

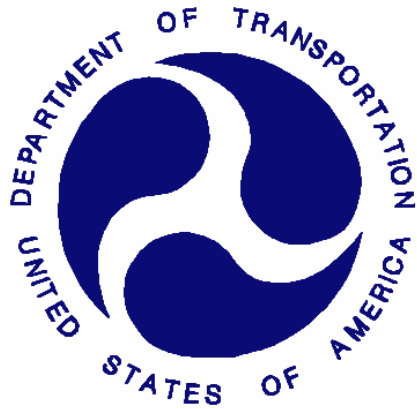
REPORT NUMBER: TWG-KAR-20-003

**SIDE AIRBAG OCCUPANT RISK PROGRAM
OCCUPANT OUT-OF-POSITION TESTS**

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

NHTSA NUMBER: M20204205TWG2

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



AUGUST 18, 2020

FINAL REPORT

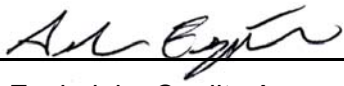
**PREPARED FOR:
ALPHA TECHNOLOGY ASSOCIATE, INC
2810 OLD LEE HWY, SUITE 120
FAIRFAX, VA 22031**

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Prepared By:  _____

Mr. Matthew J. Angeles, Project Engineer
Applus+ IDIADA KARCO Engineering, LLC.

Reviewed By:  _____

Mr. Andrew J. Espindola, Quality Assurance Manager
Applus+ IDIADA KARCO Engineering, LLC.

 _____

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

Approved By:  _____

Mr. Steven D. Matsusaka, Engineering Manager
Applus+ IDIADA KARCO Engineering, LLC.

Approval Date: _____ August 18, 2020 _____

FINAL REPORT ACCEPTANCE BY:

Engineer, Alpha Technology Associate, Inc.

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16. Abstract A side airbag out of position test was conducted on the subject 2020 Hyundai Palisade 5-Door MPV in accordance with the specifications of the Office of Crashworthiness Standards SAB OOP NCAP Laboratory Test Procedure for the generation of consumer information on vehicle side airbag protection. The test was conducted at the Applus+ IDIADA KARCO Engineering, LLC. facility in Adelanto, California on August 4, 2020. The curtain and torso/pelvis side airbags were deployed and responses were measured on a Hybrid III 6-year old child dummy. Three high speed cameras, and one real time camera recorded the event. The ambient temperature at the time of airbag deployment was 21.6°C <table border="1" style="width: 100%; border-collapse: collapse; margin: 10px 0;"> <thead> <tr> <th colspan="4" style="text-align: center;">Section 3.3.5.1 - HIII 6-Year Old Child Dummy - P2</th> </tr> <tr> <th style="width: 35%;">Measurement Description</th> <th style="width: 10%;">Units</th> <th style="width: 15%;">IARV</th> <th style="width: 40%;">Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>723</td> <td style="background-color: yellow;">66.8</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td style="background-color: yellow;">0.97</td> </tr> <tr> <td>Upper Neck Tension</td> <td>N</td> <td>1490</td> <td style="background-color: yellow;">342.9</td> </tr> <tr> <td>Upper Neck Compression</td> <td>N</td> <td>1820</td> <td style="background-color: yellow;">-1147.6</td> </tr> </tbody> </table>				Section 3.3.5.1 - HIII 6-Year Old Child Dummy - P2				Measurement Description	Units	IARV	Result	Head Injury Criteria (HIC ₁₅)	N/A	723	66.8	Nij	N/A	1	0.97	Upper Neck Tension	N	1490	342.9	Upper Neck Compression	N	1820	-1147.6
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This occupant out-of-position static side airbag deployment test is part of the Technical Working Group Occupant Injury Risk from Deploying Side Airbags Testing Program sponsored by Alpha Technology Associate, Inc. under Contract No. DTNH22-13-D-00311L. The purpose of this test was to obtain occupant injury data for a side airbag deployment.

The occupant out-of-position (OOP) side airbag test was conducted in accordance with the Technical Working Group Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SUMMARY

The effects of a roof mounted curtain airbag and a seat mounted torso/pelvis airbag deployment in a 2020 Hyundai Palisade 5-door MPV with an out-of-position Hybrid III 6-year old crash test dummy were evaluated. The test was performed at Applus+ IDIADA KARCO Engineering, LLC. on August 4, 2020. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three (3) high-speed digital cameras and one (1) real time camera were used to document the deployment of the airbags. Camera locations and other pertinent camera information can be found on Data Sheet No.1 and Data Sheet No.6.

A 6-year old anthropomorphic test device (ATD) was placed in the right front passenger seating position, along the outboard edge of foam block, facing inboard, and spine aligned with deployment trajectory of airbag according to the dummy placement instructions (3.3.5.1) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The 6-year old ATD was instrumented with head tri-axial accelerometers, upper and lower neck force, and moment transducers.

The airbags were deployed and fifteen (15) channels of data were recorded using a data acquisition system. Appendix B contains dummy response data traces. Appendix C contains the instrumentation data channel assignments. Appendix D contains ATD calibration sheets.

Orientation of the 6-year old dummy was with the dummy facing inboard. The seat is set 35 mm rearward from the full forward position. The seat was not tested in the forwardmost position in order to maximize the interaction and contact between the dummy and curtain airbag. The dummy was placed with its arms hanging at its sides on the foam block facing inboard with its legs extended. The dummy's pelvis is slid outboard until contact is made with the door panel while keeping the head in a neutral orientation. The center of gravity of the head is centered in the deployment trajectory of the airbag. The dummy's arms are bent at the elbow until the fingers just touch the booster seat. This orientation complies with section 3.3.5.1 of the Technical Working Group (TWG) recommendation in the Recommended procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

The passenger side door remained closed during the test and was operable after the airbag deployed.

The 6-year old dummy's visible contact points were as follows: The ATD's head contacted the curtain airbag. The ATD's torso contacted the torso/pelvis and curtain airbag.

The occupant data is summarized below:

Measurement Description	Units	Passenger ATD (HIII 6YO)	
		IARV	Result
Head Injury Criteria (HIC15)	N/A	723	66.8
Upper Neck Nij	N/A	1	0.97
Upper Neck Peak Tension	N	1490	342.9
Upper Neck Peak Compression	N	1820	-1147.6

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV NHTSA No.: M20204205TWG2
Test Program: TWG 3.3.5.1 Test Date: 08/04/20

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

TEST SUMMARY

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV

NHTSA No.: M20204205TWG2

Test Program: TWG 3.3.5.1

Test Date: 08/04/20

TEST DUMMY INFORMATION

Description	Passenger Seat
Dummy Type / Serial No.	6-year old / 186
Head Contact	Curtain Airbag
Chest Contact	Torso/Pelvis Airbag
Abdomen Contact	Torso/Pelvis Airbag
Pelvis Contact	Torso/Pelvis Airbag
Left Knee Contact	N/A
Right Knee Contact	N/A

VIDEO COVERAGE

Description	Quantity
High Speed Digital	3
Real Time	1
Total	4

DATA CHANNELS

Description	Quantity
Head Accelerometers	3
Upper Neck Transducers	6
Lower Neck Transducers	6
Total	15

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV NHTSA No.: M20204205TWG2
 Test Program: TWG 3.3.5.1 Test Date: 08/04/20

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA Number	M20204205TWG2
Model Year	2020
Make	Hyundai
Model	Palisade
Body Style	5-Door MPV
VIN	KM8R14HE6LU040605
Body Color	Moonlight Cloud
Odometer Reading (km / mi)	180 / 112
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

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

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Co.
Date of Manufacture	May-19
Vehicle Type	MPV

GVWR (kg)	2600
GAWR Front (kg)	1340
GAWR Rear (kg)	1450

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

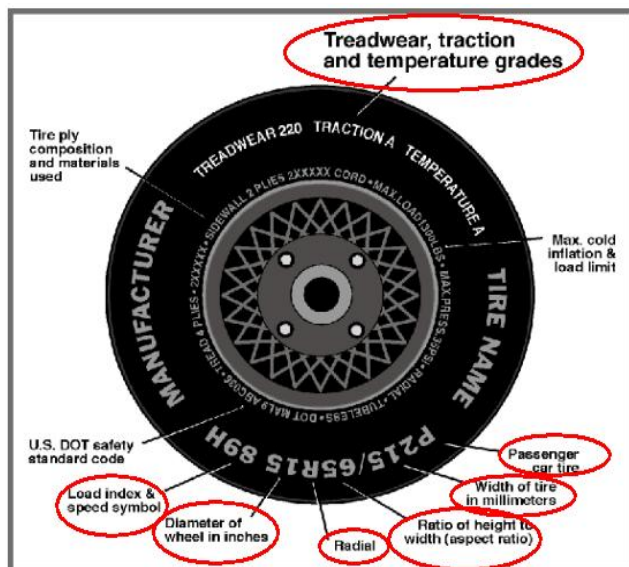
Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity	2	3	3	8	
Capacity Weight (VCW) (kg)				600.0	A
DSC x 68.04 (kg)				544.3	B
Cargo Weight (RCLW) (kg)				55.7	A-B

*Vehicle underwent New Car Assessment Program Side MDB Impact Testing on February 20, 2020.

DATA SHEET NO. 2 ... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV NHTSA No.: M20204205TWG2
 Test Program: TWG 3.3.5.1 Test Date: 08/04/20



VEHICLE TIRE INFORMATION

Measured Parameter	Front	Rear
Max. Tire Pressure (kpa)	275	275
Cold Pressure (kPa)	240	240
Recommended Tire Size	245/60R18	245/60R18
Tire Size on Vehicle	245/60R18	245/60R18
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Dueler	Dueler
Treadware	400	400
Traction Grade	A	A
Temperature Grade	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 CEL 2019	EJL2 CEL 2019
DOT Safety Code Right	EJL2 CEL 2019	EJL2 CEL 2019

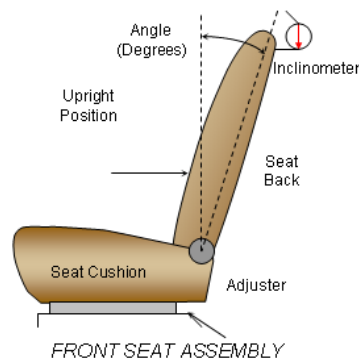
DATA SHEET NO. 3
SEAT ADJUSTMENTS

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
Test Program: TWG 3.3.5.1

NHTSA No.: M20204205TWG2
Test Date: 08/04/20

SEAT BACK ANGLE

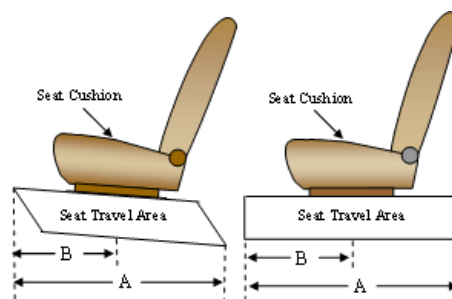
The passenger seat back is positioned per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. Seat back angle is measured at the headrest post.



Seating Position	Degrees
Passenger Seat	3.3

SEAT FORE / AFT POSITIONING

The passenger seat track travel is set per section 3.3.5.1 of the TWG recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags. The first or forward most position is counted as zero (0)



Seating Position	Total Fore-Aft Travel		Placed in Position	
	mm	Detents	mm	Detents
Passenger Seat	240	38	35	5

SEAT BELT UPPER ANCHORAGE

The seat belt upper anchorage is positioned to the uppermost position. Position "H" is the uppermost position, followed by position "M1". Position "L" is the lowermost position.

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

DATA SHEET NO. 4

DUMMY POSITIONING AND AIRBAG DIMENSIONS

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV NHTSA No.: M20204205TWG2
 Test Program: TWG 3.3.5.1 Test Date: 08/04/20

DUMMY POSITIONING

Code	Measurement Description	Passenger	
		Length (mm)	Angle (°)
SA	Seat Back Angle		3.3
AN	Top of Airbag Module to Head/Neck Junction	200	90.0
HD	Head CG to Door Panel/ Window	110	0.0
HSC	Head to Seat Back Centerline	255	0.0
HB	Head to B-Pillar (measured from bridge of nose)	300	0.0
HZ	Head to Roof (Z)	269	90.0
HHD	Head to Side Header	325	46.3
ND	Nose to Dash	529	28.5
NS	Nose to Seat Back	202	0.0
NR	Nose to Header	345	42.4
CD	Chest to Dash	437	11.1
CS	Chest to Seat Back (measured to centerline)	205	0.0
RACL	Right Arm to Seat Back Centerline	285	0.0
LACL	Left Arm to Seat Back Centerline	275	0.0
RA	Right Arm to Door Panel	70	0.0
LA	Left Arm to Door Panel	75	0.0
KK	Knee to Knee	110	0.0
TT	Toe to Toe	80	0.0
KSCR	Right Knee to Seat Cushion Centerline	80	0.0
KSCL	Left Knee to Seat Cushion Centerline	82	0.0
	Head Level (X Direction)		11.5
	Head Level (Y Direction)		4.8

AIRBAG DIMENSIONS

Code	Measurement Description	Airbag
		Length (mm)
AMW	Curtain Airbag Module Diameter	30
AML	Curtain Airbag Module Length	380
ABW	Curtain Airbag Width	2580
ABL	Curtain Airbag Length	460
AMW	Torso/Pelvis Airbag Module Diameter	30
AML	Torso/Pelvis Airbag Module Length	150
ABW	Torso/Pelvis Airbag Width	590
ABL	Torso/Pelvis Airbag Length	280

DATA SHEET NO. 5

DUMMY INJURY CRITERIA AND PERFORMANCE DATA

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV NHTSA No.: M20204205TWG2
 Test Program: TWG 3.3.5.1 Test Date: 08/04/20

HEAD PEAK ACCELERATIONS / CHEST DEFLECTIONS						
Location	Axis	Units	6 Year Old			
			Max	Time	Min	Time
Head CG	X	g	15.9	15.9	-39.4	217.3
Head CG	Y	g	20.9	15.6	-26.7	217.2
Head CG	Z	g	41.0	15.6	-16.0	12.2
Head CG Resultant	N/A	g	48.9	217.3		

UPPER NECK PEAK FORCES AND MOMENTS						
Location	Axis	Units	6 Year Old			
			Max	Time	Min	Time
Neck Force	X	N	352.1	226.2	-57.3	246.5
Neck Force	Y	N	262.1	10.7	-78.8	141.6
Neck Force	Z	N	342.9	238.7	-1147.6	223.1
Neck Force Resultant	N/A	N	1219.4	223.1		
Neck Moment	X	Nm	26.4	26.1	-24.5	10.5
Neck Moment	Y	Nm	32.4	227.8	-30.2	46.7
Neck Moment	Z	Nm	12.6	20.8	-4.6	66.7
Neck Moment Resultant	N/A	Nm	34.9	227.1		

LOWER NECK PEAK FORCES AND MOMENTS						
Location	Axis	Units	6 Year Old			
			Max	Time	Min	Time
Neck Force	X	N	427.8	14.6	-293.1	45.2
Neck Force	Y	N	494.0	11.6	-147.1	5.2
Neck Force	Z	N	393.0	238.8	-1005.6	223.6
Neck Force Resultant	N/A	N	1016.9	223.6		
Neck Moment	X	Nm	34.3	11.6	-16.4	141.3
Neck Moment	Y	Nm	25.2	221.6	-24.2	26.1
Neck Moment	Z	Nm	29.7	9.8	-16.6	62.0
Neck Moment Resultant	N/A	Nm	45.9	11.6		

HEAD INJURY CRITERIA (HIC15)				
Location	6 Year Old			
	HIC15	T ¹	T ²	Avg G
Head CG	66.8	215.2	223.7	36.0

UPPER NECK NIJ VALUES				
Location	6 Year Old			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.15	0.35	0.65	0.97

DATA SHEET NO. 6

HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV NHTSA No.: M20204205TWG2
Test Program: TWG 3.3.5.1 Test Date: 08/04/20

CAMERA LOCATIONS

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Side View	130	2840	1460	1.7	35	1000
2	High Speed 3/4 View	1970	1610	1880	12.7	50	1000
3	High Speed Front View	2015	430	1325	2.2	50	1000
4	Real Time	130	2840	1460	1.7		30

Coordinates: +X = forward of vehicle relative to dummy's head CG
+Y = right of vehicle relative to dummy's head CG
+Z = into ground

**APPENDIX A
PHOTOGRAPHS**

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FIGURE 1. Right Front ¾ View, As Received



FIGURE 2. Vehicle Certification Label



FIGURE 3. Pre-Test Vehicle Left Side View (as prepared for NCAP crash test)



FIGURE 4. Post-Test Vehicle Left Side View (as prepared for NCAP crash test)



FIGURE 5. Pre-Test Vehicle Location of Air Bag 1
(vehicle headliner for curtain air bag)



FIGURE 6. Pre-Test Vehicle Location of Air Bag 2
(vehicle a-pillar for curtain air bag)

Photo Not Available

FIGURE 7. Pre-Test Vehicle Location of Air Bag 3
(vehicle seat or door for torso air bag)

Photo Not Available

FIGURE 8. Pre-Test Vehicle Seat Back Angle (put inclinometer on headrest)



FIGURE 9. Pre-Test Dummy Left Side View



FIGURE 10. Post-Test Dummy Left Side View



FIGURE 11. Pre-Test Dummy Left Side Close-up View



FIGURE 12. Post-Test Dummy Left Side Close-up View



FIGURE 13. Pre-Test Dummy Left $\frac{3}{4}$ View



FIGURE 14. Post-Test Dummy Left $\frac{3}{4}$ View



FIGURE 15. Pre-Test Dummy Front Left $\frac{3}{4}$ Close-Up View



FIGURE 16. Post-Test Dummy Front Left $\frac{3}{4}$ Close-Up View



FIGURE 17. Pre-Test Dummy Front View



FIGURE 18. Post-Test Dummy Front View



FIGURE 19. Pre-Test Dummy Front Close-up View



FIGURE 20. Post Test Dummy Front Close-up View



FIGURE 21. Pre-Test Dummy Right $\frac{3}{4}$ View



FIGURE 22. Post-Test Dummy Right $\frac{3}{4}$ View



FIGURE 23. Pre-Test Dummy Right Side View



FIGURE 24. Post-Test Dummy Right Side View

Photo Not Available

FIGURE 25. Post-Test Dummy Right Side View (Door Open)



FIGURE 26. Post-Test Curtain Air Bag Left Side View



FIGURE 27. Post-Test Curtain Air Bag Front Left $\frac{3}{4}$ View



FIGURE 28. Post-Test Curtain Air Bag Front View

Photo Not Available

FIGURE 29. Post-Test Curtain Air Bag Right Side View (Door Open)

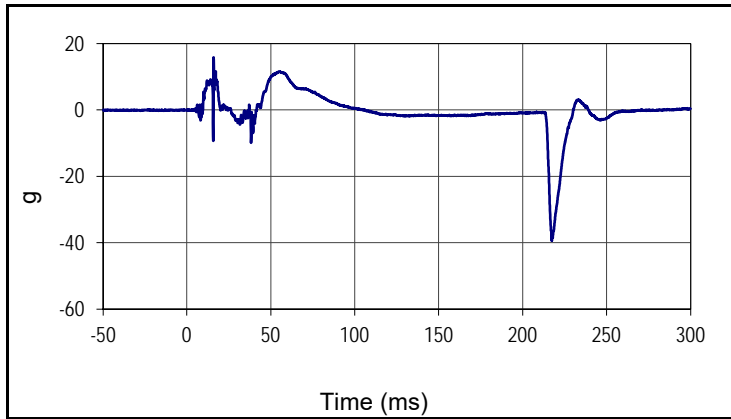
APPENDIX B
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

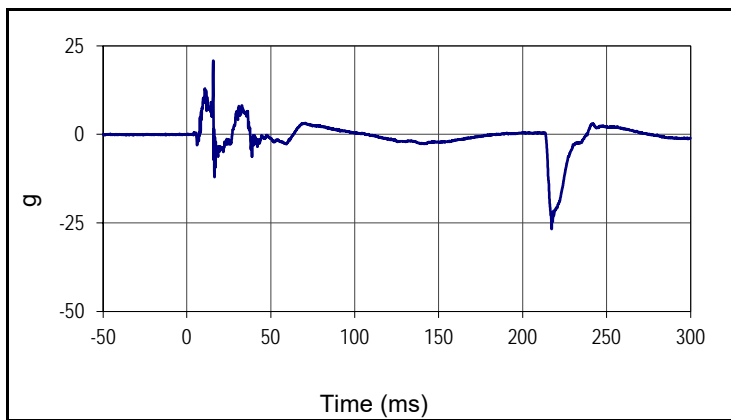
<u>Plot</u>		<u>Page</u>
1	6 Yr. Old Head Acceleration X	B-1
2	6 Yr. Old Head Acceleration Y	B-1
3	6 Yr. Old Head Acceleration Z	B-1
4	6 Yr. Old Head Acceleration Resultant	B-1
5	6 Yr. Old Upper Neck Force X	B-2
6	6 Yr. Old Upper Neck Force Y	B-2
7	6 Yr. Old Upper Neck Force Z	B-2
8	6 Yr. Old Upper Neck Force Resultant	B-2
9	6 Yr. Old Upper Neck Moment X	B-3
10	6 Yr. Old Upper Neck Moment Y	B-3
11	6 Yr. Old Upper Neck Moment Z	B-3
12	6 Yr. Old Upper Neck Moment Resultant	B-3
13	6 Yr. Old Lower Neck Force X	B-4
14	6 Yr. Old Lower Neck Force Y	B-4
15	6 Yr. Old Lower Neck Force Z	B-4
16	6 Yr. Old Lower Neck Force Resultant	B-4
17	6 Yr. Old Lower Neck Moment X	B-5
18	6 Yr. Old Lower Neck Moment Y	B-5
19	6 Yr. Old Lower Neck Moment Z	B-5
20	6 Yr. Old Lower Neck Moment Resultant	B-5
21	Driver Nij	B-6

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
 Test Program: TWG 3.3.5.1

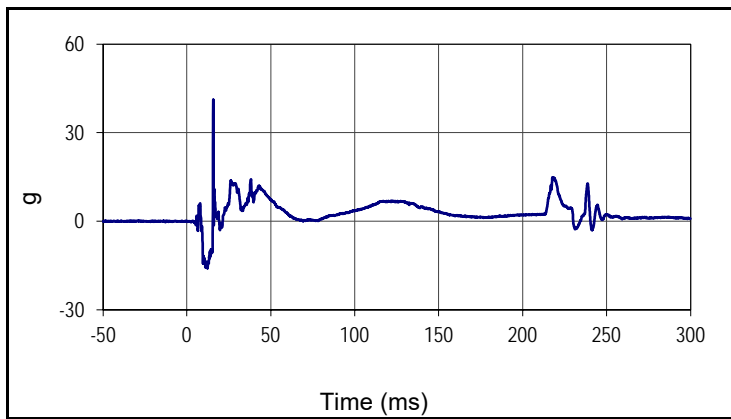
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 NHTSA No.: M20204205TWG2



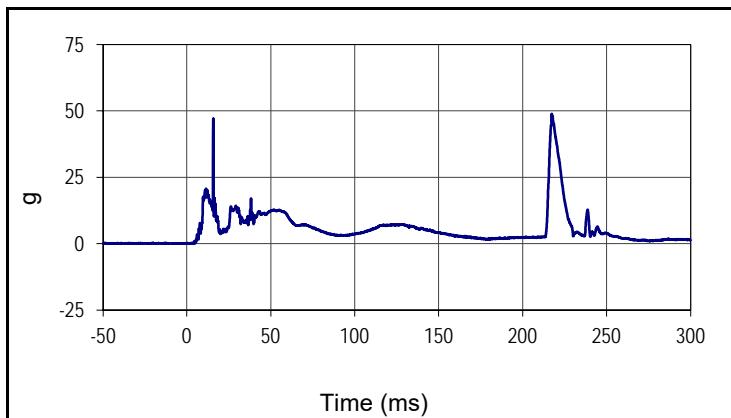
Curve Description			
6 YO Head Acceleration X			
Plot No.		SAE Class	Units
001		1000	g
Max	Time	Min	Time
15.9	15.9	-39.4	217.3



Curve Description			
6 YO Head Acceleration Y			
Plot No.		SAE Class	Units
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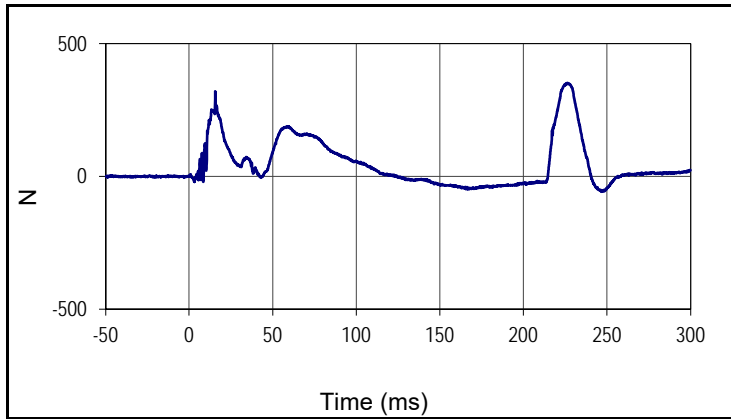
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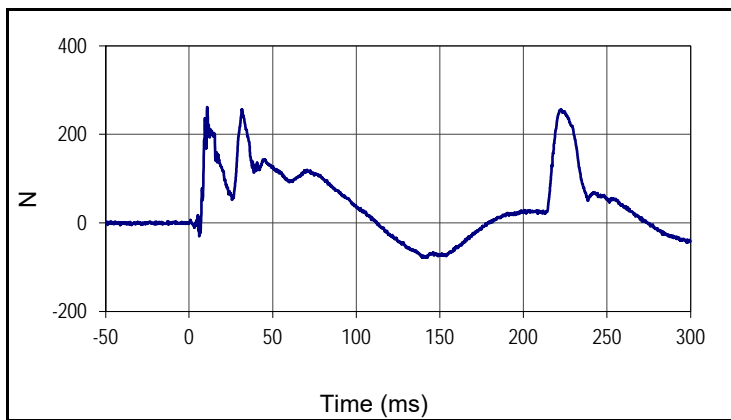
Curve Description			
6 YO Head Acceleration Primary Resultant			
Plot No.		SAE Class	Units
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Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
 Test Program: TWG 3.3.5.1

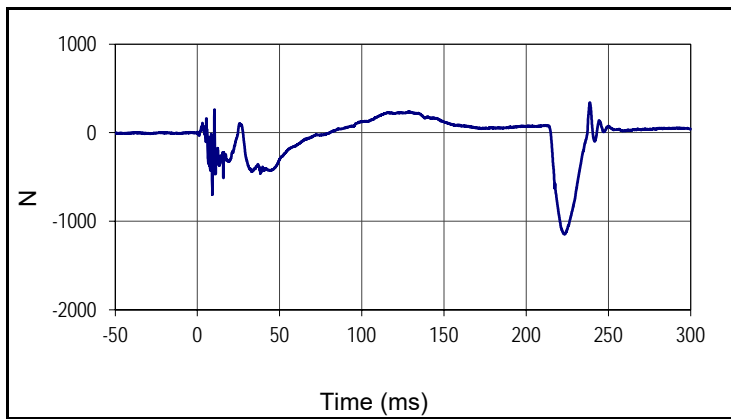
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 NHTSA No.: M20204205TWG2



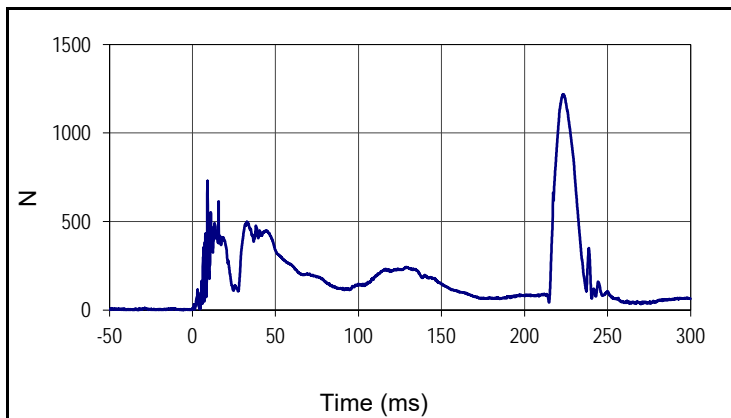
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6 YO Upper Neck Force X			
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Curve Description			
6 YO Upper Neck Force Y			
Plot No.		SAE Class	Units
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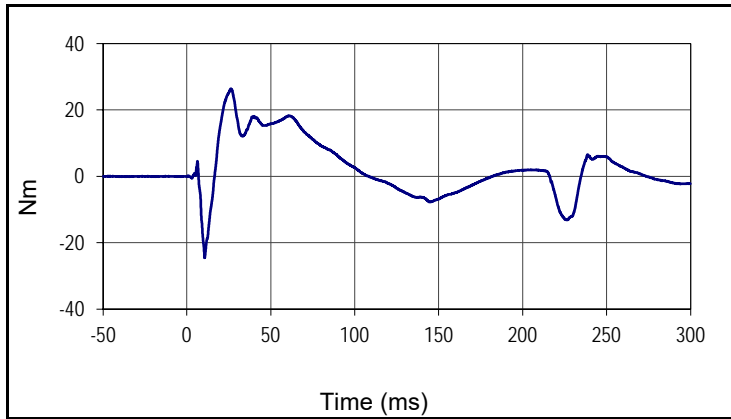
Curve Description			
6 YO Upper Neck Force Z			
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Max	Time	Min	Time
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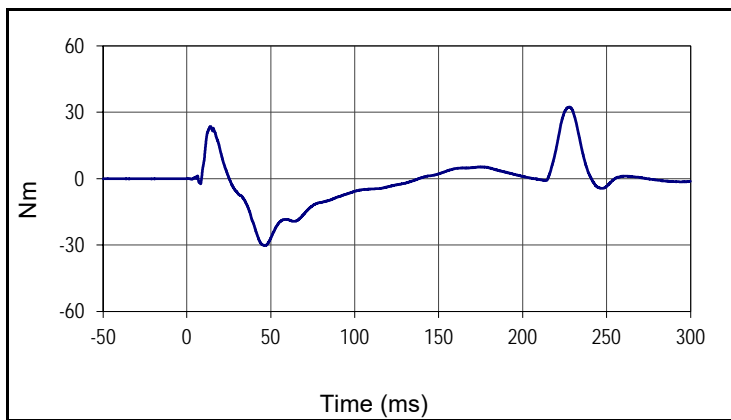
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6 YO Upper Neck Force Resultant			
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1219.4	223.1	2.8	1.3

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
 Test Program: TWG 3.3.5.1

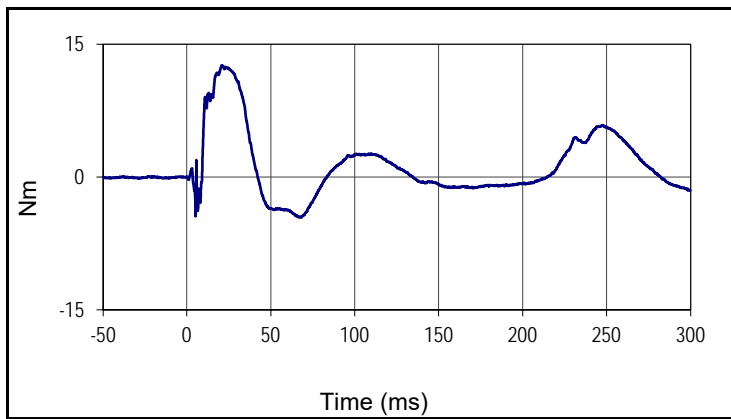
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 NHTSA No.: M20204205TWG2



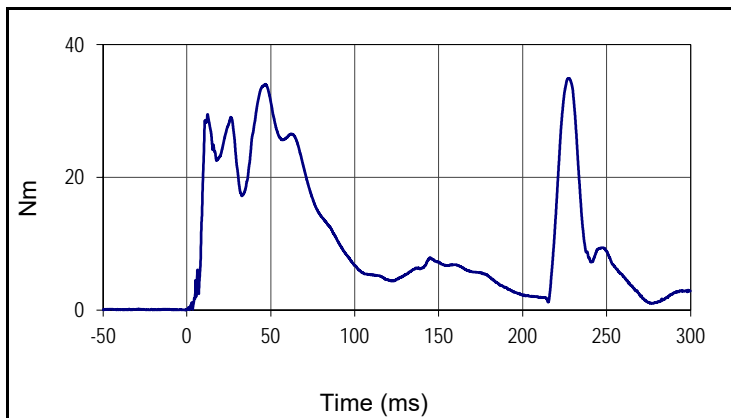
Curve Description			
6 YO Upper Neck Moment X			
Plot No.		SAE Class	Units
009		600	Nm
Max	Time	Min	Time
26.4	26.1	-24.5	10.5



Curve Description			
6 YO Upper Neck Moment Y			
Plot No.		SAE Class	Units
010		600	Nm
Max	Time	Min	Time
32.4	227.8	-30.2	46.7



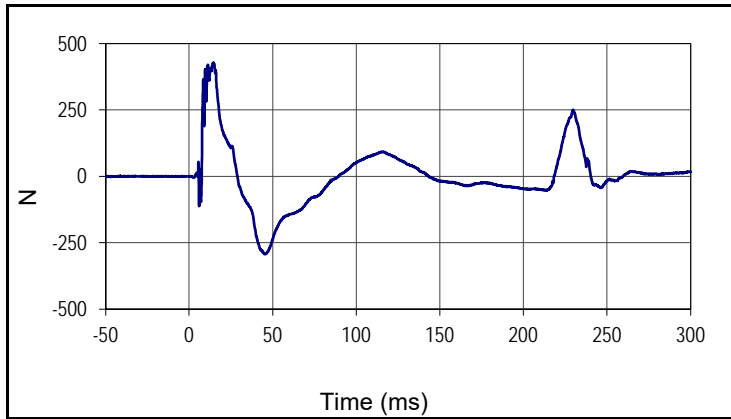
Curve Description			
6 YO Upper Neck Moment Z			
Plot No.		SAE Class	Units
011		600	Nm
Max	Time	Min	Time
12.6	20.8	-4.6	66.7



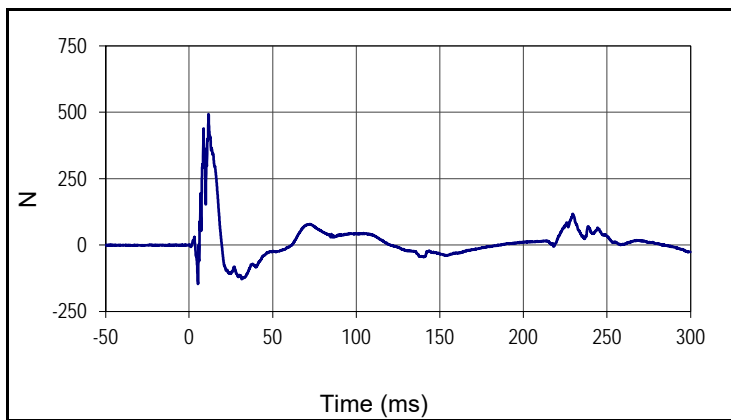
Curve Description			
6 YO Upper Neck Moment Resultant			
Plot No.		SAE Class	Units
012		600	Nm
Max	Time	Min	Time
34.9	227.1	0.0	1.4

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
 Test Program: TWG 3.3.5.1

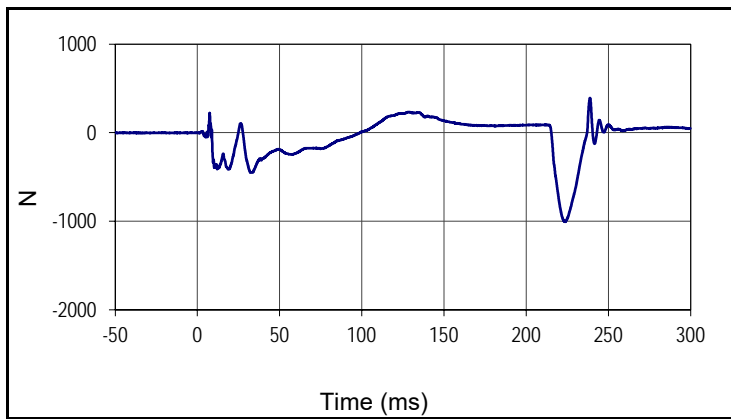
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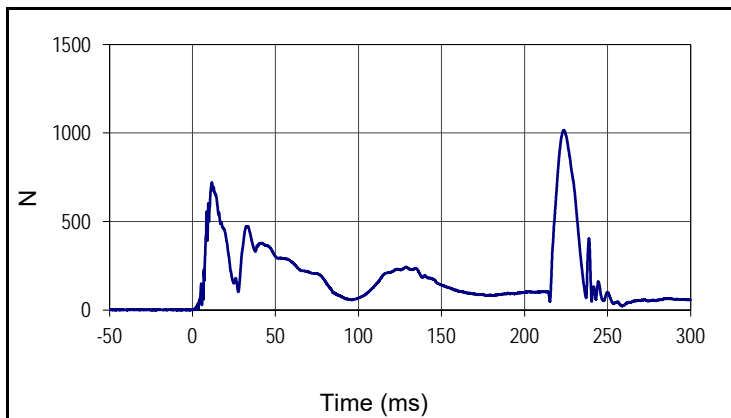
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6 YO Lower Neck Force X			
Plot No.		SAE Class	Units
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Max	Time	Min	Time
427.8	14.6	-293.1	45.2



Curve Description			
6 YO Lower Neck Force Y			
Plot No.		SAE Class	Units
014		1000	N
Max	Time	Min	Time
494.0	11.6	-147.1	5.2



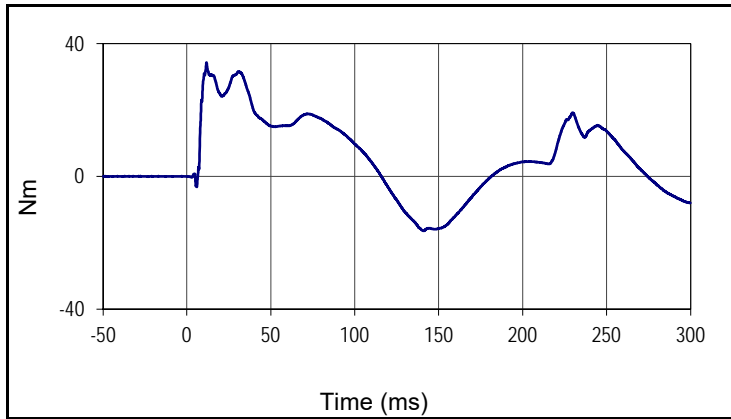
Curve Description			
6 YO Lower Neck Force Z			
Plot No.		SAE Class	Units
015		1000	N
Max	Time	Min	Time
393.0	238.8	-1005.6	223.6



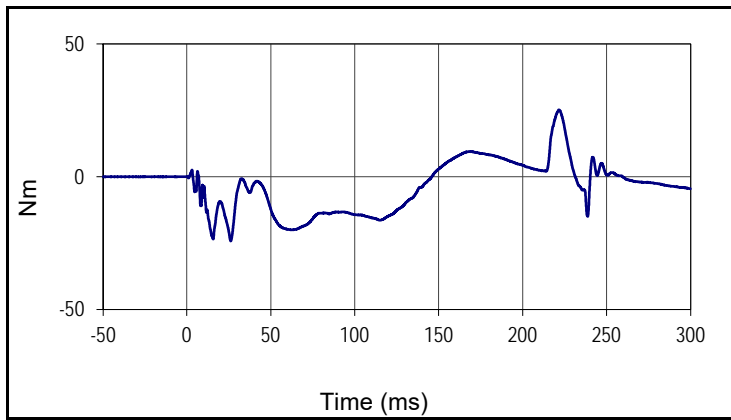
Curve Description			
6 YO Lower Neck Force Resultant			
Plot No.		SAE Class	Units
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Max	Time	Min	Time
1016.9	223.6	1.3	0.4

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
 Test Program: TWG 3.3.5.1

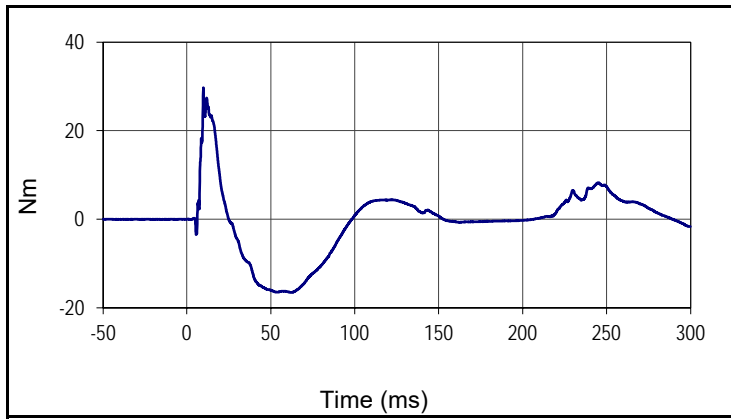
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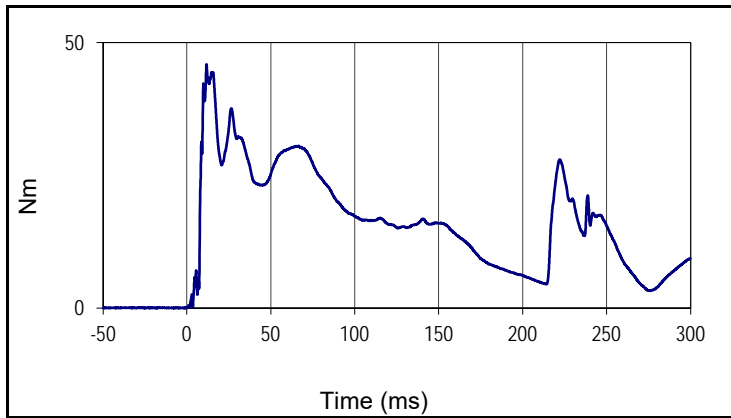
Curve Description			
6 YO Lower Neck Moment X			
Plot No.		SAE Class	Units
017		600	Nm
Max	Time	Min	Time
34.3	11.6	-16.4	141.3



Curve Description			
6 YO Lower Neck Moment Y			
Plot No.		SAE Class	Units
018		600	Nm
Max	Time	Min	Time
25.2	221.6	-24.2	26.1



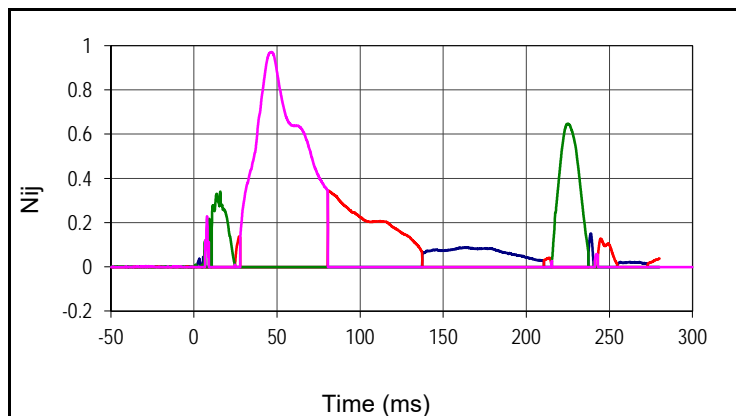
Curve Description			
6 YO Lower Neck Moment Z			
Plot No.		SAE Class	Units
019		600	Nm
Max	Time	Min	Time
29.7	9.8	-16.6	62.0



Curve Description			
6 YO Lower Neck Moment Resultant			
Plot No.		SAE Class	Units
020		600	Nm
Max	Time	Min	Time
45.9	11.6	0.1	0.3

Test Vehicle: 2020 Hyundai Palisade 5-Door MPV
 Test Program: TWG 3.3.5.1

Test Date: 08/04/20
 NHTSA No.: M20204205TWG2



Curve Description		
Driver Nij		
Units	Max	Time
Ntf	0.15	238.7
Units	Max	Time
Nte	0.35	80.5
Units	Max	Time
Ncf	0.65	224.7
Units	Max	Time
Nce	0.97	46.4

APPENDIX C
ATD CONFIGURATION AND PERFORMANCE VERIFICATION DATA

Pre-Test ATD Configuration And Performance Verification Data
Hybrid III 6 Year-Old Child ATD
S/N: 186

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	622.3	647.7	637	Pass
B - Shoulder Pivot Height	mm	348.0	363.2	353	Pass
C - H-Point Height	mm	63.5	73.7	66	Pass
D - H-Point Location From Backline	mm	88.9	99.1	94	Pass
E - Shoulder Pivot From Backline	mm	53.3	63.5	57	Pass
F - Thigh Clearance	mm	88.9	104.1	94	Pass
G - Back Of Elbow To Wrist Pivot	mm	182.9	198.1	188	Pass
H - Head Back To Backline	mm	17.8	22.8	21	Pass
I - Shoulder To Elbow Length	mm	215.9	231.1	228	Pass
J - Elbow Rest Height	mm	157.4	177.8	170	Pass
K - Buttock To Knee Length	mm	370.8	391.2	377	Pass
L - Popliteal Height	mm	269.2	289.6	281	Pass
M - Knee Pivot Height	mm	307.4	322.6	312	Pass
N - Buttock Popliteal Length	mm	320.0	340.4	325	Pass
O - Chest Depth Without Jacket	mm	129.6	144.8	137	Pass
P - Foot Length	mm	170.2	185.4	181	Pass
Q - Stature	mm	1099.9	1181.1	1142	Pass
R - Buttock To Knee Pivot Length	mm	342.9	363.3	360	Pass
S - Head Breadth	mm	137.1	147.3	146	Pass
T - Head Depth	mm	167.6	177.8	173	Pass
U - Hip Breadth	mm	208.3	223.5	217	Pass
V - Shoulder Breadth	mm	259.1	274.3	269	Pass
W - Foot Breadth	mm	62.3	77.5	75	Pass
X - Head Circumference	mm	510.5	530.9	522	Pass
Y - Chest Circ. w/Jacket	mm	596.9	622.3	615	Pass
Z - Waist Circ. w/Jacket and Abdo.	mm	558.8	584.2	575	Pass
AA - Ref. Location for Chest Circ.	mm	325.1	335.3	328	Pass
BB - Ref. Location for Waist Circ.	mm	153.7	163.9	161	Pass
Overall Test Results					Pass

Technician:



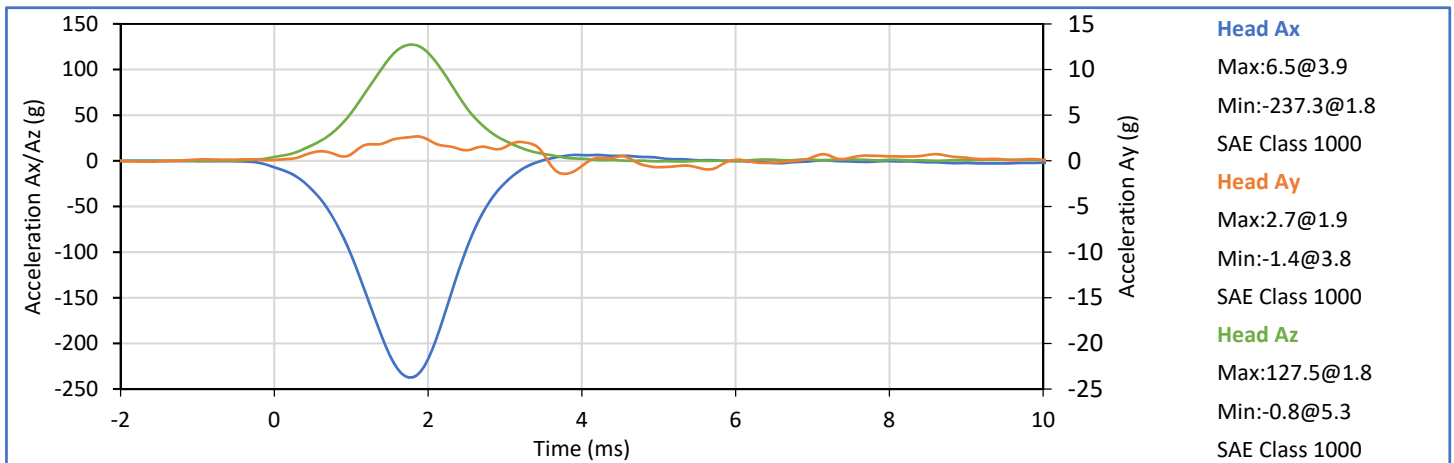
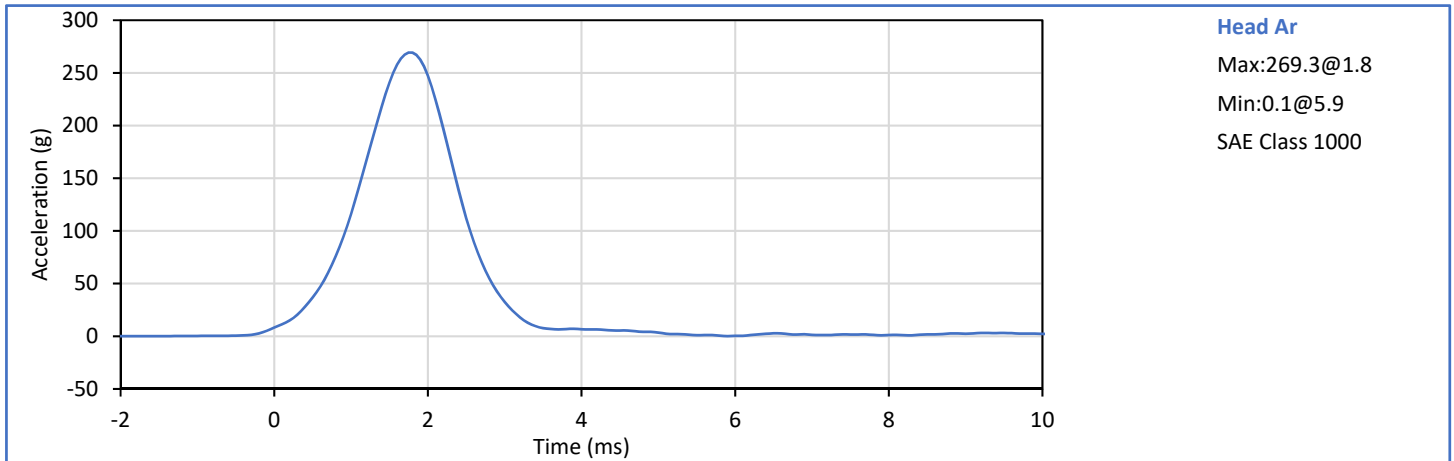
J. Hernandez

Approved By:




P. Puzzuto

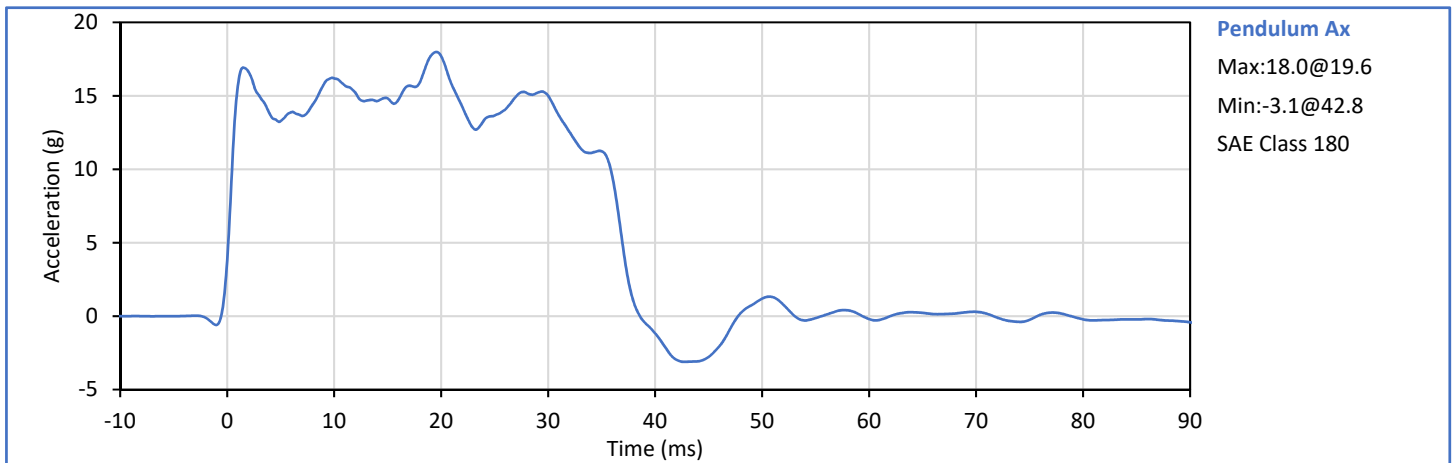
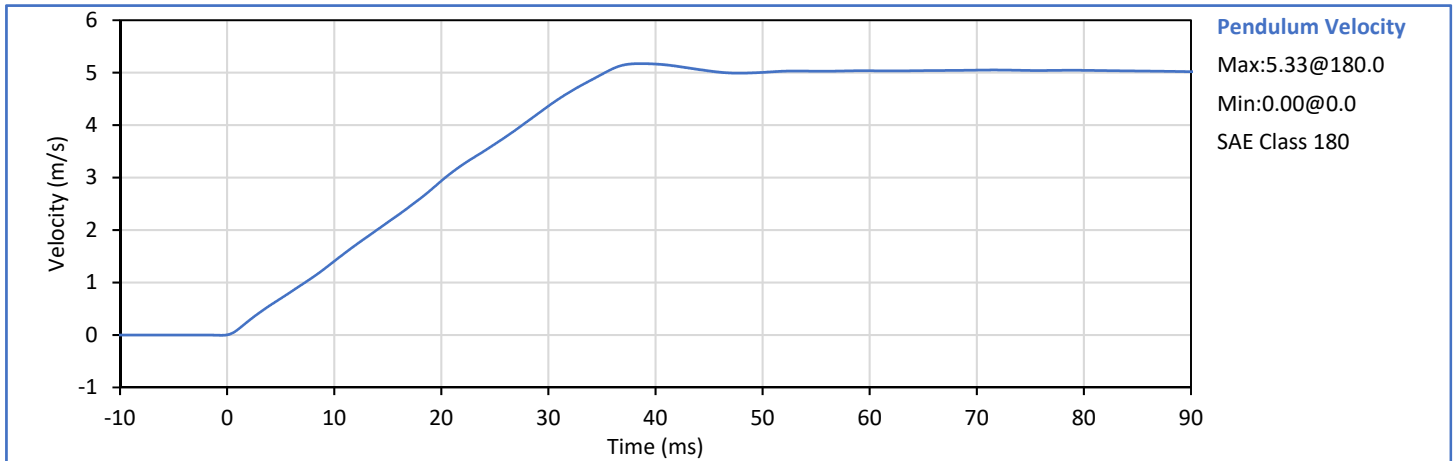
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.1	Pass
Laboratory Humidity	%	10	70	22	Pass
Peak Resultant Acceleration	g	250.0	280.0	269.3	Pass
Peak Lateral Acceleration	g	-15.0	15.0	2.7	Pass
Oscillations After Main Pulse	%	0.0	10.0	1.2	Pass
Is Acceleration Unimodal?	Yes/No	Yes		Yes	Pass
Overall Test Results					Pass




Technician: 
J. Hernandez

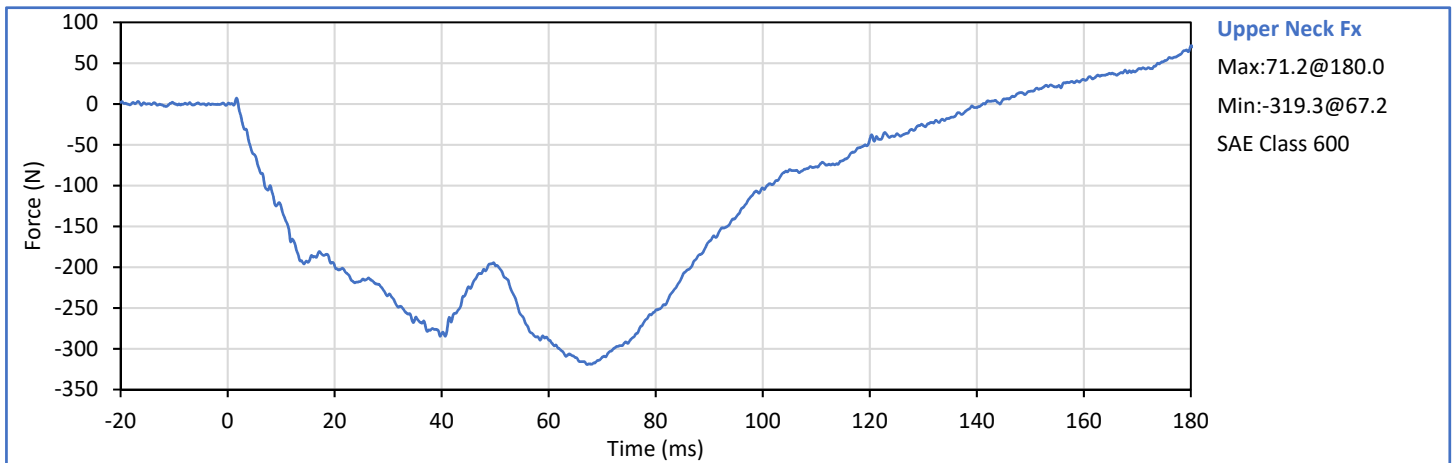
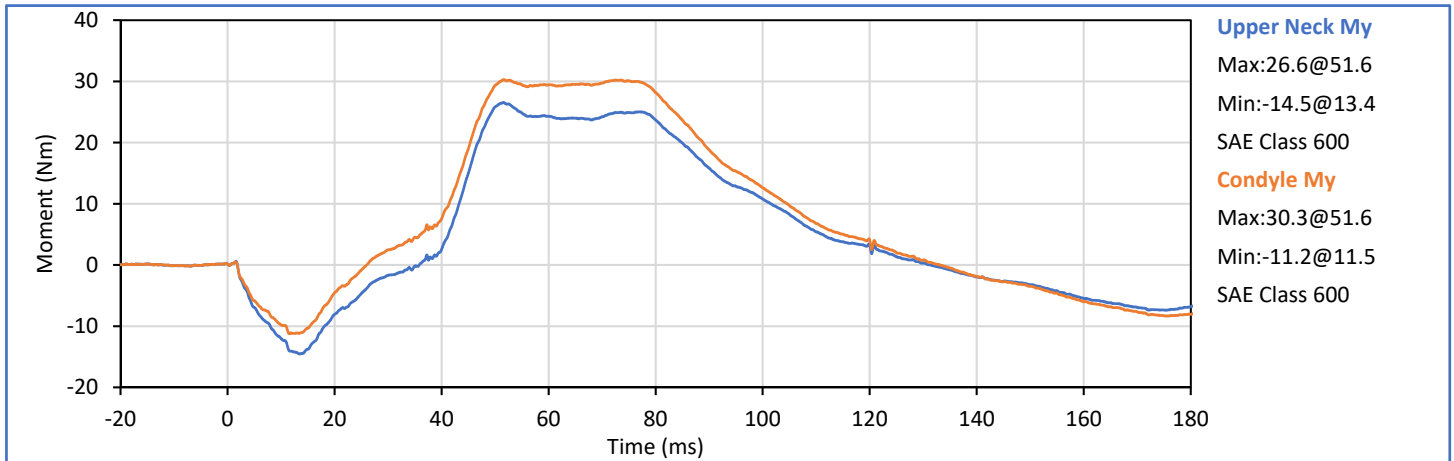
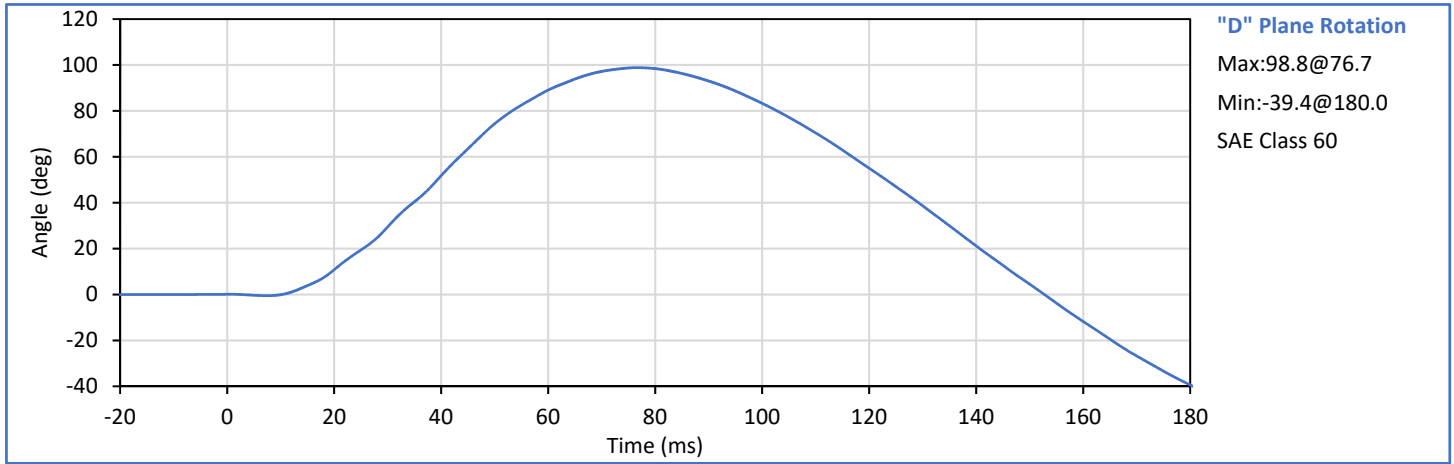
Approved By: 
P. Puzzuto

Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.2	Pass
Laboratory Humidity	%	10	70	39	Pass
Pendulum Velocity	m/s	4.83	5.07	5.03	Pass
Pendulum Velocity at 10 ms	m/s	1.20	1.60	1.41	Pass
Pendulum Velocity at 20 ms	m/s	2.40	3.40	2.94	Pass
Pendulum Velocity at 30 ms	m/s	3.80	5.00	4.36	Pass
Peak Moment in Rotation	Nm	27.0	33.0	30.3	Pass
	deg	74.0	92.0	77.3	Pass
Positive Moment Decay to 5 Nm	ms	103.0	123.0	115.1	Pass
Overall Test Results					Pass

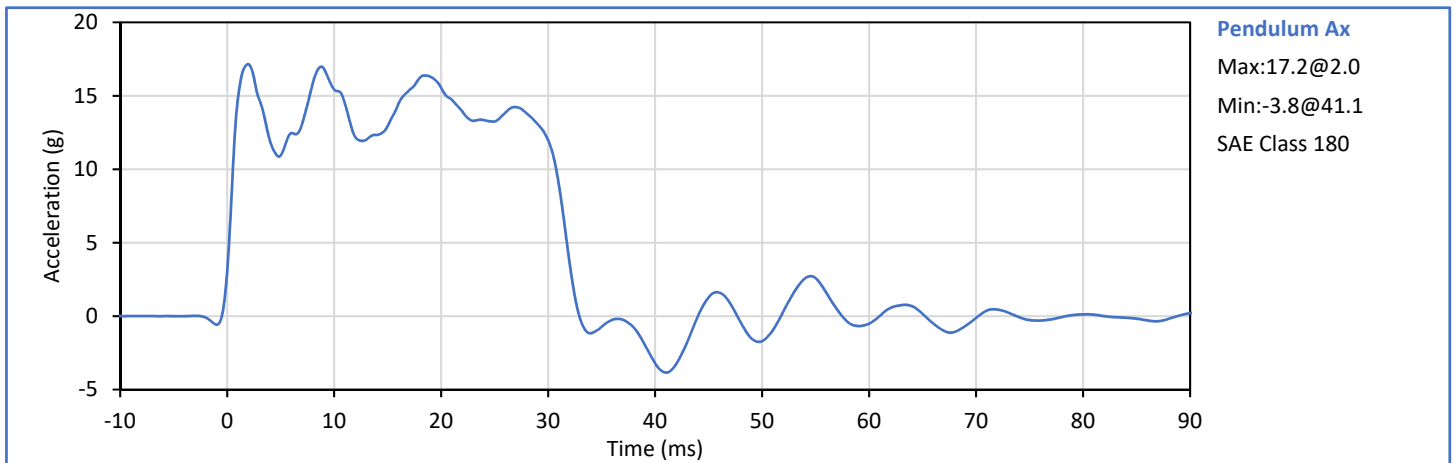
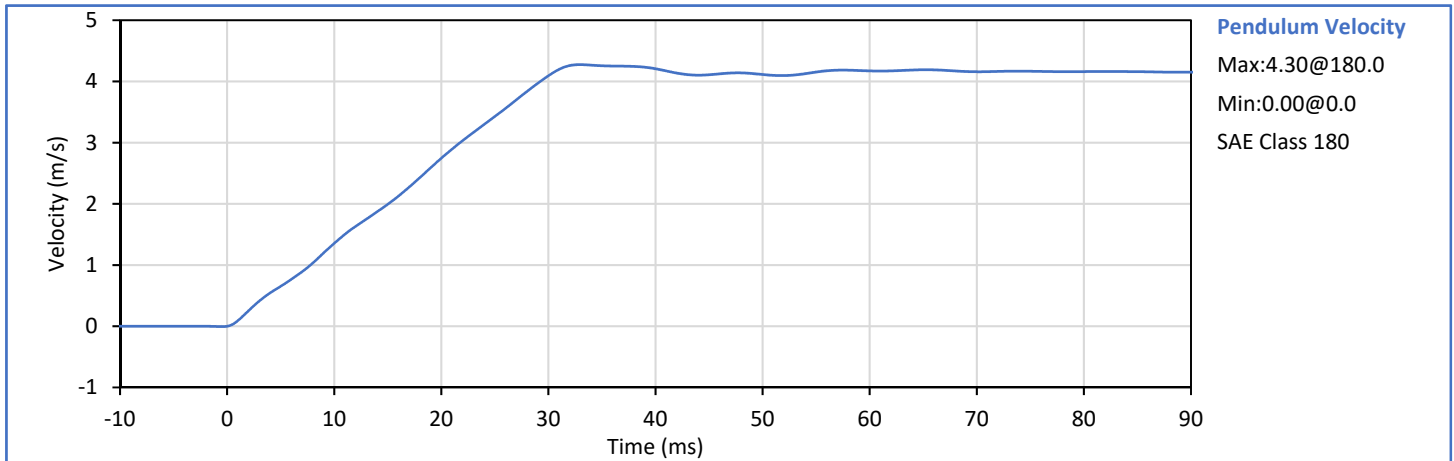


Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

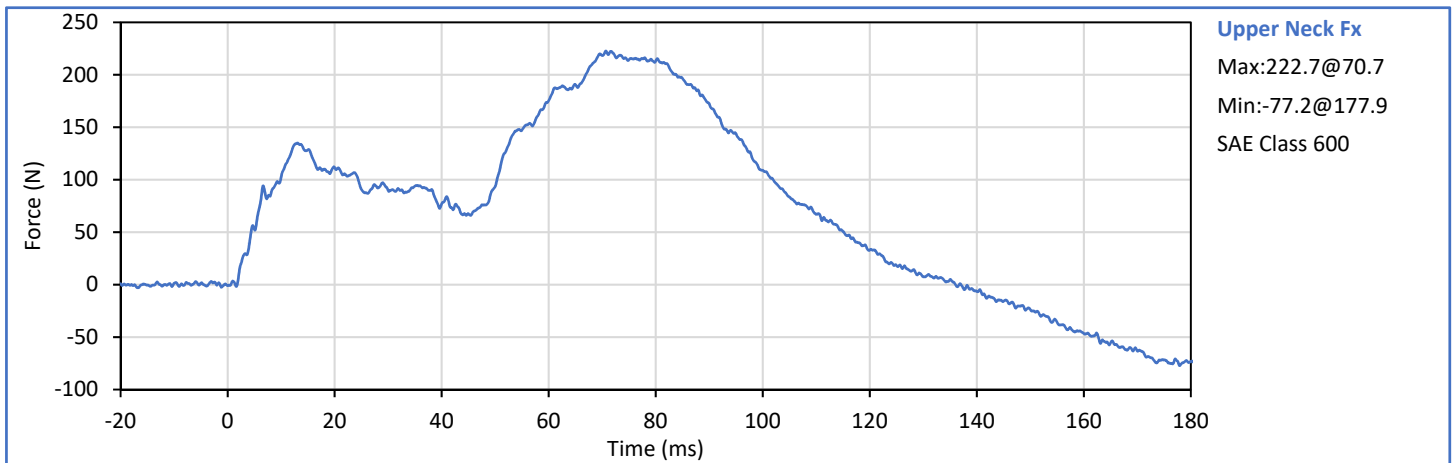
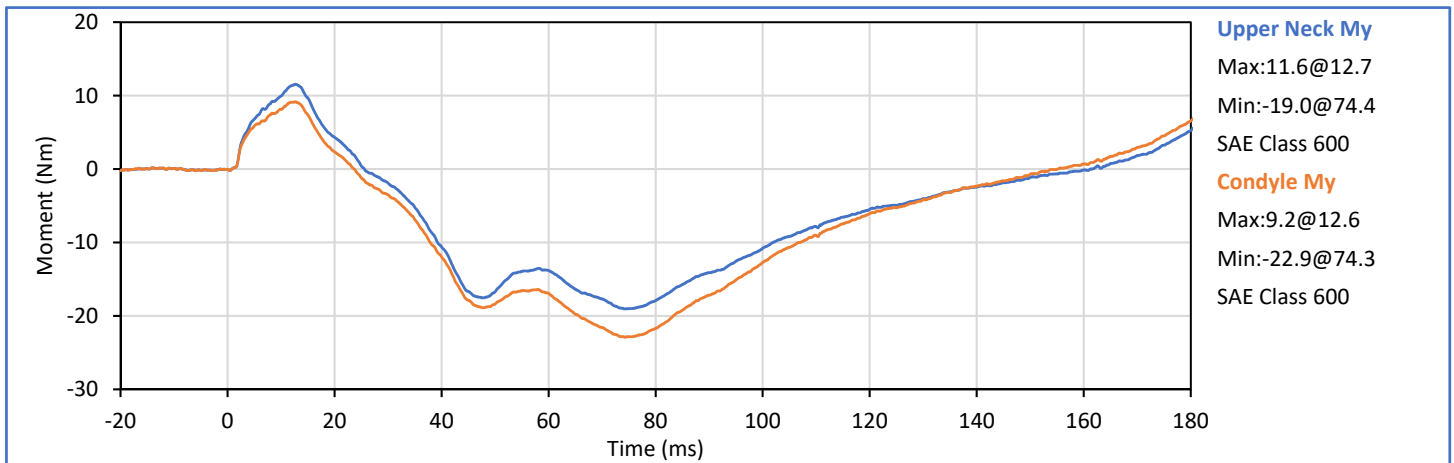
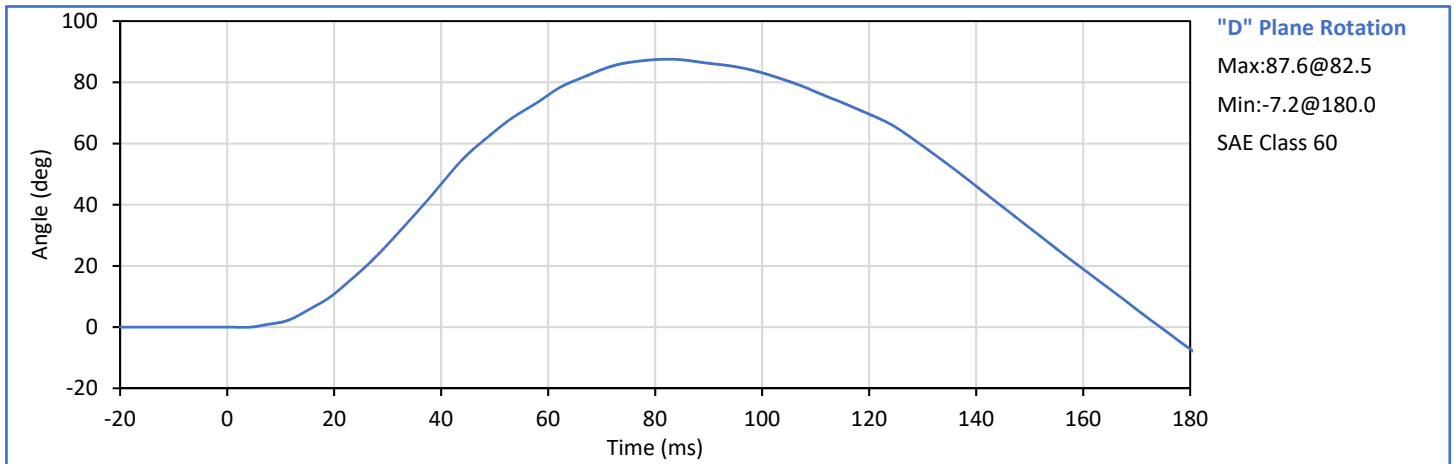


Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.1	Pass
Laboratory Humidity	%	10	70	30	Pass
Pendulum Velocity	m/s	4.18	4.42	4.20	Pass
Pendulum Velocity at 10 ms	m/s	1.00	1.40	1.35	Pass
Pendulum Velocity at 20 ms	m/s	2.20	3.00	2.75	Pass
Pendulum Velocity at 30 ms	m/s	3.20	4.20	4.09	Pass
Peak Moment in Rotation	Nm	-24.0	-19.0	-22.9	Pass
	deg	85.0	103.0	86.3	Pass
Negative Moment Decay to -5 Nm	ms	123.0	147.0	126.6	Pass
Overall Test Results					Pass

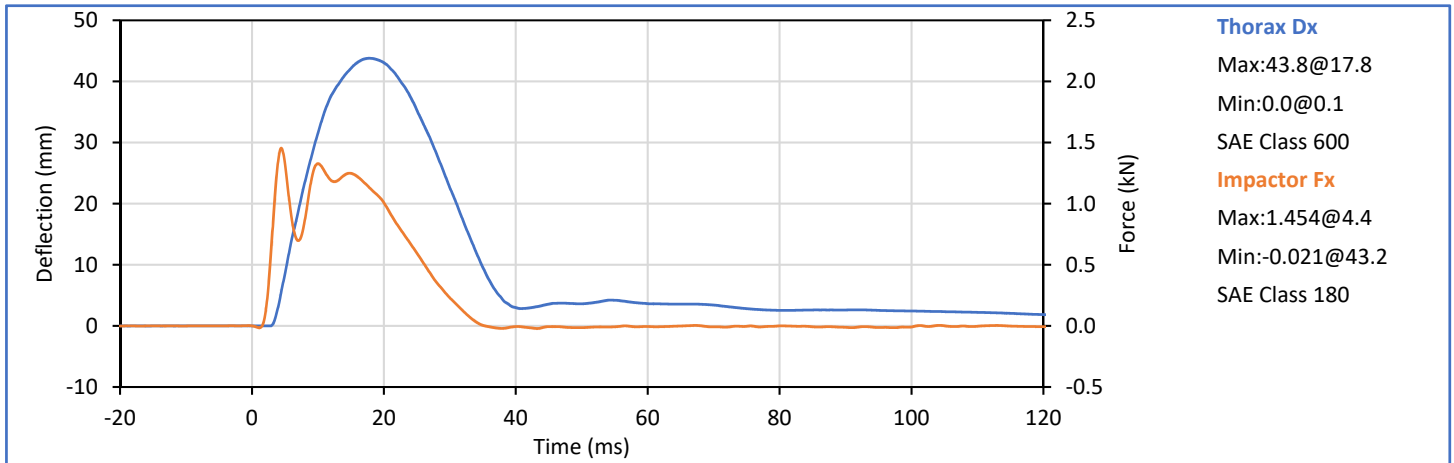
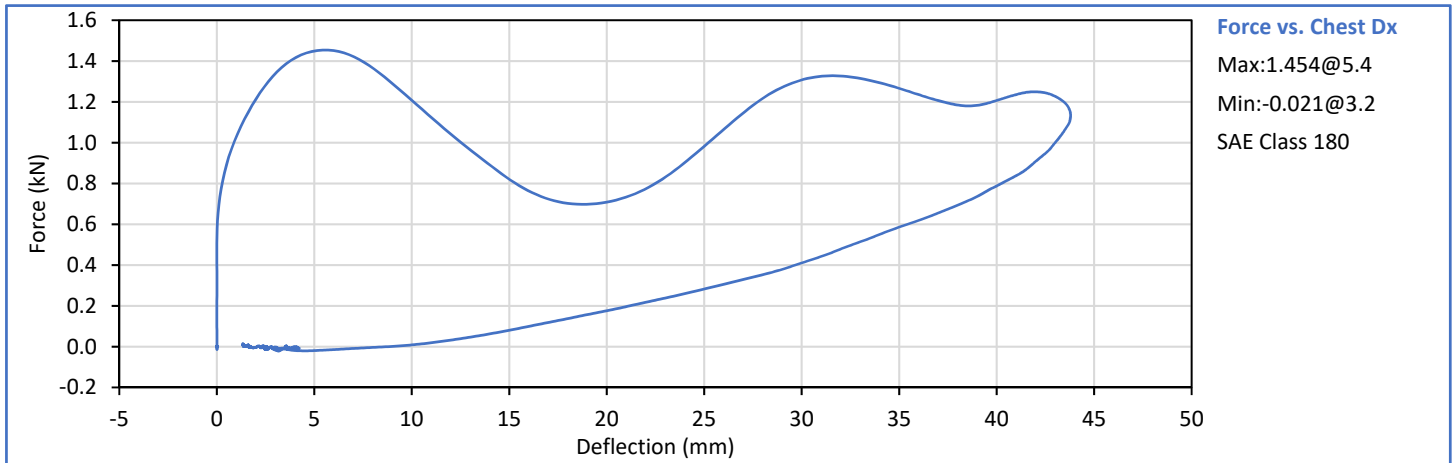


Technician: *J. Hernandez*
J. Hernandez


Approved By: *P. Puzzuto*
P. Puzzuto



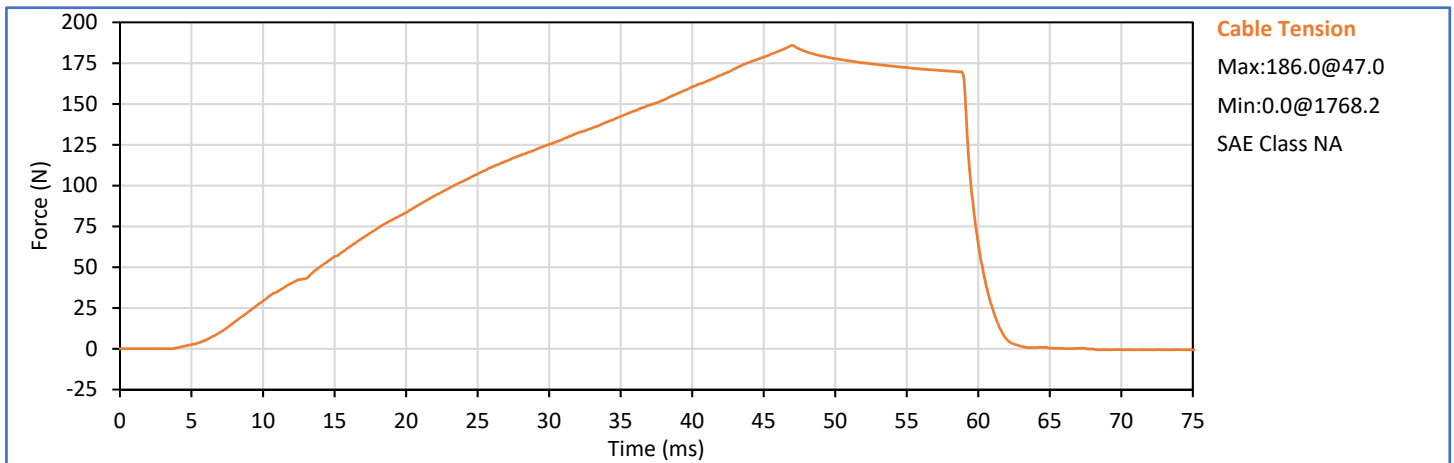
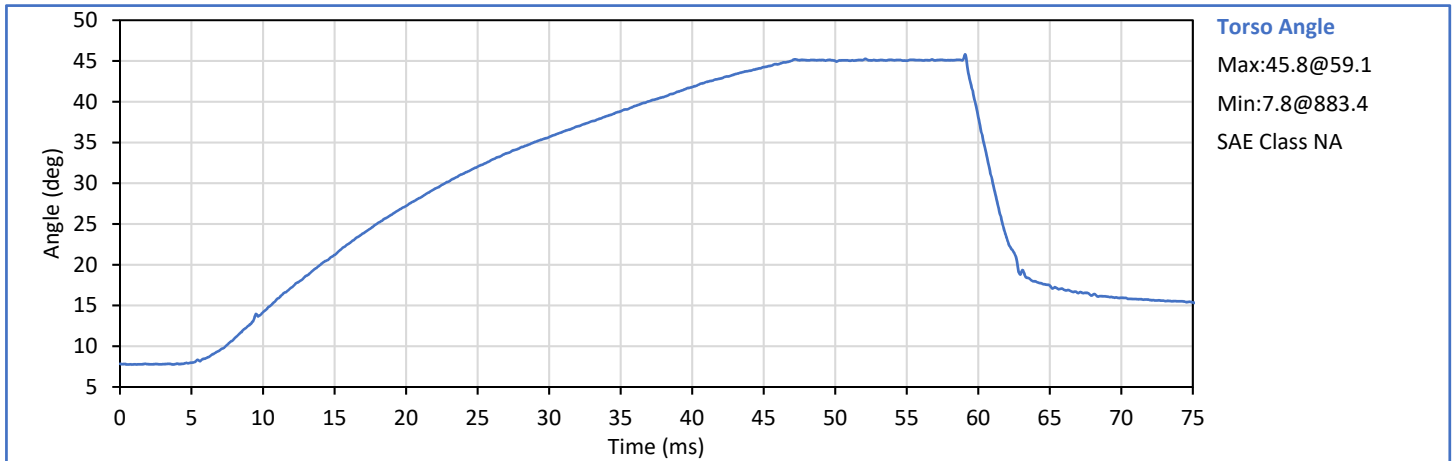
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	20.6	22.2	21.4	Pass
Laboratory Humidity	%	10	70	28	Pass
Probe Velocity	m/s	6.59	6.83	6.73	Pass
Peak Chest Deflection	mm	38.0	46.0	43.8	Pass
Peak Force from 38.0 to 46.0 mm	kN	1.150	1.380	1.249	Pass
Peak Force from 12.5 to 38.0 mm	kN	0.000	1.500	1.328	Pass
Internal Hysteresis	%	65.0	85.0	73.3	Pass
Overall Test Results					Pass





Technician: 
 J. Hernandez

Approved By: 
 P. Puzzuto

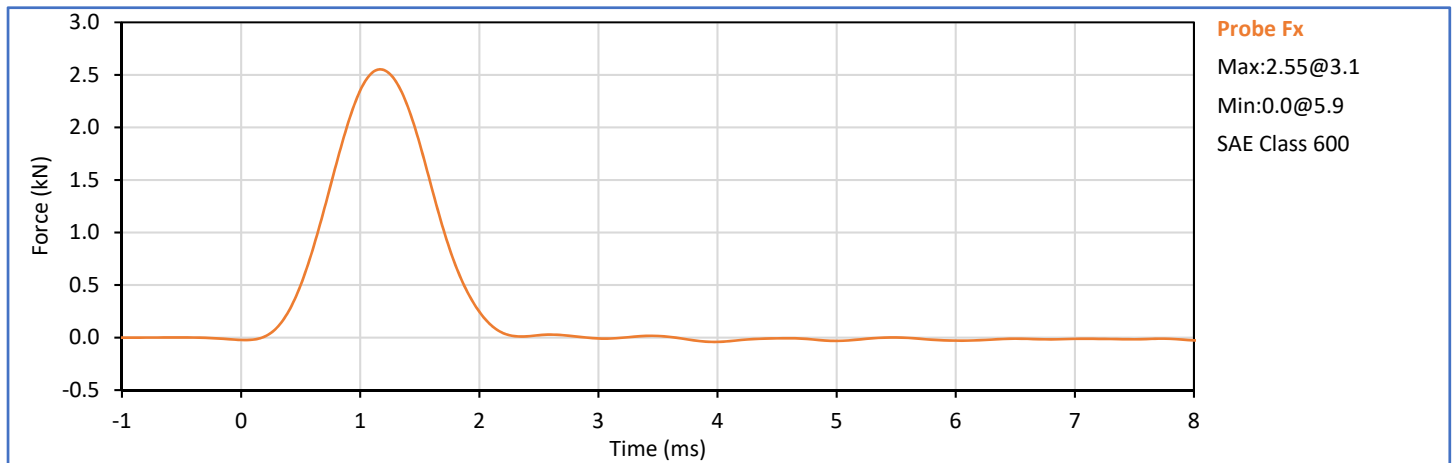
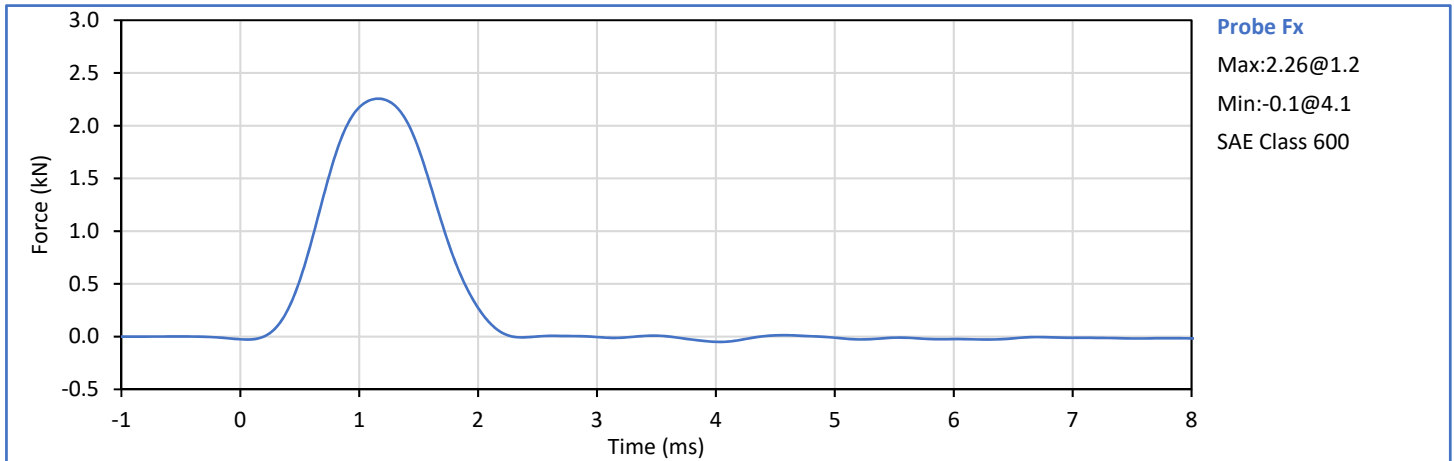
Tested Parameter	Units	Spec. Low	Spec. High	Result	Pass/Fail
Laboratory Temperature	°C	18.9	25.6	21.6	Pass
Laboratory Humidity	%	10	70	34	Pass
Orientation Angle	deg	0.0	22.0	7.5	Pass
Peak Force at 45° (+/-0.5°)	N	147.0	200.0	185.7	Pass
Torso Flexion Rate	deg/s	0.50	1.50	0.92	Pass
Final Reference Plane Angle	deg	-8.0	8.0	6.3	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	32	Pass	
Left Knee	Probe Velocity	m/s	2.070	2.130	2.095	Pass
	Peak Resistive Force	kN	2.00	3.00	2.26	Pass
Right Knee	Probe Velocity	m/s	2.070	2.130	2.085	Pass
	Peak Resistive Force	kN	2.00	3.00	2.55	Pass
Overall Test Results					Pass	



Technician: 
J. Hernandez

Approved By: 
P. Puzzuto

APPENDIX D
INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

Table 1 - ATD Instrumentation

Sensor Location	Sensor S\N	Mfr	Model	Cal Date
Head Acceleration X Primary	P51630	Endevco	7264C-2k	2020-07-23
Head Acceleration Y Primary	P52151	Endevco	7264C-2k	2020-07-23
Head Acceleration Z Primary	P49241	Endevco	7264C-2k	2020-07-23
Upper Neck Force X	2254 Fx	R.A. Denton	1716ATF	2020-07-20
Upper Neck Force Y	2254 Fy	R.A. Denton	1716ATF	2020-07-20
Upper Neck Force Z	2254 Fz	R.A. Denton	1716ATF	2020-07-20
Upper Neck Moment X	2254 Mx	R.A. Denton	1716ATF	2020-07-20
Upper Neck Moment Y	2254 My	R.A. Denton	1716ATF	2020-07-20
Upper Neck Moment Z	2254 Mz	R.A. Denton	1716ATF	2020-07-20
Lower Neck Force X	180 Fx (2430)	R.A. Denton	2430-D	2020-01-21
Lower Neck Force Y	180 Fy (2430)	R.A. Denton	2430-D	2020-01-21
Lower Neck Force Z	180 Fz (2430)	R.A. Denton	2430-D	2020-01-21
Lower Neck Moment X	180 Mx (2430)	R.A. Denton	2430-D	2020-01-21
Lower Neck Moment Y	180 My (2430)	R.A. Denton	2430-D	2020-01-21
Lower Neck Moment Z	180 Mz (2430)	R.A. Denton	2430-D	2020-01-21