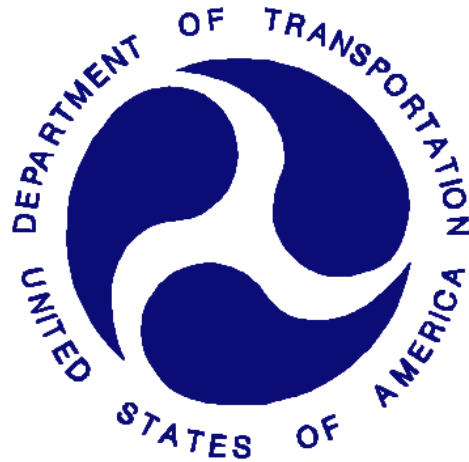


REPORT NUMBER: TWG-MGA-19-003

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

**FCA USA LLC
2019 Dodge Durango SXT 5-Door SUV
NHTSA No.: M20190302TWG2**

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



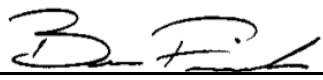
Test Date: July 18, 2019

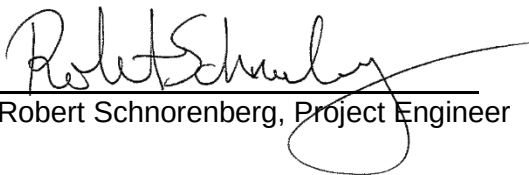
Final Report Date: June 29, 2020

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-19-003	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 Dodge Durango SXT 5-Door SUV, NHTSA No.: M20190302TWG2		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-19-003																															
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 18, 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 Dodge Durango SXT 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 18, 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>723</td><td>37</td></tr> <tr> <td>Nij</td><td></td><td>1</td><td>0.82</td></tr> <tr> <td>Neck Tension</td><td>N</td><td>1490</td><td>286</td></tr> <tr> <td>Neck Compression</td><td>N</td><td>1820</td><td>1356</td></tr> <tr> <td>Maximum Chest Displacement</td><td>mm</td><td></td><td></td></tr> <tr> <td>Maximum Chest Displacement Rate</td><td>m/s</td><td></td><td></td></tr> </tbody> </table>				Measurement Description	Units	Driver ATD (SID-IIs)		Threshold	Result	Head Injury Criteria (HIC ₁₅)		723	37	Nij		1	0.82	Neck Tension	N	1490	286	Neck Compression	N	1820	1356	Maximum Chest Displacement	mm			Maximum Chest Displacement Rate	m/s		
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17. Key Words Side Airbag Out-of-Position Technical Working Group OOP TWG HIII 6YO		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 78	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 Dodge Durango SXT 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 Dodge Durango SXT 5-Door SUV with an out-of-position Hybrid III 6-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on July 18, 2019. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three 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 Driver Door
- Front Through Windshield
- Left Side $\frac{3}{4}$ View Through Windshield

One Hybrid III 6-Year-Old child dummy (Serial Number 144) was placed in the right front passenger seat situated in the forward-facing position along the outboard edge of the seat per Section 3.3.3.5 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
- Upper Neck Load Cell
- Lower Neck Load Cell

The 18 channels of data were recorded using an off board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 6-Year-Old child dummy's visible contact points were as follows:

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

The Hybrid III 6-Year-Old child dummy was placed in the right front passenger seat. The dummy was seated on the outboard edge of a foam block aligning the upper spine with the deployment trajectory of the airbag. The head was placed between the seat bolster and pillar/side trim to minimize the fore-aft clearance between the neck and seatback. Legs were aligned such that they cross the heel placement points on the seat cushion. The dummy's pelvis was slid forward (parallel to the centerline of the vehicle) until the neck/torso junction was aligned vertically with the top edge of the airbag module. The dummy's outboard arm was raised to clear the vehicle armrest. The pelvis/torso of the dummy was in contact with the door.

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 3.3.3.5 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 Dodge Durango SXT 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
Test Date: 7/18/2019

TEST CONFIGURATION INFORMATION

Seating Position	P2	Right Front Seating Position
Test Section	3.3.3.5*	Forward-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 6-Year-Old	S/N: 144
Vehicle	Dodge	Durango
Previous Crash Test	Side MDB NCAP	November 2, 2018 – M20190302

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

EQUIPMENT INFORMATION

Number of Data Channels	18
Number of Airbag Channels	4
Number of High-Speed Video	3

VISIBLE DUMMY CONTACT POINTS

Head	Side curtain airbag to top of head
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 Dodge Durango SXT 5-Door SUV
 Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
 Test Date: 7/18/2019

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20190302	Traction Control System (TCS)	Yes
Model Year	2019	Auto-Leveling System	No
Make	Dodge	Automatic Door Locks (ADL)	Yes
Model	Durango SXT	Power Window Auto-Reverse	Yes
Body Style	5-Door SUV	Other Optional Feature	No
VIN	1C4RDHAG8KC550053	Driver Front Airbag	Yes
Body Color	Billet	Driver Curtain Airbag	Yes
Odometer Reading (km/mi)	11 km / 7 mi	Driver Head/Torso Airbag	No
Engine Displacement (L)	3.6 L	Driver Torso Airbag	No
Type/No. Cylinders	V6	Driver Torso/Pelvis Airbag	Yes
Engine Placement	Longitudinal	Driver Pelvis Airbag	No
Transmission Type	Automatic	Driver Knee Airbag	Yes
Transmission Speeds	8	Rear Pass. Curtain Airbag	Yes
Overdrive	Yes	Rear Pass. Head/Torso Airbag	No
Final Drive	RWD	Rear Pass. Torso Airbag	No
Roof Rack	No	Rear Pass. Torso/Pelvis Airbag	No
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	No
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	FCA USA LLC	GVWR (kg)	2949
Date of Manufacture	09/18	GAWR Front (kg)	1452
Vehicle Type	MPV	GAWR Rear (kg)	1770

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3	2	7	
Capacity Weight (VCW) (kg)				544	(A)
DSC x 68.04 kg				476	(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			X		X		

DATA SHEET NO. 3
SEAT ADJUSTMENT DATA

Test Vehicle: 2019 Dodge Durango SXT 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
Test Date: 7/18/2019

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	280	42	0	0
Right Rear Passenger Seat				
Seat Fore/Aft Position per TWG Guidelines	Initial Position: Rearmost and lowest adjustment			
	Seat Track Adjustments: Allowed to ensure proper alignment of the ATD upper spine 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	64.2	30	13.7	
Right Rear Passenger Seat				
OEM Back Angle Design Position	14.0° rearward of vertical			
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	Fixed		Fixed	
Right Rear Passenger Seat				
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 Dodge Durango SXT 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
Test Date: 7/18/2019

ATD Type	Hybrid III 6-Year-Old child dummy
Serial Number	144
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 Dodge Durango SXT 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
Test Date: 7/18/2019

RECORDED DATA – MINIMUMS AND MAXIMUMS

Channel	Unit	CFC	Maximum	Time (ms)	Minimum	Time (ms)
Passenger Head X	g	1000	39.0	10.8	-22.6	254.9
Passenger Head Y			14.0	253.1	-55.1	11.1
Passenger Head Z			98.6	11.0	-15.4	8.7
Passenger Upper Neck Fx	N	1000	368.3	264.2	-80.2	28.2
Passenger Upper Neck Fy			100.7	22.2	-264.5	11.5
Passenger Upper Neck Fz			285.8	109.4	-1355.8	261.3
Passenger Upper Neck Mx	Nm	600	18.0	11.4	-28.4	22.4
Passenger Upper Neck My			40.0	264.1	-27.8	29.6
Passenger Upper Neck Mz			3.9	95.2	-11.2	38.9
Passenger Lower Neck Fx	N	1000	296.2	6.0	-253.2	265.1
Passenger Lower Neck Fy			209.1	6.1	-213.9	5.7
Passenger Lower Neck Fz			316.4	110.0	-1218.7	261.3
Passenger Lower Neck Mx	Nm	600	13.5	98.5	-38.4	12.3
Passenger Lower Neck My			27.1	259.2	-32.9	11.0
Passenger Lower Neck Mz			5.2	23.7	-31.7	9.0

HEAD INJURY SUMMARY

HIC ₁₅	T ₁ (ms)	T ₂ (ms)	HIC ₃₆	T ₁ (ms)	T ₂ (ms)
37	10.7	11.6	37	10.7	11.6

NECK INJURY SUMMARY

Injury Criteria	Unit	Value	Time (ms)
Upper Neck NTF		0.11	127.5
Upper Neck NTE		0.45	49.8
Upper Neck NCF		0.82	262.7
Upper Neck NCE		0.78	30.5
Peak Tension	N	286	109.4
Peak Compression	N	1356	261.3

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

Test Vehicle: 2019 Dodge Durango SXT 5-Door SUV
 Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
 Test Date: 7/18/2019

CHEST INJURY SUMMARY

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

¹Deflection rate is calculated based on Chest Deflection potentiometer.

RESEARCH VALUE SUMMARY

Research Injury Criteria ¹	Unit	Value	Time (ms)
Upper Neck Lateral Moment	Nm	28.4	22.4
Upper Neck Twist Moment	Nm	11.2	38.9
Lower Neck Flexion Moment	Nm	40.0	264.1
Lower Neck Extension Moment	Nm	27.8	29.6
Lower Neck Lateral Moment	Nm	38.4	12.3
Lower Neck Twist Moment	Nm	31.7	9.0
Lower Neck Tension	N	316.4	110.0
Lower Neck Compression	N	1218.7	261.3
Spine Acceleration	g		

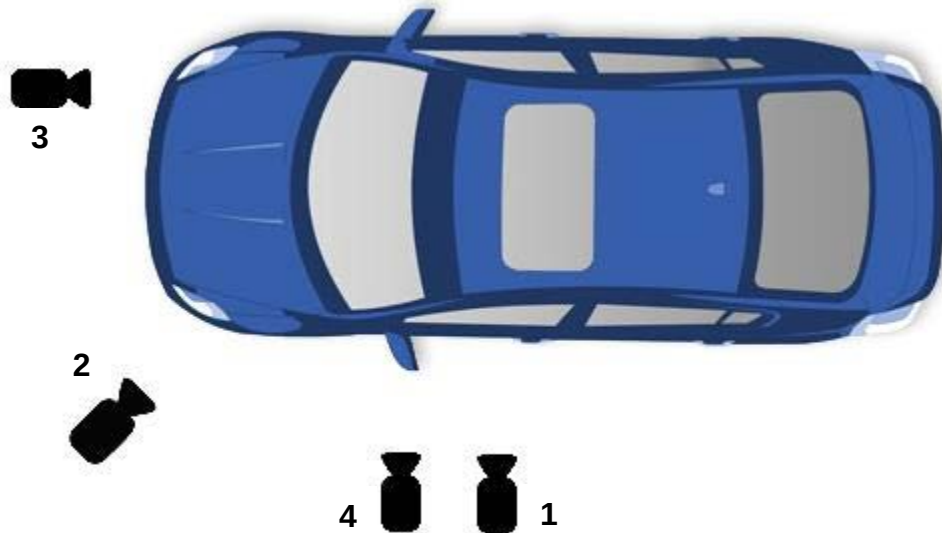
¹These injury criteria are only monitored and not considered pass/fail.

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

Test Vehicle: 2019 Dodge Durango SXT 5-Door SUV
Test Program: NCAP Side Airbag Out-of-Position

NHTSA No.: M20190302TWG2
Test Date: 7/18/2019

CAMERA SETUP DIAGRAM FOR OOP TESTS



CAMERA LOCATIONS

No.	Camera View	Location			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Left View	370	-2178	-1338	24	2700
2	Oblique View	1724	-2010	-1897	24	2700
3	Front View	2237	351	-2164	24	2700
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

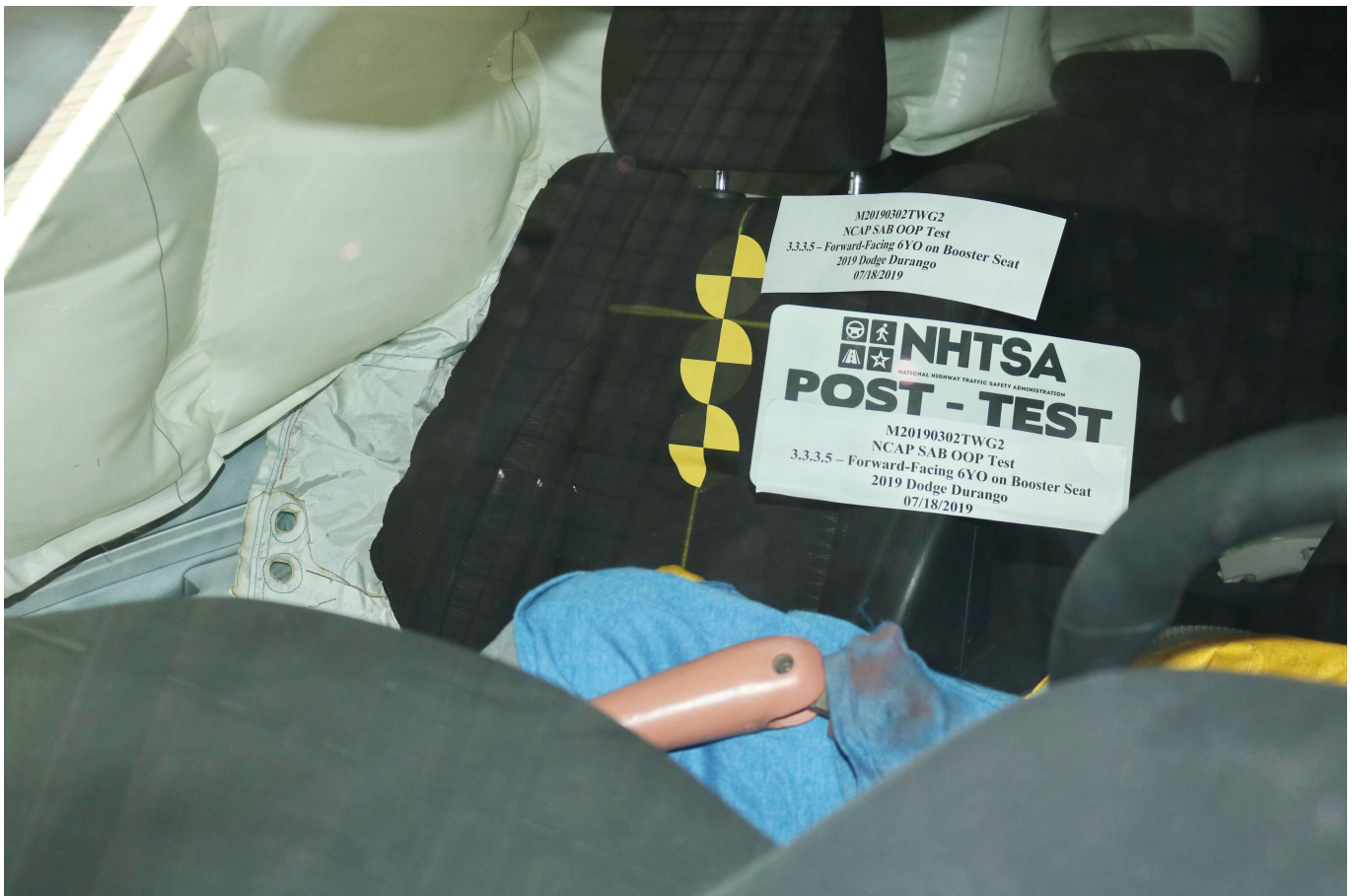


Photo No. 016 - Post-Test Dummy Left Three-Quarter Front Close-up View



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



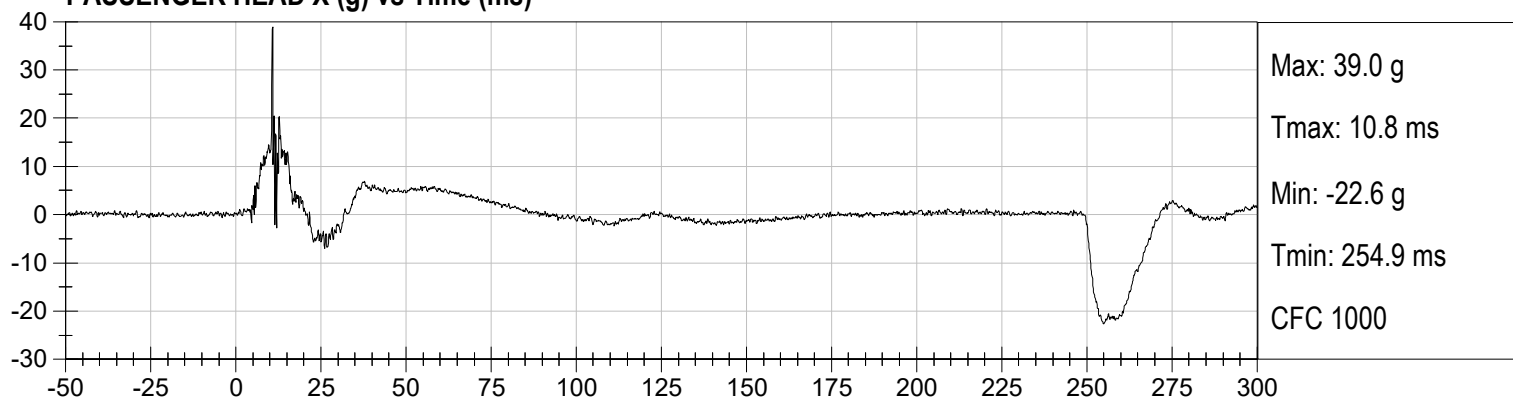
Photo No. 029 - Post-Test Curtain Air Bag Right Side View (Door Open)

APPENDIX B
DUMMY RESPONSE DATA TRACES

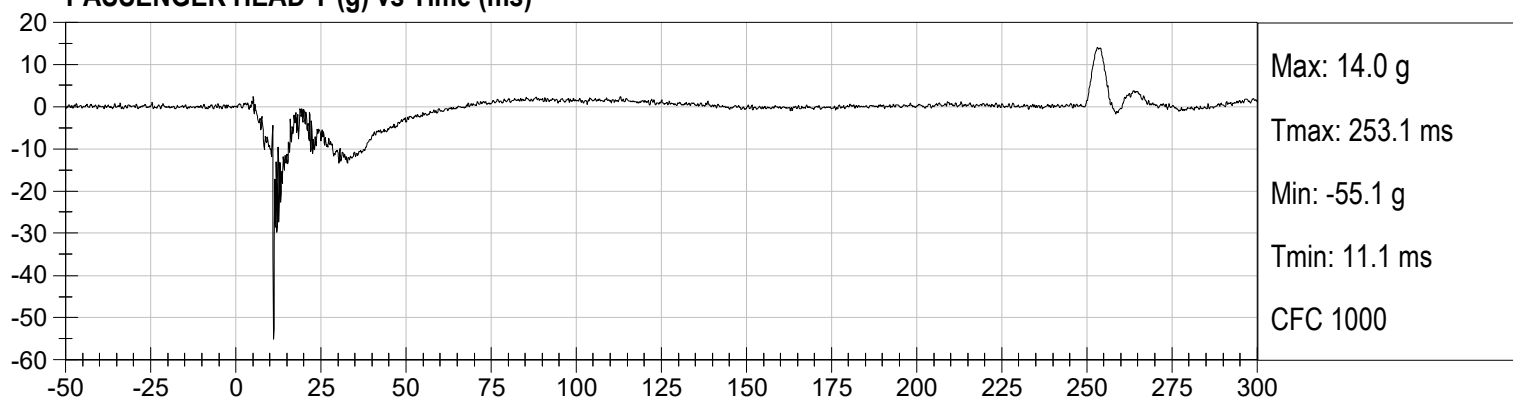
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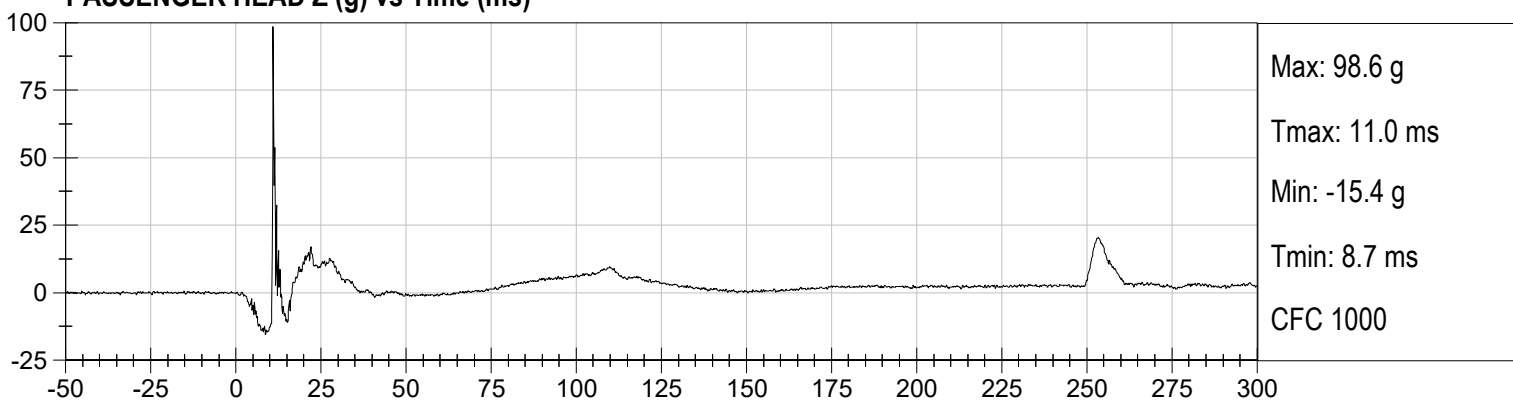
PASSENGER HEAD X (g) vs Time (ms)



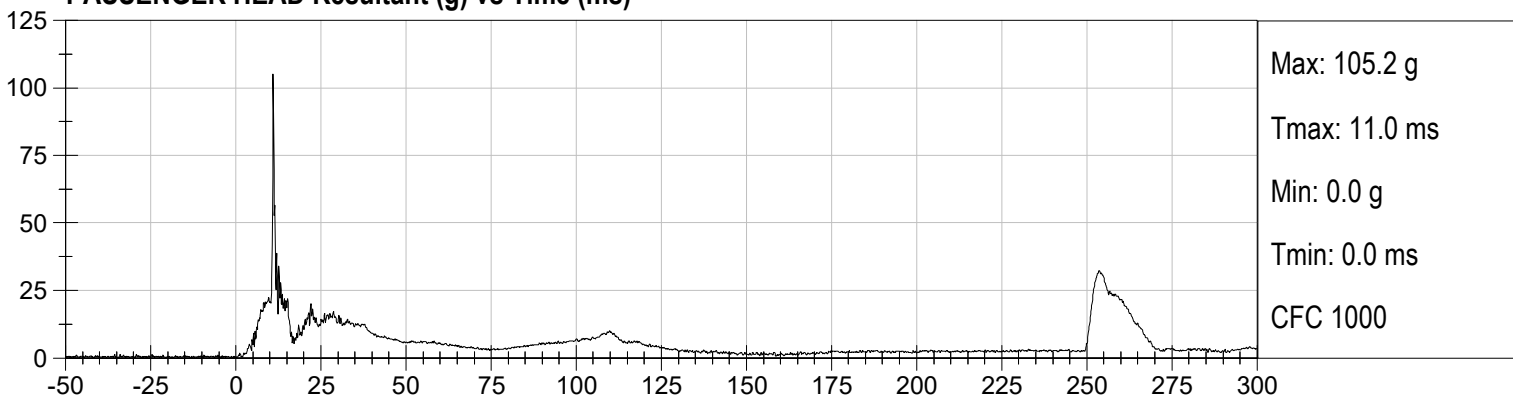
PASSENGER HEAD Y (g) vs Time (ms)



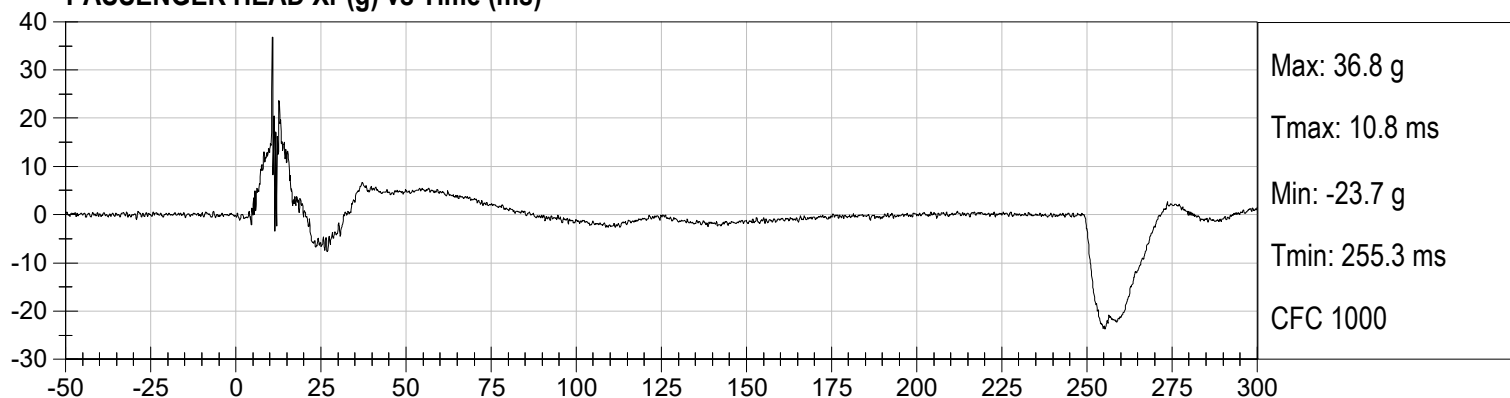
PASSENGER HEAD Z (g) vs Time (ms)



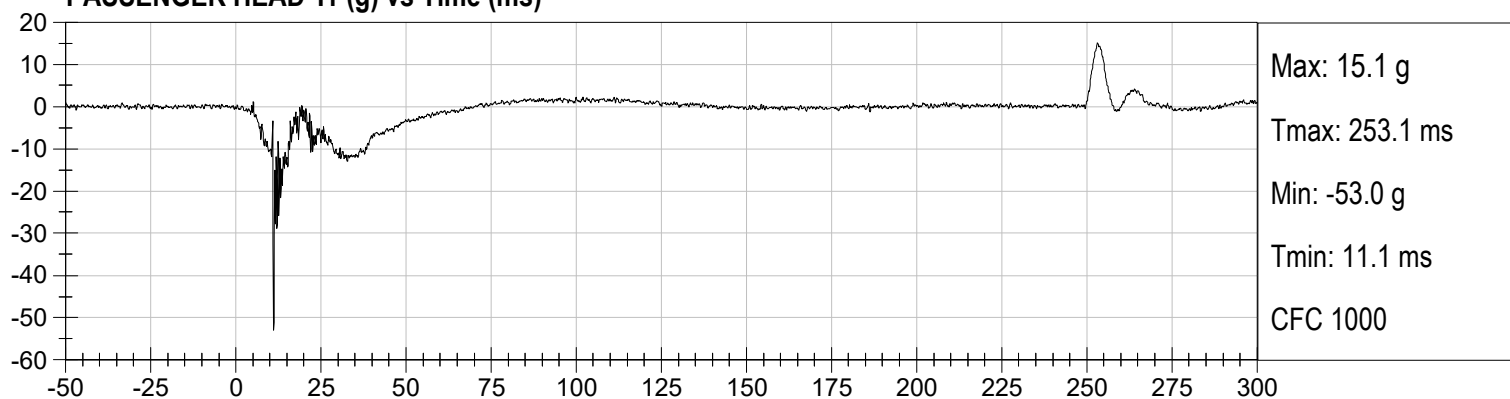
PASSENGER HEAD Resultant (g) vs Time (ms)



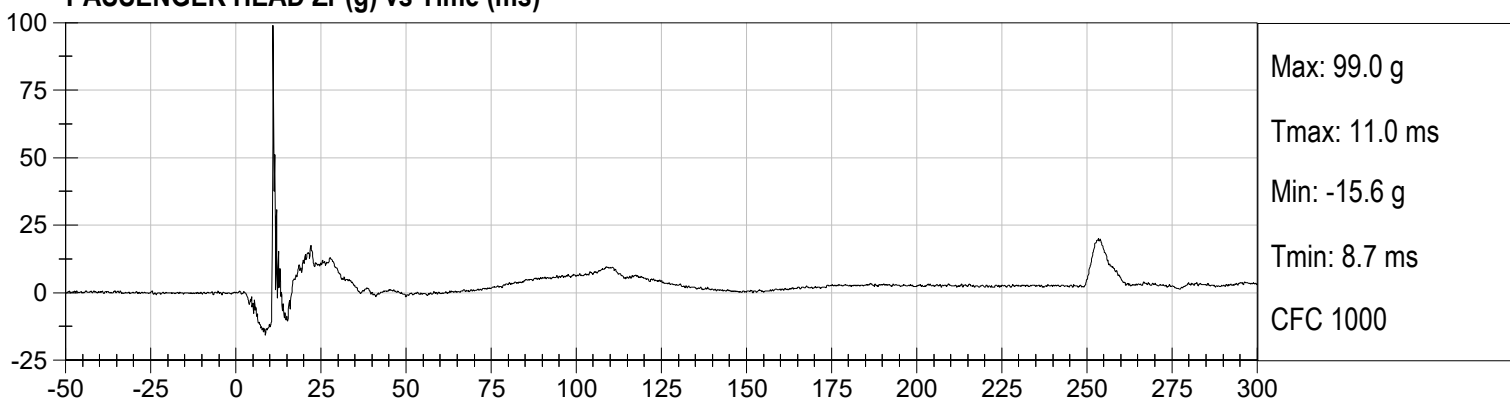
PASSENGER HEAD Xr (g) vs Time (ms)



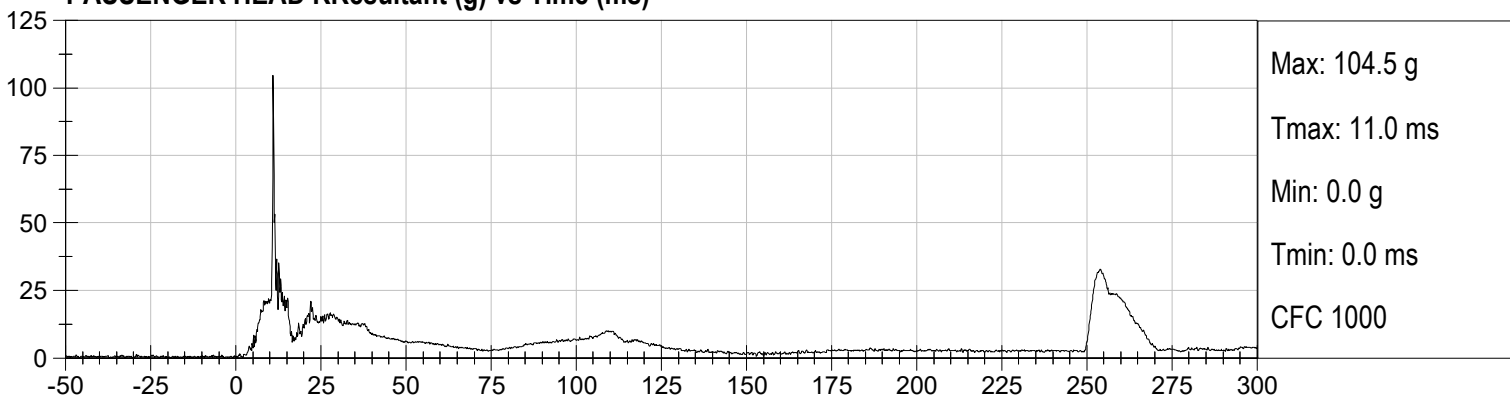
PASSENGER HEAD Yr (g) vs Time (ms)



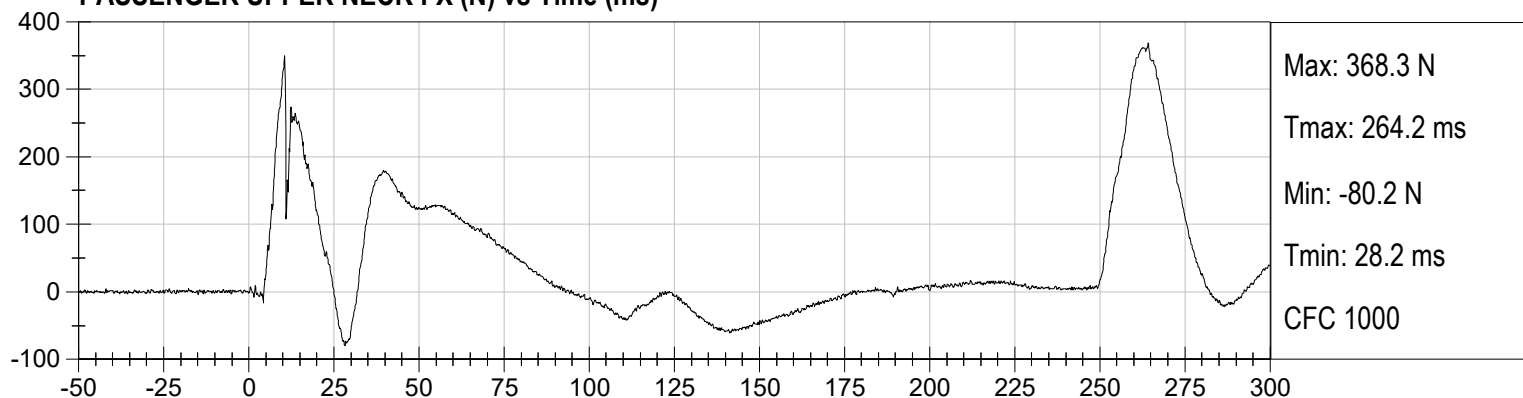
PASSENGER HEAD Zr (g) vs Time (ms)



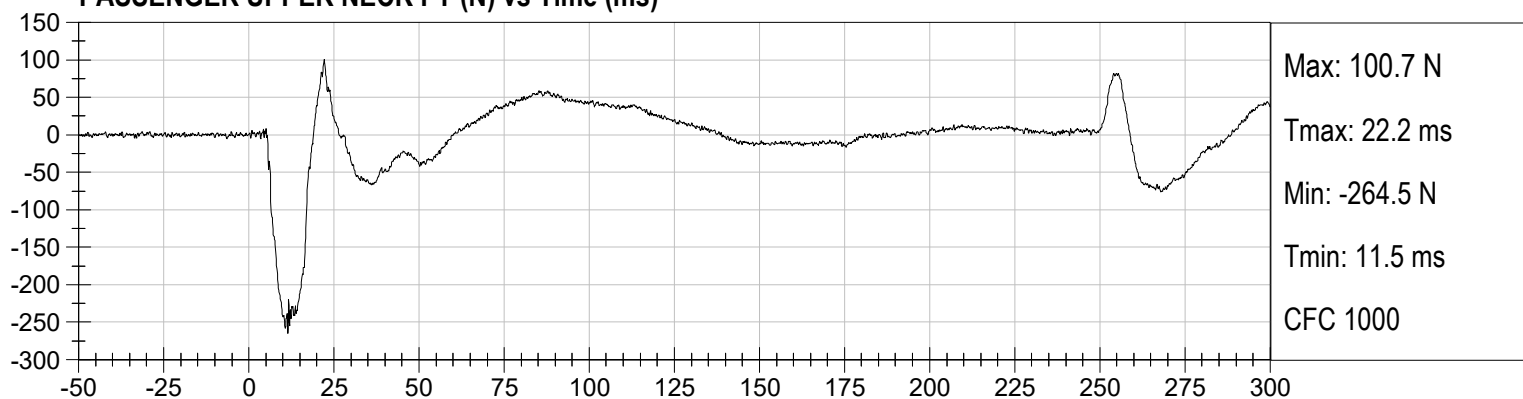
PASSENGER HEAD RResultant (g) vs Time (ms)



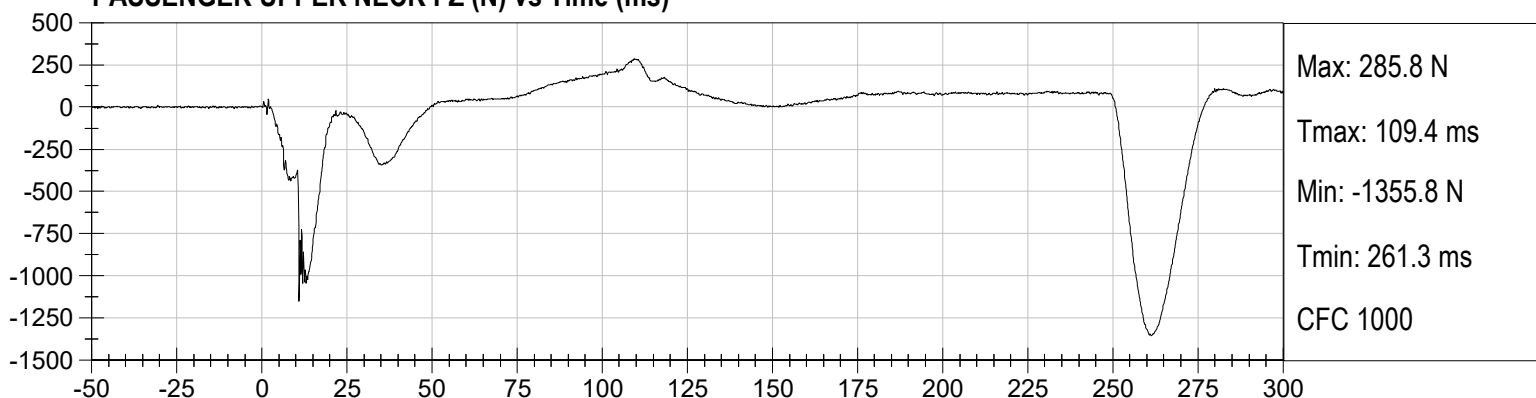
PASSENGER UPPER NECK FX (N) vs Time (ms)



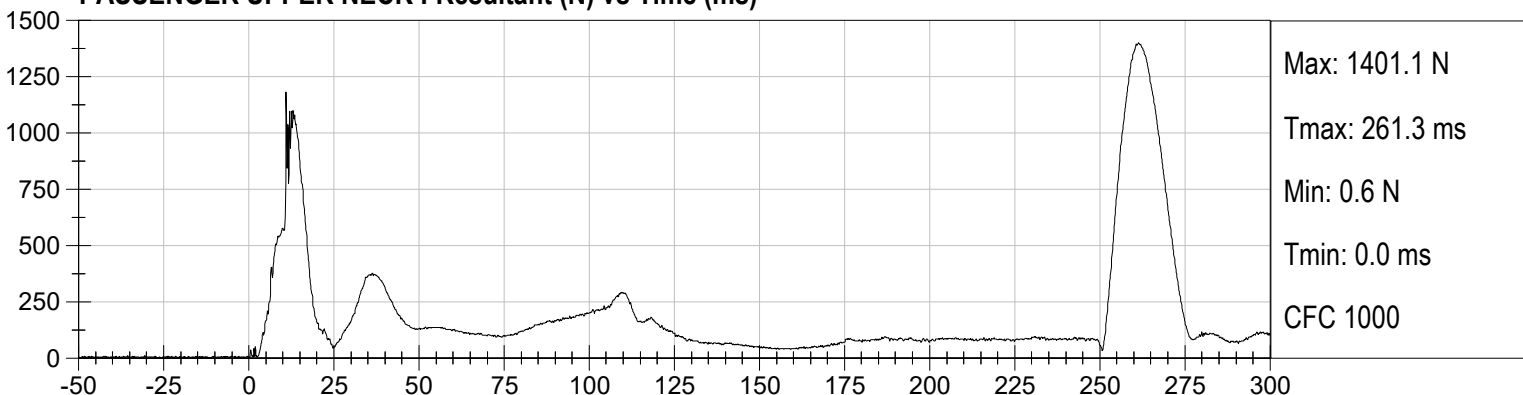
PASSENGER UPPER NECK FY (N) vs Time (ms)



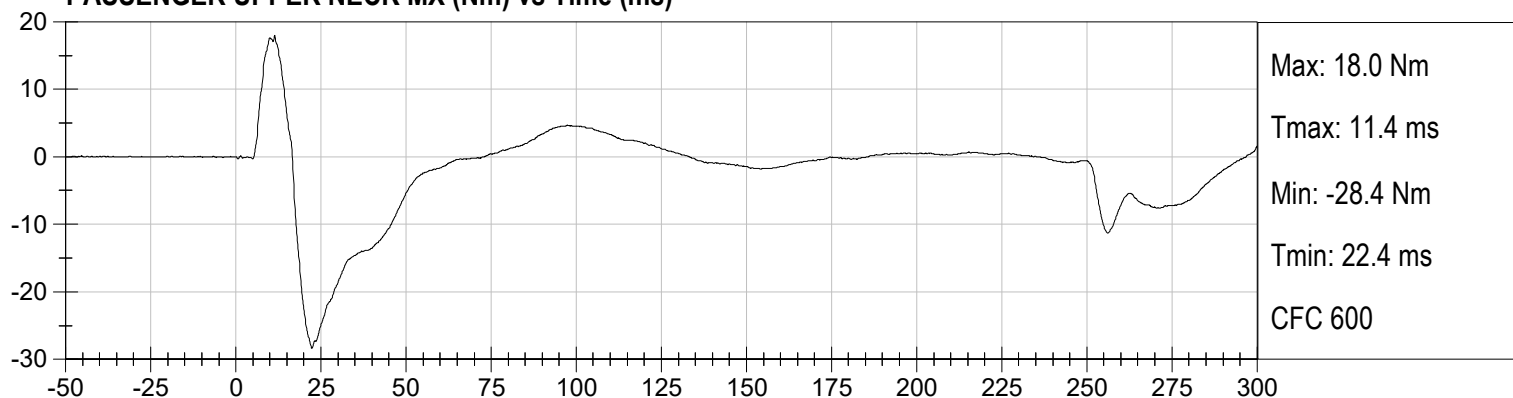
PASSENGER UPPER NECK FZ (N) vs Time (ms)



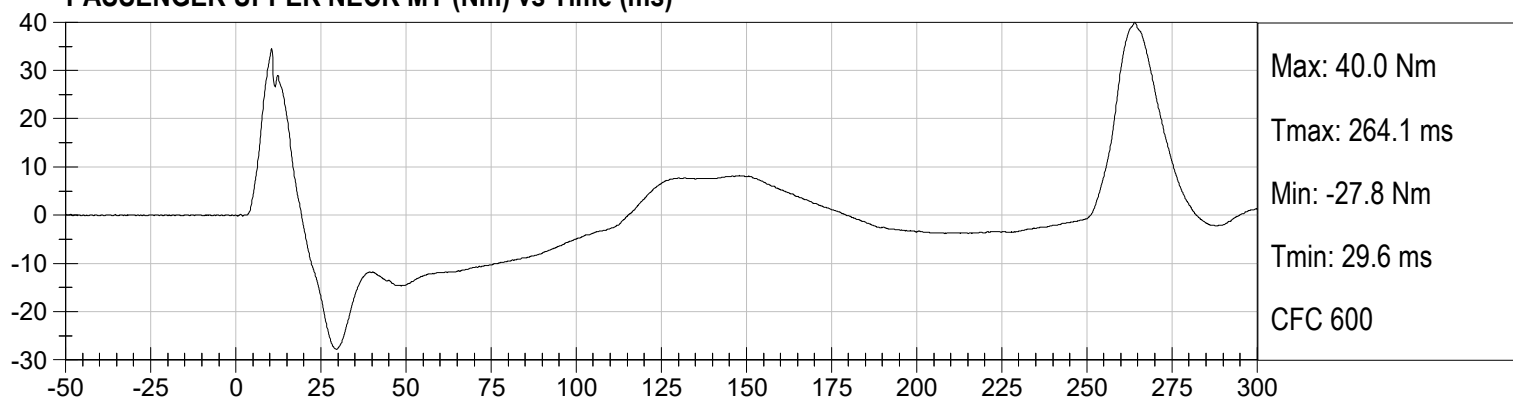
PASSENGER UPPER NECK FResultant (N) vs Time (ms)



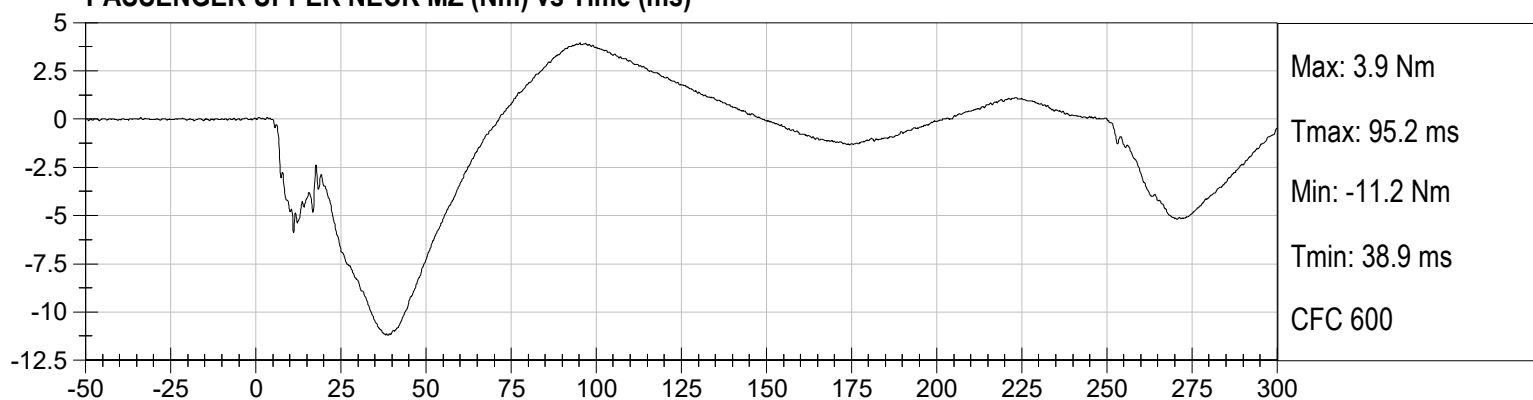
PASSENGER UPPER NECK MX (Nm) vs Time (ms)



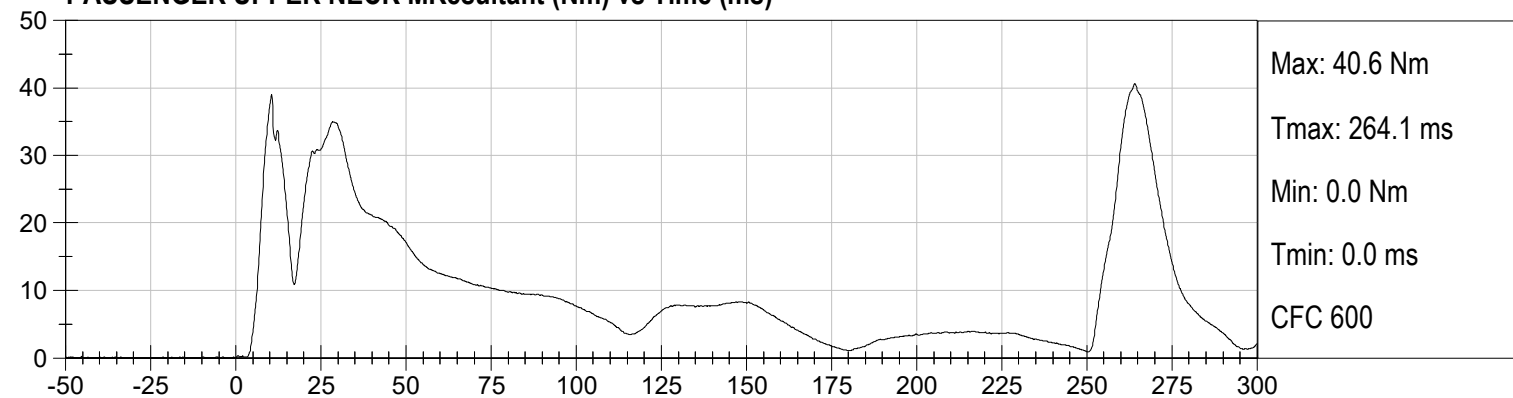
PASSENGER UPPER NECK MY (Nm) vs Time (ms)



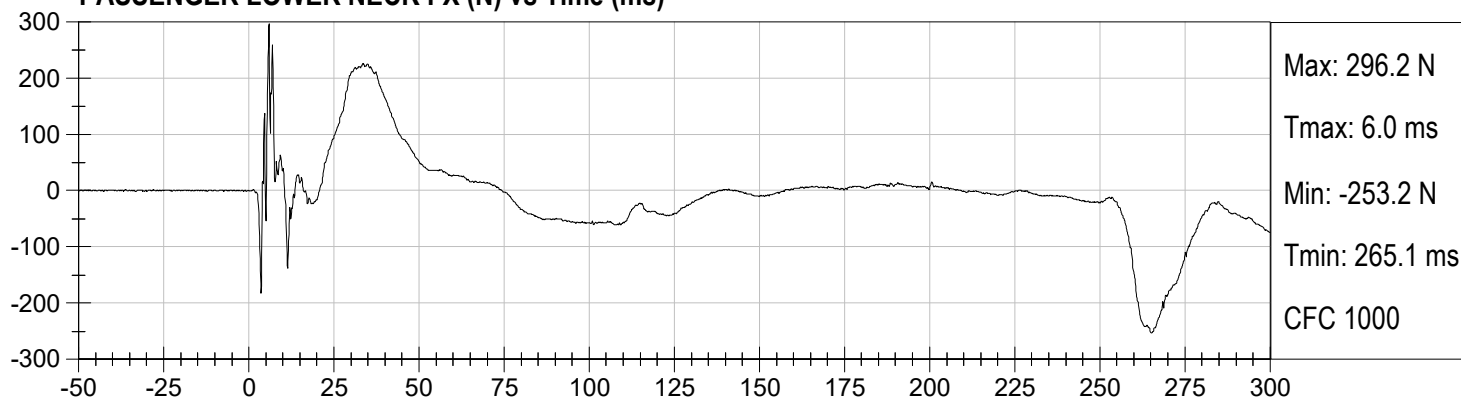
PASSENGER UPPER NECK MZ (Nm) vs Time (ms)



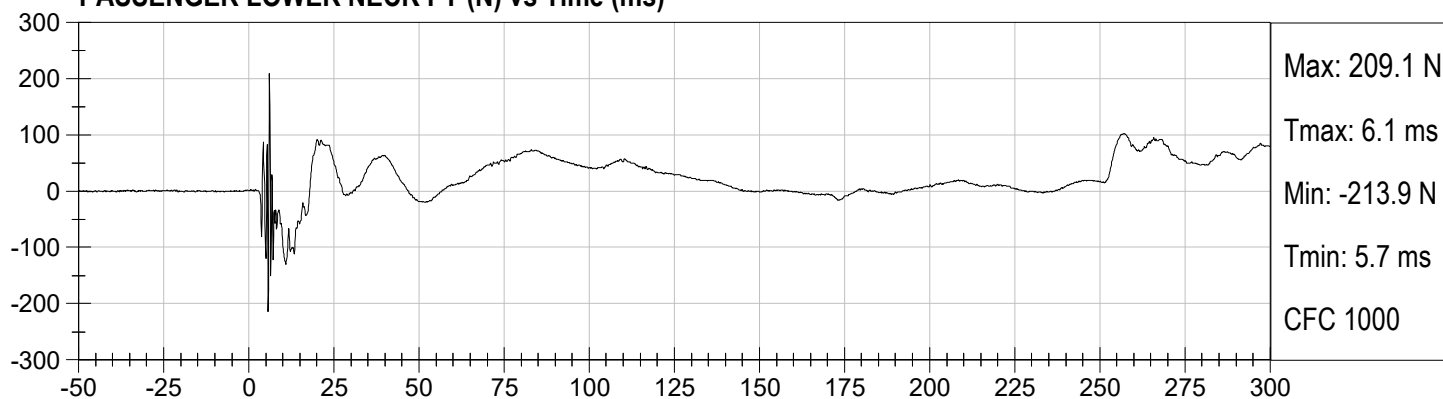
PASSENGER UPPER NECK MResultant (Nm) vs Time (ms)



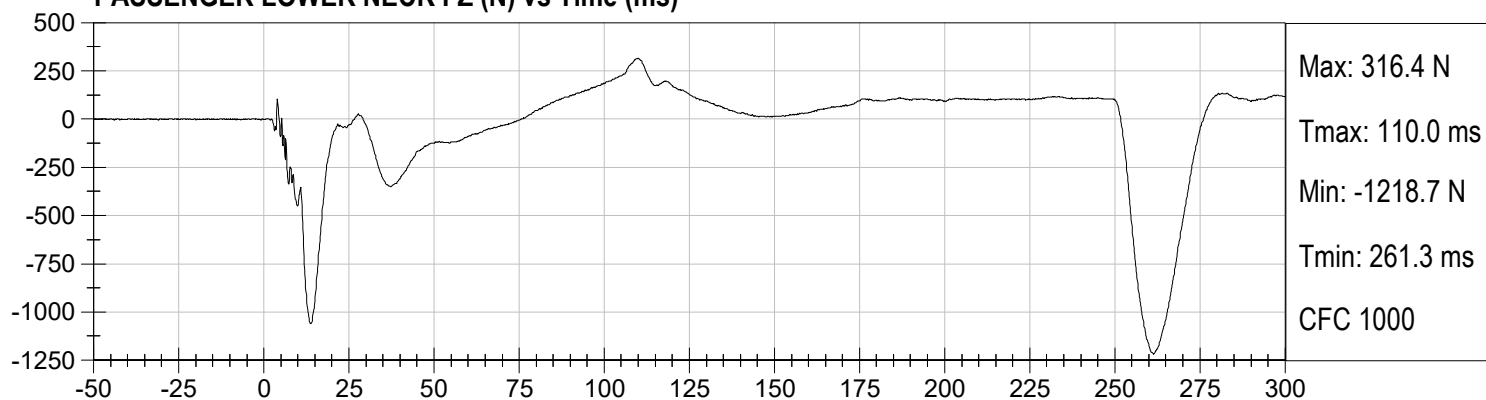
PASSENGER LOWER NECK FX (N) vs Time (ms)



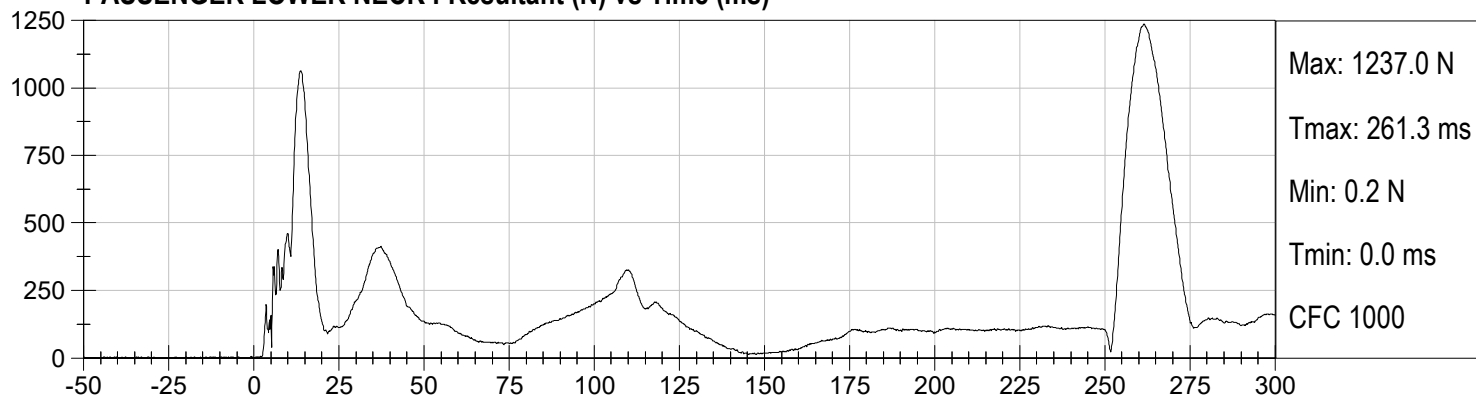
PASSENGER LOWER NECK FY (N) vs Time (ms)



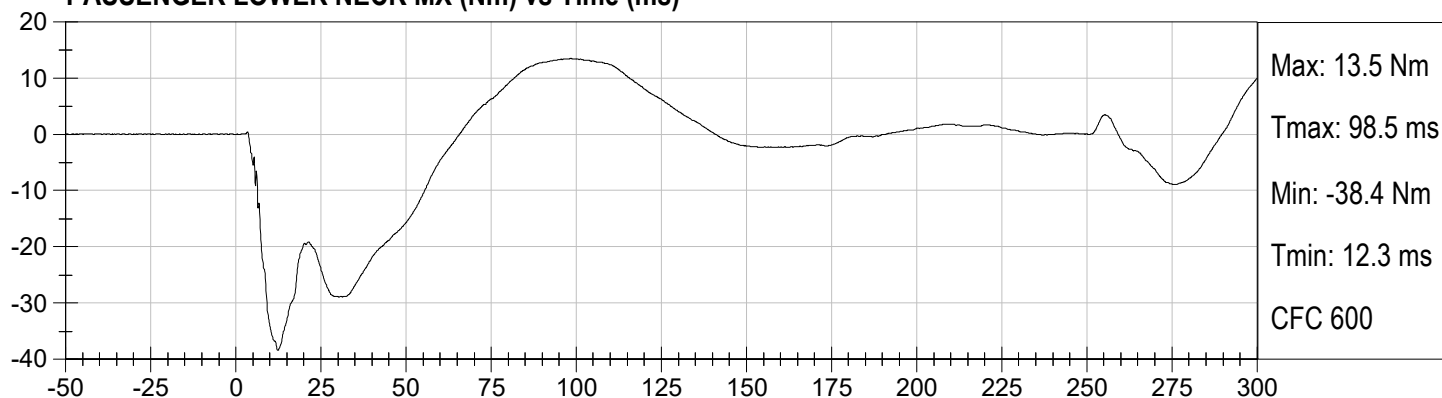
PASSENGER LOWER NECK FZ (N) vs Time (ms)



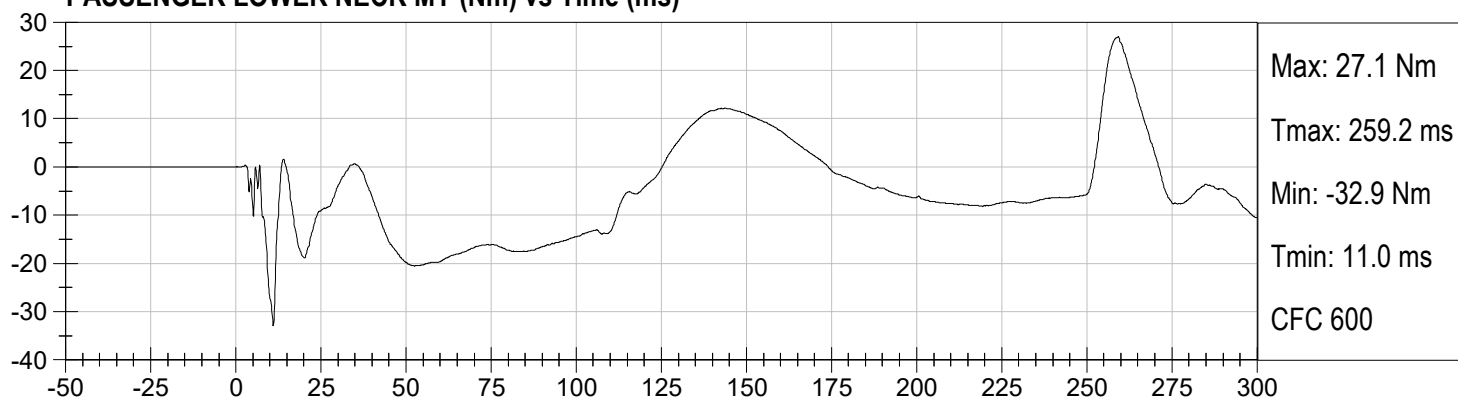
PASSENGER LOWER NECK FResultant (N) vs Time (ms)



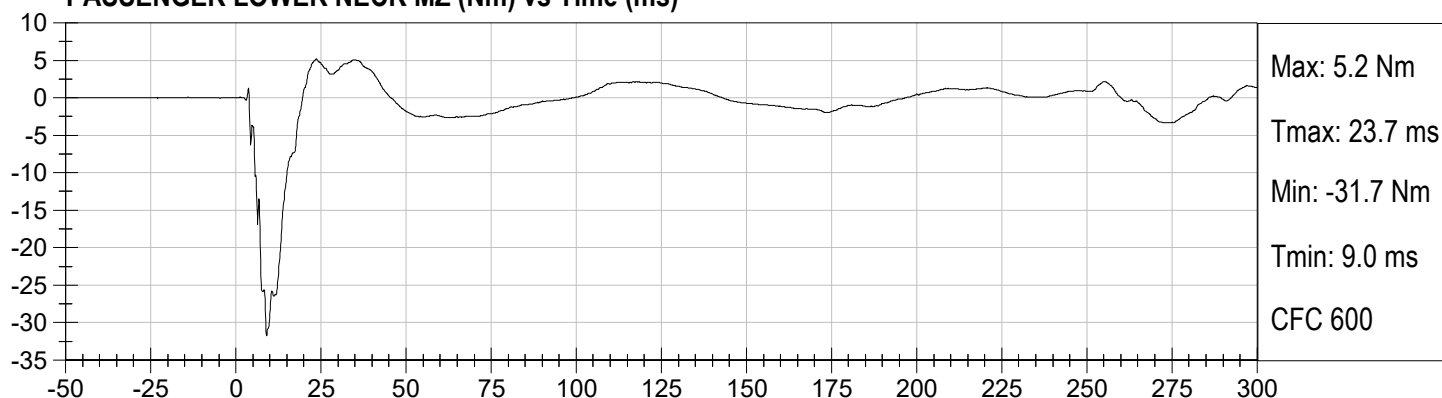
PASSENGER LOWER NECK MX (Nm) vs Time (ms)



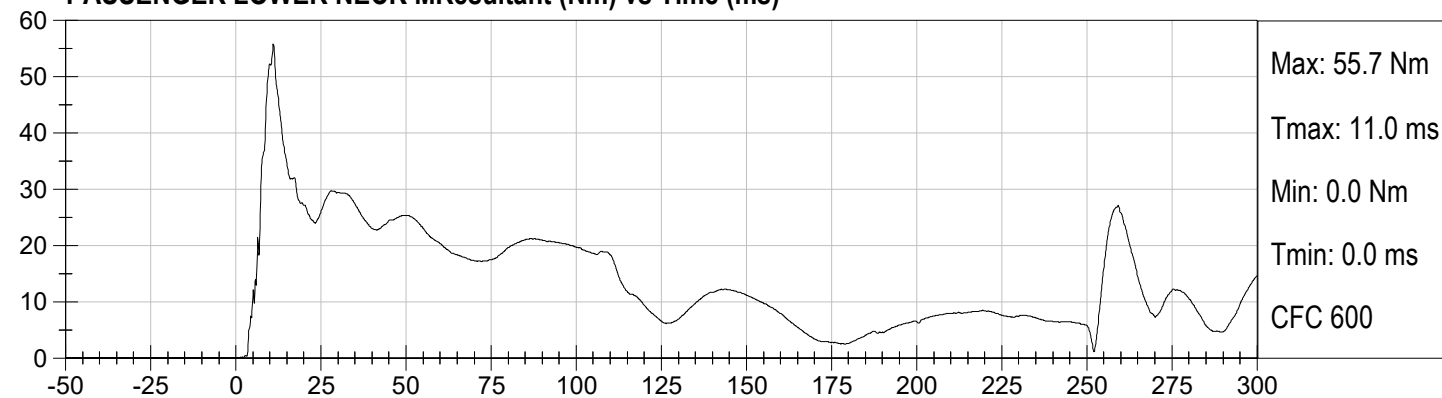
PASSENGER LOWER NECK MY (Nm) vs Time (ms)



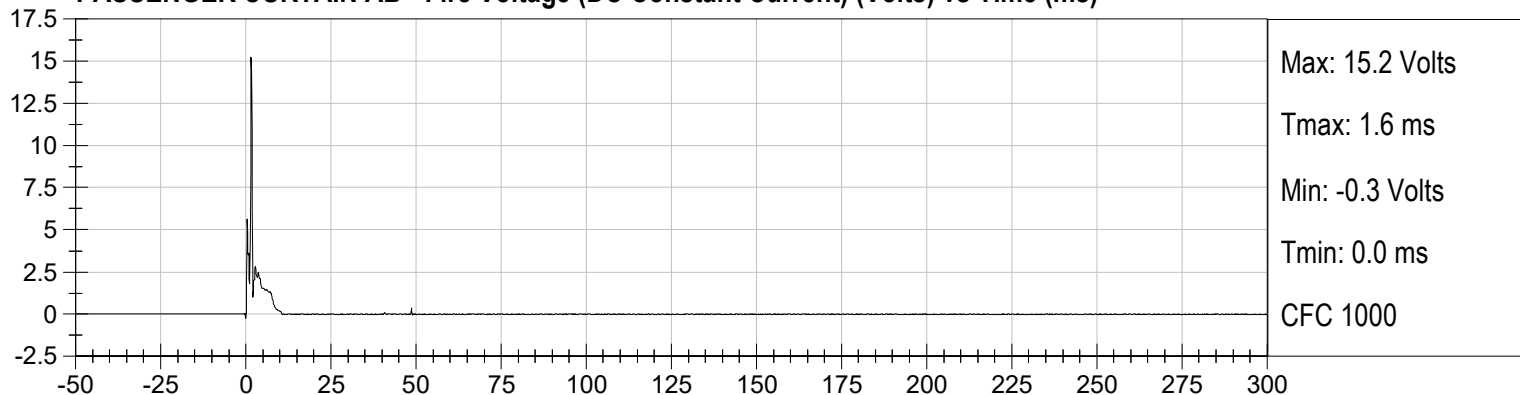
PASSENGER LOWER NECK MZ (Nm) vs Time (ms)



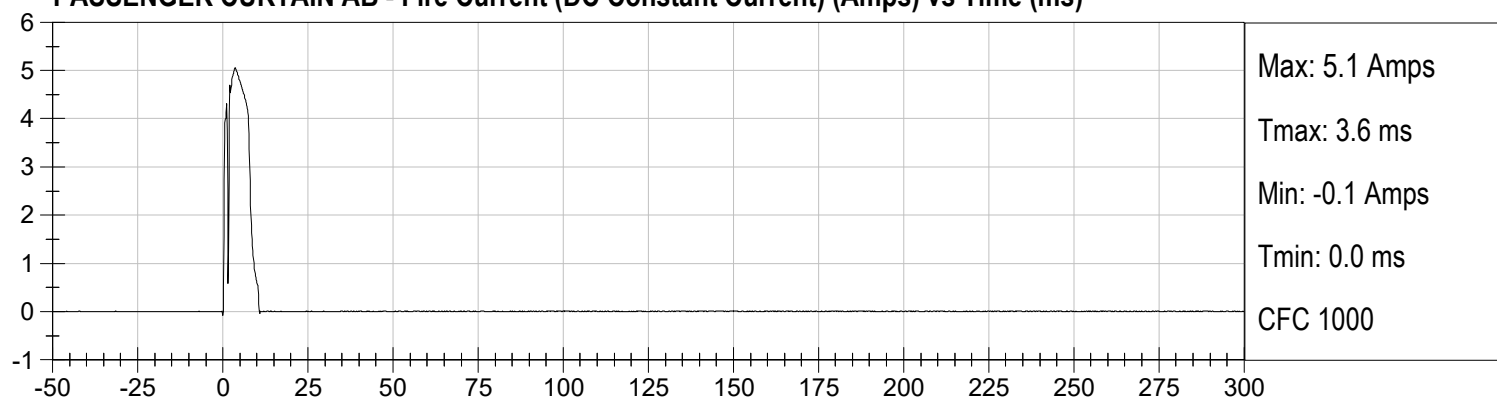
PASSENGER LOWER NECK MResultant (Nm) vs Time (ms)



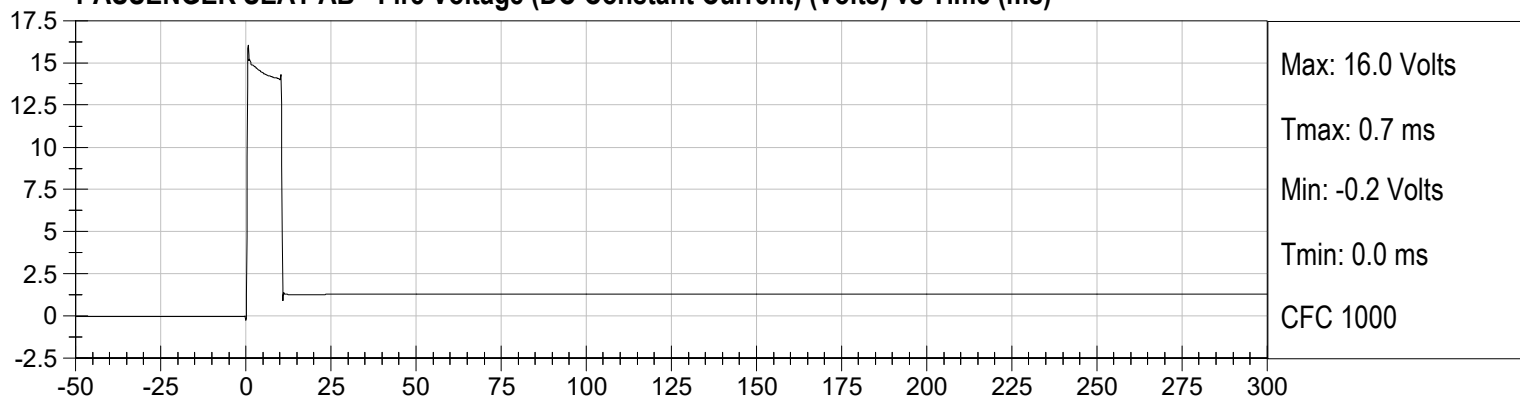
PASSENGER CURTAIN AB - Fire Voltage (DC Constant Current) (Volts) vs Time (ms)



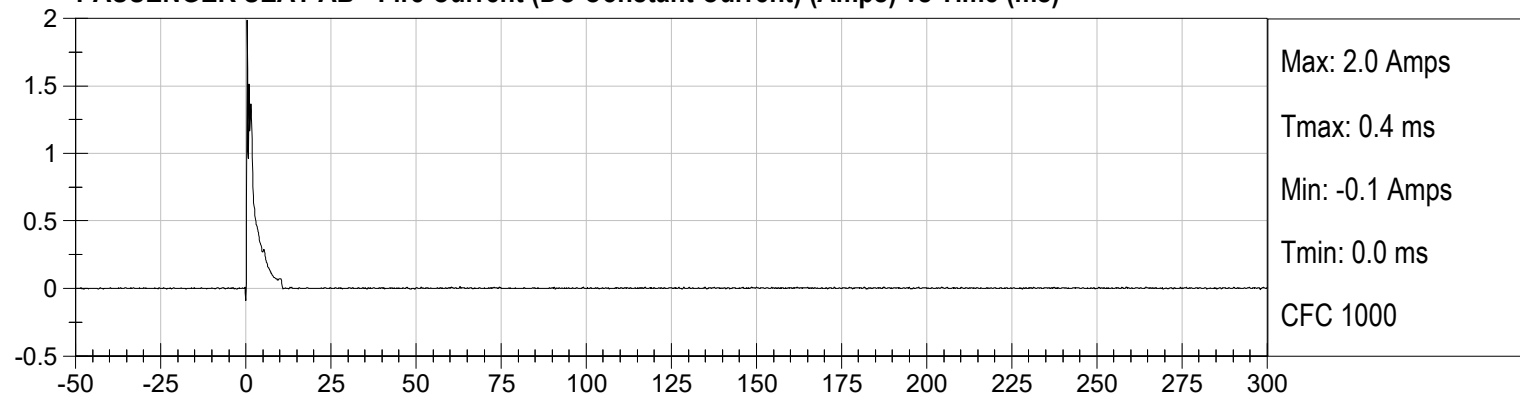
PASSENGER CURTAIN AB - Fire Current (DC Constant Current) (Amps) vs Time (ms)



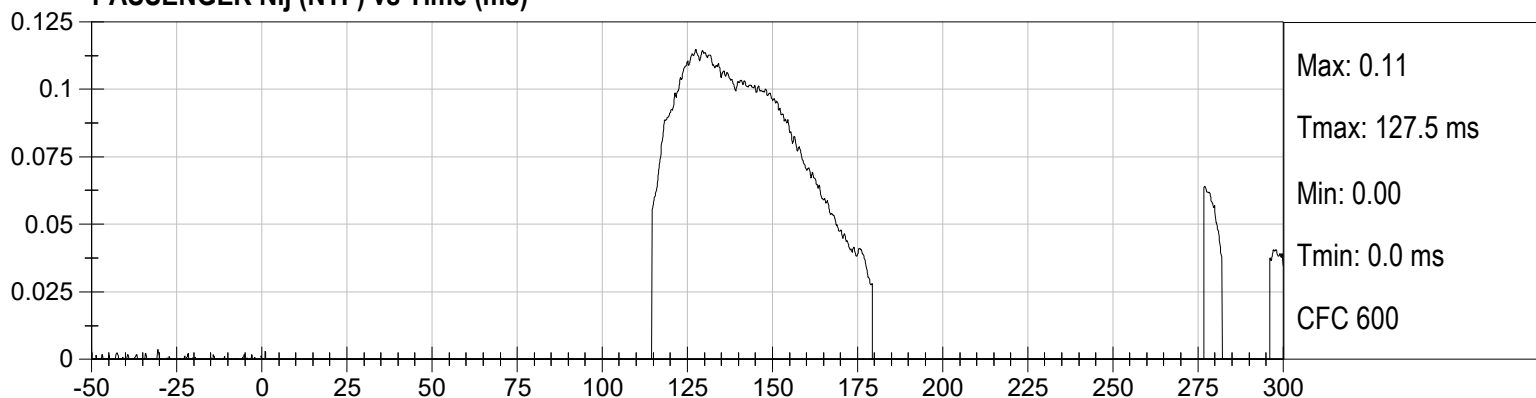
PASSENGER SEAT AB - Fire Voltage (DC Constant Current) (Volts) vs Time (ms)



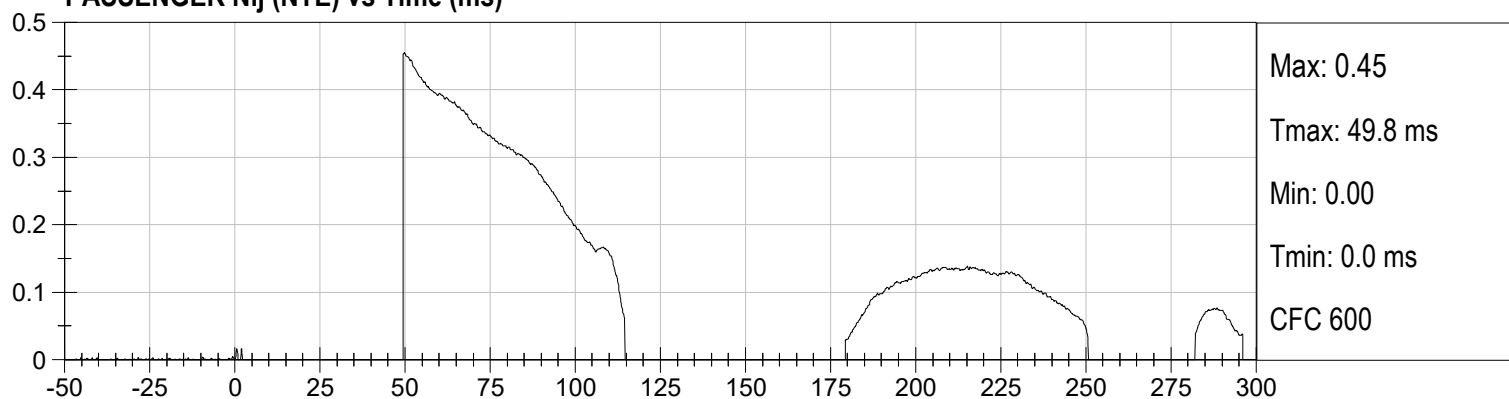
PASSENGER SEAT AB - Fire Current (DC Constant Current) (Amps) vs Time (ms)



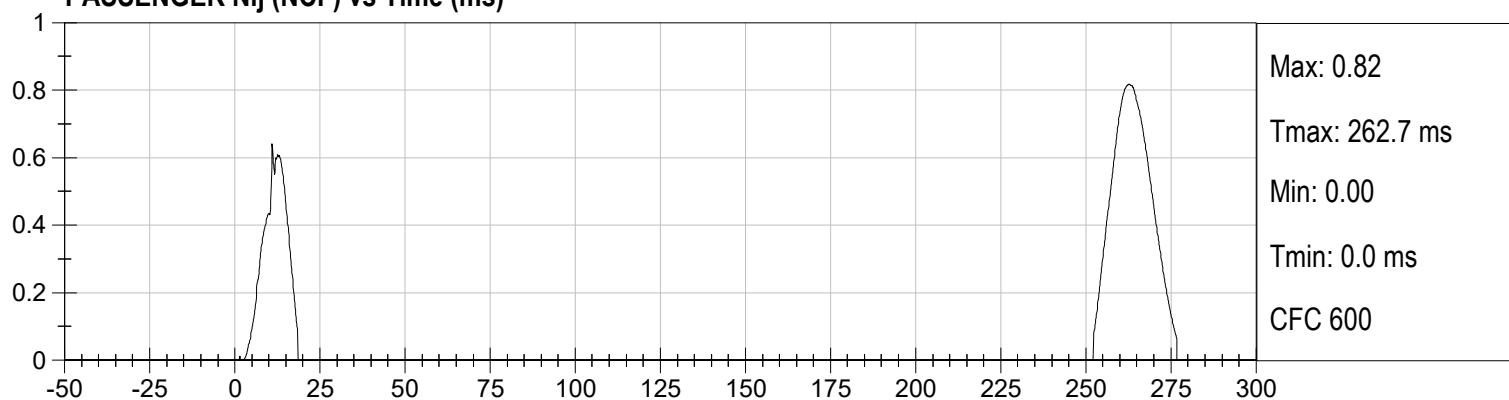
PASSENGER Nij (NTF) vs Time (ms)



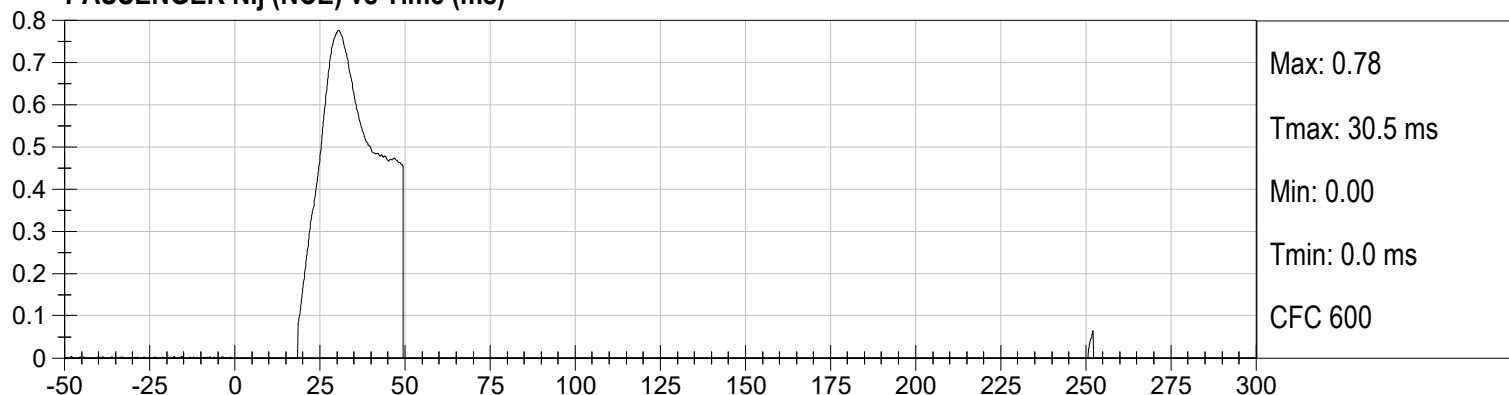
PASSENGER Nij (NTE) vs Time (ms)



PASSENGER Nij (NCF) vs Time (ms)



PASSENGER 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

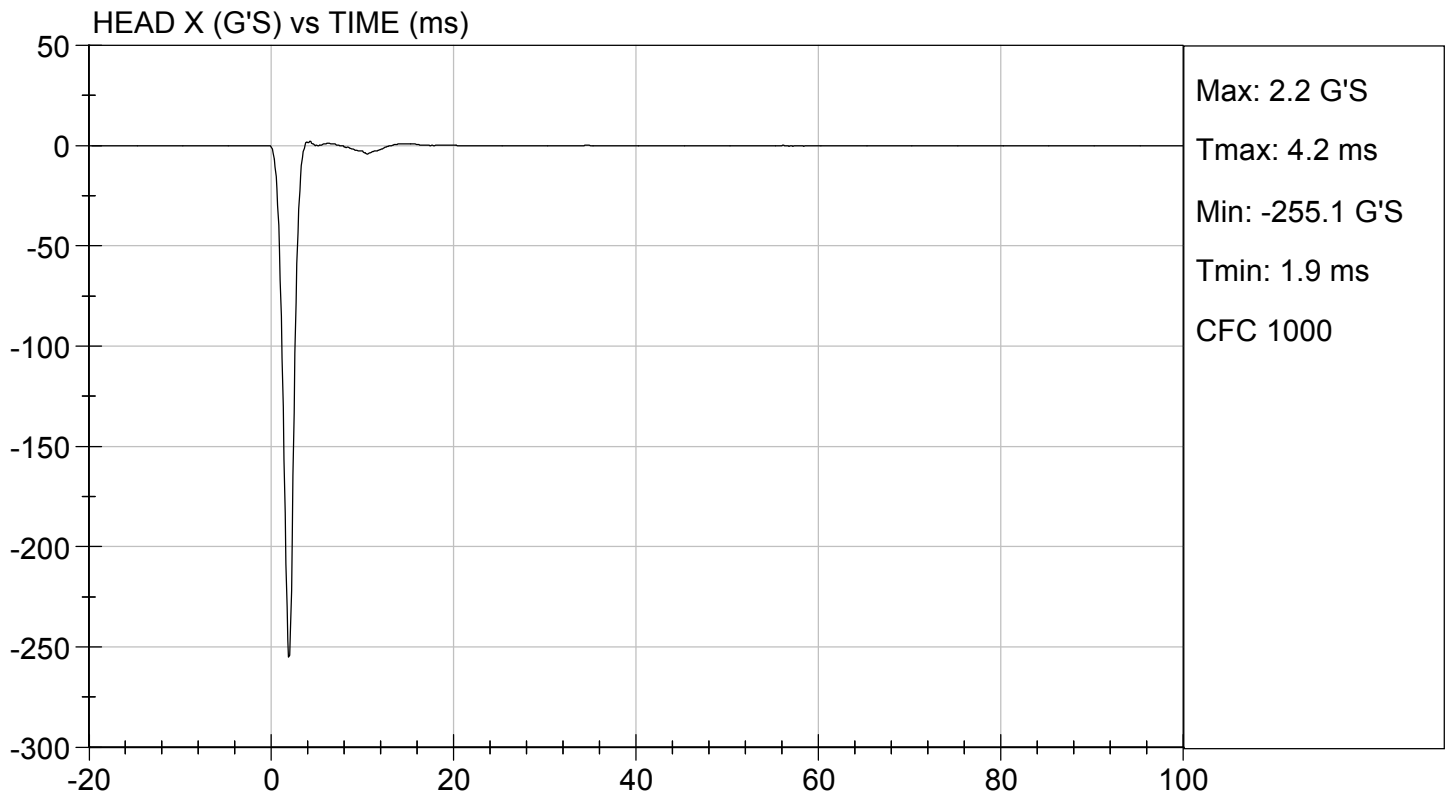
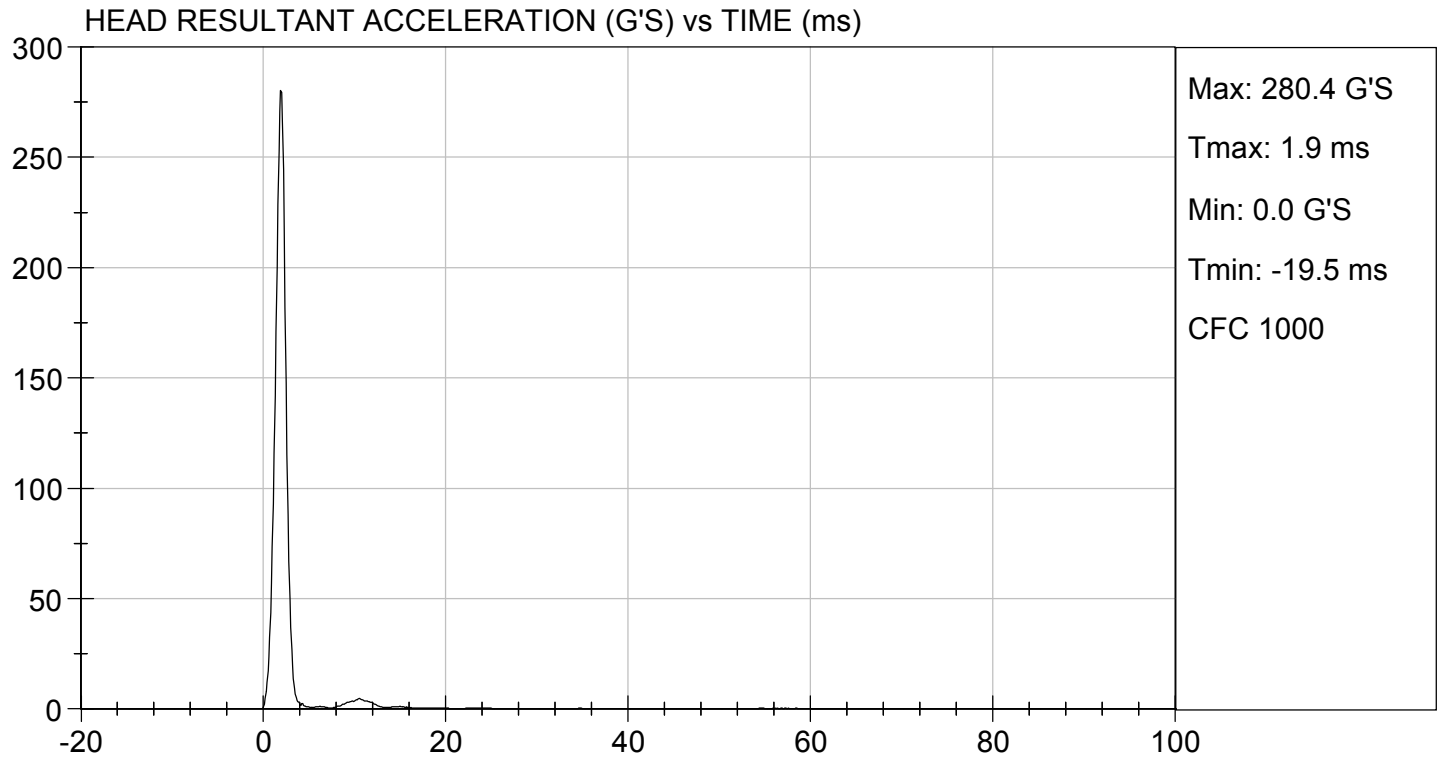
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Peak Resultant Acceleration	G's	245 to 300	280	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-6.3	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A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

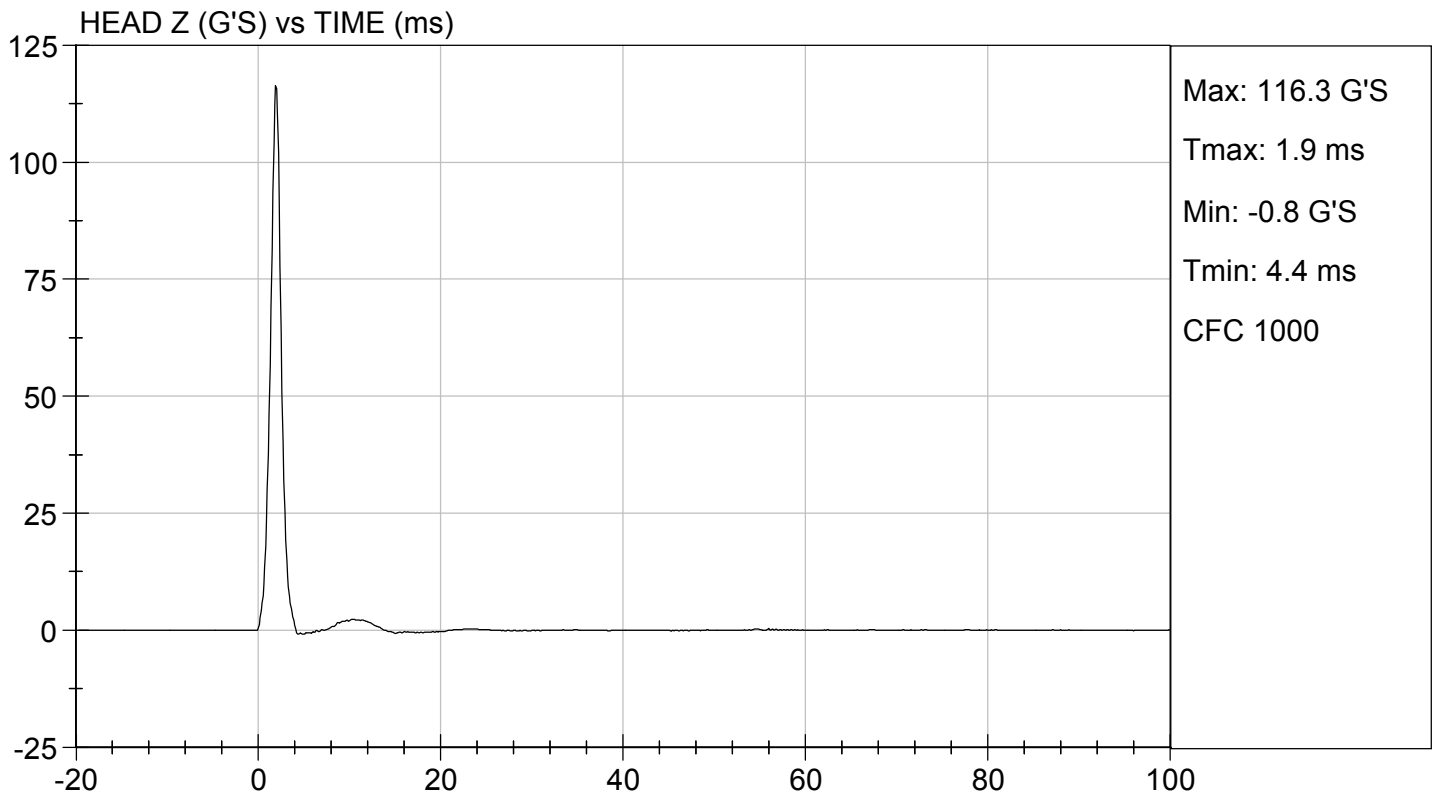
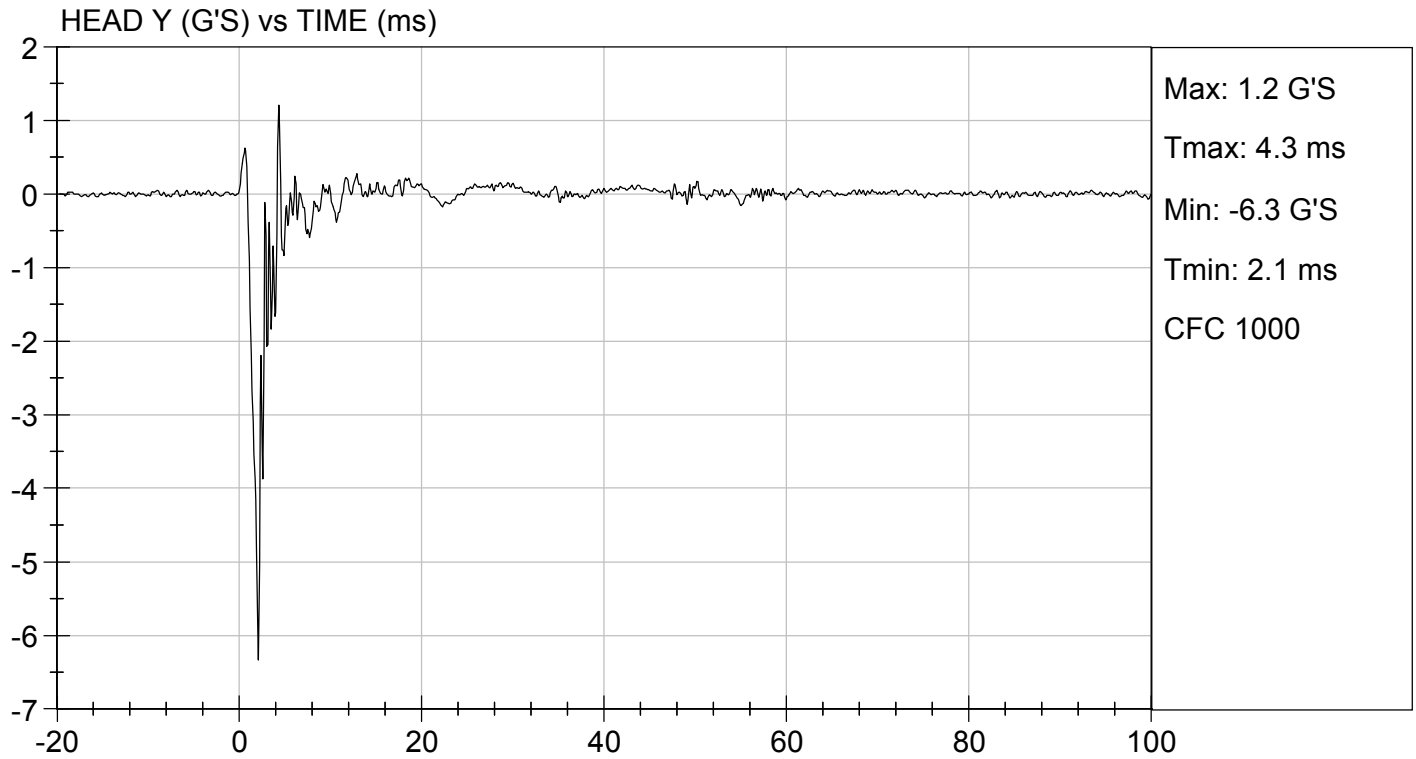
Brian Roach
Laboratory Technician

07/15/2019

Test Date

B. F. L.
Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 6 YEAR OLD

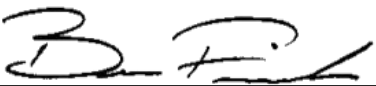
ATD Serial No: 144

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

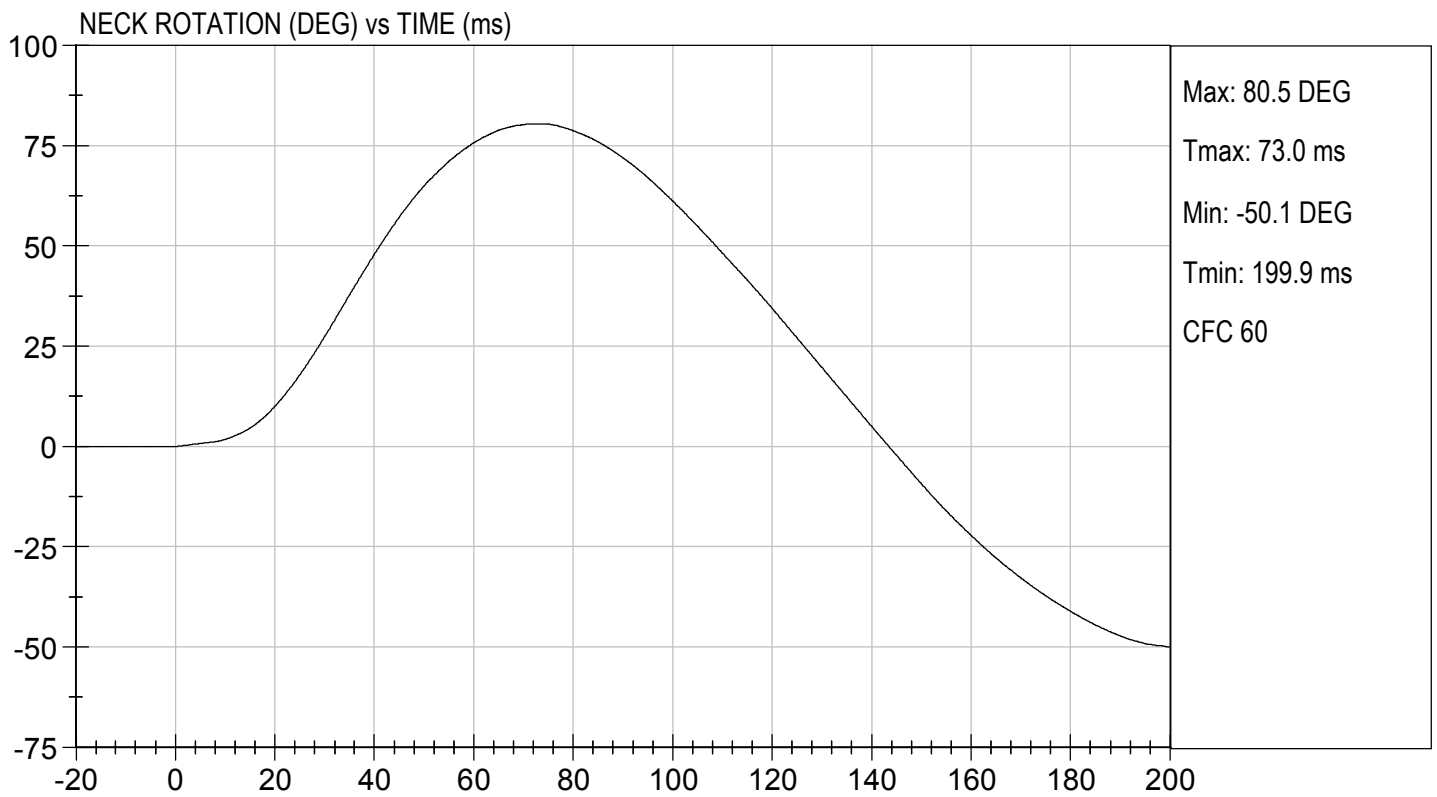
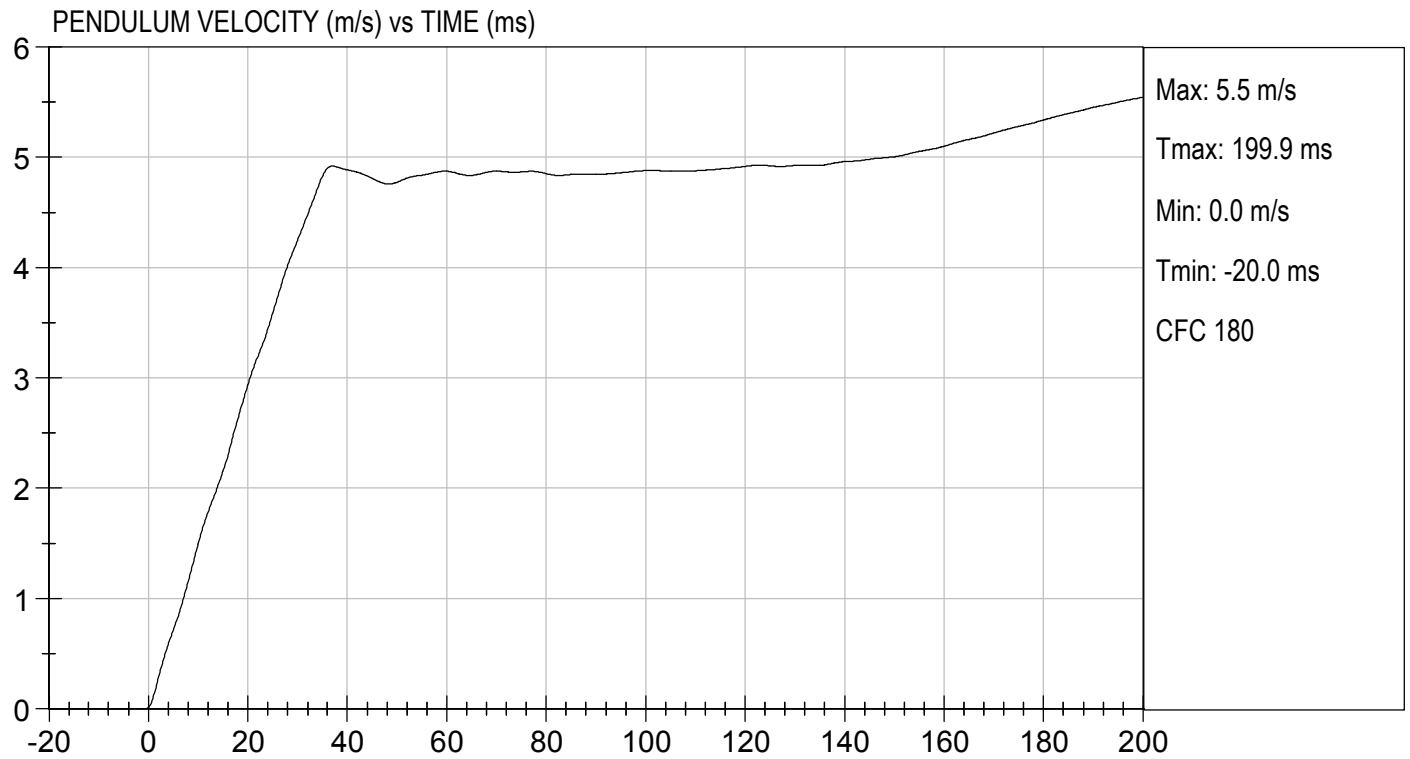
07/15/2019
 Test Date


 Approved By



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

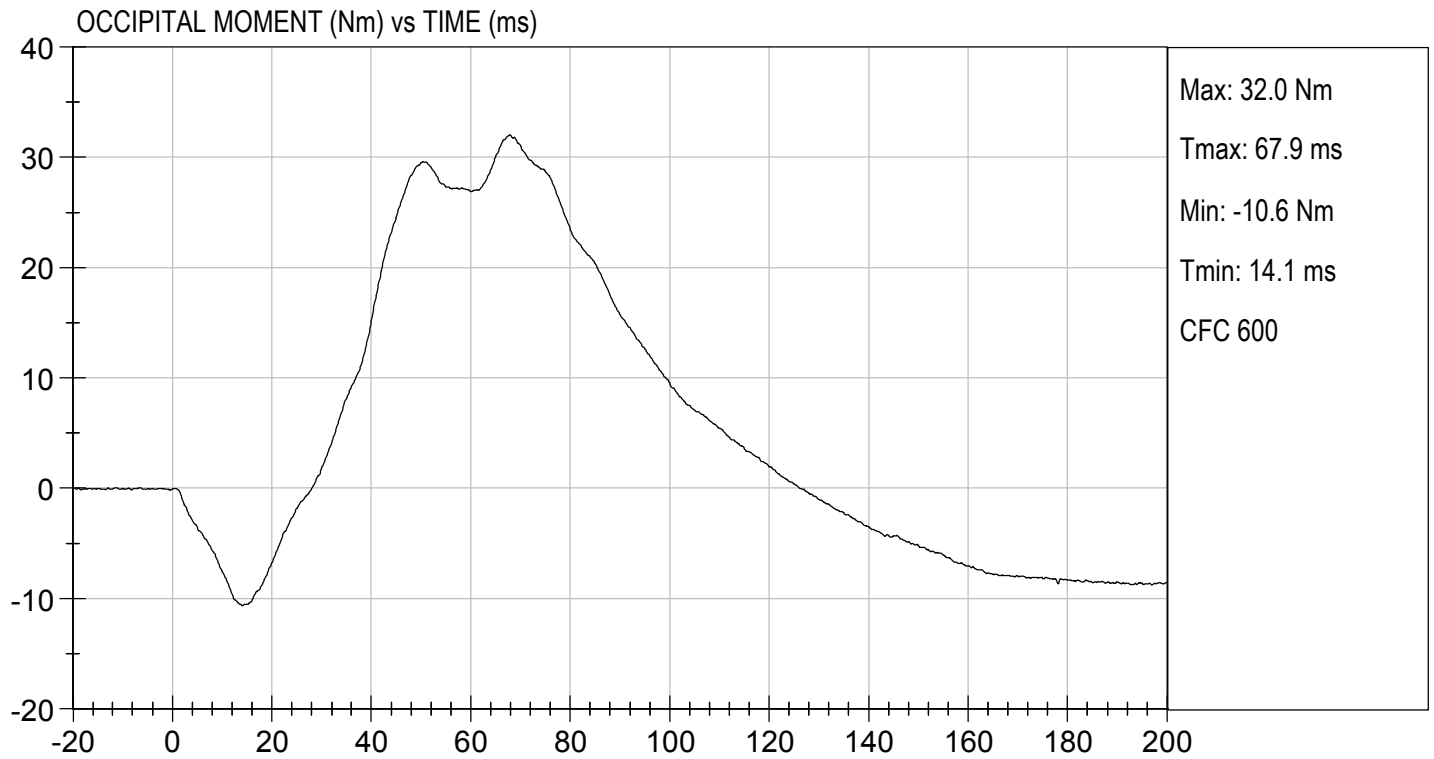
TEST DATE: 07/15/2019
TEST #: D192162





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

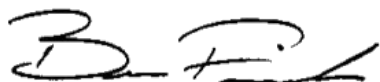
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	43	Pass
Pendulum Speed		m/s	4.18 to 4.42	4.27	Pass
Pendulum Velocity	10 ms	m/s	1.0 to 1.4	1.3	Pass
	20 ms	m/s	2.2 to 3.0	2.5	Pass
	30 ms	m/s	3.2 to 4.2	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



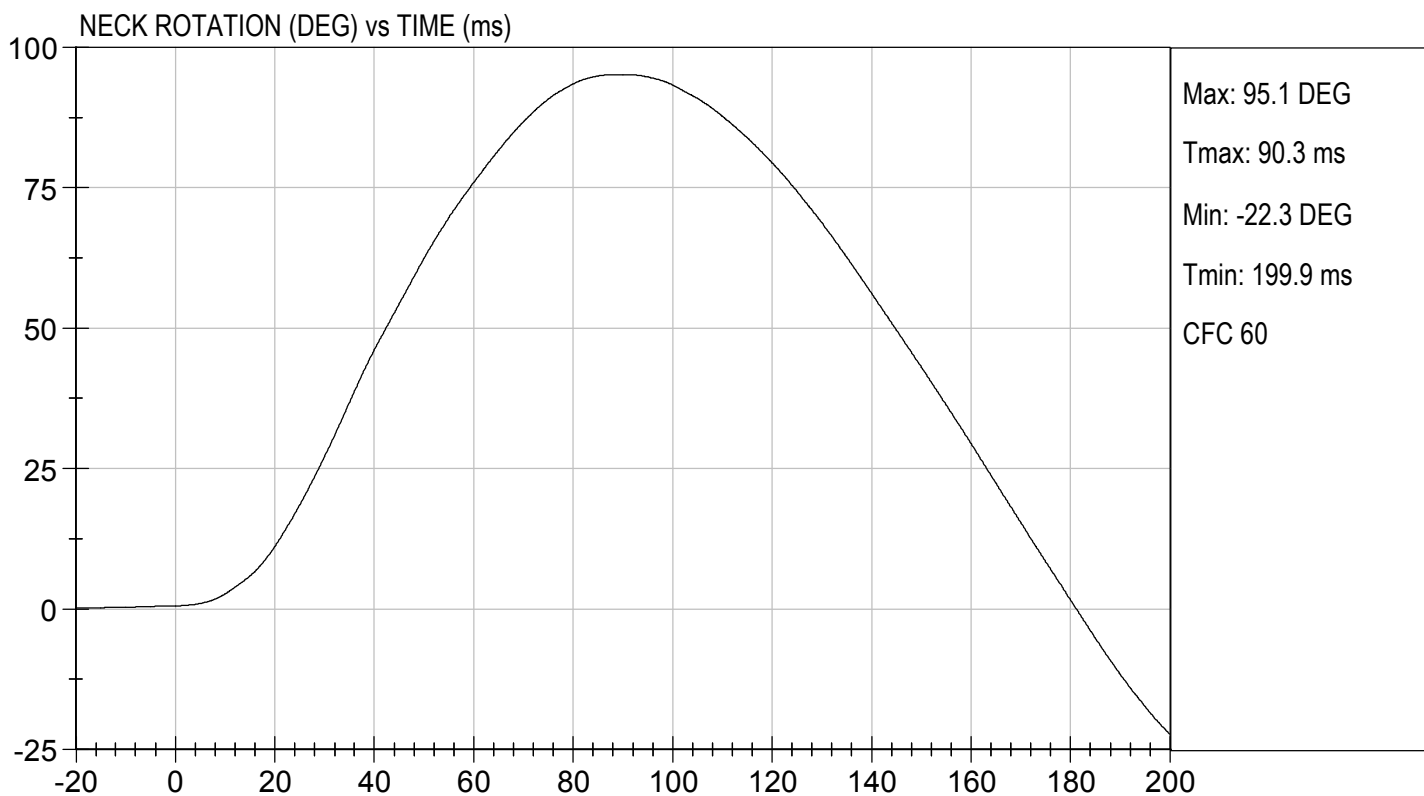
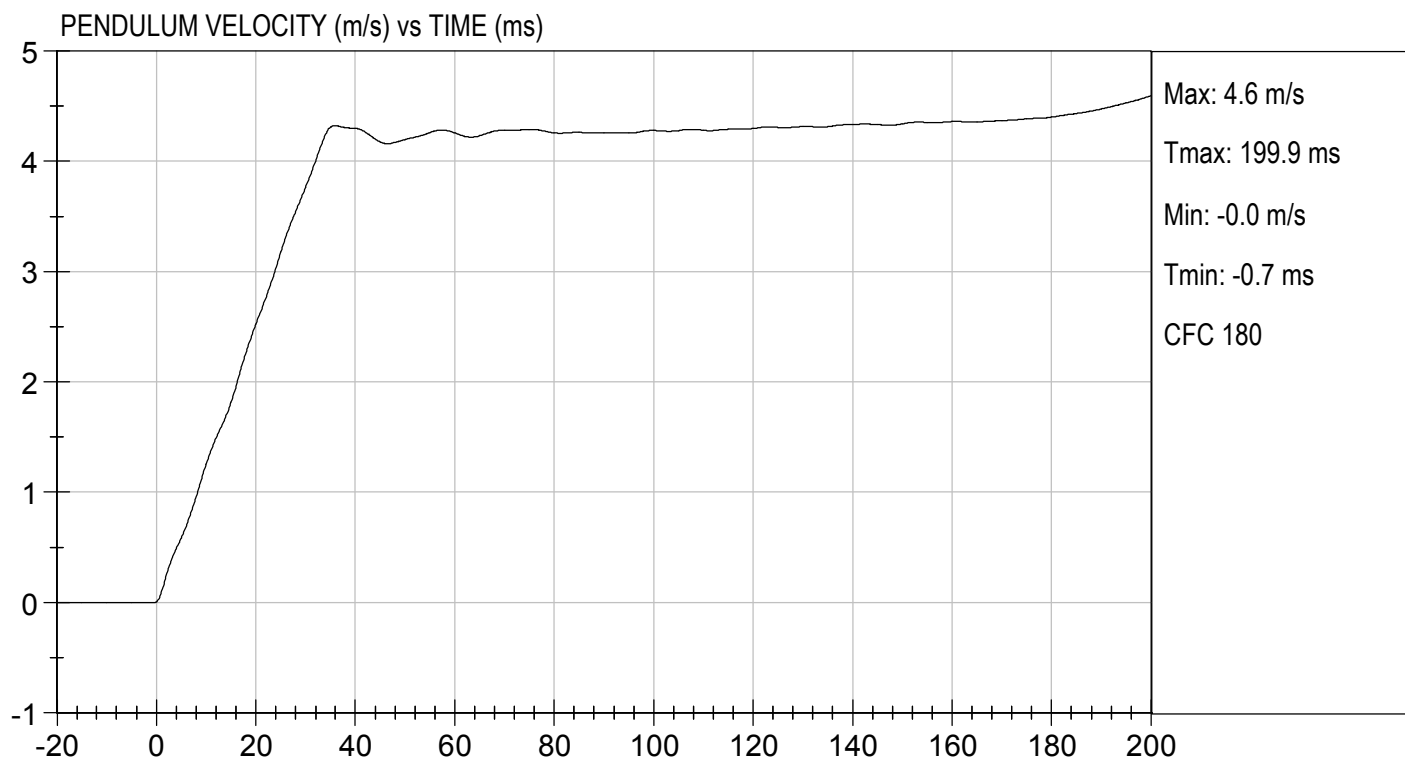
Laboratory Technician

07/15/2019

Test Date



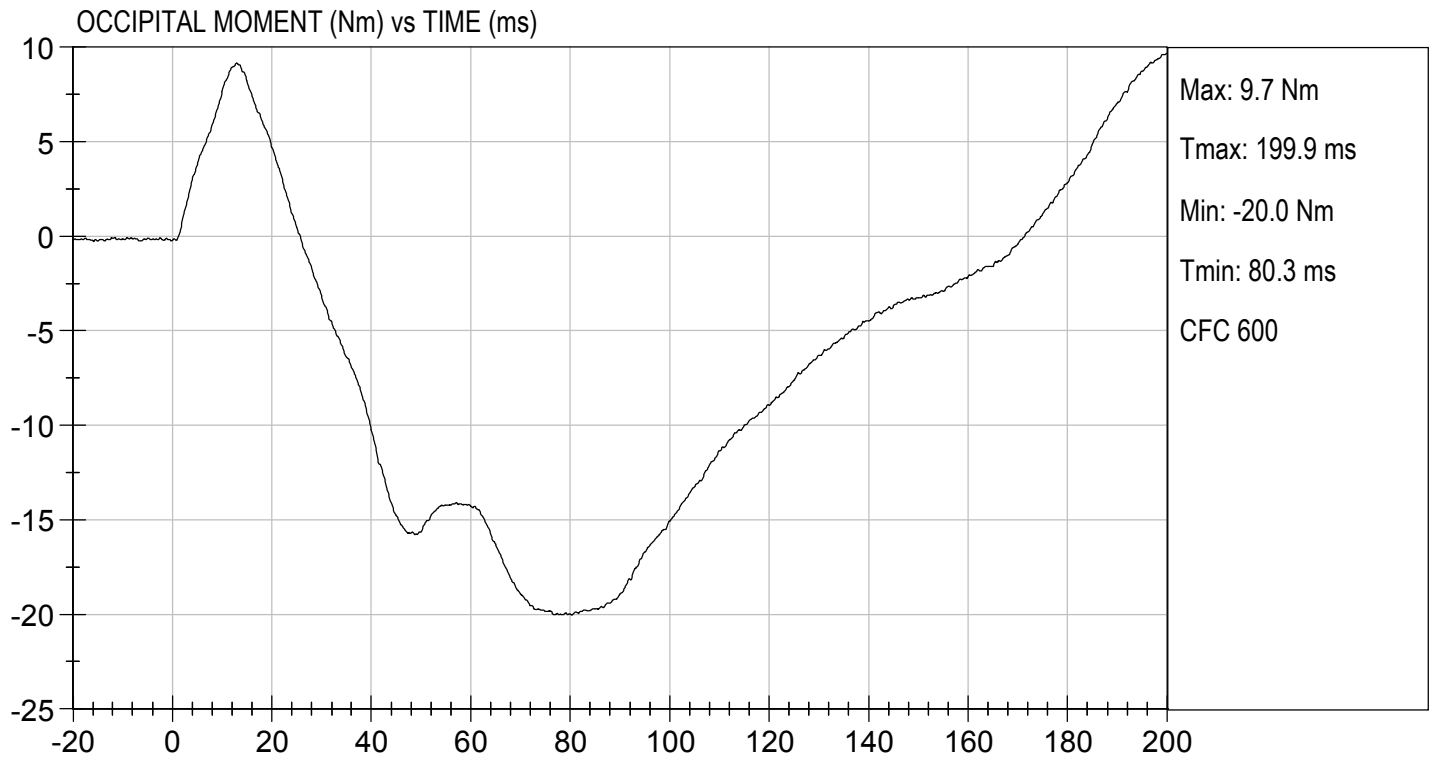
Approved By





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

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



MGA RESEARCH CORPORATION

**THORAX IMPACT
HYBRID III 6 YEAR OLD**

ATD Serial No: 144

Test I.D: D192164

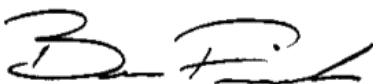
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	20.9	Pass
Relative Humidity	%	10 to 70	46	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	38.0 to 46.0	39.9	Pass
Peak Resistive Force w/in Deflection Corridor	N	1150 to 1380	1,321	Pass
Internal Hysteresis	%	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

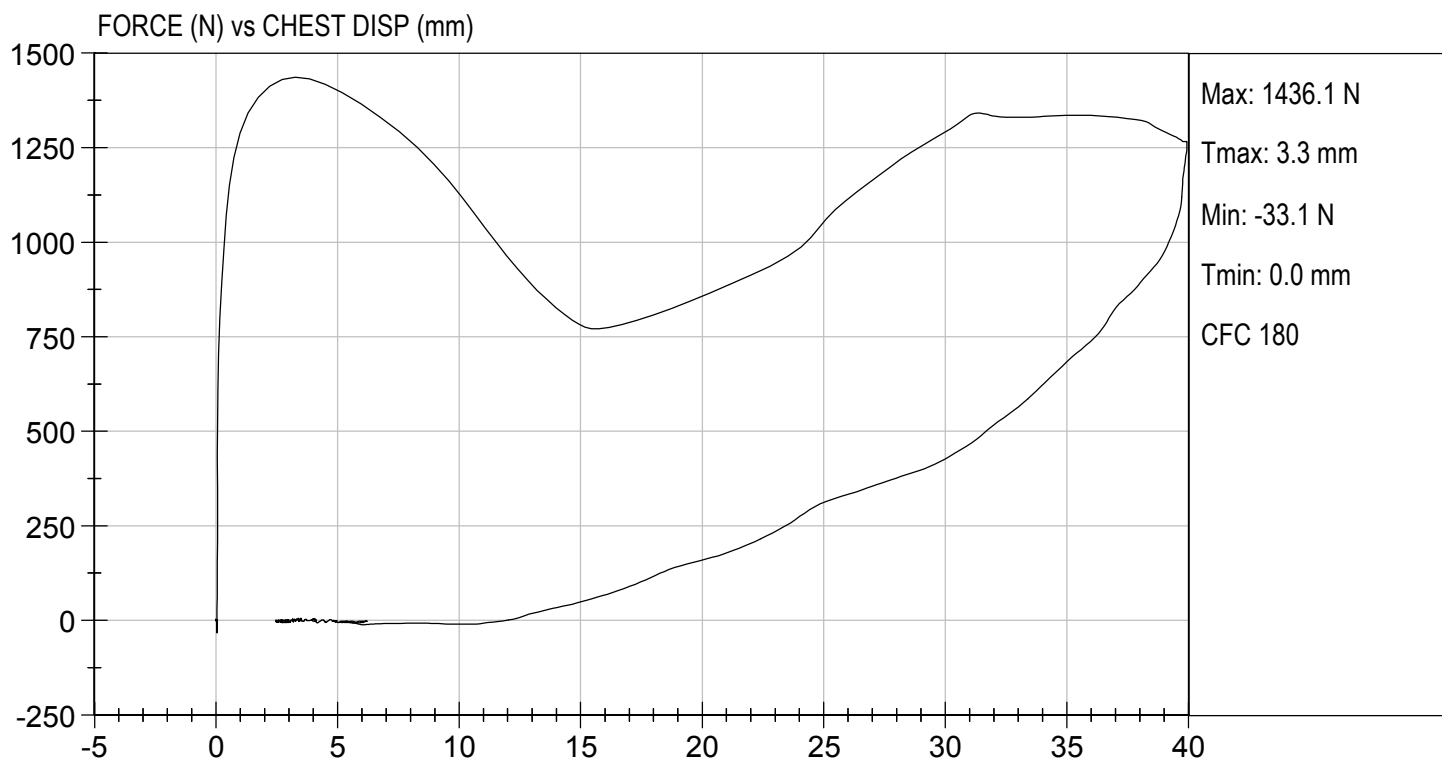


Approved By



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

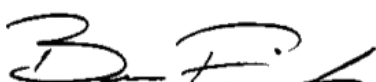
ATD Serial No: 144

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

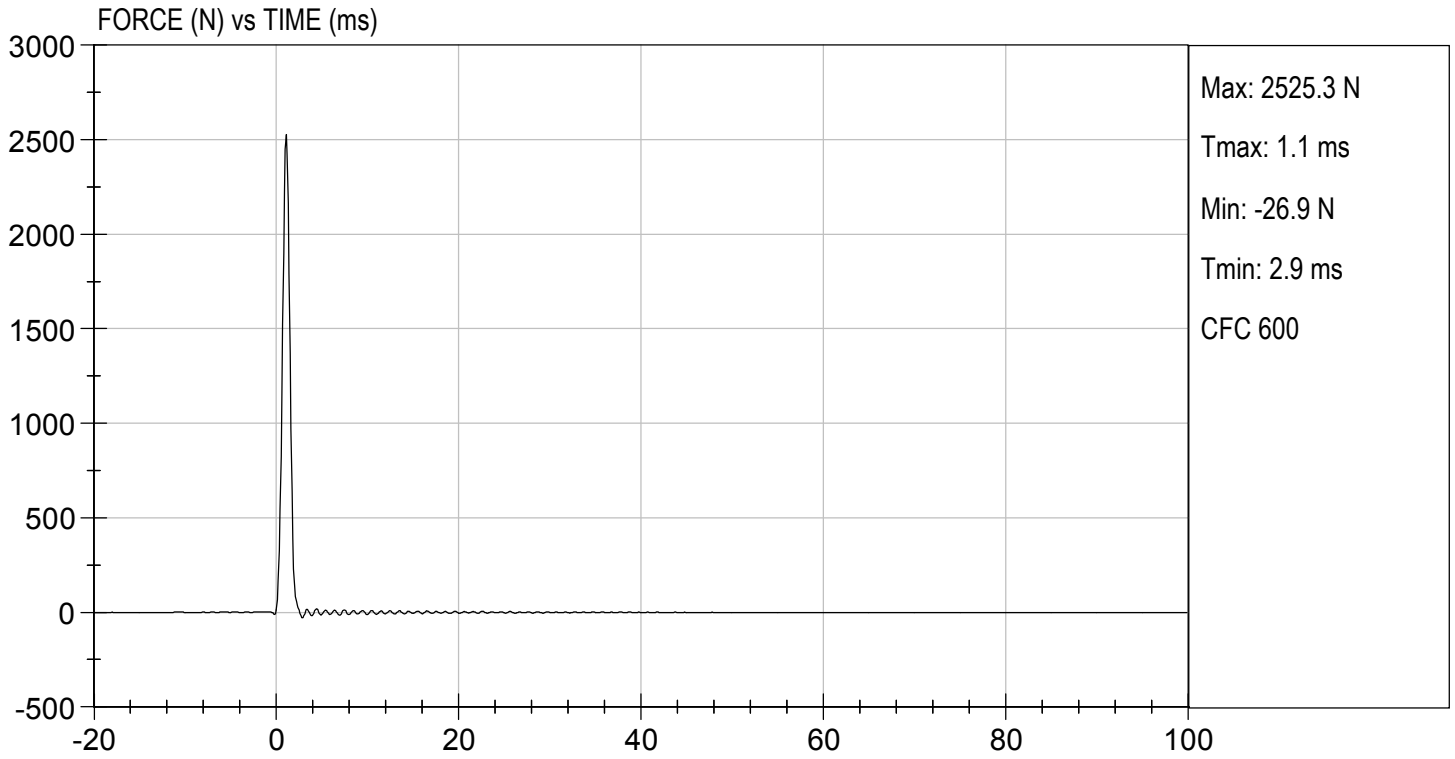
07/15/2019
Test Date


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

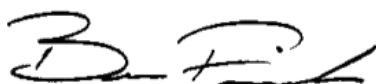
ATD Serial No: 144

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

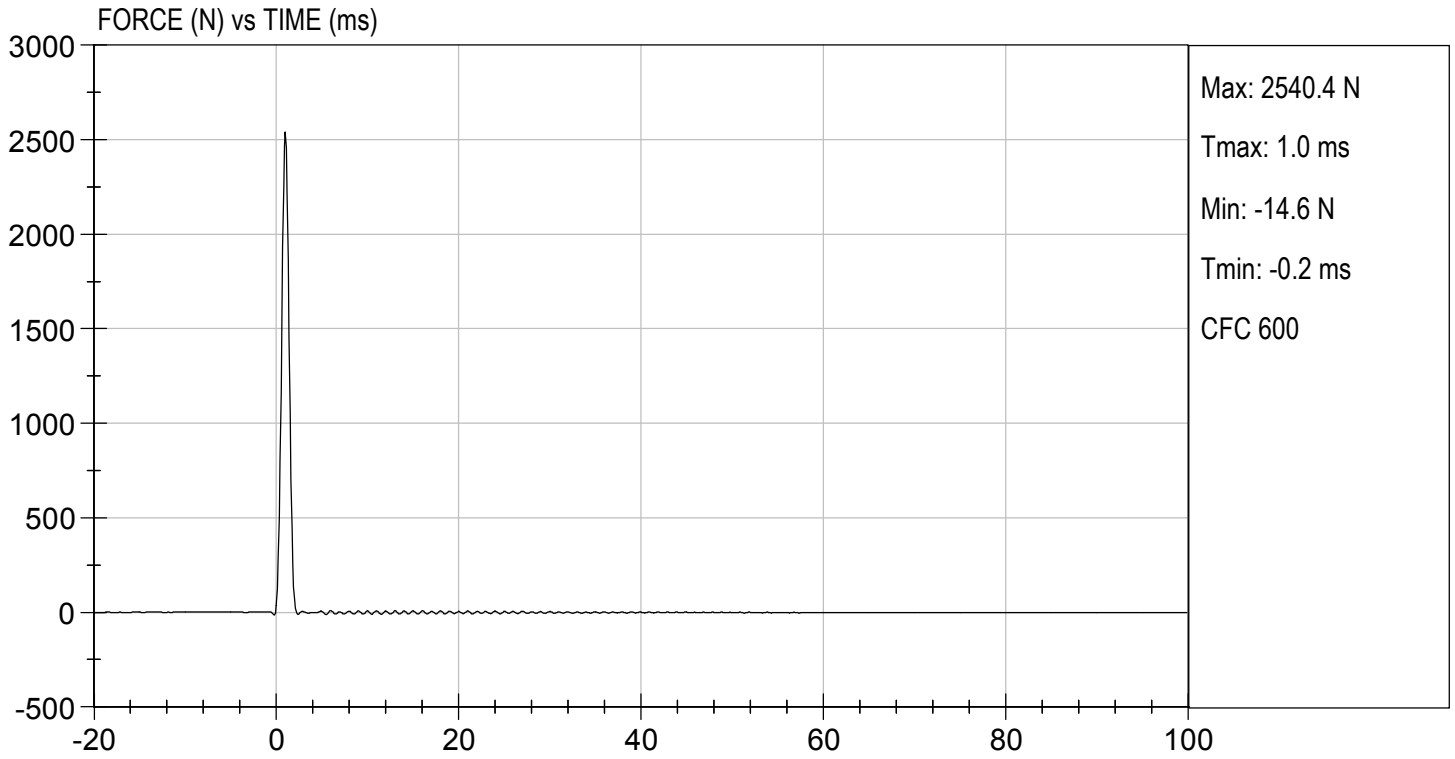
07/15/2019
Test Date


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

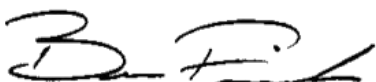
Test I.D: D192167

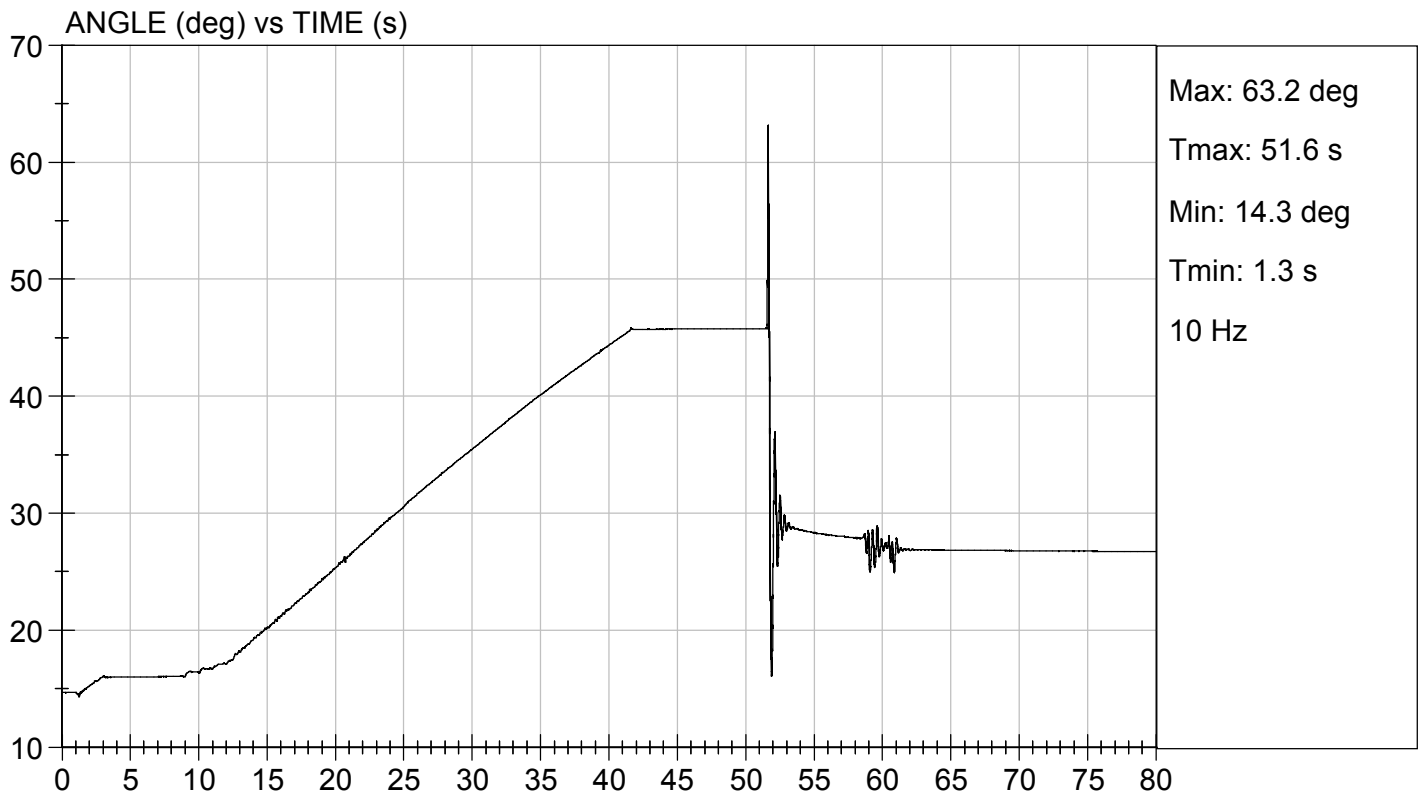
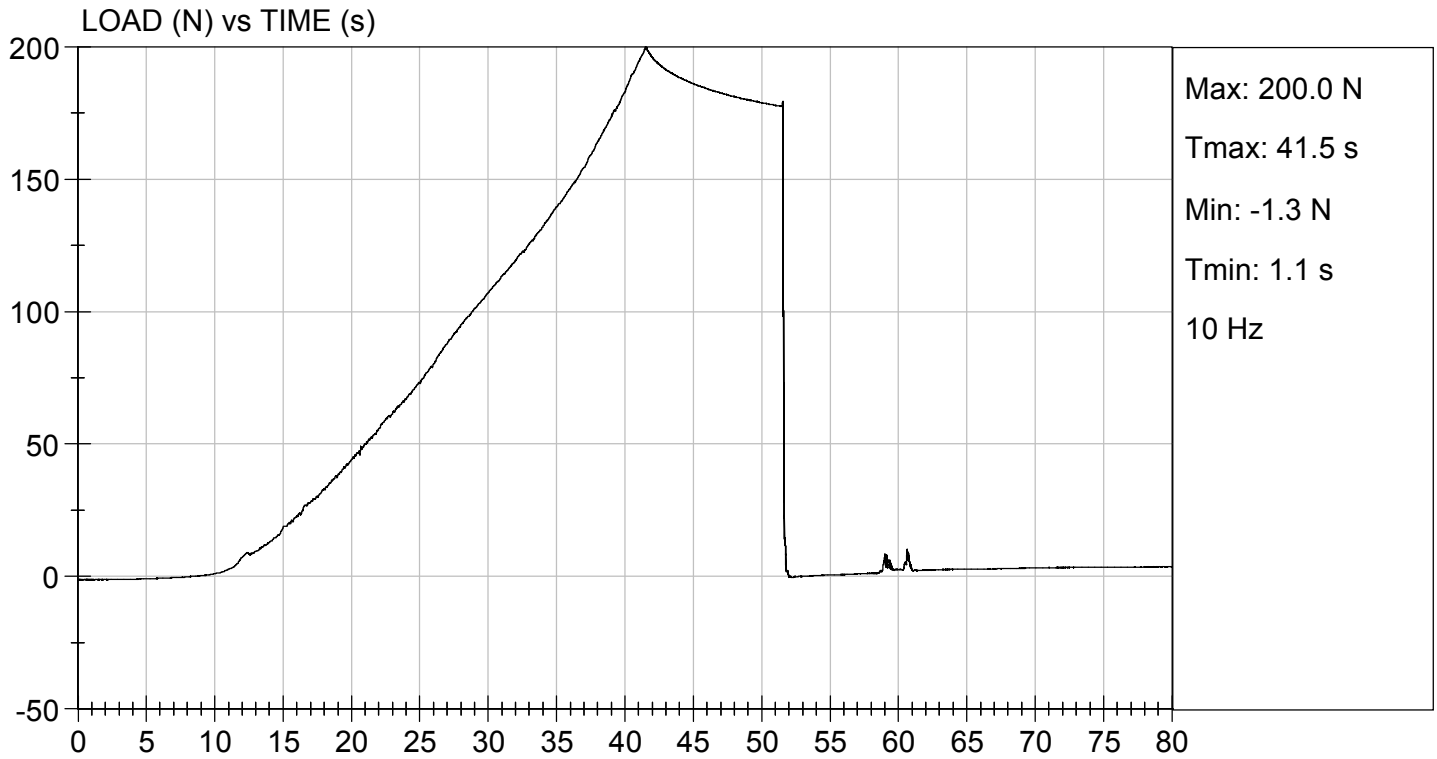
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Initial Angle	deg	0 to 22	15	Pass
Return Angle	deg	+/- 8	7	Pass
Force at 45 deg	N	147 to 200	200	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5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

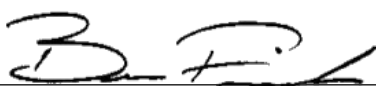
Test ID: D192351

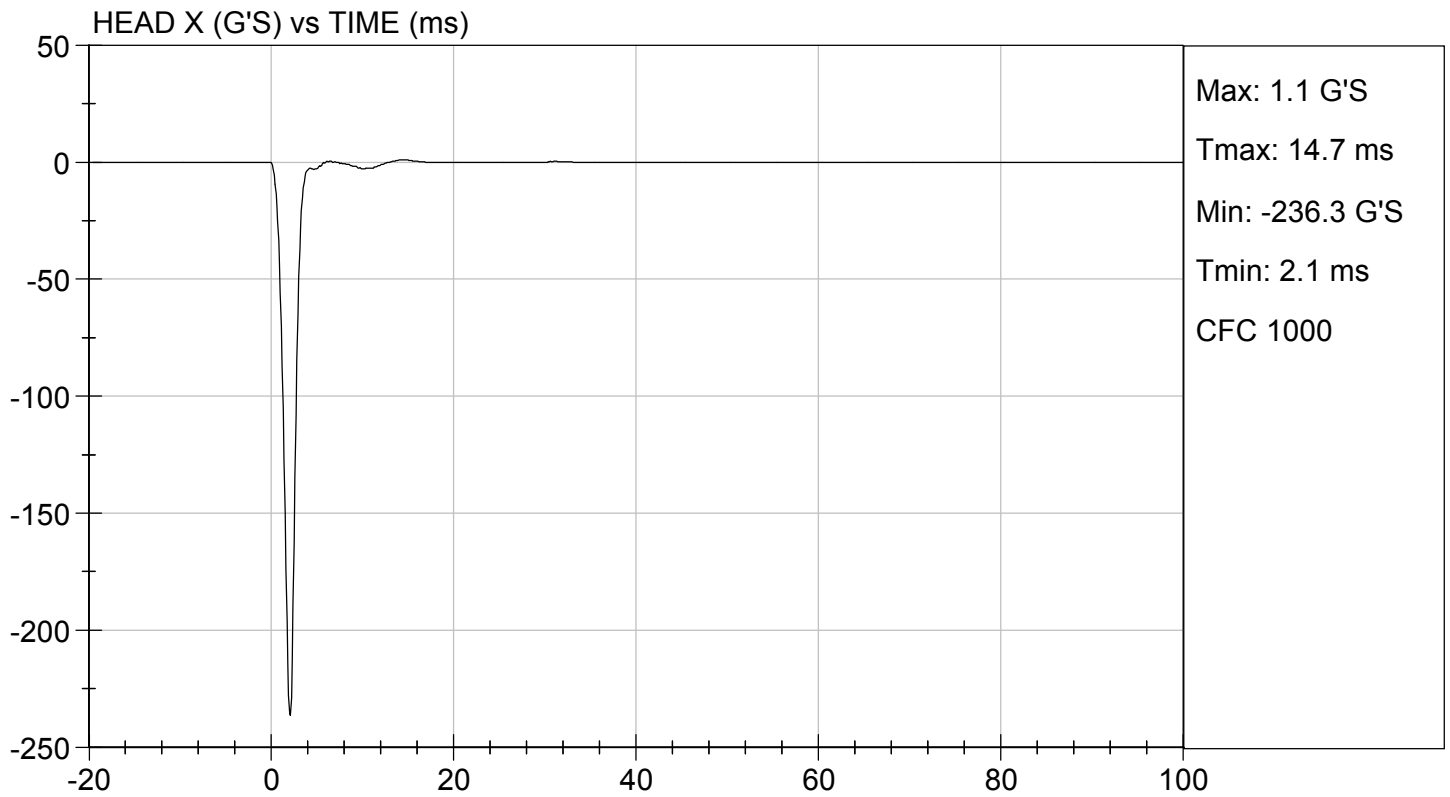
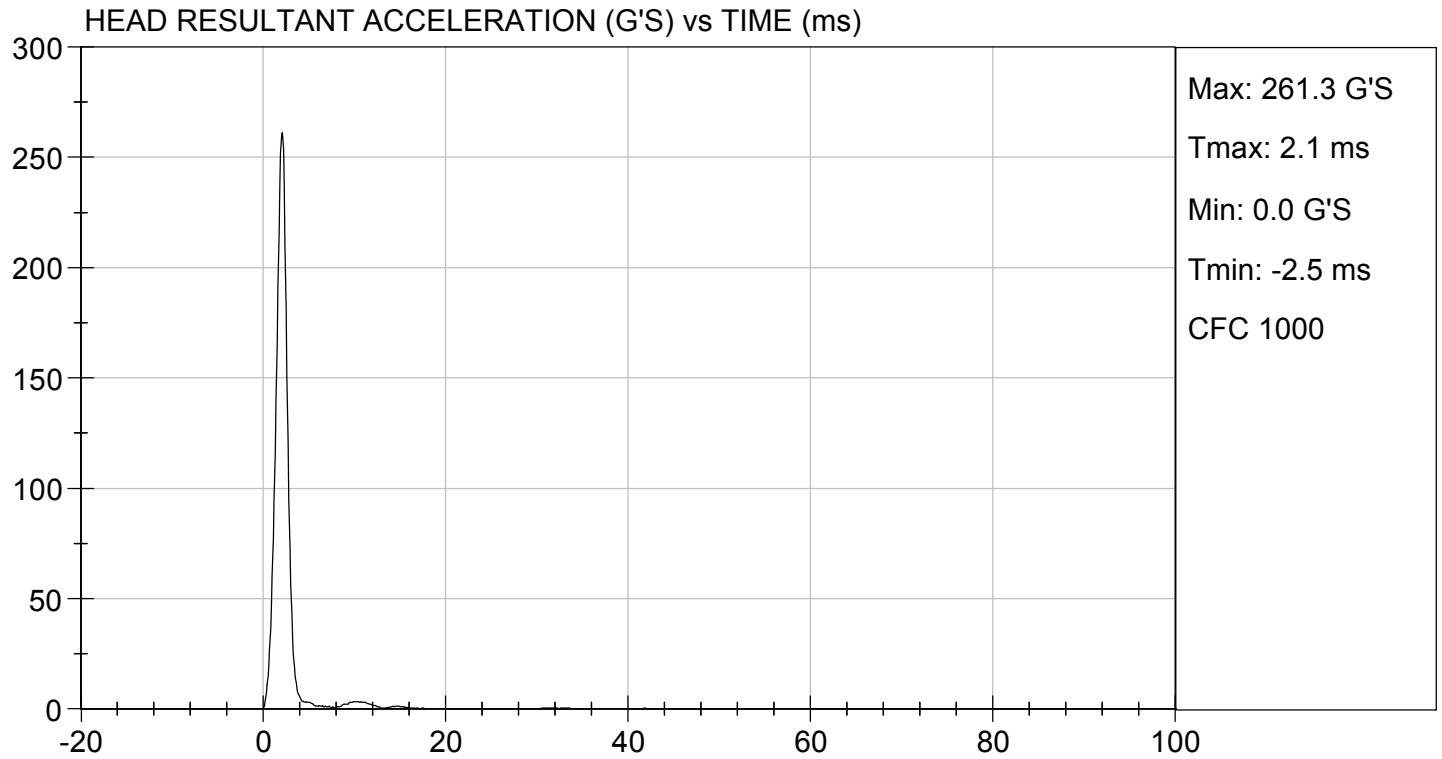
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Peak Resultant Acceleration	G's	245 to 300	261	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-5.7	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A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

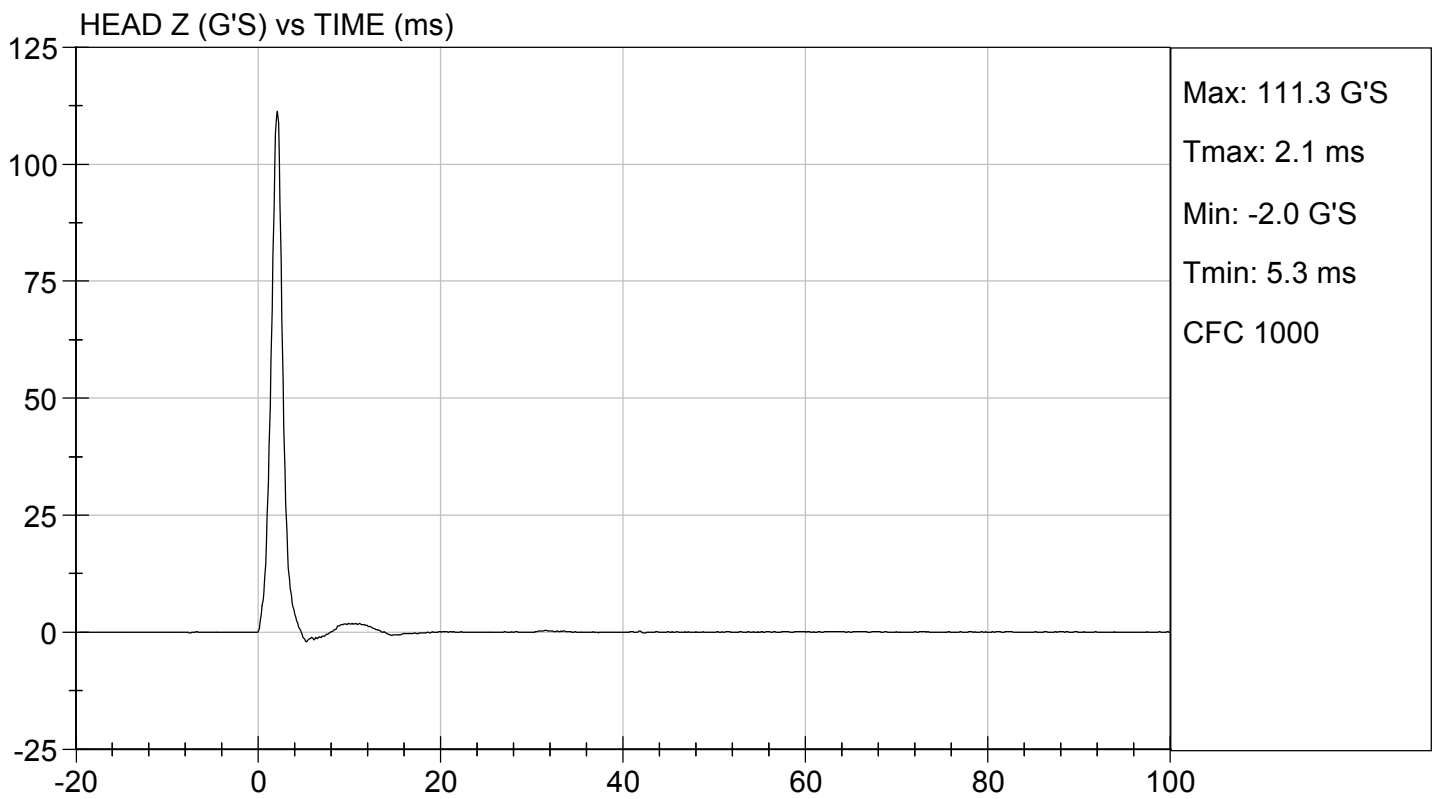
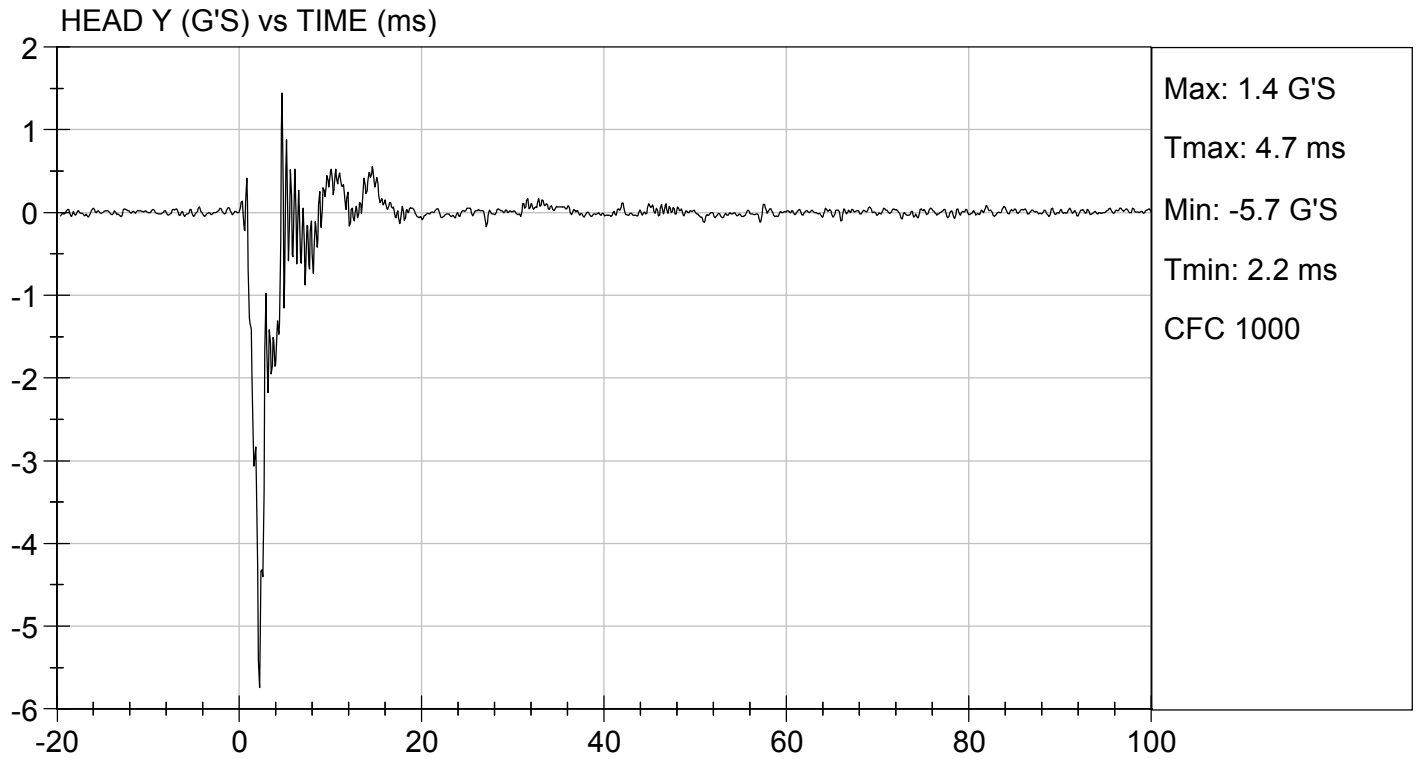

Laboratory Technician

07/29/2019

Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 6 YEAR OLD

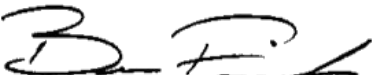
ATD Serial No: 144

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

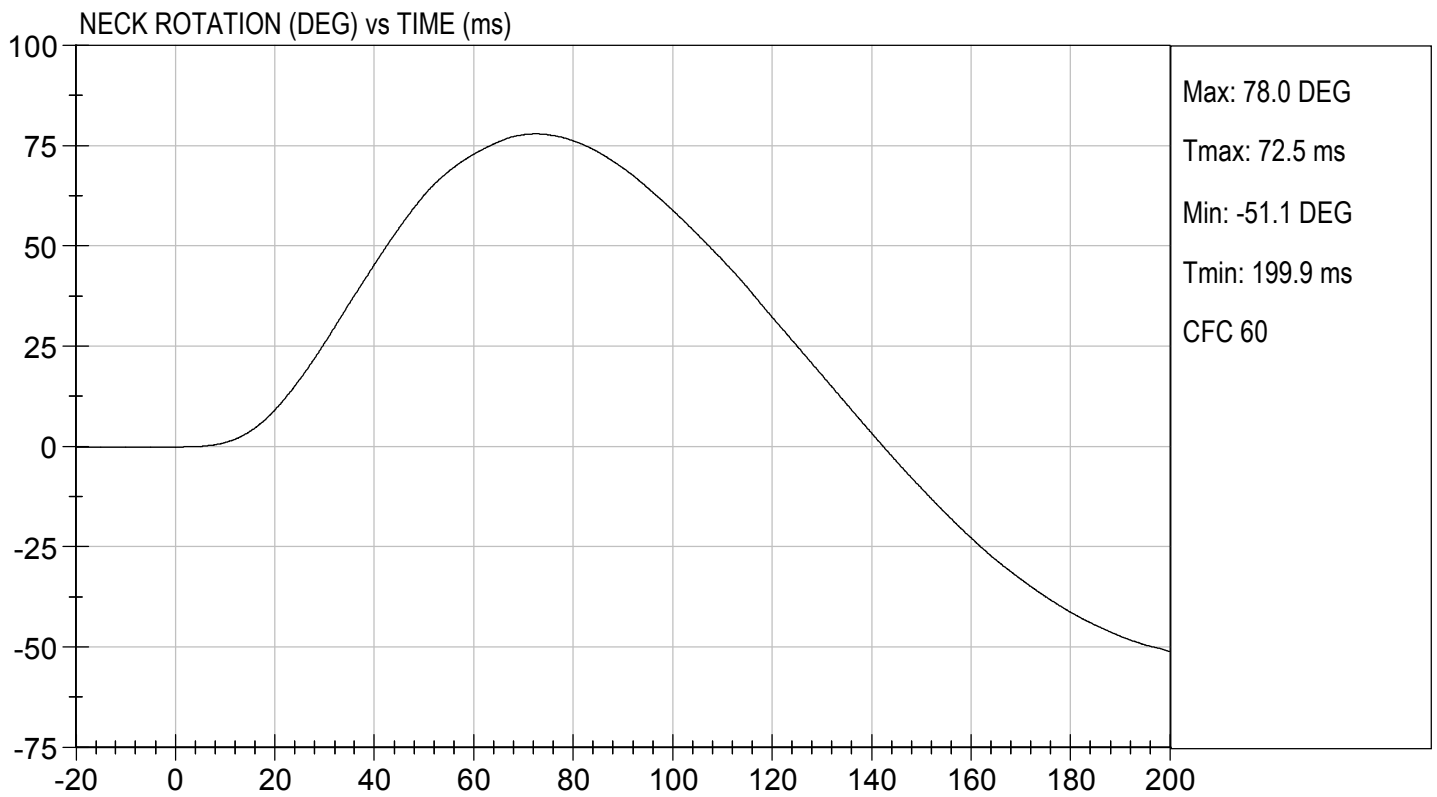
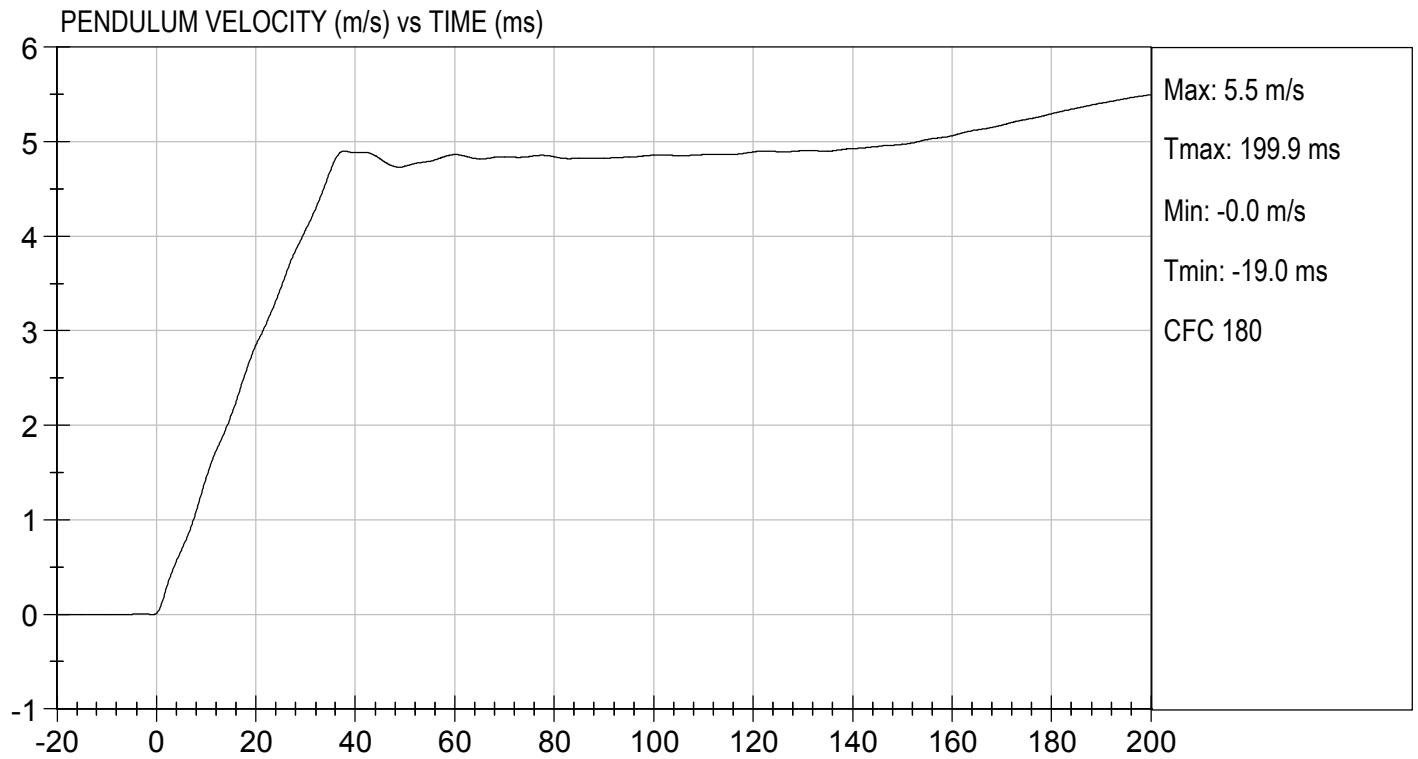
07/29/2019
 Test Date


 Approved By



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

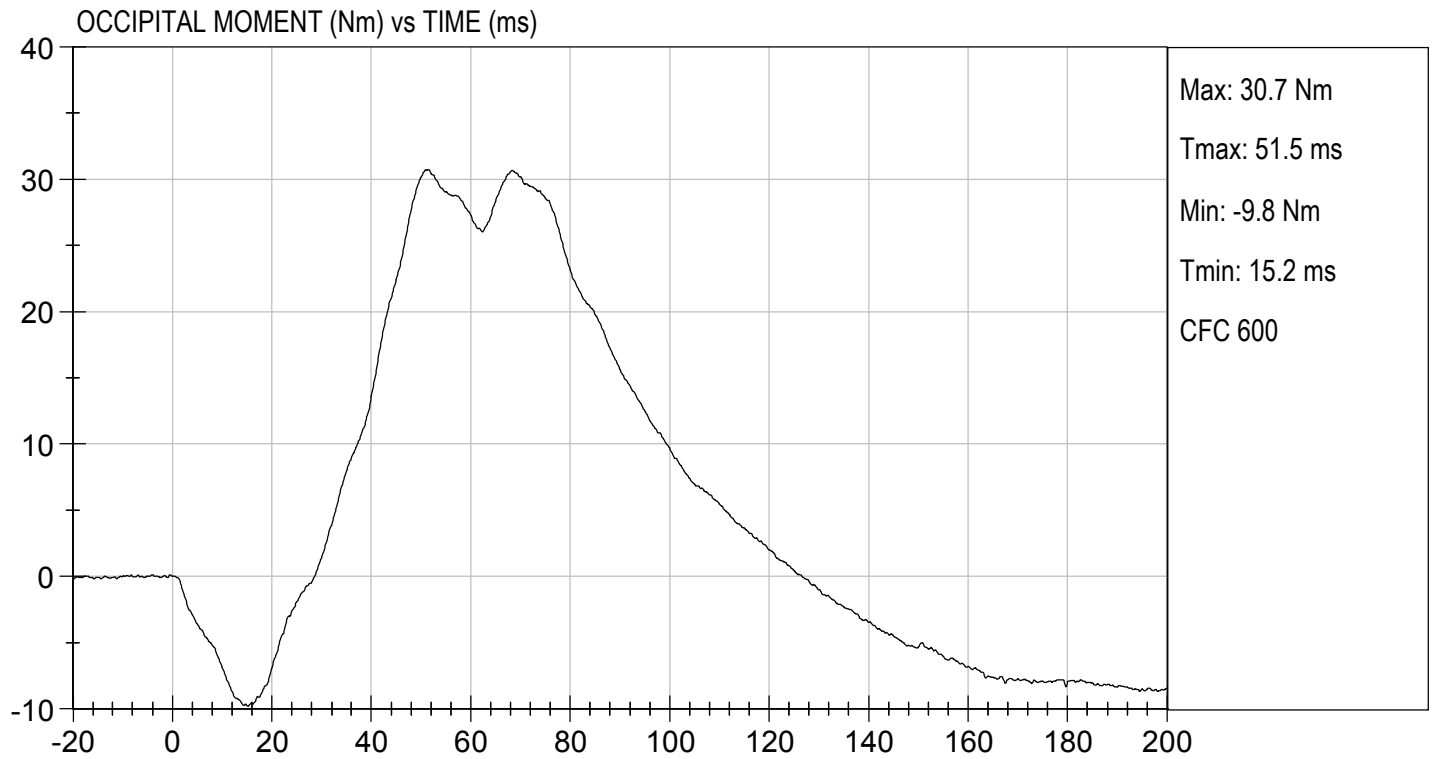
TEST DATE: 07/29/2019
TEST #: D192352





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

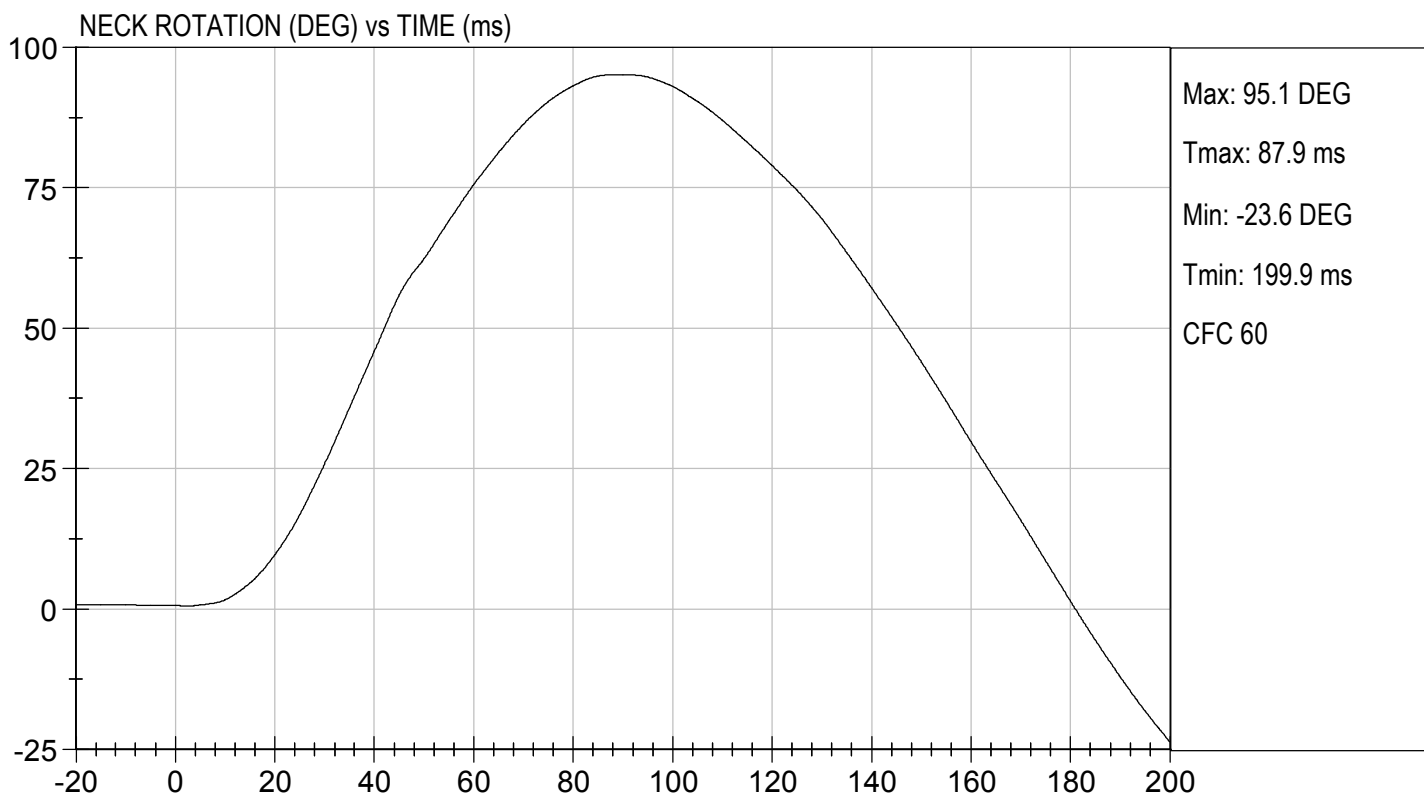
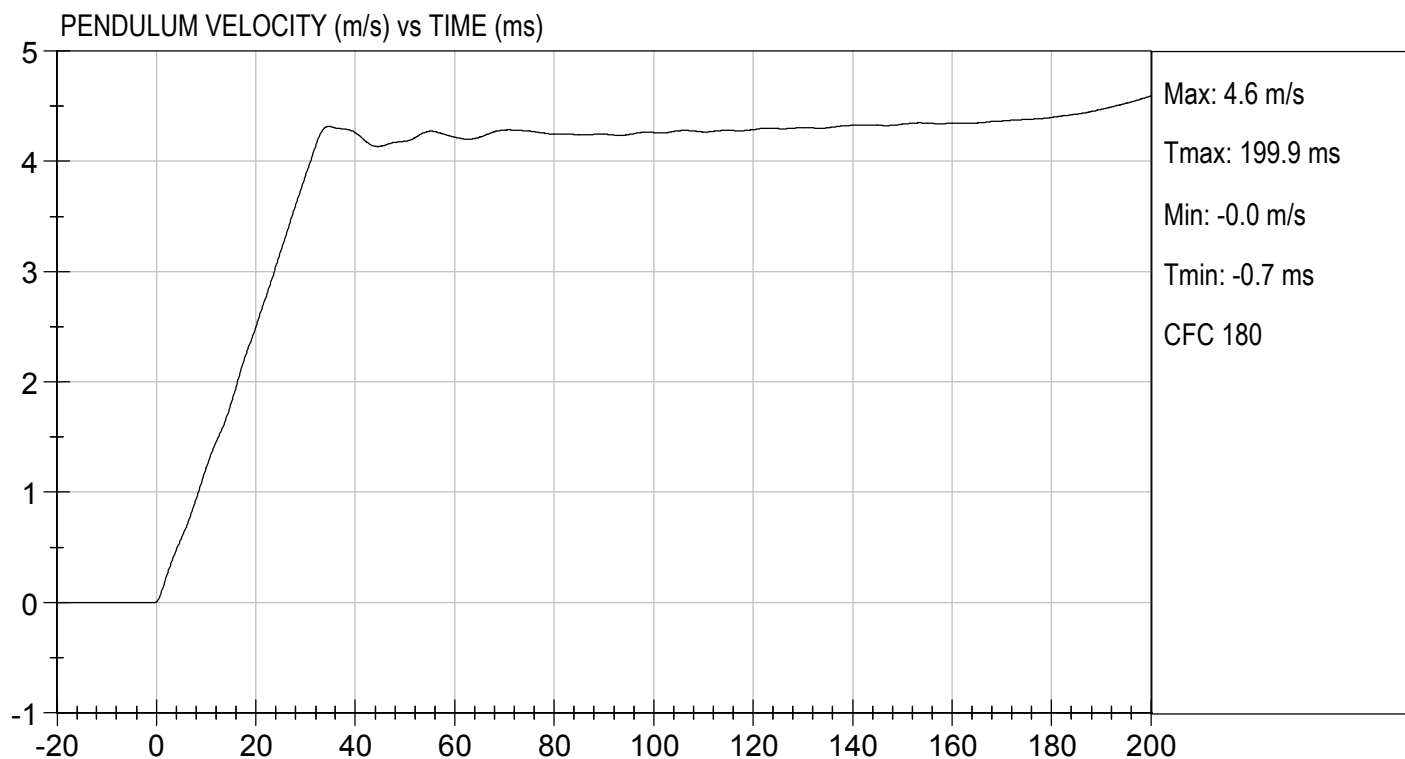
Test I.D: D192353

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

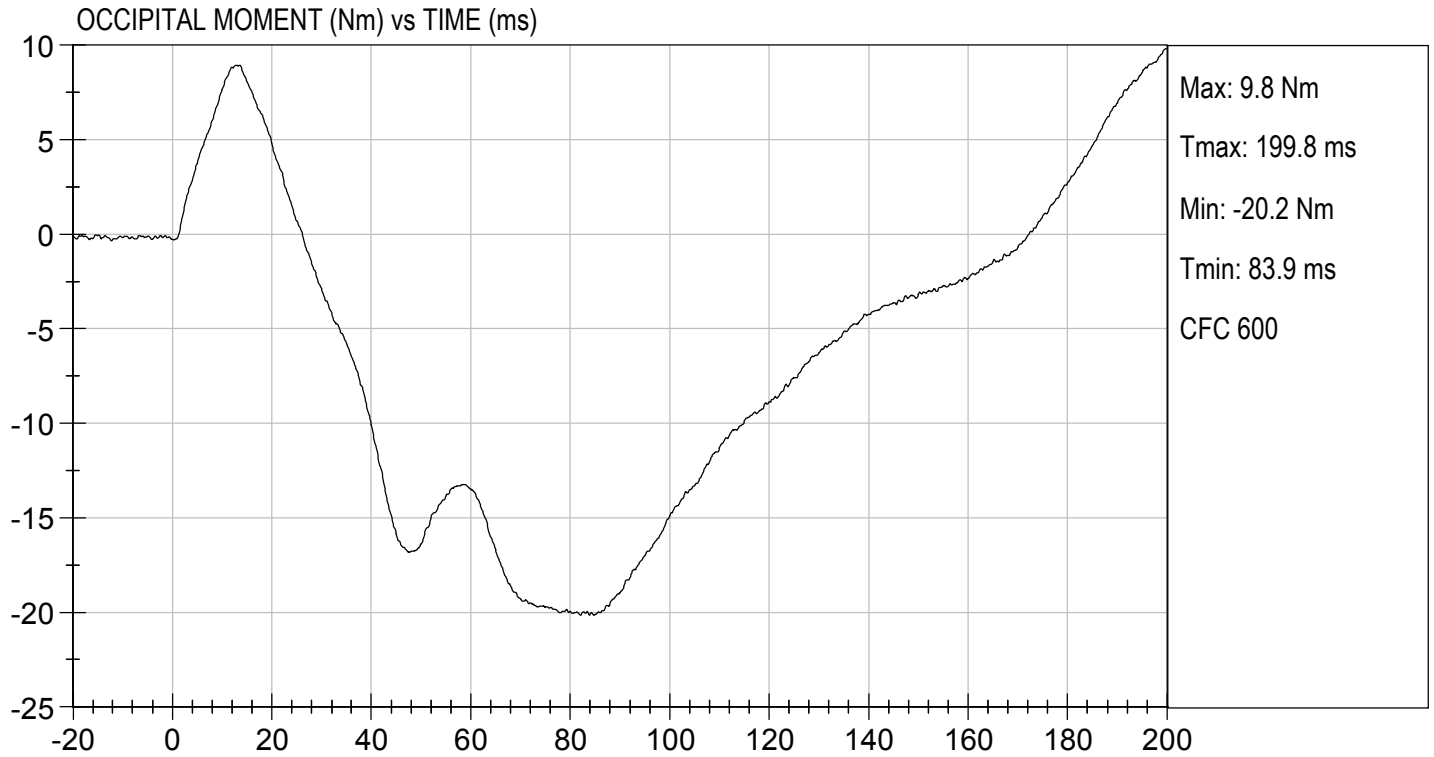
B. F. H.
Approved By





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

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



MGA RESEARCH CORPORATION

**THORAX IMPACT
HYBRID III 6 YEAR OLD**

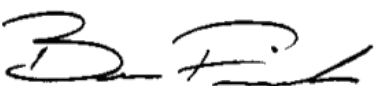
ATD Serial No: 111

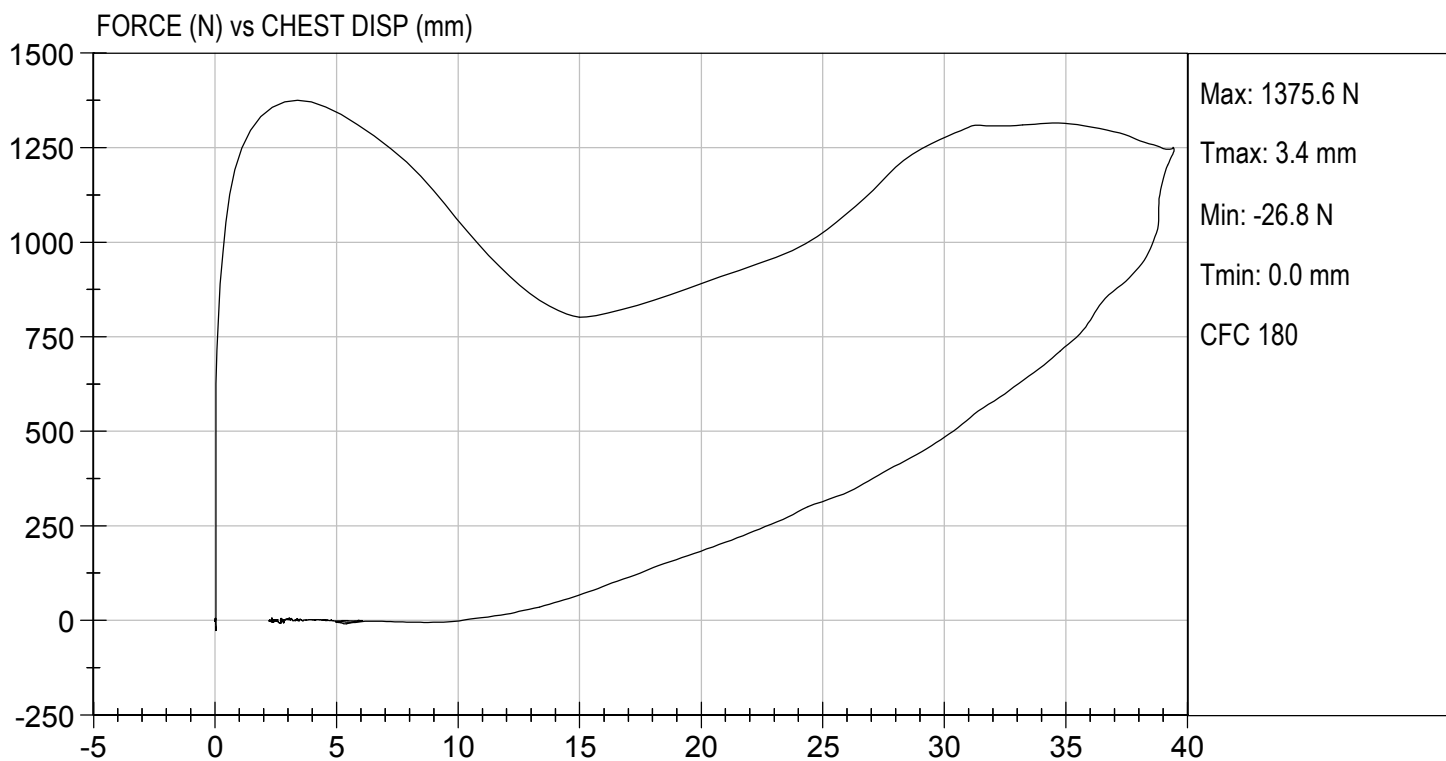
Test I.D: D192354

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



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

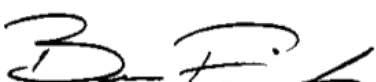
ATD Serial No: 144

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

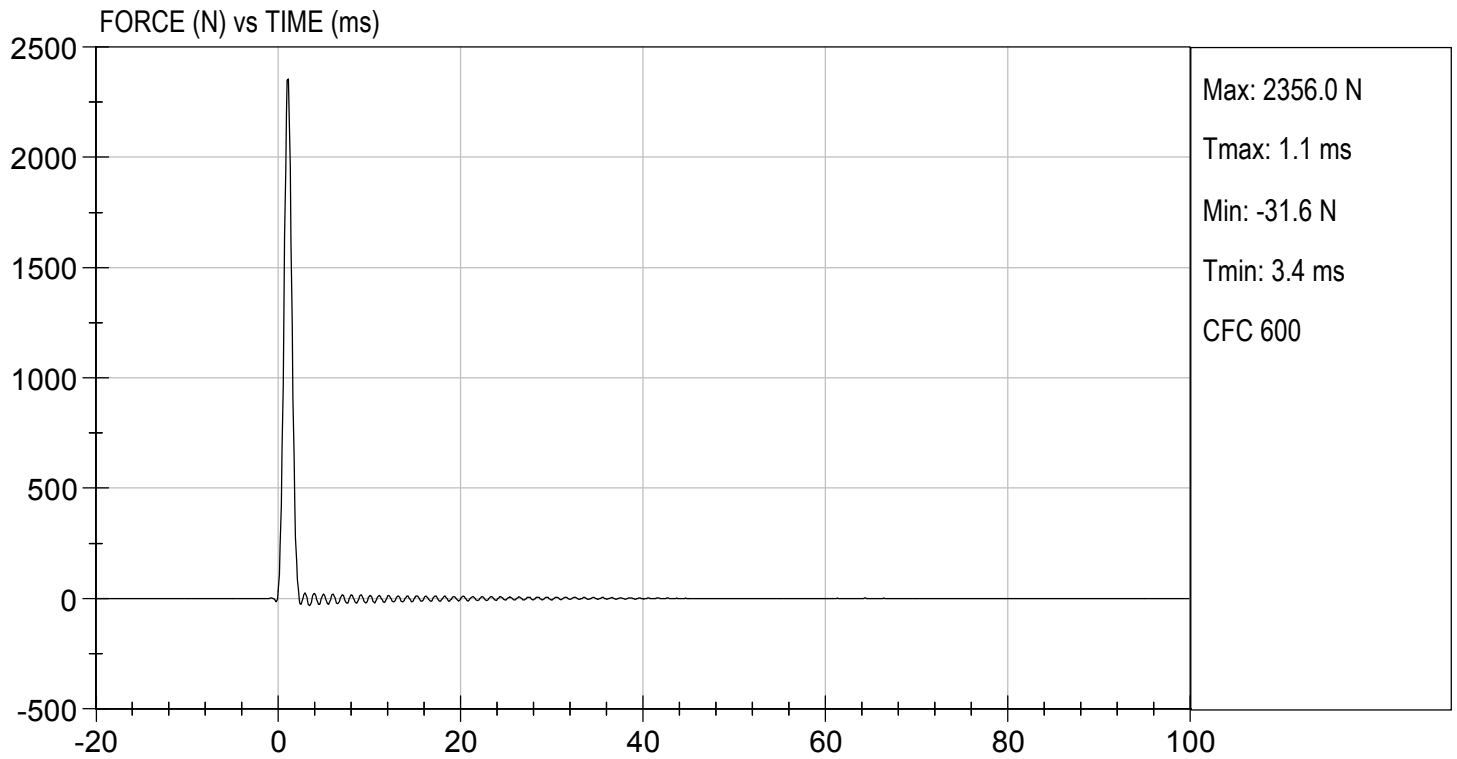
07/29/2019
Test Date


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

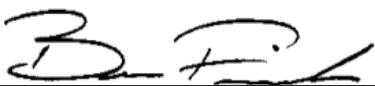
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Speed	m/s	2.07 to 2.13	2.08	Pass
Maximum Force	N	2000 to 3000	2245	Pass
Overall Test Results				Pass



Laboratory Technician

07/29/2019

Test Date

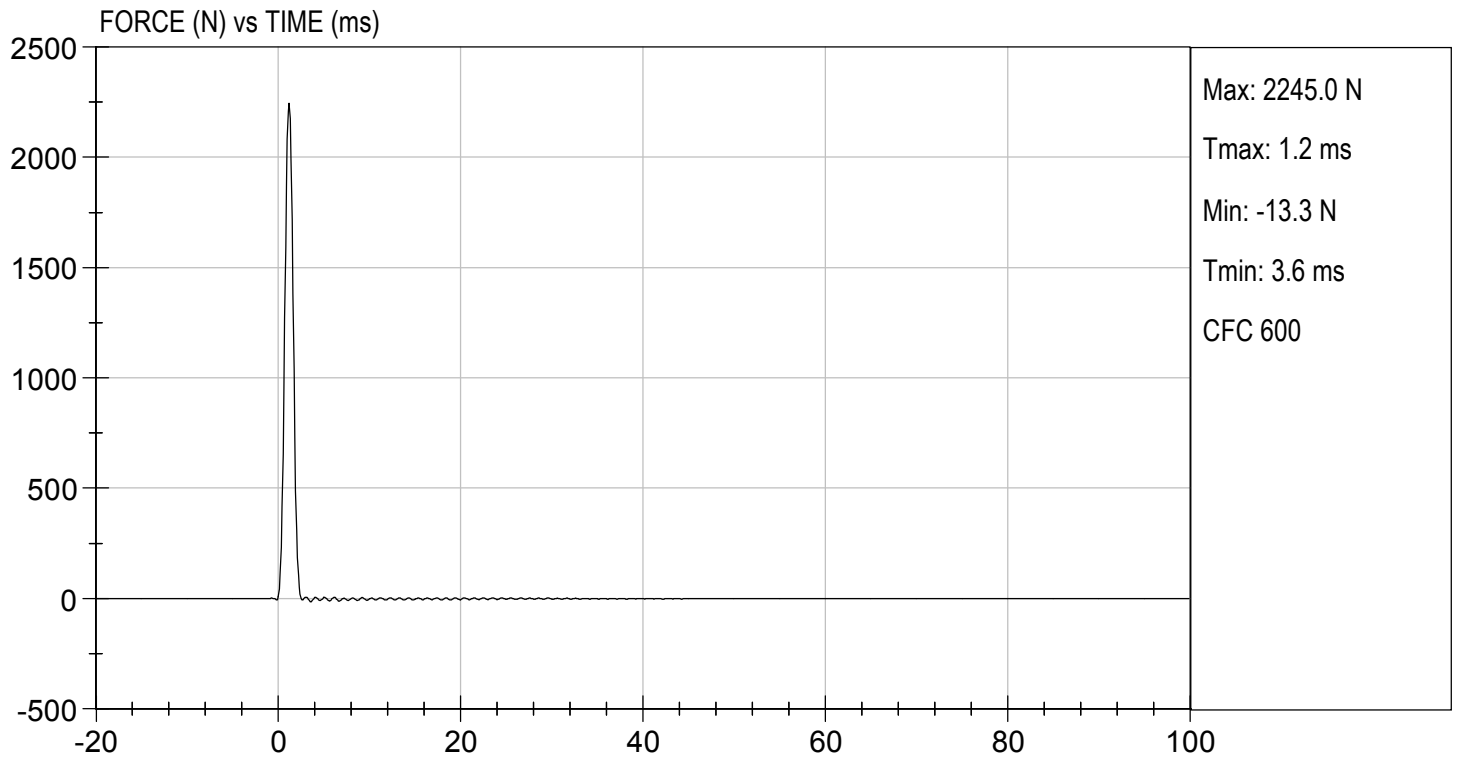


Approved By



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

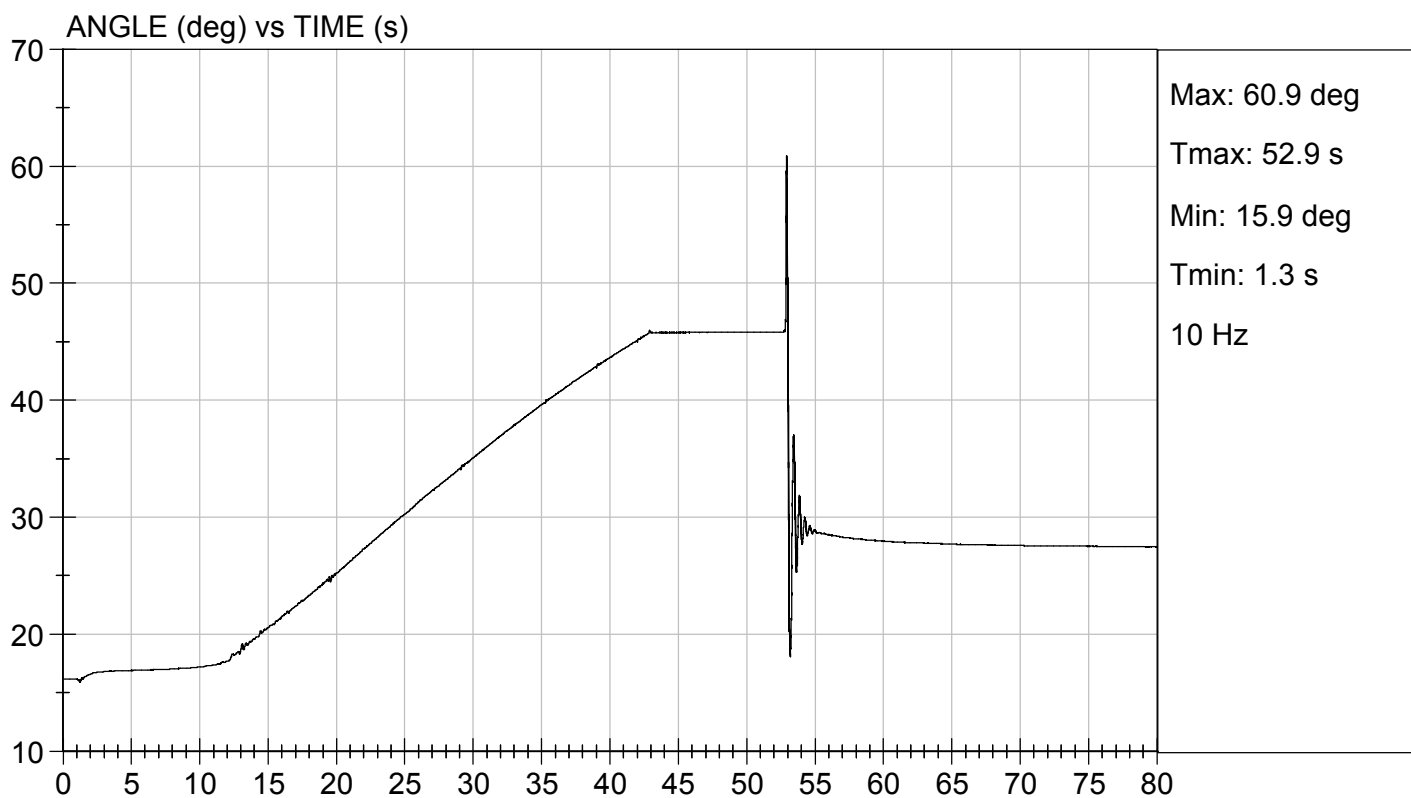
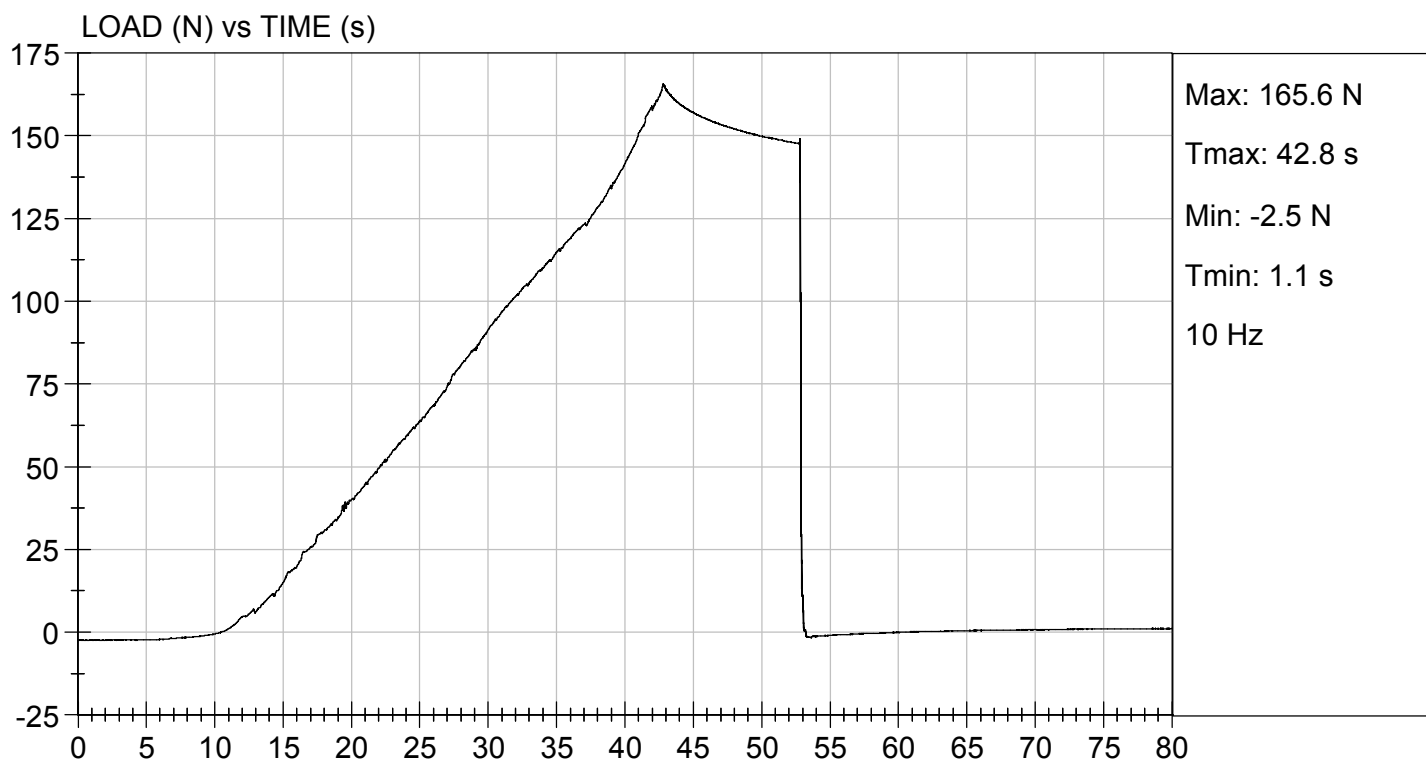
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Initial Angle	deg	0 to 22	16	Pass
Return Angle	deg	+/- 8	8	Pass
Force at 45 deg	N	147 to 200	166	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5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

Brian Rouch
Laboratory Technician

07/29/2019

Test Date

B. F. L.
Approved By



APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

Table 1 – Dummy Instrumentation

		HIII 6-Year-Old S/N 144		
		Serial Number	Manufacturer	Calibration Date
Head CG Accelerometers	X	P82104	Endevco	07/08/19
	Y	P82105	Endevco	07/08/19
	Z	P82106	Endevco	07/08/19
Upper Neck Load Cell		NG1746	Denton	08/02/18
Lower Neck Load Cell		LNG139	Denton	08/02/18