

**REPORT NUMBER: NCAP-MGA-22-035**

**NEW CAR ASSESSMENT PROGRAM (NCAP)  
Frontal Barrier Impact Test**

**FORD MOTOR CO.  
2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
NHTSA No.: M20220212**

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



**Test Date: November 23, 2022**

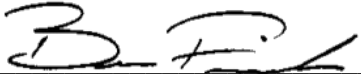
**Final Report Date: December 22, 2023**

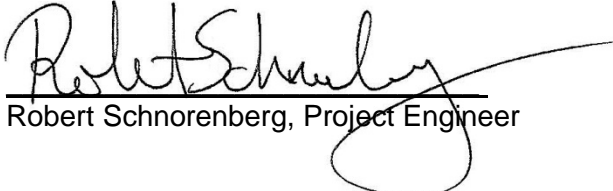
**FINAL REPORT**

**U.S. DEPARTMENT OF TRANSPORTATION  
National Highway Traffic Safety Administration  
Office of Crashworthiness Standards  
1200 New Jersey Ave, SE  
Washington, DC 20590**

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Prepared by:   
Ben Fischer, Program Manager

Approved by:   
Robert Schnorenberg, Project Engineer

Approval Date: December 22, 2023

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: \_\_\_\_\_

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

Date: \_\_\_\_\_

## TECHNICAL REPORT DOCUMENTATION PAGE

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		<b>14. Sponsoring Agency Code</b> NRM-110																																																							
<b>15. Supplementary Notes</b>																																																									
<b>16. Abstract</b> A 56.3 km/h NCAP Frontal Rigid Barrier Impact Test was conducted on a 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck in accordance with the specifications of the Office of Crashworthiness Standards Laboratory Procedure for NCAP Full Frontal Rigid Barrier Impact Testing. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on November 23, 2022.  The impact velocity of the vehicle was 56.18 km/h and the ambient temperature at the barrier face at the time of impact was 21.1°C. The target vehicle post-test maximum crush was 707 mm located to the right of the vehicle centerline. The test vehicle's performance was as follows:																																																									
<table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD</th> <th colspan="2">Passenger ATD</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC<sub>15</sub>)</td> <td></td> <td>700</td> <td>124.237</td> <td>700</td> <td>306.815</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>25.709</td> <td>52</td> <td>13.161</td> </tr> <tr> <td>Nij</td> <td></td> <td>1</td> <td>0.359</td> <td>1</td> <td>0.329</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>1581.232</td> <td>2620</td> <td>677.970</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>216.890</td> <td>2520</td> <td>476.148</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>3378.588</td> <td>6805</td> <td>2039.738</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>1607.553</td> <td>6805</td> <td>728.482</td> </tr> </tbody> </table>						Measurement Description	Units	Driver ATD		Passenger ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC <sub>15</sub> )		700	124.237	700	306.815	Maximum Chest Compression	mm	63	25.709	52	13.161	Nij		1	0.359	1	0.329	Neck Tension	N	4170	1581.232	2620	677.970	Neck Compression	N	4000	216.890	2520	476.148	Left Femur Force	N	10008	3378.588	6805	2039.738	Right Femur Force	N	10008	1607.553	6805	728.482
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<b>17. Key Words</b>  35 mph Frontal Barrier Impact Test New Car Assessment Program (NCAP)			<b>18. Distribution Statement</b> Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division 1200 New Jersey Ave, SE Washington, DC 20590																																																						
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## **SECTION 1 PURPOSE AND SUMMARY OF TEST**

### **PURPOSE**

This 56.3 km/h frontal barrier impact test is part of the Vehicle Barrier Impact Testing Program sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number 693JJ919D000006. The purpose of this test was to obtain vehicle crashworthiness and occupant restraint system performance data for consumer information purposes.

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

### **SUMMARY**

A load cell barrier consisting of 176 load cells was impacted by a 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck at a velocity of 56.18 km/h. The test was performed at MGA Research Corporation on November 23, 2022. Pre-test and post-test photographs of the vehicle and dummies can be found in Appendix A.

Two (2) real-time cameras and sixteen (16) high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in this report.

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

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

The driver (position 1) ATD (Serial No. 351) and the right-front passenger (position 2) ATD (Serial No. 142) were qualified previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 632 channels of data were recorded on a data acquisition system. Appendix B contains the dummy response data traces.

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

The maximum static crush of the vehicle was 707 mm located to the right of the vehicle centerline and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

The driver's visible contact points were as follows: The driver's head contacted the airbag. The driver's head also contacted the headrest. The driver's knees contacted the knee bolster and steering column trim. The passenger's visible contact points were as follows: The passenger's head contacted the airbag. The passenger's head also contacted the headrest. The passenger's knees contacted the glove box and frontal airbag.

The occupant data is summarized below:

ATD position	HIC <sub>15</sub>	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (g)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50 <sup>th</sup> )	124.237	0.359	1581.232	216.890	38.745	25.709	3378.588	1607.553
Passenger (5 <sup>th</sup> )	306.815	0.329	677.970	476.148	39.184	13.161	2039.738	728.482

The test data can be found on the NHTSA website at [www.nhtsa.gov](http://www.nhtsa.gov)

#### TEST NOTES

Passenger Shoulder Belt load cell was not installed.  
 Passenger Lap Belt load cell was not installed.  
 Barrier C-01 Fx recorded questionable data.  
 Barrier C-02 Fx, My recorded no valid data.  
 Barrier C-02 Mz recorded questionable data.  
 Barrier K-15 My recorded no valid data.

MGA does not endorse or certify products. The manufacturer's name appears solely for identification purposes.

**SECTION 2**  
**OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS**

**DATA SHEET NO. 1  
GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**TEST VEHICLE INFORMATION AND OPTIONS**

NHTSA No.	M20220212	Traction Control System (TCS)	Yes
Model Year	2022	Power Steering	Yes
Make	Ford	Power Window Auto-Reverse	Yes
Model	Ranger XLT SuperCab 4x4	Driver Frontal Airbag	Yes
Body Style	Pickup Truck	Driver Curtain Airbag	Yes
VIN	1FTER1FHXLND45458	Driver Head/Torso Airbag	No
Body Color	Shadow Black	Driver Torso Airbag	No
Odometer (km/mi)	40 km / 25 mi	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.3 L	Driver Pelvis Airbag	No
Type/No. Cylinders	Inline 4	Driver Knee Airbag	No
Engine Placement	Longitudinal	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	10	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	4WD	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	No	Front Pass. Knee Airbag	No
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	Yes	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other	N/A

Does owner's manual provide instructions to turn off automatic door locks?	Yes
--	-----

**DATA FROM CERTIFICATION LABEL**

Manufactured By	FORD MOTOR CO.	GVWR (kg)	2744
		GAWR Front (kg)	1410
Date of Manufacture	08/22	GAWR Rear (kg)	1529

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bucket		
Designated Seating Capacity (DSC)	2	2		4
Capacity Weight (VCW) (kg)				726
Cargo Weight (RCLW) (kg)				136

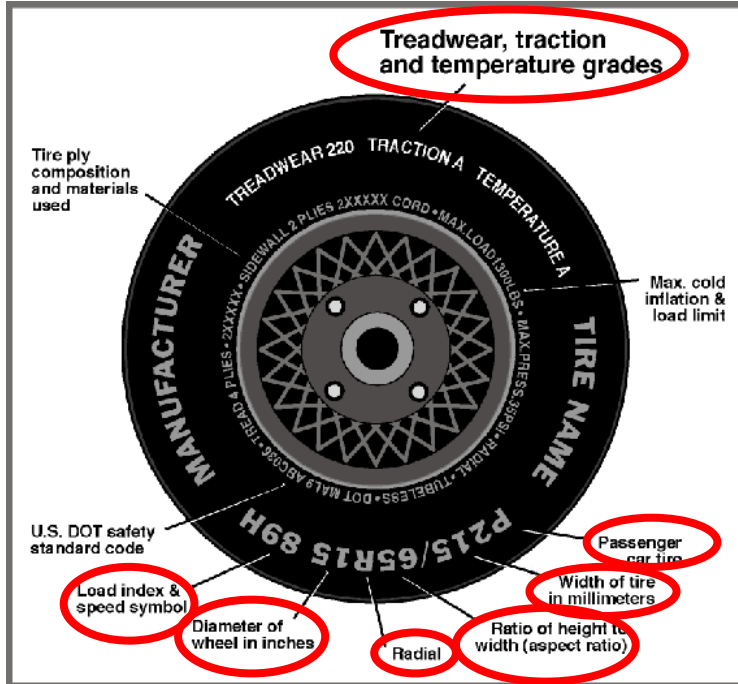
\* Rated Cargo and Luggage Weight (RCLW) limited to maximum of 300 lbs (136 kg).

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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
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NHTSA No.: M20220212  
 Test Date: 11/23/2022

**VEHICLE TIRE INFORMATION**



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	240	240
Recommended Tire Size	265/65R17	265/65R17
Tire Size on Vehicle	265/65R17	265/65R17
Tire Manufacturer	Hankook	Hankook
Tire Model	Dynapro ATM	Dynapro ATM
Treadwear	500	500
Traction	A	A
Temperature Grade	B	B
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	2 Steel, 2 Polyester, 1 Nylon	2 Steel, 2 Polyester, 1 Nylon
Load Index/Speed Symbol	112T	112T
Tire Material	Rubber	Rubber
DOT Safety Code Left	1T73WR FHO 4421	1T73WR FHO 4321
DOT Safety Code Right	1T73WR FHO 4321	1T73WR FHO 4421

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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
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NHTSA No.: M20220212  
 Test Date: 11/23/2022

**TEST VEHICLE WEIGHTS**

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	611.0	421.0		640.5	535.0	
Right	kg	553.5	399.5		564.5	515.0	
Ratio	%	58.7%	41.3%		53.4%	46.6%	
Totals	kg	1164.5	820.5	1985.0	1205.0	1050.0	2255.0

**TARGET TEST WEIGHT CALCULATION**

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1985.0
Weight of 1 P572E ATD & 1 P572O ATD	kg	141
Rated Cargo/Luggage Weight (RCLW)	kg	136
Calculated Test Vehicle Target Weight (TVTW)	kg	2262.0

**TEST VEHICLE ATTITUDES AND CG**

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	920	928	980	989	1331
As Tested	mm	904	909	950	961	1499
Post Test	mm	930	924	961	961	

**GENERAL TEST VEHICLE DATA**

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	3220
Total Vehicle Length at Left Side	mm	5187
Total Vehicle Length at Centerline	mm	5389
Total Vehicle Length at Right Side	mm	5187
Weight of Ballast in Cargo Area	kg	88
Weight of Vehicle Components Removed	kg	0
Amount of Stoddard Solvent in Fuel Tank	L	66.2

List of components removed to meet test weight: None.

List of components removed for instrumentation, data box, and equipment installation: None.

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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**TARGET VEHICLE STRUCTURAL MEASUREMENT**

	<b>Elements</b>	<b>Pre-Test (mm)</b>
1	Total Length	5389
2	Total Width	1876
3	Bumper Top Height	690
4	Bumper Bottom Height	597
5	Longitudinal Member Top Height	564
6	Distance between Longitudinal Members	715
7	Longitudinal Member Width	55
8	Engine Top Height	1050
9	Engine Bottom Height	405
10	Engine and Gearbox Width	310
11	Front Bumper-Engine Distance	410
12	Front Shock Absorber Fixing Height	775
13	Bonnet Leading Edge Height	1075
14	Front Shock Absorber Fixing Width	950
15	Front Bumper – Front Axle Distance	495
16	Front Axle – A-Pillar Distance	600
17	A-Pillar – B-Pillar Distance	1150
18	B-Pillar – Rear Axle Distance	1485
19	B-Pillar – C-Pillar Distance	530
20	Roof Sill Bottom Height	1730
21	Roof Sill Top Height	1785
22	Floor Sill Bottom Height	425
23	Floor Sill Top Height	540

**DATA SHEET NO. 2**  
**SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA**

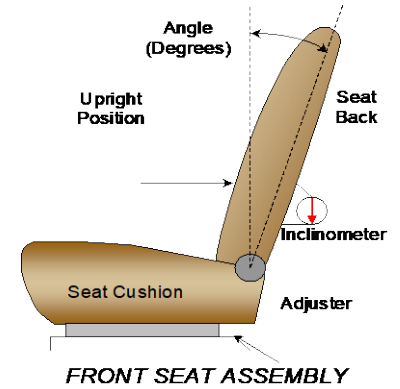
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**NOMINAL DESIGN RIDING POSITION**

The driver seat back is positioned as close as possible to the manufacturer's design angle. For the passenger seat back, seat back is adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated May 2018.

	Degrees
Driver Seat Back Angle	4.0° on outboard headrest post
Passenger Seat Back Angle	2.9° on outboard headrest post



**SEAT FORE/AFT POSITIONS**

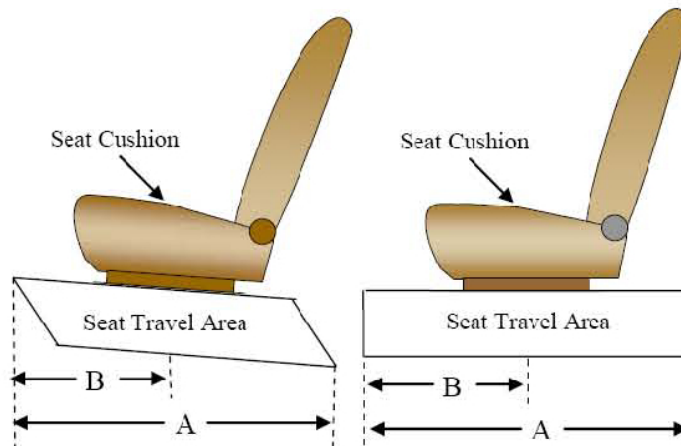
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated May 2018.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	314 mm	157 mm
Passenger Seat	255 mm	0 mm

**SEAT BELT UPPER ANCHORAGES**

The seat belt upper anchorages are set following the manufacturer's specified position as listed in Form 1.

	Total # of Positions	Placed in Position #
Driver Seat	4 (1 <sup>st</sup> as 1)	0 (1 <sup>st</sup> as 0)
Passenger Seat	4 (1 <sup>st</sup> as 1)	0 (1 <sup>st</sup> as 0)



**DATA SHEET NO. 2 (CONTINUED)**  
**SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

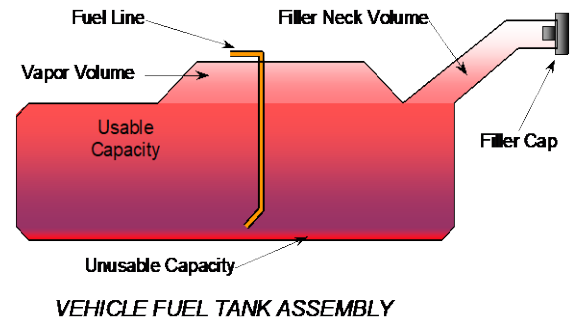
NHTSA No.: M20220212  
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**FUEL TANK CAPACITY DATA**

	<b>Liters</b>
Usable Capacity of "Standard Tank"	71.2
Usable Capacity of "Optional Tank"	
92-94% of Usable Capacity	65.5 to 66.9
Actual Amount of Solvent used	66.2
1/3 of Usable Capacity	23.7

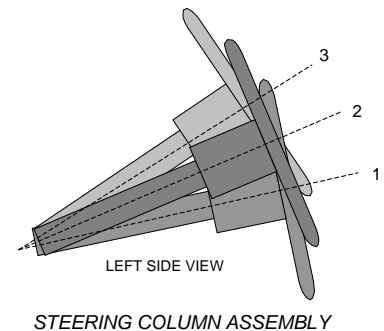
**FUEL PUMP**

The vehicle is equipped with an electronic fuel pump. The electronic fuel pump operates for a prescribed amount of time to pressurize the fuel system following the actuation of the ignition. If no attempt has been made to start the engine within two seconds following ignition operation the fuel pump will shut-off. The fuel pump operates continuously while the engine is running. If the engine stalls the fuel pump is deactivated. A fuel system shut-off system is also equipped which is designed to stop the fuel flow to the engine if the vehicle sustains an impact above a certain magnitude. The filler neck is located on the driver's side.



**STEERING COLUMN ADJUSTMENT**

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. An aluminum plate is placed across the rim of the steering wheel, an inclinometer is placed on the plate and the angle is measured.



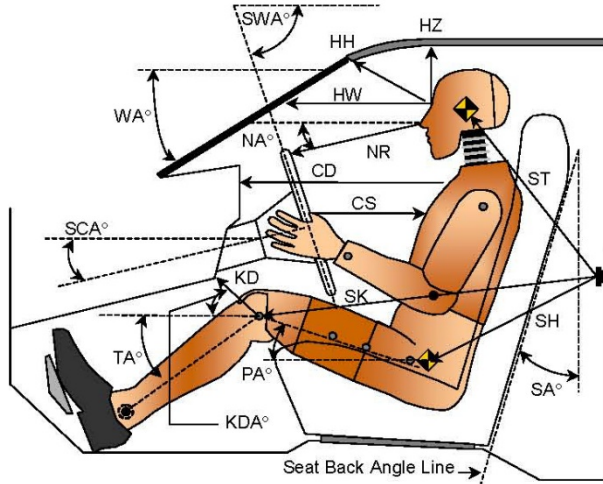
**STEERING COLUMN POSITION**

	<b>Degrees</b>	<b>Fore/Aft Position (mm)</b>
Lowermost Position 1	69.2	
Geometric Center Position 2	66.4	
Uppermost Position 3	63.6	
Telescoping Steering Wheel Travel		43
Test Position	66.4	22

**DATA SHEET NO. 3  
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
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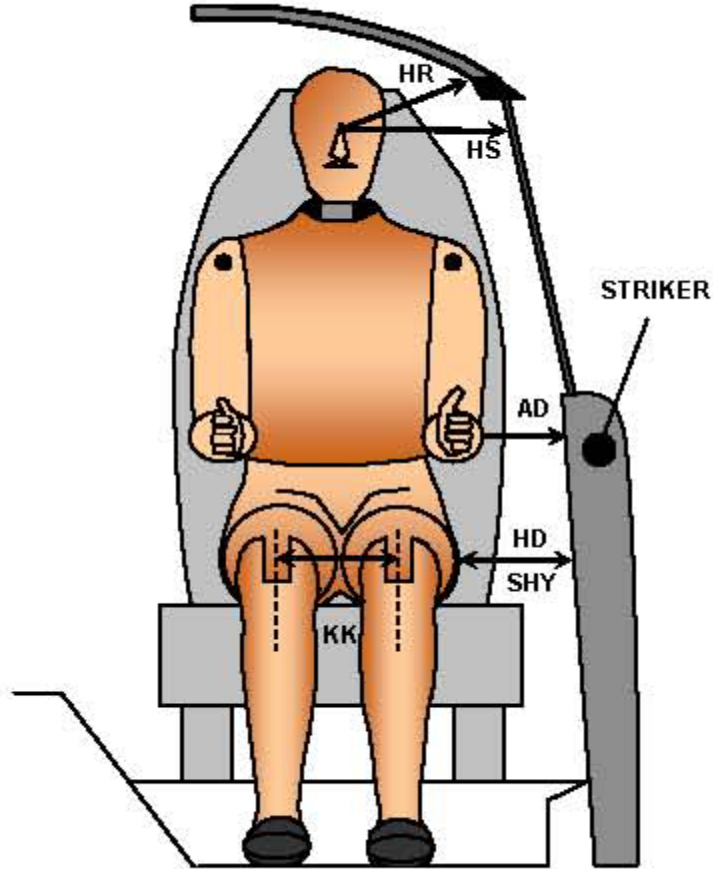
**LEFT SIDE VIEW**

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		24.7		
SWA°	Steering Wheel Angle		66.4		
SCA°	Steering Column Angle		23.6		
SA°	Seat Back Angle		4.0		2.9
HZ	Head to Roof (Z)	204	90	227	90
HH	Head to Header	345	29.3	312	50.2
HW	Head to Windshield	632	0	633	0
NR	Nose to Rim	370	10.2		
CD	Chest to Dash	517		385	
CS	Chest to Steering Hub	301	2.7		
RA	Rim to Abdomen	173	0		
KDL	Left Knee to Dash	153	41.9	89	33.5
KDR	Right Knee to Dash	140	44.7	97	33.1
PA°	Pelvic Angle		22.0		18.7
TA°	Tibia Angle		50.1		57.9
SK	Striker to Knee	698	92.8	803	94.6
ST	Striker to Head	548	111.2	553	35.3
SH	Striker to H-Point	359	118.4	473	109.4

**DATA SHEET NO. 4**  
**DUMMY LATERAL CLEARANCE DIMENSIONS**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
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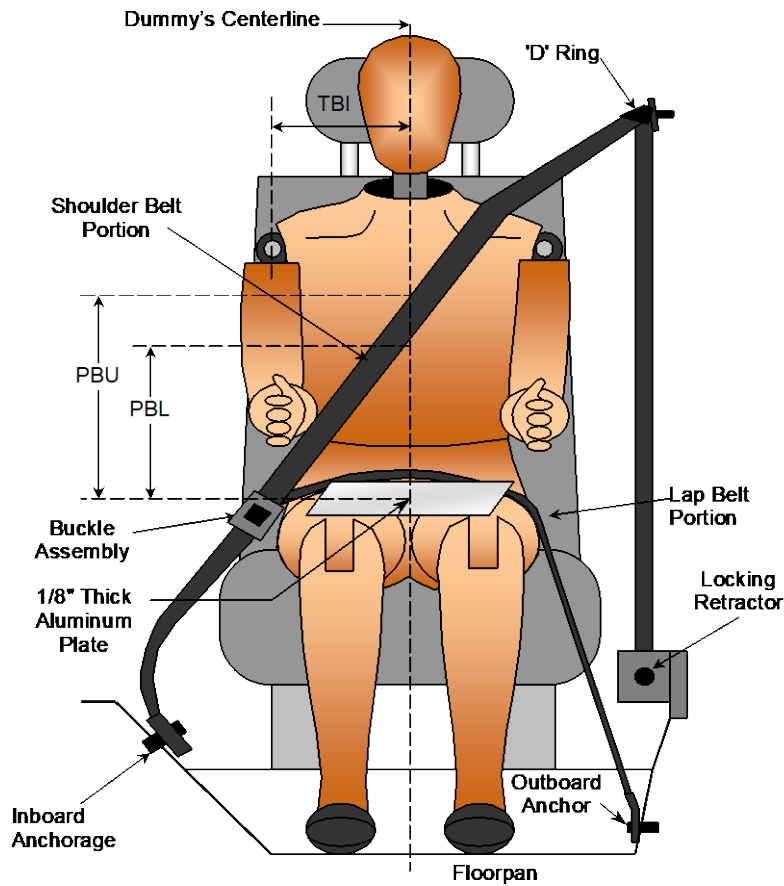
**FRONT VIEW OF DUMMY**

Code	Measurement Description	Driver	Passenger
		Length (mm)	
AD	Arm to Door	124	69
HD	H-Point to Door	142	169
HR	Head to Side Header	217	259
HS	Head to Side Window	330	350
KK	Knee to Knee	333	229
SHY	Striker to H-Point (Y Direction)	275	300
AA	Ankle to Ankle	307	170

**DATA SHEET NO. 5  
SEAT BELT POSITIONING DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022



**FRONT VIEW OF DUMMY**

**SEAT BELT POSITIONING MEASUREMENTS**

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	350	335
PBL - Top surface of reference to belt lower edge	mm	270	240

**BELT LENGTH DATA**

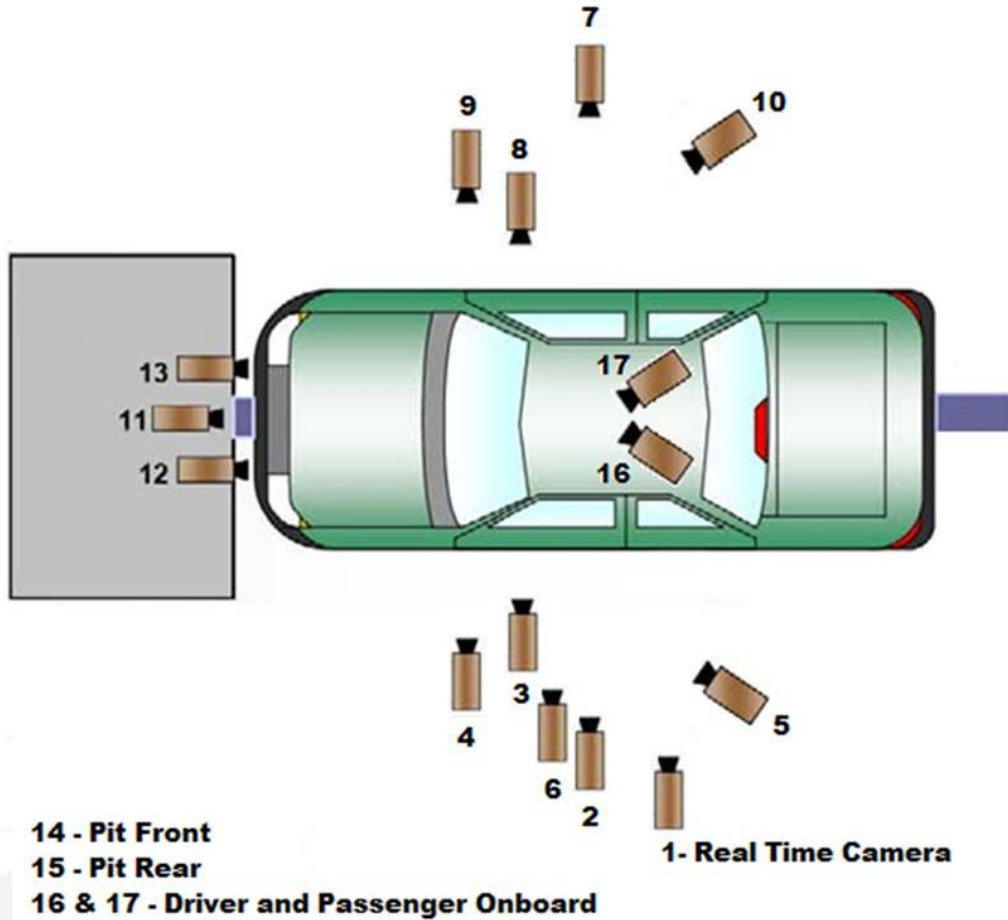
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	910	955
Lap Belt Length as measured on ATD	mm	685	740
Remainder of belt on reel	mm	905	805
Total Belt Length for Continuous Webbing Systems	mm	3000	3000

**DATA SHEET NO. 6  
HIGH-SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
Test Date: 11/23/2022

**CAMERA POSITIONS FOR FRONTAL IMPACTS**



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

**DATA SHEET NO. 6 (CONTINUED)**  
**HIGH-SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**CAMERA LOCATIONS**

No.	Camera View	Coordinates* (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall					30
2	Left Overall	-2470	-5870	-1440	12	1000
3	Driver Close-Up	-1720	-6930	-1860	50	1000
4	Left Front Half	-1180	-5890	-1380	24	1000
5	Left Angle	-7310	-5700	-1920	75	1000
6	Steering Column	-960	-5800	-1250	50	1000
7	Right Overall	-2440	5920	-1450	12	1000
8	Passenger Close-Up	-1790	6900	-1920	50	1000
9	Right Front Half	-1230	5940	-1430	24	1000
10	Right Angle	-7360	5480	-1980	75	1000
11	Windshield	150	0	-2310	12	1000
12	Driver Windshield	200	-370	-2230	25	1000
13	Passenger Windshield	200	370	-2230	25	1000
14	Pit Front	-1050	0	3340	24	1000
15	Pit Rear	-3050	0	3340	24	1000
16	Driver Onboard				12	1000
17	Passenger Onboard				12	1000
18	Real-Time Pan View					30

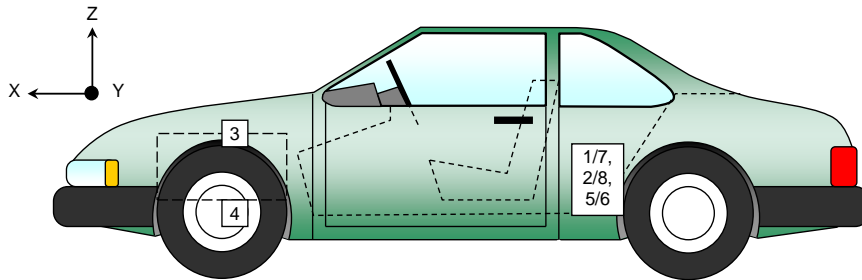
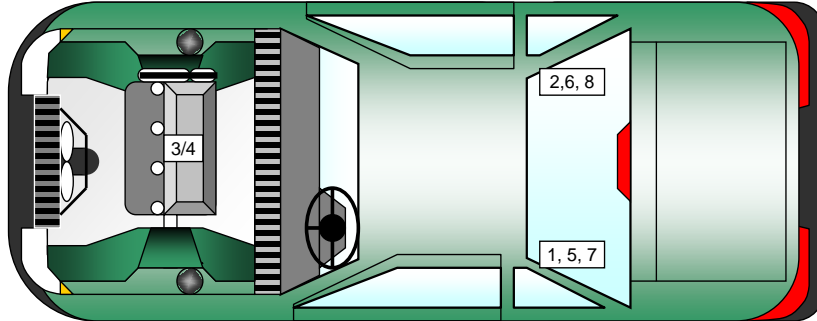
\*COORDINATES:

- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = below ground level

**DATA SHEET NO. 7**  
**VEHICLE ACCELEROMETER LOCATIONS**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
Test Date: 11/23/2022



**VEHICLE ACCELEROMETER PRE-TEST LOCATIONS**

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	2571	-395	-552
2	Right Rear Crossmember Accelerometer – X Direction	2571	425	-552
3	Engine Top X	4504	-40	-1020
4	Engine Bottom X	4268	0	-410
5	Left Rear Crossmember Accelerometer – Z Direction	2571	-395	-552
6	Right Rear Crossmember Accelerometer – Z Direction	2571	425	-552
7	Left Rear Crossmember Accelerometer Redundant – X Direction	2571	-345	-552
8	Right Rear Crossmember Accelerometer Redundant – X Direction	2571	360	-552

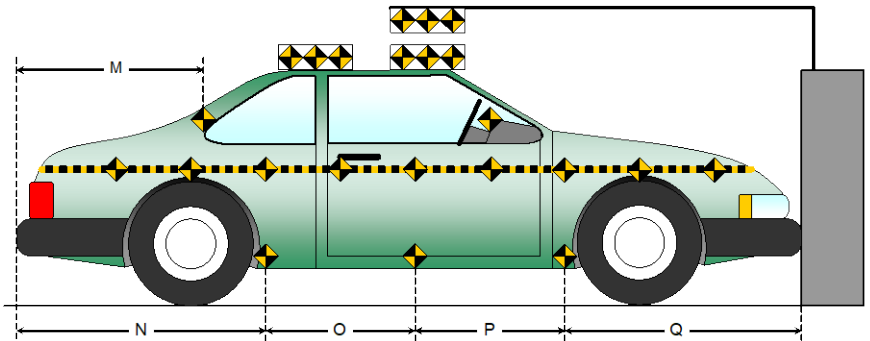
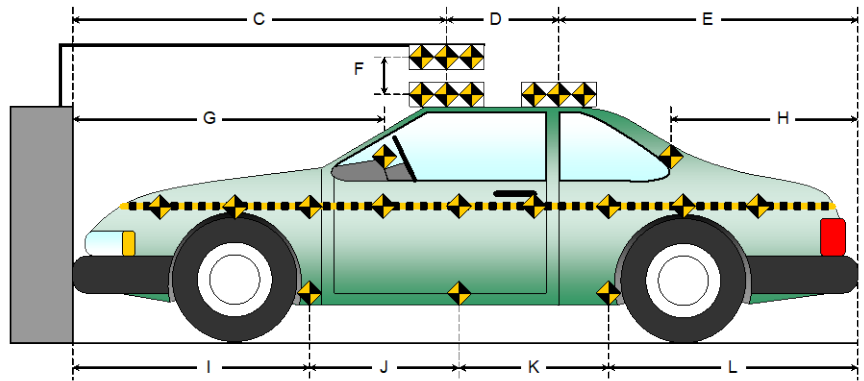
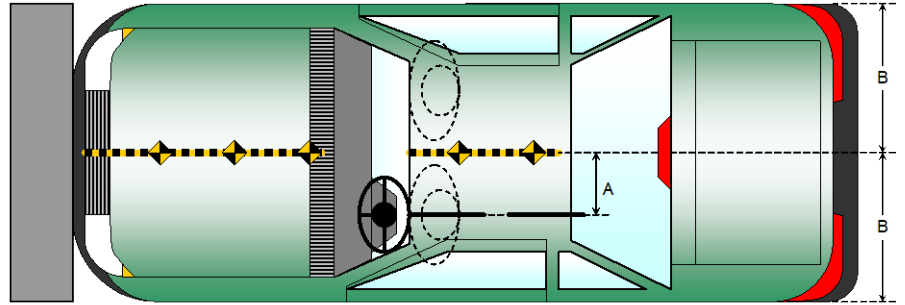
Reference Points: X - Rear Surface of Vehicle (+ forward)  
Y - Vehicle Centerline (+ to right)  
Z - Ground Plane (+ down)

**DATA SHEET NO. 8**  
**PHOTOGRAPHIC REFERENCE TARGET LOCATIONS**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

Item	Value (mm)
A	405
B	938
C	2445
D	610
E	2334
F	80
G	
H	2140
I	1509
J	1025
K	1025
L	1830
M	2140
N	1509
O	1025
P	1025
Q	1830



**DATA SHEET NO. 9  
LOAD CELL LOCATIONS ON FIXED BARRIER**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**ADVANCED RESEARCH LOAD CELL BARRIER**

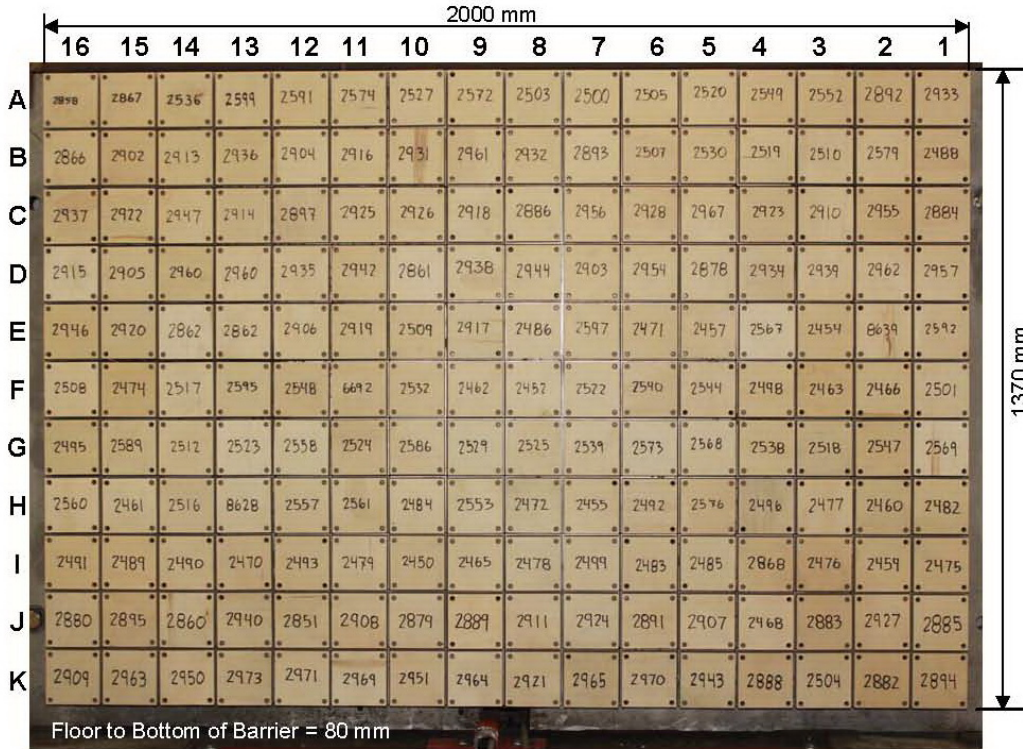


Photo for Reference Only

Centerline

A-16	A-15	A-14	A-13	A-12	A-11	A-10	A-09	A-08	A-07	A-06	A-05	A-04	A-03	A-02	A-01
B-16	B-15	B-14	B-13	B-12	B-11	B-10	B-09	B-08	B-07	B-06	B-05	B-04	B-03	B-02	B-01
C-16	C-15	C-14	C-13	C-12	C-11	C-10	C-09	C-08	C-07	C-06	C-05	C-04	C-03	C-02	C-01
D-16	D-15	D-14	D-13	D-12	D-11	D-10	D-09	D-08	D-07	D-06	D-05	D-04	D-03	D-02	D-01
E-16	E-15	E-14	E-13	E-12	E-11	E-10	E-09	E-08	E-07	E-06	E-05	E-04	E-03	E-02	E-01
F-16	F-15	F-14	F-13	F-12	F-11	F-10	F-09	F-08	F-07	F-06	F-05	F-04	F-03	F-02	F-01
G-16	G-15	G-14	G-13	G-12	G-11	G-10	G-09	G-08	G-07	G-06	G-05	G-04	G-03	G-02	G-01
H-16	H-15	H-14	H-13	H-12	H-11	H-10	H-09	H-08	H-07	H-06	H-05	H-04	H-03	H-02	H-01
I-16	I-15	I-14	I-13	I-12	I-11	I-10	I-09	I-08	I-07	I-06	I-05	I-04	I-03	I-02	I-01
J-16	J-15	J-14	J-13	J-12	J-11	J-10	J-09	J-08	J-07	J-06	J-05	J-04	J-03	J-02	J-01
K-16	K-15	K-14	K-13	K-12	K-11	K-10	K-09	K-08	K-07	K-06	K-05	K-04	K-03	K-02	K-01

Load Cells are 121 mm x 121 mm with a 7 mm gap in between each load cell.

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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**INSTRUMENTATION**

Instrumentation	Number of Channels Collected
Driver Dummy Data Channels	49
Passenger Dummy Data Channels	47
Vehicle Structure Accelerometers	8
Barrier Channels	528
Total	632

**CAMERA COVERAGE**

Type of Camera	Number Used in this Test
High-Speed Vehicle Onboard	2
High-Speed Offboard	14
Real-Time	2
Total	18

**DATA SHEET NO. 11  
POST-TEST OBSERVATIONS**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**TEST DUMMY INFORMATION AND CONTACT LOCATIONS**

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50% / 351	HIII 5% / 142
Head Contact	Frontal Airbag, Headrest	Frontal Airbag, Headrest
Upper Torso Contact	Frontal Airbag	Frontal Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Bolster	Glove Box, Frontal Airbag
Right Knee Contact	Knee Bolster, Steering Column Trim	Glove Box, Frontal Airbag

**DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION**

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were unlocked	Doors were unlocked
Front Door Opening	Remained closed and unlocked; opened without tools	Remained closed and unlocked; opened without tools
Rear Door Opening	Remained closed and unlocked; opened without tools	Remained closed and unlocked; opened without tools
Trunk/Hatch/Tailgate Opening	Remained closed; opened without tools	
Seat Track Shift (mm)	0	0
Seat Back Movement	None	None

**OTHER VEHICLE POST-TEST OBSERVATIONS**

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	Cracked by passenger frontal airbag and hood corners
Window Damage	None
Other Notable Effects	None

**VEHICLE REBOUND FROM BARRIER**

Measured Parameter	Units	Value
Left Side	mm	675
Center	mm	595
Right Side	mm	665
Average	mm	645

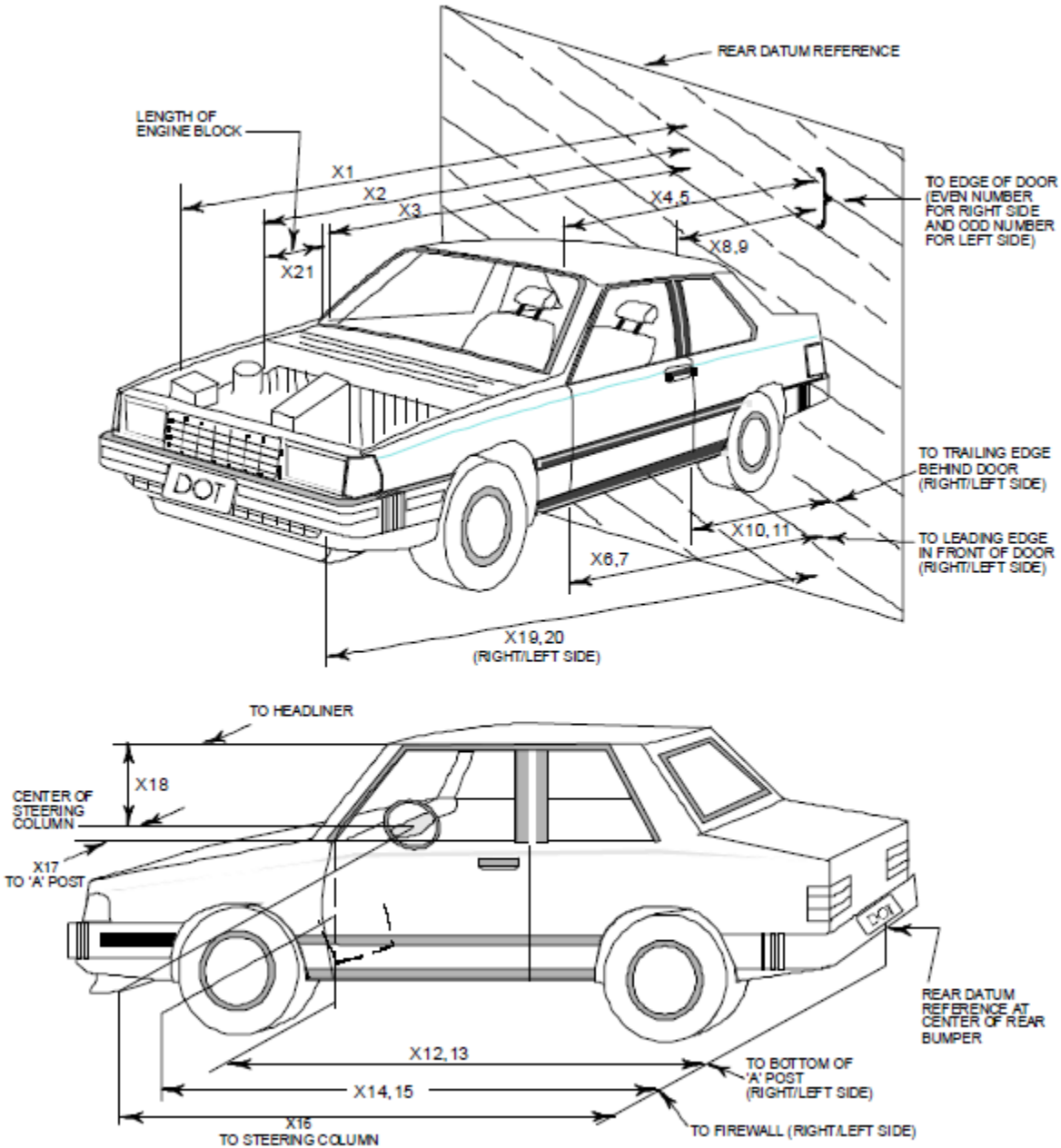
**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

Restraint Type	Driver		Passenger	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	Yes	Yes	Yes
Curtain Side Airbag	Yes	No	Yes	No
Torso/Pelvis Side Airbag	Yes	No	Yes	No
Knee Airbag	No		No	
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	
Other				

## DATA SHEET NO. 12 VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022



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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

<b>No.</b>	<b>Measurement Description</b>	<b>Pre-Test</b>	<b>Post-Test</b>	<b>Change</b>
1	Total Length of Vehicle at Centerline	5389	4805	-584
2	RSOV to Front of Engine	4671	4530	-141
3	RSOV to Firewall	4155	4140	-15
4	RSOV to Upper Leading Edge of Right Door	3854	3840	-14
5	RSOV to Upper Leading Edge of Left Door	3854	3832	-22
6	RSOV to Lower Leading Edge of Right Door	3793	3765	-28
7	RSOV to Lower Leading Edge of Left Door	3793	3766	-27
8	RSOV to Upper Trailing Edge of Right Door	2679	2680	1
9	RSOV to Upper Trailing Edge of Left Door	2679	2666	-13
10	RSOV to Lower Trailing Edge of Right Door	2744	2740	-4
11	RSOV to Lower Trailing Edge of Left Door	2744	2730	-14
12	RSOV to Bottom of "A" Post of Right Side	3834	3840	6
13	RSOV to Bottom of "A" Post of Left Side	3834	3830	-4
14	RSOV to Firewall, Right Side	4194	4180	-14
15	RSOV to Firewall, Left Side	4191	4156	-35
16	RSOV to Steering Column	3358	3415	57
17	Center of Steering Column to "A" Post	396	388	-8
18	Center of Steering Column to Headliner	450	445	-5
19	RSOV to Right Side of Front Bumper	5187	4820	-367
20	RSOV to Left Side of Front Bumper	5187	4788	-399
21	Length of Engine Block	535	535	0
RD	RSOV to Right Side of Dash Panel	3660	3650	-10
CD	RSOV to Center of Dash Panel	3569	3510	-59
LD	RSOV to Left Side of Dash Panel	3665	3630	-35

All dimensions in mm

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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
Test Program: NCAP Frontal Barrier Impact Test

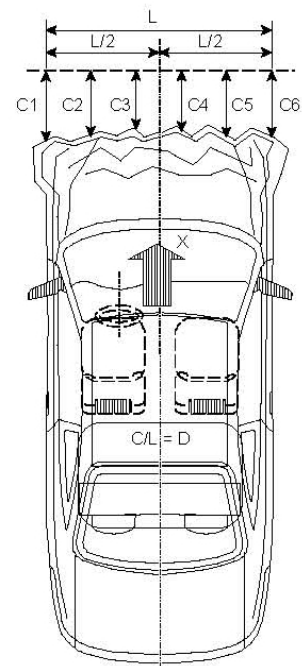
NHTSA No.: M20220212  
Test Date: 11/23/2022

**VEHICLE INFORMATION**

VIN:	<u>1FTER1FHXLND45458</u>	Wheelbase (mm):	<u>3220</u>
Vehicle Size Category:	<u>Truck</u>	Test Weight (kg):	<u>2255.0</u>

**ACCELEROMETER DATA**

Accelerometer Locations:	<u>As per Data Sheet No. 7</u>
Cal. Procedure/Interval:	<u>MGA Procedure / 6 month</u>
Integration Algorithm:	<u>Trapezoidal</u>
Linearity:	<u>&gt; 99%</u>
Impact Velocity (km/h):	<u>56.18</u>
Velocity Change (km/h):	<u>65.2</u>
Time of Separation (msec)	<u>134</u>



**CRUSH PROFILE**

Collision Deformation Classification:	<u>12FDEW3</u>
Midpoint of Damage:	<u>Centerline</u>
Damage Region Length (mm):	<u>1548</u>
Impact Mode:	<u>Frontal</u>

No.	Measurement Description	Units	Pre-Test	Post-Test	Exterior Crush
C1	Crush zone 1 at left side	mm	5187	4788	399
C2	Crush zone 2 at left side	mm	5340	4810	530
C3	Crush zone 3 at left side	mm	5386	4799	587
C4	Crush zone 4 at right side	mm	5386	4800	586
C5	Crush zone 5 at right side	mm	5340	4798	542
C6	Crush zone 6 at right side	mm	5187	4820	367
L	C1 TO C6	mm	1548	1498	50

**DATA SHEET NO. 14**  
**VEHICLE INTRUSION MEASUREMENTS**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

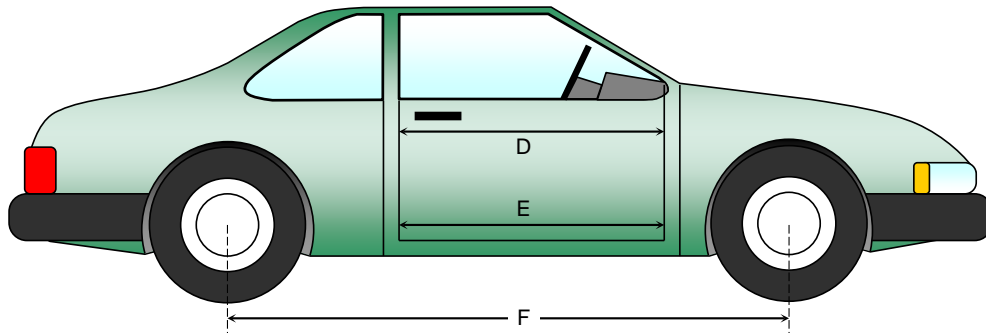
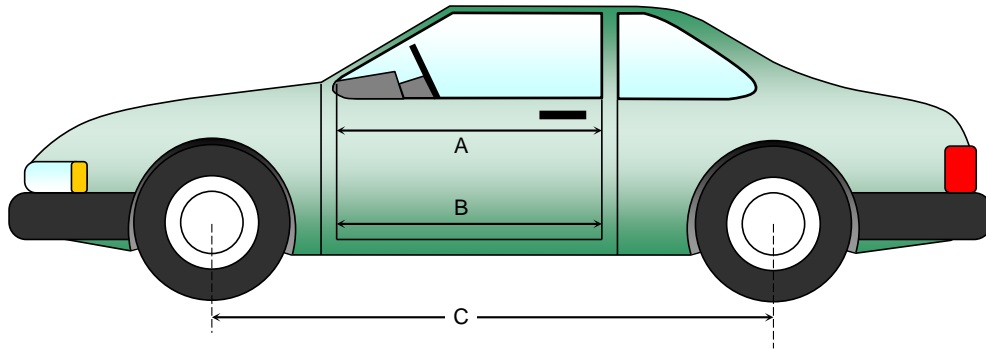
NHTSA No.: M20220212  
 Test Date: 11/23/2022

**DOOR OPENING WIDTH**

Item	Description	Units	Pre-Test	Post-Test	Change
A	Left Side Upper	mm	1054	1051	-3
B	Left Side Lower	mm	995	994	-1
D	Right Side Upper	mm	1051	1051	0
E	Right Side Lower	mm	990	989	-1

**WHEELBASE MEASUREMENTS**

Item	Description	Units	Pre-Test	Post-Test	Change
C	Left Side Wheelbase	mm	3220	3169	-51
F	Right Side Wheelbase	mm	3220	3144	-76



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

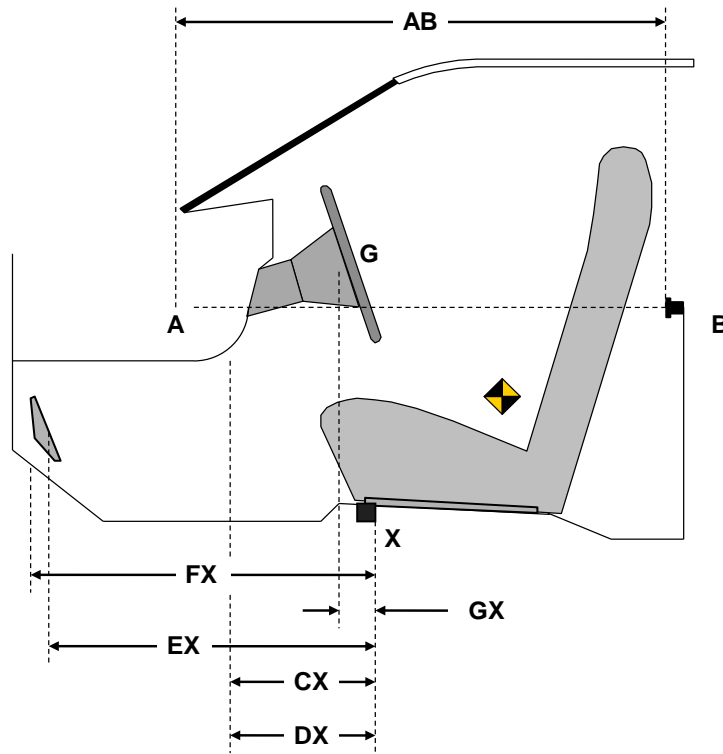
Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**DRIVER COMPARTMENT INTRUSION**

Item	Description	Units	Pre-Test	Post-Test	Change
AB	Door Opening (Inside Window Jam)	mm	860	860	0
CX	Left Knee Bolster to X	mm	340	282	-58
DX	Right Knee Bolster to X	mm	290	267	-23
EX	Brake Pedal to X	mm	580	569	-11
FX	Foot Rest to X	mm	600	561	-39
GX	Center of Steering Column Wheel Hub to X	mm	90	98	8

X = Front of Seat Track (stationary)



**DRIVER COMPARTMENT**

**DATA SHEET NO. 15**  
**SUMMARY OF FMVSS 212 AND FMVSS 219 (PARTIAL) DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**WINDSHIELD MOUNTING DETAILS**

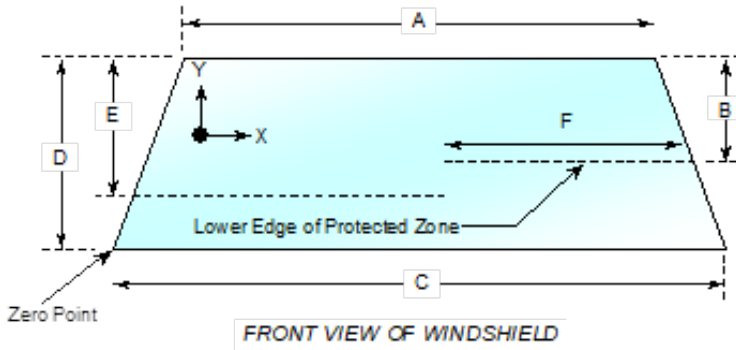
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

The standard requires that the post-test retention measurement be a minimum of 75 percent of the pre-test total periphery measurement for vehicles not equipped with occupant passive restraints and 50 percent for each side of the windshield for vehicles which are equipped with occupant passive restraints.

Temperature of windshield molding during test: 21.1°C.

**WINDSHIELD PERIPHERY MEASUREMENTS**

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2185	2185	100
Right Side	2185	2185	100
Total	4370	4370	100



Item	Units	Value
A	mm	1256
B	mm	436
C	mm	1374
D	mm	870
E	mm	536
F	mm	520

**AREA OF PROTECTED ZONE FAILURES**

A. Provide coordinates of the area that the protected zone was penetrated more than 0.25 inches by a vehicle component other than one that is normally in contact with the windshield. **None**

X	Y

B. Provide coordinates of the area beneath the protected zone that the inner surface of the windshield was penetrated by a vehicle component. **None**

X	Y

**DATA SHEET NO. 16**  
**FMVSS 301 BARRIER IMPACT AND STATIC ROLLOVER**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

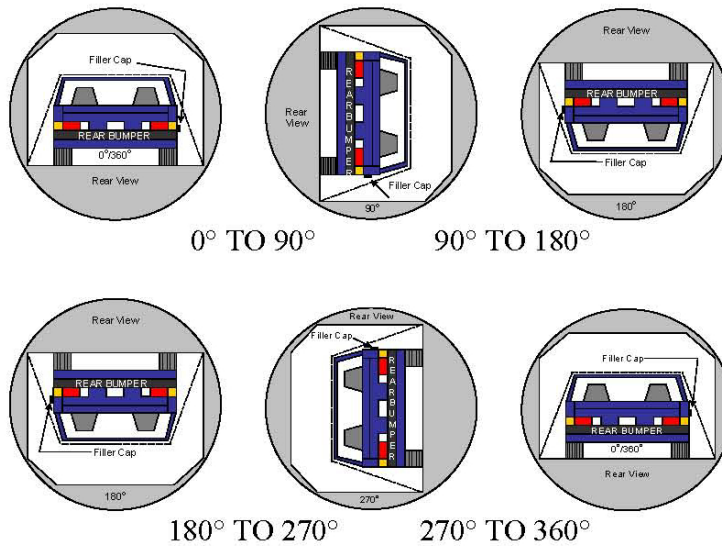
**FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA**

Temperature at Time of Impact: 21.1°C

Test Time: 11:38 a.m.

- A. From impact until vehicle motion ceases: (Maximum Allowable = 1 ounce) 0.0 oz.  
 B. For the 5 minute period after motion ceases: (Maximum Allowable = 5 ounces) 0.0 oz.  
 C. For the following 25 minutes: (Maximum Allowable = 1 ounce / minute) None  
 D. Spillage Details: None

**FMVSS 301 STATIC ROLLOVER RESULTS**



1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.
2. The position hold time at each position is 300 seconds (minimum).
3. Details of Stoddard Solvent spillage: **None**

**SOLVENT COLLECTION TIME TABLE IN SECONDS**

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	111	300	411
90° to 180°	111	300	411
180° to 270°	108	300	408
270° to 360°	110	300	410

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

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022

**FMVSS 301 SPILLAGE TABLE (UNITS IN OUNCES)**

Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eight Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

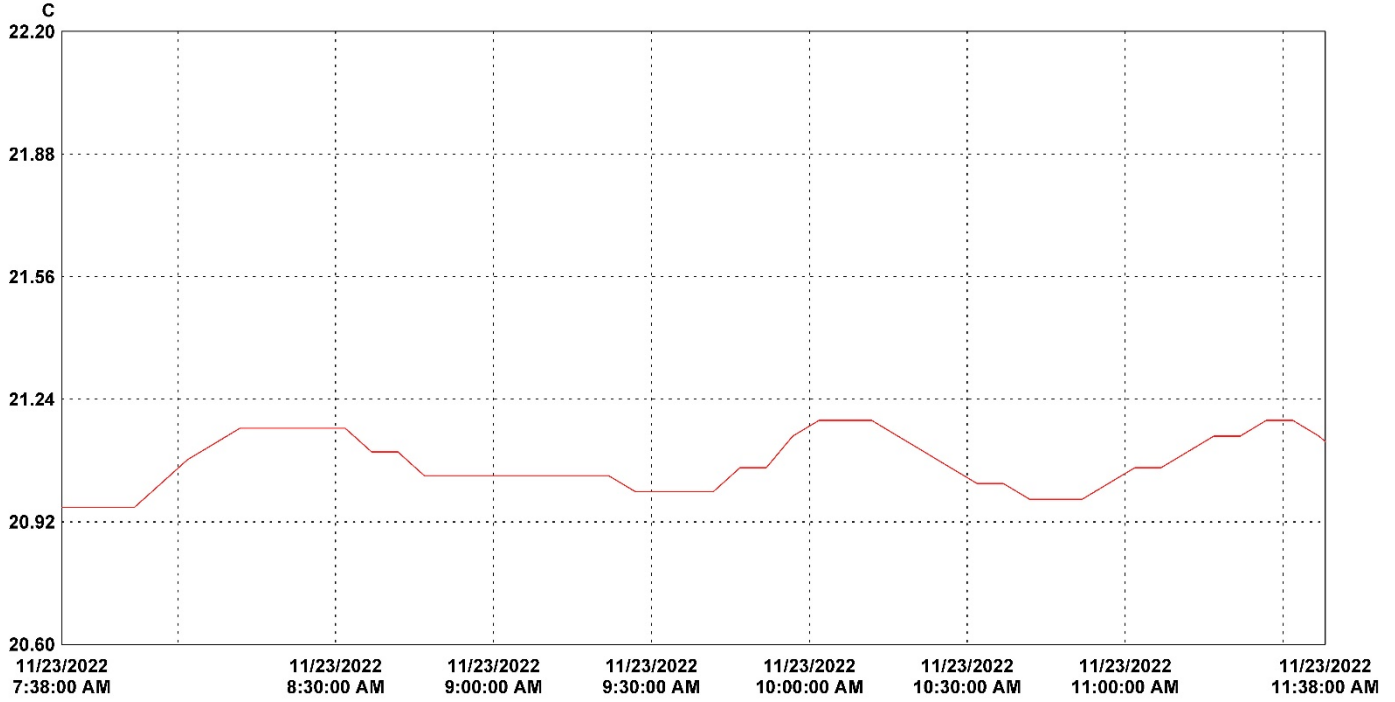
**SOLVENT SPILLAGE LOCATION TABLE**

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

**DATA SHEET NO. 17**  
**DUMMY/VEHICLE TEMPERATURE STABILIZATION DATA**

Test Vehicle: 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20220212  
 Test Date: 11/23/2022



30 minutes/div 4 hours (M/d/yyyy h:mm:ss tt) Central Time Graph file (truncated): M20220212 2022 Ford Ranger XLT SuperCab 4x4 NCAP.spg

LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	18352040	VSC_Prep_Room 1	1	21.18	21.07	20.96	C	Temperature	18352040_VSC_Prep_Room.spl	

**APPENDIX A  
PHOTOGRAPHS**

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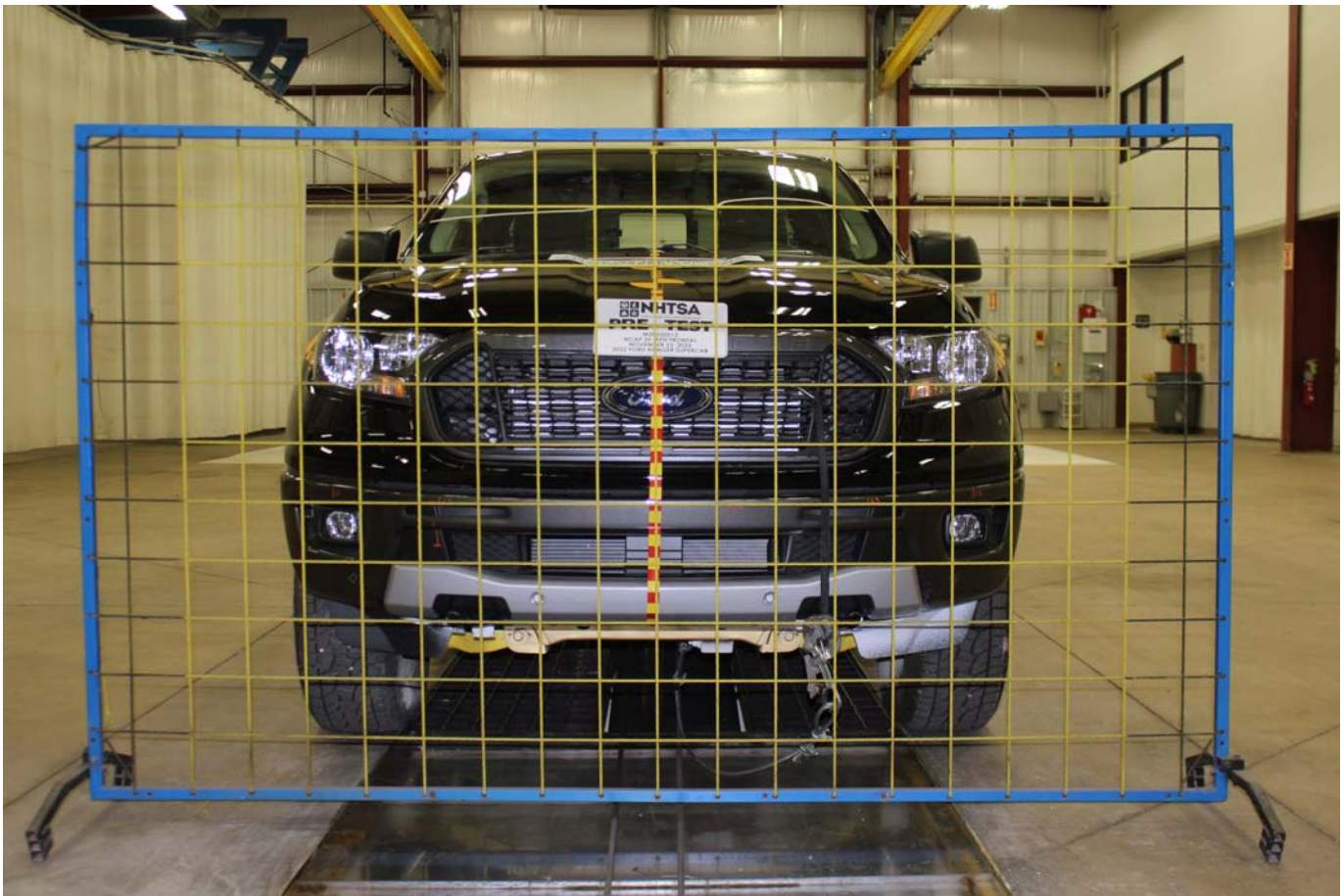


Photo No. 001 - Load Cell Location



Photo No. 002 - Pre-Test Load Cell Wall

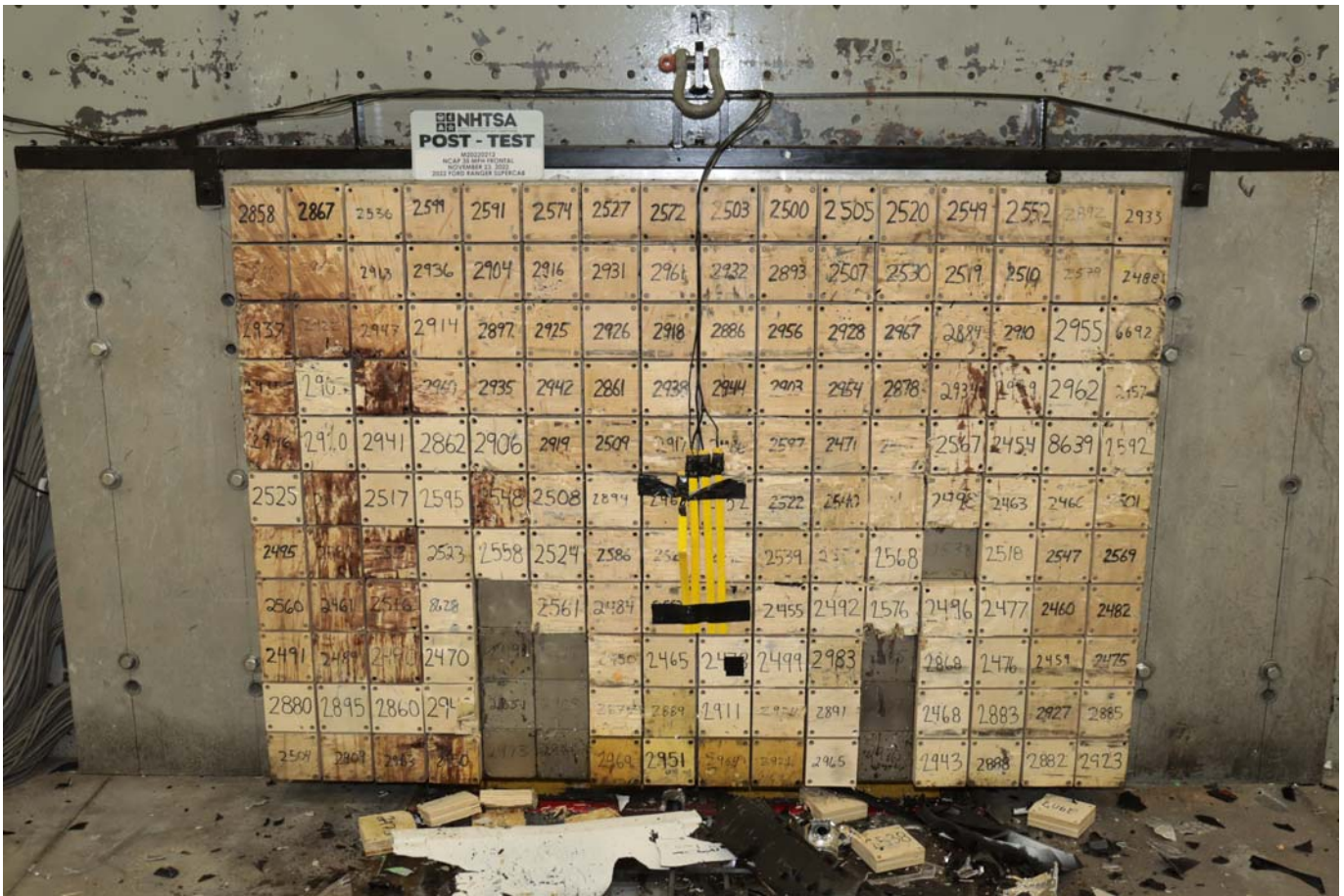


Photo No. 003 - Post-Test Load Cell Wall

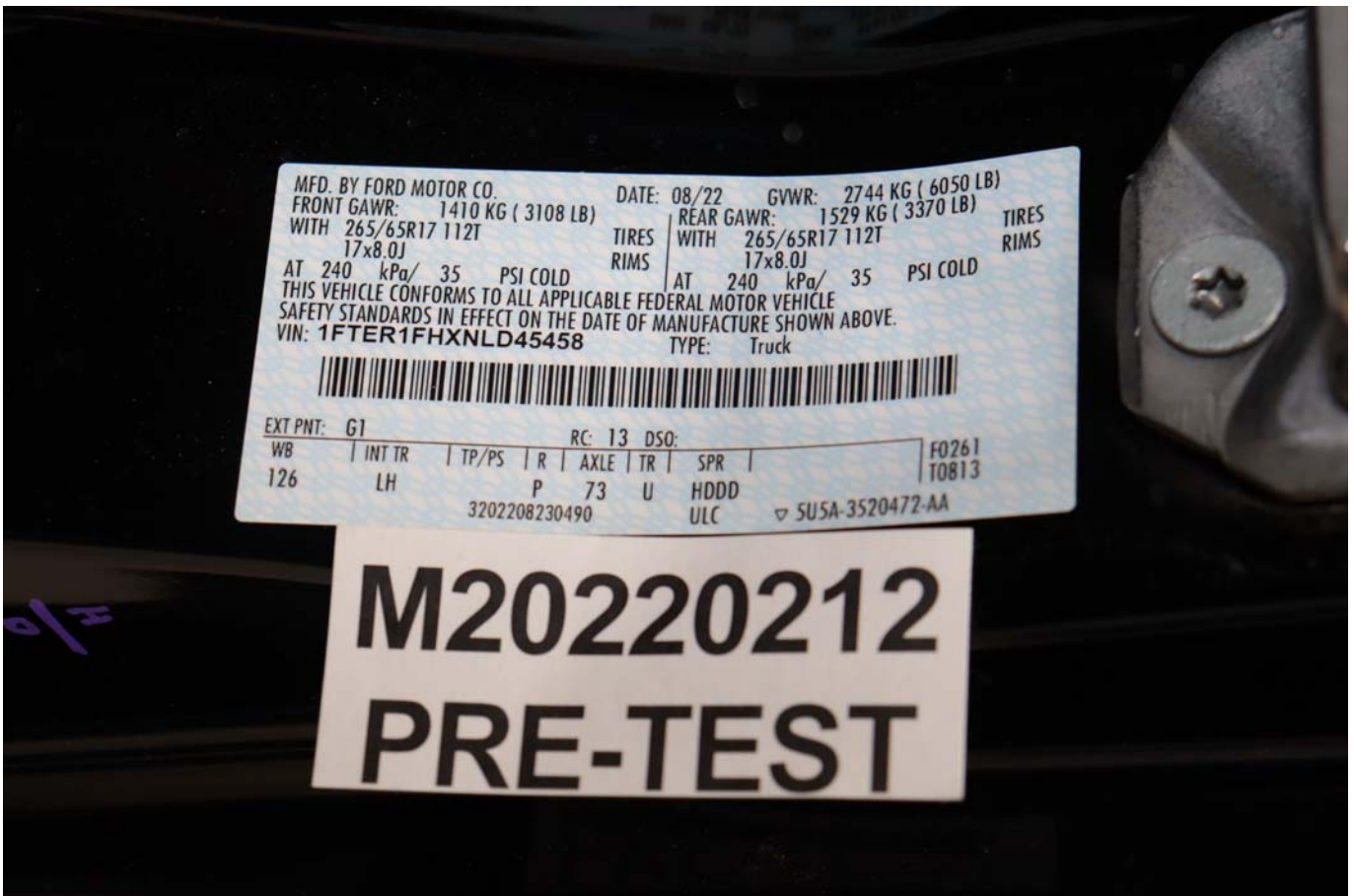


Photo No. 004 - Manufacturer's Label



Photo No. 005 - Tire Placard



Photo No. 006 - 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck Frontal As Delivered



Photo No. 007 - Left Rear 3-4 View, As Received

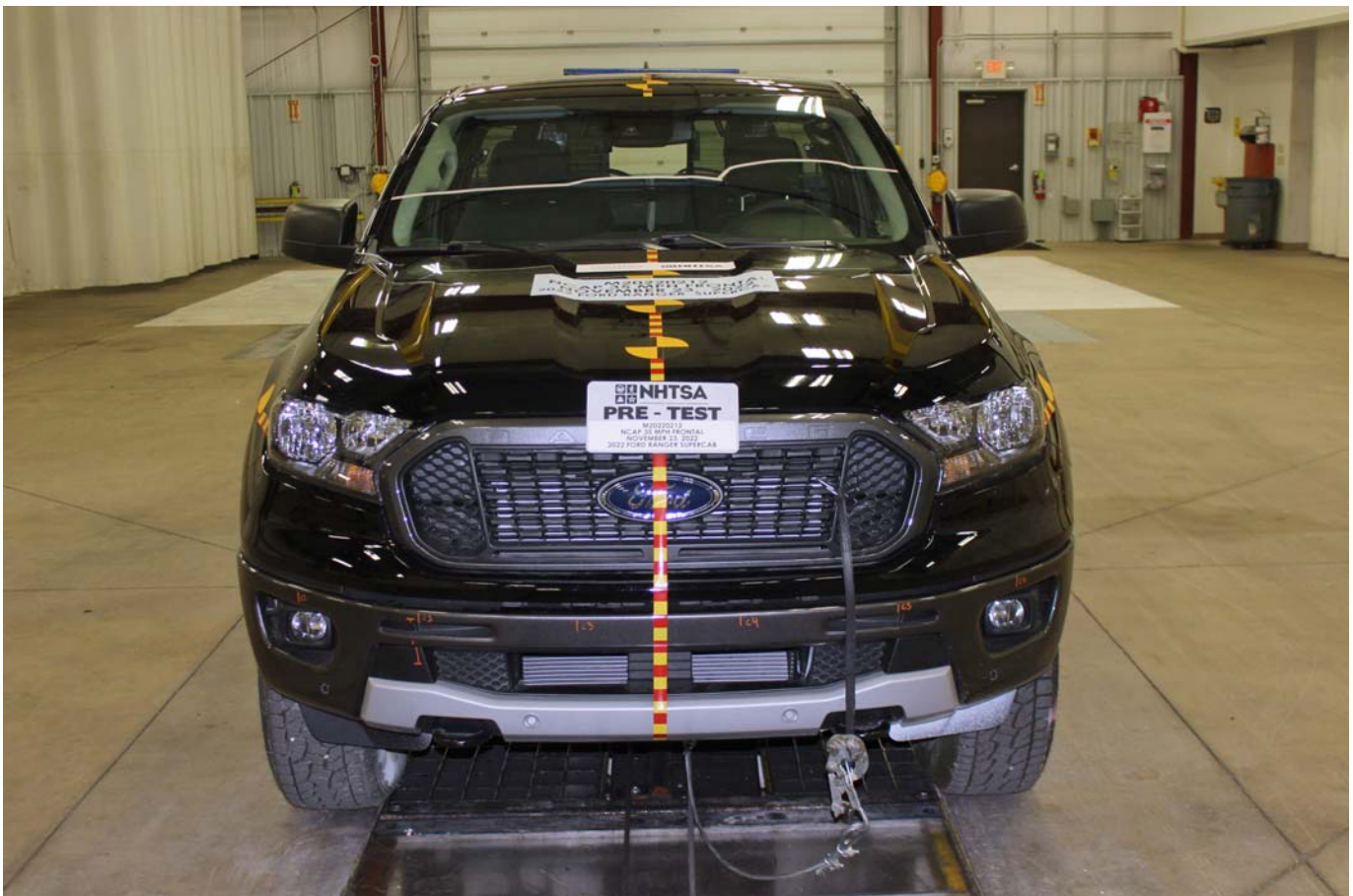


Photo No. 008 - Pre-Test Front View of Test Vehicle

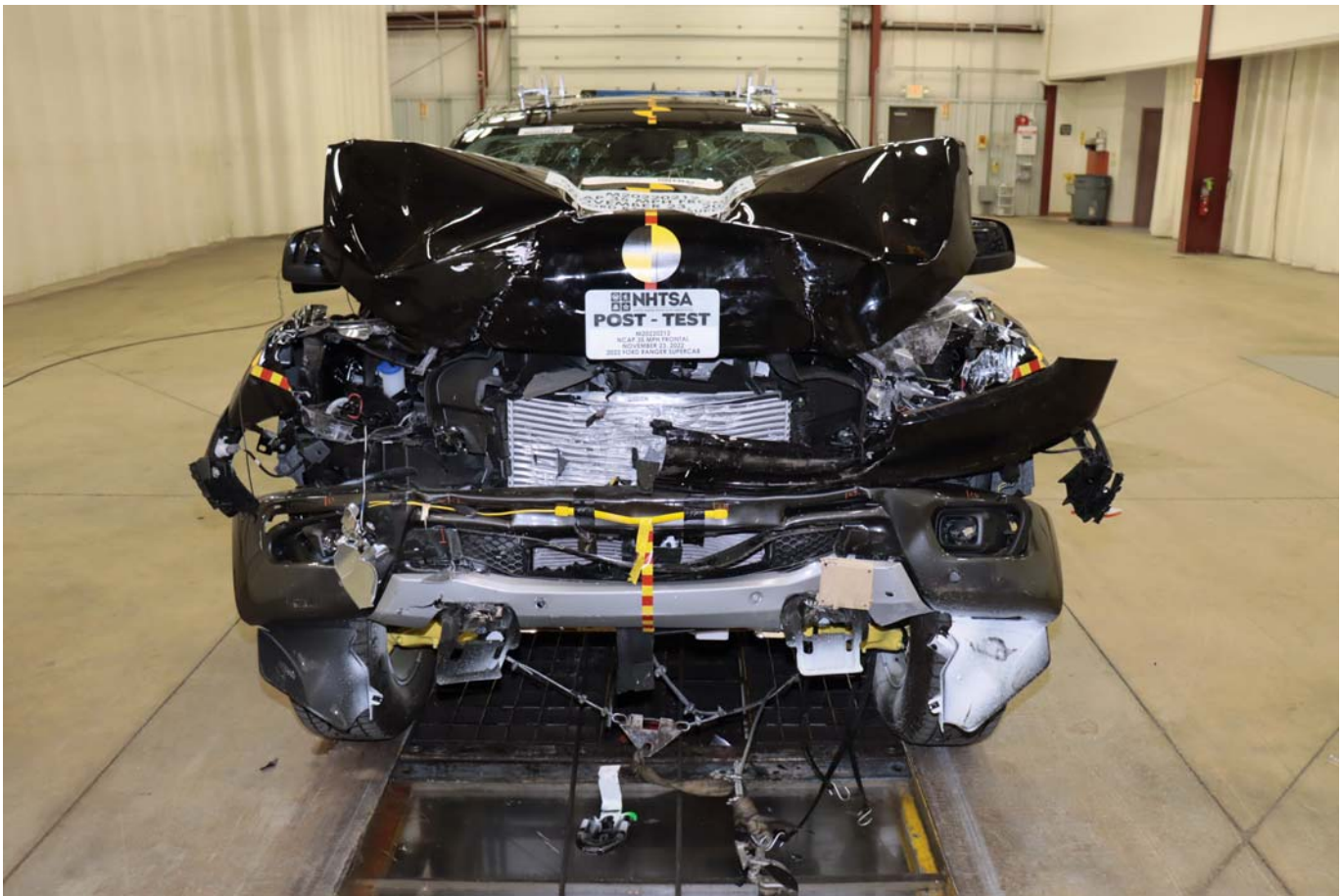


Photo No. 009 - Post-Test Front View of Test Vehicle



Photo No. 010 - Pre-Test Left View of Test Vehicle



Photo No. 011 - Post-Test Left View of Test Vehicle



Photo No. 012 - Pre-Test Right View of Test Vehicle



Photo No. 013 - Post-Test Right View of Test Vehicle



Photo No. 014 - Pre-Test Right Front 3-4 View



Photo No. 015 - Post-Test Right Front 3-4 View



Photo No. 016 - Pre-Test Left Rear 3-4 View



Photo No. 017 - Post-Test Left Rear 3-4 View



Photo No. 018 - Pre-Test Windshield View



Photo No. 019 - Post-Test Windshield View



Photo No. 020 - Pre-Test Engine Compartment View



Photo No. 021 - Post-Test Engine Compartment View



Photo No. 022 - Pre-Test Fuel Filler Cap View



Photo No. 023 - Post-Test Fuel Filler Cap View

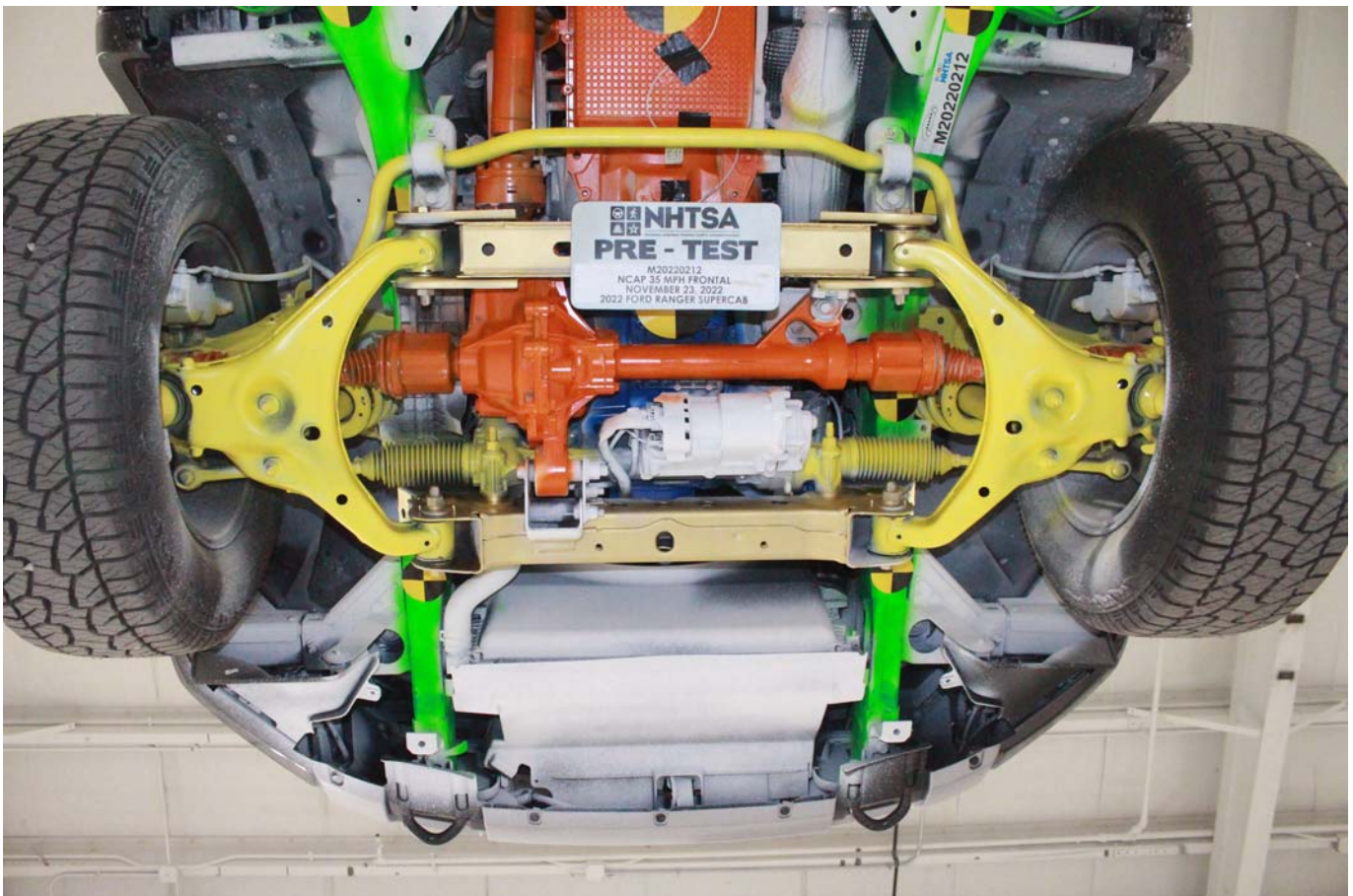


Photo No. 024 - Pre-Test Front Underbody View

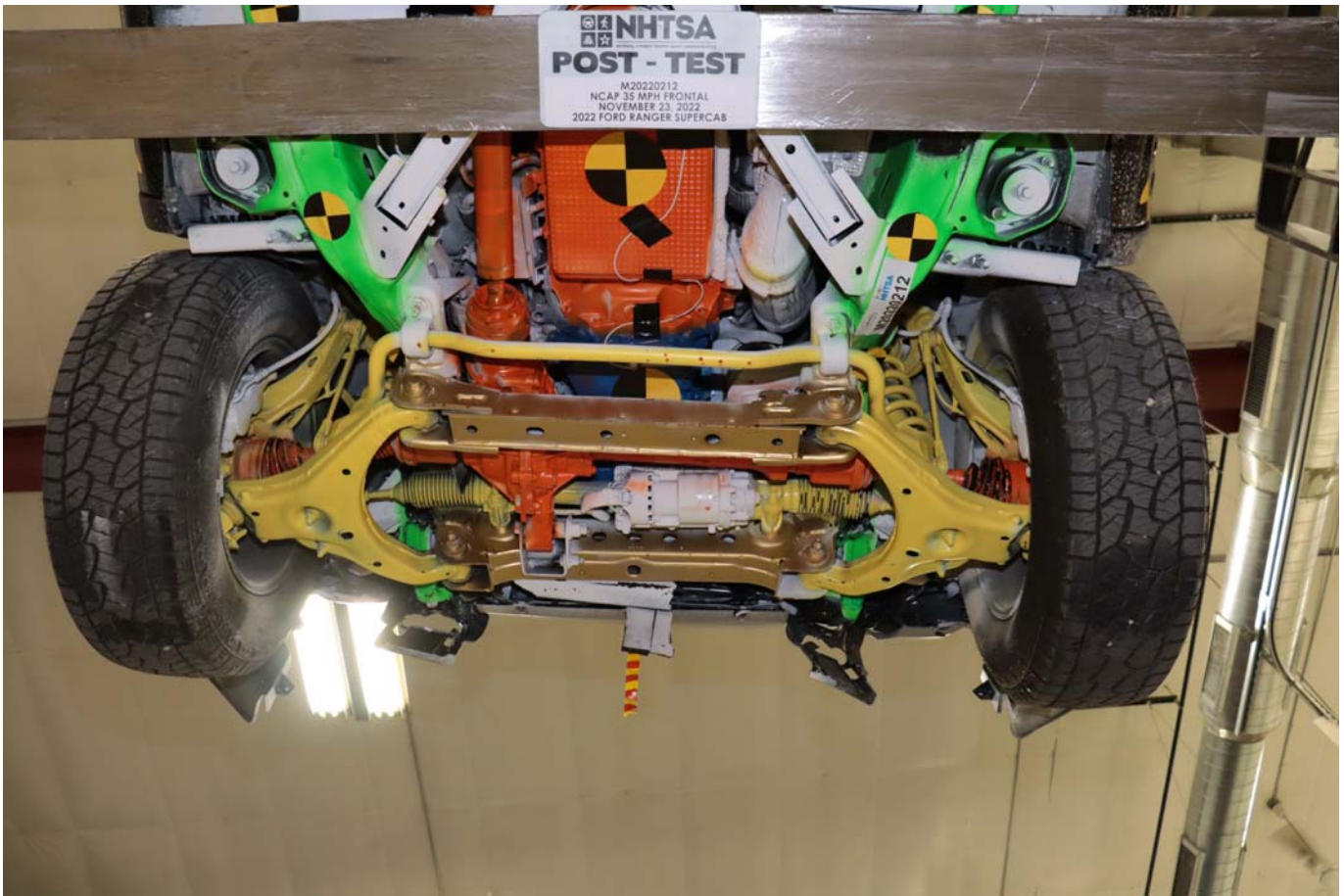


Photo No. 025 - Post-Test Front Underbody View

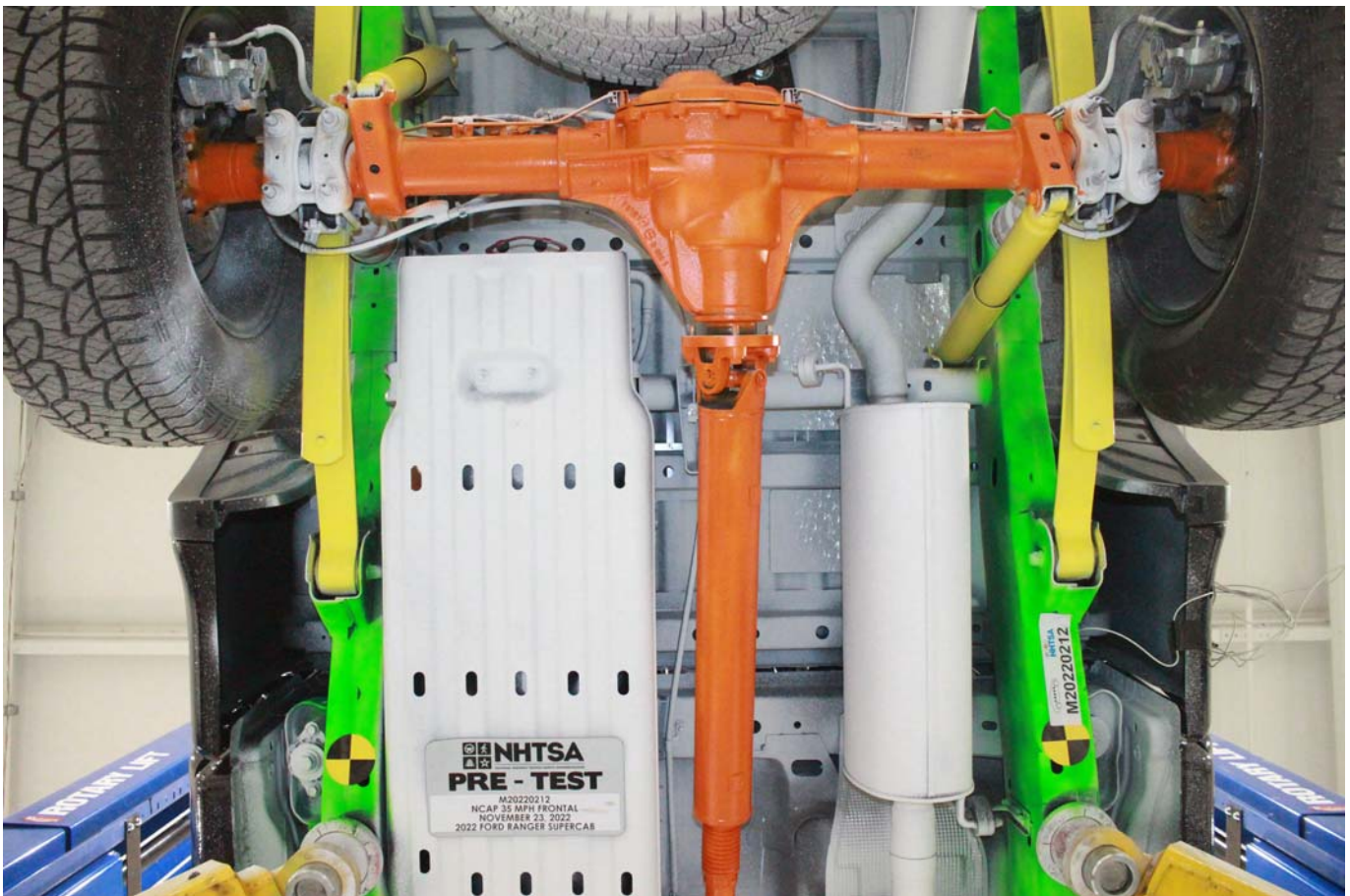


Photo No. 026 - Pre-Test Rear Underbody View

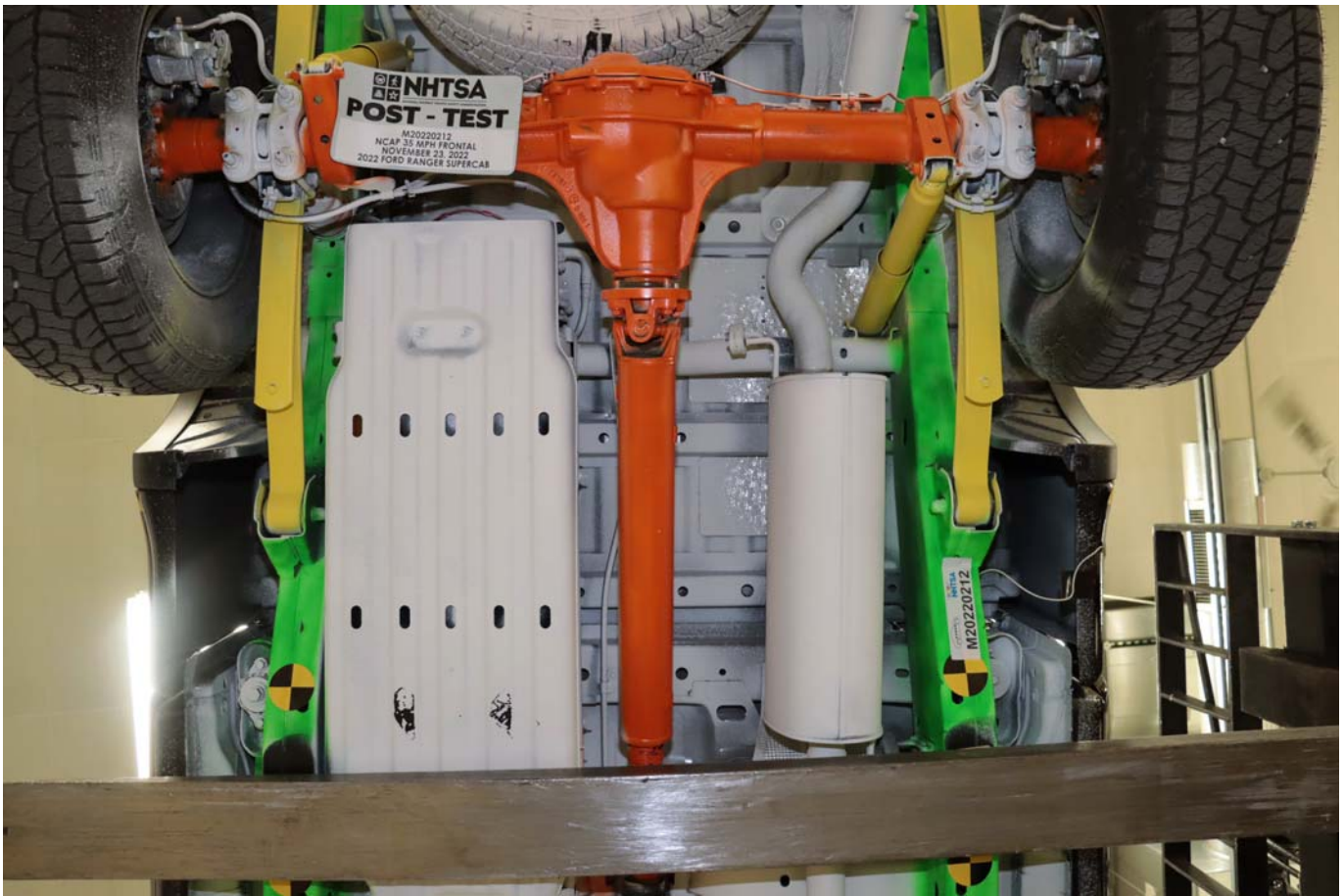


Photo No. 027 - Post-Test Rear Underbody View



Photo No. 028 - Pre-Test Dummy Cable Routing



Photo No. 029 - Post-Test Dummy Cable Routing



Photo No. 030 - Pre-Test Driver Dummy Front View



Photo No. 031 - Post-Test Driver Dummy Front View



Photo No. 032 - Pre-Test Driver Dummy Window View



Photo No. 033 - Post-Test Driver Dummy Window View



Photo No. 034 - Pre-Test Driver Dummy and Vehicle Interior View



Photo No. 035 - Post-Test Driver Dummy and Vehicle Interior View



Photo No. 036 - Pre-Test Driver's Seat Fore-Aft Markings



Photo No. 037 - Post-Test Driver's Seat Fore-Aft Markings



Photo No. 038 - Pre-Test View of Belt Anchorage for Driver Dummy



Photo No. 039 - Post-Test View of Belt Anchorage for Driver Dummy



Photo No. 040 - Pre-Test View of Belt Buckle and Latch Plate for Driver Dummy



Photo No. 041 - Post-Test View of Belt Buckle and Latch Plate for Driver Dummy



Photo No. 042 - Pre-Test Driver Dummy Feet



Photo No. 043 - Post-Test Driver Dummy Feet



Photo No. 044 - Pre-Test Driver's Side Knee Bolster

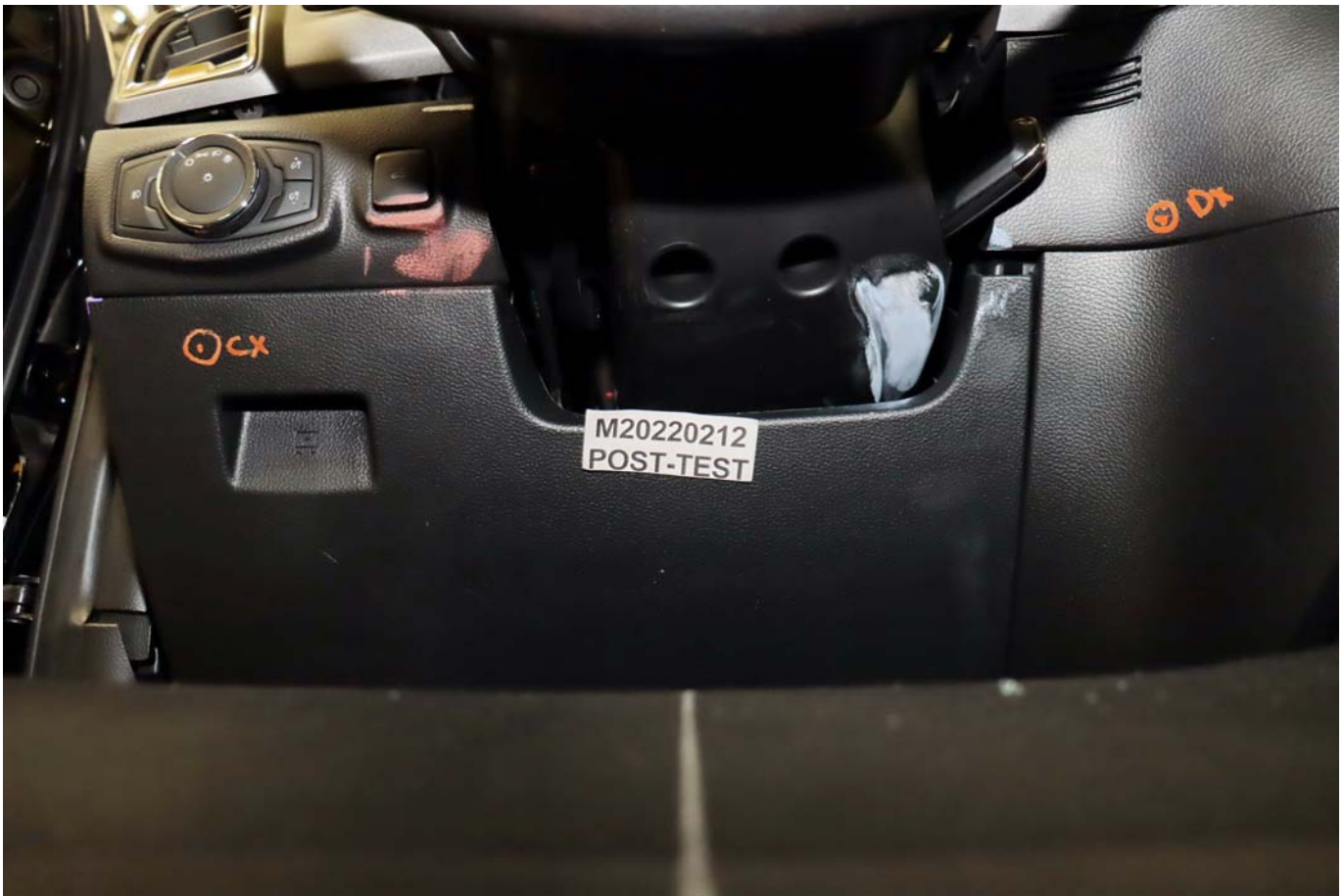


Photo No. 045 - Post-Test Driver's Side Knee Bolster



Photo No. 046 - Pre-Test Driver's Side Floorpan



Photo No. 047 - Post-Test Driver's Side Floorpan



Photo No. 048 - Post-Test Driver Dummy Face

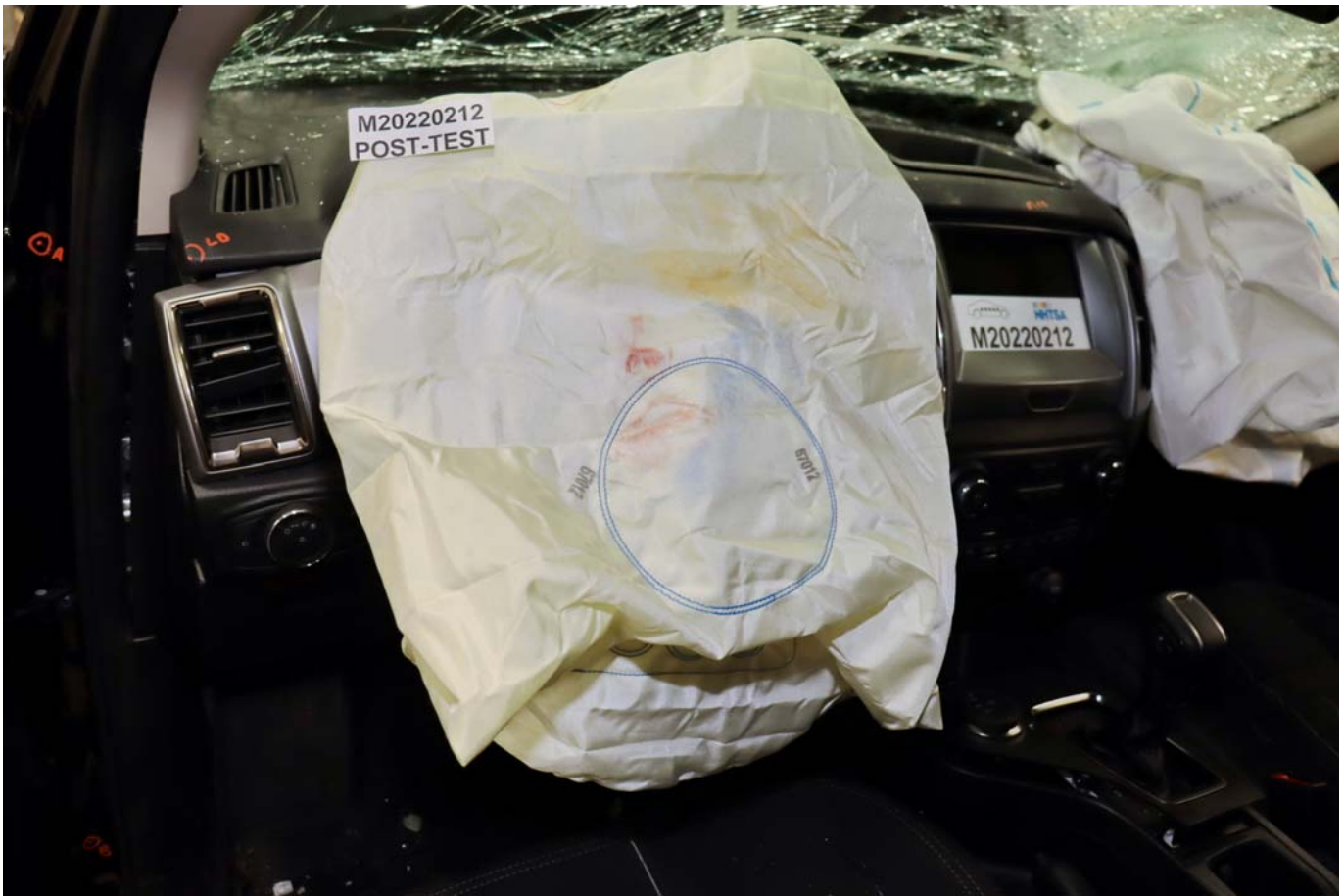


Photo No. 049 - Post-Test Driver Dummy Contact with Airbag



Photo No. 050 - Post-Test Driver Dummy Contact with Headrest



Photo No. 051 - Pre-Test View of the Steering Wheel



Photo No. 052 - Post-Test View of the Steering Wheel



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Photo No. 054 - Post-Test Passenger Dummy Front View



Photo No. 055 - Pre-Test Passenger Dummy Window View



Photo No. 056 - Post-Test Passenger Dummy Window View



Photo No. 057 - Pre-Test Passenger Dummy and Vehicle Interior View



Photo No. 058 - Post-Test Passenger Dummy and Vehicle Interior View



Photo No. 059 - Pre-Test Passenger's Seat Fore-Aft Markings



Photo No. 060 - Post-Test Passenger's Seat Fore-Aft Markings



Photo No. 061 - Pre-Test View of Belt Anchorage for Passenger Dummy



Photo No. 062 - Post-Test View of Belt Anchorage for Passenger Dummy



Photo No. 063 - Pre-Test View of Belt Buckle and Latch Plate for Passenger Dummy



Photo No. 064 - Post-Test View of Belt Buckle and Latch Plate for Passenger Dummy



Photo No. 065 - Pre-Test Passenger Dummy Feet



Photo No. 066 - Post-Test Passenger Dummy Feet



Photo No. 067 - Pre-Test Passenger's Side Knee Bolster



Photo No. 068 - Post-Test Passenger's Side Knee Bolster



Photo No. 069 - Pre-Test Passenger's Side Floorpan



Photo No. 070 - Post-Test Passenger's Side Floorpan



Photo No. 071 - Post-Test Passenger Dummy Face

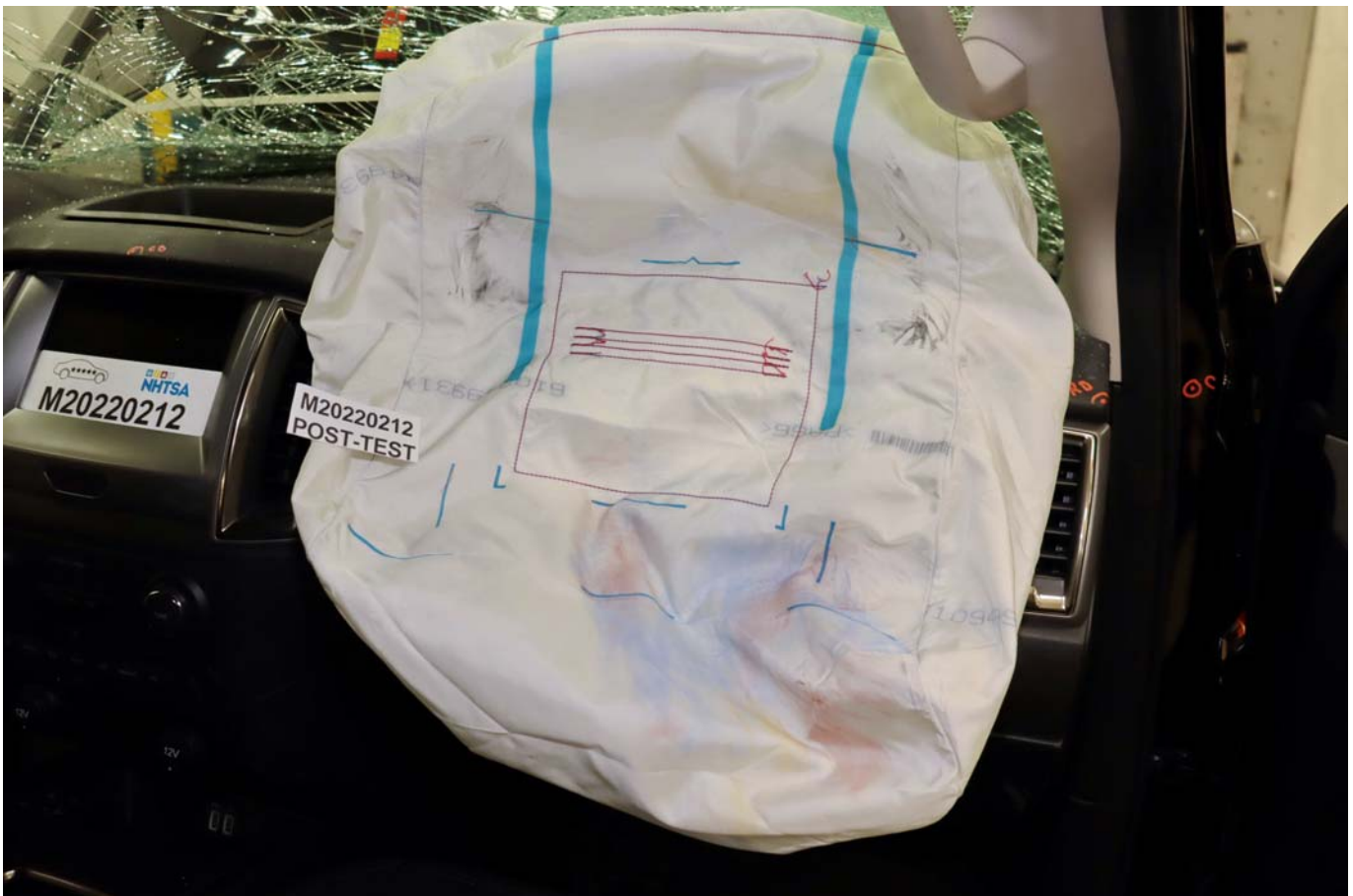


Photo No. 072 - Post-Test Passenger Dummy Contact with Airbag



Photo No. 073 - Post-Test Passenger Dummy Contact with Headrest



Photo No. 074 - Photograph of Ballast Installed in Vehicle

**PHOTOGRAPH NOT APPLICABLE**

Photo No. 075 - Post-Test Stoddard Solvent Spillage Location View



Photo No. 076 - Post-Test Speed Trap Read-Out



Photo No. 077 - Vehicle at 0 Degrees on Static Rollover Device



Photo No. 078 - Vehicle at 90 Degrees on Static Rollover Device



Photo No. 079 - Vehicle at 180 Degrees on Static Rollover Device



Photo No. 080 - Vehicle at 270 Degrees on Static Rollover Device



Photo No. 081 - Vehicle at 360 Degrees on Static Rollover Device



Photo No. 082 - 2022 Ford Ranger XLT SuperCab 4x4 Pickup Truck Frontal Impact Event



**APPENDIX B**  
**DUMMY RESPONSE DATA TRACES**

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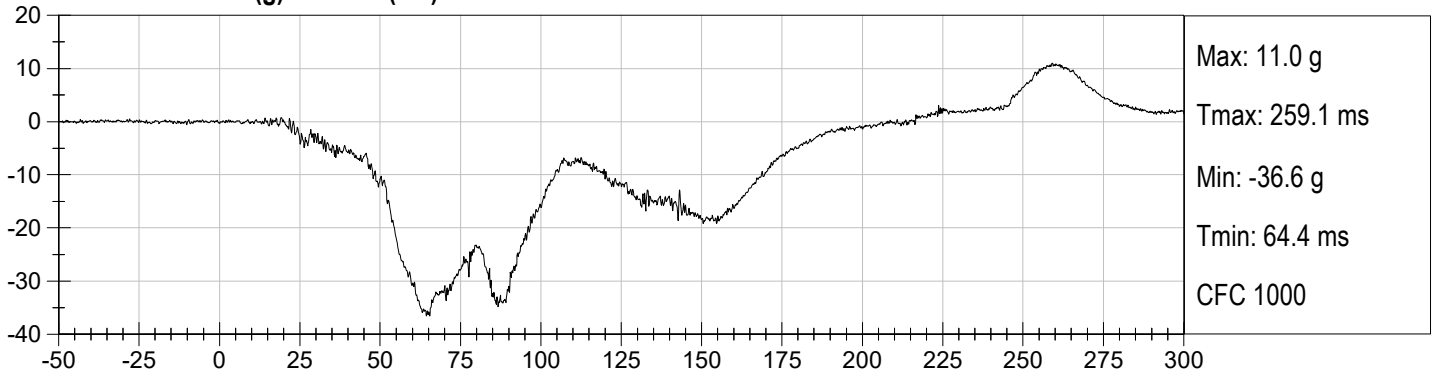
**The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at [www.nhtsa.gov](http://www.nhtsa.gov)**

Driver Head X Redundant  
Driver Head Y Redundant  
Driver Head Z Redundant  
Driver Head Angular Velocity X  
Driver Head Angular Velocity Y  
Driver Head Angular Velocity Z  
Driver Upper Neck Force Y  
Driver Upper Neck Moment X  
Driver Upper Neck Moment Z  
Driver Chest X Redundant  
Driver Chest Y Redundant  
Driver Chest Z Redundant  
Driver Pelvis X  
Driver Pelvis Y  
Driver Pelvis Z  
Driver Left Femur Redundant  
Driver Right Femur Redundant  
Driver Left Upper Tibia Moment X  
Driver Left Upper Tibia Moment Y

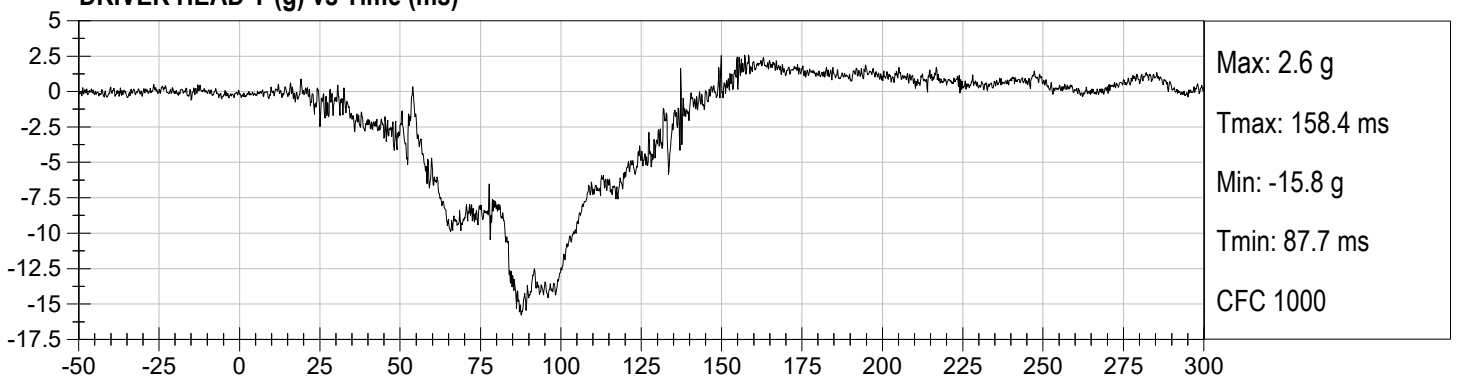
Driver Left Upper Tibia Force Z  
Driver Left Lower Tibia Moment X  
Driver Left Lower Tibia Moment Y  
Driver Left Lower Tibia Force Z  
Driver Right Upper Tibia Moment X  
Driver Right Upper Tibia Moment Y  
Driver Right Upper Tibia Force Z  
Driver Right Lower Tibia Moment X  
Driver Right Lower Tibia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

Passenger Pelvis Z  
Passenger Left Femur Redundant  
Passenger Right Femur Redundant  
Passenger Left Upper Tibia Moment X  
Passenger Left Upper Tibia Moment Y  
Passenger Left Upper Tibia Force Z  
Passenger Left Lower Tibia Moment X  
Passenger Left Lower Tibia Moment Y  
Passenger Left Lower Tibia Force Z  
Passenger Right Upper Tibia Moment X  
Passenger Right Upper Tibia Moment Y  
Passenger Right Upper Tibia Force Z  
Passenger Right Lower Tibia Moment X  
Passenger Right Lower Tibia Moment Y  
Passenger Right Lower Tibia Force Z  
Passenger Left Foot Fore Z  
Passenger Left Foot Aft X  
Passenger Left Foot Aft Z  
Passenger Right Foot Fore Z  
Passenger Right Foot Aft X  
Passenger Right Foot Aft Z  
Passenger Lap Belt Force  
Passenger Shoulder Belt Force  
Left Rear Seat Crossmember X  
Right Rear Seat Crossmember X  
Vehicle Engine Top X  
Vehicle Engine Bottom X  
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Left Rear Seat Crossmember Xr  
Right Rear Seat Crossmember Xr  
Advanced Research Load Cell Barrier – 528 channels

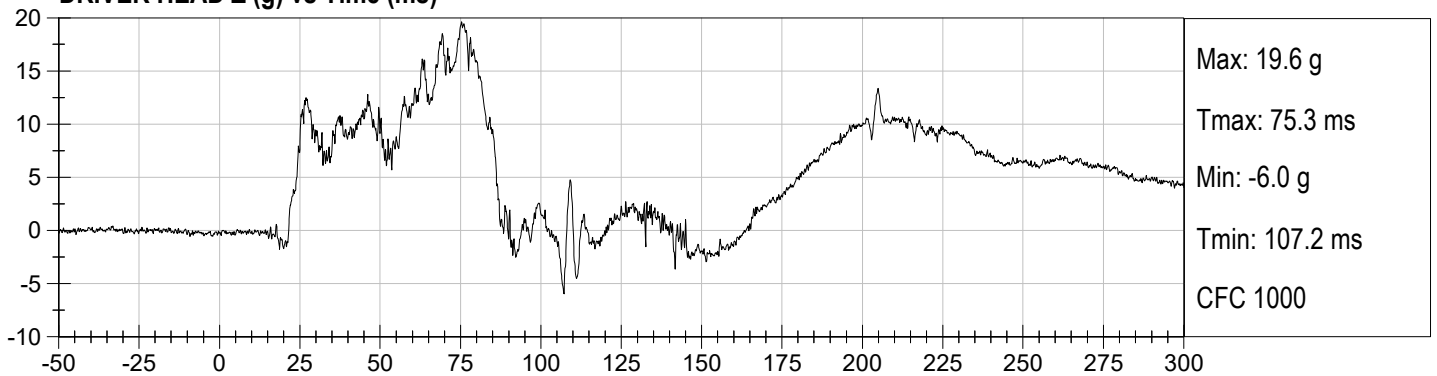
**DRIVER HEAD X (g) vs Time (ms)**



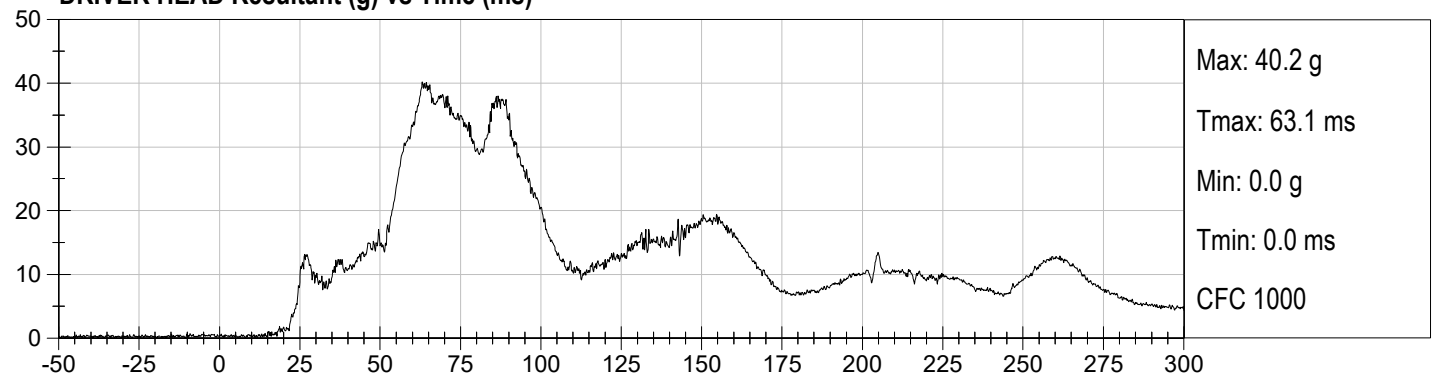
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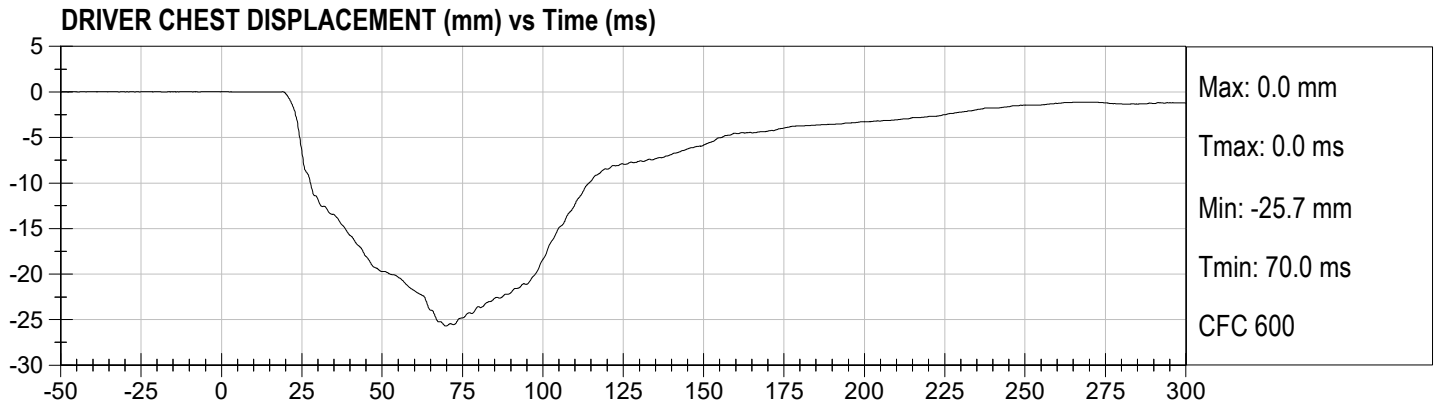


**DRIVER HEAD Z (g) vs Time (ms)**

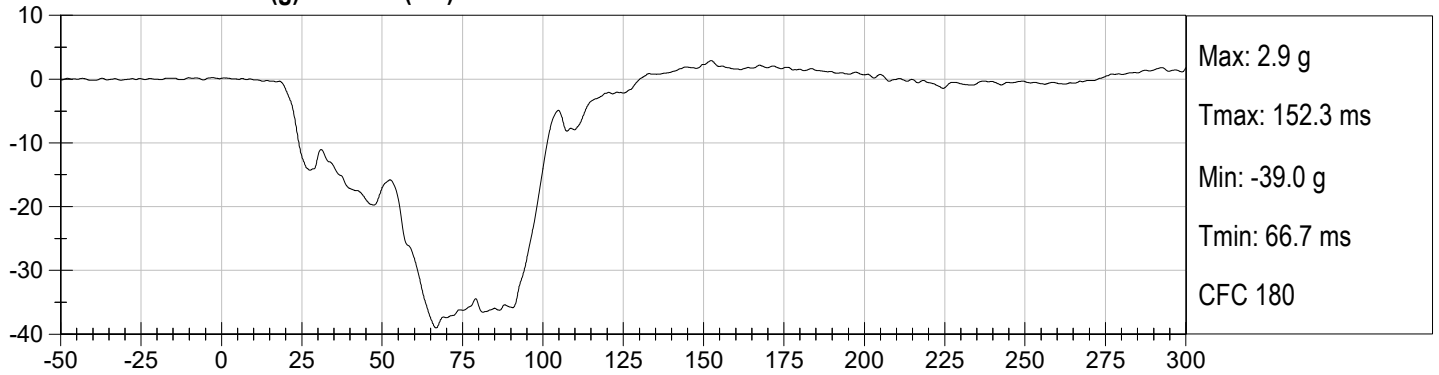


**DRIVER HEAD Resultant (g) vs Time (ms)**

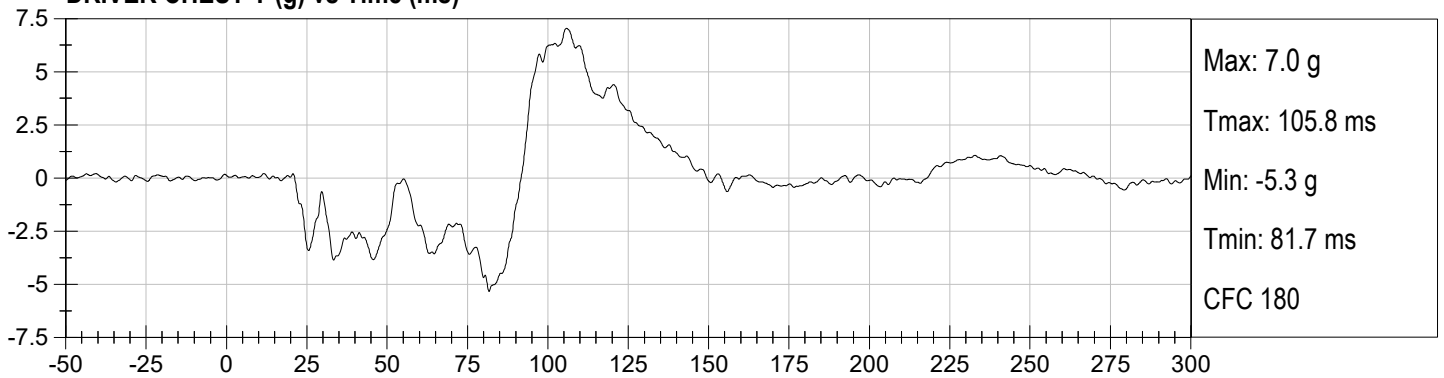




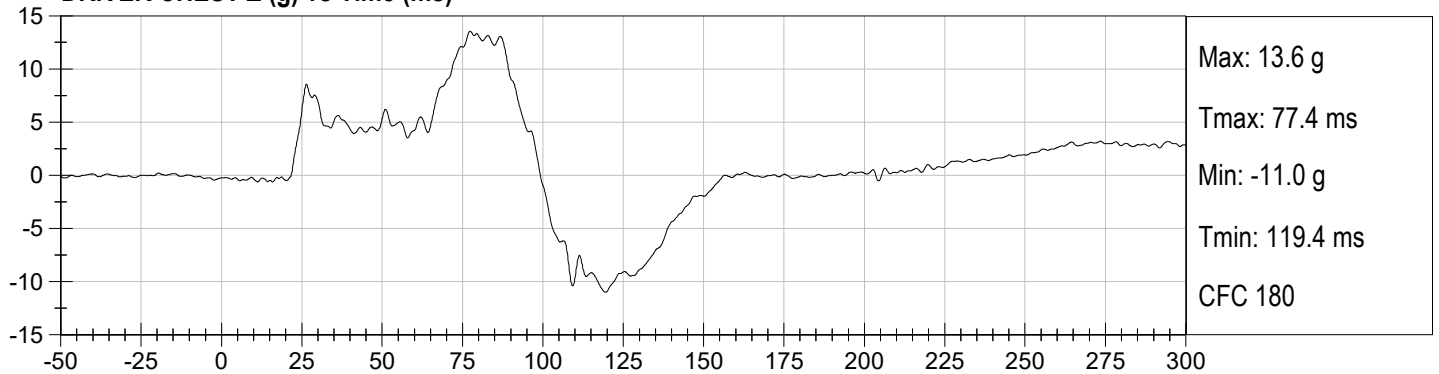
**DRIVER CHEST X (g) vs Time (ms)**



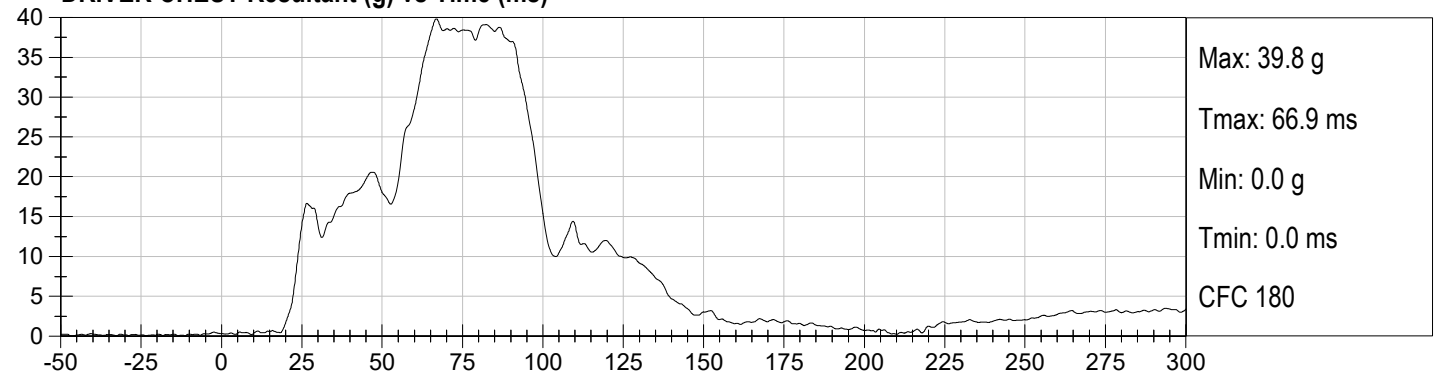
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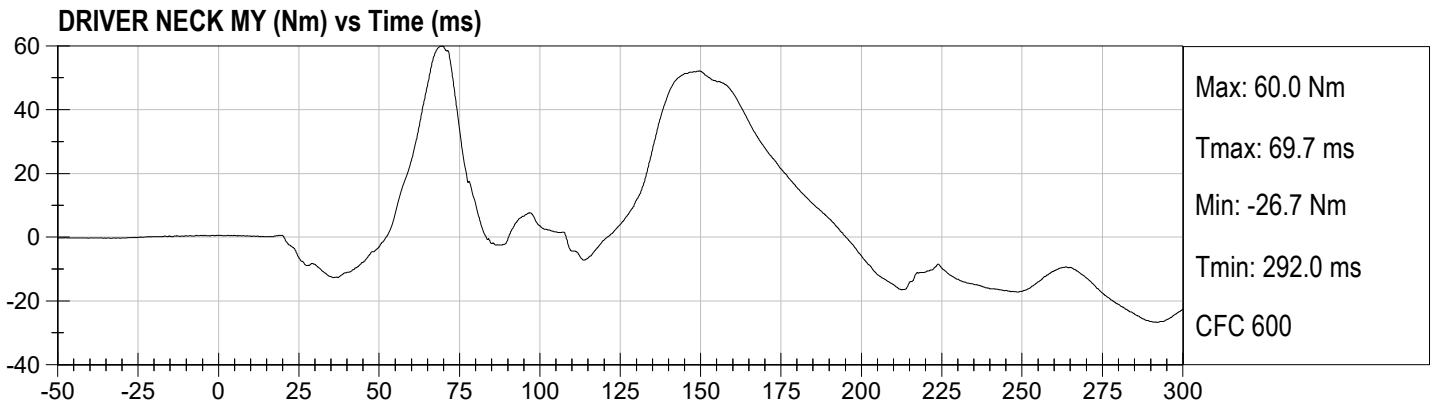
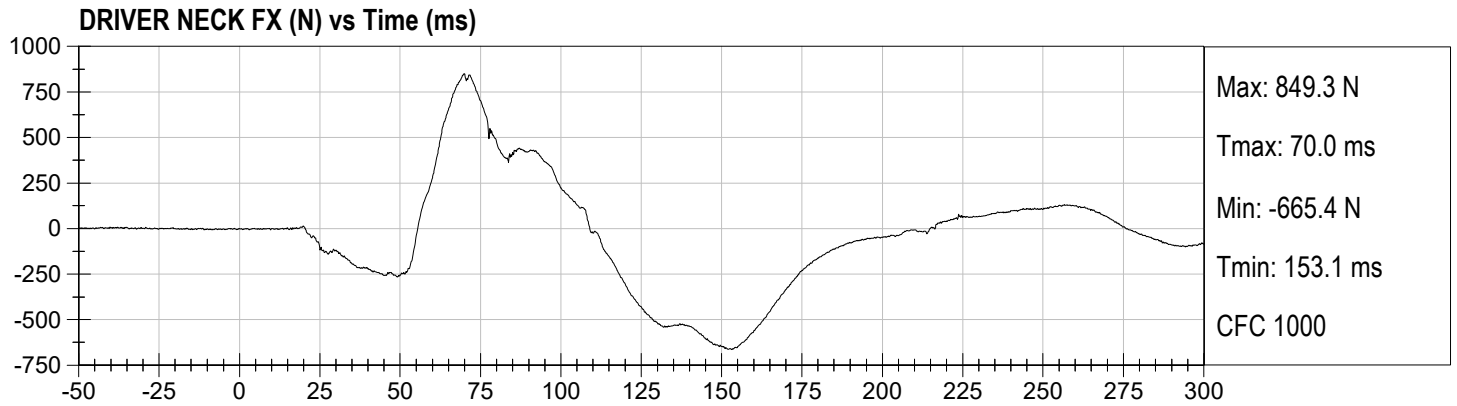


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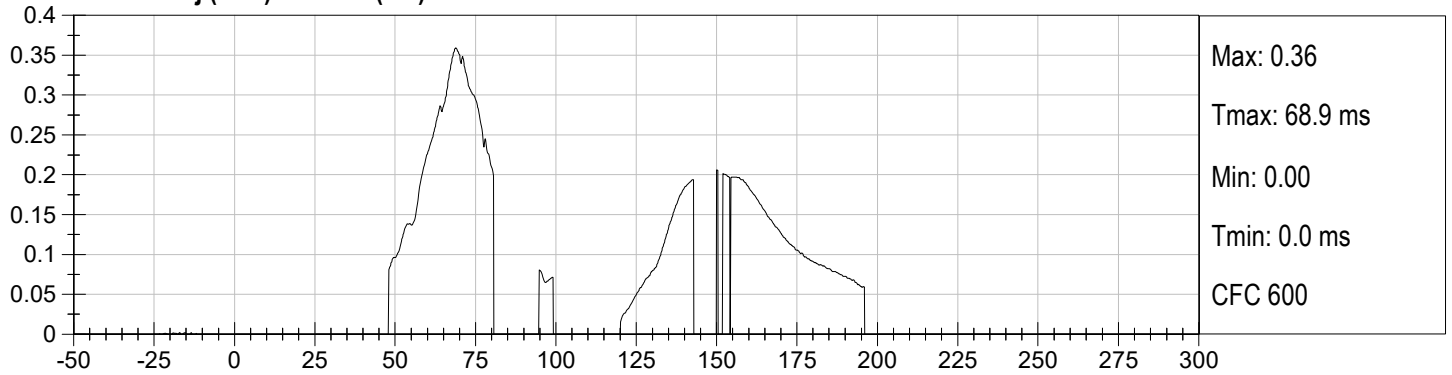


**DRIVER CHEST Resultant (g) vs Time (ms)**

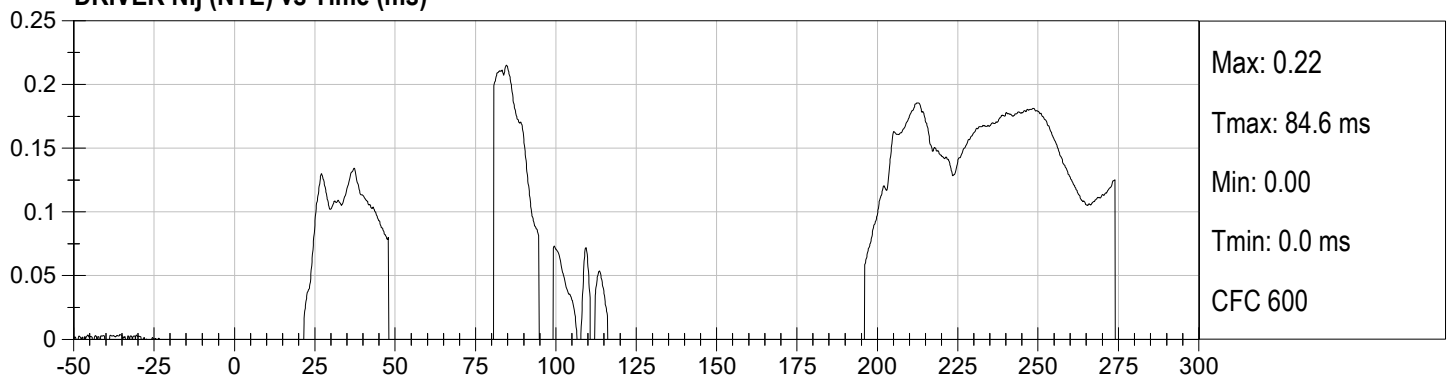




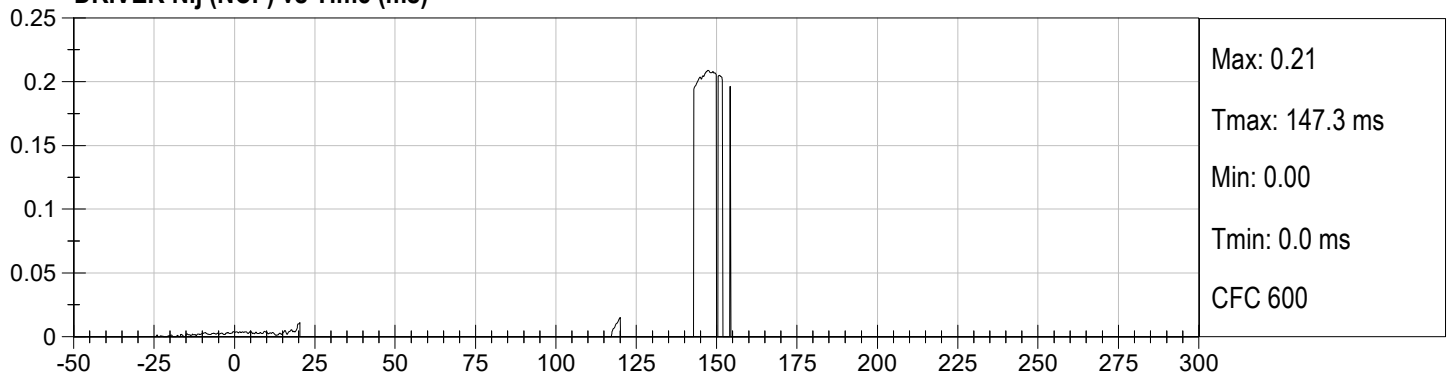
DRIVER Nij (NTF) vs Time (ms)



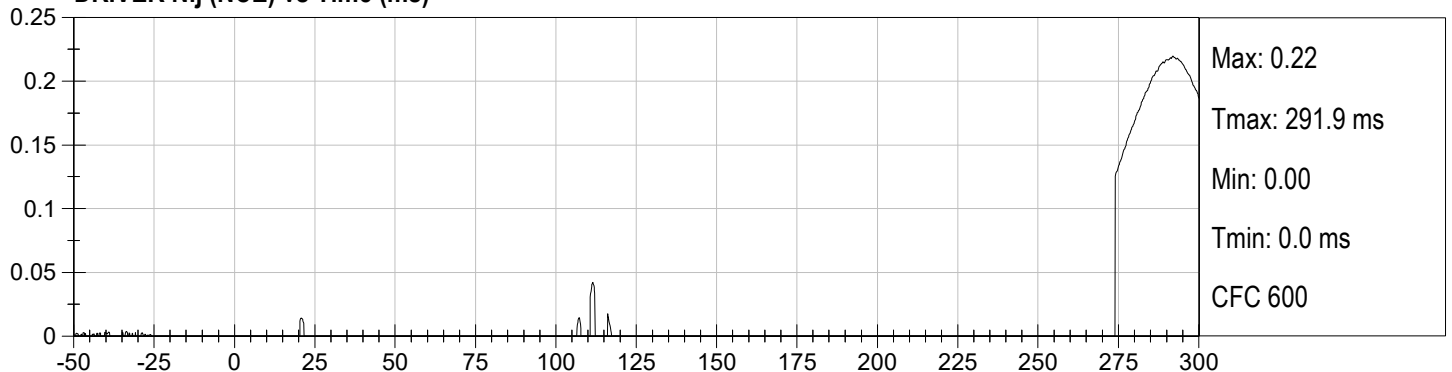
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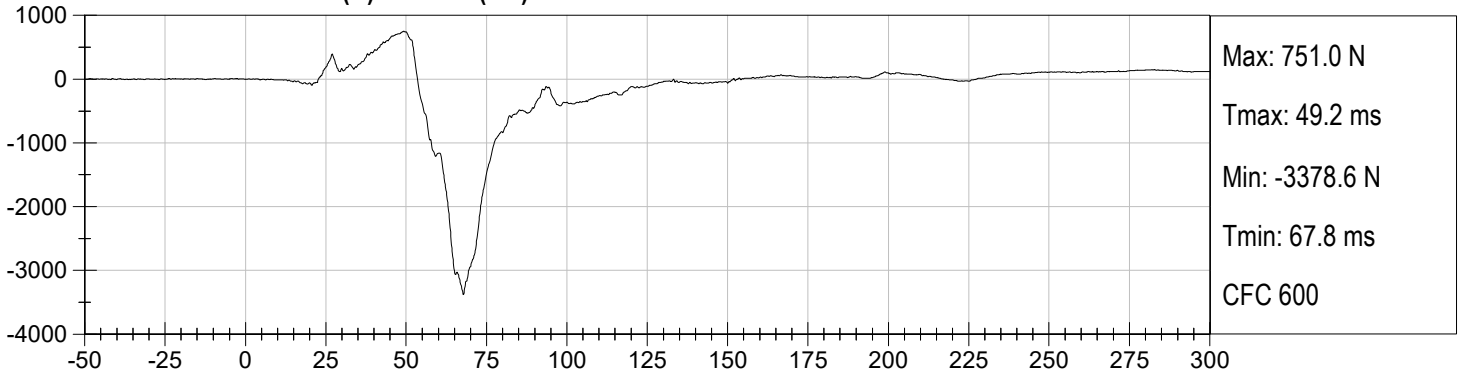
DRIVER Nij (NCF) vs Time (ms)



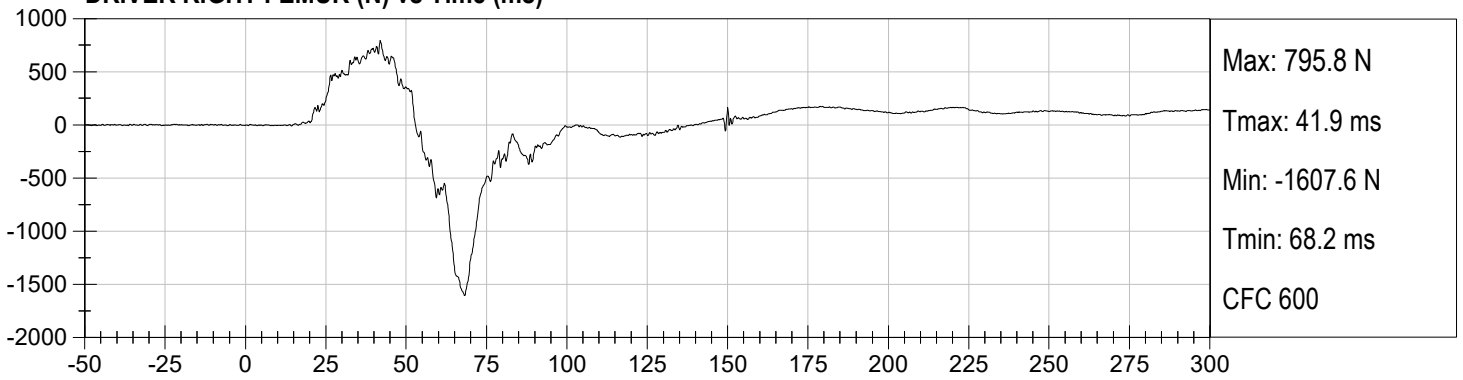
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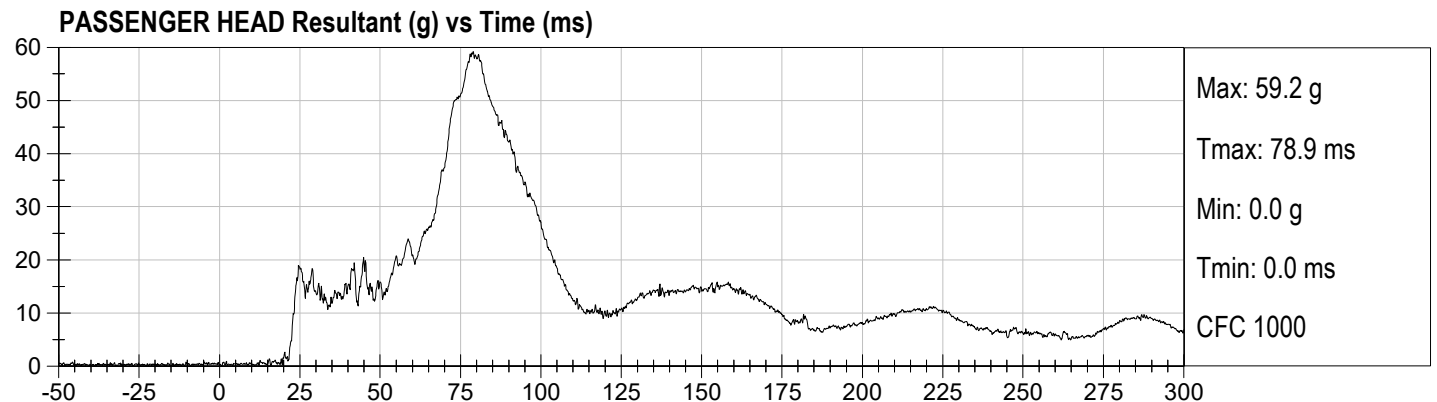
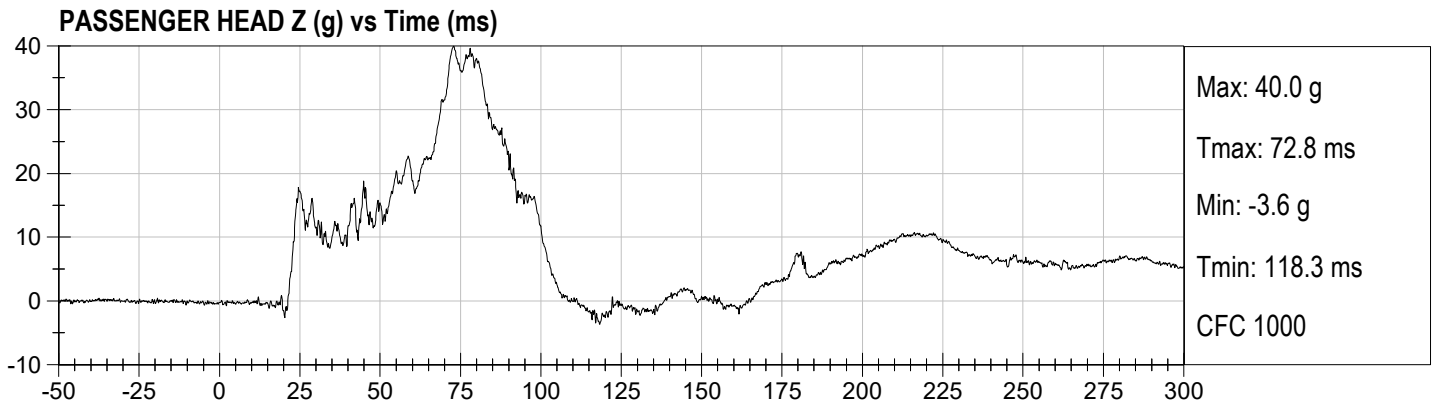
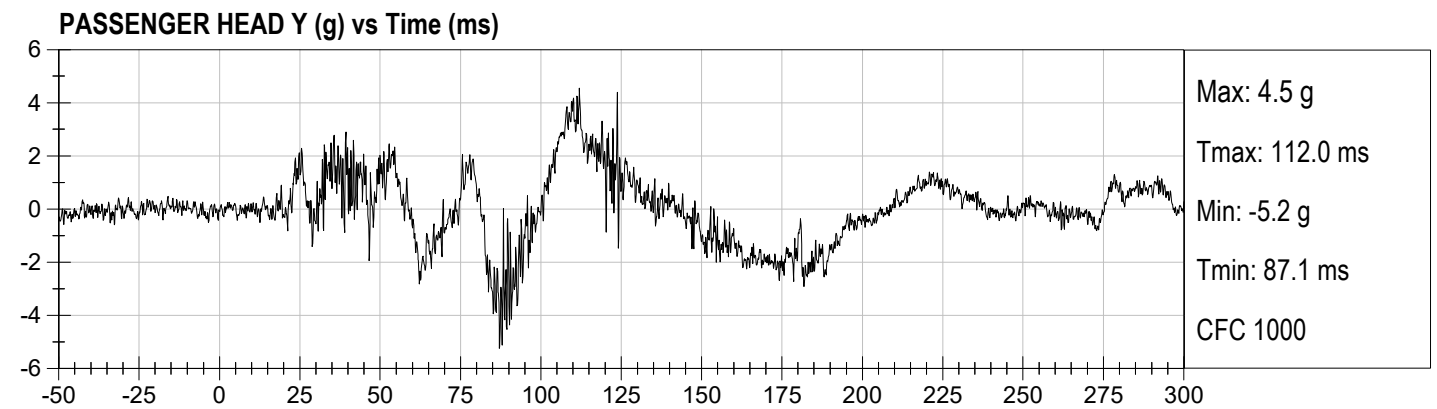
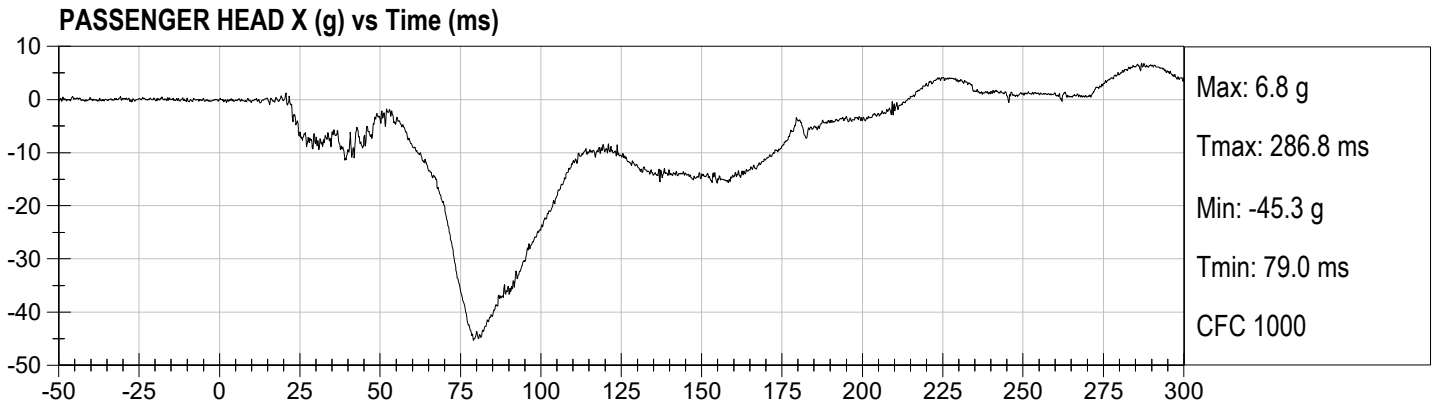


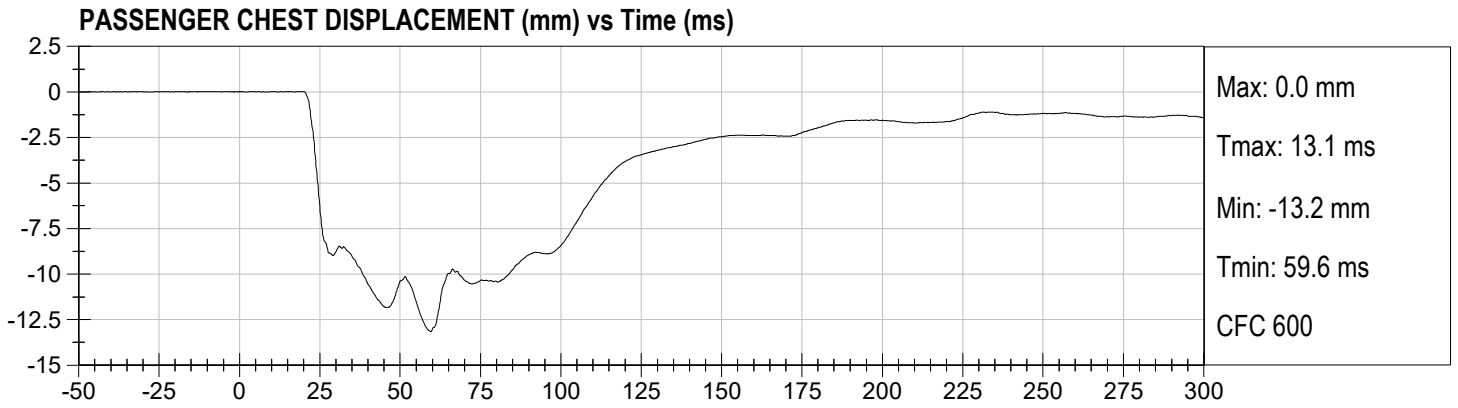
**DRIVER LEFT FEMUR (N) vs Time (ms)**



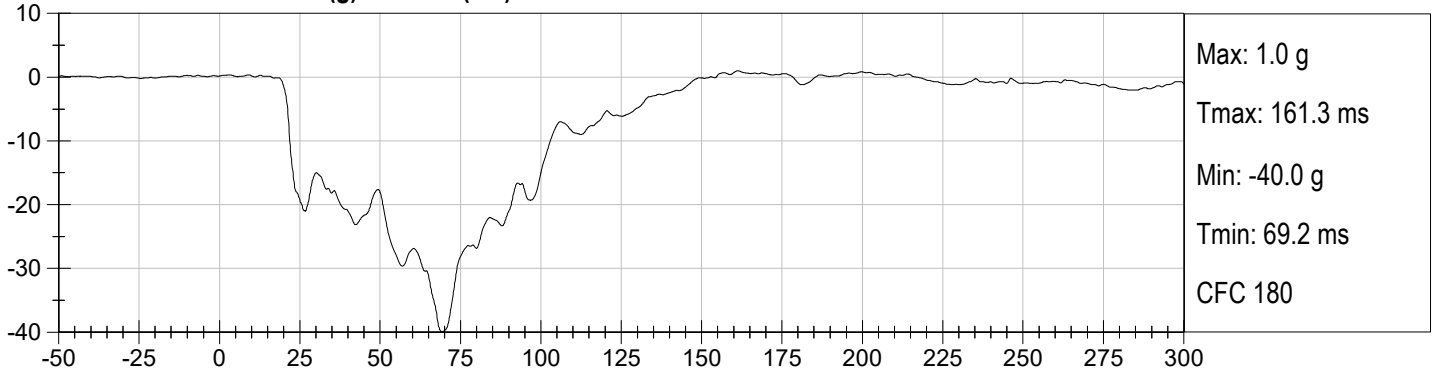
**DRIVER RIGHT FEMUR (N) vs Time (ms)**



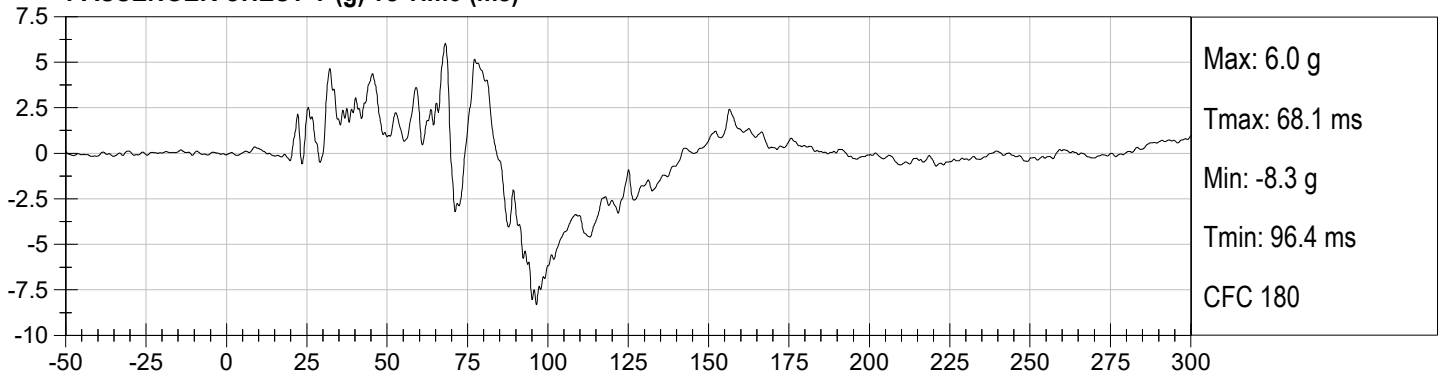




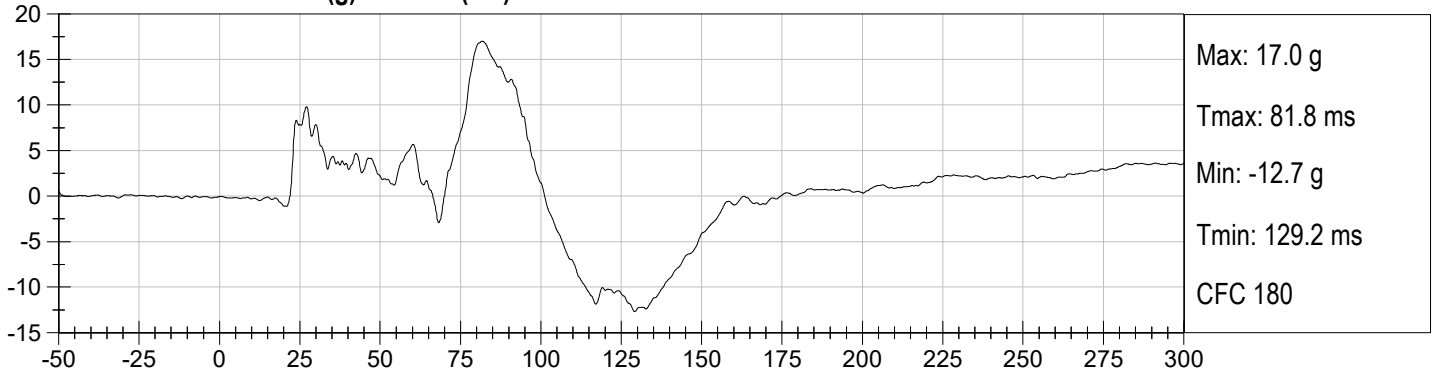
**PASSENGER CHEST X (g) vs Time (ms)**



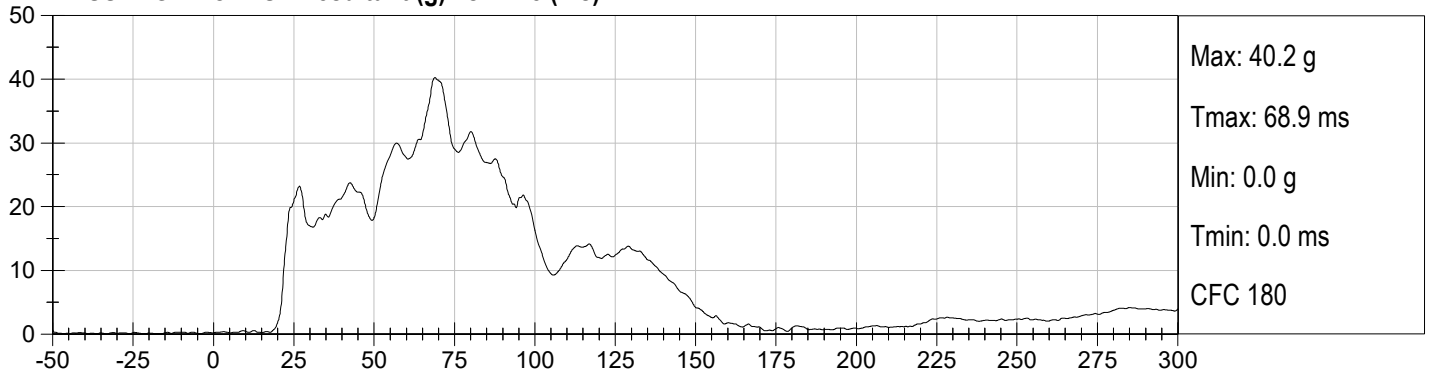
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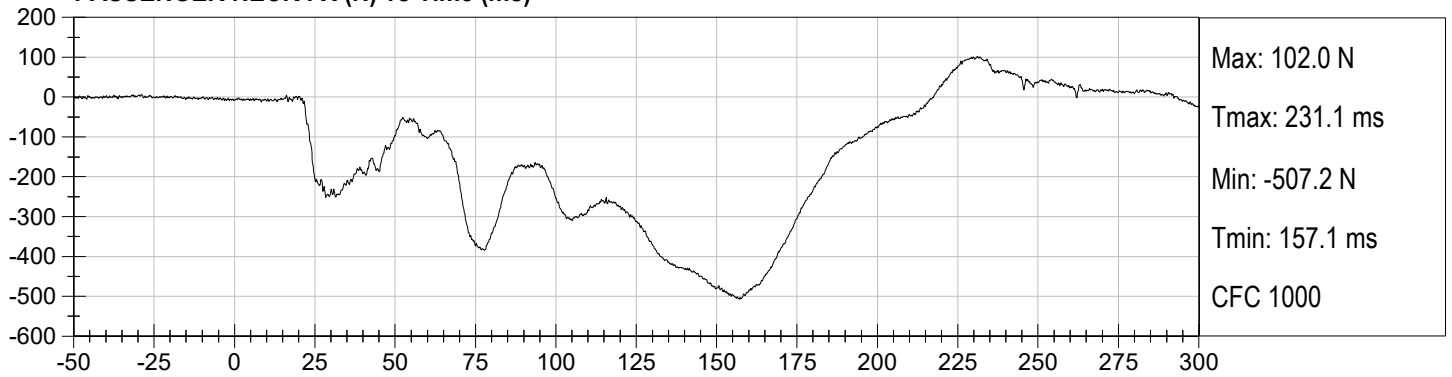
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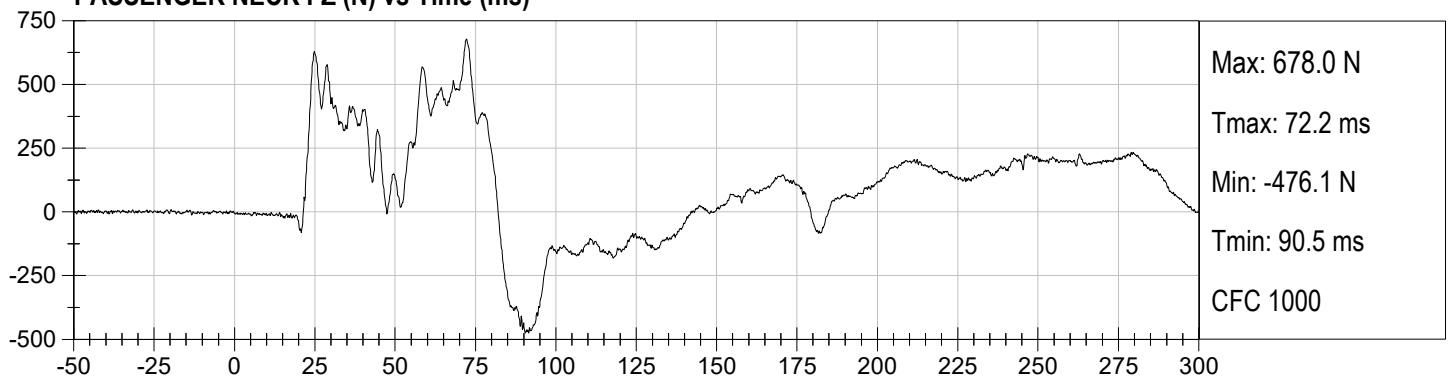
**PASSENGER CHEST Resultant (g) vs Time (ms)**



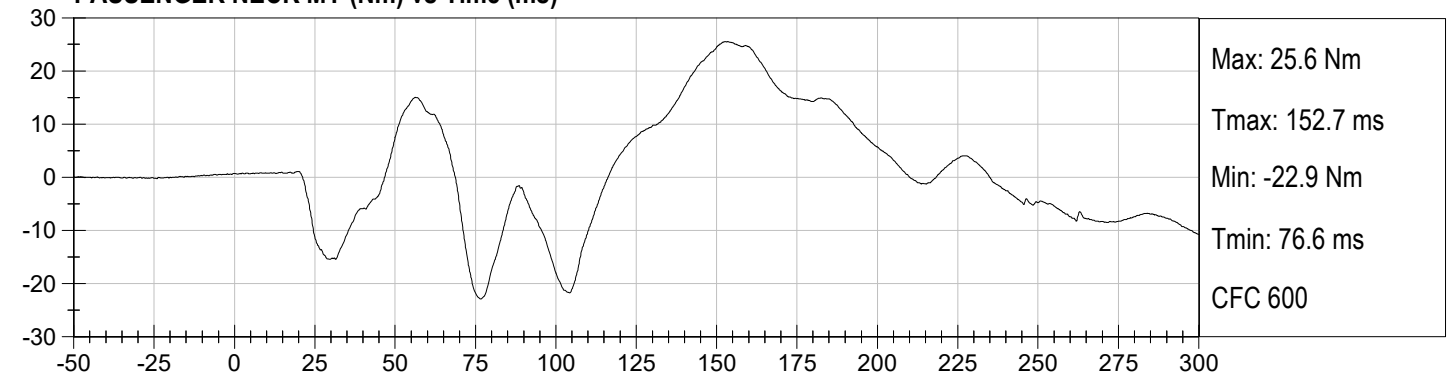
**PASSENGER NECK FX (N) vs Time (ms)**

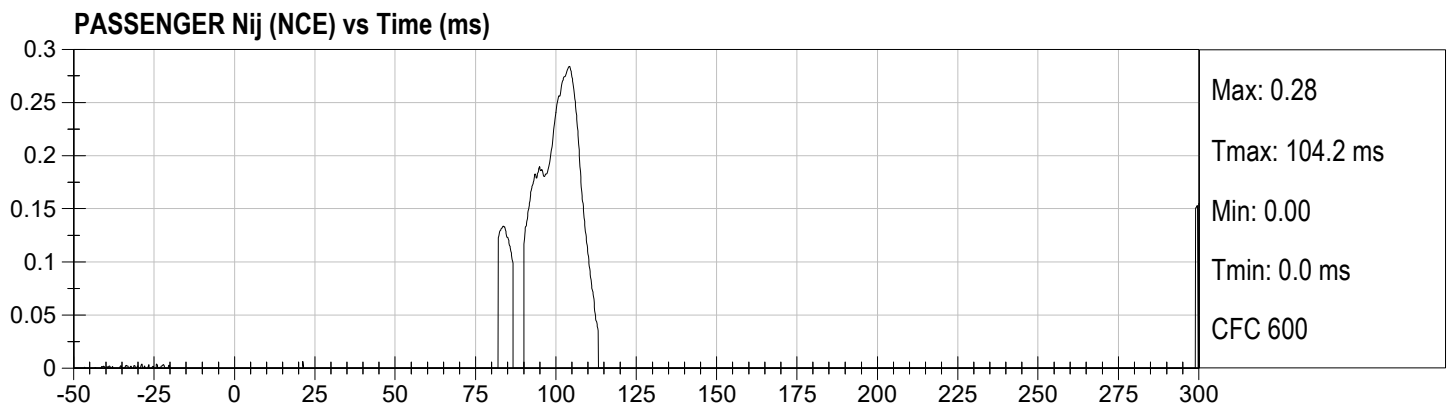
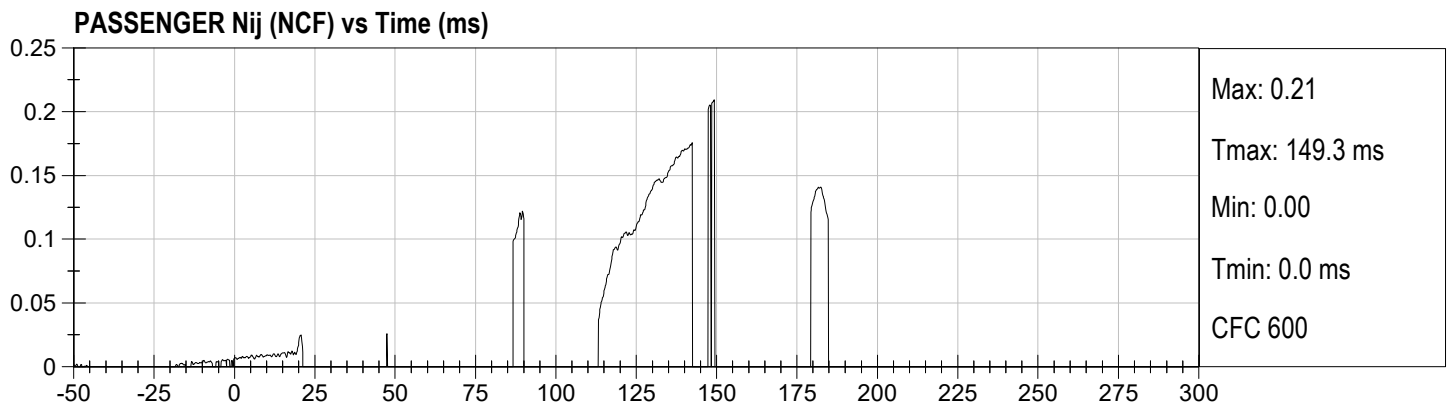
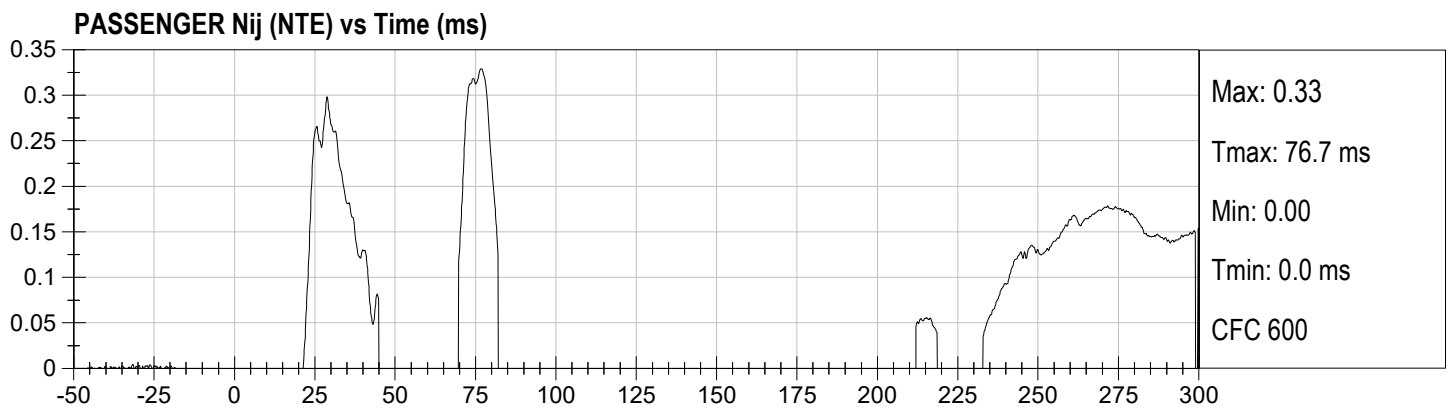
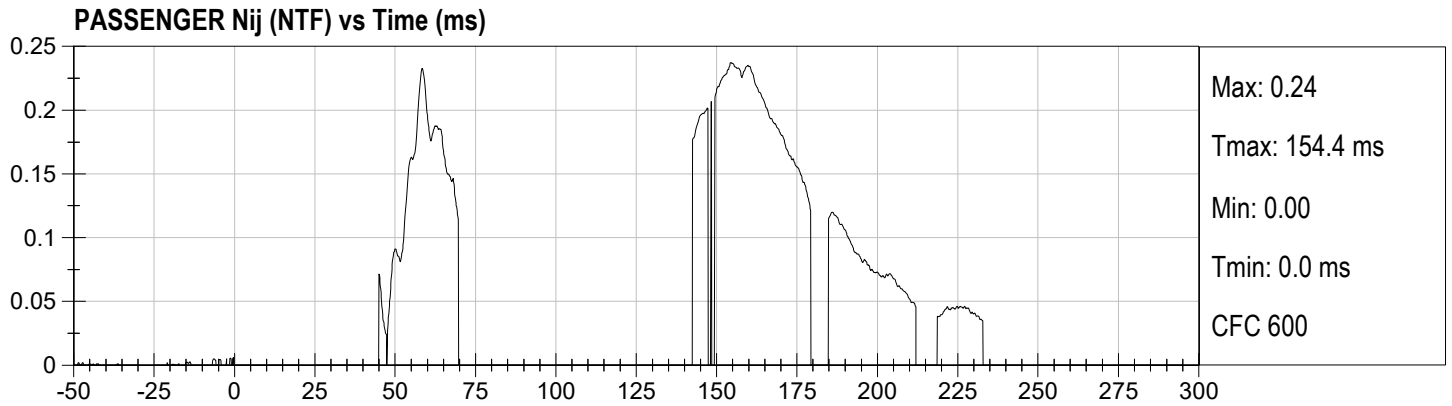


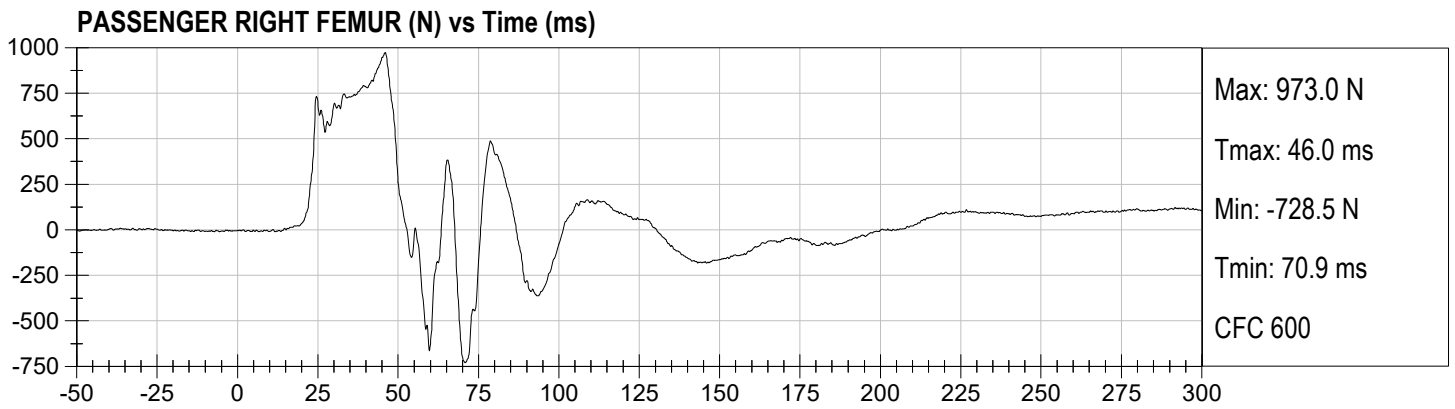
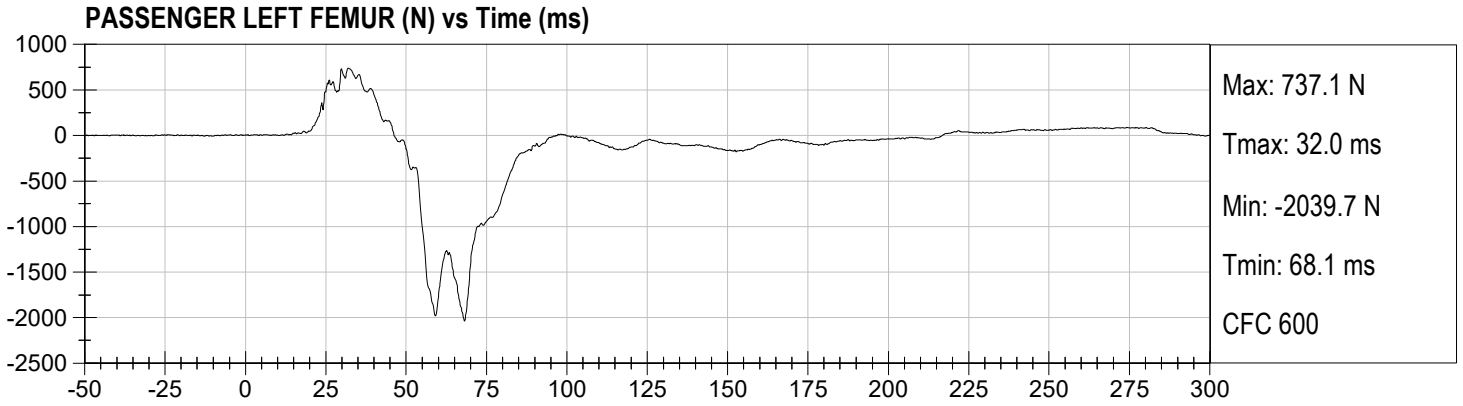
**PASSENGER NECK FZ (N) vs Time (ms)**



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







**APPENDIX C**  
**DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA**

**CALIBRATION TEST RESULTS**

**PRE-TEST**

**HYBRID III 50<sup>TH</sup> PERCENTILE MALE - DRIVER ATD**

**Hybrid III, 50th External Measurements  
SN: 351**

HYBRID III, PART 572, SUBPART E EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (inches)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	34.6-35.0	34.8
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	19.9-20.5	20.0
C	H-POINT HEIGHT	Reference	3.3-3.5	3.4
D	H-POINT LOCATION FROM BACKLINE	Reference	5.3-5.5	5.5
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	3.3-3.7	3.5
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	5.5-6.1	6.0
G	BACK OF ELBOW TO WRIST PIVOT	back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	11.4-12.0	11.8
H	HEAD BACK TO BACKLINE	Back of Skull cap skin to seat rear vertical surface (Reference)	1.6-1.8	1.7
I	SHOULDER TO- ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	13.0-13.6	13.3
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	7.5-8.3	7.8
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	22.8-23.8	23.8
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	16.9-17.9	17.0
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	19.1-19.7	19.5
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	17.8-18.8	18.8

HYBRID III, SUBPART E EXTERIOR DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS		ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 16.9-17.1 in. above seat surface	8.4-9.0	8.5
P	FOOT LENGTH	Tip of toe to rear of heel	9.9-10.5	10.3
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	16.3-17.2	16.5
W	FOOT BREADTH	The widest part of the foot	3.6-4.2	4.0
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 16.9-17.1 in. above seat surface	38.2-39.4	39.2
Z	WAIST CIRCUMFERENCE	Measured 8.9-9.1 in. above seat surface	32.9-34.1	33.7
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	16.9-17.1	17.0
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	8.9-9.1	9.0

**NOTE:** THE H-POINT IS LOCATED 1.83 INCHES FORWARD AND 2.57 INCHES DOWN FROM THE CENTER OF THE PELVIS ANGLE REFERENCE HOLE.

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 50TH PERCENTILE MALE**

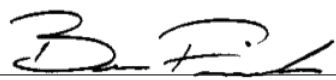
ATD Serial No: 351

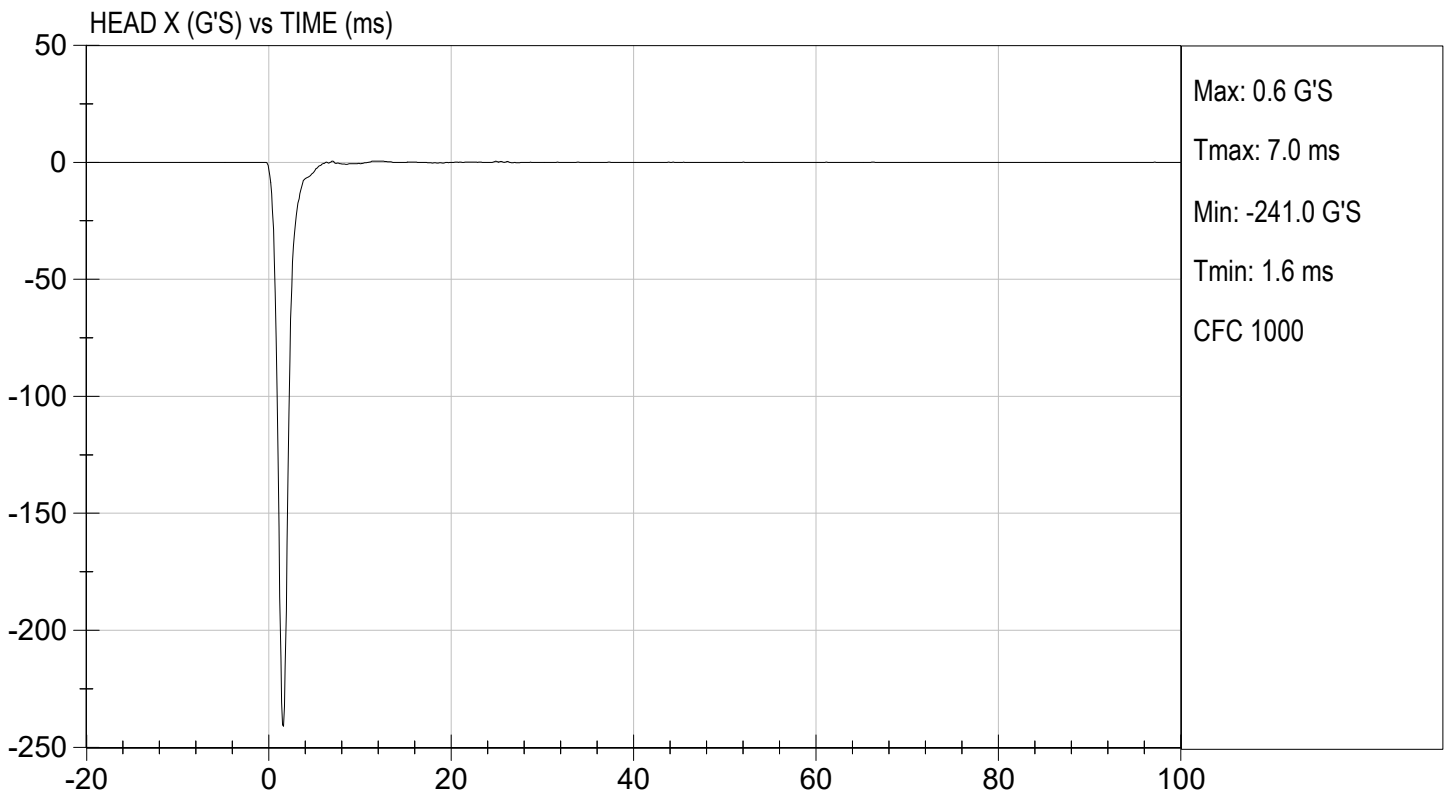
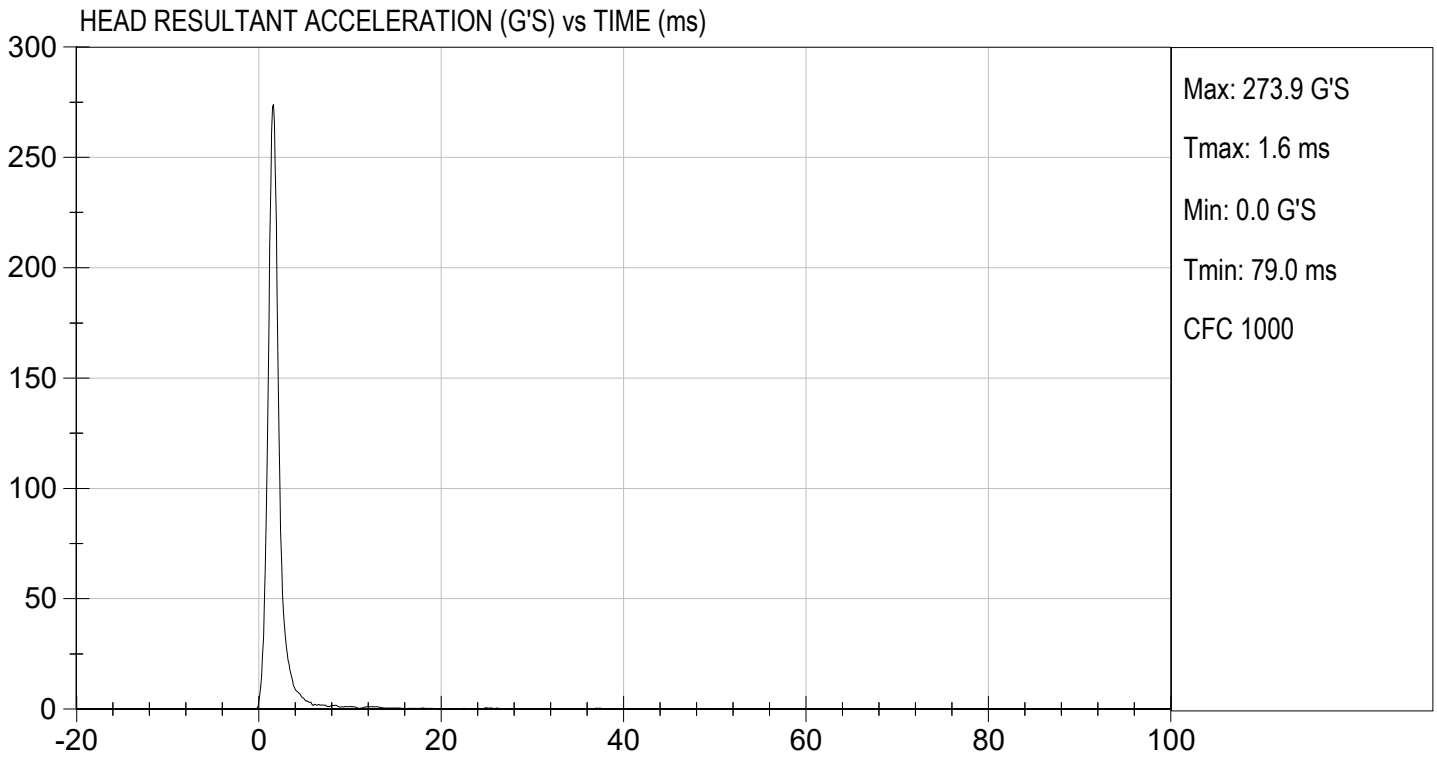
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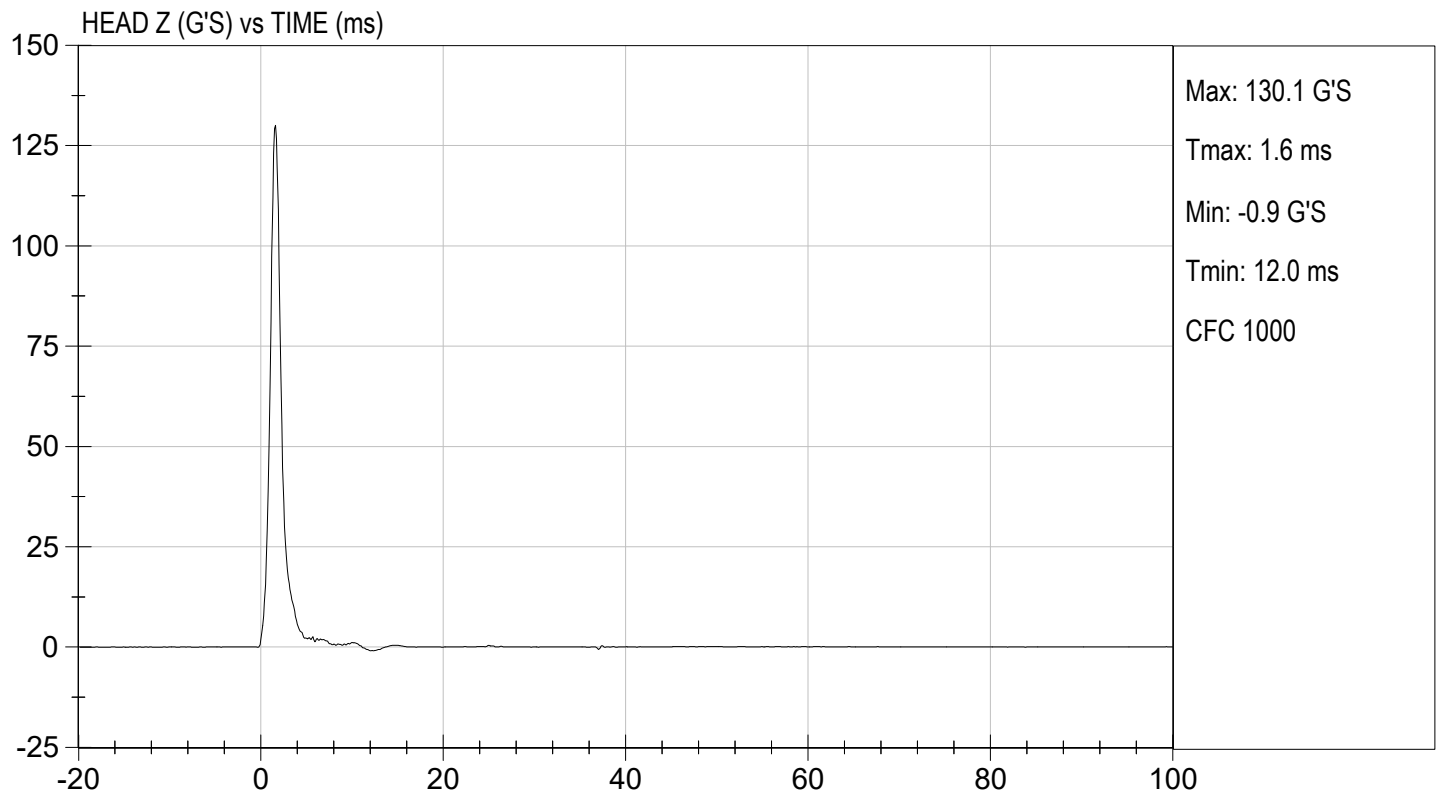
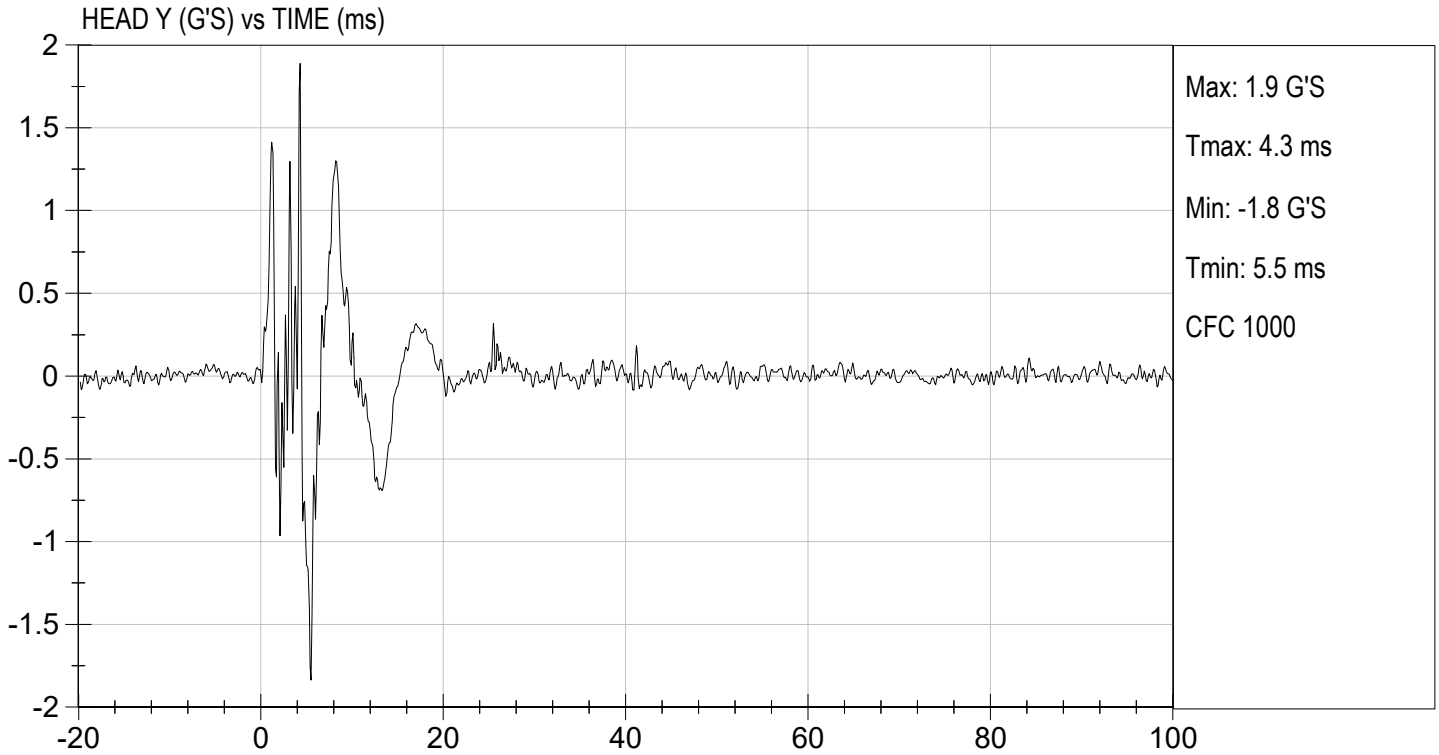
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Peak Resultant Acceleration	G's	225 to 275	274	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	1.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

  
 Laboratory Technician

11/17/2022  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**  
**NECK FLEXION TEST**  
**HYBRID III 50TH PERCENTILE MALE**

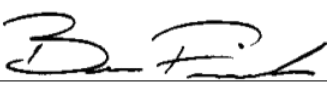
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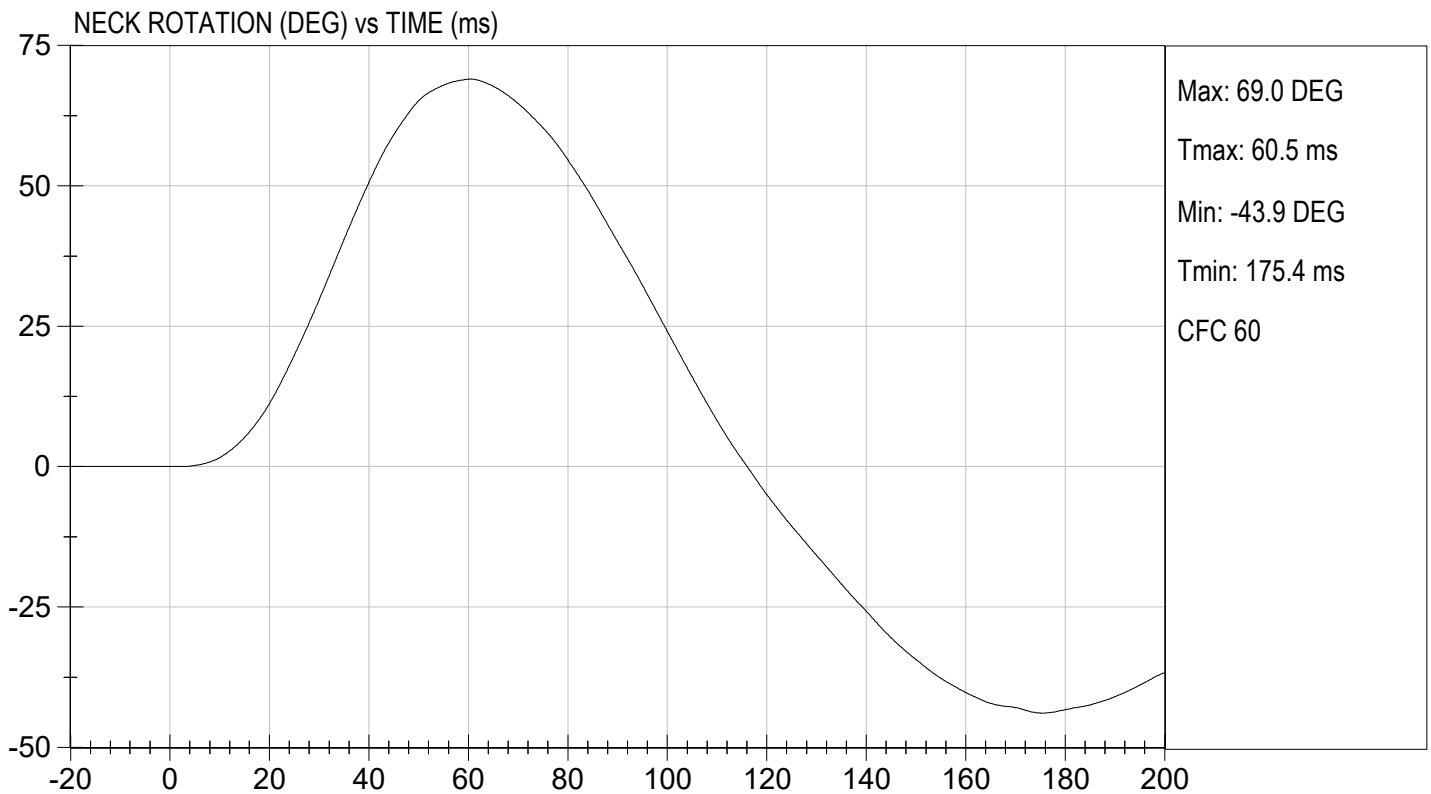
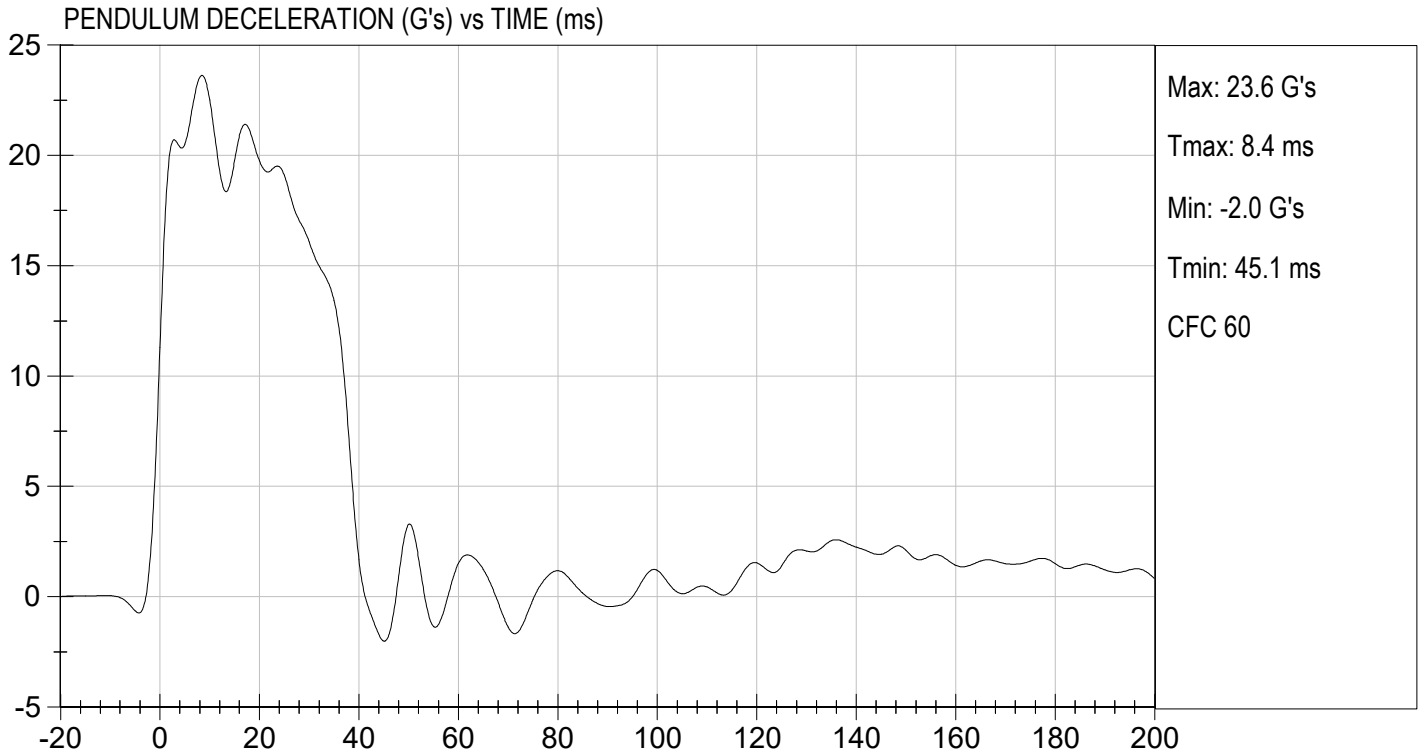
Test I.D.: D222652

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	27	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	22.51	Pass
	20 ms	G's	17.60 to 22.60	19.75	Pass
	30 ms	G's	12.50 to 18.50	16.07	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	16.0	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	38.8	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	69.0	Pass
	Time	ms	57.0 to 64.0	60.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.2	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	93.9	Pass
	Time	ms	47.0 to 58.0	50.3	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	99.2	Pass
Overall Test Results					Pass

  
 Laboratory Technician

11/17/2022  
 Test Date

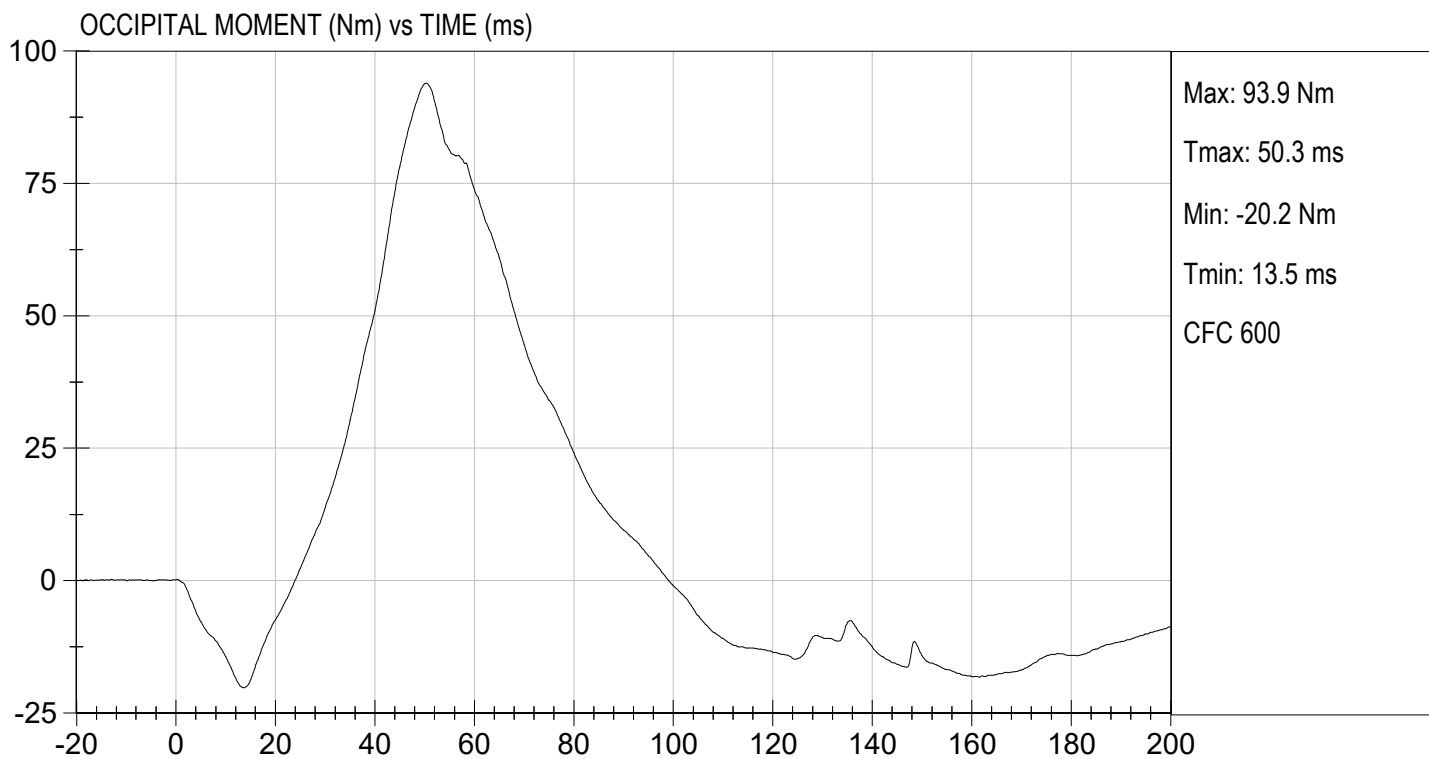
  
 Approved By





TEST DESC: NECK FLEXION  
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 11/17/2022  
TEST #: D222652



**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 50TH PERCENTILE MALE**

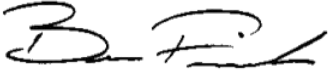
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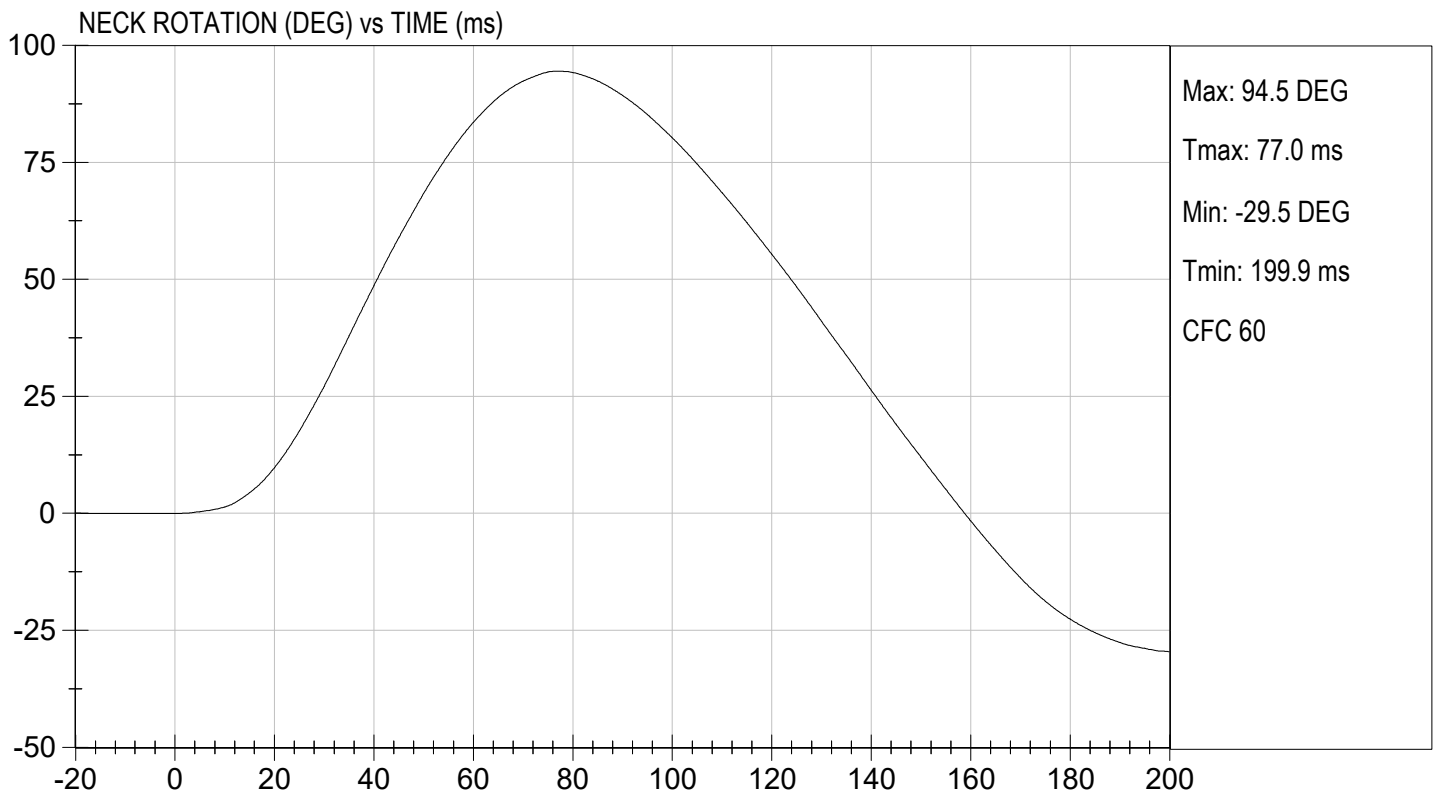
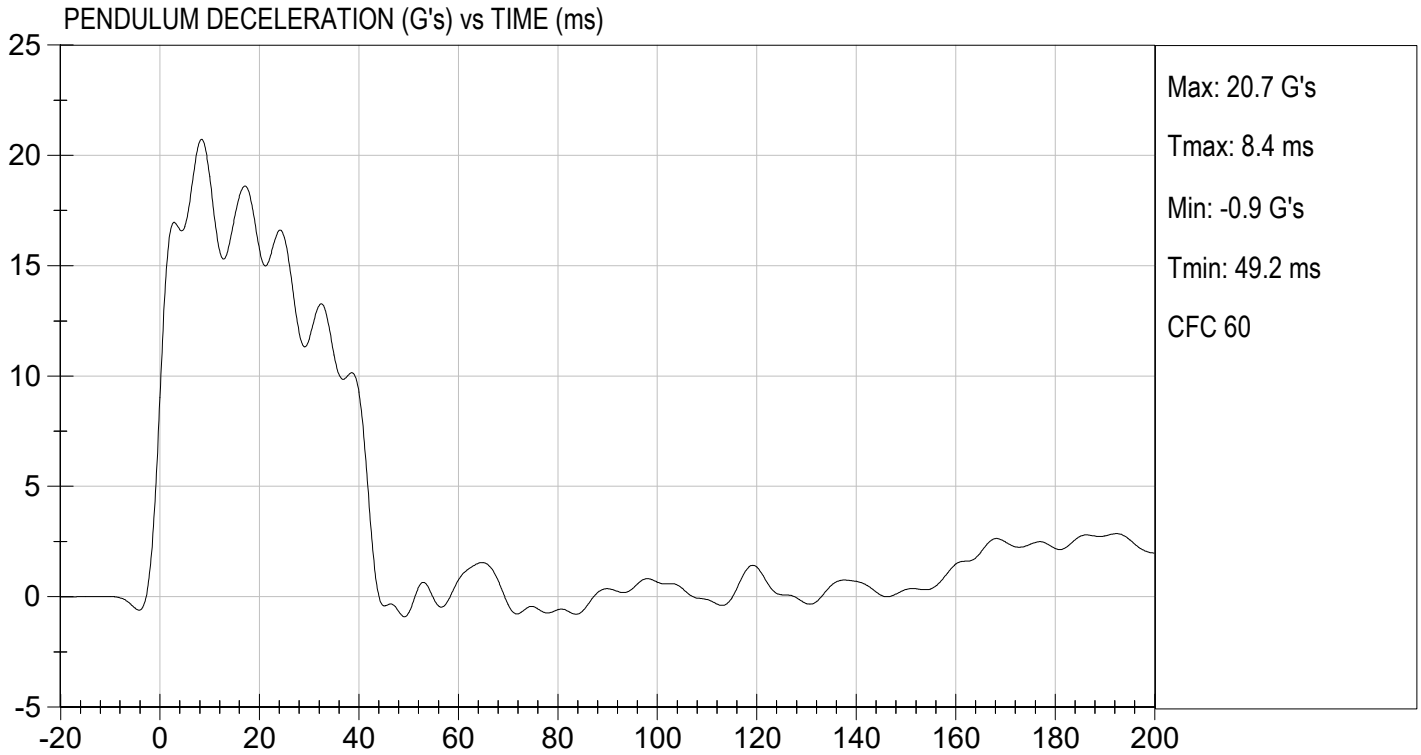
Test I.D.: D222653

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	27	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.02	Pass
	20 ms	G's	14.00 to 19.00	15.75	Pass
	30 ms	G's	11.00 to 16.00	11.68	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.3	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	41.9	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	94.5	Pass
	Time	ms	72.0 to 82.0	77.0	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	158.9	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.8	Pass
	Time	ms	65.0 to 79.0	71.2	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.7	Pass
Overall Test Results					Pass

  
 Laboratory Technician

11/17/2022  
 Test Date

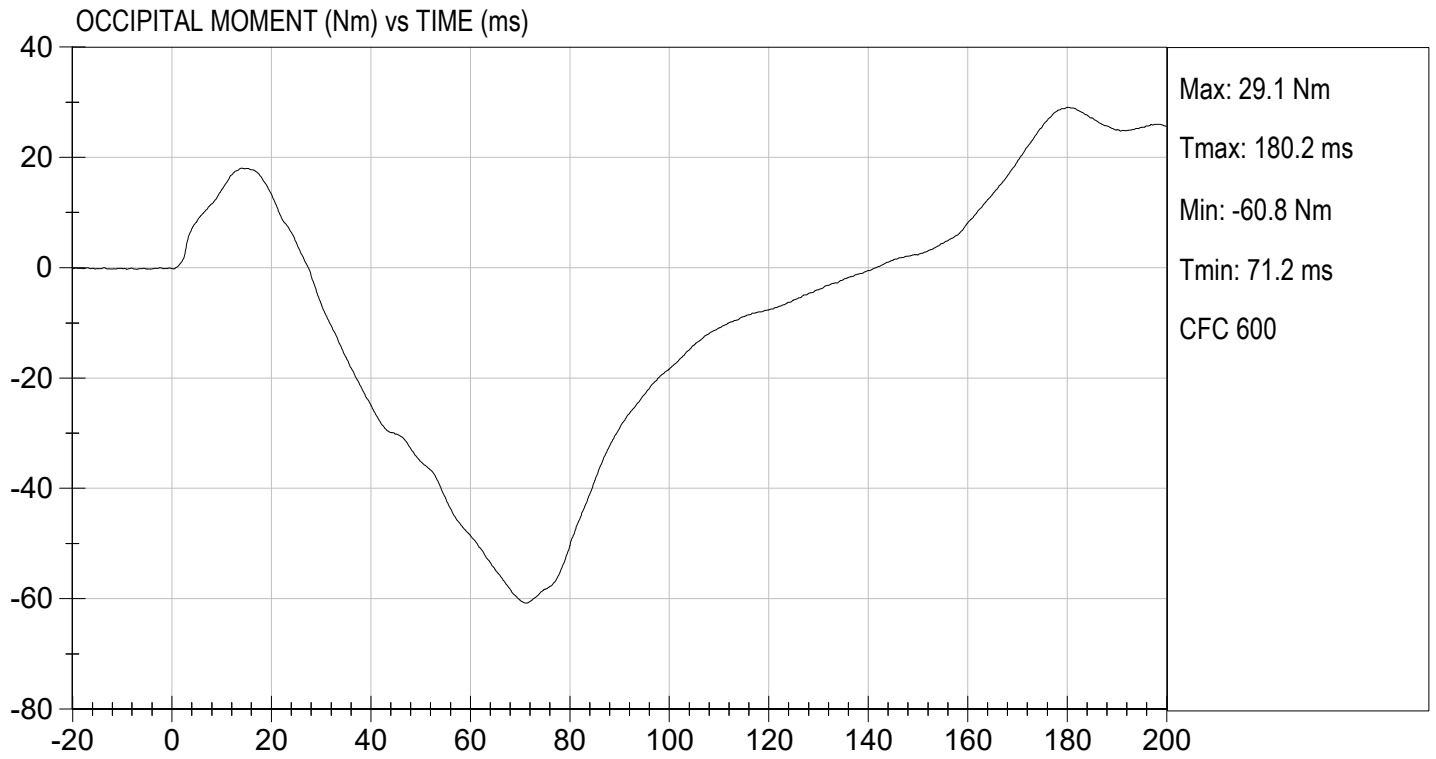
  
 Approved By





TEST DESC: NECK EXTENSION  
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 11/17/2022  
TEST #: D222653



**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 50TH PERCENTILE MALE**

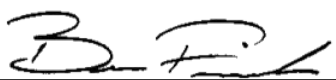
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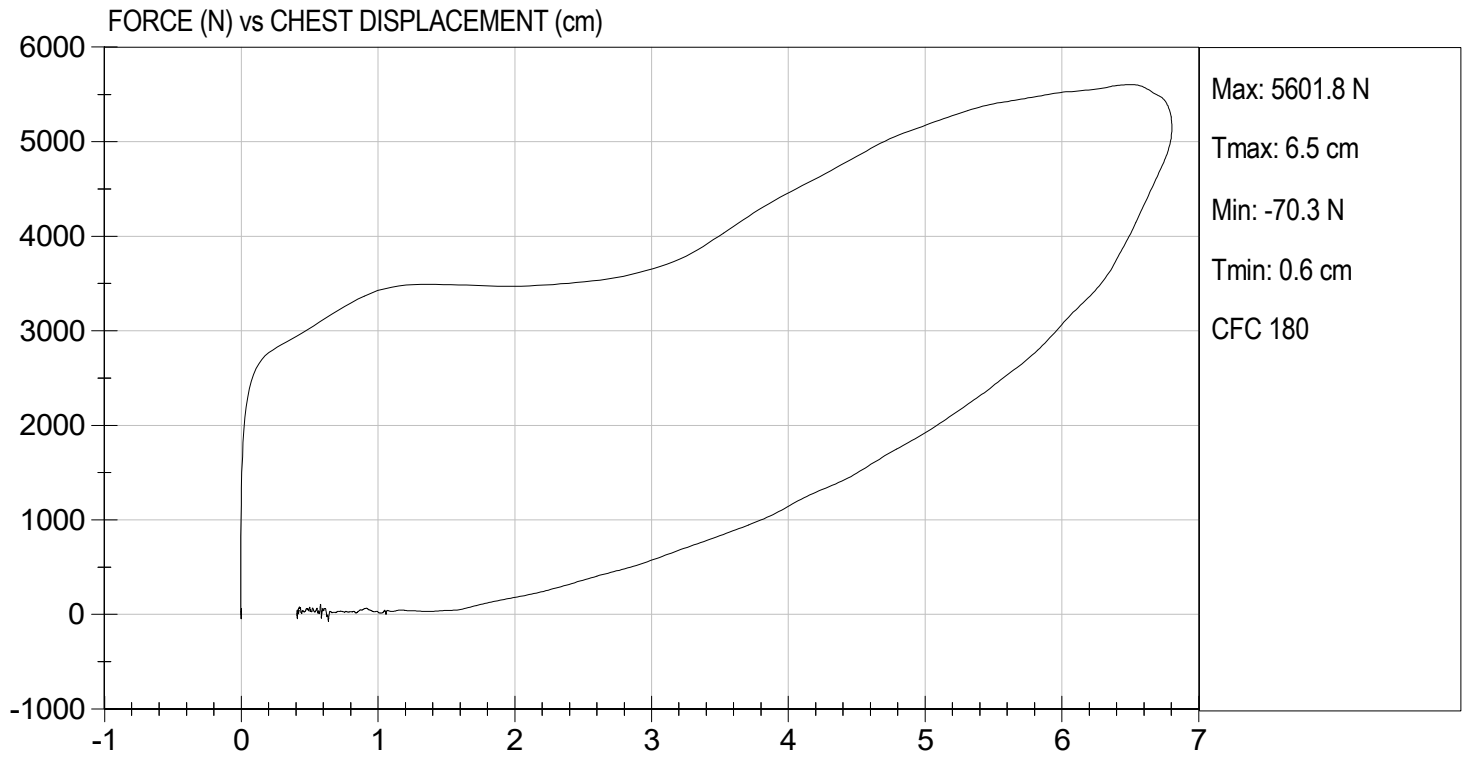
Test I.D: D222654

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	35	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,602	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.80	Pass
Internal Hysteresis	%	69 to 85	71	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

11/16/2022  
 Test Date

  
 Approved By



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 50TH PERCENTILE MALE**


ATD Serial No: 351

Test I.D: D222655

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	2.07 to 2.13	2.11	Pass
Peak Probe Force	N	4715 to 5782	4,734	Pass
Overall Test Results				Pass

  
 Laboratory Technician

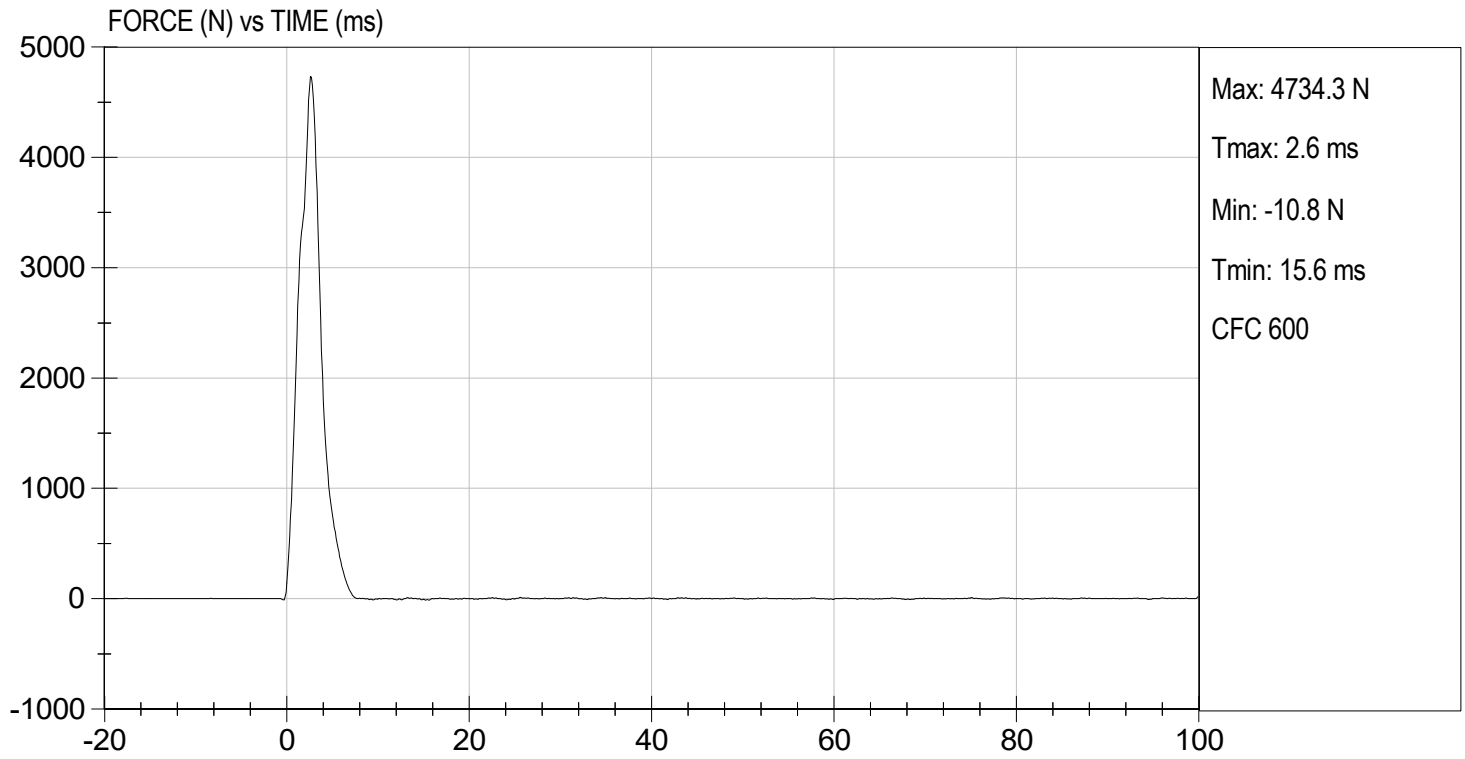
11/17/2022  
 Test Date

  
 Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.92 ft/s, 2.11 m/s

TEST DATE: 11/17/2022  
TEST #: D222655



**MGA RESEARCH CORPORATION**  
**LEFT KNEE IMPACT TEST**  
**HYBRID III 50TH PERCENTILE MALE**

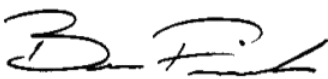
ATD Serial No: 351

Test I.D: D222656

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	2.07 to 2.13	2.11	Pass
Peak Probe Force	N	4715 to 5782	5,007	Pass
Overall Test Results				Pass

  
 \_\_\_\_\_  
 Laboratory Technician

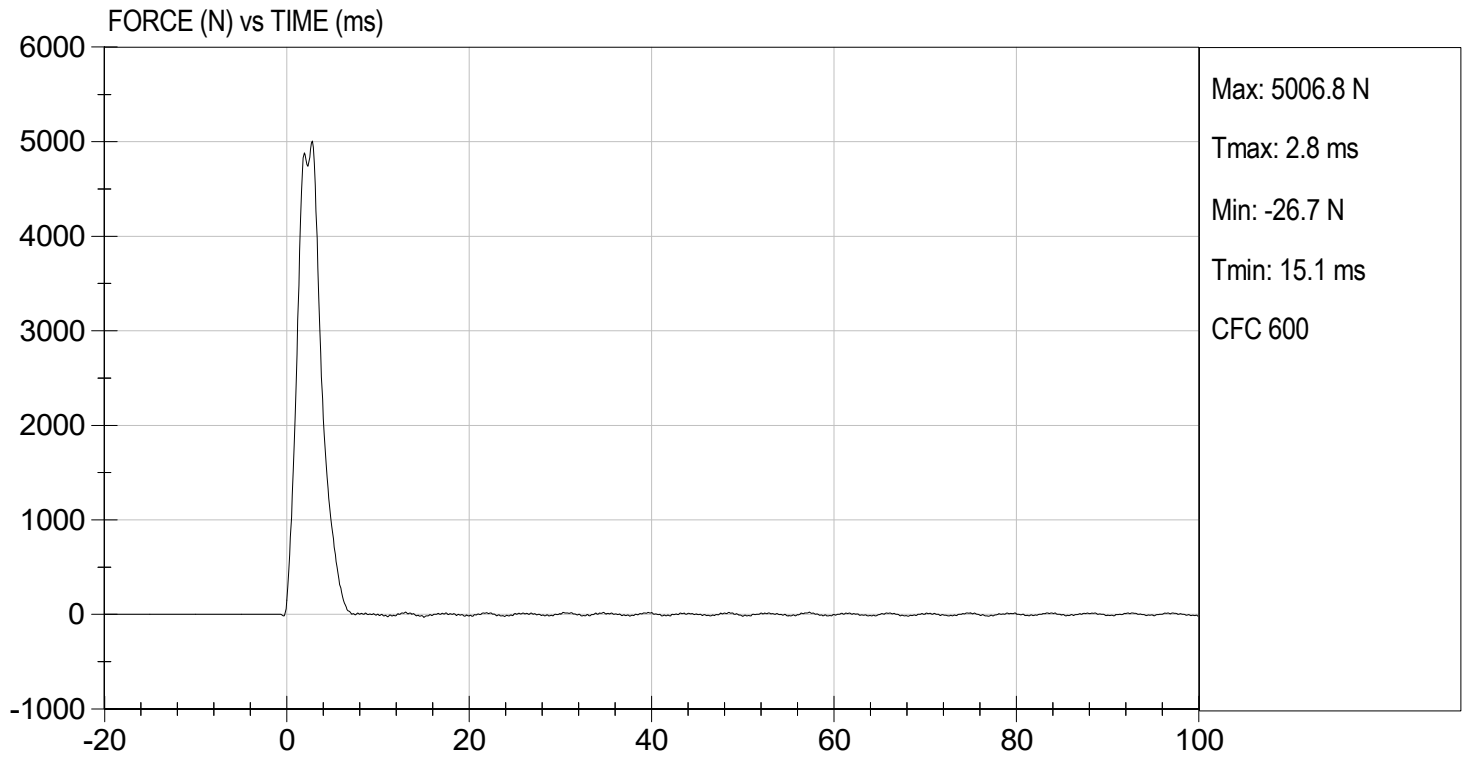
11/17/2022  
 \_\_\_\_\_  
 Test Date

  
 \_\_\_\_\_  
 Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 6.92 ft/s, 2.11 m/s

TEST DATE: 11/17/2022  
TEST #: D222656



**MGA RESEARCH CORPORATION**  
**HIP-FEMUR FLEXION TEST**  
**HYBRID III 50TH PERCENTILE MALE**

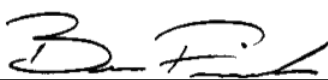
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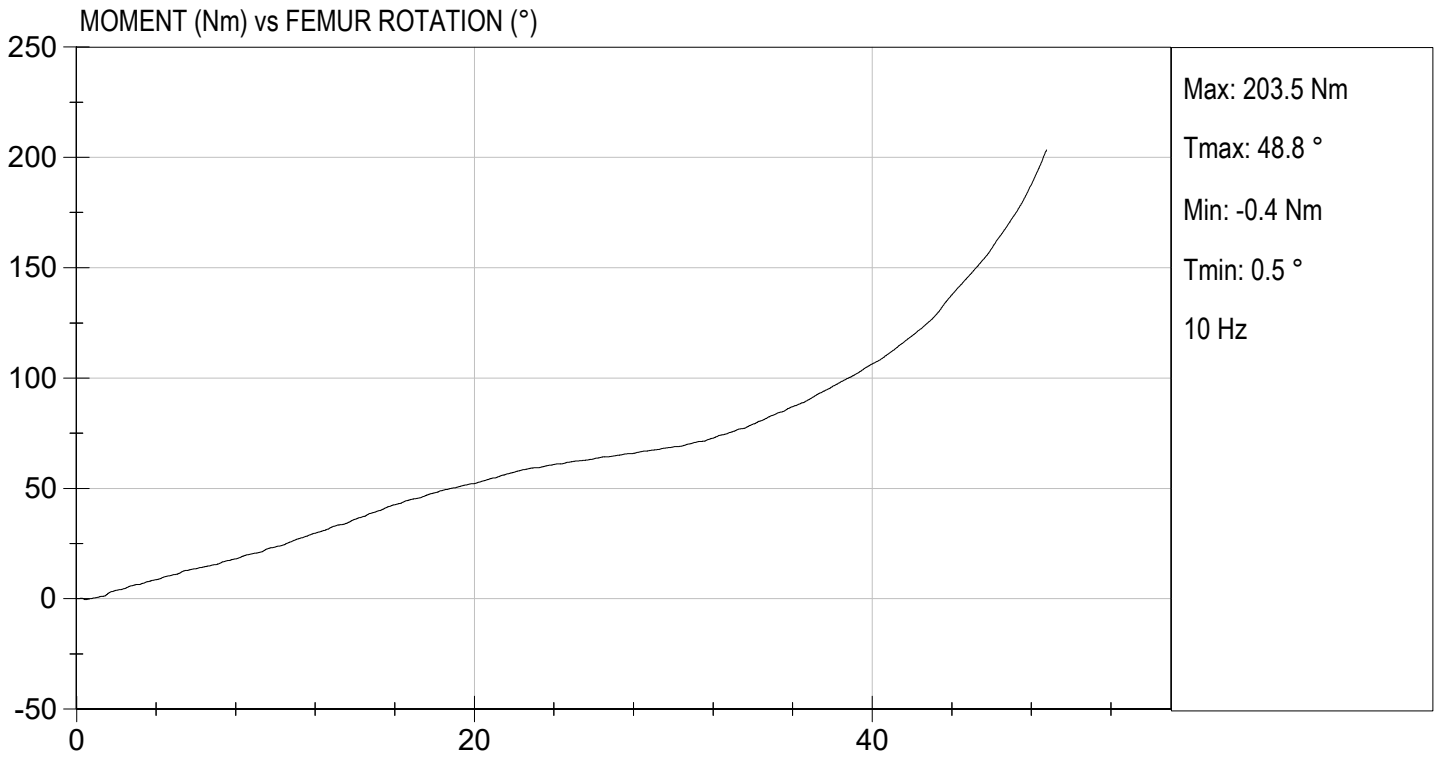
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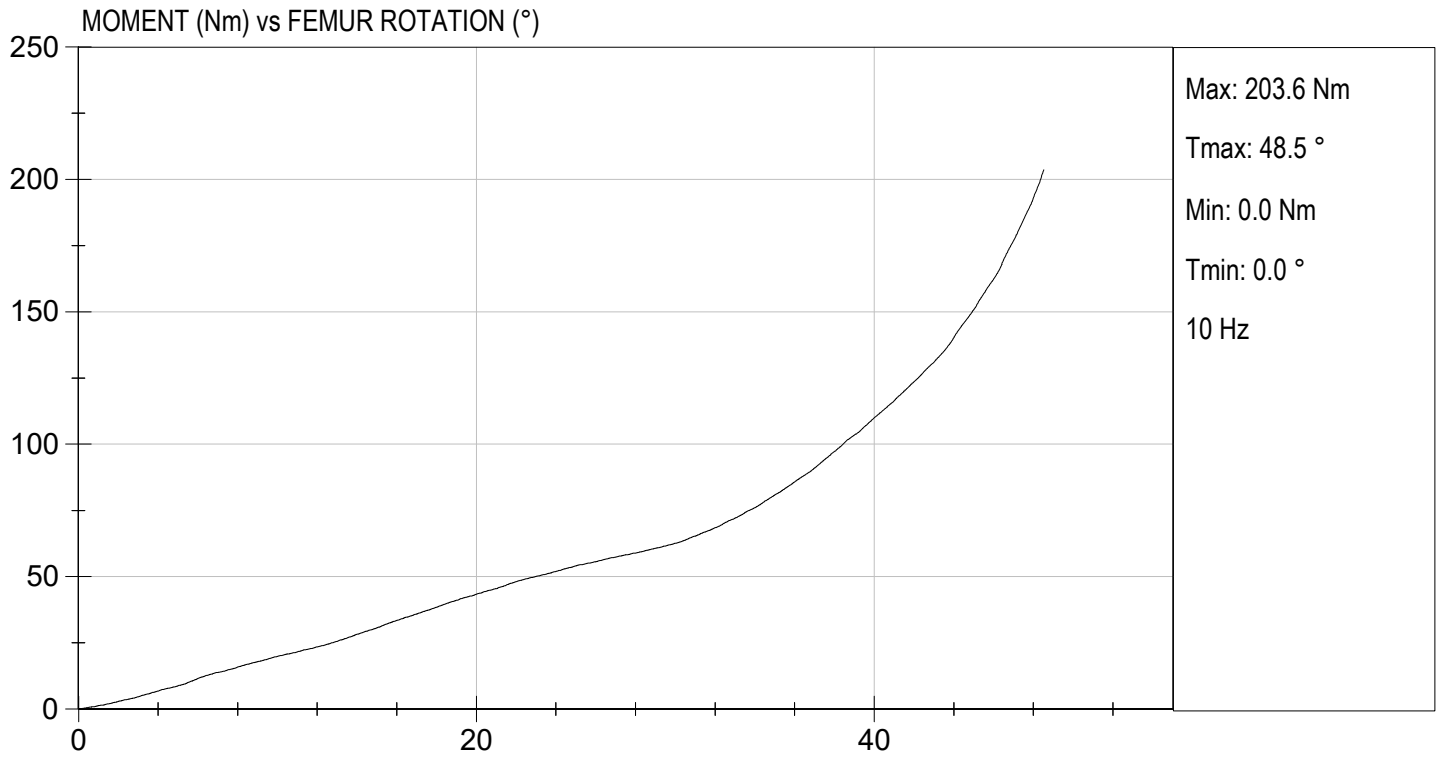
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.7	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	26	26	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.6	6.6	Pass
30 Degrees	Nm	94.9 Nm Max	68.8	62.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.8	48.5	Pass
Overall Test Results					Pass

  
 Laboratory Technician

11/17/2022  
 Test Date

  
 Approved By





**CALIBRATION TEST RESULTS**

**POST-TEST**

**HYBRID III 50<sup>TH</sup> PERCENTILE MALE - DRIVER ATD**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 50TH PERCENTILE MALE**

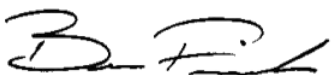
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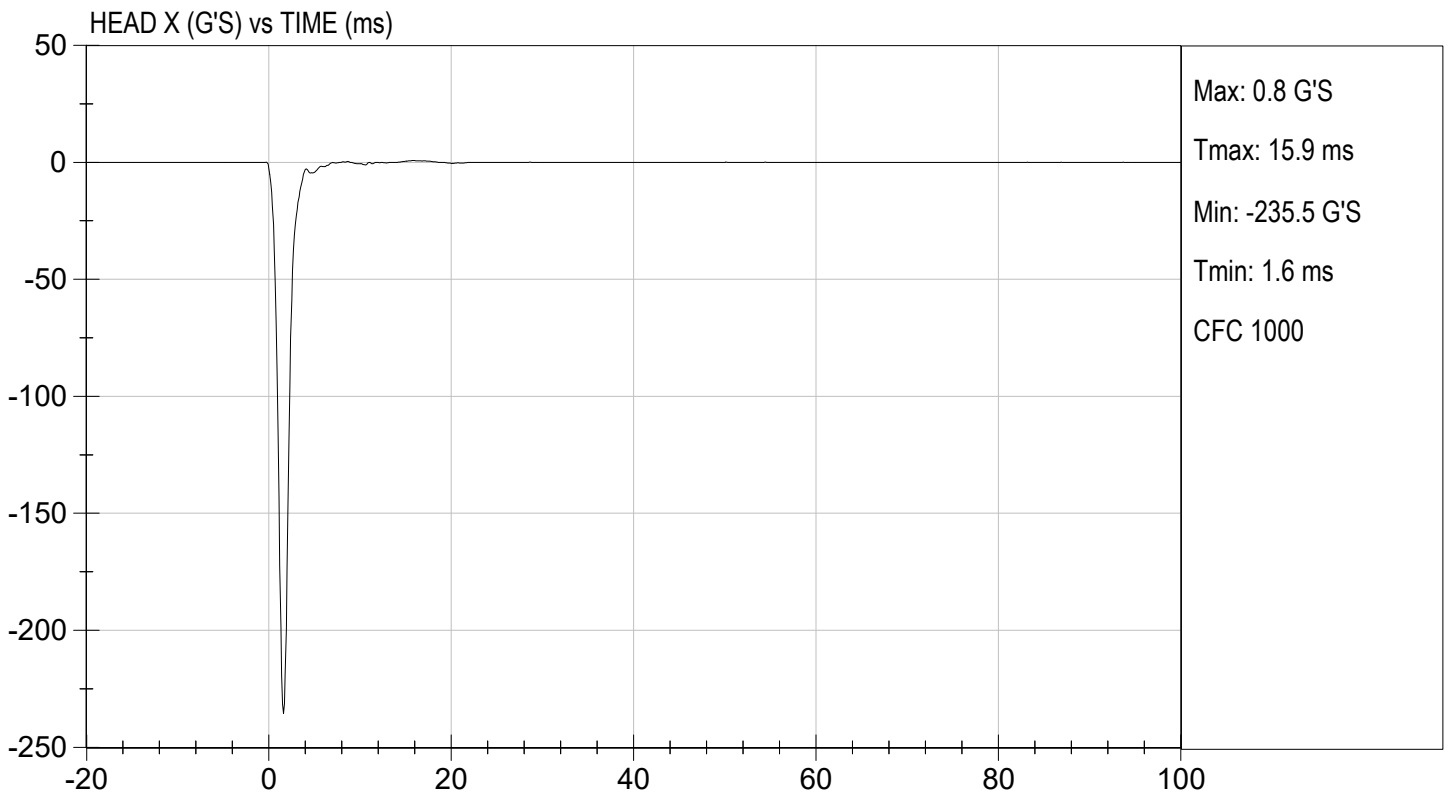
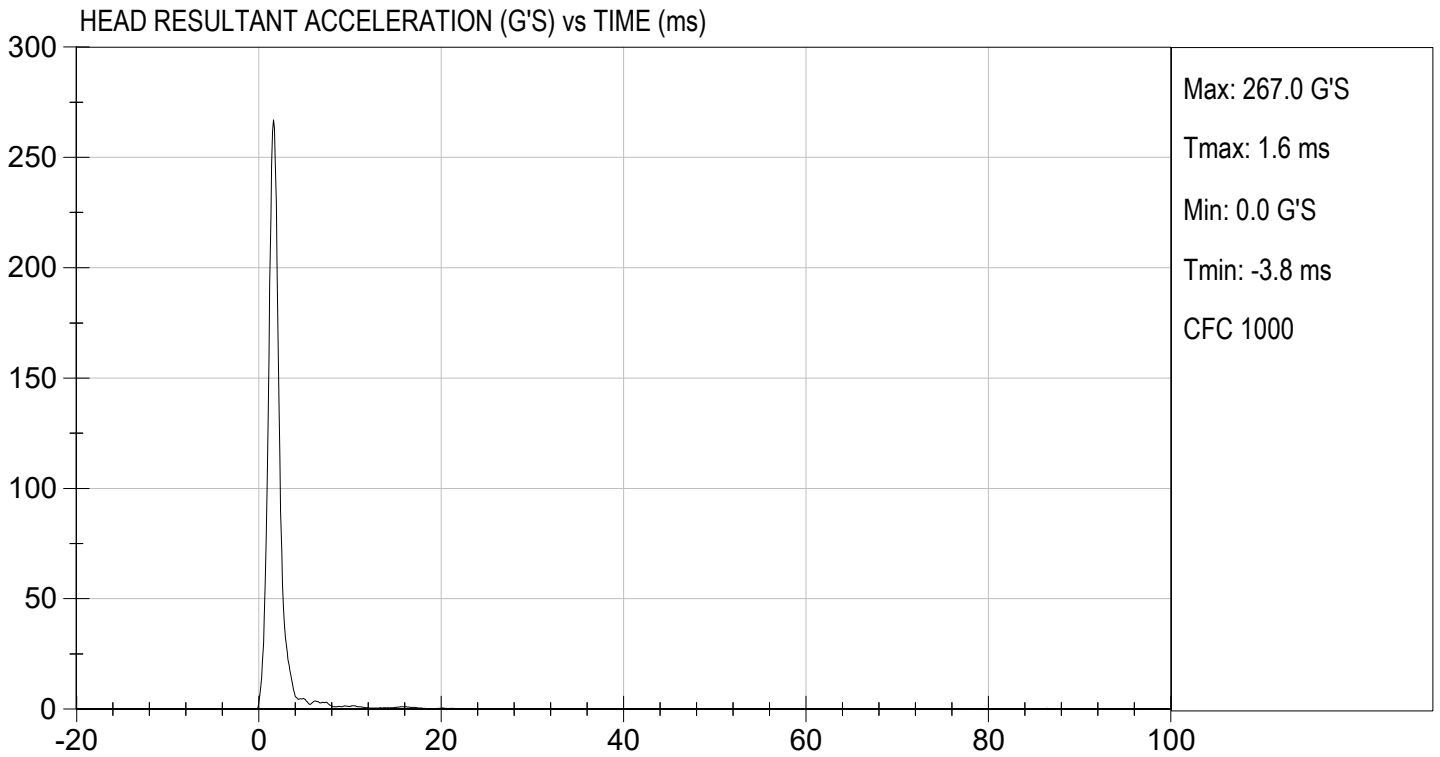
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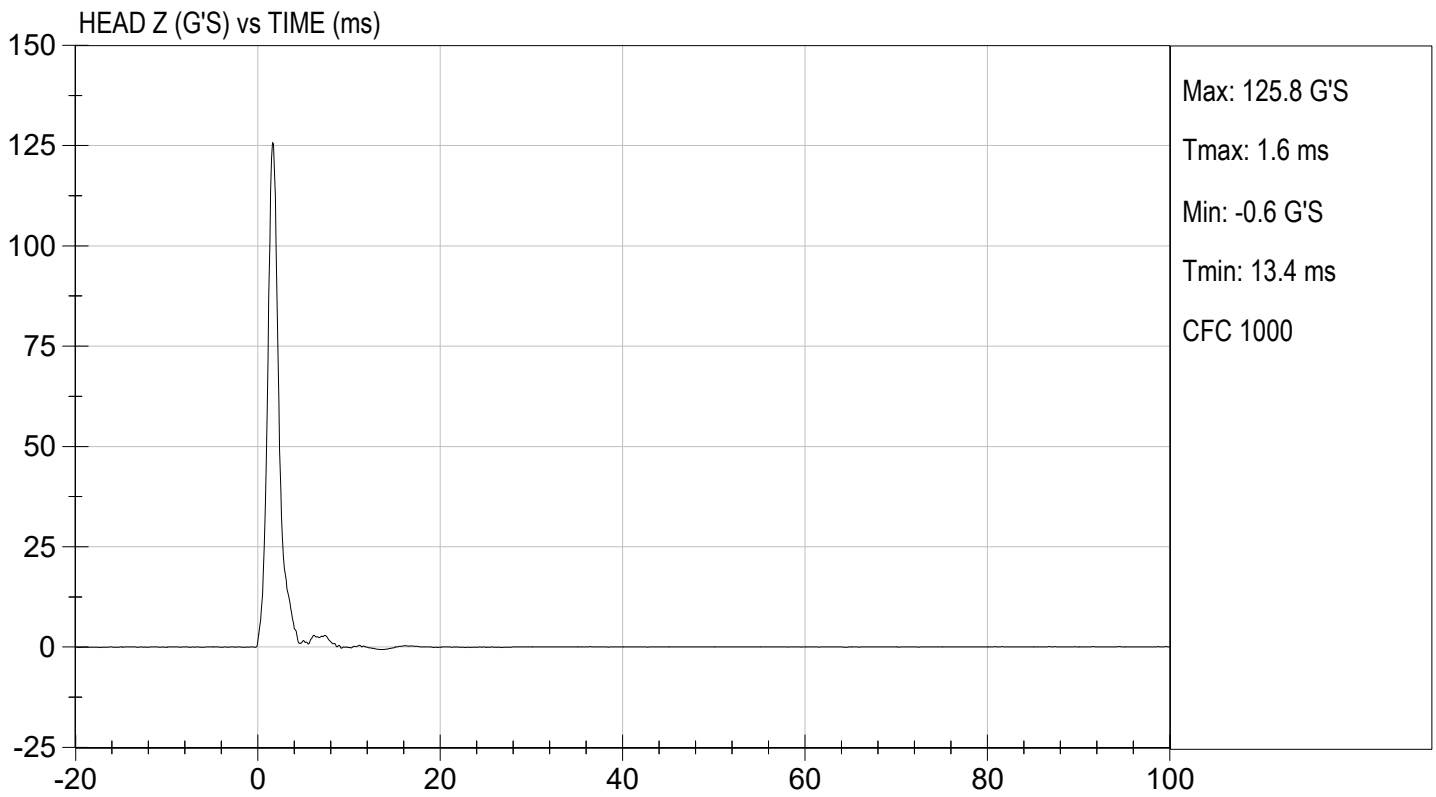
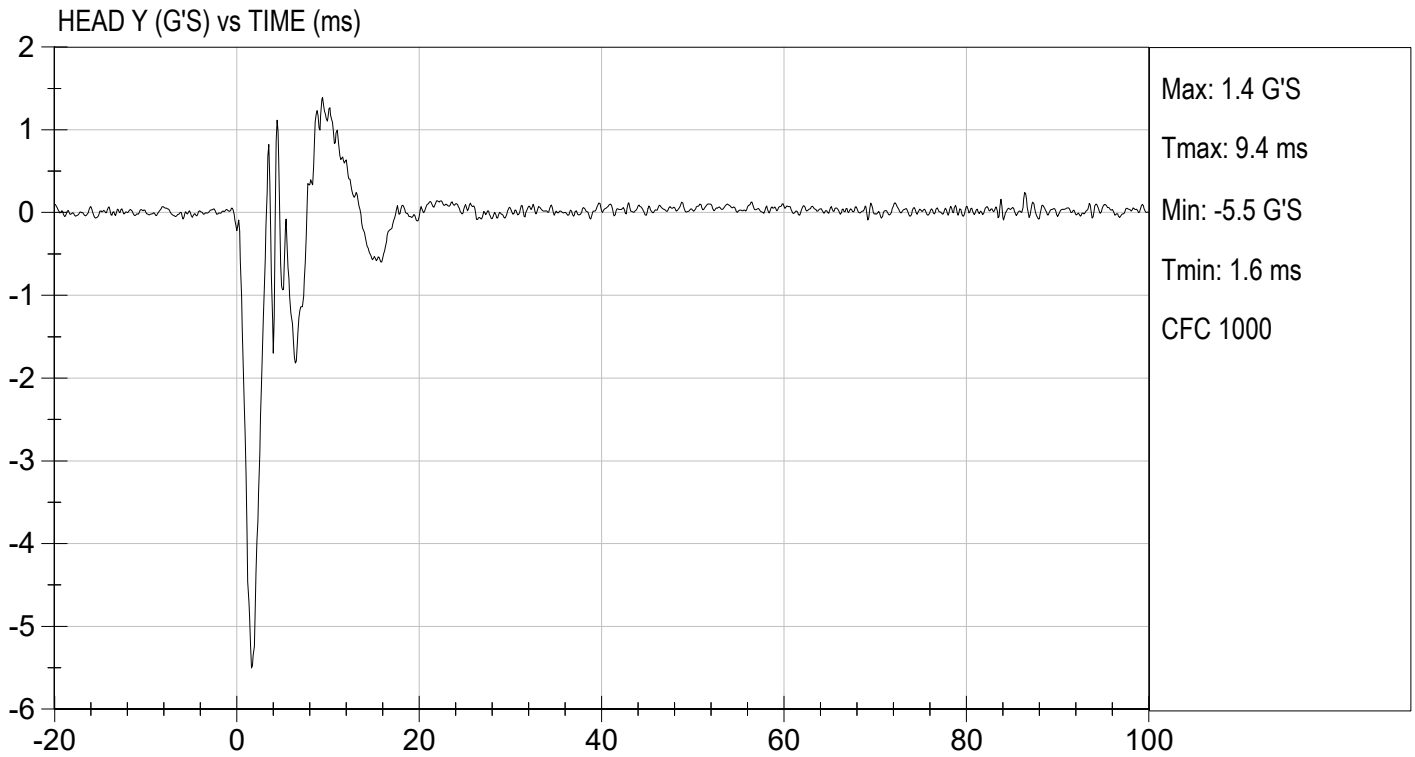
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Peak Resultant Acceleration	G's	225 to 275	267	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-5.5	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

  
 \_\_\_\_\_  
 Laboratory Technician

11/28/2022  
 \_\_\_\_\_  
 Test Date

  
 \_\_\_\_\_  
 Approved By





**MGA RESEARCH CORPORATION**  
**NECK FLEXION TEST**  
**HYBRID III 50TH PERCENTILE MALE**

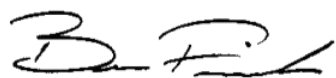
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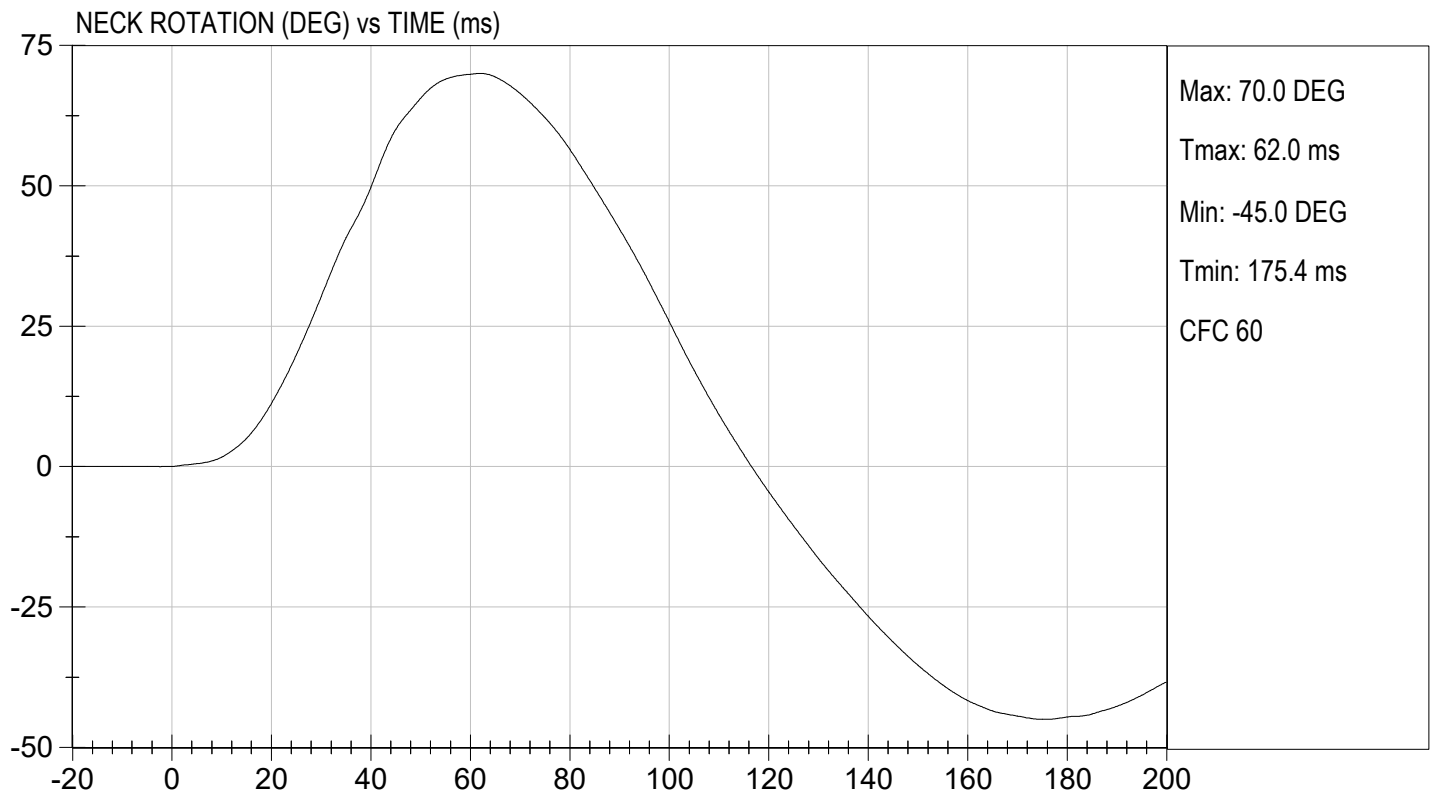
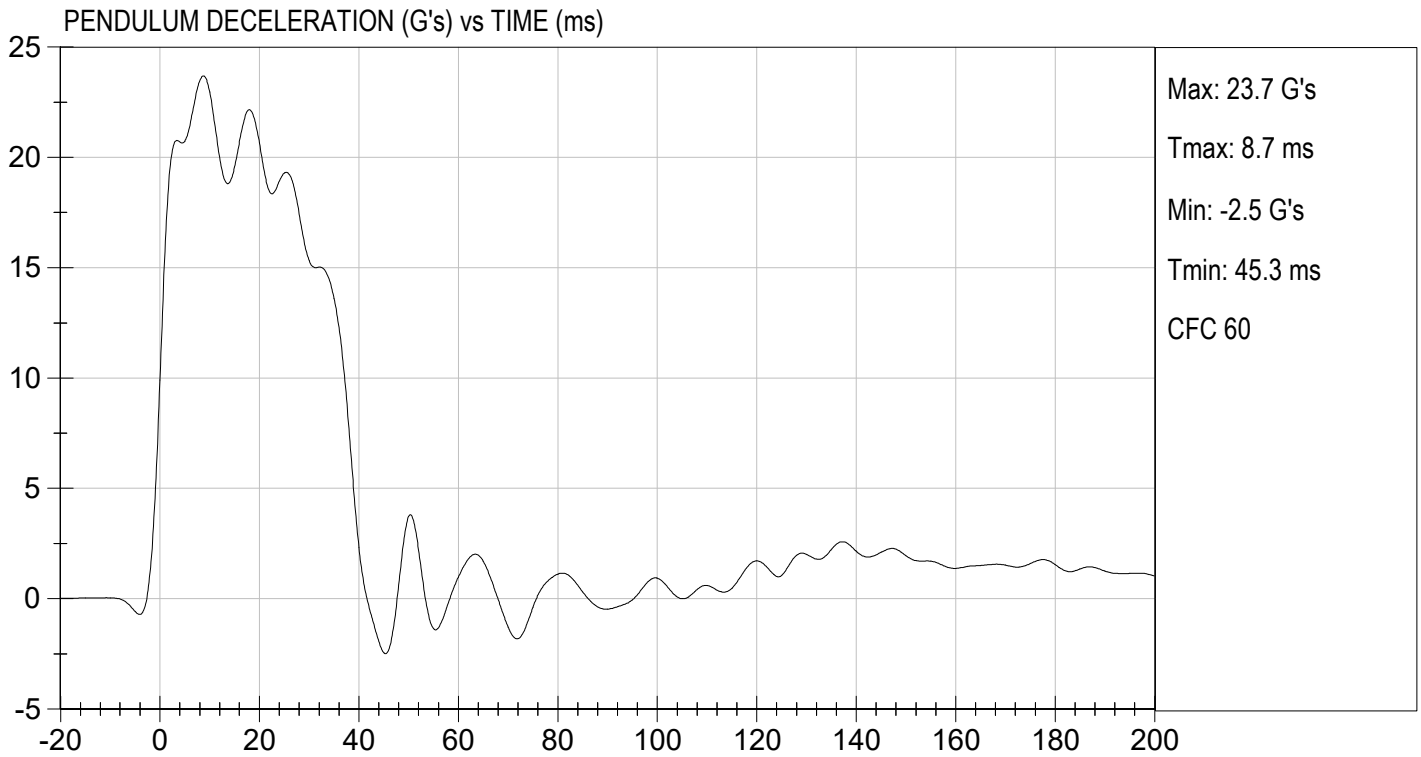
Test I.D.: D222772

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	25	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	22.95	Pass
	20 ms	G's	17.60 to 22.60	20.65	Pass
	30 ms	G's	12.50 to 18.50	15.32	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	15.3	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	39.0	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	70.0	Pass
	Time	ms	57.0 to 64.0	62.0	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.7	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	93.6	Pass
	Time	ms	47.0 to 58.0	50.5	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	100.3	Pass
Overall Test Results					Pass

  
 Laboratory Technician

11/28/2022  
 Test Date

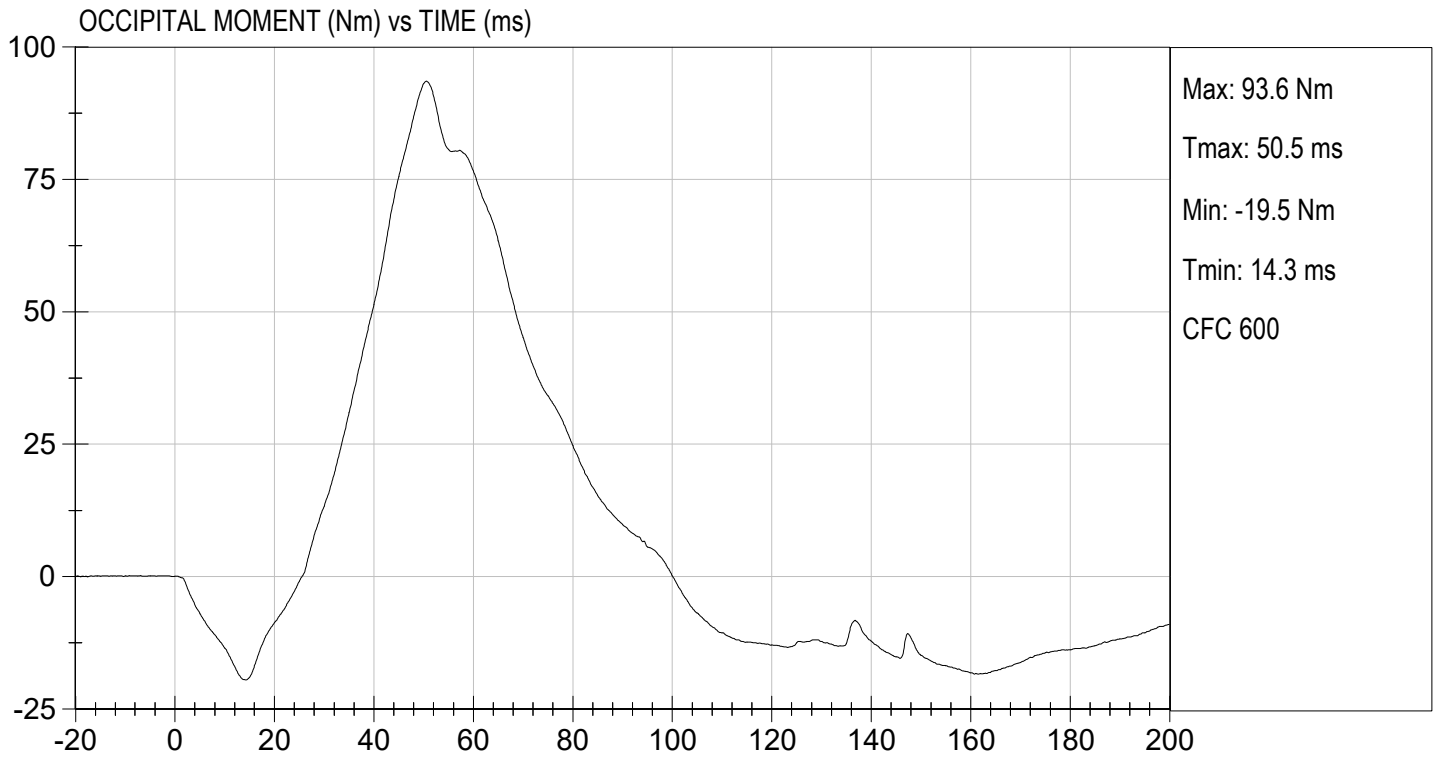
  
 Approved By





TEST DESC: NECK FLEXION  
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 11/28/2022  
TEST #: D222772



**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 50TH PERCENTILE MALE**

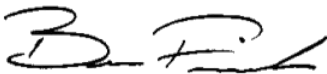
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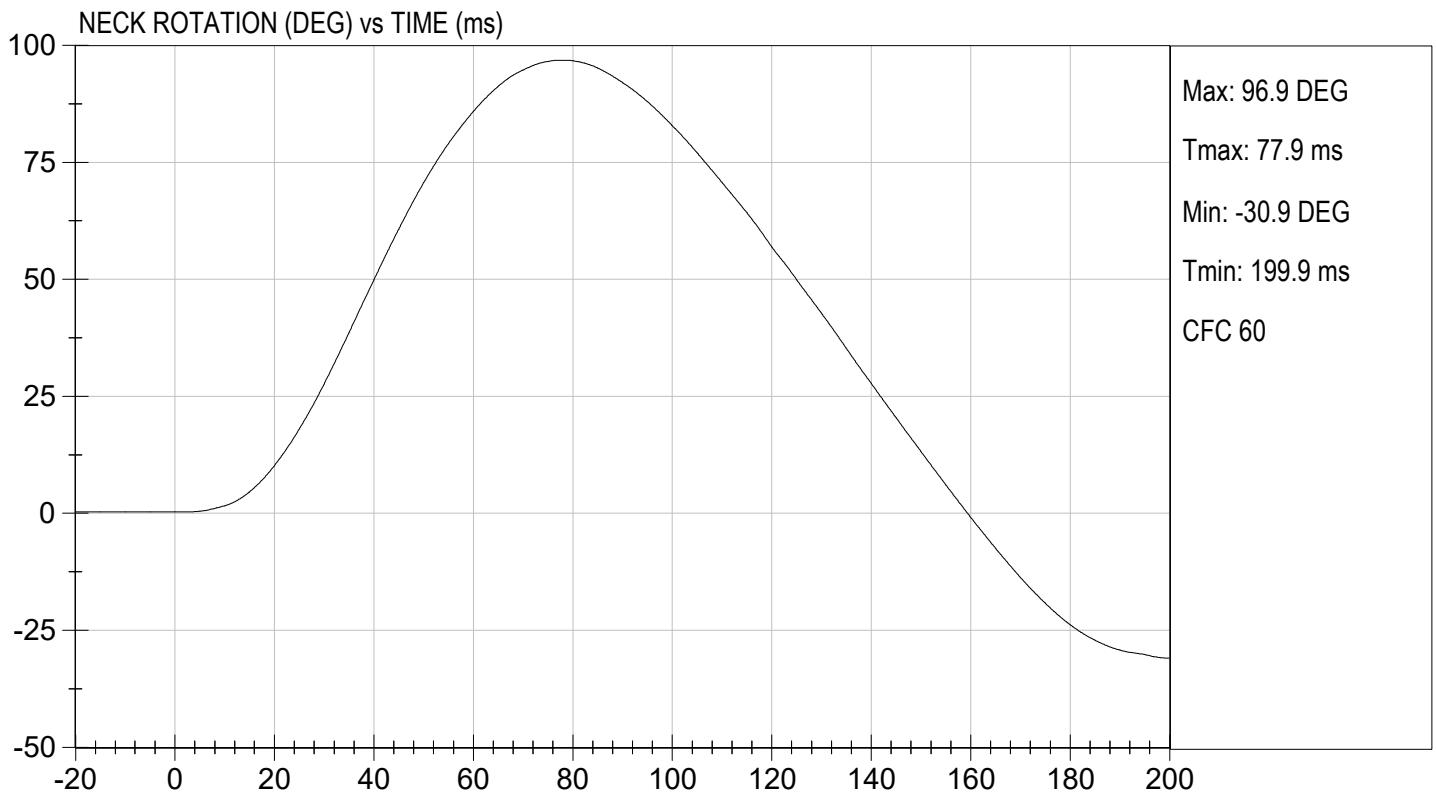
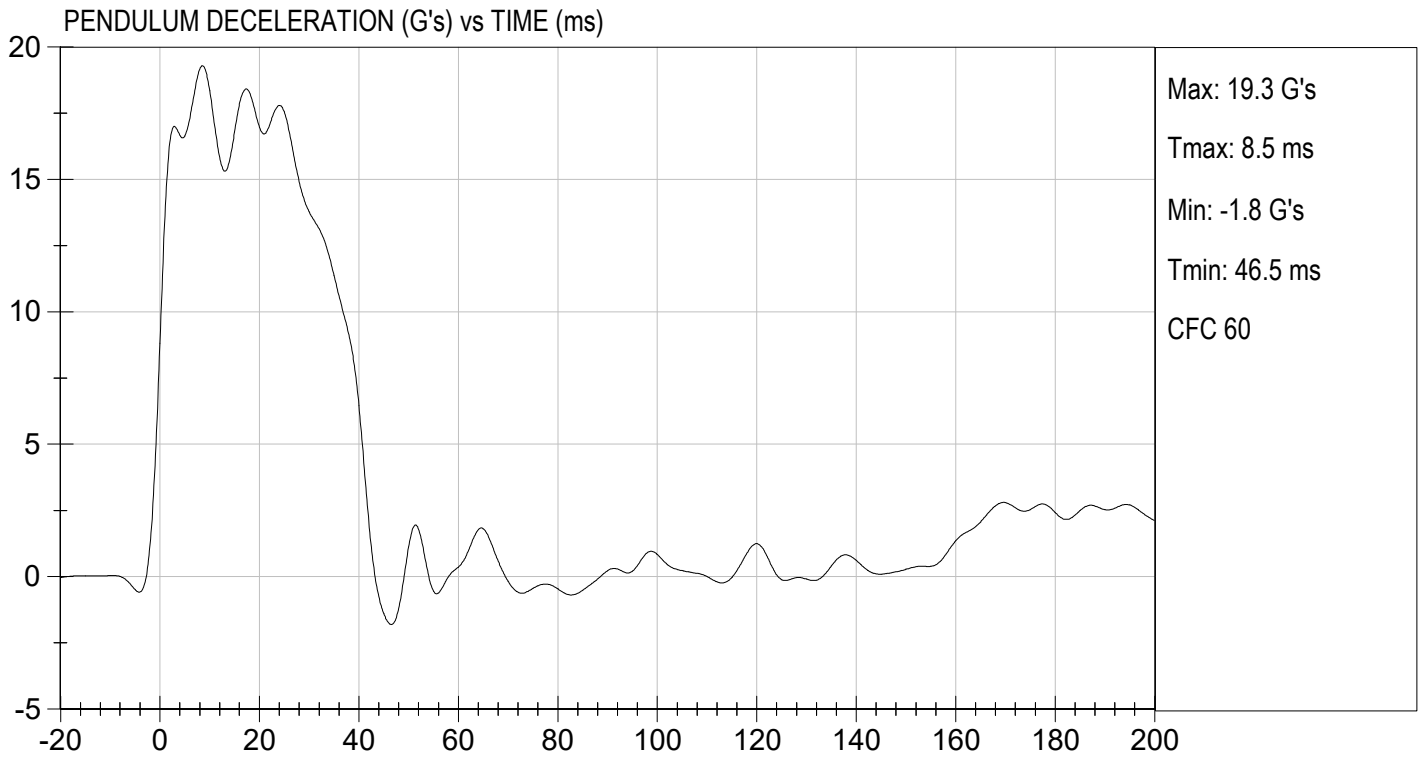
Test I.D.: D222773

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	25	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.05	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	18.35	Pass
	20 ms	G's	14.00 to 19.00	16.98	Pass
	30 ms	G's	11.00 to 16.00	13.78	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.7	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	40.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	96.9	Pass
	Time	ms	72.0 to 82.0	77.9	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	159.5	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-61.3	Pass
	Time	ms	65.0 to 79.0	70.7	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	142.2	Pass
Overall Test Results					Pass

  
 Laboratory Technician

11/28/2022  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 50TH PERCENTILE MALE**

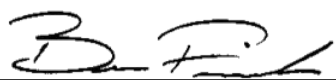
ATD Serial No: 351

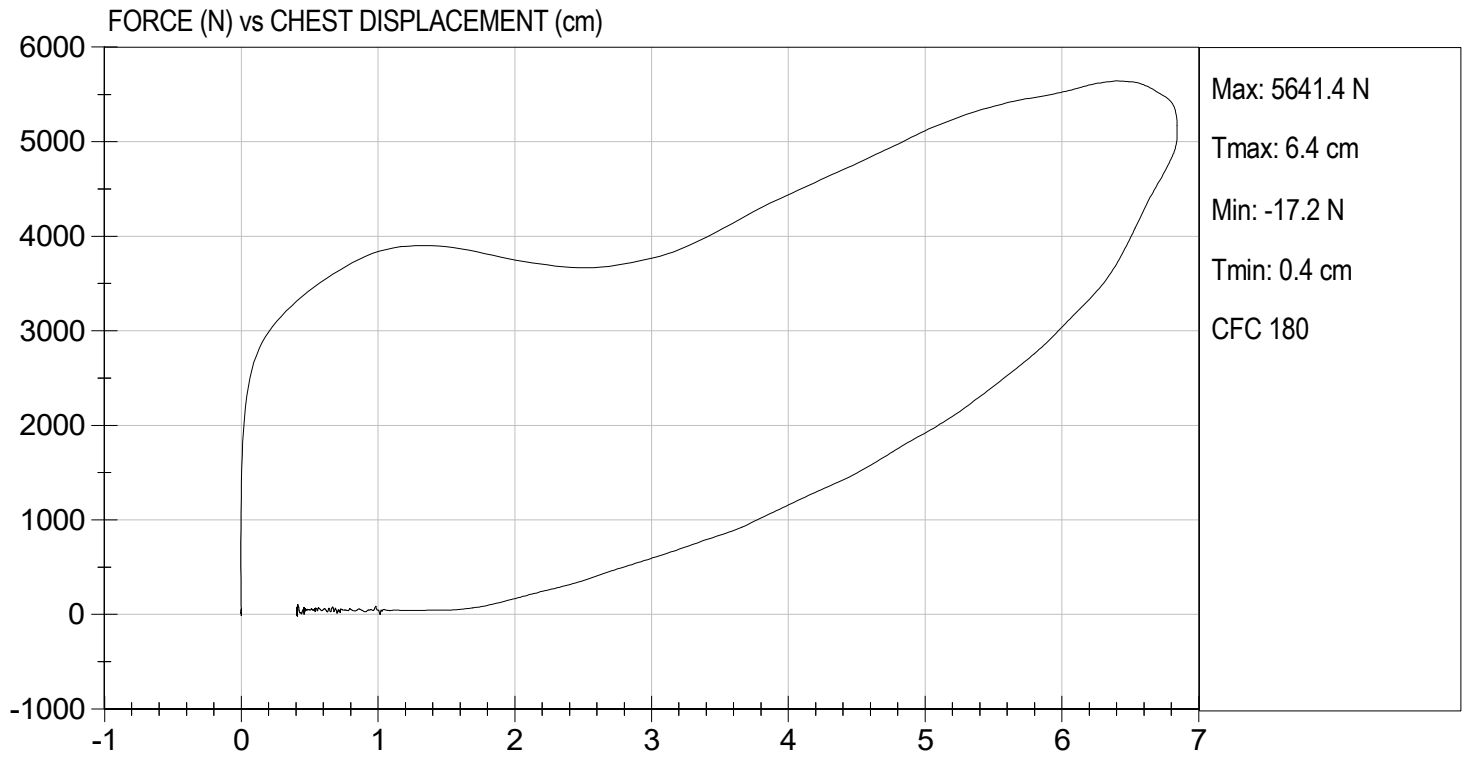
Test I.D: D222774

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,641	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.84	Pass
Internal Hysteresis	%	69 to 85	71	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

11/28/2022  
 Test Date

  
 Approved By



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 50TH PERCENTILE MALE**

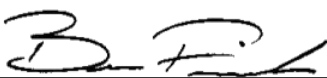
ATD Serial No: 351

Test I.D: D222775

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/s	2.07 to 2.13	2.10	Pass
Peak Probe Force	N	4715 to 5782	5,632	Pass
Overall Test Results				Pass

  
 Laboratory Technician

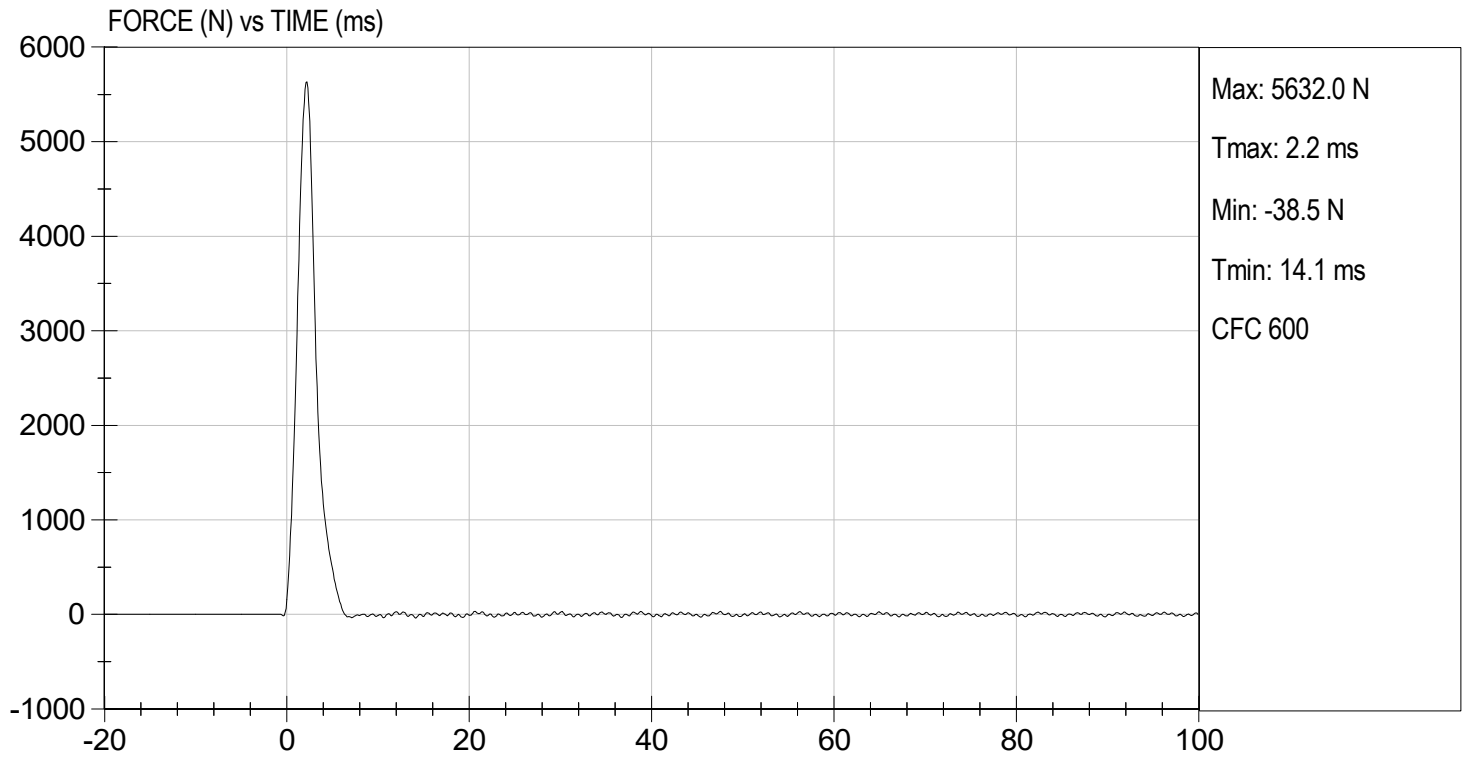
11/28/2022  
 Test Date

  
 Approved By



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

TEST DATE: 11/28/2022  
TEST #: D222775



**MGA RESEARCH CORPORATION**  
**LEFT KNEE IMPACT TEST**  
**HYBRID III 50TH PERCENTILE MALE**

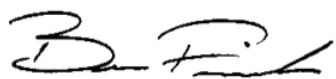
ATD Serial No: 351

Test I.D: D222776

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/s	2.07 to 2.13	2.09	Pass
Peak Probe Force	N	4715 to 5782	5,209	Pass
Overall Test Results				Pass

  
 Laboratory Technician

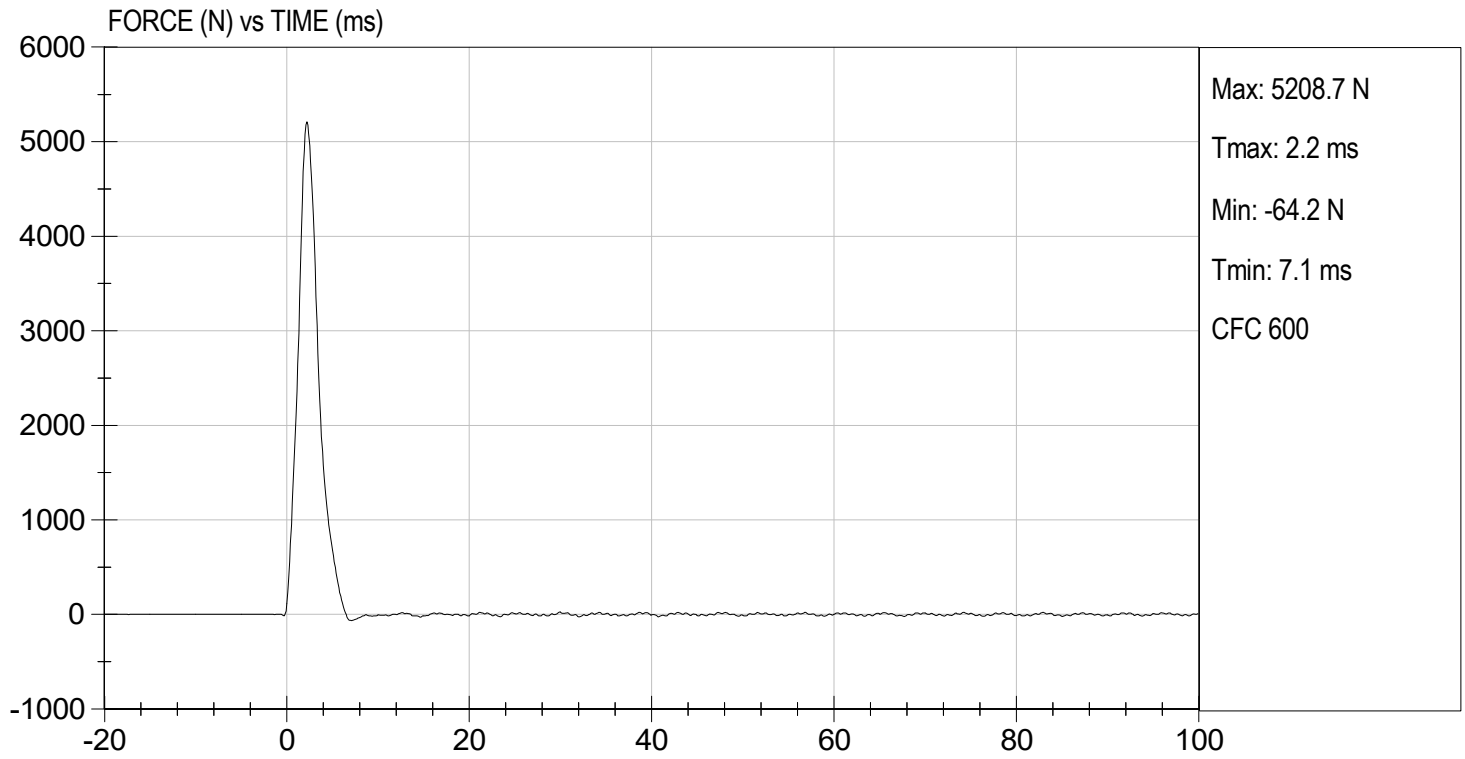
11/28/2022  
 Test Date

  
 Approved By



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

TEST DATE: 11/28/2022  
TEST #: D222776



**MGA RESEARCH CORPORATION**  
**HIP-FEMUR FLEXION TEST**  
**HYBRID III 50TH PERCENTILE MALE**

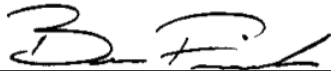
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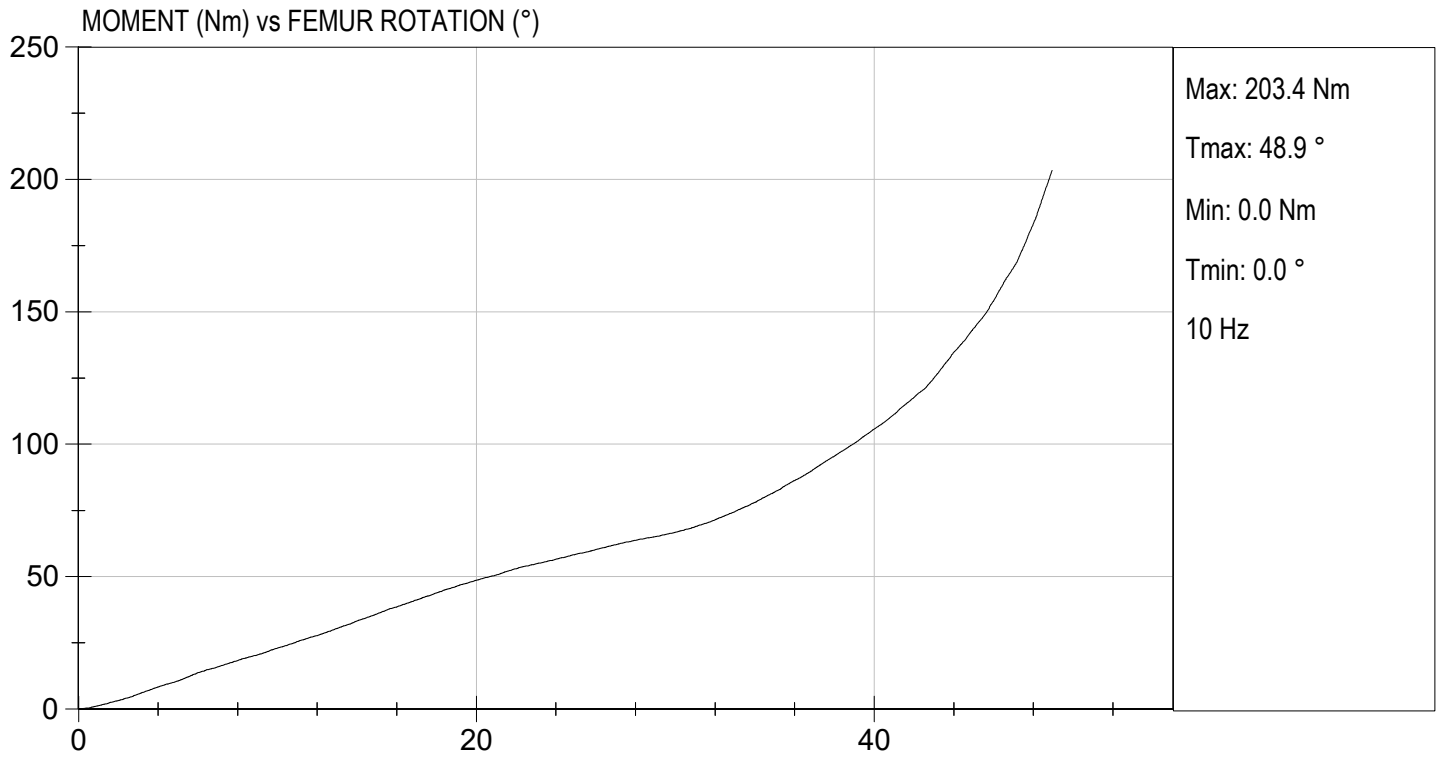
**Test I.D:** D222770

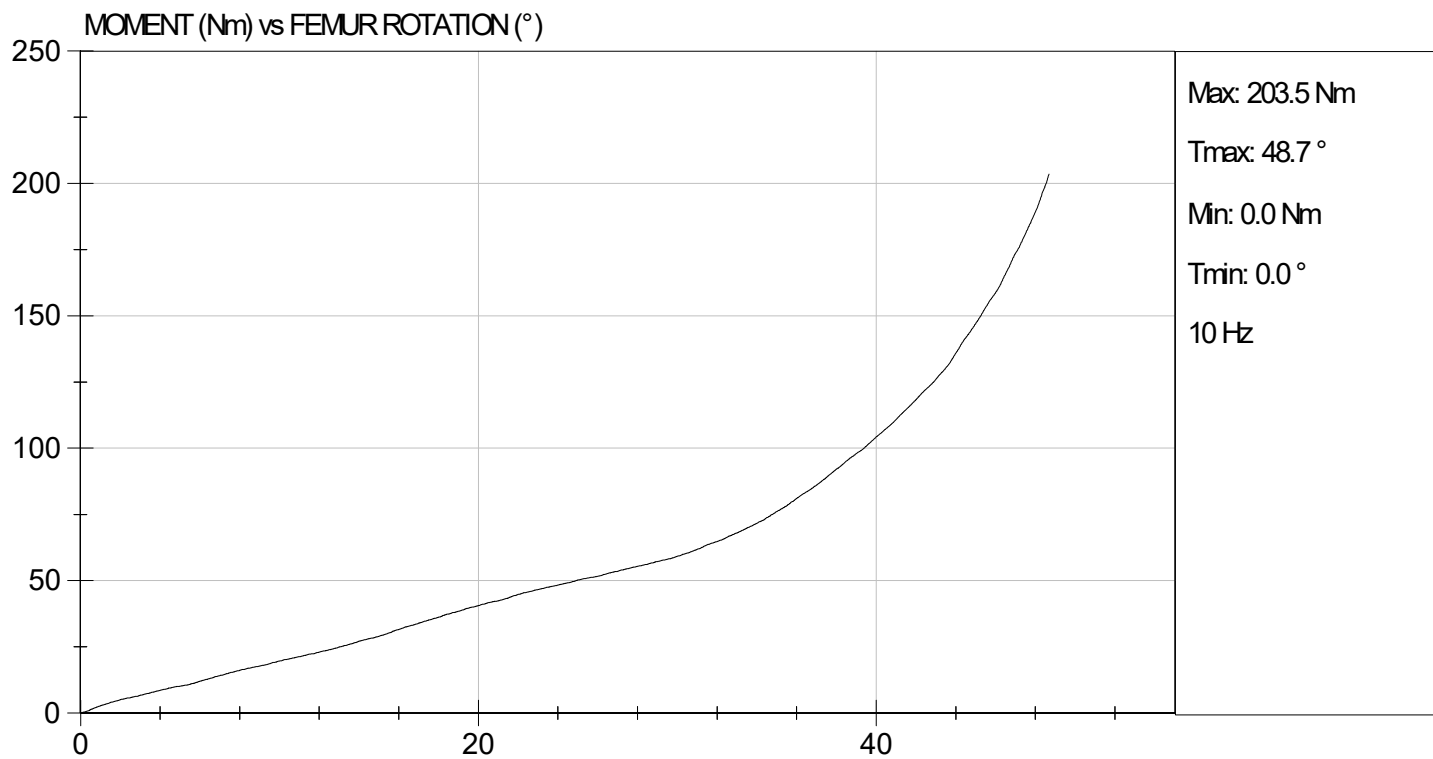
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.3	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	25	25	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.5	6.6	Pass
30 Degrees	Nm	94.9 Nm Max	66.8	59.2	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.9	48.7	Pass
Overall Test Results					Pass

  
 Laboratory Technician

11/28/2022  
 Test Date

  
 Approved By





**CALIBRATION TEST RESULTS**

**PRE-TEST**

**HYBRID III 5<sup>TH</sup> PERCENTILE FEMALE - PASSENGER ATD**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 142

Test ID: D222641

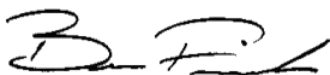
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Peak Resultant Acceleration	G's	250 to 300	286	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-2.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass



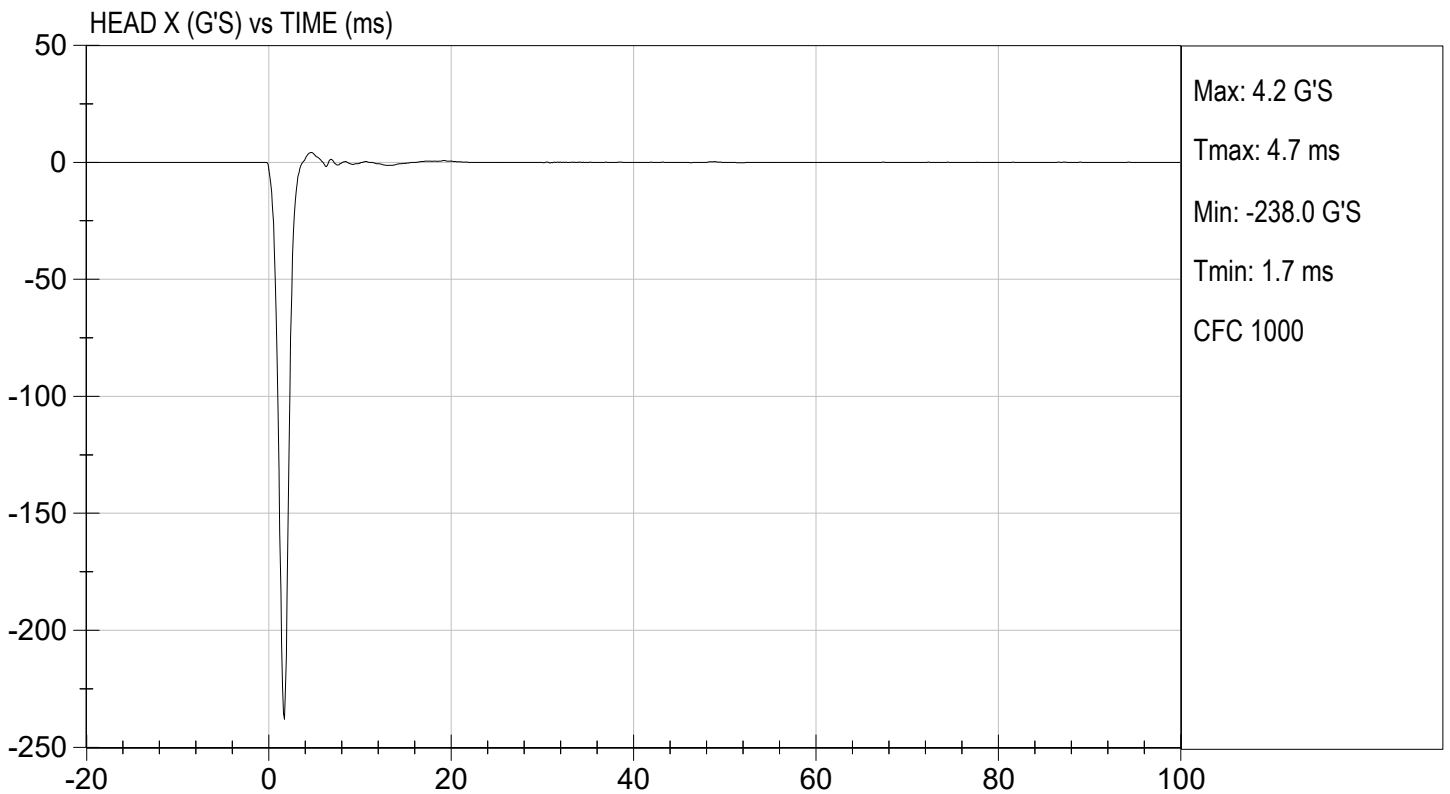
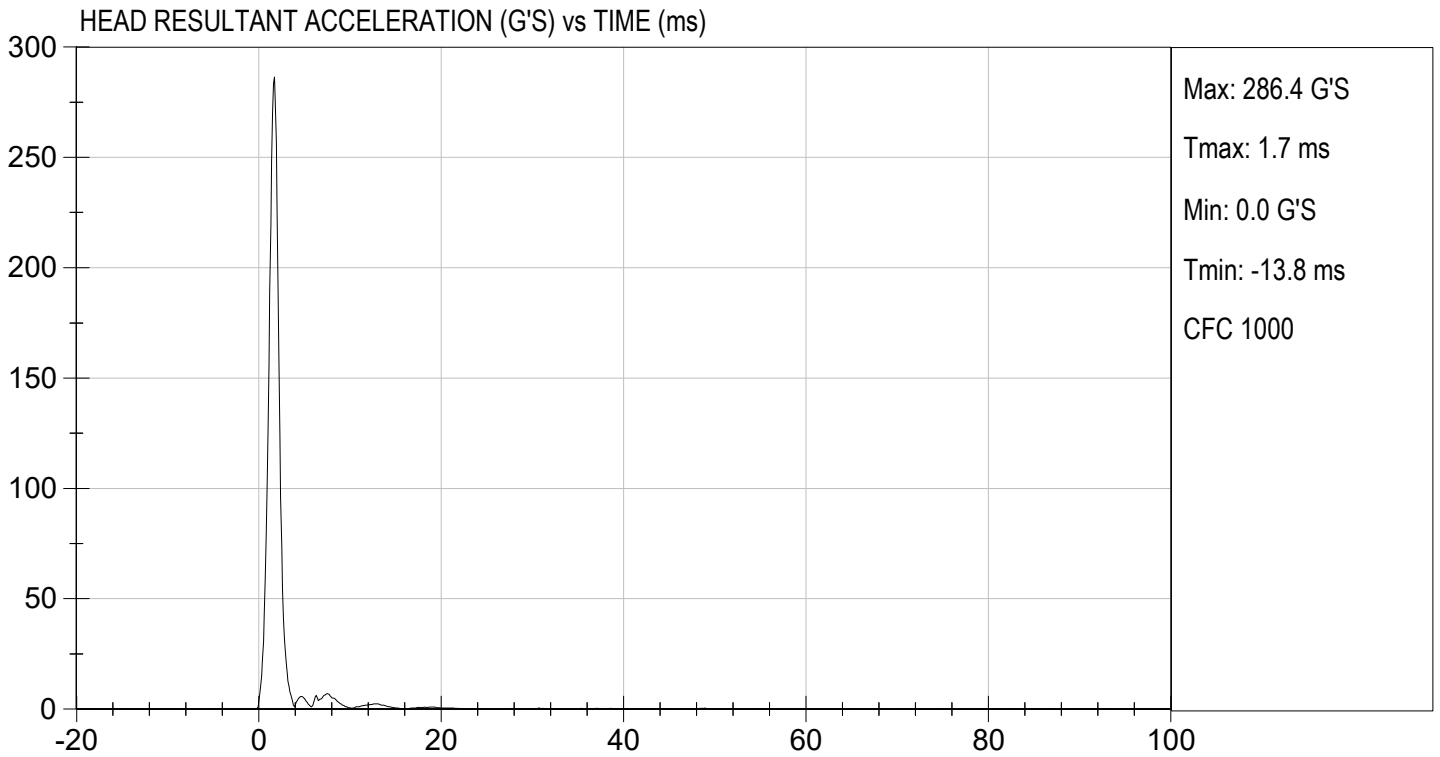
Laboratory Technician

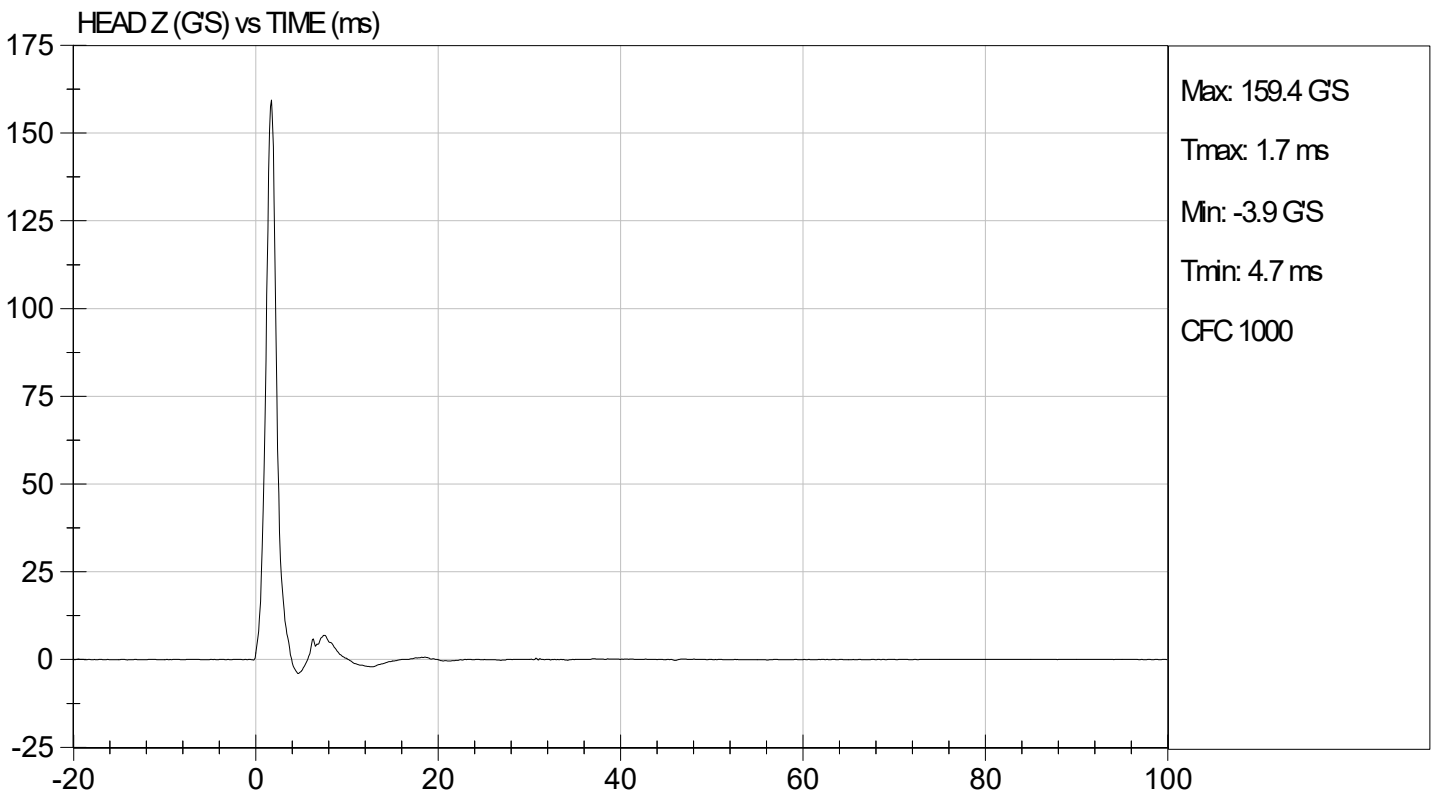
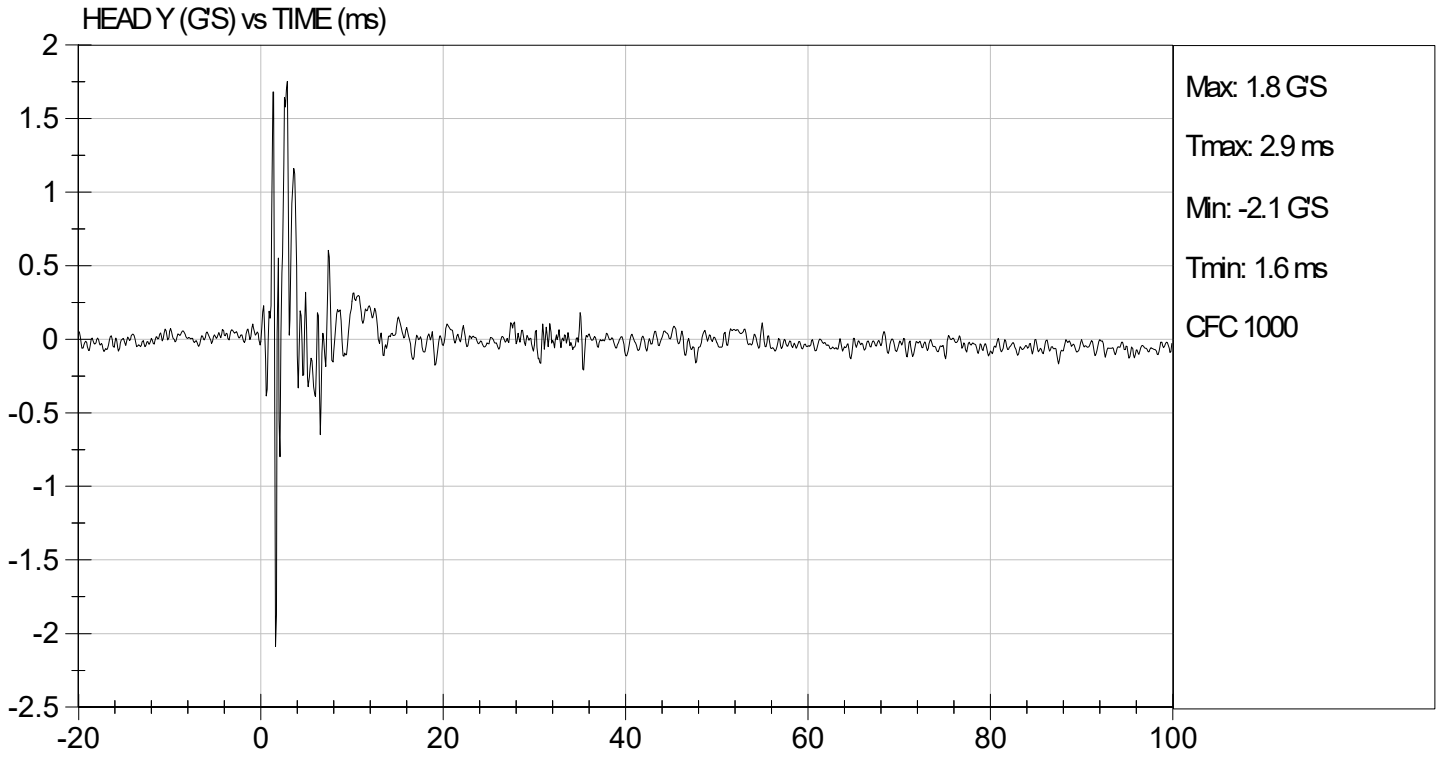
11/17/2022

Test Date



Approved By





**MGA RESEARCH CORPORATION**  
**NECK FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

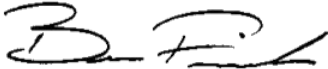
ATD Serial No: 142

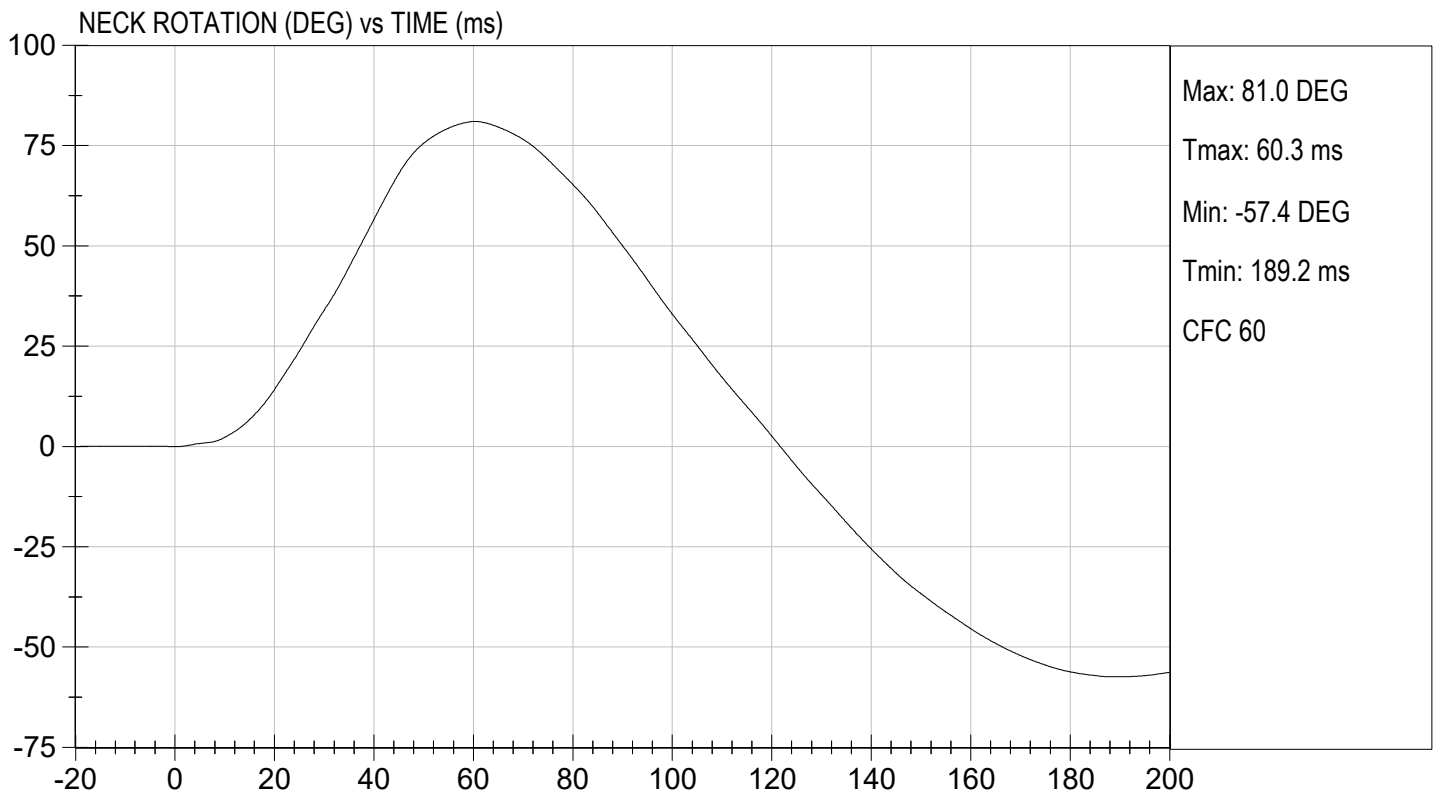
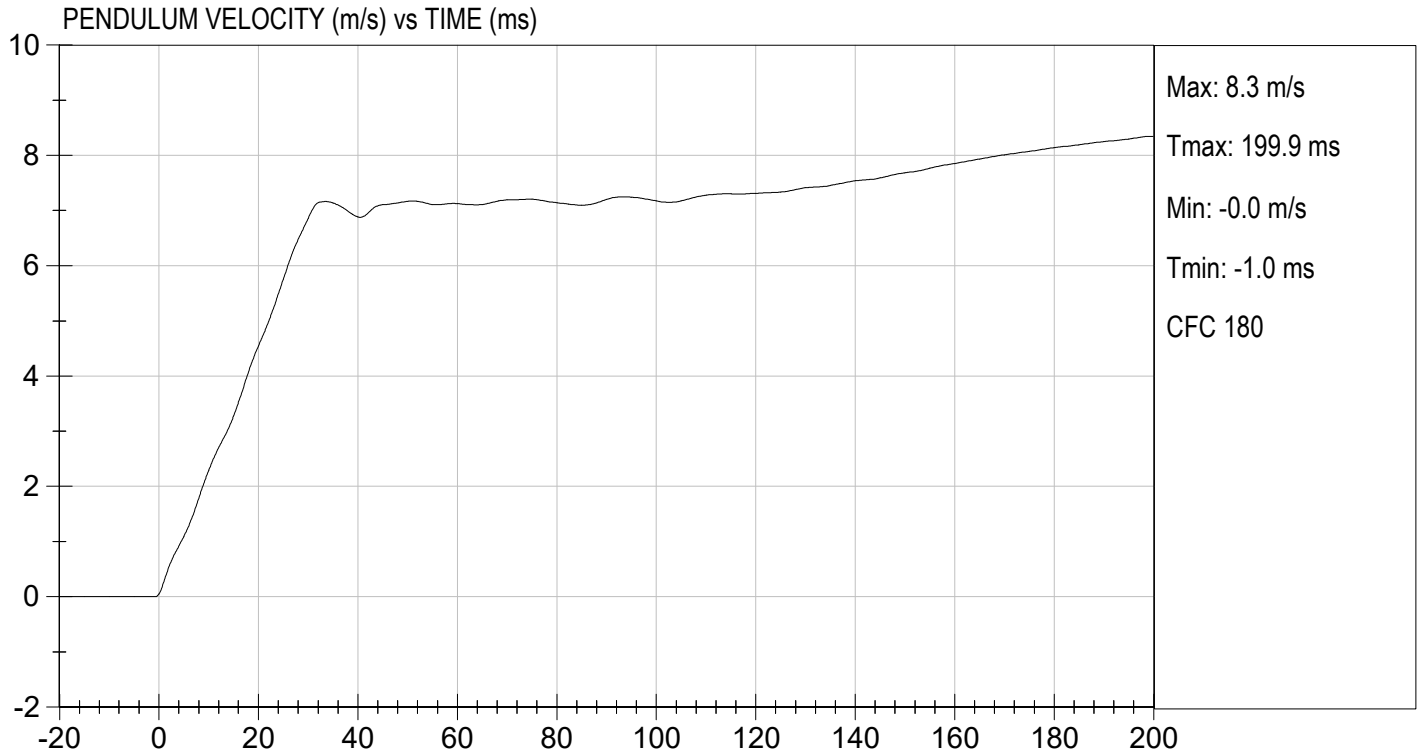
Test I.D: D222642

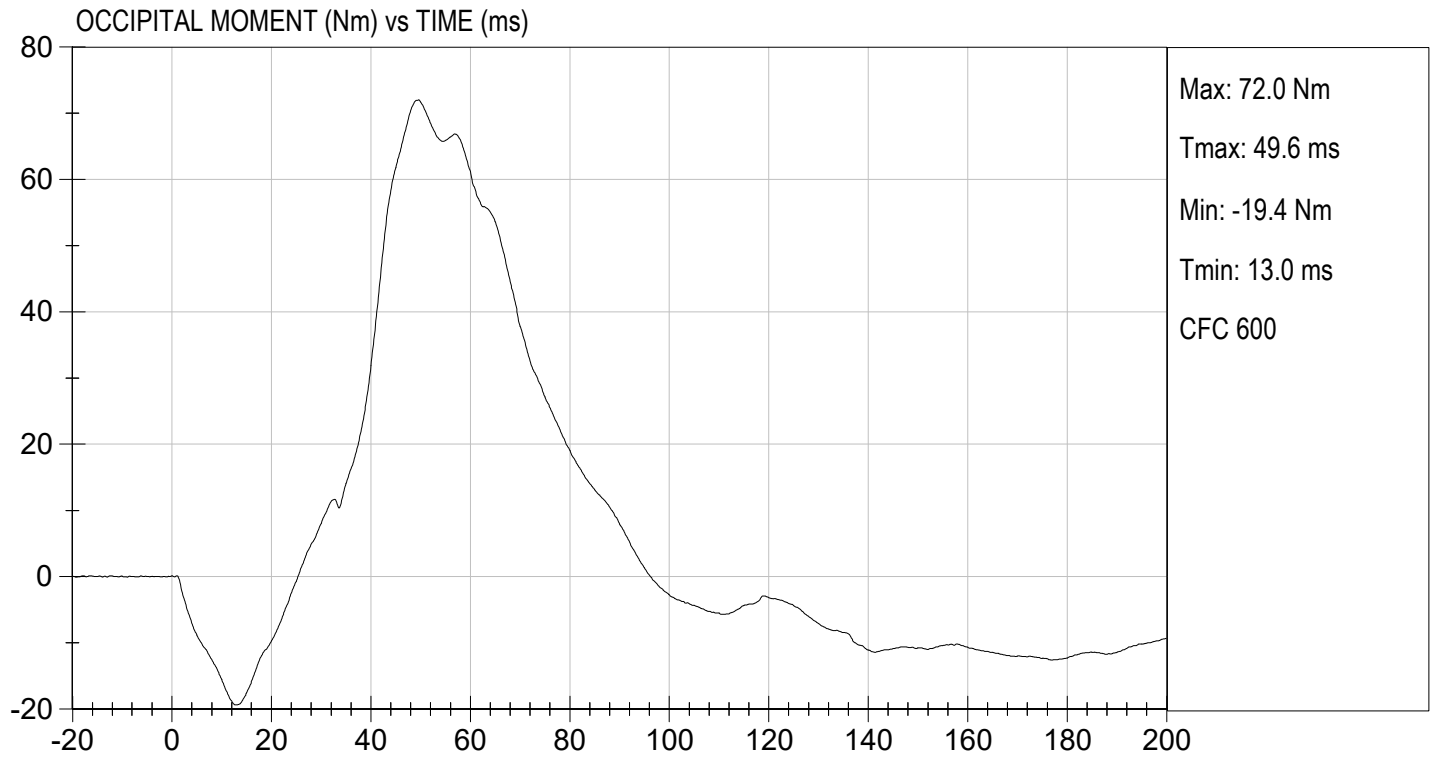
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.5	Pass
	30 ms	m/s	5.8 to 7.0	6.9	Pass
D Plane Rotation	Max	deg	77 to 91	81	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	69	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	87	Pass
Overall Results					Pass

  
 Laboratory Technician

11/18/2022  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 5TH PERCENTILE**

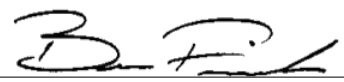
ATD Serial No: 142

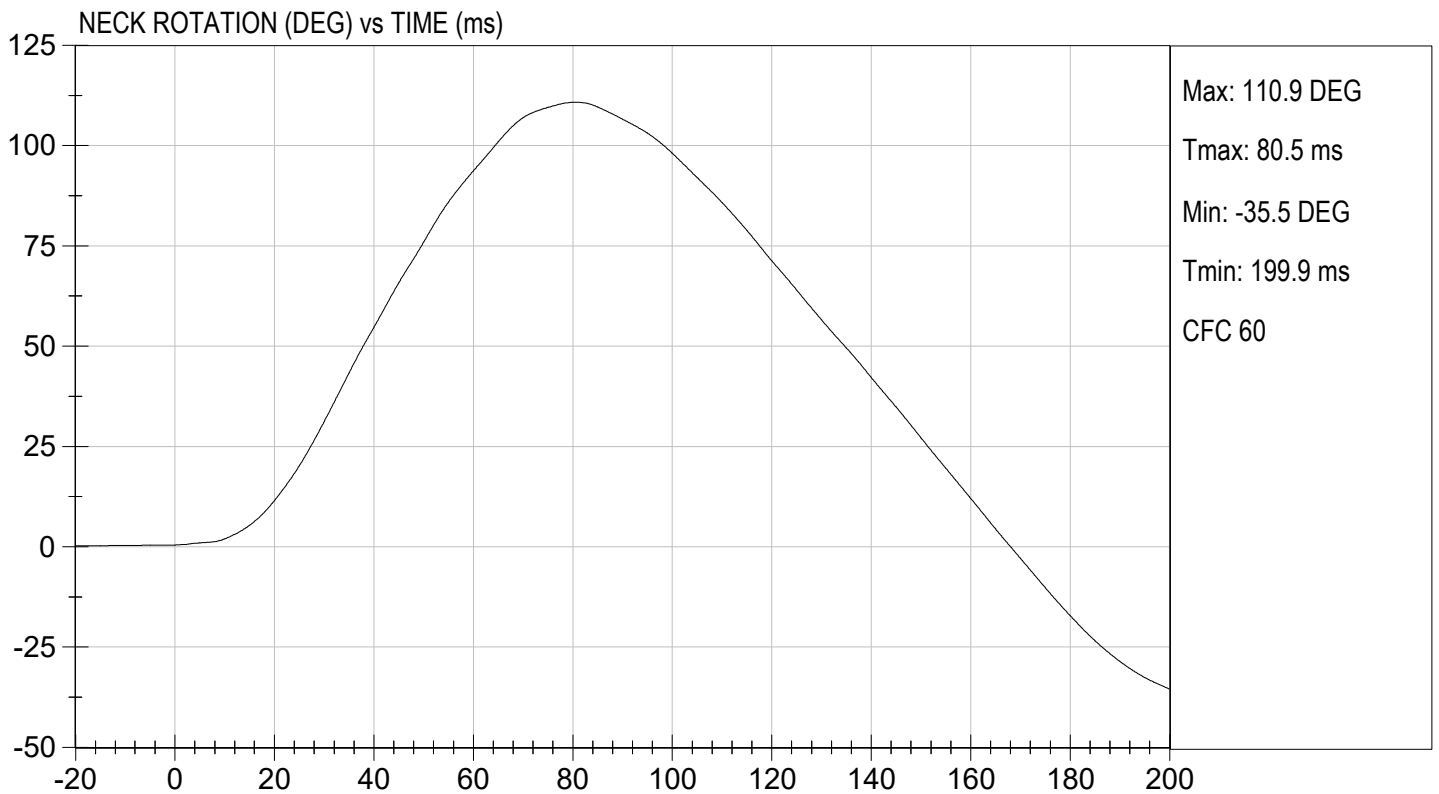
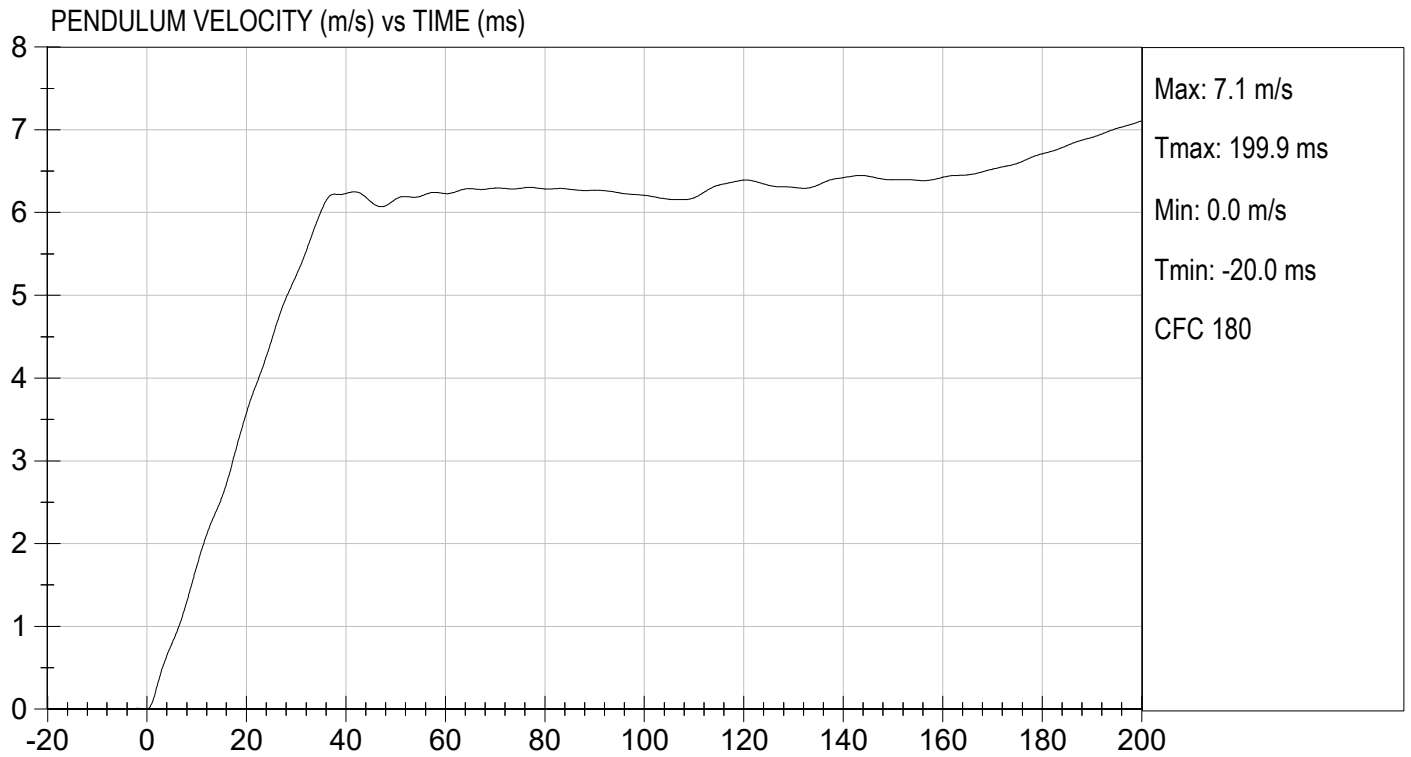
Test I.D.: D222643

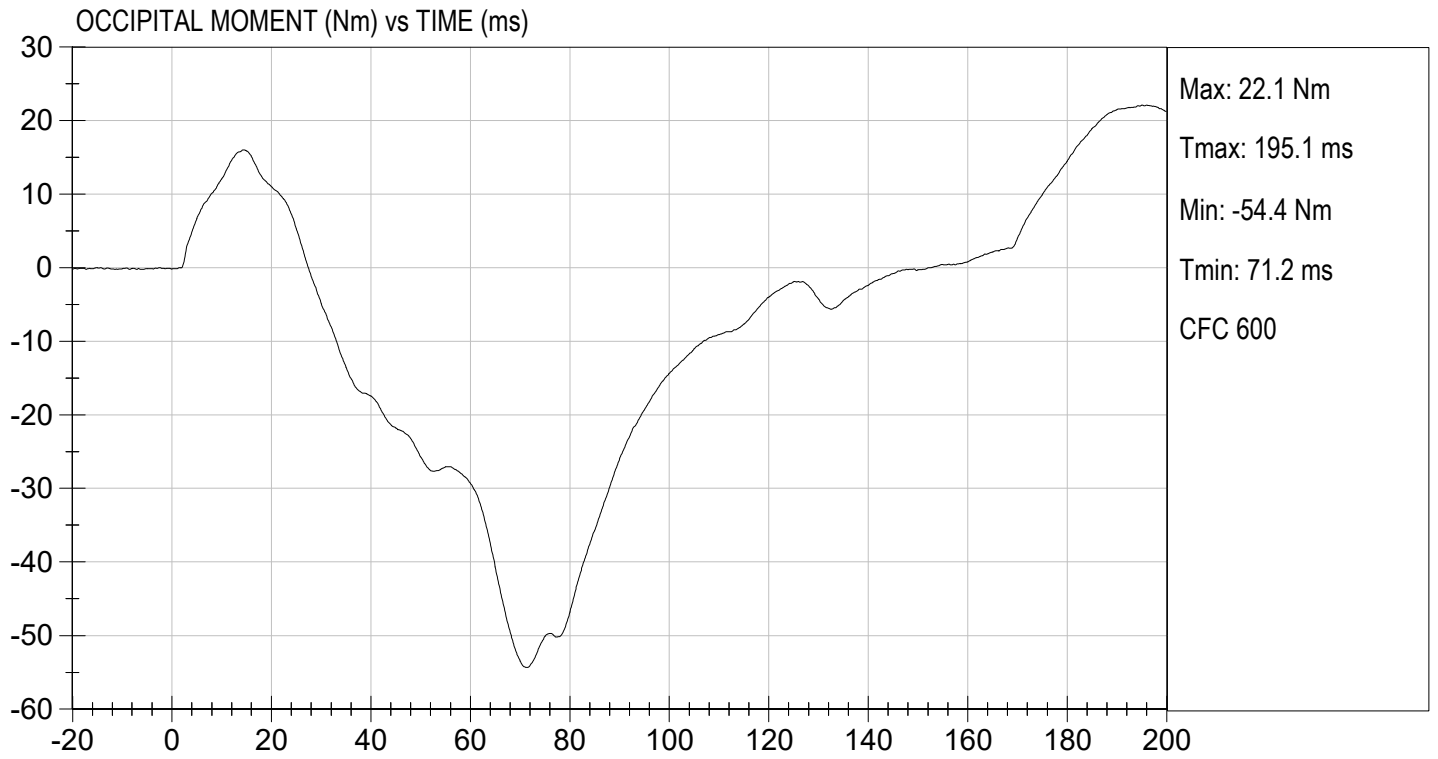
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.18	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.7	Pass
	20 ms	m/s	3.1 to 3.9	3.6	Pass
	30 ms	m/s	4.6 to 5.6	5.2	Pass
D Plane Rotation	Max	deg	99 to 114	111	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-54	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	104	Pass
Overall Results					Pass

  
 Laboratory Technician

11/18/2022  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 5TH PERCENTILE**

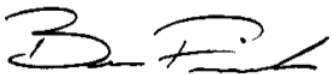
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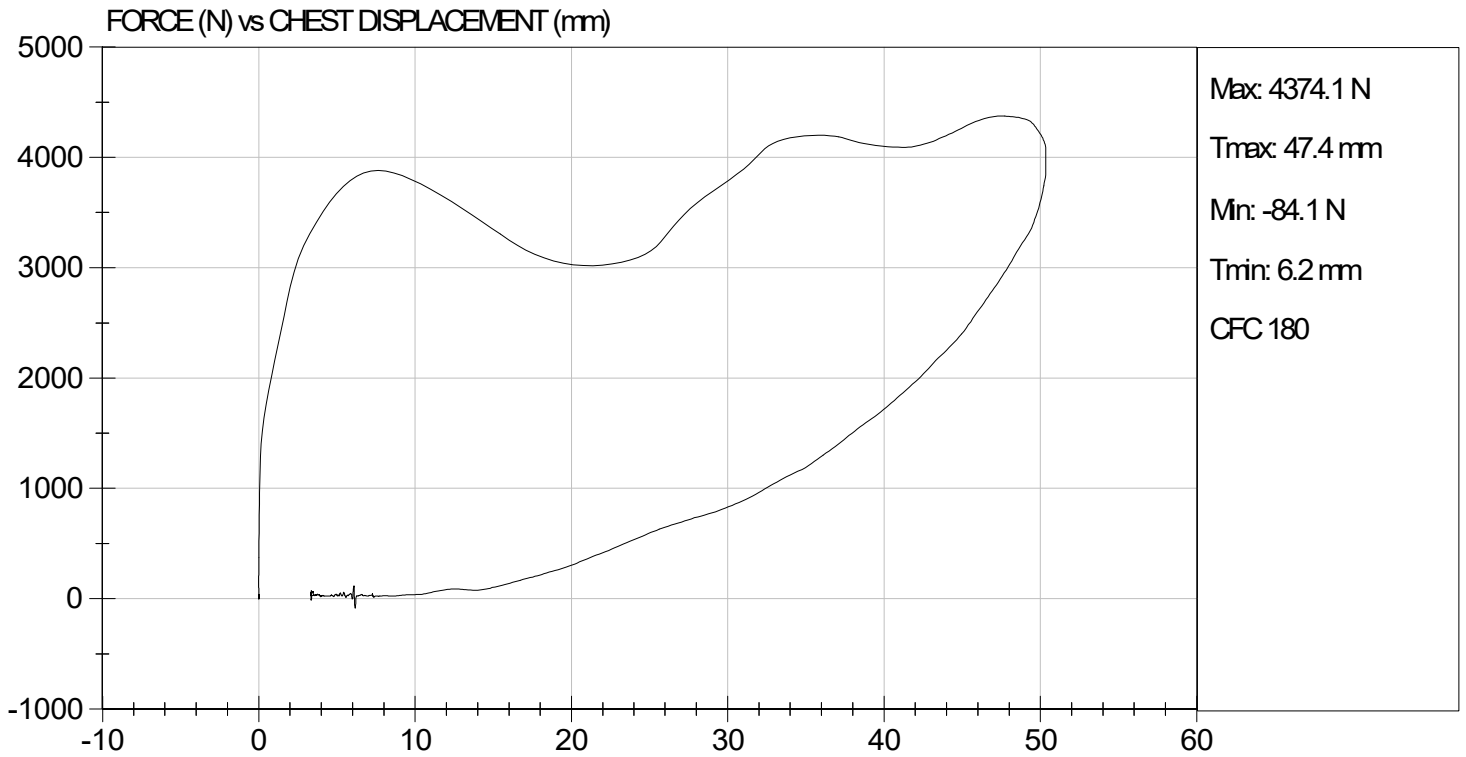
Test I.D: D222644

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Relative Humidity	%	10 to 70	27	Pass
Probe Speed	m/s	6.59 to 6.83	6.68	Pass
Peak Deflection	mm	50 to 58	50	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4200	Pass
Internal Hysteresis	%	69 to 85	75	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4374	Pass
Overall Test Results				Pass

  
 Laboratory Technician

11/17/2022  
 Test Date

  
 Approved By



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

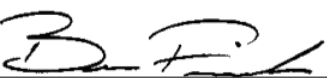
ATD Serial No: 142

Test I.D: D222645

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	3559	Pass
Overall Test Results				Pass

  
 \_\_\_\_\_  
 Laboratory Technician

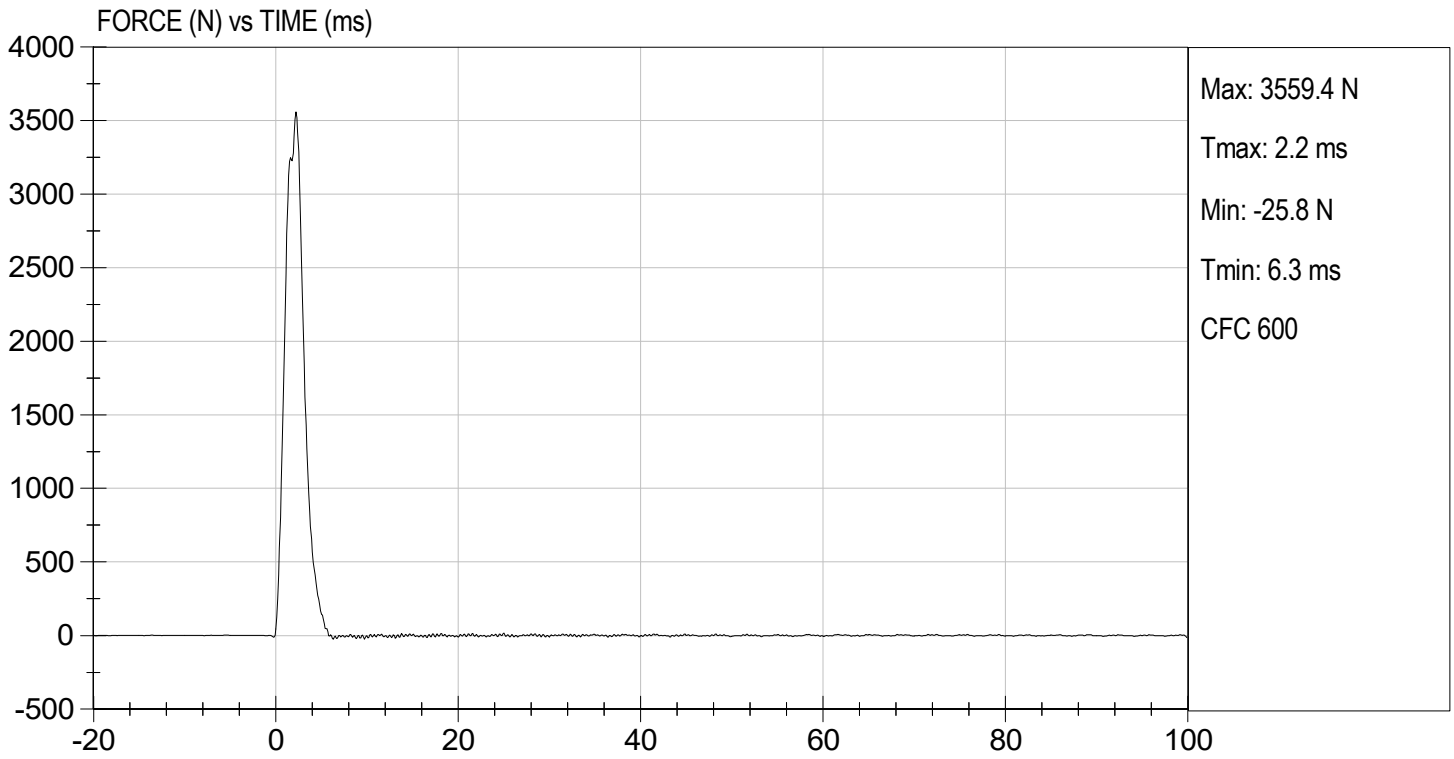
11/17/2022  
 \_\_\_\_\_  
 Test Date

  
 \_\_\_\_\_  
 Approved By



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

TEST DATE: 11/17/2022  
TEST #: D222645



**MGA RESEARCH CORPORATION**  
**LEFT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

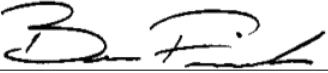
ATD Serial No: 142

Test I.D: D222646

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3871	Pass
Overall Test Results				Pass

  
\_\_\_\_\_  
Laboratory Technician

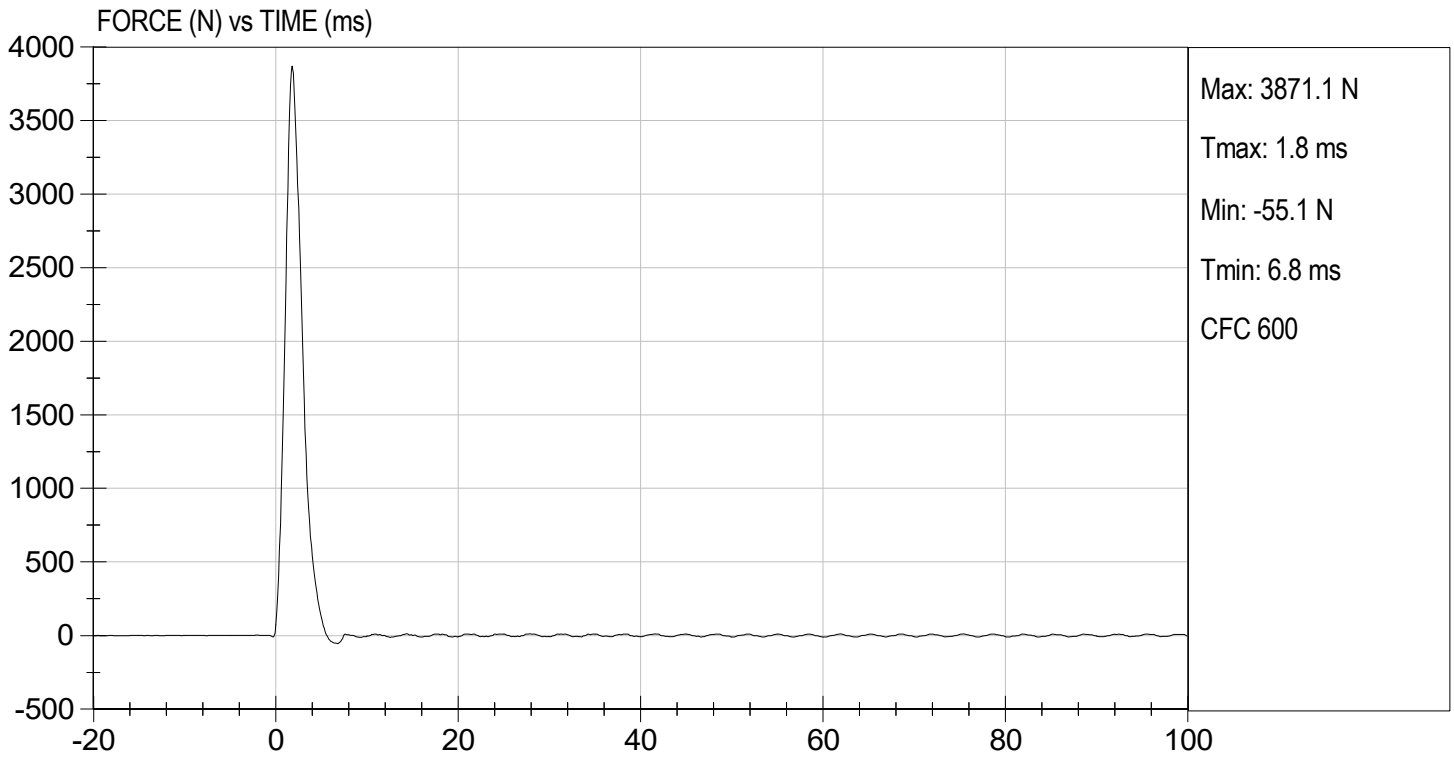
11/17/2022  
\_\_\_\_\_  
Test Date

  
\_\_\_\_\_  
Approved By



TEST DESC: LEFT KNEE  
VELOCITY: 6.97 ft/s, 2.12 m/s

TEST DATE: 11/17/2022  
TEST #: D222646



**MGA RESEARCH CORPORATION**  
**TORSO FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

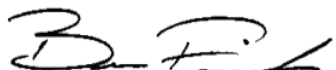
ATD Serial No: 142

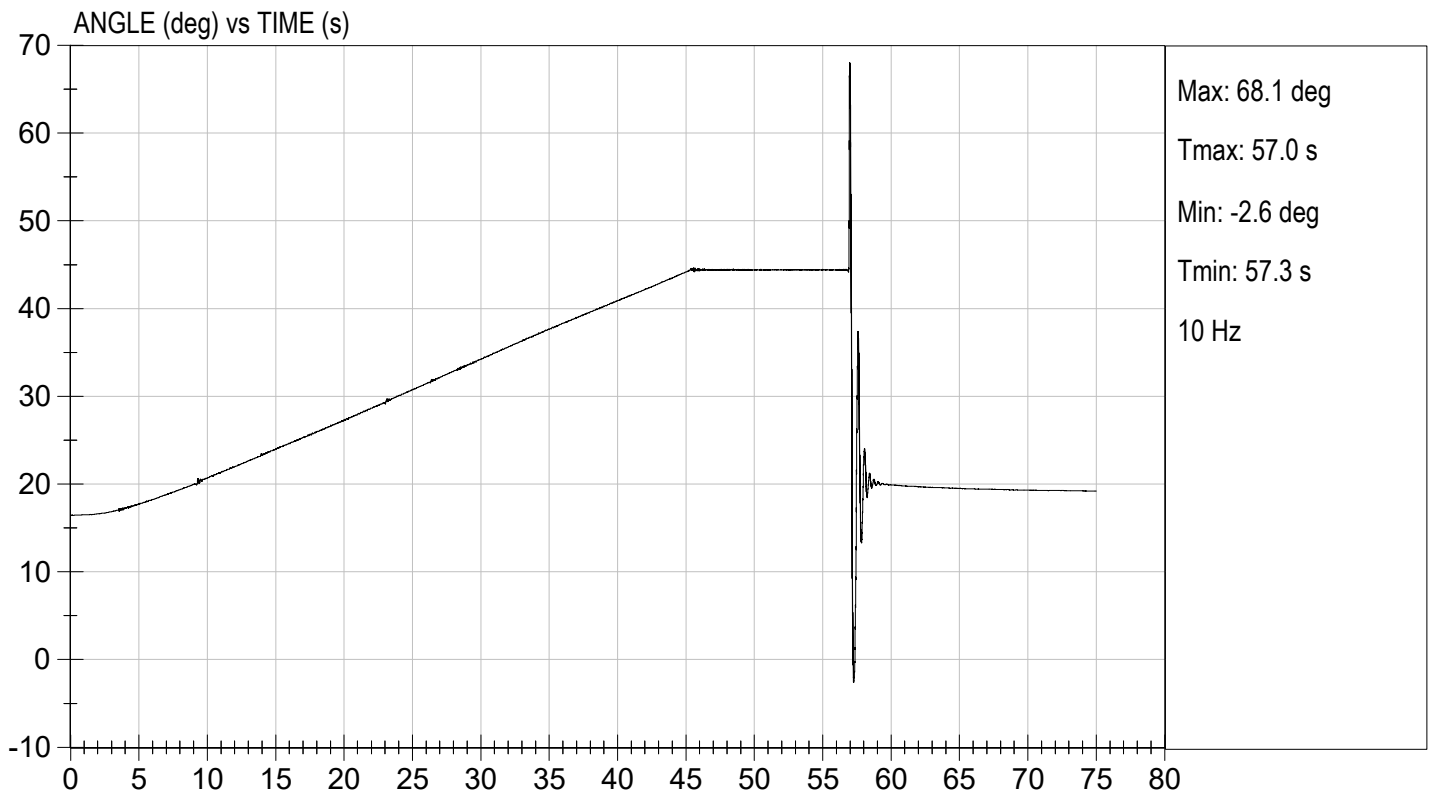
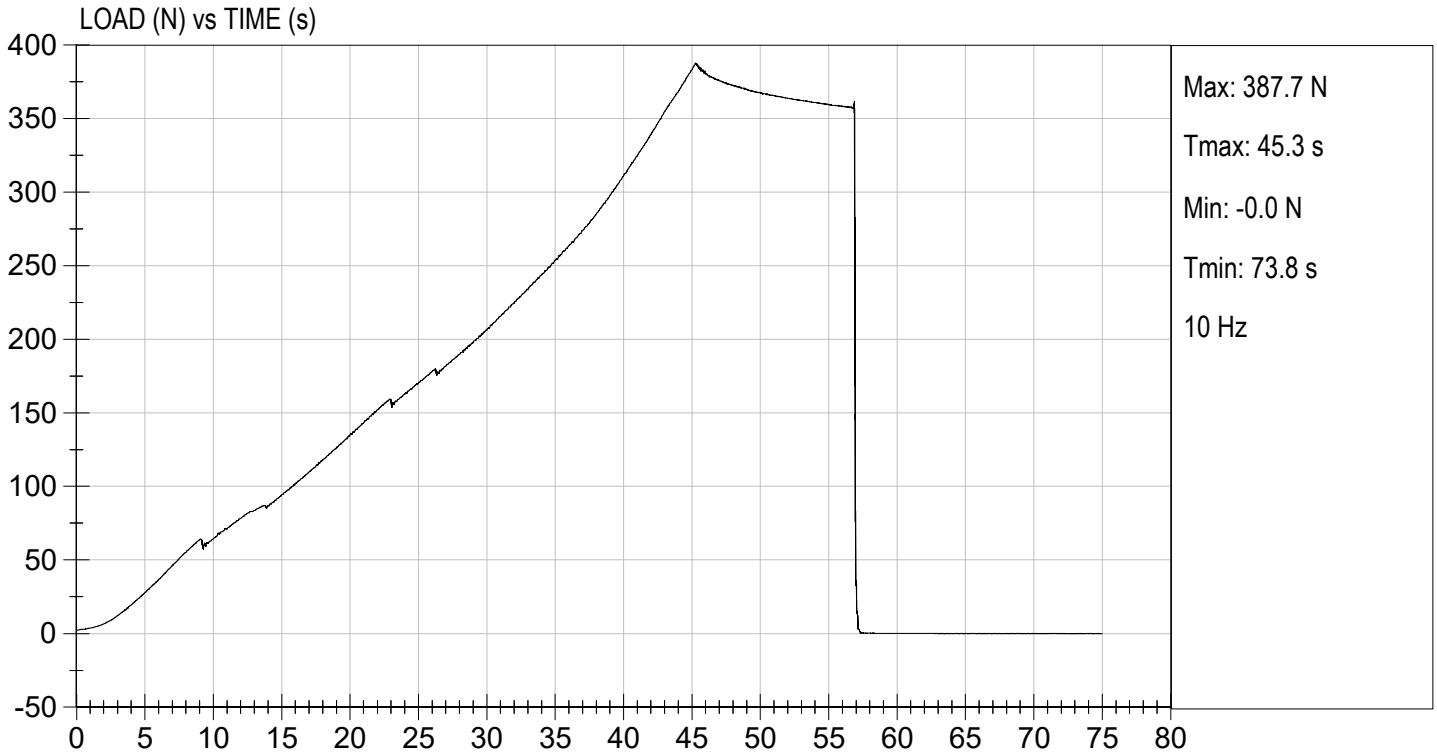
Test I.D: D222647

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Initial Angle	deg	0 to 20	16	Pass
Return Angle	deg	+/- 8	3	Pass
Force at 45 deg	N	320 to 390	387	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.7	Pass
<b>Overall Result</b>				<b>Pass</b>

  
 Laboratory Technician

11/17/2022  
 Test Date

  
 Approved By



**Hybrid III, 5th External Measurements  
SN: 142**

HYBRID III, PART 572, SUBPART O EXTERNAL DIMENSIONS				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
A	TOTAL SITTING HEIGHT	Seat surface to highest point on top of the head.	774.7-800.1	775.0
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	431.8-457.2	438.2
C	H-POINT HEIGHT	Reference	81.3-86.3	81.8
D	H-POINT LOCATION FROM BACKLINE	Reference	144.8-149.8	148.3
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	68.6-83.8	83.0
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	119.4-134.6	124.4
G	BACK OF ELBOW TO WRIST PIVOT	back of the elbow flesh to the wrist pivot in line with the elbow and wrist pivots	243.9-259.1	245.2
H	HEAD BACK TO BACKLINE	Back of Skull cap skin to seat rear vertical surface (Reference)	43.2-48.2	43.4
I	SHOULDER TO- ELBOW LENGTH	Measure from the highest point on top of the shoulder clevis to the lowest part of the flesh on the elbow in line with the elbow pivot bolt.	276.8-297.2	281.1
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	182.8-203.2	197.2
K	BUTTOCK TO KNEE LENGTH	The forward most part of the knee flesh to the rear vertical surface of the fixture.	520.7-546.1	537.2
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	355.6-376	358.8
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	393.7-419.1	403.1
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	414-439.4	435.2

HYBRID III, SUBPART O EXTERNAL DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT JACKET	Measured 304.8 ± 5.1 mm above seat surface	175.3-190.5	181.2
P	FOOT LENGTH	Tip of toe to rear of heel	218.5-233.7	227.3
Q	STANDING HEIGHT	(THEORETICAL)	1501.1	N/A
R	BUTTOCK TO KNEE PIVOT LENGTH	The rear surface of the buttocks to the knee pivot bolt	457.2-482.6	475.0
S	HEAD BREADTH	The widest part of the head	137.1-147.3	138.6
T	HEAD DEPTH	Back of the head to the forehead	177.8-188	181.0
U	HIP BREADTH	The widest part of the hip	299.7-314.9	308.4
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	350.5-365.7	362.1
W	FOOT BREADTH	The widest part of the foot	78.8-94	82.8
X	HEAD CIRCUMFERENCE	Measured at the point as in dim. "T"	528.3-548.7	545.2
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 345.4 ± 12.7 mm above seat surface	850.9-881.3	870.7
Z	WAIST CIRCUMFERENCE	Measured 165.1 ± 5.1 mm above seat surface	759.5-789.9	779.9
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	332.7-358.1	350.1
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	160.1-170.2	170.0

**CALIBRATION TEST RESULTS**

**POST-TEST**

**HYBRID III 5<sup>TH</sup> PERCENTILE FEMALE - PASSENGER ATD**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 142

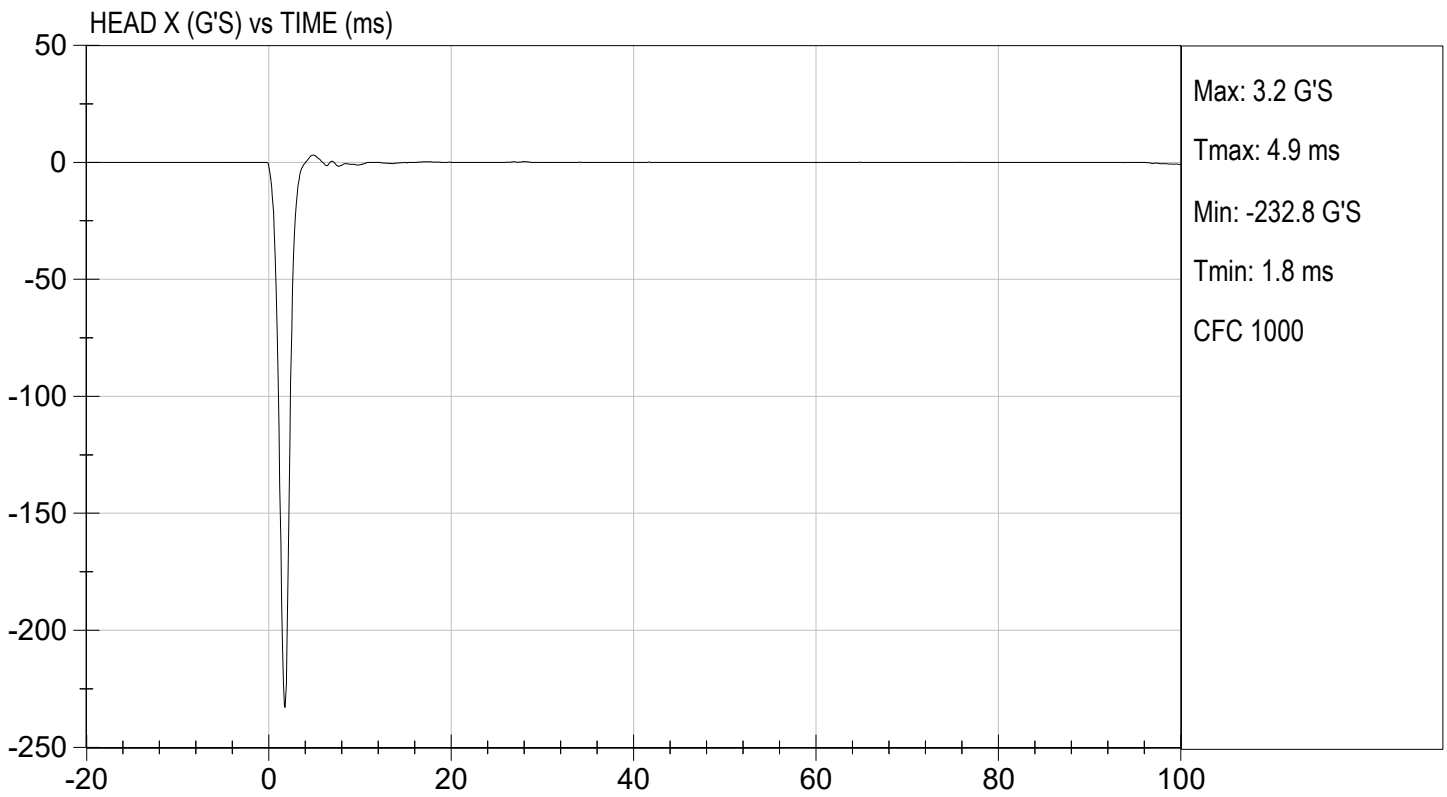
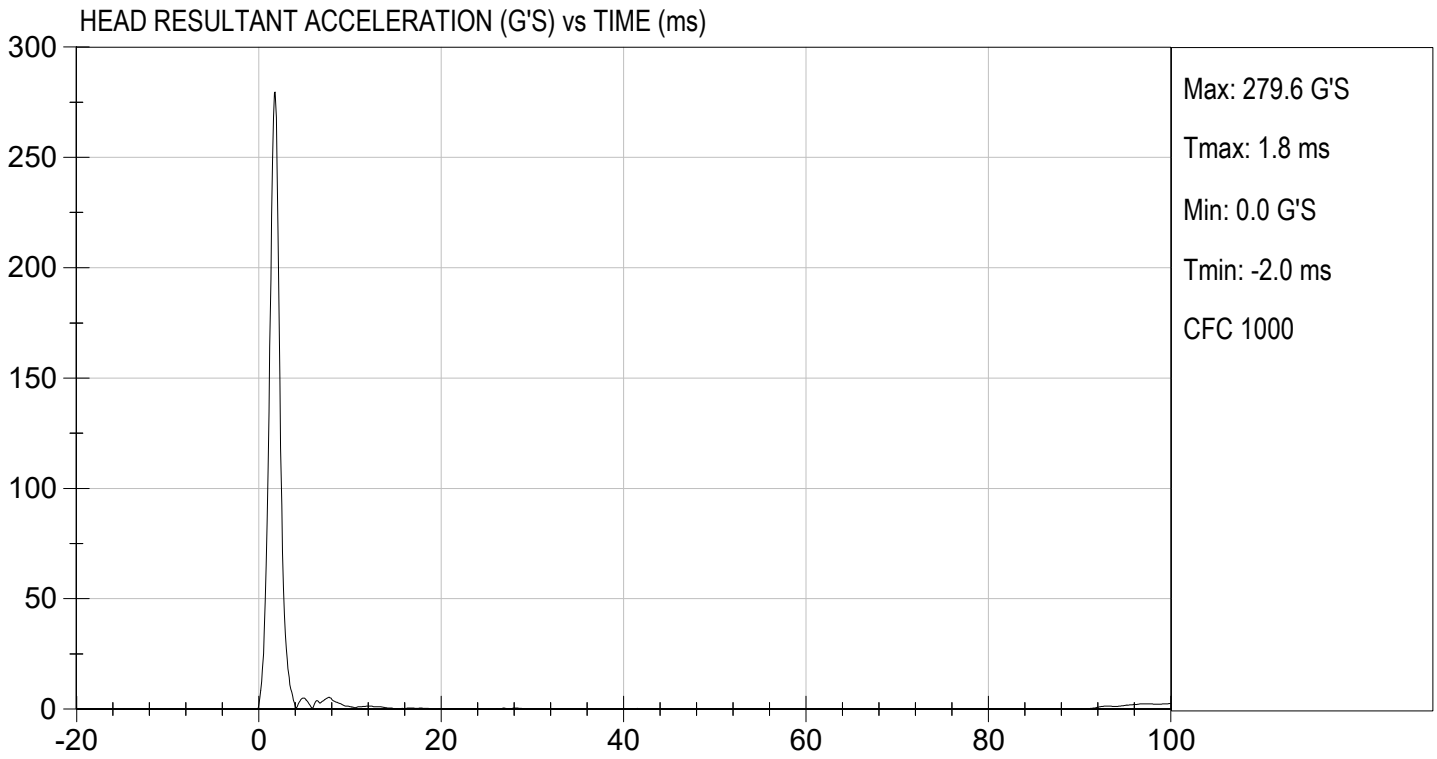
Test ID: D222761

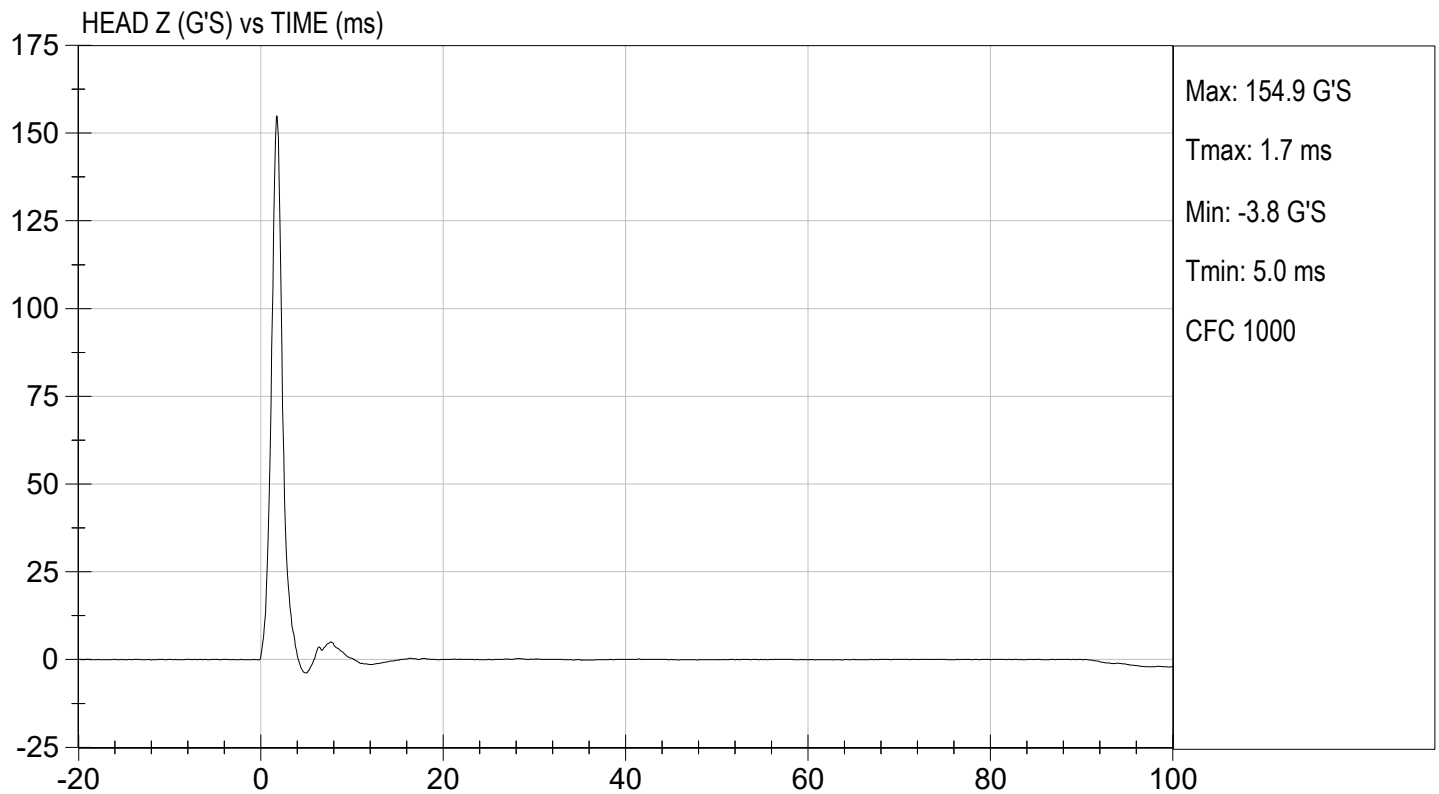
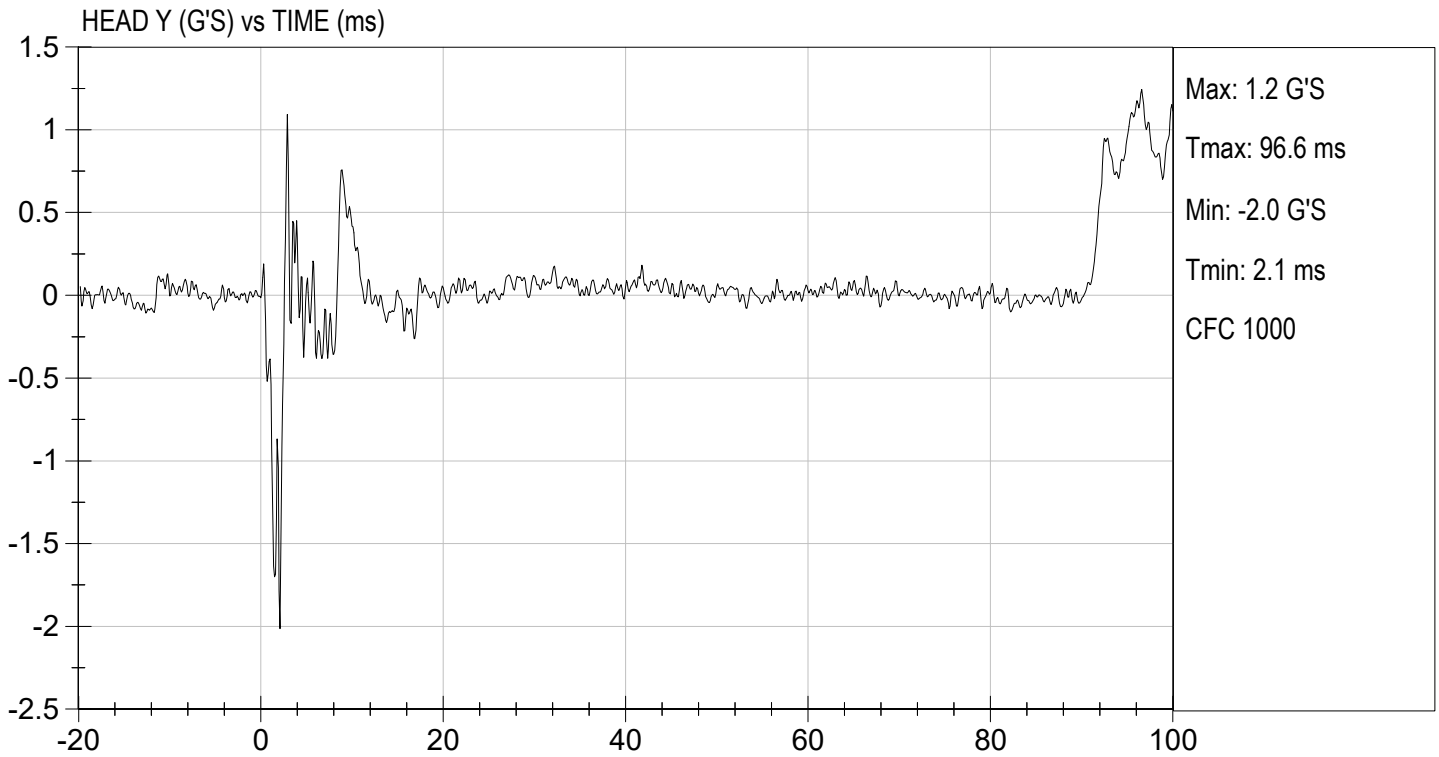
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Peak Resultant Acceleration	G's	250 to 300	280	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-2.0	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

*Nathaniel Benjamin*  
 Laboratory Technician

11/29/2022  
 Test Date

*B. F. K.*  
 Approved By





**MGA RESEARCH CORPORATION**  
**NECK FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**


ATD Serial No: 142

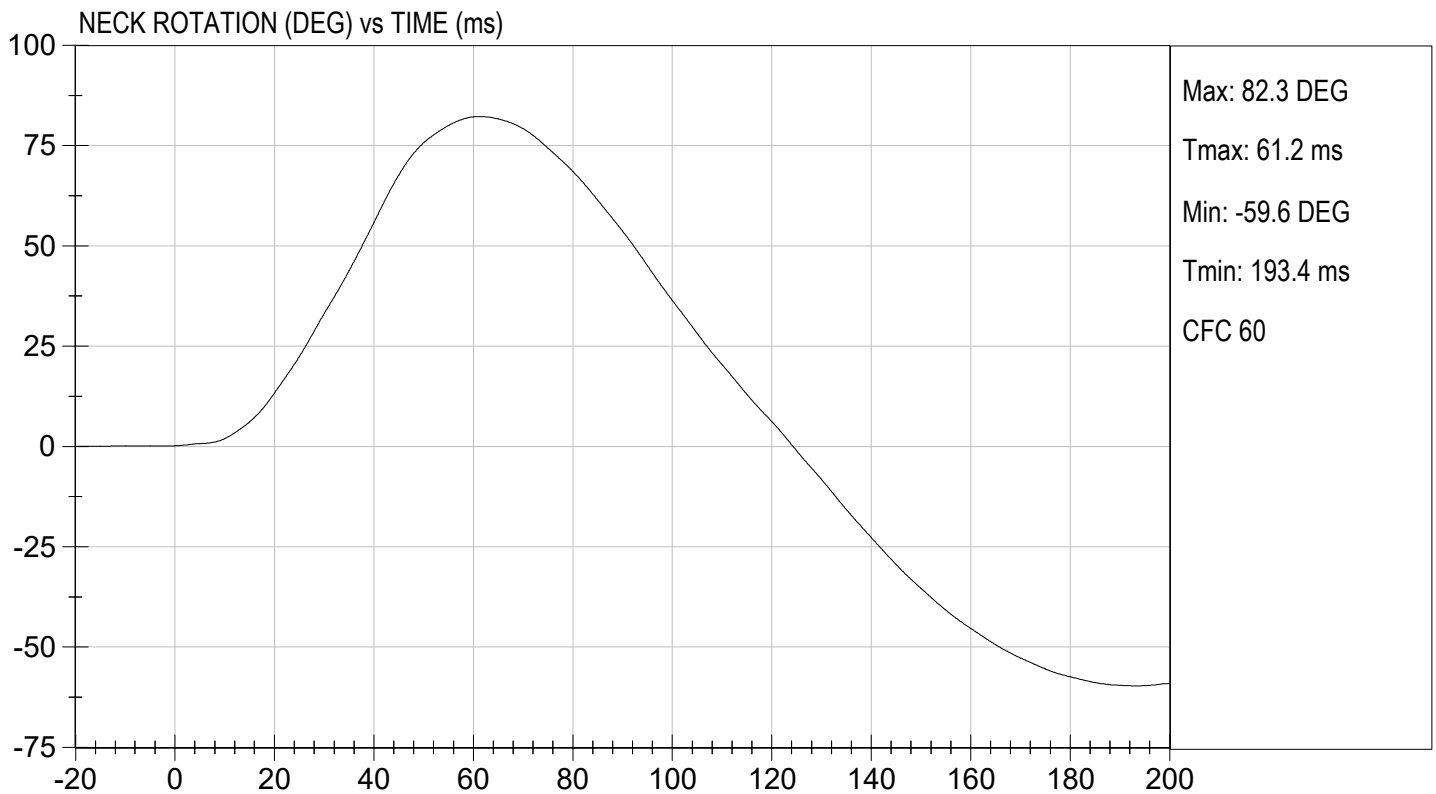
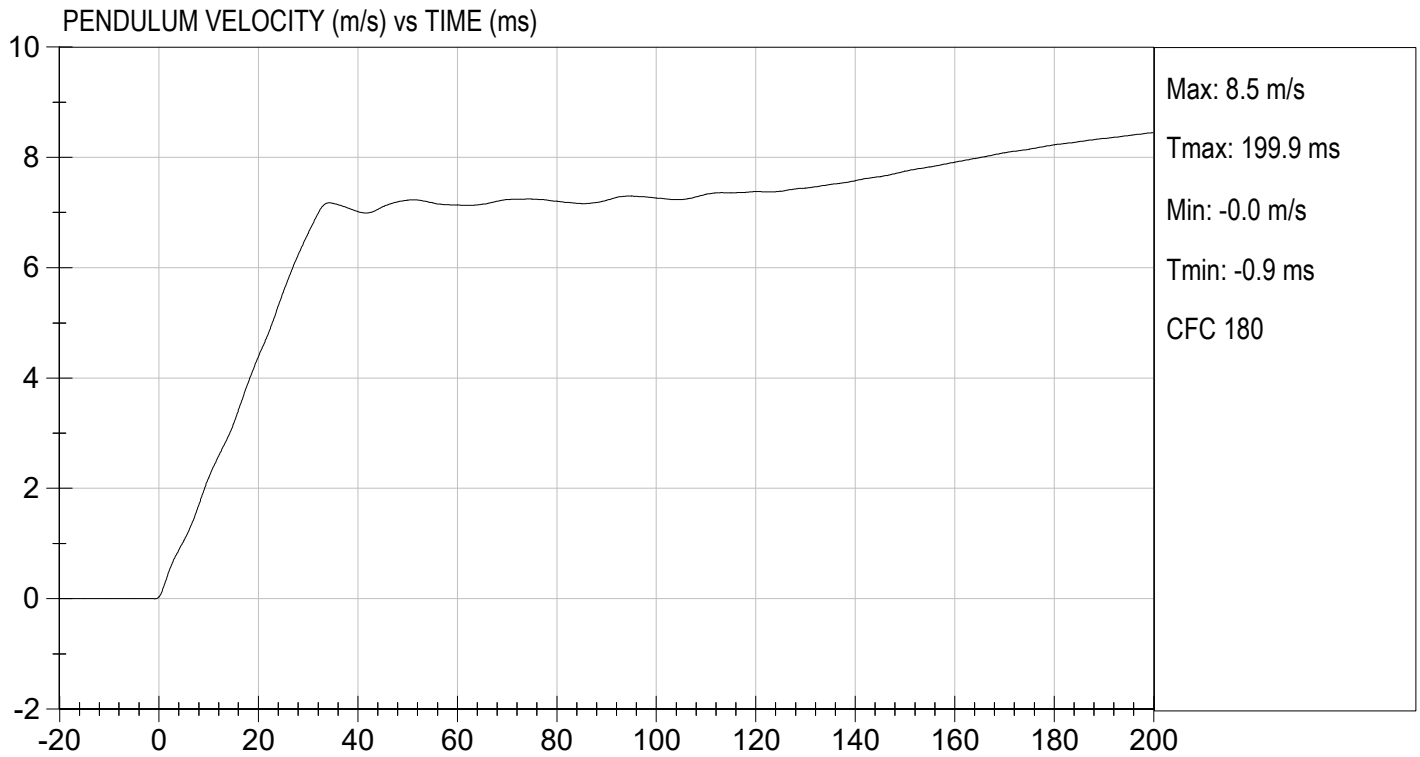
Test I.D: D222762

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	33	Pass
Pendulum Speed		m/s	6.89 to 7.13	6.96	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.2	Pass
	20 ms	m/s	4.0 to 5.0	4.4	Pass
	30 ms	m/s	5.8 to 7.0	6.6	Pass
D Plane Rotation	Max	deg	77 to 91	82	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	70	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	88	Pass
Overall Results					Pass

  
 Laboratory Technician

11/29/2022  
 Test Date

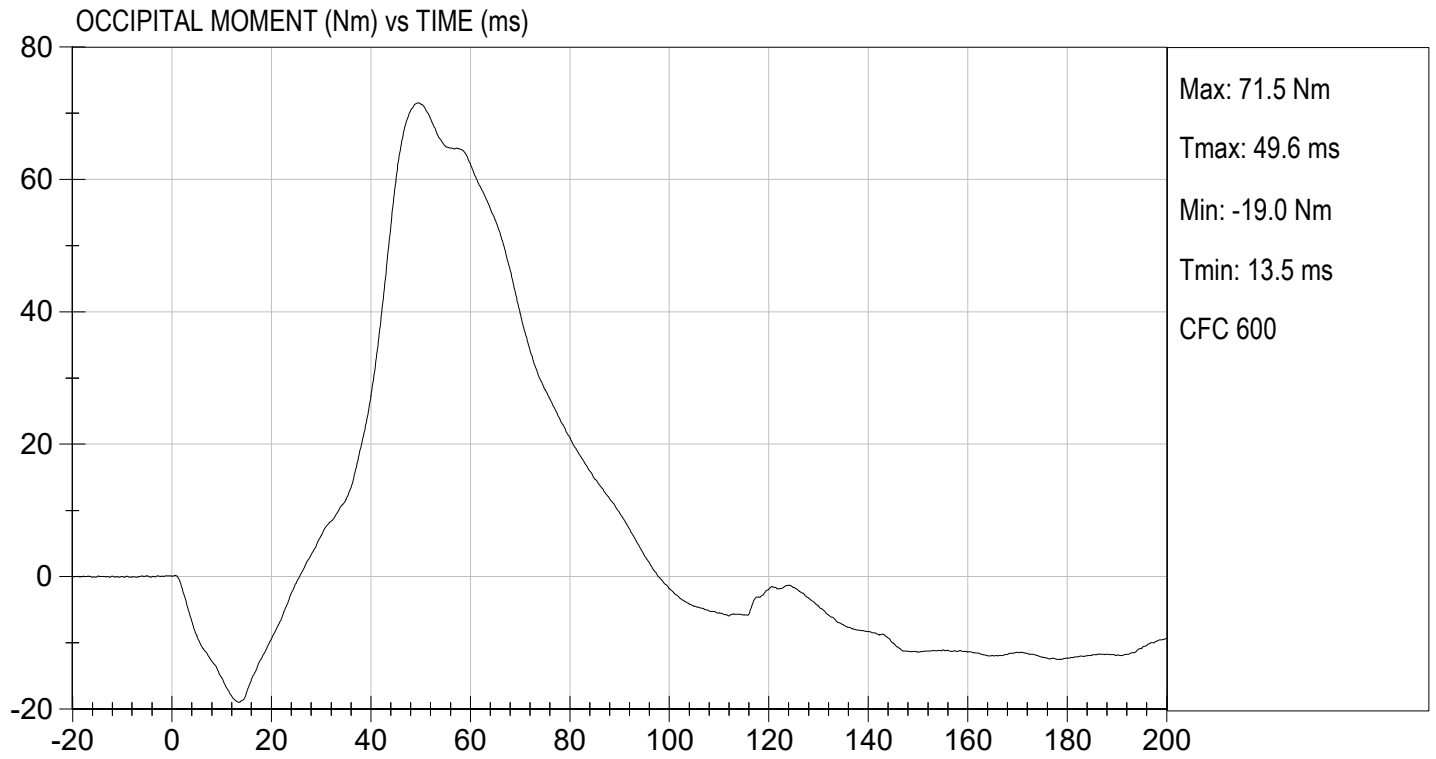
  
 Approved By





TEST DESC: NECK FLEXION  
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 11/29/2022  
TEST #: D222762



**MGA RESEARCH CORPORATION**  
**NECK EXTENSION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 142

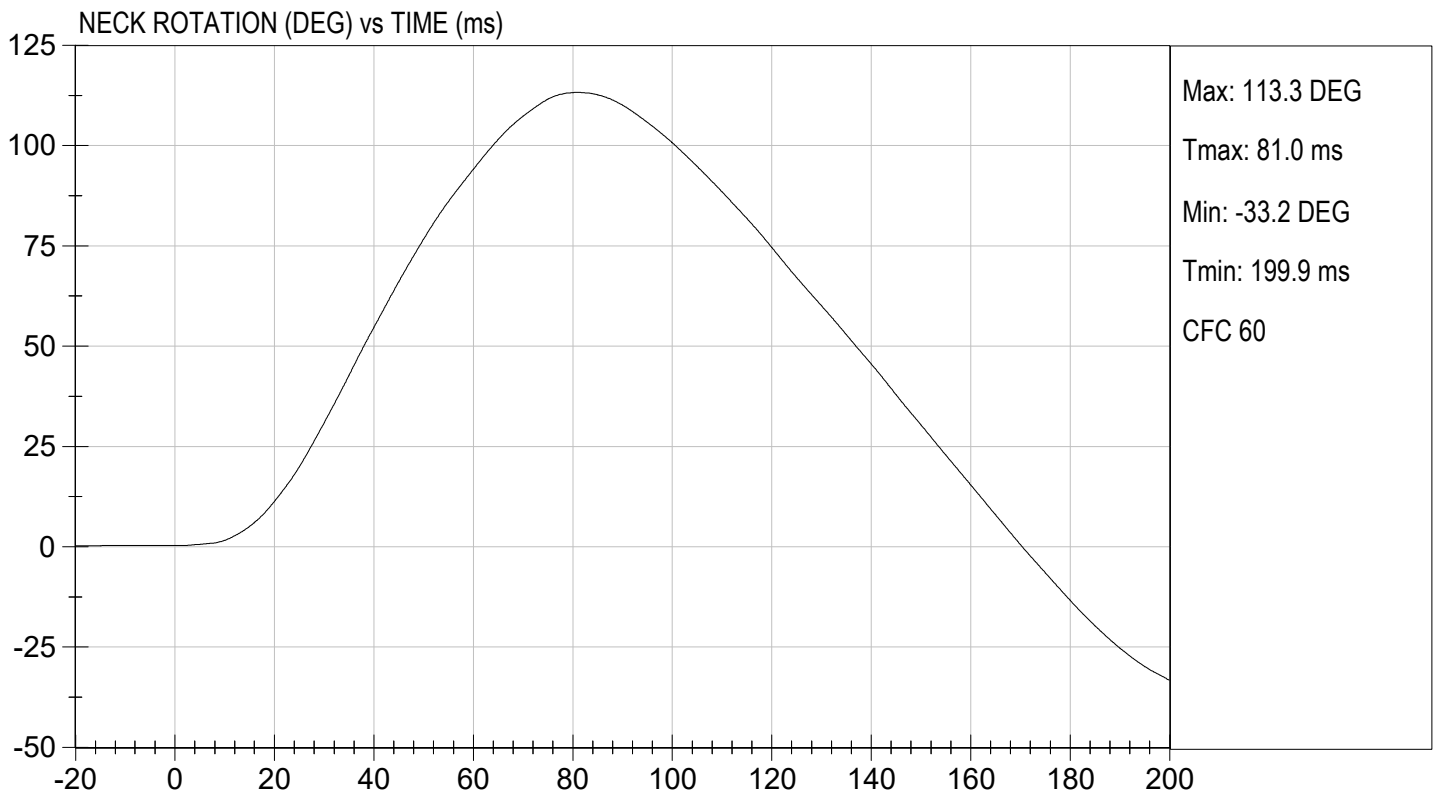
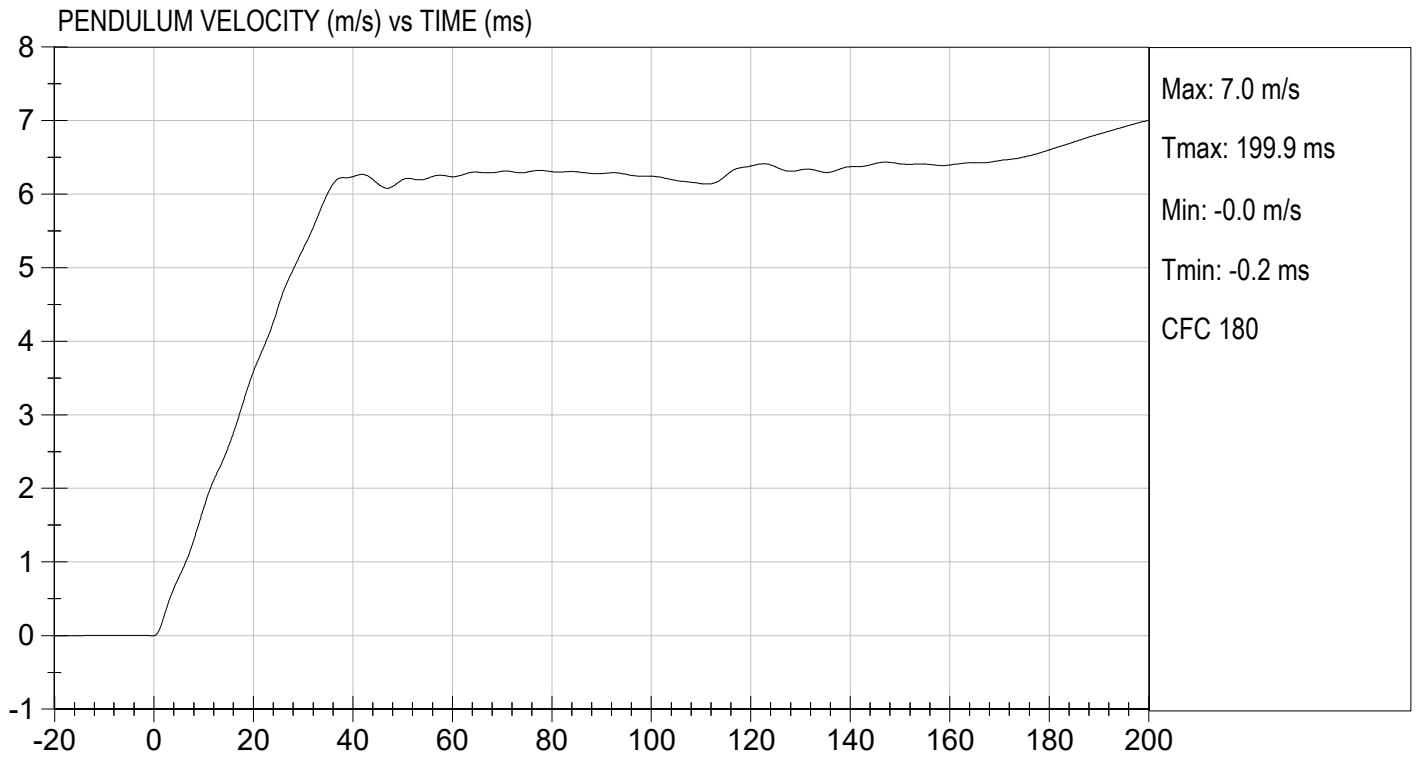
Test I.D: D222763

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	36	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.7	Pass
	20 ms	m/s	3.1 to 3.9	3.6	Pass
	30 ms	m/s	4.6 to 5.6	5.2	Pass
D Plane Rotation	Max	deg	99 to 114	113	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-54	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	105	Pass
Overall Results					Pass

*Nathaniel Benjamin*  
 Laboratory Technician

11/29/2022  
 Test Date

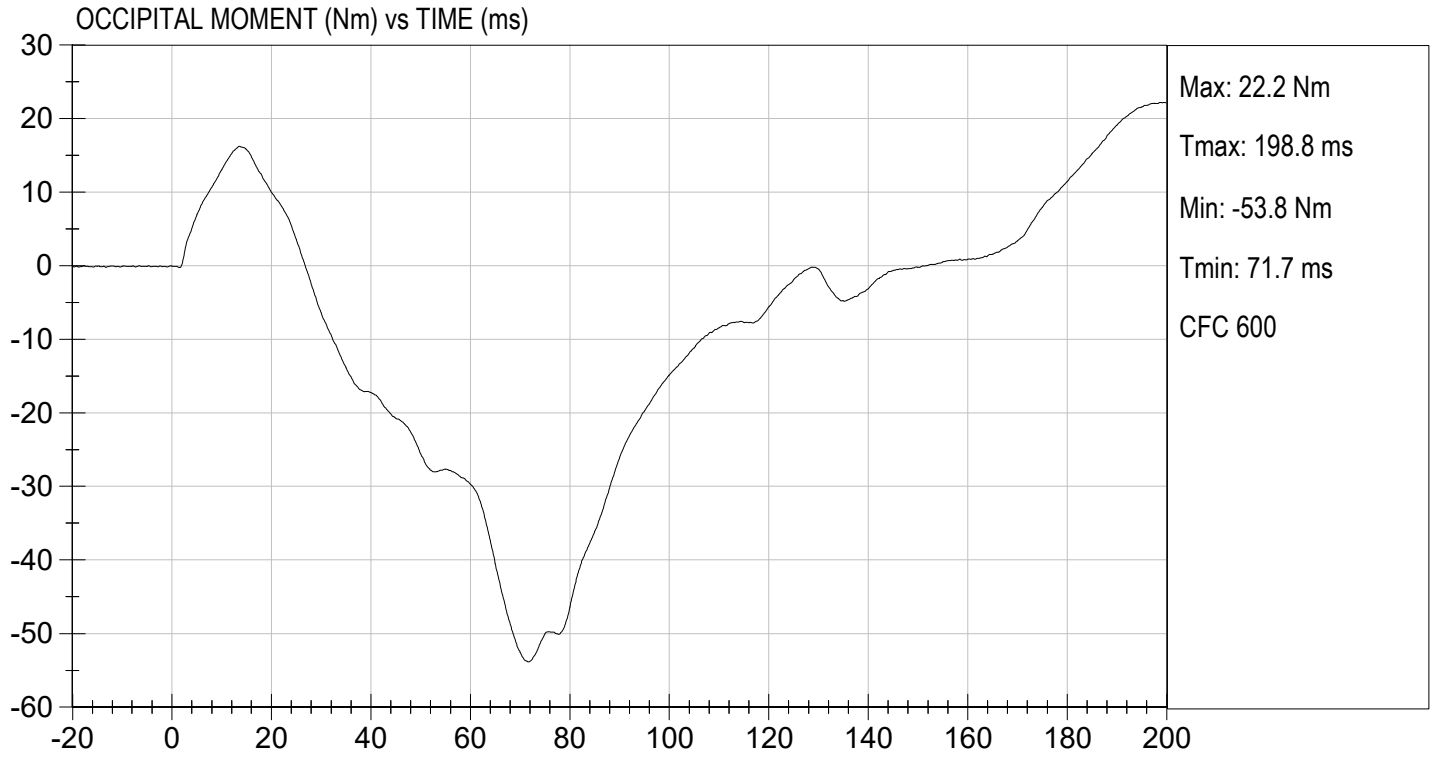
*B.F.K.*  
 Approved By





TEST DESC: NECK EXTENSION  
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 11/29/2022  
TEST #: D222763



**MGA RESEARCH CORPORATION**  
**THORAX IMPACT**  
**HYBRID III 5TH PERCENTILE**

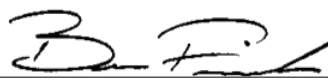
ATD Serial No: 142

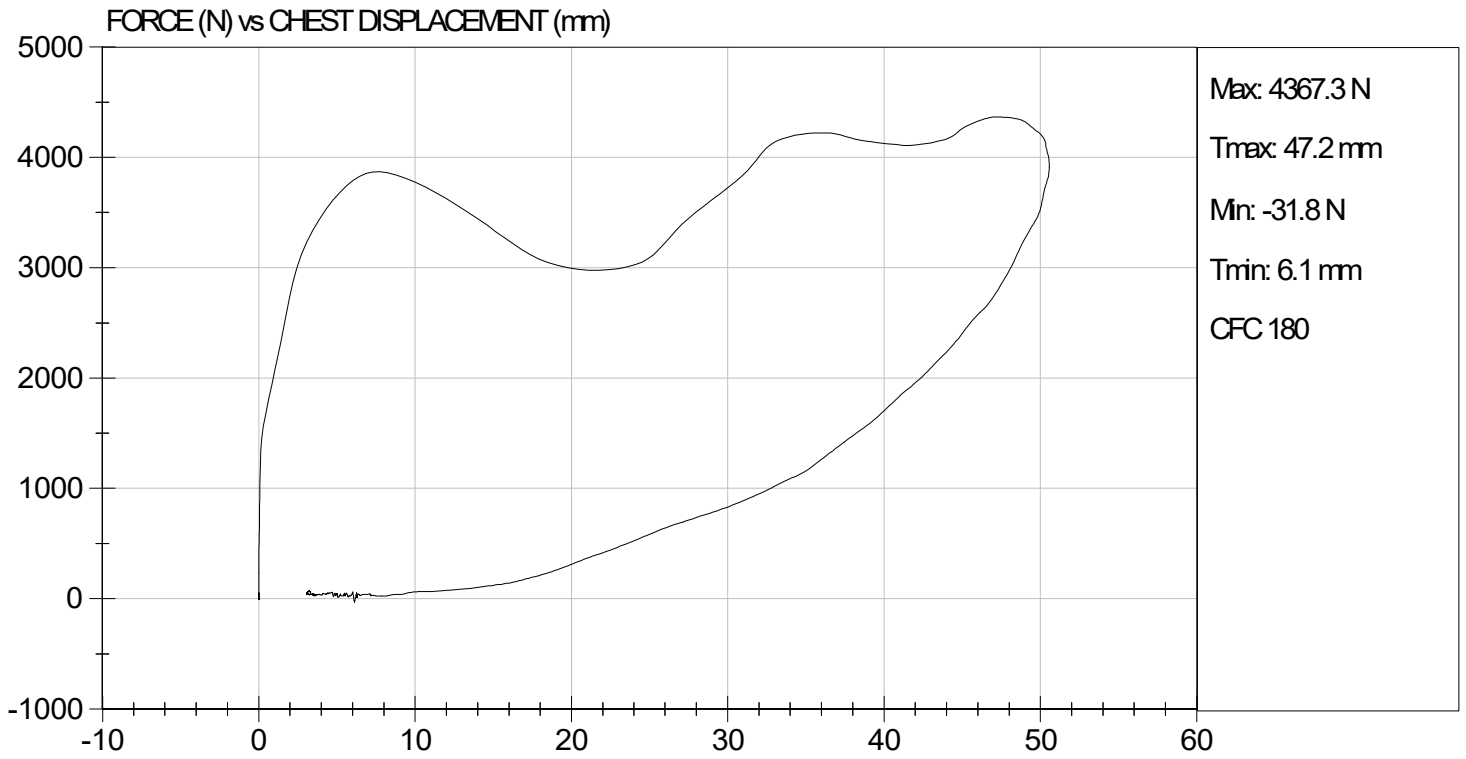
Test I.D: D222764

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Relative Humidity	%	10 to 70	27	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	51	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4209	Pass
Internal Hysteresis	%	69 to 85	75	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4367	Pass
Overall Test Results				Pass

  
 Laboratory Technician

11/28/2022  
 Test Date

  
 Approved By



**MGA RESEARCH CORPORATION**  
**RIGHT KNEE IMPACT TEST**  
**HYBRID III 5TH PERCENTILE**

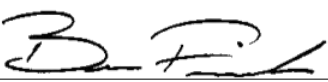
ATD Serial No: 142

Test I.D: D222765

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Probe Speed	m/s	2.07 to 2.13	2.11	Pass
Maximum Force	N	3450 to 4060	3930	Pass
Overall Test Results				Pass

  
Laboratory Technician

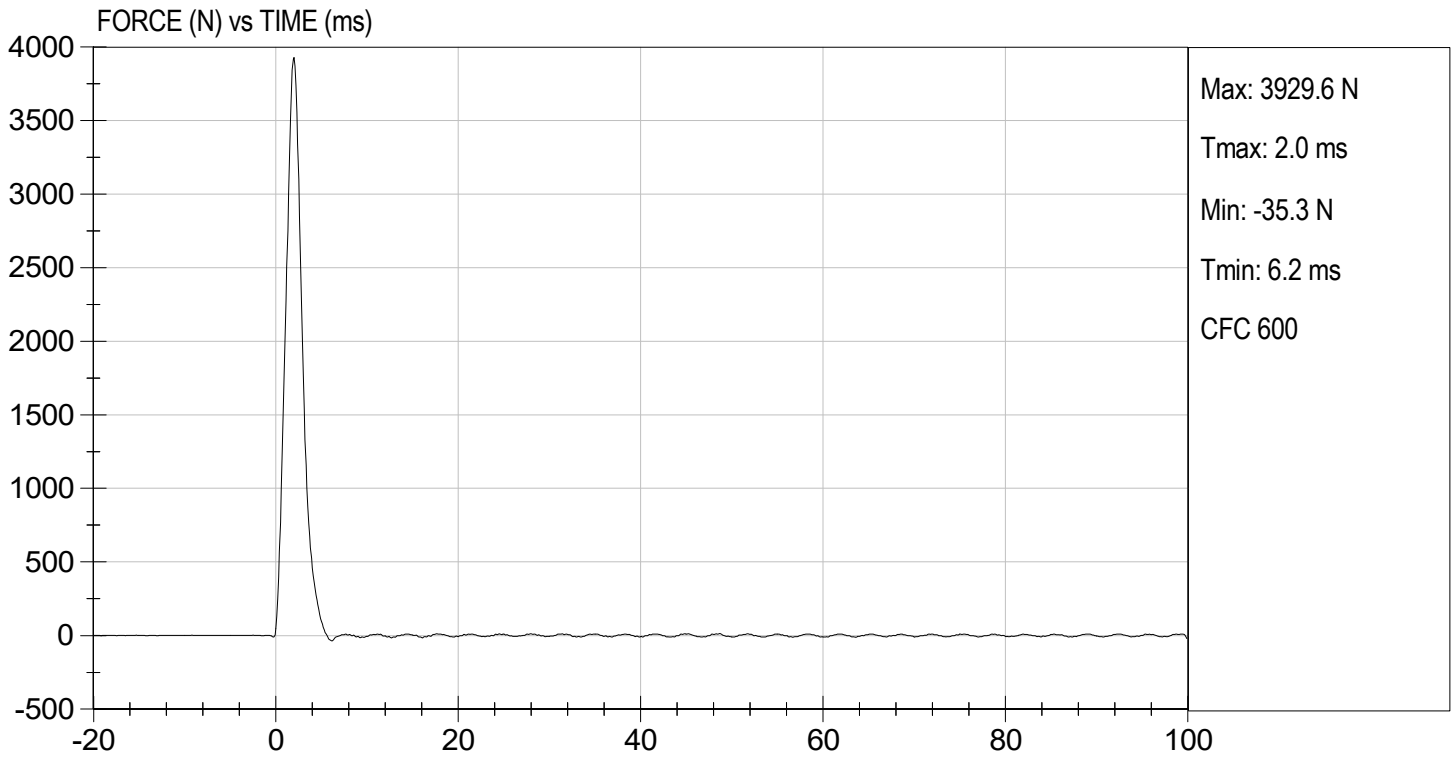
11/28/2022  
Test Date

  
Approved By



TEST DESC: RIGHT KNEE  
VELOCITY: 6.92 ft/s, 2.11 m/s

TEST DATE: 11/28/2022  
TEST #: D222765



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST  
HYBRID III 5TH PERCENTILE

ATD Serial No: 142

Test I.D: D222766

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	3637	Pass
Overall Test Results				Pass

Nathaniel Benjamin  
Laboratory Technician

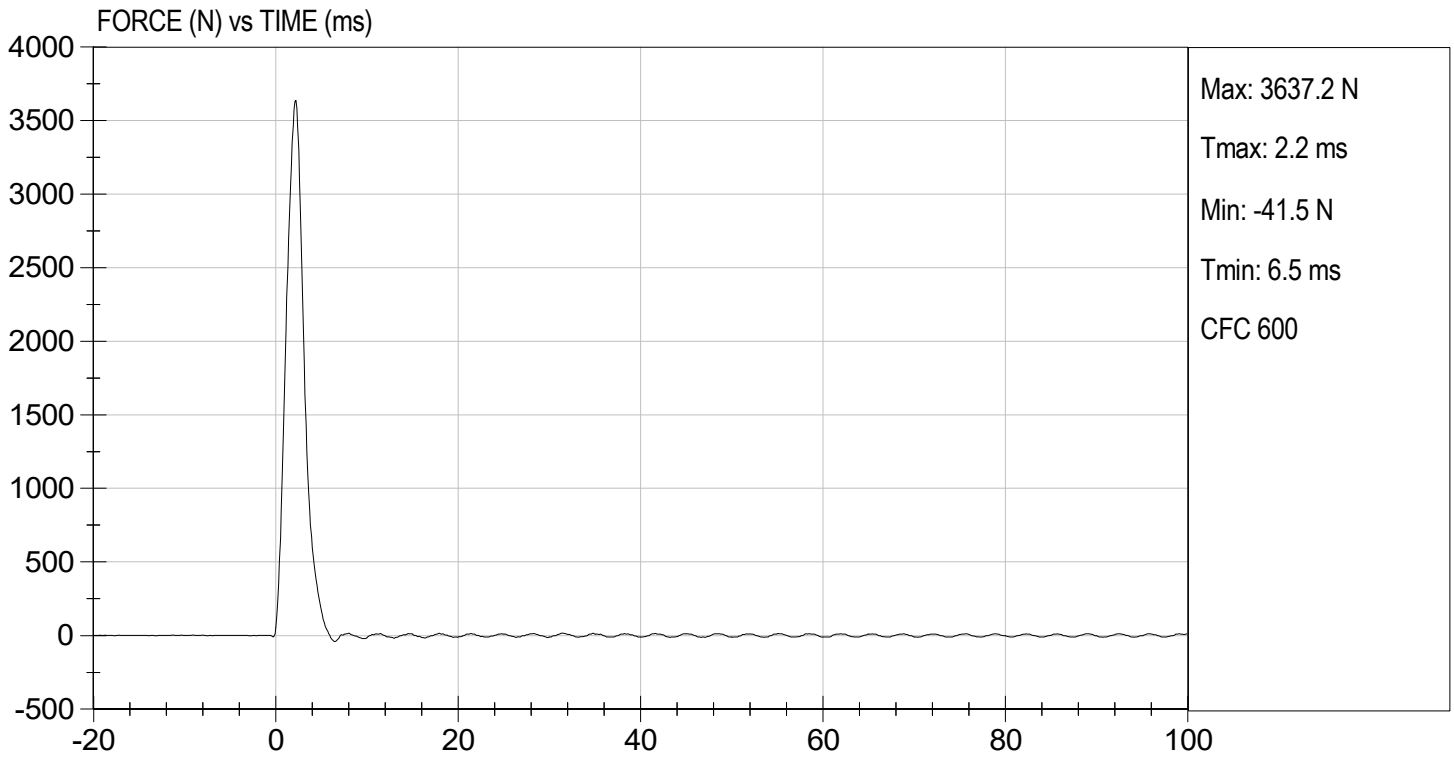
11/28/2022  
Test Date

B.F.L.  
Approved By



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

TEST DATE: 11/28/2022  
TEST #: D222766



**MGA RESEARCH CORPORATION**  
**TORSO FLEXION TEST**  
**HYBRID III 5TH PERCENTILE**

ATD Serial No: 142

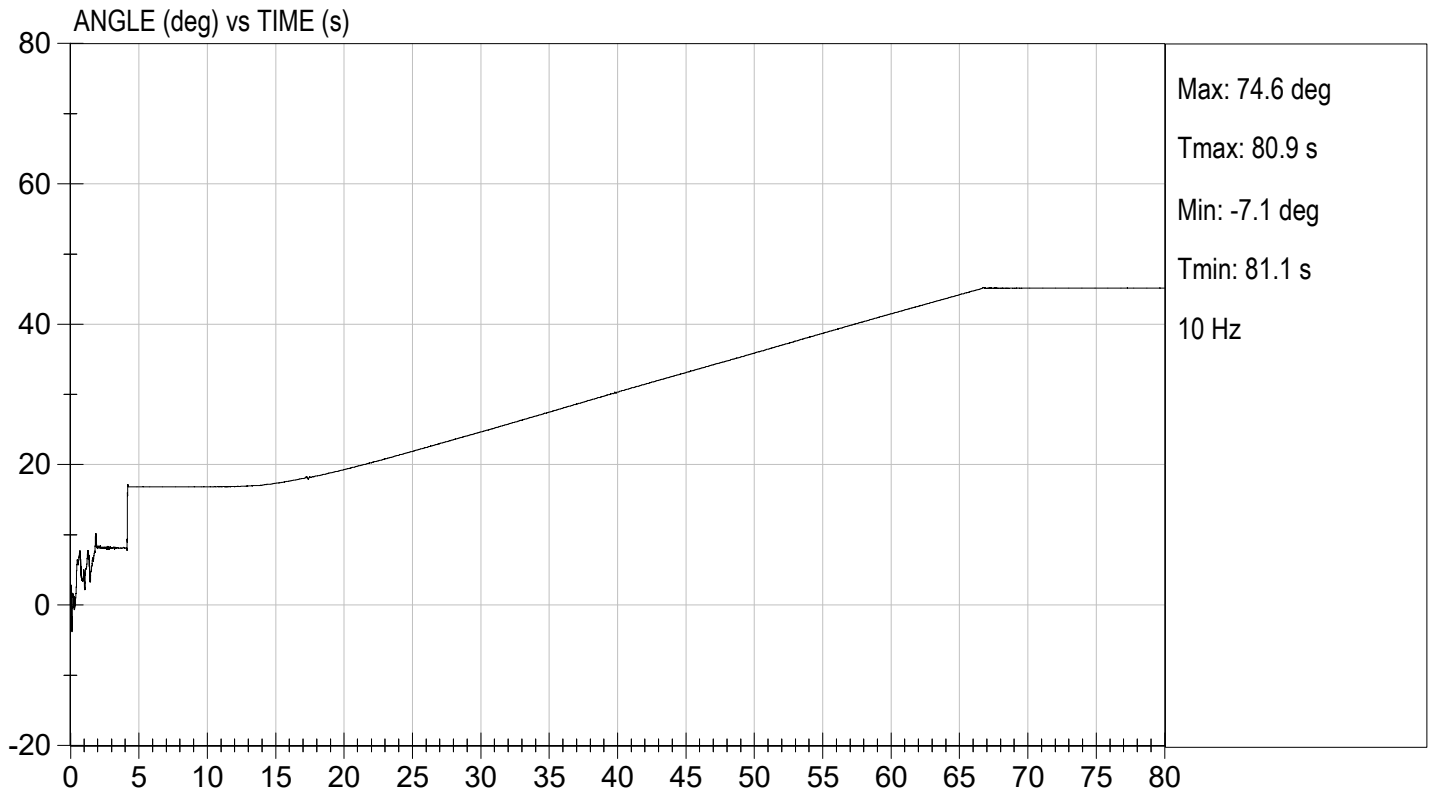
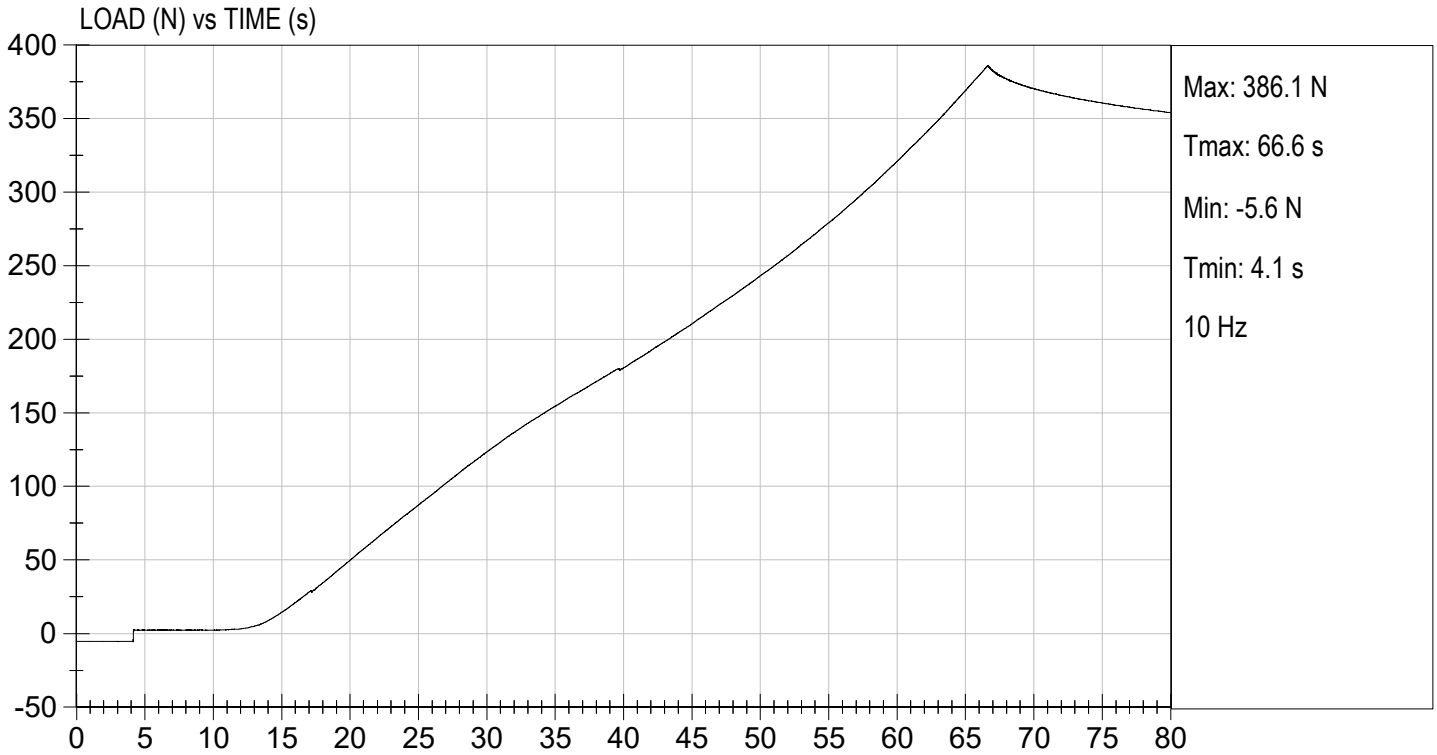
Test I.D: D222767

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Initial Angle	deg	0 to 20	3	Pass
Return Angle	deg	+/- 8	2	Pass
Force at 45 deg	N	320 to 390	386	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.6	Pass
<b>Overall Result</b>				<b>Pass</b>

Nathaniel Benjamin  
 Laboratory Technician

11/29/2022  
 Test Date

B. F. K.  
 Approved By



**APPENDIX D**  
**TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA**

**TABLE 1 – DRIVER DUMMY INSTRUMENTATION**

Instrument Location			Axis	Hybrid III 50 <sup>th</sup> S/N 351		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X		P79741	Endevco	06/30/2022
		Y		P79743	Endevco	06/30/2022
		Z		P79744	Endevco	06/30/2022
	Redundant	X		P94834	Endevco	06/30/2022
		Y		P94856	Endevco	06/30/2022
		Z		P97412	Endevco	06/30/2022
Head Angular Rate Sensors			X	ARS15213	DTS	03/15/2022
			Y	ARS7421	DTS	03/15/2022
			Z	ARS7524	DTS	03/14/2022
Upper Neck Load Cell			Fx, Fy, Fz Mx, My, Mz	NG1915	Denton	01/18/2022
Chest Accelerometers	Primary	X		P86792	Endevco	06/30/2022
		Y		P88348	Endevco	06/30/2022
		Z		P86793	Endevco	06/30/2022
	Redundant	X		P88666	Endevco	06/30/2022
		Y		P94109	Endevco	06/30/2022
		Z		P88667	Endevco	06/30/2022
Chest Potentiometer			X	351	Humanetics	07/01/2022
Pelvis Accelerometers			X	P95526	Endevco	06/30/2022
			Y	P96038	Endevco	06/30/2022
			Z	P97742	Endevco	06/30/2022
Femur Load Cells	Right	Primary	Z	FG121P	Denton	07/01/2022
		Redundant	Z	FG121R	Denton	07/01/2022
	Left	Primary	Z	FG122P	Denton	07/01/2022
		Redundant	Z	FG122R	Denton	07/01/2022
Tibia Load Cells	Right	Upper	Mx, My, Fz	TG405	Denton	01/18/2022
		Lower	Mx, My, Fz	AG368	Denton	01/18/2022
	Left	Upper	Mx, My, Fz	TG475	Denton	01/18/2022
		Lower	Mx, My, Fz	AG504	Denton	01/18/2022
Foot Accelerometers	Right	Rear	X	T22486	Endevco	07/01/2022
			Z	P97382	Endevco	06/30/2022
		Front	Z	P82120	Endevco	07/01/2022
	Left	Rear	X	T16468	Endevco	07/01/2022
			Z	T16496	Endevco	07/01/2022
		Front	Z	T16501	Endevco	07/01/2022
Seat Belt Load Cells			Lap	SBG161	FTSS	11/13/2019
			Shoulder	SBG157	FTSS	11/13/2019

**TABLE 2 – FRONT PASSENGER DUMMY INSTRUMENTATION**

Instrument Location			Axis	Hybrid III 5 <sup>th</sup> S/N 142		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary	X		P94799	Endevco	10/10/2022
		Y		P94800	Endevco	10/10/2022
		Z		P94801	Endevco	10/10/2022
	Redundant	X		P94802	Endevco	10/10/2022
		Y		P94803	Endevco	10/10/2022
		Z		P97377	Endevco	10/10/2022
Head Angular Rate Sensors			X	ARS7413	DTS	03/14/2022
			Y	ARS7602	DTS	03/14/2022
			Z	ARS15229	DTS	03/15/2022
Upper Neck Load Cell			Fx, Fy, Fz Mx, My, Mz	NG2203	Denton	03/23/2022
Chest Accelerometers	Primary	X		P88719	Endevco	10/10/2022
		Y		P94785	Endevco	10/10/2022
		Z		P94793	Endevco	10/10/2022
	Redundant	X		P95322	Endevco	10/10/2022
		Y		P95370	Endevco	10/10/2022
		Z		T30901	Endevco	10/10/2022
Chest Potentiometer			X	142	Humanetics	10/11/2022
Pelvis Accelerometers			X	P82646	Endevco	10/10/2022
			Y	P94798	Endevco	10/10/2022
			Z	P97705	Endevco	10/10/2022
Femur Load Cells	Right	Primary	Z	FG126P	Denton	10/11/2022
		Redundant	Z	FG126R	Denton	10/11/2022
	Left	Primary	Z	FG127P	Denton	10/11/2022
		Redundant	Z	FG127R	Denton	10/11/2022
Tibia Load Cells	Right	Upper	Mx, My, Fz	TG408	Denton	03/23/2022
		Lower	Mx, My, Fz	AG116	Denton	03/23/2022
	Left	Upper	Mx, My, Fz	TG480	Denton	03/23/2022
		Lower	Mx, My, Fz	AG502	Denton	03/23/2022
Foot Accelerometers	Right	Rear	X	P94795	Endevco	10/10/2022
			Z	P94796	Endevco	10/10/2022
		Front	Z	P94797	Endevco	10/10/2022
	Left	Rear	X	P83167	Endevco	10/10/2022
			Z	P83168	Endevco	10/10/2022
		Front	Z	P83169	Endevco	10/10/2022
Seat Belt Load Cells			Lap			
			Shoulder			

**TABLE 3 – VEHICLE INSTRUMENTATION**

Instrument Location			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember / Rear Seat Accelerometers	Left	Primary	X	A405510	MSI	09/27/2022
			Z	A405052	MSI	09/27/2022
		Redundant	X	A405054	MSI	09/27/2022
	Right	Primary	X	T29881	Endevco	07/14/2022
			Z	A416927	MSI	08/16/2022
		Redundant	X	T29889	Endevco	07/14/2022
Engine Accelerometers		Top	X	T32317	Endevco	11/01/2022
		Bottom	X	T32348	Endevco	11/01/2022