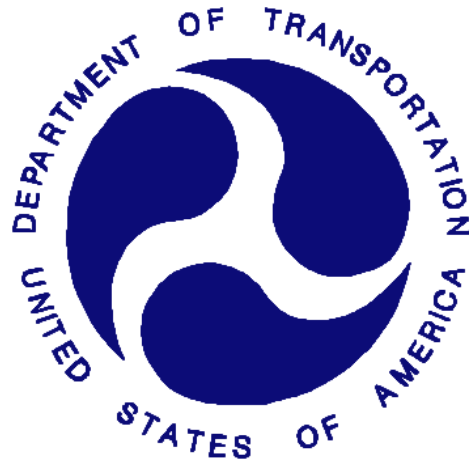


REPORT NUMBER: TWG-MGA-19-002

**SIDE AIRBAG OUT-OF-POSITION INJURY
TECHNICAL WORKING GROUP**

**NISSAN MOTOR CO., LTD.
2019 Nissan Murano S 5-Door SUV
NHTSA No.: M20195211TWG3**

**MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105**



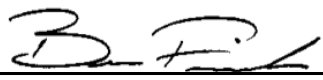
Test Date: July 17, 2019

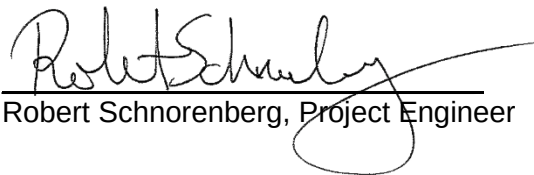
Final Report Date: June 29, 2020

FINAL REPORT

**U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
Mail Code: NRM-110
1200 New Jersey Ave, SE
Room W43-410
Washington, DC 20590**

SIGNATURE APPROVAL PAGE

Prepared by: 
Ben Fischer, Project Engineer

Approved by: 
Robert Schnorenberg, Project Engineer

Approval Date: June 29, 2020

FINAL REPORT ACCEPTANCE BY:

Date: _____

The results presented in this report relate only to the specified test items.

TECHNICAL REPORT DOCUMENTATION PAGE

1. Report No. TWG-MGA-19-002	2. Government Accession No.	3. Recipient's Catalog No.																															
4. Title and Subtitle Final Report of Side Airbag Out-of-Position Injury Technical Working Group evaluation of a 2019 Nissan Murano S 5-Door SUV, NHTSA No.: M20195211TWG3		5. Report Date June 29, 2020																															
7. Author(s) Ben Fischer, Project Engineer		6. Performing Organization Code MGA																															
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		8. Performing Organization Report No. TWG-MGA-19-002																															
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards (NRM-110) 1200 New Jersey Ave, SE, Room W43-410 Washington, D.C. 20590		10. Work Unit No.																															
		11. Contract or Grant No. DTNH22-13-D-00311L																															
		13. Type of Report and Period Covered: Final Test Report July 17, 2019 to June 29, 2020																															
15. Supplementary Notes		14. Sponsoring Agency Code NRM-110																															
16. Abstract A Side Airbag Out-of-Position Injury evaluation was conducted on the subject 2019 Nissan Murano S 5-Door SUV in accordance with the specifications of the Side Airbag Out-of-Position Injury Technical Working Group Laboratory Test Procedure for the generation of consumer information. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on July 17, 2019.																																	
<table border="1"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD (SID-IIs)</th> </tr> <tr> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td></td> <td>570</td> <td>5</td> </tr> <tr> <td>Nij</td> <td></td> <td>1</td> <td>0.59</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>1130</td> <td>347</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>1380</td> <td>225</td> </tr> <tr> <td>Maximum Chest Displacement</td> <td>mm</td> <td>36</td> <td>20</td> </tr> <tr> <td>Maximum Chest Displacement Rate</td> <td>m/s</td> <td>8.0</td> <td>3.9</td> </tr> </tbody> </table>				Measurement Description	Units	Driver ATD (SID-IIs)		Threshold	Result	Head Injury Criteria (HIC ₁₅)		570	5	Nij		1	0.59	Neck Tension	N	1130	347	Neck Compression	N	1380	225	Maximum Chest Displacement	mm	36	20	Maximum Chest Displacement Rate	m/s	8.0	3.9
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17. Key Words Side Airbag Out-of-Position Technical Working Group OOP TWG HIII 3YO		18. Distribution Statement Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Ave, SE Washington, DC 20590																															
19. Security Classification of Report Unclassified	20. Security Classification of Page Unclassified	21. No. of Pages 84	22. Price																														

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SECTION 1

TEST PUPOSE AND PROCEDURE

This side airbag out-of-position test is part of the MY2019 New Car Assessment Program (NCAP), sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-13-D-00311L. The purpose of this test is to obtain data on the performance of side airbags with out-of-position occupants in a 2019 Nissan Murano S 5-Door SUV. The airbag test was conducted in accordance with the Office of Crashworthiness Standard's Side Airbag Out-of-Position Laboratory Test Procedure, dated April 2018.

SECTION 2

SUMMARY OF TEST RESULTS

The effects of both a curtain and torso airbag deployment in a 2019 Nissan Murano S 5-Door SUV with an out-of-position Hybrid III 3-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on July 17, 2019. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Two high-speed cameras (2,700 fps) were used to document the side airbag deployment event. The following camera locations were used:

- Left Side Through Removed Left Rear Passenger Door
- Left Side $\frac{3}{4}$ View Through Windshield

One Hybrid III 3-Year-Old child dummy (Serial Number 082) was placed in the right rear passenger seat situated in the rearward-facing position along the outboard edge of the seat per Section 3.3.3.2 according to dummy placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG).

The dummy was instrumented with the following instrumentation:

- | | |
|------------------------------|--------------------------------|
| • Head Accelerometers | • Lower Spine Accelerometers |
| • Upper Neck Load Cell | • Upper Sternum Accelerometers |
| • Lower Neck Load Cell | • Lower Sternum Accelerometers |
| • Chest Accelerometers | • Chest Potentiometer |
| • Upper Spine Accelerometers | |

The 21 channels of data were recorded using an off board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 3-Year-Old child dummy's visible contact points were as follows:

- Side curtain airbag to top of head
- Side torso/pelvis airbag to face and torso/pelvis

The Hybrid III 3-Year-Old child dummy was placed in the right rear passenger seat along the outboard edge of the seat cushion, kneeling and facing rearward. The vertical centerline of the dummy's sternum was aligned as close as possible with the leading edge of the seatback bolster. The sternum contacted with seat. The dummy's head was placed in between the seat bolster and pillar/side trim to maximize contact between the sternum and seatback. The head remained in its neutral orientation. The outboard leg was positioned at the outboard edge of the seat cushion and parallel to the seat centerline and remained on the cushion. The outboard knee and lower leg was slid toward the seatback/seat cushion junction until the top edge of the upper rib was aligned horizontally with the top edge of the airbag module. The inboard leg was aligned parallel to the centerline of the seat cushion. The inboard knee and lower leg was slid toward the seat bight until a line drawn through both shoulder bolts was perpendicular to the vehicle centerline. The inboard arm was rotated towards the seatback until the thumb contacts the seatback. The outboard arm and hand was rotated to hang down as close to vertical as possible.

The dummy's skullcap seam was covered with 4mm electrical tape to prevent the airbag from getting caught in the seam. The dummy's head skin was cleaned with alcohol and dusted with baby powder to achieve acceptable frictional characteristics.

This orientation complies with Section 3.3.3.2 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group First Revision dated July 2003.

SECTION 3
OCCUPANT AND VEHICLE INFORMATION

**DATA SHEET NO. 1
TEST SUMMARY**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

TEST CONFIGURATION INFORMATION

Seating Position	P3	Right Rear Seating Position
Test Section	3.3.3.2*	Rear-Facing Child Dummy
Curtain Airbag	Roof-Rail Mounted	Side Curtain Airbag
Torso Airbag	Seat Mounted	Side Torso/Pelvis Airbag
ATD Type/Serial No.	Hybrid III 3-Year-Old	S/N: 082
Vehicle	Nissan	Murano
Previous Crash Test	Side MDB NCAP	February 5, 2019 – M20195211

*Procedure as defined by Lund, et al and the Technical Working Group dated July 2003

EQUIPMENT INFORMATION

Number of Data Channels	21
Number of Airbag Channels	4
Number of High-Speed Video	2

VISIBLE DUMMY CONTACT POINTS

Head	Side curtain airbag, Side torso/pelvis airbag
Upper Torso	Side torso/pelvis airbag
Lower Torso	Side torso/pelvis airbag
Knee	None

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20195211	Traction Control System (TCS)	Yes
Model Year	2019	Auto-Leveling System	No
Make	Nissan	Automatic Door Locks (ADL)	Yes
Model	Murano S	Power Window Auto-Reverse	Yes
Body Style	5-Door SUV	Other Optional Feature	No
VIN	5N1AZ2MJ4KN103996	Driver Front Airbag	Yes
Body Color	Deep Blue Pearl	Driver Curtain Airbag	Yes
Odometer Reading (km/mi)	48 km / 30 mi	Driver Head/Torso Airbag	No
Engine Displacement (L)	3.5 L	Driver Torso Airbag	No
Type/No. Cylinders	V6	Driver Torso/Pelvis Airbag	Yes
Engine Placement	Lateral	Driver Pelvis Airbag	No
Transmission Type	Automatic	Driver Knee Airbag	Yes
Transmission Speeds	CVT	Rear Pass. Curtain Airbag	Yes
Overdrive	Yes	Rear Pass. Head/Torso Airbag	No
Final Drive	FWD	Rear Pass. Torso Airbag	No
Roof Rack	No	Rear Pass. Torso/Pelvis Airbag	Yes
Sunroof/T-Top	No	Rear Pass. Pelvis Airbag	No
Running Boards	No	Driver Seat Belt Pretensioner	Yes
Tilt Steering Wheel	Yes	Rear Pass. Seat Belt	Yes
Power Seats	No	Driver Load Limiter	Yes
Anti-Lock Brakes (ABS)	Yes	Rear Pass. Load Limiter	No
		Other Restraint Feature	N/A

DATA FROM CERTIFICATION LABEL

Manufactured By	NISSAN MOTOR CO., LTD.	GVWR (kg)	2318
Date of Manufacture	12/18	GAWR Front (kg)	1272
Vehicle Type	MPV	GAWR Rear (kg)	1300

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3		5	
Capacity Weight (VCW) (kg)				408	(A)
DSC x 68.04 kg				340	(B)
Rated Cargo and Luggage Weight (RCLW) (kg)				68	(A-B)

VEHICLE SEAT TYPE

Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	Split Bench	Contoured	Fixed	Adjustable	
						Manual	Power
Front Seat	X					w/ Lever	
Rear or Second Row			X			w/ Lever	
Third Row Seat							

**DATA SHEET NO. 3
SEAT ADJUSTMENT DATA**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

VEHICLE SEAT FORE/AFT POSITION

Seat	Total Fore/Aft Travel		Test Position from Forward-Most Position	
	mm	Detents (1 st as 1)	mm	Detent (1 st as 0)
Right Front Passenger Seat				
Right Rear Passenger Seat	Fixed		Fixed	
Seat Fore/Aft Position per TWG Guidelines	Initial Position: Rearmost and lowest adjustment			
	Seat Track Adjustments: Allowed to ensure proper alignment of the ATD sternum and airbag deployment trajectory			
Reason for Deviation from TWG Guidelines	No deviation from TWG guidelines			

VEHICLE SEAT BACK ANGLE ADJUSTMENT

Seat	Total Seat Back Angle Range		Test Position from Vertical	
	Degrees	Detents (1 st as 1)	Degrees	Detent (1 st as 0)
Right Front Passenger Seat				
Right Rear Passenger Seat	23.8	13	-3.5	0
OEM Back Angle Design Position	0 th detent (0 as forward-most)			
Method of Measuring Back Angle Position	Angle measured on outboard headrest post			
Seat Back Position per TWG Guidelines	Initial Position: Manufacturer's design angle			
	Seat Back Adjustments: None			
Reason for Deviation from TWG Guidelines	No deviation from TWG guidelines			

VEHICLE SEAT HEIGHT ADJUSTMENT

Seat	Total Seat Height Travel		Test Position from Lowest Position	
	mm	Detents (1 st as 1)	mm	Detent (1 st as 0)
Right Front Passenger Seat				
Right Rear Passenger Seat	Fixed		Fixed	
Seat Fore/Aft Position per TWG Guidelines	Initial Position: Rearmost and lowest adjustment			
	Seat Height Adjustments: None			
Reason for Deviation from TWG Guidelines	No deviation from TWG guidelines			

DATA SHEET NO. 4
DUMMY SETUP AND POSITIONING DATA

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

ATD Type	Hybrid III 3-Year-Old child dummy
Serial Number	082
Qualification Date	7/16/2019
Qualification Type	Full
Clothing	Cotton shirt and pants, shoes
Other ATD Preparation	Skullcap seam covered with 4mm electrical tape. Head skin cleaned with alcohol and dusted with baby powder.

DATA SHEET NO. 5
DUMMY INJURY CRITERIA VALUES

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

RECORDED DATA – MINIMUMS AND MAXIMUMS

Channel	Unit	CFC	Maximum	Time (ms)	Minimum	Time (ms)
RRP Head X	g	1000	9.2	22.1	-7.2	16.6
RRP Head Y			12.6	22.9	-2.5	9.1
RRP Head Z			11.0	10.2	-1.0	20.5
RRP Head Xr	g	1000	9.0	22.0	-7.9	16.6
RRP Head Yr			13.7	22.9	-2.3	10.6
RRP Head Zr			11.0	22.3	-0.8	85.6
RRP Upper Neck Fx	N	1000	119.2	8.9	-238.9	17.6
RRP Upper Neck Fy			24.3	86.9	-233.1	28.8
RRP Upper Neck Fz			347.2	15.9	-224.7	29.4
RRP Upper Neck Mx	Nm	600	9.3	26.2	-5.6	47.3
RRP Upper Neck My			9.3	85.8	-12.6	17.6
RRP Upper Neck Mz			6.4	53.8	-5.0	22.3
RRP Lower Neck Fx	N	1000	115.5	7.1	-266.8	16.5
RRP Lower Neck Fy			19.8	108.2	-209.7	26.9
RRP Lower Neck Fz			379.1	15.6	-182.2	29.6
RRP Lower Neck Mx	Nm	600	5.2	84.0	-14.7	31.7
RRP Lower Neck My			22.6	84.9	-7.9	7.8
RRP Lower Neck Mz			5.5	55.6	-7.6	16.9
RRP Chest Displacement	mm	600	0.5	5.3	-20.2	11.9
RRP Upper Sternum X	g	1000	689.3	6.2	-240.3	10.8
RRP Lower Sternum X	g	1000	724.2	5.7	-174.8	12.6
RRP Upper Spine X	g	1000	6.5	17.2	-32.8	10.1
RRP Upper Spine Y			32.1	8.5	-4.5	12.8
RRP Upper Spine Z			15.1	9.8	-19.1	6.5
RRP Lower Spine X	g	1000	4.4	16.5	-73.5	7.4
RRP Lower Spine Y			33.7	7.1	-7.4	11.6
RRP Lower Spine Z			17.2	8.0	-4.6	5.8

HEAD INJURY SUMMARY

HIC₁₅	T₁ (ms)	T₂ (ms)	HIC₃₆	T₁ (ms)	T₂ (ms)
5	14.4	29.4	6	7.5	31.5

NECK INJURY SUMMARY

Injury Criteria	Unit	Value	Time (ms)
Upper Neck NTF		0.15	84.4
Upper Neck NTE		0.59	16.5
Upper Neck NCF		0.04	6.5
Upper Neck NCE		0.46	19.8
Peak Tension	N	347.2	15.9
Peak Compression	N	224.7	29.4

**DATA SHEET NO. 5 (CONT.)
DUMMY INJURY CRITERIA DATA**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

CHEST INJURY SUMMARY

Injury Criteria	Unit	Value	Time (ms)
Chest Deflection	mm	20	11.9
Deflection Rate ¹	m/s	3.9	8.0

¹Deflection rate is calculated based on Chest Deflection potentiometer.

RESEARCH VALUE SUMMARY

Research Injury Criteria¹	Unit	Value	Time (ms)
Upper Neck Lateral Moment	Nm	9.3	26.2
Upper Neck Twist Moment	Nm	6.4	53.8
Lower Neck Flexion Moment	Nm	9.3	85.8
Lower Neck Extension Moment	Nm	12.6	17.6
Lower Neck Lateral Moment	Nm	14.7	31.7
Lower Neck Twist Moment	Nm	7.6	16.9
Lower Neck Tension	N	379.1	15.6
Lower Neck Compression	N	182.2	29.6
Spine Acceleration	g	77.7	7.4

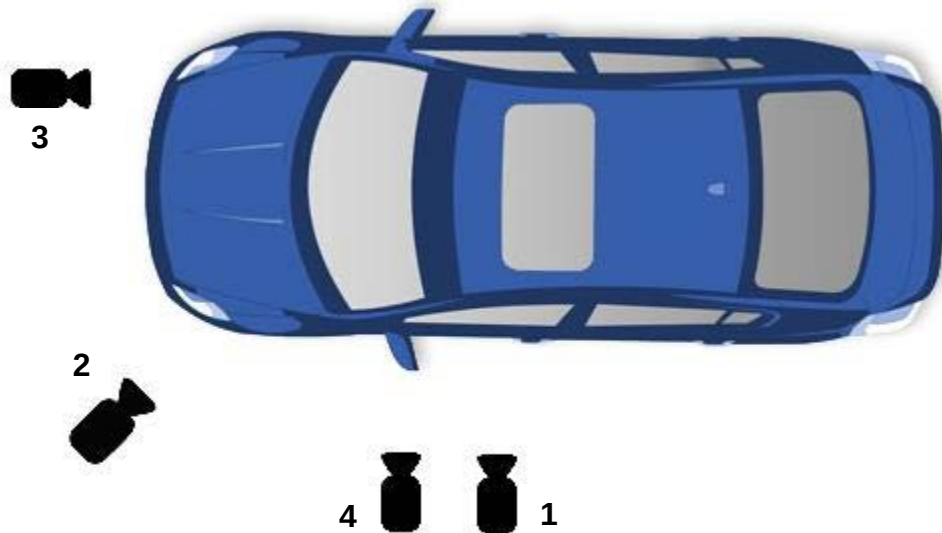
¹These injury criteria are only monitored and not considered pass/fail.

**DATA SHEET NO. 6
CAMERA SETUP AND DESCRIPTION**

Test Vehicle: 2019 Nissan Murano S 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20195211TWG3
Test Date: 7/17/2019

CAMERA SETUP DIAGRAM FOR OOP TESTS



CAMERA LOCATIONS

No.	Camera View	Location			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Left View	338	-2510	-1310	24	2700
2	Oblique View	1820	-2100	-1620	24	2700
3	Front View					
4	Real Time (optional)					30

Reference:

+X = Forward of Rear Surface of Vehicle (RSOV)

+Y = Right of Vehicle Centerline

+Z = Down from Ground

APPENDIX A

PHOTOGRAPHS

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Photo No. 001 - Right Front Three-Quarter View of Vehicle, As Delivered



Photo No. 002 - Vehicle Certification Label



Photo No. 003 - Pre-Test Vehicle Left Side View



Photo No. 004 - Post-Test Vehicle Left Side View



Photo No. 005 - Pre-Test Vehicle Location of Air Bag 1



Photo No. 006 - Pre-Test Vehicle Location of Air Bag 2



Photo No. 007 - Pre-Test Vehicle Location of Air Bag 3



Photo No. 008 - Pre-Test Vehicle Seat Back Angle



Photo No. 009 - Pre-Test Dummy Left Side View



Photo No. 010 - Post-Test Dummy Left Side View



Photo No. 011 - Pre-Test Dummy Left Side Close-up View



Photo No. 012 - Post-Test Dummy Left Side Close-up View



Photo No. 013 - Pre-Test Dummy Left Three-Quarter Front View



Photo No. 014 - Post-Test Dummy Left Three-Quarter Front View



Photo No. 015 - Pre-Test Dummy Left Three-Quarter Front Close-up View



Photo No. 016 - Post-Test Dummy Left Three-Quarter Front Close-up View



Photo No. 017 - Pre-Test Dummy Front View



Photo No. 018 - Post-Test Dummy Front View



Photo No. 019 - Pre-Test Dummy Front Close-up View



Photo No. 020 - Post-Test Dummy Front Close-up View



Photo No. 021 - Pre-Test Dummy Right Three-Quarter Front View



Photo No. 022 - Post-Test Dummy Right Three-Quarter Front View

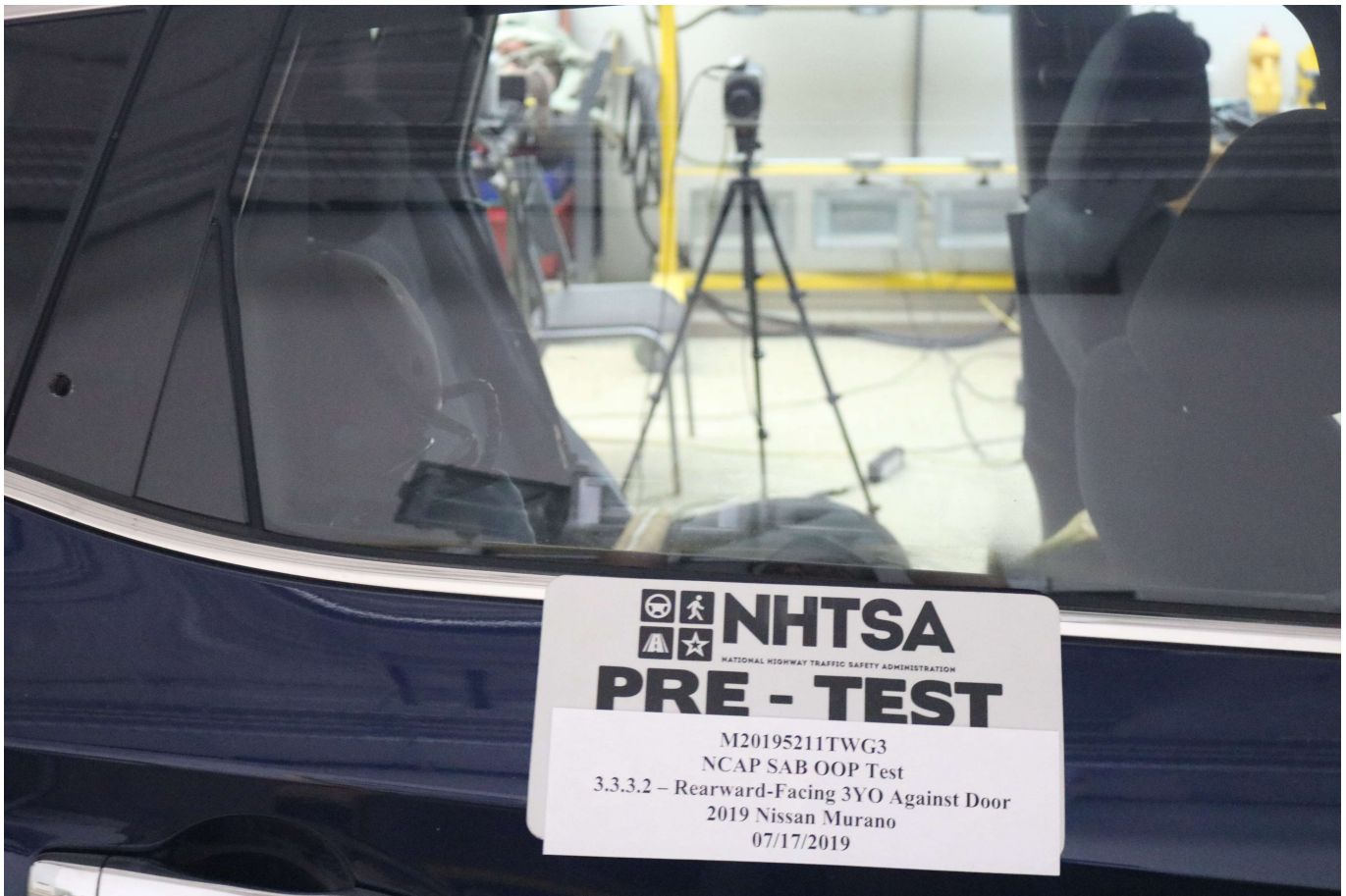


Photo No. 023 - Pre-Test Dummy Right Side View



Photo No. 024 - Post-Test Dummy Right Side View



Photo No. 025 - Post-Test Dummy Right Side View (Door Open)



Photo No. 026 - Post-Test Curtain Air Bag Left Side View



Photo No. 027 - Post-Test Curtain Air Bag Left Three-Quarter Front View



Photo No. 028 - Post-Test Curtain Air Bag Front View



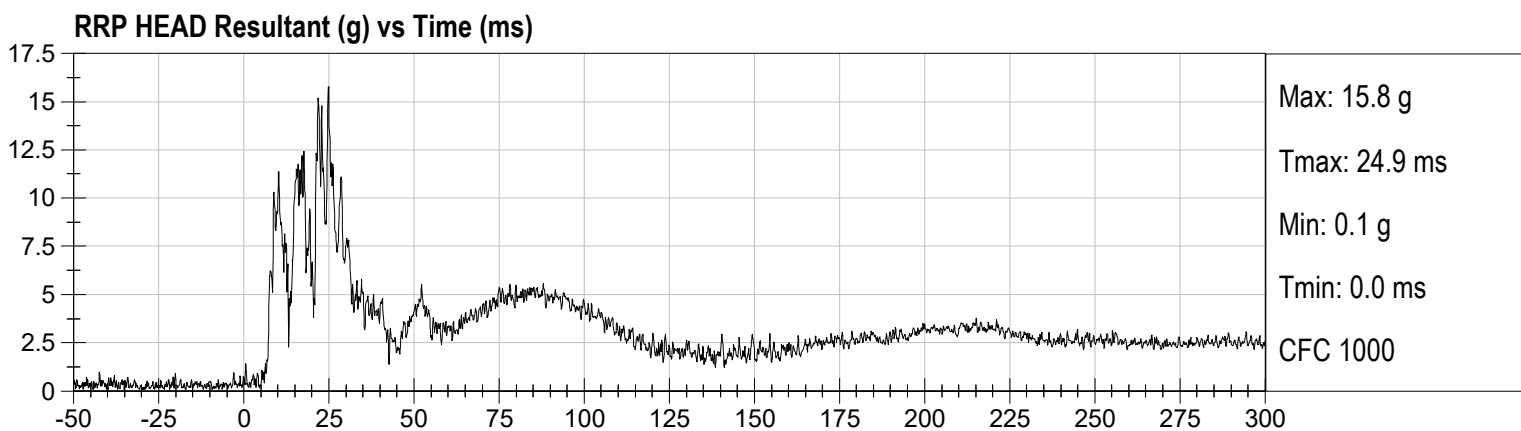
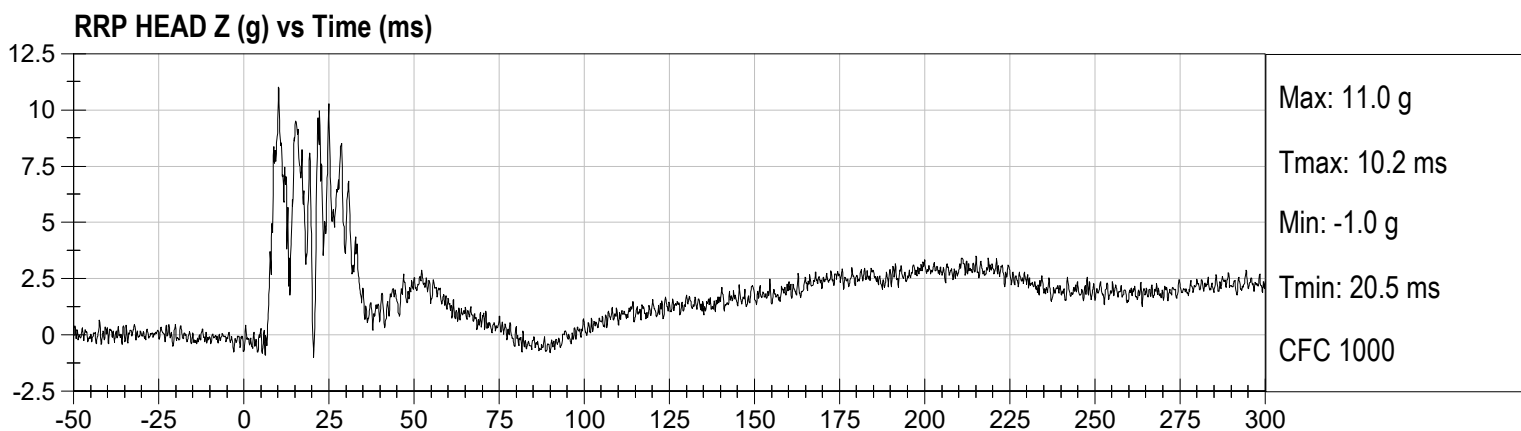
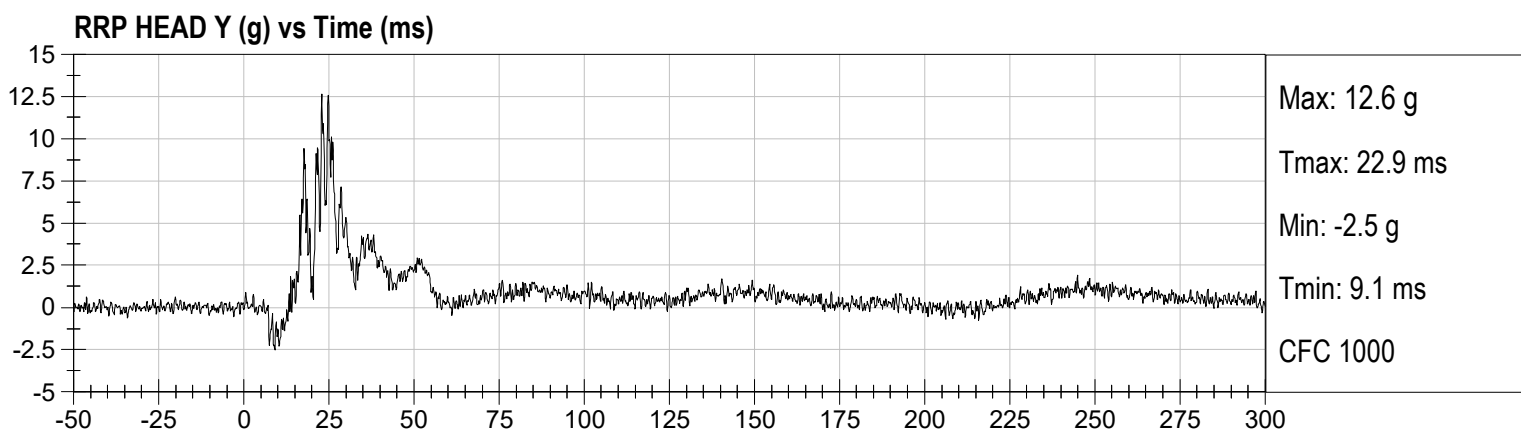
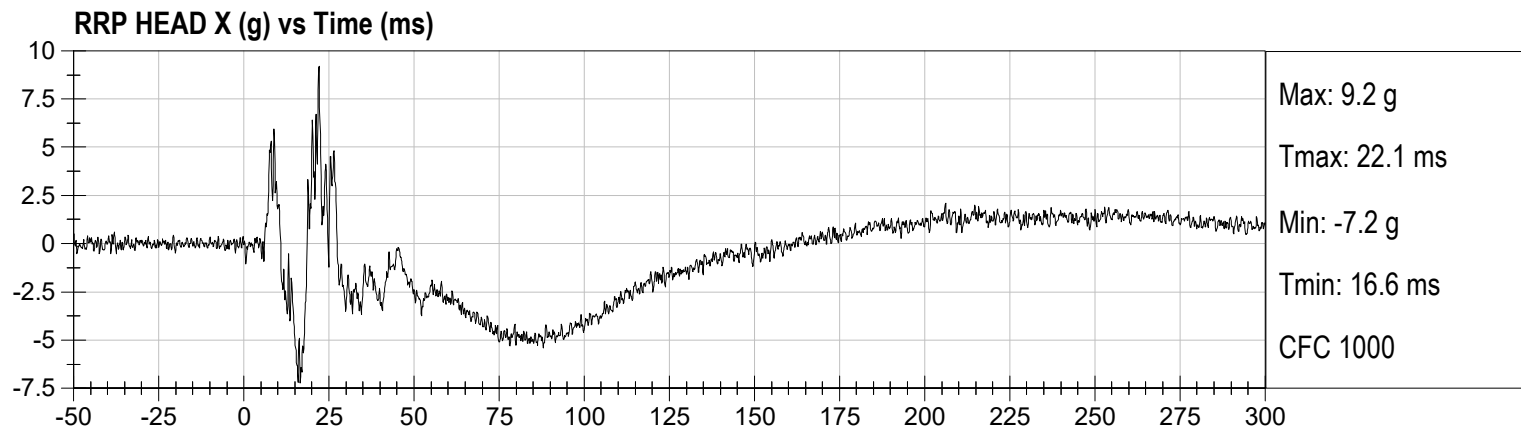
Photo No. 029 - Post-Test Curtain Air Bag Right Side View (Door Open)

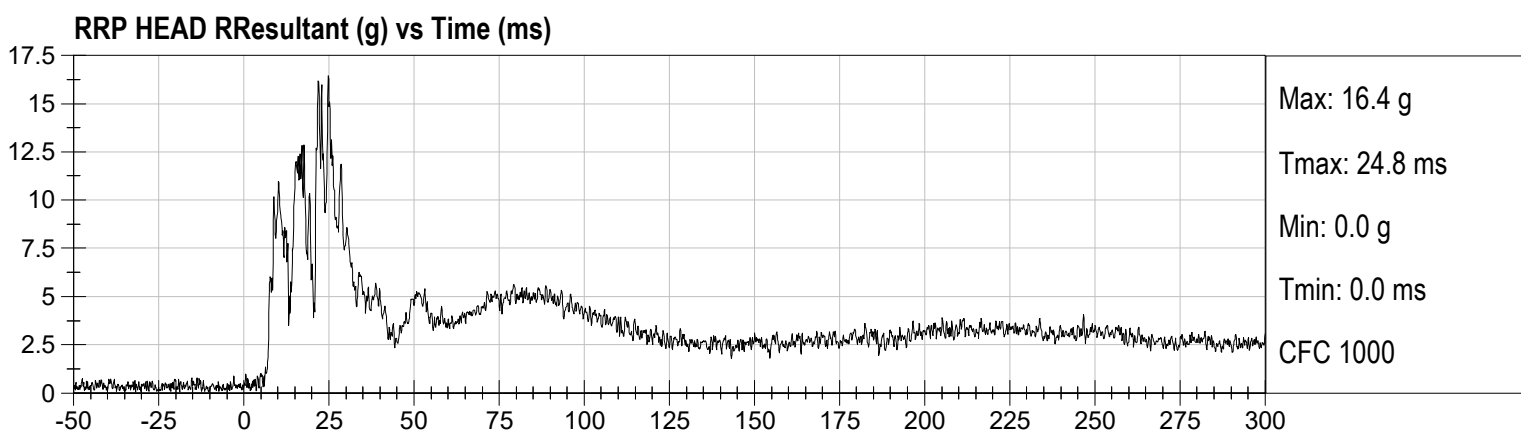
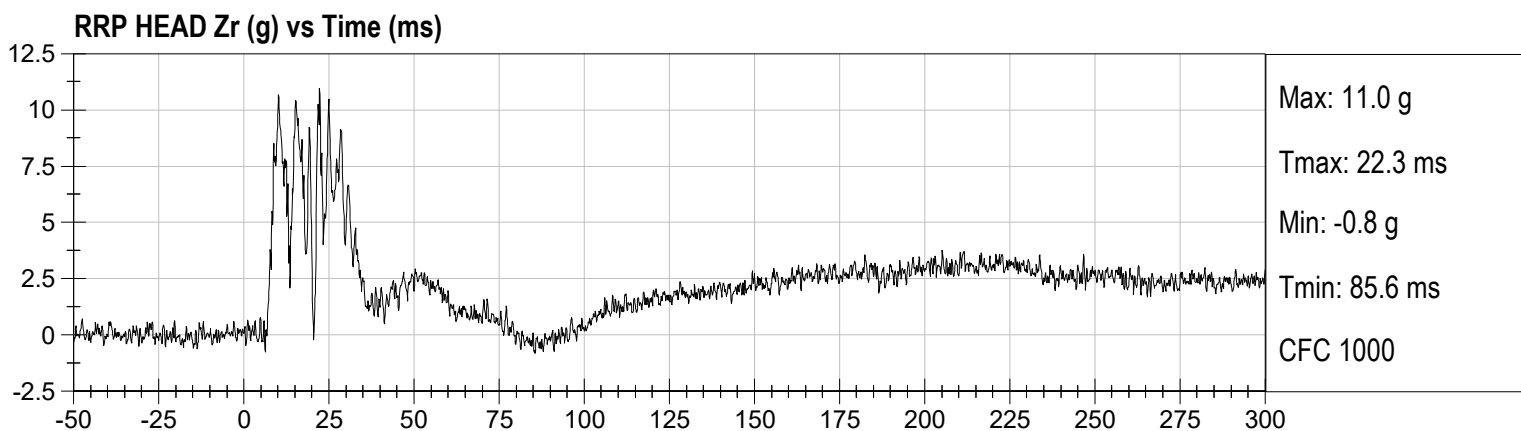
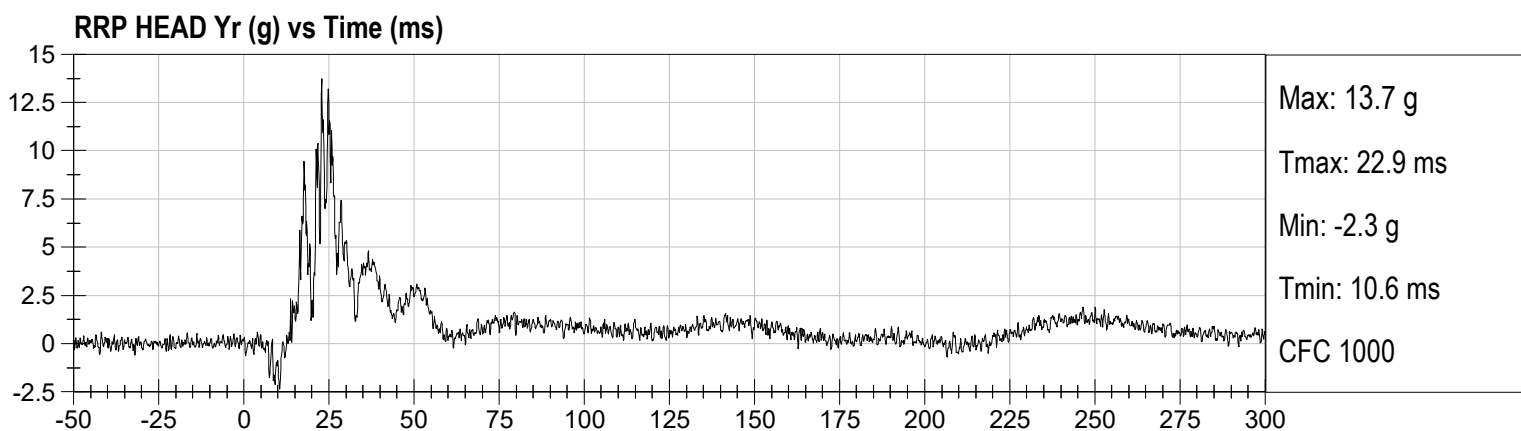
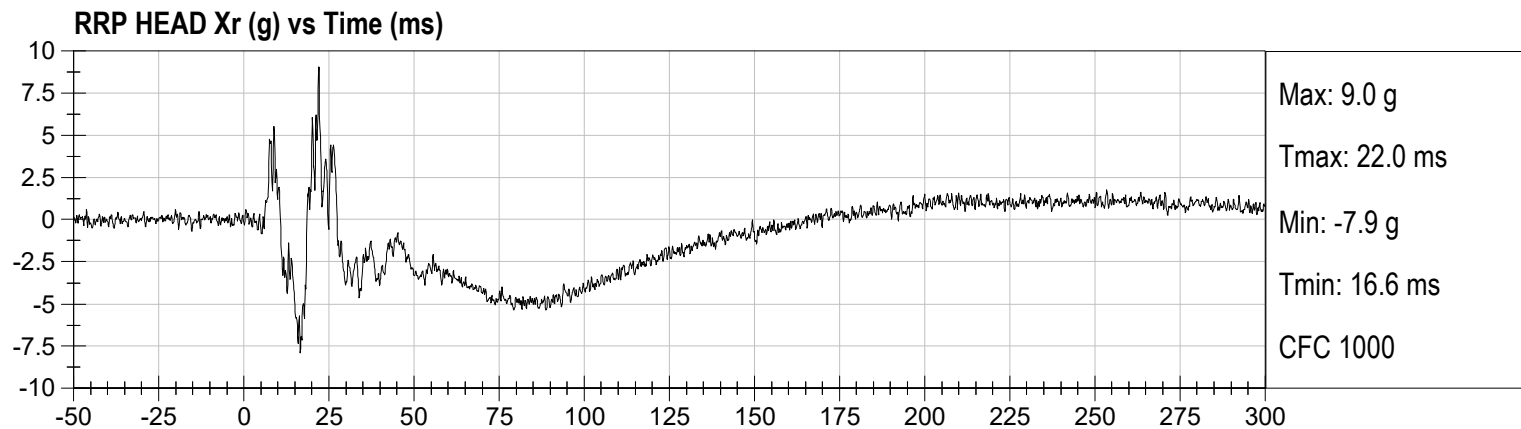
APPENDIX B
DUMMY RESPONSE DATA TRACES

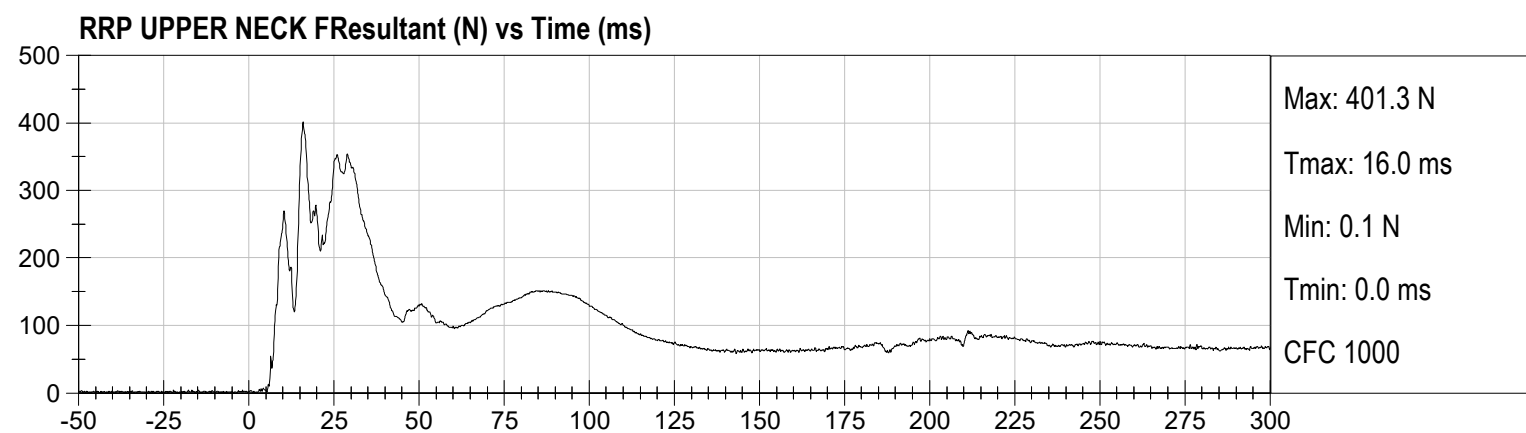
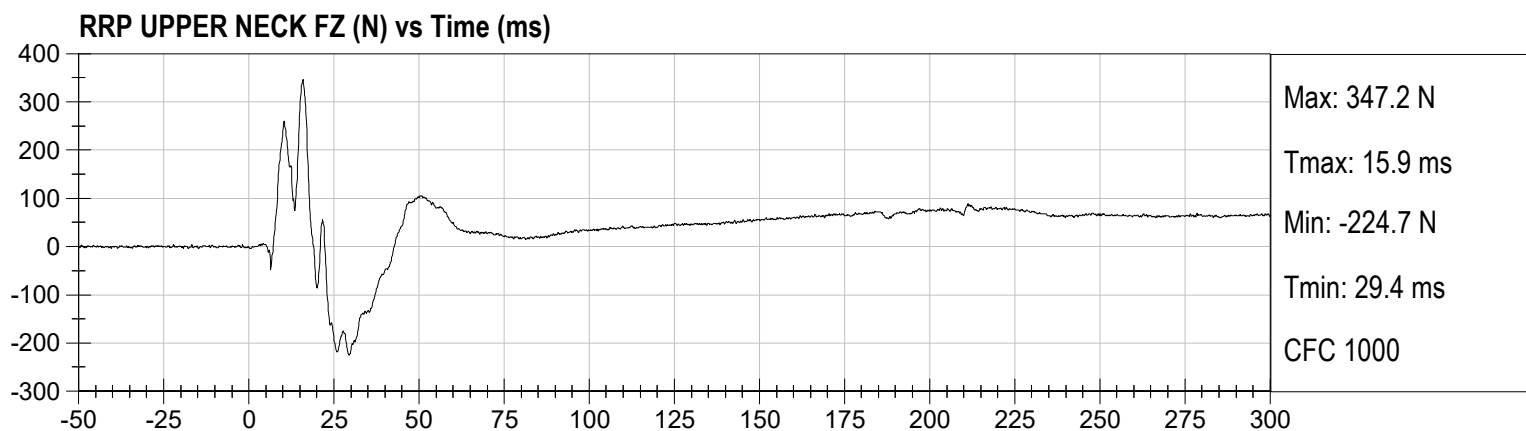
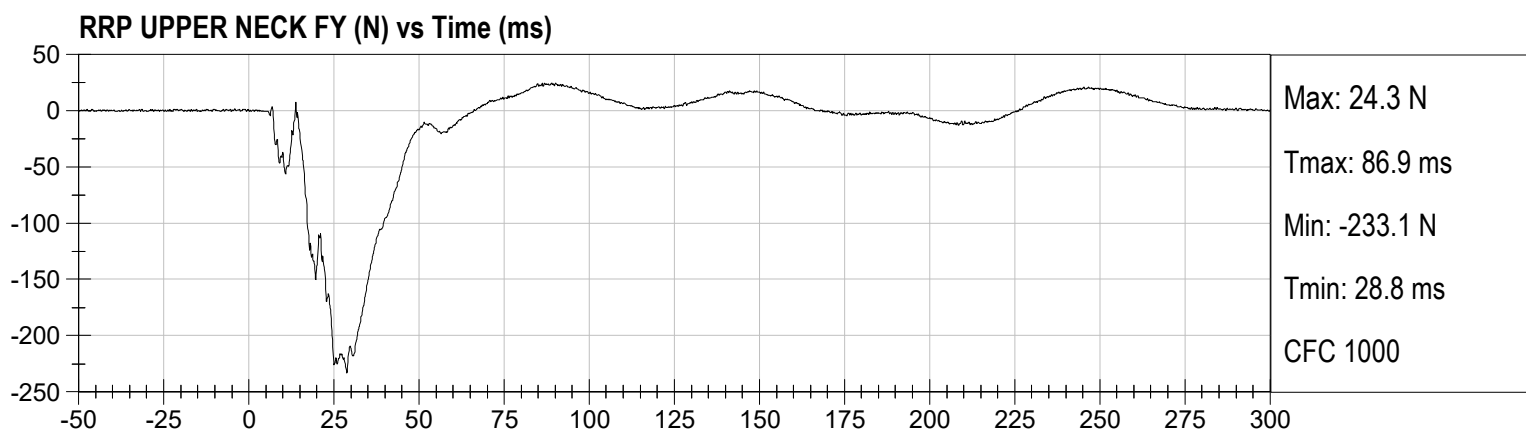
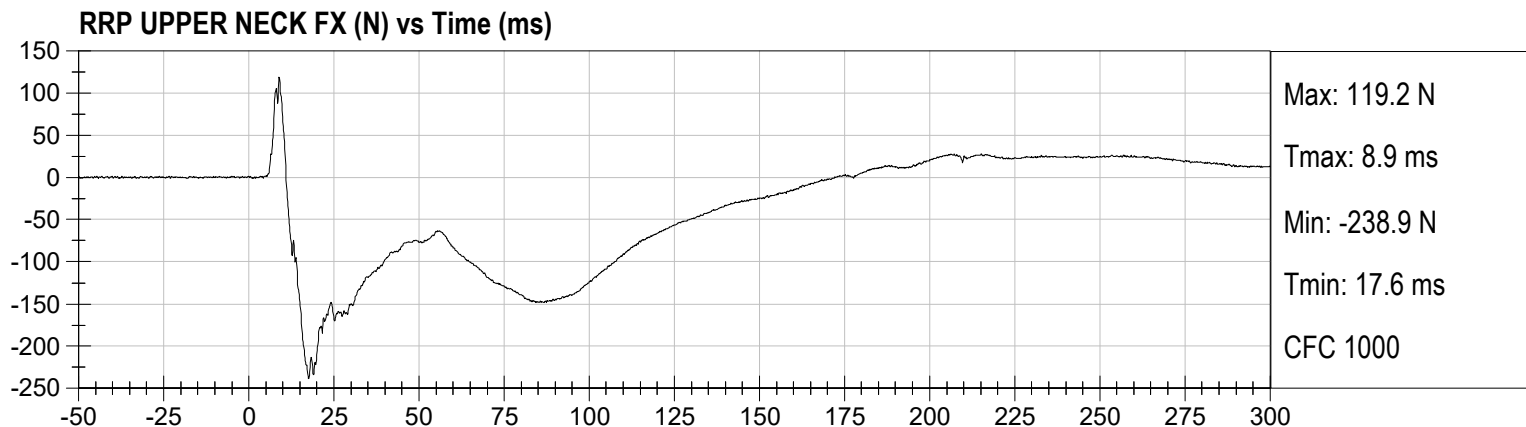
TABLE OF DATA PLOTS

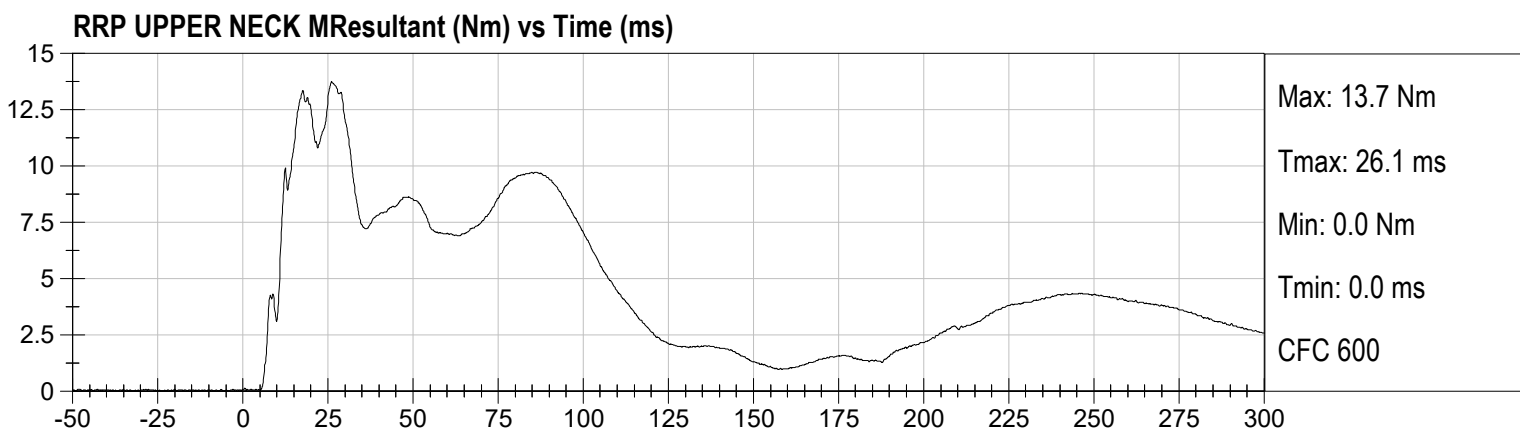
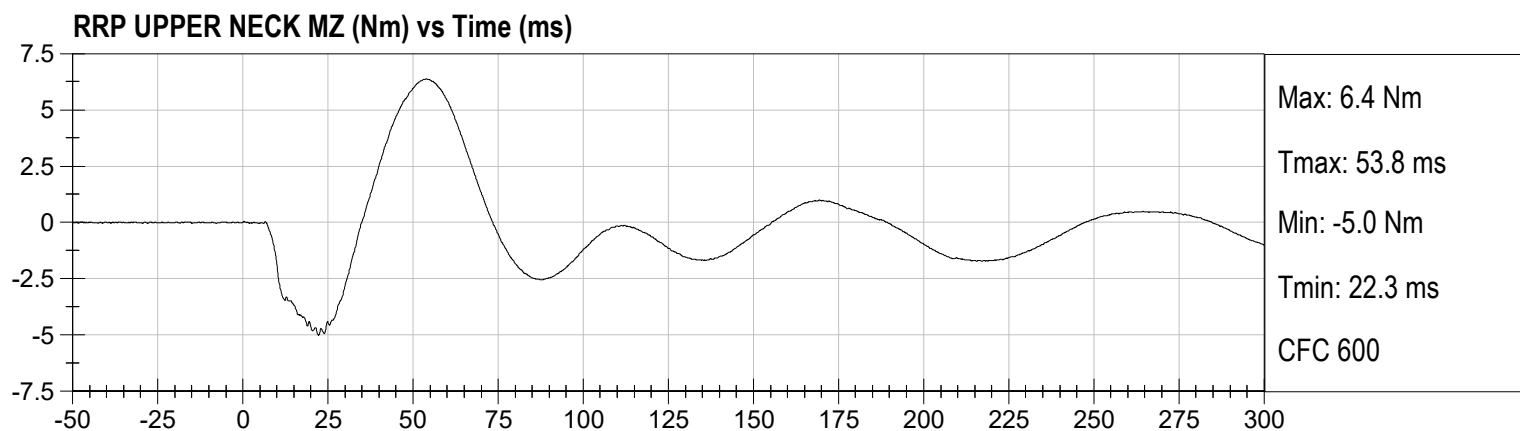
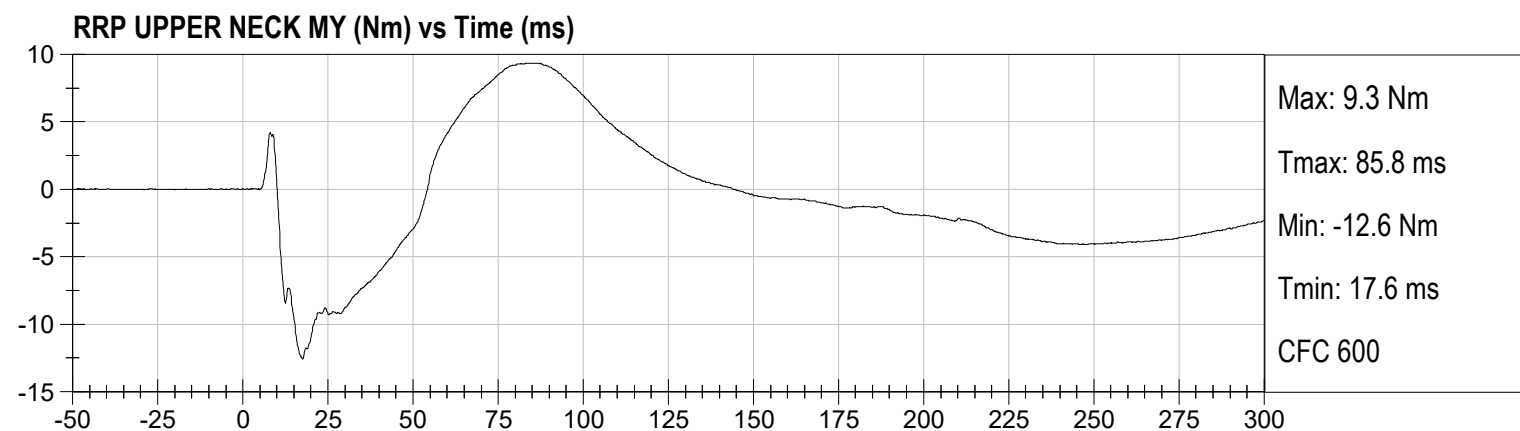
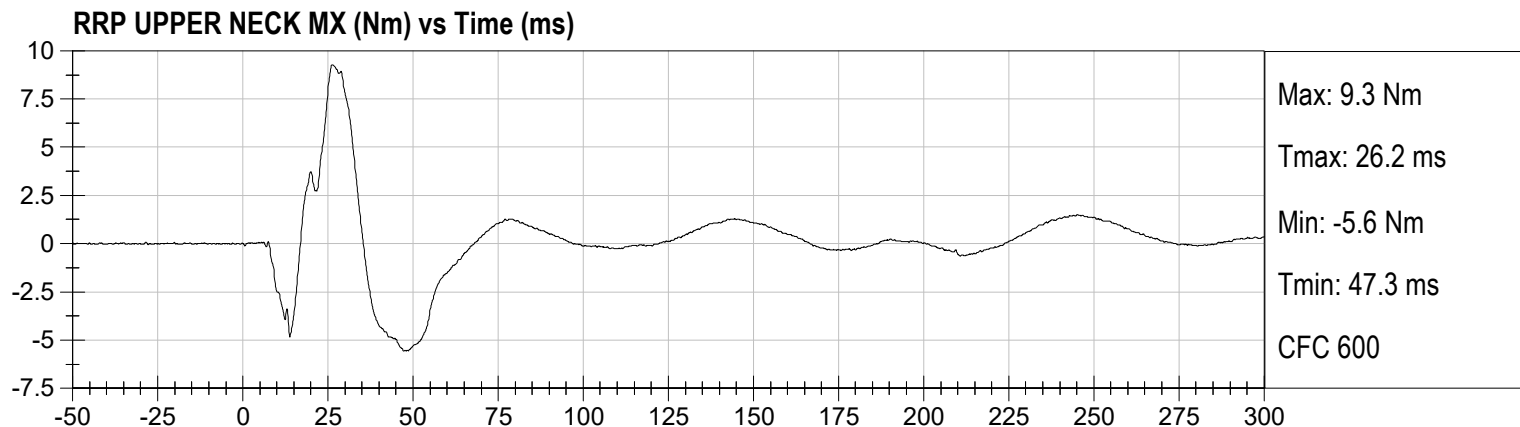
	<u>Page No.</u>
RRP Head X Acceleration vs. Time	B-1
RRP Head Y Acceleration vs. Time	B-1
RRP Head Z Acceleration vs. Time	B-1
RRP Head Resultant Acceleration vs. Time	B-1
RRP Head X Acceleration vs. Time	B-2
RRP Head Y Acceleration vs. Time	B-2
RRP Head Z Acceleration vs. Time	B-2
RRP Head Resultant Acceleration vs. Time	B-2
RRP Upper Neck X Force vs. Time	B-3
RRP Upper Neck Y Force vs. Time	B-3
RRP Upper Neck Z Force vs. Time	B-3
RRP Upper Neck Resultant Force vs. Time	B-3
RRP Upper Neck X Moment vs. Time	B-4
RRP Upper Neck Y Moment vs. Time	B-4
RRP Upper Neck Z Moment vs. Time	B-4
RRP Upper Neck Resultant Moment vs. Time	B-4
RRP Lower Neck X Force vs. Time	B-5
RRP Lower Neck Y Force vs. Time	B-5
RRP Lower Neck Z Force vs. Time	B-5
RRP Lower Neck Resultant Force vs. Time	B-5
RRP Lower Neck X Moment vs. Time	B-6
RRP Lower Neck Y Moment vs. Time	B-6
RRP Lower Neck Z Moment vs. Time	B-6
RRP Lower Neck Resultant Moment vs. Time	B-6
RRP Chest Displacement vs. Time	B-7
RRP Chest Displacement Rate vs. Time	B-7
RRP Upper Sternum X Acceleration vs. Time	B-7
RRP Lower Sternum X Acceleration vs. Time	B-7

	<u>Page No.</u>
RRP Chest X Acceleration vs. Time	B-8
RRP Chest Y Acceleration vs. Time	B-8
RRP Chest Z Acceleration vs. Time	B-8
RRP Chest Resultant Acceleration vs. Time	B-8
RRP Upper Spine X Acceleration vs. Time	B-9
RRP Upper Spine Y Acceleration vs. Time	B-9
RRP Upper Spine Z Acceleration vs. Time	B-9
RRP Upper Spine Resultant Acceleration vs. Time	B-9
RRP Lower Spine X Acceleration vs. Time	B-10
RRP Lower Spine Y Acceleration vs. Time	B-10
RRP Lower Spine Z Acceleration vs. Time	B-10
RRP Lower Spine Resultant Acceleration vs. Time	B-10
Passenger Curtain Airbag – Fire Voltage vs. Time	B-11
Passenger Curtain Airbag – Fire Current vs. Time	B-11
RRP Seat Airbag – Fire Voltage vs. Time	B-11
RRP Seat Airbag – Fire Current vs. Time	B-11
RRP Nij (NTF)	B-12
RRP Nij (NTE)	B-12
RRP Nij (NCF)	B-12
RRP Nij (NCE)	B-12

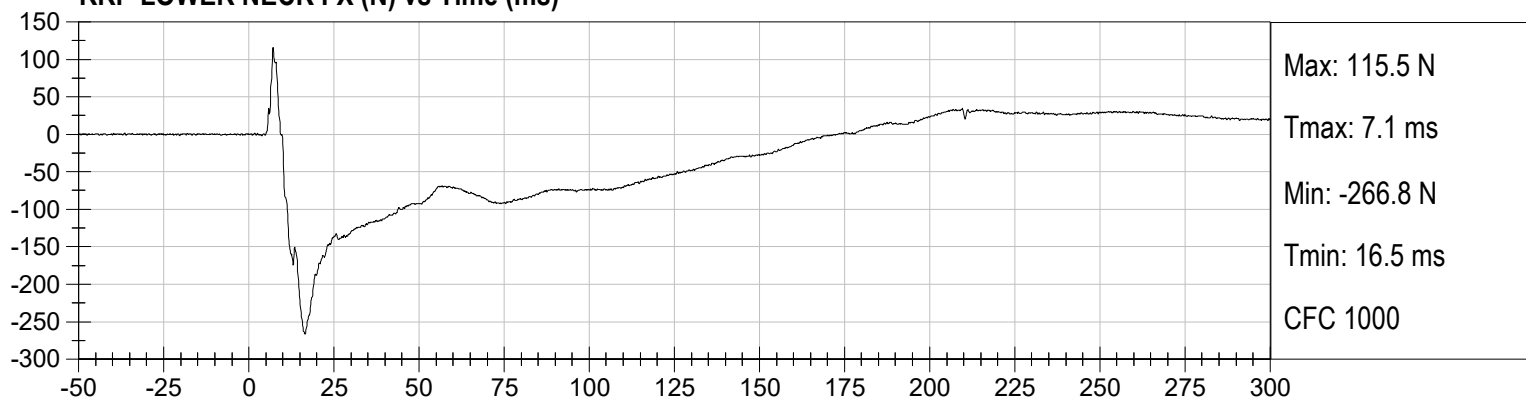




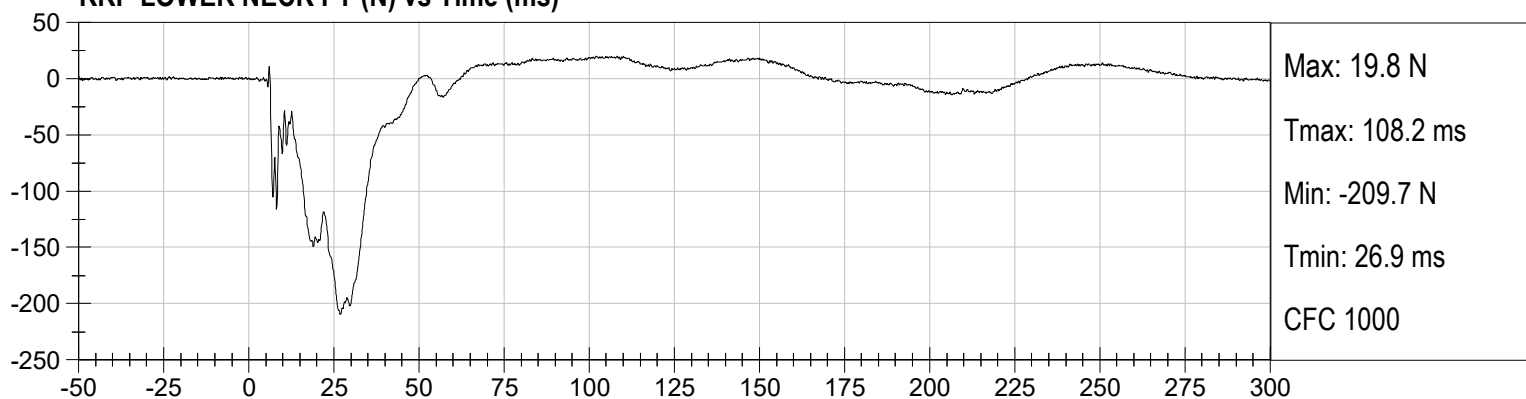




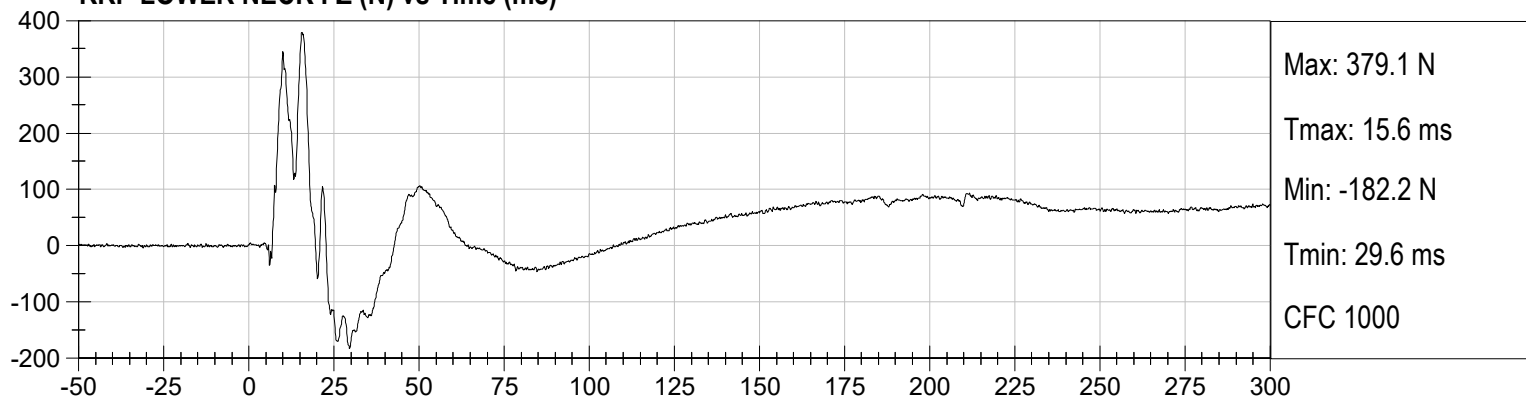
RRP LOWER NECK FX (N) vs Time (ms)



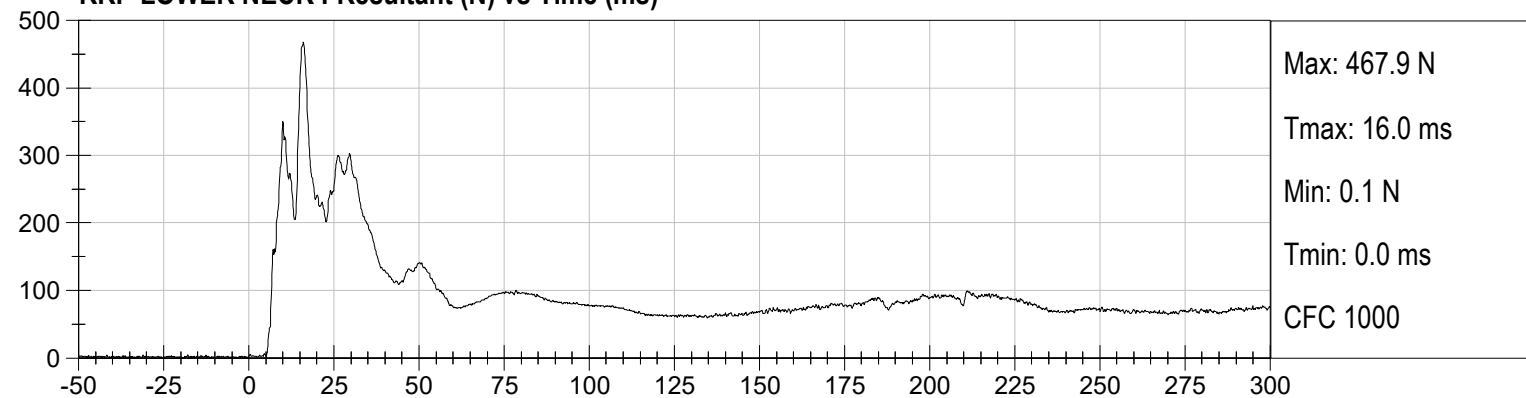
RRP LOWER NECK FY (N) vs Time (ms)



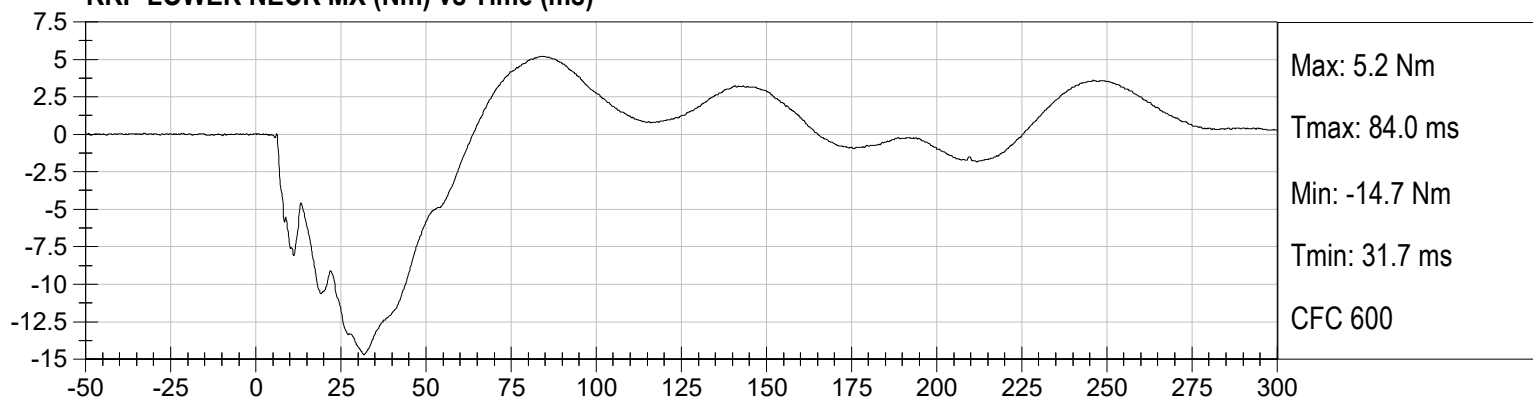
RRP LOWER NECK FZ (N) vs Time (ms)



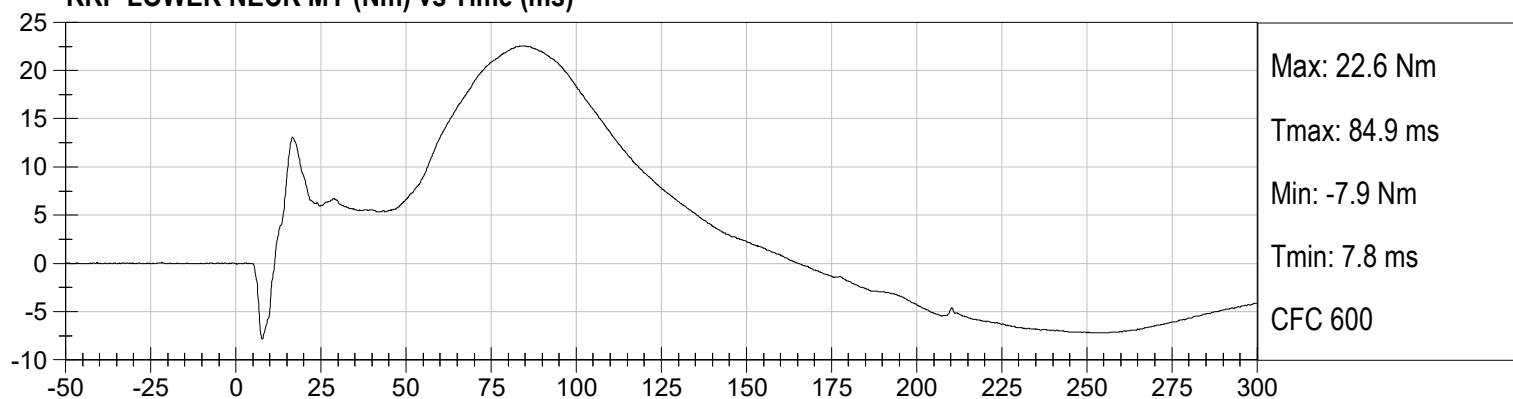
RRP LOWER NECK FResultant (N) vs Time (ms)



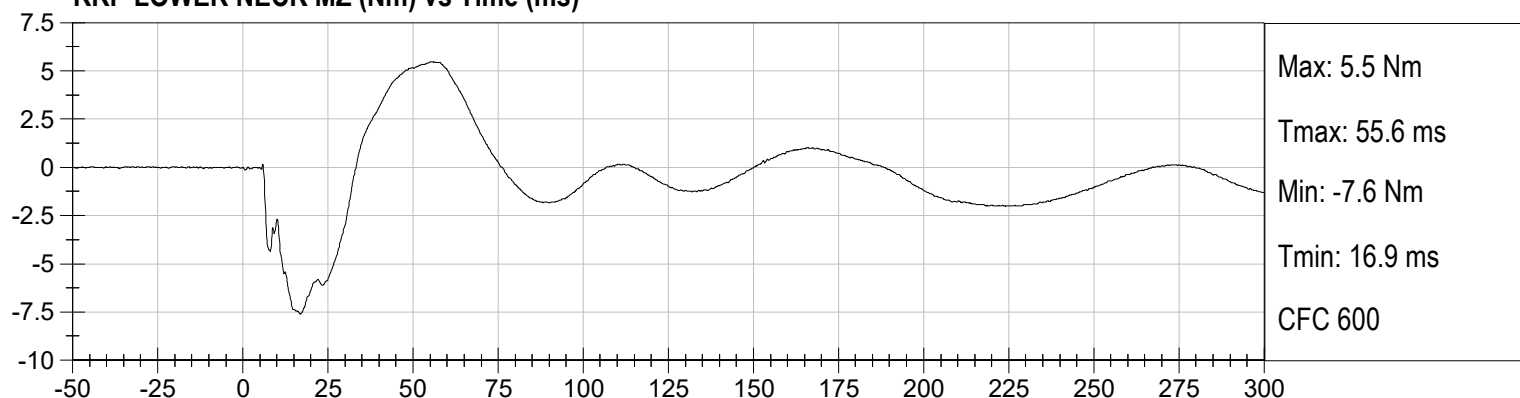
RRP LOWER NECK MX (Nm) vs Time (ms)



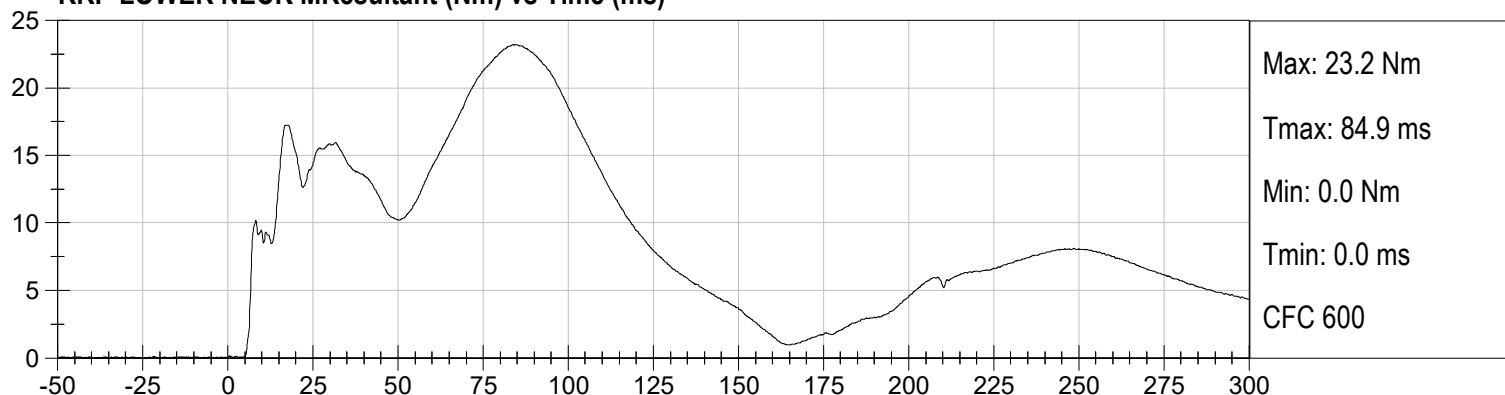
RRP LOWER NECK MY (Nm) vs Time (ms)



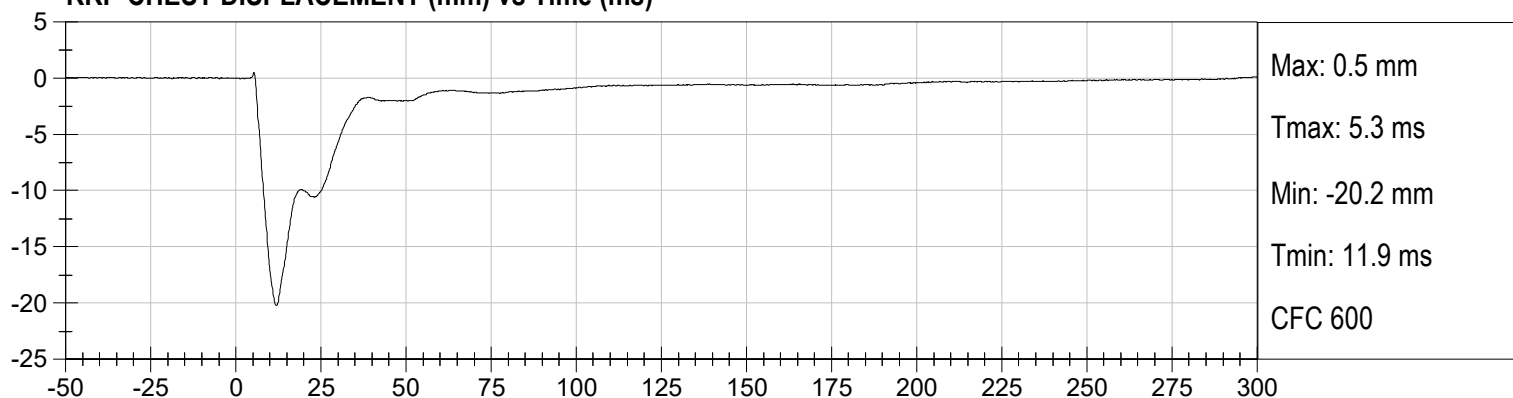
RRP LOWER NECK MZ (Nm) vs Time (ms)



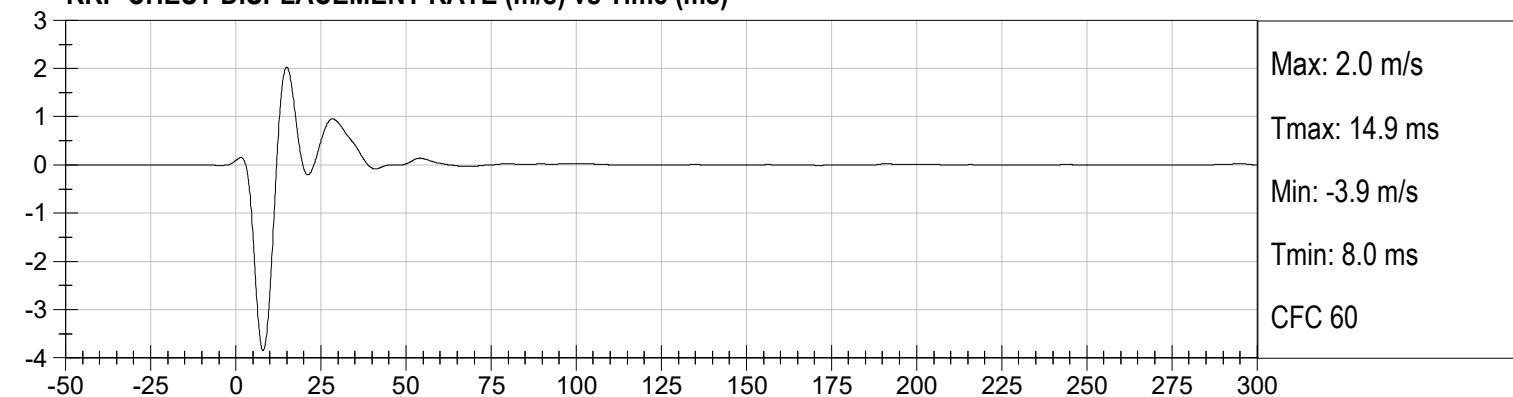
RRP LOWER NECK MResultant (Nm) vs Time (ms)



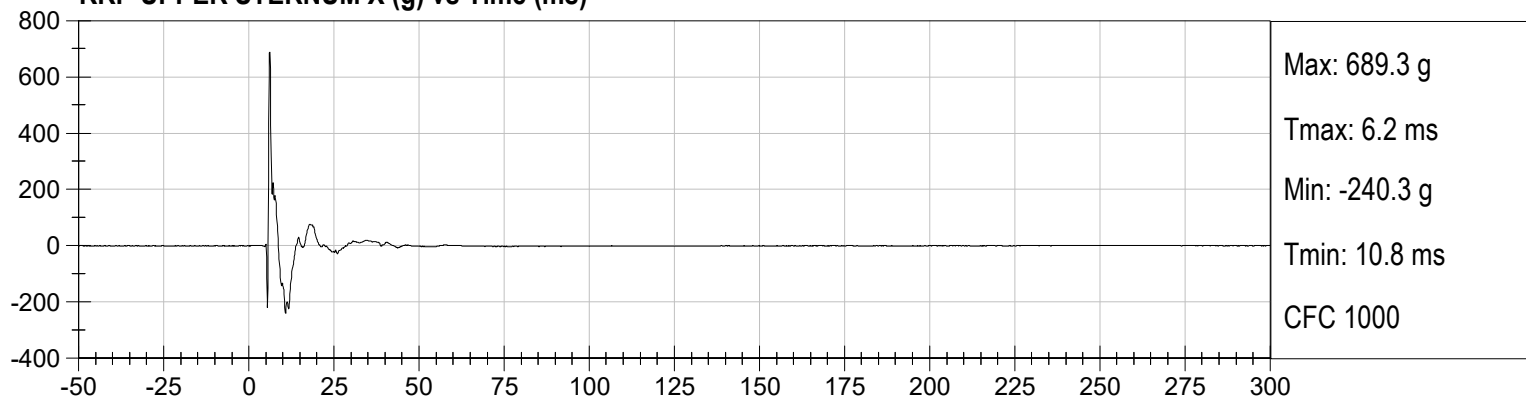
RRP CHEST DISPLACEMENT (mm) vs Time (ms)



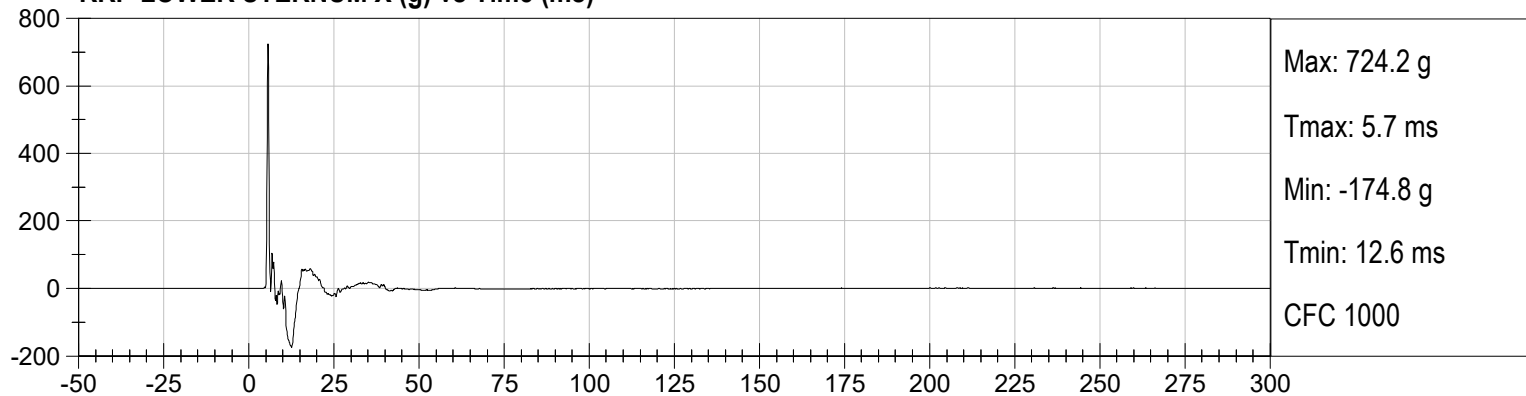
RRP CHEST DISPLACEMENT RATE (m/s) vs Time (ms)



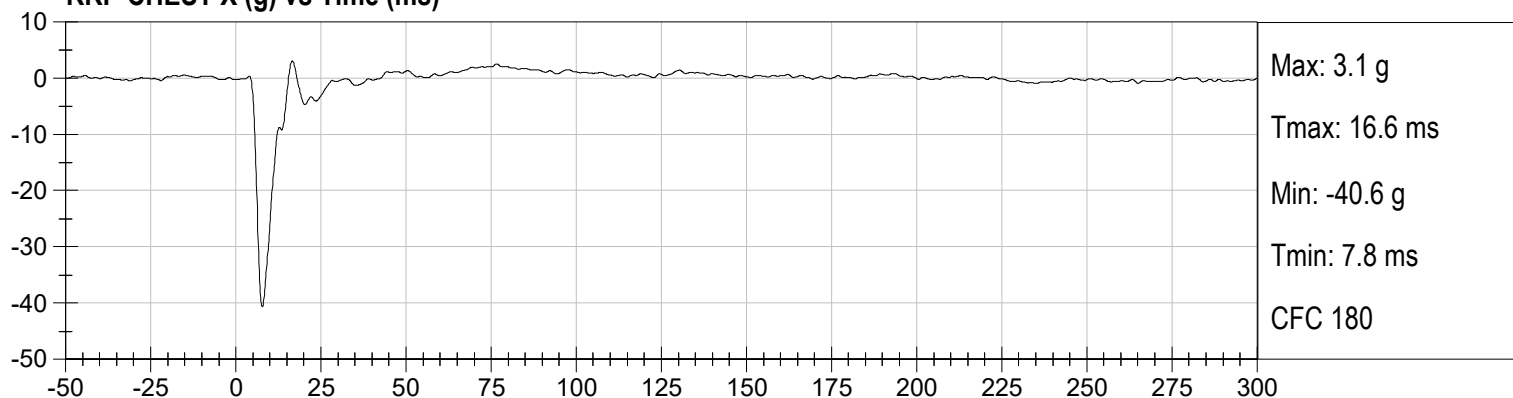
RRP UPPER STERNUM X (g) vs Time (ms)



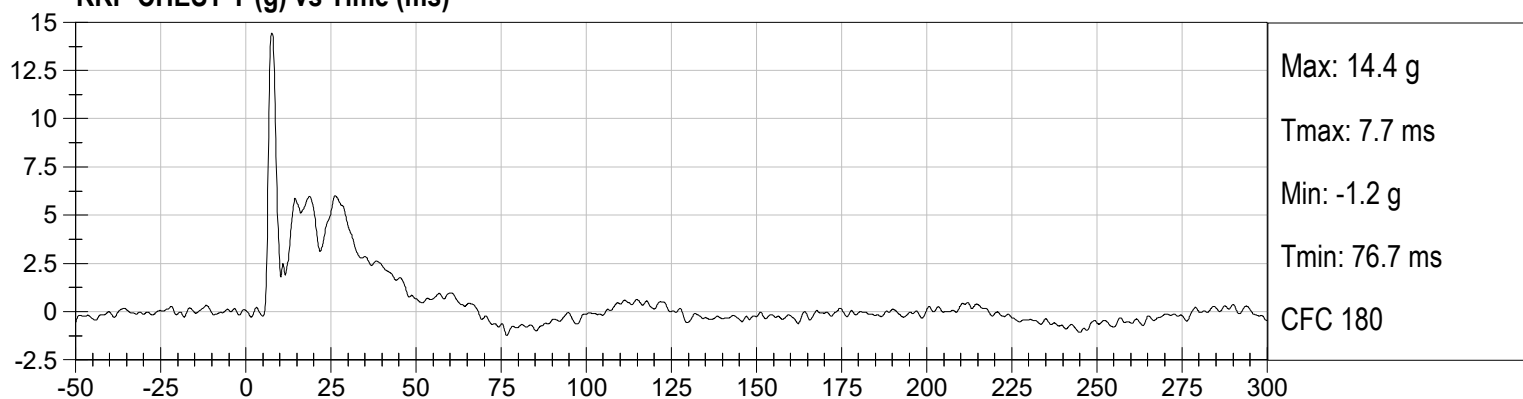
RRP LOWER STERNUM X (g) vs Time (ms)



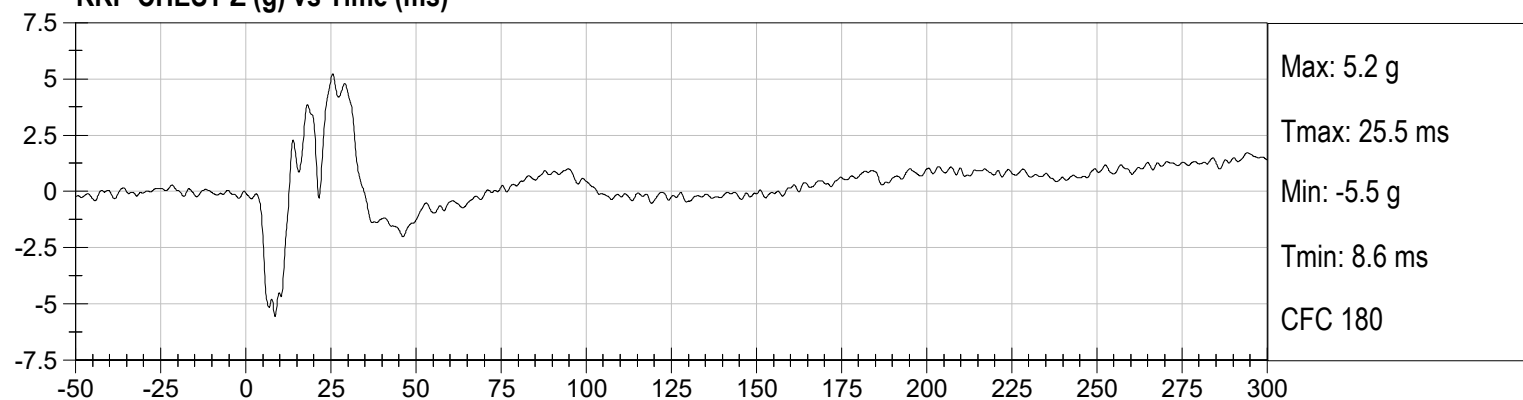
RRP CHEST X (g) vs Time (ms)



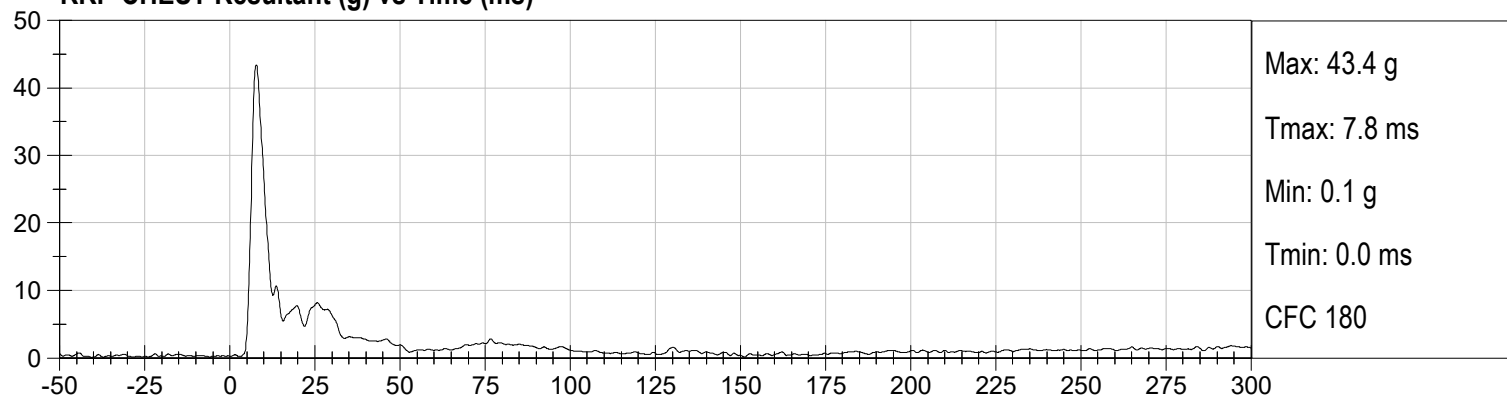
RRP CHEST Y (g) vs Time (ms)



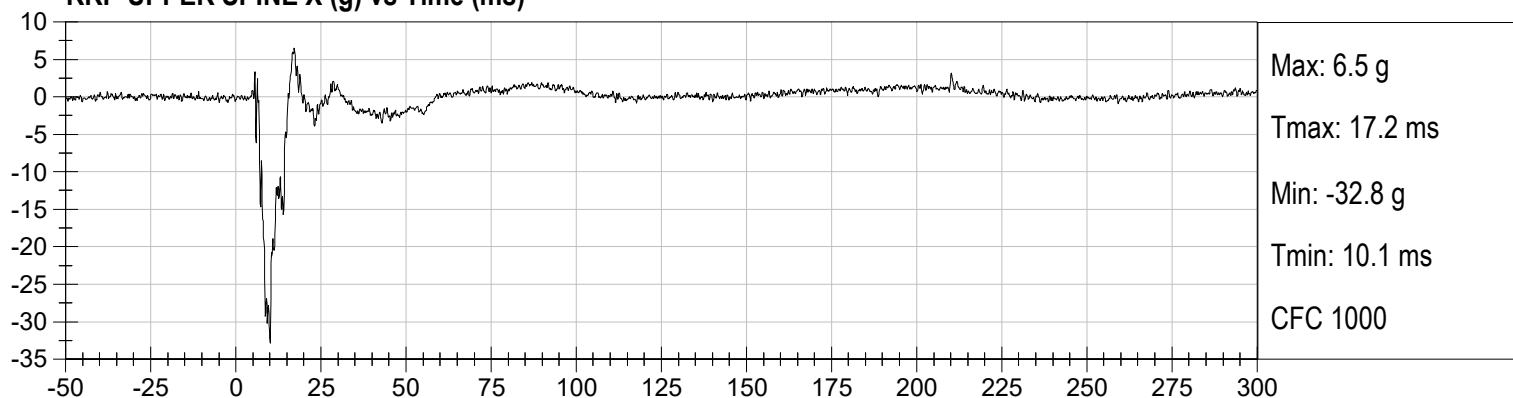
RRP CHEST Z (g) vs Time (ms)



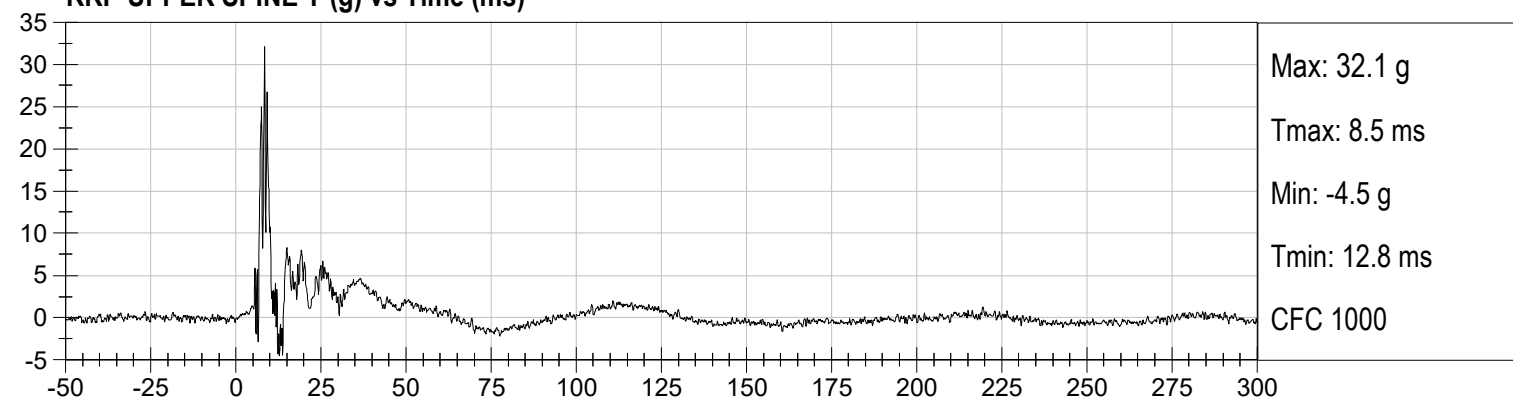
RRP CHEST Resultant (g) vs Time (ms)



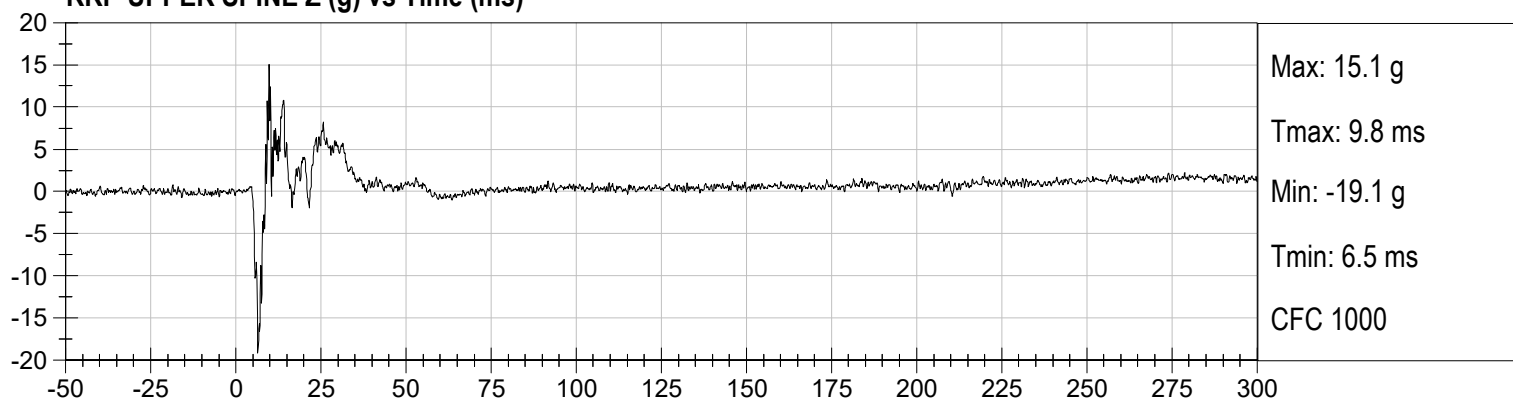
RRP UPPER SPINE X (g) vs Time (ms)



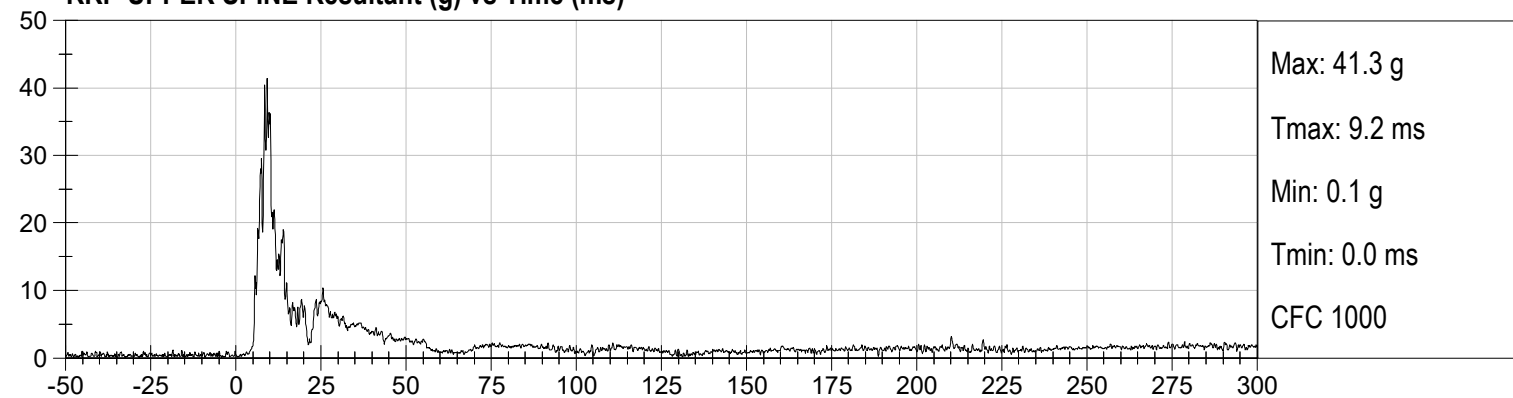
RRP UPPER SPINE Y (g) vs Time (ms)



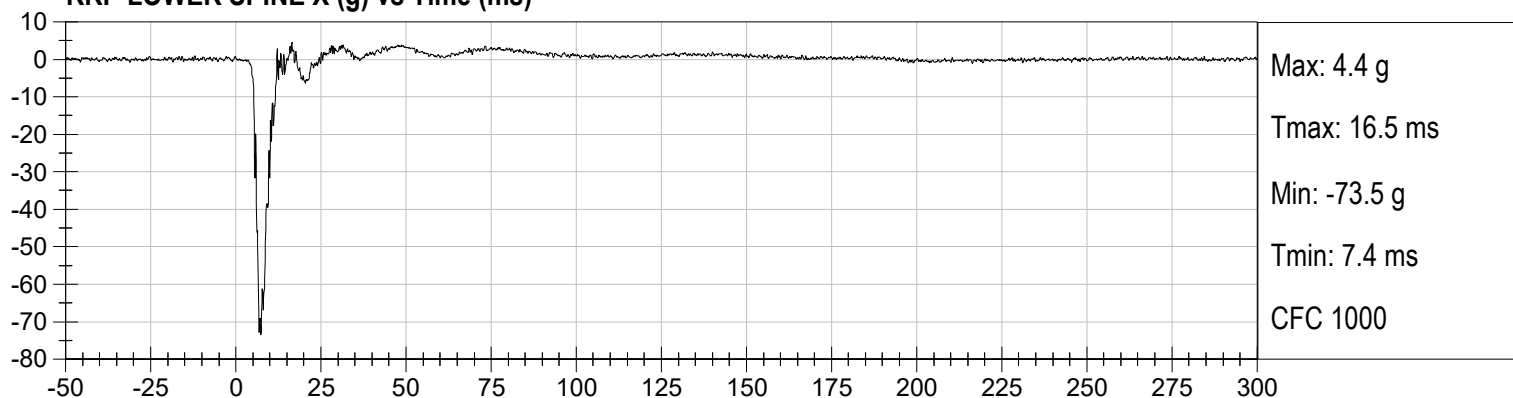
RRP UPPER SPINE Z (g) vs Time (ms)



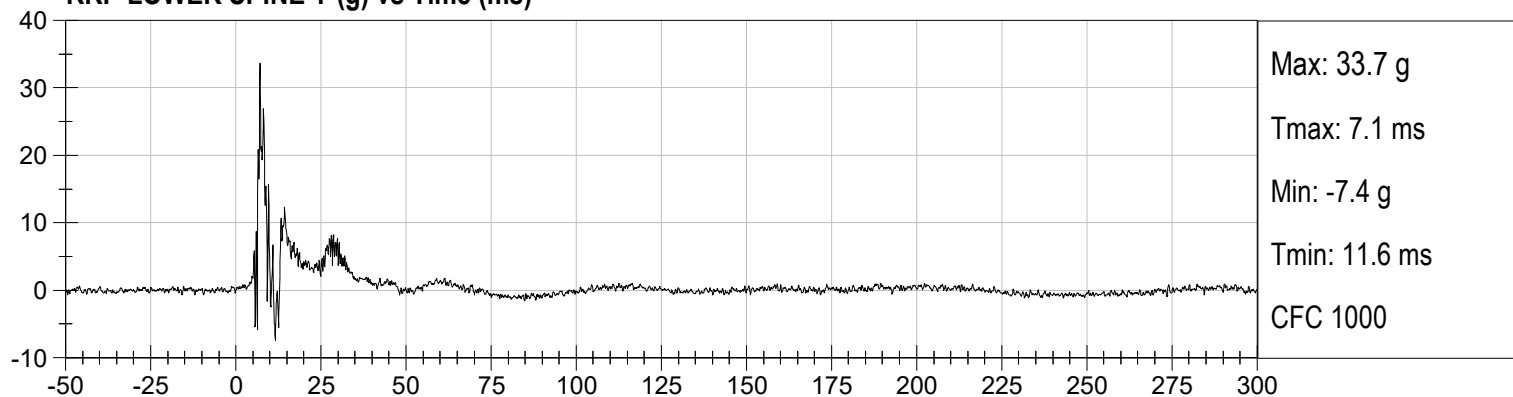
RRP UPPER SPINE Resultant (g) vs Time (ms)



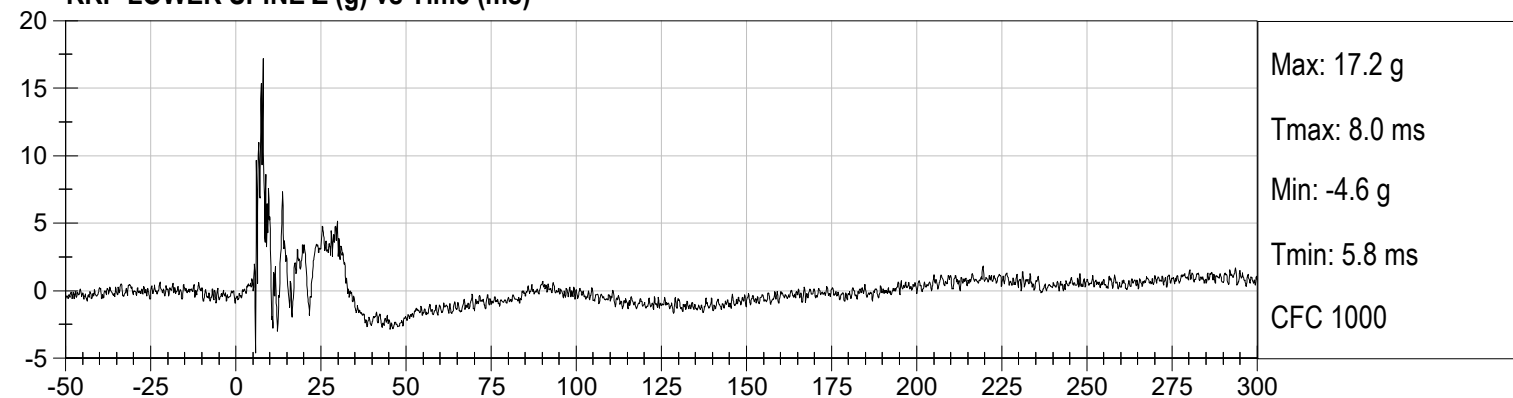
RRP LOWER SPINE X (g) vs Time (ms)



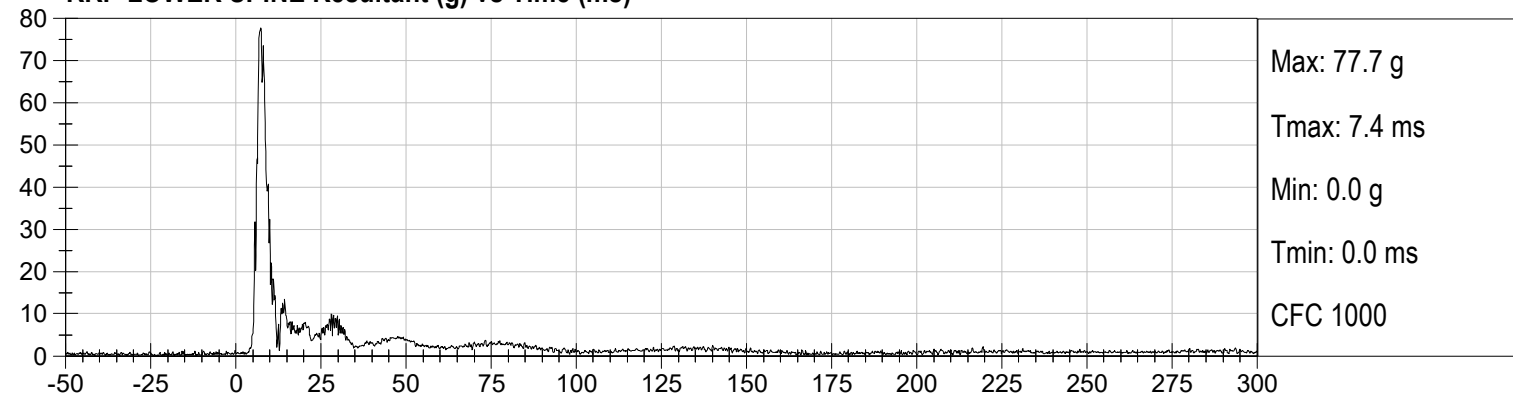
RRP LOWER SPINE Y (g) vs Time (ms)



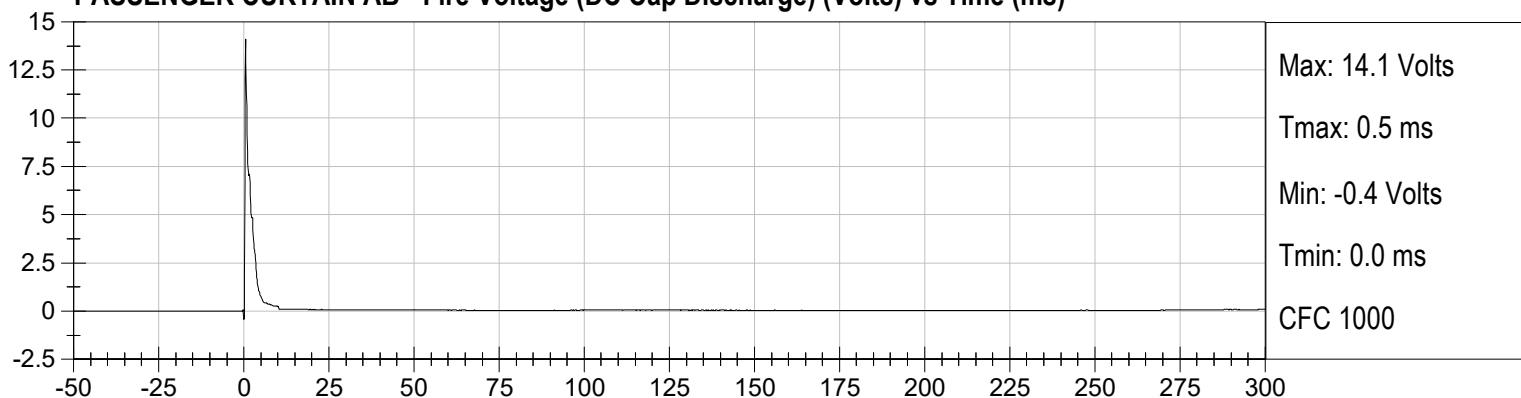
RRP LOWER SPINE Z (g) vs Time (ms)



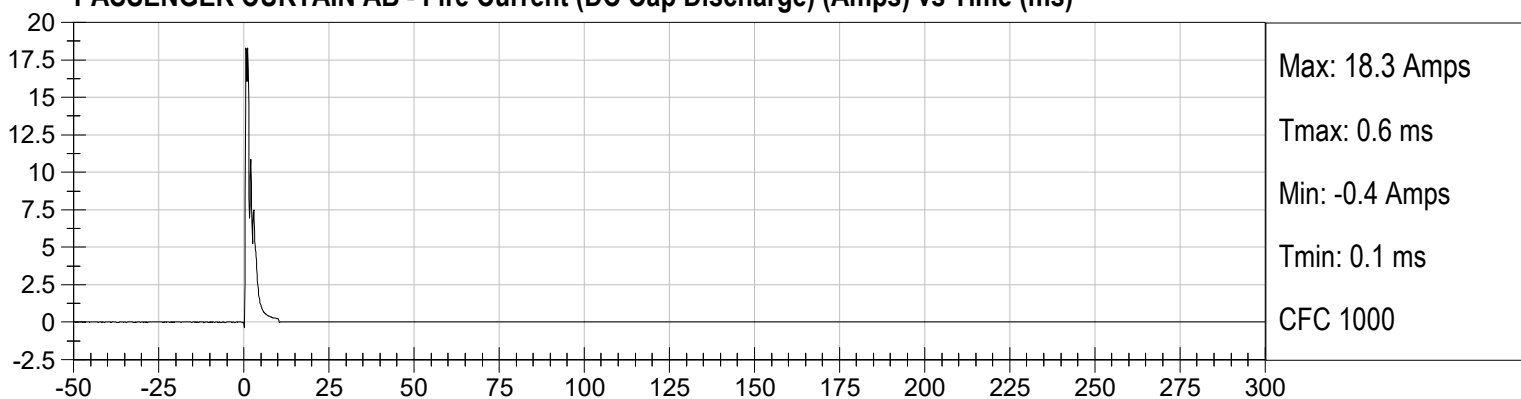
RRP LOWER SPINE Resultant (g) vs Time (ms)



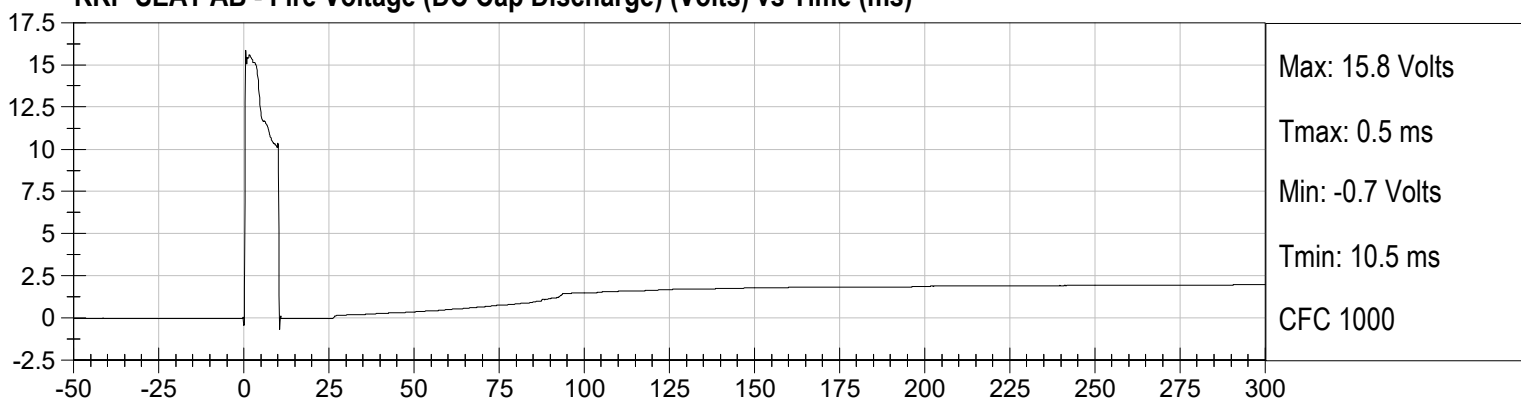
PASSENGER CURTAIN AB - Fire Voltage (DC Cap Discharge) (Volts) vs Time (ms)



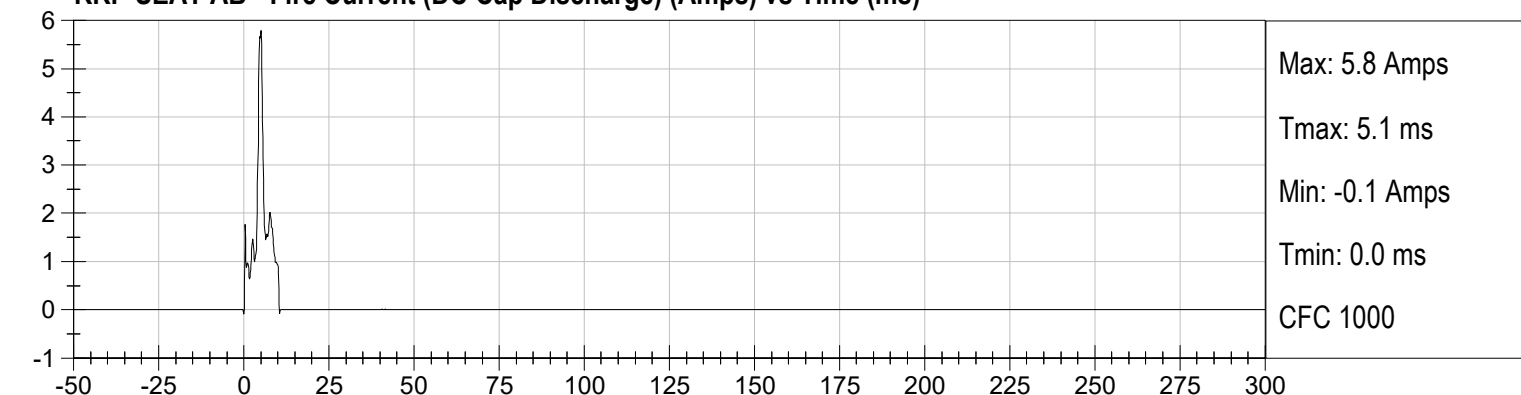
PASSENGER CURTAIN AB - Fire Current (DC Cap Discharge) (Amps) vs Time (ms)



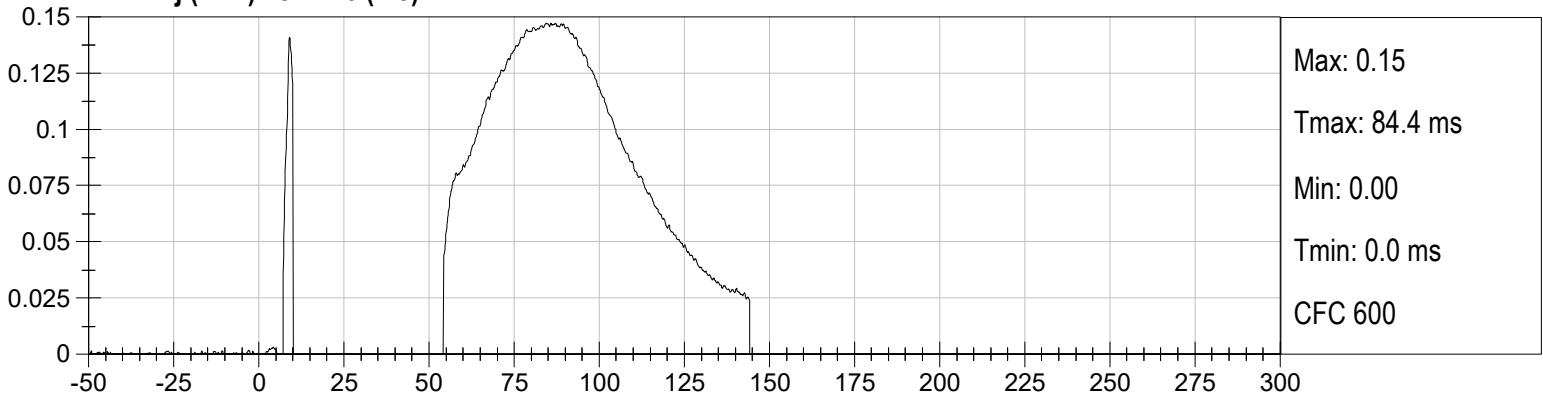
RRP SEAT AB - Fire Voltage (DC Cap Discharge) (Volts) vs Time (ms)



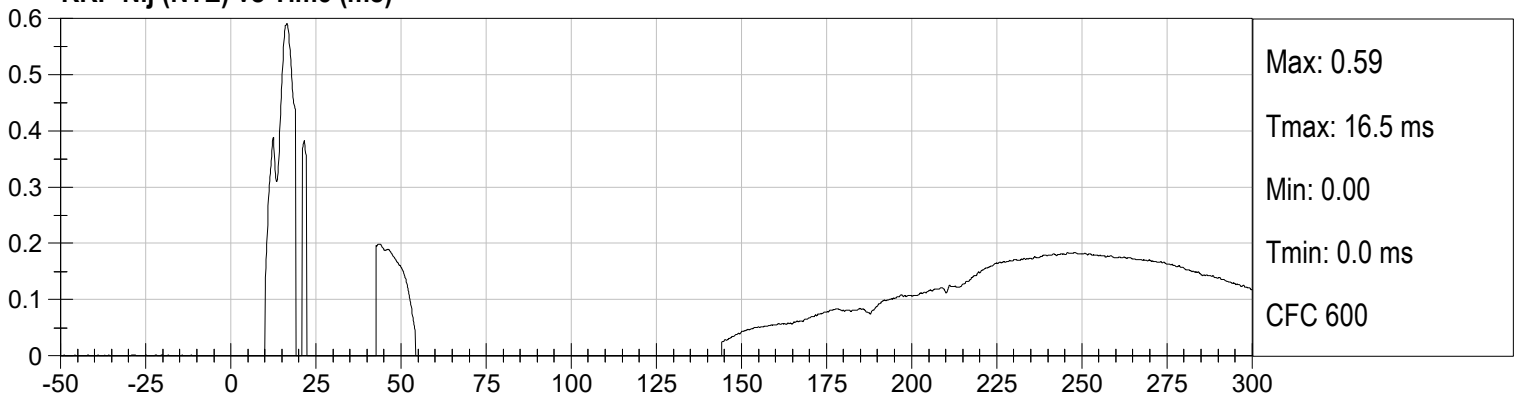
RRP SEAT AB - Fire Current (DC Cap Discharge) (Amps) vs Time (ms)



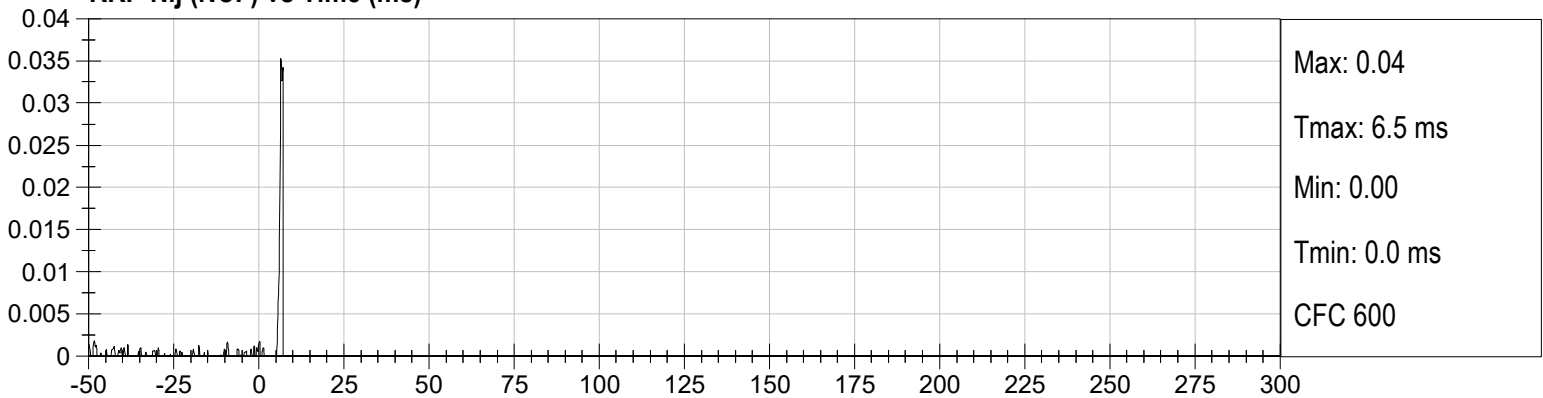
RRP Nij (NTF) vs Time (ms)



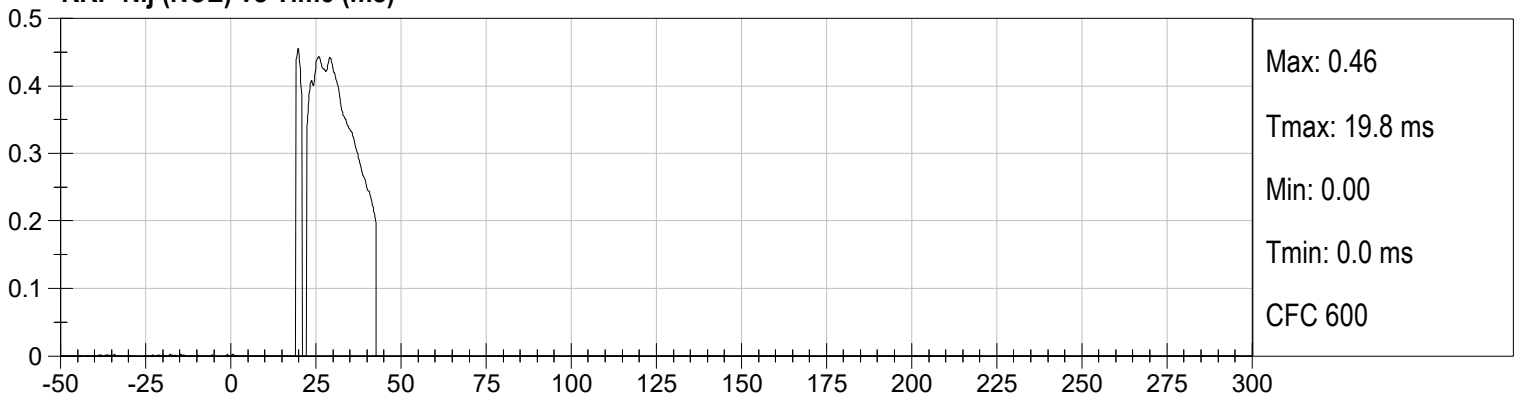
RRP Nij (NTE) vs Time (ms)



RRP Nij (NCF) vs Time (ms)



RRP Nij (NCE) vs Time (ms)



APPENDIX C
DUMMY CONFIGURATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

Hybrid III 6-Year-Old ATD

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 6 YEAR OLD

ATD Serial No: 144

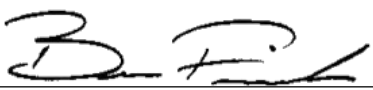
Test ID: D192161

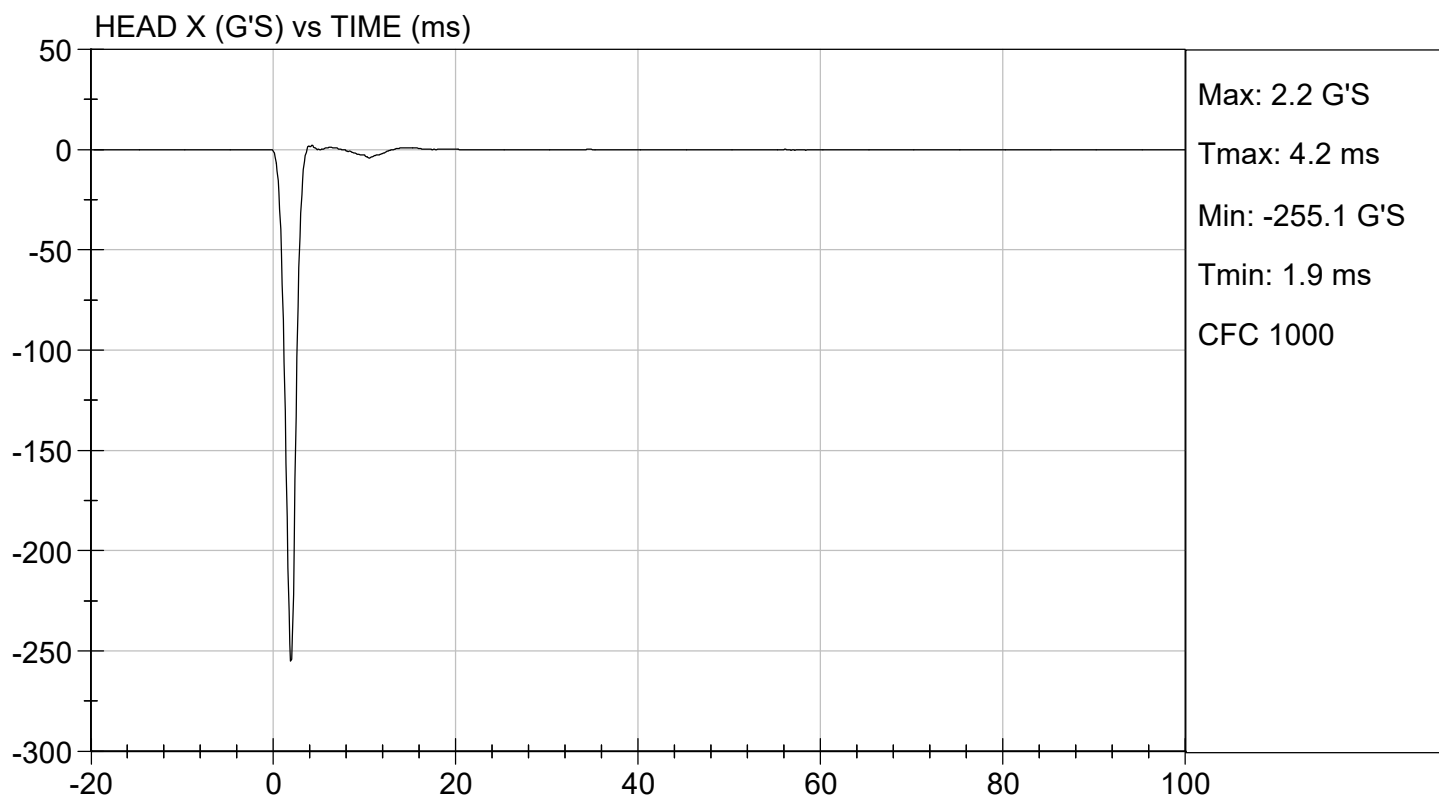
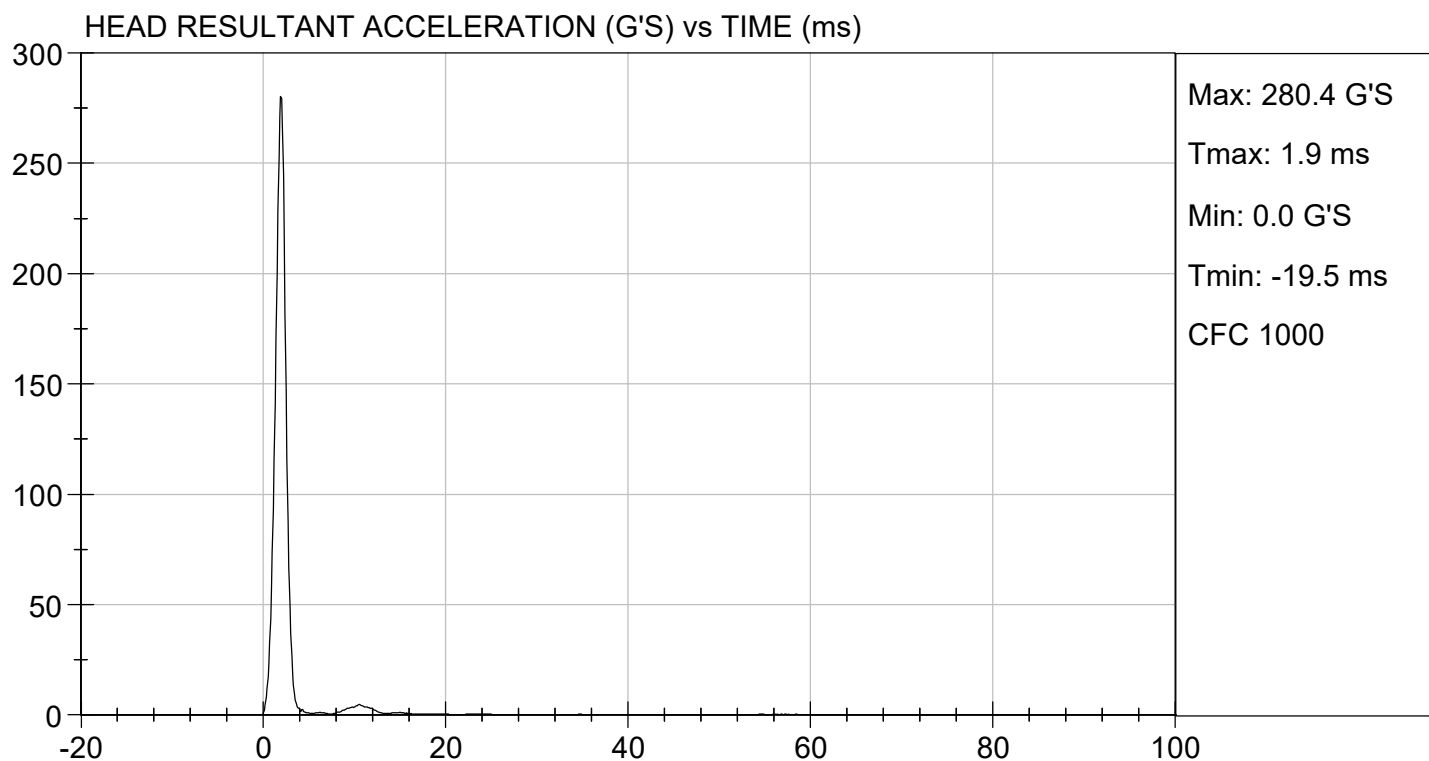
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Peak Resultant Acceleration	G's	245 to 300	280	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-6.3	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

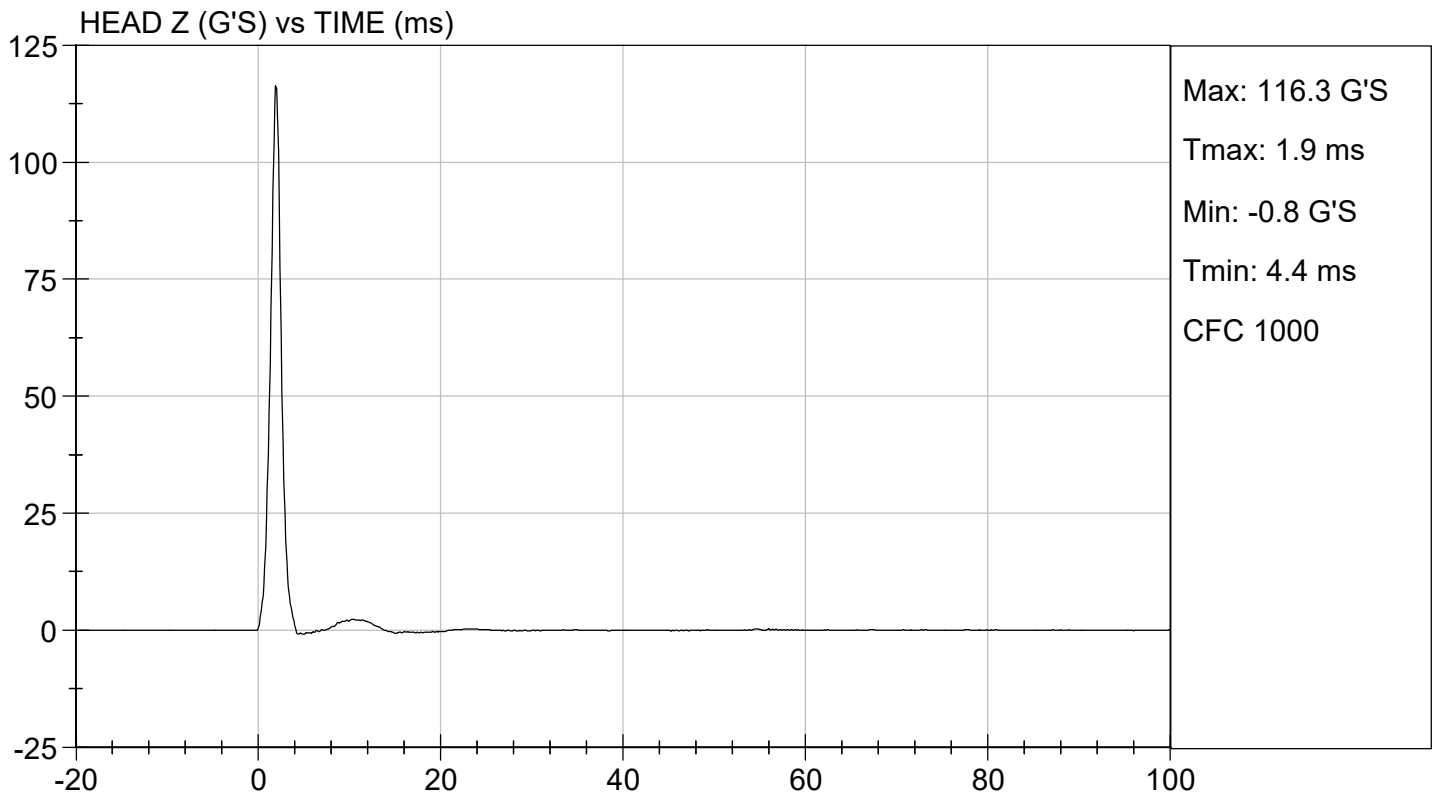
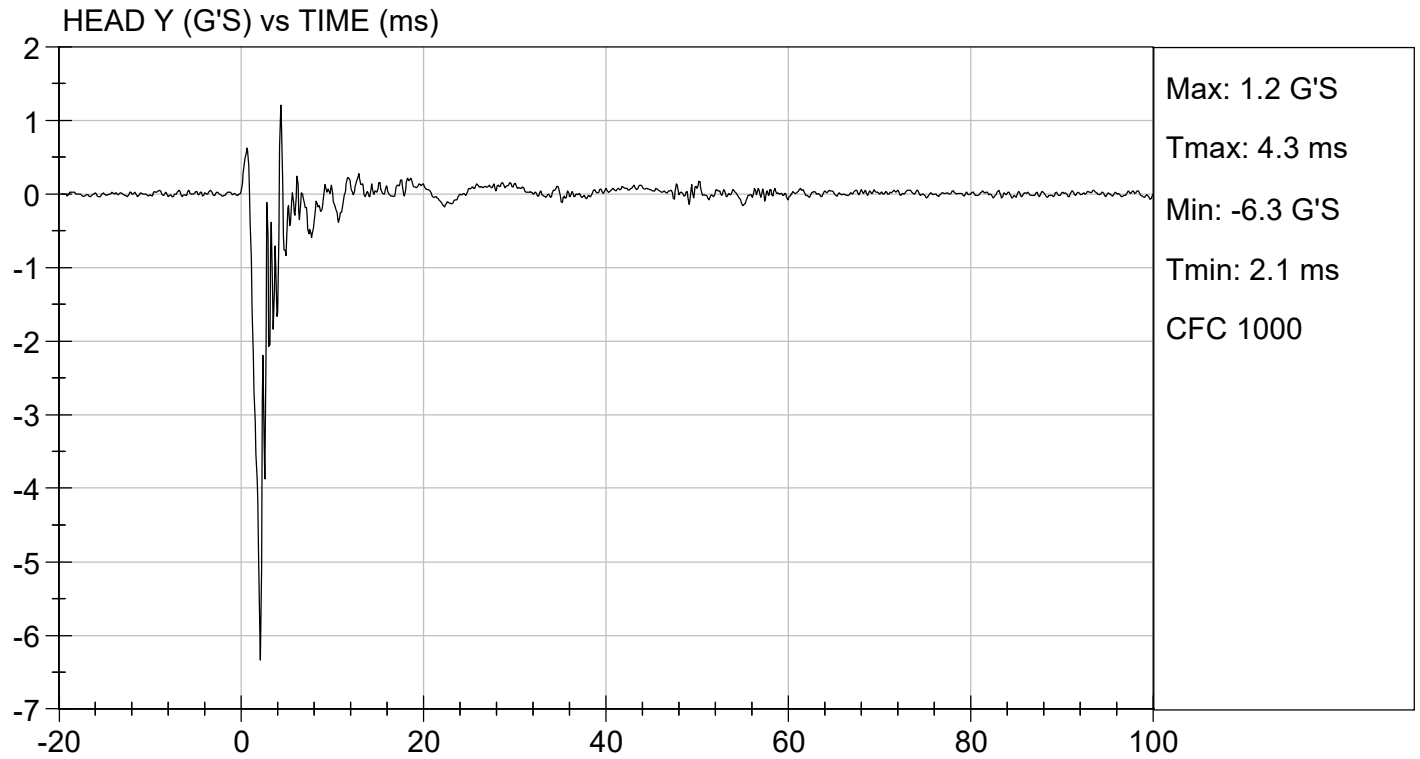

Laboratory Technician

07/15/2019

Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 6 YEAR OLD

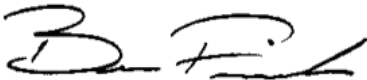
ATD Serial No: 144

Test I.D: D192162

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	43	Pass
Pendulum Speed		m/s	4.83 to 5.07	4.98	Pass
Pendulum Velocity	10 ms	m/s	1.2 to 1.6	1.5	Pass
	20 ms	m/s	2.4 to 3.4	2.9	Pass
	30 ms	m/s	3.8 to 5.0	4.2	Pass
D Plane Rotation	Max	deg	74 to 92	80	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	27 to 33	32.0	Pass
Positive Moment Time Curve Decay to 5 Nm		ms	103 to 123	108	Pass
Overall Results					Pass


 Laboratory Technician

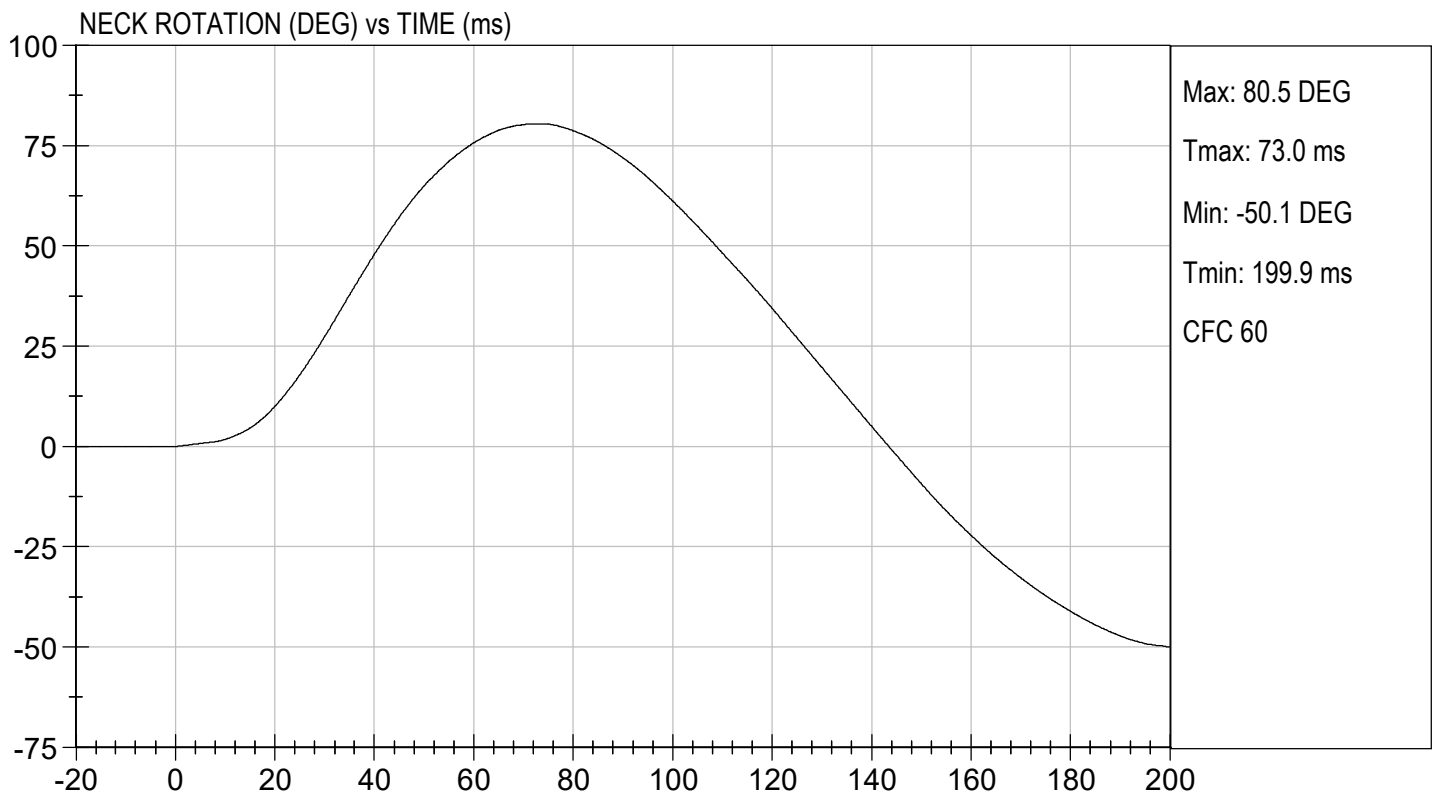
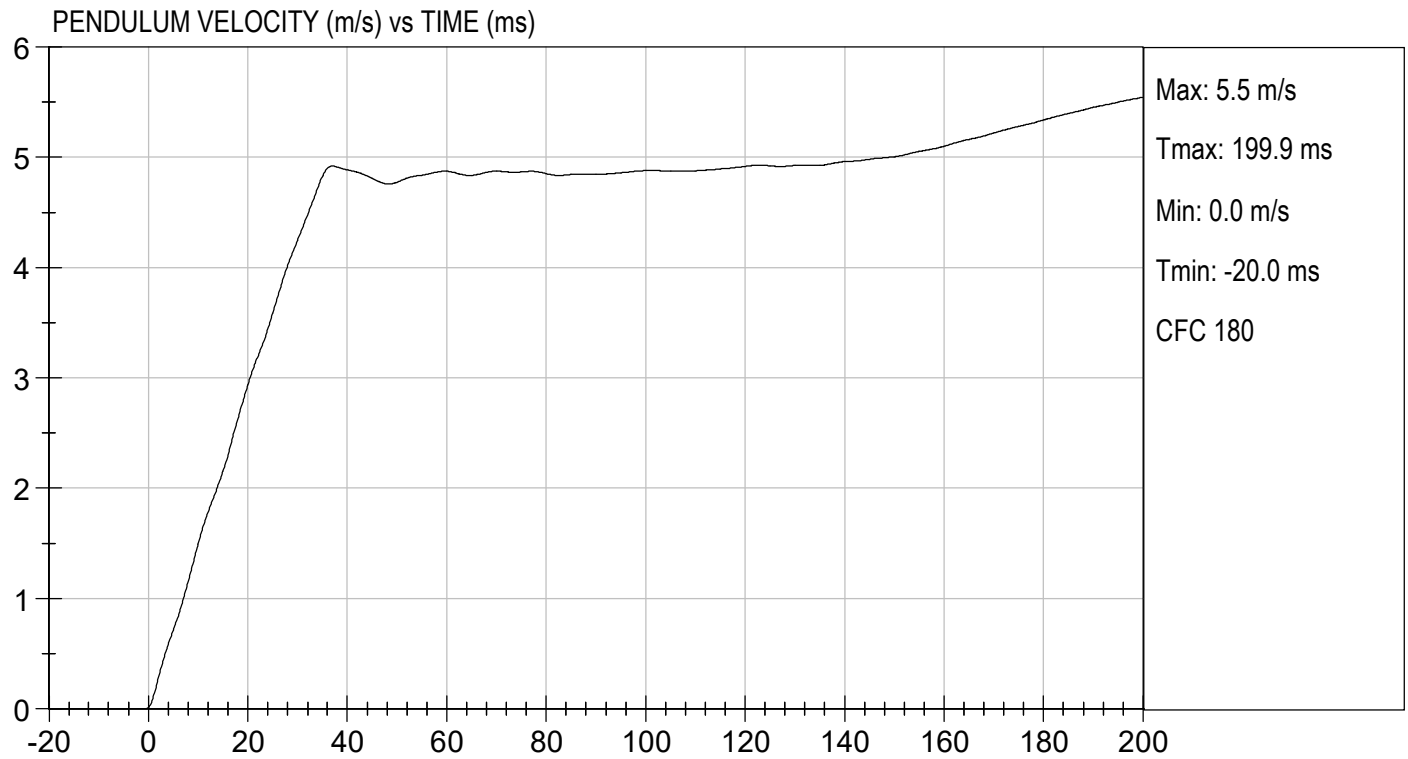
07/15/2019
 Test Date


 Approved By



TEST DESC: NECK FLEXION
VELOCITY: 16.34 ft/s, 4.98 m/s

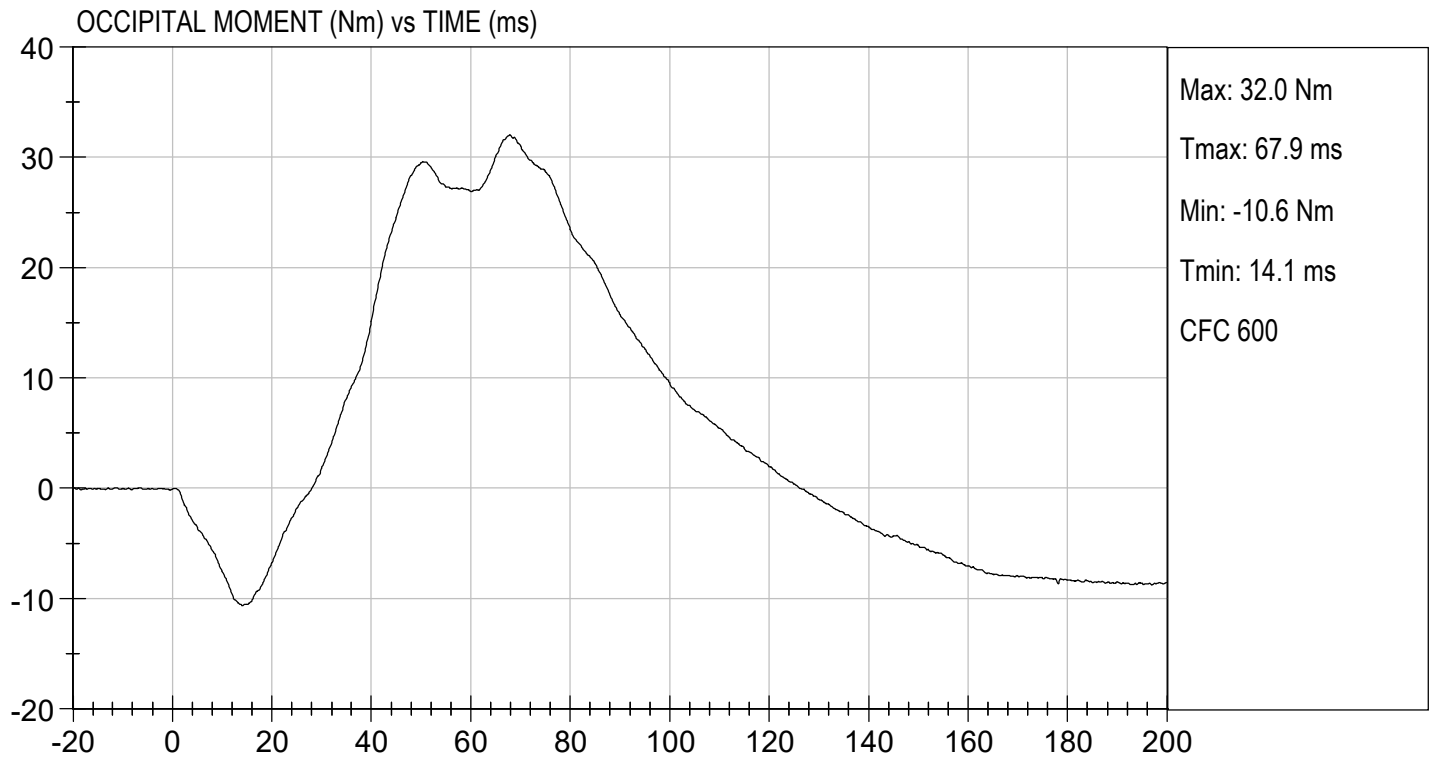
TEST DATE: 07/15/2019
TEST #: D192162





TEST DESC: NECK FLEXION
VELOCITY: 16.34 ft/s, 4.98 m/s

TEST DATE: 07/15/2019
TEST #: D192162



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 6 YEAR OLD

ATD Serial No: 144Test I.D: D192163

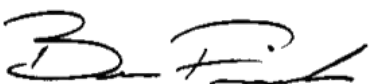
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	43	Pass
Pendulum Speed		m/s	4.18 to 4.42	4.27	Pass
Pendulum Velocity	10 ms	m/s	1.0 to 1.4	1.3	Pass
	20 ms	m/s	2.2 to 3.0	2.5	Pass
	30 ms	m/s	3.2 to 4.2	3.8	Pass
D Plane Rotation	Max	deg	85 to 103	95	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	-19 to -24	-20	Pass
Positive Moment Time Curve Decay to 5 Nm		msec	123 to 147	133	Pass
Overall Results					Pass



Laboratory Technician

07/15/2019

Test Date

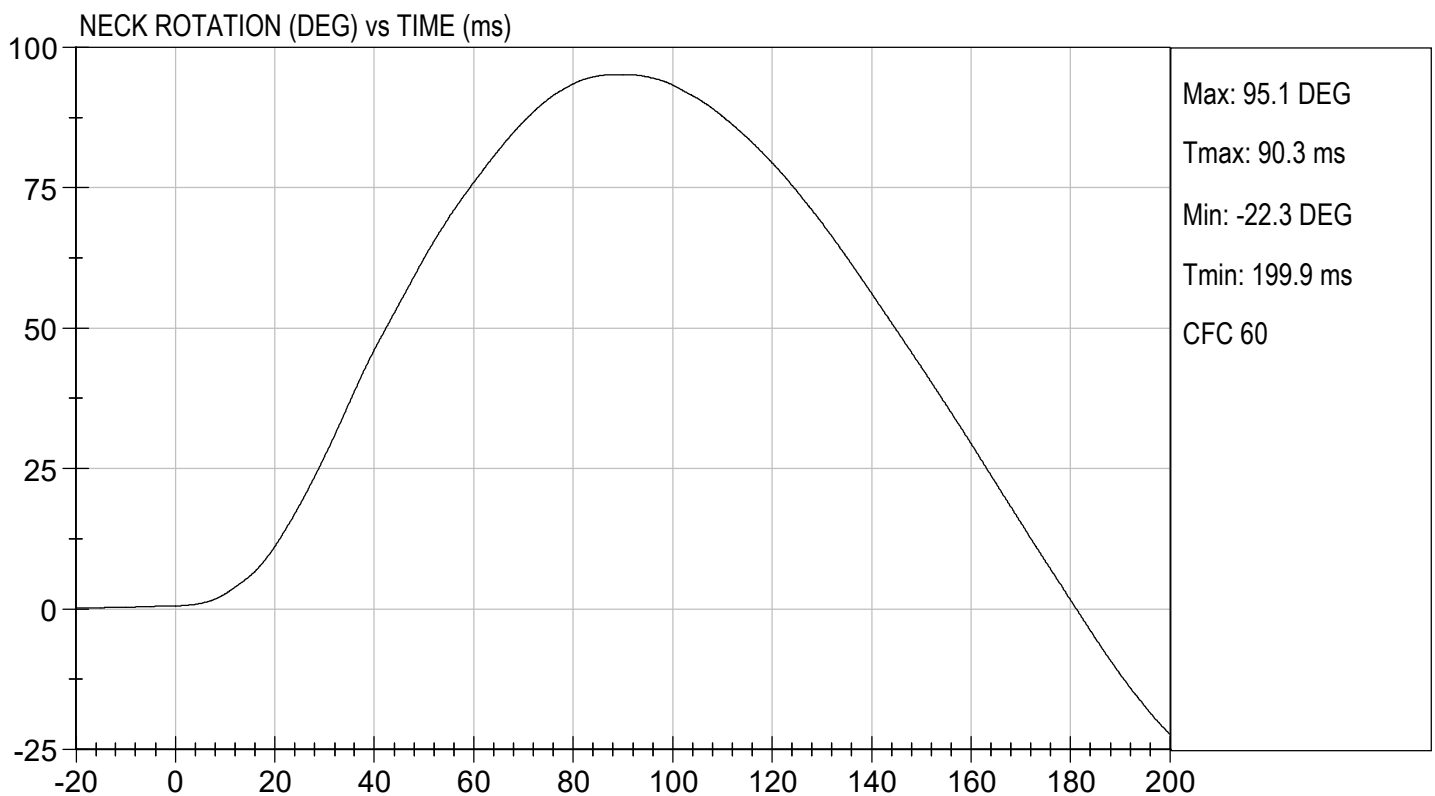
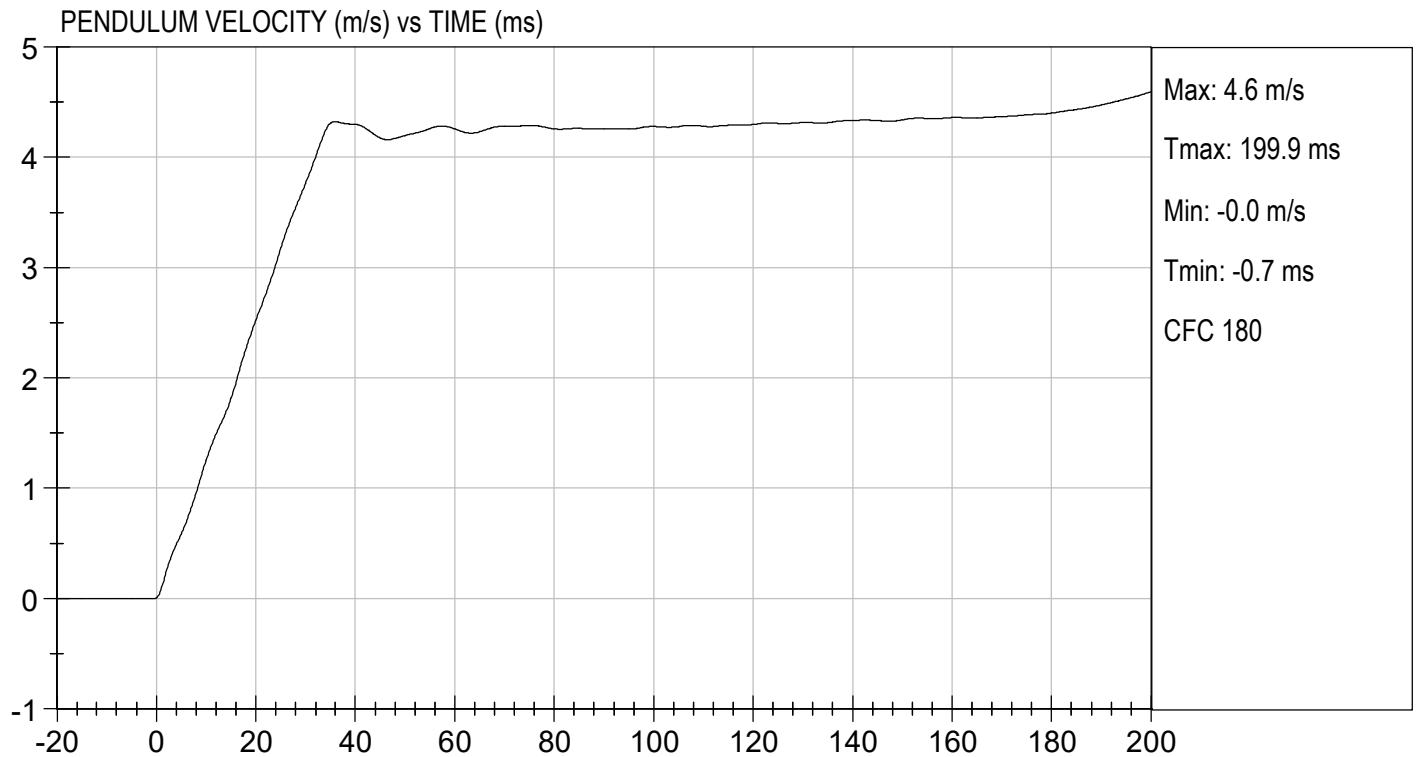


Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 14.01 ft/s, 4.27 m/s

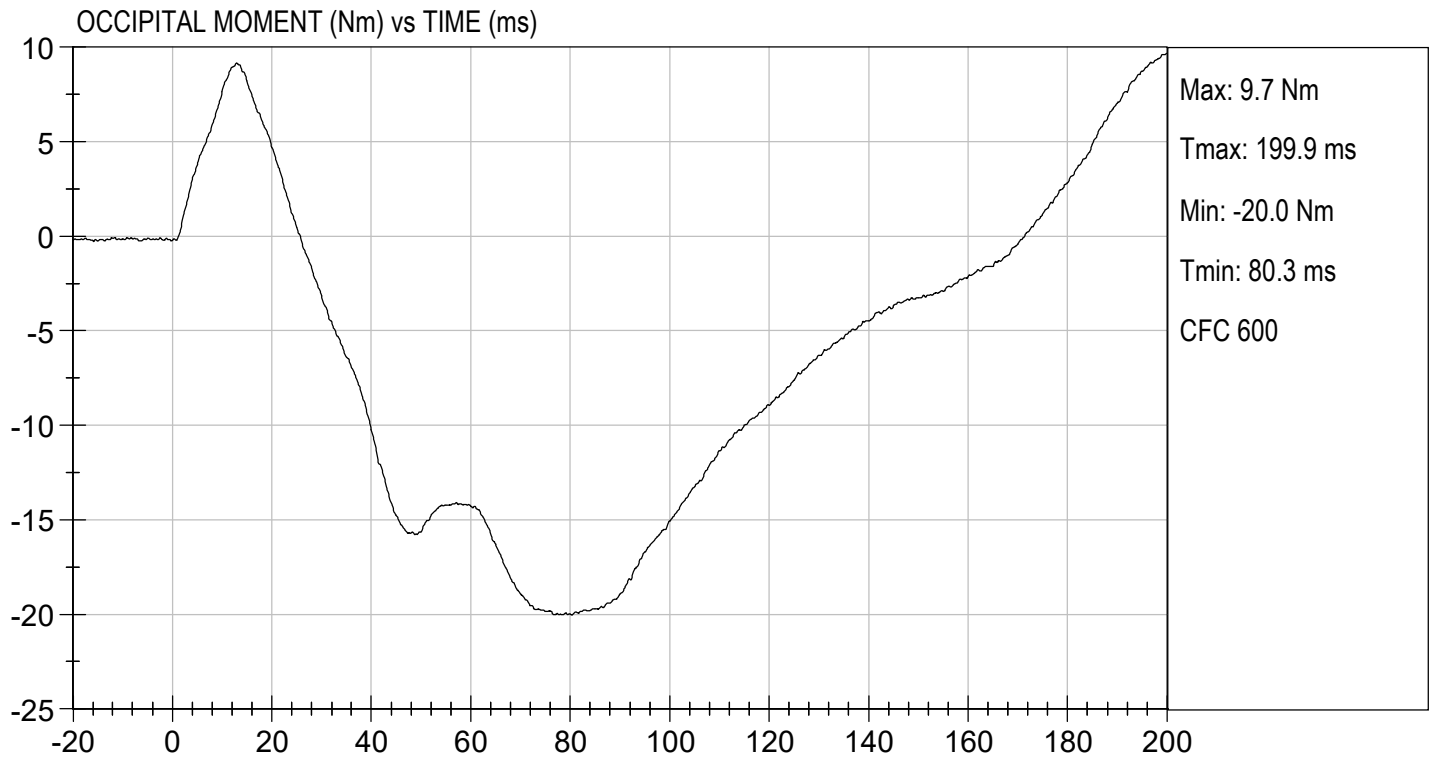
TEST DATE: 07/15/2019
TEST #: D192163





TEST DESC: NECK EXTENSION
VELOCITY: 14.01 ft/s, 4.27 m/s

TEST DATE: 07/15/2019
TEST #: D192163



MGA RESEARCH CORPORATION

**THORAX IMPACT
HYBRID III 6 YEAR OLD**

ATD Serial No: 144

Test I.D: D192164

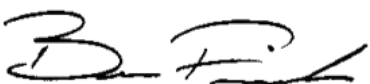
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	20.9	Pass
Relative Humidity	%	10 to 70	46	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	38.0 to 46.0	39.9	Pass
Peak Resistive Force w/in Deflection Corridor	N	1150 to 1380	1,321	Pass
Internal Hysteresis	%	65 to 85	77	Pass
Peak Force 12.5 mm - 38.0 mm	N	<= 1,500	1,341	Pass
Overall Test Results				Pass



Laboratory Technician

07/16/2019

Test Date

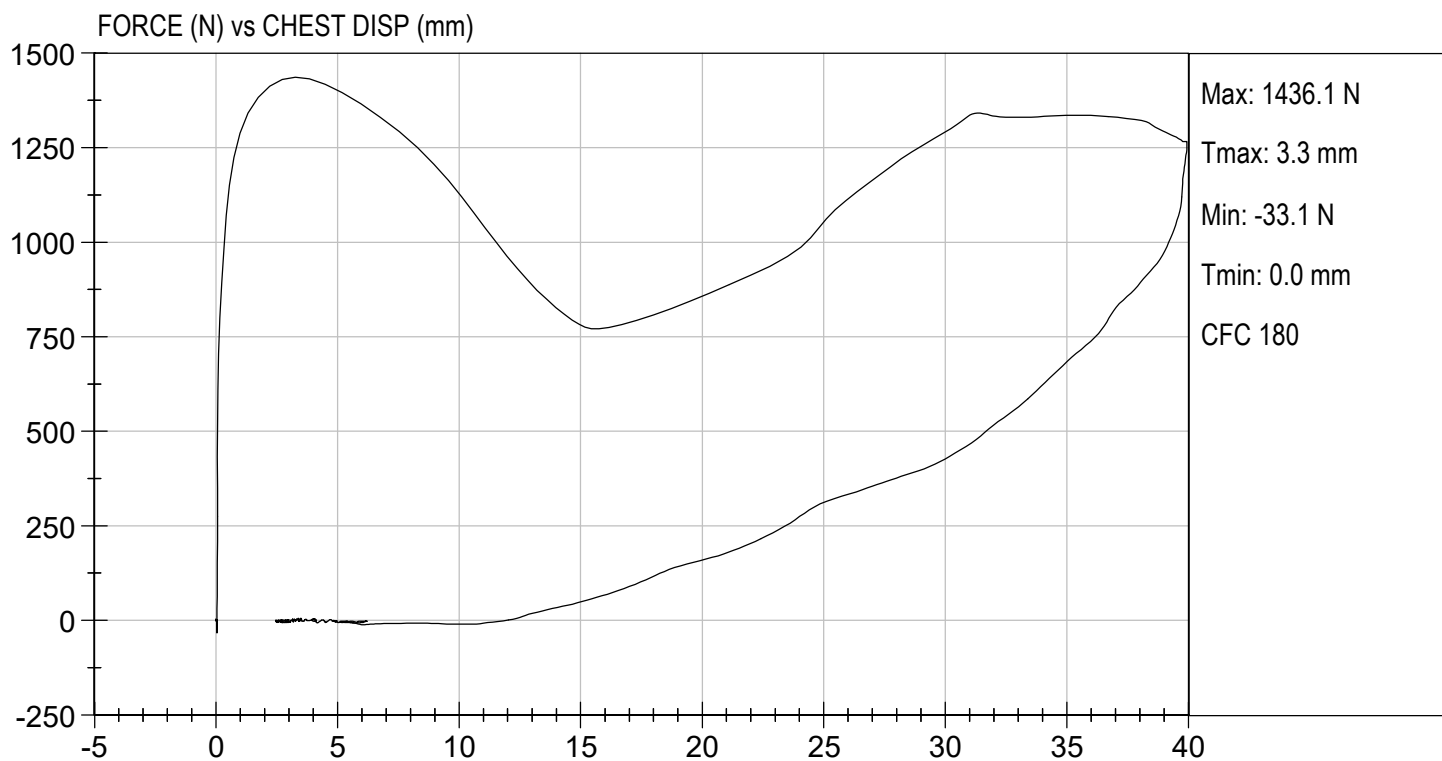


Approved By



TEST DESC: THORAX IMPACT
VELOCITY: 22.22 ft/s, 6.77 m/s

TEST DATE: 07/16/2019
TEST #: D192164



MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 6 YEAR OLD

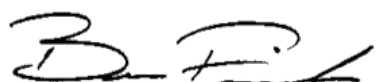
ATD Serial No: 144

Test I.D: D192165

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Probe Speed	m/s	2.07 to 2.13	2.08	Pass
Maximum Force	N	2000 to 3000	2525	Pass
Overall Test Results				Pass


Laboratory Technician

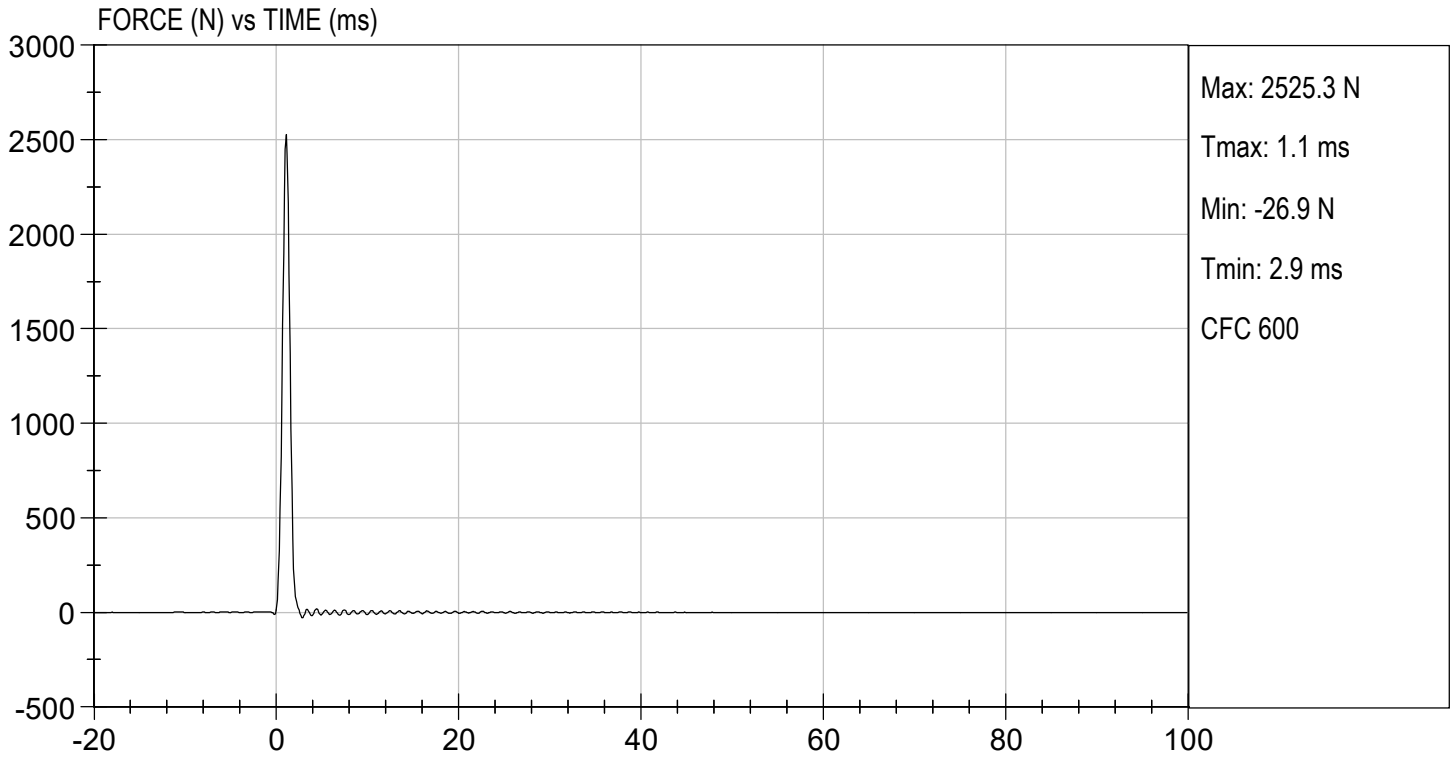
07/15/2019
Test Date


Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 6.83 ft/s, 2.08 m/s

TEST DATE: 07/15/2019
TEST #: D192165



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 6 YEAR OLD

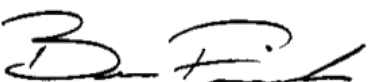
ATD Serial No: 144

Test I.D: D192166

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	2000 to 3000	2540	Pass
Overall Test Results				Pass


Laboratory Technician

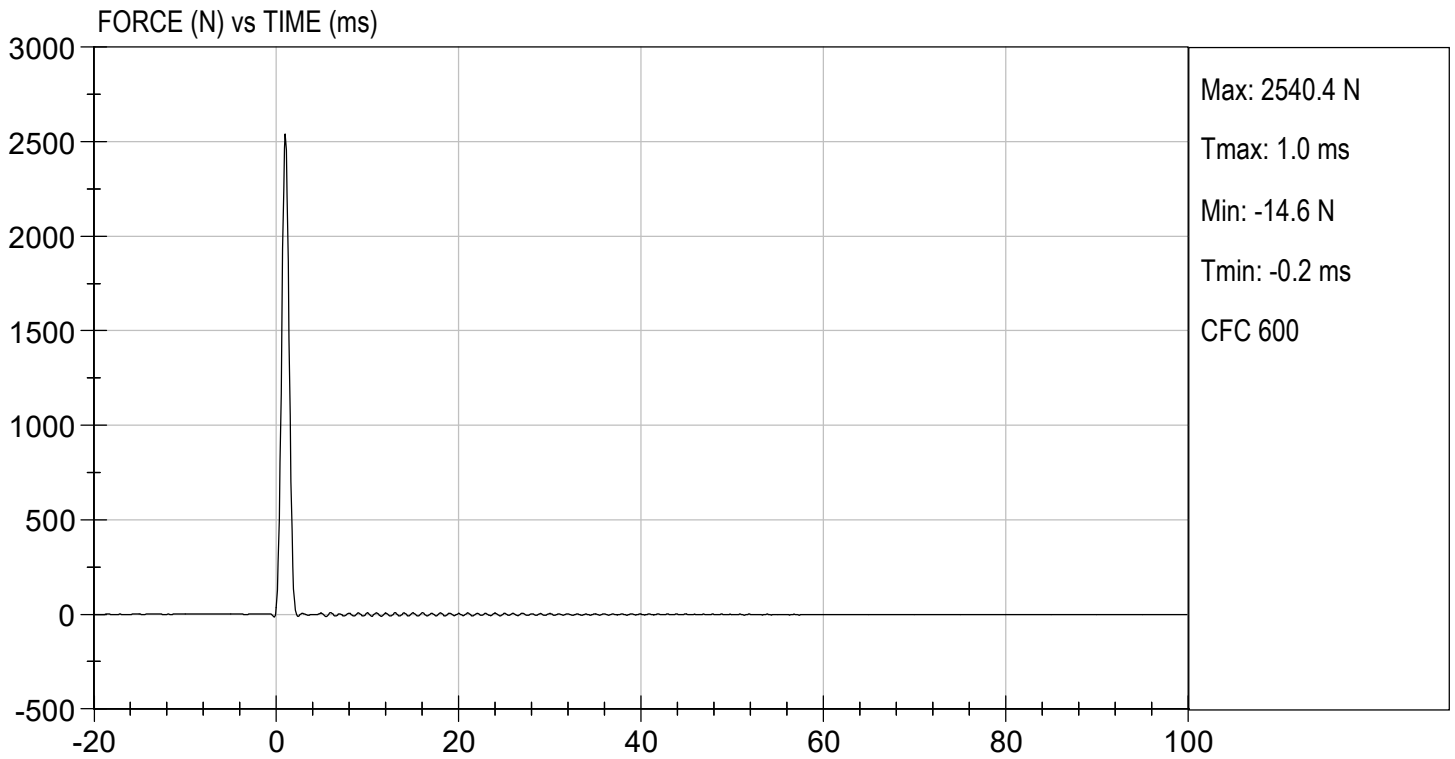
07/15/2019
Test Date


Approved By



TEST DESC: LEFT KNEE
VELOCITY: 6.89 ft/s, 2.10 m/s

TEST DATE: 07/15/2019
TEST #: D192166



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 6 YEAR OLD

ATD Serial No: 144

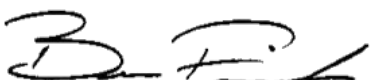
Test I.D: D192167

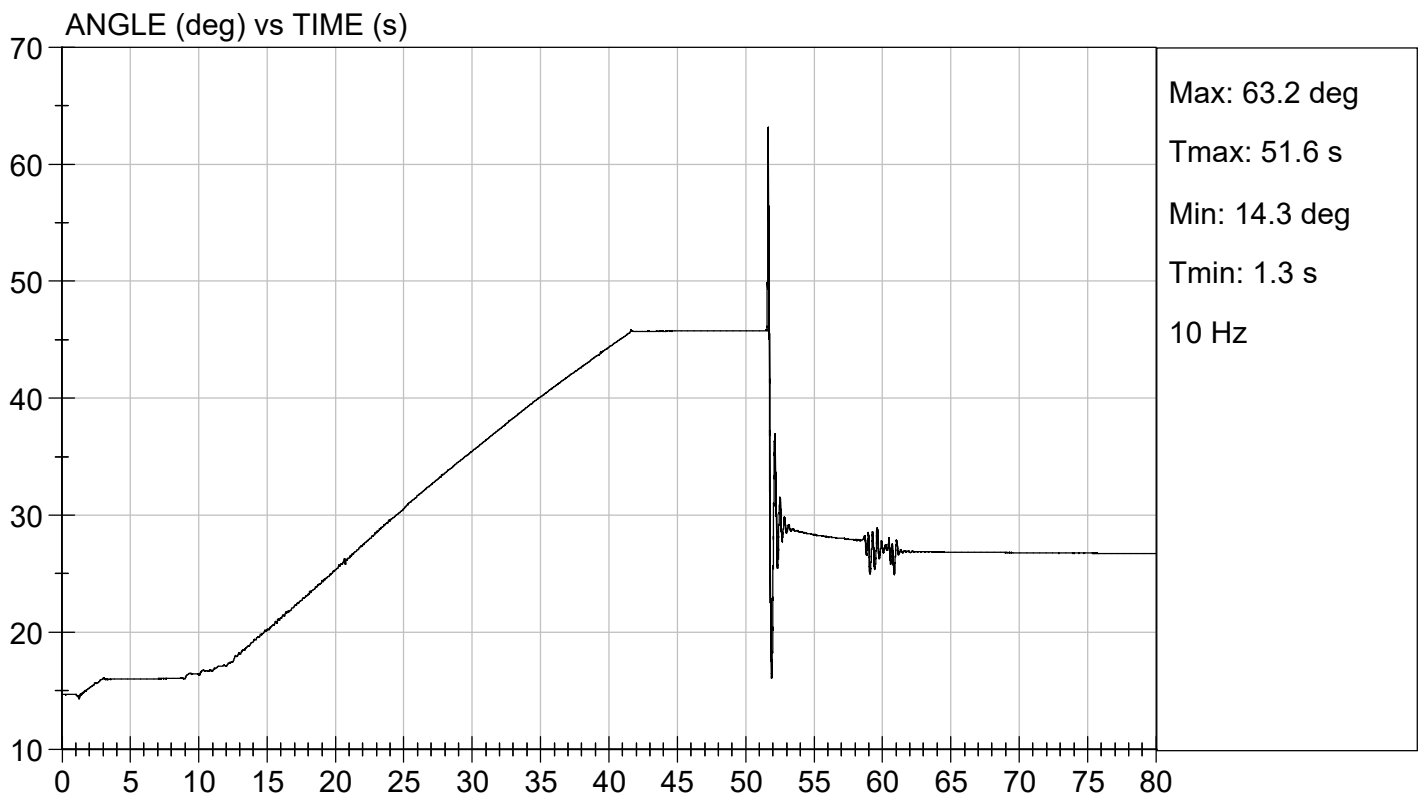
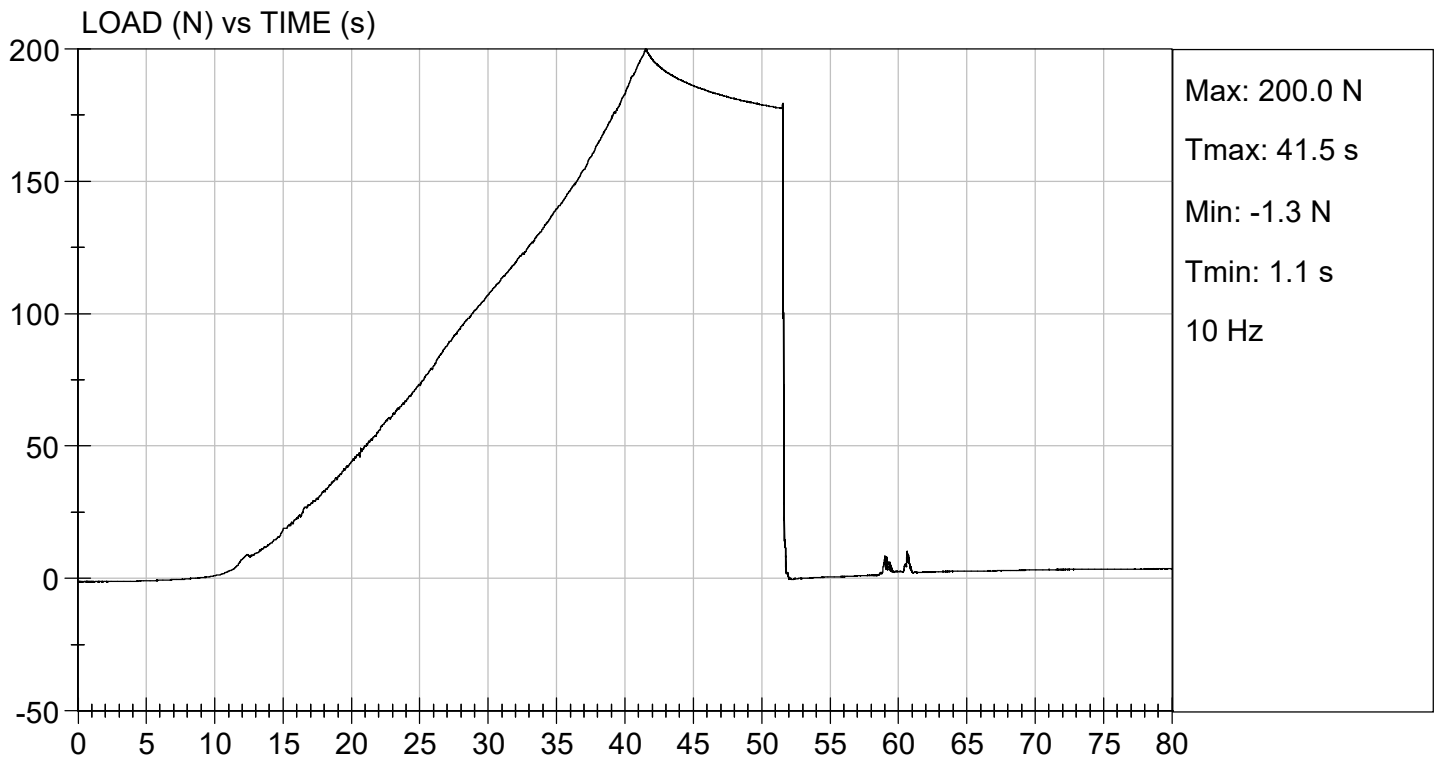
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Initial Angle	deg	0 to 22	15	Pass
Return Angle	deg	+/- 8	7	Pass
Force at 45 deg	N	147 to 200	200	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass


Laboratory Technician

07/16/2019

Test Date


Approved By



CALIBRATION TEST RESULTS

POST-TEST

Hybrid III 6-Year-Old ATD

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 6 YEAR OLD

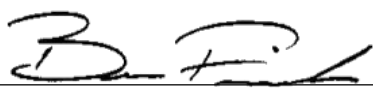
ATD Serial No: 144

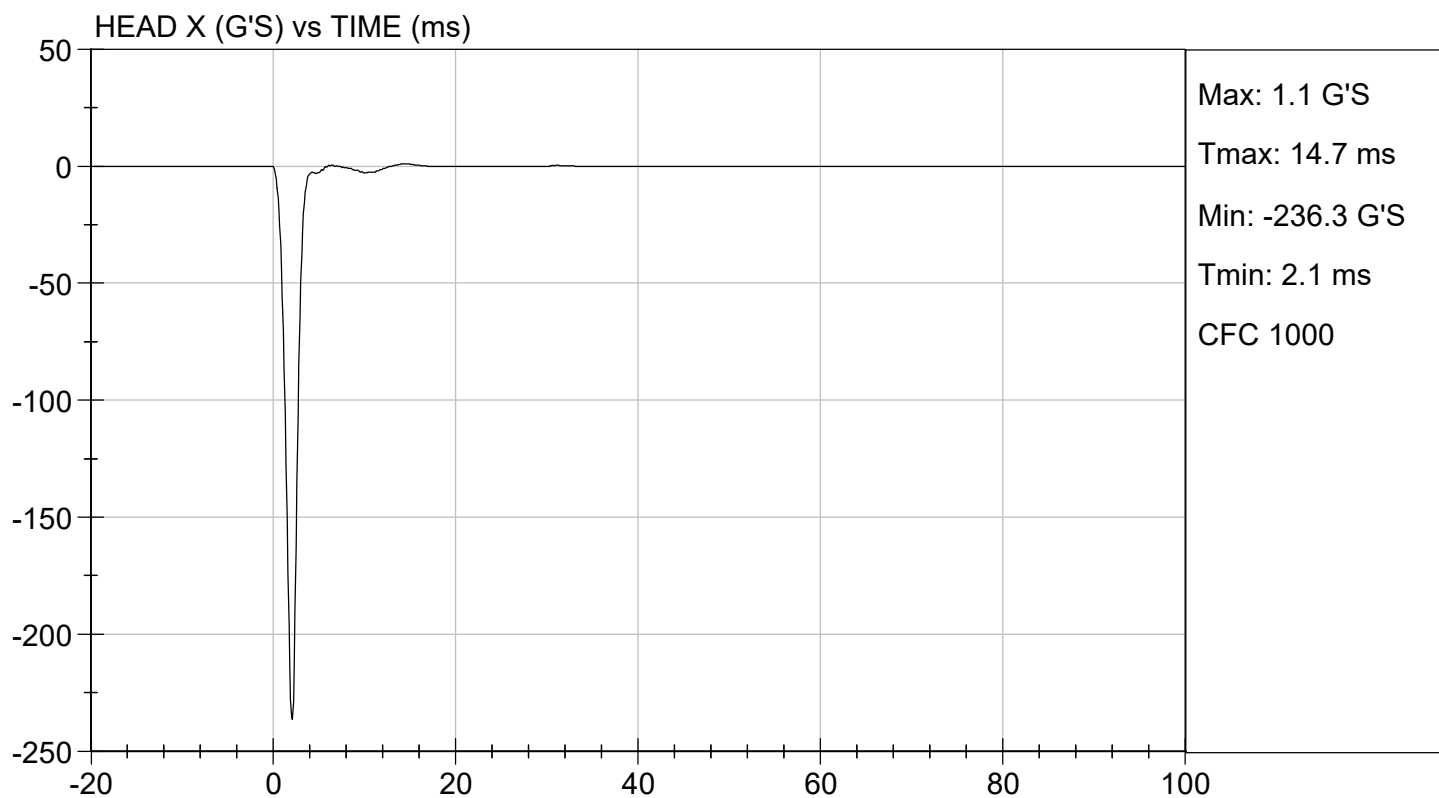
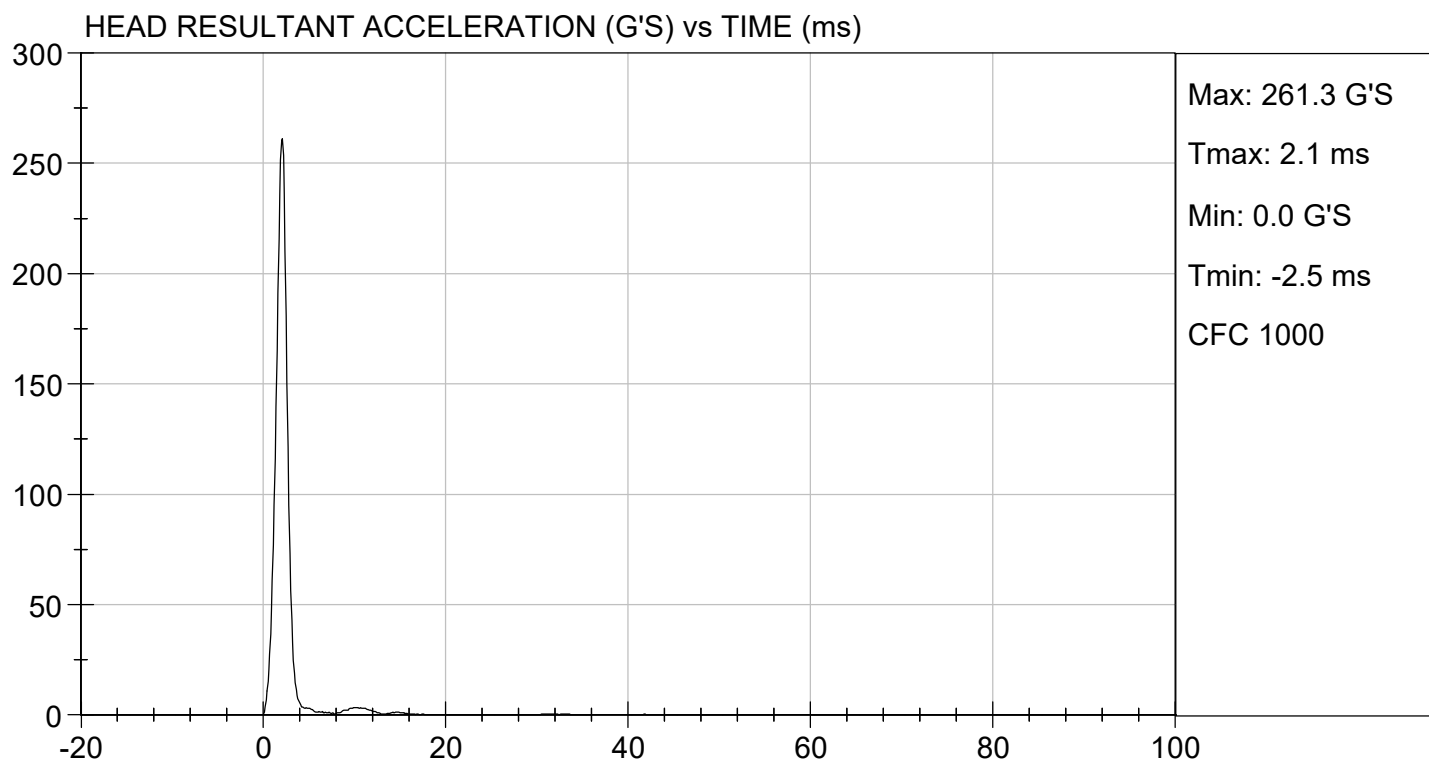
Test ID: D192351

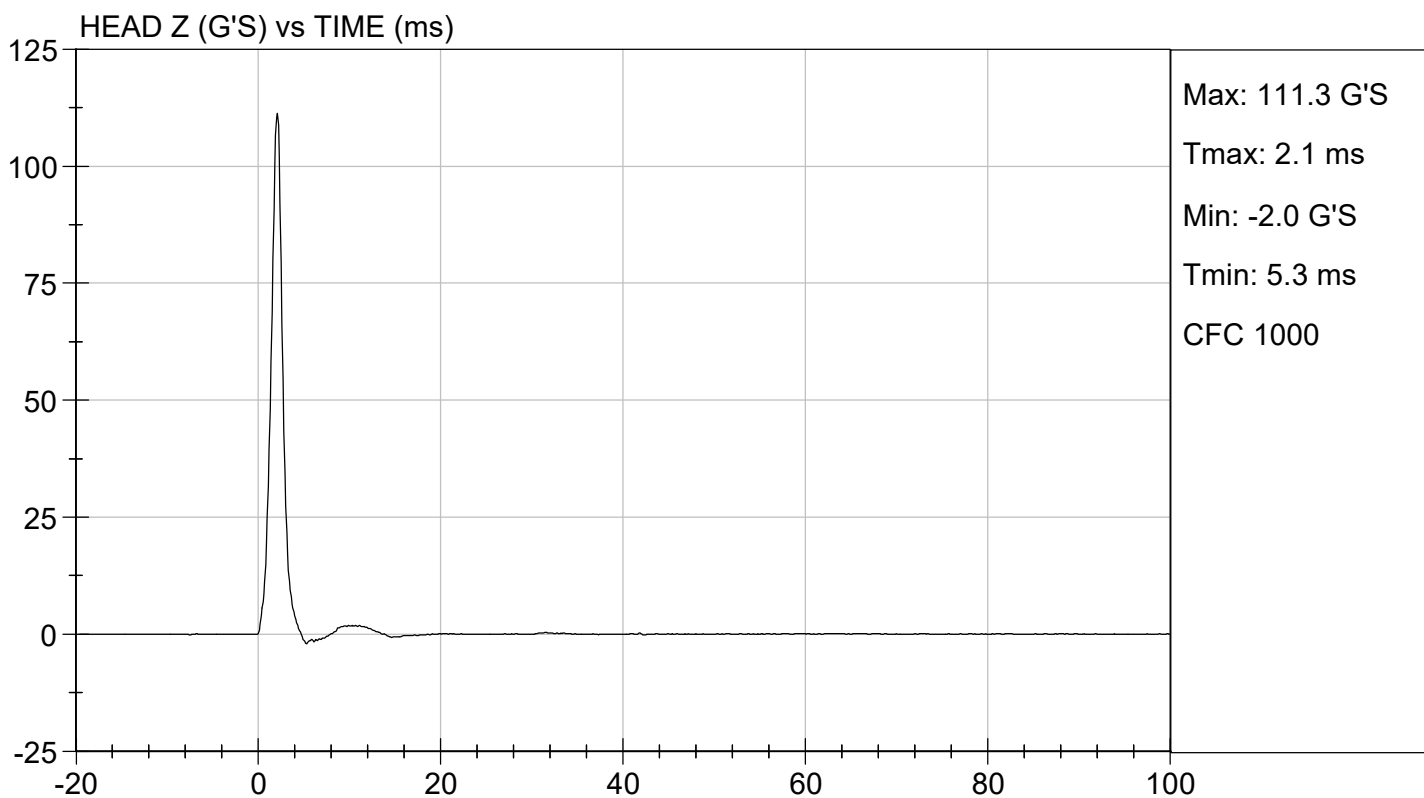
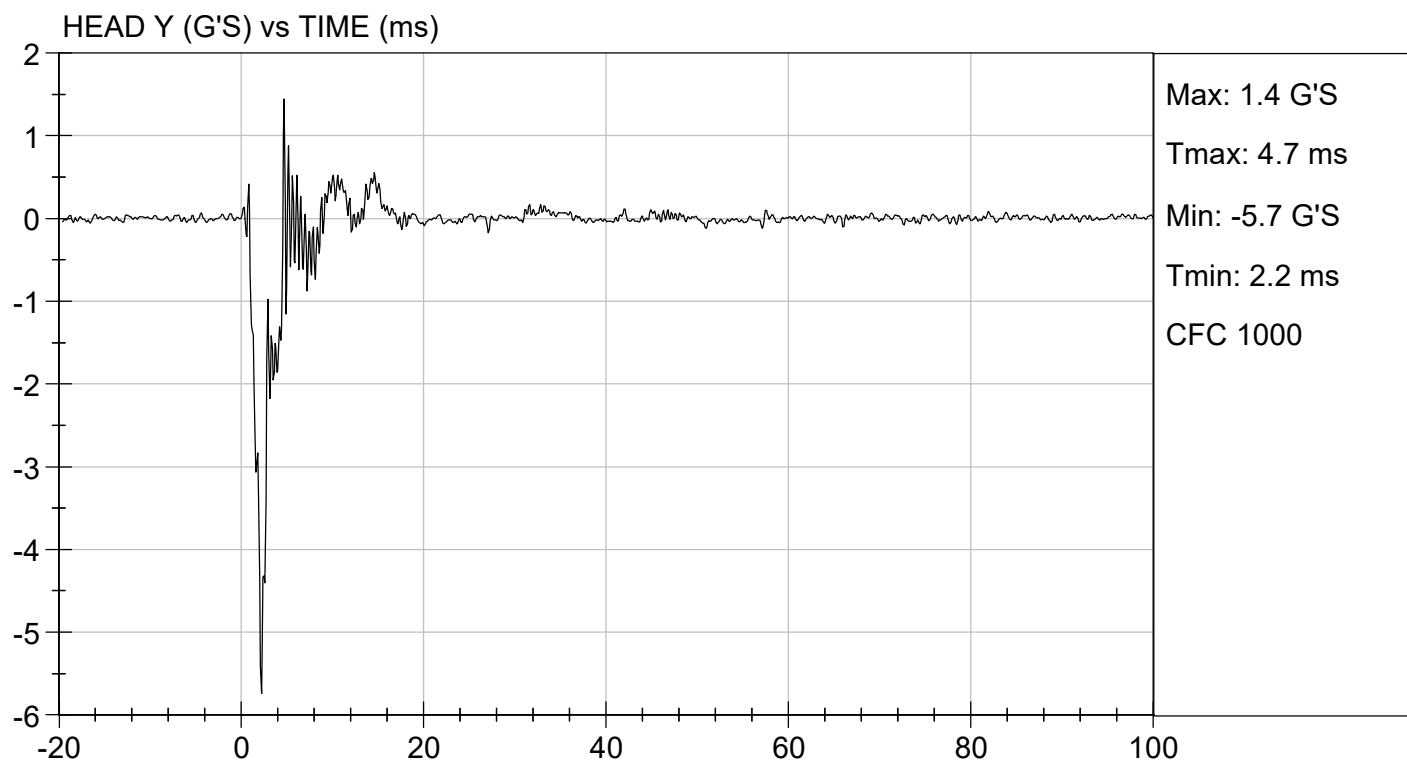
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Peak Resultant Acceleration	G's	245 to 300	261	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-5.7	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

07/29/2019
Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 6 YEAR OLD

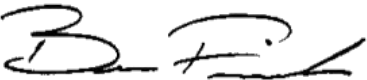
ATD Serial No: 144

Test I.D: D192352

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	42	Pass
Pendulum Speed		m/s	4.83 to 5.07	4.93	Pass
Pendulum Velocity	10 ms	m/s	1.2 to 1.6	1.4	Pass
	20 ms	m/s	2.4 to 3.4	2.8	Pass
	30 ms	m/s	3.8 to 5.0	4.1	Pass
D Plane Rotation	Max	deg	74 to 92	78	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	27 to 33	30.7	Pass
Positive Moment Time Curve Decay to 5 Nm		ms	103 to 123	108	Pass
Overall Results					Pass


 Laboratory Technician

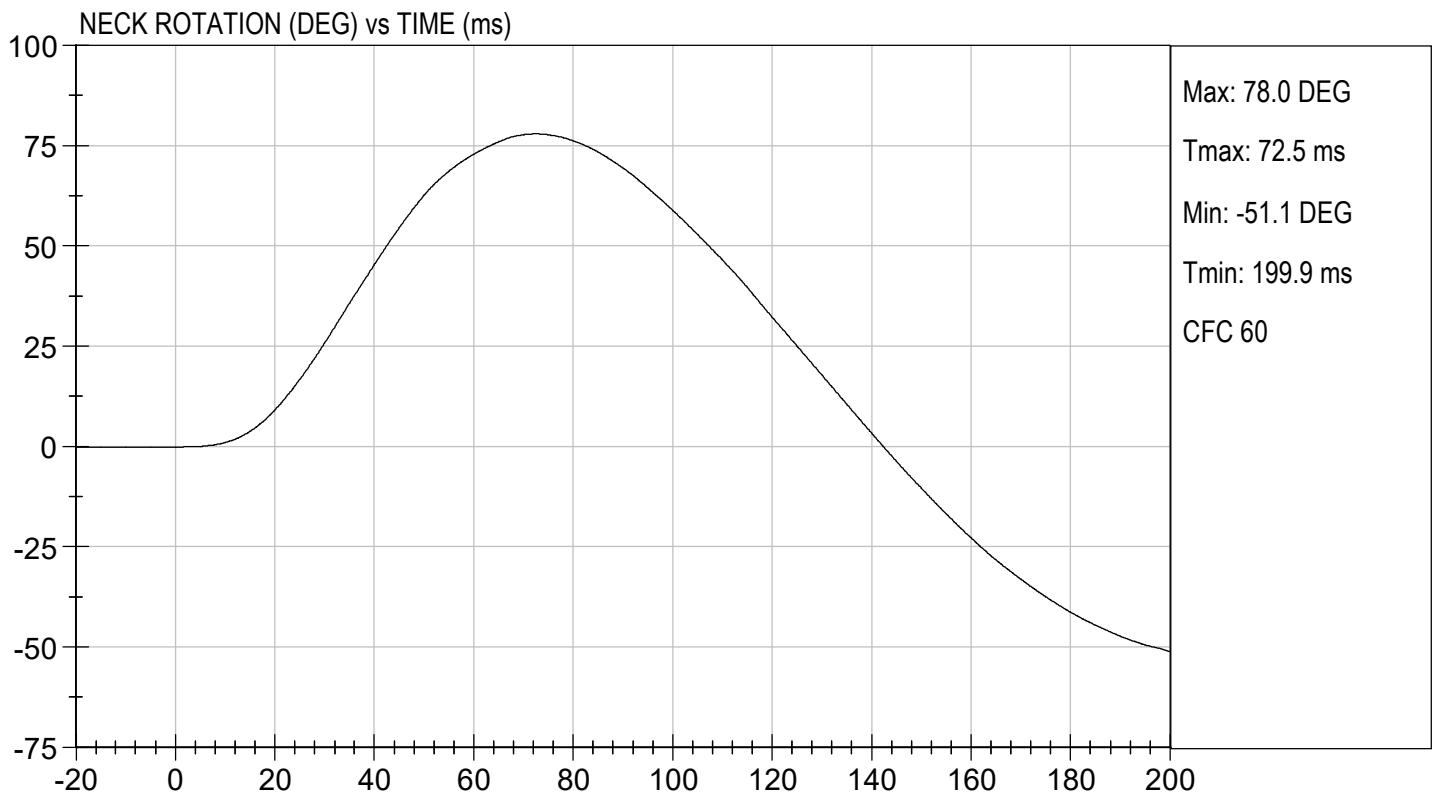
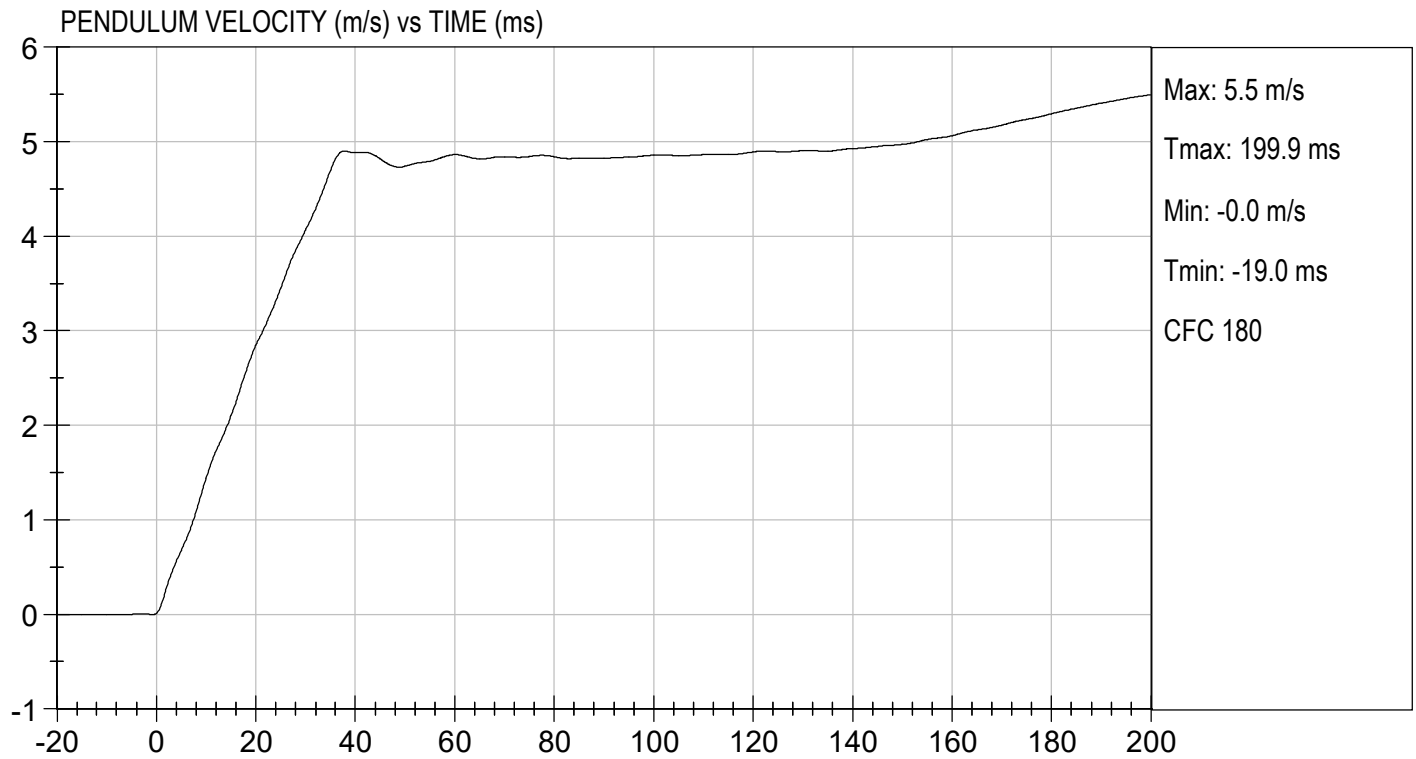
07/29/2019
 Test Date


 Approved By



TEST DESC: NECK FLEXION
VELOCITY: 16.18 ft/s, 4.93 m/s

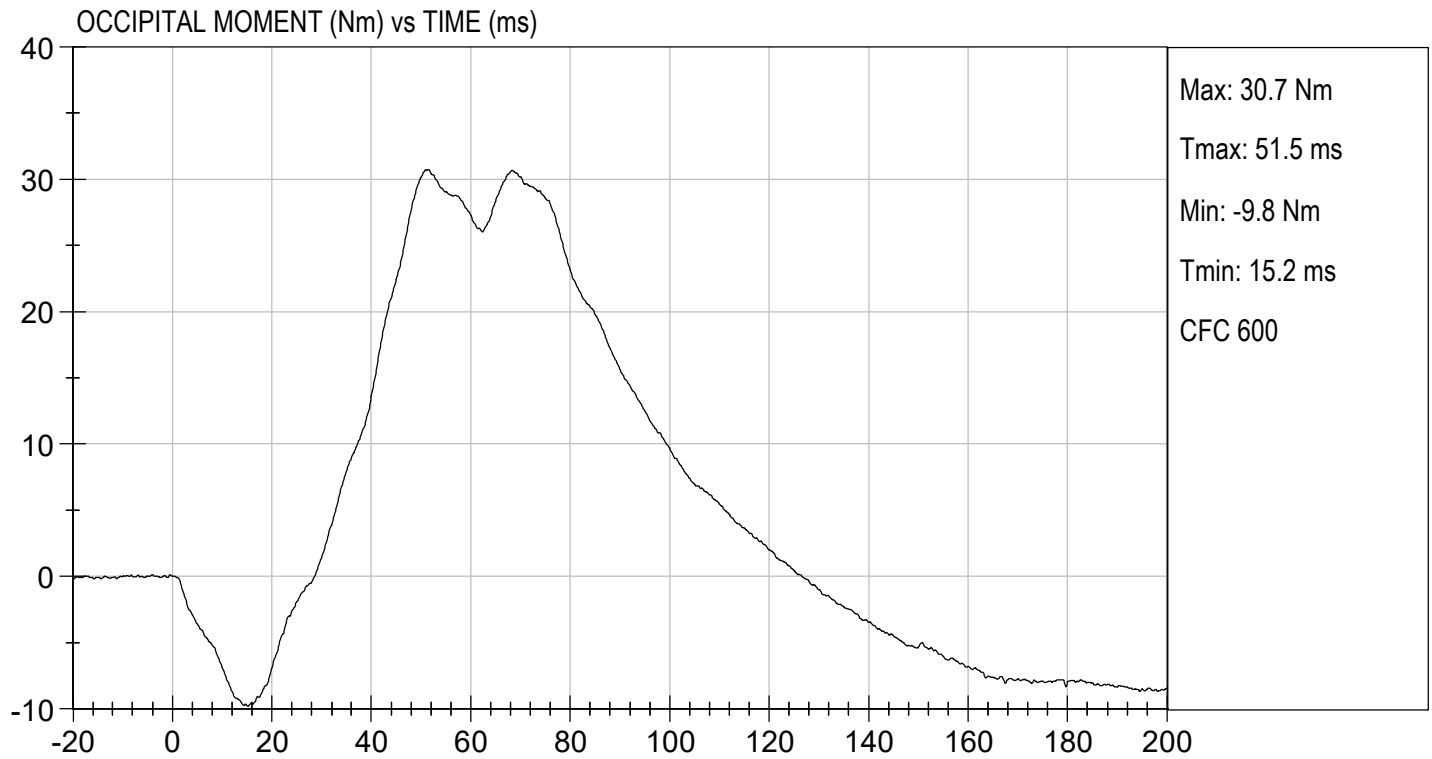
TEST DATE: 07/29/2019
TEST #: D192352





TEST DESC: NECK FLEXION
VELOCITY: 16.18 ft/s, 4.93 m/s

TEST DATE: 07/29/2019
TEST #: D192352



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 6 YEAR OLD

ATD Serial No: 144

Test I.D: D192353

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	42	Pass
Pendulum Speed		m/s	4.18 to 4.42	4.30	Pass
Pendulum Velocity	10 ms	m/s	1.0 to 1.4	1.2	Pass
	20 ms	m/s	2.2 to 3.0	2.5	Pass
	30 ms	m/s	3.2 to 4.2	3.9	Pass
D Plane Rotation	Max	deg	85 to 103	95	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	-19 to -24	-20	Pass
Positive Moment Time Curve Decay to 5 Nm		msec	123 to 147	134	Pass
Overall Results					Pass

Brian Roach
Laboratory Technician

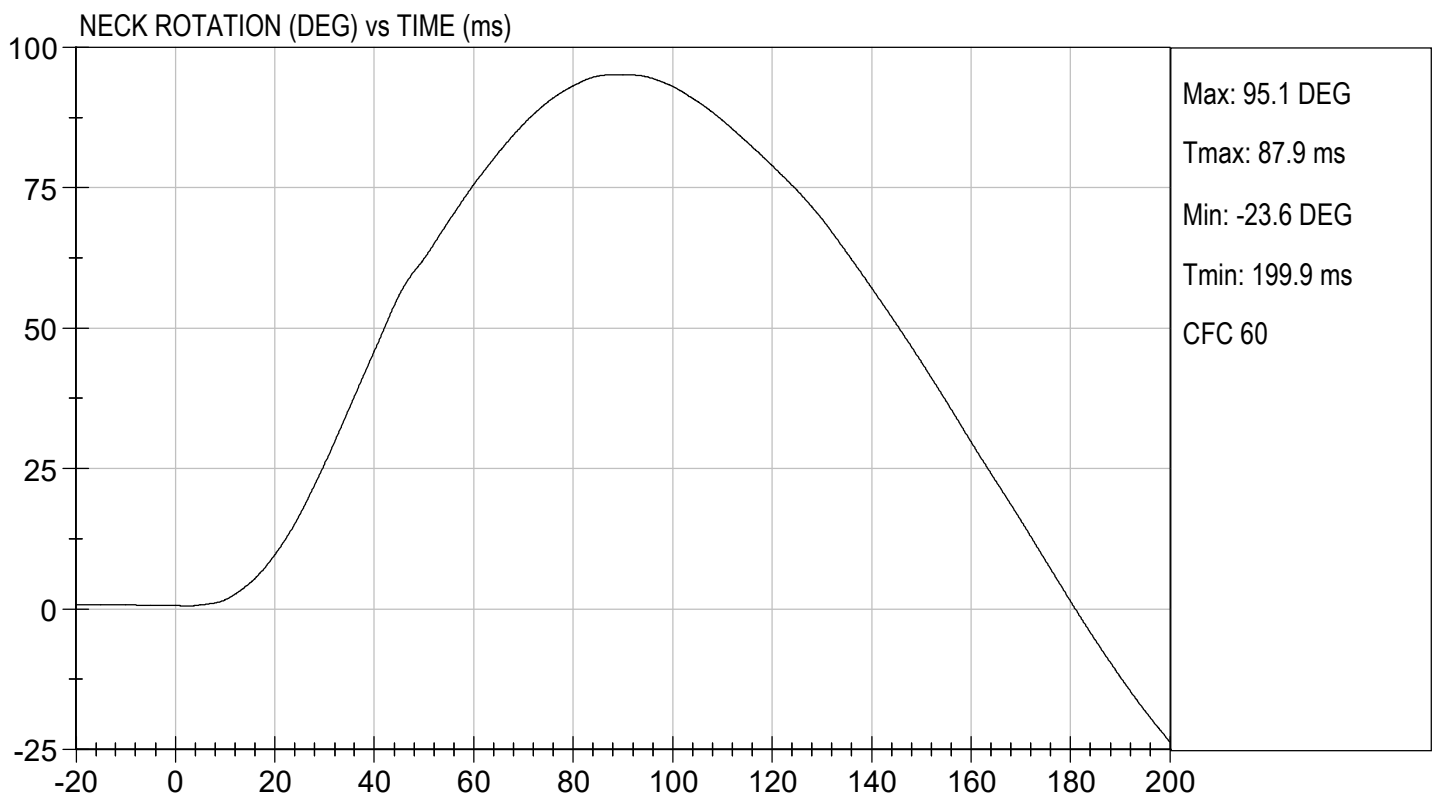
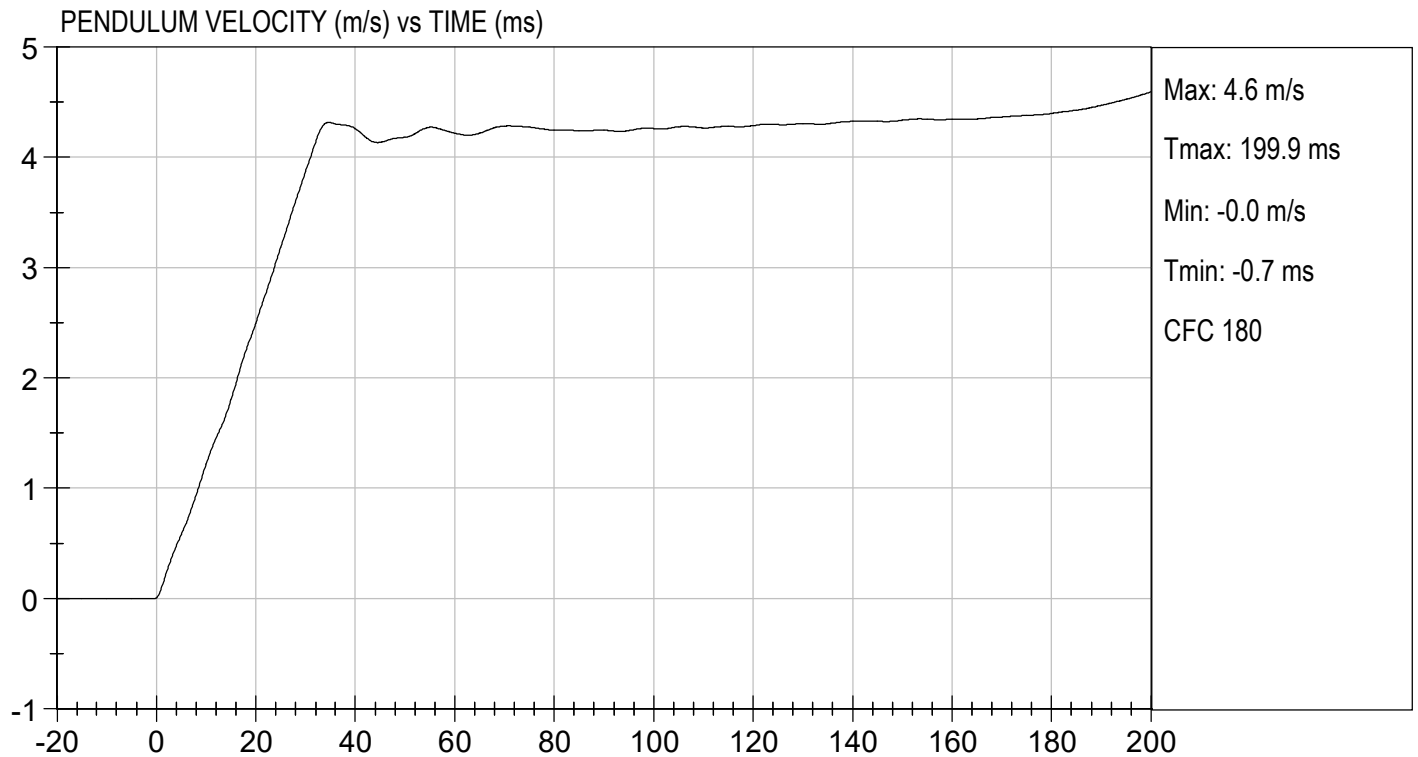
07/29/2019
Test Date

B. F. H.
Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 14.12 ft/s, 4.30 m/s

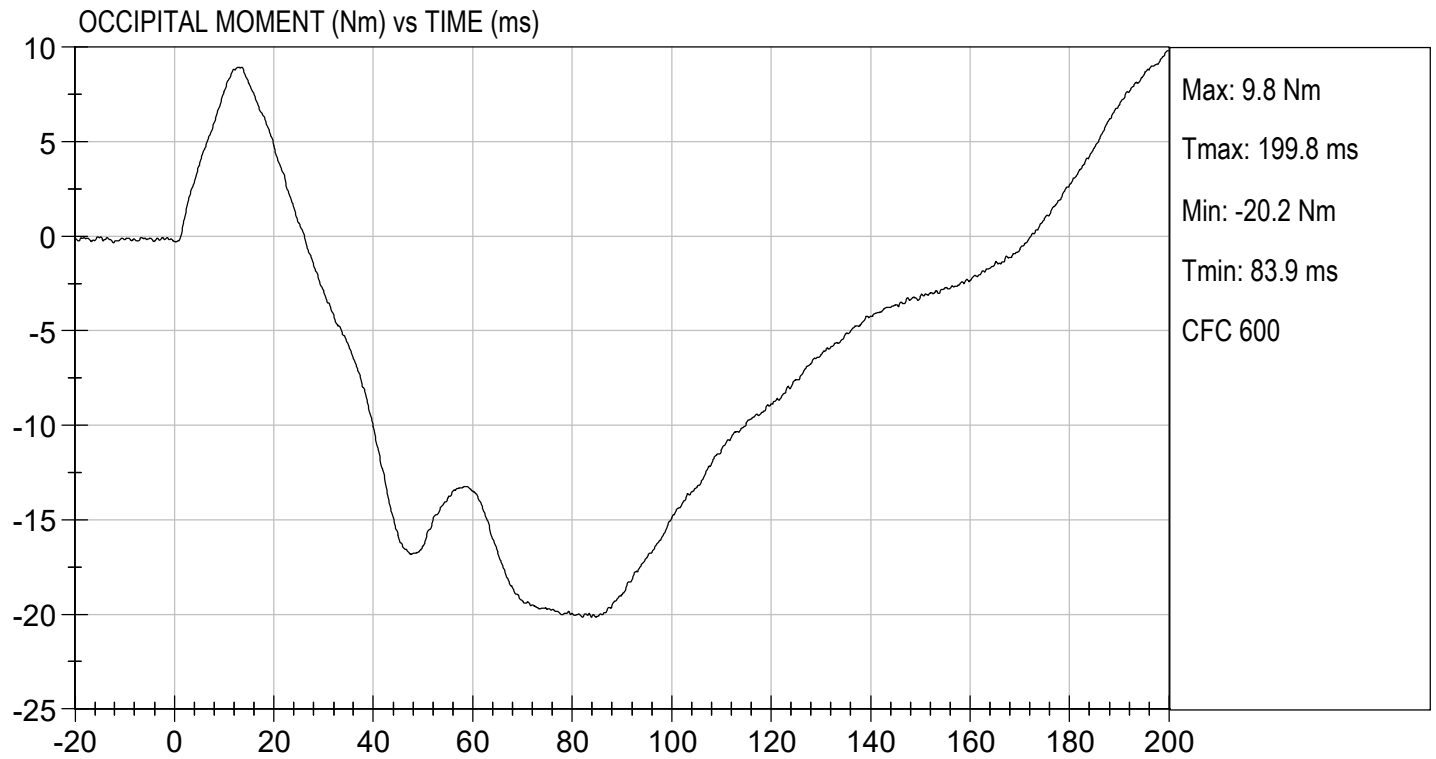
TEST DATE: 07/29/2019
TEST #: D192353





TEST DESC: NECK EXTENSION
VELOCITY: 14.12 ft/s, 4.30 m/s

TEST DATE: 07/29/2019
TEST #: D192353



MGA RESEARCH CORPORATION

**THORAX IMPACT
HYBRID III 6 YEAR OLD**

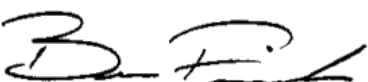
ATD Serial No: 111

Test I.D: D192354

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.2	Pass
Relative Humidity	%	10 to 70	44	Pass
Probe Speed	m/s	6.59 to 6.83	6.66	Pass
Peak Deflection	mm	38.0 to 46.0	39.5	Pass
Peak Resistive Force w/in Deflection Corridor	N	1150 to 1380	1,268	Pass
Internal Hysteresis	%	65 to 85	75	Pass
Peak Force 12.5 mm - 38.0 mm	N	<= 1,500	1,315	Pass
Overall Test Results				Pass


Laboratory Technician

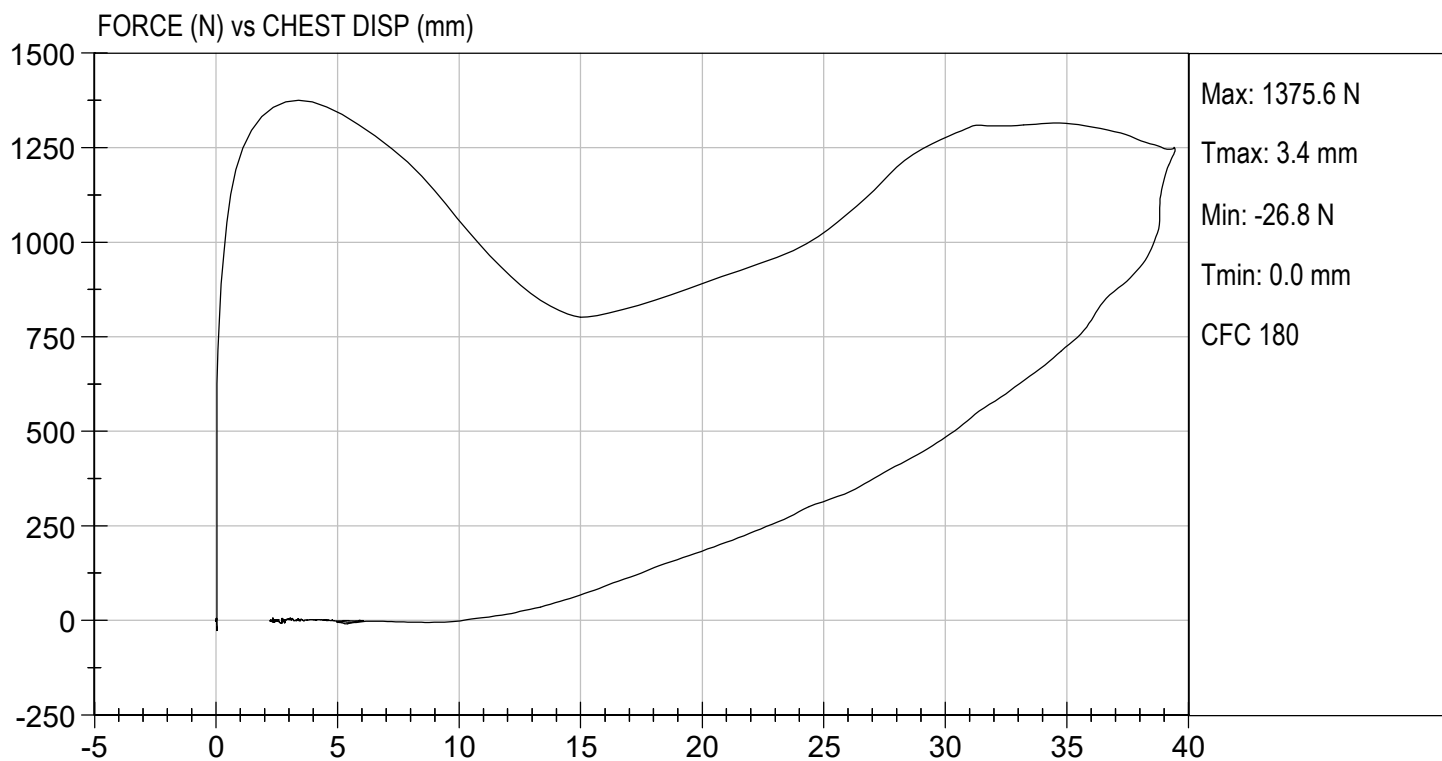
07/30/2019
Test Date


Approved By



TEST DESC: THORAX IMPACT
VELOCITY: 21.84 ft/s, 6.66 m/s

TEST DATE: 07/30/2019
TEST #: D192354



MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 6 YEAR OLD

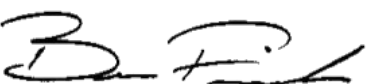
ATD Serial No: 144

Test I.D: D192355

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Speed	m/s	2.07 to 2.13	2.09	Pass
Maximum Force	N	2000 to 3000	2356	Pass
Overall Test Results				Pass


Laboratory Technician

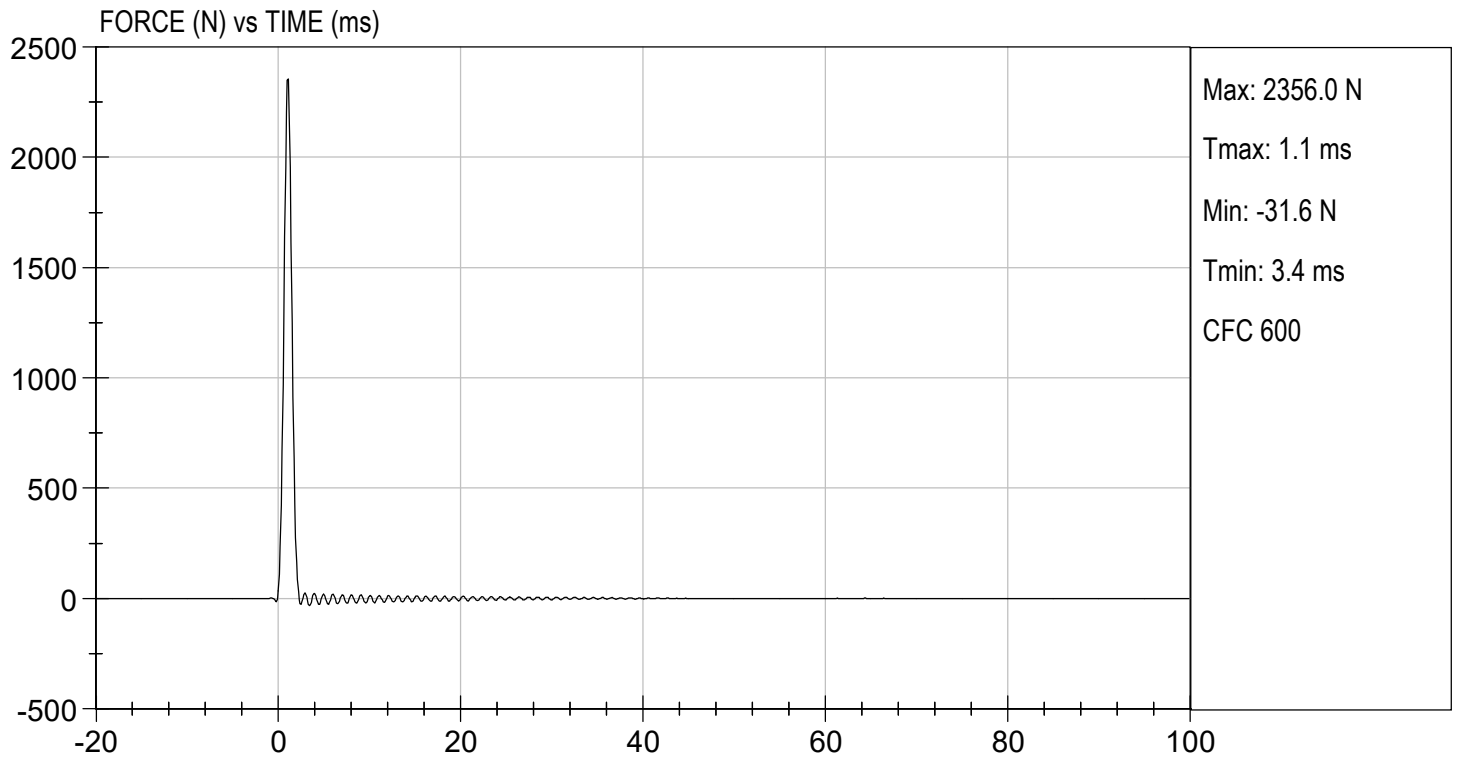
07/29/2019
Test Date


Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 6.86 ft/s, 2.09 m/s

TEST DATE: 07/29/2019
TEST #: D192355



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 6 YEAR OLD

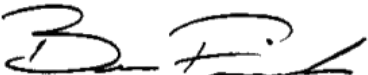
ATD Serial No: 144

Test I.D: D192356

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Speed	m/s	2.07 to 2.13	2.08	Pass
Maximum Force	N	2000 to 3000	2245	Pass
Overall Test Results				Pass


Laboratory Technician

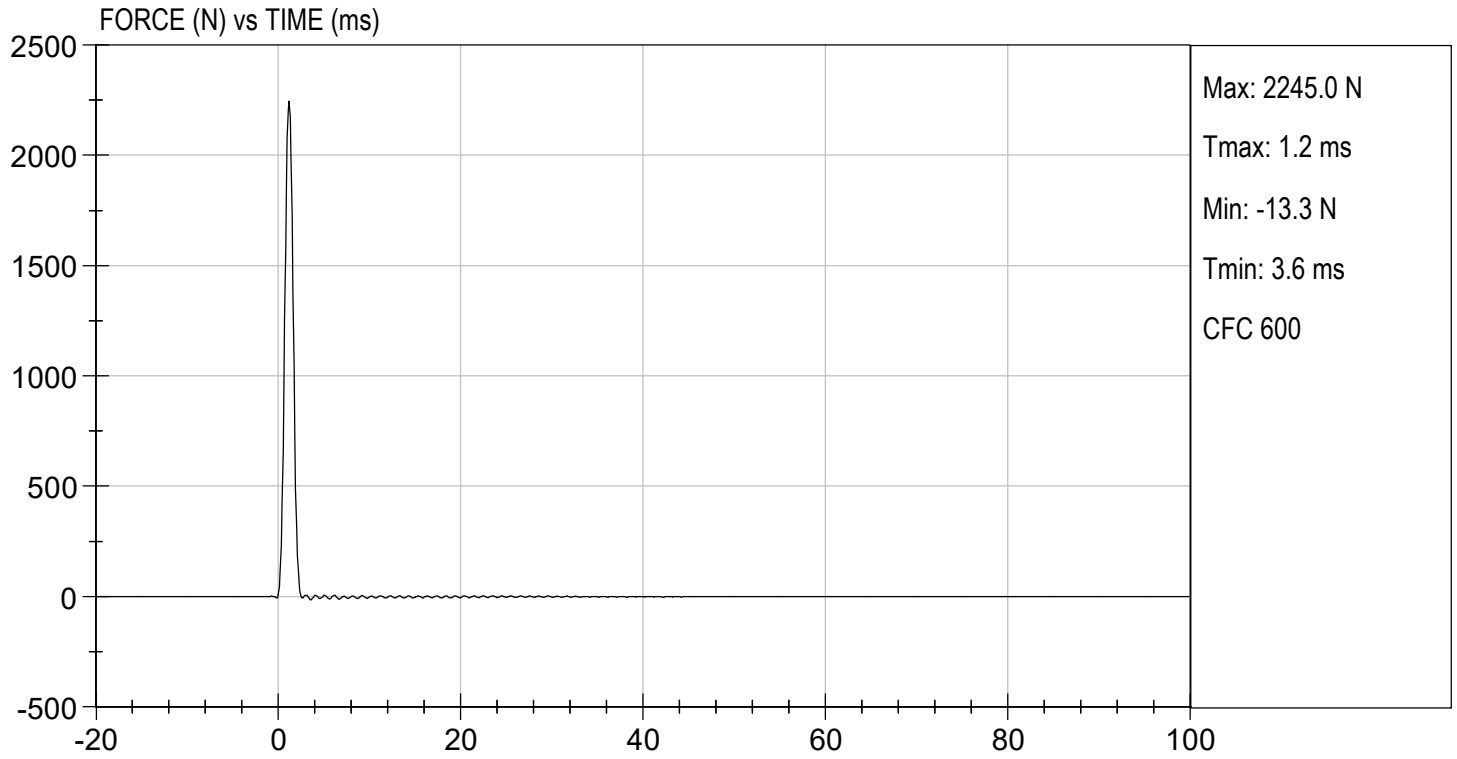
07/29/2019
Test Date


Approved By



TEST DESC: LEFT KNEE
VELOCITY: 6.83 ft/s, 2.08 m/s

TEST DATE: 07/29/2019
TEST #: D192356



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 6 YEAR OLD

ATD Serial No: 144

Test I.D: D192357

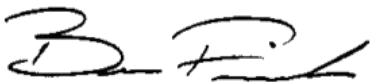
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Initial Angle	deg	0 to 22	16	Pass
Return Angle	deg	+/- 8	8	Pass
Force at 45 deg	N	147 to 200	166	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass



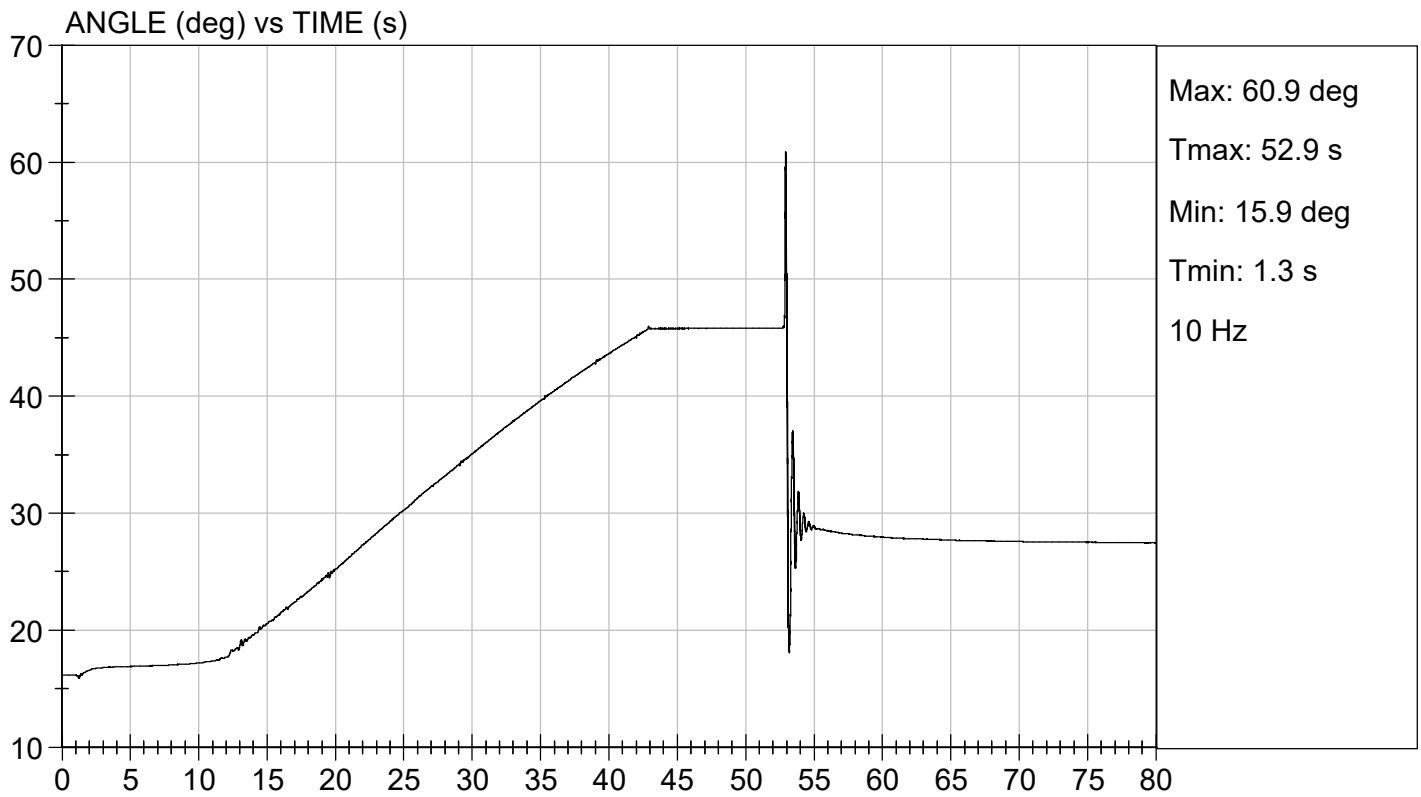
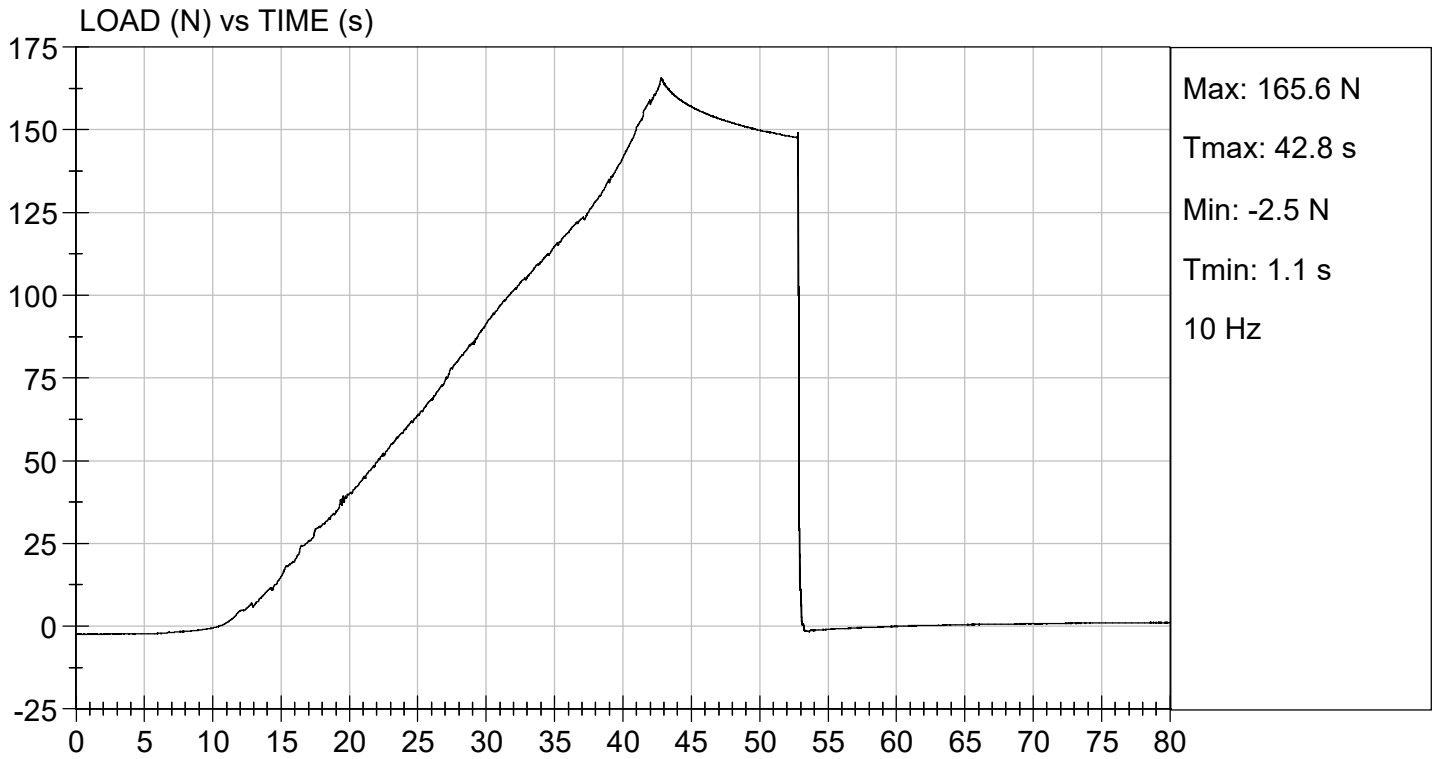
Laboratory Technician

07/29/2019

Test Date



Approved By



APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation

		HIII 3-Year-Old S/N 082		
		Serial Number	Manufacturer	Calibration Date
Head CG Accelerometers	X	P95623	Endevco	07/08/19
	Y	P95633	Endevco	07/08/19
	Z	P95637	Endevco	07/08/19
Upper Neck Load Cell		NG124	FTSS	08/02/18
Lower Neck Load Cell		NG249	Denton	08/02/18
Chest Accelerometers	X	T16901	Endevco	07/08/19
	Y	T17553	Endevco	07/08/19
	Z	T17554	Endevco	07/08/19
Chest Potentiometer		082	Servo	07/15/19
Upper Sternum Accelerometer	X	P97420	Endevco	07/08/19
Lower Sternum Accelerometer	X	P85701	Endevco	07/08/19
Upper Spine Accelerometers	X	P79695	Endevco	07/08/19
	Y	P79776	Endevco	07/08/19
	Z	P82656	Endevco	07/08/19
Lower Spine Accelerometers	X	T17562	Endevco	07/08/19
	Y	T17567	Endevco	07/08/19
	Z	T17847	Endevco	07/08/19