

REPORT NUMBER: NCAP-KAR-23-007

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

**BAYERISCHE MOTOREN WERKE AG
2023 BMW X1 xDrive28i 5-Door SUV**

NHTSA NUMBER: M20234100

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



MAY 15, 2023

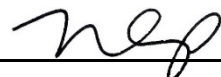
FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
OFFICE OF CRASHWORTHINESS STANDARDS
MAIL CODE : NRM-100
1200 NEW JERSEY AVE, SE
WASHINGTON, DC 20590**

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings and conclusions expressed in this publication are those of the author(s) and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names or products are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Prepared By: 
Mr. Alex Beltran, Engineering Manager
Applus+ IDIADA KARCO Engineering, LLC.

Reviewed By: 
Mr. Rushlan Amin, Project Engineer
Applus+ IDIADA KARCO Engineering, LLC.

Approved By: 
Mr. Michael L. Dunlap, Director of Operations
Applus+ IDIADA KARCO Engineering, LLC.

Approval Date: May 15, 2023

FINAL REPORT ACCEPTANCE BY OCWS:


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

Date: _____


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

Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. NCAP-KAR-23-007	2. Government Accession No.	3. Recipient's Catalog No.																																																					
4. Title and Subtitle Final Report of New Car Assessment Program Frontal Impact Testing of a 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No. M20234100		5. Report Date May 15, 2023																																																					
		6. Performing Organization Code KAR																																																					
7. Authors Mr. Rushlan Amin, Project Engineer, Applus+ IDIADA KARCO Mr. Alex Beltran, Engineering Manager, Applus+ IDIADA KARCO		8. Performing Organization Report No. TR-P43104-01-NC																																																					
9. Performing Organization Name and Address Applus+ IDIADA KARCO Engineering, LLC. 9270 Holly Rd. Adelanto, CA 92301		10. Work Unit No.																																																					
		11. Contract or Grant No. 693JJ919D000004																																																					
12. Sponsoring Agency Name and Address U. S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-100) 1200 New Jersey Ave., SE Washington, D.C. 20590		13. Type of Report and Period Covered Final Test Report, April 28 - May 15, 2023																																																					
		14. Sponsoring Agency Code NRM-100																																																					
15. Supplementary Notes																																																							
16. Abstract A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2023 BMW X1 xDrive28i 5-Door SUV in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. The test was conducted at the Applus+ IDIADA KARCO Engineering, LLC. facility in Adelanto, California on April 28, 2023. The impact velocity of the vehicle was 56.73 km/h and the ambient temperature at the barrier face at the time of impact was 32.7°C. The target vehicle's post-test maximum crush was 608 mm at C4 to the right 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>223.228</td> <td>700</td> <td>310.686</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>31.131</td> <td>52</td> <td>13.084</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.351</td> <td>1</td> <td>0.319</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>1331.244</td> <td>2620</td> <td>601.021</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>341.073</td> <td>2520</td> <td>454.442</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>1613.733</td> <td>6800</td> <td>1755.693</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>1657.576</td> <td>6800</td> <td>2009.389</td> </tr> </tbody> </table>				Measurement Description	Units	Driver ATD		Passenger ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)	N/A	700	223.228	700	310.686	Maximum Chest Compression	mm	63	31.131	52	13.084	Nij	N/A	1	0.351	1	0.319	Neck Tension	N	4170	1331.244	2620	601.021	Neck Compression	N	4000	341.073	2520	454.442	Left Femur Force	N	10008	1613.733	6800	1755.693	Right Femur Force	N	10008	1657.576	6800	2009.389
Measurement Description	Units	Driver ATD				Passenger ATD																																																	
		Threshold	Result	Threshold	Result																																																		
Head Injury Criteria (HIC ₁₅)	N/A	700	223.228	700	310.686																																																		
Maximum Chest Compression	mm	63	31.131	52	13.084																																																		
Nij	N/A	1	0.351	1	0.319																																																		
Neck Tension	N	4170	1331.244	2620	601.021																																																		
Neck Compression	N	4000	341.073	2520	454.442																																																		
Left Femur Force	N	10008	1613.733	6800	1755.693																																																		
Right Femur Force	N	10008	1657.576	6800	2009.389																																																		
17. Key Words 56.3 km/h (35 mph) Full Frontal Rigid Barrier Impact Test New Car Assessment Program (NCAP)		18. Distribution Statement National Highway Traffic Safety Administration Technical Information Services Division 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 147	22. Price																																																				

TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	Purpose and Summary of Test	1
2	Occupant and Vehicle Information / Data Sheets	3
<u>Data Sheet No.</u>		<u>Page No.</u>
1	General Test and Vehicle Parameter Data	4
2	Seat Adjustment, Fuel System, And Steering Wheel Data	8
3	Dummy Longitudinal Clearance Dimensions	10
4	Dummy Lateral Clearance Dimensions	11
5	Seat Belt Positioning Data	12
6	High-Speed Camera Locations and Data	13
7	Vehicle Accelerometer Locations	15
8	Photographic Reference Target Locations	16
9	Load Cell Locations on Fixed Barrier	17
10	Test Vehicle Summary of Results	18
11	Post-Test Observations	19
12	Vehicle Profile Measurements	20
13	Accident Investigation Division Data	22
14	Vehicle Intrusion Measurements	23
15	Summary of Indicant FMVSS 212 and 219 (Partial) Data	25
16	FMVSS 301 Barrier Impact and Static Rollover Results	26
17	Dummy / Vehicle Temperature Stabilization Chart	28
<u>Appendix</u>		<u>Page No.</u>
A	Photographic Documentation	A
B	Dummy Response Data Traces	B
C	Dummy Qualification and Performance Verification Data	C
D	Test Equipment and Instrumentation Calibration	D

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 dated May 2018 for NCAP Full Frontal Rigid Barrier Impact Testing.

SUMMARY

A load cell barrier consisting of 176 load cells was impacted by a 2023 BMW X1 xDrive28i 5-Door SUV at a velocity of 56.73 km/h. The test was performed at Applus+ IDIADA KARCO Engineering, LLC. on April 28, 2023. 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 HIII 50th percentile male anthropomorphic test device (ATD) was placed in the driver seating position and one Part HIII 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.

The driver (position 1) ATD (Serial No. 360) and the right-front passenger (position 2) ATD (Serial No. DH1644) were qualified prior to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 105 channels of dummy and vehicle response data were recorded on an on-board data acquisition system. Appendix B contains the dummy response data traces. Appendix D contains a complete list of instrumentation used for dummies and the vehicle.

There was 100 percent windshield retention and 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 of the test vehicle was 608 mm at C4 to the right of the vehicle's centerline. 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 and lower 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 and lower torso contacted the frontal airbag. Both left and right knees contacted the knee airbag and glove box.

The occupant data is summarized below:

ATD Position	HIC ₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (g)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50th Male)	223.228	0.351	1331.244	341.073	38.369	31.131	1613.733	1657.576
Passenger (5th Female)	310.686	0.319	601.021	454.442	41.063	13.084	1755.693	2009.389

GENERAL COMMENTS:

None.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

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: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20234100
Model Year	2023
Make	BMW
Model	X1
Body Style	5-Door SUV
VIN	WBX73EF00P5W05128
Body Color	Portimao Blue Metallic
Odometer Reading (km / mi)	69 / 43
Engine Displacement (L)	2.0
Type / No. of Cylinders	Inline 4
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	7
Overdrive	Yes
Final Drive	AWD
Roof Rack	No
Sunroof / T-Top	Yes
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	Yes
Driver Seat Belt Pretensioner	Yes
Driver Load Limiter	Yes
Front Pass. Seat Belt Pretensioner	Yes
Front Pass. Load Limiter	Yes
Other Safety Restraint	No

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

Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Bayerische Motoren Werke
Date of Manufacture	11/22

GVWR (kg)	2200
GAWR Front (kg)	1155
GAWR Rear (kg)	1145

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total	
Type of Seats	Bucket	Split Bench			
Designated Seating Capacity	2	3		5	
Capacity Weight (VCW) (kg)				451.0	A
DSC x 68 (kg)				340.0	B
Cargo Weight (RCLW) (kg)				111.0	A-B

DATA SHEET NO. 1 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UWV)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	477.0	371.0		492.0	489.0	
Right	kg	482.5	366.5		512.0	448.0	
Ratio	%	56.5%	43.5%	100.0%	51.7%	48.3%	100.0%
Total	kg	959.5	737.5	1697.0	1004.0	937.0	1941.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UWV)	kg	1697.0	A
Weight of 1 P572E ATD & 1 P572O ATD	kg	141.0	B
Rated Cargo/Luggage Weight (RCLW)	kg	110.8	C
Calculated Vehicle Target Weight (TVTW)	kg	1948.8	A+B+C

TEST VEHICLE ATTITUDES

Condition	Units	LF	RF	LR	RR	CG Aft of Front Axle
As Delivered	mm	773	774	784	790	1165
As Tested	mm	770	770	761	765	1294
Post-Test	mm	N/A	N/A	771	761	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheelbase	mm	2680
Total Vehicle Length at Left Side	mm	4416
Total Vehicle Length at Centerline	mm	4500
Total Vehicle Length at Right Side	mm	4429
Weight of Ballast in Cargo Area	kg	54.0
Weight of Vehicle Components Removed	kg	17.5
Amount of Stoddard Solvent in Fuel Tank	L	50.35

VEHICLE COMPONENTS REMOVED TO MEET TEST WEIGHT:

Spare tire, jack, and rear trim.

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

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

TARGET VEHICLE STRUCTURAL MEASUREMENTS

No.	Description	Pre-Test
1	Total Length	4500
2	Total Width	1843
3	Bumper Top Height	765
4	Bumper Bottom Height	400
5	Longitudinal Member Top Height	790
6	Distance Between Longitudinal Members	1010
7	Longitudinal Member Width	85
8	Engine Top Height	1005
9	Engine Bottom Height	345
10	Engine and Gearbox Width	410
11	Front Bumper to Engine Distance	175
12	Front Shock Absorber Fixing Height	990
13	Bonnet Leading Edge Height	1050
14	Front Shock Absorber Fixing Width	1235
15	Front Bumper to Front Axle Distance	420
16	Front Axle to A-Pillar Distance	480
17	A-Pillar to B-Pillar Distance	935
18	B-Pillar to Rear Axle Distance	1125
19	B-Pillar to C-Pillar Distance	805
20	Roof Sill Bottom Height	1580
21	Roof Sill Top Height	1635
22	Floor Sill Bottom Height	380
23	Floor Sill Top Height	435

All measurements in millimeters.

DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV

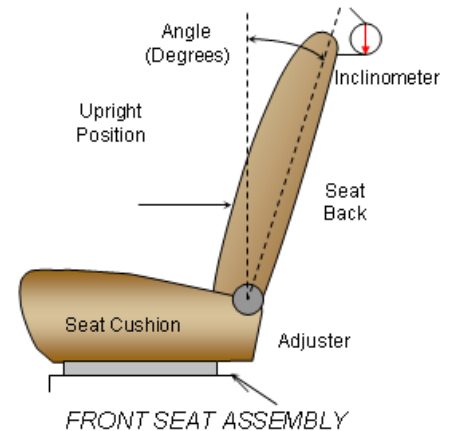
NHTSA No.: M20234100

Test Program: 56.3 km/h Frontal Impact NCAP Test

Test Date: 04/28/2023

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 with a flat edge along the seat back.

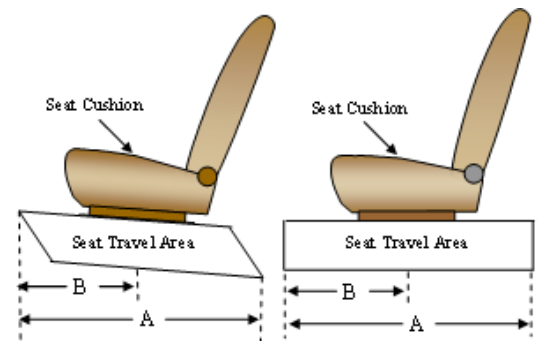


SEAT BACK ANGLE

Seating Position	Degrees
Driver Seat Back Angle	19.1
Passenger Seat Back Angle	17.3

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	285 mm	143 mm
Passenger Seat	252 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 "L" is the lowermost position, followed by position "M1". Position "H" is the uppermost position.

SEAT BELT UPPER ANCHORAGES

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

DATA SHEET NO. 2 ... (CONTINUED)

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV

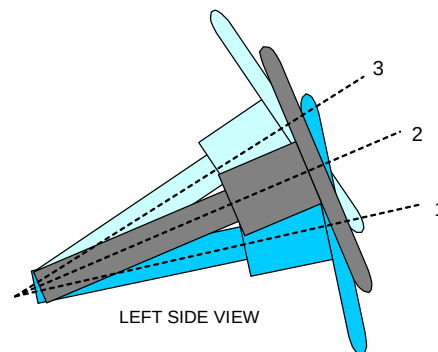
NHTSA No.: M20234100

Test Program: 56.3 km/h Frontal Impact NCAP Test

Test Date: 04/28/2023

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.



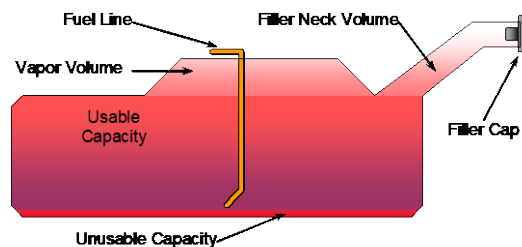
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONING

	Degrees	Fore-Aft Position (mm)
Lowermost Position, No. 1	22.6	171
Geometric Center Position, No. 2	24.8	201
Uppermost Position, No. 3	26.9	231
Telescoping Steering Wheel Travel		60
Test Position	24.8	201

FUEL PUMP

The vehicle is equipped with an electric fuel pump. The fuel starts when ignition is on. The fuel pump will operate for 5 seconds. After pressure has been built up the fuel pump switches to sleep mode until the engine will be started or the pressure decreases.



VEHICLE FUEL TANK ASSEMBLY

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank" (see Form No. 1)	54.13
Usable Capacity of "Optional Tank" (see Form No. 1)	
Usable Capacity of "Standard Tank" (see Owner's Manual)	54.13
Usable Capacity of "Optional Tank" (see Owner's Manual)	
93% of Usable Capacity	50.34
Actual amount of Solvent Used in Test	50.34
1/3 of Usable Capacity	18.04

Is the Actual Amount of Solvent Used in the test equal to 93% $\pm$ 1% of the Usable Capacity stated in the Form No. 1? ☒ Yes ☐ No

DATA SHEET NO. 3

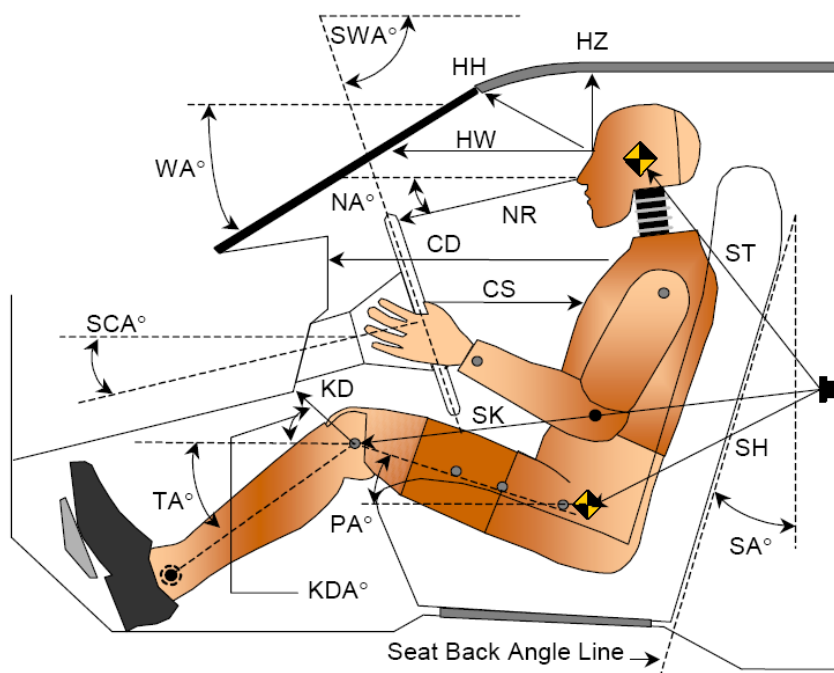
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV

NHTSA No.: M20234100

Test Program: 56.3 km/h Frontal Impact NCAP Test

Test Date: 04/28/2023



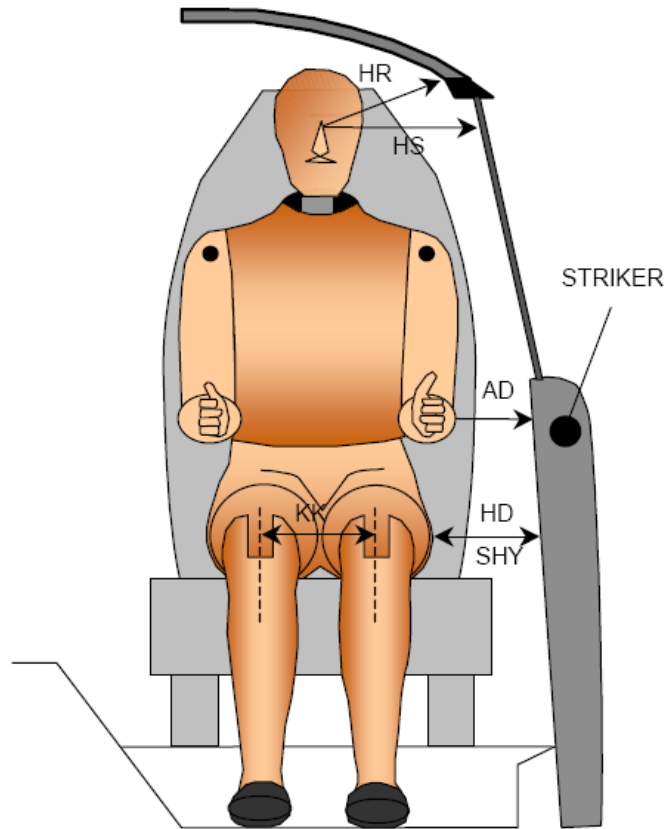
LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		37.7		
SWA°	Steering Wheel Angle		65.6		
SCA°	Steering Column Angle		24.4		
SA°	Seat Back Angle (On Seatback Post)		19.1		17.3
HZ	Head to Roof	241	90.0	280	90.0
HH	Head to Header	391	19.3	300	55.8
HW	Head to Windshield	603	0.0	615	0.0
NR	Nose to Rim	615	8.1	454	40.1
CD	Chest to Dash	645	0.0	364	8.6
CS	Chest to Steering Hub	329	1.0		
RA	Rim to Abdomen	211	0.0		
KDL	Left Knee to Dash	206	32.8	128	43.3
KDR	Right Knee to Dash	202	27.0	138	34.0
PA°	Pelvic Angle		23.3		20.4
TA°	Tibia Angle		44.9		67.5
SK	Striker to Knee	768		825	
ST	Striker to Head	533		519	
SH	Striker to H-Point	772		772	

DATA SHEET NO. 4

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

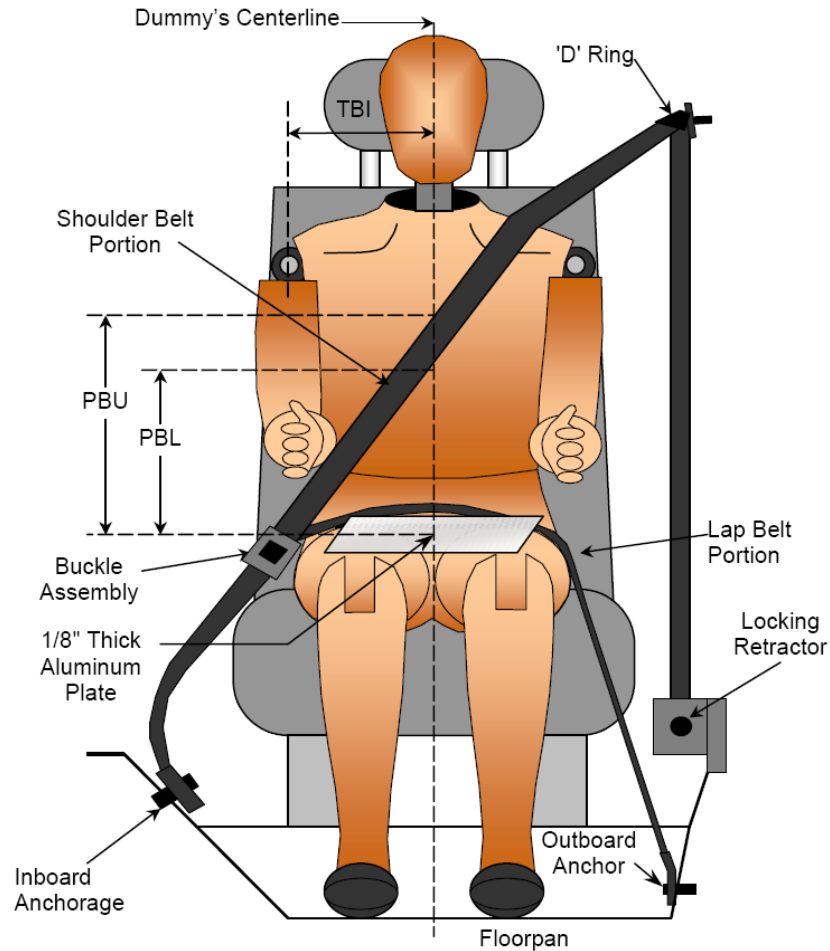


Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	124	148
HD	H-Point to Door	179	232
HR	Head to Side Header	255	322
HS	Head to Side Window	389	398
KK	Knee to Knee	256	170
SHY	Striker to H-Point (Y-Direction)		
AA	Ankle to Ankle	310	170

DATA SHEET NO. 5

SEAT BELT POSITIONING DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023



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	306	305
PBL	Top Surface of Aluminum Plate to Belt Lower Edge	mm	242	198

BELT LENGTH DATA

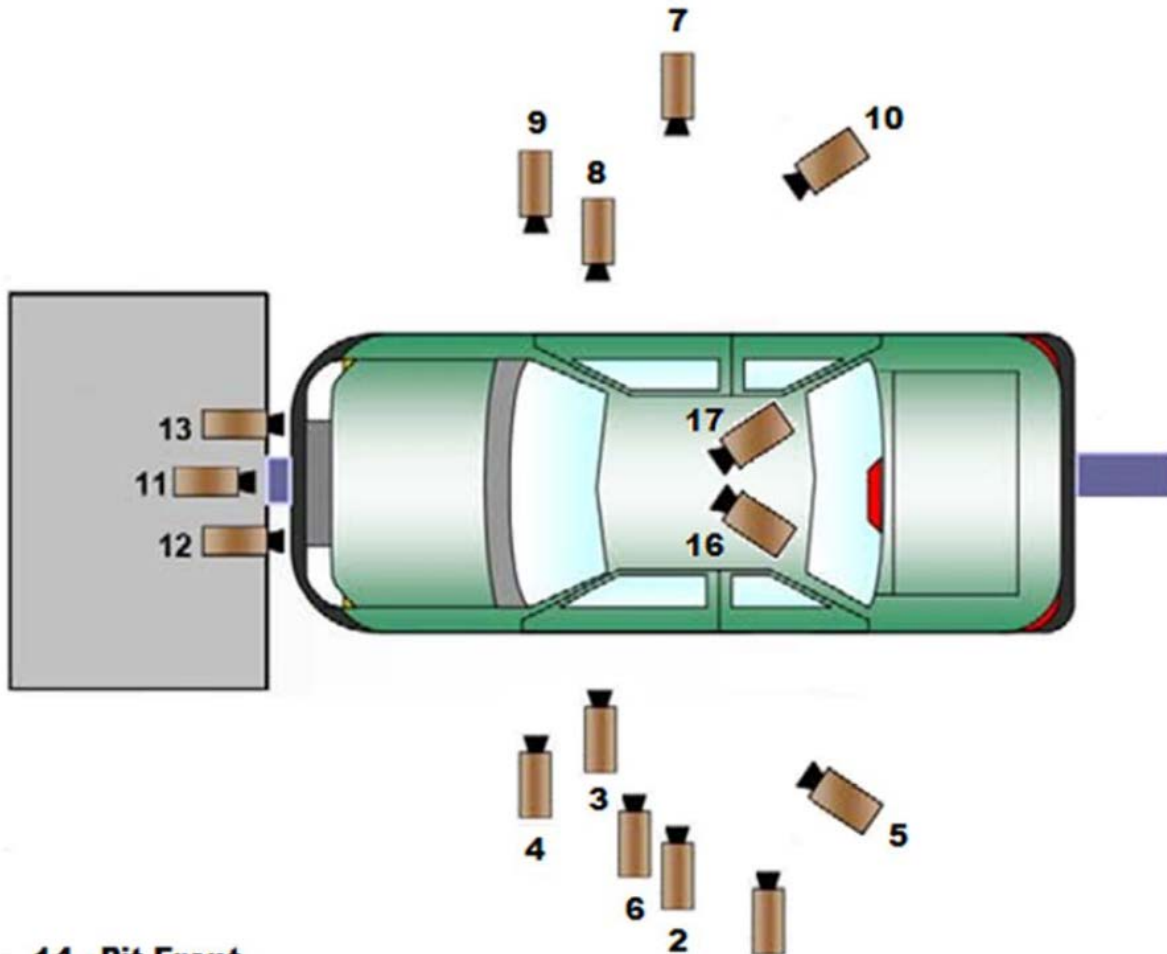
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as Measured on ATD	mm	911	981
Lap Belt Length as Measured on ATD	mm	660	619
Remainder of Belt on Reel	mm	1050	1085
Total Belt Length for Continuous Webbing Systems	mm	2621	2685

DATA SHEET NO. 6

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

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: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

CAMERA LOCATIONS

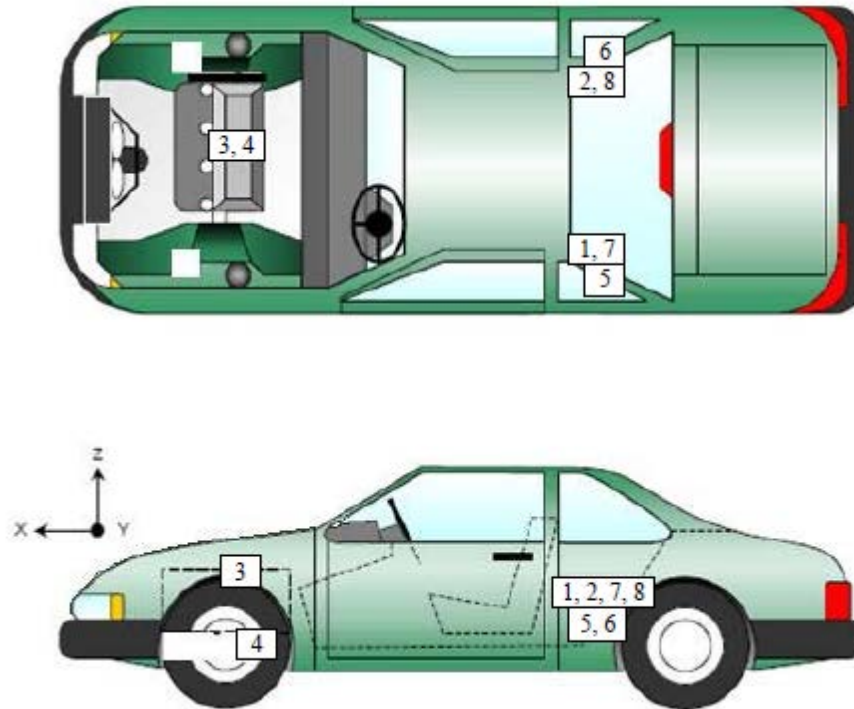
No.	Description	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-11412	-8150	-1484		30
2	Left Overall	-2456	-7975	-1025	20	1000
3	Driver Close-Up	-2590	-7950	-1371	50	1000
4	Left Front Half	-1701	-6197	-1701	35	1000
5	Left Angle	-6696	-10308	-3211	105	1000
6	Steering Column	-1966	-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	21	1000
15	Pit Rear	-3398	0	1495	15	1000
16	Driver Onboard					
17	Passenger Onboard					

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

DATA SHEET NO. 7

VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Description	Location		
		X	Y	Z
1	Left Rear Accelerometer X-Direction	2300	-760	-470
2	Right Rear Accelerometer X-Direction	2300	760	-470
3	Engine Top X	340	0	-934
4	Engine Bottom X	345	0	-381
5	Left Rear Accelerometer Z-Direction	2300	-760	-470
6	Right Rear Accelerometer Z-Direction	2300	760	-470
7	Left Rear Accelerometer X-Direction Redundant	2300	-760	-470
8	Right Rear Accelerometer X-Direction Redundant	2300	760	-470

Reference Points: X – Rear Surface of Vehicle (+ forward)

Y – Vehicle Centerline (+ to right)

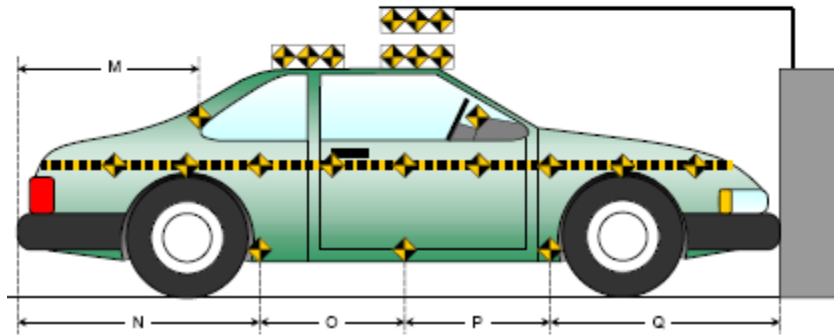
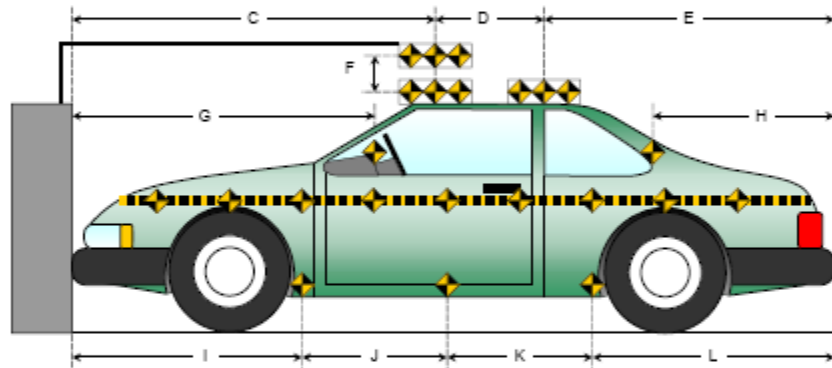
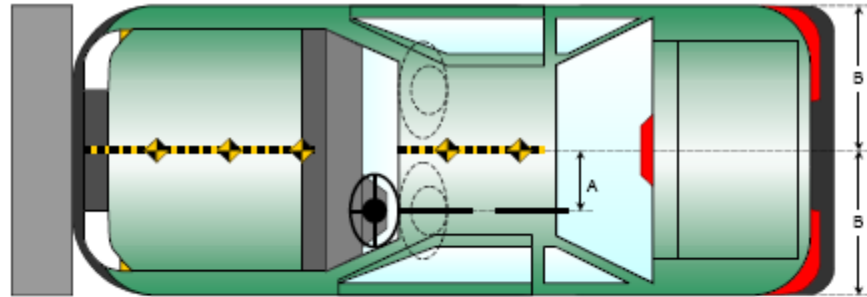
Z – Ground Plane (+ down)

DATA SHEET NO. 8

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

Item	Value
A	390
B	1340
C	2006
D	
E	1940
F	
G	1472
H	500
I	1162
J	870
K	870
L	1400
M	500
N	1400
O	870
P	870
Q	1162

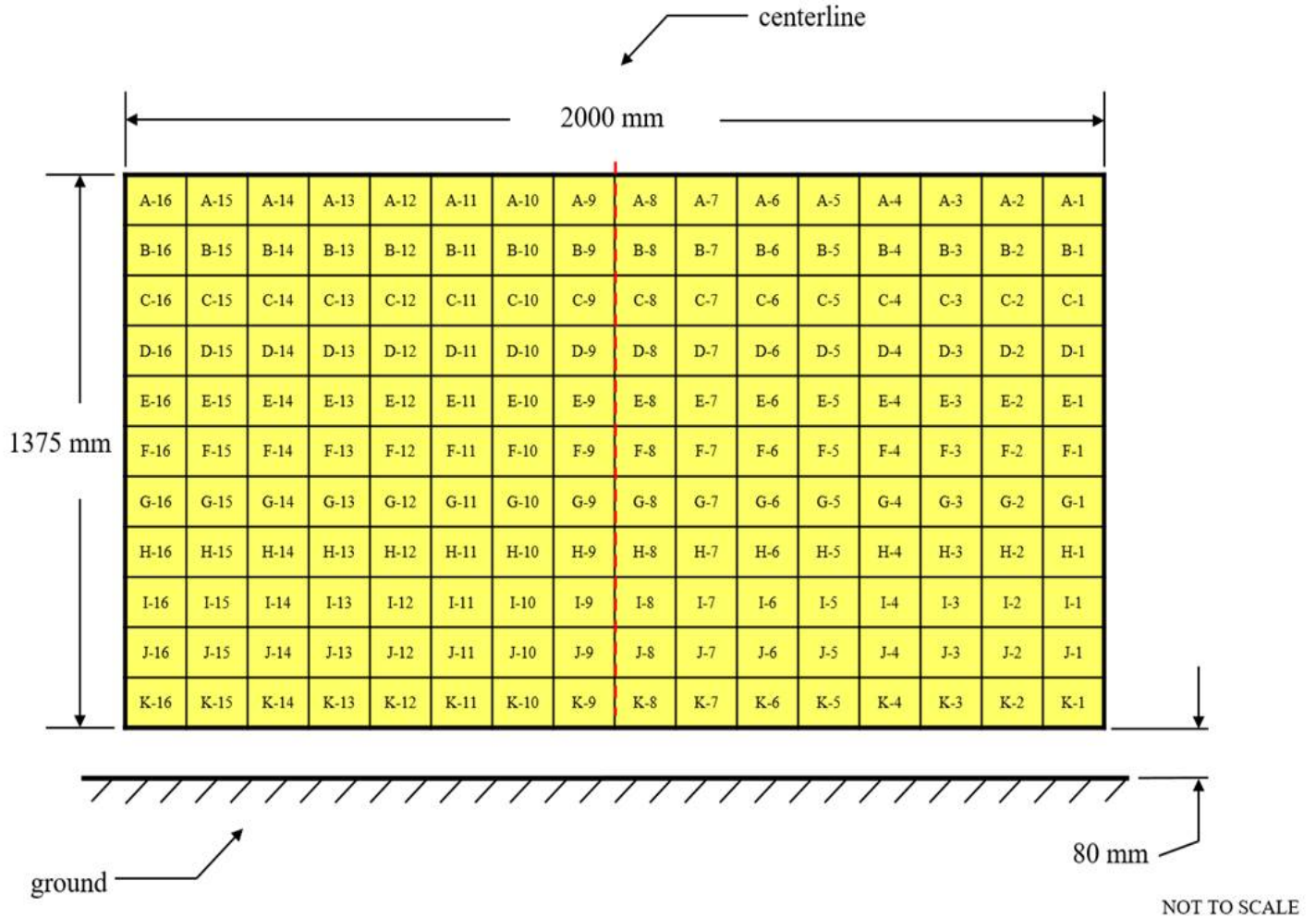


All measurements in millimeters.

DATA SHEET NO. 9

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023



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

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

INSTRUMENTATION

Driver Dummy Sensors	47
Passenger Dummy Sensors	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: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type/Serial No.	HIII 50th Percentile Male ATD / 360	HIII 5th Percentile Female ATD / DH1644
Head Contact	Frontal Airbag, Headrest	Frontal Airbag, Headrest
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	Frontal Airbag	Frontal Airbag
Left Knee Contact	Knee Airbag	Knee Airbag & Bolster
Right Knee Contact	Knee Airbag	Knee Airbag & Bolster

DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked / Unlocked Doors	Unlocked	Unlocked
Front Door Opening	Remained closed, latched, and operational	Remained closed, latched, and operational
Rear Door Opening	Remained closed, latched, and operational	Remained closed, latched, and operational
Trunk/Hatch/Tailgate Opening	None	
Seat Track Shift (mm)	20	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

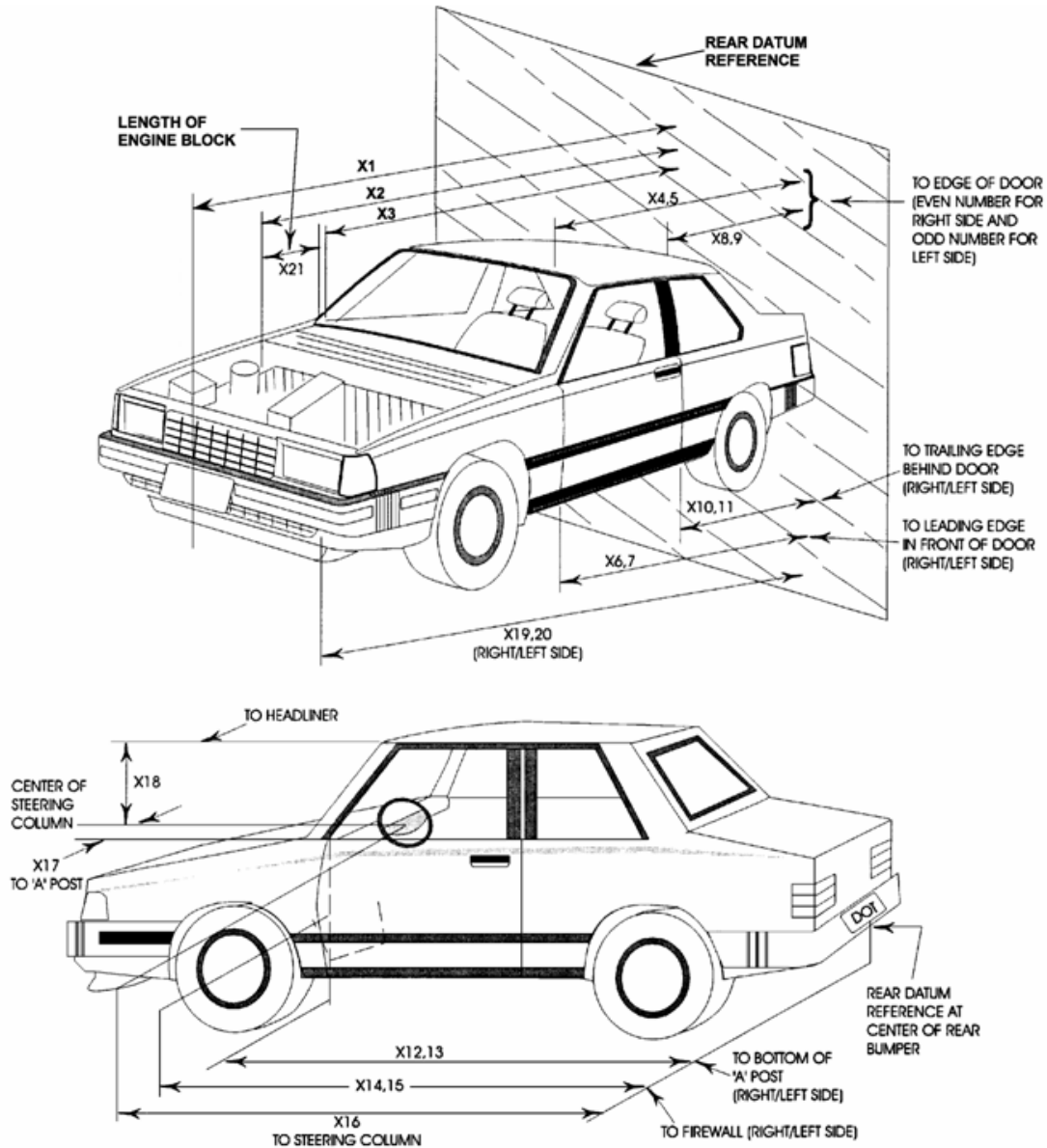
Measured Parameter	Units	Value
Left Side	mm	1675
Center	mm	1155
Right Side	mm	1619
Average	mm	1483

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

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

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023



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

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

No.	Description	Pre-Test	Post-Test	Change
1	Total Length of Vehicle at Centerline	4500	4030	-470
2	Rear Surface of Vehicle to Front of Engine	4004	3841	-163
3	RSOV to Firewall	3385	3384	-1
4	RSOV to Upper Leading Edge of Right Door	3113	3105	-8
5	RSOV to Upper Leading Edge of Left Door	3116	3114	-2
6	RSOV to Lower Leading Edge of Right Door	3089	3089	0
7	RSOV to Lower Leading Edge of Left Door	3091	3094	3
8	RSOV to Upper Trailing Edge of Right Door	2017	2017	0
9	RSOV to Upper Trailing Edge of Left Door	2019	2020	1
10	RSOV to Lower Trailing Edge of Right Door	2069	2069	0
11	RSOV to Lower Trailing Edge of Left Door	2069	2071	2
12	RSOV to Bottom of A-Pillar, Right Side	2929	2930	1
13	RSOV to Bottom of A-Pillar, Left Side	2935	2935	0
14	RSOV to Firewall, Right Side	3388	3387	-1
15	RSOV to Firewall, Left Side	3385	3384	-1
16	RSOV to Steering Column	2638	2709	71
17	Center of Steering Column to A-Pillar	292	227	-65
18	Center of Steering Column to Headliner	566	647	81
19	RSOV to Right Side of Front Bumper	3837	3706	-131
20	RSOV to Left Side of Front Bumper	3841	3813	-28
21	Length of Engine Block	442	432	-10
RD	RSOV to Right Side of Dash Panel	2799	2794	-5
CD	RSOV to Center of Dash Panel	2806	2813	7
LD	RSOV to Left Side of Dash Panel	2802	2802	0

All measurements in millimeters.

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

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

VEHICLE INFORMATION

VIN: WBX73EF00P5W05128 Wheelbase (mm): 2680
 Vehicle Size Category: SUV Test Weight (kg): 1941.0

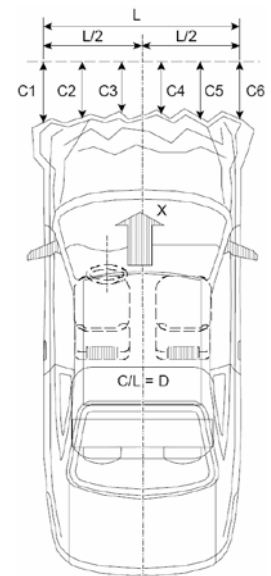
ACCELEROMETER DATA

Accelerometer Locations: Left Rear Crossmember
 Cal. Procedure/Interval: Vibration Test / 6 months
 Integration Algorithm: NHTSA Standard
 Impact Velocity (km/h): 56.73
 Velocity Change (km/h): 66.4
 Time of Separation (msec): 64.3

Linearity: Good

CRUSH PROFILE

Collision Deformation Classification: 12FDEW3
 Midpoint of Damage: Vehicle Centerline
 Damage Region Length (mm): 1412
 Impact Mode: Full Frontal



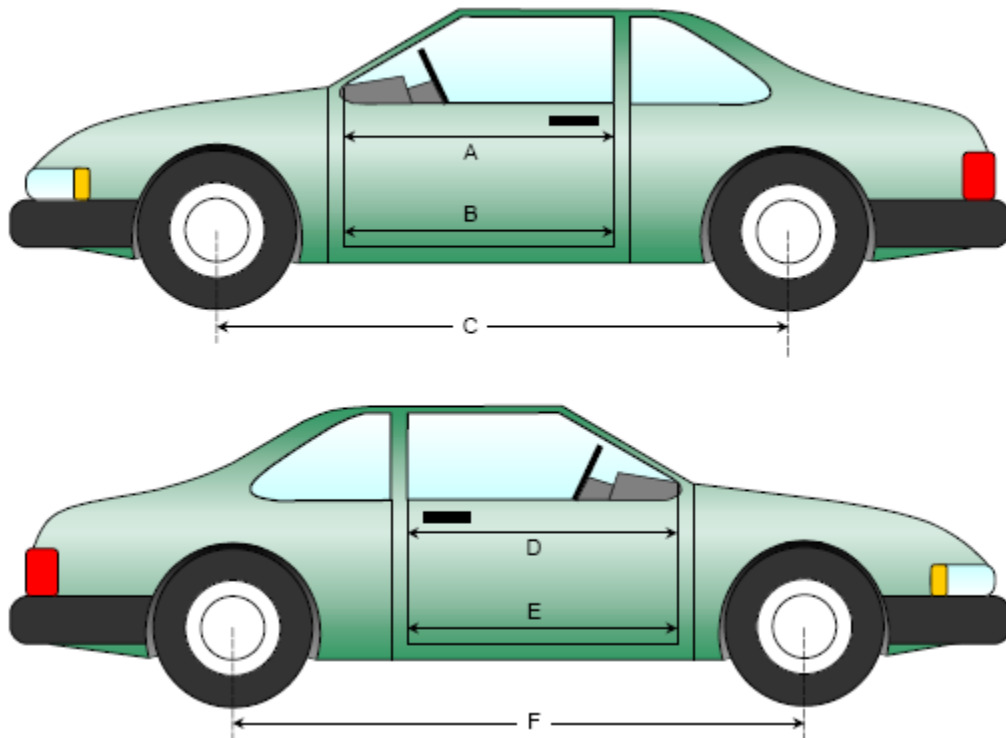
No.	Measurement Description	Units	Pre-Test	Post-Test	Crush
C1	Crush Zone 1 at Left Side	mm	3600	3221	379
C2	Crush Zone 2 at Left Side	mm	3831	3240	591
C3	Crush Zone 3 at Left Side	mm	3831	3227	604
C4	Crush Zone 4 at Right Side	mm	3831	3223	608
C5	Crush Zone 5 at Right Side	mm	3751	3235	516
C6	Crush Zone 6 at Right Side	mm	3603	3214	389
L	C1 to C6	mm	1667		

DATA SHEET NO. 14**VEHICLE INTRUSION MEASUREMENTS**Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUVNHTSA No.: M20234100Test Program: 56.3 km/h Frontal Impact NCAP TestTest Date: 04/28/2023**DOOR OPENING WIDTH**

Item	Description	Units	Pre-Test	Post-Test	Change
A	Left Side Upper	mm	1097	1094	-3
B	Left Side Lower	mm	1022	1023	1
D	Right Side Upper	mm	1096	1089	-7
E	Right Side Lower	mm	1020	1021	1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Change
C	Left Side Wheelbase	mm	2680	2620	-60
F	Right Side Wheelbase	mm	2680	2626	-54



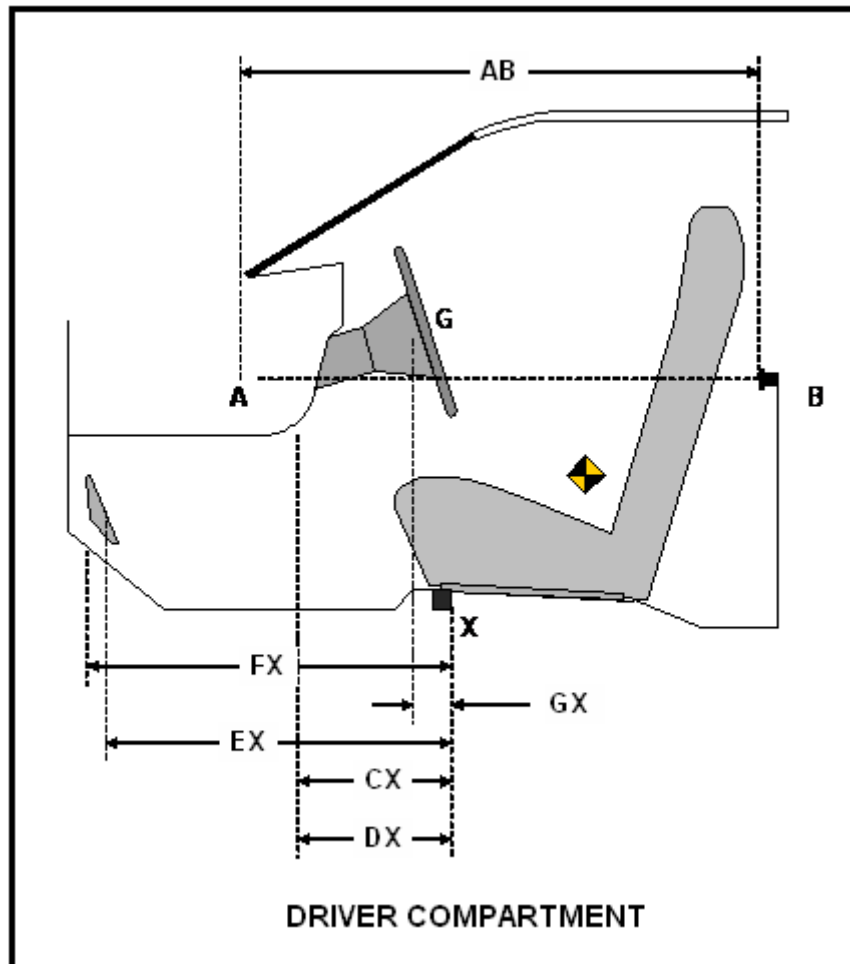
DATA SHEET NO. 14 ... (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Change
AB	Door Opening (Inside Window Jam)	mm	895	894	-1
CX	Left Knee Bolster to X	mm	259	292	33
DX	Right Knee Bolster to X	mm	264	307	43
EX	Brake Pedal to X	mm	507	515	8
FX	Foot Rest to X	mm	516	498	-18
GX	Center of Steering Wheel Hub to X	mm	26	95	69

X = Front of Seat Track (Stationary)



DATA SHEET NO. 15

SUMMARY OF INDICANT FMVSS 212 AND 219 (PARTIAL) DATA

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

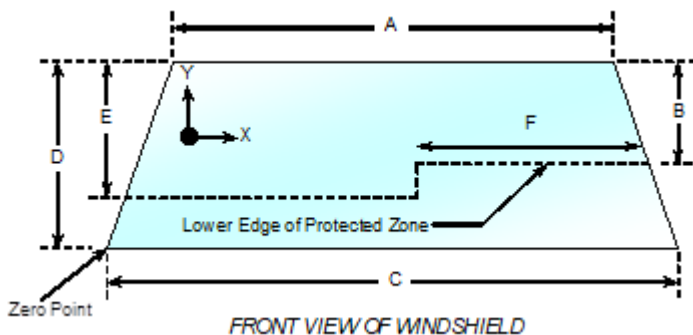
Windshield Mounting Details: Windshield glass is secured to the vehicle frame with rubber molding and rubber cement.

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: 21.5°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2208	2208	100.0%
Right Side	2208	2208	100.0%
Total	4416	4416	100.0%



Item	Units	Value
A	mm	1210
B	mm	520
C	mm	1445
D	mm	880
E	mm	550
F	mm	610

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

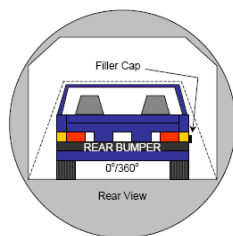
Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

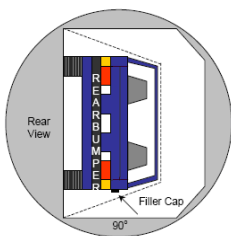
Temperature at Time of Impact: 32.7°C Test Time: 3:34 PM

Stoddard Solvent Spillage Measurements

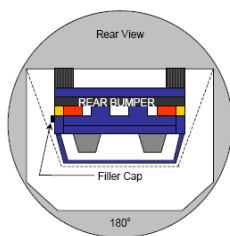
- A. From impact until vehicle motion ceases: N/A oz.
(Maximum allowable = 1 oz.)
- B. For the 5 minute period after motion ceases: N/A oz.
(Maximum allowable = 5 oz.)
- C. For the following 25 minutes: N/A oz.
(Maximum allowable = 1 oz./minute)
- D. Spillage: _____



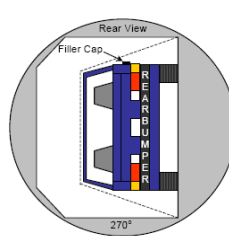
0° TO 90°



90° TO 180°



180° TO 270°



270° TO 360°

1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.
2. The position hold time at each position is 300 seconds (minimum).
3. Details of Stoddard solvent spillage: N/A

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	82	300	382
90° To 180°	85	300	385
180° To 270°	83	300	383
270° To 360°	80	300	380

DATA SHEET NO. 16 ... (CONTINUED)**FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER RESULTS**

Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023

FMVSS 301 SPILLAGE TABLE

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

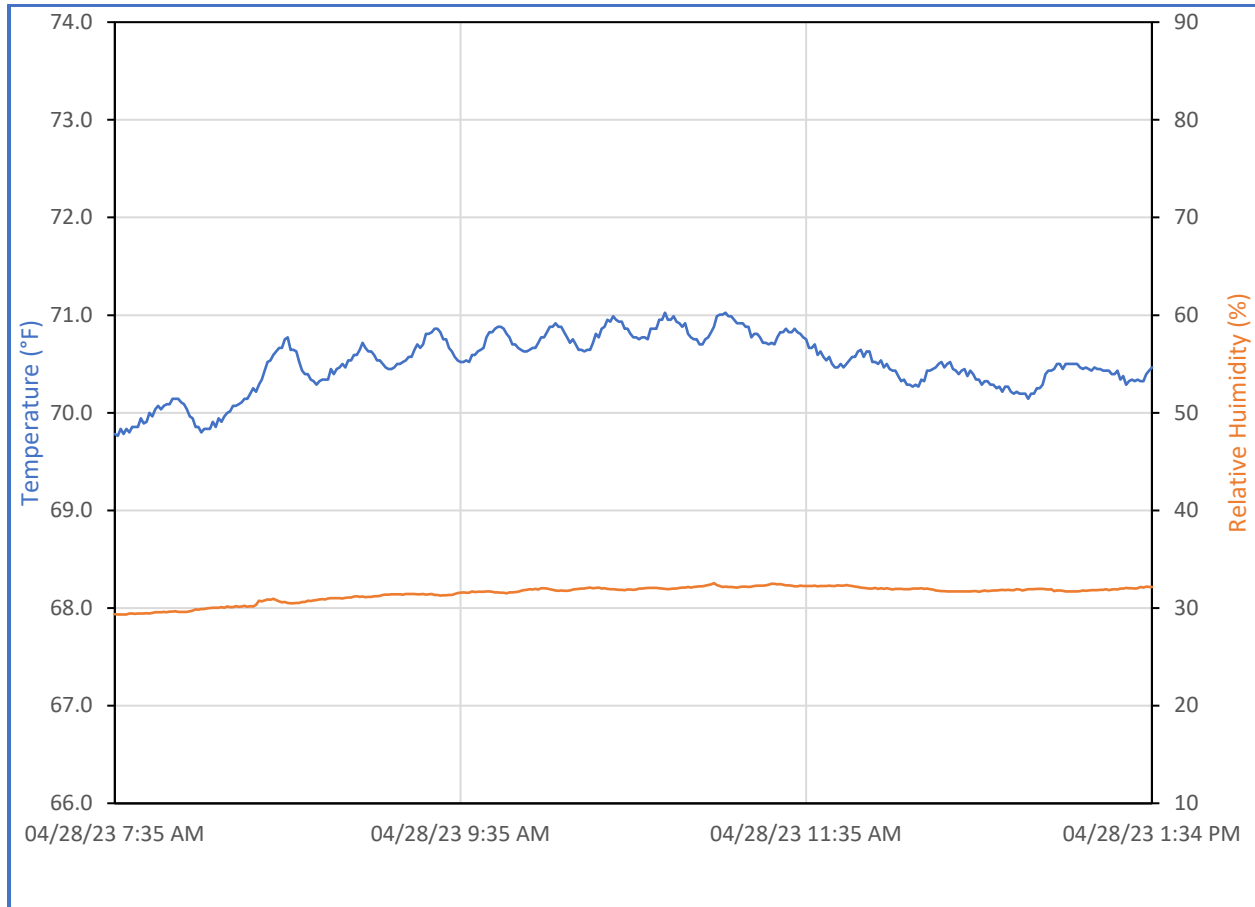
SOLVENT SPILLAGE LOCATION TABLE

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: 2023 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20234100
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 04/28/2023



APPENDIX A
PHOTOGRAPHIC DOCUMENTATION

TABLE OF PHOTOGRAPHS

Figure		Page
1	Load Cell Location	A-1
2	Pre-Test Load Cell Wall	A-1
3	Post-Test Load Cell Wall	A-2
4	Manufacturer's Label	A-2
5	Tire Placard	A-3
6	2023 BMW X1 xDrive28i 5-Door SUV Frontal as Delivered	A-3
7	Left Rear $\frac{3}{4}$ View, as Received	A-4
8	Pre-Test Front View of Test Vehicle	A-4
9	Post-Test Front View of Test Vehicle	A-5
10	Pre-Test Left View of Test Vehicle	A-5
11	Post-Test Left View of Test Vehicle	A-6
12	Pre-Test Right View of Test Vehicle	A-6
13	Post-Test Right View of Test Vehicle	A-7
14	Pre-Test Right Front $\frac{3}{4}$ View	A-7
15	Post-Test Right Front $\frac{3}{4}$ View	A-8
16	Pre-Test Left Rear $\frac{3}{4}$ View	A-8
17	Post-Test Left Rear $\frac{3}{4}$ View	A-9
18	Pre-Test Windshield View	A-9
19	Post-Test Windshield View	A-10
20	Pre-Test Engine Compartment View	A-10
21	Post-Test Engine Compartment View	A-11
22	Pre-Test Fuel Filler Cap View	A-11
23	Post-Test Fuel Filler Cap View	A-12
24	Pre-Test Front Underbody View	A-12
25	Post-Test Front Underbody View	A-13
26	Pre-Test Rear Underbody View	A-13
27	Post-Test Rear Underbody View	A-14
28	Pre-Test Dummy Cable Routing	A-14
29	Post-Test Dummy Cable Routing	A-15
30	Pre-Test Driver Dummy Front View	A-15
31	Post-Test Driver Dummy Front View	A-16
32	Pre-Test Driver Dummy Window View	A-16
33	Post-Test Driver Dummy Window View	A-17
34	Pre-Test Driver Dummy and Vehicle Interior View	A-17
35	Post-Test Driver Dummy and Vehicle Interior View	A-18
36	Pre-Test Driver's Seat Fore-Aft Markings	A-18

TABLE OF PHOTOGRAPHS ... (CONTINUED)

Figure		Page
37	Post-Test Driver's Seat Fore-Aft Markings	A-19
38	Pre-Test View of Belt Anchorage for Driver Dummy	A-19
39	Post-Test View of Belt Anchorage for Driver Dummy	A-20
40	Pre-Test View of Belt Buckle and Latch Plate for Driver Dummy	A-20
41	Post-Test View of Belt Buckle and Latch Plate for Driver Dummy	A-21
42	Pre-Test Driver Dummy Feet	A-21
43	Post-Test Driver Dummy Feet	A-22
44	Pre-Test Driver's Side Knee Bolster	A-22
45	Post-Test Driver's Side Knee Bolster	A-23
46	Pre-Test Driver's Side Floorpan	A-23
47	Post-Test Driver's Side Floorpan	A-24
48	Post-Test Driver Dummy Face	A-24
49	Post-Test Driver Dummy Contact with Airbag	A-25
50	Post-Test Driver Dummy Contact with Headrest	A-25
50a	Post-Test Driver Dummy Contact with Knee Airbag	A-26
51	Pre-Test View of the Steering Wheel	A-26
52	Post-Test View of the Steering Wheel	A-27
53	Pre-Test Passenger Dummy Front View	A-27
54	Post-Test Passenger Dummy Front View	A-28
55	Pre-Test Passenger Dummy Window View	A-28
56	Post-Test Passenger Dummy Window View	A-29
57	Pre-Test Passenger Dummy and Vehicle Interior View	A-29
58	Post-Test Passenger Dummy and Vehicle Interior View	A-30
59	Pre-Test Passenger's Seat Fore-Aft Markings	A-30
60	Post-Test Passenger's Seat Fore-Aft Markings	A-31
61	Pre-Test View of Belt Anchorage for Passenger Dummy	A-31
62	Post-Test View of Belt Anchorage for Passenger Dummy	A-32
63	Pre-Test View of Belt Buckle and Latch Plate for Passenger Dummy	A-32
64	Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy	A-33
65	Pre-Test Passenger Dummy Feet	A-33
66	Post-Test Passenger Dummy Feet	A-34
67	Pre-Test Passenger's Side Knee Bolster	A-34
68	Post-Test Passenger's Side Knee Bolster	A-35
69	Pre-Test Passenger's Side Floorpan	A-35
70	Post-Test Passenger's Side Floorpan	A-36
71	Post-Test Passenger Dummy Face	A-36
72	Post-Test Passenger Dummy Contact with Airbag	A-37

TABLE OF PHOTOGRAPHS ... (CONTINUED)

Figure		Page
73	Post-Test Passenger Dummy Contact with Headrest	A-37
74	Photograph of Ballast Installed in Vehicle	A-38
75	Post-Test Stoddard Solvent Spillage Location View	A-38
76	Post-Test Speed Trap Read-Out	A-39
77	Vehicle at 0° on Static Rollover Device	A-39
78	Vehicle at 90° on Static Rollover Device	A-40
79	Vehicle at 180° on Static Rollover Device	A-40
80	Vehicle at 270° on Static Rollover Device	A-41
81	Vehicle at 360° on Static Rollover Device	A-41
82	2023 BMW X1 xDrive28i 5-Door SUV Frontal Impact Event	A-42
83	Monroney Label Photograph	A-42

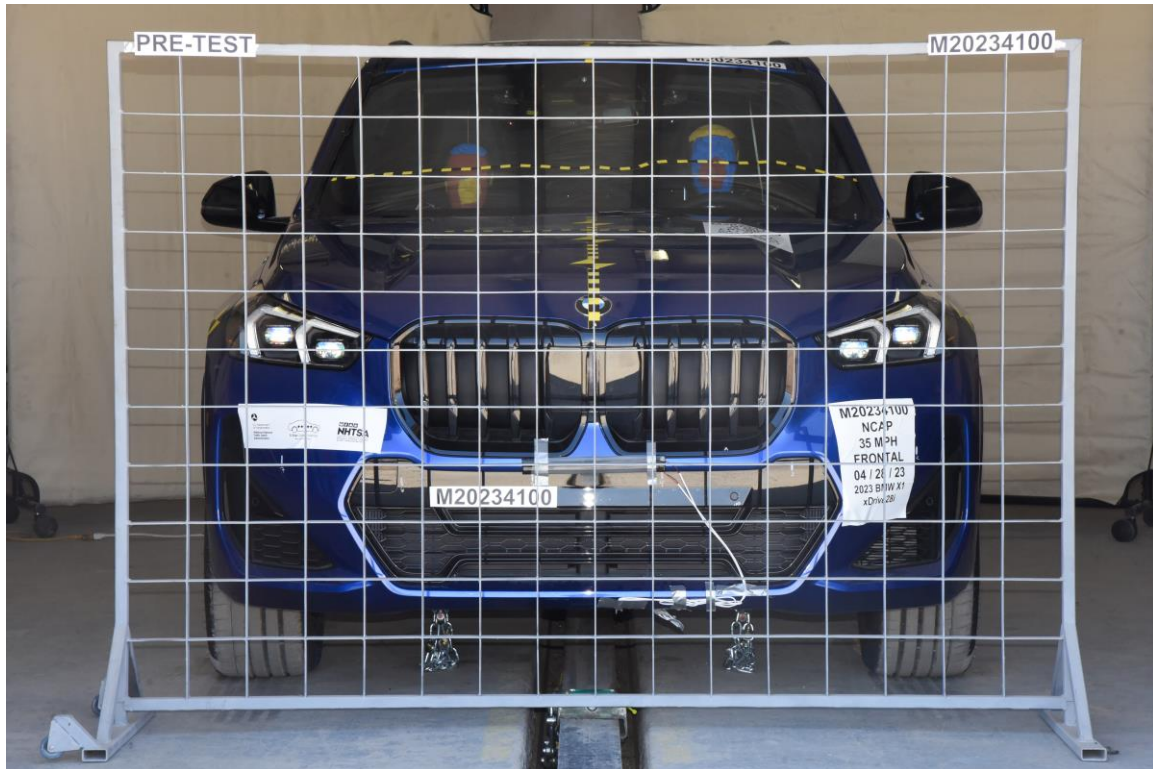


FIGURE 1. Load Cell Location

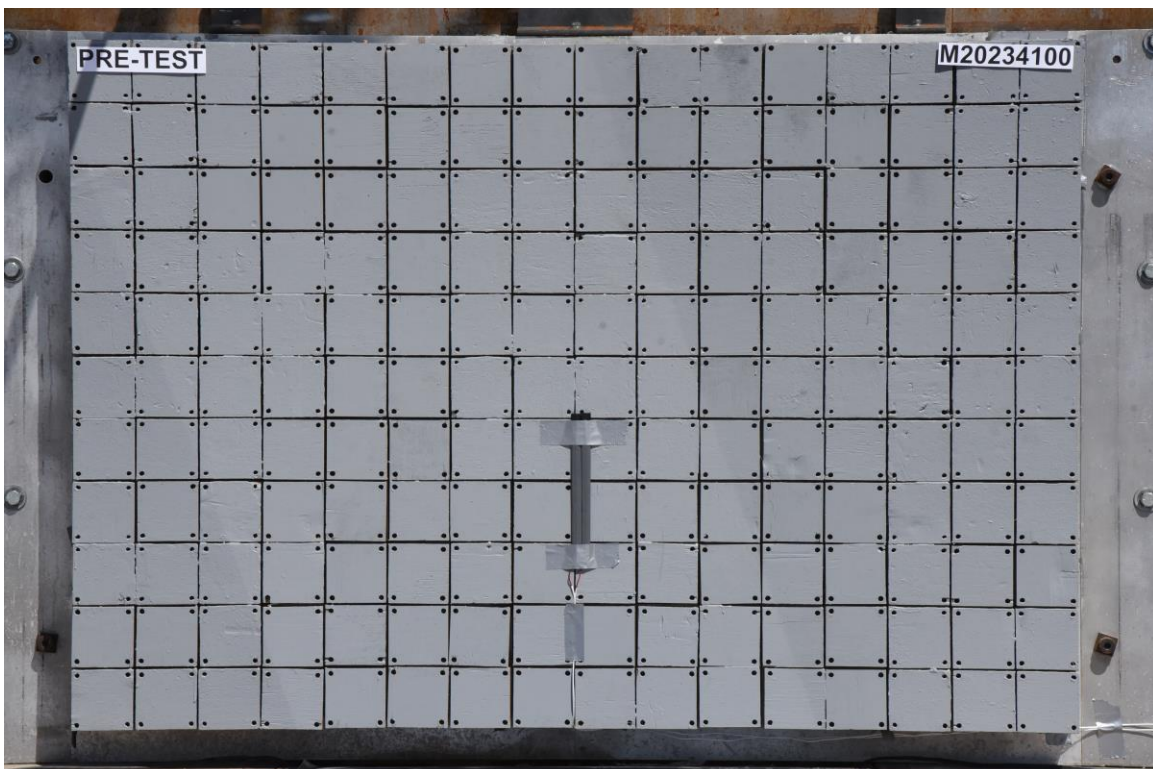


FIGURE 2. Pre-Test Load Cell Wall

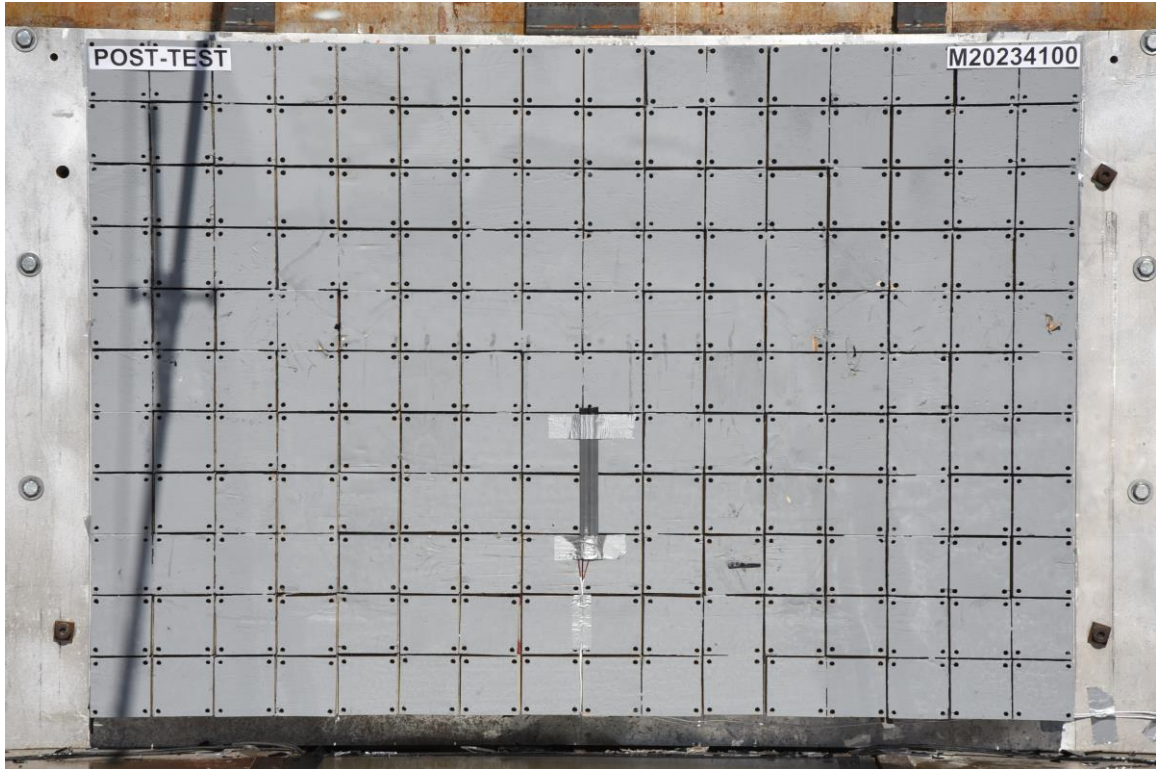


FIGURE 3. Post-Test Load Cell Wall



FIGURE 4. Manufacturer's Label



FIGURE 5. Tire Placard



FIGURE 6. 2023 BMW X1 xDrive28i 5-Door SUV 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 3/4 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

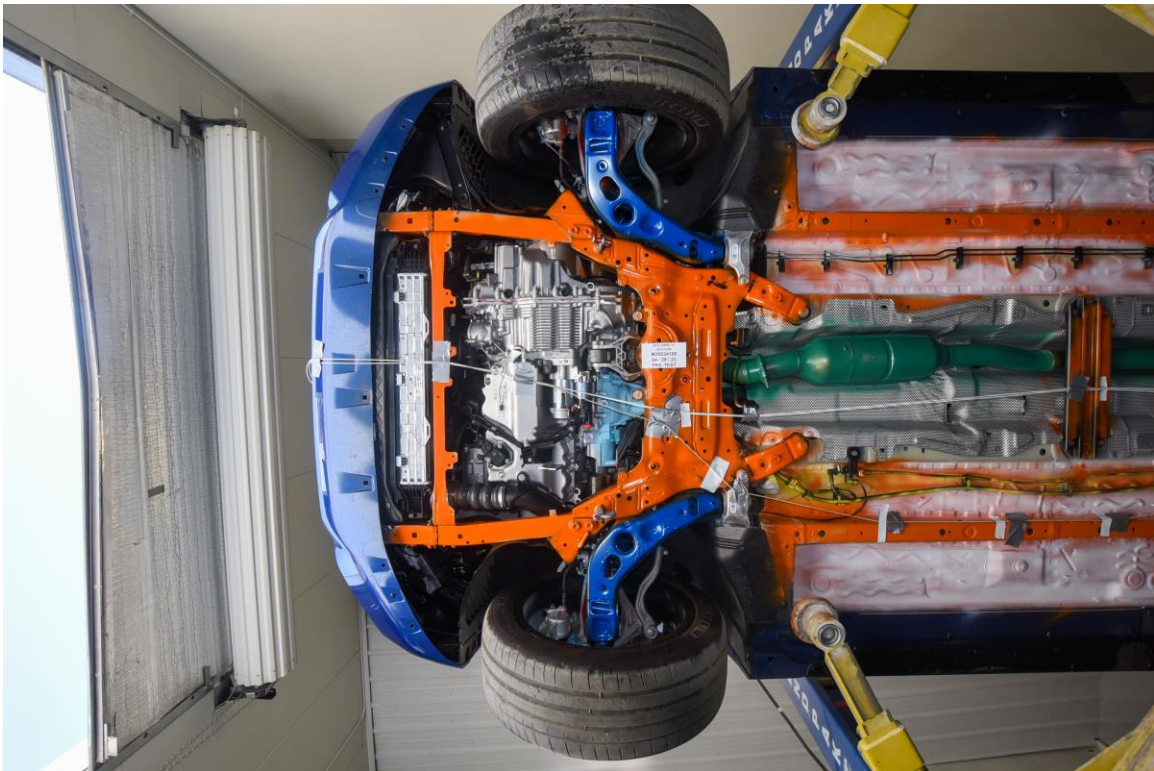


FIGURE 24. Pre-Test Front Underbody View

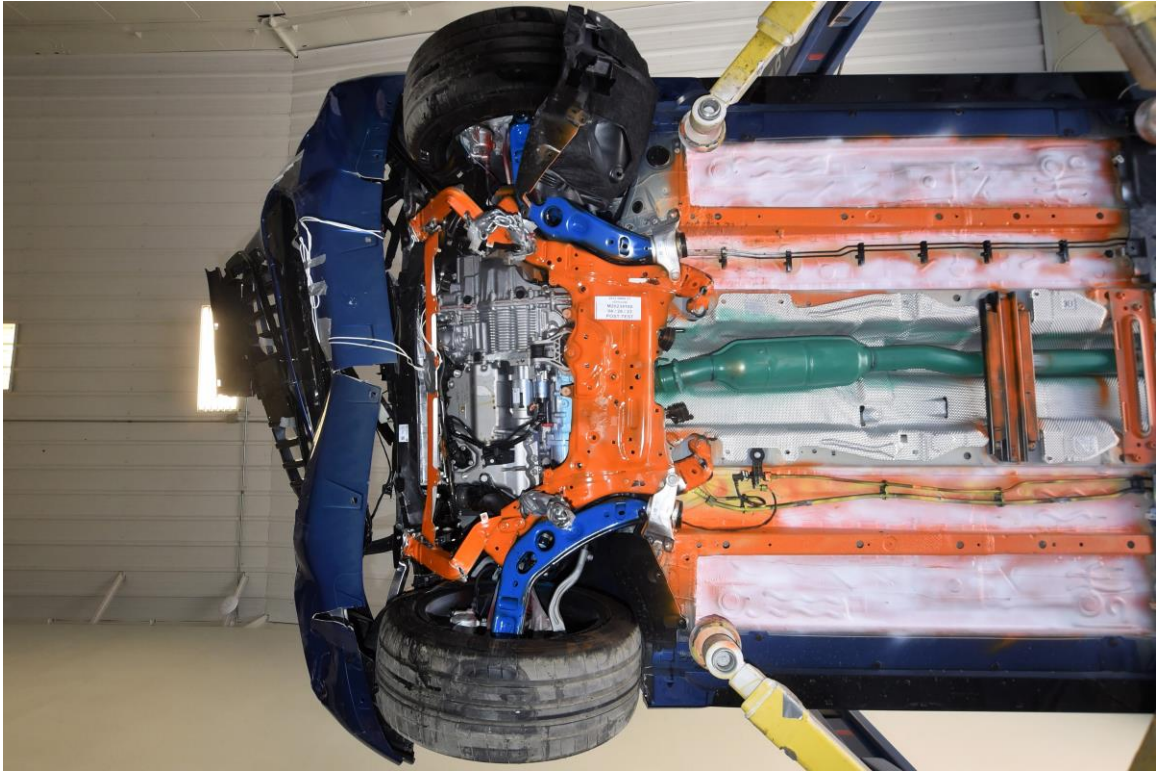


FIGURE 25. Post-Test Front Underbody View

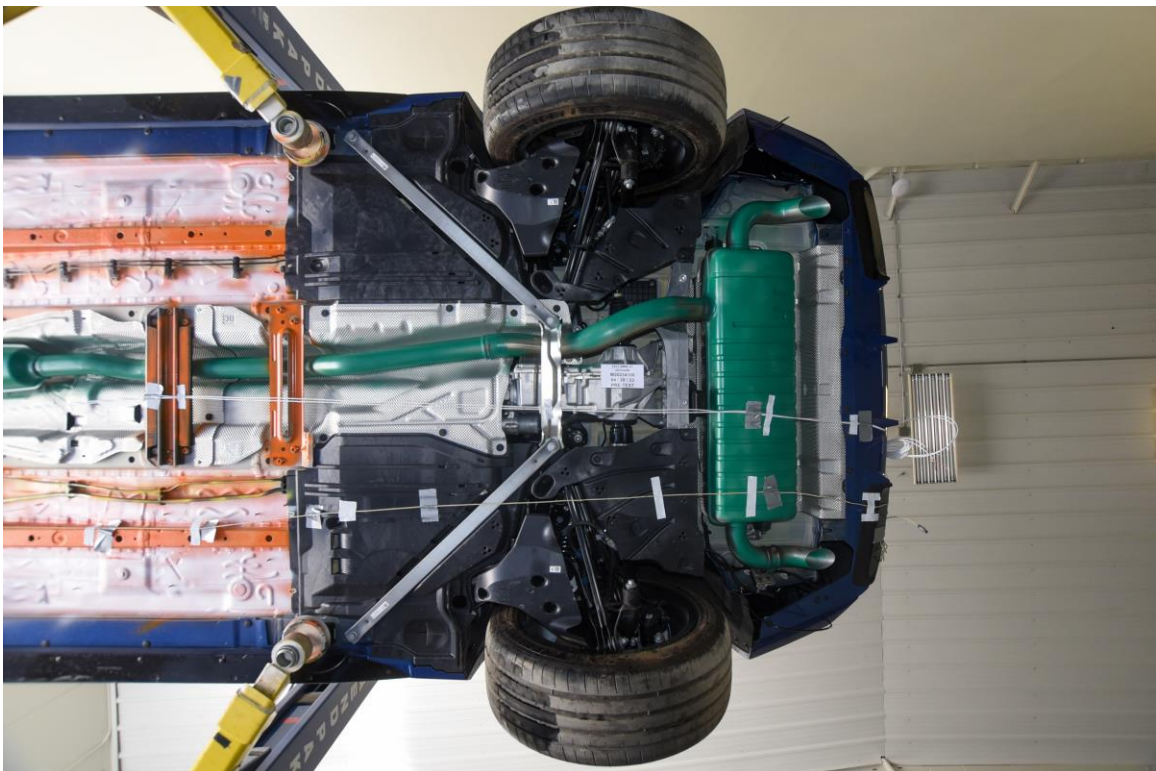


FIGURE 26. Pre-Test Rear Underbody View



FIGURE 27. Post-Test Rear Underbody View

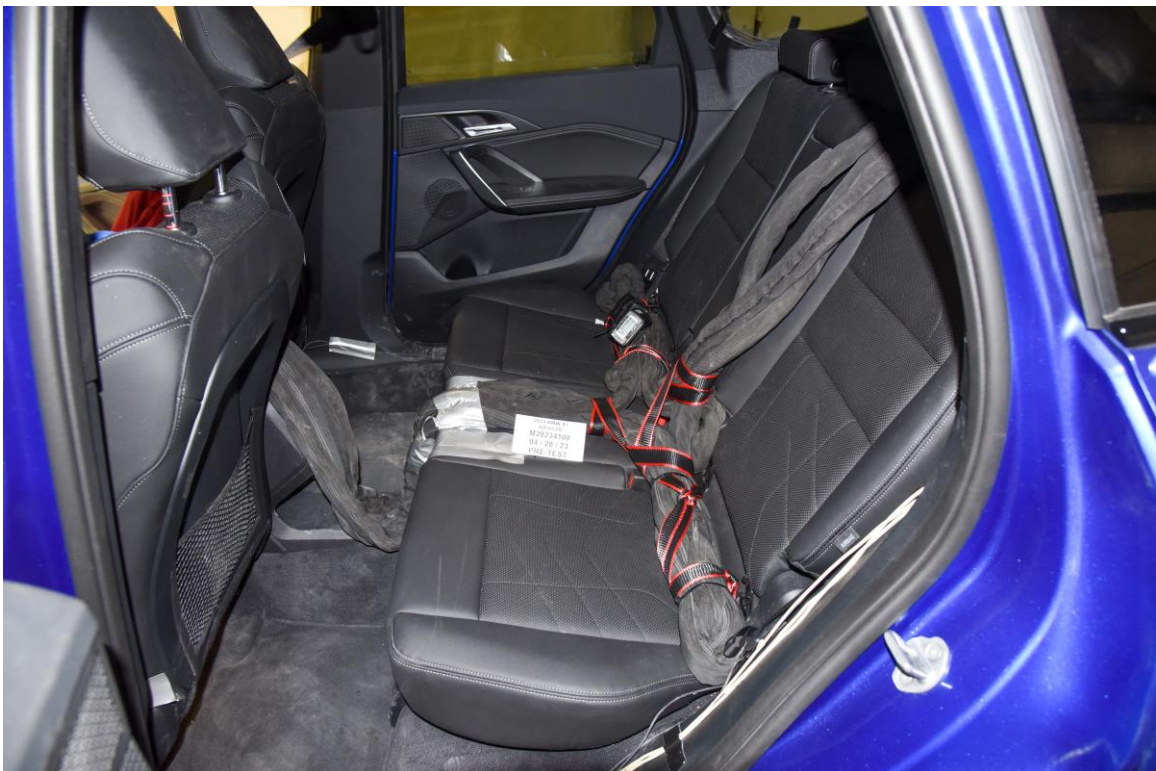


FIGURE 28. Pre-Test Dummy Cable Routing



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

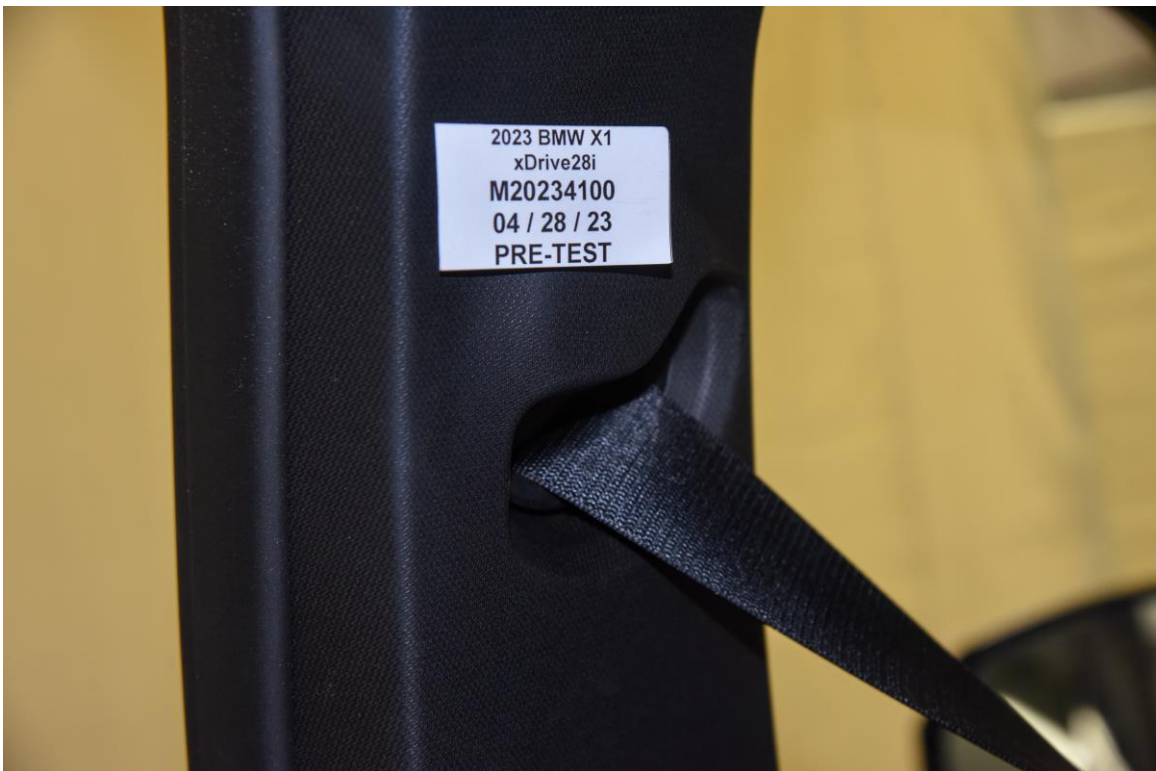


FIGURE 38. Pre-Test View of Belt Anchorage for Driver Dummy



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 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

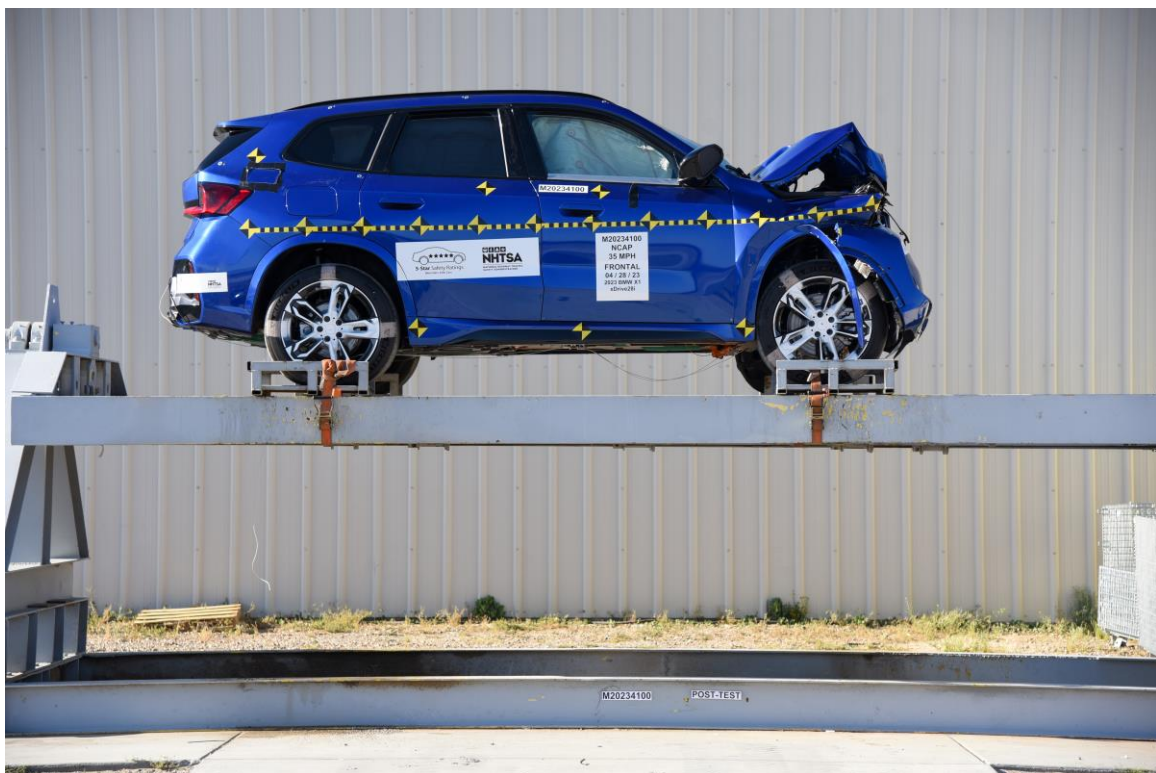


FIGURE 77. Vehicle at 0° on Static Rollover Device



FIGURE 78. Vehicle at 90° on Static Rollover Device

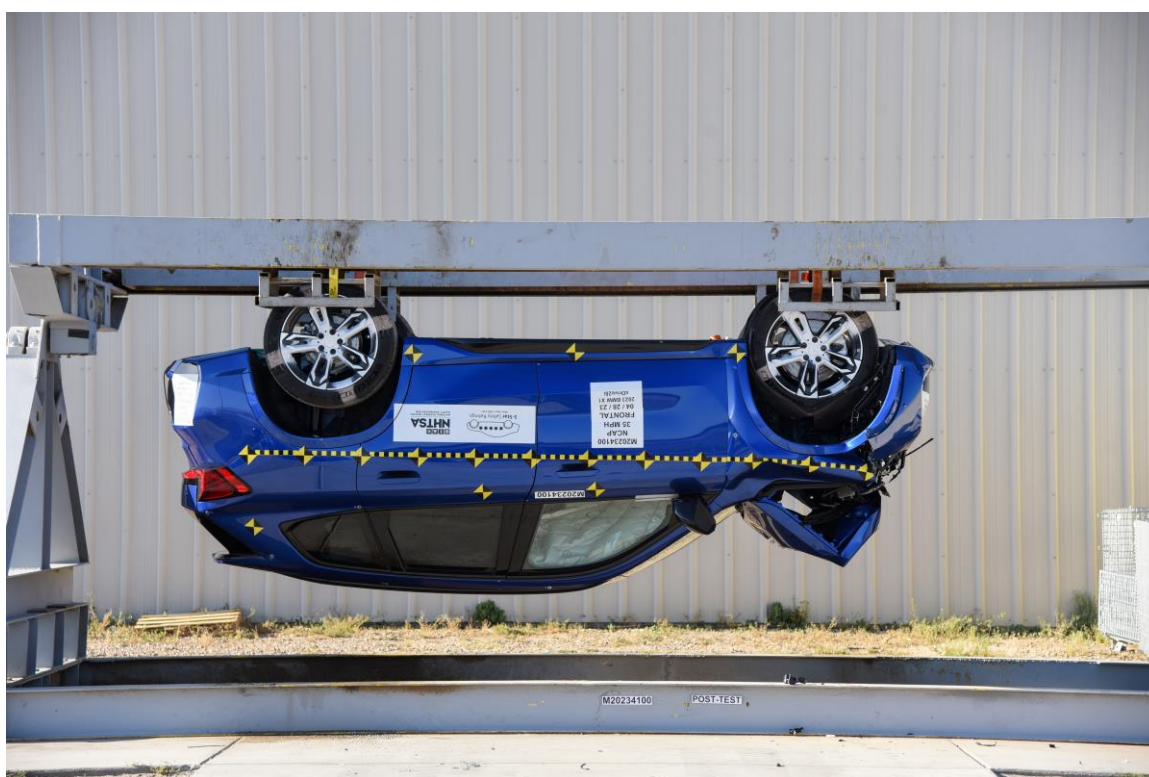


FIGURE 79. Vehicle at 180° on Static Rollover Device

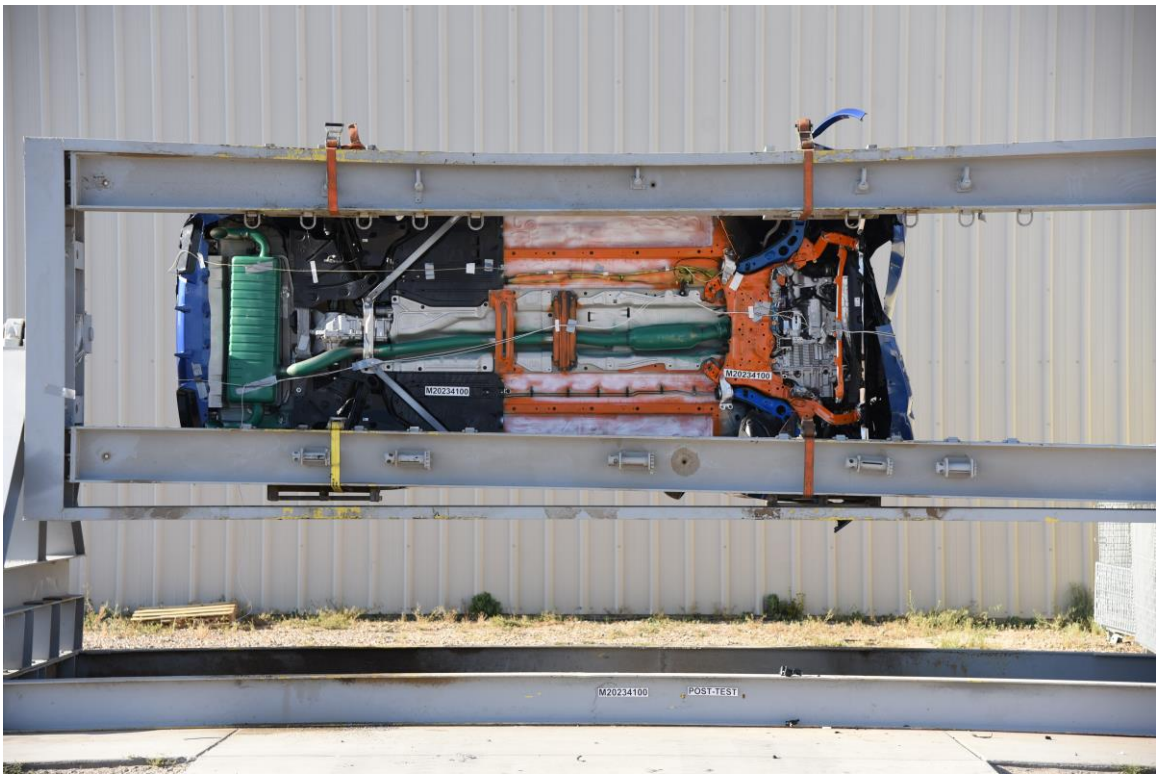


FIGURE 80. Vehicle at 270° on Static Rollover Device

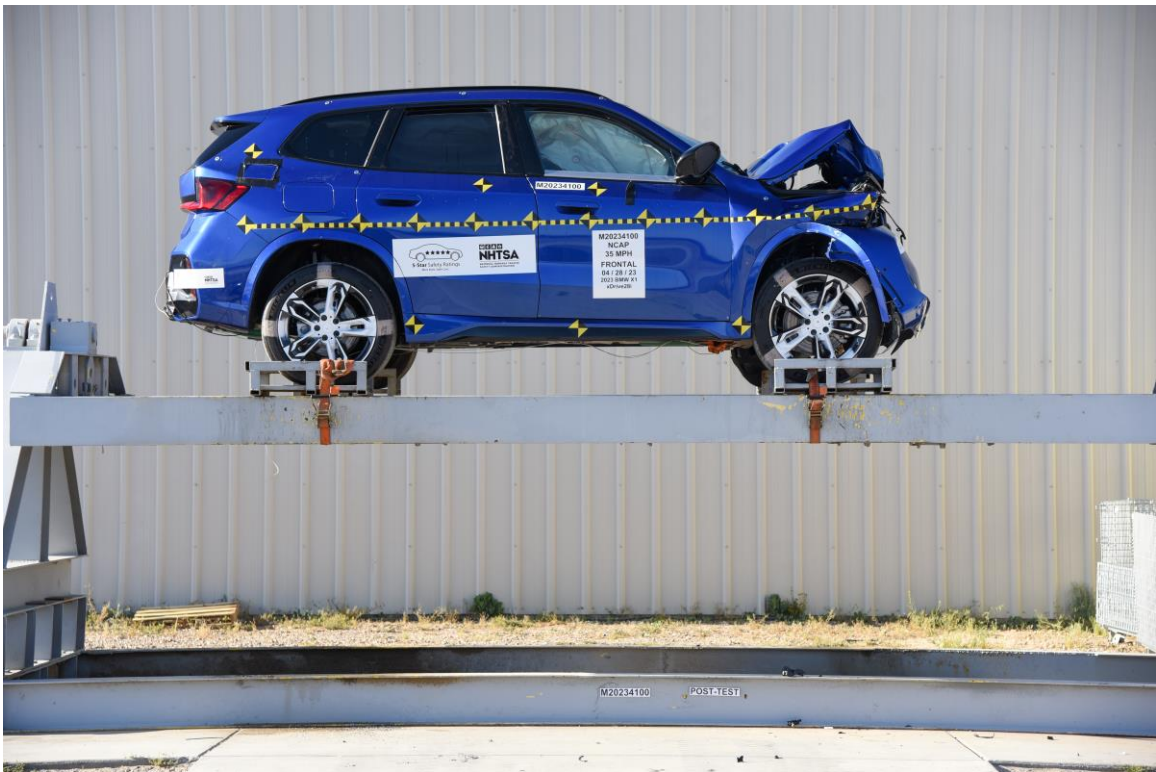


FIGURE 81. Vehicle at 360° on Static Rollover Device



FIGURE 82. 2023 BMW X1 xDrive28i 5-Door SUV Impact Event

The Ultimate Driving Machine®
2023 BMW X1 xDrive28i

Manufacturer's Suggested Retail Price	\$ 38,000.00
Options and Additional Charges: (Optional equipment may increase standard equipment; check with your authorized BMW center.)	
Portofino Blue Metallic	\$ 650.00
Black Perforated SensaTec	Included
Convenience Package	\$ 1,950.00
• Comfort Access keyless entry	
• Auto-dimming exterior mirror	
• Wireless Device Charging	
• Standard Steering Wheel	
• Standard Seats	
Shadowline Package	\$ 300.00
• Mirror Caps in Black	
• Extended Shadowline Trim	
M Sport Package	\$ 2,300.00
• 18" M Double-spoke 4-color w/	
• STEPTRONIC auto shift paddle	
• Adaptive M Suspension	
• Roof rails in High-gloss	
• Sport seats	
• Aluminum Hexacube Trim w/ Anti	
• SensaTec Dashboard	
• Shadowline exterior trim	
• Anthracite headliner	
• M Sport Exterior Elements	
• M Sport Interior Elements	
• M Sport center	
Active Blind Spot Detection	Included
Fit Col Warn w/ City Col Mitig	Included
Lane Departure Warning	Included
SULEV20 exhaust emission std	Included
Active Driving Assistant	Included
LED Headlights w/ Cornering	Included
Parking Assistant	Included
Connected Package Pro	Included
Widescreen Display	Included
SinusXM with 360L + 1 year PI	Included
Refrigerant	Included
Destination Charge	\$ 995.00
Total Suggested Retail Price	\$ 45,395.00

Standard Features
Performance and efficiency
• 2.0-liter BMW TwinPower Turbo inline 4-cylinder, 16-valve engine with variable valve control (Double-VANOS) and Valvetronic and 8-speed Steptronic automatic transmission

Handling, ride and braking
• Driving Dynamics Control with various driving modes

Connectivity
• Apple CarPlay and Android Auto compatibility

Exterior
• Satin Aluminum roof rails

Interior trim
• Perforated SensaTec upholstery

Audio system
• HiFi Sound System

Instrumentation and controls
• 5-spoke leather-wrapped sport steering wheel

Comfort and convenience
• Built-in USB Charge Port

Safety and security
• Front and rear Head Protection System (HPS)

Warranty
• 4-year/50,000-mile New Vehicle Limited Warranty for Passenger Cars

BMW Ultimate Care™
Maintenance Program
For the first 3 years or 36,000 miles, whichever comes first on scheduled maintenance.

Your Maintenance Costs:
Engine Oil Services: \$0 Air Filter: \$0
Cabin Microfilter: \$0 Spark Plugs: \$0
Vehicle Checks: \$0 Brake Fluid: \$0

EPA DOT Fuel Economy and Environment

Fuel Economy
28 MPG combined city/hwy
3.6 gallons per 100 miles

You spend \$1,750 more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost \$1,950

Fuel Economy & Greenhouse Gas Rating
This vehicle emits 313 grams CO₂ per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also creates emissions; learn more at fuel-economy.gov

Smog Rating (tailpipe only)
Best 10 Worst

PARTS CONTENT INFORMATION
For Vehicles in this Car Line:
US/Canadian Parts Content: 2%
Major Source of Foreign Parts Content: GERMANY: 21%

Note: Parts content does not include final assembly, distribution, or other non-parts costs.

For this Vehicle:
Final Assembly Point: REGENSBURG, GERMANY
Country of Origin: GERMANY
Engine: GERMANY
Transmission: GERMANY

GOVERNMENT 5-STAR SAFETY RATINGS
Based on the combined ratings of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.

Overall Vehicle Score	Not Rated
Frontal Crash	Driver Passenger Not Rated
Side Crash	Front seat Not Rated Rear seat Not Rated
Rollover	Not Rated

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest. Source: National Highway Traffic Safety Administration (NHTSA). www.safercar.gov or 1-888-327-4225

BMW of North America, LLC
Woodcliff Lake, NJ 07077

VPO Location: OXNARD, CALIFORNIA

Port of Entry: HUENEME, CALIFORNIA

Carrier: DELLUXE AUTO CARRIERS

Sold To: Crutcher BMW
1500 Auto Mall Dr
Santa Ana, CA 92705-5000

Ship To: Crutcher BMW
1500 Auto Mall Dr
Santa Ana, CA 92705-5000

FIGURE 83. Monroney Label Photograph

APPENDIX B
DUMMY RESPONSE DATA TRACES

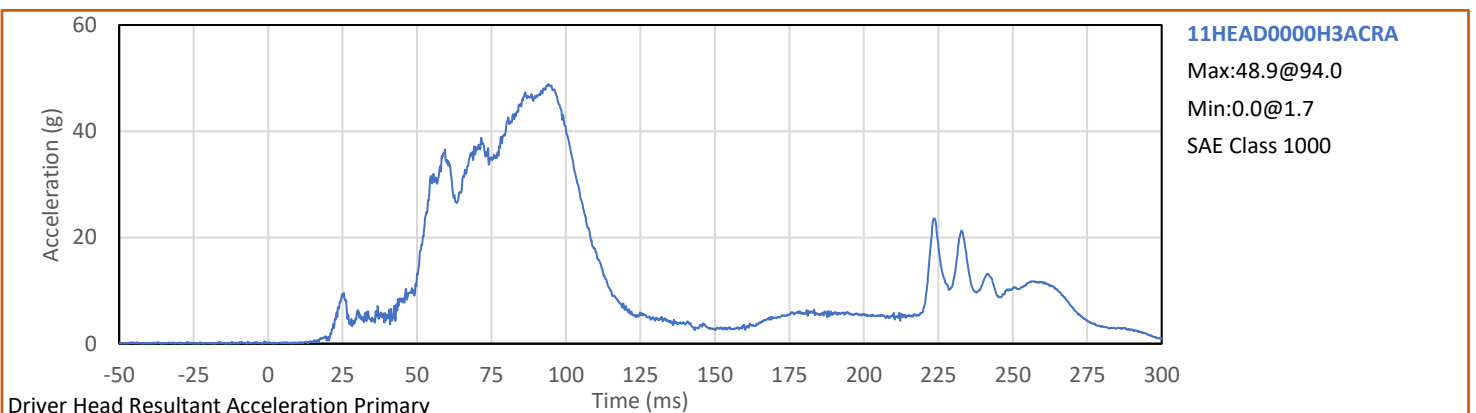
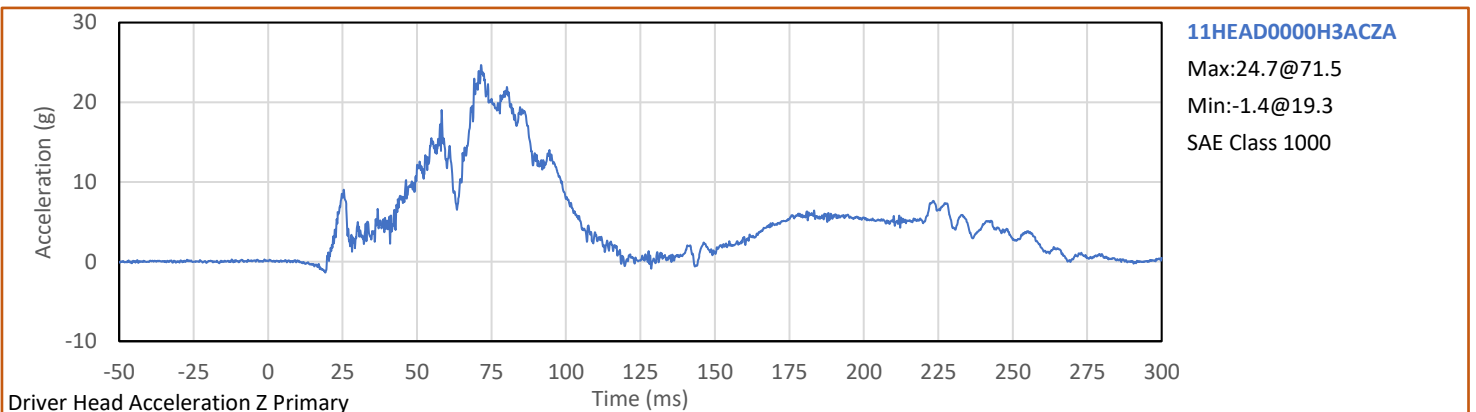
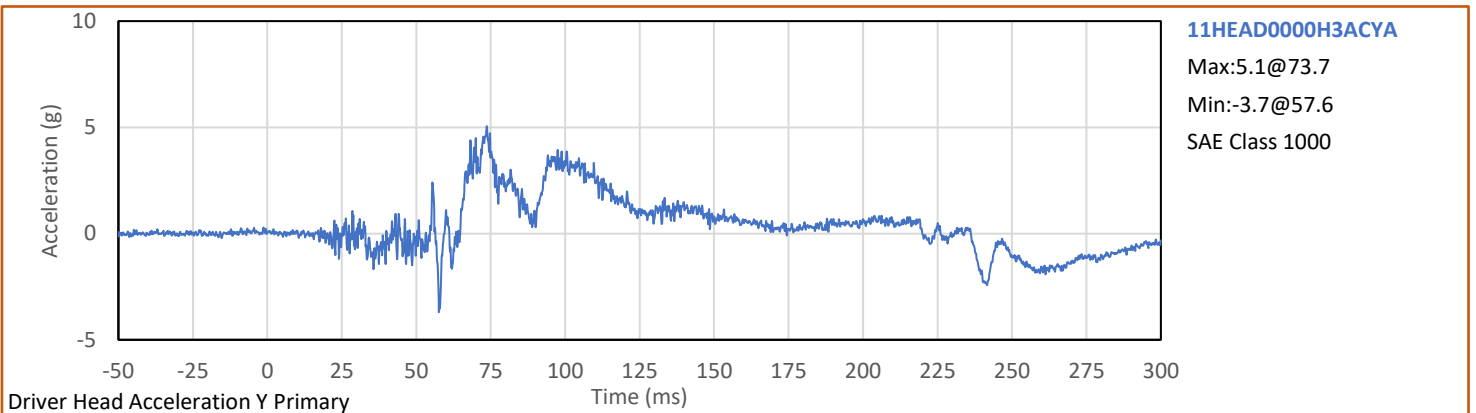
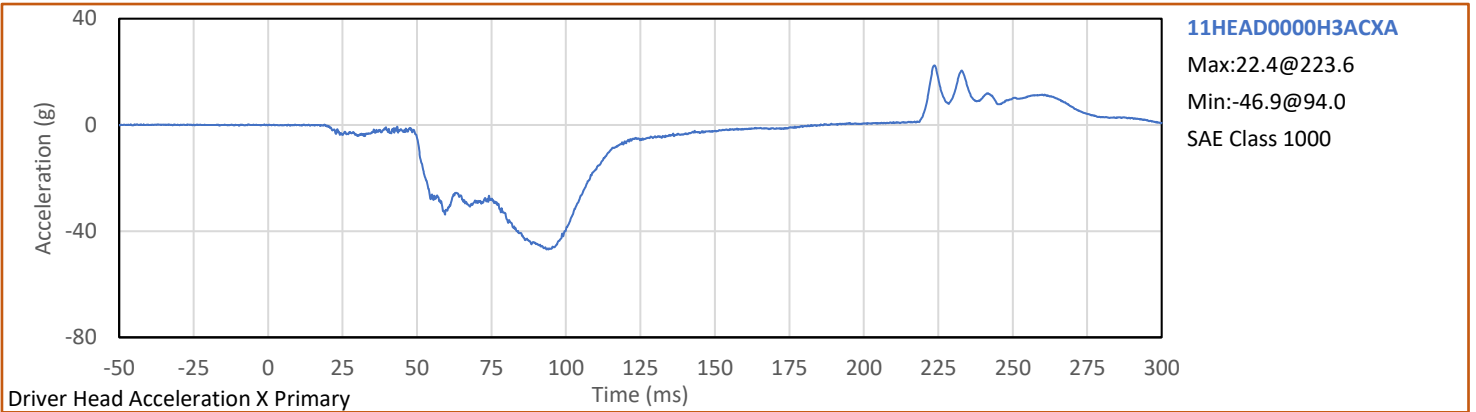
TABLE OF DATA PLOTS

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

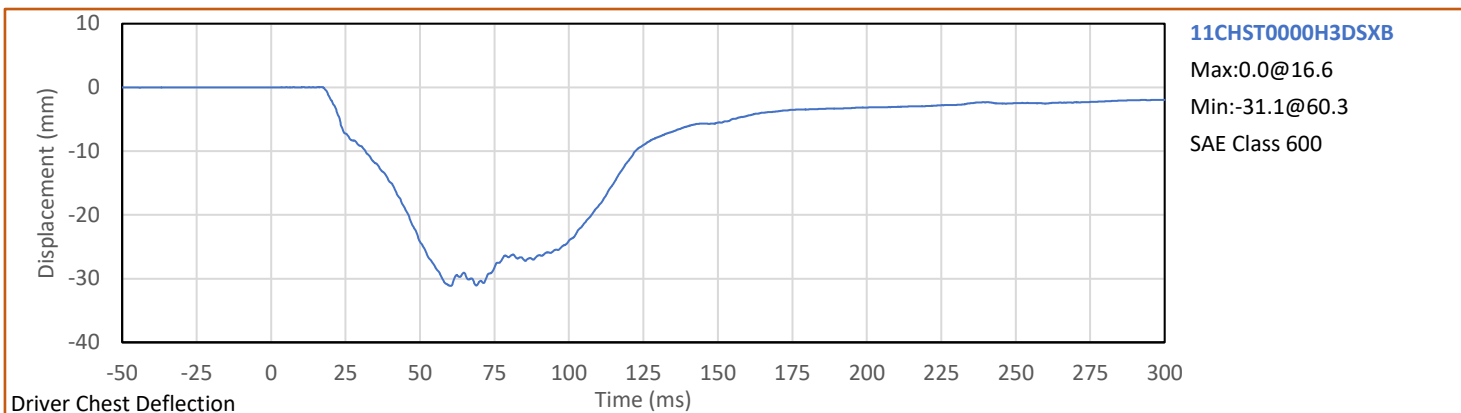
Driver Head X Acceleration Redundant
Driver Head Y Acceleration Redundant
Driver Head Z Acceleration Redundant
Driver Upper Neck Force Y
Driver Upper Neck Moment X
Driver Upper Neck Moment Z
Driver Chest X Acceleration Redundant
Driver Chest Y Acceleration Redundant
Driver Chest Z Acceleration Redundant
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

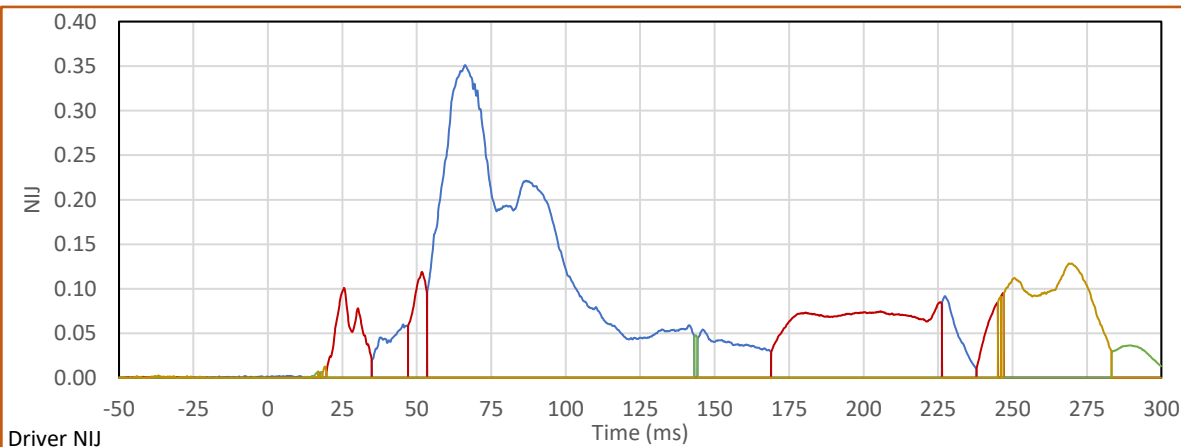
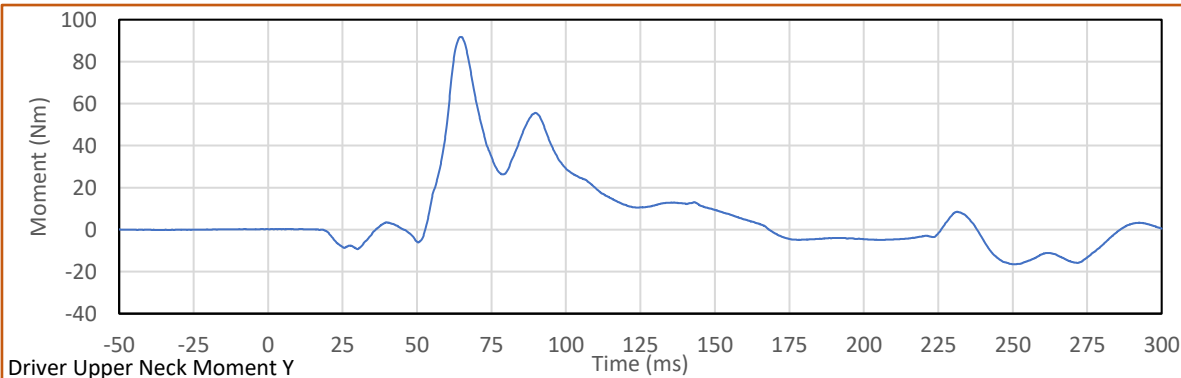
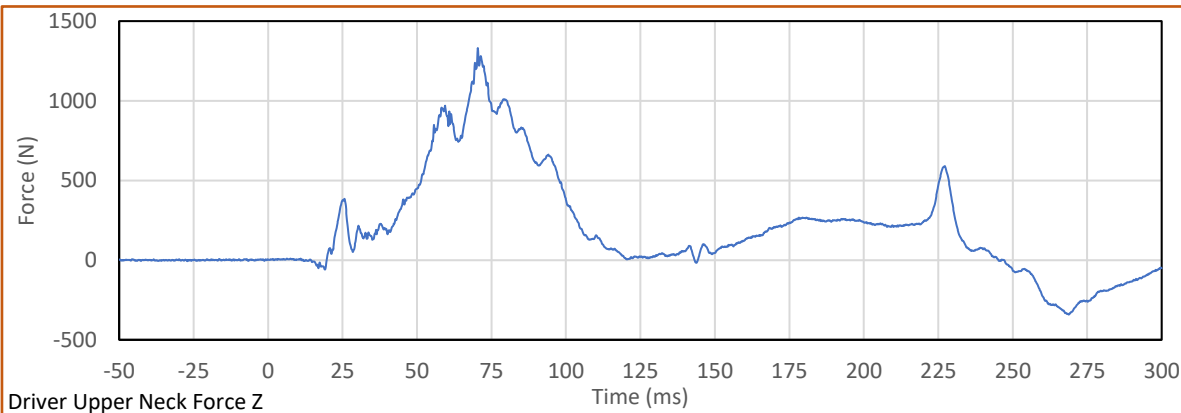
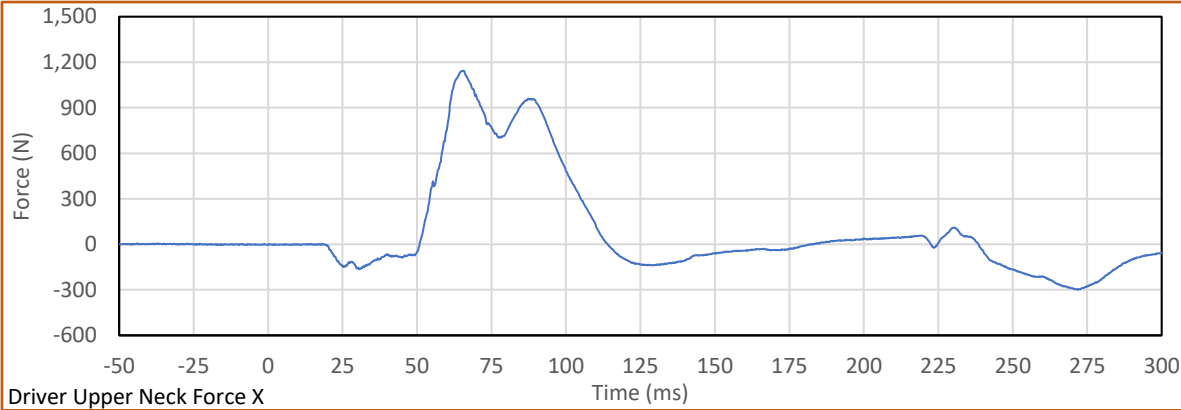
Passenger Chest X Acceleration Redundant
Passenger Chest Y Acceleration Redundant
Passenger Chest Z Acceleration Redundant
Passenger Pelvis X
Passenger Pelvis Y
Passenger Pelvis Z
Passenger Left Femur Force Redundant
Passenger Right Femur Force Redundant
Passenger Left Upper Tibia Moment X
Passenger 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

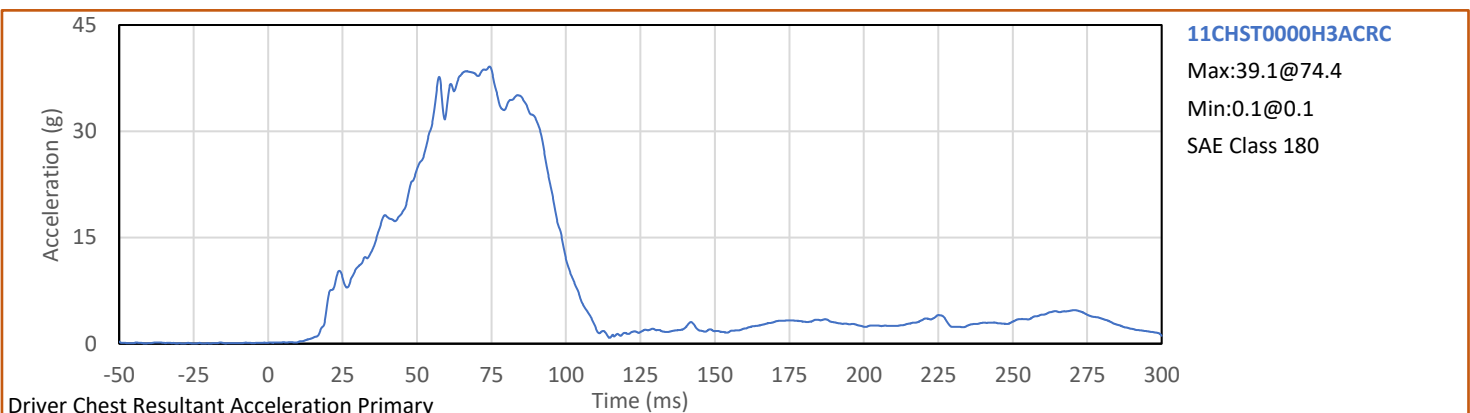
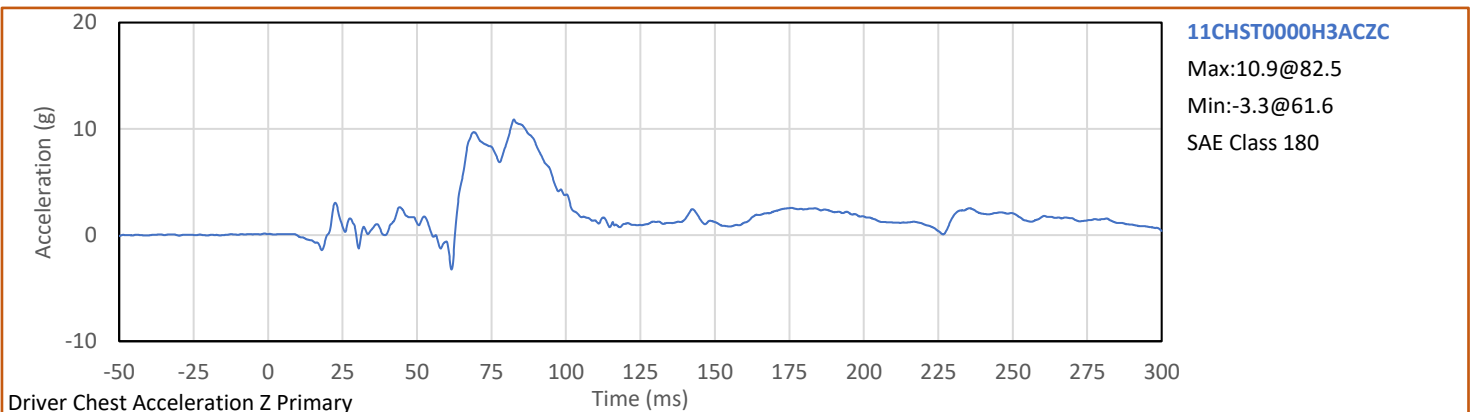
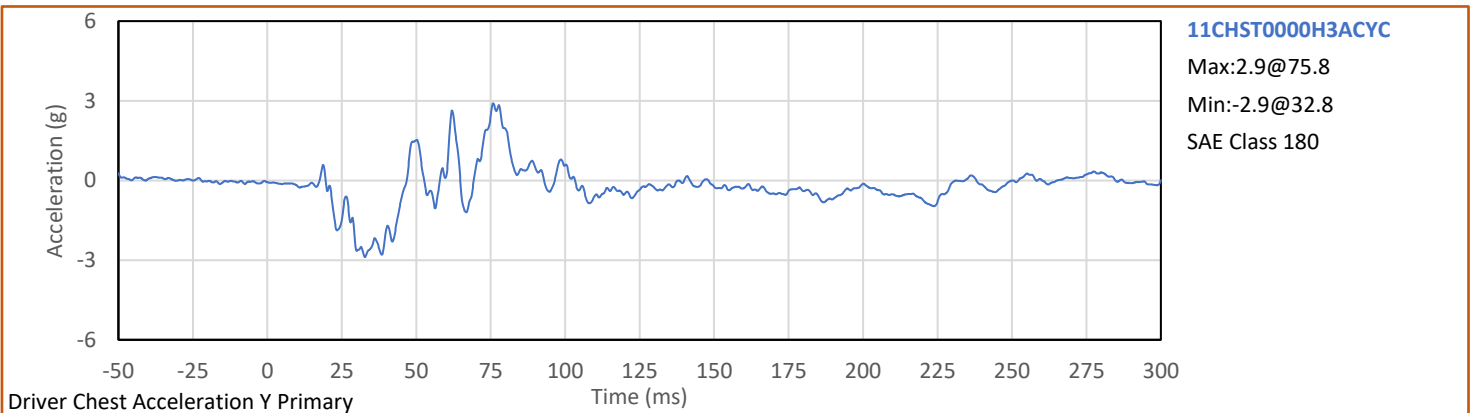
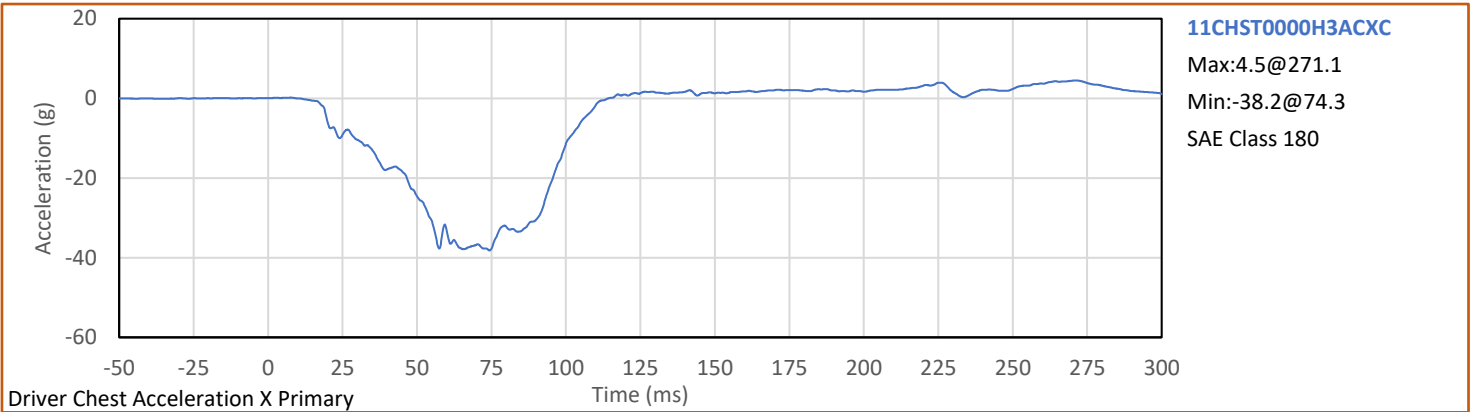


Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: M20234100
Test Date: 4/28/2023

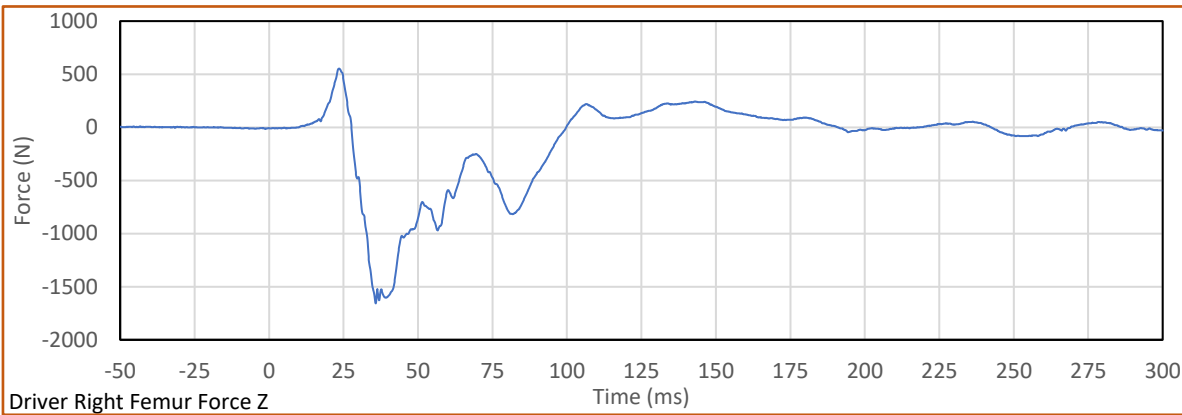
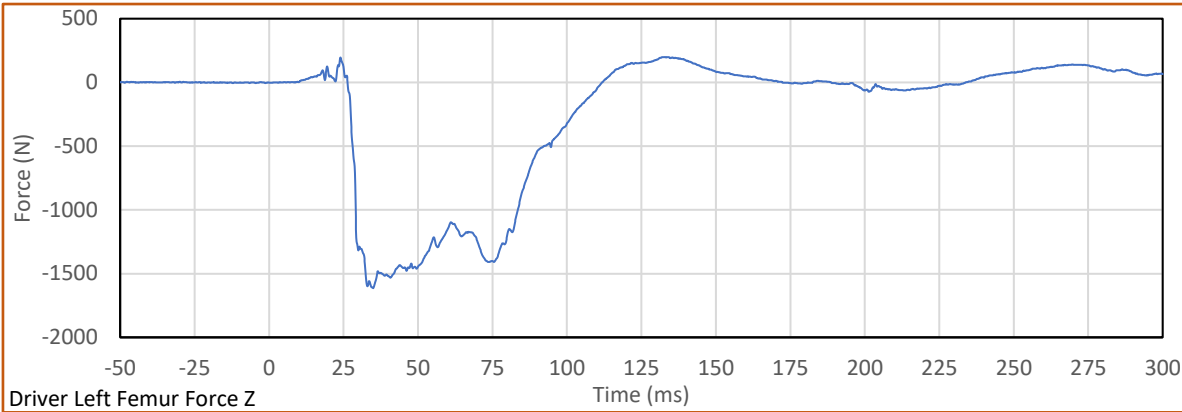


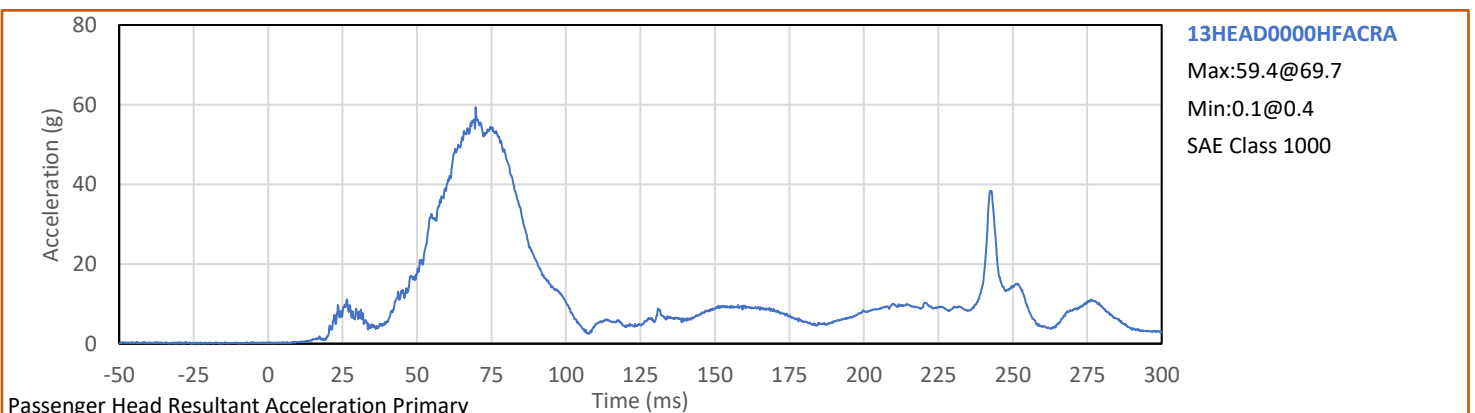
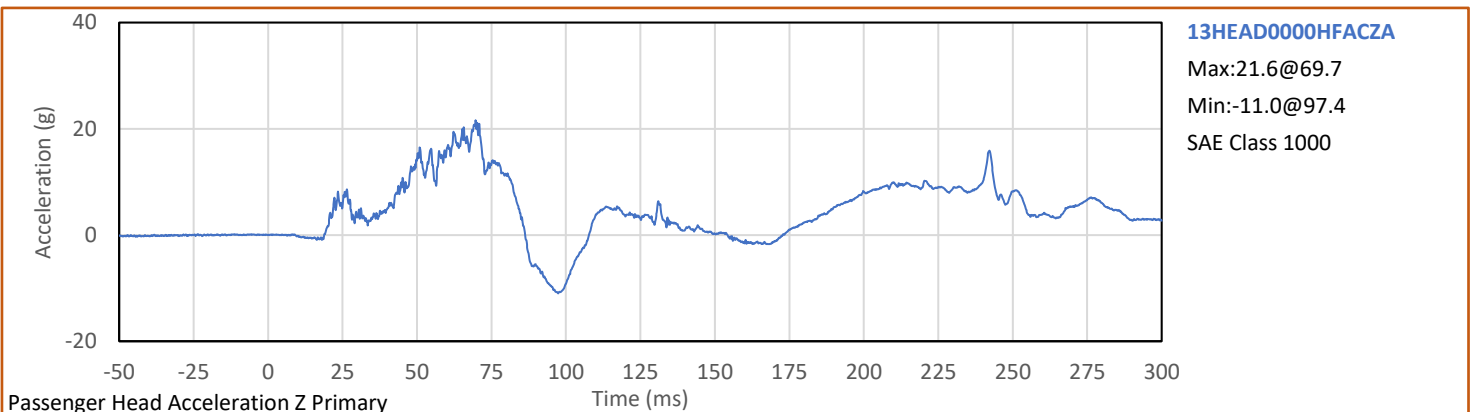
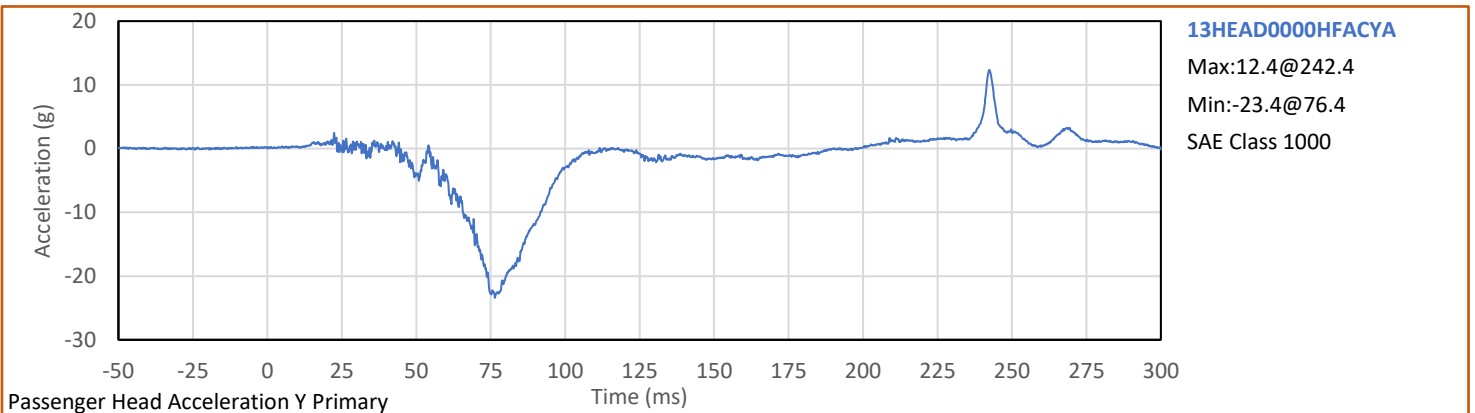
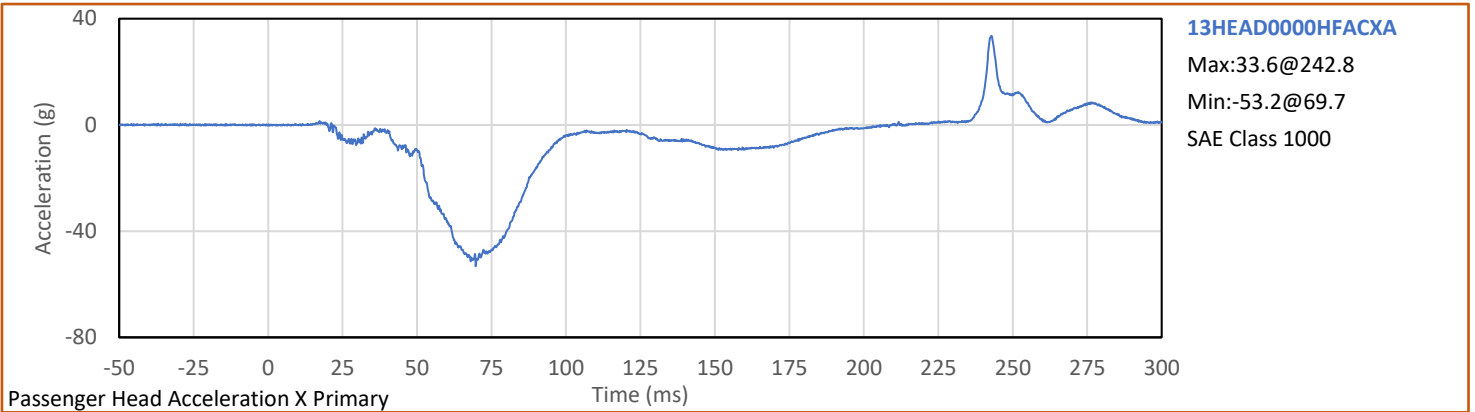




Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV
Test Program: 56.3 km/h Frontal Impact NCAP Test

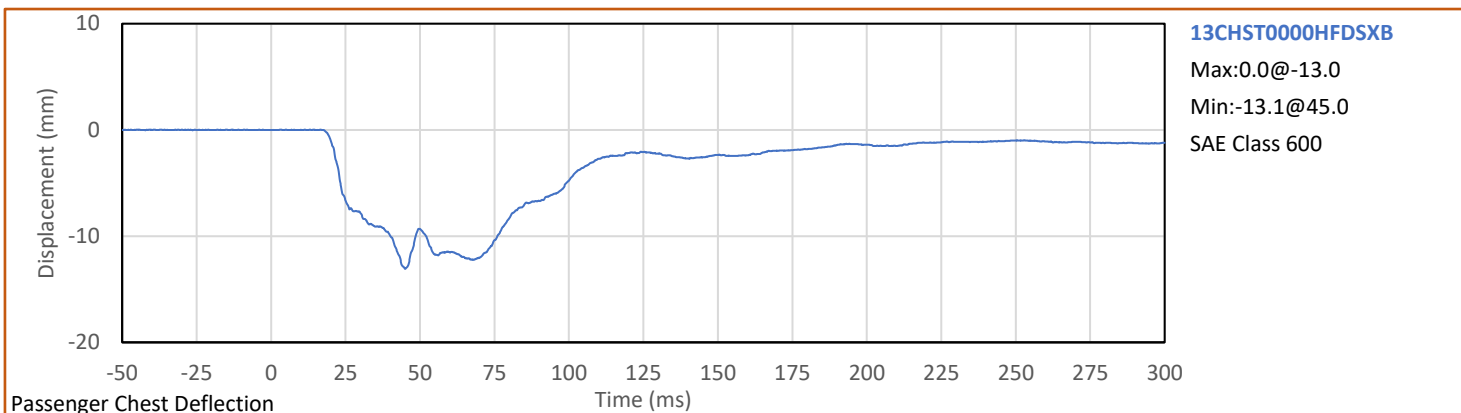
NHTSA No.: M20234100
Test Date: 4/28/2023

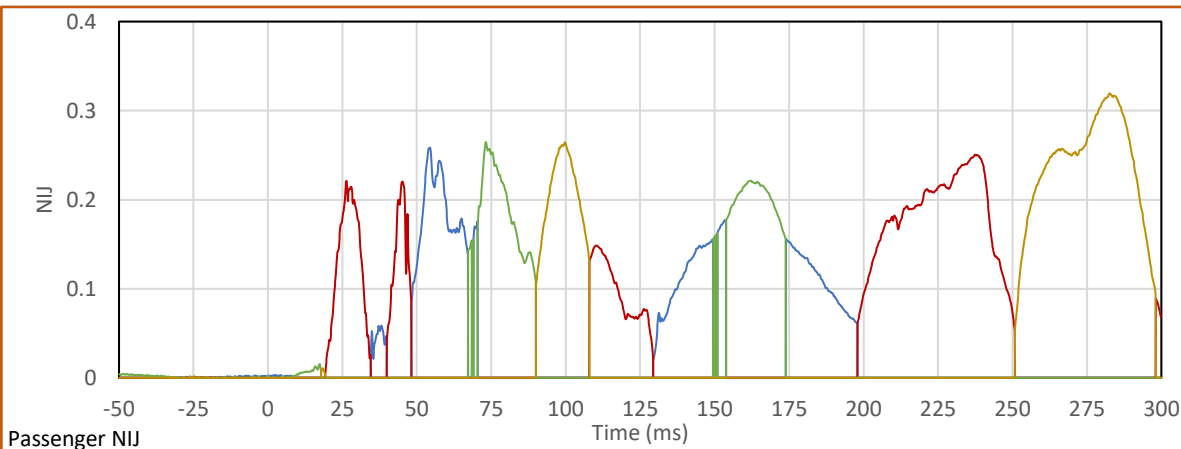
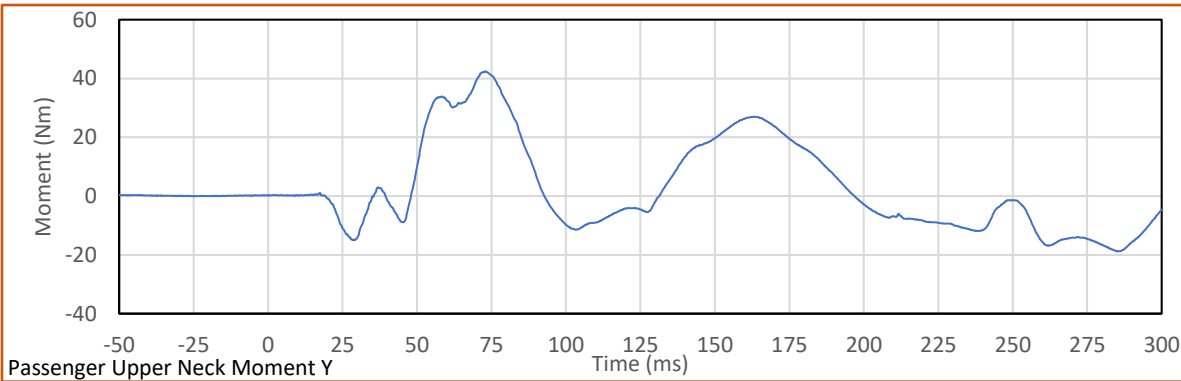
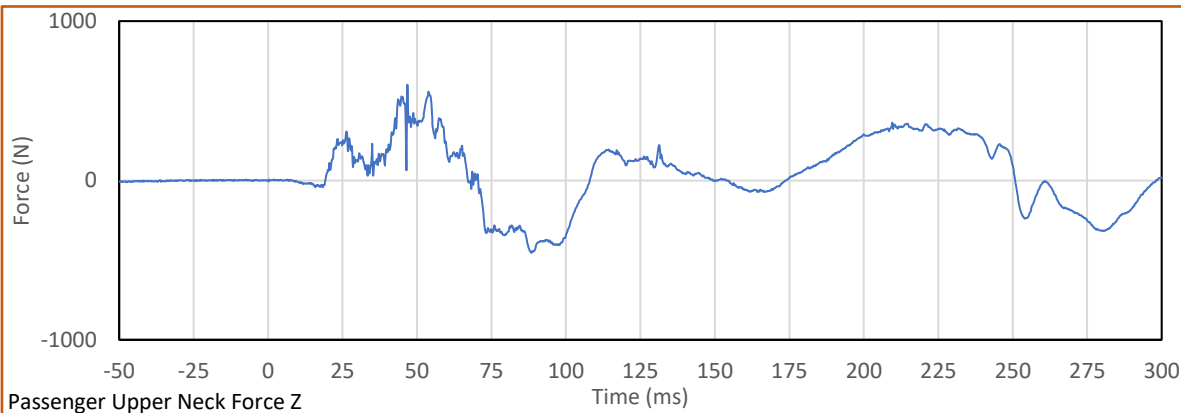
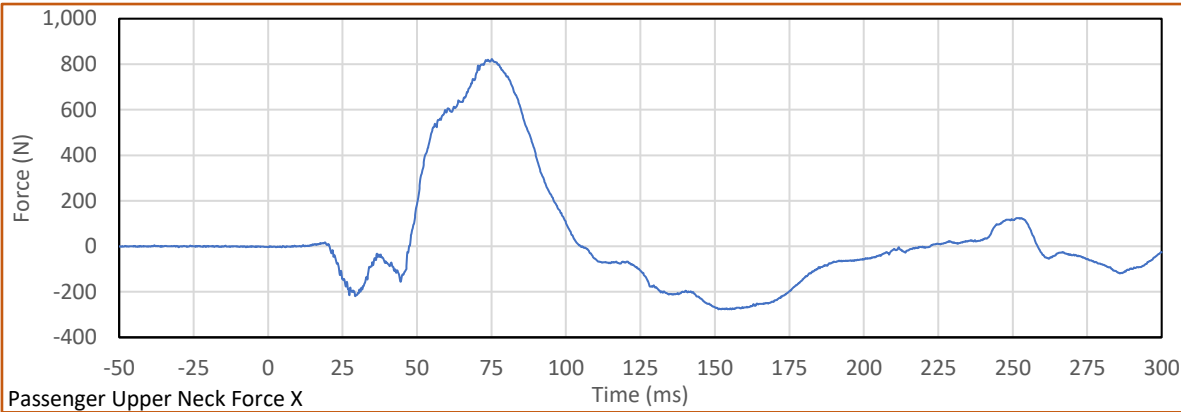


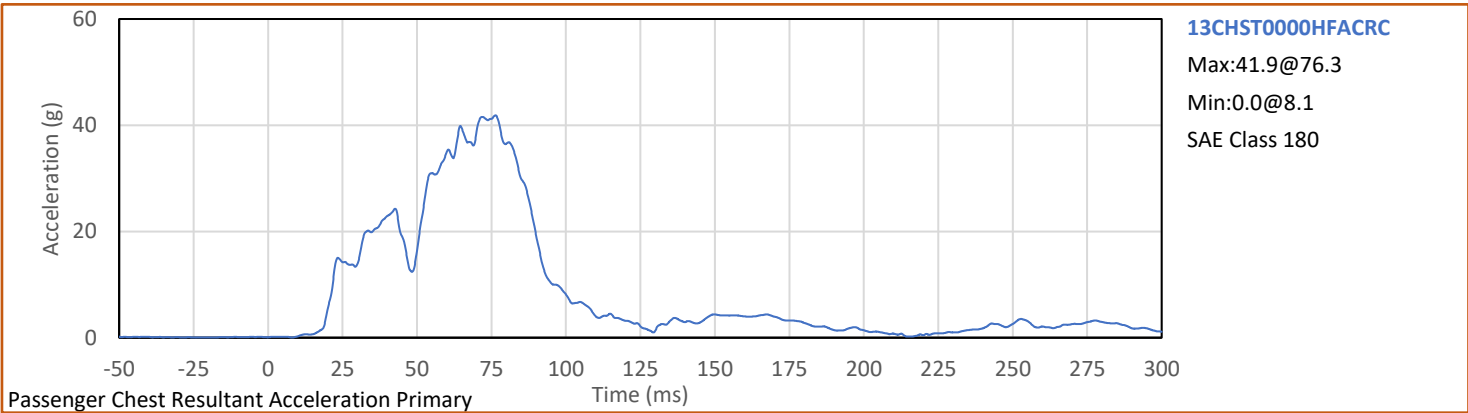
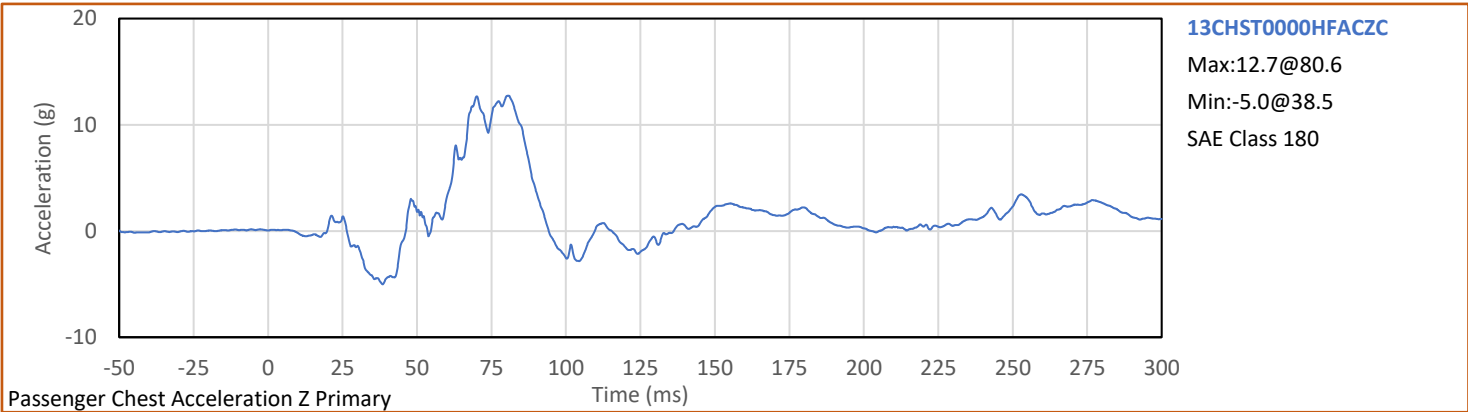
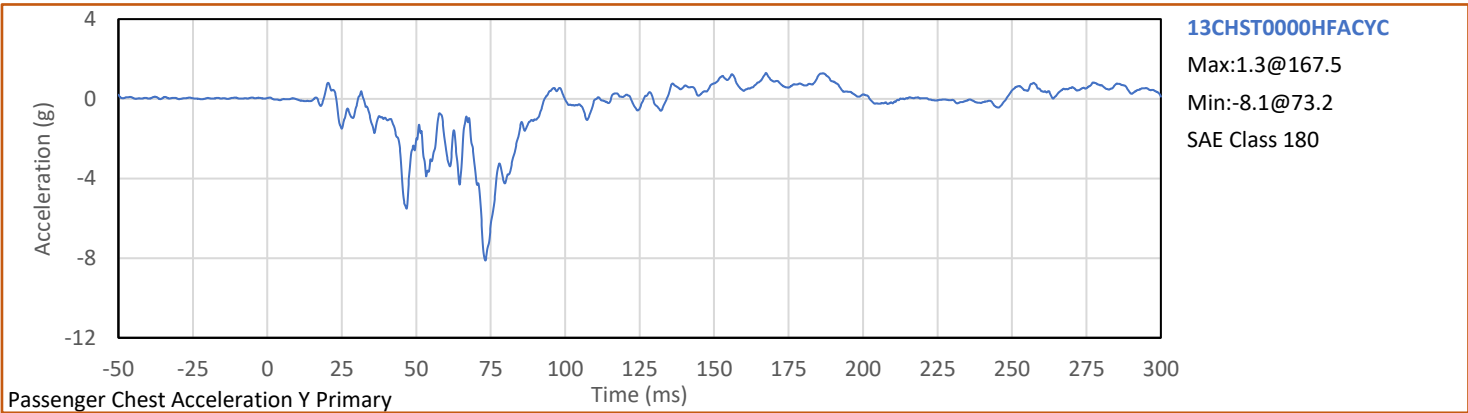
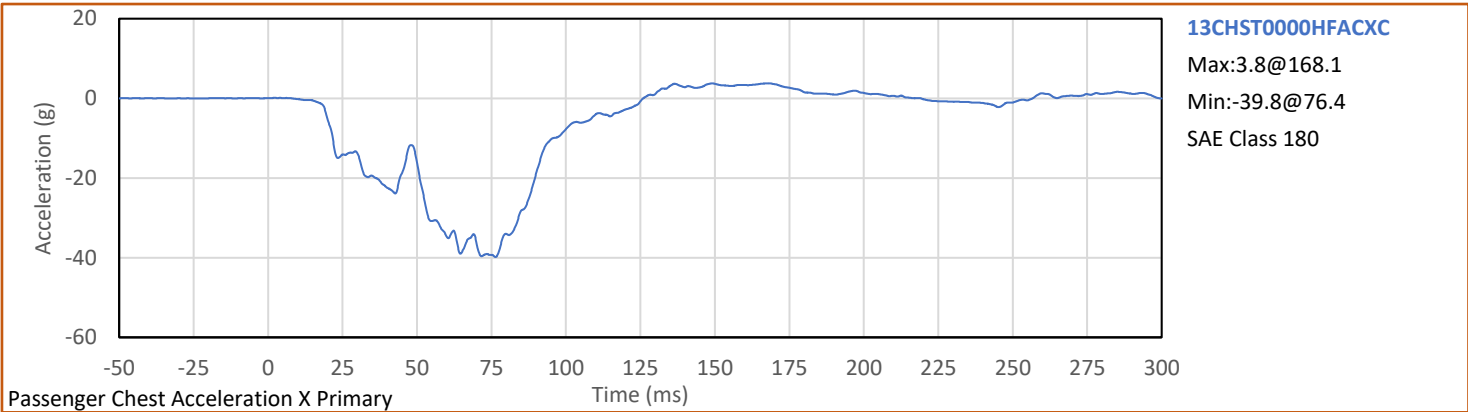


Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: M20234100
Test Date: 4/28/2023

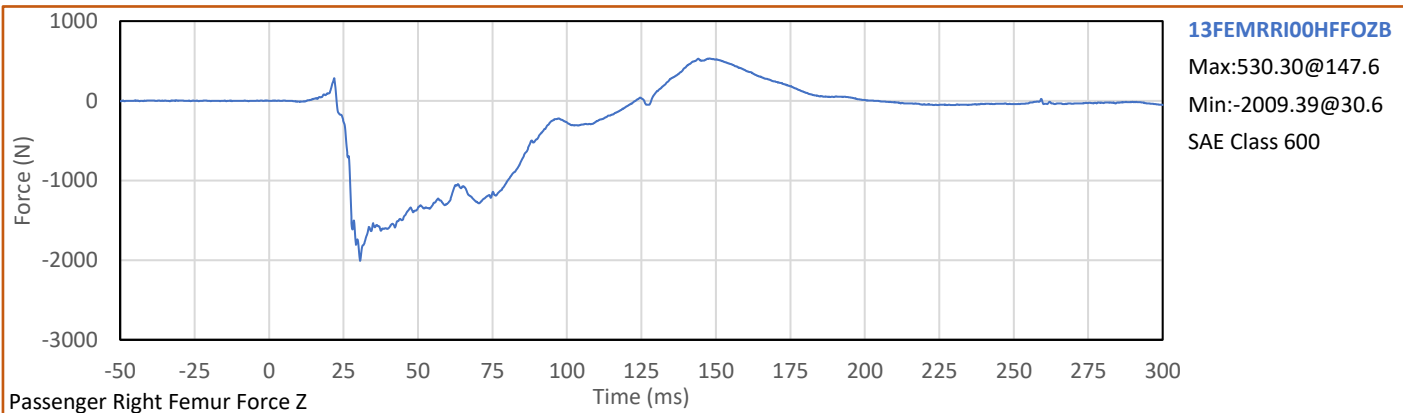
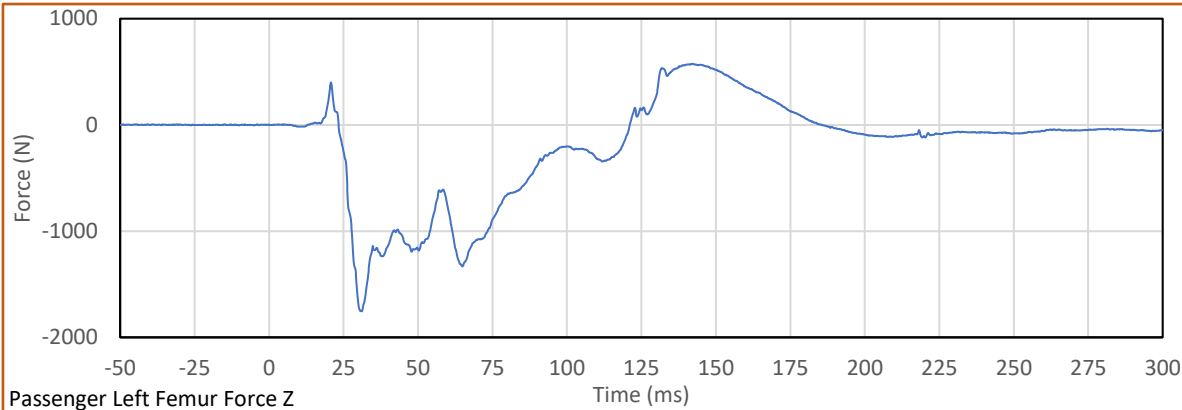






Test Vehicle: 2023 BMW X1 xDrive28i 5-Door SUV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: M20234100
Test Date: 4/28/2023



APPENDIX C
DUMMY QUALIFICATION AND PERFORMANCE VERIFICATION DATA

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

ATD Serial No.: 360

Test Date: 2023-04-21

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: 
G. Fuentes

Approved By: 
J. Hernandez

ATD Serial No.: 360

Test Date: 2023-04-21

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	881	Pass
B - Shoulder pivot height	mm	505	521	517	Pass
C - 'H' point height	mm	84	89	89	Pass
D - 'H' point location from backline	mm	135	140	139	Pass
E - Shoulder pivot from backline	mm	84	94	92	Pass
F - Thigh clearance	mm	140	155	148	Pass
G - Back of elbow to wrist pivot	mm	290	305	299	Pass
H - Head back to backline	mm	41	46	44	Pass
I - Shoulder to elbow length	mm	330	345	336	Pass
J - Elbow rest height	mm	190	211	203	Pass
K - Buttock to knee length	mm	579	604	585	Pass
L - Popliteal length	mm	429	455	445	Pass
M - Knee pivot height	mm	485	500	495	Pass
N - Buttock popliteal length	mm	452	477	463	Pass
O - Chest depth without jacket	mm	213	229	218	Pass
P - Foot length	mm	251	267	258	Pass
V - Shoulder breadth	mm	422	437	427	Pass
W - Foot breadth	mm	91	107	105	Pass
Y - Chest circum. (w/chest jacket)	mm	970	1001	986	Pass
Z - Waist circum.	mm	836	866	863	Pass
AA - Location for chest circum.	mm	429	434	433	Pass
BB - Location for waist circum.	mm	226	231	230	Pass
			Overall Test Results		Pass

Technician:



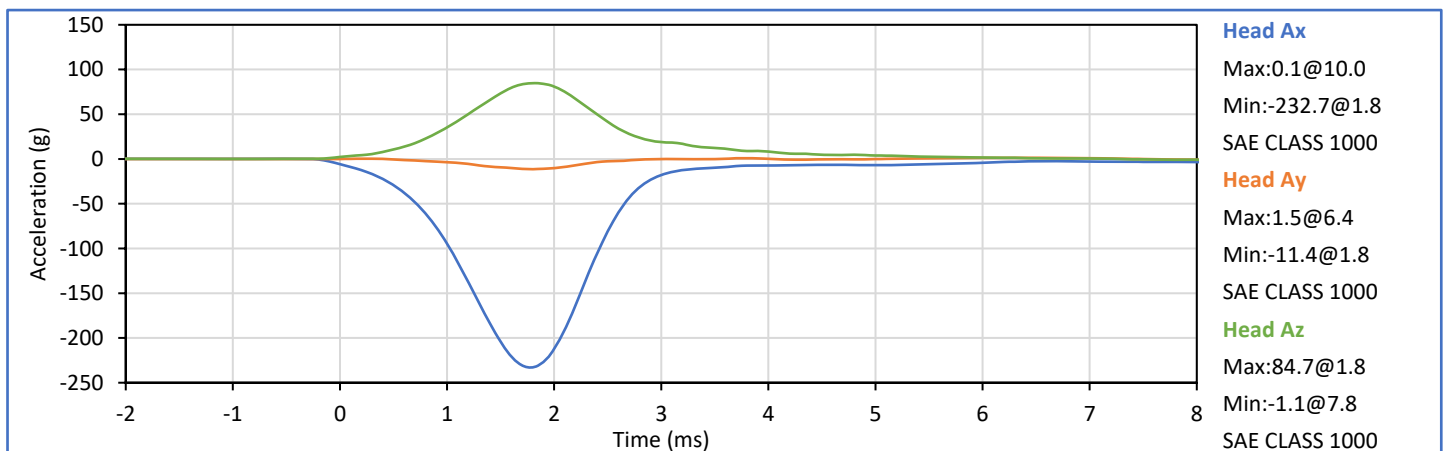
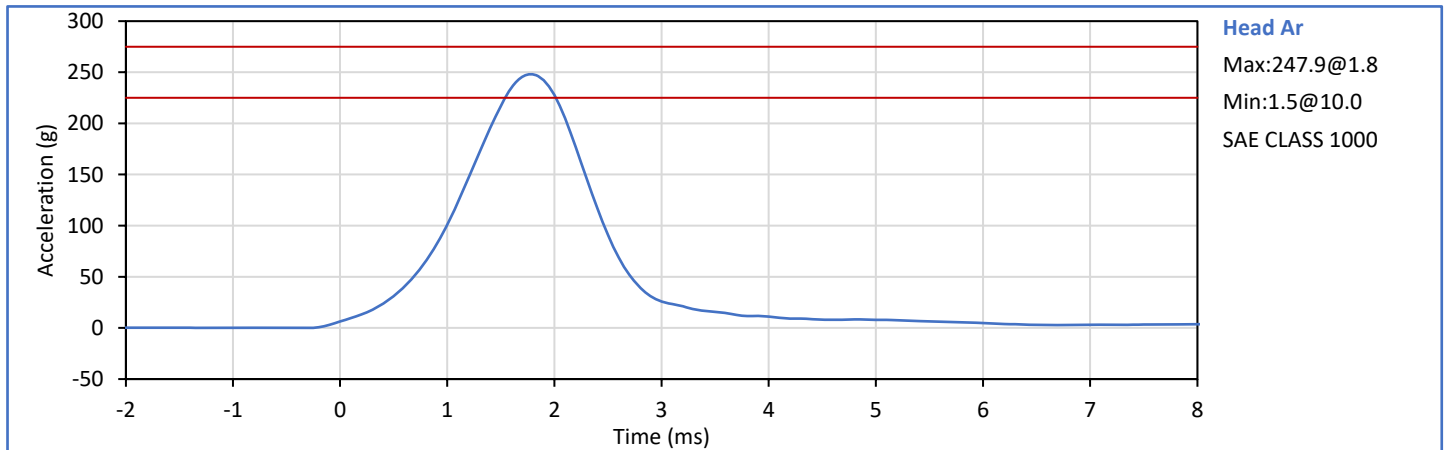
G. Fuentes

Approved By:



J. Hernandez

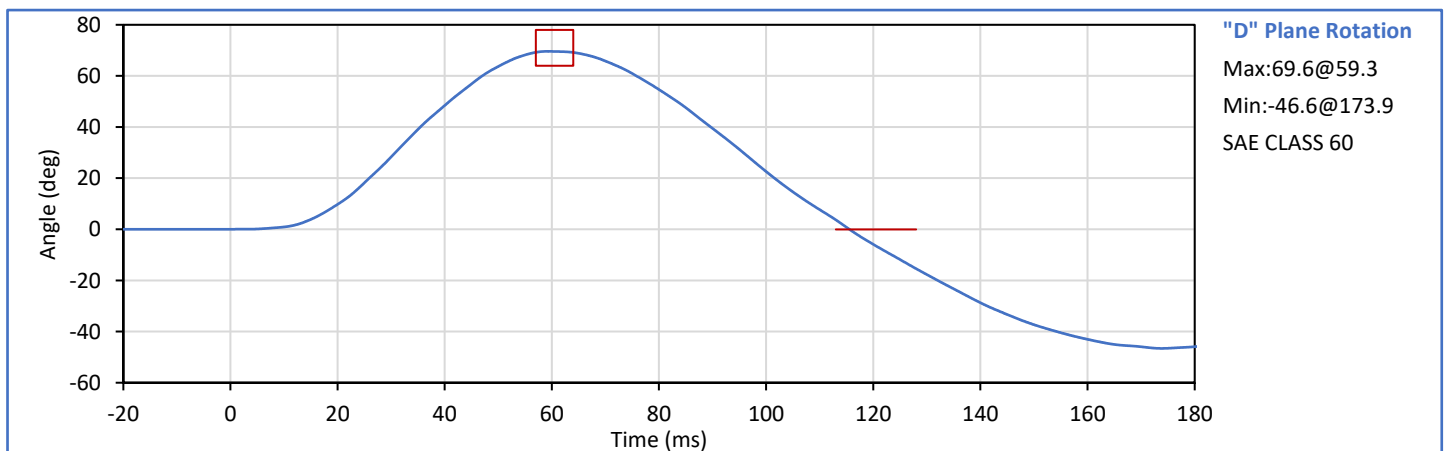
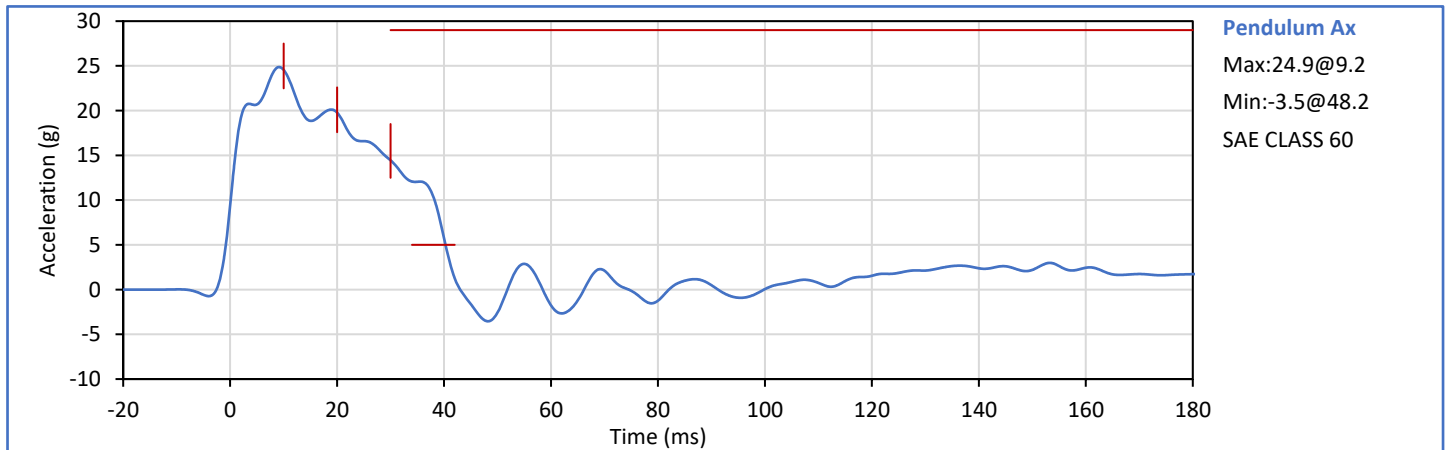
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.3	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Peak Resultant Acceleration	g	225.0	275.0	247.9	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-11.4	Pass
Oscillations After Main Pulse	%	0.0	10.0	0.0	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results	Pass	



Technician: G. Fuentes

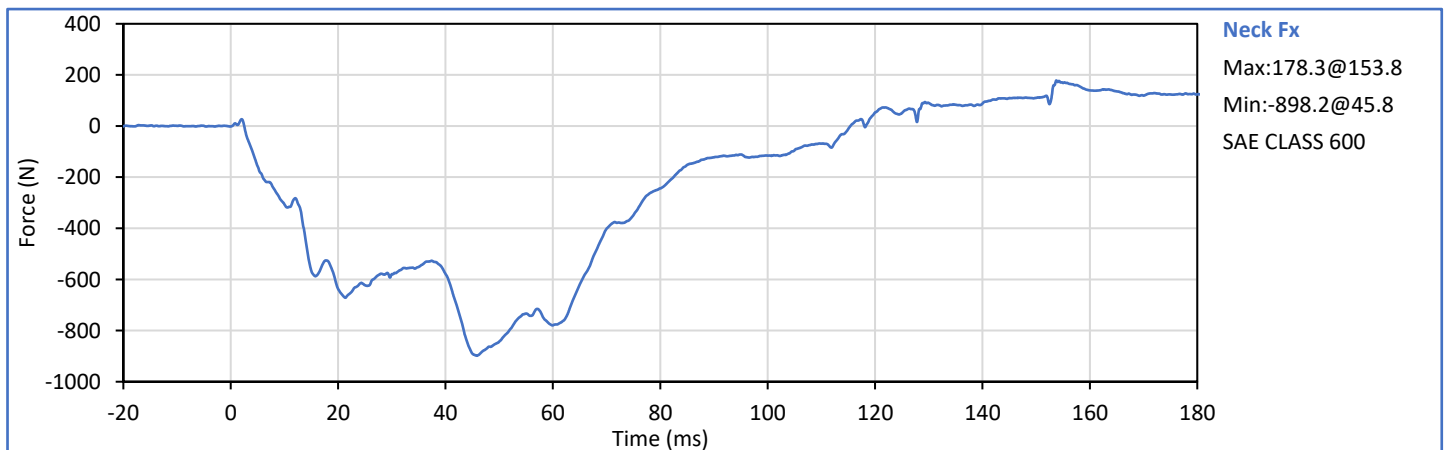
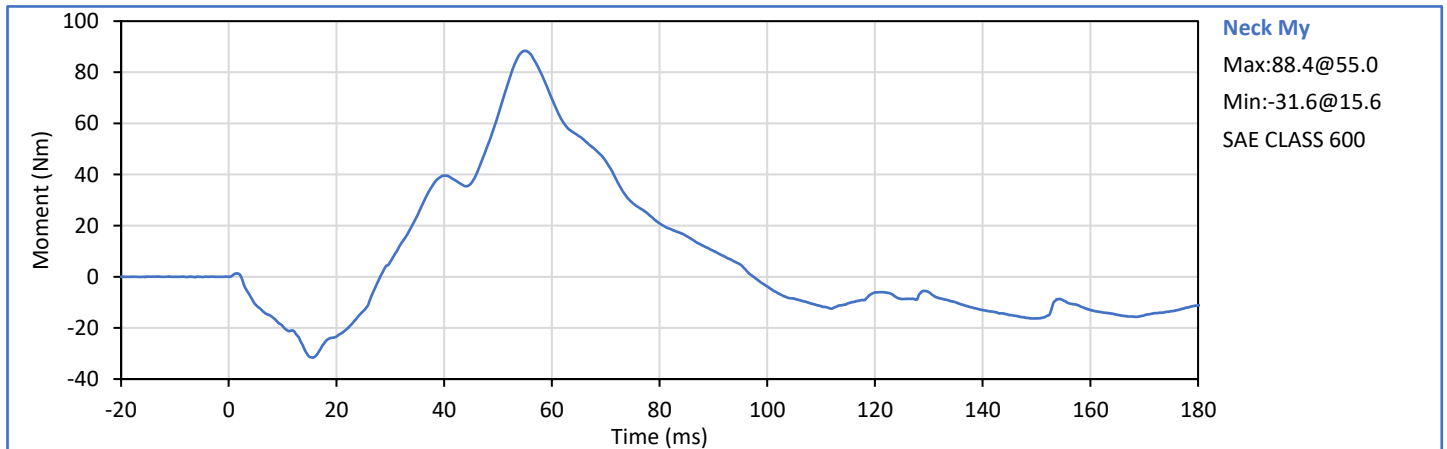
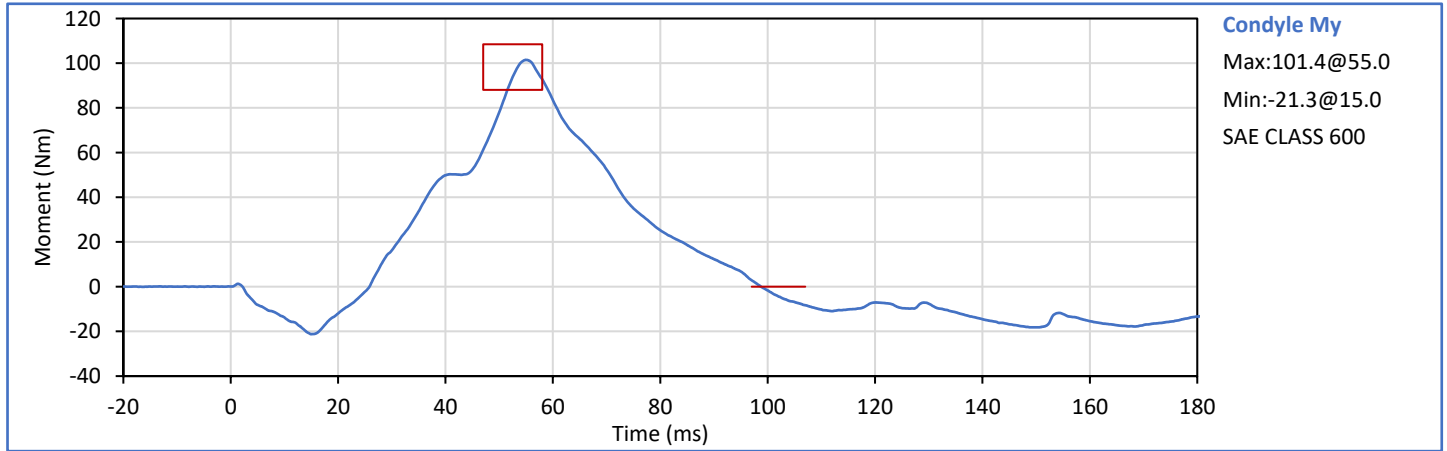
Approved By: J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Relative Humidity	%	10	70	32	Pass
Pendulum Velocity	m/s	6.89	7.13	7.01	Pass
Pendulum Deceleration at 10 ms	g	22.5	27.5	24.6	Pass
Pendulum Deceleration at 20 ms	g	17.6	22.6	19.8	Pass
Pendulum Deceleration at 30 ms	g	12.5	18.5	14.4	Pass
Peak Pendulum Decel After 30 ms	g	0.0	29.0	14.4	Pass
Deceleration Decay to Cross 5g	ms	34.0	42.0	40.3	Pass
"D" Plane Rotation peak	deg	64.0	78.0	69.6	Pass
	ms	57.0	64.0	59.3	Pass
"D" Plane Rotation Decay to Zero	ms	113.0	128.0	115.6	Pass
Moment About Occipital Condyle	Nm	88.1	108.5	101.4	Pass
	ms	47.0	58.0	55.0	Pass
Moment Decay, Peak to Zero	ms	97.0	107.0	98.8	Pass
Overall Test Results				Pass	

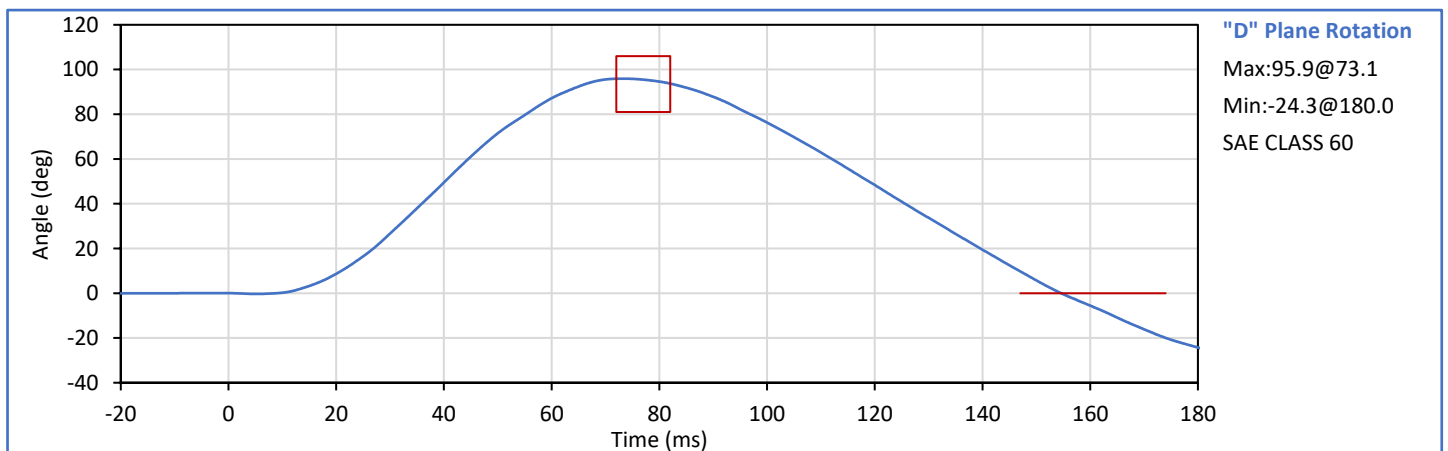
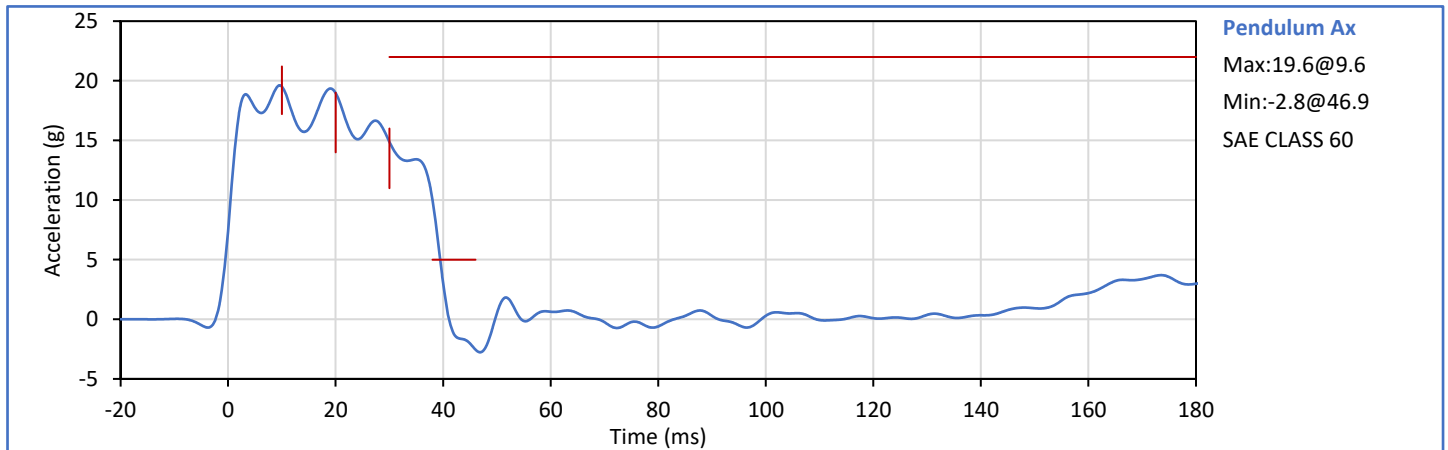


Technician: G. Fuentes

Approved By: J. Hernandez

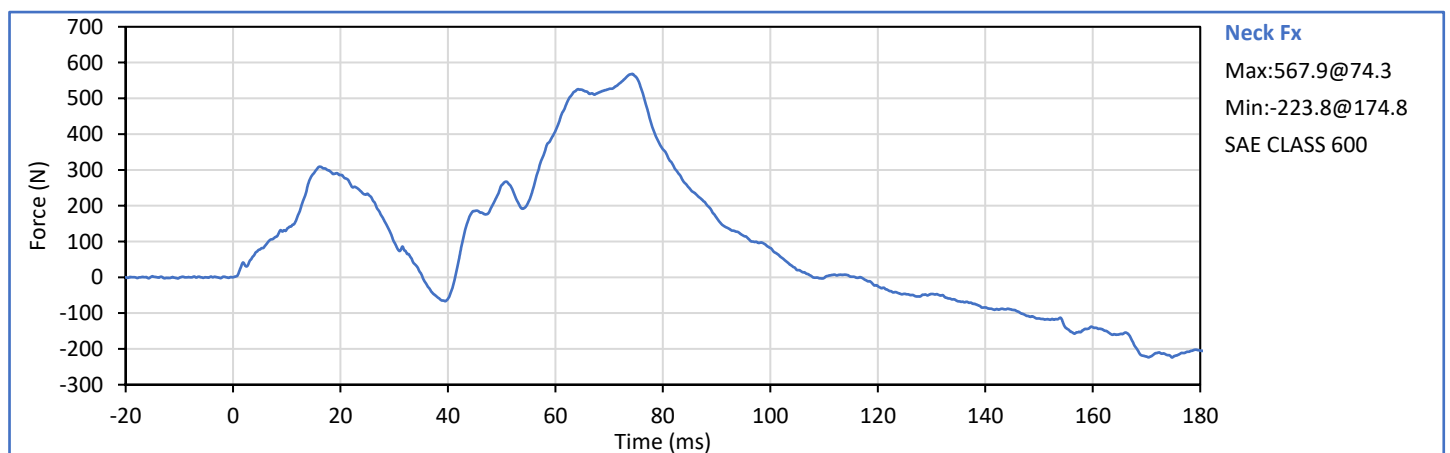
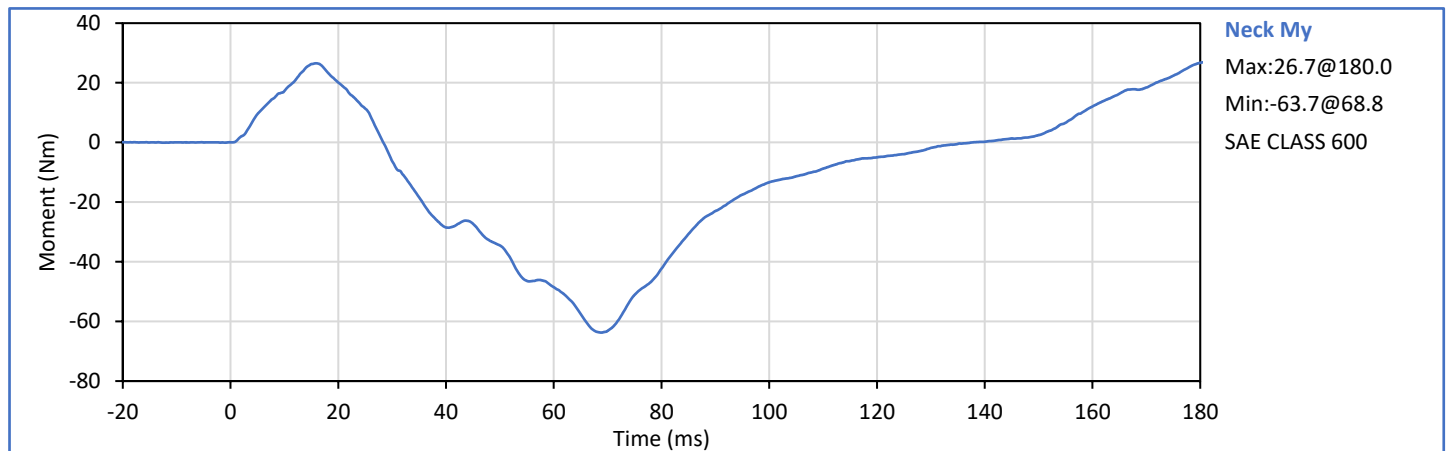
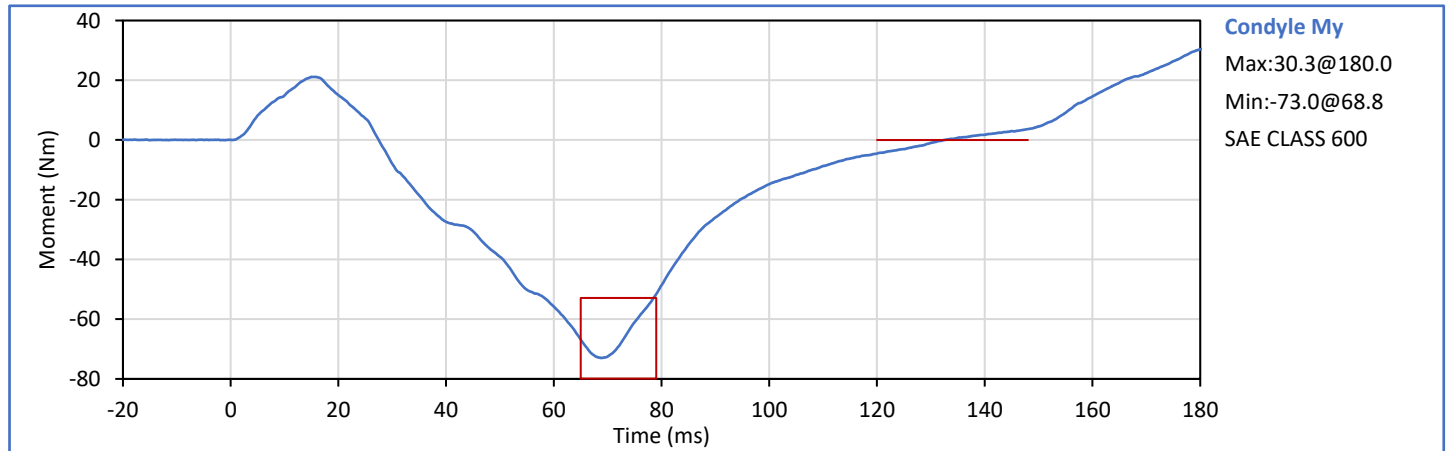


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.94	6.19	6.03	Pass
Pendulum Deceleration at 10 ms	g	17.2	21.2	19.5	Pass
Pendulum Deceleration at 20 ms	g	14.0	19.0	19.0	Pass
Pendulum Deceleration at 30 ms	g	11.0	16.0	14.9	Pass
Peak Pendulum Decel After 30 ms	g	0.0	22.0	14.9	Pass
Deceleration Decay to Cross 5g	ms	38.0	46.0	39.5	Pass
"D" Plane Rotation peak	deg	81.0	106.0	95.9	Pass
	ms	72.0	82.0	73.1	Pass
"D" Plane Rotation Decay to Zero	ms	147.0	174.0	154.7	Pass
Moment About Occipital Condyle	Nm	-79.9	-52.9	-73.0	Pass
	ms	65.0	79.0	68.8	Pass
Moment Decay, Peak to Zero	ms	120.0	148.0	132.6	Pass
Overall Test Results				Pass	

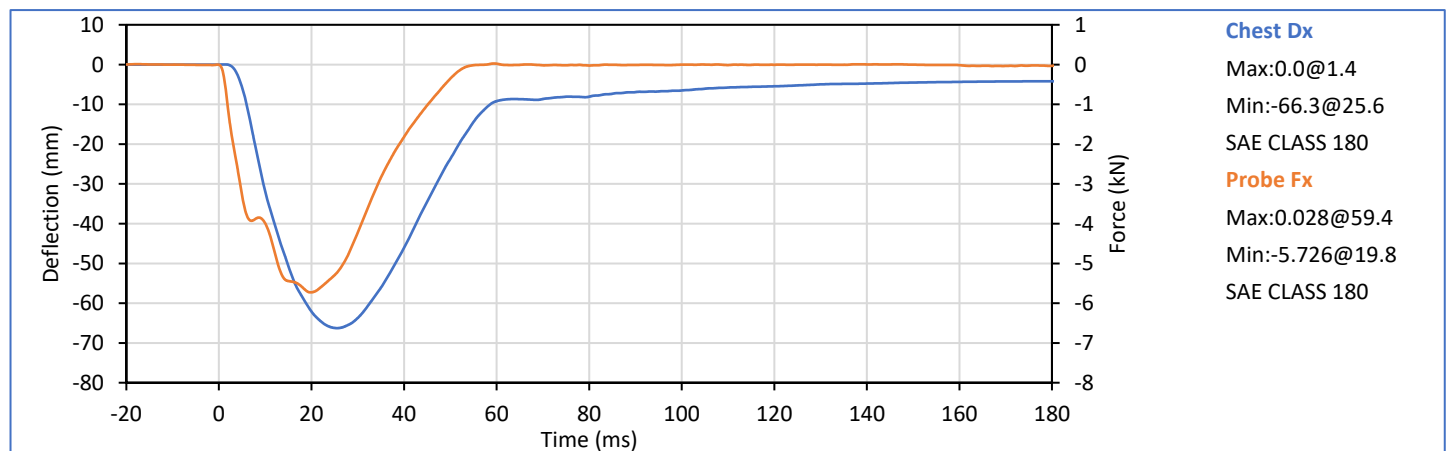
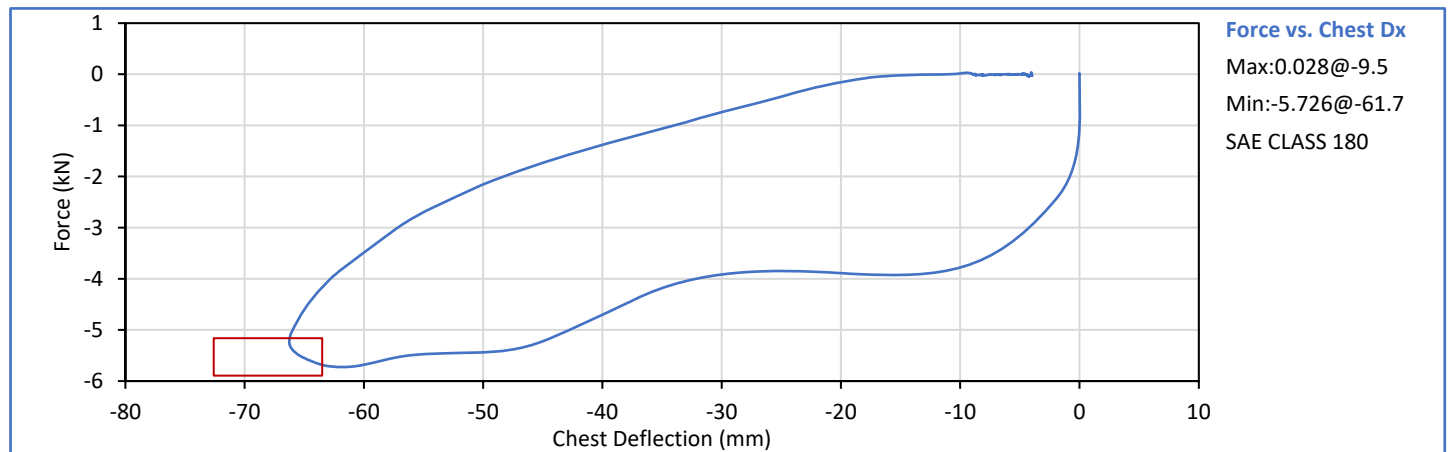


Technician: G. Fuentes

Approved By: J. Hernandez



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.6	Pass
Laboratory Relative Humidity	%	10	70	21	Pass
Probe Velocity	m/s	6.58	6.82	6.70	Pass
Peak Chest Deflection	mm	-72.6	-63.5	-66.3	Pass
Peak Probe Force	kN	-5.893	-5.159	-5.726	Pass
Internal Hysteresis	%	69.0	85.0	70.4	Pass
Overall Test Results				Pass	Pass



Technician:

G. Fuentes

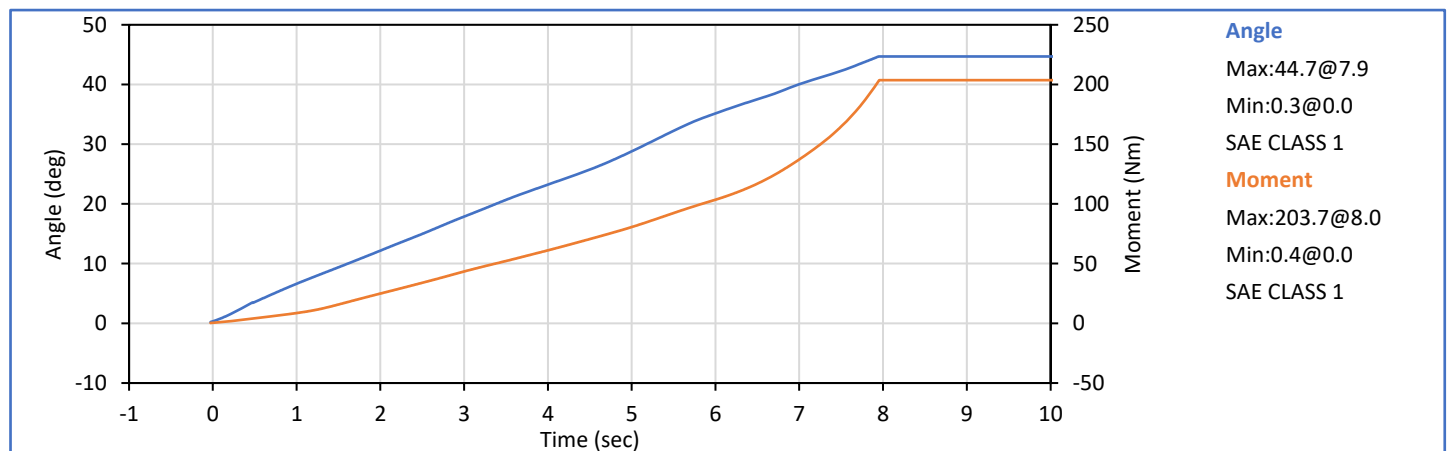
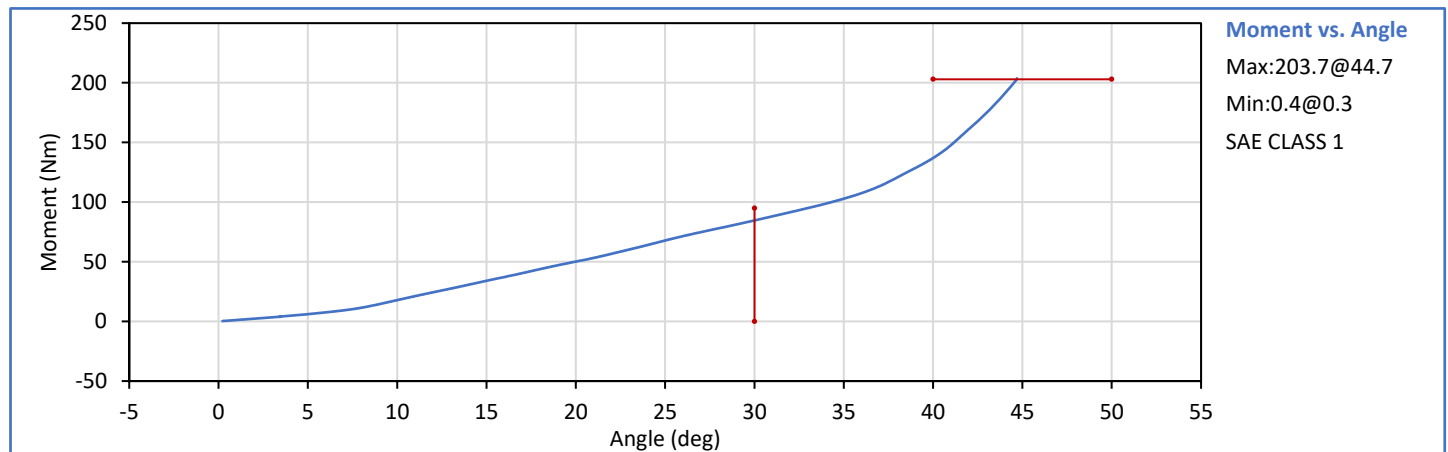
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.5	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Left Hip Rotation Rate	deg/s	5.0	10.0	5.7	Pass
Left Femur Torque at 30°	Nm	0.0	95.0	84.6	Pass
Left Hip Rotation at 203 Nm	deg	40.0	50.0	44.7	Pass
Overall Test Results				Pass	Pass



Technician:

G. Fuentes

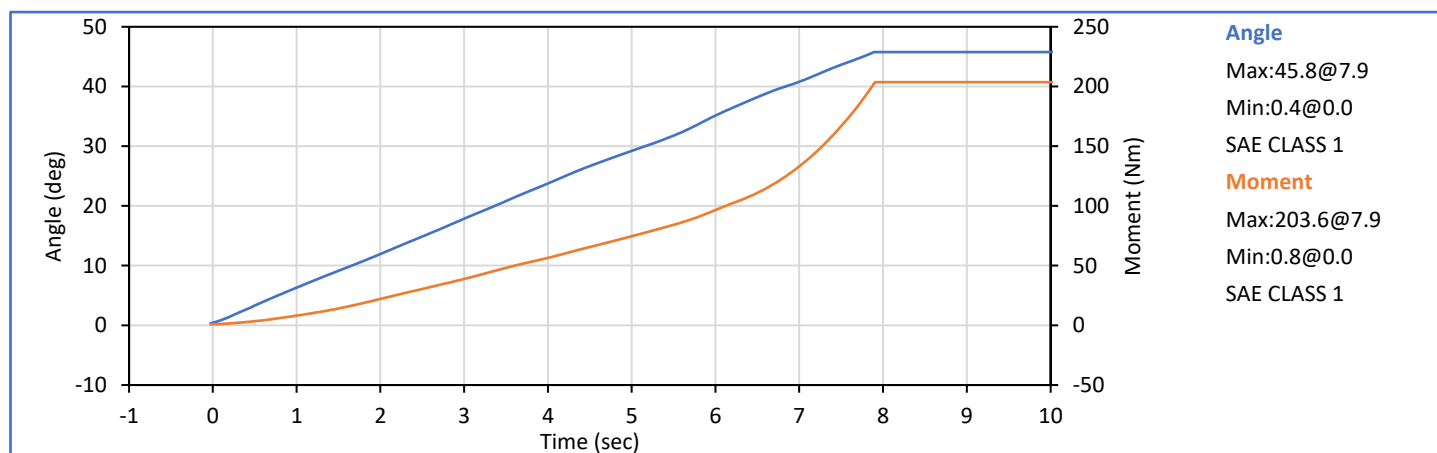
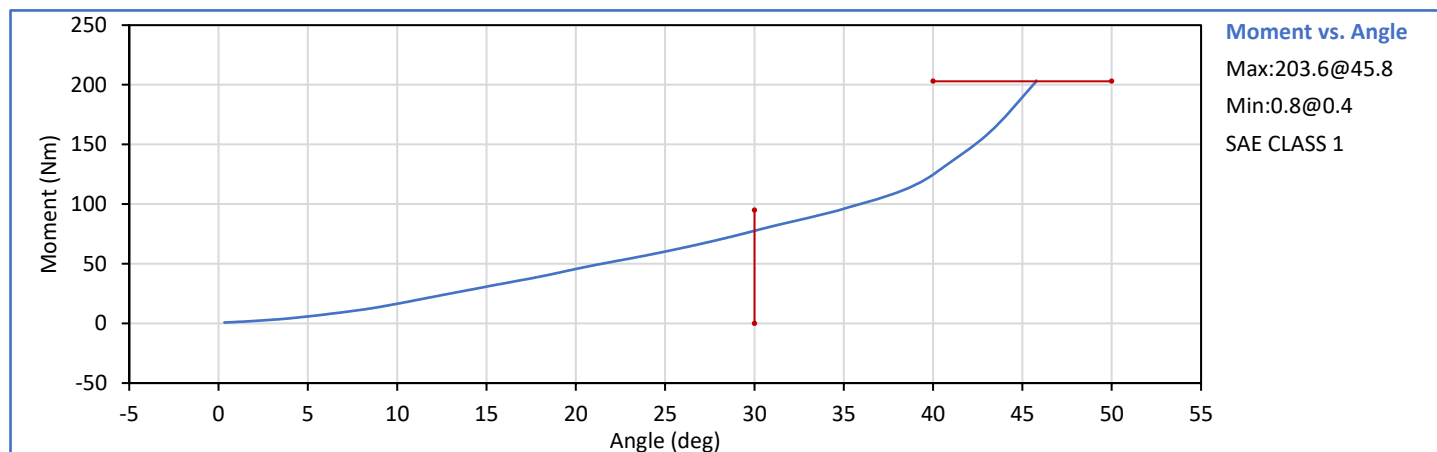
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.5	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Right Hip Rotation Rate	deg/s	5.0	10.0	5.8	Pass
Right Femur Torque at 30°	Nm	0.0	95.0	77.6	Pass
Right Hip Rotation at 203 Nm	deg	40.0	50.0	45.8	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

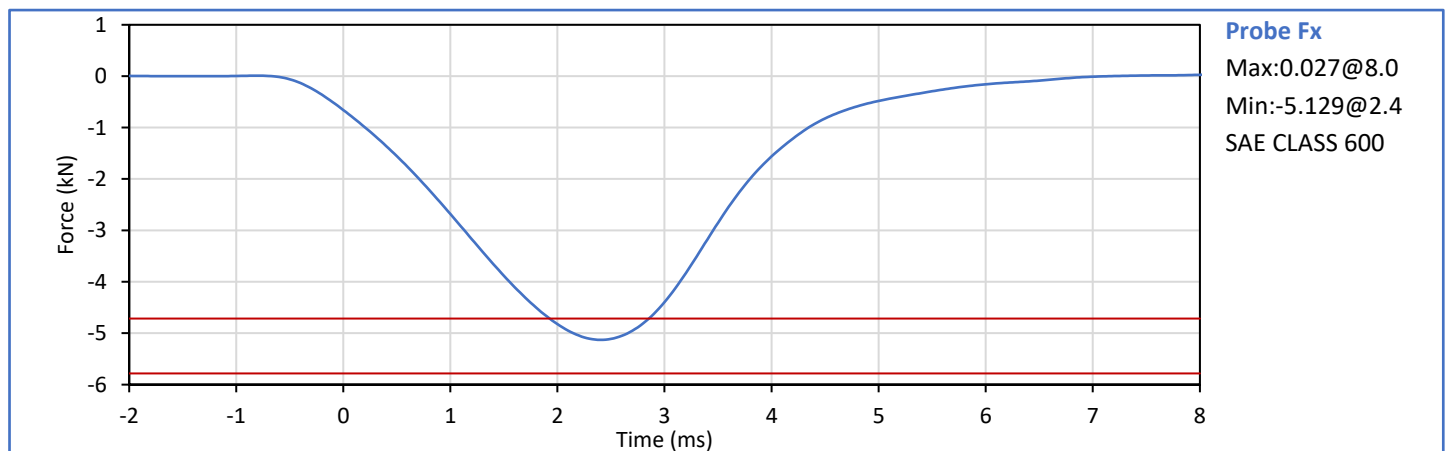
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

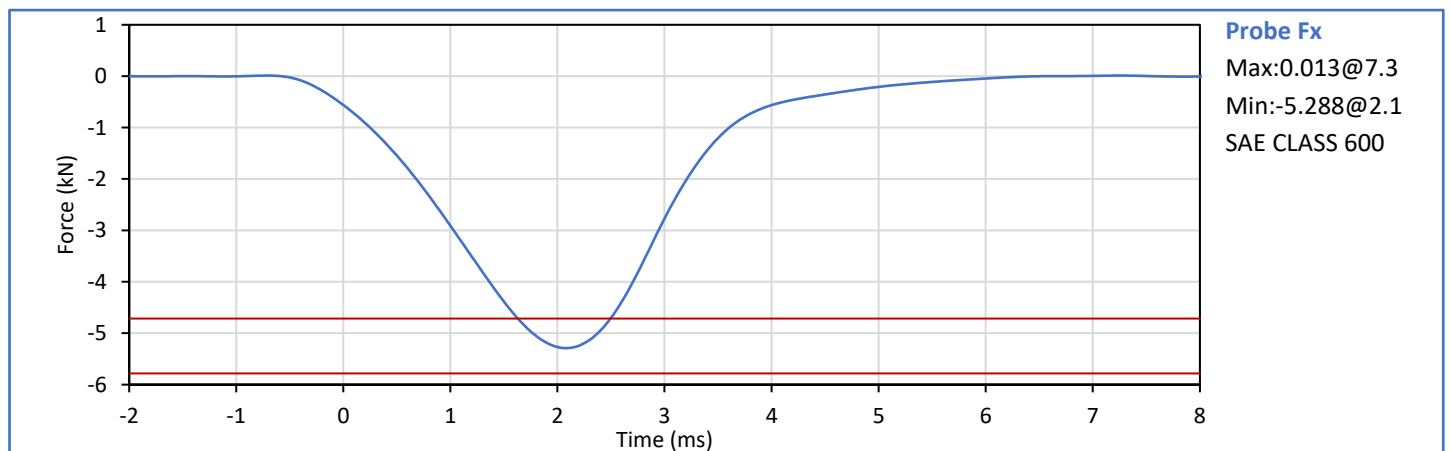
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.5	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Probe Velocity	m/s	2.070	2.130	2.109	Pass
Peak Resistive Force	kN	-5.782	-4.715	-5.129	Pass
Overall Test Results					Pass



Technician: G. Fuentes

Approved By: J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.5	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Probe Velocity	m/s	2.070	2.130	2.107	Pass
Peak Resistive Force	kN	-5.782	-4.715	-5.288	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

APPENDIX C
Pre-Test ATD Qualification and Performance Verification
Hybrid III 5th Percentile Female ATD
S/N: DH1644

ATD Serial No.: DH1644

Test Date: 2023-04-20

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: Bill LHS III

G. Fuentes

Approved By: Scott

J. Hernandez

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	31	Pass
A - Total sitting height	mm	775	800	786	Pass
B - Shoulder pivot height	mm	432	457	442	Pass
C - 'H' point height	mm	81	86	86	Pass
D - 'H' point location from backline	mm	145	150	146	Pass
E - Shoulder pivot from backline	mm	69	84	82	Pass
F - Thigh clearance	mm	119	135	131	Pass
G - Back of elbow to wrist pivot	mm	244	259	250	Pass
H - Head back to backline	mm	41	46	45	Pass
I - Shoulder to elbow length	mm	277	297	282	Pass
J - Elbow rest height	mm	183	203	192	Pass
K - Buttock to knee length	mm	521	546	540	Pass
L - Popliteal length	mm	356	376	371	Pass
M - Knee pivot height	mm	394	419	407	Pass
N - Buttock popliteal length	mm	414	439	418	Pass
O - Chest depth without jacket	mm	175	191	181	Pass
P - Foot length	mm	219	234	228	Pass
R - Buttock to Knee Pivot Length	mm	457	483	469	Pass
S - Head Breadth	mm	137	147	145	Pass
T - Head Depth	mm	178	188	185	Pass
U - Hip Breadth	mm	300	315	309	Pass
V - Shoulder breadth	mm	351	366	358	Pass
W - Foot breadth	mm	79	94	87	Pass
X - Head circum.	mm	528	549	533	Pass
Y - Chest circum. (w/chest jacket)	mm	851	881	862	Pass
Z - Waist circum.	mm	760	790	775	Pass
AA - Location for chest circum.	mm	333	358	350	Pass
BB - Location for waist circum.	mm	160	170	165	Pass
			Overall Test Results		Pass

Technician:



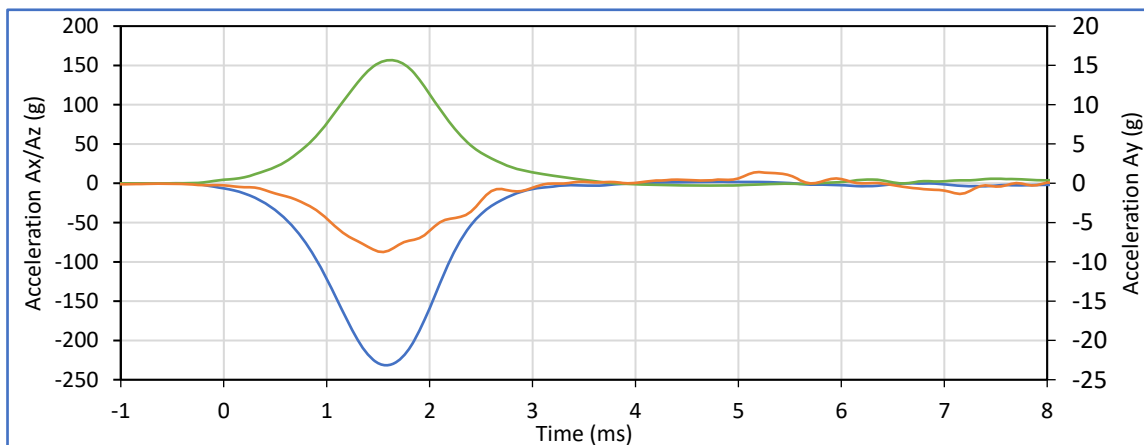
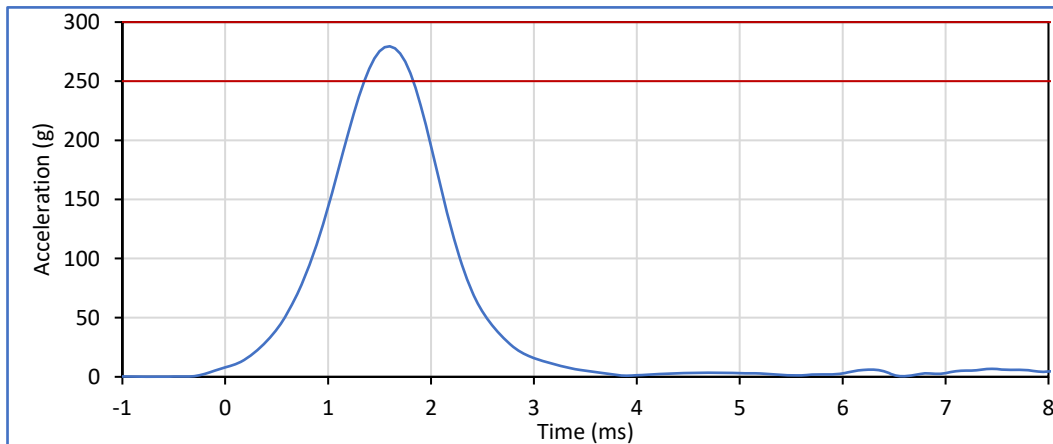
G. Fuentes

Approved By:



J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.2	Pass
Laboratory Humidity	%	10	70	31	Pass
Peak Resultant Acceleration	g	250.0	300.0	279.5	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-8.7	Pass
Oscillations After Main Pulse	%	0.0	10.0	2.4	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results	Pass	



Technician:

G. Fuentes

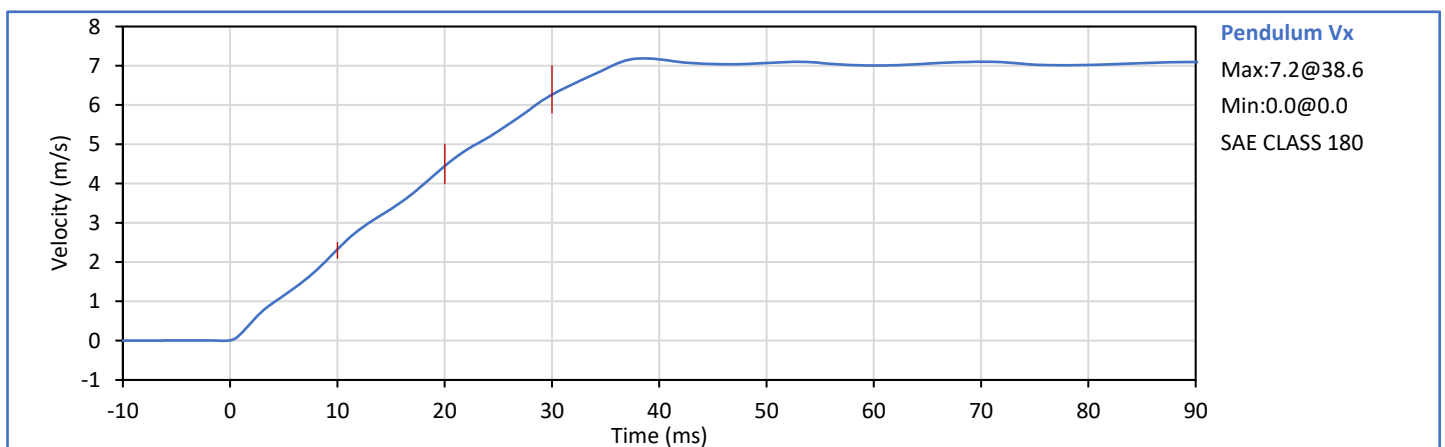
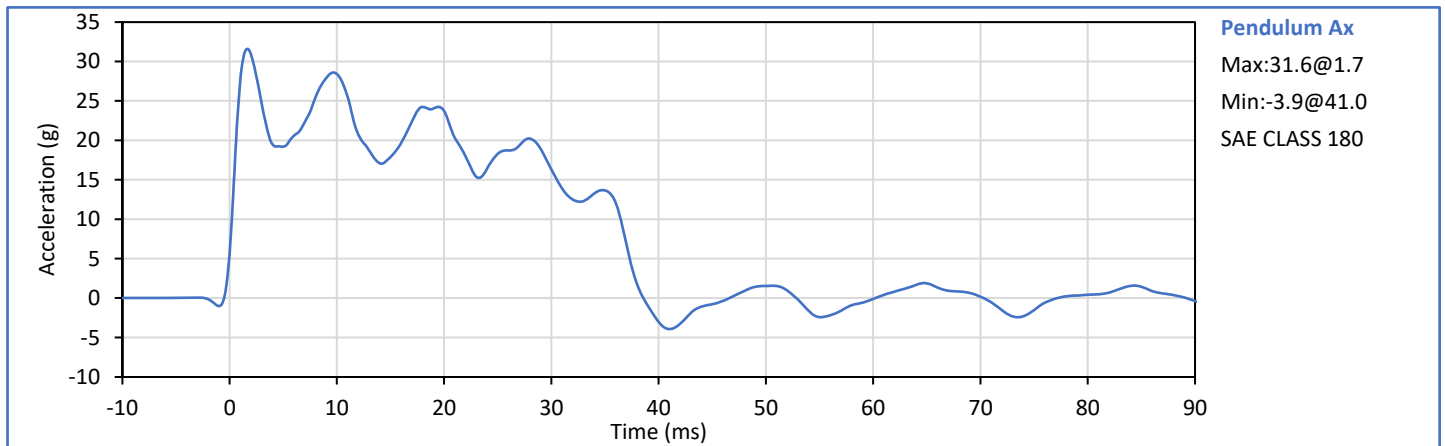
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	31	Pass
Pendulum Velocity	m/s	6.89	7.13	7.00	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	4.44	Pass
Pendulum Velocity at 30 ms	m/s	5.80	7.00	6.26	Pass
Peak "D" Plane Rotation	deg	77.0	91.0	81.3	Pass
Peak Moment in Rotation	Nm	69.0	83.0	81.2	Pass
Positive Moment Decay to 10 Nm	ms	80.0	100.0	83.2	Pass
Overall Test Results				Pass	Pass



Technician:

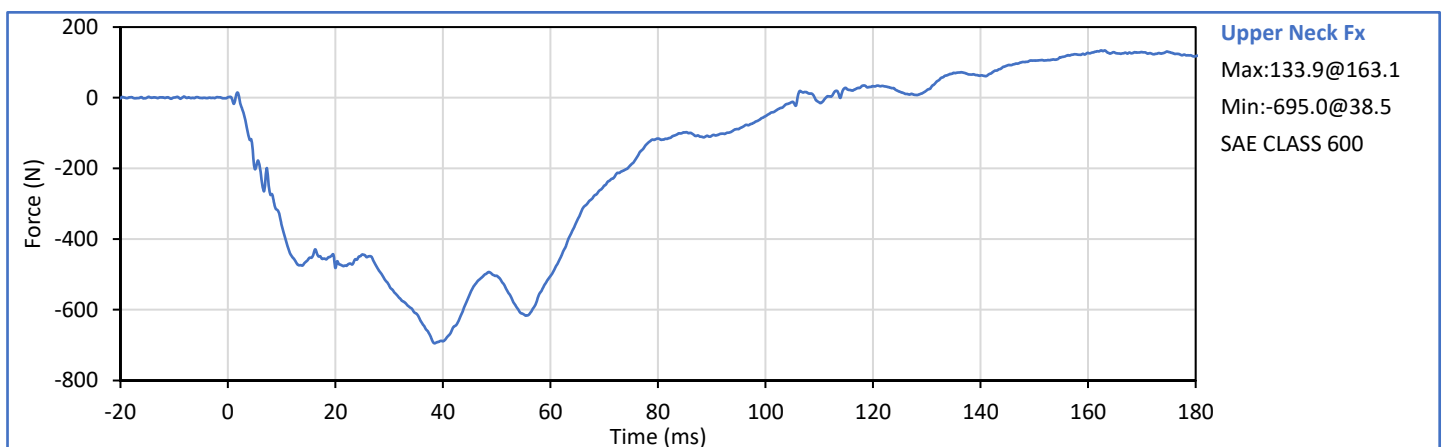
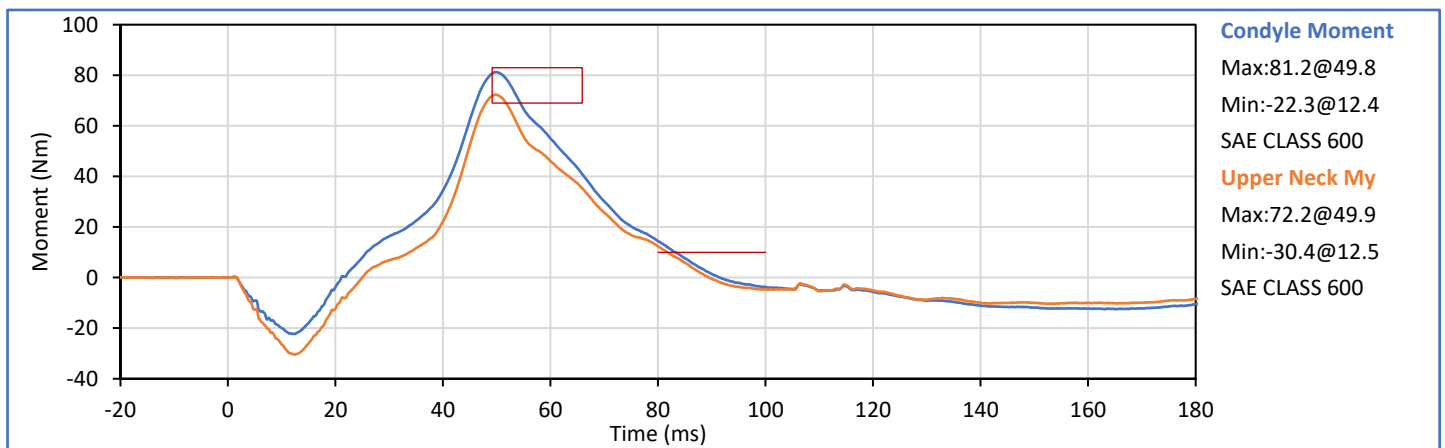
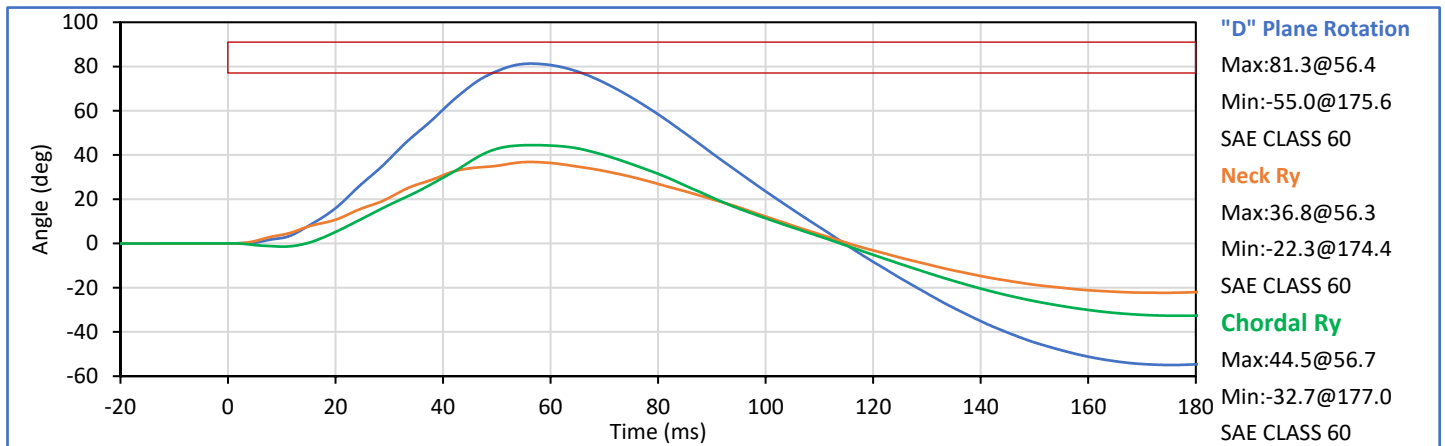
G. Fuentes

G. Fuentes

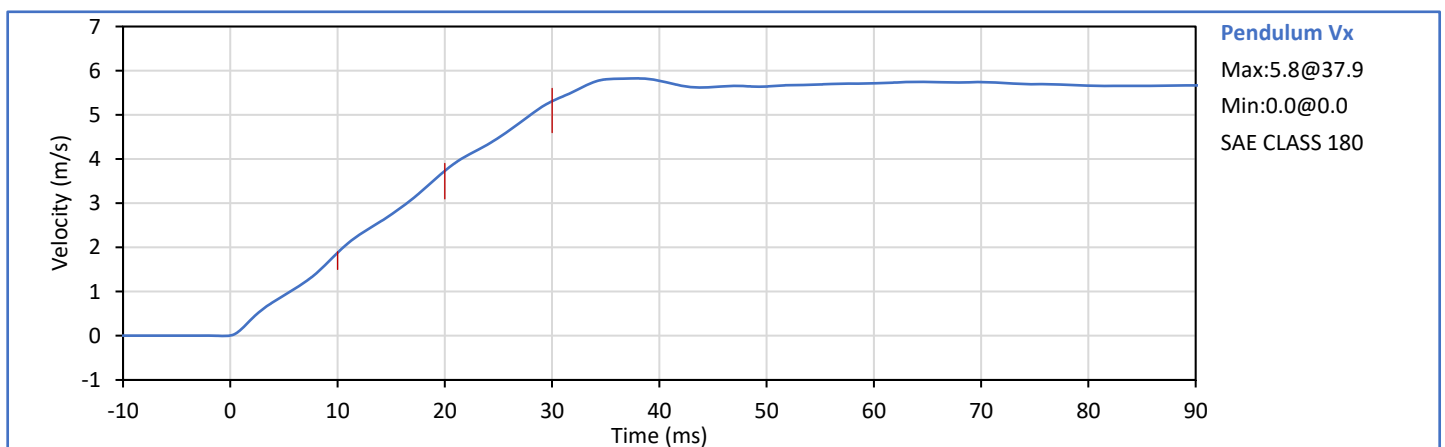
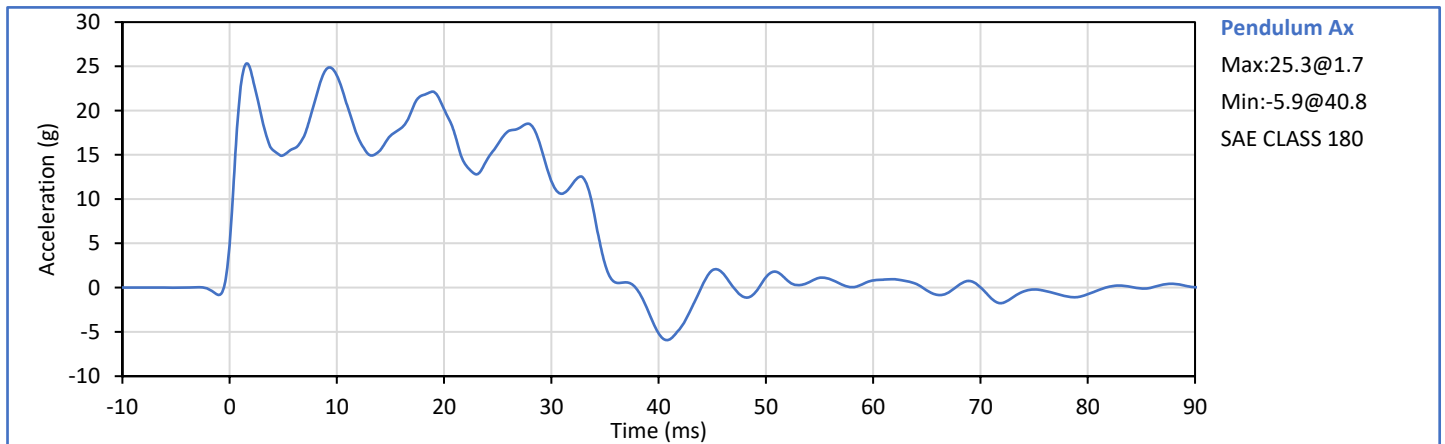
Approved By:

J. Hernandez

J. Hernandez



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.95	6.19	6.04	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	5.31	Pass
Peak "D" Plane Rotation	deg	99.0	114.0	104.8	Pass
Peak Moment in Rotation	Nm	-65.0	-53.0	-58.5	Pass
Negative Moment Decay to -10 Nm	ms	94.0	114.0	97.2	Pass
Overall Test Results					Pass



Technician:

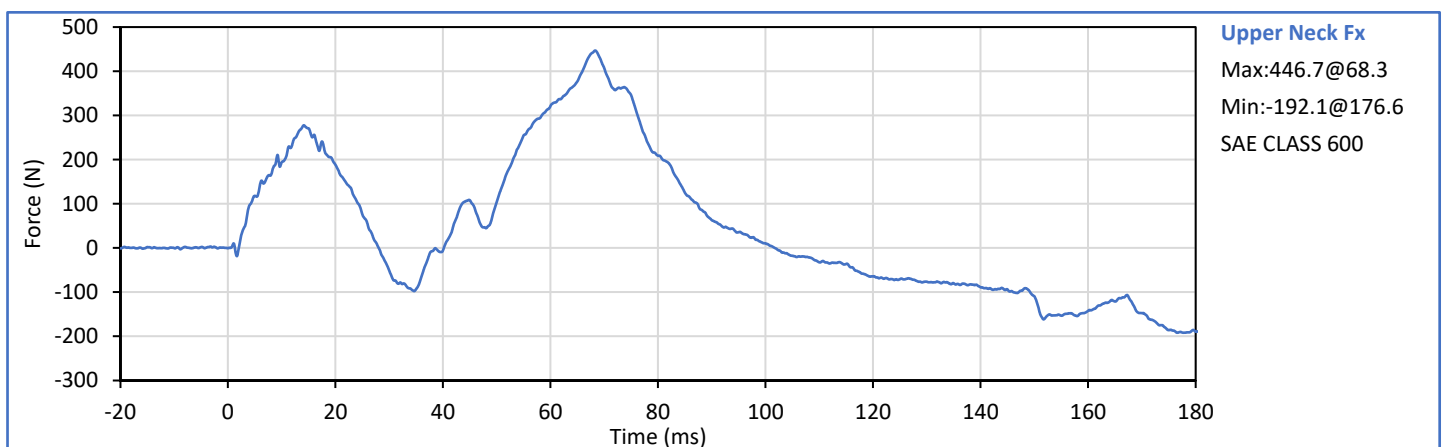
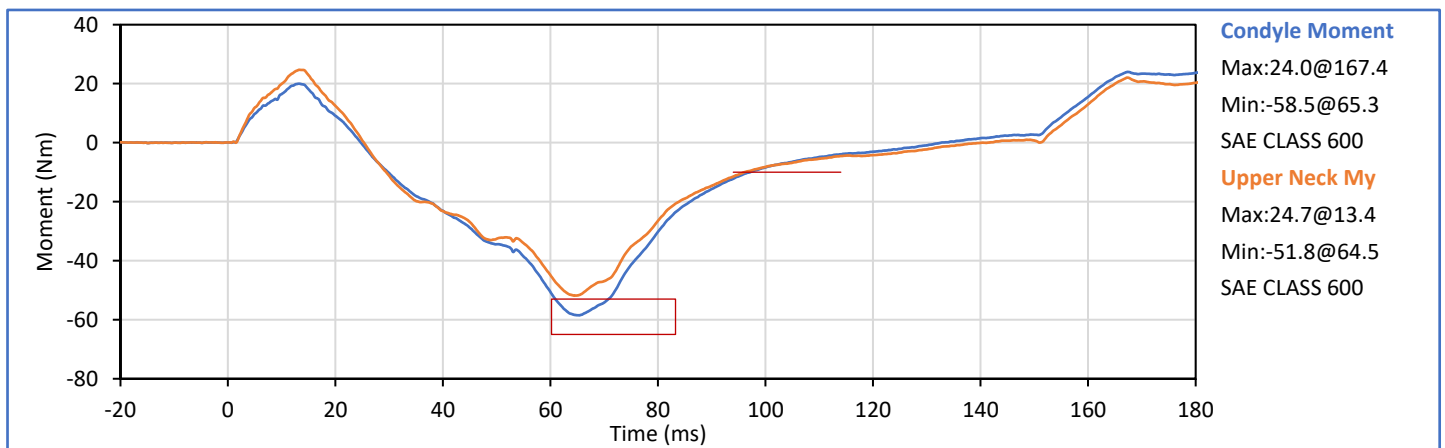
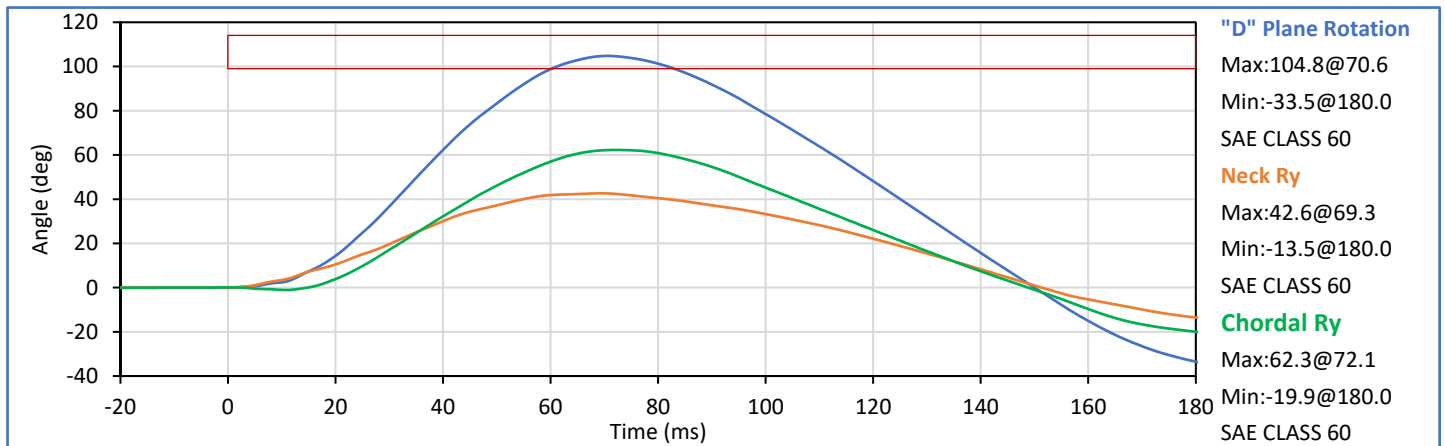
G. Fuentes

G. Fuentes

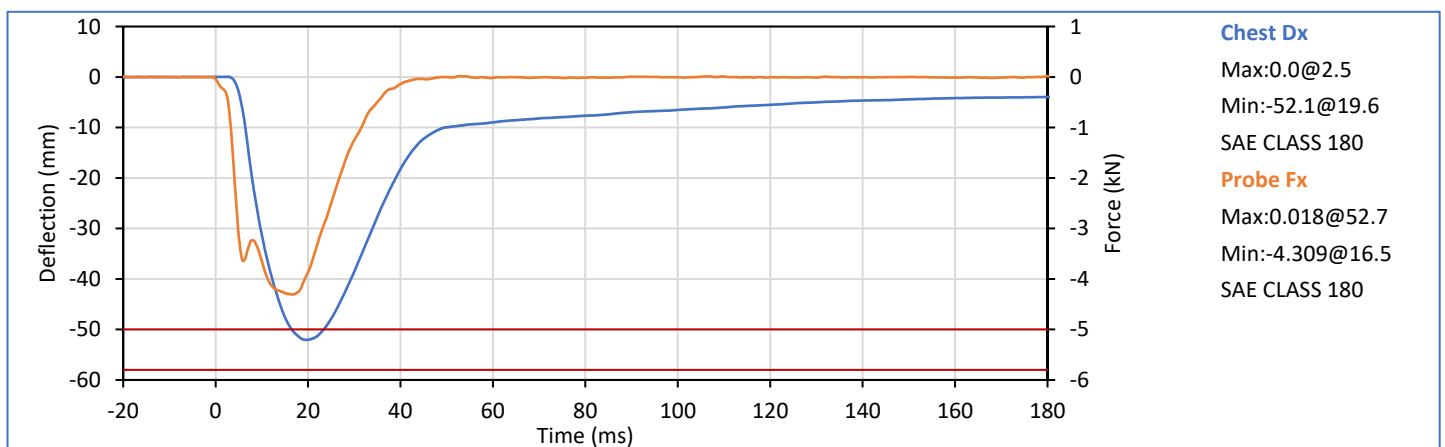
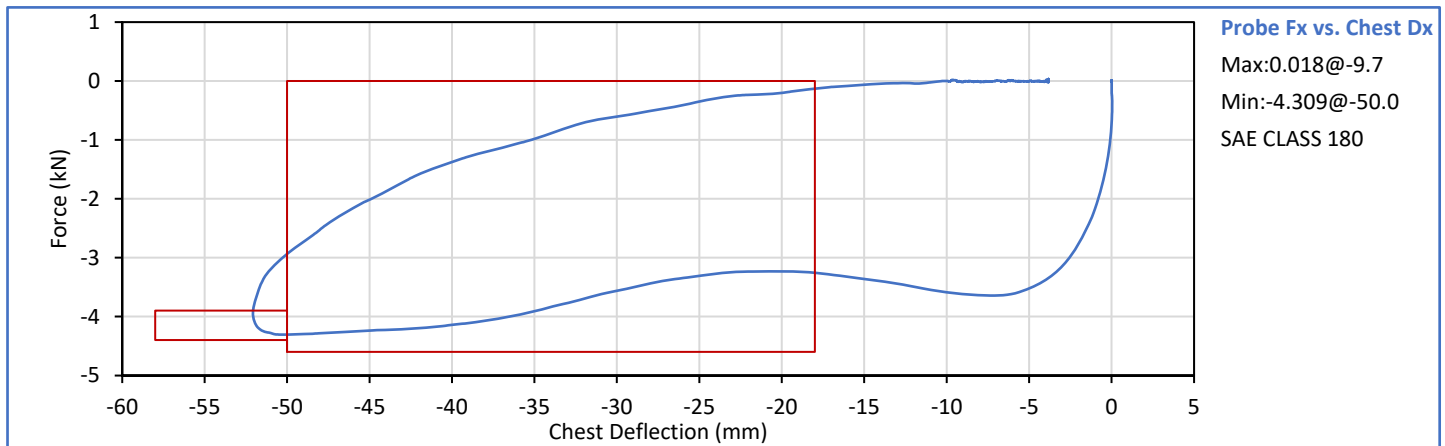
Approved By:

J. Hernandez

J. Hernandez



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory RelativeHumidity	%	10	70	31	Pass
Probe Velocity	m/s	6.59	6.83	6.72	Pass
Peak Chest Deflection	mm	-58.0	-50.0	-52.1	Pass
Peak Probe Force, 50 and 58 mm	kN	-4.400	-3.900	-4.309	Pass
Peak Probe Force, 18 and 50 mm	kN	-4.600	0.000	-4.309	Pass
Internal Hysteresis	%	69.0	85.0	78.0	Pass
Overall Test Results				Pass	Pass



Technician:

G. Fuentes

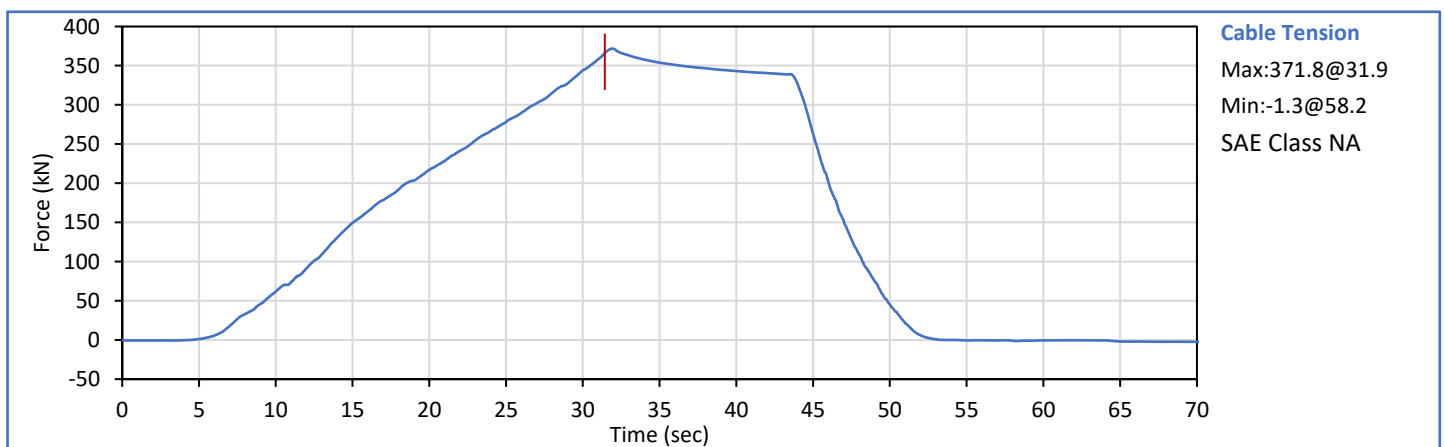
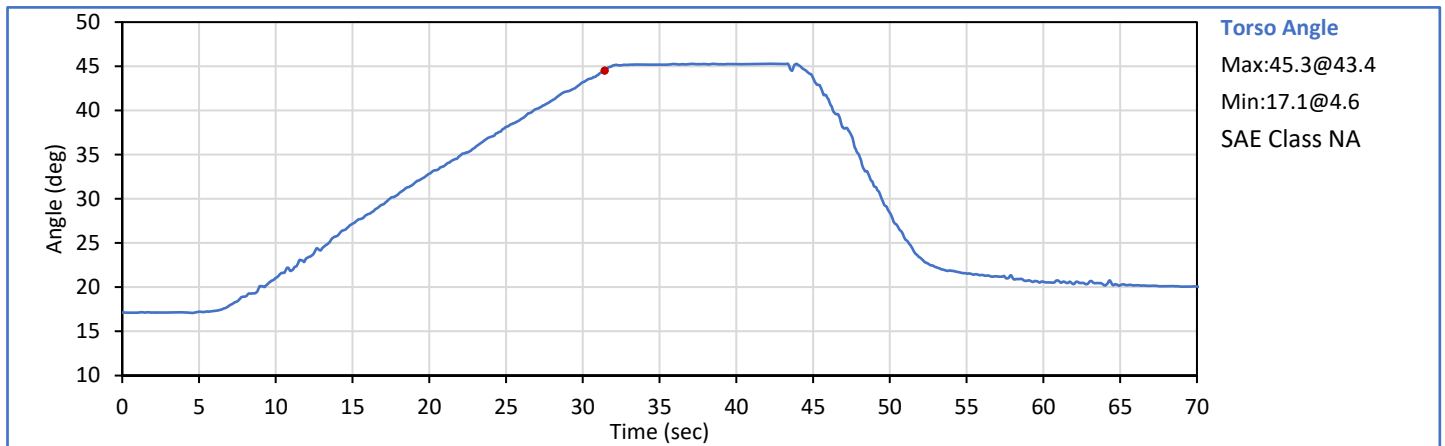
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.3	Pass
Laboratory Humidity	%	10	70	30	Pass
Orientation Angle	deg	0.0	20.0	16.5	Pass
Test Initial Angle	deg	11.0	19.0	17.1	Pass
Peak Force at 45° (+/-0.5°)	N	320.0	390.0	365.5	Pass
Torso Flexion Rate	deg/s	0.50	1.50	1.10	Pass
Final Reference Plane Angle	deg	-8.0	8.0	2.8	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

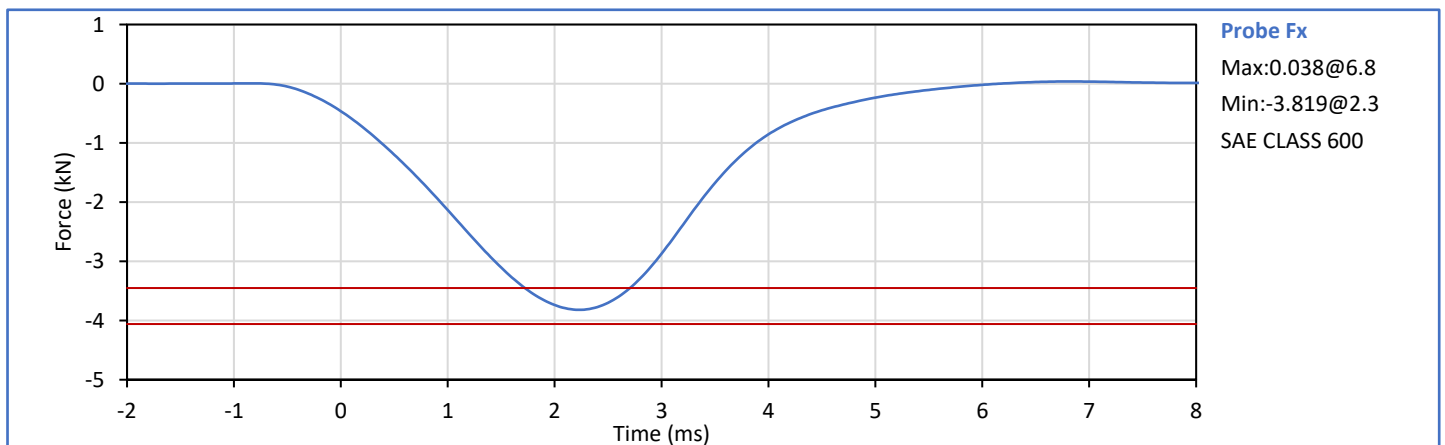
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

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	31	Pass
Probe Velocity	m/s	2.070	2.130	2.105	Pass
Peak Resistive Force	kN	-4.060	-3.450	-3.819	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

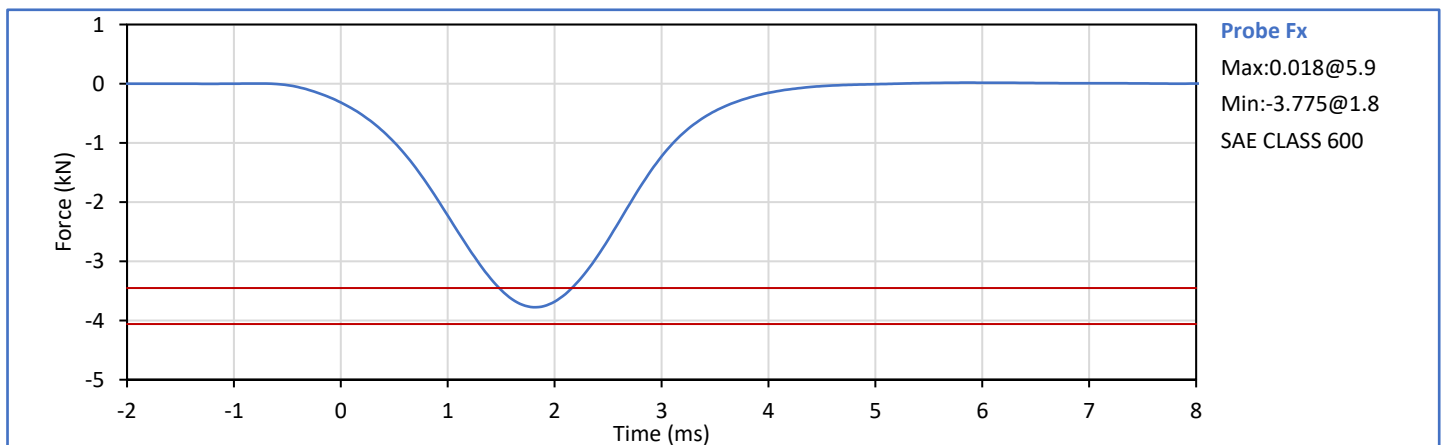
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

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	31	Pass
Probe Velocity	m/s	2.070	2.130	2.106	Pass
Peak Resistive Force	kN	-4.060	-3.450	-3.775	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

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

ATD Serial No.: 360

Test Date: 2023-05-02

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: 
G. Fuentes

Approved By: 
J. Hernandez

ATD Serial No.: 360

Test Date: 2023-05-02

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	31	Pass
A - Total sitting height	mm	879	889	884	Pass
B - Shoulder pivot height	mm	505	521	514	Pass
C - 'H' point height	mm	84	89	89	Pass
D - 'H' point location from backline	mm	135	140	138	Pass
E - Shoulder pivot from backline	mm	84	94	93	Pass
F - Thigh clearance	mm	140	155	149	Pass
G - Back of elbow to wrist pivot	mm	290	305	297	Pass
H - Head back to backline	mm	41	46	42	Pass
I - Shoulder to elbow length	mm	330	345	334	Pass
J - Elbow rest height	mm	190	211	199	Pass
K - Buttock to knee length	mm	579	604	592	Pass
L - Popliteal length	mm	429	455	433	Pass
M - Knee pivot height	mm	485	500	496	Pass
N - Buttock popliteal length	mm	452	477	466	Pass
O - Chest depth without jacket	mm	213	229	221	Pass
P - Foot length	mm	251	267	263	Pass
V - Shoulder breadth	mm	422	437	427	Pass
W - Foot breadth	mm	91	107	97	Pass
Y - Chest circum. (w/chest jacket)	mm	970	1001	983	Pass
Z - Waist circum.	mm	836	866	865	Pass
AA - Location for chest circum.	mm	429	434	431	Pass
BB - Location for waist circum.	mm	226	231	230	Pass
			Overall Test Results		Pass

Technician:



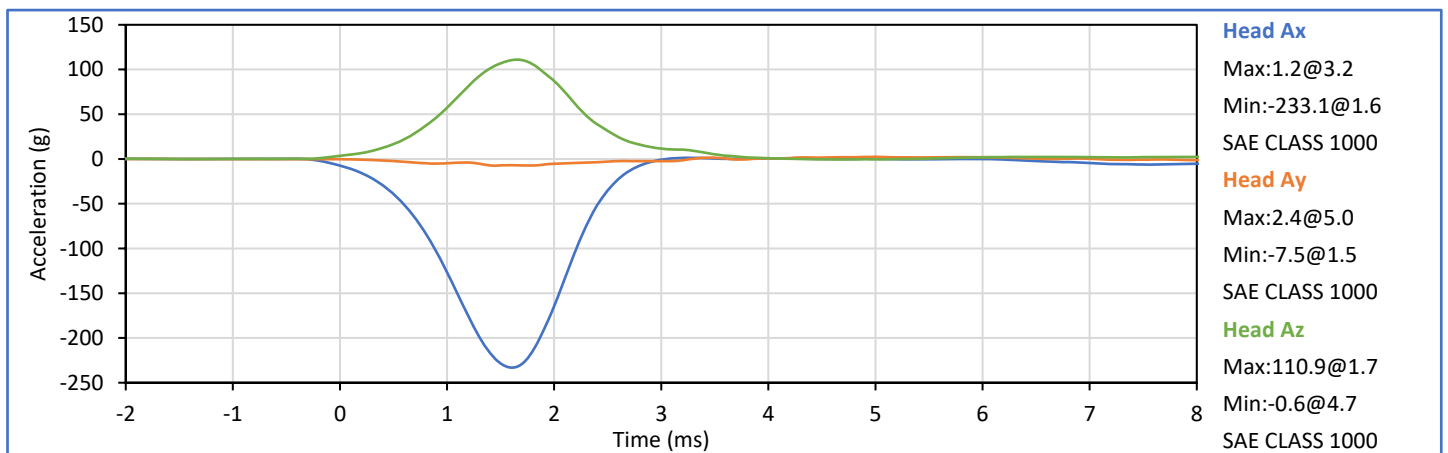
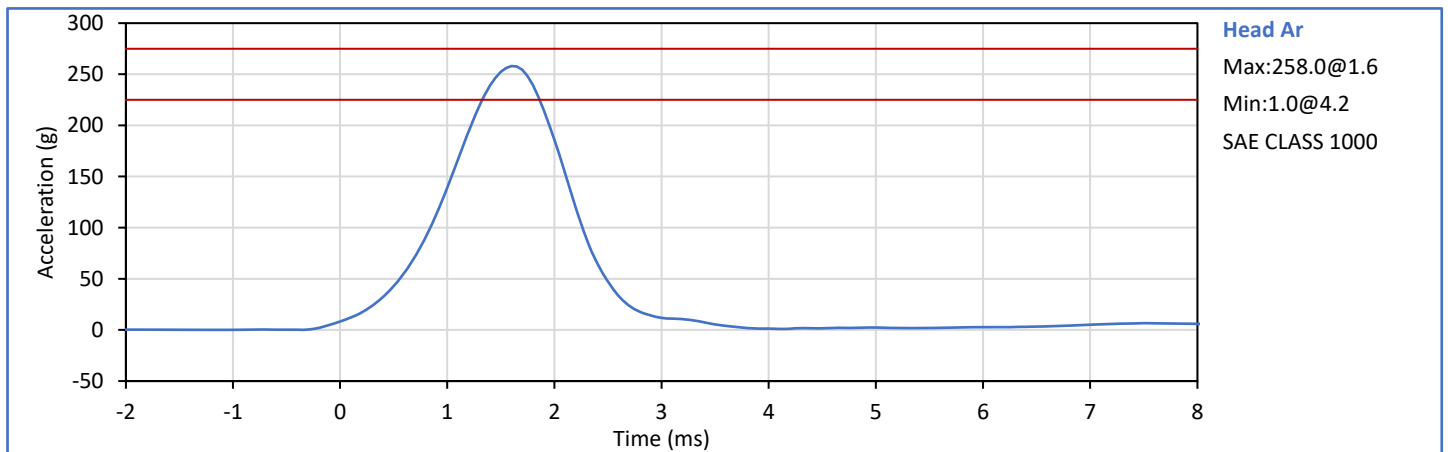
G. Fuentes

Approved By:



J. Hernandez

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	30	Pass
Peak Resultant Acceleration	g	225.0	275.0	258.0	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-7.5	Pass
Oscillations After Main Pulse	%	0.0	10.0	0.0	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass



Technician:

G. Fuentes

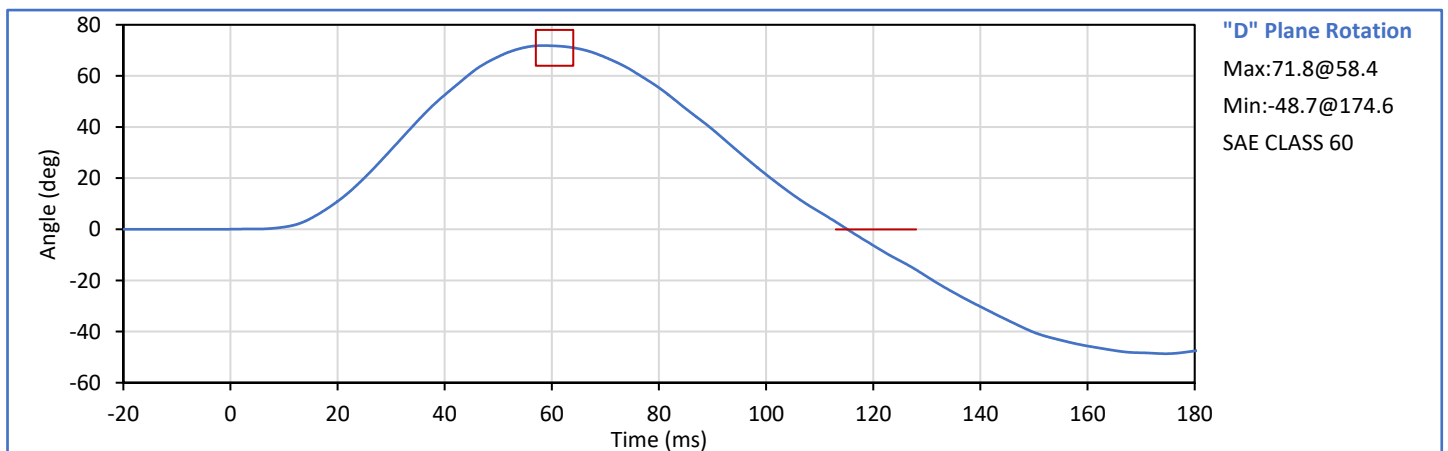
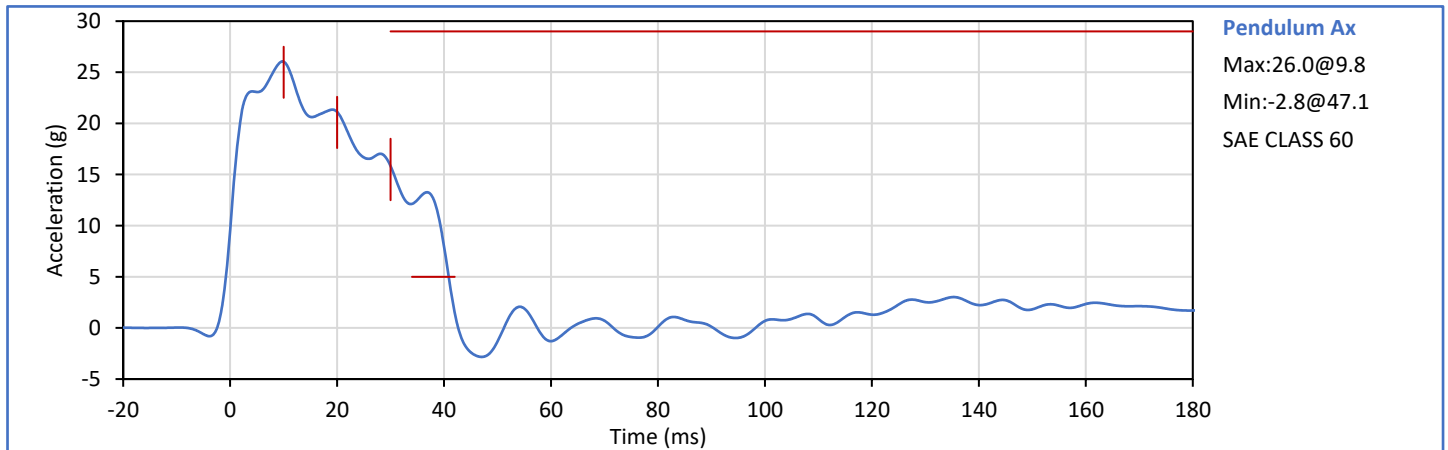
G. Fuentes

Approved By:

J. Hernandez

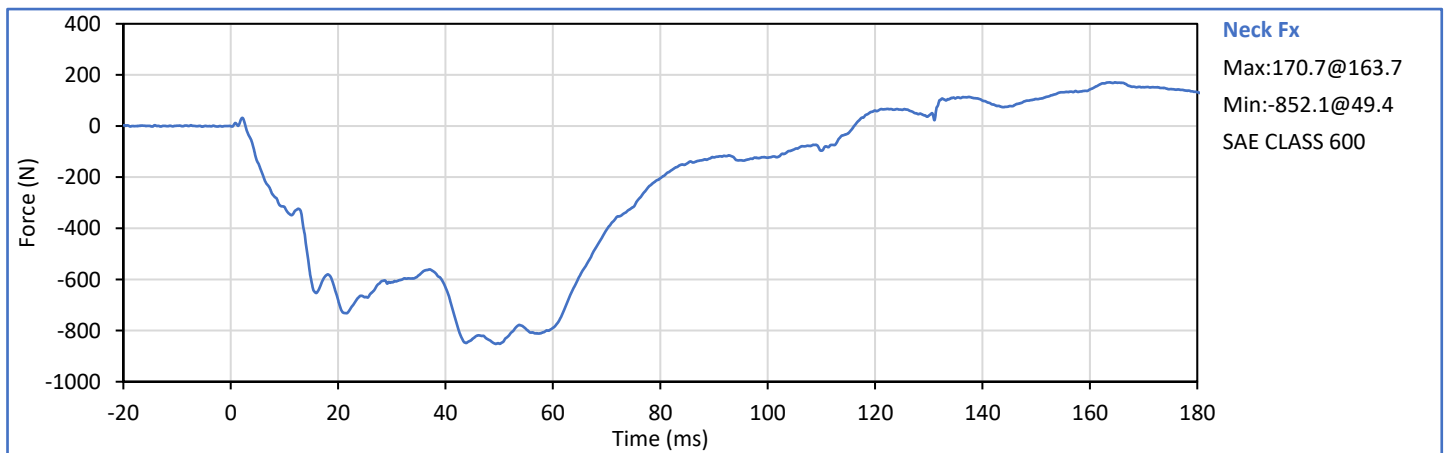
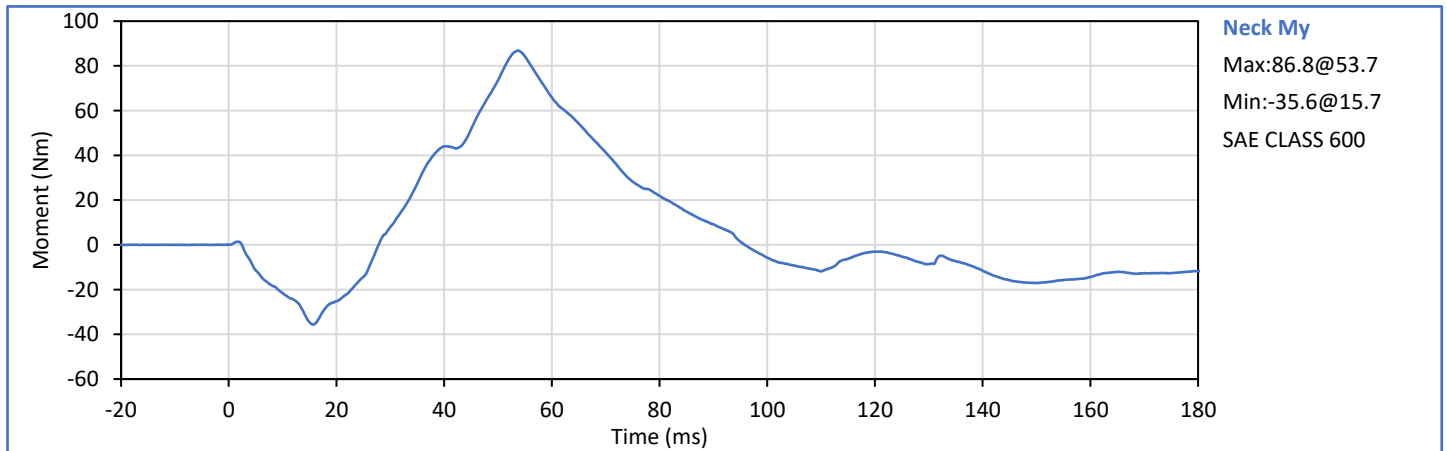
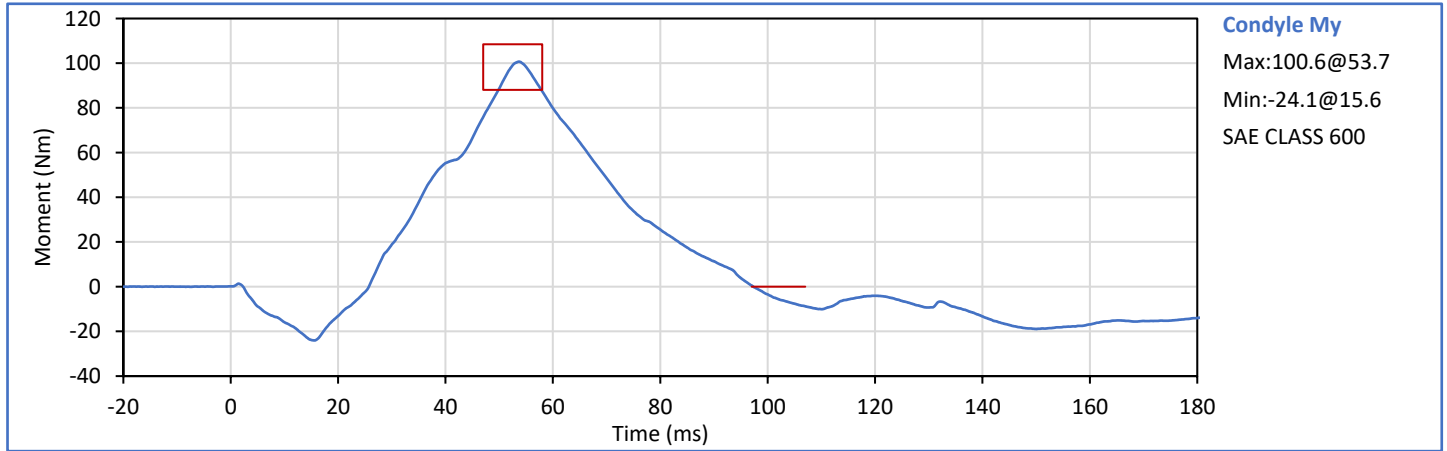
J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.6	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Pendulum Velocity	m/s	6.89	7.13	7.00	Pass
Pendulum Deceleration at 10 ms	g	22.5	27.5	26.0	Pass
Pendulum Deceleration at 20 ms	g	17.6	22.6	21.1	Pass
Pendulum Deceleration at 30 ms	g	12.5	18.5	15.8	Pass
Peak Pendulum Decel After 30 ms	g	0.0	29.0	15.8	Pass
Deceleration Decay to Cross 5g	ms	34.0	42.0	40.9	Pass
"D" Plane Rotation peak	deg	64.0	78.0	71.8	Pass
	ms	57.0	64.0	58.4	Pass
"D" Plane Rotation Decay to Zero	ms	113.0	128.0	115.2	Pass
Moment About Occipital Condyle	Nm	88.1	108.5	100.6	Pass
	ms	47.0	58.0	53.7	Pass
Moment Decay, Peak to Zero	ms	97.0	107.0	97.3	Pass
Overall Test Results				Pass	

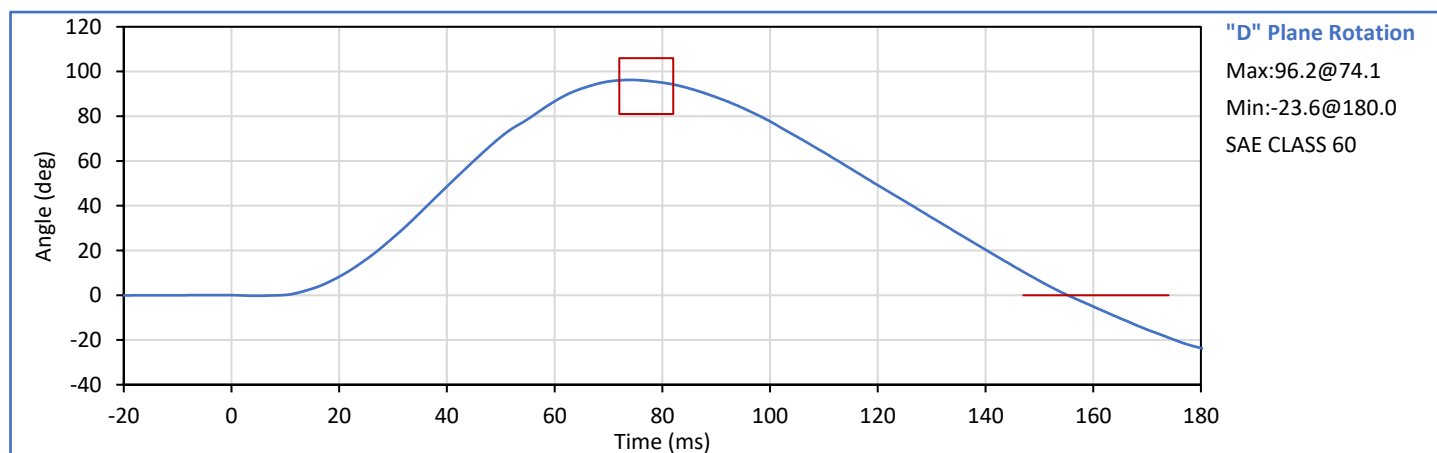
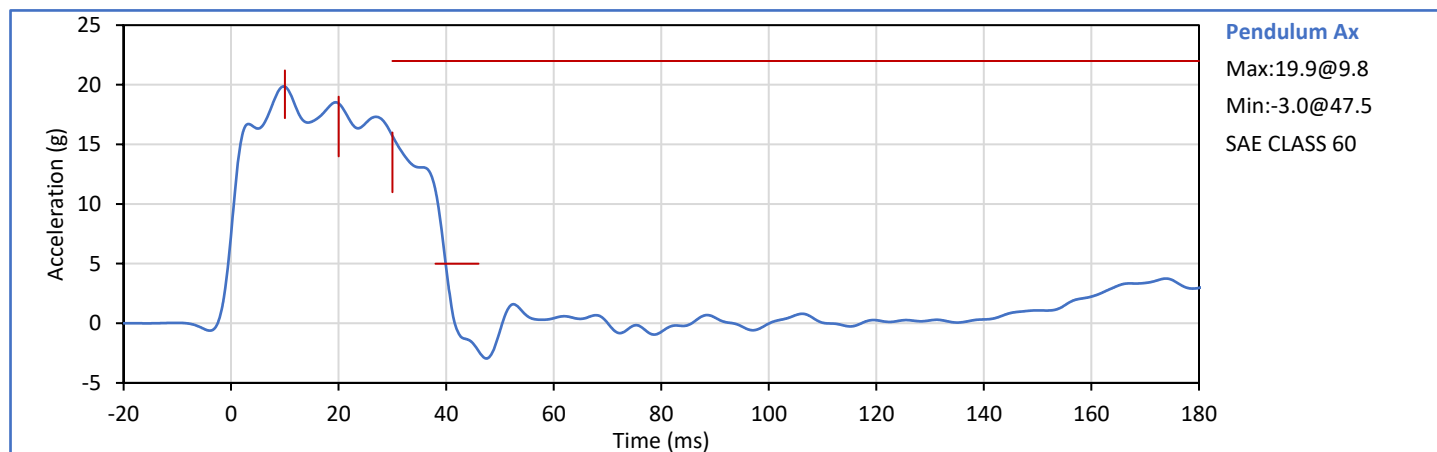


Technician: G. Fuentes

Approved By: J. Hernandez



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.6	Pass
Laboratory Relative Humidity	%	10	70	31	Pass
Pendulum Velocity	m/s	5.94	6.19	6.04	Pass
Pendulum Deceleration at 10 ms	g	17.2	21.2	19.8	Pass
Pendulum Deceleration at 20 ms	g	14.0	19.0	18.4	Pass
Pendulum Deceleration at 30 ms	g	11.0	16.0	15.7	Pass
Peak Pendulum Decel After 30 ms	g	0.0	22.0	15.7	Pass
Deceleration Decay to Cross 5g	ms	38.0	46.0	39.9	Pass
"D" Plane Rotation peak	deg	81.0	106.0	96.2	Pass
	ms	72.0	82.0	74.1	Pass
"D" Plane Rotation Decay to Zero	ms	147.0	174.0	155.3	Pass
Moment About Occipital Condyle	Nm	-79.9	-52.9	-74.5	Pass
	ms	65.0	79.0	70.2	Pass
Moment Decay, Peak to Zero	ms	120.0	148.0	133.0	Pass
Overall Test Results				Pass	



Technician:

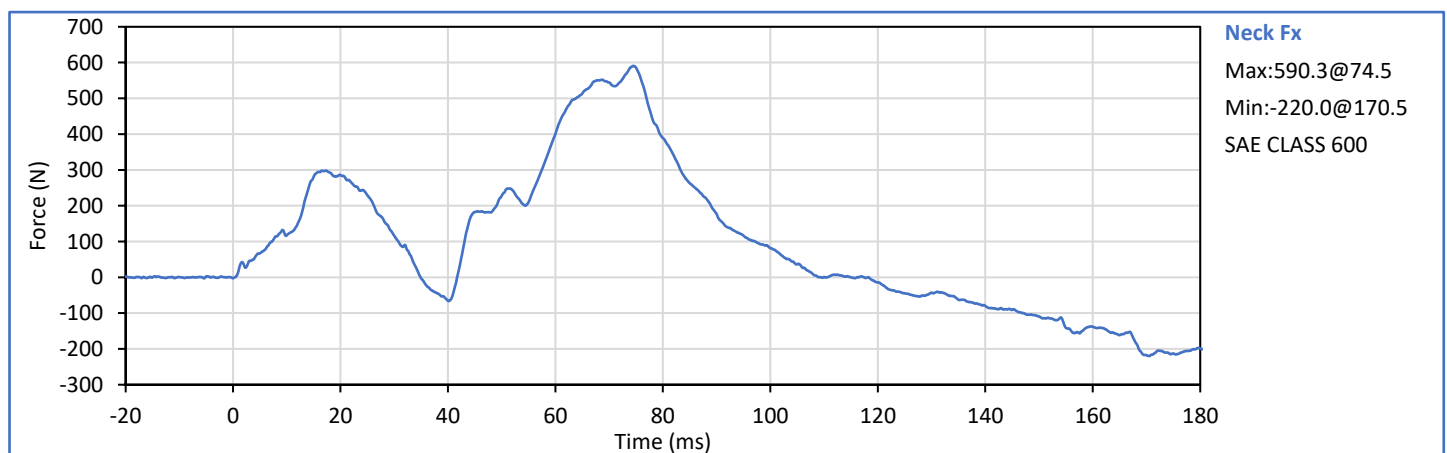
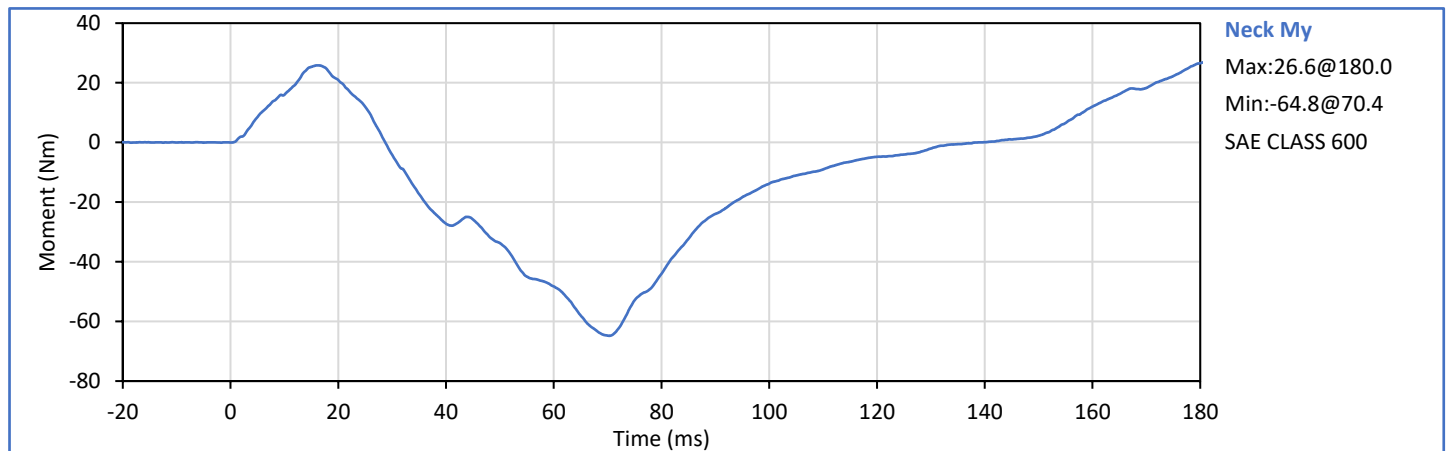
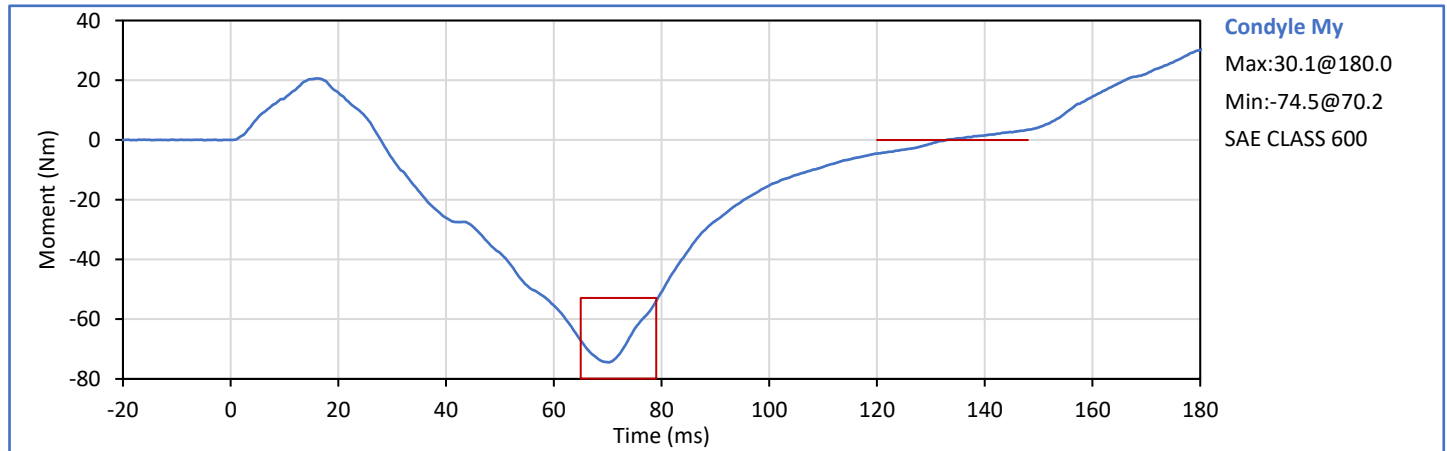
G. Fuentes

G. Fuentes

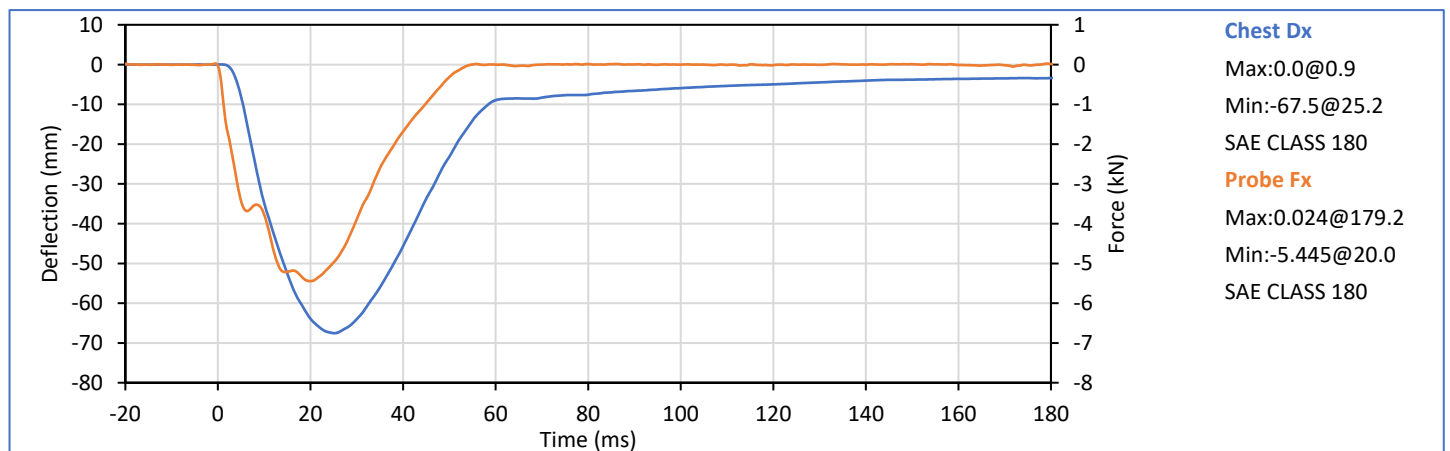
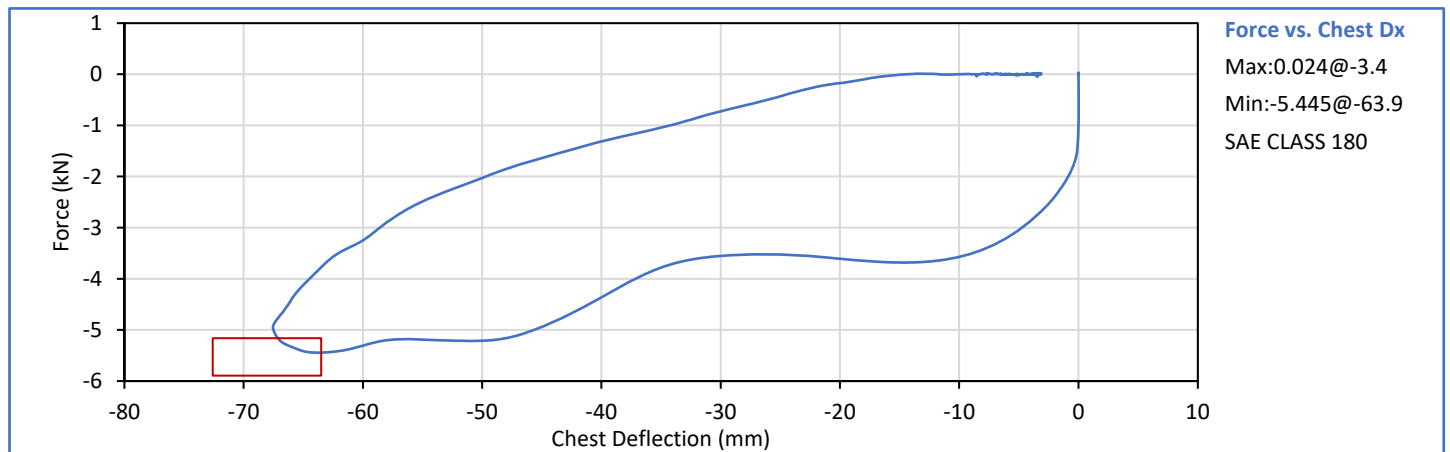
Approved By:

J. Hernandez

J. Hernandez



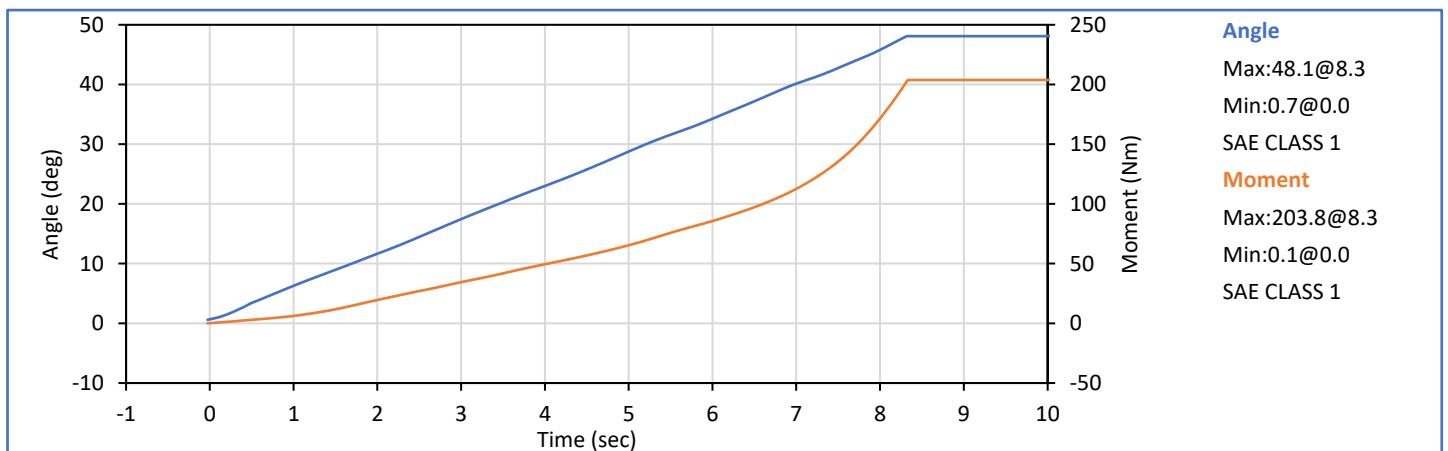
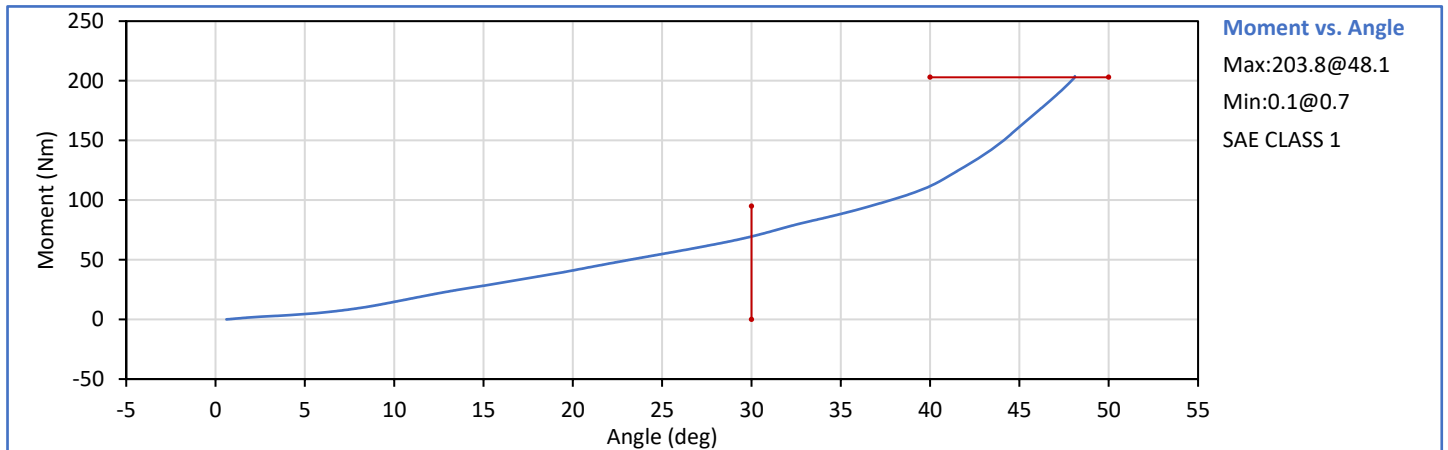
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Probe Velocity	m/s	6.58	6.82	6.71	Pass
Peak Chest Deflection	mm	-72.6	-63.5	-67.5	Pass
Peak Probe Force	kN	-5.893	-5.159	-5.445	Pass
Internal Hysteresis	%	69.0	85.0	69.2	Pass
Overall Test Results				Pass	Pass



Technician: G. Fuentes

Approved By: J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.3	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Left Hip Rotation Rate	deg/s	5.0	10.0	5.7	Pass
Left Femur Torque at 30°	Nm	0.0	95.0	69.5	Pass
Left Hip Rotation at 203 Nm	deg	40.0	50.0	48.1	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

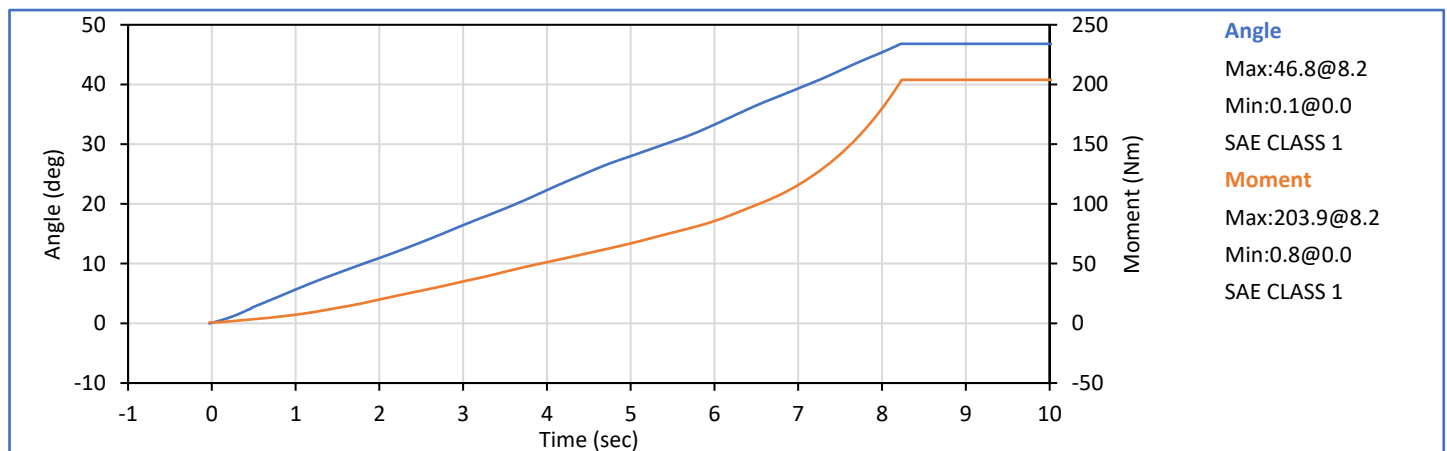
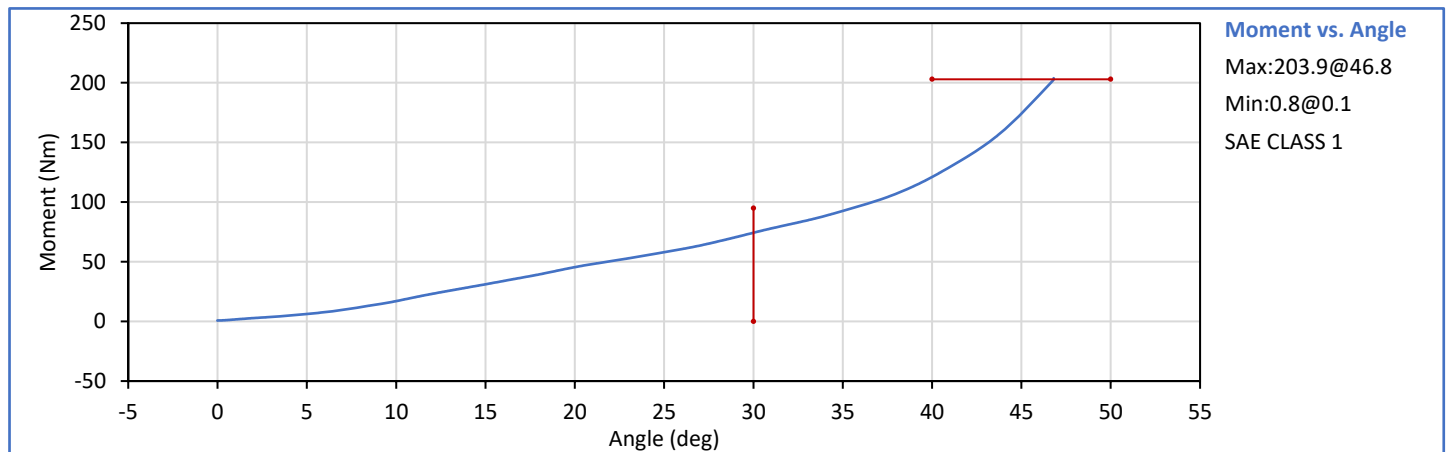
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.3	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Right Hip Rotation Rate	deg/s	5.0	10.0	5.7	Pass
Right Femur Torque at 30°	Nm	0.0	95.0	74.2	Pass
Right Hip Rotation at 203 Nm	deg	40.0	50.0	46.8	Pass
Overall Test Results				Pass	Pass



Technician:

G. Fuentes

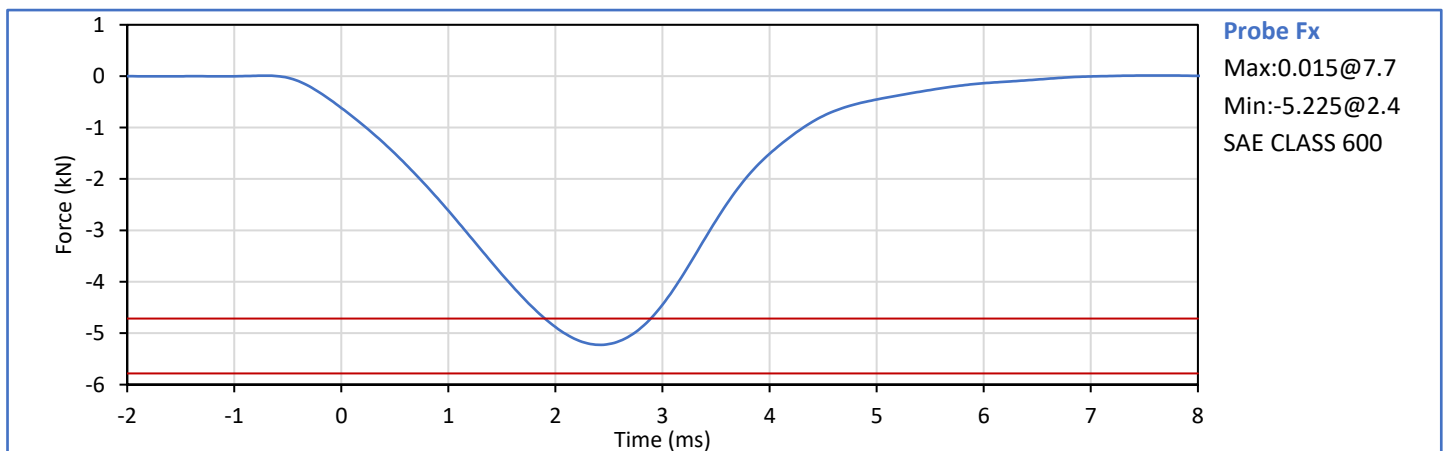
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

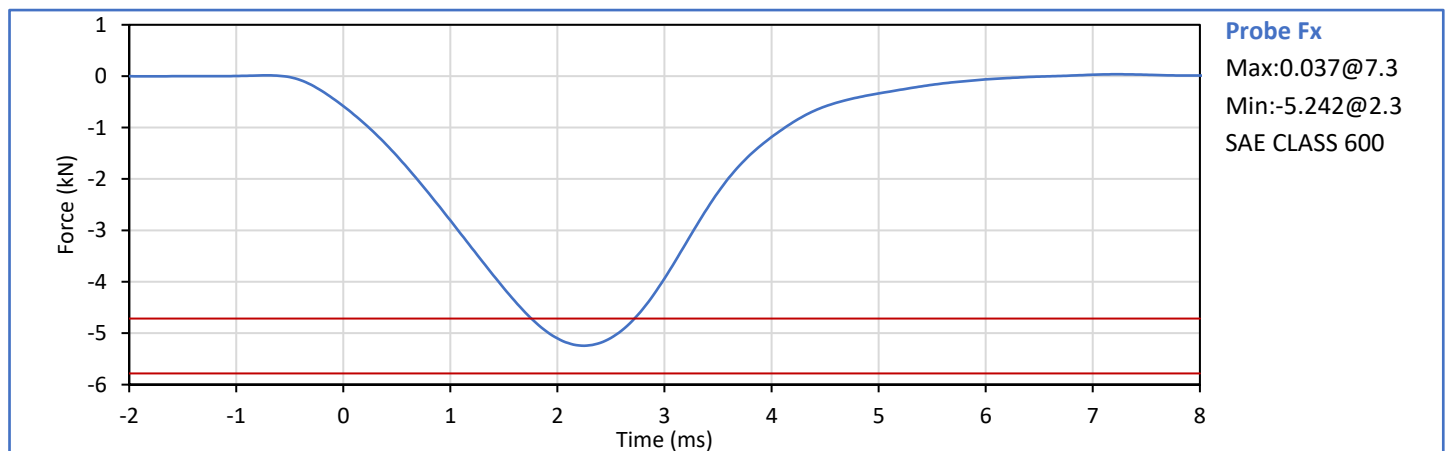
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.4	Pass
Laboratory Relative Humidity	%	10	70	32	Pass
Probe Velocity	m/s	2.070	2.130	2.105	Pass
Peak Resistive Force	kN	-5.782	-4.715	-5.225	Pass
Overall Test Results					Pass



Technician: G. Fuentes

Approved By: J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.4	Pass
Laboratory Relative Humidity	%	10	70	32	Pass
Probe Velocity	m/s	2.070	2.130	2.103	Pass
Peak Resistive Force	kN	-5.782	-4.715	-5.242	Pass
Overall Test Results					Pass



Technician: G. Fuentes

Approved By: J. Hernandez

APPENDIX C
Post-Test ATD Qualification and Performance Verification
Hybrid III 5th Percentile Female ATD
S/N: DH1644

ATD Serial No.: DH1644

Test Date: 2023-05-03

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: _____

G. Fuentes

Approved By: _____

J. Hernandez

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	31	Pass
A - Total sitting height	mm	775	800	787	Pass
B - Shoulder pivot height	mm	432	457	450	Pass
C - 'H' point height	mm	81	86	84	Pass
D - 'H' point location from backline	mm	145	150	148	Pass
E - Shoulder pivot from backline	mm	69	84	80	Pass
F - Thigh clearance	mm	119	135	125	Pass
G - Back of elbow to wrist pivot	mm	244	259	249	Pass
H - Head back to backline	mm	41	46	44	Pass
I - Shoulder to elbow length	mm	277	297	291	Pass
J - Elbow rest height	mm	183	203	187	Pass
K - Buttock to knee length	mm	521	546	534	Pass
L - Popliteal length	mm	356	376	369	Pass
M - Knee pivot height	mm	394	419	412	Pass
N - Buttock popliteal length	mm	414	439	421	Pass
O - Chest depth without jacket	mm	175	191	182	Pass
P - Foot length	mm	219	234	225	Pass
R - Buttock to Knee Pivot Length	mm	457	483	479	Pass
S - Head Breadth	mm	137	147	142	Pass
T - Head Depth	mm	178	188	183	Pass
U - Hip Breadth	mm	300	315	308	Pass
V - Shoulder breadth	mm	351	366	356	Pass
W - Foot breadth	mm	79	94	92	Pass
X - Head circum.	mm	528	549	539	Pass
Y - Chest circum. (w/chest jacket)	mm	851	881	865	Pass
Z - Waist circum.	mm	760	790	778	Pass
AA - Location for chest circum.	mm	333	358	345	Pass
BB - Location for waist circum.	mm	160	170	167	Pass
			Overall Test Results		Pass

Technician:



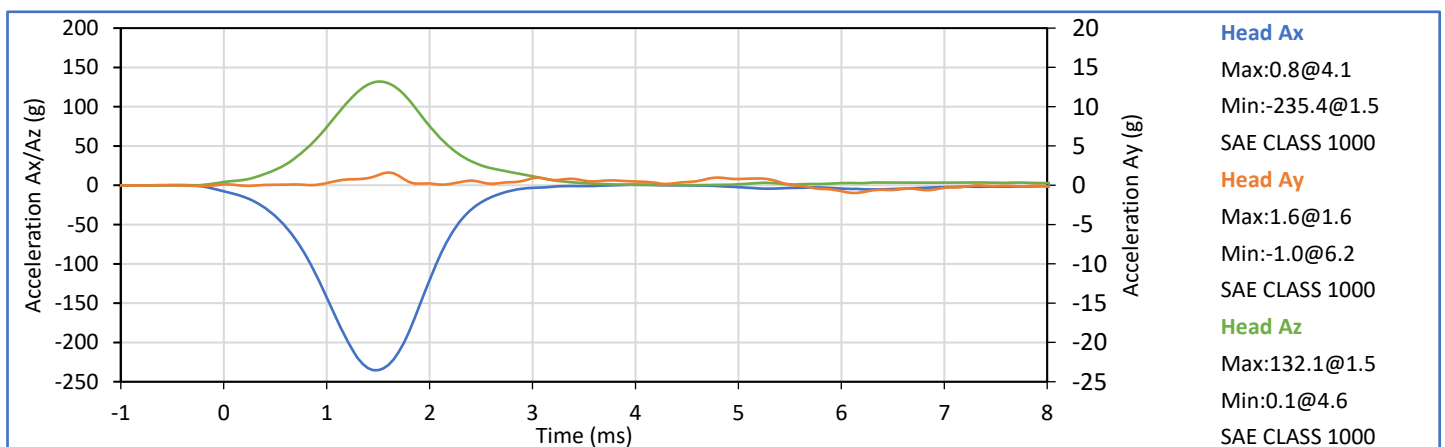
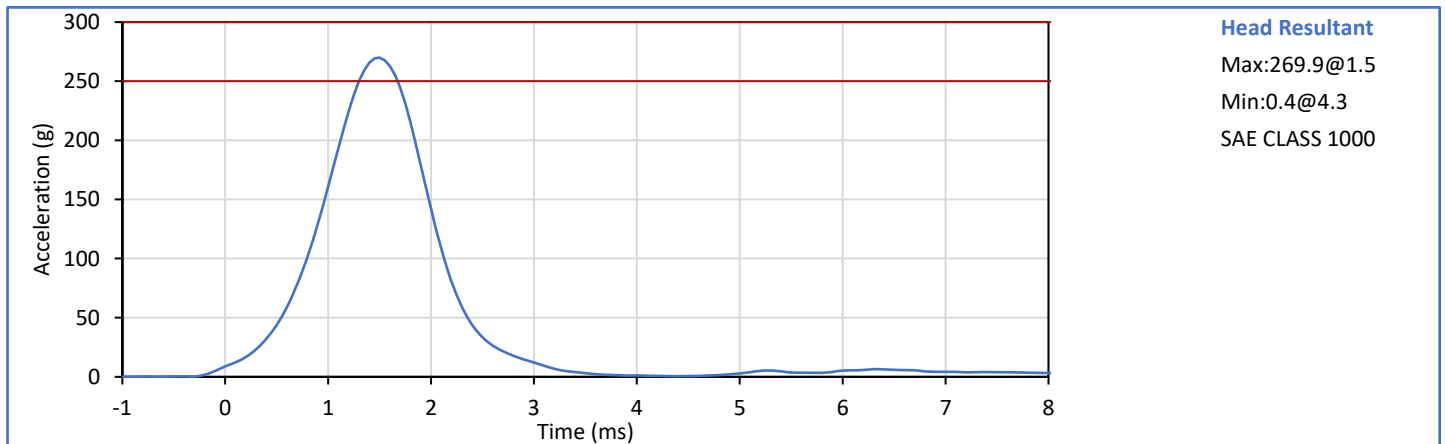
G. Fuentes

Approved By:



J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.4	Pass
Laboratory Humidity	%	10	70	32	Pass
Peak Resultant Acceleration	g	250.0	300.0	269.9	Pass
Peak Lateral Acceleration	g	-15.0	15.0	1.6	Pass
Oscillations After Main Pulse	%	0.0	10.0	2.4	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
			Overall Test Results		Pass



Technician:

G. Fuentes

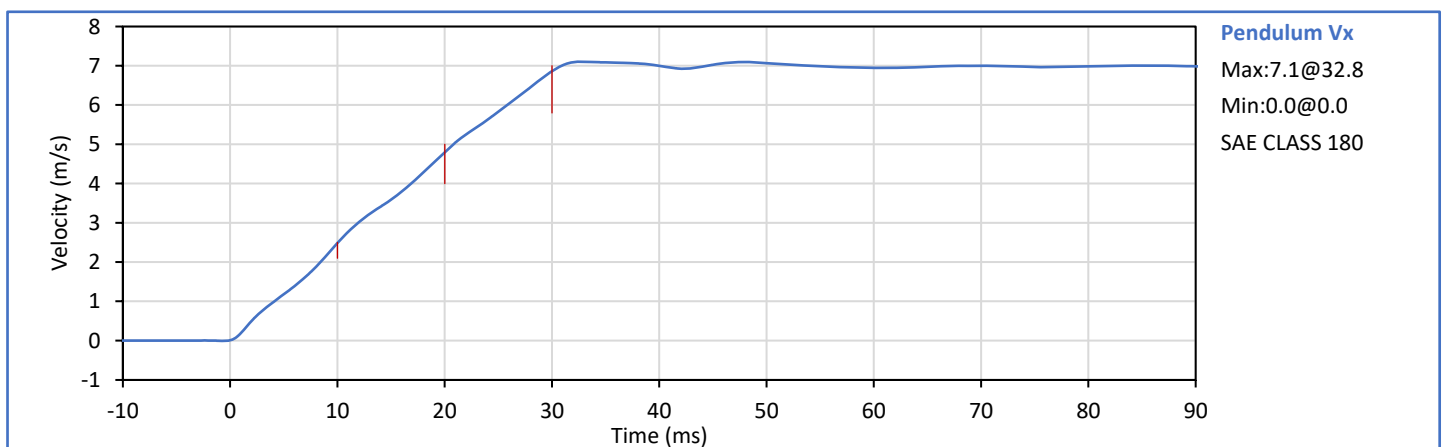
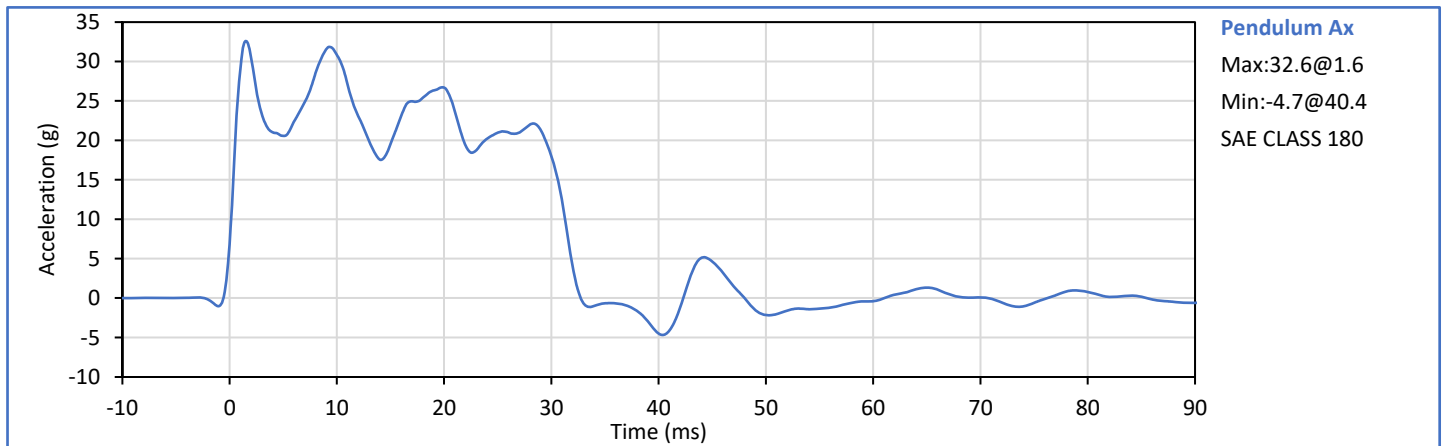
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	6.89	7.13	7.00	Pass
Pendulum Velocity at 10 ms	m/s	2.10	2.50	2.48	Pass
Pendulum Velocity at 20 ms	m/s	4.00	5.00	4.79	Pass
Pendulum Velocity at 30 ms	m/s	5.80	7.00	6.86	Pass
Peak "D" Plane Rotation	deg	77.0	91.0	83.4	Pass
Peak Moment in Rotation	Nm	69.0	83.0	75.8	Pass
Positive Moment Decay to 10 Nm	ms	80.0	100.0	84.3	Pass
Overall Test Results				Pass	Pass



Technician:

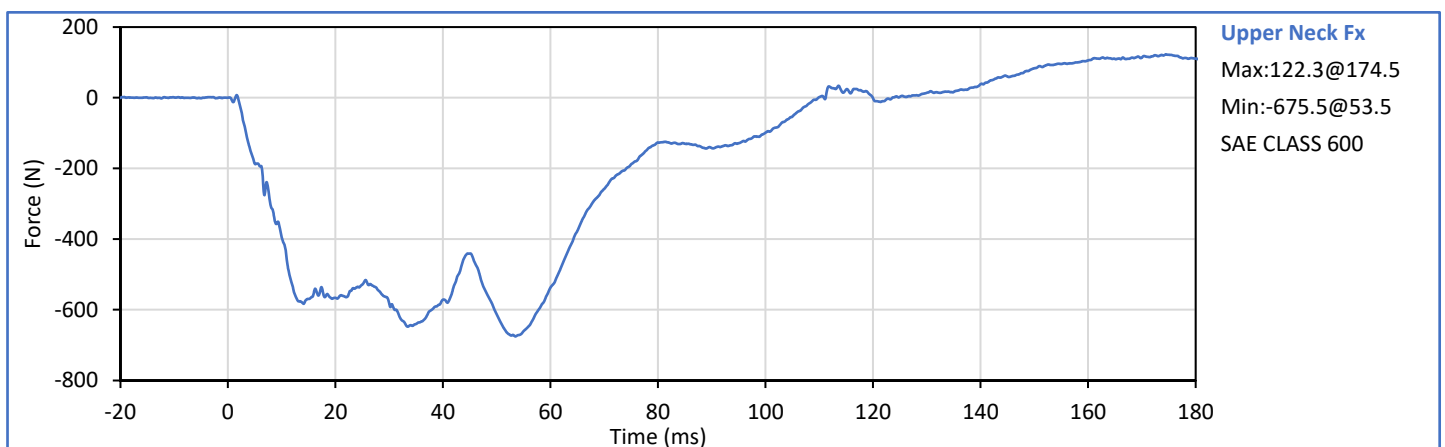
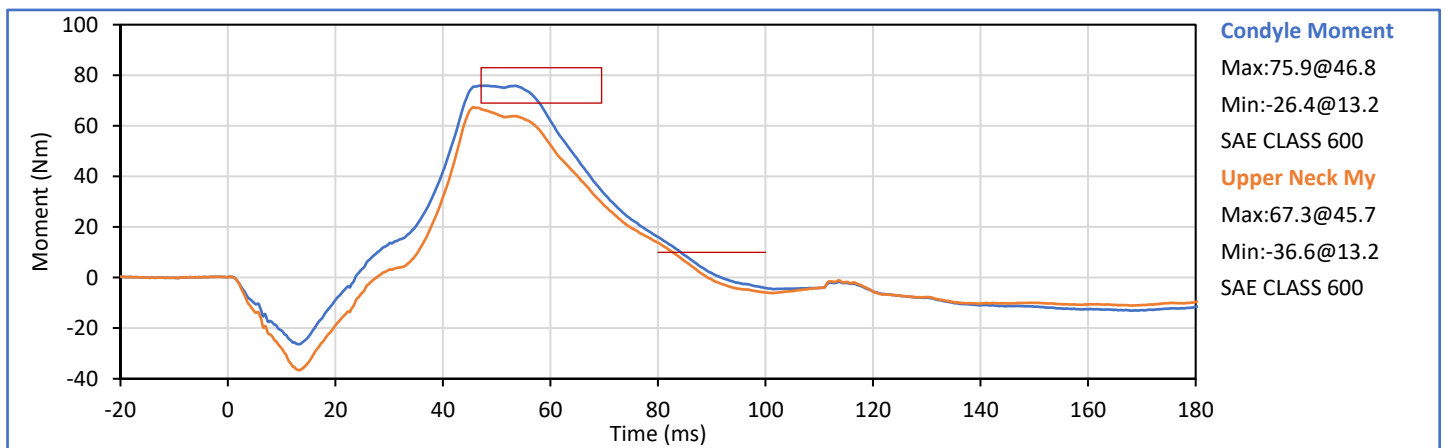
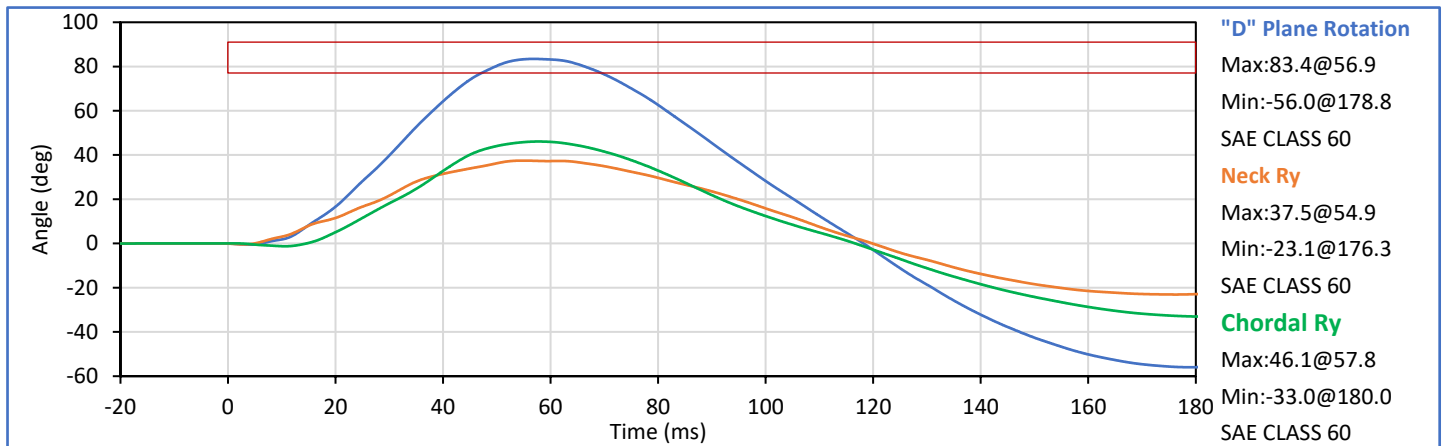
G. Fuentes

G. Fuentes

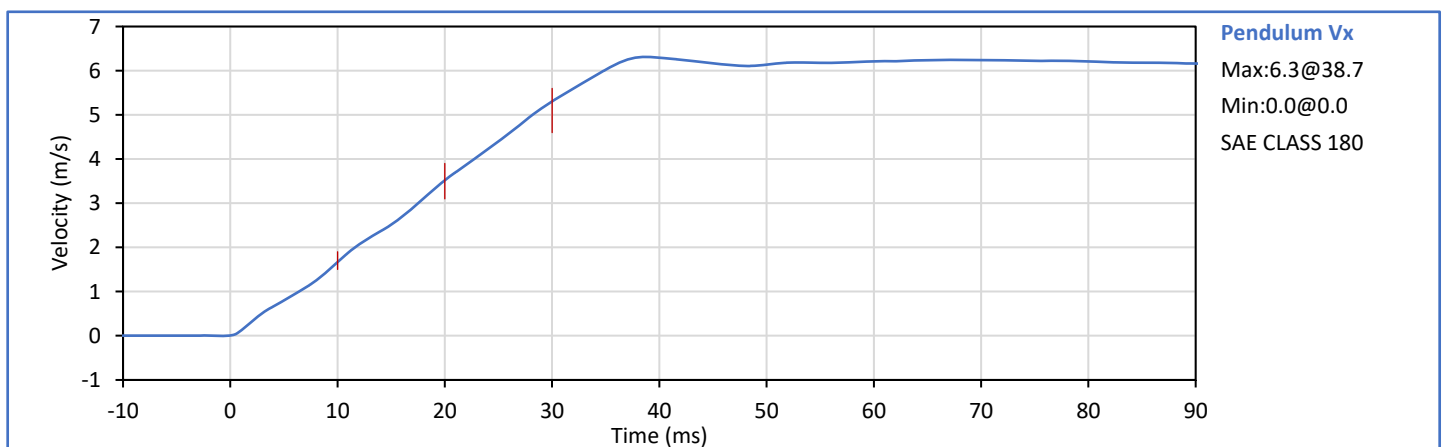
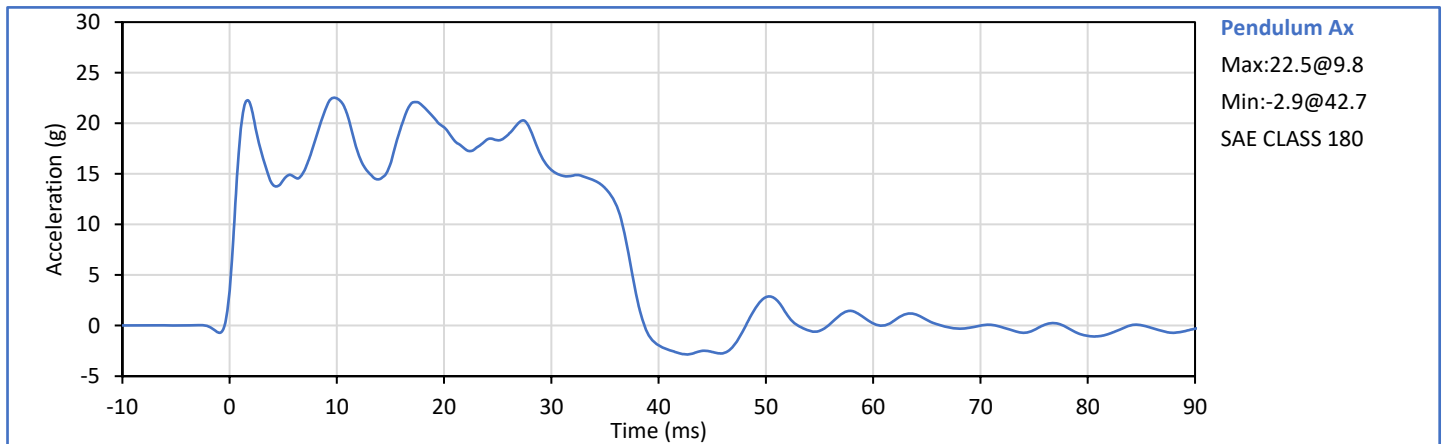
Approved By:

J. Hernandez

J. Hernandez



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.95	6.19	6.04	Pass
Pendulum Velocity at 10 ms	m/s	1.50	1.90	1.66	Pass
Pendulum Velocity at 20 ms	m/s	3.10	3.90	3.51	Pass
Pendulum Velocity at 30 ms	m/s	4.60	5.60	5.30	Pass
Peak "D" Plane Rotation	deg	99.0	114.0	109.4	Pass
Peak Moment in Rotation	Nm	-65.0	-53.0	-61.6	Pass
Negative Moment Decay to -10 Nm	ms	94.0	114.0	100.4	Pass
Overall Test Results					Pass



Technician:

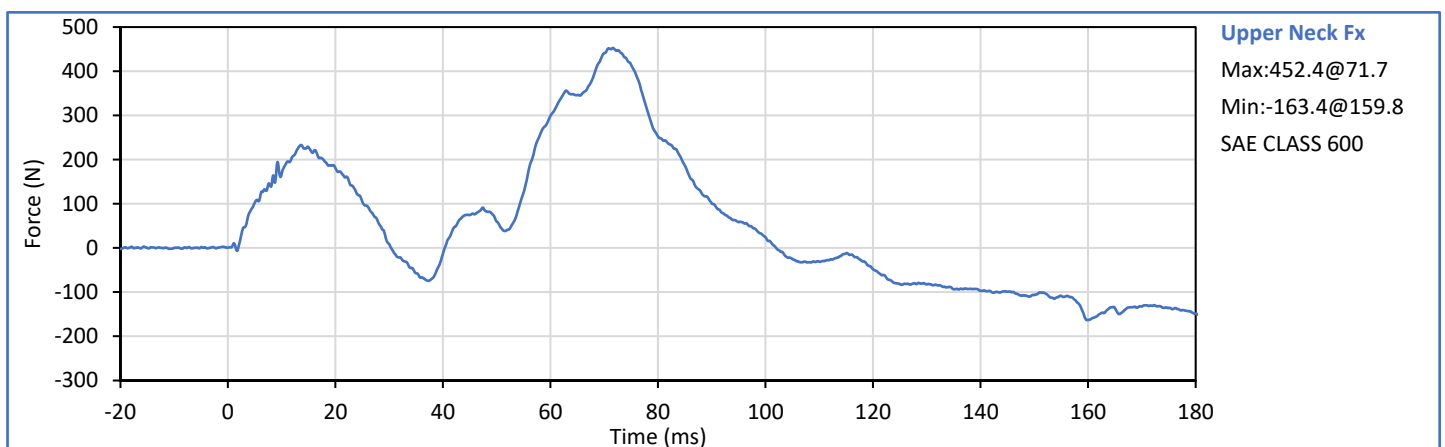
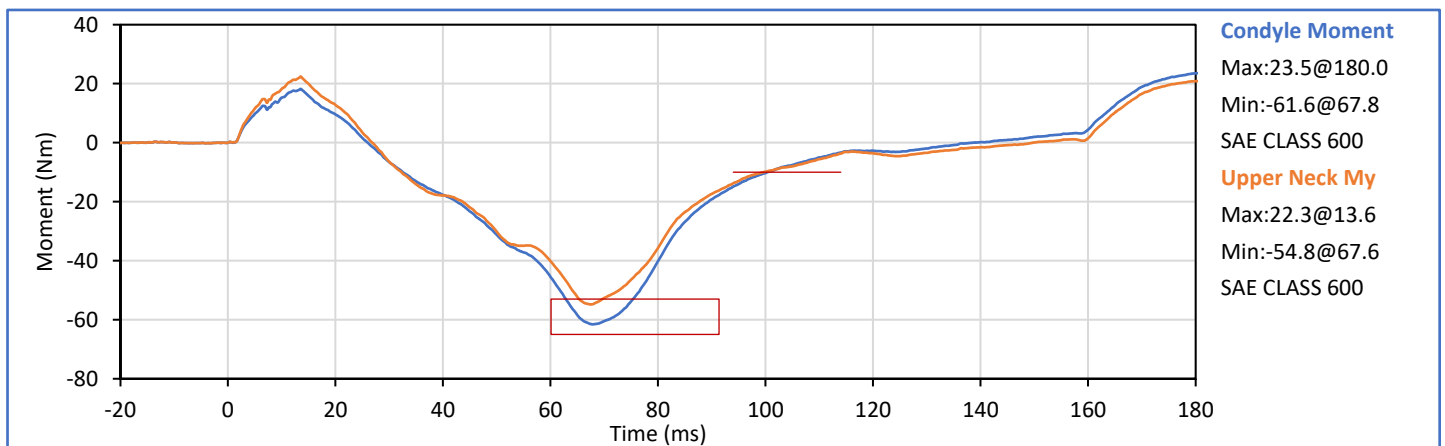
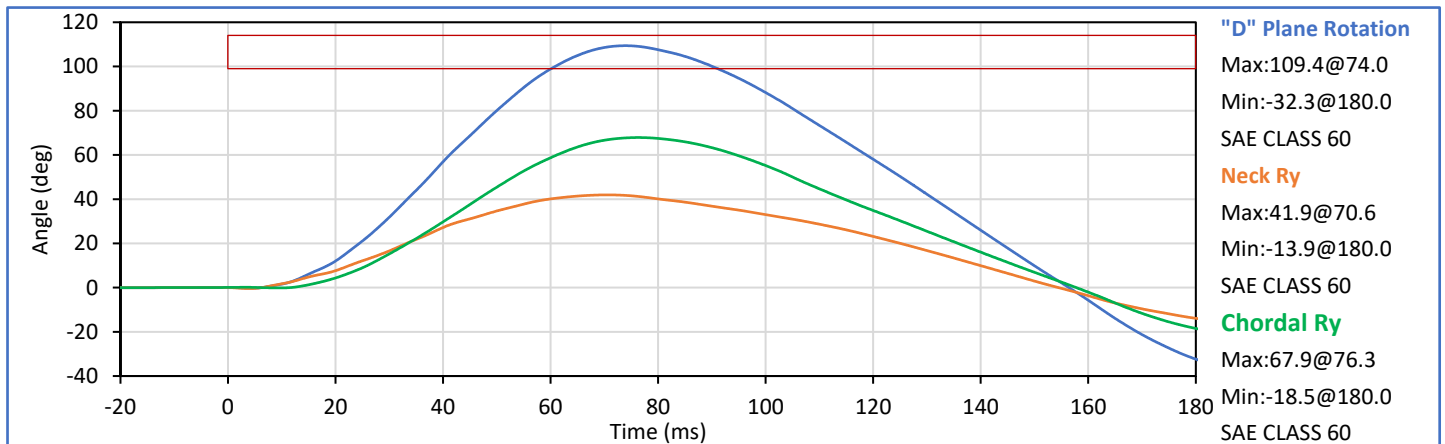
G. Fuentes

G. Fuentes

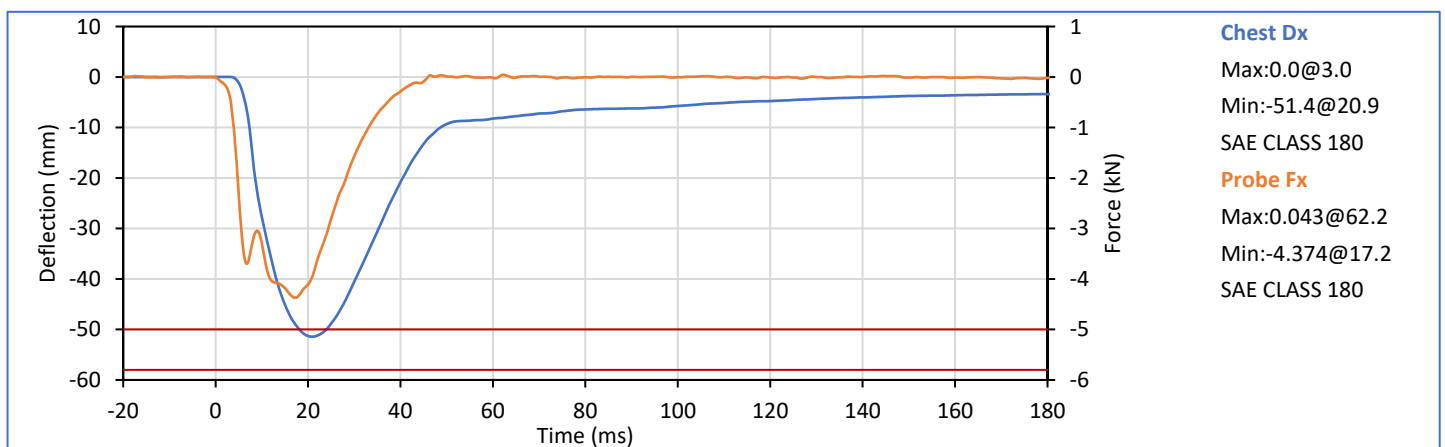
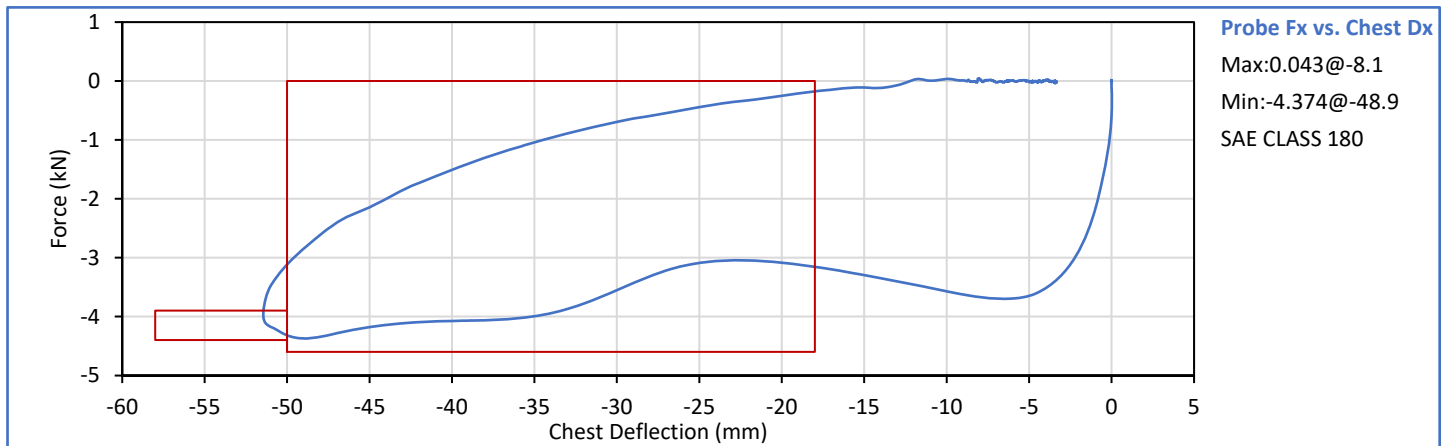
Approved By:

J. Hernandez

J. Hernandez



Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory RelativeHumidity	%	10	70	31	Pass
Probe Velocity	m/s	6.59	6.83	6.68	Pass
Peak Chest Deflection	mm	-58.0	-50.0	-51.4	Pass
Peak Probe Force, 50 and 58 mm	kN	-4.400	-3.900	-4.318	Pass
Peak Probe Force, 18 and 50 mm	kN	-4.600	0.000	-4.374	Pass
Internal Hysteresis	%	69.0	85.0	76.7	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

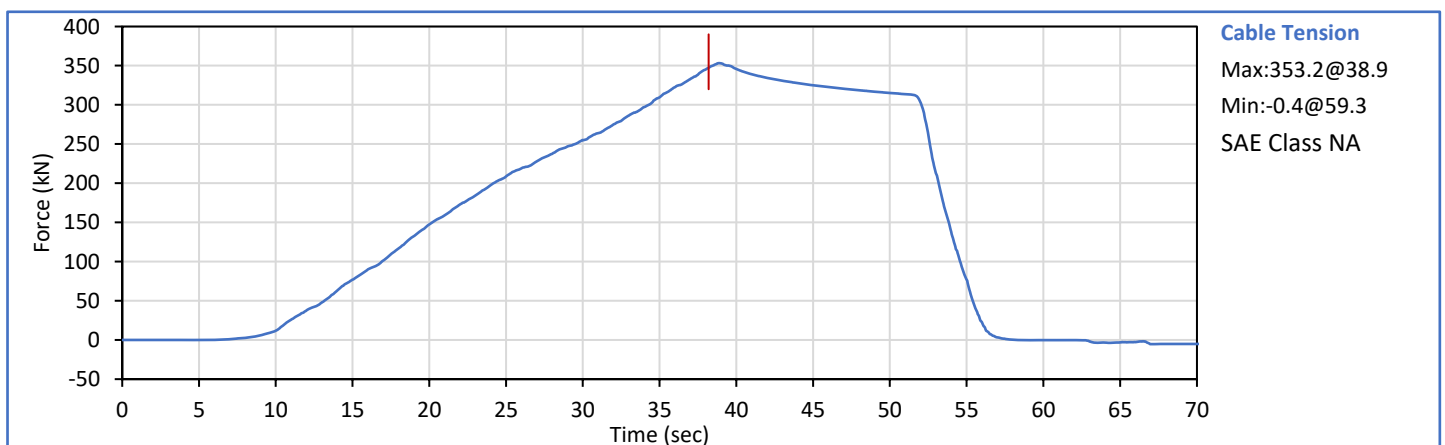
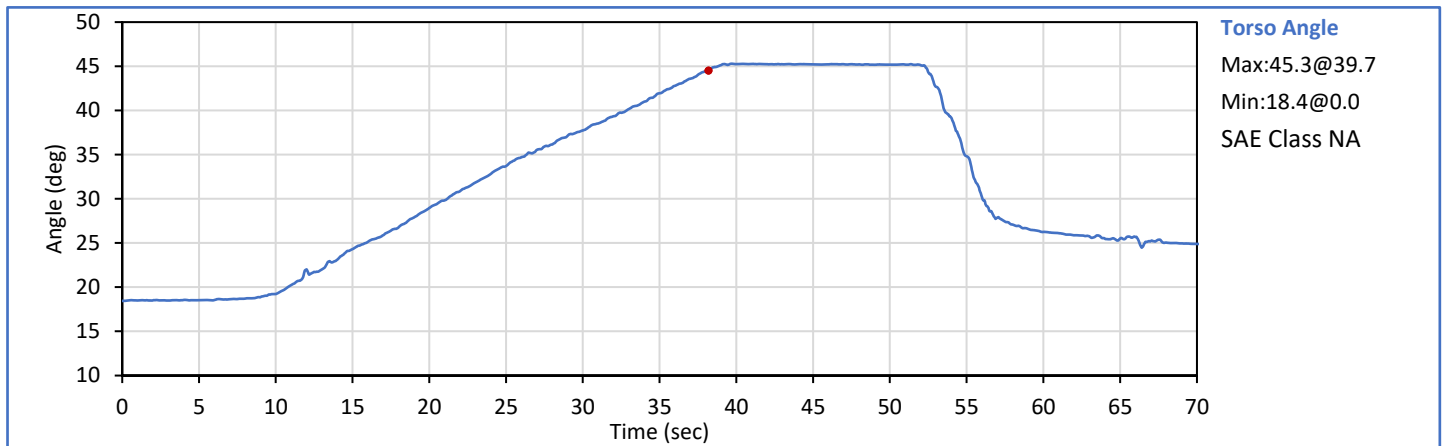
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.3	Pass
Laboratory Humidity	%	10	70	30	Pass
Orientation Angle	deg	0.0	20.0	17.3	Pass
Test Initial Angle	deg	11.0	19.0	18.4	Pass
Peak Force at 45° (+/-0.5°)	N	320.0	390.0	347.2	Pass
Torso Flexion Rate	deg/s	0.50	1.50	0.91	Pass
Final Reference Plane Angle	deg	-8.0	8.0	1.5	Pass
Overall Test Results				Pass	Pass



Technician:

G. Fuentes

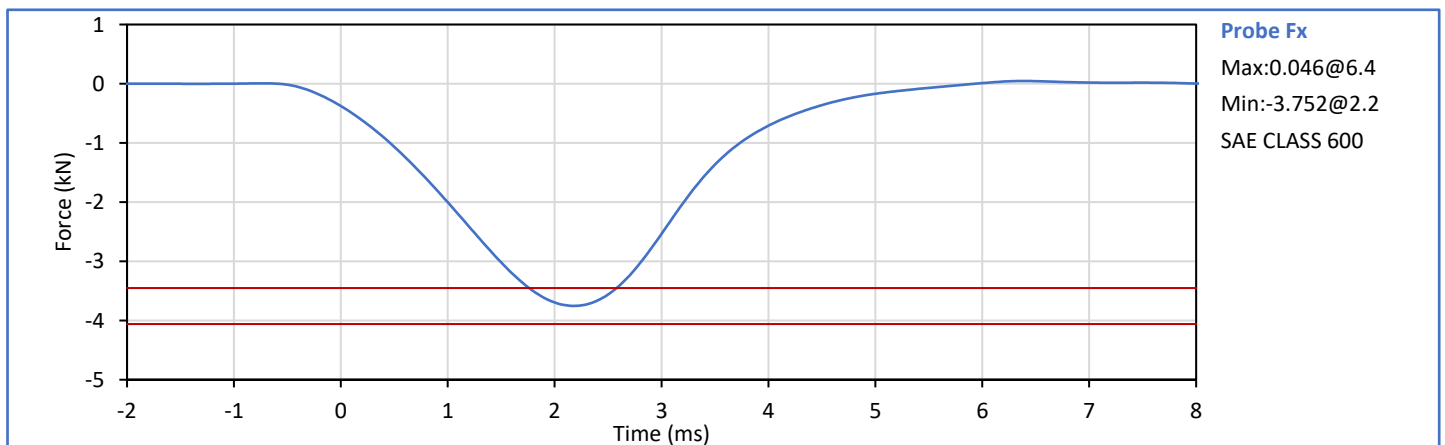
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

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	33	Pass
Probe Velocity	m/s	2.070	2.130	2.104	Pass
Peak Resistive Force	kN	-4.060	-3.450	-3.752	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

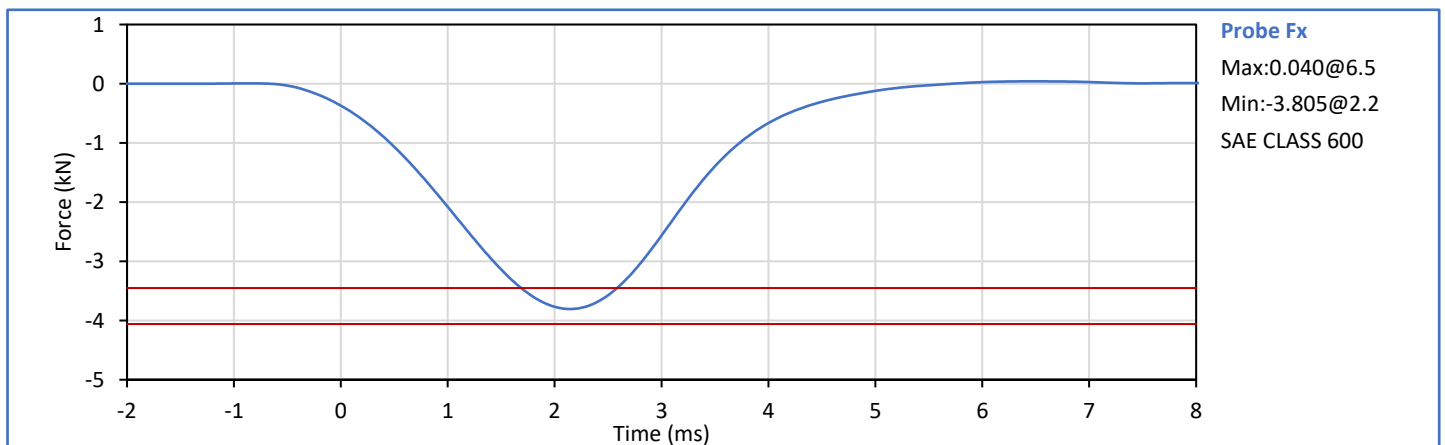
G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

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	33	Pass
Probe Velocity	m/s	2.070	2.130	2.100	Pass
Peak Resistive Force	kN	-4.060	-3.450	-3.805	Pass
Overall Test Results					Pass



Technician:

G. Fuentes

G. Fuentes

Approved By:

J. Hernandez

J. Hernandez

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	2022-11-17
Head Acceleration Y Primary	P49228	Endevco	7264C-2k	2022-11-17
Head Acceleration Z Primary	P50101	Endevco	7264C-2k	2022-11-17
Head Acceleration X Redundant	P50103	Endevco	7264C-2k	2022-11-17
Head Acceleration Y Redundant	P49210	Endevco	7264C-2k	2022-11-17
Head Acceleration Z Redundant	P58713	Endevco	7264C-2k	2022-11-17
Head Rotation Rate X	ARS7426	DTS	ARS PRO-8k (2kHz)	2023-04-07
Head Rotation Rate Y	ARS7587	DTS	ARS PRO-8k (2kHz)	2023-04-07
Head Rotation Rate Z	ARS7480	DTS	ARS PRO-8k (2kHz)	2023-04-07
Upper Neck Force X	2190 Fx	R.A. Denton	1716ATF	2023-09-12
Upper Neck Force Y	2190 Fy	R.A. Denton	1716ATF	2023-09-12
Upper Neck Force Z	2190 Fz	R.A. Denton	1716ATF	2023-09-12
Upper Neck Moment X	2190 Mx	R.A. Denton	1716ATF	2023-09-12
Upper Neck Moment Y	2190 My	R.A. Denton	1716ATF	2023-09-12
Upper Neck Moment Z	2190 Mz	R.A. Denton	1716ATF	2023-09-12
Chest Acceleration X Primary	P52112	Endevco	7264C-2k	2022-11-18
Chest Acceleration Y Primary	P49208	Endevco	7264C-2k	2022-11-18
Chest Acceleration Z Primary	P51264	Endevco	7264C-2k	2022-11-18
Chest Acceleration X Redundant	P49461	Endevco	7264C-2k	2022-11-18
Chest Acceleration Y Redundant	P58774	Endevco	7264C-2k	2022-11-18
Chest Acceleration Z Redundant	P49168	Endevco	7264C-2k	2022-11-18
Chest Deflection	0606 (H3)	Servo	14CBI-3615	2022-11-21
Pelvis Acceleration X	P49238	Endevco	7264C-2k	2022-11-21
Pelvis Acceleration Y	P58877	Endevco	7264C-2k	2022-11-21
Pelvis Acceleration Z	P50087	Endevco	7264C-2k	2022-11-21
Left Femur Force Z	DS4138 (pri)	Humanetics	3821JLN2	2022-09-12
Right Femur Force Z	DS4136 (pri)	Humanetics	3821JLN2	2022-09-12
Left Femur Force Z Redundant	DS4138 (red)	Humanetics	3821JLN2	2022-09-12
Right Femur Force Z Redundant	DS4136 (red)	Humanetics	3821JLN2	2022-09-12
Left Upper Tibia Moment X	DG6679 Mx	FTSS	IF-857	2022-05-02
Left Upper Tibia Moment Y	DG6679 My	FTSS	IF-857	2022-05-02
Left Upper Tibia Force Z	DG6679 Fz	FTSS	IF-857	2022-05-02
Left Lower Tibia Moment X	405 Mx	R.A. Denton	3644	2023-02-16
Left Lower Tibia Moment Y	405 My	R.A. Denton	3644	2023-02-16
Left Lower Tibia Force Z	405 Fz	R.A. Denton	3644	2023-02-16
Right Upper Tibia Moment X	DH3284 Mx	FTSS	IF-857	2023-02-16
Right Upper Tibia Moment Y	DH3284 My	FTSS	IF-857	2023-02-16
Right Upper Tibia Force Z	DH3284 Fz	FTSS	IF-857	2023-02-16
Right Lower Tibia Moment X	91 Mx	R.A. Denton	3644	2023-02-16
Right Lower Tibia Moment Y	91 My	R.A. Denton	3644	2023-02-16
Right Lower Tibia Force Z	91 Fz	R.A. Denton	3644	2023-02-16
Left Ankle Acceleration X	03E20-N09	Entran	EGEB6Q-2k	2022-11-22
Left Ankle Acceleration Z	P68074	Endevco	7264C-2k	2022-12-08
Left Toe Acceleration Z	03H07-Z10	Entran	EGEB6Q-2k	2022-11-23
Right Ankle Acceleration X	03E29-N20	Entran	EGEB6Q-2k	2022-11-23
Right Ankle Acceleration Z	P68602	Endevco	7264C-2k	2022-11-23
Right Toe Acceleration Z	03D09-N01	Entran	EGEB6Q-2k	2022-11-21
Seat Belt Outside Lap Force	313	FTSS	IF-964	2023-04-04
Seat Belt Upper Diagonal Force	315	FTSS	IF-964	2023-04-04

Table 2 - Right Front Passenger ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P51889	Endevco	7264C-2k	2022-11-17
Head Acceleration Y Primary	P51861	Endevco	7264C-2k	2022-11-17
Head Acceleration Z Primary	P52077	Endevco	7264C-2k	2022-11-17
Head Acceleration X Redundant	P58835	Endevco	7264C-2k	2022-11-17
Head Acceleration Y Redundant	P51703	Endevco	7264C-2k	2022-11-17
Head Acceleration Z Redundant	P52096	Endevco	7264C-2k	2022-11-17
Head Rotation Rate X	ARS7367	DTS	ARS PRO-8k (2kHz)	2023-04-07
Head Rotation Rate Y	ARS7377	DTS	ARS PRO-8k (2kHz)	2023-04-07
Head Rotation Rate Z	ARS7498	DTS	ARS PRO-8k (2kHz)	2023-04-07
Upper Neck Force X	1643 Fx	R.A. Denton	1716A	2023-02-15
Upper Neck Force Y	1643 Fy	R.A. Denton	1716A	2023-02-15
Upper Neck Force Z	1643 Fz	R.A. Denton	1716A	2023-02-15
Upper Neck Moment X	1643 Mx	R.A. Denton	1716A	2023-02-15
Upper Neck Moment Y	1643 My	R.A. Denton	1716A	2023-02-15
Upper Neck Moment Z	1643 Mz	R.A. Denton	1716A	2023-02-15
Chest Acceleration X Primary	P58860	Endevco	7264C-2k	2022-11-16
Chest Acceleration Y Primary	P51876	Endevco	7264C-2k	2022-11-16
Chest Acceleration Z Primary	P58711	Endevco	7264C-2k	2022-11-16
Chest Acceleration X Redundant	P52049	Endevco	7264C-2k	2022-11-16
Chest Acceleration Y Redundant	P51862	Endevco	7264C-2k	2022-11-16
Chest Acceleration Z Redundant	P52048	Endevco	7264C-2k	2022-11-16
Chest Deflection	0724 (HF)	Servo	14CBI-3615	2022-11-21
Pelvis Acceleration X	P52090	Endevco	7264C-2k	2022-11-28
Pelvis Acceleration Y	P58849	Endevco	7264C-2k	2022-11-28
Pelvis Acceleration Z	P58756	Endevco	7264C-2k	2022-11-28
Left Femur Force Z	132 (pri)	R.A. Denton	3821JTF	2023-02-15
Right Femur Force Z	112 (pri)	R.A. Denton	3821JTF	2023-02-15
Left Femur Force Z Redundant	132 (red)	R.A. Denton	3821JTF	2023-02-15
Right Femur Force Z Redundant	112 (red)	R.A. Denton	3821JTF	2023-02-15
Left Upper Tibia Moment X	474 Mx	R.A. Denton	3643	2023-02-16
Left Upper Tibia Moment Y	474 My	R.A. Denton	3643	2023-02-16
Left Upper Tibia Force Z	474 Fz	R.A. Denton	3643	2023-02-16
Left Lower Tibia Moment X	493 Mx	R.A. Denton	3644	2022-04-29
Left Lower Tibia Moment Y	493 My	R.A. Denton	3644	2022-04-29
Left Lower Tibia Force Z	493 Fz	R.A. Denton	3644	2022-04-29
Right Upper Tibia Moment X	465 Mx	R.A. Denton	3643	2022-05-02
Right Upper Tibia Moment Y	465 My	R.A. Denton	3643	2022-05-02
Right Upper Tibia Force Z	465 Fz	R.A. Denton	3643	2022-05-02
Right Lower Tibia Moment X	406 Mx	R.A. Denton	3644	2022-09-12
Right Lower Tibia Moment Y	406 My	R.A. Denton	3644	2022-09-12
Right Lower Tibia Force Z	406 Fz	R.A. Denton	3644	2022-09-12
Left Ankle Acceleration X	P52057	Endevco	7264C-2k	2022-11-28
Left Ankle Acceleration Z	03E18-F07	Entran	EGEB6Q-2k	2022-11-28
Left Toe Acceleration Z	P49224	Endevco	7264C-2k	2022-11-28
Right Ankle Acceleration X	P52019	Endevco	7264C-2k	2022-11-28
Right Ankle Acceleration Z	P58755	Endevco	7264C-2k	2022-11-28
Right Toe Acceleration Z	P52076	Endevco	7264C-2k	2022-11-28
Seat Belt Outside Lap Force	251	FTSS	IF-964	2023-04-04
Seat Belt Upper Diagonal Force	263	FTSS	IF-964	2023-04-04

Table 3 - Vehicle Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Left Rear Primary Ax	M11170	Endevco	758H-2k	2022-11-05
Right Rear Primary Ax	M11090	Endevco	758H-2k	2022-12-10
Engine Top Ax	A331790	MSI	52F-2k	2023-03-14
Engine Bottom Ax	M11159	Endevco	758H-2k	2023-03-15
Left Rear Az	M11287	Endevco	758H-2k	2022-11-04
Right Rear Az	M11076	Endevco	758H-2k	2022-12-01
Left Rear Redundant Ax	M11143	Endevco	758H-2k	2023-04-13
Right Rear Redundant Ax	M11132	Endevco	758H-2k	2022-12-13