

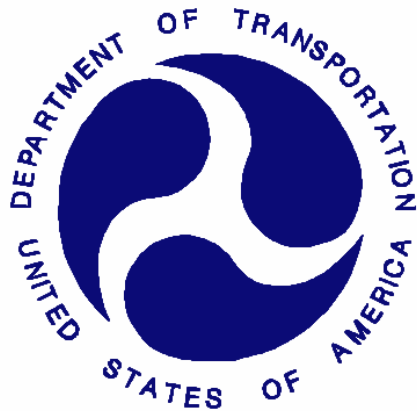
REPORT NUMBER: NCAP-KAR-20-005

**NEW CAR ASSESSMENT PROGRAM (NCAP)
FRONTAL BARRIER IMPACT TEST**

**SUBARU CORPORATION
2020 SUBARU OUTBACK 5-DOOR MPV**

NHTSA NUMBER: O20205502

**PREPARED BY:
APPLUS IDIADA KARCO ENGINEERING, LLC.
9270 HOLLY ROAD
ADELANTO, CA 92301**



DECEMBER 26, 2019

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF CRASHWORTHINESS STANDARDS
1200 NEW JERSEY AVE, SE
ROOM W43-410
WASHINGTON, DC 20590**

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Approval Date: _____ December 26, 2019 _____

FINAL REPORT ACCEPTANCE BY OCWS:

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NHTSA, Office of Crashworthiness Standards

Date: _____

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

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NCAP-KAR-20-005	2. Government Accession No.	3. Recipient's Catalog No.																																																					
4. Title and Subtitle Final Report of New Car Assessment Program Testing of a 2020 Subaru Outback 5-Door MPV NHTSA No. O20205502		5. Report Date December 26, 2019																																																					
		6. Performing Organization Code KAR																																																					
7. Authors Mr. Robert S. Ramos, Program Manager, Applus IDIADA KARCO Mr. Steven D. Matsusaka, Engineering Manager, Applus IDIADA KARCO		8. Performing Organization Report No. TR-P39303-01-NC																																																					
		10. Work Unit No.																																																					
9. Performing Organization Name and Address Applus IDIADA KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301		11. Contract or Grant No. 693JJ919D000004																																																					
		13. Type of Report and Period Covered Final Test Report, December 12 - 26, 2019																																																					
12. Sponsoring Agency Name and Address U. S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards 1200 New Jersey Ave., SE, Room W43-410 Washington, D.C. 20590		14. Sponsoring Agency Code NRM-110																																																					
		15. Supplementary Notes																																																					
16. Abstract A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2020 Subaru Outback 5-door MPV in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and footwell intrusion performance. The test was conducted at the Applus IDIADA KARCO Engineering, LLC. facility in Adelanto, California on December 12, 2019. The impact velocity of the vehicle was 56.43 km/h and the ambient temperature at the barrier face at the time of impact was 19.4°C. The target vehicle's post-test maximum crush was 542 mm at DPD3 to the left of the vehicle's centerline. The test vehicle's performance is as follows: <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD</th> <th colspan="2">Passenger ATD</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>700</td> <td>101.2</td> <td>700</td> <td>166.5</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>-19</td> <td>52</td> <td>-10</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.25</td> <td>1</td> <td>0.38</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>1107.5</td> <td>2620</td> <td>902.2</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>-254.1</td> <td>2520</td> <td>-394.2</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10000</td> <td>-896.5</td> <td>6805</td> <td>-849.6</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10000</td> <td>-1304.6</td> <td>6805</td> <td>-288.5</td> </tr> </tbody> </table>				Measurement Description	Units	Driver ATD		Passenger ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)	N/A	700	101.2	700	166.5	Maximum Chest Compression	mm	63	-19	52	-10	Nij	N/A	1	0.25	1	0.38	Neck Tension	N	4170	1107.5	2620	902.2	Neck Compression	N	4000	-254.1	2520	-394.2	Left Femur Force	N	10000	-896.5	6805	-849.6	Right Femur Force	N	10000	-1304.6	6805	-288.5
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17. Key Words 56.3 km/h (35 mph) Full Frontal Rigid Barrier Impact Test New Car Assessment Program (NCAP)		18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Ave., SE Washington, DC 20590																																																					
		19. Security Classification of this report UNCLASSIFIED																																																					
20. Security Classification of this page UNCLASSIFIED		21. No. of Pages 142	22. Price																																																				

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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program, sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number 693JJ919D000004. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

The 56.3 km/h frontal barrier impact test was conducted in accordance with the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing.

SUMMARY

A load cell barrier consisting of 176 load cells was impacted by a 2020 Subaru Outback 5-door MPV at a velocity of 56.43 km/h. The test was performed at Applus IDIADA KARCO Engineering, LLC. on December 12, 2019. Pre- and post-test photographs of the vehicle and dummies can be found in Appendix A of this report.

One (1) real-time cameras and sixteen (16) high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in Data Sheet 6 of this report.

One Part 572E 50th percentile male anthropomorphic test device (ATD) was placed in the driver seating position and one Part 572O 5th percentile female ATD was placed in the right-front passenger seating position according to dummy placement instructions specified in the Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck force transducers, right / left femur load cells, and lower leg instrumentation. Seat belt load cells were installed on the driver's and passenger's lap and shoulder belts to measure dummy torso and pelvic section loading.

The driver (position 1) ATD (Serial No. 360) and the right-front passenger (position 2) ATD (Serial No. 141) were qualified prior to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 106 channels of dummy and vehicle response data were recorded on an on-board data acquisition system. Appendix B contains the dummy response data traces.

There was 100 percent windshield retention and no intrusion into the protected zone of the windshield during the event. There was no Stoddard solvent leakage after the event or during any phase of the static rollover.

The maximum static crush was 542 mm at DPD3 to the left of the vehicle's centerline and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

The driver's visible contact points were as follows: the driver ATD's head contacted the frontal airbag and headrest. The upper torso contacted the frontal airbag. Both left and right knees contacted the knee airbag.

The passenger's visible contact points were as follows: the passenger ATD's head contacted the frontal airbag and headrest. The upper torso contacted the frontal airbag. Both left and right knees contacted the knee bolster.

The occupant data is summarized below:

ATD Position	HIC ₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50th Male)	101.2	0.25	1107.5	-254.1	40	-19	-896.5	-1304.6
Passenger (5th Female)	166.5	0.38	902.2	-394.2	43	-10	-849.6	-288.5

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

CONVERSION FACTORS

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	miles/hr	km/hr	1.609344
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.574
Pressure	Tire Pressures	lbf/in ²	kPa	6.895
Temperature	General Use	°F	°C	$=(T_f - 32)/1.8$
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf-ft	N•m	1.355

DATA SHEET NO. 1

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	O20205502
Model Year	2020
Make	Subaru
Model	Outback
Body Style	5-Door MPV
VIN	4S4BTACC7L3103751
Body Color	Abyss Blue Pearl
Odometer Reading (km / mi)	113 / 70
Engine Displacement (L)	2.5
Type / No. of Cylinders	4 Cylinders
Engine Placement	Longitudinal
Transmission Type	Automatic
Transmission Speeds	8
Overdrive	Yes
Final Drive	AWD
Roof Rack	Yes
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	Yes
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

Traction Control System	Yes
Power Steering	Yes
Power Window Auto-Reverse	Yes
Driver Frontal 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
Front Pass. Frontal Airbag	Yes
Front Pass. Curtain Airbag	Yes
Front Pass. Head/Torso Airbag	No
Front Pass. Torso Airbag	No
Front Pass. Torso/Pelvis Airbag	Yes
Front Pass. Pelvis Airbag	No
Front Pass. Knee Airbag	No
Driver Seat Belt Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Seat Belt Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other Safety Restraint	Yes; Pass. Seat Pan

Does Owner's Manual provide instructions to turn off automatic door locks?

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Subaru Corporation
Date of Manufacture	Aug-19

GVWR (kg)	2200
GAWR Front (kg)	1250
GAWR Rear (kg)	1220

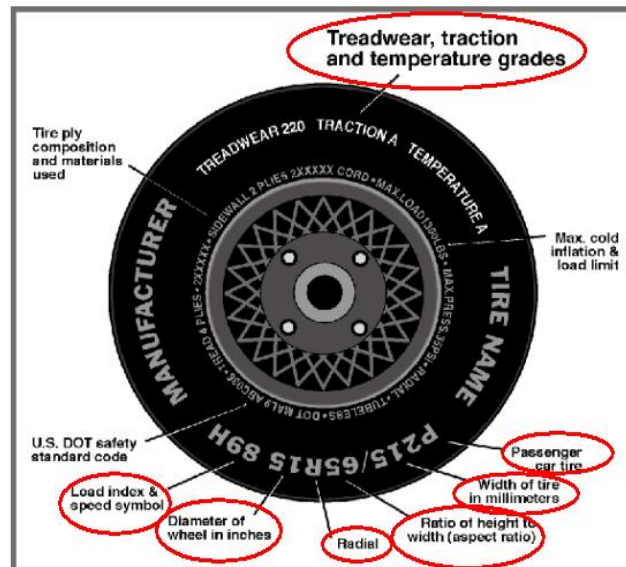
VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Type of Seats	Bucket	Bench			
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				408.0	A
DSC x 68.04 (kg)				340.2	B
Cargo Weight (RCLW) (kg)				67.8	A-B

DATA SHEET NO. 1 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	240	230
Recommended Tire Size	225/65 R17	225/65 R17
Tire Size on Vehicle	225/65 R17	225/65 R17
Tire Manufacturer	Yokohama	Yokohama
Tire Model	AVID GT	AVID GT
Treadwear	400	400
Traction	B	B
Temperature Grades	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index / Speed Symbol	102H	102H
Tire Material	Polyester, Steel, Nylon	Polyester, Steel, Nylon
DOT Safety Code Left	4UF5 6JK 1419	4UF5 6JK 1419
DOT Safety Code Right	4UF5 6JK 1419	4UF5 6JK 1419

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

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UWV)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	474.0	378.5		514.0	472.0	
Right	kg	460.0	349.0		458.0	419.5	
Ratio	%	56.2%	43.8%	100.0%	52.2%	47.8%	100.0%
Total	kg	934.0	727.5	1661.5	972.0	891.5	1863.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UWV)	kg	1661.5	A
Weight of 1 P572E ATD & 1 P572O ATD	kg	141.0	B
Rated Cargo/Luggage Weight (RCLW)	kg	67.8	C
Calculated Vehicle Target Weight (TVTW)	kg	1870.3	A+B+C

TEST VEHICLE ATTITUDES

Condition	Units	LF	RF	LR	RR	CG Aft of Front Axle
As Delivered	mm	882	887	885	892	1198
As Tested	mm	854	857	848	857	1309
Post-Test	mm	855	909	840	850	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheelbase	mm	2735
Total Vehicle Length at Left Side	mm	4208
Total Vehicle Length at Centerline	mm	4853
Total Vehicle Length at Right Side	mm	4197
Weight of Ballast in Cargo Area	kg	67.0
Weight of Vehicle Components Removed	kg	6.0
Amount of Stoddard Solvent in Fuel Tank	L	65.12

VEHICLE COMPONENTS REMOVED TO MEET TEST WEIGHT:

Rear Trim (6.0 kg)

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

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

TARGET VEHICLE STRUCTURAL MEASUREMENTS

No.	Description	Pre-Test
1	Total Length	4853
2	Total Width	1840
3	Bumper Top Height	705
4	Bumper Bottom Height	353
5	Longitudinal Member Top Height	588
6	Distance Between Longitudinal Members	855
7	Longitudinal Member Width	70
8	Engine Top Height	922
9	Engine Bottom Height	206
10	Engine and Gearbox Width	735
11	Front Bumper to Engine Distance	543
12	Front Shock Absorber Fixing Height	940
13	Bonnet Leading Edge Height	895
14	Front Shock Absorber Fixing Width	1192
15	Front Bumper to Front Axle Distance	999
16	Front Axle to A-Pillar Distance	518
17	A-Pillar to B-Pillar Distance	1040
18	B-Pillar to Rear Axle Distance	1177
19	B-Pillar to C-Pillar Distance	1022
20	Roof Sill Bottom Height	1442
21	Roof Sill Top Height	1525
22	Floor Sill Bottom Height	281
23	Floor Sill Top Height	450

All measurements in millimeters.

DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2020 Subaru Outback 5-Door MPV

NHTSA No.: O20205502

Test Program: 56.3 km/h Frontal Impact NCAP Test

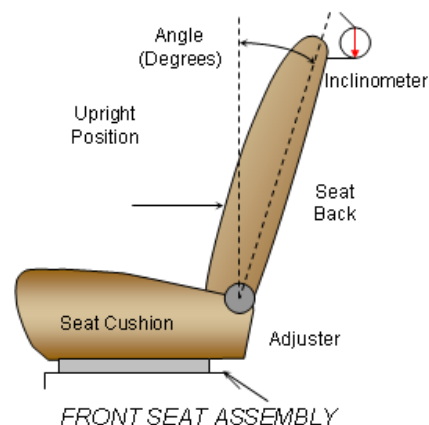
Test Date: 12/12/19

NOMINAL DESIGN RIDING POSITION

The procedure for the driver is as follows: the seat back is set to the manufacturer's designated angle. The procedure for the passenger is as follows: the seat back is set to position the transverse instrumentation platform of the dummy's head at $0^\circ \pm 0.5^\circ$. Seat back angle is measured at the headrest post.

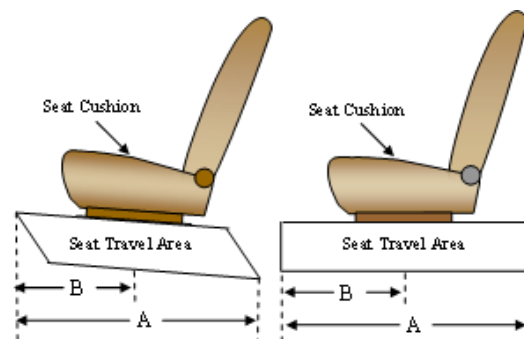
SEAT BACK ANGLE

Seating Position	Degrees
Driver Seat Back Angle	8.7
Passenger Seat Back Angle	5.6



SEAT FORE / AFT POSITIONING

The total seat travel is measured from the forward most possible position to the rear most possible position. The driver's seat is set to the middle of the fore-aft travel. The passenger's seat is set to the forward most position where the ATD will not contact any interior panels.



SEAT FORE/AFT POSITIONS

Seating Position	Total Fore-Aft Travel	Placed in Position
Driver Seat	302 mm	151 mm
Passenger Seat	250 mm	0 mm

SEAT BELT UPPER ANCHORAGE

The seat belt upper anchorage is positioned to the manufacturer's design position for a 50th percentile adult male ATD for the driver, and a 5th percentile adult female ATD for the passenger. Position "H" is the uppermost position, followed by position "M2", followed by position "M1", and Position "L" is the lowermost position.

SEAT BELT UPPER ANCHORAGES

Seating Position	Total No. of Positions	Placed in Position
Driver Seat	4	M2
Passenger Seat	4	M2

DATA SHEET NO. 2 ... (CONTINUED)

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

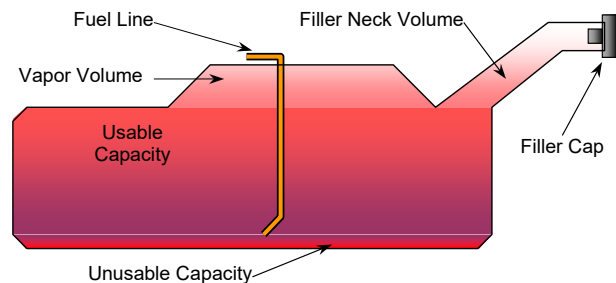
Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	70.02
Usable Capacity of "Optional Tank"	
92 - 94% of Usable Capacity	64.42 to 65.82
Actual Amount of Stoddard Solvent Used	65.12
1/3 of Usable Capacity	23.34

FUEL PUMP

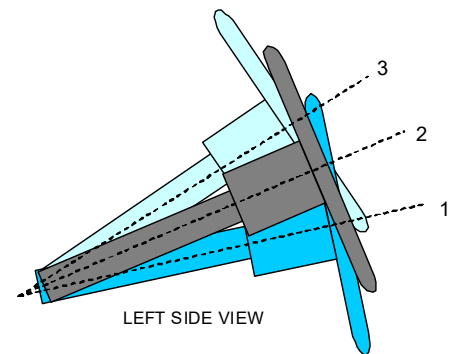
The vehicle is equipped with an electric fuel pump.
The fuel pump operates after the ignition switch is turned ON and while the engine is running.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. A digital inclinometer is used to measure a plate which is placed across the rim of the steering wheel for angular measurements.



STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONING

	Degrees	Fore-Aft Position (mm)
Lowermost Position, No. 1	20.9	118
Geometric Center Position, No. 2	22.7	147
Uppermost Position, No. 3	24.5	175
Telescoping Steering Wheel Travel		57
Test Position	24.5	147

DATA SHEET NO. 3

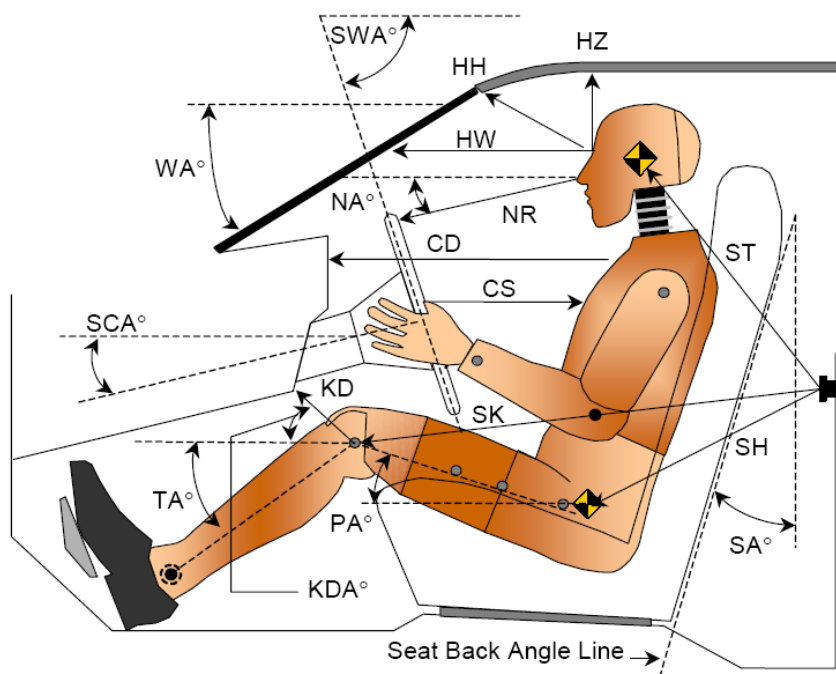
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Subaru Outback 5-Door MPV

NHTSA No.: O20205502

Test Program: 56.3 km/h Frontal Impact NCAP Test

Test Date: 12/12/19

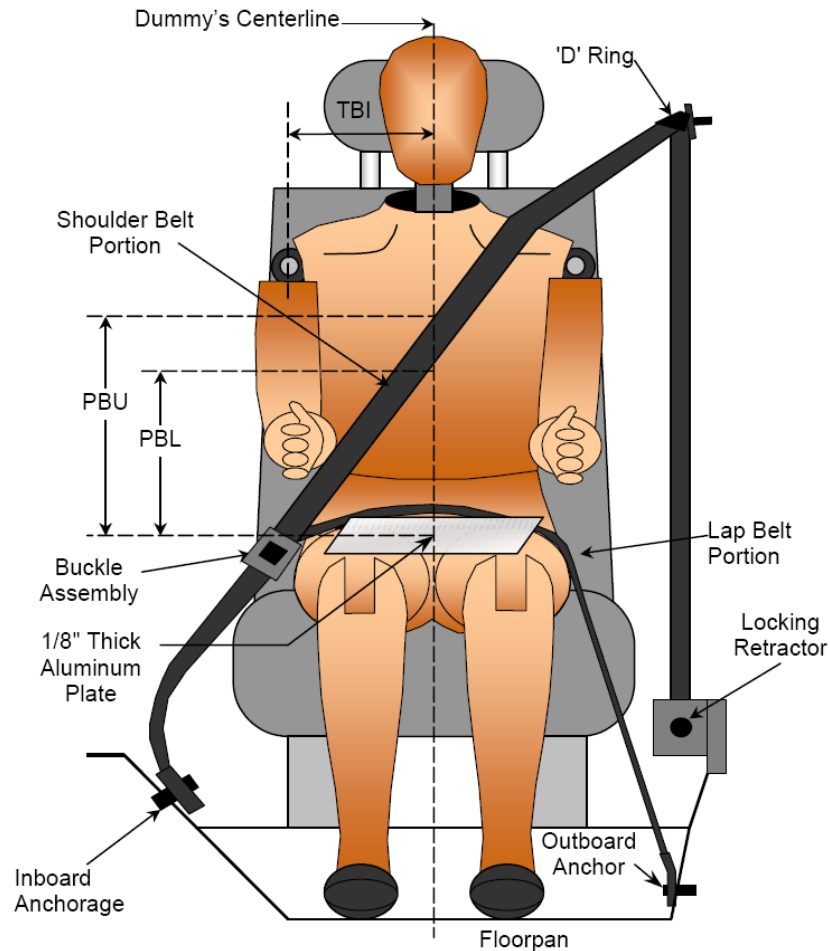


LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		26.7		
SWA°	Steering Wheel Angle		66.9		
SCA°	Steering Column Angle		23.1		
SA°	Seat Back Angle (On Headrest Post)		8.7		5.6
HZ	Head to Roof	191	90.0	221	90.0
HH	Head to Header	329	34.7	315	51.3
HW	Head to Windshield	615	0.0	645	0.0
NR	Nose to Rim	364	11.8	490	25.2
CD	Chest to Dash	495	19.3	420	20.1
CS	Chest to Steering Hub	274	0.0		
RA	Rim to Abdomen	189	0.0		
KDL	Left Knee to Dash	165	45.8	110	41.2
KDR	Right Knee to Dash	126	41.2	90	40.8
PA°	Pelvic Angle		20.0		19.6
TA°	Tibia Angle		43.3		48.0
SK	Striker to Knee	619	12.9	702	11.1
ST	Striker to Head	444	70.7	437	59.2
SH	Striker to H-Point	340	45.8	401	29.1

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Code	Measurement Description	Units	Driver	Passenger
PBU	Top Surface of Aluminum Plate to Belt Upper Edge	mm	340	305
PBL	Top Surface of Aluminum Plate to Belt Lower Edge	mm	250	190

BELT LENGTH DATA

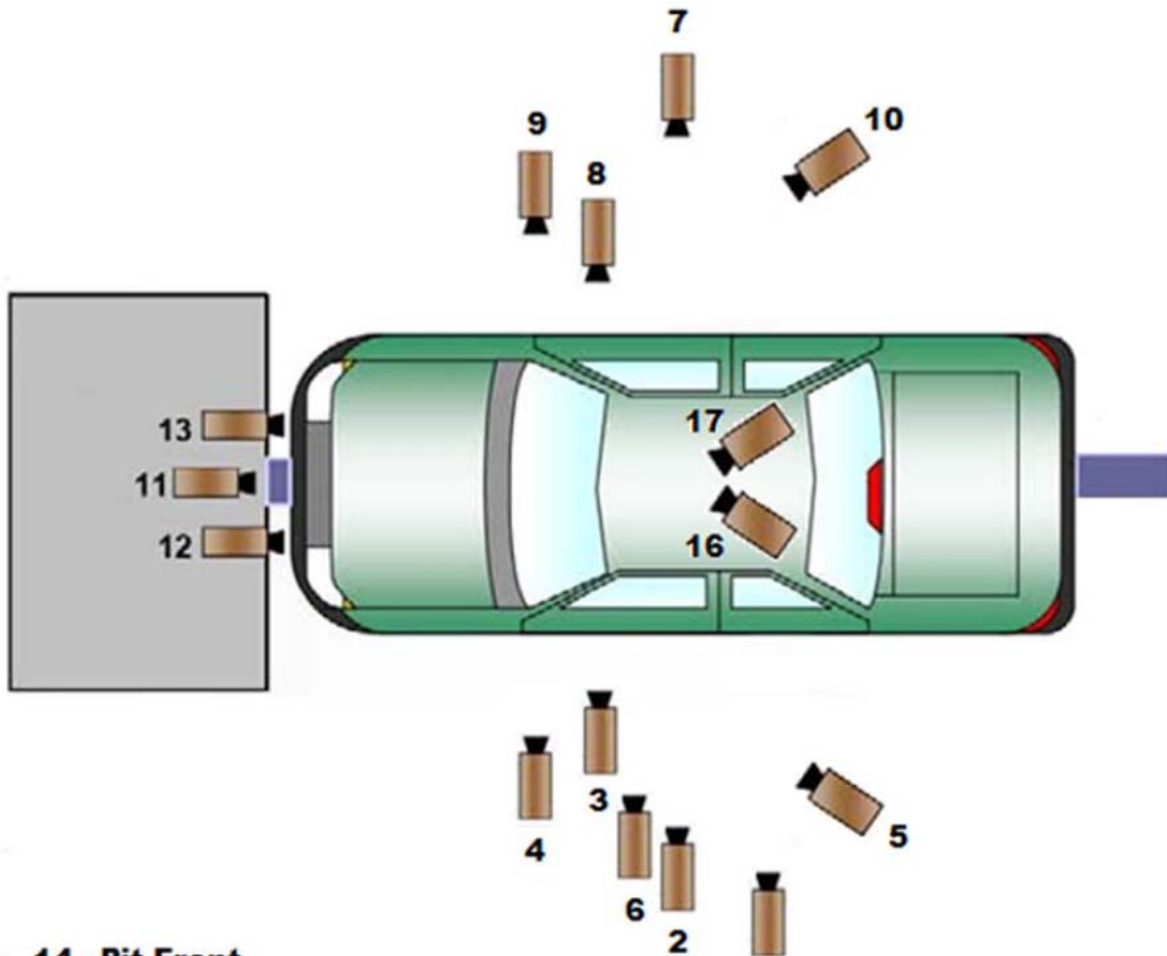
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as Measured on ATD	mm	845	927
Lap Belt Length as Measured on ATD	mm	630	878
Remainder of Belt on Reel	mm	1253	929
Total Belt Length for Continuous Webbing Systems	mm	2728	2734

DATA SHEET NO. 6

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

CAMERA POSITIONS FOR FRONTAL IMPACTS



14 - Pit Front

15 - Pit Rear

16 & 17 - Driver and Passenger Onboard

1- Real Time Camera

***Camera locations are approximate and not to scale*

DATA SHEET NO. 6 ... (CONTINUED)**HIGH-SPEED CAMERA LOCATIONS AND DATA**Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19**CAMERA LOCATIONS**

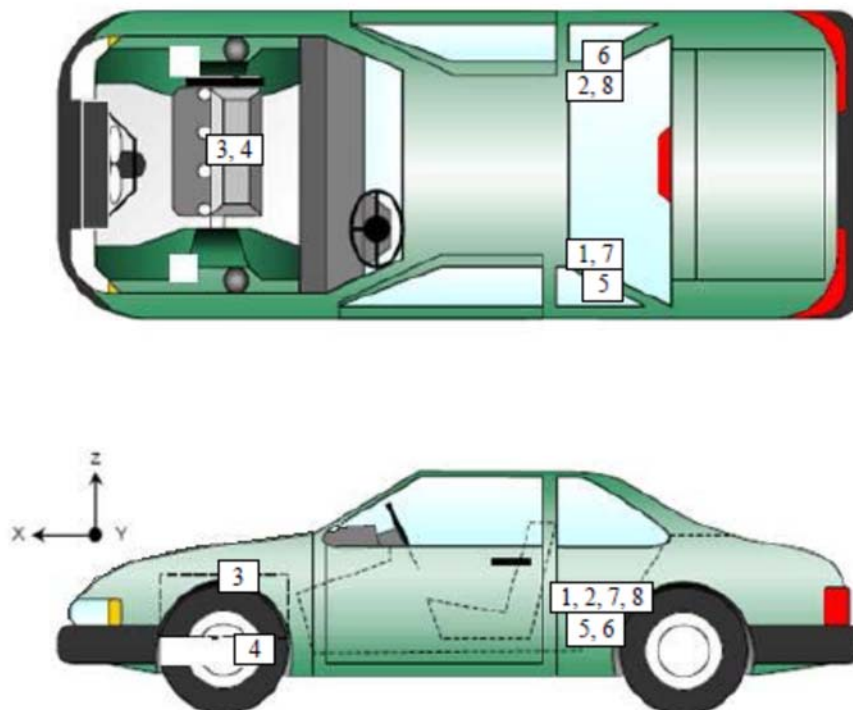
No.	Description	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-11412	-8150	-1484		30
2	Left Overall	-2456	-7975	-1025	20	1000
3	Driver Close-Up	-2590	-7950	-1371	50	1000
4	Left Front Half	-1701	-6197	-1701	35	1000
5	Left Angle	-6696	-10308	-3211	105	1000
6	Steering Column	-1966	-10412	-3688	35	1000
7	Right Overall	-2336	7569	-1012	20	1000
8	Passenger Close-Up	-1733	7581	-1408	50	1000
9	Right Front Half	-1600	8214	-1811	35	1000
10	Right Angle	-6217	9516	-4830	85	1000
11	Windshield	-354	0	-5749	28	1000
12	Driver Windshield	297	-366	-2460	24	1000
13	Passenger Windshield	297	366	-2460	24	1000
14	Pit Front	-756	0	1495	20	1000
15	Pit Rear	-3398	0	1495	20	1000
16	Driver Onboard	-1543	-291	-1611	8	1000
17	Passenger Onboard	-1542	286	-1599	8	1000

Coordinates: +X = forward impact plane
 +Y = right of monorail center
 +Z = into ground

DATA SHEET NO. 7

VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Description	Location		
		X	Y	Z
1	Left Rear Accelerometer X-Direction	1946	-708	-548
2	Right Rear Accelerometer X-Direction	1945	710	-550
3	Engine Top X	4028	23	-1011
4	Engine Bottom X	3386	34	-347
5	Left Rear Accelerometer Z-Direction	1946	-708	-548
6	Right Rear Accelerometer Z-Direction	1945	732	-550
7	Left Rear Accelerometer X-Direction Redundant	1946	-708	-548
8	Right Rear Accelerometer X-Direction Redundant	1945	710	-550

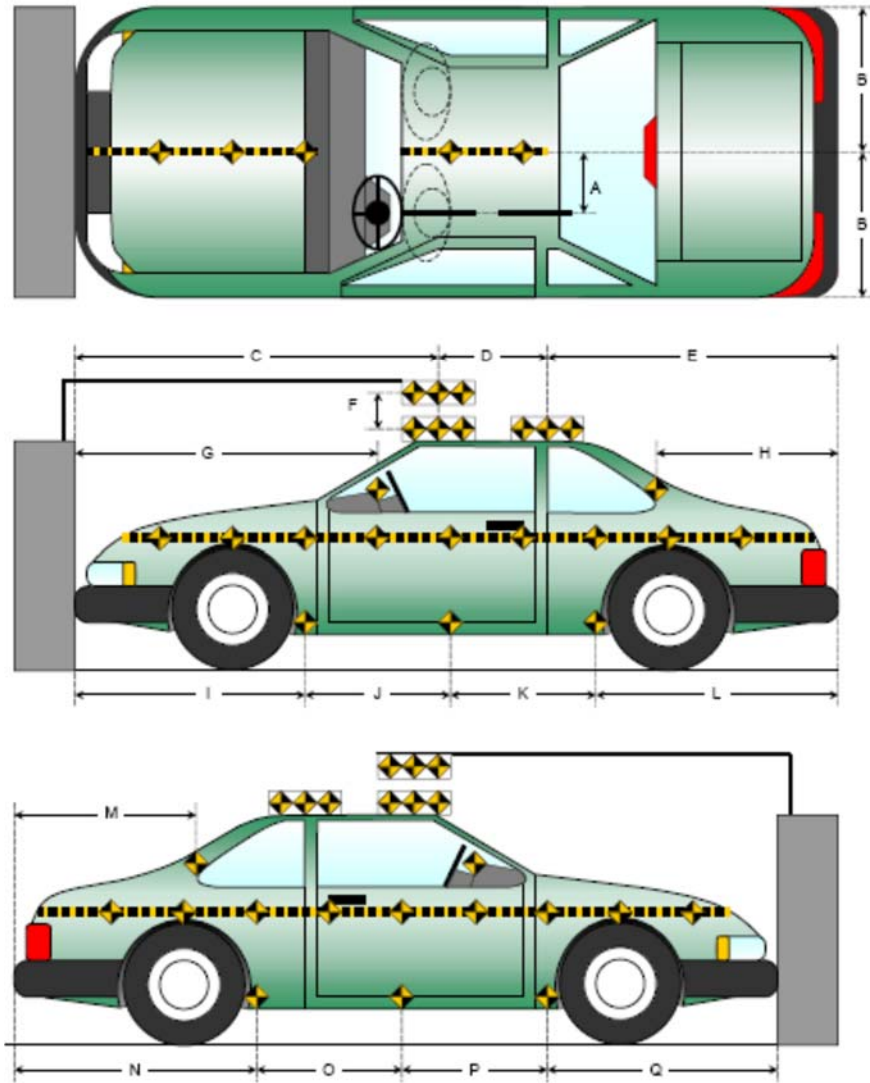
Reference Points:
 X – Rear Surface of Vehicle (+ forward)
 Y – Vehicle Centerline (+ to right)
 Z – Ground Plane (+ down)

DATA SHEET NO. 8

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

Item	Value
A	838
B	920
C	2288
D	607
E	1959
F	305
G	1792
H	552
I	1463
J	905
K	926
L	1558
M	544
N	1555
O	915
P	905
Q	1461



All measurements in millimeters.

DATA SHEET NO. 9

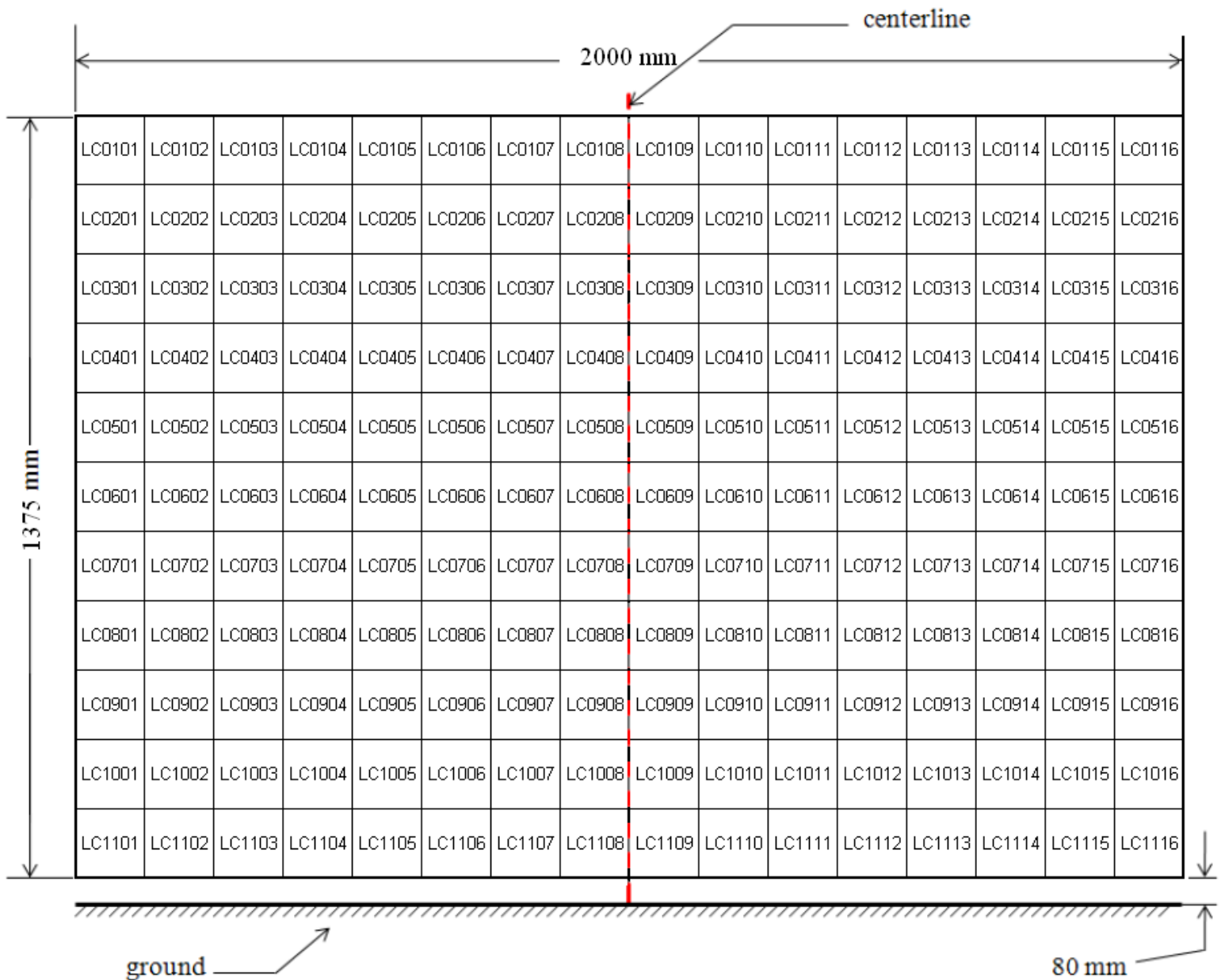
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2020 Subaru Outback 5-Door MPV

NHTSA No.: O20205502

Test Program: 56.3 km/h Frontal Impact NCAP Test

Test Date: 12/12/19



DATA SHEET NO. 10**TEST VEHICLE SUMMARY OF RESULTS**

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

INSTRUMENTATION

Driver Dummy Accelerometers	47
Passenger Dummy Accelerometers	47
Vehicle Structure Accelerometers	8
Seat Belt Load Cells	4
Load Cell Barrier	528
Total	634

CAMERA COVERAGE

High-Speed Vehicle On Board	2
High-Speed Off Board	14
Real Time	1
Total	17

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type/Serial No.	P572E 50th Percentile Male ATD / 360	P572O 5th Percentile Female ATD / 141
Head Contact	Frontal Airbag, Headrest	Frontal Airbag, Headrest
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Knee Bolster
Right Knee Contact	Knee Airbag	Knee Bolster

DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked / Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Remained closed and latched, operational	Remained closed and latched, operational
Rear Door Opening	Remained closed and latched, operational	Remained closed and latched, operational
Trunk/Hatch/Tailgate Opening	None	None
Seat Track Shift (mm)	0	0
Seat Back Movement from Initial Position	None	None

OTHER VEHICLE POST-TEST OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	Broken
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

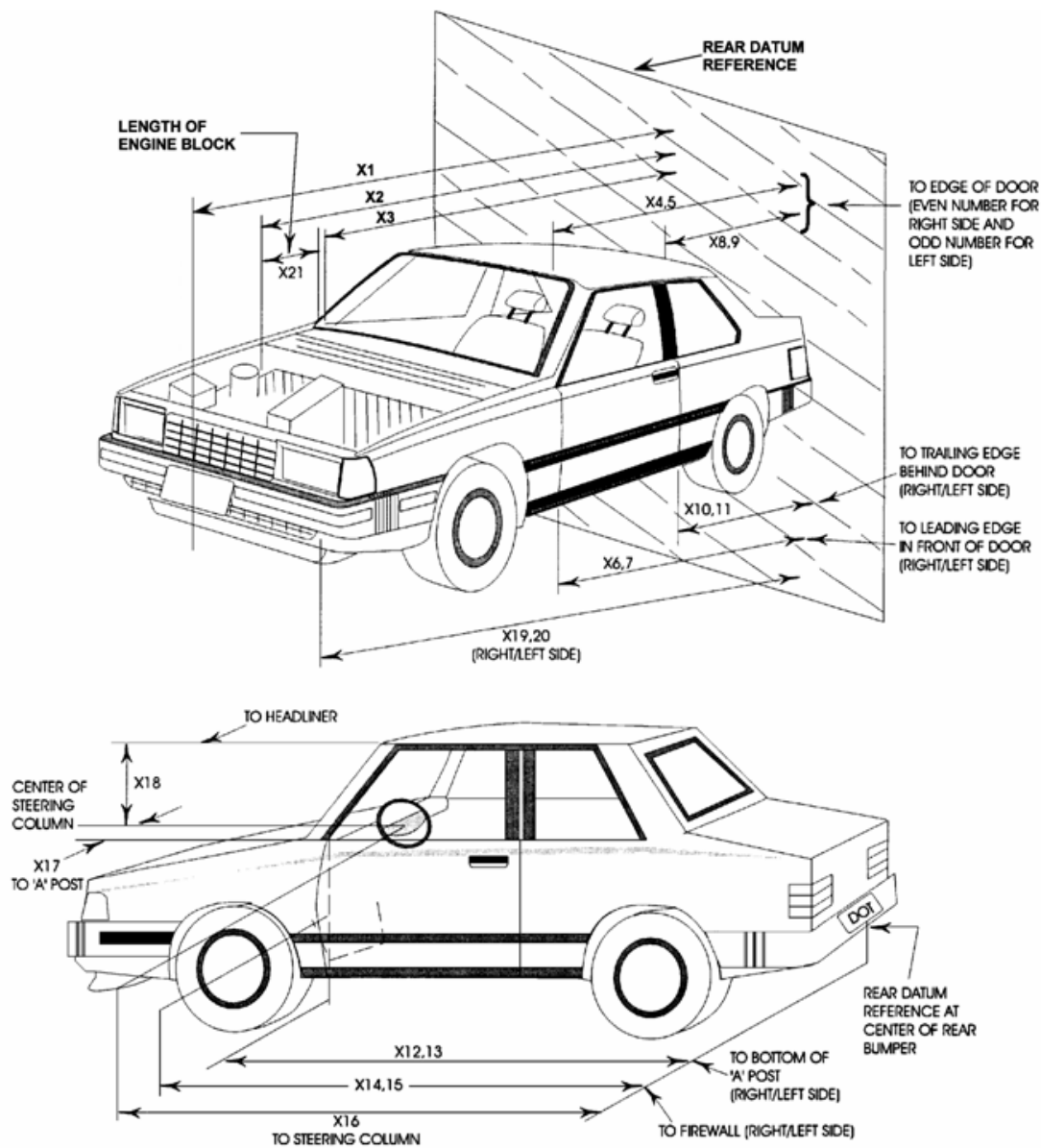
Measured Parameter	Units	Value
Left Side	mm	2565
Center	mm	2515
Right Side	mm	2451
Average	mm	2510

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver		Passenger	
	Installed	Operated	Installed	Operated
Front Airbag	Yes	Yes	Yes	Yes
Side Airbag 1 (Curtain)	Yes	No	Yes	No
Side Airbag 2 (Torso/Pelvis)	Yes	No	Yes	No
Knee Airbag	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes	Yes	Yes	Yes
Other (Seat Pan)	No		Yes	Yes

DATA SHEET NO. 12 **VEHICLE PROFILE MEASUREMENTS**

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19



DATA SHEET NO. 12 ... (CONTINUED)**VEHICLE PROFILE MEASUREMENTS**

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

No.	Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4853	4423	-430
2	Rear Surface of Vehicle to Front of Engine	4310	4100	-210
3	RSOV to Firewall	3681	3639	-42
4	RSOV to Upper Leading Edge of Right Door	3364	3353	-11
5	RSOV to Upper Leading Edge of Left Door	3374	3367	-7
6	RSOV to Lower Leading Edge of Right Door	3332	3323	-9
7	RSOV to Lower Leading Edge of Left Door	3340	3334	-6
8	RSOV to Upper Trailing Edge of Right Door	2228	2221	-7
9	RSOV to Upper Trailing Edge of Left Door	2236	2230	-6
10	RSOV to Lower Trailing Edge of Right Door	2254	2247	-7
11	RSOV to Lower Trailing Edge of Left Door	2264	2259	-5
12	RSOV to Bottom of A-Pillar, Right Side	3326	3318	-8
13	RSOV to Bottom of A-Pillar, Left Side	3336	3330	-6
14	RSOV to Firewall, Right Side	3662	3612	-50
15	RSOV to Firewall, Left Side	3677	3660	-17
16	RSOV to Steering Column	2868	2914	46
17	Center of Steering Column to A-Pillar	468	416	-52
18	Center of Steering Column to Headliner	417	468	51
19	RSOV to Right Side of Front Bumper	4197	4047	-150
20	RSOV to Left Side of Front Bumper	4208	4003	-205
21	Length of Engine Block	535	532	-3
RD	RSOV to Right Side of Dash Panel	3060	3052	-8
CD	RSOV to Center of Dash Panel	2971	2974	3
LD	RSOV to Left Side of Dash Panel	3066	3063	-3

All measurements in millimeters.

DATA SHEET NO. 13**ACCIDENT INVESTIGATION DIVISION DATA**

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

VEHICLE INFORMATION

VIN: 4S4BTACC7L3103751 Wheelbase (mm): 2735
 Vehicle Size Category: MPV Test Weight (kg): 1863.5

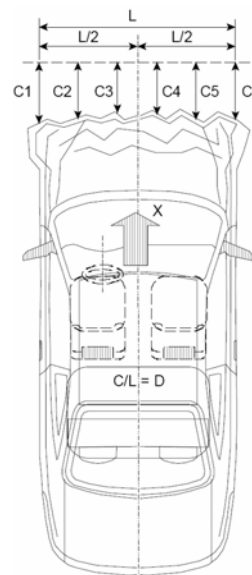
ACCELEROMETER DATA

Accelerometer Locations: Left Rear Crossmember
 Cal. Procedure/Interval: Vibration Test / 6 months
 Integration Algorithm: NHTSA Standard
 Impact Velocity (km/h): 56.43
 Velocity Change (km/h): 65.0
 Time of Separation (msec): 77.6

Linearity: Good

CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
 Midpoint of Damage: Vehicle Centerline
 Damage Region Length (mm): 1641
 Impact Mode: Full Frontal



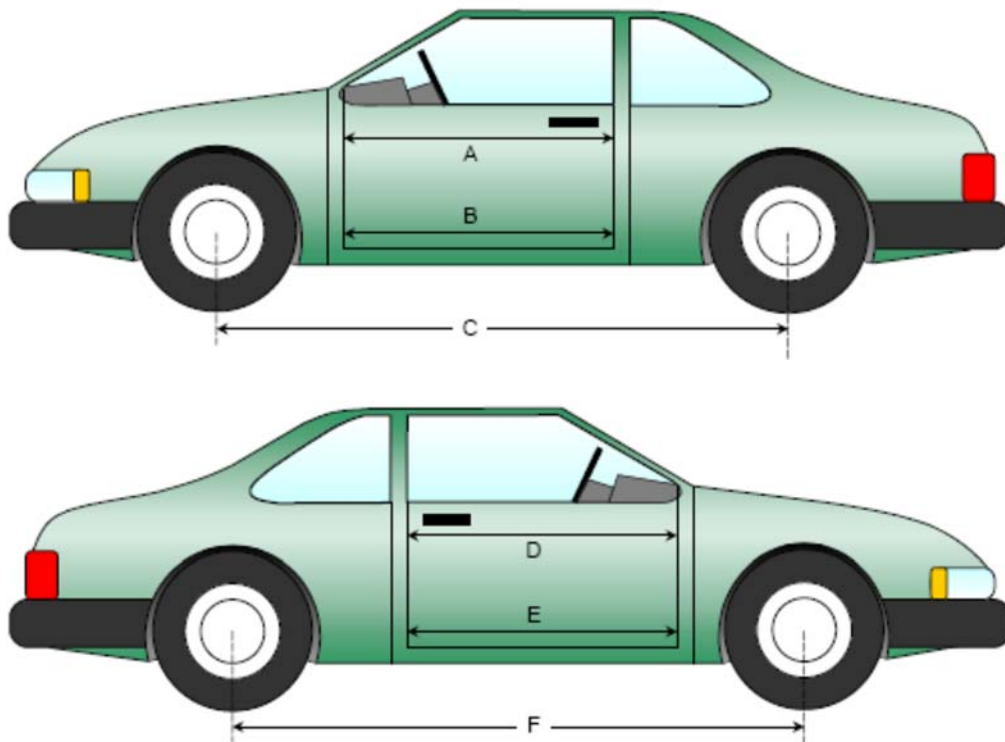
No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	235	535	300
C2	Crush Zone 2 at Left Side	mm	31	535	504
C3	Crush Zone 3 at Left Side	mm	0	542	542
C4	Crush Zone 4 at Right Side	mm	0	502	502
C5	Crush Zone 5 at Right Side	mm	31	450	419
C6	Crush Zone 6 at Right Side	mm	235	497	262
L	C1 to C6	mm	1641		

DATA SHEET NO. 14**VEHICLE INTRUSION MEASUREMENTS**Test Vehicle: 2020 Subaru Outback 5-Door MPVNHTSA No.: O20205502Test Program: 56.3 km/h Frontal Impact NCAP TestTest Date: 12/12/19**DOOR OPENING WIDTH**

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1138	1137	1
B	Left Side Lower	mm	1076	1075	1
D	Right Side Upper	mm	1136	1133	3
E	Right Side Lower	mm	1078	1076	2

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2735	2720	15
F	Right Side Wheelbase	mm	2730	2739	-9



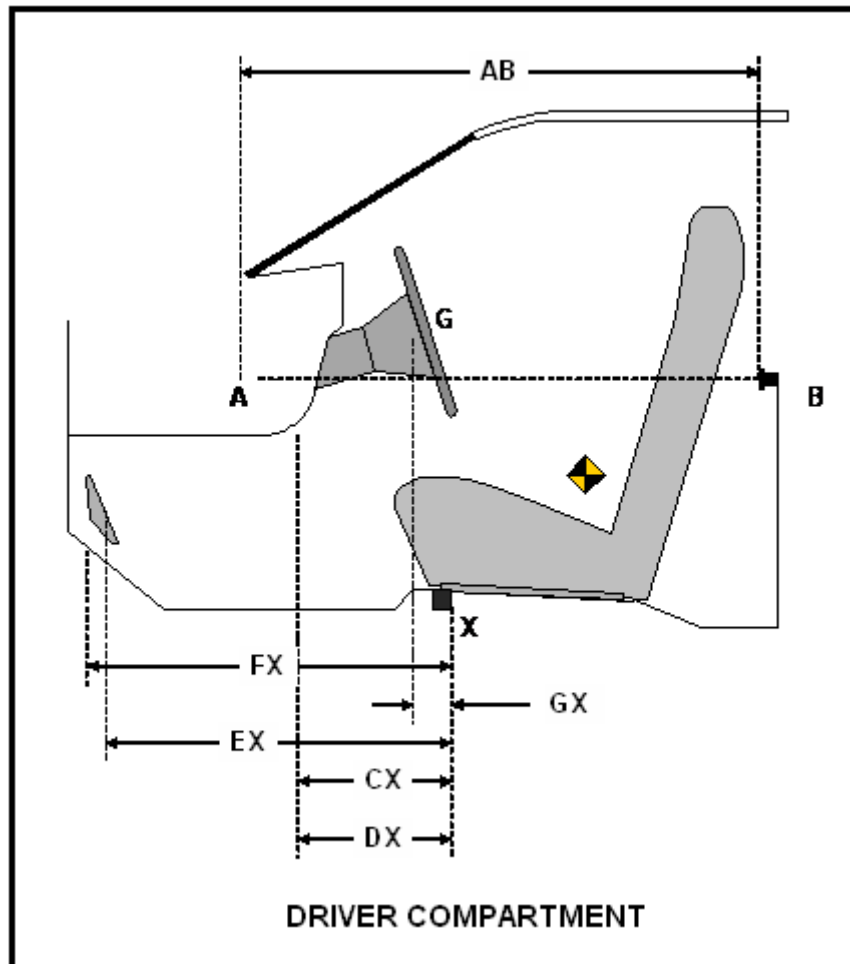
DATA SHEET NO. 14 ... (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	1041	1036	-5
CX	Left Knee Bolster to X	mm	233	258	25
DX	Right Knee Bolster to X	mm	225	255	30
EX	Brake Pedal to X	mm	507	546	39
FX	Foot Rest to X	mm	504	511	7
GX	Center of Steering Wheel Hub to X	mm	-27	49	76

X = Front of Seat Track (Stationary)



DATA SHEET NO. 15**SUMMARY OF INDICANT FMVSS 212 AND 219 (PARTIAL) DATA**

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

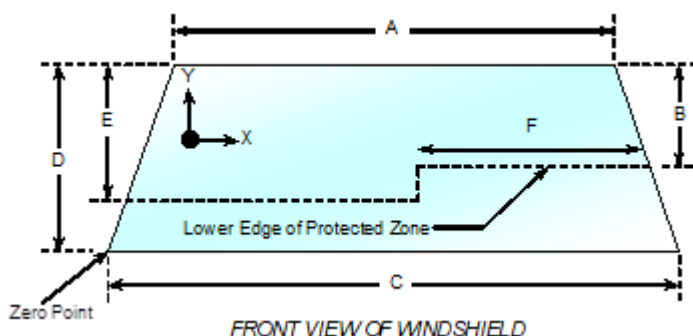
Windshield Mounting Details: Windshield glass is secured to the vehicle frame with rubber molding and rubber cement.

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

Temperature of windshield molding during test: 21.4° C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2269	2269	100.0%
Right Side	2269	2269	100.0%
Total	4538	4538	100.0%



Item	Units	Value
A	mm	1193
B	mm	420
C	mm	1475
D	mm	935
E	mm	560
F	mm	570

AREAS OF PROTECTED ZONE FAILURES

- A. Provide Coordinates of the area that the protected zone was penetrated more than 0.25 inches by a vehicle component other than one that is normally in contact with the windshield.

X	Y

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

X	Y

DATA SHEET NO. 16

FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER RESULTS

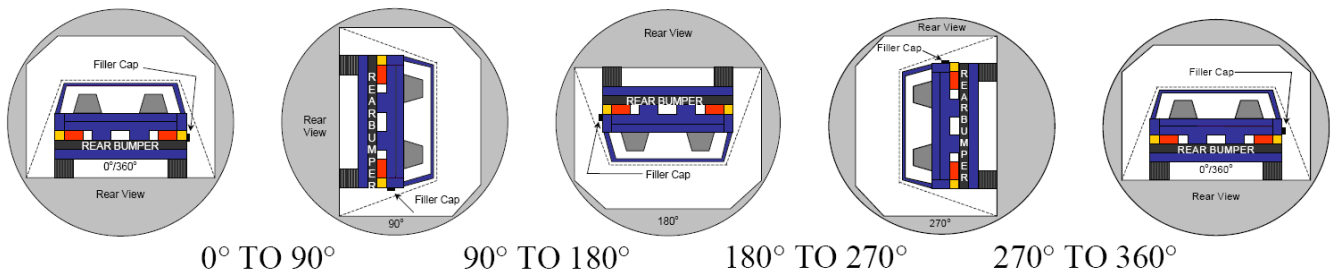
Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 19.4° C Test Time: 2:44 PM

Stoddard Solvent Spillage Measurements

- A. From impact until vehicle motion ceases: 0 oz.
(Maximum allowable = 1 oz.)
- B. For the 5 minute period after motion ceases: 0 oz.
(Maximum allowable = 5 oz.)
- C. For the following 25 minutes: 0 oz.
(Maximum allowable = 1 oz./minute)
- D. Spillage: There was no Stoddard solvent spillage.



1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.
2. The position hold time at each position is 300 seconds (minimum).
3. Details of Stoddard solvent spillage: There was no Stoddard solvent spillage.

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	85	300	385
90° To 180°	79	300	379
180° To 270°	81	300	381
270° To 360°	80	300	380

DATA SHEET NO. 16 ... (CONTINUED)**FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER RESULTS**Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19**FMVSS 301 SPILLAGE TABLE**

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

SOLVENT SPILLAGE LOCATION TABLE

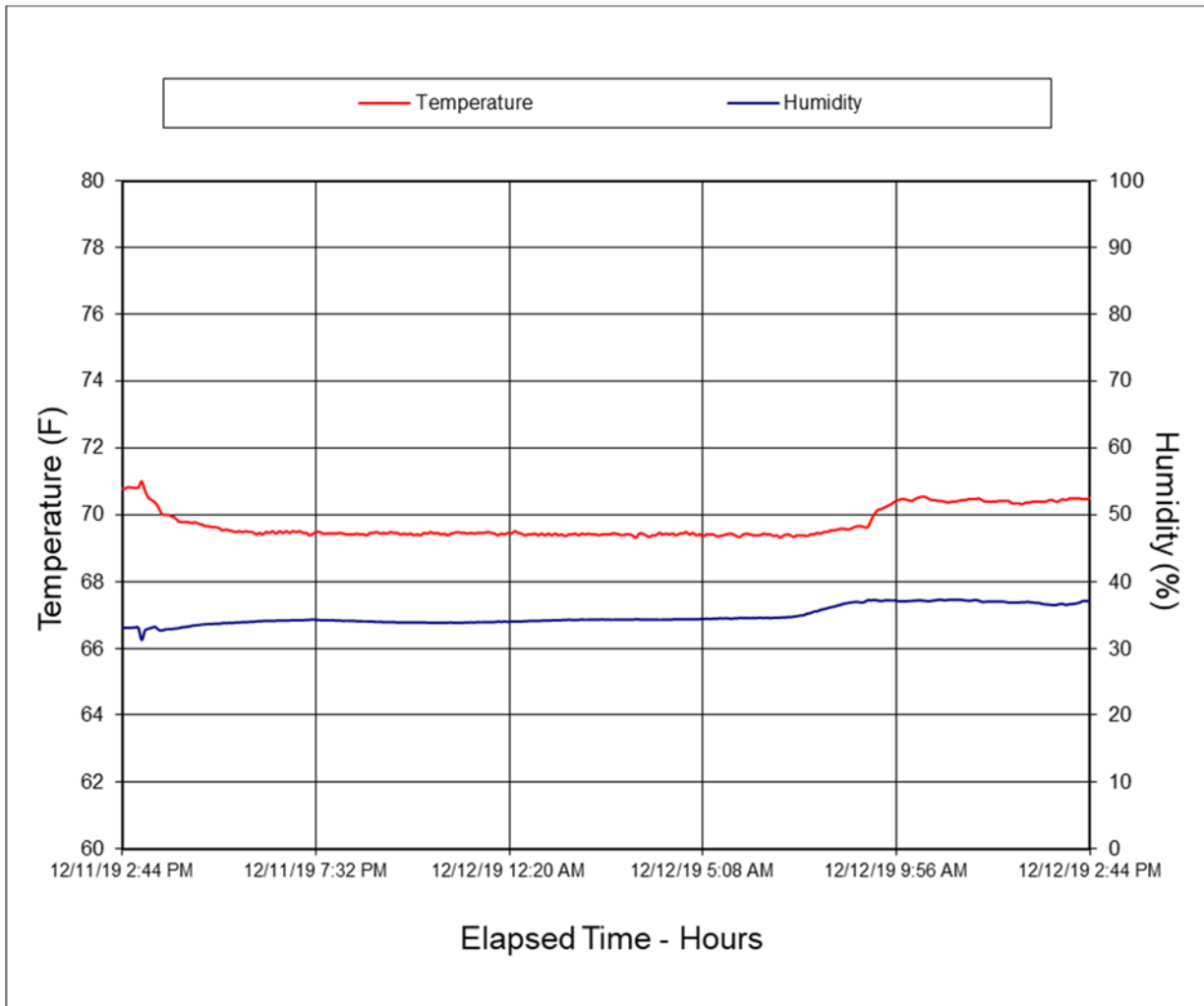
Test Phase	Spillage Location
0° To 90°	
90° To 180°	
180° To 270°	
270° To 360°	

DATA SHEET NO. 17

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2020 Subaru Outback 5-Door MPV NHTSA No.: O20205502

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 12/12/19



APPENDIX A
PHOTOGRAPHIC DOCUMENTATION

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FIGURE 1. Load Cell Location



FIGURE 2. Pre-Test Load Cell Wall



FIGURE 3. Post-Test Load Cell Wall

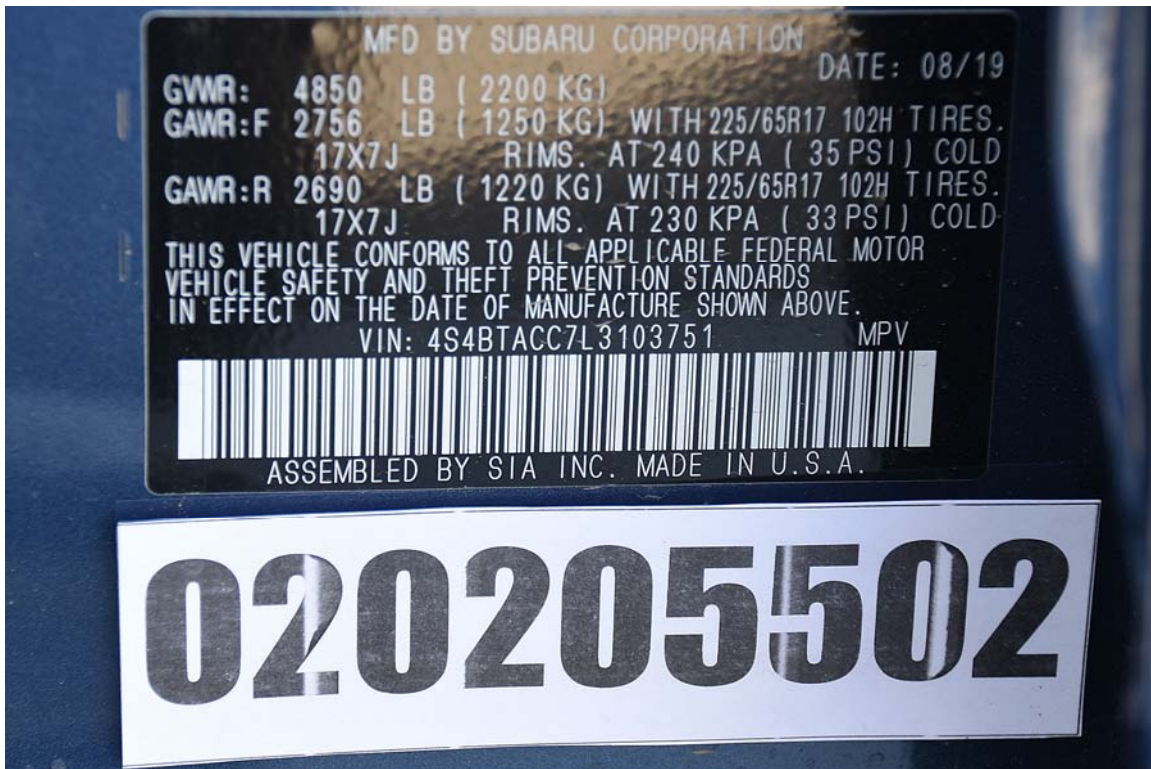


FIGURE 4. Manufacturer's Label

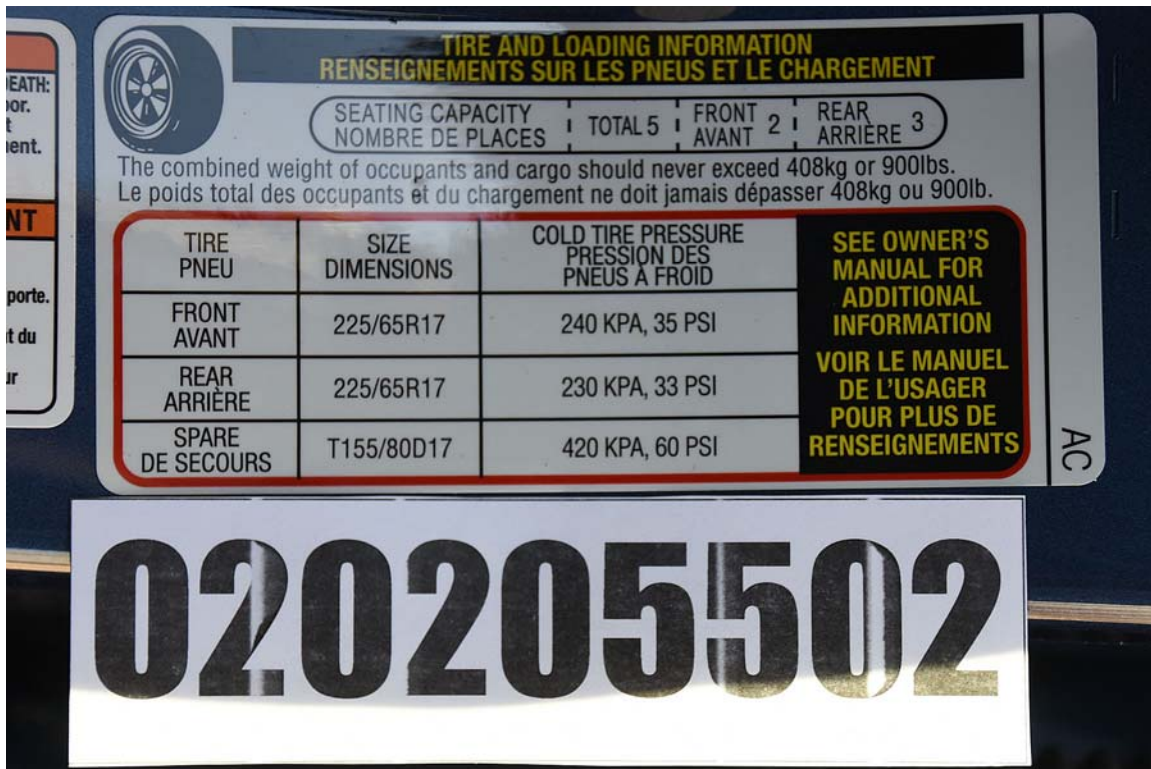


FIGURE 5. Tire Placard



FIGURE 6. 2020 Subaru Outback Frontal as Delivered



FIGURE 7. Left Rear $\frac{3}{4}$ View, as Received



FIGURE 8. Pre-Test Front View of Test Vehicle



FIGURE 9. Post-Test Front View of Test Vehicle



FIGURE 10. Pre-Test Left View of Test Vehicle



FIGURE 11. Post-Test Left View of Test Vehicle

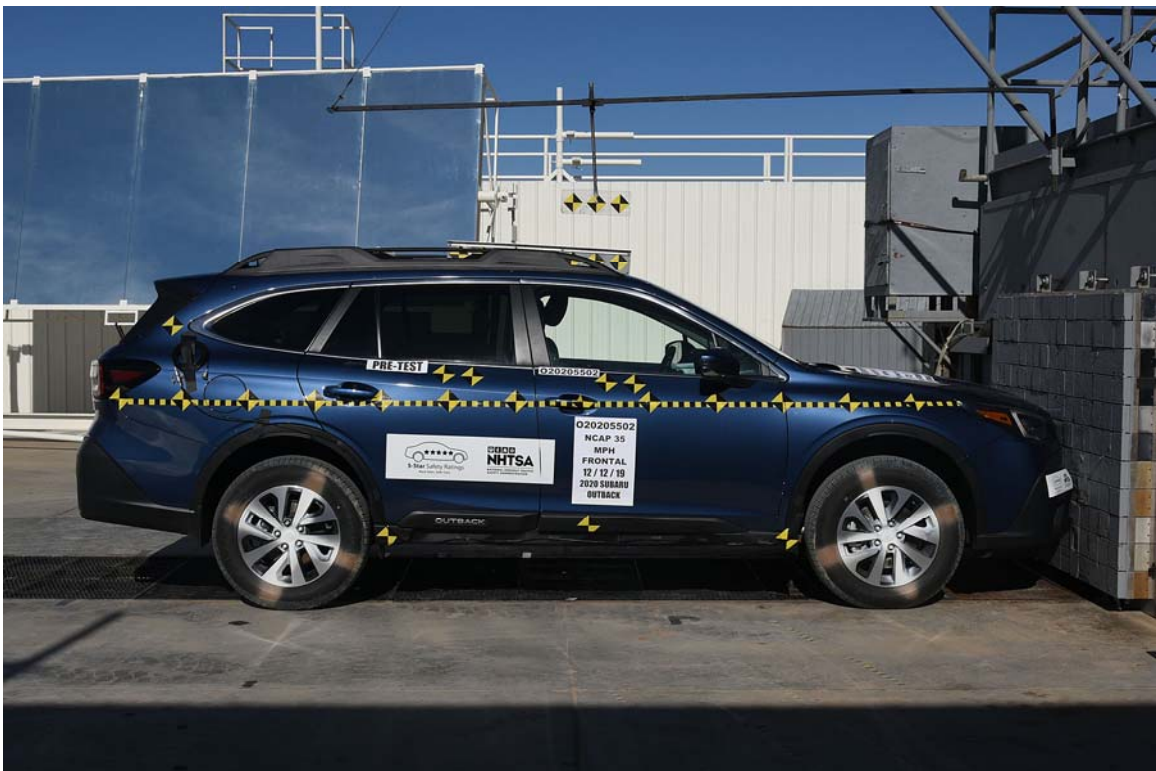


FIGURE 12. Pre-Test Right View of Test Vehicle



FIGURE 13. Post-Test Right View of Test Vehicle



FIGURE 14. Pre-Test Right Front ¾ View



FIGURE 15. Post-Test Right Front $\frac{3}{4}$ View



FIGURE 16. Pre-Test Left Rear $\frac{3}{4}$ View



FIGURE 17. Post-Test Left Rear $\frac{3}{4}$ View

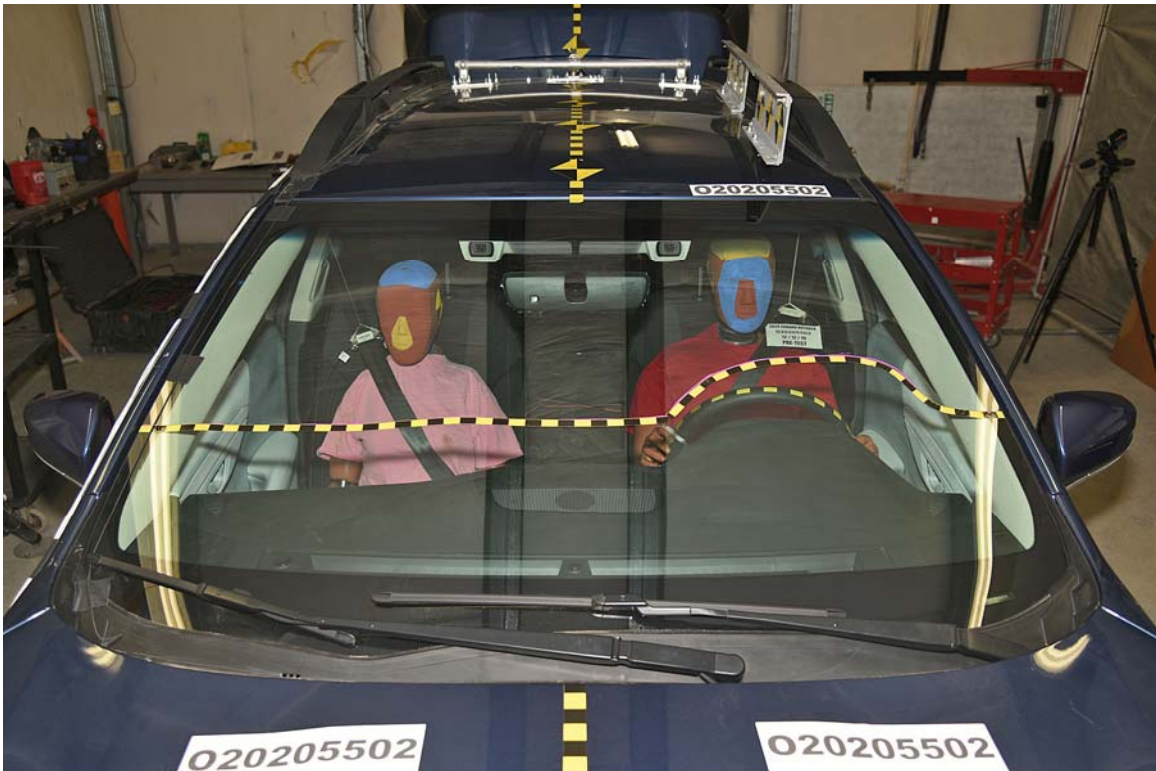


FIGURE 18. Pre-Test Windshield View



FIGURE 19. Post-Test Windshield View

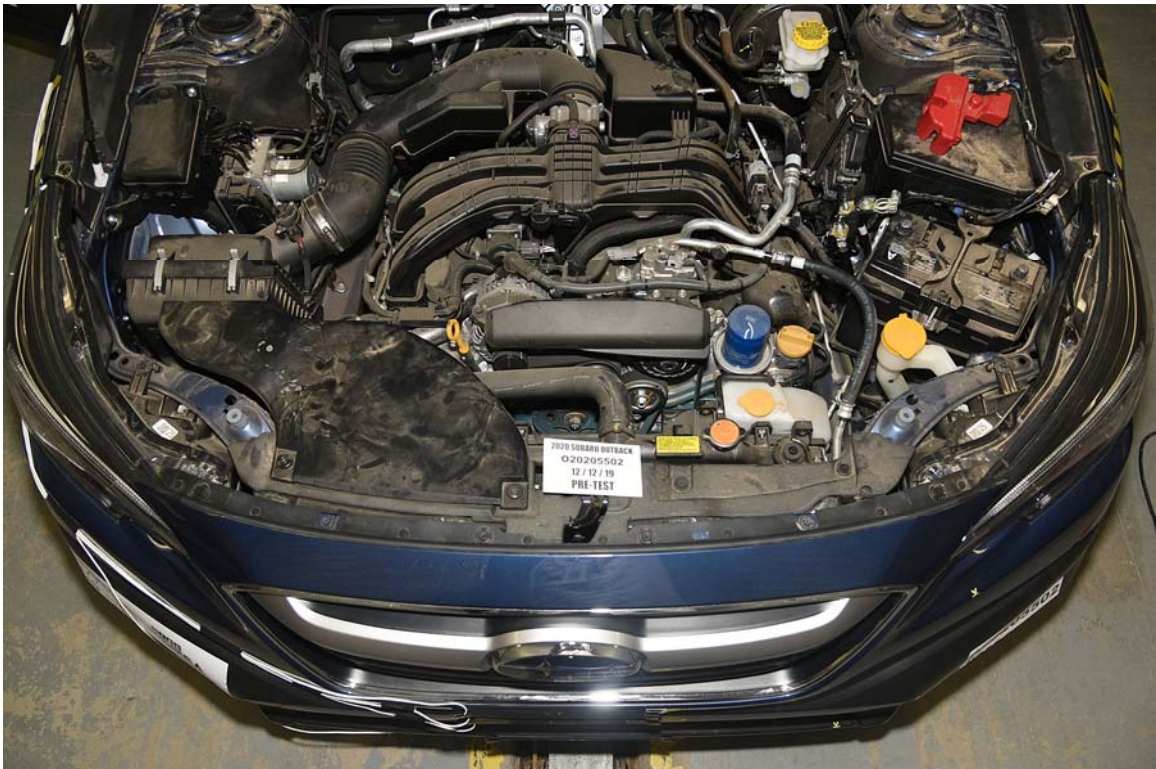


FIGURE 20. Pre-Test Engine Compartment View



FIGURE 21. Post-Test Engine Compartment View



FIGURE 22. Pre-Test Fuel Filler Cap View



FIGURE 23. Post-Test Fuel Filler Cap View

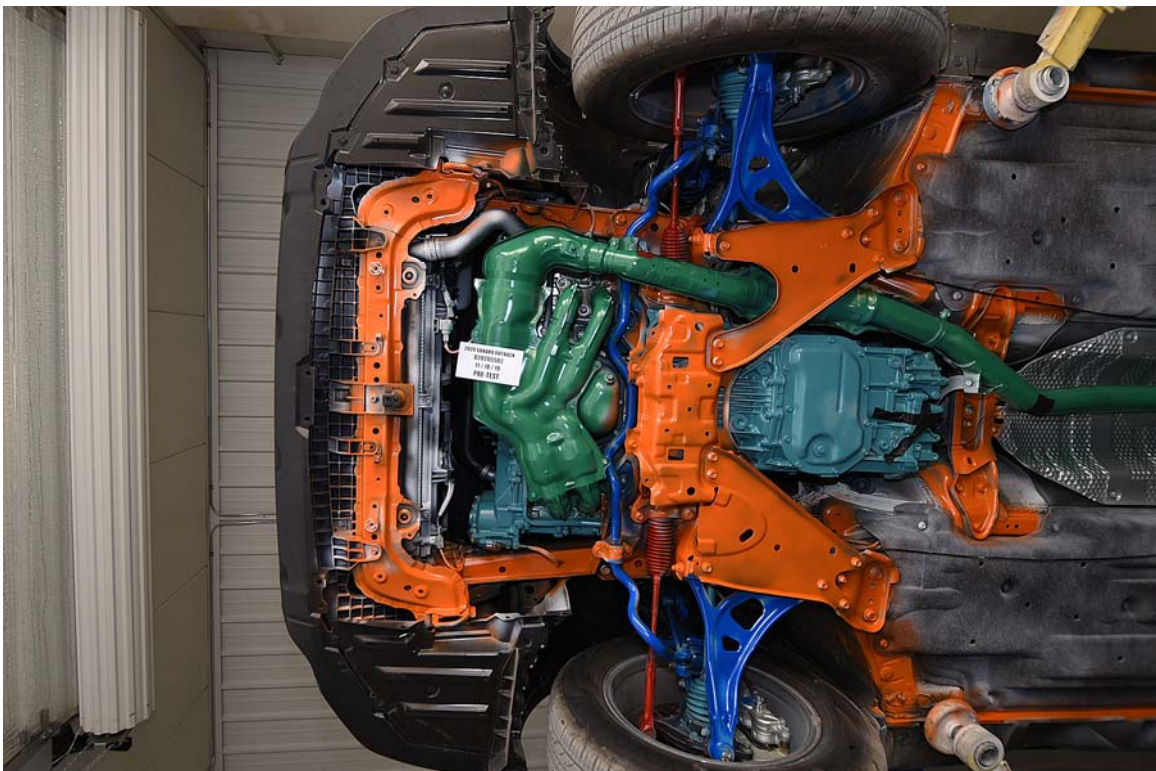


FIGURE 24. Pre-Test Front Underbody View



FIGURE 25. Post-Test Front Underbody View

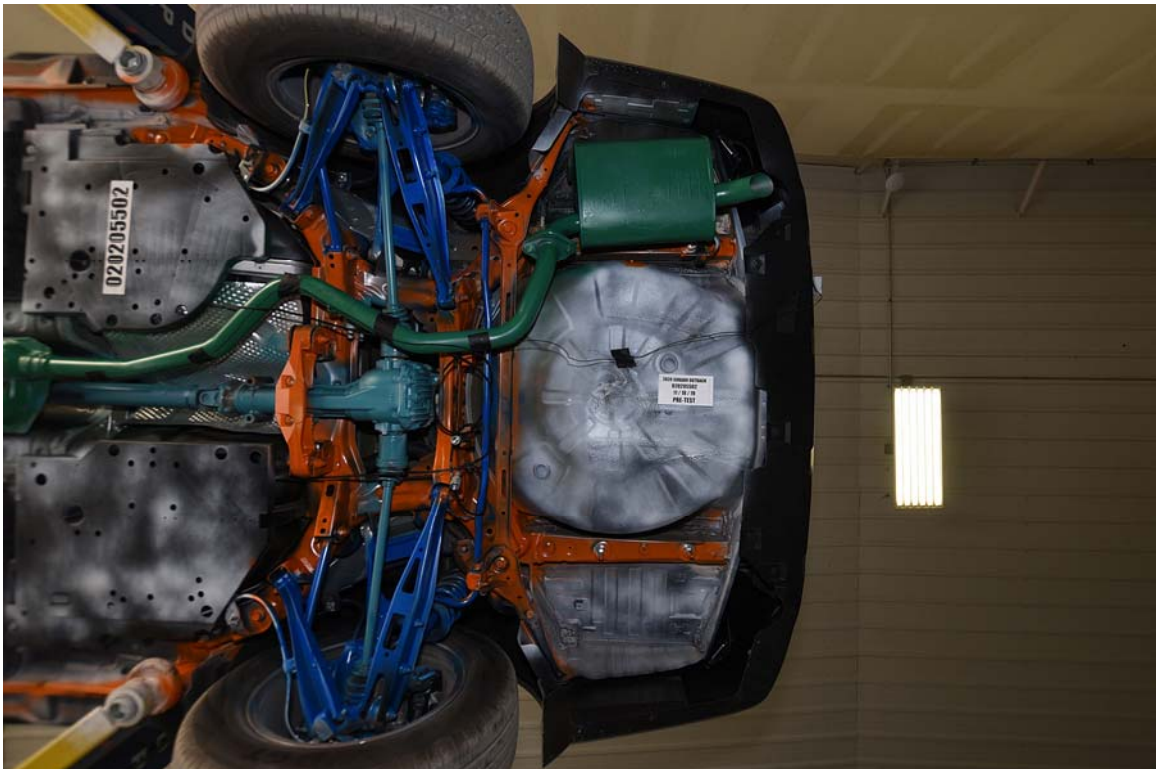


FIGURE 26. Pre-Test Rear Underbody View

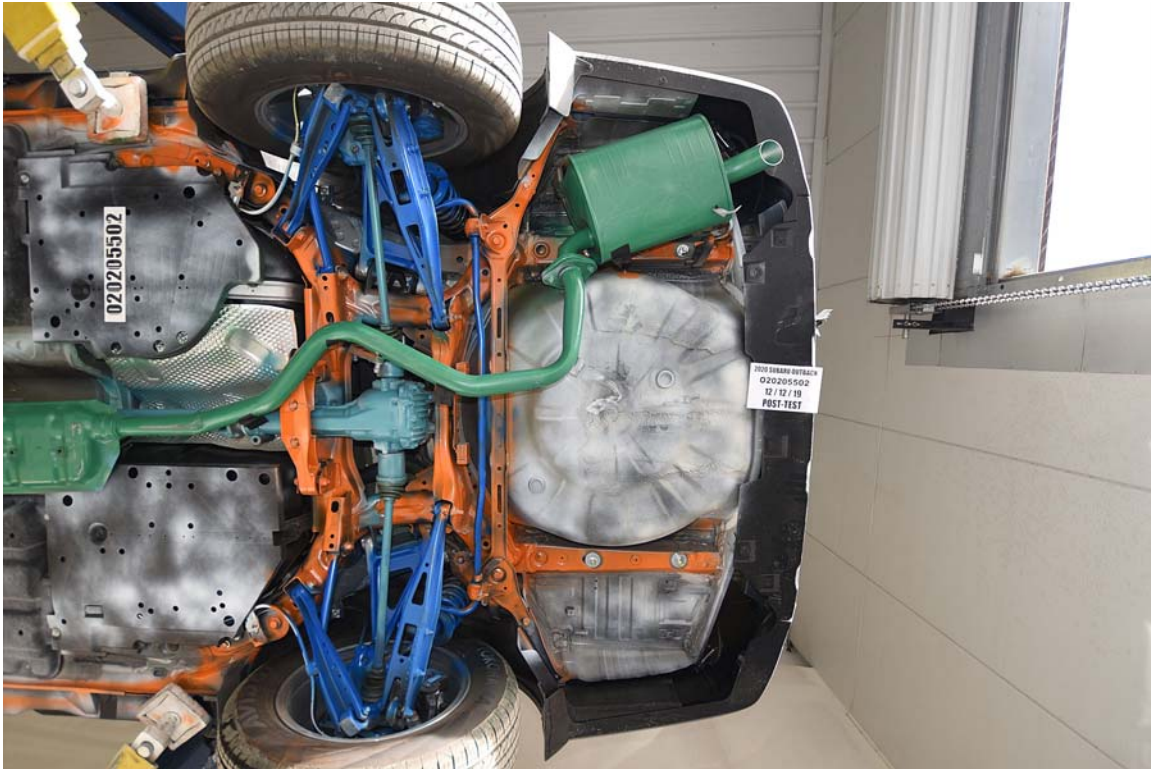


FIGURE 27. Post-Test Rear Underbody View



FIGURE 28. Pre-Test Dummy Cable Routing



FIGURE 29. Post-Test Dummy Cable Routing



FIGURE 30. Pre-Test Driver Dummy Front View



FIGURE 31. Post-Test Driver Dummy Front View



FIGURE 32. Pre-Test Driver Dummy Window View



FIGURE 33. Post-Test Driver Dummy Window View



FIGURE 34. Pre-Test Driver Dummy and Vehicle Interior View



FIGURE 35. Post-Test Driver Dummy and Vehicle Interior View



FIGURE 36. Pre-Test Driver's Seat Fore-Aft Markings



FIGURE 37. Post-Test Driver's Seat Fore-Aft Markings



FIGURE 38. Pre-Test View of Belt Anchorage for Driver Dummy



FIGURE 39. Post-Test View of Belt Anchorage for Driver Dummy



FIGURE 40. Pre-Test View of Belt Buckle and Latch Plate for Driver Dummy



FIGURE 41. Post-Test View of Belt Buckle and Latch Plate for Driver Dummy



FIGURE 42. Pre-Test Driver Dummy Feet



FIGURE 43. Post-Test Driver Dummy Feet



FIGURE 44. Pre-Test Driver's Side Knee Bolster



FIGURE 45. Post-Test Driver's Side Knee Bolster



FIGURE 46. Pre-Test Driver's Side Floorpan



FIGURE 47. Post-Test Driver's Side Floorpan



FIGURE 48. Post-Test Driver Dummy Face



FIGURE 49. Post-Test Driver Dummy Contact with Airbag



FIGURE 50. Post-Test Driver Dummy Contact with Headrest



FIGURE 50a. Post-Test Driver Dummy Contact with Knee Airbag



FIGURE 51. Pre-Test View of the Steering Wheel



FIGURE 52. Post-Test View of the Steering Wheel



FIGURE 53. Pre-Test Passenger Dummy Front View



FIGURE 54. Post-Test Passenger Dummy Front View



FIGURE 55. Pre-Test Passenger Dummy Window View



FIGURE 56. Post-Test Passenger Dummy Window View



FIGURE 57. Pre-Test Passenger Dummy and Vehicle Interior View



FIGURE 58. Post-Test Passenger Dummy and Vehicle Interior View

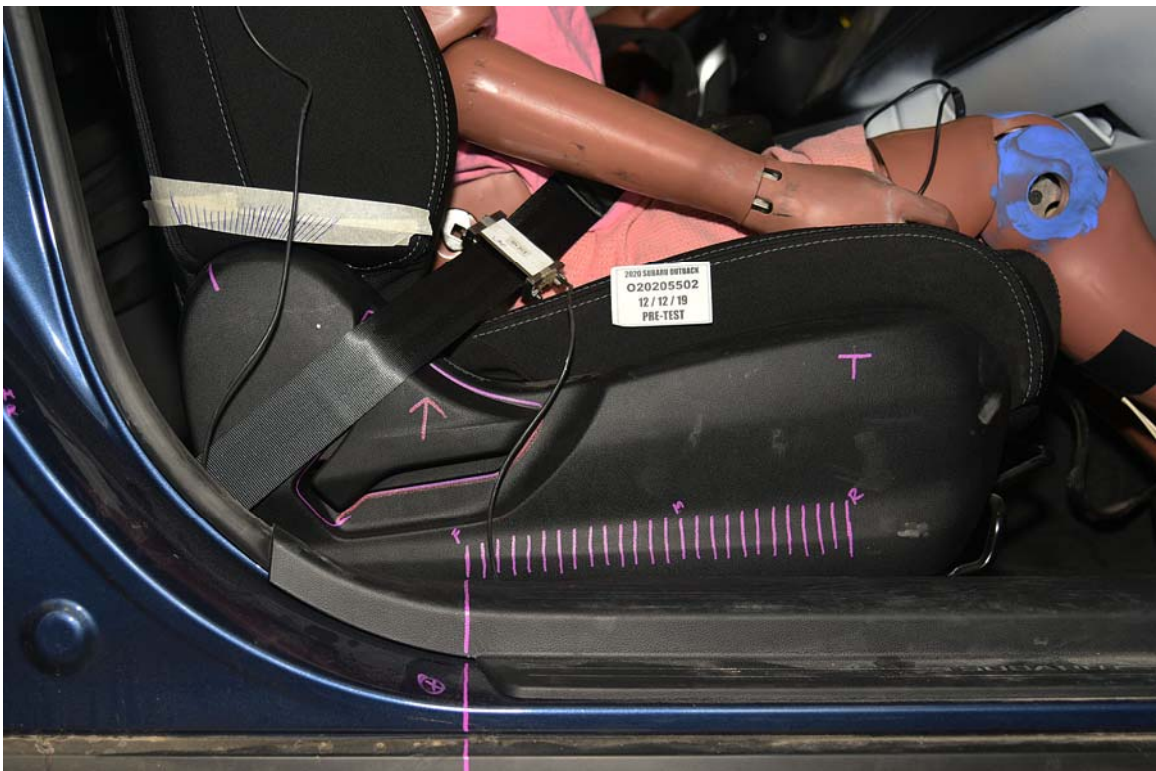


FIGURE 59. Pre-Test Passenger's Seat Fore-Aft Markings

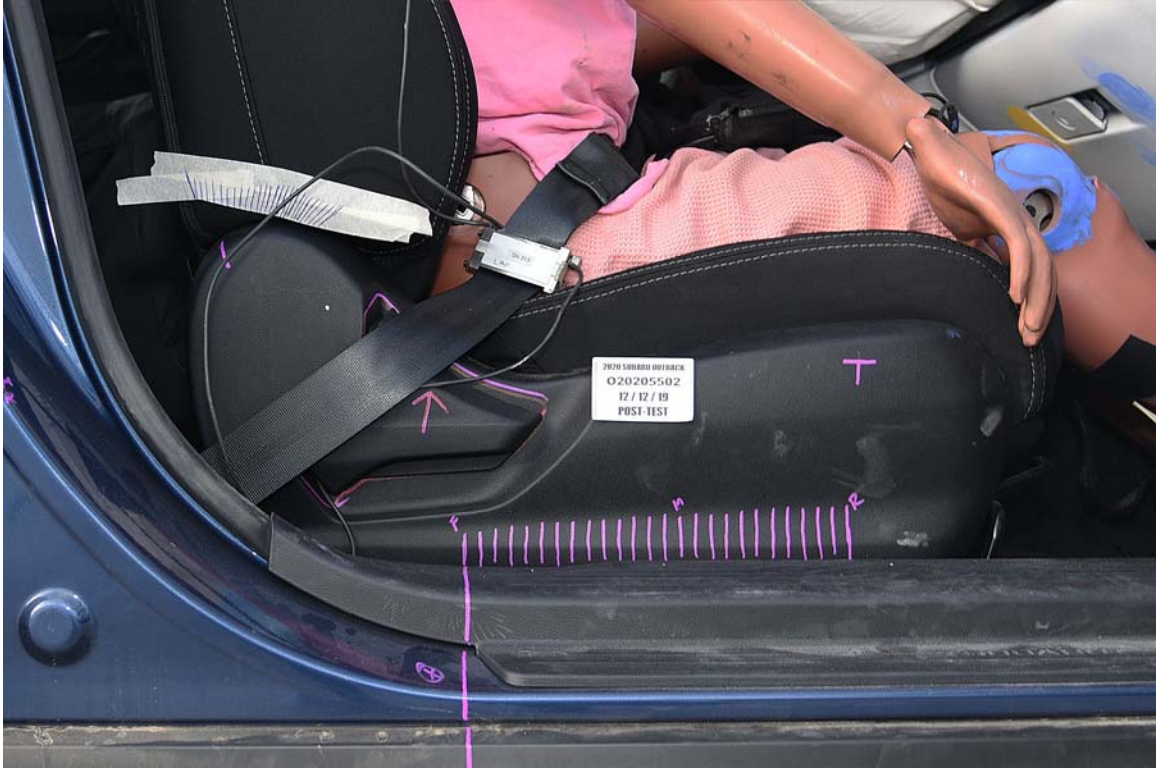


FIGURE 60. Post-Test Passenger's Seat Fore-Aft Markings



FIGURE 61. Pre-Test View of Belt Anchorage for Passenger Dummy



FIGURE 62. Post-Test View of Belt Anchorage for Passenger Dummy



FIGURE 63. Pre-Test View of Belt Buckle and Latch Plate for Passenger Dummy



FIGURE 64. Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy



FIGURE 65. Pre-Test Passenger Dummy Feet



FIGURE 66. Post-Test Passenger Dummy Feet



FIGURE 67. Pre-Test Passenger's Side Knee Bolster



FIGURE 68. Post-Test Passenger's Side Knee Bolster



FIGURE 69. Pre-Test Passenger's Side Floorpan



FIGURE 70. Post-Test Passenger's Side Floorpan



FIGURE 71. Post-Test Passenger Dummy Face



FIGURE 72. Post-Test Passenger Dummy Contact with Airbag



FIGURE 73. Post-Test Passenger Dummy Contact with Headrest



FIGURE 73a. Post-Test Passenger Dummy Contact with Knee Bolster



FIGURE 74. Photograph of Ballast Installed in Vehicle

Photograph Not Applicable

No Stoddard Solvent Spillage

FIGURE 75. Post-Test Stoddard Solvent Spillage Location View



FIGURE 76. Post-Test Speed Trap Read-Out

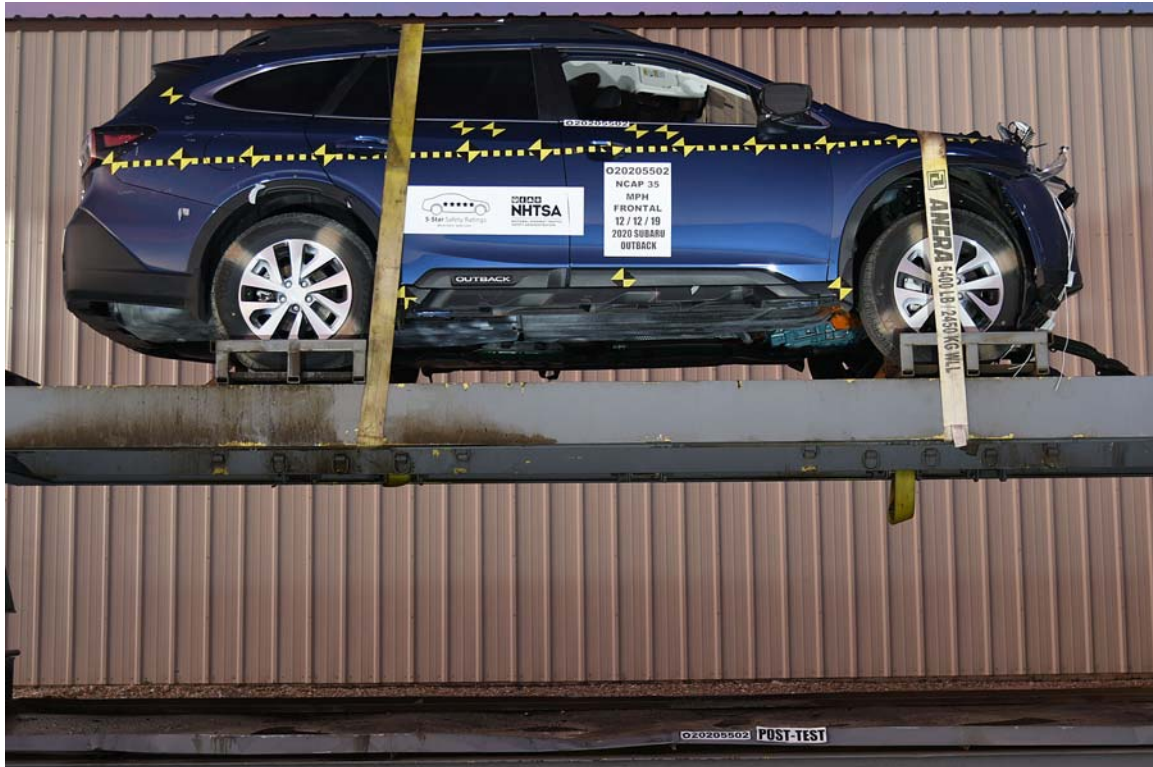


FIGURE 77. Vehicle at 0° on Static Rollover Device



FIGURE 78. Vehicle at 90° on Static Rollover Device



FIGURE 79. Vehicle at 180° on Static Rollover Device

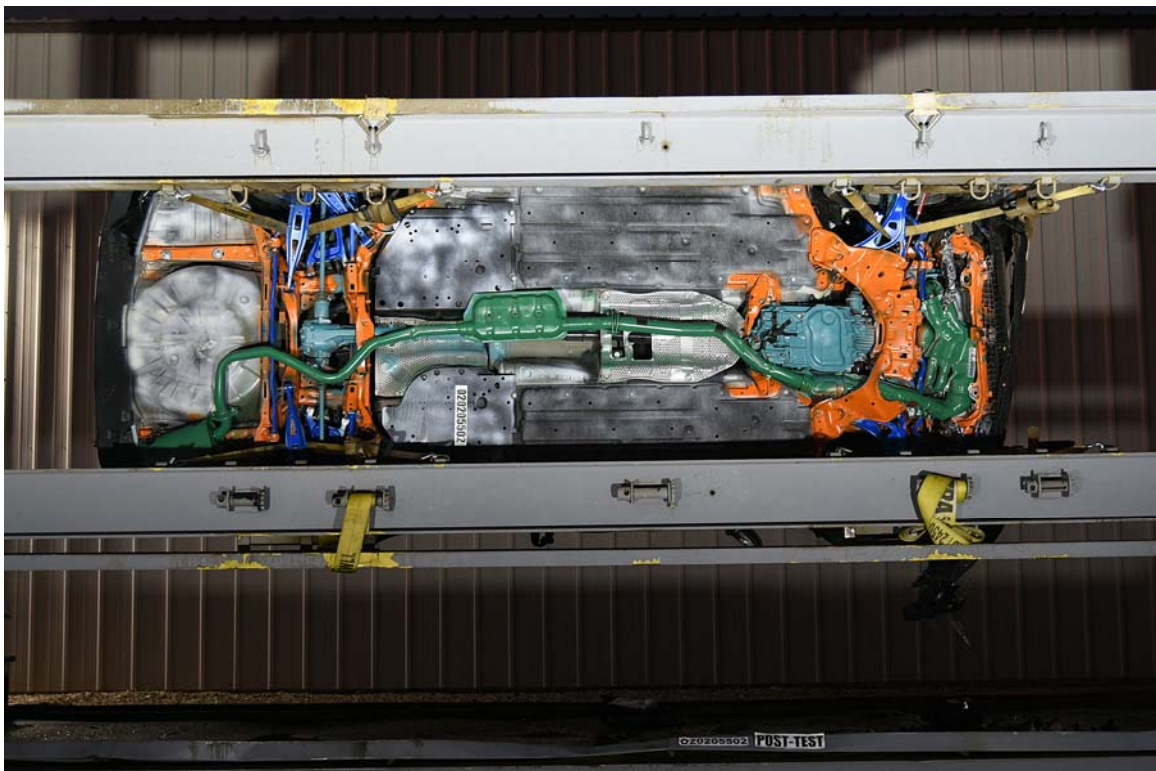


FIGURE 80. Vehicle at 270° on Static Rollover Device

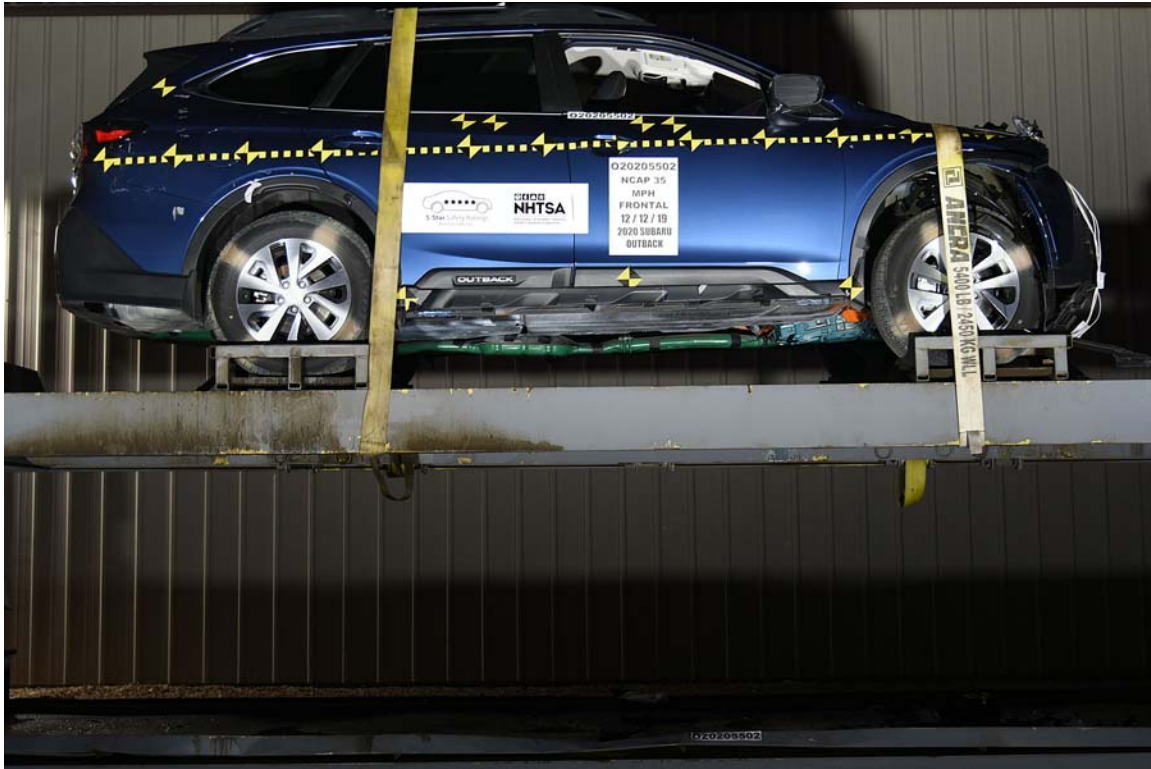


FIGURE 81. Vehicle at 360° on Static Rollover Device

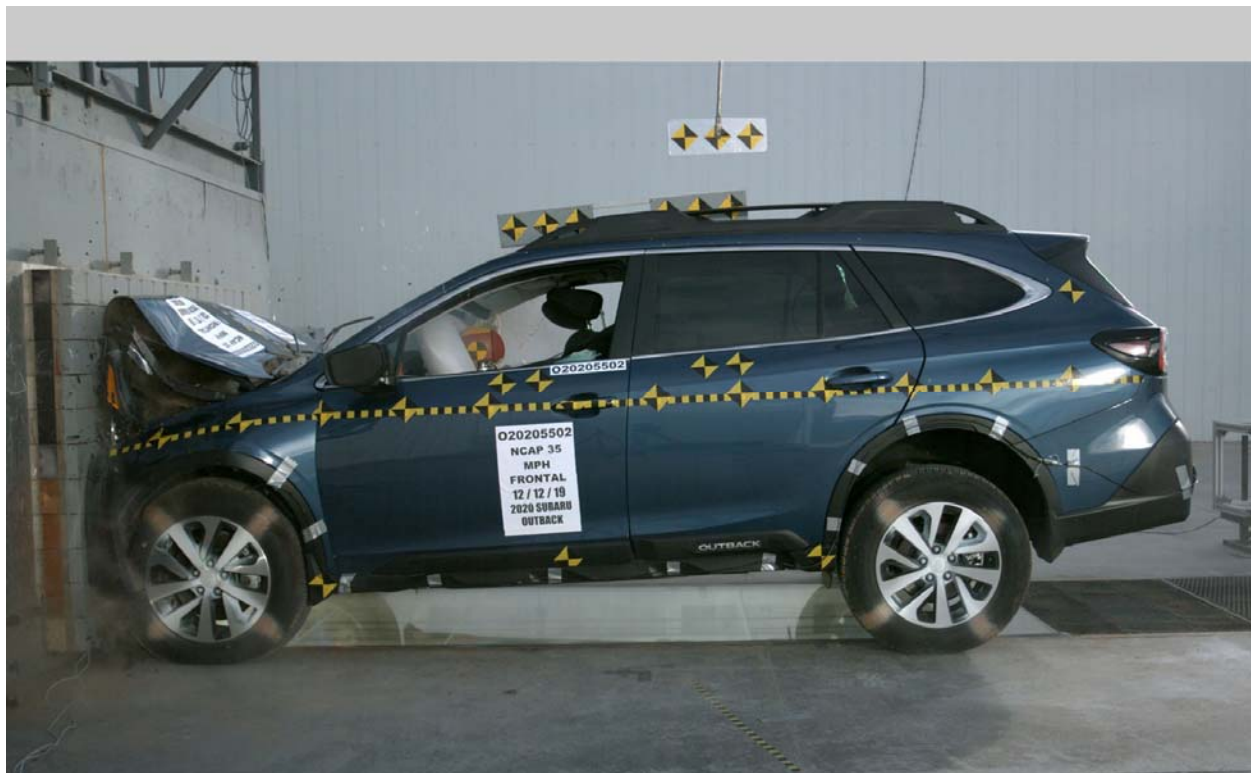


FIGURE 82. 2020 Subaru Outback Frontal Impact Event

APPENDIX B
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

Plot		Page
1	Driver Head Acceleration X Primary	B-1
2	Driver Head Acceleration Y Primary	B-1
3	Driver Head Acceleration Z Primary	B-1
4	Driver Head Resultant Acceleration Primary	B-1
5	Driver Chest X Deflection	B-2
6	Driver Upper Neck Force X	B-3
7	Driver Upper Neck Force Z	B-3
8	Driver Upper Neck Moment Y	B-3
9	Driver Nij	B-3
10	Driver Chest Acceleration X Primary	B-4
11	Driver Chest Acceleration Y Primary	B-4
12	Driver Chest Acceleration Z Primary	B-4
13	Driver Chest Resultant Acceleration Primary	B-4
14	Driver Left Femur Force Z	B-5
15	Driver Right Femur Force Z	B-5
16	Passenger Head Acceleration X Primary	B-6
17	Passenger Head Acceleration Y Primary	B-6
18	Passenger Head Acceleration Z Primary	B-6
19	Passenger Head Resultant Acceleration Primary	B-6
20	Passenger Chest X Deflection	B-7
21	Passenger Upper Neck Force X	B-8
22	Passenger Upper Neck Force Z	B-8
23	Passenger Upper Neck Moment Y	B-8
24	Passenger Nij	B-8
25	Passenger Chest Acceleration X Primary	B-9
26	Passenger Chest Acceleration Y Primary	B-9
27	Passenger Chest Acceleration Z Primary	B-9
28	Passenger Chest Resultant Acceleration Primary	B-9
29	Passenger Left Femur Force Z	B-10
30	Passenger Right Femur Force Z	B-10

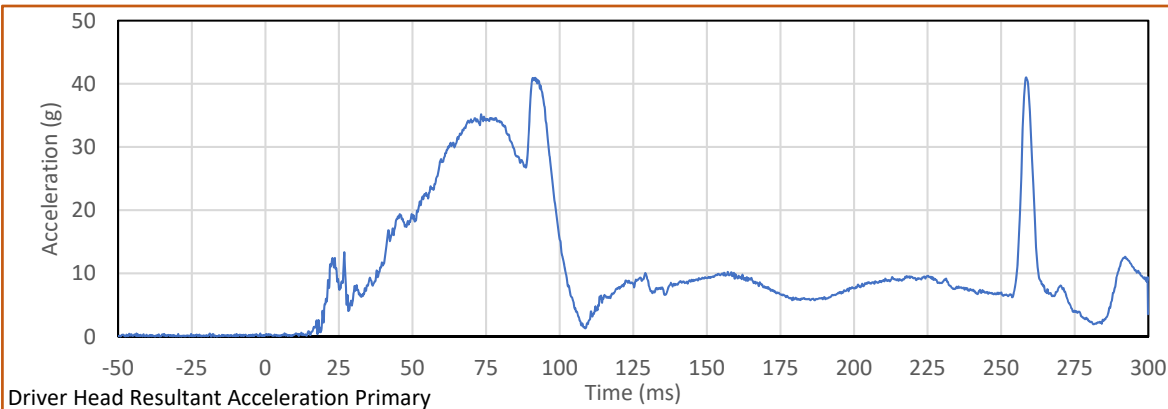
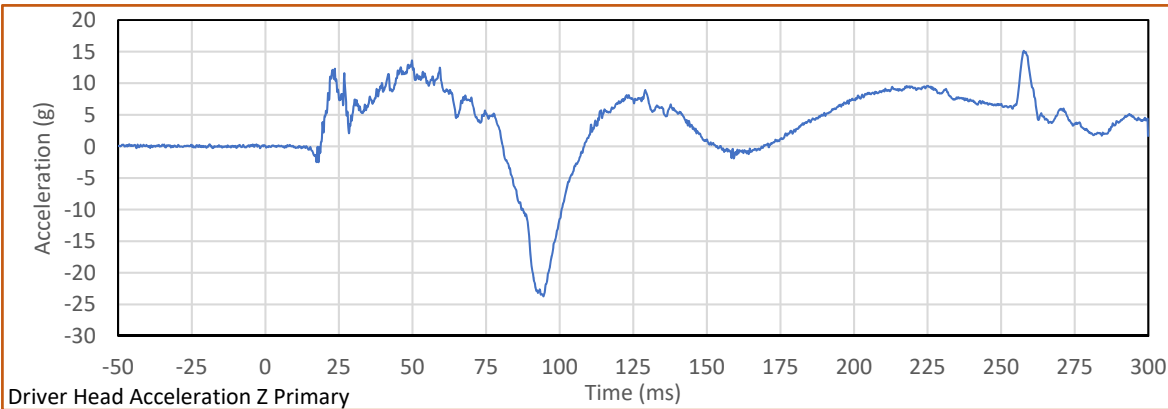
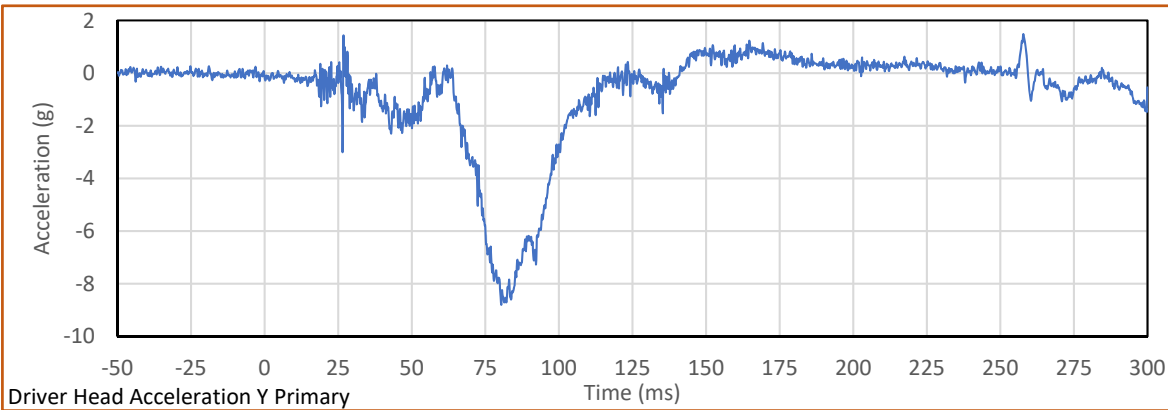
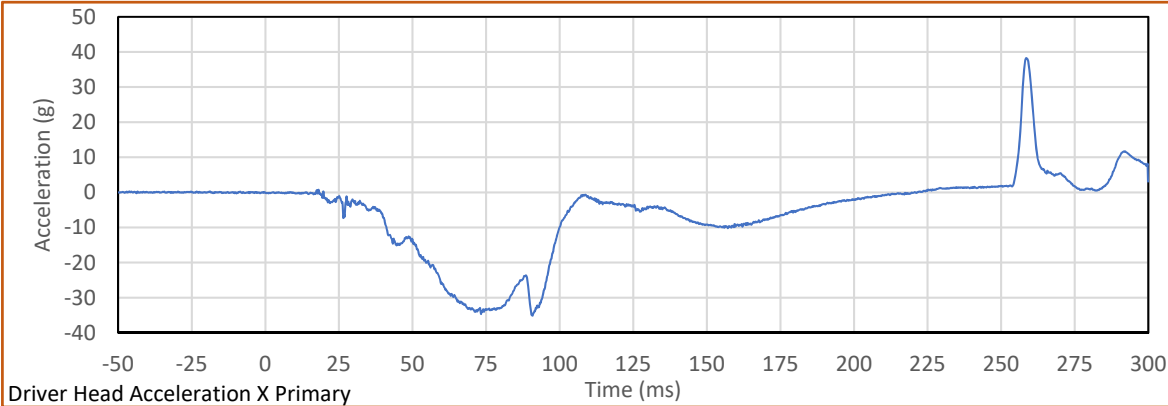
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.nhtsa.gov

Driver Head X Acceleration Redundant
Driver Head Y Acceleration Redundant
Driver Head Z Acceleration Redundant
Driver Upper Neck Force Y
Driver Upper Neck Moment X
Driver Upper Neck Moment Z
Driver Chest X Acceleration Redundant
Driver Chest Y Acceleration Redundant
Driver Chest Z Acceleration Redundant
Driver Pelvis X
Driver Pelvis Y
Driver Pelvis Z
Driver Left Femur Force Z Redundant
Driver Right Femur Force Z Redundant
Driver Left Upper Tibia Moment X
Driver Left Upper Tibia Moment Y
Driver Left Upper Tibia Force Z
Driver Left Lower Tibia Moment X
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver Left Foot Fore Z
Driver Left Foot Aft X
Driver Left Foot Aft Z
Driver Right Foot Fore Z
Driver Right Foot Aft X
Driver Right Foot Aft Z
Driver Shoulder Belt Force
Driver Lap Belt Force
Driver Head Angular Velocity X
Driver Head Angular Velocity Y
Driver Head Angular Velocity Z
Passenger Head X Acceleration Redundant
Passenger Head Y Acceleration Redundant
Passenger Head Z Acceleration Redundant
Passenger Upper Neck Force X
Passenger Upper Neck Force Z
Passenger Upper Neck Moment Y

Passenger Chest X Acceleration Redundant
Passenger Chest Y Acceleration Redundant
Passenger Chest Z Acceleration Redundant
Passenger Pelvis X
Passenger Pelvis Y
Passenger Pelvis Z
Passenger Left Femur Force Redundant
Passenger Right Femur Force Redundant
Passenger Left Upper Tibia Moment X
Passenger Left Upper Tibia Moment Y
Passenger Left Upper Tibia Force Z
Passenger Left Lower Tibia Moment X
Passenger Left Lower Tibia Moment Y
Passenger Left Lower Tibia Force Z
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right Upper Tibia Force Z
Passenger Right Lower Tibia Moment X
Passenger Right Lower Tibia Moment Y
Passenger Right Lower Tibia Force Z
Passenger Left Foot Fore Z
Passenger Left Foot Aft X
Passenger Left Foot Aft Z
Passenger Right Foot Fore Z
Passenger Right Foot Aft X
Passenger Right Foot Aft Z
Passenger Shoulder Belt Force
Passenger Lap Belt Force
Passenger Head Angular Velocity X
Passenger Head Angular Velocity Y
Passenger Head Angular Velocity Z
Left Rear Seat Crossmember X
Left Rear Seat Crossmember Z
Right Rear Seat Crossmember X
Right Rear Seat Crossmember Z
Left Rear Seat Crossmember X Redundant
Right Rear Seat Crossmember X Redundant
Vehicle Engine Top X
Vehicle Engine Bottom X
Load Cell Barrier Forces and Moments

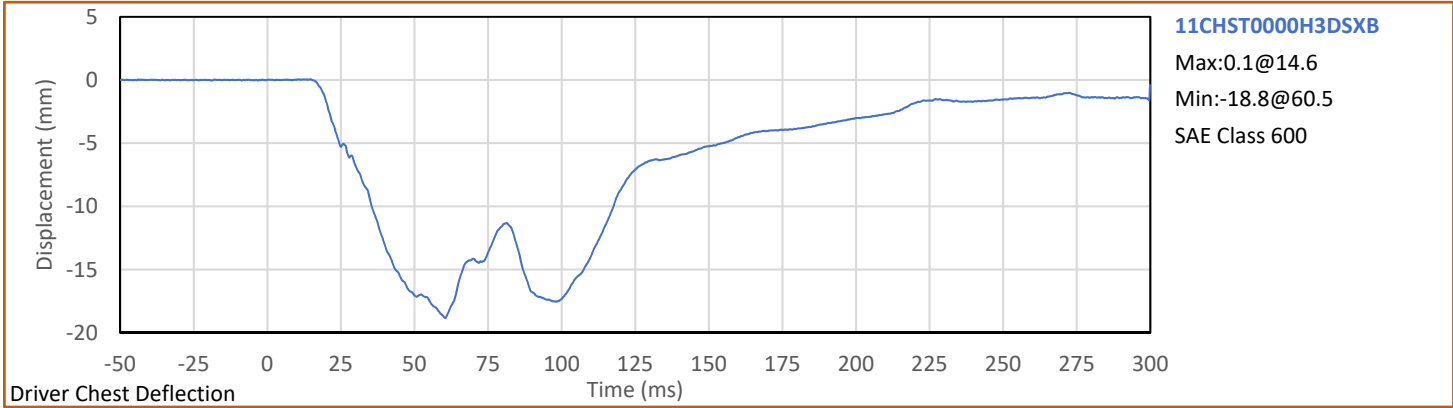
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Test Program: 56.3 km/h Frontal Impact NCAP Test

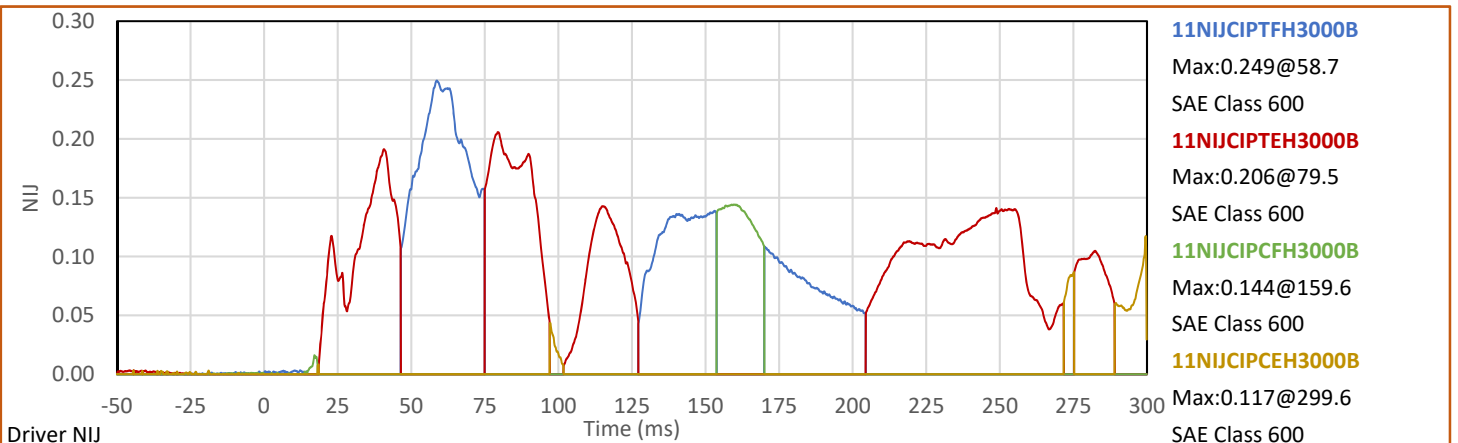
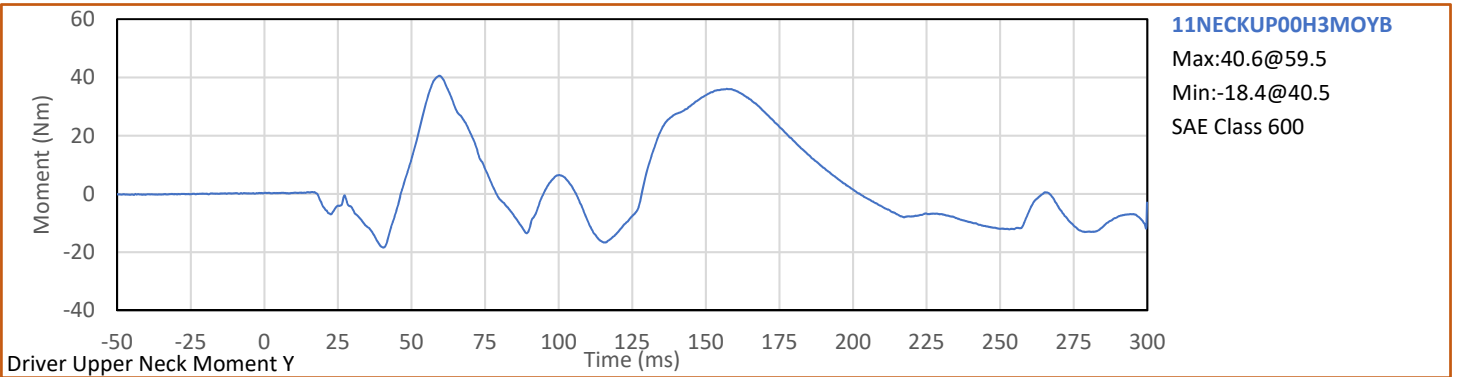
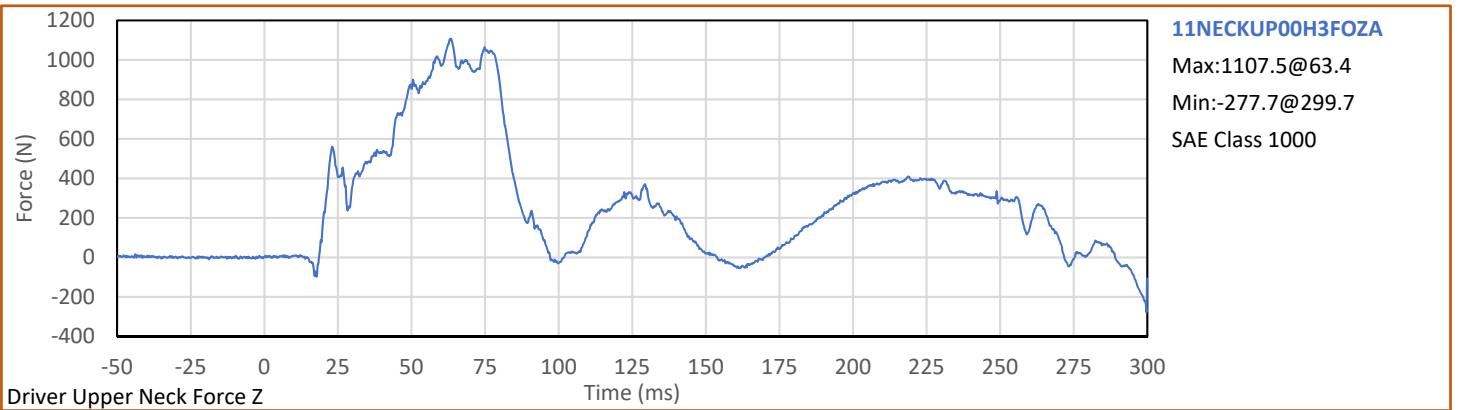
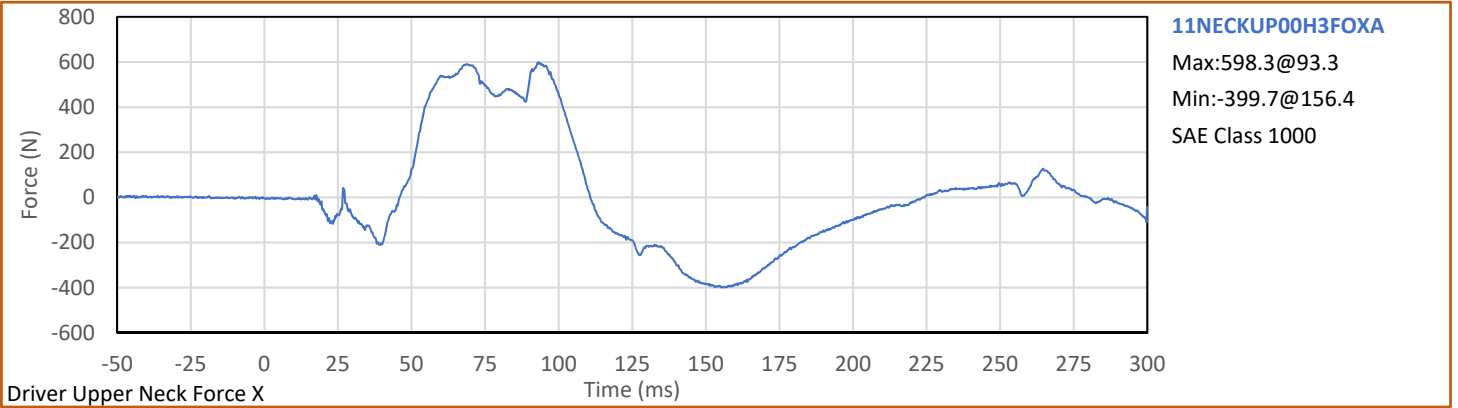
NHTSA No.: O20205502
Test Date: 12/12/2019



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Test Program: 56.3 km/h Frontal Impact NCAP Test

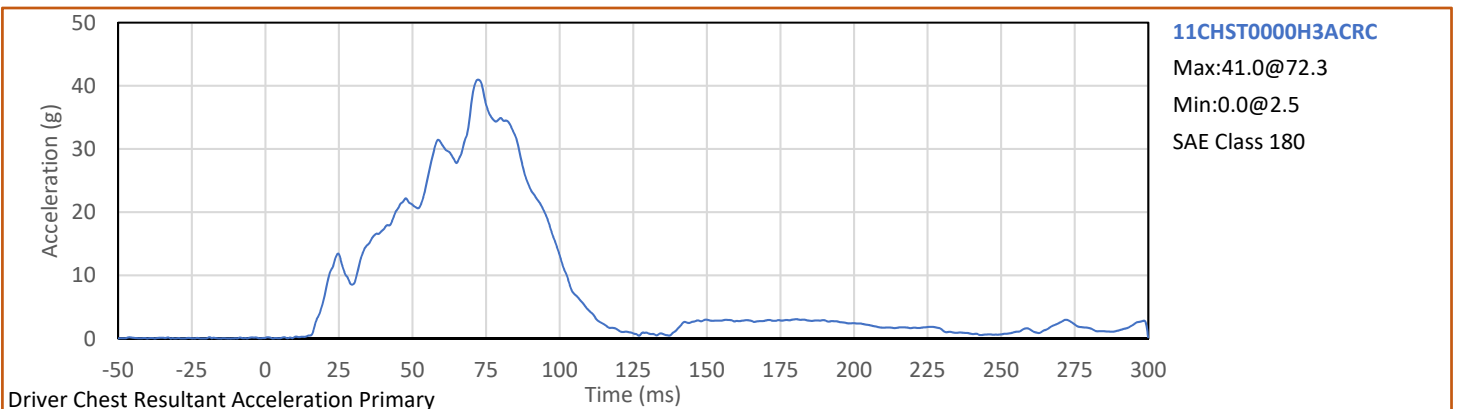
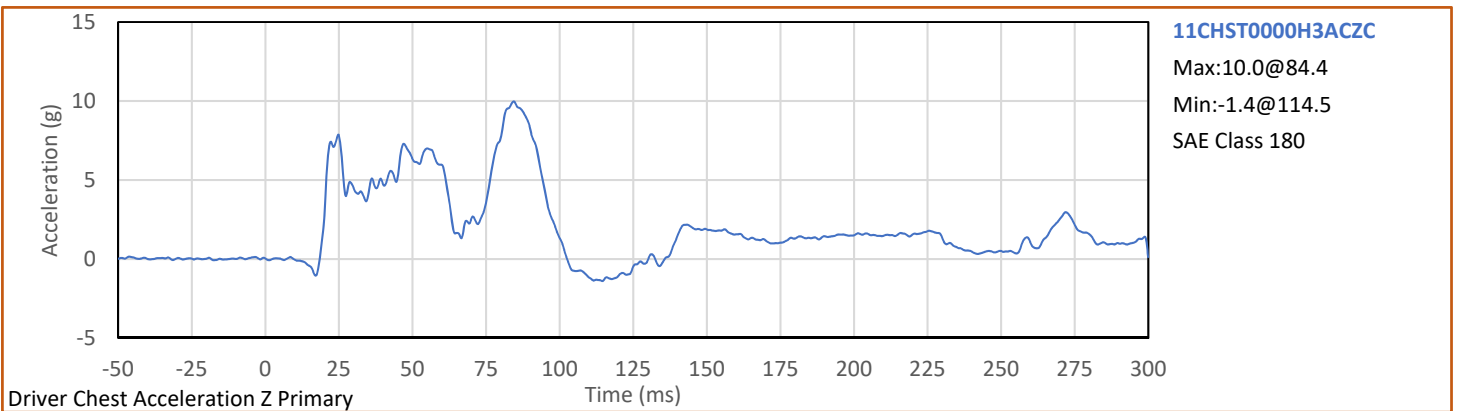
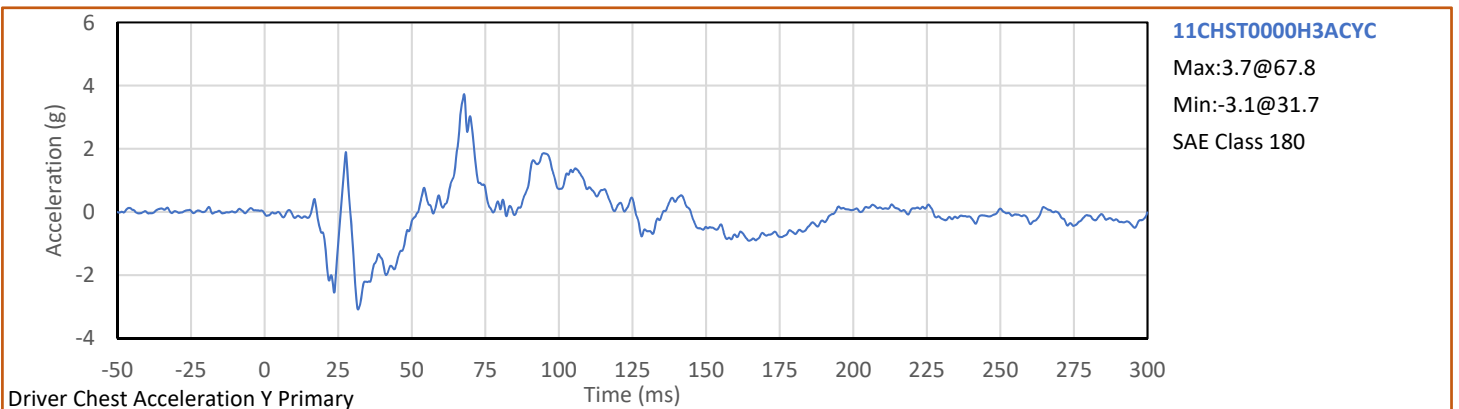
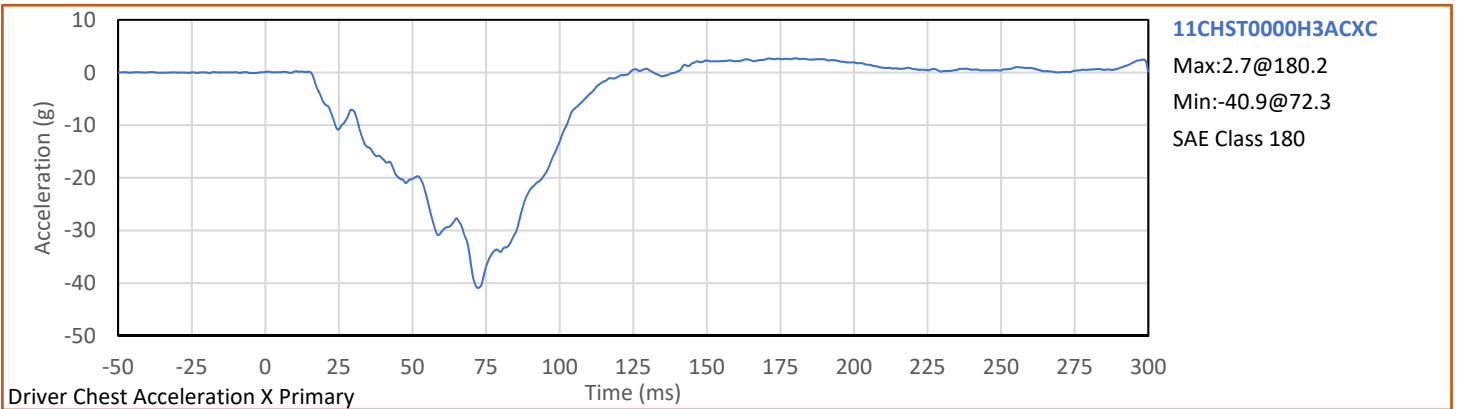
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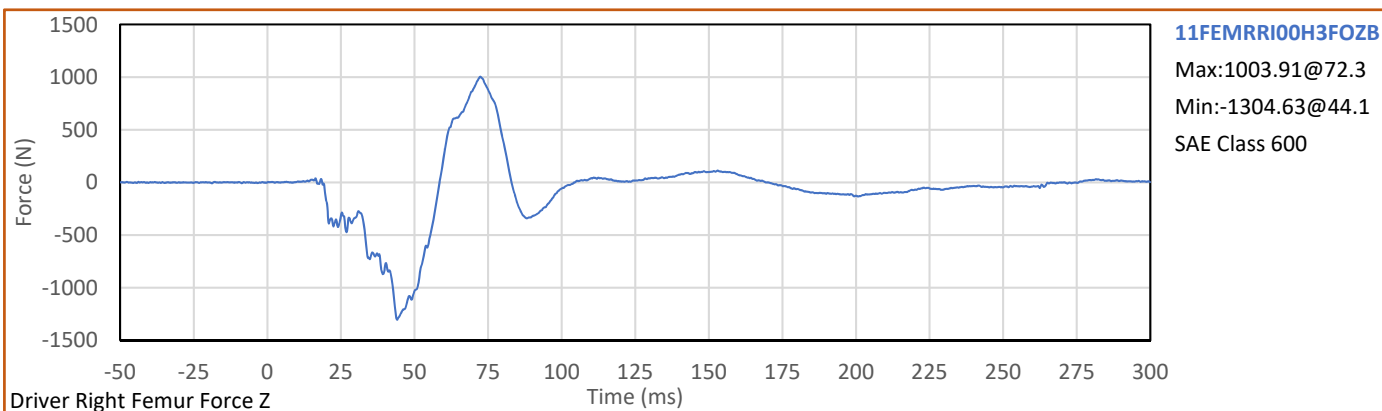
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Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: O20205502
Test Date: 12/12/2019



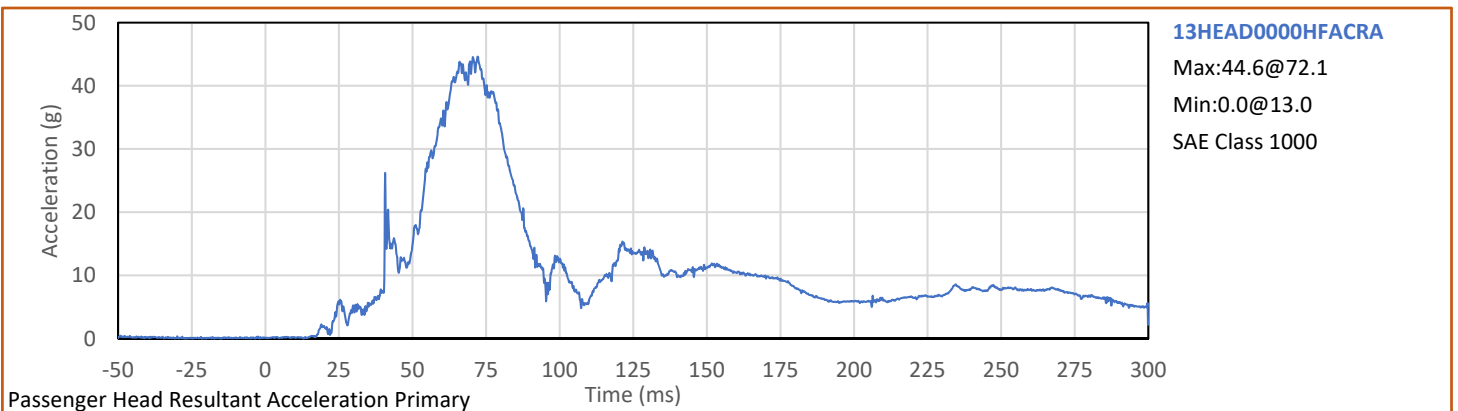
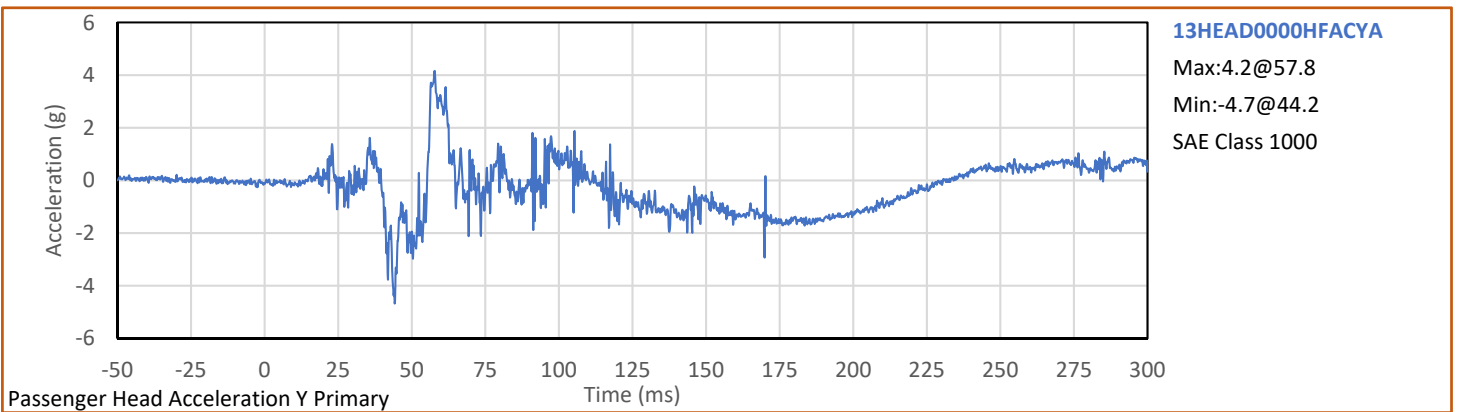
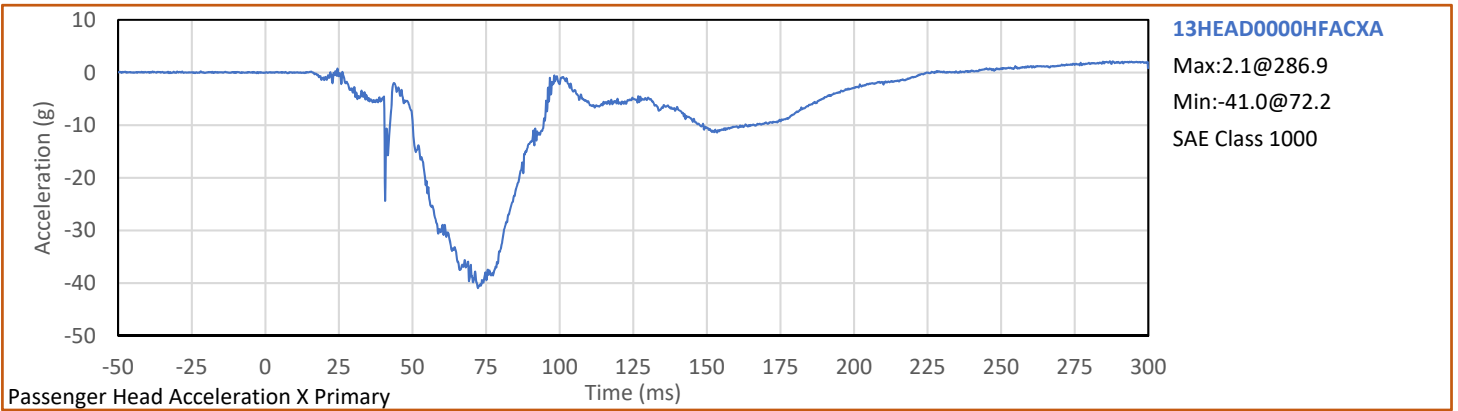
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Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: O20205502
Test Date: 12/12/2019



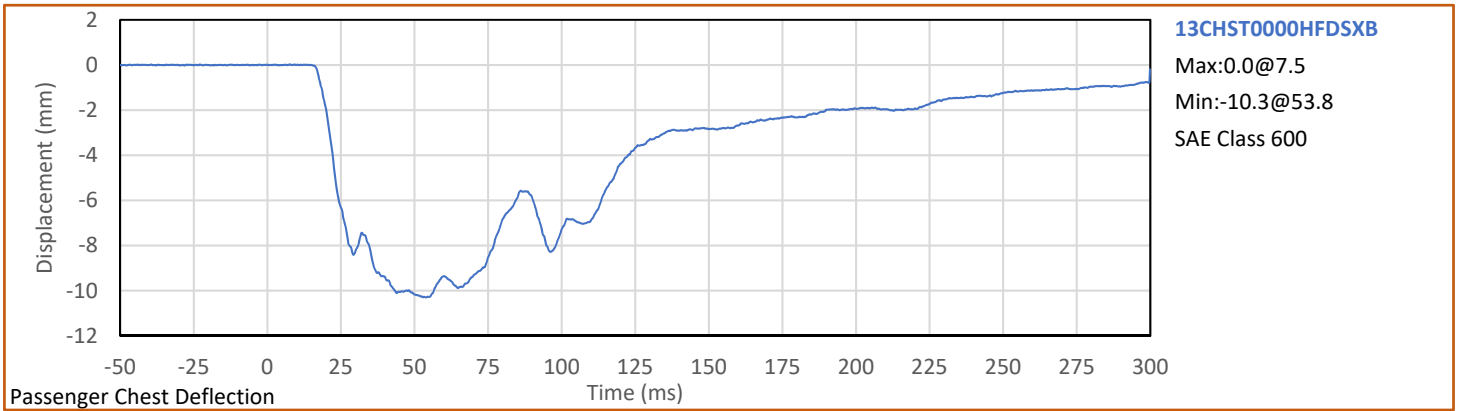
Test Vehicle: 2020 Subaru Outback 5-Door MPV
Test Program: 56.3 km/h Frontal Impact NCAP Test

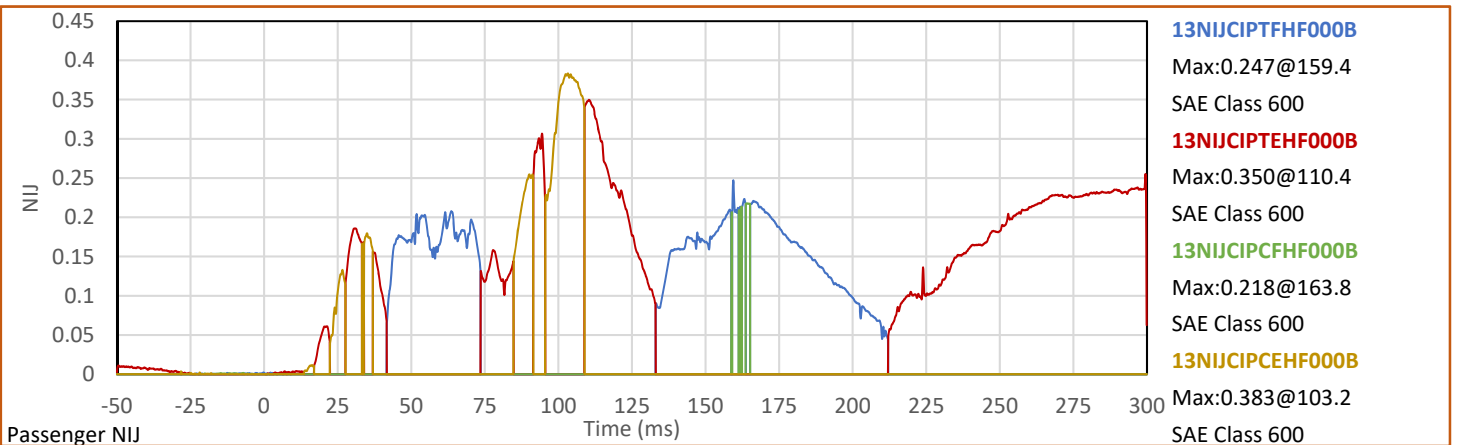
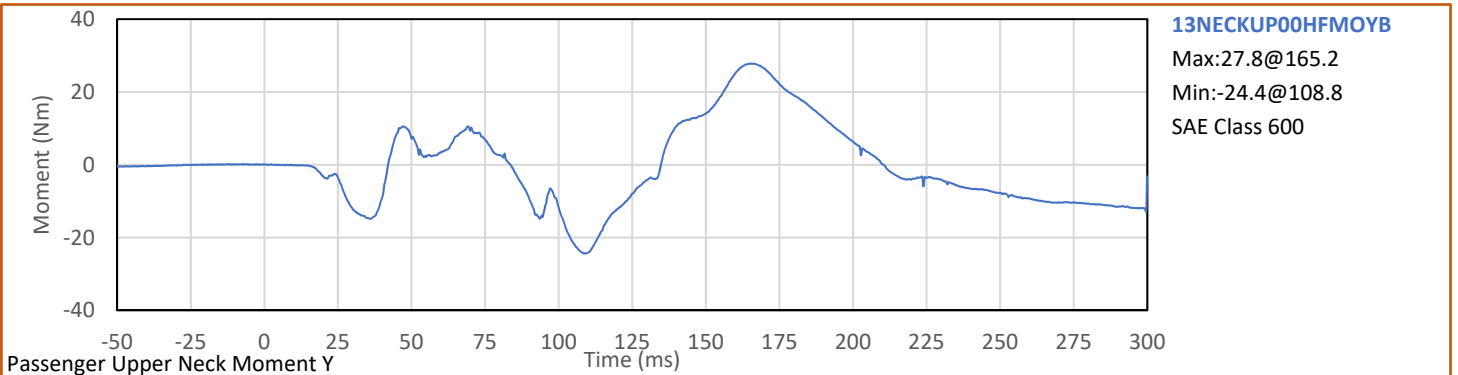
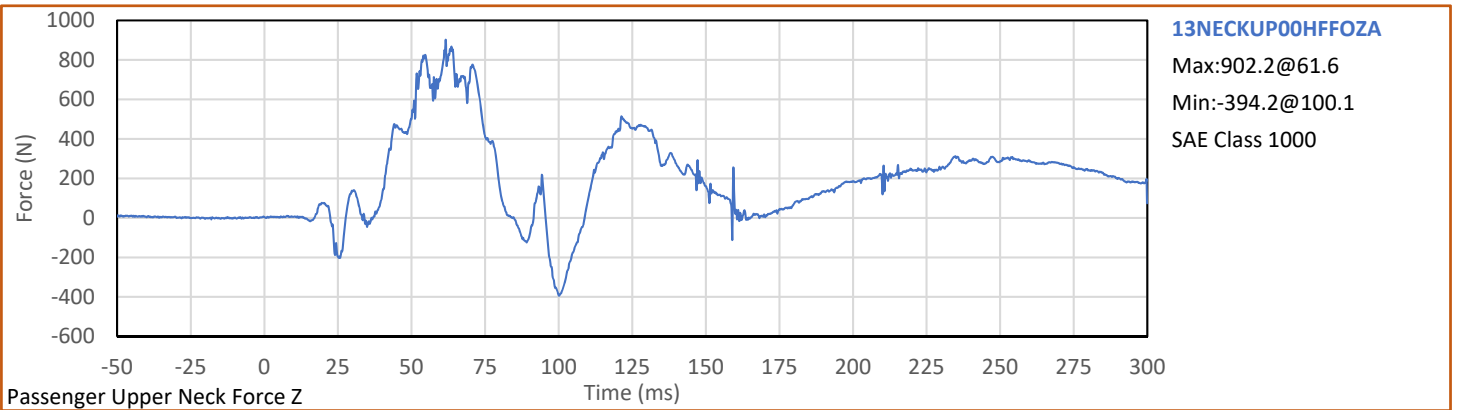
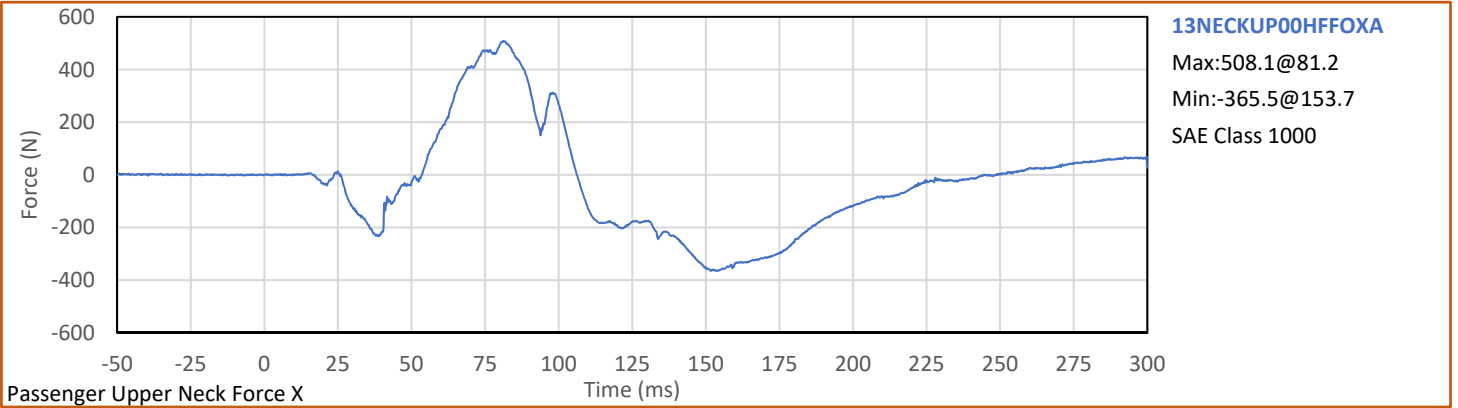
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Test Date: 12/12/2019



Test Vehicle: 2020 Subaru Outback 5-Door MPV
Test Program: 56.3 km/h Frontal Impact NCAP Test

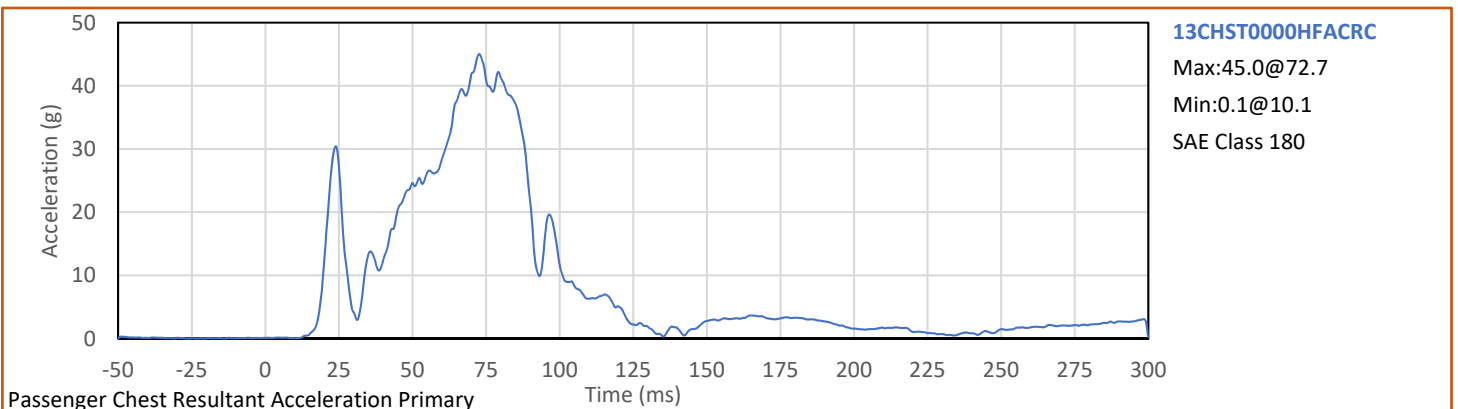
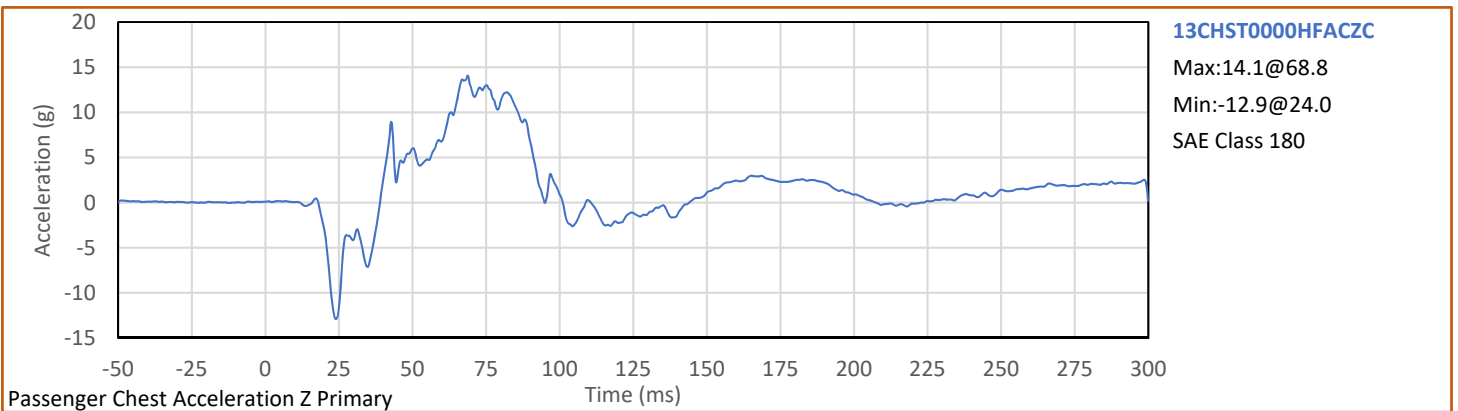
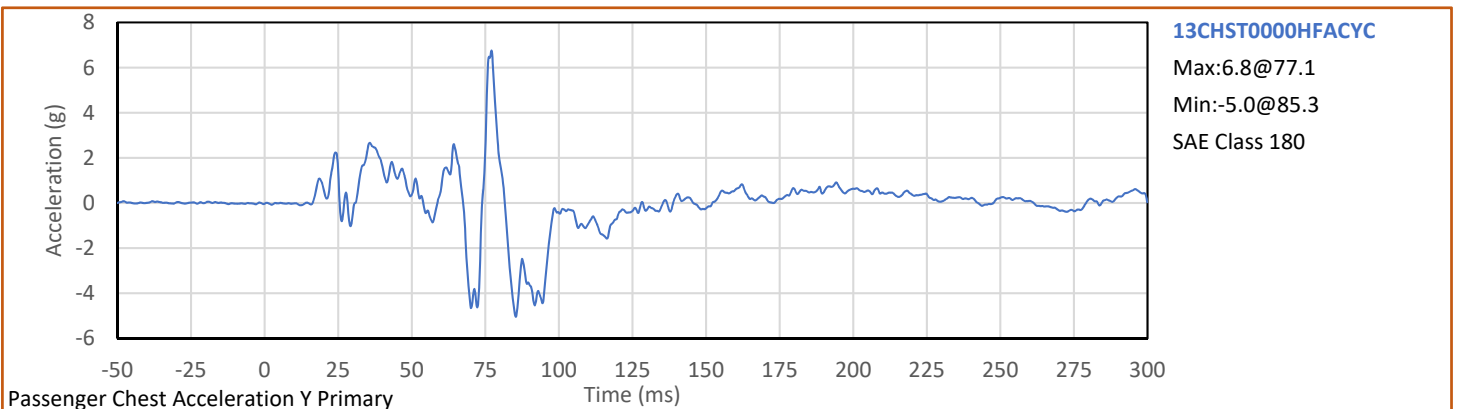
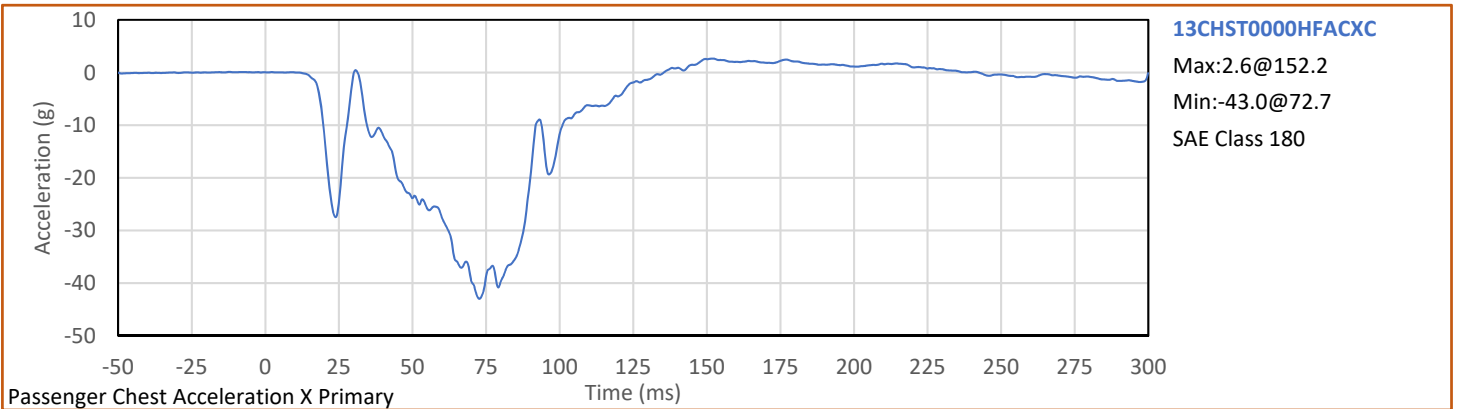
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Test Date: 12/12/2019





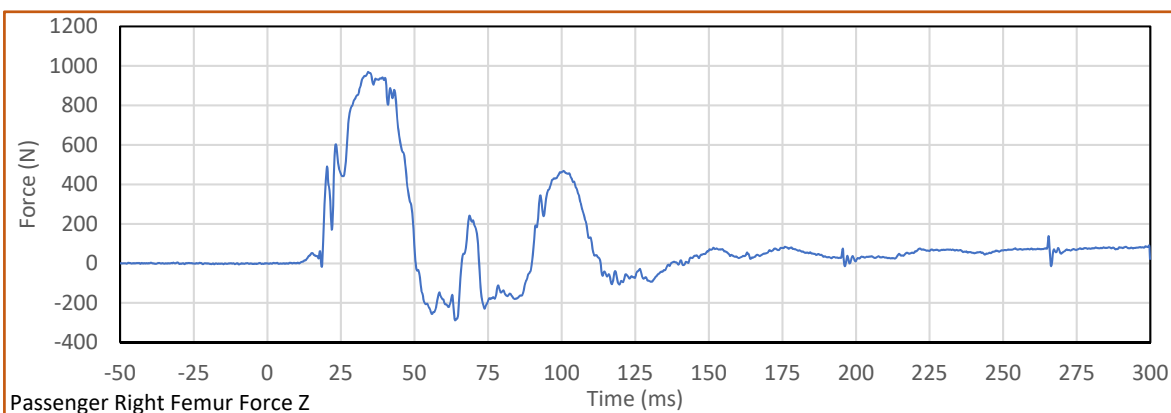
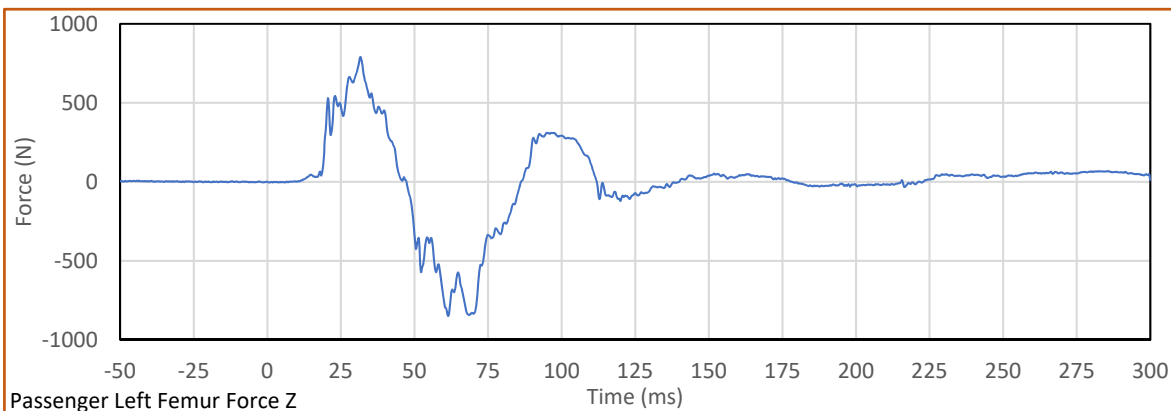
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Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: O20205502
Test Date: 12/12/2019



Test Vehicle: 2020 Subaru Outback 5-Door MPV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: O20205502
Test Date: 12/12/2019



APPENDIX C
DUMMY QUALIFICATION AND PERFORMANCE VERIFICATION

APPENDIX C
Pre-Test ATD Qualification and Performance Verification
Hybrid III 50th Percentile Male ATD
S/N: 360

ATD Serial No.: 360

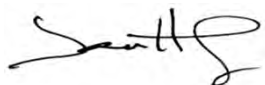
Test Date: 2019-12-04

Dummy Item	Inspect for	Comments	Damage	OK
Entire ATD	Perform general cleaning			✓
Outer Skin	Gashes, rips, cracks			✓
Head	Ballast secure			✓
	General appearance			✓
Neck bracket	Upper neck firmly attached to lower bracket			✓
Neck	Broken or cracked rubber			✓
	Looseness at the condyle joint			✓
Nodding block	Cracked or out of position			✓
Lumbar Spine	Broken or cracked rubber			✓
Ribs	Broken or bent ribs			✓
	Broken or bent rib supports			✓
	Damping material separated or cracked			✓
	Rubber bumpers in place			✓
Chest Displ. Assembly	Bent shaft			✓
	Slider arm riding in track			✓
Sensors	Check cables for cuts, tears			✓
	Check for damaged insulation			✓
Accelerometer Mounting	Head mounting secure			✓
	Chest mounting secure			✓
Knees	Skin condition			✓
	Insert (do not remove)			✓
	Casting			✓
Limbs	Normal movement and adjustment			✓
Knee Sliders	Wires intact			✓
	Rubber returned to "resting" position			✓
Pelvis	Broken			✓
Other	Describe below as needed			✓

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician:



J. Hernandez

Approved By:



P. Puzzuto

ATD Serial No.: 360

Test Date: 2019-12-04

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
A - Total sitting height	mm	879	889	884	Pass
B - Shoulder pivot height	mm	505	521	519	Pass
C - 'H' point height	mm	84	89	88	Pass
D - 'H' point location from backline	mm	135	140	138	Pass
E - Shoulder pivot from backline	mm	84	94	90	Pass
F - Thigh clearance	mm	140	155	147	Pass
G - Back of elbow to wrist pivot	mm	290	305	296	Pass
H - Head back to backline	mm	41	46	46	Pass
I - Shoulder to elbow length	mm	330	345	344	Pass
J - Elbow rest height	mm	190	211	202	Pass
K - Buttock to knee length	mm	579	604	589	Pass
L - Popliteal length	mm	429	455	447	Pass
M - Knee pivot height	mm	485	500	497	Pass
N - Buttock popliteal length	mm	452	477	468	Pass
O - Chest depth without jacket	mm	213	229	222	Pass
P - Foot length	mm	251	267	259	Pass
V - Shoulder breadth	mm	422	437	434	Pass
W - Foot breadth	mm	91	107	103	Pass
Y - Chest circum. (w/chest jacket)	mm	970	1001	990	Pass
Z - Waist circum.	mm	836	866	847	Pass
AA - Location for chest circum.	mm	429	434	433	Pass
BB - Location for waist circum.	mm	226	231	228	Pass
				Overall Test Results	Pass

Technician:



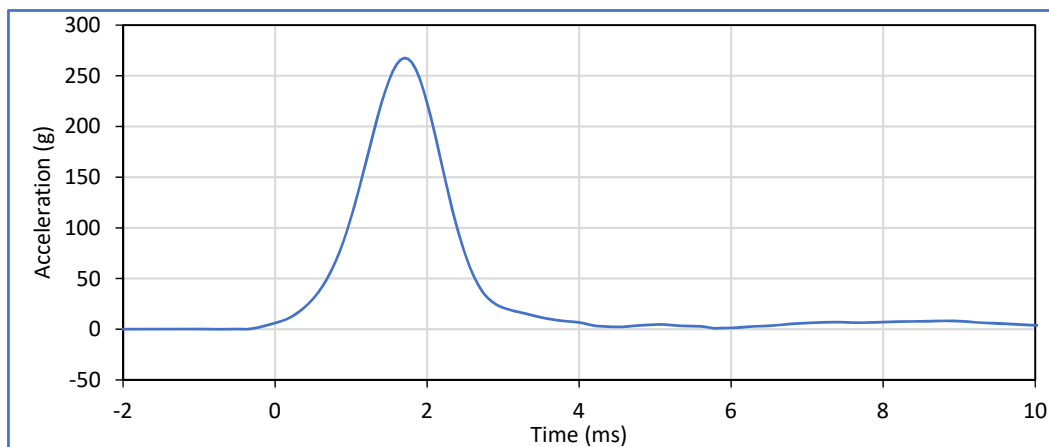
J. Hernandez

Approved By:



P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.7	Pass
Laboratory Relative Humidity	%	10	70	39	Pass
Peak Resultant Acceleration	g	225.0	275.0	267.6	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-6.5	Pass
Oscillations After Main Pulse	%	0.0	10.0	3.2	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass

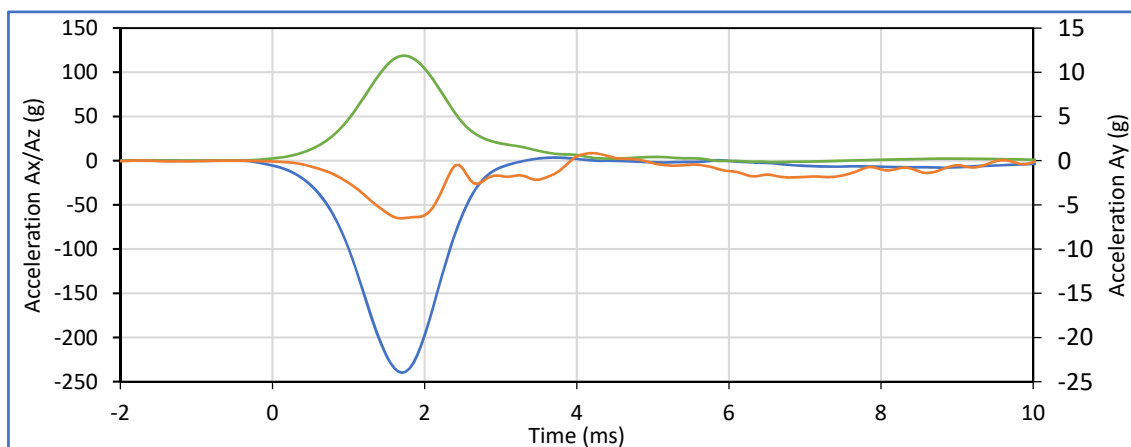


Head Resultant

Max:267.6@1.7

Min:0.9@5.8

SAE Class 1000



Head Ax

Max:3.6@3.7

Min:-239.7@1.7

SAE Class 1000

Head Ay

Max:0.8@4.2

Min:-6.5@1.7

SAE Class 1000

Head Az

Max:118.8@1.8

Min:-1.7@6.6

SAE Class 1000

Technician:

J. Hernandez

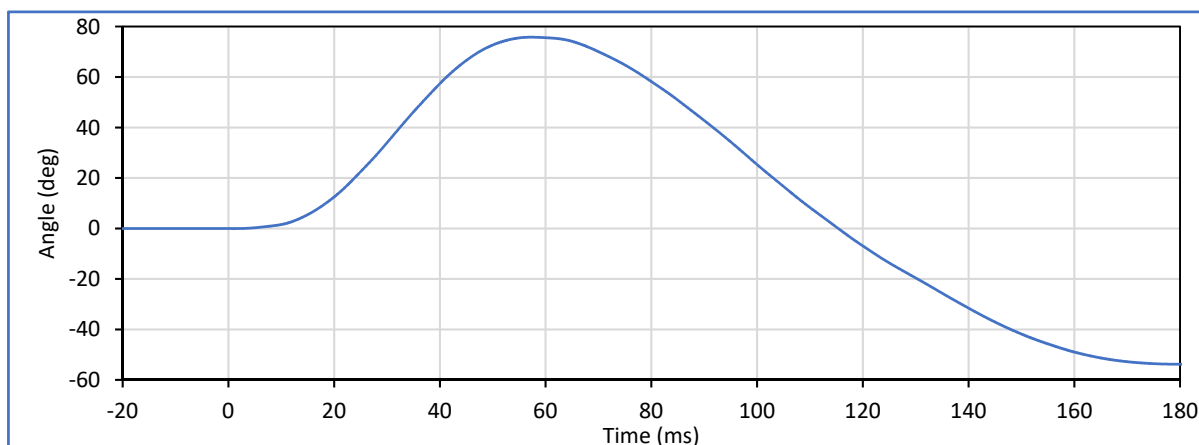
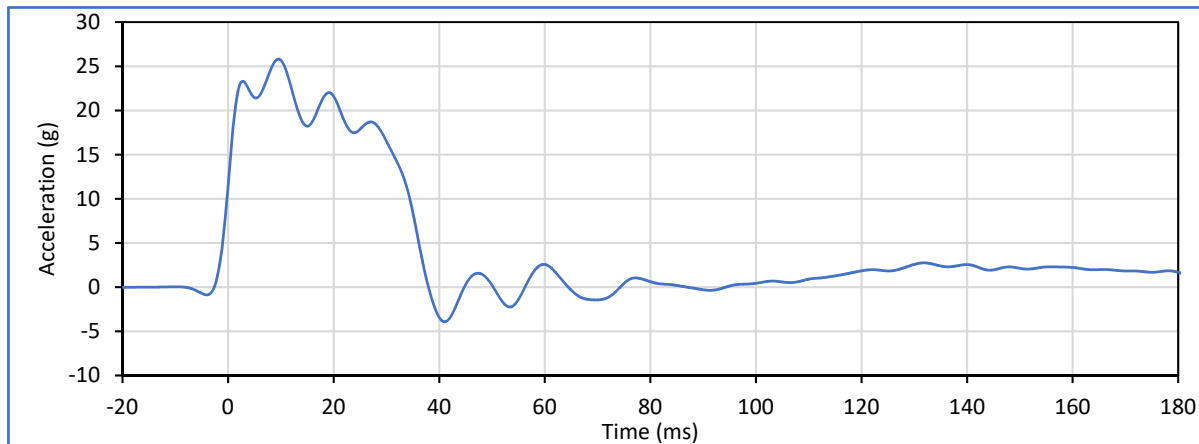
J. Hernandez

Approved By:

P. Puzzuto

P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	41	Pass
Pendulum Velocity	m/s	6.89	7.13	6.92	Pass
Pendulum Deceleration at 10 ms	g	22.5	27.5	25.7	Pass
Pendulum Deceleration at 20 ms	g	17.6	22.6	21.6	Pass
Pendulum Deceleration at 30 ms	g	12.5	18.5	16.5	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	29.0	16.5	Pass
Deceleration Decay to Cross 5 g	ms	34.0	42.0	36.1	Pass
"D" Plane Rotation peak	deg	64.0	78.0	75.8	Pass
	ms	57.0	64.0	57.3	Pass
"D" Plane Rotation Decay To Zero	ms	113.0	128.0	115.4	Pass
Moment About Occipital Condyle	Nm	88.1	108.5	95.4	Pass
	ms	47.0	58.0	47.6	Pass
Moment Decay, Peak to Zero	ms	97.0	107.0	102.1	Pass
Overall Test Results				Pass	



Technician:

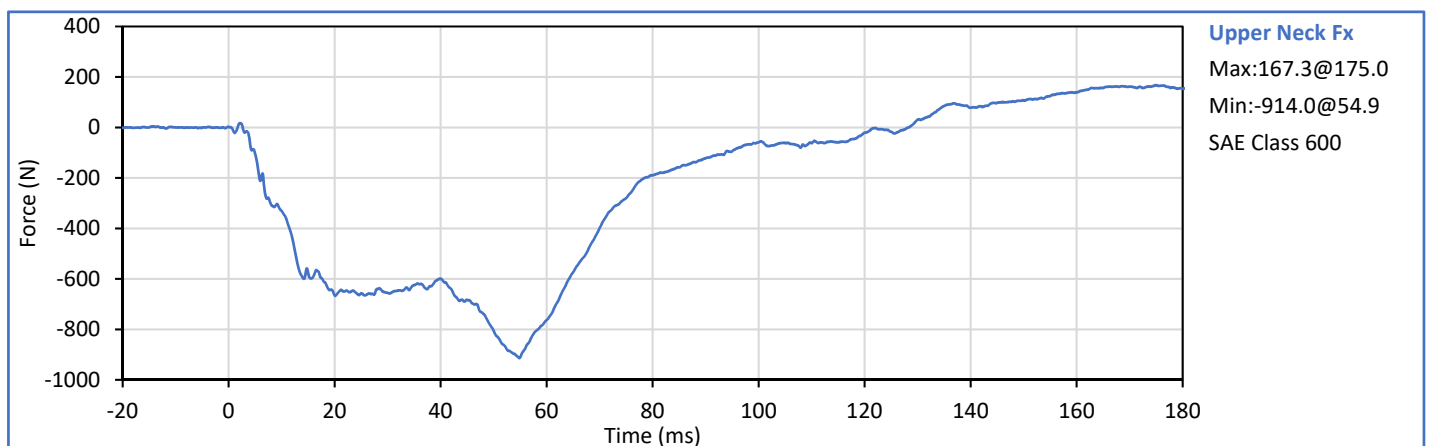
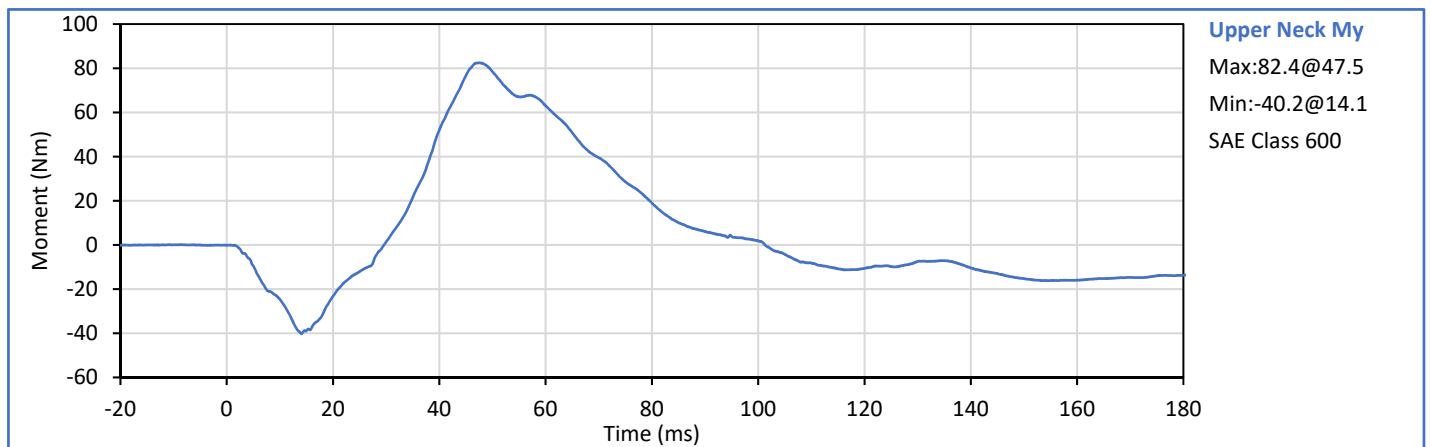
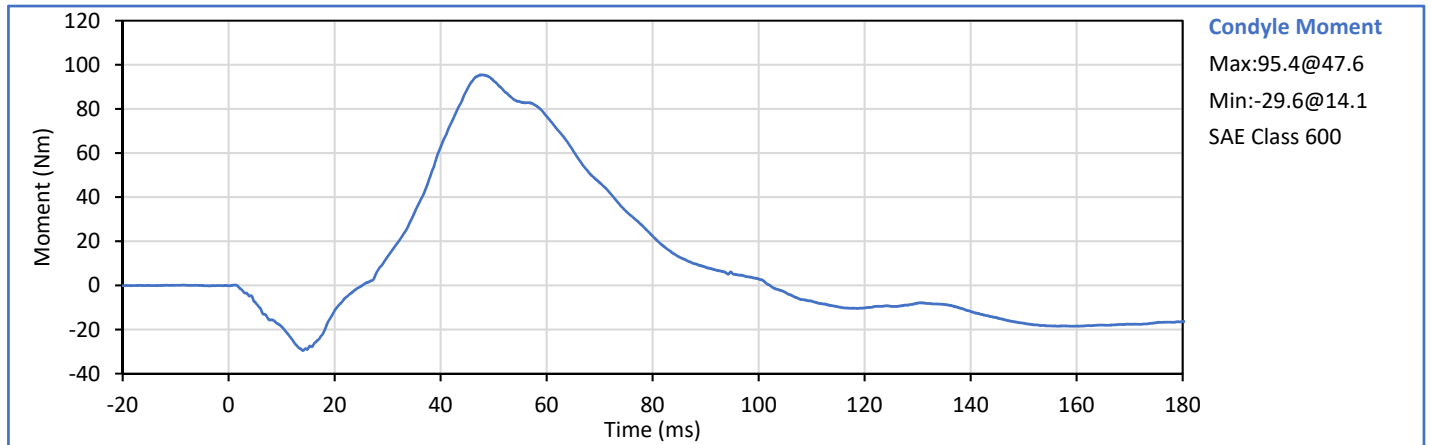
J. Hernandez

J. Hernandez

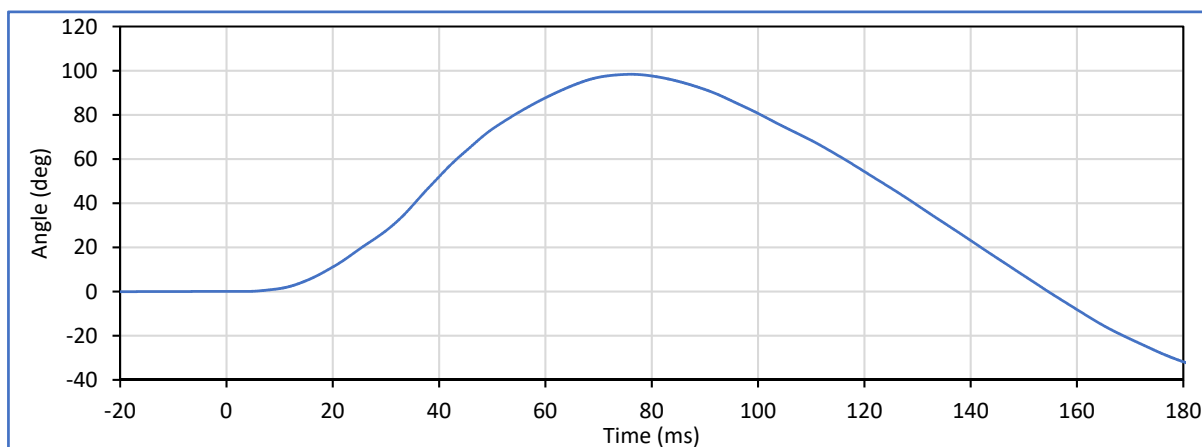
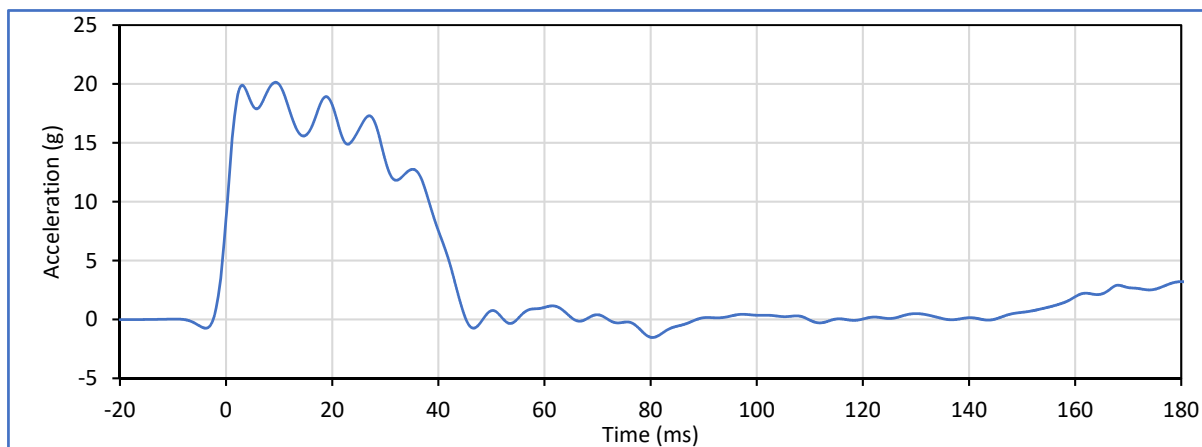
Approved By:

P. Puzzuto

P. Puzzuto



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	40	Pass
Pendulum Velocity	m/s	5.94	6.19	6.05	Pass
Pendulum Deceleration at 10 ms	g	17.2	21.2	20.0	Pass
Pendulum Deceleration at 20 ms	g	14.0	19.0	18.2	Pass
Pendulum Deceleration at 30 ms	g	11.0	16.0	13.5	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	22.0	13.5	Pass
Deceleration Decay to Cross 5 g	ms	38.0	46.0	42.0	Pass
"D" Plane Rotation peak	deg	81.0	106.0	98.4	Pass
	ms	72.0	82.0	76.1	Pass
"D" Plane Rotation Decay To Zero	ms	147.0	174.0	154.6	Pass
Moment About Occipital Condyle	Nm	-79.9	-52.9	-76.5	Pass
	ms	65.0	79.0	65.5	Pass
Moment Decay, Peak to Zero	ms	120.0	148.0	132.7	Pass
Overall Test Results				Pass	



Technician:

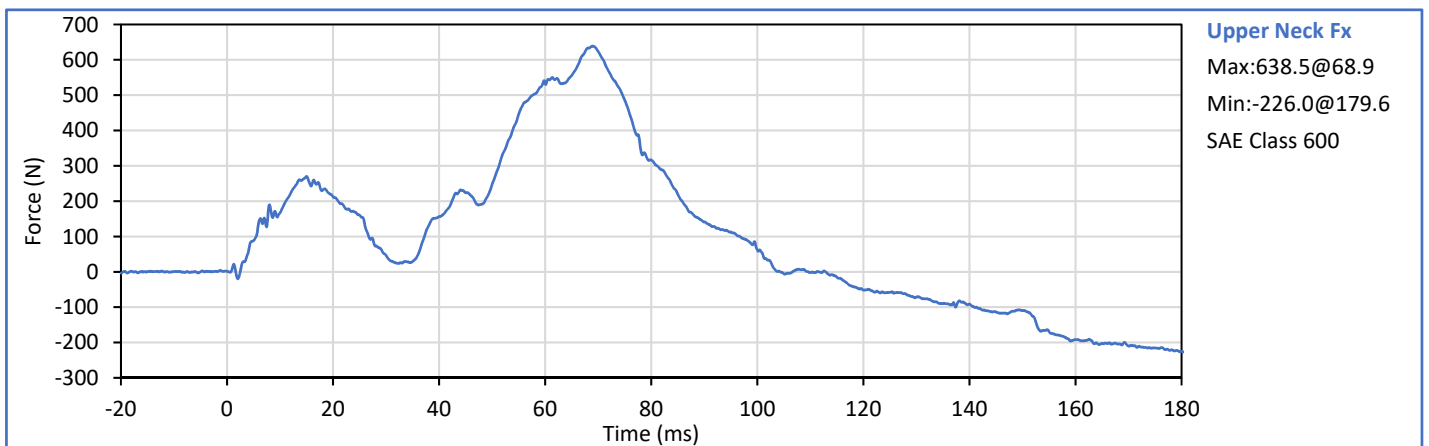
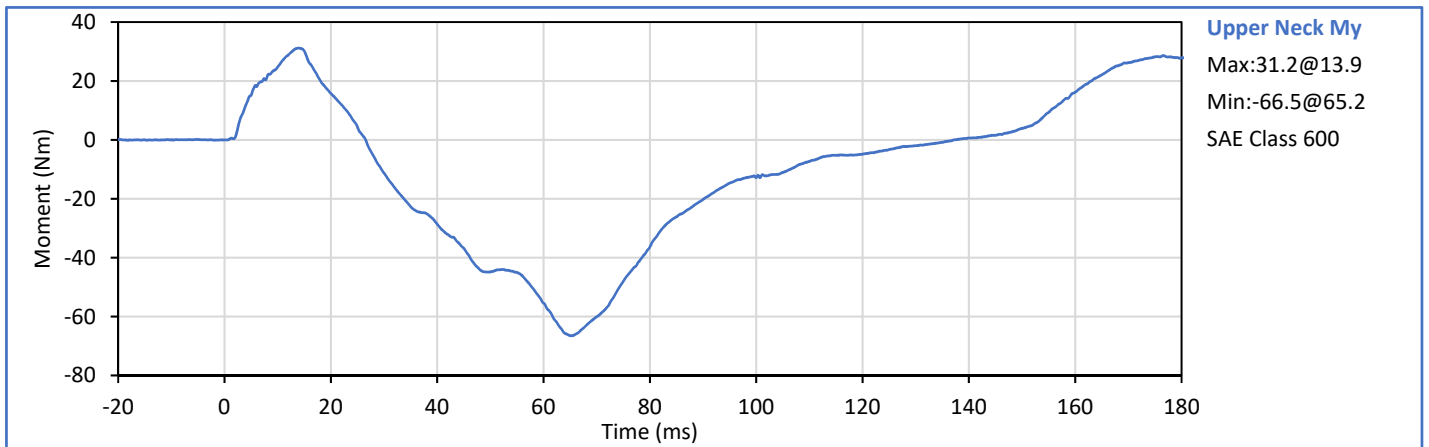
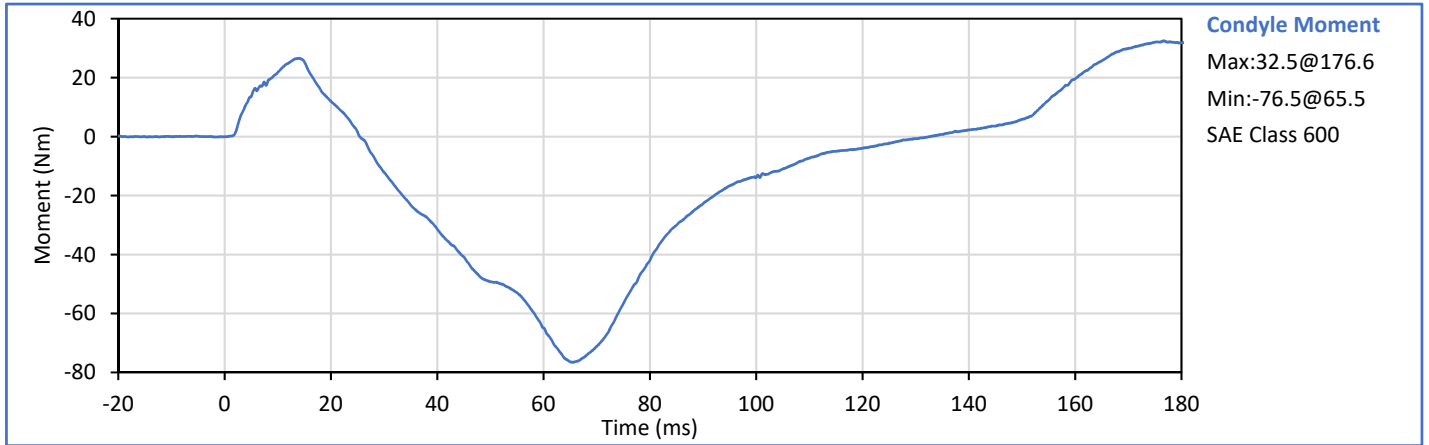
J. Hernandez

J. Hernandez

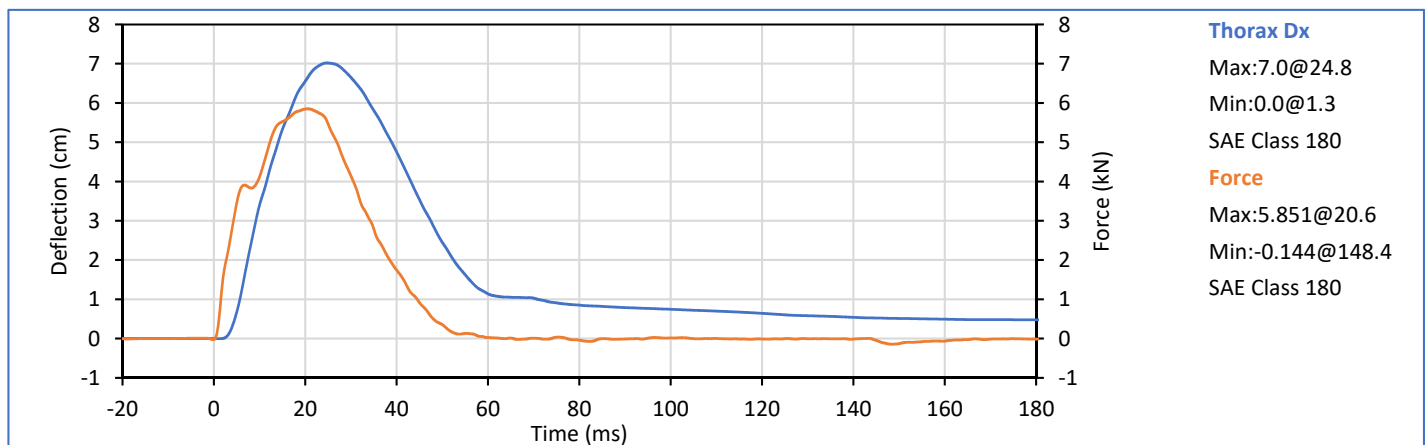
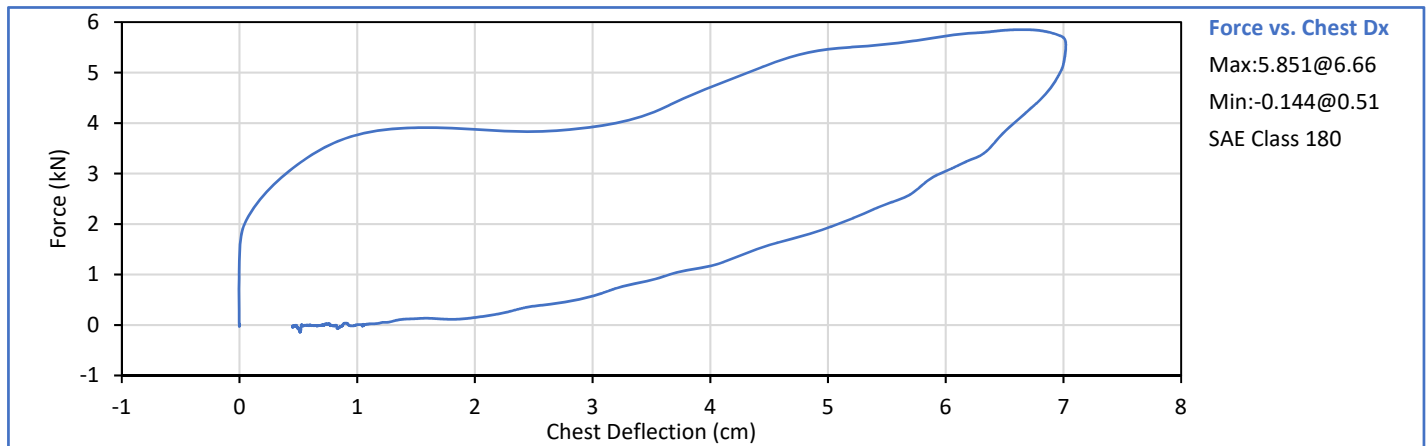
Approved By:

P. Puzzuto

P. Puzzuto



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	35	Pass
Probe Velocity	m/s	6.58	6.82	6.69	Pass
Peak Chest Deflection	cm	6.35	7.26	7.02	Pass
Peak Probe Force	kN	5.159	5.893	5.851	Pass
Internal Hysteresis	%	69.0	85.0	70.6	Pass
Overall Test Results				Pass	



Technician:

J. Hernandez

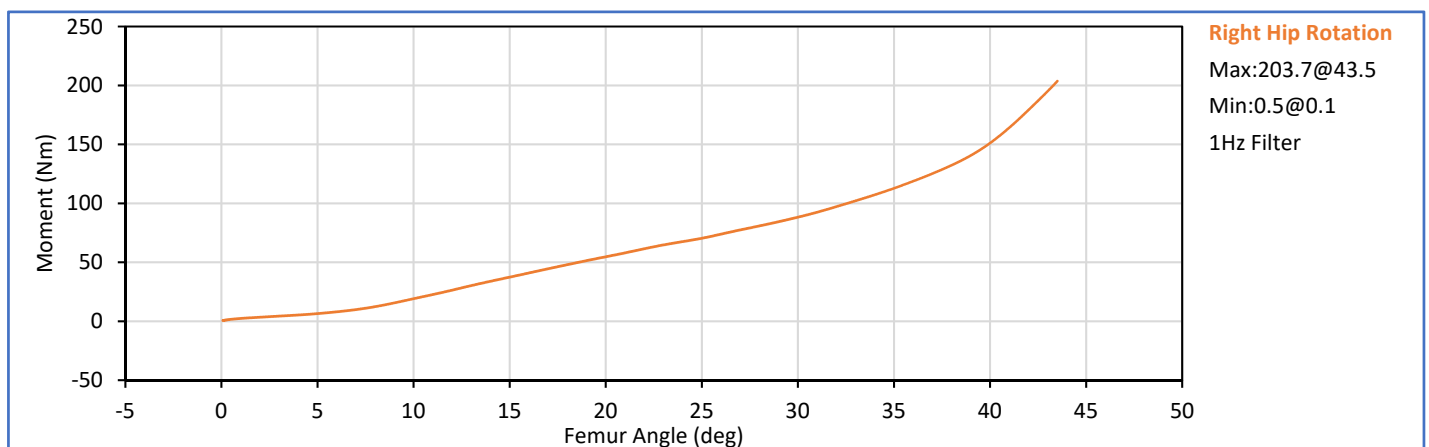
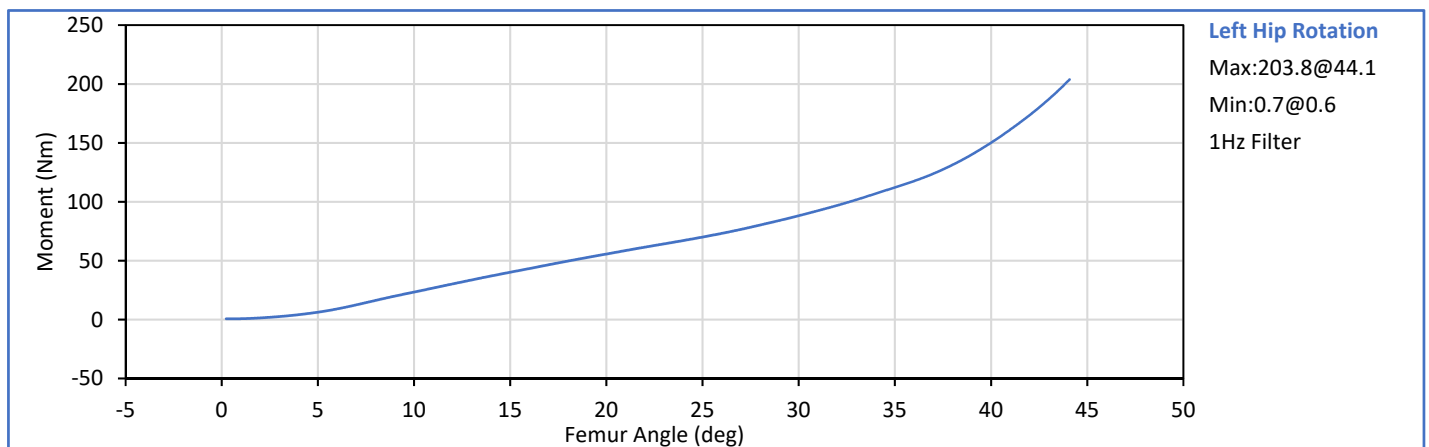
J. Hernandez

Approved By:

P. Puzzuto

P. Puzzuto

Tested Parameter		Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature		°C	18.9	25.6	21.1	Pass
Laboratory Relative Humidity		%	10	70	37	Pass
Left Hip	Left Hip Rotation Rate	deg/s	5.0	10.0	5.7	Pass
	Left Femur Torque at 30°	Nm	0.0	95.0	88.3	Pass
	Left Hip Rotation at 203 Nm	deg	40.0	50.0	44.0	Pass
Right Hip	Right Hip Rotation Rate	deg/s	5.0	10.0	5.8	Pass
	Right Femur Torque at 30°	Nm	0.0	95.0	88.3	Pass
	Right Hip Rotation at 203 Nm	deg	40.0	50.0	43.5	Pass
Overall Test Results						Pass



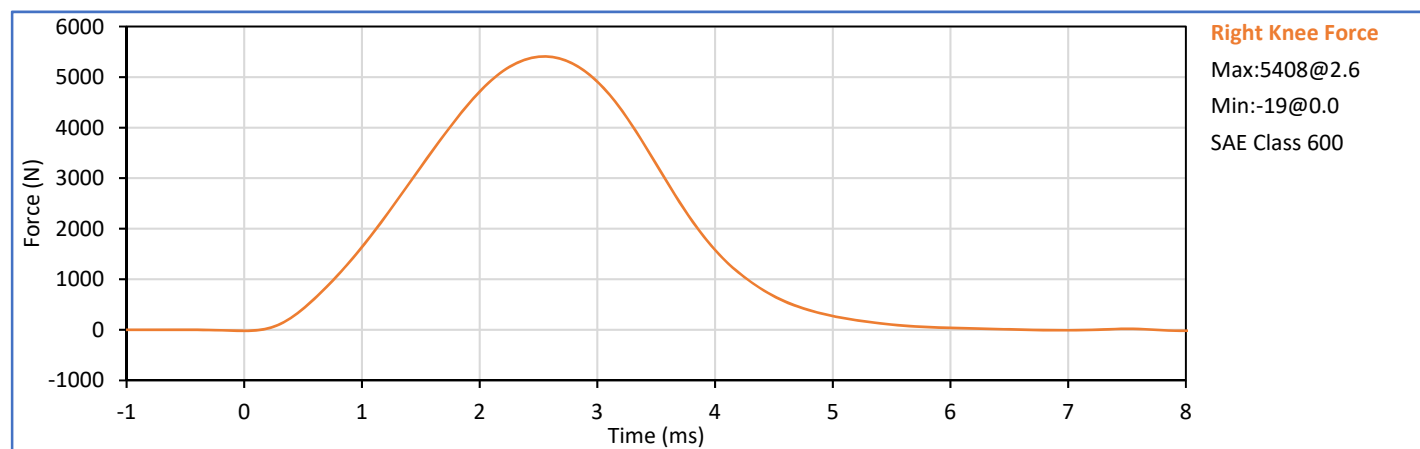
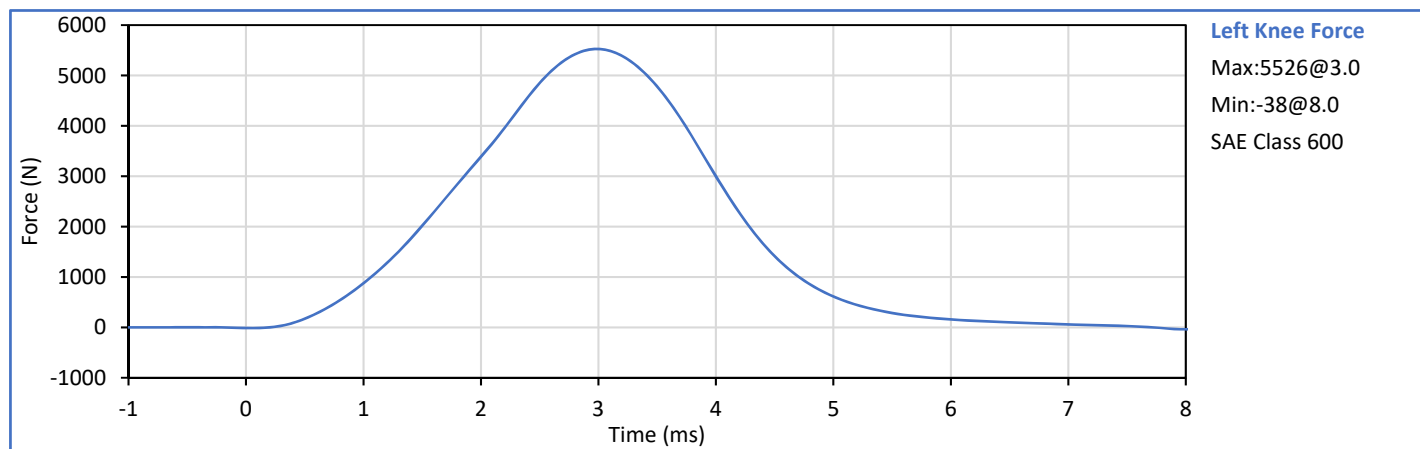
Technician: J. Hernandez

Approved By: P. Puzzuto

ATD Serial No.: 360

Test Date: 2019-12-06

	Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
	Laboratory Temperature	°C	18.9	25.6	20.6	Pass
	Laboratory Relative Humidity	%	10	70	41	Pass
Left	Probe Velocity	m/s	2.070	2.130	2.100	Pass
Knee	Peak Resistive Force	N	4715	5782	5526	Pass
Right	Probe Velocity	m/s	2.070	2.130	2.087	Pass
Knee	Peak Resistive Force	N	4715	5782	5408	Pass
Overall Test Results						Pass



Technician: J. Hernandez

Approved By: P. Puzzuto

APPENDIX C
Pre-Test ATD Qualification and Performance Verification
Hybrid III 5th Percentile Female ATD
S/N: 141

Dummy Item	Inspect for	Comments	Damage	Okay
Entire ATD	Perform general cleaning			✓
Outer Skin	Gashes, rips, cracks			✓
Head	Ballast secure			✓
	General appearance			✓
Neck bracket	Upper neck firmly attached to lower bracket			✓
Neck	Broken or cracked rubber			✓
	Looseness at the condyle joint			✓
Nodding block	Cracked or out of position			✓
Lumbar Spine	Broken or cracked rubber			✓
Ribs	Broken or bent ribs			✓
	Broken or bent rib supports			✓
	Damping material separated or cracked			✓
	Rubber bumpers in place			✓
Chest Displ. Assembly	Bent shaft			✓
	Slider arm riding in track			✓
Sensors	Check cables for cuts, tears			✓
	Check for damaged insulation			✓
Accelerometer Mounting	Head mounting secure			✓
	Chest mounting secure			✓
Knees	Skin condition			✓
	Insert (do not remove)			✓
	Casting			✓
Limbs	Normal movement and adjustment			✓
Knee Sliders	Wires intact			✓
	Rubber returned to "resting" position			✓
Pelvis	Broken			✓
Other	Describe below as needed			✓

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician:

J. Hernandez

Approved By:

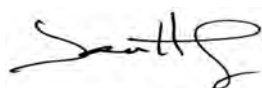
P. Puzzuto

ATD Serial No.: 141

Test Date: 2019-11-11

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	22	Pass
A - Total sitting height	mm	775	800	788	Pass
B - Shoulder pivot height	mm	432	457	453	Pass
C - 'H' point height	mm	81	86	86	Pass
D - 'H' point location from backline	mm	145	150	148	Pass
E - Shoulder pivot from backline	mm	69	84	78	Pass
F - Thigh clearance	mm	119	135	128	Pass
G - Back of elbow to wrist pivot	mm	244	259	254	Pass
H - Head back to backline	mm	41	46	43	Pass
I - Shoulder to elbow length	mm	277	297	287	Pass
J - Elbow rest height	mm	183	203	197	Pass
K - Buttock to knee length	mm	521	546	531	Pass
L - Popliteal length	mm	356	376	367	Pass
M - Knee pivot height	mm	394	419	407	Pass
N - Buttock popliteal length	mm	414	439	428	Pass
O - Chest depth without jacket	mm	175	191	183	Pass
P - Foot length	mm	219	234	231	Pass
R - Buttock to Knee Pivot Length	mm	457	483	473	Pass
S - Head Breadth	mm	137	147	144	Pass
T - Head Depth	mm	178	188	184	Pass
U - Hip Breadth	mm	300	315	308	Pass
V - Shoulder breadth	mm	351	366	360	Pass
W - Foot breadth	mm	79	94	88	Pass
X - Head circum.	mm	528	549	535	Pass
Y - Chest circum. (w/chest jacket)	mm	851	881	868	Pass
Z - Waist circum.	mm	760	790	776	Pass
AA - Location for chest circum.	mm	333	358	339	Pass
BB - Location for waist circum.	mm	160	170	168	Pass
			Overall Test Results		Pass

Technician:



J. Hernandez

Approved By:

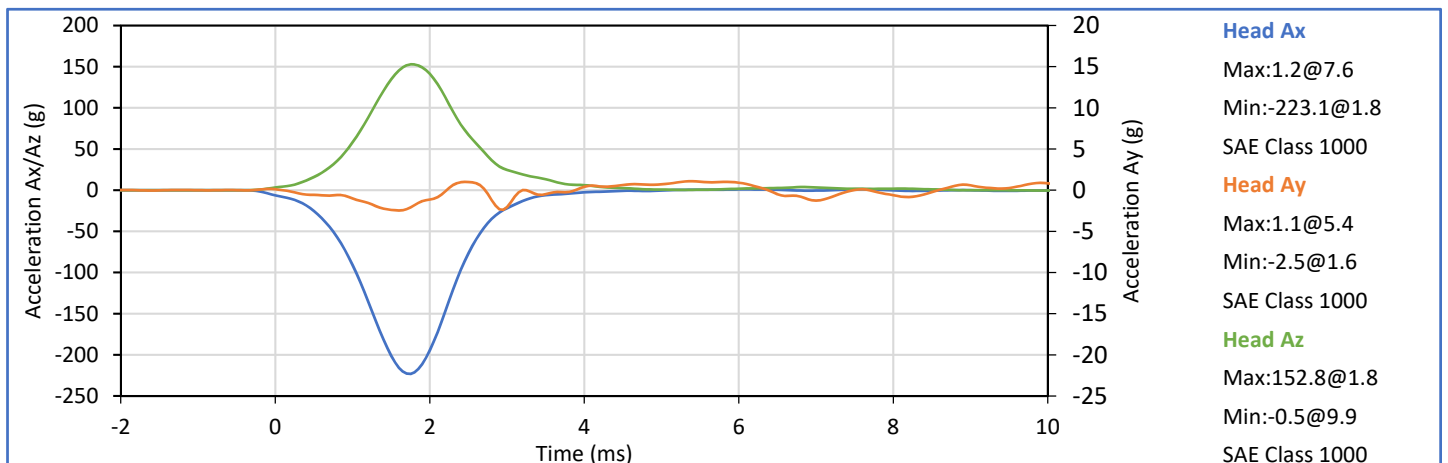
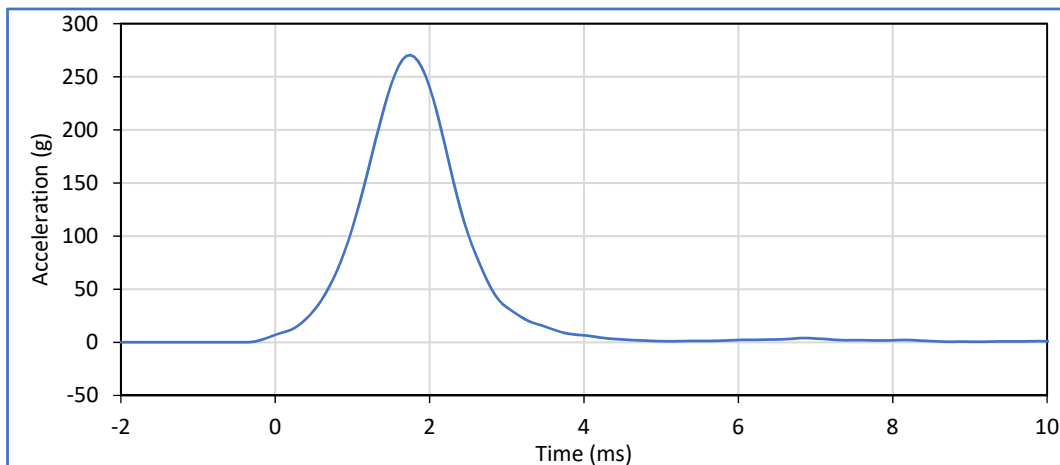


P. Puzzuto

ATD Serial No.: 141

Test Date: 2019-11-11

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	17	Pass
Peak Resultant Acceleration	g	250.0	300.0	270.4	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-2.5	Pass
Oscillations After Main Pulse	%	0.0	10.0	1.5	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results	Pass	



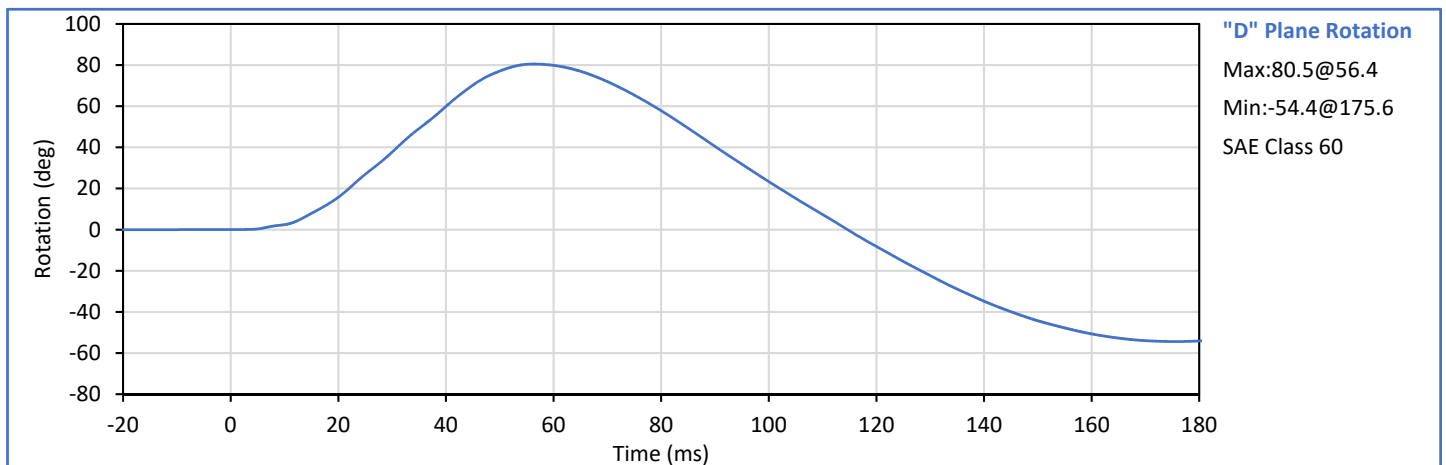
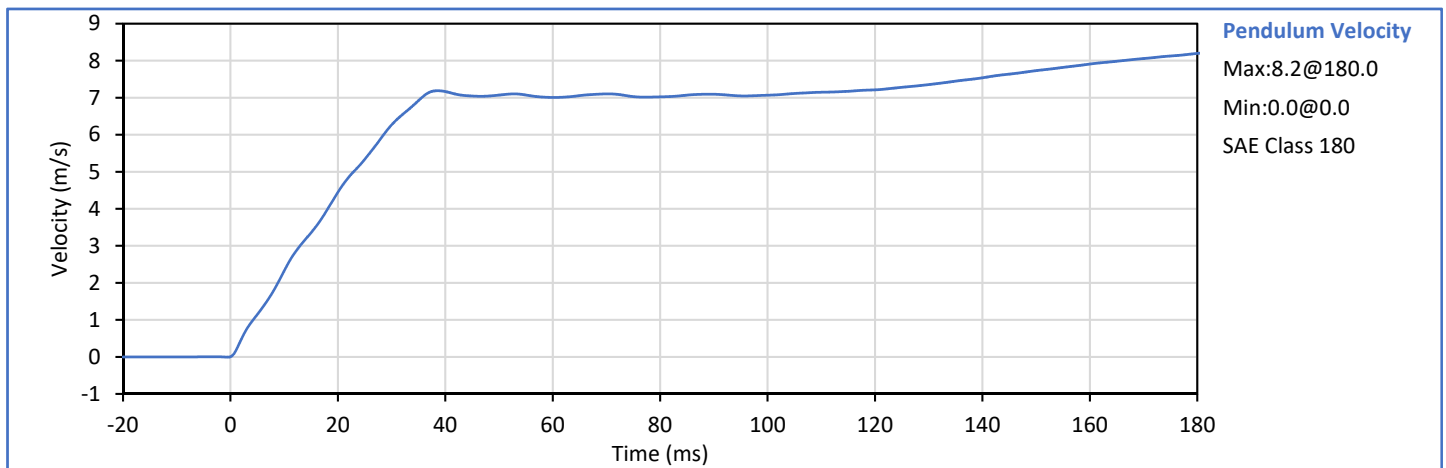
Technician: J. Hernandez

Approved By: P. Puzzuto

ATD Serial No.: 141

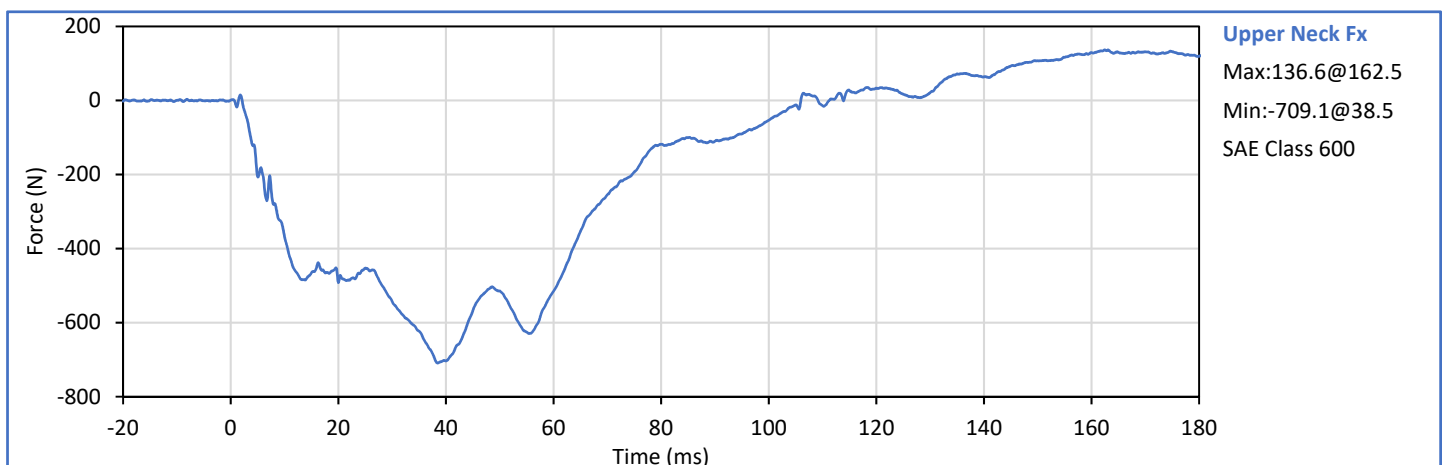
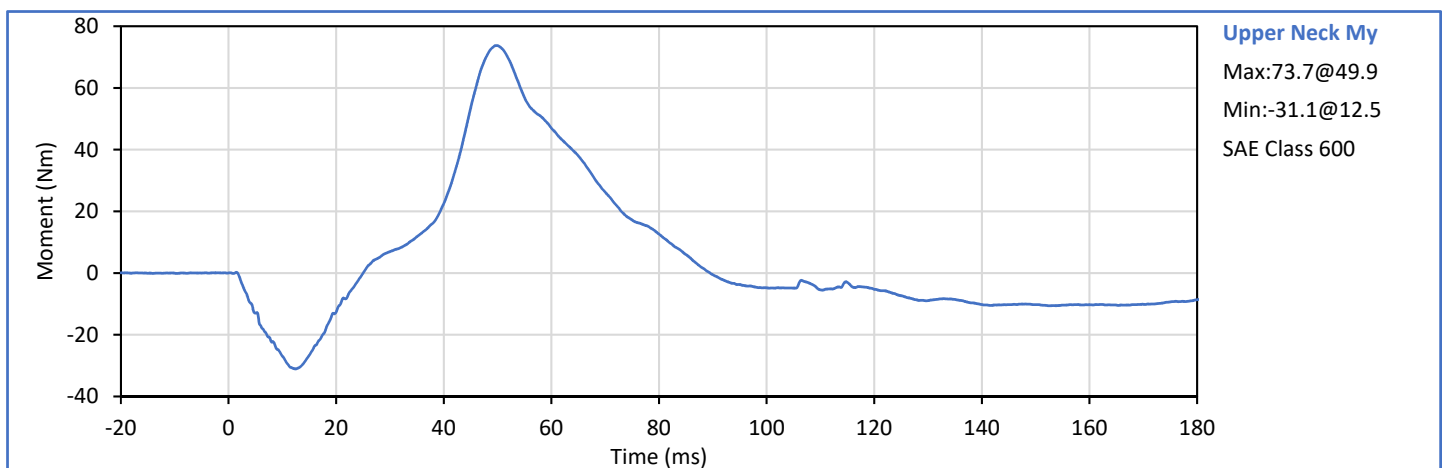
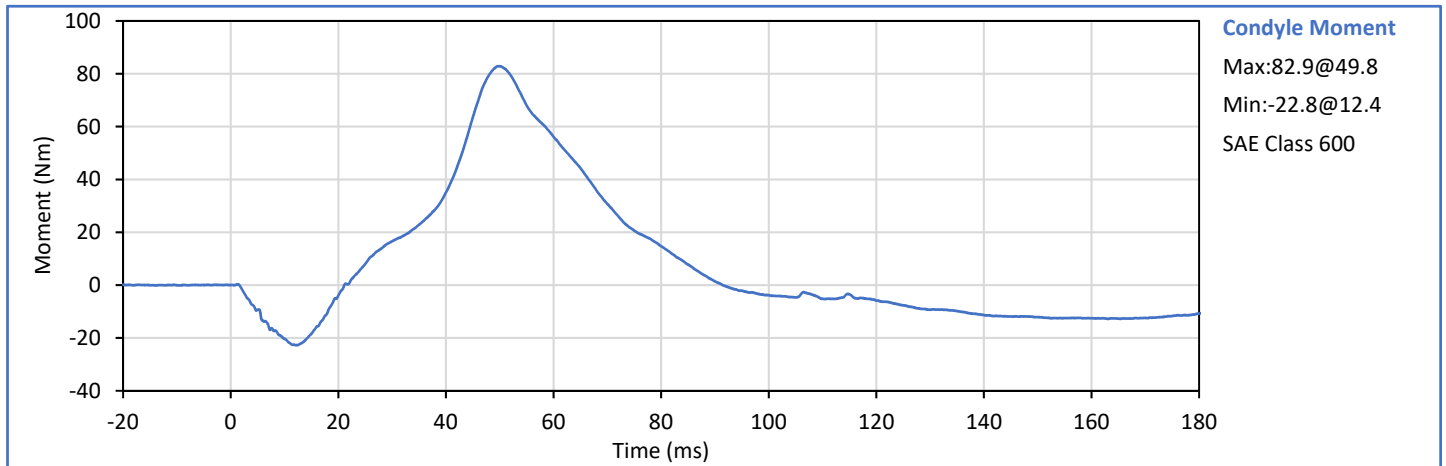
Test Date: 2019-11-14

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	25	Pass
Pendulum Velocity	m/s	6.89	7.13	7.05	Pass
Pendulum Velocity at 10 ms	m/s	2.10	2.50	2.32	Pass
Pendulum Velocity at 20 ms	m/s	4.00	5.00	4.45	Pass
Pendulum Velocity at 30 ms	m/s	5.80	7.00	6.27	Pass
Peak "D" Plane Rotation	deg	77.0	91.0	80.5	Pass
Peak Moment in Rotation	Nm	69.0	83.0	82.9	Pass
Positive Moment Decay to 10 Nm	ms	80.0	100.0	83.5	Pass
Overall Test Results				Pass	Pass

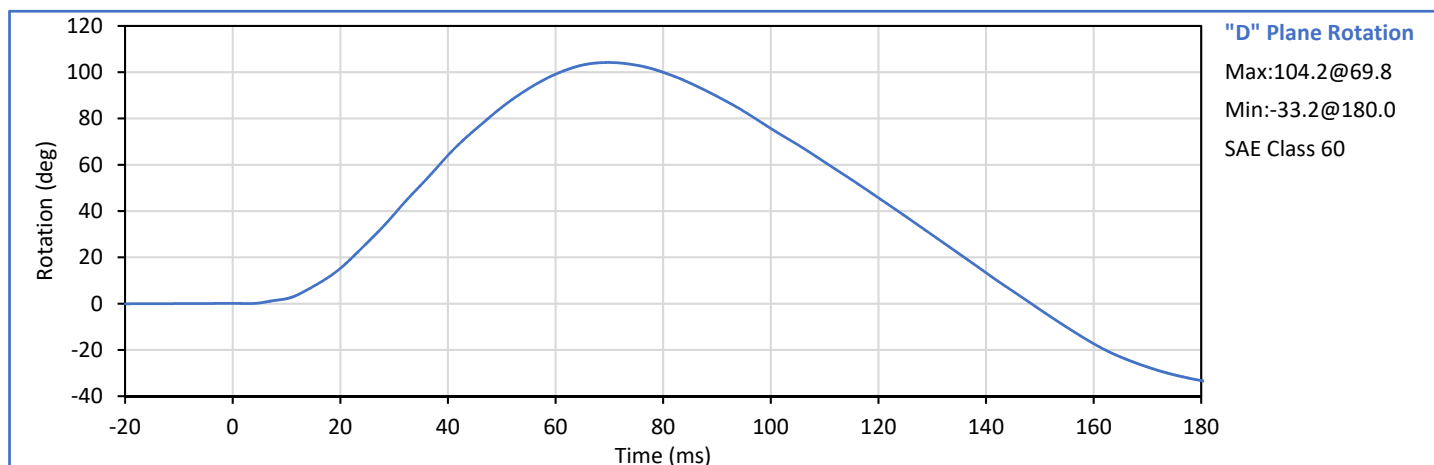
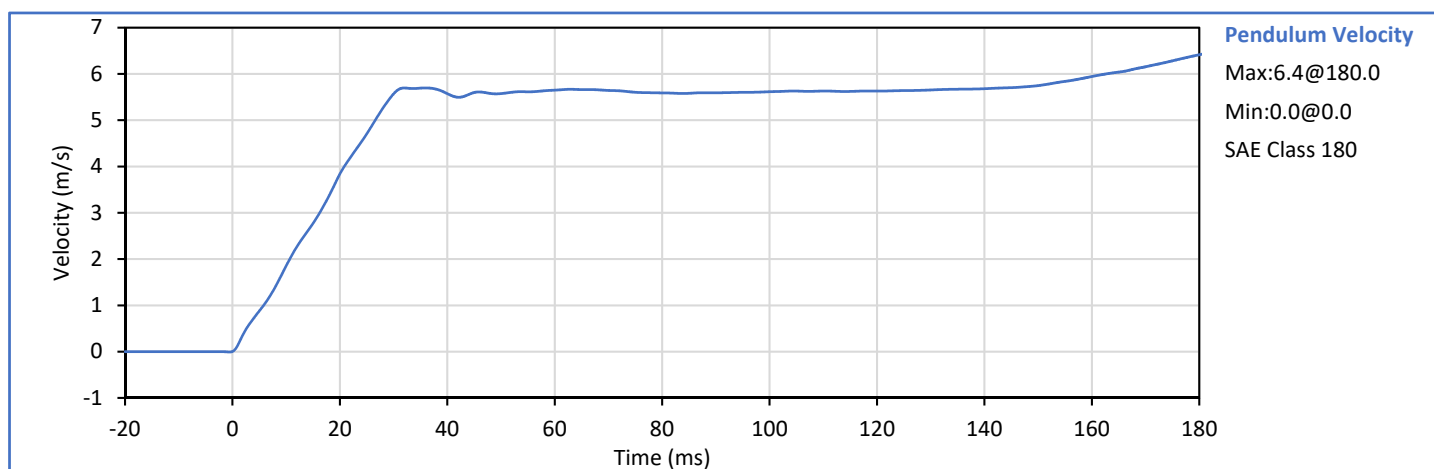


Technician: J. Hernandez

Approved By: P. Puzzuto



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	25	Pass
Pendulum Velocity	m/s	5.95	6.19	6.16	Pass
Pendulum Velocity at 10 ms	m/s	1.50	1.90	1.85	Pass
Pendulum Velocity at 20 ms	m/s	3.10	3.90	3.84	Pass
Pendulum Velocity at 30 ms	m/s	4.60	5.60	5.57	Pass
Peak "D" Plane Rotation	deg	99.0	114.0	104.2	Pass
Peak Moment in Rotation	Nm	-65.0	-53.0	-62.0	Pass
Negative Moment Decay to -10 Nm	ms	94.0	114.0	96.7	Pass
Overall Test Results				Pass	Pass

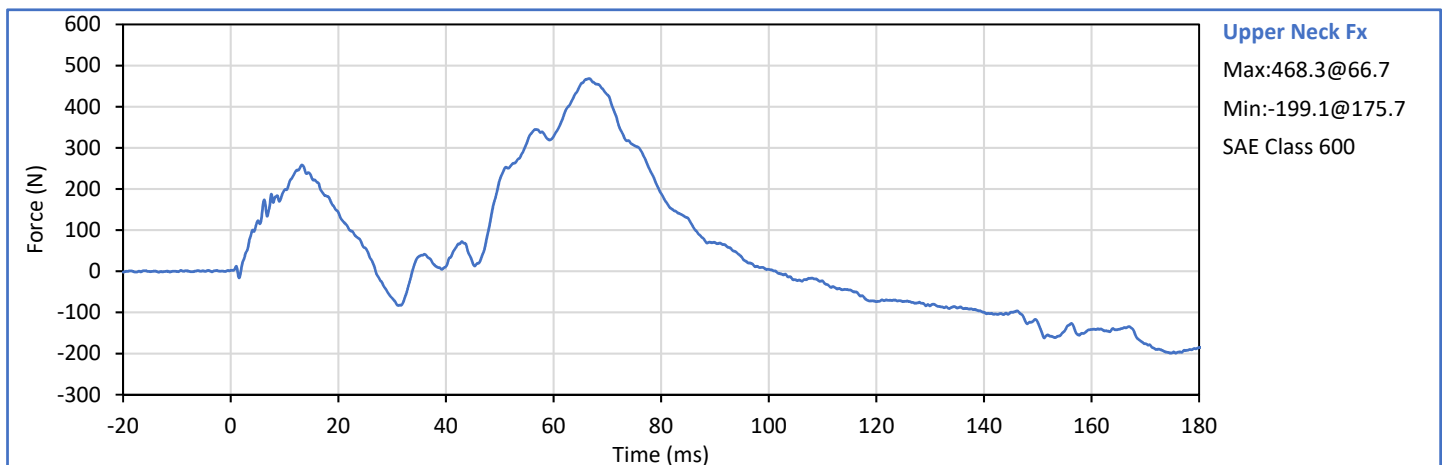
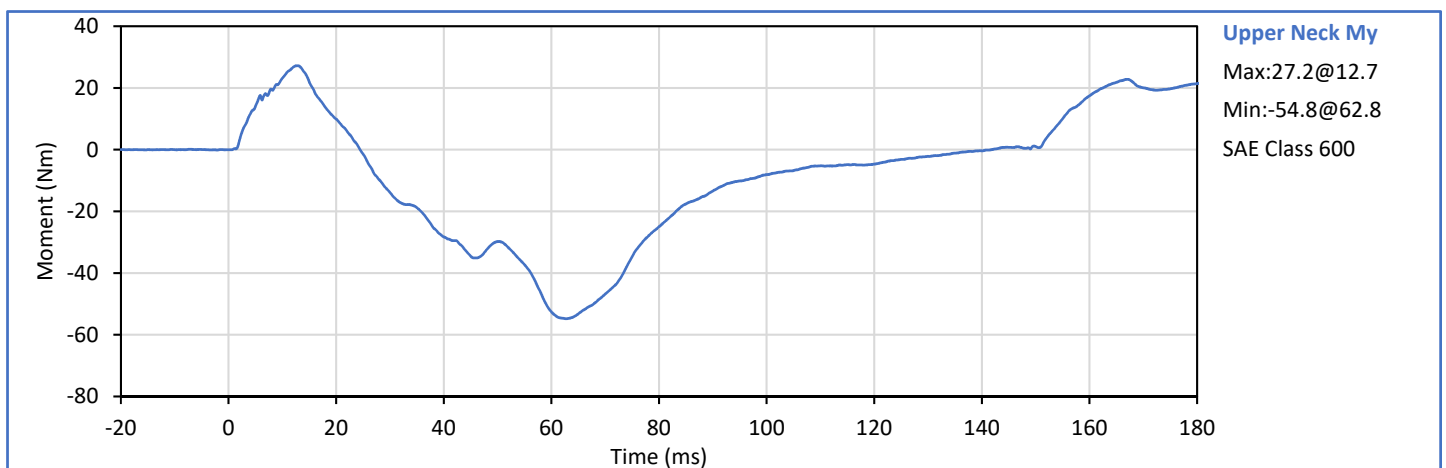
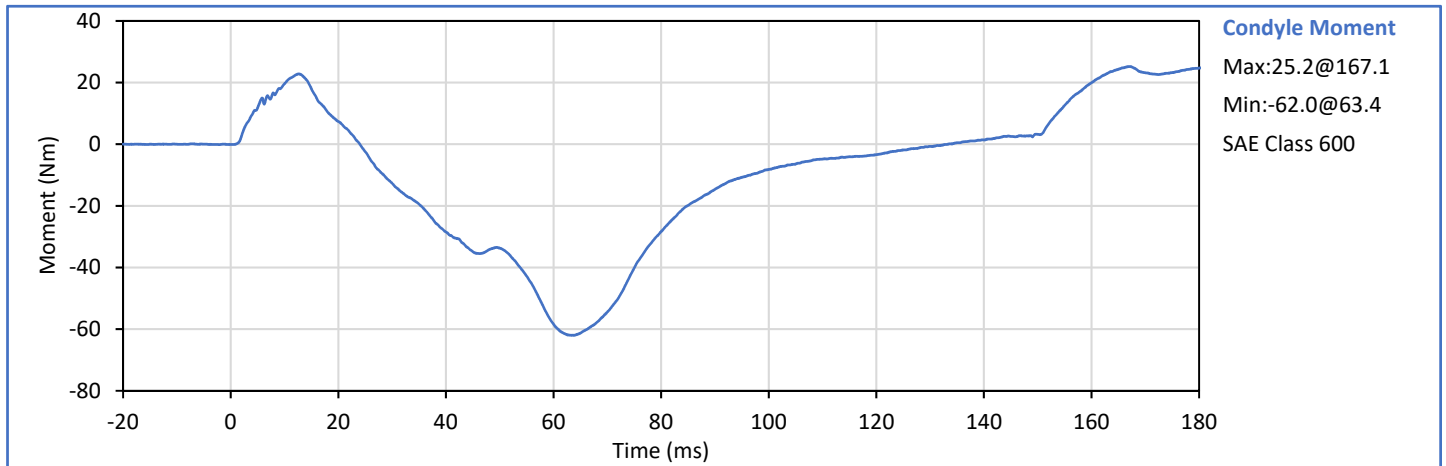


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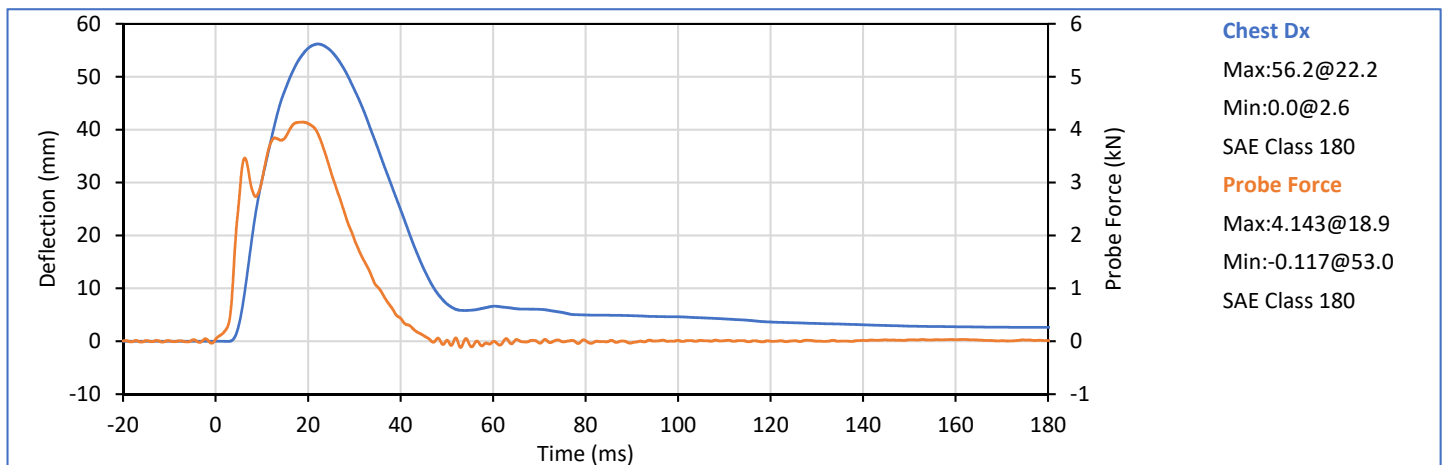
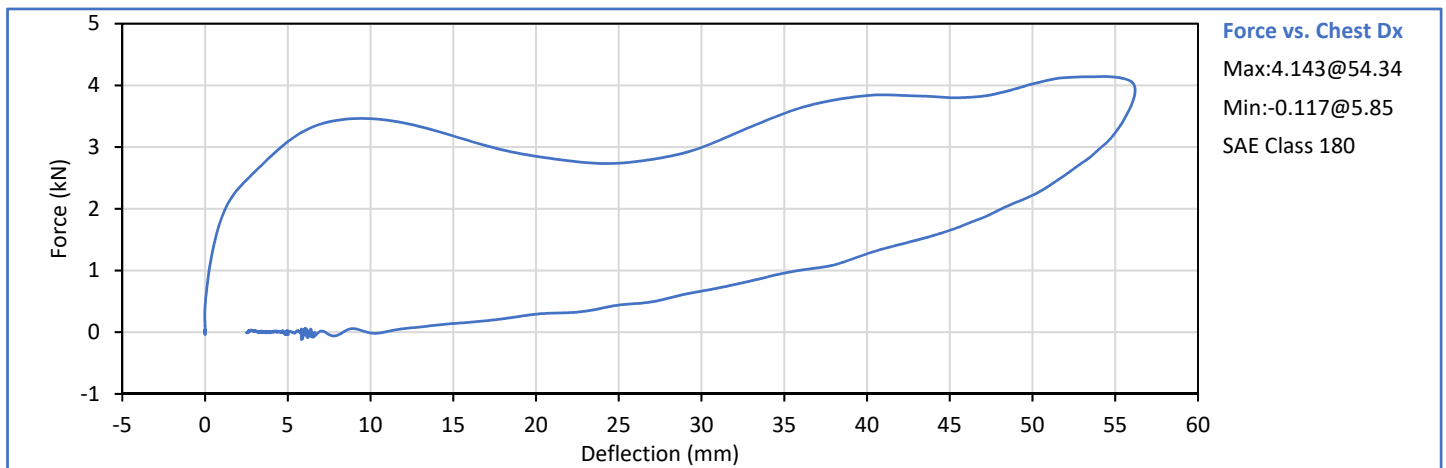
J. Hernandez

Approved By:

P. Puzzuto



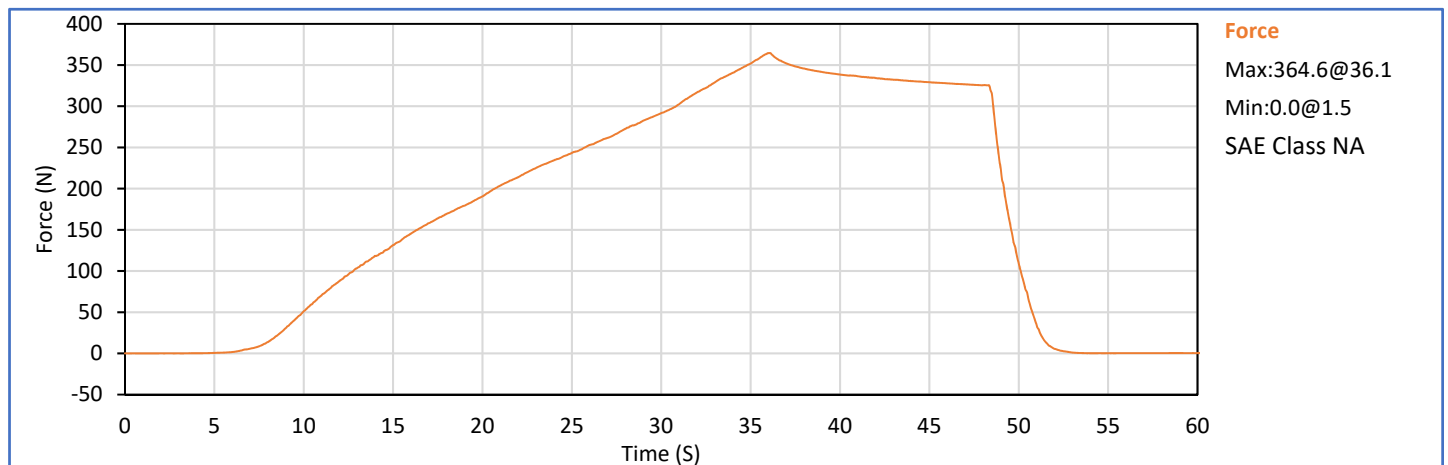
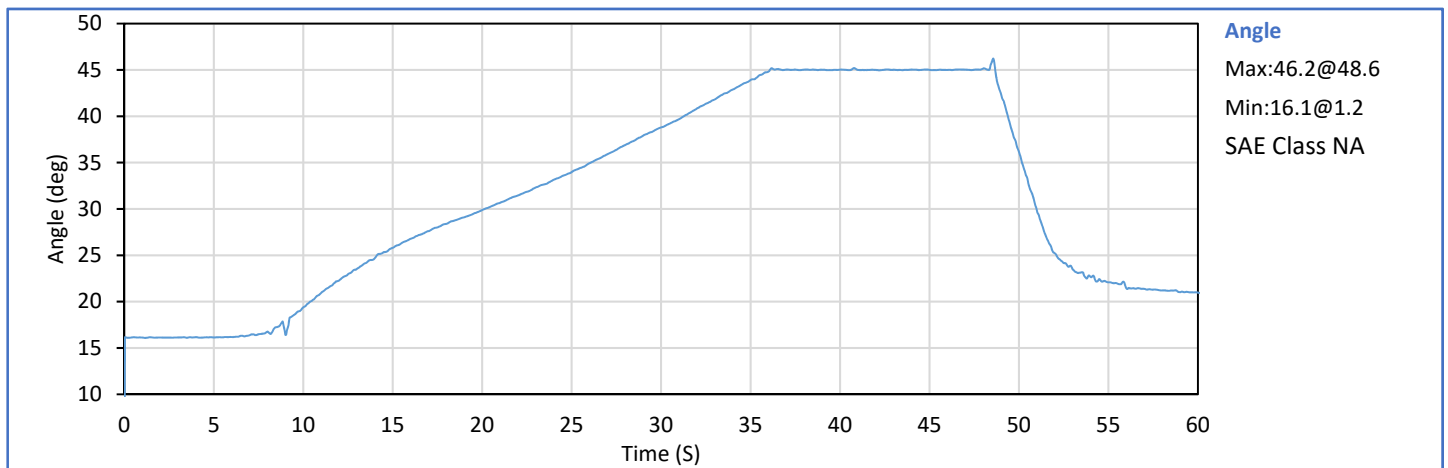
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Humidity	%	10	70	36	Pass
Probe Velocity	m/s	6.59	6.83	6.64	Pass
Peak Chest Deflection	mm	50.0	58.0	56.2	Pass
Peak Probe Force, 50 and 58 mm	kN	3.900	4.400	4.143	Pass
Peak Probe Force, 18 and 50 mm	kN	0.000	4.600	4.026	Pass
Internal Hysteresis	%	69.0	85.0	73.4	Pass
Overall Test Results					Pass



Technician: J. Hernandez

Approved By: P. Puzzuto
 C-18

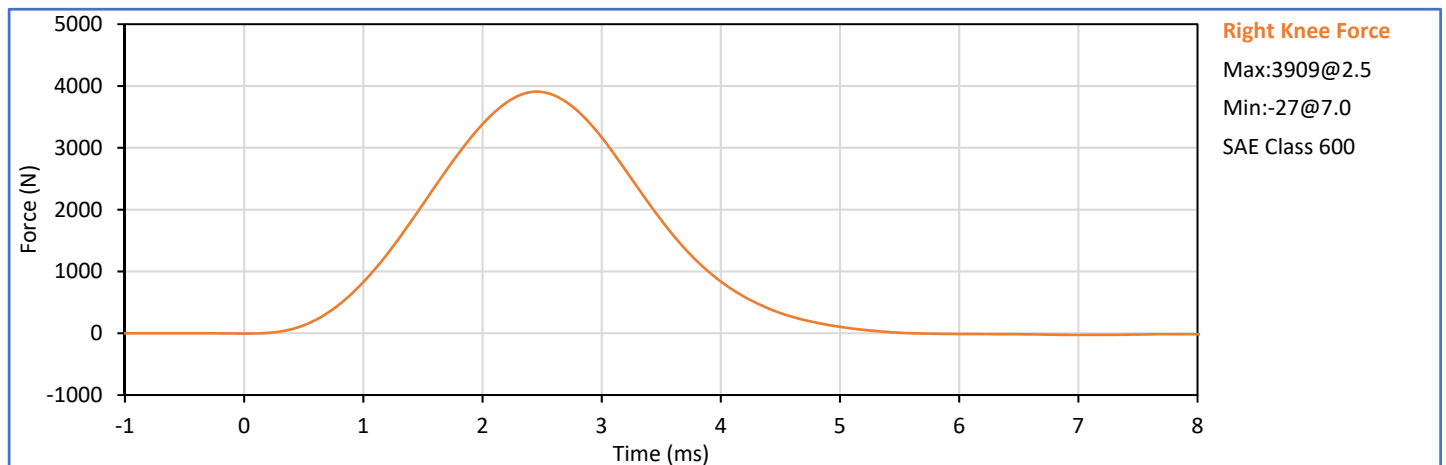
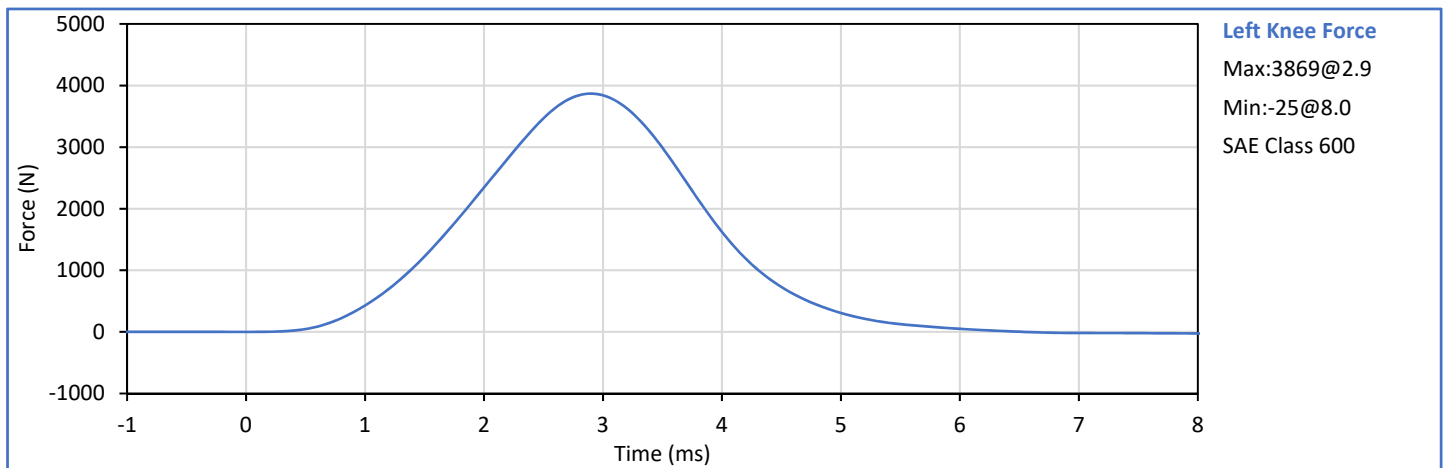
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	25	Pass
Orientation Angle	deg	0.0	20.0	15.5	Pass
Test Initial Angle	deg	11.0	19.0	16.1	Pass
Peak Force at 45° (+/-0.5°)	N	320.0	390.0	364.6	Pass
Torso Flexion Rate	deg/s	0.50	1.50	1.01	Pass
Final Reference Plane Angle	deg	-8.0	8.0	3.4	Pass
Overall Test Results					Pass



Technician: J. Hernandez

Approved By: P. Puzzuto
C-19

	Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
	Laboratory Temperature	°C	18.9	25.6	21.1	Pass
	Laboratory Humidity	%	10	70	25	Pass
Left	Probe Velocity	m/s	2.070	2.130	2.092	Pass
Knee	Peak Resistive Force	N	3450	4060	3869	Pass
Right	Probe Velocity	m/s	2.070	2.130	2.096	Pass
Knee	Peak Resistive Force	N	3450	4060	3909	Pass
Overall Test Results					Pass	



Technician: J. Hernandez

Approved By: P. Puzzuto
C-20

APPENDIX C
Post-Test Dummy Qualification and Performance Verification
Hybrid III 50th Percentile Male ATD
S/N: 360

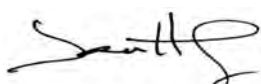
ATD Serial No.: 360

Test Date: 2019-12-16

Dummy Item	Inspect for	Comments	Damage	OK
Entire ATD	Perform general cleaning			✓
Outer Skin	Gashes, rips, cracks			✓
Head	Ballast secure			✓
	General appearance			✓
Neck bracket	Upper neck firmly attached to lower bracket			✓
Neck	Broken or cracked rubber			✓
	Looseness at the condyle joint			✓
Nodding block	Cracked or out of position			✓
Lumbar Spine	Broken or cracked rubber			✓
Ribs	Broken or bent ribs			✓
	Broken or bent rib supports			✓
	Damping material separated or cracked			✓
	Rubber bumpers in place			✓
Chest Displ.	Bent shaft			✓
Assembly	Slider arm riding in track			✓
Sensors	Check cables for cuts, tears			✓
	Check for damaged insulation			✓
Accelerometer	Head mounting secure			✓
Mounting	Chest mounting secure			✓
Knees	Skin condition			✓
	Insert (do not remove)			✓
	Casting			✓
Limbs	Normal movement and adjustment			✓
Knee Sliders	Wires intact			✓
	Rubber returned to "resting" position			✓
Pelvis	Broken			✓
Other	Describe below as needed			✓

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician: 
J. Hernandez

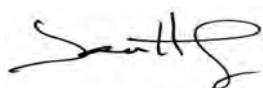
Approved By: 
P. Puzzuto

ATD Serial No.: 360

Test Date: 2019-12-16

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	26	Pass
A - Total sitting height	mm	879	889	886	Pass
B - Shoulder pivot height	mm	505	521	513	Pass
C - 'H' point height	mm	84	89	88	Pass
D - 'H' point location from backline	mm	135	140	138	Pass
E - Shoulder pivot from backline	mm	84	94	92	Pass
F - Thigh clearance	mm	140	155	149	Pass
G - Back of elbow to wrist pivot	mm	290	305	301	Pass
H - Head back to backline	mm	41	46	44	Pass
I - Shoulder to elbow length	mm	330	345	337	Pass
J - Elbow rest height	mm	190	211	201	Pass
K - Buttock to knee length	mm	579	604	587	Pass
L - Popliteal length	mm	429	455	437	Pass
M - Knee pivot height	mm	485	500	495	Pass
N - Buttock popliteal length	mm	452	477	470	Pass
O - Chest depth without jacket	mm	213	229	224	Pass
P - Foot length	mm	251	267	263	Pass
V - Shoulder breadth	mm	422	437	434	Pass
W - Foot breadth	mm	91	107	100	Pass
Y - Chest circum. (w/chest jacket)	mm	970	1001	985	Pass
Z - Waist circum.	mm	836	866	847	Pass
AA - Location for chest circum.	mm	429	434	431	Pass
BB - Location for waist circum.	mm	226	231	228	Pass
			Overall Test Results		Pass

Technician:



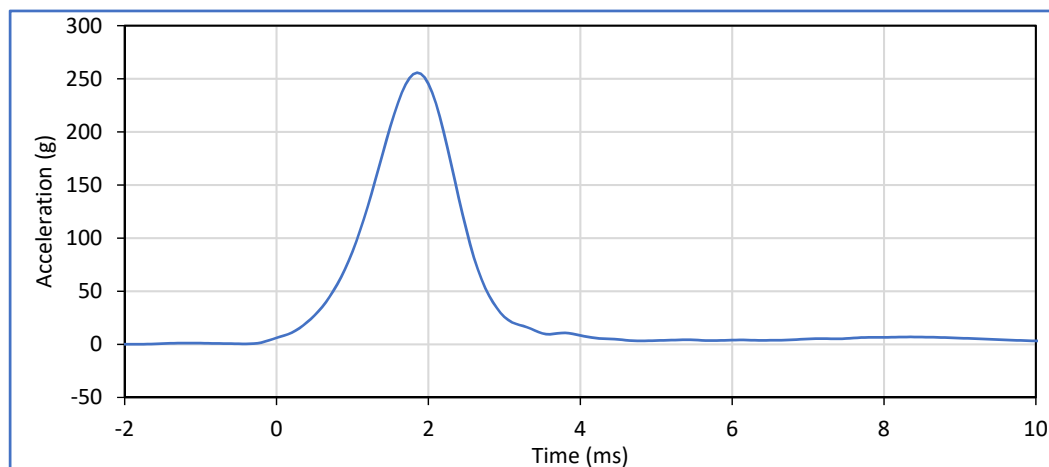
J. Hernandez

Approved By:



P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.7	Pass
Laboratory Relative Humidity	%	10	70	28	Pass
Peak Resultant Acceleration	g	225.0	275.0	255.7	Pass
Peak Lateral Acceleration	g	-15.0	15.0	1.6	Pass
Oscillations After Main Pulse	%	0.0	10.0	2.7	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results	Pass	

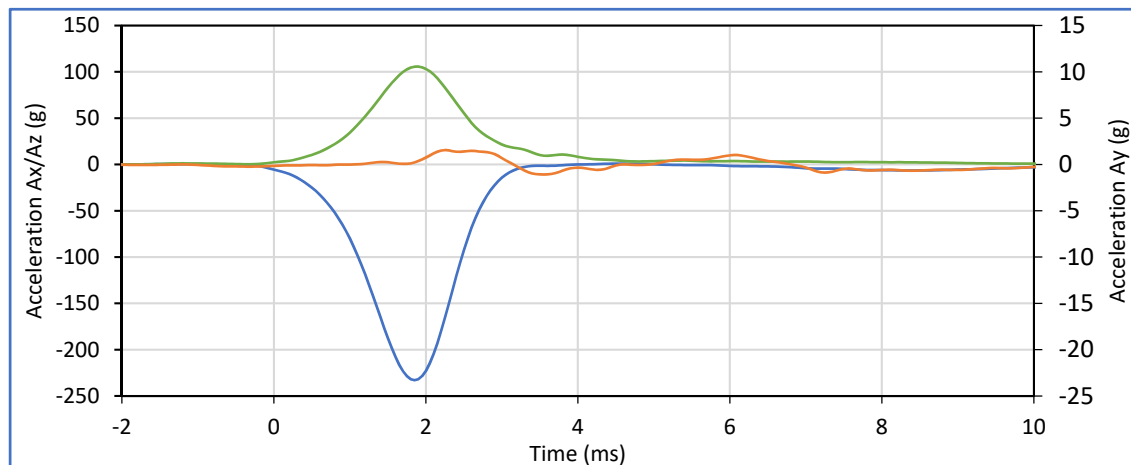


Head Resultant

Max:255.7@1.9

Min:3.2@10.0

SAE Class 1000



Head Ax

Max:0.9@4.5

Min:-232.9@1.9

SAE Class 1000

Head Ay

Max:1.6@2.3

Min:-1.1@3.6

SAE Class 1000

Head Az

Max:105.7@1.9

Min:0.9@10.0

SAE Class 1000

Technician:

J. Hernandez

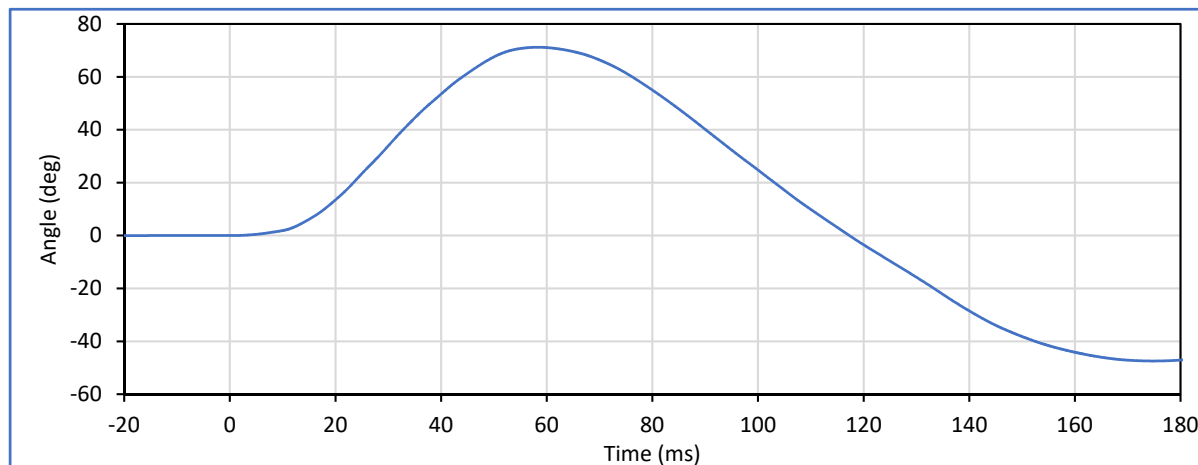
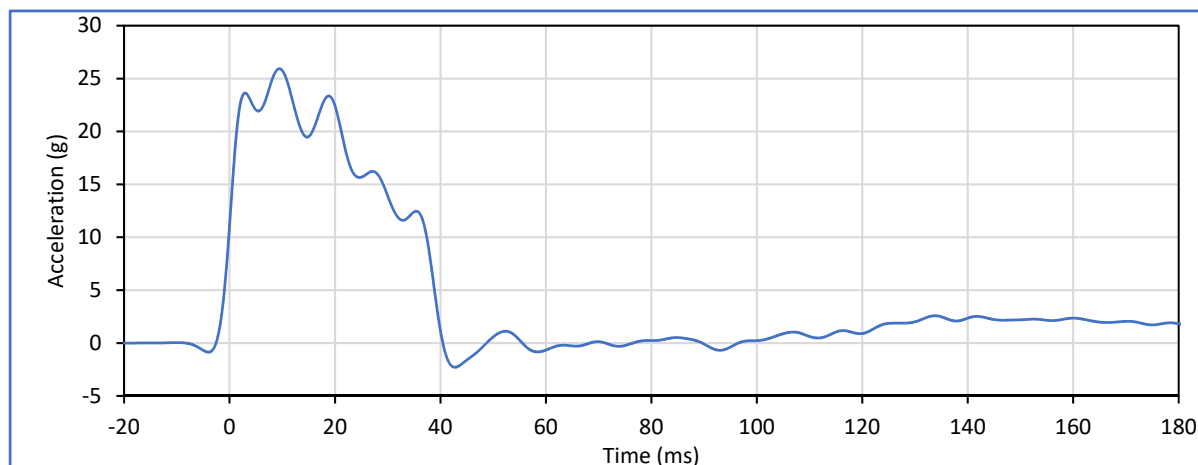
J. Hernandez

Approved By:

P. Puzzuto

P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	19	Pass
Pendulum Velocity	m/s	6.89	7.13	6.92	Pass
Pendulum Deceleration at 10 ms	g	22.5	27.5	25.8	Pass
Pendulum Deceleration at 20 ms	g	17.6	22.6	22.4	Pass
Pendulum Deceleration at 30 ms	g	12.5	18.5	13.9	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	29.0	13.9	Pass
Deceleration Decay to Cross 5 g	ms	34.0	42.0	38.9	Pass
"D" Plane Rotation peak	deg	64.0	78.0	71.2	Pass
	ms	57.0	64.0	58.4	Pass
"D" Plane Rotation Decay To Zero	ms	113.0	128.0	117.4	Pass
Moment About Occipital Condyle	Nm	88.1	108.5	91.2	Pass
	ms	47.0	58.0	53.2	Pass
Moment Decay, Peak to Zero	ms	97.0	107.0	97.8	Pass
Overall Test Results				Pass	



Technician:

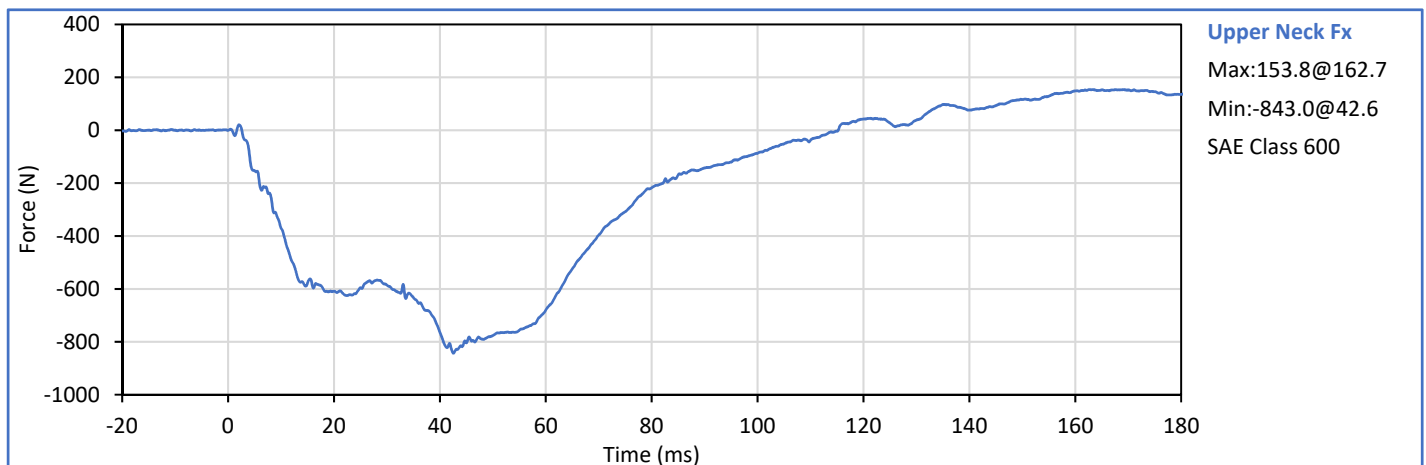
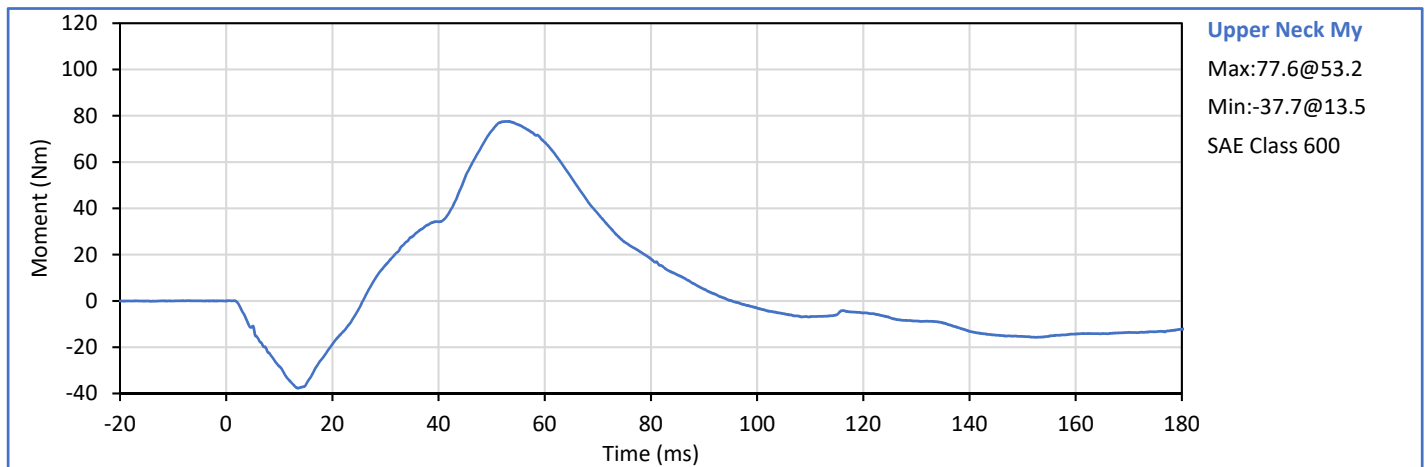
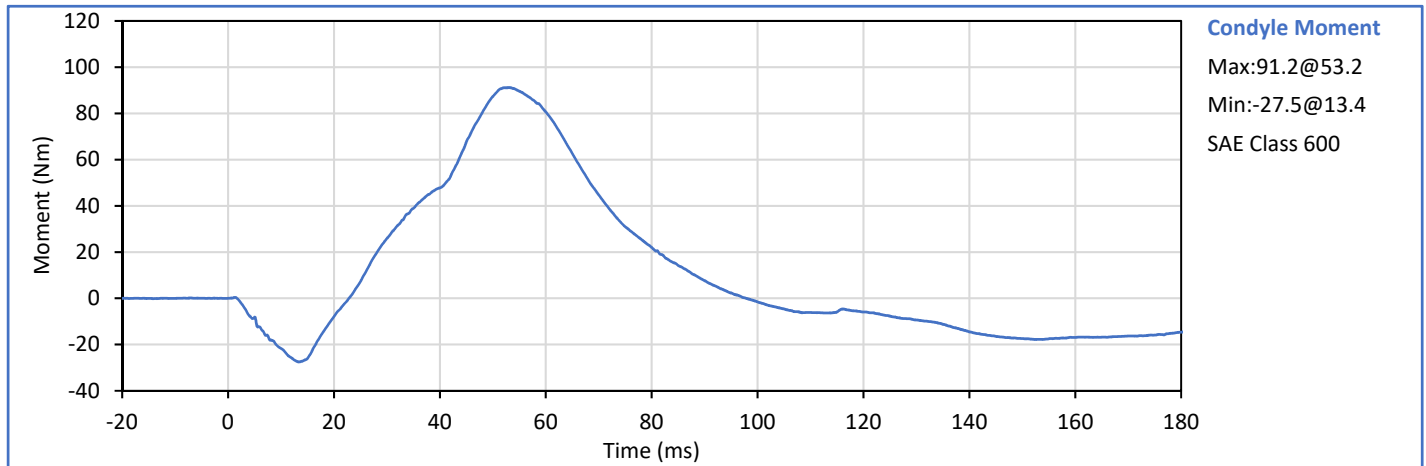
J. Hernandez

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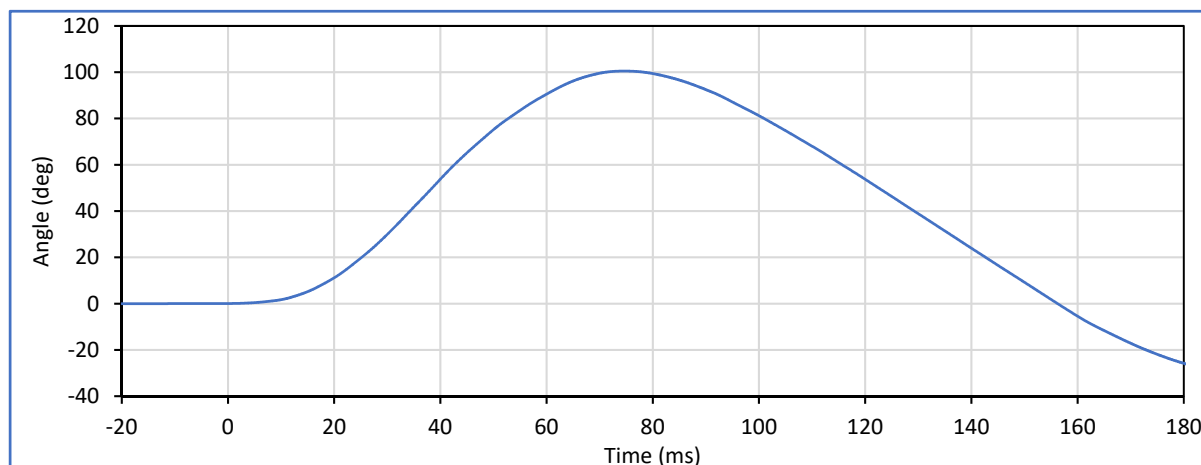
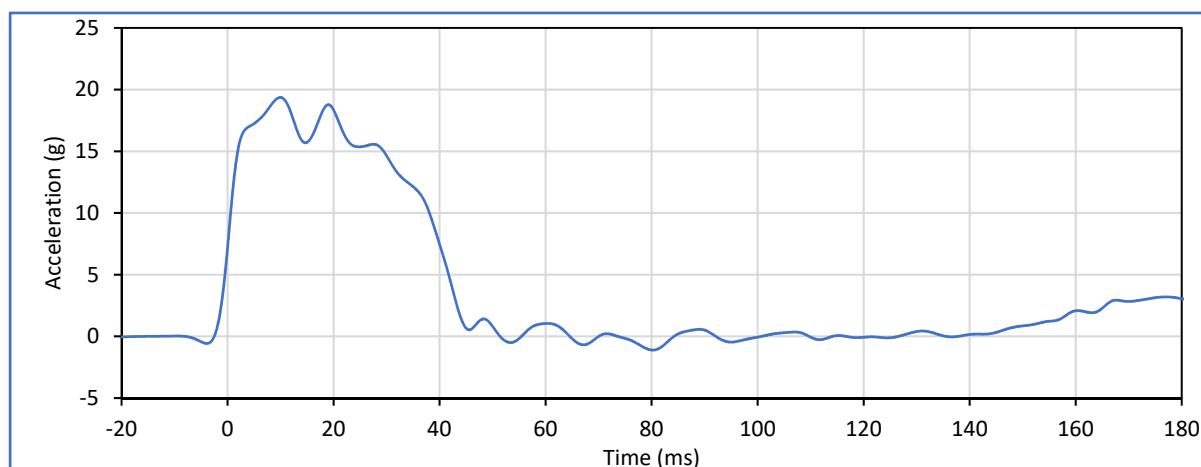
Approved By:

P. Puzzuto

P. Puzzuto



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	20	Pass
Pendulum Velocity	m/s	5.94	6.19	6.05	Pass
Pendulum Deceleration at 10 ms	g	17.2	21.2	19.4	Pass
Pendulum Deceleration at 20 ms	g	14.0	19.0	18.4	Pass
Pendulum Deceleration at 30 ms	g	11.0	16.0	14.6	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	22.0	14.6	Pass
Deceleration Decay to Cross 5 g	ms	38.0	46.0	41.7	Pass
"D" Plane Rotation peak	deg	81.0	106.0	100.5	Pass
	ms	72.0	82.0	74.6	Pass
"D" Plane Rotation Decay To Zero	ms	147.0	174.0	156.3	Pass
Moment About Occipital Condyle	Nm	-79.9	-52.9	-71.5	Pass
	ms	65.0	79.0	69.2	Pass
Moment Decay, Peak to Zero	ms	120.0	148.0	137.1	Pass
Overall Test Results				Pass	



Technician:

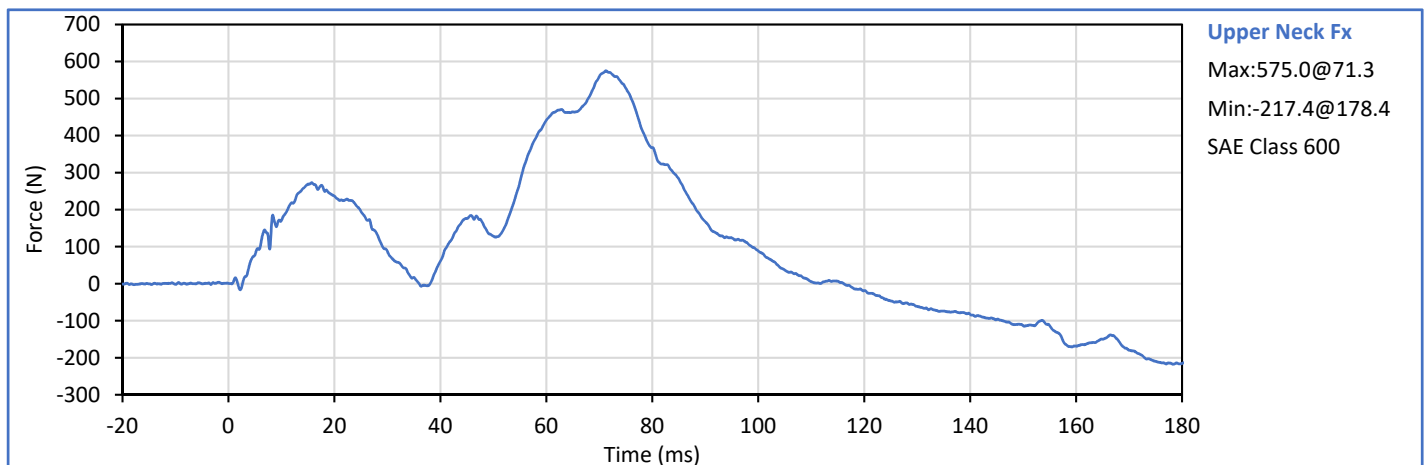
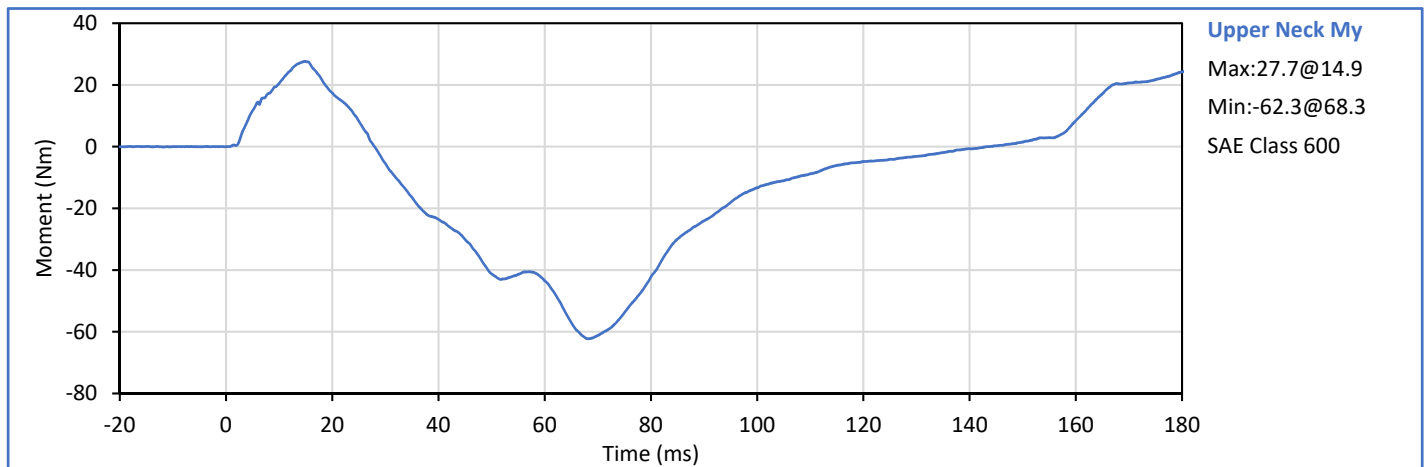
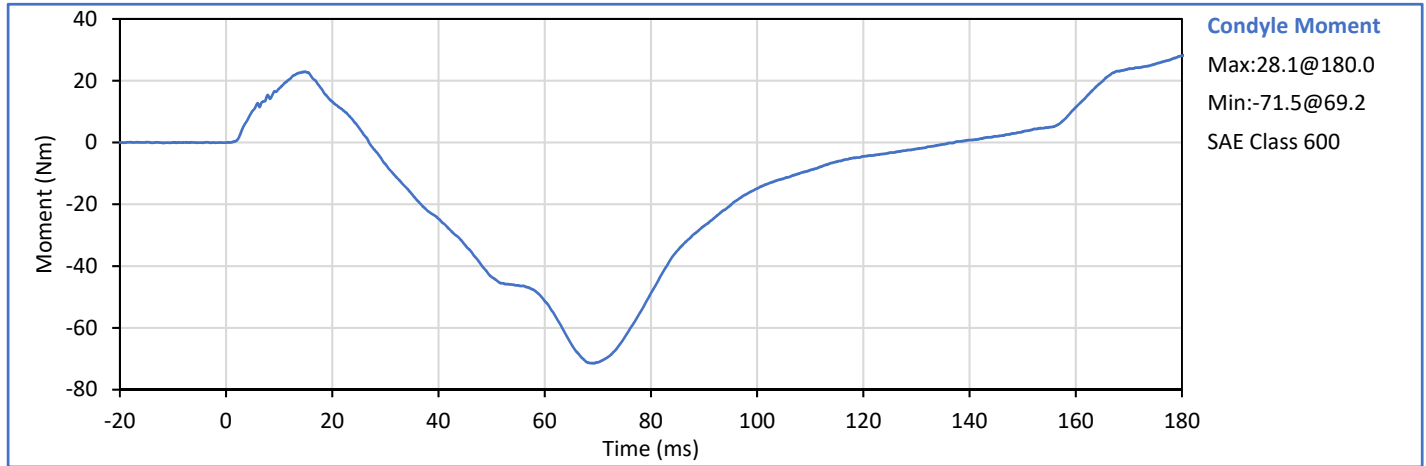
J. Hernandez

J. Hernandez

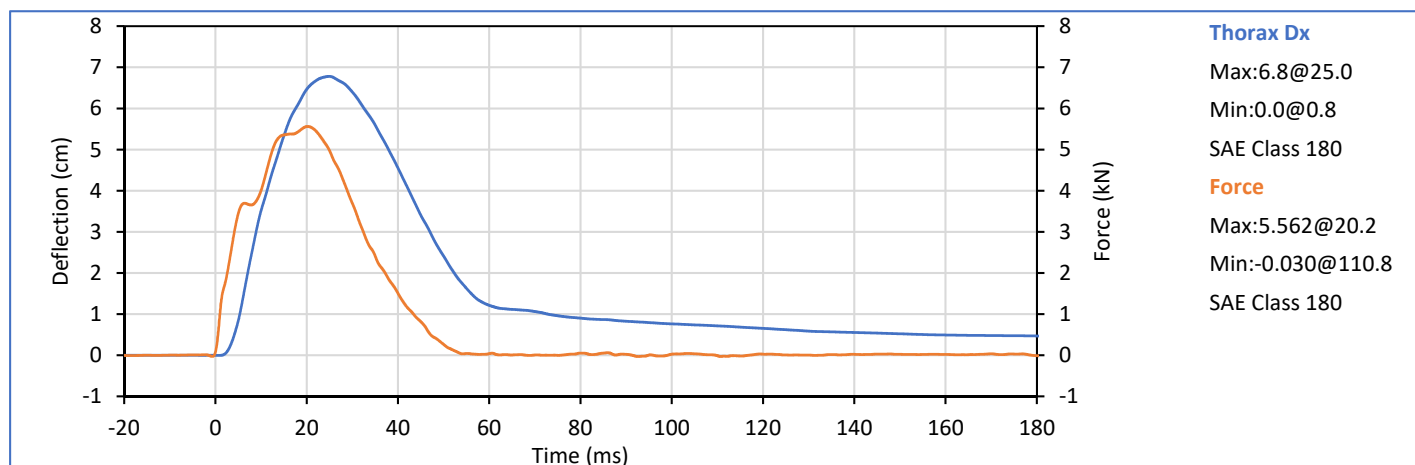
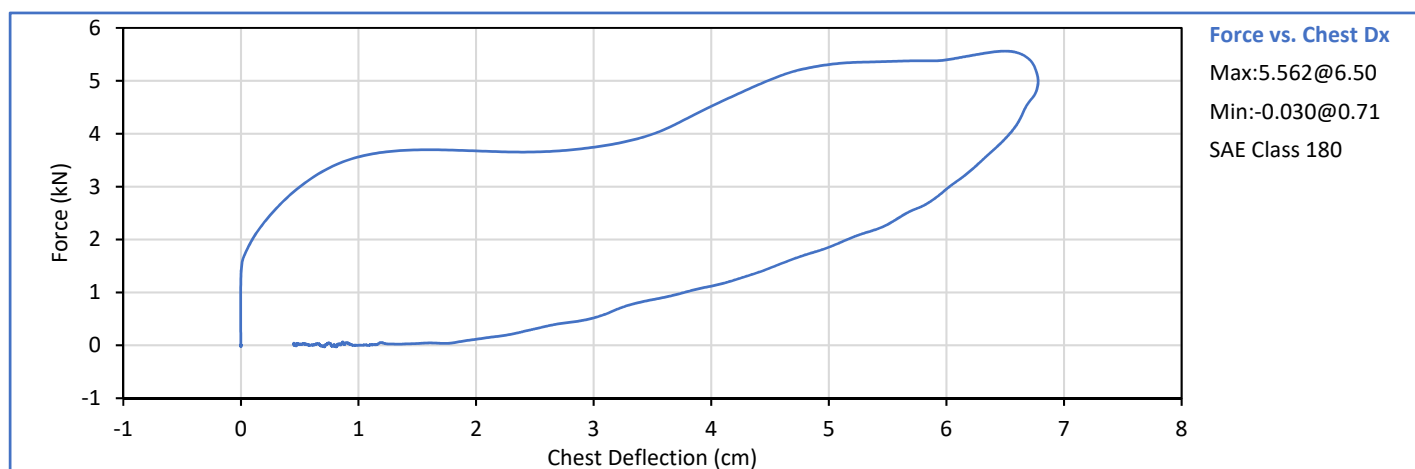
Approved By:

P. Puzzuto

P. Puzzuto



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	26	Pass
Probe Velocity	m/s	6.58	6.82	6.76	Pass
Peak Chest Deflection	cm	6.35	7.26	6.78	Pass
Peak Probe Force	kN	5.159	5.893	5.562	Pass
Internal Hysteresis	%	69.0	85.0	72.5	Pass
Overall Test Results				Pass	Pass



Technician:

J. Hernandez

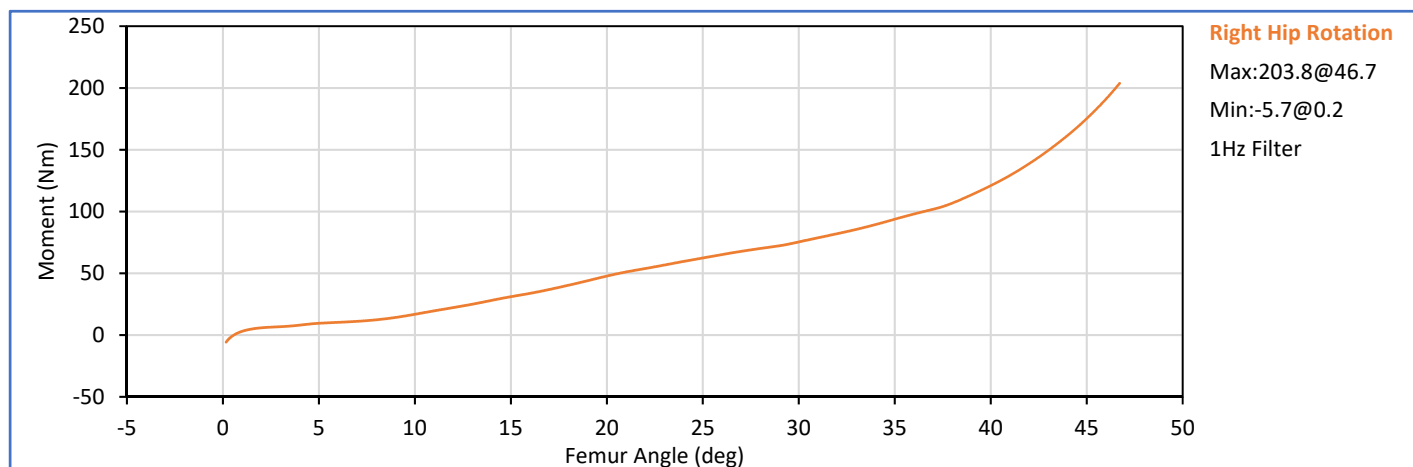
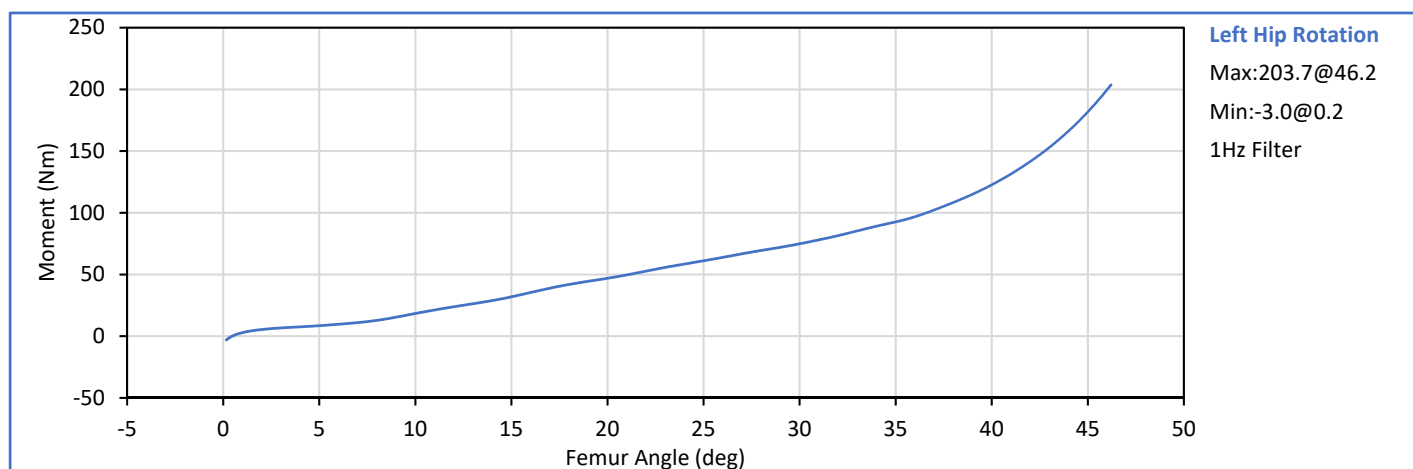
J. Hernandez

Approved By:

P. Puzzuto

P. Puzzuto

Tested Parameter		Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature		°C	18.9	25.6	21.2	Pass
Laboratory Relative Humidity		%	10	70	21	Pass
Left Hip	Left Hip Rotation Rate	deg/s	5.0	10.0	5.8	Pass
	Left Femur Torque at 30°	Nm	0.0	95.0	74.9	Pass
	Left Hip Rotation at 203 Nm	deg	40.0	50.0	46.2	Pass
Right Hip	Right Hip Rotation Rate	deg/s	5.0	10.0	5.8	Pass
	Right Femur Torque at 30°	Nm	0.0	95.0	75.4	Pass
	Right Hip Rotation at 203 Nm	deg	40.0	50.0	46.7	Pass
Overall Test Results						Pass



Technician:

J. Hernandez

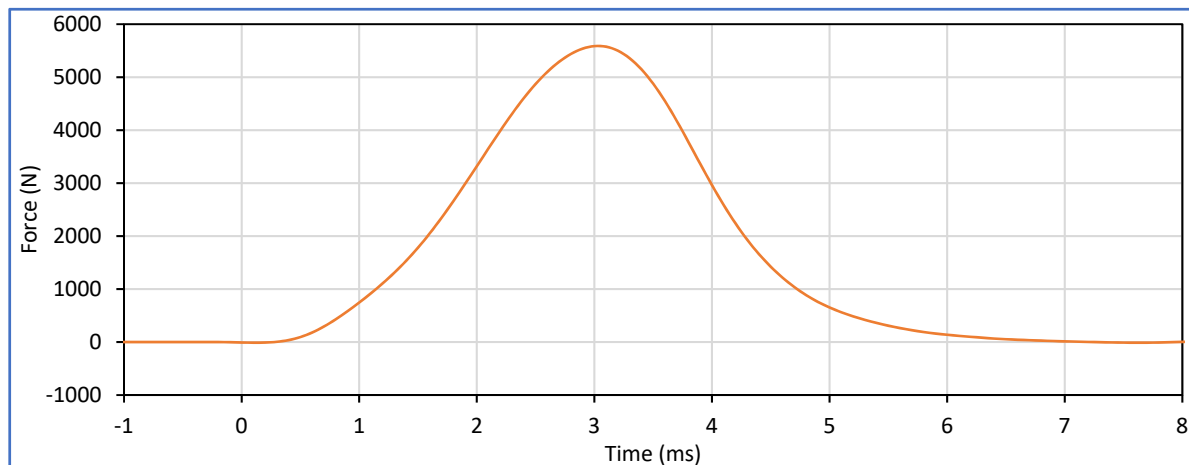
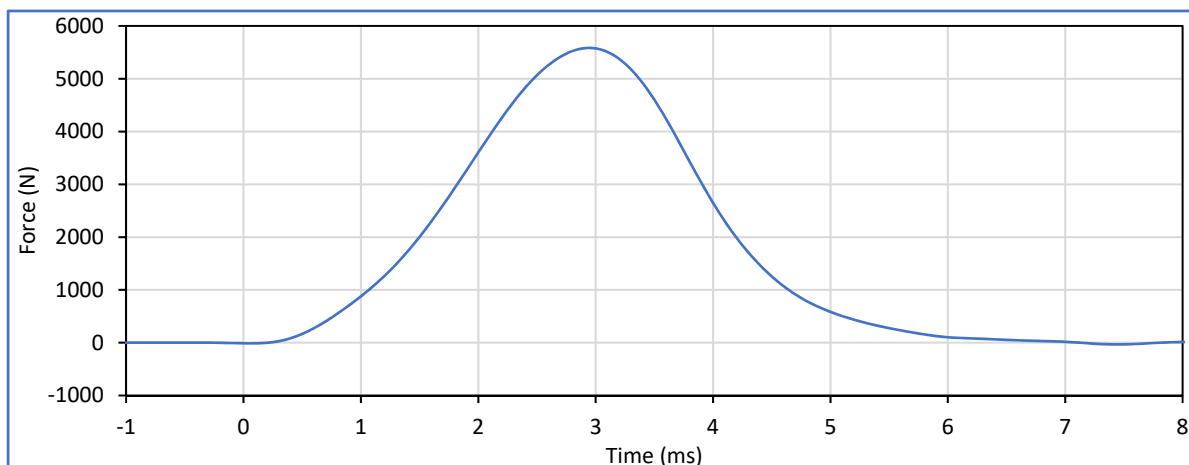
J. Hernandez

Approved By:

P. Puzzuto

P. Puzzuto

Tested Parameter		Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature		°C	18.9	25.6	21.2	Pass
Laboratory Relative Humidity		%	10	70	21	Pass
Left Knee	Probe Velocity	m/s	2.070	2.130	2.124	Pass
	Peak Resistive Force	N	4715	5782	5584	Pass
Right Knee	Probe Velocity	m/s	2.070	2.130	2.122	Pass
	Peak Resistive Force	N	4715	5782	5589	Pass
Overall Test Results					Pass	



Technician:

J. Hernandez

J. Hernandez

Approved By:

P. Puzzuto

P. Puzzuto

APPENDIX C
Post-Test ATD Qualification and Performance Verification
Hybrid III 5th Percentile Female ATD
S/N: 141

Dummy Item	Inspect for	Comments	Damage	Okay
Entire ATD	Perform general cleaning			✓
Outer Skin	Gashes, rips, cracks			✓
Head	Ballast secure			✓
	General appearance			✓
Neck bracket	Upper neck firmly attached to lower bracket			✓
Neck	Broken or cracked rubber			✓
	Looseness at the condyle joint			✓
Nodding block	Cracked or out of position			✓
Lumbar Spine	Broken or cracked rubber			✓
Ribs	Broken or bent ribs			✓
	Broken or bent rib supports			✓
	Damping material separated or cracked			✓
	Rubber bumpers in place			✓
Chest Displ.	Bent shaft			✓
Assembly	Slider arm riding in track			✓
Sensors	Check cables for cuts, tears			✓
	Check for damaged insulation			✓
Accelerometer	Head mounting secure			✓
Mounting	Chest mounting secure			✓
Knees	Skin condition			✓
	Insert (do not remove)			✓
	Casting			✓
Limbs	Normal movement and adjustment			✓
Knee Sliders	Wires intact			✓
	Rubber returned to "resting" position			✓
Pelvis	Broken			✓
Other	Describe below as needed			✓

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician:

J. Hernandez

Approved By:

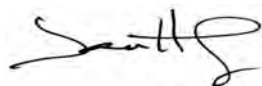
P. Puzzuto

ATD Serial No.: 141

Test Date: 2019-12-16

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	22	Pass
A - Total sitting height	mm	775	800	788	Pass
B - Shoulder pivot height	mm	432	457	453	Pass
C - 'H' point height	mm	81	86	86	Pass
D - 'H' point location from backline	mm	145	150	148	Pass
E - Shoulder pivot from backline	mm	69	84	78	Pass
F - Thigh clearance	mm	119	135	128	Pass
G - Back of elbow to wrist pivot	mm	244	259	254	Pass
H - Head back to backline	mm	41	46	43	Pass
I - Shoulder to elbow length	mm	277	297	287	Pass
J - Elbow rest height	mm	183	203	197	Pass
K - Buttock to knee length	mm	521	546	531	Pass
L - Popliteal length	mm	356	376	367	Pass
M - Knee pivot height	mm	394	419	407	Pass
N - Buttock popliteal length	mm	414	439	428	Pass
O - Chest depth without jacket	mm	175	191	183	Pass
P - Foot length	mm	219	234	231	Pass
R - Buttock to Knee Pivot Length	mm	457	483	473	Pass
S - Head Breadth	mm	137	147	144	Pass
T - Head Depth	mm	178	188	184	Pass
U - Hip Breadth	mm	300	315	308	Pass
V - Shoulder breadth	mm	351	366	360	Pass
W - Foot breadth	mm	79	94	88	Pass
X - Head circum.	mm	528	549	535	Pass
Y - Chest circum. (w/chest jacket)	mm	851	881	868	Pass
Z - Waist circum.	mm	760	790	776	Pass
AA - Location for chest circum.	mm	333	358	339	Pass
BB - Location for waist circum.	mm	160	170	168	Pass
			Overall Test Results		Pass

Technician:



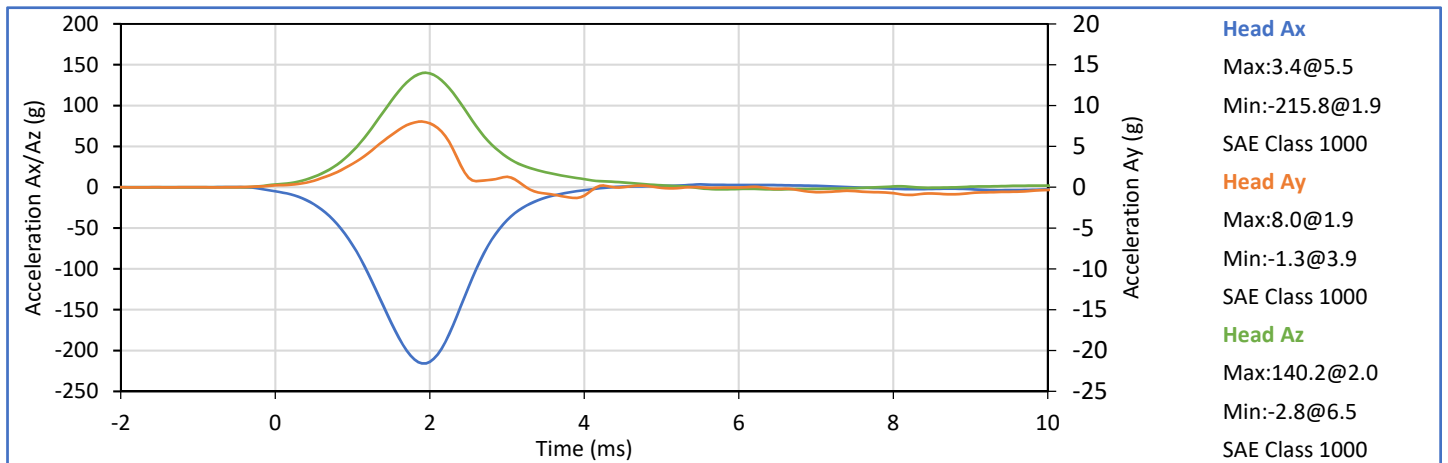
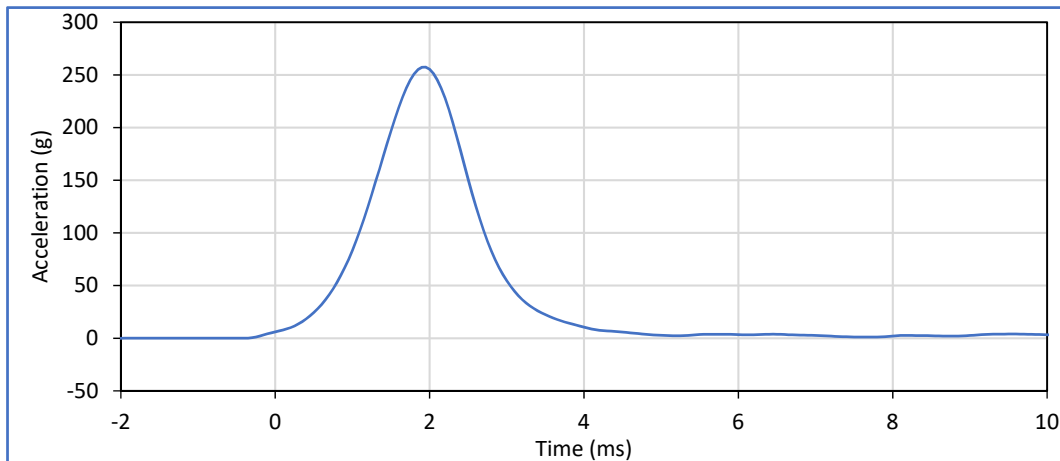
J. Hernandez

Approved By:



P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	28	Pass
Peak Resultant Acceleration	g	250.0	300.0	257.4	Pass
Peak Lateral Acceleration	g	-15.0	15.0	8.0	Pass
Oscillations After Main Pulse	%	0.0	10.0	1.5	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results	Pass	



Technician:

J. Hernandez

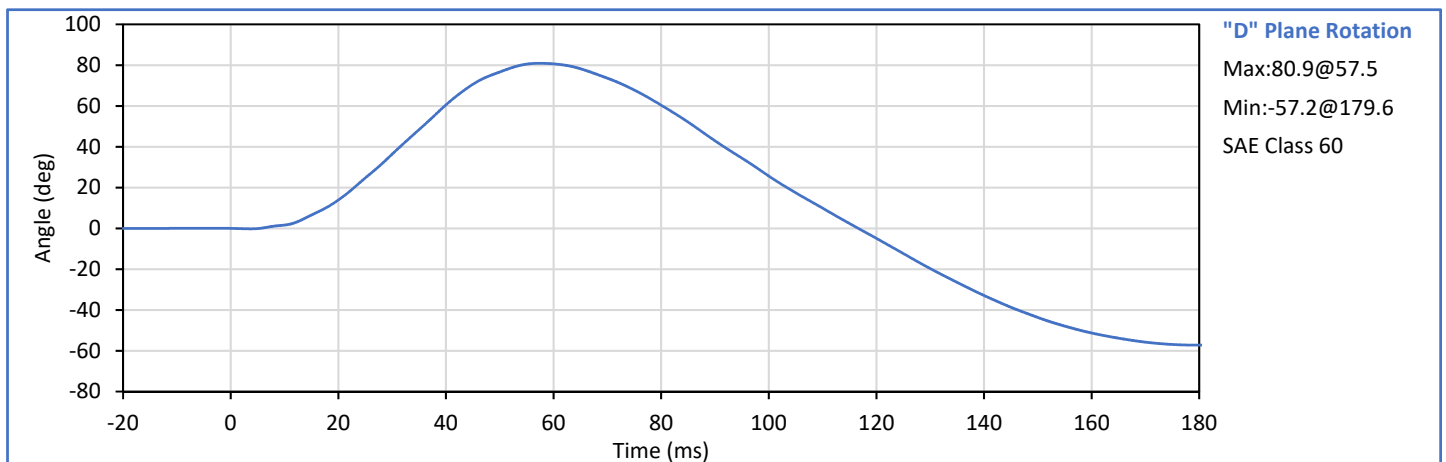
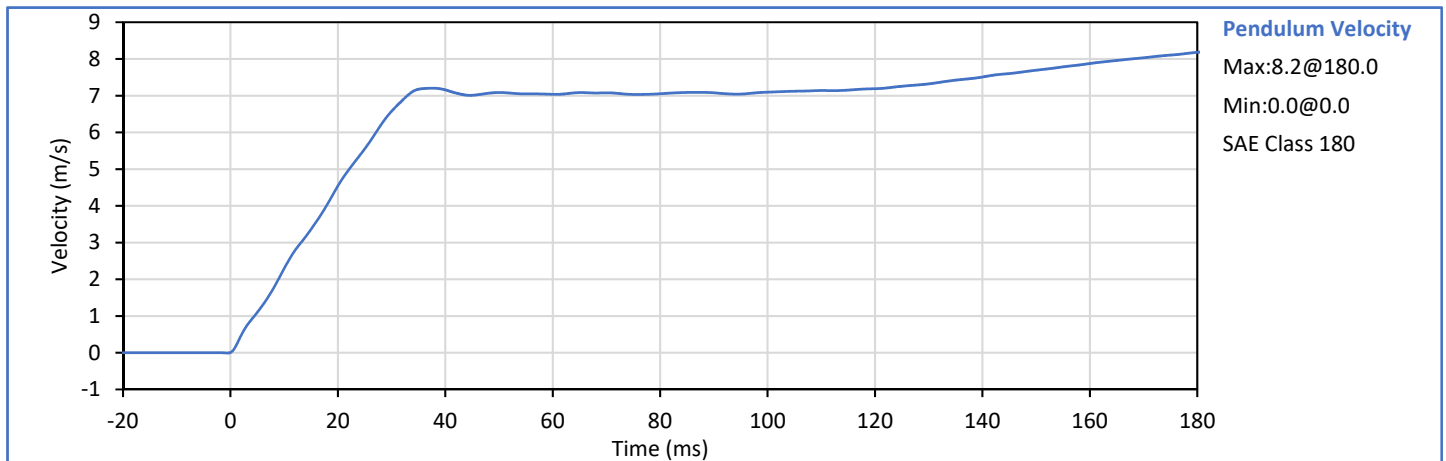
Approved By:

P. Puzzuto

ATD Serial No.: 141

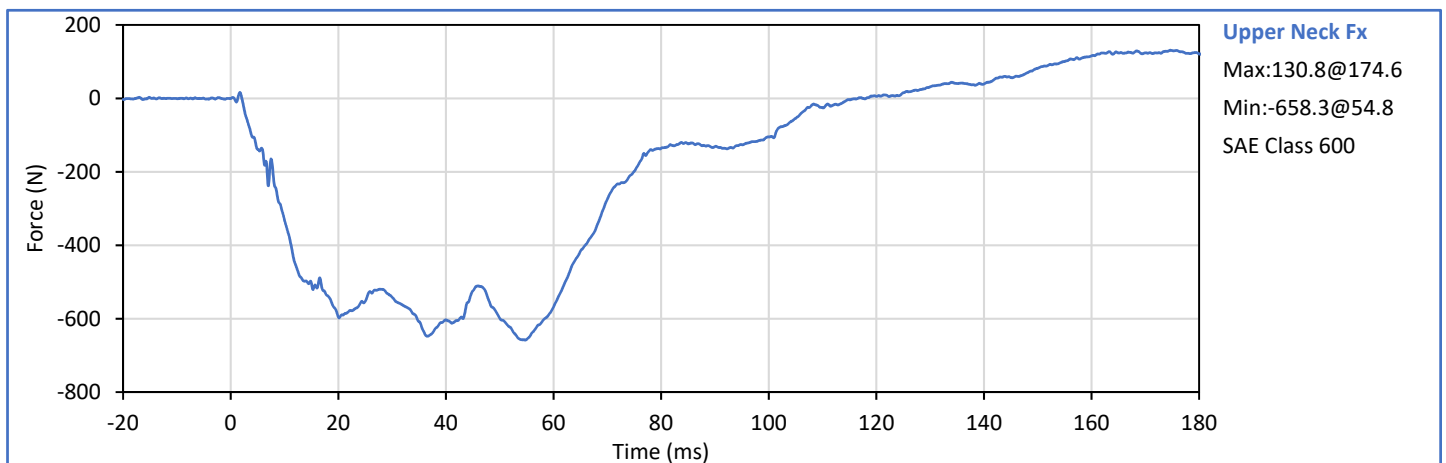
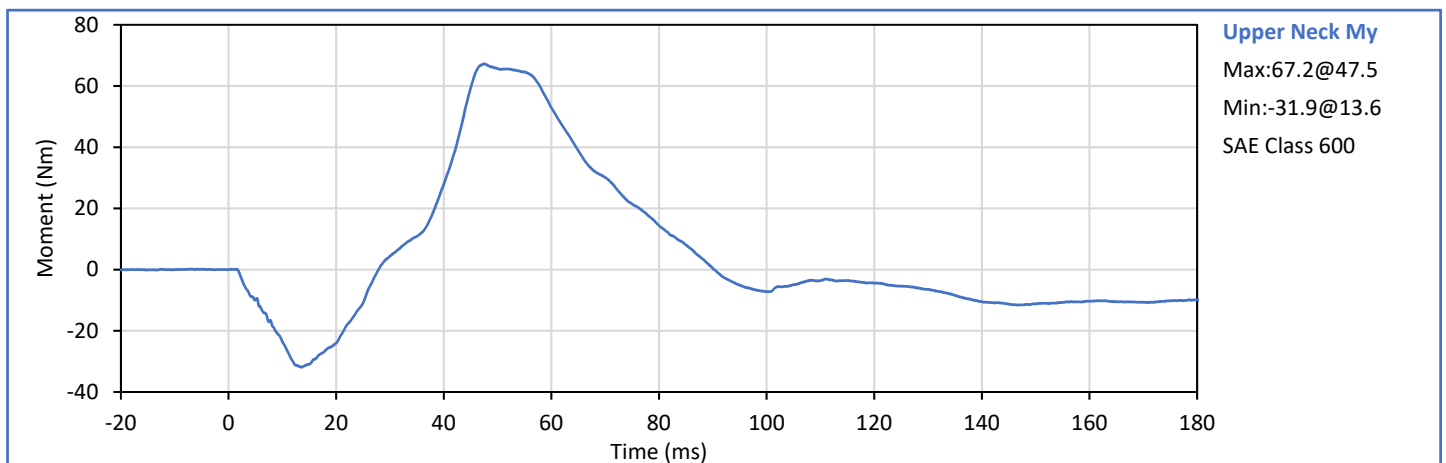
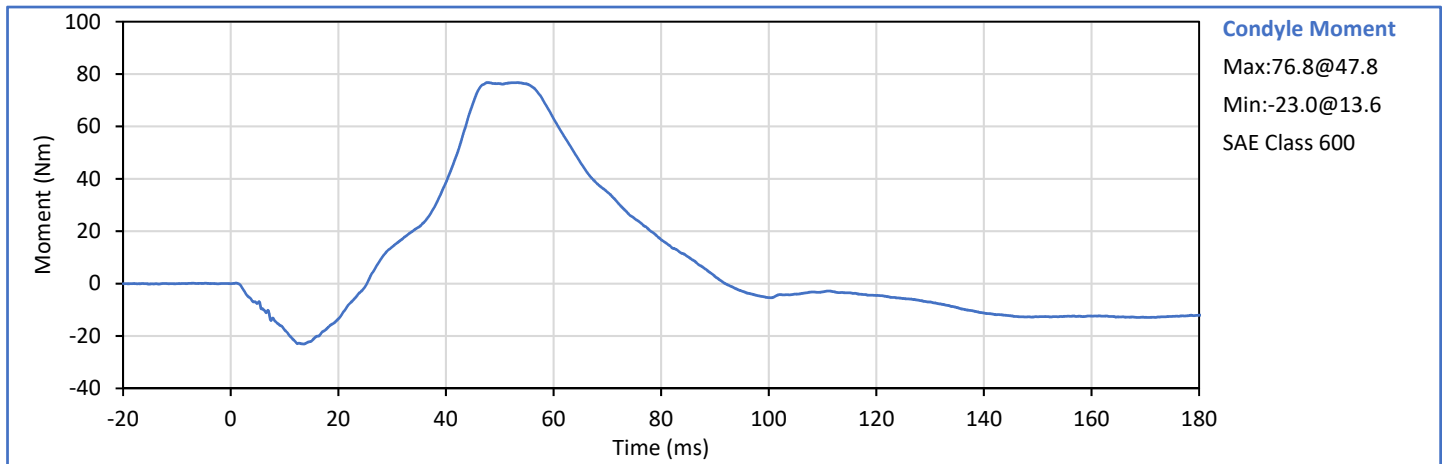
Test Date: 2019-12-18

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	18	Pass
Pendulum Velocity	m/s	6.89	7.13	7.02	Pass
Pendulum Velocity at 10 ms	m/s	2.10	2.50	2.29	Pass
Pendulum Velocity at 20 ms	m/s	4.00	5.00	4.54	Pass
Pendulum Velocity at 30 ms	m/s	5.80	7.00	6.58	Pass
Peak "D" Plane Rotation	deg	77.0	91.0	80.9	Pass
Peak Moment in Rotation	Nm	69.0	83.0	76.8	Pass
Positive Moment Decay to 10 Nm	ms	80.0	100.0	85.3	Pass
Overall Test Results				Pass	Pass

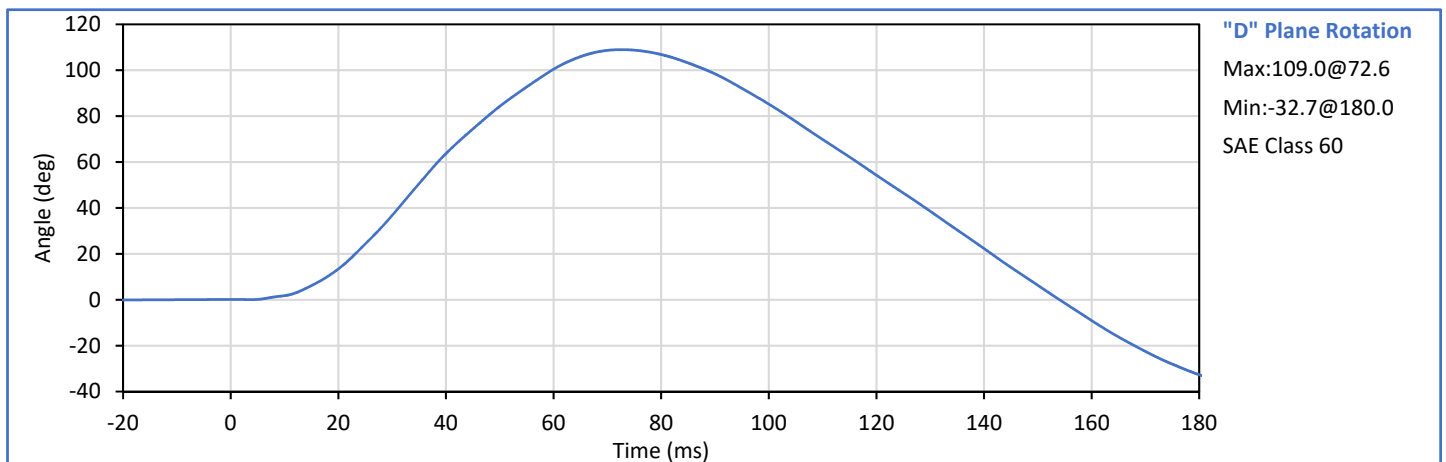
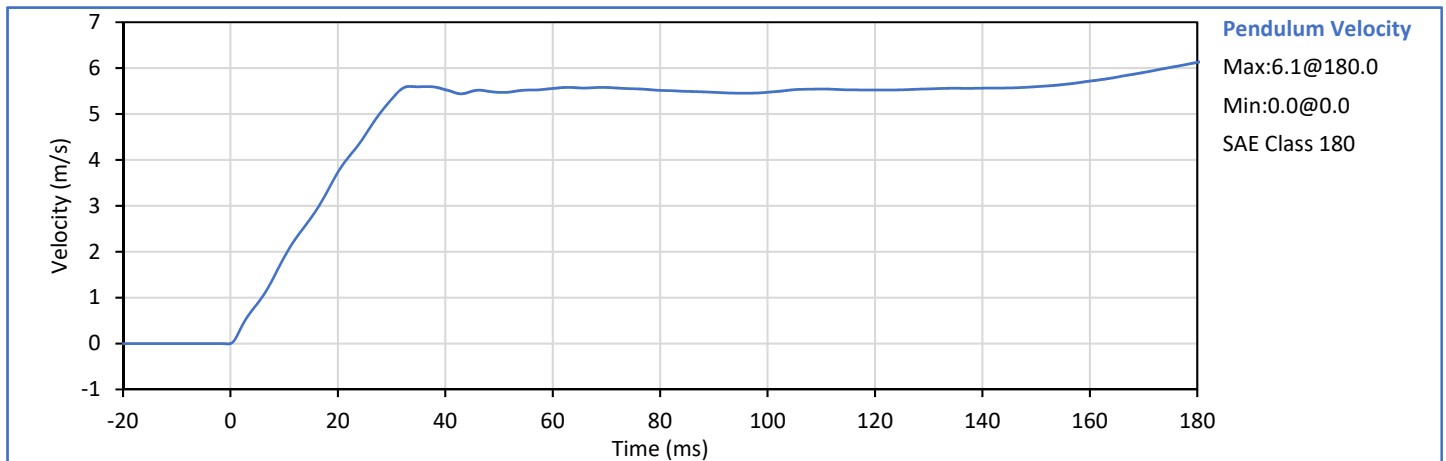


Technician: J. Hernandez

Approved By: P. Puzzuto

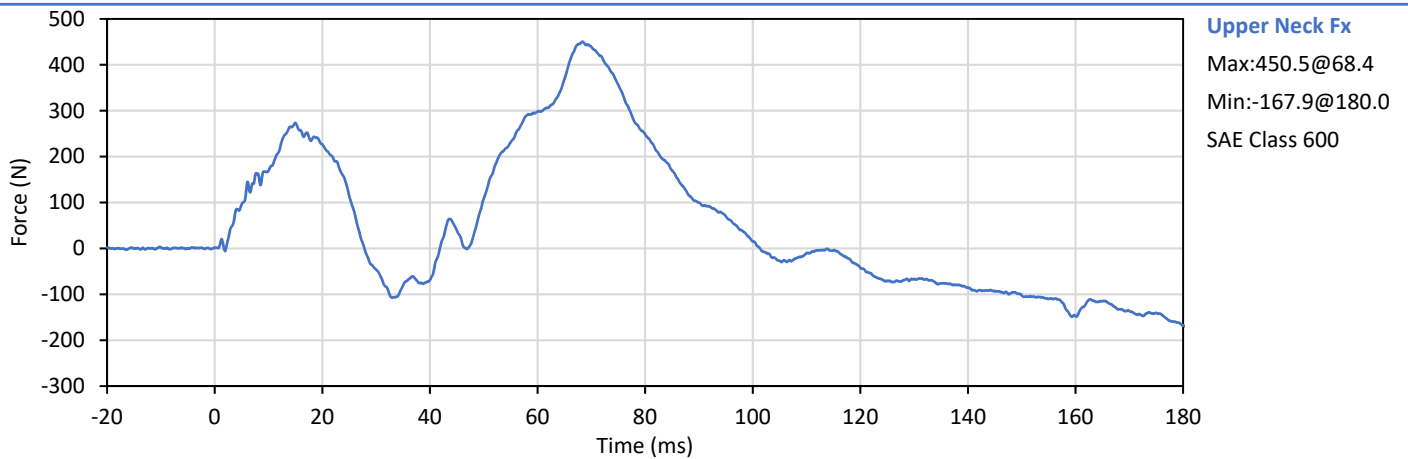
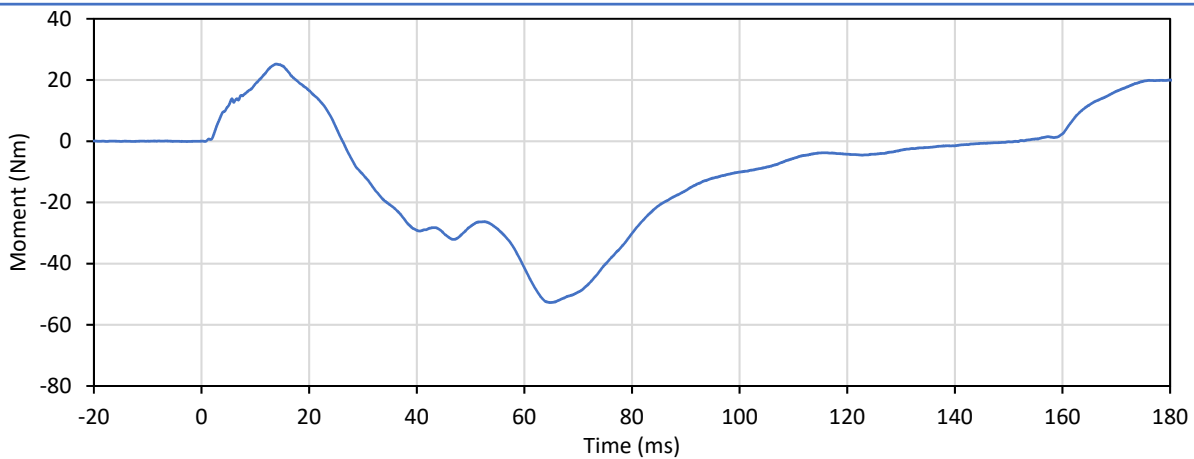
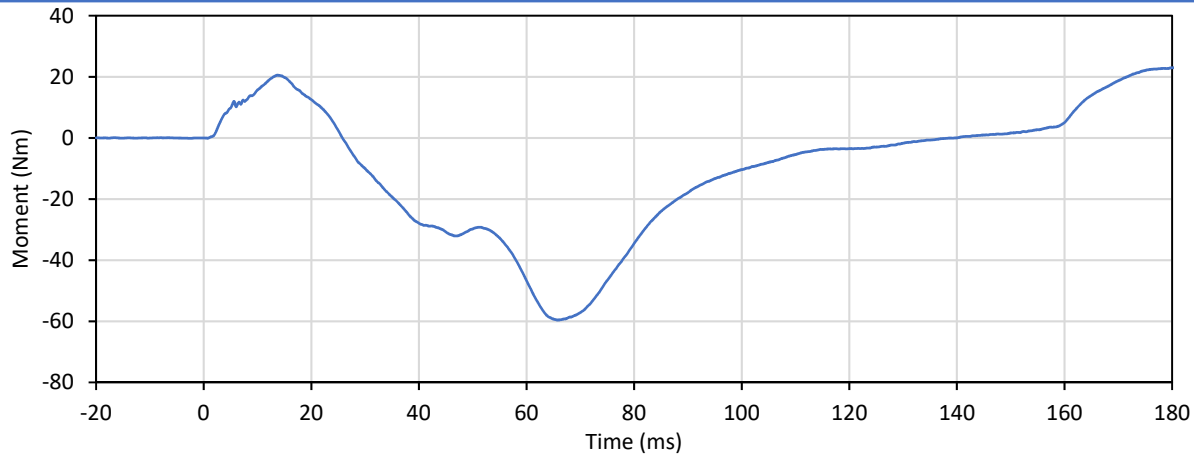


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	28	Pass
Pendulum Velocity	m/s	5.95	6.19	6.13	Pass
Pendulum Velocity at 10 ms	m/s	1.50	1.90	1.88	Pass
Pendulum Velocity at 20 ms	m/s	3.10	3.90	3.73	Pass
Pendulum Velocity at 30 ms	m/s	4.60	5.60	5.32	Pass
Peak "D" Plane Rotation	deg	99.0	114.0	109.0	Pass
Peak Moment in Rotation	Nm	-65.0	-53.0	-59.6	Pass
Negative Moment Decay to -10 Nm	ms	94.0	114.0	100.8	Pass
Overall Test Results				Pass	Pass

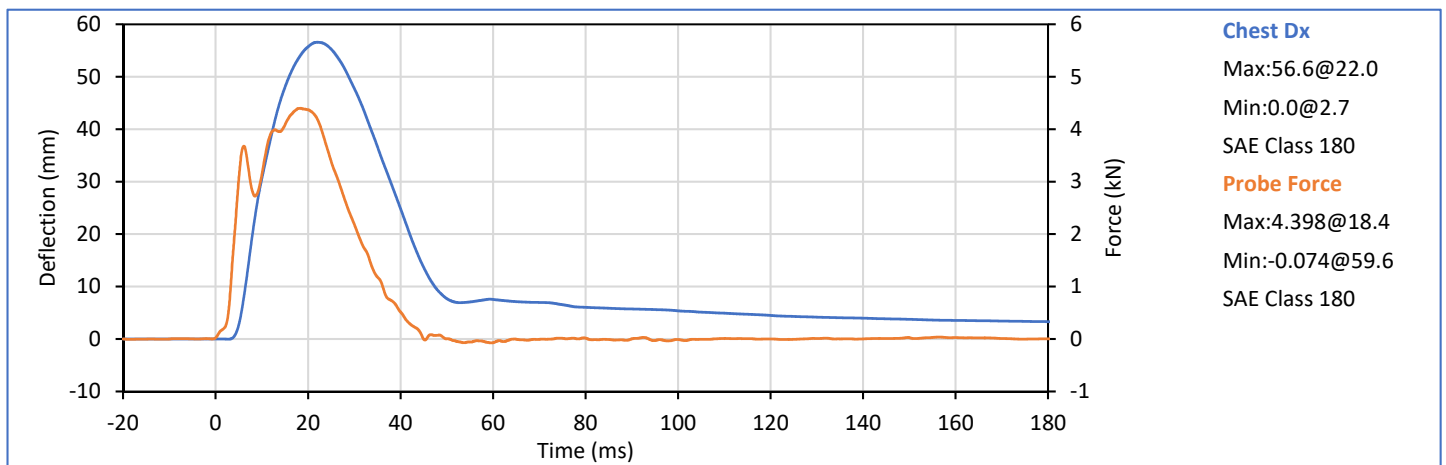
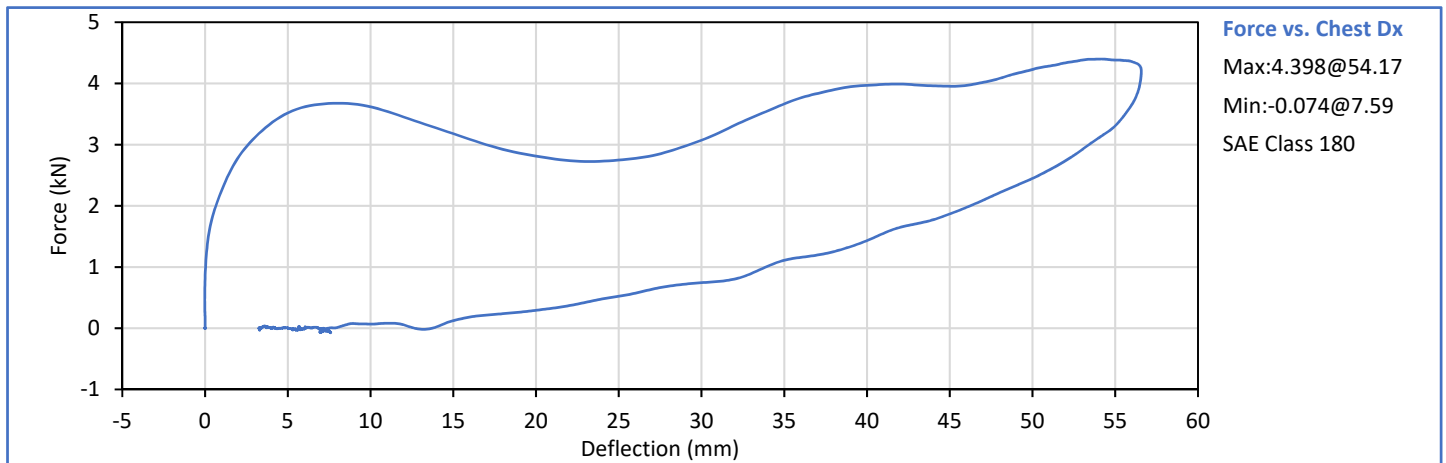


Technician: J. Hernandez

Approved By: P. Puzzuto



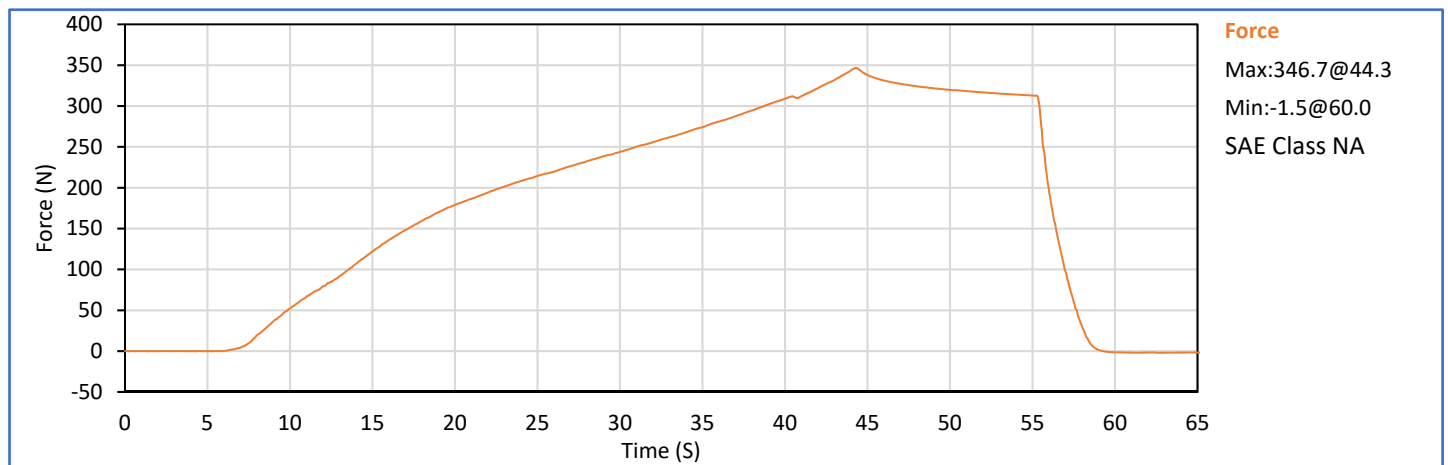
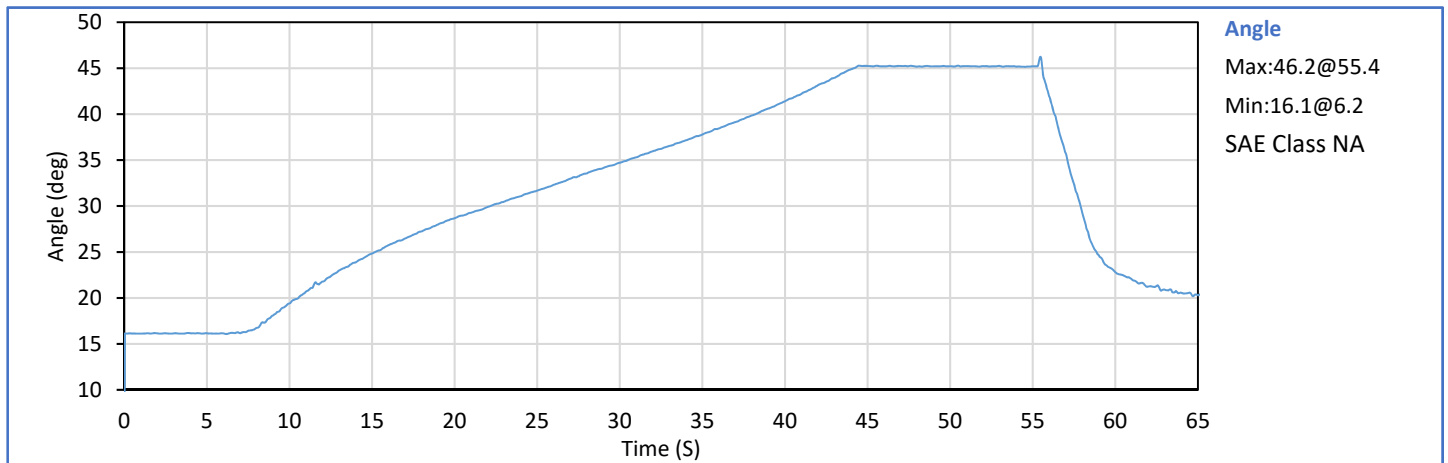
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	22	Pass
Probe Velocity	m/s	6.59	6.83	6.71	Pass
Peak Chest Deflection	mm	50.0	58.0	56.6	Pass
Peak Probe Force, 50 and 58 mm	kN	3.900	4.400	4.398	Pass
Peak Probe Force, 18 and 50 mm	kN	0.000	4.600	4.226	Pass
Internal Hysteresis	%	69.0	85.0	71.4	Pass
Overall Test Results				Pass	Pass



Technician: J. Hernandez

Approved By: P. Puzzuto

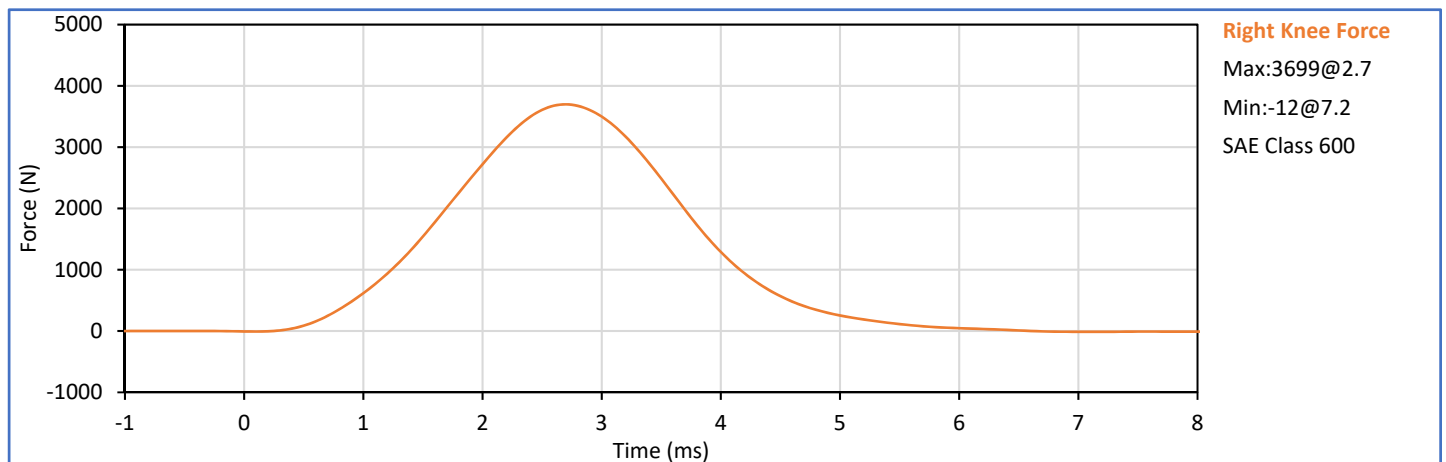
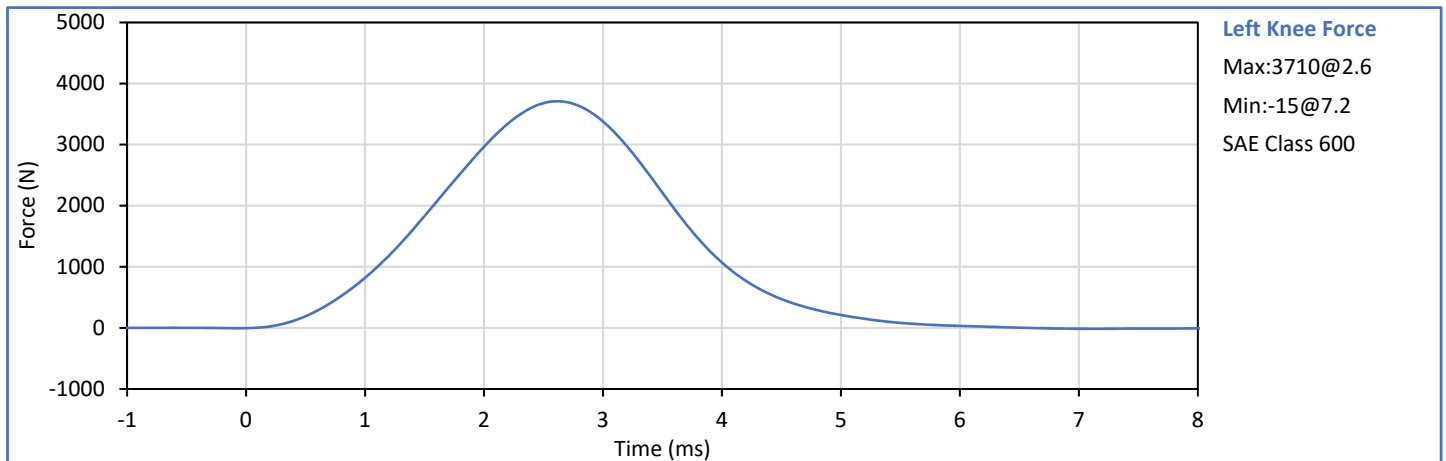
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.6	Pass
Laboratory Humidity	%	10	70	20	Pass
Orientation Angle	deg	0.0	20.0	14.8	Pass
Test Initial Angle	deg	11.0	19.0	16.1	Pass
Peak Force at 45° (+/-0.5°)	N	320.0	390.0	346.7	Pass
Torso Flexion Rate	deg/s	0.50	1.50	0.78	Pass
Final Reference Plane Angle	deg	-8.0	8.0	3.6	Pass
Overall Test Results					Pass



Technician: J. Hernandez

Approved By: P. Puzzuto

	Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
	Laboratory Temperature	°C	18.9	25.6	21.7	Pass
	Laboratory Humidity	%	10	70	20	Pass
Left	Probe Velocity	m/s	2.070	2.130	2.081	Pass
Knee	Peak Resistive Force	N	3450	4060	3710	Pass
Right	Probe Velocity	m/s	2.070	2.130	2.085	Pass
Knee	Peak Resistive Force	N	3450	4060	3699	Pass
Overall Test Results					Pass	



Technician: J. Hernandez

Approved By: P. Puzzuto

APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

Table 1 - Driver ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P49209	Endevco	7264C-2k	2019-11-06
Head Acceleration Y Primary	P49228	Endevco	7264C-2k	2019-11-06
Head Acceleration Z Primary	A199910	MSI	64C-2000	2019-11-06
Head Acceleration X Redundant	P50103	Endevco	7264C-2k	2019-11-06
Head Acceleration Y Redundant	P49210	Endevco	7264C-2k	2019-11-06
Head Acceleration Z Redundant	P58713	Endevco	7264C-2k	2019-11-06
Head Rotation Rate X	ARS7587	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Y	ARS7426	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Z	ARS7480	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Upper Neck Force X	2185 Fx	R.A. Denton	1716ATF	2019-09-03
Upper Neck Force Y	2185 Fy	R.A. Denton	1716ATF	2019-09-03
Upper Neck Force Z	2185 Fz	R.A. Denton	1716ATF	2019-09-03
Upper Neck Moment X	2185 Mx	R.A. Denton	1716ATF	2019-09-03
Upper Neck Moment Y	2185 My	R.A. Denton	1716ATF	2019-09-03
Upper Neck Moment Z	2185 Mz	R.A. Denton	1716ATF	2019-09-03
Chest Acceleration X Primary	P52112	Endevco	7264C-2k	2019-11-16
Chest Acceleration Y Primary	P49208	Endevco	7264C-2k	2019-11-16
Chest Acceleration Z Primary	P51264	Endevco	7264C-2k	2019-11-16
Chest Acceleration X Redundant	P49461	Endevco	7264C-2k	2019-11-16
Chest Acceleration Y Redundant	P58774	Endevco	7264C-2k	2019-11-16
Chest Acceleration Z Redundant	P49168	Endevco	7264C-2k	2019-11-16
Chest Deflection	0606	Servo	14CBI-3615	2019-11-16
Pelvis Acceleration X	P49238	Endevco	7264C-2k	2019-11-16
Pelvis Acceleration Y	P58877	Endevco	7264C-2k	2019-11-16
Pelvis Acceleration Z	P50087	Endevco	7264C-2k	2019-11-16
Left Femur Force Z	DS9756 (pri)	Humanetics	3821JLN2	2019-09-03
Right Femur Force Z	DS4139 (pri)	Humanetics	3821JLN2	2019-09-03
Left Femur Force Z Redundant	DS9756 (red)	Humanetics	3821JLN2	2019-09-03
Right Femur Force Z Redundant	DS4139 (red)	Humanetics	3821JLN2	2019-09-03
Left Leg Upper Tibia Moment X	DH3309 Mx	FTSS	IF-857	2019-09-09
Left Leg Upper Tibia Moment Y	DH3309 My	FTSS	IF-857	2019-09-09
Left Leg Upper Tibia Force Z	DH3309 Fz	FTSS	IF-857	2019-09-09
Left Leg Lower Tibia Moment X	DI4186 Mx	FTSS	IF-853	2019-09-06
Left Leg Lower Tibia Moment Y	DI4186 My	FTSS	IF-853	2019-09-06
Left Leg Lower Tibia Force Z	DI4186 Fz	FTSS	IF-853	2019-09-06
Right Leg Upper Tibia Moment X	DG6679 Mx	FTSS	IF-857	2019-09-09
Right Leg Upper Tibia Moment Y	DG6679 My	FTSS	IF-857	2019-09-09
Right Leg Upper Tibia Force Z	DG6679 Fz	FTSS	IF-857	2019-09-09
Right Leg Lower Tibia Moment X	DI4188 Mx	FTSS	IF-853	2019-09-06
Right Leg Lower Tibia Moment Y	DI4188 My	FTSS	IF-853	2019-09-06
Right Leg Lower Tibia Force Z	DI4188 Fz	FTSS	IF-853	2019-09-06
Left Ankle Acceleration X	03E20-N09	Entran	EGEB6Q-2k	2019-11-16
Left Ankle Acceleration Z	03D30-N13	Entran	EGEB6Q-2k	2019-11-16
Left Toe Acceleration Z	03H07-Z10	Entran	EGEB6Q-2k	2019-11-16
Right Ankle Acceleration X	03E29-N20	Entran	EGEB6Q-2k	2019-11-16
Right Ankle Acceleration Z	03E18-F02	Entran	EGEB6Q-2k	2019-11-16
Right Toe Acceleration Z	05H31-Z04	Entran	EGEB6Q-2k	2019-11-16
Seat Belt Outside Lap Force	300	FTSS	IF-964	2019-10-02
Seat Belt Upper Diagonal Force	315	FTSS	IF-964	2019-10-02

Table 2 - Right Front Passenger ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P58902	Endevco	7264C-2k	2019-11-13
Head Acceleration Y Primary	P58900	Endevco	7264C-2k	2019-11-13
Head Acceleration Z Primary	P58989	Endevco	7264C-2k	2019-11-13
Head Acceleration X Redundant	P58906	Endevco	7264C-2k	2019-11-13
Head Acceleration Y Redundant	P58983	Endevco	7264C-2k	2019-11-13
Head Acceleration Z Redundant	P58901	Endevco	7264C-2k	2019-11-13
Head Rotation Rate X	ARS7473	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Y	ARS7342	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Z	ARS7548	DTS	ARS PRO-8k (2000Hz)	2019-07-09
Upper Neck Force X	1646 Fx	R.A. Denton	1716A	2019-09-03
Upper Neck Force Y	1646 Fy	R.A. Denton	1716A	2019-09-03
Upper Neck Force Z	1646 Fz	R.A. Denton	1716A	2019-09-03
Upper Neck Moment X	1646 Mx	R.A. Denton	1716A	2019-09-03
Upper Neck Moment Y	1646 My	R.A. Denton	1716A	2019-09-03
Upper Neck Moment Z	1646 Mz	R.A. Denton	1716A	2019-09-03
Chest Acceleration X Primary	P58742	Endevco	7264C-2k	2019-11-13
Chest Acceleration Y Primary	P51640	Endevco	7264C-2k	2019-11-13
Chest Acceleration Z Primary	P58988	Endevco	7264C-2k	2019-11-13
Chest Acceleration X Redundant	P51632	Endevco	7264C-2k	2019-11-13
Chest Acceleration Y Redundant	P58793	Endevco	7264C-2k	2019-11-13
Chest Acceleration Z Redundant	P58790	Endevco	7264C-2k	2019-11-13
Chest Deflection	02527	Servo	14CBI-3615	2019-11-13
Pelvis Acceleration X	P50076	Endevco	7264C-2k	2019-11-13
Pelvis Acceleration Y	P58897	Endevco	7264C-2k	2019-11-13
Pelvis Acceleration Z	P51724	Endevco	7264C-2k	2019-11-13
Left Femur Force Z	DS4137 (pri)	Humanetics	3821JLN2	2019-09-03
Right Femur Force Z	DS4141 (pri)	Humanetics	3821JLN2	2019-09-03
Left Femur Force Z Redundant	DS4137 (red)	Humanetics	3821JLN2	2019-09-03
Right Femur Force Z Redundant	DS4141 (red)	Humanetics	3821JLN2	2019-09-03
Left Upper Tibia Moment X	653 Mx	R.A. Denton	3643	2019-09-09
Left Upper Tibia Moment Y	653 My	R.A. Denton	3643	2019-09-09
Left Upper Tibia Force Z	653 Fz	R.A. Denton	3643	2019-09-09
Left Lower Tibia Moment X	498 Mx	R.A. Denton	3644	2019-09-06
Left Lower Tibia Moment Y	498 My	R.A. Denton	3644	2019-09-06
Left Lower Tibia Force Z	498 Fz	R.A. Denton	3644	2019-09-06
Right Upper Tibia Moment X	DH3302 Mx	FTSS	IF-857	2019-09-09
Right Upper Tibia Moment Y	DH3302 My	FTSS	IF-857	2019-09-09
Right Upper Tibia Force Z	DH3302 Fz	FTSS	IF-857	2019-09-09
Right Lower Tibia Moment X	501 Mx	R.A. Denton	3644	2019-09-06
Right Lower Tibia Moment Y	501 My	R.A. Denton	3644	2019-09-06
Right Lower Tibia Force Z	501 Fz	R.A. Denton	3644	2019-09-06
Left Ankle Acceleration X	A199899	MSI	64C-2000	2019-11-13
Left Ankle Acceleration Z	A199908	MSI	64C-2000	2019-11-13
Left Toe Acceleration Z	A199930	MSI	64C-2000	2019-11-13
Right Ankle Acceleration X	A202287	MSI	64C-2000	2019-11-13
Right Ankle Acceleration Z	A201195	MSI	64C-2000	2019-11-13
Right Toe Acceleration Z	A201202	MSI	64C-2000	2019-11-13
Seat Belt Outside Lap Force	313	FTSS	IF-964	2019-10-02
Seat Belt Upper Diagonal Force	251	FTSS	IF-964	2019-10-02

Table 3 - Vehicle Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Left Rear Primary Ax	Accels\A264816	MSI	52F-2000	2019-12-02
Right Rear Primary Ax	Accels\A254893	MSI	52F-2000	2019-12-02
Engine Top Ax	Accels\A265844	MSI	52F-2000	2019-12-02
Engine Bottom Ax	Accels\A273418	MSI	52F-2000	2019-11-27
Left Rear Az	Accels\A265846	MSI	52F-2000	2019-12-02
Right Rear Az	Accels\A254936	MSI	52F-2000	2019-12-02
Left Rear Redundant Ax	Accels\A264073	MSI	52F-2000	2019-12-02
Right Rear Redundant Ax	Accels\A254937	MSI	52F-2000	2019-12-02