

REPORT NUMBER: SPNCAP-CAL-20-013

**NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE IMPACT POLE TEST**

**Toyota Motor Manufacturing, Indiana Inc.
2020 Toyota Highlander L
SUV**

NHTSA No: M20205101

**PREPARED BY:
CALSPAN CORPORATION
P.O. BOX 400
BUFFALO, NEW YORK 14225**



November 6, 2020

FINAL REPORT

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF CRASHWORTHINESS STANDARDS
MAIL CODE: NRM-110
1200 NEW JERSEY AVE SE, ROOM W43-410
WASHINGTON, D.C. 20590**

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-14-D-00352.

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Date: November 6, 2020

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Date: November 6, 2020

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. SPNCAP-CAL-20-013	2. Government Accession No.	3. Recipient's Catalog No.																												
4. Title and Subtitle Final Report of New Car Assessment Program Side Impact Pole Testing of a 2020 Toyota Highlander NHTSA No.: M20205101		5. Report Date November 6, 2020																												
		6. Performing Organization Code CAL																												
7. Author(s) Matthew Pronko, Test Engineer Vanessa Hansen, Operations Manager		8. Performing Organization Report No. CAL-DOT-2020-013																												
9. Performing Organization Name and Address Calspan Corporation Transportation Test Operation P.O. Box 400 Buffalo, New York 14225		10. Work Unit No.																												
		11. Contract or Grant No. DTNH22-14-D-00352																												
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave., SE, Room W43-410 Washington, D.C. 20590		13. Type of Report and Period Covered: Final Test Report, August 12, 2020 - November 6, 2020																												
		14. Sponsoring Agency Code NRM-110																												
15. Supplementary Notes																														
16. Abstract A 32.20 km/h (20 mph), 75° oblique impact Side NCAP Test was conducted on the subject 2020 Toyota Highlander SUV in accordance with the specifications of the Office of Crashworthiness Standards Side NCAP Pole Laboratory Test Procedure for the generation of consumer information on vehicle side pole crash protection. This test was conducted at Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on August 12, 2020. The impact velocity of the vehicle was 32.13 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle was 21°C. The target vehicle's maximum post-test static crush was 380 mm located at level 3. The test vehicle's occupant performance data is as follows:																														
<table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th colspan="3">Driver ATD (SID-IIs) (Serial No. DG8012)</th> </tr> <tr> <th>Units</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₃₆)</td> <td></td> <td>1000</td> <td>366.099</td> </tr> <tr> <td>Resultant Lower Spine Acceleration</td> <td>G</td> <td>82</td> <td>40.901</td> </tr> <tr> <td>Total Pelvic Force (sum of acetabular and iliac forces)</td> <td>N</td> <td>5525</td> <td>2953.771</td> </tr> <tr> <td>Maximum Thoracic Rib Deflection</td> <td>mm</td> <td>38</td> <td>13.178</td> </tr> <tr> <td>Maximum Abdomen Rib Deflection</td> <td>mm</td> <td>45</td> <td>21.197</td> </tr> </tbody> </table>				Measurement Description	Driver ATD (SID-IIs) (Serial No. DG8012)			Units	Threshold	Result	Head Injury Criteria (HIC ₃₆)		1000	366.099	Resultant Lower Spine Acceleration	G	82	40.901	Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2953.771	Maximum Thoracic Rib Deflection	mm	38	13.178	Maximum Abdomen Rib Deflection	mm	45	21.197
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The two doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite doors did not open during the side impact event.																														
17. Key Words New Car Assessment Program (NCAP) Side Impact Pole Part 572V SID-IIs		18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, 1200 New Jersey Ave. SE Washington, D.C. 20590																												
19. Security Class. (of this report) UNCLASSIFIED	20. Security Class. (of this page) UNCLASSIFIED	21. No. of Pages 123	22. Price																											

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SECTION 1

TEST PURPOSE AND PROCEDURE

This side impact test was conducted as part of the MY 2020 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-14-D-00352. The purpose of this test is to generate comparative side impact performance in a 2020 Toyota Highlander SUV. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Side NCAP Pole Laboratory Test Procedure, dated October 2015.

SECTION 2

SUMMARY OF TEST RESULTS

A rigid pole side impact test was conducted on a 2020 Toyota Highlander SUV. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 32.13 km/h. The test was conducted by Calspan Corporation's Transportation Test Operations facility in Buffalo, New York on August 12, 2020. Pre-test and post-test photographs of the test vehicle and side impact dummy (SID-IIs) are included in Appendix A of this report.

One Part 572V (SID-IIs) dummy was placed in the driver designated seating position according to instructions specified in the OCWS Side NCAP Pole Laboratory Test Procedure, dated October 2015. Camera locations and other pertinent camera information are included on page 3-11 in this report.

The Part 572V (SID-IIs) dummy was instrumented accordingly:

Head CG tri-axial accelerometers

Thorax upper, middle, and lower rib displacement potentiometers

Abdomen upper and lower rib displacement potentiometers

Lower spine tri-axial accelerometers

Iliac load cell

Acetabulum load cell

Appendix B contains the dummy response data. Dummy configuration and performance verification data can be found in Appendix C of this report. Appendix D identifies all serial numbers, manufacturers, and calibration dates for test equipment, dummy sensors, potentiometers, and load cells used to collect data during the test.

Injury readings for the SID-IIs dummy were recorded as follows:

INJURY READINGS

Measurement Description	Driver ATD (SID-IIs)		
	Units	IARV	Result
Head Injury Criteria (HIC ₃₆)		1000	366.099
Resultant Lower Spine Acceleration	g	82	40.901
Total Pelvic Force (sum of acetabular and iliac forces)	N	5525	2953.771
Maximum Thoracic Rib Deflection	mm	38*	13.178
Maximum Abdominal Rib Deflection	mm	45*	21.197

*Proposed IARV

Supplemental restraint information was recorded as follows:

SUPPLEMENTAL RESTRAINT INFORMATION

Restraint Type	Left Front (Driver) Occupant Location 1		Left Rear (Passenger) Occupant Location 4	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No		
Knee Airbag	Yes	No		
Side Airbag 1 - Curtain	Yes	Yes	Yes	Yes
Side Airbag 2 – Torso/Pelvis	Yes	Yes	No	N/A
Seat Belt Pretensioner	Yes	Yes	No	N/A
Seat Belt Load Limiter	Yes	Yes	No	N/A
Other				

GENERAL COMMENTS:

1. P1 serial number – DG8012

Data Anomalies:

- Left Sill A-Pillar Y Acceleration, Exceeded calibration range at 42.9 ms
- Left Front Sill Y Acceleration, Exceeded calibration range at 28 ms

SECTION 3
OCCUPANT AND VEHICLE INFORMATION

This section contains information reporting for the following Data Sheets:

Data Sheet No. 1 – General Test and Vehicle Parameter Data

Data Sheet No. 2 – Seat, Seat Belt, Steering Wheel Adjustment and Fuel Systems Data

Data Sheet No. 3 – Dummy Longitudinal Clearance Dimensions

Data Sheet No. 4 – Dummy Lateral Clearance Dimensions

Data Sheet No. 5 – Camera and instrumentation Data

Data Sheet No. 6 – Vehicle Accelerometer Data

Data Sheet No. 7 – Rigid Pole Load Cell Data

Data Sheet No. 8 – Post-Test Observations

Data Sheet No. 9 – Test Vehicle Profile Measurements

Data Sheet No. 10 – Test Vehicle Exterior Crush Measurements

Data Sheet No. 11 – Vehicle Damage Profile Distances

Data Sheet No. 12 – FMVSS No. 301 Static Rollover Results

Data Sheet No. 13 – Dummy / Vehicle Temperature and Humidity Stabilization Data

**DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20205101
Model Year	2020
Make	Toyota
Model	Highlander
Body Style	SUV
VIN	5TDCZRAHXLS015960
Body Color	Black
Odometer Reading (km/mi)	5 mi
Engine Displacement (L)	3.5
Type / No. Cylinders	V6
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8-Speed
Overdrive	Yes
Final Drive	Front Wheel Drive
Roof Rack	No
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes

Traction Control System (TCS)	Yes
Auto-Leveling System	No
Automatic Door Locks (ADL)	Yes
Power Window Auto-Reverse	No
Other Optional Feature	-
Driver Front Airbag	Yes
Driver Curtain Airbag	Yes
Driver Head/Torso Airbag	No
Driver Torso Airbag	No
Driver Torso / Pelvis Airbag	Yes
Driver Pelvis Airbag	No
Driver Knee Airbag	Yes
Rear Pass. Curtain Airbag	Yes
Rear Pass. Head / Torso Airbag	No
Rear Pass. Torso Airbag	No
Rear Pass. Torso / Pelvis Airbag	No
Rear Pass. Pelvis Airbag	No
Driver Seat Belt Pretensioner	Yes
Rear Pass. Seat Belt Pretensioner	No
Driver Load Limiter	Yes
Rear Pass. Load Limiter	No
Front Passenger seat cushion airbag	Yes

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

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Manufacturing, Indiana, Inc.	GVWR (kg)	2645
Date of Manufacture	06/20	GAWR Front (kg)	1635
Vehicle Type	MPV	GAWR Rear (kg)	1635

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3	3	8	
Capacity Weight (VCW) (kg)				622	(A)
DSC X 68.04 kg				544.32	(B)
Cargo Weight (RCLW) (kg)				77.68	(A-B)

VEHICLE SEAT TYPE

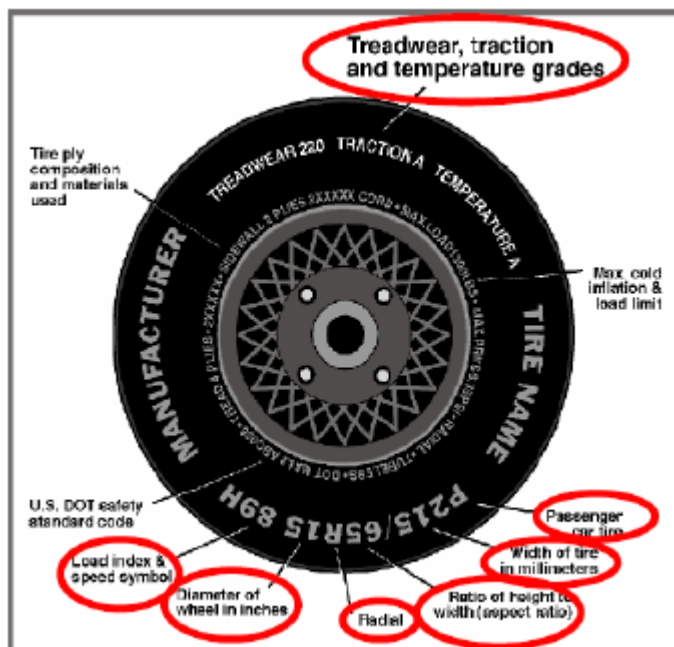
Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						W/ Lever	W/ Knob
Front Seat	X						X
Rear or Second Row Seat			X			X	
Third Row seat			X			X	

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

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

Collected for year, make, model, & VIN, all items circled in red, tire manufacturer and tire name.



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	250	250
Recommended Tire Size	235/65R18	235/65R18
Tire Size on Vehicle	235/65R18	235/65R18
Tire Manufacturer	Michelin	Michelin
Tire Model	Premier LTX	Premier LTX
Treadwear	620	620
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Polyester, 1 Polyamide, 2 Steel	2 Polyester, 1 Polyamide, 2 Steel
Load Index/Speed Symbol	106V	106V
Tire Material	Rubber	Rubber
DOT Safety Code Left	B9MB020X1120	B9MB020X1120
DOT Safety Code Right	B9MB020X1120	B9MB020X1120

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

Test Vehicle: 2020 Toyota Highlander SUV
Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
Test Date: 8/12/2020

TIRE PRESSURES

	Units	LF	RF	LR	RR
As Delivered	kPa	251	241	257	250
Tire Placard	kPa	250	250	250	250
Owner's Manual	kPa	250	250	250	250
As Tested	kPa	250	250	250	250

TEST VEHICLE AXLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	555.5	398		567.5	446		582.5	450	
Right	kg	522	403		529	455.5		524.5	450.5	
Ratio	%	57.3	42.7		54.9	45.1		55.1	44.9	
Totals	kg	1076.5	801	1877.5	1096.5	901.5	1998	1107	900.5	2007.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total As Delivered Weight (UVW)	kg	1877.5	(A)
Actual Weight of 1 P572V (SID-IIs) ATD Used	kg	50	(B)
Rated Cargo / Luggage Weight (RCLW)	kg	77.68	(C)
Calculated Vehicle Target Weight (TVTWTW)	kg	2005.18	(A+B+C)

Does the measured As Test Vehicle Weight lie within the required weight range
(i.e. Calculated Test Vehicle Target Weight – 4.5 kg to – 9 kg)? Yes No

TEST VEHICLE ATTITUDES AND CG

Measurement Description	Units	As Delivered	As Tested	Fully Loaded	Meets Rqmt***
Driver Door Sill Angle (front-to-rear)*	Deg	-0.95	-0.6	-0.6	Yes
Front Passenger Sill Angle (front-to-rear)*	Deg	-0.9	-0.7	-0.3	Yes
Front Bumper-Line Angle (left-to-right)**	Deg	+0.3	+0.2	+0.2	Yes
Rear Bumper-Line Angle (left-to-right)**	Deg	+0.15	+0.15	+0.3	Yes
Vehicle CG (Aft of Front Axle)	mm	1218	1288	1281	
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	14	12	24	

* ND = Nose Down (-), NU = Nose Up (+)

** LD = Left Down (-), LU = Left Up (+)

*** The "As Tested" vehicle attitude measurements must be equal to or between the "As Delivered" and "Fully Loaded" vehicle attitude measurements. Indicate "Yes" or "No" for Meets Requirement"

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

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

WEIGHT OF BALLAST AND VEHICLE COMPONENTS REMOVED TO MEET TVTW

Component Description	Weight (kg)
Trunk Carpeting	10
Jack	3
Ballast / Equipment Added	42

Test Height – Adjustable Suspension Setting, if Applicable	N/A
--	-----

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

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

SEAT POSITIONING

The driver's seat, front center seat (if applicable), and right front passenger's seat should be set to the forward-most, mid-height, mid-angle position. The struck-side rear passenger's seat, rear center seat, and non-struck side rear passenger's seats should be set to the rear-most, lowest, mid-angle position.

SCRL ANGLE RANGE

Seat	SCRL (°)		
	Max	Min	Mid
Driver Seat	15.9	7.1	11.5
Front Passenger Seat	Not Adjustable		
Front Center Seat	N/A	N/A	N/A
Struck Side Rear Seat	Fixed	Fixed	Fixed
Non-Struck Side Rear Seat	Fixed	Fixed	Fixed
Rear Center Seat	Fixed	Fixed	Fixed

SEAT HEIGHT AND ANGLE

Seat	As Tested SCRL Angle (Mid) (°)	As Tested SCRP Height (mm)	SCRP Height Position	SCRP Height (mm)		
				Rearmost	Mid-Fore / Aft	Forward-Most
Driver Seat	11.5	33	Max	55	57	59
			Mid	29	31	33
			Min	0	2	5
Front Passenger Seat	Not Adjustable		Max	-	-	-
			Mid	-	-	-
			Min	-	-	-
Front Center Seat	N/A	N/A	Max	-	-	-
			Mid	-	-	-
			Min	-	-	-
Struck Side Rear Seat	Fixed	Fixed	Max	-	-	-
			Mid	-	-	-
			Min	-	-	-
Non-Struck Side Rear Seat	Fixed	Fixed	Max	-	-	-
			Mid	-	-	-
			Min	-	-	-
Rear Center Seat	Fixed	Fixed	Max	-	-	-
			Mid	-	-	-
			Min	-	-	-

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

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

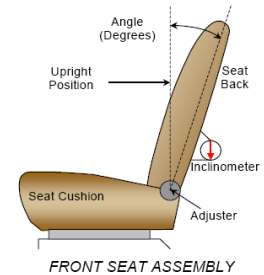
NHTSA No.: M20205101
 Test Date: 8/12/2020

SEAT FORE / AFT POSITION

Seat	Total Fore / Aft Travel		Test Position from Forward most Position	
	mm	Detents*	mm	Detents*
Driver Seat	240	-	0	-
Front Passenger Seat	240	25 (0-24)	0	0
Front Center Seat	N/A	N/A	N/A	N/A
Struck Side Rear Seat	180	19 (0-18)	180	18
Non-Struck Side Rear Seat	180	19 (0-18)	180	18
Rear Center Seat	180	19 (0-18)	180	18

SEAT BACK ANGLE ADJUSTMENT

The driver's seat back is positioned such that the dummy's head is level. The front center and front passenger's seat backs are positioned in a similar manner as the driver's seat back. The struck-side rear passenger seat back is positioned in accordance with the information provided by the manufacturer on Form No. 1 for the 5th percentile female dummy in a Side NCAP MDB test. The rear center and non-struck side rear passenger's seat back are set to match the struck-side rear seat back.



Seat	Total Seat Back Angle Range		Test Position from Most Upright	
	Degrees	Detents*	Degrees	Detents*
Driver Seat w/Seated Dummy	-8.0 to 44.1	N/A	6.9	N/A
Front Passenger Seat	-9.1 to 44.1	N/A	7.1	1
Front Center Seat	N/A	N/A	N/A	N/A
Struck Side Rear Seat	+5.1 to +21.1	9 (0-8)	+9.0	2
Non-Struck Side Rear Seat	+5.5 to +21.1	9 (0-8)	+9.5	2
Rear Center Seat	+5.5 to +21.1	9 (0-8)	+9.5	2

SEAT BELT ANCHORAGE ADJUSTMENT

Seat belt anchorages are adjusted in accordance with the information provided by the manufacturer on Form No. 1. Zero is defined as the uppermost detent

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

HEAD RESTRAINT ADJUSTMENT

The driver's head restraint is adjusted to the lowest and most full forward in-use position.

Seat	Total # of Positions	Placed in Position #
Driver Seat	3 (0-2)	Lowermost

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

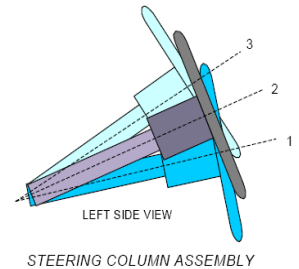
Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the center of its geometric locus it describes when it moves through its full range of motion.

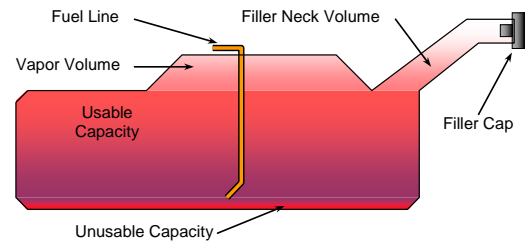
		Degrees	Fore / Aft Position (mm)
Lowermost	– Position 1	22.3	
Geometric Center	– Position 2	24.3	
Uppermost	– Position 3	26.6	
Telescoping Steering Wheel Travel			60
Test Position		24.3	30



FUEL PUMP

Describe the fuel pump type, details about how it operates, and the location of the fuel filler neck.

The vehicle is equipped with an electric fuel pump.
The fuel filler neck is on the left side of the vehicle.
The pump creates positive pressure in the fuel lines, pushing the gasoline to the engine. See form 1 for more information.



FUEL TANK CAPACITY DATA

Description	Liters
Usable Capacity of "Standard Tank" - see Form No. 1	68.13
Usable Capacity of "Optional Tank" - see Form No. 1	N/A
Usable Capacity of "Standard Tank" - see Owner's Manual	68.0
Usable Capacity of "Optional Tank" - see Owner's Manual	N/A
93% of Usable Capacity	63.3
Actual Amount of Solvent Used in Test	63.3
1/3 of Usable Capacity	22.6

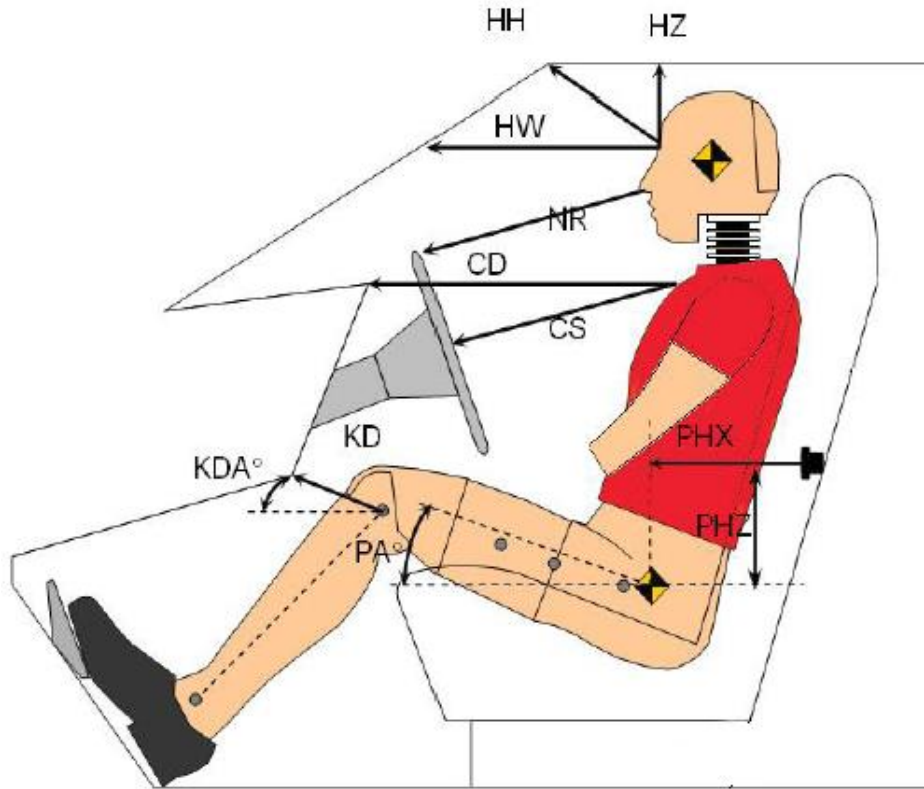
Is the Actual Amount of Solvent Used in the test equal to 93% ±1% of the Usable Capacity stated in Form No. 1?

Yes No

**DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



Left Side View

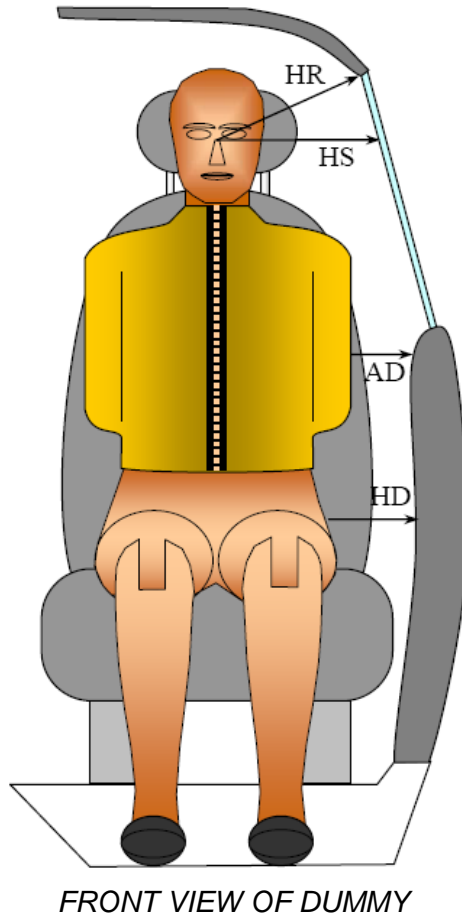
DUMMY LONGITUDINAL CLEARANCE DIMENSION INFORMATION

Driver Code	Description	Driver (Serial No. DG8012)	
		Length (mm)	Angle (°)
HH	Head to Header	288	
HW	Head to Windshield	574	
HZ	Head to Roof Liner	226	
NR	Nose to Rim	233	
CD	Chest to Dash	408	
CS	Chest to Steering Wheel	182	
KD(L) / KDA(L)°	Left Knee to Dash	118	30.2
KD(R) / KDA(R)°	Right Knee to Dash	113	20.2
PAX°	Pelvic Tilt Angle (X-Axis)		20.3
PAY°	Pelvic Tilt Angle (Y-Axis)		0.3
PHX	Hip Point to Striker (X-Axis)	329	
PHZ	Hip Point to Striker (Z-Axis)	180	

**DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



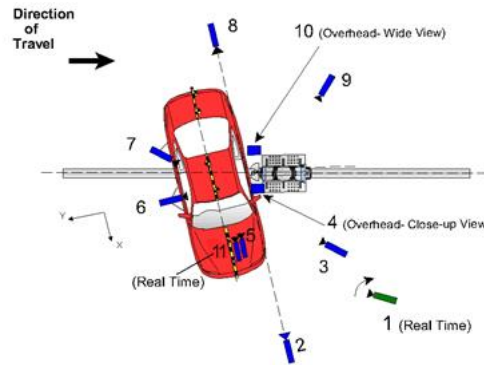
DUMMY LATERAL CLEARANCE DIMENSION INFORMATION

Code	Measurement Description	Units	Driver - Length (Serial No. DG8012)
HR	Head To Side Header	mm	271
HS	Head to Side Window	mm	395
AD	Arm to Door	mm	178
HD	Hip Point to Door	mm	180

**DATA SHEET NO. 5
CAMERA AND INSTRUMENTATION DATA**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



CAMERA LOCATIONS AND DATA

No.	Camera View	Coordinates (mm)			Lens Length (mm)	Operating Frame Rate (fps)
		X	Y	Z		
1	Real-time (24 - 30 fps) pan view of impact				Zoom	60
2	Front ground level - impact view	8220	0	-1452	28	1000
3	Impact side 45° - forward pole view	4984	-1484	-1574	24	1000
4	Overhead Close-up view of impact	0	0	-9375	28	1000
5	Onboard - dummy front view				25	1000
6	Onboard - dummy side view				12.5	1000
7	Onboard - dummy rear oblique view				12.5	1000
8	Rear ground level - impact view	-9420	0	-1543	28	1000
9	Impact side 45° - rearward pole view	-5260	-4423	-1502	24	1000
10	Overhead wide - view of impact	0	0	-9375	12.5	1000
11	Real-time (24 - 30 fps) - dummy front view				Zoom	60

Notes: Reference - From Point of Impact for X and Y; from Ground for Z
 +X = Forward of vehicle, +Y = Right of vehicle, +Z = Down
 * All measurements accurate to ± 6 mm. Vehicle is at a 75° angle to the rigid pole.

Comments: All cameras operated as intended.

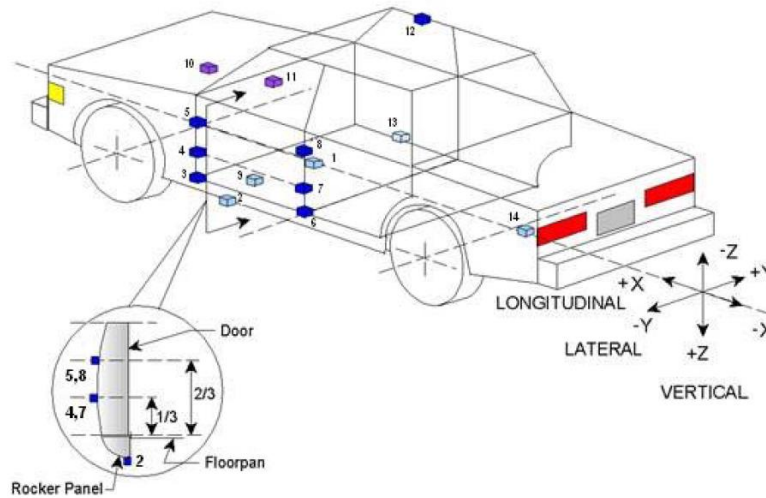
INSTRUMENTATION

Description	Number of Channels
Driver Dummy Channels	16
Vehicle Structure Accelerometers	18
Pole Load Cells	8
Total	42

**DATA SHEET NO. 6
VEHICLE ACCELEROMETER DATA**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



TEST VEHICLE ACCELEROMETER LOCATIONS

No.	Accelerometer Location	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2697	-4	46
2	Left Floor Sill	3053	-685	260
3	A-Pillar Sill	3451	-633	163
4	A-Pillar Low	3506	-630	-1
5	A-Pillar Mid	3316	-665	-554
6	B-Pillar Sill	2534	-706	105
7	B-Pillar Low	2412	-701	-152
8	B-Pillar Mid	2344	-687	-502
9	Driver Seat Track	2668	-568	158
10	Engine Top	3989	173	-303
11	Firewall	3698	52	-285
12	Right Roof	2527	552	-1034
13	Right Floor Sill	3062	687	238
14	Rear Floorpan	1266	8	79

Reference: X – Rear surface of vehicle (+ forward)
 Y – Vehicle centerline (+ to right)
 Z – Ground plane (+ down)

**DATA SHEET NO. 7
RIGID POLE LOAD CELL DATA**

Test Vehicle: 2020 Toyota Highlander SUV
Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
Test Date: 8/12/2020

POLE BARRIER



RIGID POLE LOAD CELL LOCATIONS

ID	Units	Height From Ground
1	mm	200
2	mm	590
3	mm	750
4	mm	1075
5	mm	1260
6	mm	1740
7	mm	1920
8	mm	2300

**DATA SHEET NO. 8
POST-TEST OBSERVATIONS**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

TEST DUMMY INFORMATION AND CONTACT POINTS

Dummy Body Part	Driver Seat Dummy (SID-IIs)
Face	Curtain Airbag
Top of Head	Curtain Airbag
Left Side of Head	Curtain Airbag
Back of Head	Headrest
Left Shoulder	Seatback & Torso/Pelvis Airbag
Upper Torso	Seatback
Lower Torso	Seatback
Left Hip	Seatpan & Torso/Pelvis Airbag
Left Knee	None

POST-TEST DOOR PERFORMANCE

Description	Struck Side		Non-Struck Side		Rear Hatch/Other
	Front	Rear	Front	Rear	
Remained Closed and Operational	No	No	Yes	Yes	Yes
Total Separation from Vehicle at Hinges or Latches	No	No	No	No	No
Latch or Hinge Systems Pulled Out of Their Anchorages	No	No	No	No	No
Disengaged from Latched Position	No	No	No	No	No
Latch Separated from Striker	No	No	No	No	No
Jammed Shut	Yes	Yes	No	No	No
If Door Opened at Striker, Width of Opening at Striker (mm)	0	0	0	0	0

POST-TEST SEAT PERFORMANCE

Description	Struck Side		Non-Struck Side	
	Front	Rear	Front	Rear
Seat Movement Along Seat Track	No	No	No	No
Seat Disengagement from Floor Pan	No	No	No	No
Seat Back Movement from Initial Position	No	No	No	No
Seat Back Collapse	No	No	No	No

**DATA SHEET NO. 8 ... (CONTINUED)
POST-TEST OBSERVATIONS**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	A-Pillar Buckled
Sill Separation	None
Windshield Damage	Cracks throughout with separation along A-Pillar and Roof
Side Window Damage	Driver Window Shattered
Other Notable Effects	None

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Struck Side Driver		Struck Side Rear Passenger	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No		
Knee Airbag	Yes	No		
Side Airbag 1 - Curtain	Yes	Yes	Yes	Yes
Side Airbag 2 – Torso/Pelvis	Yes	Yes	No	N/A
Seat Belt Pretensioner	Yes	Yes	No	N/A
Seat Belt Load Limiter	Yes	Yes	No	N/A
Other				

VEHICLE SPEED, VEHICLE ANGLE AT IMPACT AND IMPACT POINT LOCATION DATA

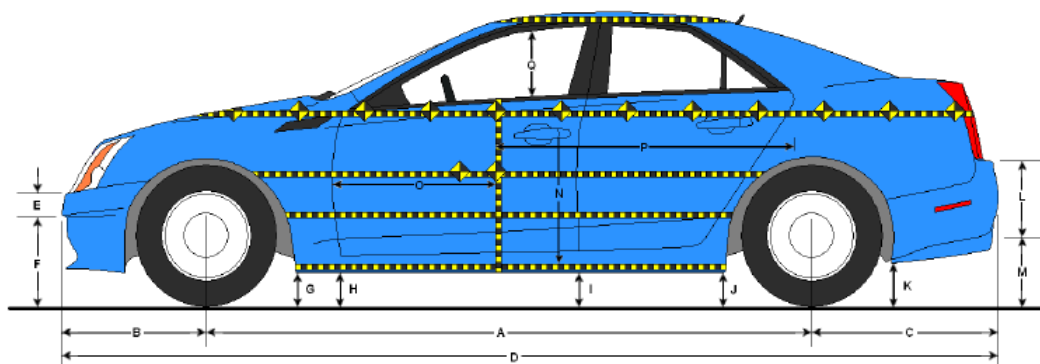
Measured Parameter	Units	Tolerance	Value
Vertical Impact Ref Line - Aft of Front Axle, Intended Impact Pt	mm		1050
Actual Impact Point - Aft of Front Axle	mm		1053
Horizontal Offset (+ forward / - rearward)	mm	+/- 38 *	-3
Angle Between Vehicle's Longitudinal Centerline and Line of Forward Motion	deg	75 +/- 3	75.0
Trap No. 1 Velocity - Primary	kph	31.4 to 33.0	32.13
Trap No. 2 Velocity - Redundant	kph	31.4 to 33.0	32.11

* Of Intended Impact Point

**DATA SHEET NO. 9
TEST VEHICLE PROFILE MEASUREMENTS**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



LEFT SIDE VIEW

VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

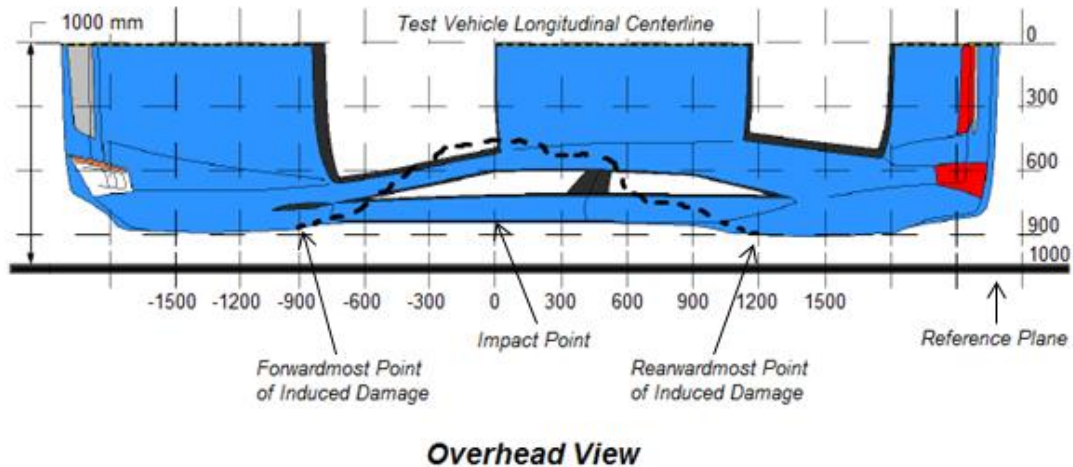
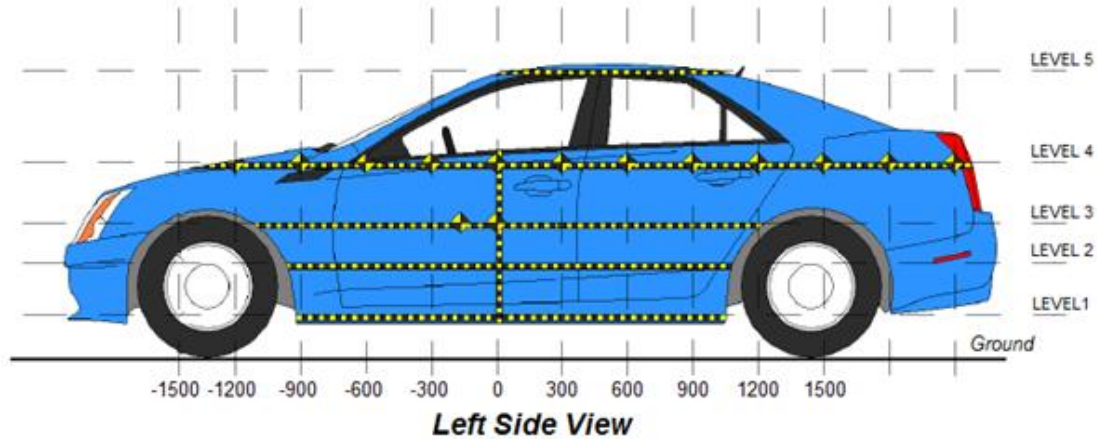
Code	Description	Pre-Test	Post-Test	Difference
A	Vehicle Wheelbase	2855	2784	71
B	Front Axle to FSOV	983	1021	-38
C	Rear Axle to RSOV	1109	1109	0
D	Total Length at Centerline	4946	4914	32
E	Front Bumper Thickness	135	135	0
F	Front Bumper Bottom to Ground	494	521	-27
G	Sill Height at Front Wheel Well	249	242	7
H	Sill Height at Front Door Leading Edge	259	252	7
I	Sill Height at B-Pillar	314	344	-30
J1	Sill Height at Rear Wheel Well	288	313	-25
J2	Pinch Weld Height at Rear Wheel Well	285	316	-31
K	Sill Height Aft of Rear Wheel Well	324	333	-9
L	Rear Bumper Thickness	193	193	0
M	Rear Bumper Bottom to Ground	453	441	12
N	Sill Height to Bottom of Front Window Sill	910	908	2
O	Front Door Leading Edge to Impact CL	597	496	101
P	Rear Door Trailing Edge to Impact CL	1576	1495	81
Q	Front Window Opening	427	403	24
R	Right Side Length	4889	4880	9
S	Left Side Length	4887	4823	64
T	Vehicle Width at B-Pillars	1909	1838	71

* All measurements in mm with tolerance of ± 3mm

**DATA SHEET NO. 10
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



MAXIMUM EXTERIOR CRUSH MEASUREMENTS

Level	Measurement Description	Units	Height Above Ground	Maximum Exterior Static Crush	Distance from Impact
1	Sill Top	mm	340	307	0
2	Occupant Hip Point	mm	748	378	0
3	Mid - Door	mm	820	380	0
4	Window Sill	mm	1148	286	0
5	Window Top	mm	1631	104	0

NOTE: The above measurements should be taken along the vertical impact reference line. Vehicle measurements forward of the vertical impact reference line are negative.

DATA SHEET NO. 10 ... (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

EXTERIOR CRUSH MEASUREMENTS AT EACH LEVEL

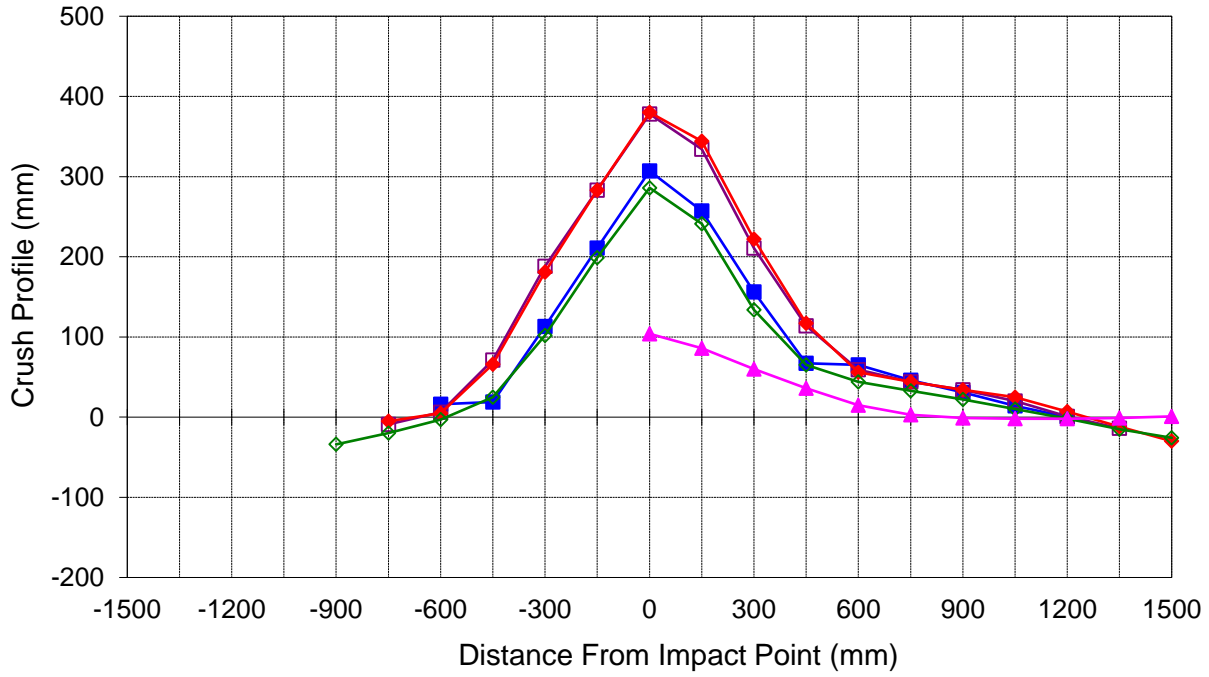
	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1500															
-1350															
-1200															
-1050															
-900				838					872					-34	
-750		967	963	846			976	968	866			-9	-5	-20	
-600	938	968	965	851		922	962	960	854		16	6	5	-3	
-450	931	958	957	847		912	887	891	822		19	71	66	25	
-300	932	954	955	847		819	766	774	745		113	188	181	102	
-150	935	953	957	855		724	670	674	656		211	283	283	199	
0	937	952	957	862	627	630	574	577	576	523	307	378	380	286	104
150	935	951	957	864	660	678	617	613	623	574	257	334	344	241	86
300	932	949	955	869	667	776	738	733	735	607	156	211	222	134	60
450	928	947	953	871	672	861	833	836	806	636	67	114	117	65	36
600	923	944	949	875	674	858	885	893	831	659	65	59	56	44	15
750	915	939	945	881	675	869	895	901	848	672	46	44	44	33	3
900	909	935	940	888	675	878	901	906	866	676	31	34	34	22	-1
1050	908	938	936	891	674	894	918	911	881	676	14	20	25	10	-2
1200	915	955	950	894	672	915	954	943	896	674	0	1	7	-2	-2
1350		966	964	888	668		980	976	903	669		-14	-12	-15	-1
1500			966	889	664			996	915	663			-30	-26	1

NOTE: Pre-test measurements are taken when the vehicle is in the “As Tested” weight condition. Vehicle measurements forward of the vertical impact reference line are negative. The crush profile grid is established prior to the test based on an estimated impact point. The final distance from impact is determined after the final dummy positioning and the pole is aligned with the center of gravity of the dummy’s head.

DATA SHEET NO. 10 ... (CONTINUED)
TEST VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020



■ LEVEL 1 Side Sill: -319 mm above ground	□ LEVEL 2 H-Point: 88 mm above ground
◆ LEVEL 3 Mid Door: 161 mm above ground	◇ LEVEL 4 Window Sill: 488 mm above ground
▲ LEVEL 5 Window Top: 971 mm above ground	

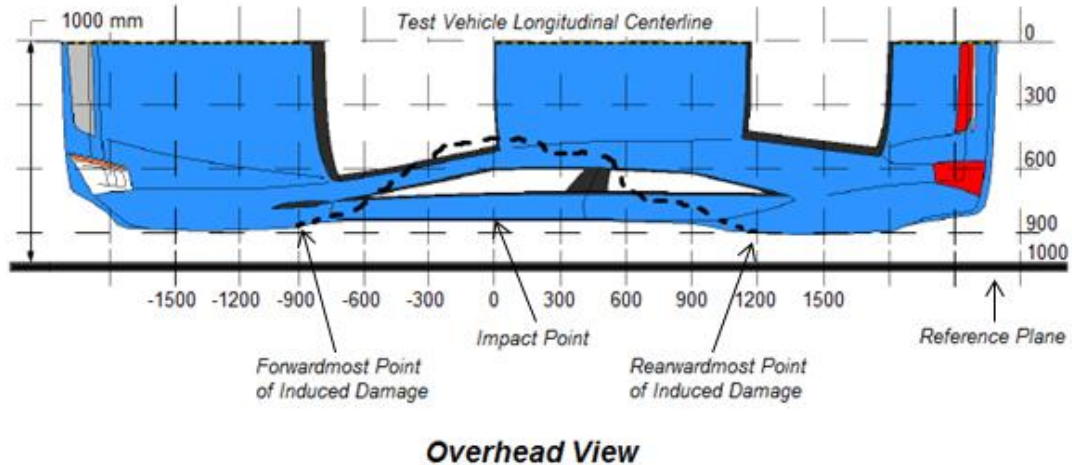
Vehicle Exterior Crush Measurements - Visual Representation

**DATA SHEET NO. 11
VEHICLE DAMAGE PROFILE DISTANCES**

Test Vehicle: 2020 Toyota Highlander SUV
 Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
 Test Date: 8/12/2020

For guidance regarding damage profile distance measurements, please refer to the latest version of the *NHTSA Test Reference Guide, Volume 1: Vehicle Tests*.



VEHICLE DAMAGE PROFILE DISTANCES

DPD	Distance From Impact Point (mm)	Level	Post-Test (mm)	Pre-Test (mm)	Crush (mm)
1	-750	3	32	37	-5
2	-300	3	226	45	181
3	150	3	387	43	344
4	600	3	107	51	56
5	1050	3	89	64	25
6	1500	3	4	34	-30

**DATA SHEET NO. 12
FMVSS NO. 301 STATIC ROLLOVER RESULTS**

Test Vehicle:	<u>2020 Toyota Highlander SUV</u>	NHTSA No.:	<u>M20205101</u>
Test Program:	<u>NCAP Side MDB Impact Test</u>	Test Date:	<u>8/12/2020</u>
Test Time:	<u>9:15 AM</u>	Temperature:	<u>21° C</u>

- A. From impact until vehicle motion ceases: 0 oz.
(Maximum allowable is 1 oz.)
- B. For the 5-minute period after motion ceases: 0 oz.
(Maximum allowable is 5 oz.)
- C. For the following 25 minutes: 0 oz.
(Maximum allowable is 1 oz./minute)
- D. Spillage Details: No Spillage Occurred

FMVSS NO. 301 STATIC ROLLOVER DATA



ROLLOVER SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	71	300	371
90° to 180°	69	300	369
180° to 270°	67	300	367
270° to 360°	70	300	370

FMVSS NO. 301 ROLLOVER SPILLAGE TABLE

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

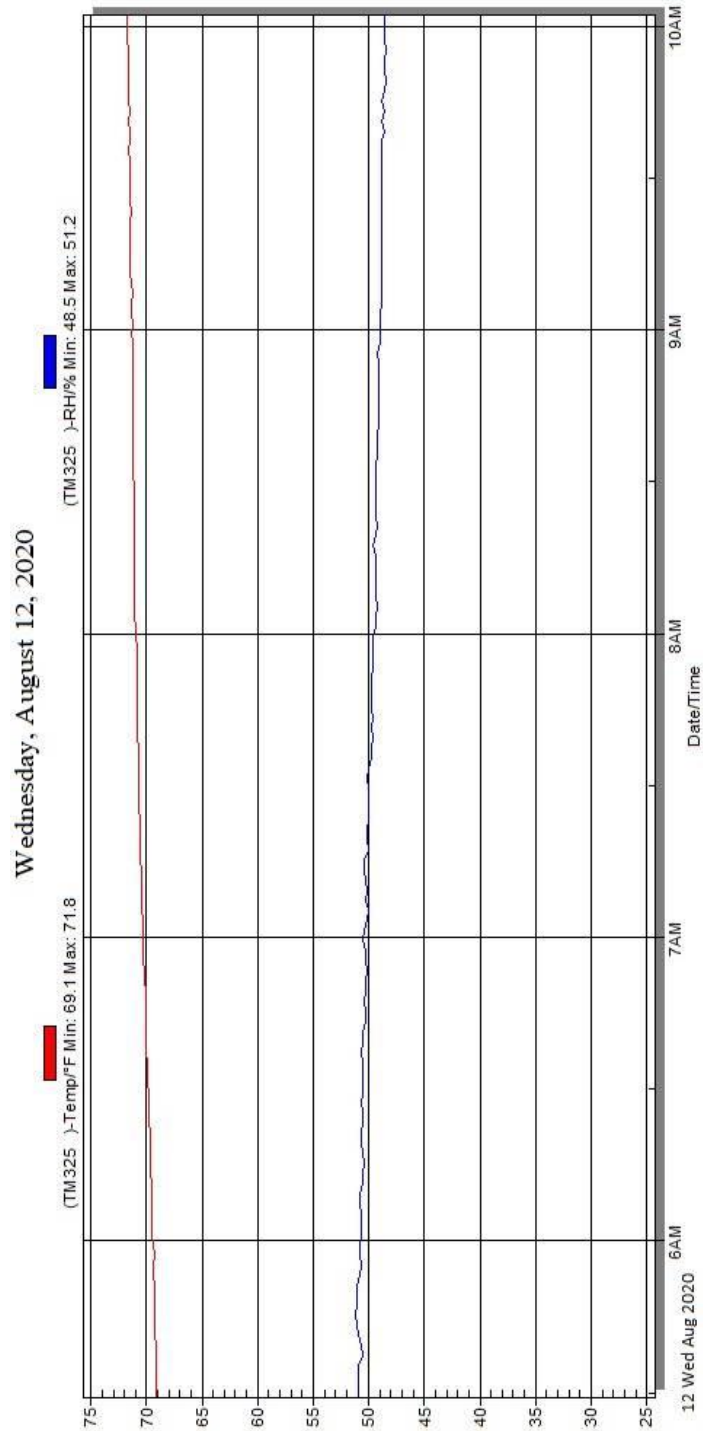
ROLLOVER SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	No Spillage Occurred
90° to 180°	No Spillage Occurred
180° to 270°	No Spillage Occurred
270° to 360°	No Spillage Occurred

DATA SHEET NO. 13
DUMMY / VEHICLE TEMPERATURE AND HUMIDITY STABILIZATION DATA

Test Vehicle: 2020 Toyota Highlander SUV
Test Program: NCAP Side Pole Impact Test

NHTSA No.: M20205101
Test Date: 8/12/2020



Temperature and Humidity Stabilization Chart / Data for Dummies and Test Vehicle

APPENDIX A
PHOTOGRAPHS

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M20205101

Figure A-1: As Delivered Right Front ¾ View of Test Vehicle



M20205101

Figure A-2: As Delivered Left Rear ¾ View of Test Vehicle



Figure A-3: Pre-Test Frontal View of Test Vehicle



Figure A-4: Post-Test Frontal View of Test Vehicle



Figure A-5: Pre-Test Left Front $\frac{3}{4}$ View of Test Vehicle



Figure A-6: Post-Test Left Front $\frac{3}{4}$ View of Test Vehicle

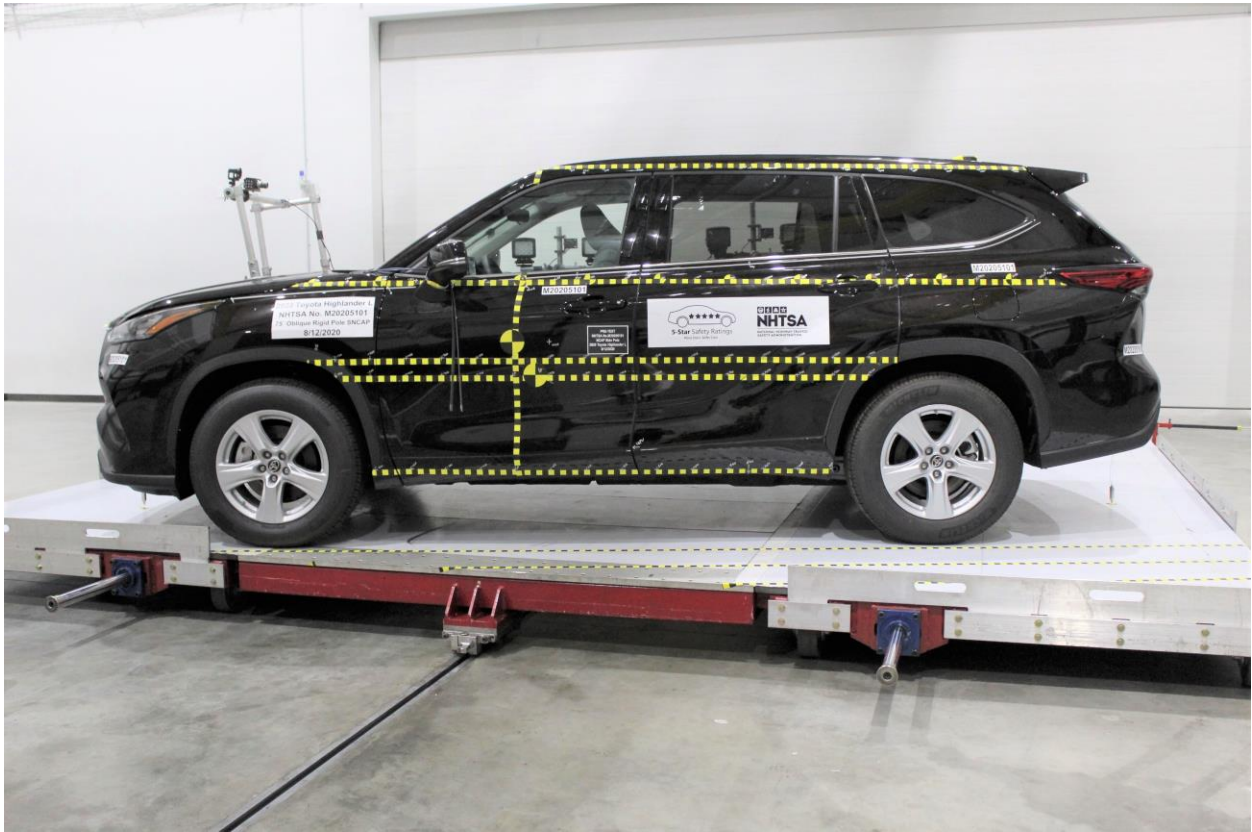


Figure A-7: Pre-Test Left Side View of Test Vehicle



Figure A-8: Post-Test Left Side View of Test Vehicle



Figure A-9: Pre-Test Left Rear $\frac{3}{4}$ View of Test Vehicle



Figure A-10: Post-Test Left Rear $\frac{3}{4}$ View of Test Vehicle



Figure A-11: Pre-Test Rear View of Test Vehicle



Figure A-12: Post-Test Rear View of Test Vehicle



Figure A-13: Pre-Test Right Side View of Test Vehicle



Figure A-14: Post-Test Right Side View of Test Vehicle

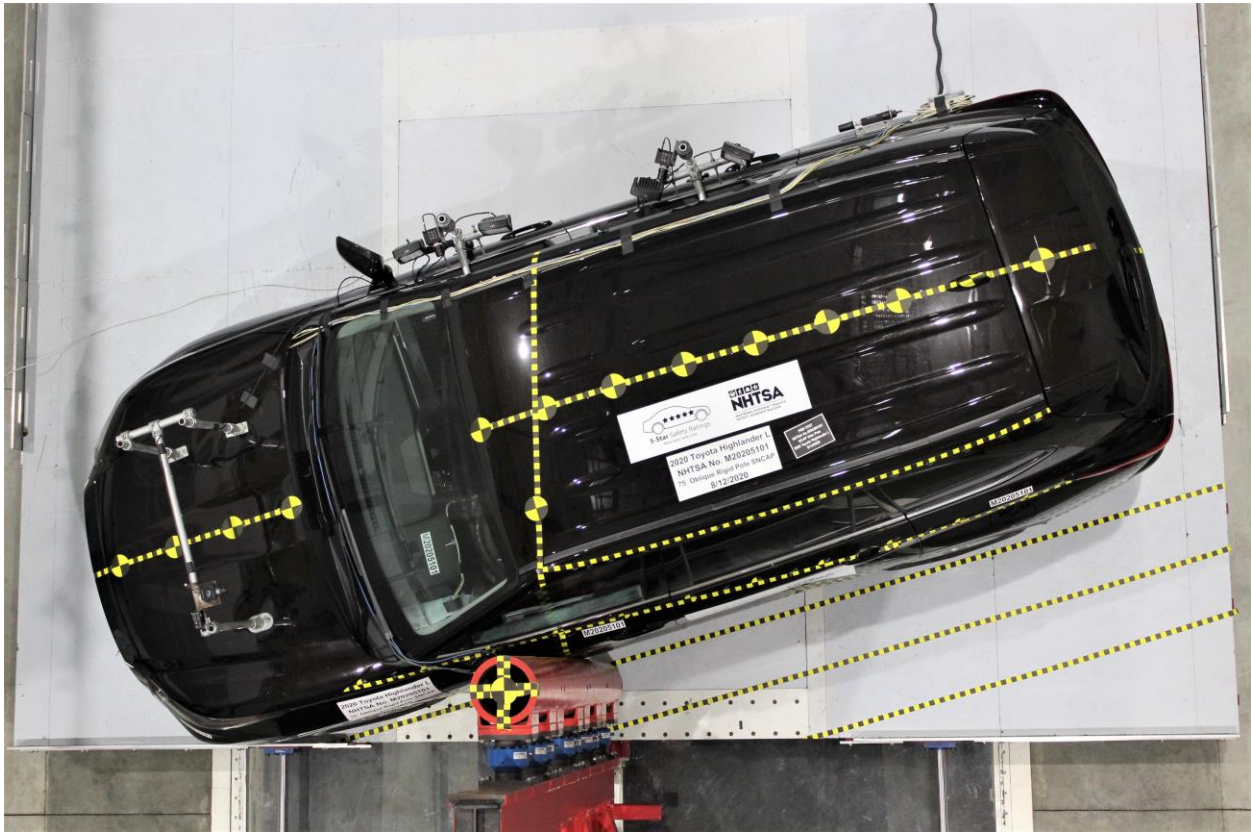


Figure A-15: Pre-Test Overhead View of Test Area

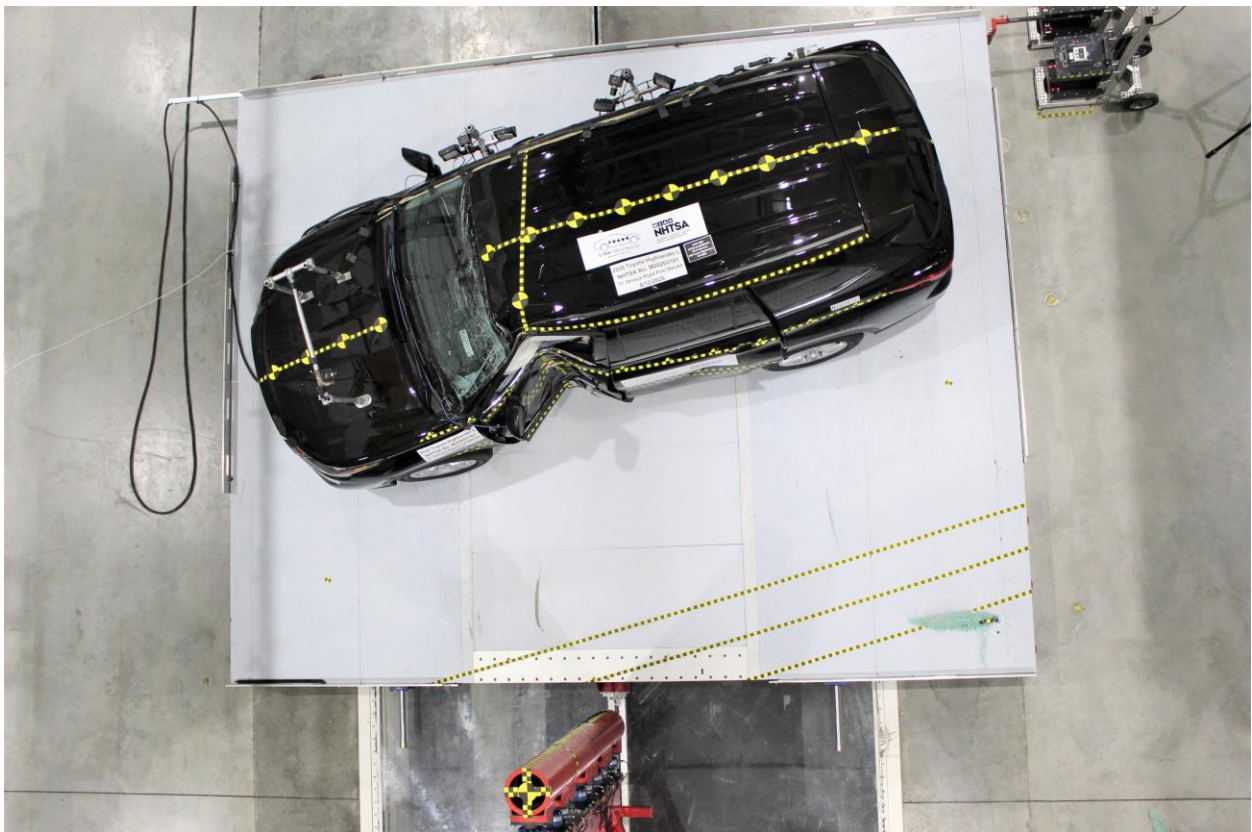


Figure A-16: Post-Test Overhead View of Test Area



Figure A-17: Pre-Test Left Side View of Pole Positioned Against Side of Vehicle



Figure A-18: Pre-Test Right Side View of Pole Positioned Against Side of Vehicle

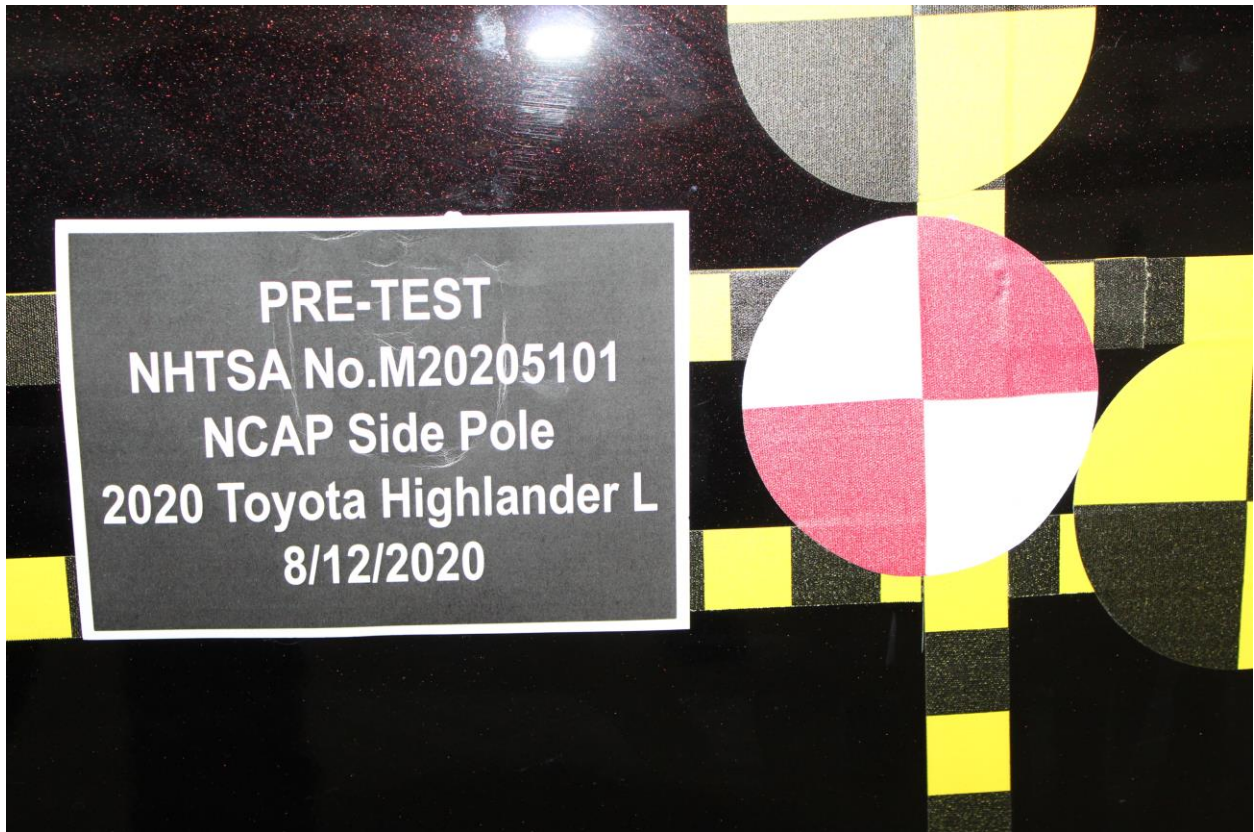


Figure A-19: Pre-Test Close-Up View of Impact Point Target



Figure A-20: Post-Test Close-Up View of Impact Point Target Showing Impact Location



Figure A-21: Pre-Test Front Close-Up View of Dummy Head and Chest



Figure A-22: Post-Test Front Close-Up View of Dummy



Figure A-23: Pre-Test Left Side View of Dummy Showing Belt and Chalking



Figure A-24: Pre-Test Left Side View of Dummy Shoulder and Door Top View



Figure A-25: Post-Test Left Side View of Dummy Shoulder and Door Top View



Figure A-26: Pre-Test Frontal View of Seat Back Prior to Dummy Positioning

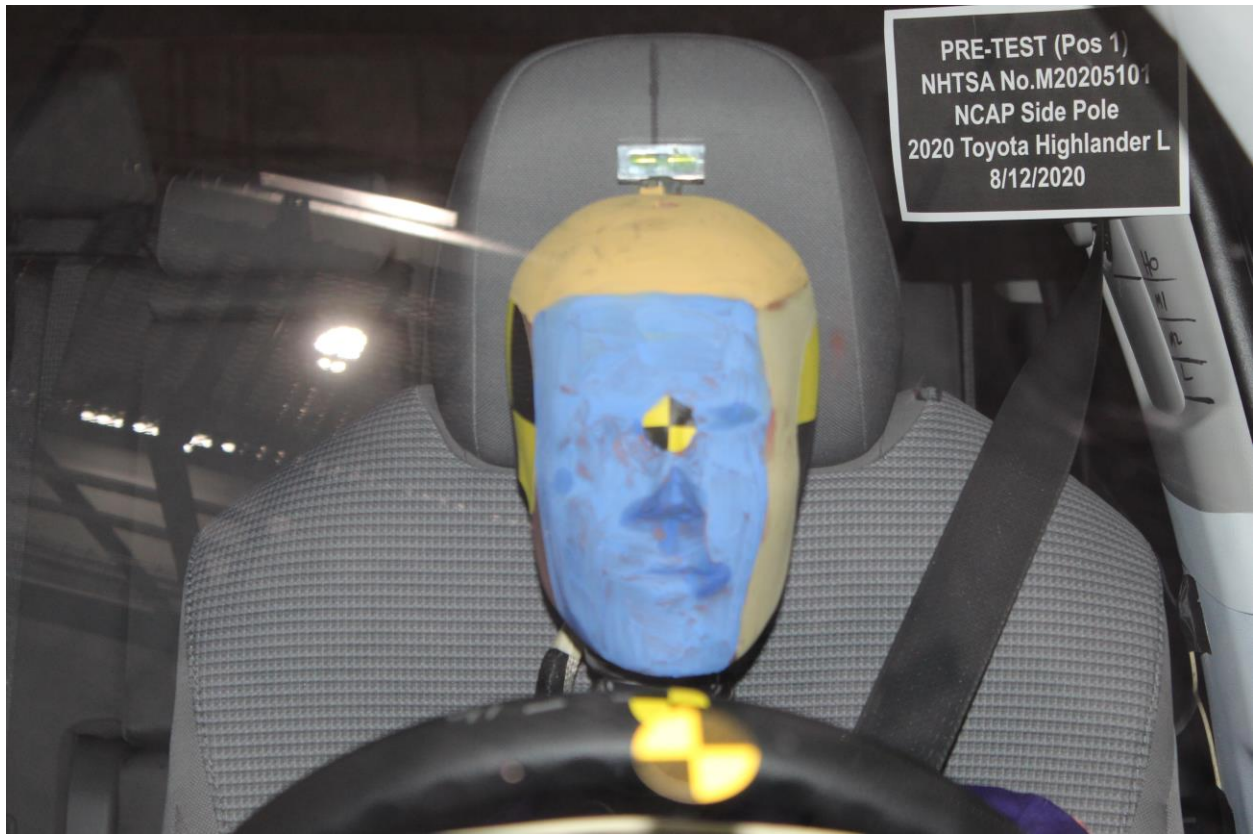


Figure A-27: Pre-Test Frontal Close-Up View of Dummy Head / Shoulders in Relation to Head Restraint



Figure A-28: Pre-Test Frontal View of Seat Pan Prior to Dummy Positioning



Figure A-29: Pre-Test Overhead View of Dummy Thighs on Seat Pan

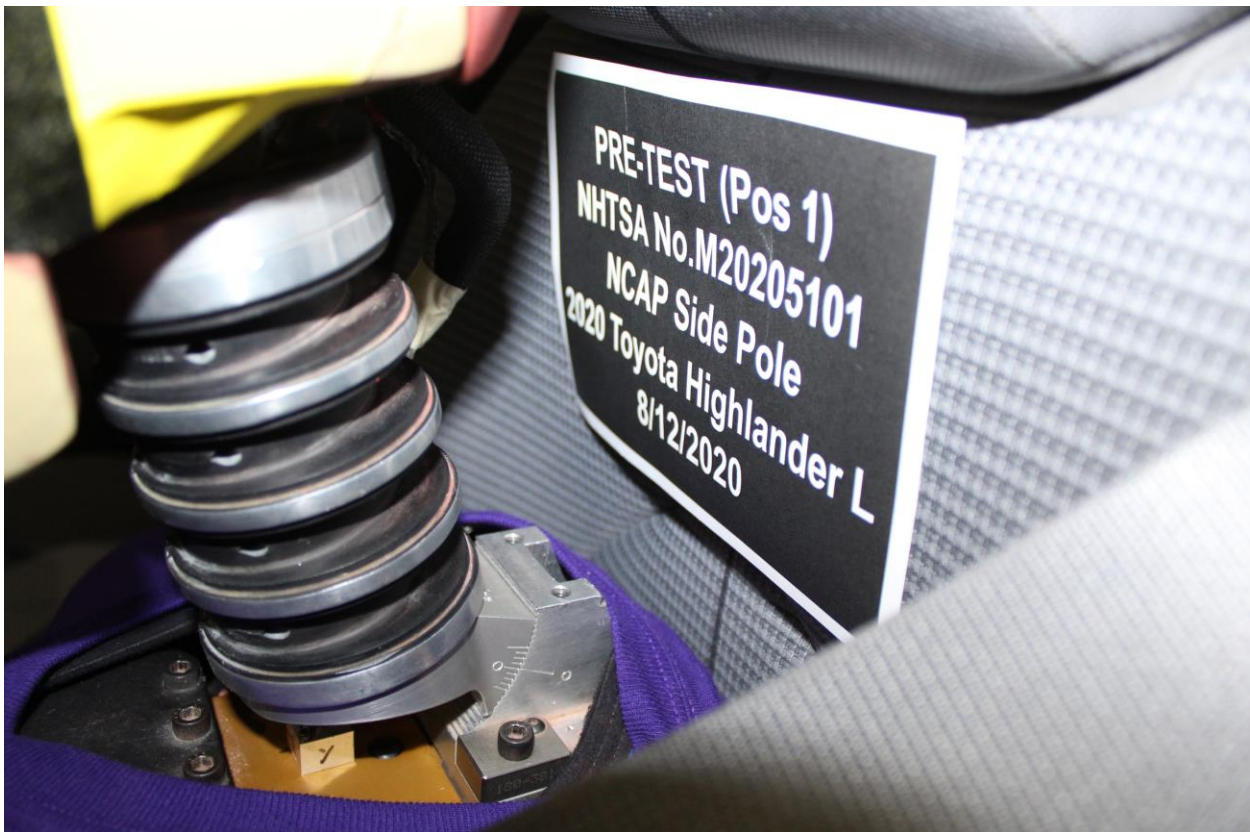


Figure A-30: Pre-Test Left Side View of Dummy's Neck Showing Position of Adjustable Neck Bracket



Figure A-31: Pre-Test Left Side View of Dummy's Head Showing Dummy's Head is Level



Figure A-32: Pre-Test Placement of Dummy's Feet



Figure A-33: Pre-Test View of Belt Anchorage for Dummy



Figure A-34: Pre-Test Left Side View of Steering Wheel



Figure A-35: Pre-Test View of Disengaged Parking Brake



Figure A-36: Pre-Test View of Parking Brake

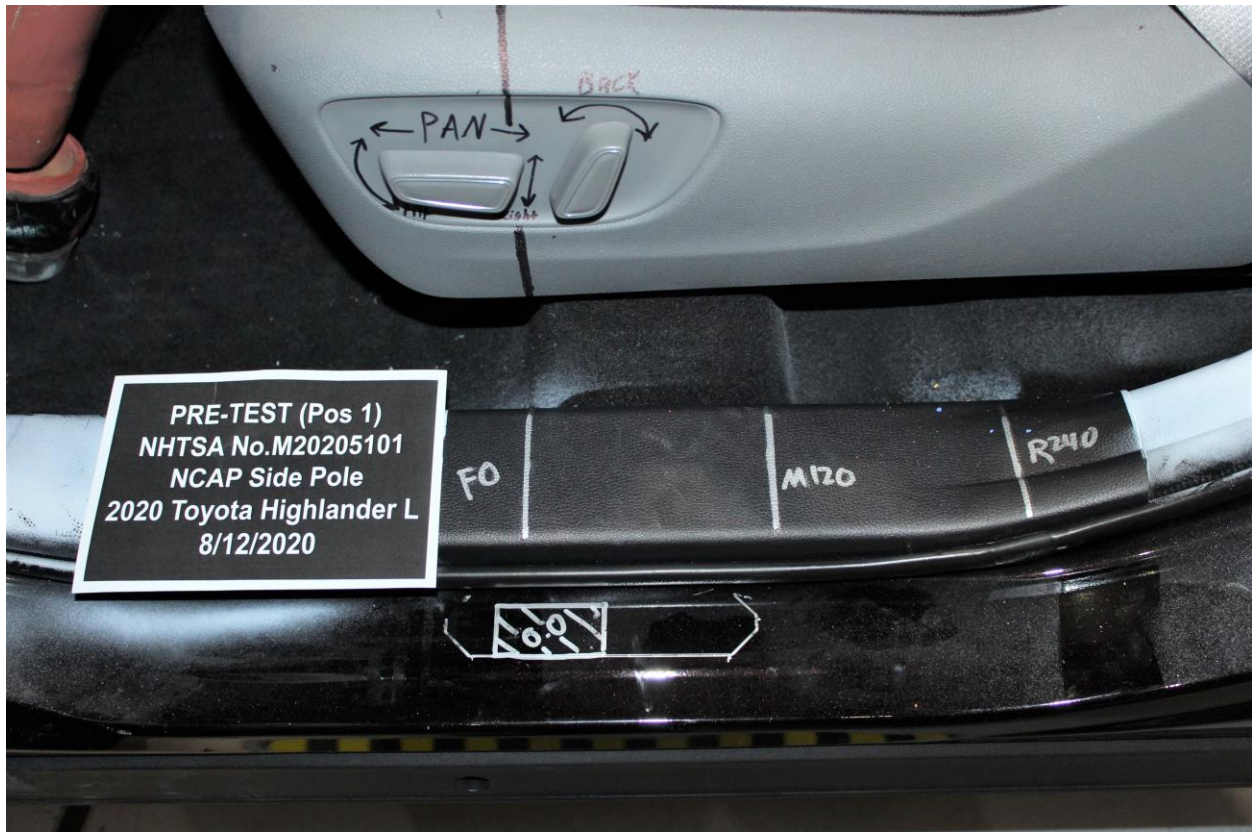


Figure A-37: Pre-Test Close-Up Left Side View of Driver Seat Track



Figure A-38: Pre-Test Close-Up Left Side View of Driver Seat Back



Figure A-39: Pre-Test Close-Up View of Driver Seat Back or Head Restraint



Figure A-40: Pre-Test Dummy and Door Clearance View



Figure A-41: Post-Test Dummy and Door Clearance View



Figure A-42: Pre-Test Right Side View of Dummy and Front Seat of Occupant Compartment



Figure A-43: Post-Test Right Side View of Dummy and Front Seat of Occupant Compartment



Figure A-44: Pre-Test Inner Door Panel View



Figure A-45: Post-Test Inner Door Panel View Showing Dummy Contact Location



Figure A-46: Post-Test Dummy Close-Up Head Contact with Vehicle Interior View



Figure A-47: Post-Test Dummy Close-Up Head Contact with Side Airbag View



Figure A-48: Post-Test Dummy Close-Up Torso Contact with Vehicle Interior View



Figure A-49: Post-Test Dummy Close-Up Torso Contact with Side Airbag View



Figure A-50: Post-Test Dummy Close-Up Pelvis Contact with Vehicle Interior View



Figure A-51: Post-Test Dummy Close-Up Pelvis Contact with Side Airbag View

Photo Not Applicable

Figure A-52: Post-Test Dummy Close-Up Knee Contact with Vehicle Interior View



Figure A-53: Pre-Test View of Fuel Filler Cap or Fuel Filler Neck



Figure A-54: Post-Test View of Fuel Filler Cap or Fuel Filler Neck

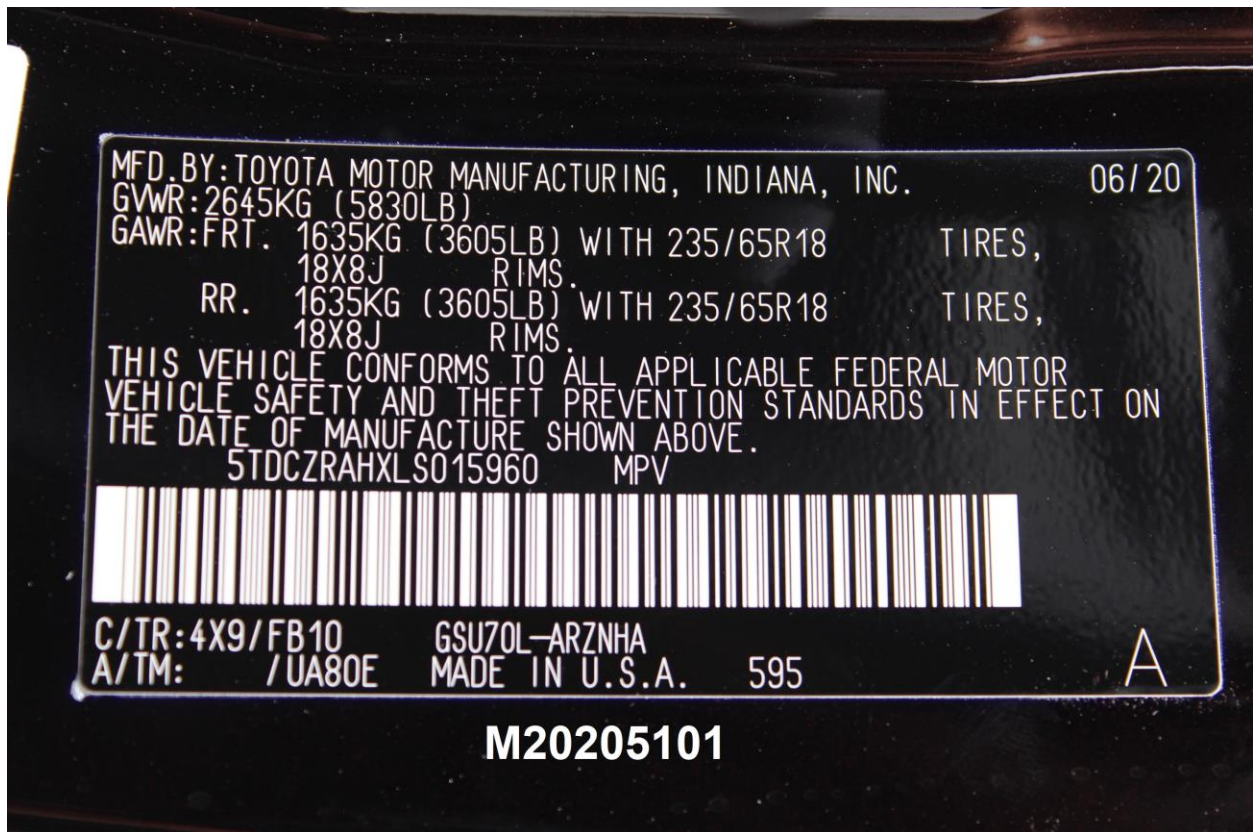


Figure A-55: Close-Up View of Vehicle's Certification Label



Figure A-55a: Close-Up View of Reduced Load Capacity Label

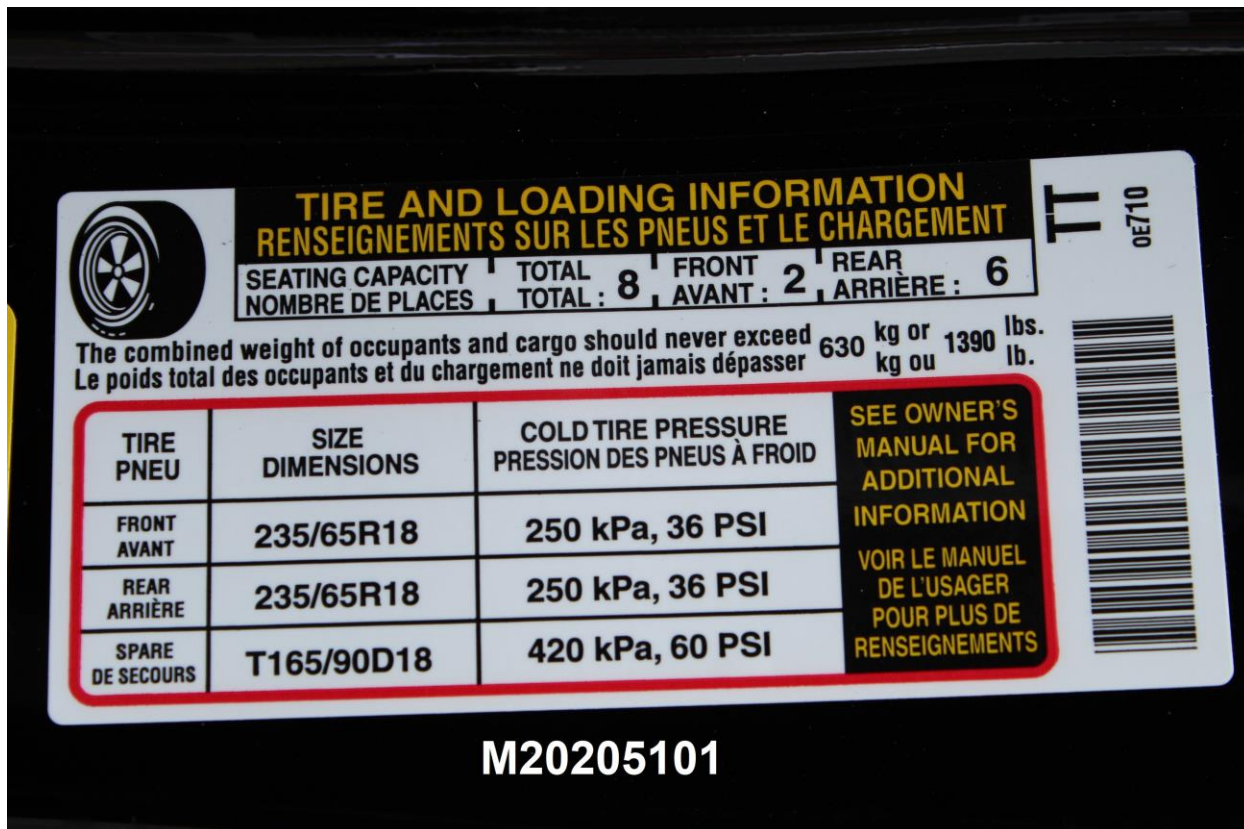


Figure A-56: Close-Up View of Vehicle's Tire Information Placard or Label

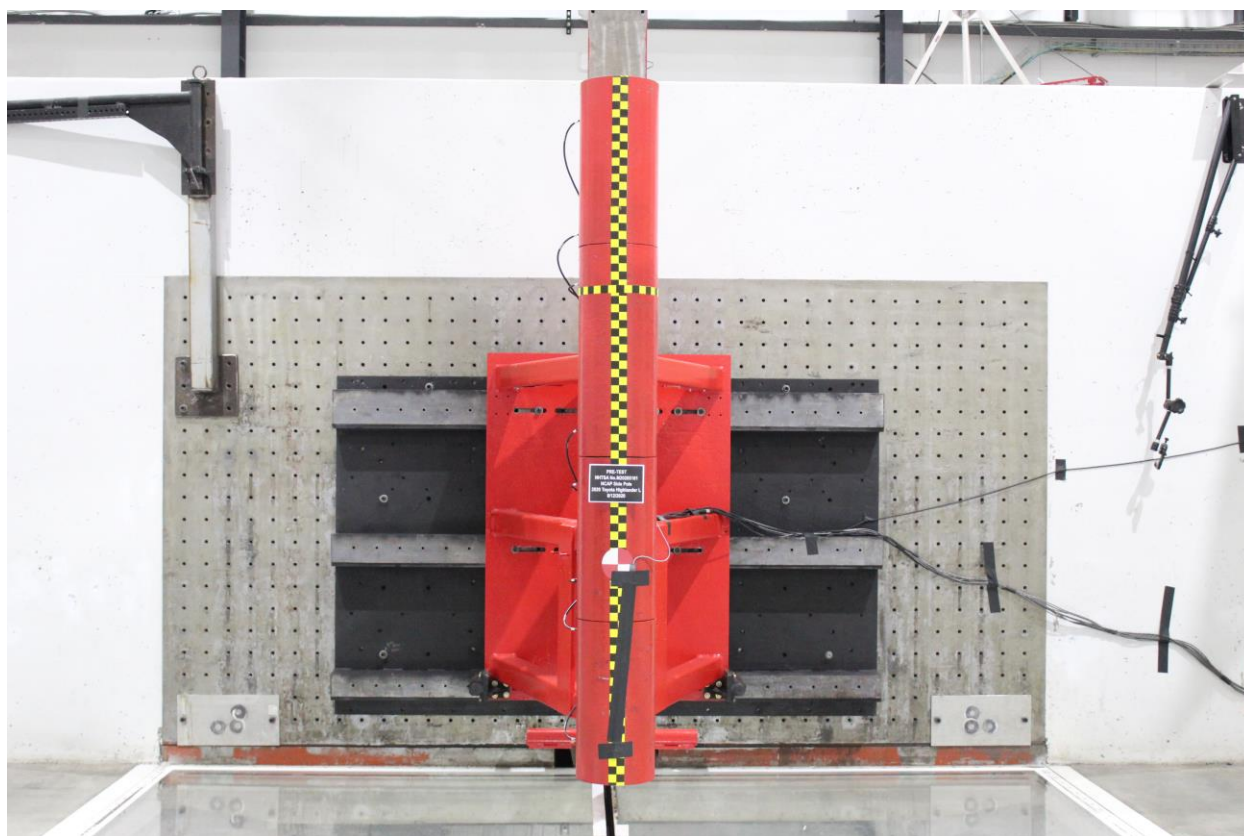


Figure A-57: Pre-Test Pole Barrier Front View

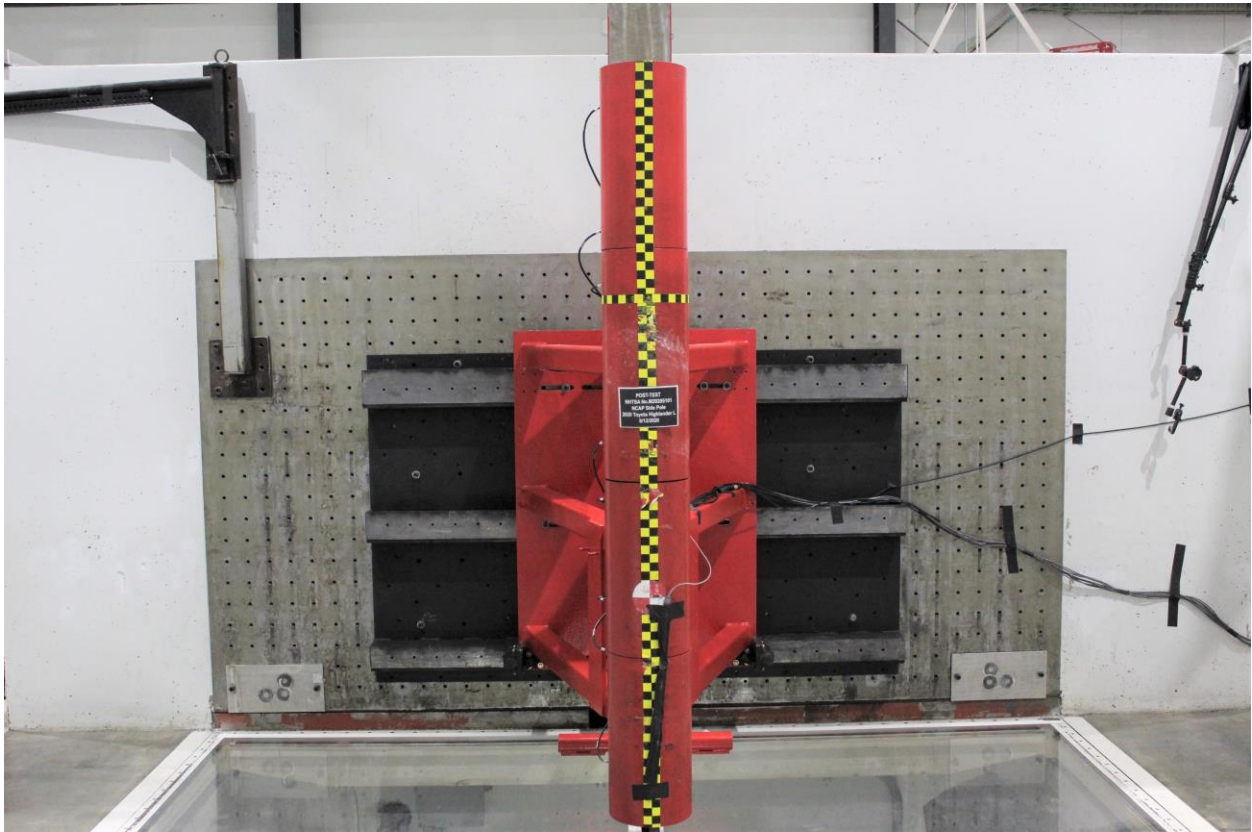


Figure A-58: Post-Test Pole Barrier Front View

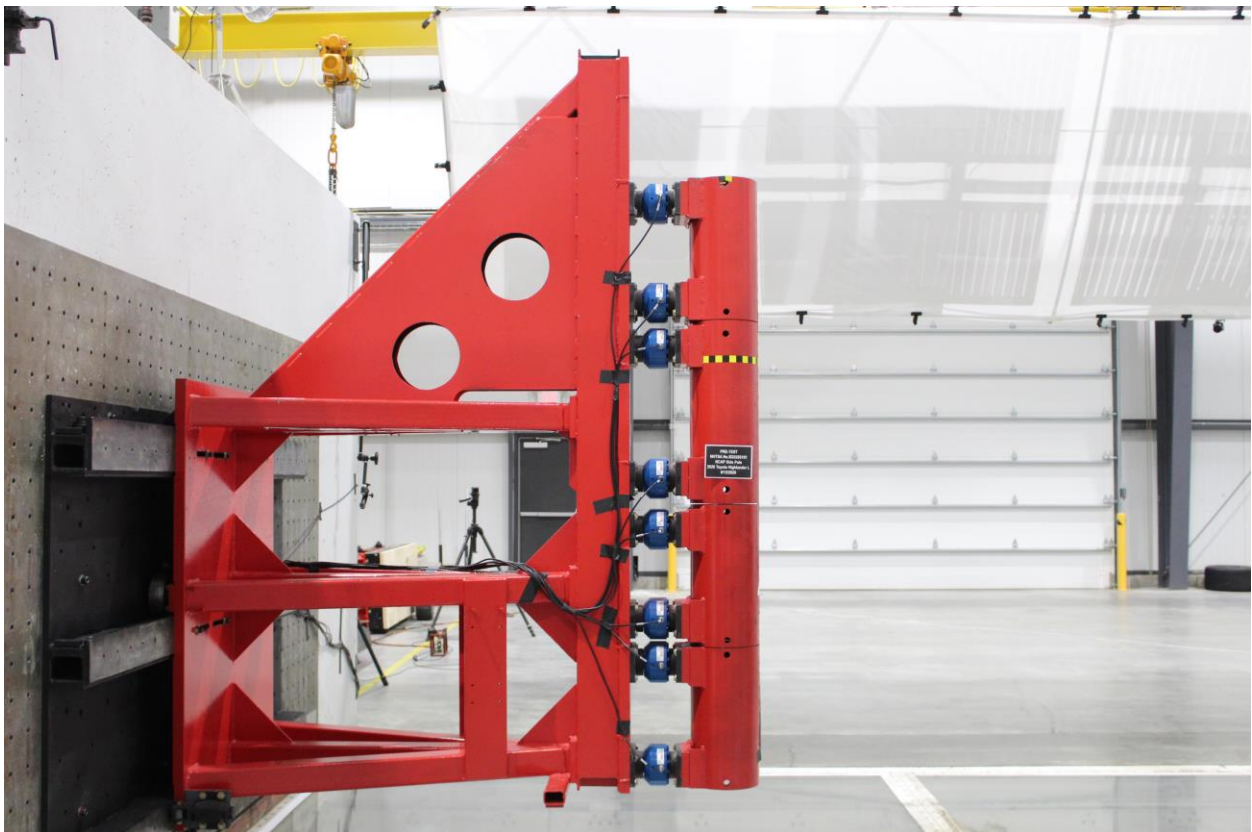


Figure A-59: Pre-Test Pole Barrier Side View

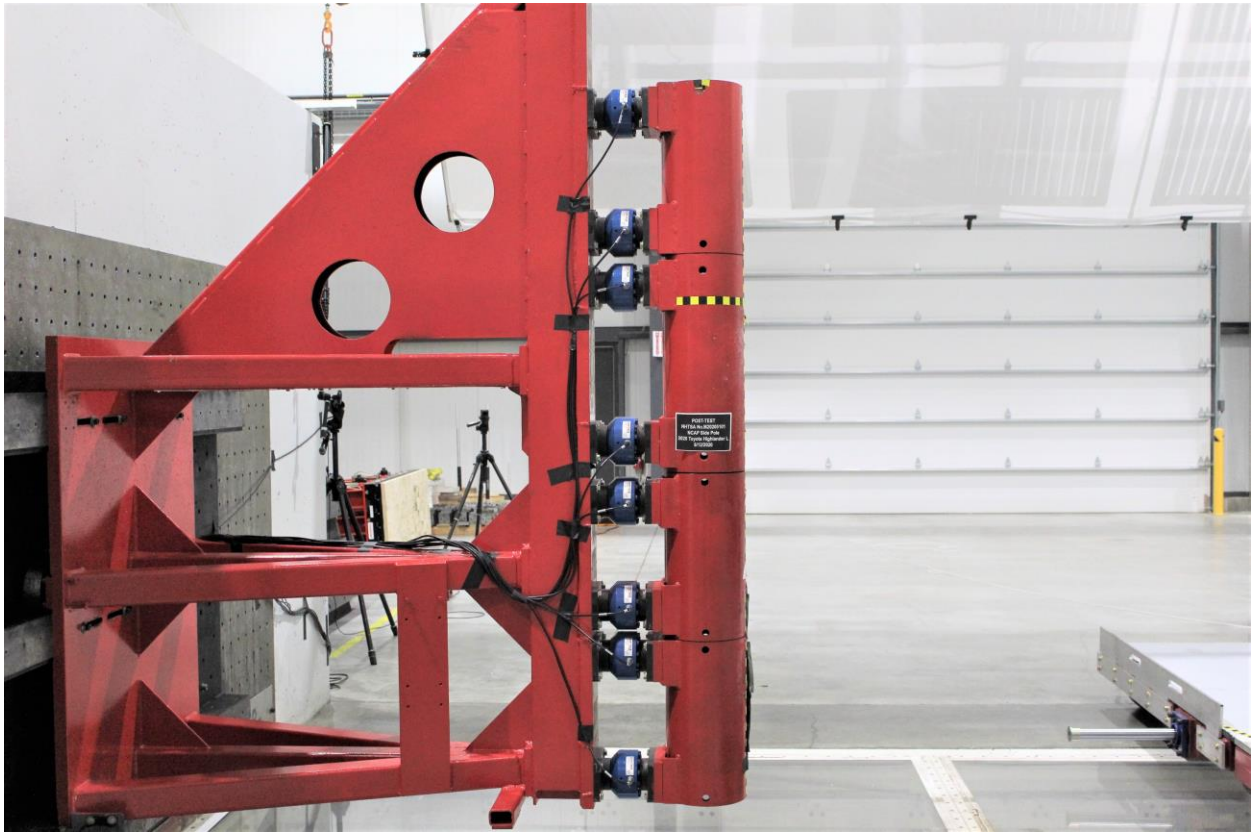


Figure A-60: Post-Test Pole Barrier Side View

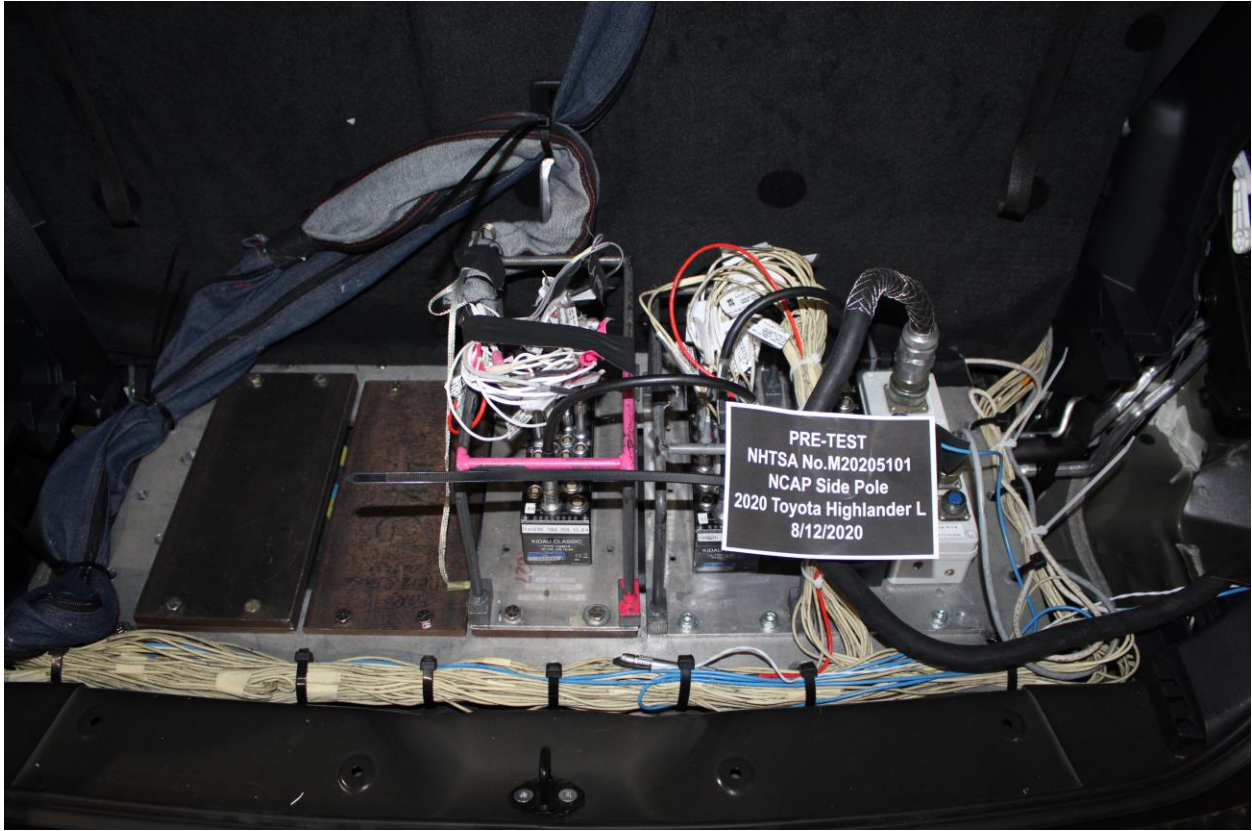


Figure A-61: Pre-Test Ballast View



Figure A-62: Post-Test Primary and Redundant Speed Trap Read-Out



Figure A-63: FMVSS No. 301 Static Rollover 0 Degrees

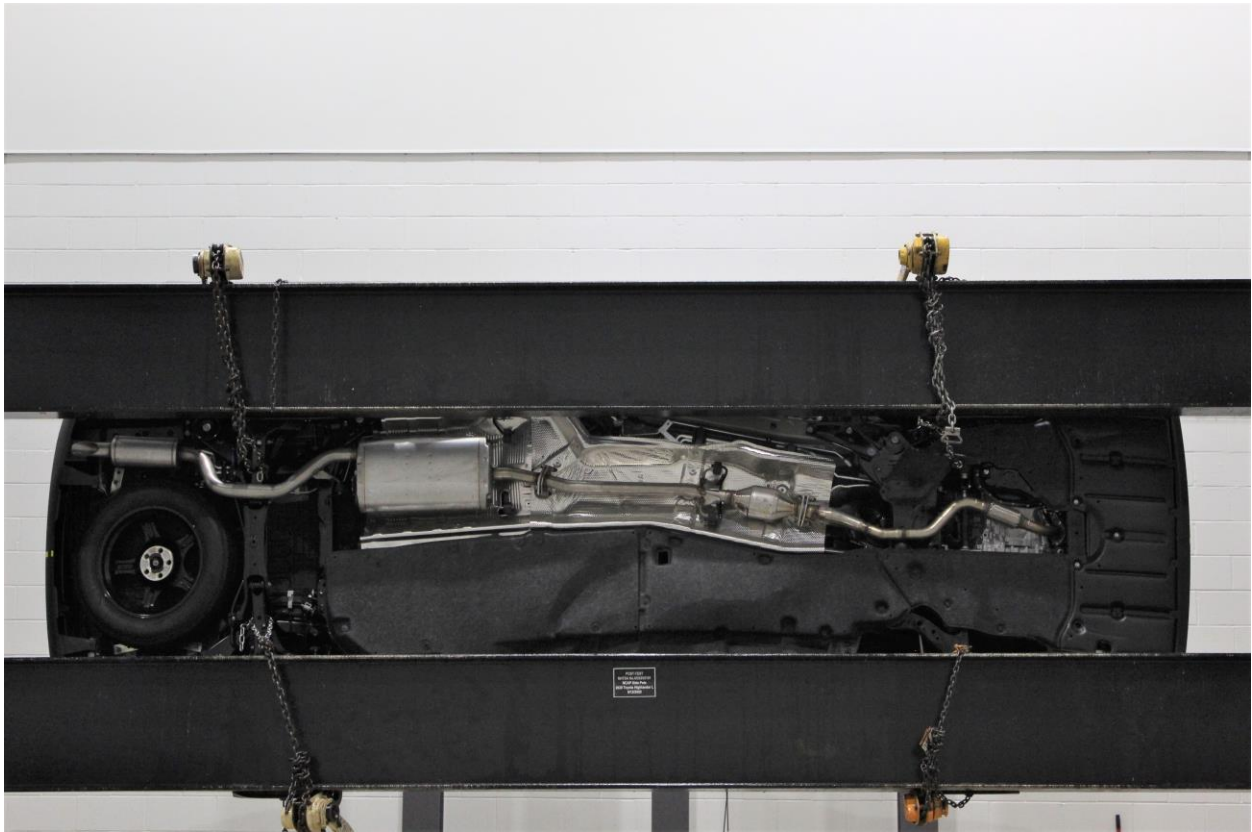


Figure A-64: FMVSS No. 301 Static Rollover 90 Degrees

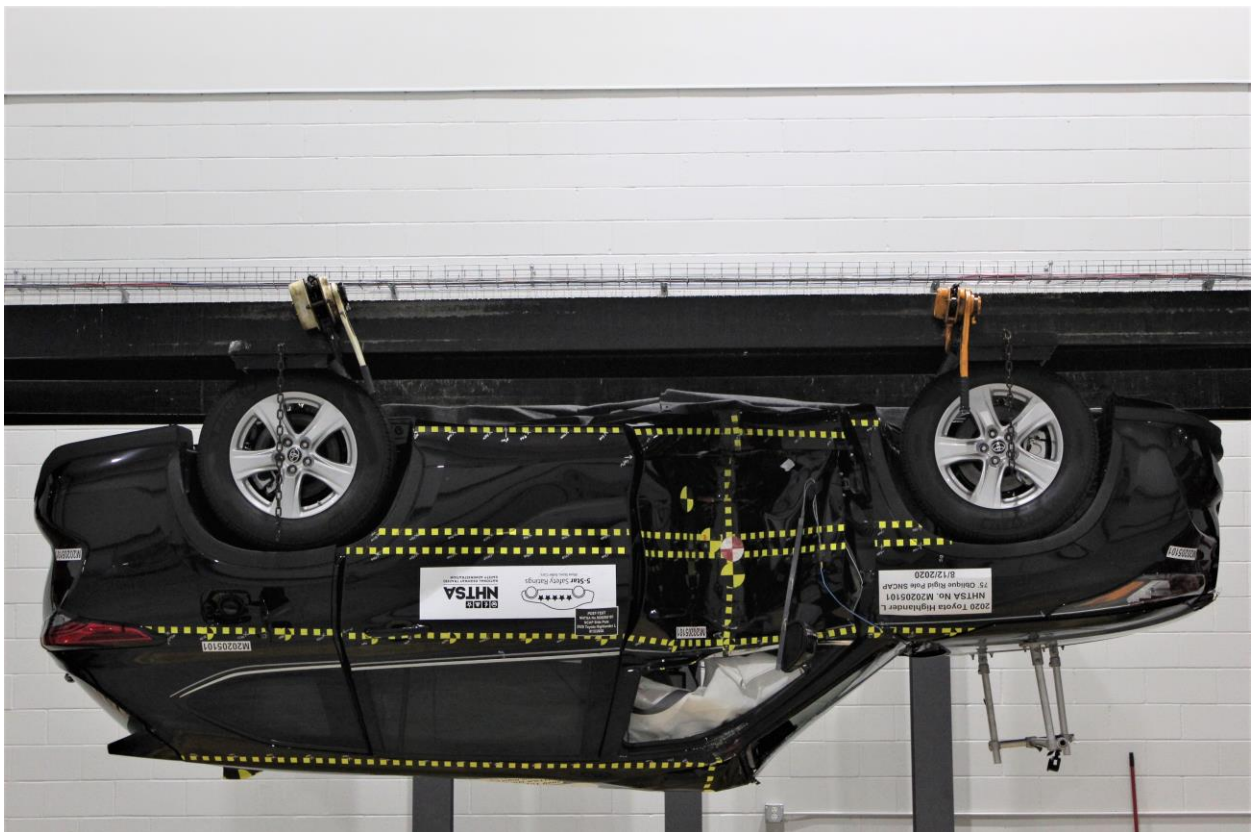


Figure A-65: FMVSS No. 301 Static Rollover 180 Degrees

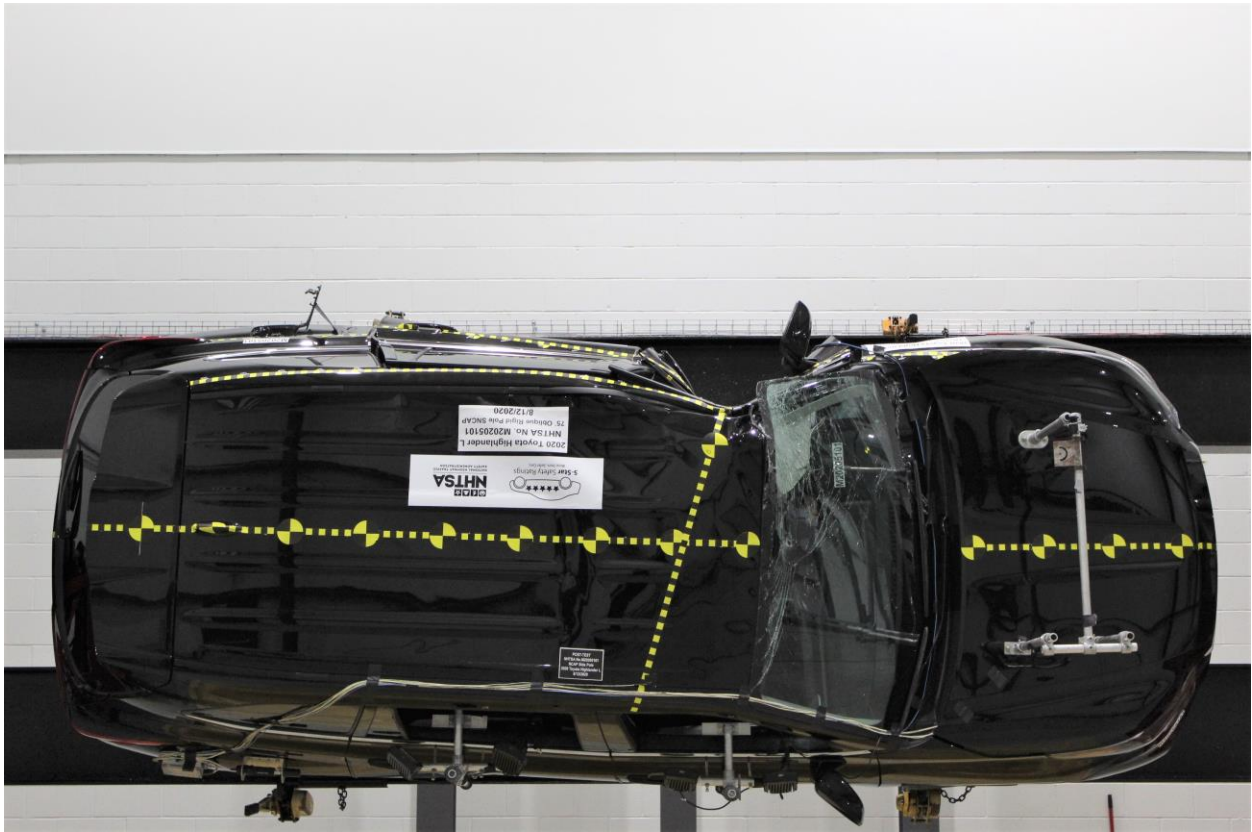


Figure A-66: FMVSS No. 301 Static Rollover 270 Degrees



Figure A-67: FMVSS No. 301 Static Rollover 360 Degrees



Figure A-68: Impact Event

TOYOTA <i>Let's Go Places</i>		STANDARD EQUIPMENT MECHANICAL & PERFORMANCE - 3.5L V6 Engine 8-Speed Automatic SAFETY & CONVENIENCE - Toyota Safety Sense 2.0: Pre-Collision System w/Pedestrian Detection, Full-Speed Range Dynamic Radar Cruise Control, Lane Departure Alert w/Steering Assist, Lane Tracing Assist, Automatic High Beams, Road Sign Assist & Airbags, Star Safety System - LATCH-Lower Anchor & Tether for Children - Safety Connect w/1-Year Trial EXTERIOR - 18" Alloy Wheels w/Temporary Spare - LED Headlights & Taillights - Heated Power Outside Mirrors INTERIOR - Power Driver Seat - 3rd Row 60/40 Split Fold-Flat Seats - Audio: 8" Touch Screen & Speakers, iUSB Media Port, 4 USB Charge-Ports, SiriusXM w/3-Month All-Access Trial, Android Auto & Apple CarPlay Compatible - Smart Key System w/Push Button Start *For Full Product Details, Please Visit Toyota.com/Highlander **Full Tank of Gas**	MANUFACTURER'S SUGGESTED RETAIL PRICE \$34,600.00 OPTIONAL EQUIPMENT FE 50 State Emissions DK Preferred Owner's Portfolio 318.00 ZT All-Weather Floor/Cargo Liner
DESC: HIGHLANDER L - FWD VIN: 5TDCZRAHXL015960 YR/MDL: 2020/8935A CLR: OPULENT AMBER/GRAPHITE (04X9/10) FINAL ASSEMBLY POINT: PRINCETON, INDIANA, U.S.A.			
GOVERNMENT 5-STAR SAFETY RATINGS <p>This vehicle has not been rated by the government for overall vehicle score, frontal crash, side crash or rollover risk.</p> <p>Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest. Source: National Highway Traffic Safety Administration (NHTSA) www.safercar.gov or 1-888-327-4236</p>			
EPA DOT Fuel Economy and Environment Gasoline Vehicle			
Fuel Economy 24 MPG Small SUVs range from 16 to 100 MPG. The best vehicle rate: 138 MPG. 21 29 combined city/hwy city highway 4.2 gallons per 100 miles		You spend \$1,000 more in fuel costs over 5 years compared to the average new vehicle.	
Annual fuel cost \$1,700		Fuel Economy & Greenhouse Gas Rating (tailpipe only) Smog Rating (tailpipe only) 1 5 10 1 5 10 Best Best	
Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 22 MPG and costs \$7,500 to fuel over 5 years. Good economy rate based on 15,000 miles per year at \$2.79 per gallon before taxes per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.			
fuel economy.gov Calculate personalized estimates and compare vehicles		DELIVERY PROCESSING AND HANDLING FEE 1,120.00 TOTAL \$36,038.00 The New Vehicle Limited Warranty provides 3-year/50,000-mile basic coverage, 5-year/100,000-mile powertrain coverage, and 3-year/unlimited-mile corrosion perforation coverage. See Warranty and Maintenance Guide for details. An extended service contract may be available for the vehicle. Ask dealer for details. Dealer's suggested retail price includes manufacturer's recommended pre-delivery service. Gasoline, license and title fees, applicable taxes, state and local taxes and dealer and distributor installed options and accessories are not included in the manufacturer's suggested retail price. ToyotaCare, which covers normal factory scheduled maintenance for two years or 25,000 miles, whichever occurs first, is included as part of the sales price of the vehicle for qualifying buyers. See participating dealer for eligibility and coverage details.	
QR Code		Delivered by Truck to: 19047 KOON'S WESTMINSTER TOYOTA 315 BALTIMORE BLVD. WESTMINSTER MD21157	

Figure A-69: Monroney Label

Head restraints

Head restraints are provided for all seats.

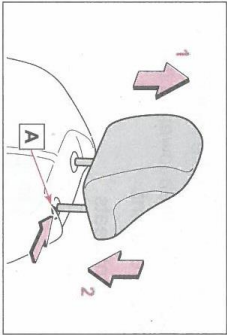
WARNING

Head restraint precautions

- Observe the following precautions regarding the head restraints. Failure to do so may result in death or serious injury.
- Use the head restraints designed for each respective seat.
- Adjust the head restraints to the correct position at all times.
- After adjusting the head restraints, push down on them and make sure they are locked in position.
- Do not drive with the head restraints removed.

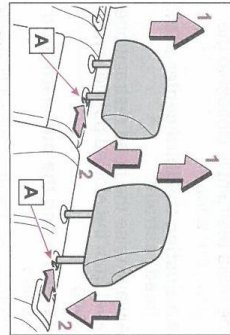
Adjusting a head restraint

Front seats

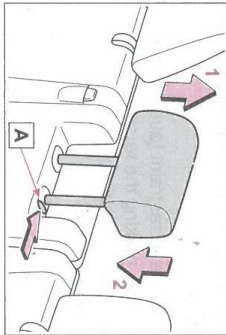


- 1 Up
Pull the head restraints up.
- 2 Down
Push the head restraint down while pressing the lock release button **A**.

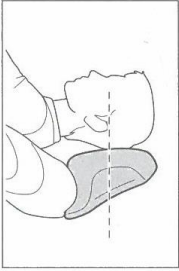
Second seats



- 1 Up
Pull the head restraints up.
 - 2 Down
Push the head restraint down while pressing the lock release button **A**.
- Third center seat**



- 1 Up
Pull the head restraints up.
 - 2 Down
Push the head restraint down while pressing the lock release button **A**.
- Adjusting the height of the head restraints**



3 Before driving

Figure A-70: Head Restraint Use and Adjustment Information from Vehicle Owner's Manual



Figure A-71: Post-Test View of Shattered Vehicle Inner Door Panel (if applicable)

APPENDIX B

VEHICLE AND DUMMY RESPONSE DATA PLOTS

TABLE OF DATA PLOTS
Driver Dummy Instrumentation Plots

Fig.	Description	Page
1	Driver Head Acceleration (X) Primary vs. Time	B-4
2	Driver Head Acceleration (Y) Primary vs. Time	B-4
3	Driver Head Acceleration (Z) Primary vs. Time	B-4
4	Driver Head Resultant Acceleration Primary vs. Time	B-4
5	Driver Lower Spine T12 Acceleration (X) vs. Time	B-5
6	Driver Lower Spine T12 Acceleration (Y) vs. Time	B-5
7	Driver Lower Spine T12 Acceleration (Z) vs. Time	B-5
8	Driver Lower Spine T12 Resultant Acceleration vs. Time	B-5
9	Driver Iliac Wing Force on Impact Side (Y) vs. Time	B-6
10	Driver Acetabulum Force on Impact Side (Y) vs. Time	B-6
11	Driver Total Pelvis Force on Impact Side (Y) vs. Time	B-6

The following additional data for this test can be obtained from the Research and Development section of the NHTSA website. The website can be found at www.NHTSA.gov.

Additional Driver Dummy Instrumentation Data

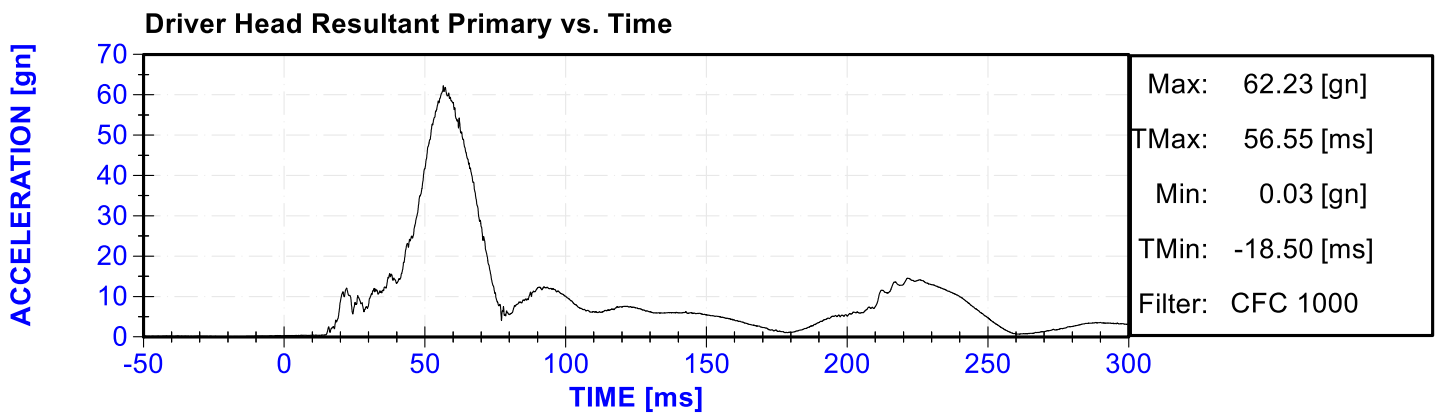
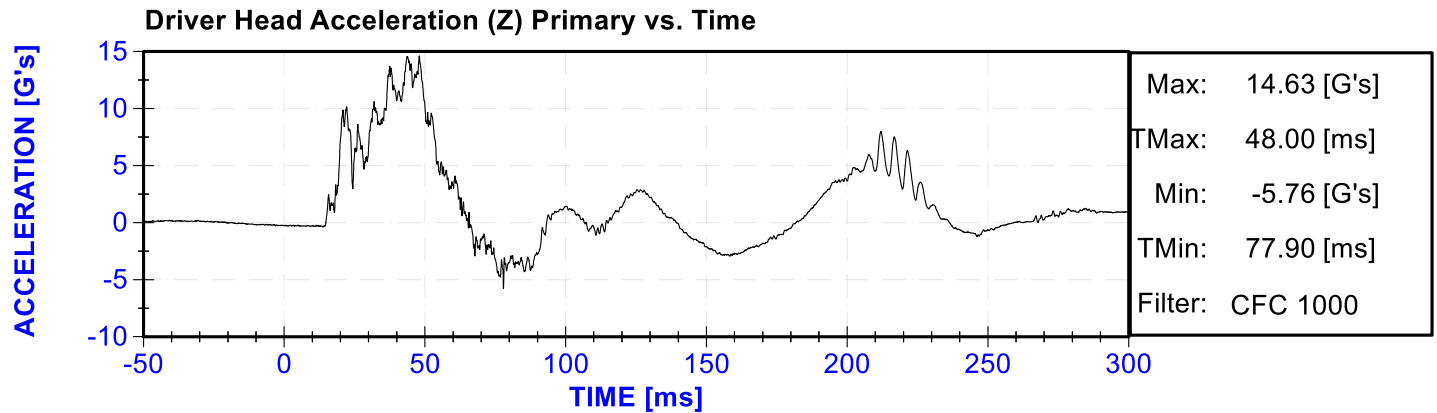
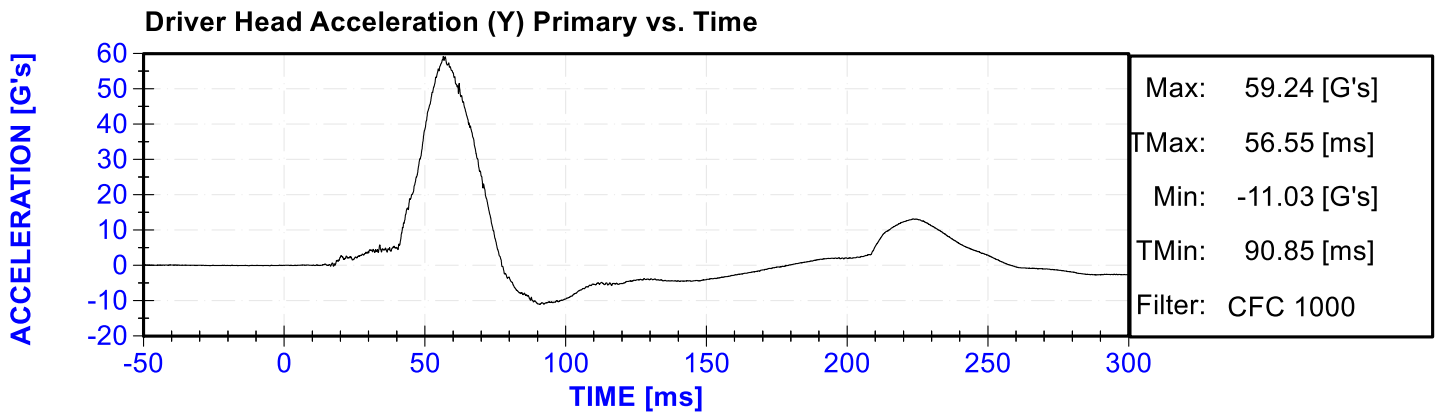
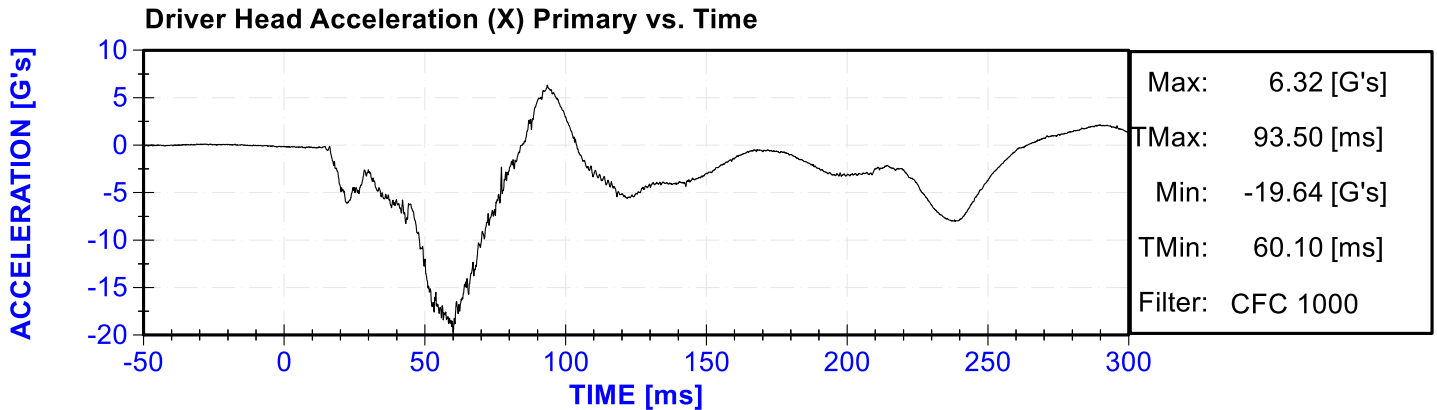
Driver Head Acceleration Redundant (X)
Driver Head Acceleration Redundant (Y)
Driver Head Acceleration Redundant (Z)
Driver Upper Thorax Rib Deflection (Y)
Driver Middle Thorax Rib Deflection (Y)
Driver Lower Thorax Rib Deflection (Y)
Driver Upper Abdomen Rib Deflection (Y)
Driver Lower Abdomen Rib Deflection (Y)

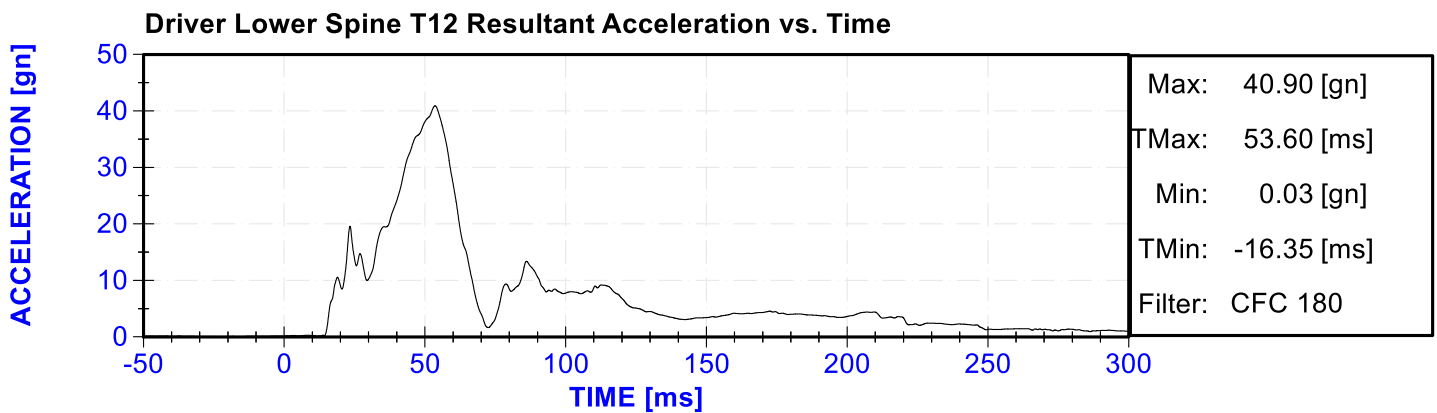
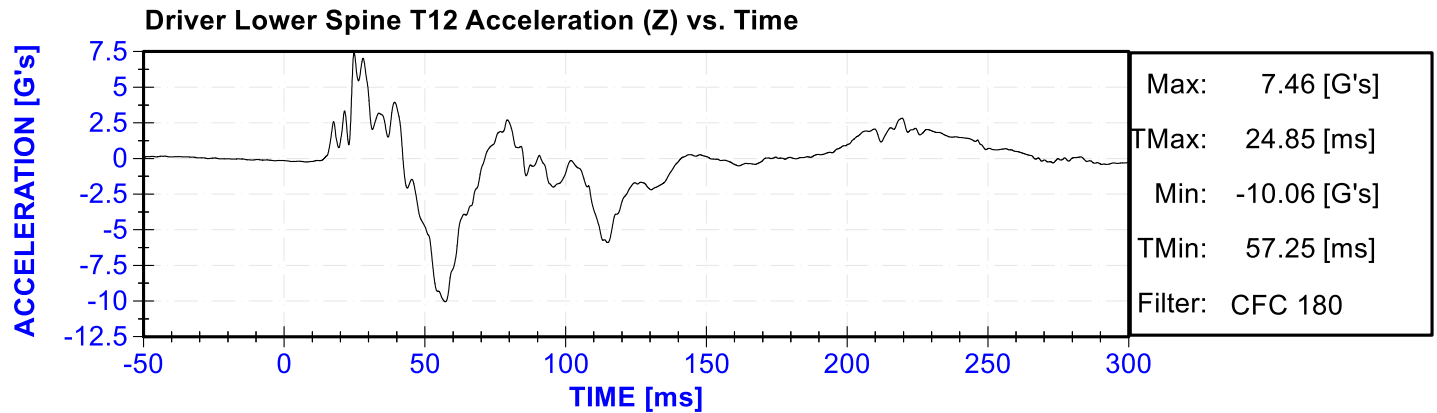
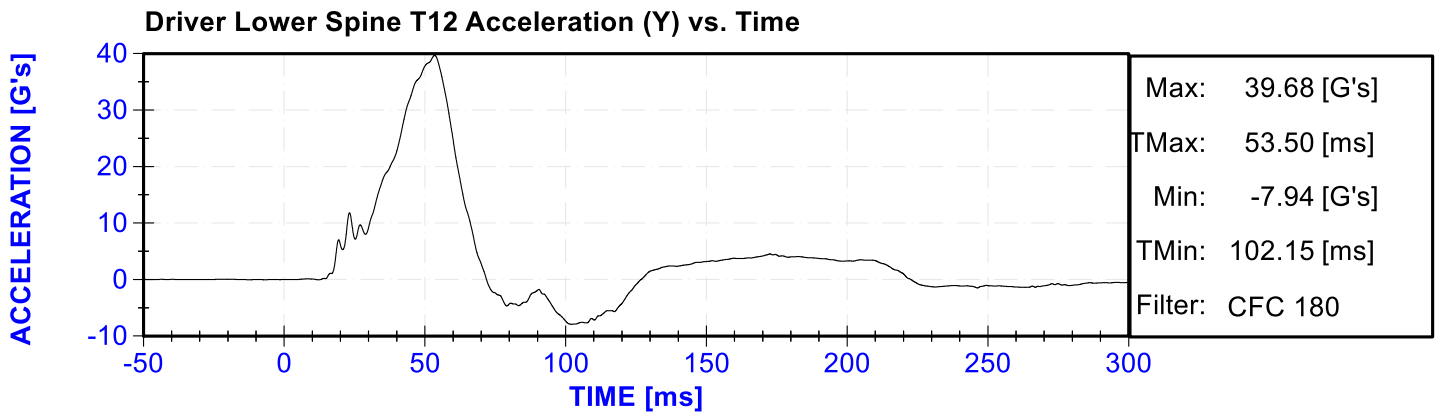
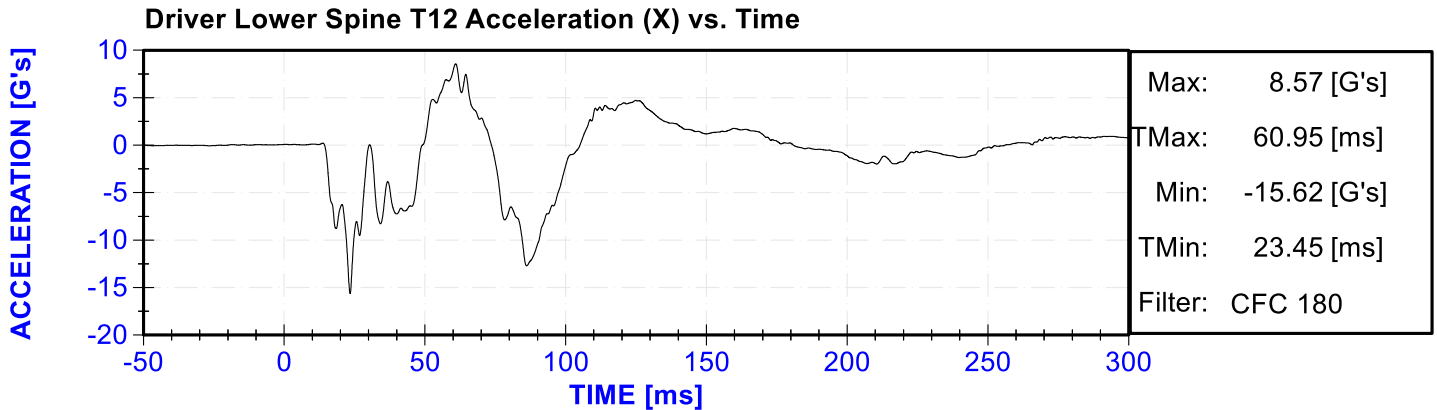
Vehicle Instrumentation Data

Vehicle Center of Gravity Acceleration (X)
Vehicle Center of Gravity Acceleration (Y)
Vehicle Center of Gravity Acceleration (Z)
Left Floor Sill Acceleration (Y)
Left A-Pillar Sill Acceleration (Y)
Left Lower A-Pillar Acceleration (Y)
Left Mid A-Pillar Acceleration (Y)
Left B-Pillar Sill Acceleration (Y)
Left Lower B-Pillar Acceleration (Y)
Left Mid B-Pillar Acceleration (Y)
Driver Seat Track at Dummy Hip Point Acceleration (Y)
Engine Top Acceleration (X)
Engine Top Acceleration (Y)
Firewall Center Acceleration (Y)
Right Roof at Vertical Impact Reference Line Acceleration (Y)
Right Sill at Vertical Impact Reference Line Acceleration (Y)
Rear Floorpan Behind Rear Axle at Centerline Acceleration (X)
Rear Floorpan Behind Rear Axle at Centerline Acceleration (Y)

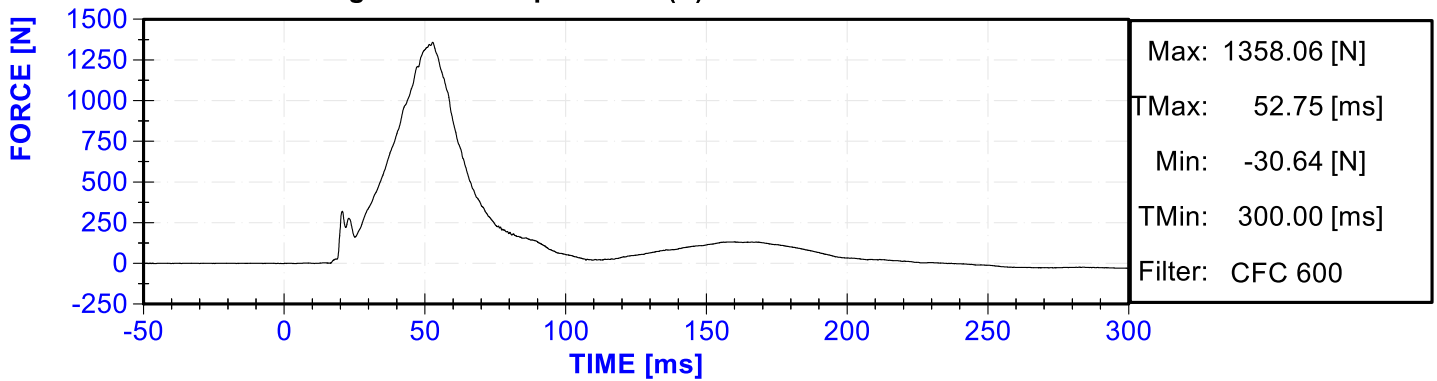
Pole Instrumentation Data

Load Cell Pole Barrier #1 Force (Y)
Load Cell Pole Barrier #2 Force (Y)
Load Cell Pole Barrier #3 Force (Y)
Load Cell Pole Barrier #4 Force (Y)
Load Cell Pole Barrier #5 Force (Y)
Load Cell Pole Barrier #6 Force (Y)
Load Cell Pole Barrier #7 Force (Y)
Load Cell Pole Barrier #8 Force (Y)

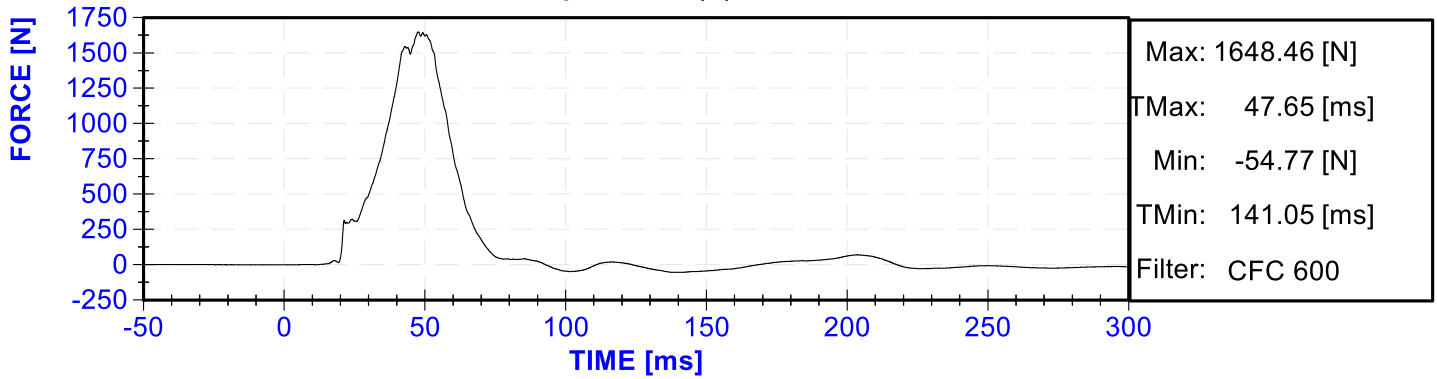




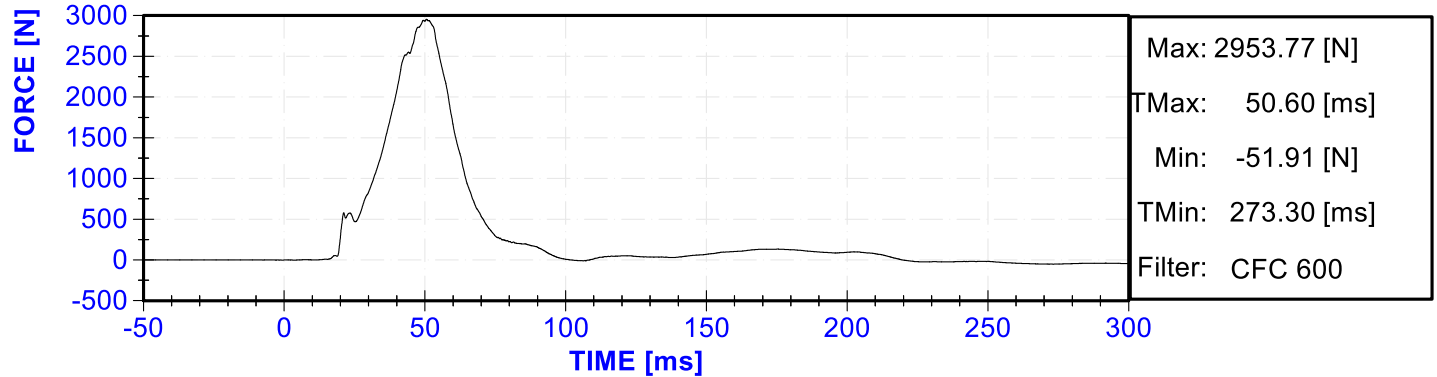
Driver Iliac Wing Force on Impact Side (Y) vs. Time



Driver Acetabulum Force on Impact Side (Y) vs. Time



Driver Total Pelvis Force on Impact Side (Y) vs. Time



APPENDIX C

DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD

SERIAL NO: DG8012

(CONFIGURED FOR LEFT SIDE IMPACT)

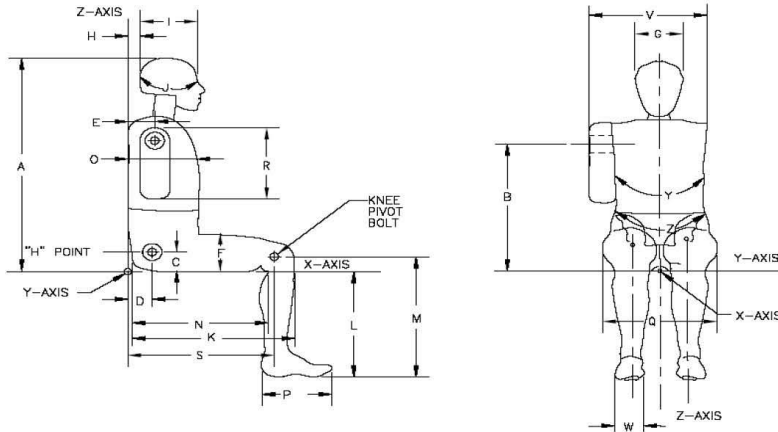


External Measurements - SID-IIs

Technician: K. Dutton

Date: 08/10/2020

Dummy Serial Number: DG8012



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	772	788	779	Pass
B	Shoulder Pivot Height	437	453	446	Pass
C	H-point Height	79	89	84	Pass
D	H-point from seatback	141	151	146	Pass
E	Shoulder Pivot from Backline	97	107	104	Pass
F	Thigh Clearance	119	135	127	Pass
G	Head Breadth	140	148	144	Pass
H	Head Back from Backline	40	46	44	Pass
I	Head Depth	178	188	183	Pass
J	Head Circumference	541	551	547	Pass
K	Buttock to Knee Length	514	540	533	Pass
L	Popliteal Height	343	369	357	Pass
M	Knee Pivot to floor height	392	409	403	Pass
N	Buttock Popliteal Length	416	442	433	Pass
O	Chest Depth w/o jacket	195	211	206	Pass
P	Foot Length	216	232	224	Pass
Q	Hip Breadth (w/pelvic plugs)	313	323	319	Pass
R	Arm Length	249	259	255	Pass
S	Knee Joint to seatback	477	493	486	Pass
V	Shoulder Width	341	357	346	Pass
W	Foot Width	78	94	86	Pass
Y	Chest Circumference w/jacket	851	881	867	Pass
Z	Waist Circumference	761	791	781	Pass

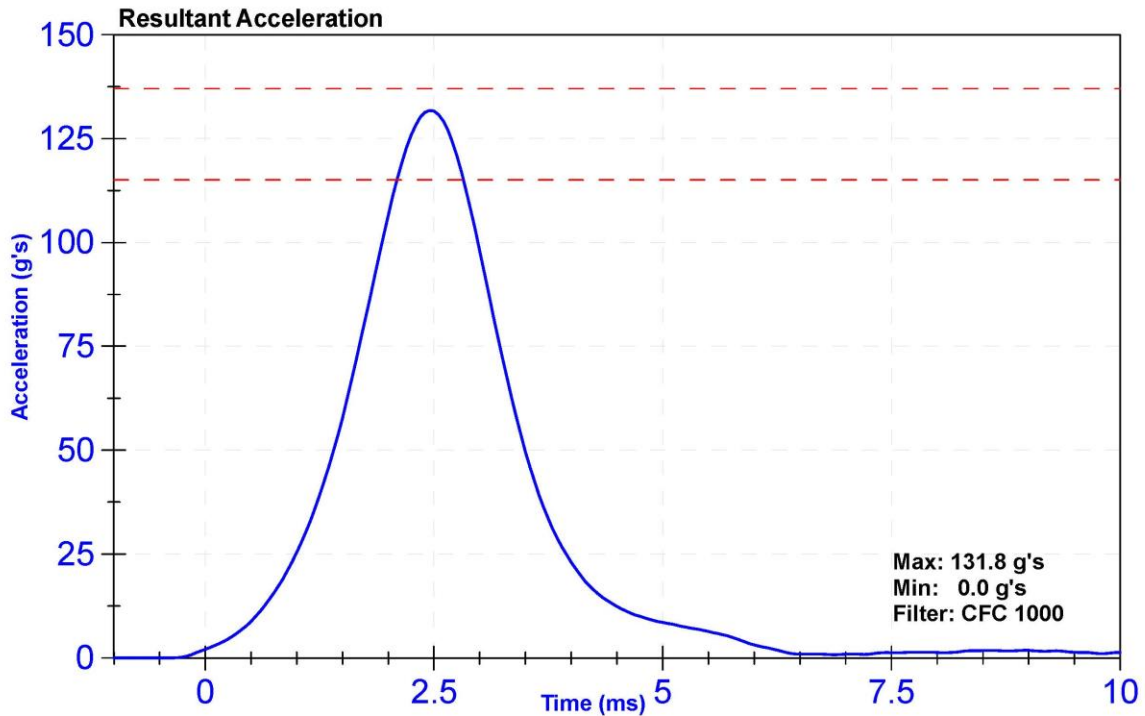
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

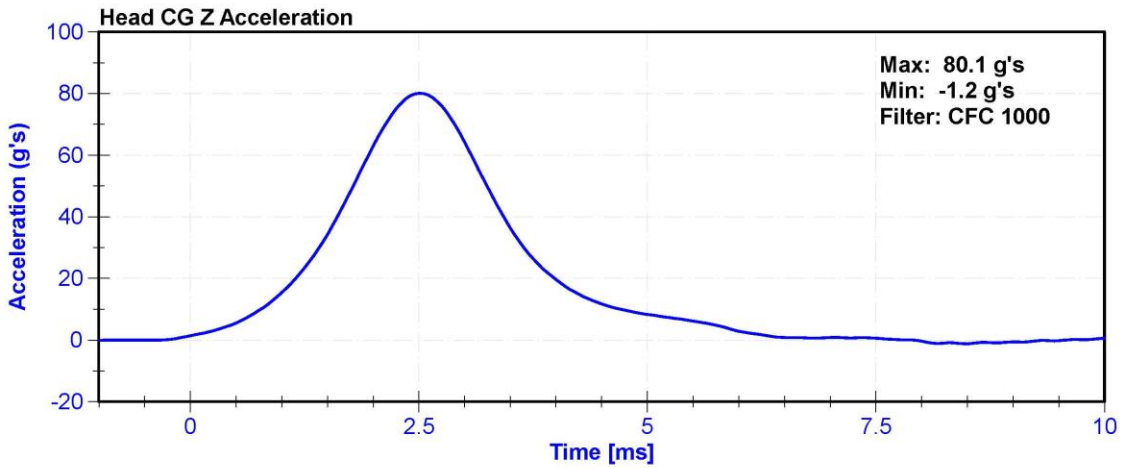
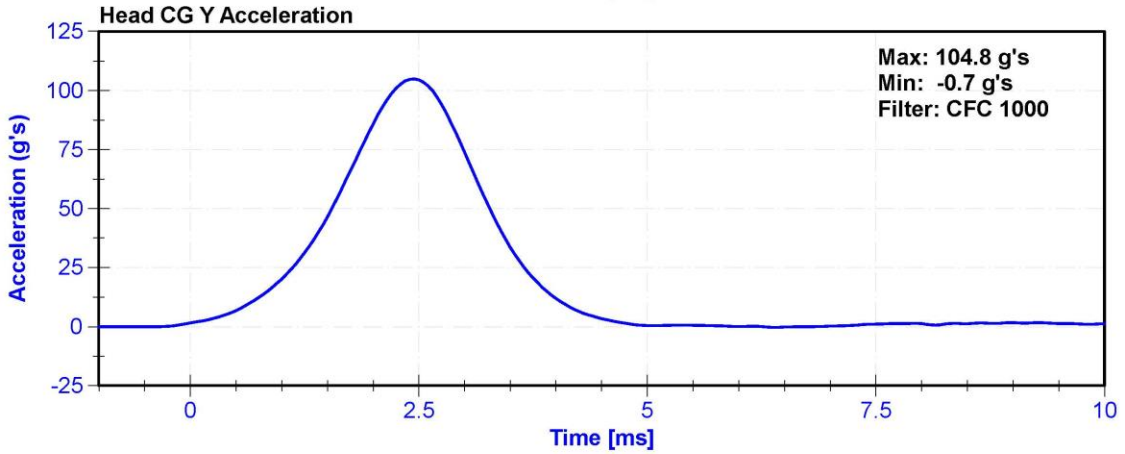
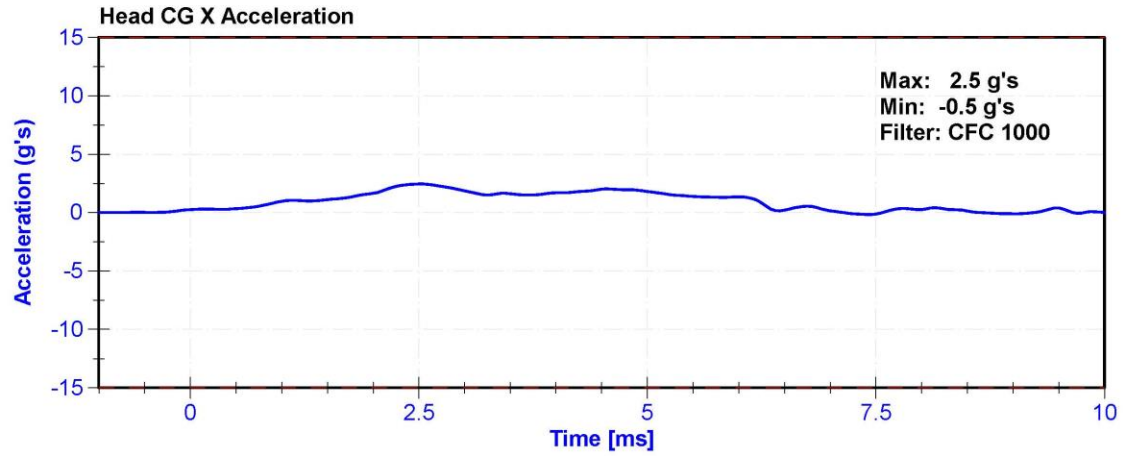
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	62	Pass
Resultant Acceleration	115	137	g's	131.8	Pass
Oscillation	0	15	%	1.3	Pass
Fore-Aft Acceleration	-15	15	g's	2.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	AC-P74788	4/16/2020	10/15/2020
Y Accelerometer	ENDEVCO 7264CT	AC-P83432	4/16/2020	10/15/2020
Z Accelerometer	ENDEVCO 7264	AC-P83319	4/16/2020	10/15/2020





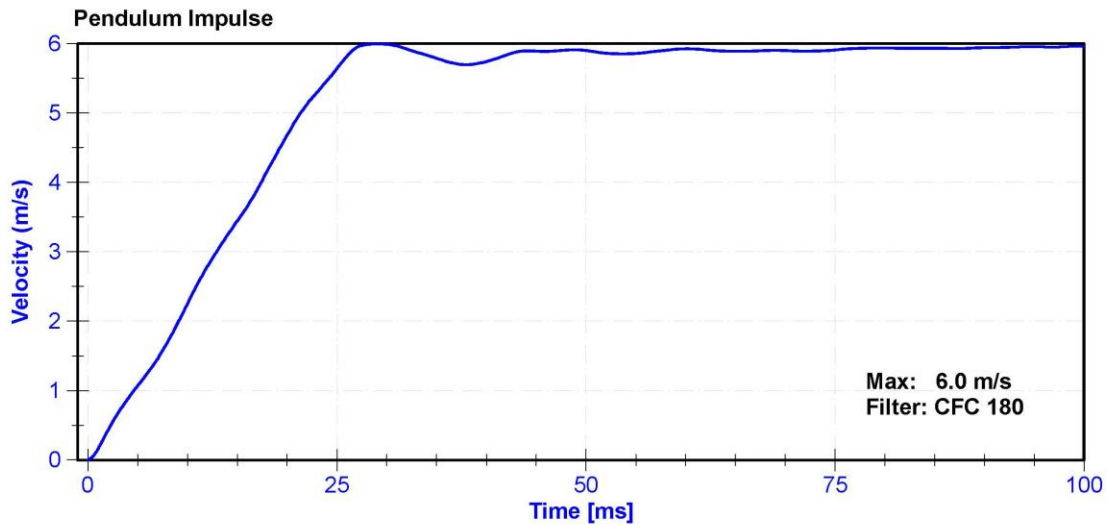
ATD Manufacturer	FTSS	Test Technician	E. Helenbrook
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

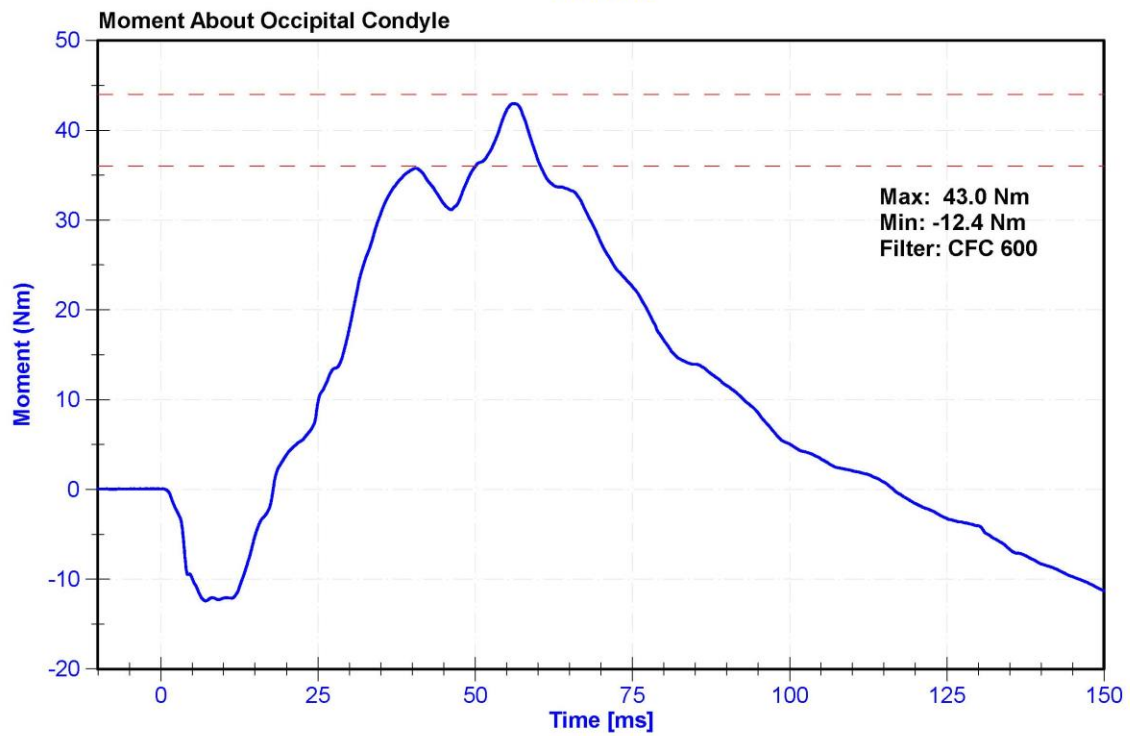
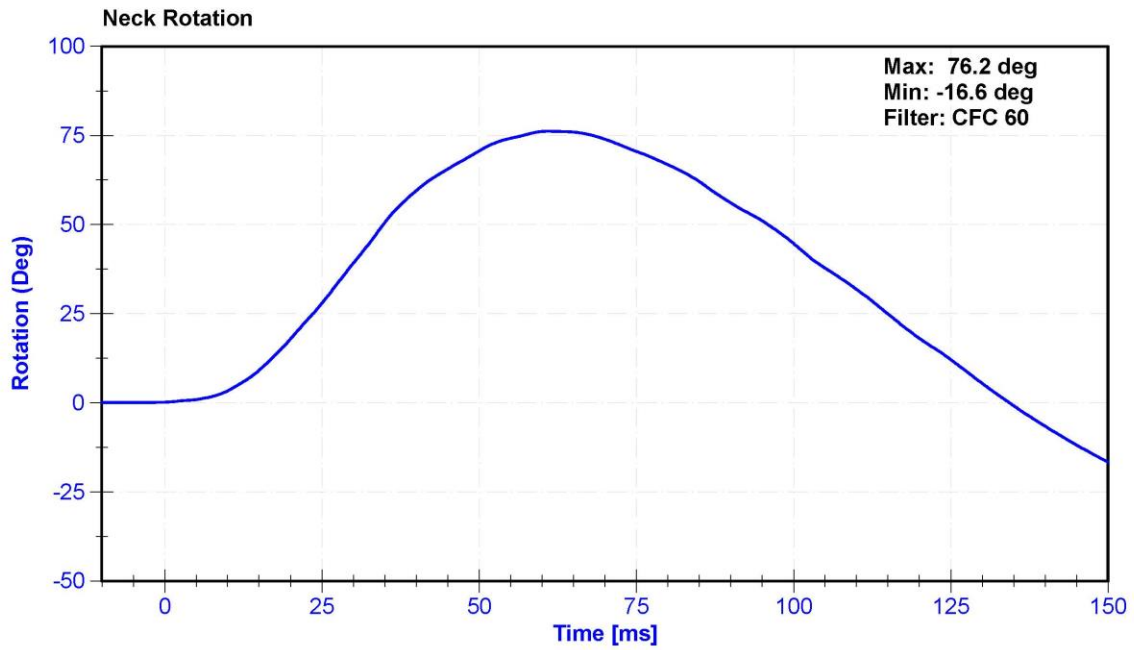
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.3	Pass
Humidity	10	70	%	55.4	Pass
Velocity	5.51	5.63	m/s	5.584	Pass
Pendulum Impulse at 10ms	2.2	2.8	m/s	2.25	Pass
Pendulum Impulse at 15ms	3.3	4.1	m/s	3.44	Pass
Pendulum Impulse at 20ms	4.4	5.4	m/s	4.68	Pass
Pendulum Impulse at 25ms	5.4	6.1	m/s	5.64	Pass
Pendulum Impulse from 25 to 100ms	5.5	6.2	m/s	6.00	Pass
Neck Rotation	71	81	deg	76.2	Pass
Time at Maximum Rotation	50	70	ms	61.0	Pass
Moment about the OC	36	44	Nm	43.0	Pass
Moment Decay to 0 Nm	102	126	ms	116.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	Denton 78051-342	DS-184Pend	11/4/2019	11/3/2020
Condyle Potentiometer	Denton 78051-342	DS-185Pend	11/4/2019	11/3/2020
Upper Neck Load Cell	Denton 1716	17162019 FY	3/18/2020	3/18/2021





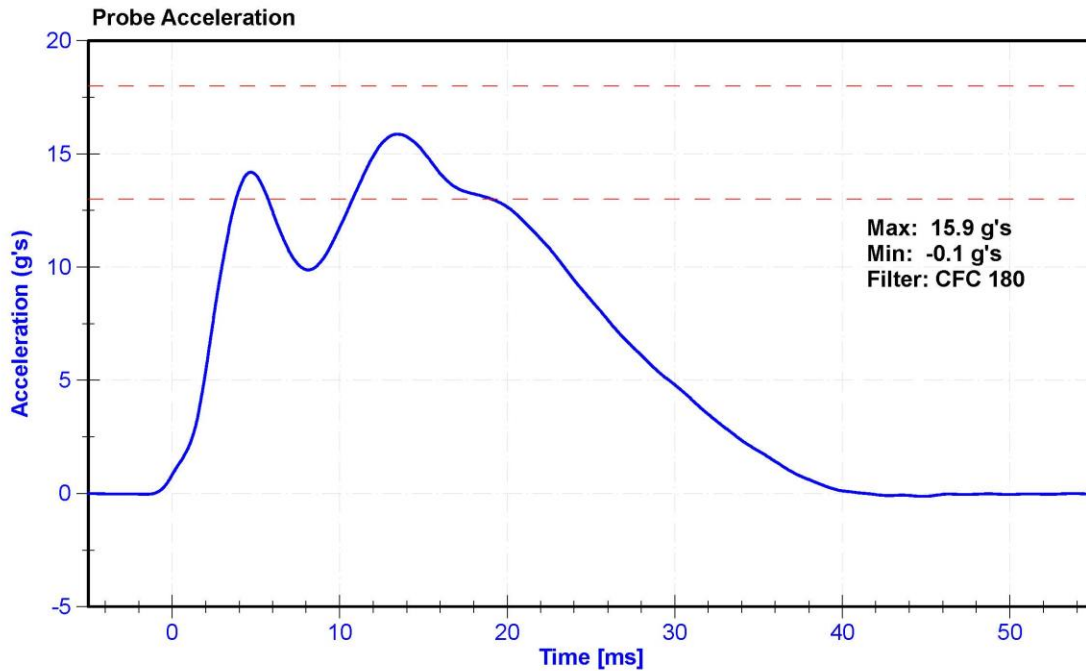
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

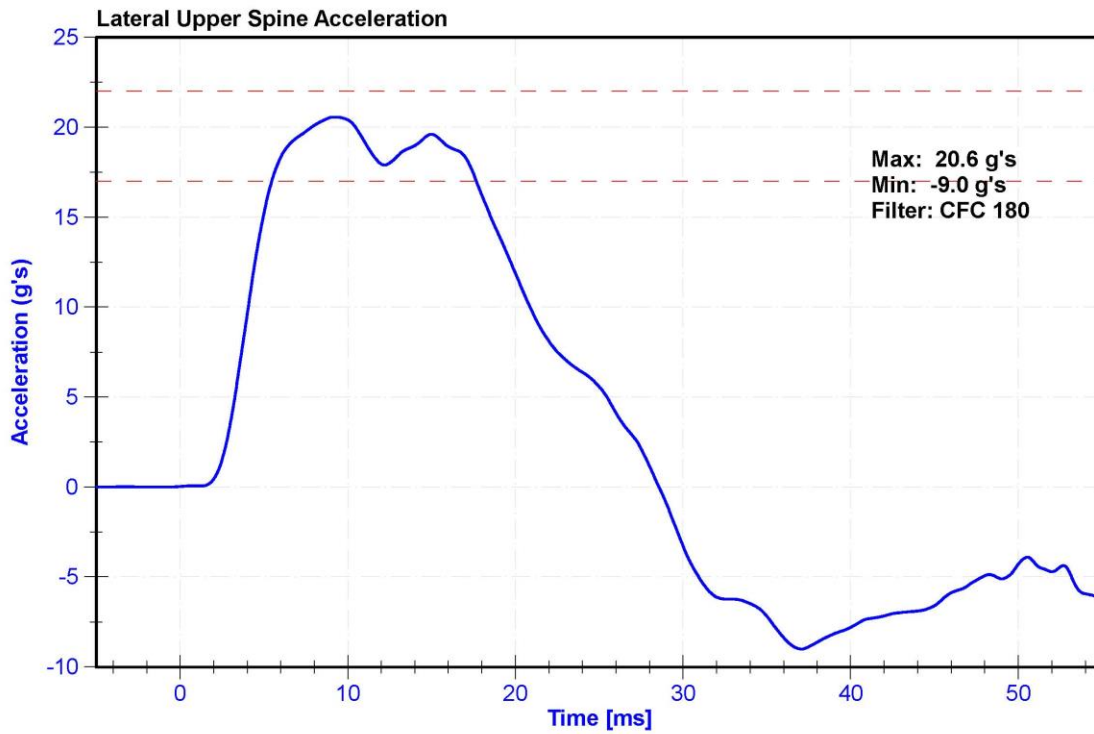
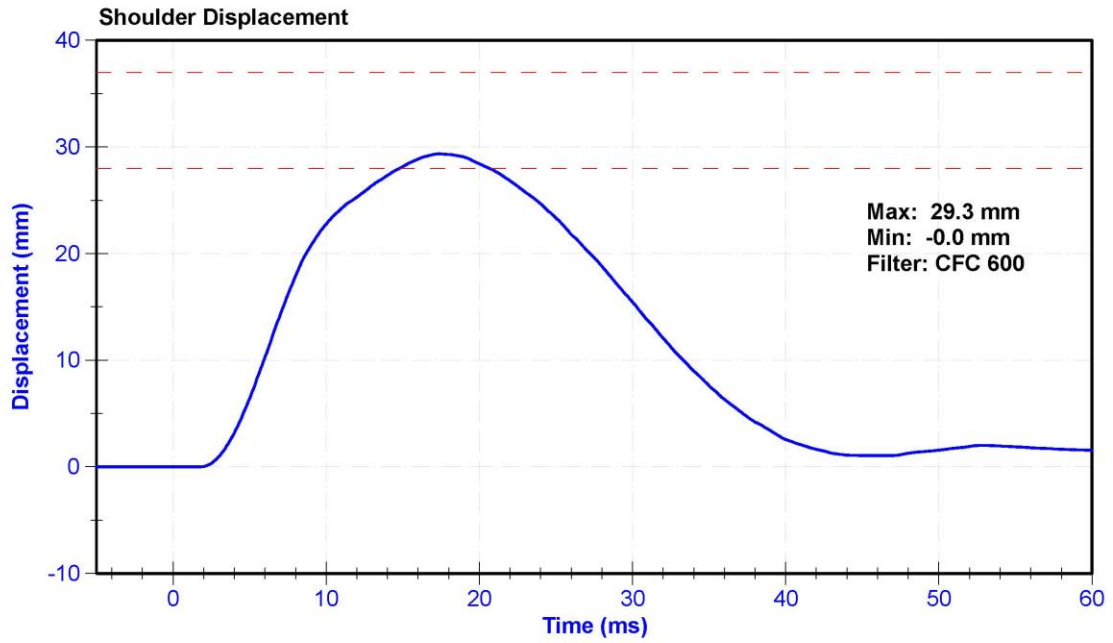
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	62	Pass
Velocity	4.2	4.4	m/s	4.32	Pass
Probe Acceleration	13	18	g's	15.9	Pass
Shoulder Deflection	28	37	mm	29.3	Pass
Lateral Upper Spine Acceleration	17	22	g's	20.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Shoulder Potentiometer	Servo 08TC1-3745	DS-1845GFE	5/6/2020	11/4/2020
Upper Spine Y Accelerometer	ENDEVCO 7264CT	AC-P64148	4/16/2020	10/15/2020





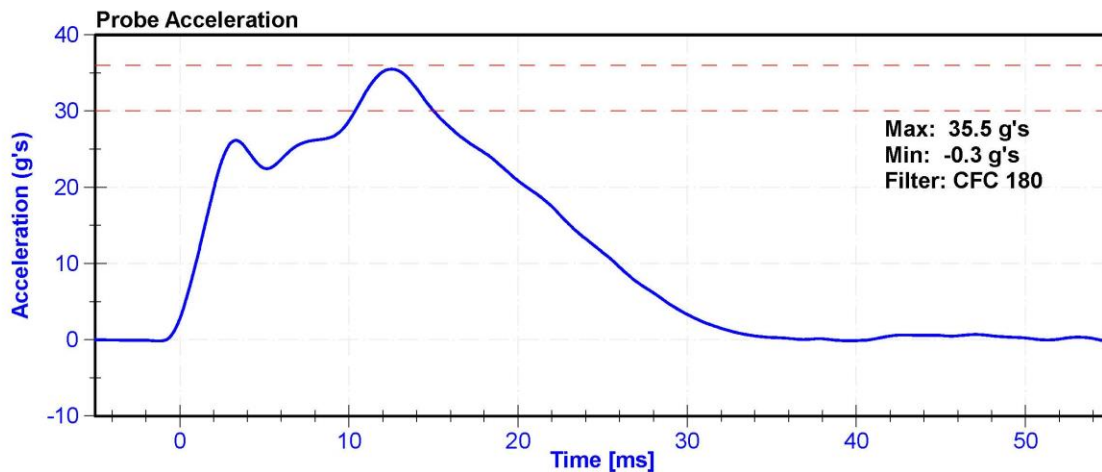
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ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

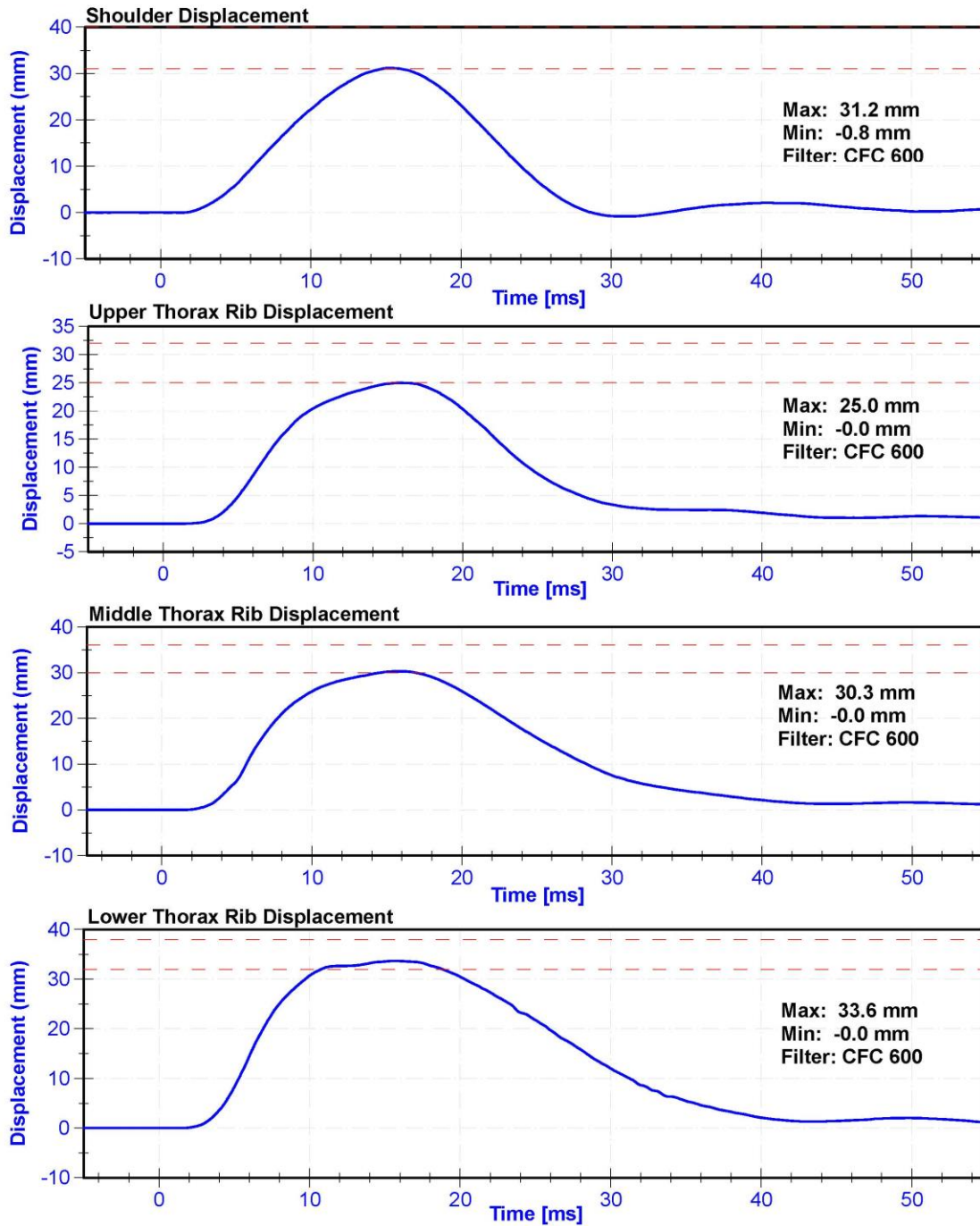
Results

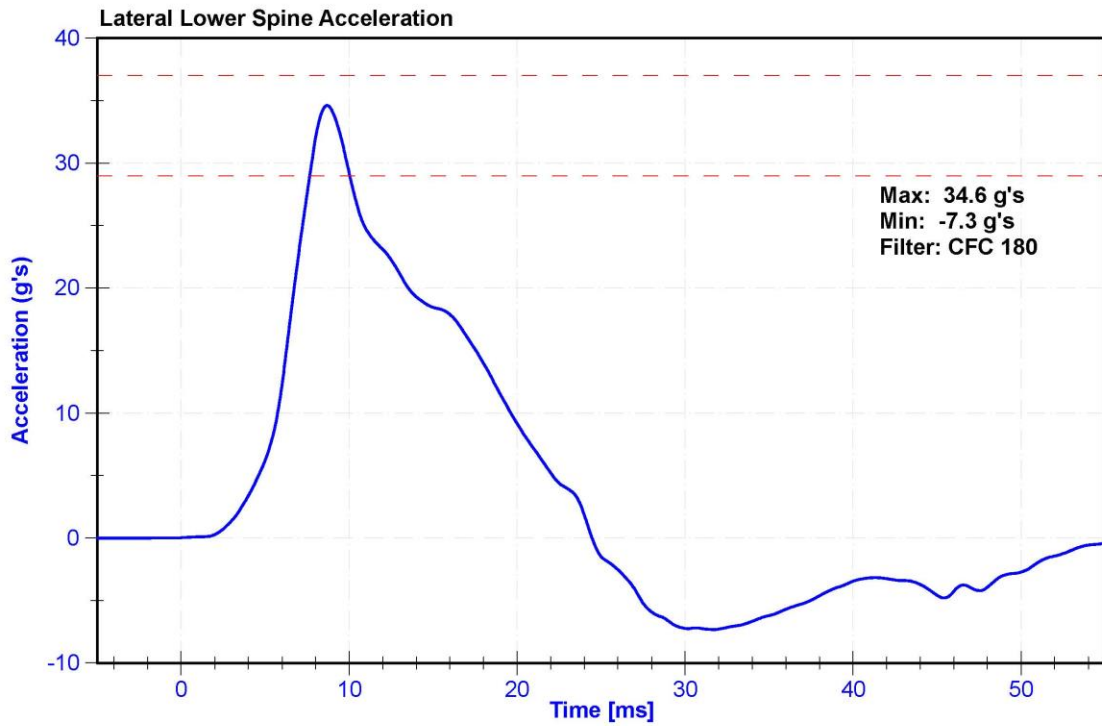
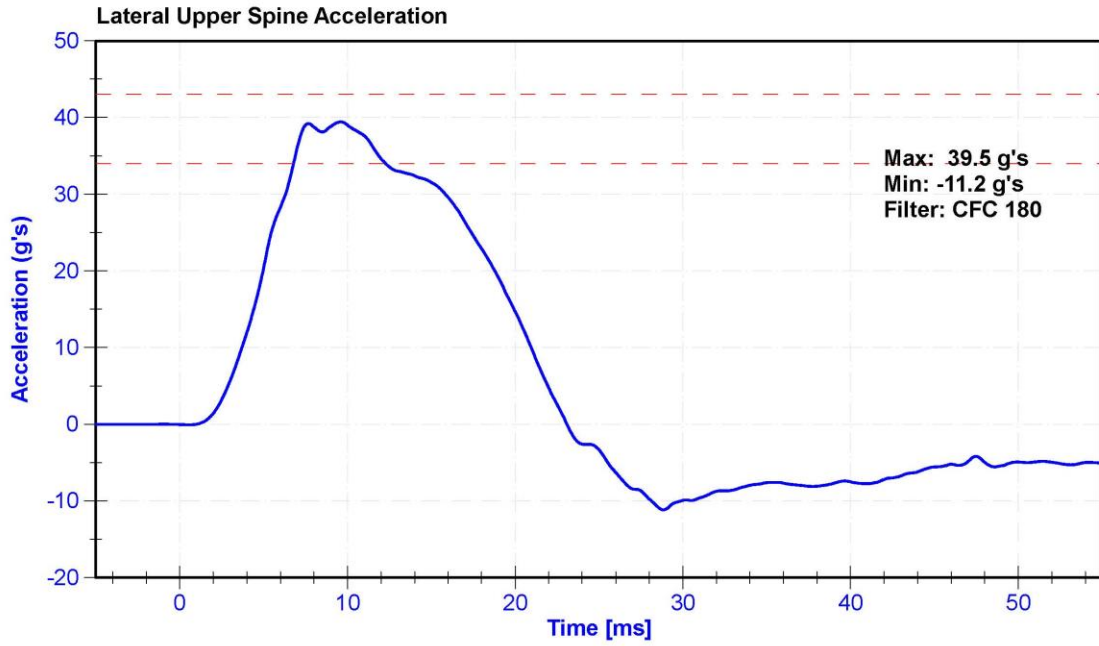
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.6	Pass
Humidity	10	70	%	59.0	Pass
Velocity	6.6	6.8	m/s	6.67	Pass
Probe Acceleration after 5 ms	30	36	g's	35.5	Pass
Lateral Upper Spine Acceleration	34	43	g's	39.5	Pass
Lateral Lower Spine Acceleration	29	37	g's	34.6	Pass
Shoulder Deflection	31	40	mm	31.2	Pass
Upper Thorax Rib Deflection	25	32	mm	25.0	Pass
Mid Thorax Rib Deflection	30	36	mm	30.3	Pass
Lower Thorax Rib Deflection	32	38	mm	33.6	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Upper Spine T1 Y Accelerometer	ENDEVCO 7264CT	AC-P64148	4/16/2020	10/15/2020
Upper Spine T12 Y Accelerometer	ENDEVCO 7264C-2K-TZ2	AC-P51327	4/16/2020	10/15/2020
Shoulder Potentiometer	Servo 08TC1-3745	DS-1845GFE	5/6/2020	11/4/2020
Upper Thorax Rib Potentiometer	Servo 1246	DS-2165GFE	5/6/2020	11/4/2020
Middle Thorax Rib Potentiometer	Servo 08TC1-3621	DS-45 GFE	5/6/2020	11/4/2020
Lower Thorax Rib Potentiometer	Servo 08TC1-3787	DS-011GFE	5/6/2020	11/4/2020







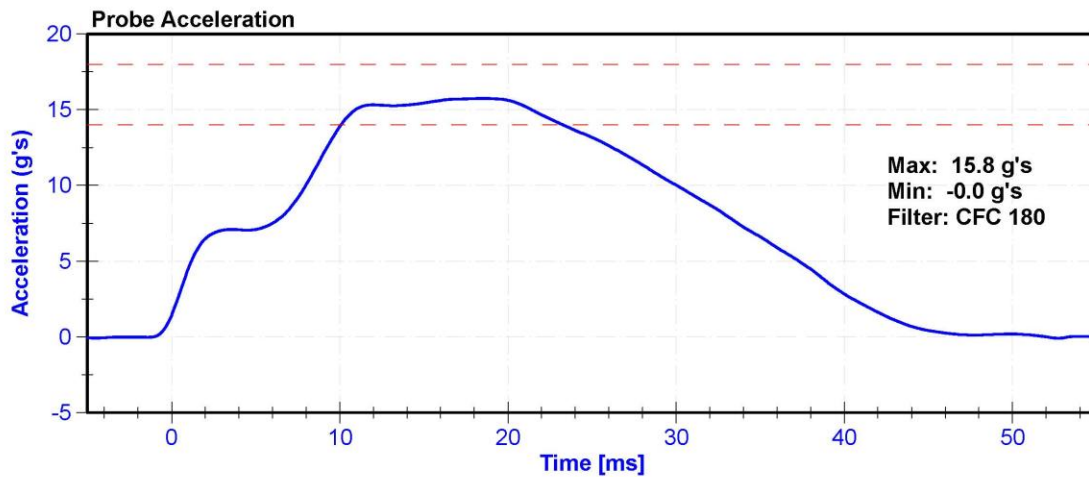
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

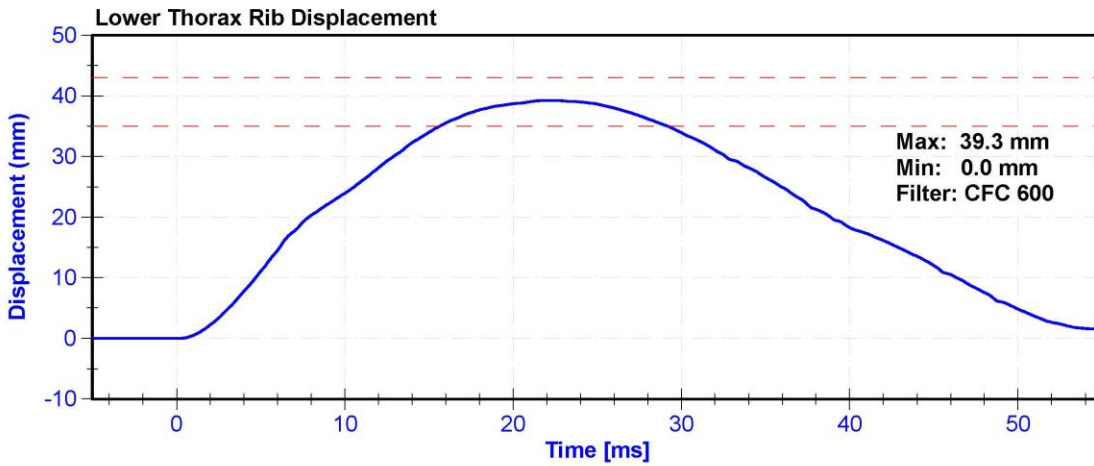
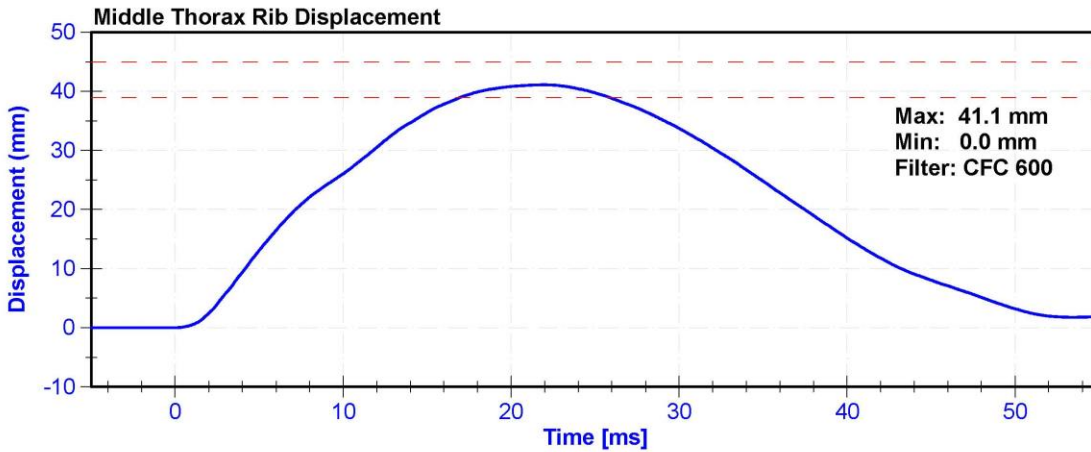
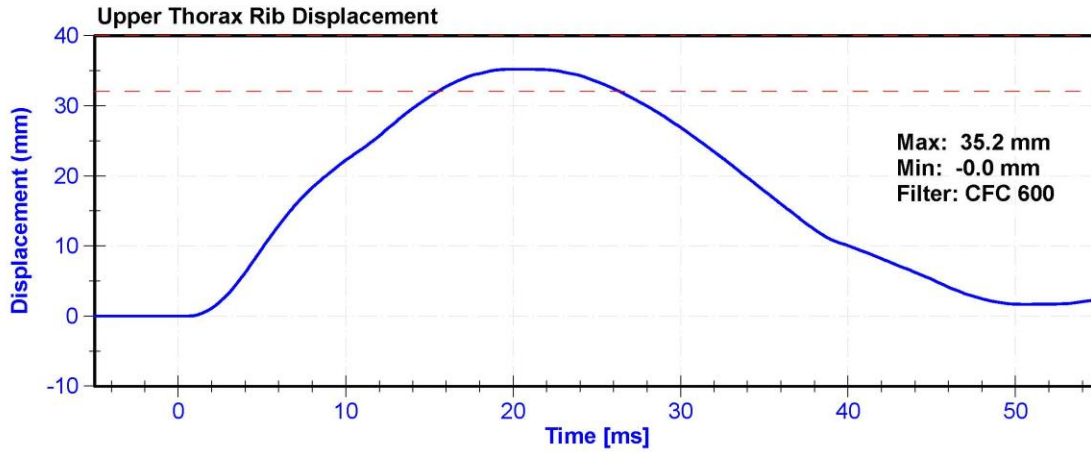
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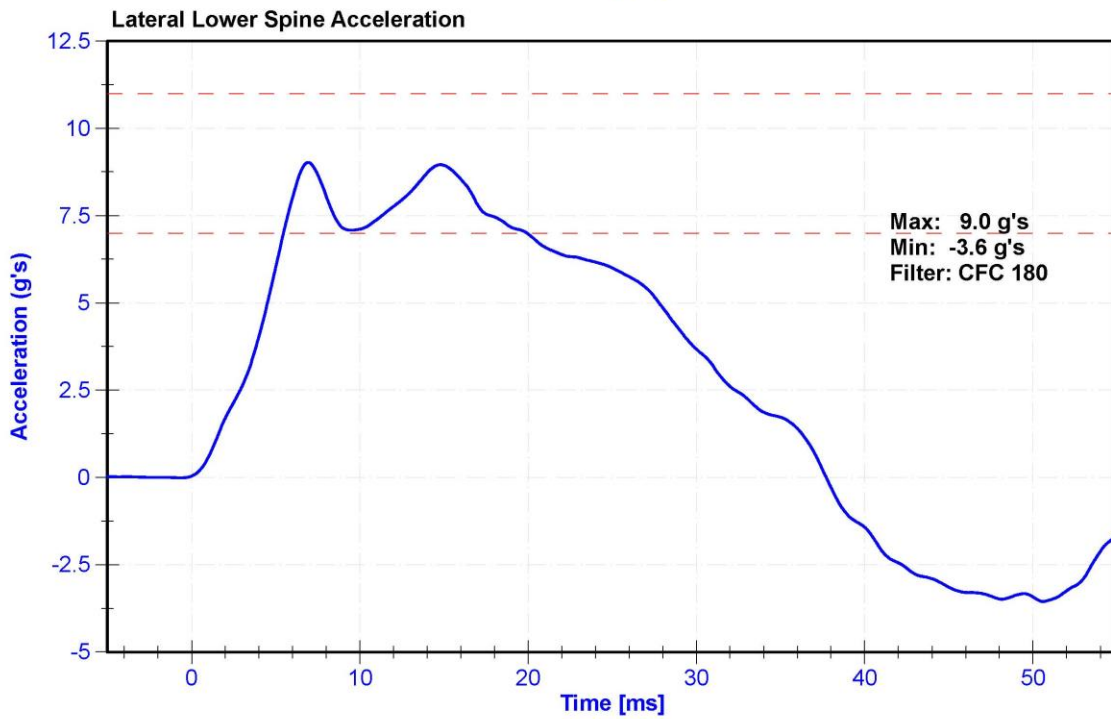
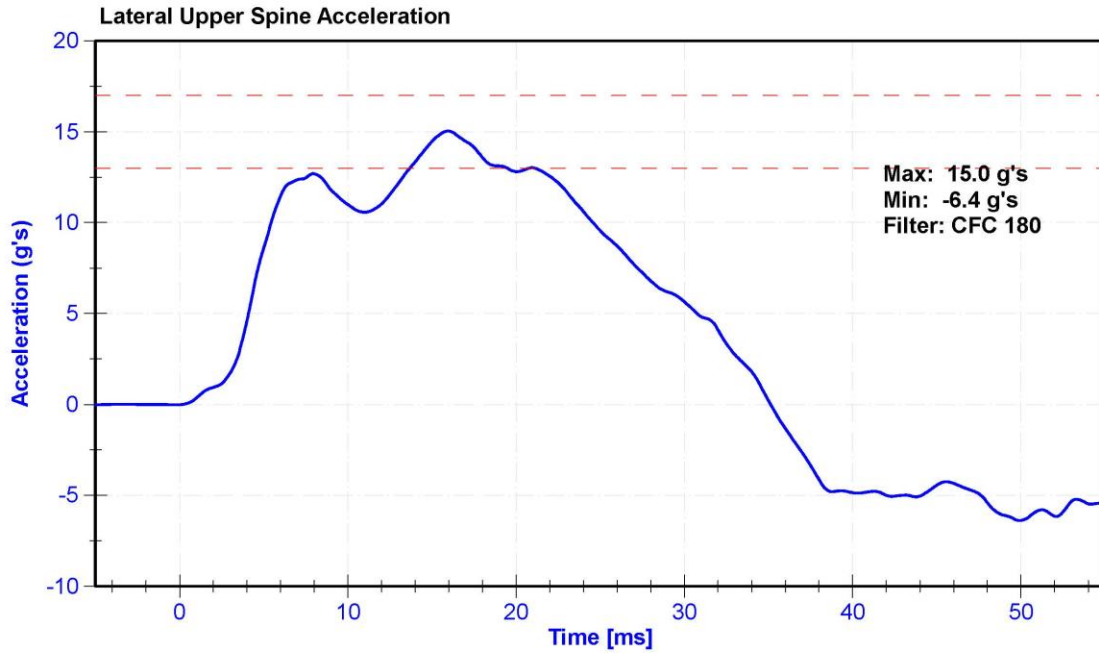
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	62	Pass
Velocity	4.2	4.4	m/s	4.27	Pass
Probe Acceleration	14	18	g's	15.8	Pass
Lateral Upper Spine Acceleration	13	17	g's	15.0	Pass
Lateral Lower Spine Acceleration	7	11	g's	9.0	Pass
Upper Thorax Rib Deflection	32	40	mm	35.2	Pass
Middle Thorax Rib Deflection	39	45	mm	41.1	Pass
Lower Thorax Rib Deflection	35	43	mm	39.3	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Upper Spine Y Accelerometer	ENDEVCO 7264CT	AC-P64148	4/16/2020	10/15/2020
Lower Spine Y Accelerometer	ENDEVCO 7264C-2K-TZ2	AC-P51327	4/16/2020	10/15/2020
Upper Thorax Rib Potentiometer	Servo 1246	DS-2165GFE	5/6/2020	11/4/2020
Middle Thorax Rib Potentiometer	Servo 08TC1-3621	DS-45 GFE	5/6/2020	11/4/2020
Lower Thorax Rib Potentiometer	Servo 08TC1-3787	DS-011GFE	5/6/2020	11/4/2020







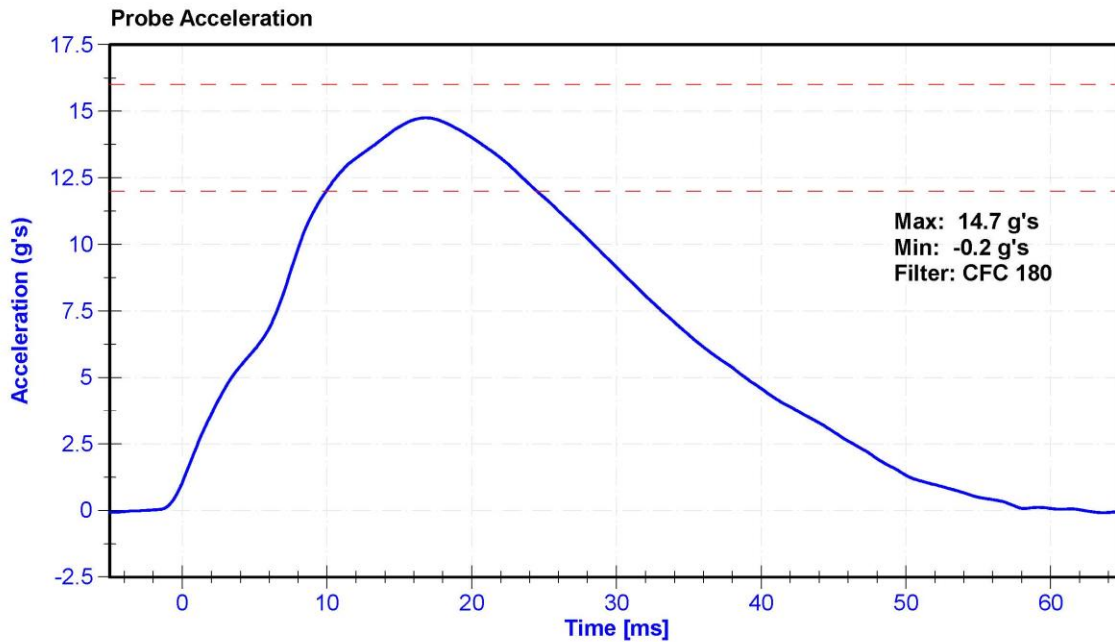
ATD Manufacturer	FTSS	Test Technician	D,Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

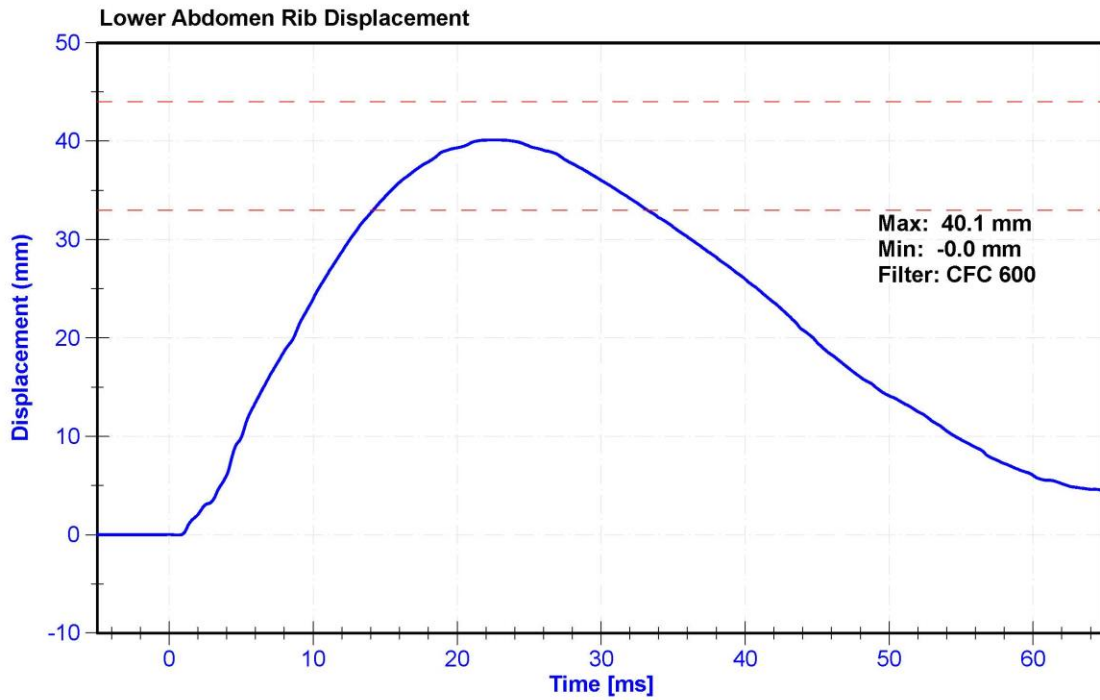
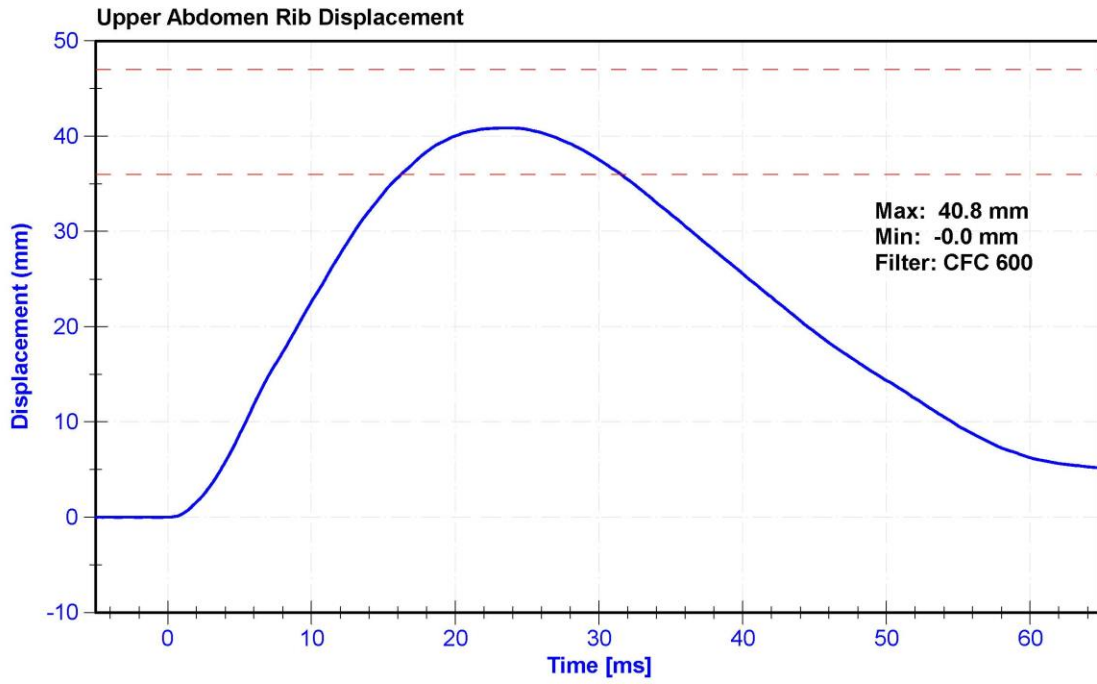
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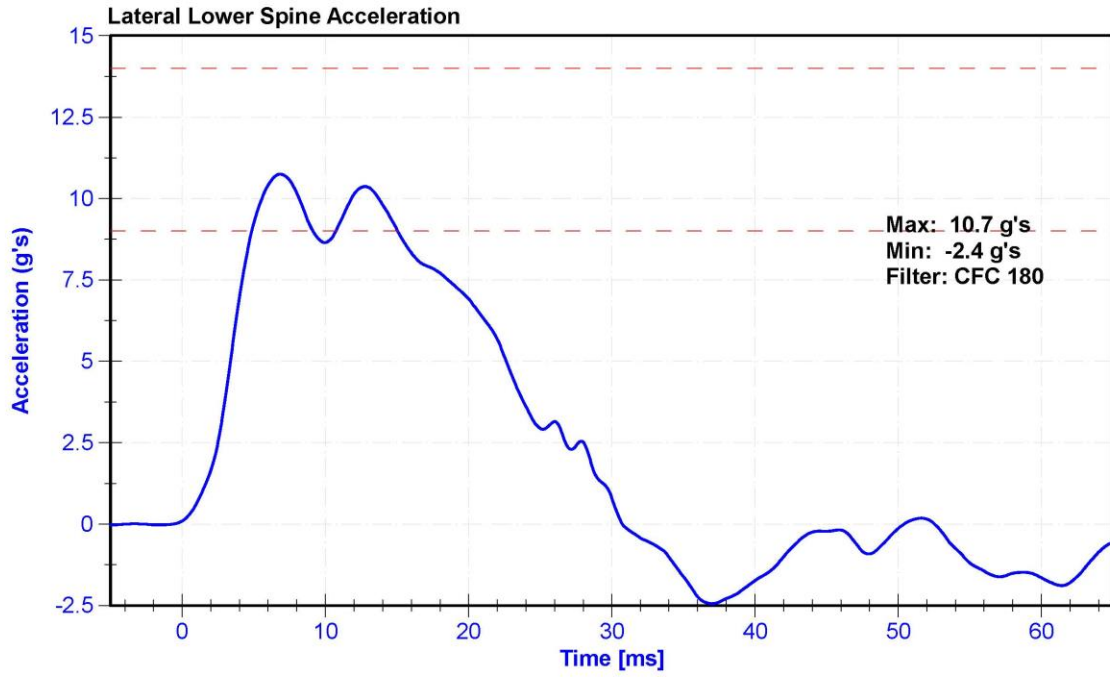
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	65.0	Pass
Velocity	4.2	4.4	m/s	4.27	Pass
Probe Acceleration	12	16	g's	14.7	Pass
Lateral Lower Spine Acceleration	9	14	g's	10.7	Pass
Upper Abdomen Rib Deflection	36	47	mm	40.8	Pass
Lower Abdomen Rib Deflection	33	44	mm	40.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Lower Spine Y Accelerometer	ENDDEVCO 7264C-2K-TZAC-P51327	ZAC-P51327	4/16/2020	10/15/2020
Upper Abdomen Rib Potentiometer	Servo 08TC1-3725	DS-008GFE	5/6/2020	11/4/2020
Lower Abdomen Rib Potentiometer	Servo 08TC1-3745	DS-1774GFE	5/6/2020	11/4/2020







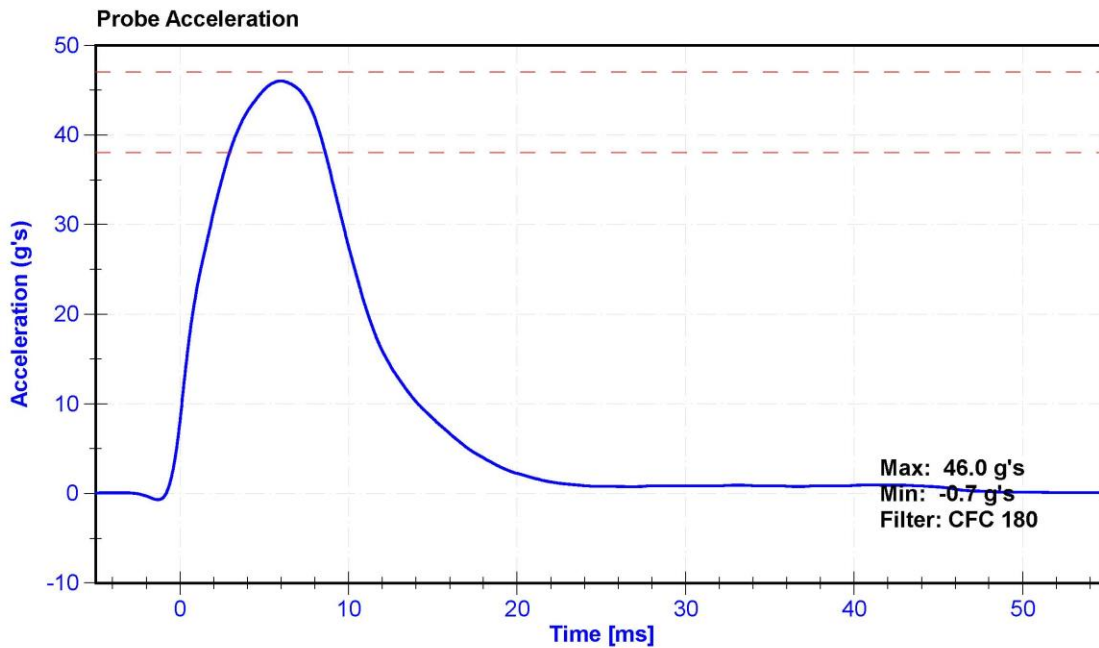
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

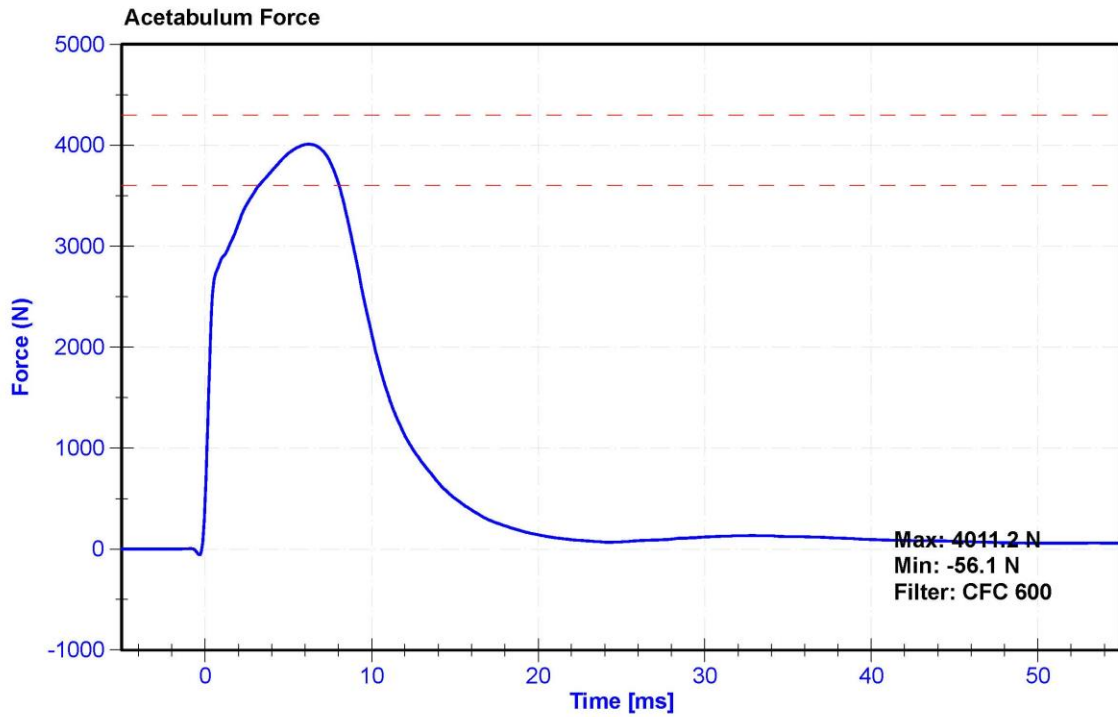
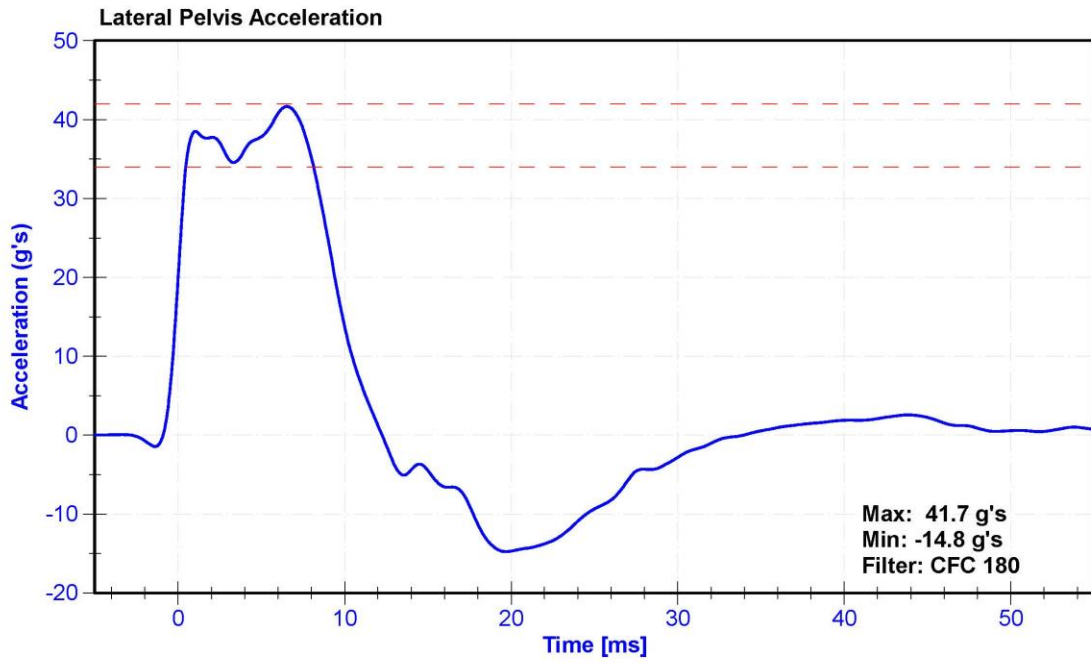
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	62	Pass
Velocity	6.6	6.8	m/s	6.64	Pass
Probe Acceleration	38	47	g's	46.0	Pass
Lateral Pelvis Acceleration after 6ms	34	42	g's	41.7	Pass
Acetabulum Force	3600	4300	N	4011.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Pelvis Y Accelerometer	ENDEVCO 7264C	AC-P51875	4/16/2020	10/15/2020
Acetabulum Load Cell	Denton 3249J	LC-267Fy	3/19/2020	3/19/2021
Certification Plug	SACO	13178	8/8/2019	N/A
Crash Test Plug	SACO	13277	8/12/2019	N/A







Crash
D68012
8/10/2019

SID-Its Pelvis Plug Certification Test

Plug S/N 13277

Test Number 10700

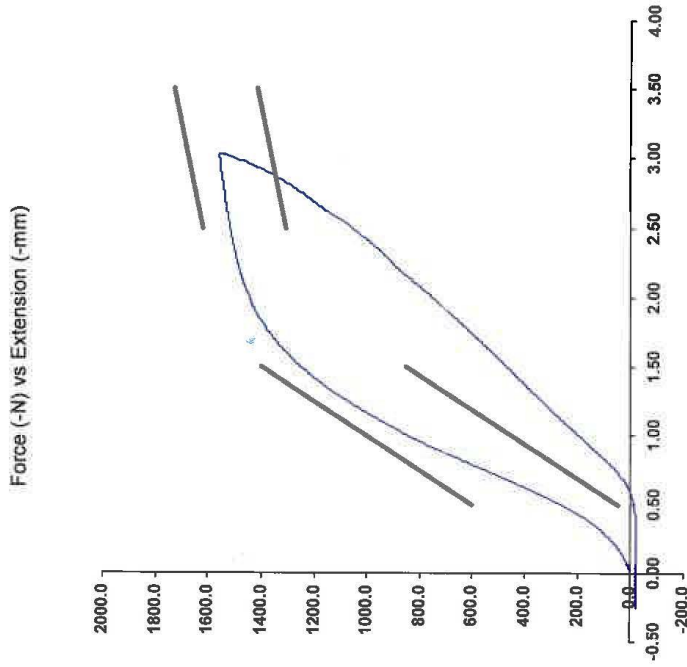
Report Number 10737

Test Date 8/12/2019 10:35:14 AM

Test Results	Spec. Min	Spec. Max
Force @ 0.5 mm (N)	50.00	600.00
Force @ 1.5 mm (N)	850.00	1,400.00
Force @ 2.5 mm (N)	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,361.00	1,673.00

Testing Machine STM-20 596554;
 Load Cell S/N (F1360947), Units (LBS) 1000
 Crosshead Speed (mm / min) or Rate 12.7
 Extension or Position Measured by XHD_100 (XHD100)

Notes:



Operator _____ Part Number 180-4450

Template No 107 12-Aug-19

SACO Research

By: *DC* Date: *8/12/2019*

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



SID-Its Pelvis Plug Certification Test

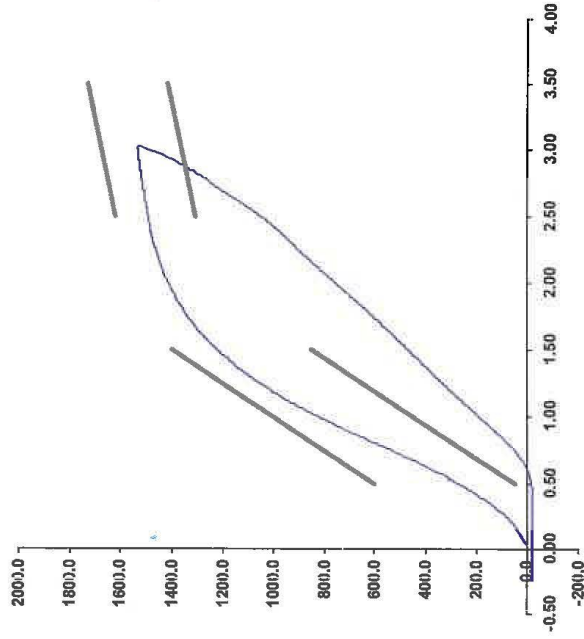
Plug S/N 13178

Test Number 10573

Report Number 10608

Test Date 8/8/2019 11:19:51 AM

Force (-N) vs Extension (-mm)



Test Results	Spec. Min	Spec. Max
Force @ 0.5 mm (N)	50.00	600.00
Force @ 1.5 mm (N)	850.00	1,400.00
Force @ 2.5 mm (N)	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,361.00	1,673.00

Testing Machine STM-20 5965542
 Load Cell S/N (FI360947), Units (LBS) 1000
 Crosshead Speed (mm / min) or Rate 12.7
 Extension or Position Measured by XHD_100 (XHD100)

Notes:

Operator 131
 Part Number 180-4450

Template No 107 08-Aug-19
 SACO Research

By: *RC* Date: *8/8/2019*

SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX

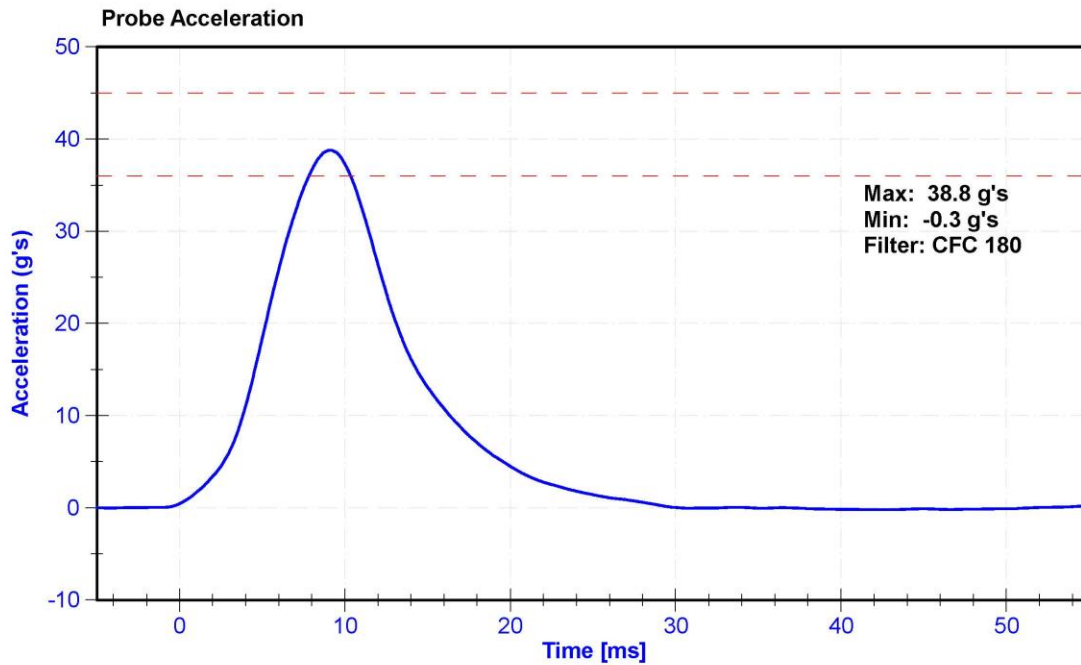
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

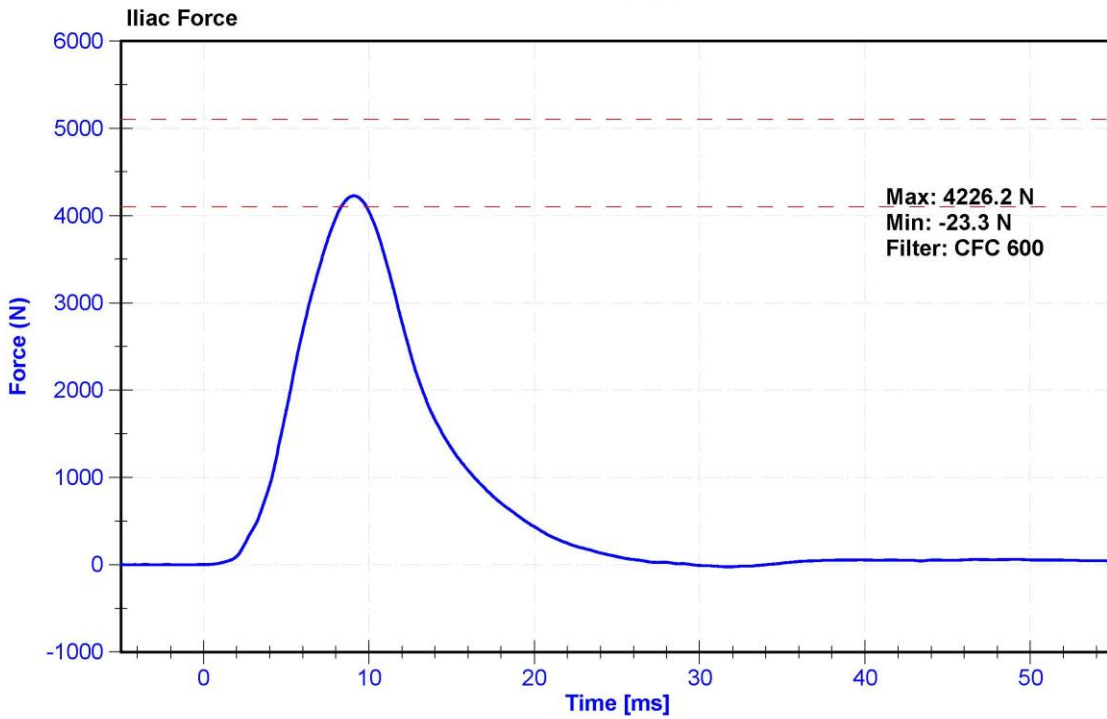
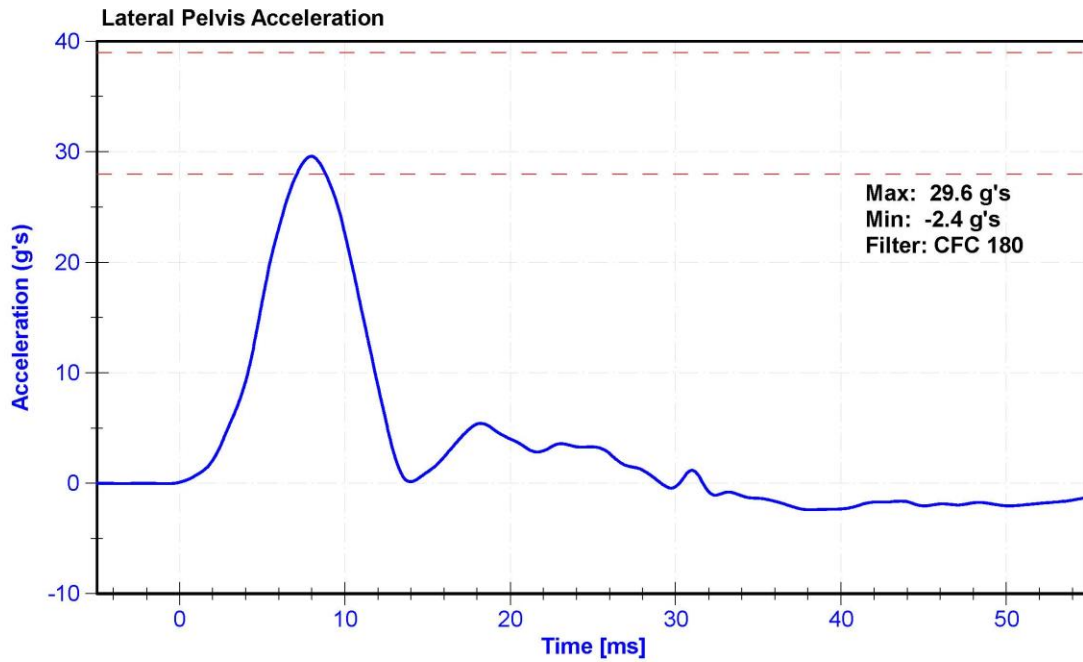
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	62.0	Pass
Velocity	4.2	4.4	m/s	4.36	Pass
Probe Acceleration	36	45	g's	38.8	Pass
Lateral Pelvis Acceleration	28	39	g's	29.6	Pass
Iliac Force	4100	5100	N	4226.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A286228	1/29/2020	1/28/2021
Pelvis Y Accelerometer	ENDEVCO 7264C-2K-TZ2	AC-P51875	4/16/2020	10/15/2020
Iliac Load Cell	DENTON 3228J	LC-290Fy	9/25/2019	9/24/2020





CALIBRATION TEST RESULTS

POST-TEST

SID-IIS 5TH PERCENTILE FEMALE - DRIVER ATD

SERIAL NO: DG8012

(CONFIGURED FOR LEFT SIDE IMPACT)

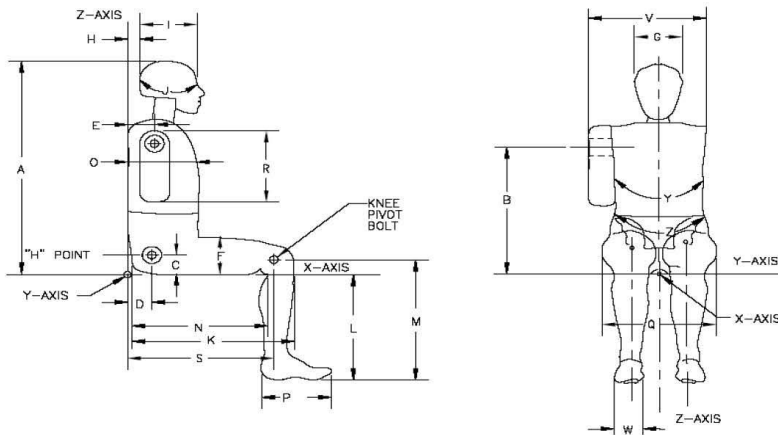


External Measurements - SID-IIs

Technician: K. Dutton

Date: 08/14/2020

Dummy Serial Number: DG8012



Symbol	Description	Specification (mm)		Result (mm)	Pass/Fail
A	Sitting Height	772	788	779	Pass
B	Shoulder Pivot Height	437	453	446	Pass
C	H-point Height	79	89	84	Pass
D	H-point from seatback	141	151	146	Pass
E	Shoulder Pivot from Backline	97	107	104	Pass
F	Thigh Clearance	119	135	127	Pass
G	Head Breadth	140	148	144	Pass
H	Head Back from Backline	40	46	44	Pass
I	Head Depth	178	188	184	Pass
J	Head Circumference	541	551	547	Pass
K	Buttock to Knee Length	514	540	533	Pass
L	Popliteal Height	343	369	357	Pass
M	Knee Pivot to floor height	392	409	402	Pass
N	Buttock Popliteal Length	416	442	433	Pass
O	Chest Depth w/o jacket	195	211	206	Pass
P	Foot Length	216	232	225	Pass
Q	Hip Breadth (w/pelvic plugs)	313	323	319	Pass
R	Arm Length	249	259	255	Pass
S	Knee Joint to seatback	477	493	486	Pass
V	Shoulder Width	341	357	346	Pass
W	Foot Width	78	94	85	Pass
Y	Chest Circumference w/jacket	851	881	867	Pass
Z	Waist Circumference	761	791	781	Pass

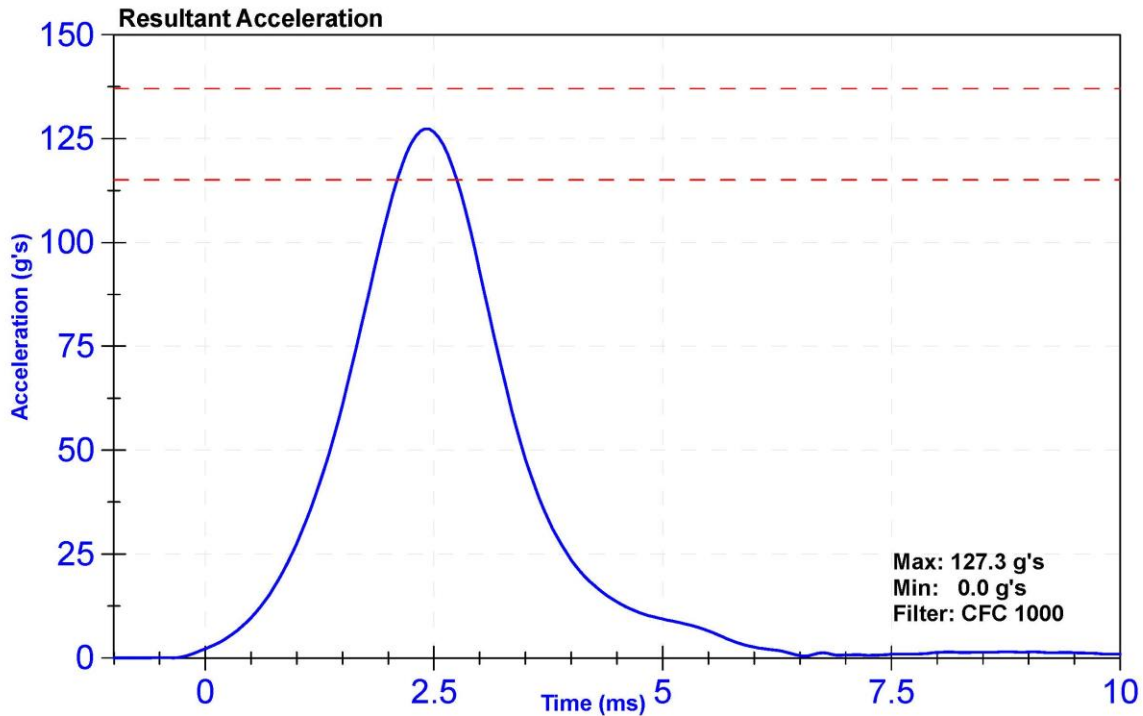
ATD Manufacturer	FTSS	Test Technician	K. Dutton
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

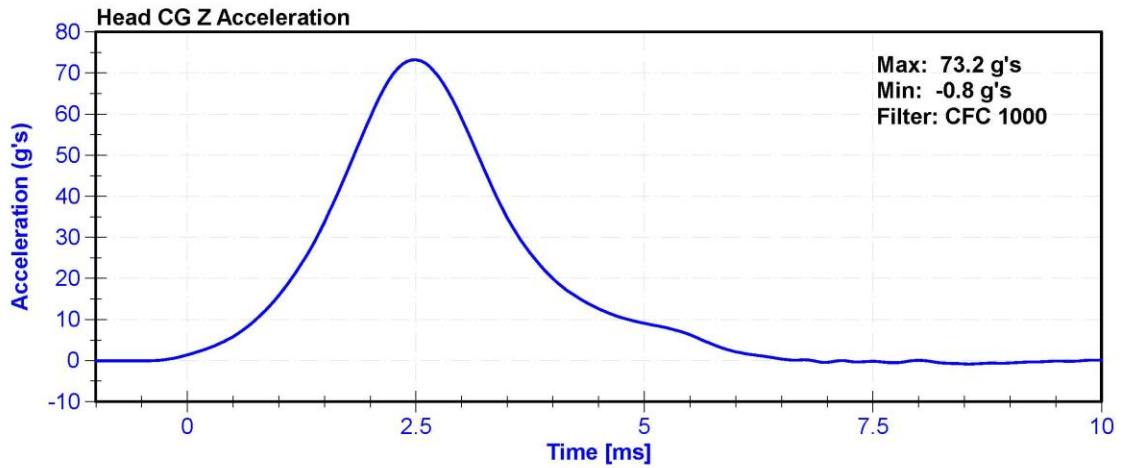
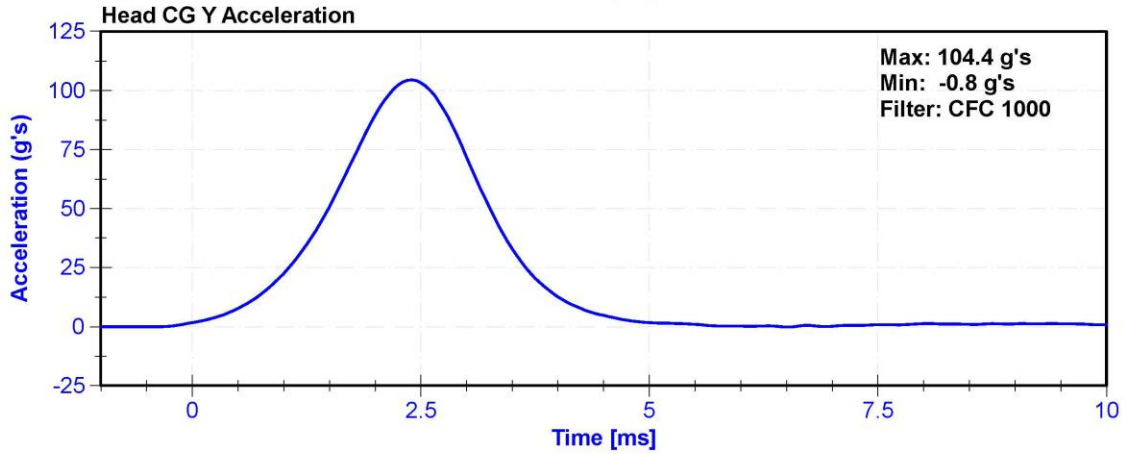
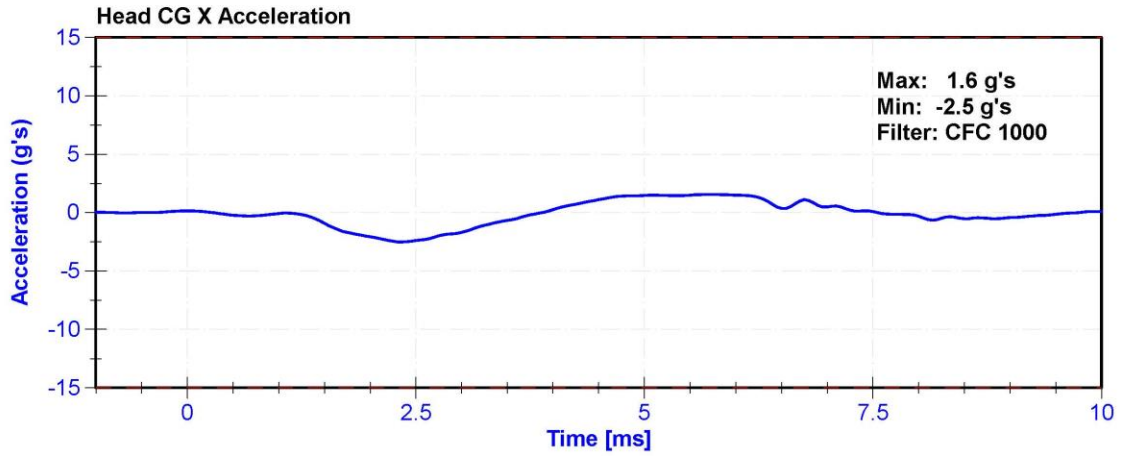
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.9	Pass
Humidity	10	70	%	66	Pass
Resultant Acceleration	115	137	g's	127.3	Pass
Oscillation	0	15	%	1.1	Pass
Fore-Aft Acceleration	-15	15	g's	-2.5	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
X Accelerometer	ENDEVCO 7264	AC-P74788	4/16/2020	10/15/2020
Y Accelerometer	ENDEVCO 7264CT	AC-P83432	4/16/2020	10/15/2020
Z Accelerometer	ENDEVCO 7264	AC-P83319	4/16/2020	10/15/2020





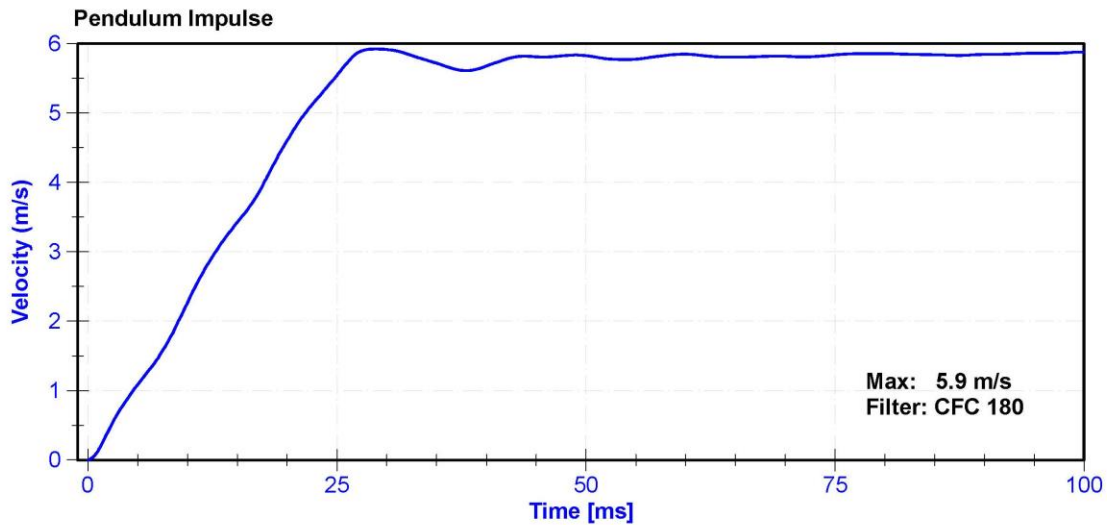
ATD Manufacturer	FTSS	Test Technician	K. Dutton
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

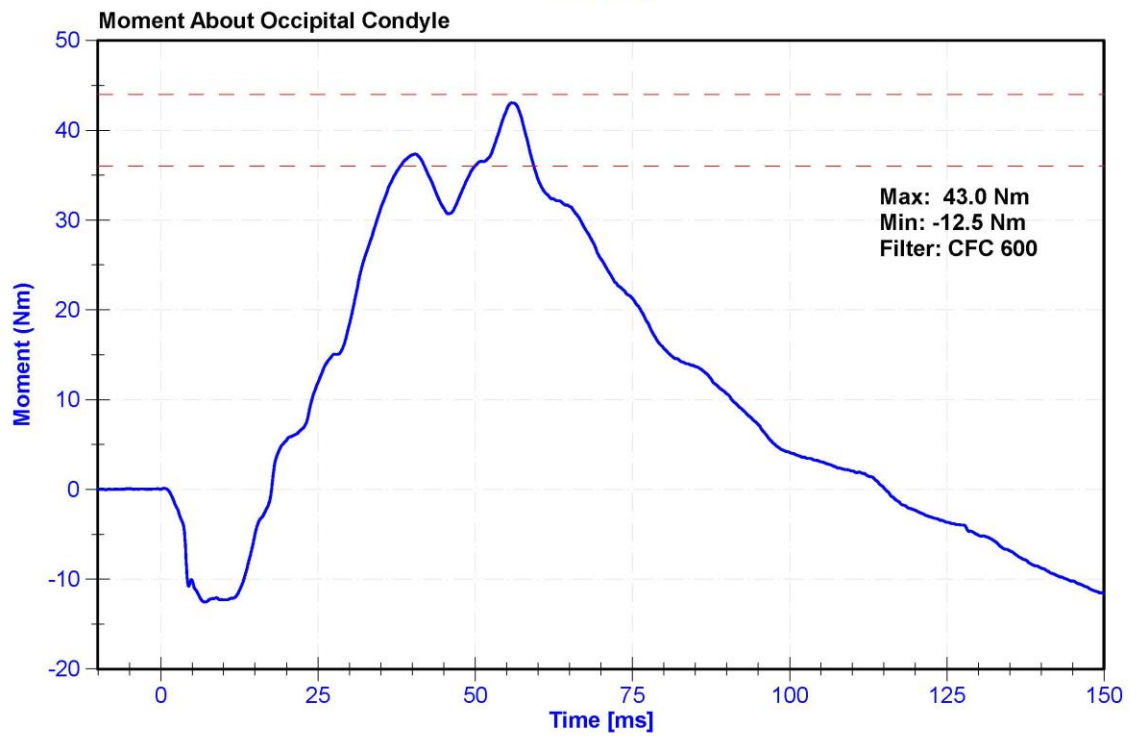
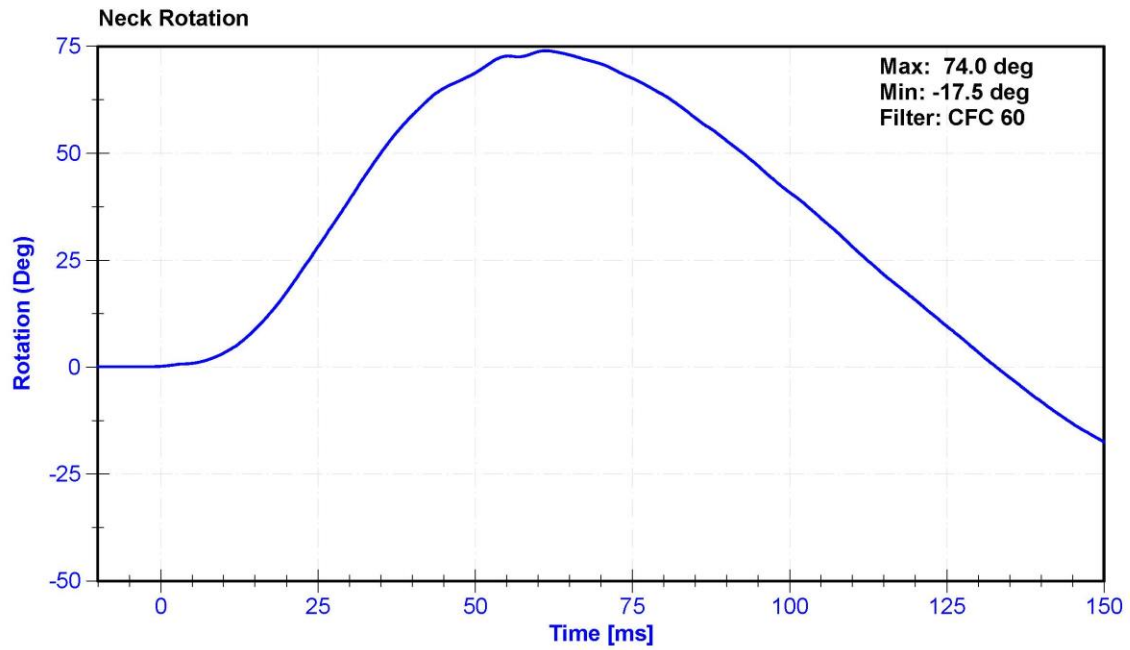
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	21.3	Pass
Humidity	10	70	%	62.3	Pass
Velocity	5.51	5.63	m/s	5.584	Pass
Pendulum Impulse at 10ms	2.2	2.8	m/s	2.27	Pass
Pendulum Impulse at 15ms	3.3	4.1	m/s	3.42	Pass
Pendulum Impulse at 20ms	4.4	5.4	m/s	4.60	Pass
Pendulum Impulse at 25ms	5.4	6.1	m/s	5.54	Pass
Pendulum Impulse from 25 to 100ms	5.5	6.2	m/s	5.92	Pass
Neck Rotation	71	81	deg	74.0	Pass
Time at Maximum Rotation	50	70	ms	61.2	Pass
Moment about the OC	36	44	Nm	43.0	Pass
Moment Decay to 0 Nm	102	126	ms	115.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	ENDEVCO 7231CT	AC-AH5M9 Pend	1/30/2020	1/29/2021
Pendulum Potentiometer	Denton 78051-342	DS-184Pend	11/4/2019	11/3/2020
Condyle Potentiometer	Denton 78051-342	DS-185Pend	11/4/2019	11/3/2020
Upper Neck Load Cell	Denton 1716	17162019 FY	3/18/2020	3/18/2021





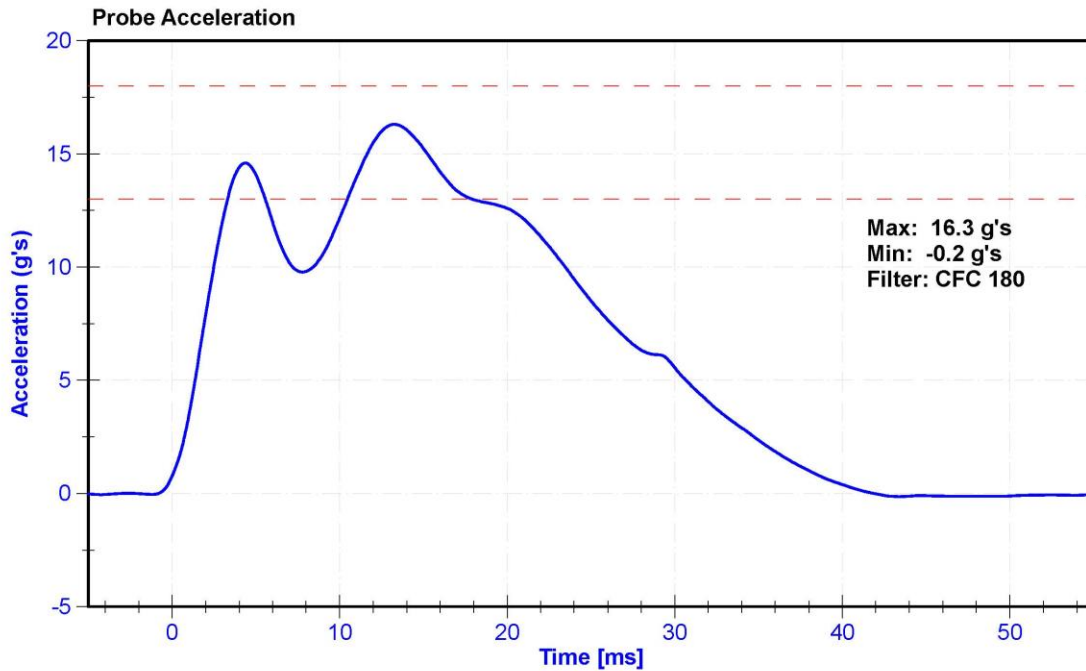
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

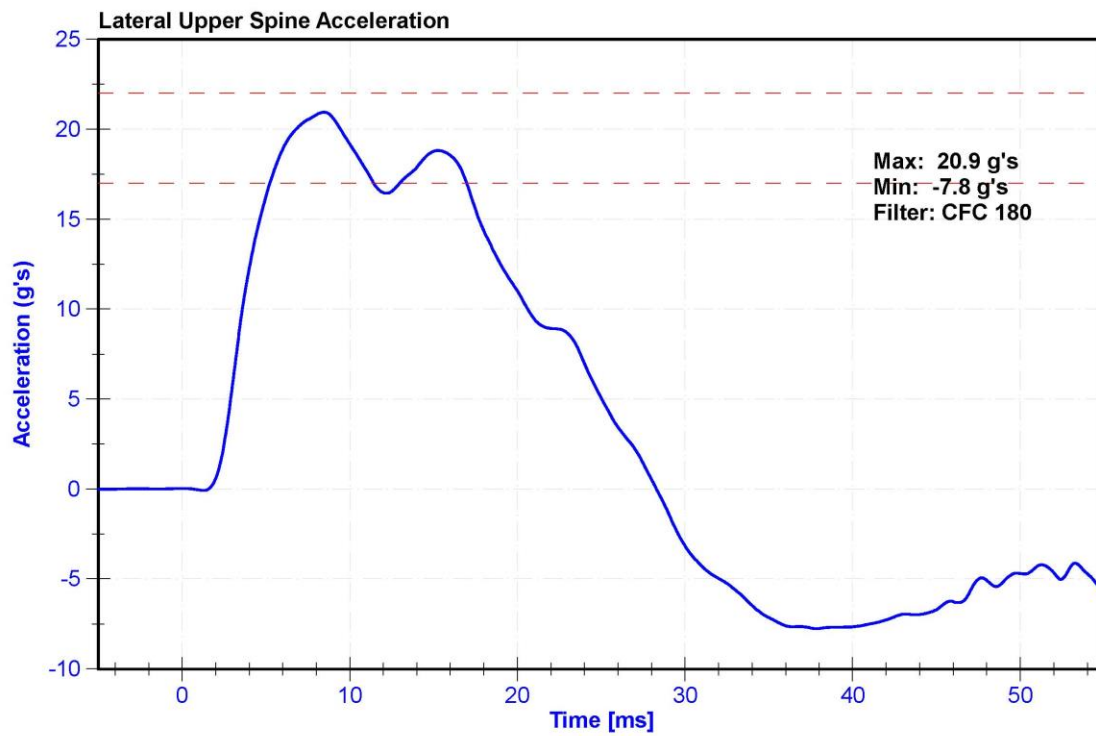
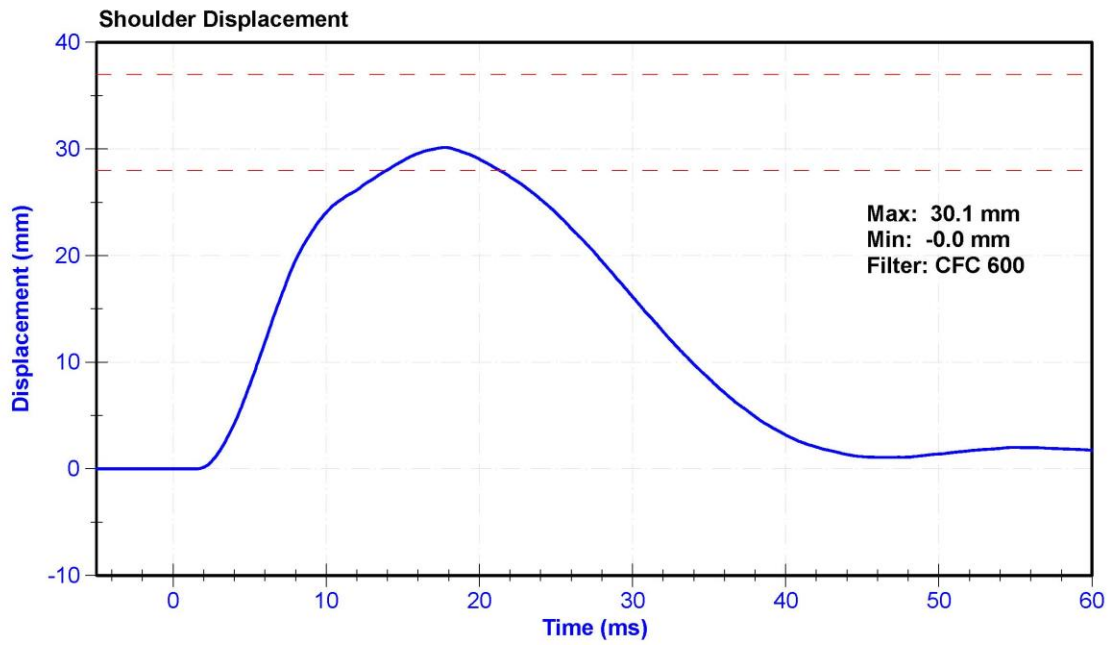
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	56	Pass
Velocity	4.2	4.4	m/s	4.35	Pass
Probe Acceleration	13	18	g's	16.3	Pass
Shoulder Deflection	28	37	mm	30.1	Pass
Lateral Upper Spine Acceleration	17	22	g's	20.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021
Shoulder Potentiometer	Servo 08TC1-3745	DS-1845GFE	5/6/2020	11/4/2020
Upper Spine Y Accelerometer	ENDEVCO 7264CT	AC-P64148	4/16/2020	10/15/2020





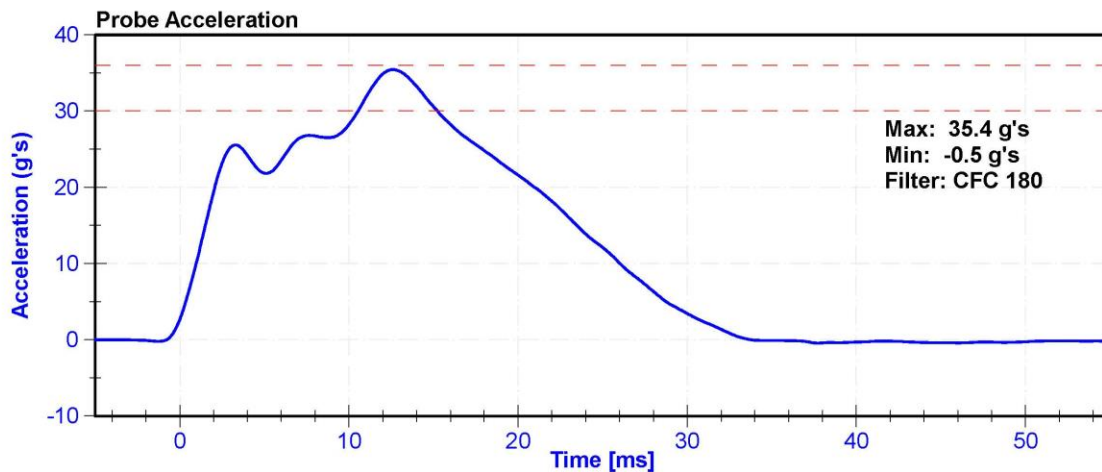
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

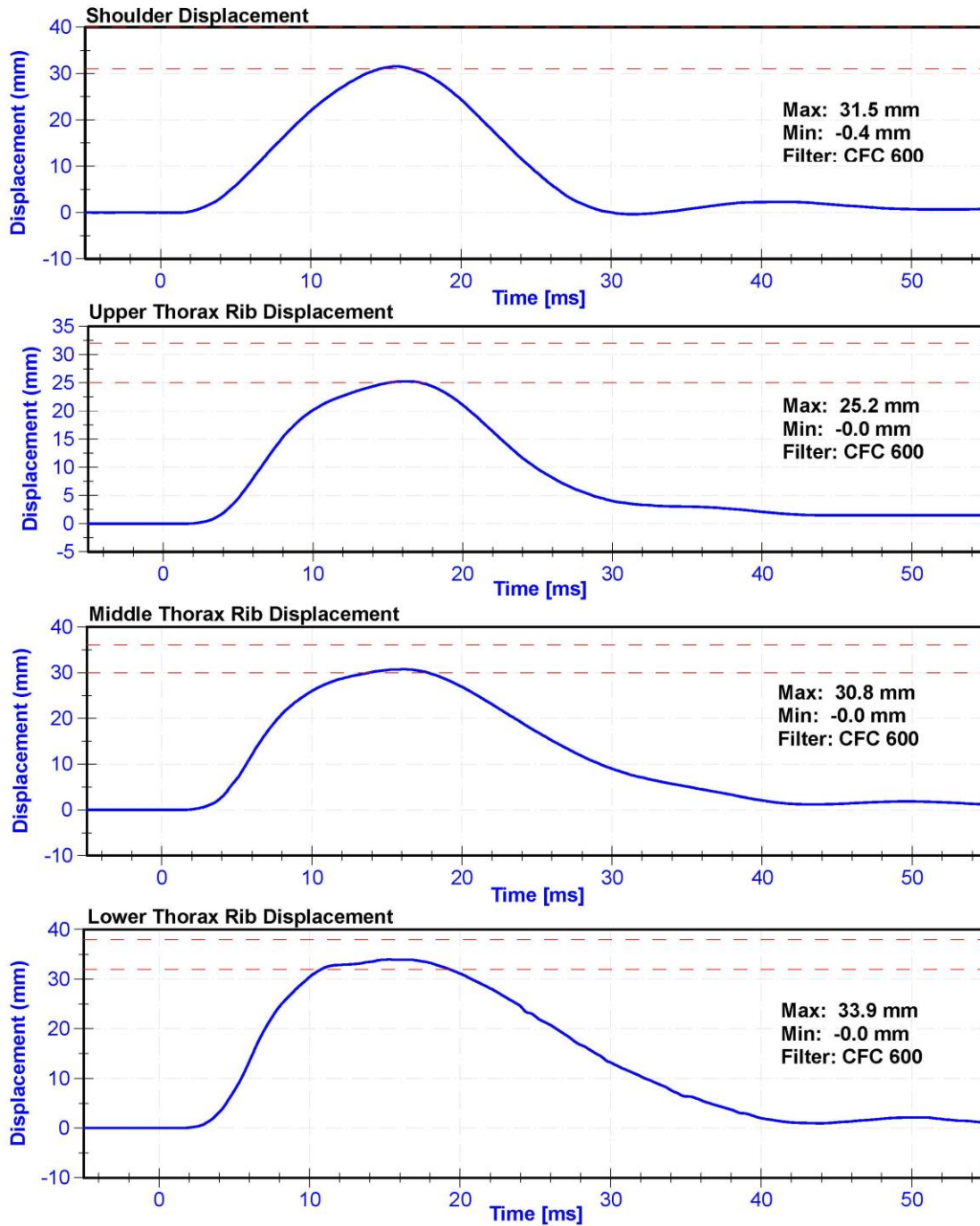
Results

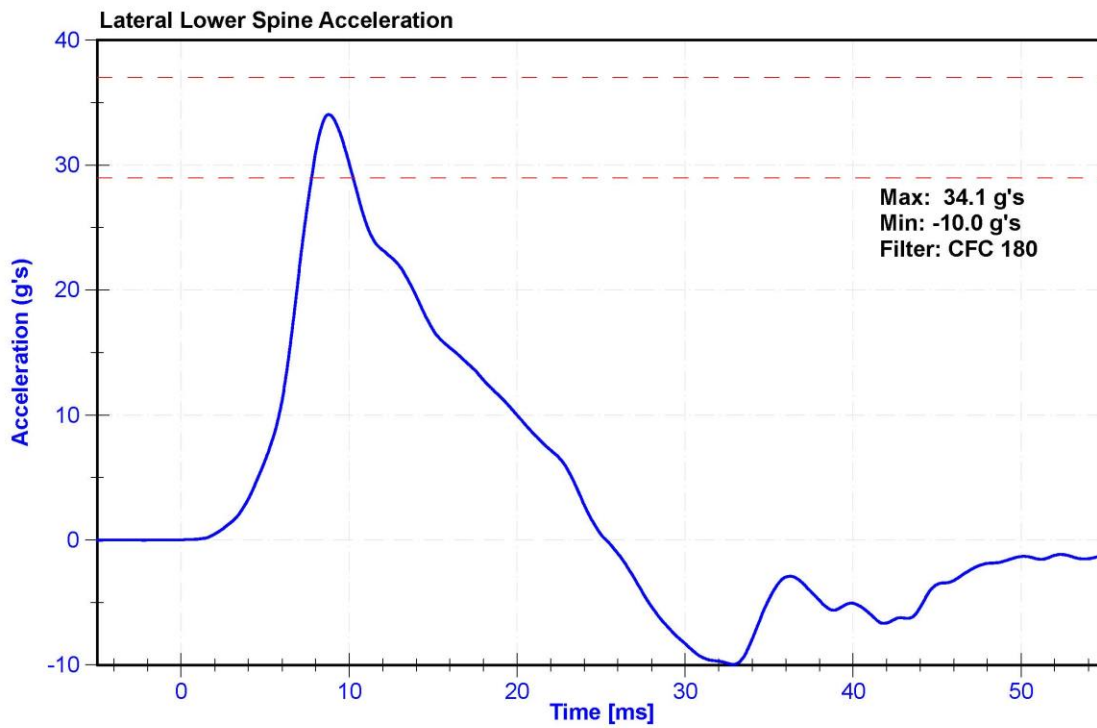
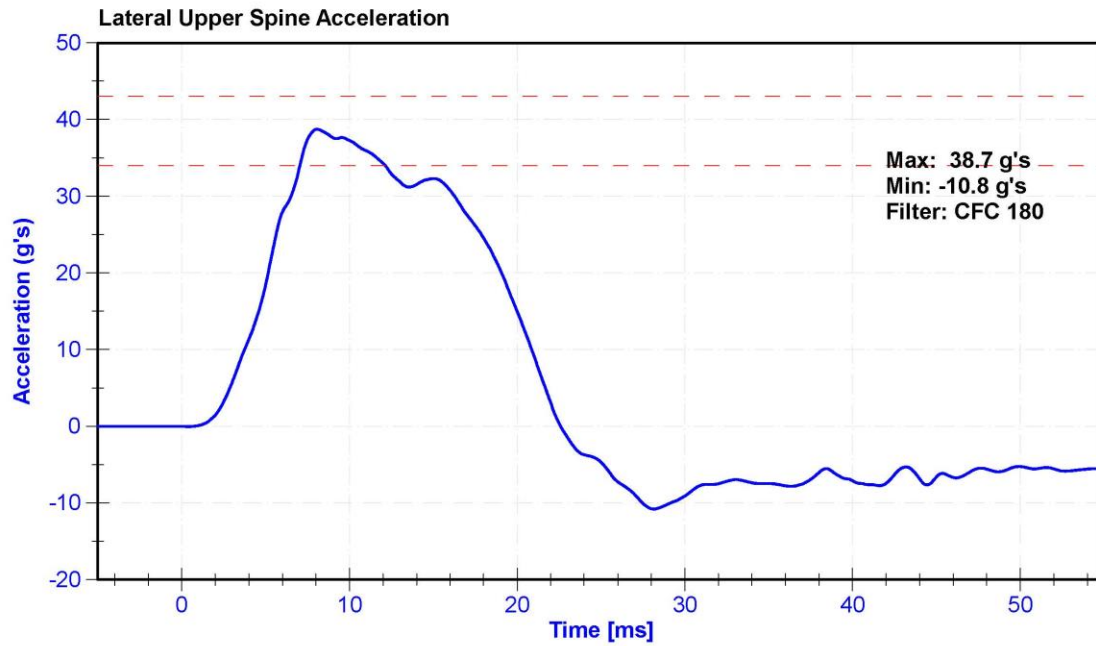
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	56.0	Pass
Velocity	6.6	6.8	m/s	6.60	Pass
Probe Acceleration after 5 ms	30	36	g's	35.4	Pass
Lateral Upper Spine Acceleration	34	43	g's	38.7	Pass
Lateral Lower Spine Acceleration	29	37	g's	34.1	Pass
Shoulder Deflection	31	40	mm	31.5	Pass
Upper Thorax Rib Deflection	25	32	mm	25.2	Pass
Mid Thorax Rib Deflection	30	36	mm	30.8	Pass
Lower Thorax Rib Deflection	32	38	mm	33.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021
Upper Spine T1 Y Accelerometer	ENDEVCO 7264CT	AC-P64148	4/16/2020	10/15/2020
Upper Spine T12 Y Accelerometer	ENDEVCO 7264C-2K-TZ2	AC-P51327	4/16/2020	10/15/2020
Shoulder Potentiometer	Servo 08TC1-3745	DS-1845GFE	5/6/2020	11/4/2020
Upper Thorax Rib Potentiometer	Servo 1246	DS-2165GFE	5/6/2020	11/4/2020
Middle Thorax Rib Potentiometer	Servo 08TC1-3621	DS-45 GFE	5/6/2020	11/4/2020
Lower Thorax Rib Potentiometer	Servo 08TC1-3787	DS-011GFE	5/6/2020	11/4/2020







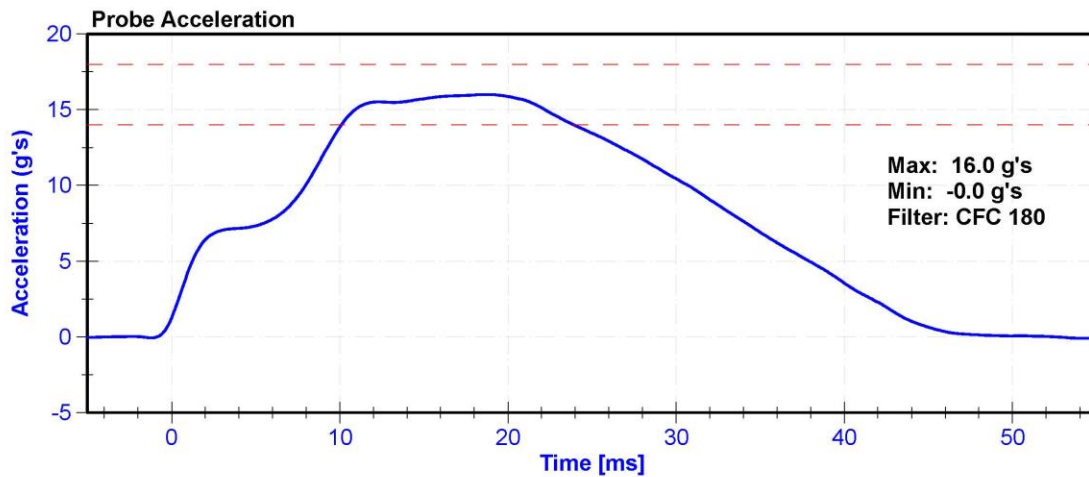
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

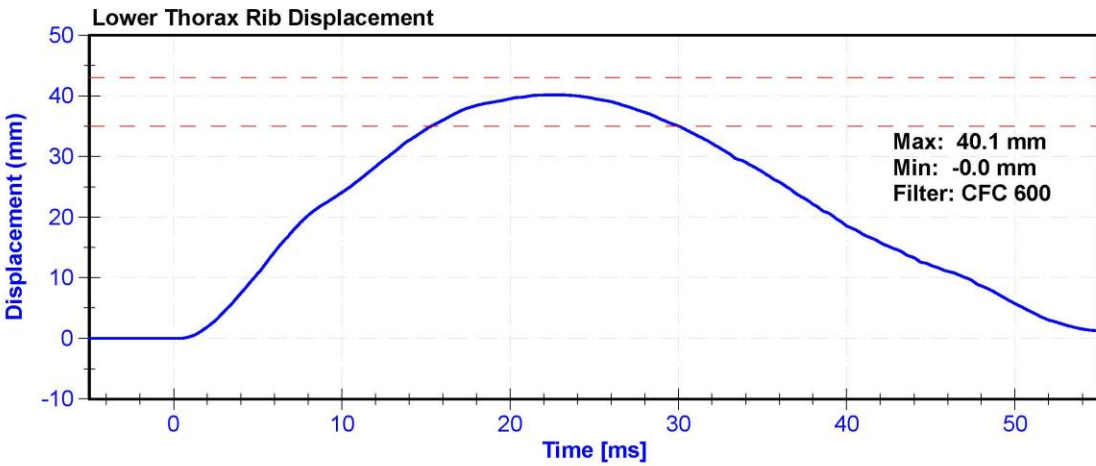
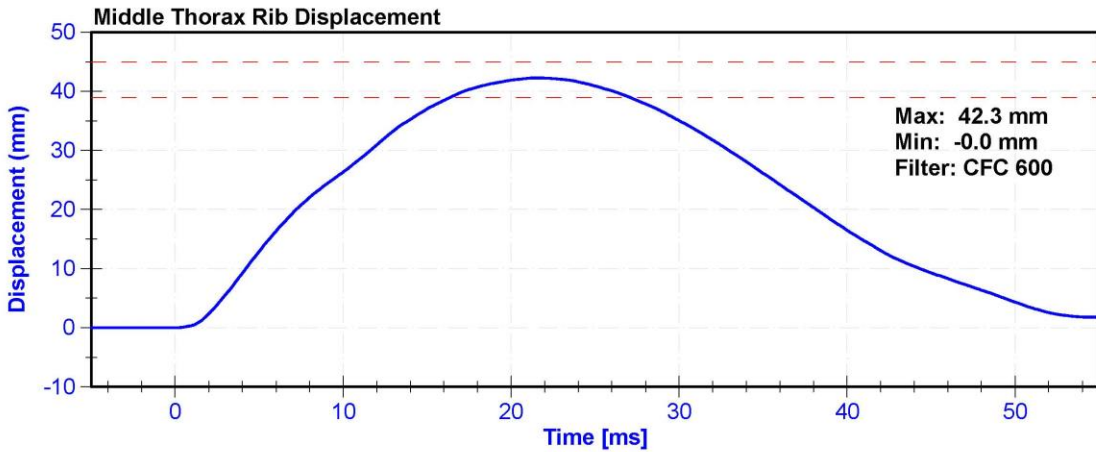
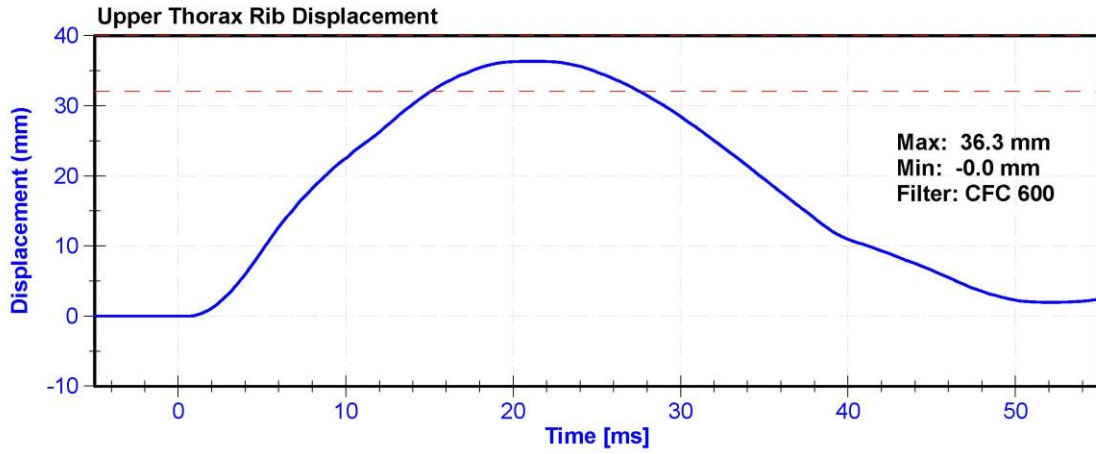
Results

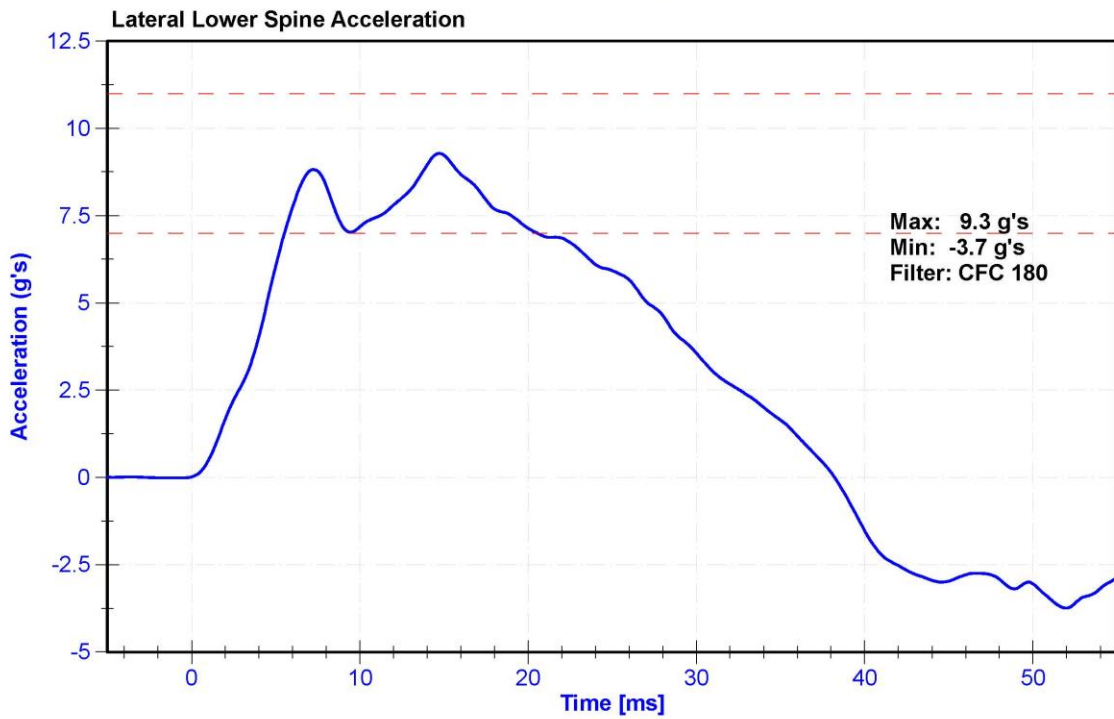
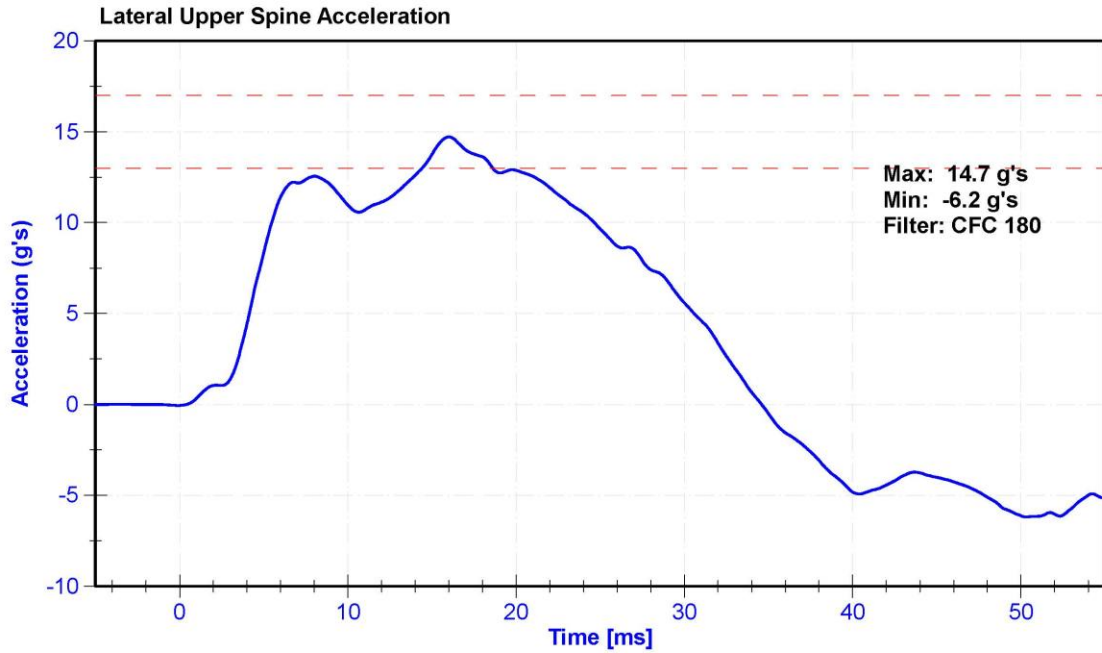
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.8	Pass
Humidity	10	70	%	56	Pass
Velocity	4.2	4.4	m/s	4.31	Pass
Probe Acceleration	14	18	g's	16.0	Pass
Lateral Upper Spine Acceleration	13	17	g's	14.7	Pass
Lateral Lower Spine Acceleration	7	11	g's	9.3	Pass
Upper Thorax Rib Deflection	32	40	mm	36.3	Pass
Middle Thorax Rib Deflection	39	45	mm	42.3	Pass
Lower Thorax Rib Deflection	35	43	mm	40.1	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021
Upper Spine Y Accelerometer	ENDEVCO 7264CT	AC-P64148	4/16/2020	10/15/2020
Lower Spine Y Accelerometer	ENDEVCO 7264C-2K-TZ2	AC-P51327	4/16/2020	10/15/2020
Upper Thorax Rib Potentiometer	Servo 1246	DS-2165GFE	5/6/2020	11/4/2020
Middle Thorax Rib Potentiometer	Servo 08TC1-3621	DS-45 GFE	5/6/2020	11/4/2020
Lower Thorax Rib Potentiometer	Servo 08TC1-3787	DS-011GFE	5/6/2020	11/4/2020







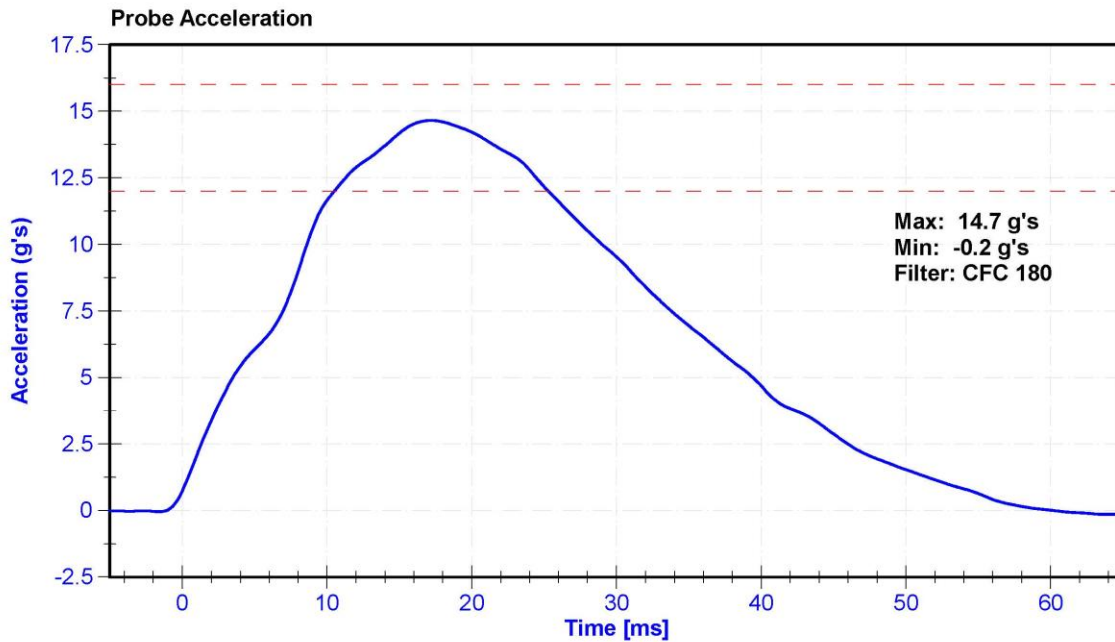
ATD Manufacturer	FTSS	Test Technician	D,Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

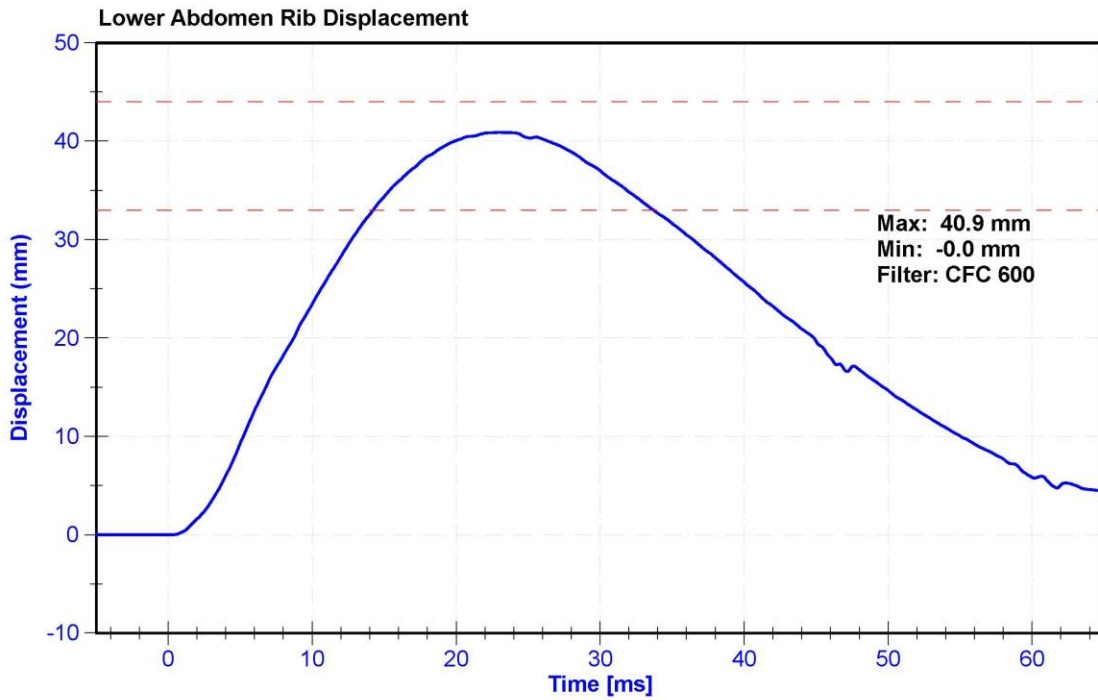
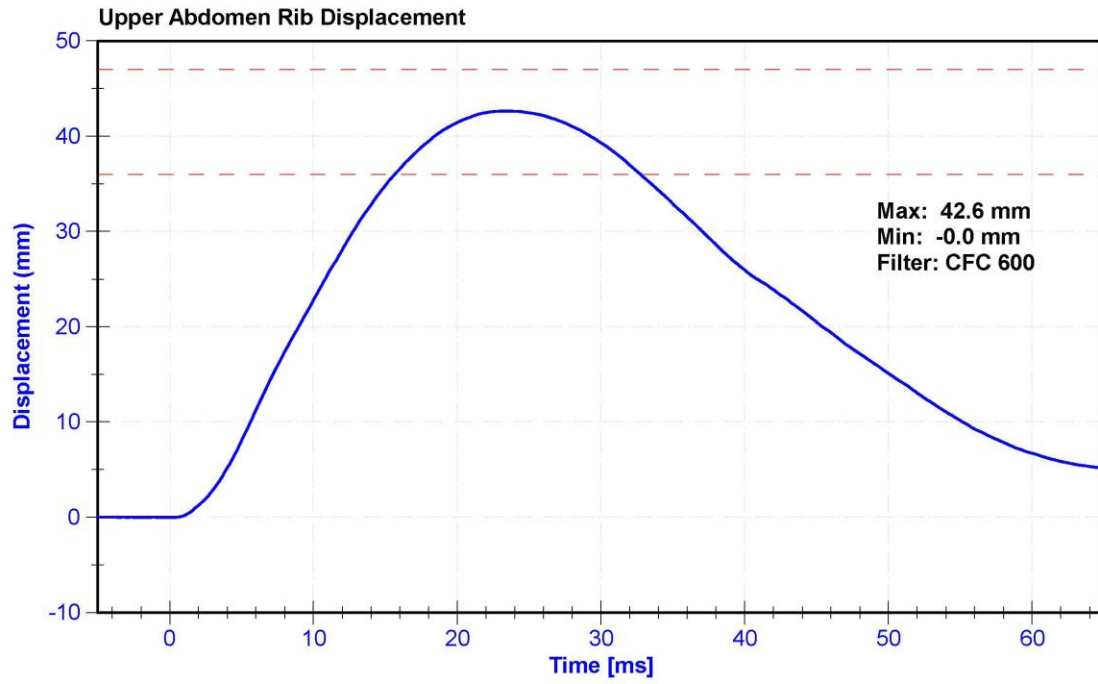
Results

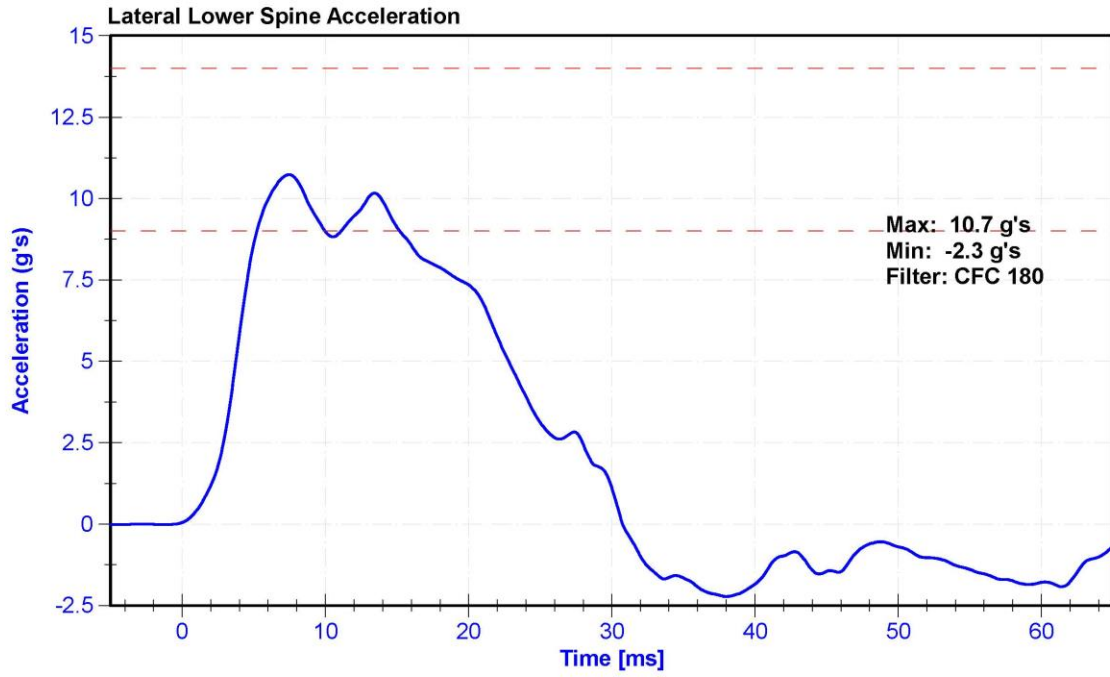
Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	55.0	Pass
Velocity	4.2	4.4	m/s	4.31	Pass
Probe Acceleration	12	16	g's	14.7	Pass
Lateral Lower Spine Acceleration	9	14	g's	10.7	Pass
Upper Abdomen Rib Deflection	36	47	mm	42.6	Pass
Lower Abdomen Rib Deflection	33	44	mm	40.9	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Probe Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021
Lower Spine Y Accelerometer	ENDEVCO 7264C	AC-P51327	4/16/2020	10/15/2020
Upper Abdomen Rib Potentiometer	Servo 08TC1-3725	DS-008GFE	5/6/2020	11/4/2020
Lower Abdomen Rib Potentiometer	Servo 08TC1-3745	DS-1774GFE	5/6/2020	11/4/2020







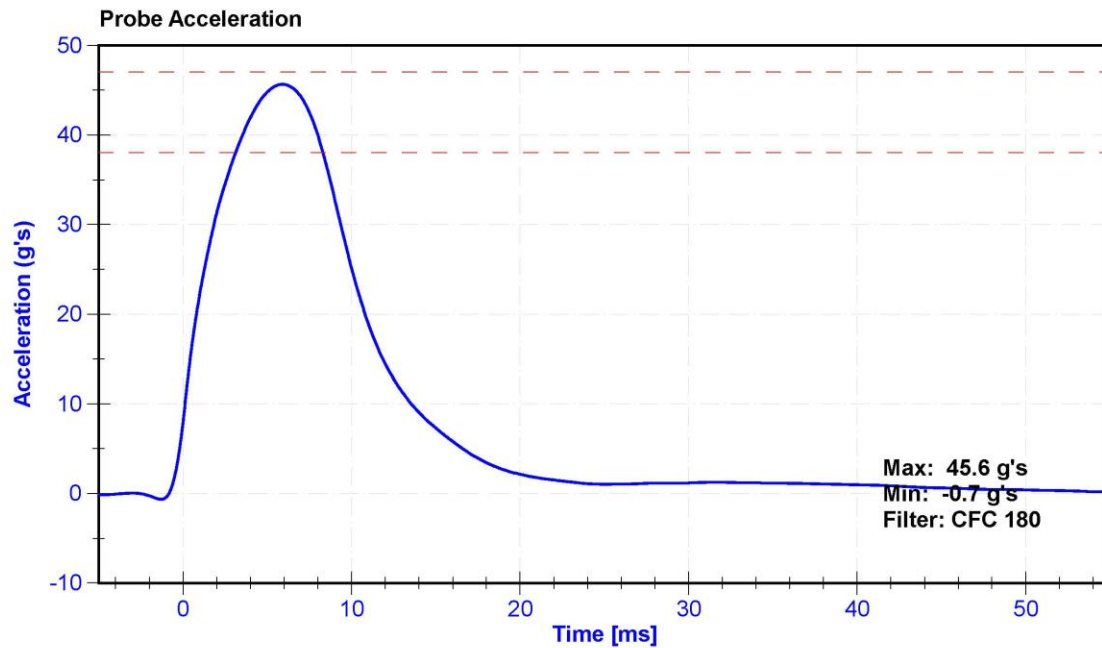
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

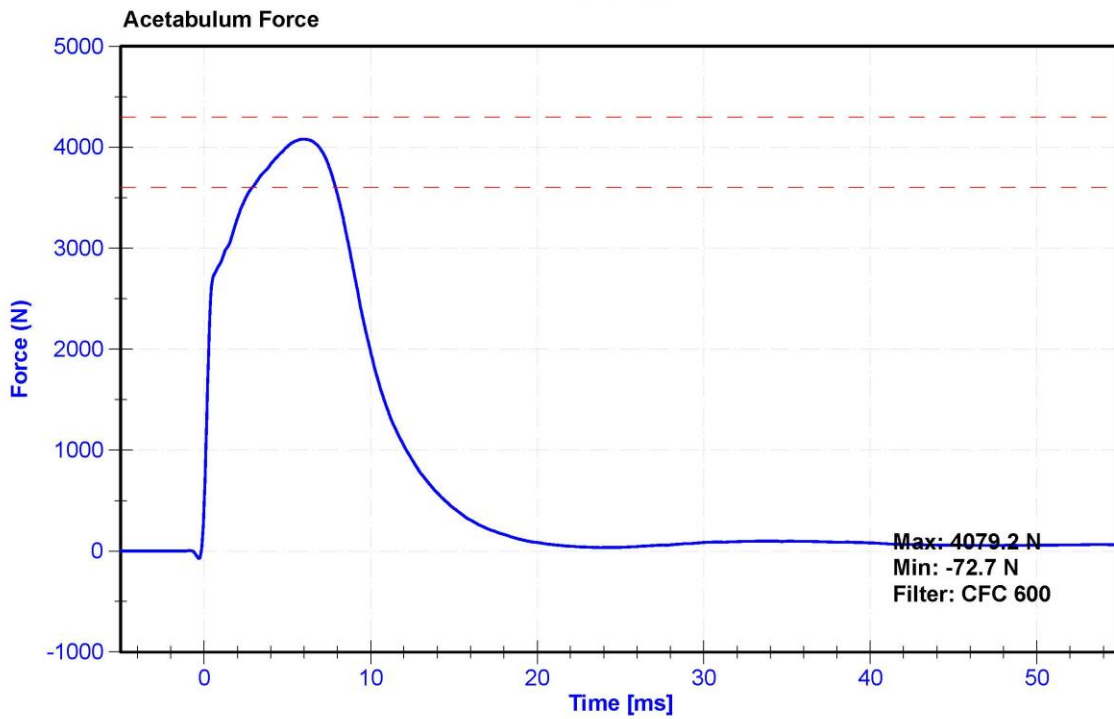
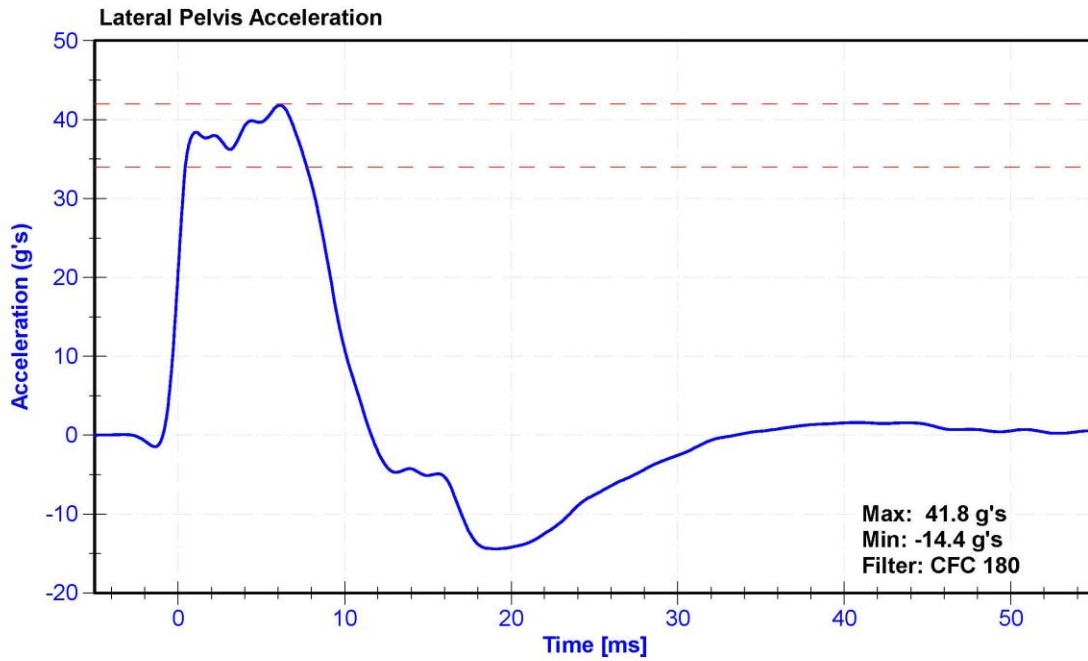
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	56	Pass
Velocity	6.6	6.8	m/s	6.67	Pass
Probe Acceleration	38	47	g's	45.6	Pass
Lateral Pelvis Acceleration after 6ms	34	42	g's	41.8	Pass
Acetabulum Force	3600	4300	N	4079.2	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021
Pelvis Y Accelerometer	ENDEVCO 7264C	AC-P51875	4/16/2020	10/15/2020
Acetabulum Load Cell	Denton 3249J	LC-267Fy	3/19/2020	3/19/2021
Certification Plug	SACO	13177	8/8/2019	N/A
Crash Test Plug	SACO	13224	8/12/2019	N/A







DE 8012
Crash
8/17/19

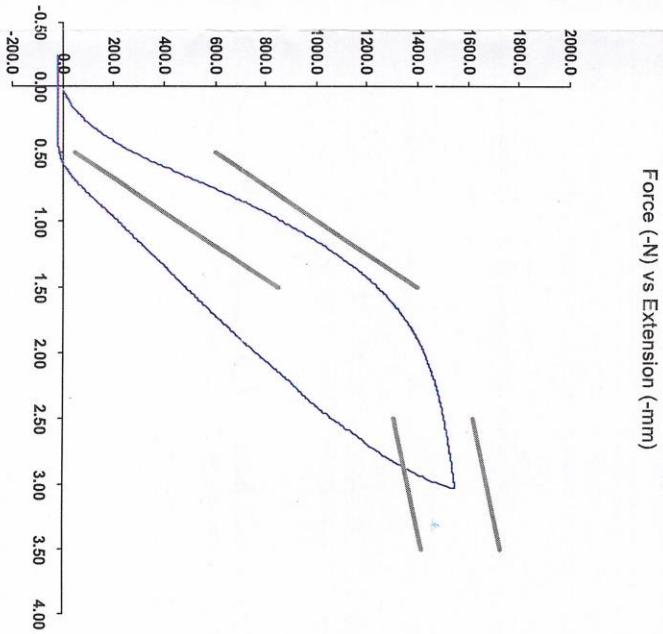
SID-lis Pelvis Plug Certification Test

Plug S/N 13224
Test Number 10646
Report Number 10682
Test Date 8/12/2019 7:39:03 AM

Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50.00	600.00
Force @ 1.5 mm (N)	850.00	1,400.00
Force @ 2.5 mm (N)	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,361.00	1,673.00

Testing Machine STM-20 5965542
Load Cell S/N (F1360947), Units (LBS) 1000
Crosshead Speed (mm/min) or Rate 12.7
Extension or Position Measured by XHD_100 (XHD100)

Notes:



Operator

Part Number 180-4450

Template No 107 12-Aug-19
SACO Research

By: DC Date: 8/12/2019
SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



DC 8/17/19
certified

SID-11s Pelvis Plug Certification Test

Plug S/N 13177
Test Number 10572
Report Number 10607
Test Date 8/8/2019 11:18:09 AM

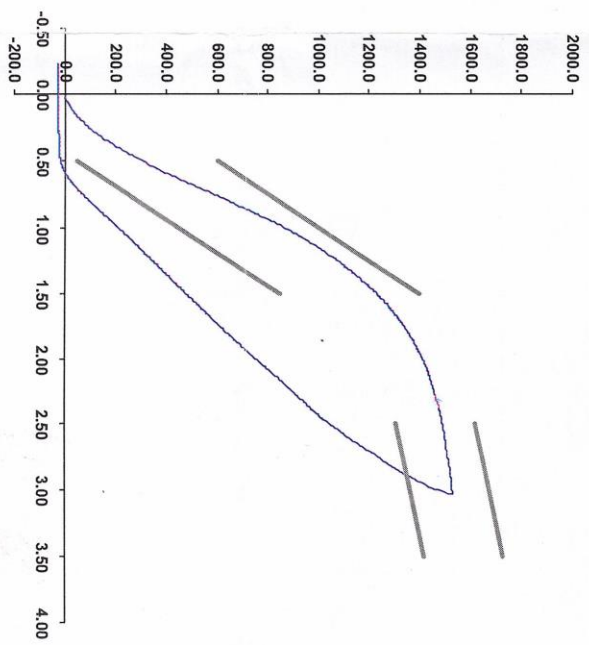
Test Results	Spec Min	Spec Max
Force @ 0.5 mm (N)	50.00	600.00
Force @ 1.5 mm (N)	850.00	1,400.00
Force @ 2.5 mm (N)	1,306.00	1,618.00
Force @ 3.0 mm (N)	1,529.61	1,673.00

Testing Machine STM-20 5965542
 Load Cell S/N (F1360947), Units (LBS) 1000
 Crosshead Speed (mm/min) or Rate 12.7
 Extension or Position Measured by XHD_100 (XHD100)

Notes:

Operator 131
 Part Number 180-4450
 Template No 107 08-Aug-19
 SACO Research

By: DC Date: 8/8/2019
 SACO Research 41735 Elm St, #401 Murrieta, CA 92562 Tel 310-694-2082 FAX



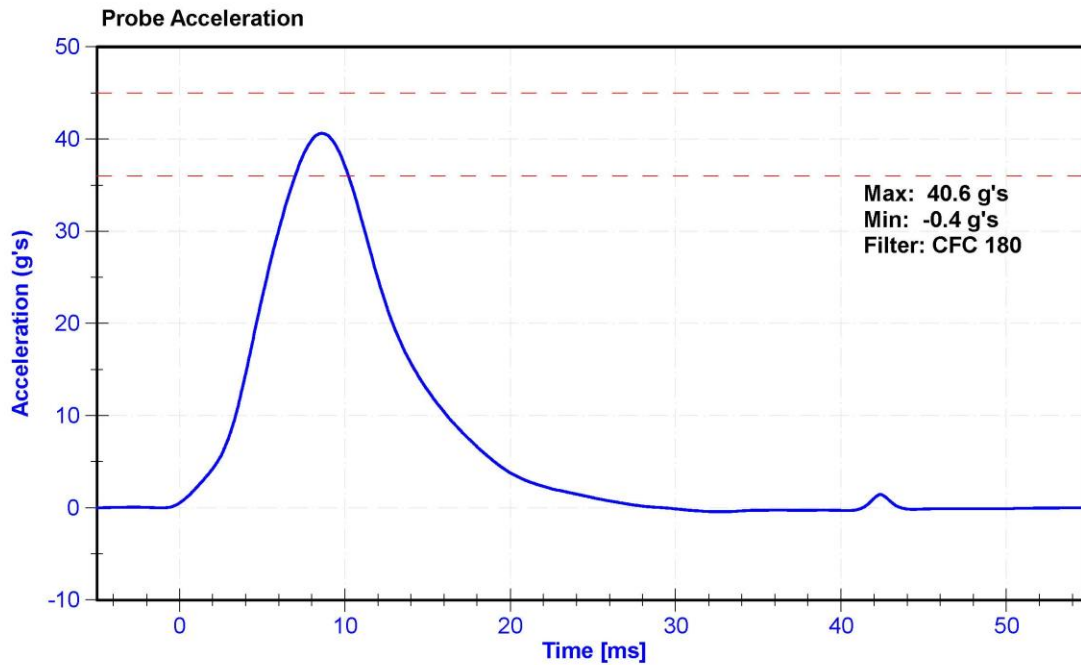
ATD Manufacturer	FTSS	Test Technician	D.Reinhard
ATD Serial Number	DG8012	Laboratory Supervisor	K. Brogan

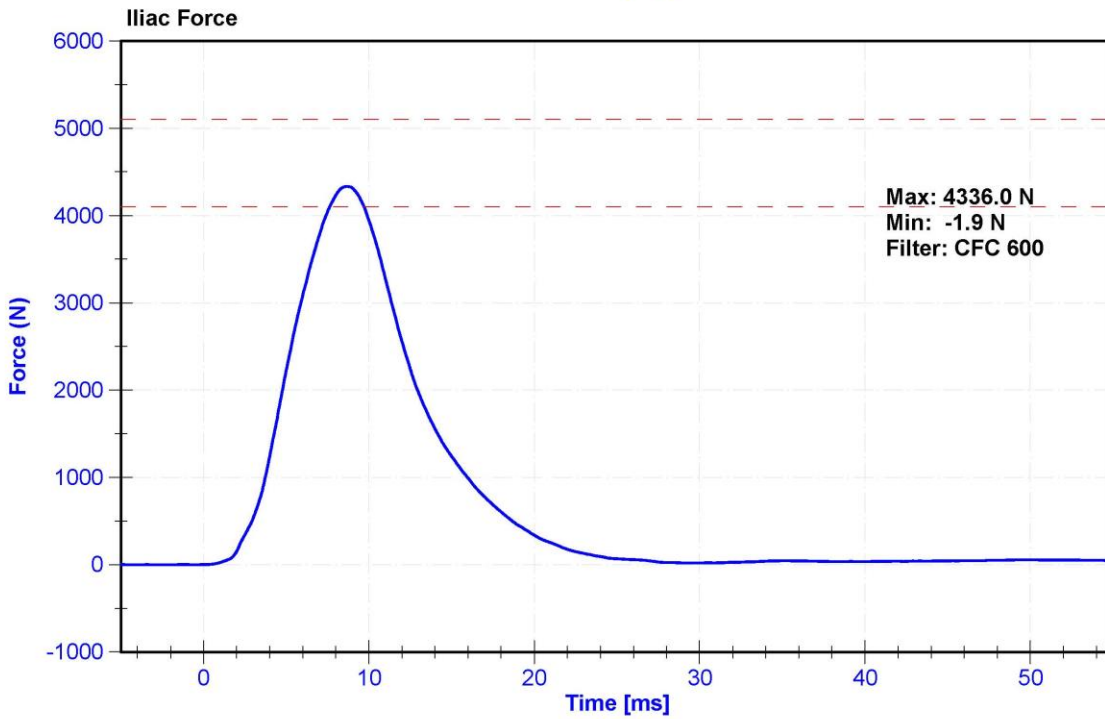
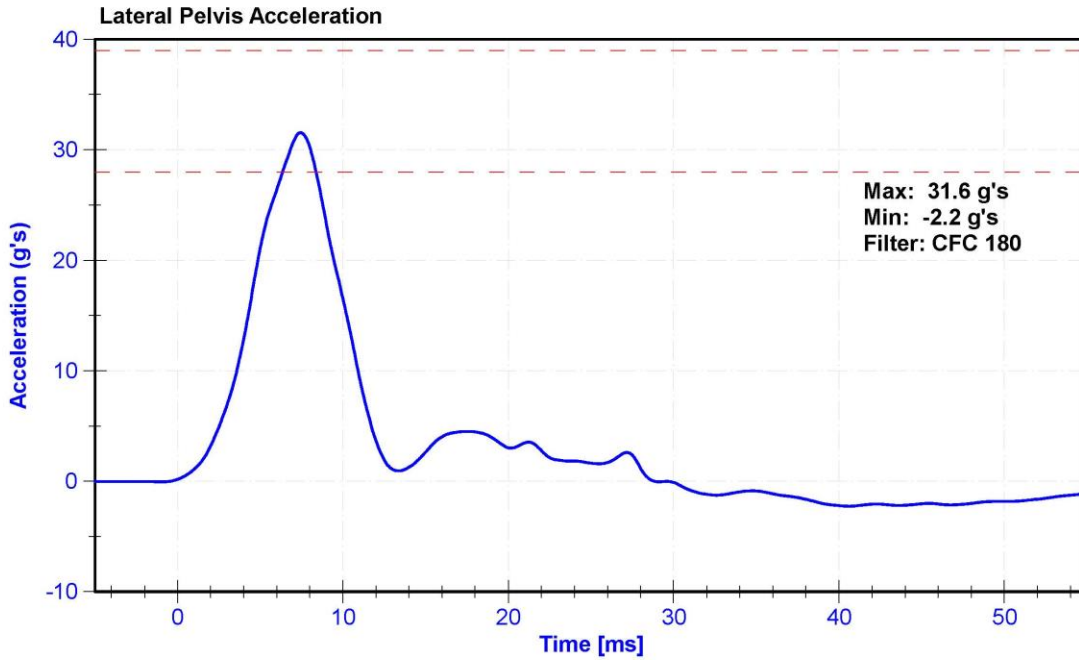
Results

Test Parameter	Minimum Specification	Maximum Specification	Unit	Result	Pass/Fail
Temperature	20.6	22.2	°C	20.7	Pass
Humidity	10	70	%	59.0	Pass
Velocity	4.2	4.4	m/s	4.39	Pass
Probe Acceleration	36	45	g's	40.6	Pass
Lateral Pelvis Acceleration	28	39	g's	31.6	Pass
Iliac Force	4100	5100	N	4336.0	Pass

Transducer Calibrations

Channel	Manufacturer	Serial Number	Calibration Date	Calibration Due Date
Pendulum Accelerometer	MSI 64C-2000	A279031	5/8/2020	5/8/2021
Pelvis Y Accelerometer	ENDEVCO 7264C-2K-TZ2	AC-P51875	4/16/2020	10/15/2020
Iliac Load Cell	DENTON 3228J	LC-290Fy	9/25/2019	9/24/2020





APPENDIX D

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation (SID-IIs)

				SID-IIs S/N: DG8012		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers		X	AC-P74788	ENDEVCO	4/16/2020	
		Y	AC-P83432	ENDEVCO	4/16/2020	
		Z	AC-P83319	ENDEVCO	4/16/2020	
Head Accelerometers - Redundant		X	AC-P80334	ENDEVCO	4/16/2020	
		Y	AC-P52155	ENDEVCO	4/16/2020	
		Z	AC-P83322	ENDEVCO	4/16/2020	
Displacement Potentiometer	Shoulder		Y			
	Thoracic Rib	Upper	Y	DS-2165GFE	Servo	5/6/2020
		Middle	Y	DS-45 GFE	Servo	5/6/2020
		Lower	Y	DS-011GFE	Servo	5/6/2020
	Abdominal Rib	Upper	Y	DS-008GFE	Servo	5/6/2020
		Lower	Y	DS-1774GFE	Servo	5/6/2020
Lower Spine Accelerometers (T12)		X	AC-P52040	ENDEVCO	5/19/2020	
		Y	AC-P51327	ENDEVCO	4/16/2020	
		Z	AC-P52067	ENDEVCO	4/16/2020	
Acetabulum Load Cell		Y	LC-267Fy	Denton	3/19/2020	
Lilac Wing Load Cell		Y	LC-290Fy	Denton	9/25/2019	
Pelvis Plug (Struck Side)			13277	SACO	8/12/2019	
Pelvis Plug (Non-Struck Side)						

Table 2 – Vehicle Instrumentation

Vehicle Instrumentation		Serial Number	Manufacturer	Calibration Date
Vehicle Center of Gravity	X	A280364	MSI 1201-1000	5/1/2020
Vehicle Center of Gravity	Y	A284232	MSI 1201-1000	5/5/2020
Vehicle Center of Gravity	Z	A315106	MSI 1201-1000	3/31/2020
Left Floor Sill	Y	A315930	MSI 1201-1000	3/31/2020
A-Pillar Sill	Y	A315960	MSI 1201-1000	6/18/2020
A-Pillar Low	Y	A315799	MSI 1201-1000	3/27/2020
A-Pillar Mid	Y	A281026	MSI 1201-1000	5/5/2020
B-Pillar Sill	Y	A255982	MSI 1201-1000	5/5/2020
B-Pillar Low	Y	A255975	MSI 1201-1000	5/6/2020
B-Pillar Mid	Y	A284908	MSI 1201-1000	6/18/2020
Driver Seat	Y	A315901	MSI 1201-1000	3/26/2020
Engine Top	X	A315122	MSI 1201-1000	3/31/2020
Engine Top	Y	A315968	MSI 1201-1000	3/31/2020
Firewall	Y	A281458	MSI 1201-1000	5/5/2020
Right Roof	Y	A280955	MSI 1201-1000	5/5/2020
Right Floor Sill	Y	A197009	MSI 1201-1000	5/1/2020
Rear Floorpan	X	A280951	MSI 1201-1000	2/27/2020
Rear Floorpan	Y	A280996	MSI 1201-1000	3/26/2020

Table 3 – Pole Instrumentation

Pole Instrumentation	Serial Number	Manufacturer	Calibration Date
Load Cell 1	1220AF-1117012-F0	Interface	10/16/2019
Load Cell 2	1220AF-1117023-F0	Interface	10/25/2019
Load Cell 3	1220AF-1117025-F0	Interface	10/25/2019
Load Cell 4	1220AF-1117019-F0	Interface	10/25/2019
Load Cell 5	1220AF-1117011-F0	Interface	10/25/2019
Load Cell 6	1220AF-1117017-F0	Interface	10/25/2019
Load Cell 7	1220AF-1117035-F0	Interface	10/25/2019
Load Cell 8	1220AF-1117006-F0	Interface	10/7/2019