

REPORT NUMBER: NCAP-KAR-20-017

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

**HYUNDAI MOTOR COMPANY
2020 HYUNDAI PALISADE AWD 5-DOOR MPV**

NHTSA NUMBER: M20204203

**PREPARED BY:
APPLUS IDIADA KARCO ENGINEERING, LLC.
9270 HOLLY ROAD
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MARCH 6, 2020

FINAL REPORT

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

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NHTSA, Office of Crashworthiness Standards

Date: _____

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Date: _____

TECHNICAL REPORT DOCUMENTATION PAGE

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16. Abstract A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2020 Hyundai Palisade AWD 5-door MPV in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and footwell intrusion performance. The test was conducted at the Applus IDIADA KARCO Engineering, LLC. facility in Adelanto, California on February 21, 2020. The impact velocity of the vehicle was 56.37 km/h and the ambient temperature at the barrier face at the time of impact was 18.9°C. The target vehicle's post-test maximum crush was 503 mm at DPD3 left of the vehicle's centerline. The test vehicle's performance is as follows:																																																							
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

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

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

SUMMARY

A load cell barrier consisting of 176 load cells was impacted by a 2020 Hyundai Palisade AWD 5-door MPV at a velocity of 56.37 km/h. The test was performed at Applus IDIADA KARCO Engineering, LLC. on February 21, 2020. Pre- and post-test photographs of the vehicle and dummies can be found in Appendix A of this report.

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

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

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

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

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

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

The maximum static crush was 503 mm at DPD3 left of the vehicle's centerline and both the driver and passenger side doors remained closed during the impact event and were operable after the impact. The Engine Top Acceleration X channel failed at 32.5 milliseconds.

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

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

The occupant data is summarized below:

ATD Position	HIC ₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50th Male)	159.9	0.19	714.8	-186.3	38	-19	-417.7	-672.4
Passenger (5th Female)	332.5	0.35	589.1	-190.6	43	-12	-1561.0	-1359.2

GENERAL COMMENTS

Three channels of the load cell barrier either failed or yielded questionable results. Details regarding these data anomalies are listed below:

- LC1103, Barrier M_z – Channel failure, no data
- LC0803, Barrier F_x – Channel failure, no data
- LC1113, Barrier F_x – Questionable data

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

CONVERSION FACTORS

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

DATA SHEET NO. 1

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20204203
Model Year	2020
Make	Hyundai
Model	Palisade AWD
Body Style	5-Door MPV
VIN	KM8R1DHE8LU070849
Body Color	Steel Graphite
Odometer Reading (km / mi)	24 / 15
Engine Displacement (L)	3.8
Type / No. of Cylinders	V6
Engine Placement	Transverse
Transmission Type	Automatic
Transmission Speeds	8
Overdrive	Yes
Final Drive	AWD
Roof Rack	No
Sunroof / T-Top	No
Running Boards	No
Tilt Steering Wheel	Yes
Power Seats	No
Anti-Lock Brakes (ABS)	Yes
Automatic Door Locks (ADLs)	Yes

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

Does Owner's Manual provide instructions to turn off automatic door locks? No

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company
Date of Manufacture	Sep-19

GVWR (kg)	2663
GAWR Front (kg)	1340
GAWR Rear (kg)	1450

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

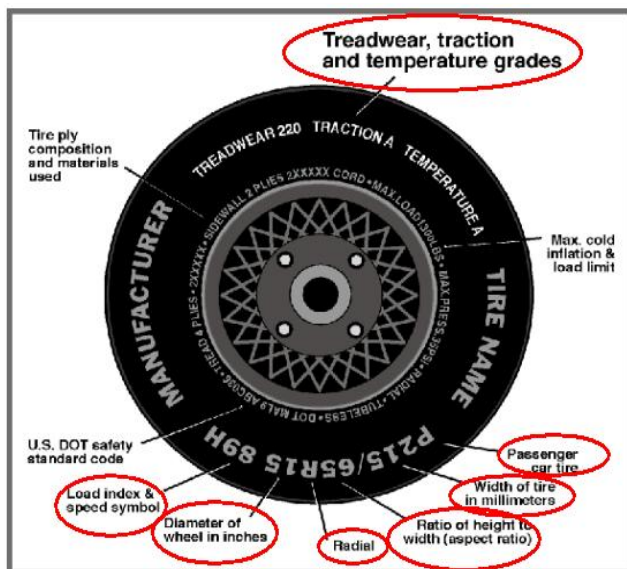
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	Bench	
Designated Seating Capacity	2	3	3	8
Capacity Weight (VCW) (kg)				600.0
DSC x 68.04 (kg)				544.3
Cargo Weight (RCLW) (kg)				55.7

A
B
A-B

DATA SHEET NO. 1 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	275	275
Cold Pressure (kPa)	240	240
Recommended Tire Size	245/60 R18	245/60 R18
Tire Size on Vehicle	245/60 R18	245/60 R18
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Dueler H/P	Dueler H/P
Treadwear	400	400
Traction	A	A
Temperature Grades	B	B
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index / Speed Symbol	105H	105H
Tire Material	Polyester, Steel, Nylon	Polyester, Steel, Nylon
DOT Safety Code Left	EJL2 CEC 2019	EJL2 CEC 2019
DOT Safety Code Right	EJL2 CEC 2019	EJL2 CEC 2019

DATA SHEET NO. 1 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

TEST VEHICLE WEIGHTS

	Units	As Delivered Weights (UWW)			As Tested Weights (ATW)		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	552.5	416.0		590.0	477.5	
Right	kg	549.5	408.5		566.5	481.0	
Ratio	%	57.2%	42.8%	100.0%	54.7%	45.3%	100.0%
Total	kg	1102.0	824.5	1926.5	1156.5	958.5	2115.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UWW)	kg	1926.5	A
Weight of 1 P572E ATD & 1 P572O ATD	kg	141.0	B
Rated Cargo/Luggage Weight (RCLW)	kg	55.7	C
Calculated Vehicle Target Weight (TVTW)	kg	2123.2	A+B+C

TEST VEHICLE ATTITUDES

Condition	Units	LF	RF	LR	RR	CG Aft of Front Axle
As Delivered	mm	876	879	898	902	1241
As Tested	mm	863	865	885	887	1314
Post-Test	mm	858	870	882	849	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheelbase	mm	2900
Total Vehicle Length at Left Side	mm	4240
Total Vehicle Length at Centerline	mm	4970
Total Vehicle Length at Right Side	mm	4240
Weight of Ballast in Cargo Area	kg	90.5
Weight of Vehicle Components Removed	kg	43.0
Amount of Stoddard Solvent in Fuel Tank	L	66.01

VEHICLE COMPONENTS REMOVED TO MEET TEST WEIGHT:

Trunk Trim (2.0 kg), Tools (5.0 kg), and 3rd Row Seat (36.0 kg)

DATA SHEET NO. 1 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

TARGET VEHICLE STRUCTURAL MEASUREMENTS

No.	Description	Pre-Test
1	Total Length	4970
2	Total Width	1965
3	Bumper Top Height	865
4	Bumper Bottom Height	543
5	Longitudinal Member Top Height	600
6	Distance Between Longitudinal Members	930
7	Longitudinal Member Width	50
8	Engine Top Height	950
9	Engine Bottom Height	148
10	Engine and Gearbox Width	600
11	Front Bumper to Engine Distance	560
12	Front Shock Absorber Fixing Height	995
13	Bonnet Leading Edge Height	1030
14	Front Shock Absorber Fixing Width	1280
15	Front Bumper to Front Axle Distance	930
16	Front Axle to A-Pillar Distance	535
17	A-Pillar to B-Pillar Distance	970
18	B-Pillar to Rear Axle Distance	1325
19	B-Pillar to C-Pillar Distance	994
20	Roof Sill Bottom Height	1597
21	Roof Sill Top Height	1735
22	Floor Sill Bottom Height	335
23	Floor Sill Top Height	445

All measurements in millimeters.

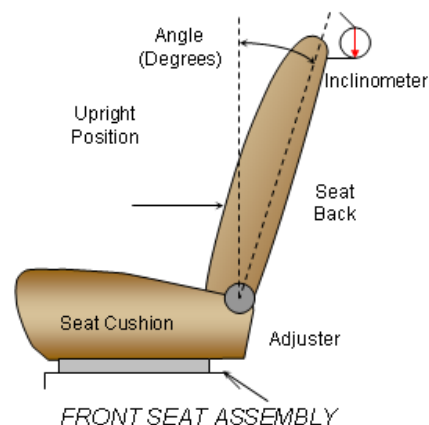
DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

NOMINAL DESIGN RIDING POSITION

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

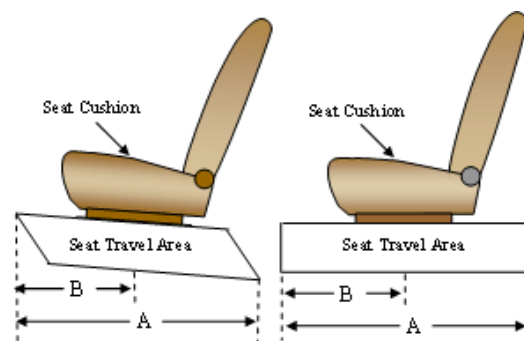


SEAT BACK ANGLE

Seating Position	Degrees
Driver Seat Back Angle	1.0
Passenger Seat Back Angle	0.1

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	290 mm	145 mm
Passenger Seat	240 mm	0 mm

SEAT BELT UPPER ANCHORAGE

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

SEAT BELT UPPER ANCHORAGES

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

DATA SHEET NO. 2 ... (CONTINUED)

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

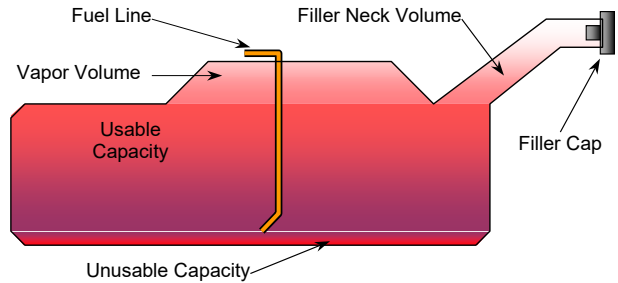
Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

FUEL TANK CAPACITY

Description	Liters
Usable Capacity of "Standard Tank"	71.01
Usable Capacity of "Optional Tank"	
92 - 94% of Usable Capacity	65.33 to 66.75
Actual Amount of Stoddard Solvent Used	66.01
1/3 of Usable Capacity	23.67

FUEL PUMP

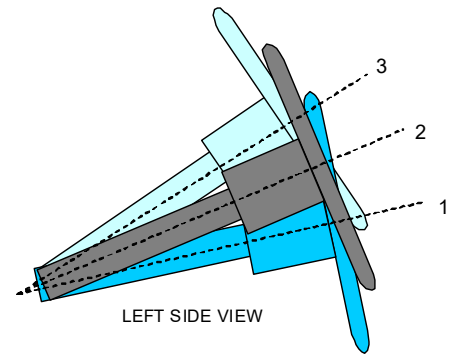
The vehicle is equipped with an electronic fuel pump. The fuel pump normally operates when the vehicle's electrical system is activated. The fuel pump operates when the engine is running.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

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



STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONING

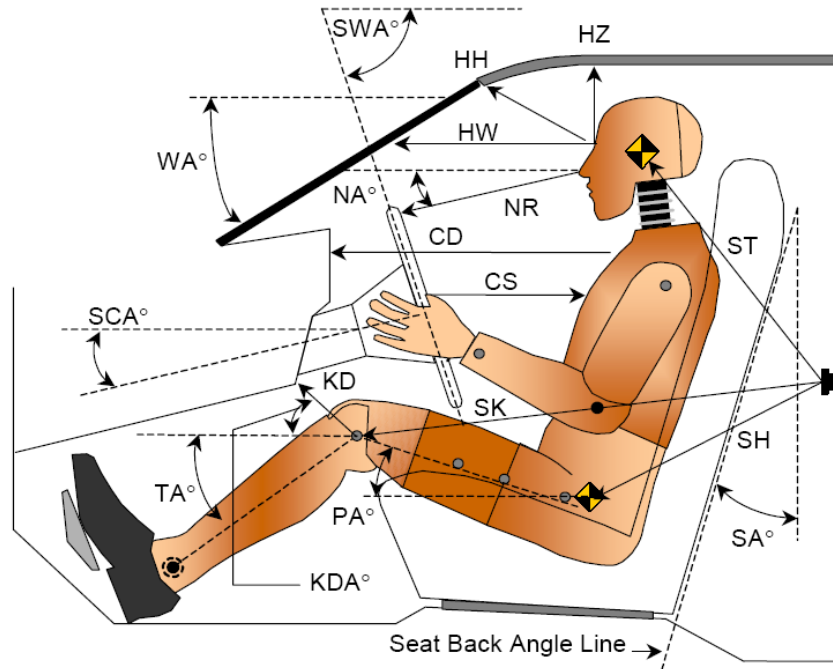
	Degrees	Fore-Aft Position (mm)
Lowermost Position, No. 1	24.2	107
Geometric Center Position, No. 2	26.9	131
Uppermost Position, No. 3	29.6	155
Telescoping Steering Wheel Travel		48
Test Position	26.9	131

DATA SHEET NO. 3

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



LEFT SIDE VIEW

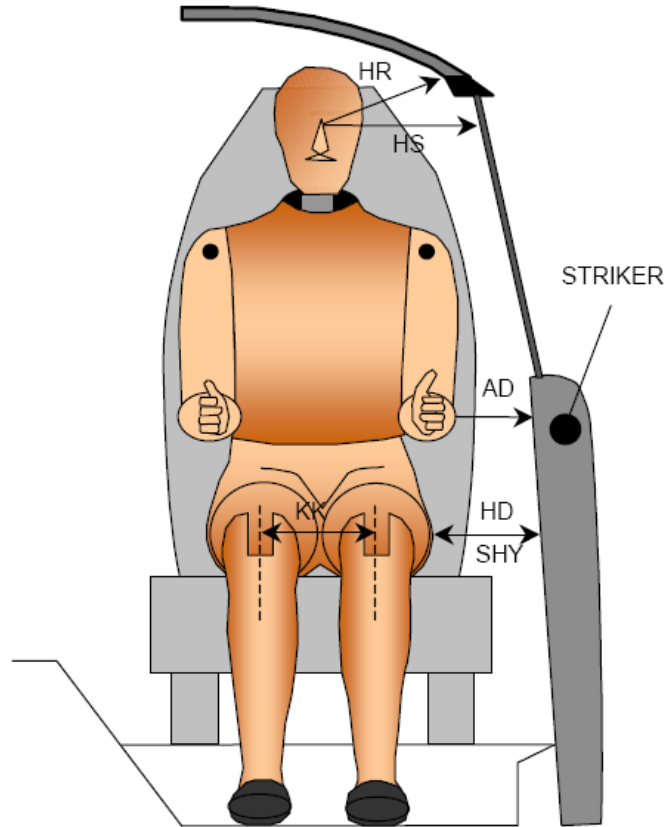
Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		28.7		
SWA°	Steering Wheel Angle		63.4		
SCA°	Steering Column Angle		23.7		
SA°	Seat Back Angle (On Headrest Post)		1.0		0.1
HZ	Head to Roof	210	90.0	235	90.0
HH	Head to Header	362	26.1	337	41.0
HW	Head to Windshield	662	0.0	624	0.0
NR	Nose to Rim	374	6.8	478	12.2
CD	Chest to Dash	535	13.5	397	7.6
CS	Chest to Steering Hub	289	0.0		
RA	Rim to Abdomen	182	0.0		
KDL	Left Knee to Dash	158	27.4	96	31.9
KDR	Right Knee to Dash	151	32.4	111	30.0
PA°	Pelvic Angle		23.2		19.0
TA°	Tibia Angle		51.4		54.3
SK	Striker to Knee	605	8.7	687	12.3
ST	Striker to Head	435	74.5	406	62.1
SH	Striker to H-Point	316	46.2	401	31.6

DATA SHEET NO. 4

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

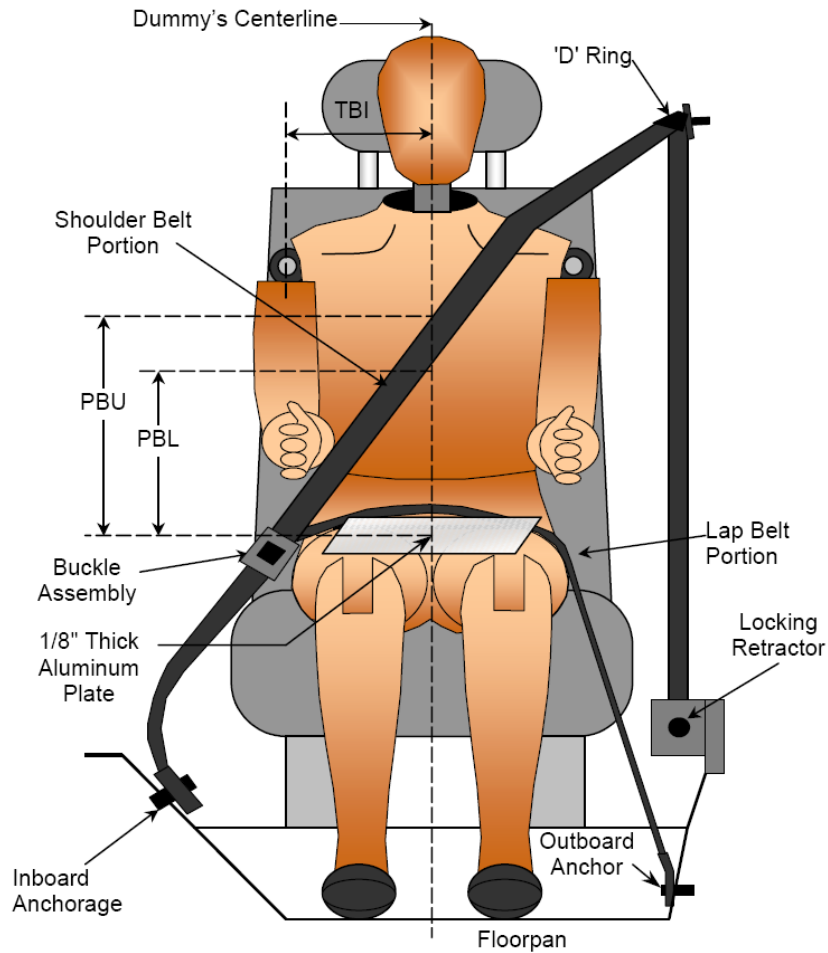
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



Code	Description	Driver (mm)	Passenger (mm)
AD	Arm to Door	144	88
HD	H-Point to Door	162	180
HR	Head to Side Header	247	279
HS	Head to Side Window	390	406
KK	Knee to Knee	270	165
SHY	Striker to H-Point (Y-Direction)	273	303
AA	Ankle to Ankle	330	170

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



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	325	275
PBL	Top Surface of Aluminum Plate to Belt Lower Edge	mm	230	170

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as Measured on ATD	mm	880	959
Lap Belt Length as Measured on ATD	mm	781	838
Remainder of Belt on Reel	mm	895	747
Total Belt Length for Continuous Webbing Systems	mm	2556	2544

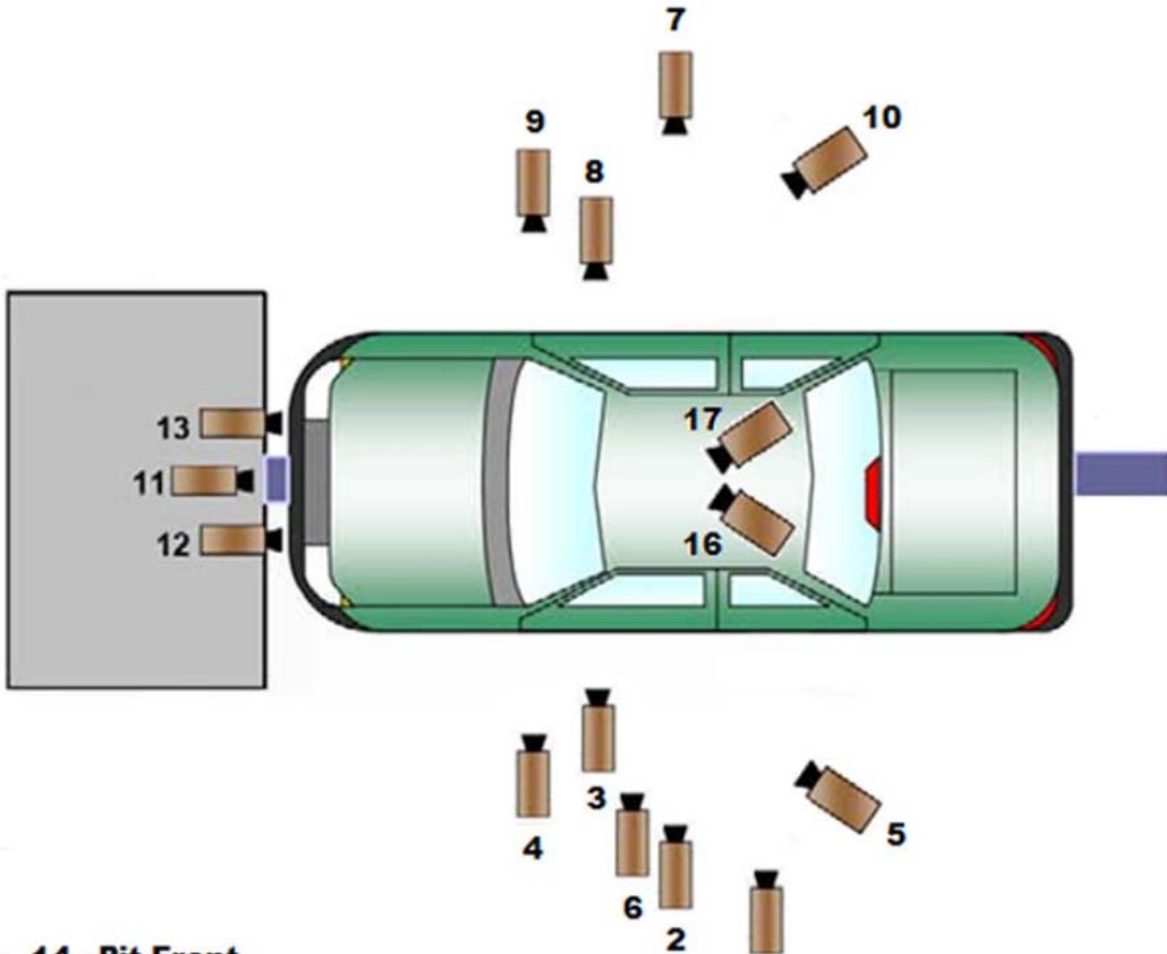
DATA SHEET NO. 6

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

CAMERA POSITIONS FOR FRONTAL IMPACTS



14 - Pit Front

15 - Pit Rear

16 & 17 - Driver and Passenger Onboard

1- Real Time Camera

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

DATA SHEET NO. 6 ... (CONTINUED)

HIGH-SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

CAMERA LOCATIONS

No.	Description	Location (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall	-11412	-8150	-1484		30
2	Left Overall	-2456	-7975	-1025	20	1000
3	Driver Close-Up	-2590	-7950	-1371	50	1000
4	Left Front Half	-1701	-6197	-1701	35	1000
5	Left Angle	-6696	-10308	-3211	105	1000
6	Steering Column	-1966	-10412	-3688	35	1000
7	Right Overall	-2336	7569	-1012	20	1000
8	Passenger Close-Up	-1733	7581	-1408	50	1000
9	Right Front Half	-1600	8214	-1811	35	1000
10	Right Angle	-6217	9516	-4830	85	1000
11	Windshield	-354	0	-5749	28	1000
12	Driver Windshield	297	-366	-2460	24	1000
13	Passenger Windshield	297	366	-2460	24	1000
14	Pit Front	-756	0	1495	20	1000
15	Pit Rear	-3398	0	1495	20	1000
16	Driver Onboard	-1640	-350	-1640	8	1000
17	Passenger Onboard	-1640	350	-1640	8	1000

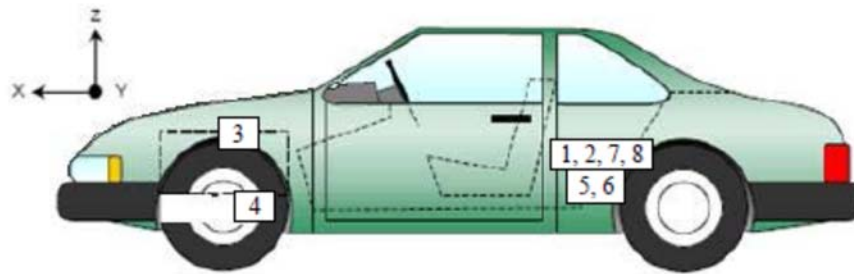
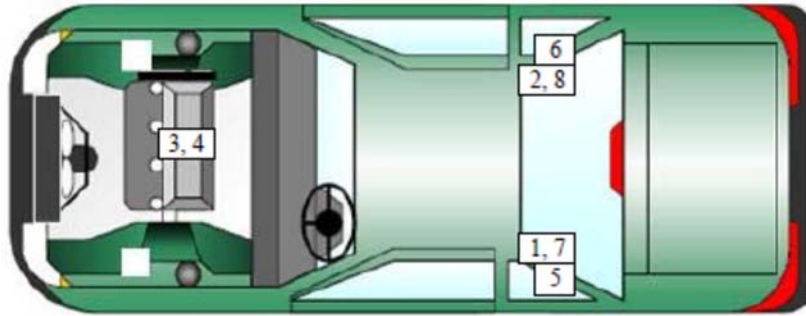
Coordinates: +X = forward impact plane
 +Y = right of monorail center
 +Z = into ground

DATA SHEET NO. 7

VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Description	Location		
		X	Y	Z
1	Left Rear Accelerometer X-Direction	2070	-835	-455
2	Right Rear Accelerometer X-Direction	2070	835	-460
3	Engine Top X	4240	375	-820
4	Engine Bottom X	3980	130	-560
5	Left Rear Accelerometer Z-Direction	2070	-835	-455
6	Right Rear Accelerometer Z-Direction	2070	835	-460
7	Left Rear Accelerometer X-Direction Redundant	2070	-835	-455
8	Right Rear Accelerometer X-Direction Redundant	2070	835	-460

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

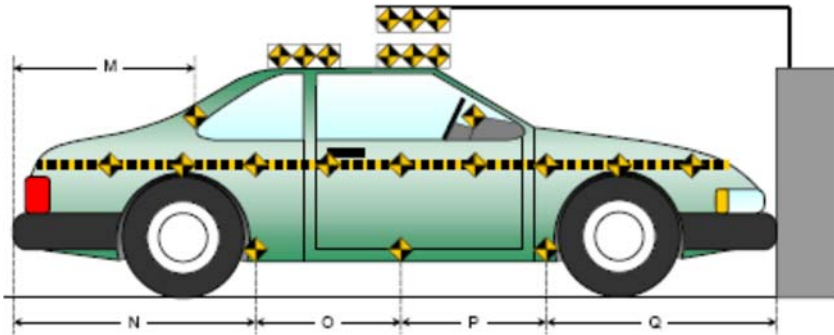
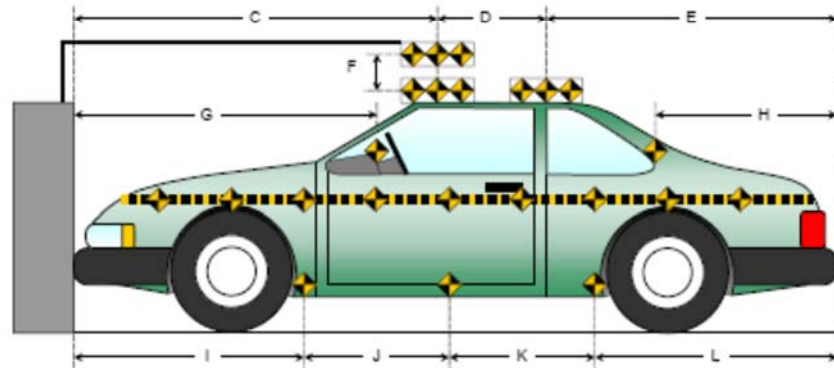
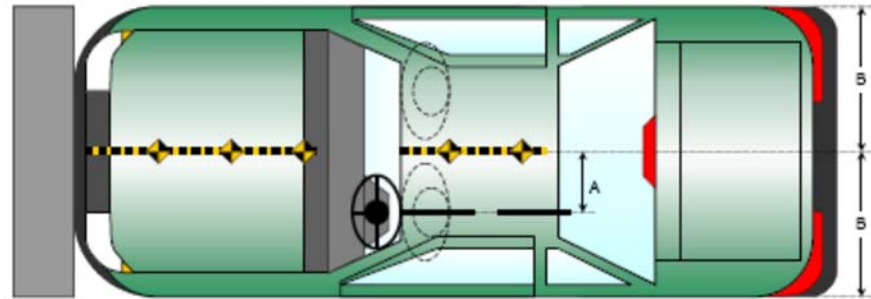
DATA SHEET NO. 8

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

Item	Value
A	425
B	983
C	2230
D	610
E	2135
F	305
G	1770
H	470
I	1437
J	959
K	955
L	1635
M	470
N	1635
O	955
P	955
Q	1437



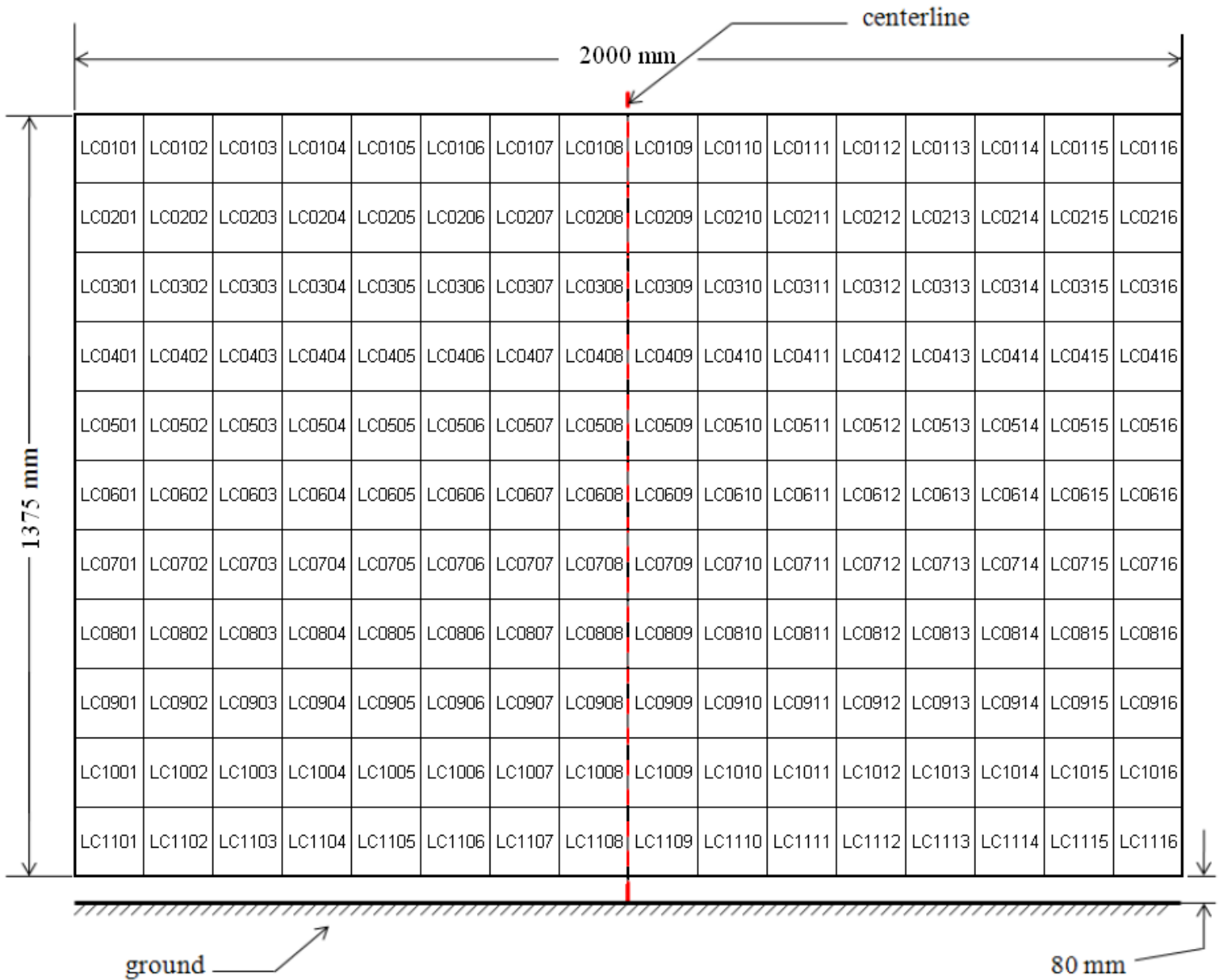
All measurements in millimeters.

DATA SHEET NO. 9

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



DATA SHEET NO. 10

TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

INSTRUMENTATION

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

CAMERA COVERAGE

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

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

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

DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION

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

OTHER VEHICLE POST-TEST OBSERVATIONS

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

VEHICLE REBOUND FROM BARRIER

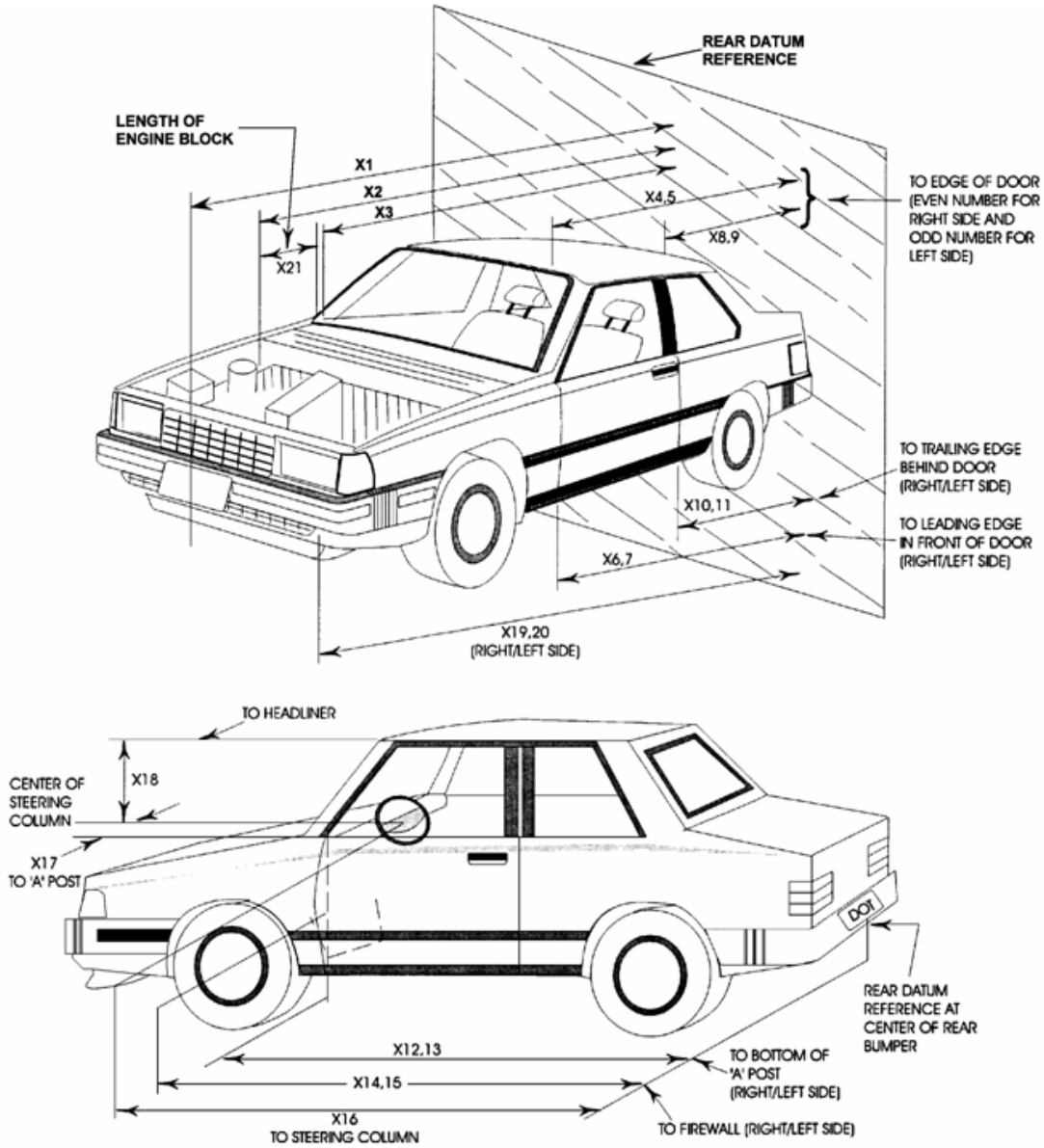
Measured Parameter	Units	Value
Left Side	mm	2360
Center	mm	2270
Right Side	mm	2230
Average	mm	2287

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



DATA SHEET NO. 12 ... (CONTINUED)**VEHICLE PROFILE MEASUREMENTS**Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

No.	Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4970	4475	-495
2	Rear Surface of Vehicle to Front of Engine	4410	4270	-140
3	RSOV to Firewall	3953	3945	-8
4	RSOV to Upper Leading Edge of Right Door	3500	3499	-1
5	RSOV to Upper Leading Edge of Left Door	3500	3493	-7
6	RSOV to Lower Leading Edge of Right Door	3475	3478	3
7	RSOV to Lower Leading Edge of Left Door	3475	3482	7
8	RSOV to Upper Trailing Edge of Right Door	2410	2410	0
9	RSOV to Upper Trailing Edge of Left Door	2410	2413	3
10	RSOV to Lower Trailing Edge of Right Door	2442	2443	1
11	RSOV to Lower Trailing Edge of Left Door	2442	2443	1
12	RSOV to Bottom of A-Pillar, Right Side	3485	3460	-25
13	RSOV to Bottom of A-Pillar, Left Side	3485	3470	-15
14	RSOV to Firewall, Right Side	3890	3874	-16
15	RSOV to Firewall, Left Side	3890	3875	-15
16	RSOV to Steering Column	3200	3250	50
17	Center of Steering Column to A-Pillar	430	430	0
18	Center of Steering Column to Headliner	530	420	-110
19	RSOV to Right Side of Front Bumper	4240	4210	-30
20	RSOV to Left Side of Front Bumper	4240	4147	-93
21	Length of Engine Block	560	560	0
RD	RSOV to Right Side of Dash Panel	3235	3240	5
CD	RSOV to Center of Dash Panel	3225	3220	-5
LD	RSOV to Left Side of Dash Panel	3235	3240	5

All measurements in millimeters.

DATA SHEET NO. 13

ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

VEHICLE INFORMATION

VIN: KM8R1DHE8LU070849
 Vehicle Size Category: MPV

Wheelbase (mm): 2900
 Test Weight (kg): 2115.0

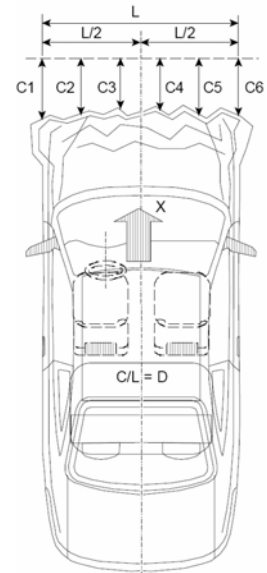
ACCELEROMETER DATA

Accelerometer Locations: Left Rear Crossmember
 Cal. Procedure/Interval: Vibration Test / 6 months
 Integration Algorithm: NHTSA Standard
 Impact Velocity (km/h): 56.37
 Velocity Change (km/h): 65.0
 Time of Separation (msec): 77.5

Linearity: Good

CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
 Midpoint of Damage: Vehicle Centerline
 Damage Region Length (mm): 1397
 Impact Mode: Full Frontal



No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush Zone 1 at Left Side	mm	150	520	370
C2	Crush Zone 2 at Left Side	mm	25	510	485
C3	Crush Zone 3 at Left Side	mm	2	505	503
C4	Crush Zone 4 at Right Side	mm	2	500	498
C5	Crush Zone 5 at Right Side	mm	25	510	485
C6	Crush Zone 6 at Right Side	mm	150	500	350
L	C1 to C6	mm	1397		

DATA SHEET NO. 14

VEHICLE INTRUSION MEASUREMENTS

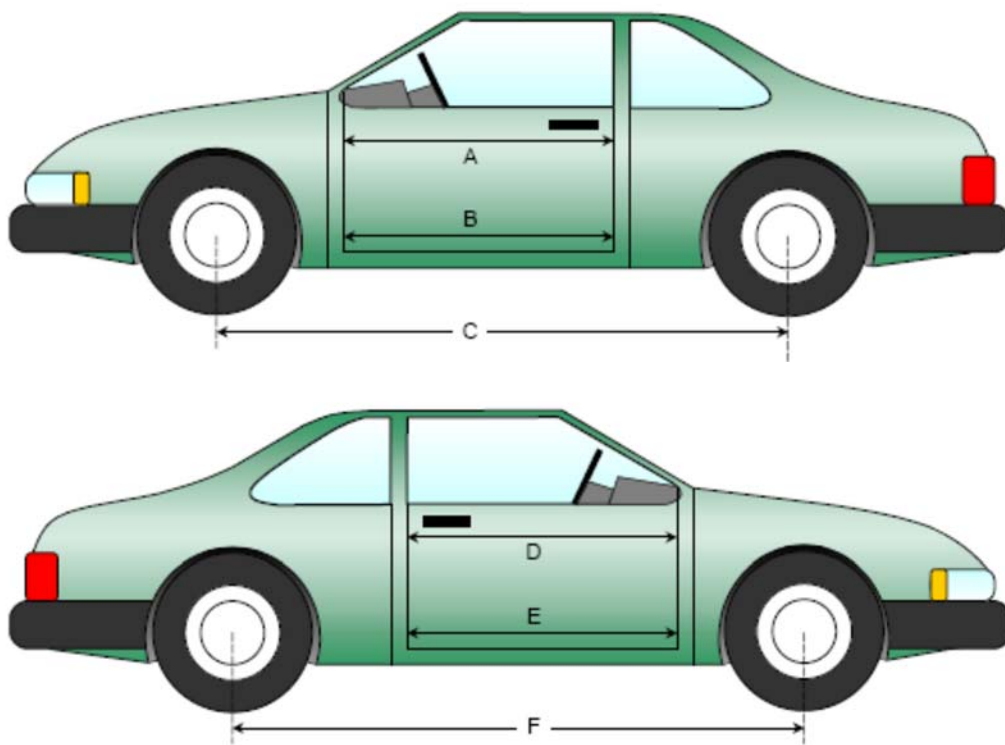
Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	970	968	2
B	Left Side Lower	mm	910	914	-4
D	Right Side Upper	mm	975	975	0
E	Right Side Lower	mm	895	893	2

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2900	2865	35
F	Right Side Wheelbase	mm	2900	2885	15



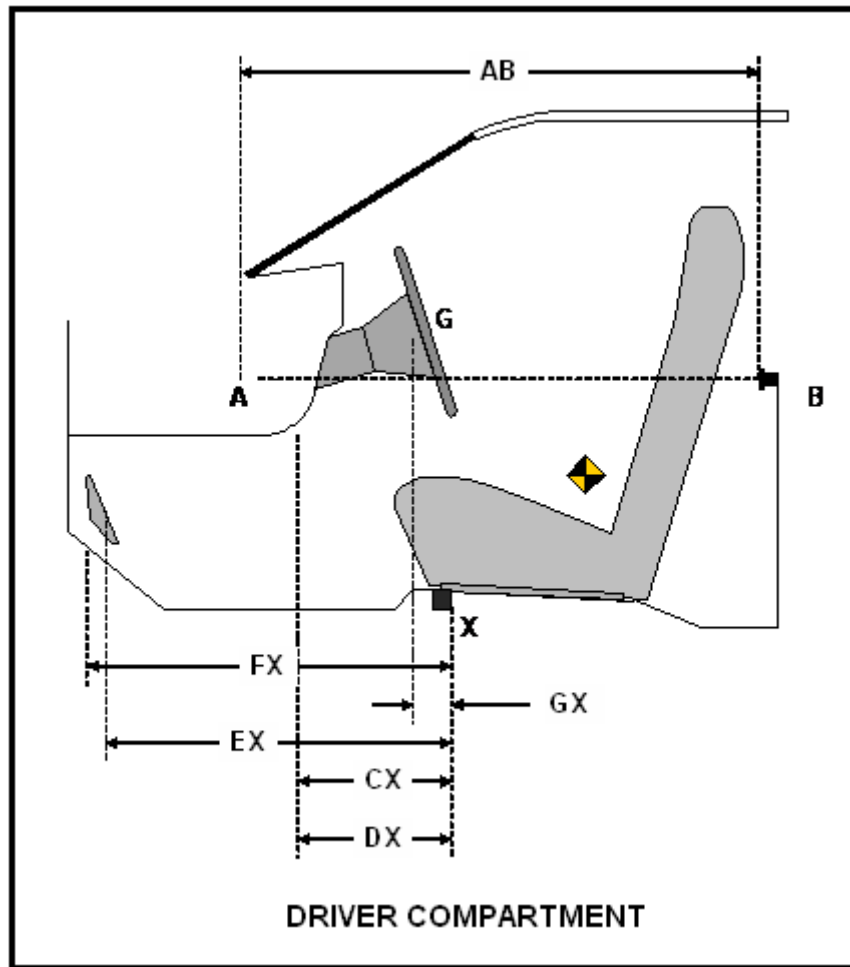
DATA SHEET NO. 14 ... (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203
 Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	873	882	-9
CX	Left Knee Bolster to X	mm	240	300	-60
DX	Right Knee Bolster to X	mm	240	295	-55
EX	Brake Pedal to X	mm	515	475	40
FX	Foot Rest to X	mm	510	510	0
GX	Center of Steering Wheel Hub to X	mm	55	90	-35

X = Front of Seat Track (Stationary)



DATA SHEET NO. 15

SUMMARY OF INDICANT FMVSS 212 AND 219 (PARTIAL) DATA

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

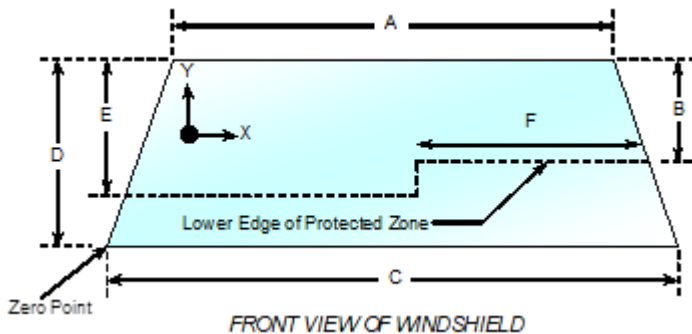
Windshield Mounting Details: Windshield glass is secured to the vehicle frame with rubber molding and rubber cement.

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: 21.3° C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% Retention
Left Side	2322	2322	100.0%
Right Side	2322	2322	100.0%
Total	4644	4644	100.0%



Item	Units	Value
A	mm	1340
B	mm	355
C	mm	1593
D	mm	855
E	mm	436
F	mm	555

AREAS OF PROTECTED ZONE FAILURES

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

X	Y

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

X	Y

DATA SHEET NO. 16

FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER RESULTS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

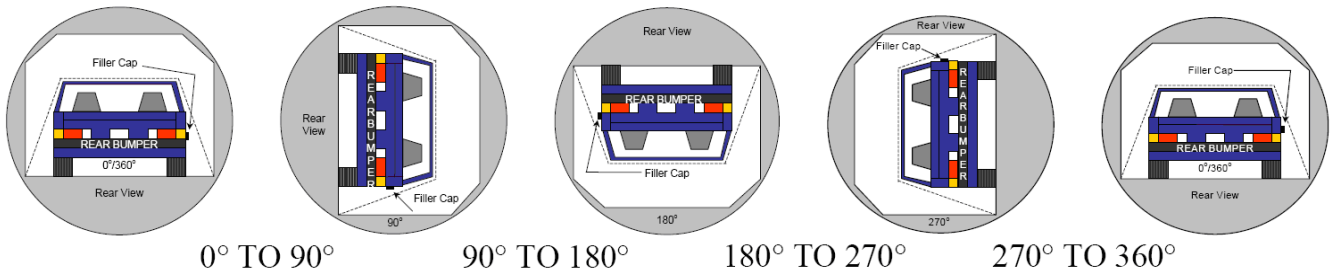
Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 18.9° C Test Time: 4:09 PM

Stoddard Solvent Spillage Measurements

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



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

SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° To 90°	79	300	379
90° To 180°	79	300	379
180° To 270°	82	300	382
270° To 360°	79	300	379

DATA SHEET NO. 16 ... (CONTINUED)

FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER RESULTS

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20

FMVSS 301 SPILLAGE TABLE

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

SOLVENT SPILLAGE LOCATION TABLE

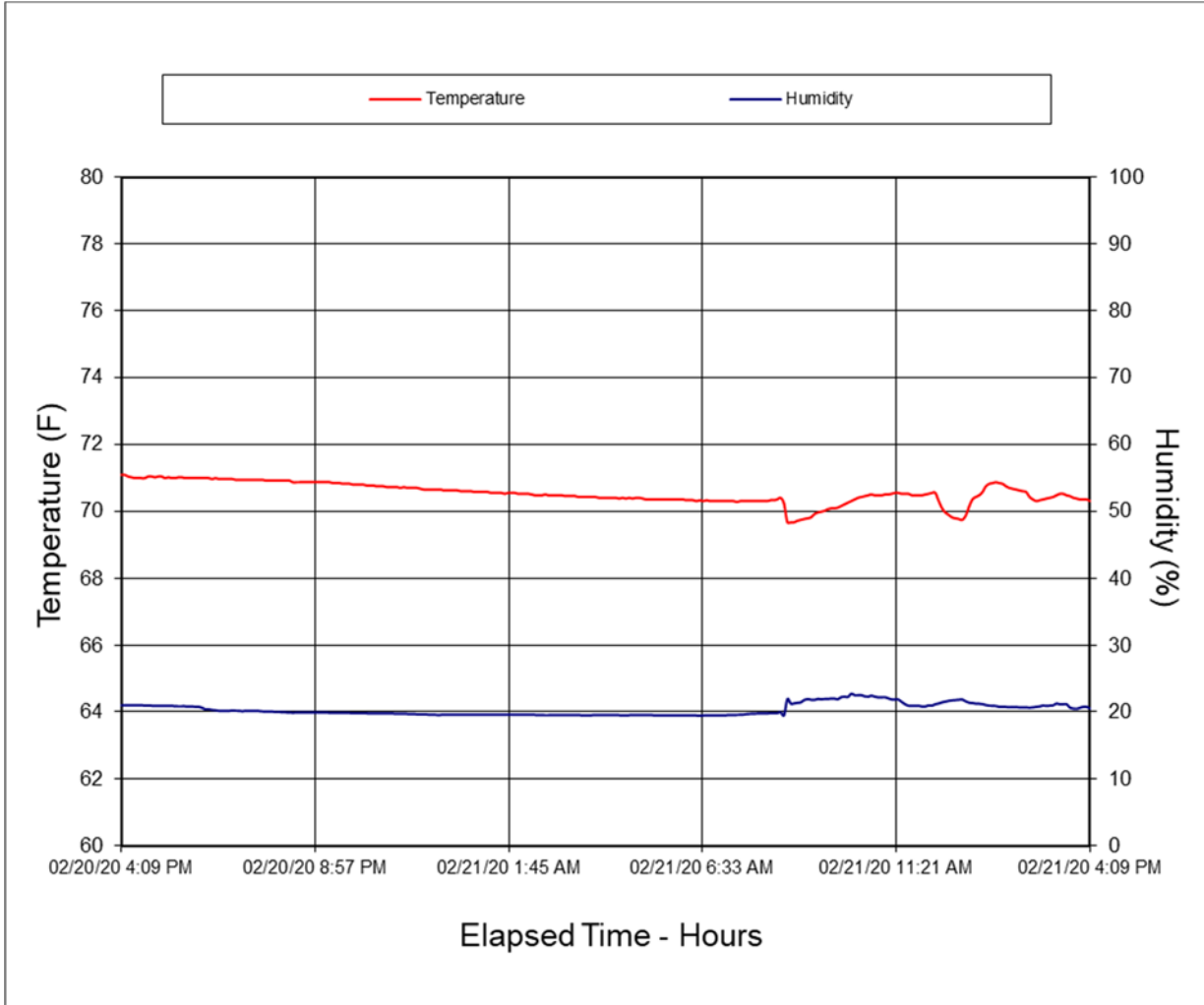
Test Phase	Spillage Location
0° To 90°	
90° To 180°	
180° To 270°	
270° To 360°	

DATA SHEET NO. 17

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV NHTSA No.: M20204203

Test Program: 56.3 km/h Frontal Impact NCAP Test Test Date: 02/21/20



APPENDIX A
PHOTOGRAPHIC DOCUMENTATION

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FIGURE 1. Load Cell Location

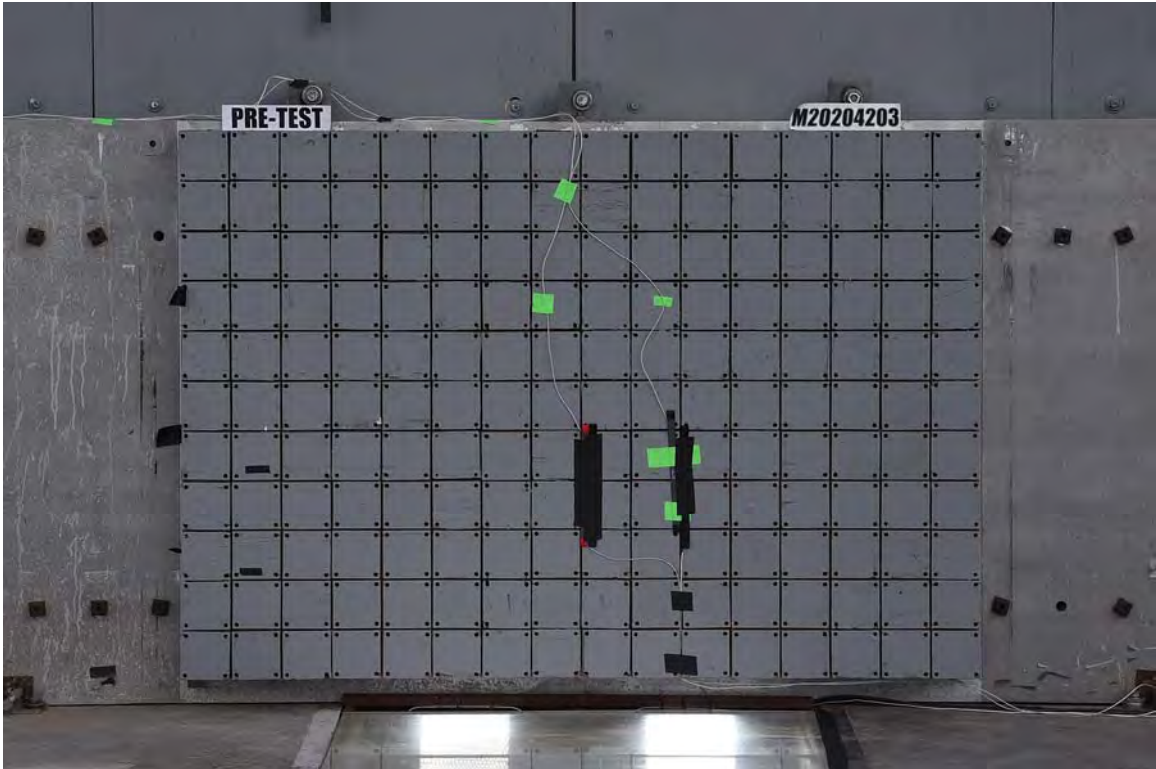


FIGURE 2. Pre-Test Load Cell Wall

Photograph Not Available

FIGURE 3. Post-Test Load Cell Wall



FIGURE 4. Manufacturer's Label



FIGURE 5. Tire Placard



FIGURE 6. 2020 Hyundai Palisade AWD Frontal as Delivered



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



FIGURE 8. Pre-Test Front View of Test Vehicle



FIGURE 9. Post-Test Front View of Test Vehicle



FIGURE 10. Pre-Test Left View of Test Vehicle



FIGURE 11. Post-Test Left View of Test Vehicle



FIGURE 12. Pre-Test Right View of Test Vehicle



FIGURE 13. Post-Test Right View of Test Vehicle



FIGURE 14. Pre-Test Right Front 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

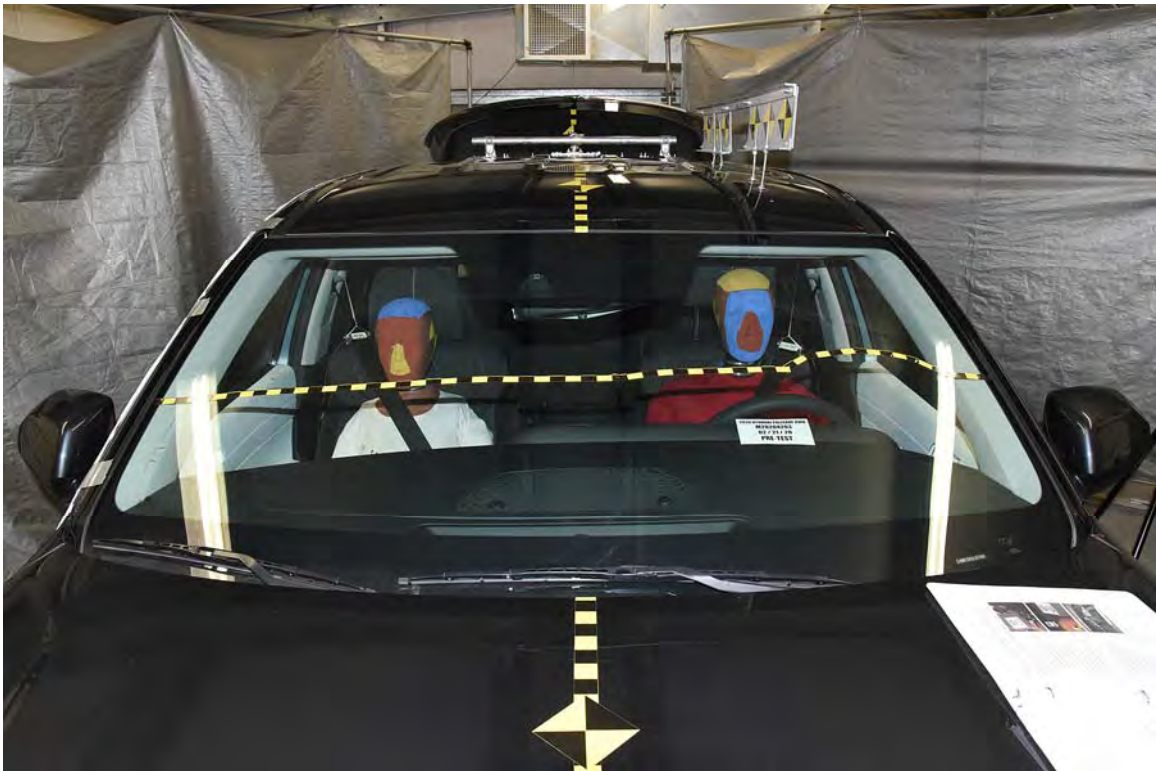


FIGURE 18. Pre-Test Windshield View



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

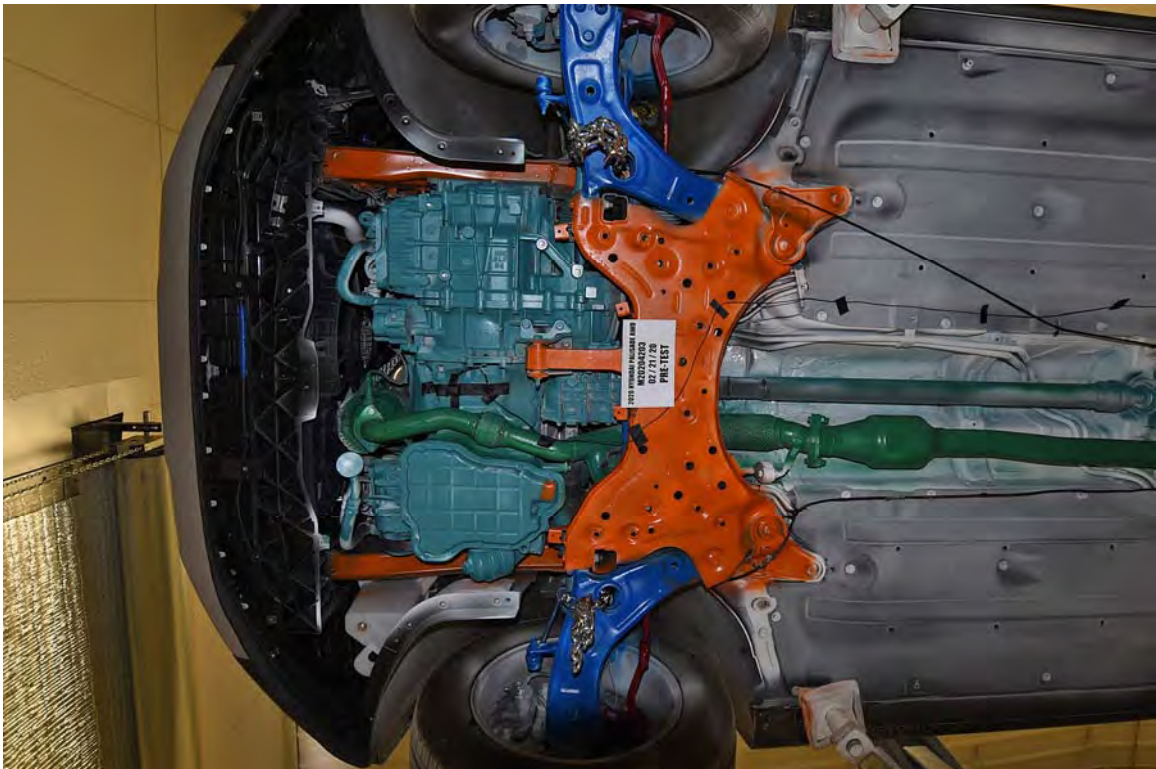


FIGURE 24. Pre-Test Front Underbody View

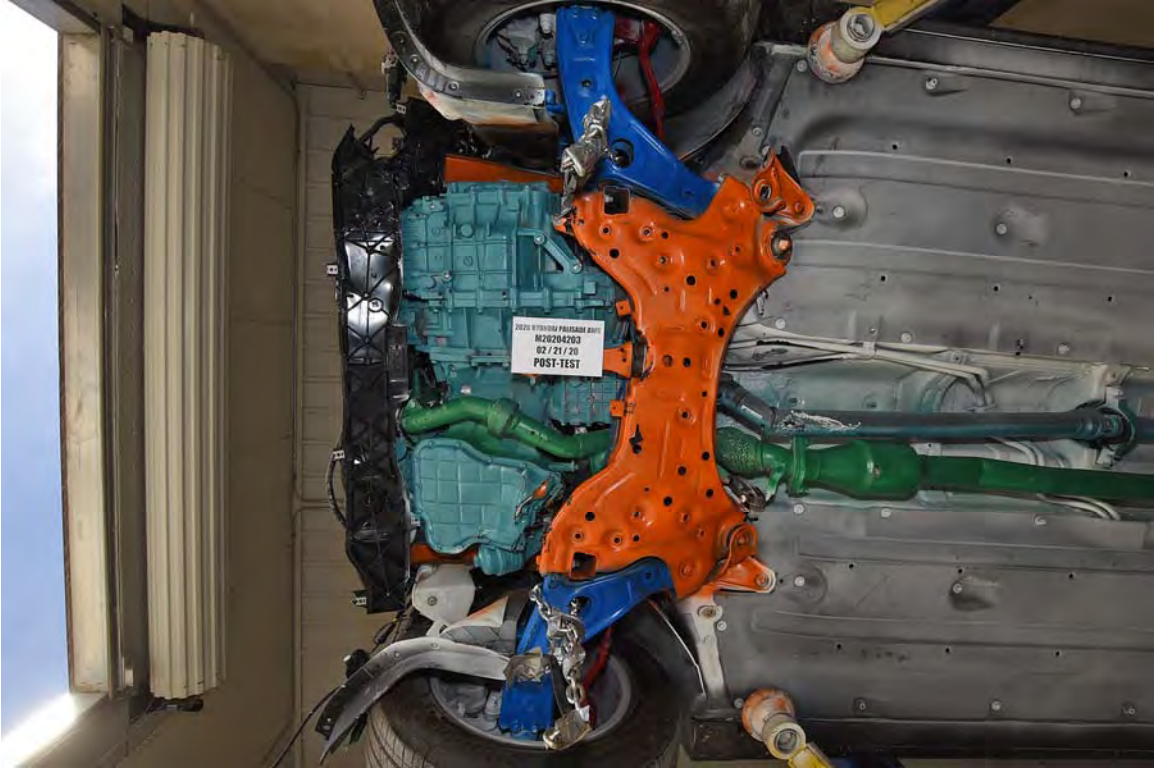


FIGURE 25. Post-Test Front Underbody View

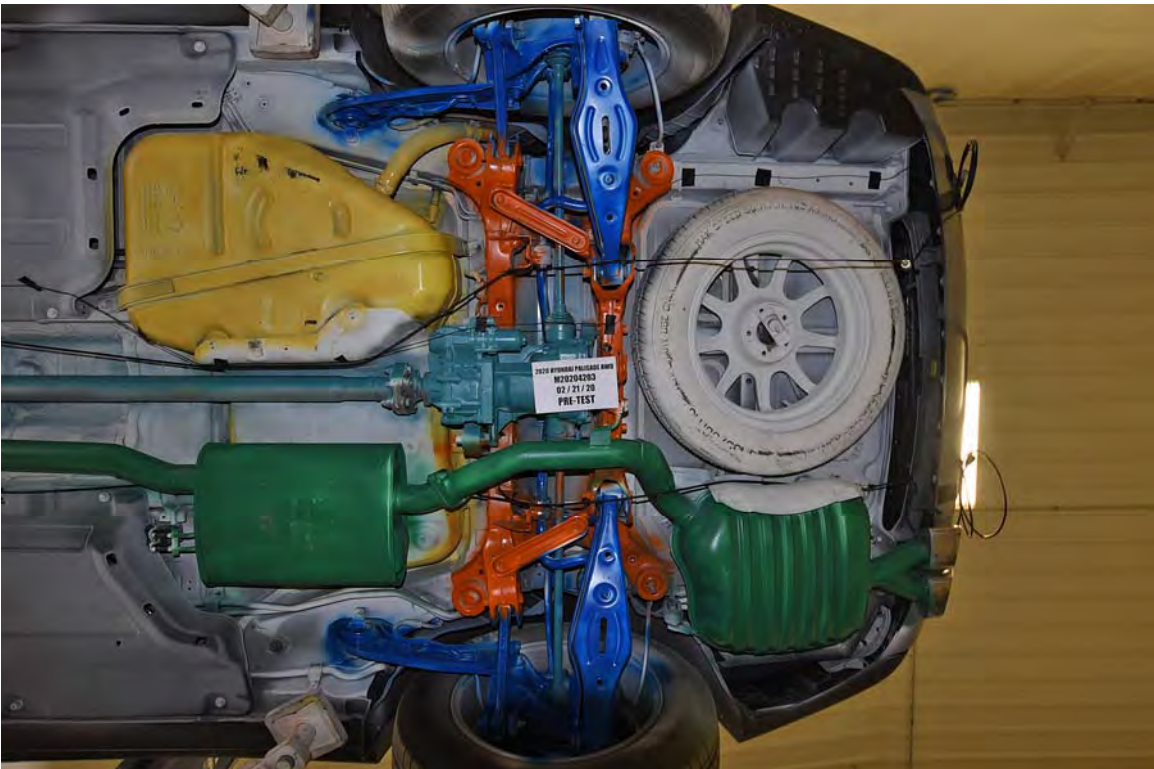


FIGURE 26. Pre-Test Rear Underbody View

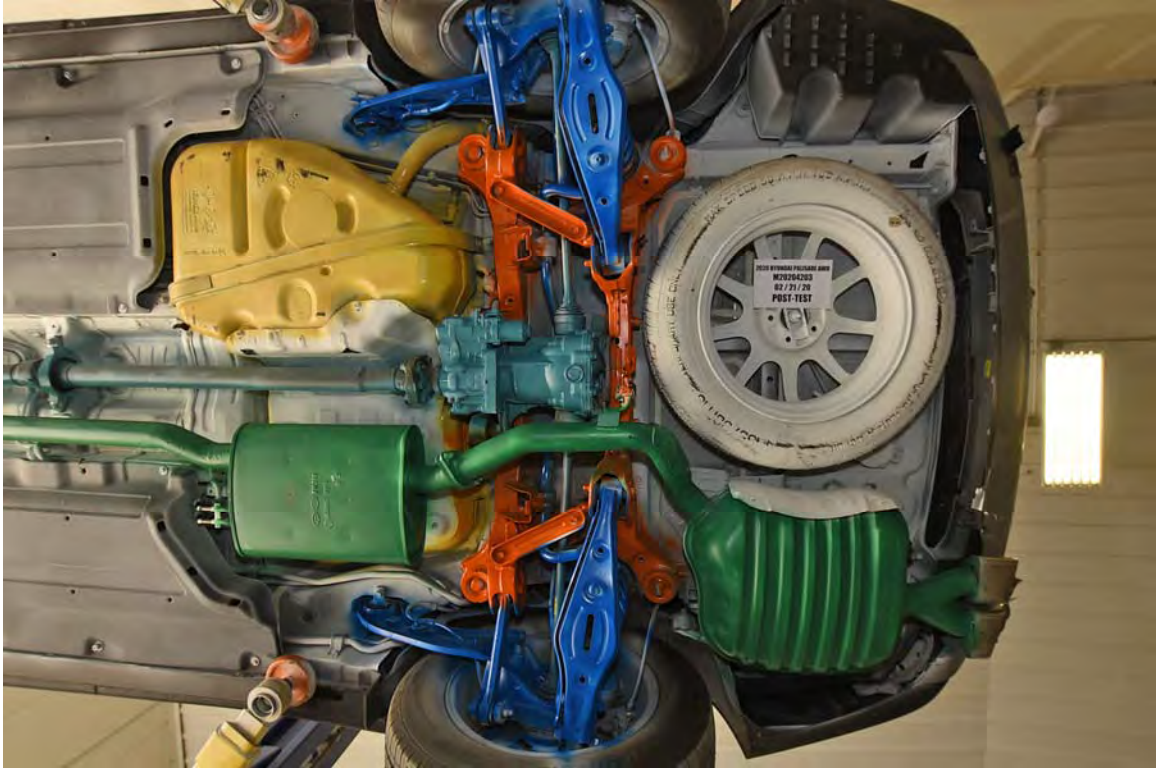


FIGURE 27. Post-Test Rear Underbody View



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

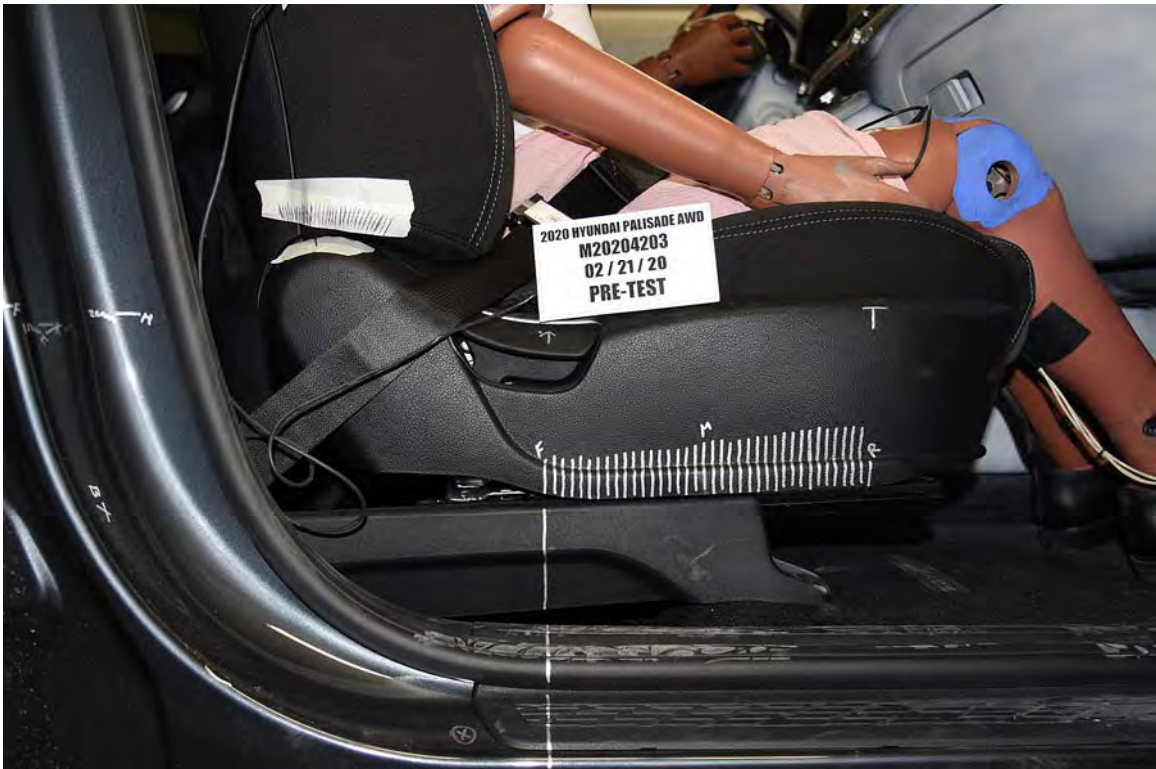


FIGURE 59. Pre-Test Passenger's Seat Fore-Aft Markings



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

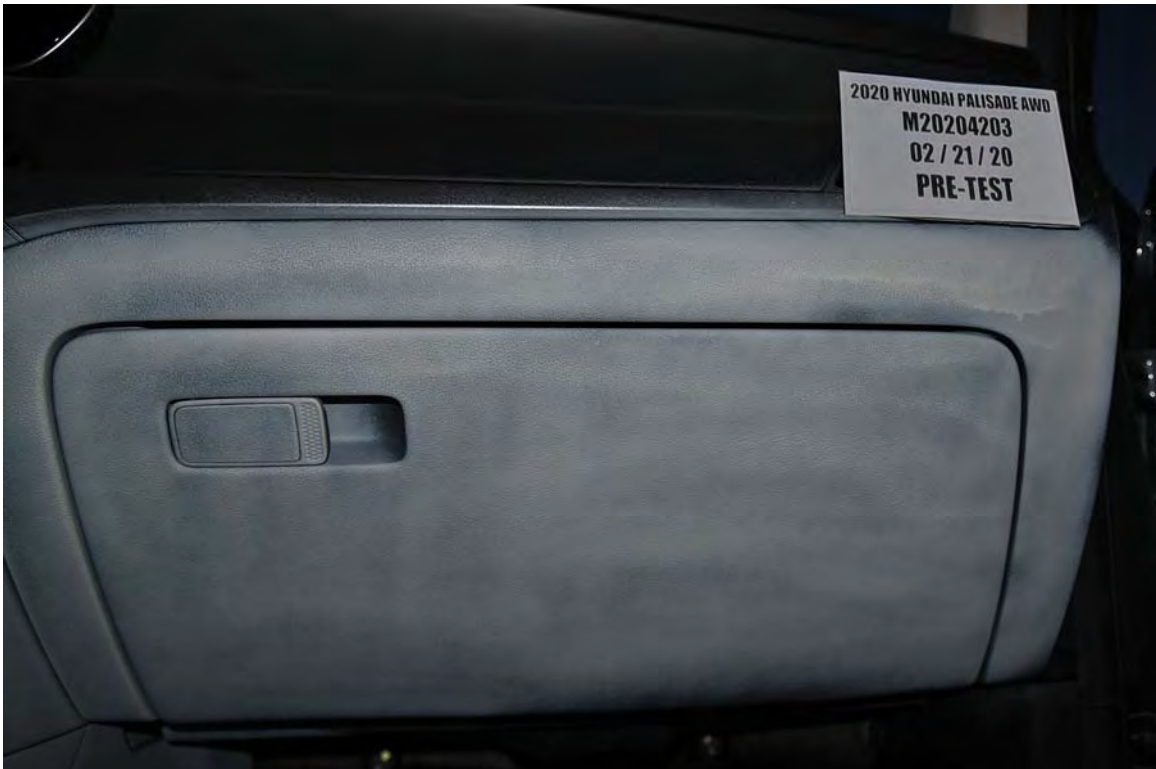


FIGURE 67. Pre-Test Passenger's Side Knee Bolster



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

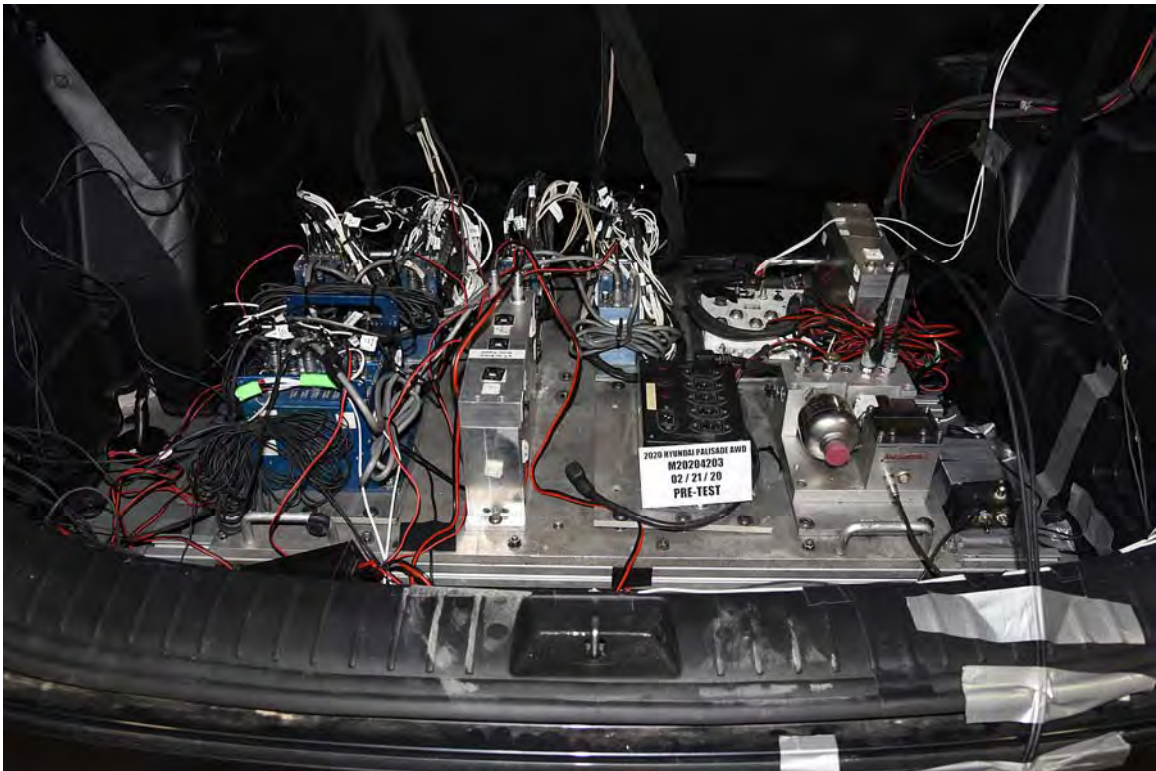


FIGURE 74. Photograph of Ballast Installed in Vehicle

Photograph Not Applicable

No Stoddard Solvent Spillage

FIGURE 75. Post-Test Stoddard Solvent Spillage Location View



FIGURE 76. Post-Test Speed Trap Read-Out



FIGURE 77. Vehicle at 0° on Static Rollover Device



FIGURE 78. Vehicle at 90° on Static Rollover Device



FIGURE 79. Vehicle at 180° on Static Rollover Device



FIGURE 80. Vehicle at 270° on Static Rollover Device



FIGURE 81. Vehicle at 360° on Static Rollover Device



FIGURE 82. 2020 Hyundai Palisade AWD Frontal Impact Event

APPENDIX B
DUMMY RESPONSE DATA TRACES

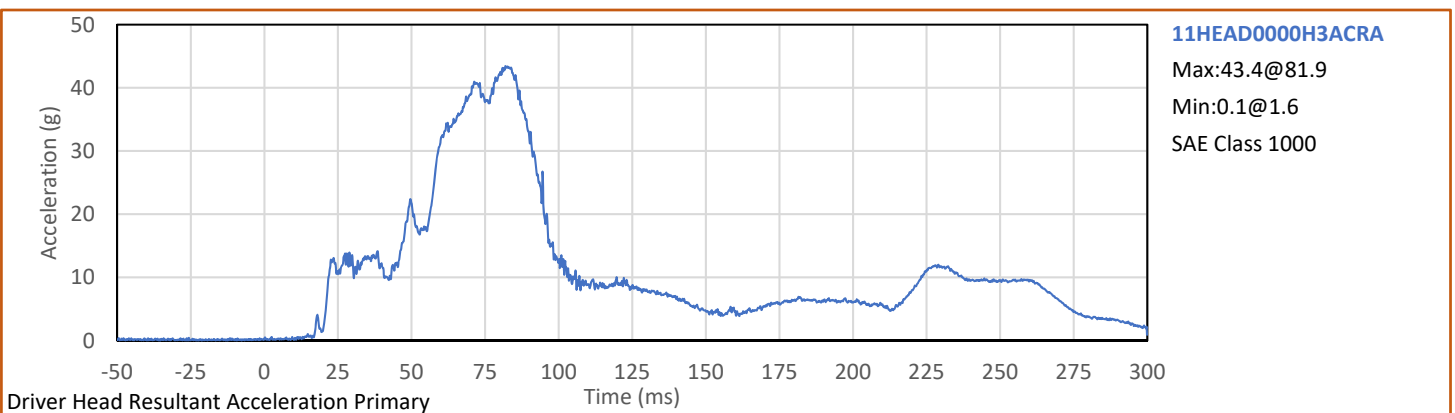
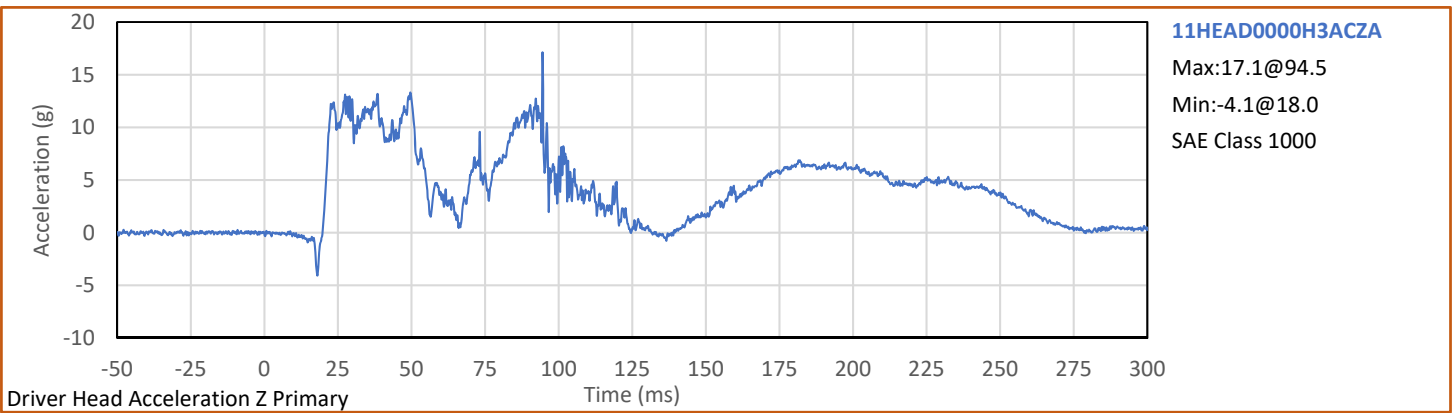
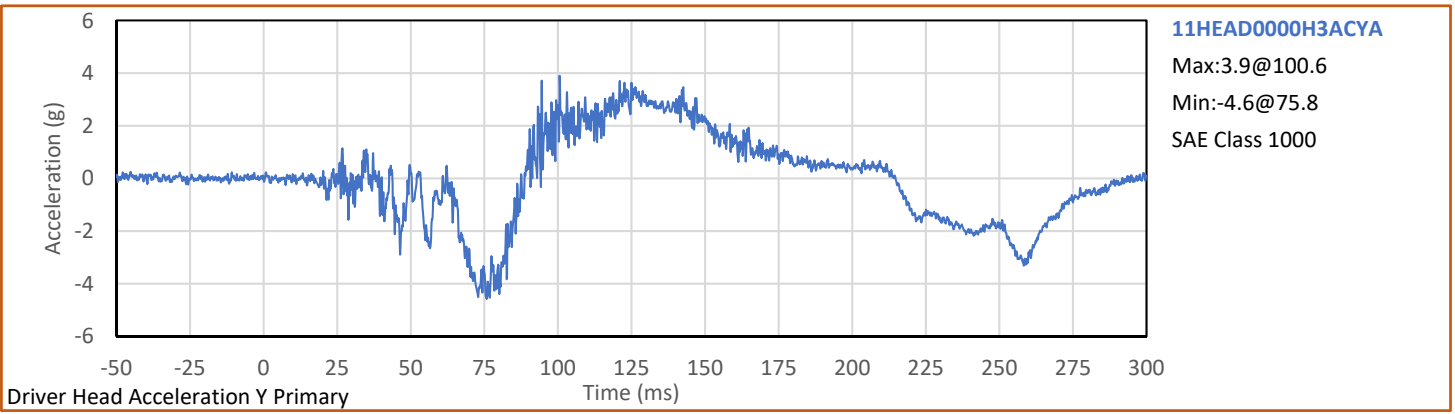
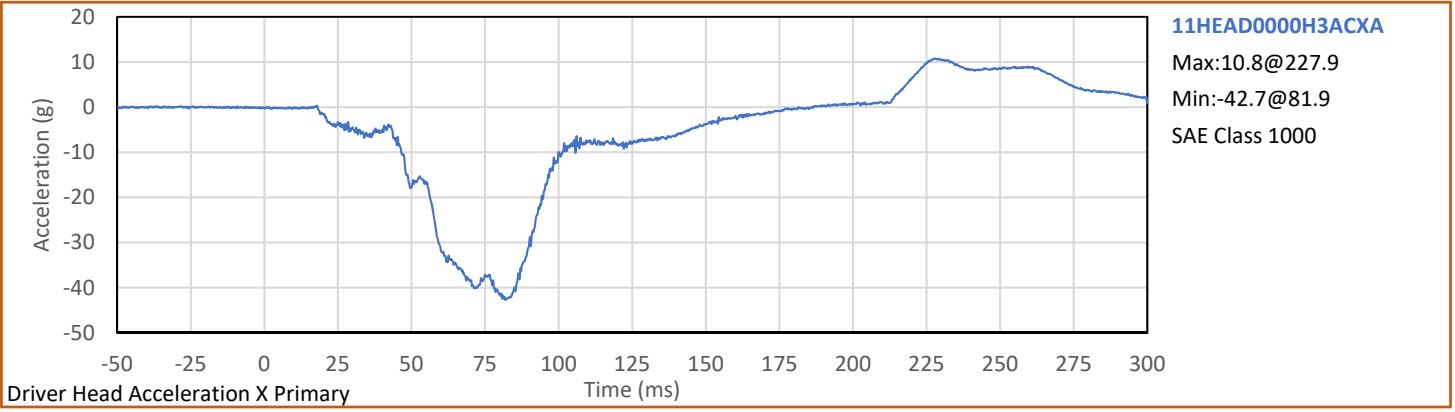
TABLE OF DATA PLOTS

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

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

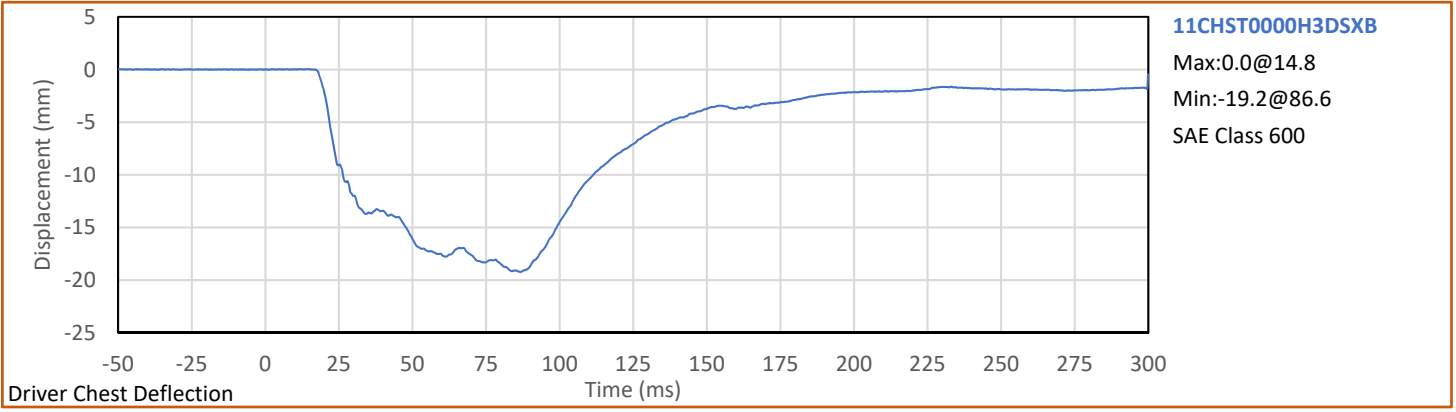
Driver Head X Acceleration Redundant
Driver Head Y Acceleration Redundant
Driver Head Z Acceleration Redundant
Driver Upper Neck Force Y
Driver Upper Neck Moment X
Driver Upper Neck Moment Z
Driver Chest X Acceleration Redundant
Driver Chest Y Acceleration Redundant
Driver Chest Z Acceleration Redundant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

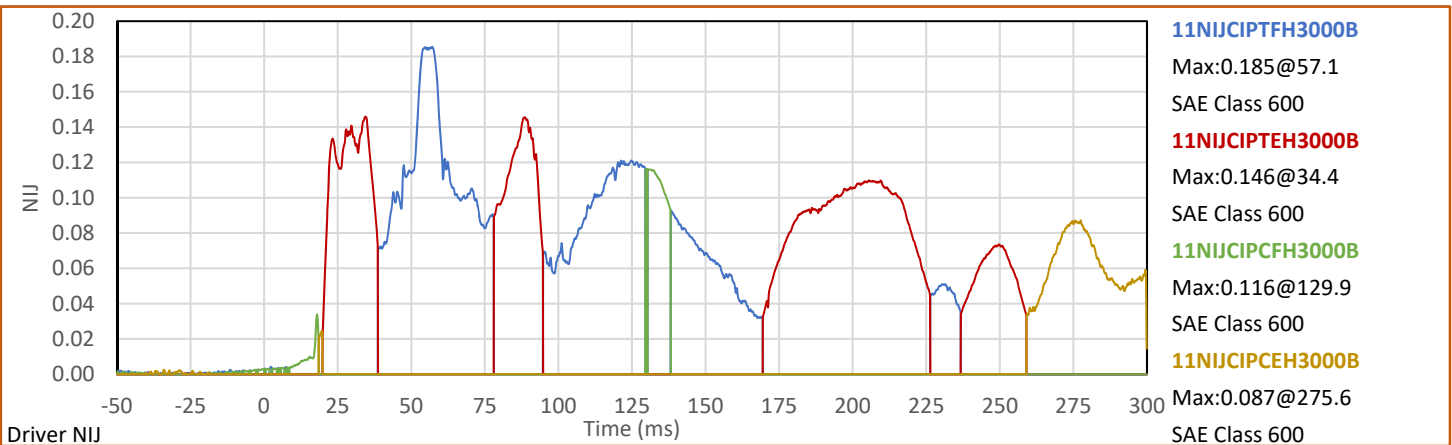
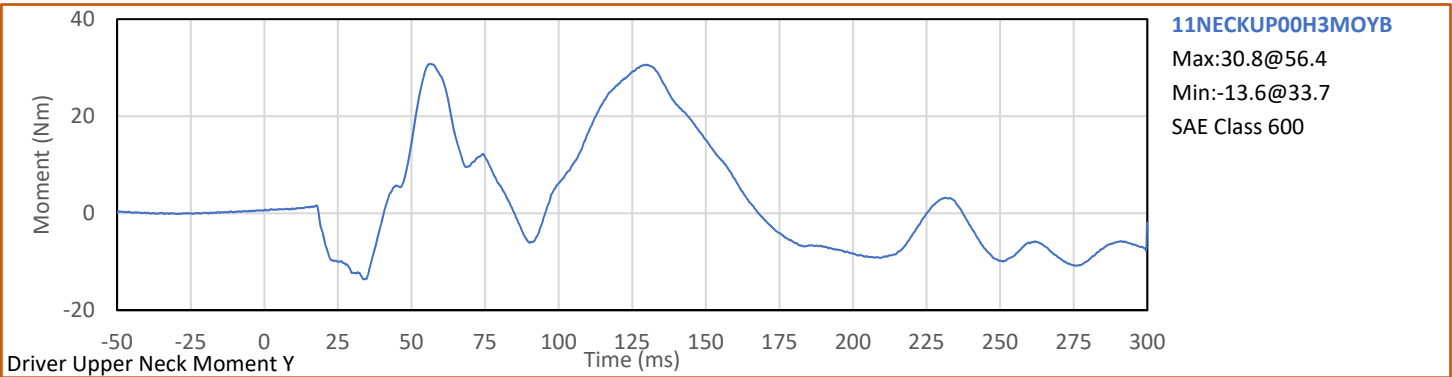
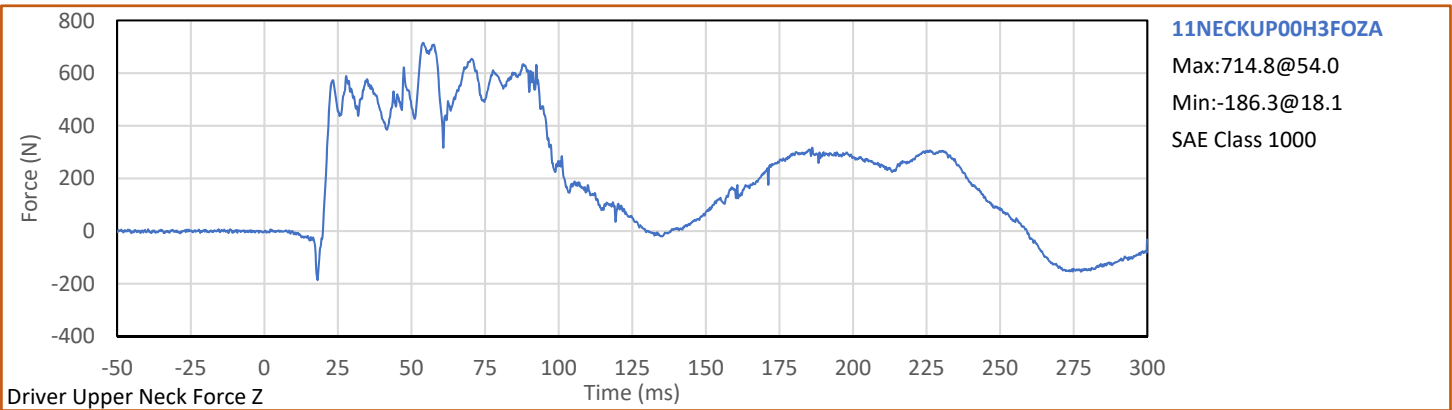
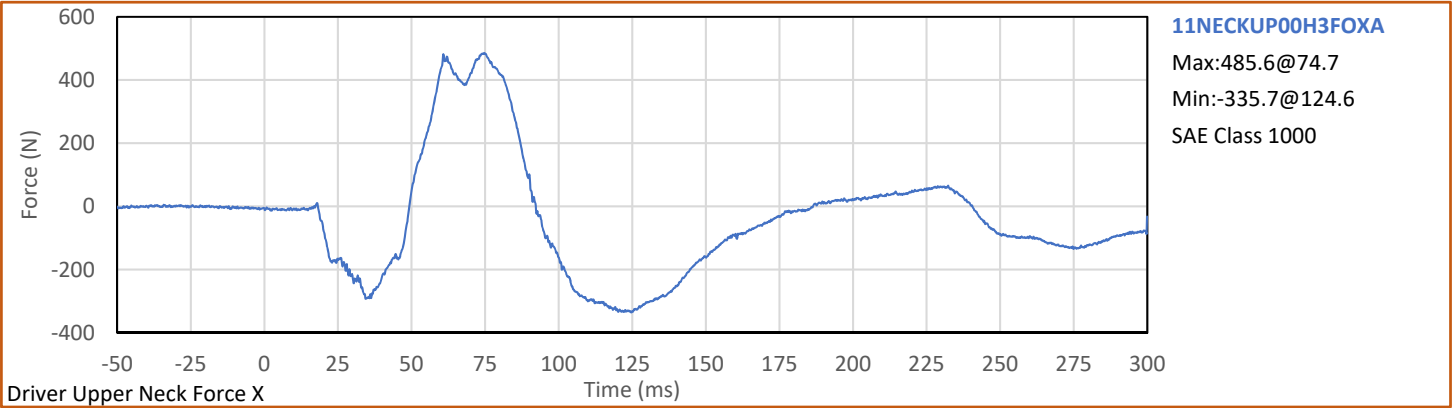
Passenger Chest X Acceleration Redundant
Passenger Chest Y Acceleration Redundant
Passenger Chest Z Acceleration Redundant
Passenger Pelvis X
Passenger Pelvis Y
Passenger Pelvis Z
Passenger Left Femur Force Redundant
Passenger Right Femur Force Redundant
Passenger Left Upper Tibia Moment X
Passenger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

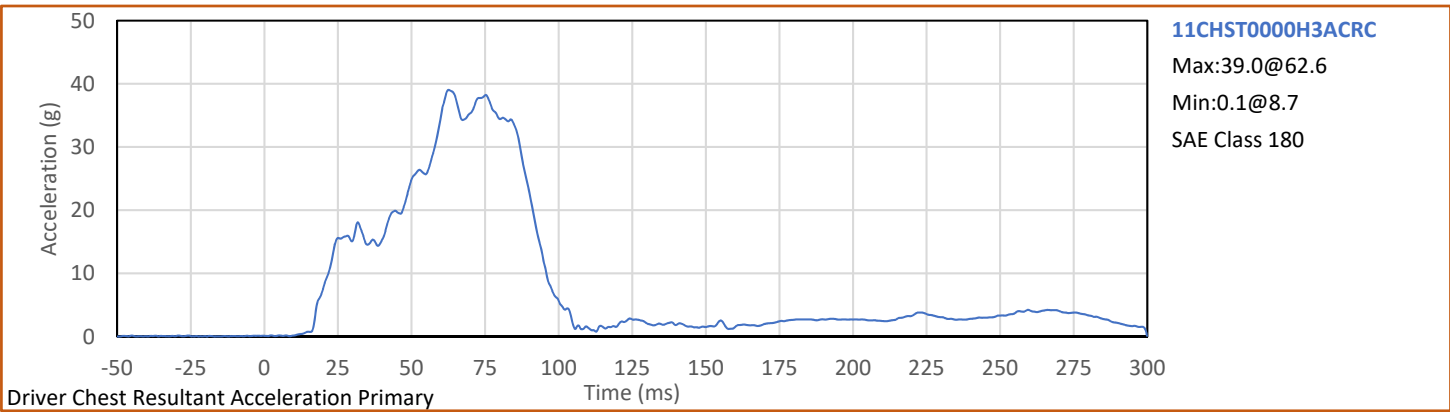
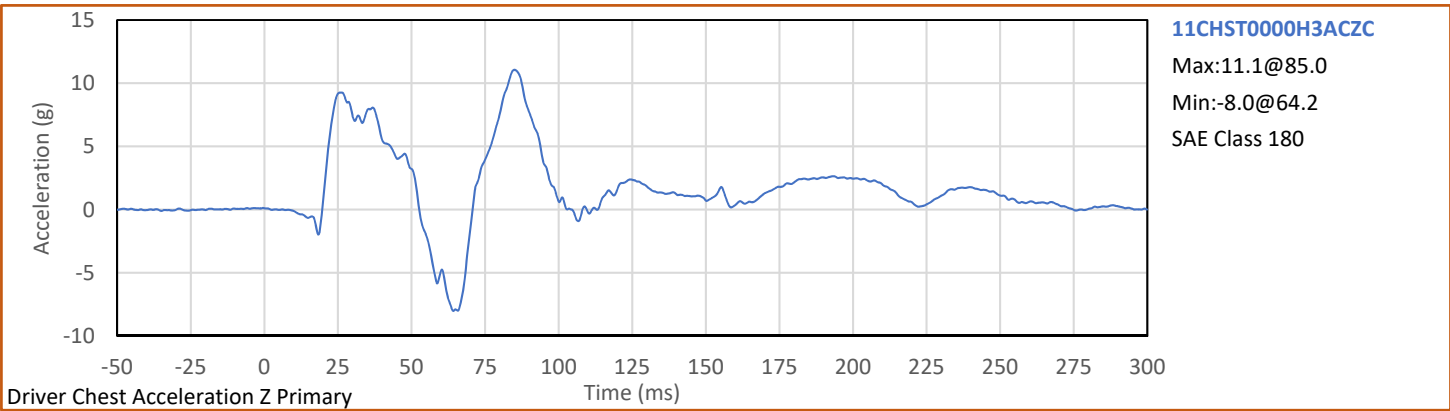
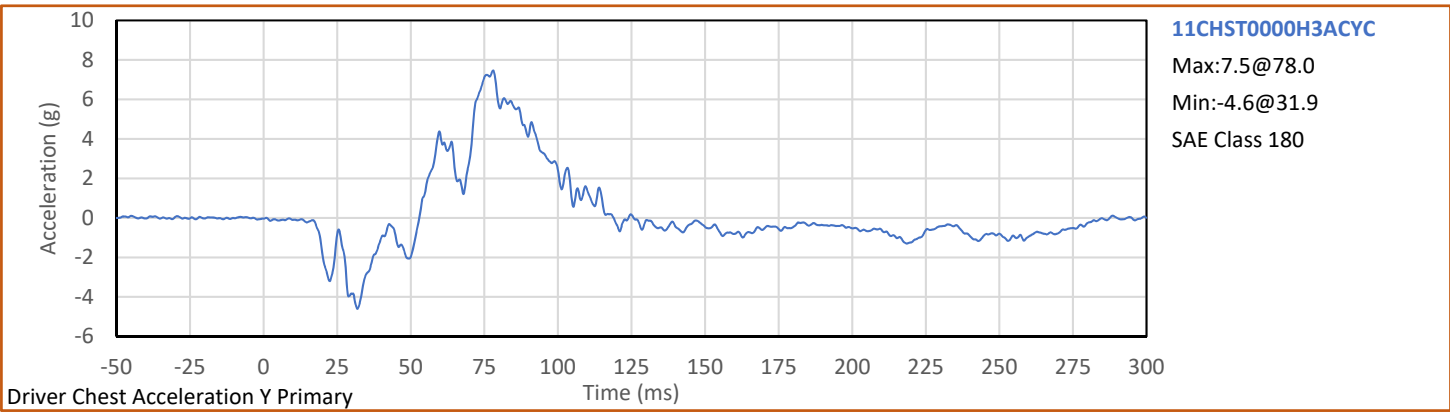
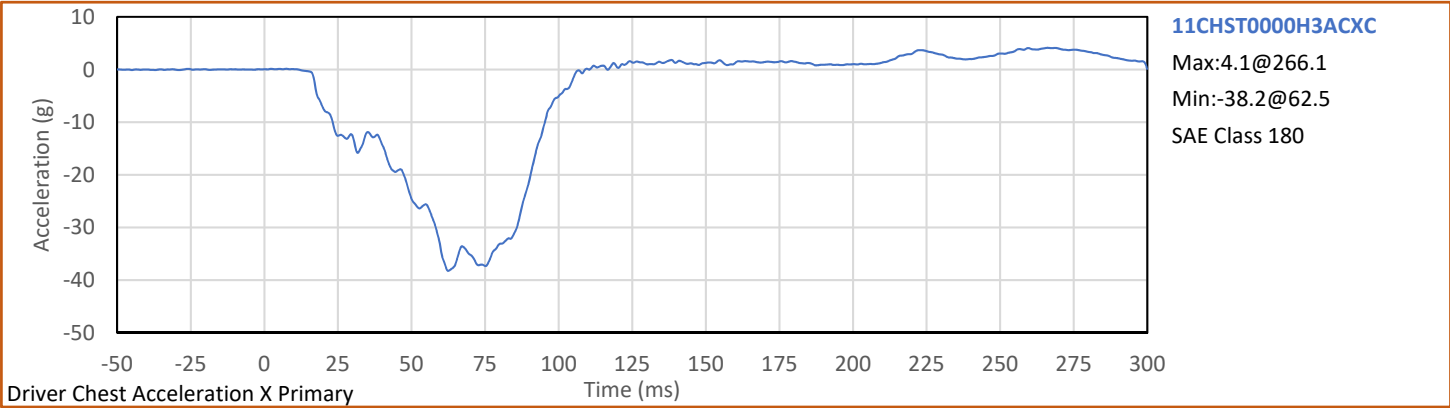


Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: M20204203
Test Date: 2/21/2020

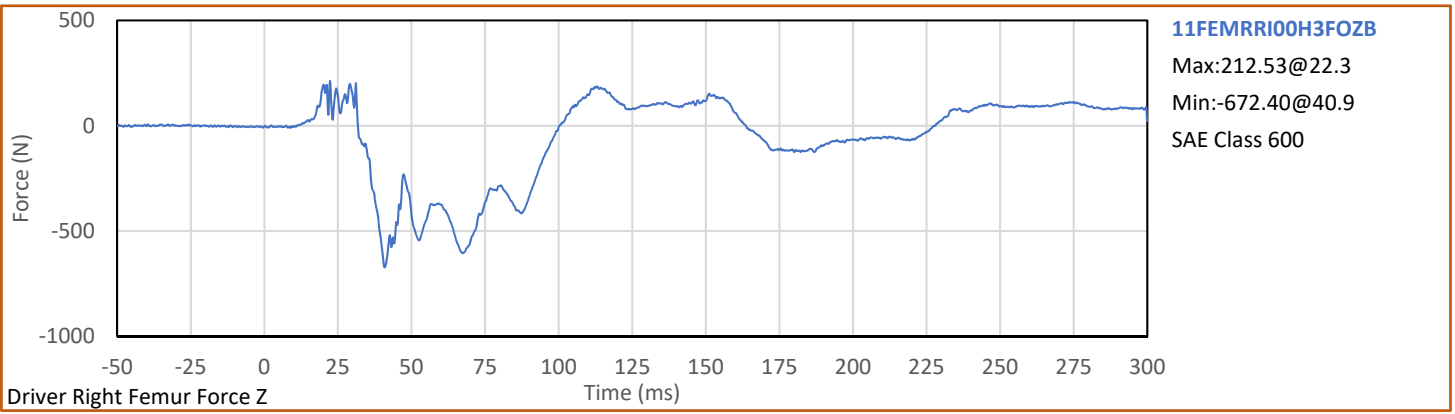
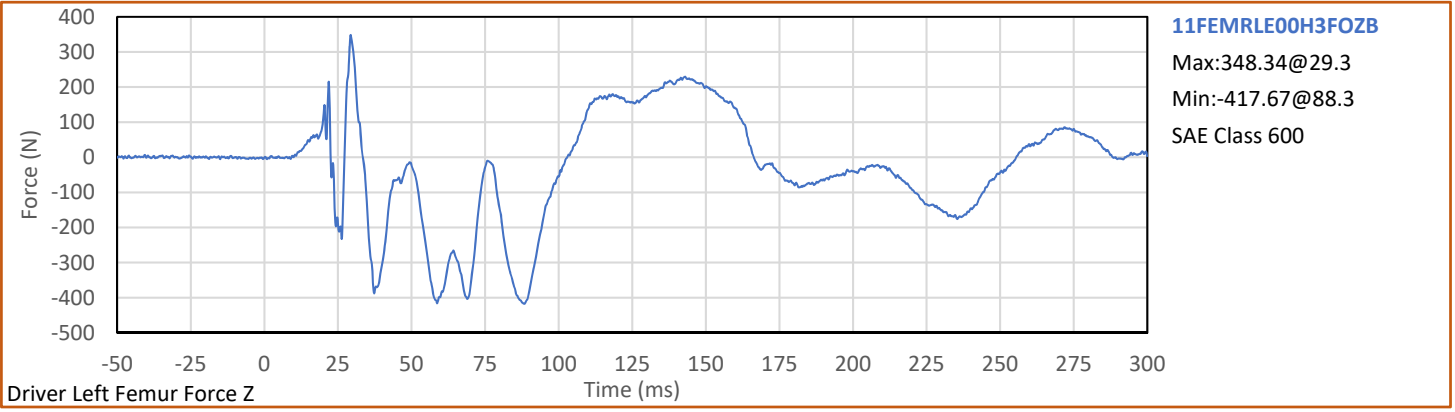


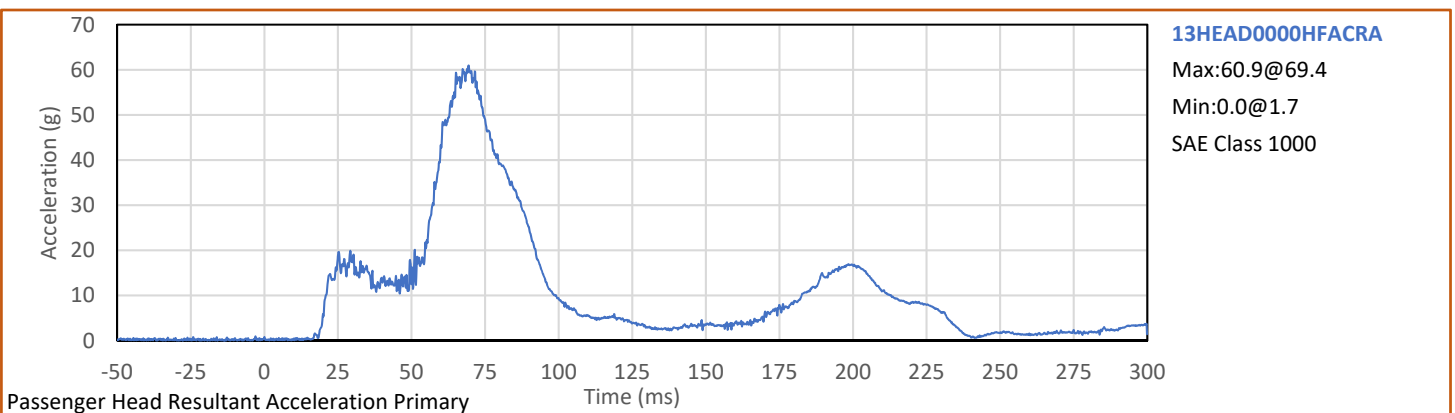
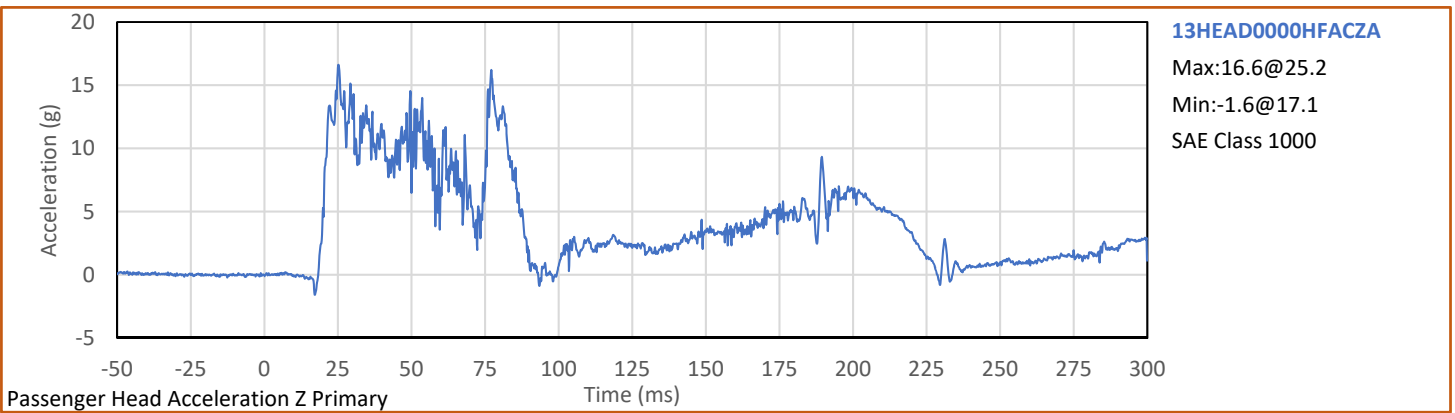
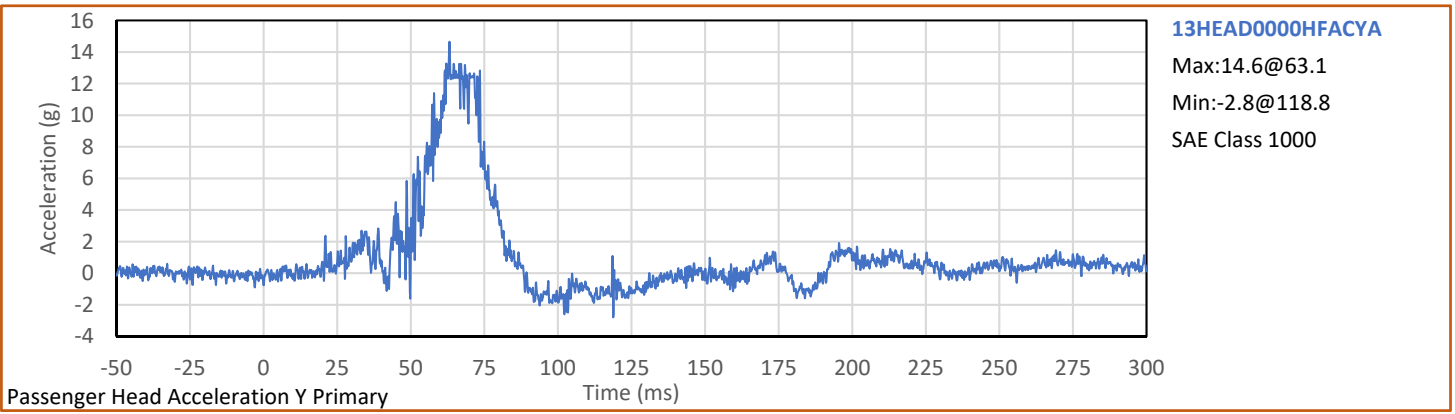
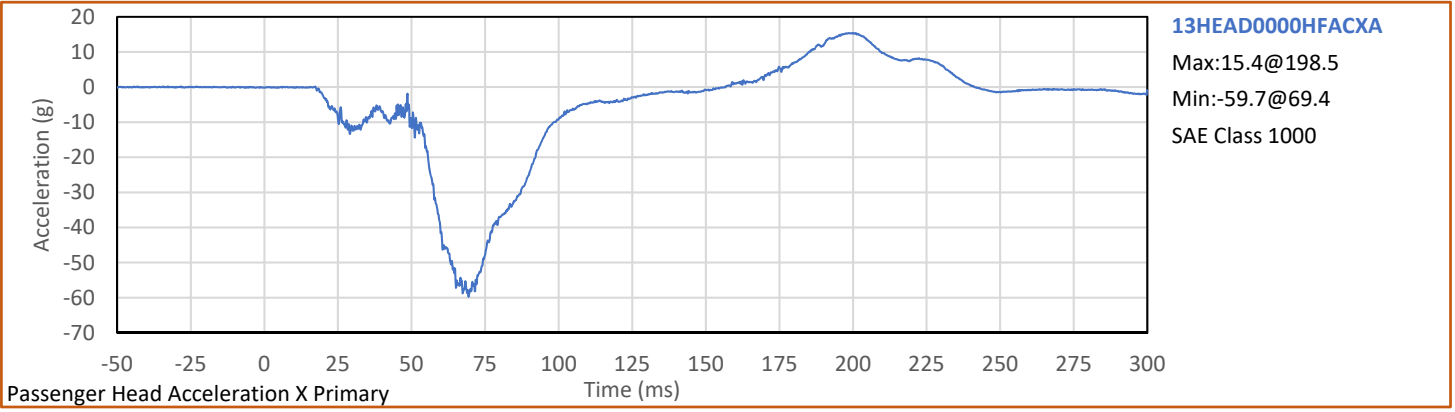




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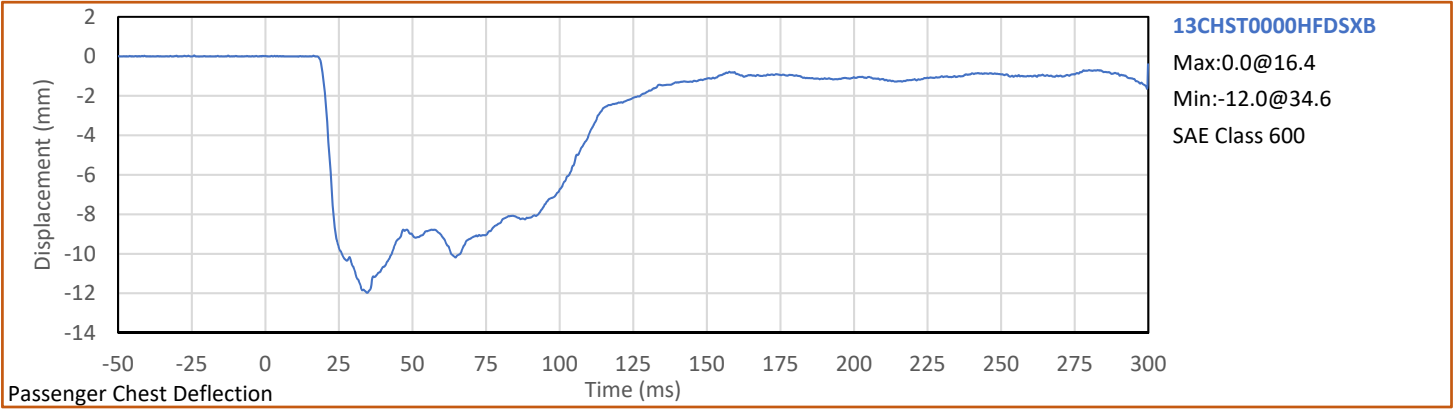
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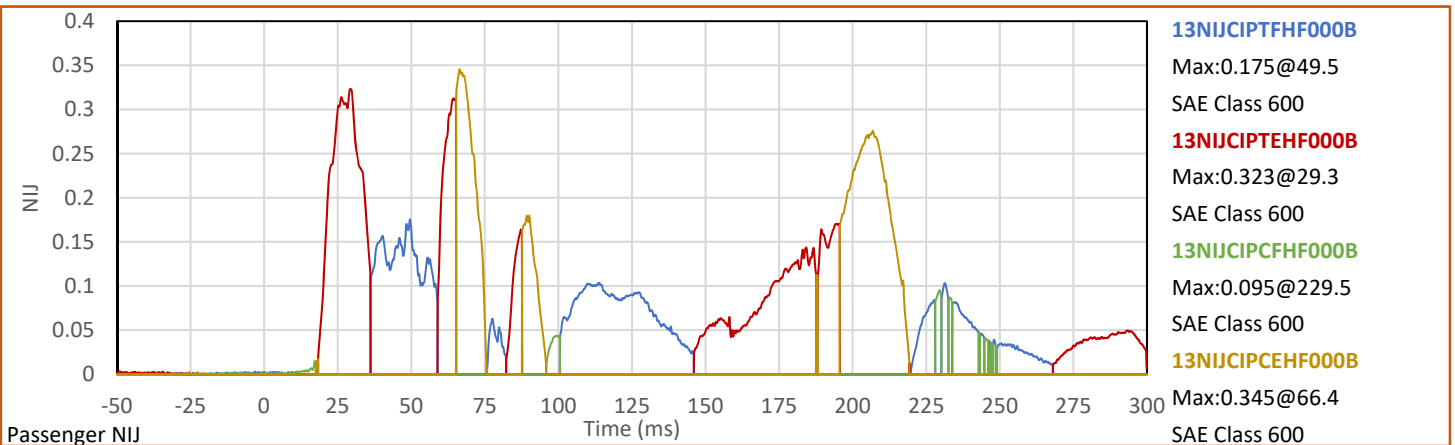
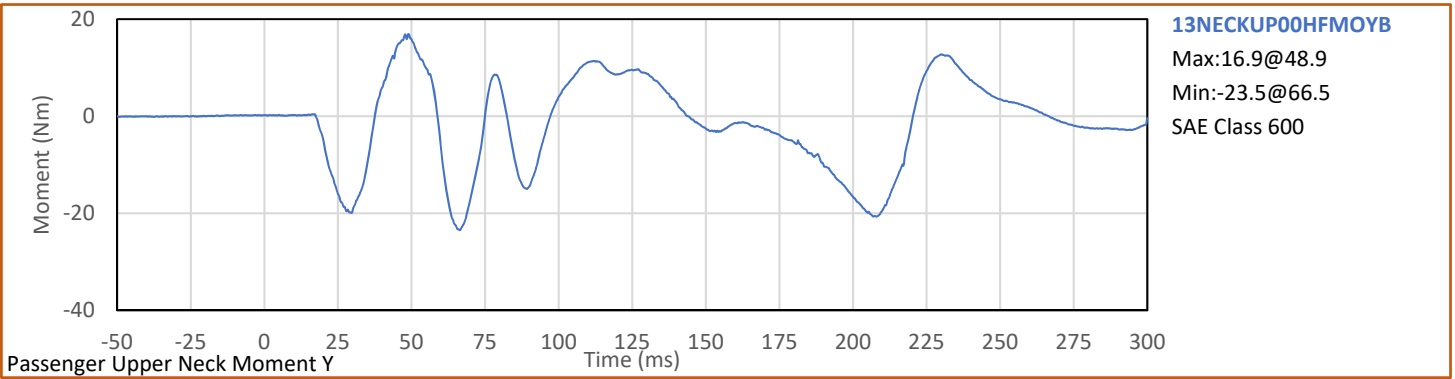
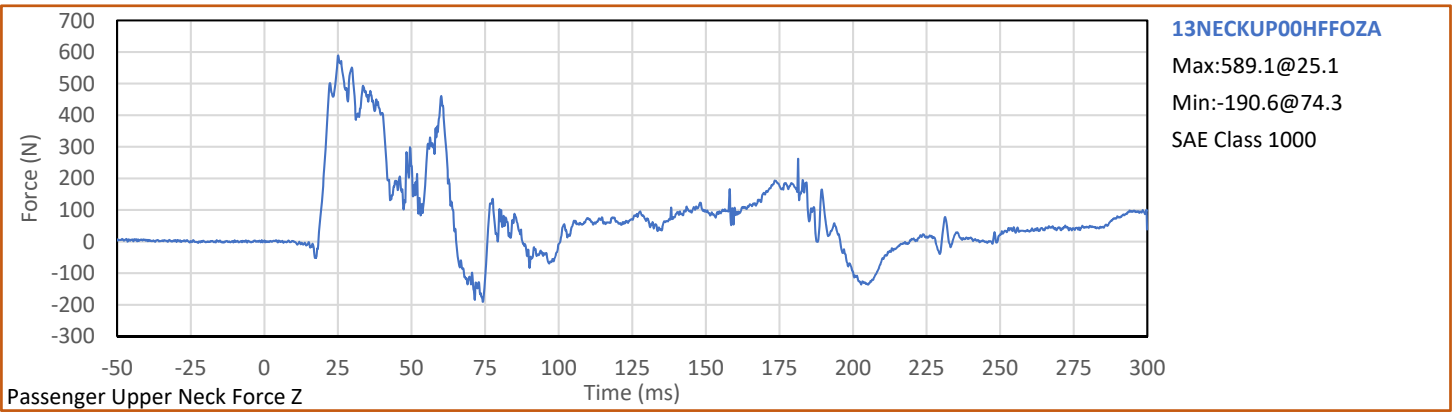
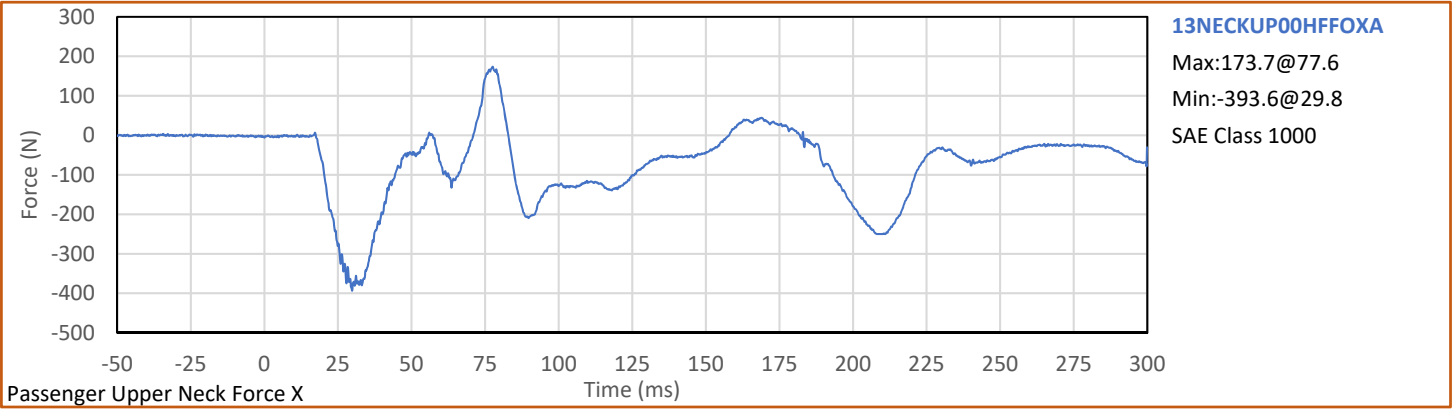


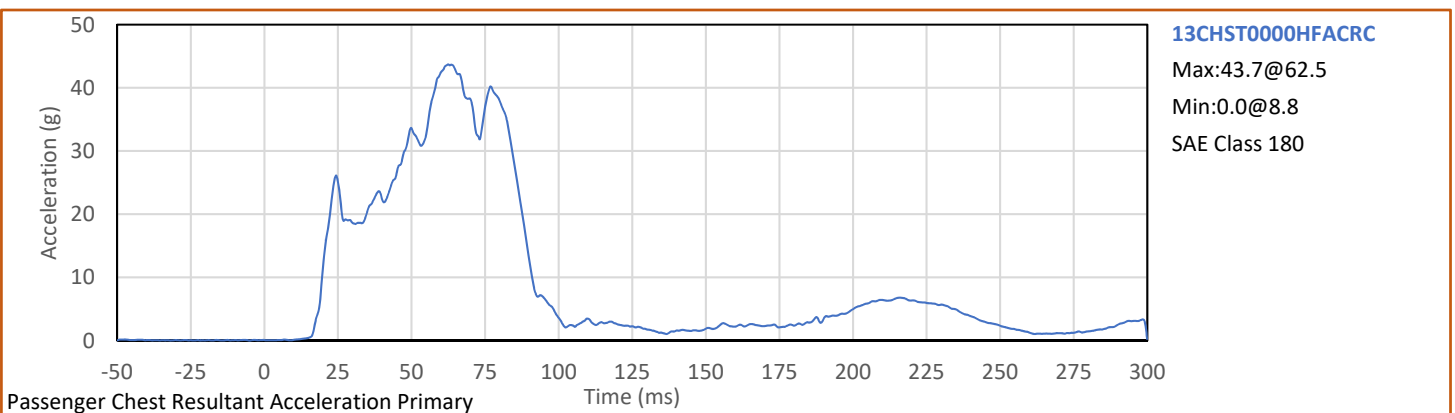
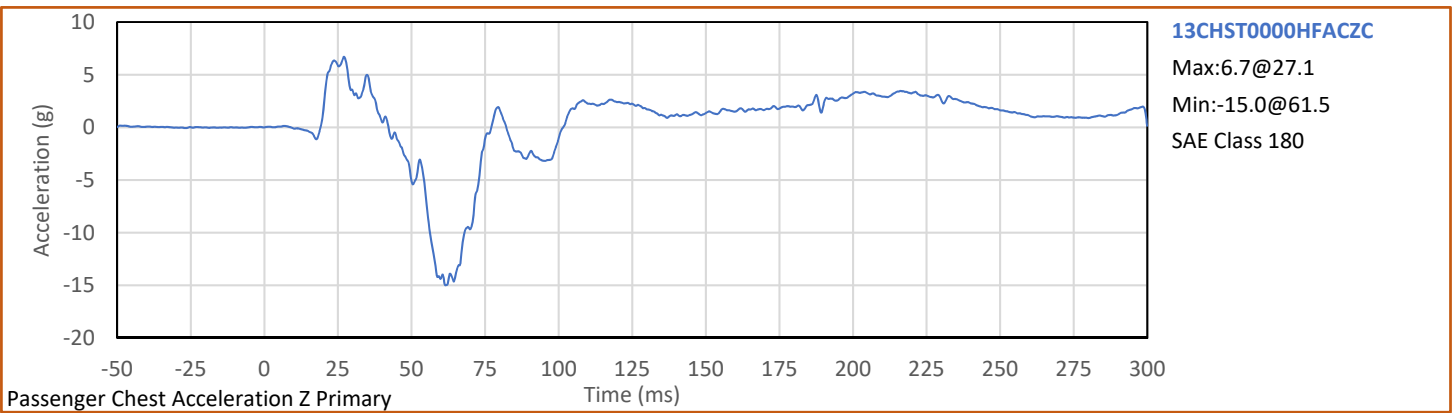
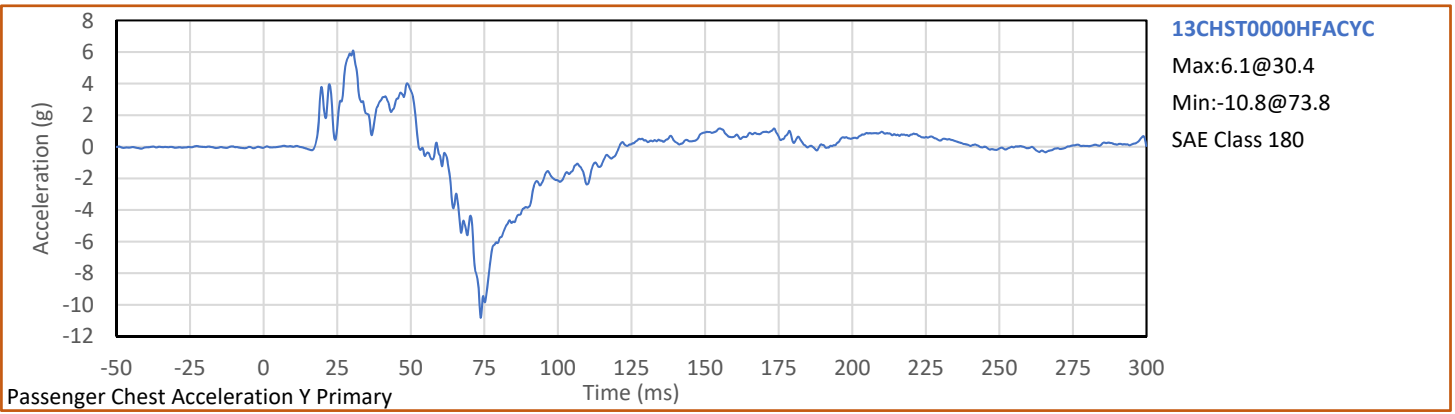
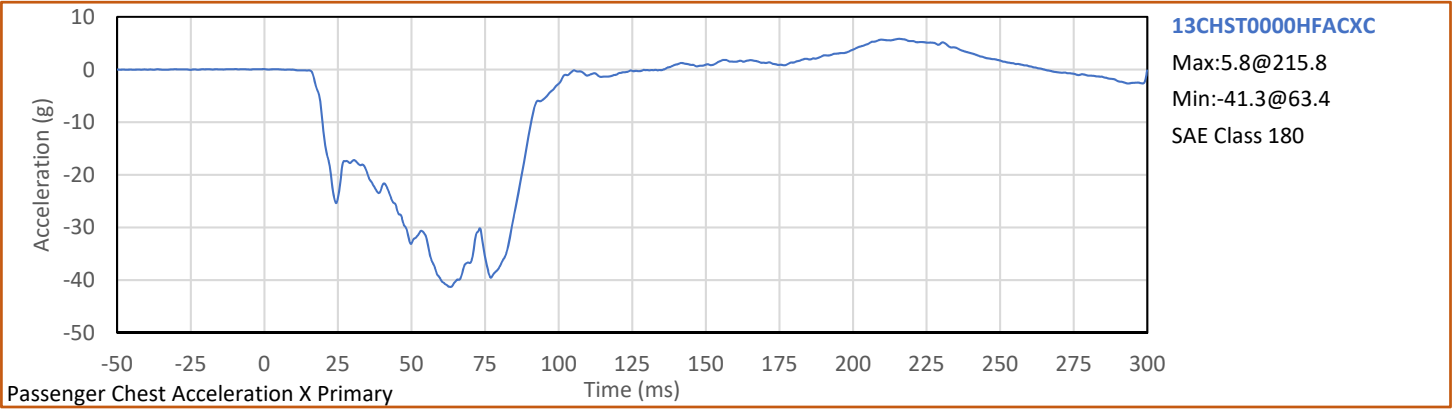


Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: M20204203
Test Date: 2/21/2020

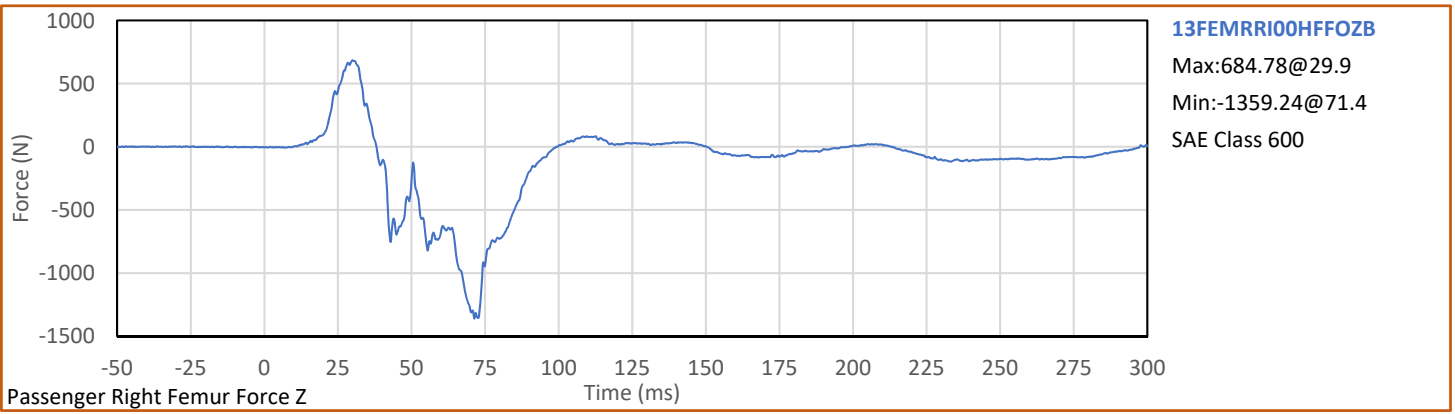
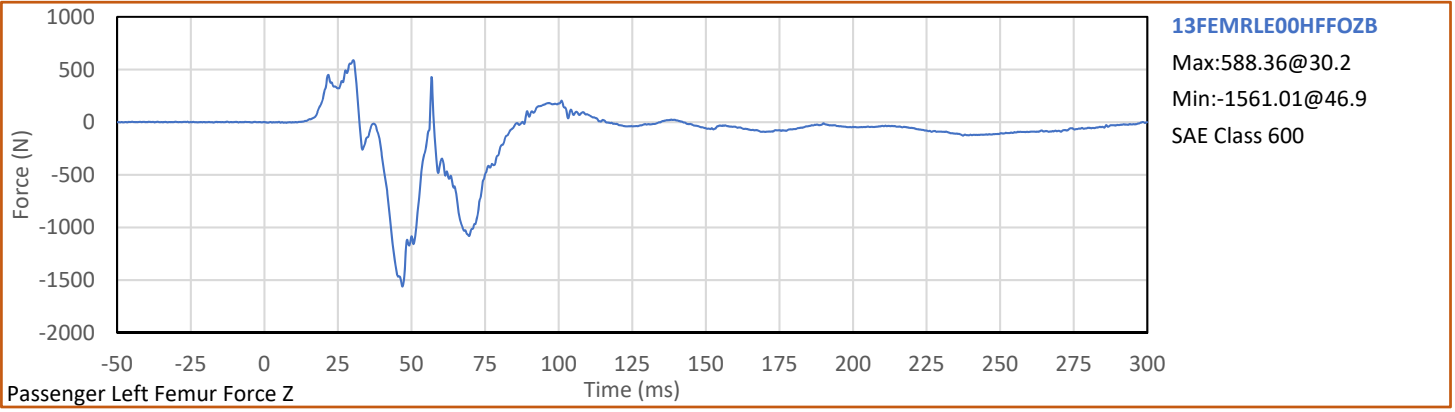






Test Vehicle: 2020 Hyundai Palisade AWD 5-Door MPV
Test Program: 56.3 km/h Frontal Impact NCAP Test

NHTSA No.: M20204203
Test Date: 2/21/2020



APPENDIX C
DUMMY QUALIFICATION AND PERFORMANCE VERIFICATION

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

ATD Serial No.: 360


Test Date: 2020-01-22

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

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	26	Pass
A - Total sitting height	mm	879	889	887	Pass
B - Shoulder pivot height	mm	505	521	517	Pass
C - 'H' point height	mm	84	89	87	Pass
D - 'H' point location from backline	mm	135	140	139	Pass
E - Shoulder pivot from backline	mm	84	94	91	Pass
F - Thigh clearance	mm	140	155	151	Pass
G - Back of elbow to wrist pivot	mm	290	305	297	Pass
H - Head back to backline	mm	41	46	46	Pass
I - Shoulder to elbow length	mm	330	345	343	Pass
J - Elbow rest height	mm	190	211	204	Pass
K - Buttock to knee length	mm	579	604	589	Pass
L - Popliteal length	mm	429	455	440	Pass
M - Knee pivot height	mm	485	500	495	Pass
N - Buttock popliteal length	mm	452	477	464	Pass
O - Chest depth without jacket	mm	213	229	220	Pass
P - Foot length	mm	251	267	258	Pass
V - Shoulder breadth	mm	422	437	431	Pass
W - Foot breadth	mm	91	107	103	Pass
Y - Chest circum. (w/chest jacket)	mm	970	1001	980	Pass
Z - Waist circum.	mm	836	866	851	Pass
AA - Location for chest circum.	mm	429	434	432	Pass
BB - Location for waist circum.	mm	226	231	228	Pass
Overall Test Results					Pass

Technician:



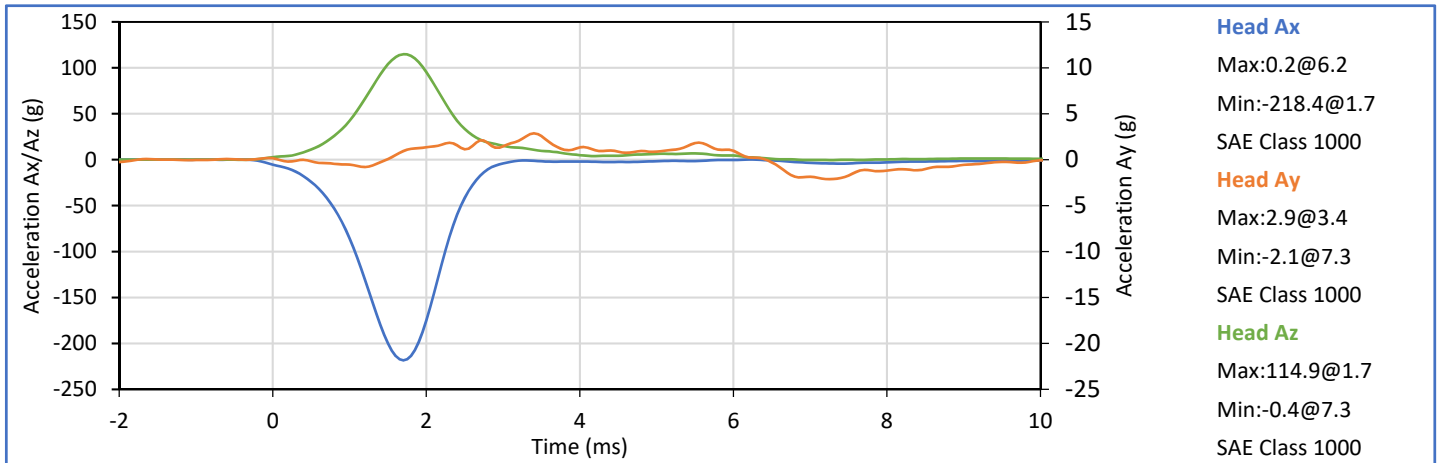
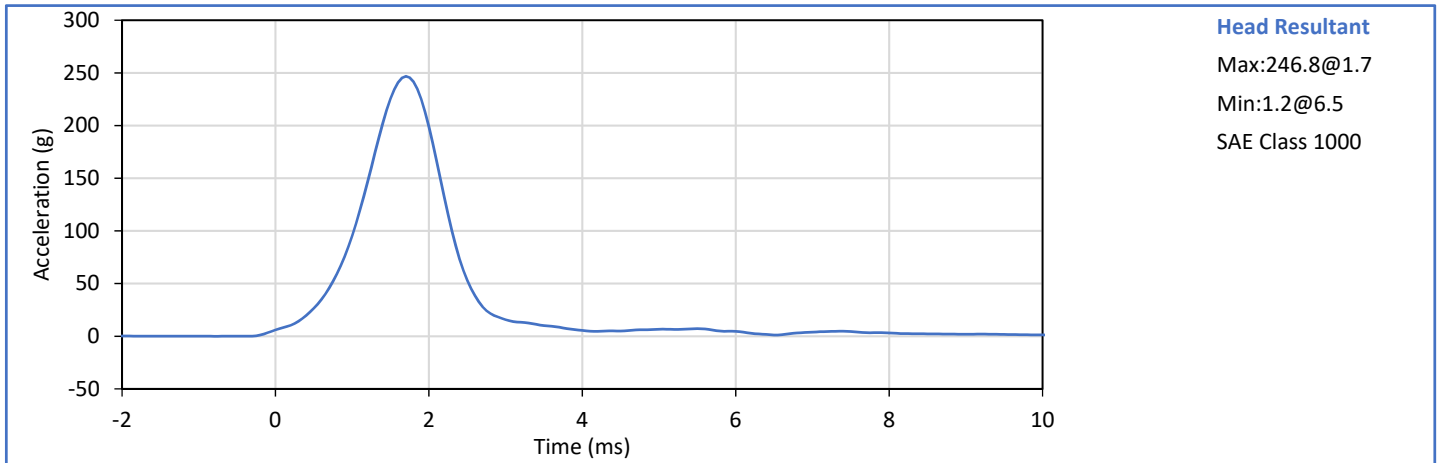
J. Hernandez

Approved By:




P. Puzzuto

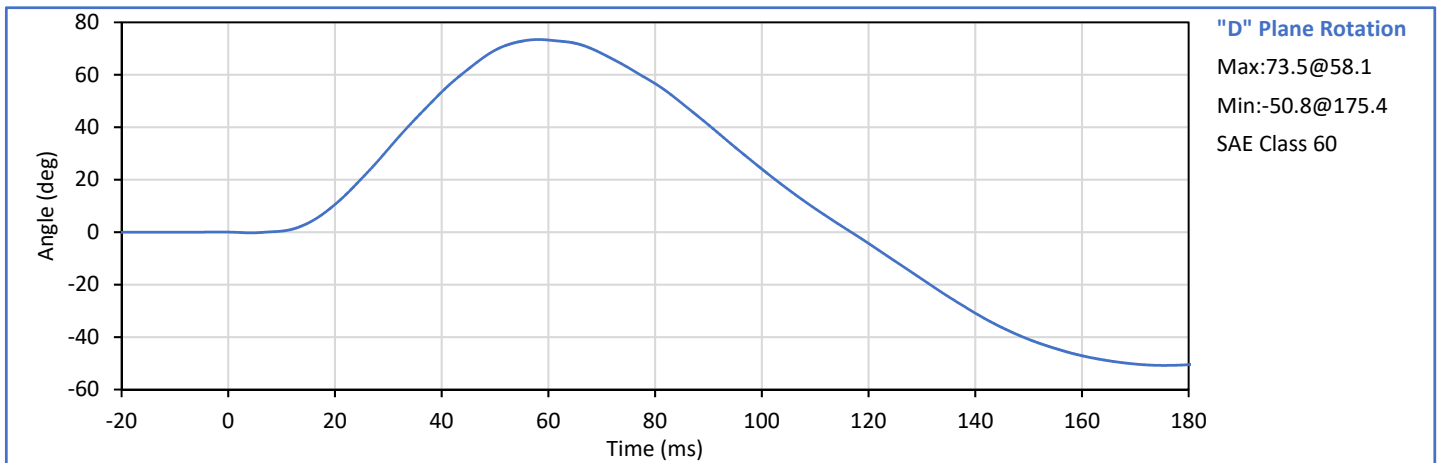
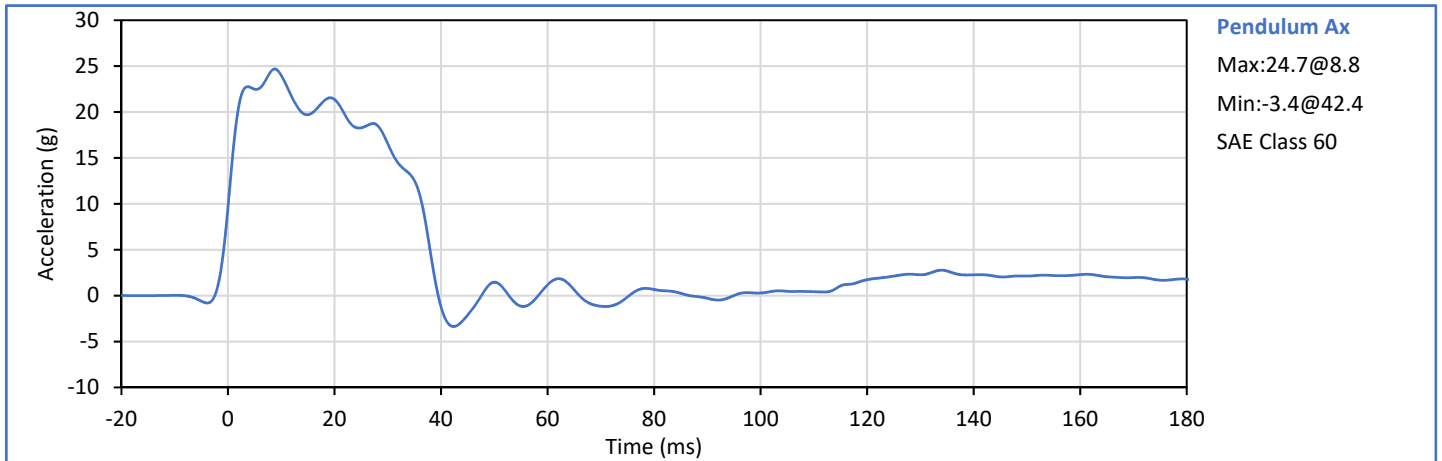
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.7	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Peak Resultant Acceleration	g	225.0	275.0	246.8	Pass
Peak Lateral Acceleration	g	-15.0	15.0	2.9	Pass
Oscillations After Main Pulse	%	0.0	10.0	2.4	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
Overall Test Results					Pass





Technician: 
J. Hernandez

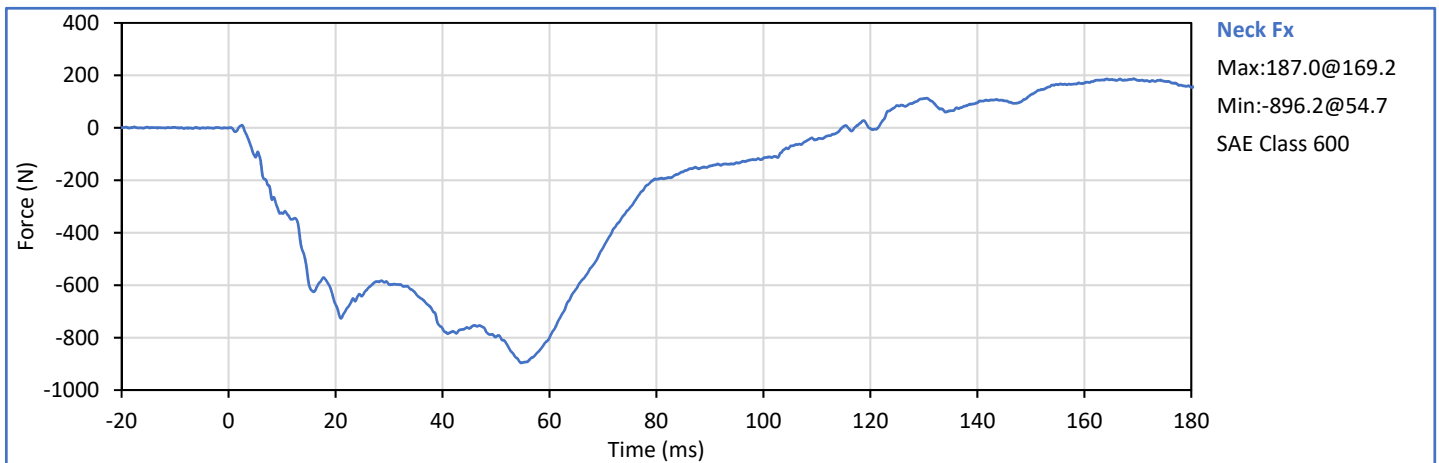
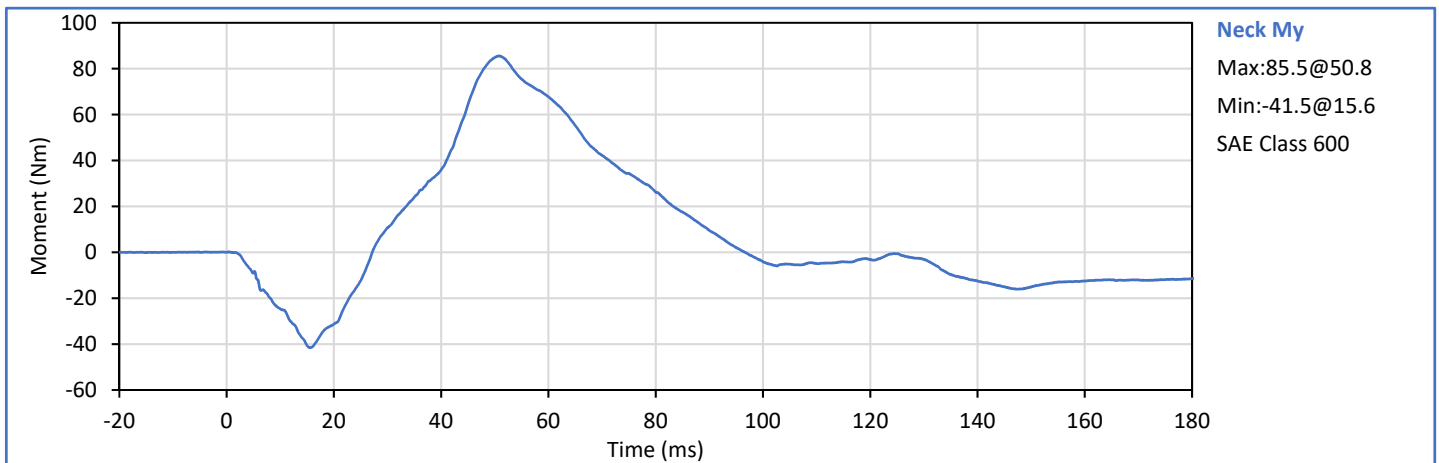
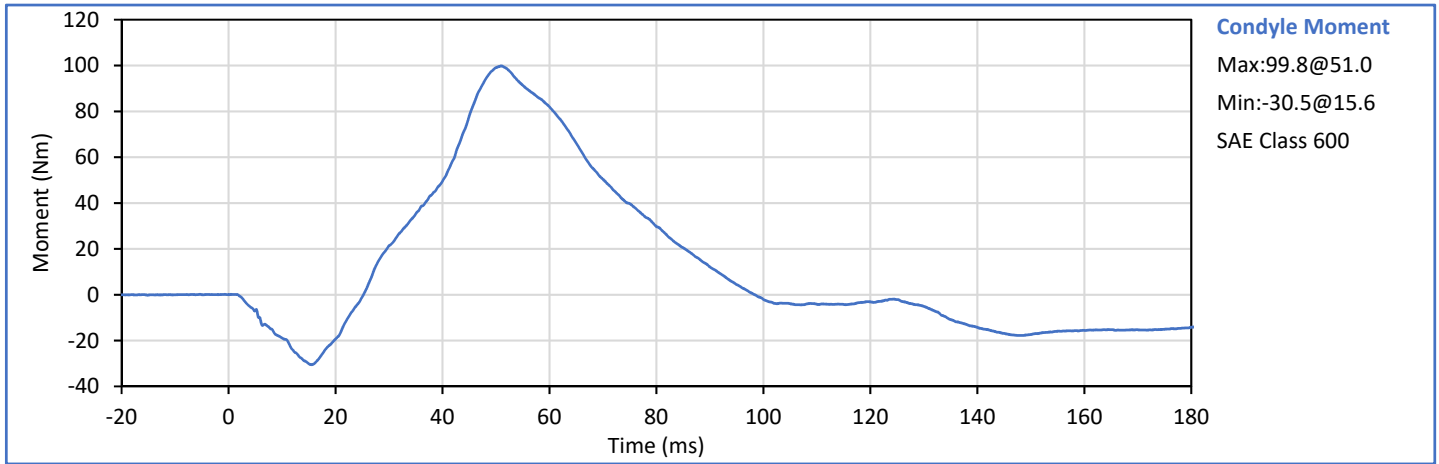
Approved By: 
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.7	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	6.89	7.13	7.08	Pass
Pendulum Deceleration at 10 ms	g	22.5	27.5	24.0	Pass
Pendulum Deceleration at 20 ms	g	17.6	22.6	21.4	Pass
Pendulum Deceleration at 30 ms	g	12.5	18.5	16.6	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	29.0	16.6	Pass
Deceleration Decay to Cross 5 g	ms	34.0	42.0	37.9	Pass
"D" Plane Rotation peak	deg	64.0	78.0	73.5	Pass
	ms	57.0	64.0	58.1	Pass
"D" Plane Rotation Decay To Zero	ms	113.0	128.0	116.8	Pass
Moment About Occipital Condyle	Nm	88.1	108.5	99.8	Pass
	ms	47.0	58.0	51.0	Pass
Moment Decay, Peak to Zero	ms	97.0	107.0	98.4	Pass
Overall Test Results					Pass

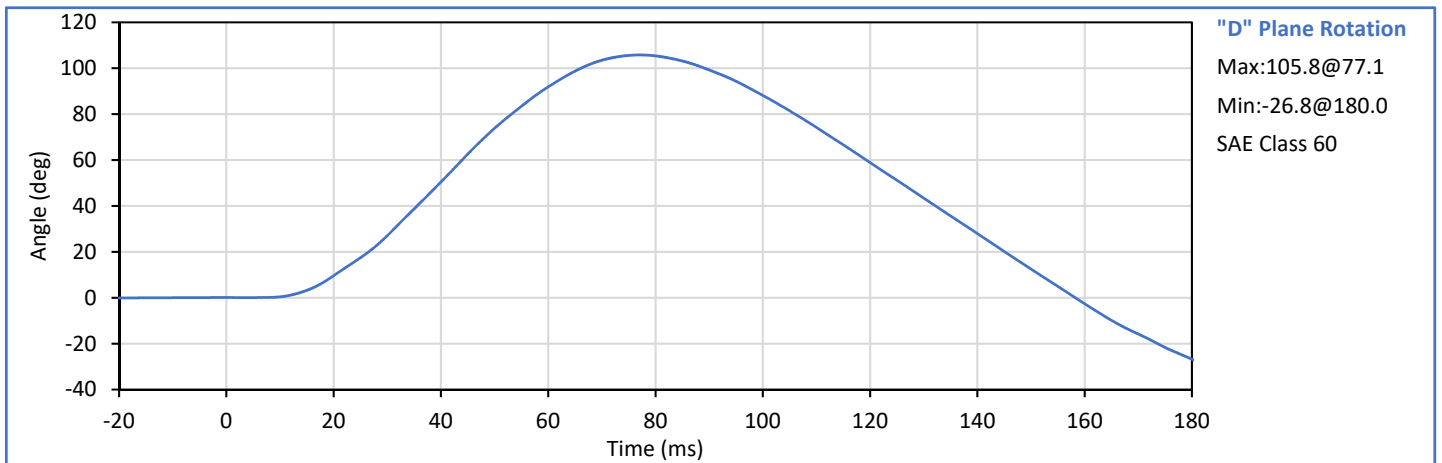
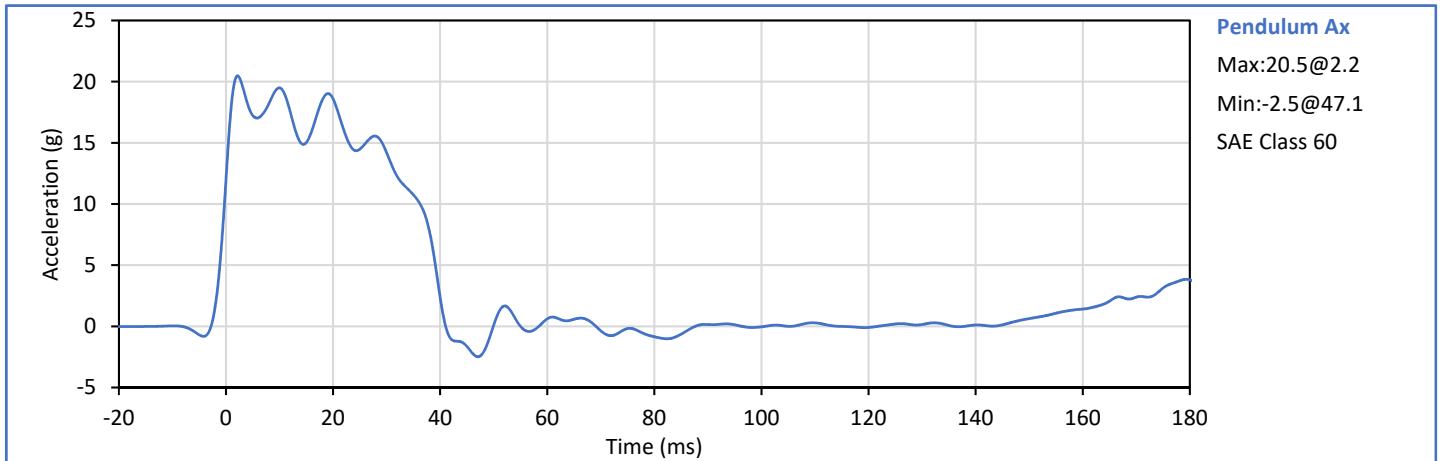


Technician: 
J. Hernandez


Approved By: 
P. Puzzuto

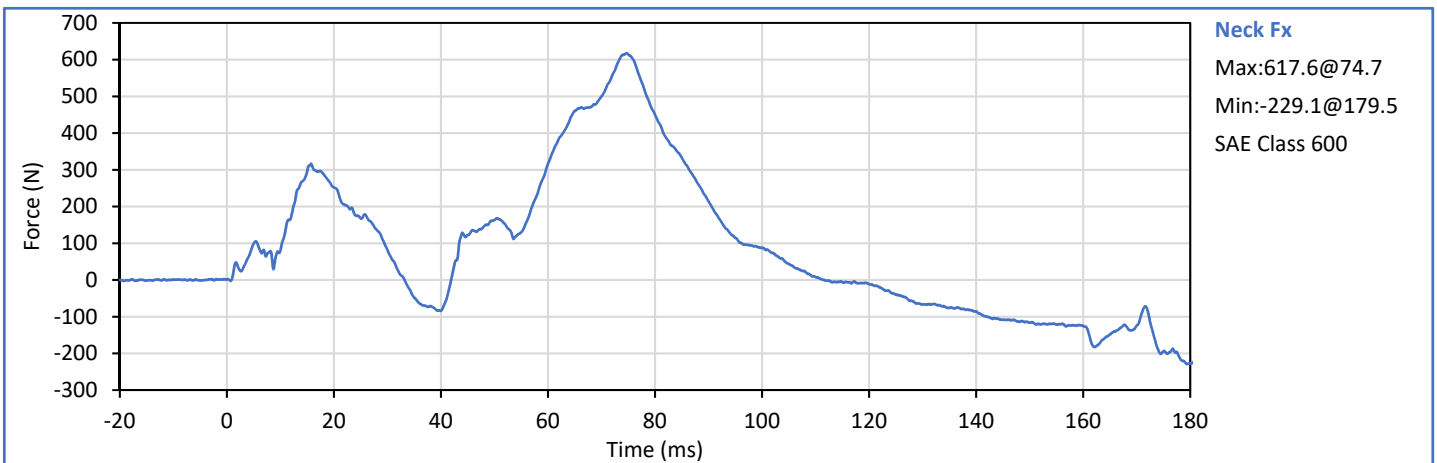
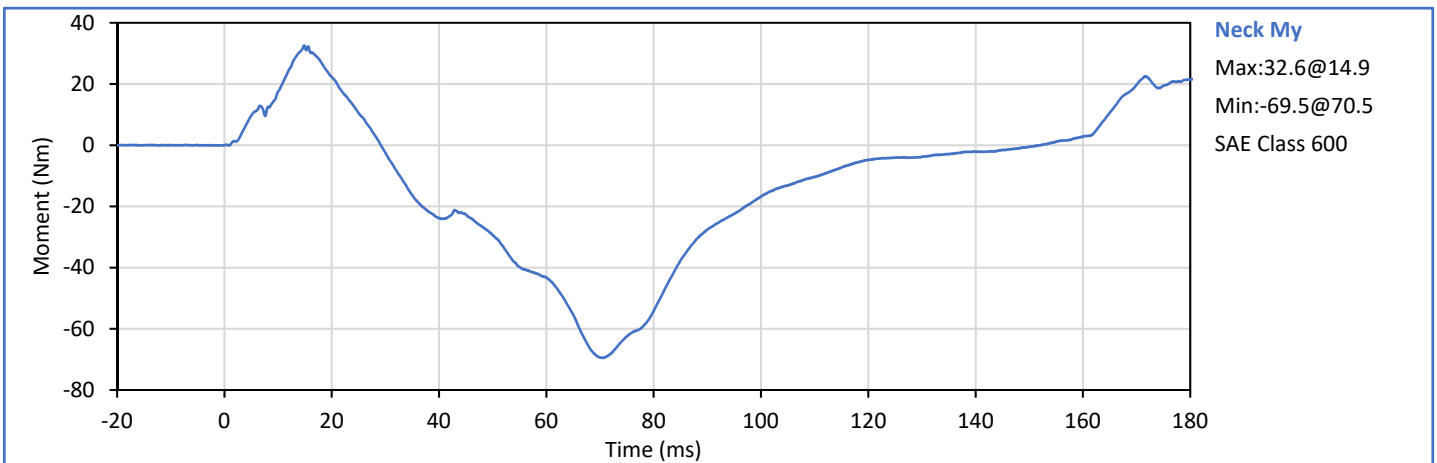
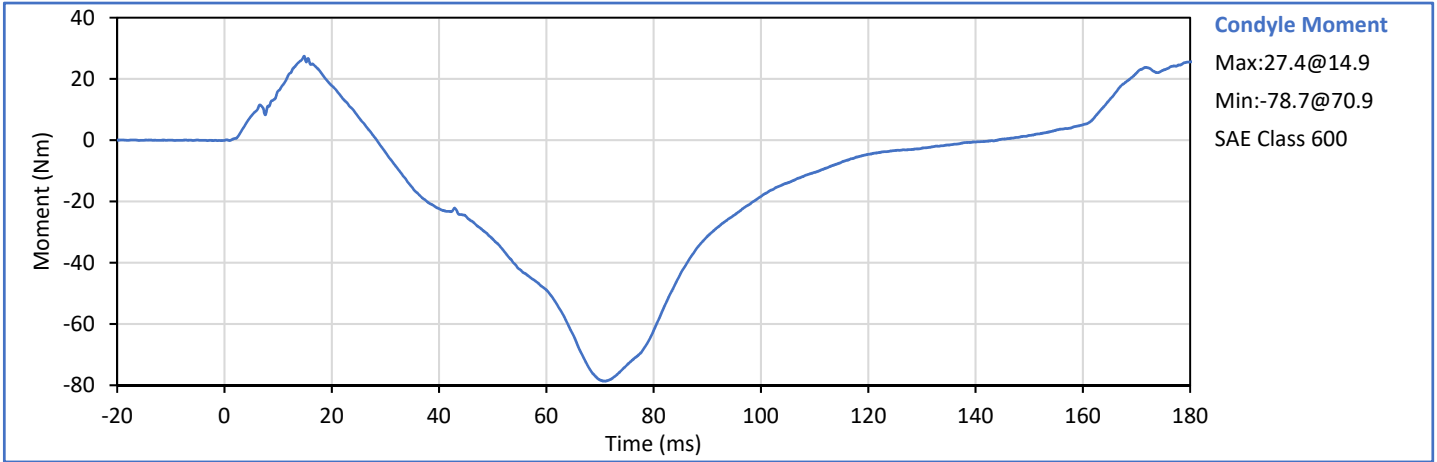


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	32	Pass
Pendulum Velocity	m/s	5.94	6.19	6.10	Pass
Pendulum Deceleration at 10 ms	g	17.2	21.2	19.5	Pass
Pendulum Deceleration at 20 ms	g	14.0	19.0	18.6	Pass
Pendulum Deceleration at 30 ms	g	11.0	16.0	14.2	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	22.0	14.2	Pass
Deceleration Decay to Cross 5 g	ms	38.0	46.0	39.1	Pass
"D" Plane Rotation peak	deg	81.0	106.0	105.8	Pass
	ms	72.0	82.0	77.1	Pass
"D" Plane Rotation Decay To Zero	ms	147.0	174.0	158.3	Pass
Moment About Occipital Condyle	Nm	-79.9	-52.9	-78.7	Pass
	ms	65.0	79.0	70.9	Pass
Moment Decay, Peak to Zero	ms	120.0	148.0	144.0	Pass
Overall Test Results					Pass

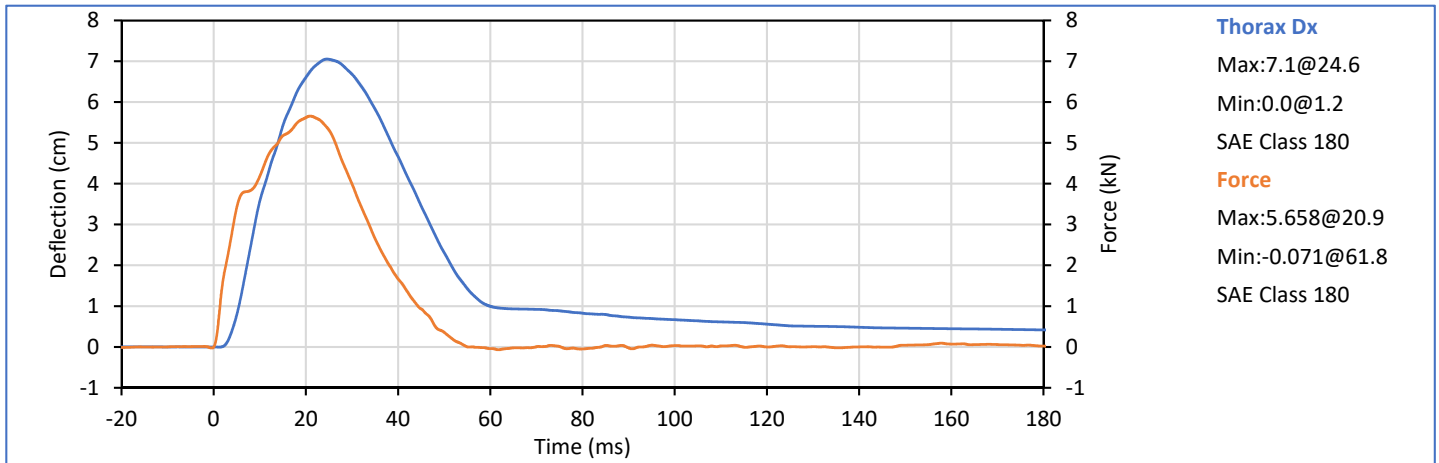
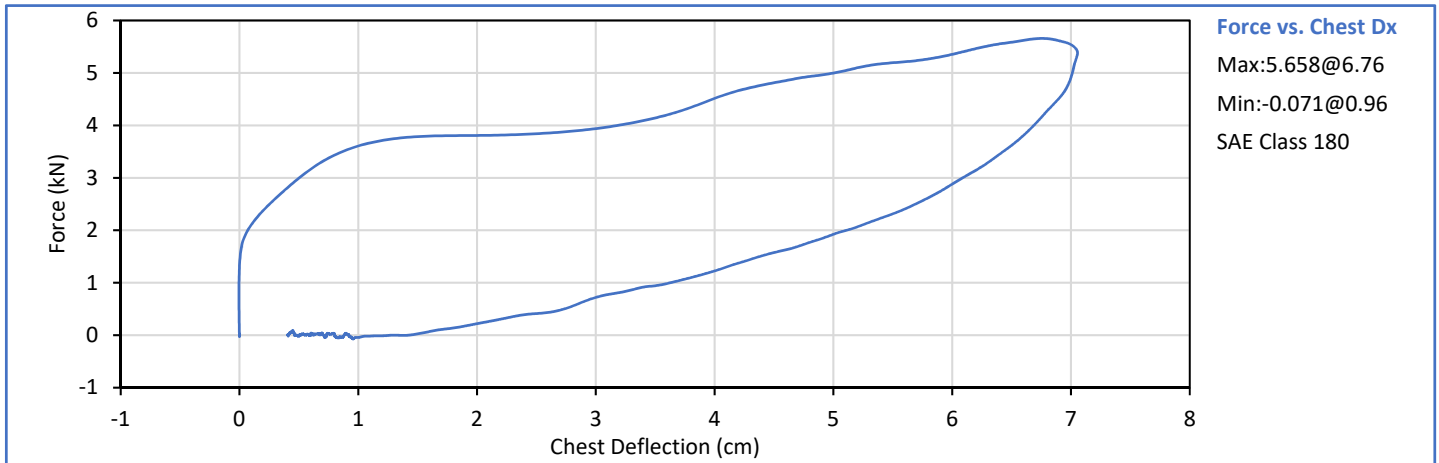


Technician: 
J. Hernandez


Approved By: 
P. Puzzuto



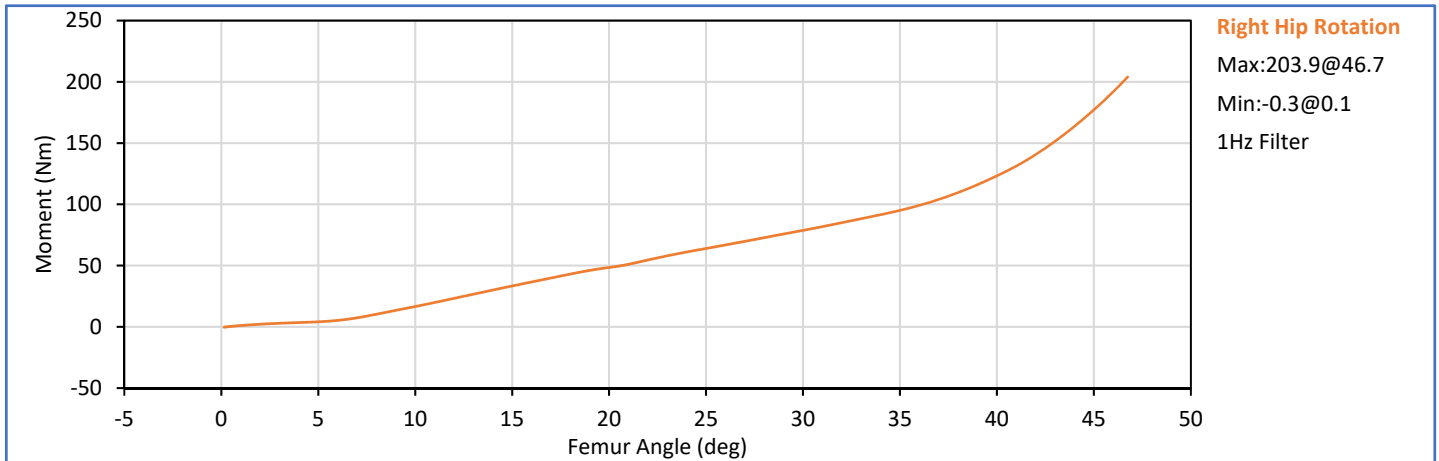
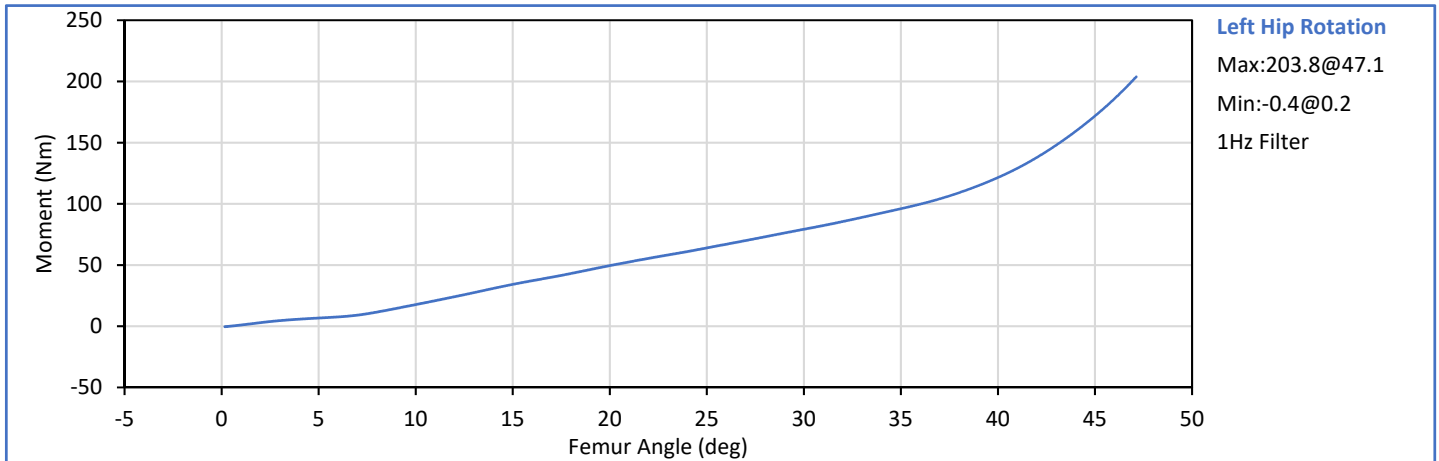
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	32	Pass
Probe Velocity	m/s	6.58	6.82	6.65	Pass
Peak Chest Deflection	cm	6.35	7.26	7.06	Pass
Peak Probe Force	kN	5.159	5.893	5.658	Pass
Internal Hysteresis	%	69.0	85.0	69.4	Pass
Overall Test Results					Pass




Technician: 
 J. Hernandez

Approved By: 
 P. Puzzuto

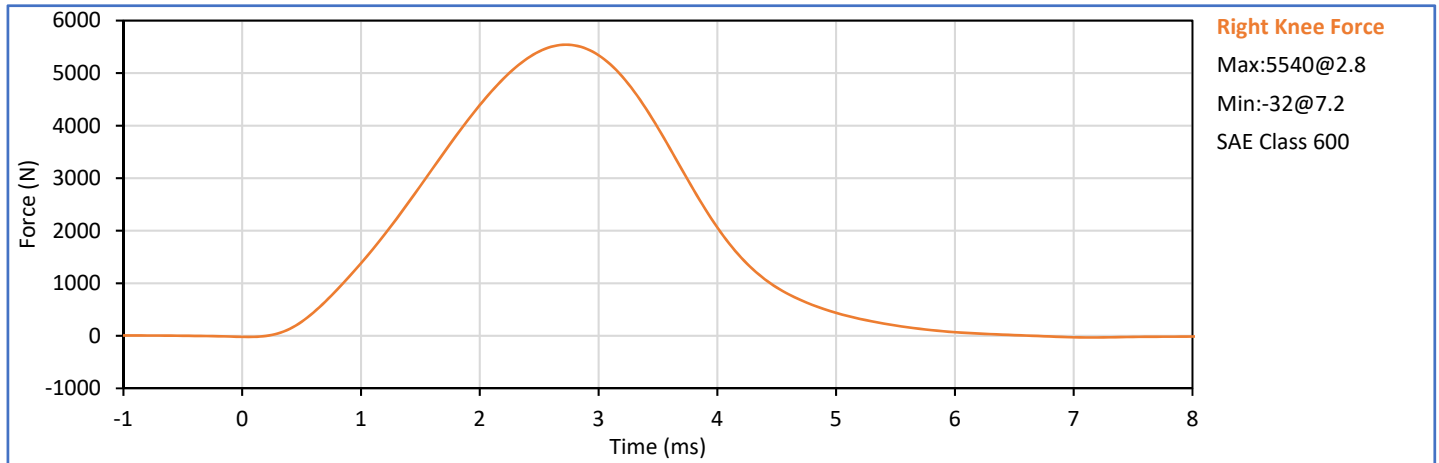
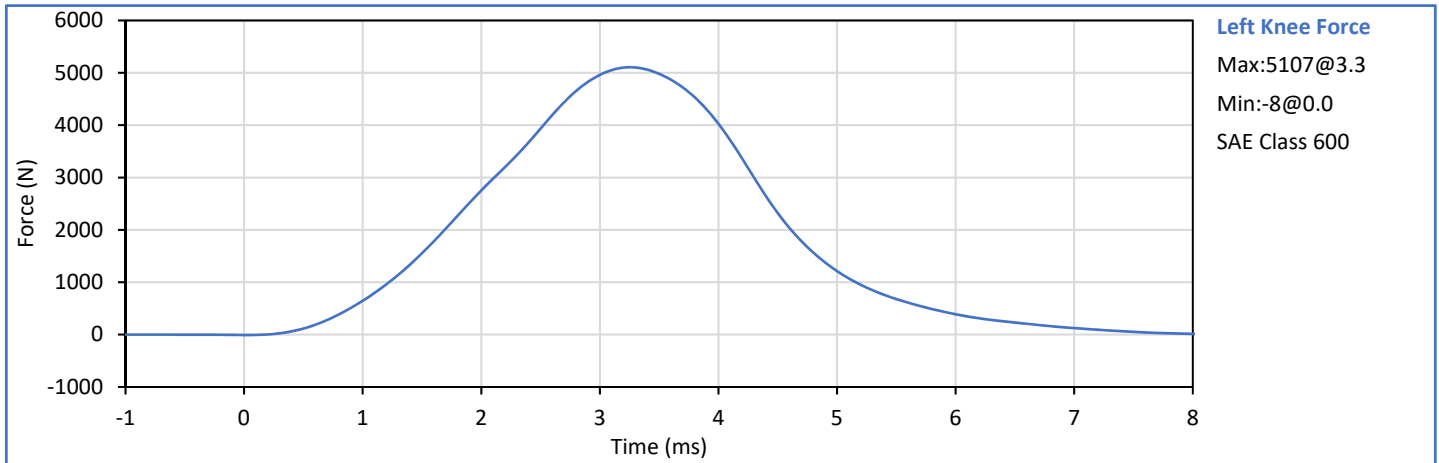
	Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
	Laboratory Temperature	°C	18.9	25.6	21.1	Pass
	Laboratory Relative Humidity	%	10	70	30	Pass
Left Hip	Left Hip Rotation Rate	deg/s	5.0	10.0	5.8	Pass
	Left Femur Torque at 30°	Nm	0.0	95.0	79.3	Pass
	Left Hip Rotation at 203 Nm	deg	40.0	50.0	47.1	Pass
Right Hip	Right Hip Rotation Rate	deg/s	5.0	10.0	5.8	Pass
	Right Femur Torque at 30°	Nm	0.0	95.0	78.8	Pass
	Right Hip Rotation at 203 Nm	deg	40.0	50.0	46.7	Pass
Overall Test Results						Pass




Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail	
Laboratory Temperature	°C	18.9	25.6	21.1	Pass	
Laboratory Relative Humidity	%	10	70	27	Pass	
Left Knee	Probe Velocity	m/s	2.070	2.130	2.093	Pass
	Peak Resistive Force	N	4715	5782	5107	Pass
Right Knee	Probe Velocity	m/s	2.070	2.130	2.081	Pass
	Peak Resistive Force	N	4715	5782	5540	Pass
Overall Test Results					Pass	



Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

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

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

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician: _____

J. Hernandez

Approved By: _____

P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	22	Pass
A - Total sitting height	mm	775	800	792	Pass
B - Shoulder pivot height	mm	432	457	449	Pass
C - 'H' point height	mm	81	86	84	Pass
D - 'H' point location from backline	mm	145	150	147	Pass
E - Shoulder pivot from backline	mm	69	84	77	Pass
F - Thigh clearance	mm	119	135	126	Pass
G - Back of elbow to wrist pivot	mm	244	259	252	Pass
H - Head back to backline	mm	41	46	42	Pass
I - Shoulder to elbow length	mm	277	297	282	Pass
J - Elbow rest height	mm	183	203	198	Pass
K - Buttock to knee length	mm	521	546	530	Pass
L - Popliteal length	mm	356	376	371	Pass
M - Knee pivot height	mm	394	419	404	Pass
N - Buttock popliteal length	mm	414	439	430	Pass
O - Chest depth without jacket	mm	175	191	184	Pass
P - Foot length	mm	219	234	227	Pass
R - Buttock to Knee Pivot Length	mm	457	483	470	Pass
S - Head Breadth	mm	137	147	141	Pass
T - Head Depth	mm	178	188	184	Pass
U - Hip Breadth	mm	300	315	310	Pass
V - Shoulder breadth	mm	351	366	361	Pass
W - Foot breadth	mm	79	94	87	Pass
X - Head circum.	mm	528	549	537	Pass
Y - Chest circum. (w/chest jacket)	mm	851	881	868	Pass
Z - Waist circum.	mm	760	790	776	Pass
AA - Location for chest circum.	mm	333	358	340	Pass
BB - Location for waist circum.	mm	160	170	165	Pass
Overall Test Results					Pass

Technician: _____



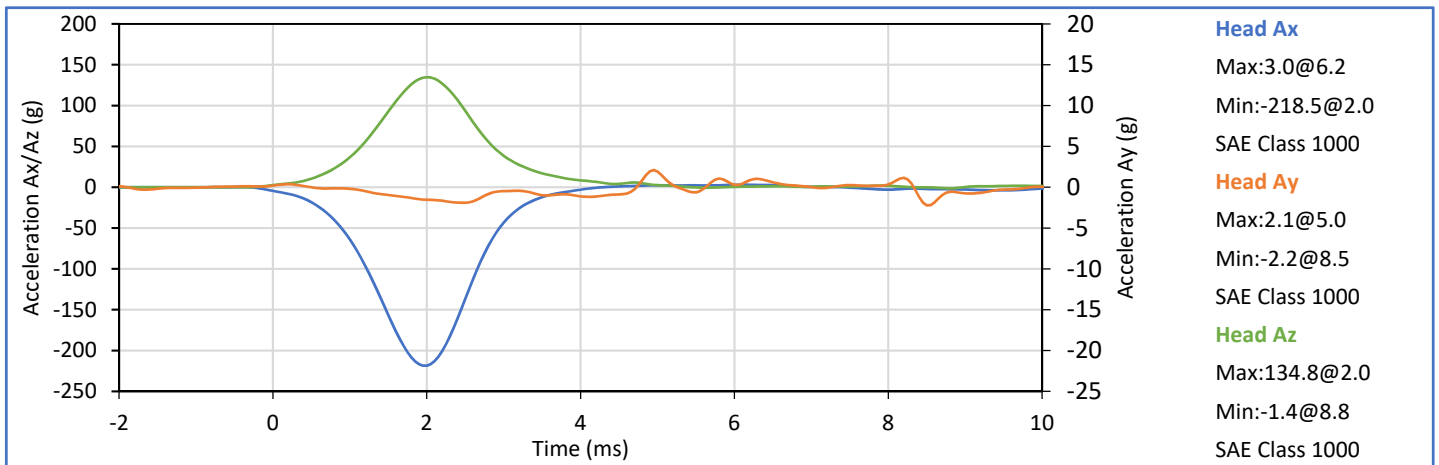
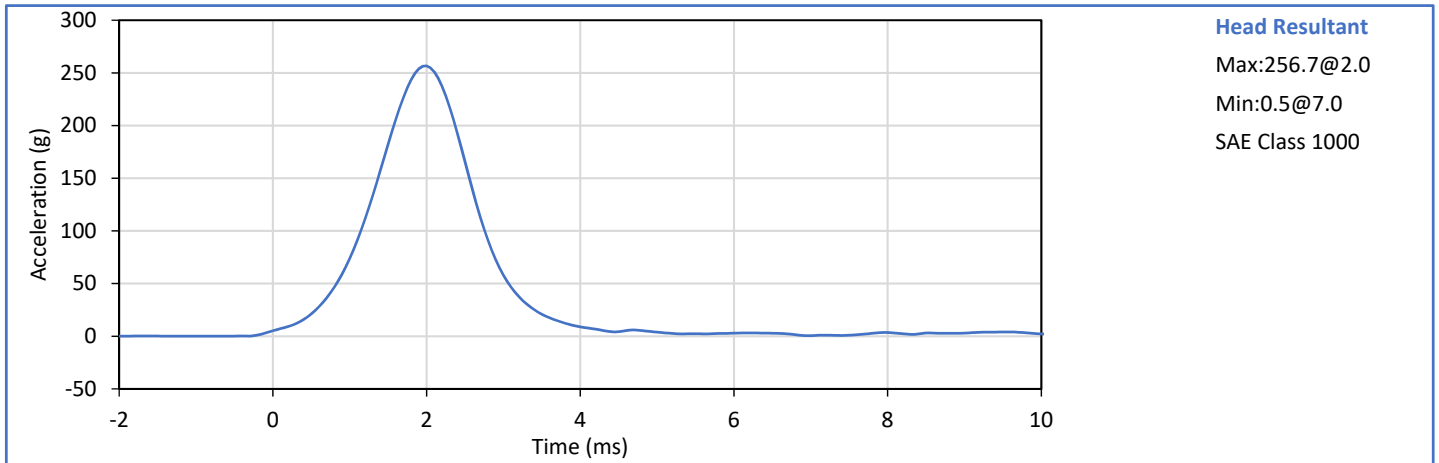
J. Hernandez

Approved By: _____




P. Puzzuto

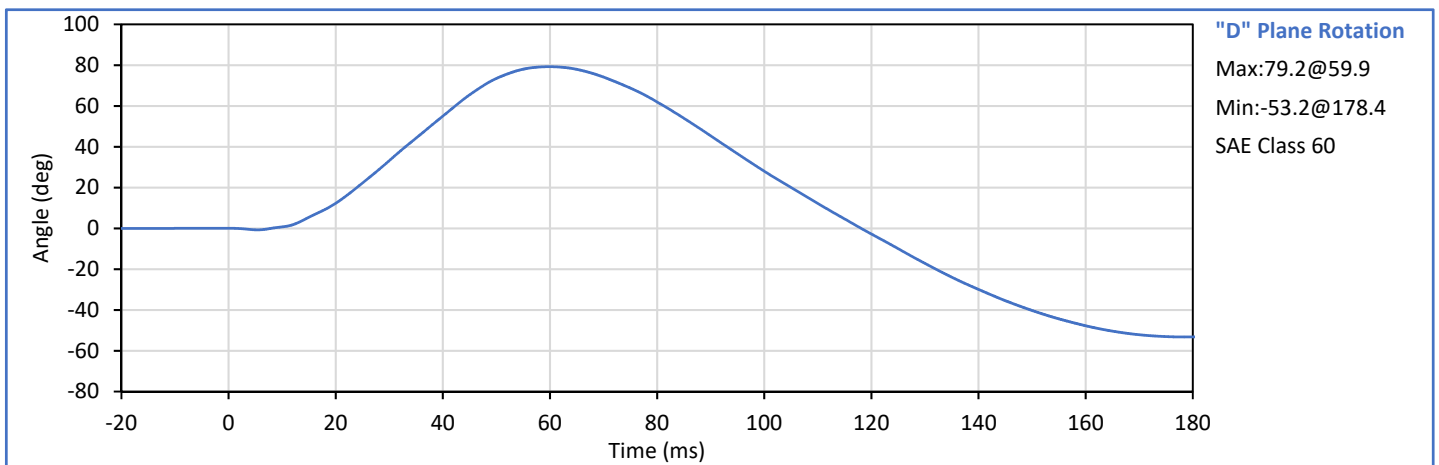
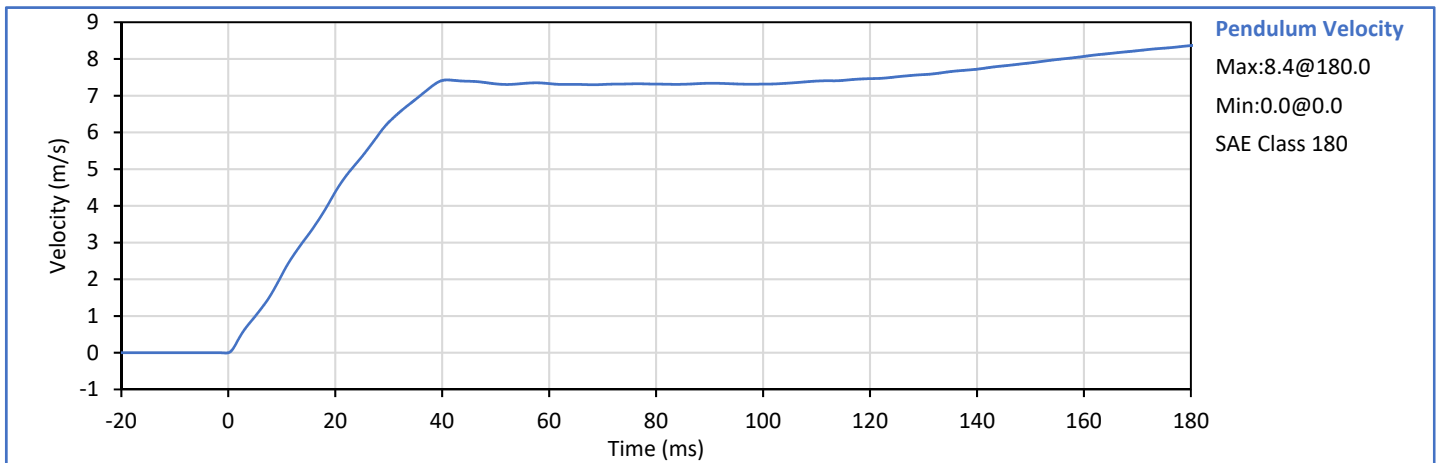
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	20.0	Pass
Laboratory Humidity	%	10	70	20	Pass
Peak Resultant Acceleration	g	250.0	300.0	256.7	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-2.2	Pass
Oscillations After Main Pulse	%	0.0	10.0	1.6	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
Overall Test Results					Pass





Technician: 
J. Hernandez

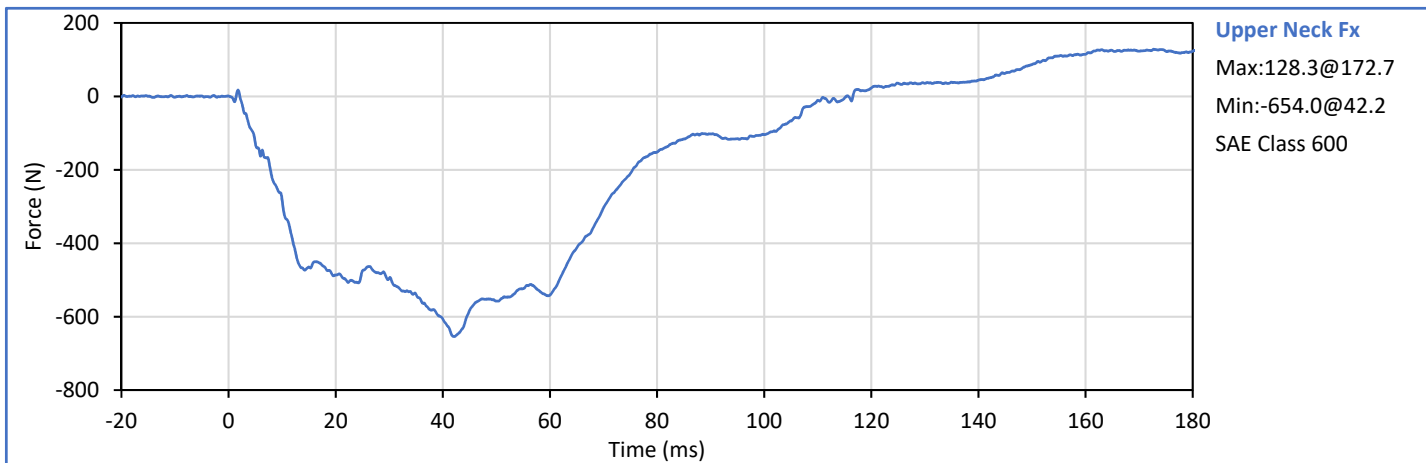
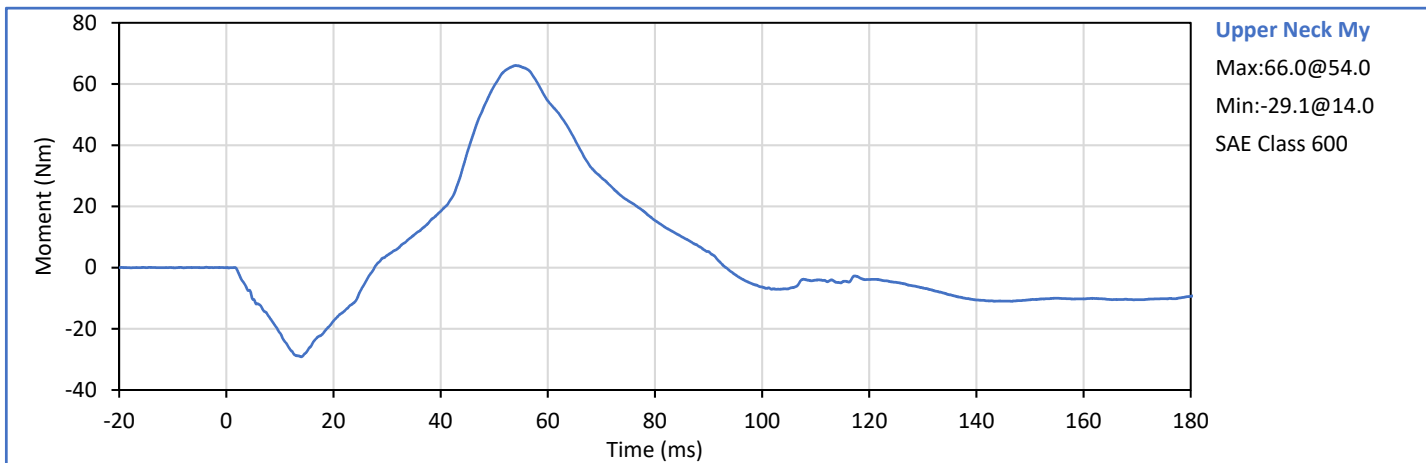
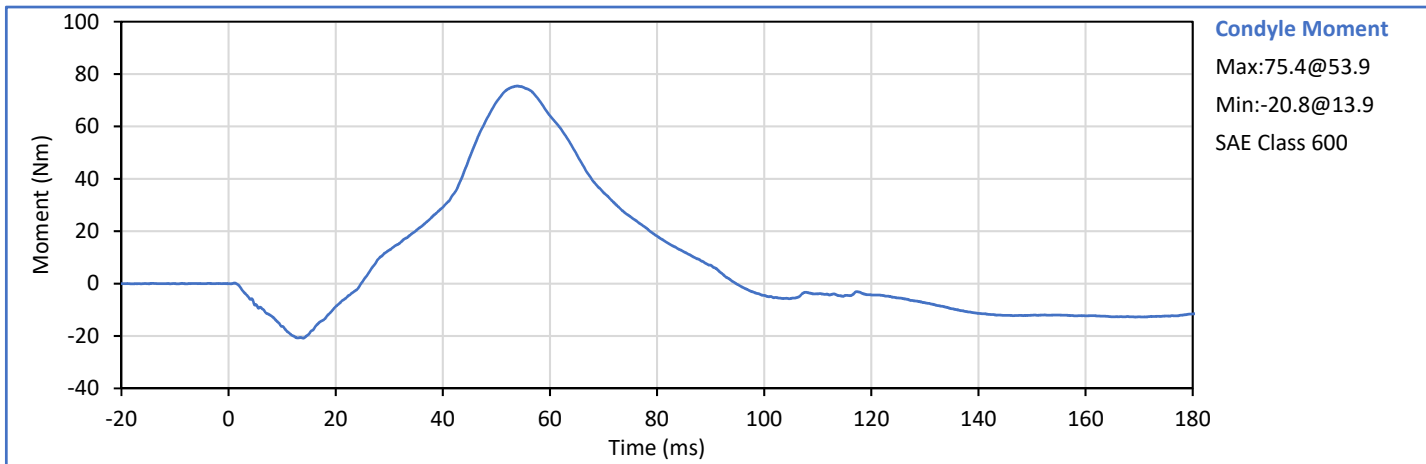
Approved By: 
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	17	Pass
Pendulum Velocity	m/s	6.89	7.13	7.01	Pass
Pendulum Velocity at 10 ms	m/s	2.10	2.50	2.12	Pass
Pendulum Velocity at 20 ms	m/s	4.00	5.00	4.38	Pass
Pendulum Velocity at 30 ms	m/s	5.80	7.00	6.28	Pass
Peak "D" Plane Rotation	deg	77.0	91.0	79.2	Pass
Peak Moment in Rotation	Nm	69.0	83.0	75.4	Pass
Positive Moment Decay to 10 Nm	ms	80.0	100.0	87.1	Pass
Overall Test Results					Pass



Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

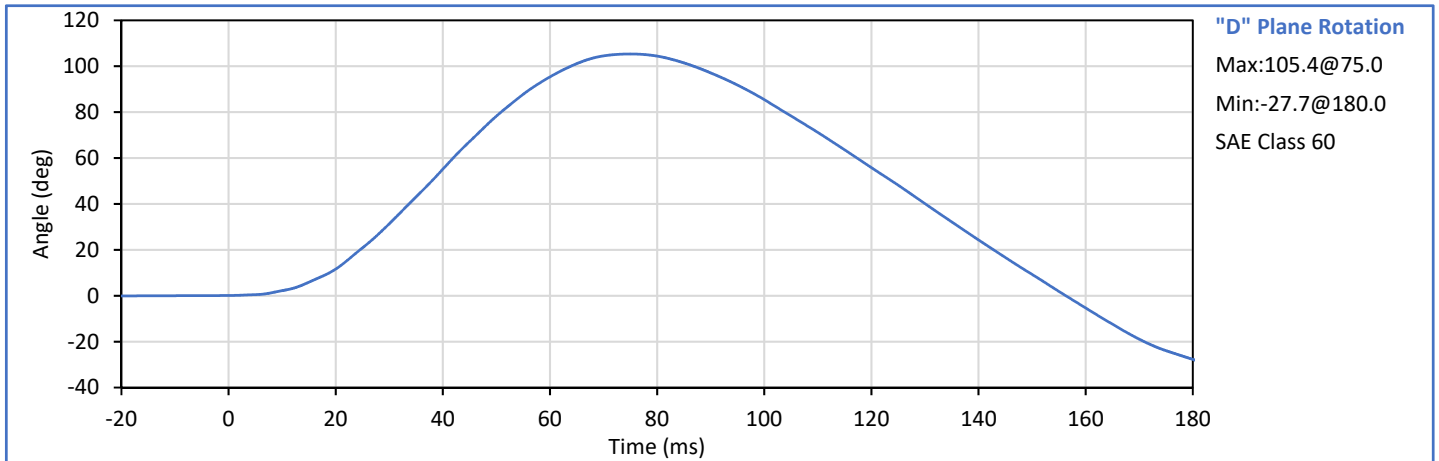
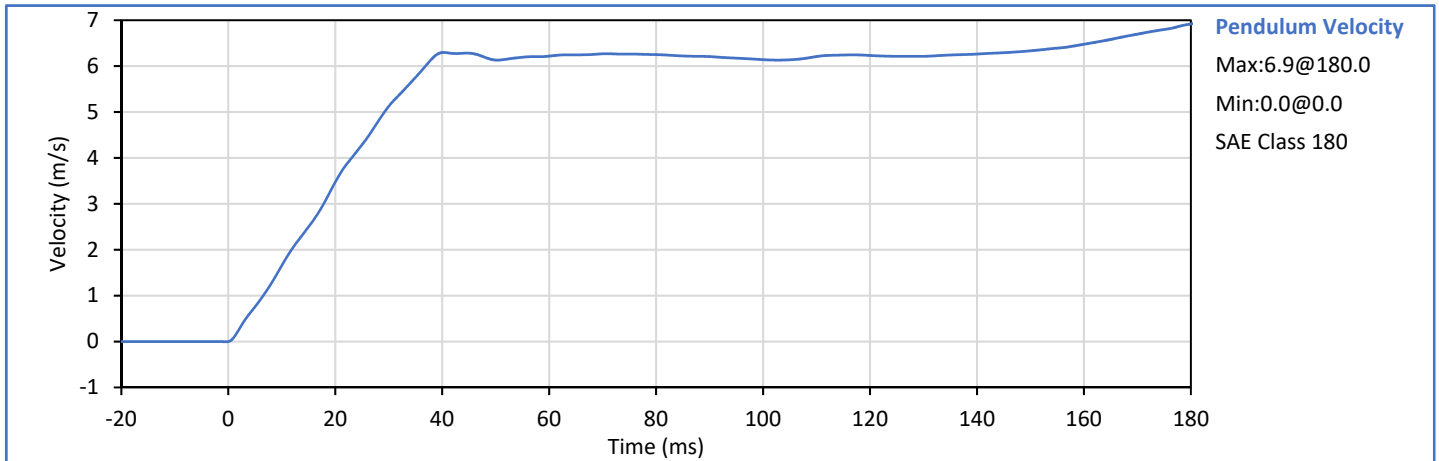


APPENDIX C
Post-Test ATD Qualification and Performance Verification
Hybrid III 50th Percentile Male ATD
S/N: 360


ATD Serial No.: 141

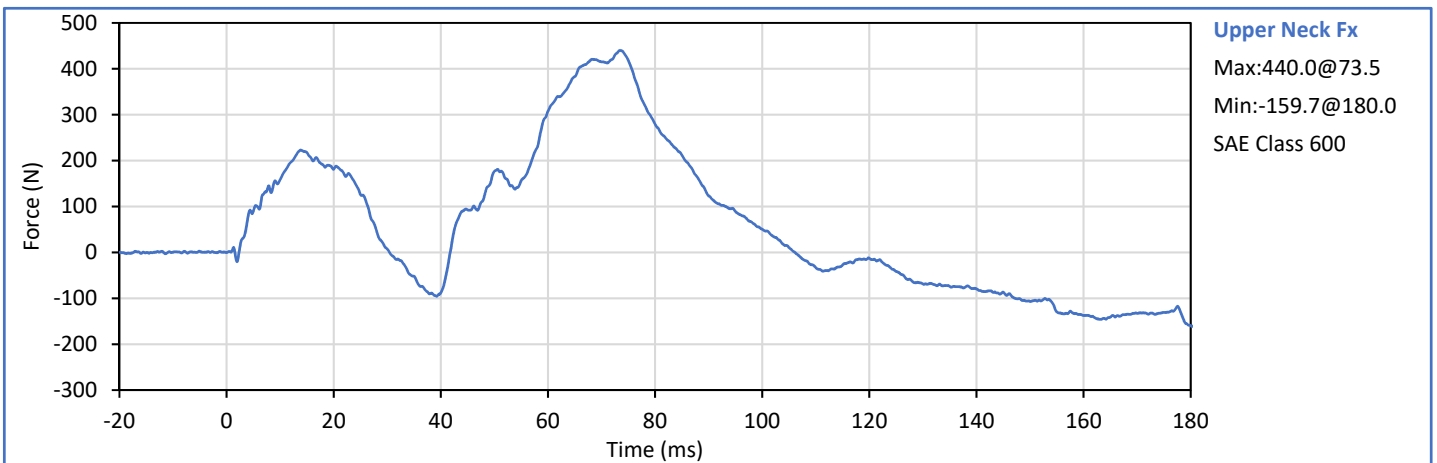
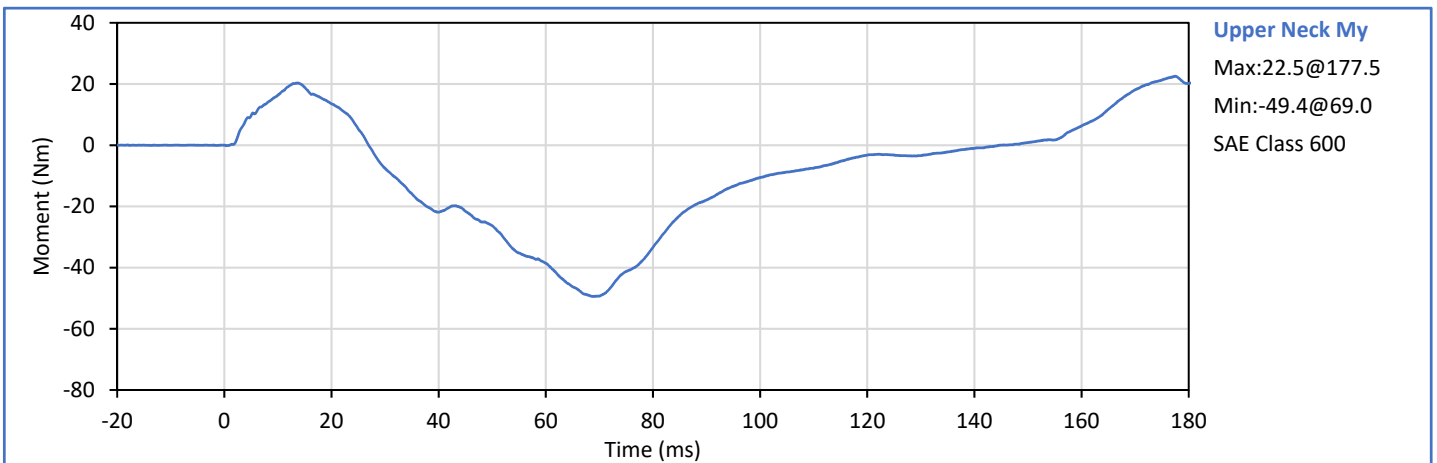
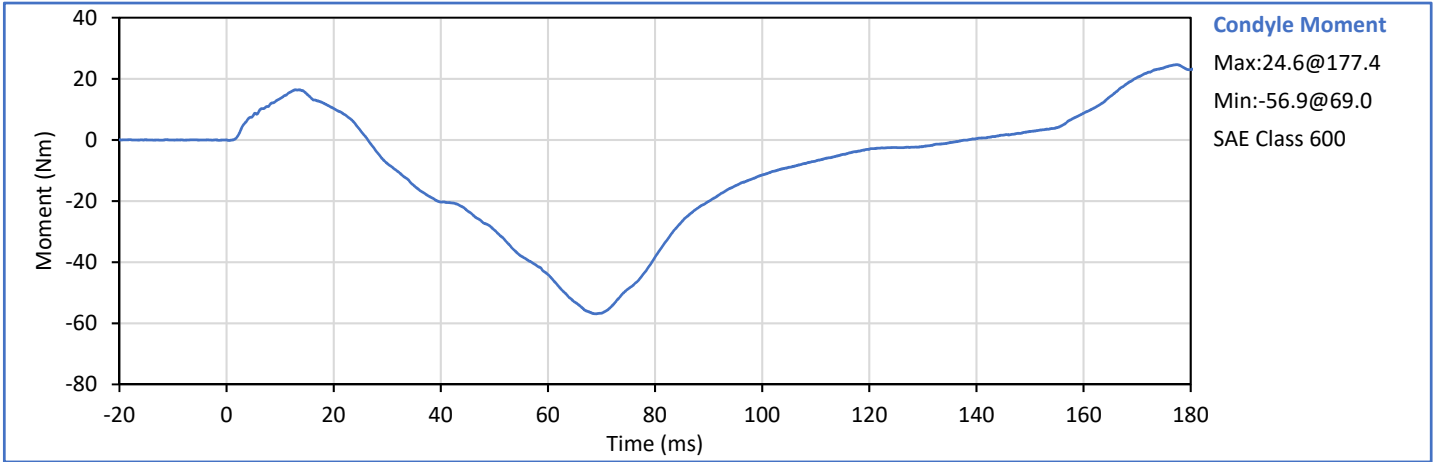
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Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	16	Pass
Pendulum Velocity	m/s	5.95	6.19	6.02	Pass
Pendulum Velocity at 10 ms	m/s	1.50	1.90	1.66	Pass
Pendulum Velocity at 20 ms	m/s	3.10	3.90	3.47	Pass
Pendulum Velocity at 30 ms	m/s	4.60	5.60	5.12	Pass
Peak "D" Plane Rotation	deg	99.0	114.0	105.4	Pass
Peak Moment in Rotation	Nm	-65.0	-53.0	-56.9	Pass
Negative Moment Decay to -10 Nm	ms	94.0	114.0	102.8	Pass
Overall Test Results					Pass

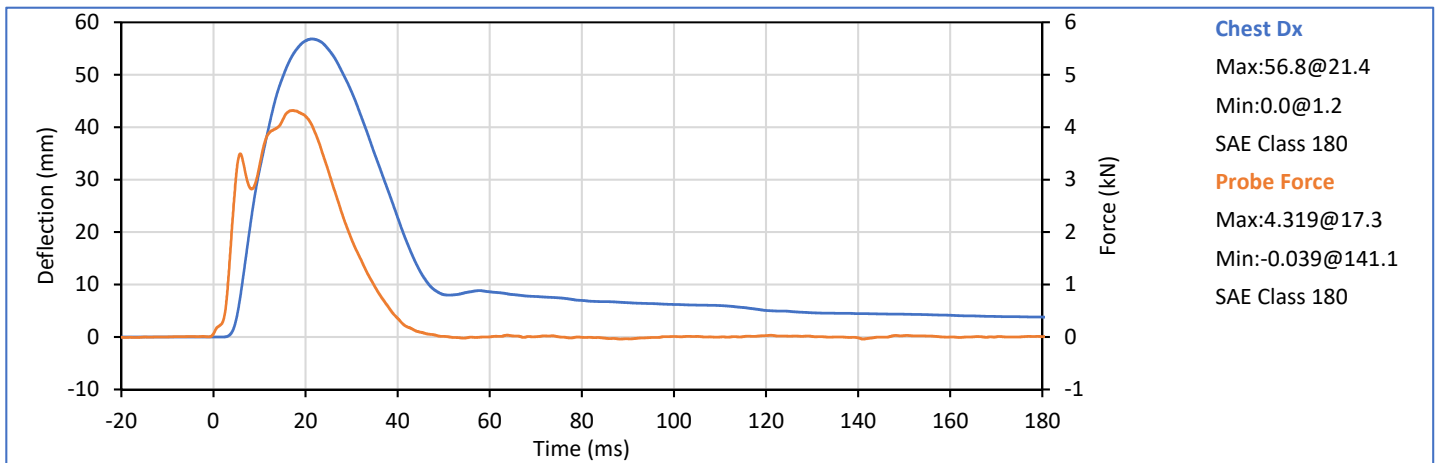
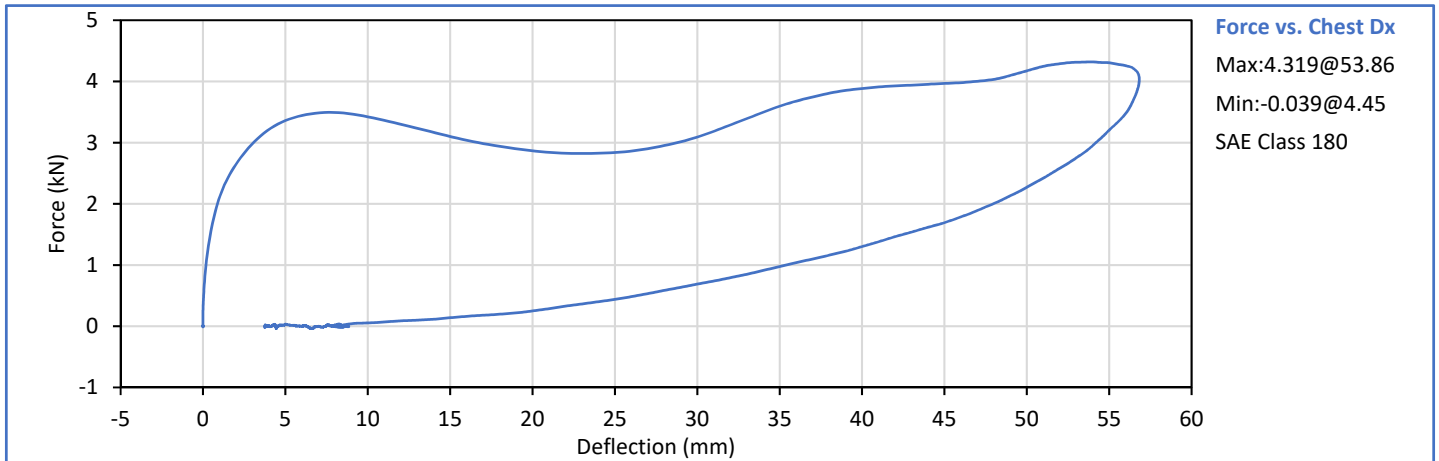


Technician: 
J. Hernandez


Approved By: 
P. Puzzuto



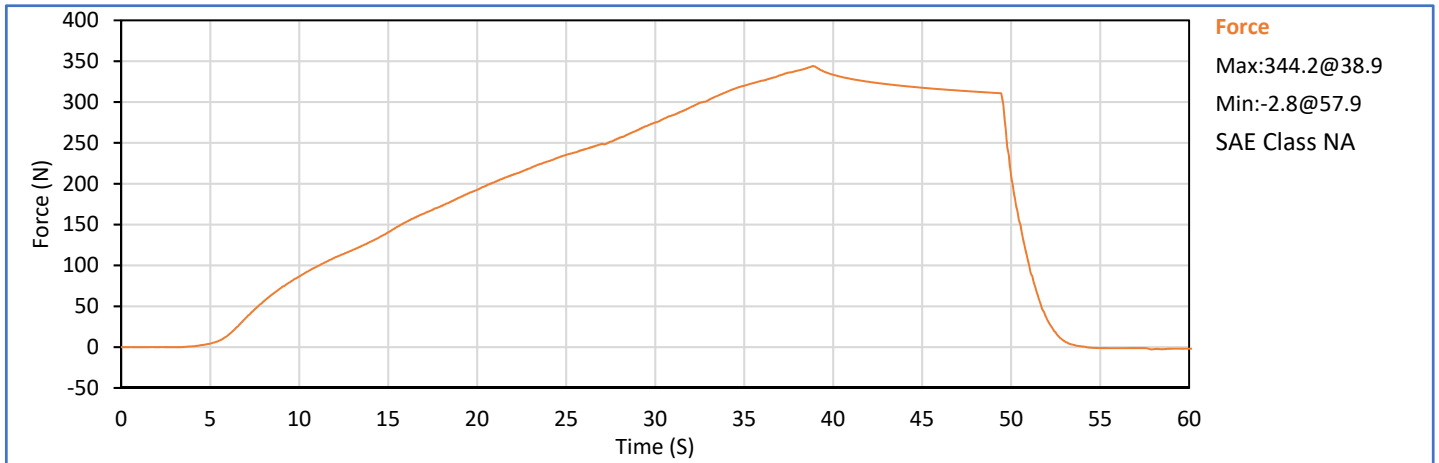
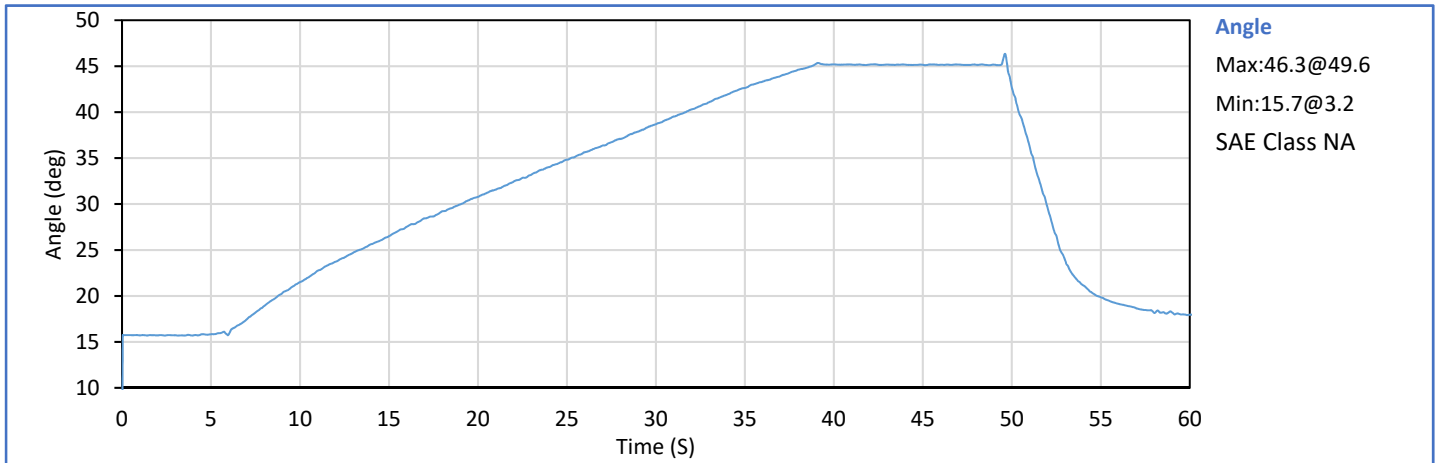
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	20	Pass
Probe Velocity	m/s	6.59	6.83	6.64	Pass
Peak Chest Deflection	mm	50.0	58.0	56.8	Pass
Peak Probe Force, 50 and 58 mm	kN	3.900	4.400	4.319	Pass
Peak Probe Force, 18 and 50 mm	kN	0.000	4.600	4.171	Pass
Internal Hysterisis	%	69.0	85.0	72.8	Pass
Overall Test Results					Pass




Technician: 
 J. Hernandez

Approved By: 
 P. Puzzuto

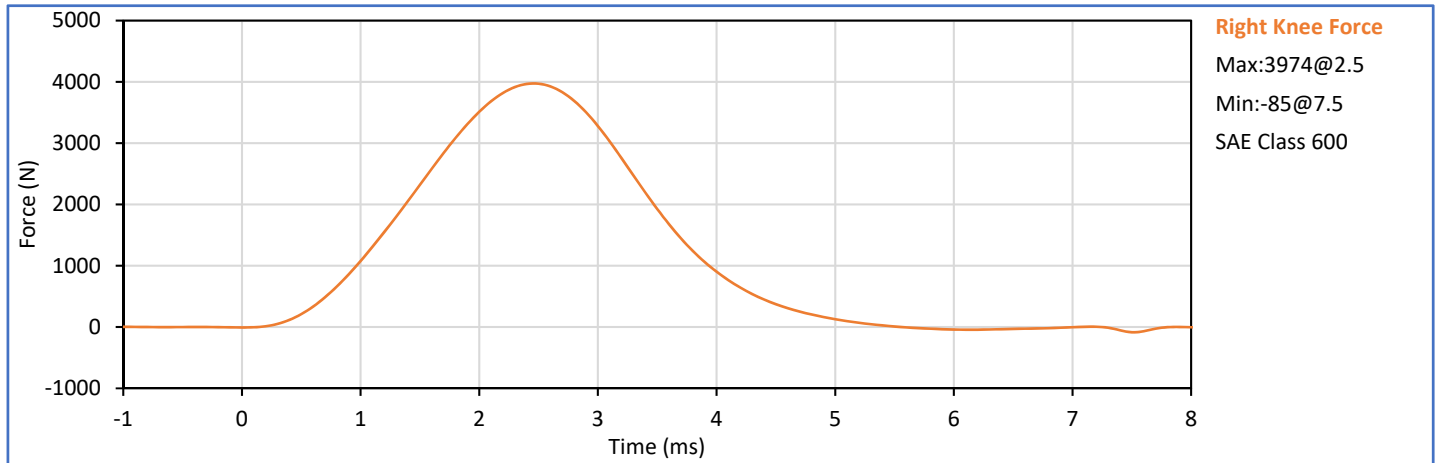
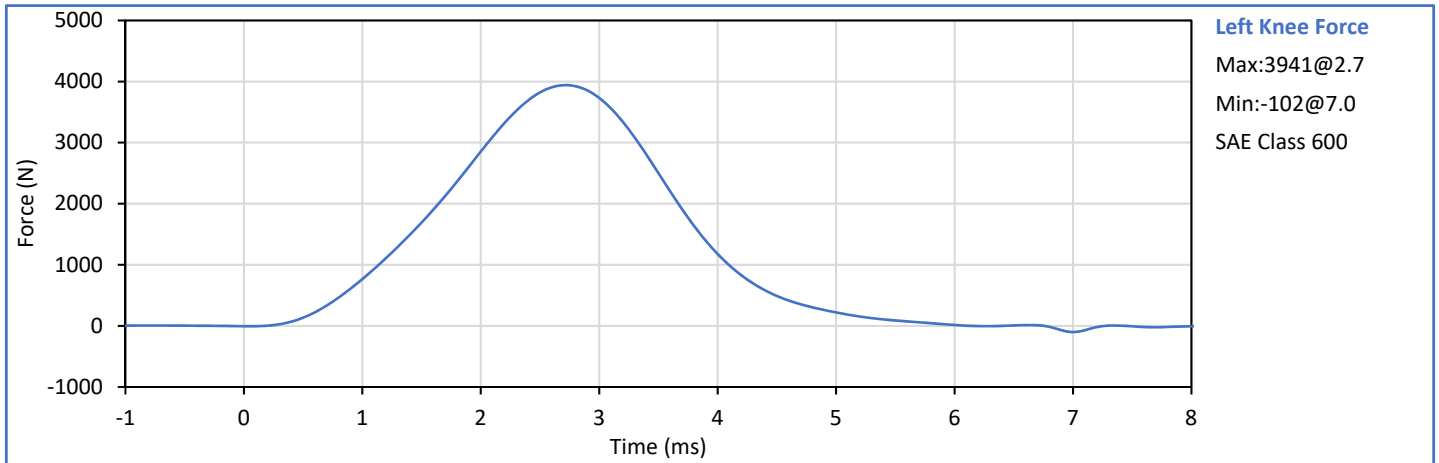
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	20.6	Pass
Laboratory Humidity	%	10	70	20	Pass
Orientation Angle	deg	0.0	20.0	15.0	Pass
Test Initial Angle	deg	11.0	19.0	15.7	Pass
Peak Force at 45° (+/-0.5°)	N	320.0	390.0	344.2	Pass
Torso Flexion Rate	deg/s	0.50	1.50	0.88	Pass
Final Reference Plane Angle	deg	-8.0	8.0	0.8	Pass
Overall Test Results					Pass




Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

	Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
	Laboratory Temperature	°C	18.9	25.6	20.0	Pass
	Laboratory Humidity	%	10	70	18	Pass
Left	Probe Velocity	m/s	2.070	2.130	2.121	Pass
Knee	Peak Resistive Force	N	3450	4060	3941	Pass
Right	Probe Velocity	m/s	2.070	2.130	2.115	Pass
Knee	Peak Resistive Force	N	3450	4060	3974	Pass
Overall Test Results						Pass



Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

ATD Serial No.: 360


Test Date: 2020-02-24

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

Describe any repairs or replacement of parts or other findings:

No Problems Found

Technician: _____



J. Hernandez


Approved By: _____



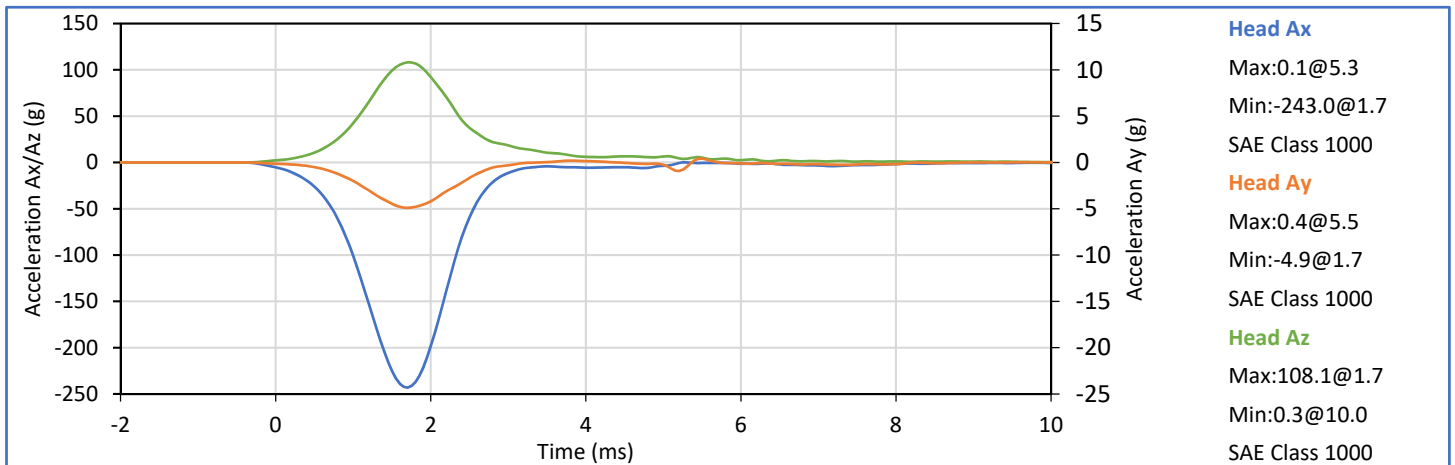
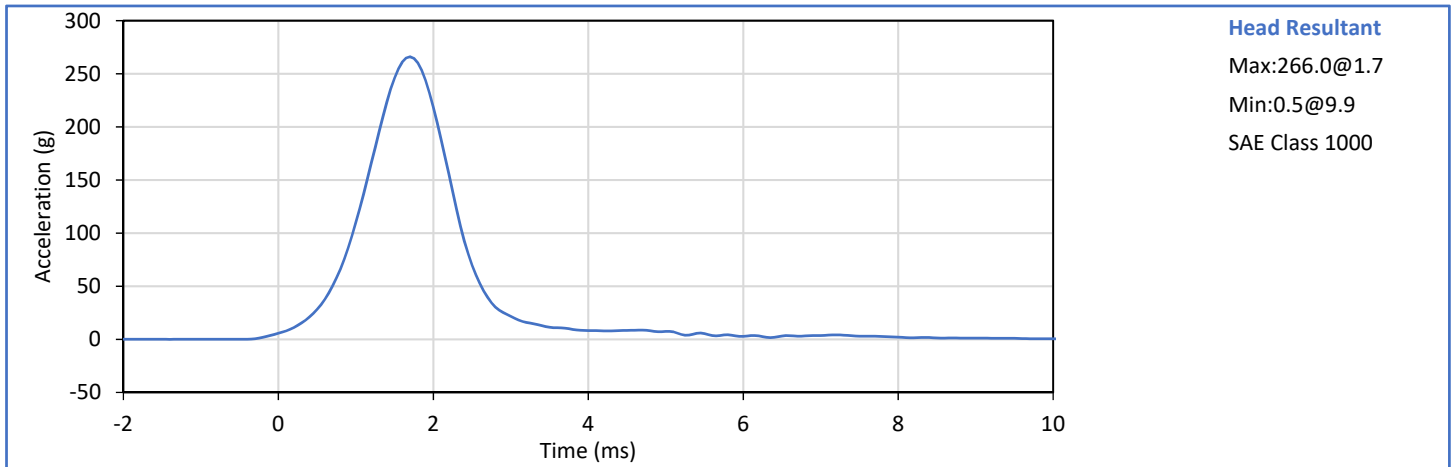
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Relative Humidity	%	10	70	26	Pass
A - Total sitting height	mm	879	889	885	Pass
B - Shoulder pivot height	mm	505	521	519	Pass
C - 'H' point height	mm	84	89	87	Pass
D - 'H' point location from backline	mm	135	140	138	Pass
E - Shoulder pivot from backline	mm	84	94	91	Pass
F - Thigh clearance	mm	140	155	153	Pass
G - Back of elbow to wrist pivot	mm	290	305	301	Pass
H - Head back to backline	mm	41	46	46	Pass
I - Shoulder to elbow length	mm	330	345	339	Pass
J - Elbow rest height	mm	190	211	203	Pass
K - Buttock to knee length	mm	579	604	592	Pass
L - Popliteal length	mm	429	455	448	Pass
M - Knee pivot height	mm	485	500	492	Pass
N - Buttock popliteal length	mm	452	477	467	Pass
O - Chest depth without jacket	mm	213	229	220	Pass
P - Foot length	mm	251	267	259	Pass
V - Shoulder breadth	mm	422	437	431	Pass
W - Foot breadth	mm	91	107	98	Pass
Y - Chest circum. (w/chest jacket)	mm	970	1001	975	Pass
Z - Waist circum.	mm	836	866	850	Pass
AA - Location for chest circum.	mm	429	434	431	Pass
BB - Location for waist circum.	mm	226	231	228	Pass
Overall Test Results					Pass

Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

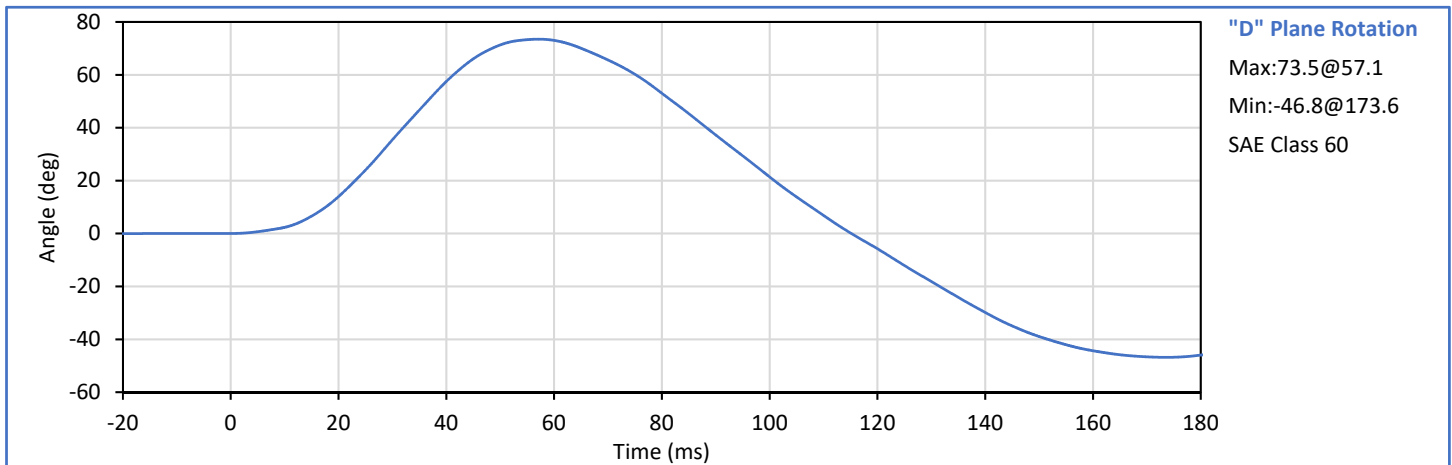
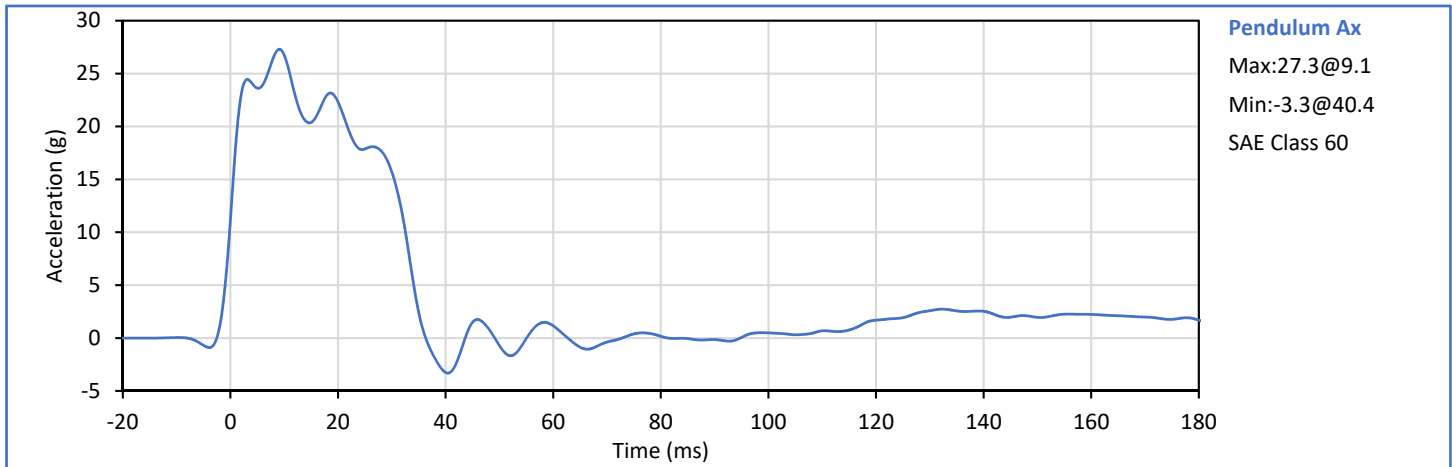
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Peak Resultant Acceleration	g	225.0	275.0	266.0	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-4.9	Pass
Oscillations After Main Pulse	%	0.0	10.0	1.6	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
Overall Test Results					Pass

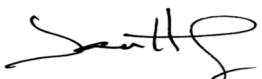



Technician: J. Hernandez

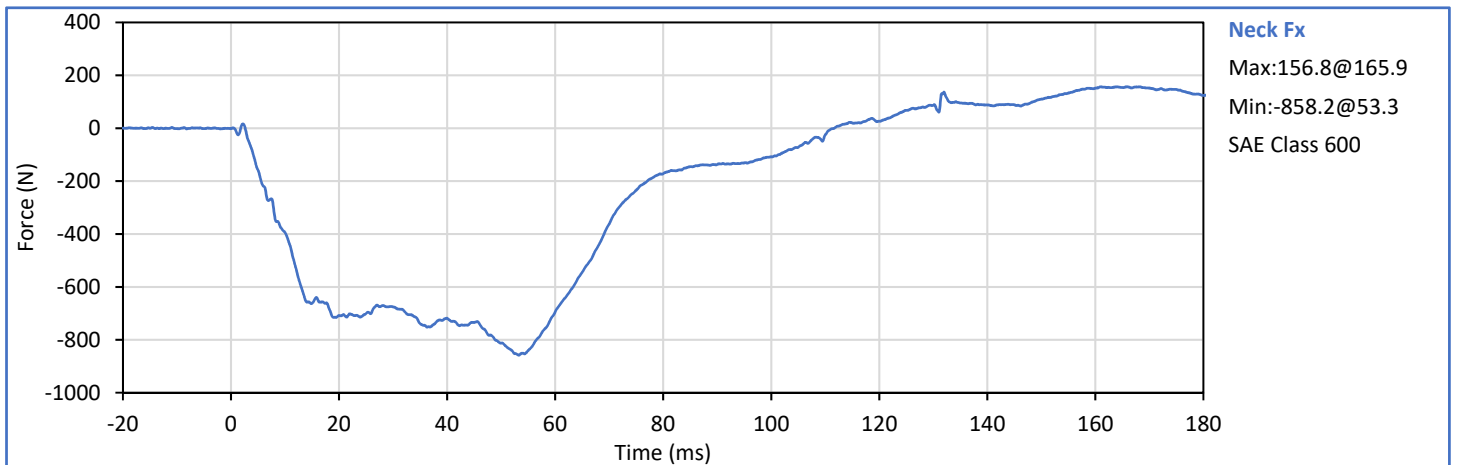
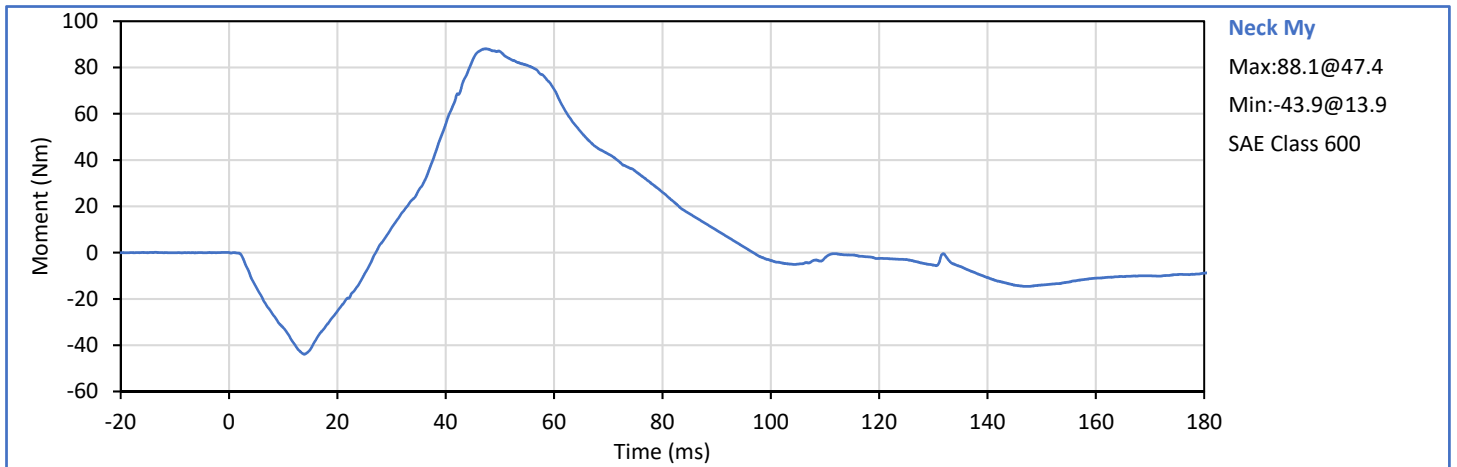
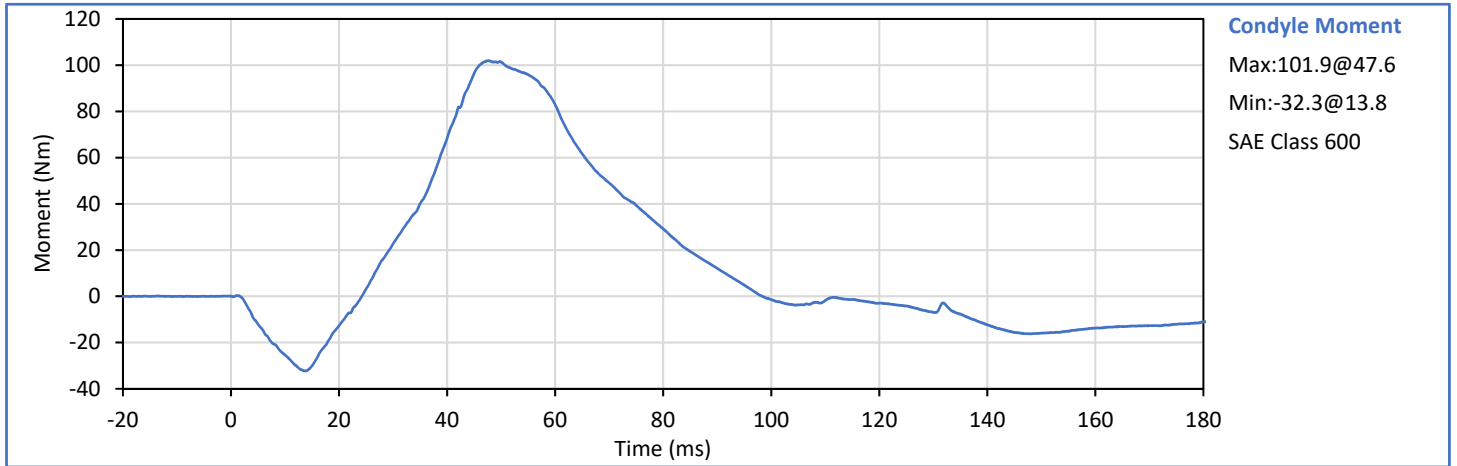
Approved By: P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	29	Pass
Pendulum Velocity	m/s	6.89	7.13	7.00	Pass
Pendulum Deceleration at 10 ms	g	22.5	27.5	26.7	Pass
Pendulum Deceleration at 20 ms	g	17.6	22.6	22.3	Pass
Pendulum Deceleration at 30 ms	g	12.5	18.5	15.7	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	29.0	15.7	Pass
Deceleration Decay to Cross 5 g	ms	34.0	42.0	34.1	Pass
"D" Plane Rotation peak	deg	64.0	78.0	73.5	Pass
	ms	57.0	64.0	57.1	Pass
"D" Plane Rotation Decay To Zero	ms	113.0	128.0	115.2	Pass
Moment About Occipital Condyle	Nm	88.1	108.5	101.9	Pass
	ms	47.0	58.0	47.6	Pass
Moment Decay, Peak to Zero	ms	97.0	107.0	98.4	Pass
Overall Test Results					Pass

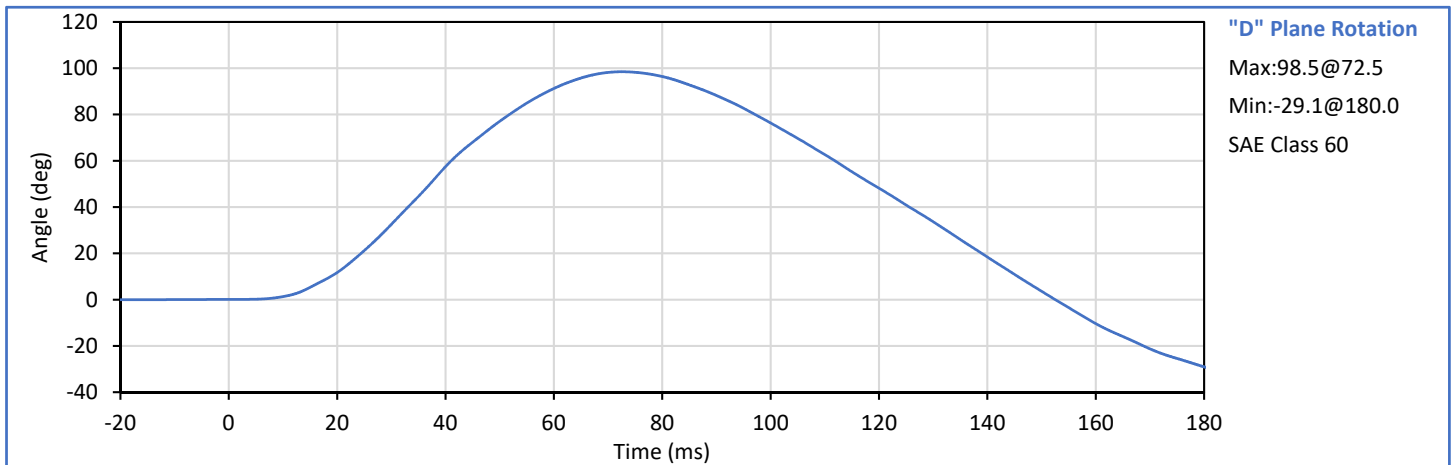
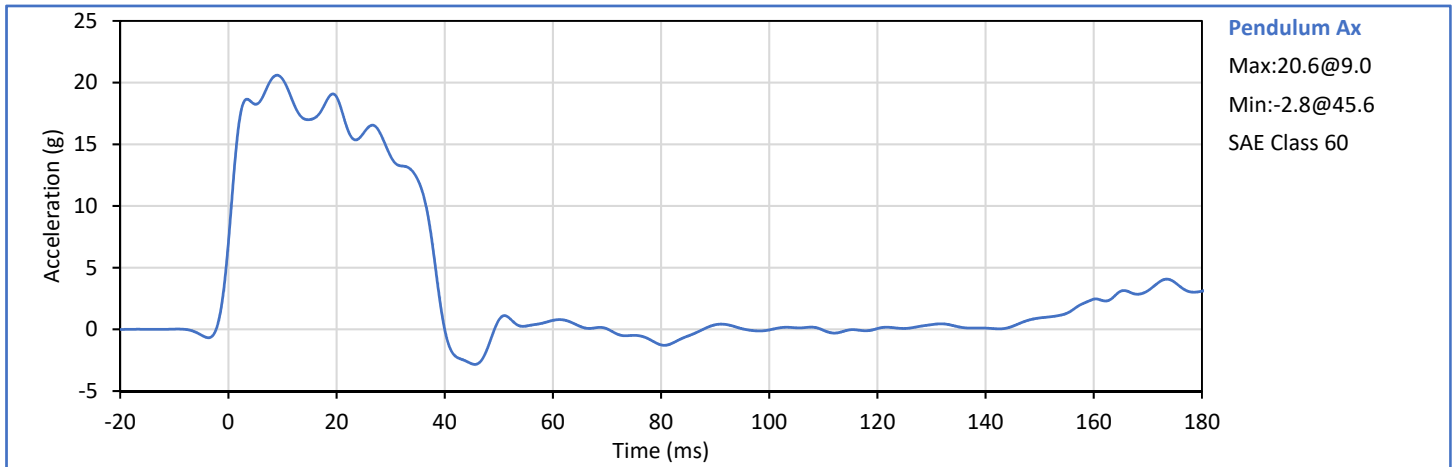


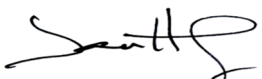
Technician: 
J. Hernandez


Approved By: 
P. Puzzuto

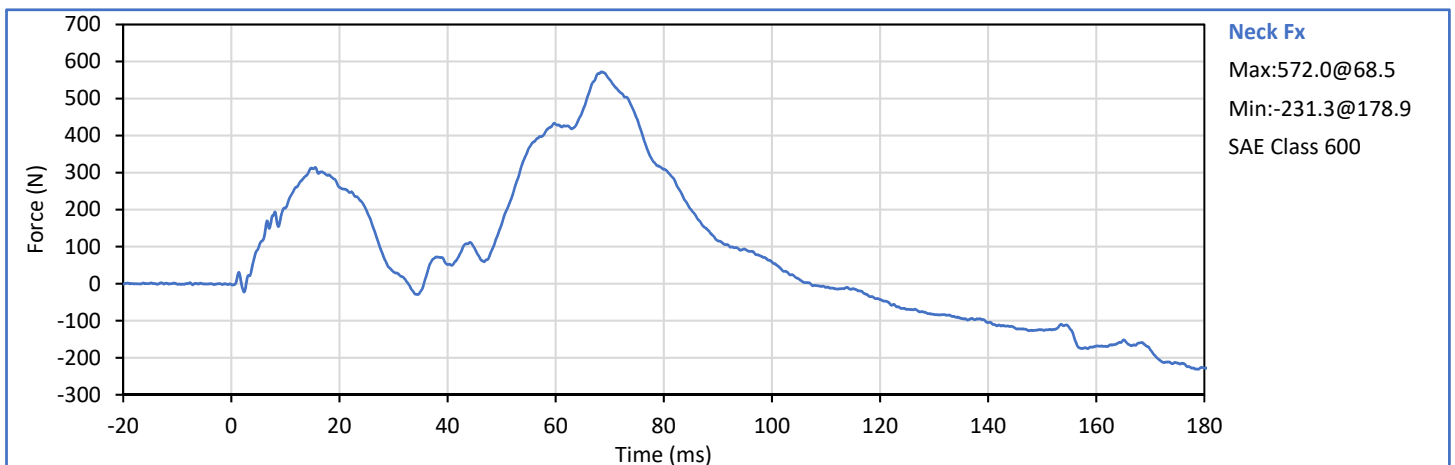
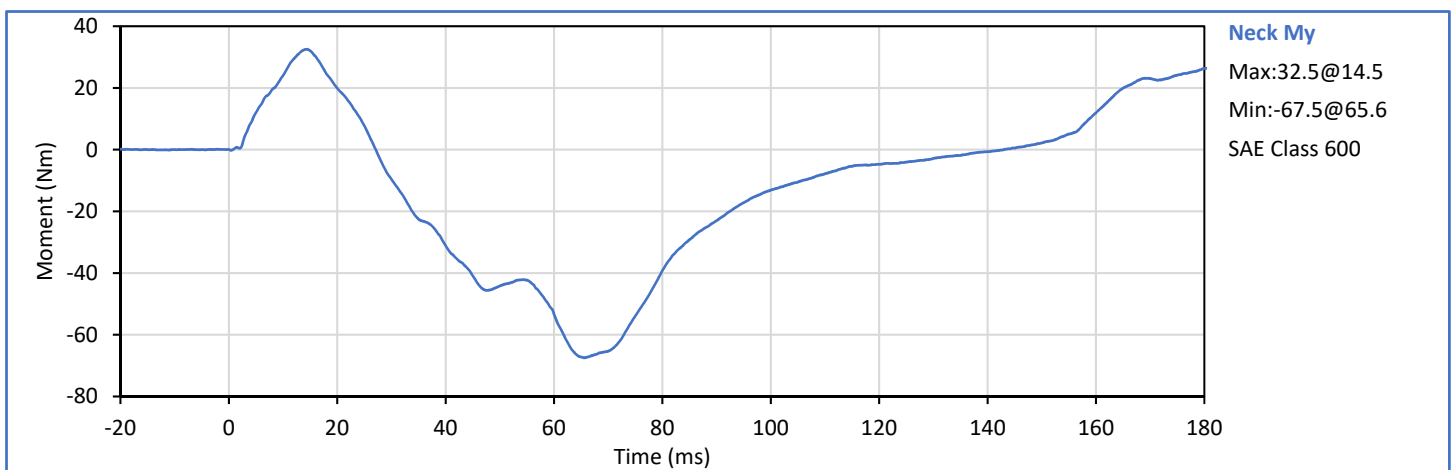
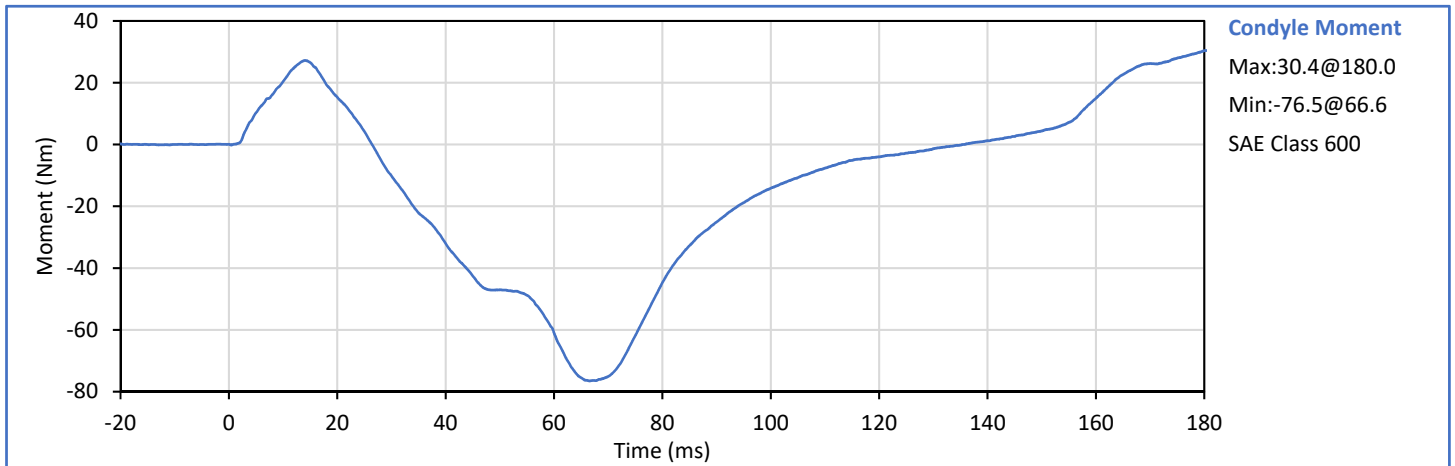


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.94	6.19	6.06	Pass
Pendulum Deceleration at 10 ms	g	17.2	21.2	20.3	Pass
Pendulum Deceleration at 20 ms	g	14.0	19.0	18.8	Pass
Pendulum Deceleration at 30 ms	g	11.0	16.0	14.0	Pass
Peak Pendulum Decel. after 30 ms	g	0.0	22.0	14.0	Pass
Deceleration Decay to Cross 5 g	ms	38.0	46.0	38.3	Pass
"D" Plane Rotation peak	deg	81.0	106.0	98.5	Pass
	ms	72.0	82.0	72.5	Pass
"D" Plane Rotation Decay To Zero	ms	147.0	174.0	152.6	Pass
Moment About Occipital Condyle	Nm	-79.9	-52.9	-76.5	Pass
	ms	65.0	79.0	66.6	Pass
Moment Decay, Peak to Zero	ms	120.0	148.0	135.4	Pass
Overall Test Results					Pass

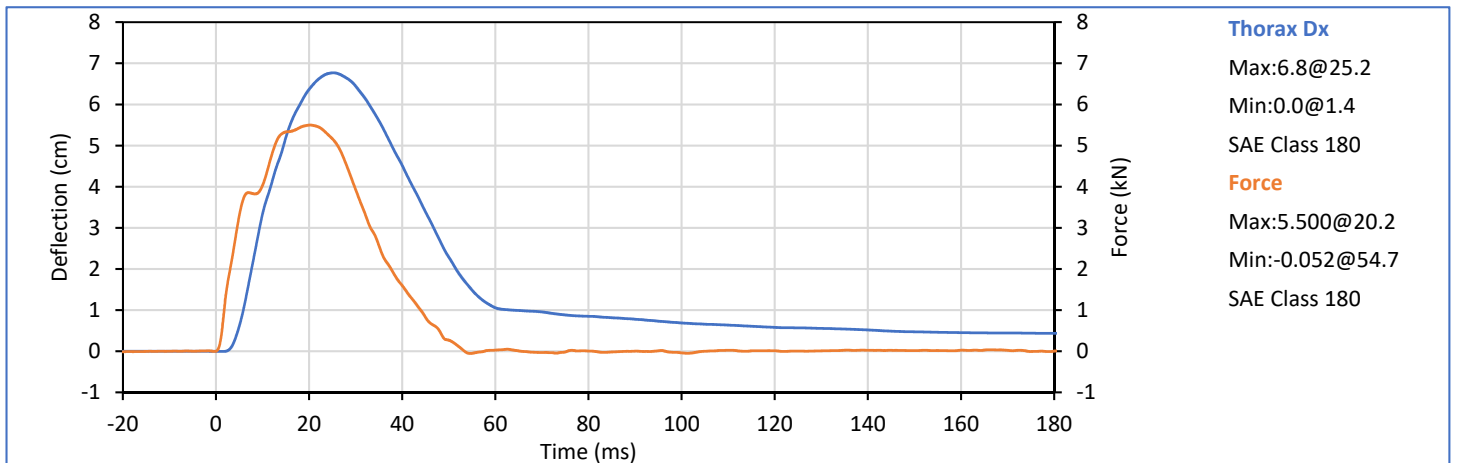
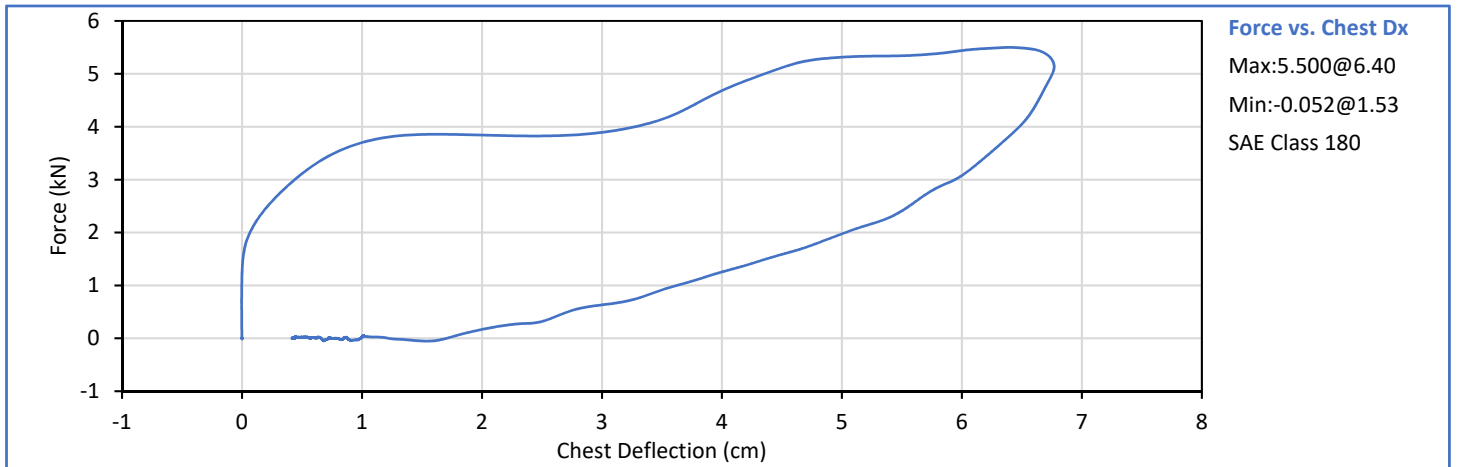


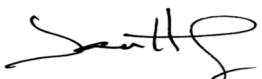
Technician: 
J. Hernandez


Approved By: 
P. Puzzuto



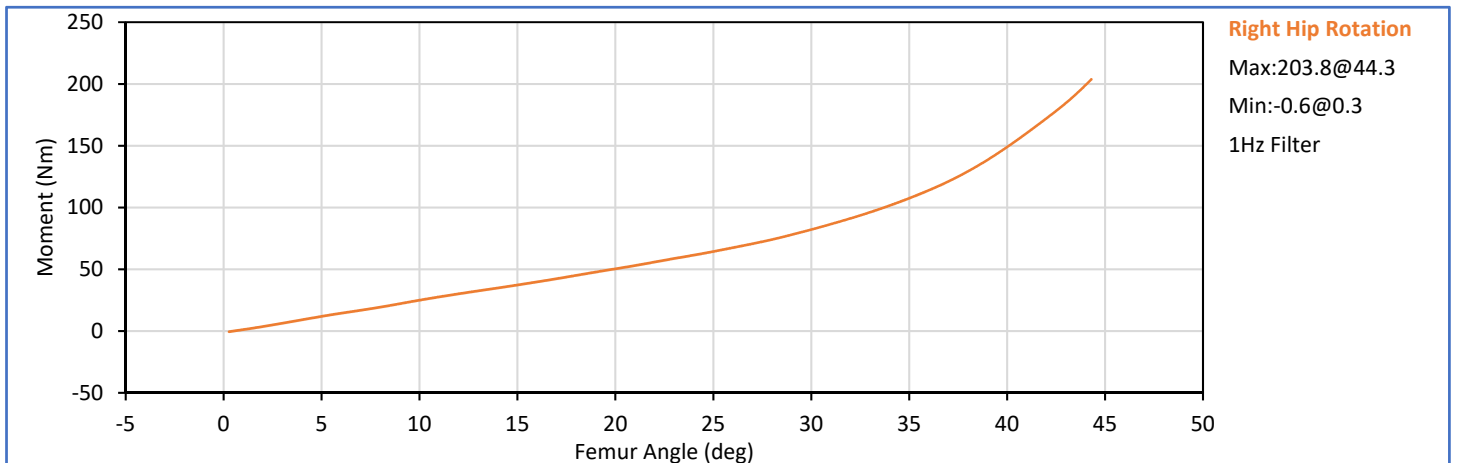
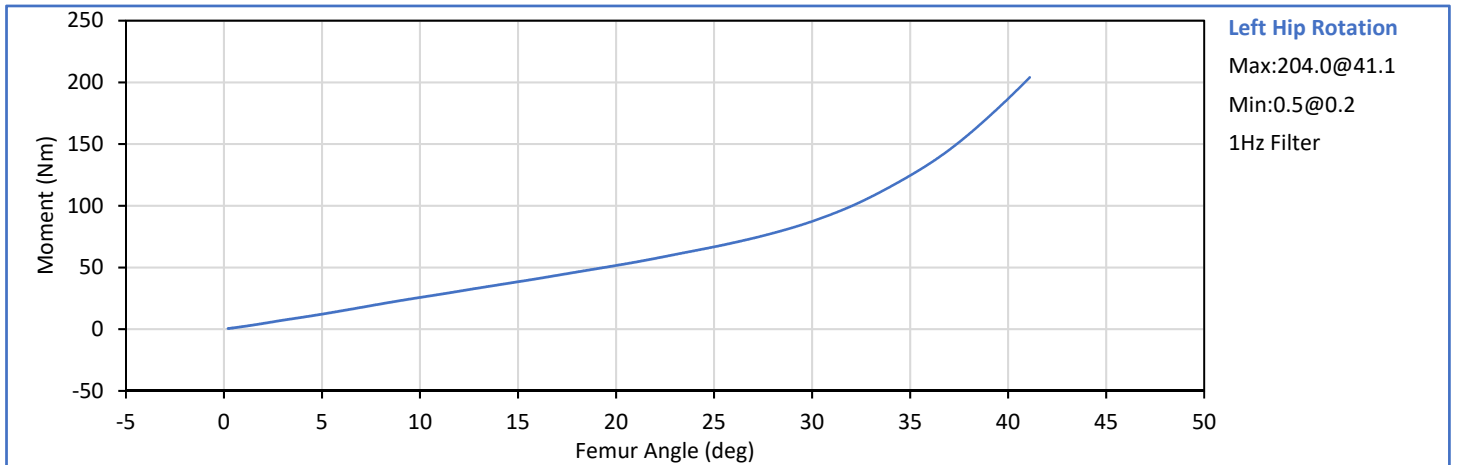
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Relative Humidity	%	10	70	27	Pass
Probe Velocity	m/s	6.58	6.82	6.67	Pass
Peak Chest Deflection	cm	6.35	7.26	6.77	Pass
Peak Probe Force	kN	5.159	5.893	5.500	Pass
Internal Hysterisis	%	69.0	85.0	71.6	Pass
Overall Test Results					Pass




Technician: 
 J. Hernandez

Approved By: 
 P. Puzzuto

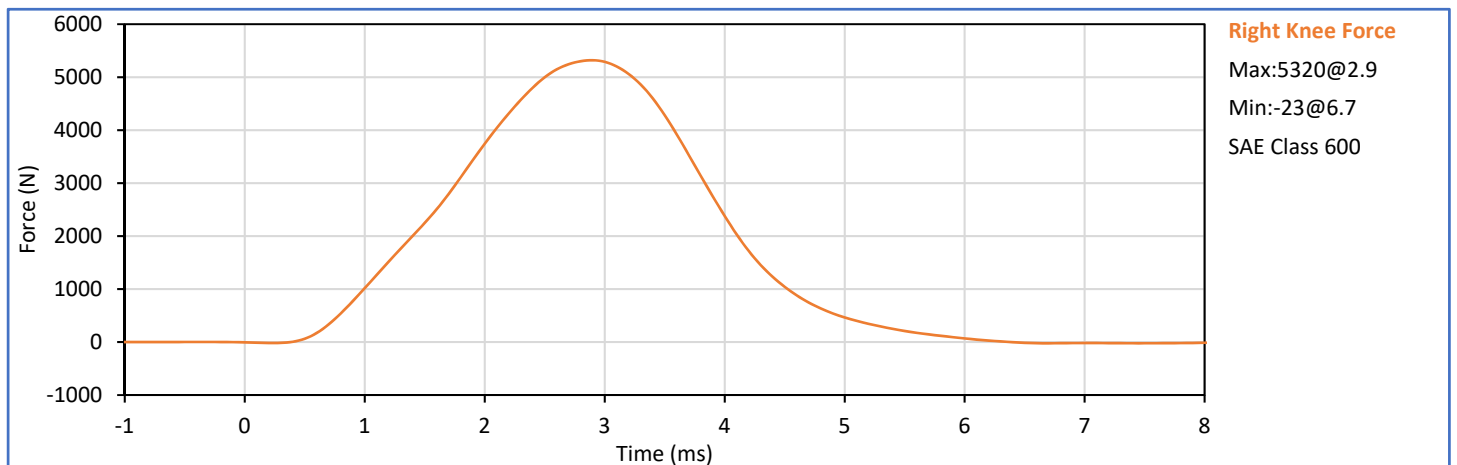
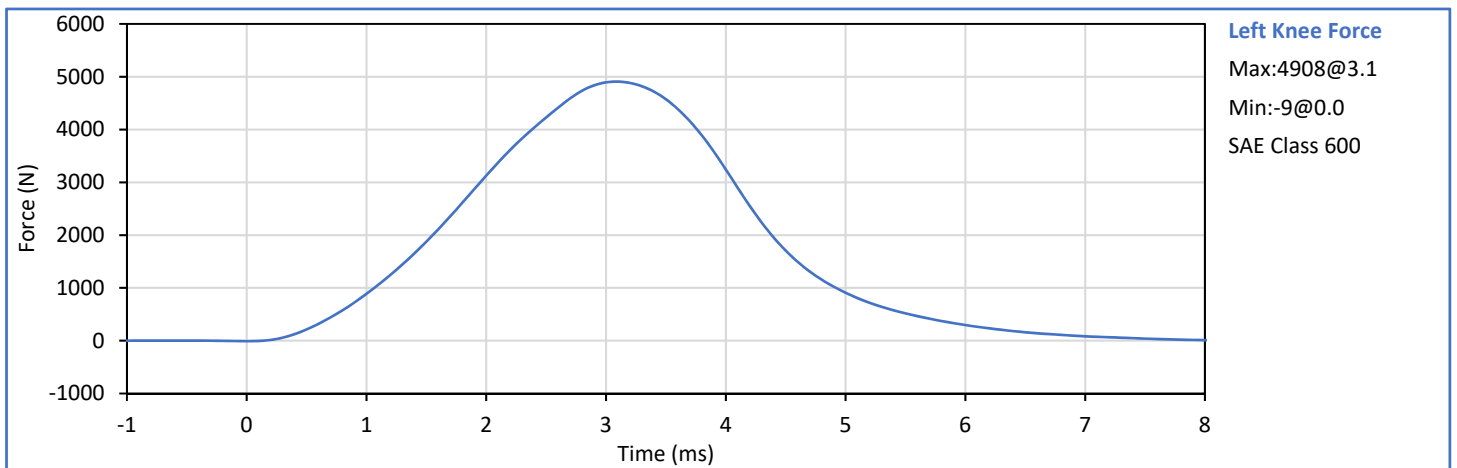
Tested Parameter		Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature		°C	18.9	25.6	21.1	Pass
Laboratory Relative Humidity		%	10	70	27	Pass
Left Hip	Left Hip Rotation Rate	deg/s	5.0	10.0	5.7	Pass
	Left Femur Torque at 30°	Nm	0.0	95.0	87.4	Pass
	Left Hip Rotation at 203 Nm	deg	40.0	50.0	41.0	Pass
Right Hip	Right Hip Rotation Rate	deg/s	5.0	10.0	6.2	Pass
	Right Femur Torque at 30°	Nm	0.0	95.0	82.2	Pass
	Right Hip Rotation at 203 Nm	deg	40.0	50.0	44.2	Pass
Overall Test Results					Pass	Pass




Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

Tested Parameter		Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature		°C	18.9	25.6	21.1	Pass
Laboratory Relative Humidity		%	10	70	32	Pass
Left	Probe Velocity	m/s	2.070	2.130	2.128	Pass
Knee	Peak Resistive Force	N	4715	5782	4908	Pass
Right	Probe Velocity	m/s	2.070	2.130	2.125	Pass
Knee	Peak Resistive Force	N	4715	5782	5320	Pass
Overall Test Results					Pass	



Technician: 
J. Hernandez

Approved By: 
P. Puzzuto


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

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


Describe any repairs or replacement of parts or other findings:


No Problems Found

Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

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

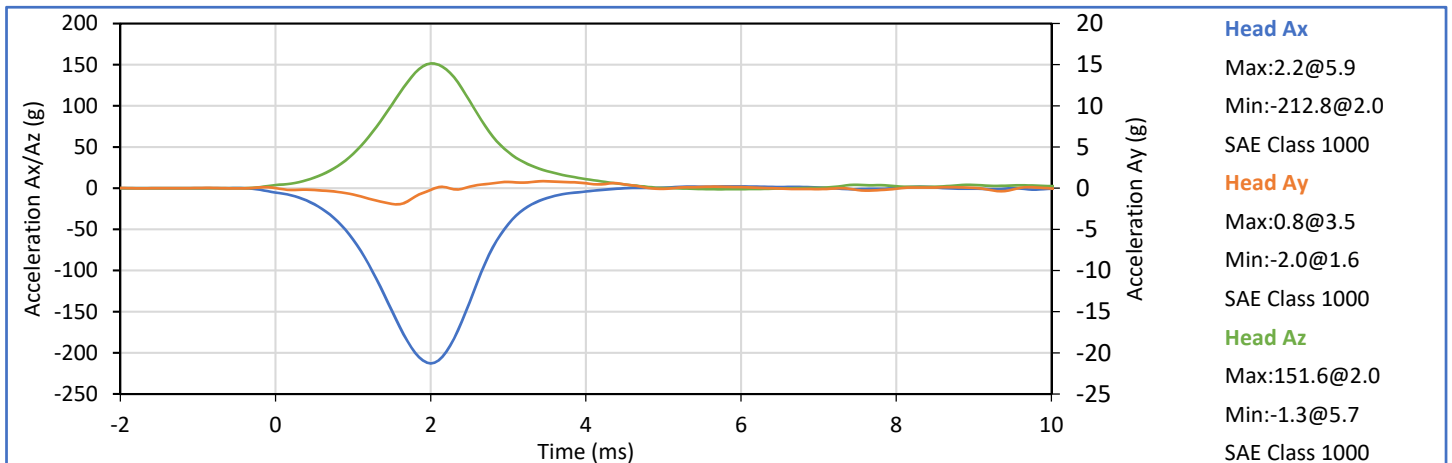
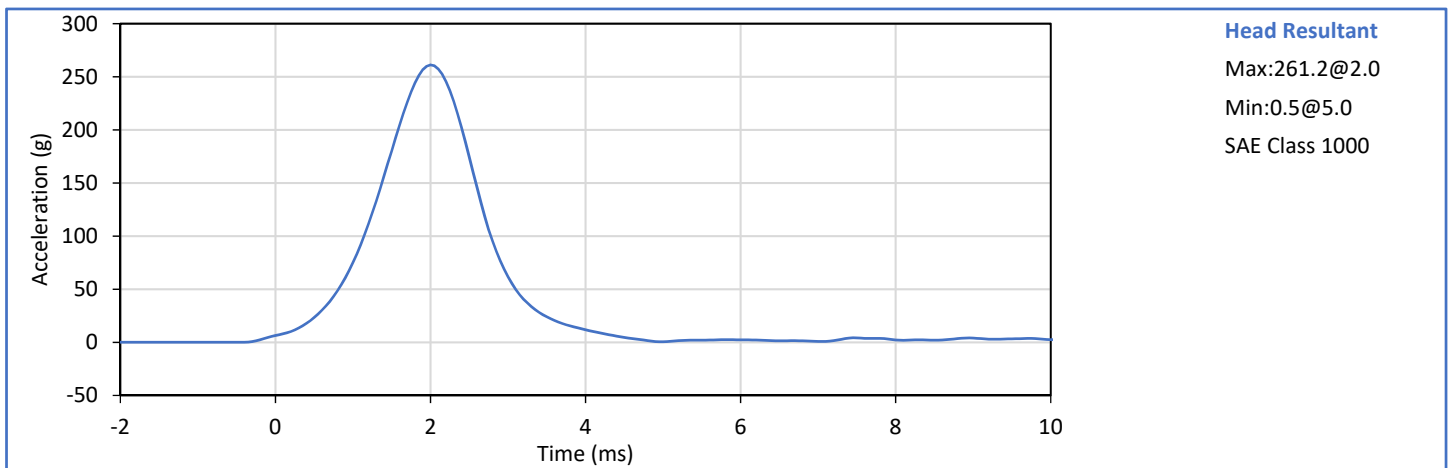
Technician: 
J. Hernandez

Approved By: 
P. Puzzuto


ATD Serial No.: 141

Test Date: 2020-02-24

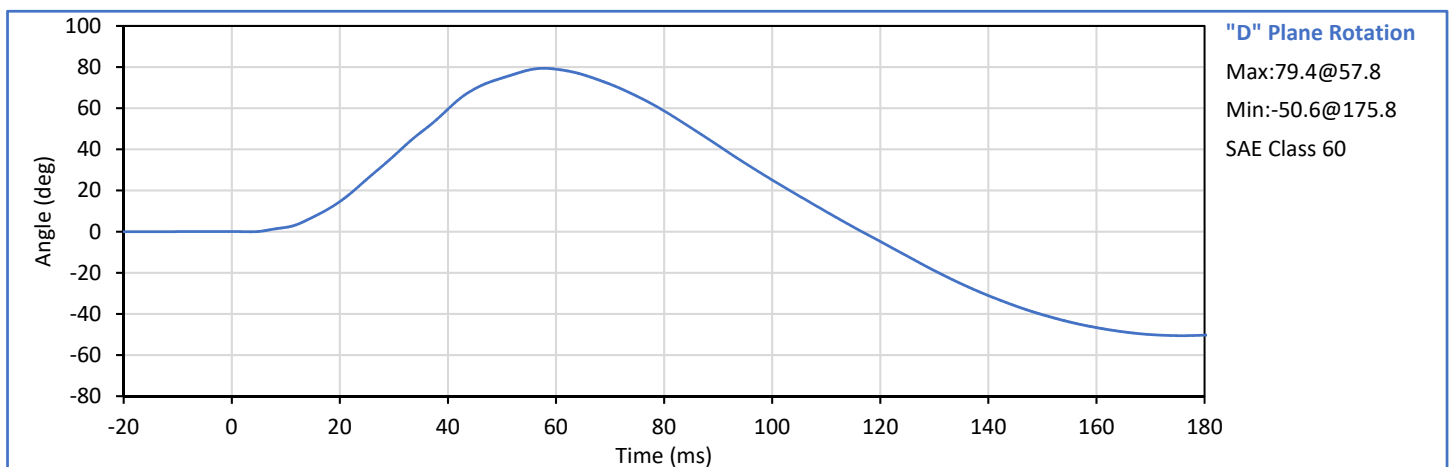
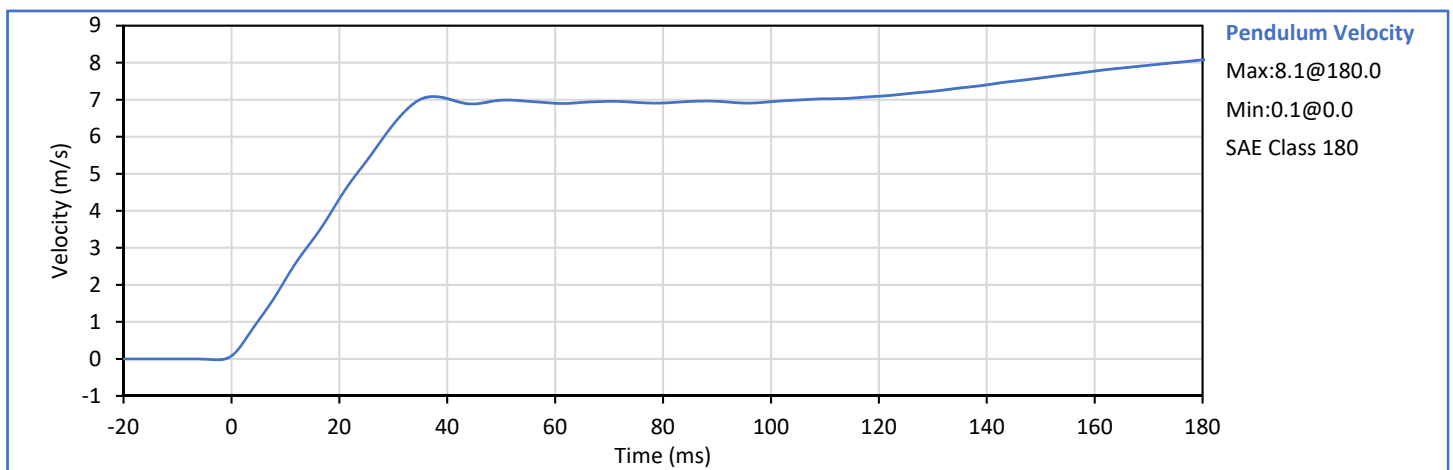
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	29	Pass
Peak Resultant Acceleration	g	250.0	300.0	261.2	Pass
Peak Lateral Acceleration	g	-15.0	15.0	-2.0	Pass
Oscillations After Main Pulse	%	0.0	10.0	1.6	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
Overall Test Results					Pass

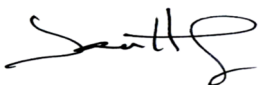



Technician: 
 J. Hernandez

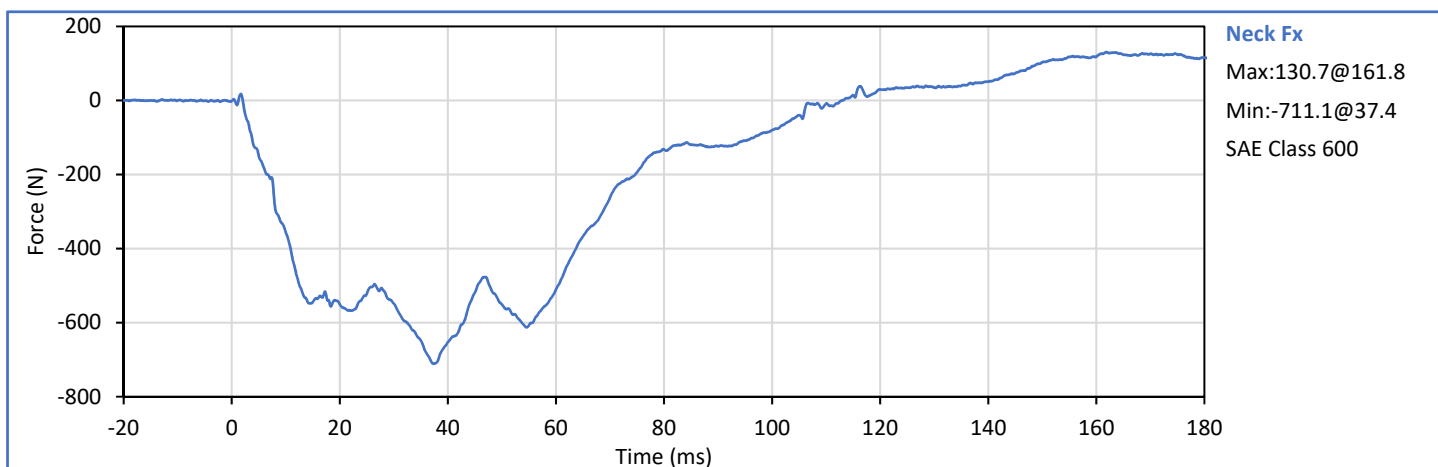
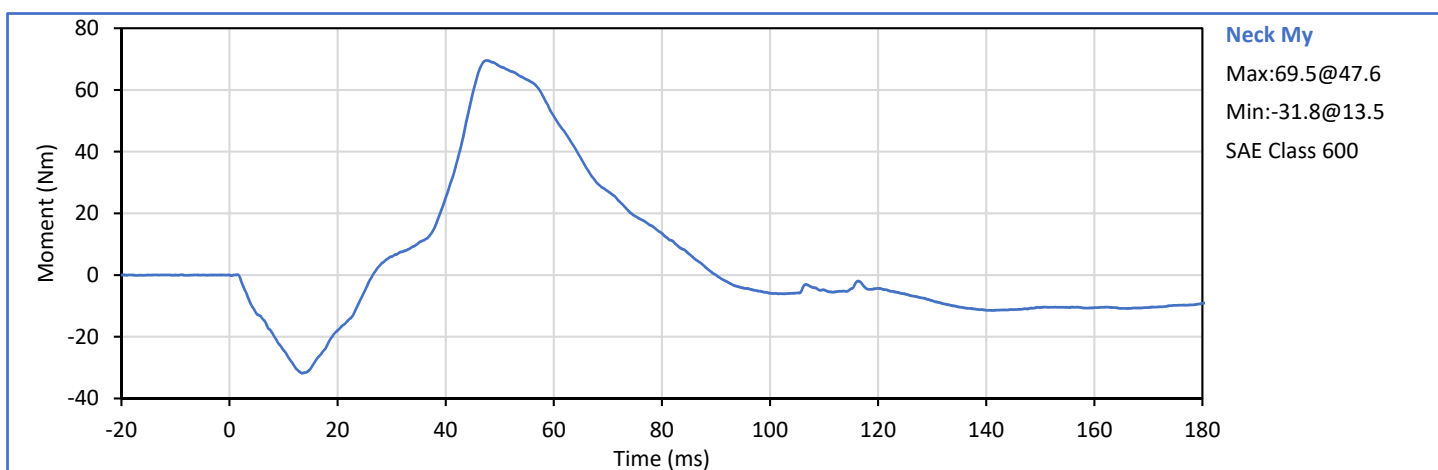
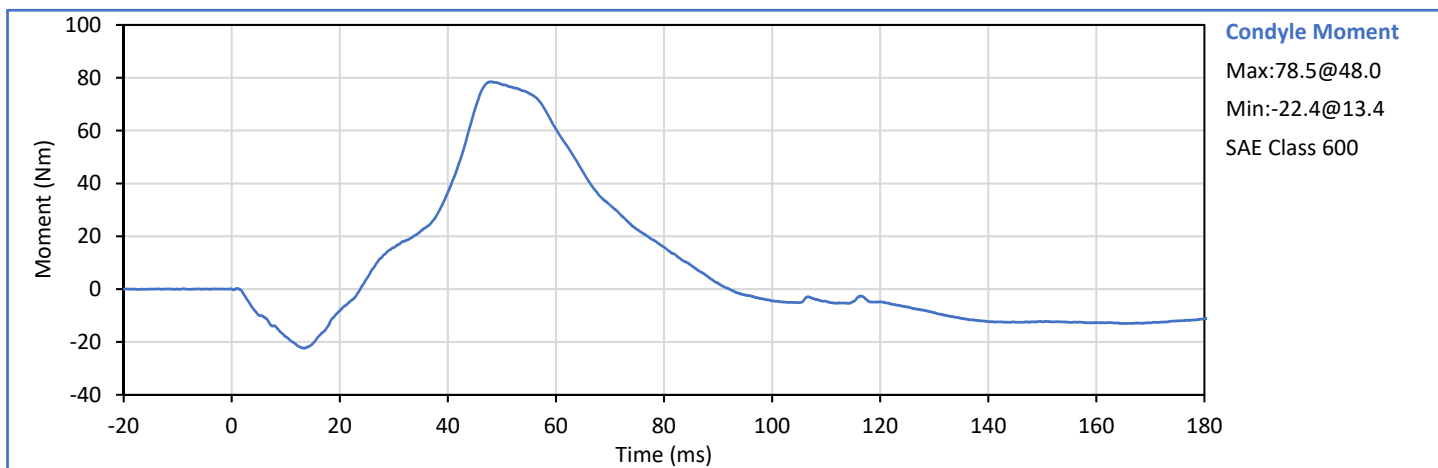
Approved By: 
 P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	6.89	7.13	6.97	Pass
Pendulum Velocity at 10 ms	m/s	2.10	2.50	2.14	Pass
Pendulum Velocity at 20 ms	m/s	4.00	5.00	4.32	Pass
Pendulum Velocity at 30 ms	m/s	5.80	7.00	6.33	Pass
Peak "D" Plane Rotation	deg	77.0	91.0	79.4	Pass
Peak Moment in Rotation	Nm	69.0	83.0	78.5	Pass
Positive Moment Decay to 10 Nm	ms	80.0	100.0	84.4	Pass
Overall Test Results					Pass

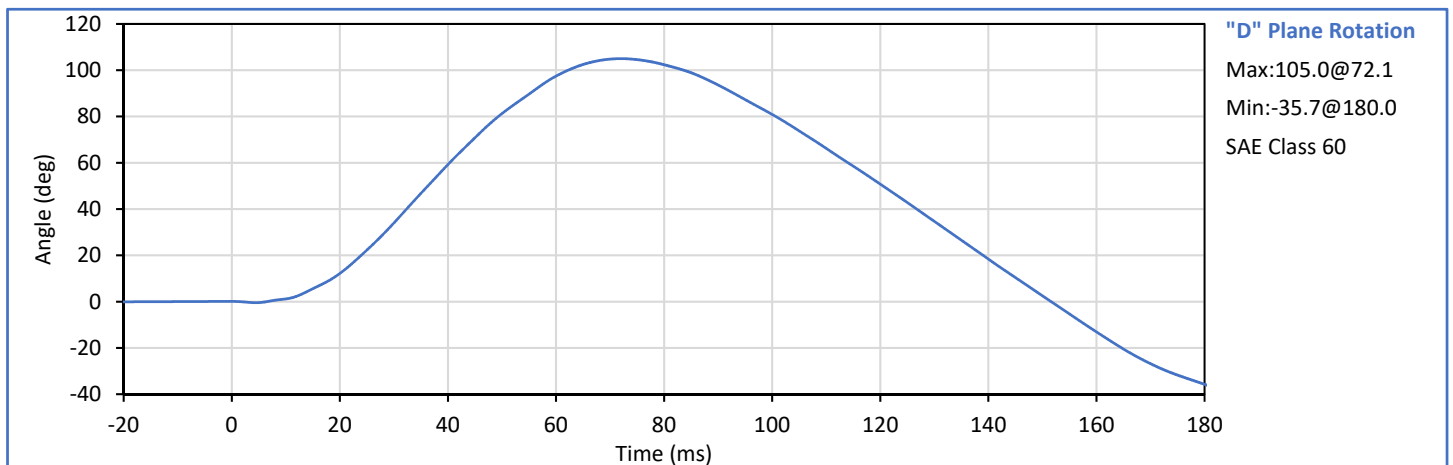
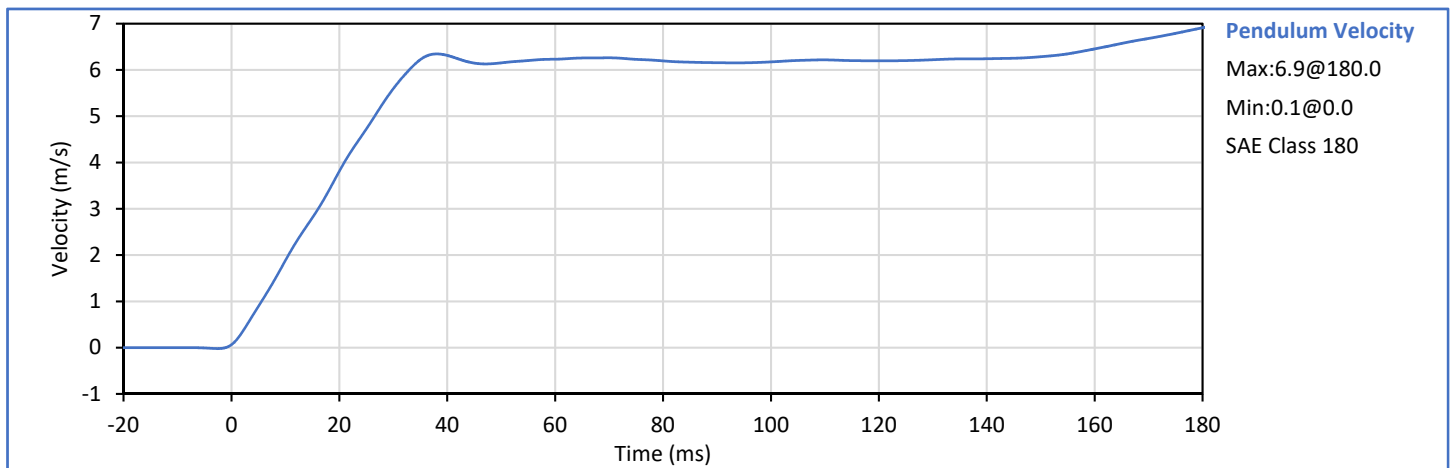


Technician: 
J. Hernandez


Approved By: 
P. Puzzuto

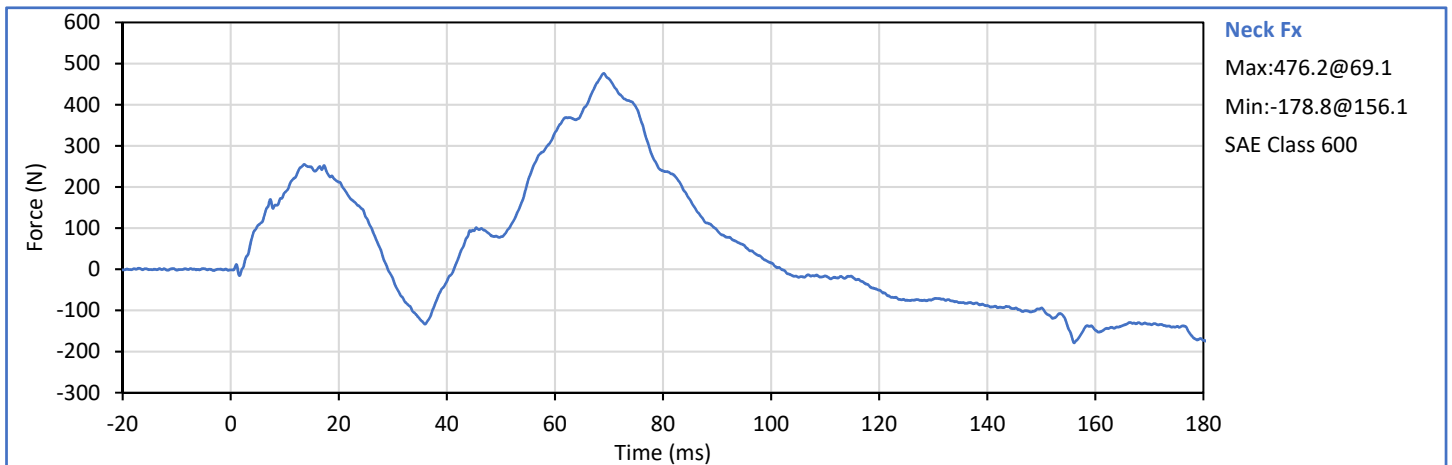
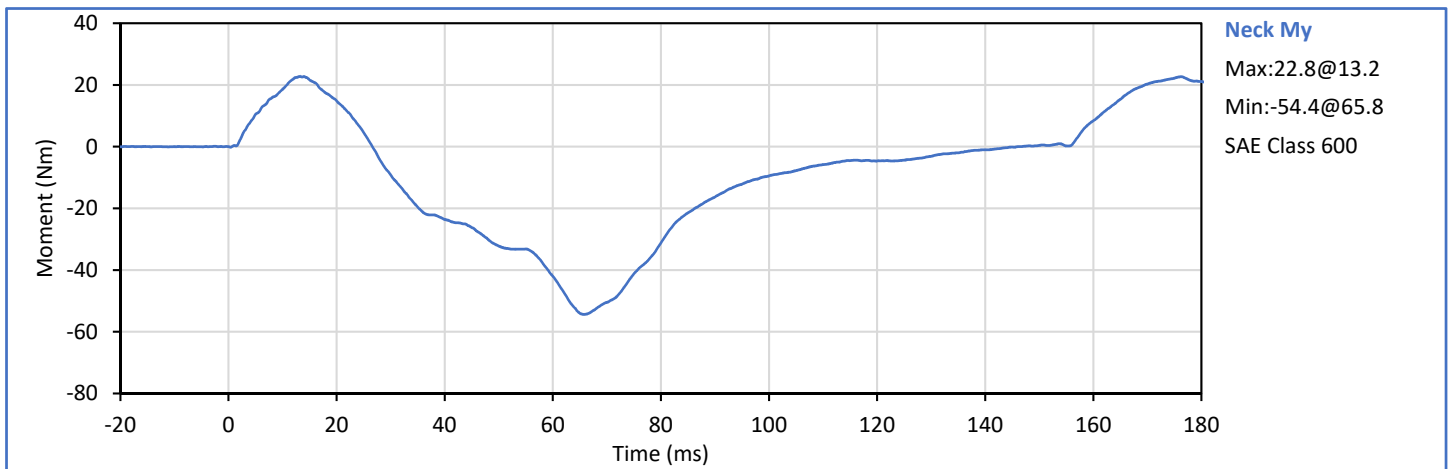
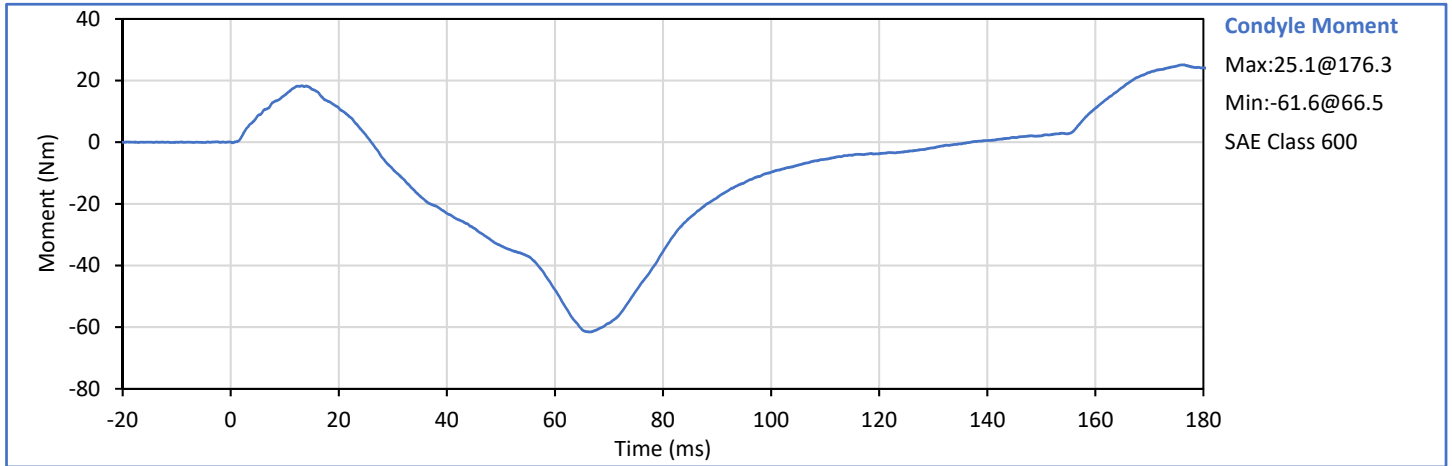


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	5.95	6.19	6.17	Pass
Pendulum Velocity at 10 ms	m/s	1.50	1.90	1.88	Pass
Pendulum Velocity at 20 ms	m/s	3.10	3.90	3.81	Pass
Pendulum Velocity at 30 ms	m/s	4.60	5.60	5.60	Pass
Peak "D" Plane Rotation	deg	99.0	114.0	105.0	Pass
Peak Moment in Rotation	Nm	-65.0	-53.0	-61.6	Pass
Negative Moment Decay to -10 Nm	ms	94.0	114.0	99.7	Pass
Overall Test Results					Pass



Technician: 
J. Hernandez

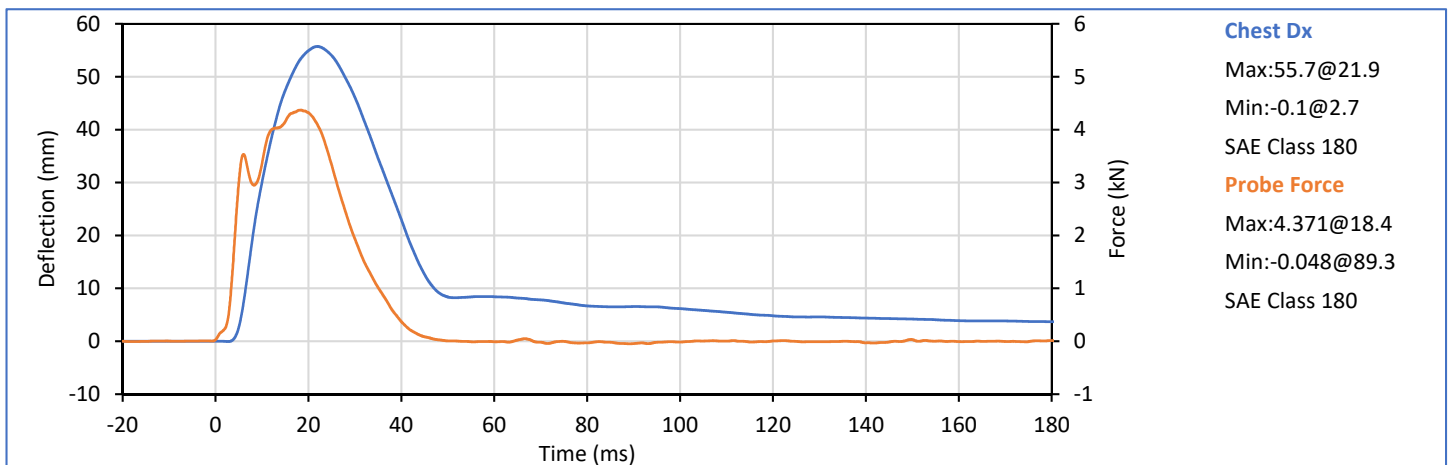
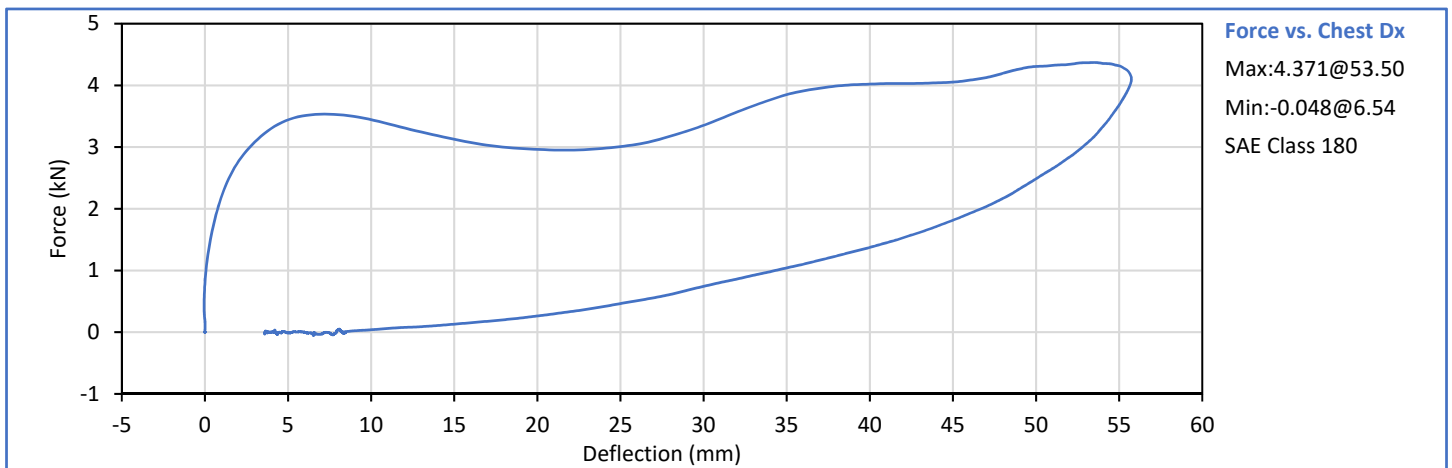
Approved By: 
P. Puzzuto




ATD Serial No.: 141

Test Date: 2020-02-25

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	30	Pass
Probe Velocity	m/s	6.59	6.83	6.66	Pass
Peak Chest Deflection	mm	50.0	58.0	55.7	Pass
Peak Probe Force, 50 and 58 mm	kN	3.900	4.400	4.371	Pass
Peak Probe Force, 18 and 50 mm	kN	0.000	4.600	4.308	Pass
Internal Hysterisis	%	69.0	85.0	73.1	Pass
Overall Test Results					Pass



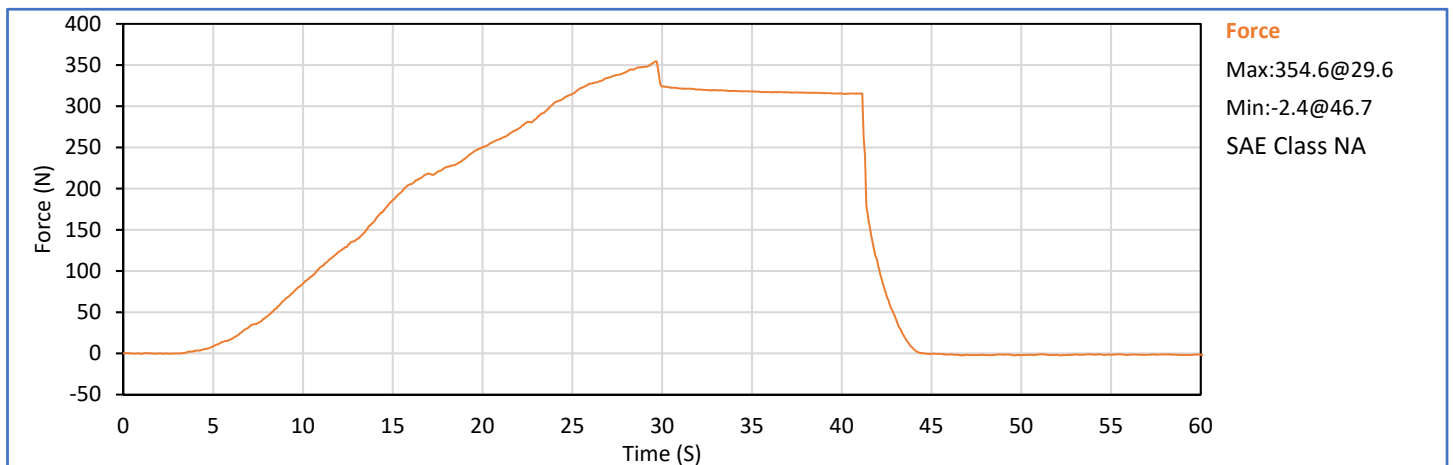
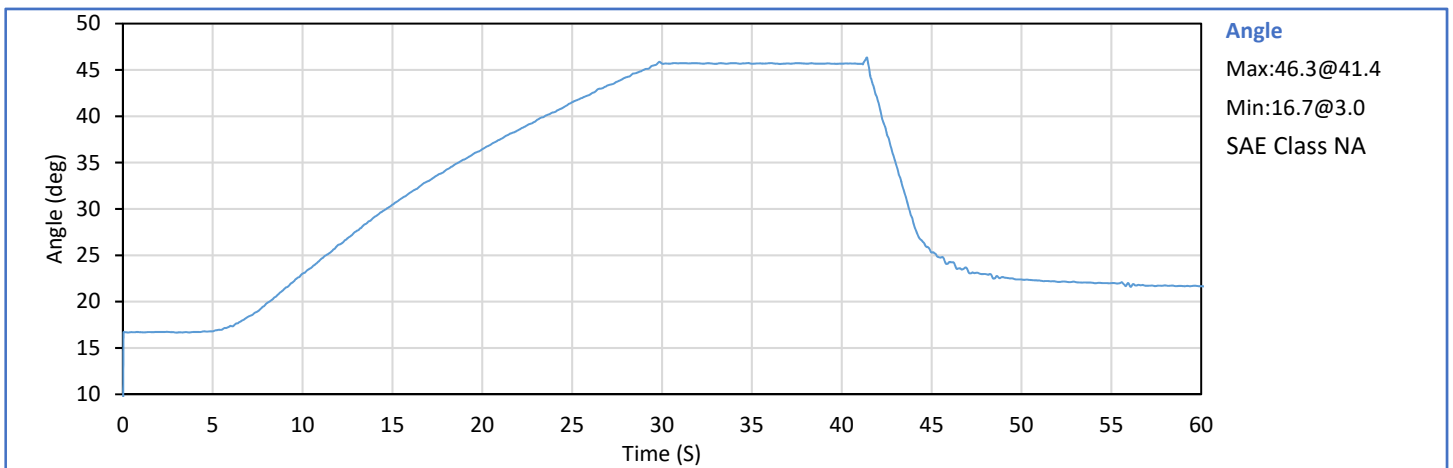
Technician: 
J. Hernandez

Approved By: 
P. Puzzuto


ATD Serial No.: 141

Test Date: 2020-02-22

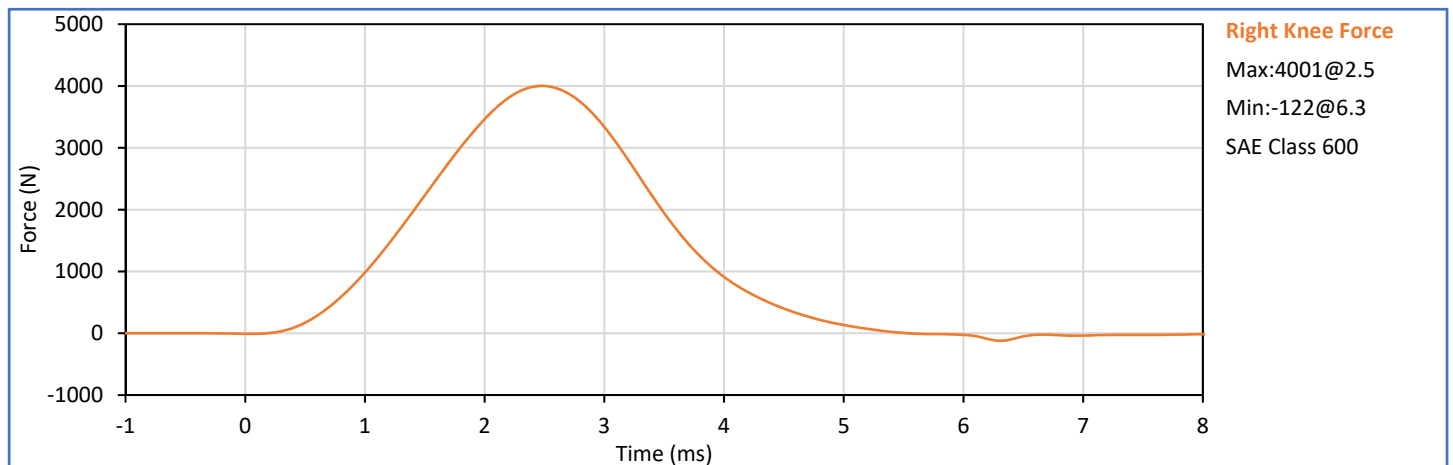
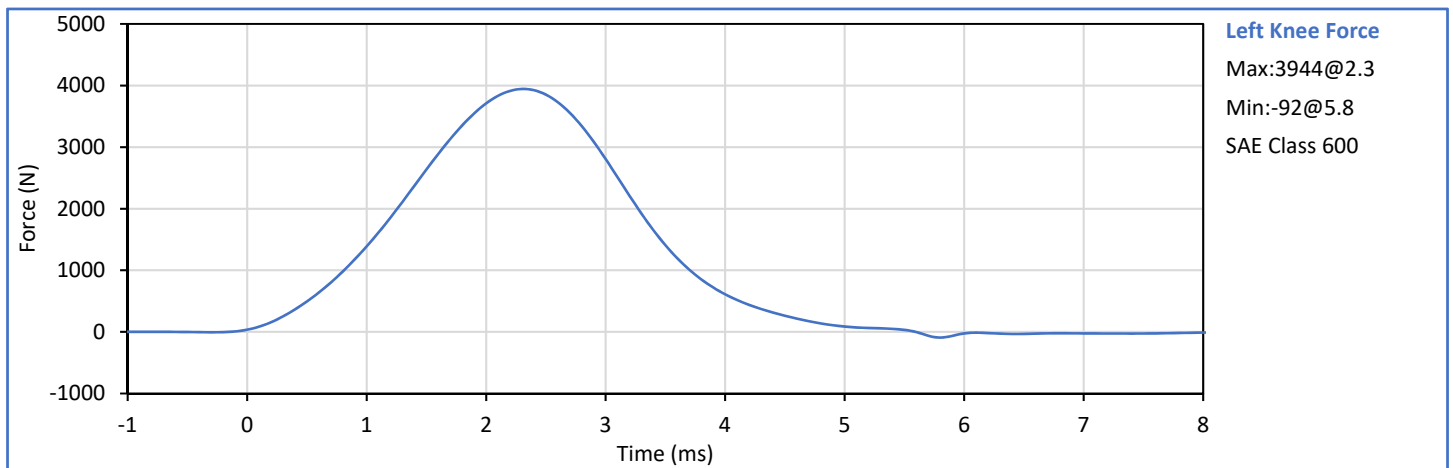
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.6	Pass
Laboratory Humidity	%	10	70	34	Pass
Orientation Angle	deg	0.0	20.0	16.5	Pass
Test Initial Angle	deg	11.0	19.0	16.7	Pass
Peak Force at 45° (+/-0.5°)	N	320.0	390.0	347.9	Pass
Torso Flexion Rate	deg/s	0.50	1.50	1.21	Pass
Final Reference Plane Angle	deg	-8.0	8.0	3.2	Pass
Overall Test Results					Pass




Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

Tested Parameter		Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature		°C	18.9	25.6	20.6	Pass
Laboratory Humidity		%	10	70	31	Pass
Left	Probe Velocity	m/s	2.070	2.130	2.109	Pass
Knee	Peak Resistive Force	N	3450	4060	3944	Pass
Right	Probe Velocity	m/s	2.070	2.130	2.106	Pass
Knee	Peak Resistive Force	N	3450	4060	4001	Pass
Overall Test Results					Pass	



Technician: 
J. Hernandez

Approved By: 
C-40 P. Puzzuto

APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

Table 1 - Driver ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P49209	Endevco	7264C-2k	2020-01-06
Head Acceleration Y Primary	P49228	Endevco	7264C-2k	2020-01-06
Head Acceleration Z Primary	A199910	MSI	64C-2000	2020-01-06
Head Acceleration X Redundant	P50103	Endevco	7264C-2k	2020-01-06
Head Acceleration Y Redundant	P49210	Endevco	7264C-2k	2020-01-06
Head Acceleration Z Redundant	P58713	Endevco	7264C-2k	2020-01-06
Head Rotation Rate X	ARS7587	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Y	ARS7426	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Head Rotation Rate Z	ARS7480	DTS	ARS PRO-8k (2000Hz)	2019-07-08
Upper Neck Force X	2185 Fx	R.A. Denton	1716ATF	2019-09-03
Upper Neck Force Y	2185 Fy	R.A. Denton	1716ATF	2019-09-03
Upper Neck Force Z	2185 Fz	R.A. Denton	1716ATF	2019-09-03
Upper Neck Moment X	2185 Mx	R.A. Denton	1716ATF	2019-09-03
Upper Neck Moment Y	2185 My	R.A. Denton	1716ATF	2019-09-03
Upper Neck Moment Z	2185 Mz	R.A. Denton	1716ATF	2019-09-03
Chest Acceleration X Primary	P52112	Endevco	7264C-2k	2020-01-06
Chest Acceleration Y Primary	P49208	Endevco	7264C-2k	2020-01-06
Chest Acceleration Z Primary	P51264	Endevco	7264C-2k	2020-01-06
Chest Acceleration X Redundant	P49461	Endevco	7264C-2k	2020-01-06
Chest Acceleration Y Redundant	P58774	Endevco	7264C-2k	2020-01-06
Chest Acceleration Z Redundant	P49168	Endevco	7264C-2k	2020-01-06
Chest Deflection	0606	Servo	14CBI-3615	2020-01-06
Pelvis Acceleration X	P49238	Endevco	7264C-2k	2020-01-06
Pelvis Acceleration Y	P58877	Endevco	7264C-2k	2020-01-06
Pelvis Acceleration Z	P50087	Endevco	7264C-2k	2020-01-06
Left Femur Force Z	DS9756 (pri)	Humanetics	3821JLN2	2019-09-03
Right Femur Force Z	DS4139 (pri)	Humanetics	3821JLN2	2019-09-03
Left Femur Force Z Redundant	DS9756 (red)	Humanetics	3821JLN2	2019-09-03
Right Femur Force Z Redundant	DS4139 (red)	Humanetics	3821JLN2	2019-09-03
Left Upper Tibia Moment X	DH3309 Mx	FTSS	IF-857	2019-09-09
Left Upper Tibia Moment Y	DH3309 My	FTSS	IF-857	2019-09-09
Left Upper Tibia Force Z	DH3309 Fz	FTSS	IF-857	2019-09-09
Left Lower Tibia Moment X	DI4186 Mx	FTSS	IF-853	2019-09-06
Left Lower Tibia Moment Y	DI4186 My	FTSS	IF-853	2019-09-06
Left Lower Tibia Force Z	DI4186 Fz	FTSS	IF-853	2019-09-06
Right Upper Tibia Moment X	DG6679 Mx	FTSS	IF-857	2019-09-09
Right Upper Tibia Moment Y	DG6679 My	FTSS	IF-857	2019-09-09
Right Upper Tibia Force Z	DG6679 Fz	FTSS	IF-857	2019-09-09
Right Lower Tibia Moment X	DI4188 Mx	FTSS	IF-853	2019-09-06
Right Lower Tibia Moment Y	DI4188 My	FTSS	IF-853	2019-09-06
Right Lower Tibia Force Z	DI4188 Fz	FTSS	IF-853	2019-09-06
Left Ankle Acceleration X	03E20-N09	Entran	EGEB6Q-2k	2020-01-02
Left Ankle Acceleration Z	03D30-N13	Entran	EGEB6Q-2k	2020-01-02
Left Toe Acceleration Z	03H07-Z10	Entran	EGEB6Q-2k	2020-01-02
Right Ankle Acceleration X	03E29-N20	Entran	EGEB6Q-2k	2020-01-02
Right Ankle Acceleration Z	03E18-F02	Entran	EGEB6Q-2k	2020-01-02
Right Toe Acceleration Z	05H31-Z04	Entran	EGEB6Q-2k	2020-01-02
Seat Belt Outside Lap Force	263	FTSS	IF-964	2019-10-02
Seat Belt Upper Diagonal Force	315	FTSS	IF-964	2019-10-02

Table 2 - Right Front Passenger ATD Instrumentation

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

Table 3 - Vehicle Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Left Rear Primary Ax	Accels\A265853	MSI	52F-2000	2019-11-13
Right Rear Primary Ax	Accels\A254893	MSI	52F-2000	2019-12-02
Engine Top Ax	Accels\A217304	MSI	52F-2000	2019-12-02
Engine Bottom Ax	Accels\A185686	MSI	52F-2000	2019-12-02
Left Rear Az	Accels\A273444	MSI	52F-2000	2019-12-13
Right Rear Az	Accels\A254936	MSI	52F-2000	2019-12-02
Left Rear Redundant Ax	Accels\A266317	MSI	52F-2000	2019-11-13
Right Rear Redundant Ax	Accels\A254937	MSI	52F-2000	2019-12-02