

REPORT NUMBER: R&D – CAL – 11 - 013

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

**2011 SMART FOR TWO
56 MPH, 15 DEGREE ANGLE, 35% OVERLAP**

**TEST DATE: AUGUST 29th 2011
NHTSA NO: RB0526**

**PREPARED BY;
CALSPAN CORPORATION
4455 GENESEE, BUFFALO NY**



FINAL REPORT SUBMITTED:

FEBRUARY 8, 2012

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FINAL REPORT ACCEPTANCE BY OCWS:

Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

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16. Abstract A test was conducted in accordance with Task Order 0001 of Contract DTNH22-10-D-00155. The Test consisted of a research moving deformable barrier (RRMDB) traveling at a target speed of 90.12 kph into a stationary 2011 Smart ForTwo two door coupe. 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 crash test facility in Buffalo, New York on 8/29/2011. The impact velocity of the vehicle was 90.67 km/h, and the ambient temperature at the barrier face at the time of impact was 18.3°C. The target vehicle post-test maximum crush was 539 mm of Vehicle. The test vehicle's performance is as follows: <table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th colspan="3">Driver ATD</th> <th colspan="3">Pass. ATD</th> </tr> <tr> <th>Units</th> <th>Threshold</th> <th>Result</th> <th>Units</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>700</td> <td>365.54</td> <td>N/A</td> <td>700</td> <td></td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>-46.69</td> <td>mm</td> <td>52</td> <td></td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.88</td> <td>N/A</td> <td>1</td> <td></td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4,170</td> <td>7206.36</td> <td>N</td> <td>2,620</td> <td></td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4,000</td> <td>-5232.28</td> <td>N</td> <td>2,520</td> <td></td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10,008</td> <td>-9105.56</td> <td>N</td> <td>6,805</td> <td></td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10,008</td> <td>-8575.76</td> <td>N</td> <td>6,805</td> <td></td> </tr> </tbody> </table>				Measurement Description	Driver ATD			Pass. ATD			Units	Threshold	Result	Units	Threshold	Result	Head Injury Criteria (HIC ₁₅)	N/A	700	365.54	N/A	700		Maximum Chest Compression	mm	63	-46.69	mm	52		Nij	N/A	1	0.88	N/A	1		Neck Tension	N	4,170	7206.36	N	2,620		Neck Compression	N	4,000	-5232.28	N	2,520		Left Femur Force	N	10,008	-9105.56	N	6,805		Right Femur Force	N	10,008	-8575.76	N	6,805	
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SECTION 1

PURPOSE

Test Vehicle:	<u>2011 Smart ForTwo</u>	NHTSA No:	<u>RB0526</u>
Test Program:	<u>R&D 56mph 15°/ 35% Offset</u>	Test Date	<u>8/29/2011</u>

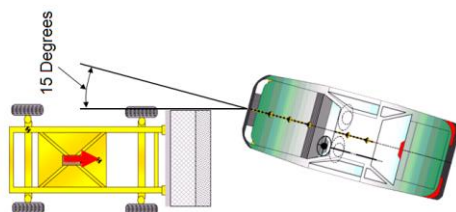
This 90.12 km/h (56 mph) Moving Barrier into a vehicle test is part of Frontal Offset Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-10-D-00155. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

This test was conducted in accordance with the instructions set forth by NHTSA for a 15° angle, 35% offset moving barrier to vehicle impact, outlined in Task Order (TO) DTNH22. 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 TO DTNH22.

SECTION 2 SUMMARY OF TEST

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

A model year 2011 Smart ForTwo was impacted on the left front corner by a Research Moving Deformable Barrier. The test vehicle was stationary and positioned at a target angle of 15° and a target offset of 35% to the line of forward motion of the RMDB. The RMDB was towed down the test track in a full forward direction, without any crabbing, and the targeted impact velocity of 90.12 km/h (56 mph) into the test vehicle.



The test vehicle mass was 1033.5 kg (2274 lbs), and the RMDB mass was 2486.2 kg (5481 lbs). The test was conducted by Calspan Corporation on August 29, 2011.

The test was documented by one (1) real time and fourteen (14) high-speed video cameras. Camera locations and other pertinent data are located in Data Sheet No. 06 of this report. Pre- and post-test photographs of the test vehicle, the RMDB and the 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 MK (Mod Kit) anthropomorphic test device (ATD) (Serial No.: 007) was seated in the left front (driver's) seating position. The THOR MK driver was positioned according to instructions specified in Laboratory Test Procedure for FMVSS No. 208, "Occupant Crash Protection", TP208 13, July 27, 2005.

The driver was restrained with a 3-point seat belt, a dual stage frontal airbag, a curtain airbag, a seat mounted torso airbag, and a bolster mounted knee airbag.

SECTION 2 (CONTINUED)
SUMMARY OF TEST

Test Vehicle:	<u>2011 Smart ForTwo</u>	NHTSA No:	<u>RB0526</u>
Test Program:	<u>R&D 56mph 15°/ 35% Offset</u>	Test Date	<u>8/29/2011</u>

One hundred and fifty six (156) channels of data from the ATD, test vehicle and RMDB were collected using Kayser-Threde and Slice data acquisition systems. Appendix B contains dummy data plots, as well as vehicle and RMDB response data plots.

There was 74.6% total windshield retention, with 54.1% and 95.1% 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 test. The maximum static crush of the vehicle was 539 mm at C2 to the left of the vehicle's centerline. The maximum crush of the lower bumper beam was 545 mm at C1 of the lower bumper beam, to the left of vehicle's centerline. Full vehicle measurements are presented in Section 3 of this report.

Both vehicle doors remained closed and latched during the test. The left front door was jammed shut, but was able to be opened. The Right front door remained operational after the test.

Structure observations include the following:

- The A-Pillar buckled, causing some separation at the top of the door from the vehicle.
- The hood and back hatch opened after contact and the hatch window was detached from the vehicle.

The driver ATD's visible contact points are as follows:

- The head contacted the steering wheel airbag and the bottom of the driver's side window frame.
- The torso contacted the front airbag, bottom of the steering wheel, and the door.
- The knees contacted the knee airbag.

SECTION 2 (CONTINUED)
CRASH VEHICLE SUMMARY

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

PRIMARY IMPACT DATA

Measured Parameter	Units	Value
RMDB Velocity at Impact	km/h	90.3
RMDB Test Weight	kg	2491
RMDB Maximum Static Crush	mm	194.4
Vehicle Test Weight	kg	1033.5
Actual Vehicle Angle	°	15
Vehicle Maximum Static Crush	mm	539
Vertical Offset from Target Point	mm	2 to the bottom
Lateral Offset from Target Point	mm	25 to the Left
Number of Data Channels		198
Number of Real-Time Cameras		1
Number of High-Speed Cameras		14

DUMMY CONTACTS

	Driver (P1)	Picture Ref.	Passenger (P4)	Picture Ref.
Dummy Type	50% Male, Thor 007	-		
Head Contact	Driver steering wheel airbag and bottom of driver's side window frame	A-37 A-48		
Upper Torso Contact	Driver steering wheel airbag and Door	-		
Lower Torso Contact	Driver's Side Door	A-46 A-47		
Left Knee Contact	Knee bolster airbag	A-45		
Right Knee Contact	Knee bolster airbag	A-44		

Comments: There was no P4 (passenger) ATD for this test.

Data Anomalies:

P1 Driver: V2P1 NECK UPPER FZ ->questionable 93 -136 ms
V2P1 PELVIS ASIS RIGHT FY ->Questionable after 6 ms
V2P1 RIGHT ILIAC FX ->questionable after 97 ms
V2P1 RIGHT ILIAC MY ->channel failed
V2P1 LEFT FEMUR FX ->questionable after 18 ms
V2P1 KNEE LEFT Dx ->questionable 32-49ms sat.
V2P1 TIBIA LEFT UPPER FZ ->questionable after 19 ms
V2P1 TIBIA LEFT LOWER FX ->Questionable magnitude
V2P1 RIGHT FEMUR MX ->questionable after 31 ms

Vehicle Instrumentation:

V2 RIGHT REAR SILL Y ->channel failed

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2011 Smart for Two 2-Door Coupe NHTSA No.: RB0526
Test Program: Research and Development Narrow Offset Test Date: 8/29/2011

Driver: Thor Serial No. 007 Injury Summary

	Nomenclature	Units	Source	Max	Min
Head	Head Rotational Acceleration X	rad/s ²	SIMon	369176.28	-445113.72
	Head Rotational Acceleration Y	rad/s ²	SIMon	534655.68	-402404.32
	Head Rotational Acceleration Z	rad/s ²	SIMon	546369.61	-495470.39
	Head Rotational Acceleration Resultant	rad/s ²	Compute	593039.29	
	Head Rotational Velocity X	rad/s	SIMon	43.28	-75.47
	Head Rotational Velocity Y	rad/s	SIMon	84.40	-41.63
	Head Rotational Velocity Z	rad/s	SIMon	26.49	-90.09
	Head Rotational Velocity Resultant	rad/s	Compute	106.72	
	36 ms HIC		Compute	503.23	
	15 ms HIC		Compute	365.54	
	Head Resultant CG Acceleration, 3 ms Clip	g	Compute	62.30	
	Skull fracture correlate	-	SIMon	56.85	
	Cumulative strain (Tolerance = 0.05)	-	SIMon	1.00	0.00
	Cumulative strain (Tolerance = 0.10)	-	SIMon	0.89	0.00
	Cumulative strain (Tolerance = 0.15)	-	SIMon	0.51	0.00
Neck	UNLC Transferred to OC, Neck System, FX	N	1000	343.98	-618.50
	UNLC Neck System Tension, FZ	N	1000	7206.36 ⁽¹⁾	
	UNLC Neck System Compression, FZ	N	1000		-5232.28 ⁽¹⁾
	UNLC Transferred to OC, Neck System Flexion, MY	N-m	Thortest	4.60	
	UNLC Transferred to OC, Neck System Extension, MY	N-m	Thortest		-16.63
	NIJ		Compute	0.88	
	On head acting through total neck section, FX	N	Thortest	551.05	-1372.49
	On head acting through total neck section, FY	N	Thortest	486.59	-162.99
	On head acting through total neck section, FZ	N	Thortest	7387.33 ⁽¹⁾	-5045.78 ⁽¹⁾
	On head acting through total neck section, MX	N-m	Thortest	59.55	-48.89
	On head acting through total neck section, MY	N-m	Thortest	32.76	-21.00
	On head acting through total neck section, MZ	N-m	Thortest	12.68	-19.99
	On head acting through O.C. joint only, FX	N	Thortest	403.87	-1295.14
	On head acting through O.C. joint only, FZ	N	Thortest	6304.84 ⁽¹⁾	-4421.60 ⁽¹⁾
	On head acting through O.C. joint only, MY	N-m	Thortest	4.60	-16.63
Chest	Upper Left Crux X – deflection	mm	Thortest	1.63	-18.13
	Upper Left Crux Y – deflection	mm	Thortest	8.41	-16.38
	Upper Left Crux Z – deflection	mm	Thortest	10.15	-11.24
	Upper Left Crux D – deflection	mm	Thortest	0.97	-18.06
	Upper Right Crux X – deflection	mm	Thortest	0.02	-48.33
	Upper Right Crux Y – deflection	mm	Thortest	17.27	-9.82
	Upper Right Crux Z – deflection	mm	Thortest	26.57	-0.41
	Upper Right Crux D – deflection	mm	Thortest	0.02	-46.69

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver

Test Vehicle: 2011 Smart for Two 2-Door Coupe NHTSA No.: RB0526
 Test Program: Research and Development Narrow Offset Test Date: 8/29/2011

Driver: Thor Serial No. 007 Injury Summary

	Nomenclature	Units	Source	Max	Min
Chest (Con't)	Lower Left Crux X – deflection	mm	Thortest	8.89	-5.03
	Lower Left Crux Y – deflection	mm	Thortest	8.94	-27.36
	Lower Left Crux Z – deflection	mm	Thortest	10.23	-11.03
	Lower Left Crux D – deflection	mm	Thortest	8.88	-5.30
	Lower Right Crux X – deflection	mm	Thortest	0.04	-40.34
	Lower Right Crux Y – deflection	mm	Thortest	3.01	-26.38
	Lower Right Crux Z – deflection	mm	Thortest	14.56	-6.88
	Lower Right Crux D – deflection	mm	Thortest	0.04	-38.00
	Chest CG Acceleration, 3 ms clip	g	Compute	57.18	
Abdomen	Lower Left X – deflection	mm	Thortest	0.17	-48.77
	Lower Left Y – deflection	mm	Thortest	11.37	-0.04
	Lower Left Z – deflection	mm	Thortest	6.05	-7.74
	Left Viscous Criterion Based on X - deflection		Compute	1.11	
	Lower Right X – deflection	mm	Thortest	0.03	-54.35
	Lower Right Y – deflection	mm	Thortest	3.29	-8.94
	Lower Right Z – deflection	mm	Thortest	10.69	-0.16
	Right Viscous Criterion Based on X - deflection		Compute	2.89	
Spine	Upper Spine (T1) AX	g	180	19.04	-104.96
	Upper Spine (T1) AY	g	180	30.99	-32.80
	Upper Spine (T1) AZ	g	180	21.51	-7.88
	Upper Spine (T1) Resultant	g	Compute	108.50	
	Middle Spine (T6) AX	g	180	15.37	-58.96
	Middle Spine (T6) AY	g	180	23.34	-13.10
	Middle Spine (T6) AZ	g	180	15.42	-20.48
	Middle Spine (T6) Resultant	g	Compute	60.39	
Pelvis	Pelvis CG Resultant Acceleration	g	Compute	129.56	
Acetabulum	Left FX force	N	600	661.07	-4629.00
	Left FY force	N	600	938.57	-2152.40
	Left FZ force	N	600	3535.95	-134.33
	Left Acetabulum Resultant	N	Compute	5043.45	
	Right FX force	N	600	975.20	-3719.66
	Right FY force	N	600	26016.61 ⁽²⁾	-4241.55 ⁽²⁾
	Right FZ force	N	600	1596.31	-537.64
	Right Acetabulum Resultant	N	Compute	26028.75 ⁽²⁾	

SECTION 2 (CONTINUED)
PRELIMINARY INJURY SUMMARY: Driver Legs

Test Vehicle: 2011 Smart for Two 2-Door Coupe NHTSA No.: RB0526
 Test Program: Research and Development Narrow Offset Test Date: 8/29/2011

Driver: Thor Serial No. 007 Injury Summary

	Nomenclature	Units	Source	Max	Min
Knee	Left Knee Displacement, DX	mm	180	1.50 ⁽³⁾	-23.37 ⁽³⁾
	Right Knee Displacement, DX	mm	180	1.67	-19.69
Femur	Left Femur Force, FZ	N	600	629.66	-9105.56
	Left Femur Moment, MX	N-m	600	43.96	-352.69
	Left Femur Moment, MY	N-m	600	258.20	-706.78
	Left Femur Res (MX / MY only, not MZ)	N-m	Compute	757.95	
	Right Femur Force, FZ	N	600	934.65	-8575.76
	Right Femur Moment, MX	N-m	600	375.73 ⁽⁴⁾	-373.40 ⁽⁴⁾
	Right Femur Moment, MY	N-m	600	116.27	-12.98
	Right Femur Res (MX / MY only, not MZ)	N-m	Compute	378.85 ⁽⁴⁾	
	Left Upper Tibia, FZ	N	600	13871.54 ⁽⁵⁾	-7787.59 ⁽⁵⁾
	Left Upper Tibia, MY	N-m	600	276.46	-111.70
Tibia	Left Upper Tibia, Index		Compute	1.54 ⁽⁵⁾	
	Right Upper Tibia, FZ	N	600	2324.91	-4085.90
	Right Upper Tibia, MY	N-m	600	212.53	-162.65
	Right Upper Tibia, Index		Compute	1.51	
	Left Lower Tibia, FZ	N	600	532.57	-4288.46
	Left Lower Tibia, MY	N-m	600	134.90	-124.52
	Left Lower Tibia, Index		Compute	0.85	
	Right Lower Tibia, FZ	N	600	1121.23	-6276.26
	Right Lower Tibia, MY	N-m	600	146.08	-239.63
	Right Lower Tibia, Index		Compute	1.77	
Ankle	Left Ankle Rotation, RX	Deg	180	32.68	-22.68
	Left Ankle Rotation, RY	Deg	180	40.34	-4.17
	Right Ankle Rotation, RX	Deg	180	16.23	-31.36
	Right Ankle Rotation, RY	Deg	180	23.33	-8.04
Anomalies (1) Questionable between 93 -136 ms (2) Questionable after 6 ms (3) Questionable between 32-49ms; saturated (4) Questionable after 31 ms (5) Questionable after 19 ms					

SECTION 3

DATA SHEETS

Test Vehicle:	<u>2011 Smart ForTwo</u>	NHTSA No:	<u>RB0526</u>
Test Program:	<u>R&D 56mph 15°/ 35% Offset</u>	Test Date	<u>8/29/2011</u>

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DATA SHEET NO. 1

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

TEST VEHICLE INFORMATION

NHTSA No.	RB0526
Model Year	2011
Make	Smart
Model	ForTwo
Body Style	Two Door Coupe
VIN	WMEEJ3BA7BK420857
Body Color	Light blue
Delivery Date	8/9/2011
Odometer Reading (km/mi)	38.6 km / 24 mi
Dealer	Smart Center Bloomfield Hills
Transmission	5-Speed Automatic
Final Drive	Rear Wheel Drive
Type/No. Cylinders	I3
Engine Displacement (L)	1.0
Engine Placement	Lateral
Roof Rack	No
Sunroof/T-Top	No
Tinted Glass	No
Traction Control	No
Power Brakes	Yes
Front Disc	Yes
Rear Disc	No
NHTSA No.	RB0526

TEST VEHICLE OPTIONS

Anti-Lock Brakes	Yes
All-Wheel Drive	No
Power Steering	Yes
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	Yes
Front Pass. Front Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	Yes
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Knee Airbag	No
Pretensioners	Yes
Load Limiters	Yes
Tilt Steering	Yes
Automatic Door Locks	Yes
Power Windows	No
Power Seats	No
Air Conditioning	Yes

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

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Diamler AG
Date of Manufacture	9/2010

GVWR (kg)	1050
GAWR Front (kg)	440
GAWR Rear (kg)	660

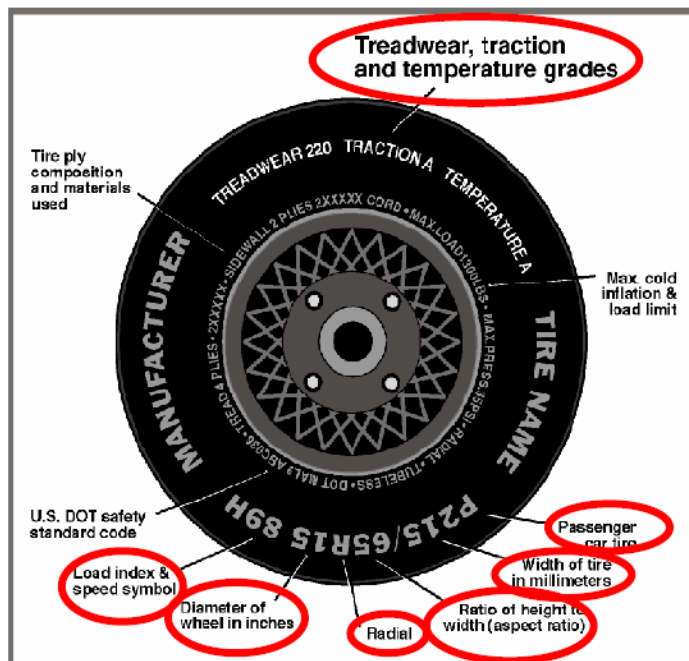
VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	N/A	N/A	
Number of Occupants	2	N/A	N/A	2
Capacity Wt. (VCW) (kg)				240
Cargo Wt. (RCLW) (kg)				104

DATA SHEET NO. 1 (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



Measured Parameter	Front	Rear
Maximum Tire Pressure	300	300
Cold Pressure (kPa)	200	250
Recommended Tire Size	155/60R15	175/55R15
Tire Size on Vehicle	155/60R15	175/55R15
Tire Manufacturer	Continental	Continental
Tire Model	ContitracProContact	ContitracProContact
Treadwear	400	400
Traction	AA	AA
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	1 Polyester, 2 Steel	1 Polyester, 2 Steel, 1 Nylon
Load Index/Speed Symbol	74T	77T
Tire Material	Rubber	Rubber
DOT Safety Code Right	CN93PVH63310	CN93PVH60410
DOT Safety Code Left	CN93PVH63310	CN93PVH60410

DATA SHEET NO. 1 (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	182.5	235.5		226.5	301.5	
Right	kg	180	239		206.5	299	
Ratio	%	43.3%	56.7%		41.9%	58.1%	
Totals	kg	362.5	474.5	837	433	600.5	1033.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	837
Weight of 1 P572E ATD	kg	100
Rated Cargo/Luggage Weight (RCLW)	kg	104
Calculated Vehicle Target Weight (TVTW)	kg	1041.0

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	618	616	654	655	1062
As Tested	mm	595	594	615	615	1089
Post Test	mm	-	-	-	-	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	1870
Total Vehicle Length at Left Side	mm	2645
Total Vehicle Length at Centerline	mm	2704
Total Vehicle Length at Right Side	mm	2645
Weight of Ballast in Cargo Area	kg	22.7
Weight of Vehicle Components Removed	kg	0
Amount of Stoddard Solvent in Fuel Tank	L	30.7

LIST OF COMPONENTS REMOVED TO MEET TEST WEIGHT:

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

MASS OF BALLAST ADDED (kg) 22.7

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

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements	Pre-Test (mm)
1	Total Length	2704
2	Total Width	1454
3	Bumper Top Height	-41
4	Bumper Bottom Height	99
5	Longitudinal Member Top Height	-43
6	Distance Between Longitudinal Members	735
7	Longitudinal Member Width	69
8	Engine Top Height	0
9	Engine Bottom Height	0
10	Engine and Gearbox Width	0
11	Front Bumper-Engine Distance	151
12	Front Shock Absorber Fixing Height	-260
13	Bonnet Leading Edge Height	-173
14	Front Shock Absorber Fixing Width	881
15	Front Bumper – Front Axle Distance	436
16	Front Axle – A Pillar Distance	333
17	A- Pillar – B-Pillar Distance	1283
18	B-Pillar – Rear Axle Distance	251
19	B-Pillar – C-Pillar Distance	299
20	Roof Sill Bottom Height	-1001
21	Roof Sill Top Height	-1058
22	Floor Sill Bottom Height	113
23	Floor Sill Top Height	54

DATA SHEET NO. 2

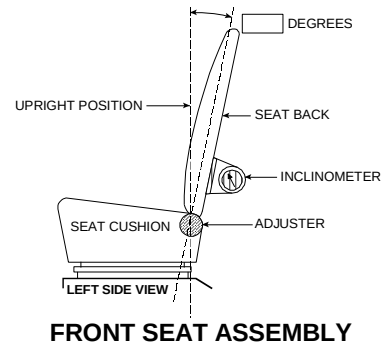
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

NOMINAL DESIGN RIDING POSITION

Inclinometer was zeroed on the door sill, then placed on the head rest post to measure the set angle, according to form 1. Seat back was also set 3 notches forward of the rearmost position.

	Deg.
Driver seat back angle:	9
Passenger seat back angle:	Seat removed



SEAT FORE/AFT POSITIONS

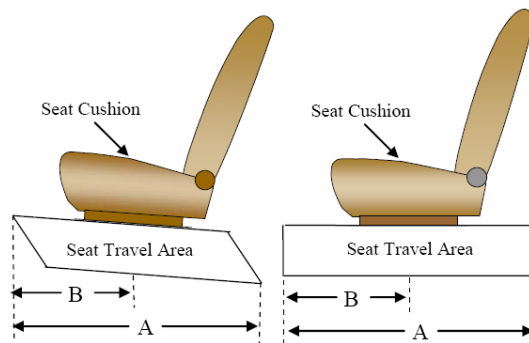
Seat was set to full forward, full up and marked. Then moved to the full rear, full down position, and marked. Mid point was measured, and seat was set to full down, mid position, as per form 1.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	0-21	11
Passenger Seat	Seat removed	Seat removed

SEAT BELT UPPER ANCHORAGE

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.

	Total # of Positions	Placed in Position #
Driver Seat	Fixed	Fixed
Passenger Seat	Seat removed	Seat removed

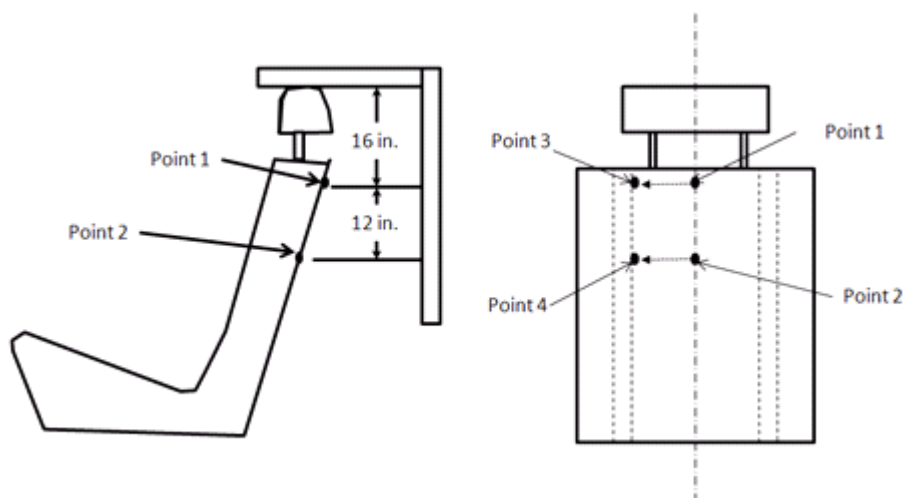


DATA SHEET NO. 2 (CONTINUED)

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

SEAT BACK MEASUREMENT POINTS



Reference point: Rear most center of the top of rear bumper beam
+X - From the rear of the vehicle to the front of the vehicle
+Y - From 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

	X	Y	Z
Point 3	737.7755	-409.657	-582.556
Point 4	869.6496	-414.753	-242.83

See Appendix F.1 for detailed description of the CMM measurement procedure

DATA SHEET NO. 2 (CONTINUED)

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

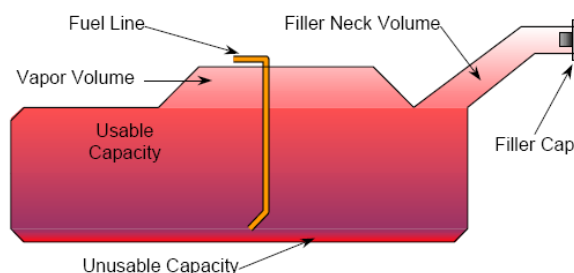
Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	33
Usable Capacity of "Optional Tank"	
92%-94% of Usable Capacity	30.7
Actual Amount of Solvent Used	30.7
1/3 of Usable Capacity	11

Electric fuel pump is located on the top of the tank in the center of the car.

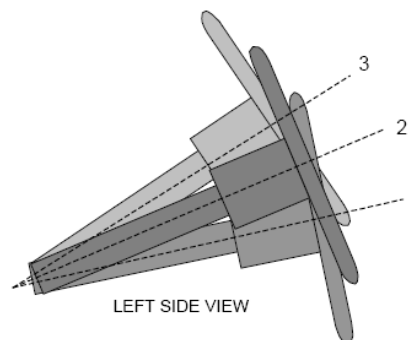
Wires: Red/Blue (+) Brown (-)



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

A level line was drawn on the steering wheel and an inclinometer was used to determine the angle of adjustment. The steering column was then moved full in and full out. Positions were marked and the steering wheel was set to the geometric center of its possible movement. The steering wheel was not adjustable for this test.



STEERING COLUMN ASSEMBLY

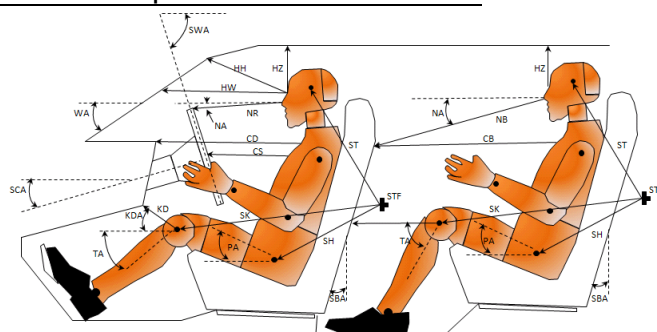
STEERING COLUMN POSITIONS

	Degrees	Fore/Aft Position (mm)
Lowermost position No. 1	NA	NA
Geometric center position No. 2	NA	NA
Uppermost position No. 3	NA	NA
Telescoping Steering Wheel Travel	NA	NA
Test Position	NA	NA

DATA SHEET NO. 3

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011



Code	Measurement Description	Driver		Left Rear Passenger	
		Length (mm)	Angle(°)	Length (mm)	Angle (°)
WA°	Windshield Angle		-34.5		
SWA°	Steering Wheel Angle		19.7		
SCA°	Steering Column Angle		24.5		
SA°	Seat Back Angle (on headrest post)		9		N/A
HZ	Head to Roof (Z)	198	90	N/A	N/A
HH	Head to Header	508	10		
HW	Head to Windshield	638	0		
NR/NB	Nose to Rim/Seat Back	505	-17	N/A	N/A
CD/CB	Chest to Dash/Seat Back	632		N/A	
CS	Chest to Steering Hub	433	-16.6		
RA	Rim to Abdomen	225	0		
KDL/KBL	Left Knee to Dash/Seat Back	120	29	N/A	N/A
KDR/KBR	Right Knee to Dash/Seat Back	101	25	N/A	N/A
PA°	Pelvic Angle		-24.7		N/A
TA°	Tibia Angle		-50		N/A
SK	Striker to Knee	755	-7.7	N/A	N/A
ST	Striker to Head	516	64.2	N/A	N/A
SH	Striker to H-Point	378	-36.3	N/A	N/A
HAX°	Head Angle X		-0.2		
HAY°	Head Angle Y		0.4		
NAX°	Neck Angle X		1.5		
NAY°	Neck Angle Y		0.1		
TAX°	T6 Angle X		16.3		
TAY°	T6 Angle Y		0.8		
LAX°	Lumbar Angle (X)		-0.9		
LAY°	Lumbar Angle (Y)		23.2		

Note: There was no P4 (passenger) ATD for this test.

DATA SHEET NO. 3

DUMMY CMM MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

Description	Units	Driver			Left Rear Passenger		
		X	Y	Z	X	Y	Z
Striker (Driver/Passenger)	mm	774.063	-656.237	-410.4			
Head CG	mm	978.0759	-366.605	-887.152			
Bridge of Nose	mm	1073.477	-283.265	-895.402			
Tip of Nose	mm	1072.712	-283.766	-842.825			
Shoulder Bolt	mm	1024.445	-471.052	-637.243			
Tip of Chin	mm	1070.125	-282.224	-762.134			
H-point	mm	1132.255	-560.209	-186.162			
Left Knee	mm	1537.04	-478.985	-315.639			
Right Knee	mm	1556.325	-193.339	-307.177			
Left Ankle	mm	1833.833	-449.055	-19.3441			
Right Ankle	mm	1865.255	-179.806	-20.69			
Left Heel	mm	1900.57	-422.642	111.9861			
Right Heel	mm	1879.651	-126.579	113.2606			
Driver's Outboard Seat Anchor Bolt	mm	775.3282	-424.826	-782.999			
Outboard Head Restraint Post	mm	790.7497	-280.885	-933.543			
Top of Head Restraint*	mm	1833.833	-449.055	-19.3441			
Center of Steering Wheel	mm	1497.26	-288.165	-549.7			

Note: There was no P4 (passenger) ATD for this test.

Reference point: Rear most center of the top of rear bumper beam

+X - From the rear of the vehicle to the front of the vehicle

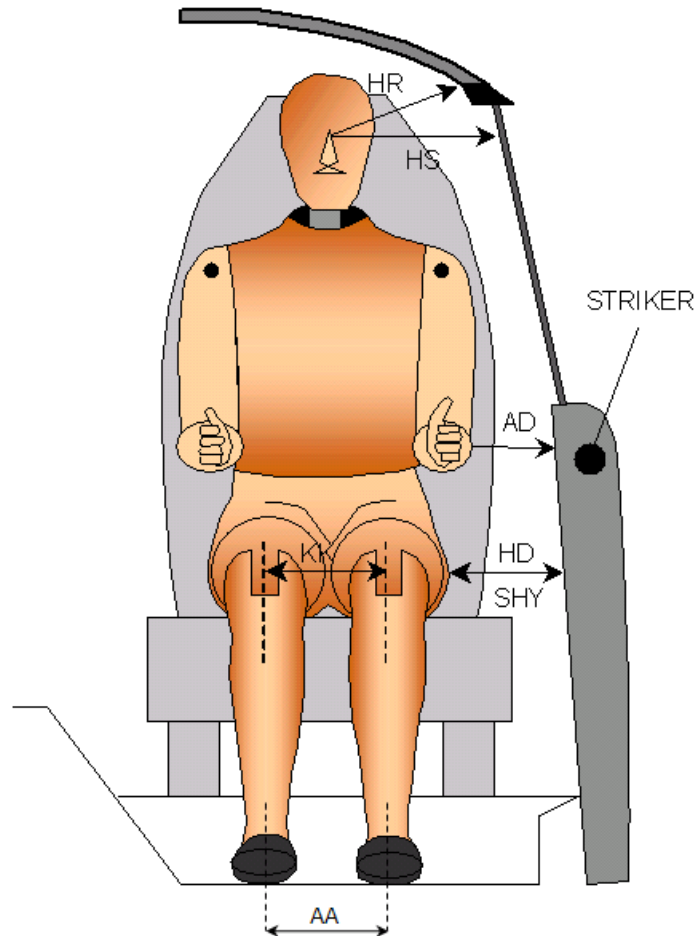
+Y - From left side of the vehicle to the right side of the vehicle

+Z - From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO. 4

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



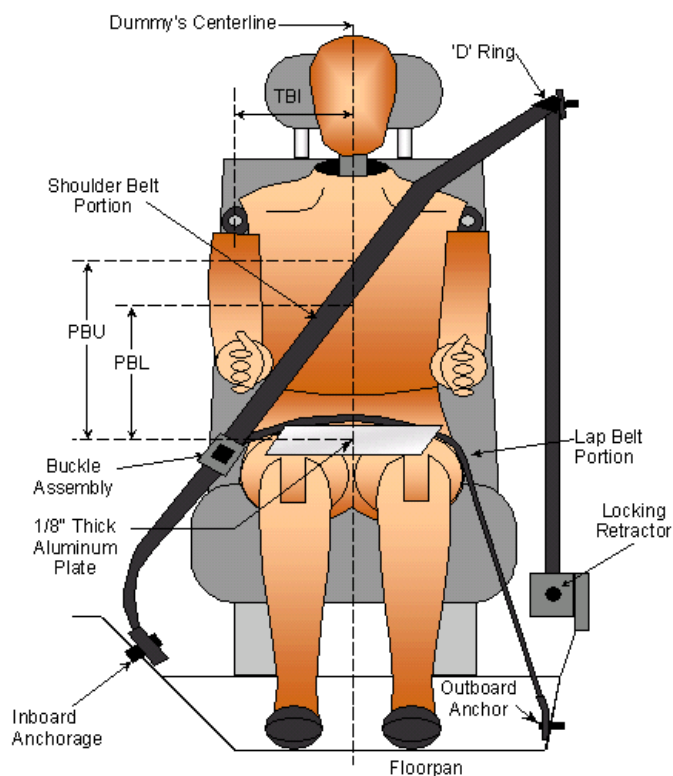
Code	Description	Units	Driver	Left Rear Passenger
AD	Arm to Door	mm	86	
HD	H-Point to Door	mm	96	
HR	Head to Side Header	mm	171	
HS	Head to Side Window	mm	304	
KK	Knee to Knee	mm	290	
SHY	Striker to H-Point (Y Direction)	mm	180	
AA	Ankle to Ankle	mm	274	

Note: There was no P4 (passenger) ATD for this test.

DATA SHEET NO. 5

SEAT BELT POSITIONING DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU — Top surface of aluminum plate to belt upper edge	mm	345	
PBL — Top surface of aluminum plate to belt lower edge	mm	265	

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	1140	
Lap Belt Length as measured on ATD	mm	700	
Remainder of belt on reel	mm	910	
Total belt length for continuous webbing systems	mm	2750	

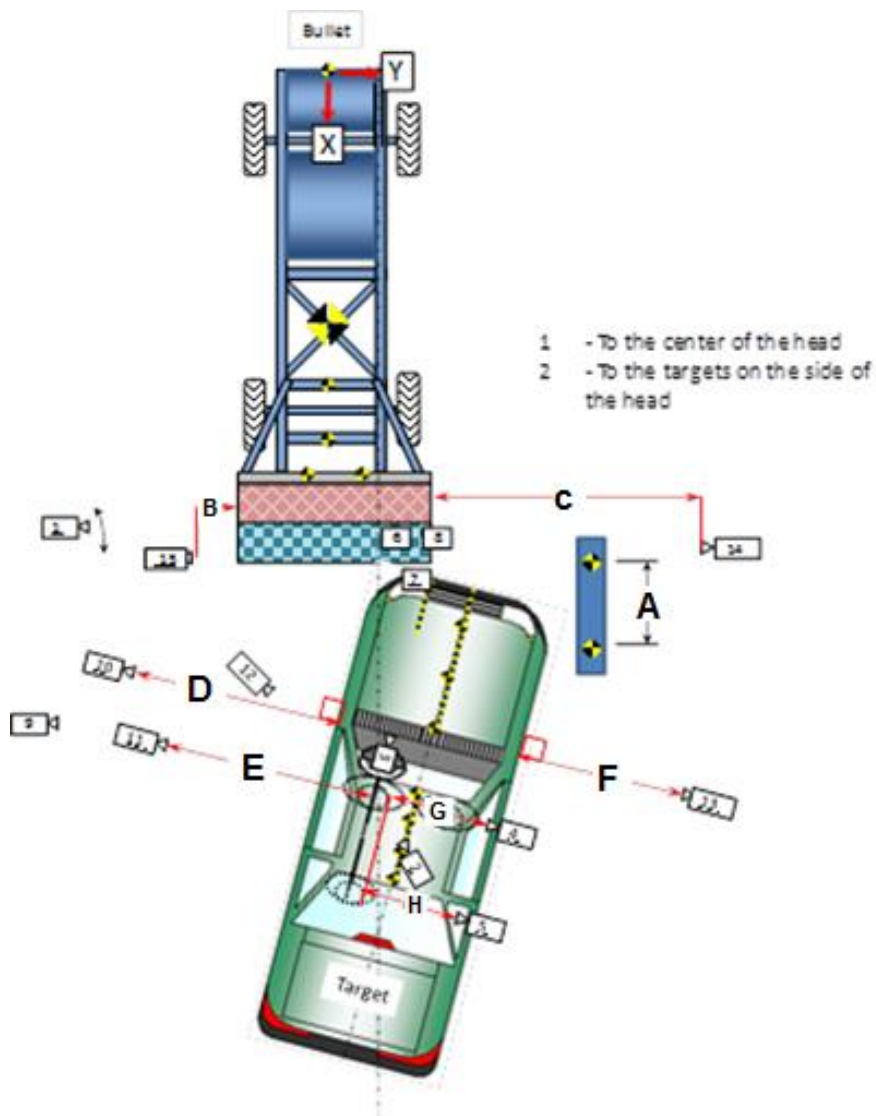
Note: There was no P4 (passenger) ATD for this test.

DATA SHEET NO. 6

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

Horizontal Location



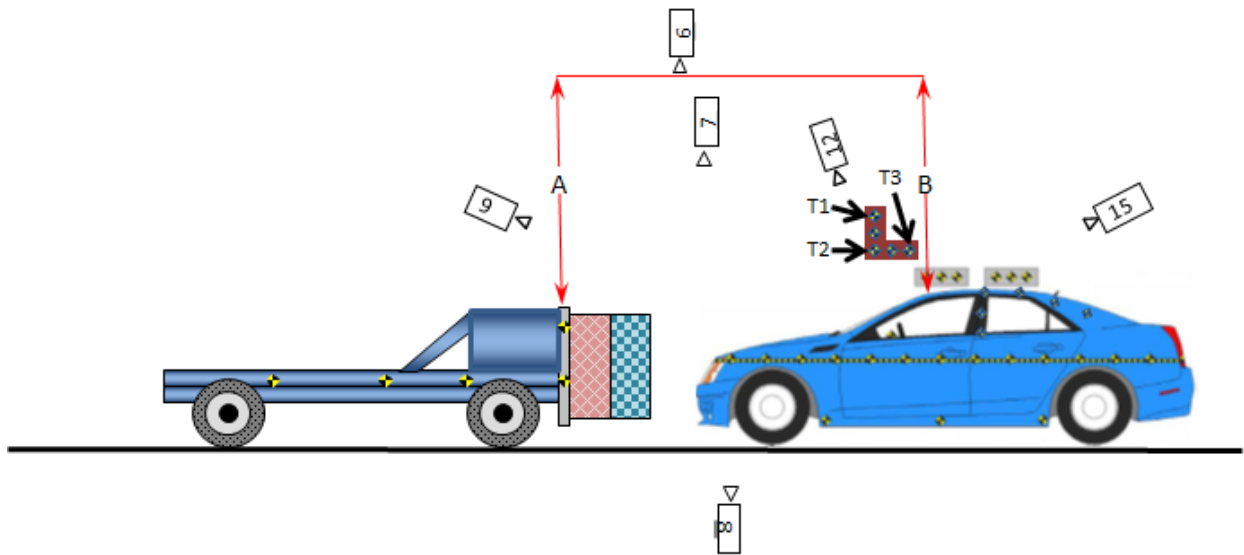
A	mm	915
B	mm	7960
C	mm	8330
D	mm	9340
E	mm	10040
F	mm	8330
G	mm	710
H	mm	N/A

DATA SHEET NO. 6 (CONTINUED)

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

Horizontal Location



Measurement	Units	Value
A	mm	3960
B	mm	3800

DATA SHEET NO. 6 (CONTINUED)

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

CAMERA LOCATIONS

No.	Camera View	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View	-	-	-	-	-
2	Onboard Driver Over Shoulder	6518	950	1320	6.5	500
3	Onboard Driver Lower Leg	5588	600	250	6.5	500
4	Onboard Driver Perpendicular	5978	1300	1170	12.5	500
5	Onboard Left Rear Passenger Perpendicular	N/A	N/A	N/A	N/A	N/A
6	Overall Top View	6428	960	5050	14	1000
7	Zoomed Top View	0	1100	3650	28	1000
8	Pit Front	-	-	-	-	-
9	Overall Left Side	9398	9650	2030	24	1000
10	Ladder View Rear	5758	9130	1340	24	1000
11	Driver's Motion	5108	9252	1220	50	1000
12	Look Down Driver's Motion	3100	2100	3370	24	1000
13	Target Vehicle Right Side	9580	1700	1510	24	1000
14	Bullet Vehicle Left Side	-	-	-	-	-
15	Front Ladder View	5058	9310	2135	24	1000
16	Above RMDB	4758	810	1910	13	1000

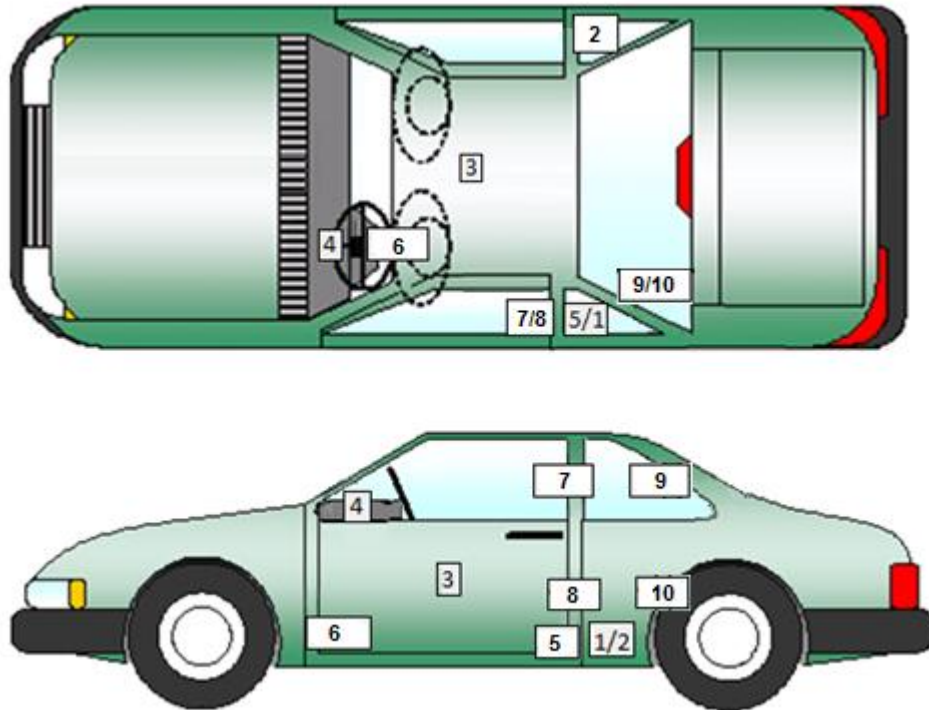
Reference point: center most rearward point of the RMDB when in contact with the Target Vehicle):

- +X = from back of RMDB to front of RMDB
- +Y = right of monorail center
- +Z = up from ground

DATA SHEET NO. 7

VEHICLE INSTRUMENTATION LOCATIONS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011



Accelerometer Location	Axes	Units	Location		
			X	Y	Z
Left Rear Sill	X,Y	mm	944	-545	-115
Right Rear Sill	X,Y	mm	908	554	-58
Vehicle CG	X, Y, Z	mm	1602	52	41
Driver Seat Track	X	mm	1695	33	-502
Instrument Panel	X, Y, Z	mm	808	-289	-39
Behind Brake Pedal	X, Y, Z	mm	2204	-264	-122

Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

VEHICLE INSTRUMENTATION DATA

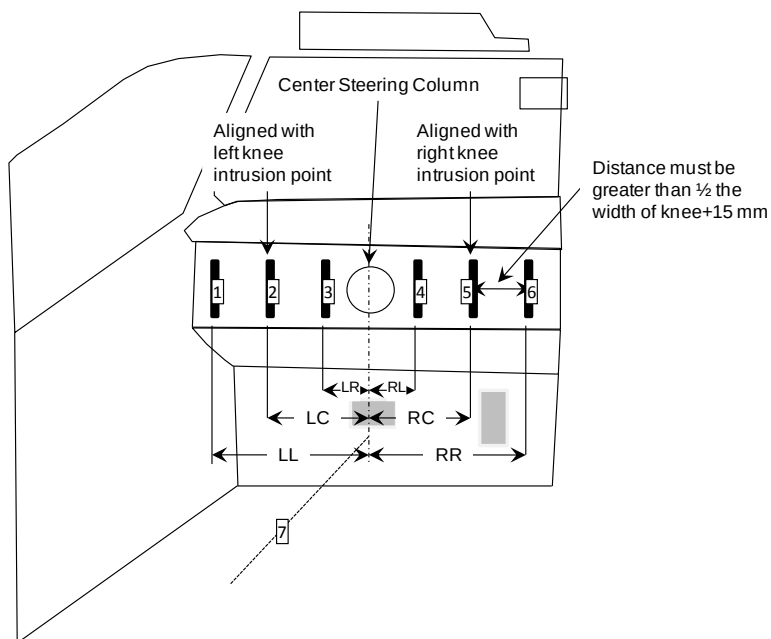
Loc.	Description	Axes	Units	Positive Direction		Negative Direction	
				Max	Time (ms)	Max	Time (ms)
1	Left Rear Cross Member	X	G	0.49	111.35	-28.76	15.70
		Y	G	32.97	44.85	-9.33	39.65
2	Right Rear Cross Member	X	G	2.03	109.60	-40.49	53.30
		Y	G	0.15	17.45	-0.30	70.30
3	Vehicle CG	X	G	1.85	110.30	-44.37	41.15
		Y	G	39.21	35.50	-22.61	28.80
		Z	G	20.99	34.45	-12.65	22.40
4	Instrument Panel	X	G	50.06	49.15	-87.58	27.50
5	Driver Seat Track	X	G	3.00	111.25	-48.66	16.60
		Y	G	18.38	56.95	-8.87	25.90
		Z	G	11.16	39.00	-23.45	27.30
6	Behind Brake Pedal	X	G	48.94	27.50	-152.27	10.10
		Y	G	84.90	19.95	-14.40	49.35
		Z	G	26.55	19.45	-18.74	12.55
7	Driver Shoulder Belt		N	3333.39	34.40	-1.06	-1.35
8	Driver Lap Belt		N	5517.30	37.90	-41.28	250.45
9	Passenger Shoulder Belt		N				
10	Passenger Lap Belt		N				

- No Passenger data (no passenger dummy)

DATA SHEET NO. 7 (CONTINUED)

VEHICLE INSTRUMENTATION DATA

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



Location	Distance (mm)	Location	Distance (mm)
LL	200	RL	100
LC	150	RC	150
LR	100	RR	200

VEHICLE INSTRUMENTATION DATA

Loc.	Description		Positive Direction		Negative Direction	
			Max	Time (ms)	Max	Time (ms)
1	Left knee contact switch (LL) (ms)	*	0	-50	-1	21.60
2	Left knee contact switch (LC) (ms)	*	0	-50	-1	18.60
3	Left knee contact switch (LR) (ms)	*	0	-50	-1	18.90
4	Right knee contact switch (RL) (ms)	*	0	-50	-1	19.10
5	Right knee contact switch (RC) (ms)	*	0	-50	-1	18.85
6	Right knee contact switch (RR) (ms)	*	0	-50	-1	21.55
7	Toe pan string pot (mm)		0.12	-0.8	-367.35	39.85

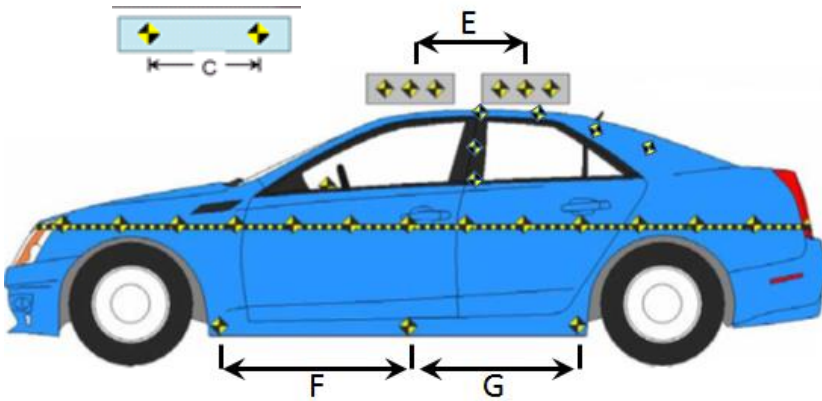
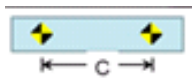
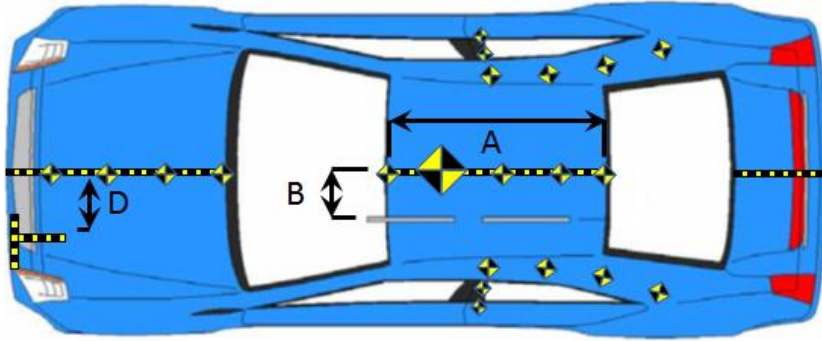
* The measurement indicates the initial time the voltage changed

DATA SHEET NO. 8

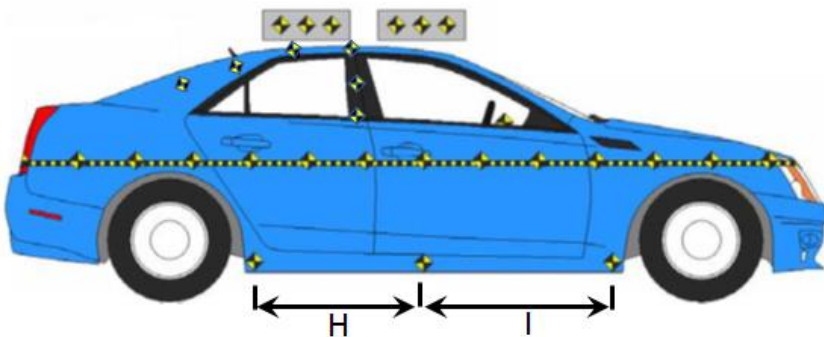
VEHICLE PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2011 Smart ForTwo
Test Program: R&D 56mph 15°/ 35% Offset

NHTSA No: RB0526
Test Date: 8/29/2011



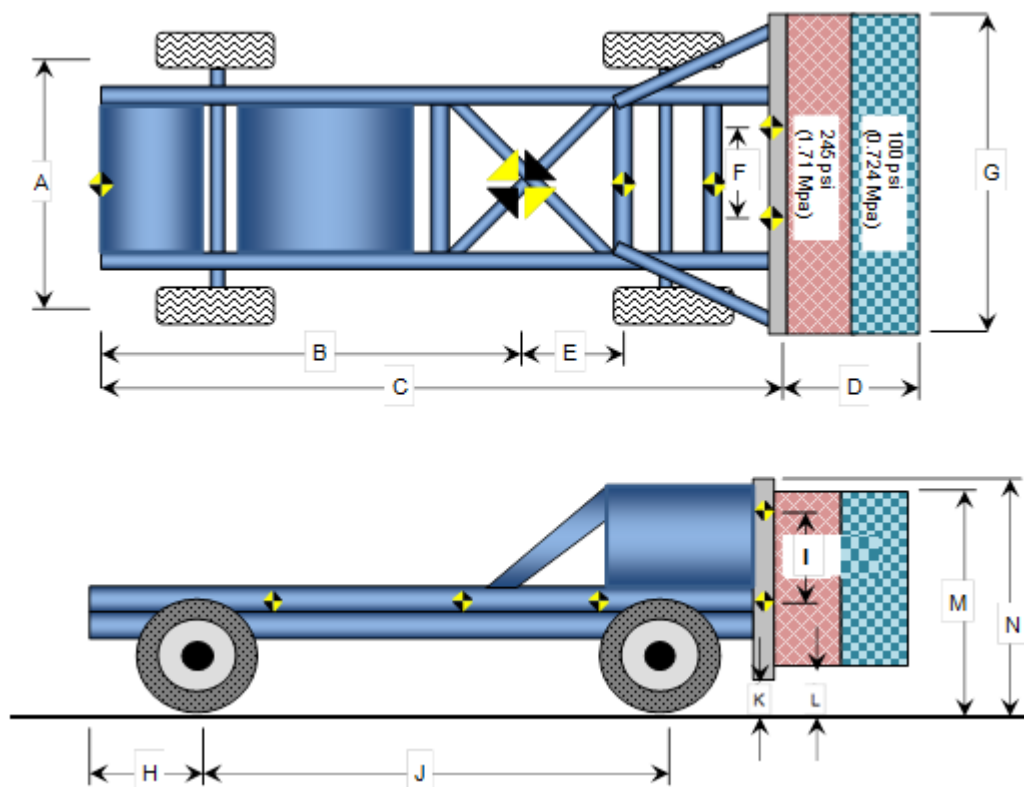
Item	Units	Value
A	mm	610
B	mm	249
C	mm	915
D	mm	256
E	mm	1258
F	mm	583
G	mm	561
H	mm	560
I	mm	579



DATA SHEET NO. 8 (CONTINUED)

RMDB PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011



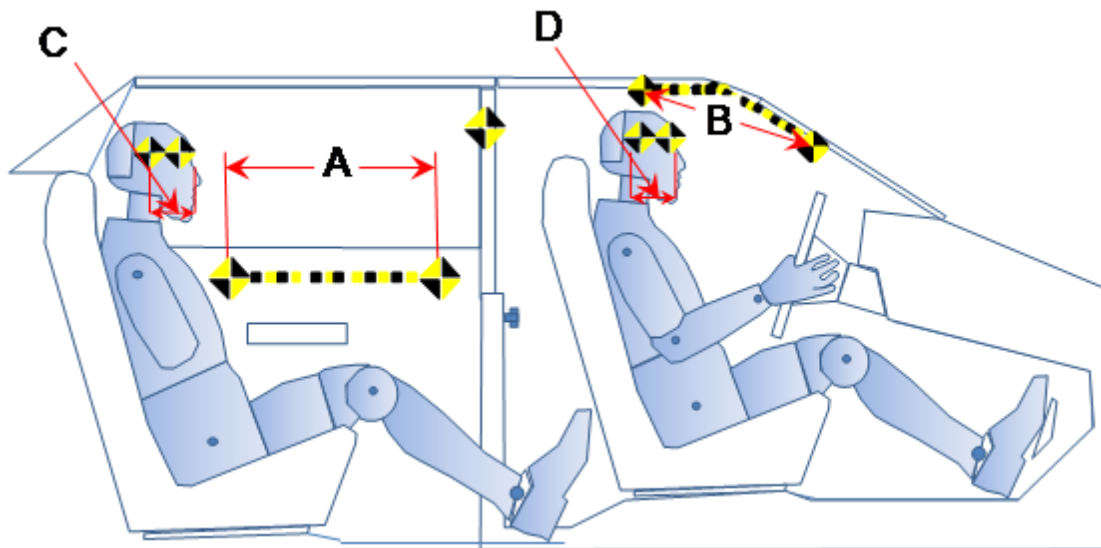
Item	Units	Value
A	mm	1550
B	mm	2215
C	mm	3940
D	mm	606
E	mm	1185
F	mm	1130
G	mm	2210
H	mm	795
I	mm	500
J	mm	2585
K	mm	90
L	mm	98
M	mm	1055
N	mm	1190

	Units	Front Axle	Rear Axle	Total
Left	kg	779.3	470.4	1249.7
Right	kg	749.3	487.2	1236.5
Ratio	%	61.5%	38.5%	100%
Total	kg	1528.6	957.6	2486.2
CG After of Front Axle	mm			1286

DATA SHEET NO. 8 (CONTINUED)

DUMMY PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011



Item	Units	Value
A	mm	NA
B	mm	305
C	mm	NA
D	mm	52

Target measurements are center to center

Note: There was no P4 (passenger) ATD for this test.

DATA SHEET NO. 9

TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

INSTRUMENTATION

Driver Dummy Accelerometers	119
Passenger Dummy Accelerometers	
Vehicle Structure Accelerometers	16
Total	169

CAMERA COVERAGE

High-Speed Vehicle Onboard	4
High-Speed Off board	9
Real-Time Panning	1
Total	14

DATA SHEET NO. 10

POST TEST OBSERVATIONS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Picture Ref.	Passenger	Picture Ref.
Dummy Type	THOR 50 th Male	N/A		
Dummy Serial No.	0007	N/A		
Lower Leg Type	THOR-FLX Lower Leg	N/A		
Lower Leg Serial No.	LX0036/0037	N/A		
Head Contact	Steering wheel airbag, THOR's left shoulder	A-37 A-48		
Upper Torso Contact	Steering wheel airbag	-		
Lower Torso Contact	Knee bolster airbag and steering rim	A-46 A-47		
Left Knee Contact	Knee bolster airbag	A-45		
Right Knee Contact	Knee bolster airbag	A-44		

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Unlocked	
Front Door Opening	Door Remained Closed	
Rear Door Opening	N/A	
Seat Track Shift (mm)	No Movement	
Seat Back Failure	No Failure	
Glazing Damage	None	

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions	Picture Ref
Windshield Damage	Tears in the center of the windshield with separation at the lower left corner	A-21
Window Damage	Driver's side and rear window shattered during impact event.	A-36 / A-51
Other Notable Effects	None	-

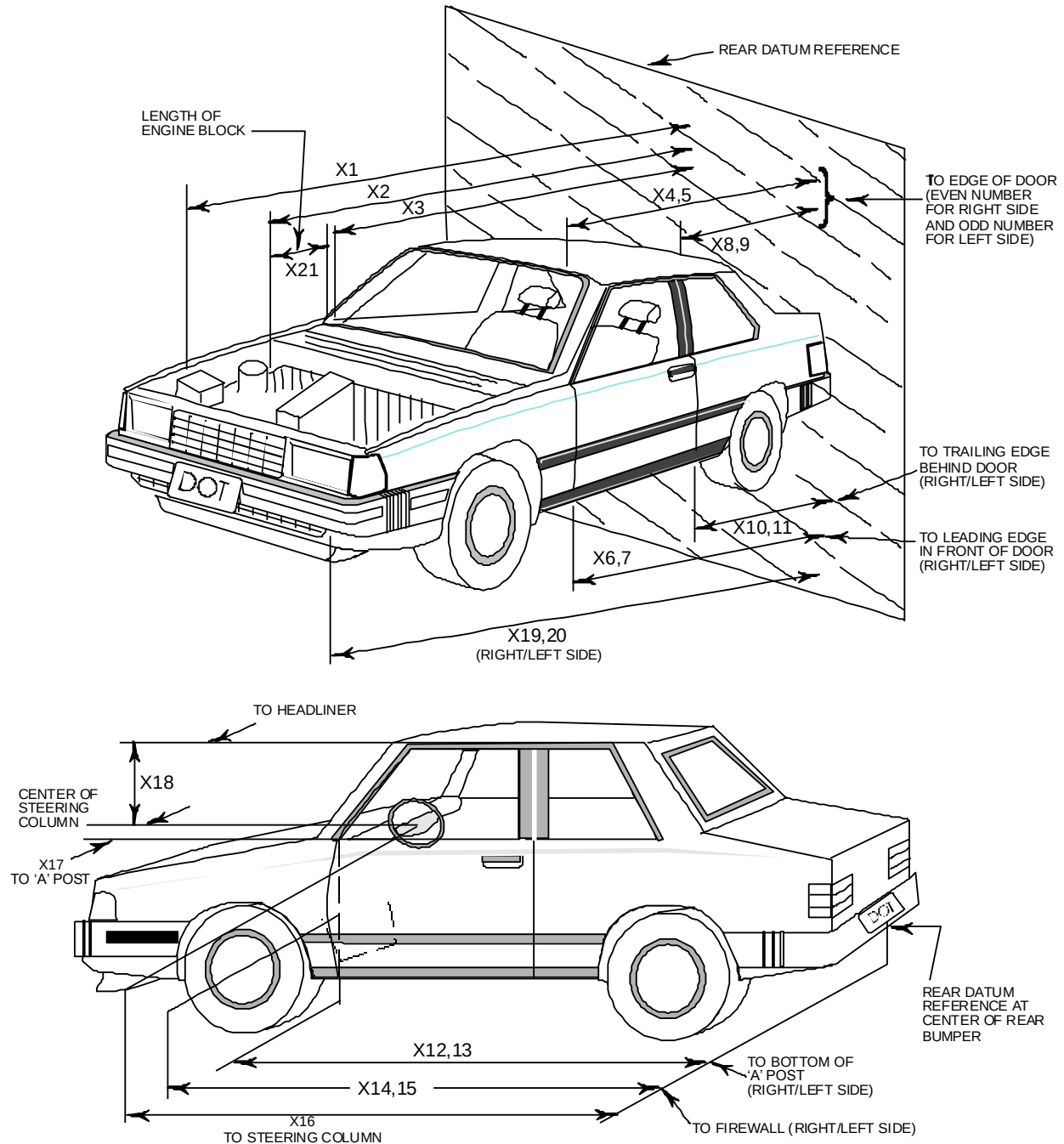
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver (Occupant 1)		Passenger (Occupant 2)	
	Installed	Operated	Installed	Operated
Front Airbag	Yes	Yes		
Combination Head/Torso Airbag	N/A	N/A		
Curtain Airbag	Yes	No		
Knee Airbag	Yes	Yes		
Seat Belt Pretensioner	Yes	Yes		
Seat Belt Load Limiter	Yes	Yes		

DATA SHEET NO. 11

VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



DATA SHEET NO. 11 (CONTINUED)**VEHICLE PROFILE MEASUREMENTS**

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	2704	*2361	*343
2	Rear Surface of Vehicle (RSOV) to Front of Engine	2553	2199	354
3	RSOV to Firewall	2323	2108	214
4	RSOV to Upper Leading Edge of Right Door	1928	1931	-3
5	RSOV to Upper Leading Edge of Left Door	1929	1845	84
6	RSOV to Lower Leading Edge of Right Door	1835	1835	0
7	RSOV to Lower Leading Edge of Left Door	1831	1804	27
8	RSOV to Upper Trailing Edge of Right Door	687	687	0
9	RSOV to Upper Trailing Edge of Left Door	892	884	8
10	RSOV to Lower Trailing Edge of Right Door	1032	1031	1
11	RSOV to Lower Trailing Edge of Left Door	1068	1045	23
12	RSOV to Bottom of "A" Post of Right Side	2030	2028	2
13	RSOV to Bottom of "A" Post of Left Side	2023	1846	177
14	RSOV to Firewall, Right Side	2195	2198	-2
15	RSOV to Firewall, Left Side	2194	1889	305
16	RSOV to Steering Column	1497	1346	152
17	Center of Steering Column to "A" Post	246	198	48
18	Center of Steering Column to Headliner	413	421	-8
19	RSOV to Right Side of Front Bumper	2671	*2856	*-185
20	RSOV to Left Side of Front Bumper	2669	*2144	*525
21	Length of Engine Block	231	104	127
RD	RSOV to Right Side of Dash Panel	1638	1643	-5
CD	RSOV to Center of Dash Panel	1716	1592	124
LD	RSOV to Left Side of Dash Panel	1633	1383	250

All Dimensions in mm, *Measurements are approximate

DATA SHEET NO. 12

ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date: 8/29/2011

VEHICLE INFORMATION

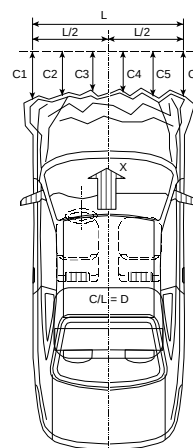
VIN: WMEEJ3BA7BK420857 Wheelbase: 1,870
 Vehicle Size Category: Passenger Test Weight (kg): 1,033.5

ACCELEROMETER DATA

Accelerometer Locations: Data Sheet No.7 Linearity: >99%
 Cal. Procedure/Interval: Calspan/ 6 Months
 Integration Algorithm: Trapezoidal
 Impact Velocity (km/h): 90.67
 Velocity Change (km/h): 90.67

CRUSH PROFILE

Collision Deformation Classification : 12FLAE6
 Midpoint of Damage: C2
 Damage Region Length (mm): 1430
 Impact Mode: 35% Offset, 15° Angle



CRUSH MEASUREMENTS: WITH BUMPER COVER REMOVED

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	2589	2215	374
C2	Crush zone 2 at left side	mm	2688	2149	539
C3	Crush zone 3 at left side	mm	2702	2234	468
C4	Crush zone 4 at right side	mm	2701	2503	198
C5	Crush zone 5 at right side	mm	2686	2775	-89
C6	Crush zone 6 at right side	mm	2582	2877	-295
L	C1 to C6	mm	1430	977	453

CRUSH MEASUREMENTS: WITH BUMPER COVER REMOVED

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	2651	2106	-545
C2	Crush zone 2 at left side	mm	2645	2139	-506
C3	Crush zone 3 at left side	mm	2675	2320	-355
C4	Crush zone 4 at right side	mm	2679	2507	-172
C5	Crush zone 5 at right side	mm	2657	2670	14
C6	Crush zone 6 at right side	mm	2669	2835	166
L	C1 to C6	mm	998	559	439

DATA SHEET NO. 13

VEHICLE INTRUSION MEASUREMENTS

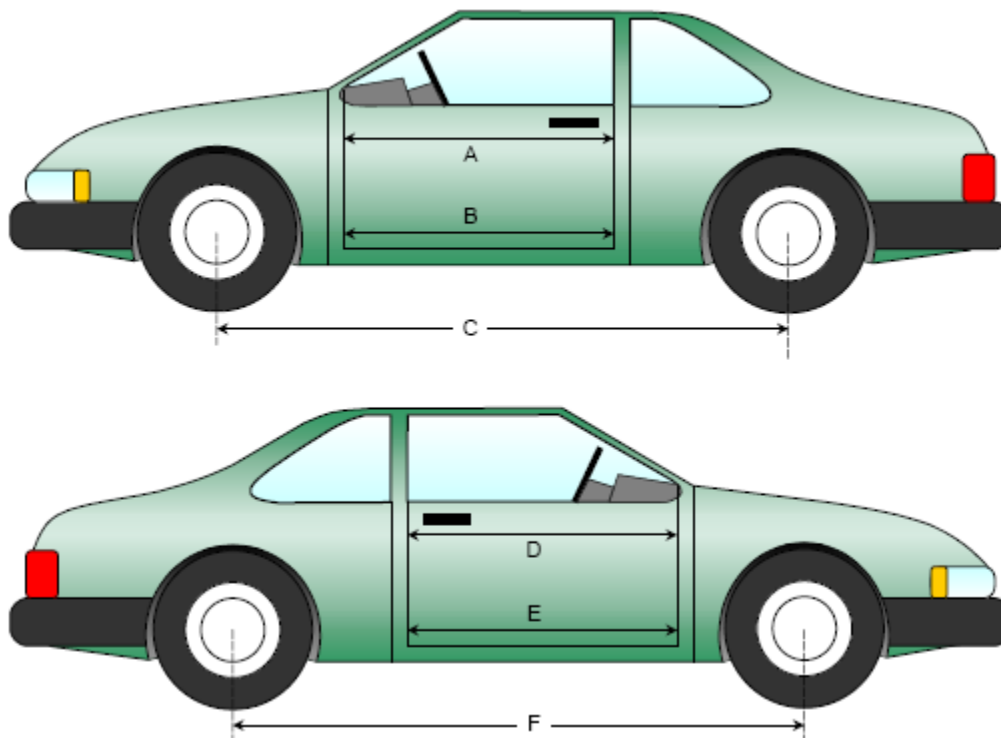
Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
Test Program: R&D 56mph 15°/ 35% Offset Test Date: 8/29/2011

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1177	976	-201
B	Left Side Lower	mm	920	771	-149
D	Right Side Upper	mm	1152	1151	0
E	Right Side Lower	mm	919	918	-1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	1867	1576	-291
F	Right Side Wheelbase	mm	1873	1951	78



DATA SHEET NO.13 (CONTINUED)

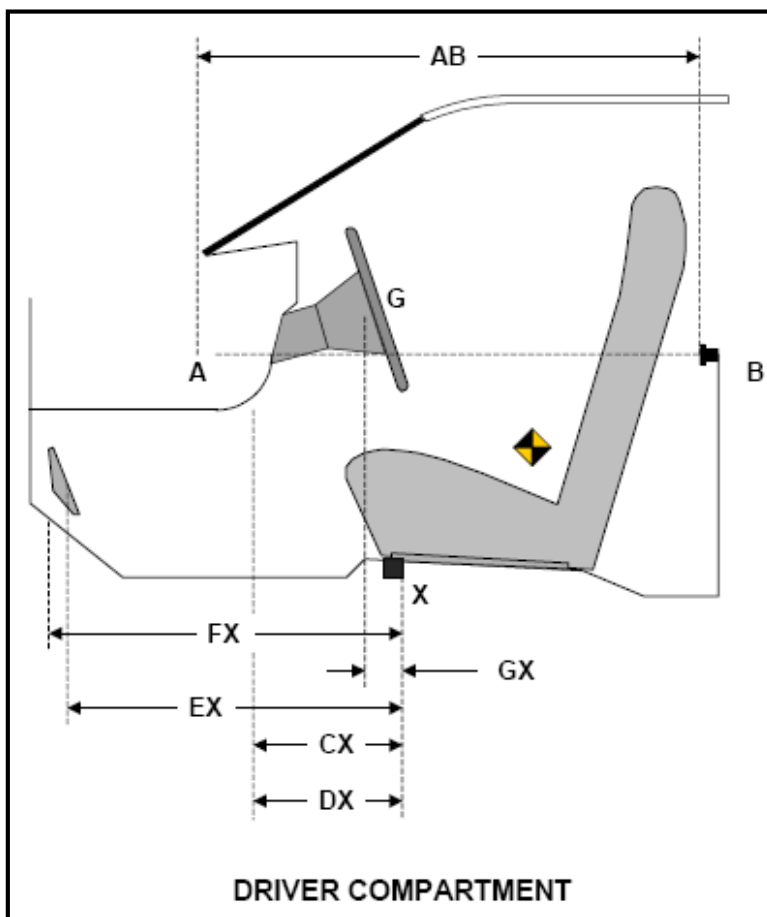
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	821	777	-44
CX	Left Knee Bolster to X	mm	233	19	-214
DX	Right Knee Bolster to X	mm	217	101	-116
EX	Brake Pedal to X	mm	551	354	-197
FX	Foot Rest to X	mm	527	363	-165
GX	Center of Steering Column Wheel Hub to X	mm	67	-55	-122

X = Front of Seat Track (Stationary)

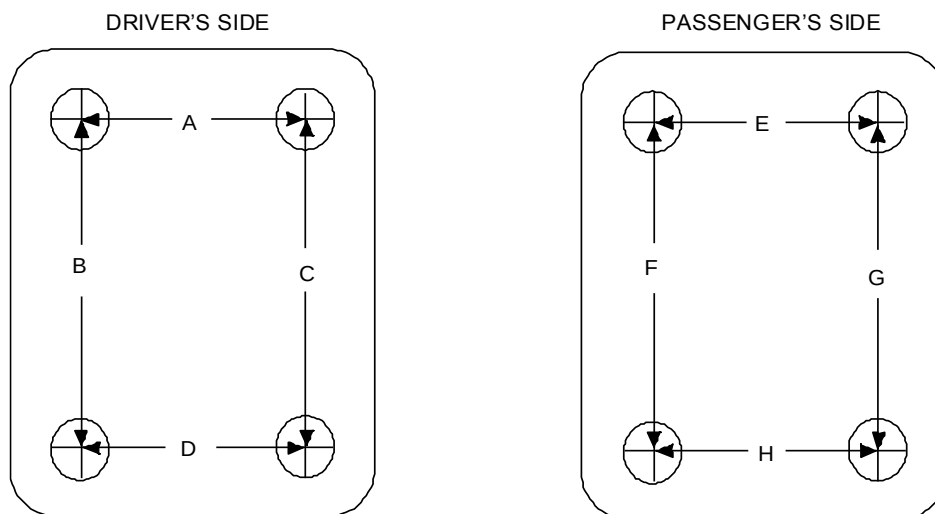


DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

TOP VIEW THROUGH FLOOR PAN



UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	484	401	83
B	295	204	90
C	259	216	43
D	494	488	6
E	476	474	2
F	287	312	-25
G	151	135	16
H	467	468	-1

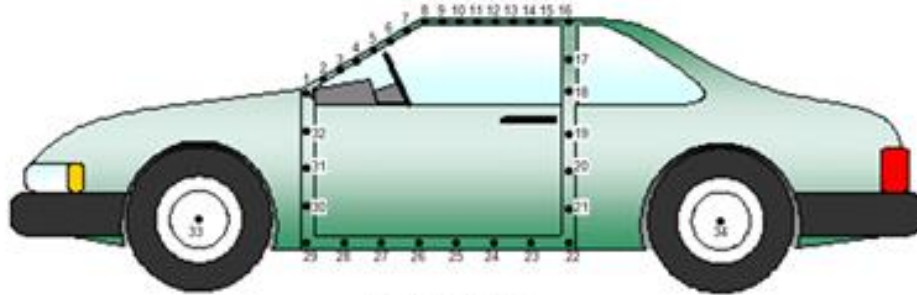
All units in millimeters

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

Driver Side Door Sill Intrusions



Left Side View

Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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

DRIVER SIDE DOOR SILL INTRUSIONS

Pt.	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
1	1900.3	-620.5	-623.9	1752.4	-556.7	-569.5	-147.9	63.8	54.5
2	1851.5	-624.8	-697.7	1741.5	-565.4	-654.9	-110.0	59.3	42.8
3	1789.0	-612.8	-748.4	1708.9	-568.9	-729.3	-80.1	43.8	19.2
4	1722.7	-599.3	-797.5	1670.7	-570.1	-804.1	-52.1	29.2	-6.6
5	1655.4	-583.4	-847.8	1630.1	-570.0	-879.3	-25.3	13.4	-31.4
6	1584.5	-568.2	-891.9	1585.5	-570.3	-951.0	1.0	-2.1	-59.1
7	1510.4	-552.6	-932.8	1520.7	-559.0	-990.8	10.3	-6.4	-58.0
8	1435.6	-539.6	-965.1	1443.5	-543.6	-1016.4	7.9	-4.0	-51.3
9	1352.9	-531.7	-985.1	1359.5	-534.0	-1027.9	6.6	-2.3	-42.8
10	1269.9	-527.6	-997.3	1275.4	-528.8	-1030.9	5.5	-1.3	-33.6
11	1185.2	-525.3	-1005.3	1191.4	-525.4	-1031.0	6.2	-0.1	-25.7
12	1100.8	-524.3	-1010.1	1106.3	-523.7	-1027.1	5.5	0.6	-17.0
13	1016.4	-525.5	-1009.3	1023.2	-523.6	-1019.3	6.7	1.9	-10.0

Note: Please see Appendix F.2 for a detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

DRIVER SIDE DOOR SILL INTRUSIONS (CONTINUED)

Pt.	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
14	933.0	-526.9	-1007.2	939.1	-523.8	-1010.1	6.2	3.1	-2.9
15	848.8	-531.0	-999.7	855.7	-527.4	-994.2	6.9	3.6	5.5
16	769.7	-544.5	-972.4	775.7	-538.6	-962.2	6.0	5.9	10.2
17	682.2	-610.9	-826.9	686.0	-603.6	-814.4	3.8	7.4	12.5
18	665.5	-648.9	-644.9	666.9	-638.3	-631.8	1.4	10.7	13.1
19	732.9	-652.7	-475.4	723.2	-640.2	-460.1	-9.7	12.5	15.4
20	826.7	-657.1	-315.0	819.7	-650.5	-300.0	-7.0	6.6	15.0
21	932.5	-647.3	-164.9	920.9	-643.1	-146.2	-11.6	4.2	18.7
22	1043.9	-639.3	-24.8	1026.4	-638.3	-1.8	-17.5	1.0	23.1
23	1145.3	-642.3	31.4	1125.3	-638.5	59.3	-20.0	3.7	27.9
24	1259.8	-645.4	51.7	1237.1	-636.4	87.2	-22.7	9.0	35.5
25	1373.2	-645.5	68.9	1348.5	-632.7	113.0	-24.7	12.8	44.0
26	1490.2	-641.7	85.3	1463.1	-623.2	140.4	-27.1	18.5	55.1
27	1602.8	-643.9	100.8	1576.0	-618.9	166.6	-26.8	25.0	65.8
28	1718.5	-644.7	115.8	1687.3	-618.9	180.2	-31.2	25.8	64.4
29	1836.1	-630.6	104.5	1773.2	-568.8	149.6	-62.9	61.9	45.1
30	1896.0	-627.1	-64.5	1760.5	-539.3	-25.8	-135.5	87.8	38.7
31	1911.9	-621.9	-244.9	1738.1	-533.7	-199.1	-173.8	88.3	45.7
32	1911.6	-604.7	-426.9	1715.9	-528.1	-379.1	-195.7	76.6	47.8

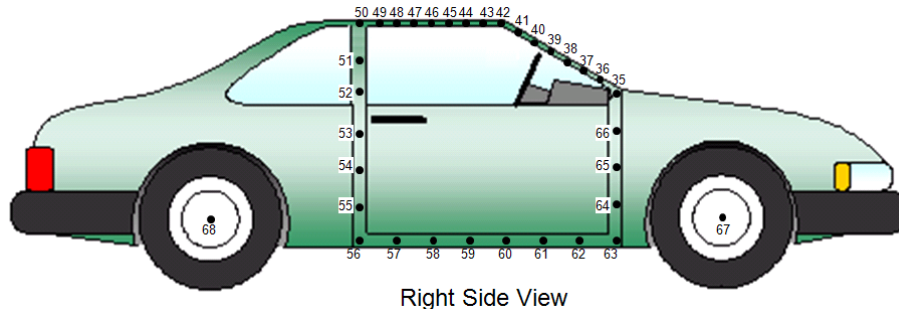
Note: Please see Appendix F.2 for a detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

Passenger Side Door Sill Intrusions



Right Side View

Reference point: Rear most center of the top of rear bumper beam

+X - From the rear of the vehicle to the front of the vehicle

+Y - From 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

PASSENGER SIDE DOOR SILL INTRUSION

Pt.	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
35	1895.0	629.5	-634.7	1895.5	634.4	-634.3	0.5	4.9	0.4
36	1844.5	634.3	-707.2	1843.2	637.3	-706.3	-1.3	3.0	0.8
37	1782.4	622.2	-759.1	1781.3	623.4	-758.0	-1.1	1.2	1.1
38	1713.8	608.8	-810.4	1713.1	607.9	-809.5	-0.6	-0.9	0.9
39	1642.5	594.3	-857.8	1641.3	591.7	-857.1	-1.3	-2.6	0.8
40	1570.5	578.3	-904.0	1569.9	574.7	-902.8	-0.6	-3.7	1.2
41	1497.5	563.5	-943.1	1497.4	559.3	-942.3	0.0	-4.2	0.9
42	1421.9	552.2	-971.4	1422.9	547.9	-971.6	1.0	-4.2	-0.2
43	1340.3	545.3	-989.6	1341.3	541.8	-989.3	1.0	-3.5	0.3
44	1255.8	541.4	-1000.8	1256.1	538.6	-1000.6	0.4	-2.8	0.2
45	1169.0	539.3	-1007.9	1169.3	536.8	-1008.1	0.3	-2.4	-0.2
46	1081.0	539.0	-1010.1	1082.4	537.5	-1009.4	1.5	-1.5	0.7
47	1081.0	539.0	-1010.1	1082.4	537.5	-1009.4	1.5	-1.5	0.7

Note: Please see Appendix F.2 for a detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

PASSENGER SIDE DOOR SILL INTRUSION (CONTINUED)

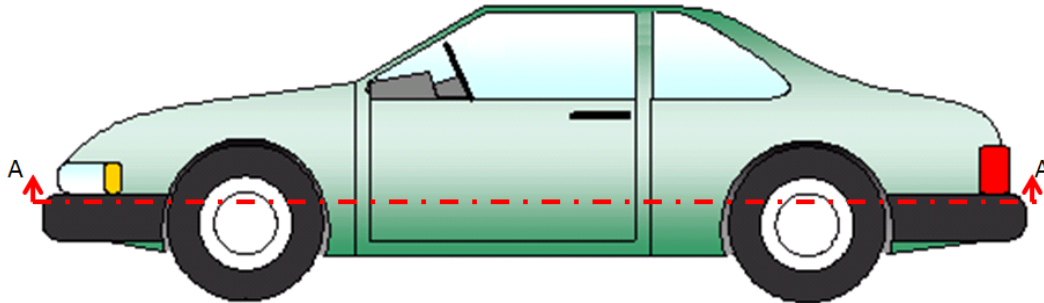
Pt.	Pre-Test			Post-Test			Difference		
	X	Y	Z	X	Y	Z	X	Y	Z
48	994.5	539.5	-1009.7	995.1	538.3	-1009.3	0.6	-1.2	0.3
49	908.0	541.3	-1006.2	908.4	540.9	-1005.2	0.4	-0.4	1.1
50	824.5	547.6	-993.5	823.8	546.3	-994.5	-0.6	-1.3	-1.0
51	751.5	564.9	-956.6	752.1	563.8	-957.3	0.6	-1.1	-0.6
52	681.9	632.1	-796.0	680.1	632.1	-799.7	-1.7	0.0	-3.7
53	673.3	658.4	-616.6	674.0	656.6	-617.3	0.6	-1.8	-0.7
54	747.3	658.6	-453.9	747.4	655.9	-455.6	0.1	-2.7	-1.7
55	839.0	653.1	-301.5	840.5	652.5	-301.1	1.5	-0.7	0.4
56	947.1	651.7	-151.3	948.2	651.5	-151.8	1.1	-0.3	-0.5
57	1065.1	648.0	-10.3	1066.9	648.2	-9.9	1.8	0.1	0.4
58	1167.4	651.1	35.6	1167.4	651.9	35.5	-0.1	0.8	-0.1
59	1278.9	651.3	53.7	1281.5	650.1	54.1	2.6	-1.1	0.5
60	1389.7	650.0	69.7	1390.8	650.2	70.3	1.1	0.2	0.6
61	1500.4	647.4	84.7	1501.7	647.6	85.9	1.2	0.1	1.2
62	1610.4	647.3	99.0	1611.6	644.8	100.6	1.3	-2.5	1.6
63	1721.9	645.7	112.9	1722.4	644.0	114.9	0.5	-1.8	2.0
64	1835.6	650.9	116.8	1837.5	650.7	120.1	1.9	-0.2	3.3
65	1892.8	620.8	-55.6	1892.7	622.5	-55.2	-0.1	1.7	0.3
66	1909.1	623.8	-238.5	1908.5	629.8	-239.2	-0.6	5.9	-0.8
67	1914.8	612.1	-423.7	1913.7	619.4	-423.9	-1.0	7.3	-0.2
68	994.5	539.5	-1009.7	995.1	538.3	-1009.3	0.6	-1.2	0.3

Note: Please see Appendix F.2 for a detailed procedure on how to measure the required door sill intrusions.

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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

VEHICLE EXTERIOR CRUSH PROFILE SECTION A-A

Pt.	Pre-Test			Pt.	Post-Test		
	X	Y	Z		X	Y	Z
1	676.5	774.9	-42.6	1	93.5	-766.4	-30.5
2	849.4	728.4	-39.8	2	60.8	-745.0	-35.5
3	1008.7	712.5	-35.4	3	31.5	-679.3	-42.4
4	1333.6	724.7	-35.5	4	19.1	-622.7	-47.3
5	1622.3	723.1	-39.9	5	8.8	-511.7	-56.5
6	1917.5	718.4	-38.7	6	4.0	-351.0	-69.6
7	2029.8	738.7	-39.5	7	3.0	-171.1	-81.2
8	120.0	-766.4	-41.4	8	7.0	-3.7	-95.1
9	72.2	-736.6	-47.2	9	16.1	144.5	-105.7
10	41.9	-665.9	-47.2	10	27.4	260.4	-110.7
11	18.5	-506.3	-49.4	11	55.7	443.7	-123.0
12	6.4	-236.4	-52.3	12	56.6	534.6	-130.3
13	2.9	-1.9	-49.9	13	43.3	558.0	-134.5
14	6.5	203.6	-52.8	14	64.6	663.6	-137.8
15	17.5	484.7	-37.6	15	96.6	734.5	-144.1
16	68.5	730.5	-53.3	16	256.0	792.5	-136.1
17	103.0	765.3	-52.9	17	599.9	793.9	-118.4
18	125.8	774.3	-45.5	18	737.6	764.6	-106.9
19	2533.9	726.2	-29.8	19	818.1	729.3	-98.3

Note: See appendix F.3 for a detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

VEHICLE EXTERIOR CRUSH PROFILE SECTION A-A (CONTINUED)

Pt.	Pre-Test			Pt.	Post-Test		
	X	Y	Z		X	Y	Z
20	2596.3	701.3	-34.8	20	943.4	720.8	-93.7
21	2649.0	633.8	-33.5	21	1165.1	726.7	-74.2
22	2675.3	502.3	-28.3	22	1521.7	729.1	-68.6
23	2687.6	296.3	-26.6	23	1783.1	720.2	-36.6
24	2699.7	-0.8	-32.1	24	1901.5	716.6	-29.9
25	2696.9	-184.4	-33.6	25	1908.6	635.9	-22.4
26	2679.7	-418.1	-33.6	26	1986.5	646.9	-18.4
27	2647.4	-634.7	-37.3	27	2010.8	733.8	-24.7
28	2601.1	-697.0	-41.3	28	2126.7	748.6	2.7
29	2538.6	-727.0	-39.9	29	2171.4	845.6	-21.2
30	2015.8	-736.8	-37.2	30	2208.4	847.0	-20.3
31	1913.3	-714.2	-38.9	31	2593.9	780.4	10.2
32	1694.9	-719.5	-39.4	32	2603.7	687.6	15.9
33	1447.0	-722.8	-38.1	33	2587.6	592.2	22.0
34	1190.7	-718.7	-42.9	34	2500.4	480.0	25.8
35	999.3	-709.6	-41.4	35	2652.2	501.9	24.8
36	845.2	-722.6	-42.4	36	2660.9	448.4	34.5
37	681.6	-767.9	-46.5	37	2534.8	365.3	36.6
38	676.5	774.9	-42.6	38	2503.5	312.1	38.3
				39	2425.2	238.5	38.7
				40	2287.3	103.8	53.0
				41	2179.5	70.4	47.7
				42	2151.2	8.6	48.7
				43	2171.8	-60.5	69.3
				44	2193.6	-144.8	64.4
				45	2173.1	-187.9	62.9
				46	2228.7	-278.6	80.3
				47	2059.4	-190.3	56.8
				48	1922.8	-230.2	52.9
				49	1996.8	-358.3	68.7
				50	1918.3	-401.3	65.1
				51	1788.3	-273.3	47.1
				52	1786.0	-347.1	53.9

Note: See appendix F.3 for a detailed procedure on how to measure vehicle exterior crush profile

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

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

**VEHICLE EXTERIOR CRUSH PROFILE
SECTION A-A (CONTINUED)**

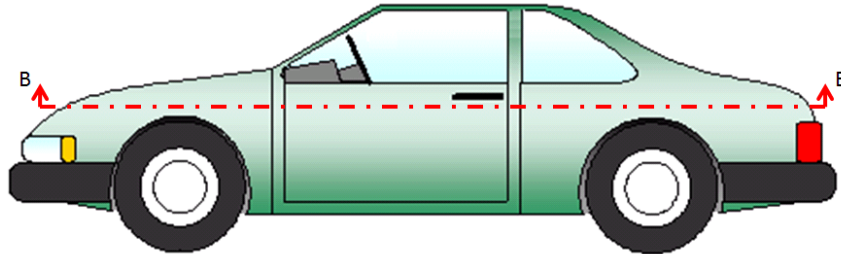
Pt.	Post-Test		
	X	Y	Z
53	1780.0	-451.6	58.3
54	1820.1	-595.8	75.7
55	2000.5	-721.2	95.8
56	1923.1	-705.4	92.1
57	1848.4	-700.4	82.4
58	1648.5	-757.4	76.1
59	1651.9	-757.1	72.3
60	1546.0	-772.4	63.0
61	1372.1	-787.0	57.8
62	1024.1	-802.7	36.6
63	951.3	-708.3	24.2
64	742.0	-758.3	16.8
65	690.4	-770.8	12.5

Note: See appendix F.3 for a detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date: 8/29/2011



Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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

VEHICLE EXTERIOR CRUSH PROFILE SECTION B-B

Pt.	Pre-Test			Pt.	Post-Test		
	X	Y	Z		X	Y	Z
1	166.6	754.9	-215.8	1	583.6	-760.1	-195.7
2	252.4	771.7	-214.7	2	410.6	-779.0	-205.2
3	552.7	759.4	-218.4	3	202.6	-762.9	-217.0
4	714.2	731.8	-218.6	4	104.0	-719.4	-224.5
5	861.4	728.9	-219.5	5	62.3	-556.4	-241.0
6	1140.1	742.6	-213.0	6	90.2	-522.5	-236.6
7	1469.2	741.0	-218.5	7	71.4	-311.9	-263.9
8	1773.0	731.8	-211.6	8	61.1	3.7	-289.7
9	2080.5	730.7	-215.1	9	66.4	152.2	-294.6
10	2381.3	708.5	-213.0	10	87.4	358.0	-311.5
11	2462.0	674.3	-216.3	11	123.3	533.6	-319.6
12	180.4	-751.7	-222.9	12	153.2	653.2	-328.7
13	124.1	-729.4	-218.0	13	283.3	719.8	-325.3
14	93.7	-688.9	-216.9	14	501.2	743.9	-308.6
15	65.1	-567.8	-218.5	15	640.4	746.7	-301.4
16	96.3	-489.4	-206.2	16	712.7	732.3	-300.8
17	72.2	-237.8	-205.7	17	792.3	732.7	-294.2
18	63.3	3.4	-214.0	18	1145.0	749.5	-274.8
19	70.6	227.9	-209.0	19	1439.6	742.9	-268.1
20	95.1	494.9	-205.0	20	1732.8	742.7	-235.6
21	65.5	566.6	-214.2	21	1931.5	737.3	-221.7

Note: See appendix F.3 for a detailed procedure on how to measure vehicle exterior crush profile

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

VEHICLE EXTERIOR CRUSH PROFILE SECTION B-B (CONTINUED)

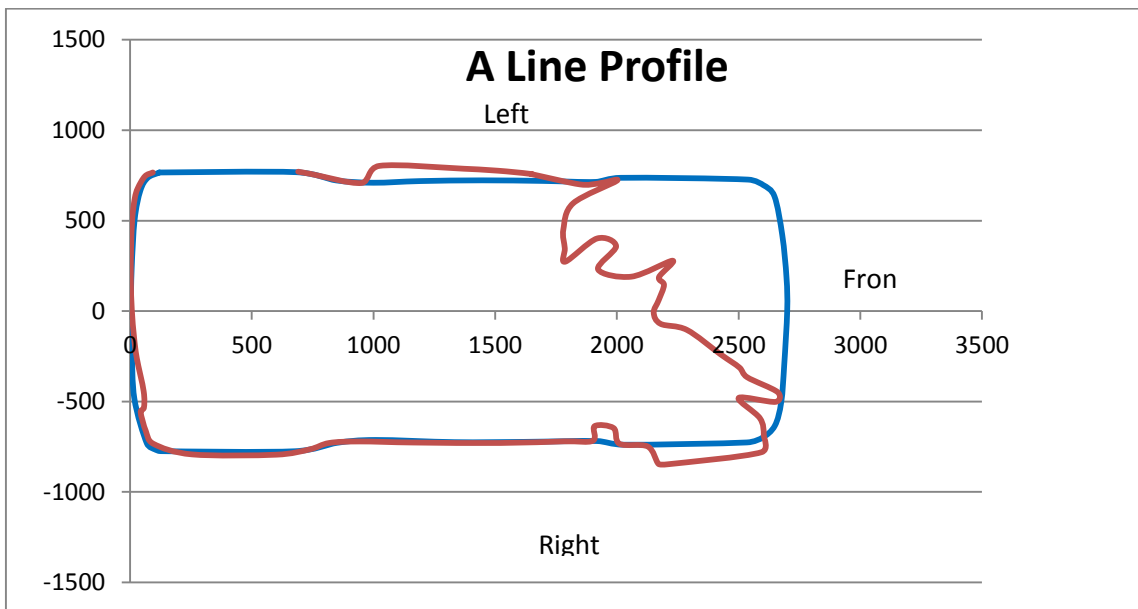
Pt.	Pre-Test			Pt.	Post-Test		
	X	Y	Z		X	Y	Z
22	106.8	715.8	-213.0	22	1936.1	641.5	-221.0
23	137.7	744.4	-212.4	23	2060.9	636.3	-206.5
24	2490.6	657.8	-213.6	24	2123.9	648.9	-205.2
25	2557.0	596.1	-214.2	25	2162.9	646.9	-206.0
26	2624.0	477.3	-213.4	26	2264.4	649.0	-194.3
27	2657.0	355.3	-217.3	27	2417.5	662.2	-197.4
28	2681.6	165.6	-220.3	28	2493.2	719.5	-185.8
29	2676.4	5.3	-227.7	29	2504.0	517.6	-177.1
30	2674.4	-228.6	-220.3	30	2493.8	396.9	-163.2
31	2656.7	-359.5	-211.7	31	2874.0	576.0	-154.4
32	2562.9	-585.8	-213.6	32	2806.4	321.4	-140.8
33	2472.4	-669.3	-212.1	33	2681.6	221.2	-140.8
34	2434.8	-684.0	-202.6	34	2649.1	226.0	-133.1
35	2365.8	-709.7	-204.7	35	2524.4	163.3	-127.9
36	2067.0	-728.3	-213.3	36	2352.2	136.3	-146.7
37	1757.6	-732.4	-223.5	37	2220.6	160.7	-156.4
38	1456.5	-737.7	-215.4	38	2122.0	109.6	-141.4
39	1148.4	-733.9	-218.4	39	2068.4	-16.0	-151.0
40	839.4	-723.9	-214.4	40	2043.9	-183.4	-140.4
41	717.3	-724.1	-212.4	41	2109.3	-287.1	-135.9
42	539.3	-760.8	-215.9	42	2175.9	-348.6	-112.5
43	382.7	-771.0	-225.3	43	2153.7	-433.6	-114.4
44	195.3	-756.4	-222.8	44	1876.0	-438.1	-130.2
Note: Please see Appendix F.3 for a detailed procedure on how to measure vehicle exterior crush profile				45	1826.0	-503.9	-130.6
				46	2035.4	-671.5	-107.3
				47	1915.2	-675.8	-96.6
				48	1875.3	-679.0	-111.7
				49	1731.7	-754.9	-115.1
				50	1711.9	-764.3	-119.9
				51	1572.2	-801.8	-128.1
				52	1371.9	-826.7	-136.7
				53	1135.2	-838.1	-150.4
				54	854.1	-839.4	-165.8
				55	828.6	-720.3	-177.5
				56	614.1	-756.7	-188.0
				57	583.6	-760.1	-195.7

DATA SHEET NO.13 (CONTINUED)

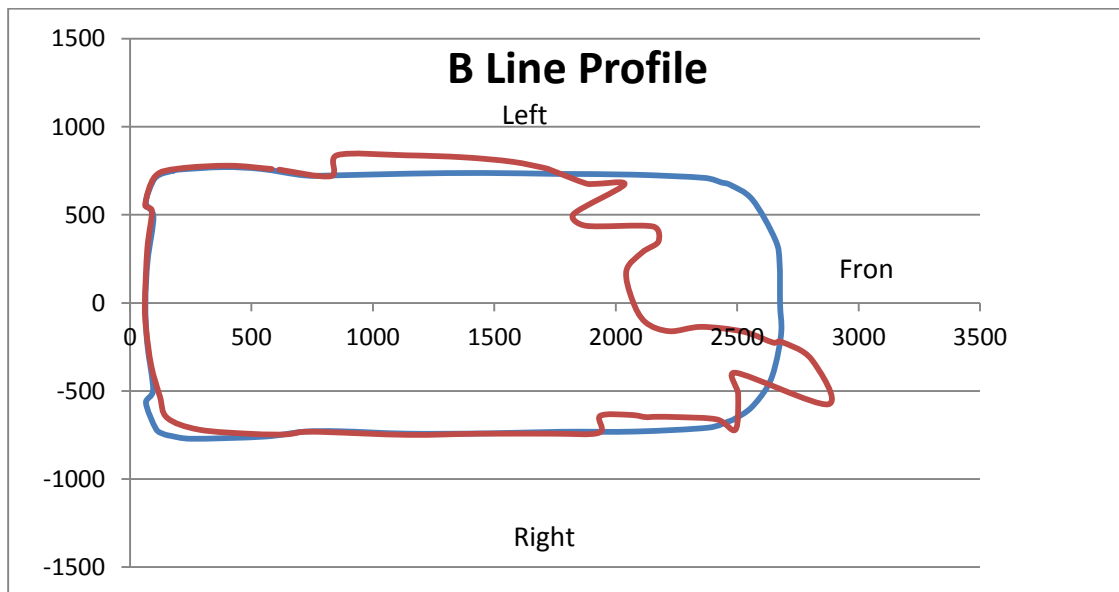
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

SECTION A-A



SECTION B-B



DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

LEFT PROFILE OF THE DASH



Points	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
LB3	1774.7	-439.2	-238.8	1490.7	-350.4	-284.5	-284.1	88.8	-45.7
LB2	1735.5	-440.3	-271.5	1441.3	-339.4	-343.1	-294.2	100.9	-71.6
LB1	1696.0	-440.1	-306.4	1420.0	-323.3	-387.3	-276.0	116.8	-80.9
DIPL	1663.3	-439.4	-341.0	1394.6	-319.2	-430.7	-268.7	120.2	-89.7
LT1	1633.0	-439.5	-384.3	1418.1	-323.0	-462.2	-214.8	116.5	-77.9
LT2	1656.9	-437.2	-414.9	1477.4	-341.4	-448.1	-179.4	95.8	-33.3
LT3	1705.5	-435.9	-400.6	1520.8	-352.4	-419.9	-184.7	83.5	-19.4
LT4	1745.2	-436.9	-370.3	1568.3	-358.1	-409.0	-176.9	78.8	-38.7
LT5	1792.8	-434.4	-360.1	1612.5	-368.4	-424.7	-180.2	66.0	-64.6
LT6	1840.7	-438.9	-371.2	1611.9	-363.5	-470.7	-228.9	75.4	-99.5
LT7	1856.6	-441.2	-418.3	1584.9	-347.1	-508.8	-271.7	94.0	-90.4
LT8	1859.8	-441.1	-469.4	1494.1	-319.0	-654.8	-365.7	122.1	-185.4
LT9	Not Applicable								

Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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

Note: Please see Appendix F.4 for a detailed procedure for how to measure the required profile dash

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011

RIGHT PROFILE OF THE DASH



Points	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
RB3	1756.3	-140.5	-238.2	1543.2	-56.8	-231.1	-213.2	83.7	7.1
RB2	1717.8	-140.8	-270.6	1513.8	-50.2	-247.3	-204.0	90.7	23.3
RB1	1679.5	-140.5	-305.6	1502.1	-45.8	-327.9	-177.4	94.7	-22.4
DIPR	1647.0	-141.0	-342.9	1471.1	-37.9	-370.1	-175.9	103.1	-27.2
RT1	1620.6	-140.6	-387.4	1446.7	-26.2	-405.6	-173.9	114.4	-18.2
RT2	1653.9	-142.3	-404.3	1475.3	-32.8	-431.1	-178.6	109.6	-26.8
RT3	1698.6	-141.6	-389.7	1514.1	-48.1	-409.5	-184.5	93.5	-19.8
RT4	1736.1	-116.2	-395.8	1531.1	-23.7	-426.2	-205.0	92.5	-30.4
RT5	1763.1	-118.2	-436.2	1576.1	-33.5	-442.5	-187.0	84.8	-6.3
RT6	1764.4	-115.6	-484.2	1563.7	-28.0	-503.1	-200.7	87.6	-18.9
RT7	1750.7	-133.3	-530.7	1528.5	-17.9	-565.7	-222.2	115.4	-35.0
RT8	1779.4	-136.7	-552.8	1555.0	-28.9	-589.1	-224.4	107.8	-36.3
RT9	Not Applicable								

Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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

Note: Please see Appendix F.4 for a detailed procedure for how to measure the required profile dash

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date: 8/29/2011

	Points	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
		X	Y	Z	X	Y	Z	X	Y	Z
Lower Bumper Beam	1	2650.7	-499.6	72.3	2106.0	-112.3	10.7	-545	387	-62
	2	2645.0	-316.8	62.5	2138.8	66.0	26.5	-506	383	-36
	3	2674.7	-116.4	68.3	2319.7	127.4	3.1	-355	244	-65
	4	2678.9	91.3	65.2	2507.1	215.9	-25.7	-172	125	-91
	5	2656.5	289.2	55.0	2670.1	326.7	-62.6	14	37	-118
	6	2668.6	498.1	60.3	2834.8	447.0	-81.2	166	-51	-141
Upper Bumper Beam	1	2645.3	-500.8	2.3	2078.7	-99.5	-52.5	-567	401	-55
	2	2648.9	-313.0	-1.6	2122.1	77.7	-32.1	-527	391	-30
	3	2676.0	-112.5	-0.2	2311.4	136.0	-64.7	-365	248	-65
	4	2680.5	91.5	-1.9	2493.8	220.6	-94.3	-187	129	-92
	5	2660.5	293.8	-7.4	2665.6	327.2	-121.6	5	33	-114
	6	2664.7	498.0	-5.1	2842.5	425.6	-142.0	178	-72	-137
Upper Radiator Support	1	2515.9	-486.1	-188.3	1999.8	-155.4	-201.8	2515.9	-486.1	-188.3
	2	2547.0	-293.2	-189.5	2018.3	35.5	-195.0	2547.0	-293.2	-189.5
	3	2558.8	-114.1	-200.9	2106.7	128.3	-216.9	2558.8	-114.1	-200.9
	4	2562.4	106.2	-198.5	2312.7	202.8	-241.2	2562.4	106.2	-198.5
	5	2556.0	298.8	-194.1	2513.8	349.0	-177.1	2556.0	298.8	-194.1
	6	2526.0	517.2	-180.0	2502.0	553.6	-217.6	2526.0	517.2	-180.0

*Points unrecoverable, support beam was destroyed in crash

Reference point: Rear most center of the top of rear bumper beam

+X - From the rear of the vehicle to the front of the vehicle

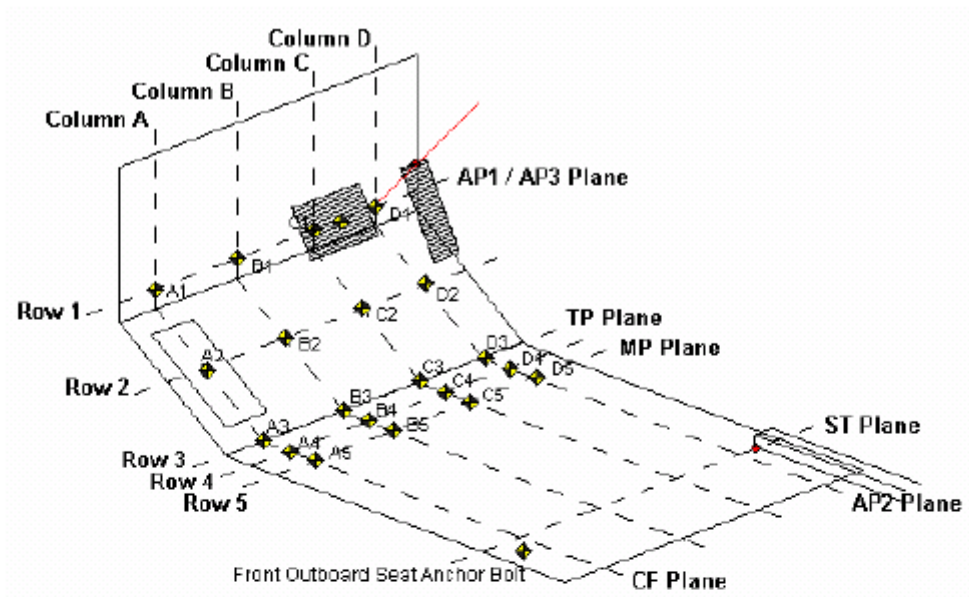
+Y - From left side of the vehicle to the right side of the vehicle

+Z - From the top of the vehicle to the bottom of the vehicle

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle:	2011 Smart ForTwo	NHTSA No:	RB0526
Test Program:	R&D 56mph 15°/ 35% Offset	Test Date	8/29/2011



AP1: Y-Z Plane passing through D1

AP2: X-Z Plane passing through D1

AP3: X-Y plane passing through D1

MP: Y-Z plane, halfway between the ST plane and AP1 plane

CF Plane: X-Z plane passes through center of footrest.

BP Plane: X-Z plane passes through center of brake pedal

TP Plane: Y-Z plane, intersection of BP Plane and the intersection of the toe pan and floorboard

Column A: intersection of vehicle and CF plane

Column D: Intersection of vehicle and AP2 plane

Row 1: intersection of the vehicle and the AP3 Plane

Row 3: intersection of the vehicle and TP plane

Row 5: intersection of the vehicle and MP plane

Row 2: evenly spaced between row 1 and 3

Row 4: evenly spaced between row 3 and 5

DATA SHEET NO.13 (CONTINUED)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date 8/29/2011

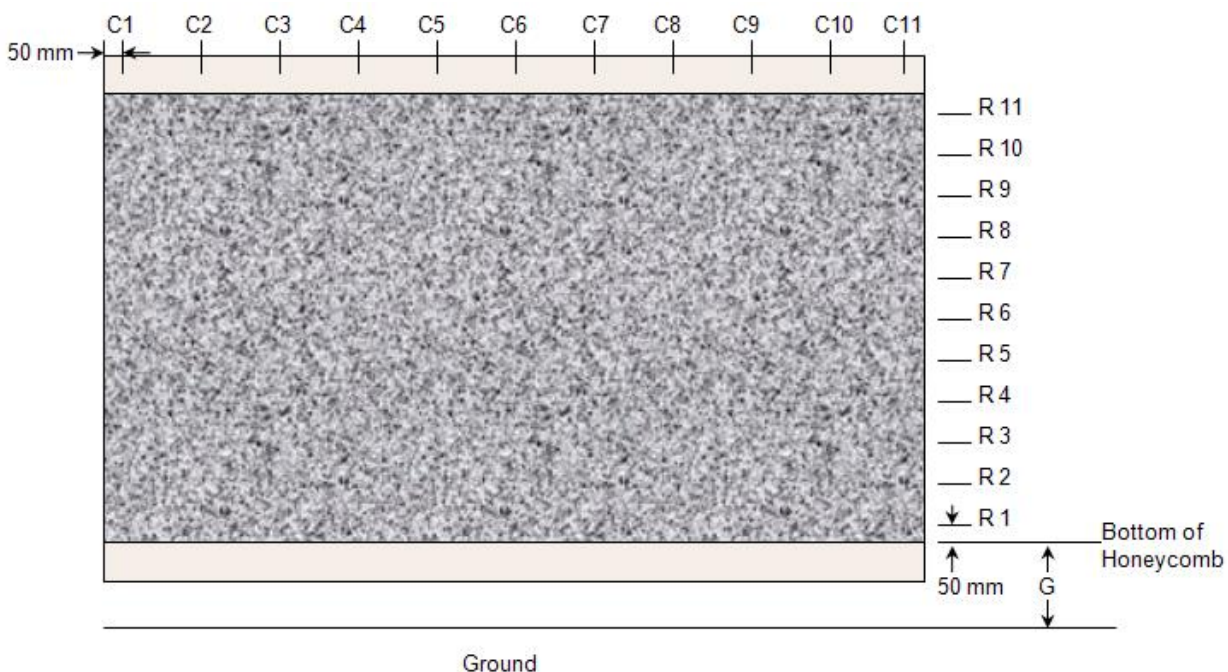
Intrusion Location	Pre-Test (mm)			Post-Test (mm)			Difference (mm)		
	X	Y	Z	X	Y	Z	X	Y	Z
A1	2020.59	-491.62	-41.10	1784.58	-341.80	-9.42	-236.01	149.82	31.68
B1	2201.39	-349.67	-33.83	1902.70	-165.66	-39.41	-298.69	184.01	-5.58
C1	2216.66	-218.53	-27.61	1918.24	-49.67	-21.93	-298.42	168.86	5.68
D1	2222.69	-99.60	-35.84	1944.79	69.50	-15.71	-277.90	169.11	20.12
A2	1957.40	-490.38	32.82	1763.32	-365.50	82.81	-194.09	124.88	49.99
B2	2157.97	-352.39	32.35	1889.80	-193.14	34.51	-268.16	159.25	2.17
C2	2190.72	-228.82	35.57	1930.98	-76.15	51.05	-259.74	152.68	15.47
D2	1971.85	-112.52	35.82	1973.05	24.66	82.54	1.21	137.17	46.72
A3	1925.70	-493.15	99.13	1772.95	-385.46	149.80	-152.75	107.69	50.66
B3	1985.20	-357.42	104.54	1789.72	-235.50	173.14	-195.48	121.92	68.61
C3	2067.72	-195.21	115.24	1920.48	-78.03	61.10	-147.24	117.19	-54.14
D3	1947.51	-110.82	98.47	1905.65	-10.22	135.36	-41.87	100.60	36.89
A4	1900.88	-492.23	116.35	1787.82	-395.09	184.22	-113.06	97.14	67.87
B4	1904.10	-359.64	118.72	1772.89	-269.22	202.59	-131.21	90.41	83.87
C4	1907.72	-234.76	122.69	1752.58	-139.10	213.81	-155.14	95.66	91.12
D4	1909.44	-112.19	122.42	1845.69	-40.38	162.27	-63.75	71.81	39.86
A5	1816.88	-489.99	117.00	1728.51	-418.55	206.24	-88.36	71.44	89.24
B5	1815.34	-363.12	119.63	1696.01	-301.39	204.99	-119.34	61.73	85.36
C5	1818.28	-236.40	95.04	1736.02	-197.59	157.08	-82.27	38.81	62.05
D5	1814.16	-110.95	117.05	1781.96	-93.97	139.55	-32.20	16.98	22.51
Brake Pedal	1980.69	-244.49	-66.52	1754.37	-180.23	18.95	-226.32	64.26	85.47
IP Left	1663.27	-439.38	-341.02	1420.04	-323.25	-387.26	-243.23	116.13	-46.24
IP Right	1647.01	-141.05	-342.92	1502.10	-45.78	-327.94	-144.90	95.26	14.98
Steering Column	1497.26	-288.16	-549.71	1345.58	-267.80	-588.68	-151.68	20.36	-38.97
Front Outboard Bolt	1429.96	-500.49	74.21	1400.65	-497.89	5.34	-29.31	2.60	-68.87
IIHS Foot Rest	1957.4	-490.38	32.82	1763	-365.5	82.811	-194.09	124.88	49.99
IIHS Brake Pedal	1980.69	-244.49	-66.52	1754.37	-180.23	18.95	-226.32	64.26	85.47
IIHS Left	1663.27	-439.38	-341.02	1420.04	-323.25	-387.26	-243.23	116.13	-46.24
IIHS Right	1647.01	-141.05	-342.92	1502.10	-45.78	-327.94	-144.90	95.26	14.98

Reference point: Rear most center of the top of rear bumper beam
 +X - From the rear of the vehicle to the front of the vehicle
 +Y - From 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: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date: 8/29/2011



BARRIER X-CRUSH

		C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11
		50 mm	260 mm	470 mm	680 mm	890 mm	1100 mm	1310 mm	1520 mm	1730 mm	1940 mm	2150 mm
R11	910mm	1.7	3.2	2.9	2.5	2.8	2.7	2.4	2.5	3.0	0.4	1.9
R10	824mm	1.9	1.3	1.0	0.8	0.4	0.4	0.6	12.6	14.9	5.5	4.5
R9	738mm	1.9	1.0	0.6	0.5	0.1	0.3	0.3	15.8	15.5	6.7	8.1
R8	652mm	2.0	0.9	0.9	0.4	0.1	0.1	0.4	3.7	19.6	3.4	13.1
R7	566mm	2.0	0.7	0.6	0.4	0.4	0.4	0.4	0.5	94.1	19.5	20.4
R6	480mm	1.7	0.5	0.5	0.7	0.5	0.6	0.8	7.2	66.4	31.7	34.5
R5	384mm	1.7	0.8	0.6	0.8	0.8	0.8	1.0	2.6	57.5	45.8	57.4
R4	308mm	1.5	1.0	0.7	0.8	1.0	0.9	1.2	1.6	105.5	67.3	83.8
R3	222mm	1.4	1.0	0.8	1.1	1.0	1.2	1.4	5.7	138.7	87.2	112.9
R2	136mm	1.2	1.5	1.5	1.6	1.6	1.6	1.4	14.1	165.4	98.5	144.9
R1	50mm	1.5	1.4	1.9	2.1	*	*	1.6	24.6	194.4	120.4	183.1

*Barrier was cut to clear rail and defined points were unmeasurable

DATA SHEET NO. 15

SUMMARY OF FMVSS 212, 219 (PARTIAL), AND 301 DATA

Test Vehicle: 2011 Smart ForTwo NHTSA No: RB0526
 Test Program: R&D 56mph 15°/ 35% Offset Test Date: 8/29/2011

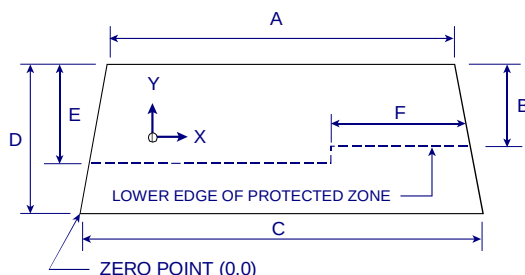
Please provide windshield mounting details. _____

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: 23.8°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	1536	831	54.1
Right Side	1536	1461	95.1
Total	3071	2292	74.6



Item	Units	Value
A	mm	1035
B	mm	393
C	mm	1250
D	mm	393
E	mm	720
F	mm	443

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.

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.

X	Y

DATA SHEET NO. 15 (CONTINUED)

SUMMARY OF FMVSS 212, 219 (PARTIAL), AND 301 DATA

Test Vehicle:	<u>2011 Smart ForTwo</u>	NHTSA No:	<u>RB0526</u>
Test Program:	<u>R&D 56mph 15°/ 35% Offset</u>	Test Date	<u>8/29/2011</u>

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 23.8°C

Test Time: 2:00 PM

Stoddard Solvent Spillage Measurements

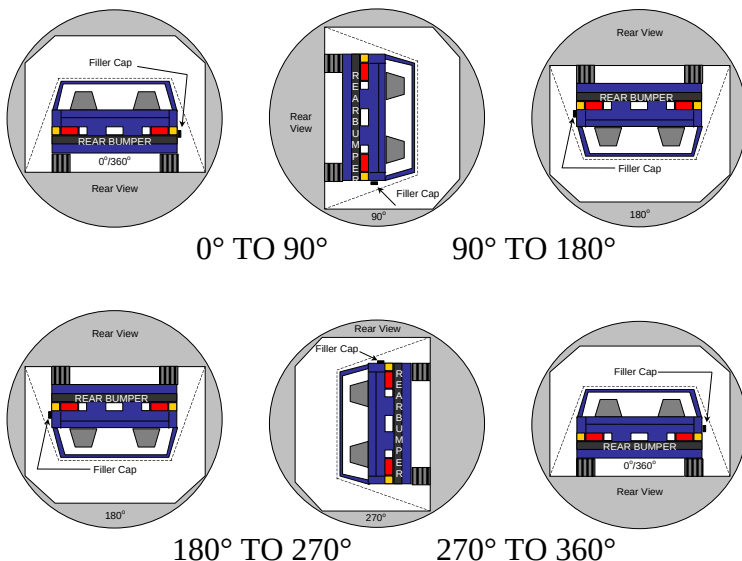
- | | | |
|----|---|---------------|
| A. | From impact until vehicle motion ceases:
(maximum allowable = 1 oz.) | <u>0</u> oz. |
| B. | For the 5-minute period after motion ceases:
(maximum allowable = 5 oz.) | <u>0</u> oz. |
| C. | For the following 25 minutes:
(maximum allowable = 1 oz./minute) |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

DATA SHEET NO. 16

FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2011 Smart ForTwo
 Test Program: R&D 56mph 15°/ 35% Offset

NHTSA No: RB0526
 Test Date: 8/29/2011



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).
2. Details of Stoddard Solvent spillage: _____

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	68	300	368
90° to 180°	62	300	362
180° to 270°	64	300	364
270° to 360°	70	300	370

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°	
90° to 180°	
180° to 270°	
270° to 360°	

DATA SHEET NO. 17

DUMMY/VEHICLE TEMPERATURE STABILIZATION

Test Vehicle:	<u>2011 Smart ForTwo</u>	NHTSA No:	<u>RB0526</u>
Test Program:	<u>R&D 56mph 15°/ 35% Offset</u>	Test Date	<u>8/29/2011</u>

NOT AVAILABLE

APPENDIX A
PHOTOGRAPHS

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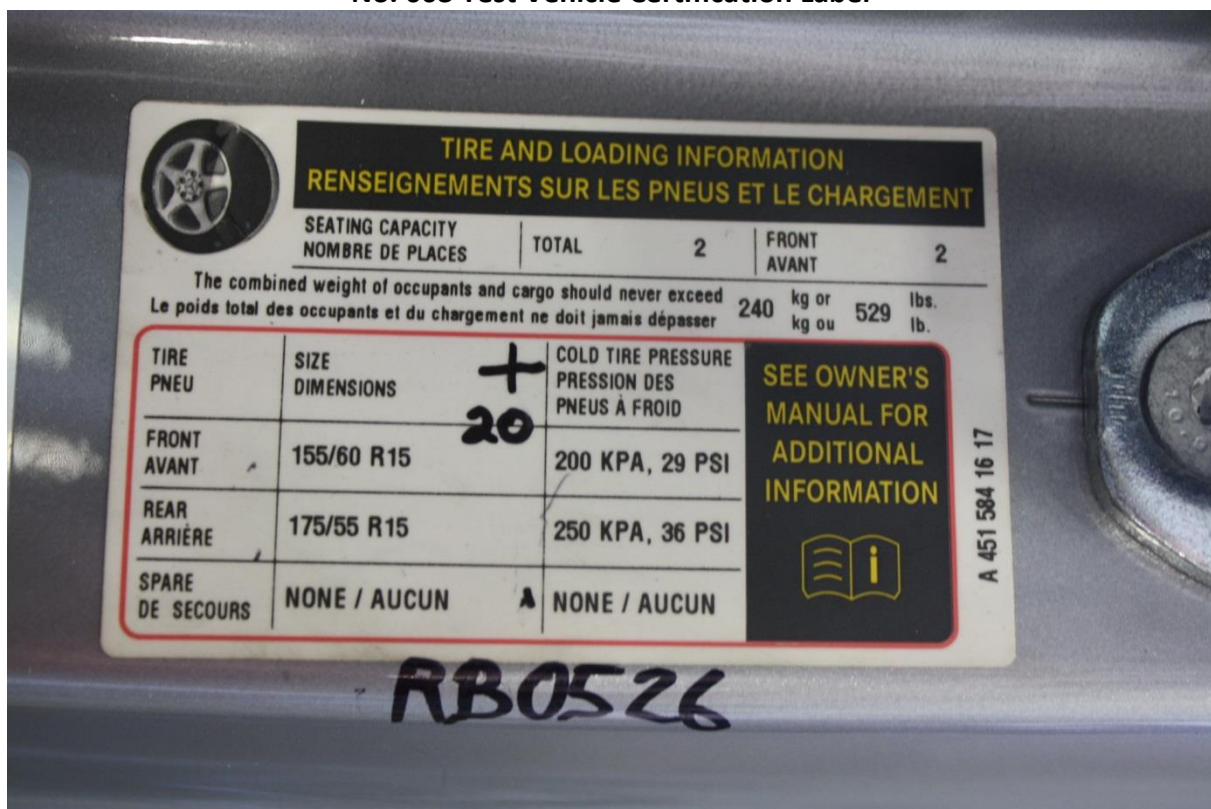
No. 001 As Delivered Right Front 3-4 View of Test Vehicle



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



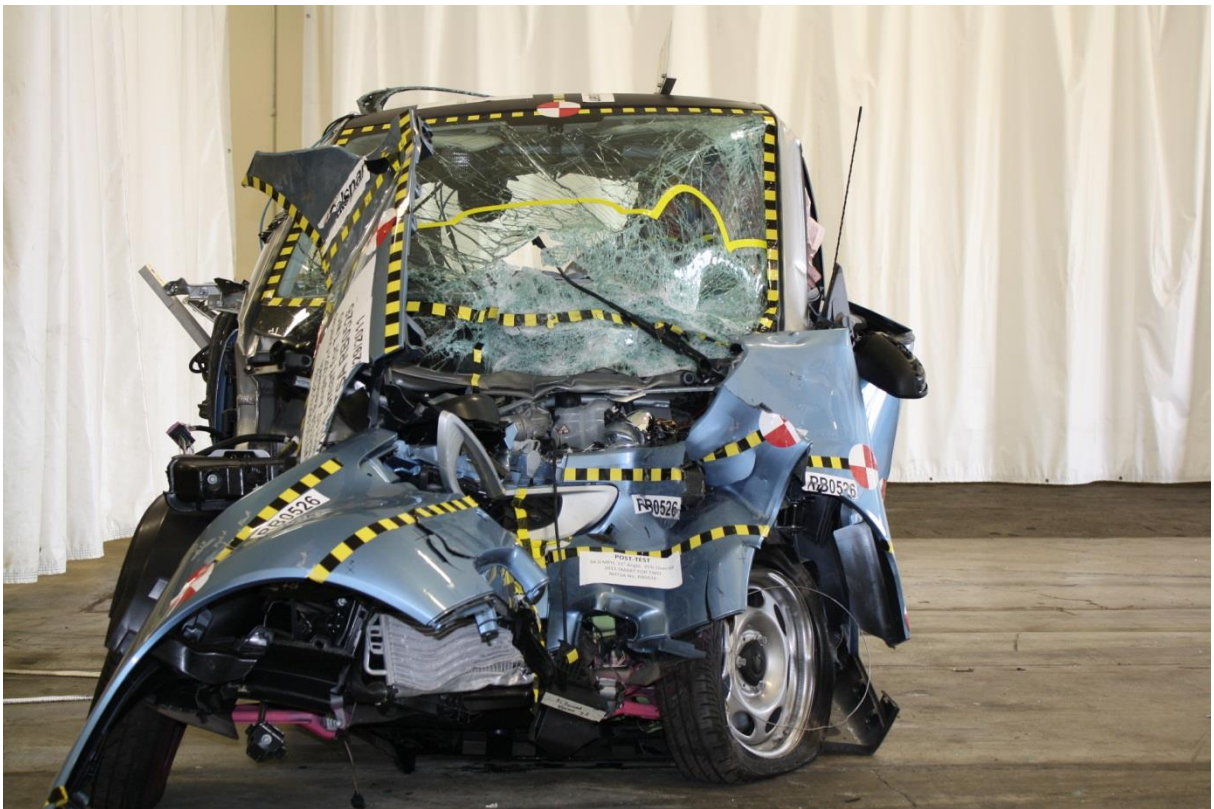
No. 003 Test Vehicle Certification Label



No. 004 Test Vehicle Tire Placard



No. 005 Pre-Test Front View of Test Vehicle



No. 006 Post-Test Front View of Test Vehicle



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



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



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



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



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



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



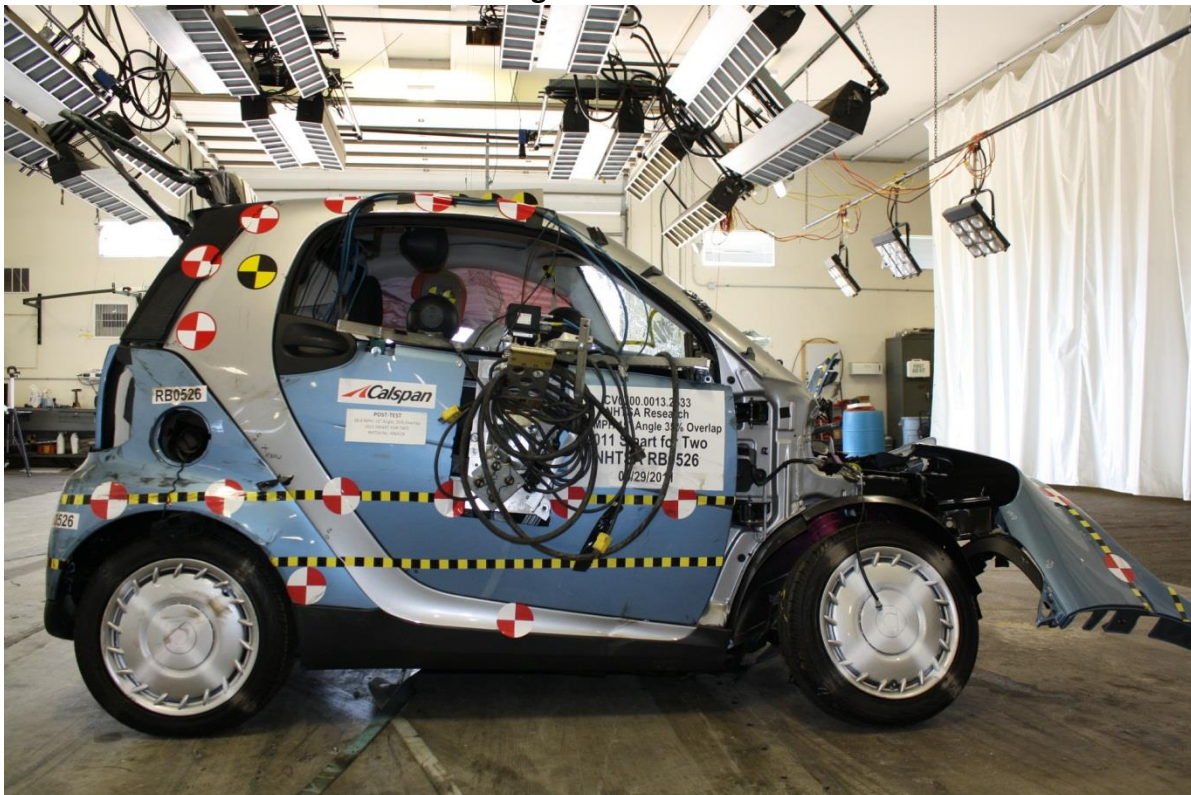
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No. 014 Post-Test Rear View of Test Vehicle



No. 015 Pre-Test Right Side View of Test Vehicle



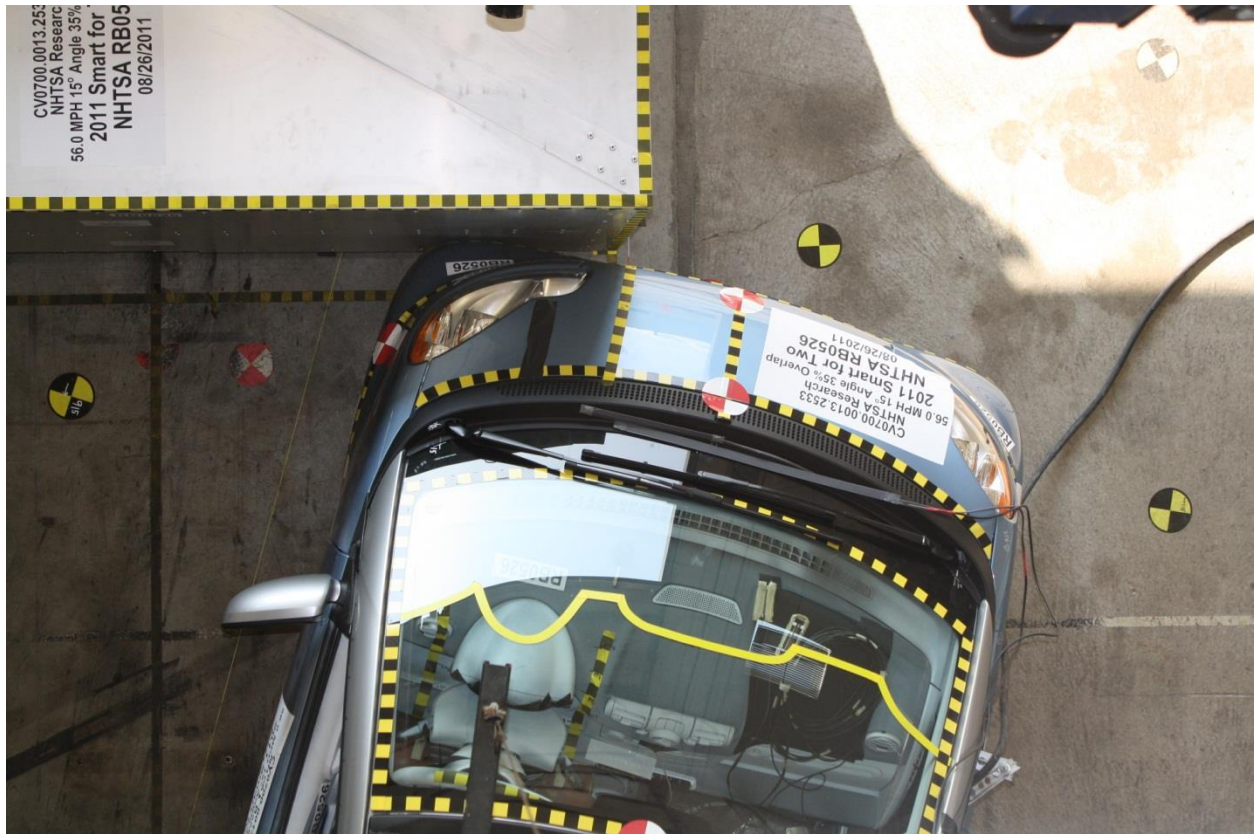
No. 016 Post-Test Right Side View of Test Vehicle



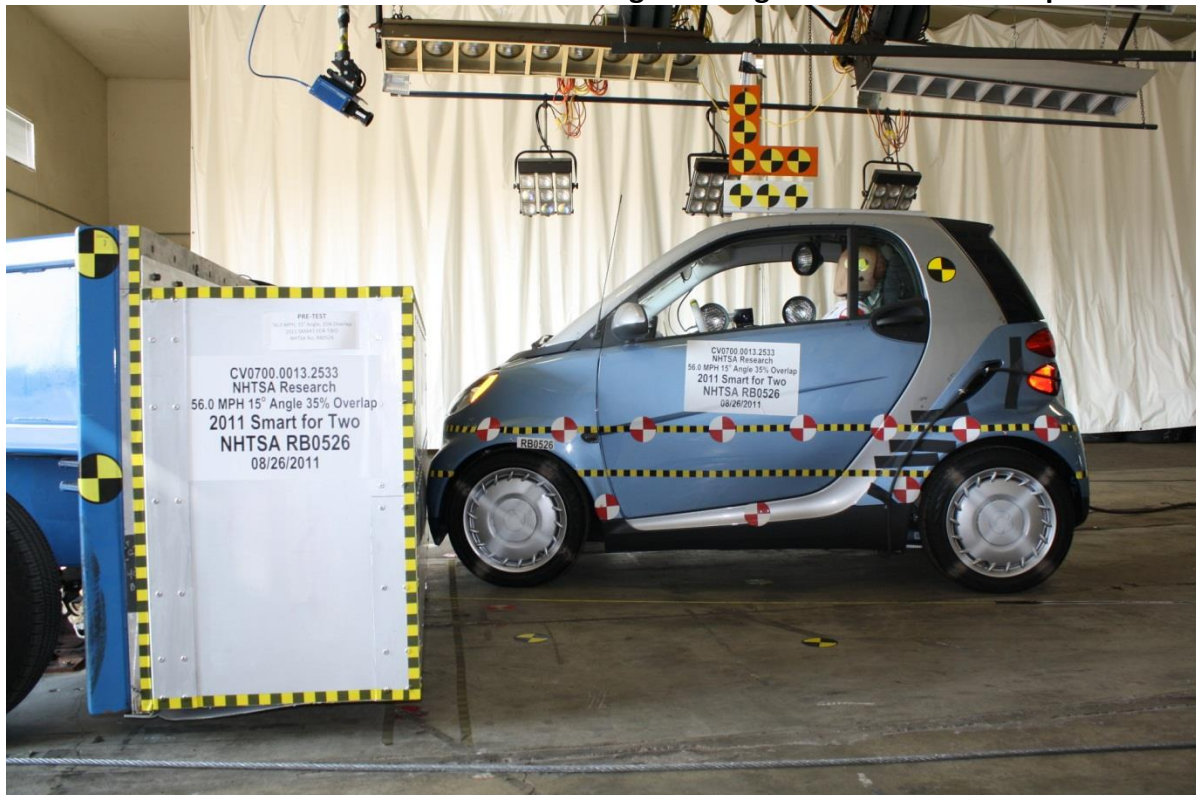
No. 017 Pre-Test Right Front 3-4 View of Test Vehicle



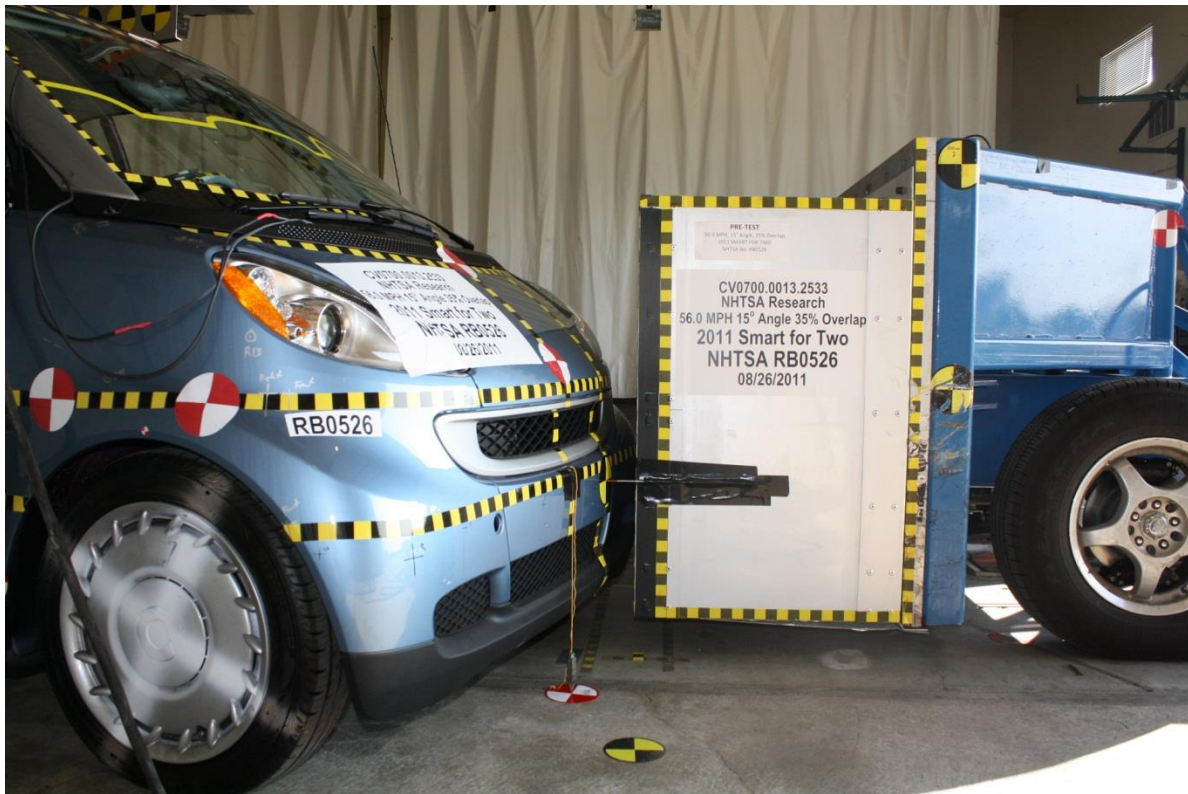
No. 018 Post-Test Right Front 3-4 View of Test Vehicle



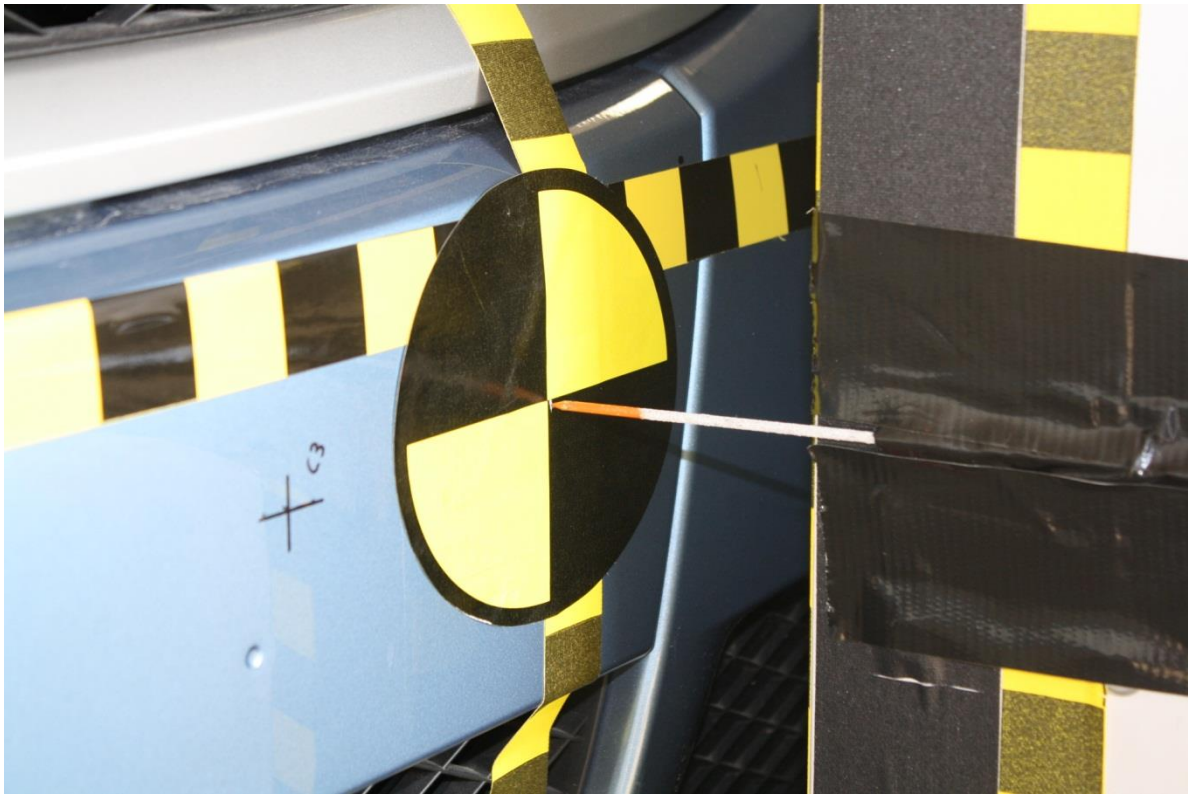
No. 019 Pre-Test Overhead View of RRMDB against target vehicle at ideal Impact Point



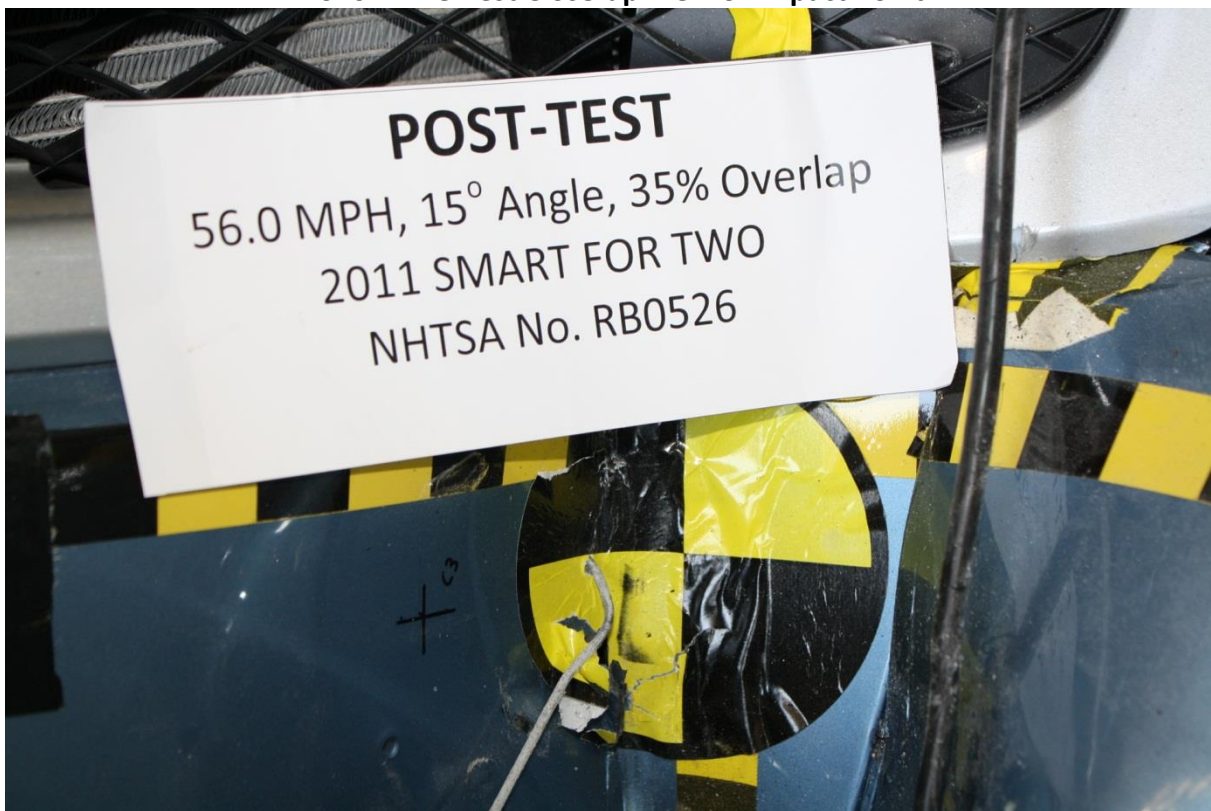
No. 020 Pre-Test Left Side View of RRMDB against target vehicle at ideal Impact Point



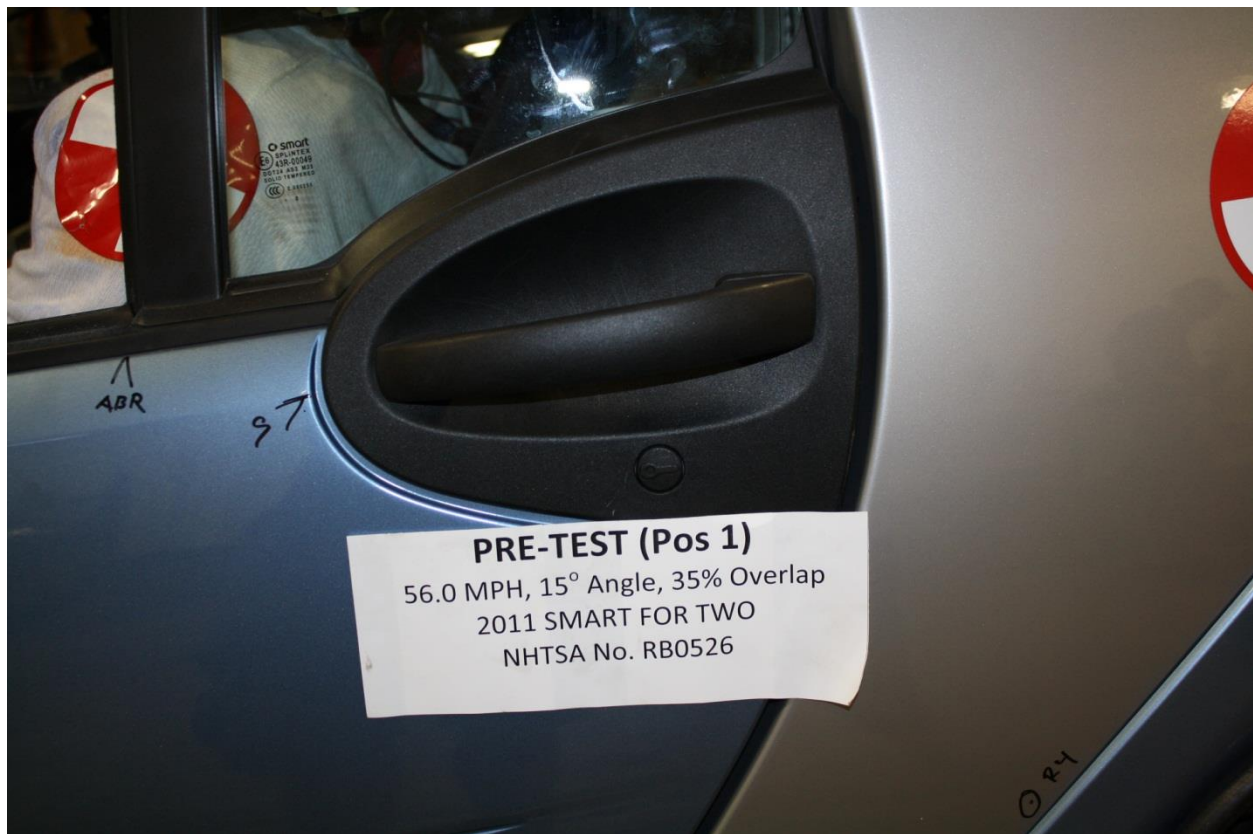
No. 021 Pre-Test Right Side View of RRMDB against target vehicle at ideal Impact Point



No. 022 Pre-Test Close-up View of Impact Point



No. 023 Post-Test Close-up View of Impact Point



No. 024 Pre-Test Close-up View of Left Front Door Latch



No. 025 Post-Test Close-up View of Left Front Door Latch

Photo Not Applicable

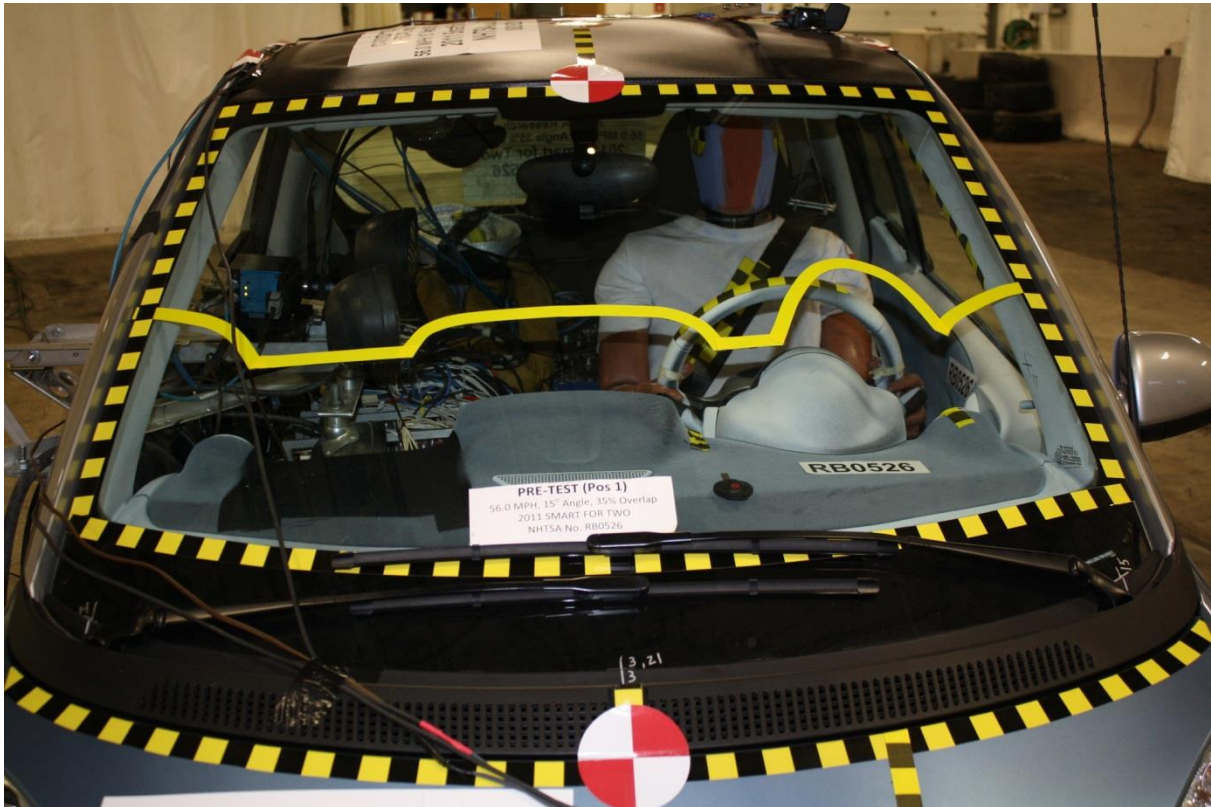
Pre-Test Close-up View of Left Rear Door Latch

No. 026 Pre-Test Close-up View of Left Rear Door Latch

Photo Not Applicable

Post-Test Close-up View of Left Rear Door Latch

No. 027 Post-Test Close-up View of Left Rear Door Latch



No. 028 Pre-Test Windshield View



No. 029 Post-Test Windshield View



No. 030 Pre-Test View of Driver Inner Door Panel



No. 031 Post-Test View of Driver Inner Door Panel

Photo Not Applicable

Pre-Test View of Passenger Inner Door Panel

No. 032 Pre-Test View of Passenger Inner Door Panel

Photo Not Applicable

Post-Test View of Passenger Inner Door Panel

No. 033 Post-Test View of Passenger Inner Door Panel



No. 034 Pre-Test Frontal View of Driver Seat pan



No. 035 Pre-Test Frontal View of Driver Seat back

Photo Not Applicable

Pre-Test Frontal View of Left Rear Seat pan

No. 036 Pre-Test Frontal View of Left Rear Seat pan

Photo Not Applicable

Pre-Test Frontal View of Left Rear Seat back

No. 037 Pre-Test Frontal View of Left Rear Seat back



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



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



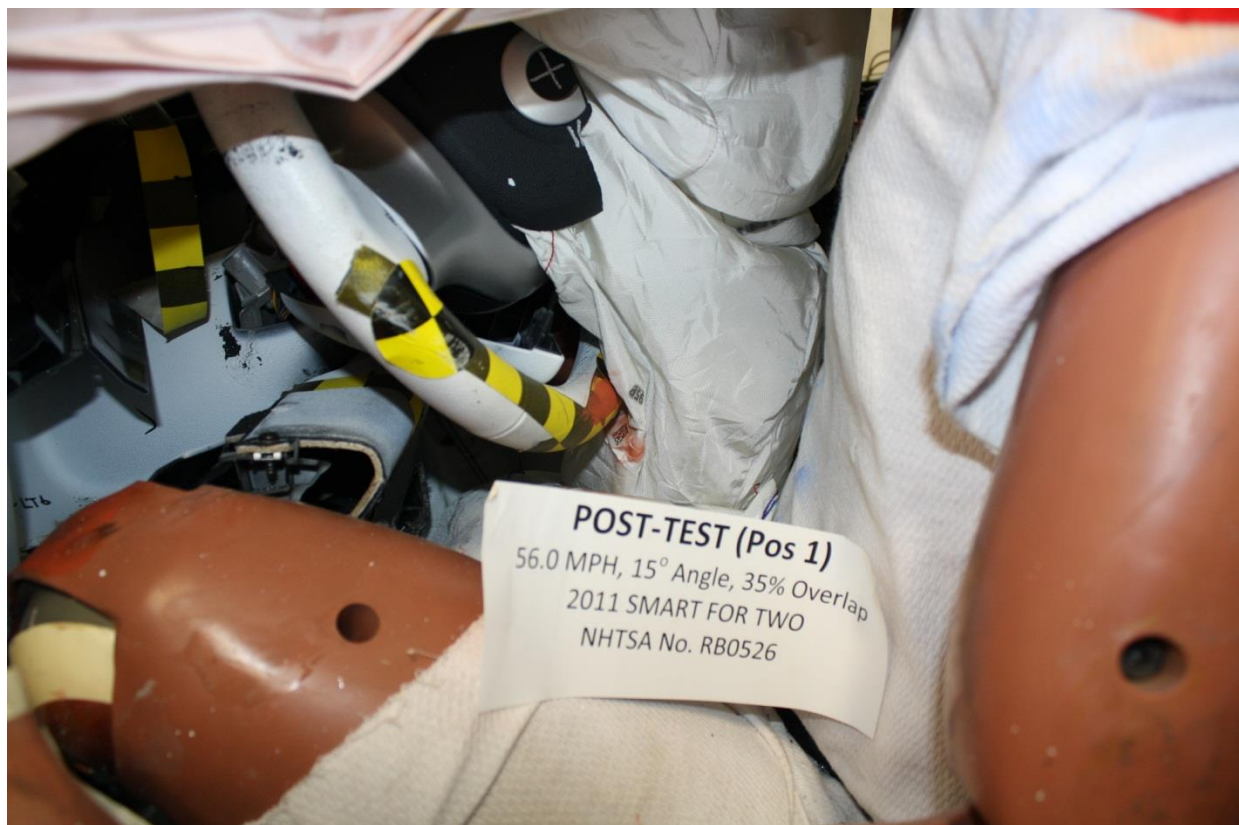
No. 040 Pre-Test Overall View of Driver Knee Bolsters with panel removed



No. 041 Post-Test Overall View of Driver Knee Bolsters with panel removed



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



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



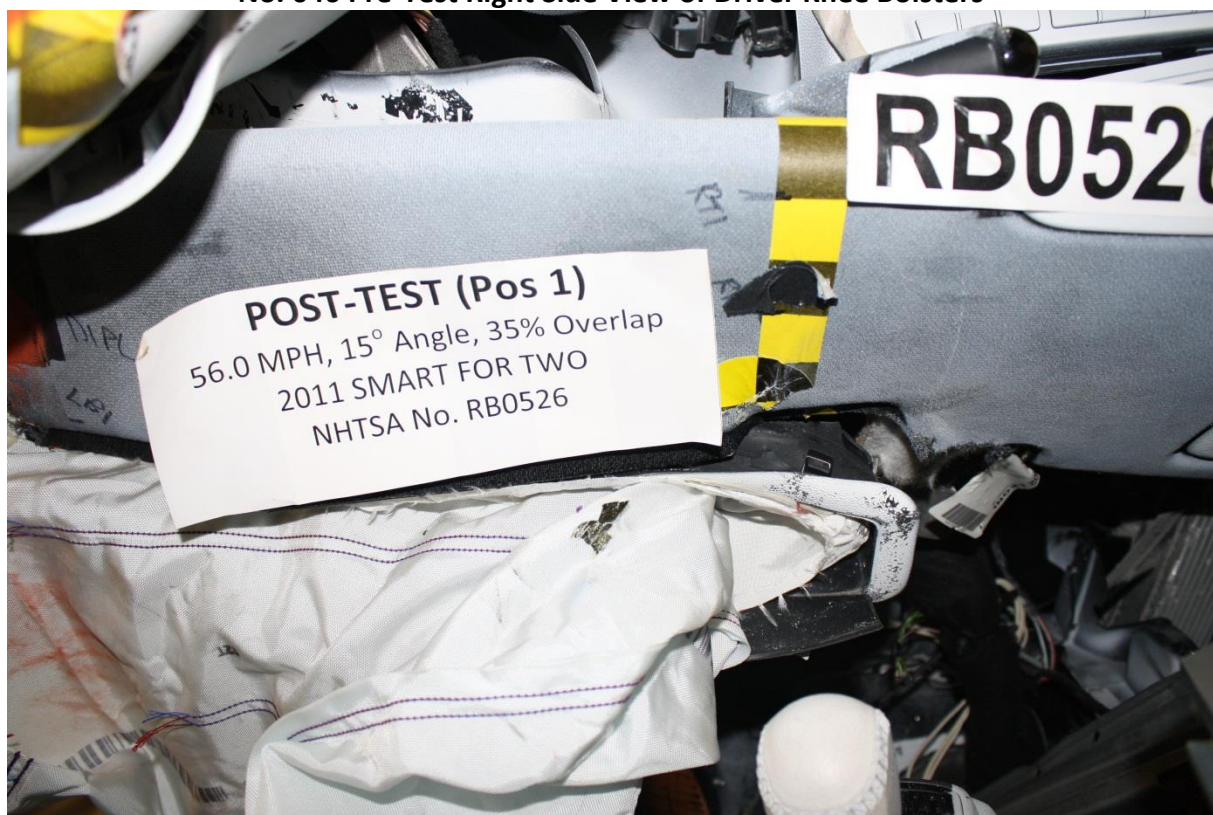
No. 044 Pre-Test Left Side View of Driver Knee Bolsters with panel removed



No. 045 Post-Test Left Side View of Driver Knee Bolsters with panel removed



No. 046 Pre-Test Right Side View of Driver Knee Bolsters



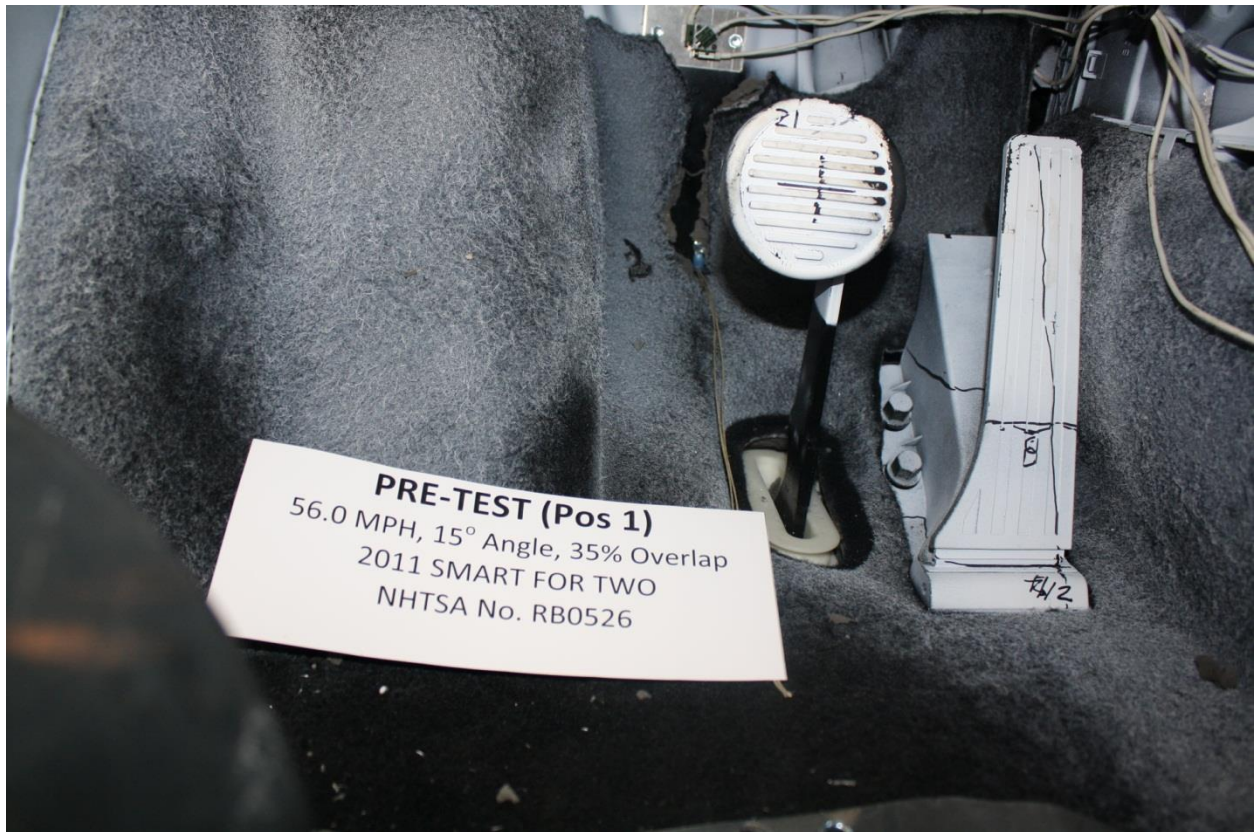
No. 047 Post-Test Right Side View of Driver Knee Bolsters



No. 048 Pre-Test Right Side View of Driver Knee Bolster with panel removed



No. 049 Post-test right side view of driver knee bolster with panel removed



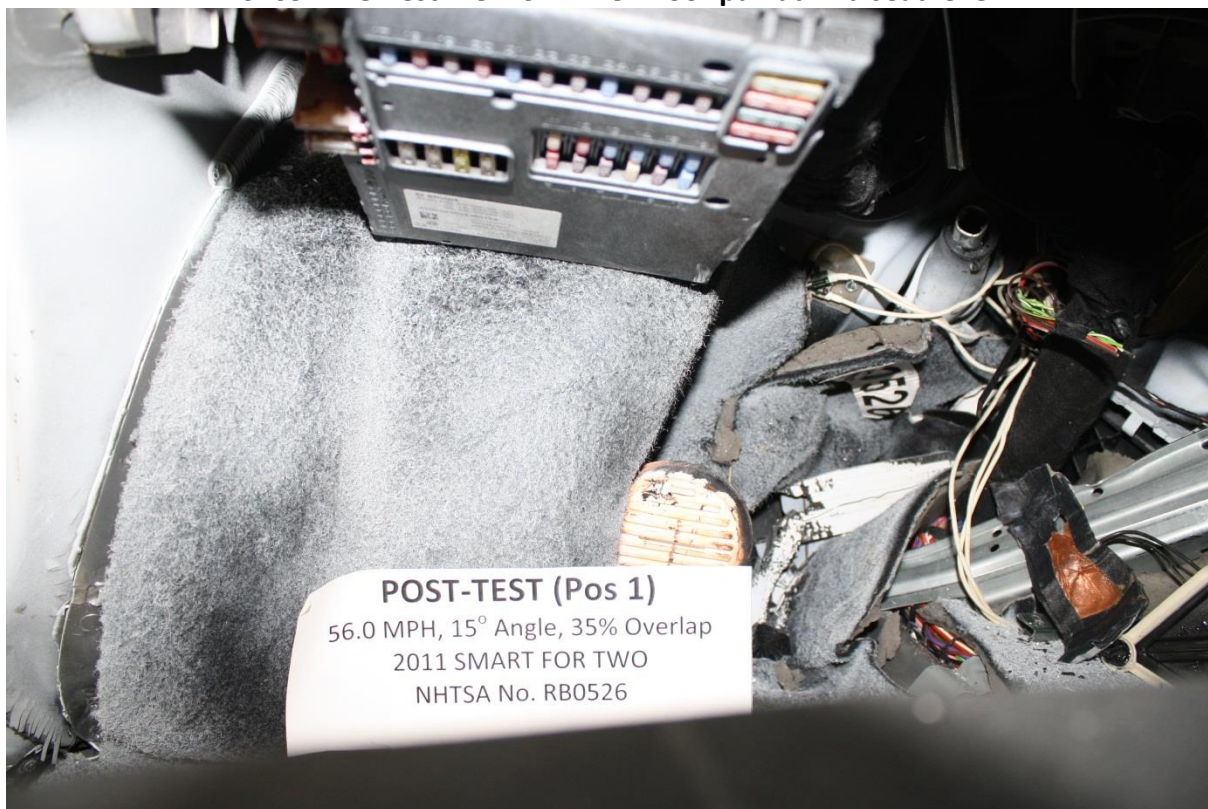
No. 050 Pre-Test View of Driver Floor pan at Left sill level



No. 051 Post-Test View of Driver Floor pan at Left sill level



No. 052 Pre-Test View of Driver Floor pan at Mid seat level



No. 053 Post-Test view of Driver Floor pan at Mid seat level



No. 054 Pre-Test Driver Dummy Front Windshield View



No. 055 Post-Test Driver Dummy Front Windshield View



No. 056 Pre-Test Left Side View of Driver Dummy and Interior



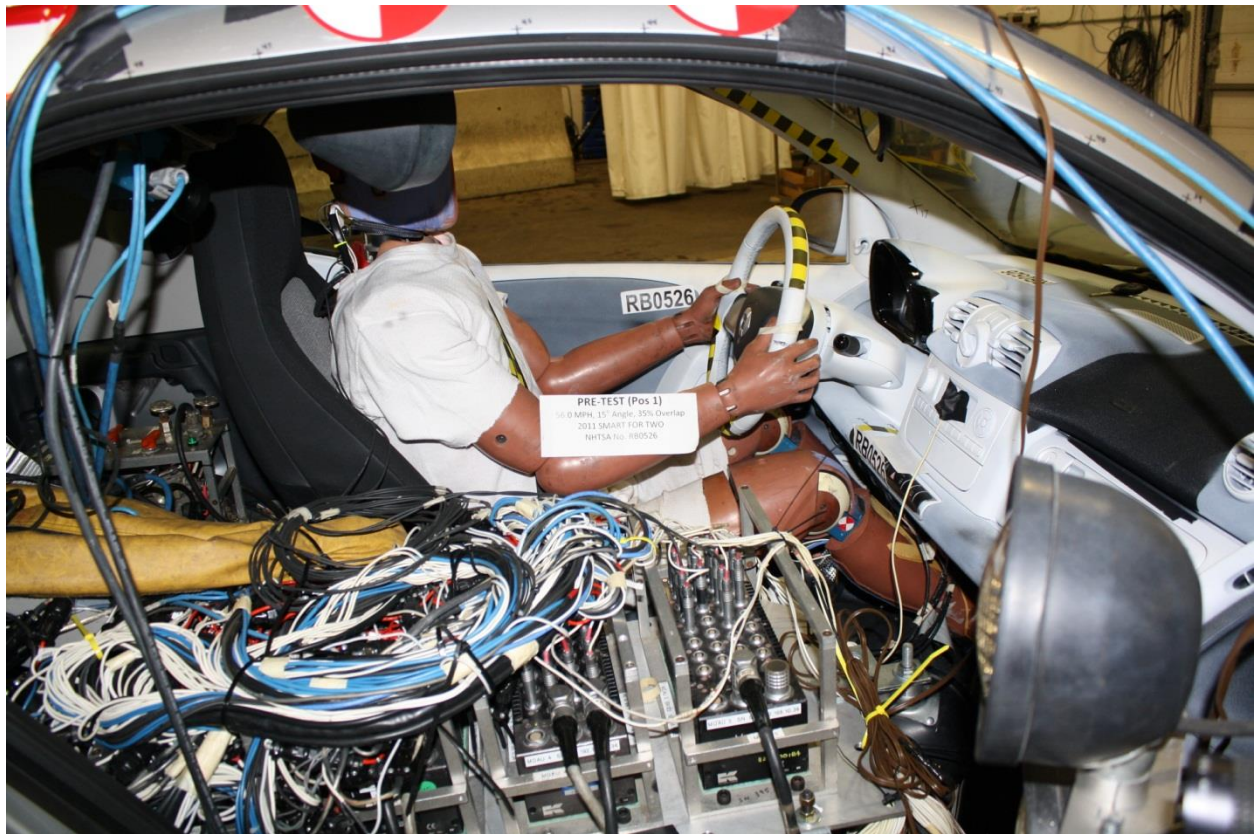
No. 057 Post-Test Left Side View of Driver Dummy and Interior



No. 058 Pre-Test Left Side Driver Dummy Window View



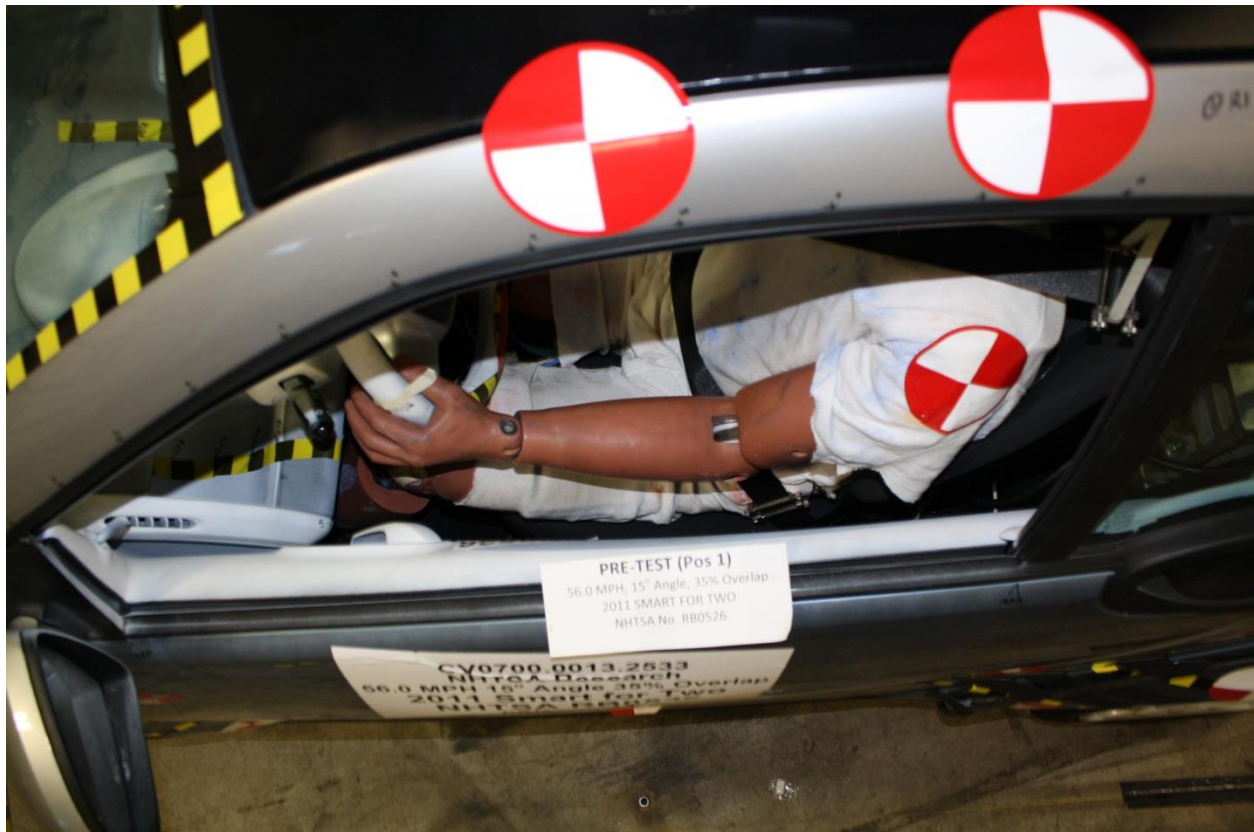
No. 059 Post-Test Left Side Driver Dummy Window View



No. 060 Pre-Test Right Side View of Driver Dummy and Interior



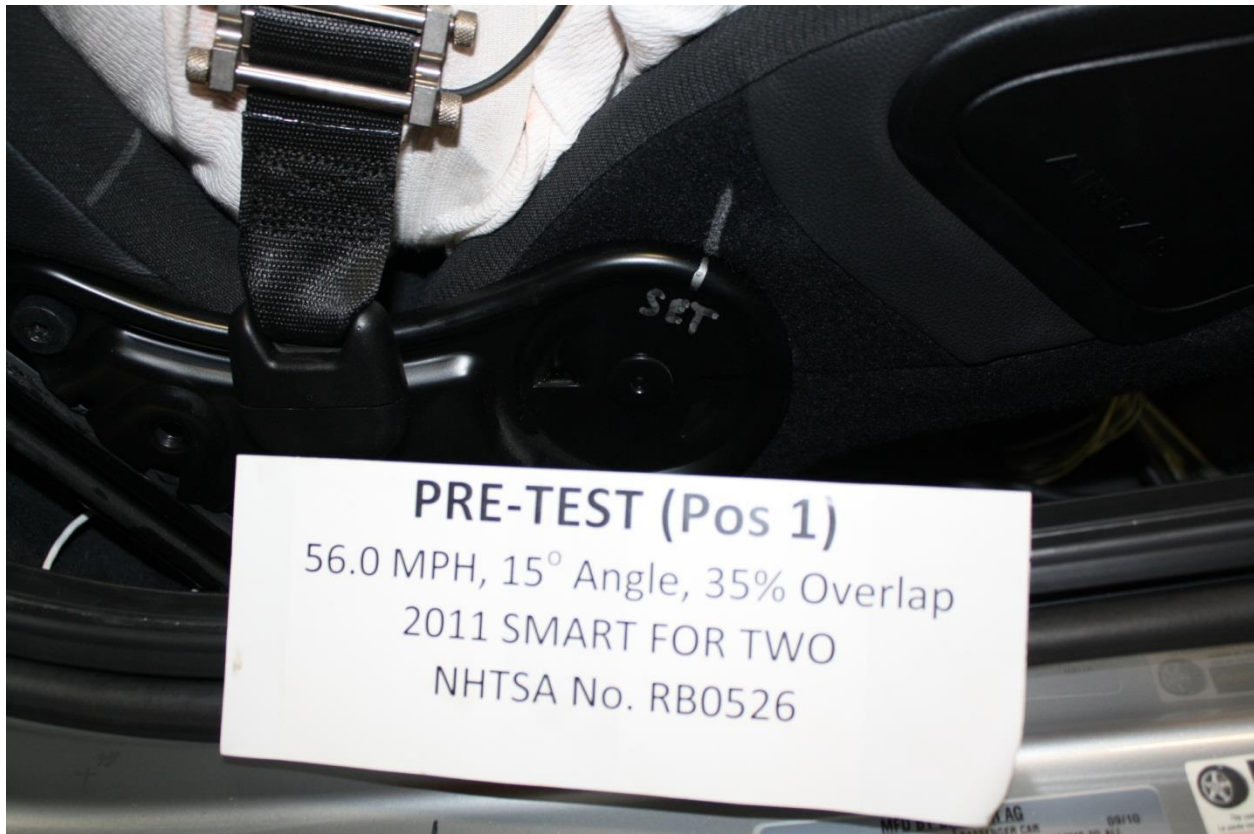
No. 061 Post-Test Right Side View of Driver Dummy and Interior



No. 062 Pre-Test View of Driver Dummy Door Clearance



No. 063 Post-Test View of Driver Dummy Door Clearance



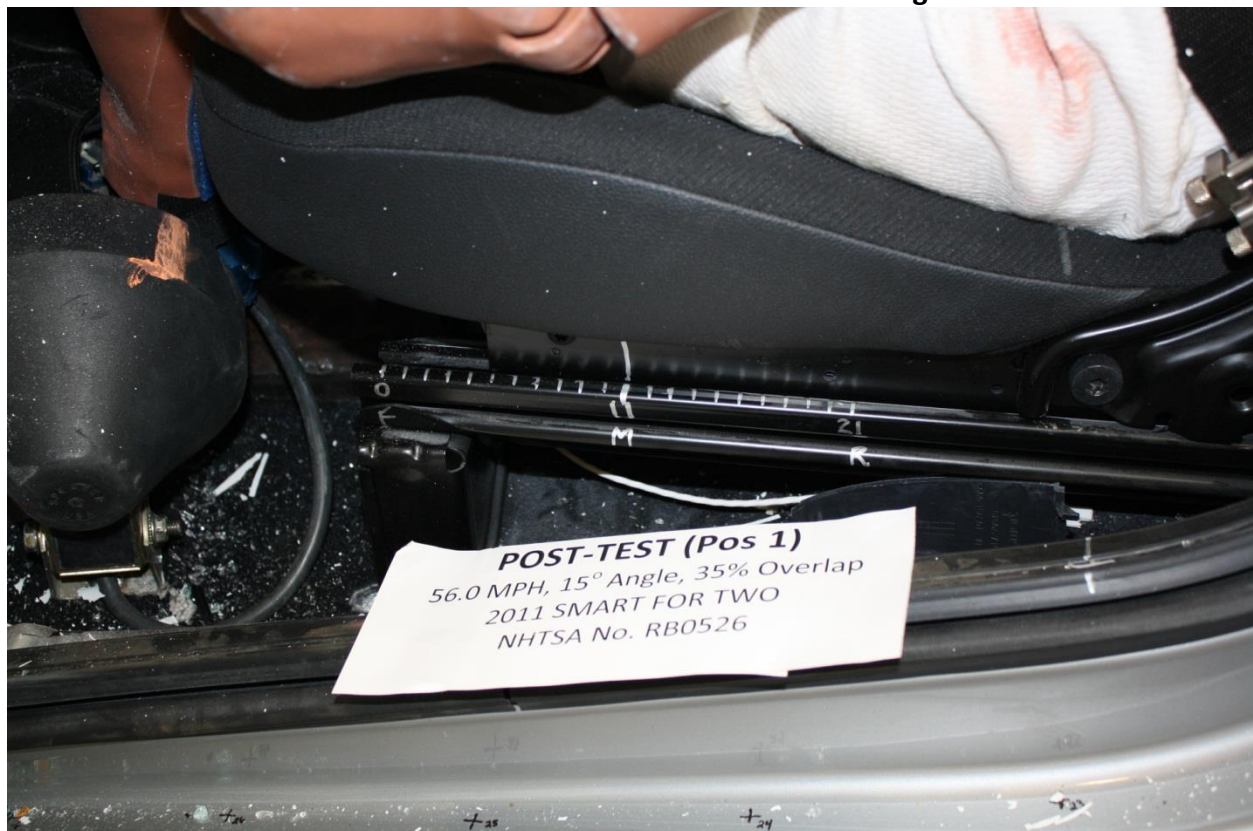
No. 064 Pre-Test Driver Seat Back Position markings



No. 065 Pre-Test Driver Seat Back Position with Level or Inclinometer



No. 066 Pre-Test Driver Seat Fore Aft Markings



No. 067 Post-Test Driver Seat Fore Aft Markings



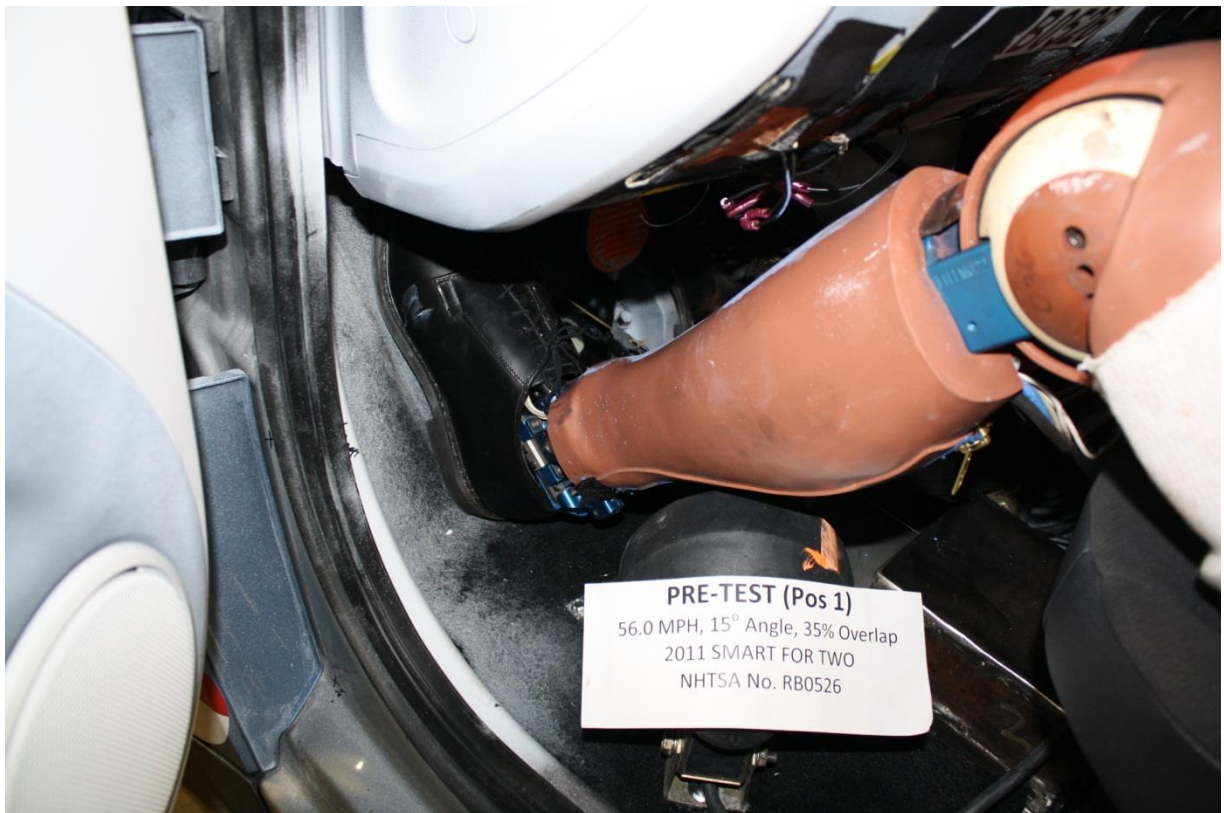
No. 068 Pre-Test Driver Adjustable D-ring



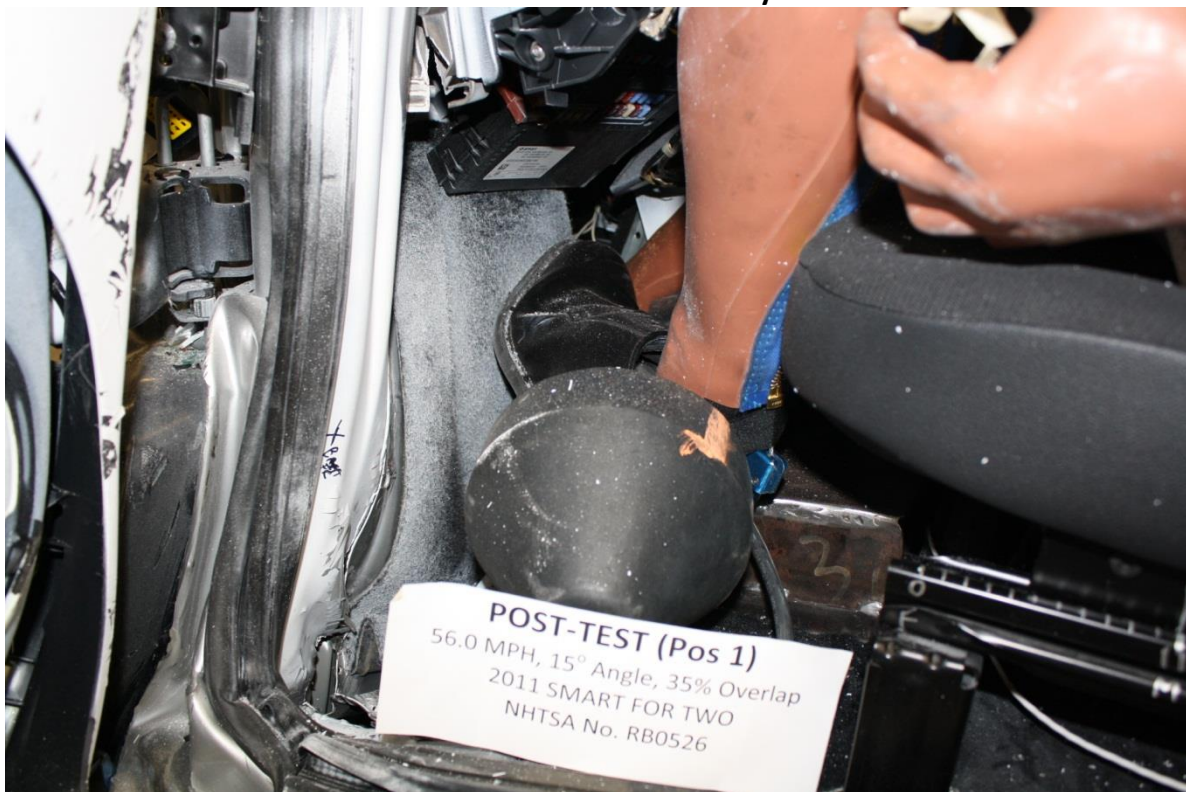
No. 069 Pre-Test Overhead View of Driver Dummy Thighs in seat



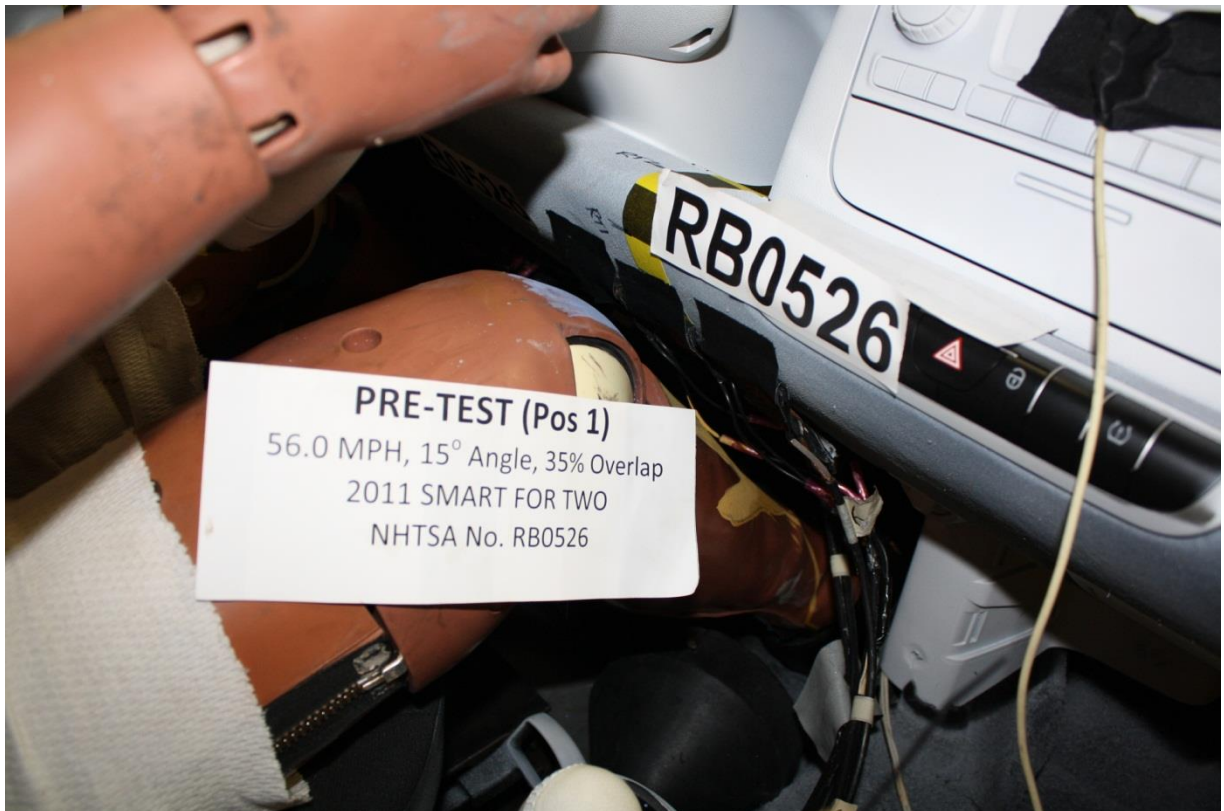
No. 070 Pre-Test View of Parking Brake



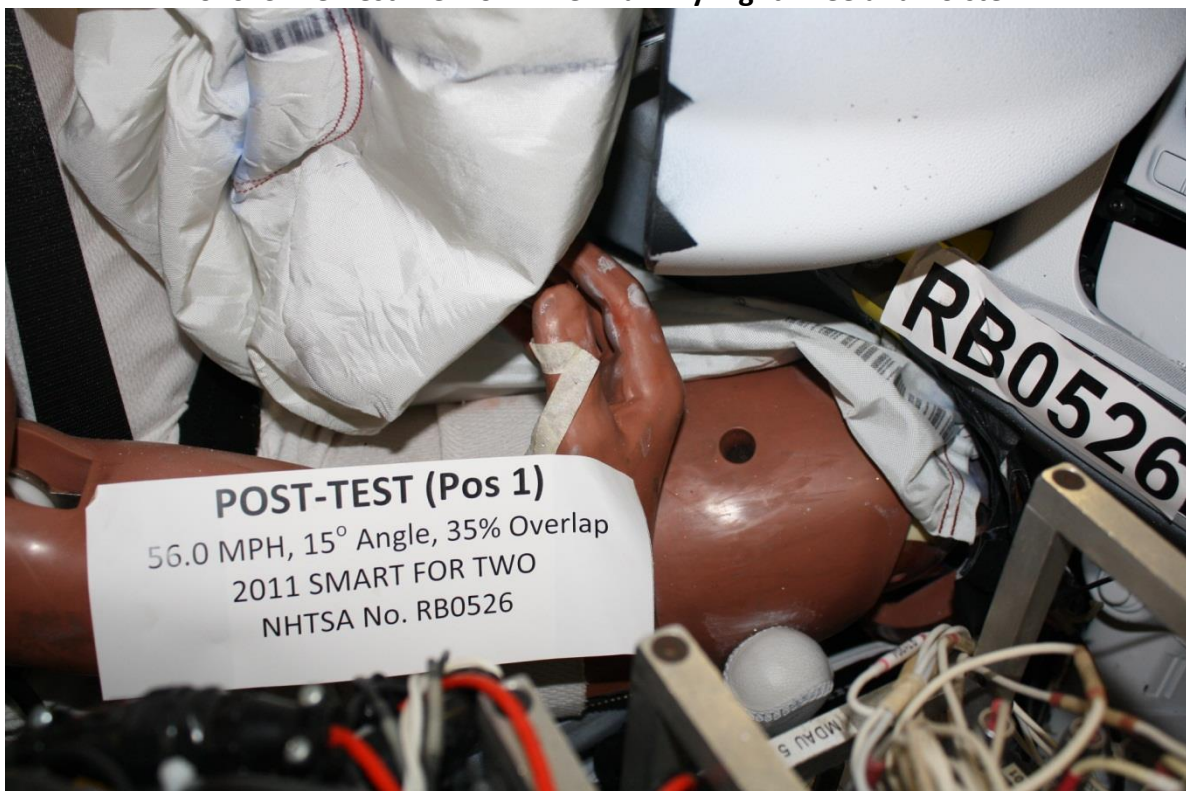
No. 071 Pre-Test Driver Dummy Feet



No. 072 Post-Test Driver Dummy Feet



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



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



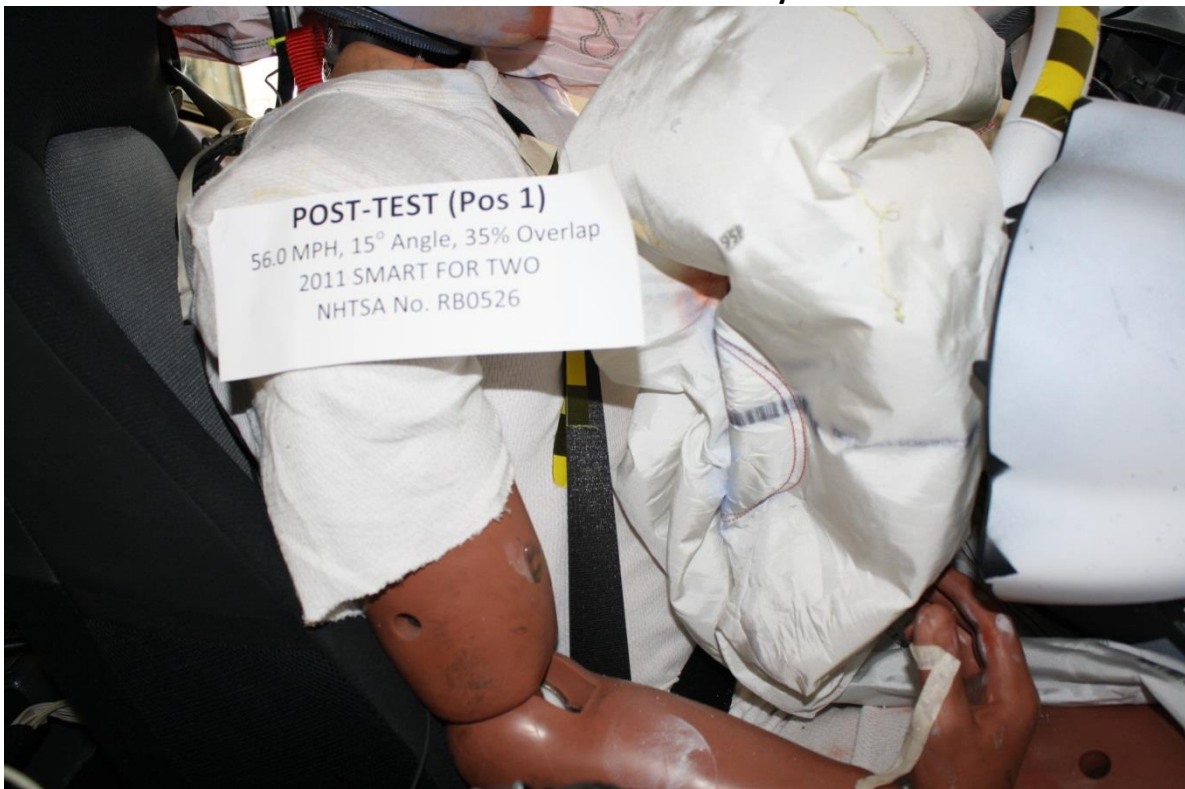
No. 075 Pre-Test View of Driver Dummy Left Knee and Bolster



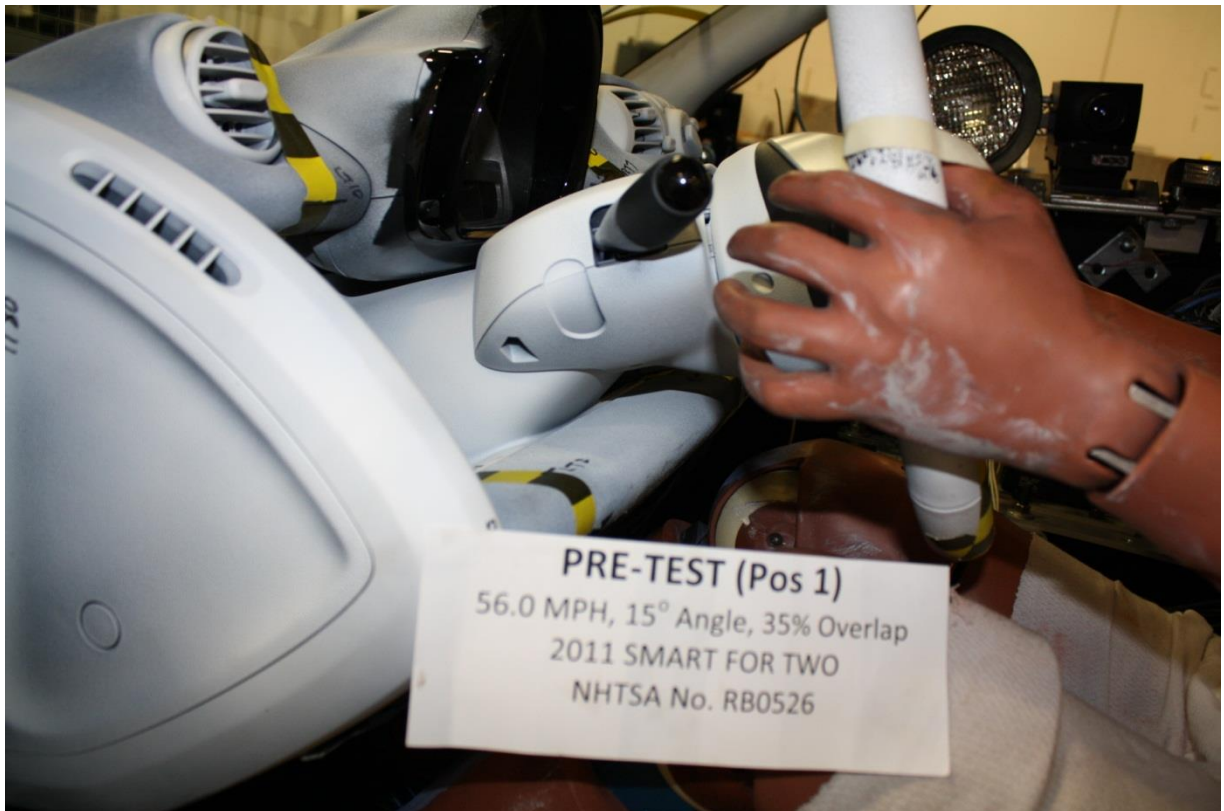
No. 076 Post-Test View of Driver Dummy Left Knee and Bolster



No. 077 Pre-Test View of Driver Dummy Abdomen



No. 078 Post-Test View of Driver Dummy Abdomen



No. 079 Pre-Test Left Side View of Steering Wheel set position



No. 080 Post-Test Left Side View of Steering Wheel set position



No. 081 Post-Test View of Driver Dummy Head Contact with Airbag



No. 082 Post-Test View of Driver Dummy Head Contact with Vehicle Interior (a, b, c, etc)



No. 083 Pre-Test Passenger Dummy Front Close-up View

Photo Not Applicable

Post-Test Passenger Dummy Front Close-up View

No. 084 Post-Test Passenger Dummy Front Close-up View

Photo Not Applicable

Pre-Test Left Side Passenger Dummy and Interior View

No. 085 Pre-Test Left Side Passenger Dummy and Interior View

Photo Not Applicable

Post-Test Left Side Passenger Dummy and Interior View

No. 086 Post-Test Left Side Passenger Dummy and Interior View

Photo Not Applicable

Pre-Test Left Side Passenger Dummy Window View

No. 087 Pre-Test Left Side Passenger Dummy Window View

Photo Not Applicable

Post-Test Left Side Passenger Dummy Window View

No. 088 Post-Test Left Side Passenger Dummy Window View

Photo Not Applicable

Pre-Test Right Side View of Passenger Dummy and Interior

No. 089 Pre-Test Right Side View of Passenger Dummy and Interior

Photo Not Applicable

Post-Test Right Side View of Passenger Dummy and Interior

No. 090 Post-Test Right Side View of Passenger Dummy and Interior

Photo Not Applicable

Pre-Test View of Passenger Dummy Door Clearance

No. 091 Pre-Test View of Passenger Dummy Door Clearance

Photo Not Applicable

Post-Test View of Passenger Dummy Door Clearance

No. 092 Post-Test View of Passenger Dummy Door Clearance

Photo Not Applicable

Pre-Test Passenger View Showing Head Level

No. 093 Pre-Test Passenger View Showing Head Level

Photo Not Applicable

Pre-Test Passenger Seat Fore-Aft Markings

No. 094 Pre-Test Passenger Seat Fore-Aft Markings

Photo Not Applicable

Pre-Test Passenger Seat Back Angle

No. 095 Pre-Test Passenger Seat Back Angle

Photo Not Applicable

Pre-Test Overhead View of Passenger Dummy Thighs on seat

No. 096 Pre-Test Overhead View of Passenger Dummy Thighs on seat

Photo Not Applicable

Pre-Test Passenger Adjustable D-ring

No. 097 Pre-Test Passenger Adjustable D-ring

Photo Not Applicable

Pre-Test View of Passenger Dummy Feet

No. 098 Pre-Test View of Passenger Dummy Feet

Photo Not Applicable

Post-Test View of Passenger Dummy Feet

No. 099 Post-Test View of Passenger Dummy Feet

Photo Not Applicable

Post-Test View of Passenger Dummy Head contact with Airbag

No. 100 Post-Test View of Passenger Dummy Head contact with Airbag

Photo Not Applicable

Post-Test View of Passenger Dummy Head contact with Interior (a,b,c)

No. 101 Post-Test View of Passenger Dummy Head contact with Interior (a,b,c)

Photo Not Applicable

Post-Test View of Passenger Dummy Knee Contact with Seatback

No. 102 Post-Test View of Passenger Dummy Knee Contact with Seatback



No. 103 Pre-Test Ballast Locations



No. 104 Post-Test Speed Trap Readout



No. 105 Pre-Test View of Fuel Filler Cap



No. 106 Post-Test View of Fuel Filler Cap

Photo Not Available

No. 107 Pre-Test Engine Compartment View



No. 108 Post-Test Engine Compartment View



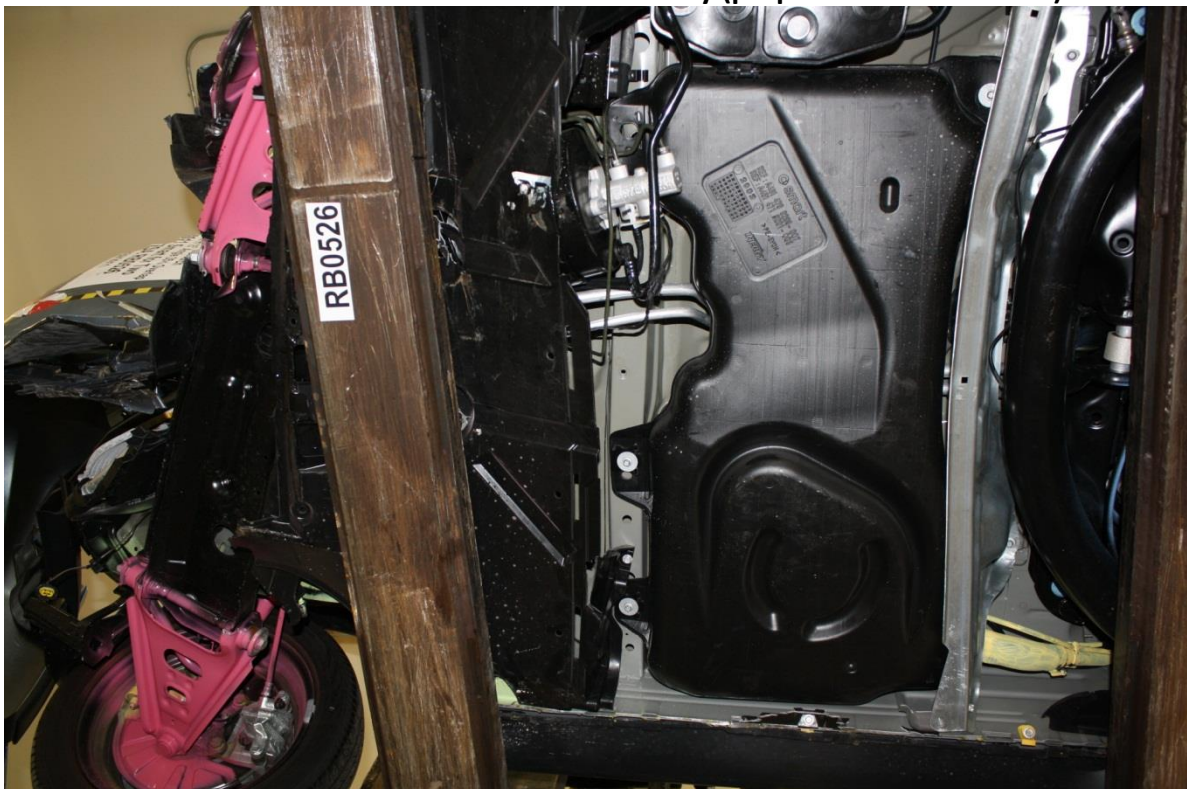
No. 109 Pre-Test View of Front Underbody (perpendicular to vehicle)



No. 110 Post-Test View of Front Underbody (perpendicular to vehicle)



No. 111 Pre-Test View of Overall Underbody (perpendicular to vehicle)



No. 112 Post-Test View of Overall Underbody (perpendicular to vehicle)



No. 113 Pre-Test View of Steering rack and or sway bar



No. 114 Post-Test View of Steering rack and or sway bar



No. 115 Pre-Test Close up of Bumper and Crush Initiators



No. 116 Post-Test View of Front Sub-Frame Deformation



No. 117 Pre-Test Frame Rail with tire removed



No. 118 Post-Test Frame Rail with tire removed



No. 119 Pre-Test View of Wheel Well with tire removed



No. 120 Post-Test View of Wheel Well with tire removed



No. 121 Post-Test View of Door Sill with door open



No. 122 Post-Test View of Deformation of A pillar



No. 123 Post-Test View of Deformation of B pillar



No. 124 Post-Test View of Deformation of C pillar



No. 125 Post-Test View of Wheel and or Tire Deformation



No. 126 Post-Test View of Deformation of Rocker or Post



No. 127 Post-Test View of Windshield Separation



No. 128 Pre-Test Left Side View of RRMDB



No. 129 Post-Test Left Side View of RRMDB



No. 130 Pre-Test Right Side View of RRMDB



No. 131 Post-Test Right Side View of RRMDB



No. 132 Pre-Test Top View of RRMDB



No. 133 Post-Test Top View of RRMDB



No. 134 Pre-Test Front View of RRMDB



No. 135 Post-Test Front View of RRMDB



No. 136 Vehicle at 0 Degrees on Static Rollover Device



No. 137 Vehicle at 90 Degrees on Static Rollover Device



No. 138 Vehicle at 180 Degrees on Static Rollover Device



No. 139 Vehicle at 270 Degrees on Static Rollover Device



No. 140 Vehicle at 360 Degrees on Static Rollover Device

APPENDIX B
VEHICLE & DUMMY RESPONSE DATA TRACES

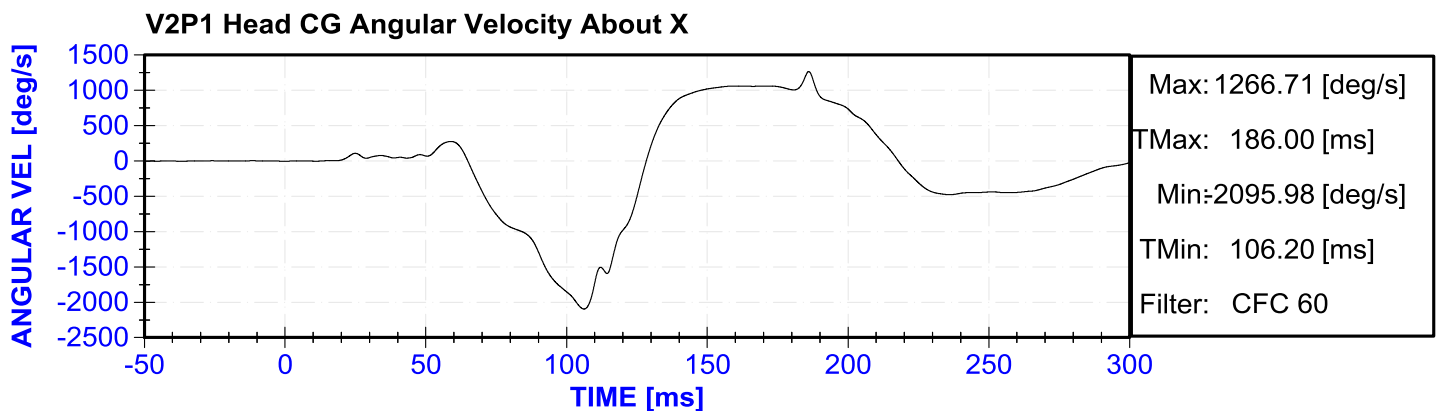
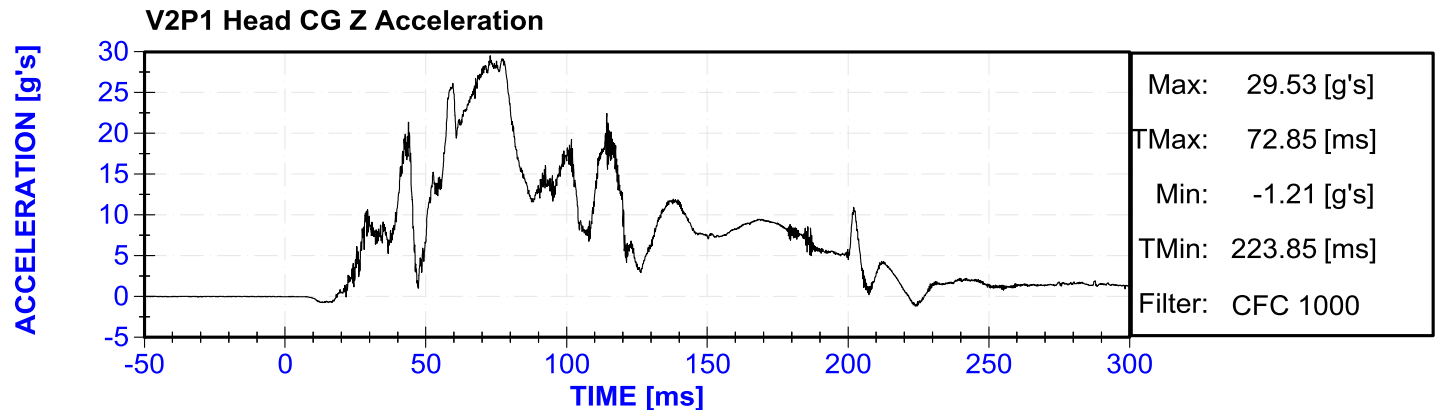
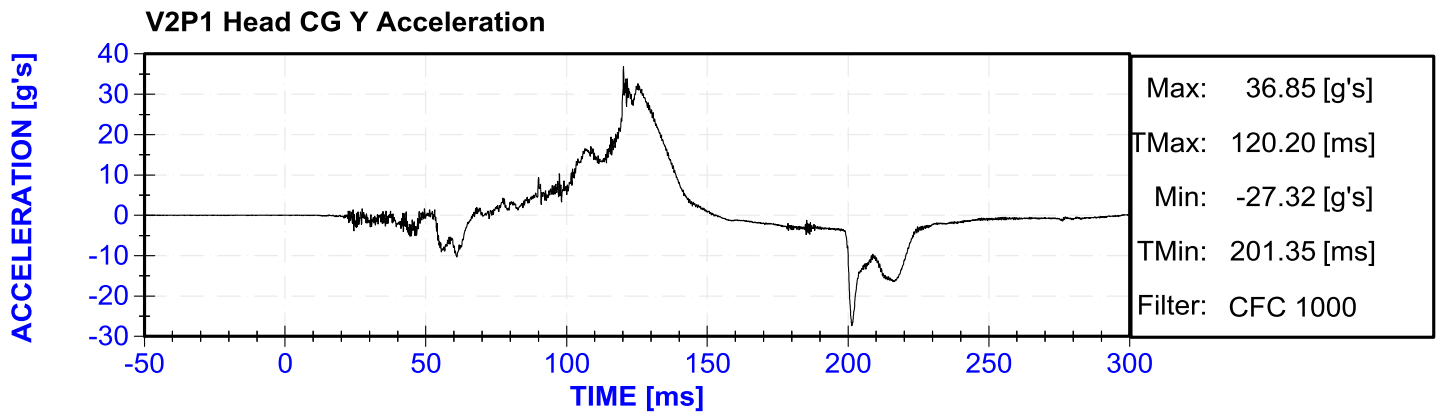
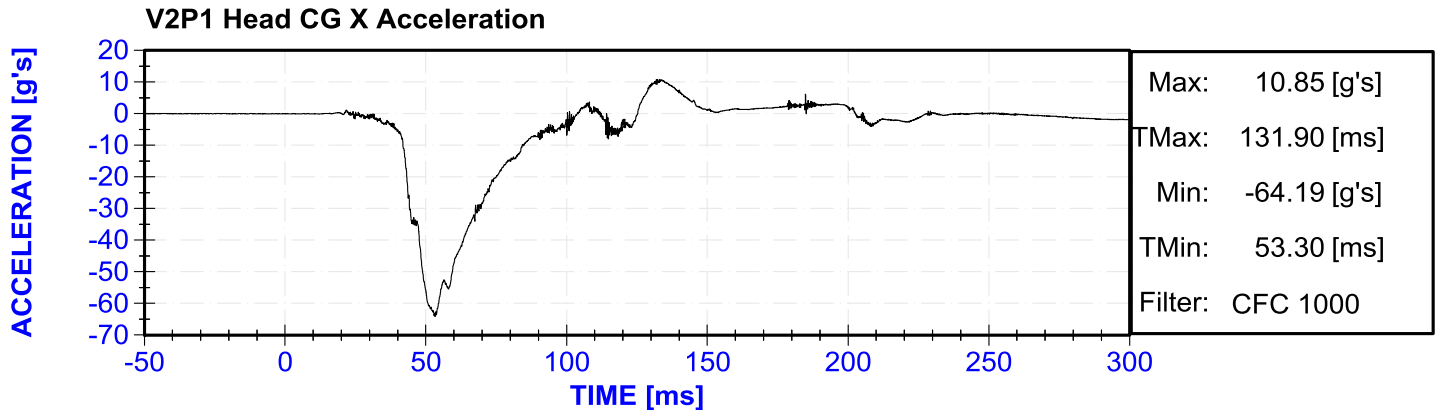
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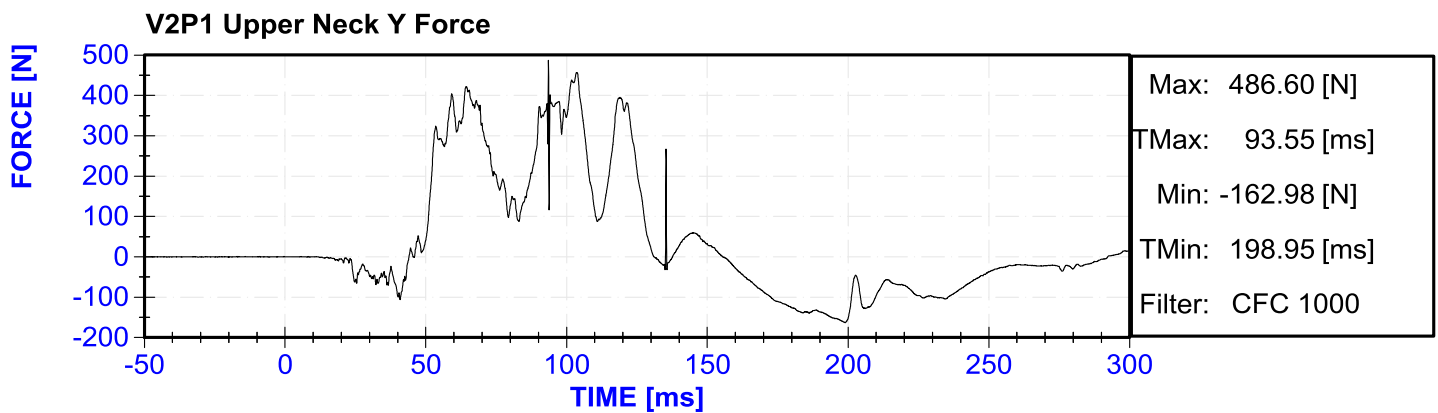
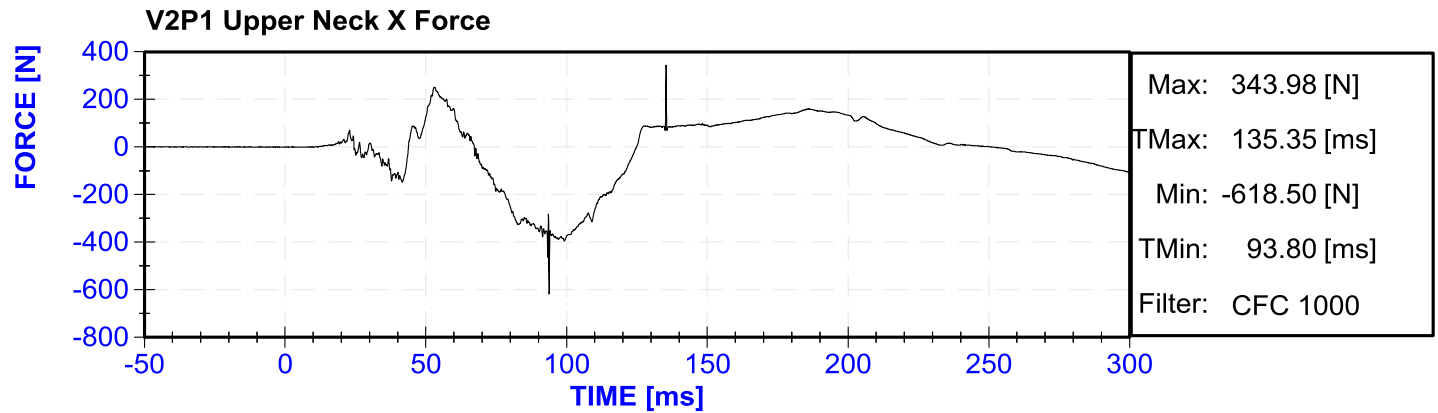
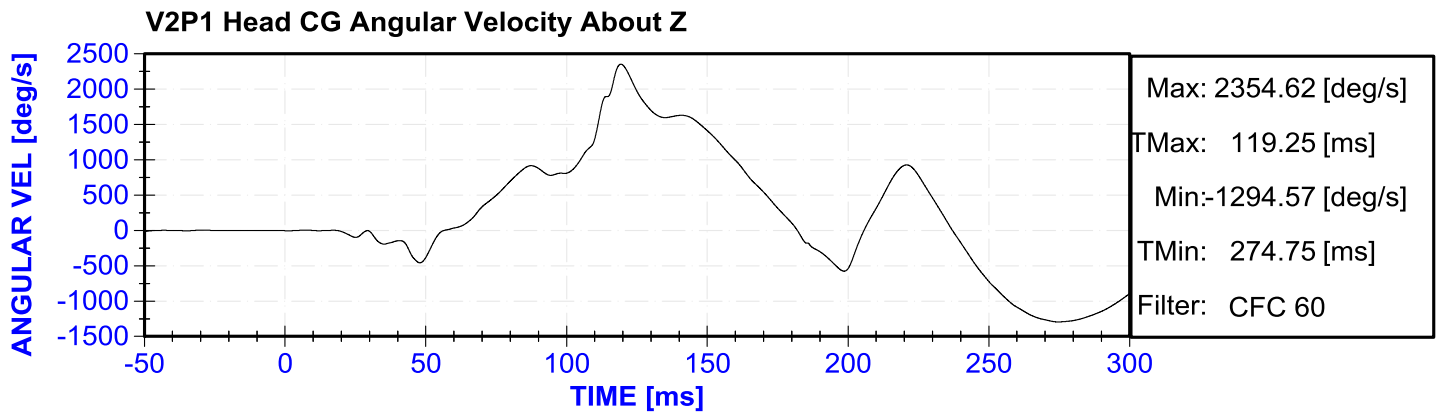
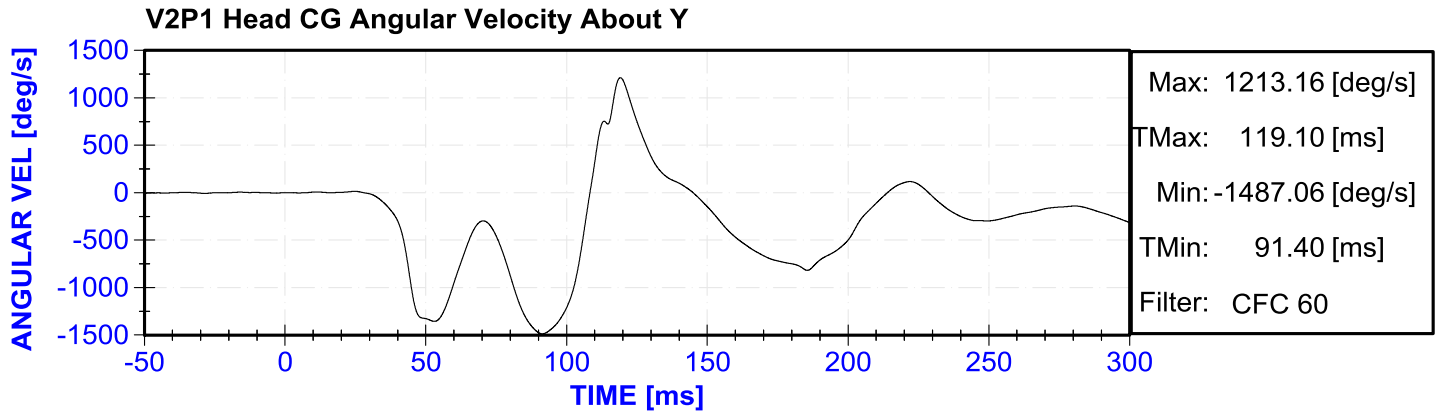
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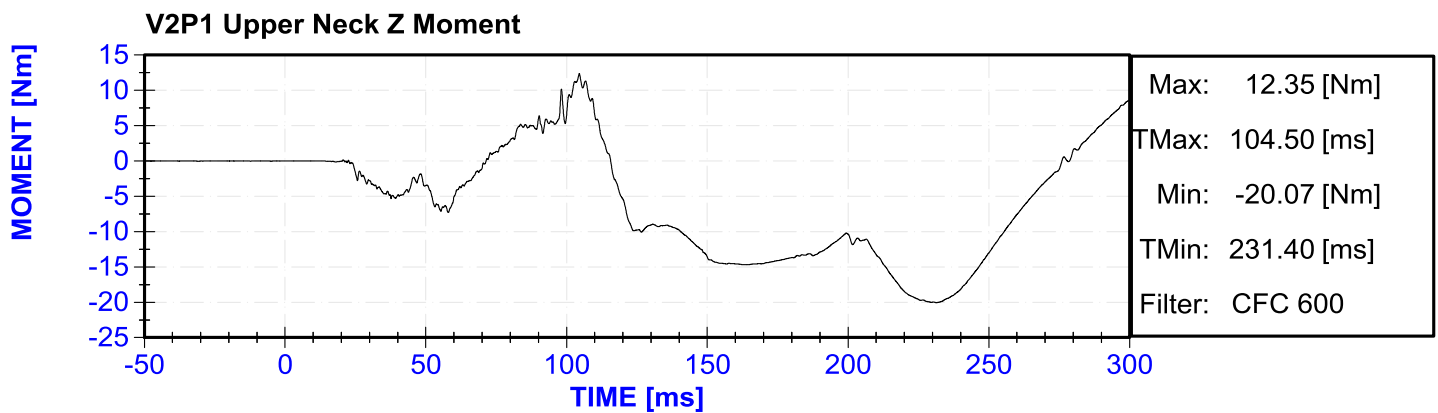
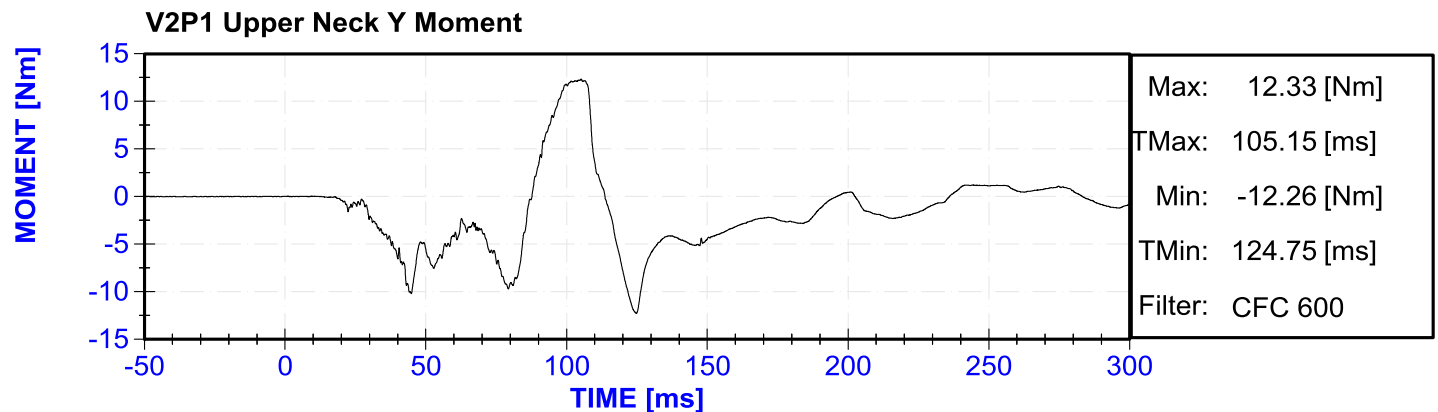
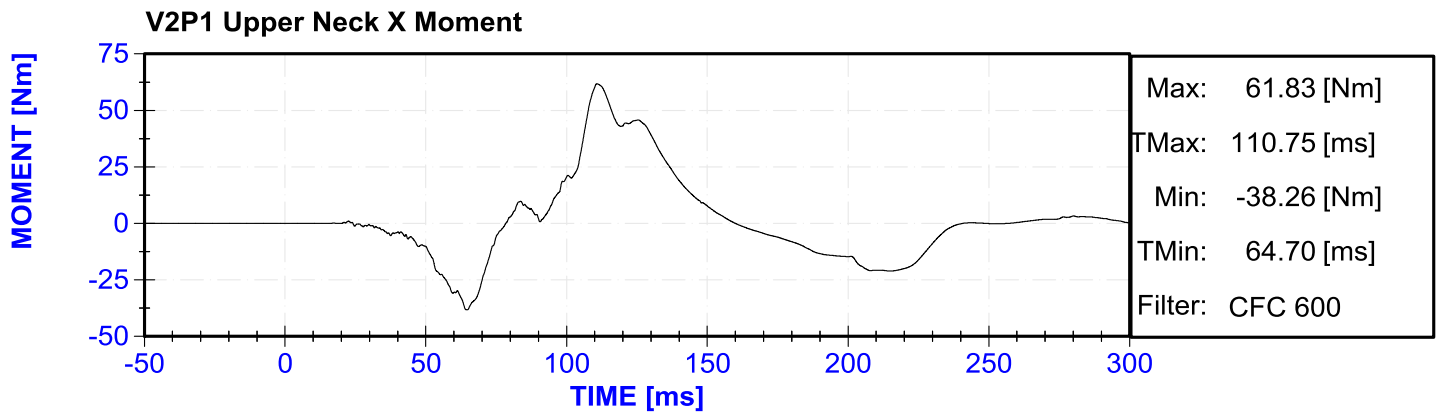
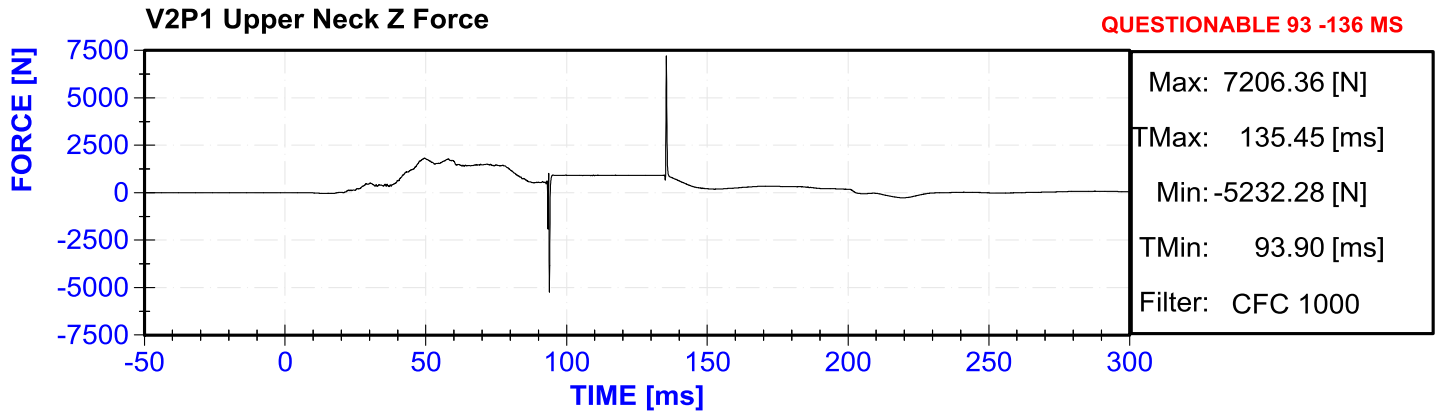
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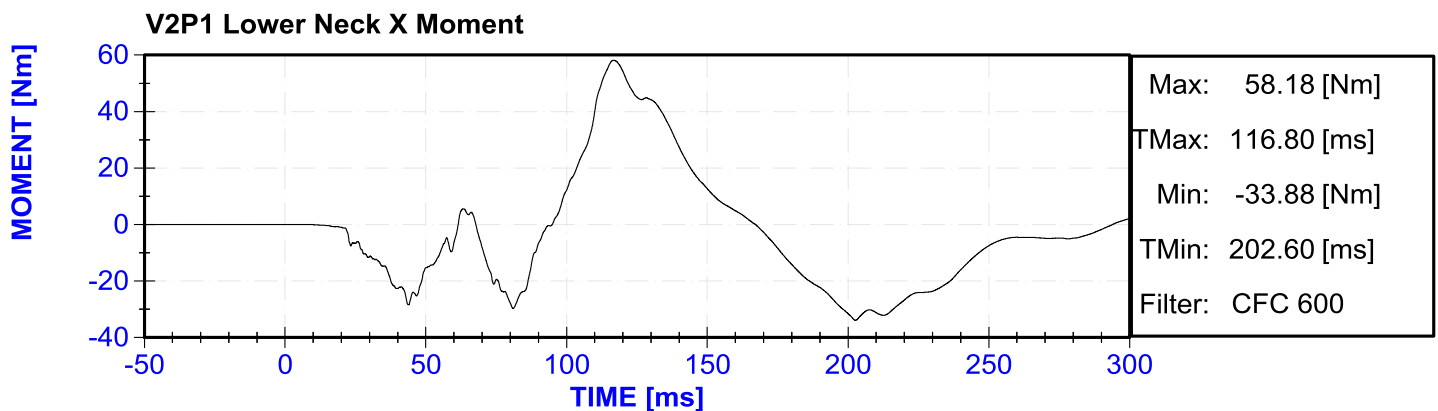
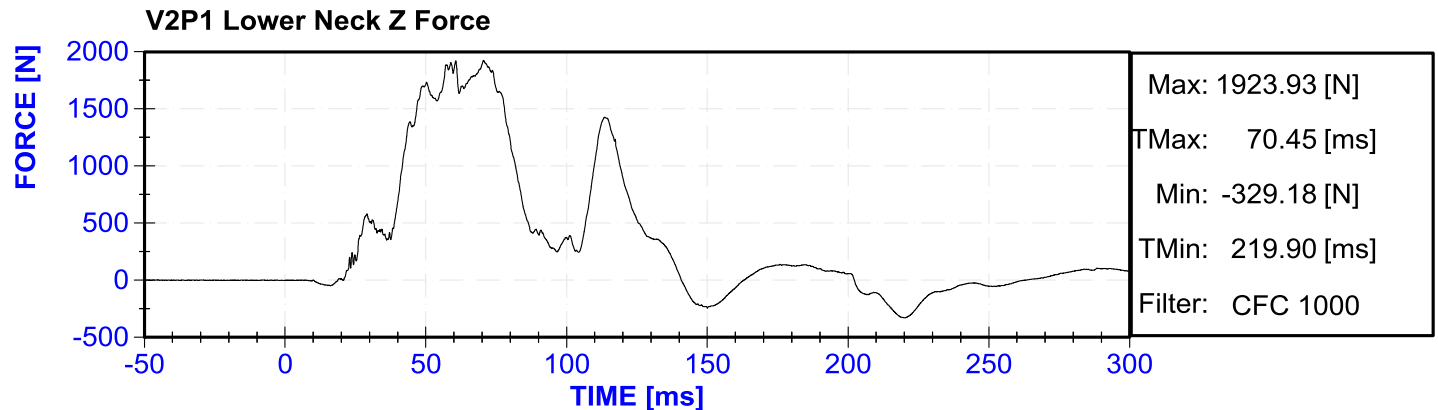
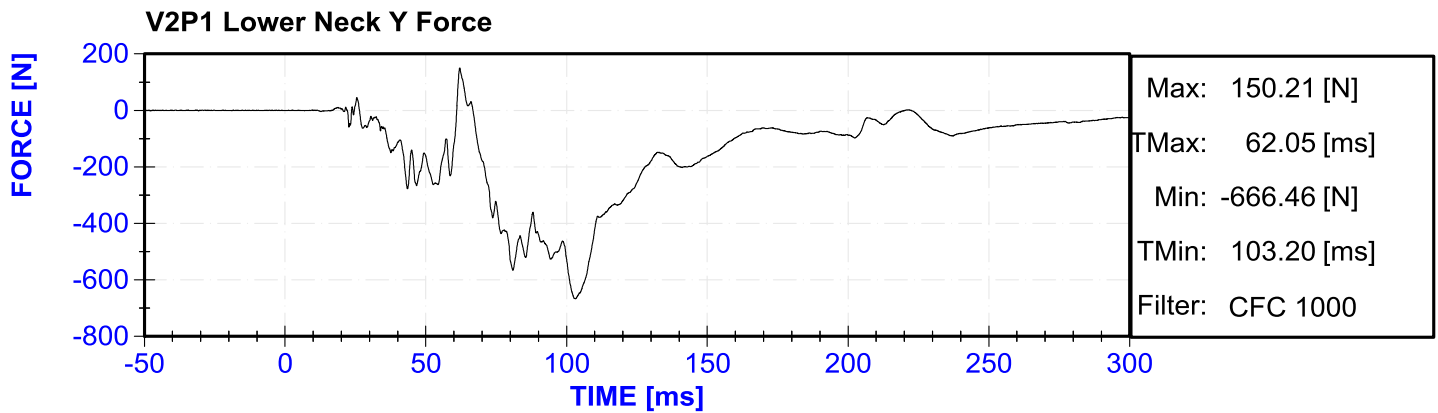
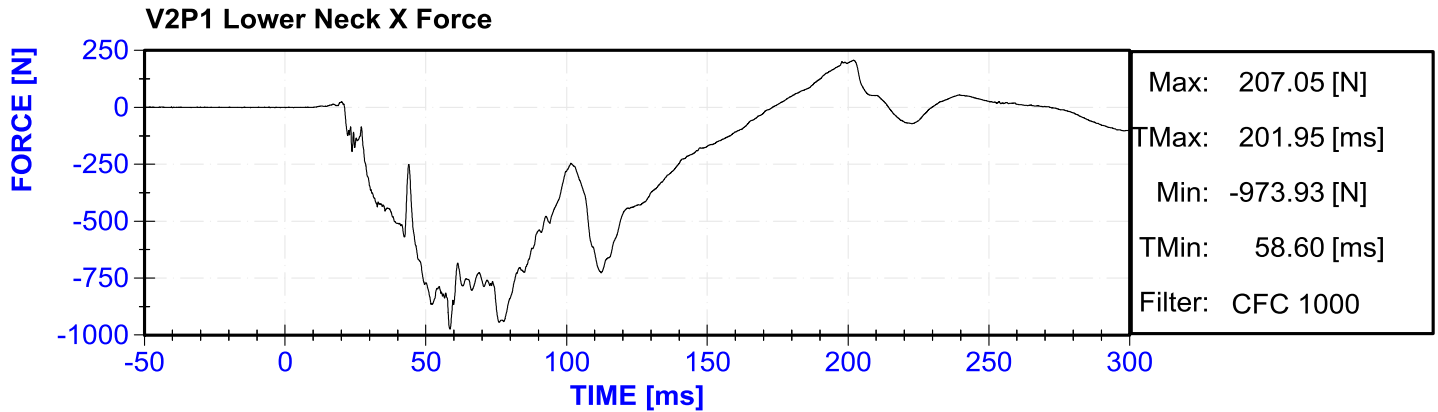
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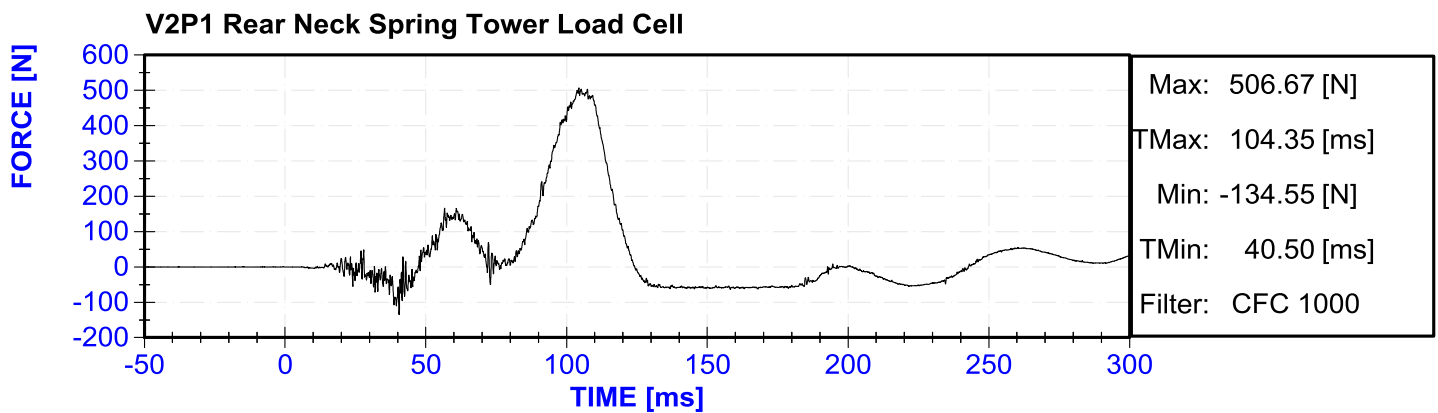
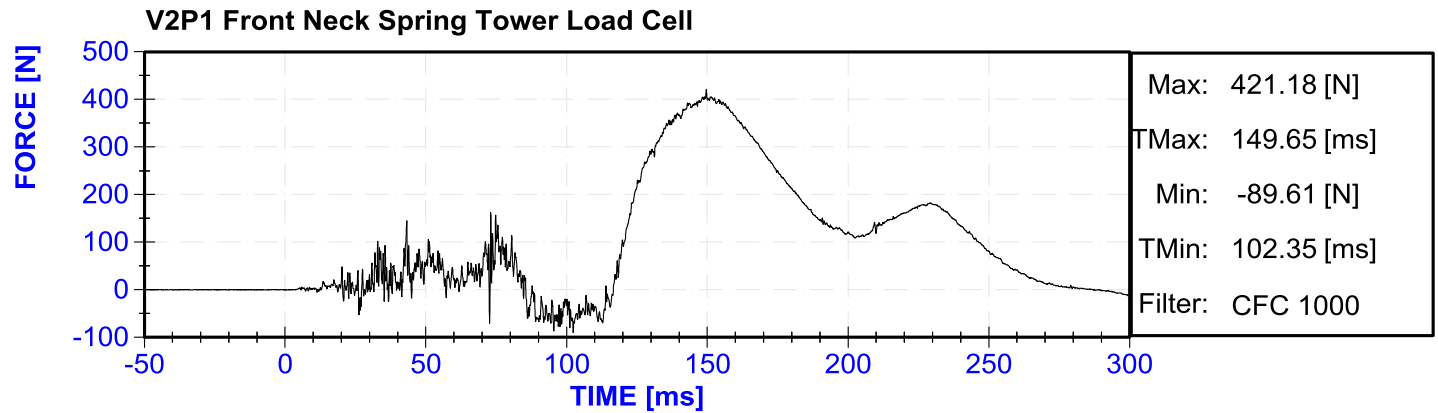
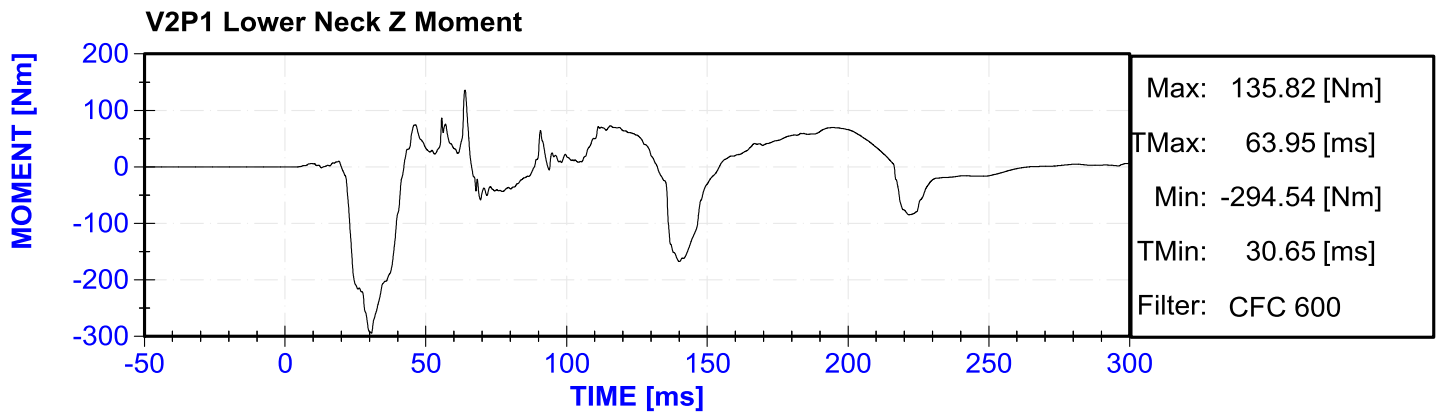
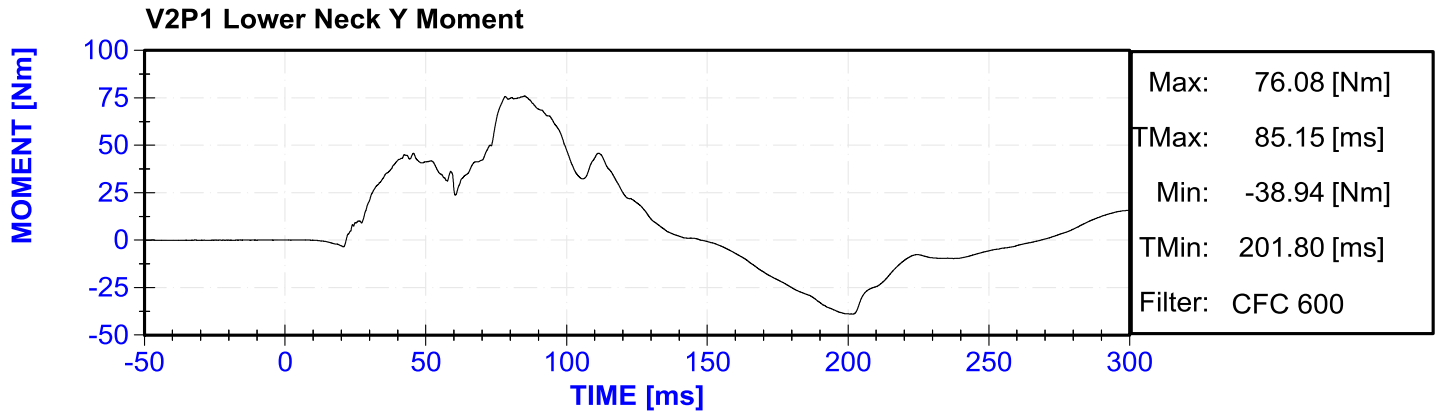
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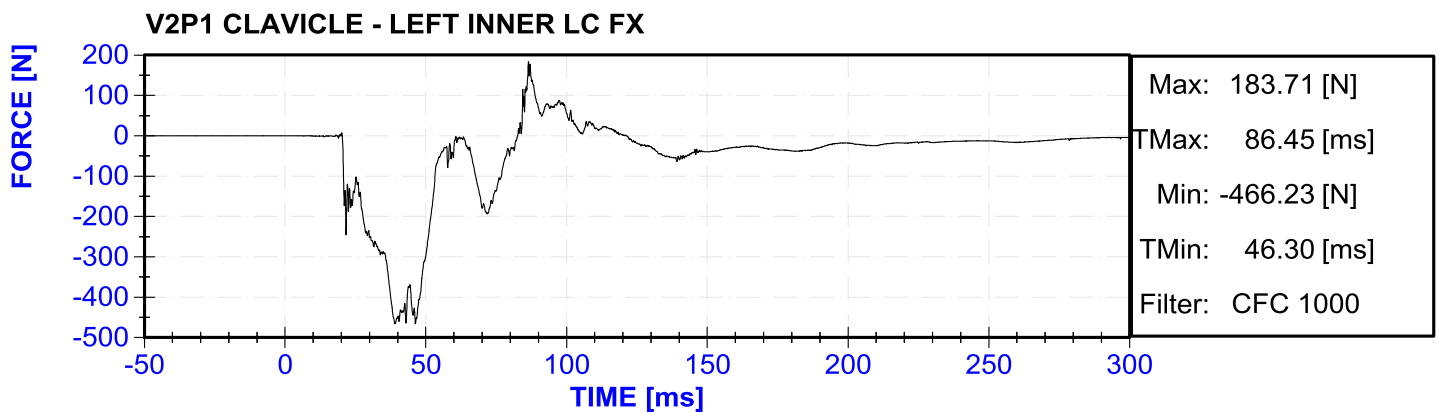
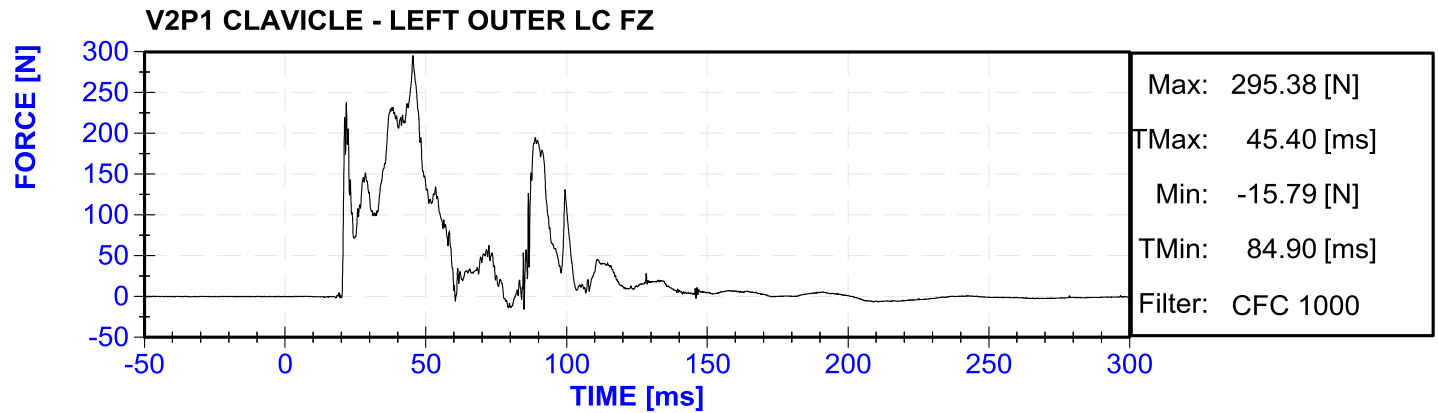
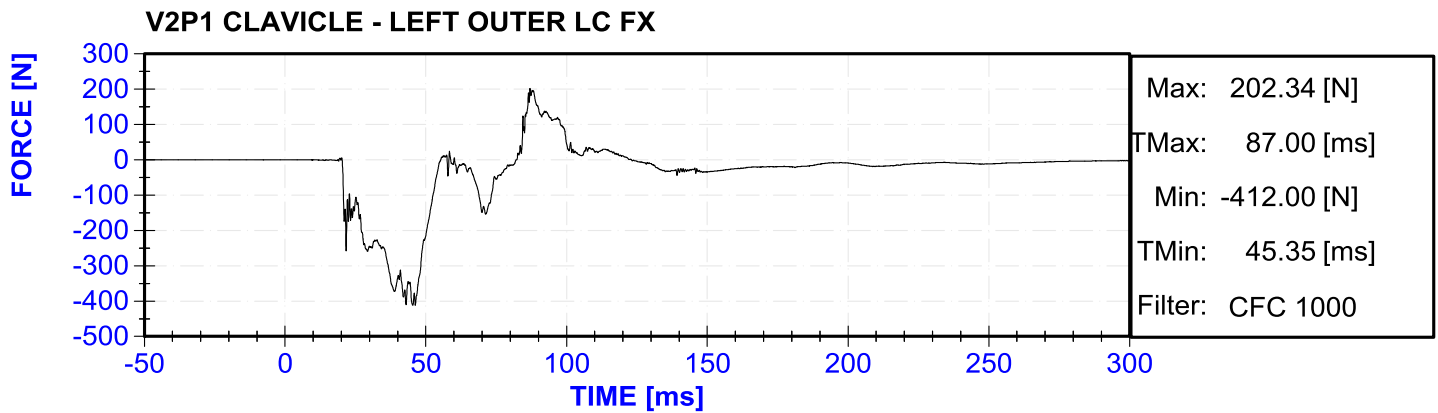
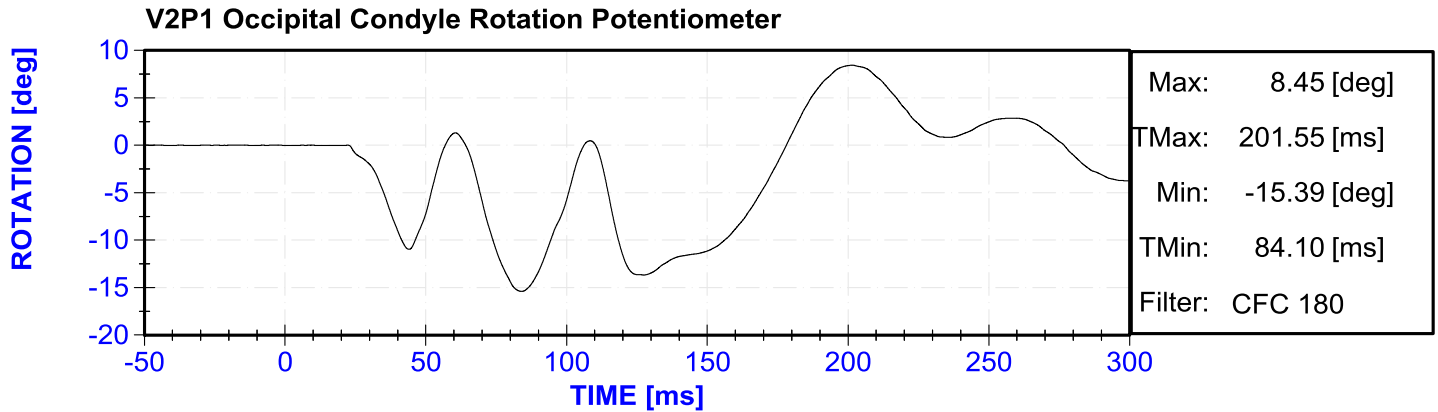




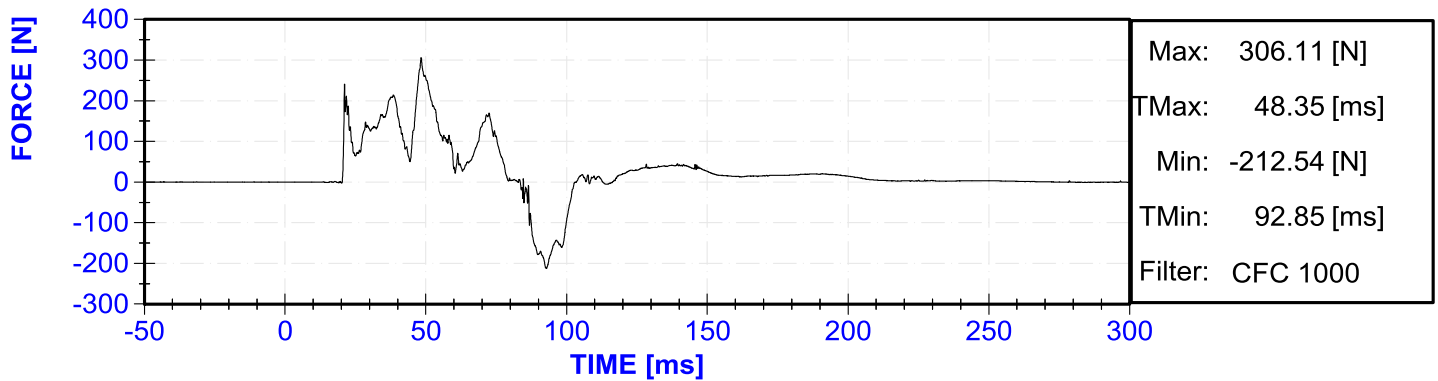




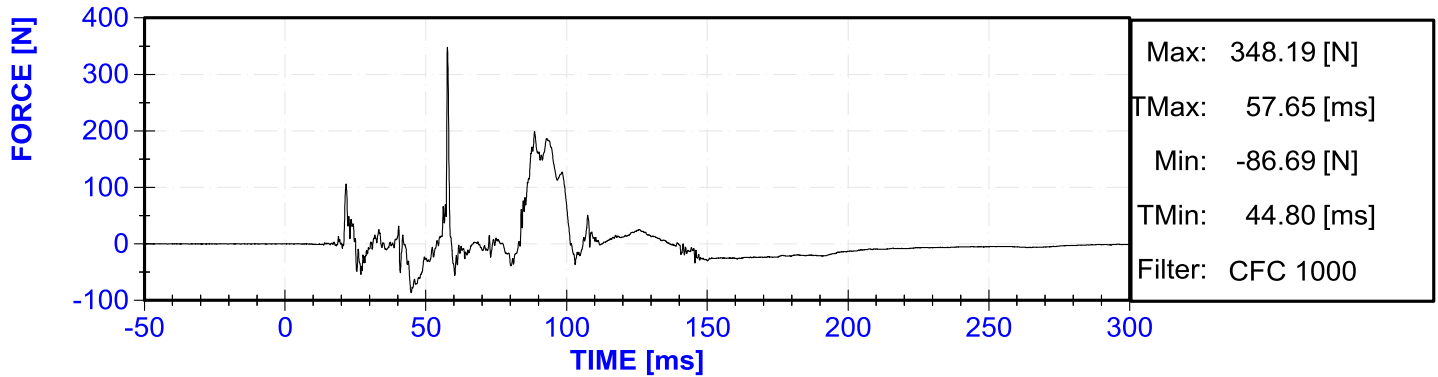




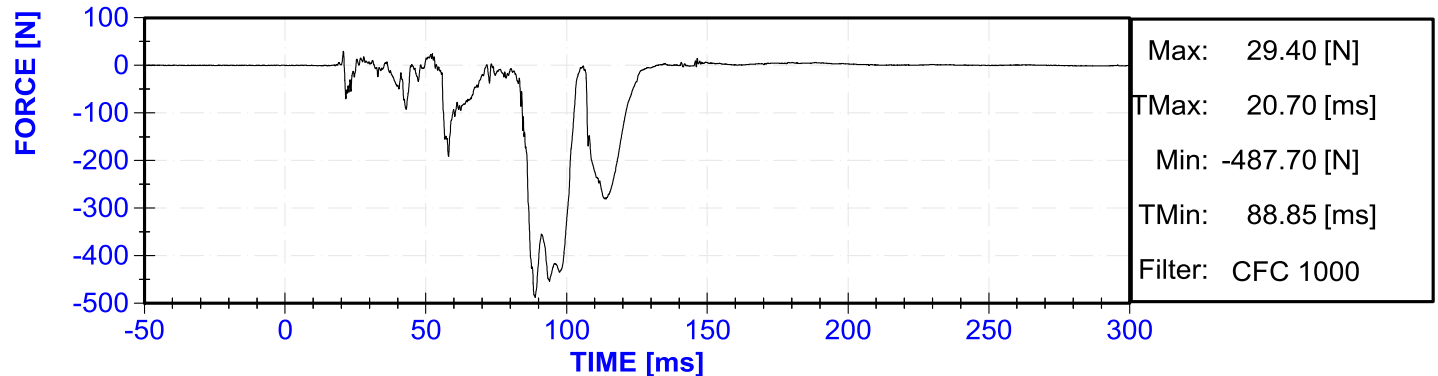
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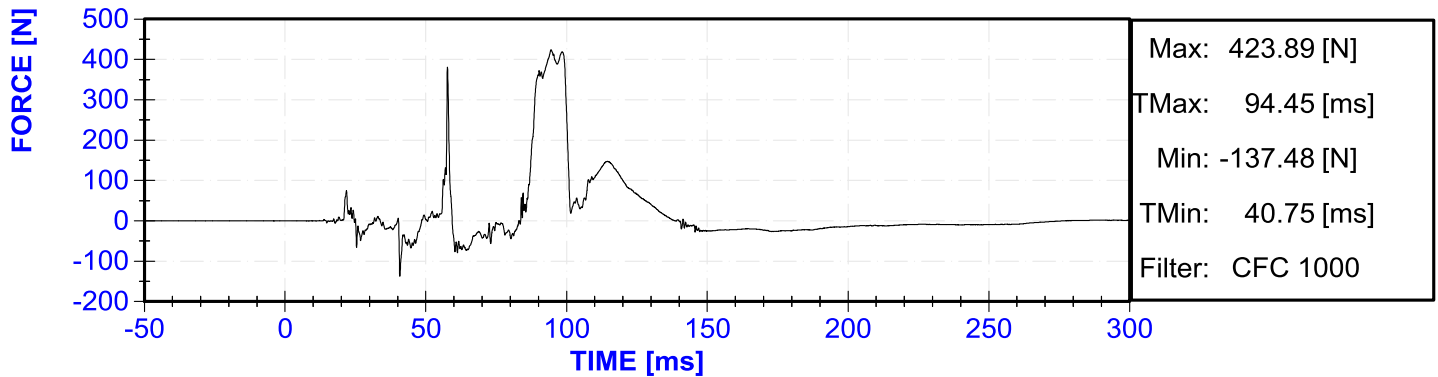
V2P1 CLAVICLE - RIGHT OUTER LC FX



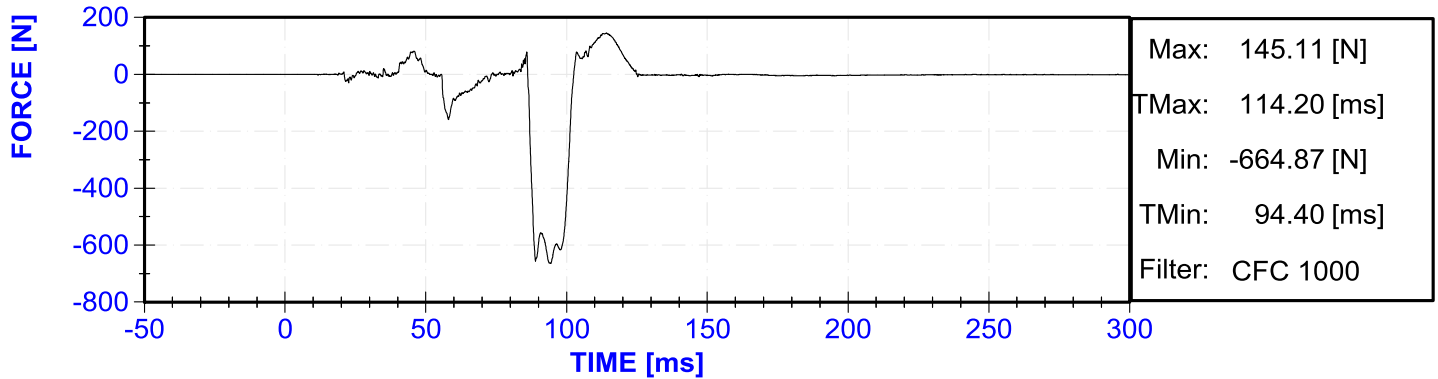
V2P1 CLAVICLE - RIGHT OUTER LC FZ



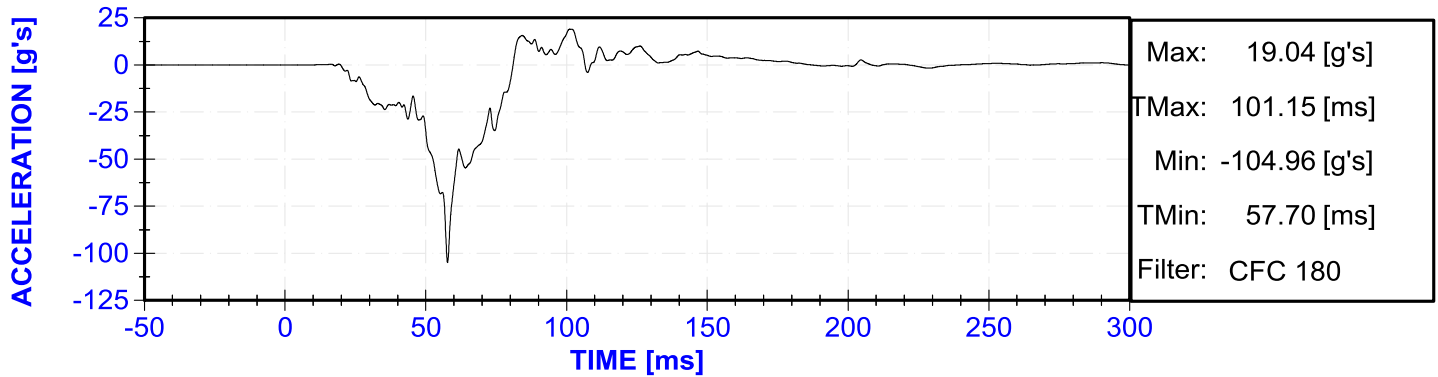
V2P1 CLAVICLE - RIGHT INNER LC FX



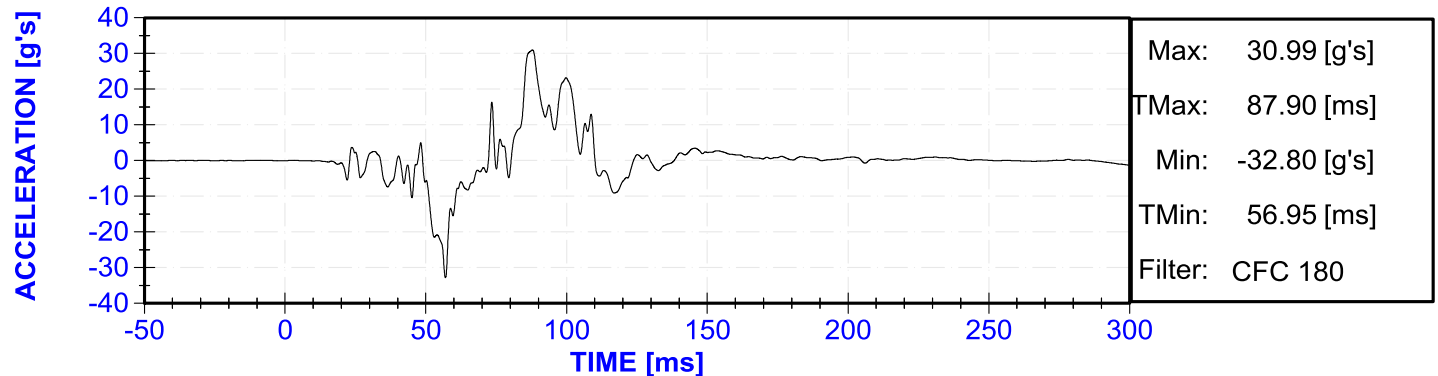
V2P1 CLAVICLE - RIGHT INNER LC FZ



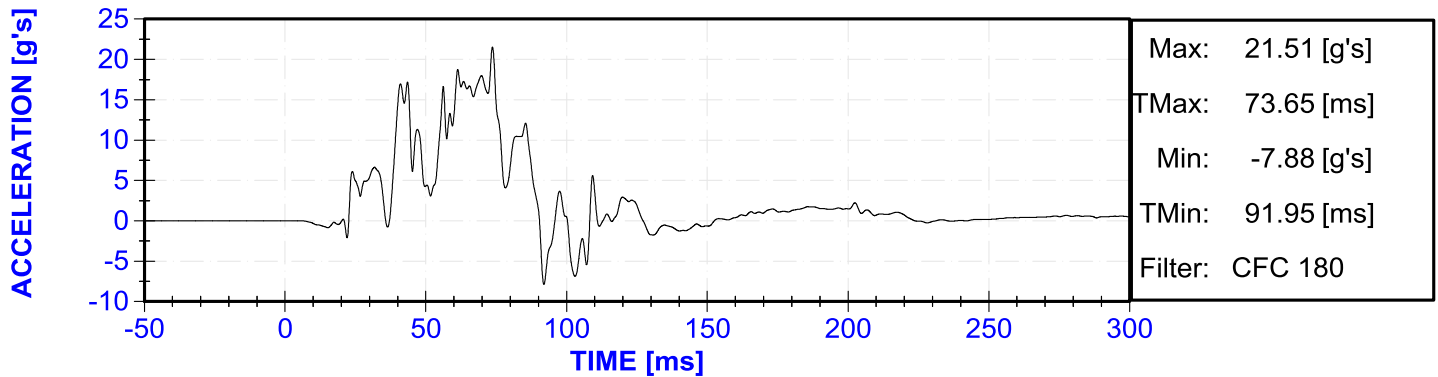
V2P1 T1 X Acceleration

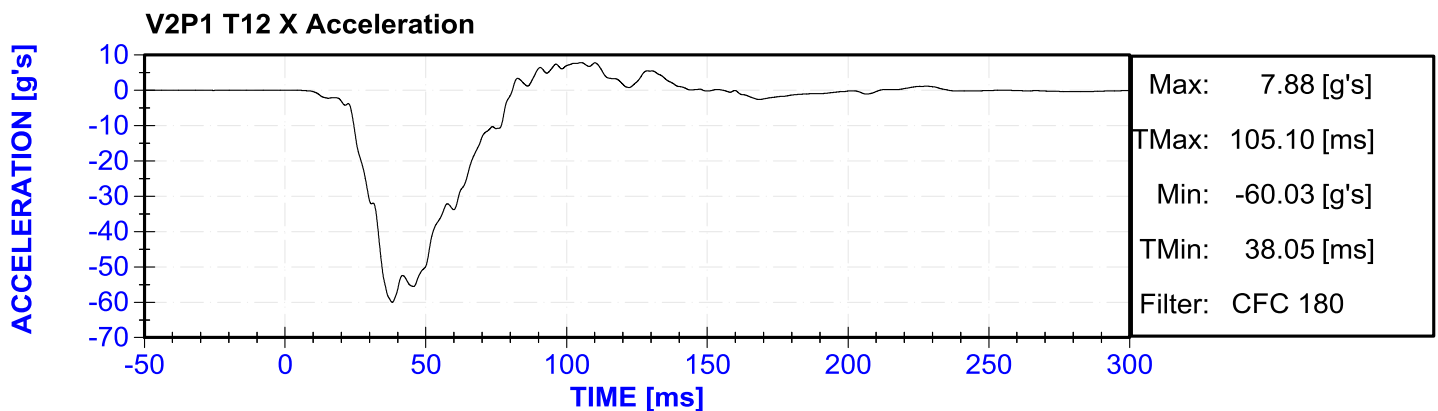
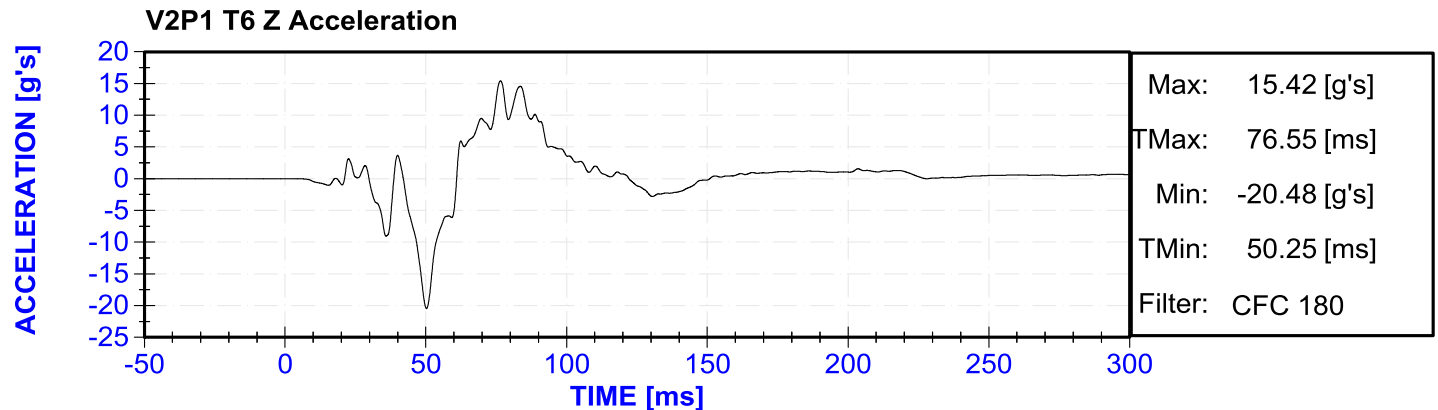
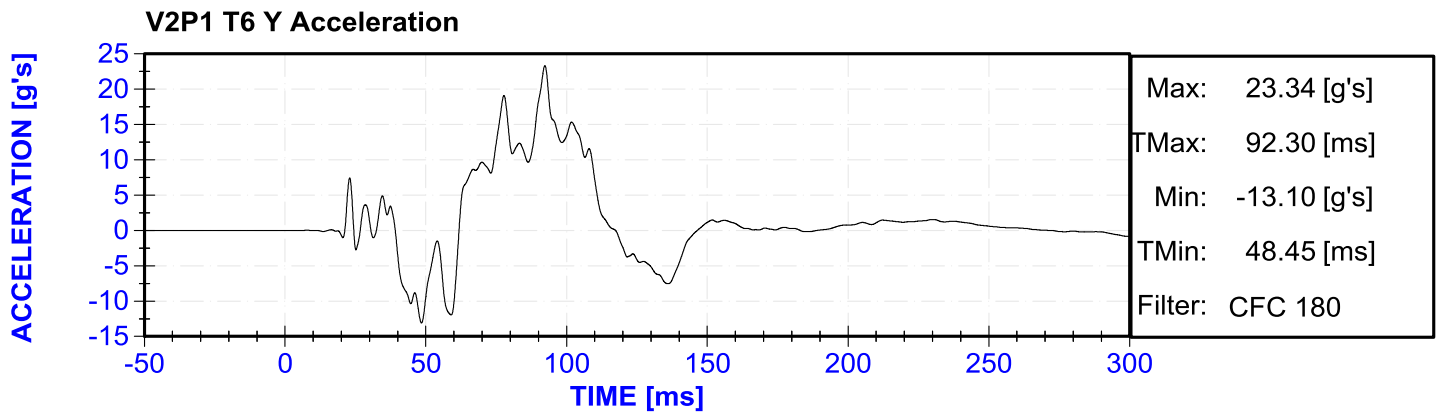
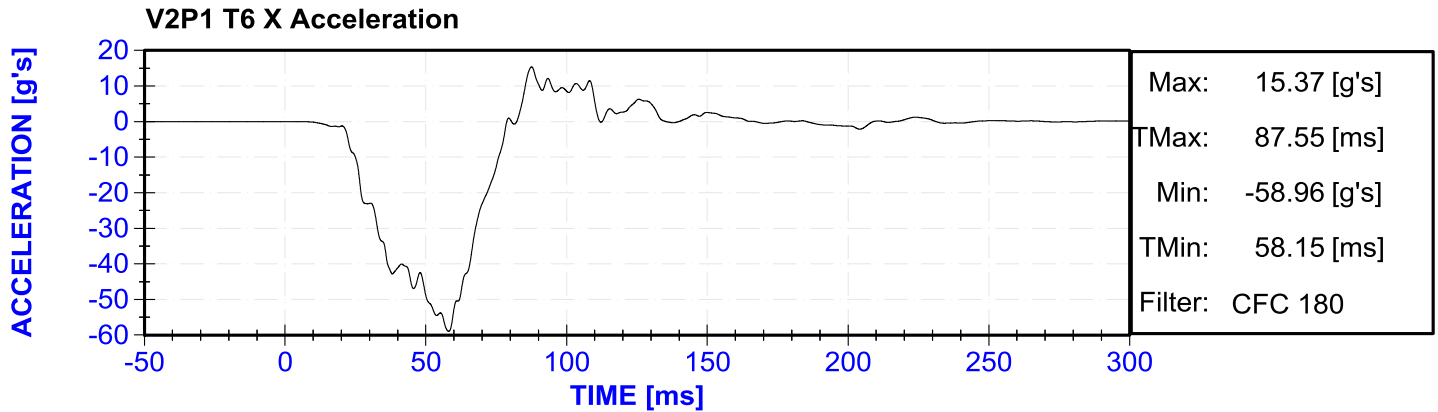


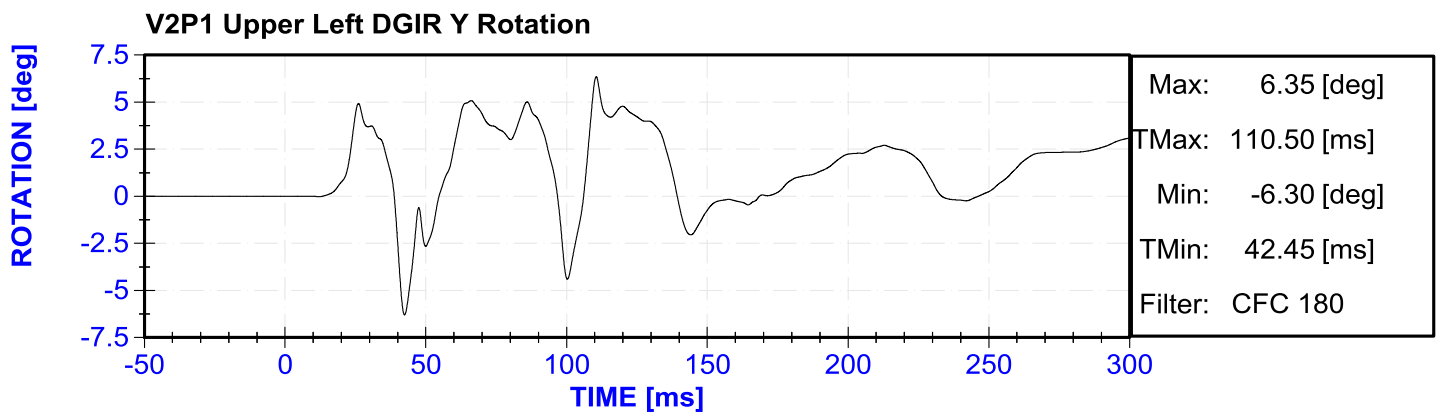
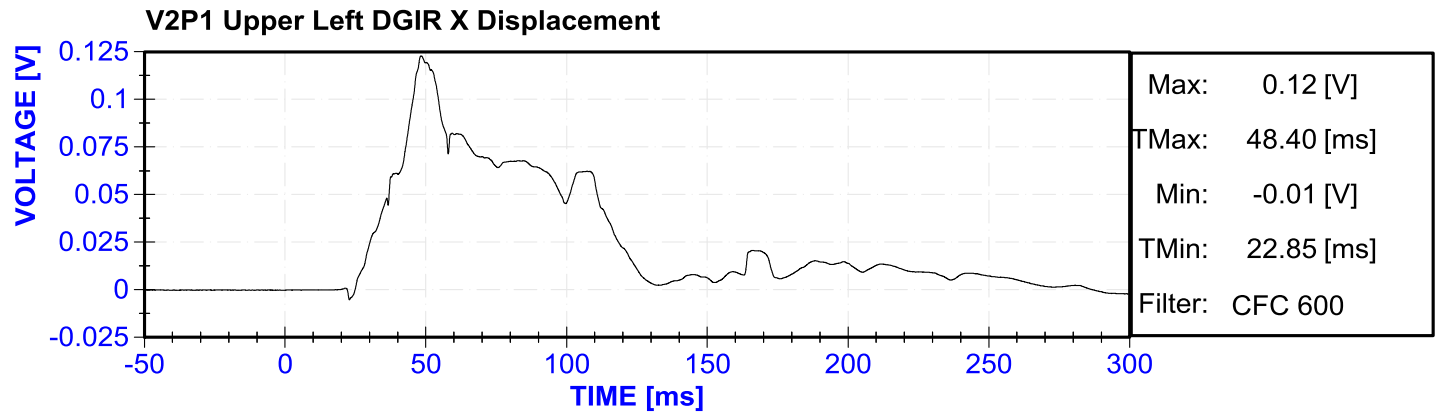
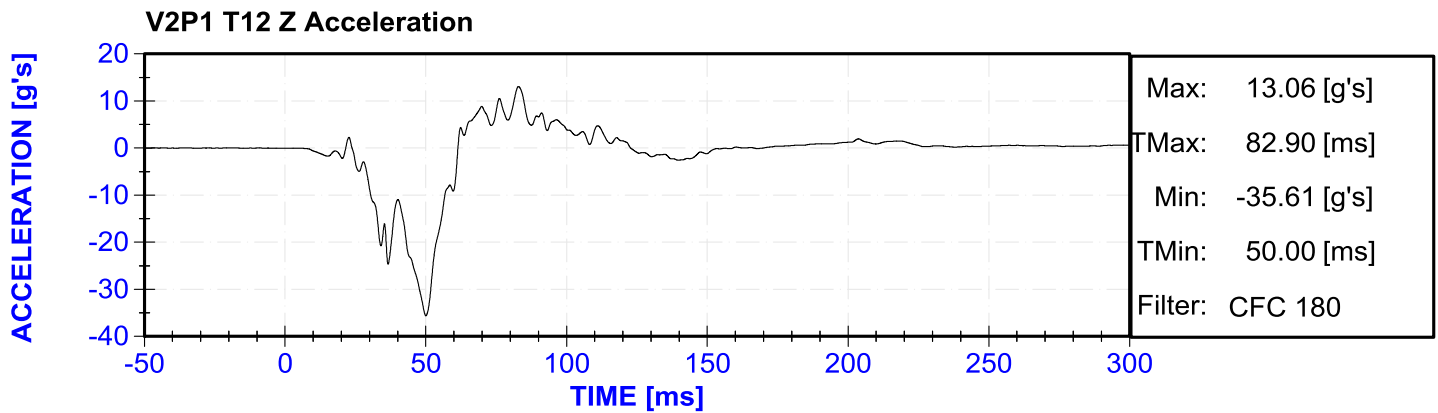
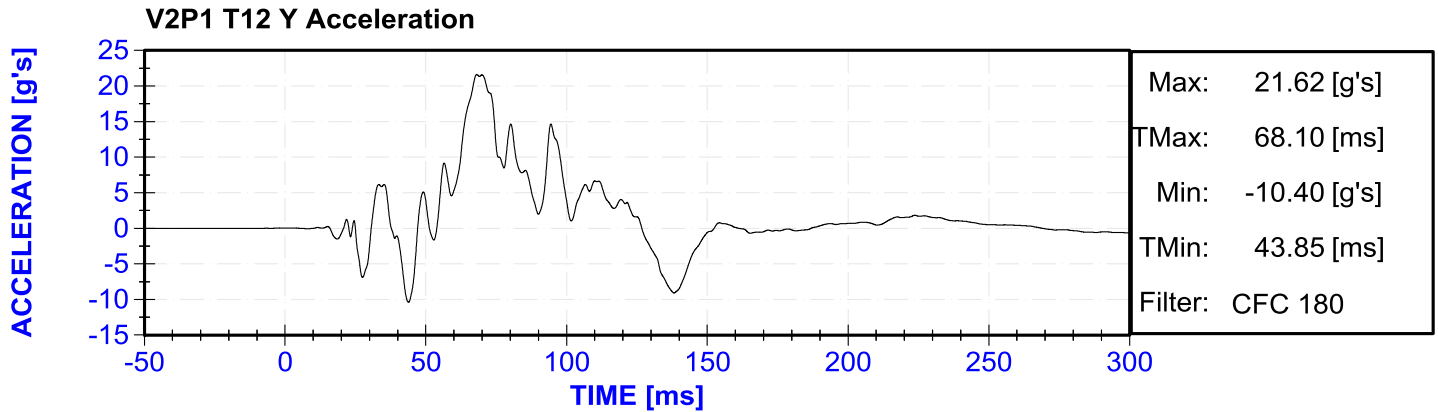
V2P1 T1 Y Acceleration

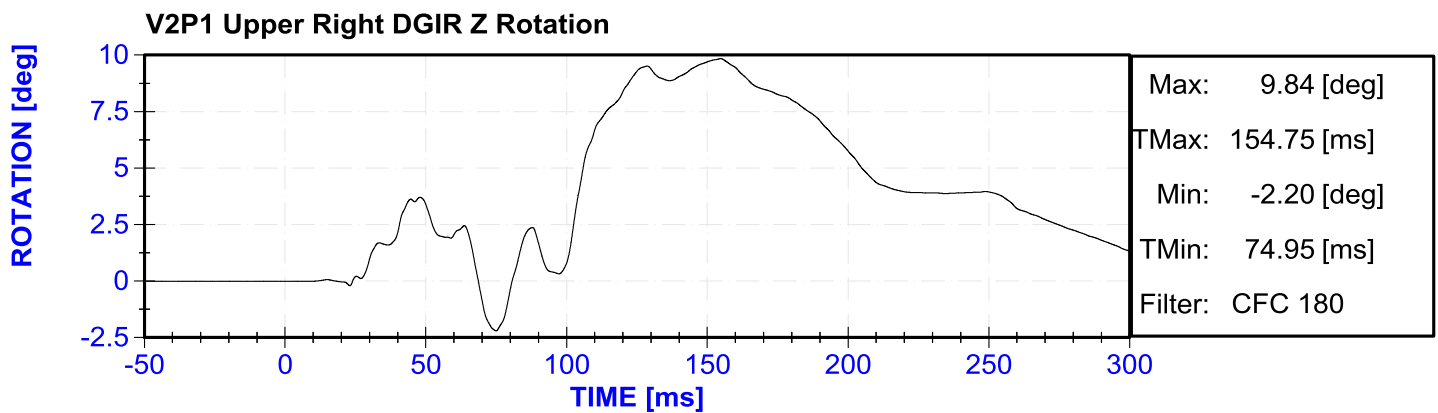
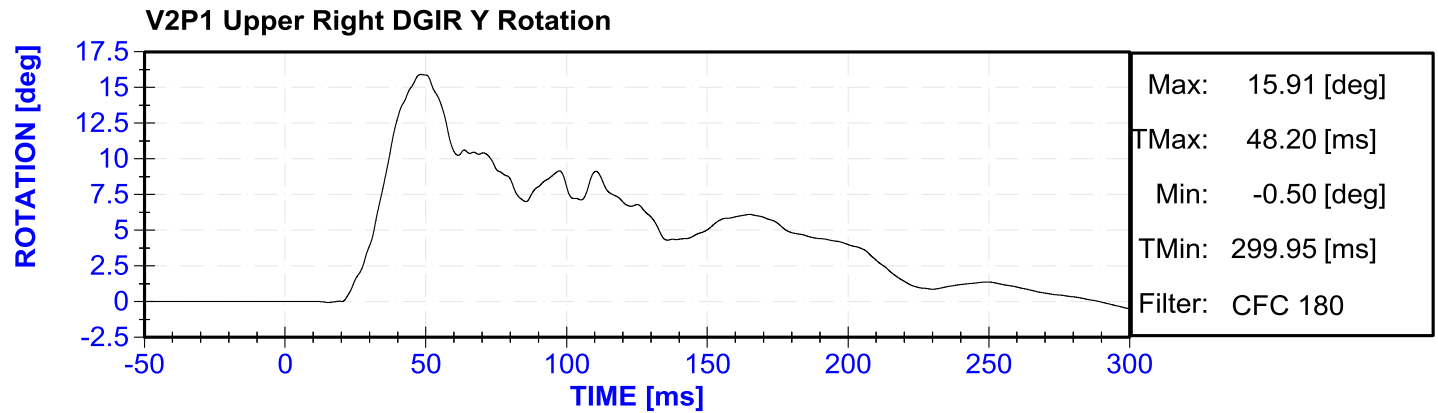
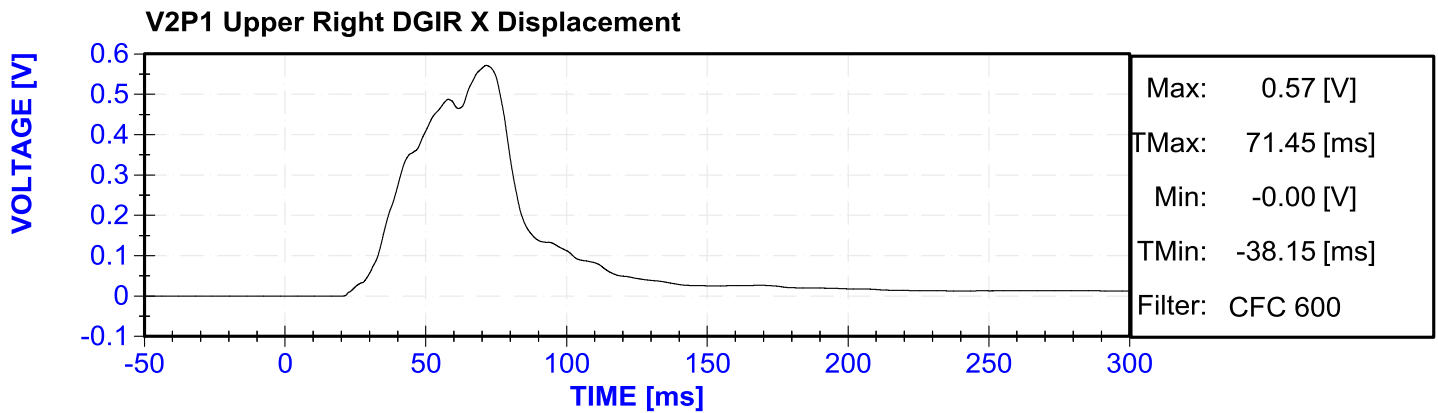
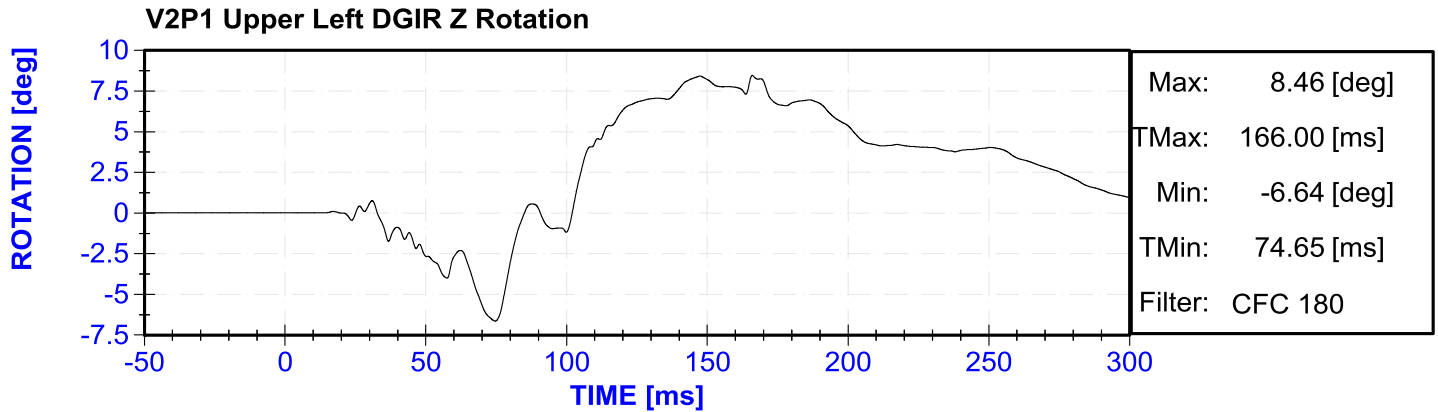


V2P1 T1 Z Acceleration

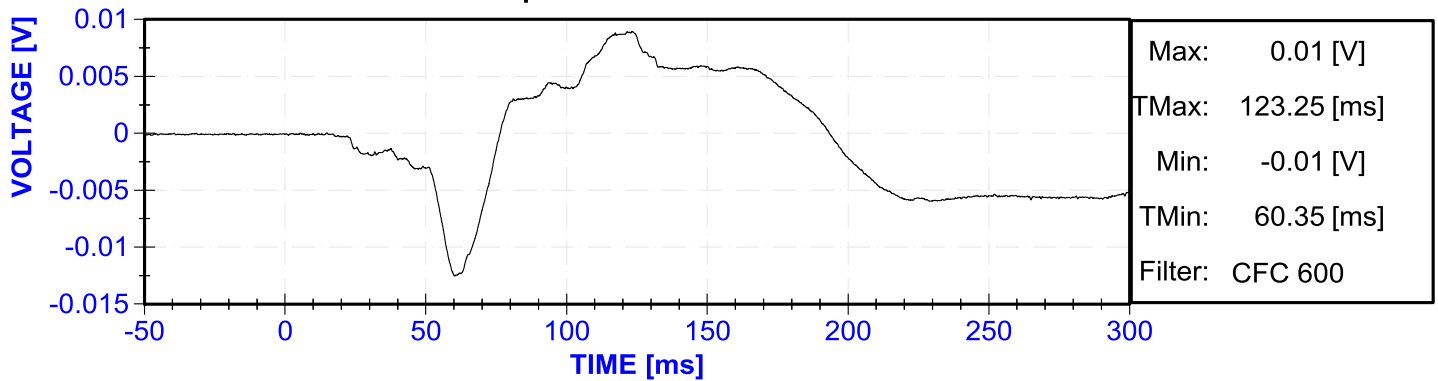




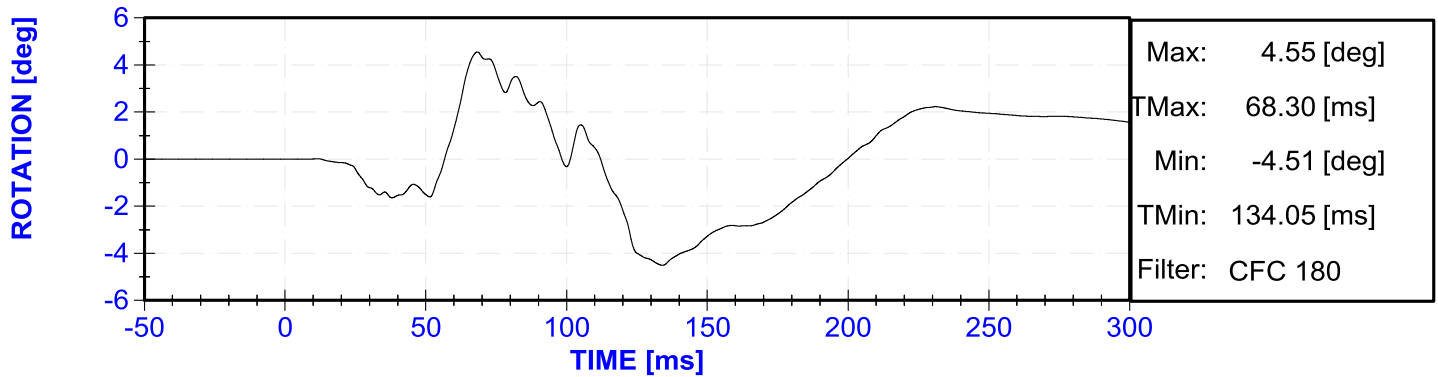




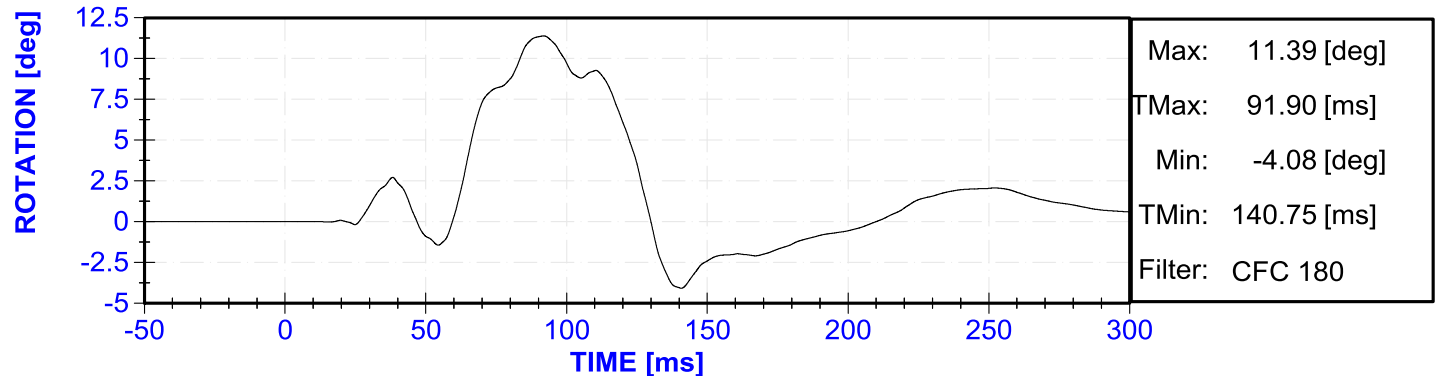
V2P1 Lower Left DGIR X Displacement



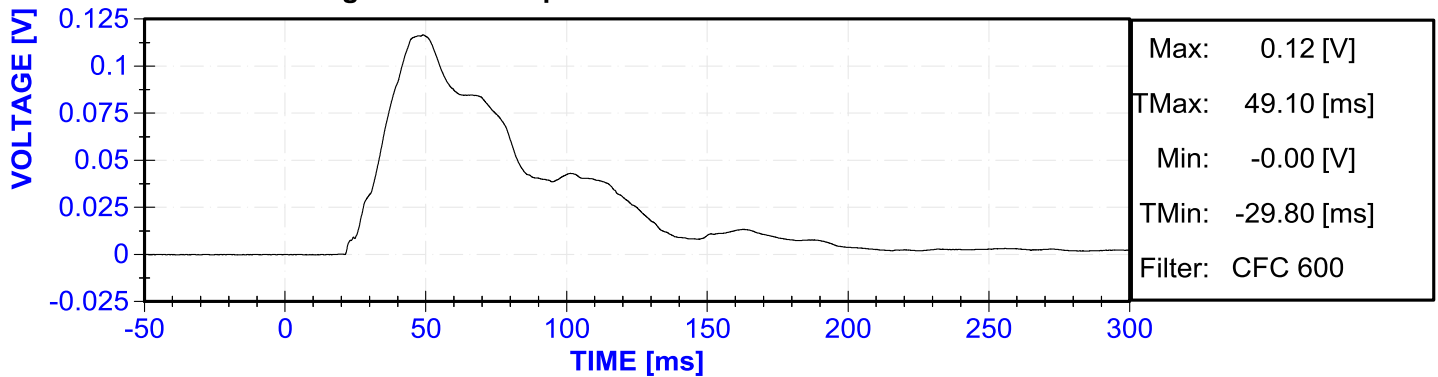
V2P1 Lower Left DGIR Y Rotation

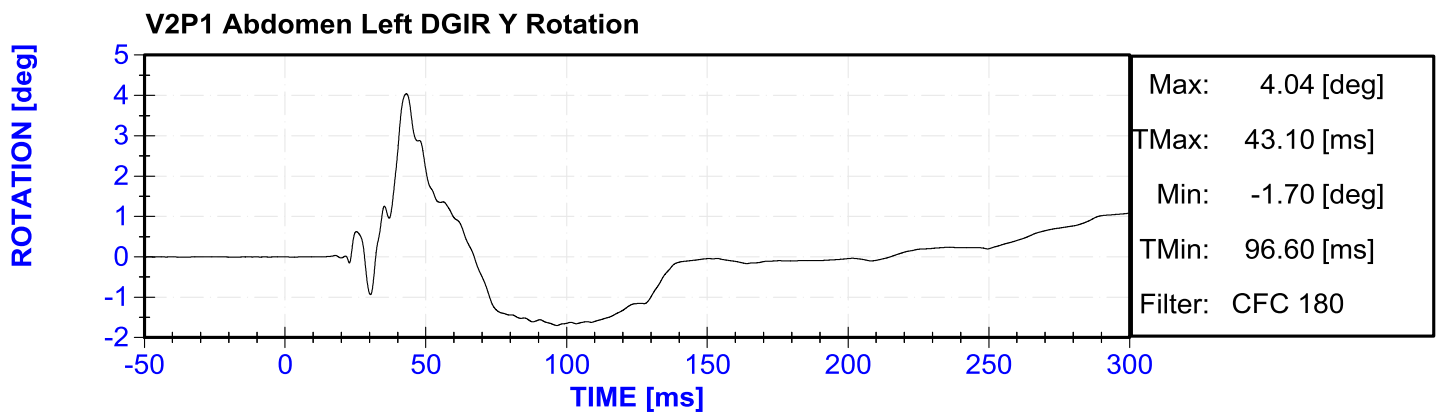
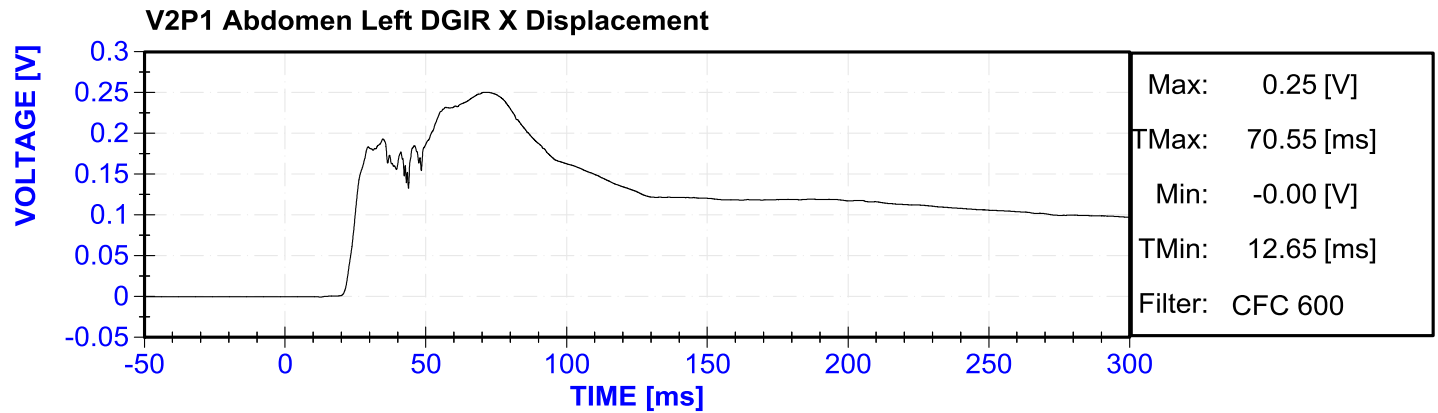
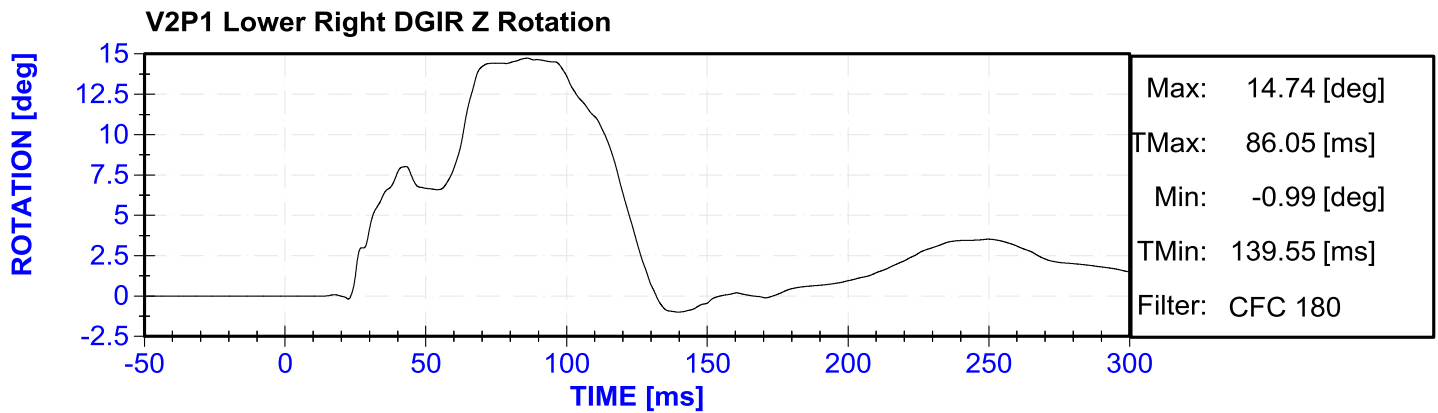
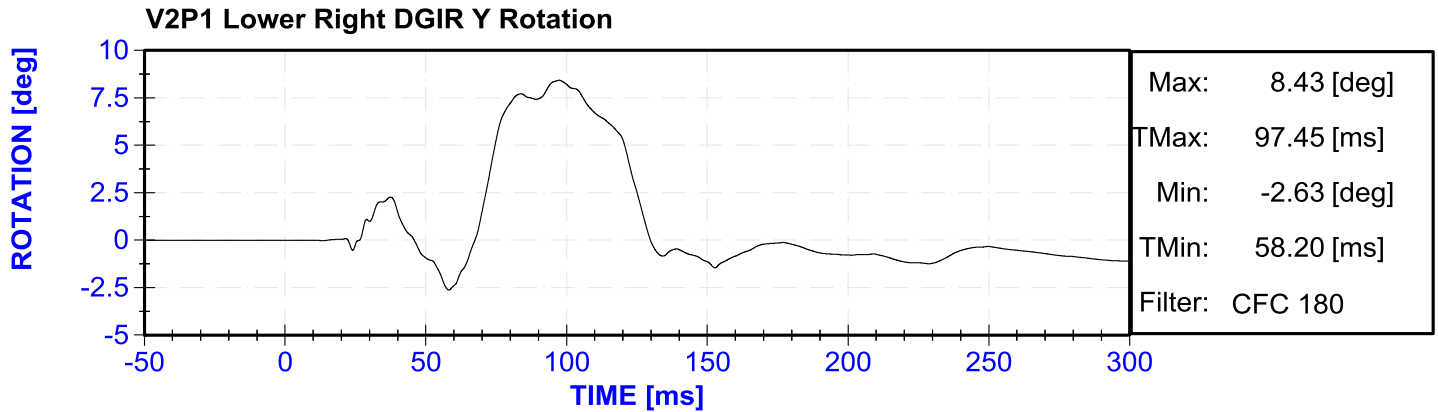


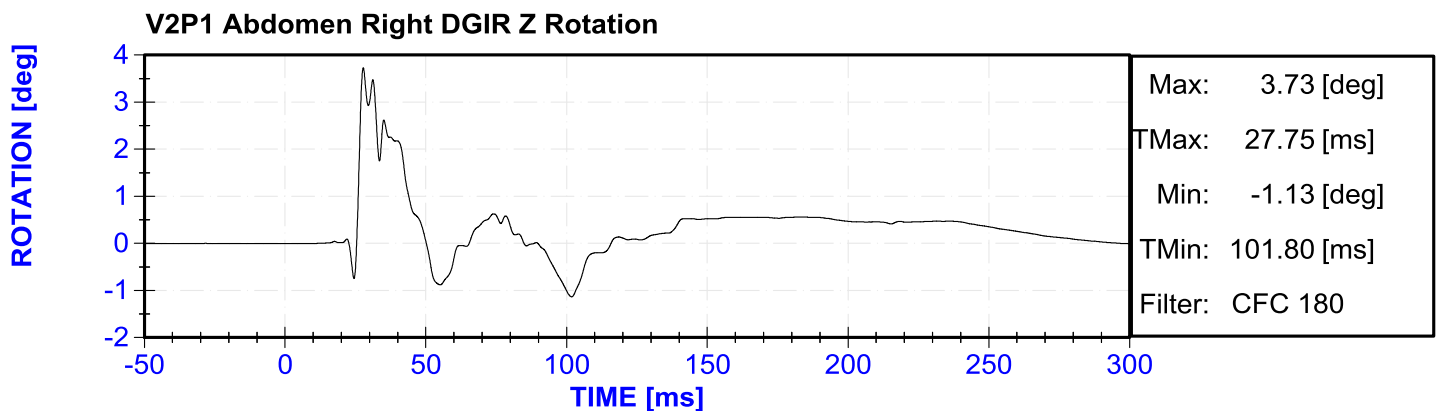
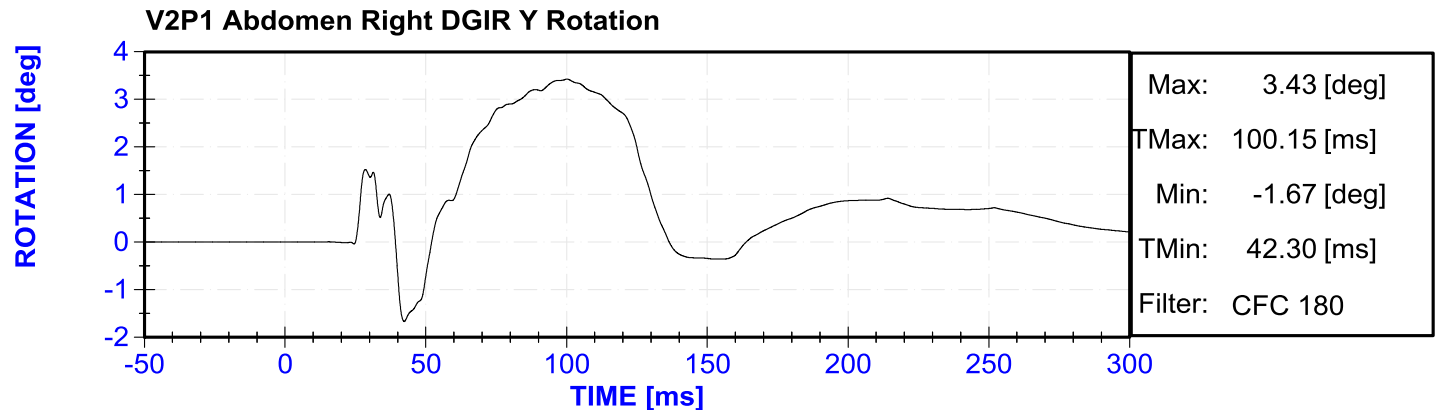
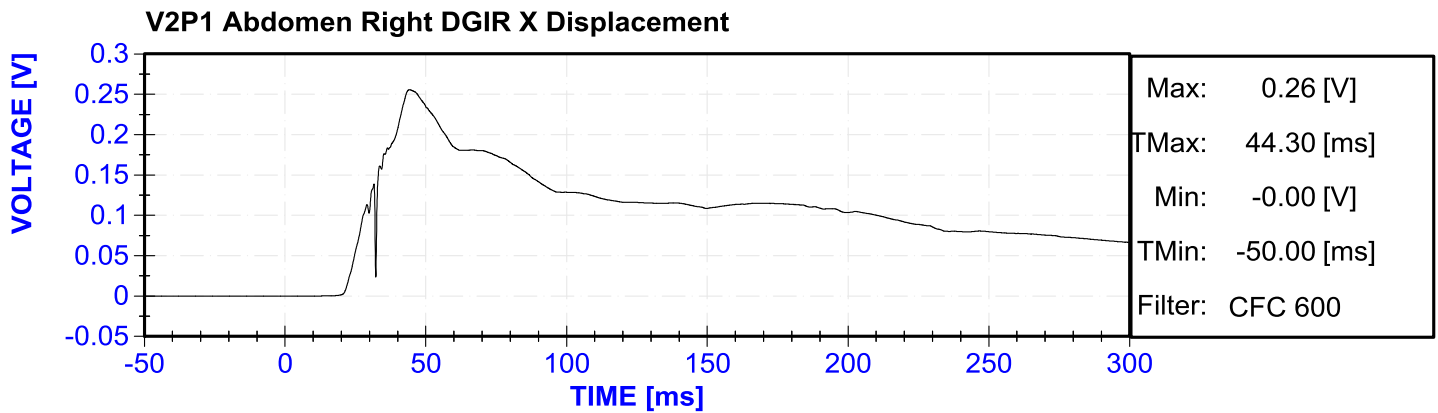
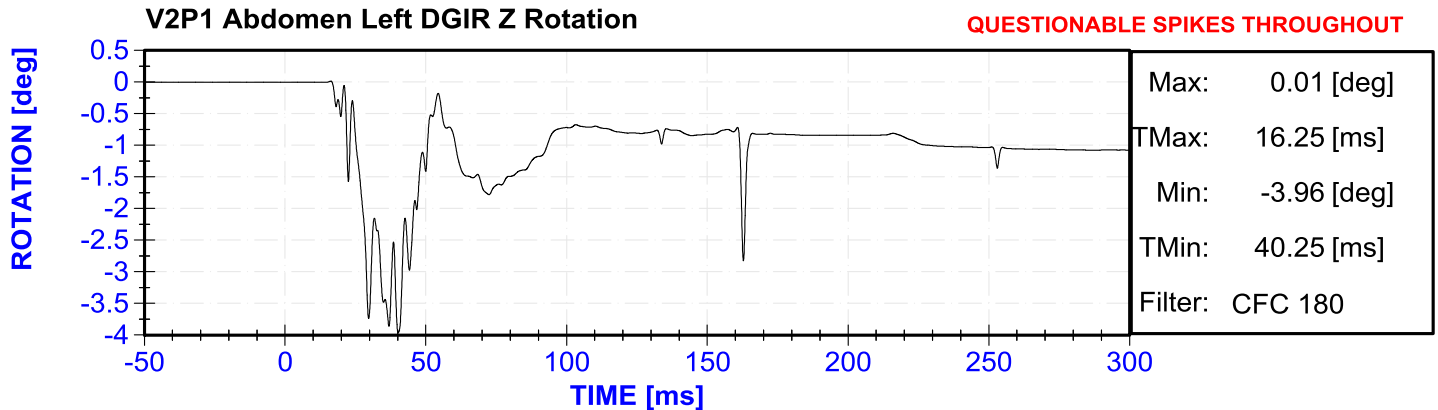
V2P1 Lower Left DGIR Z Rotation

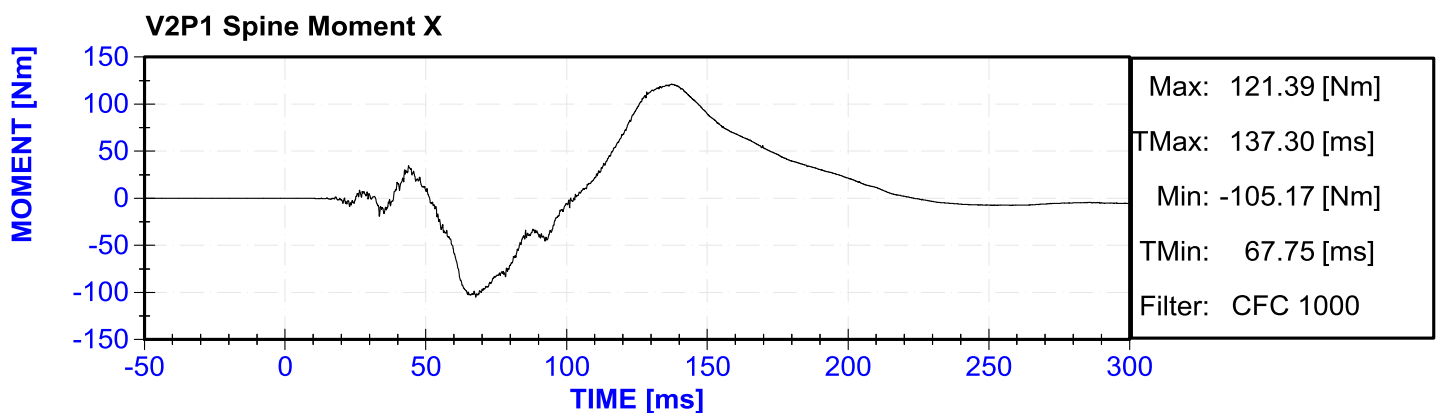
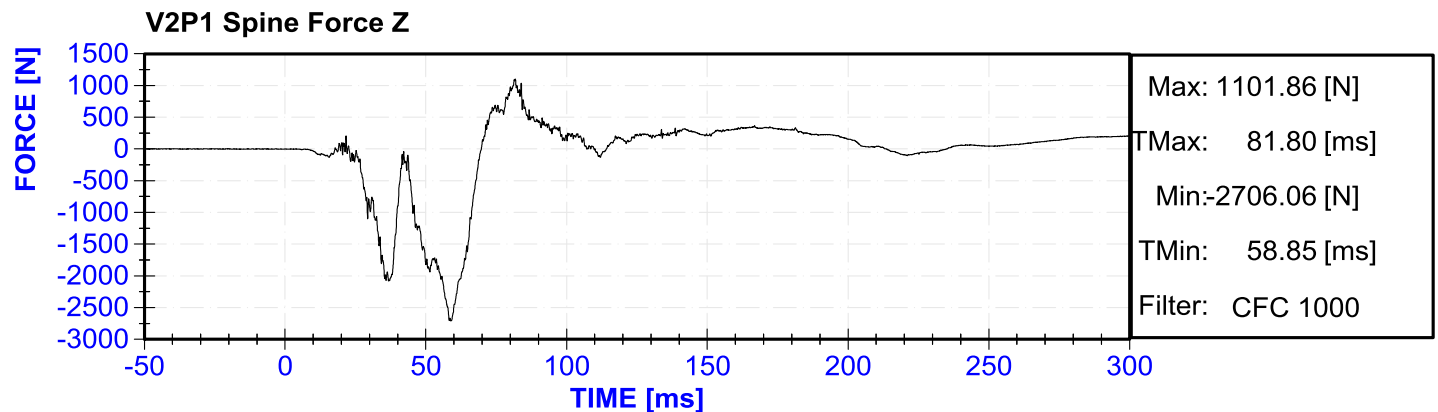
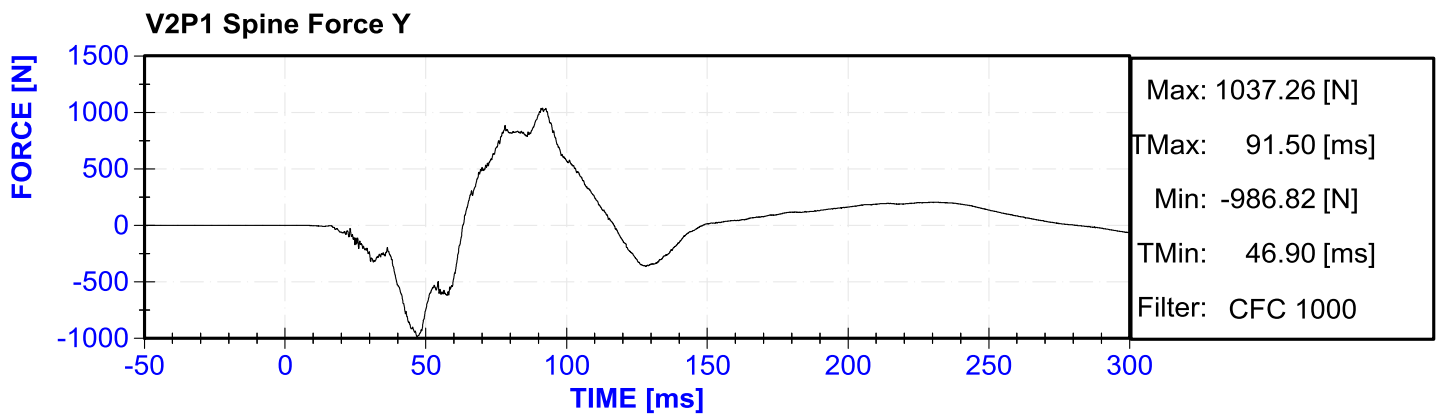
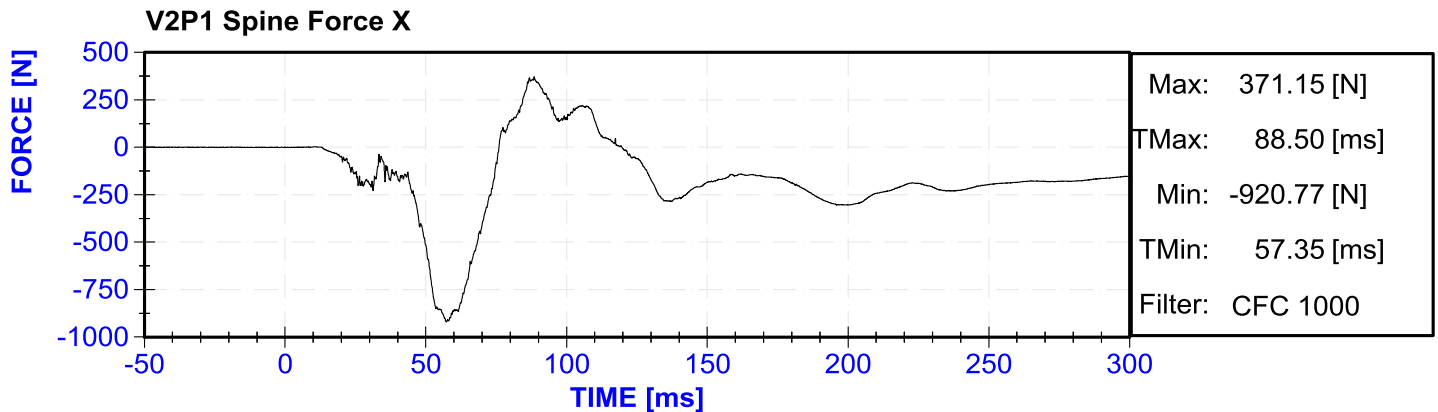


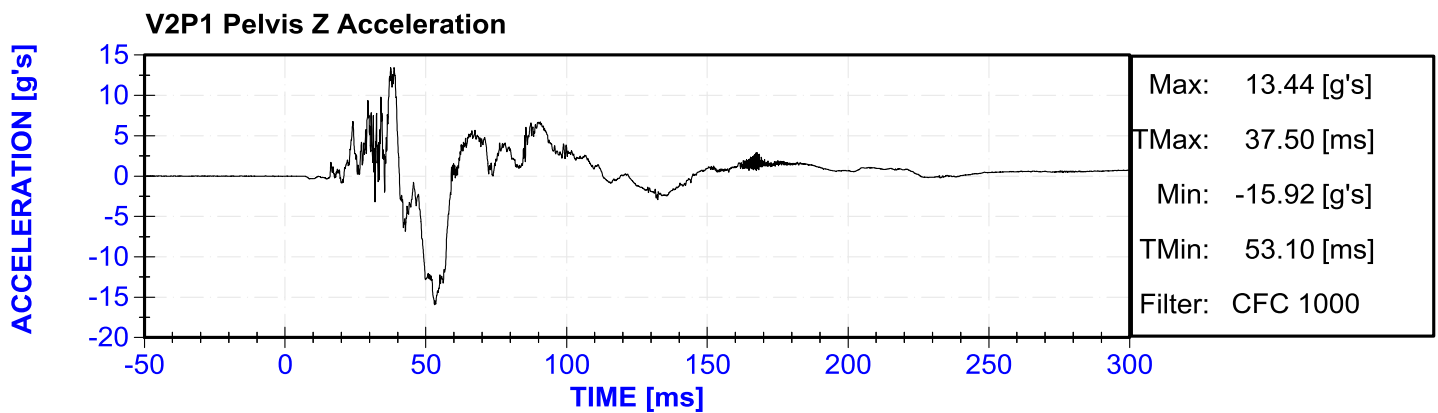
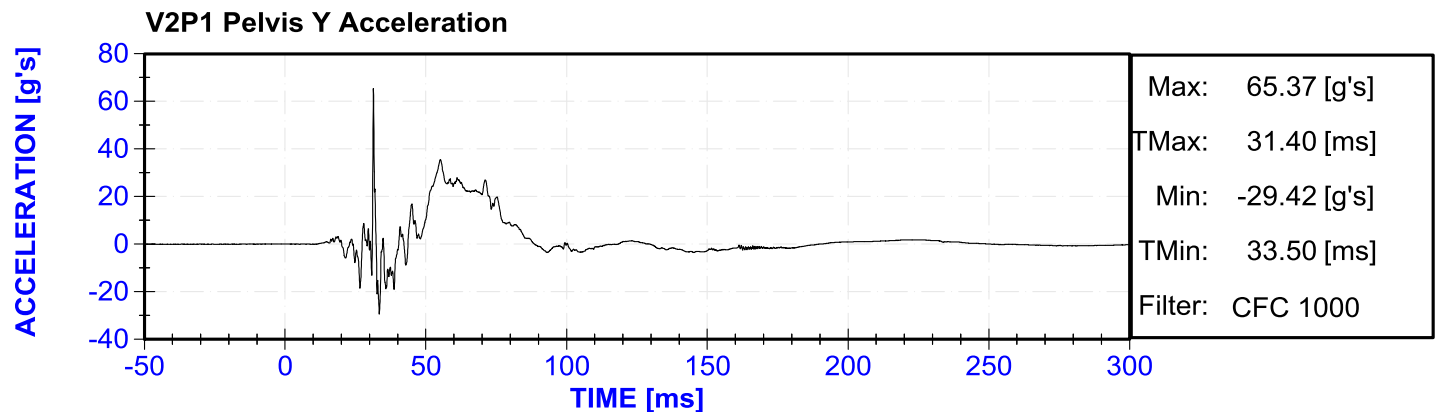
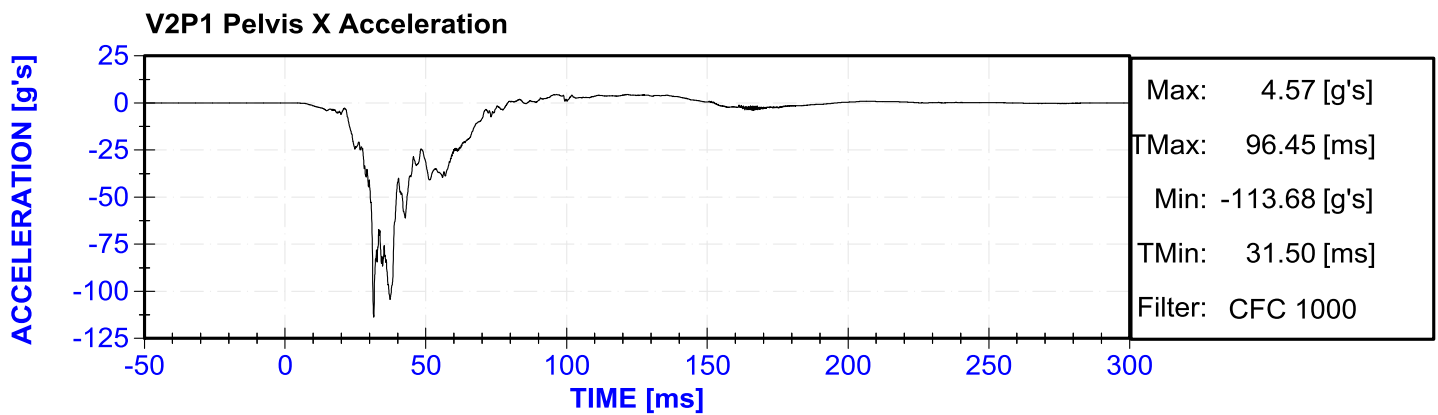
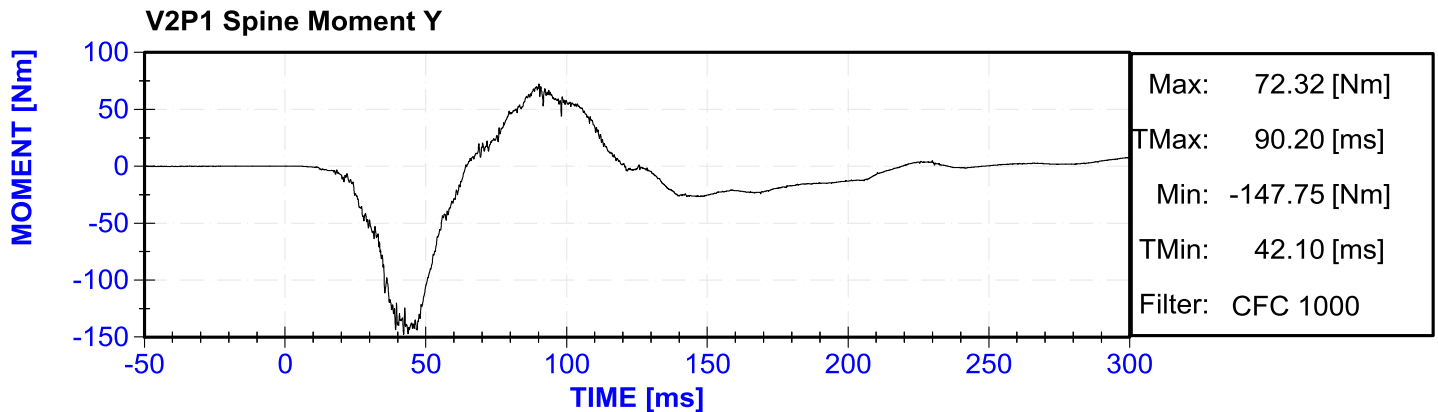
V2P1 Lower Right DGIR X Displacement

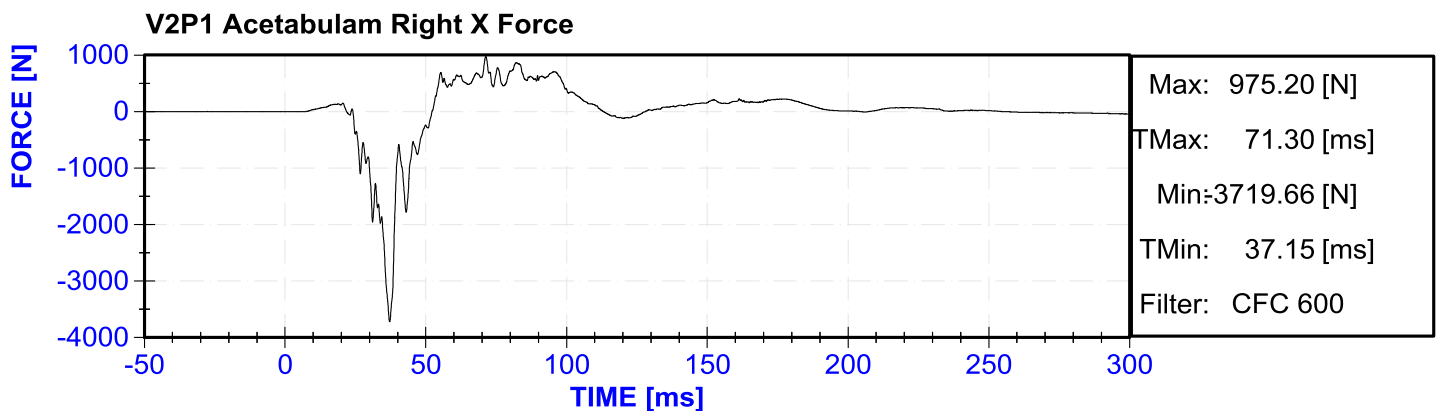
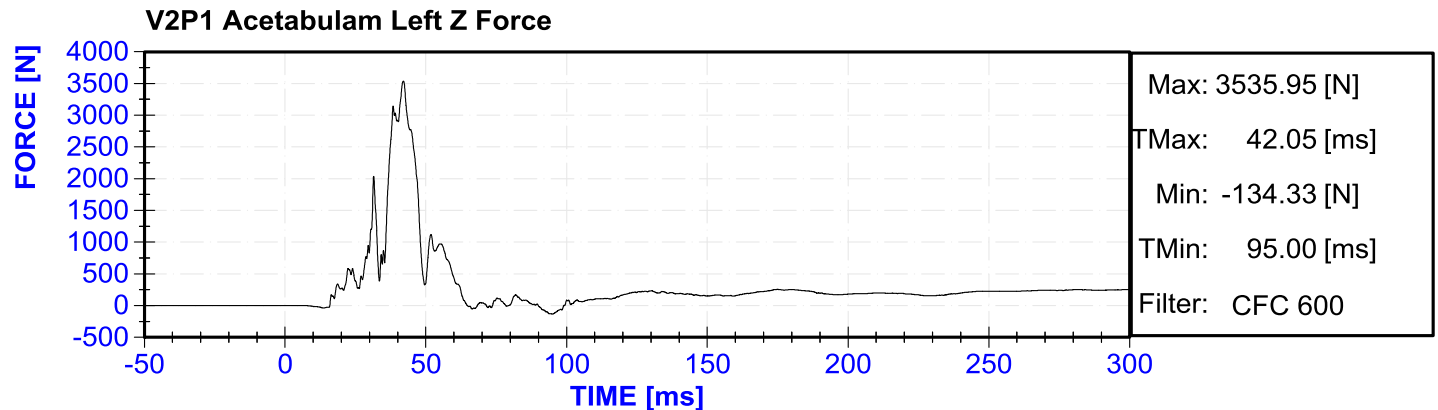
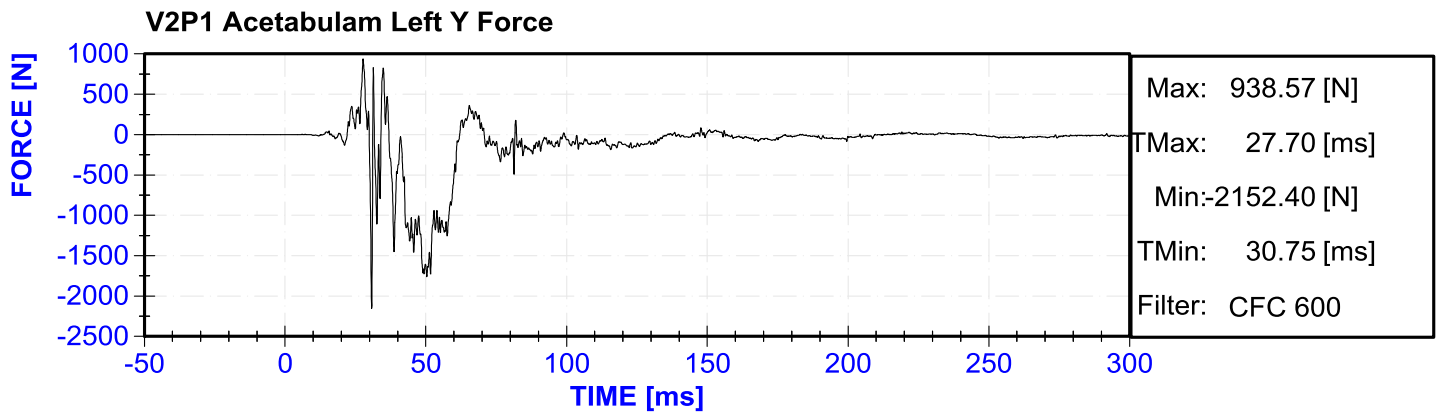
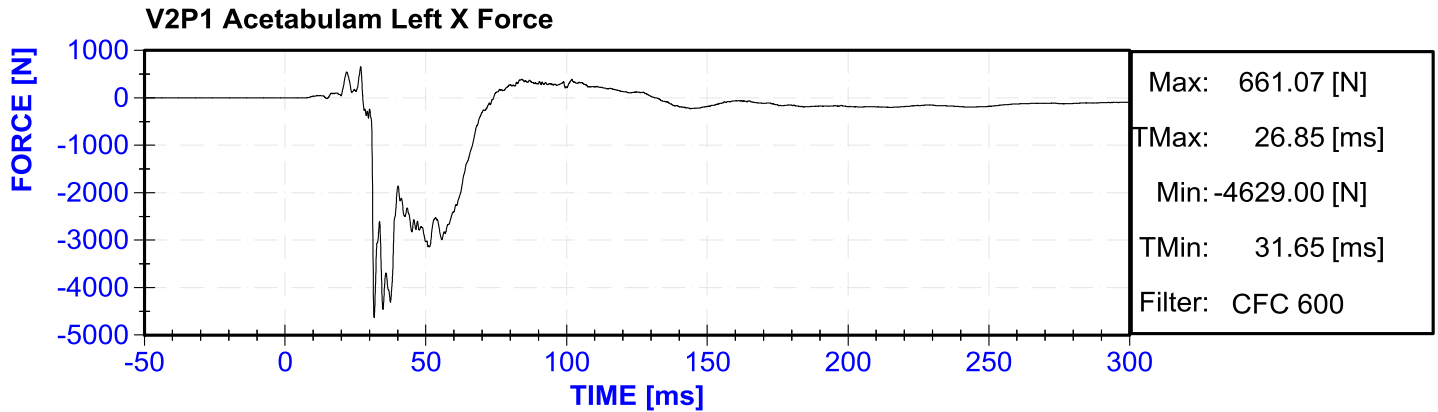


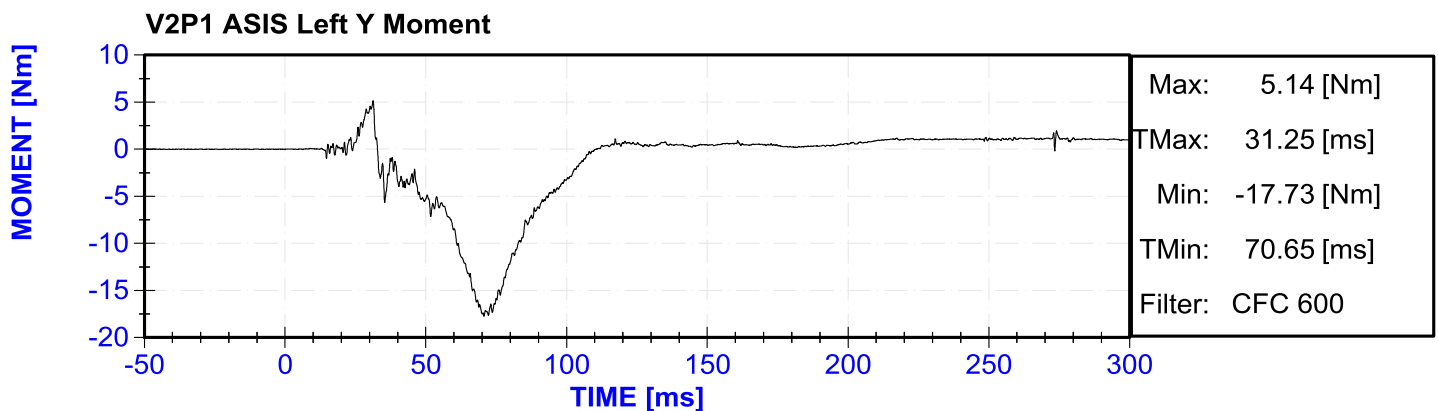
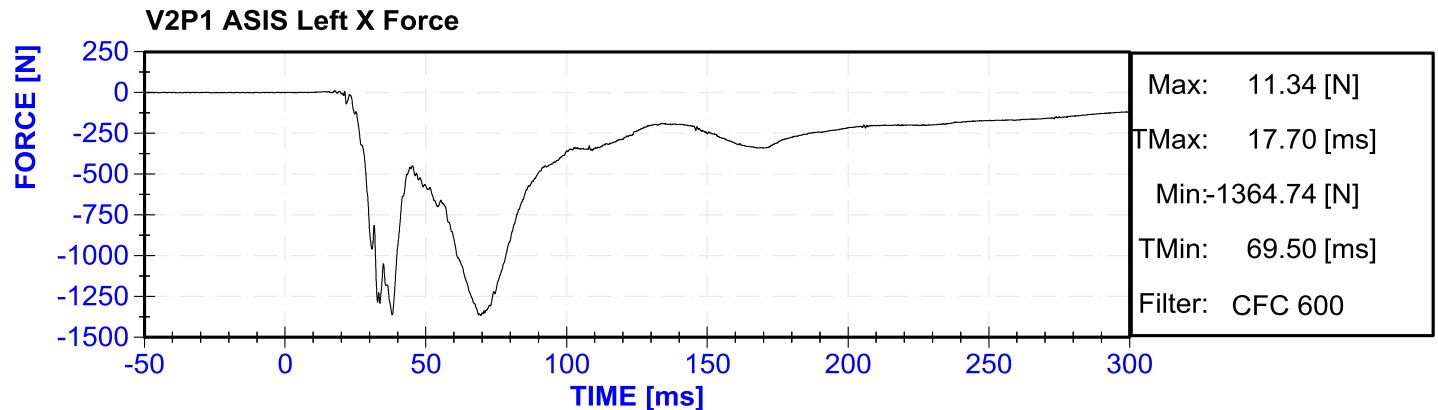
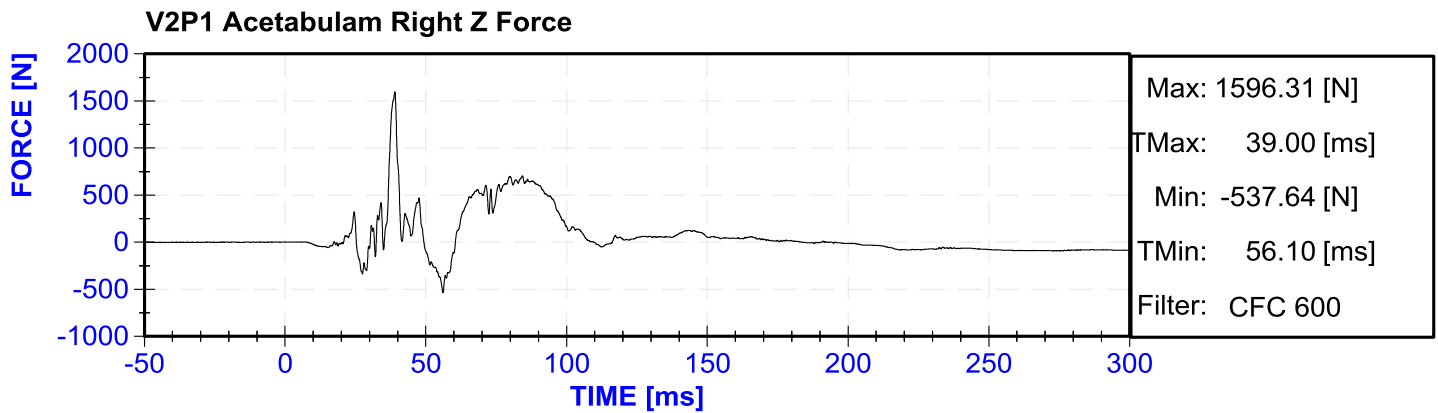
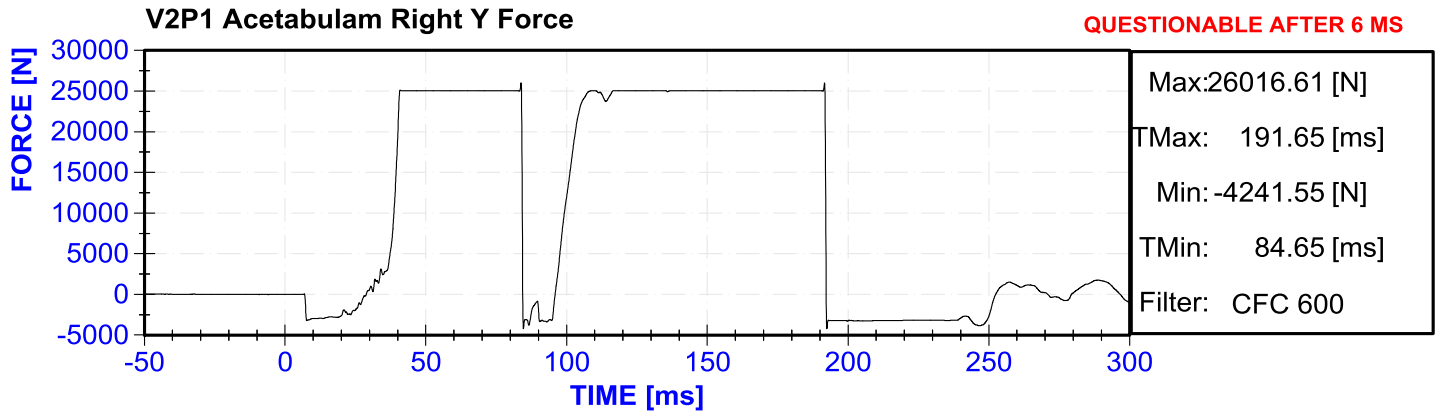


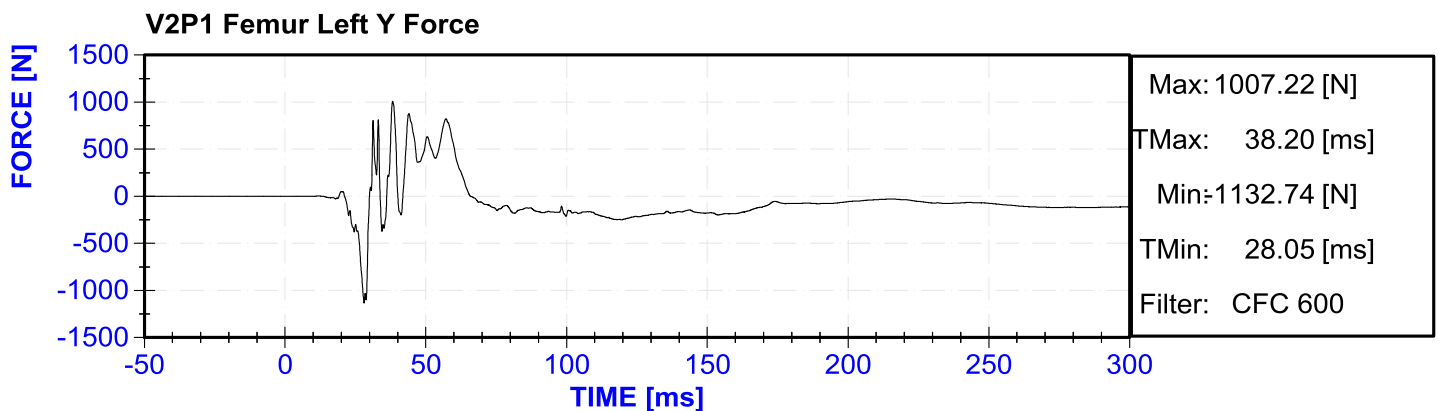
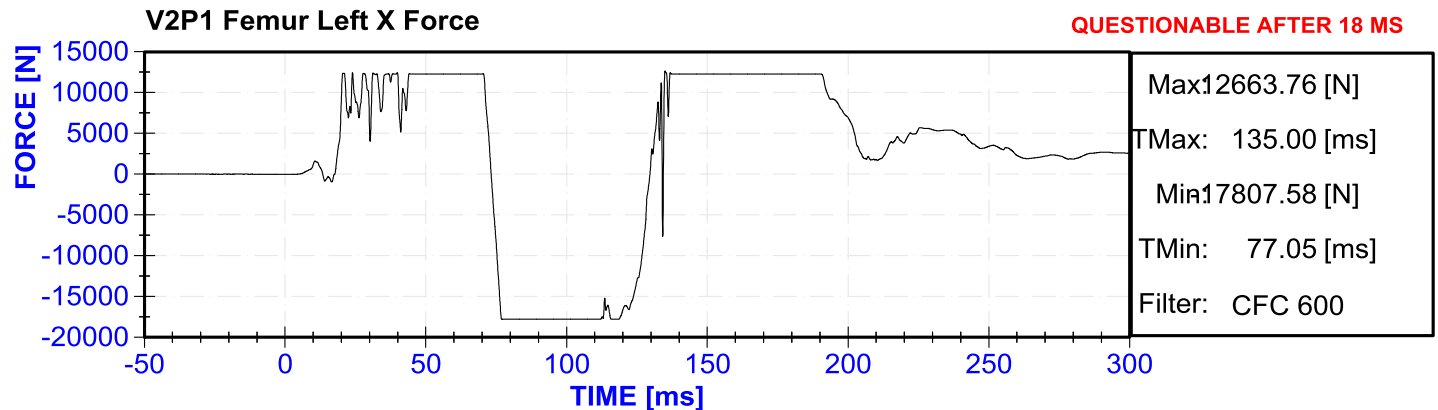
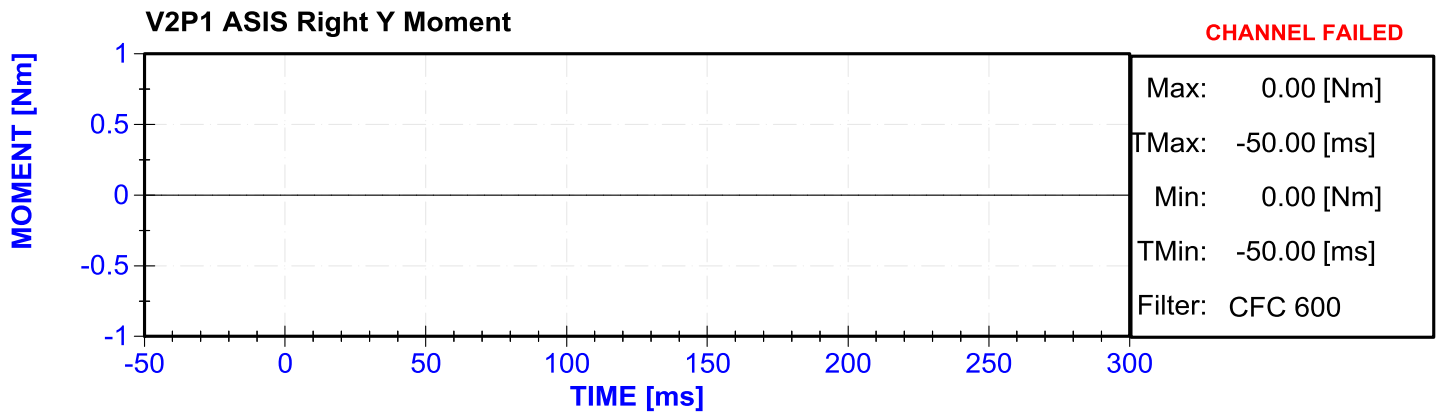
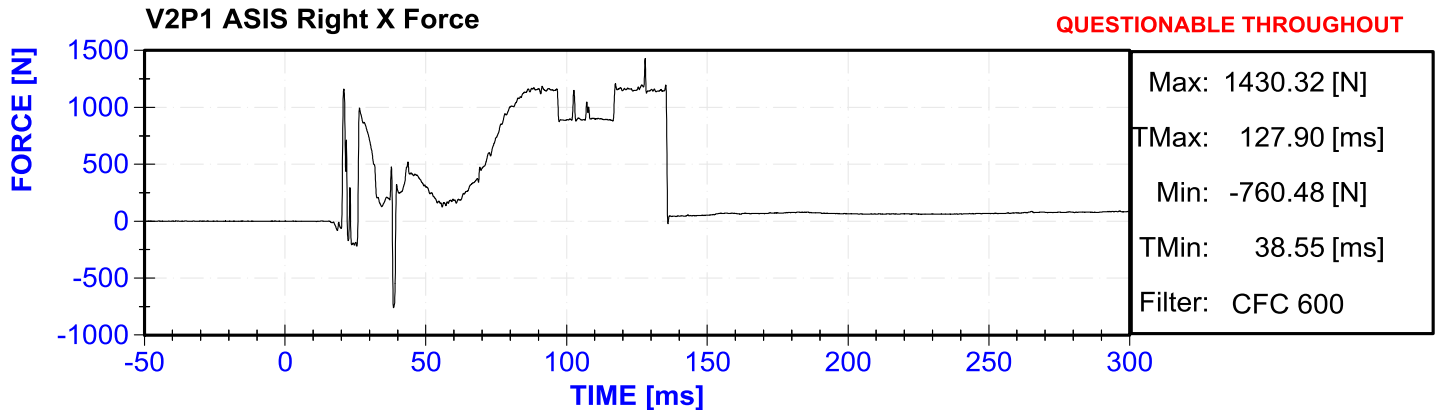


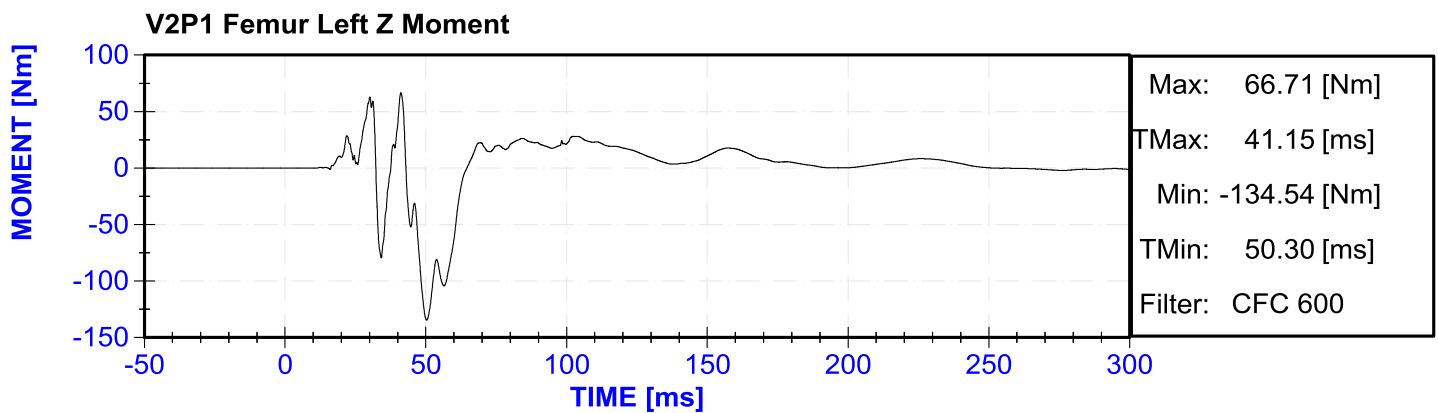
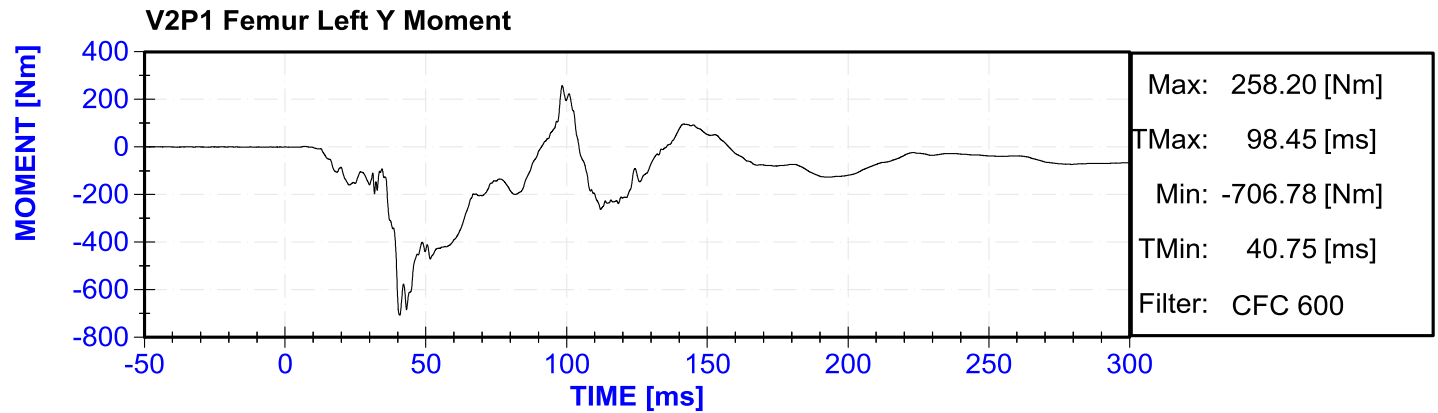
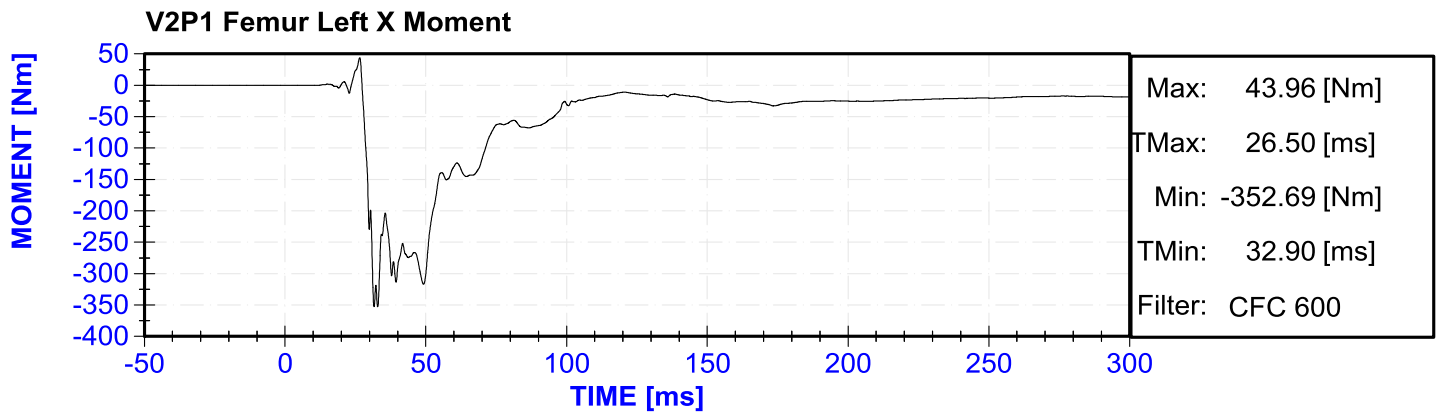
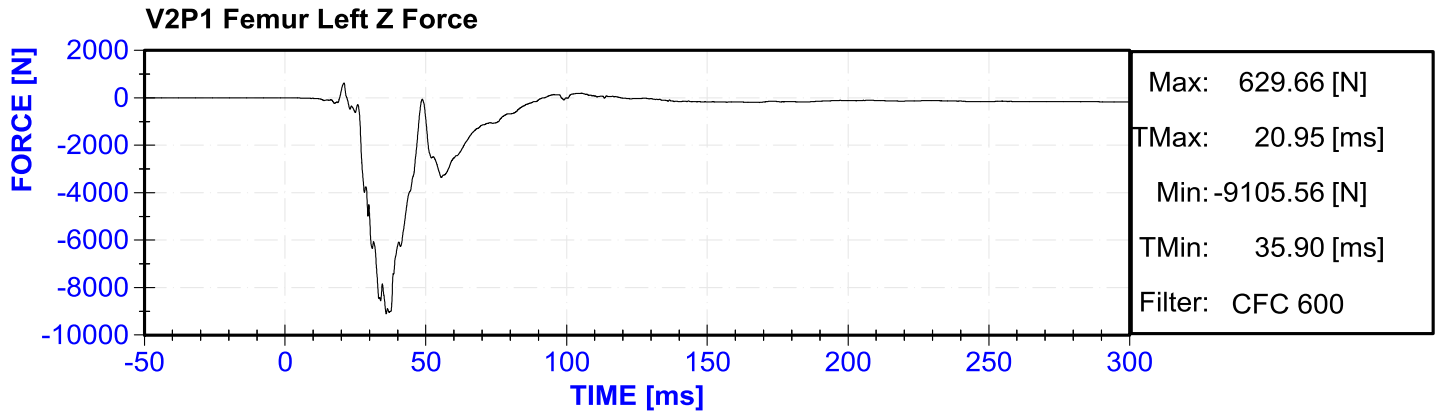


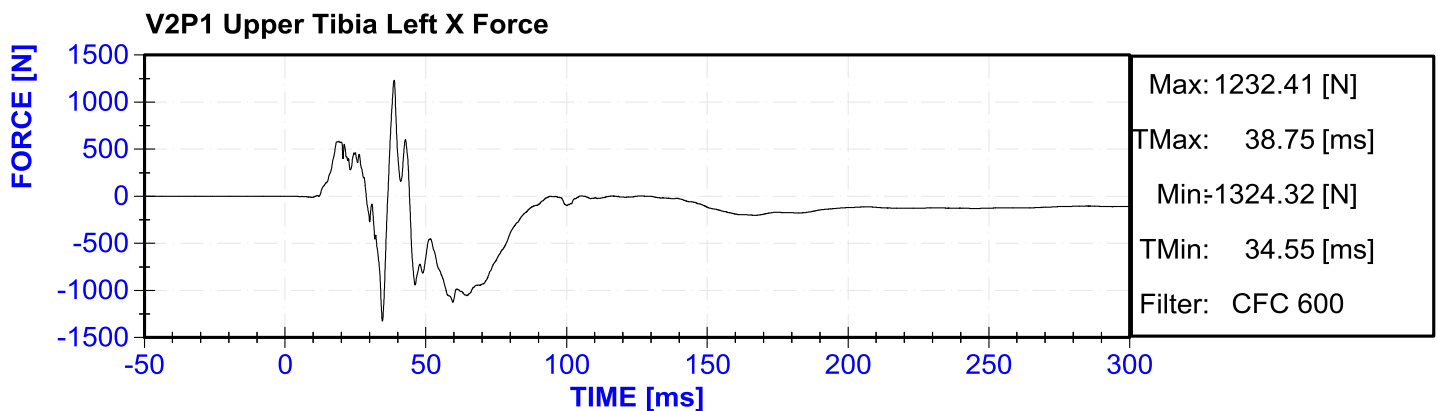
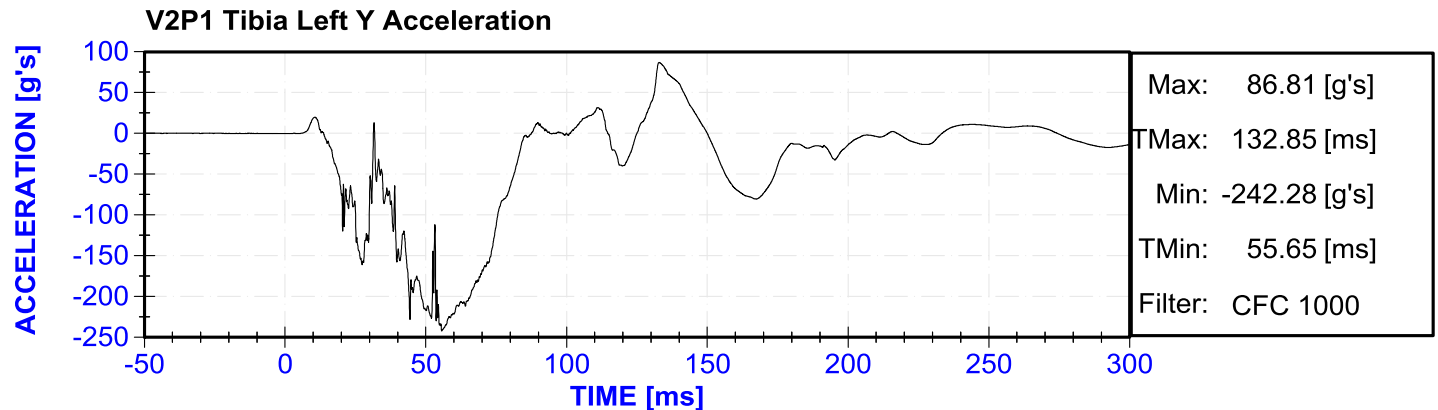
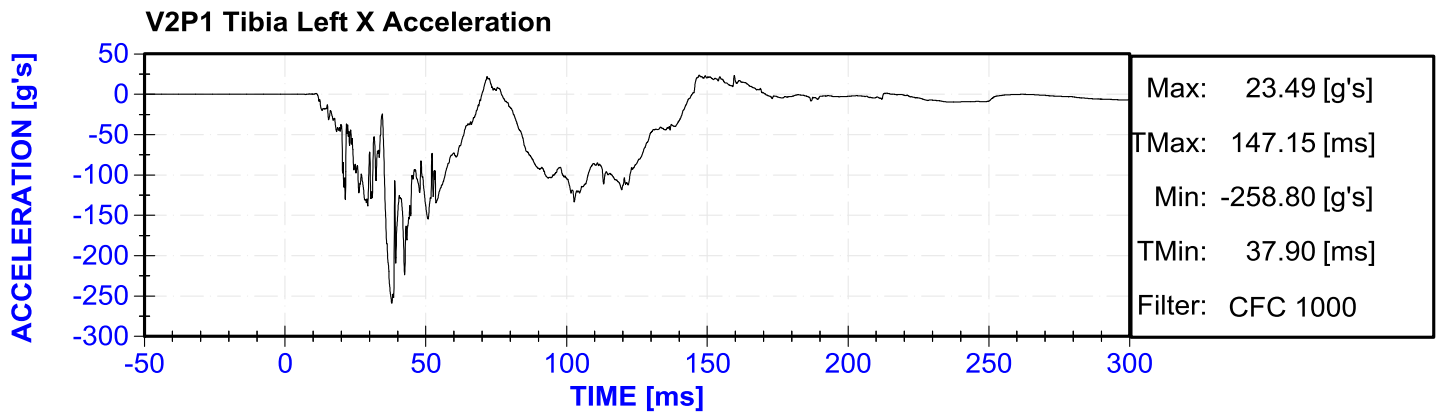
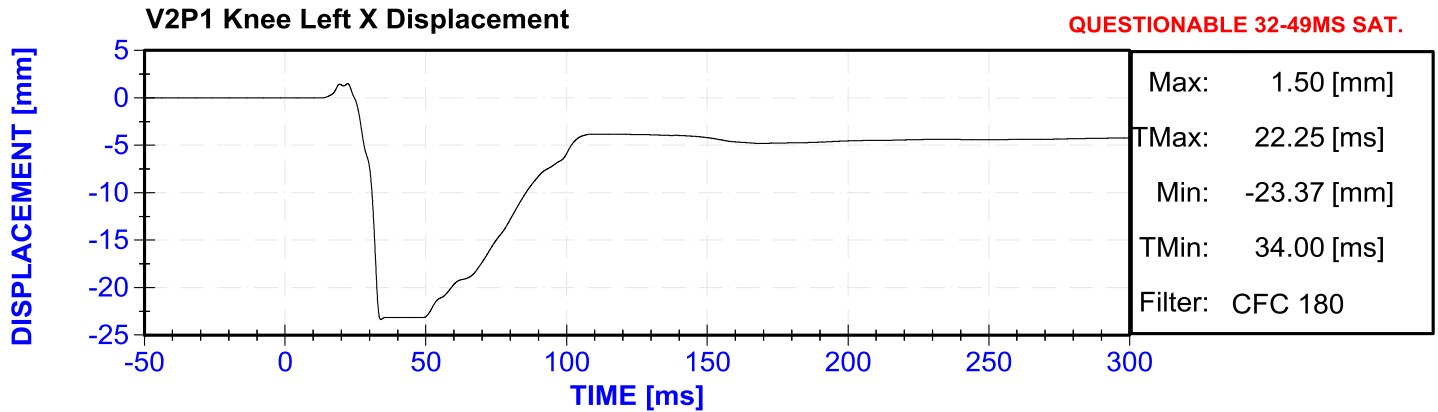


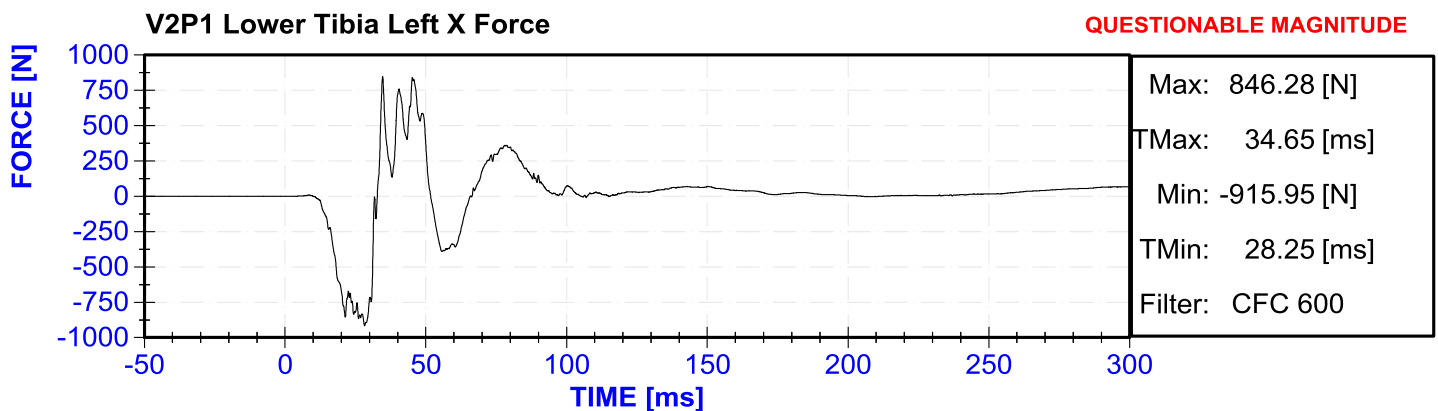
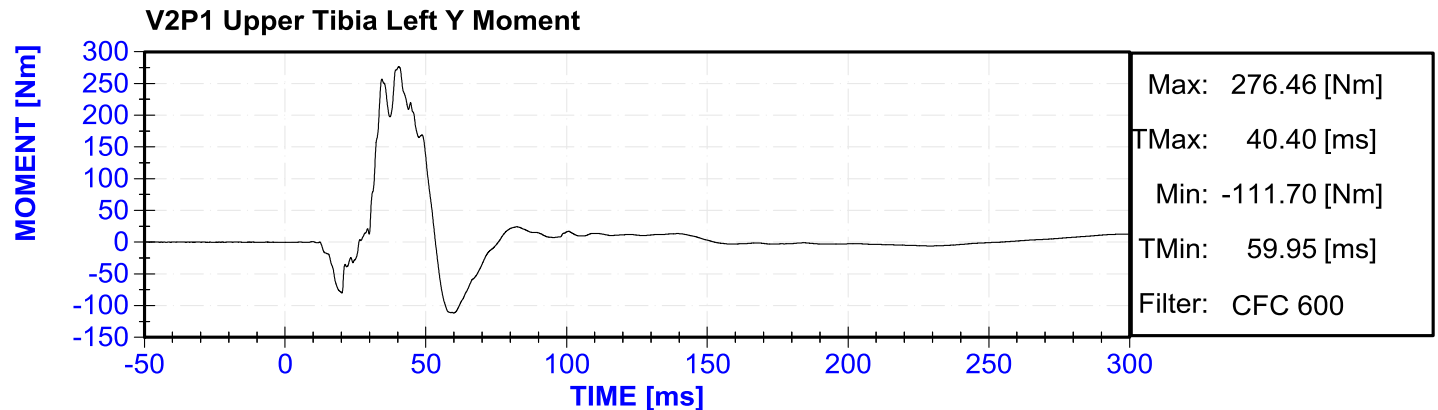
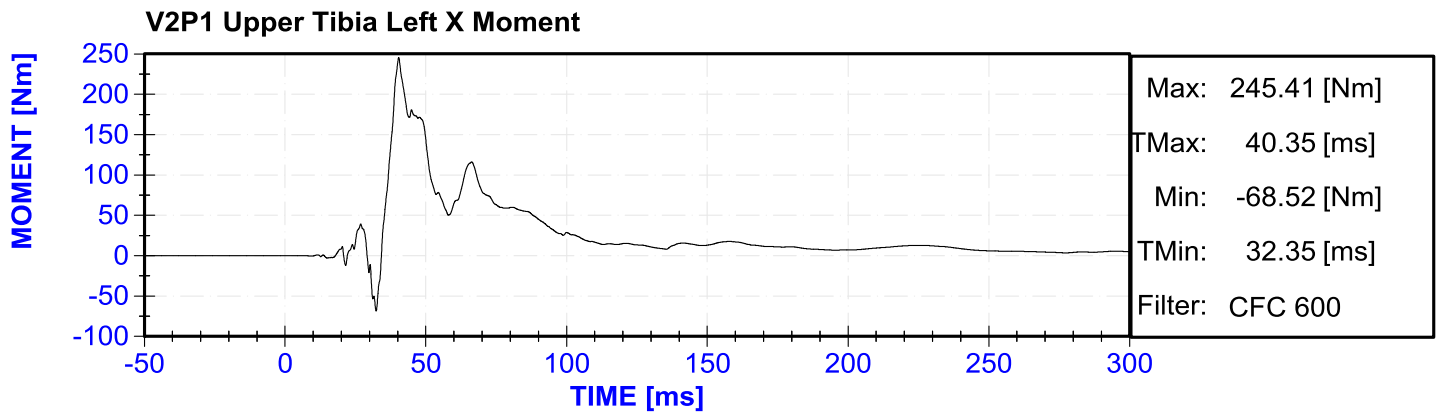
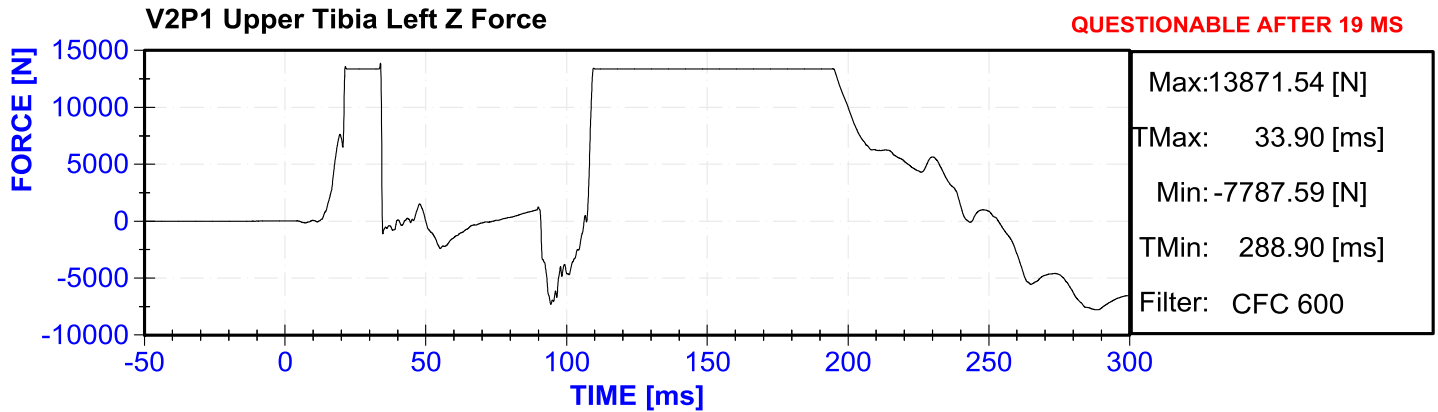


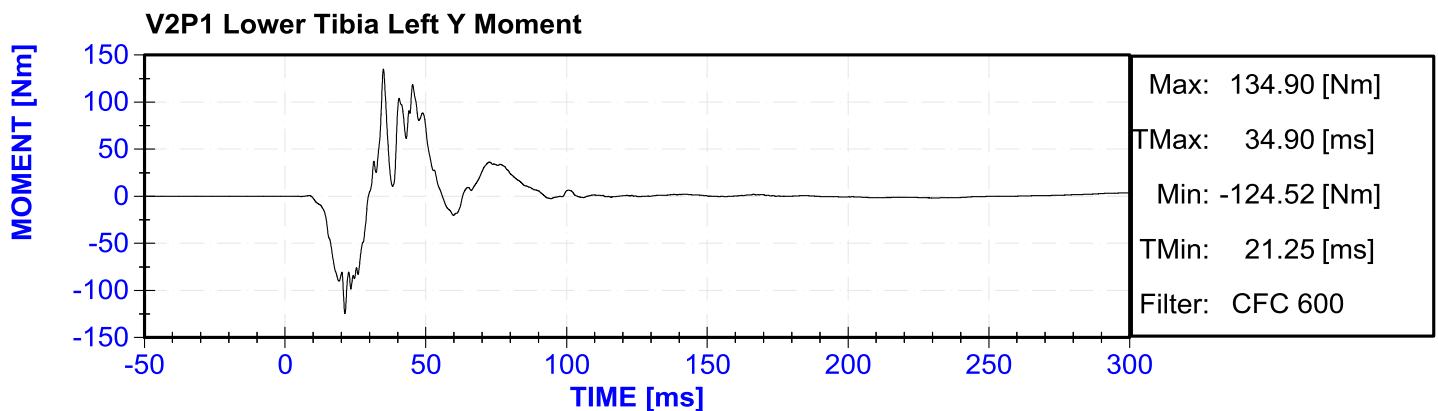
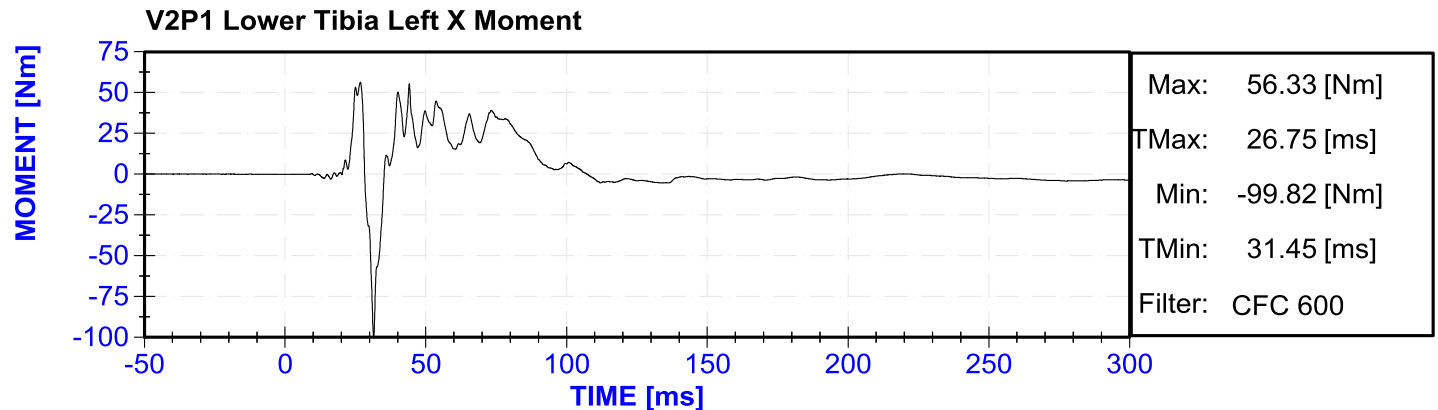
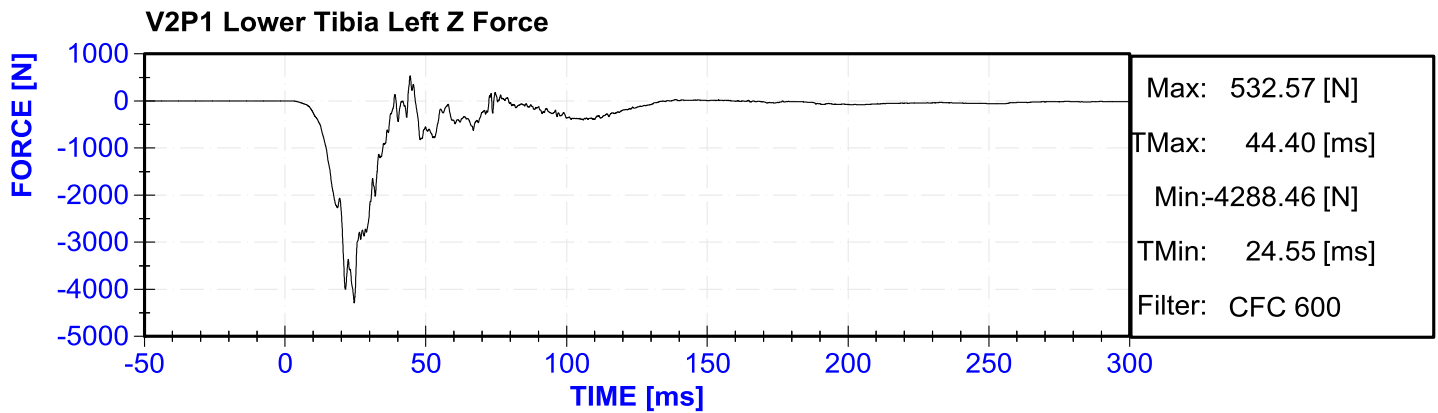
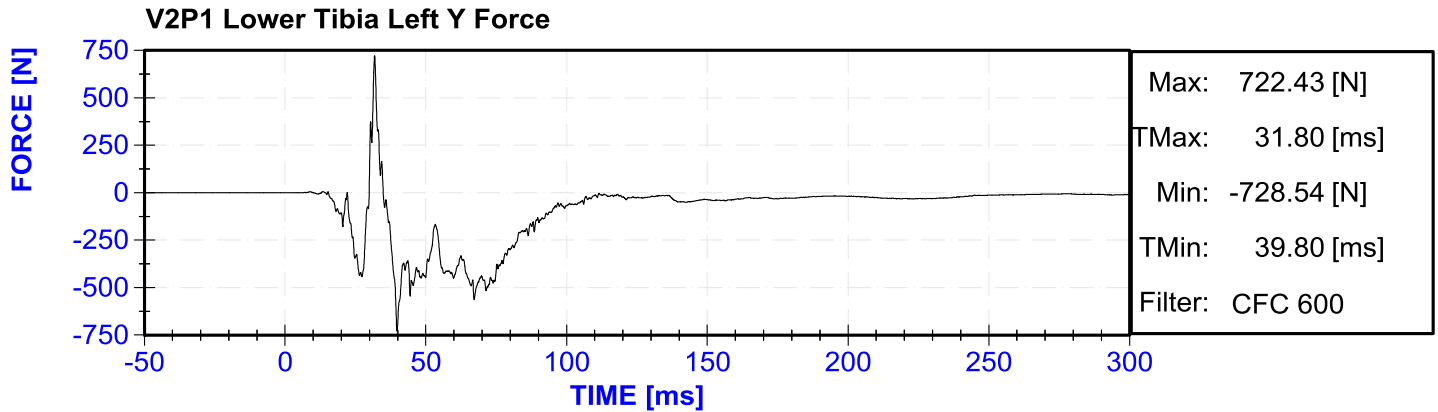


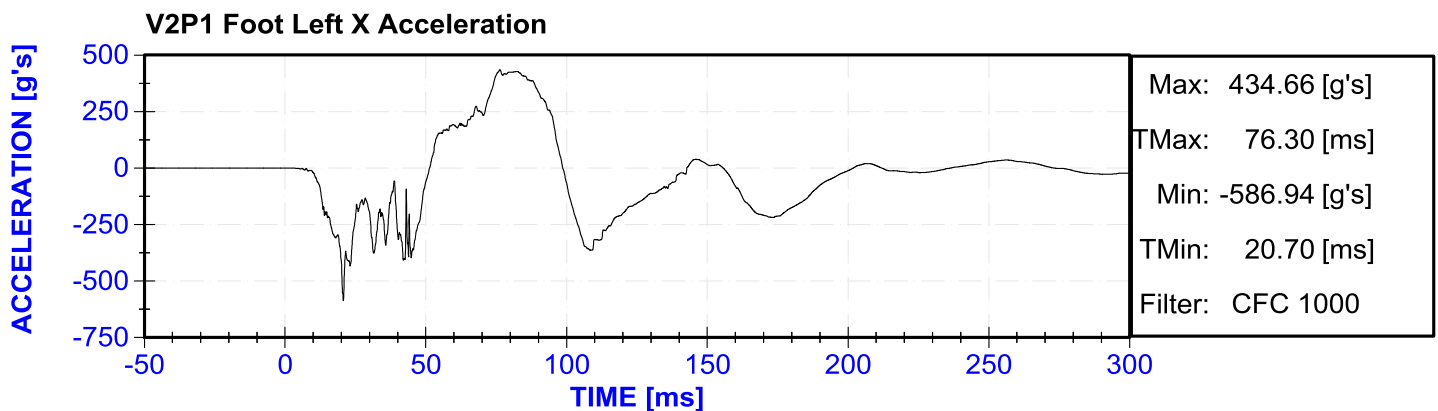
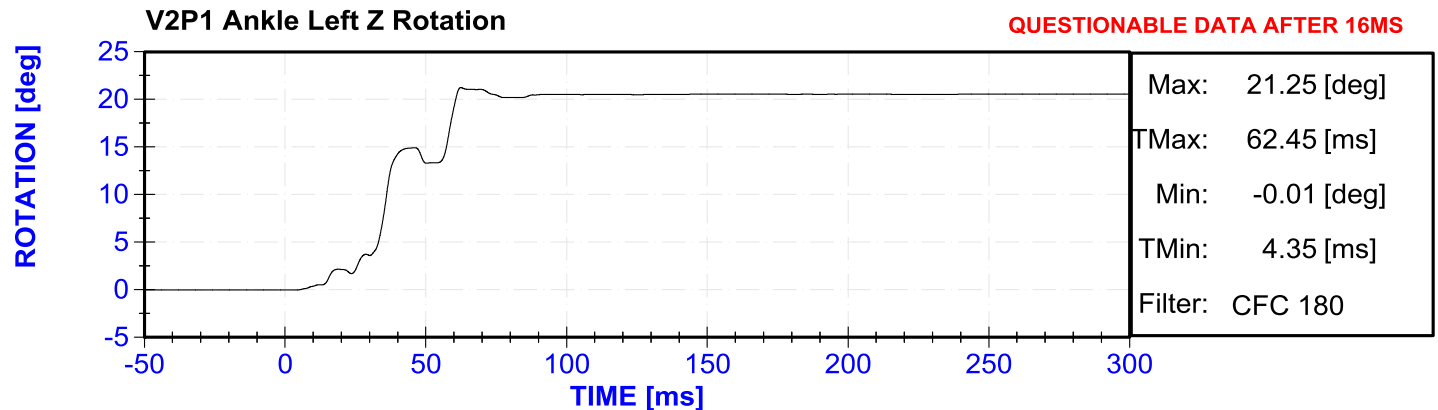
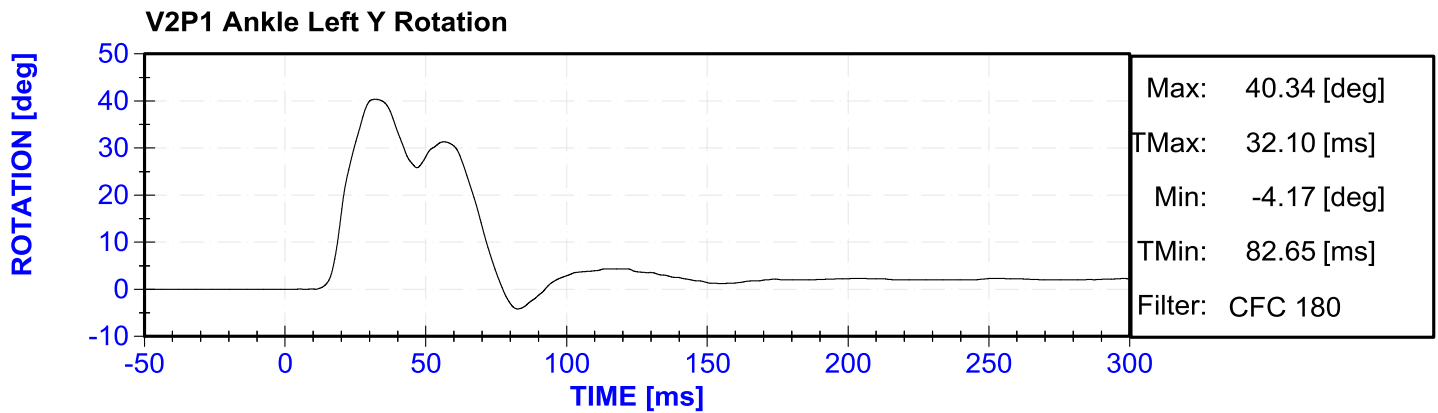
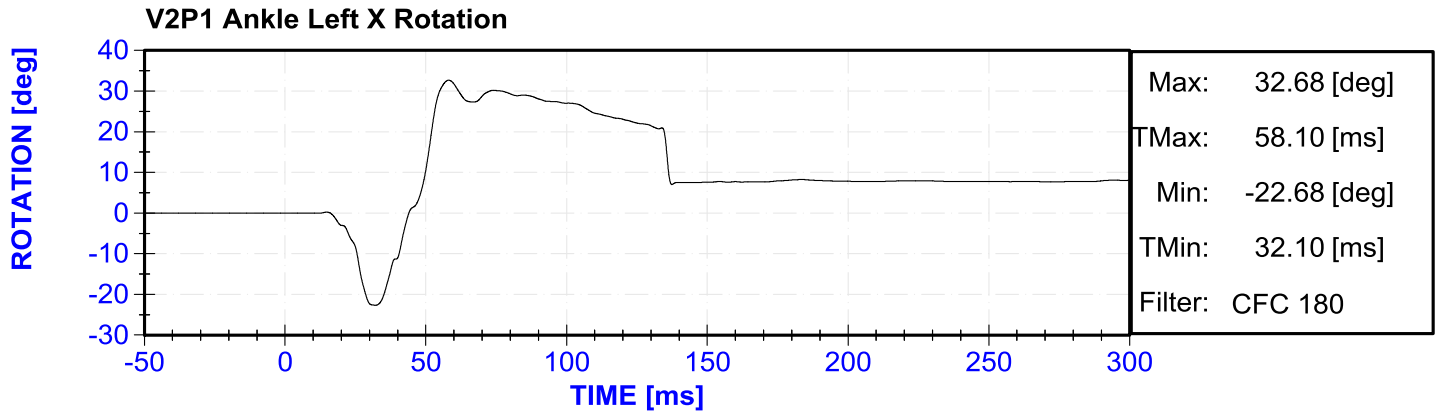


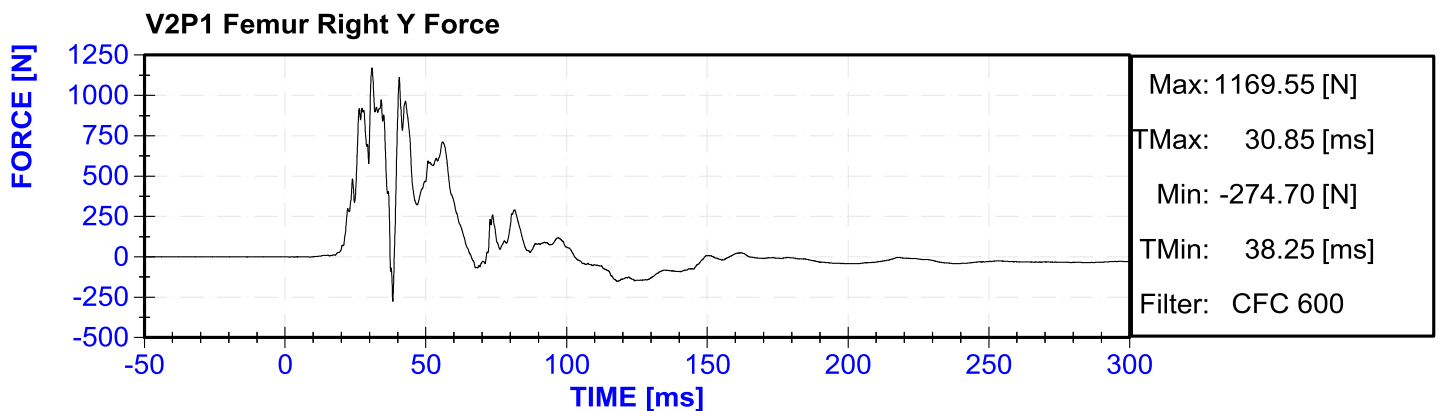
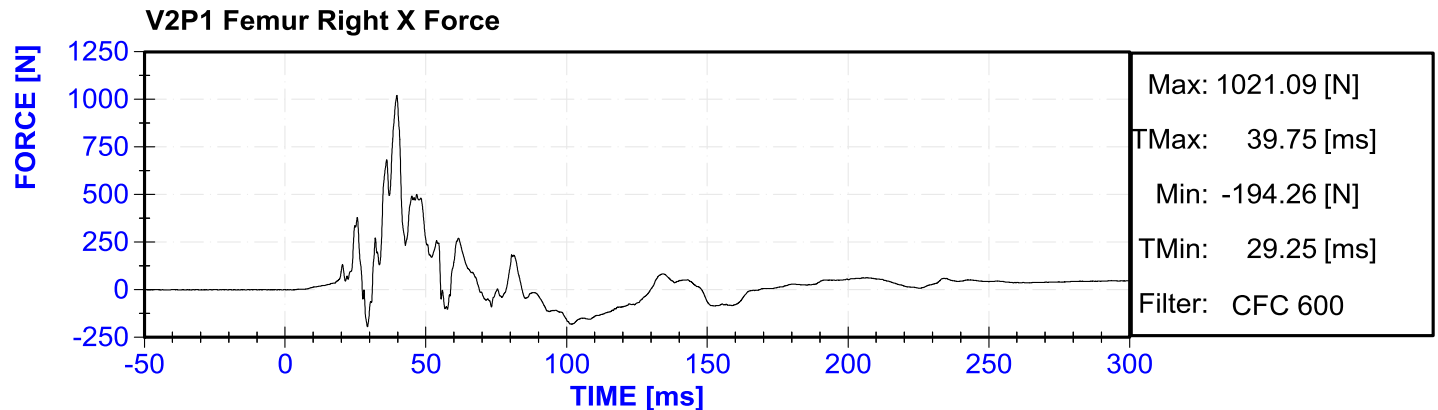
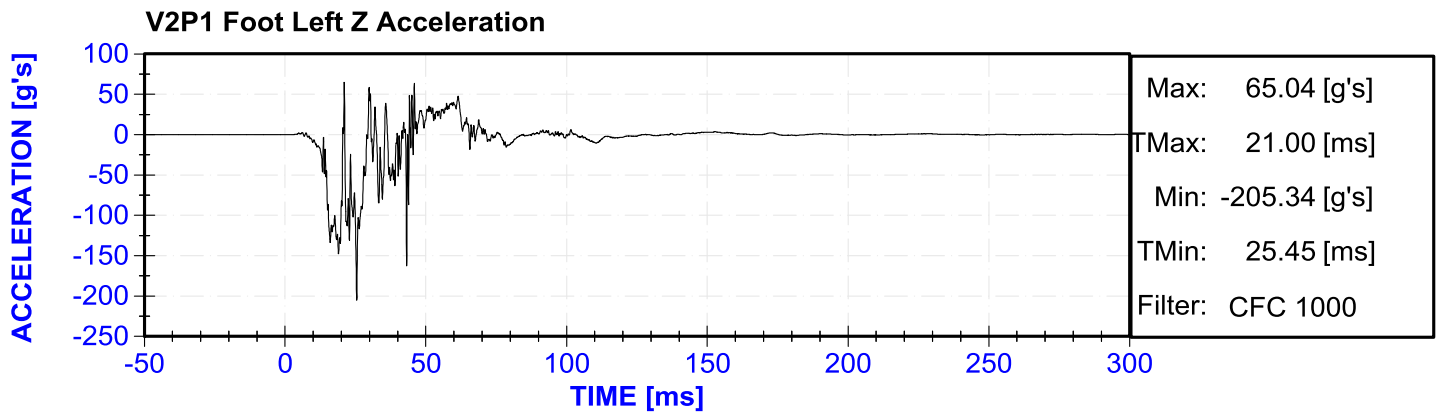
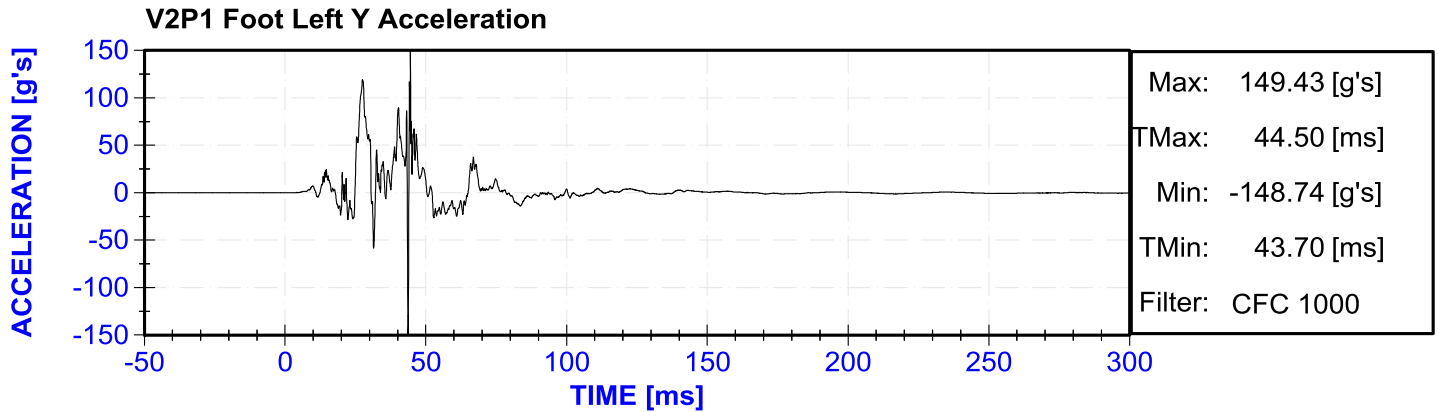


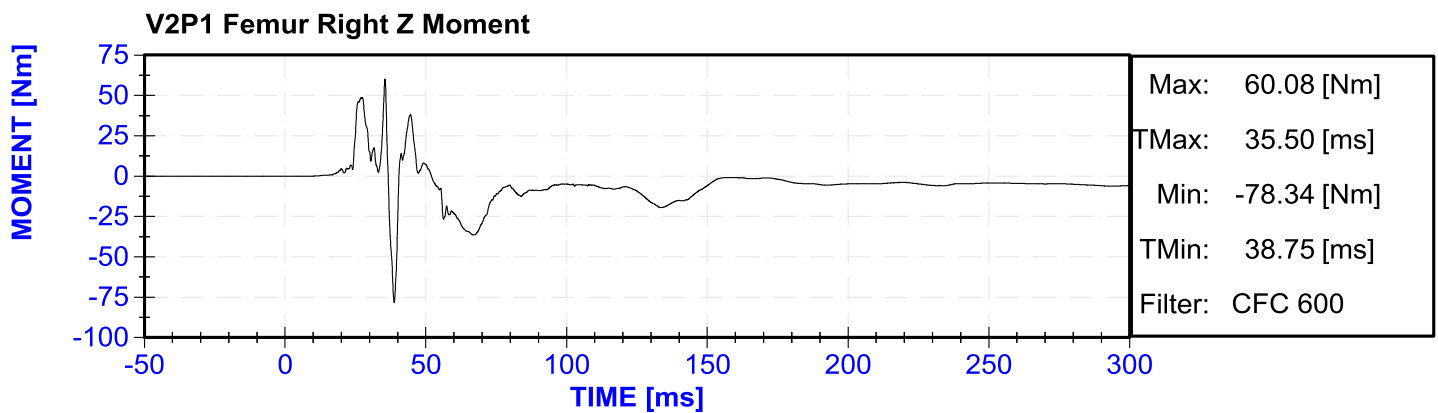
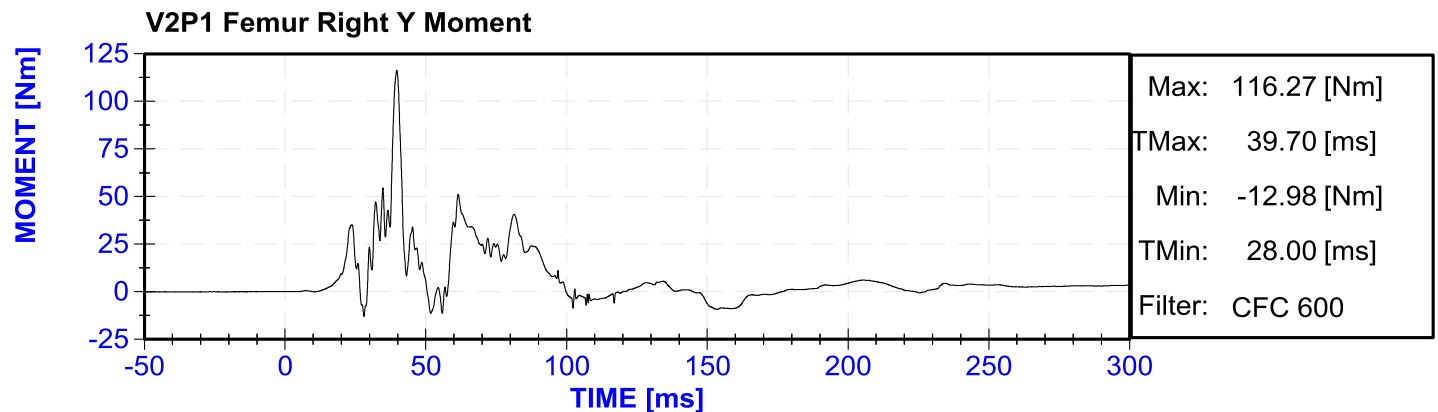
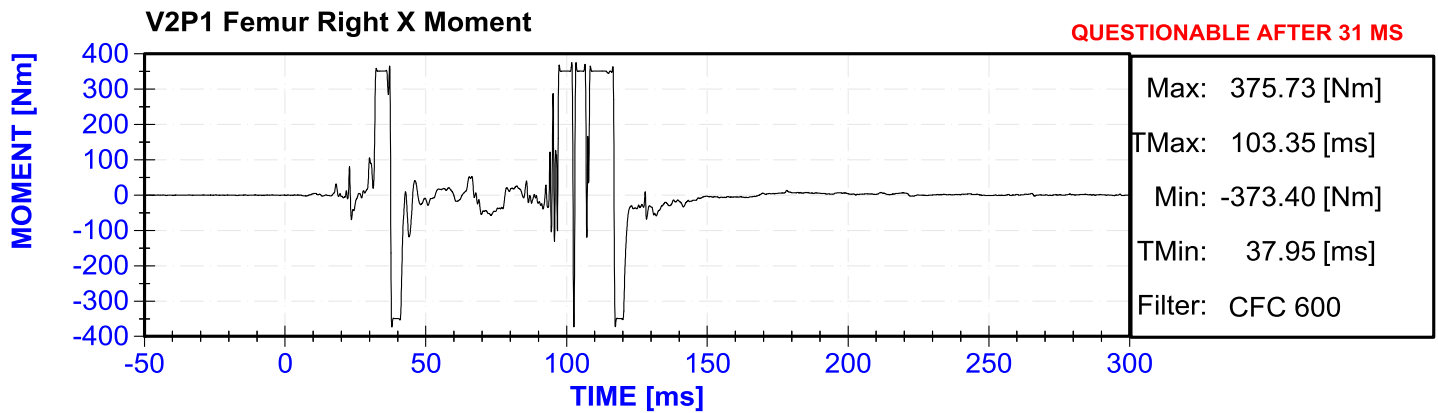
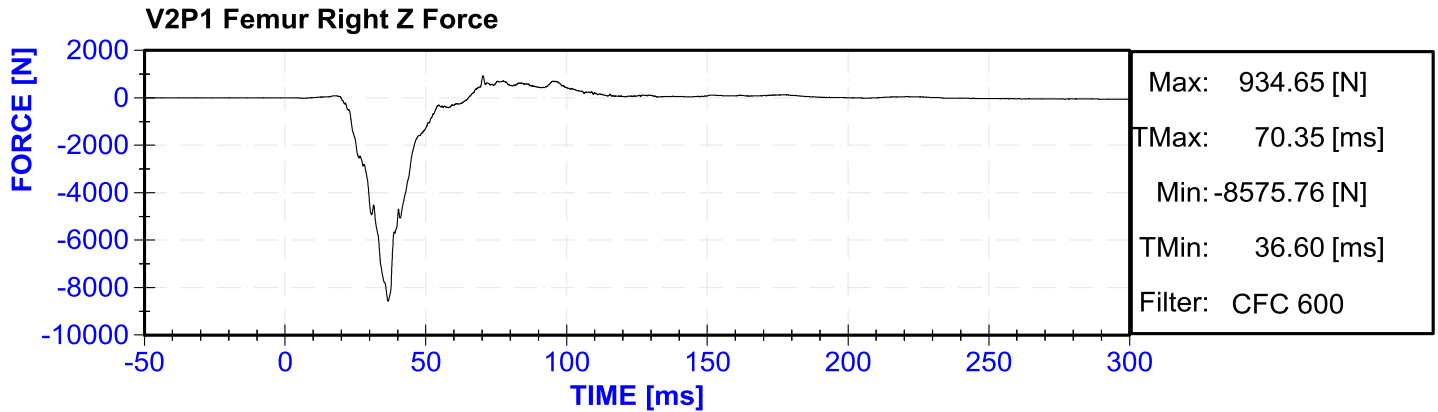


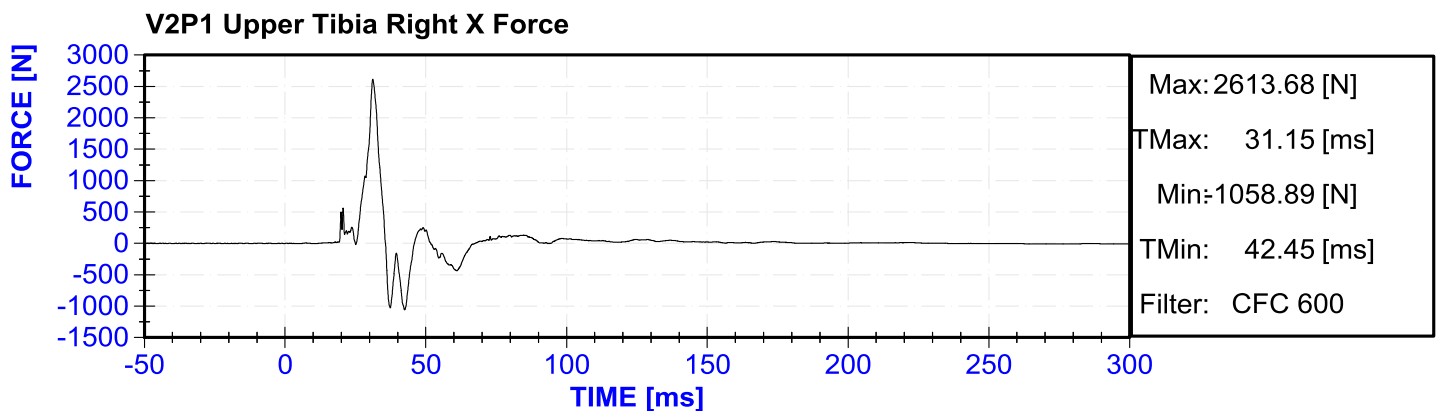
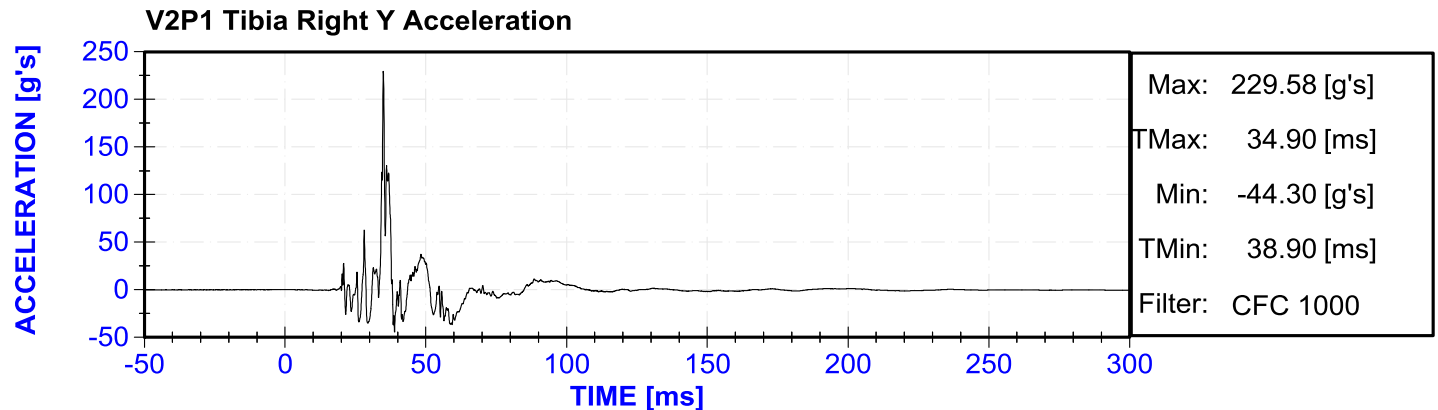
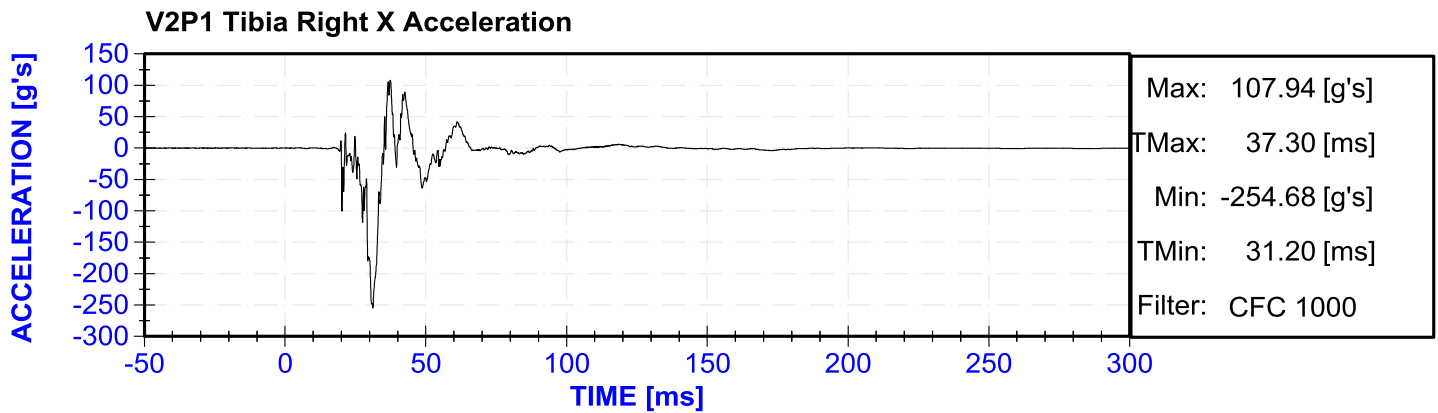
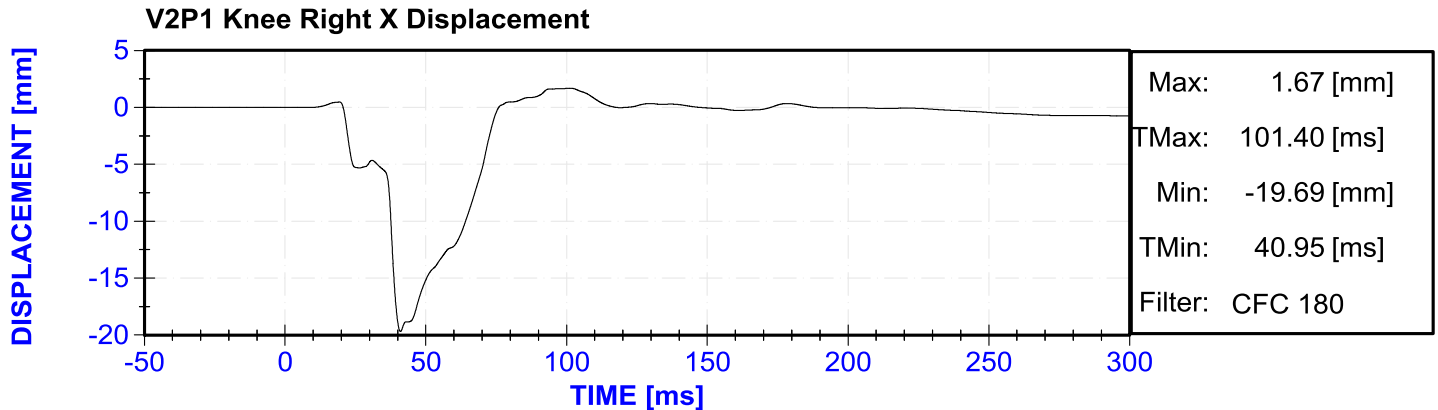


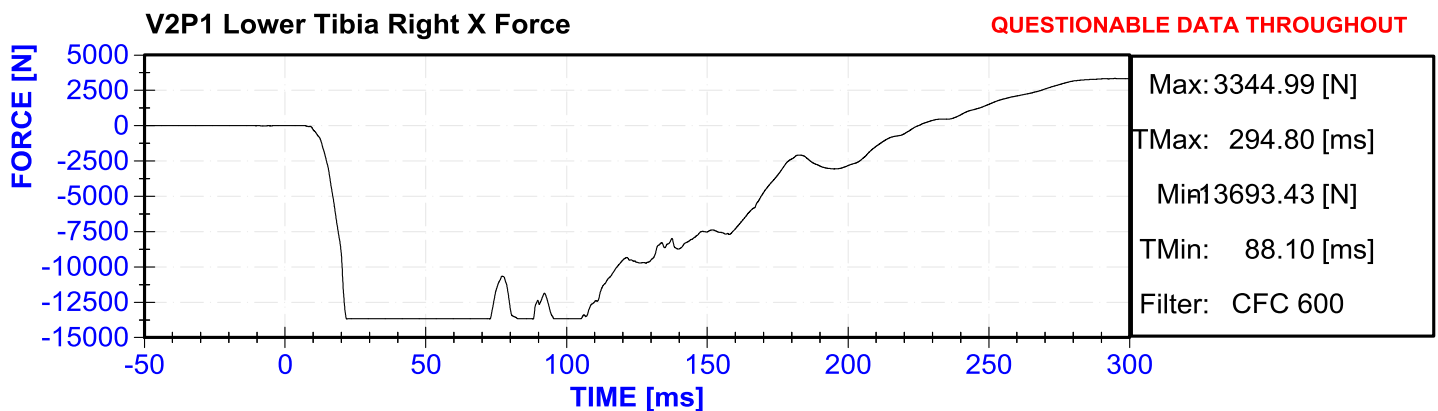
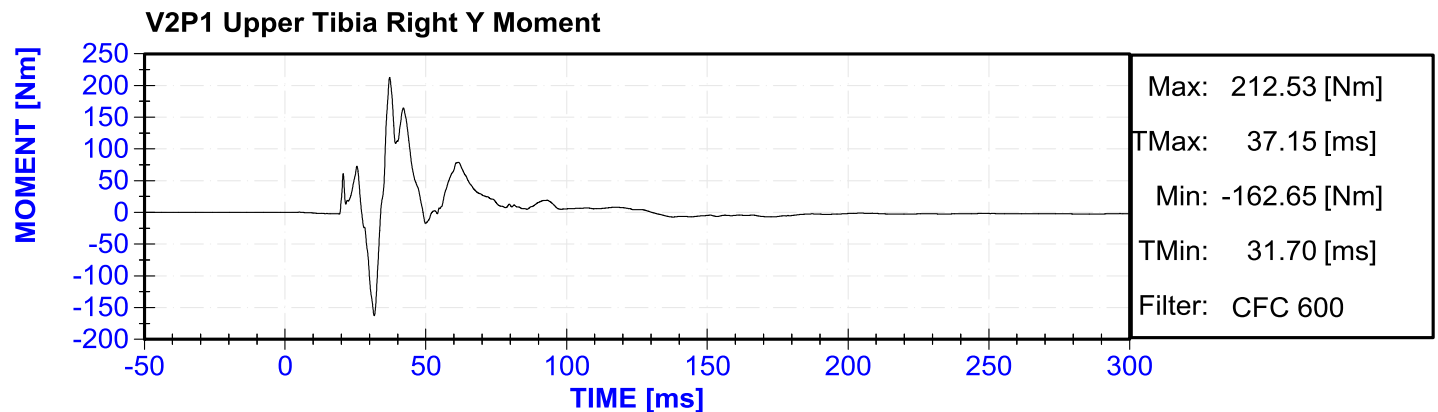
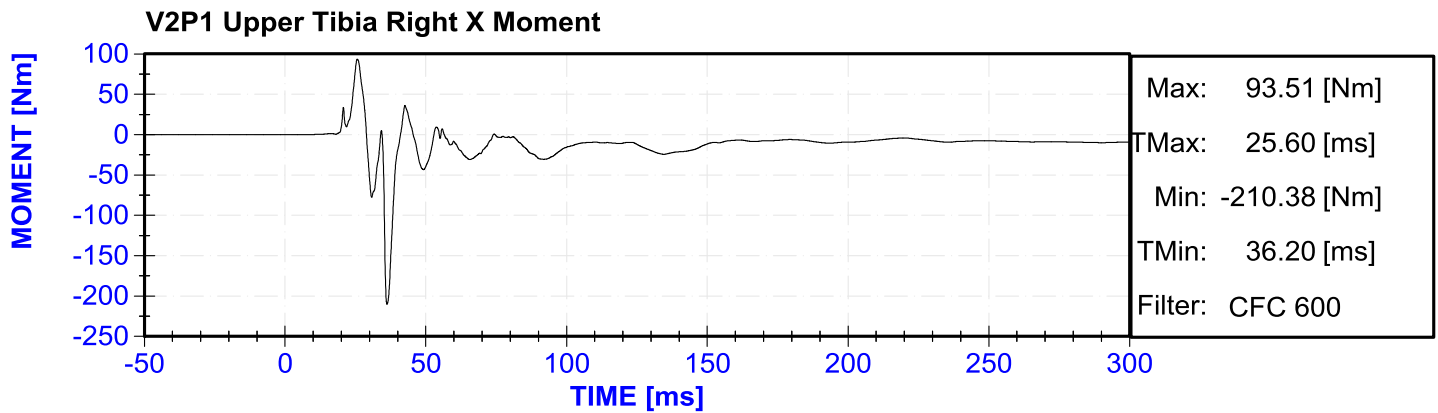
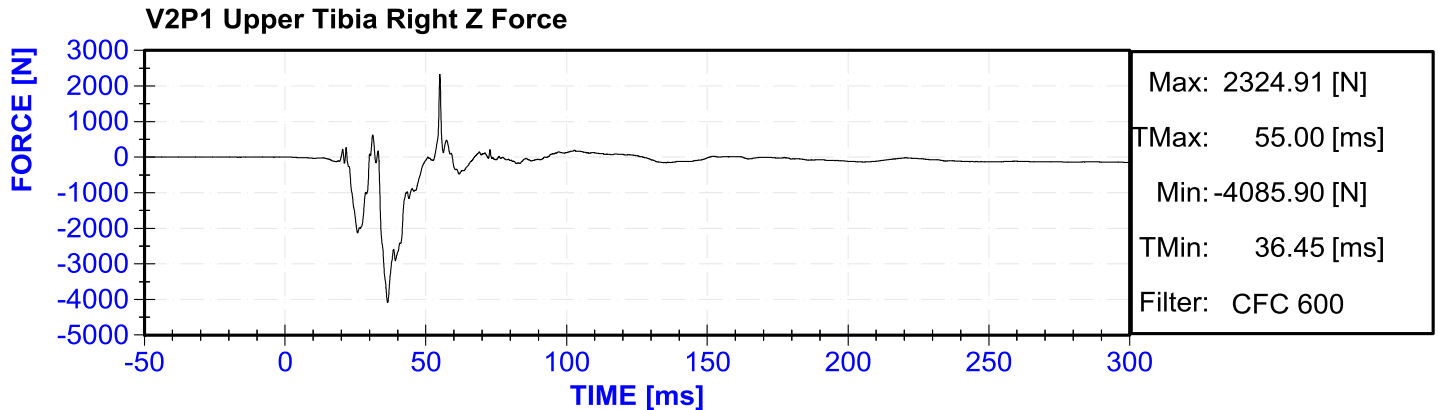


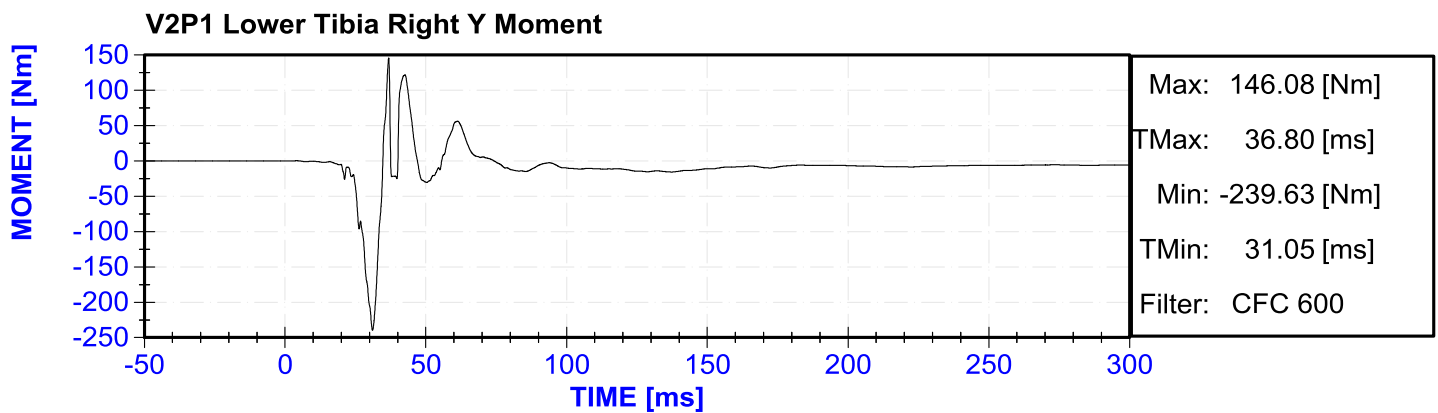
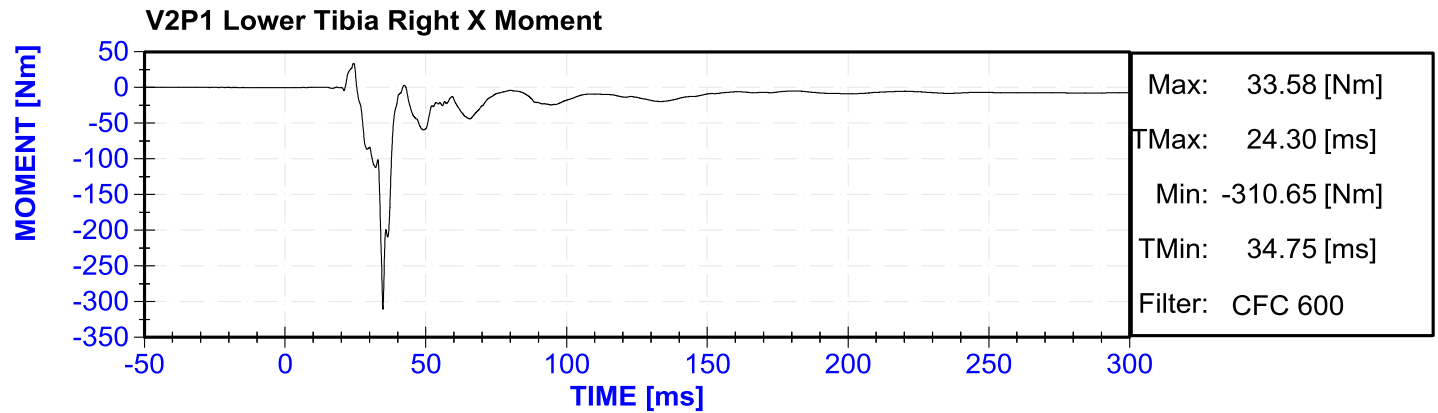
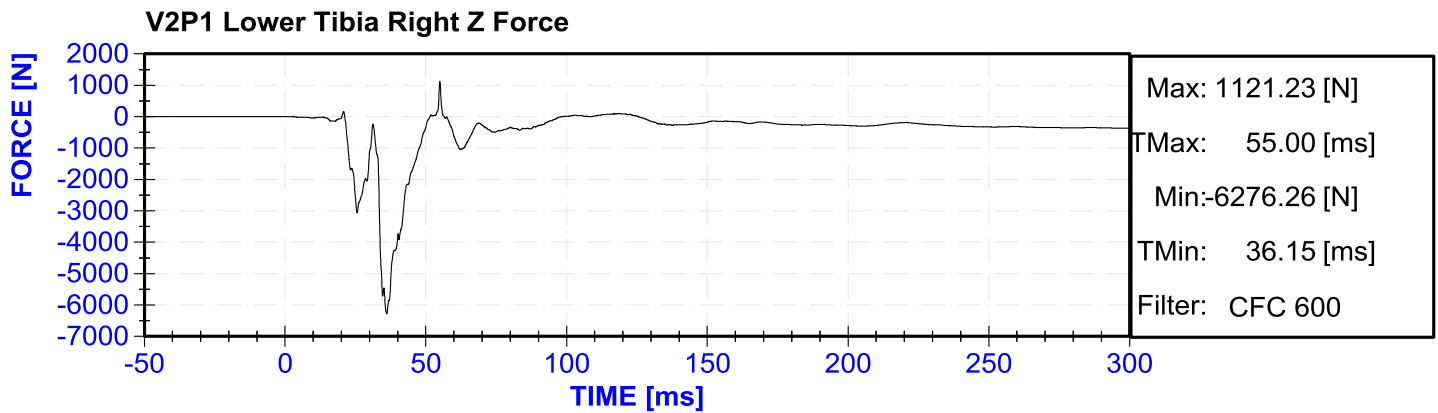
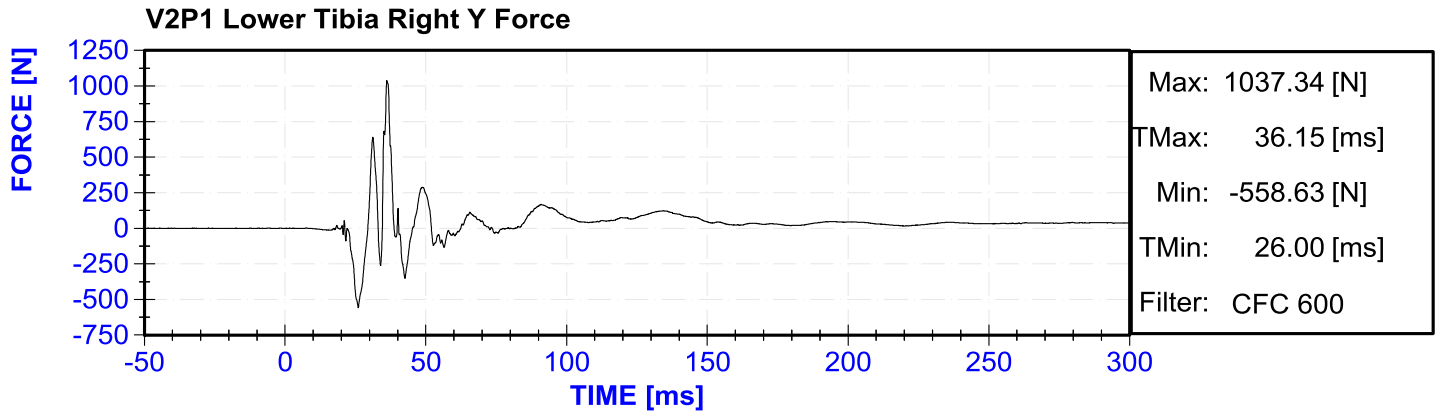


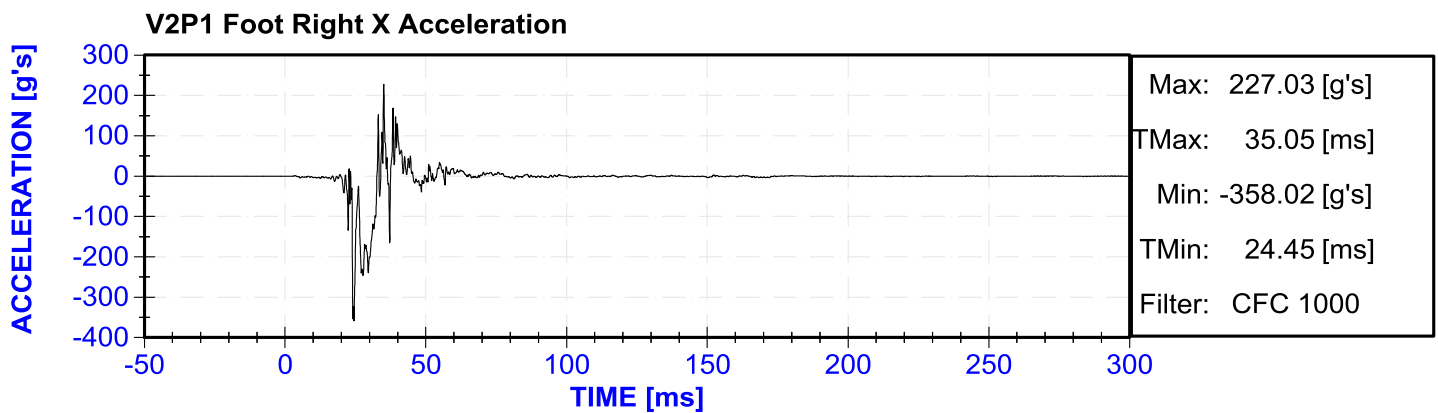
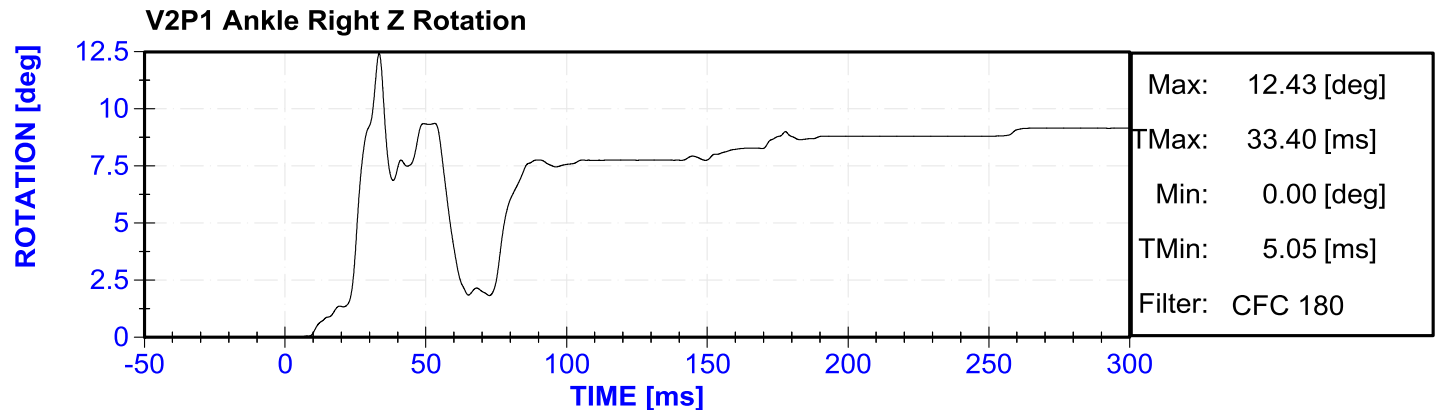
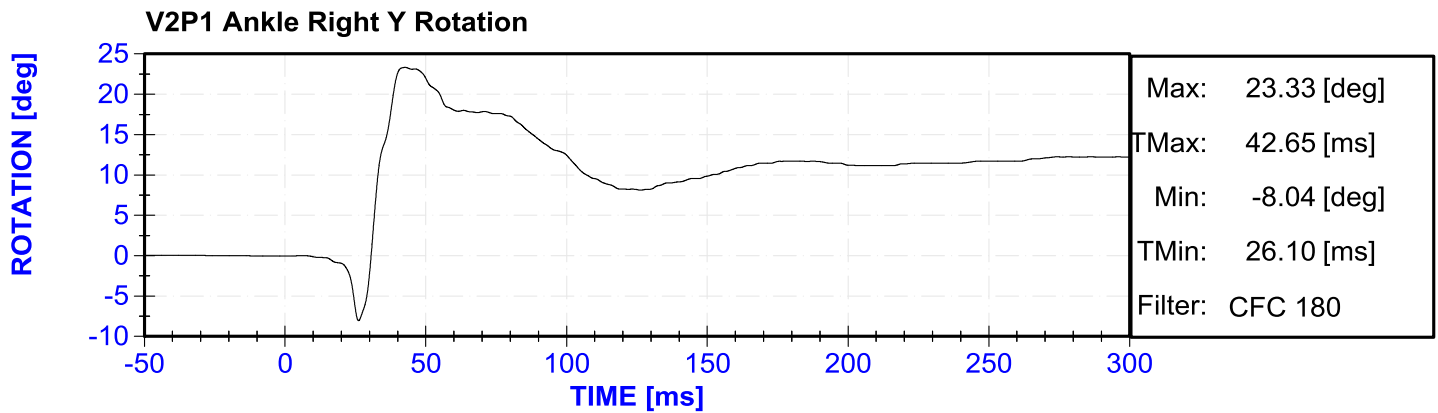
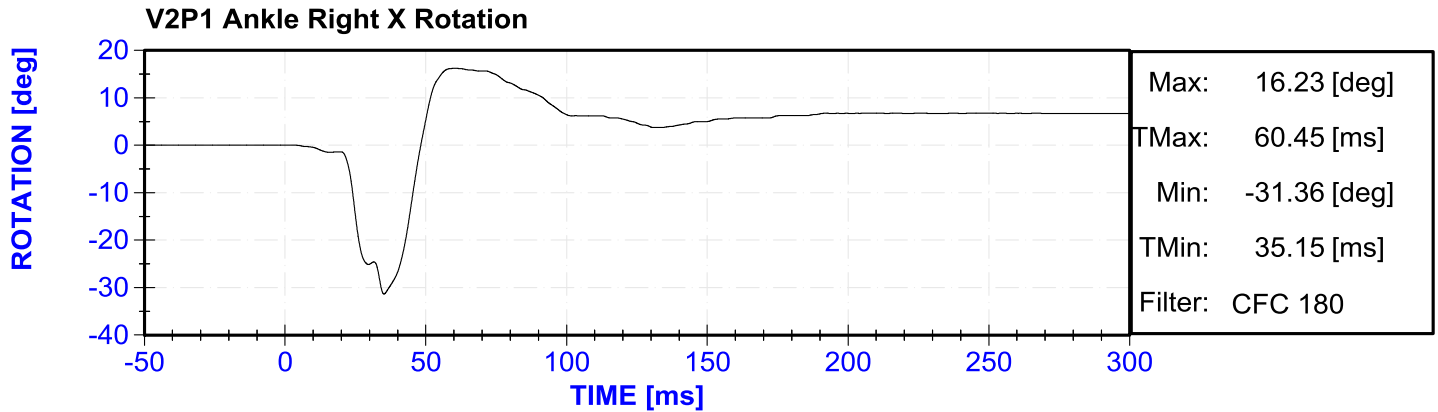


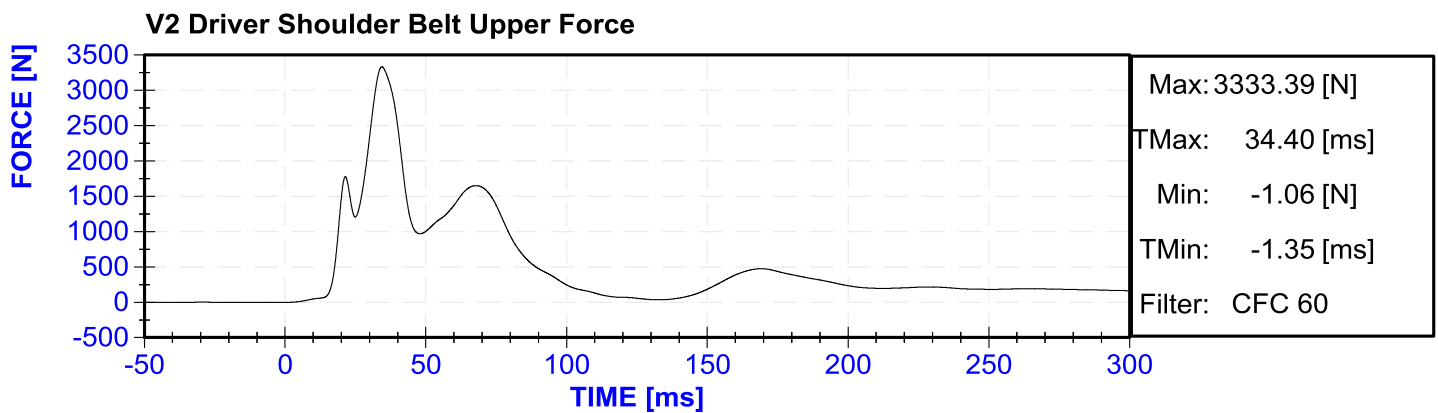
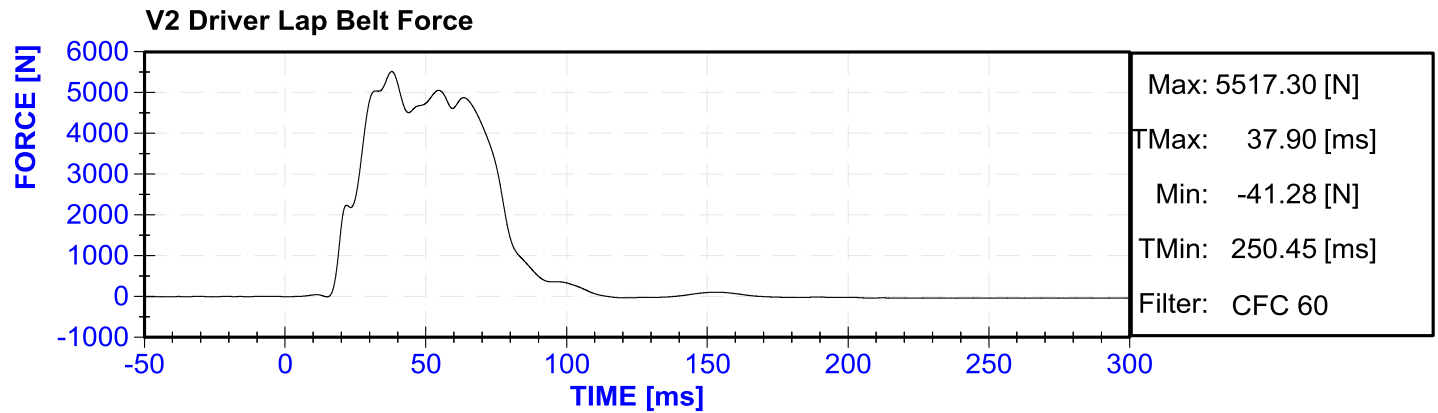
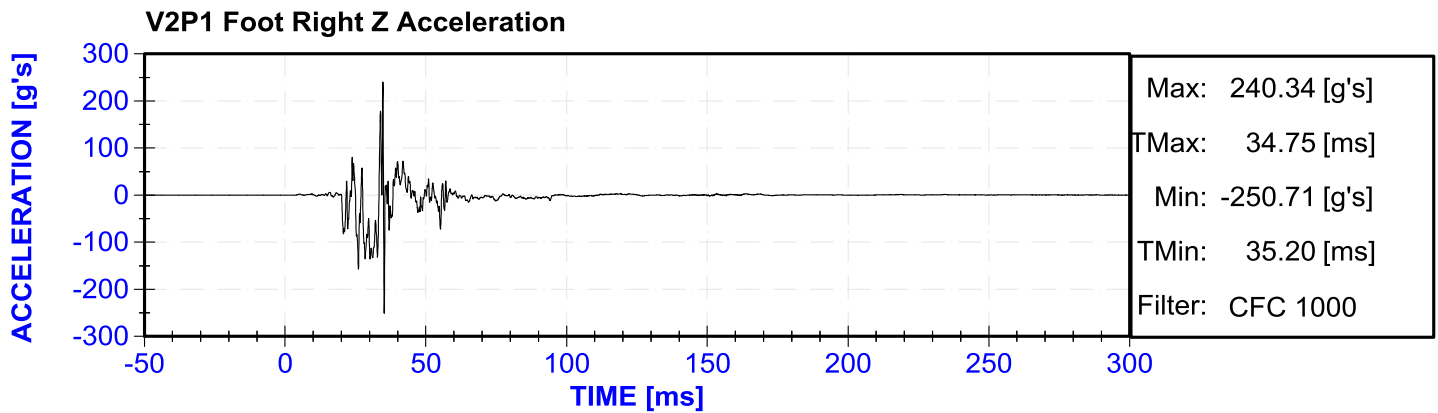
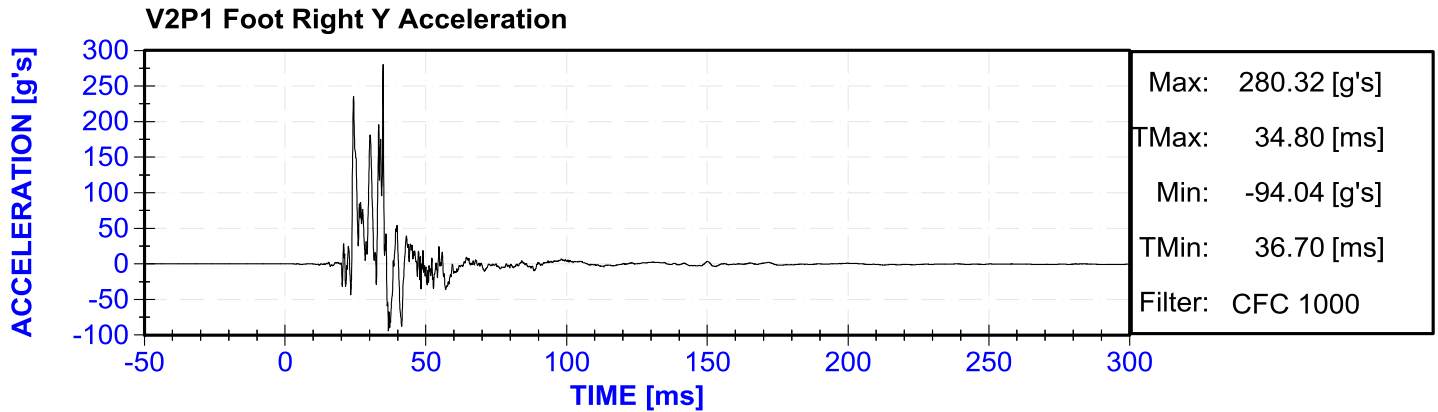


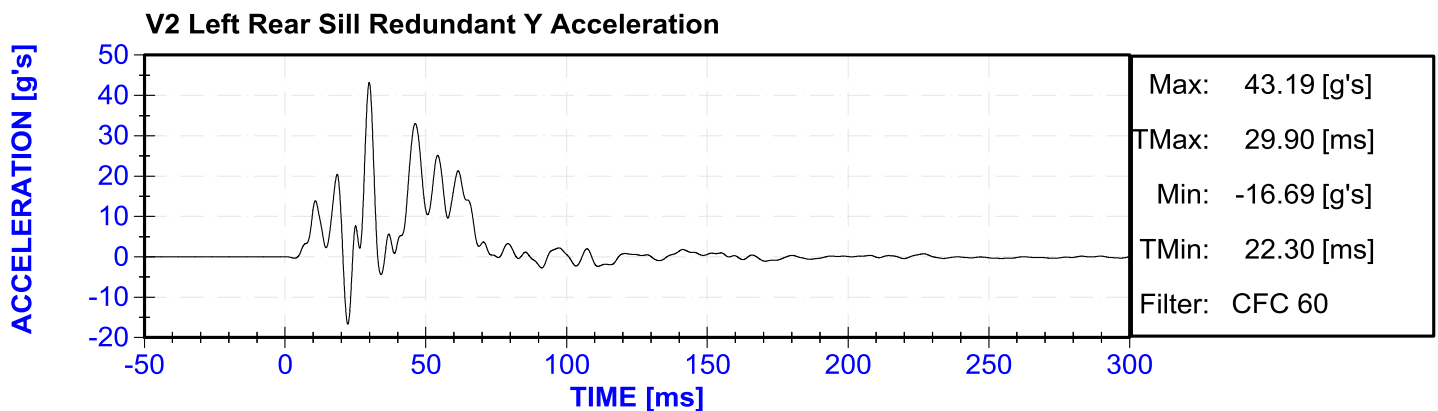
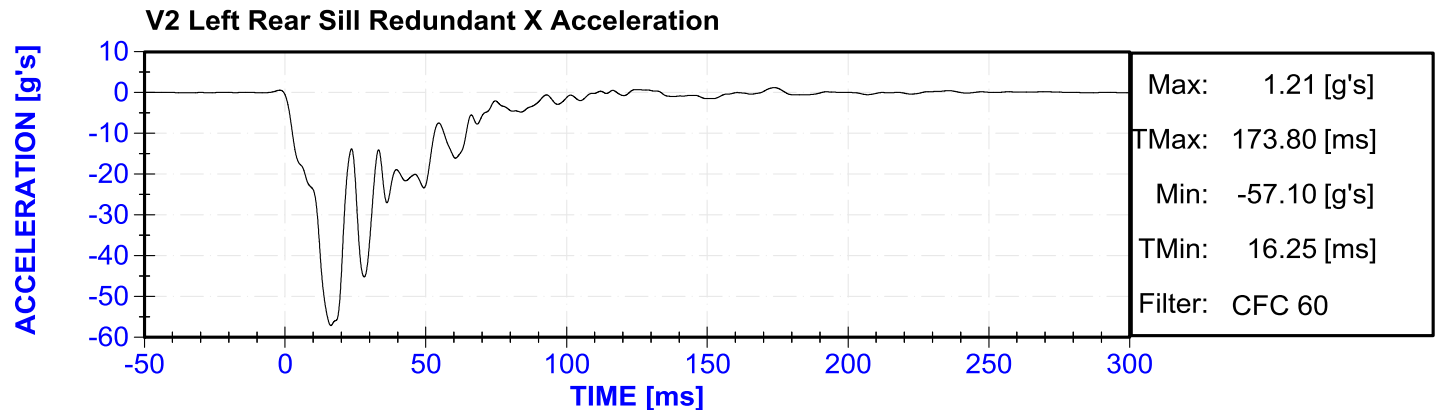
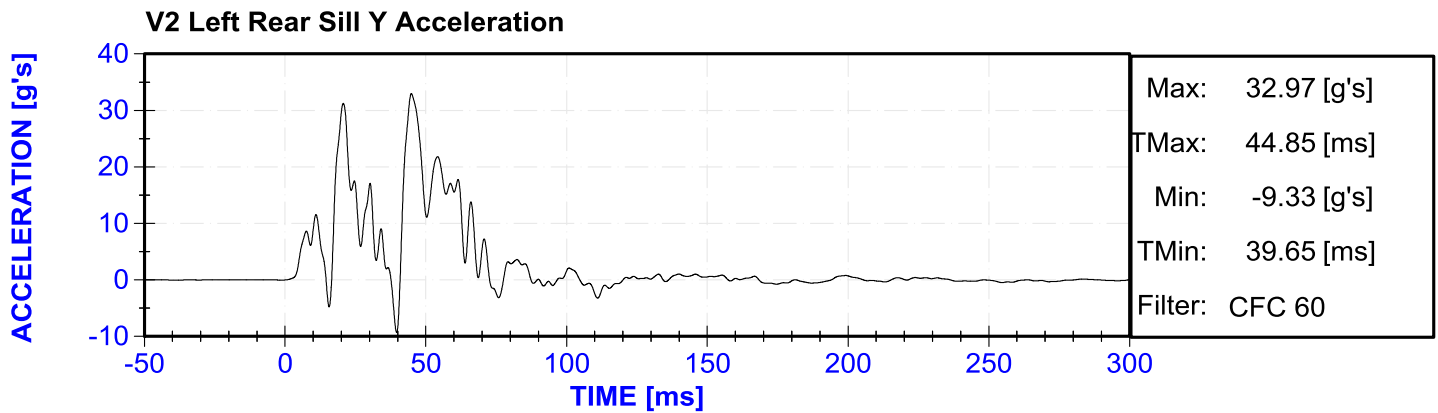
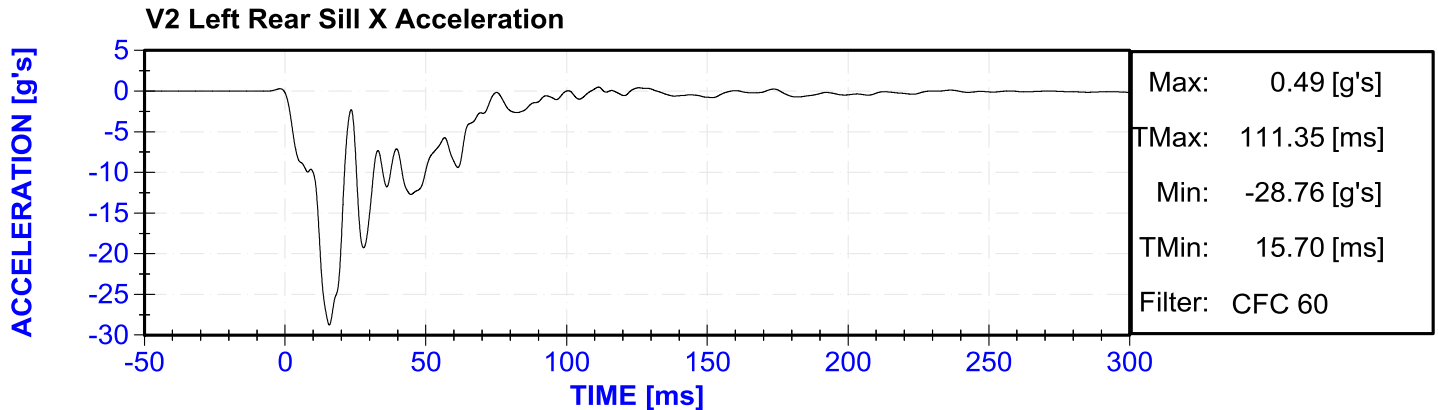


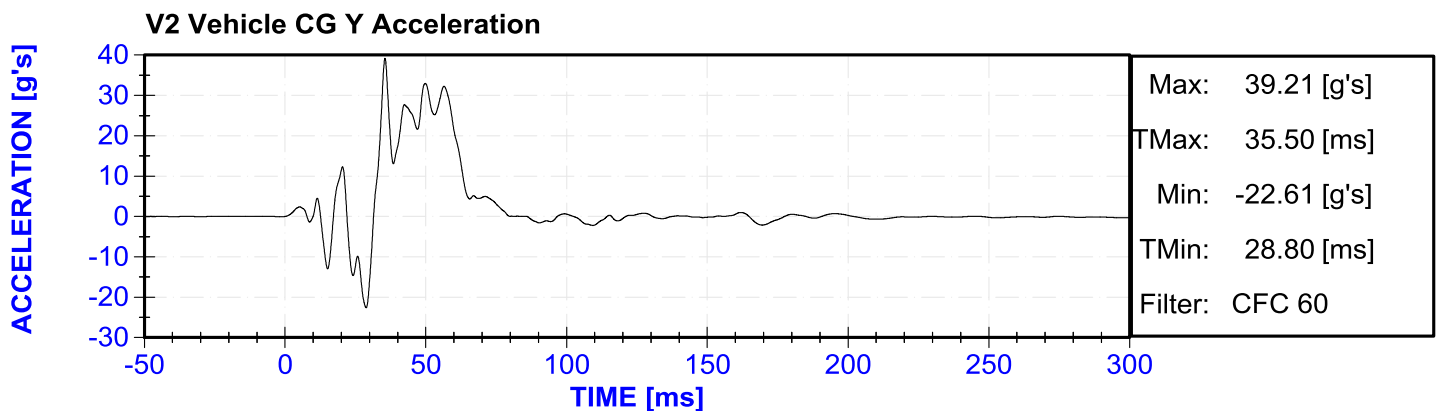
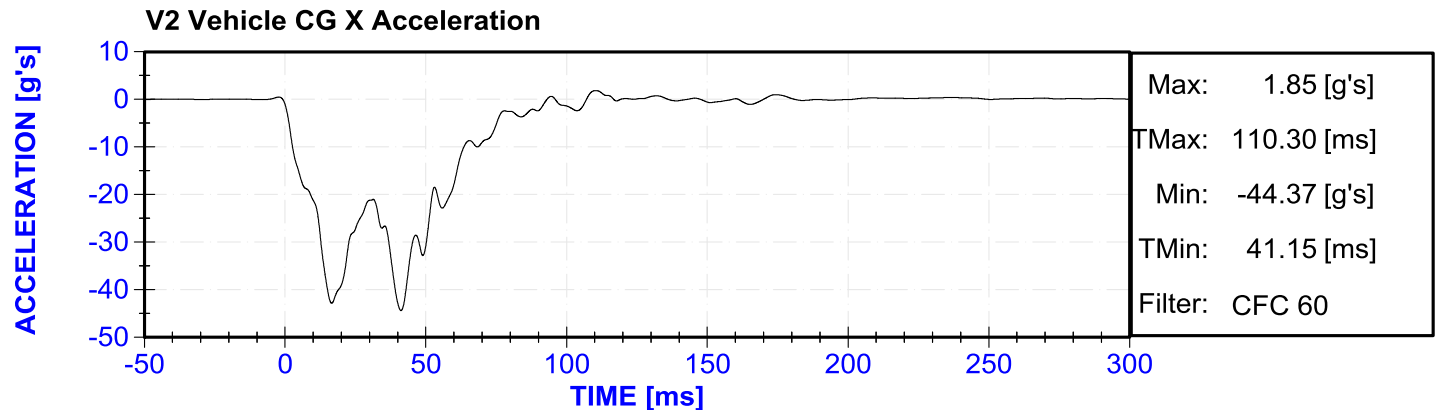
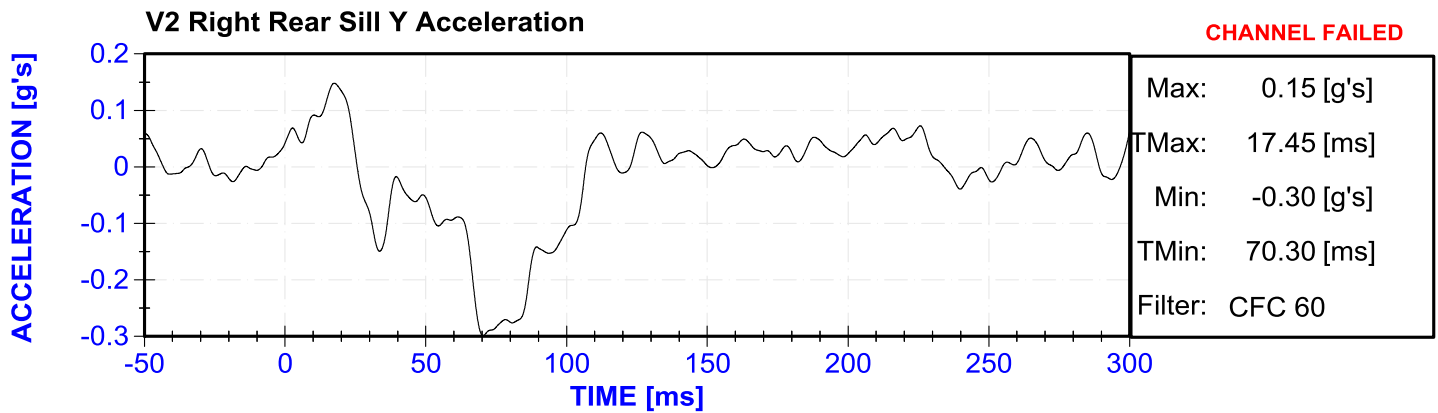
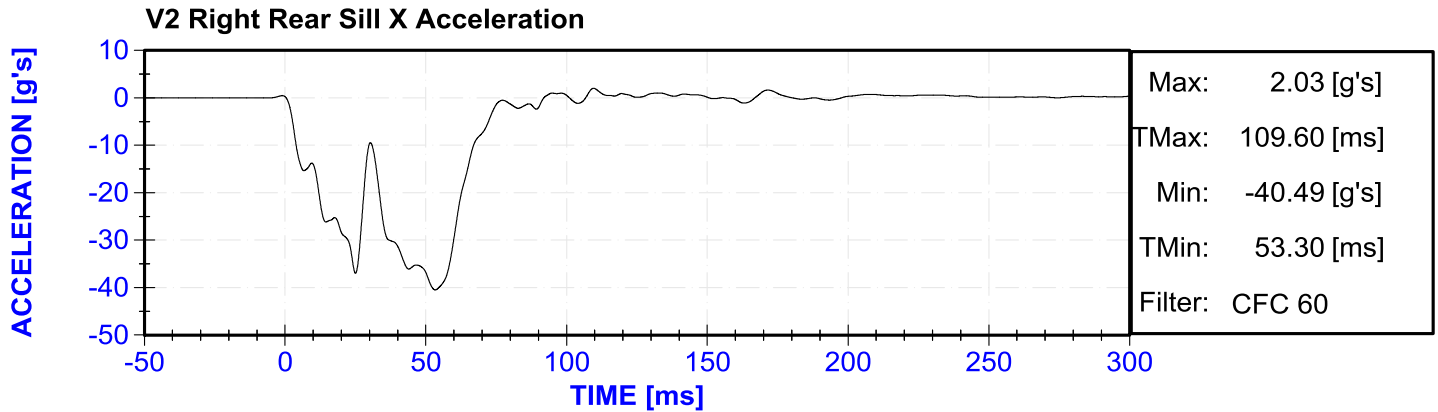


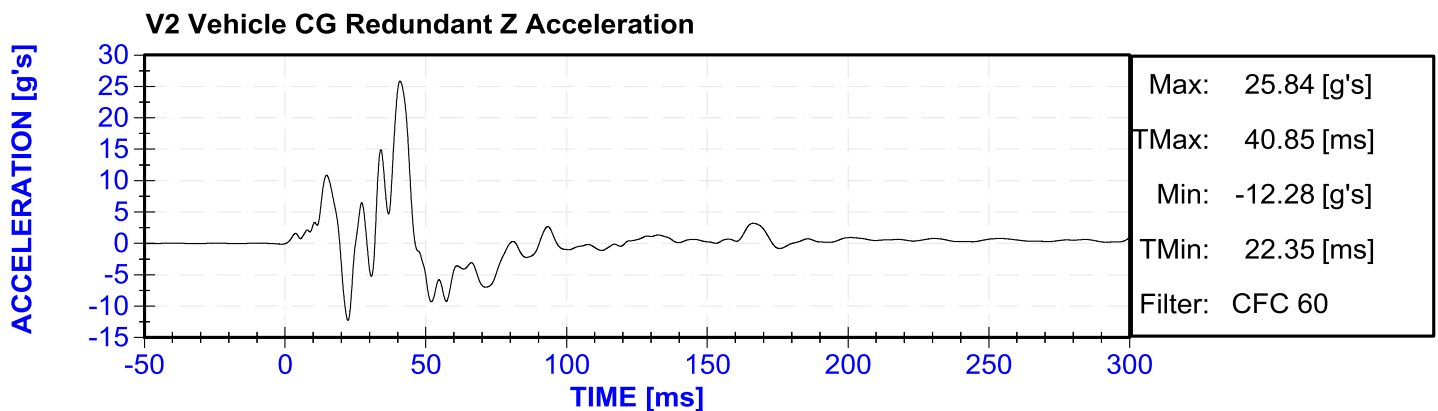
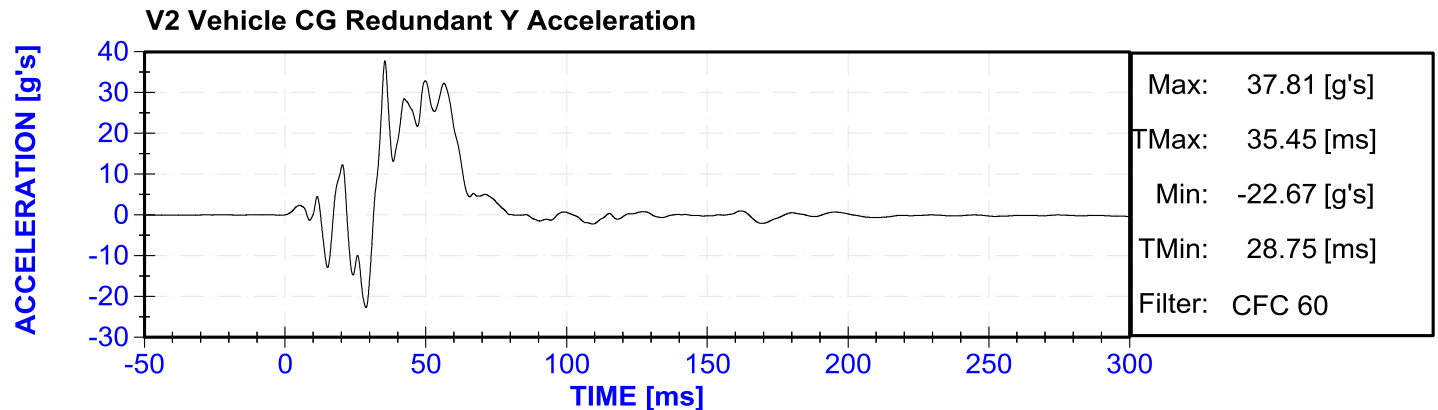
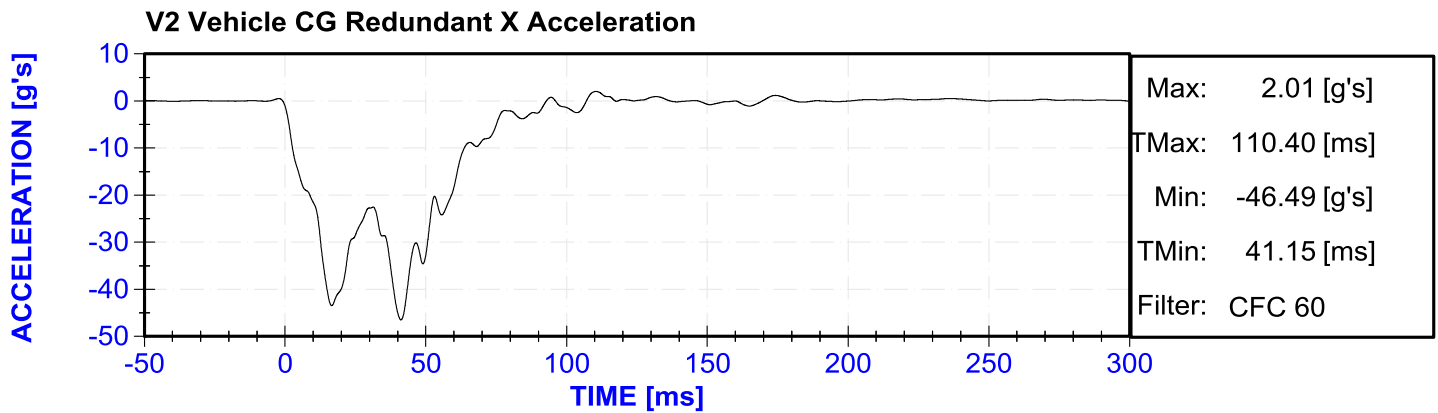
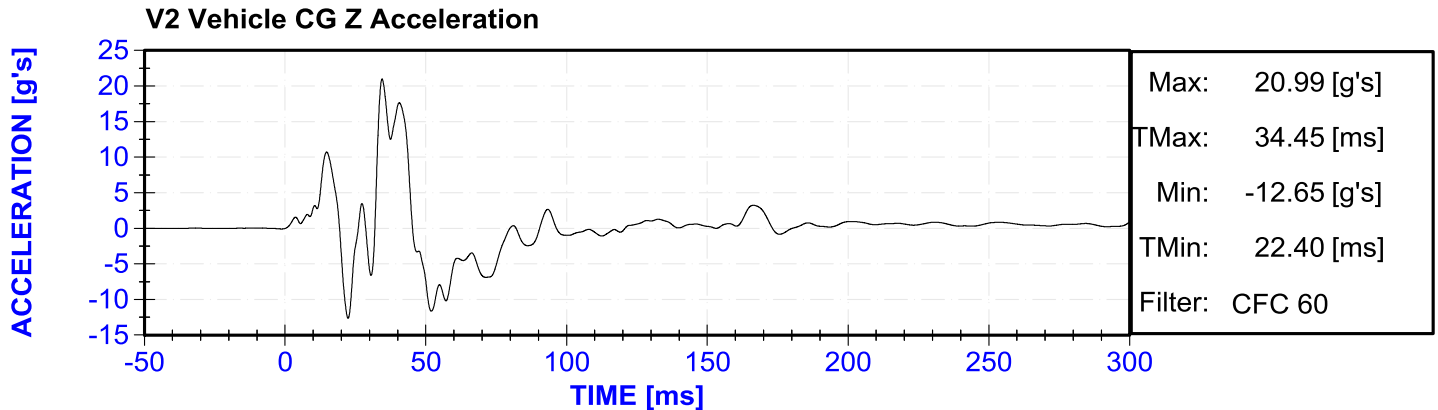




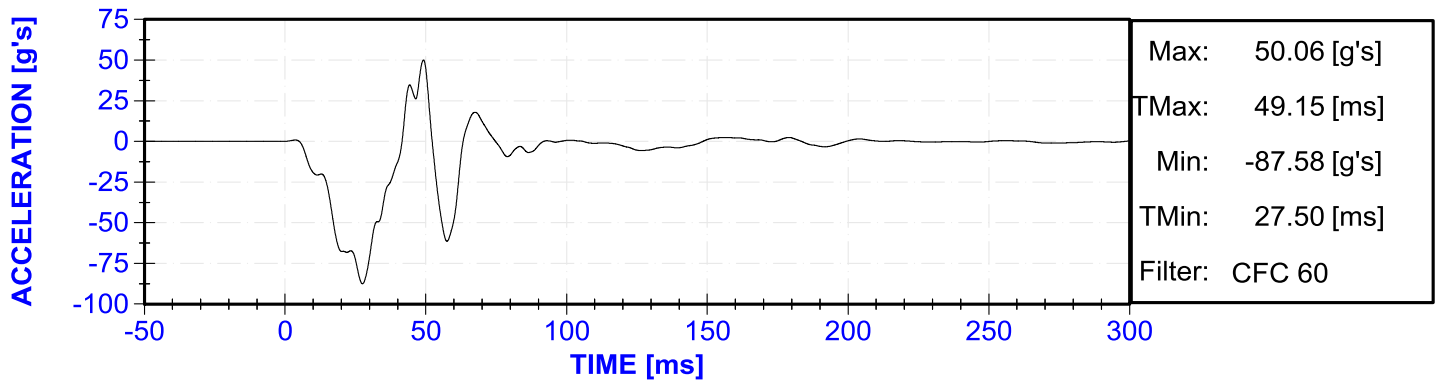




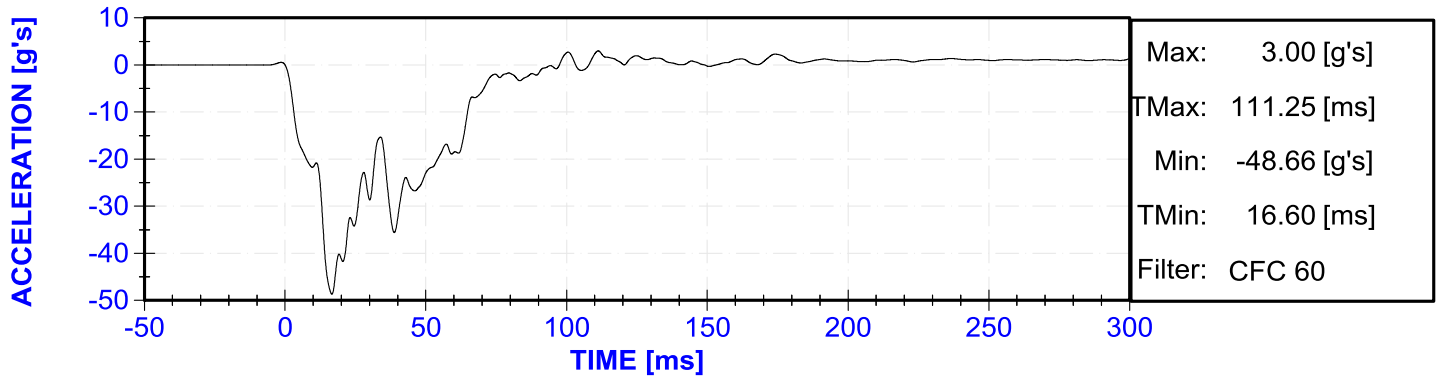




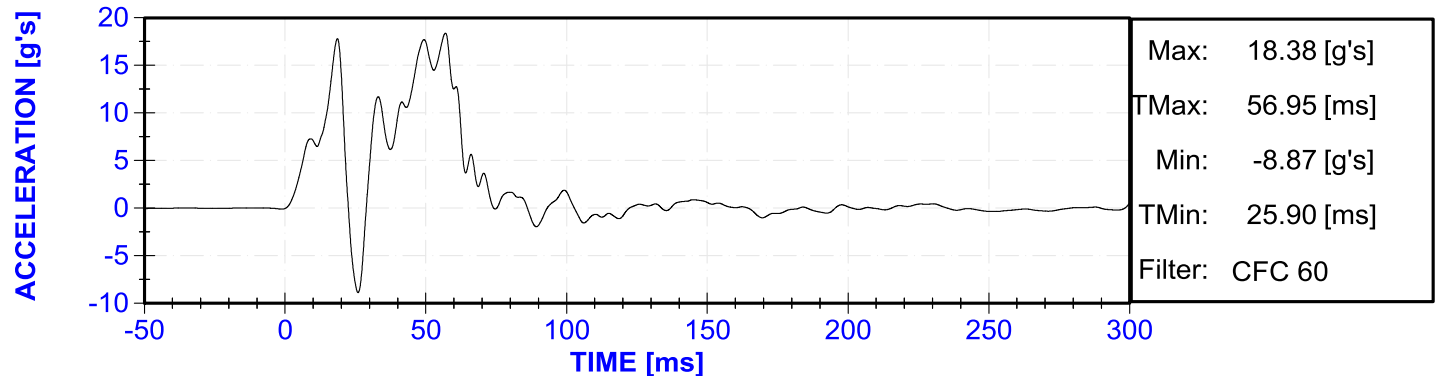
V2 Instrument Panel X Acceleration



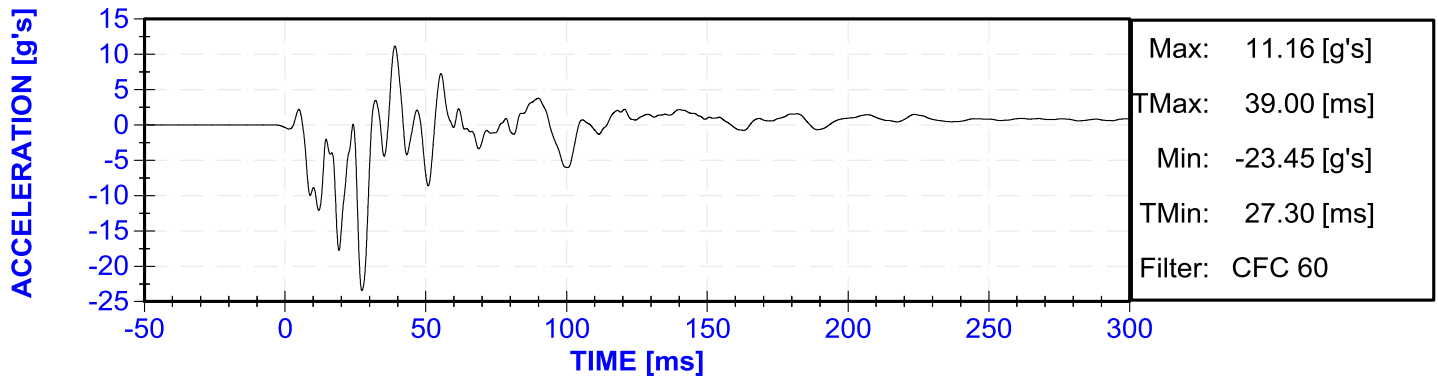
V2 Driver Seat Track X Acceleration



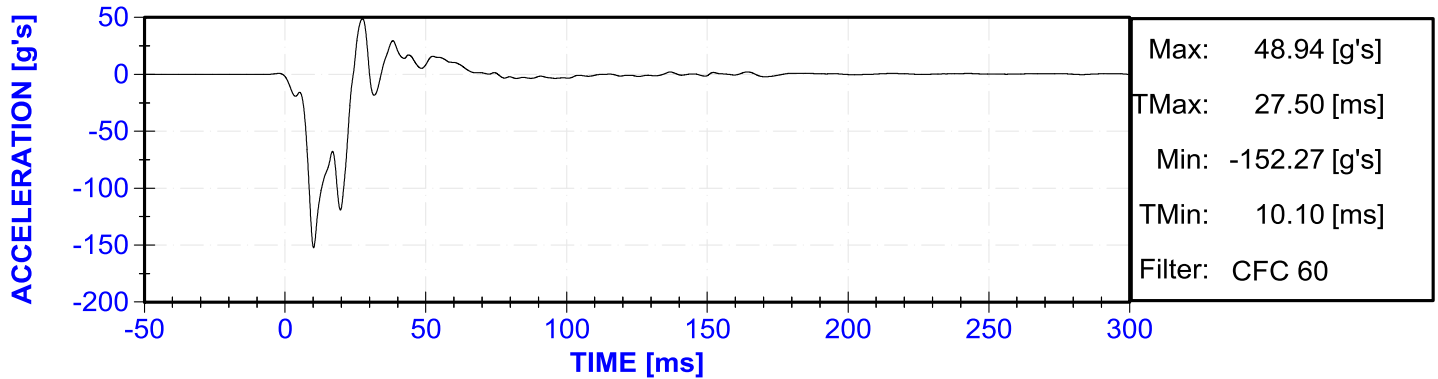
V2 Driver Seat Track Y Acceleration



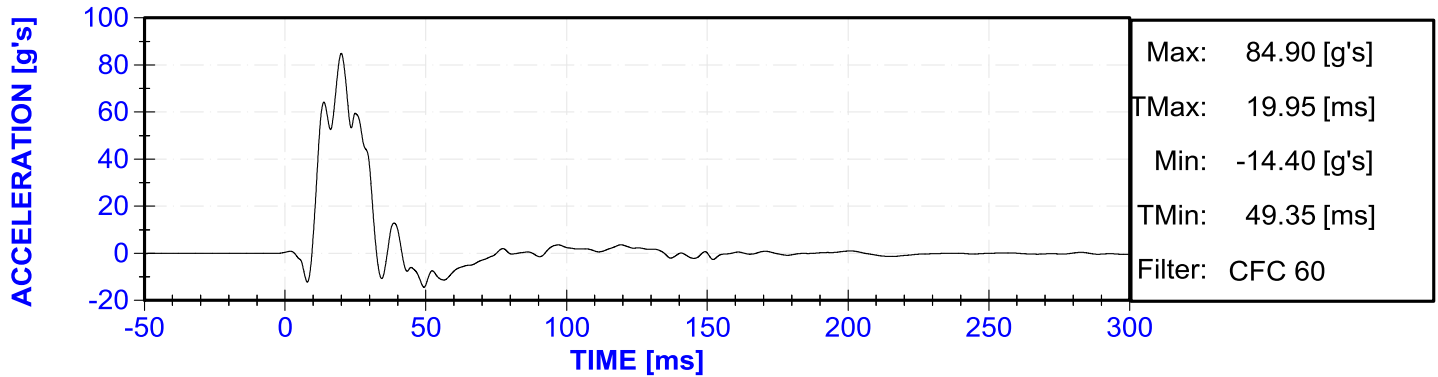
V2 Driver Seat Track Z Acceleration



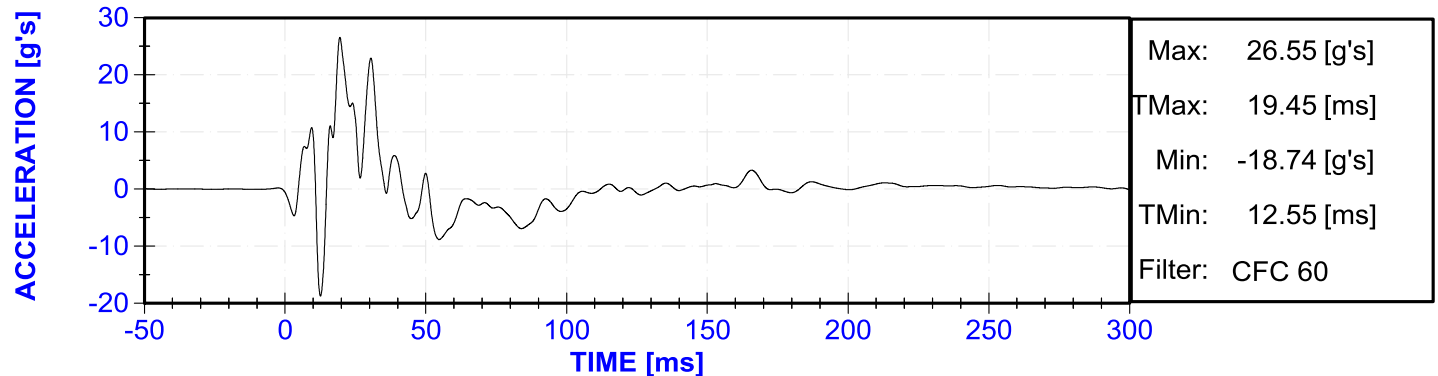
V2 Driver Floor Pan X Acceleration



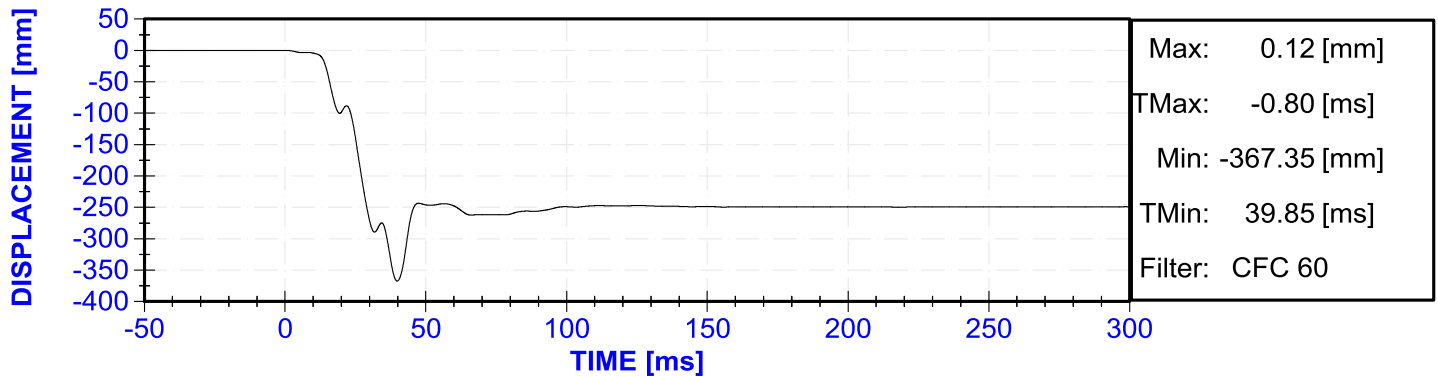
V2 Driver Floor Pan Y Acceleration

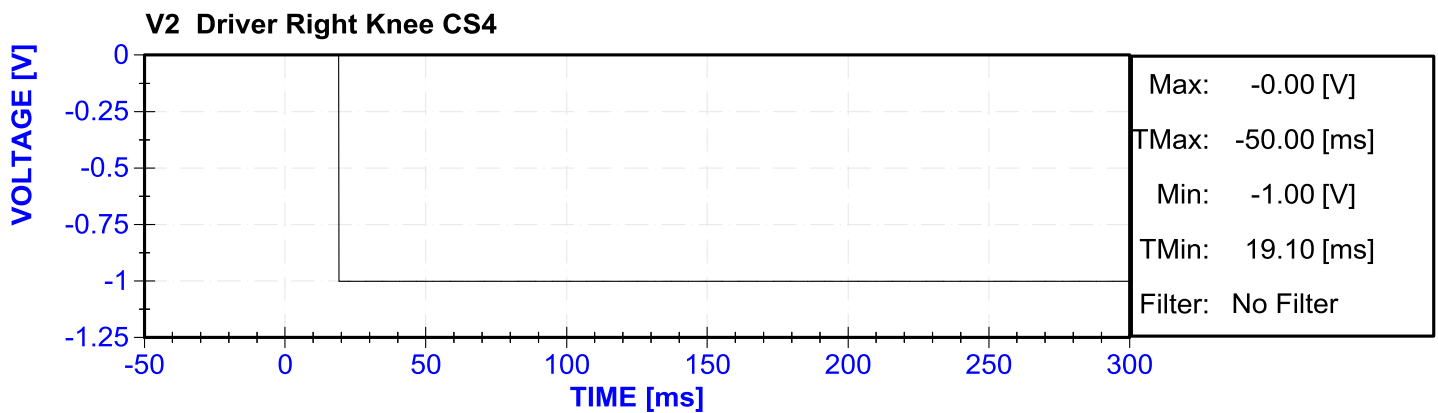
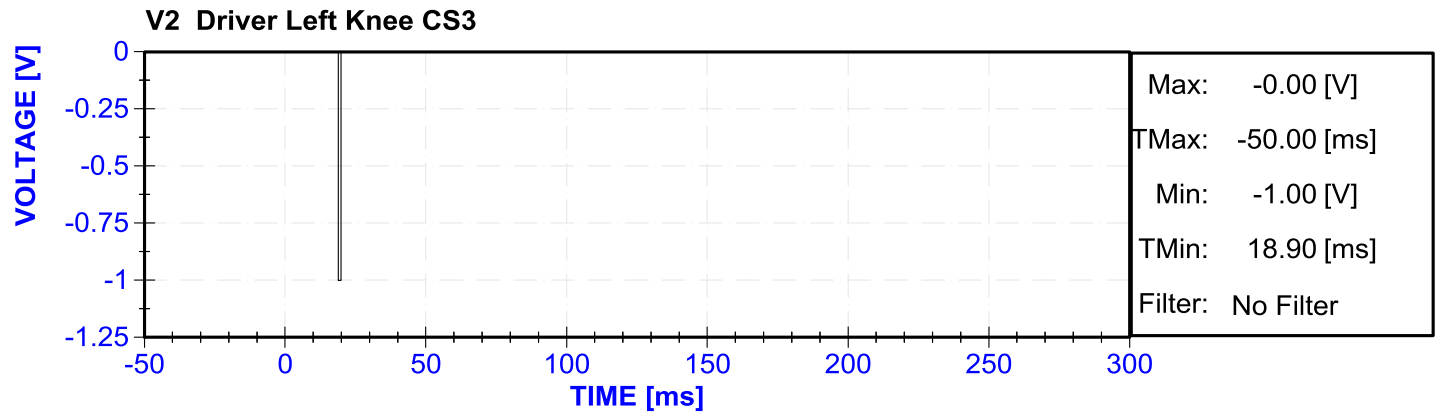
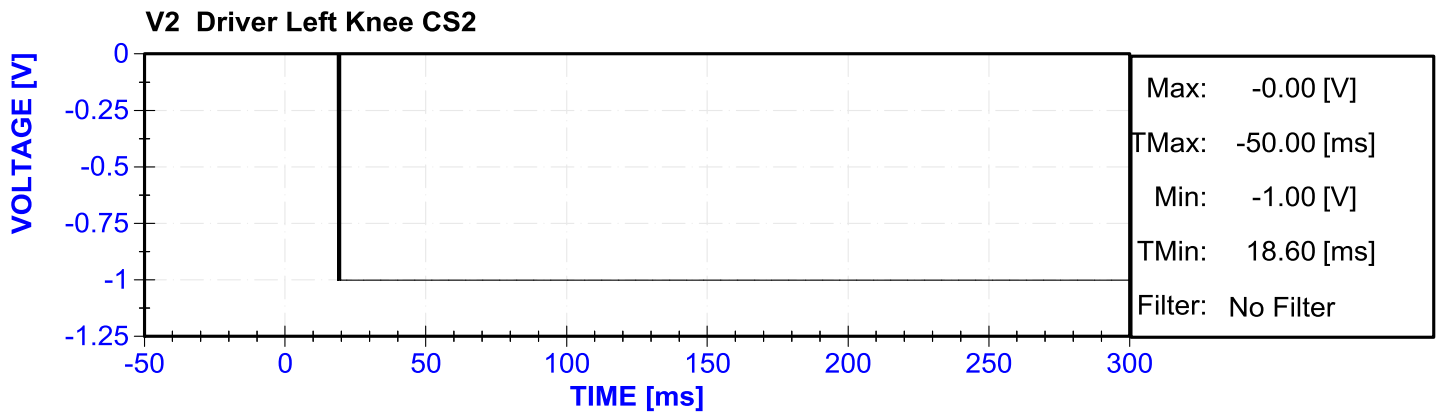
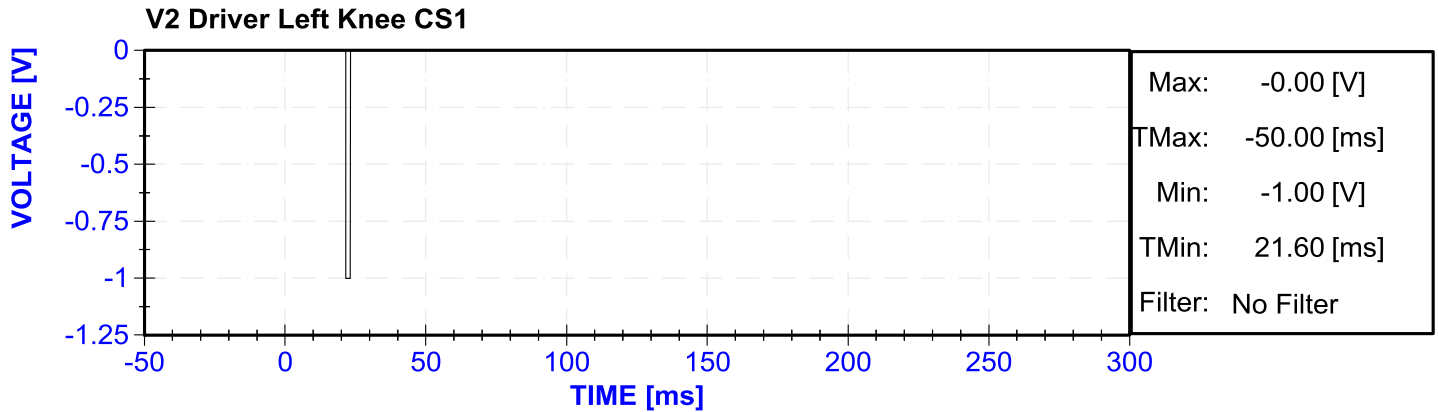


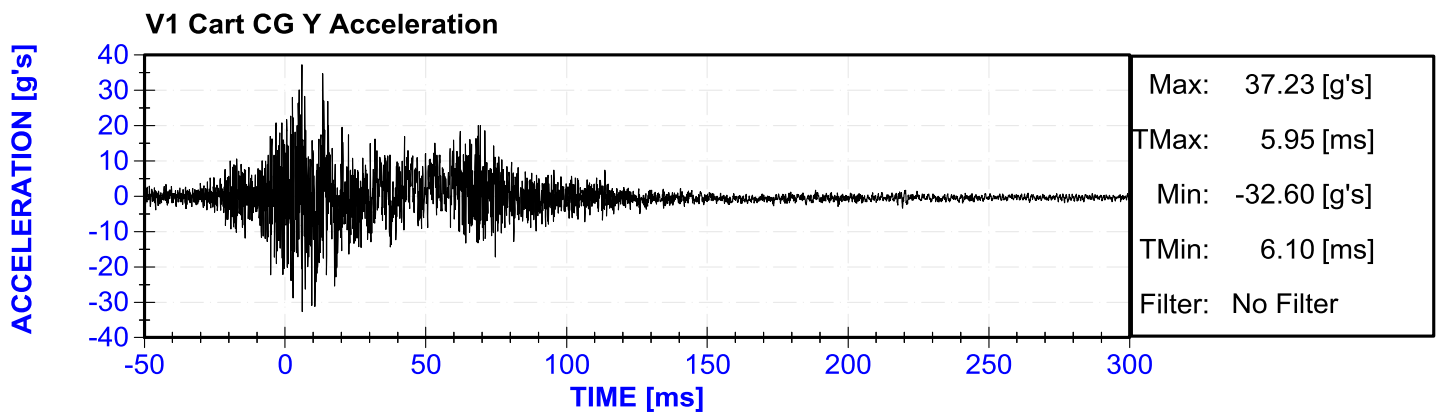
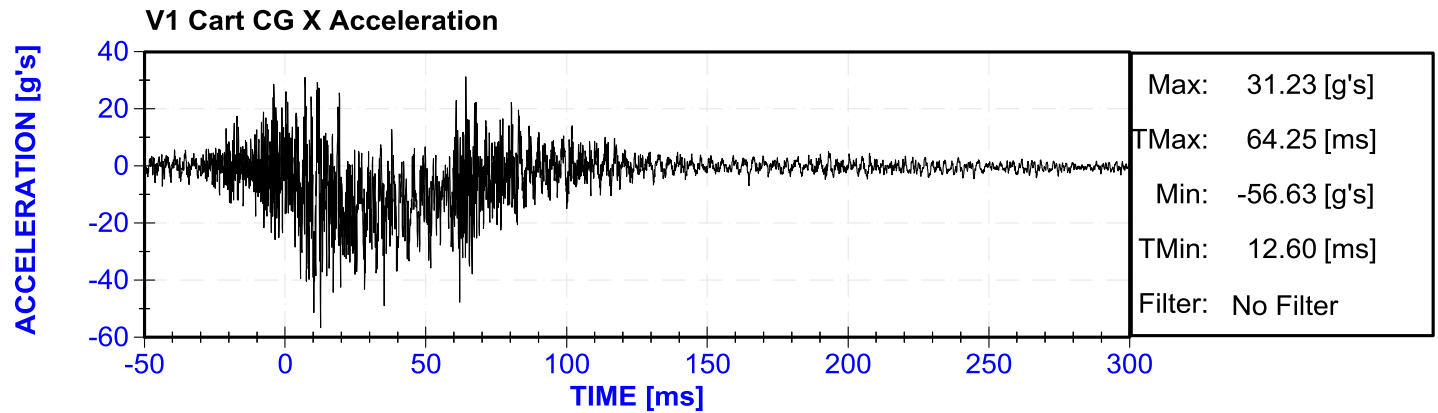
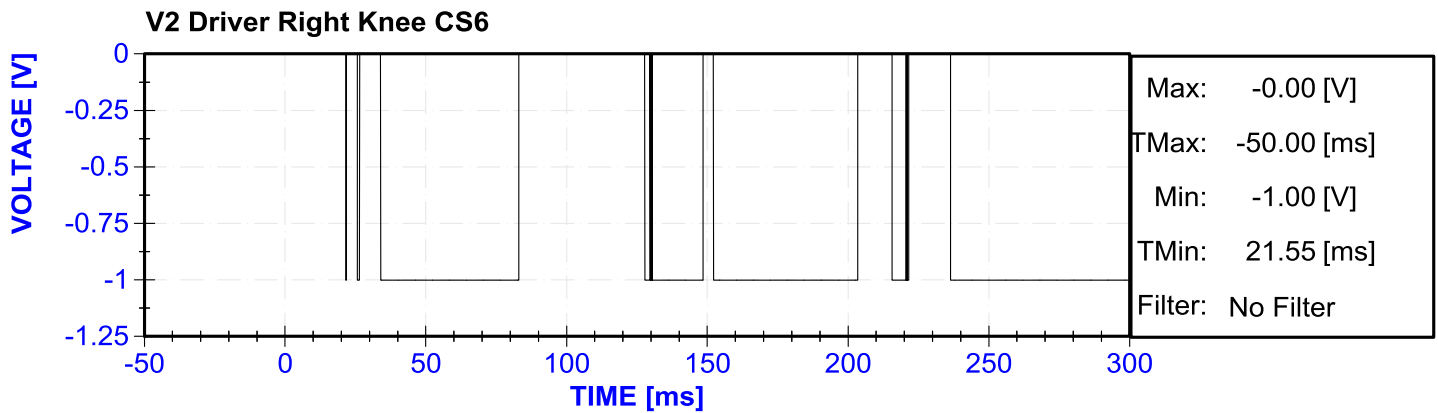
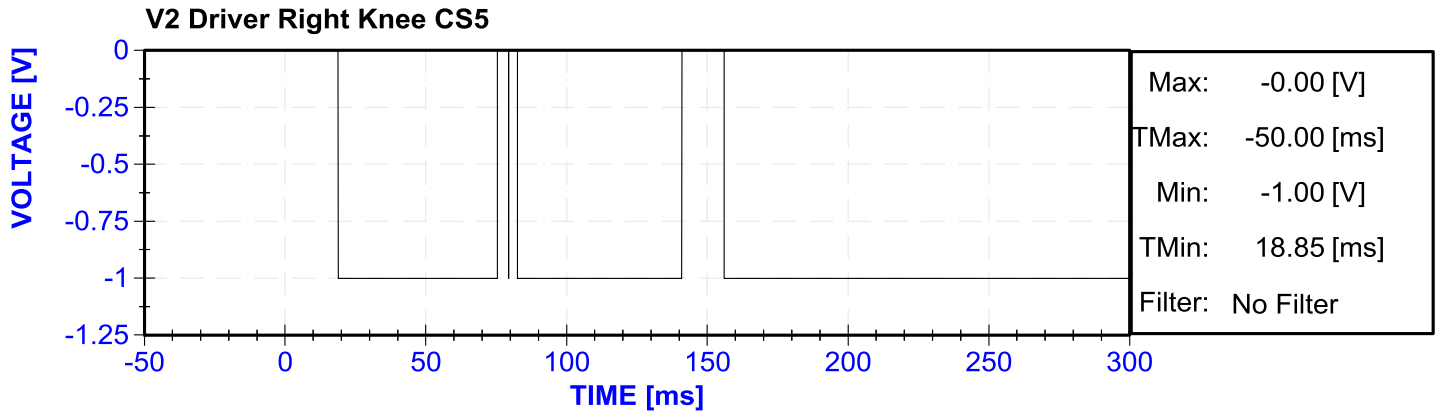
V2 Driver Floor Pan Z Acceleration

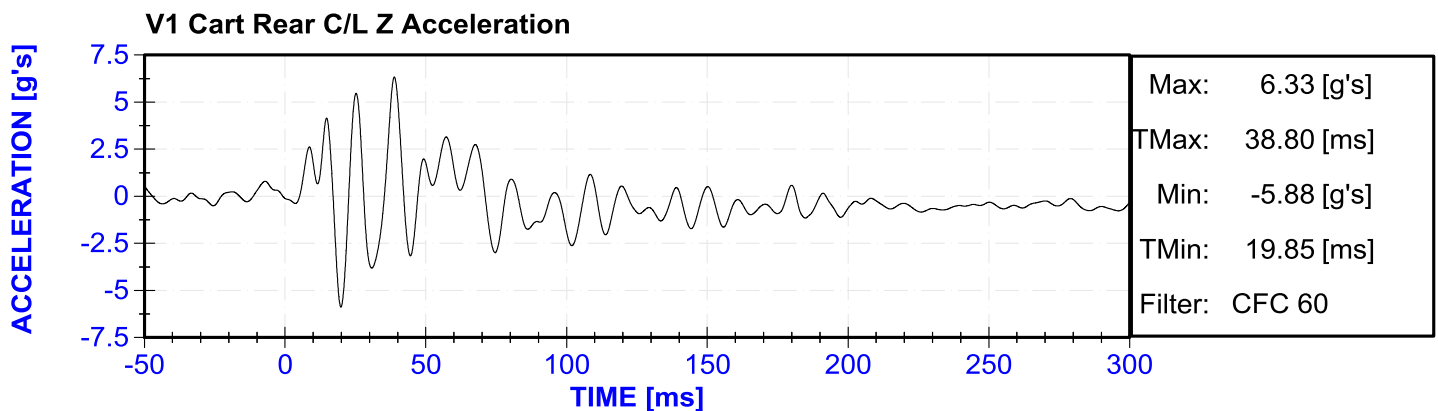
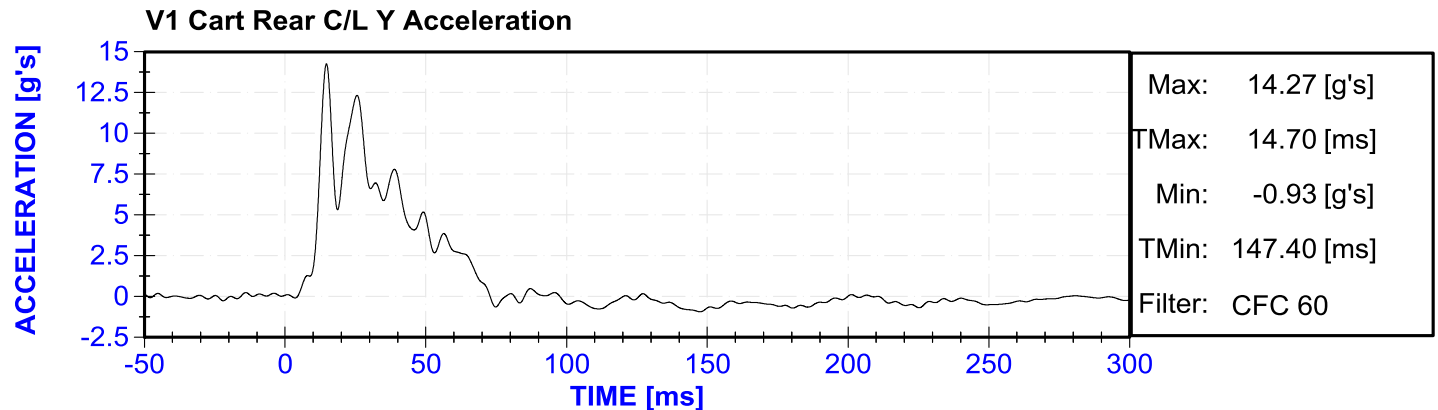
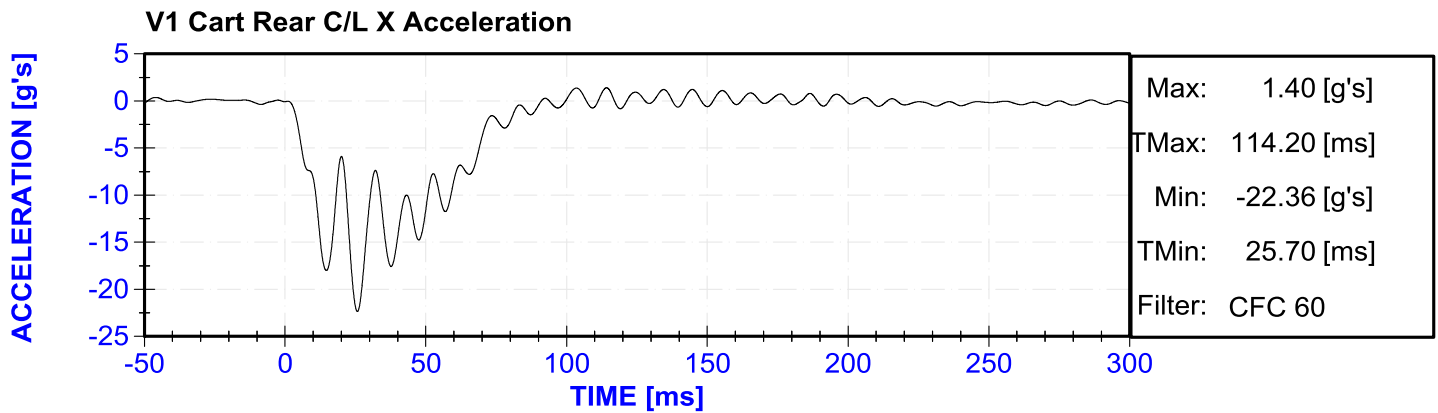
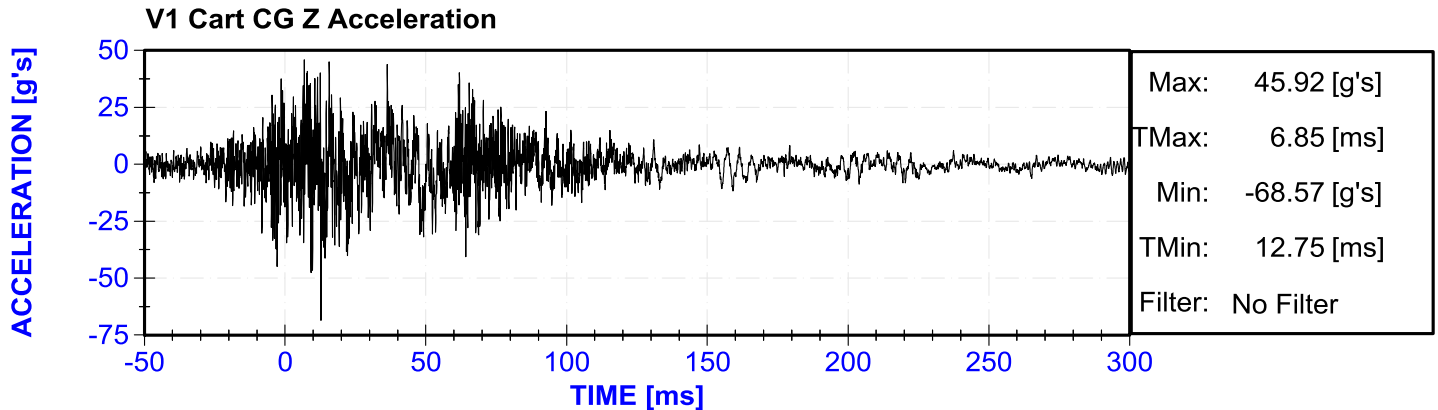


V2 Driver Floor Pan X Deflection

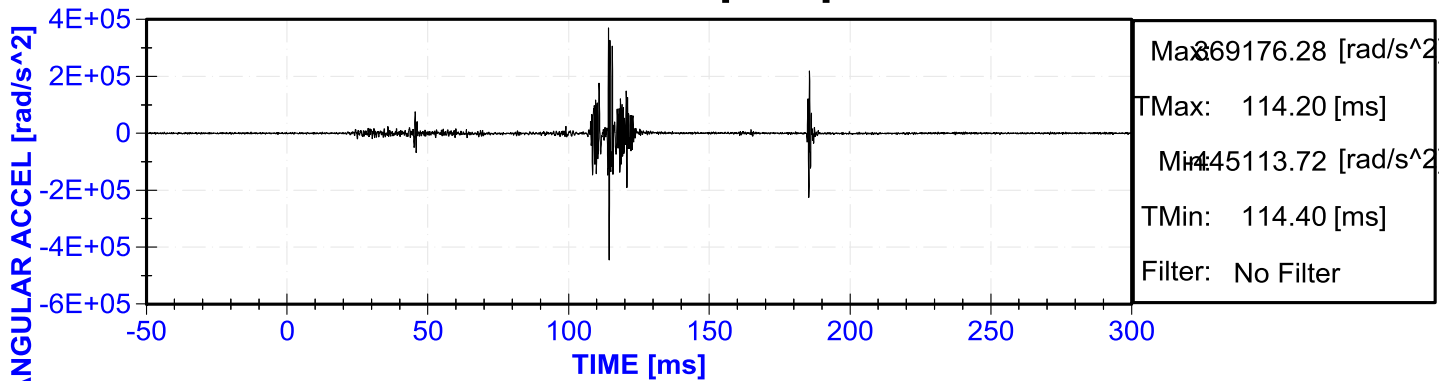




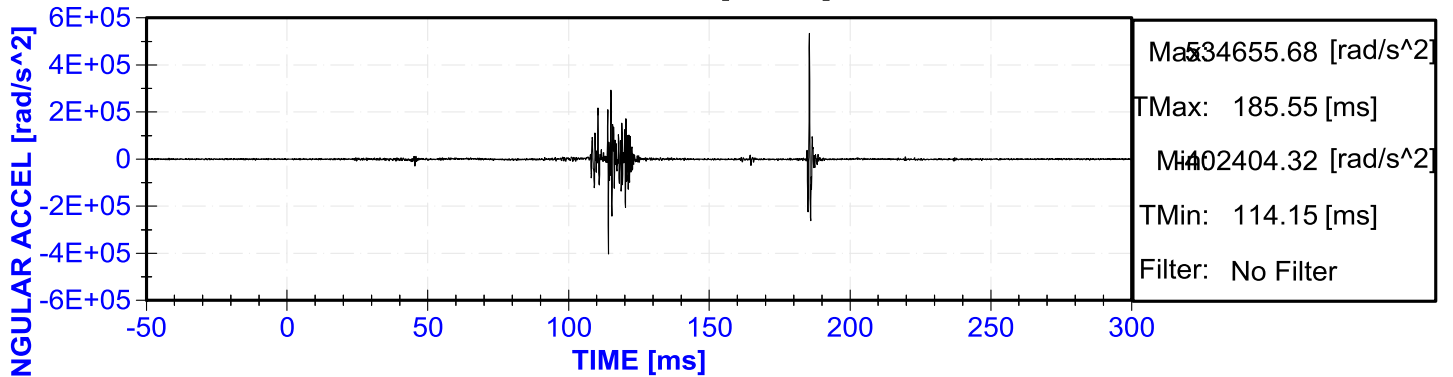




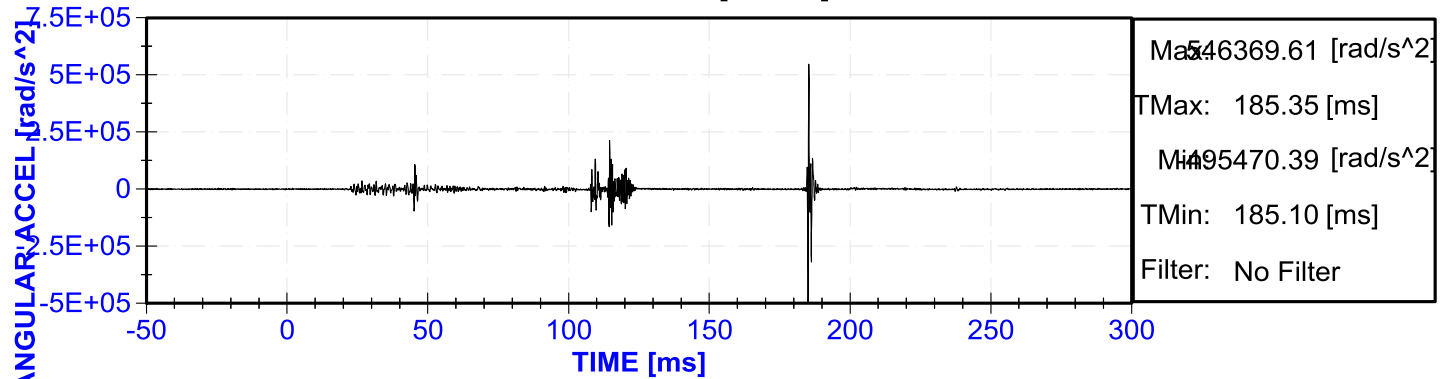
V2P1 HEAD ANGULAR ACCELERATION X [SIMON]



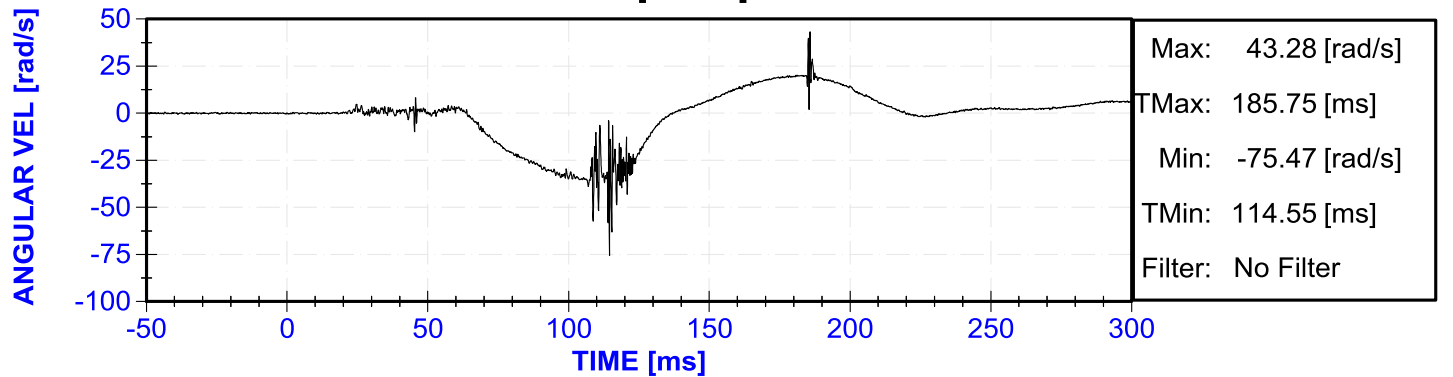
V2P1 HEAD ANGULAR ACCELERATION Y [SIMON]

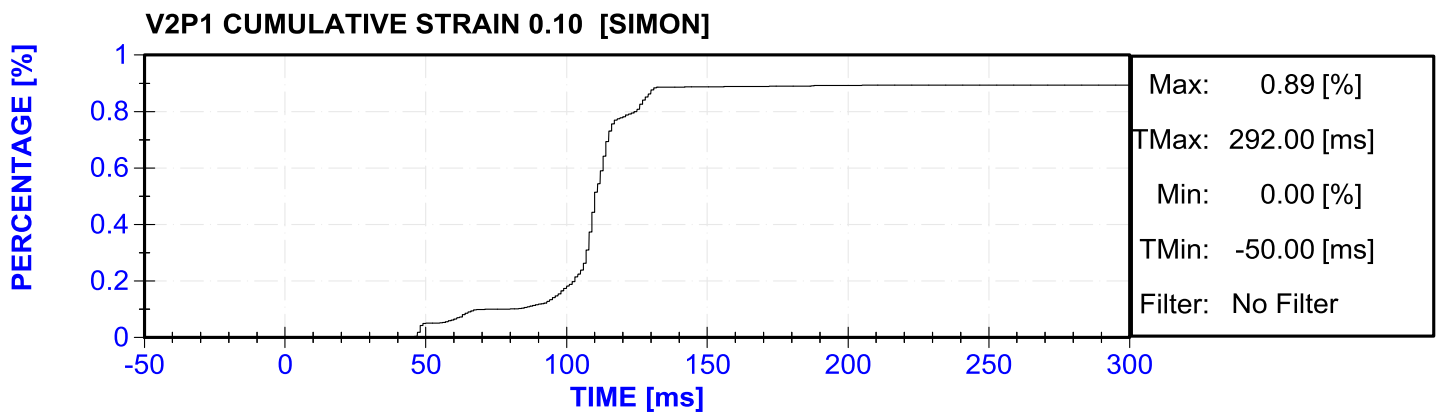
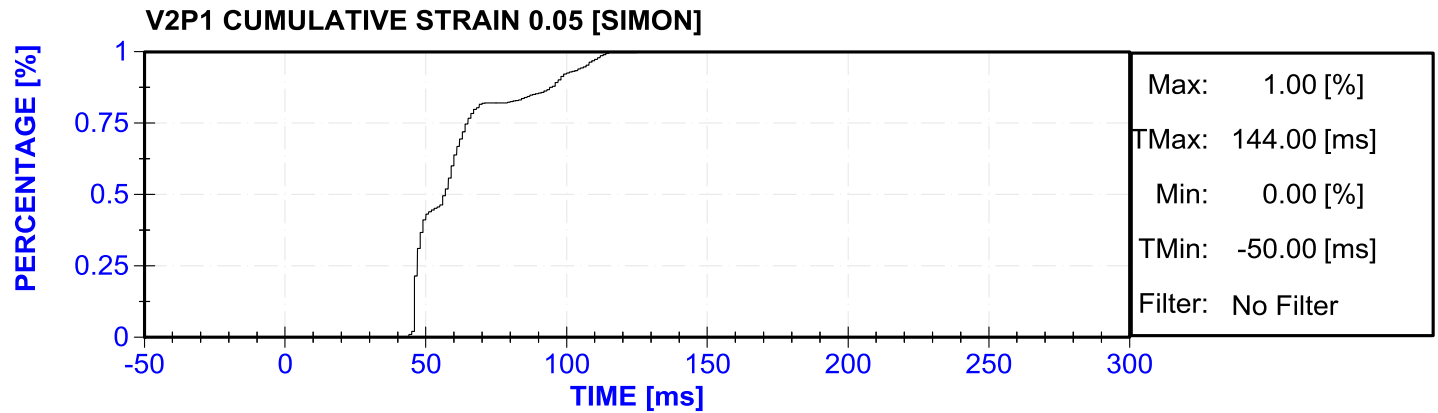
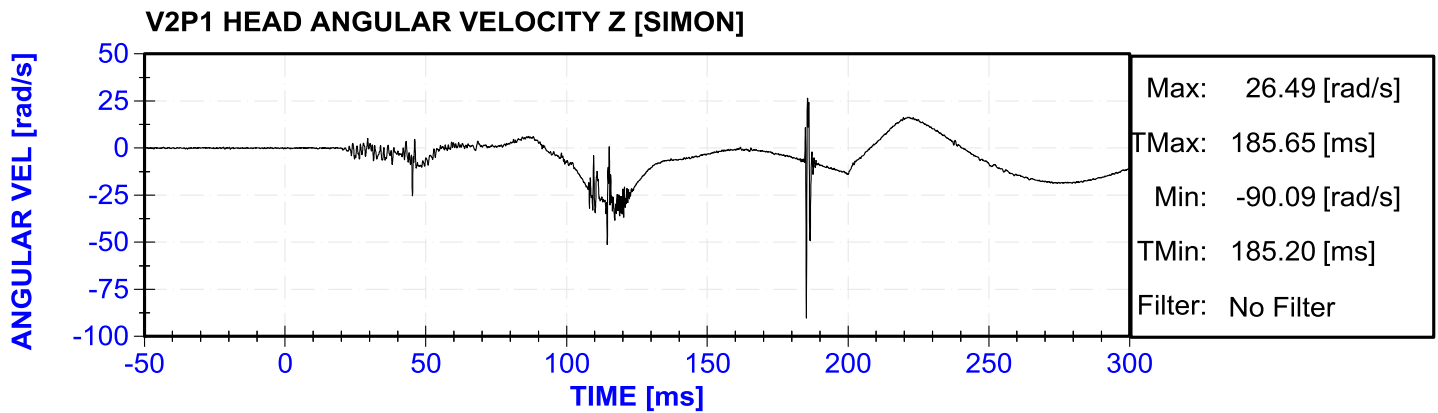
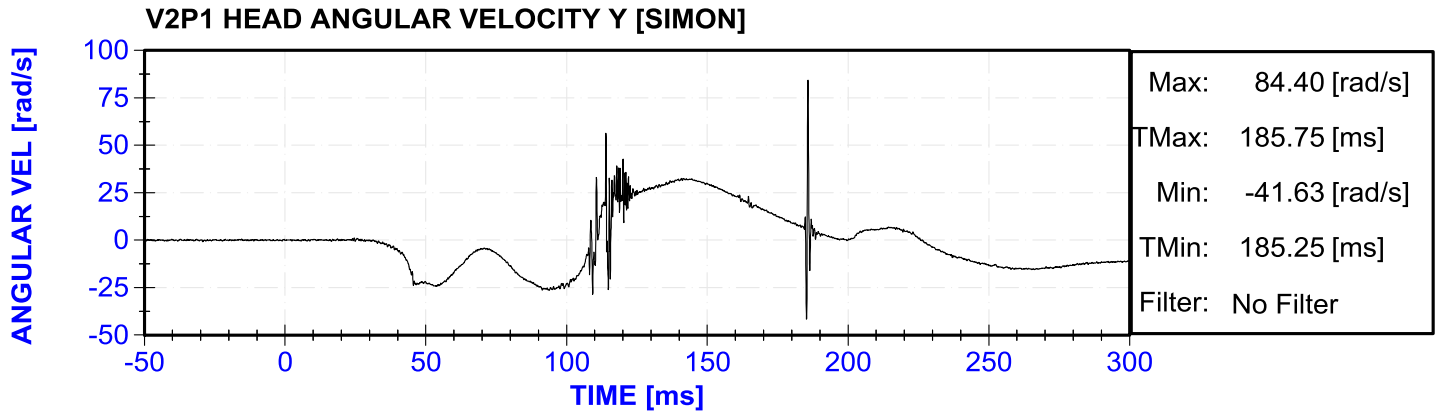


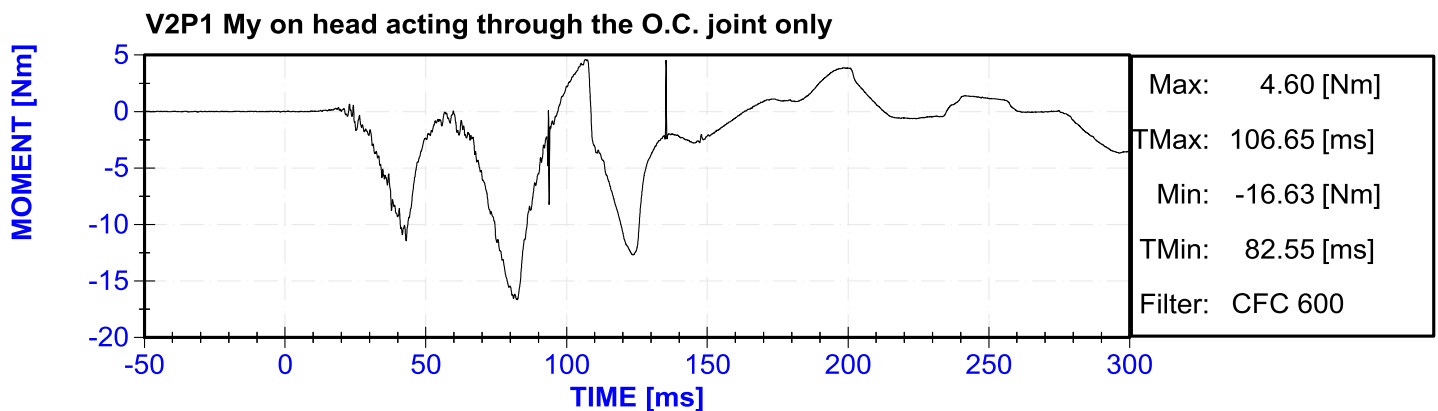
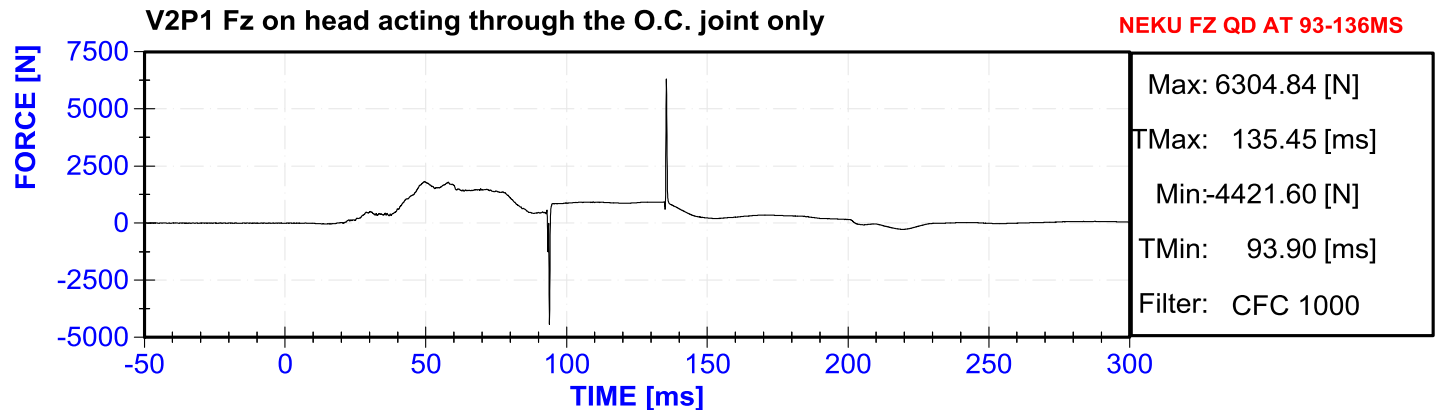
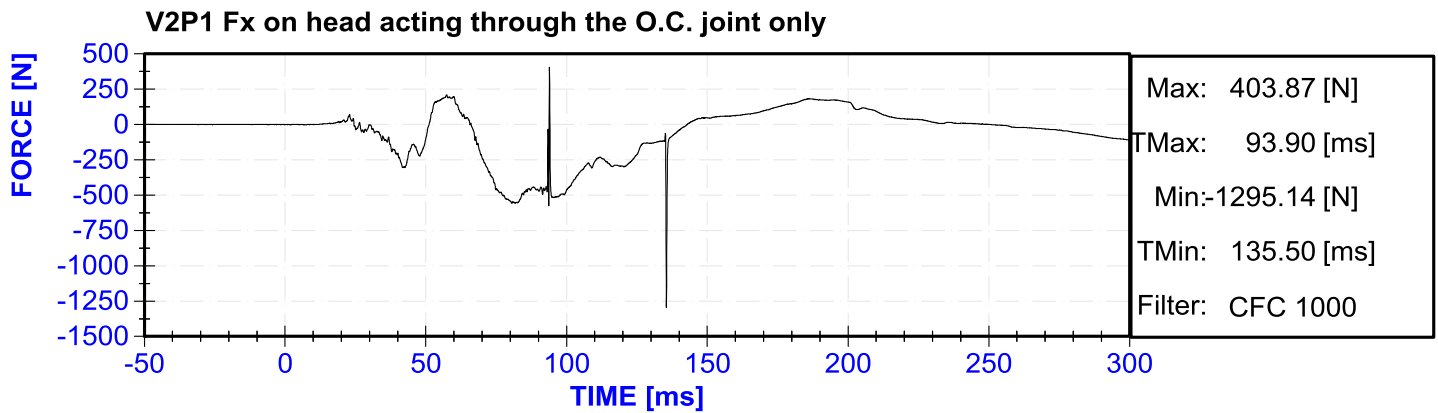
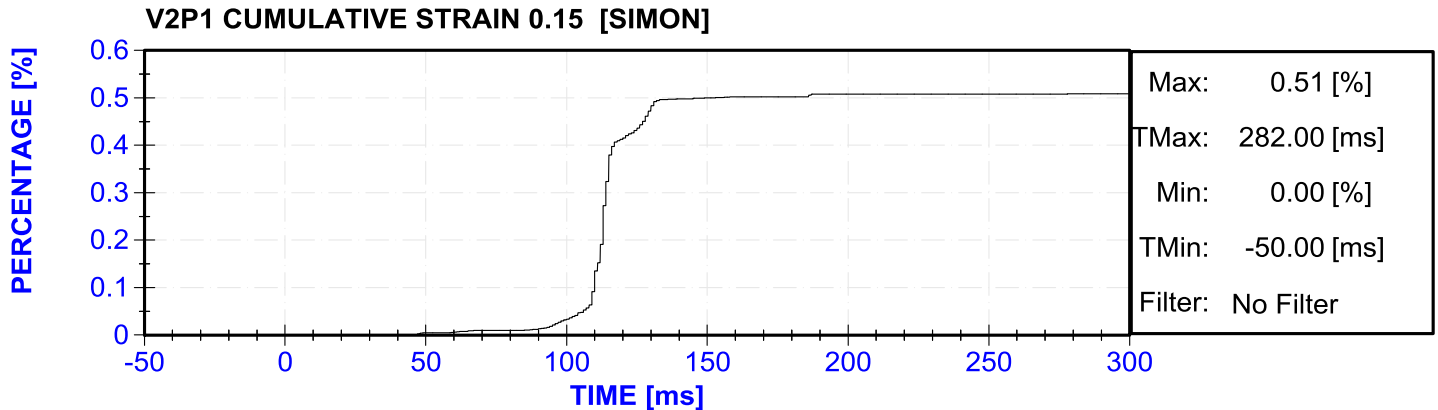
V2P1 HEAD ANGULAR ACCELERATION Z [SIMON]



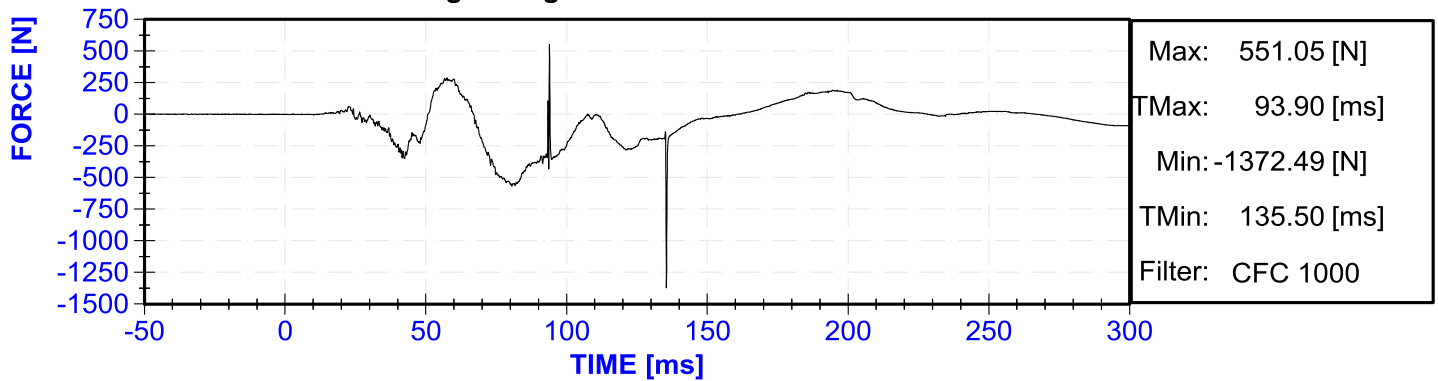
V2P1 HEAD ANGULAR VELOCITY X [SIMON]



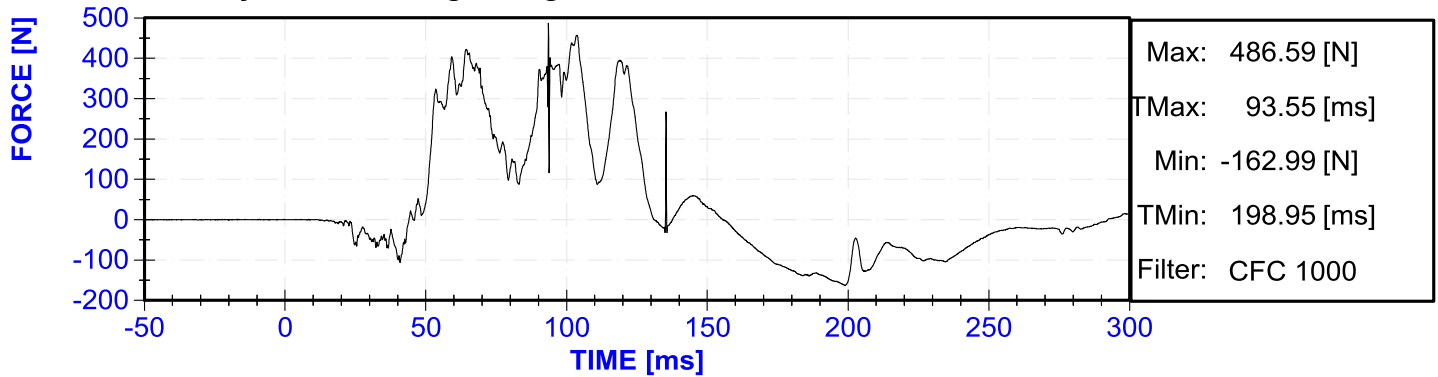




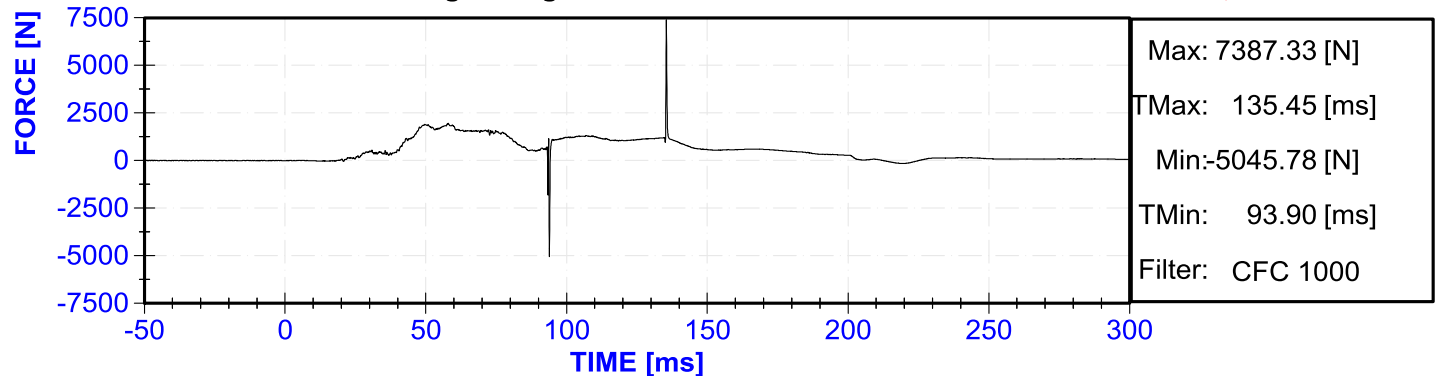
V2P1 Fx on head acting through the total neck section



V2P1 Fy on head acting through the total neck section

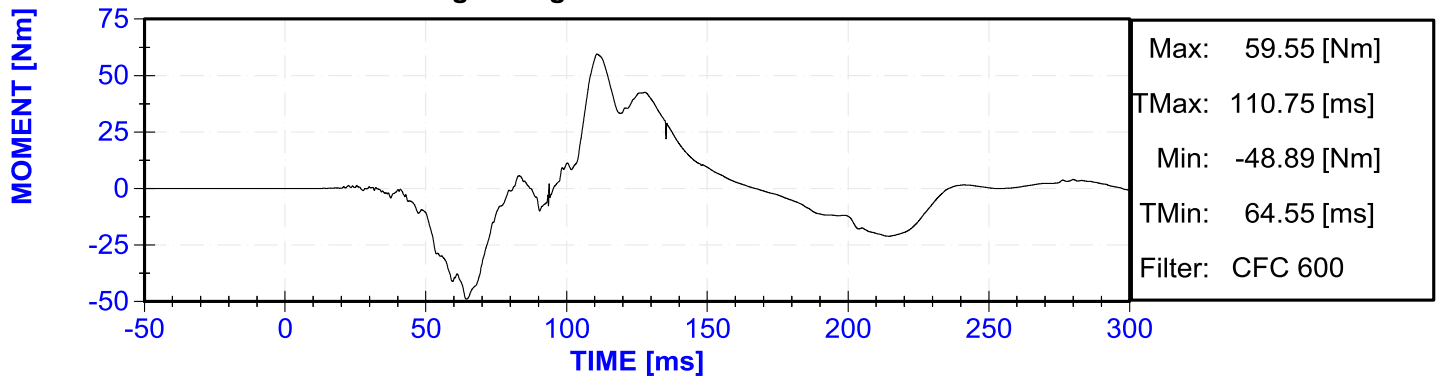


V2P1 Fz on head acting through the total neck section

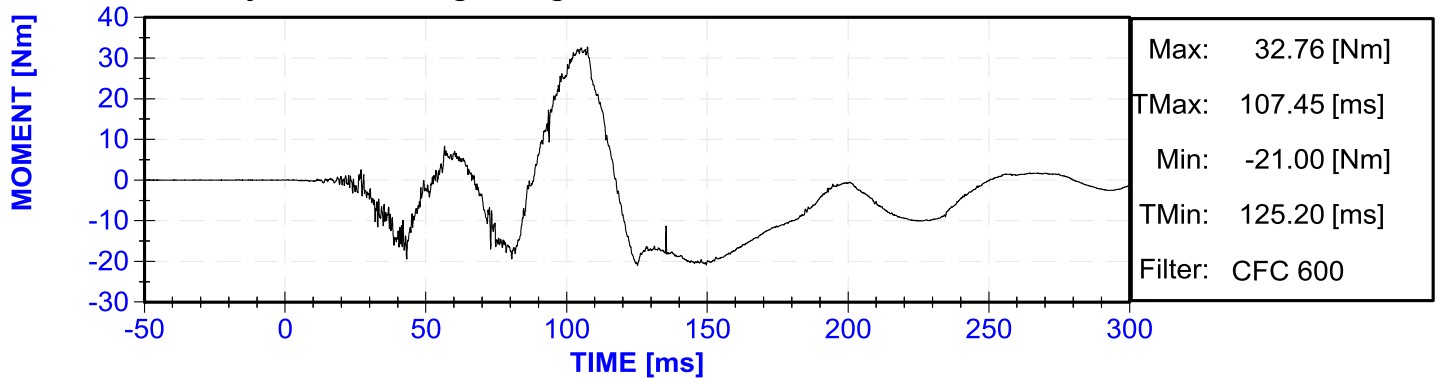


V2P1 NEKU FZ QD AT 93 -136 MS

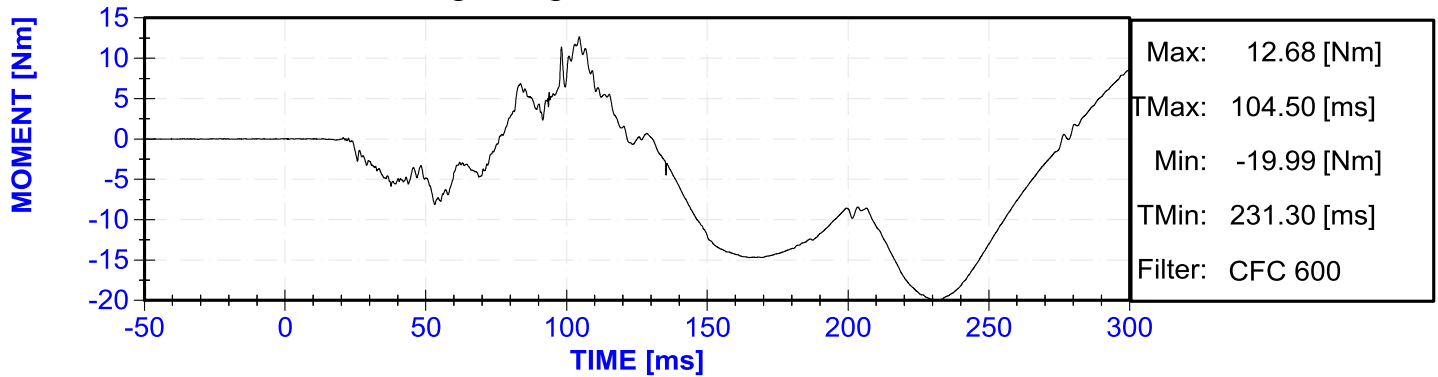
V2P1 Mx on head acting through the total neck section



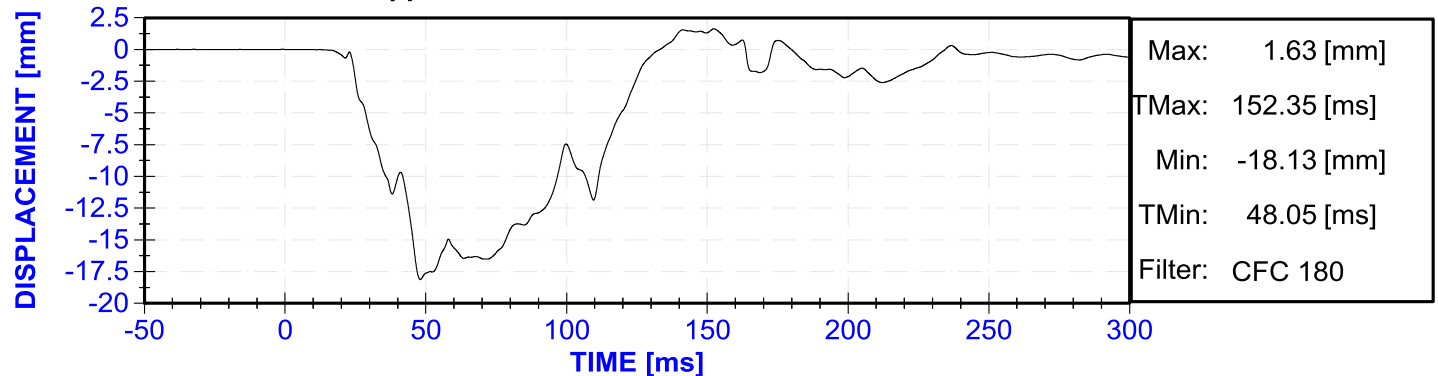
V2P1 My on head acting through the total neck section



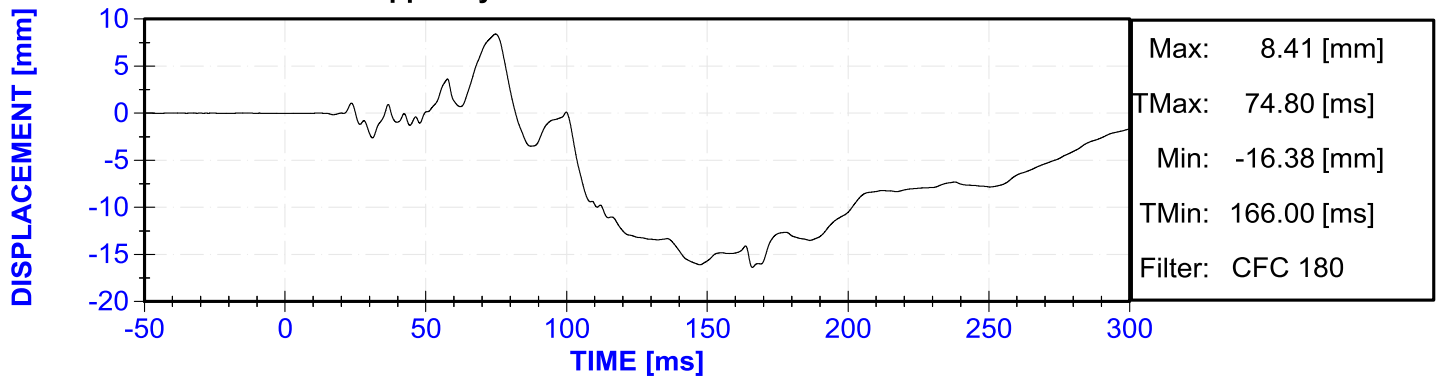
V2P1 Mz on head acting through the total neck section

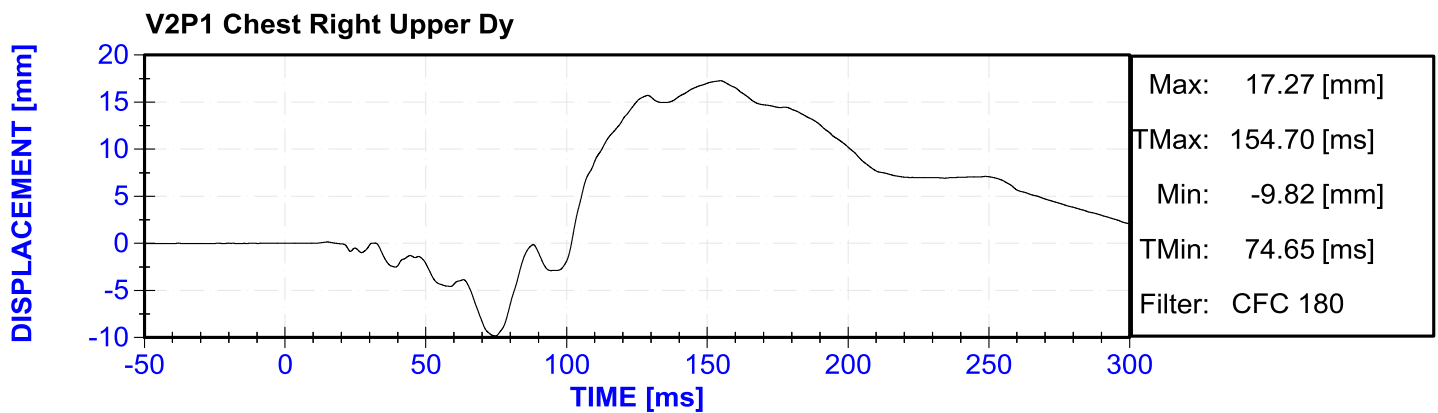
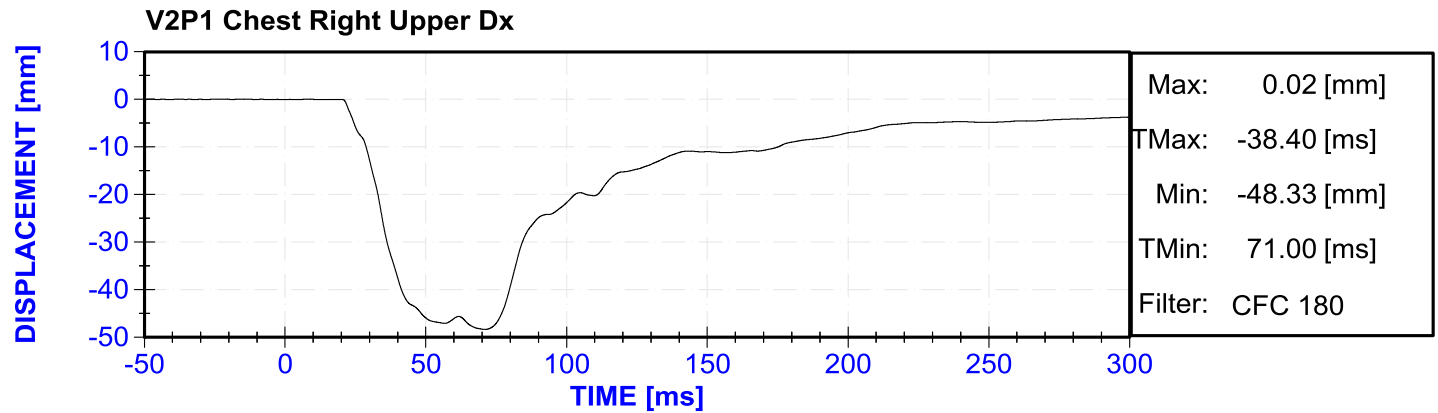
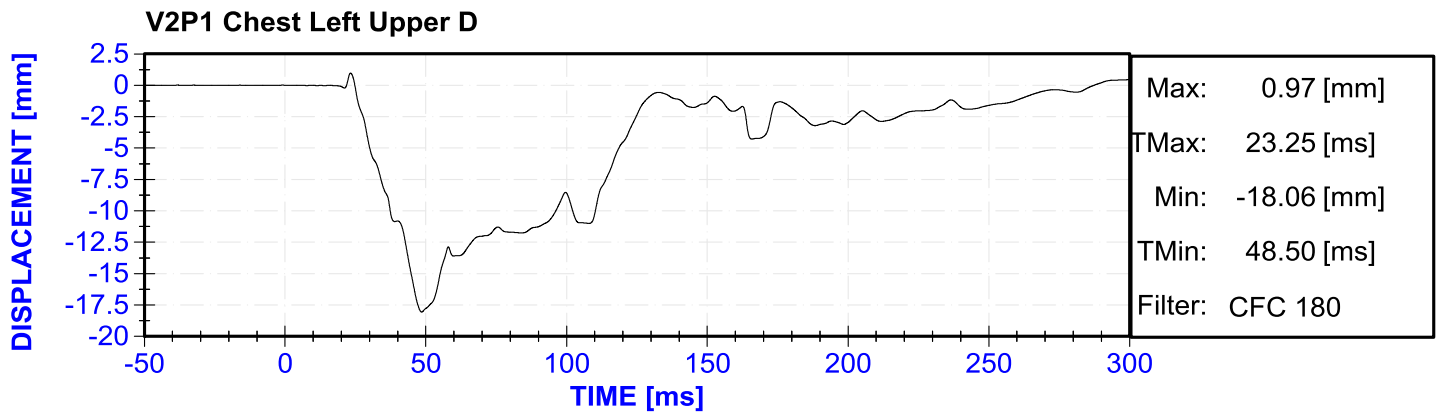
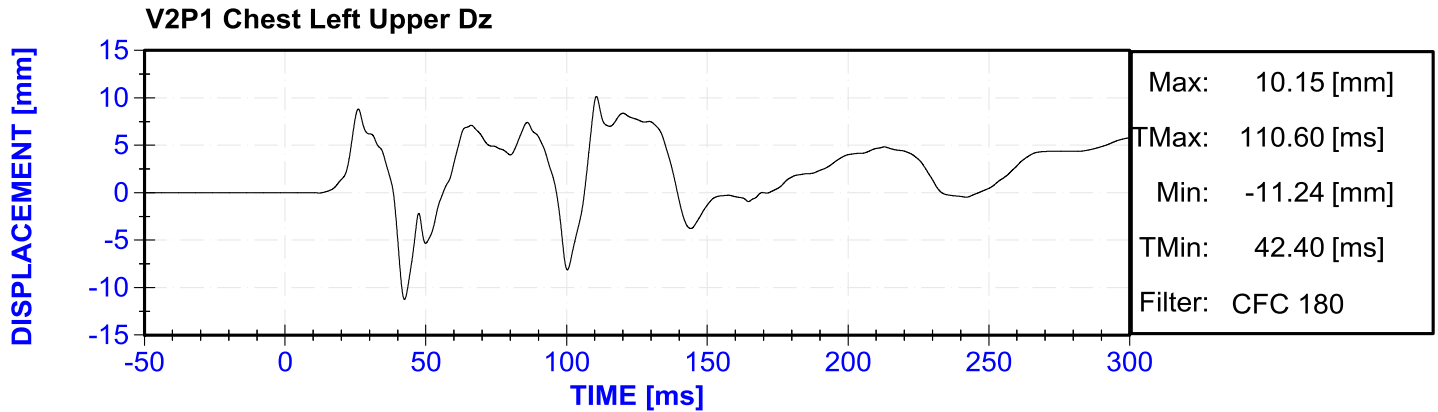


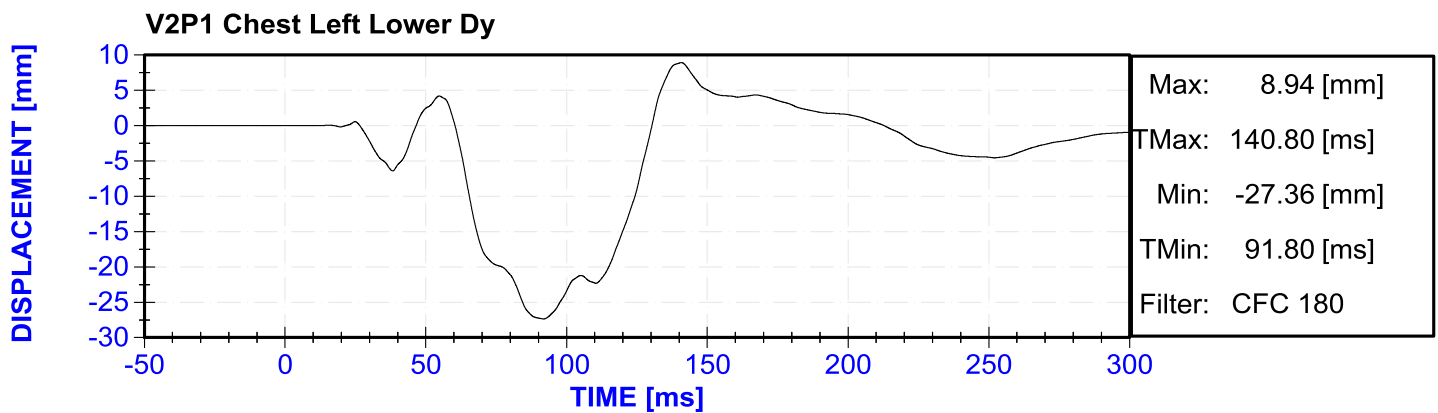
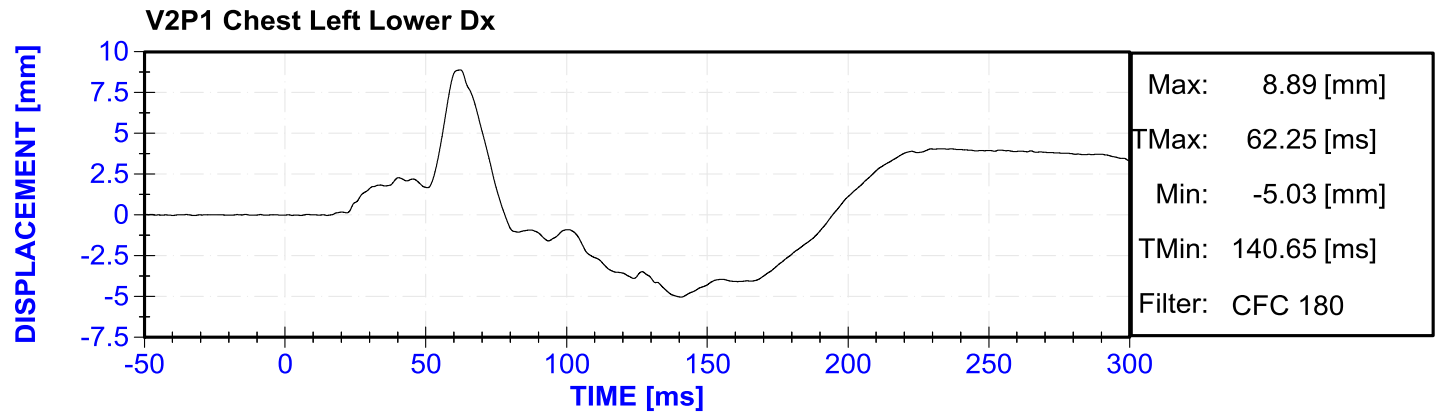
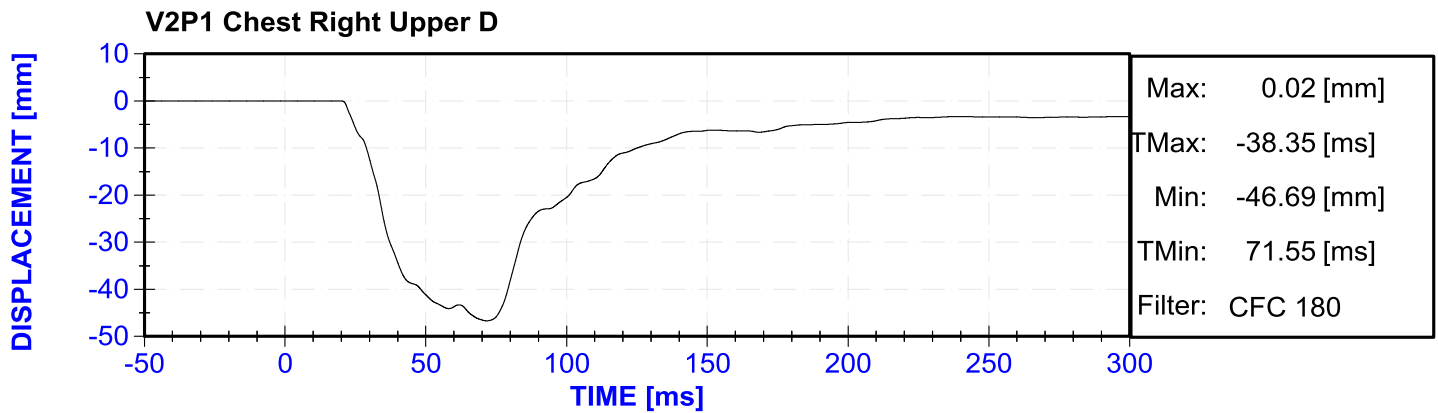
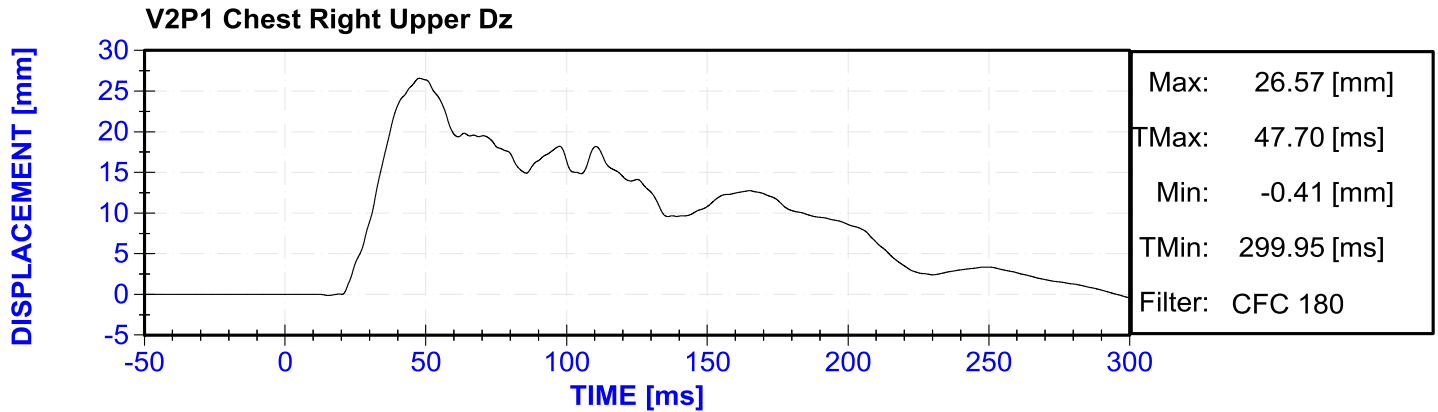
V2P1 Chest Left Upper Dx

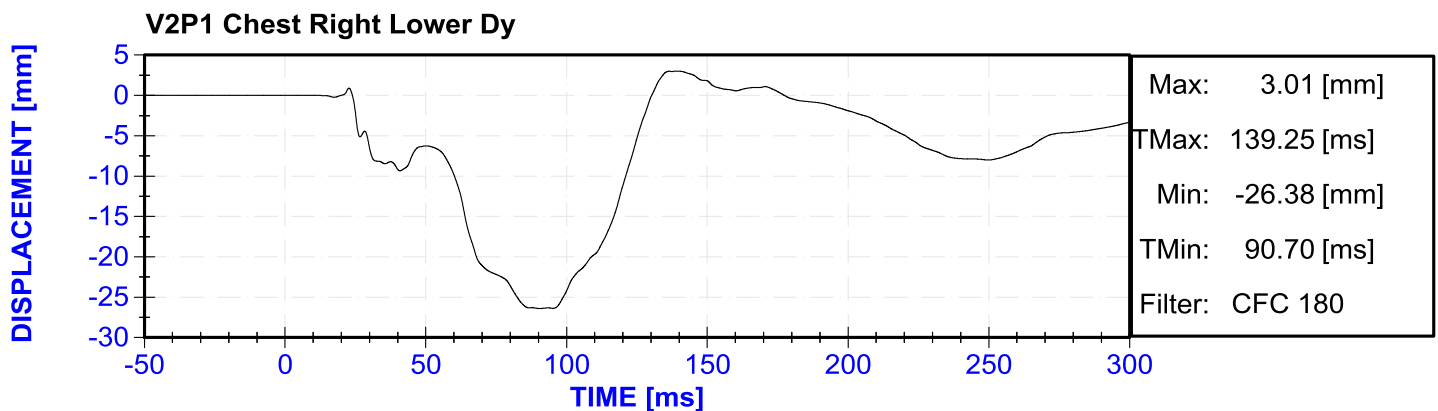
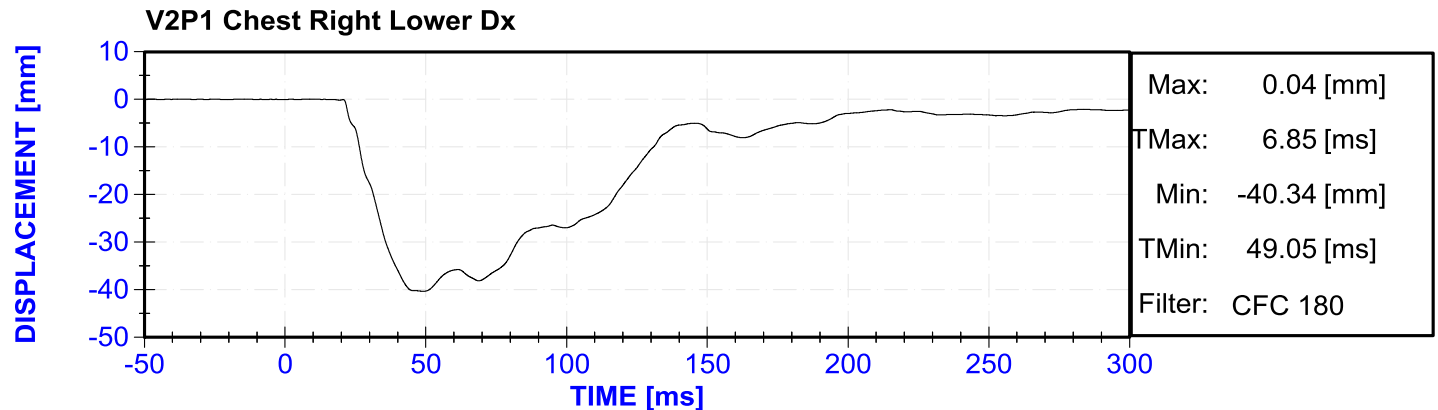
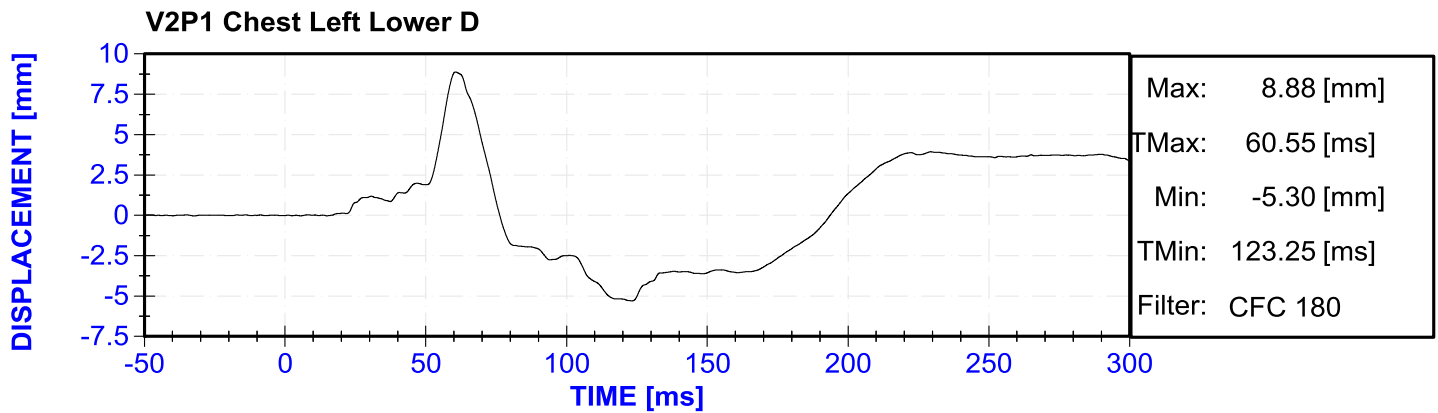
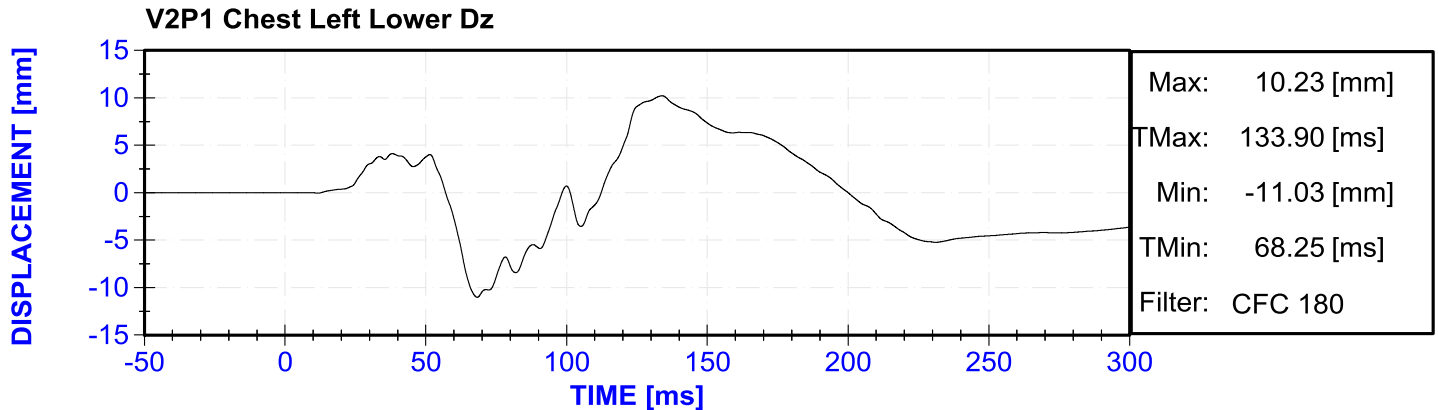


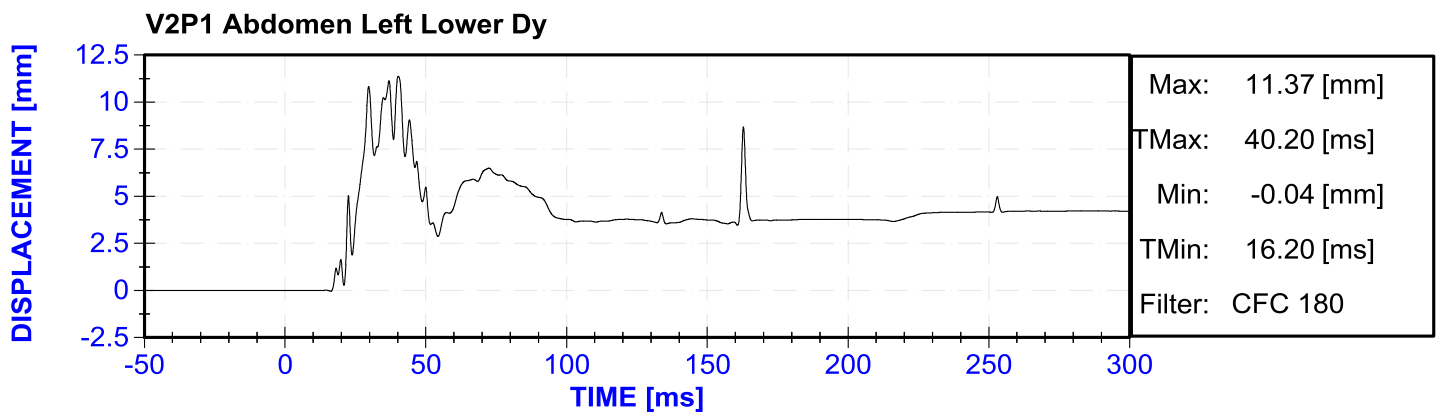
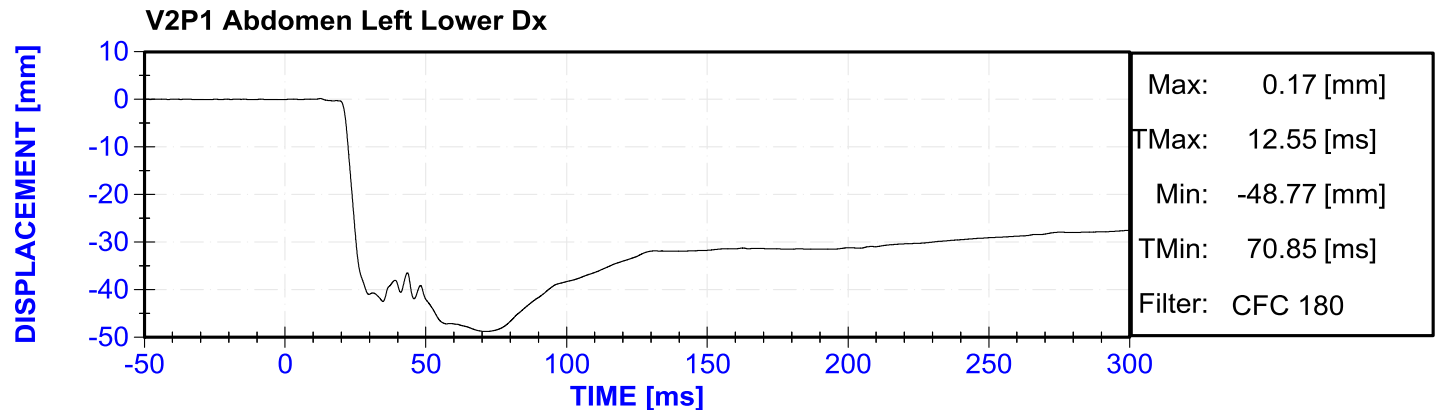
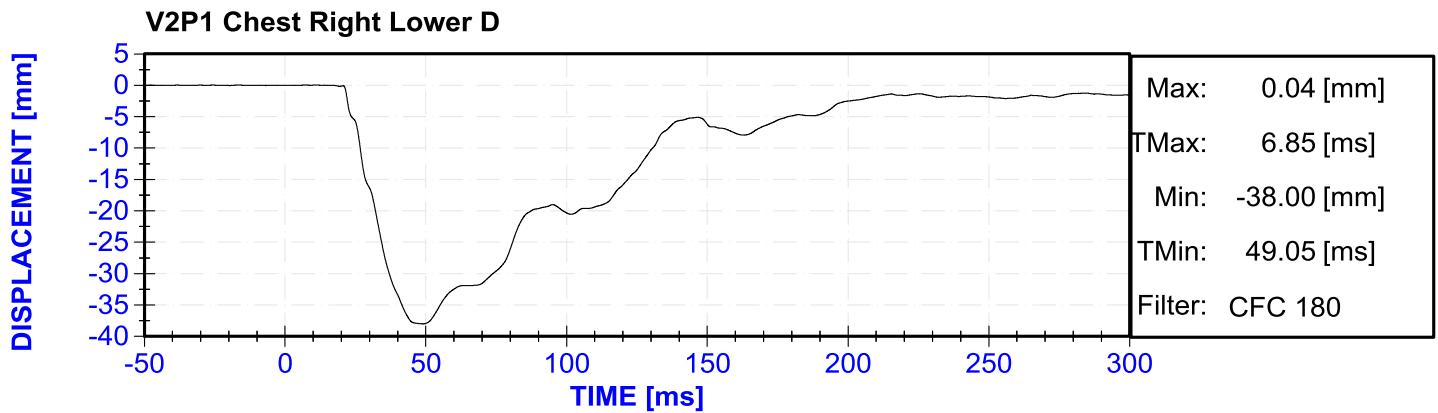
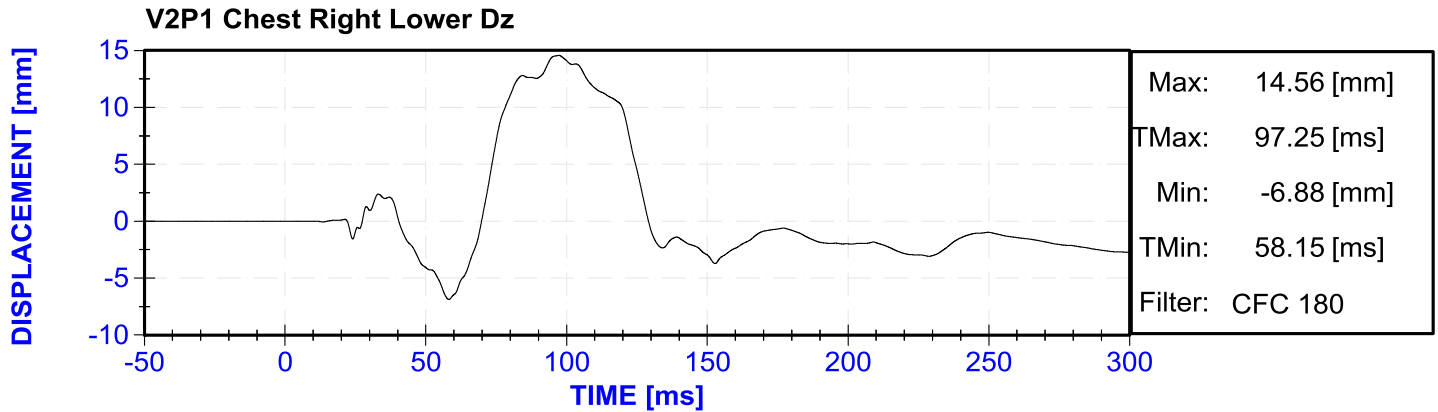
V2P1 Chest Left Upper Dy

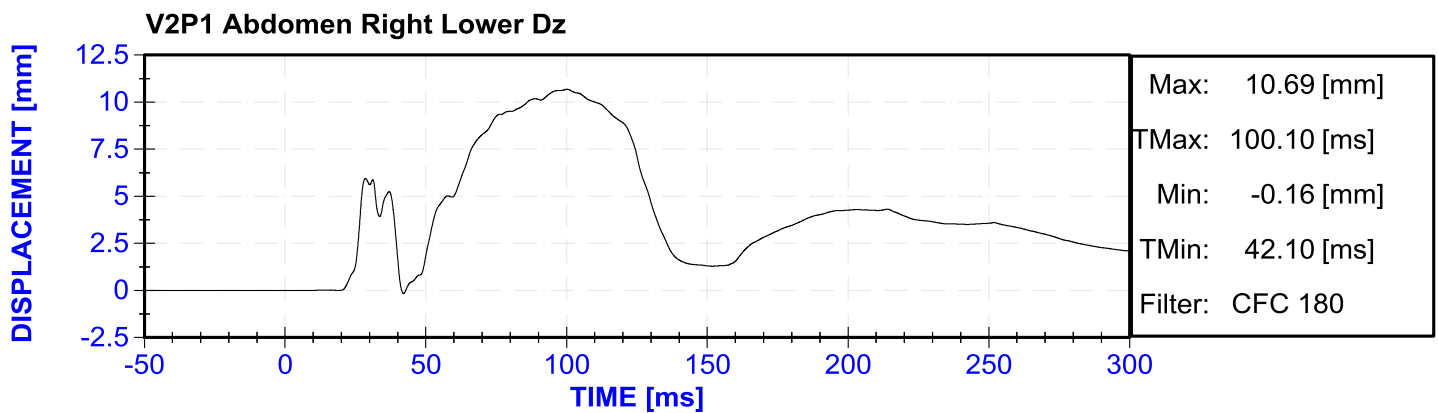
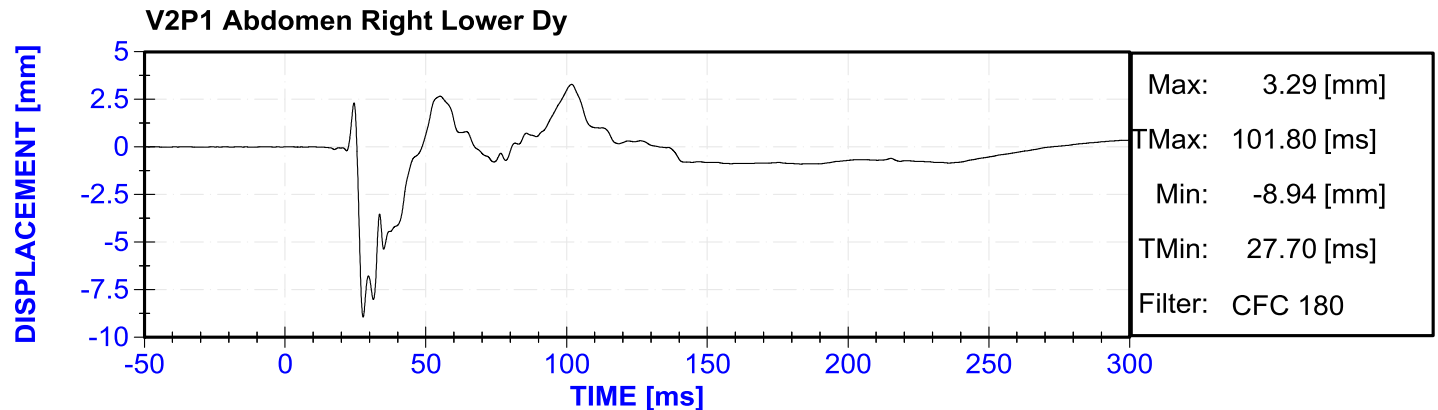
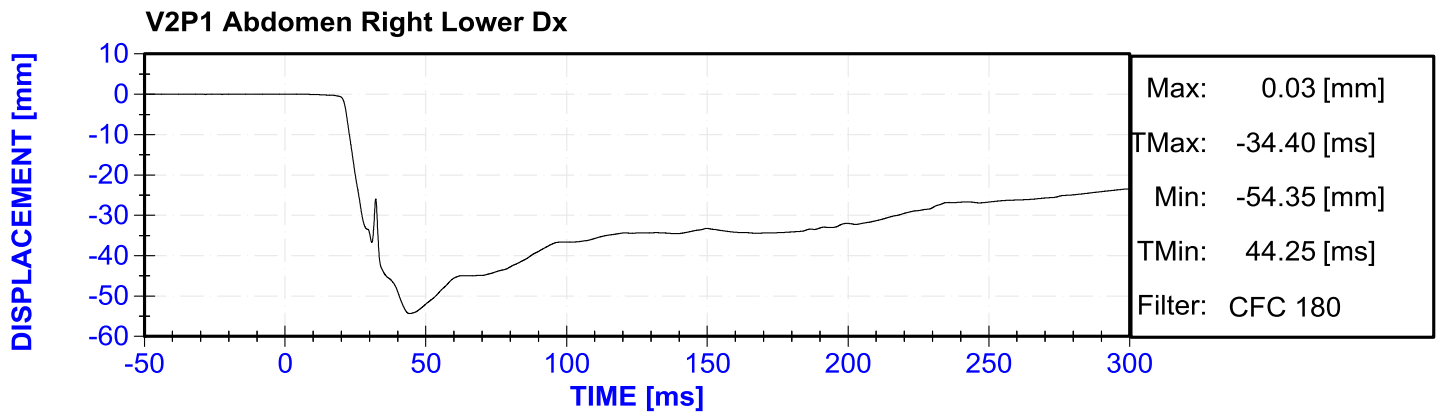
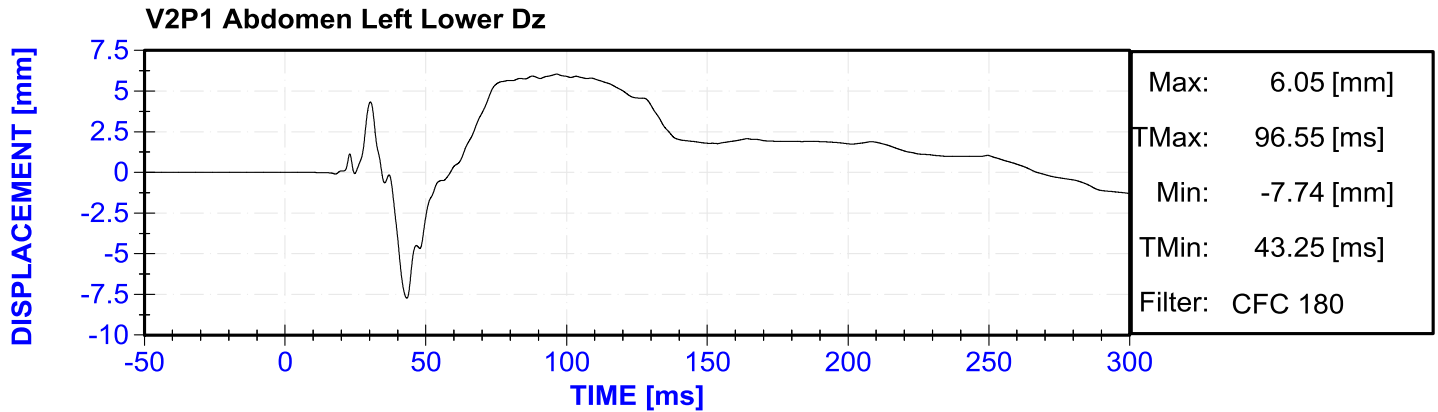












APPENDIX C

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

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Table1	Dummy Information	C-3
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Table 1 – Dummy Information

TYPE	DESCRIPTION	SERIAL NUMBER
THOR	50 TH Male	0007
Hybrid III	5 th Female	N/A

Table 2 – THOR6 Set File

LFTX	LFTY	LFTZ	RFTX	RFTY	RFTZ
Left Ankle X Rotation	Left Ankle Y Rotation	Left Ankle Z Rotation	Right Ankle X Rotation	Right Ankle X Rotation	Right Ankle X Rotation
-0.45826	14.266	0	-0.26949	10.57	0

Table 3 - THOR Dummy Initial SetUp Information

THOR – NT S/N: 0006									Sensitivit y (JARI)	Sensitivit y (GESAC)	Setup Angle (GESAC)
Sensor	Description/ Axis	MFG	Capacit y	Unit 1	Unit 2	Range	Direction	CF C	V/Unit -1	V/Unit-1	Degrees
NKCRP	Upper Right Base										
Thorax CRUX	Upper Right Mid										
Thorax CRUX	Upper Right Elbow										
Thorax CRUX	Upper Left Base										
Thorax CRUX	Upper Left Mid										
Thorax CRUX	Upper Left Elbow										
Thorax CRUX	Lower Right Base										
Thorax CRUX	Lower Right Mid										
Thorax CRUX	Lower Right Elbow										
Thorax CRUX	Lower Left Base										
Thorax CRUX	Lower Left Mid										
Thorax CRUX	Lower left Elbow										
Thorax CRUX	Right Abdomen X										
DGSP	Right Abdomen Y										
DGSP	Right Abdomen Z										
DGSP	Left Abdomen X										
DGSP	Left Abdomen Y										
DGSP	Left Abdomen Z										
DGSP	Upper Right Base										

Table 4: Pre-Test Inspection Sheet

THOR Inspection Checklist

Date: July 27, 2011
NHTSA Representative: James Saunders
Witness(es):
Inspection type (circle one): PRE POST
Dummy S/N: 007
Dummy Description: THOR 007
Date of last Certification or Inspection:
<u>Tests conducted since last full certification or inspection:</u> Ford Fiesta RB0225
<u>Known errors in data channels (no data, clipping, unexpected drops):</u>
<u>Physical evidence of damage:</u>
<u>Anecdotal evidence of damage:</u>
<u>Equipment delivered to Borrower:</u> THOR S/N 07 has THOR 06's Femurs installed

HEAD	
☒ Y / N	Rear head cap mounts securely to head
☒ Y / N	Head skin fits securely over skull
☒ Y / N	Head skin shows no sign of tears or damage
☒ Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
☒ Y / N	Head securely mounted to OC joint
OTHER	
NECK	
☒ Y / N	Neck cables slide freely through holes in neck plates
☒ Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / ☒ N	No evidence of debonding between neck pucks and plates If N – indicate which interface (where plate/puck 1 attach to upper neck load cell): - Debonding between pucks 4-5 posterior
Y / ☒ N	No evidence of debonding or permanent compression in neck soft stop assemblies - Front soft stop is loose / detaches
☒ 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



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 - Scuffs/ Abrasions on the left and right pads
☒ Y / N	Clavicles securely attached to sternum and shoulder - Slight movement at ends but secure
Y ☒ N	No evidence of debonding, tearing, or permanent compression of posterior soft stops - Left soft stop debonding (top surface)
OTHER	
THORAX	
Y ☒ N	No evidence of contact at top, bottom, or interior faces of rib damping material - Left / Right Rib #4 interior faces show contact
Y / ☒ N	No evidence of debonding between rib damping material and ribs - Rib #5 left side debonding
☒ Y / N	CRUX anterior arms securely attached to anterior ribs
☒ Y / N	CRUX posterior arms securely attached to double gimbals, spine
☒ Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration
☒ Y / N	Ribs securely attached to posterior spine
Y ☒ N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners) - Left side Rib #4 has a slight gap - Right side Rib #5 has a slight gap
OTHER	
ABDOMEN	
Y ☒ N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper - Small tear on the top left side

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 - Broken stitches on the top right corner
☒ Y / N	Lower abdomen insert securely attached to spine
☒ Y / N	Lower abdomen insert shows no evidence of permanent set
OTHER	
PELVIS	
☒ Y / N	Pelvis flesh fits securely over pelvis bones
☒ Y / N	H-point tool fits securely into hole on both sides of pelvis
OTHER	
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 - Cuts and scuffing on both of the knee flesh areas
OTHER	
LOWER EXTREMITY (LX)	
☒ Y / N	Rotational potentiometers in ankle securely attached
☒ Y / N	Achilles tendon provides resistance to dorsiflexion

Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
OTHER	Horizontal cut in flesh on the right shin
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
OTHER	

Table 5: Post-Test Inspection Sheet

THOR Inspection Checklist

Date: August 30, 2011	
NHTSA Representative: James Saunders	
Witness(es):	
Inspection type (circle one):	PRE POST
Dummy S/N: 007	
Dummy Description: THOR 007	
Date of last Certification or Inspection:	
<u>Tests conducted since last full certification or inspection:</u> Smart For Two RB0526	
<u>Known errors in data channels (no data, clipping, unexpected drops):</u> 	
<u>Physical evidence of damage:</u> 	
<u>Anecdotal evidence of damage:</u> 	
<u>Equipment delivered to Borrower:</u> 	

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 - Gash on the upper left forehead
☒ Y / N	Interior components of skull cavity (ballast, accelerometer mount, accelerometers) securely attached
Y / ☐ N	Head securely mounted to OC joint - Lateral wobble in the OC joint, but securely mounted
OTHER	
NECK	
☒ Y / N	Neck cables slide freely through holes in neck plates
☒ Y / N	Neck cables show no sign of fraying, broken strands, or kinking
Y / ☒ N	No evidence of debonding between neck pucks and plates If N – indicate which interface (where plate/puck 1 attach to upper neck load cell): - Debonding between pucks 4-5 (rear)
Y / ☒ N	No evidence of debonding or permanent compression in neck soft stop assemblies - Front soft stop is loose
☒ 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

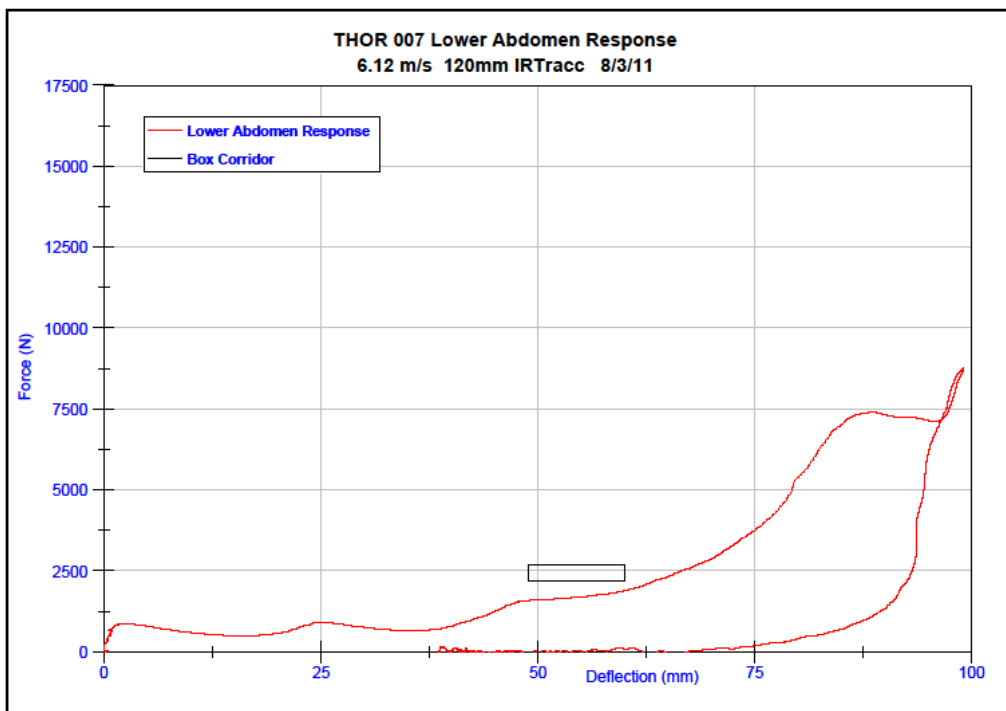
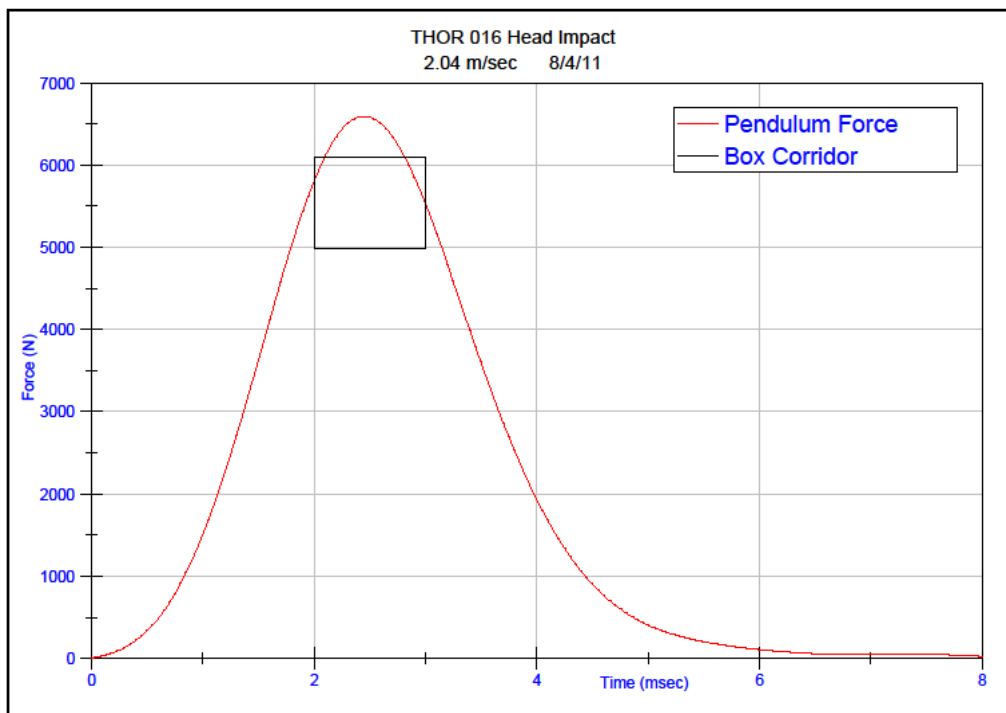


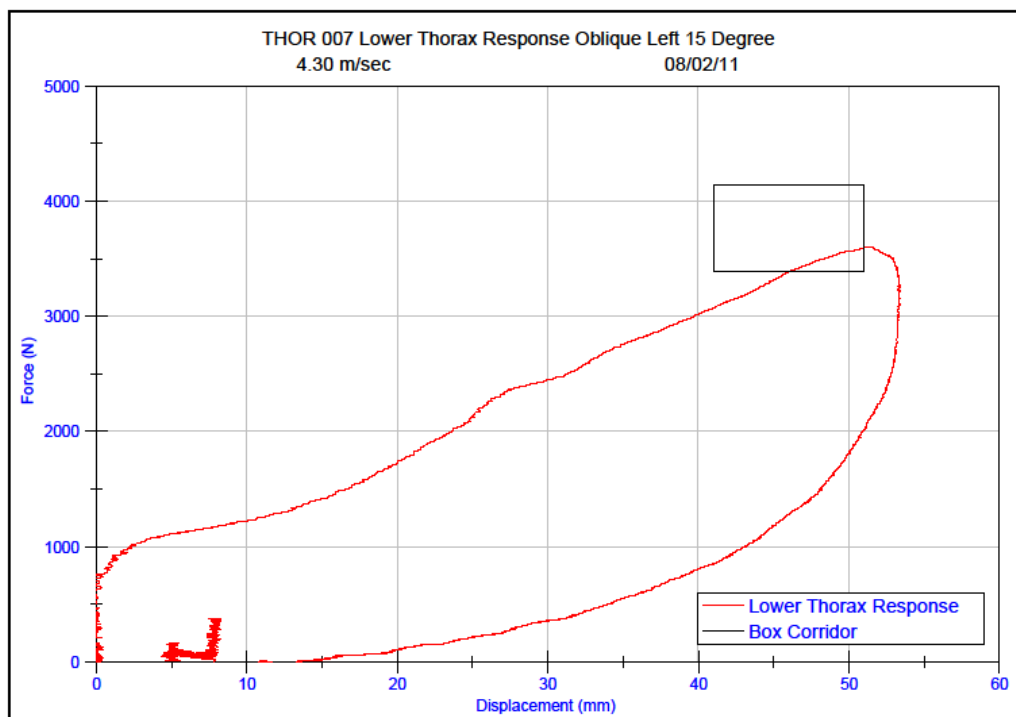
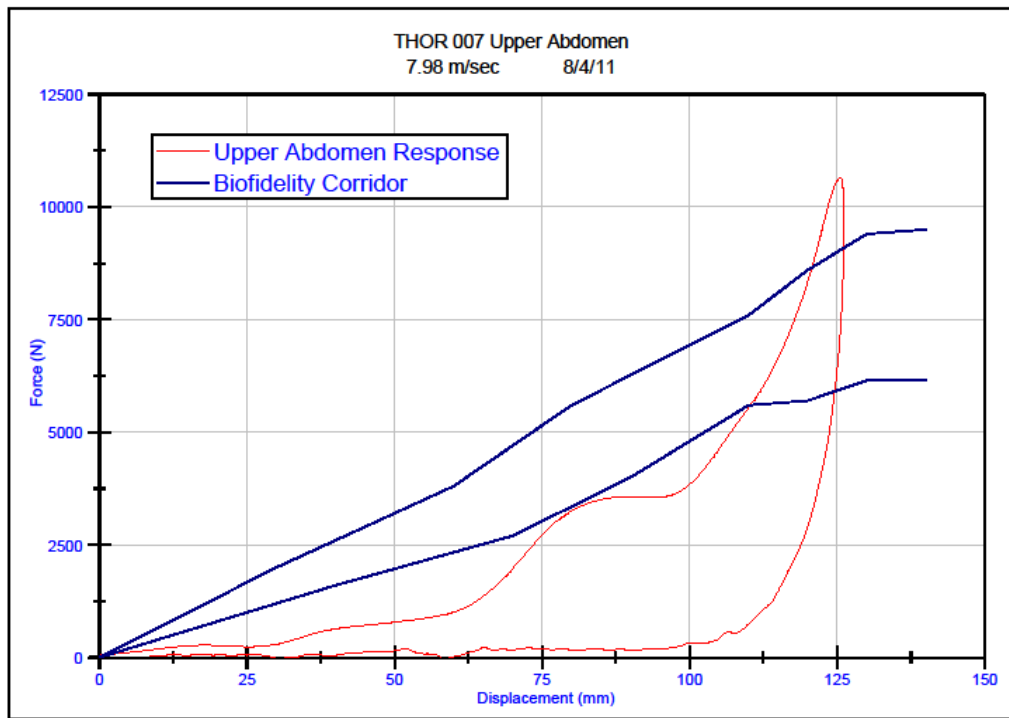
Y / N	No evidence of debonding between lumbar spine flex joint and metal plates
☒ Y / N	Lumbar spine pitch change joint mechanism mating teeth are engaged
OTHER	
SHOULDER	
Y ☒ N	Urethane shoulder pads show no evidence of contact - Scuffs on the left and right pads
☒ Y / N	Clavicles securely attached to sternum and shoulder
Y ☒ N	No evidence of debonding, tearing, or permanent compression of posterior soft stops - Left soft stop debonding
OTHER	
THORAX	
Y ☒ N	No evidence of contact at top, bottom, or interior faces of rib damping material - Left / Right Rib #4 contact interior
☒ Y / N	No evidence of debonding between rib damping material and ribs
☒ Y / N	CRUX anterior arms securely attached to anterior ribs
☒ Y / N	CRUX posterior arms securely attached to double gimbals, spine
☒ Y / N	Urethane bib is securely attached to ribs with no sign of tearing or washer penetration
☒ Y / N	Ribs securely attached to posterior spine
Y ☒ N	Rib stiffeners show no evidence of bending (no gaps between ribs and stiffeners) - Left side Rib #4 - Right side Rib #5
OTHER	
ABDOMEN	
Y ☒ N	No evidence of tearing, cuts, or broken stitches in upper abdomen bag and zipper - Small cut on the top left

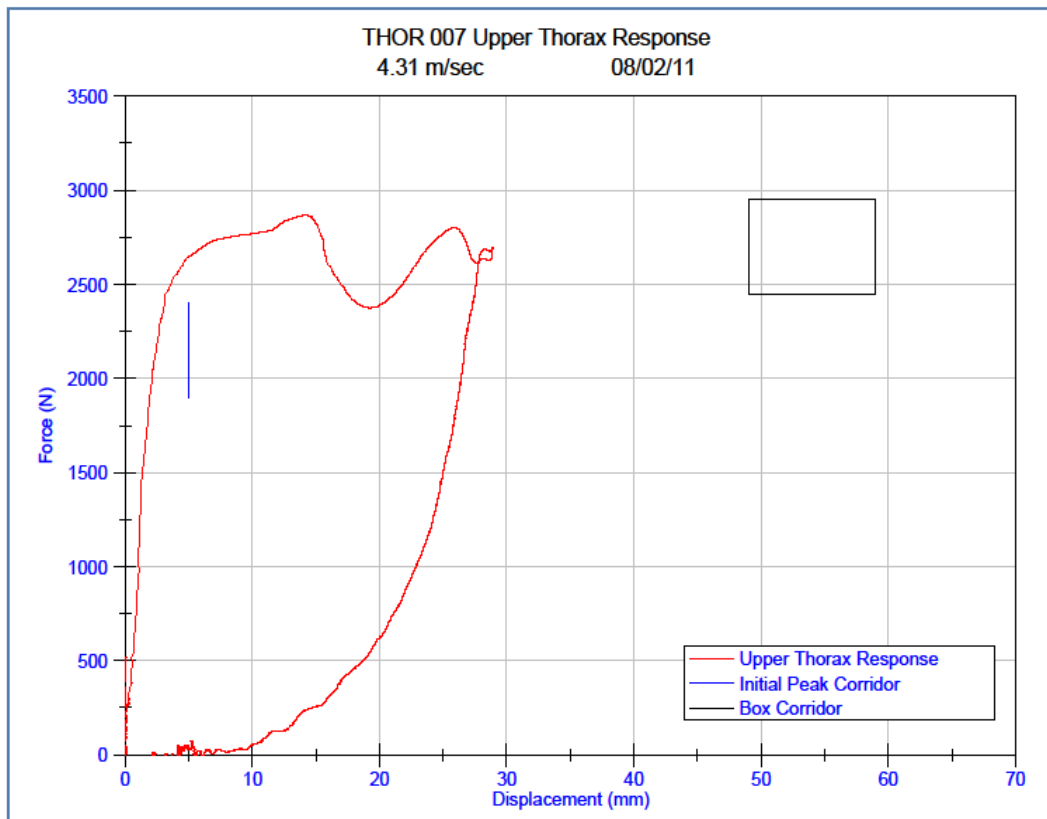
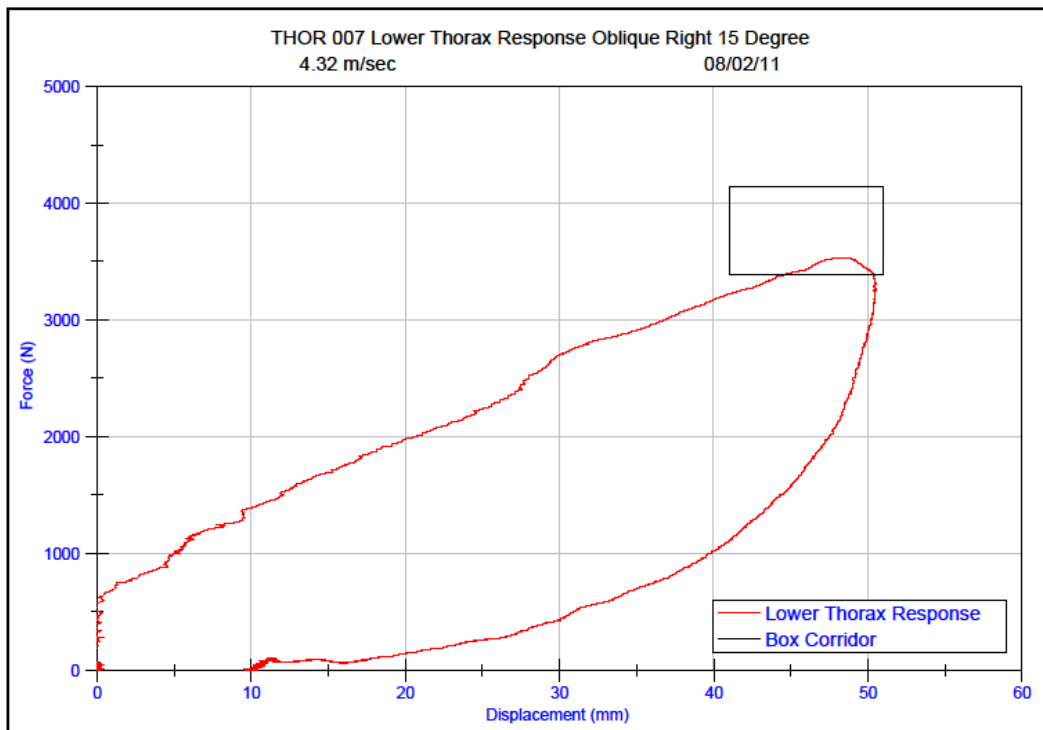
Y / N	Upper abdomen insert securely attached to spine
☒ Y / N	Upper abdomen insert shows no evidence of permanent set
Y / ☒ N	No evidence of tearing, cuts, or broken stitches in lower abdomen bag and zipper - Broken stitches on the top right corner
☒ Y / N	Lower abdomen insert securely attached to spine
☒ Y / N	Lower abdomen insert shows no evidence of permanent set
OTHER	
PELVIS	
☒ Y / N	Pelvis flesh fits securely over pelvis bones
☒ Y / N	H-point tool fits securely into hole on both sides of pelvis
OTHER	
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 - Cuts and scuffing on both of the knee flesh areas - Gash on the left knee
OTHER	
LOWER EXTREMITY (LX)	
☒ Y / N	Rotational potentiometers in ankle securely attached
☒ Y / N	Achilles tendon provides resistance to dorsiflexion

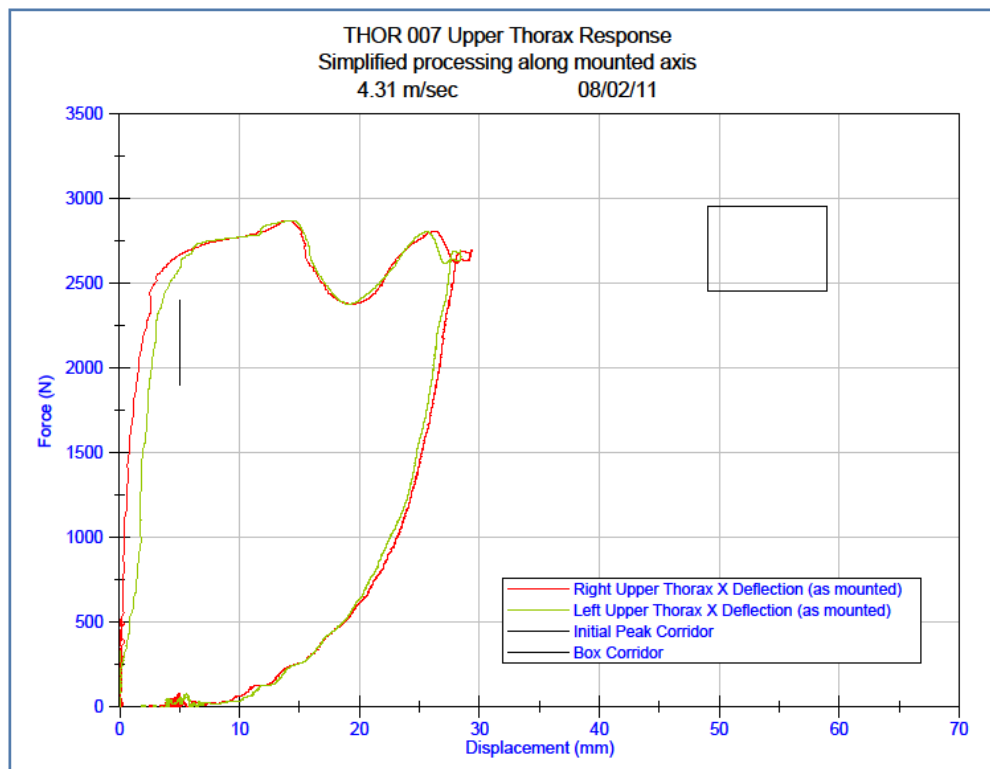
Y / N	No evidence of debonding, tearing, or permanent compression of ankle soft stops
OTHER	Puncture on the upper left shin
JACKET	
☒ Y / N	Rib stiffeners show no sign of permanent deformation
☒ Y / N	No evidence of tears or holes in jacket fabric, velcro, or zippers
OTHER	

Dummy Calibration Plots

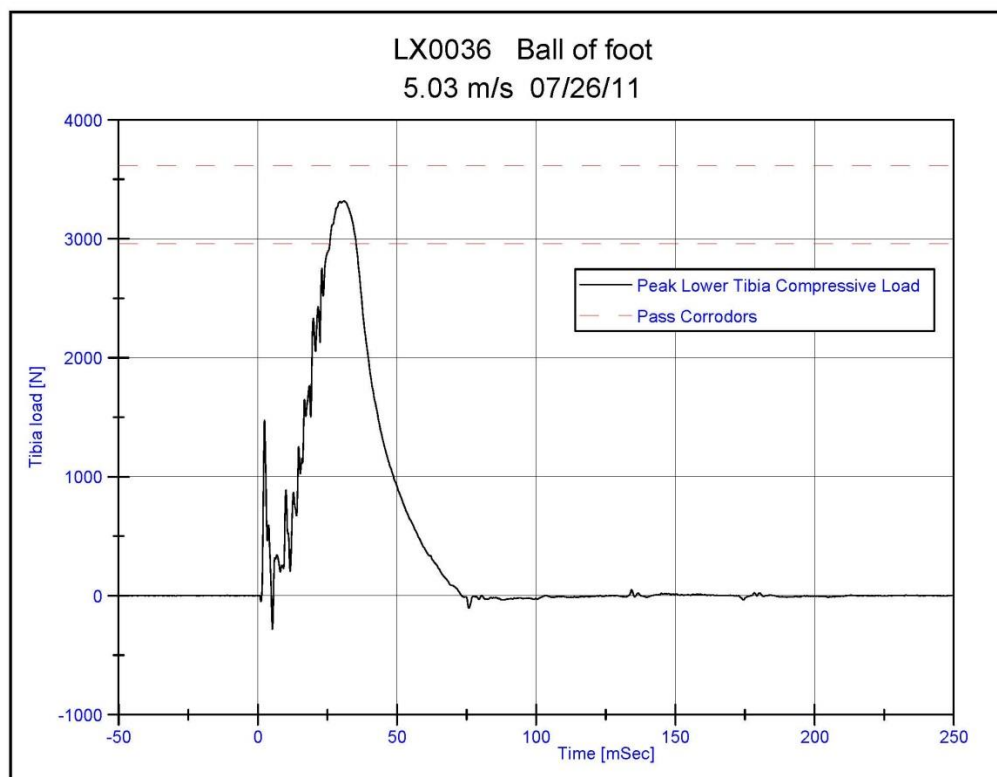


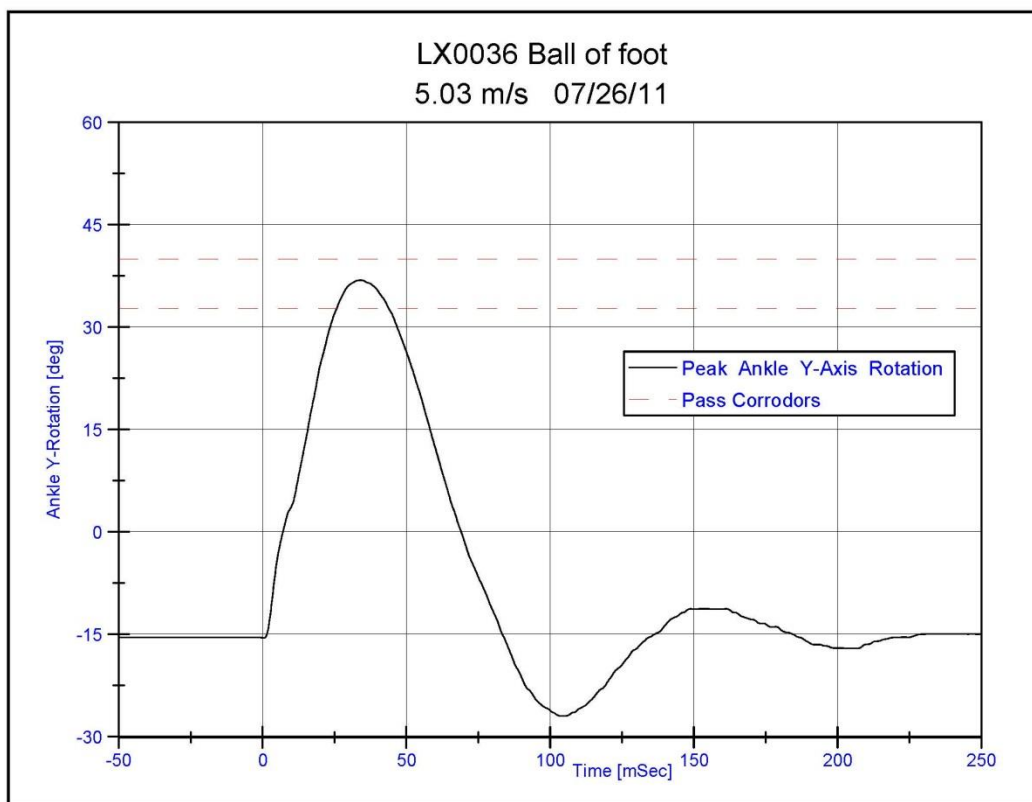
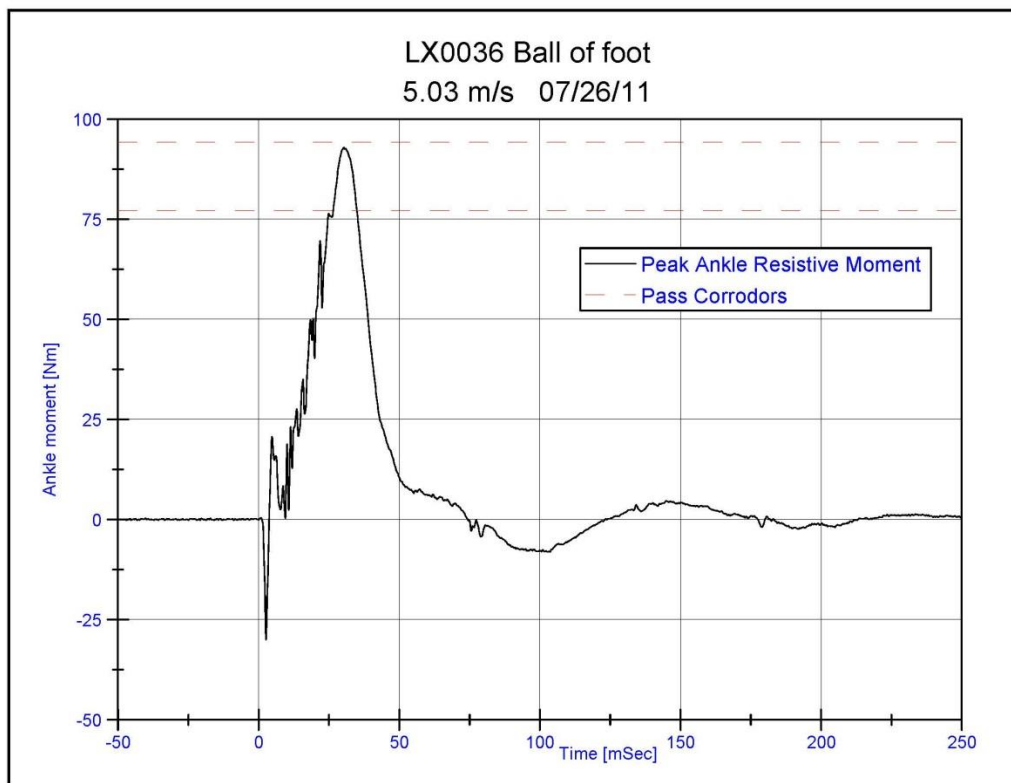


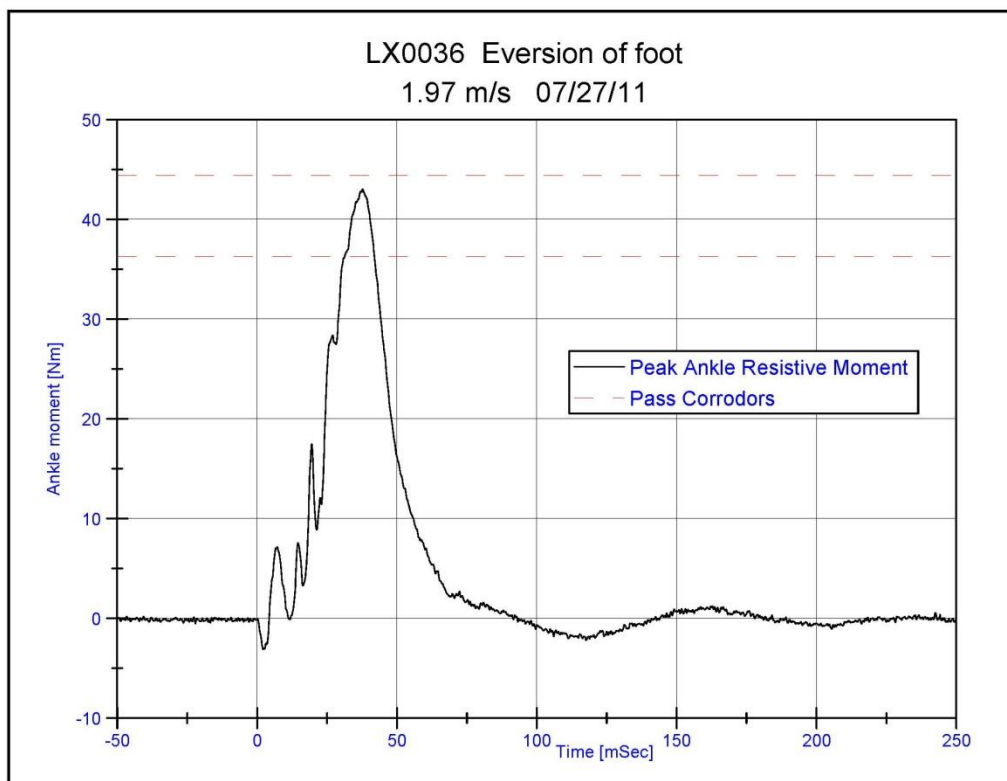
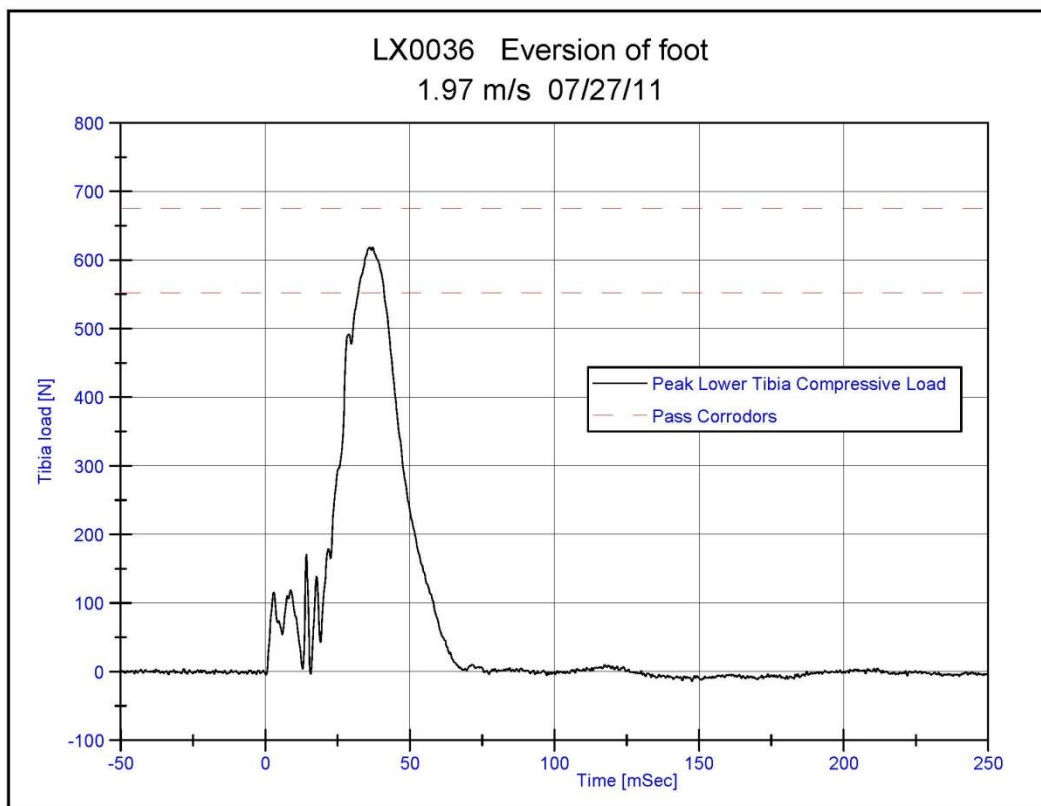


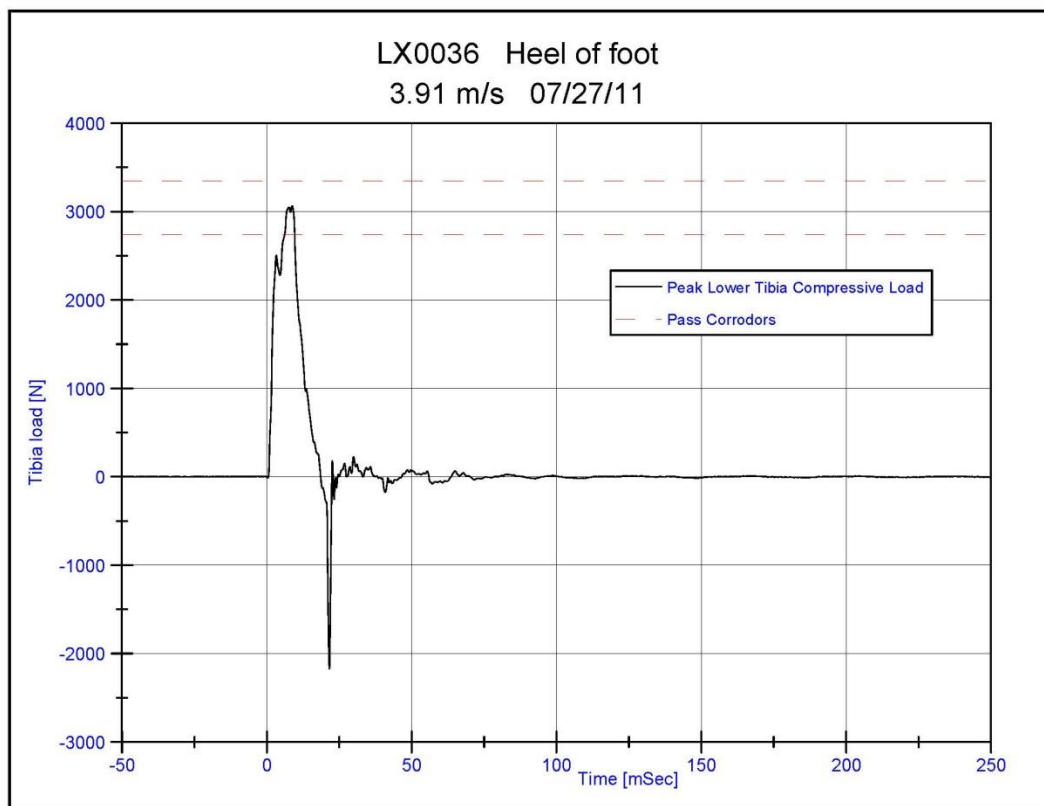
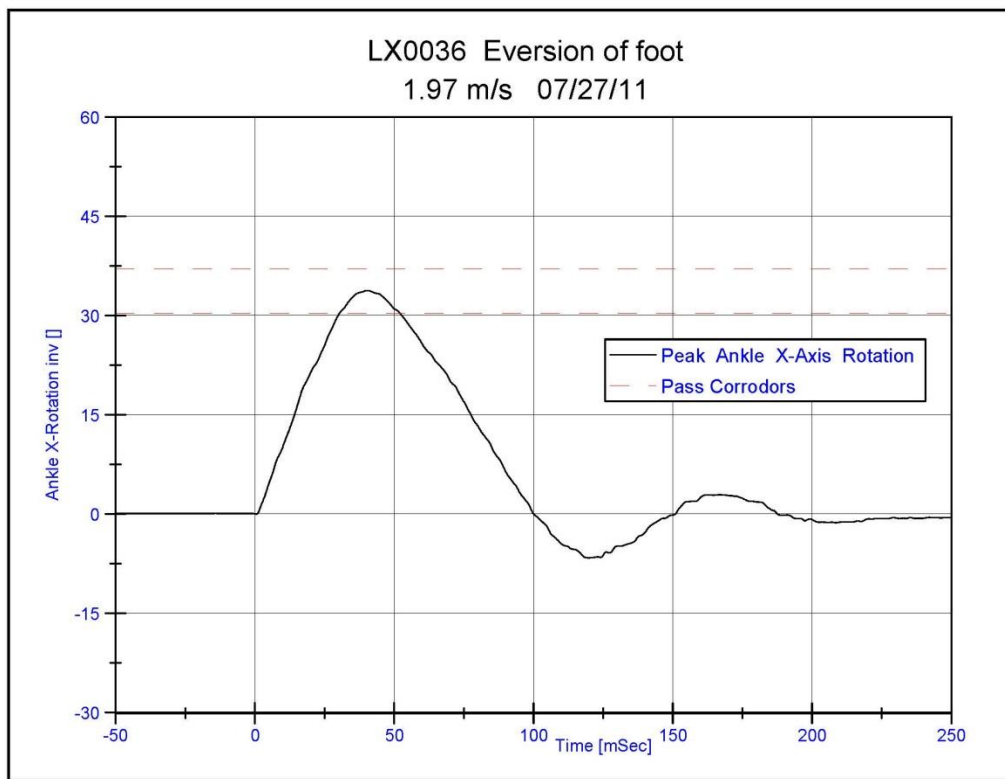


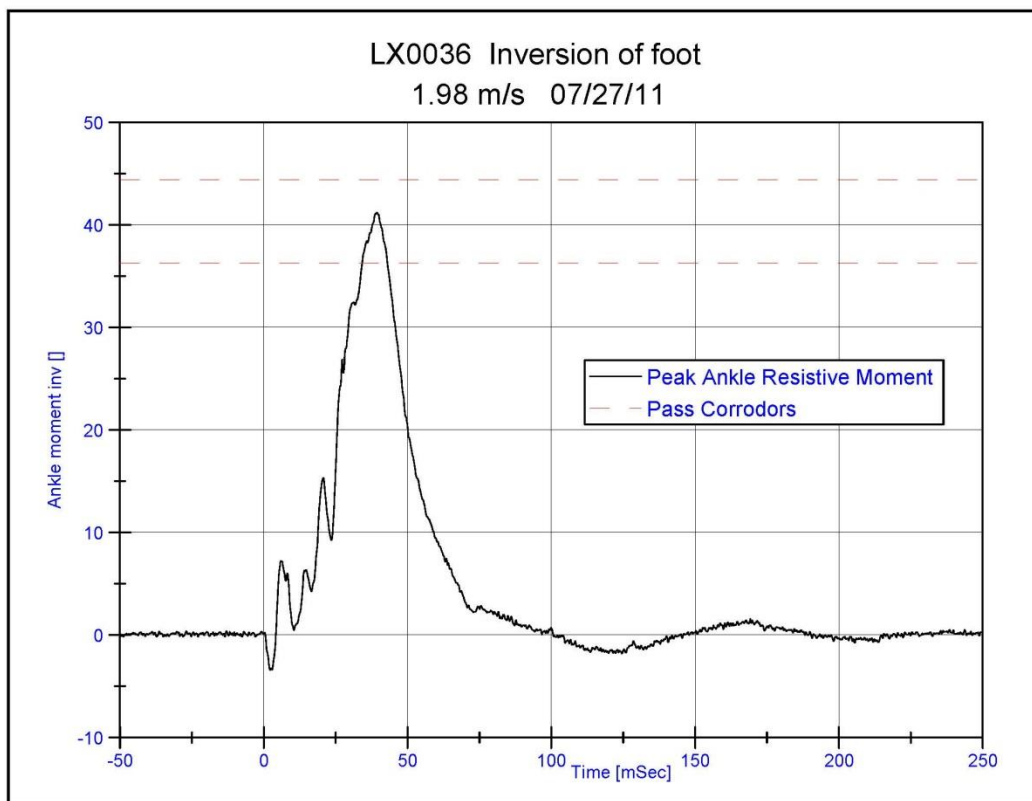
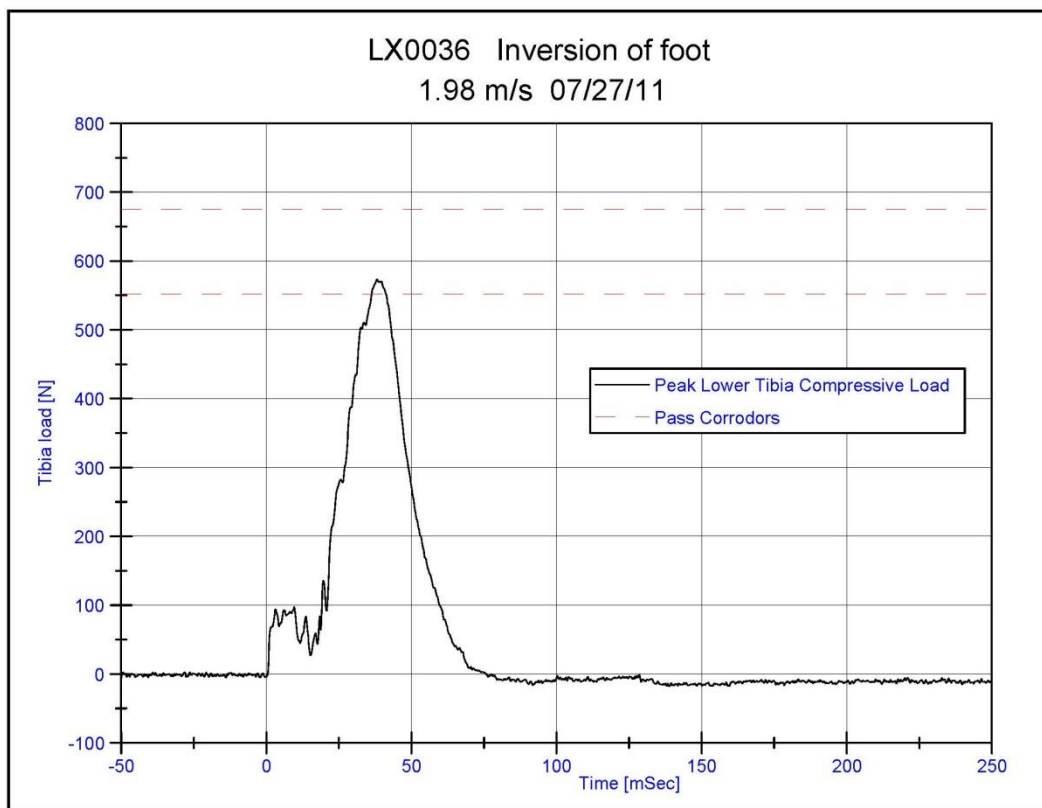
LEG S/N: LX036 / LX037

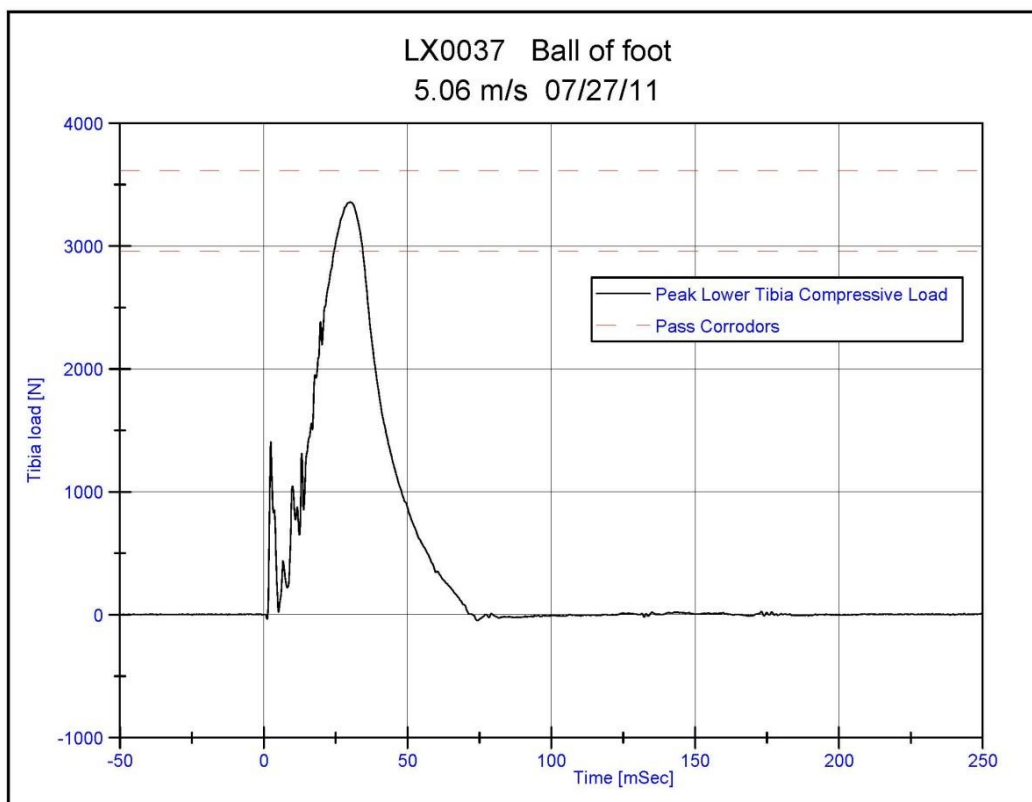
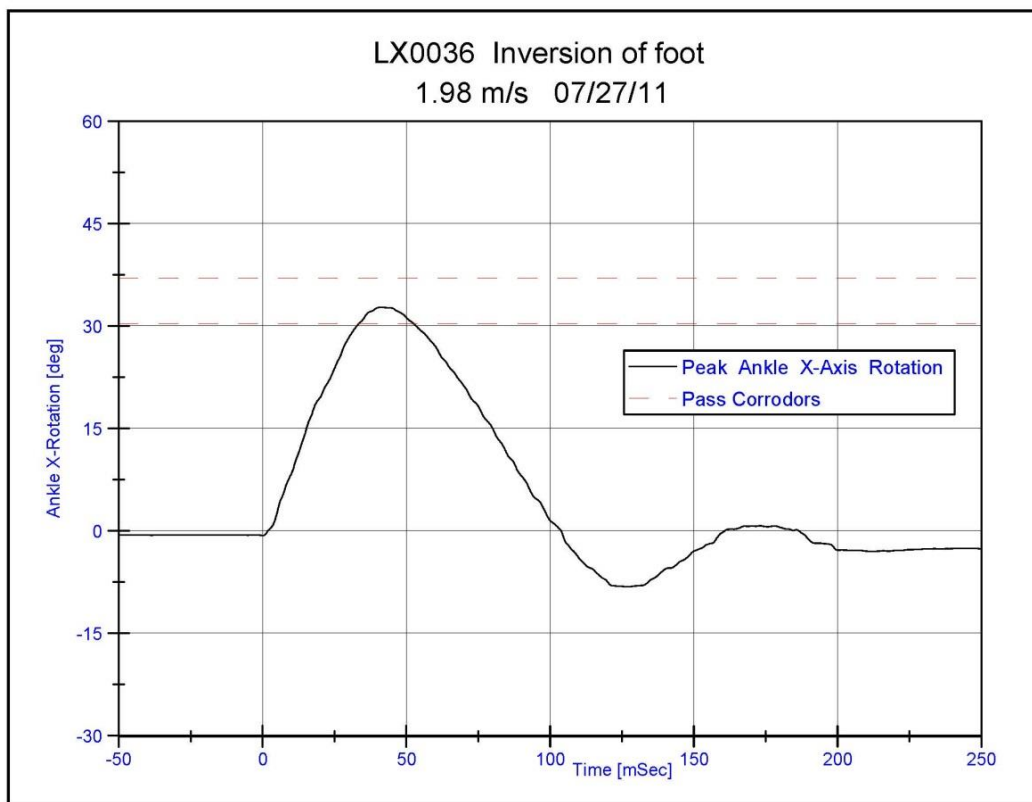


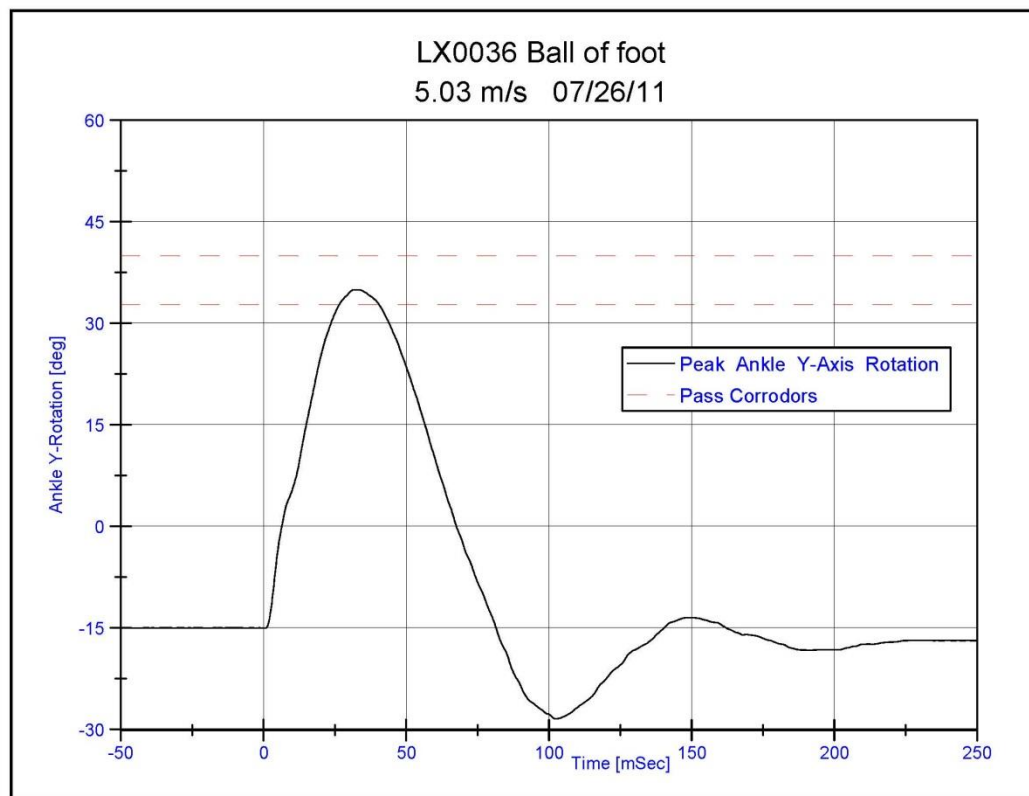
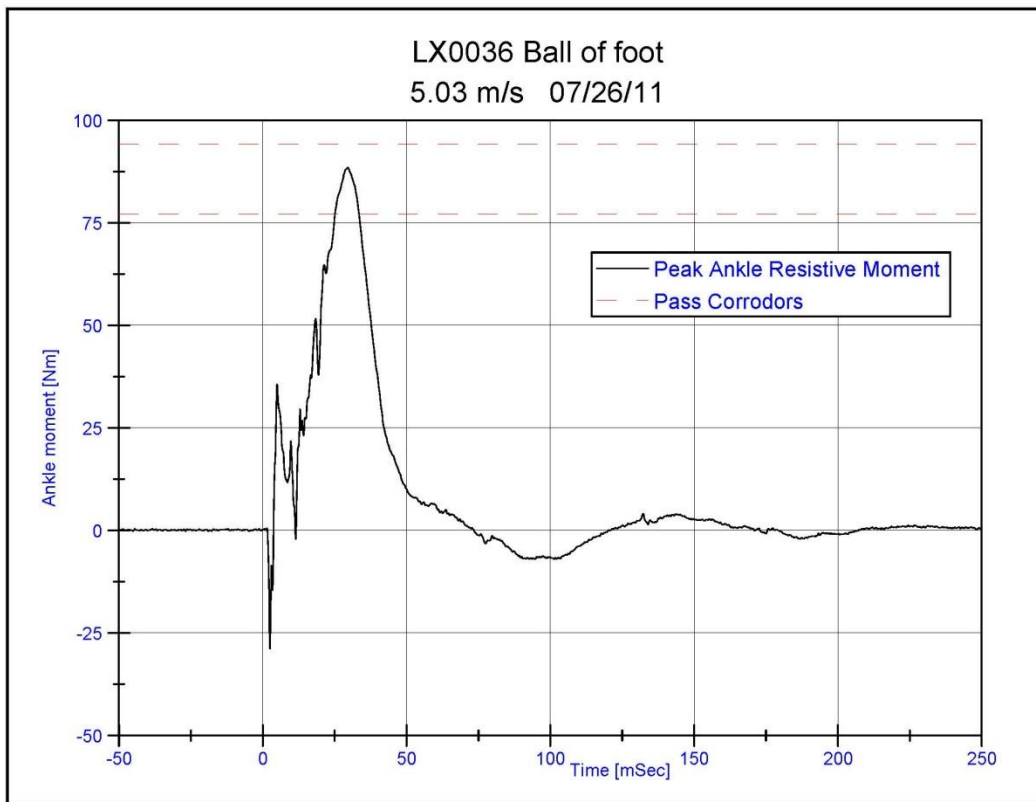


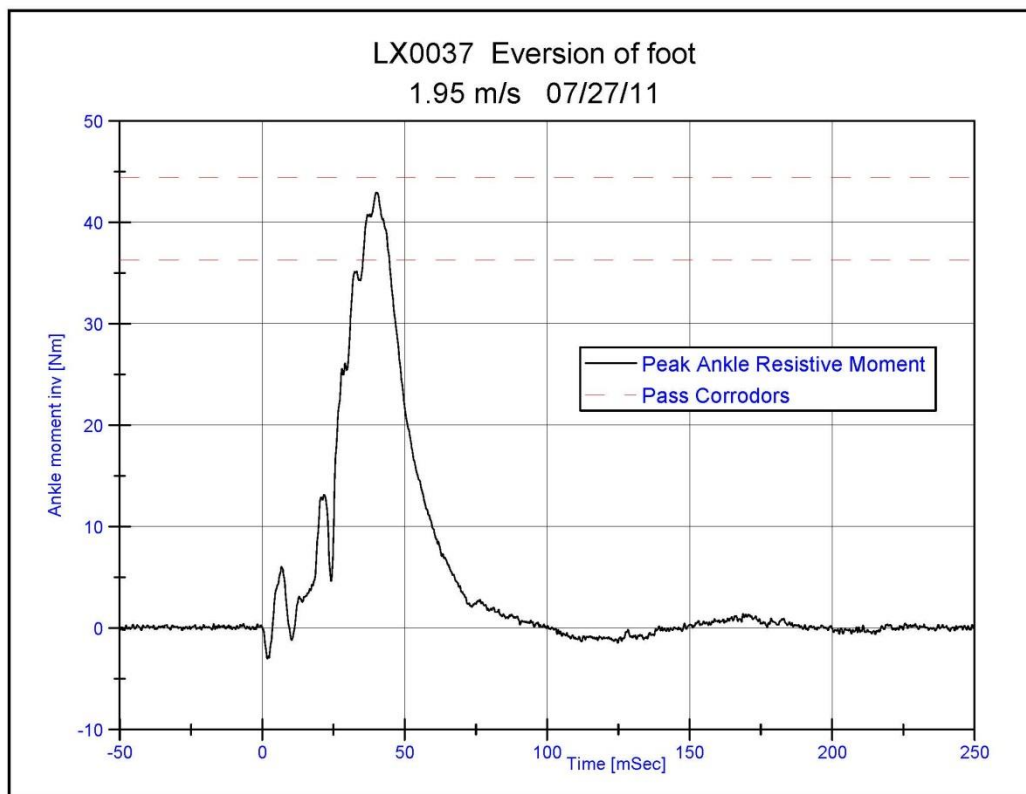
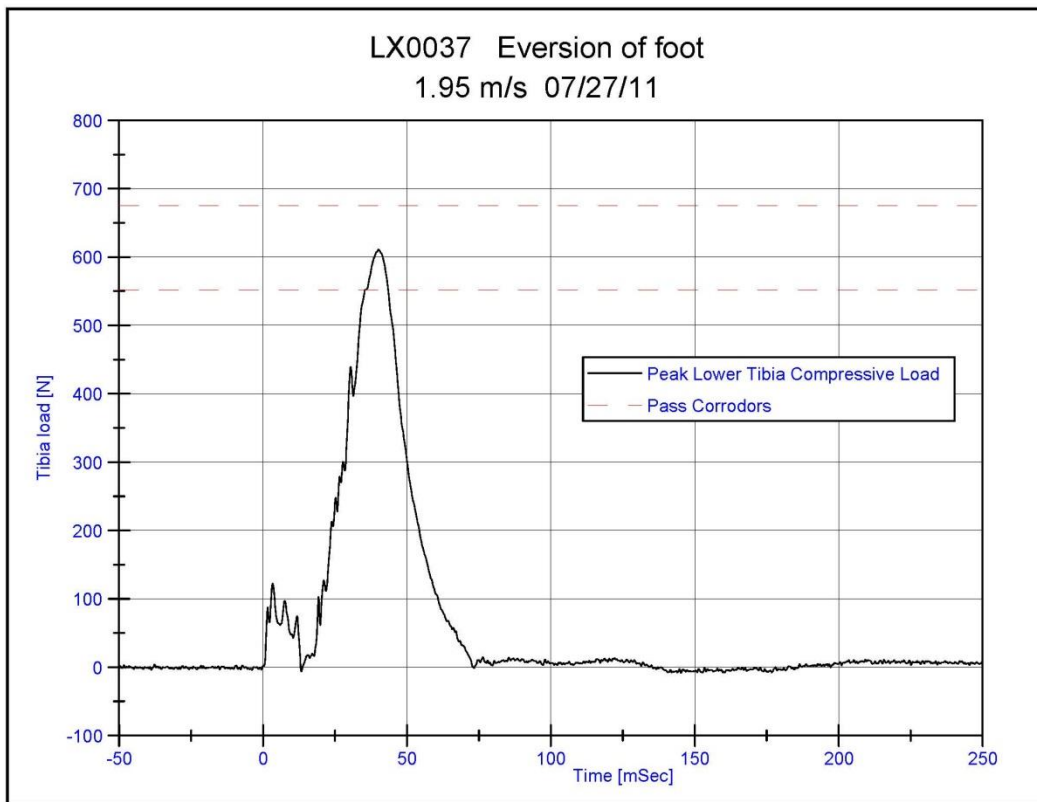


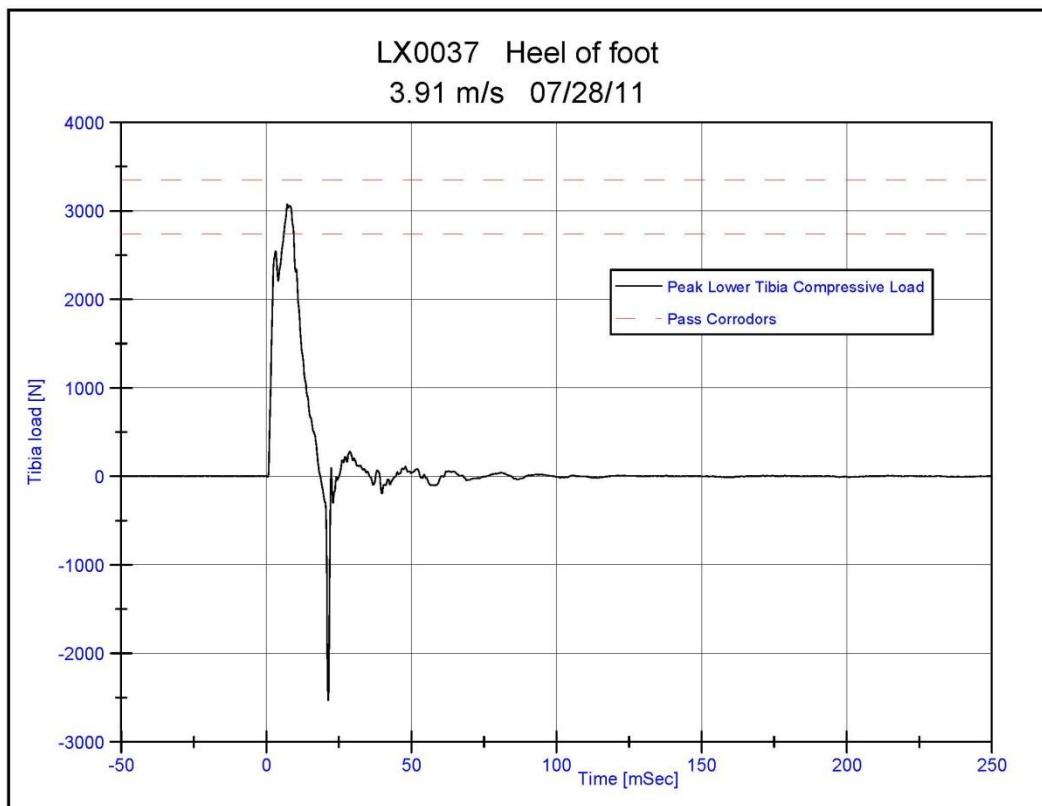
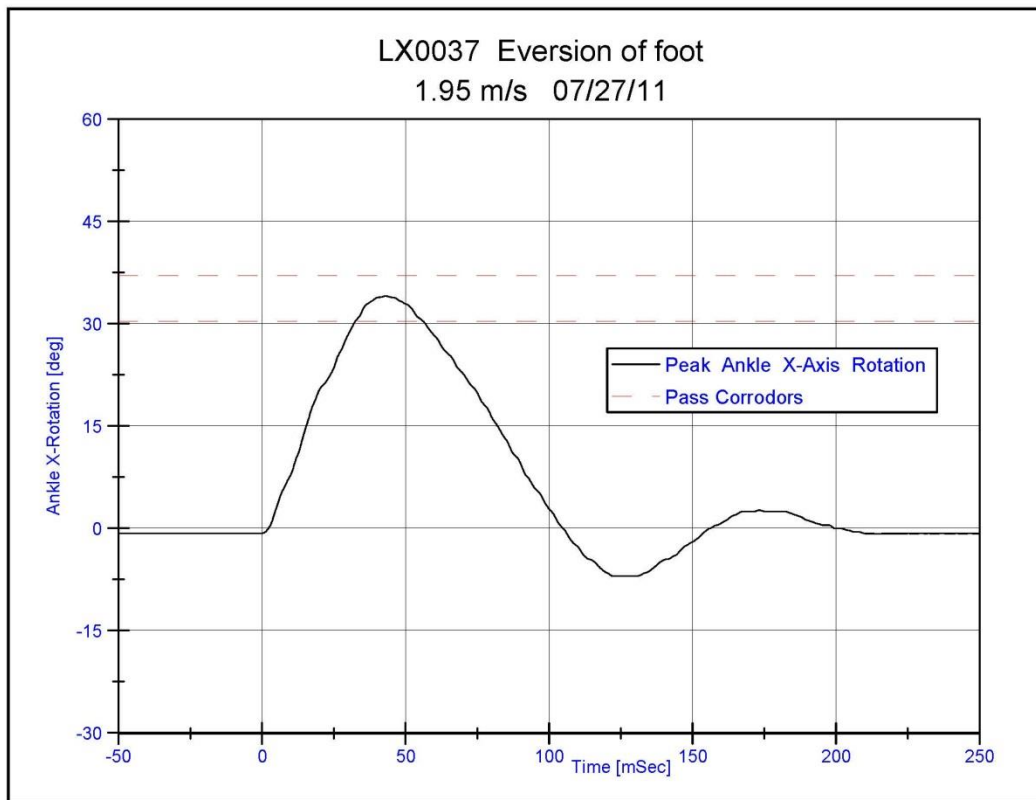


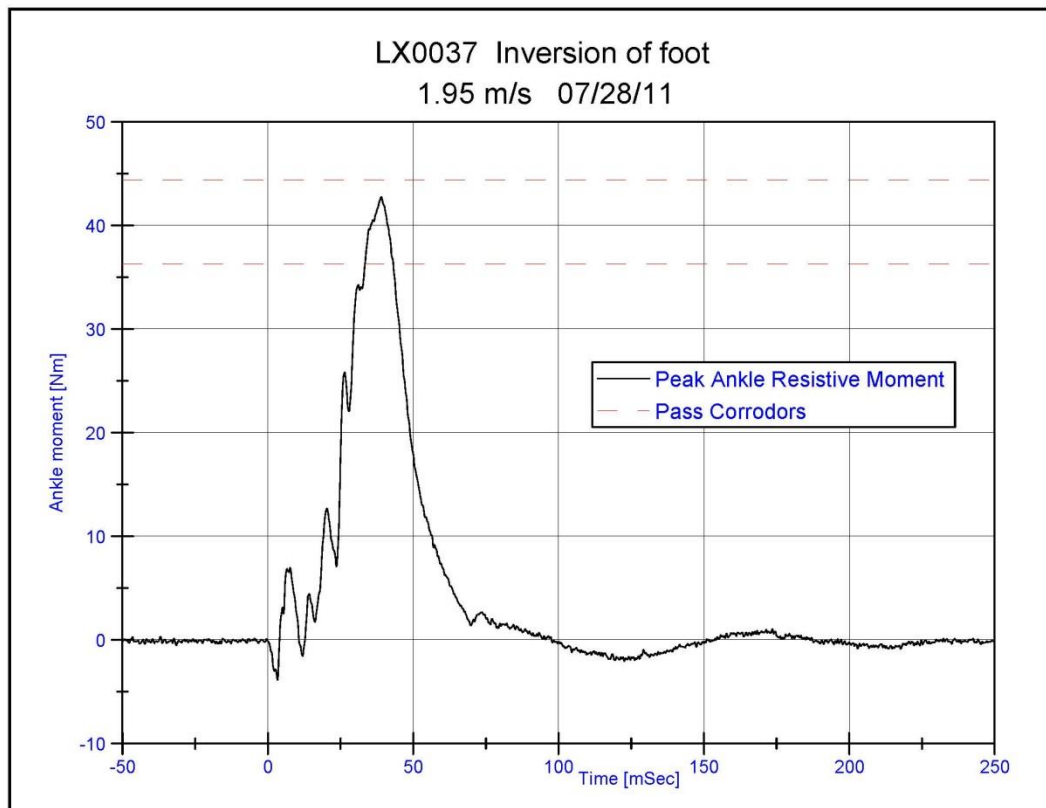
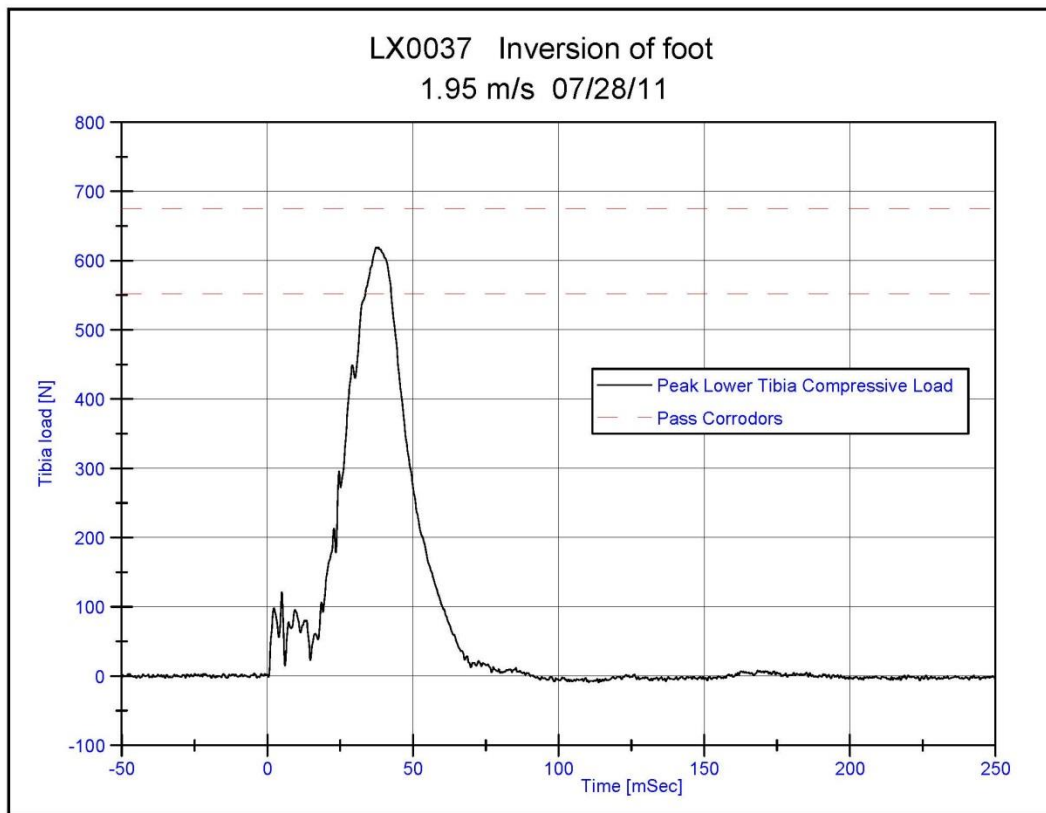


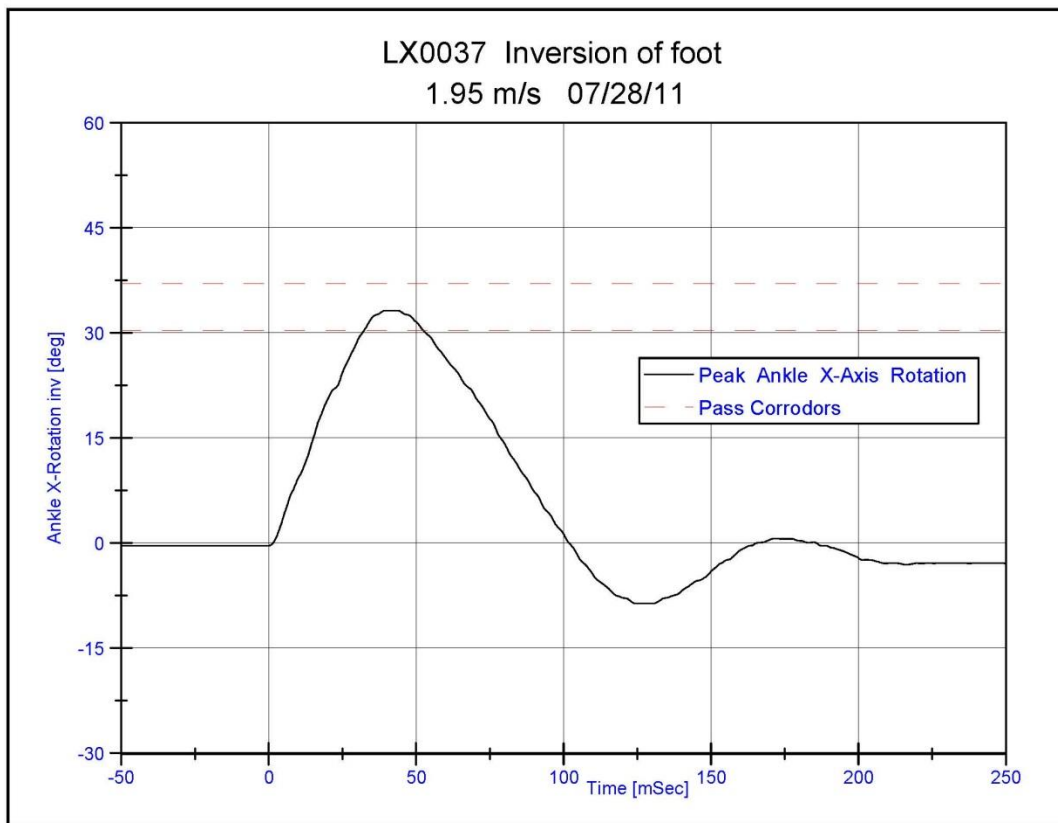












APPENDIX D

ADDITIONAL MEASUREMENTS & DATA CALCULATIONS

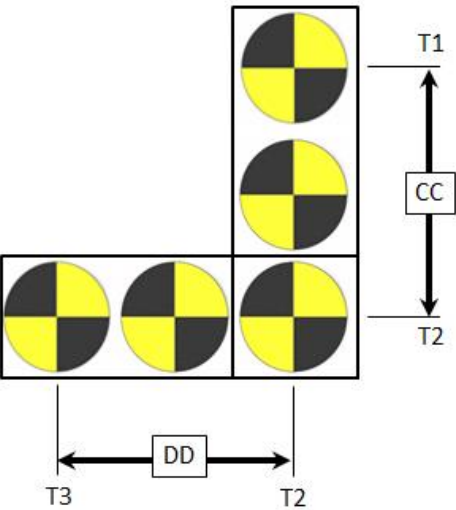
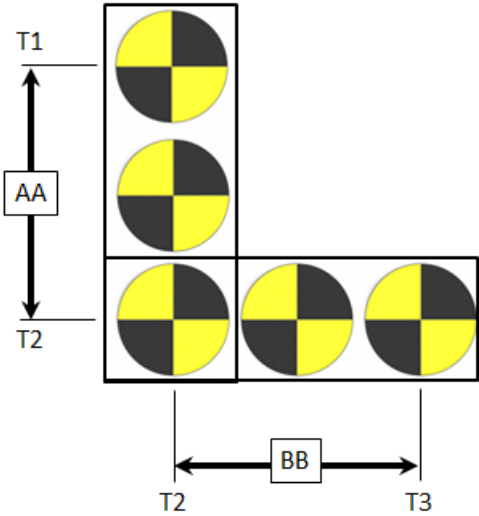
ADDITIONAL TARGETS

Overhead Reference Targets:

AA (T1 to T2)	<u>236</u>	mm
BB (T2 to T3)	<u>236</u>	mm

Ground Reference Targets:

CC (T1 to T2)	<u>236</u>	mm
DD (T2 to T3)	<u>236</u>	mm



APPENDIX E

Positioning Procedure for rear seat Part 572O 5th female ATD

The rear seat 5th female was positioned using a combination of the FMVSS 214D side impact and FMVSS 208 seating procedures.

The lateral seat centerline was determined by following the FMVSS 214D seating procedures for the rear seat.. Once the Part 572O 5th female dummy was located on the lateral centerline, the dummy was positioned following FMVSS 208 as if would be if it were in the front seating position. The legs would be positioned at the 120 degree angle and the pelvis would be pushed back against the seatback until the calves contacted the seat cushion. If the seatback was adjustable, the seatback would be raised to level the head. The 5th female dummy used in this test series had a lower neck transducer which prevented using the neck bracket as an adjustment to level the head.

APPENDIX F

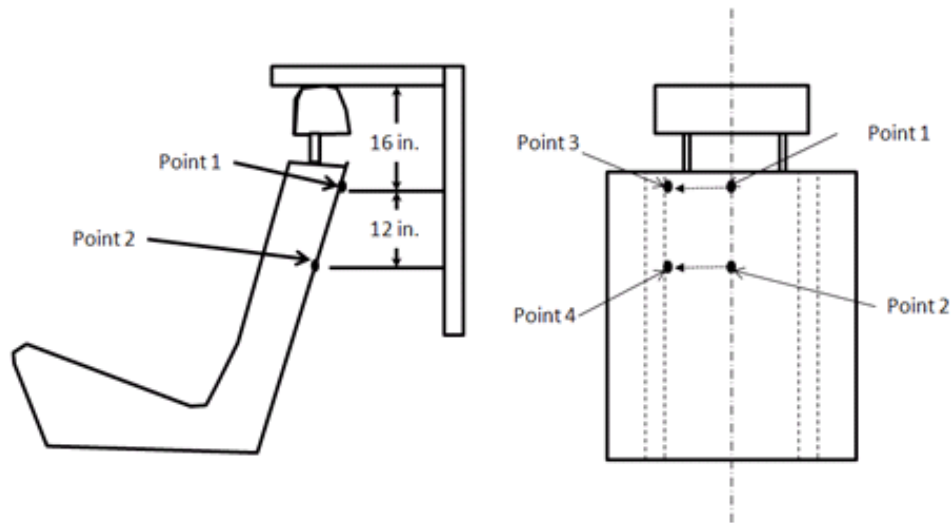
CMM MEASUREMENT PROCEDURES

SECTION F.1

SEAT BACK MEASUREMENT PROCEDURE

The following procedure was used in obtaining the required seat back measurements, please see the below diagram for additional clarification:

1. Measure Points 3 and 4 on the using the following method after positioning the dummy and head restraint:
2. Place a level at the center of the head restraint and make sure it is level to the horizontal
3. Measure down 16 inches from the bottom of the level in the vertical direction
4. Project a line in the longitudinal direction until contact with seat and mark point 1 with a marker
5. Project another line in the longitudinal direction until contact with seat and mark point 2 with a marker
6. Push on the seat fabric at point 1 and determine if there is any structure. Do not push in the longitudinal direction more than an inch
7. If no structure found push on the seat cloth and move in the lateral direction toward the outboard of the seat until seat structure is found
8. Cut a slit in the seat fabric
9. Mark Point 3 at the begin on the structure and measure the point
10. Perform the same procedure to determine Point 4 using Point 2



SECTION F.2

DOOR SILL INTRUSION MEASUREMENT PROCEDURE

The following procedure was conducted in order to obtain the required door sill intrusion measurements for this test. Please see the below picture for further clarifications:

1. Put steering wheel in center position. Create a horizontal plane (plane 1) that passes through the center of the steering wheel.
2. Point 1: Mark the sheet metal at the intersection of plane 1 and the outer edge of rubber part of the door sill running down the A-pillar.
3. Point 22: Mark the sheet metal at the intersection of plane 1 and the outer edge of rubber part of the door sill running down the B-pillar.
4. Mark 20 evenly spaced points between points 1 and 22 along the outer edge of the rubber door sill on the sheet metal. (A tape measure can be used to mark these points).
5. Mark 20 evenly spaced points between points 22 and 1 along the outer edge of the rubber door sill on the sheet metal. (A tape measure can be used to mark these points).
6. Measure points using CMM
7. Record in the appropriate data sheet and calculate the difference by subtracting the post-test minus the pre-test. A picture with the points labeled shall be included on the data sheet. All points shall be visible in the pictures.

8. Repeat on the passenger door.



SECTION F.3

VEHICLE EXTERIOR CRUSH PROFILE PROCEDURE

1. Expose the bumper beam and level the vehicle such that all attitudes are within 5 mm.
2. Cross section A-A is defined as a horizontal plane passing through the center of the front bumper beam at the centerline of the vehicle (Figure F.3.1). Record the height of this plane (d1) and take enough points at this height to create an exterior cross-section of the vehicle.
3. Perform the same procedure for cross-section B-B. Cross section B-B is defined as a plane passing through the top the upper radiator support.
4. Post-test put the vehicle back to its original coordinate system (Figure F.3.2). Take enough points at the height of d1 and d2 to create a post-test cross-section A-A and B-B. There can be more points measured posttest than pre-test (Figure F.3.3). Record these points in the appropriate data sheet.

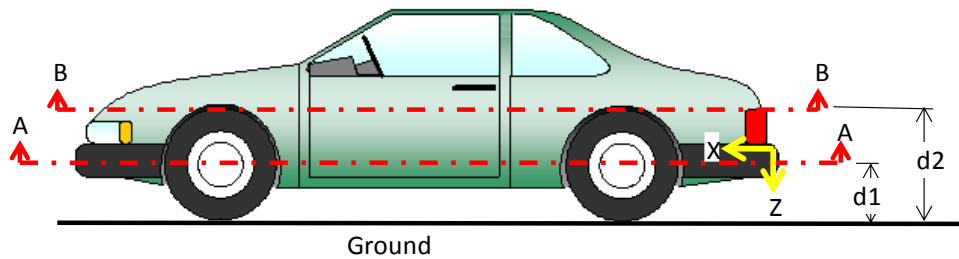


Figure F.3.1 - Pre-Test Cross-Sections

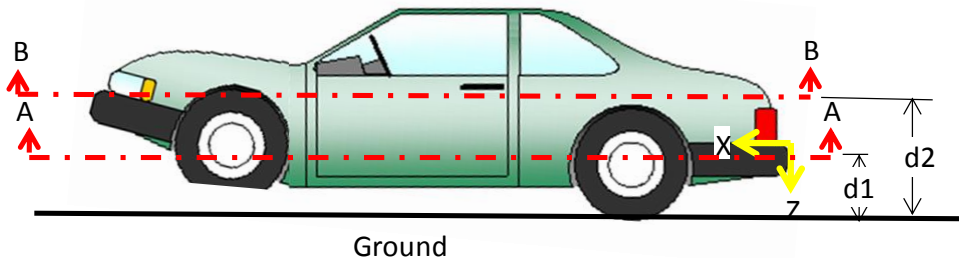


Figure F.3.2 - Post-Test Cross-Sections

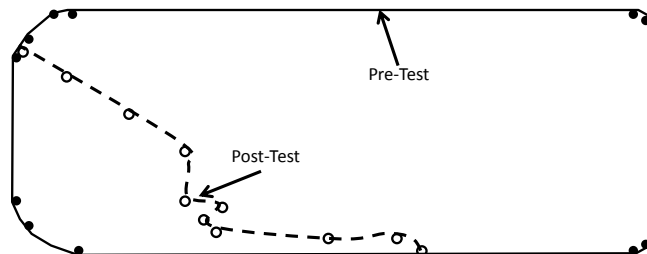


Figure F.3.3 - Plot of Cross-Section

SECTION F.4

DASH PROFILE MEASUREMENT PROCEDURE

The following procedure was used in order to obtain the dash profile measurements required for this test. Please see the diagram on the following page for further clarifications:

1. Left Plane: create a vertical plane that is parallel to the longitudinal axis of the vehicle and is located 150mm to the left of the center of the steering wheel (Figure 31).
2. Left Line: create a line on the IP/Knee Bolster at the intersection of the Left Plane and the IP/KneeBolster
3. L1: create a point on the dash that is located on the Left Line and is 450 mm above the floorboard (with floor mats removed). Note this is the Left IP point for the IP5 file and IP Left in DATA SHEET NO.13 (CONTINUED) - VEHICLE INTRUSION MEASUREMENTS.
4. Lt1: From L1 move up the Left Line 50 mm
5. Lt2: From Lt1 move up the Left Line 50 mm
6. Ltn: Mark points at 50 mm increments along Left Line until the window sill is reached.
7. Lb1: From L1 move down the Left Line 50 mm
8. Lb2: From Lb1 move down the Left Line 50 mm
9. Lbn: Mark points at 50 mm increments along Left Line until the bottom of the IP/Knee Bolster is reached.
10. Right Plane: create a vertical plane that is parallel to the longitudinal axis of the vehicle and is located 150mm to the right of the center of the steering wheel (Figure 31).
11. Right Line: create a line on the IP/Knee Bolster at the intersection of the Right Plane and the IP/KneeBolster
12. R1: create a point on the dash that is located on the Right Line and is 450 mm above the floorboard (with floor mats removed). Note this is the Right IP point for the IP5 file and IP Right in DATA SHEET NO.13 (CONTINUED) - VEHICLE INTRUSION MEASUREMENTS.
13. Rt1: From R1 move up the Right Line 50 mm
14. Rt2: From Rt1 move up the Right Line 50 mm
15. Rtn: Mark points at 50 mm increments along Right Line until the window sill is reached.
16. Rb1: From R1 move down the Right Line 50 mm
17. Rb2: From Rb1 move down the Right Line 50 mm
18. Rbn: Mark points at 50 mm increments along Right Line until the bottom of the IP/Knee Bolster is reached.

19. If dash panel or knee bolster loosens or breaks away in the crash, the post-test measurements are taken by pressing and holding the panel against the underlying structure. Record in the appropriate data sheet and calculate the difference by subtracting the post-test minus the pre-test. A picture with the points labeled shall be included on the data sheet. All points shall be visible in the picture.

