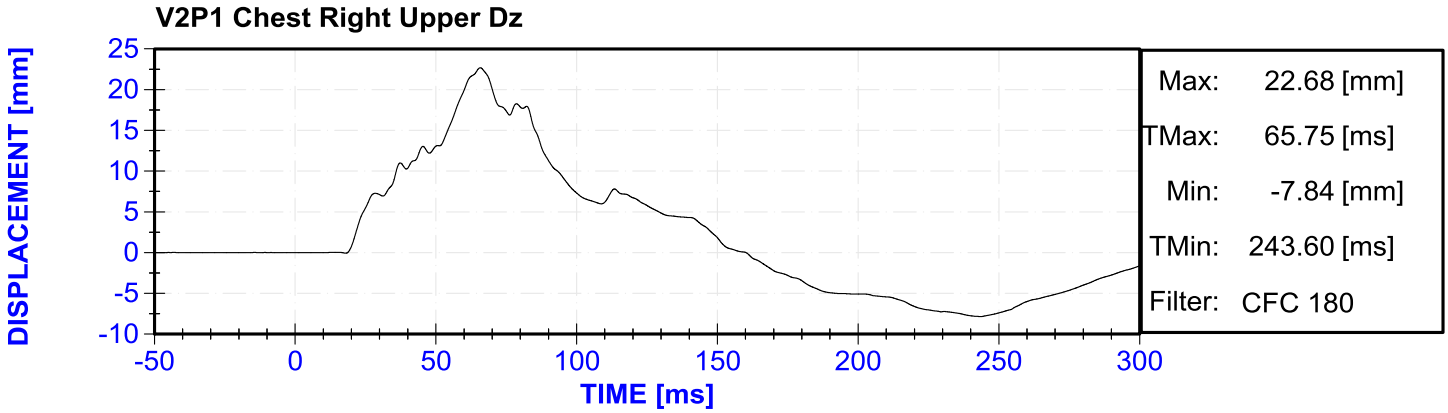


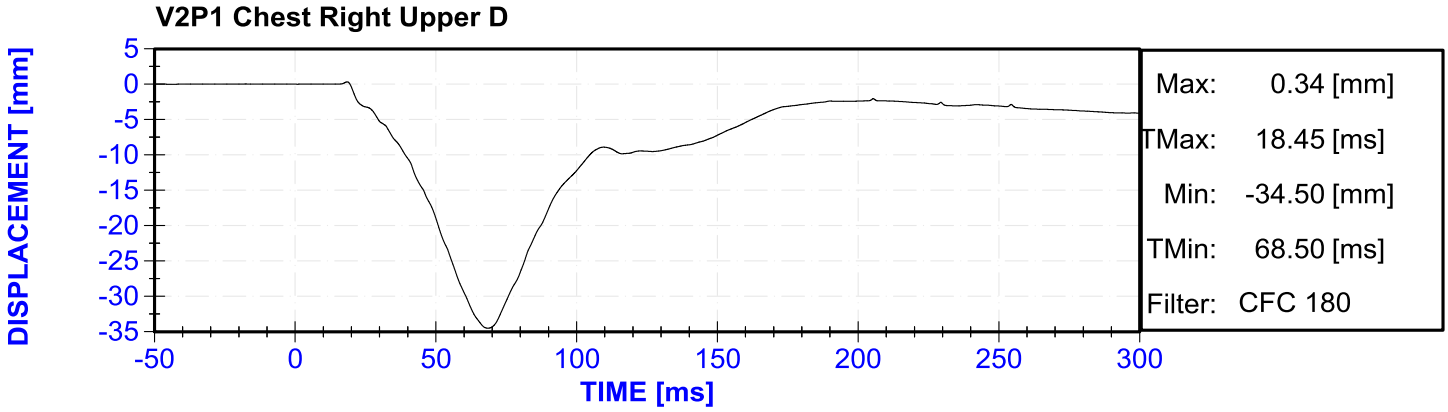
V2P1 Chest Right Upper Dx

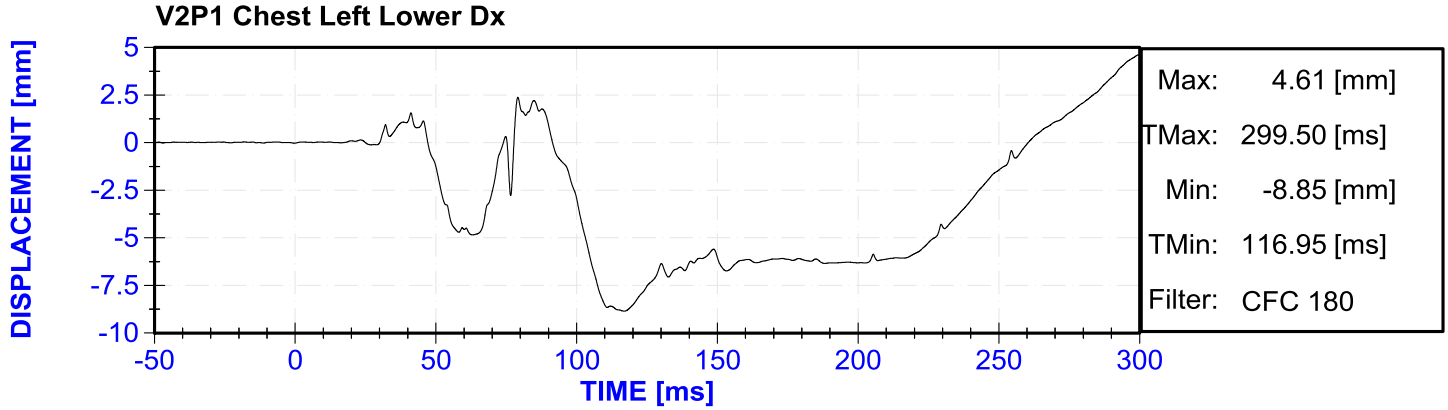


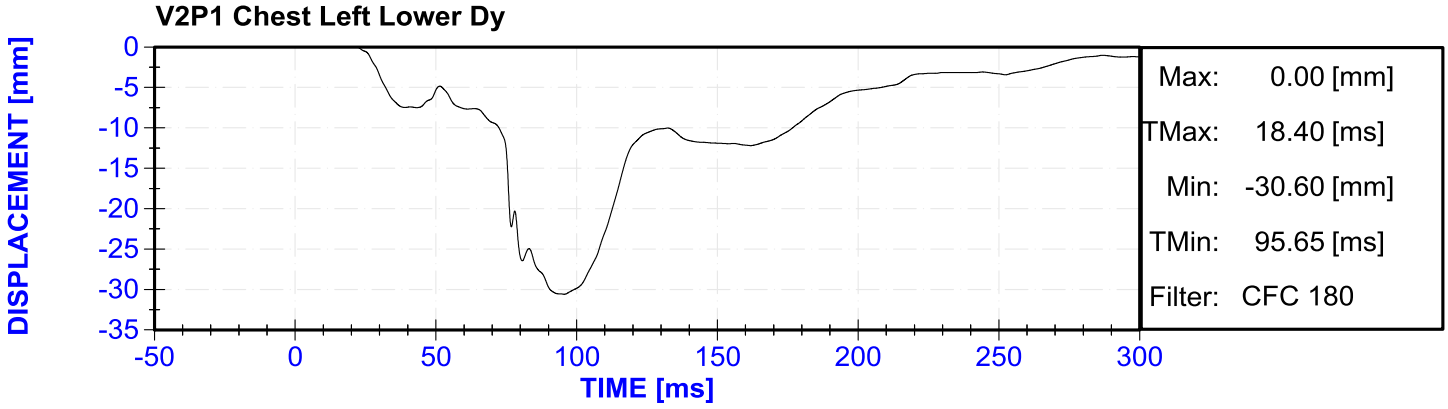
V2P1 Chest Right Upper Dy



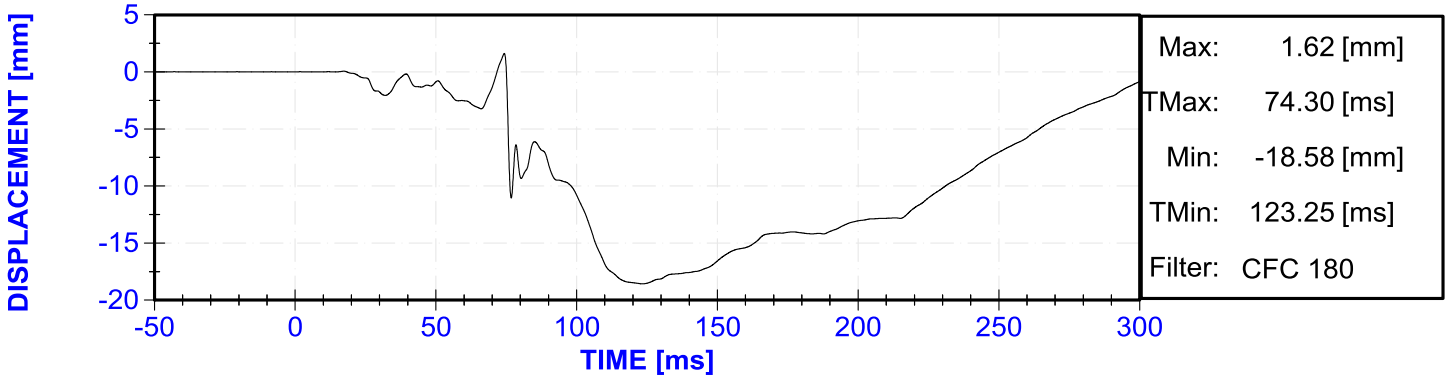

V2P1 Chest Right Upper Dz
DISPLACEMENT [mm]
TIME [ms]
Max: 22.68 [mm]
TMax: 65.75 [ms]
Min: -7.84 [mm]
TMin: 243.60 [ms]
Filter: CFC 180


V2P1 Chest Right Upper D
DISPLACEMENT [mm]
TIME [ms]
Max: 0.34 [mm]
TMax: 18.45 [ms]
Min: -34.50 [mm]
TMin: 68.50 [ms]
Filter: CFC 180

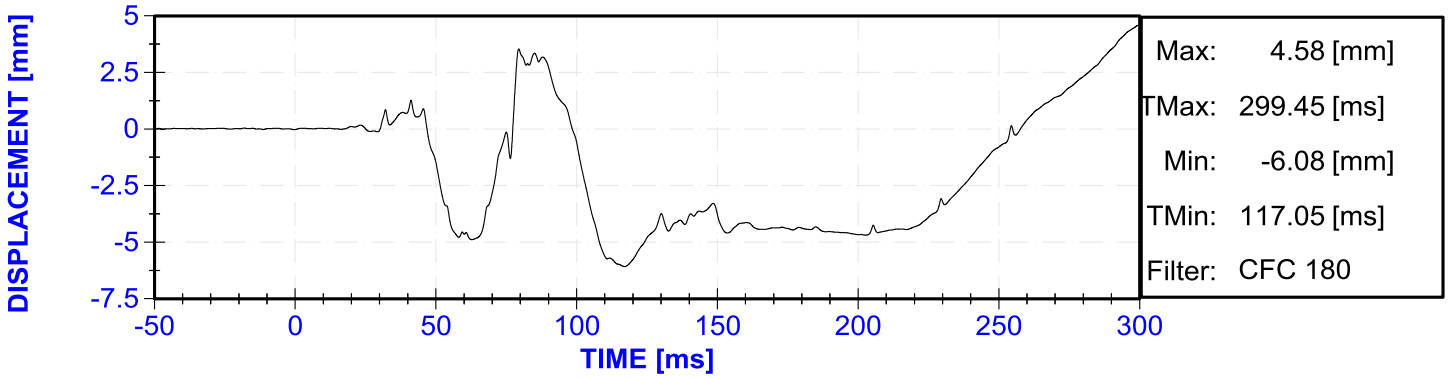

V2P1 Chest Left Lower Dx
DISPLACEMENT [mm]
TIME [ms]
Max: 4.61 [mm]
TMax: 299.50 [ms]
Min: -8.85 [mm]
TMin: 116.95 [ms]
Filter: CFC 180


V2P1 Chest Left Lower Dy
DISPLACEMENT [mm]
TIME [ms]
Max: 0.00 [mm]
TMax: 18.40 [ms]
Min: -30.60 [mm]
TMin: 95.65 [ms]
Filter: CFC 180

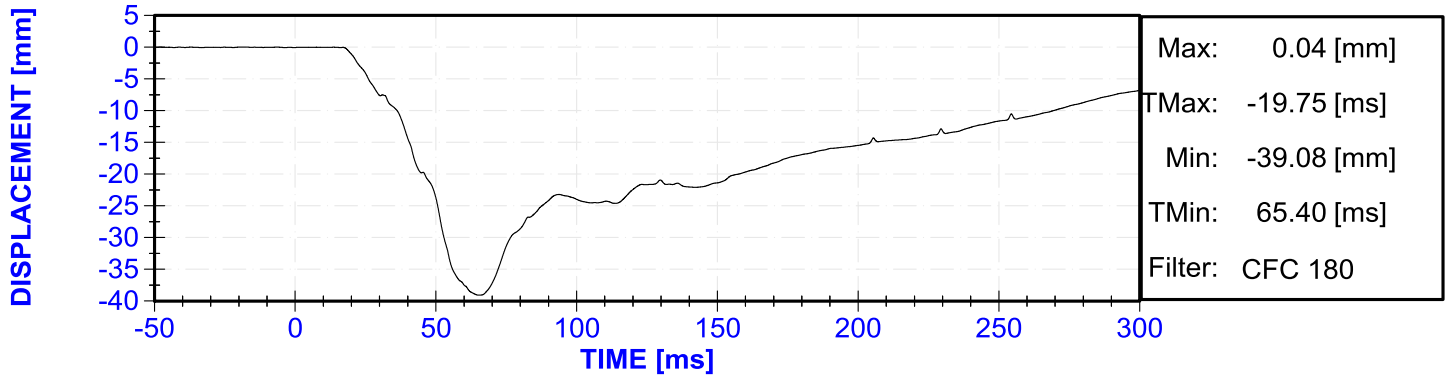
V2P1 Chest Left Lower Dz



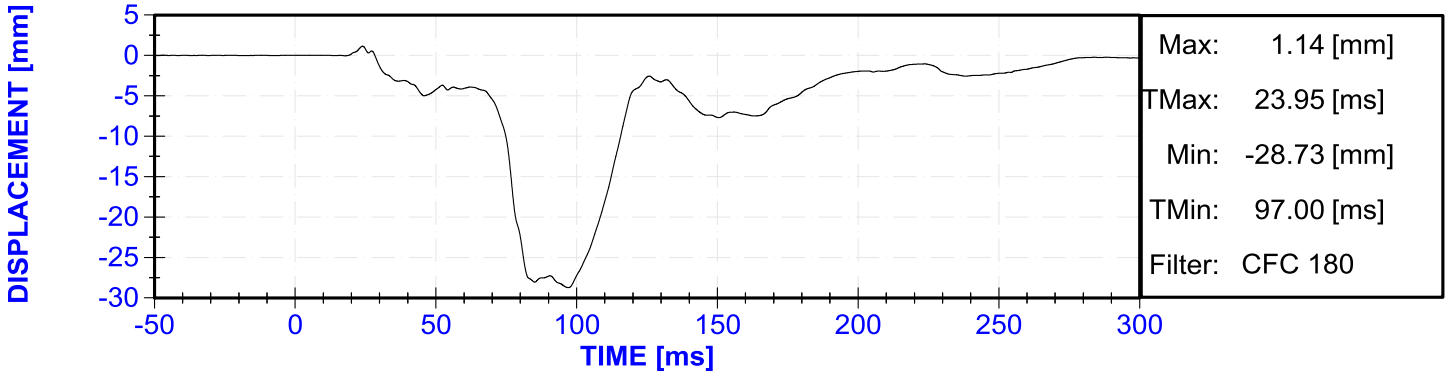
V2P1 Chest Left Lower D



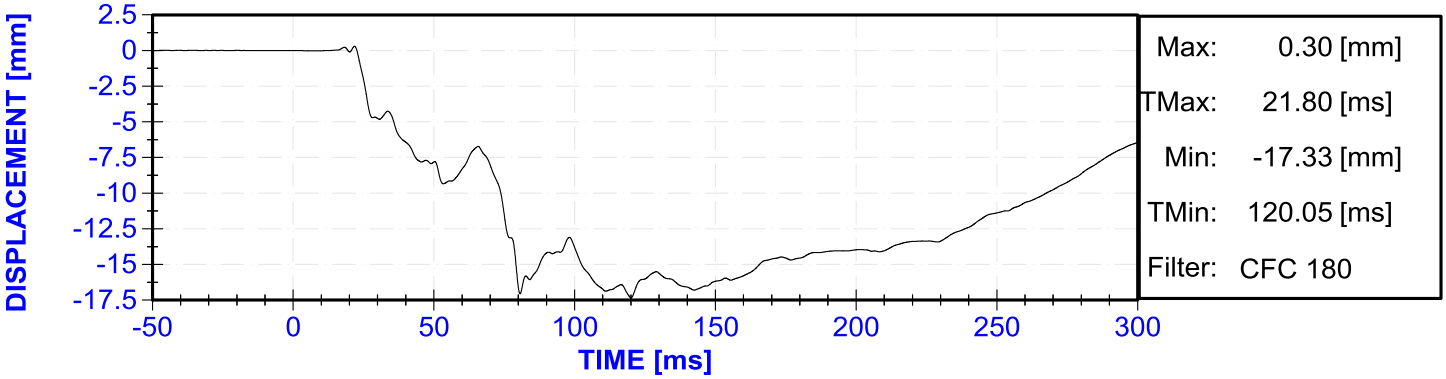
V2P1 Chest Right Lower Dx



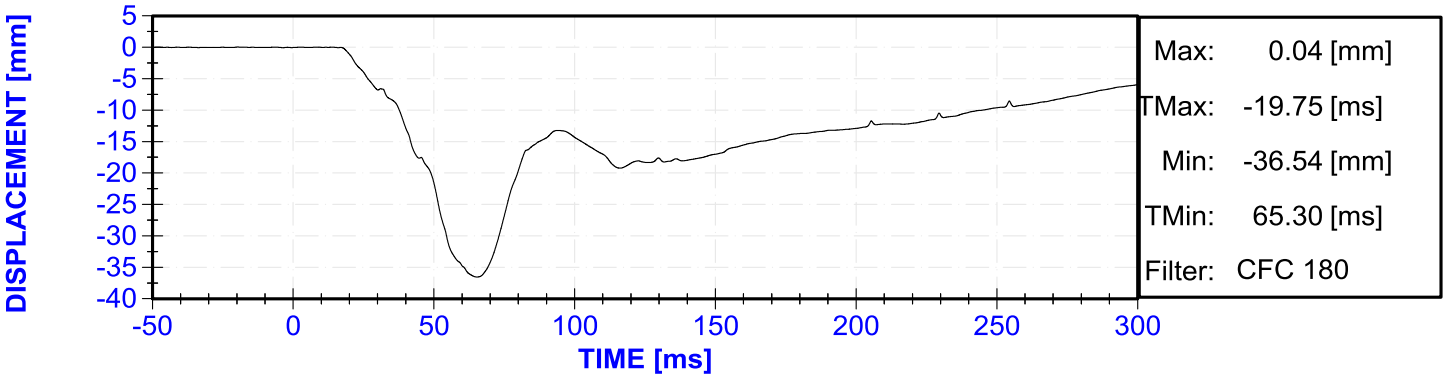
V2P1 Chest Right Lower Dy



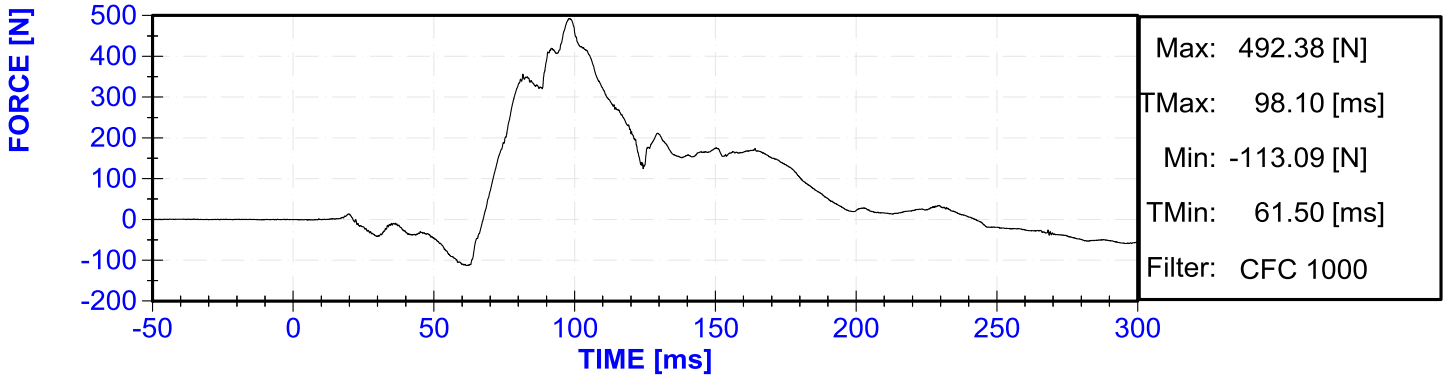
V2P1 Chest Right Lower Dz



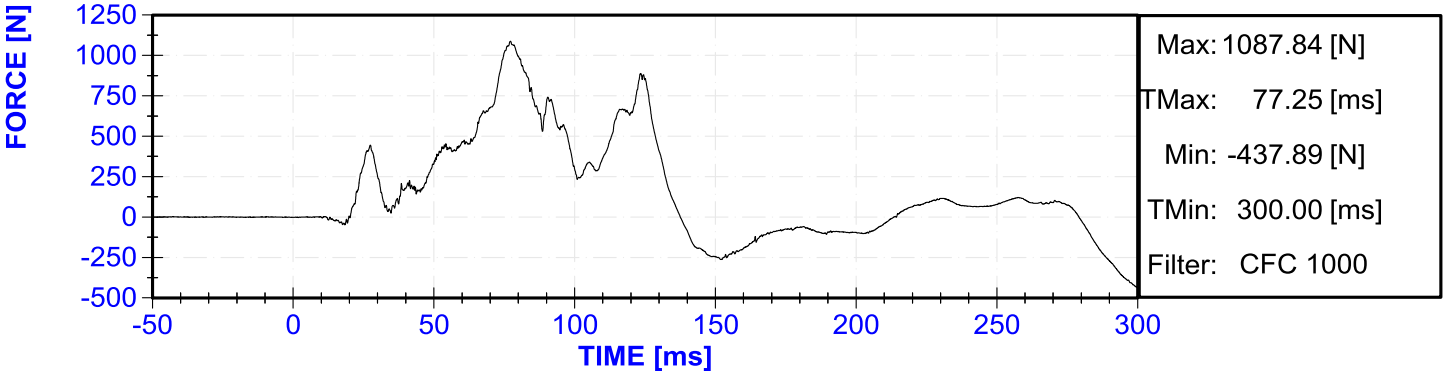
V2P1 Chest Right Lower D



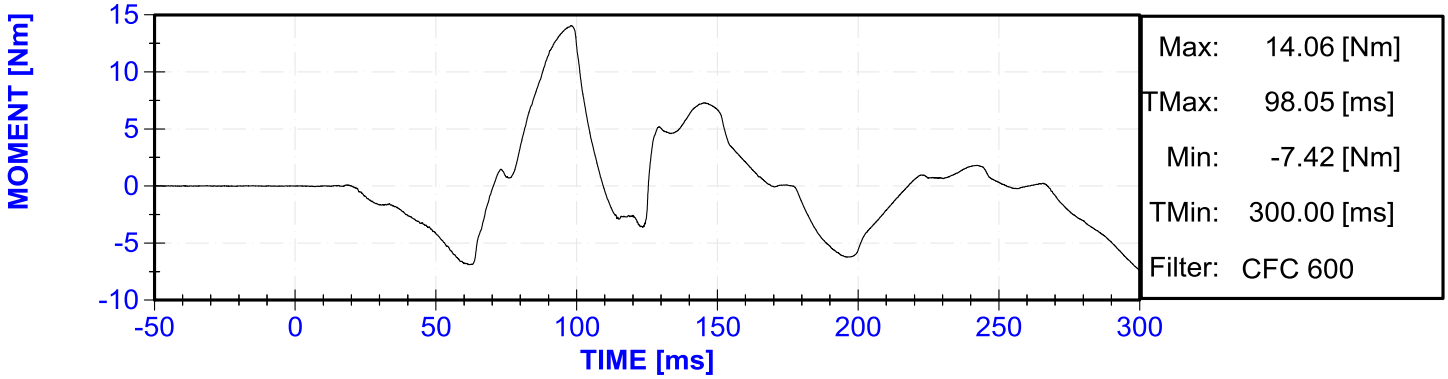
V2P2 Fx on head acting through the O.C. joint only



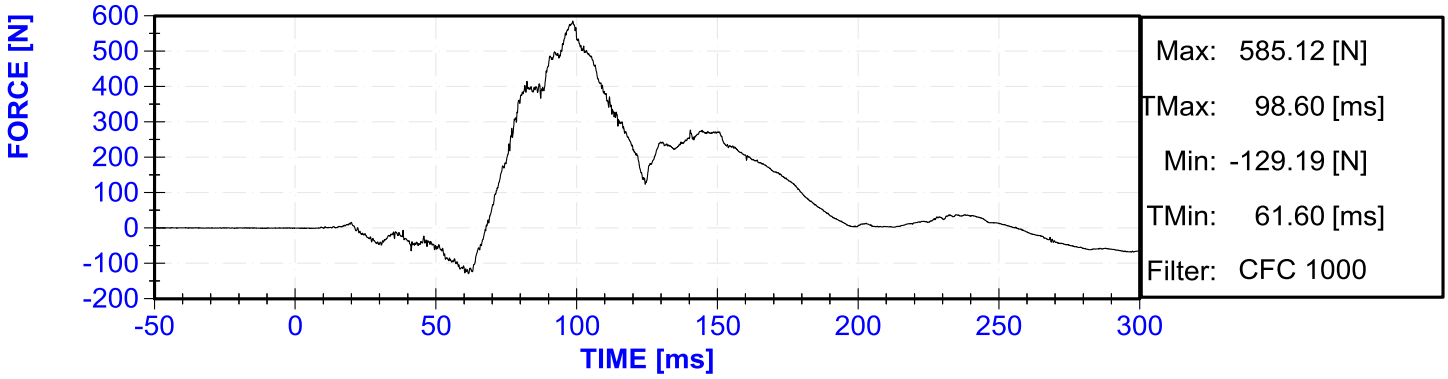
V2P2 Fz on head acting through the O.C. joint only



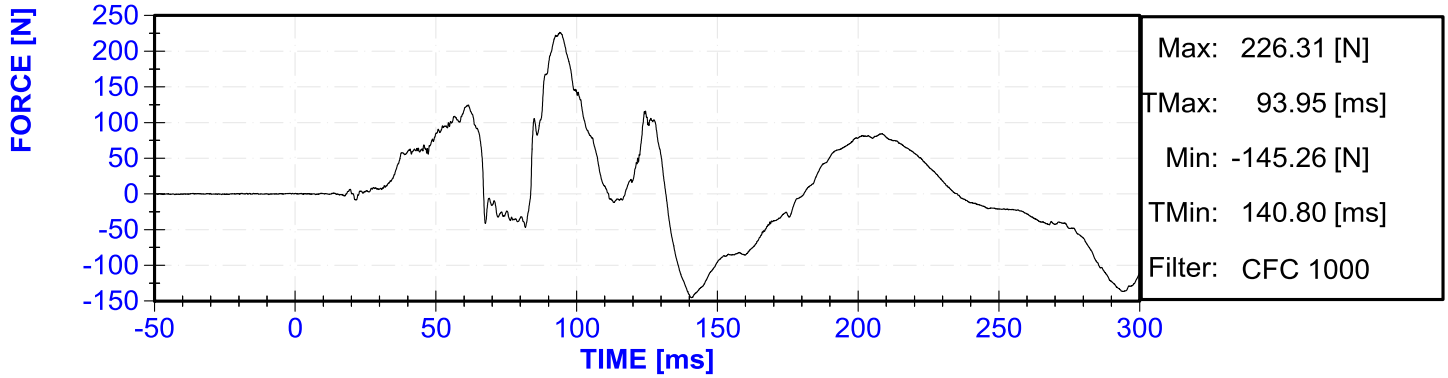
V2P2 My on head acting through the O.C. joint only



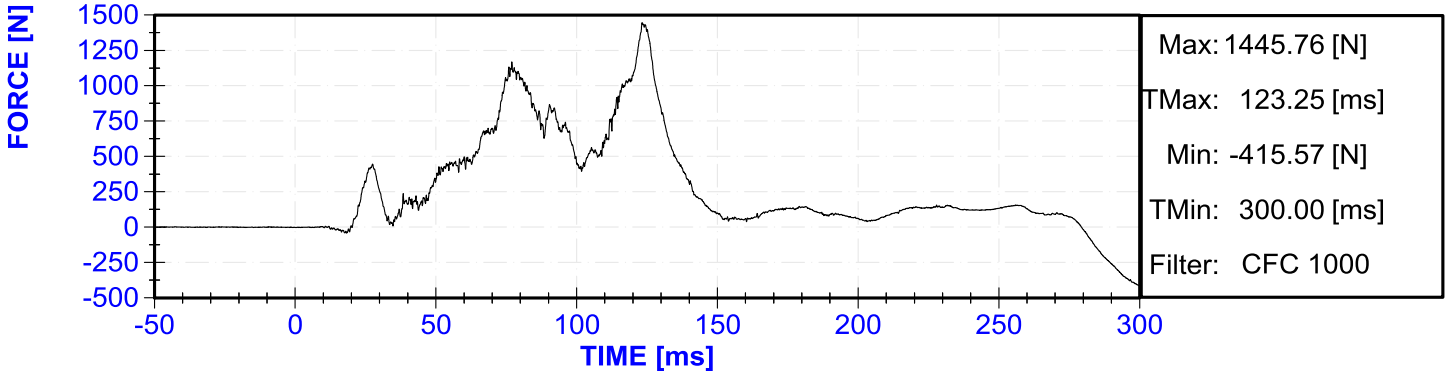
V2P2 Fx on head acting through the total neck section



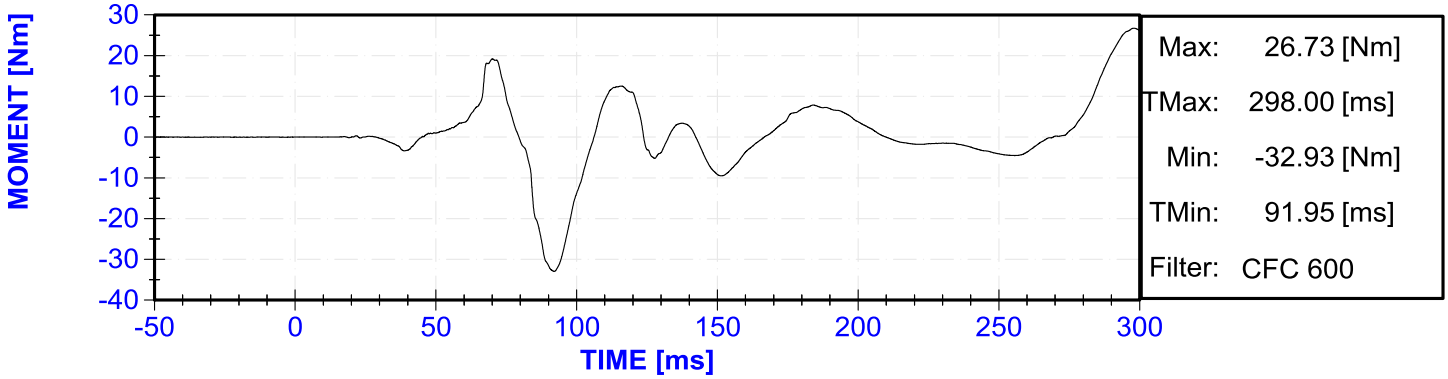
V2P2 Fy on head acting through the total neck section



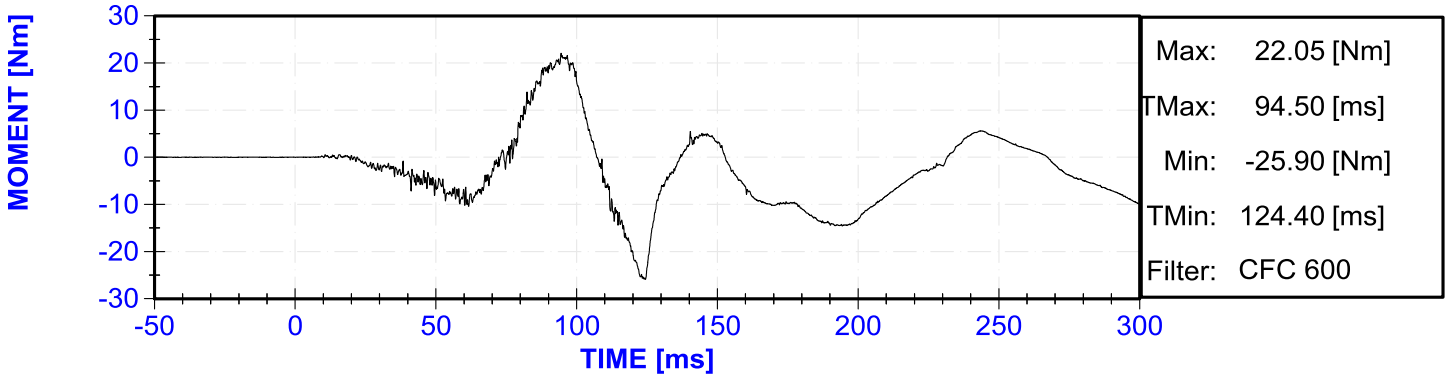
V2P2 Fz on head acting through the total neck section



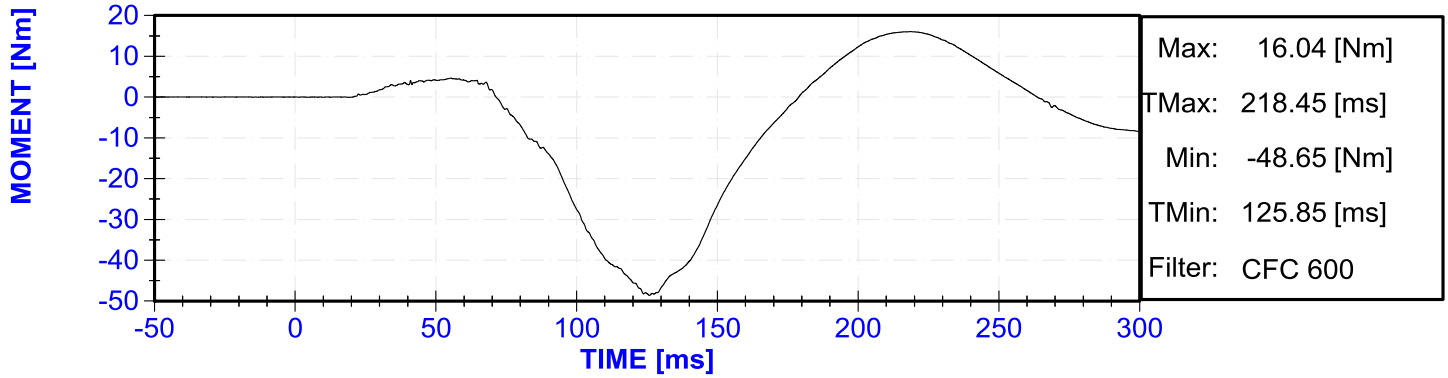
V2P2 Mx on head acting through the total neck section



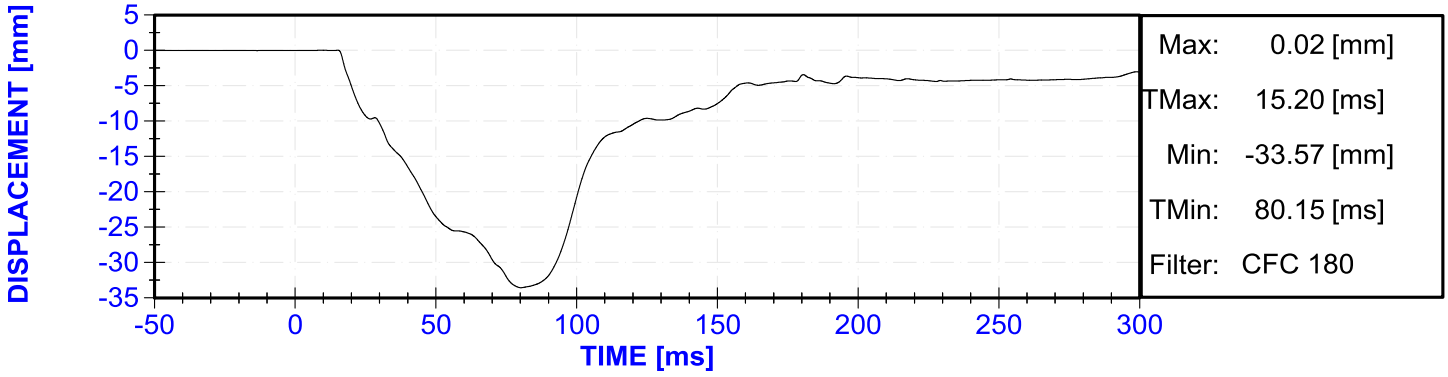
V2P2 My on head acting through the total neck section

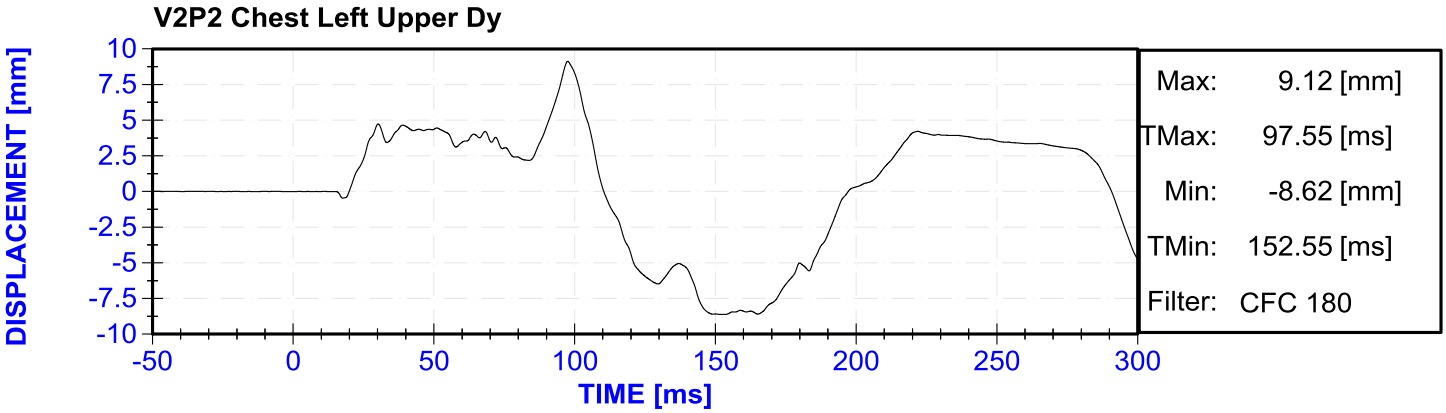


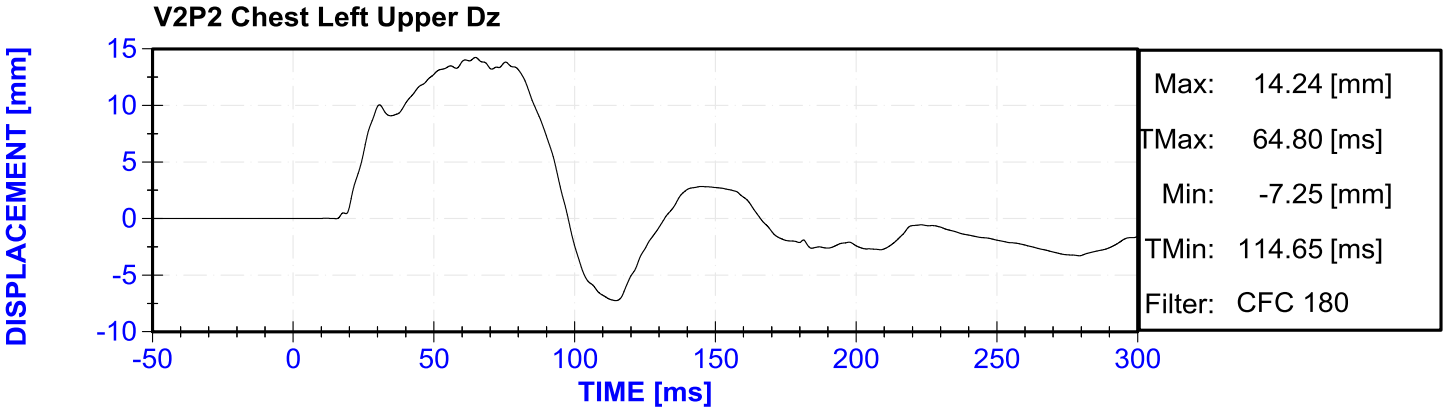
V2P2 Mz on head acting through the total neck section

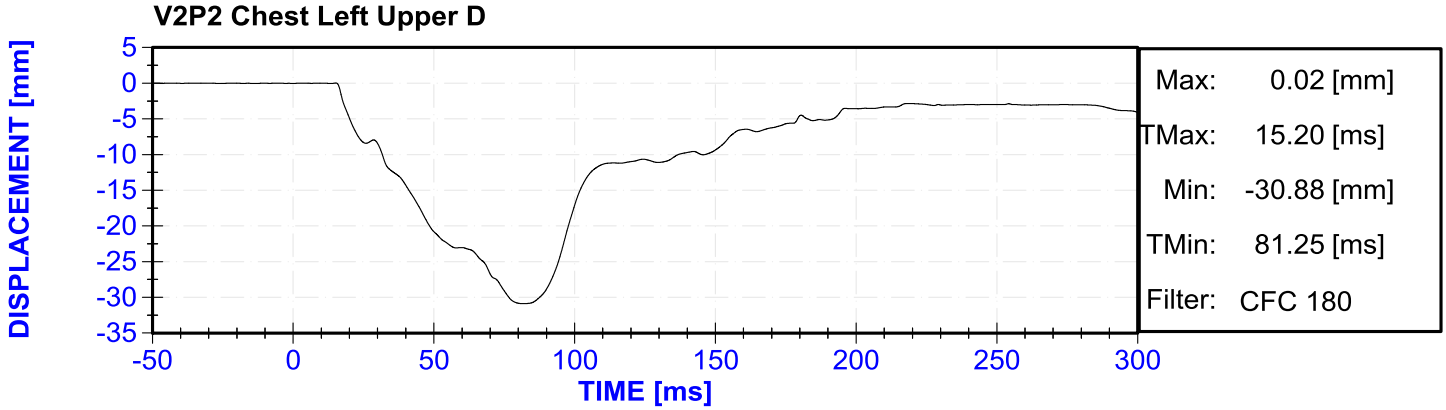


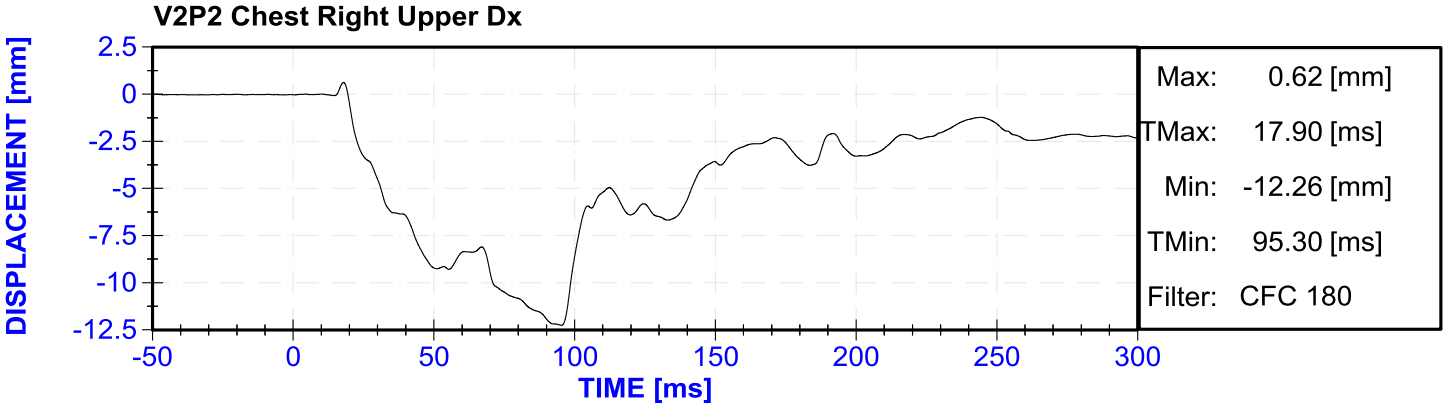
V2P2 Chest Left Upper Dx

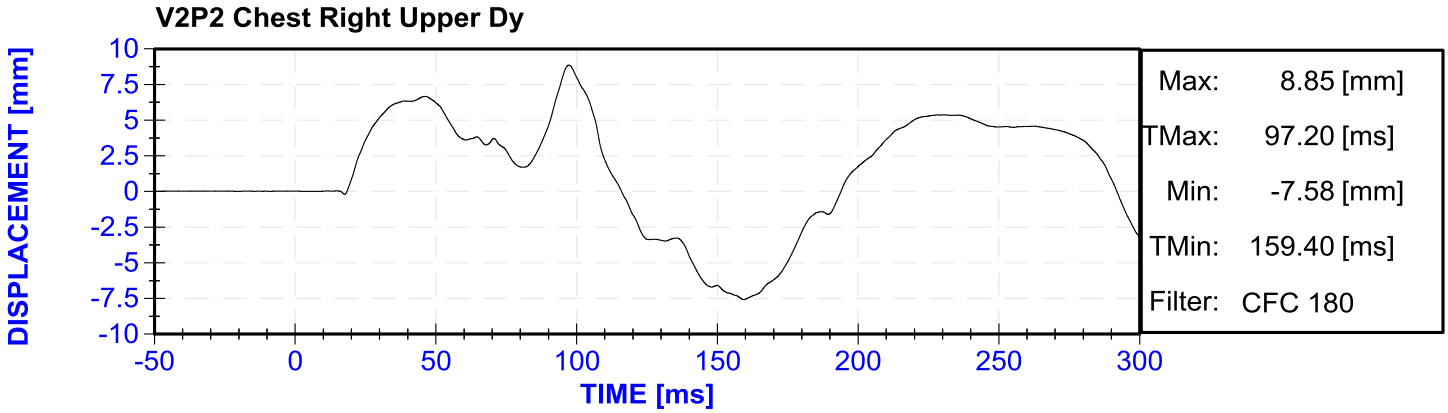


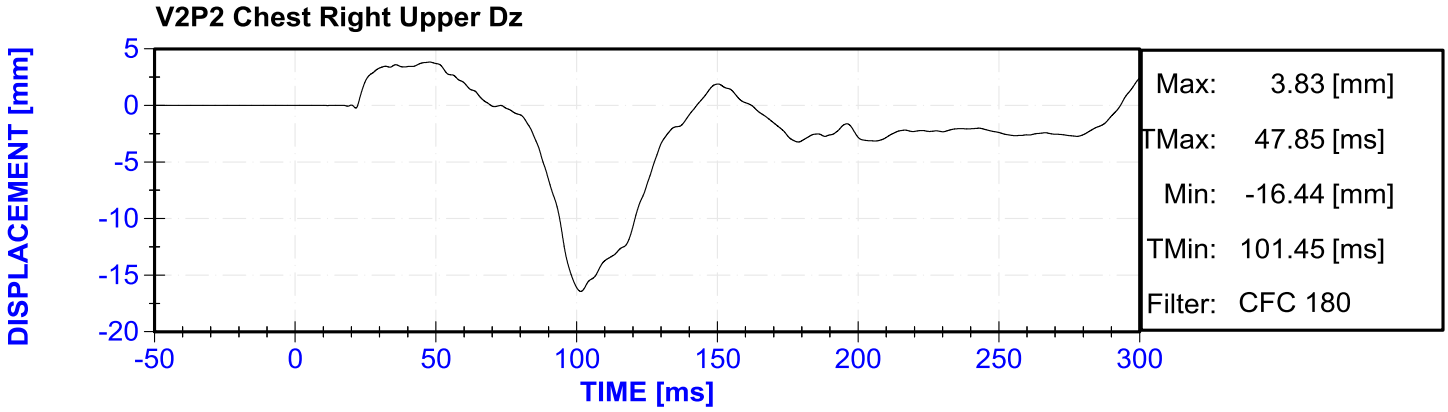

V2P2 Chest Left Upper Dy
DISPLACEMENT [mm]
TIME [ms]
Max: 9.12 [mm]
TMax: 97.55 [ms]
Min: -8.62 [mm]
TMin: 152.55 [ms]
Filter: CFC 180

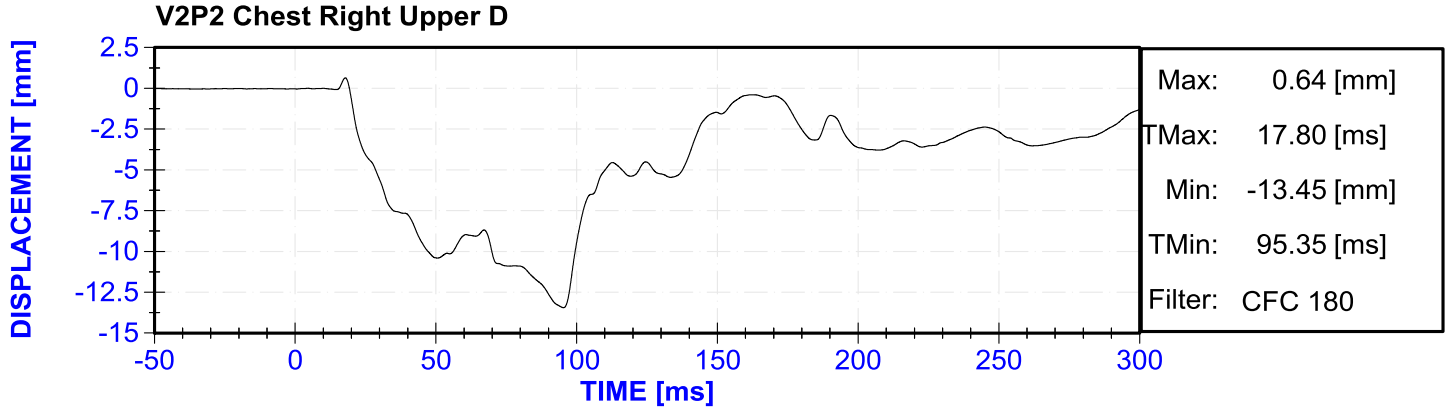

V2P2 Chest Left Upper Dz
DISPLACEMENT [mm]
TIME [ms]
Max: 14.24 [mm]
TMax: 64.80 [ms]
Min: -7.25 [mm]
TMin: 114.65 [ms]
Filter: CFC 180

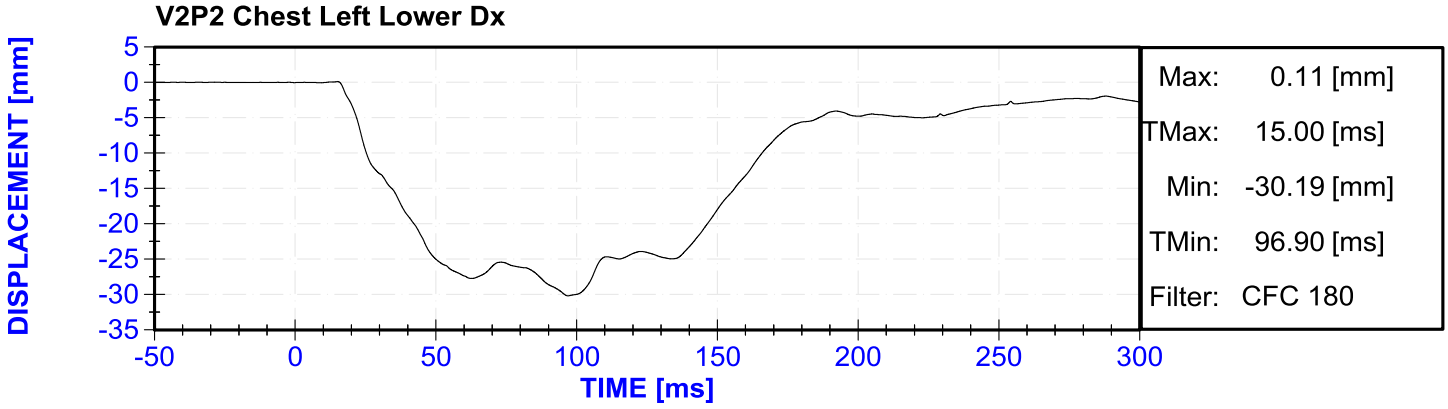

V2P2 Chest Left Upper D
DISPLACEMENT [mm]
TIME [ms]
Max: 0.02 [mm]
TMax: 15.20 [ms]
Min: -30.88 [mm]
TMin: 81.25 [ms]
Filter: CFC 180

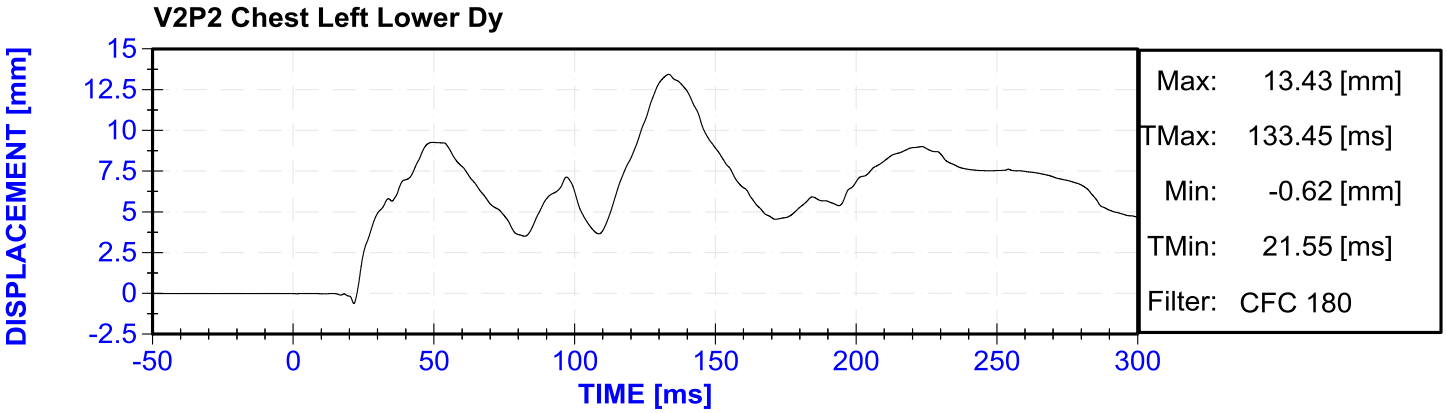

V2P2 Chest Right Upper Dx
DISPLACEMENT [mm]
TIME [ms]
Max: 0.62 [mm]
TMax: 17.90 [ms]
Min: -12.26 [mm]
TMin: 95.30 [ms]
Filter: CFC 180

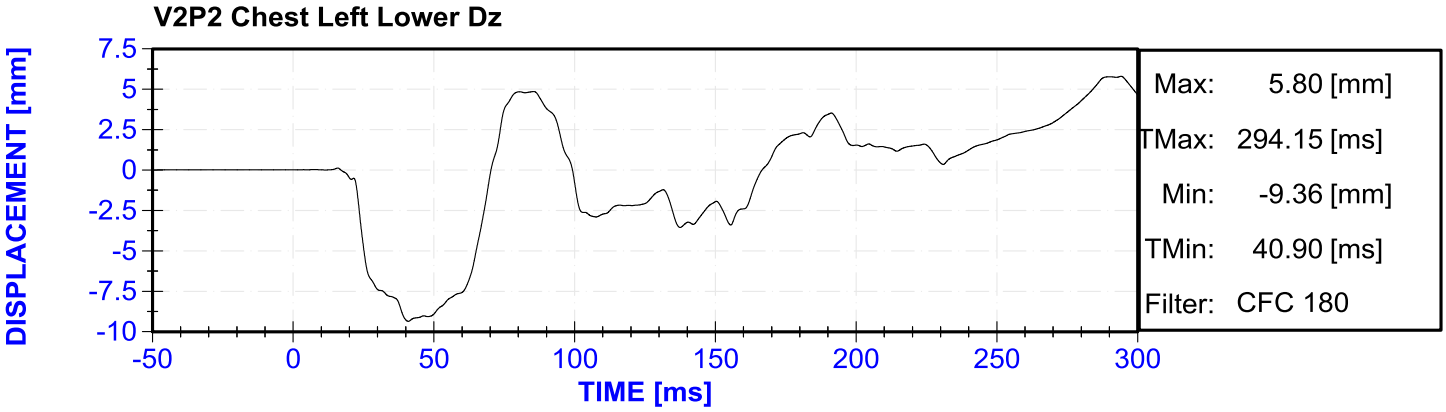

V2P2 Chest Right Upper Dy
DISPLACEMENT [mm]
TIME [ms]
Max: 8.85 [mm]
TMax: 97.20 [ms]
Min: -7.58 [mm]
TMin: 159.40 [ms]
Filter: CFC 180

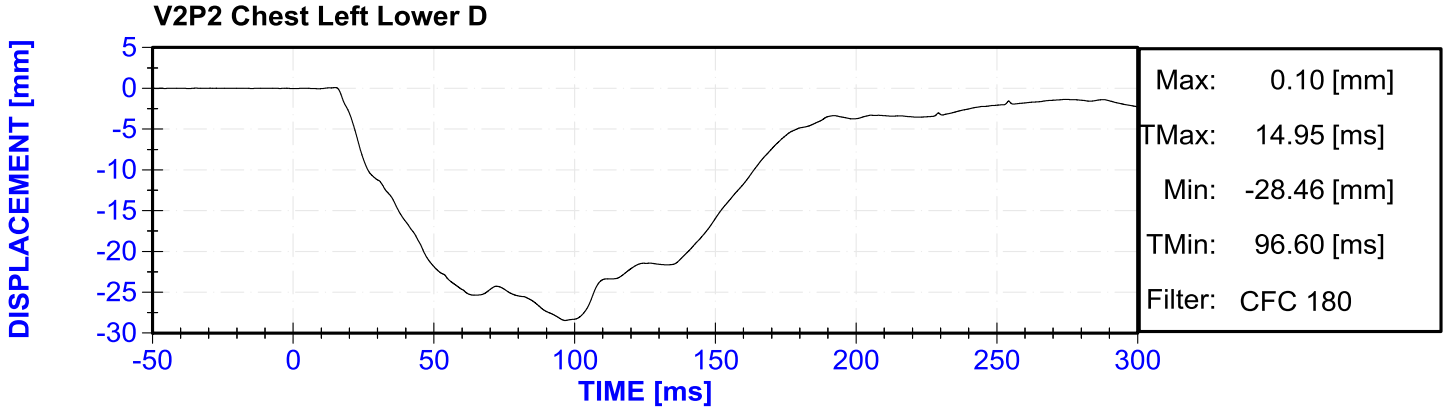

V2P2 Chest Right Upper Dz
DISPLACEMENT [mm]
TIME [ms]
Max: 3.83 [mm]
TMax: 47.85 [ms]
Min: -16.44 [mm]
TMin: 101.45 [ms]
Filter: CFC 180

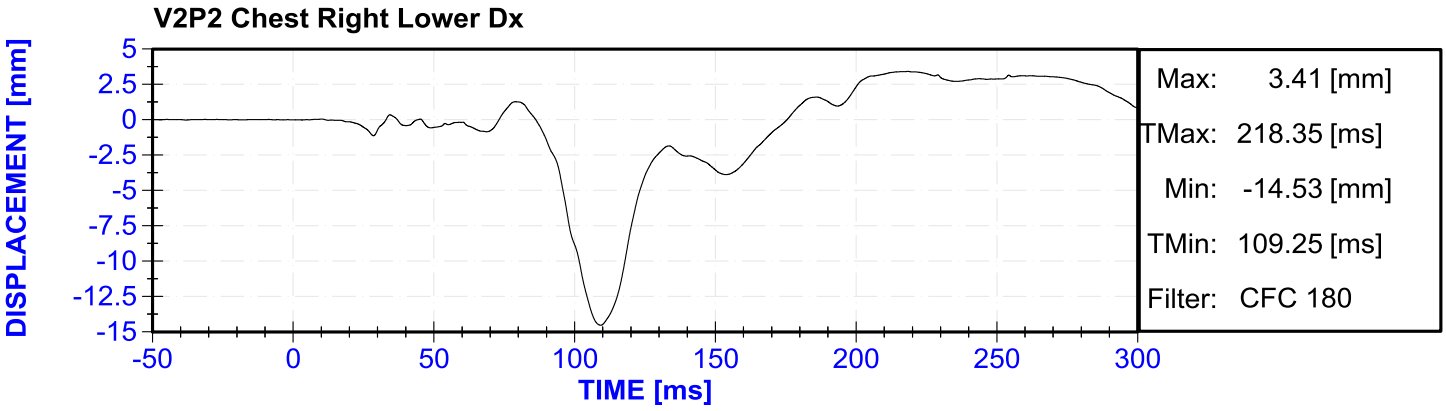

V2P2 Chest Right Upper D
DISPLACEMENT [mm]
TIME [ms]
Max: 0.64 [mm]
TMax: 17.80 [ms]
Min: -13.45 [mm]
TMin: 95.35 [ms]
Filter: CFC 180

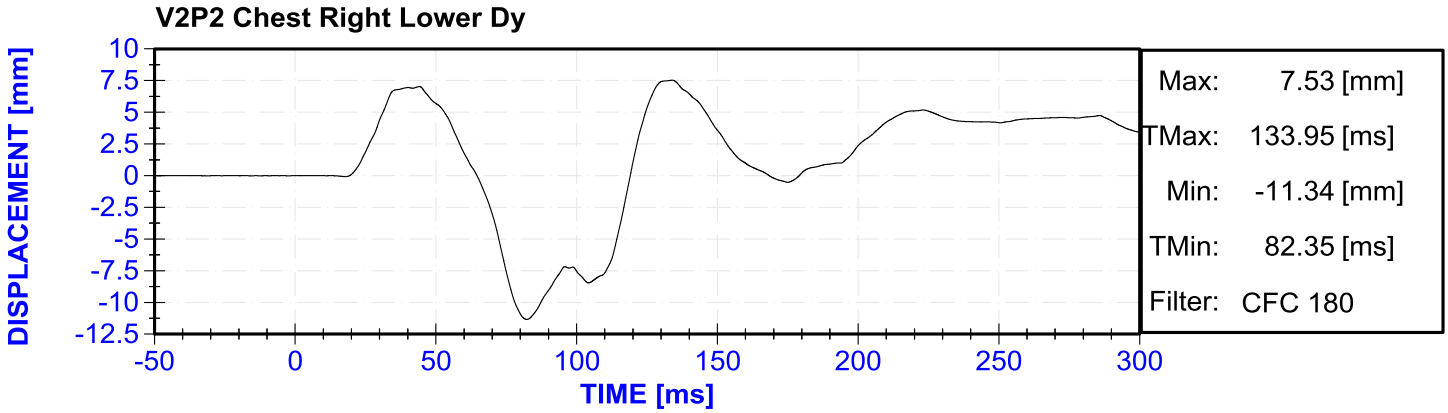

V2P2 Chest Left Lower Dx
DISPLACEMENT [mm]
TIME [ms]
Max: 0.11 [mm]
TMax: 15.00 [ms]
Min: -30.19 [mm]
TMin: 96.90 [ms]
Filter: CFC 180

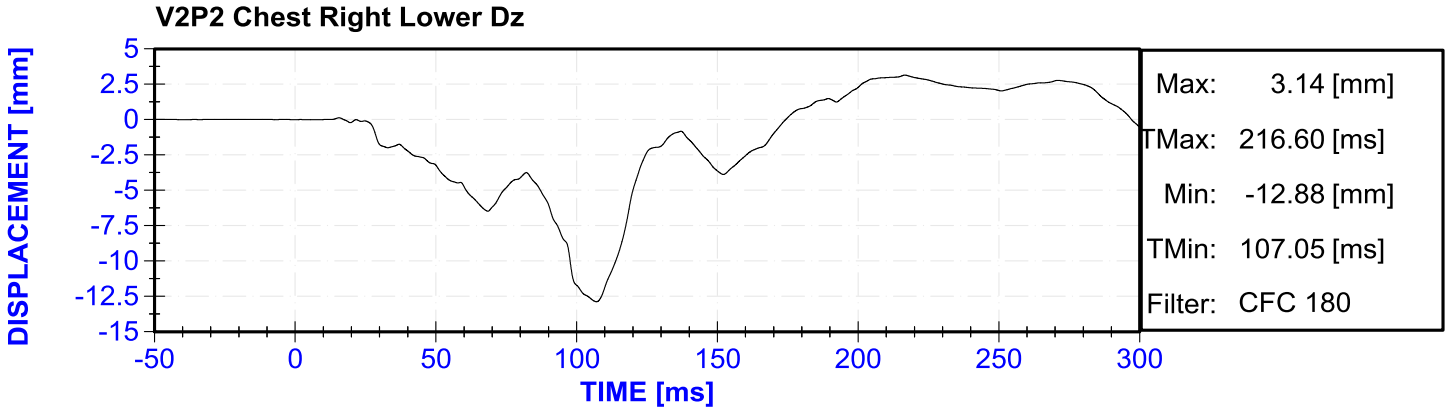

V2P2 Chest Left Lower Dy
DISPLACEMENT [mm]
TIME [ms]
Max: 13.43 [mm]
TMax: 133.45 [ms]
Min: -0.62 [mm]
TMin: 21.55 [ms]
Filter: CFC 180

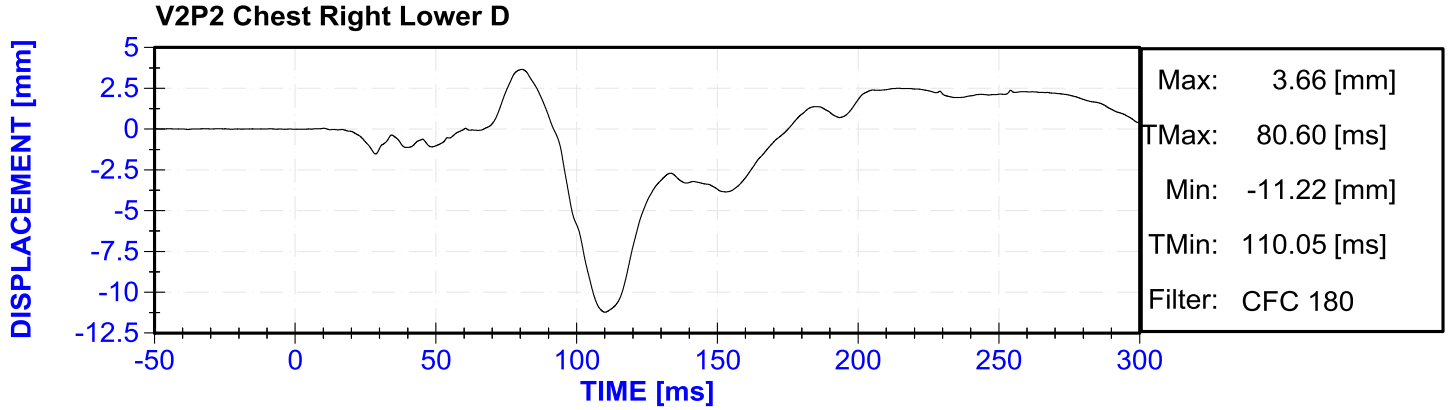

V2P2 Chest Left Lower Dz
DISPLACEMENT [mm]
TIME [ms]
Max: 5.80 [mm]
TMax: 294.15 [ms]
Min: -9.36 [mm]
TMin: 40.90 [ms]
Filter: CFC 180


V2P2 Chest Left Lower D
DISPLACEMENT [mm]
TIME [ms]
Max: 0.10 [mm]
TMax: 14.95 [ms]
Min: -28.46 [mm]
TMin: 96.60 [ms]
Filter: CFC 180


V2P2 Chest Right Lower Dx
DISPLACEMENT [mm]
TIME [ms]
Max: 3.41 [mm]
TMax: 218.35 [ms]
Min: -14.53 [mm]
TMin: 109.25 [ms]
Filter: CFC 180


V2P2 Chest Right Lower Dy
DISPLACEMENT [mm]
TIME [ms]
Max: 7.53 [mm]
TMax: 133.95 [ms]
Min: -11.34 [mm]
TMin: 82.35 [ms]
Filter: CFC 180


V2P2 Chest Right Lower Dz
DISPLACEMENT [mm]
TIME [ms]
Max: 3.14 [mm]
TMax: 216.60 [ms]
Min: -12.88 [mm]
TMin: 107.05 [ms]
Filter: CFC 180


V2P2 Chest Right Lower D
DISPLACEMENT [mm]
TIME [ms]
Max: 3.66 [mm]
TMax: 80.60 [ms]
Min: -11.22 [mm]
TMin: 110.05 [ms]
Filter: CFC 180

APPENDIX C

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

Table C-1: Dummy Information

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

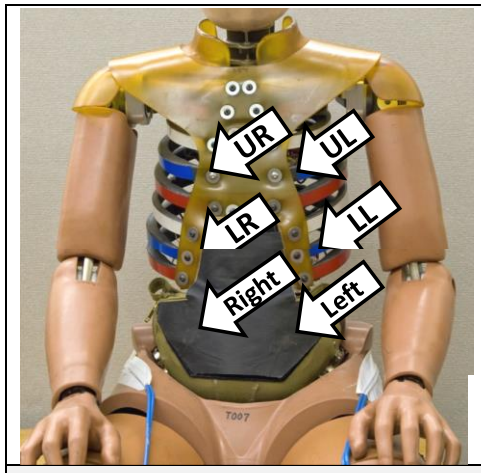


Figure 1. Manipulation to determine thoracic and abdominal IR-TRACC polarity.

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

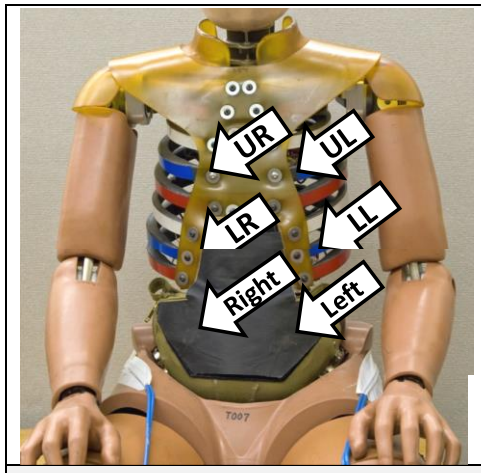


Figure 2. Manipulation to determine thoracic and abdominal IR-TRACC polarity.

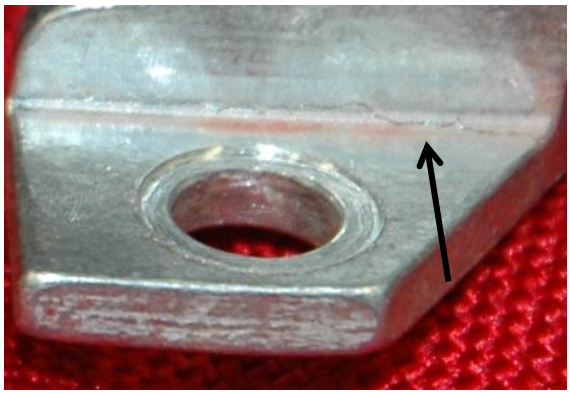
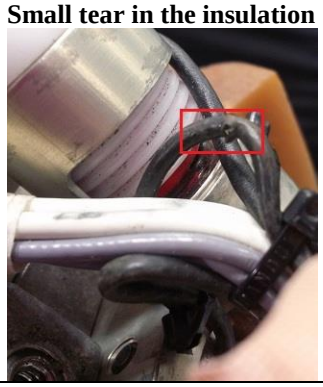
Channel	Motion
DX	Push inward
RY	Push upward
RZ	Push rightward

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

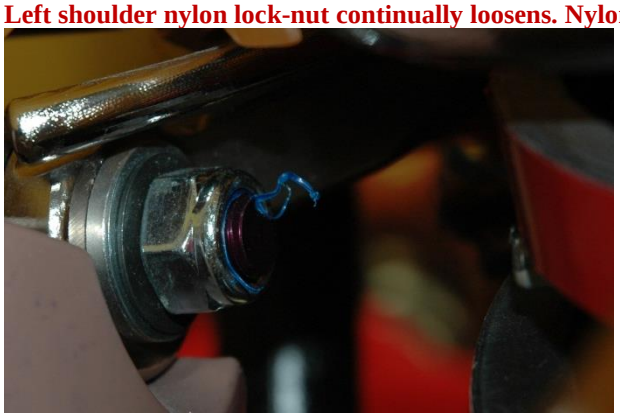
Date: **12/20/2013**	
NHTSA Representative: **James Saunders**	
Inspection Reporter: **Matthew Goehle**	
Witness(es):	
Inspection type (check one): ☒ PRE ☐ POST	
Dummy S/N: **0016**	Legs S/N: **LX019/LX018**
Dummy Description: **Thor NT 50th Male**	
Date of last Certification or Inspection: **12/18/2013**	
Tests conducted since last full certification or inspection: Since last inspection: **CAL2668 – Test Vehicle 3100** Since last certification: **RD0332 Dodge Dart** **RD5371 Honda Civic** **RE5507 Subaru Forester** **RD5910 Volvo XC60** **CAL2658- Test Vehicle 8572** **CAL2659 – Test Vehicle 3A** **CAL2660 – Test Vehicle 3B** **CAL2660 – Test Vehicle 03EX** **CAL2665 – Test Vehicle 25002** **CAL2667 – Test Vehicle 9293** **CAL2668 – Test Vehicle 3100**	
Known errors in data channels (no data, clipping, unexpected drops): **-None**	
Physical evidence of damage: **See Report - Right shoulder loosens easily**	
Anecdotal evidence of damage: **N/A**	
Equipment delivered to Borrower: **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**	*Continued* **2 LX Leg Assemblies** **2 Upper Tibia LC** **2 Lower Tibia LC** **6 Ank1e Potentiometers** **2 Knee Sliders** **1 Neck Skin** **1 Neck Foam** **1 Tiltview Interface Cable** **4 Tilt Sensors** **1 H-Point Tool** **1 Tool Box** **1 Laptop**

Note: New Damage is Noted in Red

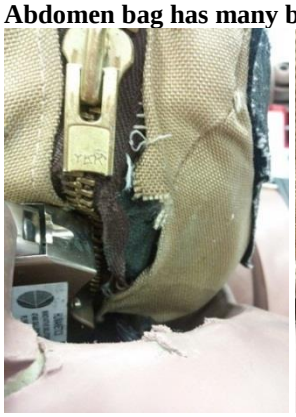
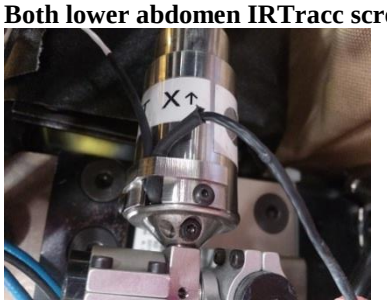
HEAD	
Y / N	Rear head cap mounts securely to head **1 cap tab broke. The other tab has a stress crack.** 
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
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	

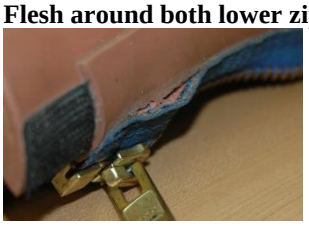
SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates **Debonding has occurred at bottom of thoracic spine rubber. Second photo after CAL2665**
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates **Debonding has occurred at bottom of lumbar spine rubber.**
Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	

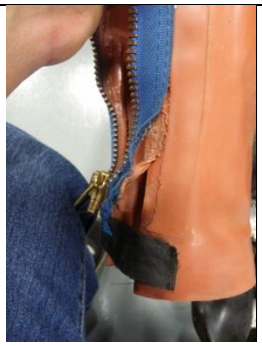
SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact
Y / N	Clavicles securely attached to sternum and shoulder
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops
OTHER	**Left shoulder nylon lock-nut continually loosens. Nylon strips off on keyed shaft.**  **Tear to the left wrist area and 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	IRTRACCs arms securely attached to anterior ribs **IRTRACC housing bolts were loose on both right IRTRACCs. We confirmed and tested electrical function.**
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 - got worse after RD5910**

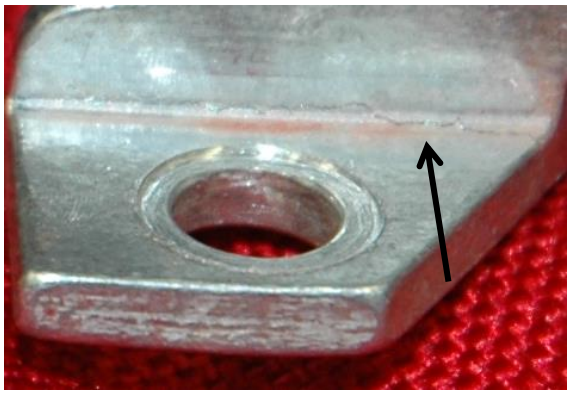
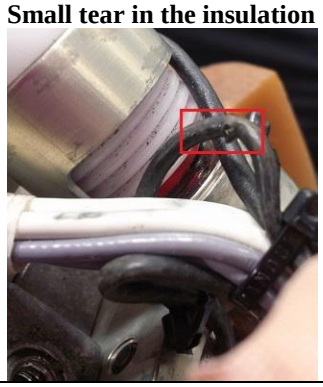
FEMUR	
Y / N	Acetabular load cells firmly attached
Y / N	Femur load cells firmly attached
Y / N	No evidence of deformation of knee slider bump stop
Y / N	No cuts, tears, or scuffing of knee flesh
Other	
LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached **-Left ankle Y pot 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 **Flesh around both lower zippers are starting to tear:**  **Numerous minor cuts. Additional abrasion on right leg seen after CAL2660. Right outer knee cap rubber started to pull away from composite material.** **Scuff on upper left shin after CAL2665** **Zipper on right ankle is pulling away from the flesh – This became much worse during the RE5507 test. (See second photo) (Replaced flesh) Right knee has some nicks in the flesh**

	
Other	**Damage to the metal of the right ankle**
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: **1/7/2014**	
NHTSA Representative: **James Saunders**	
Inspection Reporter: **Matthew Goehle**	
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: **12/20/2013**	
Tests conducted since last full certification or inspection: Since last inspection: **RC5911 Volvo S60** Since last certification: **RD0332 Dodge Dart** **RD5371 Honda Civic** **RE5507 Subaru Forester** **RD5910 Volvo XC60** **CAL2658- Test Vehicle 8572** **CAL2659 – Test Vehicle 3A** **CAL2660 – Test Vehicle 3B** **CAL2660 – Test Vehicle 03EX** **CAL2665 – Test Vehicle 25002** **CAL2667 – Test Vehicle 9293** **CAL2668 – Test Vehicle 3100** **RC5911 Volvo S60**	
Known errors in data channels (no data, clipping, unexpected drops): **-None**	
Physical evidence of damage: **See Page 7 - Airbag burn on left rear jacket**	
Anecdotal evidence of damage: **N/A**	
Equipment delivered to Borrower: **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**	*Continued* **2 LX Leg Assemblies** **2 Upper Tibia LC** **2 Lower Tibia LC** **6 Ank1e Potentiometers** **2 Knee Sliders** **1 Neck Skin** **1 Neck Foam** **1 Tiltview Interface Cable** **4 Tilt Sensors** **1 H-Point Tool** **1 Tool Box** **1 Laptop**

Note: New Damage is Noted in Red

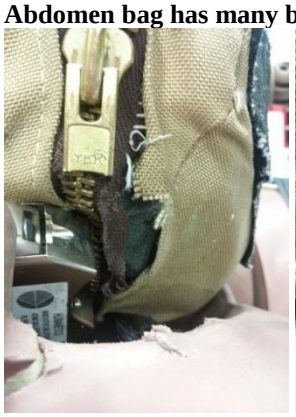
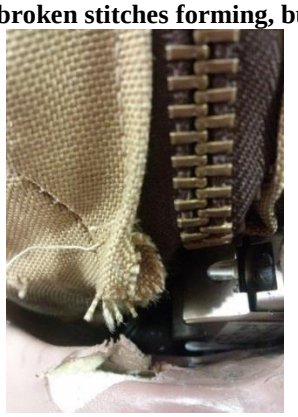
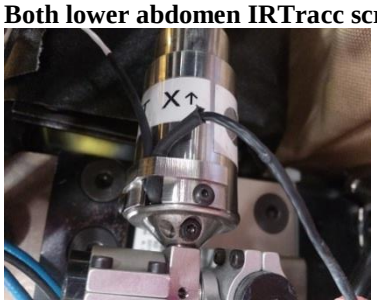
HEAD	
Y / N	Rear head cap mounts securely to head **1 cap tab broke. The other tab has a stress crack.** 
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
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	

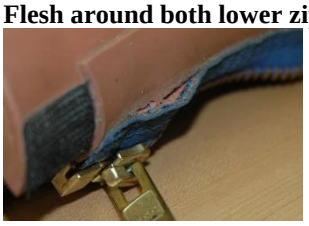
SPINE	
Y / N	No evidence of debonding between thoracic spine flex joint and metal plates **Debonding has occurred at bottom of thoracic spine rubber. Second photo after CAL2665**
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates **Debonding has occurred at bottom of lumbar spine rubber.**
Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	

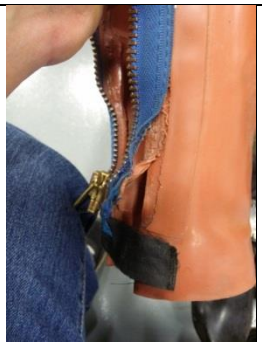
SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact
Y / N	Clavicles securely attached to sternum and shoulder
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops
OTHER	**Left shoulder nylon lock-nut continually loosens. Nylon strips off on keyed shaft.** **Tear to the left wrist area and 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	IRTRACCs arms securely attached to anterior ribs **IRTRACC housing bolts were loose on both right IRTRACCs. We confirmed and tested electrical function.**
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 - got worse after RD5910**

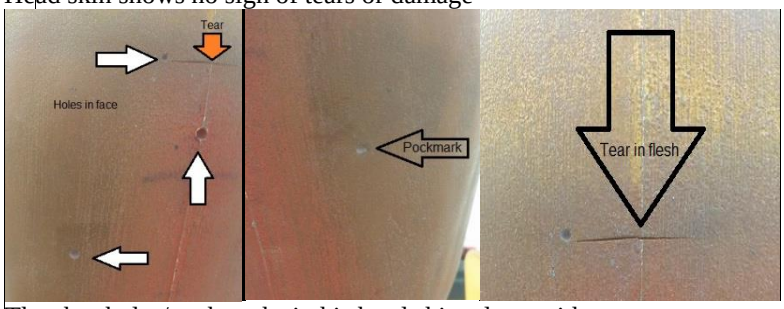
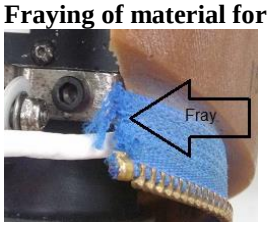
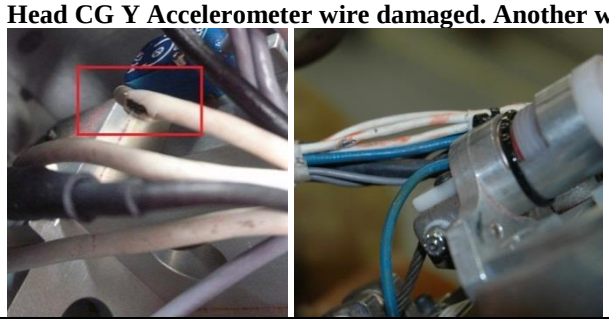
FEMUR	
Y / N	Acetabular load cells firmly attached
Y / N	Femur load cells firmly attached
Y / N	No evidence of deformation of knee slider bump stop
Y / N	No cuts, tears, or scuffing of knee flesh
Other	
LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached **-Left ankle Y pot 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 **Flesh around both lower zippers are starting to tear:**  **Numerous minor cuts. Additional abrasion on right leg seen after CAL2660. Right outer knee cap rubber started to pull away from composite material.** **Scuff on upper left shin after CAL2665** **Zipper on right ankle is pulling away from the flesh – This became much worse during the RE5507 test. (See second photo) (Replaced flesh) Right knee has some nicks in the flesh**

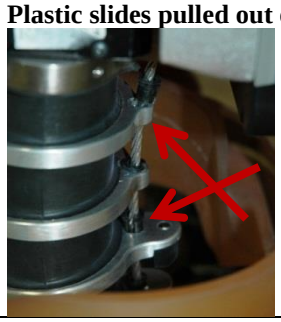
	
Other	 **Damage to the metal of the right ankle**
JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers **Jacket has tears around neck and at most seam ends as seen here on the front left shoulder.** **Airbag burn on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

THOR Inspection Checklist

Date: **12/20/2013**	
NHTSA Representative: **James Saunders**	
Inspection Reporter: **Matthew Goehle**	
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: **12/18/2013**	
Tests conducted since last full certification or inspection: Since last inspection: **CAL2668 – Test Vehicle 3100** Since last certification: **RD0332 Dodge Dart** **RD5371 Honda Civic** **RE5507 Subaru Forester** **RD5910 Volvo XC60** **CAL2658- Test Vehicle 8572** **CAL2659 – Test Vehicle 3A** **CAL2660 – Test Vehicle 3B** **CAL2660 – Test Vehicle 03EX** **CAL2665 – Test Vehicle 25002** **CAL2667 – Test Vehicle 9293** **CAL2668 – Test Vehicle 3100**	
Known errors in data channels (no data, clipping, unexpected drops): **-None**	
Physical evidence of damage: **-None New**	
Anecdotal evidence of damage: **N/A**	
Equipment delivered to Borrower: **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**	*Continued* **2 LX Leg Assemblies** **2 Upper Tibia LC** **2 Lower Tibia LC** **6 Ank1e Potentiometers** **2 Knee Sliders** **1 Neck Skin** **1 Neck Foam** **1 Tiltview Interface Cable** **4 Tilt Sensors** **1 H-Point Tool** **1 Tool Box** **1 Laptop** **1 LX Zeroing Bracket**

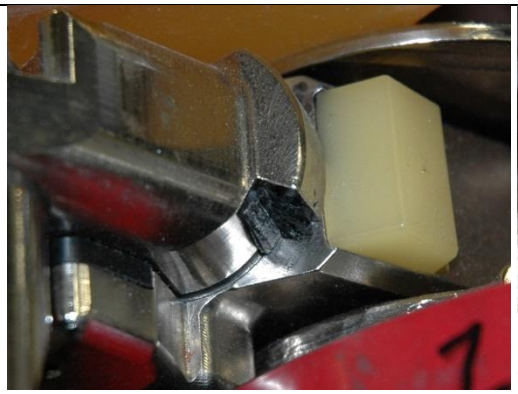
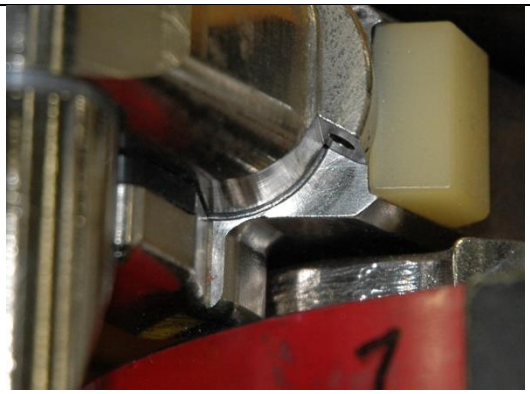
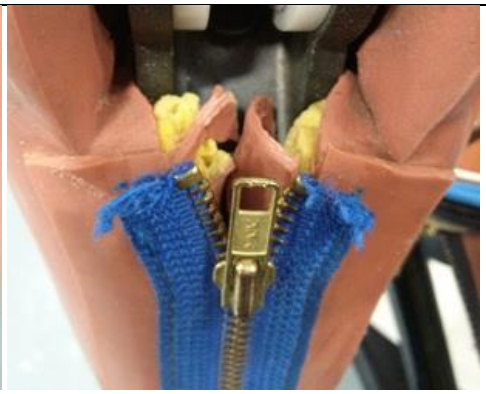
Note: New Damage is Noted in Red

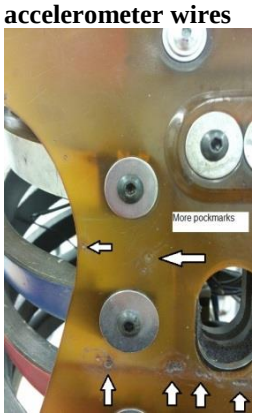
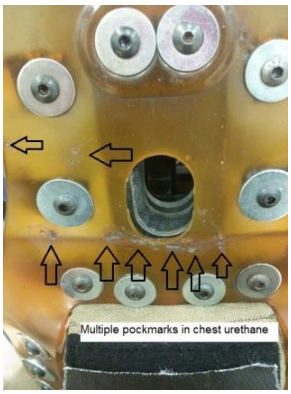
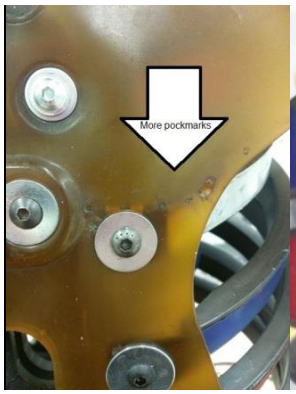
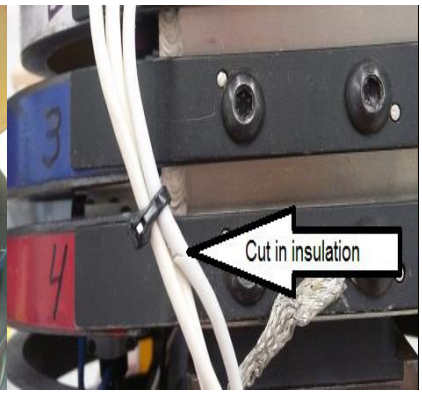
HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage  Thor has holes/pockmarks in his head skin, along with a tear
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
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. Another wire insulation damaged during CAL2659** 

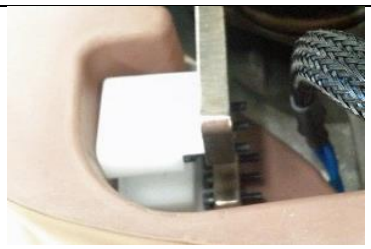
NECK	
Y / N	Neck cables slide freely through holes in neck plates **Plastic slides pulled out of cable. We reinstalled.** 
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates If N – indicate which interface (where plate/puck 1 attach to upper neck load cell):
Y / N	No evidence of debonding or permanent compression in neck soft stop assemblies **Slight damage to upper neck stop.**

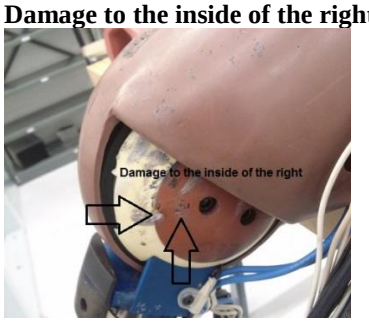
Y / N	Neck securely attached to upper neck load cell
Y / N	Neck securely attached to lower neck load cell **THOR 0015 does not have a lower neck load cell**
Y / N	Neck pitch change joint mechanism mating teeth are engaged
OTHER	**Lifting strap has begun to stretch. (We installed a 250lb cable tie around strap for safety)**
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	

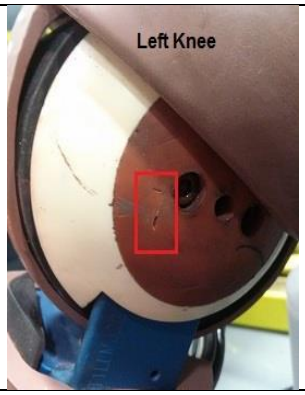
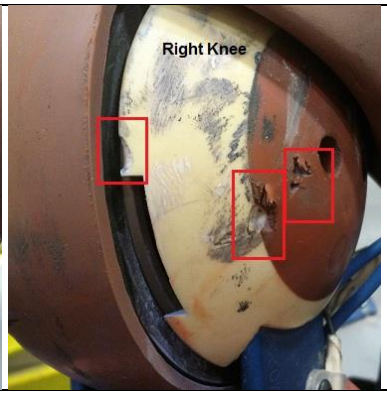
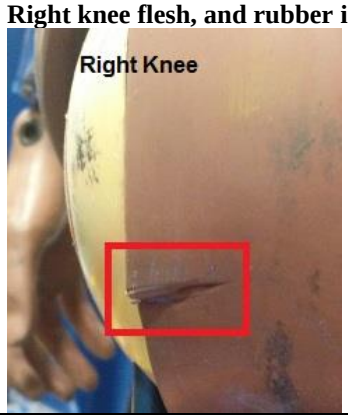
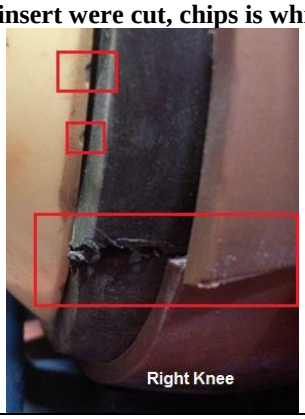
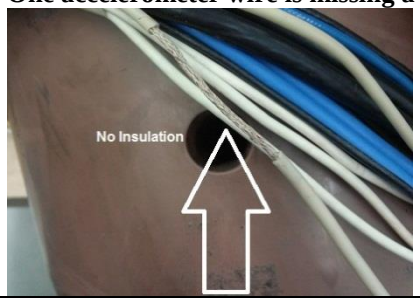
SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact
Y / N	Clavicles securely attached to sternum and shoulder **Inner right clavicle pin missing C-clip. (Replaced)**
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops **Left rubber shoulder stop compressed. Stop fell out during CAL2665**

	 
OTHER	 **Both left and right arms show signs of internal tearing**

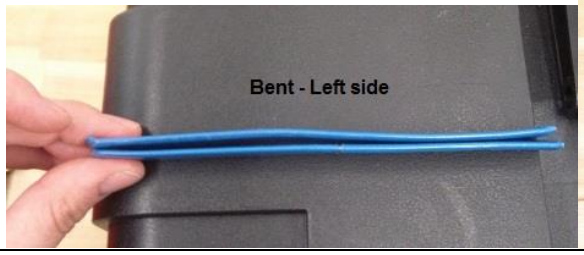
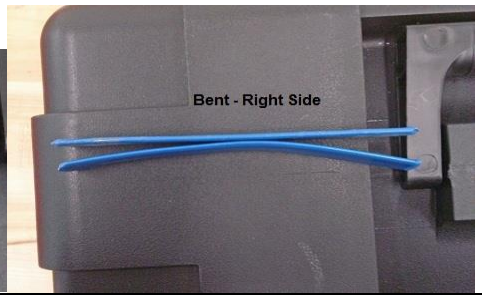
THORAX	
Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	CRUX anterior arms securely attached to anterior ribs
Y / N	CRUX posterior arms securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration **See "OTHER" below.**
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**    

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**

	 
Y / N	No cuts, tears, or scuffing of knee flesh **Right knee flesh, and rubber insert were cut, chips is white area**  
Other	**One accelerometer wire is missing a large portion of insulation** 

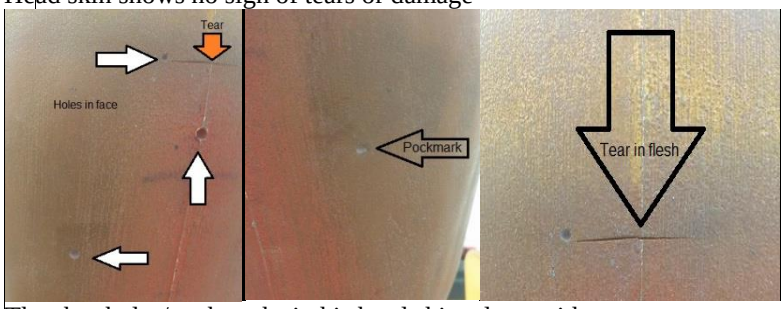
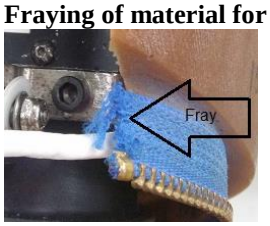
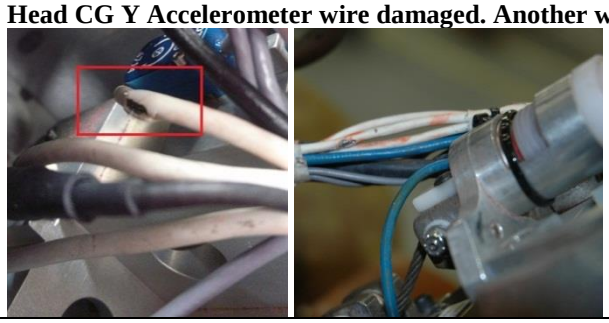
LOWER EXTREMITY (LX)	
Y / N	Rotational potentiometers in ankle securely attached
Y / N	Achilles tendon provides resistance to dorsiflexion
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
Y / N	No cuts, tears, or scuffing of leg flesh **Right leg flesh shows separation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

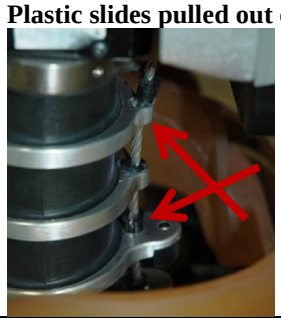
JACKET	
Y / N	Rib stiffeners show no sign of permanent deformation **One of the left rib stiffeners has damage to the outer coating that goes all the way around, also, the rib stiffeners were severely bent when we received 0015.**  
Y / N	No evidence of tears or holes in jacket fabric, Velcro, or zippers **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: **1/7/2014**	
NHTSA Representative: **James Saunders**	
Inspection Reporter: **Matthew Goehle**	
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: **12/20/2013**	
Tests conducted since last full certification or inspection: Since last inspection: **RC5911 Volvo S60** Since last certification: **RD0332 Dodge Dart** **RD5371 Honda Civic** **RE5507 Subaru Forester** **RD5910 Volvo XC60** **CAL2658- Test Vehicle 8572** **CAL2659 – Test Vehicle 3A** **CAL2660 – Test Vehicle 3B** **CAL2660 – Test Vehicle 03EX** **CAL2665 – Test Vehicle 25002** **CAL2667 – Test Vehicle 9293** **CAL2668 – Test Vehicle 3100** **RC5911 Volvo S60**	
Known errors in data channels (no data, clipping, unexpected drops): **-None**	
Physical evidence of damage: **-None New**	
Anecdotal evidence of damage: **N/A**	
Equipment delivered to Borrower: **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**	*Continued* **2 LX Leg Assemblies** **2 Upper Tibia LC** **2 Lower Tibia LC** **6 Ank1e Potentiometers** **2 Knee Sliders** **1 Neck Skin** **1 Neck Foam** **1 Tiltview Interface Cable** **4 Tilt Sensors** **1 H-Point Tool** **1 Tool Box** **1 Laptop** **1 LX Zeroing Bracket**

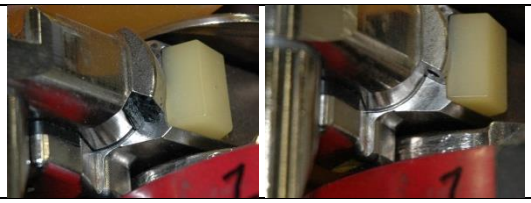
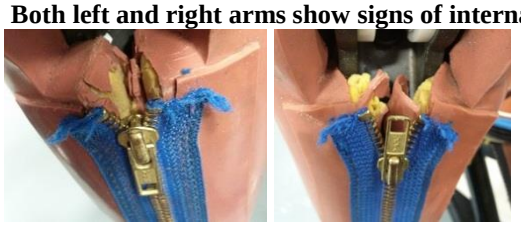
Note: New Damage is Noted in Red

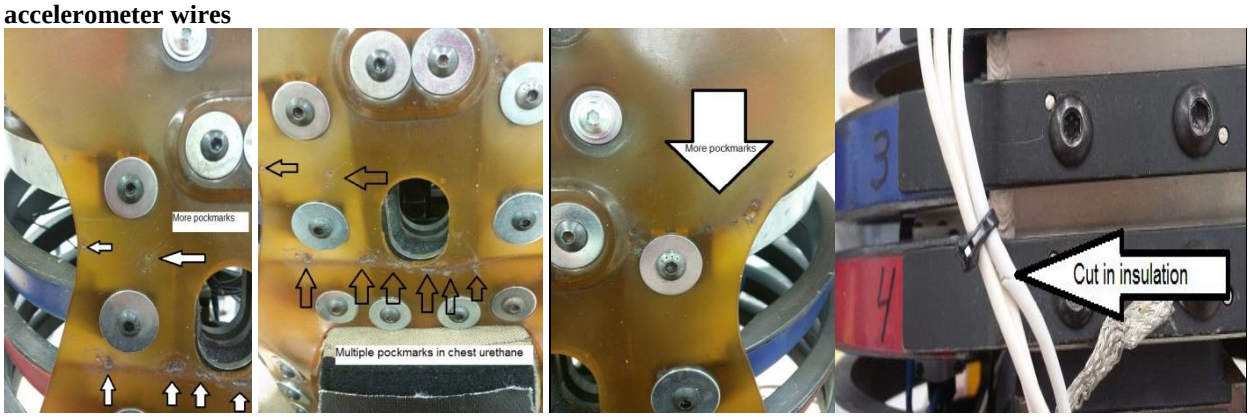
HEAD	
Y / N	Rear head cap mounts securely to head
Y / N	Head skin fits securely over skull
Y / N	Head skin shows no sign of tears or damage  Thor has holes/pockmarks in his head skin, along with a tear
Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
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. Another wire insulation damaged during CAL2659** 

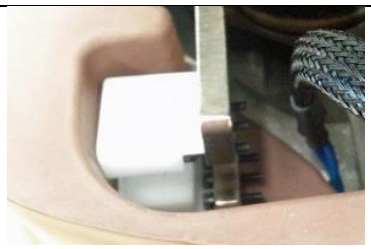
NECK	
Y / N	Neck cables slide freely through holes in neck plates **Plastic slides pulled out of cable. We reinstalled.** 
Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / N	No evidence of debonding between neck pucks and plates If N – indicate which interface (where plate/puck 1 attach to upper neck load cell):
Y / N	No evidence of debonding or permanent compression in neck soft stop assemblies **Slight damage to upper neck stop.**

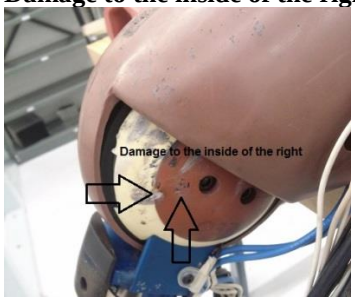
Y / N	Neck securely attached to upper neck load cell
Y / N	Neck securely attached to lower neck load cell **THOR 0015 does not have a lower neck load cell**
Y / N	Neck pitch change joint mechanism mating teeth are engaged
OTHER	**Lifting strap has begun to stretch. (We installed a 250lb cable tie around strap for safety)**
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	

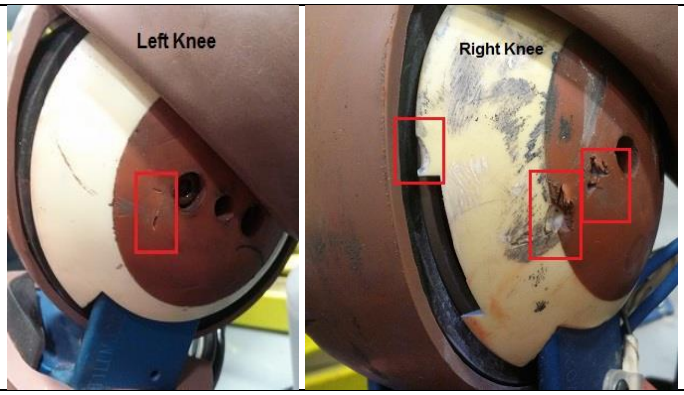
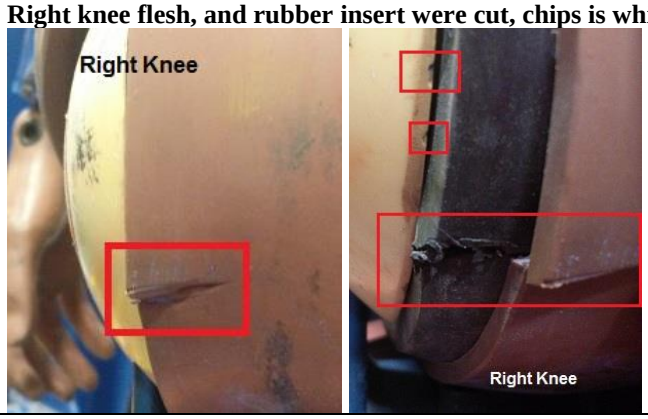
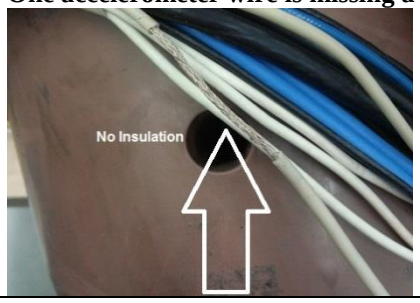
SHOULDER	
Y / N	Urethane shoulder pads show no evidence of contact
Y / N	Clavicles securely attached to sternum and shoulder **Inner right clavicle pin missing C-clip. (Replaced)**
Y / N	No evidence of debonding, tearing, or permanent compression of posterior soft stops **Left rubber shoulder stop compressed. Stop fell out during CAL2665**

	
OTHER	**Both left and right arms show signs of internal tearing**  **Left arm shows worse tearing after RC5911.**

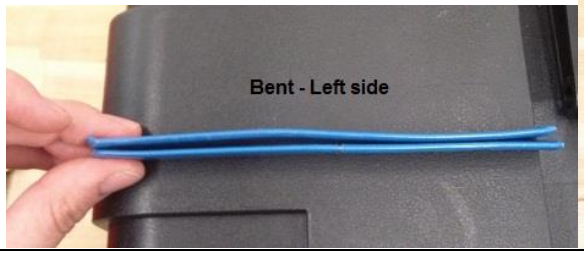
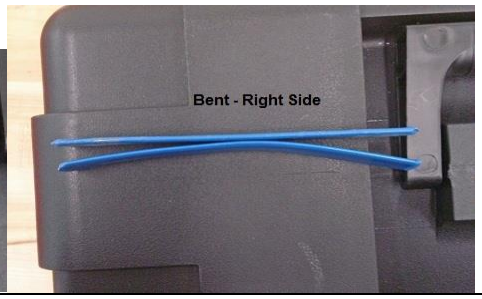
THORAX	
Y / N	No evidence of contact at top, bottom, or interior faces of rib damping material
Y / N	No evidence of debonding between rib damping material and ribs
Y / N	CRUX anterior arms securely attached to anterior ribs
Y / N	CRUX posterior arms securely attached to double gimbals, spine
Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration **See "OTHER" below.**
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** 

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**

	
Y / N	No cuts, tears, or scuffing of knee flesh **Right knee flesh, and rubber insert were cut, chips is white area** 
Other	**One accelerometer wire is missing a large portion of insulation** 

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.**  
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	

DUMMY CALIBRATIONS

50% ADULT MALE THOR016 DUMMY CALIBRATIONS

Summary of Thor 16 Certification Test Results

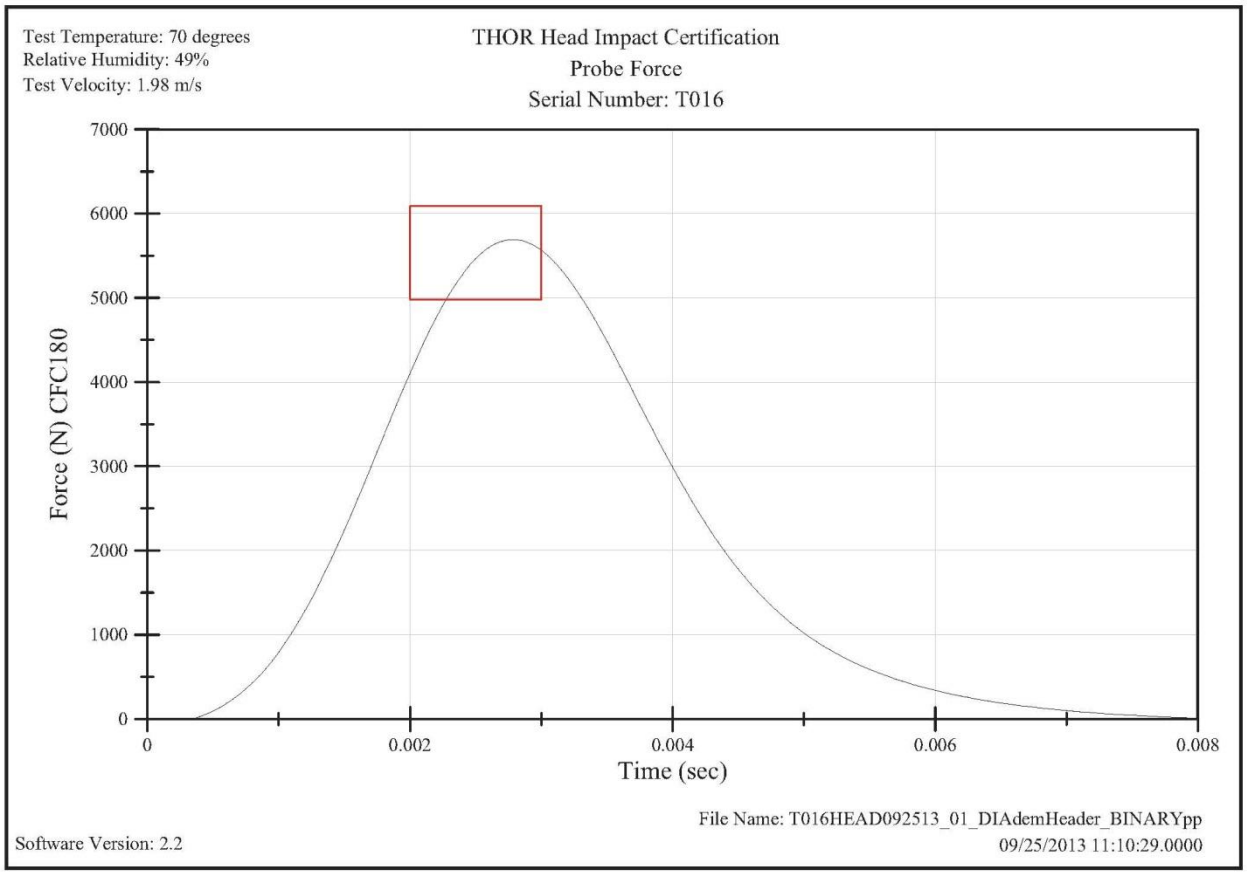
Reported by: Calspan

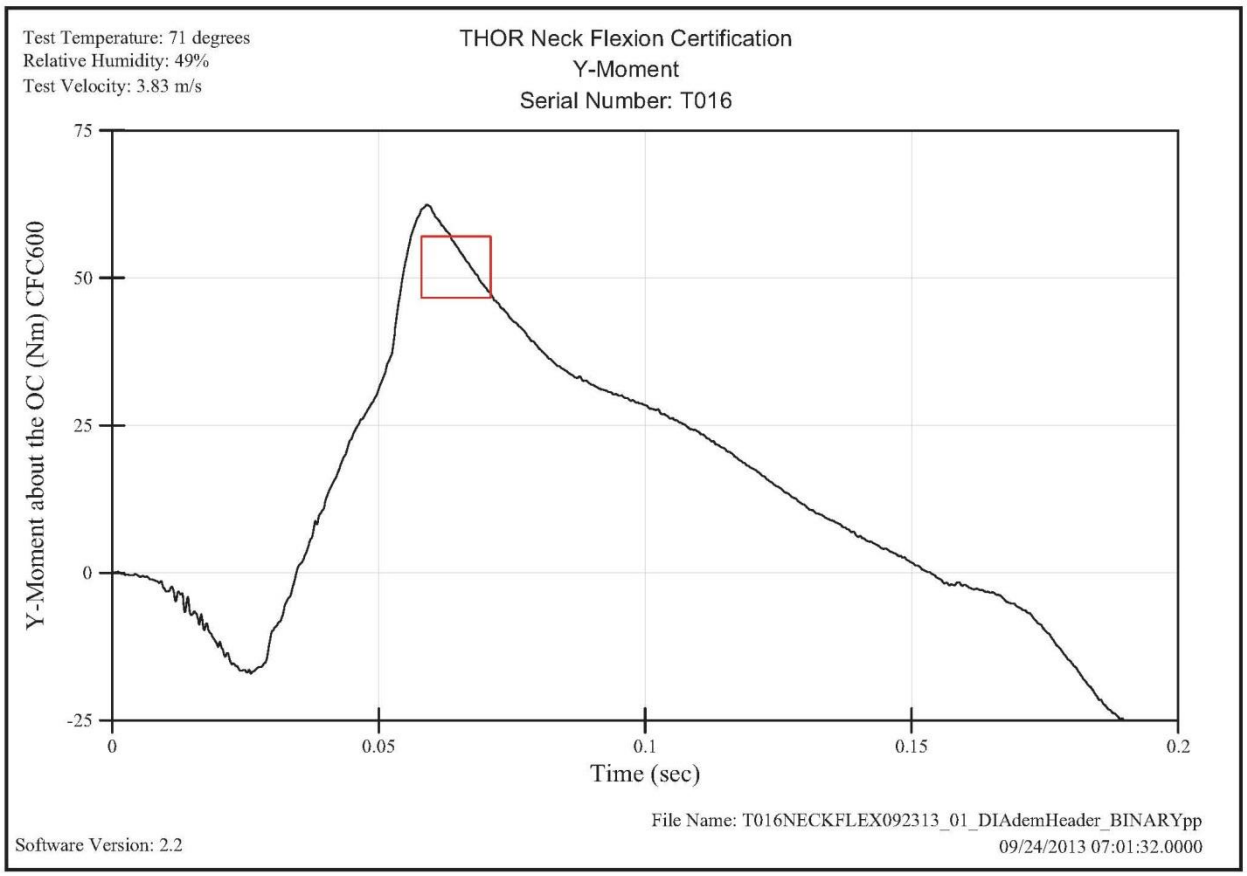
Technician: M. Goehle

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
Force (N) CFC180
7000
6000
5000
4000
3000
2000
1000
0
0
0.002
0.004
0.006
0.008
Time (sec)
File Name: T016HEAD092513_01_DIAdemHeader_BINARYpp
Software Version: 2.2
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
Y-Moment about the OC (Nm) CFC600
75
50
25
0
-25
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T016NECKFLEX092313_01_DIAdemHeader_BINARYpp
Software Version: 2.2
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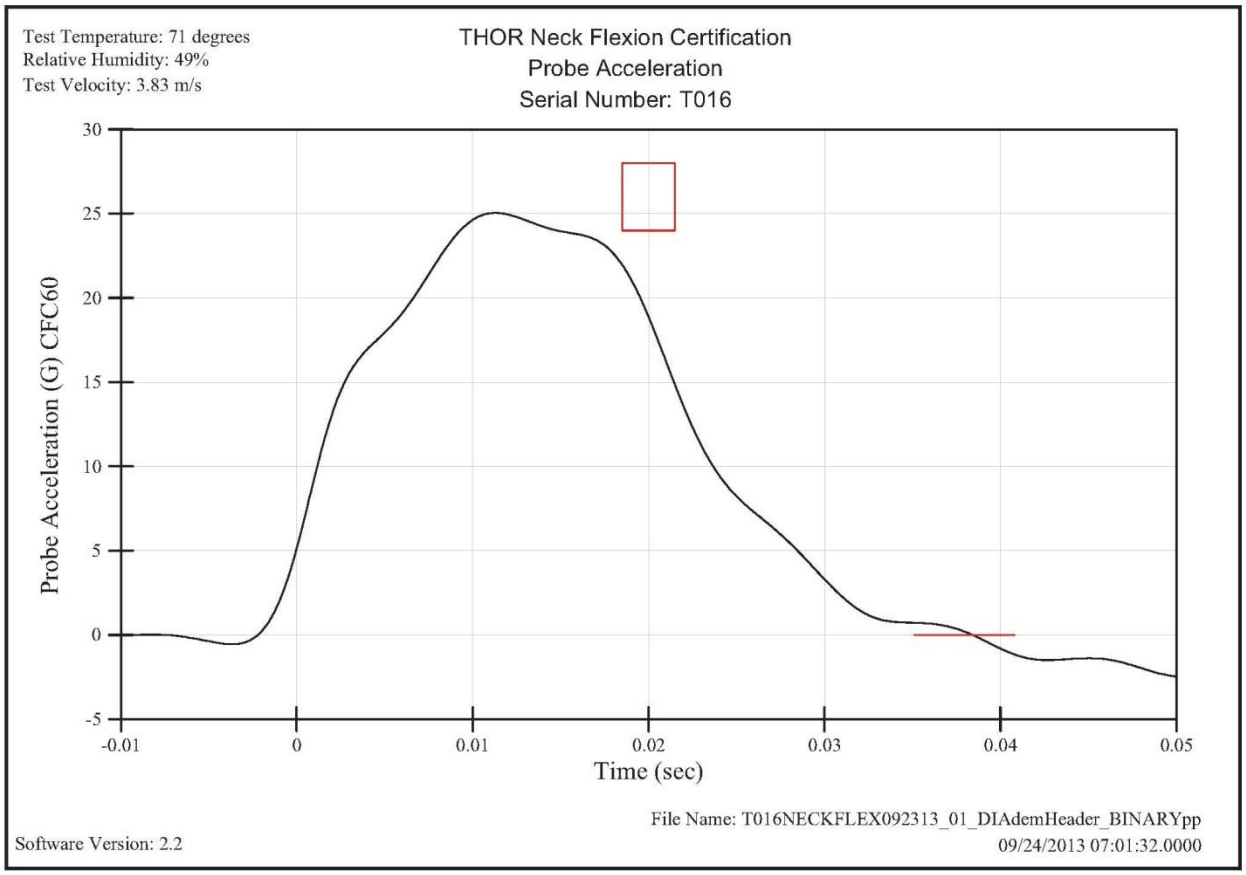
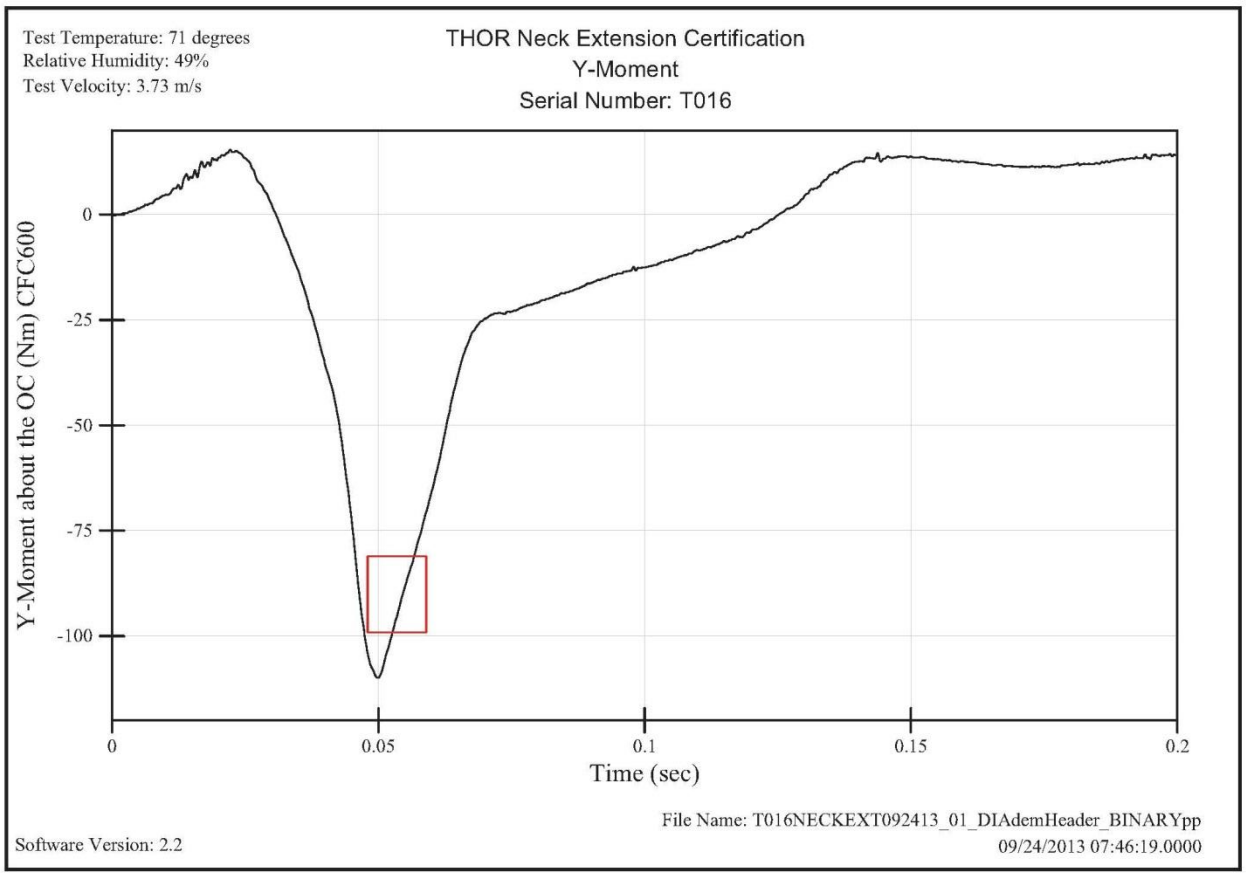
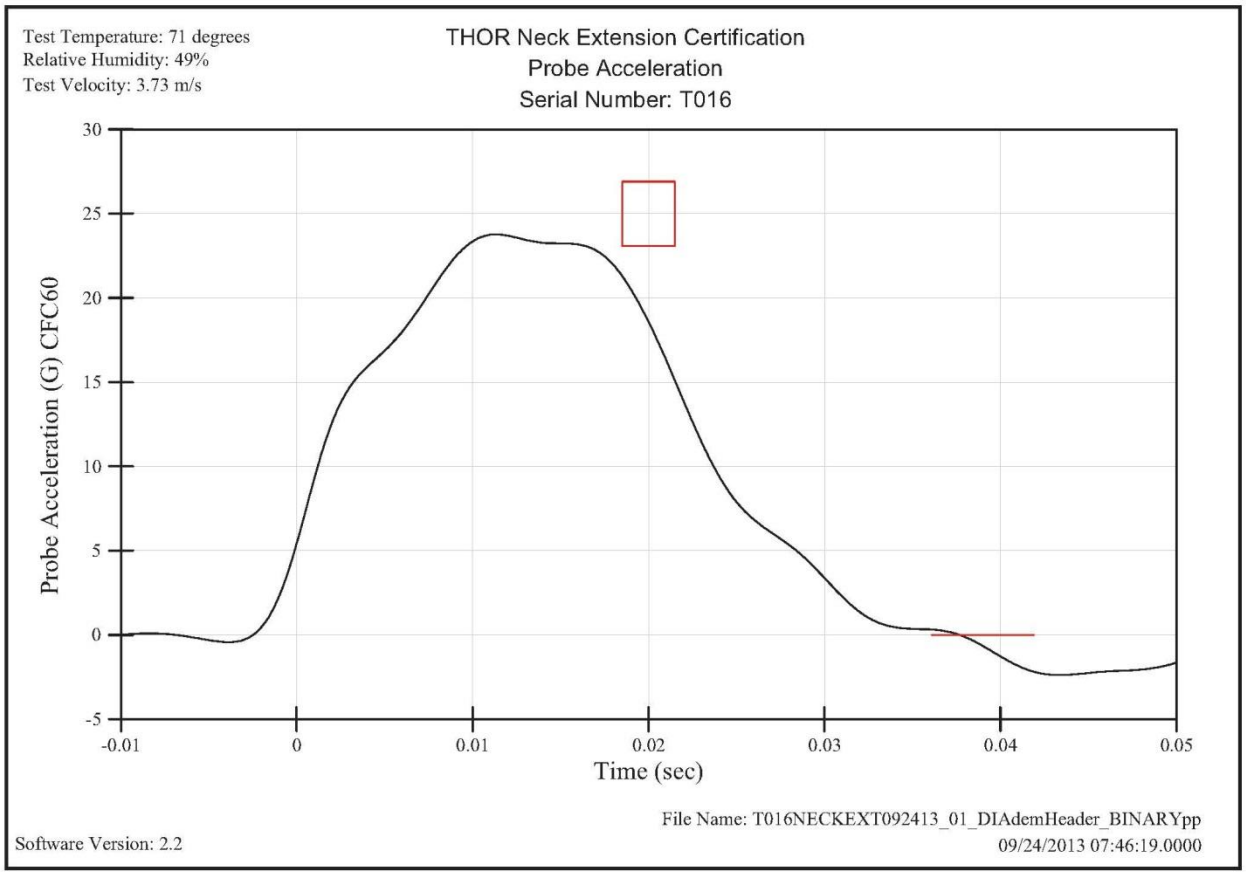
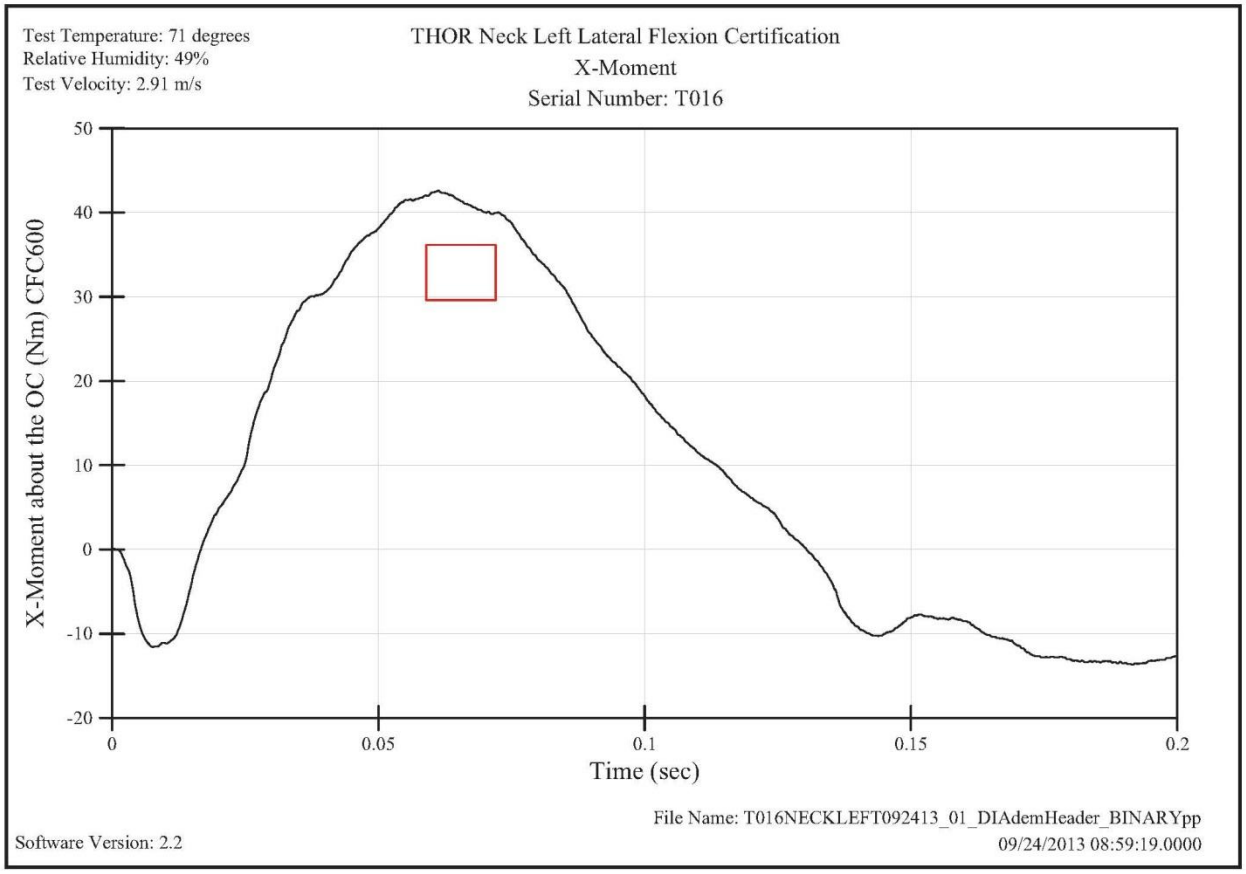
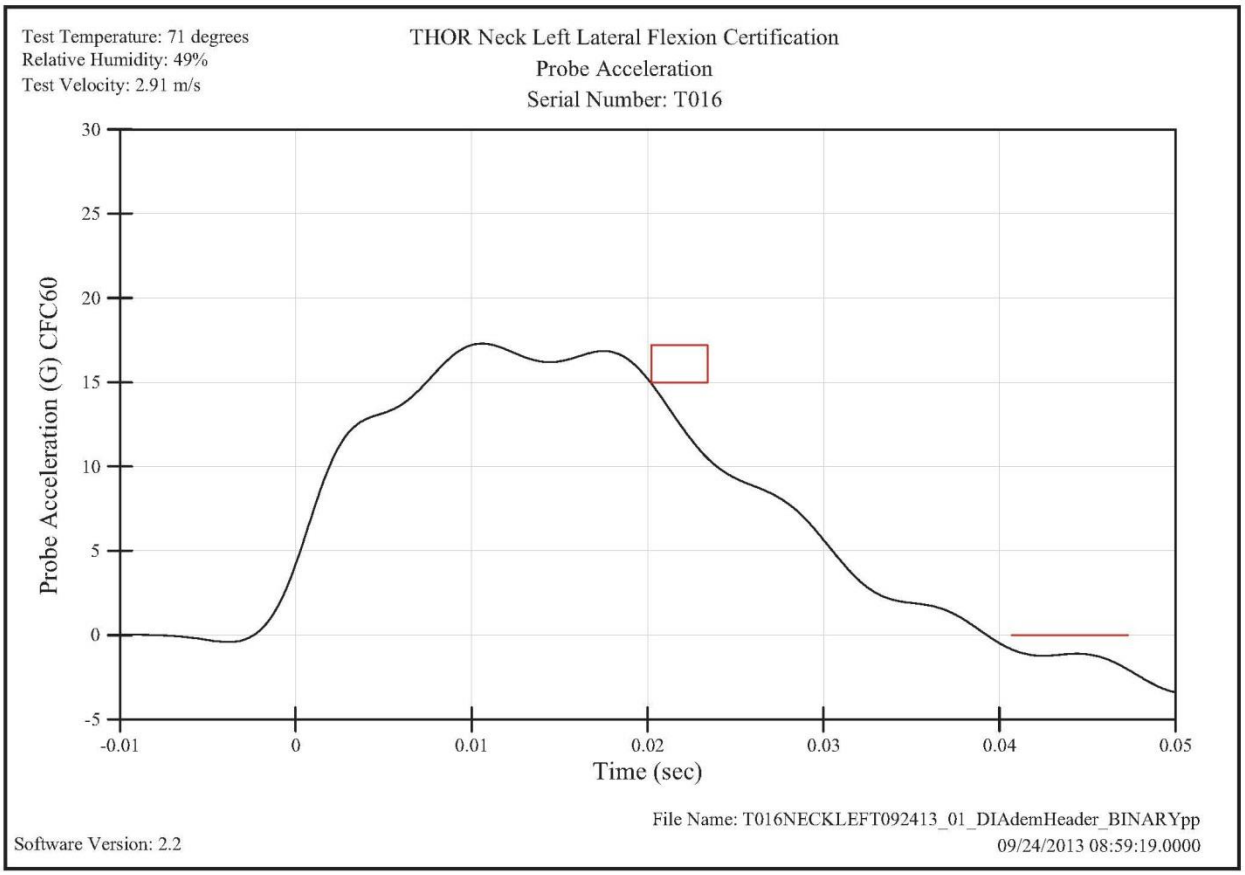
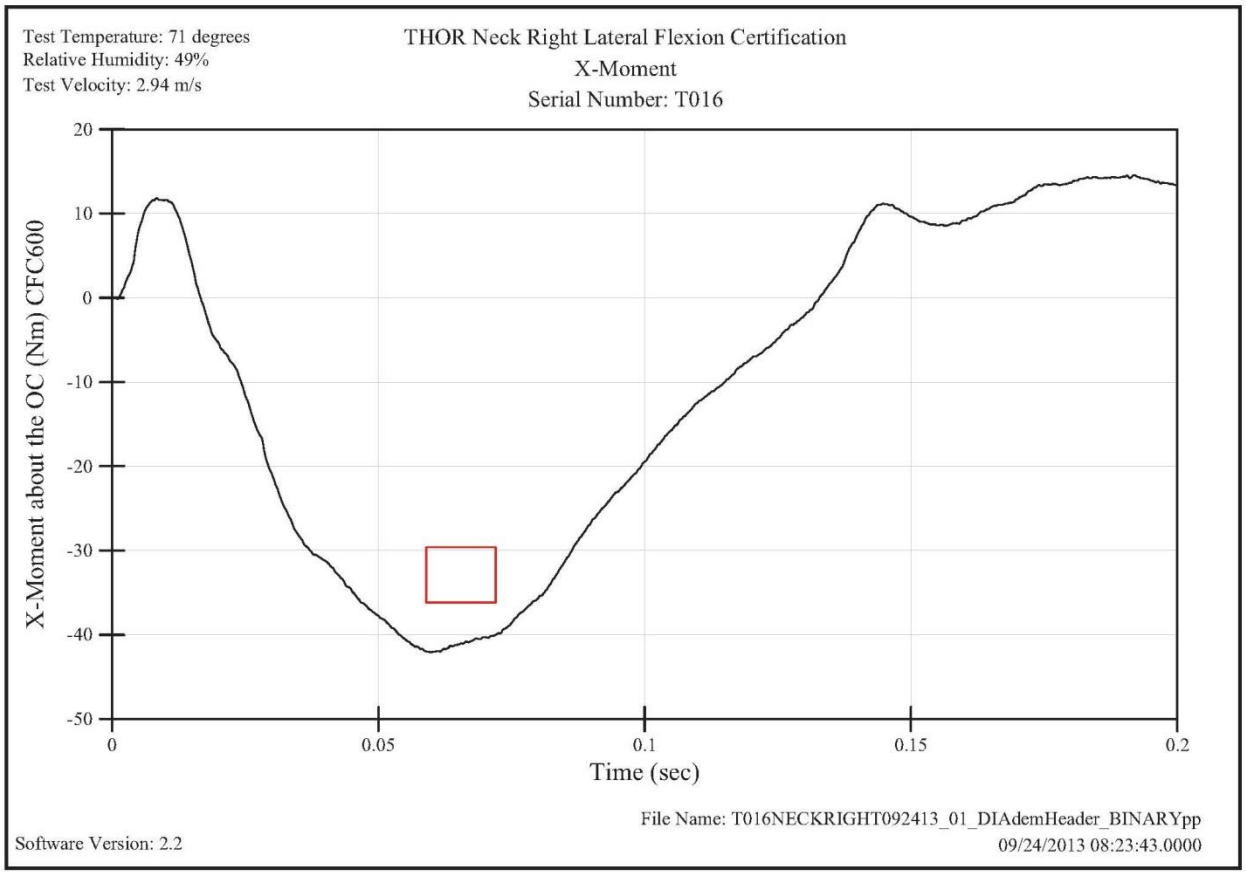

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.83 m/s
THOR Neck Flexion Certification
Probe Acceleration
Serial Number: T016
Probe Acceleration (G) CFC60
30
25
20
15
10
5
0
-5
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (sec)
File Name: T016NECKFLEX092313_01_DIAdemHeader_BINARYpp
09/24/2013 07:01:32.0000
Software Version: 2.2

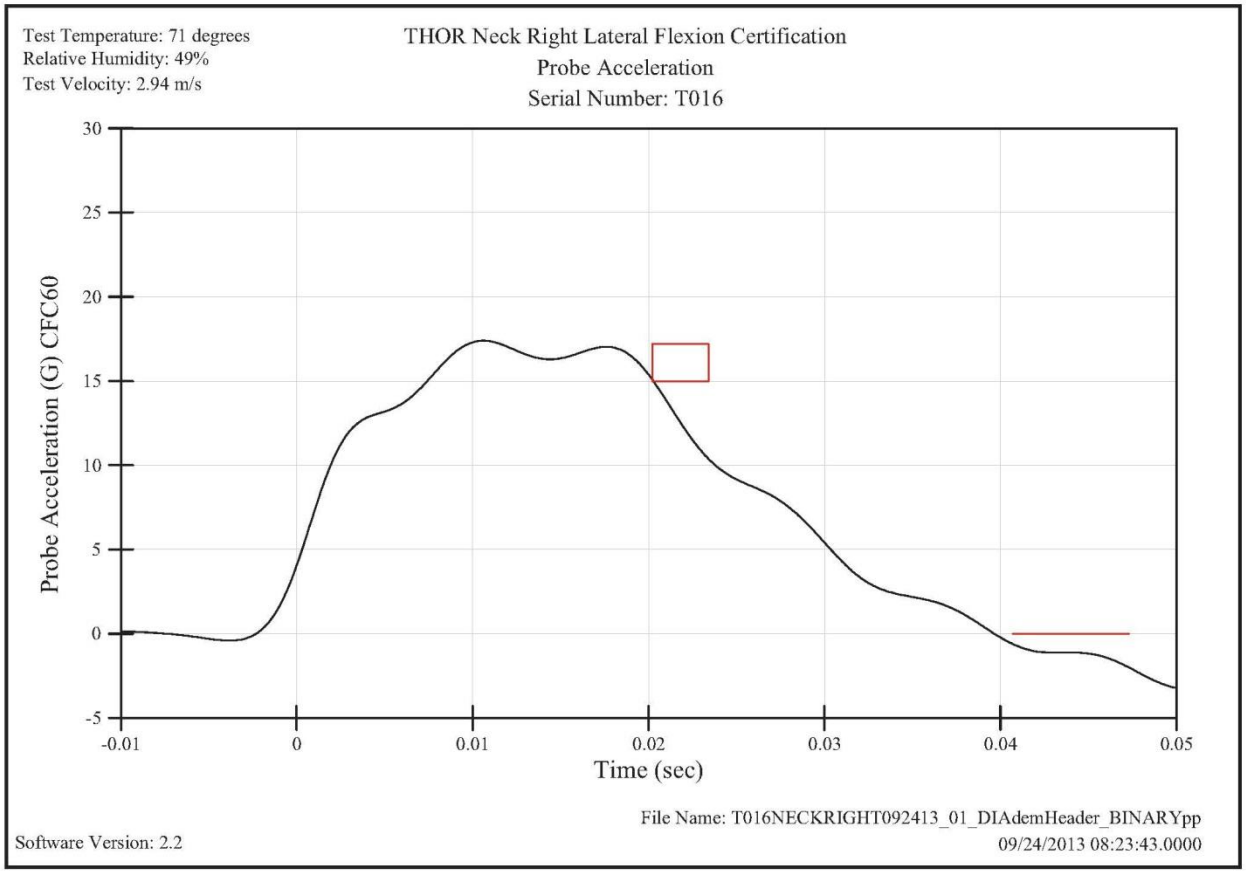

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.73 m/s
THOR Neck Extension Certification
Y-Moment
Serial Number: T016
Y-Moment about the OC (Nm) CFC600
0
-25
-50
-75
-100
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T016NECKEXT092413_01_DIAdemHeader_BINARYpp
09/24/2013 07:46:19.0000
Software Version: 2.2

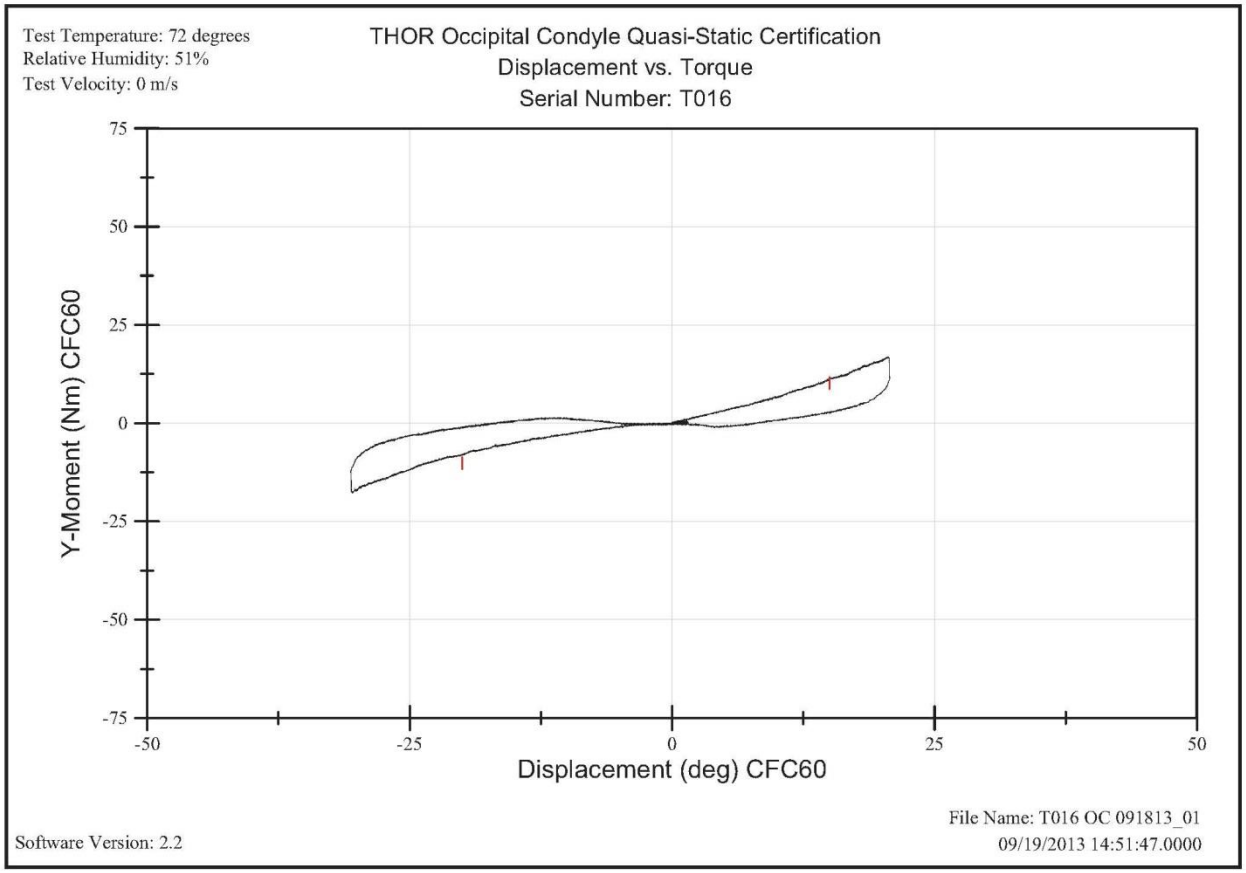

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 3.73 m/s
THOR Neck Extension Certification
Probe Acceleration
Serial Number: T016
Probe Acceleration (G) CFC60
Time (sec)
File Name: T016NECKEXT092413_01_DIAdemHeader_BINARYpp
09/24/2013 07:46:19.0000
Software Version: 2.2

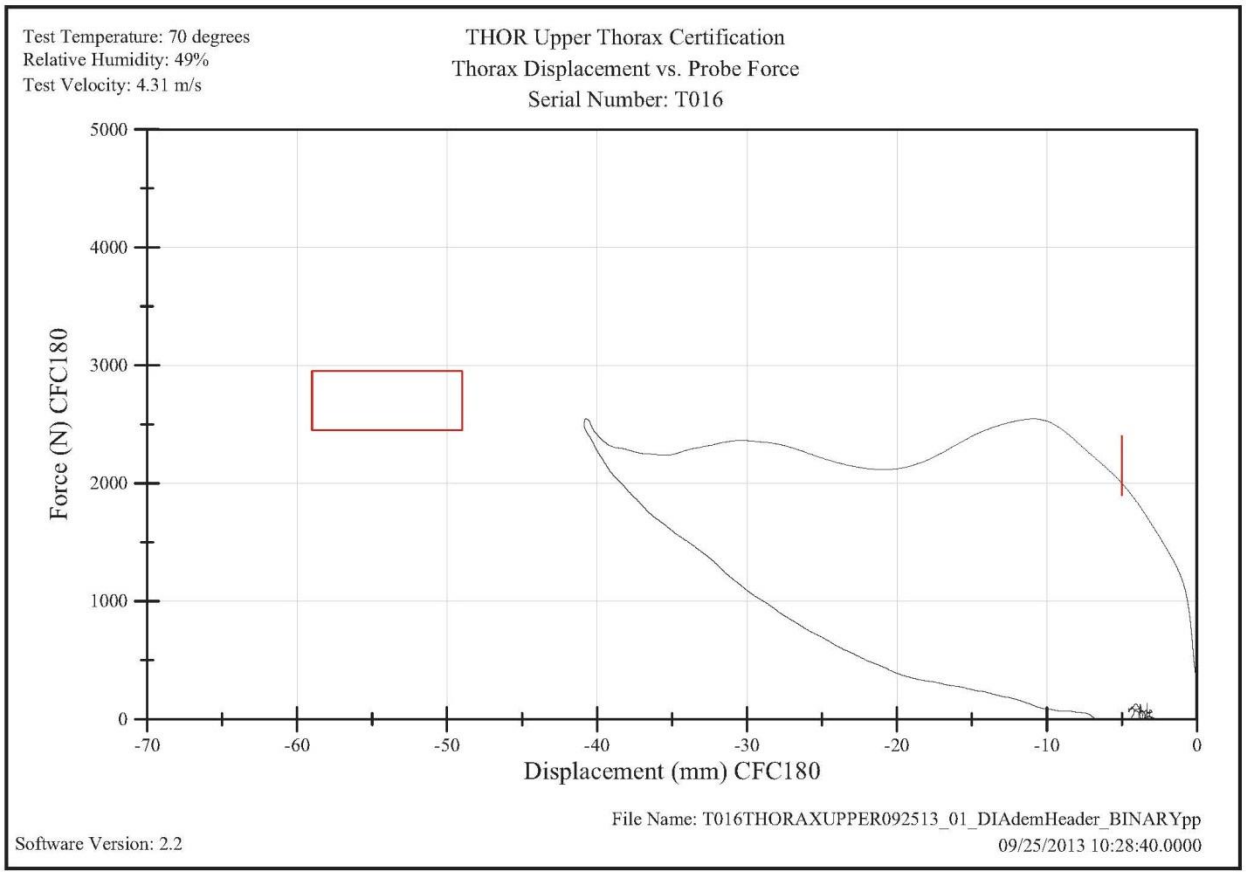

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.91 m/s
THOR Neck Left Lateral Flexion Certification
X-Moment
Serial Number: T016
X-Moment about the OC (Nm) CFC600
Time (sec)
File Name: T016NECKLEFT092413_01_DIAdemHeader_BINARYpp
09/24/2013 08:59:19.0000
Software Version: 2.2

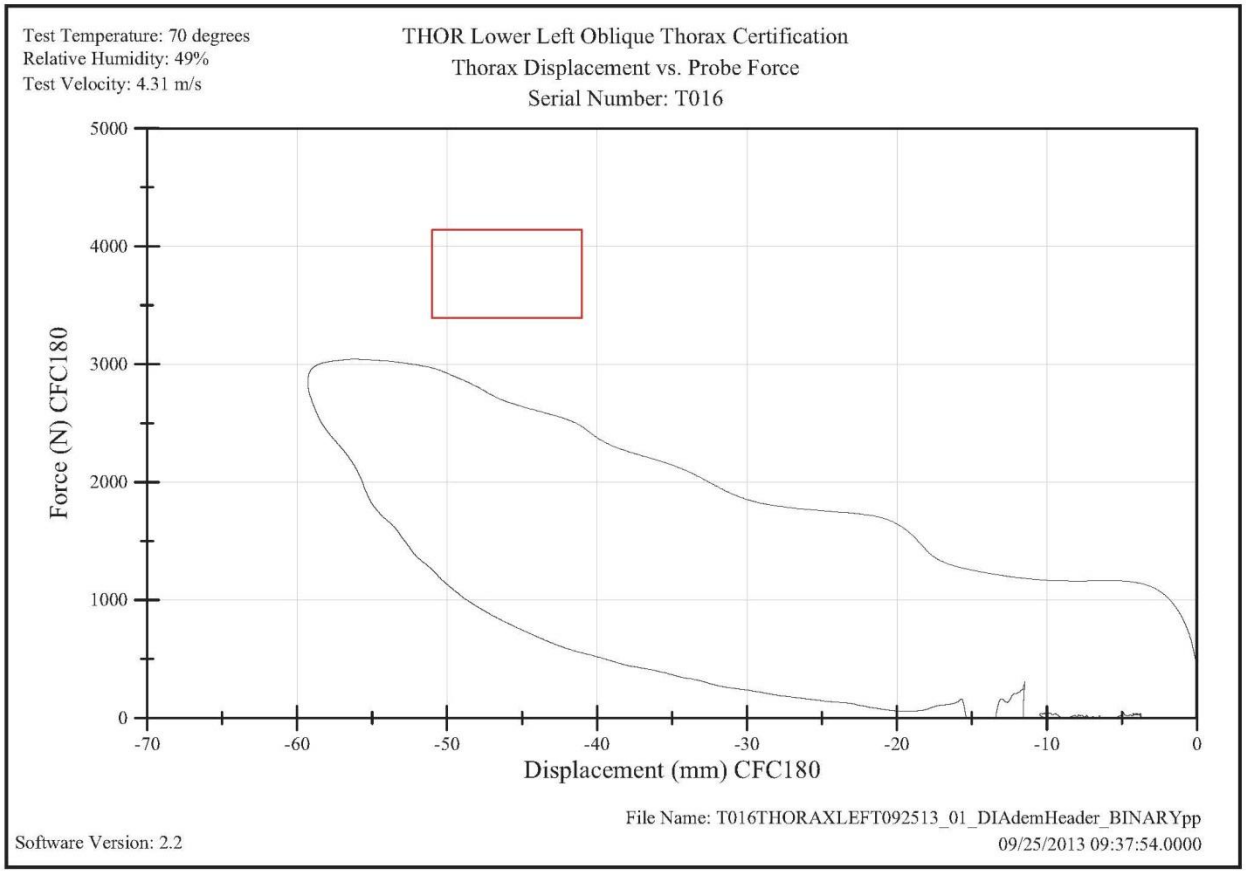

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.91 m/s
THOR Neck Left Lateral Flexion Certification
Probe Acceleration
Serial Number: T016
Probe Acceleration (G) CFC60
30
25
20
15
10
5
0
-5
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (sec)
File Name: T016NECKLEFT092413_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/24/2013 08:59:19.0000

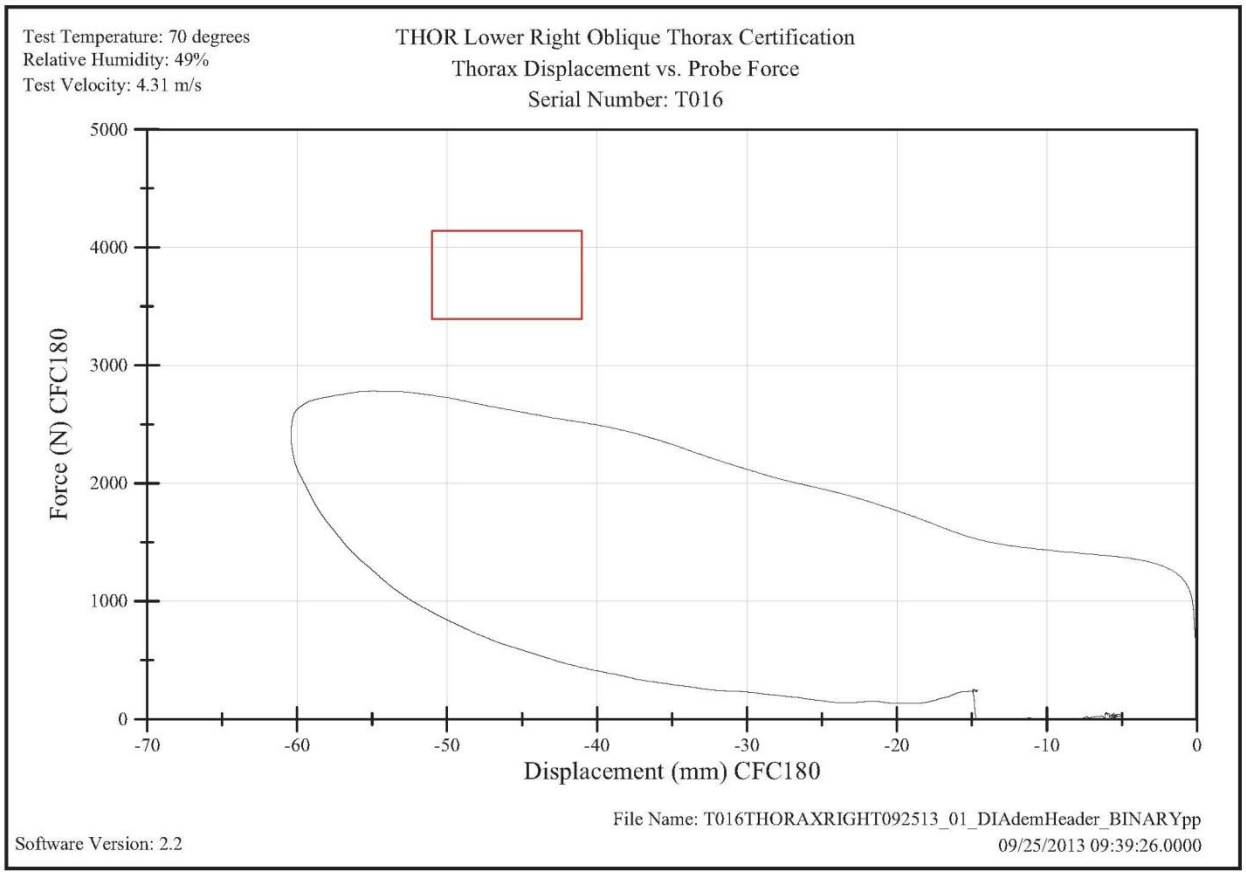

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.94 m/s
THOR Neck Right Lateral Flexion Certification
X-Moment
Serial Number: T016
X-Moment about the OC (Nm) CFC600
20
10
0
-10
-20
-30
-40
-50
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T016NECKRIGHT092413_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/24/2013 08:23:43.0000

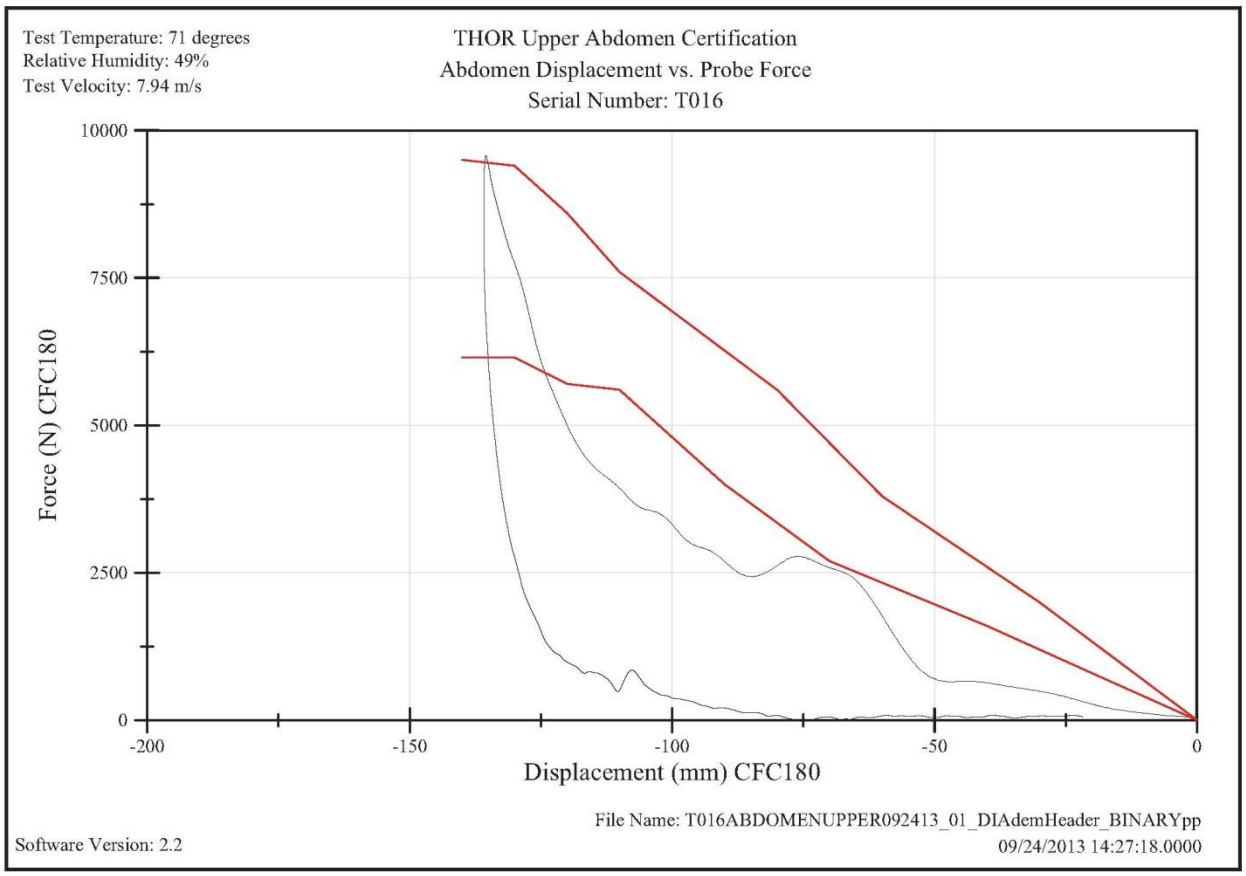

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 2.94 m/s
THOR Neck Right Lateral Flexion Certification
Probe Acceleration
Serial Number: T016
Probe Acceleration (G) CFC60
Time (sec)
File Name: T016NECKRIGHT092413_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/24/2013 08:23:43.0000

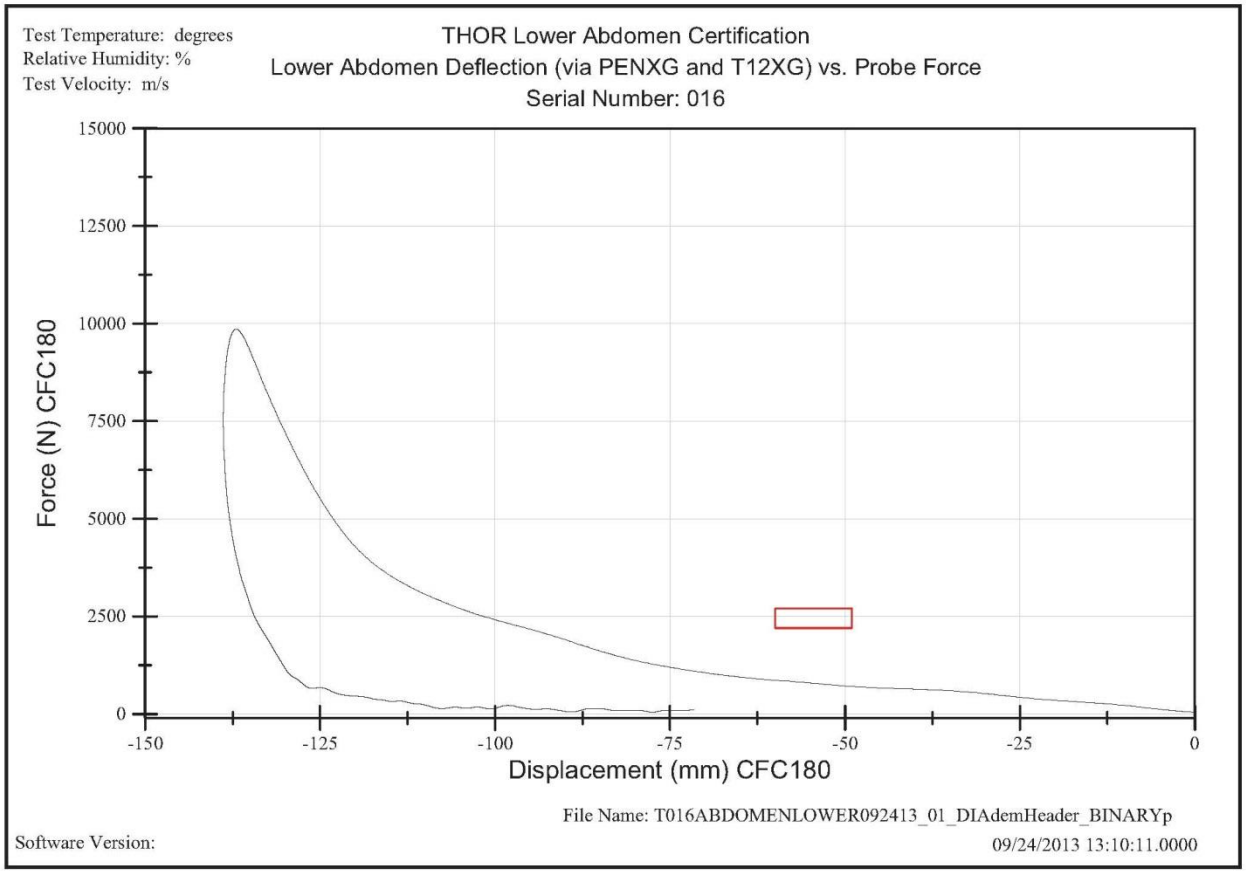

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 0 m/s
THOR Occipital Condyle Quasi-Static Certification
Displacement vs. Torque
Serial Number: T016
Y-Moment (Nm) CFC60
Displacement (deg) CFC60
File Name: T016 OC 091813_01
Software Version: 2.2
09/19/2013 14:51:47.0000

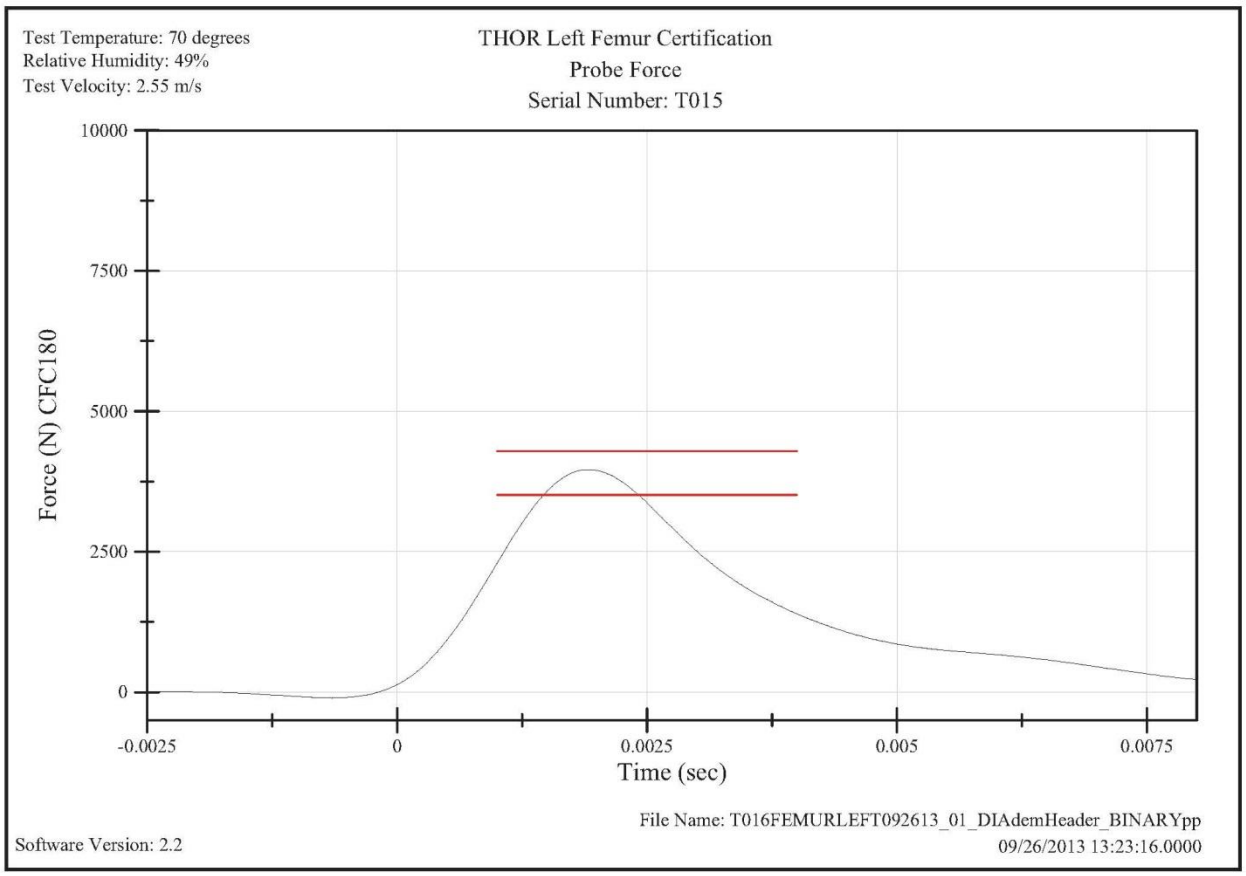

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 4.31 m/s
THOR Upper Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T016
Force (N) CFC180
5000
4000
3000
2000
1000
0
-70
-60
-50
-40
-30
-20
-10
0
Displacement (mm) CFC180
File Name: T016THORAXUPPER092513_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/25/2013 10:28:40.0000

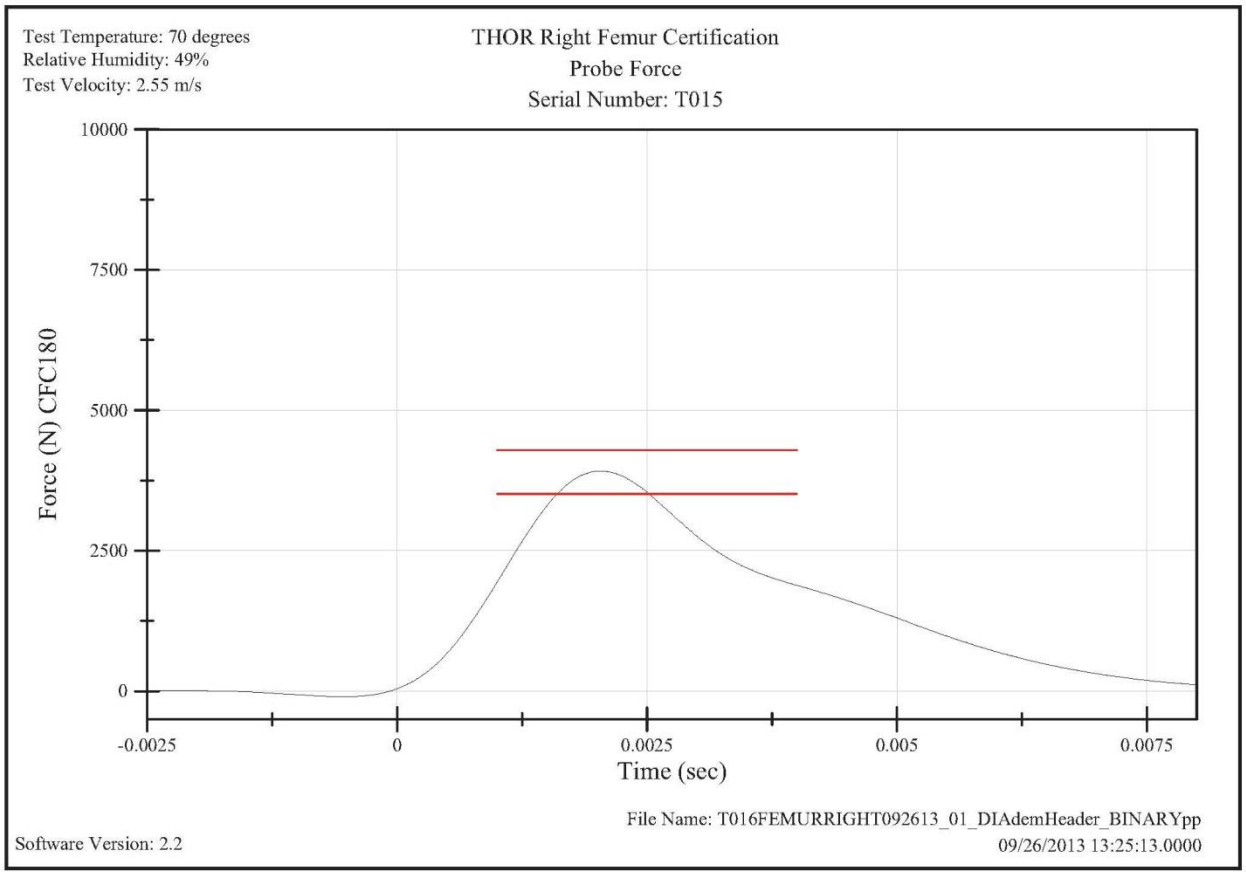

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 4.31 m/s
THOR Lower Left Oblique Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T016
Force (N) CFC180
5000
4000
3000
2000
1000
0
-70
-60
-50
-40
-30
-20
-10
0
Displacement (mm) CFC180
File Name: T016THORAXLEFT092513_01_DIAdemHeader_BINARYpp
Software Version: 2.2
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
Force (N) CFC180
5000
4000
3000
2000
1000
0
-70
-60
-50
-40
-30
-20
-10
0
Displacement (mm) CFC180
File Name: T016THORAXRIGHT092513_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/25/2013 09:39:26.0000

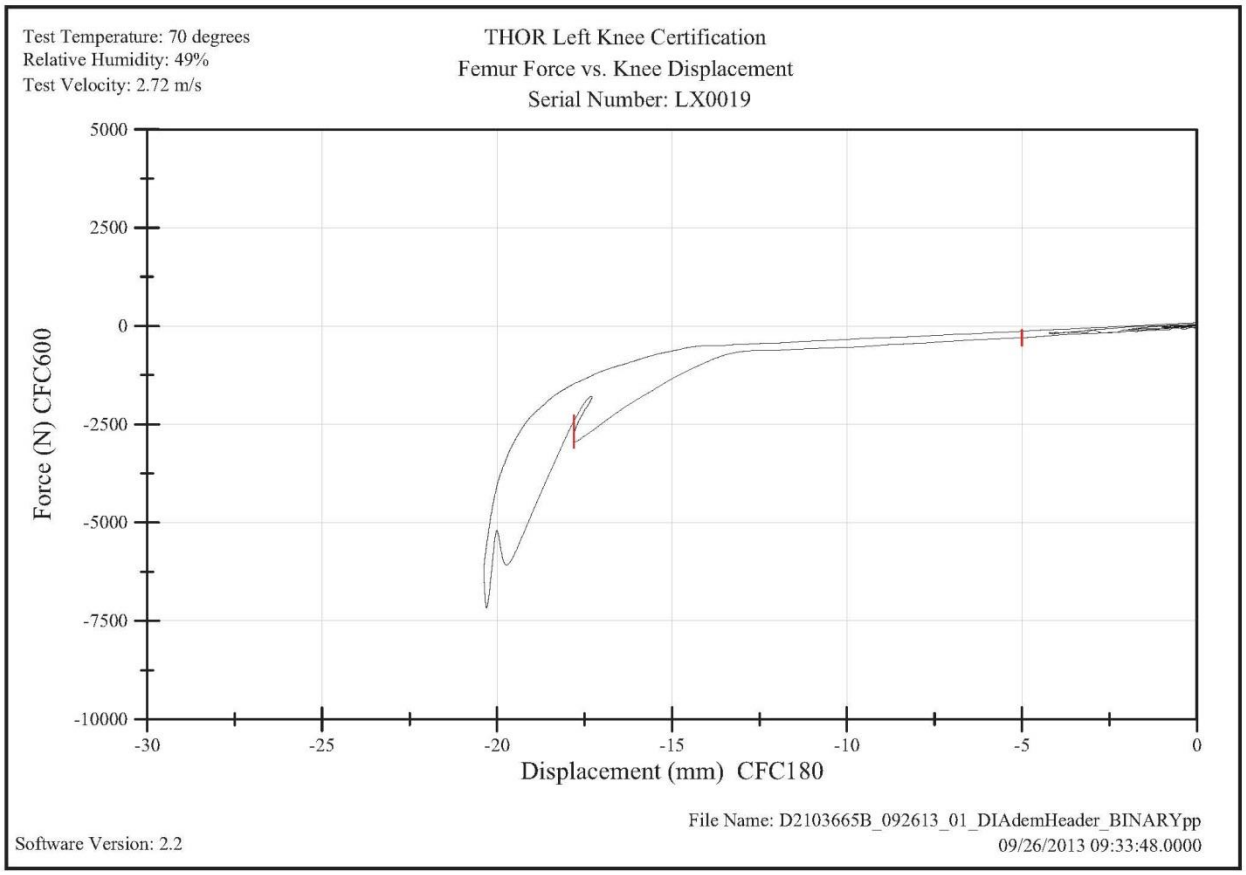

Test Temperature: 71 degrees
Relative Humidity: 49%
Test Velocity: 7.94 m/s
THOR Upper Abdomen Certification
Abdomen Displacement vs. Probe Force
Serial Number: T016
Force (N) CFC180
10000
7500
5000
2500
0
-200
-150
-100
-50
0
Displacement (mm) CFC180
File Name: T016ABDOMENUPPER092413_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/24/2013 14:27:18.0000

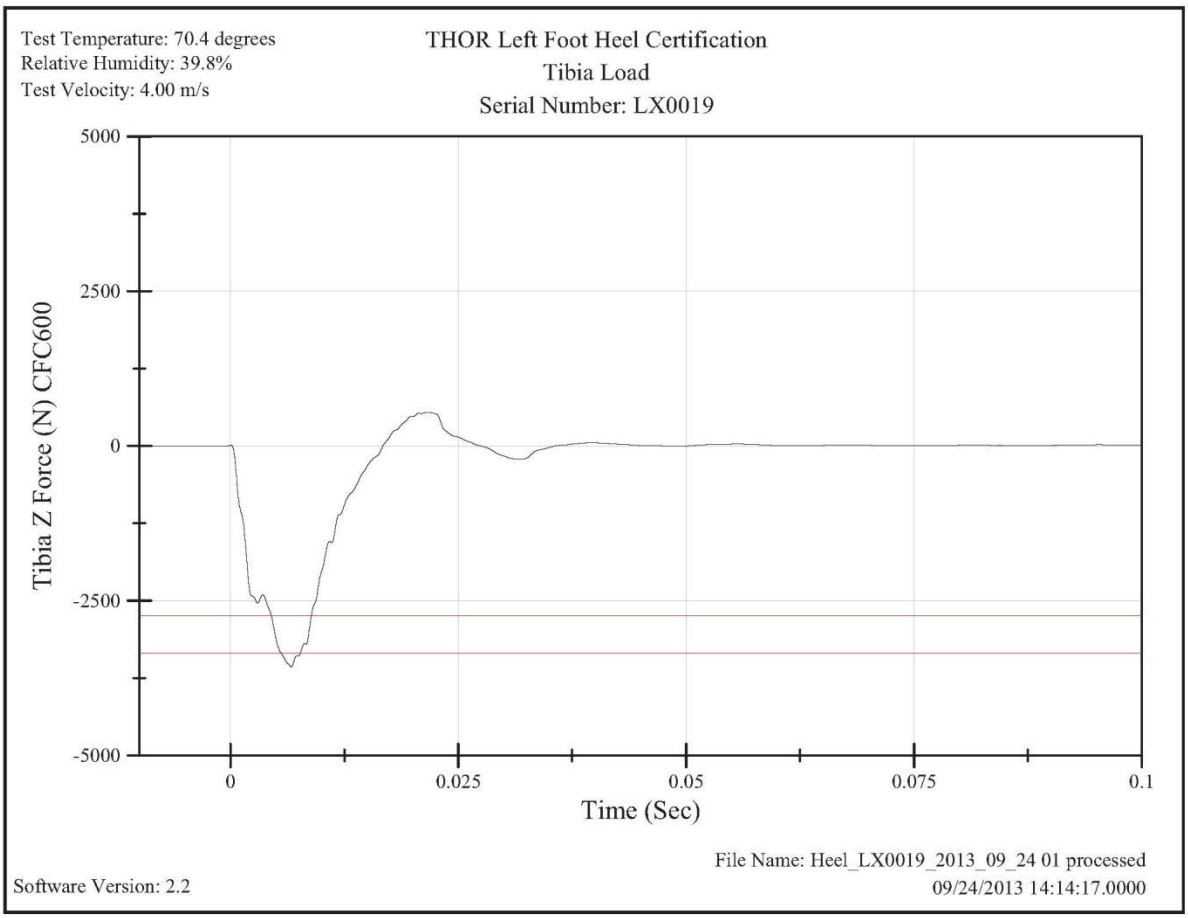

Test Temperature: degrees
Relative Humidity: %
Test Velocity: m/s
THOR Lower Abdomen Certification
Lower Abdomen Deflection (via PENXG and T12XG) vs. Probe Force
Serial Number: 016
Force (N) CFC180
15000
12500
10000
7500
5000
2500
0
-150
-125
-100
-75
-50
-25
0
Displacement (mm) CFC180
File Name: T016ABDOMENLOWER092413_01_DIAdemHeader_BINARYp
Software Version:
09/24/2013 13:10:11.0000

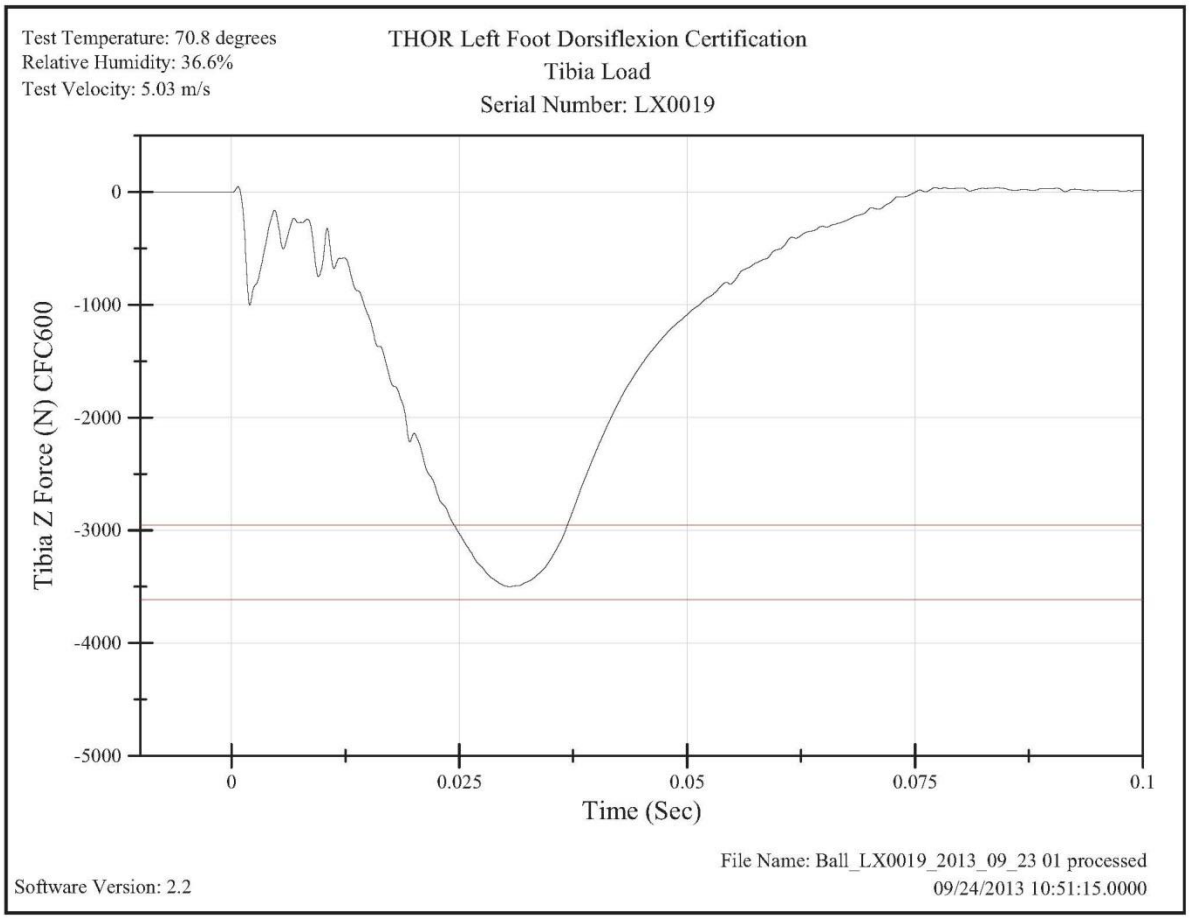

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.55 m/s
THOR Left Femur Certification
Probe Force
Serial Number: T015
Force (N) CFC180
10000
7500
5000
2500
0
-0.0025
0
0.0025
0.005
0.0075
Time (sec)
File Name: T016FEMURLEFT092613_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/26/2013 13:23:16.0000

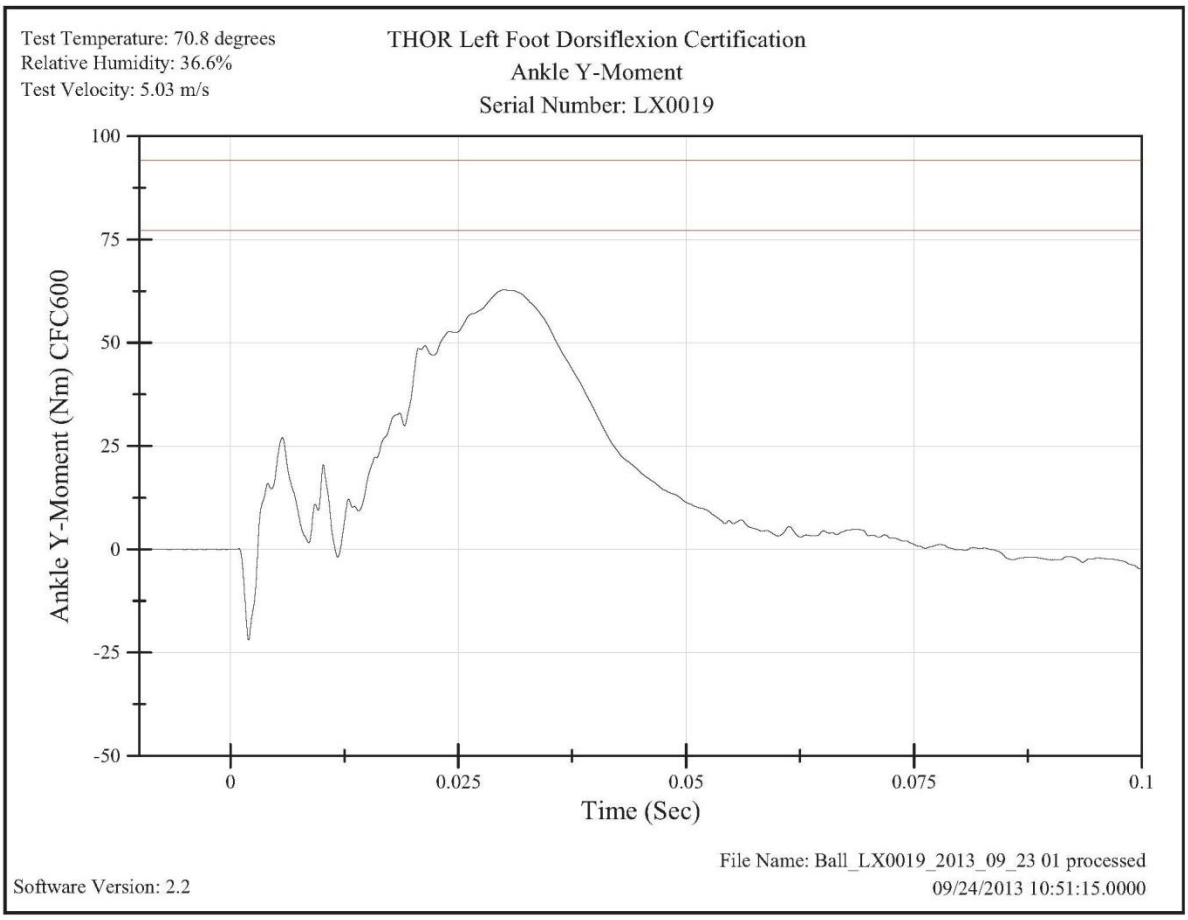

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.55 m/s
THOR Right Femur Certification
Probe Force
Serial Number: T015
Force (N) CFC180
10000
7500
5000
2500
0
-0.0025
0
0.0025
0.005
0.0075
Time (sec)
File Name: T016FEMURRIGHT092613_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/26/2013 13:25:13.0000

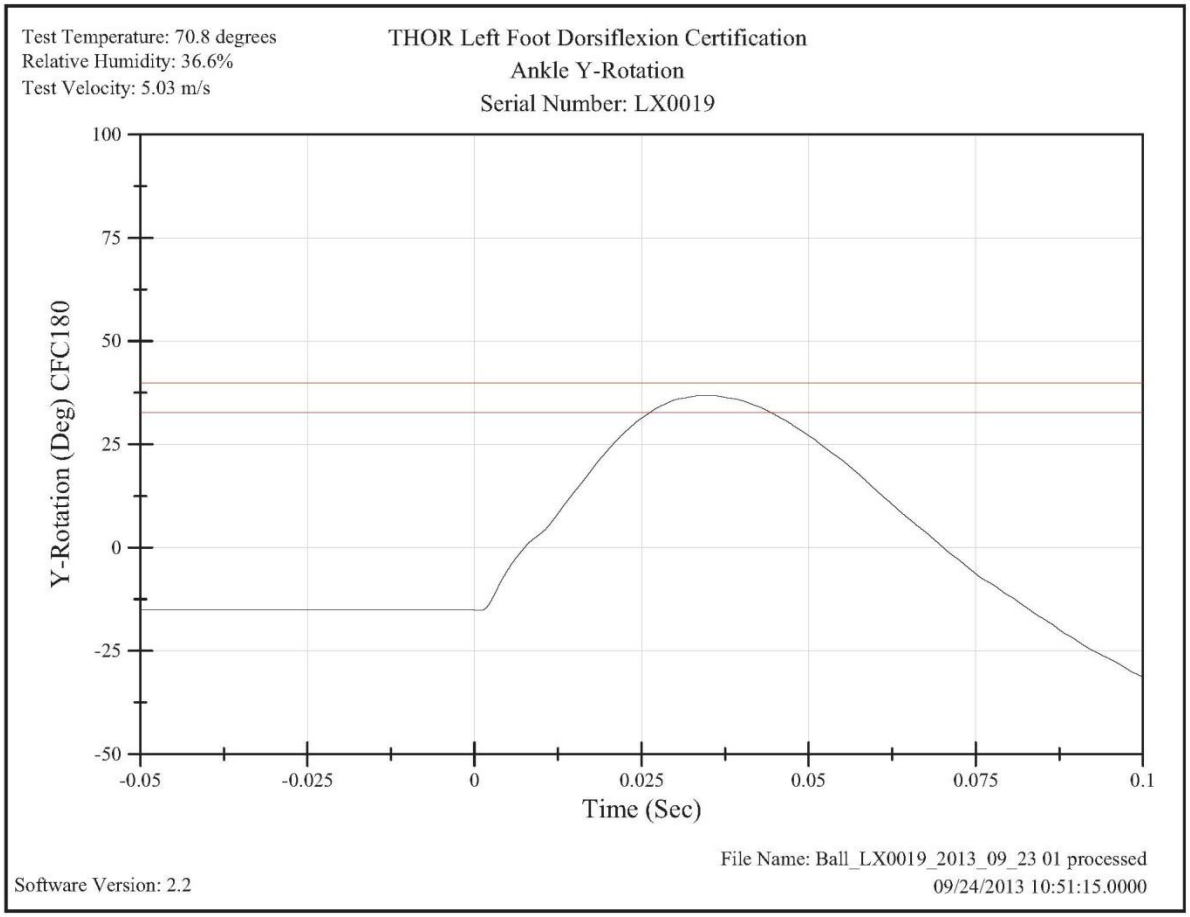
THOR 016 LEG CALIBRATIONS
LX0018/ LX0019

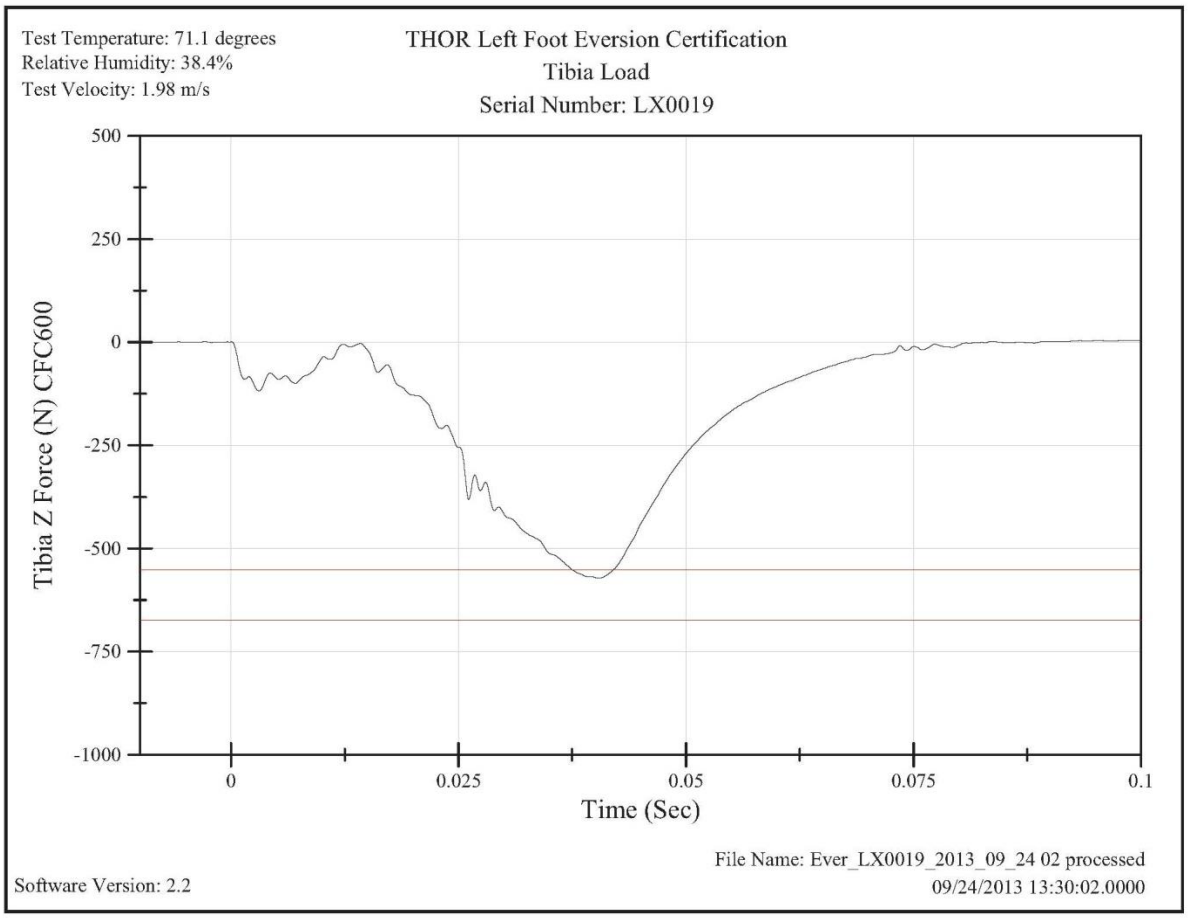

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.72 m/s
THOR Left Knee Certification
Femur Force vs. Knee Displacement
Serial Number: LX0019
Force (N) CFC600
5000
2500
0
-2500
-5000
-7500
-10000
-30
-25
-20
-15
-10
-5
0
Displacement (mm) CFC180
File Name: D2103665B_092613_01_DIAdemHeader_BINARYpp
09/26/2013 09:33:48.0000
Software Version: 2.2

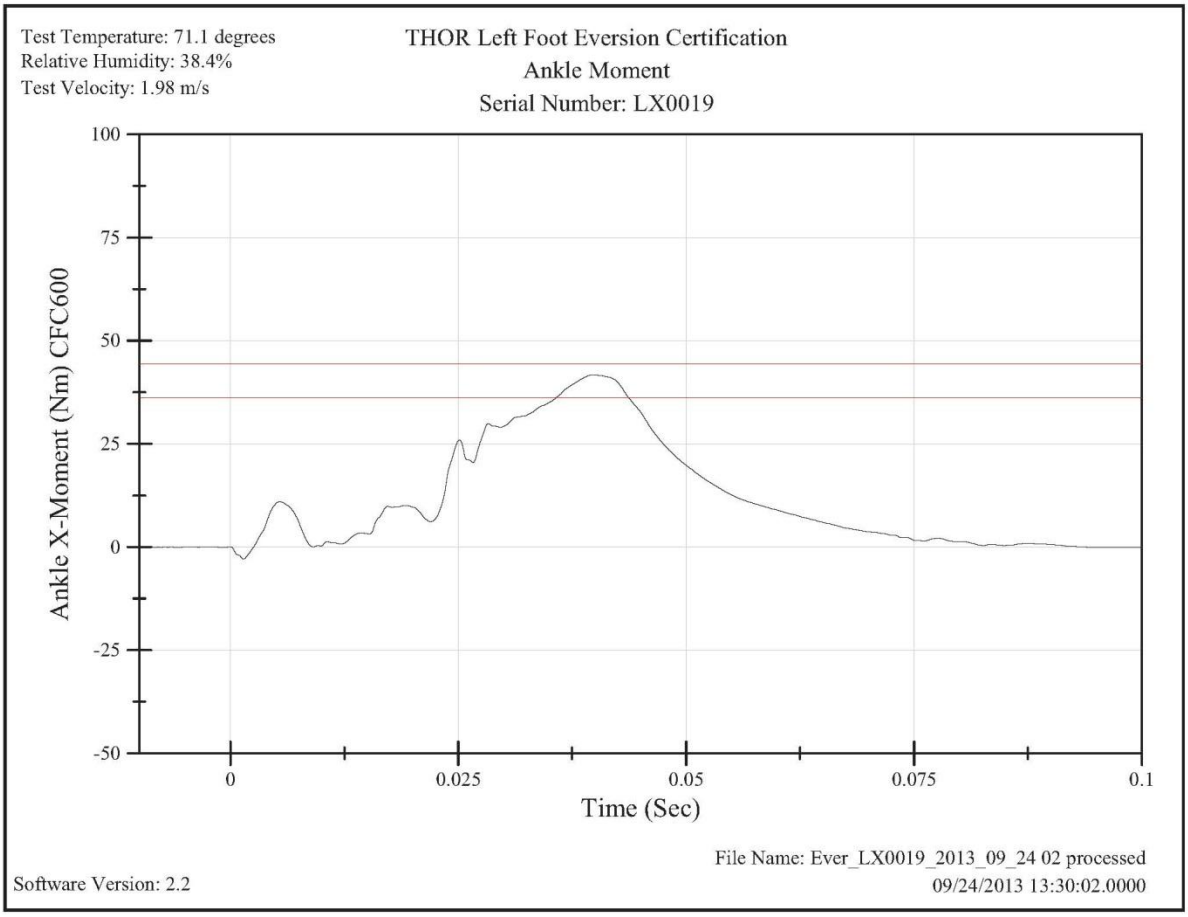

Test Temperature: 70.4 degrees
Relative Humidity: 39.8%
Test Velocity: 4.00 m/s
THOR Left Foot Heel Certification
Tibia Load
Serial Number: LX0019
Tibia Z Force (N) CFC600
5000
2500
0
-2500
-5000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Heel_LX0019_2013_09_24 01 processed
09/24/2013 14:14:17.0000
Software Version: 2.2

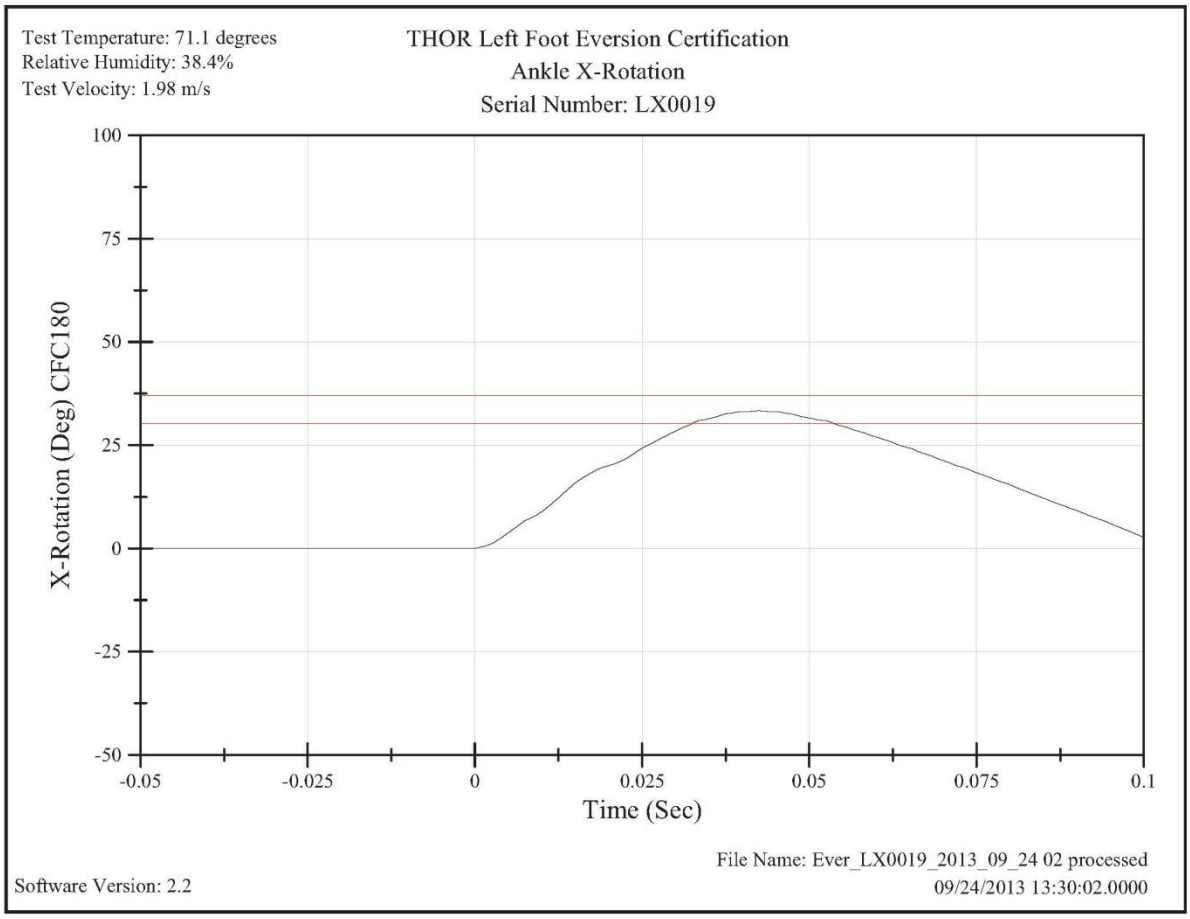

Test Temperature: 70.8 degrees
Relative Humidity: 36.6%
Test Velocity: 5.03 m/s
THOR Left Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0019
Tibia Z Force (N) CFC600
0
-1000
-2000
-3000
-4000
-5000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0019_2013_09_23 01 processed
Software Version: 2.2
09/24/2013 10:51:15.0000

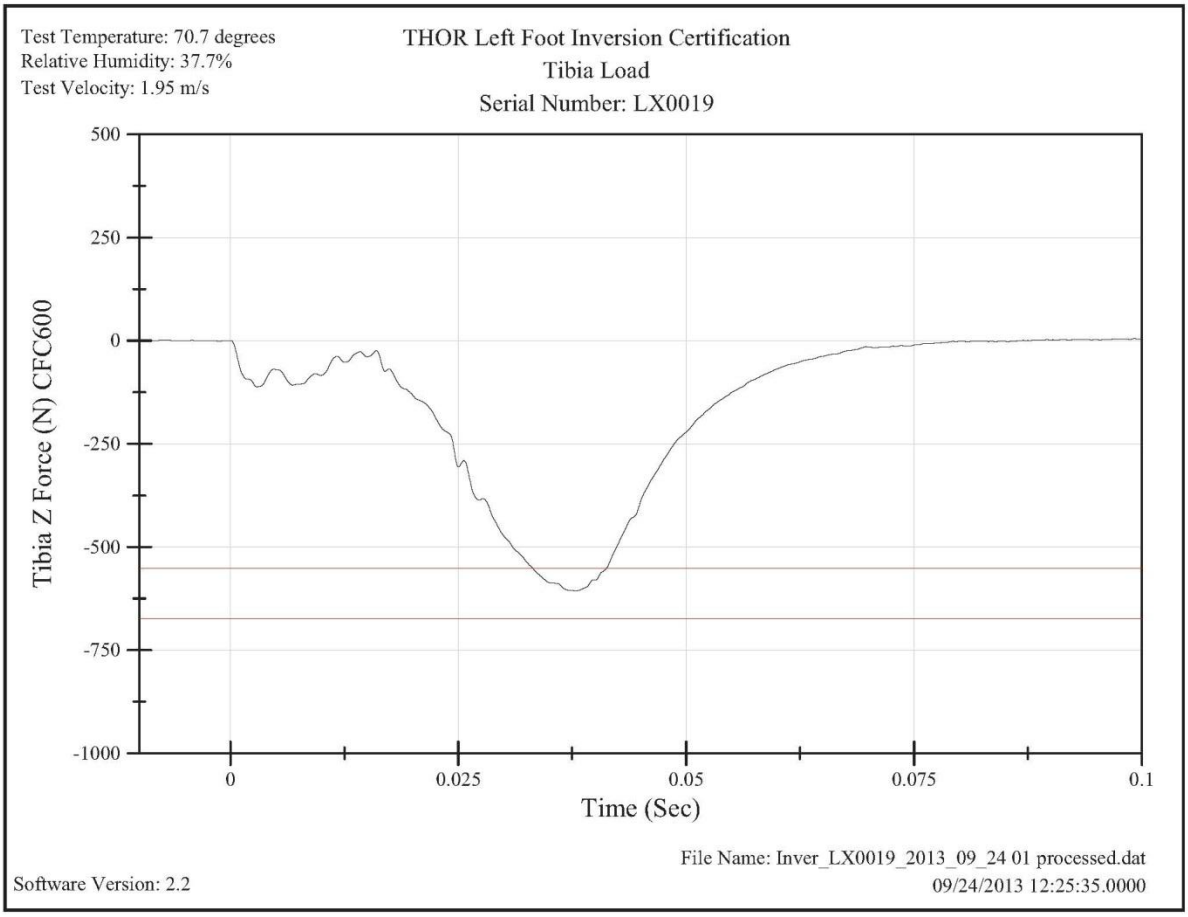

Test Temperature: 70.8 degrees
Relative Humidity: 36.6%
Test Velocity: 5.03 m/s
THOR Left Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0019
Ankle Y-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0019_2013_09_23 01 processed
Software Version: 2.2
09/24/2013 10:51:15.0000

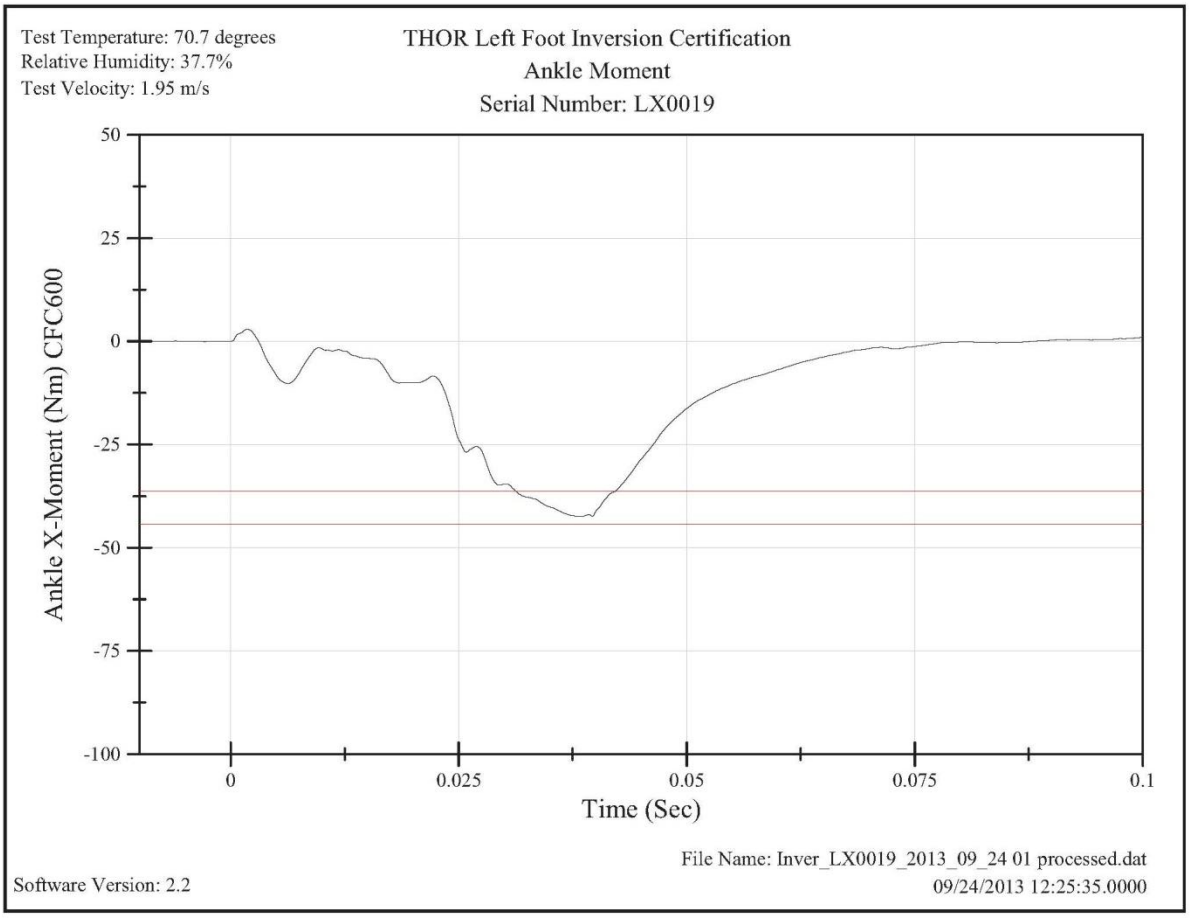

Test Temperature: 70.8 degrees
Relative Humidity: 36.6%
Test Velocity: 5.03 m/s
THOR Left Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0019
Y-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0019_2013_09_23 01 processed
09/24/2013 10:51:15.0000
Software Version: 2.2

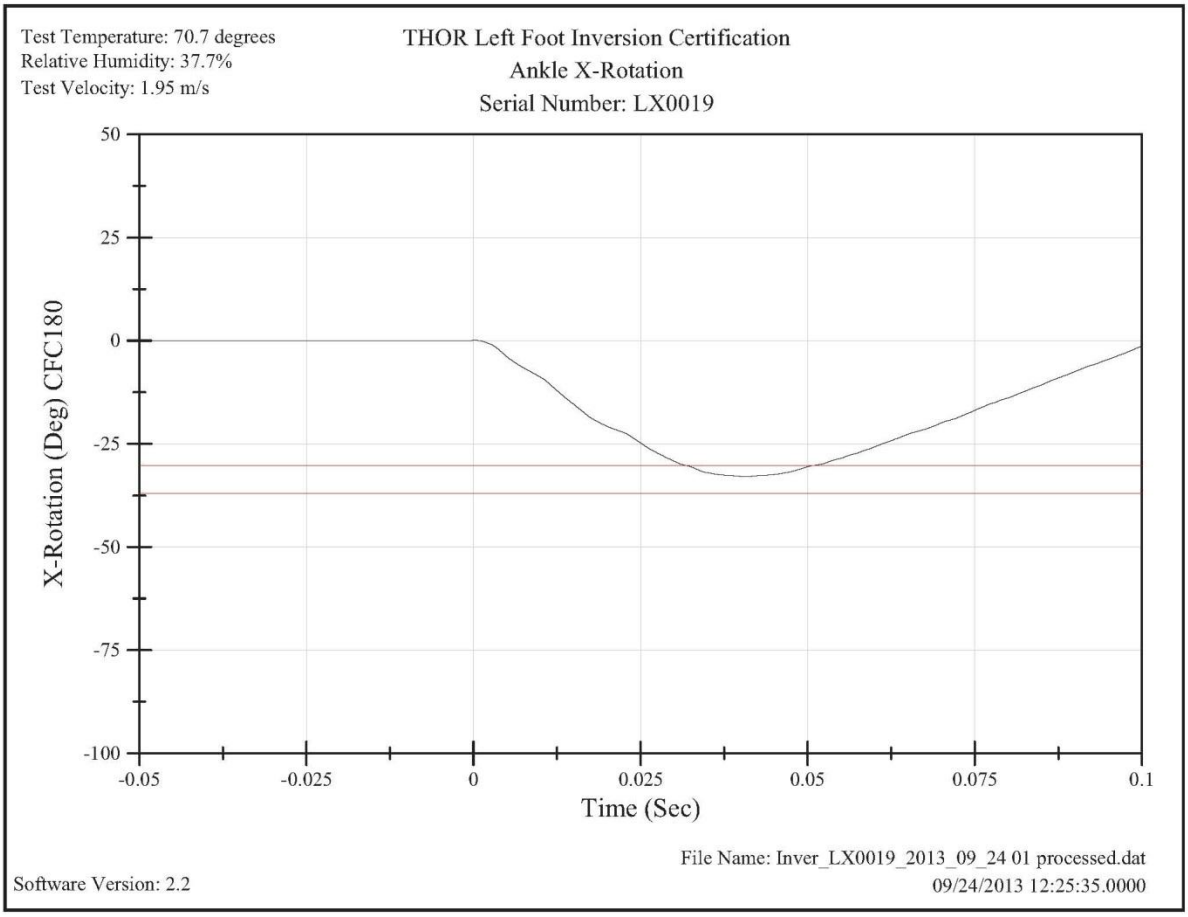

Test Temperature: 71.1 degrees
Relative Humidity: 38.4%
Test Velocity: 1.98 m/s
THOR Left Foot Eversion Certification
Tibia Load
Serial Number: LX0019
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0019_2013_09_24 02 processed
09/24/2013 13:30:02.0000
Software Version: 2.2

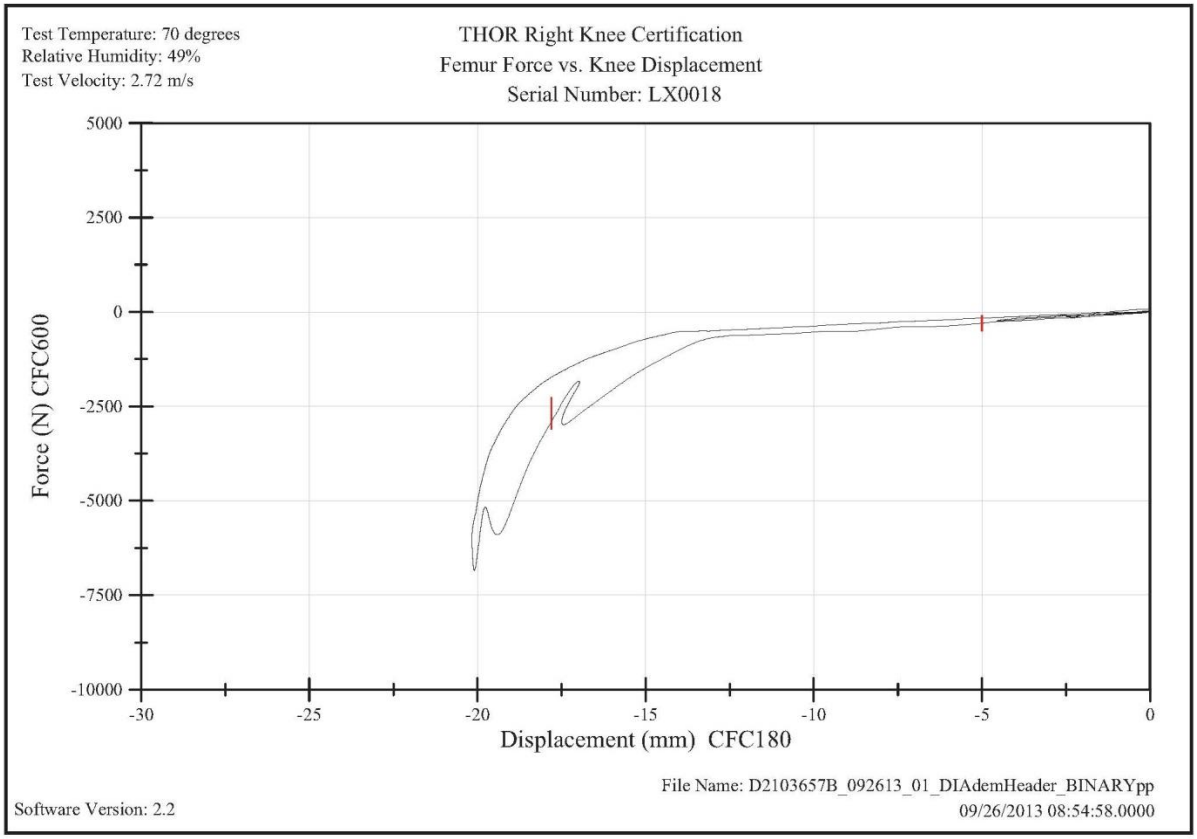

Test Temperature: 71.1 degrees
Relative Humidity: 38.4%
Test Velocity: 1.98 m/s
THOR Left Foot Eversion Certification
Ankle Moment
Serial Number: LX0019
Ankle X-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0019_2013_09_24 02 processed
Software Version: 2.2
09/24/2013 13:30:02.0000

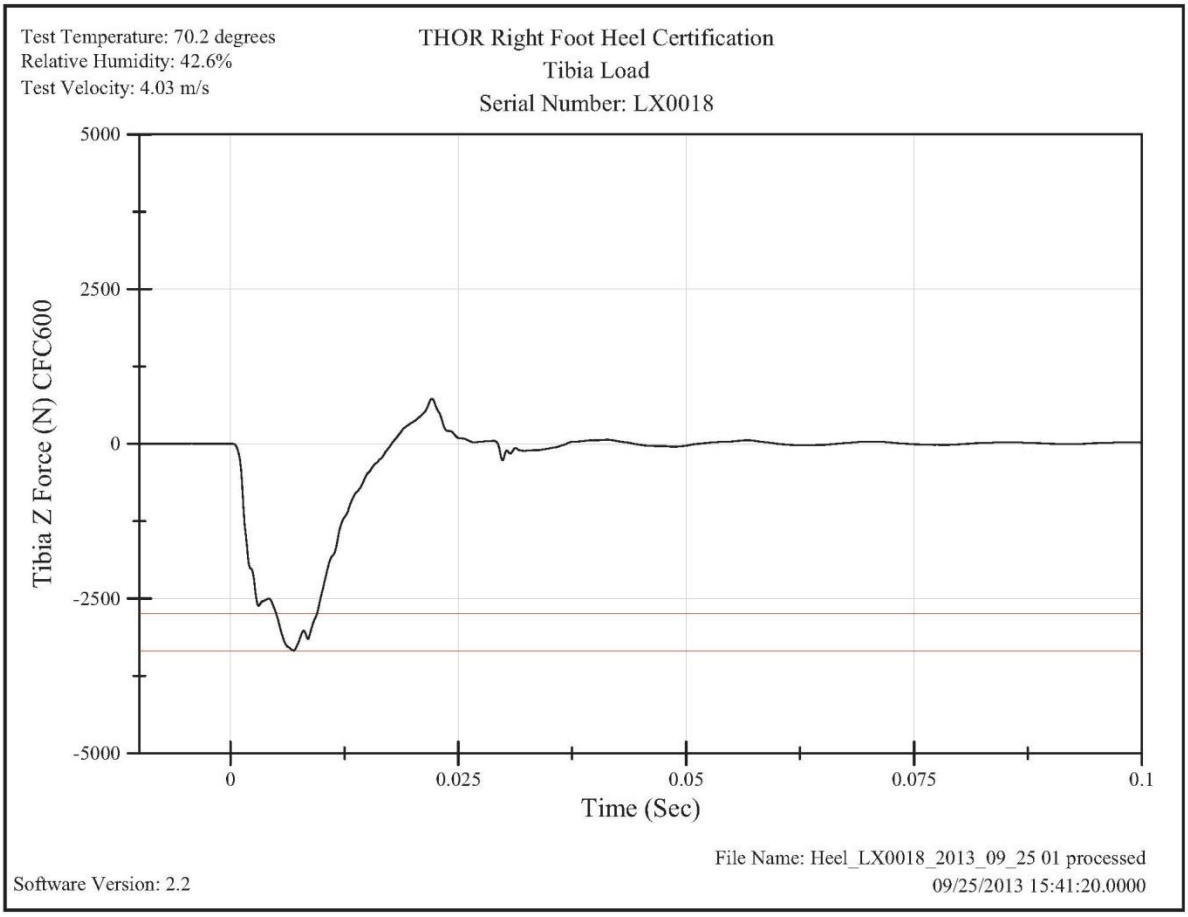

Test Temperature: 71.1 degrees
Relative Humidity: 38.4%
Test Velocity: 1.98 m/s
THOR Left Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0019
X-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0019_2013_09_24 02 processed
Software Version: 2.2
09/24/2013 13:30:02.0000

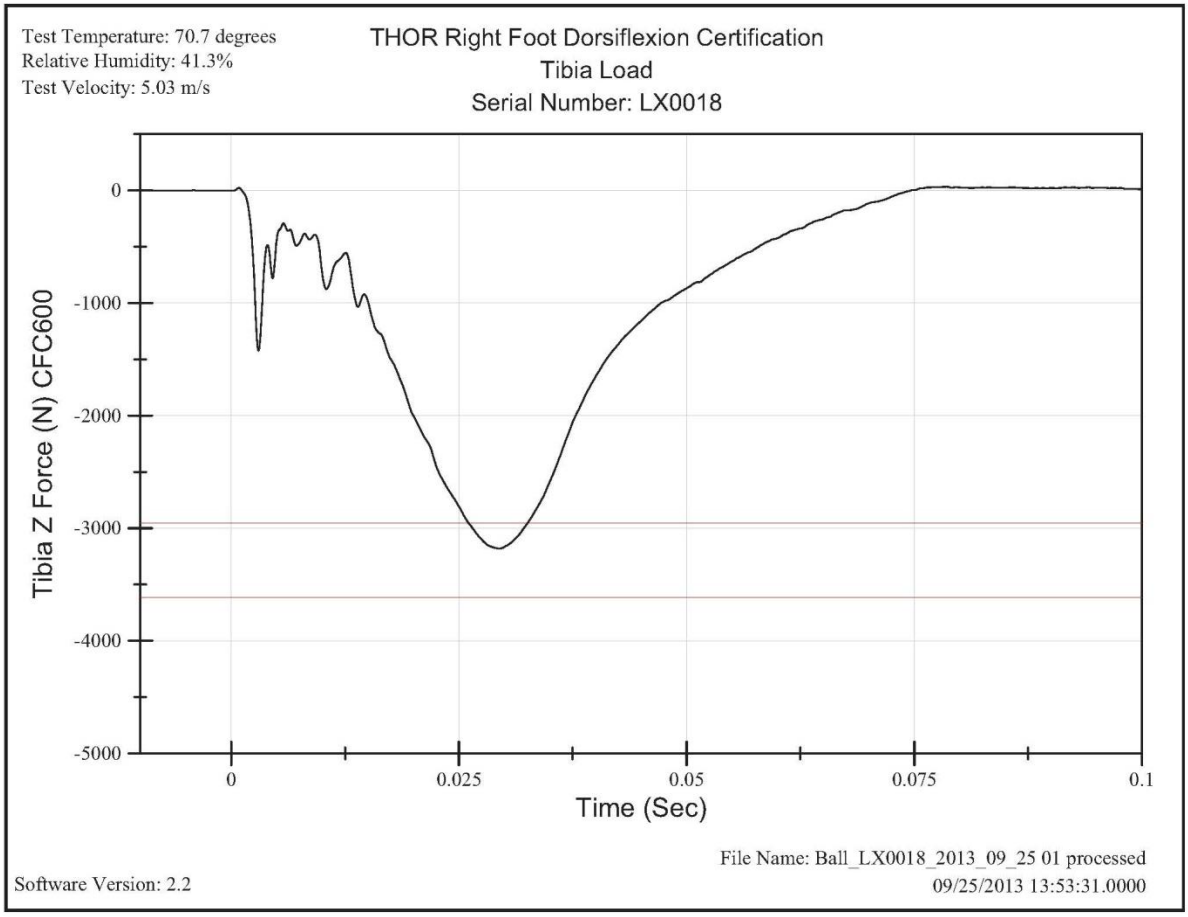

Test Temperature: 70.7 degrees
Relative Humidity: 37.7%
Test Velocity: 1.95 m/s
THOR Left Foot Inversion Certification
Tibia Load
Serial Number: LX0019
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0019_2013_09_24 01 processed.dat
Software Version: 2.2
09/24/2013 12:25:35.0000

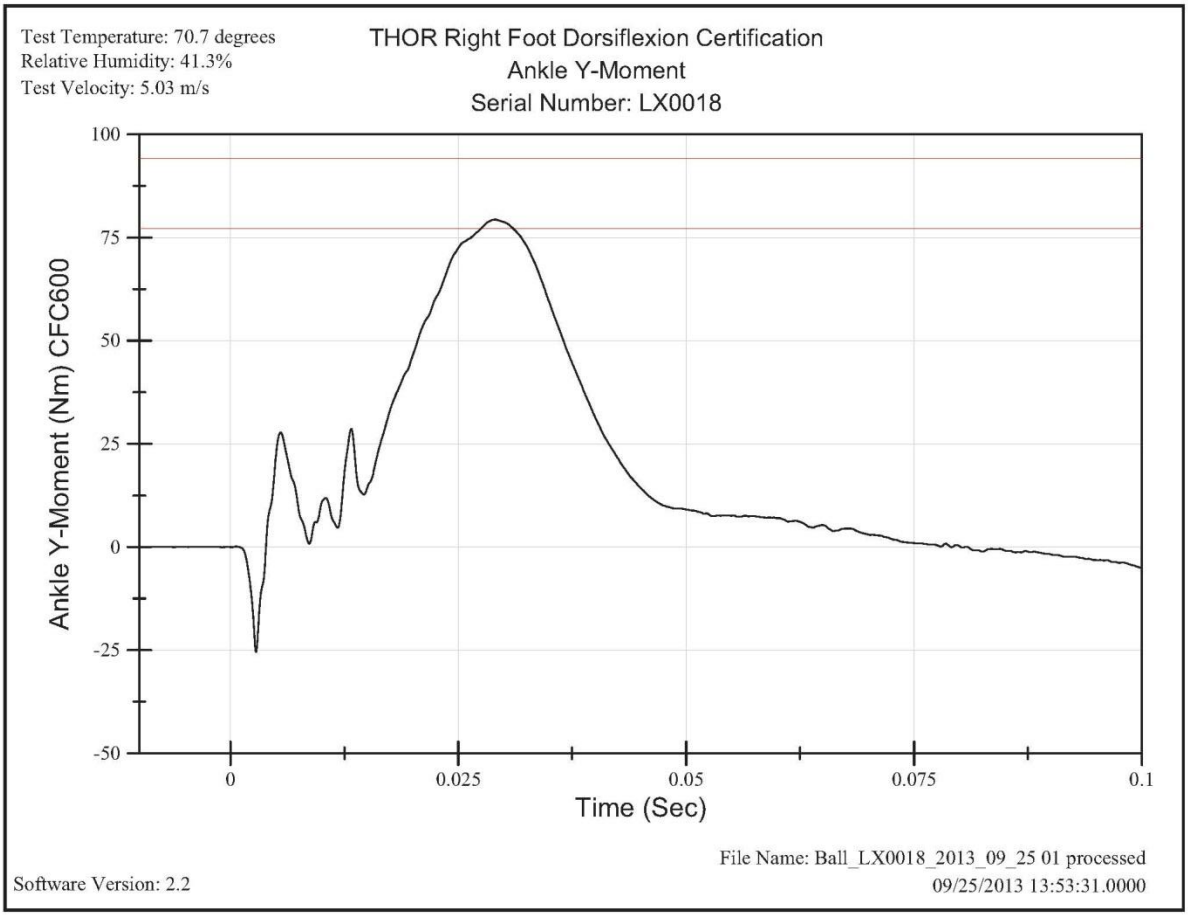

Test Temperature: 70.7 degrees
Relative Humidity: 37.7%
Test Velocity: 1.95 m/s
THOR Left Foot Inversion Certification
Ankle Moment
Serial Number: LX0019
Ankle X-Moment (Nm) CFC600
50
25
0
-25
-50
-75
-100
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0019_2013_09_24 01 processed.dat
Software Version: 2.2
09/24/2013 12:25:35.0000

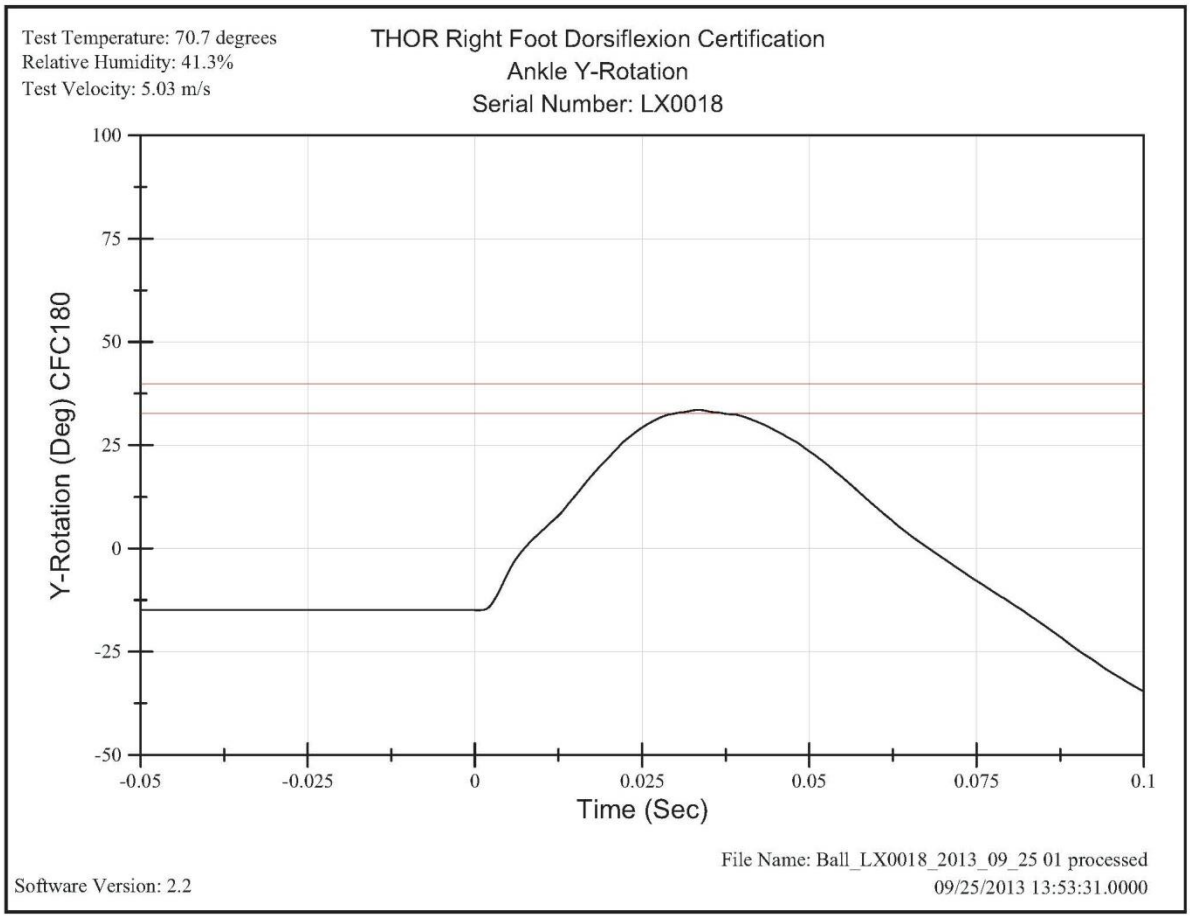

Test Temperature: 70.7 degrees
Relative Humidity: 37.7%
Test Velocity: 1.95 m/s
THOR Left Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0019
X-Rotation (Deg) CFC180
50
25
0
-25
-50
-75
-100
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0019_2013_09_24 01 processed.dat
Software Version: 2.2
09/24/2013 12:25:35.0000

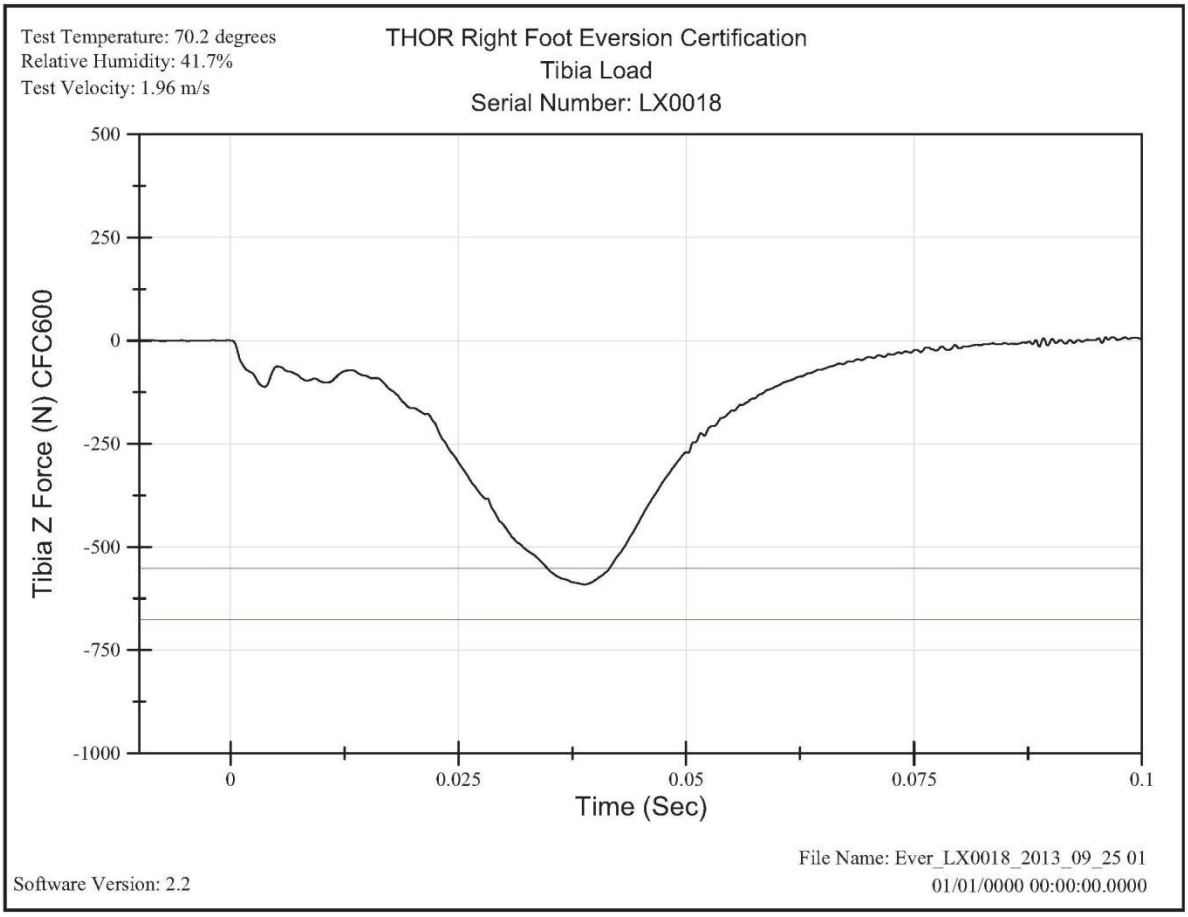

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 2.72 m/s
THOR Right Knee Certification
Femur Force vs. Knee Displacement
Serial Number: LX0018
Force (N) CFC600
5000
2500
0
-2500
-5000
-7500
-10000
-30
-25
-20
-15
-10
-5
0
Displacement (mm) CFC180
File Name: D2103657B_092613_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/26/2013 08:54:58.0000

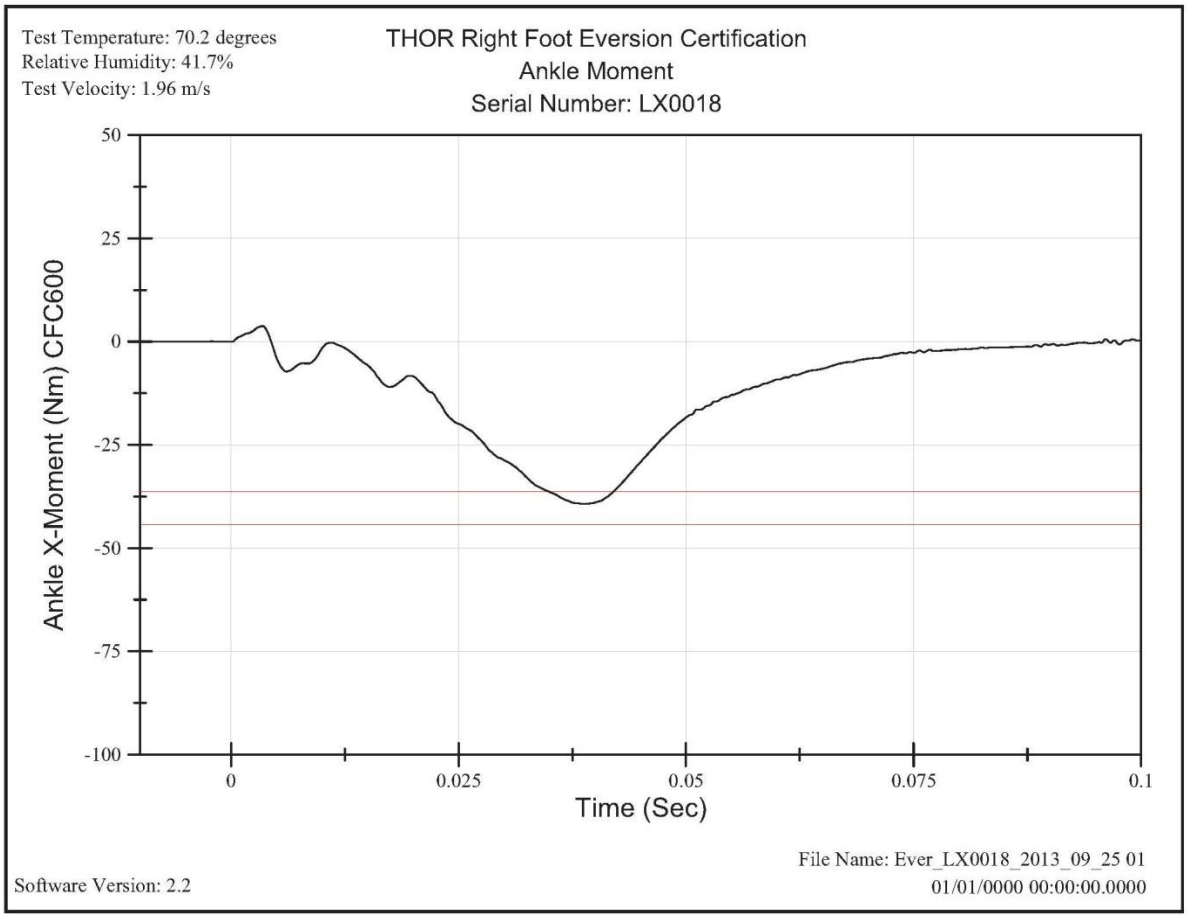

Test Temperature: 70.2 degrees
Relative Humidity: 42.6%
Test Velocity: 4.03 m/s
THOR Right Foot Heel Certification
Tibia Load
Serial Number: LX0018
Tibia Z Force (N) CFC600
5000
2500
0
-2500
-5000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Heel_LX0018_2013_09_25 01 processed
Software Version: 2.2
09/25/2013 15:41:20.0000

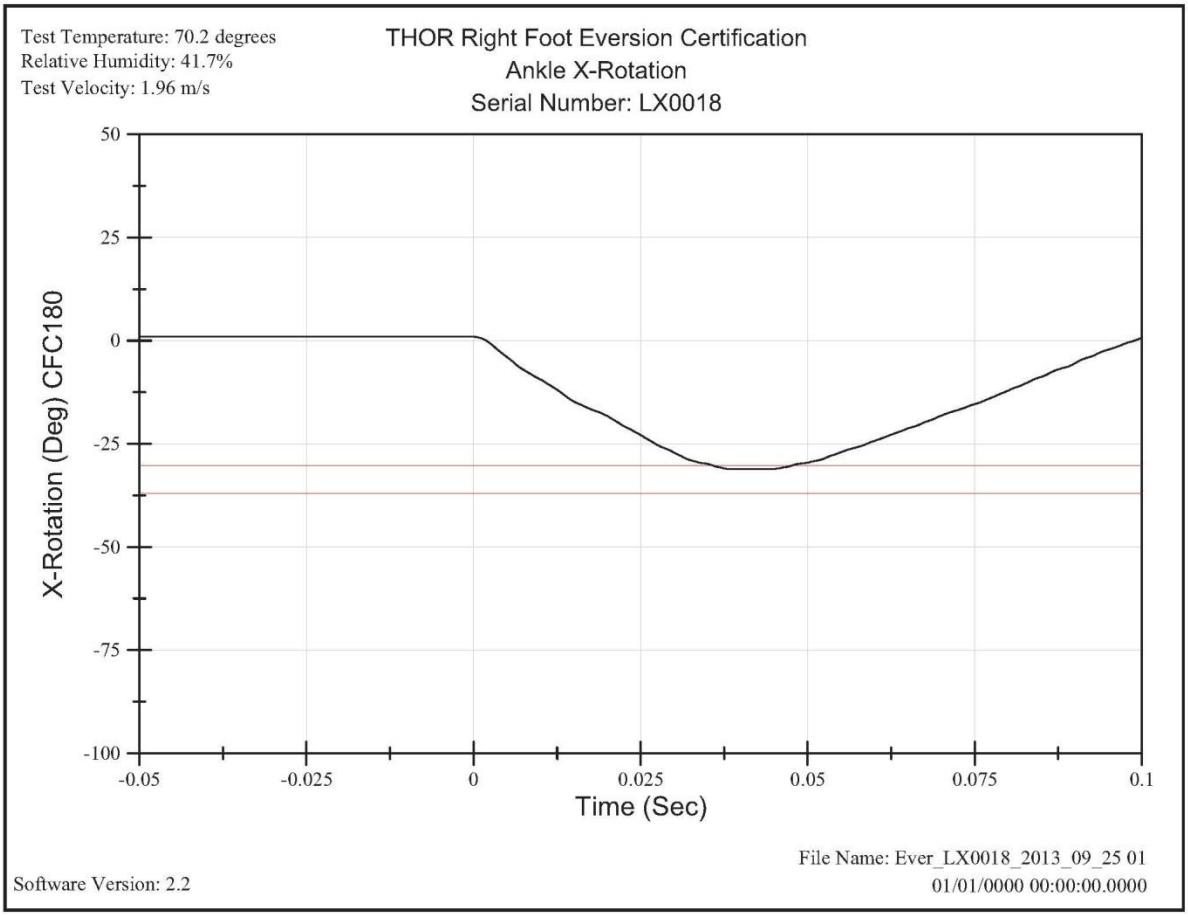

Test Temperature: 70.7 degrees
Relative Humidity: 41.3%
Test Velocity: 5.03 m/s
THOR Right Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0018
Tibia Z Force (N) CFC600
0
-1000
-2000
-3000
-4000
-5000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0018_2013_09_25 01 processed
Software Version: 2.2
09/25/2013 13:53:31.0000

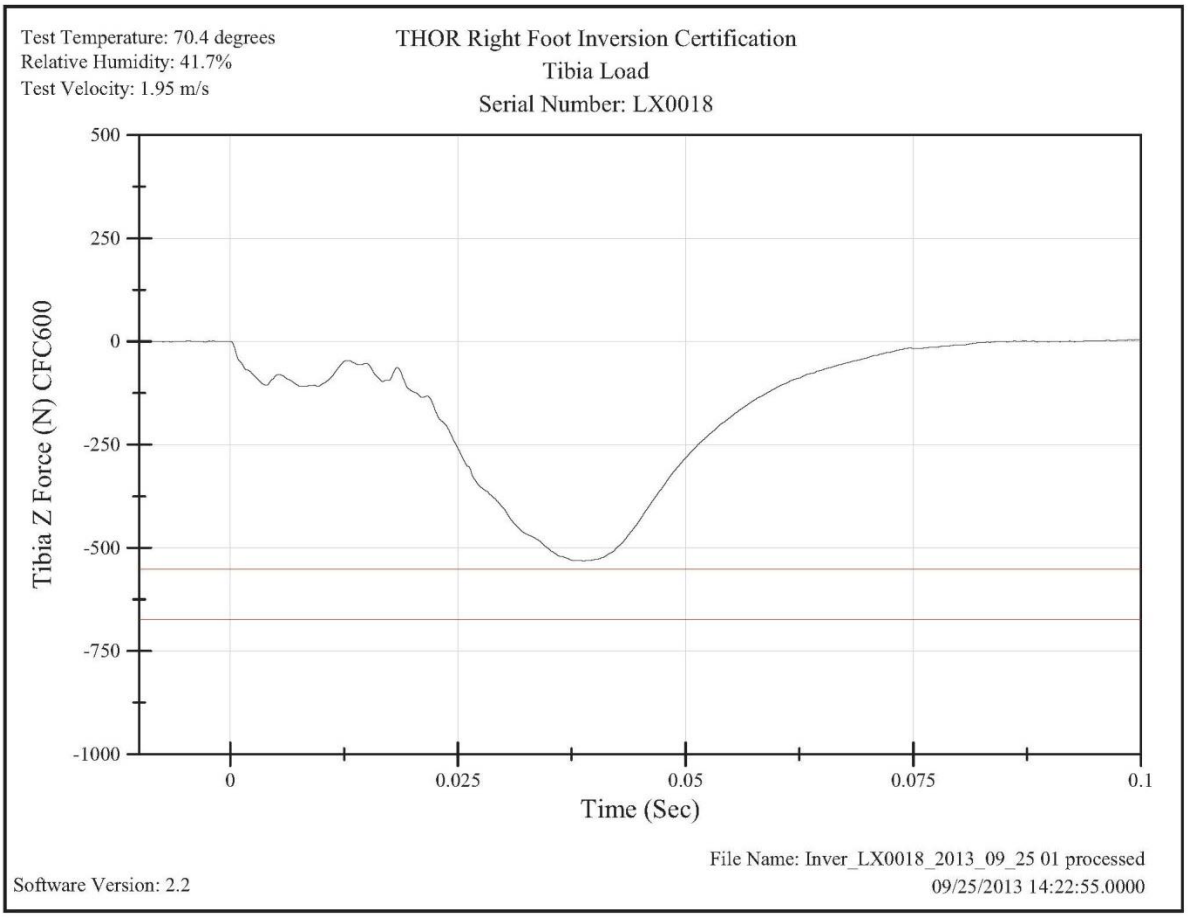

Test Temperature: 70.7 degrees
Relative Humidity: 41.3%
Test Velocity: 5.03 m/s
THOR Right Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0018
Ankle Y-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0018_2013_09_25 01 processed
Software Version: 2.2
09/25/2013 13:53:31.0000

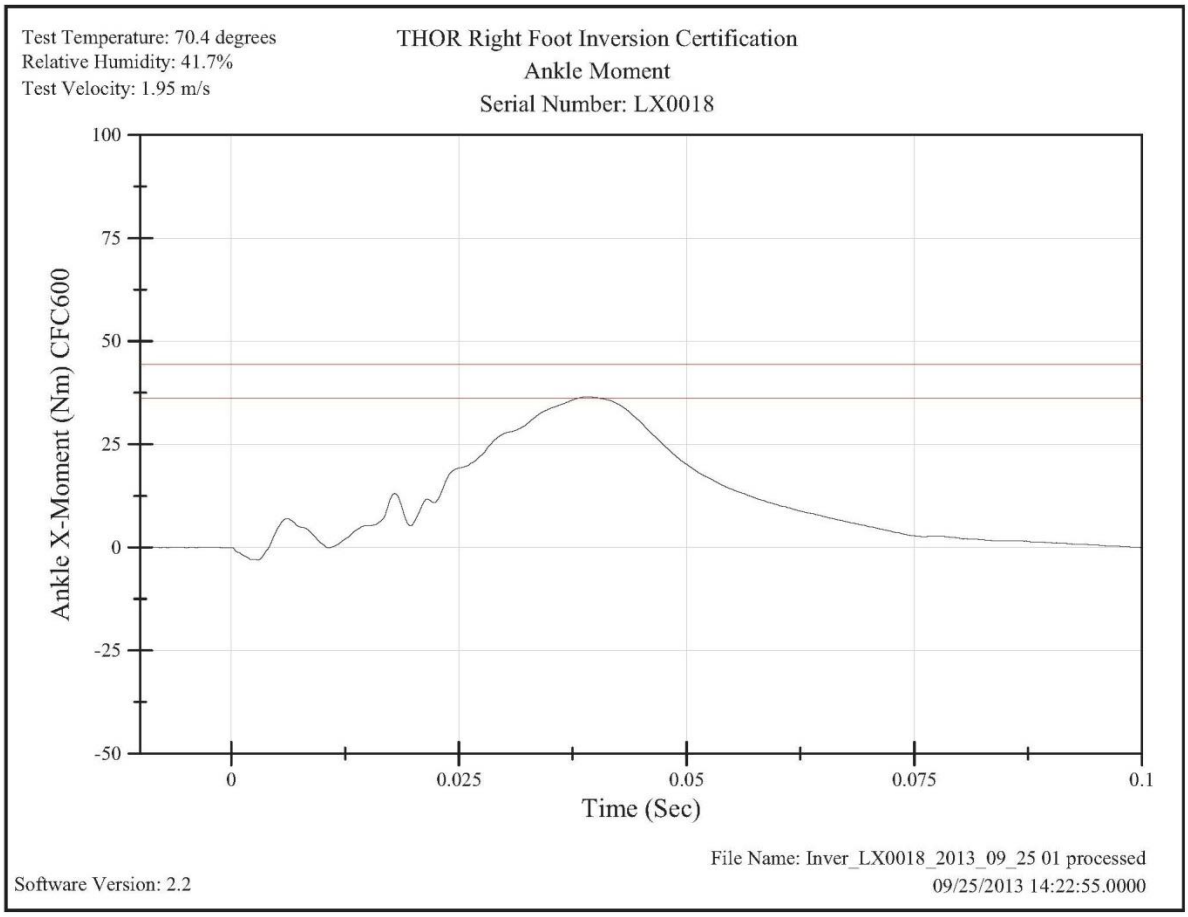

Test Temperature: 70.7 degrees
Relative Humidity: 41.3%
Test Velocity: 5.03 m/s
THOR Right Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0018
Y-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0018_2013_09_25 01 processed
Software Version: 2.2
09/25/2013 13:53:31.0000

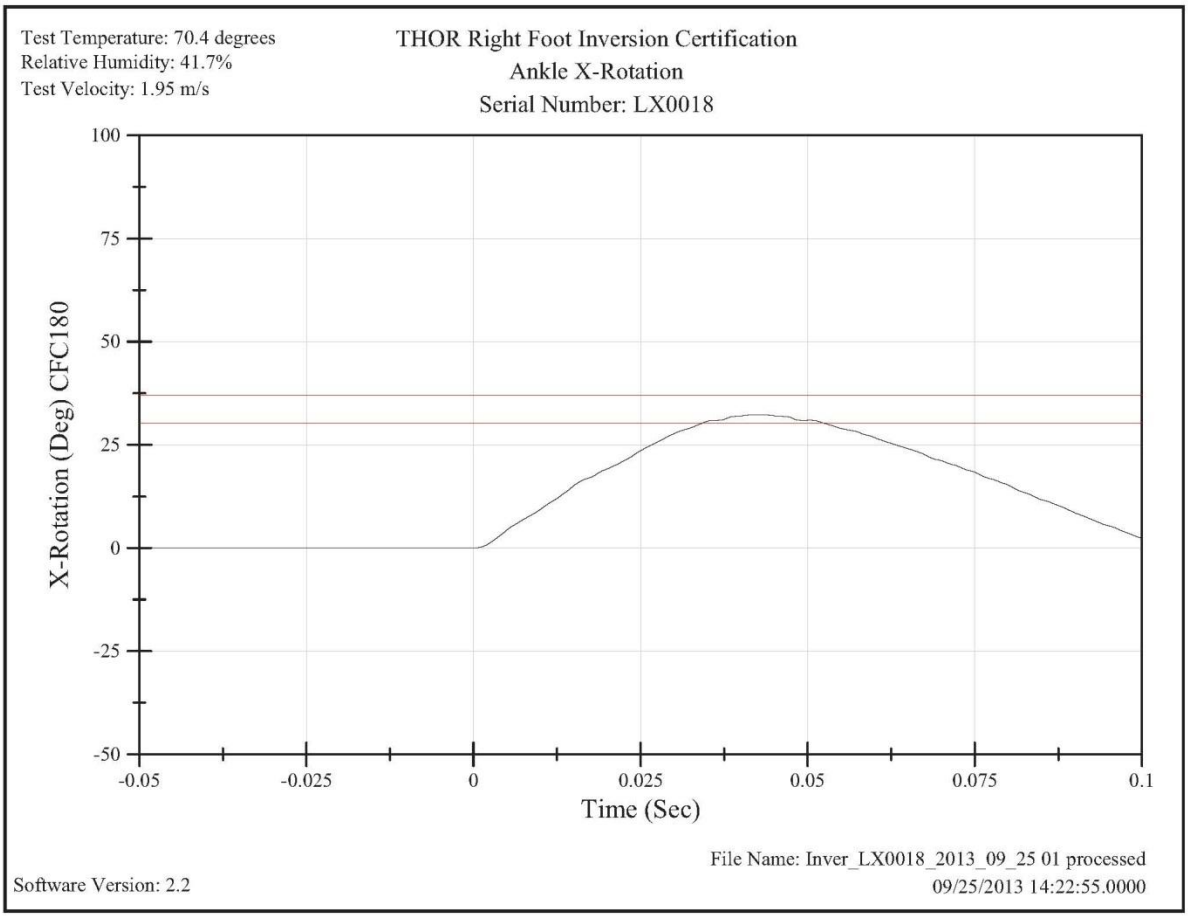

Test Temperature: 70.2 degrees
Relative Humidity: 41.7%
Test Velocity: 1.96 m/s
THOR Right Foot Eversion Certification
Tibia Load
Serial Number: LX0018
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0018_2013_09_25 01
01/01/0000 00:00:00.0000
Software Version: 2.2


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
Ankle X-Moment (Nm) CFC600
50
25
0
-25
-50
-75
-100
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0018_2013_09_25 01
01/01/0000 00:00:00.0000
Software Version: 2.2


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
X-Rotation (Deg) CFC180
50
25
0
-25
-50
-75
-100
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0018_2013_09_25 01
01/01/0000 00:00:00.0000
Software Version: 2.2


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
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0018_2013_09_25 01 processed
09/25/2013 14:22:55.0000
Software Version: 2.2


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
Ankle X-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0018_2013_09_25 01 processed
Software Version: 2.2
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
X-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0018_2013_09_25 01 processed
Software Version: 2.2
09/25/2013 14:22:55.0000

50% ADULT MALE THOR015 DUMMY CALIBRATIONS

Summary of Thor 15 Certification Test Results

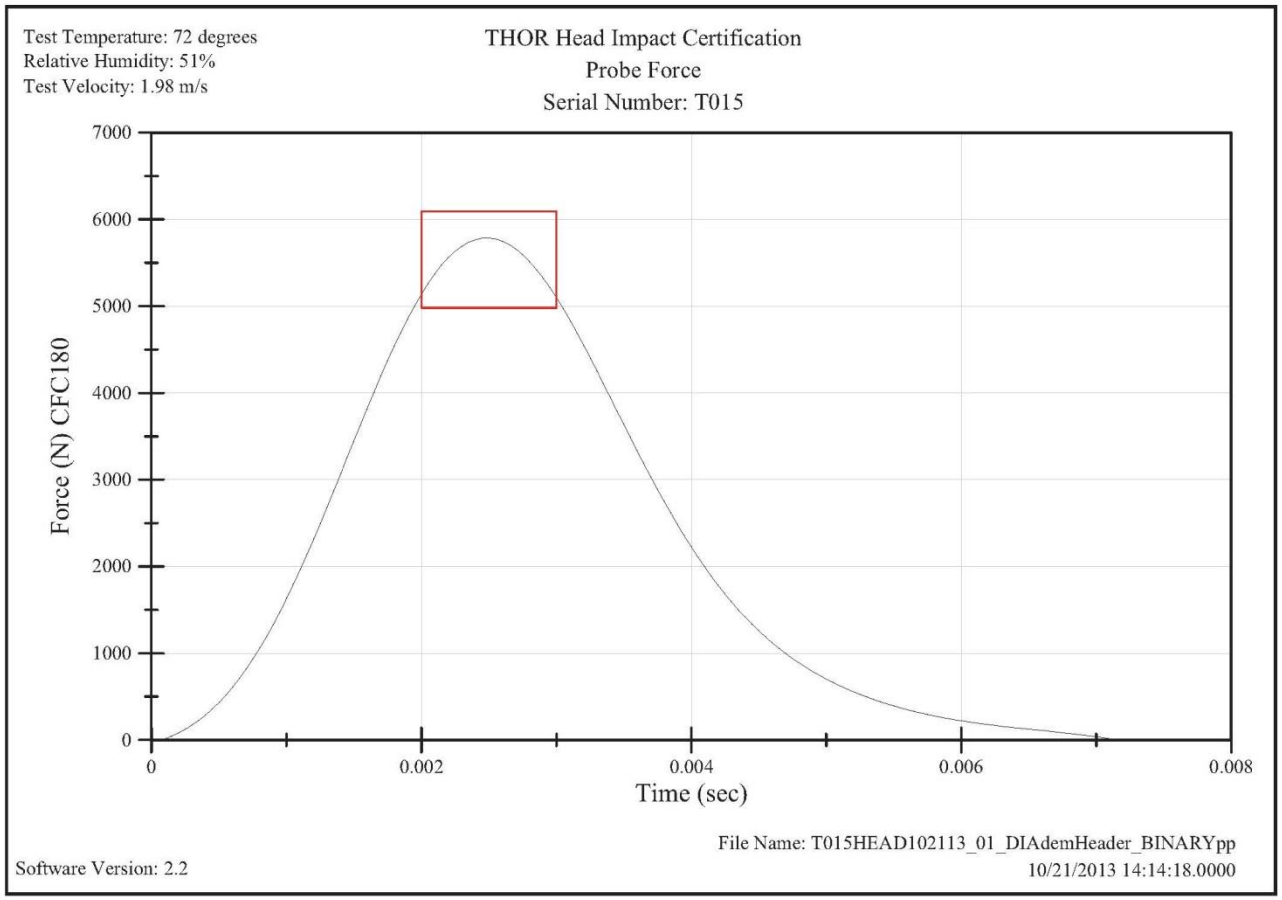
Reported by: Calspan

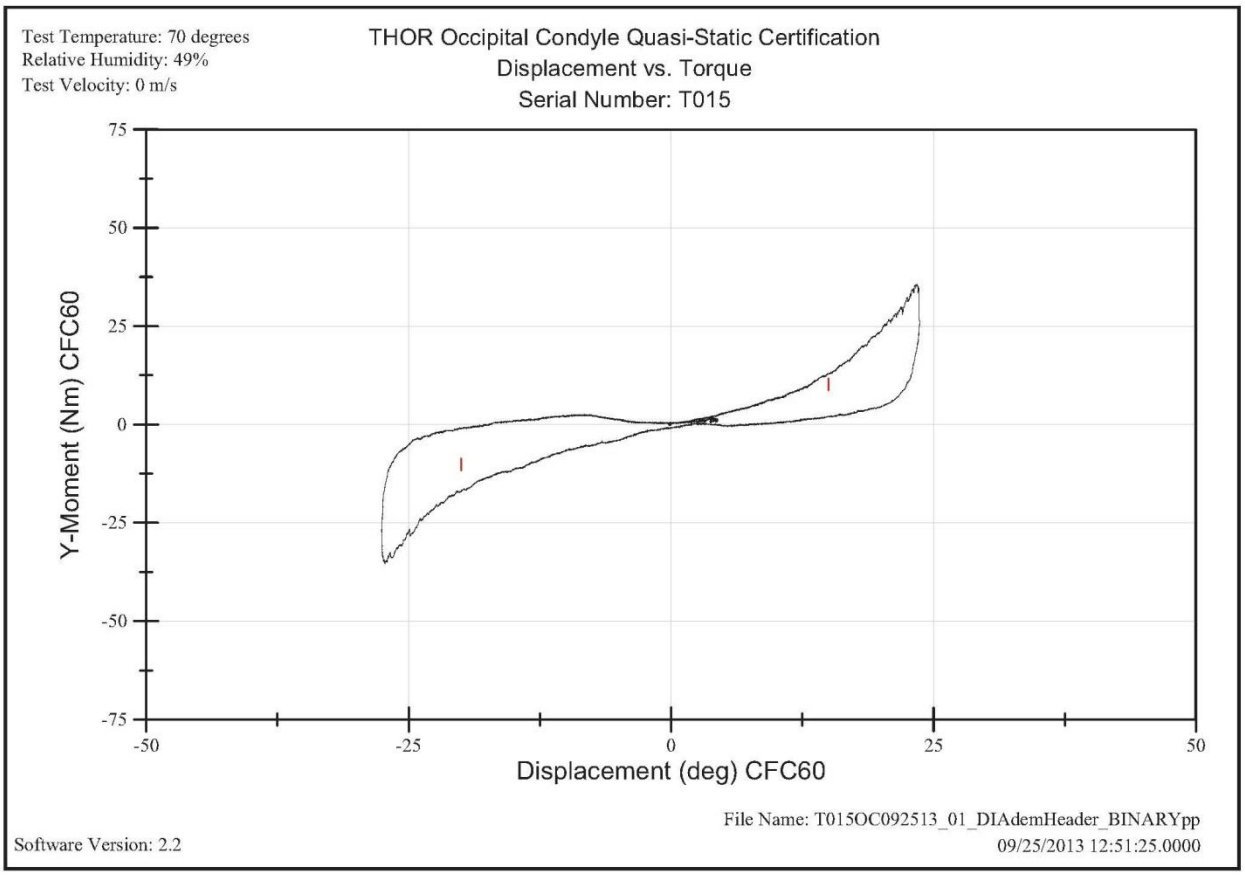
Technician: M. Goehle

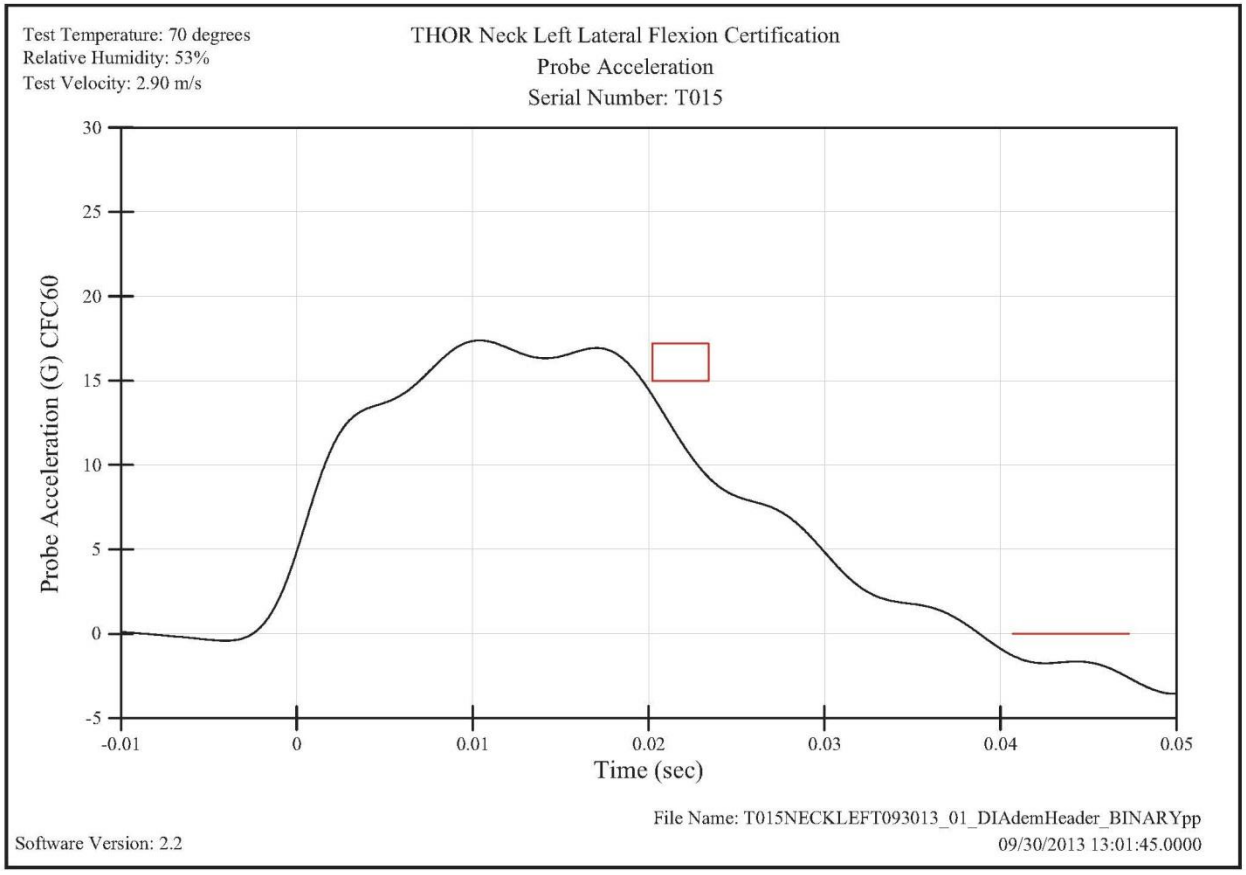
Date: 10/28/2013

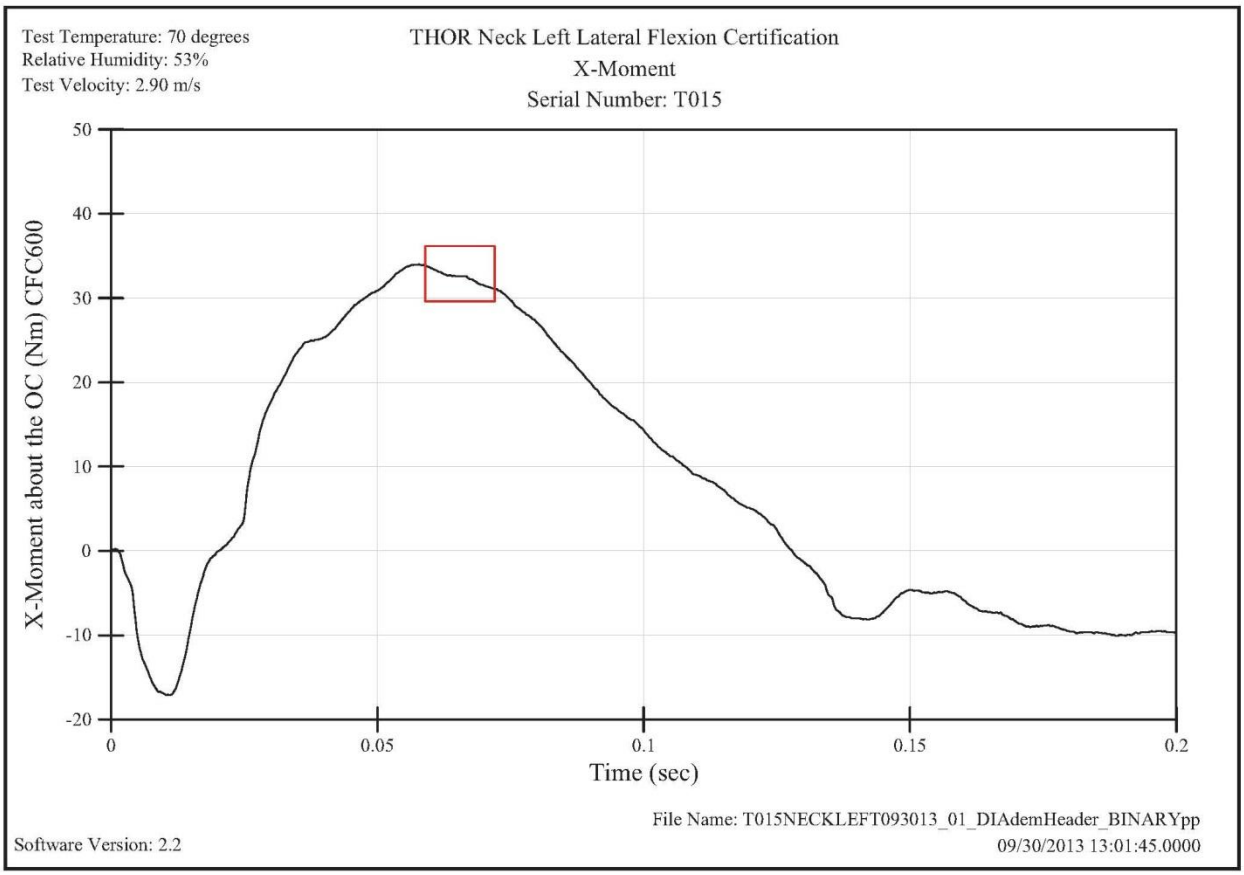
Head Impact	Passed
Occipital Condyle Quasi-Static	Failed
Neck Left Lateral Flexion	Failed
Neck Right Lateral Flexion	Failed
Neck Flexion	Failed
Neck Extension	Failed
Upper Thorax	Failed
Lower Left Oblique Thorax	Failed
Lower Right Oblique Thorax	Failed
Upper Abdomen	Failed
Lower Abdomen	Failed
Left Femur	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

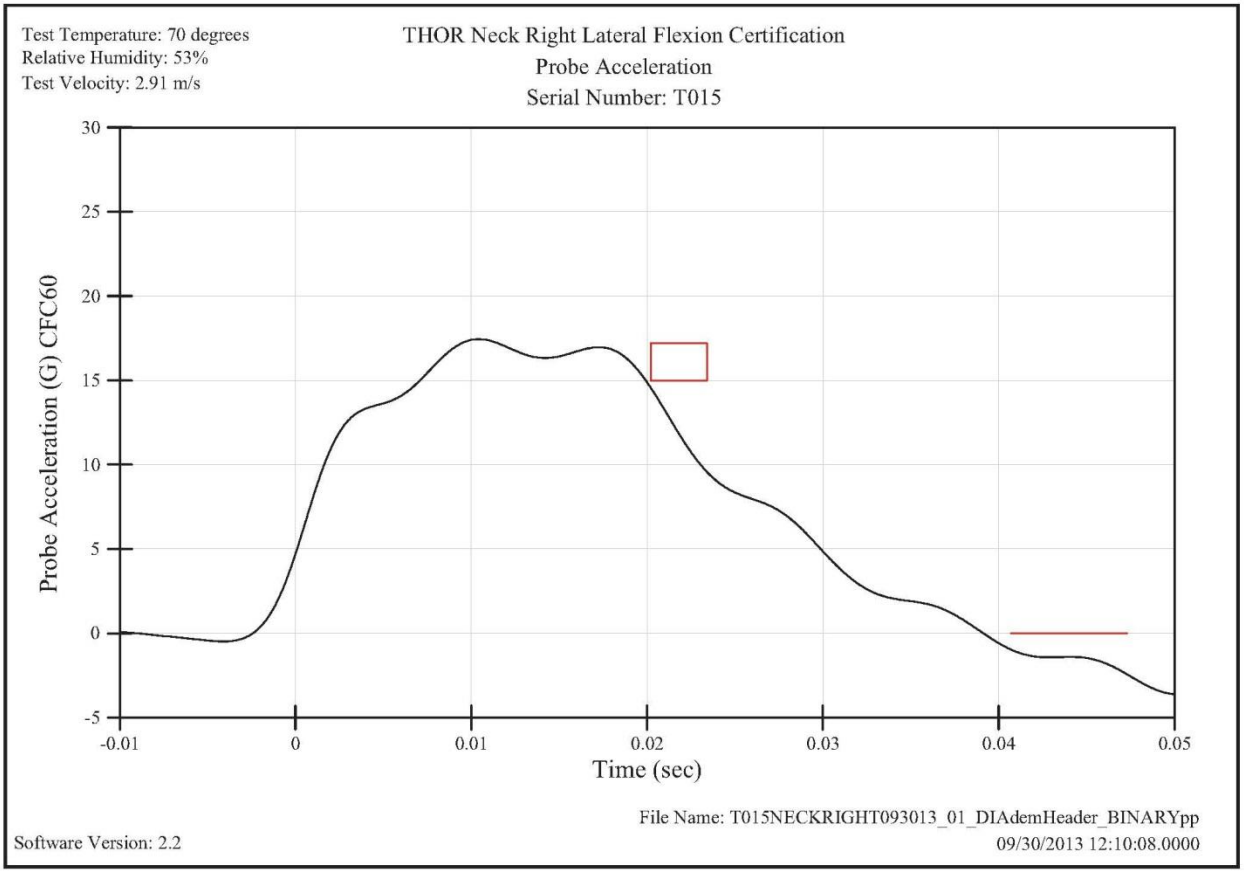
Certifications performed by VRTC

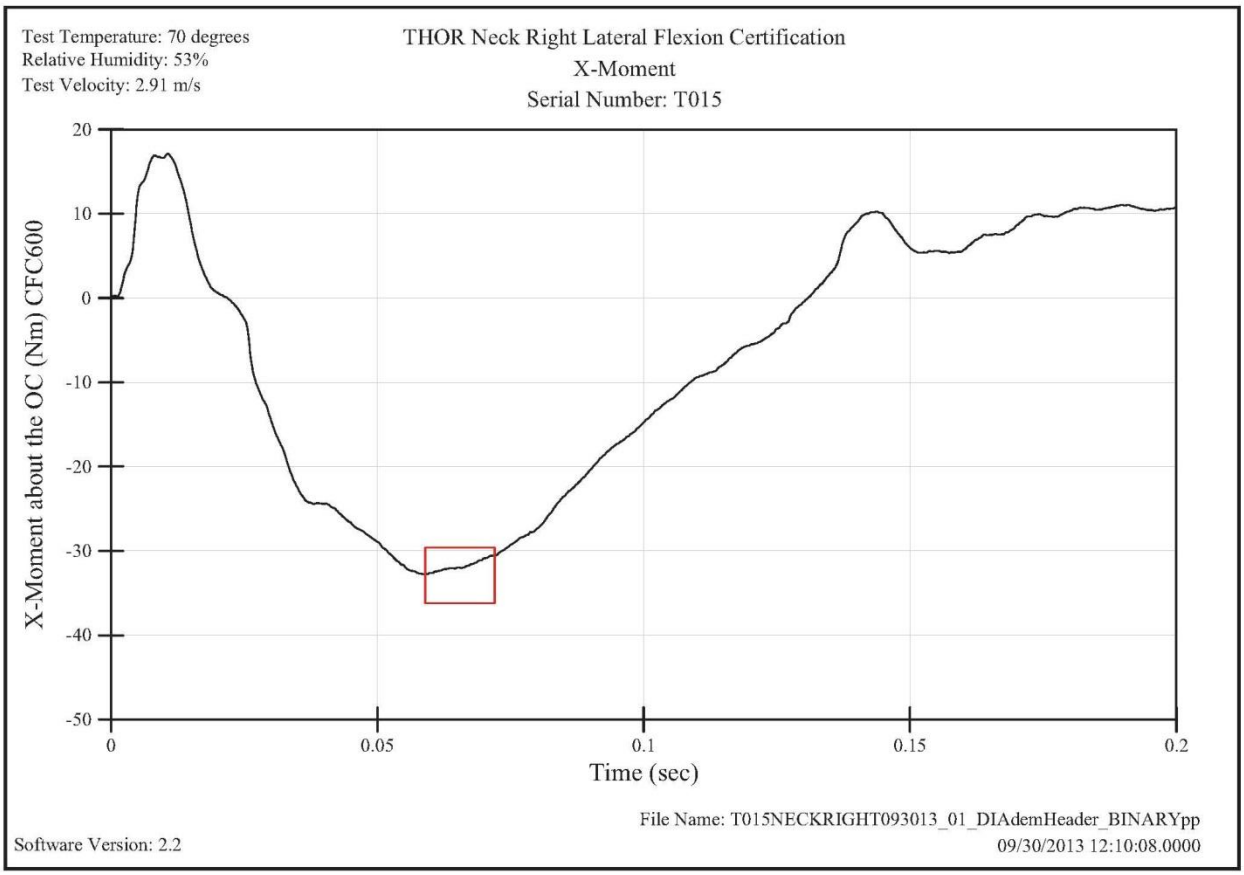

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 1.98 m/s
THOR Head Impact Certification
Probe Force
Serial Number: T015
Force (N) CFC180
7000
6000
5000
4000
3000
2000
1000
0
0
0.002
0.004
0.006
0.008
Time (sec)
File Name: T015HEAD102113_01_DIAdemHeader_BINARYpp
Software Version: 2.2
10/21/2013 14:14:18.0000

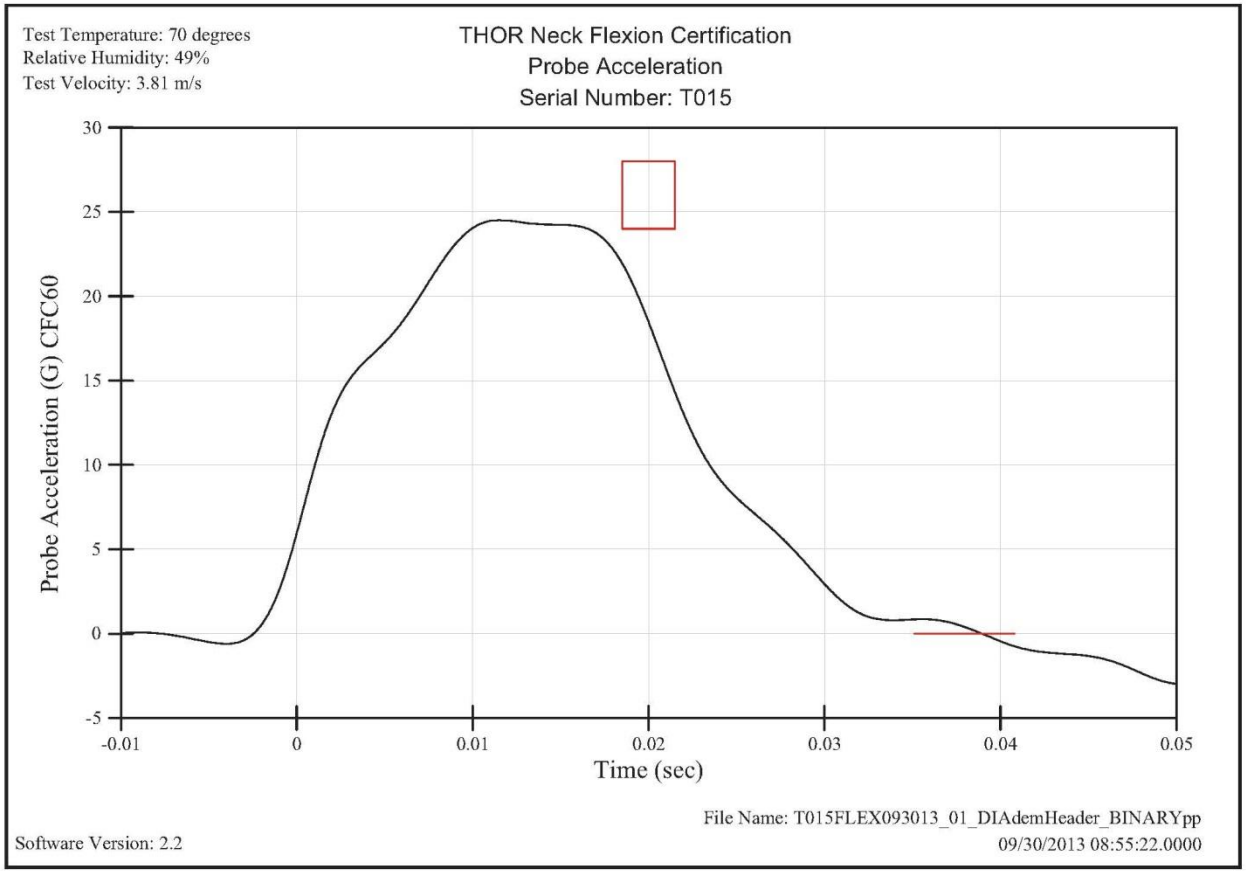

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 0 m/s
THOR Occipital Condyle Quasi-Static Certification
Displacement vs. Torque
Serial Number: T015
Y-Moment (Nm) CFC60
75
50
25
0
-25
-50
-75
-50
-25
0
25
50
Displacement (deg) CFC60
File Name: T015OC092513_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/25/2013 12:51:25.0000

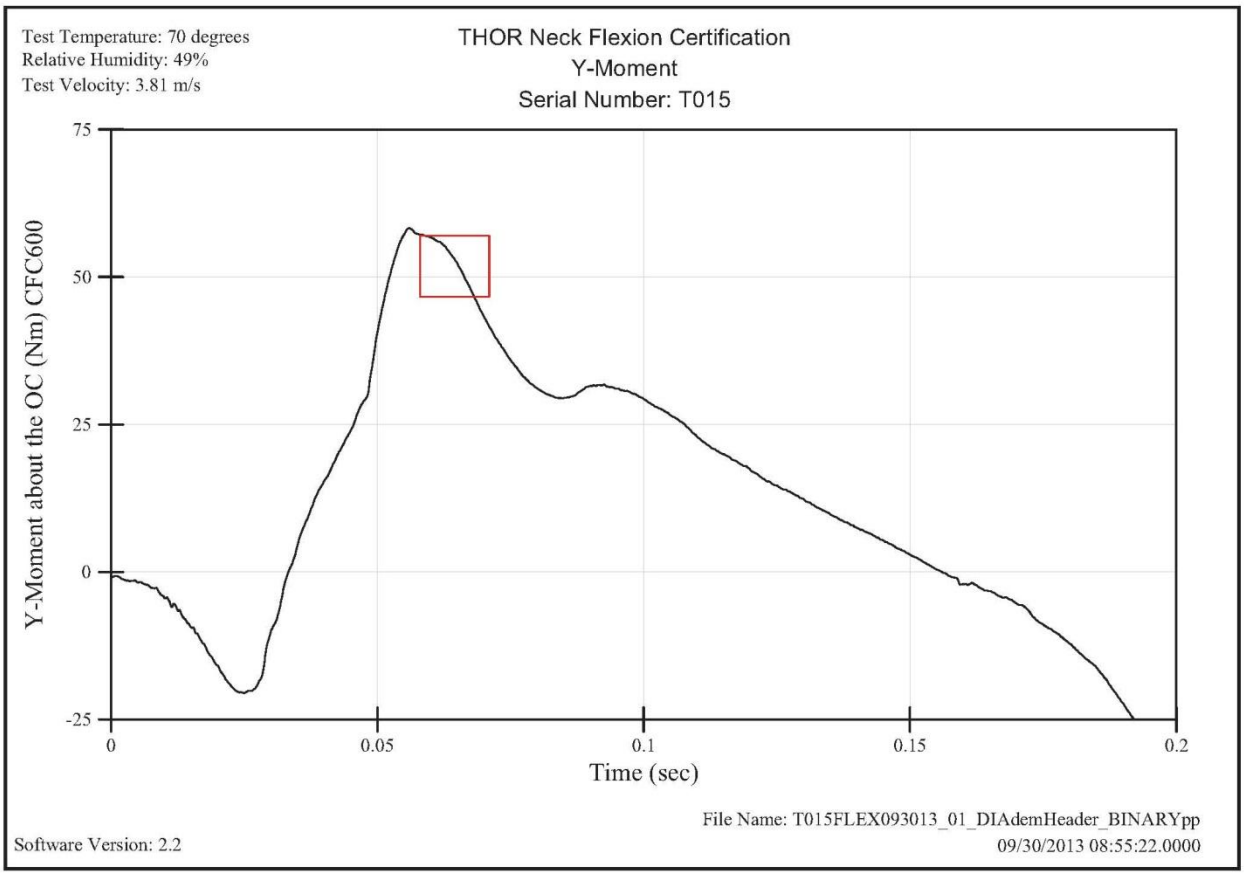

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.90 m/s
THOR Neck Left Lateral Flexion Certification
Probe Acceleration
Serial Number: T015
Probe Acceleration (G) CFC60
30
25
20
15
10
5
0
-5
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (sec)
File Name: T015NECKLEFT093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 13:01:45.0000

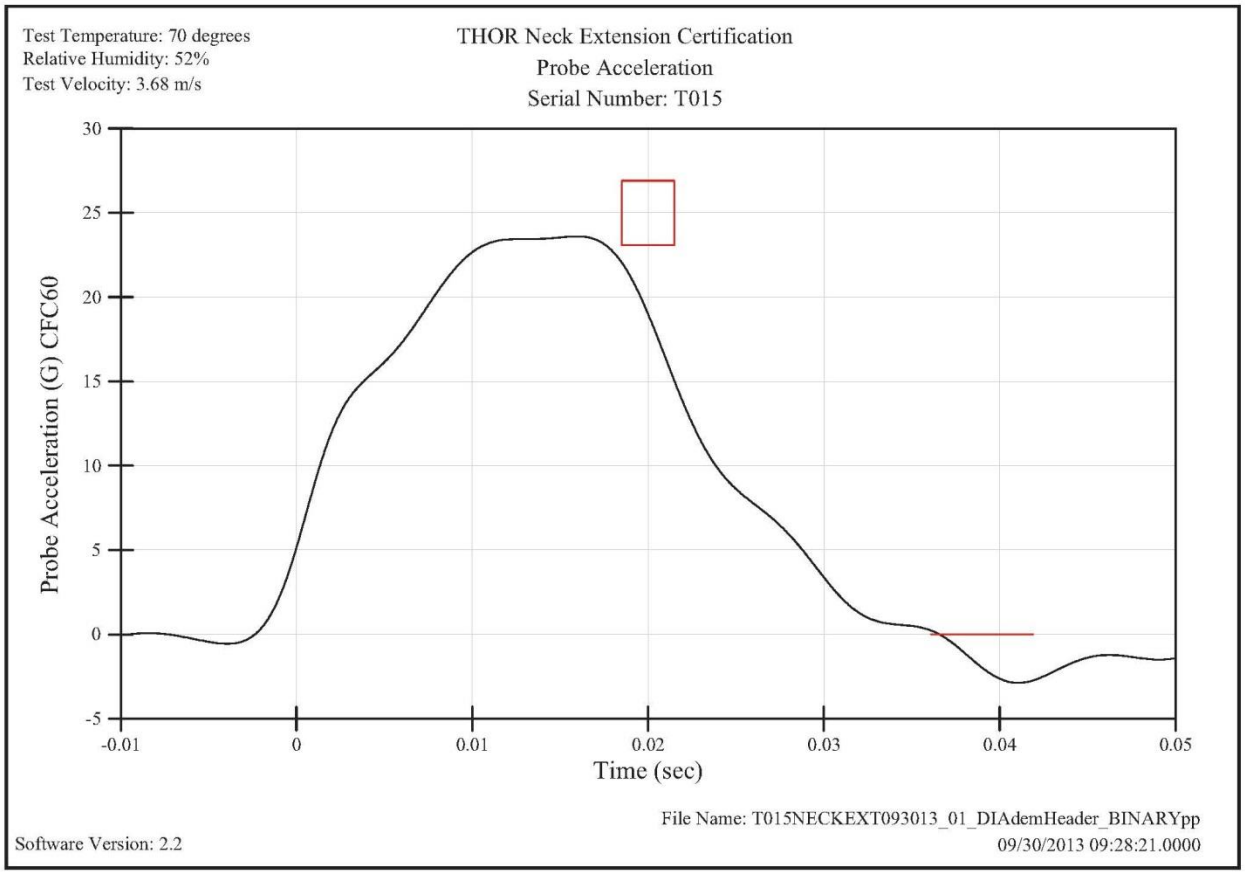

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.90 m/s
THOR Neck Left Lateral Flexion Certification
X-Moment
Serial Number: T015
X-Moment about the OC (Nm) CFC600
50
40
30
20
10
0
-10
-20
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T015NECKLEFT093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 13:01:45.0000

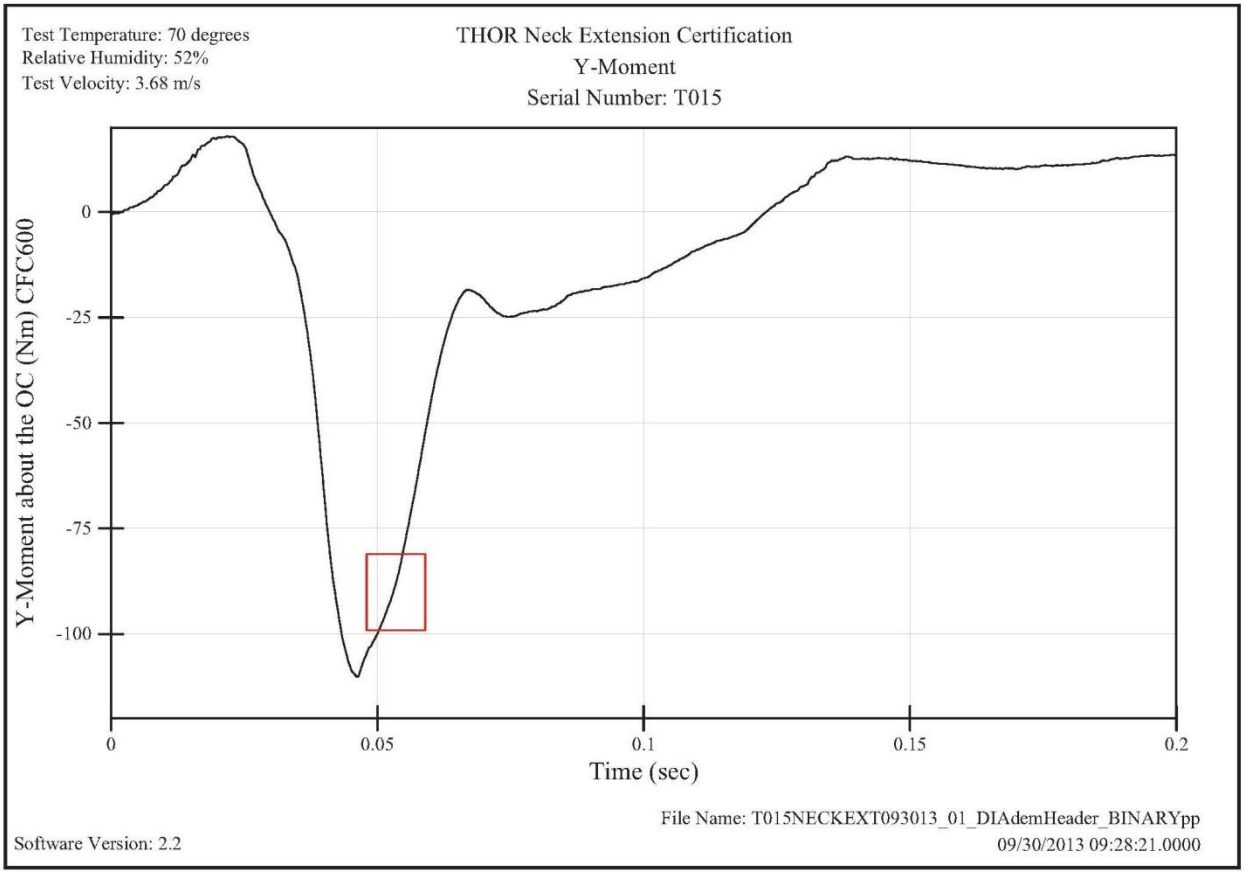

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.91 m/s
THOR Neck Right Lateral Flexion Certification
Probe Acceleration
Serial Number: T015
Probe Acceleration (G) CFC60
30
25
20
15
10
5
0
-5
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (sec)
File Name: T015NECKRIGHT093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 12:10:08.0000

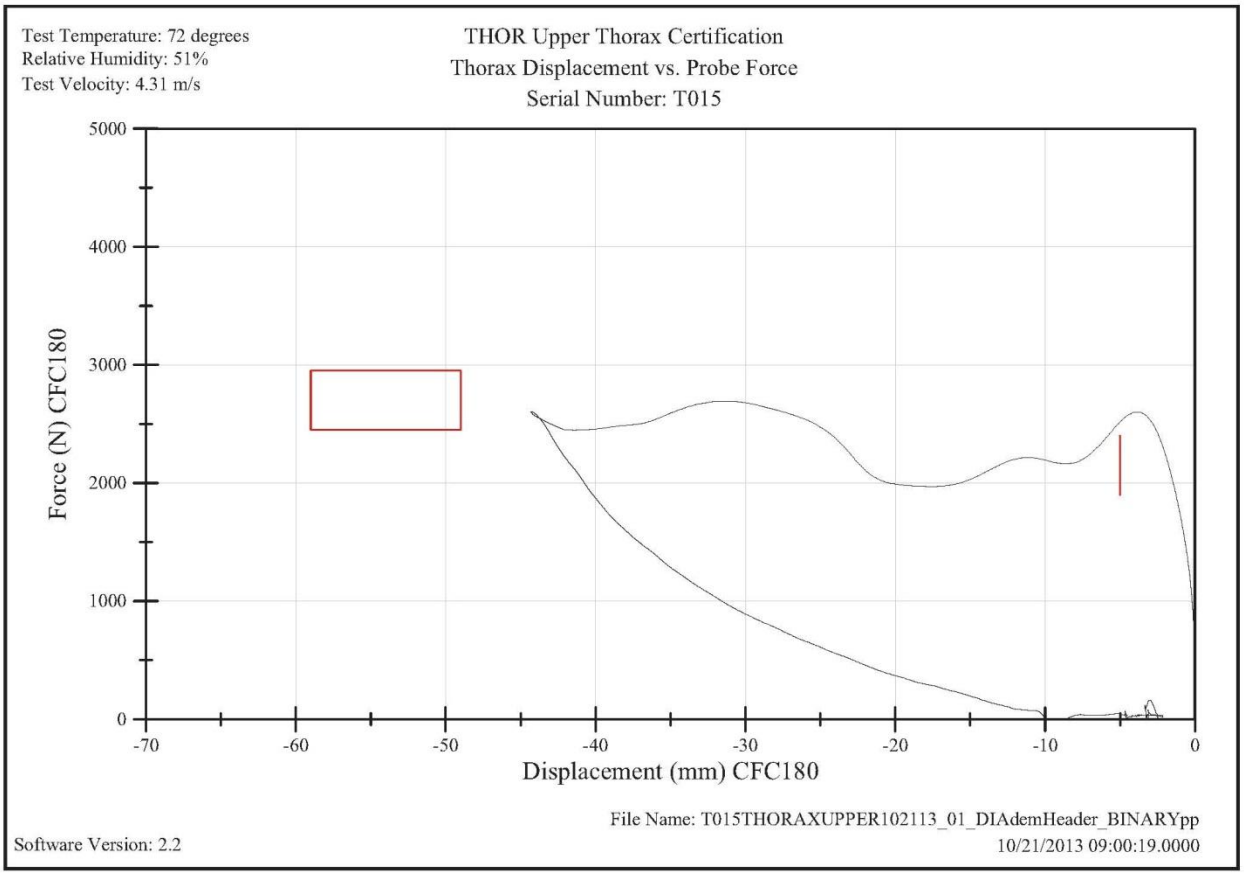

Test Temperature: 70 degrees
Relative Humidity: 53%
Test Velocity: 2.91 m/s
THOR Neck Right Lateral Flexion Certification
X-Moment
Serial Number: T015
X-Moment about the OC (Nm) CFC600
20
10
0
-10
-20
-30
-40
-50
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T015NECKRIGHT093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 12:10:08.0000

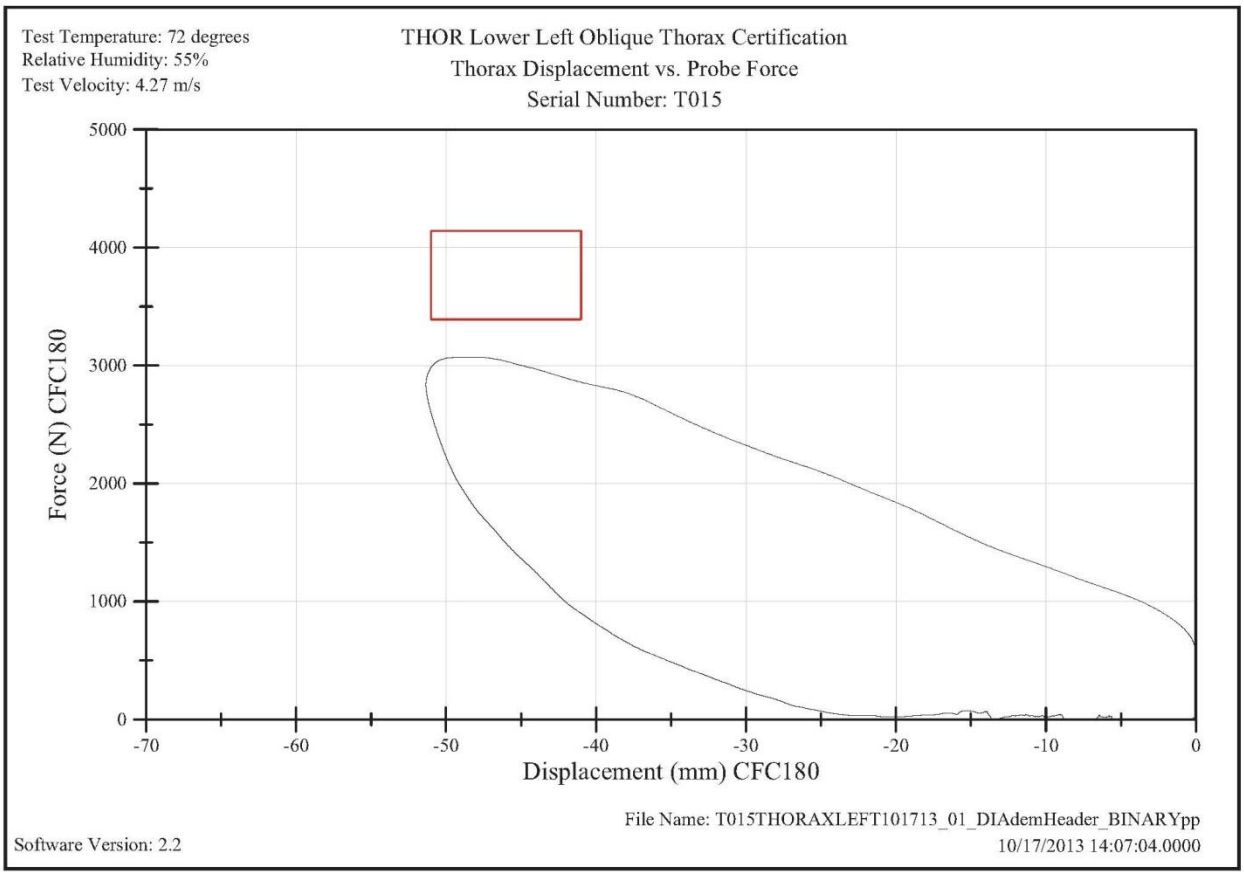

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 3.81 m/s
THOR Neck Flexion Certification
Probe Acceleration
Serial Number: T015
Probe Acceleration (G) CFC60
30
25
20
15
10
5
0
-5
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (sec)
File Name: T015FLEX093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 08:55:22.0000

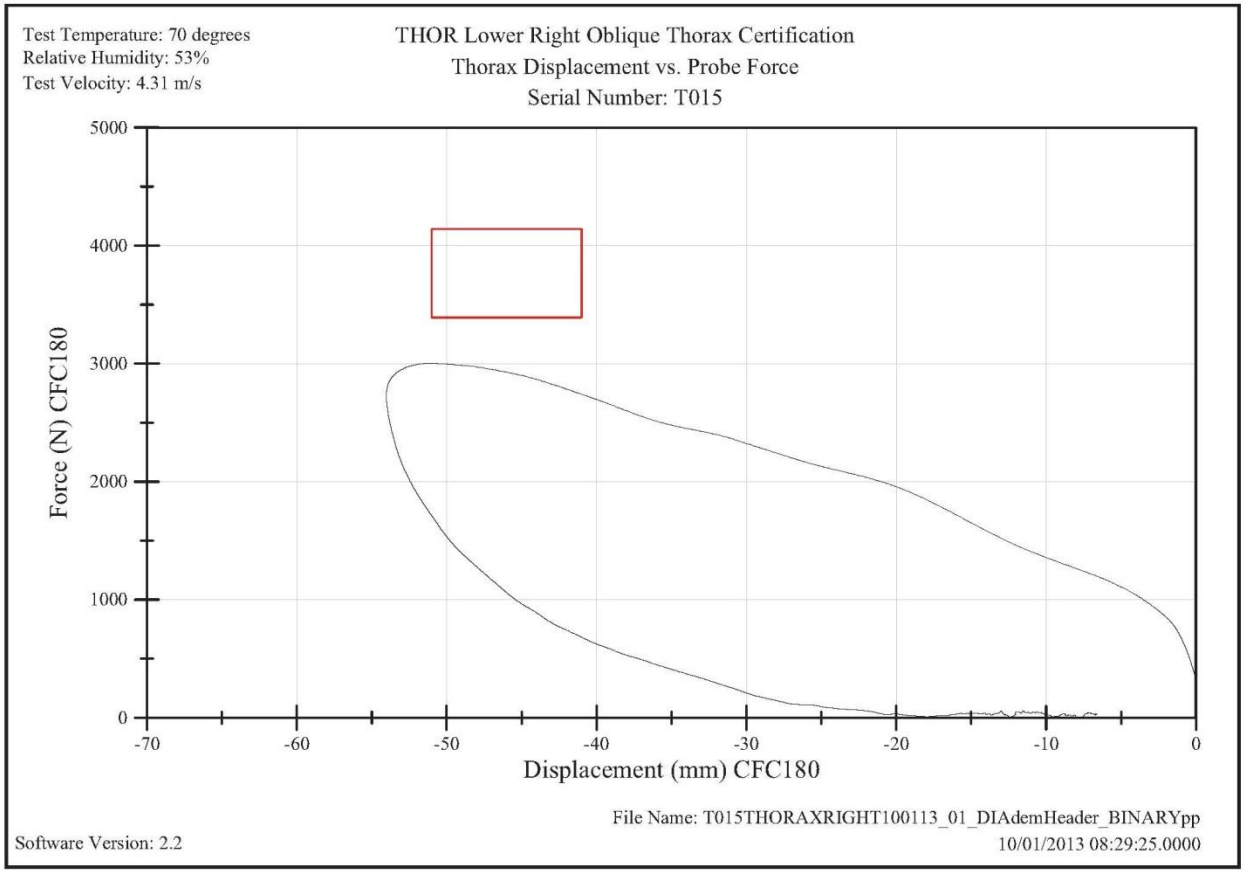

Test Temperature: 70 degrees
Relative Humidity: 49%
Test Velocity: 3.81 m/s
THOR Neck Flexion Certification
Y-Moment
Serial Number: T015
Y-Moment about the OC (Nm) CFC600
75
50
25
0
-25
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T015FLEX093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 08:55:22.0000

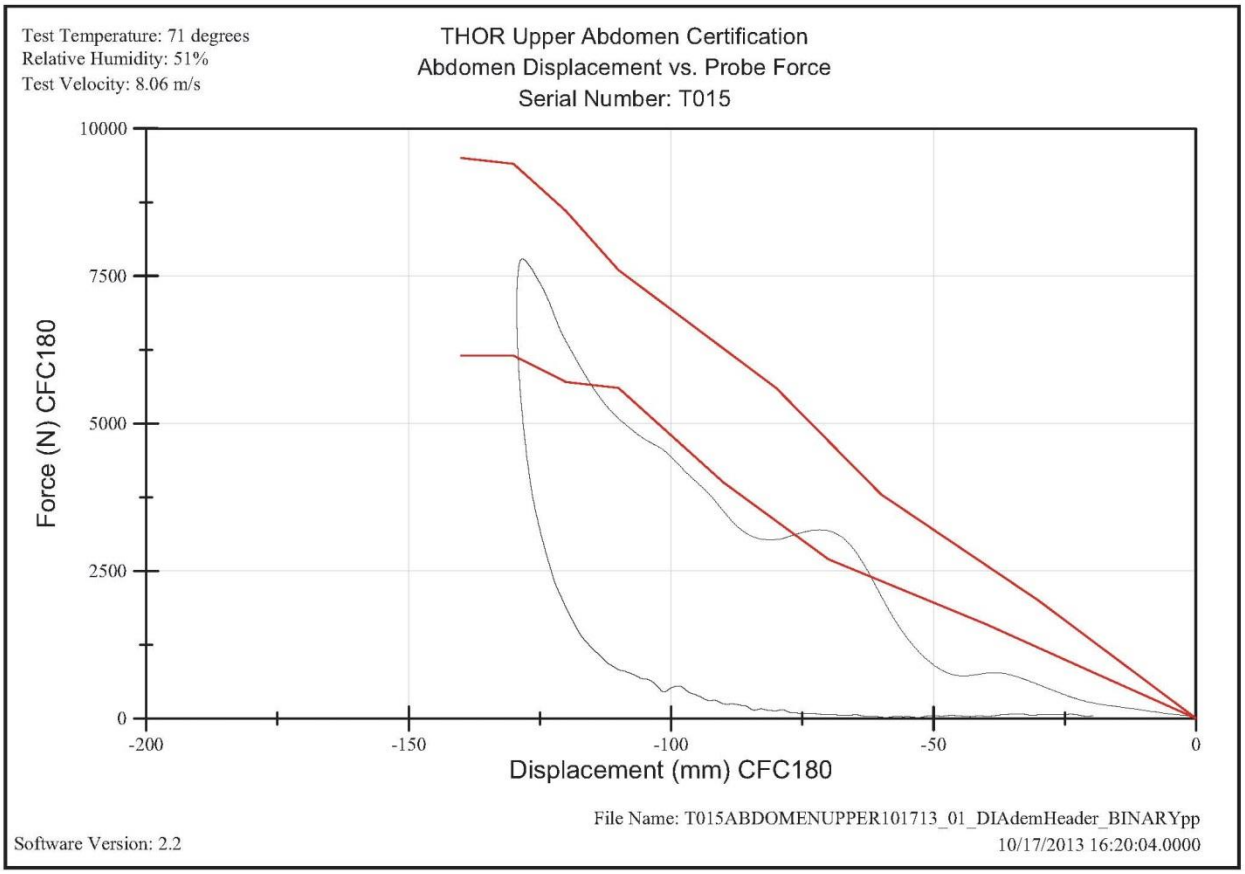

Test Temperature: 70 degrees
Relative Humidity: 52%
Test Velocity: 3.68 m/s
THOR Neck Extension Certification
Probe Acceleration
Serial Number: T015
Probe Acceleration (G) CFC60
30
25
20
15
10
5
0
-5
-0.01
0
0.01
0.02
0.03
0.04
0.05
Time (sec)
File Name: T015NECKEXT093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 09:28:21.0000

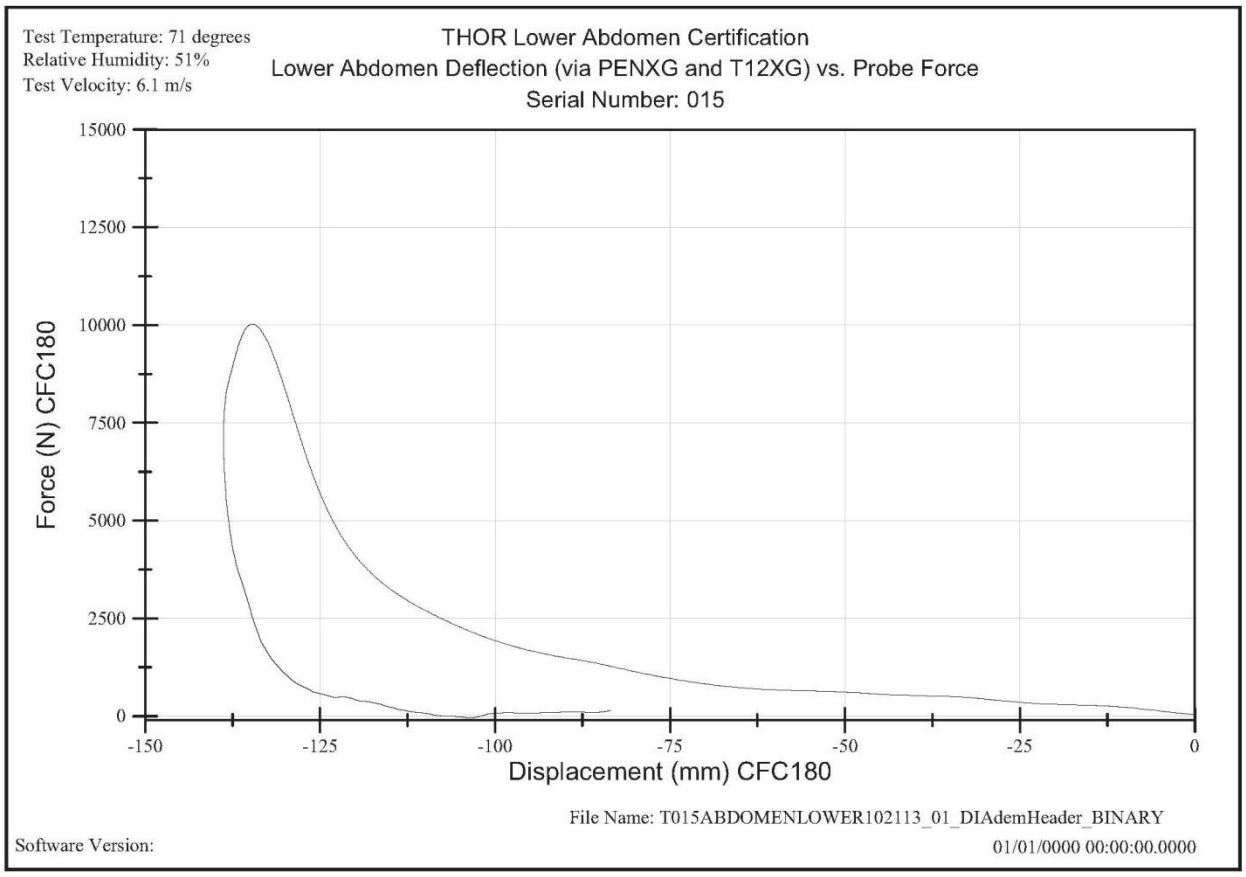

Test Temperature: 70 degrees
Relative Humidity: 52%
Test Velocity: 3.68 m/s
THOR Neck Extension Certification
Y-Moment
Serial Number: T015
Y-Moment about the OC (Nm) CFC600
0
-25
-50
-75
-100
0
0.05
0.1
0.15
0.2
Time (sec)
File Name: T015NECKEXT093013_01_DIAdemHeader_BINARYpp
Software Version: 2.2
09/30/2013 09:28:21.0000

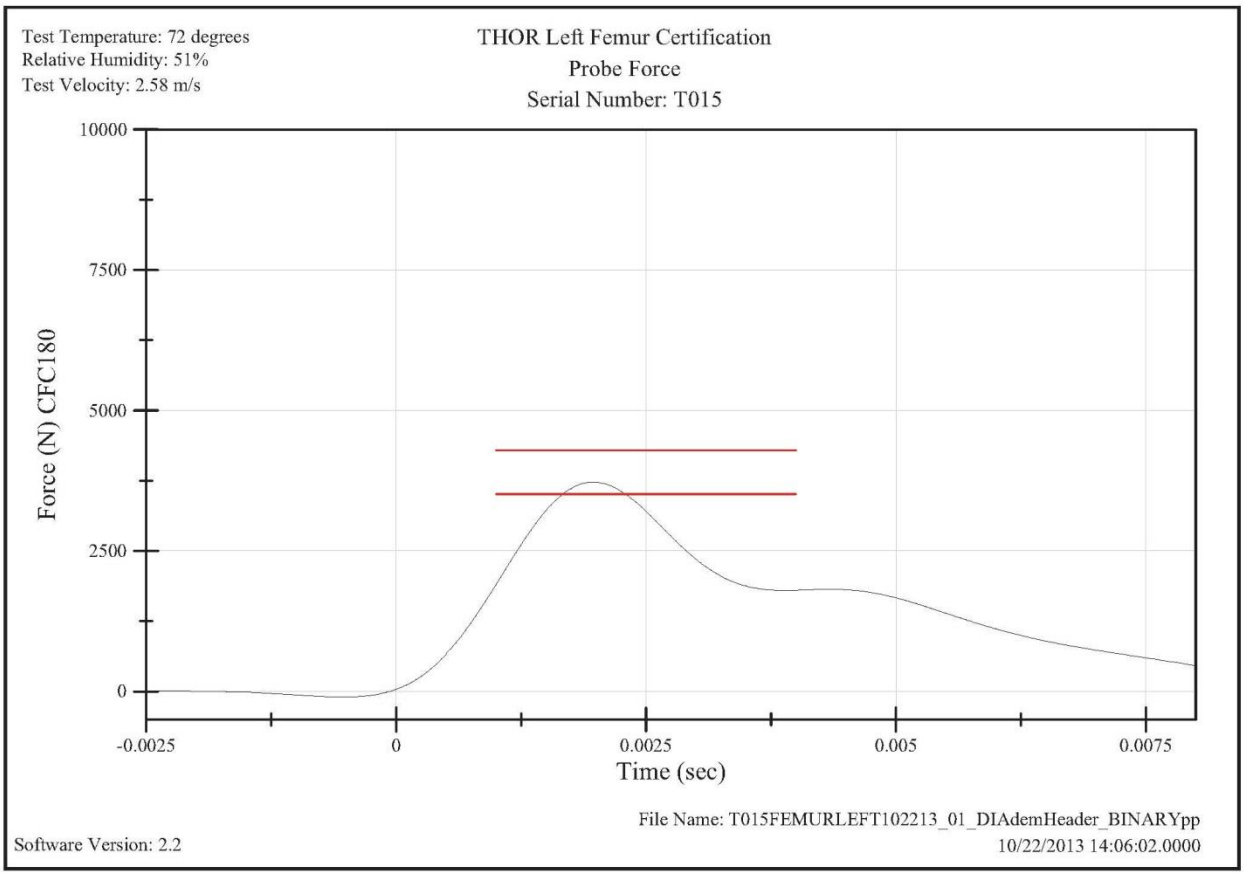

Test Temperature: 72 degrees
Relative Humidity: 51%
Test Velocity: 4.31 m/s
THOR Upper Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T015
Force (N) CFC180
5000
4000
3000
2000
1000
0
-70
-60
-50
-40
-30
-20
-10
0
Displacement (mm) CFC180
File Name: T015THORAXUPPER102113_01_DIAdemHeader_BINARYpp
Software Version: 2.2
10/21/2013 09:00:19.0000

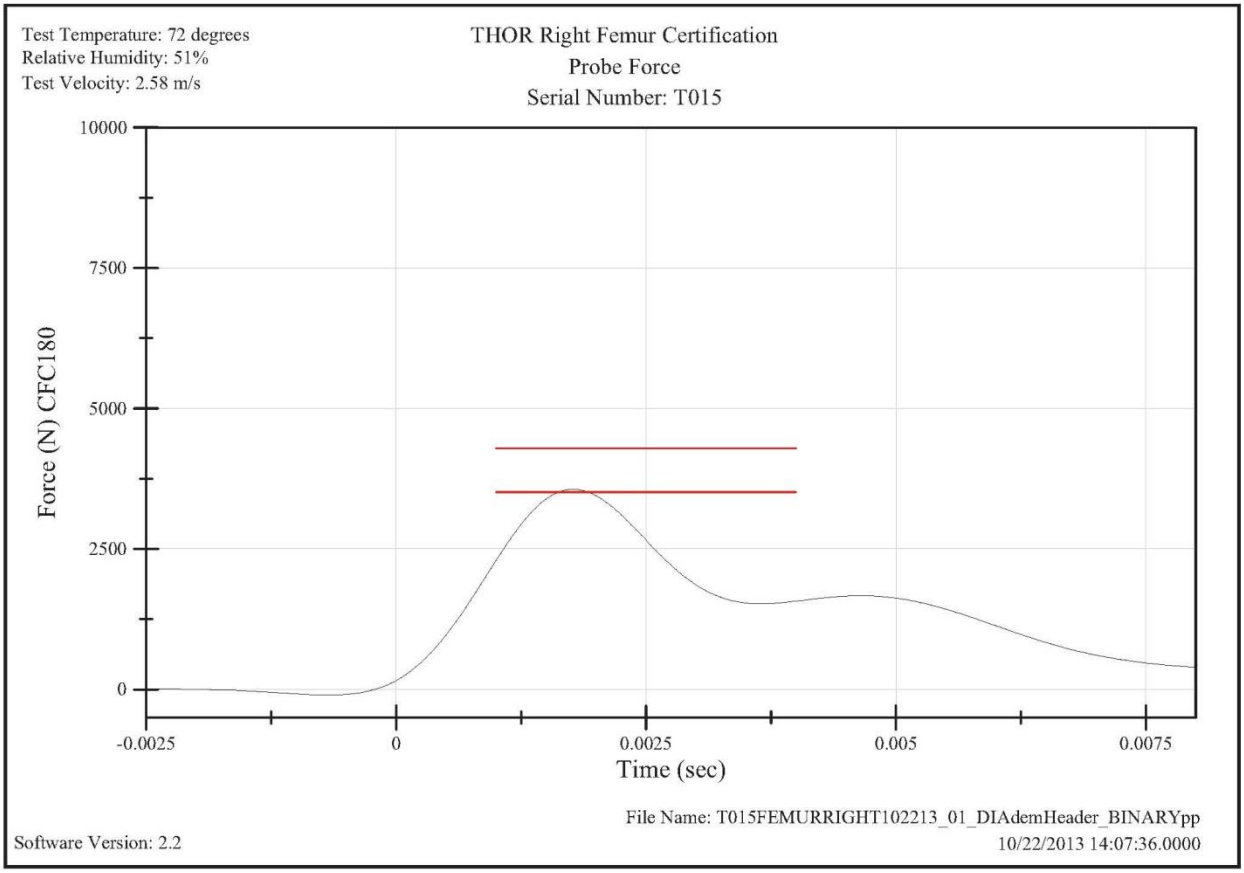

Test Temperature: 72 degrees
Relative Humidity: 55%
Test Velocity: 4.27 m/s
THOR Lower Left Oblique Thorax Certification
Thorax Displacement vs. Probe Force
Serial Number: T015
Force (N) CFC180
5000
4000
3000
2000
1000
0
-70
-60
-50
-40
-30
-20
-10
0
Displacement (mm) CFC180
File Name: T015THORAXLEFT101713_01_DIAdemHeader_BINARYpp
Software Version: 2.2
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
Force (N) CFC180
5000
4000
3000
2000
1000
0
-70
-60
-50
-40
-30
-20
-10
0
Displacement (mm) CFC180
File Name: T015THORAXRIGHT100113_01_DIAdemHeader_BINARYpp
Software Version: 2.2
10/01/2013 08:29:25.0000

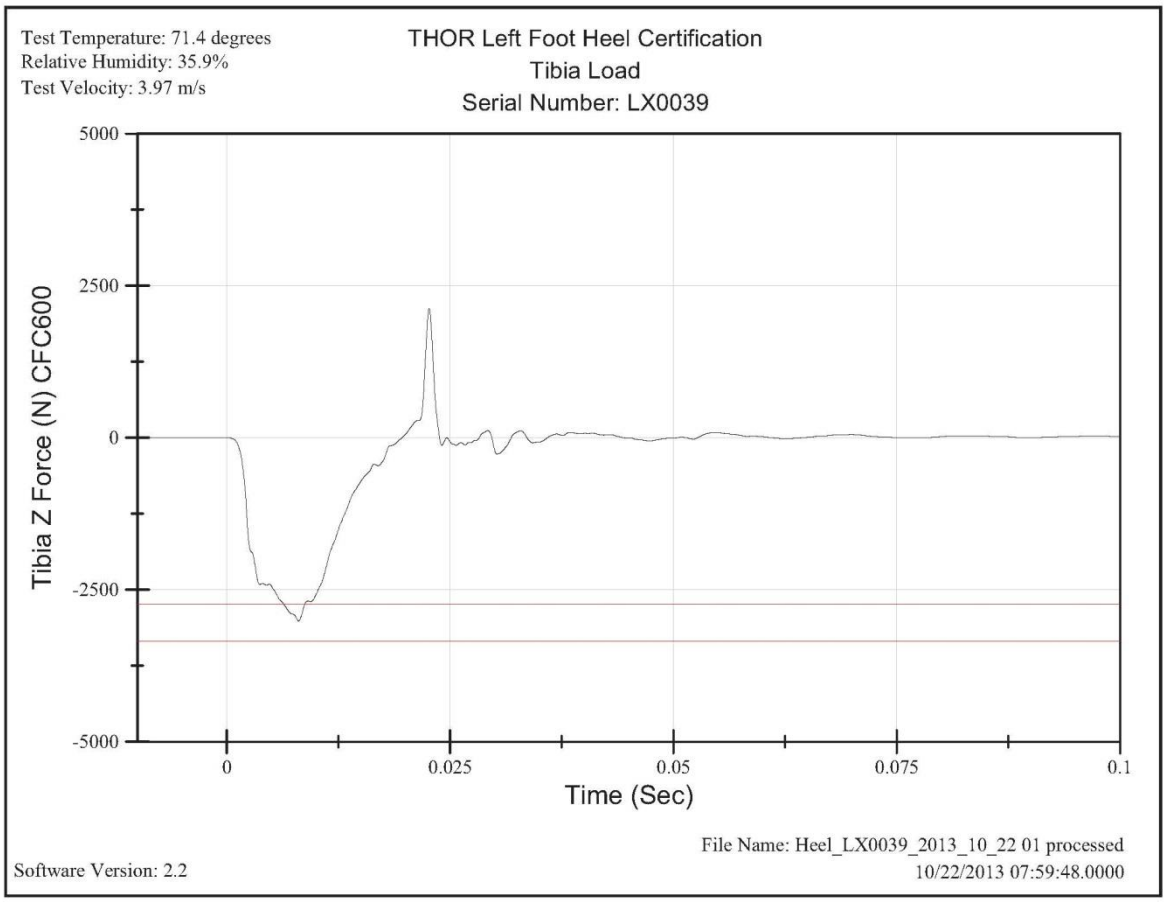

Test Temperature: 71 degrees
Relative Humidity: 51%
Test Velocity: 8.06 m/s
THOR Upper Abdomen Certification
Abdomen Displacement vs. Probe Force
Serial Number: T015
Force (N) CFC180
10000
7500
5000
2500
0
-200
-150
-100
-50
0
Displacement (mm) CFC180
File Name: T015ABDOMENUPPER101713_01_DIAdemHeader_BINARYpp
Software Version: 2.2
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
Force (N) CFC180
15000
12500
10000
7500
5000
2500
0
-150
-125
-100
-75
-50
-25
0
Displacement (mm) CFC180
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
Force (N) CFC180
10000
7500
5000
2500
0
-0.0025
0
0.0025
0.005
0.0075
Time (sec)
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
Force (N) CFC180
10000
7500
5000
2500
0
-0.0025
0
0.0025
0.005
0.0075
Time (sec)
File Name: T015FEMURRIGHT102213_01_DIAdemHeader_BINARYpp
Software Version: 2.2
10/22/2013 14:07:36.0000

THOR 015 LEG CALIBRATIONS
LX0039 / LX0038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Test Velocity: 3.97 m/s
THOR Left Foot Heel Certification
Tibia Load
Serial Number: LX0039
Tibia Z Force (N) CFC600
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2500
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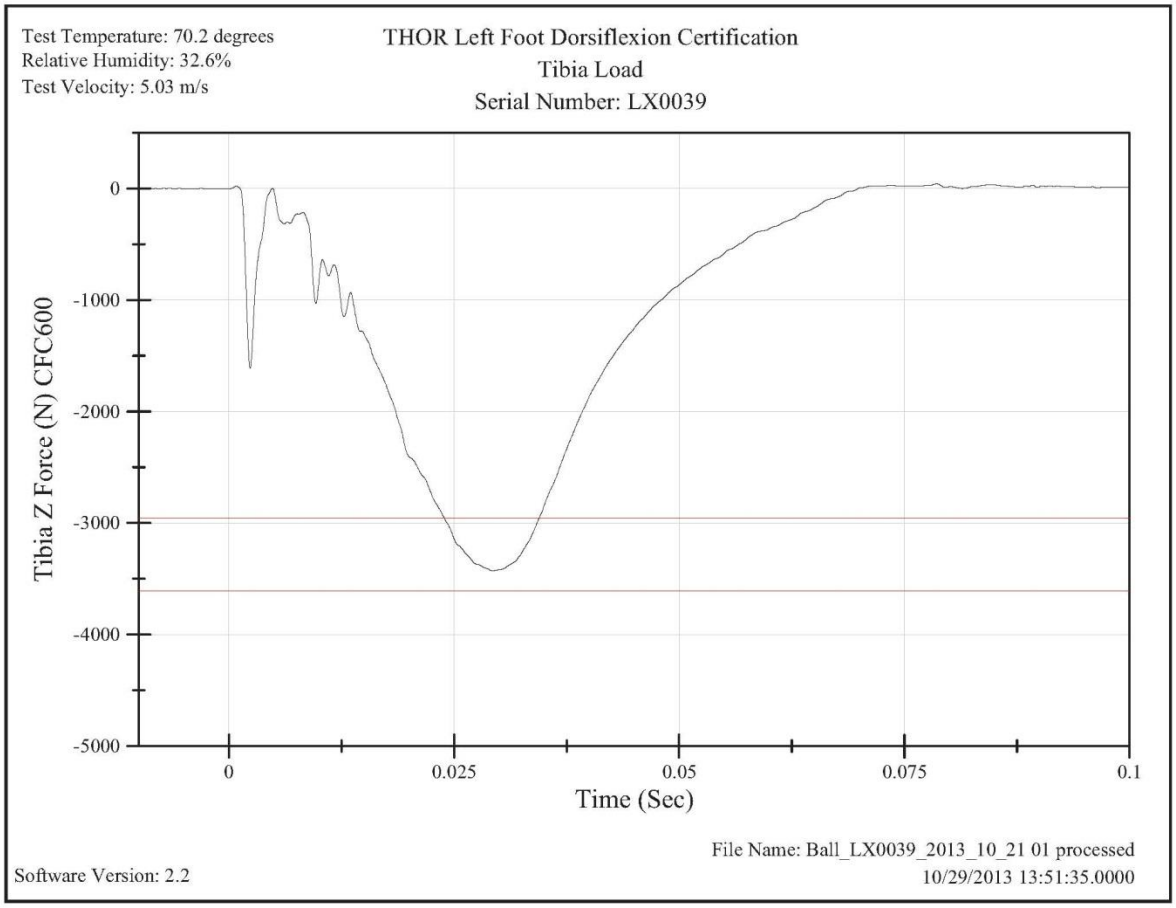
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Relative Humidity: 32.6%
Test Velocity: 5.03 m/s
THOR Left Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0039
Tibia Z Force (N) CFC600
0
-1000
-2000
-3000
-4000
-5000
0
0.025
0.05
0.075
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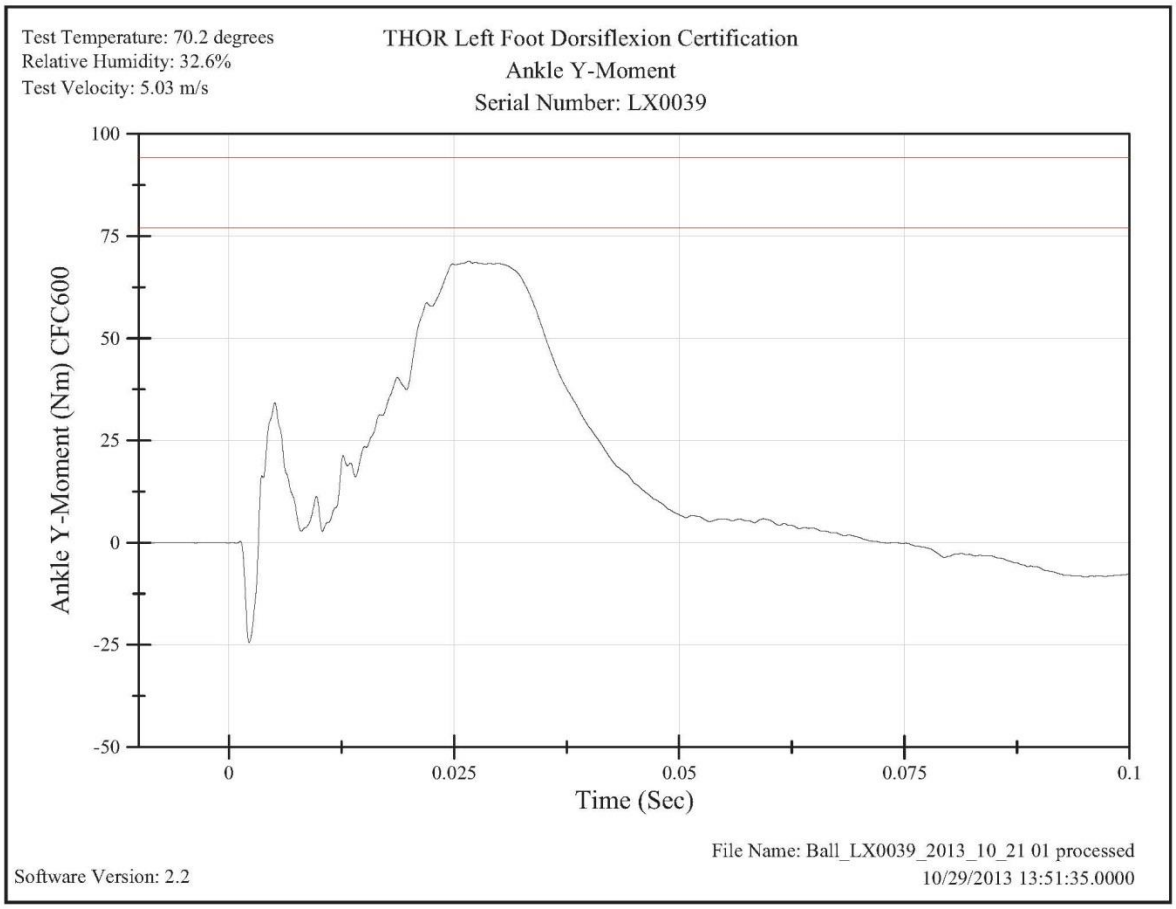
Test Temperature: 70.2 degrees
Relative Humidity: 32.6%
Test Velocity: 5.03 m/s
THOR Left Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0039
Ankle Y-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ball_LX0039_2013_10_21 01 processed
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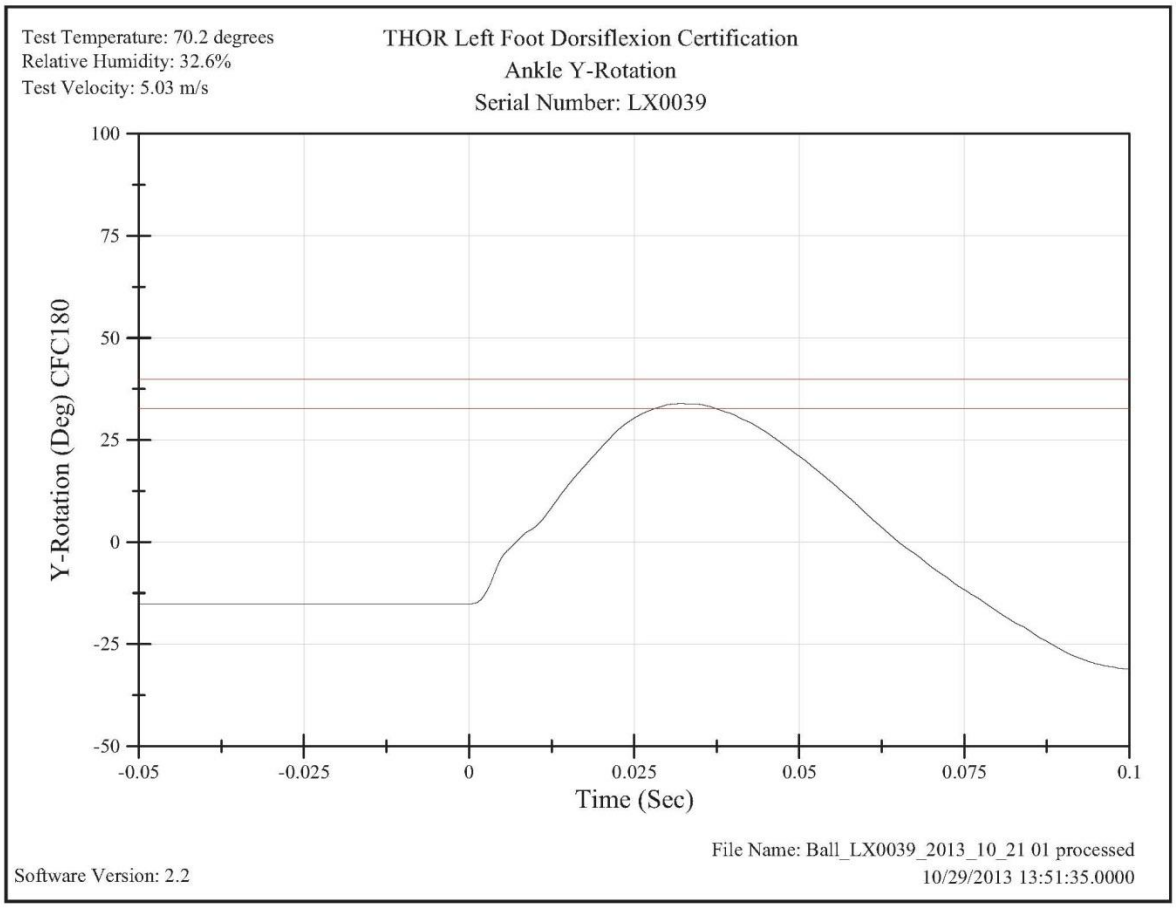
Test Temperature: 70.2 degrees
Relative Humidity: 32.6%
Test Velocity: 5.03 m/s
THOR Left Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0039
Y-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
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Time (Sec)
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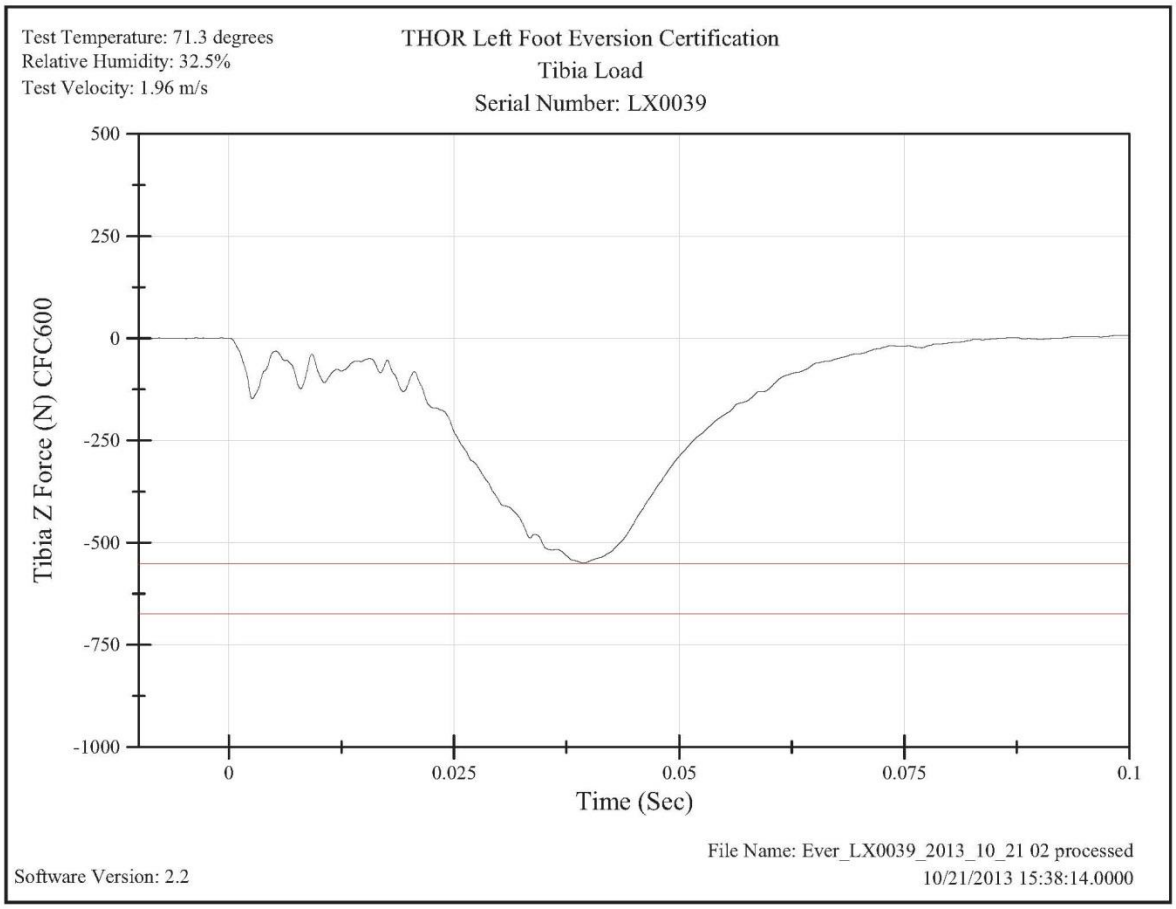
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Relative Humidity: 32.5%
Test Velocity: 1.96 m/s
THOR Left Foot Eversion Certification
Tibia Load
Serial Number: LX0039
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
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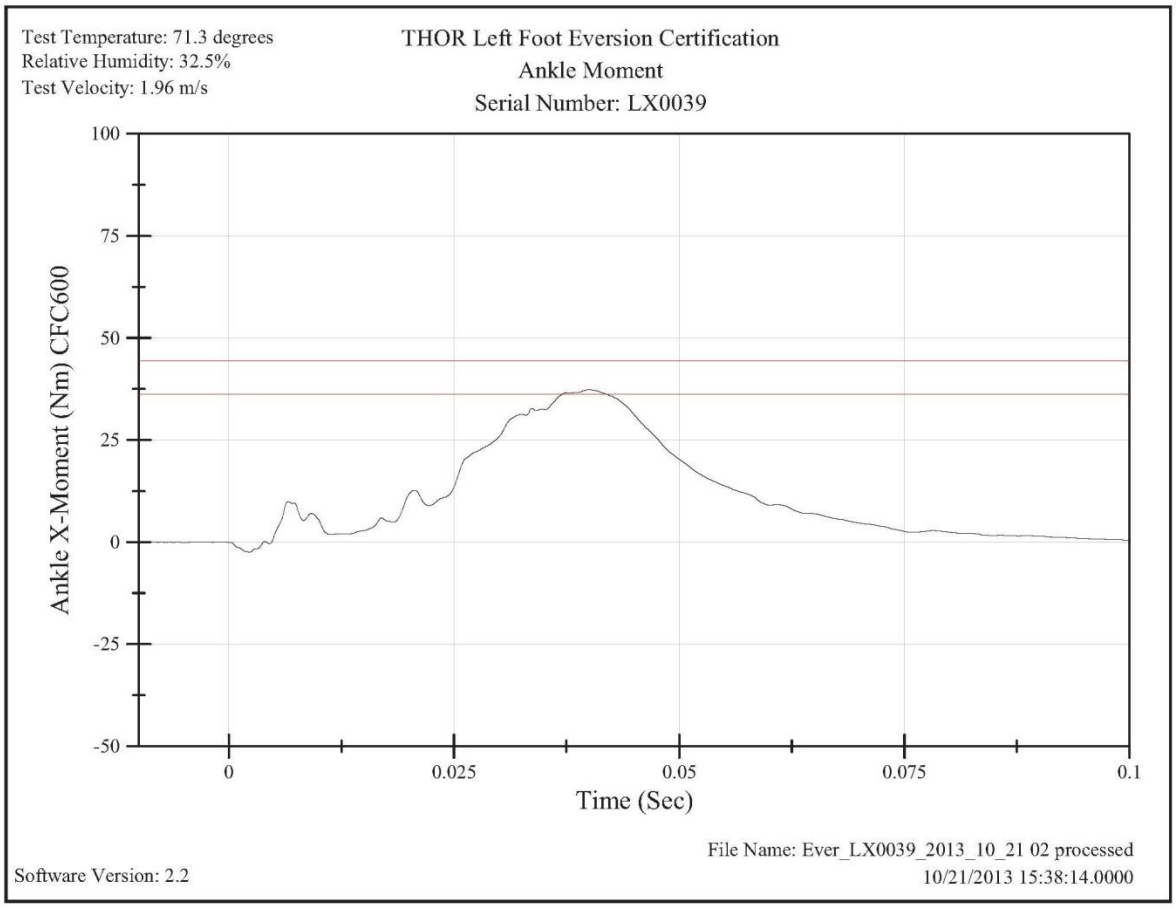
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Relative Humidity: 32.5%
Test Velocity: 1.96 m/s
THOR Left Foot Eversion Certification
Ankle Moment
Serial Number: LX0039
Ankle X-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0039_2013_10_21 02 processed
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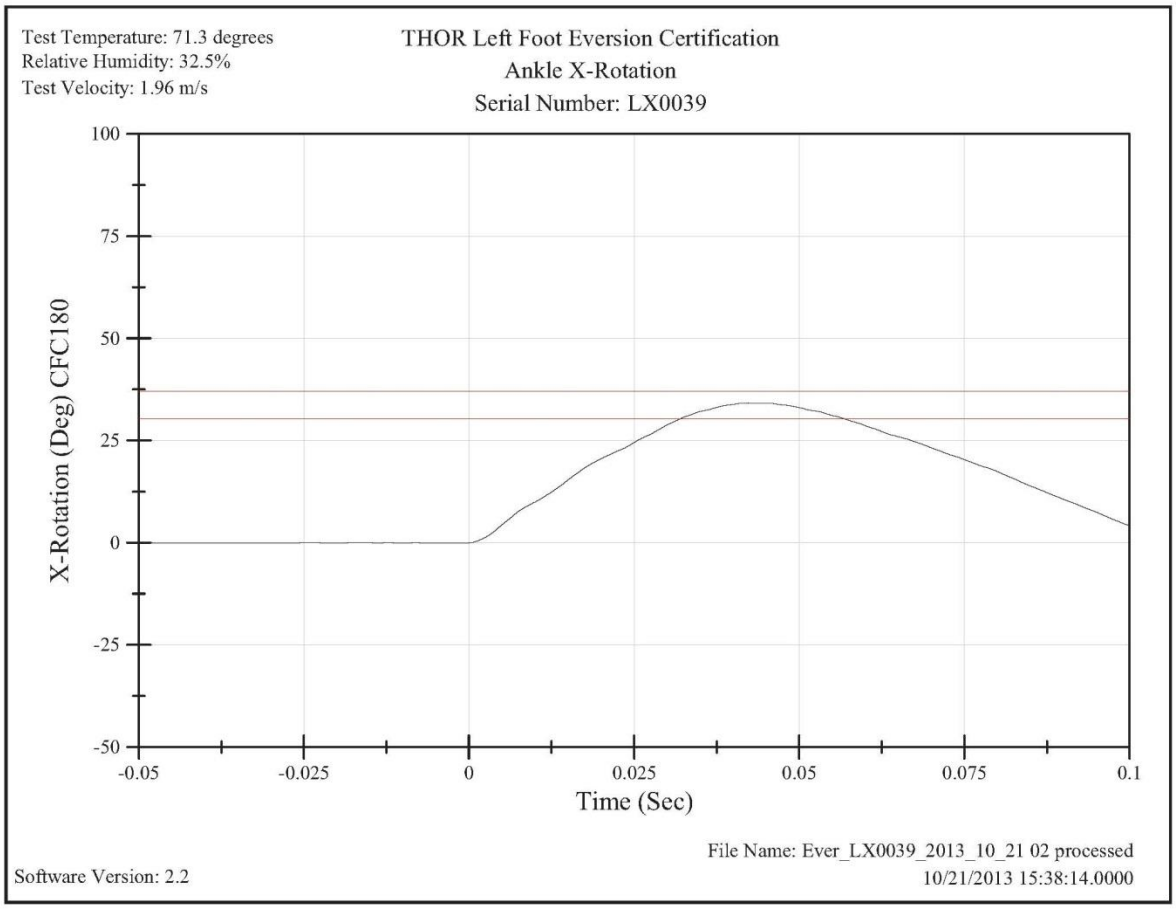
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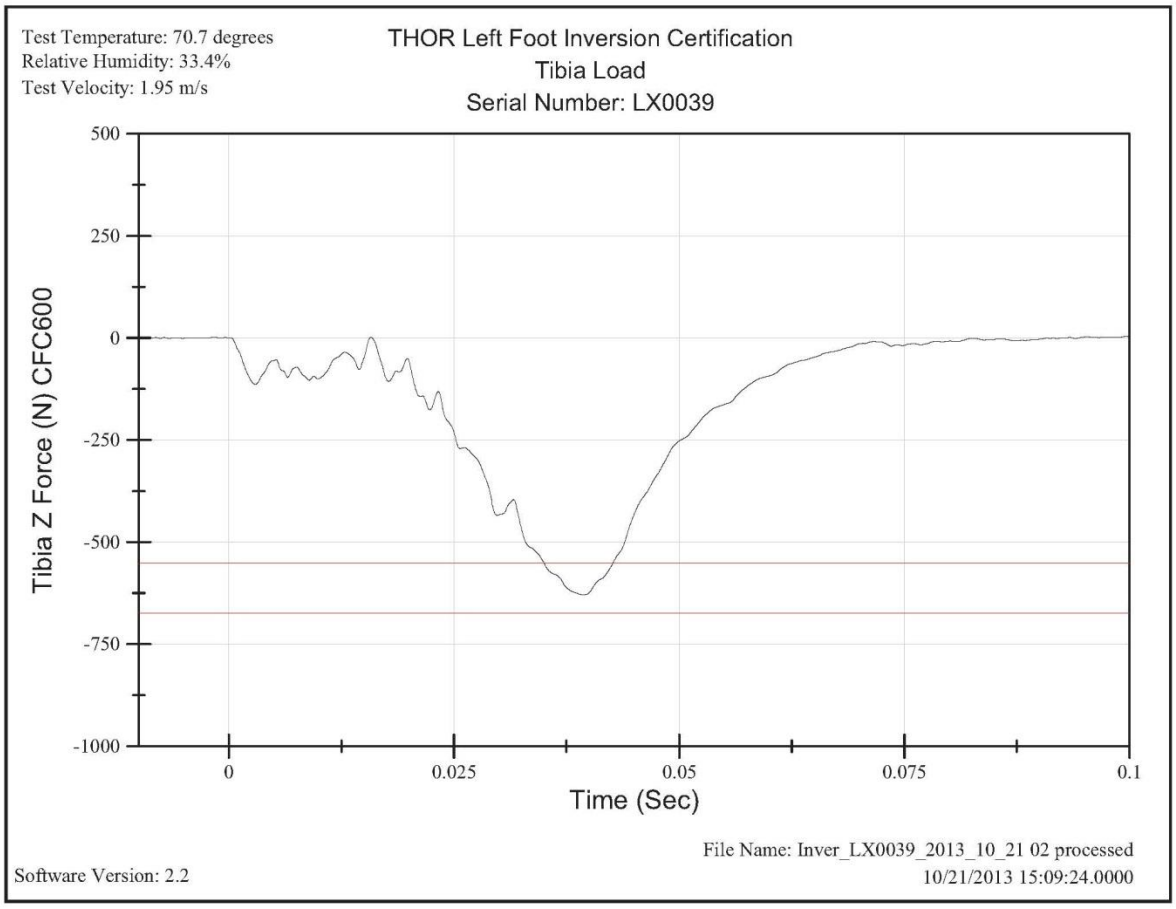
Relative Humidity: 32.5%
Test Velocity: 1.96 m/s
THOR Left Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0039
X-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0039_2013_10_21 02 processed
Software Version: 2.2
10/21/2013 15:38:14.0000


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
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
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Time (Sec)
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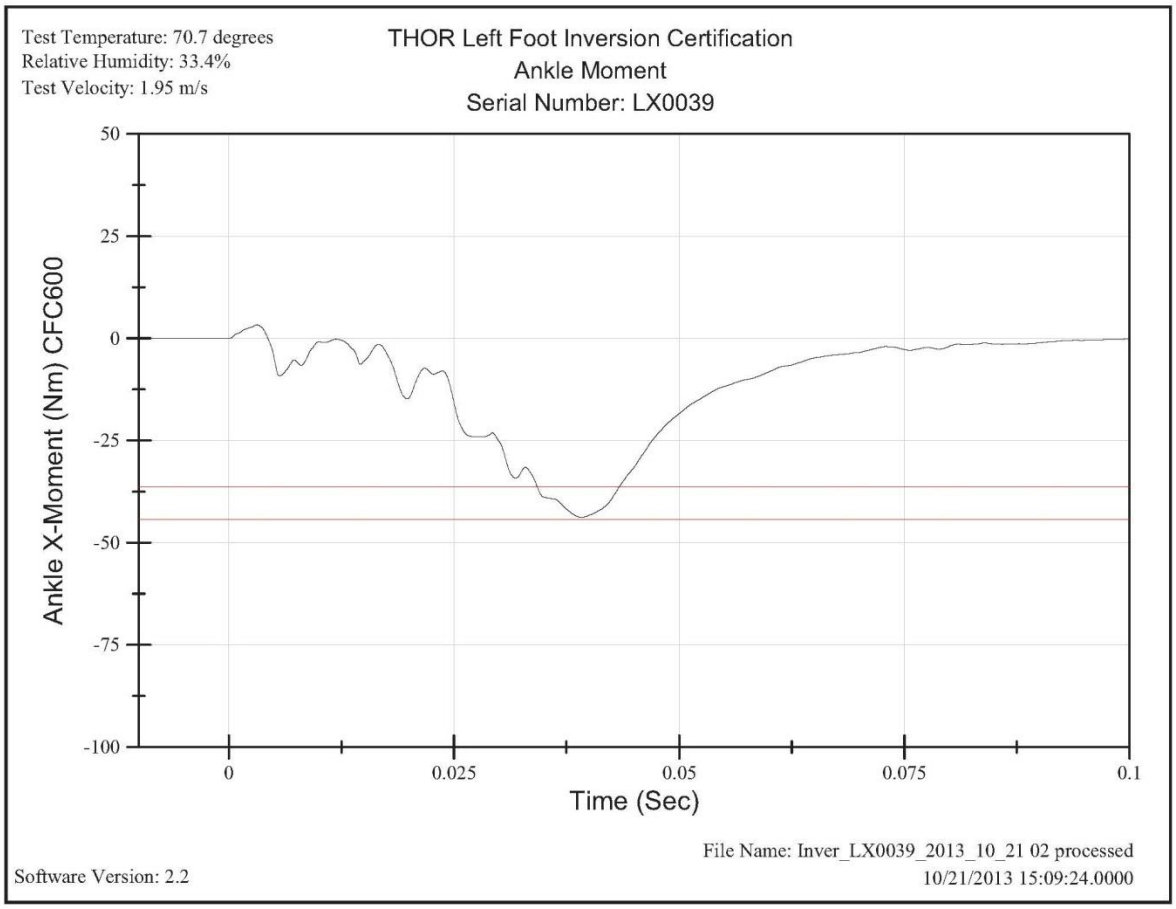
Test Temperature: 70.7 degrees
Relative Humidity: 33.4%
Test Velocity: 1.95 m/s
THOR Left Foot Inversion Certification
Ankle Moment
Serial Number: LX0039
Ankle X-Moment (Nm) CFC600
50
25
0
-25
-50
-75
-100
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0039_2013_10_21 02 processed
Software Version: 2.2
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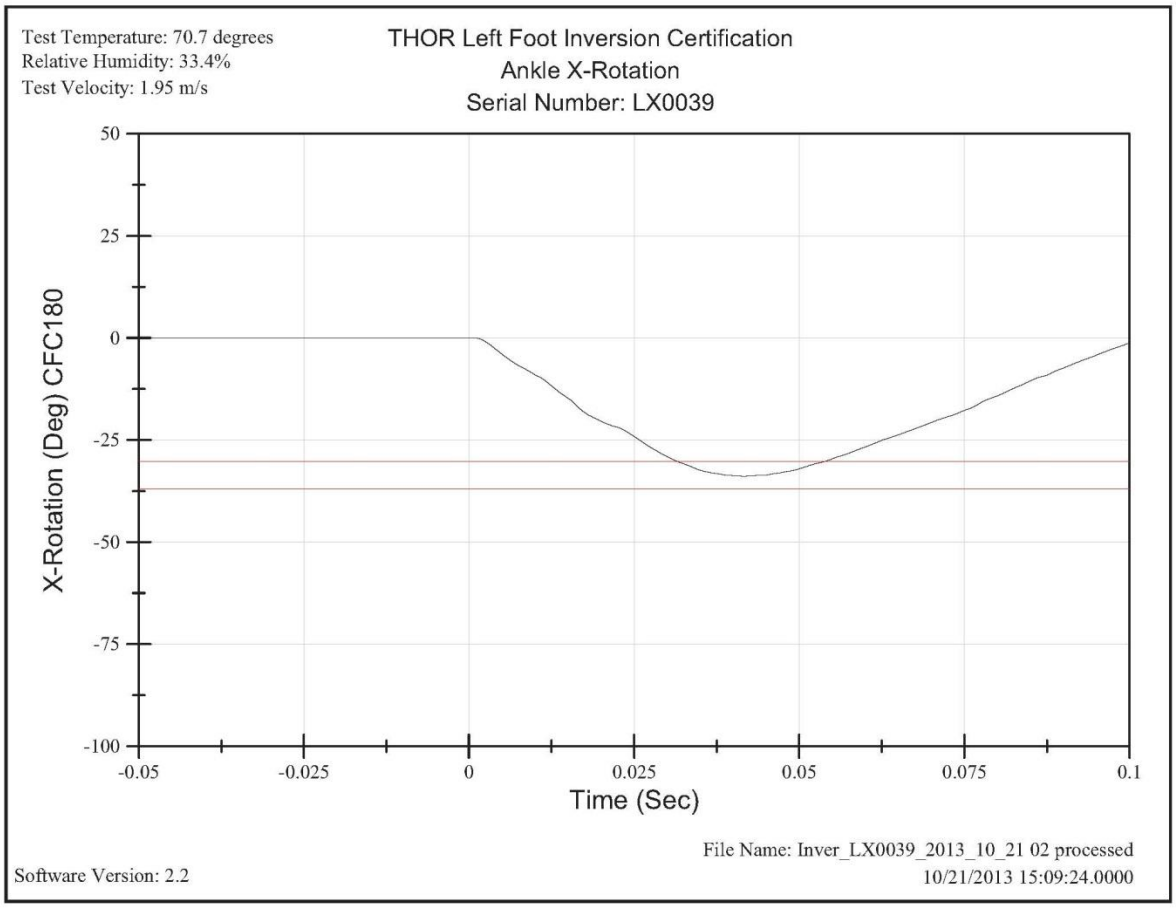
Test Temperature: 70.7 degrees
Relative Humidity: 33.4%
Test Velocity: 1.95 m/s
THOR Left Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0039
X-Rotation (Deg) CFC180
50
25
0
-25
-50
-75
-100
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0039_2013_10_21 02 processed
Software Version: 2.2
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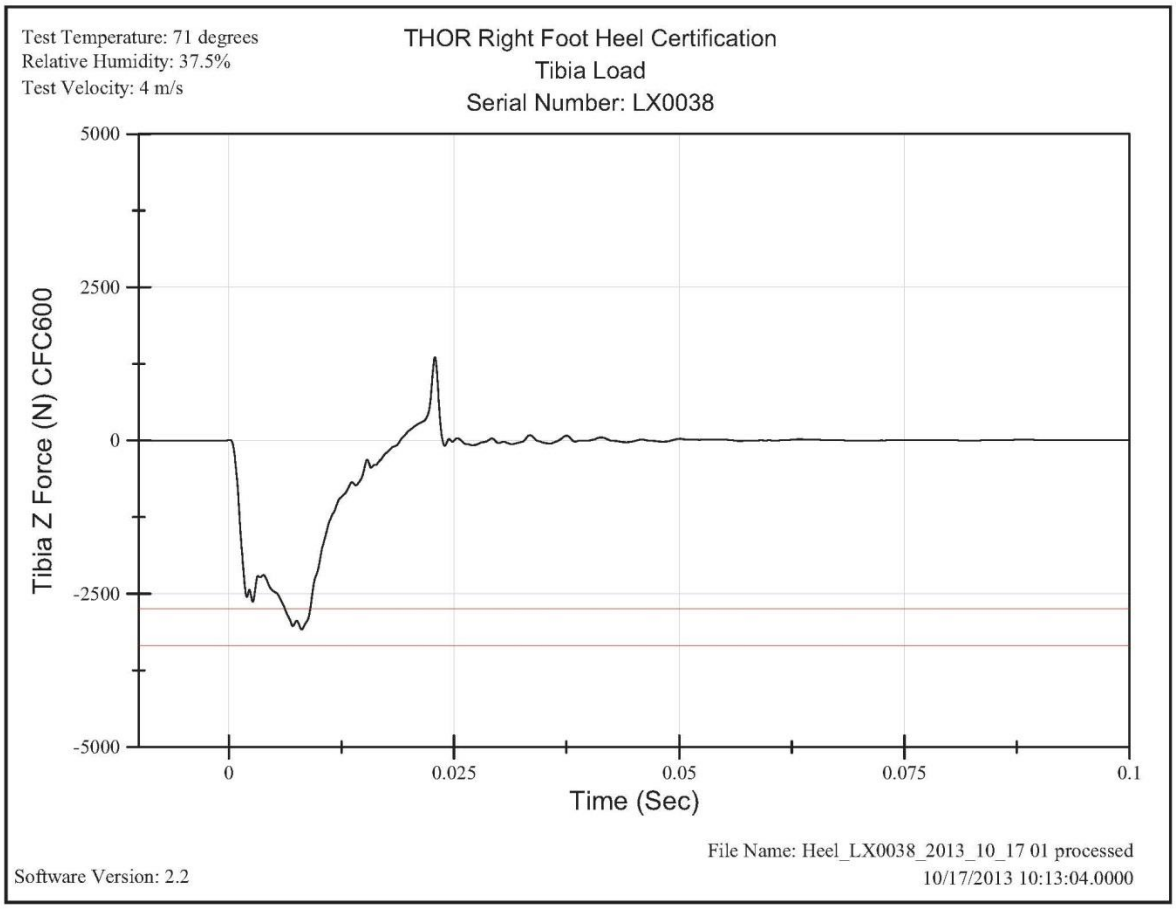
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Test Velocity: 4 m/s
THOR Right Foot Heel Certification
Tibia Load
Serial Number: LX0038
Tibia Z Force (N) CFC600
5000
2500
0
-2500
-5000
0
0.025
0.05
0.075
0.1
Time (Sec)
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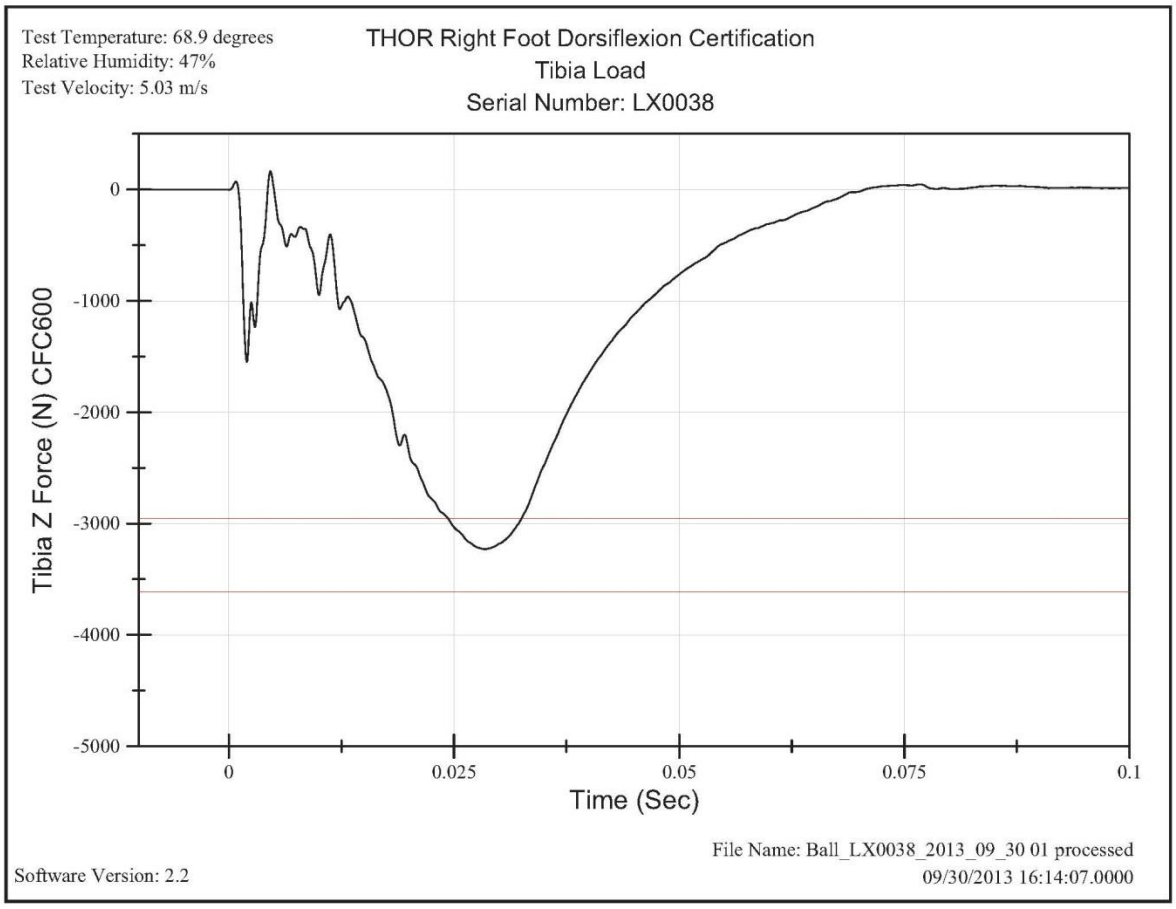
Test Temperature: 68.9 degrees
Relative Humidity: 47%
Test Velocity: 5.03 m/s
THOR Right Foot Dorsiflexion Certification
Tibia Load
Serial Number: LX0038
Tibia Z Force (N) CFC600
0
-1000
-2000
-3000
-4000
-5000
0
0.025
0.05
0.075
0.1
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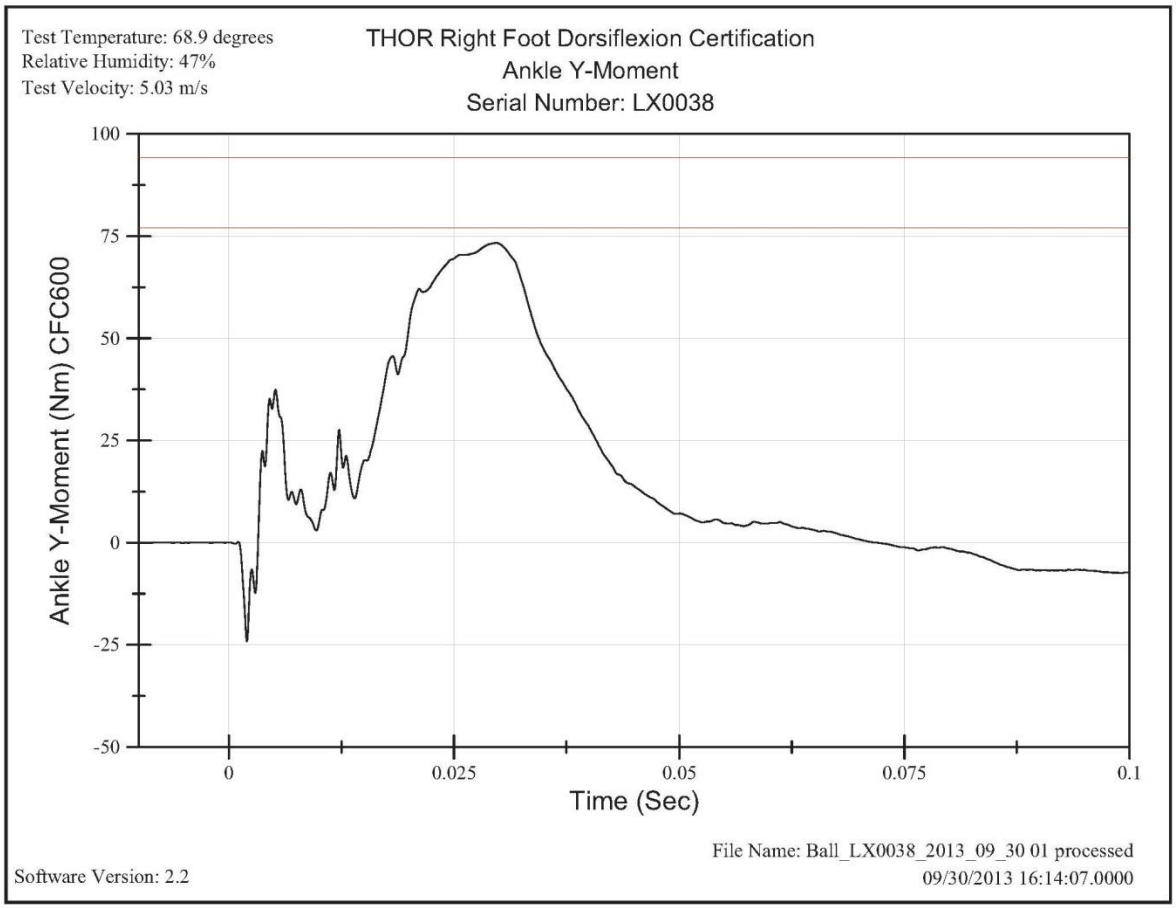
Test Temperature: 68.9 degrees
Relative Humidity: 47%
Test Velocity: 5.03 m/s
THOR Right Foot Dorsiflexion Certification
Ankle Y-Moment
Serial Number: LX0038
Ankle Y-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
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Software Version: 2.2
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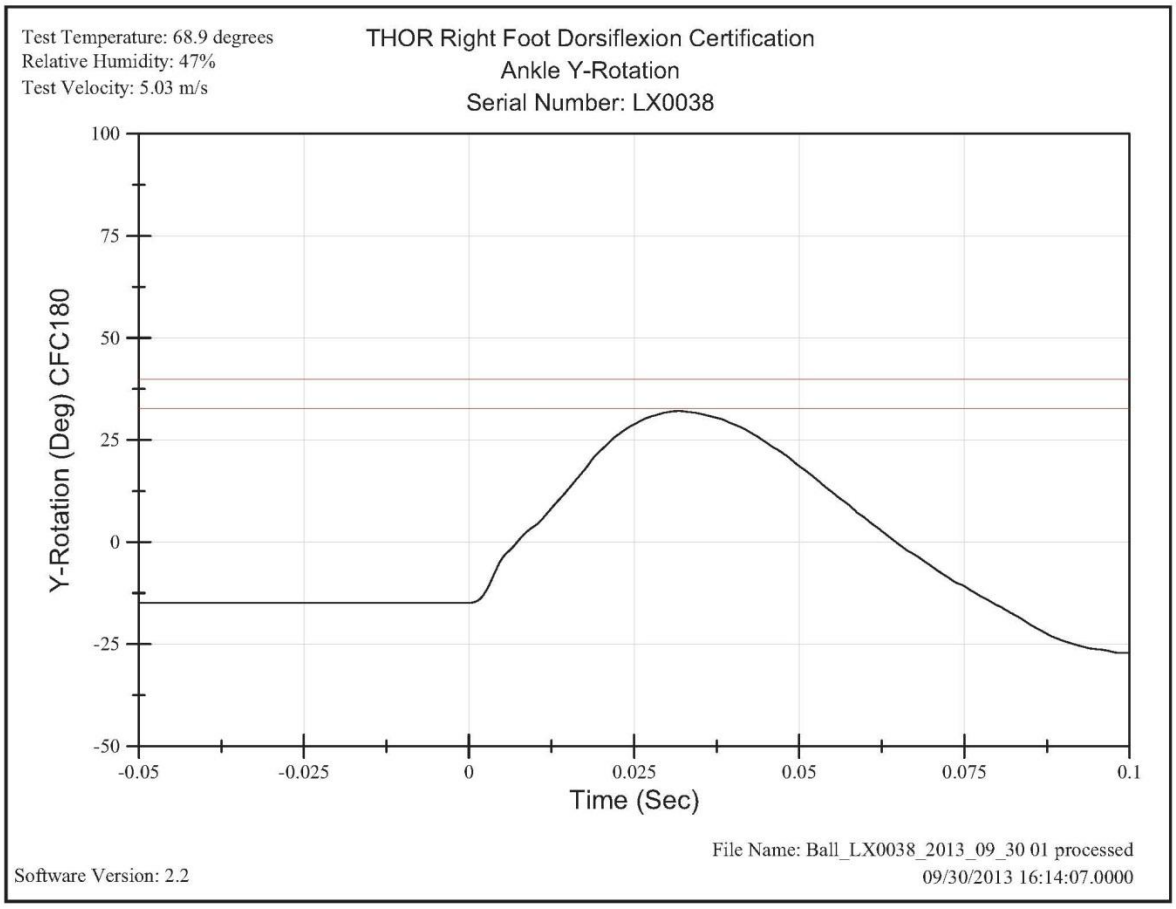
Test Temperature: 68.9 degrees
Relative Humidity: 47%
Test Velocity: 5.03 m/s
THOR Right Foot Dorsiflexion Certification
Ankle Y-Rotation
Serial Number: LX0038
Y-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
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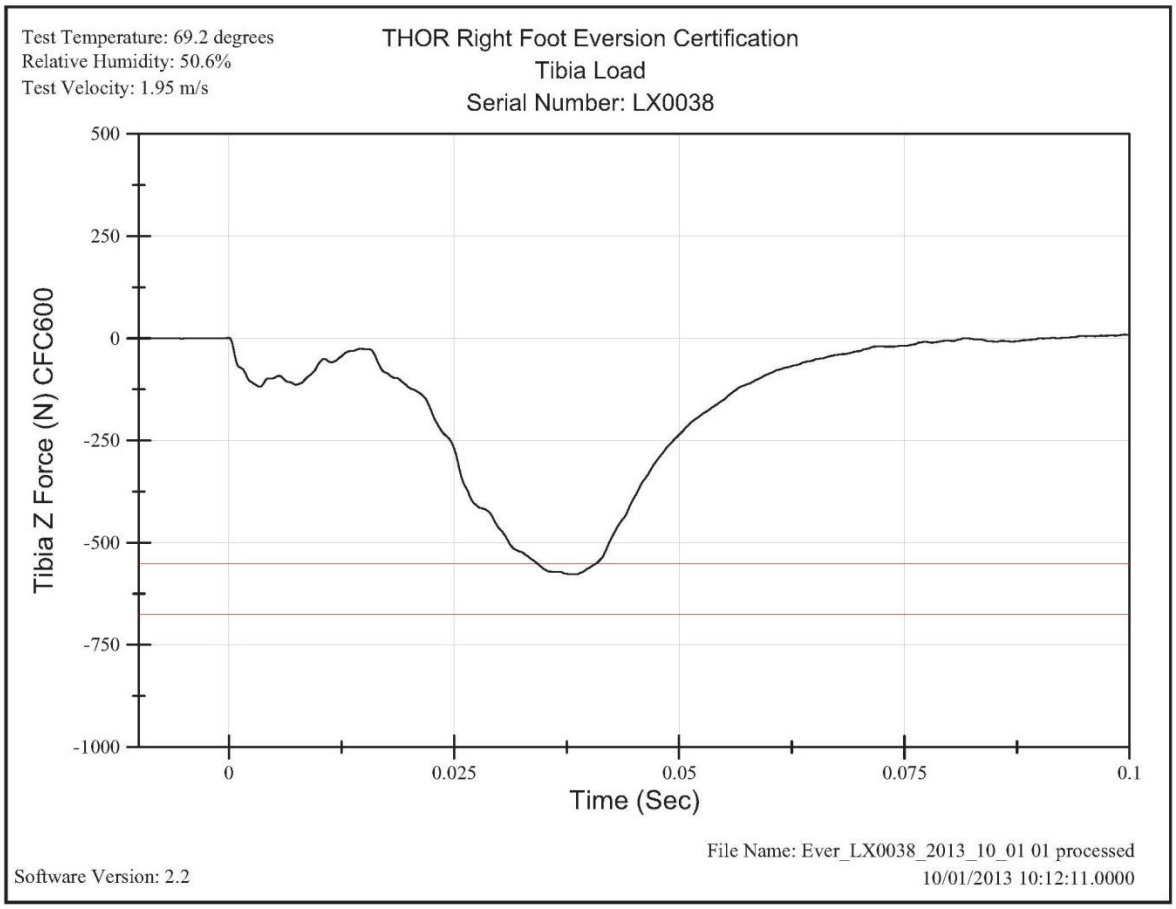
Test Temperature: 69.2 degrees
Relative Humidity: 50.6%
Test Velocity: 1.95 m/s
THOR Right Foot Eversion Certification
Tibia Load
Serial Number: LX0038
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
0.1
Time (Sec)
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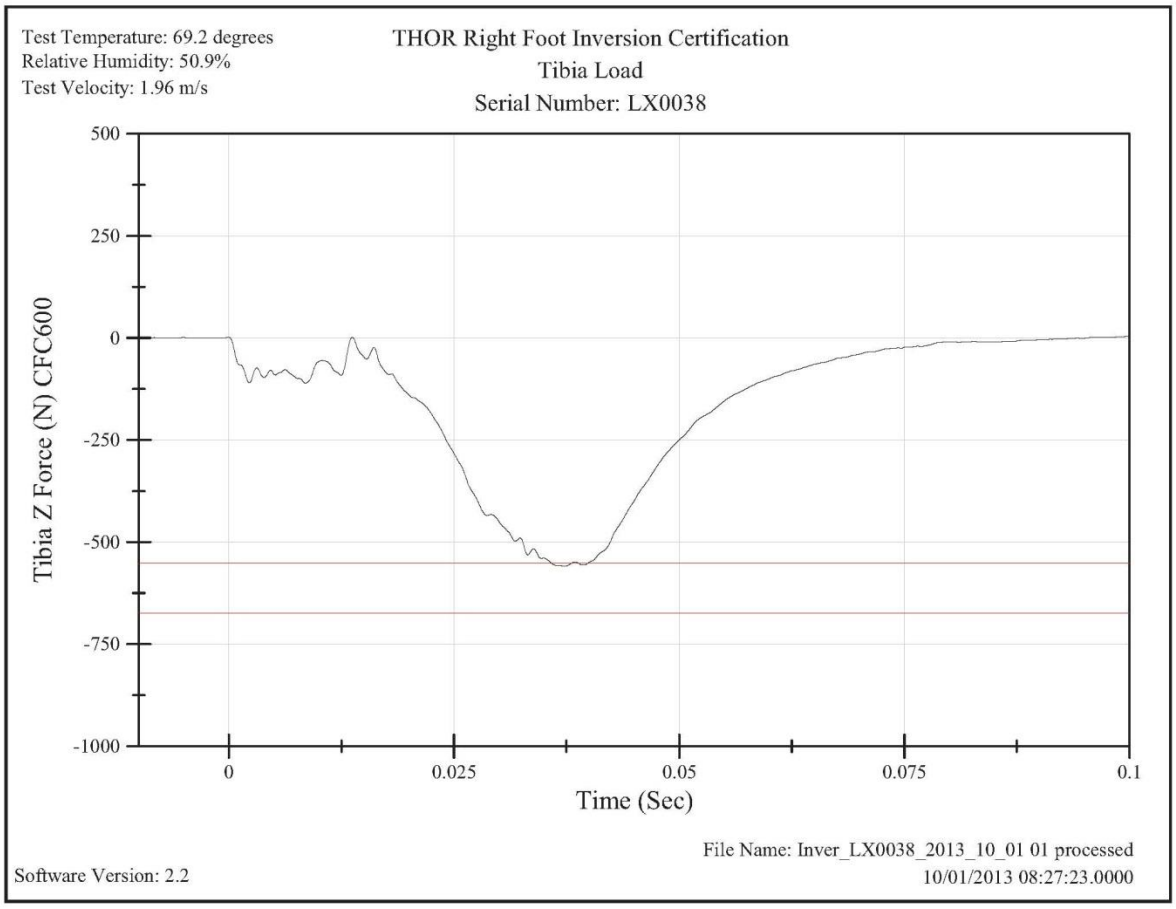
Test Temperature: 69.2 degrees
Relative Humidity: 50.9%
Test Velocity: 1.96 m/s
THOR Right Foot Inversion Certification
Tibia Load
Serial Number: LX0038
Tibia Z Force (N) CFC600
500
250
0
-250
-500
-750
-1000
0
0.025
0.05
0.075
0.1
Time (Sec)
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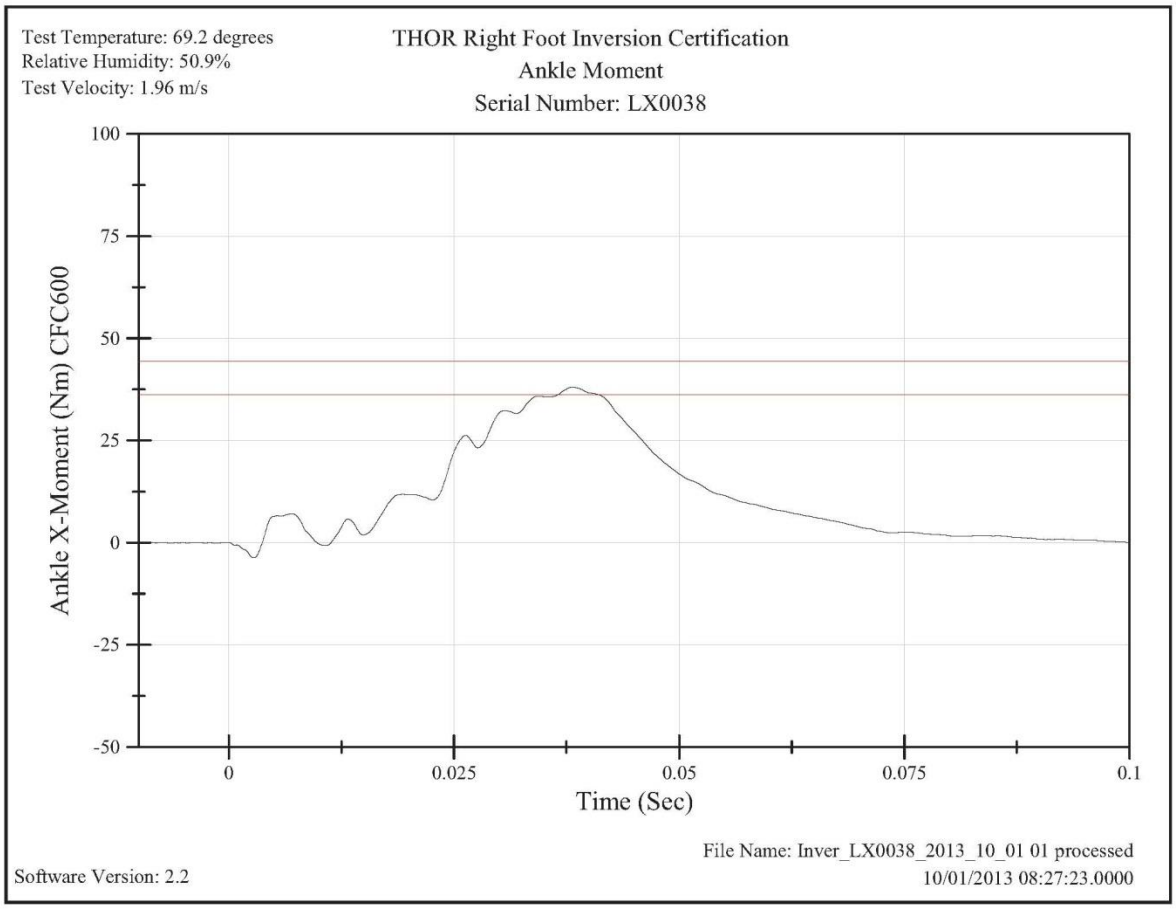
Test Temperature: 69.2 degrees
Relative Humidity: 50.9%
Test Velocity: 1.96 m/s
THOR Right Foot Inversion Certification
Ankle Moment
Serial Number: LX0038
Ankle X-Moment (Nm) CFC600
100
75
50
25
0
-25
-50
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0038_2013_10_01 01 processed
Software Version: 2.2
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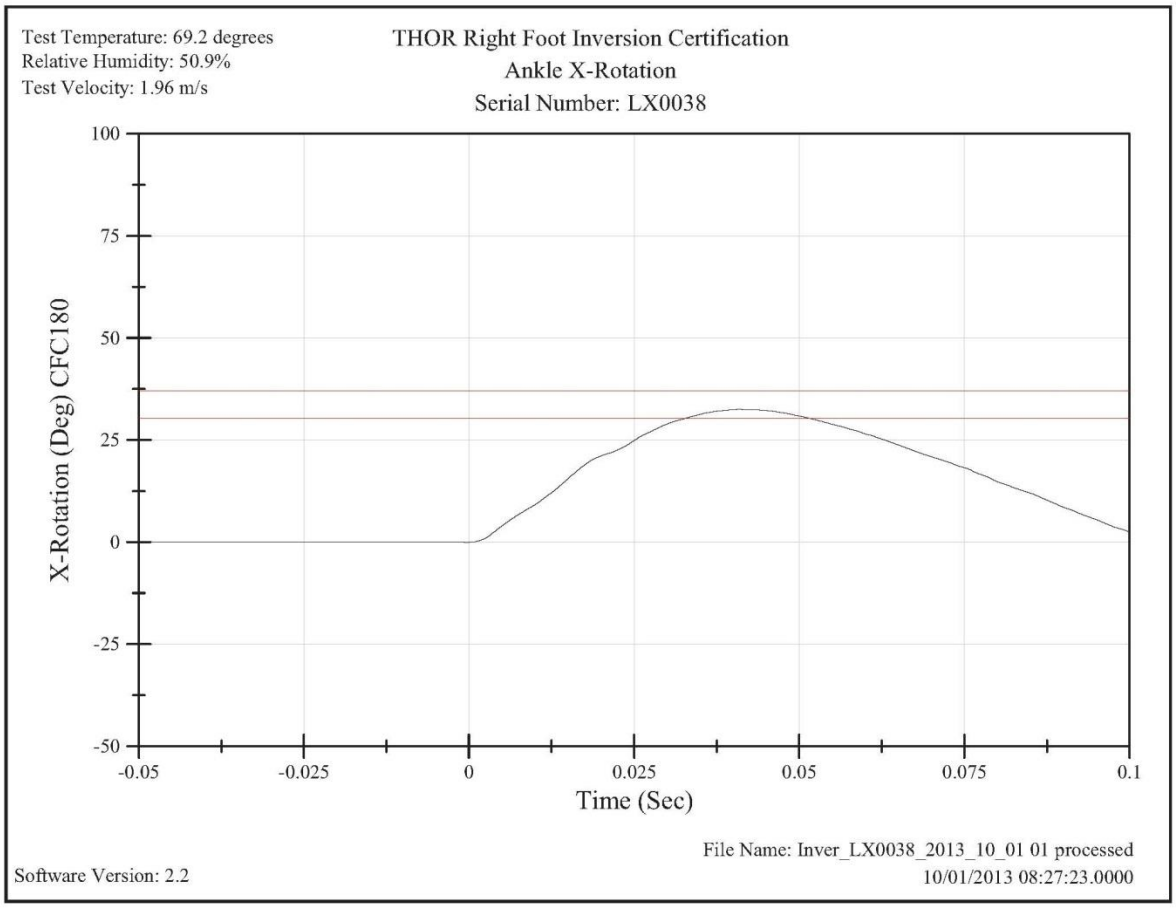
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Relative Humidity: 50.9%
Test Velocity: 1.96 m/s
THOR Right Foot Inversion Certification
Ankle X-Rotation
Serial Number: LX0038
X-Rotation (Deg) CFC180
100
75
50
25
0
-25
-50
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Inver_LX0038_2013_10_01 01 processed
Software Version: 2.2
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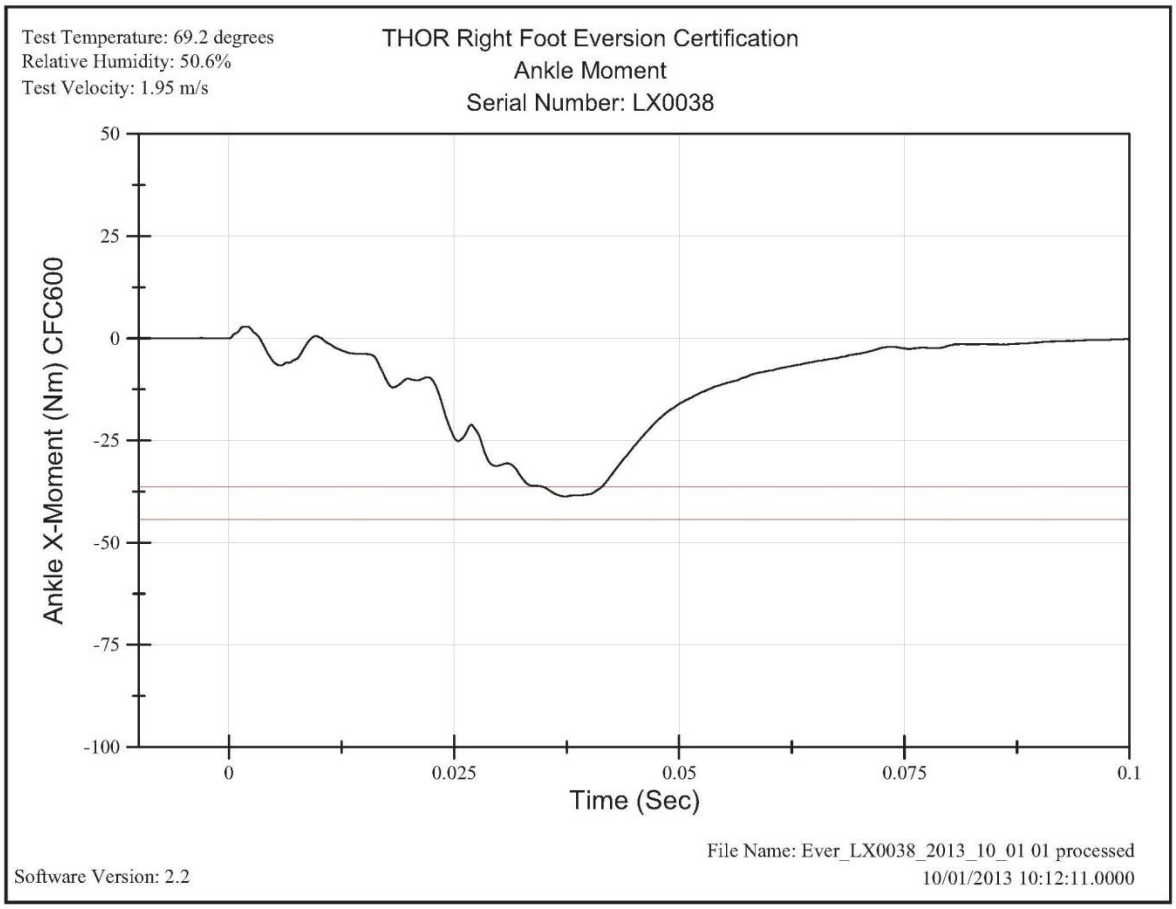
Test Temperature: 69.2 degrees
Relative Humidity: 50.6%
Test Velocity: 1.95 m/s
THOR Right Foot Eversion Certification
Ankle Moment
Serial Number: LX0038
Ankle X-Moment (Nm) CFC600
50
25
0
-25
-50
-75
-100
0
0.025
0.05
0.075
0.1
Time (Sec)
File Name: Ever_LX0038_2013_10_01 01 processed
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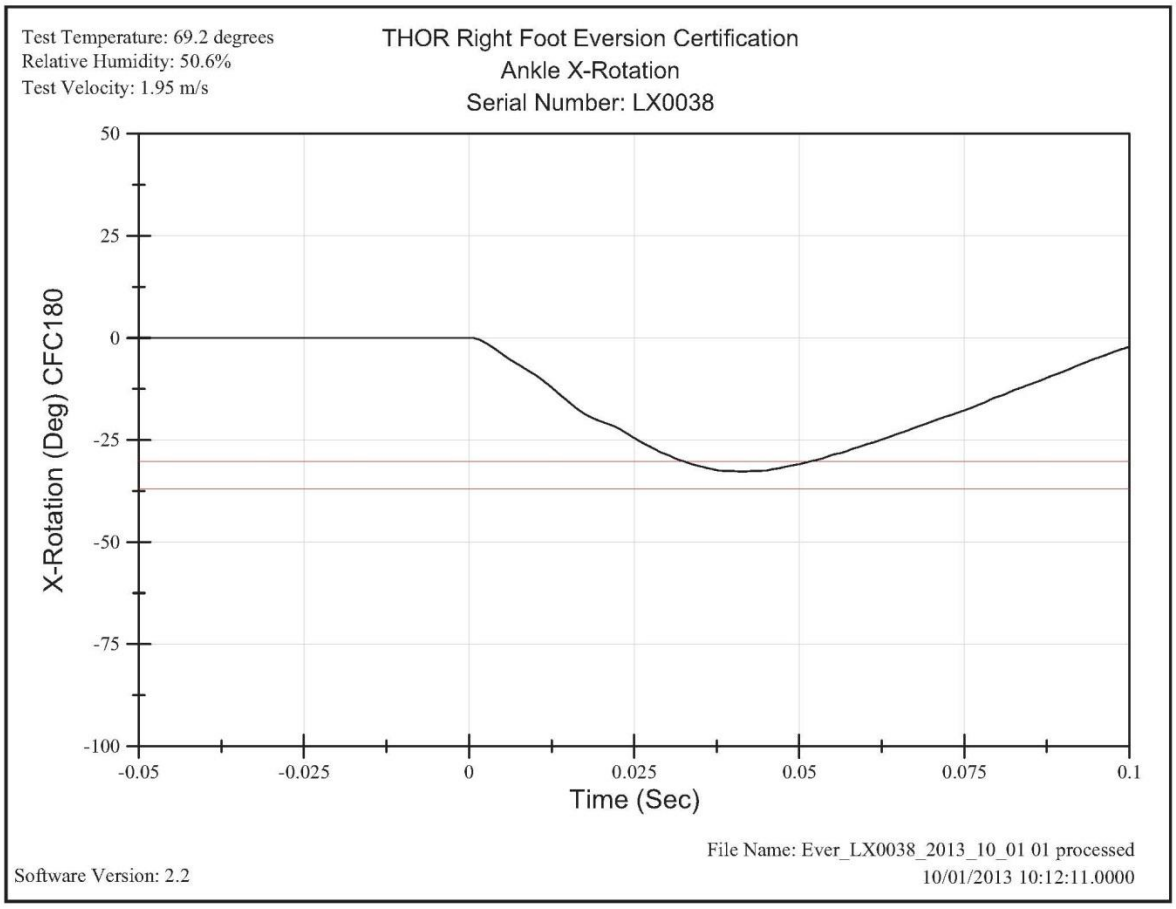
Test Temperature: 69.2 degrees
Relative Humidity: 50.6%
Test Velocity: 1.95 m/s
THOR Right Foot Eversion Certification
Ankle X-Rotation
Serial Number: LX0038
X-Rotation (Deg) CFC180
50
25
0
-25
-50
-75
-100
-0.05
-0.025
0
0.025
0.05
0.075
0.1
Time (Sec)
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APPENDIX 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

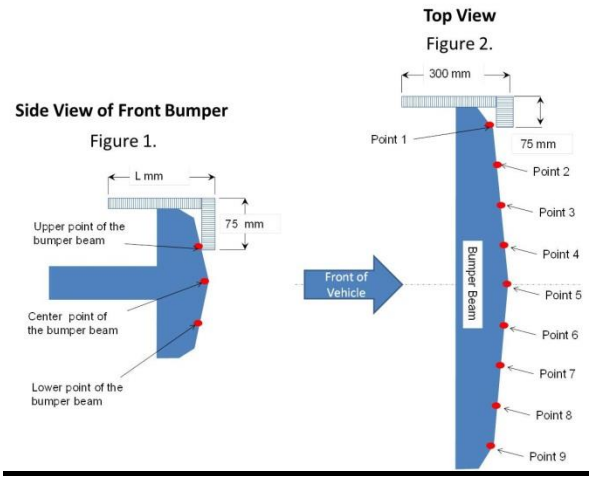
The Brake Pedal Reference Point is the x, y, and z location of the geometric center of the brake pedal pad (top surface) in the VCS.

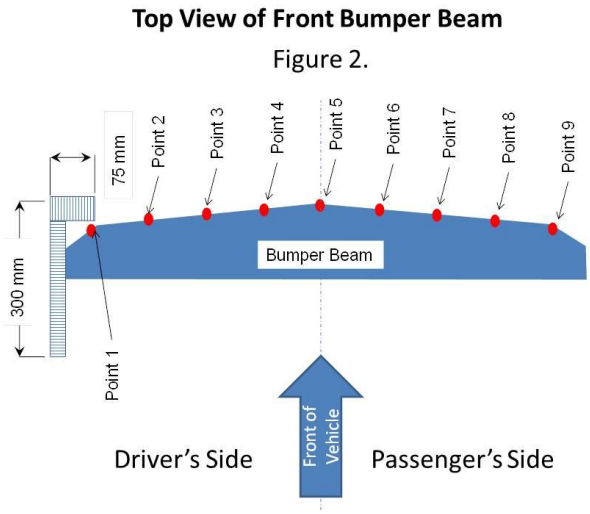
Floor Reference Point

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 toepan/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.

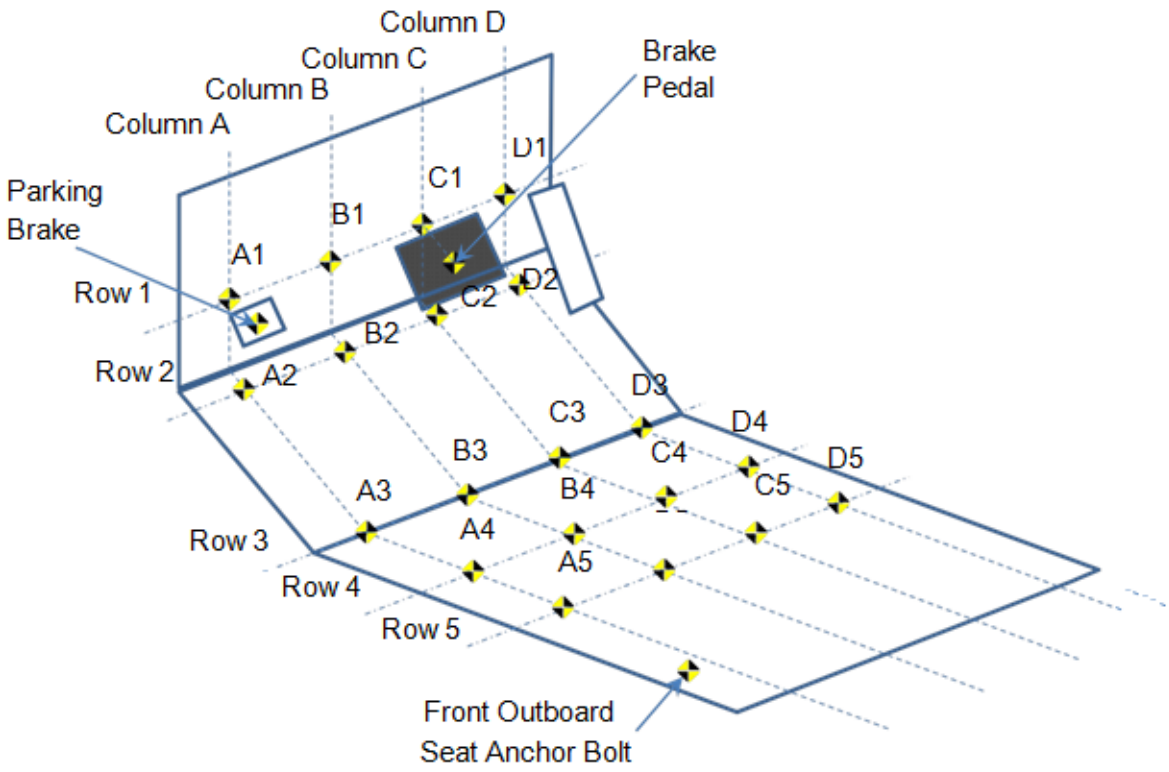
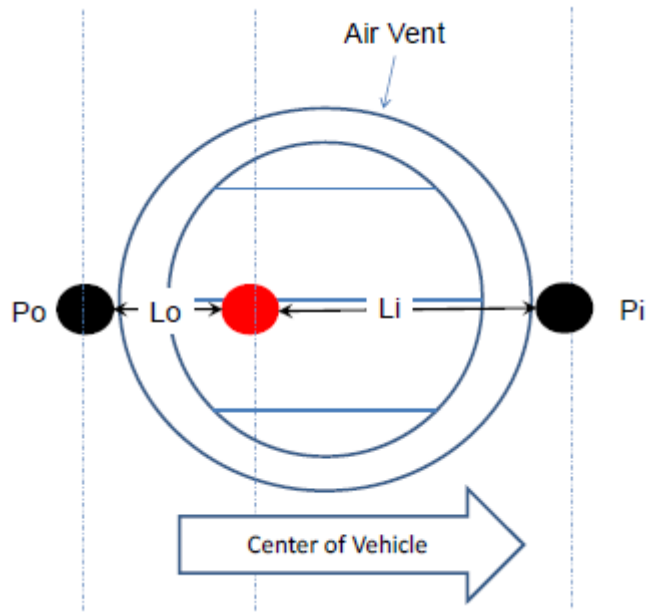


Figure 22: Lower interior intrusion measurements

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.



$$dp = \frac{Li}{Lo + Li}[X_o, Y_o, Z_o] + \frac{Lo}{Lo + Li}[X_o, Y_o, Z_o]$$

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.

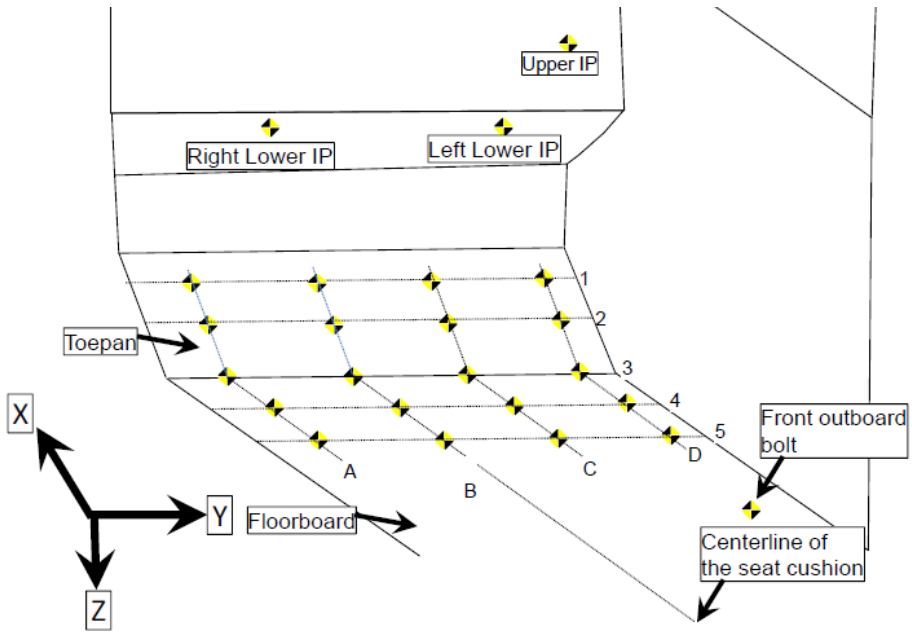


Figure 24: Passenger side lower interior measurements

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

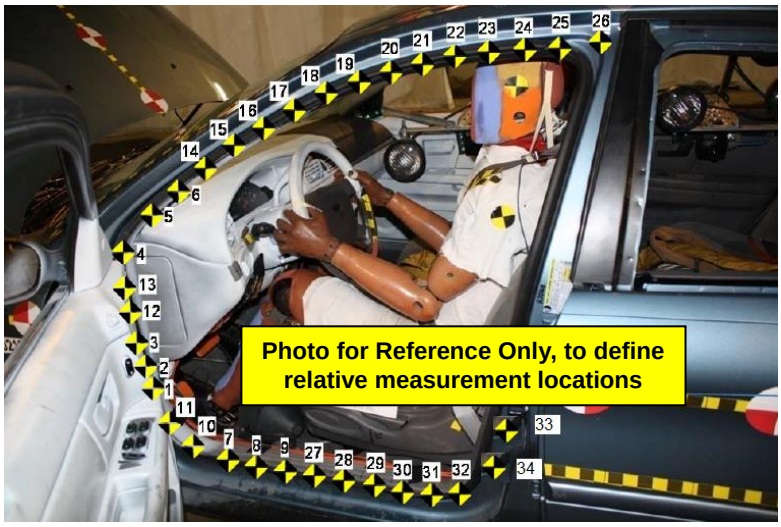


Figure 25: Driver Door Measurements

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.

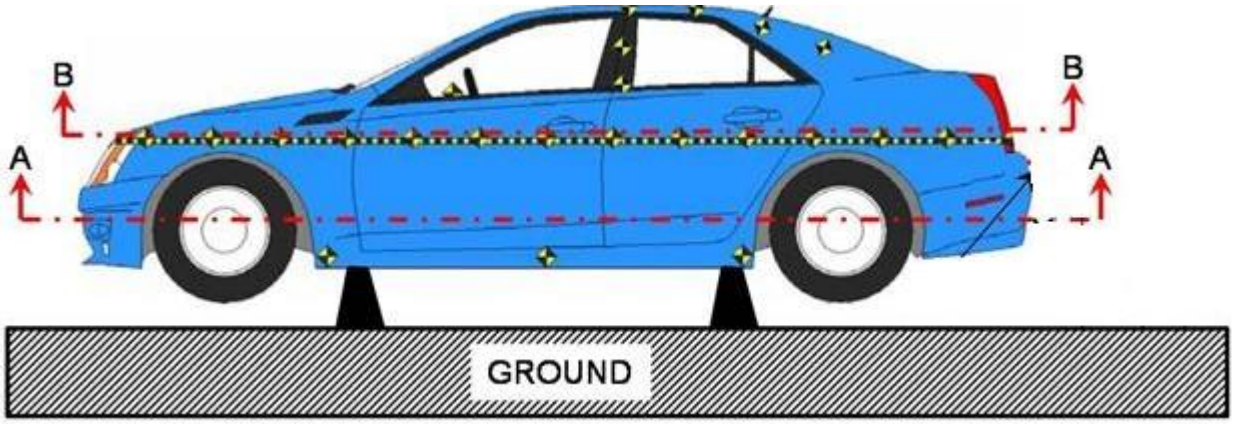


Figure 26: Pre-Test Vehicle Profile

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.

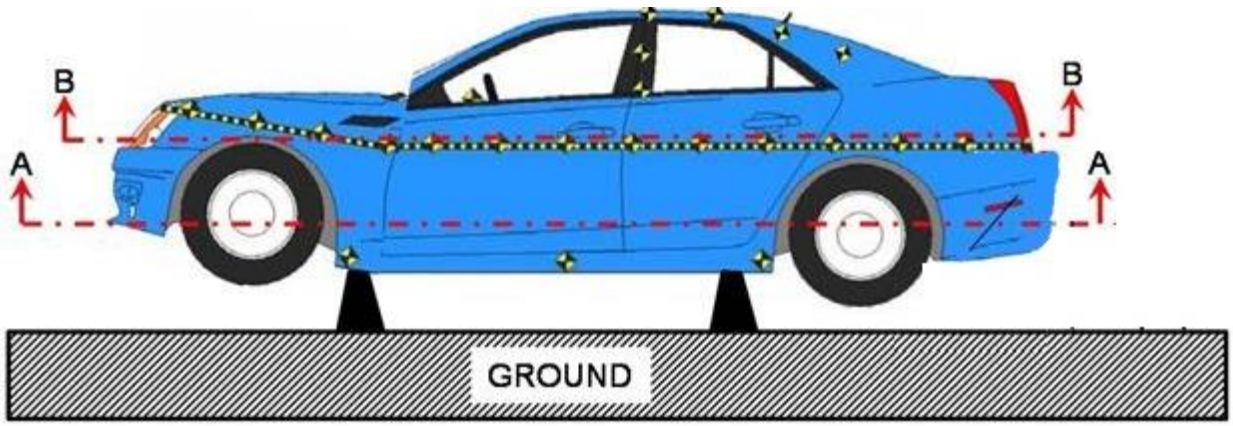
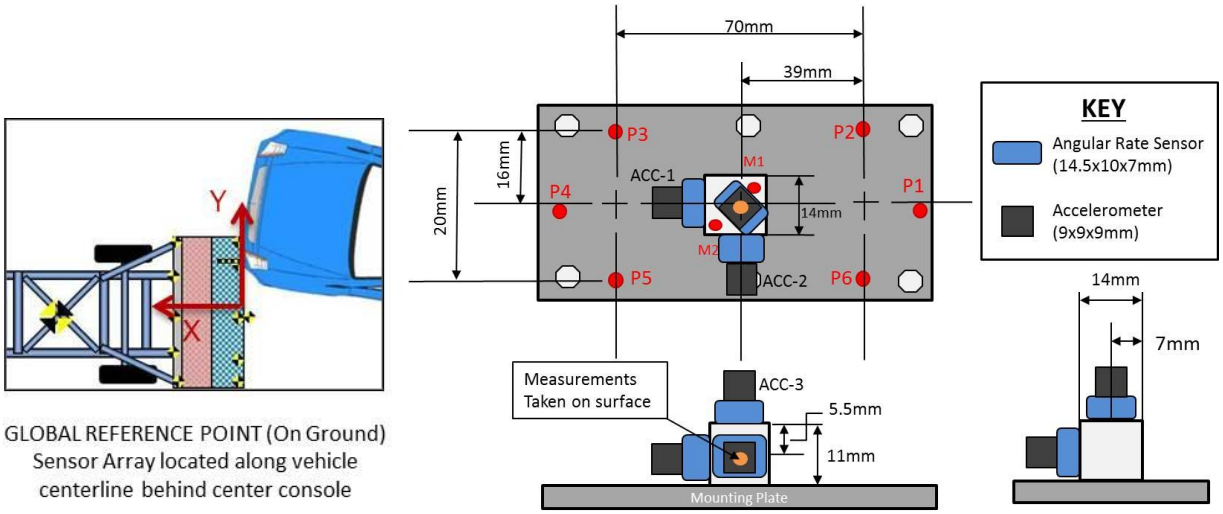


Figure 27: Post-Test Vehicle Profile

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