

REPORT NUMBER: NCAP-MGA-24-015

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

**VOLVO CAR CORPORATION
2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
NHTSA No.: O20245900**

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



Test Date: June 18, 2024

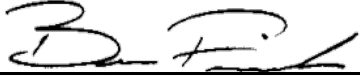
Final Report Date: December 30, 2024

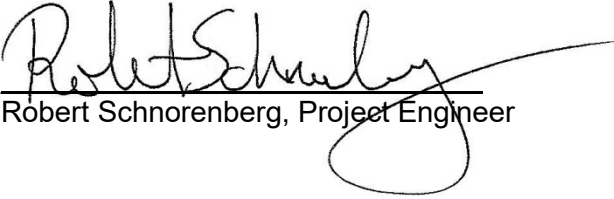
FINAL REPORT

**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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Approval Date: December 30, 2024

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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4. Title and Subtitle Final Report of New Car Assessment Program Frontal Impact Testing and FMVSS No. 305 Indicant Testing of a 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV, NHTSA No.: O20245900		5. Report Date December 30, 2024																																																							
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16. Abstract A 56.3 km/h NCAP Frontal Rigid Barrier Impact Test was conducted on a 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV 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 June 18, 2024. The impact velocity of the vehicle was 56.32 km/h and the ambient temperature at the barrier face at the time of impact was 21.7°C. The target vehicle post-test maximum crush was 502 mm located to the left of the vehicle centerline. The test vehicle's performance was as follows:		13. Type of Report and Period Covered Final Test Report June 18, 2024 to December 30, 2024																																																							
14. Sponsoring Agency Code NRM-110																																																									
<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 (HIC₁₅)</td> <td></td> <td>700</td> <td>214.589</td> <td>700</td> <td>235.250</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>25.335</td> <td>52</td> <td>10.672</td> </tr> <tr> <td>Nij</td> <td></td> <td>1</td> <td>0.255</td> <td>1</td> <td>0.286</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>979.521</td> <td>2620</td> <td>601.106</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>84.139</td> <td>2520</td> <td>314.801</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>2029.903</td> <td>6805</td> <td>1323.211</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>2502.490</td> <td>6805</td> <td>959.389</td> </tr> </tbody> </table>						Measurement Description	Units	Driver ATD		Passenger ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)		700	214.589	700	235.250	Maximum Chest Compression	mm	63	25.335	52	10.672	Nij		1	0.255	1	0.286	Neck Tension	N	4170	979.521	2620	601.106	Neck Compression	N	4000	84.139	2520	314.801	Left Femur Force	N	10008	2029.903	6805	1323.211	Right Femur Force	N	10008	2502.490	6805	959.389
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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 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV at a velocity of 56.32 km/h. The test was performed at MGA Research Corporation on June 18, 2024. 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 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5th 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 and passenger's lap and shoulder belts to measure dummy torso and pelvic section loading.

The driver (position 1) ATD (Serial No. 064) 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 282 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 or battery electrolyte leakage and no loss of high-voltage battery isolation after the event or during any phase of the static rollover.

The maximum static crush of the vehicle was 502 mm located to the left 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 airbag.

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.

The occupant data is summarized below:

ATD position	HIC₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (g)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50 th)	214.589	0.255	979.521	84.139	42.116	25.335	2029.903	2502.490
Passenger (5 th)	235.250	0.286	601.106	314.801	38.984	10.672	1323.211	959.389

The test data can be found on the NHTSA website at www.nhtsa.gov

TEST NOTES

None.

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: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV NHTSA No.: O20245900
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/18/2024

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20245900	Traction Control System (TCS)	Yes
Model Year	2024	Power Steering	Yes
Make	Volvo	Power Window Auto-Reverse	Yes
Model	XC60 Recharge AWD	Driver Frontal Airbag	Yes
Body Style	5-Door SUV	Driver Curtain Airbag	Yes
VIN	YV4H60DJ8R1892202	Driver Head/Torso Airbag	No
Body Color	Onyx Black	Driver Torso Airbag	No
Odometer (km/mi)	32 km / 20 mi	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0	Driver Pelvis Airbag	No
Type/No. Cylinders	PHEV/Inline 4	Driver Knee Airbag	Yes
Engine Placement	Lateral	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	8	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	AWD	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	Yes	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?	No
--	----

DATA FROM CERTIFICATION LABEL

Manufactured By	VOLVO CAR CORPORATION	GVWR (kg)	2658
Date of Manufacture	01/24	GAWR Front (kg)	1320
		GAWR Rear (kg)	1420

VEHICLE SEATING AND WEIGHT CAPACITY DATA

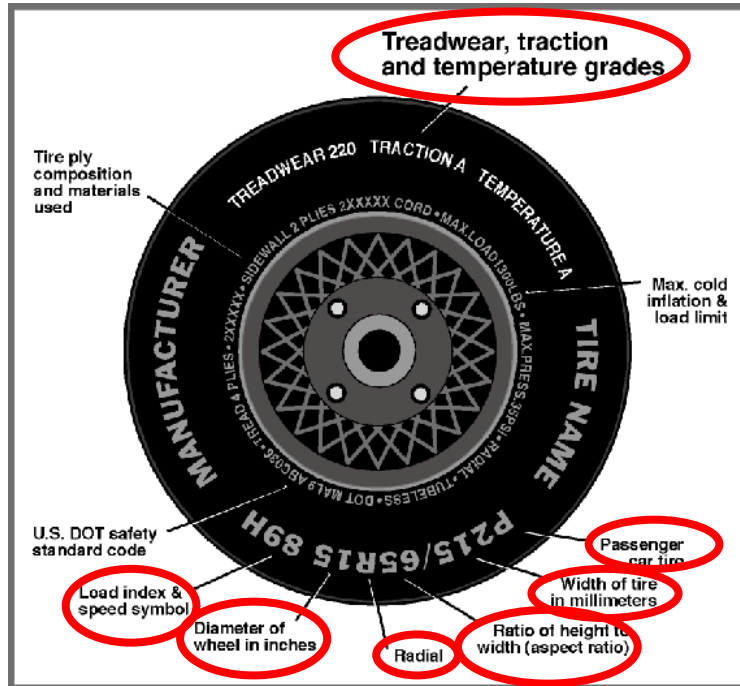
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Contoured		
Designated Seating Capacity (DSC)	2	3		5
Capacity Weight (VCW) (kg)				430
Cargo Weight (RCLW) (kg)				90

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	260	260
Recommended Tire Size	255/40R21	255/40R21
Tire Size on Vehicle	255/40R21	255/40R21
Tire Manufacturer	Pirelli	Pirelli
Tire Model	Scorpion Zero	Scorpion Zero
Treadwear	500	500
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	2 Rayon	2 Rayon
Tire Plies Body	2 Rayon, 2 Steel, 1 Polyamide	2 Rayon, 2 Steel, 1 Polyamide
Load Index/Speed Symbol	102V	102V
Tire Material	Rubber	Rubber
DOT Safety Code Left	1XB RM582P 4623	1XB RM582P 4623
DOT Safety Code Right	1XB RM582P 4623	1XB RM582P 4623

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	587.5	489.0		623.7	566.1	
Right	kg	553.5	507.5		581.5	591.0	
Ratio	%	53.4%	46.6%		51.0%	49.0%	
Totals	kg	1141.0	996.5	2137.5	1205.2	1157.1	2362.3

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	2137.5
Weight of 1 P572E ATD & 1 P572O ATD	kg	141
Rated Cargo/Luggage Weight (RCLW)	kg	90
Calculated Test Vehicle Target Weight (TVTW)	kg	2368.5

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	821	822	825	827	1336
As Tested	mm	792	798	799	807	1403
Post Test	mm	860	861	803	807	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2865
Total Vehicle Length at Left Side	mm	4525
Total Vehicle Length at Centerline	mm	4701
Total Vehicle Length at Right Side	mm	4532
Weight of Ballast in Cargo Area	kg	24
Weight of Vehicle Components Removed	kg	15
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: Cargo Area Cover, Cargo Area Carpet, Cargo Area Divider/Organizer, Jack/Tool Kit, Tire Repair Kit/Compressor, Front Underbody Plastic.

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements	Pre-Test (mm)
1	Total Length	4701
2	Total Width	1898
3	Bumper Top Height	605
4	Bumper Bottom Height	475
5	Longitudinal Member Top Height	616
6	Distance between Longitudinal Members	938
7	Longitudinal Member Width	78
8	Engine Top Height	856
9	Engine Bottom Height	250
10	Engine and Gearbox Width	830
11	Front Bumper-Engine Distance	507
12	Front Shock Absorber Fixing Height	930
13	Bonnet Leading Edge Height	867
14	Front Shock Absorber Fixing Width	1010
15	Front Bumper – Front Axle Distance	712
16	Front Axle – A-Pillar Distance	697
17	A-Pillar – B-Pillar Distance	1000
18	B-Pillar – Rear Axle Distance	1168
19	B-Pillar – C-Pillar Distance	1095
20	Roof Sill Bottom Height	1390
21	Roof Sill Top Height	1446
22	Floor Sill Bottom Height	223
23	Floor Sill Top Height	398

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

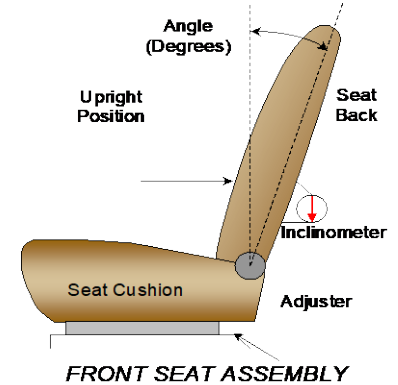
Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

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	22.5° on seat back
Passenger Seat Back Angle	15.5° on seat back



SEAT FORE/AFT POSITIONS

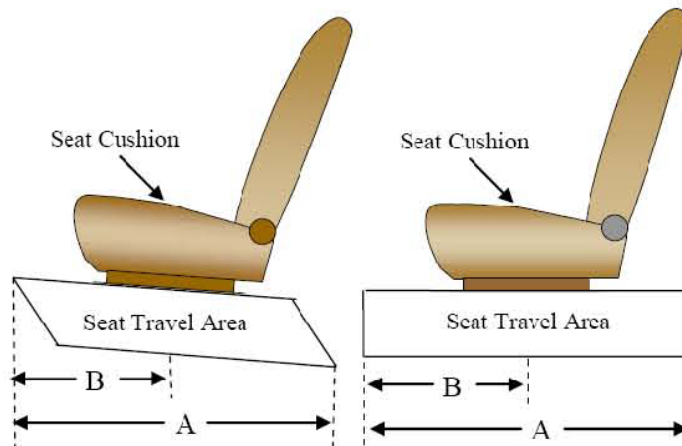
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated May 2018.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	326 mm	163 mm
Passenger Seat	265 mm	19 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 (1st as 1)	0 (1st as 0)
Passenger Seat	4 (1st as 1)	0 (1st as 0)



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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

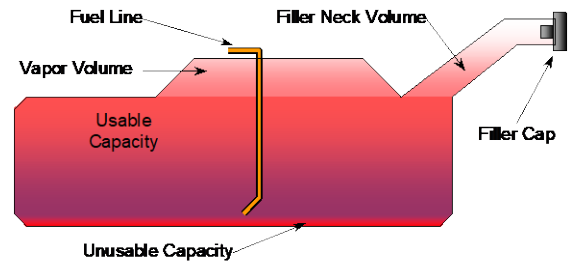
NHTSA No.: O20245900
 Test Date: 6/18/2024

FUEL TANK CAPACITY DATA

	Liters
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

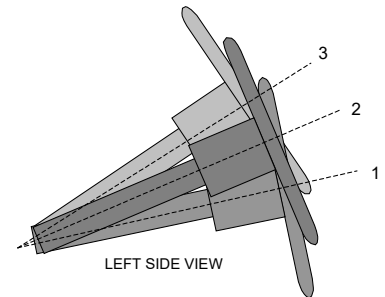
The vehicle is equipped with an electronic fuel pump. The fuel pump will run when the engine is running. The pump will also normally operate when the vehicle's electrical system is activated. The filler neck is located on the passenger's side.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the geometric center of the locus it describes when moved through its full range of motion. 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 ASSEMBLY

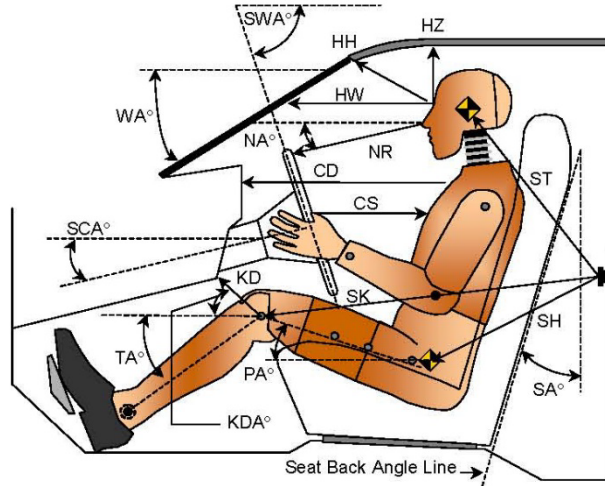
STEERING COLUMN POSITION

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	68.7	
Geometric Center Position 2	65.8	
Uppermost Position 3	62.8	
Telescoping Steering Wheel Travel		53
Test Position	65.8	27

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024



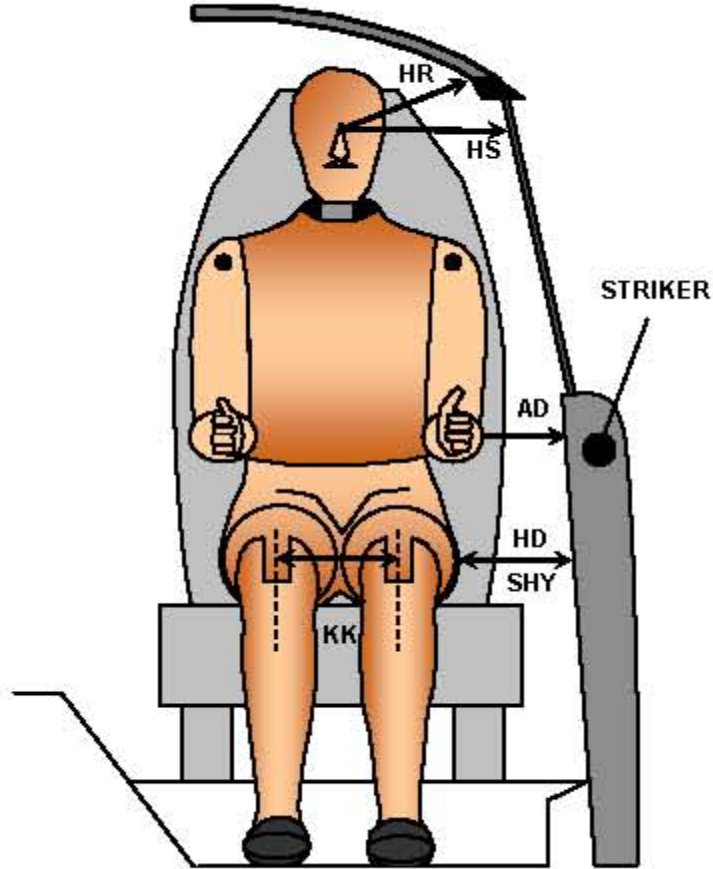
LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		26.5		
SWA°	Steering Wheel Angle		65.8		
SCA°	Steering Column Angle		24.2		
SA°	Seat Back Angle		22.5		15.5
HZ	Head to Roof (Z)	181	90	188	90
HH	Head to Header	364	28.4	281	49.6
HW	Head to Windshield	679	0	620	0
NR	Nose to Rim	409	9.2		
CD	Chest to Dash	529		353	
CS	Chest to Steering Hub	319	2.5		
RA	Rim to Abdomen	204	0		
KDL	Left Knee to Dash	224	26.1	66	55.0
KDR	Right Knee to Dash	193	6.6	67	35.7
PA°	Pelvic Angle		24.8		21.6
TA°	Tibia Angle		30.8		63.5
SK	Striker to Knee	534	94.0	628	91.8
ST	Striker to Head	505	2.5	493	20.1
SH	Striker to H-Point	225	133.6	314	109.7

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024



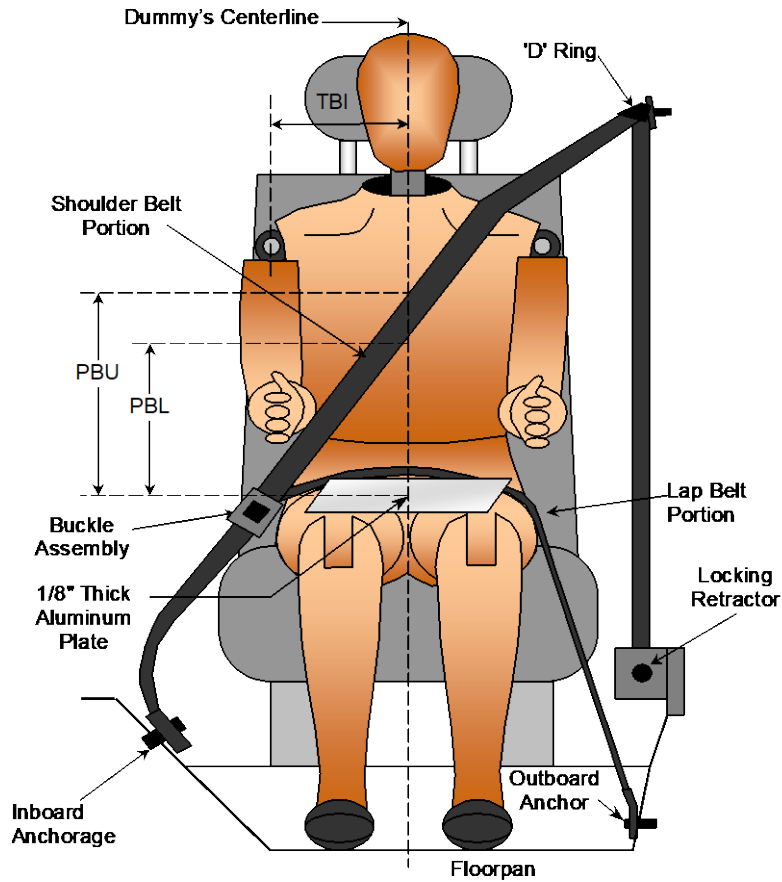
FRONT VIEW OF DUMMY

Code	Measurement Description	Units	Driver	Passenger
AD	Arm to Door	mm	111	85
HD	H-Point to Door	mm	196	228
HR	Head to Side Header	mm	204	238
HS	Head to Side Window	mm	336	347
KK	Knee to Knee	mm	370	228
SHY	Striker to H-Point (Y Direction)	mm	251	308
AA	Ankle to Ankle	mm	373	175

DATA SHEET NO. 5 SEAT BELT POSITIONING DATA

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	360	335
PBL - Top surface of reference to belt lower edge	mm	275	240

BELT LENGTH DATA

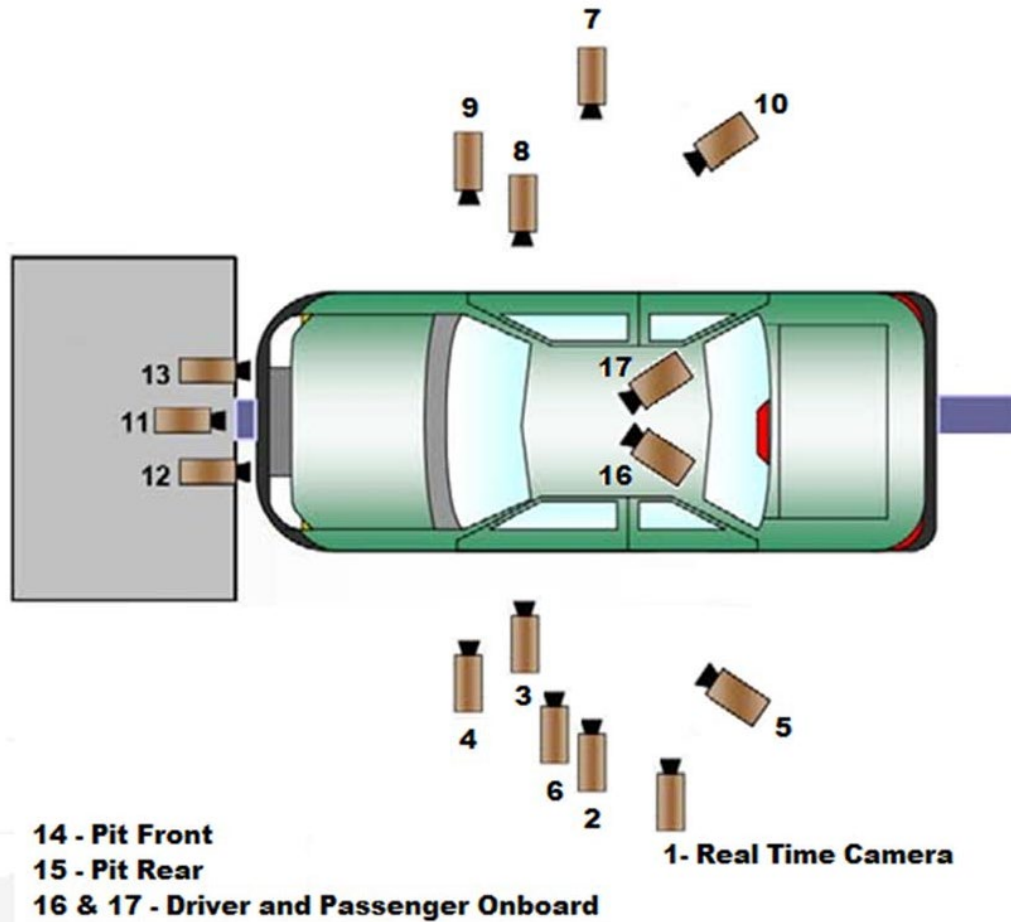
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	925	980
Lap Belt Length as measured on ATD	mm	650	630
Remainder of belt on reel	mm	195	160
Total Belt Length for Continuous Webbing Systems	mm	2420	2420

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

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: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

CAMERA LOCATIONS

No.	Camera View	Coordinates* (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall					30
2	Left Overall	-2400	-5910	-1440	11-16	1000
3	Driver Close-Up	-1740	-6840	-2110	50	1000
4	Left Front Half	-1560	-5490	-1480	24	1000
5	Left Angle	-7160	-5810	-2140	75	1000
6	Steering Column	-1710	-5880	-1260	50	1000
7	Right Overall	-2180	5650	-1480	11-16	1000
8	Passenger Close-Up	-1670	6370	-2080	50	1000
9	Right Front Half	-1310	5310	-1480	24	1000
10	Right Angle	-7410	5510	-2170	75	1000
11	Windshield	150	0	-2310	11-16	1000
12	Driver Windshield	200	-370	-2230	25	1000
13	Passenger Windshield	200	370	-2230	25	1000
14	Pit Front	-900	0	3340	24	1000
15	Pit Rear	-2910	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

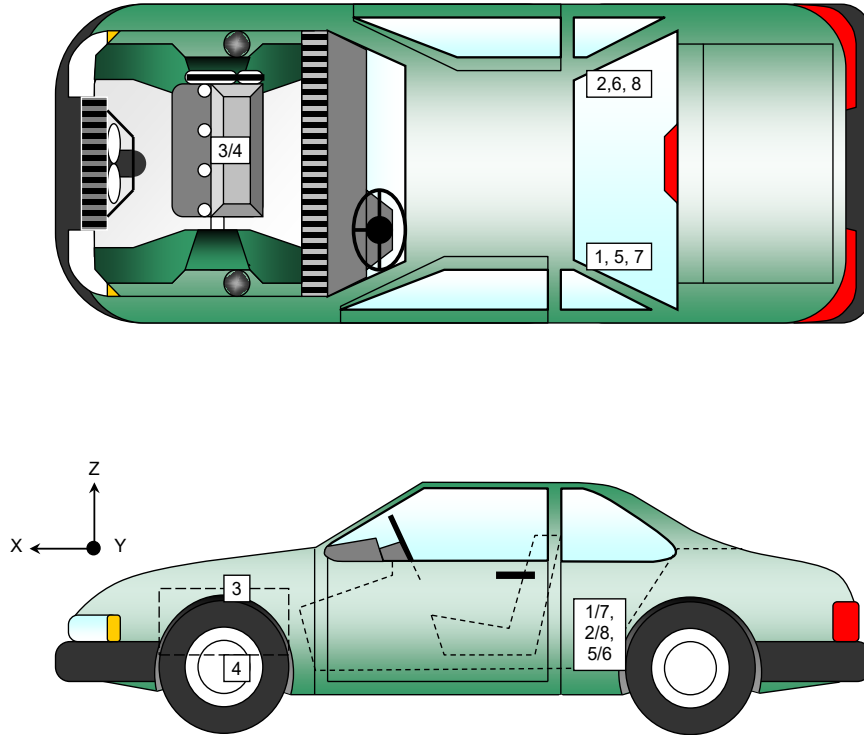
+Y = right of monorail centerline

+Z = below ground level

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	1877	-388	-279
2	Right Rear Crossmember Accelerometer – X Direction	1866	383	-290
3	Engine Top X	4050	267	-851
4	Engine Bottom X	4037	43	-238
5	Left Rear Crossmember Accelerometer – Z Direction	1877	-388	-279
6	Right Rear Crossmember Accelerometer – Z Direction	1866	383	-290
7	Left Rear Crossmember Accelerometer Redundant – X Direction	1877	-388	-279
8	Right Rear Crossmember Accelerometer Redundant – X Direction	1866	383	-290

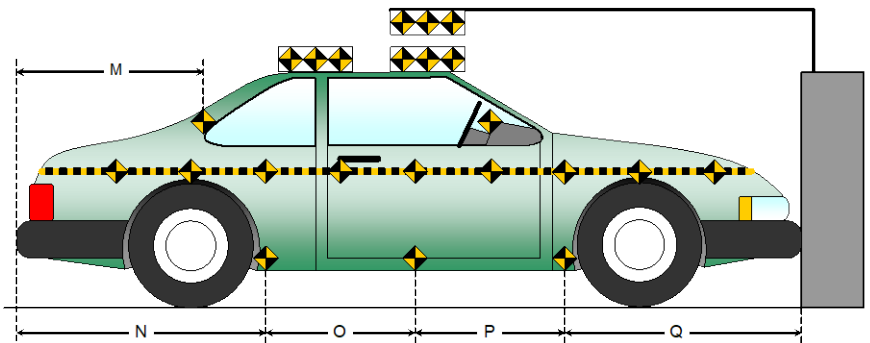
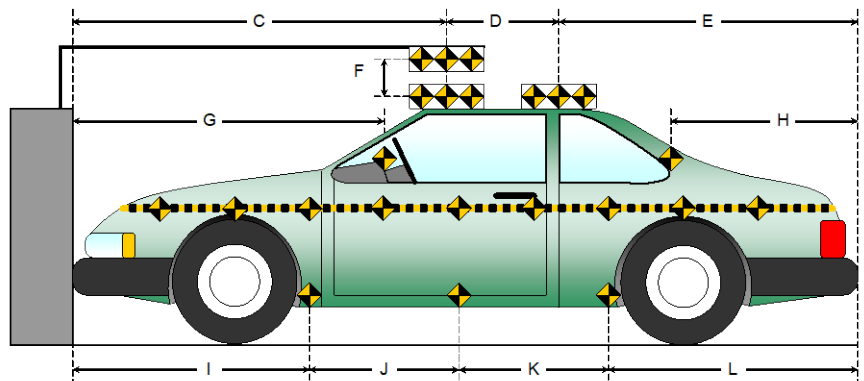
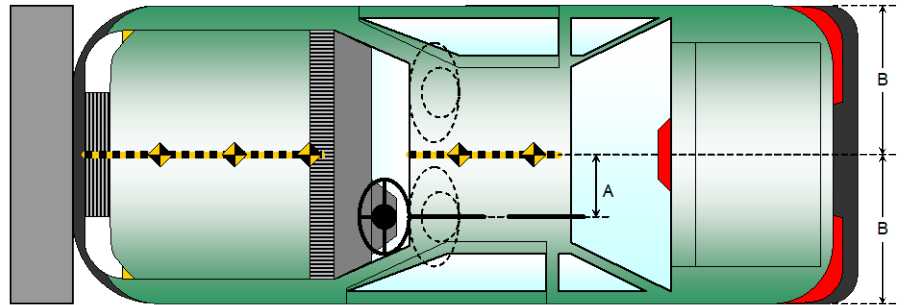
Reference Points: X - Rear Surface of Vehicle (+ forward)
Y - Vehicle Centerline (+ to right)
Z - Ground Plane (+ down)

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

Item	Value (mm)
A	399
B	949
C	2470
D	609
E	1622
F	170
G	
H	1071
I	1345
J	960
K	964
L	1431
M	1072
N	1433
O	967
P	959
Q	1343



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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

ADVANCED RESEARCH LOAD CELL BARRIER

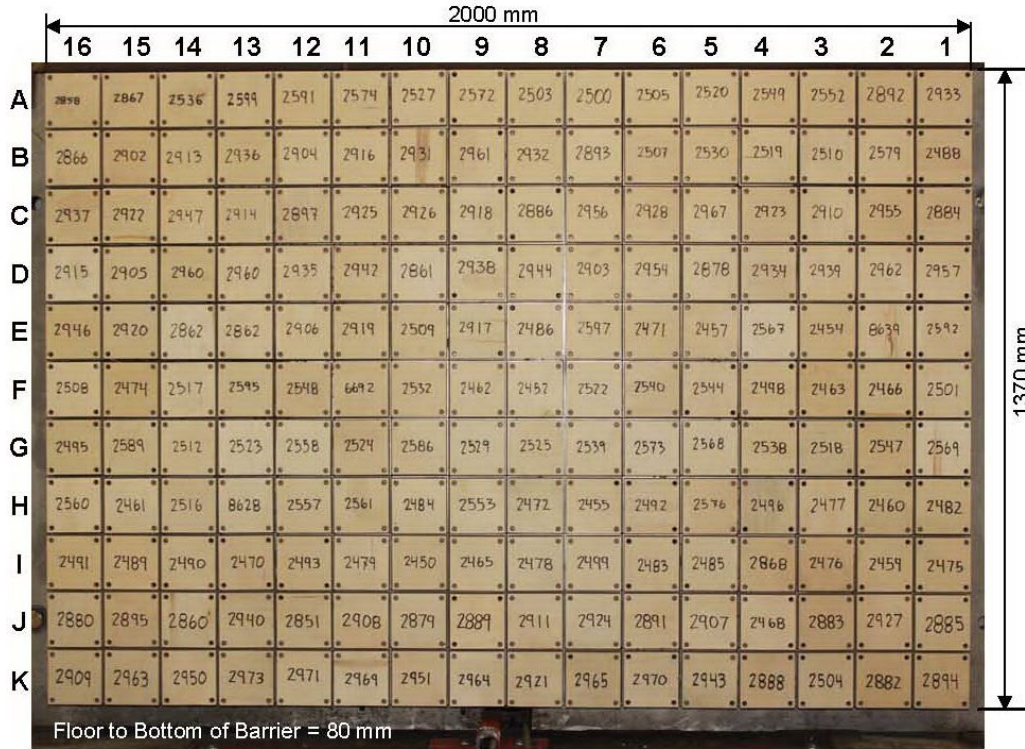


Photo for Reference Only

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: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV NHTSA No.: O20245900
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/18/2024

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Data Channels	49
Passenger Dummy Data Channels	49
Vehicle Structure Accelerometers	8
Barrier Channels	176
Total	282

CAMERA COVERAGE

Type of Camera	Number Used in this Test
High-Speed Vehicle Onboard	2
High-Speed Offboard	15
Real-Time	2
Total	19

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50% / 064	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 Airbag	Glove Box
Right Knee Contact	Knee Airbag	Glove Box

DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were locked	Doors were locked
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	None
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1660
Center	mm	1645
Right Side	mm	1615
Average	mm	1640

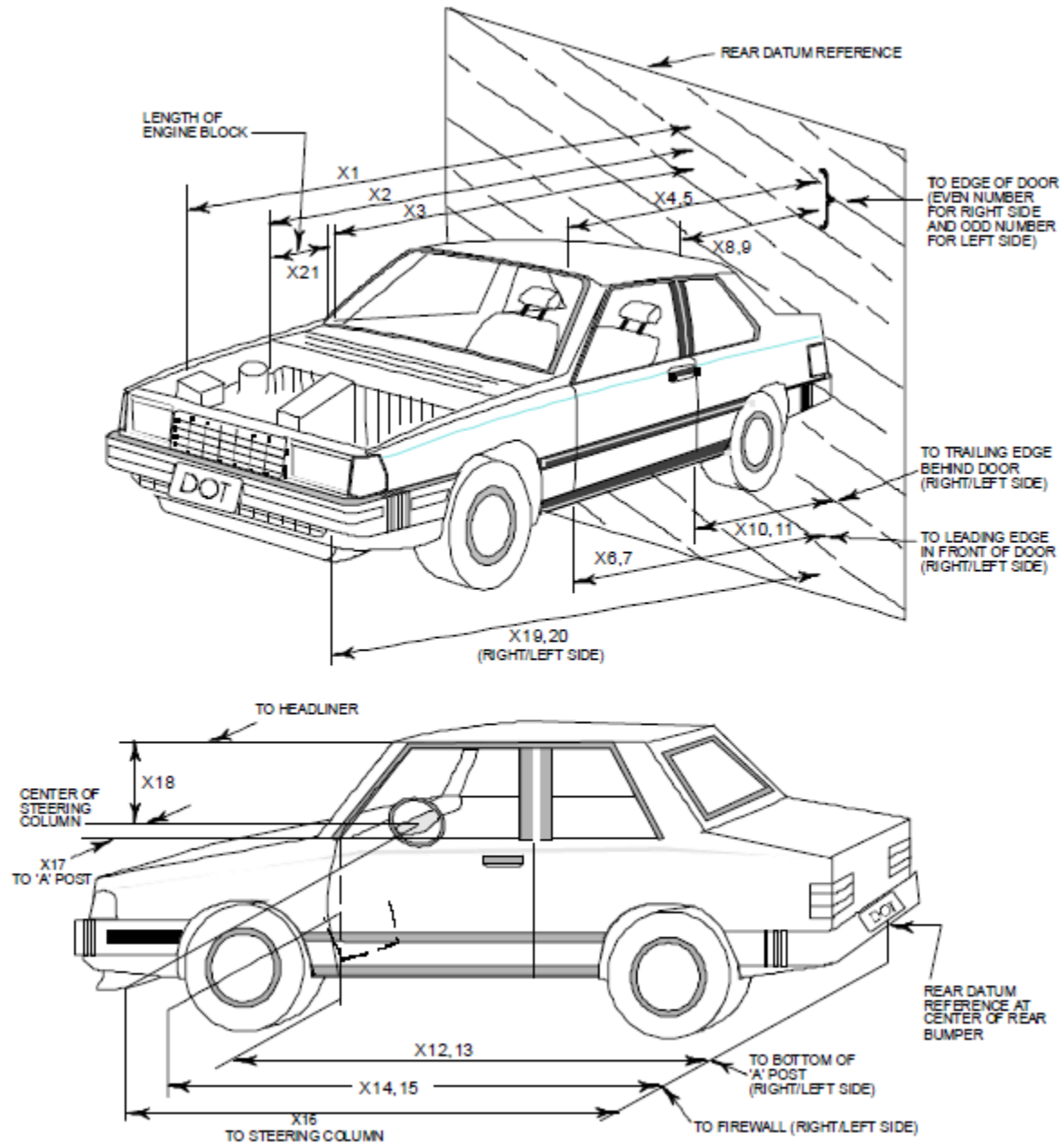
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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	Yes	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: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024



DATA SHEET NO. 12 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

No.	Measurement Description	Pre-Test	Post-Test	Change
1	Total Length of Vehicle at Centerline	4701	4182	-519
2	RSOV to Front of Engine	4032	3841	-191
3	RSOV to Firewall	3687	3619	-68
4	RSOV to Upper Leading Edge of Right Door	3164	3168	4
5	RSOV to Upper Leading Edge of Left Door	3163	3167	4
6	RSOV to Lower Leading Edge of Right Door	3209	3211	2
7	RSOV to Lower Leading Edge of Left Door	3206	3210	4
8	RSOV to Upper Trailing Edge of Right Door	2060	2064	4
9	RSOV to Upper Trailing Edge of Left Door	2058	2064	6
10	RSOV to Lower Trailing Edge of Right Door	2144	2147	3
11	RSOV to Lower Trailing Edge of Left Door	2142	2145	3
12	RSOV to Bottom of "A" Post of Right Side	3358	3361	3
13	RSOV to Bottom of "A" Post of Left Side	3356	3359	3
14	RSOV to Firewall, Right Side	3407	3406	-1
15	RSOV to Firewall, Left Side	3397	3403	6
16	RSOV to Steering Column	2664	2753	89
17	Center of Steering Column to "A" Post	261	263	2
18	Center of Steering Column to Headliner	454	476	22
19	RSOV to Right Side of Front Bumper	4532	4314	-218
20	RSOV to Left Side of Front Bumper	4525	4202	-323
21	Length of Engine Block	152	152	0
RD	RSOV to Right Side of Dash Panel	2907	2915	8
CD	RSOV to Center of Dash Panel	2873	2878	5
LD	RSOV to Left Side of Dash Panel	2903	2911	8

All dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

VEHICLE INFORMATION

VIN: YV4H60DJ8R1892202
Vehicle Size Category: MPV

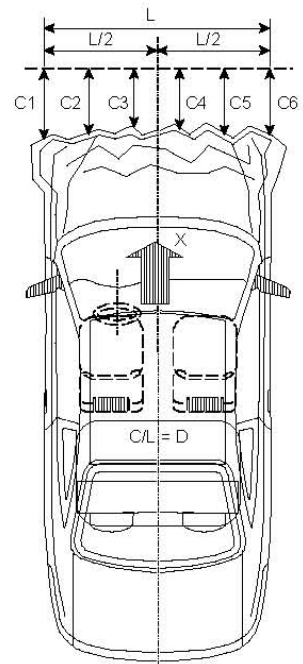
Wheelbase (mm): 2865
Test Weight (kg): 2362.3

ACCELEROMETER DATA

Accelerometer Locations: As per Data Sheet No. 7
Cal. Procedure/Interval: MGA Procedure / 6 month
Integration Algorithm: Trapezoidal
Linearity: > 99%
Impact Velocity (km/h): 56.32
Velocity Change (km/h): 66.3
Time of Separation (msec) 80

CRUSH PROFILE

Collision Deformation Classification: 12FDEW3
Midpoint of Damage: Centerline
Damage Region Length (mm): 1338
Impact Mode: Frontal



No.	Measurement Description	Units	Pre-Test	Post-Test	Exterior Crush
C1	Crush zone 1 at left side	mm	2475	2803	328
C2	Crush zone 2 at left side	mm	2347	2849	502
C3	Crush zone 3 at left side	mm	2315	2782	467
C4	Crush zone 4 at right side	mm	2314	2755	441
C5	Crush zone 5 at right side	mm	2340	2741	401
C6	Crush zone 6 at right side	mm	2468	2691	223
L	C1 TO C6	mm	1338	1367	29

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

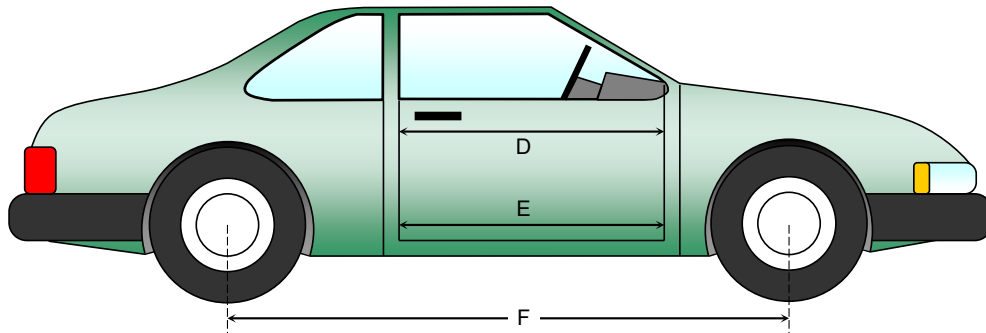
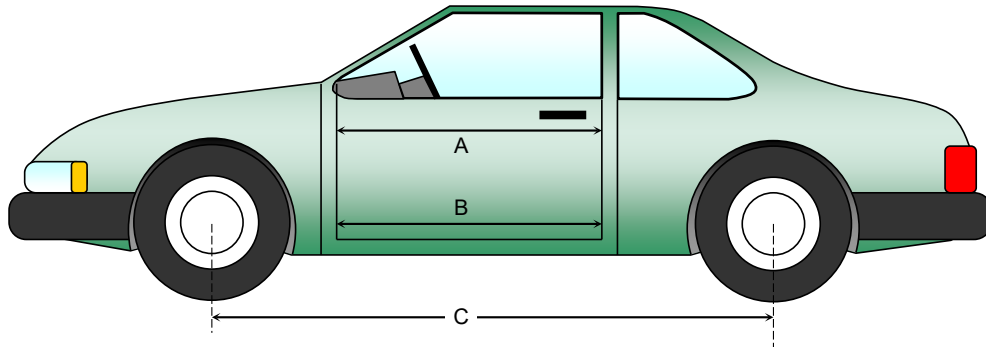
NHTSA No.: O20245900
Test Date: 6/18/2024

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Change
A	Left Side Upper	mm	990	990	0
B	Left Side Lower	mm	898	896	-2
D	Right Side Upper	mm	988	987	-1
E	Right Side Lower	mm	887	886	-1

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Change
C	Left Side Wheelbase	mm	2865	2784	-81
F	Right Side Wheelbase	mm	2864	2737	-127



DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

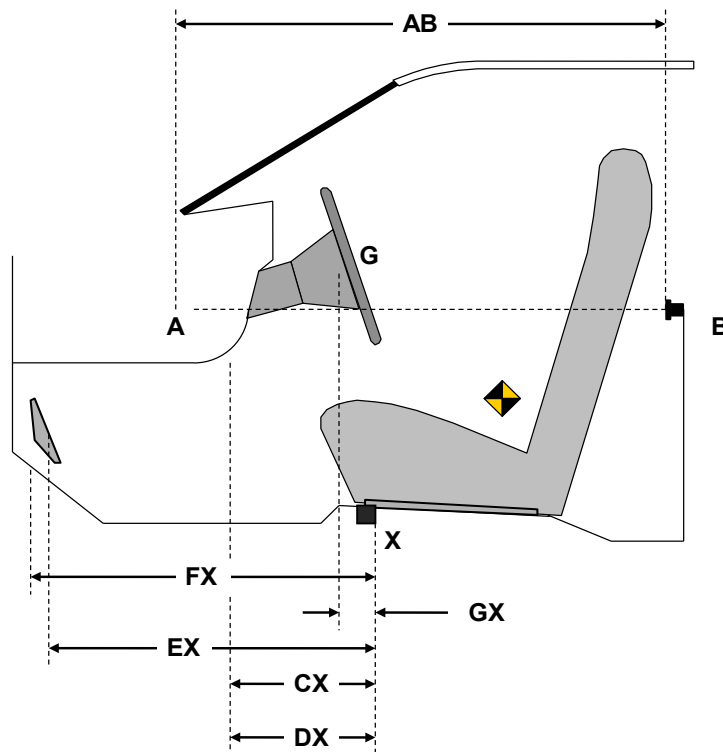
Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Change
AB	Door Opening (Inside Window Jam)	mm	774	776	2
CX	Left Knee Bolster to X	mm	326	328	2
DX	Right Knee Bolster to X	mm	335	336	1
EX	Brake Pedal to X	mm	568	671	103
FX	Foot Rest to X	mm	609	614	5
GX	Center of Steering Column Wheel Hub to X	mm	63	148	85

X = Front of Seat Track (stationary)



DRIVER COMPARTMENT

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

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

WINDSHIELD MOUNTING DETAILS

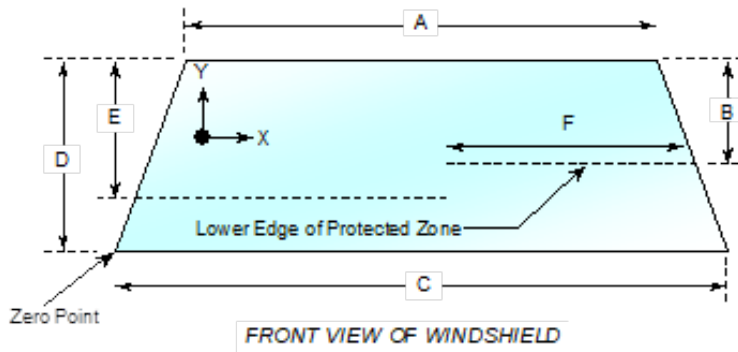
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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: 21.7°C.

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2277	2277	100
Right Side	2277	2277	100
Total	4554	4554	100



Item	Units	Value
A	mm	1254
B	mm	451
C	mm	1556
D	mm	872
E	mm	486
F	mm	588

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 NO. 301 BARRIER IMPACT AND STATIC ROLLOVER RESULTS

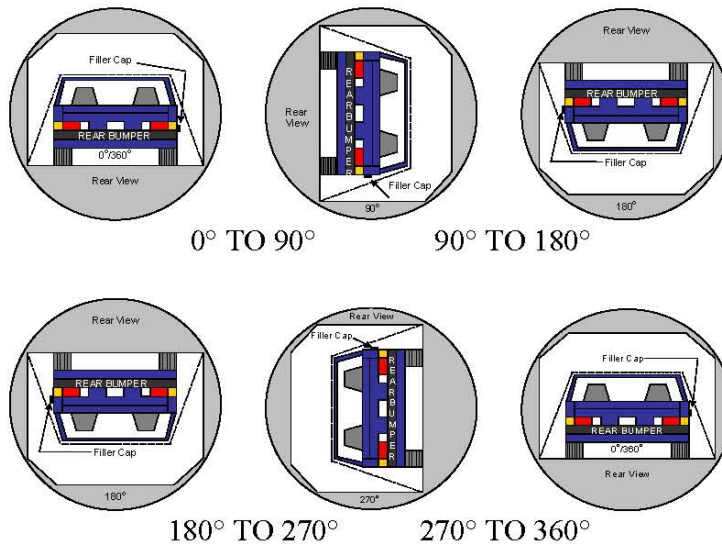
Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV NHTSA No.: O20245900
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/18/2024

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21.7°C Test Time: 11:56 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°	109	300	409
90° to 180°	110	300	410
180° to 270°	109	300	409
270° to 360°	111	300	411

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

Test Vehicle:	<u>2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV</u>	NHTSA No.:	<u>O20245900</u>
Test Program:	<u>NCAP Frontal Barrier Impact Test</u>	Test Date:	<u>6/18/2024</u>

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	

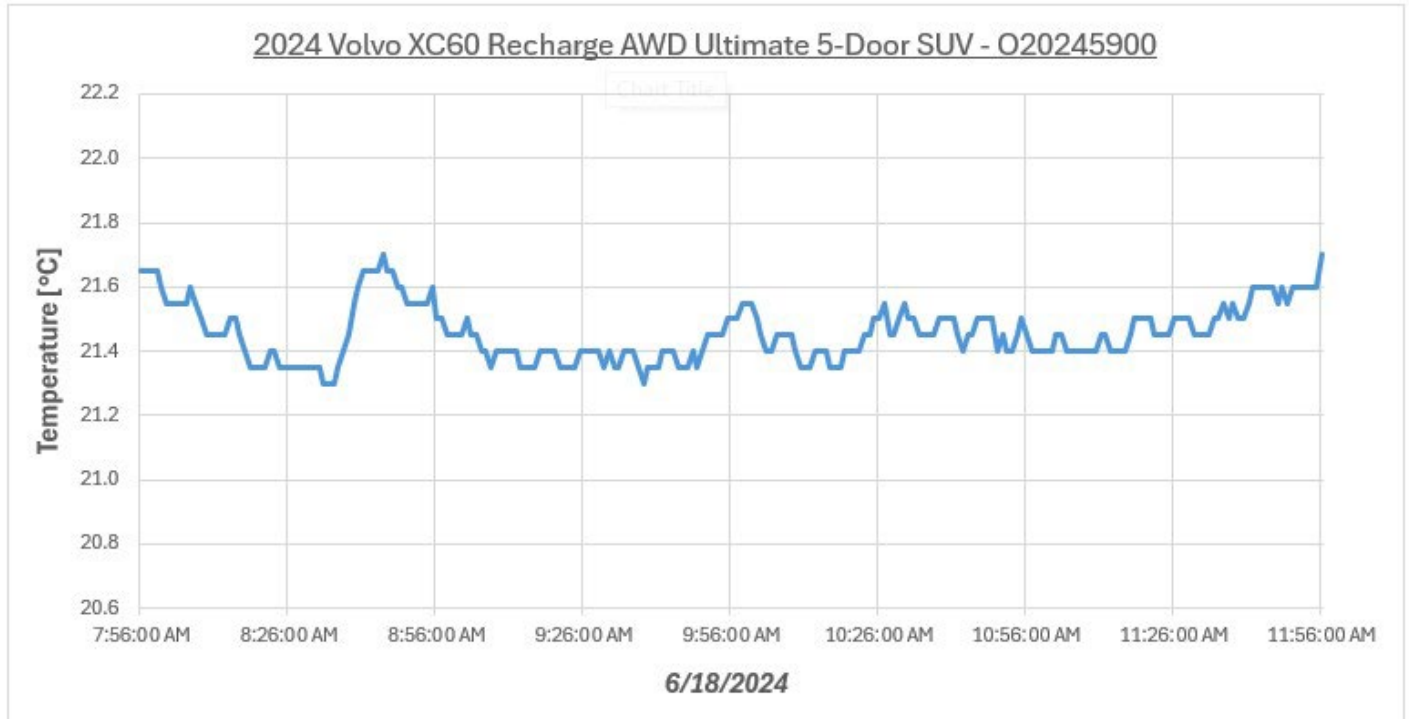
SOLVENT SPILLAGE LOCATION TABLE

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: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024



Serial #	Description	Maximum	Average	Minimum	Units
RFL100-U3731464	VSC Start Room A	21.7	21.5	21.3	°C

DATA SHEET NO. 305-1
GENERAL TEST AND VEHICLE PARAMETER DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV NHTSA No.: O20245900
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/18/2024

ELECTRIC VEHICLE PROPULSION SYSTEM

	Units	Observations and Conclusions
Type of Electric Vehicle		Gas-Electric Hybrid
Propulsion Battery Type		Lithium Ion Cells
Nominal Voltage	V	369
Physical Location of Automatic Propulsion Battery Disconnect		Inside the Battery Distribution Unit
Auxiliary Battery Type		12 V Lead

PROPULSION BATTERY SYSTEM DATA

	Units	Observations and Conclusions
Electrolyte Fluid Type		Dry cells
Electrolyte Fluid Specific Gravity		
Electrolyte Fluid Kinematic Viscosity		
Electrolyte Fluid Color		Neutral
Propulsion Battery Coolant Type, Color, Specific Gravity (if applicable)		Glycol, Green
Location of Battery Modules		Inside Passenger Compartment
	X	Outside Passenger Compartment
		The high-voltage battery is in the tunnel under the vehicle.

PROPULSION BATTERY STATE OF CHARGE

<i>For all battery types:</i>	
Voltage range corresponding to useable energy of the battery:	
Minimum State of Charge	285.6 V
Maximum State of Charge	426.36 V
95% of Maximum State of Charge	405.0 V
Test Voltage - No less than 95% of maximum State of Charge	418.1 V
<i>For batteries that are rechargeable ONLY by an energy source on the vehicle:</i>	
Voltage range corresponding to useable energy of the battery:	
Minimum State of Charge	
Maximum State of Charge	
Test Voltage – Maximum practicable State of Charge within Normal Operating Range	

**DATA SHEET NO. 305-2
PRE-IMPACT DATA
FOR INDICANT FMVSS NO. 305 TESTING**

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

VEHICLE CHASSIS GROUND POINT(S) LOCATION(S)

Details of Vehicle Chassis Ground Point(s) & Location(s)	HV battery breakout box ground
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PROPULSION BATTERY SYSTEM

Details of Electric Energy Storage/Conversion System Test Points	Connected at + and – terminal ends of propulsion system via HV battery breakout box.
Additional Comments	None

DATA SHEET NO. 305-3
PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

VOLTMETER INFORMATION

	Units	Observations and Conclusions
Make		Fluke
Model		177
Serial Number		58990422
Internal Impedance Value	MΩ	> 10 MΩ < 100 pF
Resolution	V	0.001
Last Calibration Date		6/5/2024

PROPULSION BATTERY VOLTAGE

Measurement shall be made with Energy Storage/Conversion System connected to the vehicle propulsion system, and the vehicle in the “ready-to-drive” (propulsion system energized) position.
NOTE: If voltage measurement is not at the voltage or within the normal operating voltage range specified by the manufacturer, the battery must be charged.

Vb	V	418.1
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ELECTRIC ISOLATION MEASUREMENTS
PROPULSION BATTERY TO VEHICLE CHASSIS

Vehicle chassis point(s) determined and supplied to contractor by COTR.

V1	V	8.2
V2	V	396.5

PROPULSION BATTERY TO VEHICLE CHASSIS ACROSS RESISTOR

The known resistance Ro (in ohms) should be approximately 500 times the normal operating voltage of the vehicle (in volts) per SAE J1766.

Ro	Ω	542,700
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V1' Pre-Impact	V	5.1
V2' Pre-Impact	V	248.6

DATA SHEET NO. 305-3 (CONTINUED)
PRE-IMPACT ELECTRICAL ISOLATION MEASUREMENTS AND CALCULATIONS
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV NHTSA No.: O20245900
Test Program: NCAP Frontal Barrier Impact Test Test Date: 6/18/2024

ELECTRICAL ISOLATION CALCULATIONS

NOTE: If measured voltage is zero and results in a division by zero, record "Zero Volts".
This "zero voltage" condition is considered as being compliant.

$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$		
Ri1 Pre-Impact	Ω	16,280,611
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$		
Ri2 Pre-Impact	Ω	329,547
$R_i = \text{The lesser of } R_{i1} \text{ and } R_{i2}$		
Ri Pre-Impact	Ω	329,547
$R_i / V_b = \text{Electrical Isolation Value} / \text{Nominal Battery Voltage}$		
Ri / Vb Pre-Impact	Ω/V	788

NOTE: The minimum Electrical Isolation Value is 500 Ω/V .

	Yes	No (Fail)
Is the measured Electrical Isolation Value $\geq 500 \Omega/V$?	X	
Additional Comments	None	

DATA SHEET NO. 305-4
POST-IMPACT DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

VOLTMETER INFORMATION

	Units	Observations and Conclusions
Make		Fluke
Model		177
Serial Number		58990422
Internal Impedance Value	MΩ	> 10 MΩ < 100 pF
Resolution	V	0.001
Last Calibration Date		6/5/2024

ELECTRICAL ISOLATION MEASUREMENTS

Vb Post-Impact	V	0.02
----------------	---	------

V1 Post-Impact	V	0.19	Impact Time	1	Minutes	37	Seconds
V2 Post-Impact	V	0.22		1	Minutes	40	Seconds
V1' Post-Impact	V	0.11		1	Minutes	52	Seconds
V2' Post-Impact	V	0.13		1	Minutes	46	Seconds

Ro	Ω	542,700
----	---	---------

DATA SHEET NO. 305-4 (CONTINUED)
POST-IMPACT DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

ELECTRICAL ISOLATION CALCULATIONS

NOTE: If measured voltage is zero and results in a division by zero, record "Zero Volts".
 This "zero voltage" condition is considered as being compliant.

$R_{i1} = R_o (1 + V_2/V_1) [(V_1 - V_1')/V_1']$							
Ri1 Post-Impact	Ω	851,701	Impact Time	1	Minutes	52	Seconds
$R_{i2} = R_o (1 + V_1/V_2) [(V_2 - V_2')/V_2']$							
Ri2 Post-Impact	Ω	700,197	Impact Time	1	Minutes	46	Seconds
Ri = The lesser of Ri1 and Ri2							
Ri Post-Impact	Ω	700,197	Impact Time	1	Minutes	46	Seconds
Ri / Vb = Electrical Isolation Value / Nominal Battery Voltage							
Ri / Vb Post-Impact	Ω/V	35,009,843	Impact Time	1	Minutes	46	Seconds

NOTE: The minimum Electrical Isolation Value is 500 Ω/V.

	Yes	No (Fail)
Is the measured Electrical Isolation Value ≥ 500 Ω/V?	X	
Additional Comments	None	

DATA SHEET NO. 305-4 (CONTINUED)
POST-IMPACT DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

PROPULSION BATTERY SYSTEM COMPONENTS

Describe any Propulsion Battery Module movement within the passenger compartment [Supply photographs as appropriate]:
Not Applicable

	Yes (Fail)	No
Has the Propulsion Battery Module moved within the passenger compartment?		X

Describe intrusion of an outside Propulsion Battery Component into the passenger compartment [Supply photographs as appropriate]:
No Intrusion

	Yes (Fail)	No
Has an outside Propulsion Battery Component intruded into the passenger compartment?		X

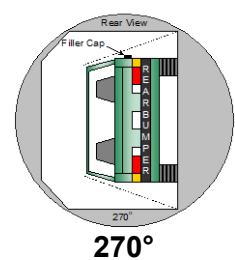
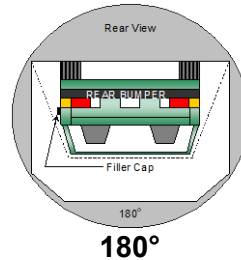
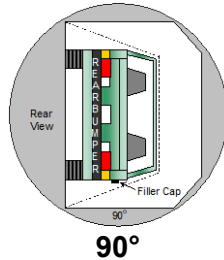
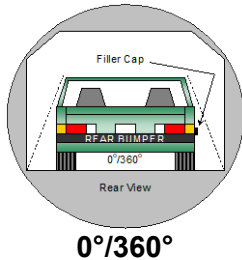
	Yes (Fail)	No
Is the Propulsion Battery Electrolyte Spillage visible in the passenger compartment?		X

DATA SHEET NO. 305-5
STATIC ROLLOVER TEST DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

PROPULSION BATTERY SYSTEM COMPONENTS



PROPULSION BATTERY ELECTROLYTE COLLECTION TIME PERIOD

Test Phase	Rotation Time (spec. 1-3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
0° - 90°	1	min	49	sec	5	min	6	min	49	sec	7	min
90° - 180°	1	min	50	sec	5	min	6	min	50	sec	7	min
180° - 270°	1	min	49	sec	5	min	6	min	49	sec	7	min
270° - 360°	1	min	51	sec	5	min	6	min	51	sec	7	min

TEST VEHICLE PROPULSION BATTERY ELECTROLYTE SPILLAGE

NOTE: The maximum allowable Propulsion Battery Electrolyte Spillage is 5.0 Liters.

Test Phase	Propulsion Battery Electrolyte Spillage (L)	Spillage Location
0° to 90°	0	Not Applicable
90° to 180°	0	Not Applicable
180° to 270°	0	Not Applicable
270° to 360°	0	Not Applicable
Total Spillage	0	

	Yes (Fail)	No
Is the total Propulsion Battery Electrolyte Spillage greater than 5.0 Liters?		X
Is the Propulsion Battery Electrolyte Spillage visible in the passenger compartment?		X

DATA SHEET NO. 305-5 (CONTINUED)
STATIC ROLLOVER TEST DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
Test Date: 6/18/2024

VOLTMETER INFORMATION

	Units	Observations and Conclusions
Make		Fluke
Model		177
Serial Number		58990422
Internal Impedance Value	MΩ	> 10 MΩ < 100 pF
Resolution	V	0.001
Last Calibration Date		6/5/2024

ELECTRICAL ISOLATION MEASUREMENTS

Vb Post-Impact	V	0.05
Ro	Ω	542,700

Record V1, V2, V1', V2' voltage measurements at the start of each successive increment of 90°, 180°, 270°, and 360° of the static rollover test.

	Voltage	Units	Test Phase	Time			
V1	0.14	V	0°		min		sec
	0.08		90°	3		14	
	0.06		180°	2		24	
	0.12		270°	3		46	
	0.14		360°	2		35	
V2	0.19	V	0°		min		sec
	0.13		90°	3		20	
	0.11		180°	2		29	
	0.17		270°	3		51	
	0.20		360°	2		40	
V1'	0.08	V	0°		min		sec
	0.02		90°	3		36	
	0.02		180°	2		45	
	0.05		270°	4		7	
	0.07		360°	2		53	
V2'	0.12	V	0°		min		sec
	0.06		90°	3		25	
	0.05		180°	2		34	
	0.08		270°	3		59	
	0.10		360°	2		46	

DATA SHEET NO. 305-5 (CONTINUED)
STATIC ROLLOVER TEST DATA
FOR INDICANT FMVSS NO. 305 TESTING

Test Vehicle: 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20245900
 Test Date: 6/18/2024

ELECTRICAL ISOLATION CALCULATIONS

NOTE: If measured voltage is zero and results in a division by zero, record "Zero Volts".
 This "zero voltage" condition is considered as being compliant.

	Voltage	Units	Test Phase	Time			
Ri1 = Ro (1 + V2/V1) [(V1-V1')/V1']							
Ri1	959,416	Ω	0°		min		sec
	4,273,763		90°	3		36	
	3,075,300		180°	2		45	
	1,836,135		270°	4		7	
	1,317,986		360°	2		53	
Ri2 = Ro (1 + V1/V2) [(V2-V2')/V2']							
Ri2	549,841	Ω	0°		min		sec
	1,022,781		90°	3		25	
	1,006,462		180°	2		34	
	1,041,505		270°	3		59	
	922,590		360°	2		46	
Ri = The lesser of Ri1 and Ri2							
Ri	549,841	Ω	0°		min		sec
	1,022,781		90°	3		25	
	1,006,462		180°	2		34	
	1,041,505		270°	3		59	
	922,590		360°	2		46	
Ri / Vb = Electrical Isolation Value / Nominal Battery Voltage							
Ri / Vb	10,996,816	Ω/V	0°		min		sec
	20,455,615		90°	3		25	
	20,129,236		180°	2		34	
	20,830,103		270°	3		59	
	18,451,800		360°	2		46	

NOTE: The minimum Electrical Isolation Value is 500 Ω/V .

	Yes	No (Fail)
Is the measured Electrical Isolation Value $\geq 500 \Omega/V$?	X	
Additional Comments	None	

**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 - 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV 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

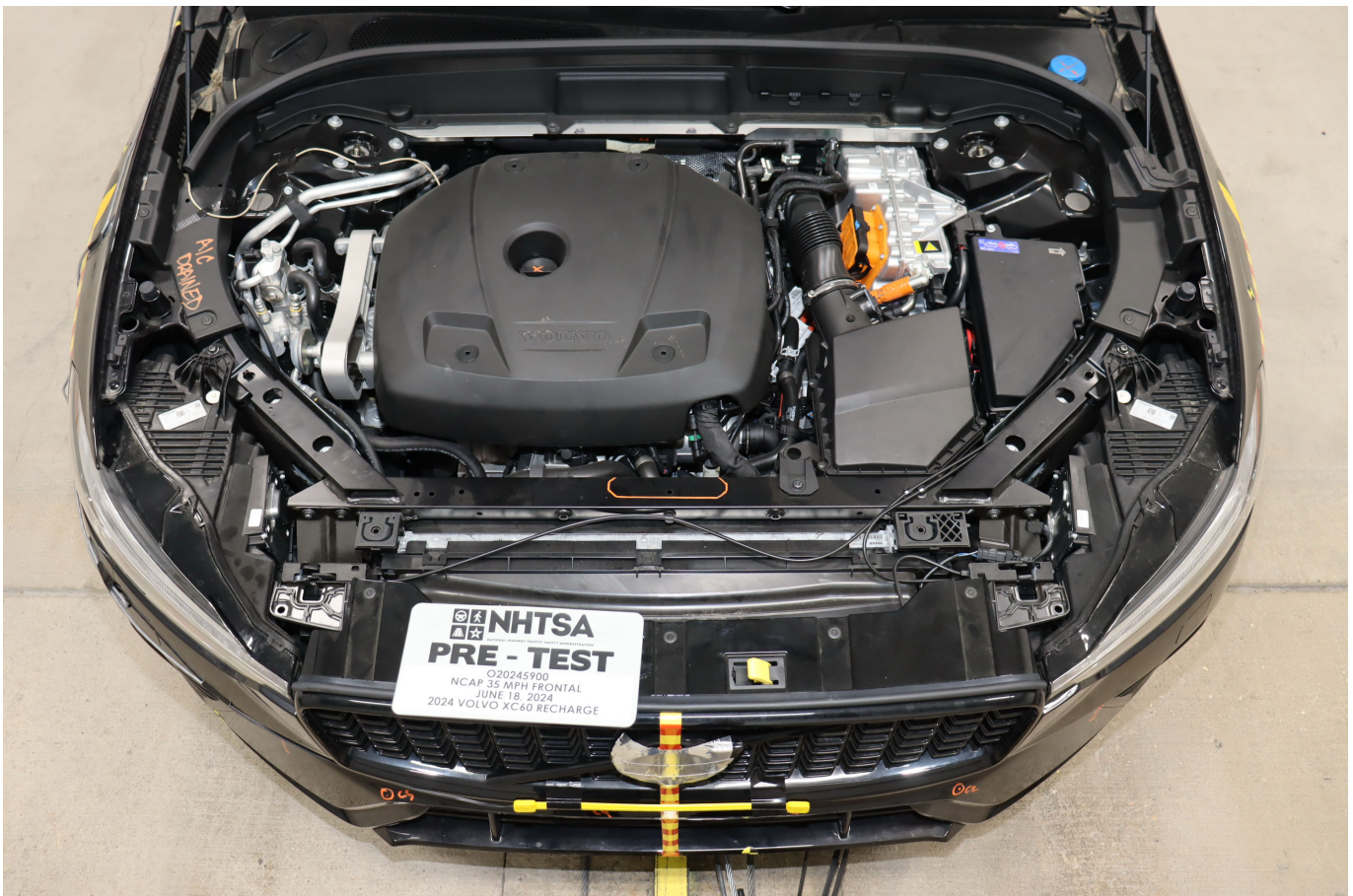


Photo No. 020 - Pre-Test Engine Compartment View



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

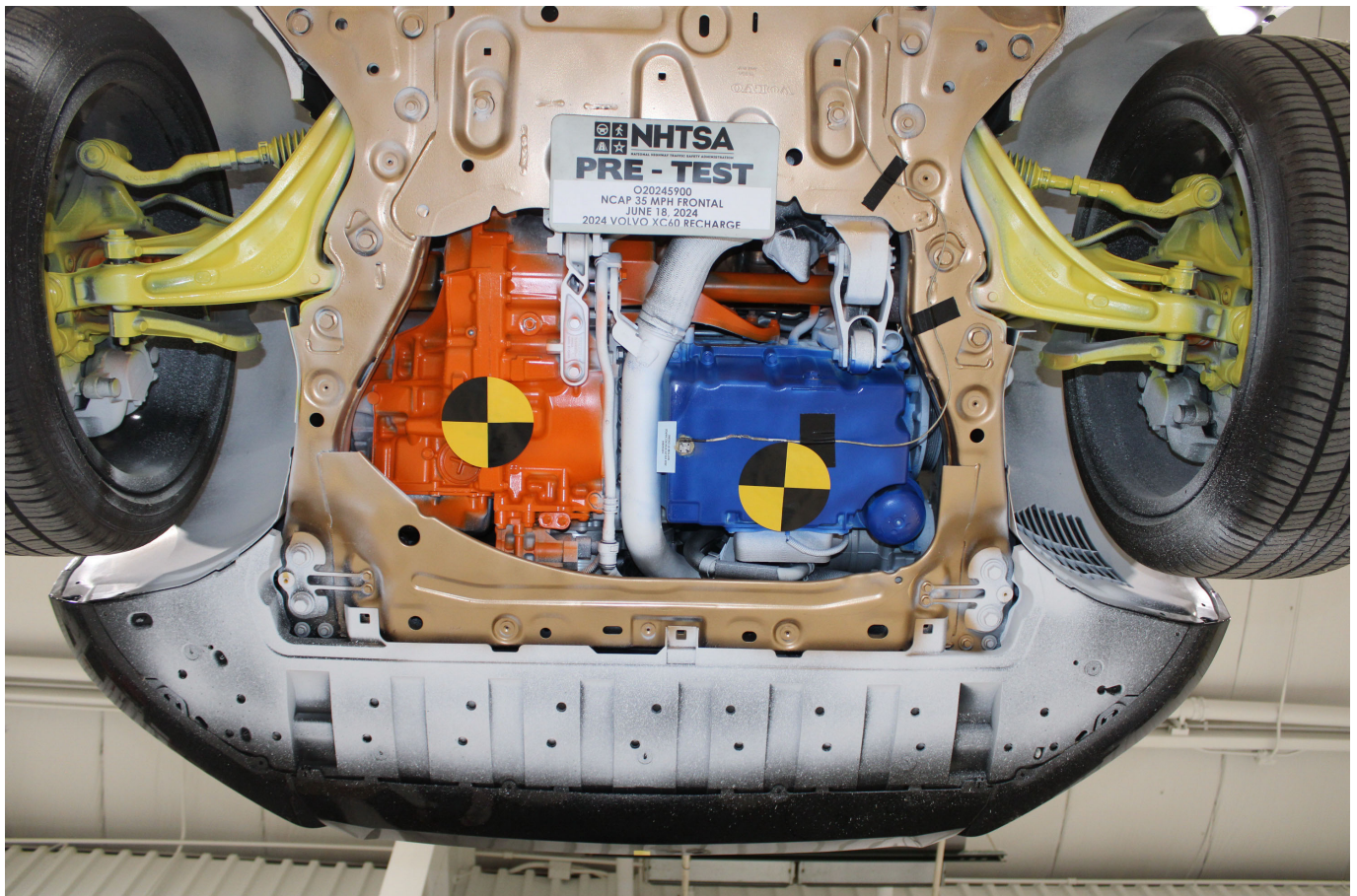


Photo No. 024 - Pre-Test Front Underbody View

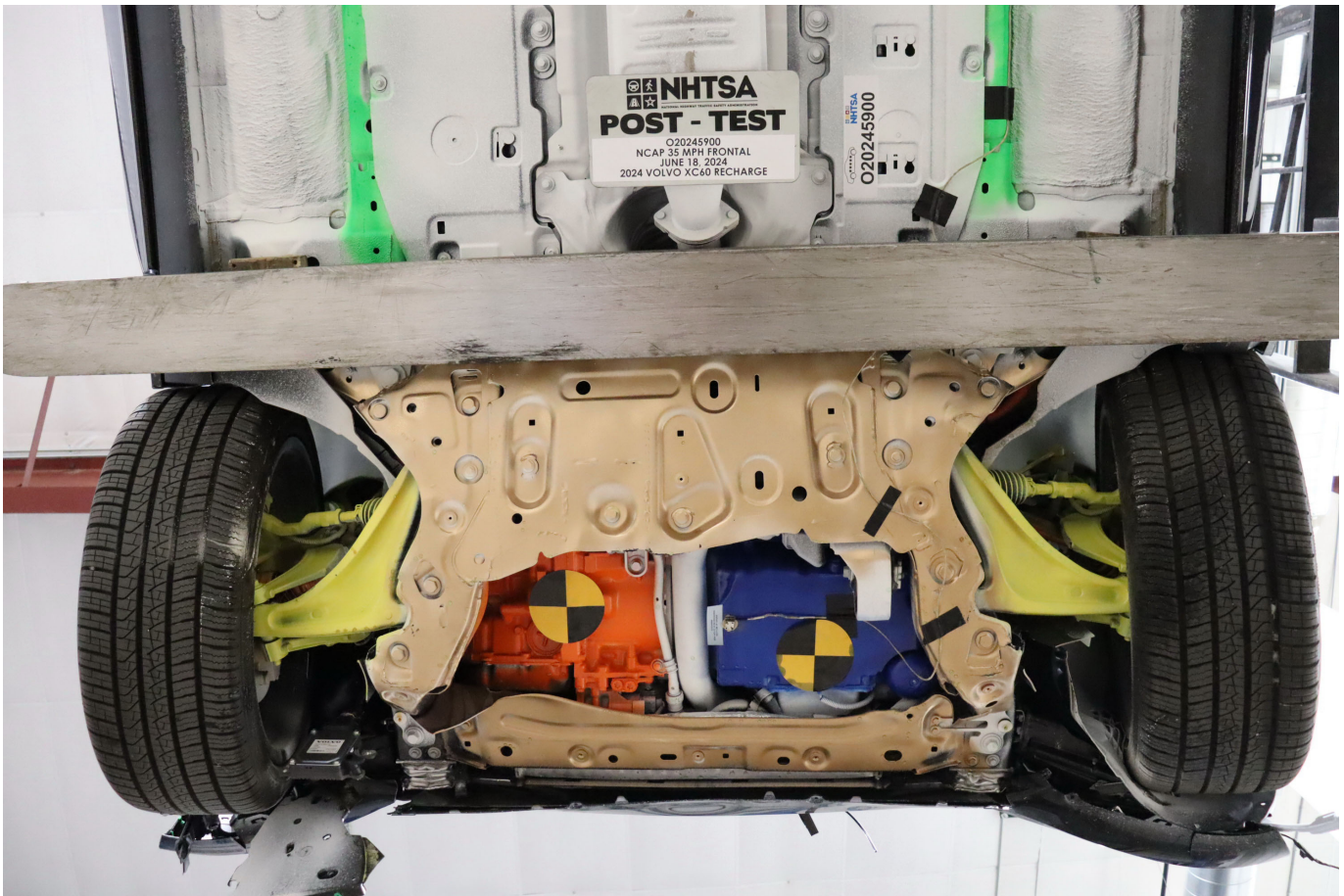


Photo No. 025 - Post-Test Front Underbody View

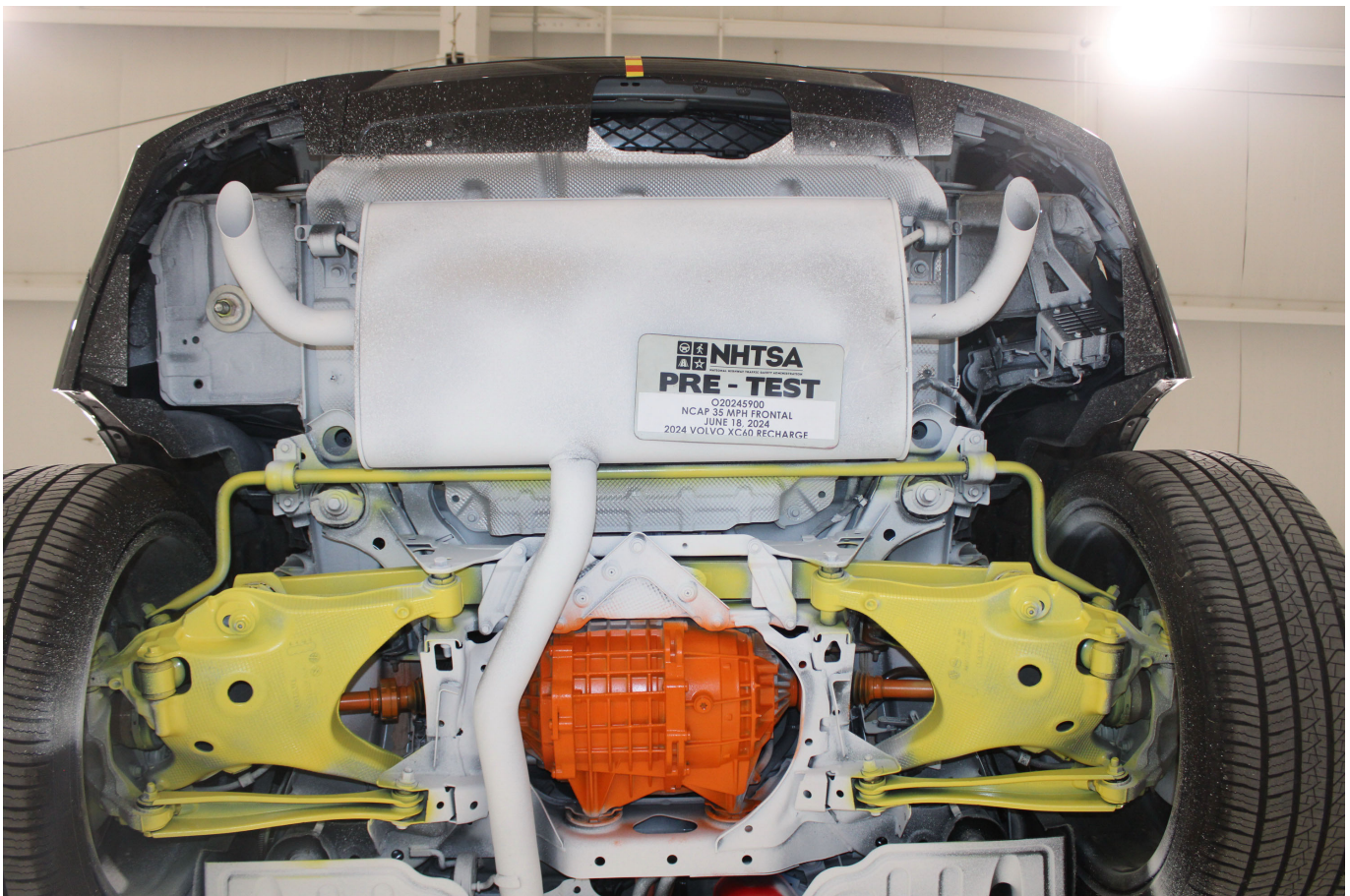


Photo No. 026 - Pre-Test Rear Underbody View

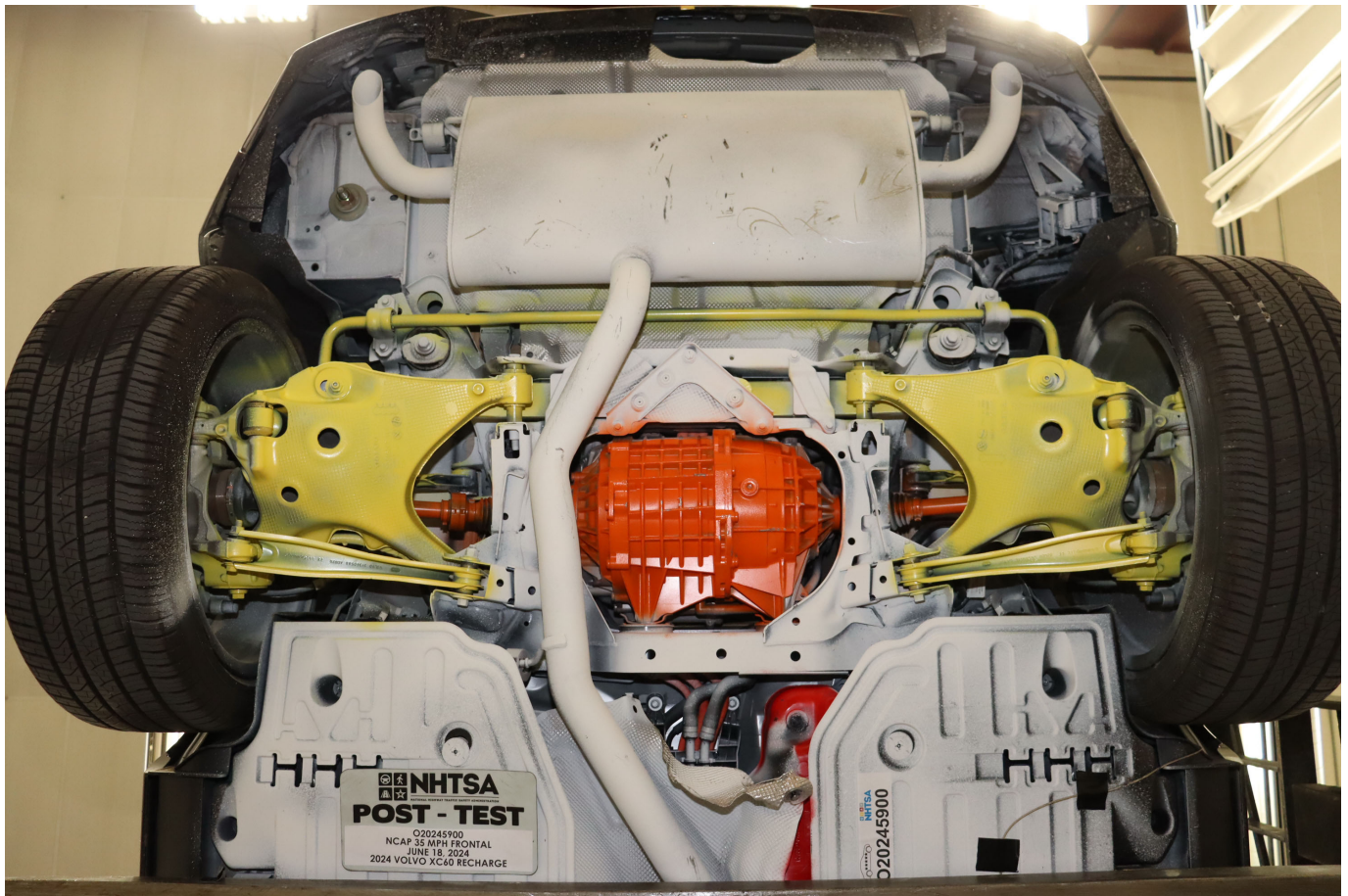


Photo No. 027 - Post-Test Rear Underbody View



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



Photo No. 053 - Pre-Test Passenger Dummy Front View

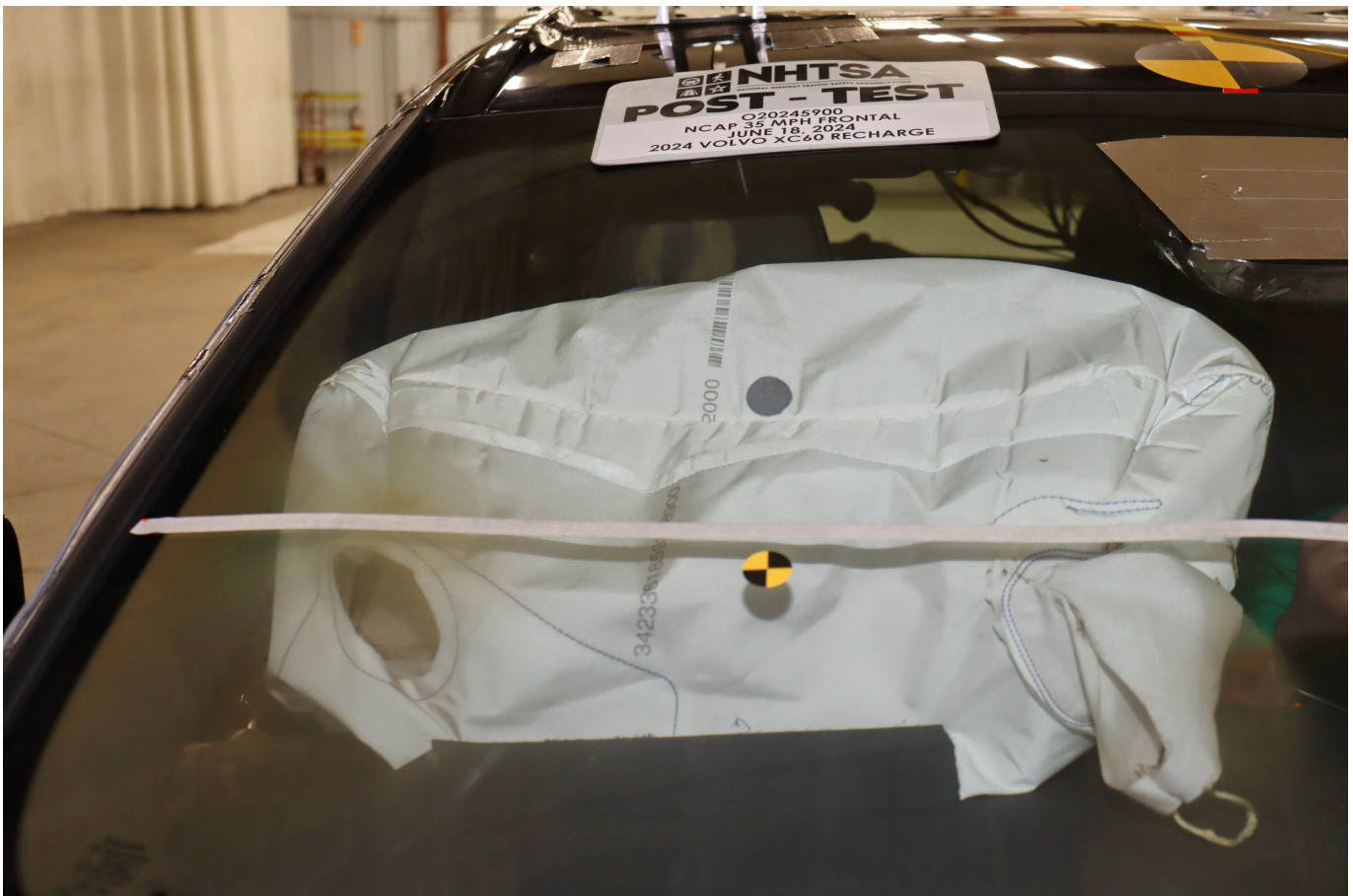


Photo No. 054 - Post-Test Passenger Dummy Front View



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. 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 - 2024 Volvo XC60 Recharge AWD Ultimate 5-Door SUV Frontal Impact Event

XC60 RECHARGE AWD ULTIMATE BLACK EDITION

Volvo Cars USA LLC
www.volvocars.com/us

PERFORMANCE

2.0L Turbo-Charged, Direct Inject Engine with Electric Motor
18.8 kWh High Voltage Battery
Dual Voltage Charging Cable
8-Speed Geartronic Automatic Trans w/ Start-Stop
Combined 455 HP and 523 lb-ft Torque (312 HP Direct Inject w/ 143 HP Electric Motor)
Anti-Lock Braking System (ABS)
Advanced Electronic Stability Control (ESC)
21" Black Diamond Cut Alloy Wheel with All Season Tires

AUDIO & TECHNOLOGY

12.3" Digital Driver Display
USB-C Ports, 2 Front + 2 Rear
Bluetooth Connectivity
Digital Services Package 4-Yr Subscription includes:
Google built-in with Google Maps,
Google Play Store & Google Assistant
Volvo Cars Remote App Services
Remote Start and Remote Lock/Unlock
Road Sign Information
Over the Air Updates
Apple CarPlay
SiriusXM Radio with Trial Subscription
Harman Kardon Premium Sound

SAFETY & SECURITY

BLIS Blind Spot Information System with Steering Assist and Cross Traffic Alert
Collision Avoidance Featuring:
Low & High Speed Collision Mitigation
Detects Vehicle/Pedestrian/Cyclist/Large Animal
Oncoming Mitigation by Braking
Driver Alert Control
Front, Side & Curtain Airbags with Driver Side Knee Airbag
Whiplash Protection System (WHIPS) in Front Seats
Pilot Assist Driver Assistance System with Adaptive Cruise Control
Automatic Unlocking after Collision
Lane Keeping Aid
Forward Collision Warning
Post Impact Braking
Tire Repair Kit

LUXURY & CONVENIENCE

Laminated Panoramic Sunroof with Power Sunshade
Keyless Entry and Drive
Heated Front Seats
High-Gloss Black Mesh Grille and Lower Outer Grille
High-Gloss Black Window Trim, Mirror Caps & Grill Frame
Black Ironmark Front Grill, Black Badging Front and Rear
2-Zone Automatic Climate Control
Power Front Seats with Front Seat Memory
4-Way Power Lumbar Support, Front Seats
Air Purifier
Laminated Glass, Side Door Windows
Graphical Head-Up Display
Power Adjustable Side Support (only w/ Nappa Leather)
Nappa Leather
or Nappa Leather & Leatherette Textile Upholstery
Ventilated Front Seats (only w/ Nappa Leather)

AUTHORIZED RETAILER

MAGUIRE VOLVO 3725
370 ELMIRA RD
ITHACA, NY US 14850

WARRANTY

48 Month/50,000 Mile Limited Warranty Coverage 144 Month Corrosion Protection "Unlimited Mileage" Refer to Warranty Info Book for Specific Limitations.

VOLVO On-Call Roadside Assistance

Volvo Increased Protection: Ask Your Volvo Retailer About an Extended Service Contract

MAINTENANCE

Complimentary Factory Scheduled Maintenance for the First 3 Years or 36,000 Miles, for your first three regularly scheduled maintenance services. Includes a comprehensive assessment of your vehicle and full diagnostic checks of all Passive and Active Safety Systems by our factory-trained technicians.

ACCESSORIES

Enhance the driving pleasure with Volvo accessories. Enrich the styling, integrate technology, boost performance, or simply carry more cargo - from function to fun, there's something for everyone.

To view full accessory product line - Scan this Smartphone QR code or visit <https://accessories.volvocars.com/en-us>

JOIN THE CONVERSATION

See what our fans are saying about Volvo and join in!

Have a question?
Instagram: @VolvoCarUSA
Facebook: Volvo Car USA
YouTube: Volvo Car USA

PRICING

Manufacturer's Suggested Retail Price: \$68,950.00

Ultimate Black Edition Features:

Harman Kardon Premium sound
Interior High Level Illumination
Tailored Dashboard
Crystal Geartronic Gearshift by Oronoro
Air Purifier
Hondalink
Power Folding Rear Headrests
Passenger Memory Front Seats
4-Way Power Lumbar, Front Seats
Laminated Glass, Side Windows
Graphical Head-Up Display
Power Cushion Extension, Front Seats
2-Zone Automatic Climate Control
Power Child Locks, Rear Side Doors
Pilot Assist Driver Assistance System with ACC
Park Assist Front, Rear and Side
360 Surround View Camera
Black Ironmark Front Grill, Black Badging Front and Rear

Climate Package

Heating/Cooling
Heated Steering Wheel
Heated Rear Seats

Power Operated Tailgate

Destination Charge

Total Suggested Retail Price: \$71,195.00

The price shown does not include License and Title Fees, State and Local Taxes and Dealer Installed Options and Accessories. The factory reserves the right to modify price, designs and equipment without previous notice.

EPA DOT

Fuel Economy and Environment

Plug-In Hybrid Vehicle
Electricity-Gasoline

Fuel Economy Small SUV 4WD range from 14 to 123 MPG. The best vehicle rates 140 MPGe.

Electricity
Charge Time: 5 Hours (240V)
63 MPGe
0.1 gallons per 100 miles
50 kWh per 100 miles
Combined city/highway

Gasoline Only
28 MPG
3.6 gallons per 100 miles
Combined city/highway

You save
\$2,000
in fuel costs over 5 years
compared to the average new vehicle.

Driving Range
Electricity + Gasoline
0 12 24 36 48 60 72 84 96 108 120 132 144 156 168 180 192 204 216 228 240 252 264 276 288 300 312 324 336 348 360 372 384 396 408 420 432 444 456 468 480 492 504 516 528 540 552 564 576 588 600 612 624 636 648 660 672 684 696 708 720 732 744 756 768 780 792 804 816 828 840 852 864 876 888 900 912 924 936 948 960 972 984 996 1000

Annual Fuel Cost

\$1,550

Fuel Economy & Greenhouse Gas Rating (tailpipe only) Smog Rating (tailpipe only)

MPG 8 10 Best
CO₂ 9 Best
This vehicle emits 122 grams CO₂ per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions, learn more at fuelconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 28 MPG and costs \$9.750 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at \$4.30 per gallon and \$0.15 per kWh. This is a dual fueled automobile. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fuelconomy.gov

Calculate personalized estimates and compare vehicles

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS
CARLINE: XC60 RECHARGE

U.S./CANADIAN PARTS
CONTENT: 0%

MAJOR SOURCES OF
FOREIGN PARTS CONTENT:
SWEDEN: 30%
FINLAND: 20%

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT:
TORSLANDA, SWEDEN

COUNTRY OF ORIGIN:
ENGINE PARTS:
SWEDEN

TRANSMISSION PARTS:
JAPAN

Note: Parts contents does not include final assembly, distribution, or other non-parts costs.

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the government for overall vehicle score, frontal crash, or rollover risk

Star ratings range from 1 to 5 stars (★★★★★) with 5 being the highest
Source: National Highway Traffic Safety Administration (NHTSA)
www.safercar.gov or 1-888-327-4236

VEHICLE IDENTIFICATION
Type & Chassis: 246 892202
Model Year: 2024
Est. Chryx Black
Int. Charcoal Ventilated Nappa
Leather
VIN: YV4H60DJ8R1892202

Port of Importation: NEWARK, NJ, NEW JERSEY
Delivered By: Truck
DELIVERY ADDRESS
MAGUIRE VOLVO 3725
370 ELMIRA RD
ITHACA, NY, US 14850



YV4H60DJ8R1892202

Photo No. 083 - Monroney Label Photograph



Photo No. 305-01 - Auxiliary Power Module Warning Label



Photo No. 305-02 - Power Inverter Warning Label

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-03 - First Responder Warning Label

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-04 - First Responder Warning Location



Photo No. 305-05 - Other Vehicle Label(s) Related to Electrical Propulsion System



Photo No. 305-06 - Manual High Voltage Service Disconnect in Place



Photo No. 305-07 - Manual High Voltage Service Disconnect Removed



Photo No. 305-08 - Manual High Voltage Service Disconnect Removed

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-09 - Pre-Impact View of Propulsion Battery

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-10 - Post-Impact Front View of Propulsion Battery

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-11 - Post-Impact Rear View of Propulsion Battery

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-12 - Pre-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-13 - Post-Impact View of Battery Box(s) or Container(s) Which Holds Individual Battery Modules

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-14 - Pre-Impact View of Propulsion Battery Module(s)

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-15 - Post-Impact View of Propulsion Battery Module(s)

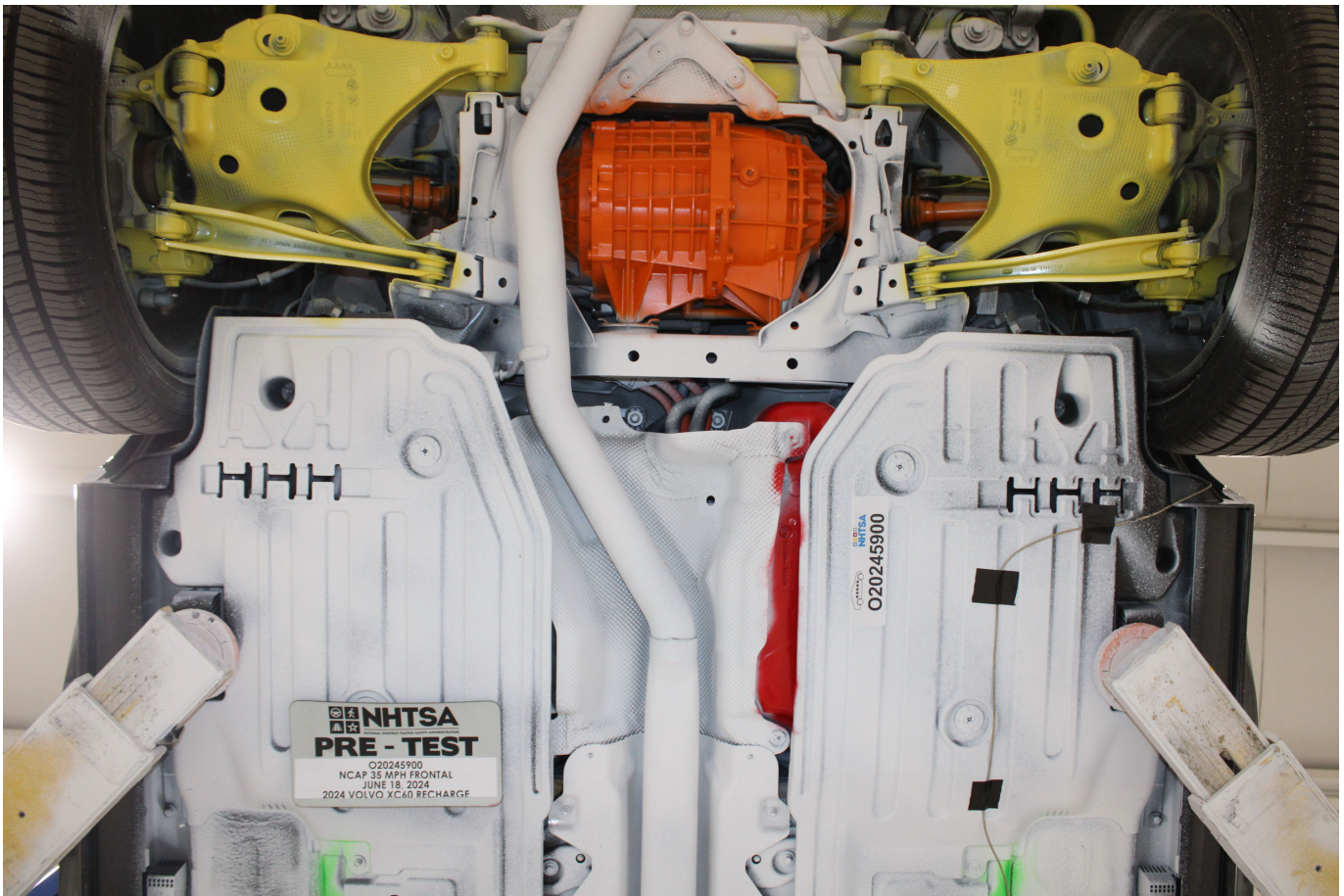


Photo No. 305-16 - Pre-Impact View of Electric Propulsion Drive

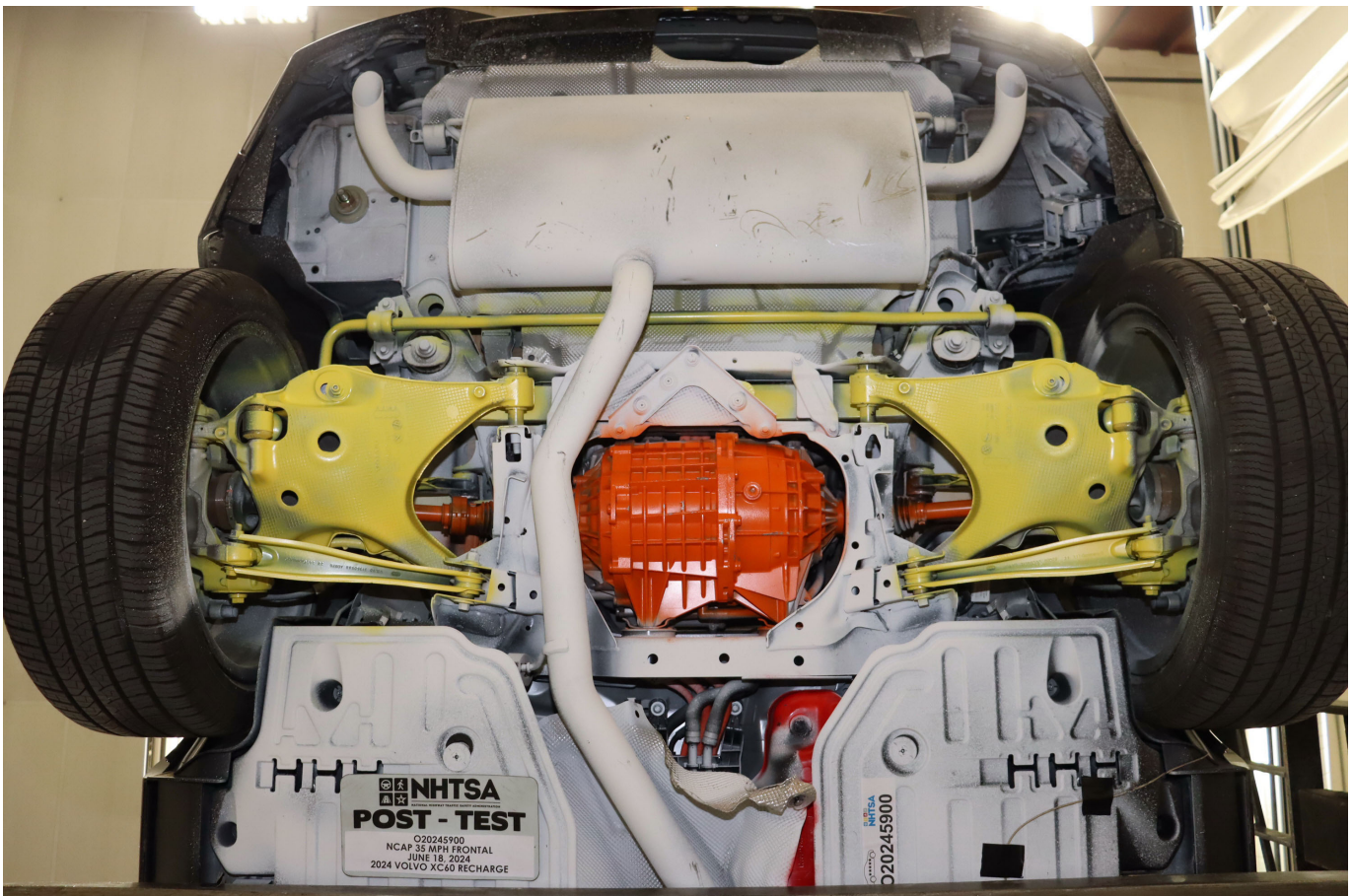


Photo No. 305-17 - Post-Impact View of Electric Propulsion Drive



Photo No. 305-18 - Pre-Impact View of High Voltage Interconnect(s)

PHOTOGRAPH NOT AVAILABLE

Photo No. 305-19 - Pre-Impact View Propulsion Battery Venting System(s)

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-20 - Pre-Impact View of Other Visible Electric Propulsion Components



Photo No. 305-21 - Pre-Impact View of Ground Lead Attached



Photo No. 305-22 - Pre-Impact View of High Voltage Leads Attached



Photo No. 305-23 - Pre-Impact Close-Up View of High Voltage Leads Attached

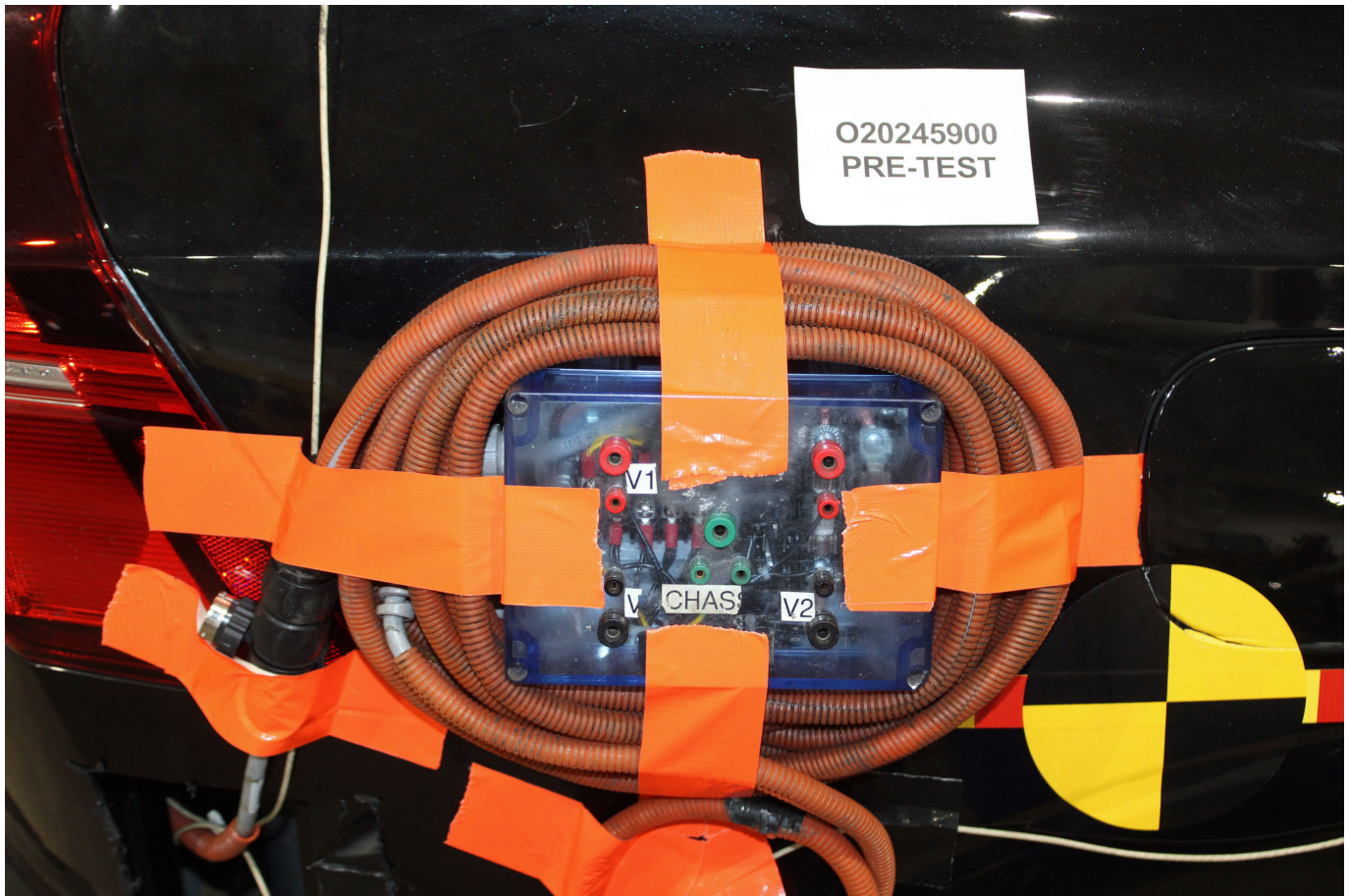


Photo No. 305-24 - Pre-Impact View of Installed Test Interface Port

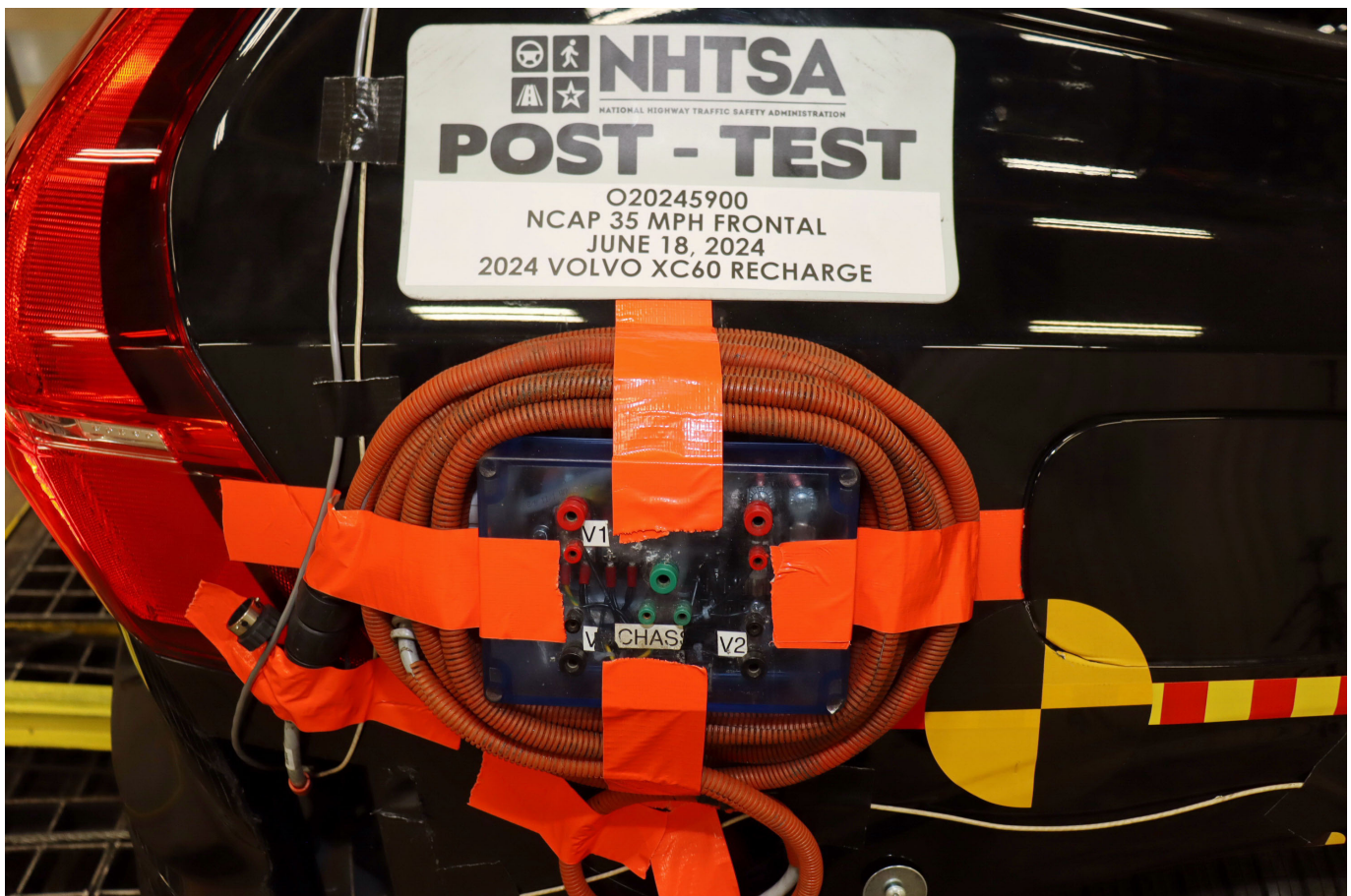


Photo No. 305-25 - Post-Impact View of Installed Test Interface Port



Photo No. 305-26 - Pre-Impact View of Other Test Devices



Photo No. 305-27 - Post-Impact View of Other Test Devices



Photo No. 305-28 - FMVSS No. 305 Static Rollover at 90 Degrees



Photo No. 305-29 - FMVSS No. 305 Static Rollover at 180 Degrees



Photo No. 305-30 - FMVSS No. 305 Static Rollover at 270 Degrees



Photo No. 305-31 - FMVSS No. 305 Static Rollover at 360 Degrees



Photo No. 305-32 - Pre-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery



Photo No. 305-33 - Post-Impact View of the Vehicle Passenger Compartment Adjacent to Propulsion Battery

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-34 - Post-Impact Propulsion Battery System Mounting and-or Intrusion Failure(s)

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-35 - Post-Impact View of Battery Component Intrusion

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-36 - Post-Impact View of Battery Module Movement or Retention Loss

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-37 - Post-Impact View of Propulsion Battery Electrolyte Spillage Location

PHOTOGRAPH NOT APPLICABLE

Photo No. 305-38 - Post-Test View of Propulsion Battery Electrolyte Spillage Location

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DUMMY RESPONSE DATA TRACES

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Figure No. 3.	Driver Head Z Acceleration vs. Time	B-1
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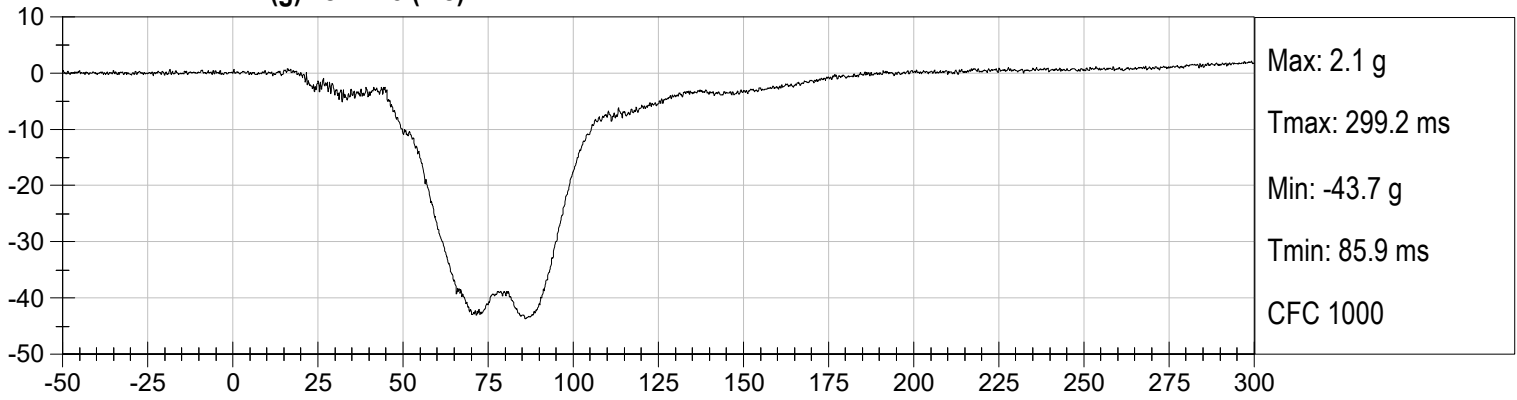
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.nhtsa.gov

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

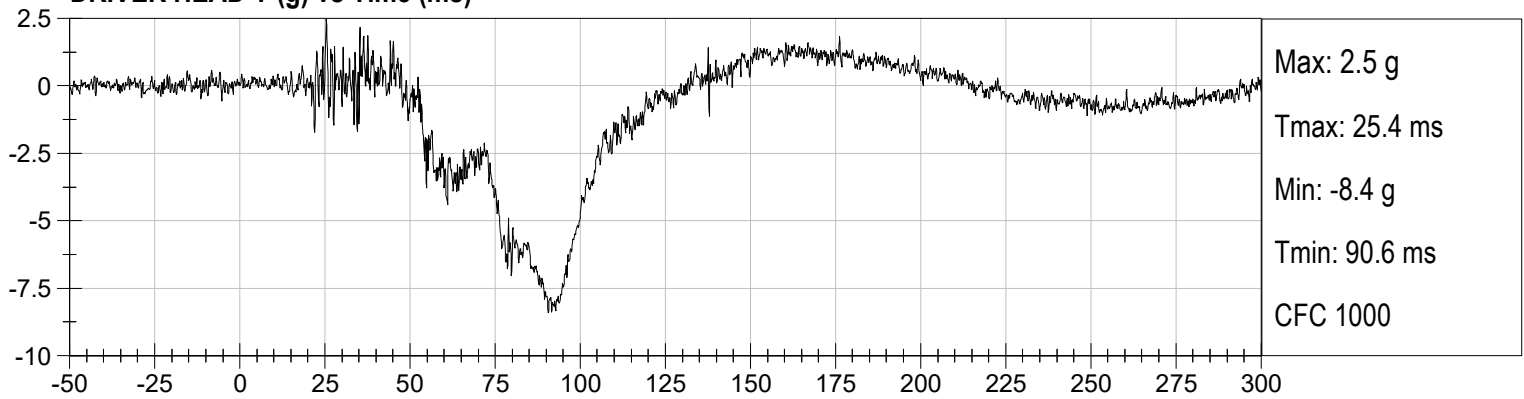
Driver Left Upper Tibia Force Z
Driver Left Lower Tibia Moment X
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver 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
Left Rear Seat Crossmember Z
Right Rear Seat Crossmember Z
Left Rear Seat Crossmember Xr
Right Rear Seat Crossmember Xr
Advanced Research Load Cell Barrier – 528 channels

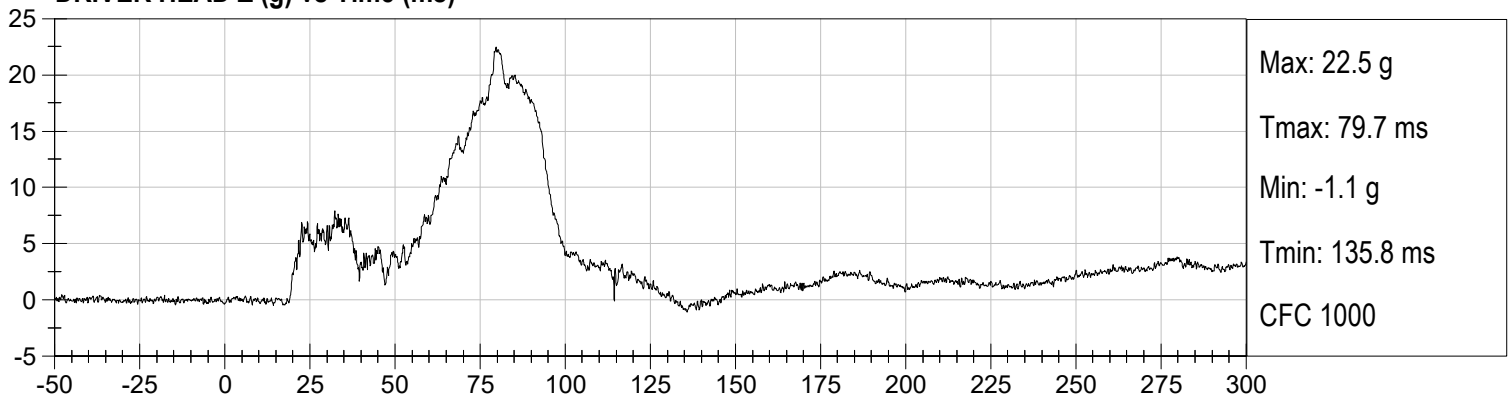
DRIVER HEAD X (g) vs Time (ms)



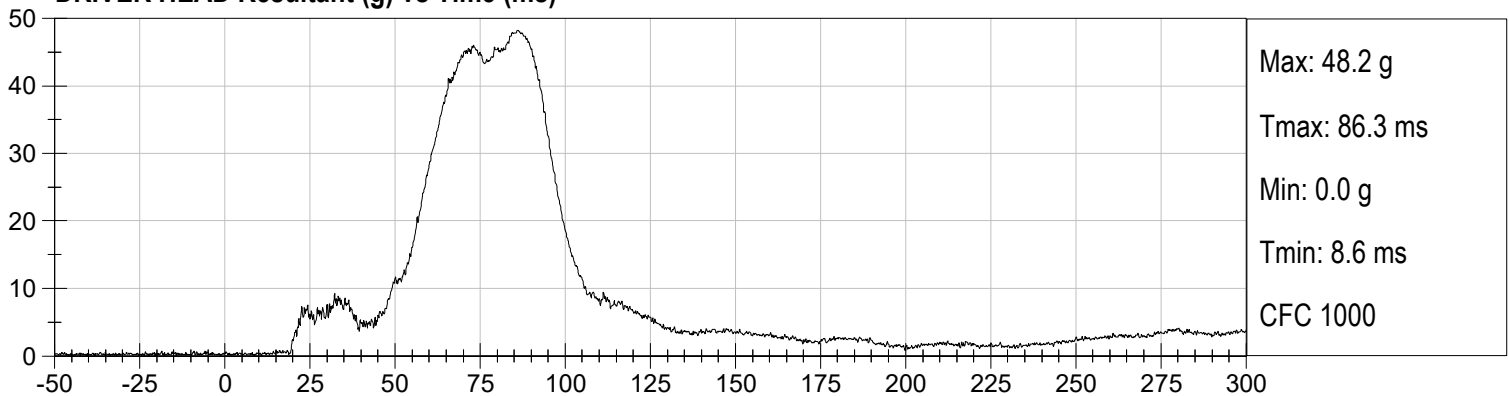
DRIVER HEAD Y (g) vs Time (ms)



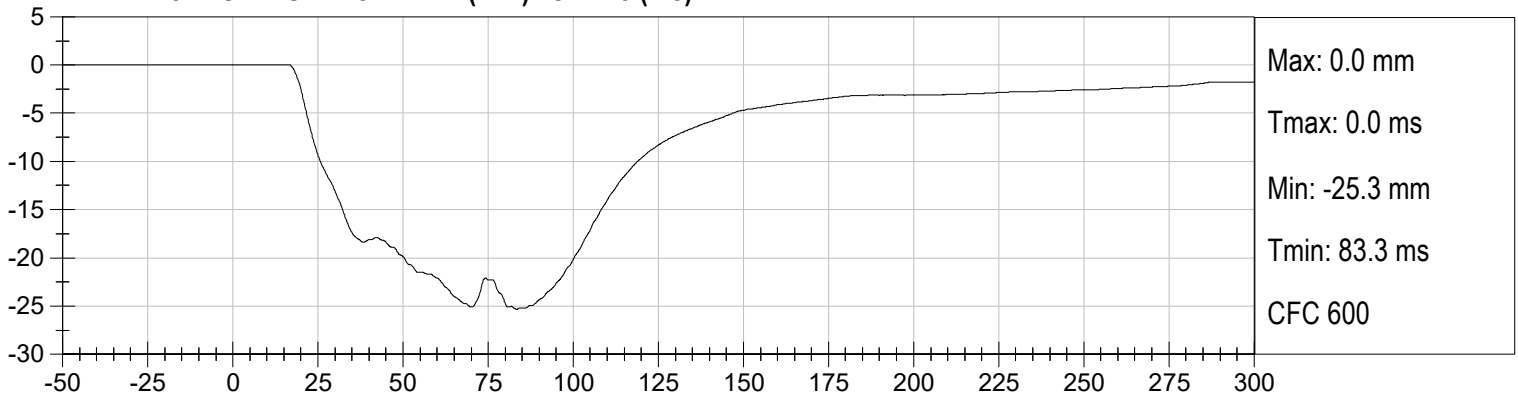
DRIVER HEAD Z (g) vs Time (ms)



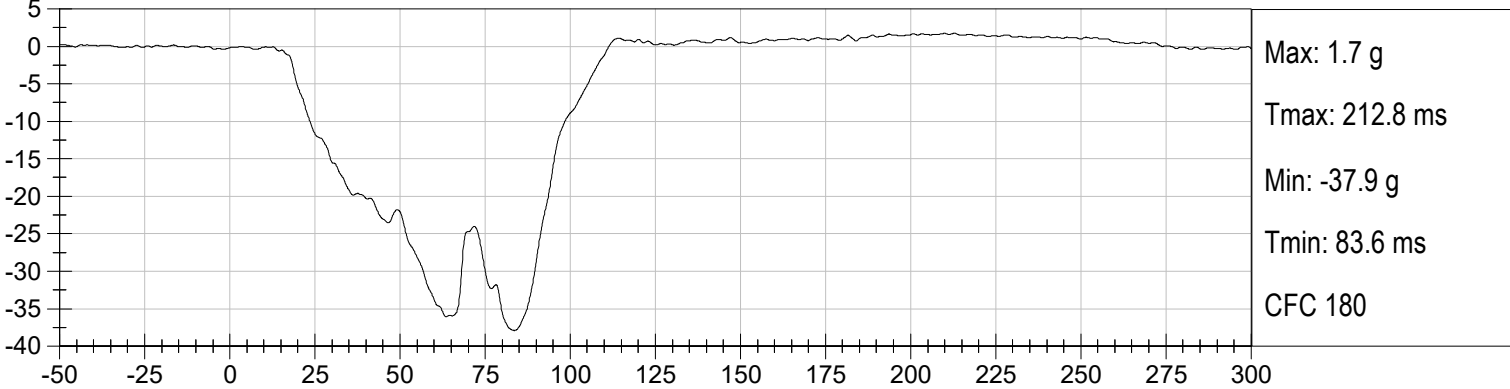
DRIVER HEAD Resultant (g) vs Time (ms)



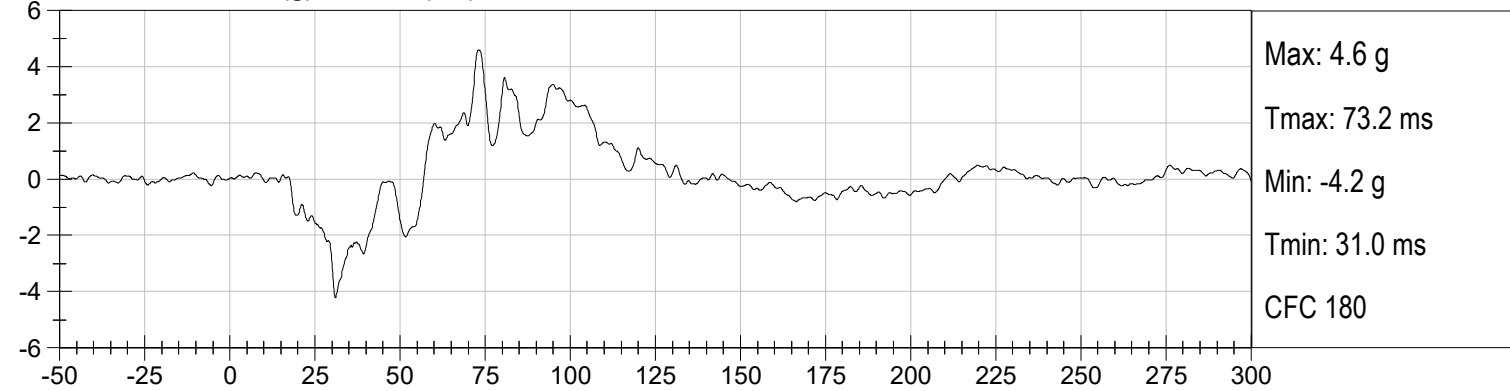
DRIVER CHEST DISPLACEMENT (mm) vs Time (ms)



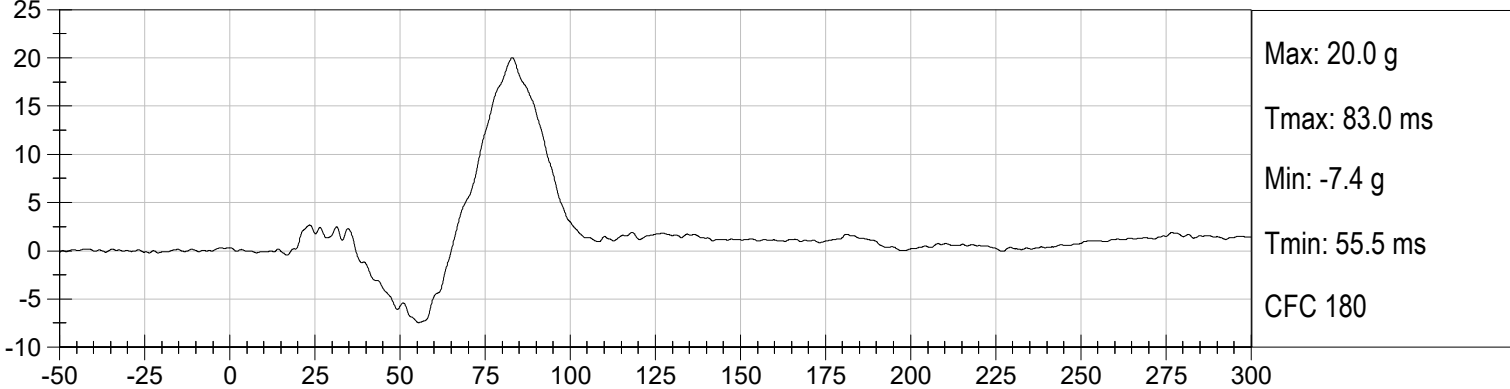
DRIVER CHEST X (g) vs Time (ms)



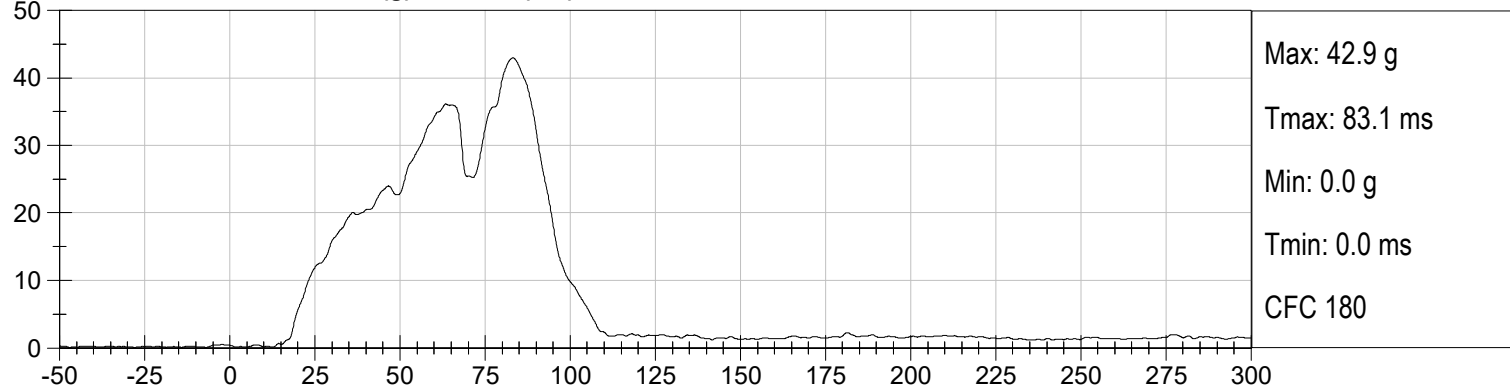
DRIVER CHEST Y (g) vs Time (ms)

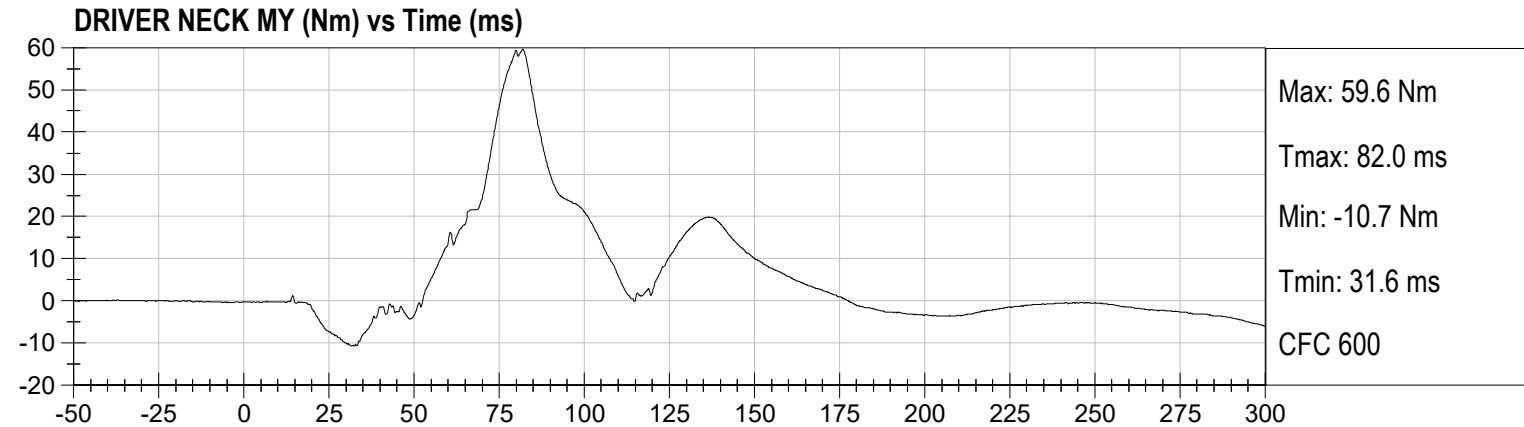
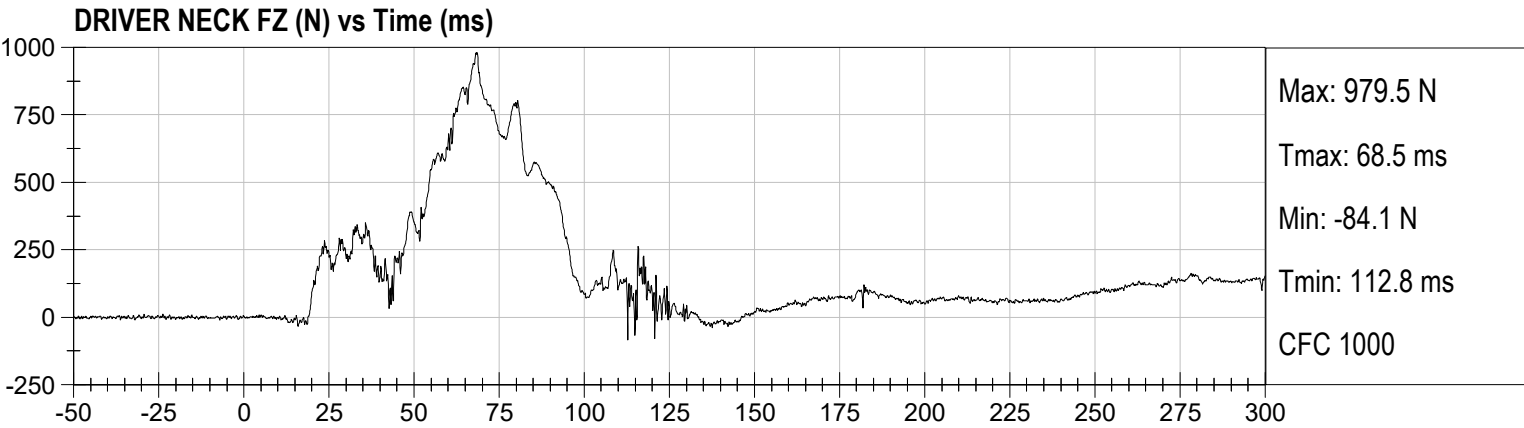
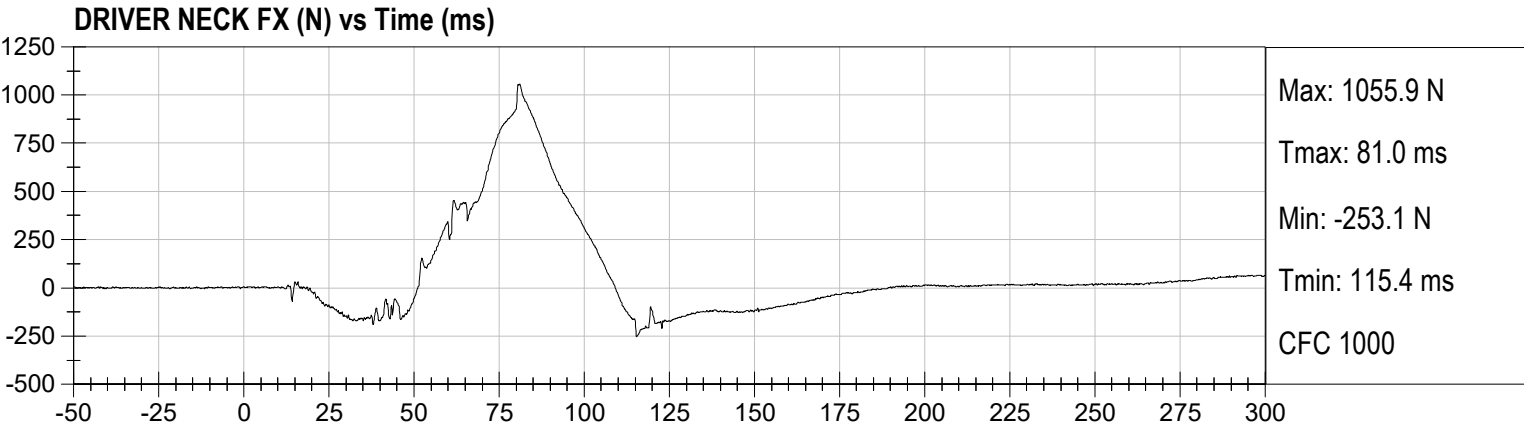


DRIVER CHEST Z (g) vs Time (ms)

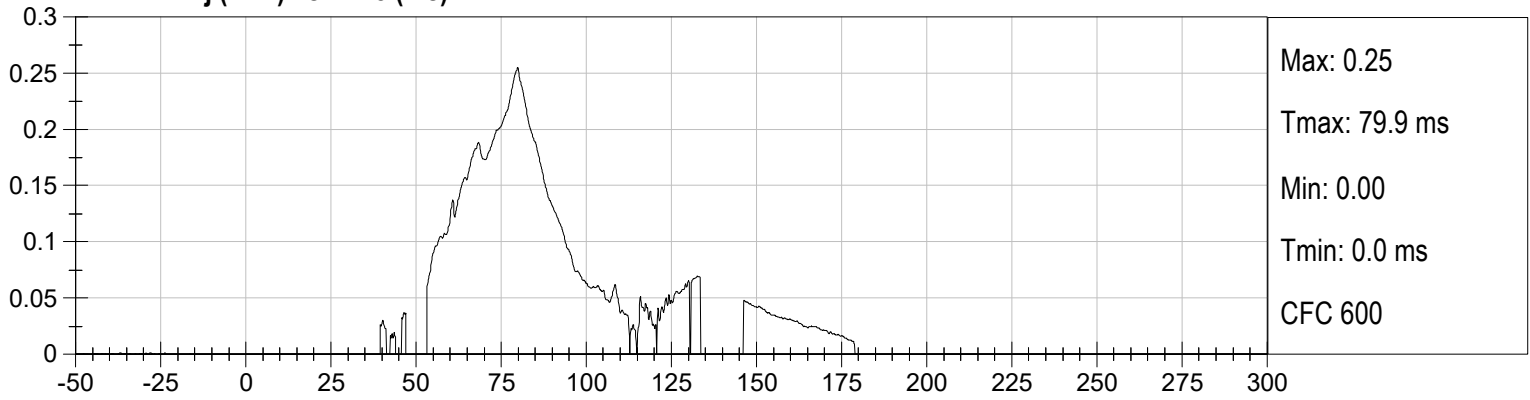


DRIVER CHEST Resultant (g) vs Time (ms)

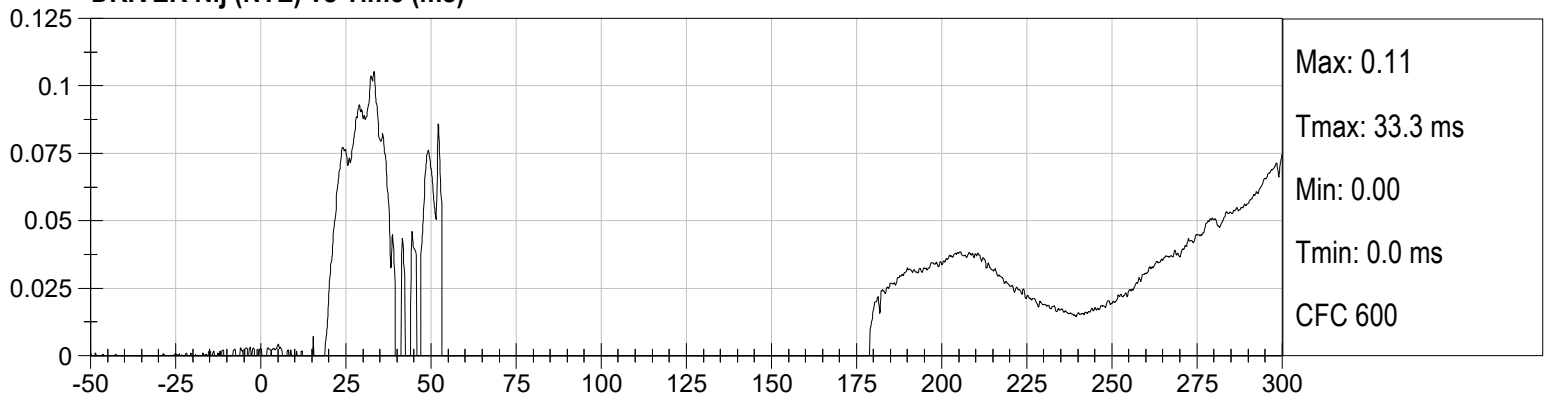




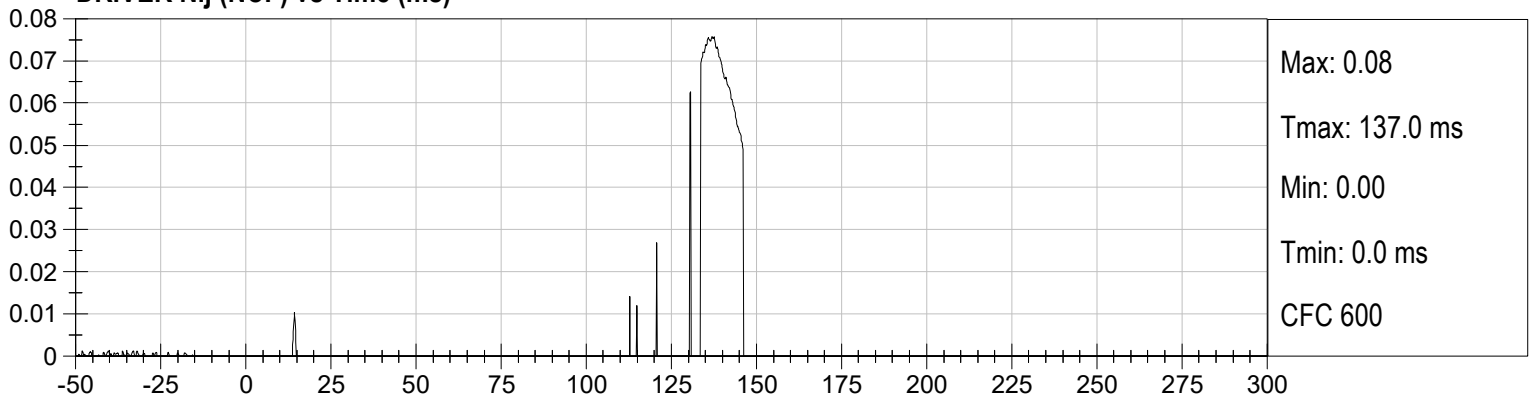
DRIVER Nij (NTF) vs Time (ms)



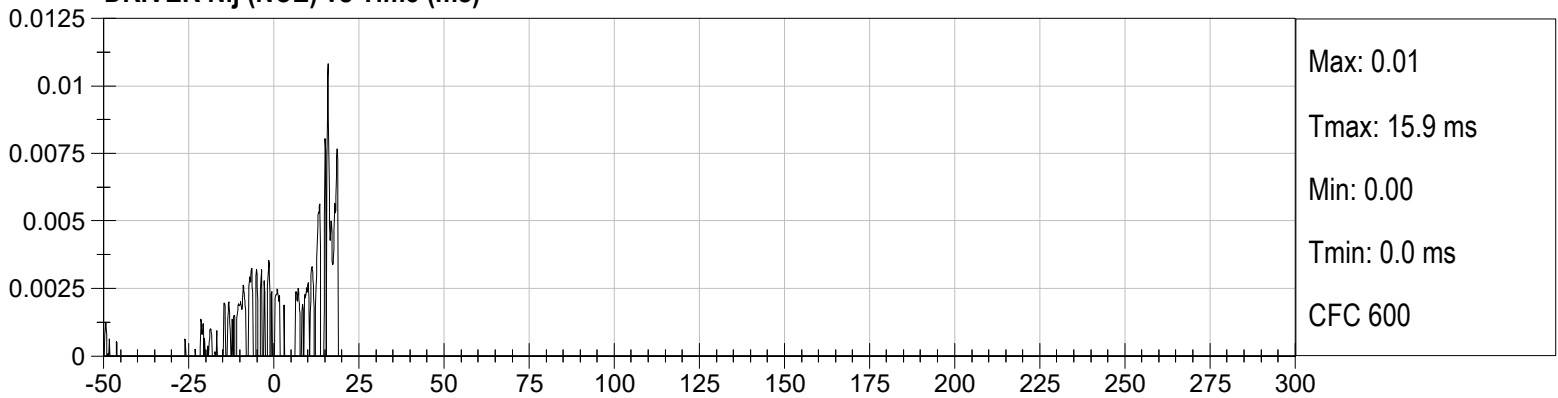
DRIVER Nij (NTE) vs Time (ms)



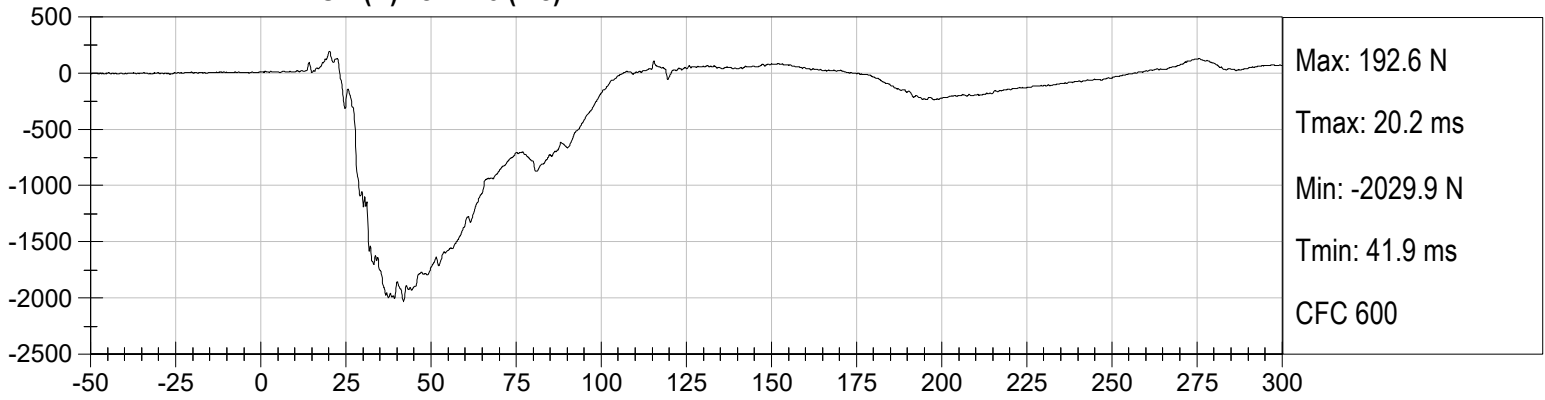
DRIVER Nij (NCF) vs Time (ms)



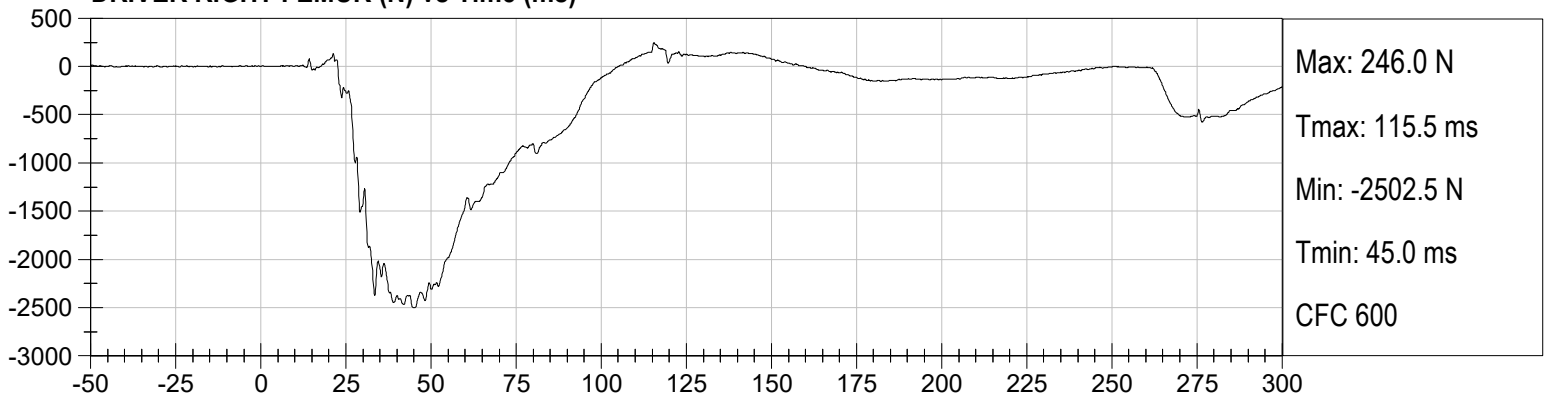
DRIVER Nij (NCE) vs Time (ms)



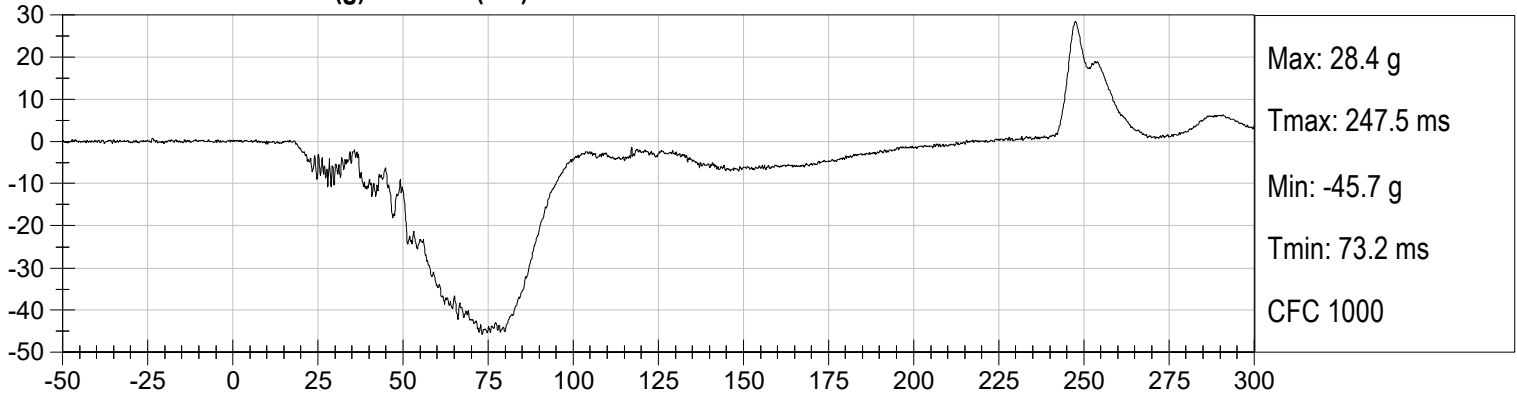
DRIVER LEFT FEMUR (N) vs Time (ms)



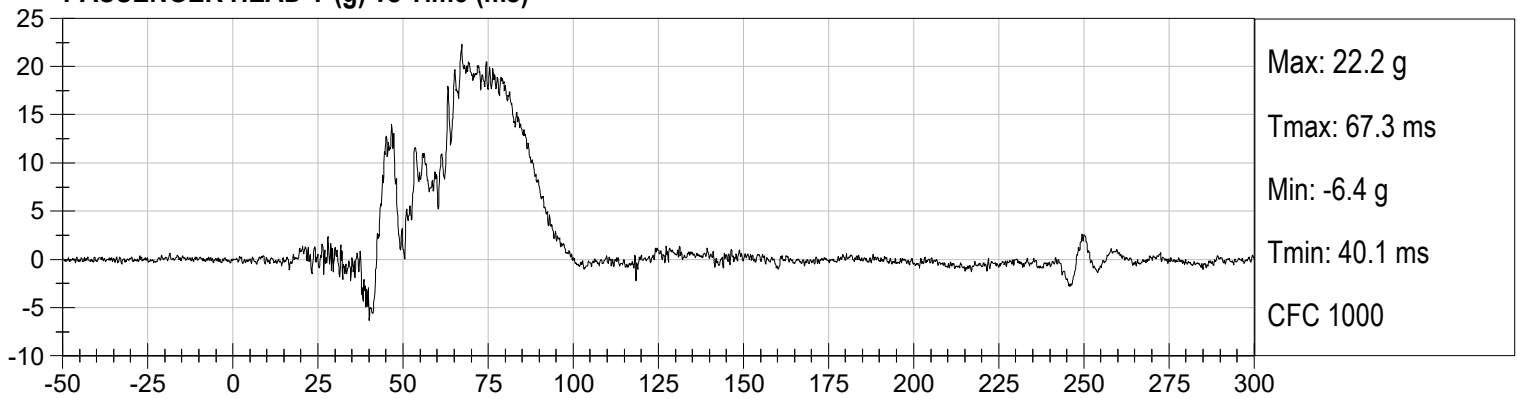
DRIVER RIGHT FEMUR (N) vs Time (ms)



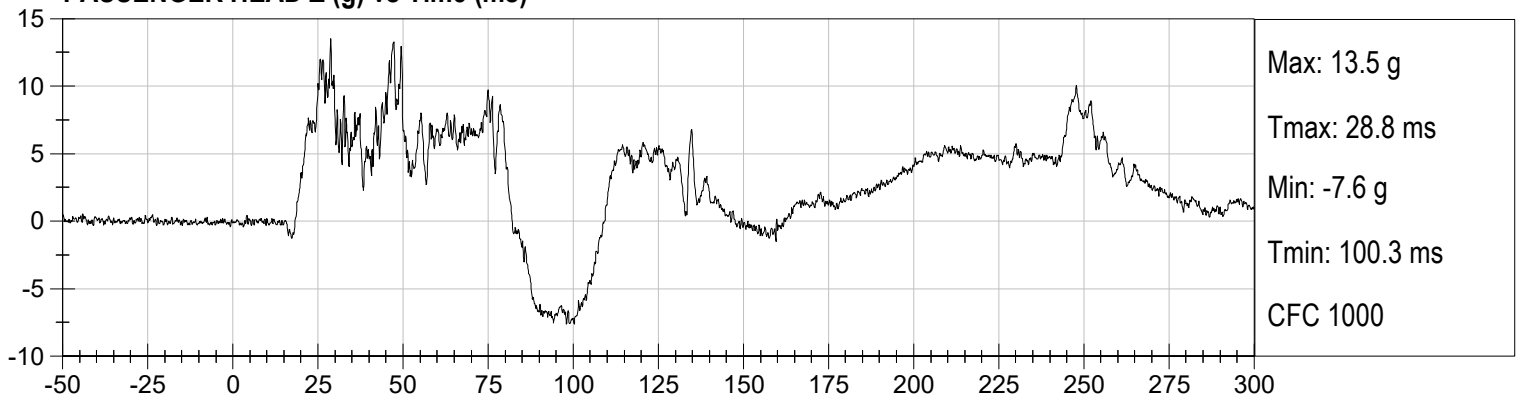
PASSENGER HEAD X (g) vs Time (ms)



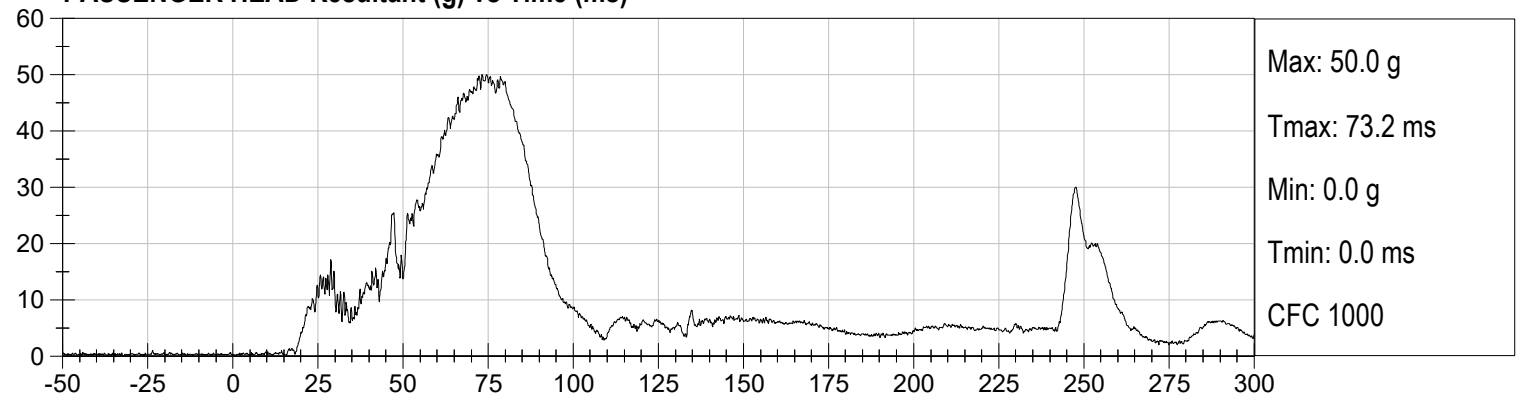
PASSENGER HEAD Y (g) vs Time (ms)

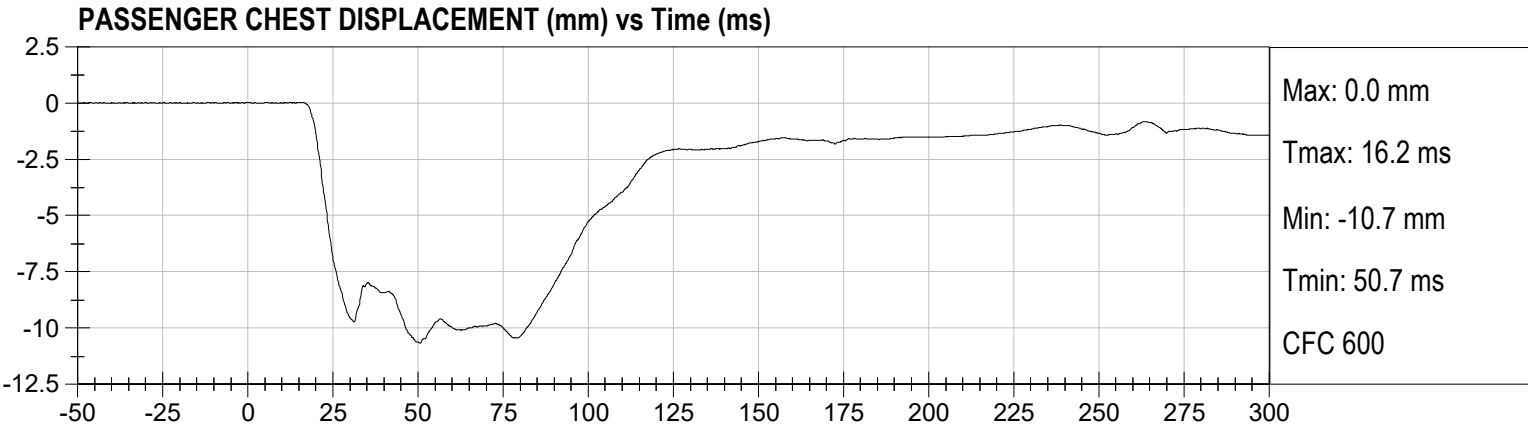


PASSENGER HEAD Z (g) vs Time (ms)

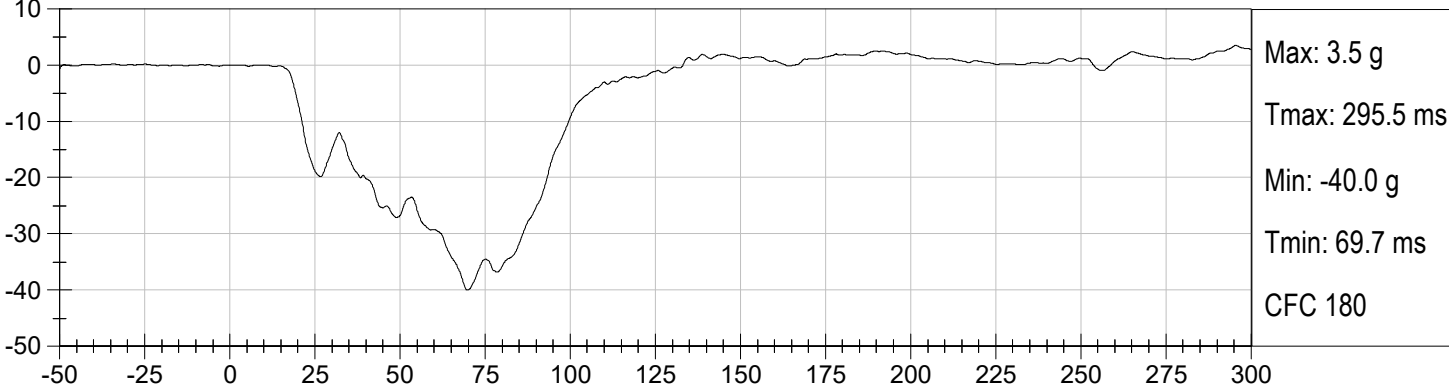


PASSENGER HEAD Resultant (g) vs Time (ms)

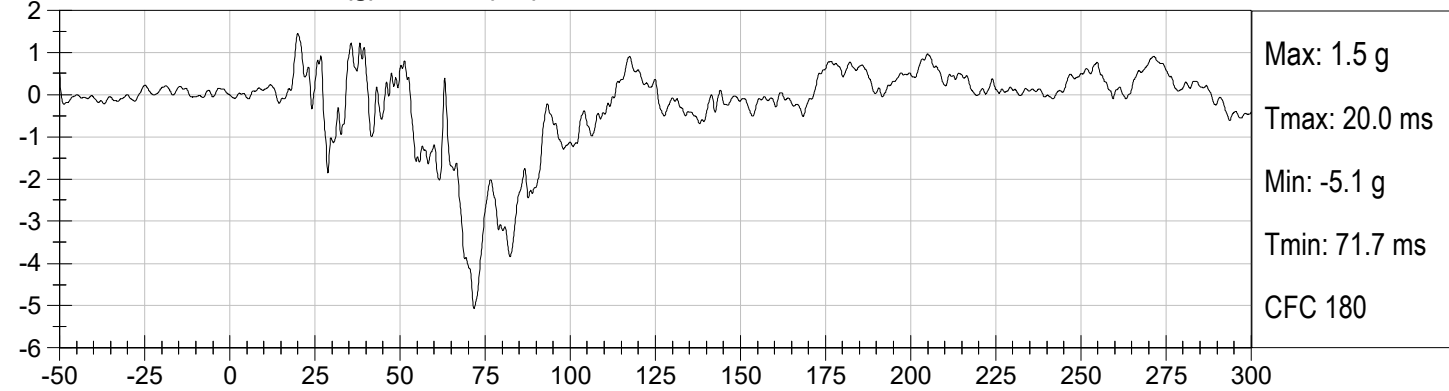




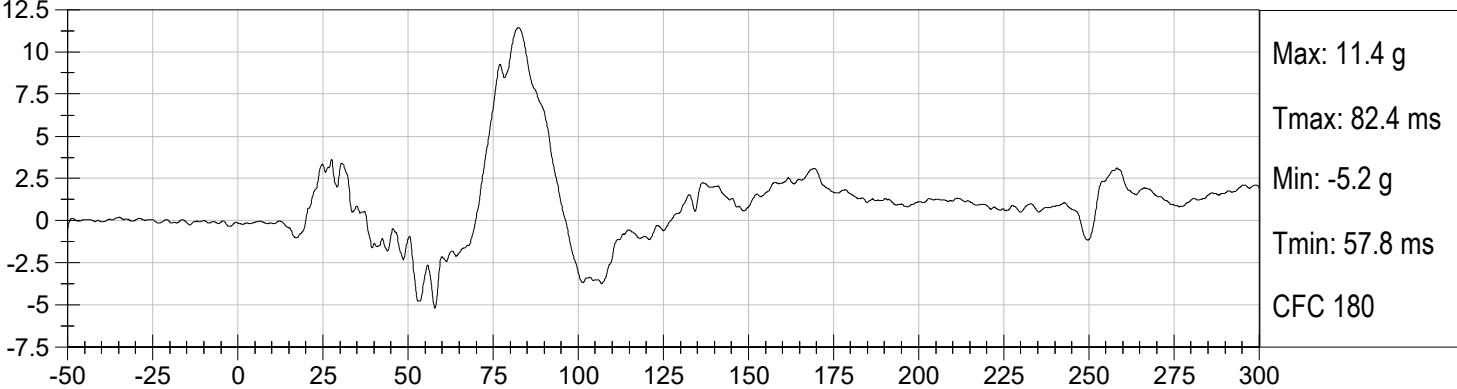
PASSENGER CHEST X (g) vs Time (ms)



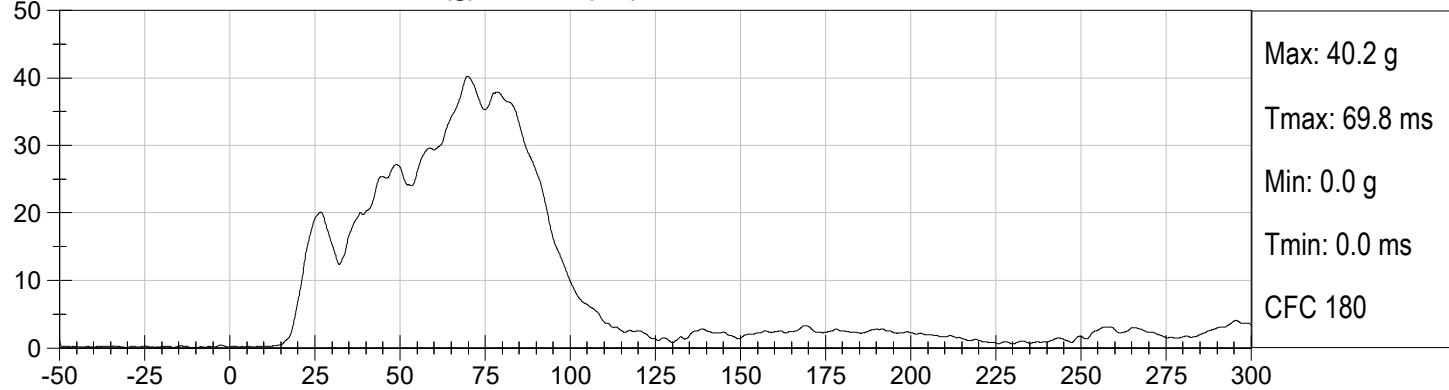
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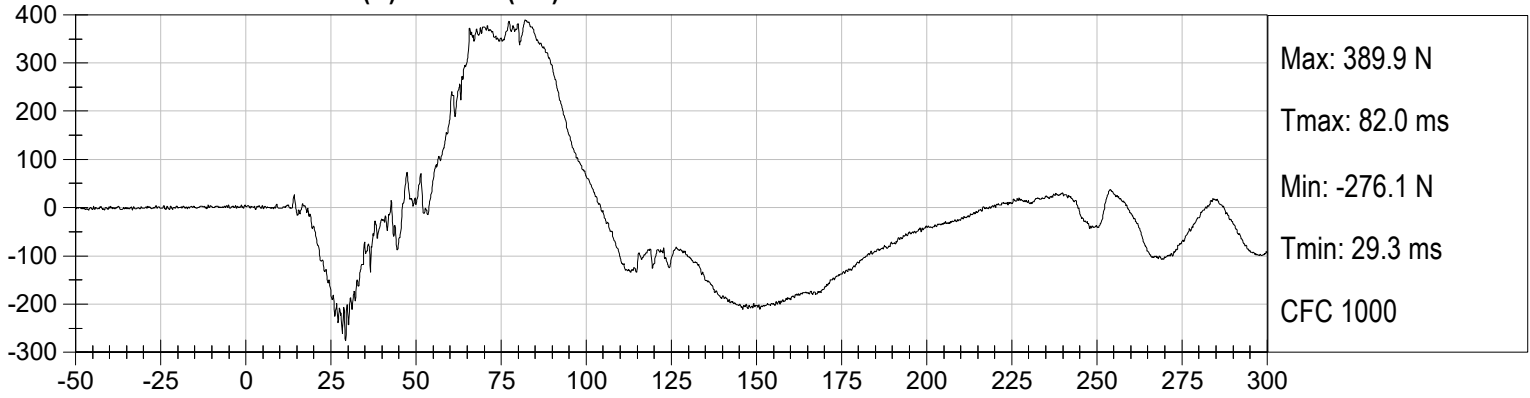
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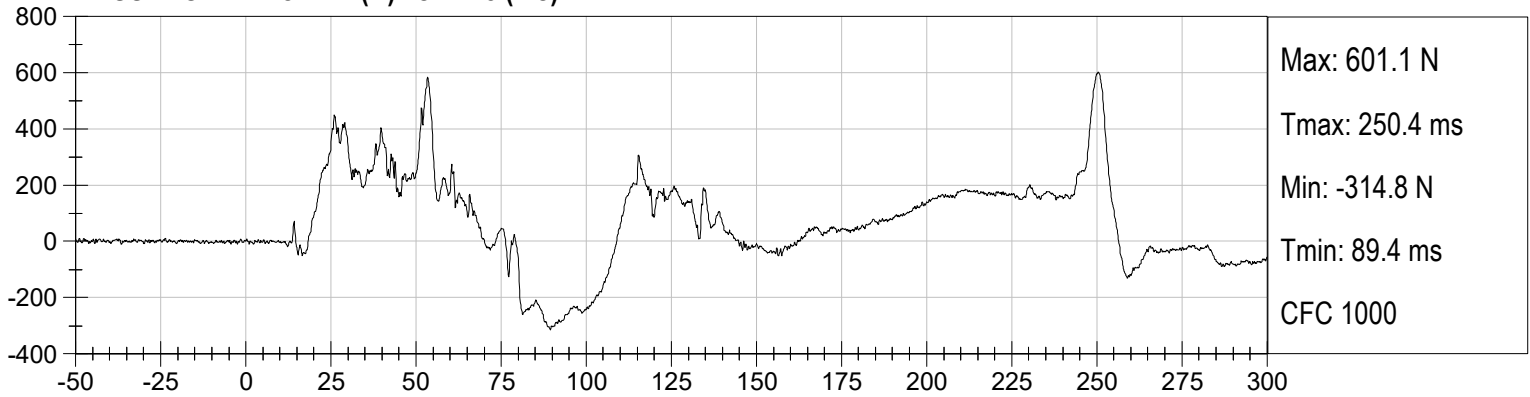
PASSENGER CHEST Resultant (g) vs Time (ms)



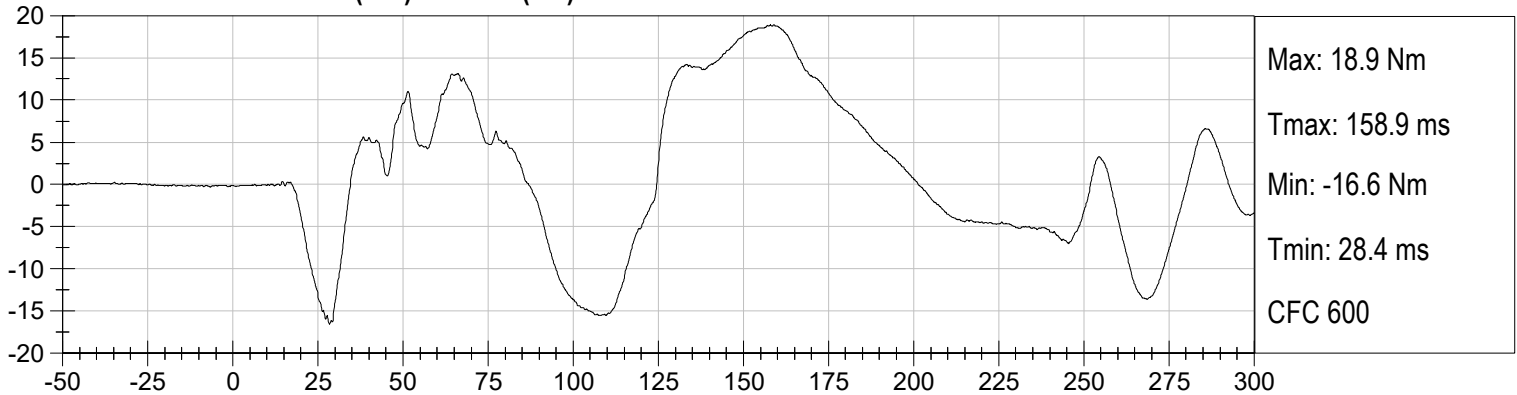
PASSENGER NECK FX (N) vs Time (ms)



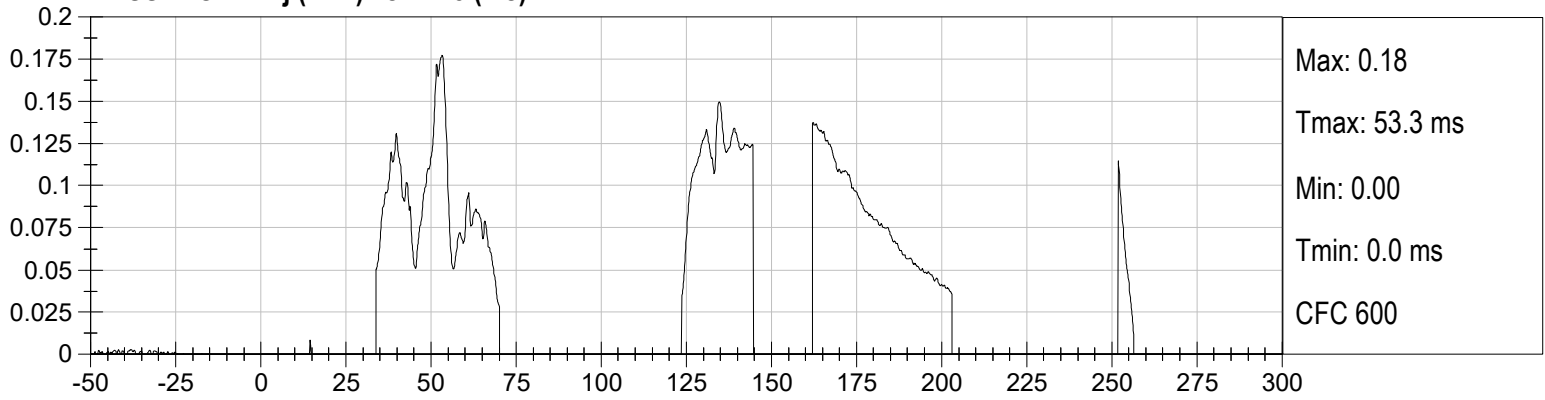
PASSENGER NECK FZ (N) vs Time (ms)



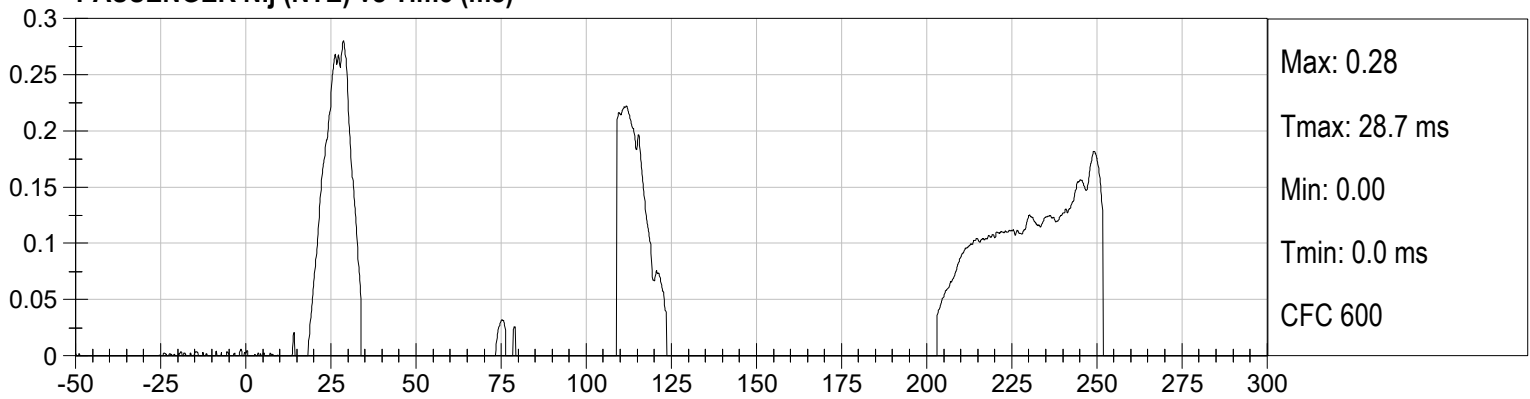
PASSENGER NECK MY (Nm) vs Time (ms)



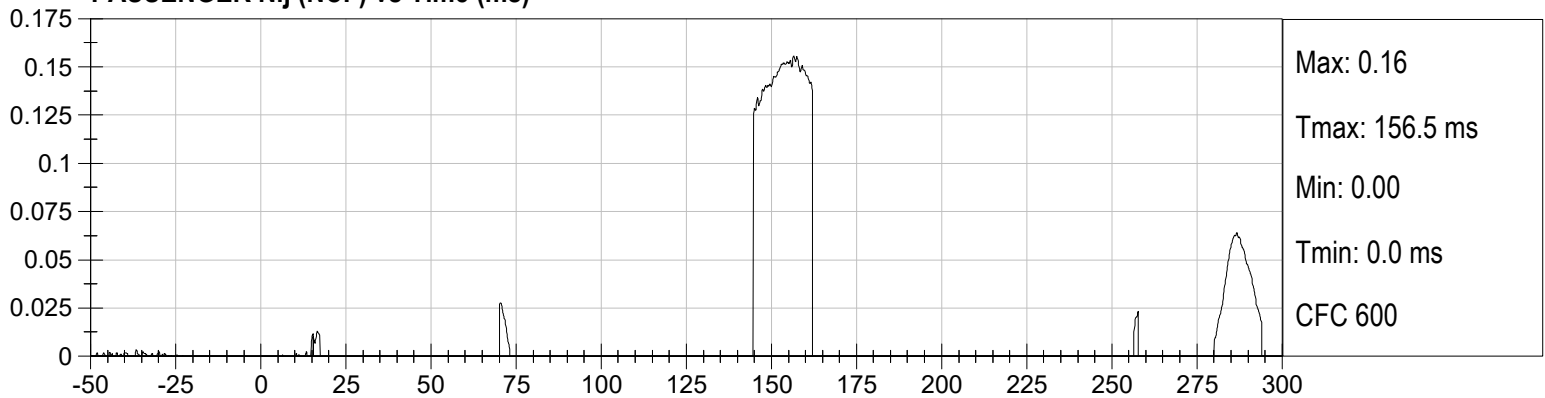
PASSENGER Nij (NTF) vs Time (ms)



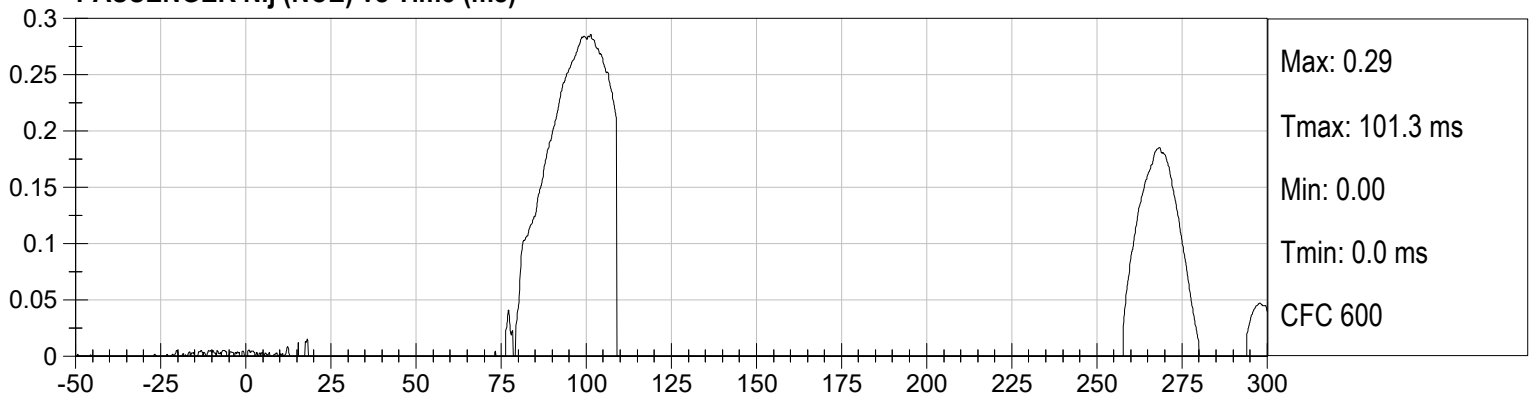
PASSENGER Nij (NTE) vs Time (ms)



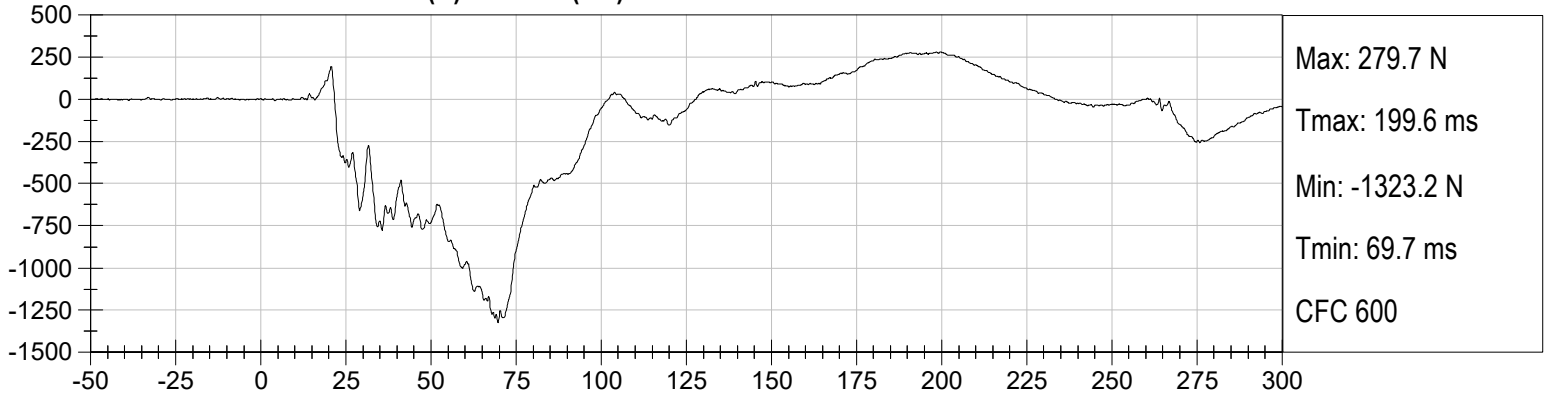
PASSENGER Nij (NCF) vs Time (ms)



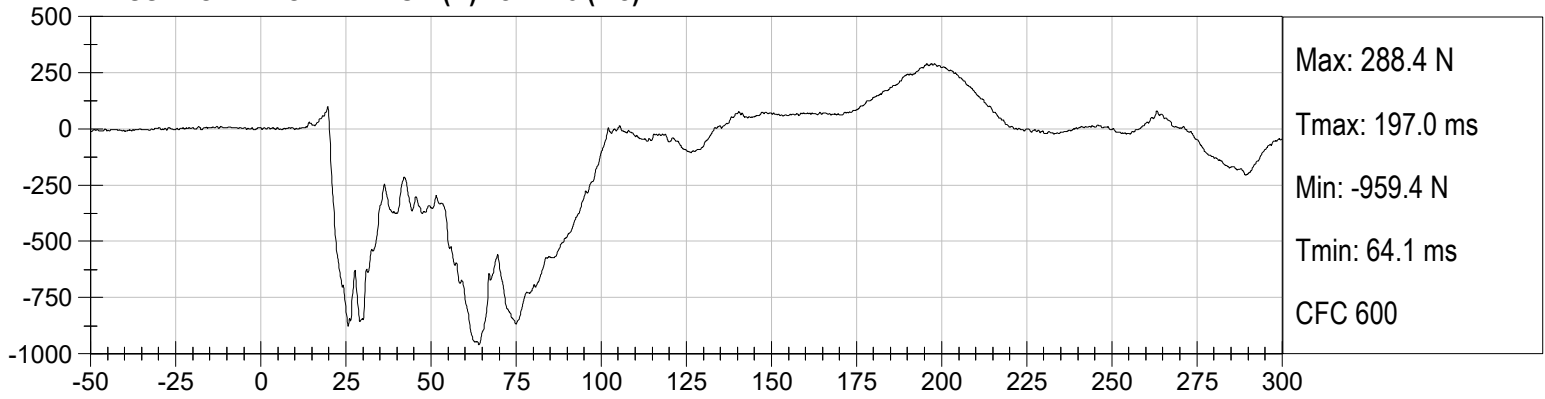
PASSENGER Nij (NCE) vs Time (ms)



PASSENGER LEFT FEMUR (N) vs Time (ms)



PASSENGER RIGHT FEMUR (N) vs Time (ms)



APPENDIX C
DUMMY QUALIFICATION AND PERFORMANCE VERIFICATION

QUALIFICATION TEST RESULTS

PRE-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

**Hybrid III 50th, External Measurements
SN: 064**

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	34.71
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	19.9-20.5	20.31
C	H-POINT HEIGHT	Reference	3.3-3.5	3.38
D	H-POINT LOCATION FROM BACKLINE	Reference	5.3-5.5	5.40
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	3.3-3.7	3.46
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	5.5-6.1	6.09
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	11.48
H	HEAD BACK TO BACKLINE	Back of Skull cap skin to seat rear vertical surface (Reference)	1.6-1.8	1.75
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	13.08
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	7.5-8.3	8.13
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	23.49
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	16.9-17.9	17.01
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	19.1-19.7	19.22
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	18.20

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	8.43
P	FOOT LENGTH	Tip of toe to rear of heel	9.9-10.5	10.33
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	16.3-17.2	16.65
W	FOOT BREADTH	The widest part of the foot	3.6-4.2	3.94
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 16.9-17.1 in. above seat surface	38.2-39.4	39.25
Z	WAIST CIRCUMFERENCE	Measured 8.9-9.1 in. above seat surface	32.9-34.1	33.89
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	16.9-17.1	17.00
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	8.9-9.1	9.00

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

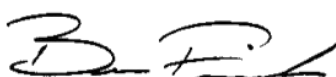
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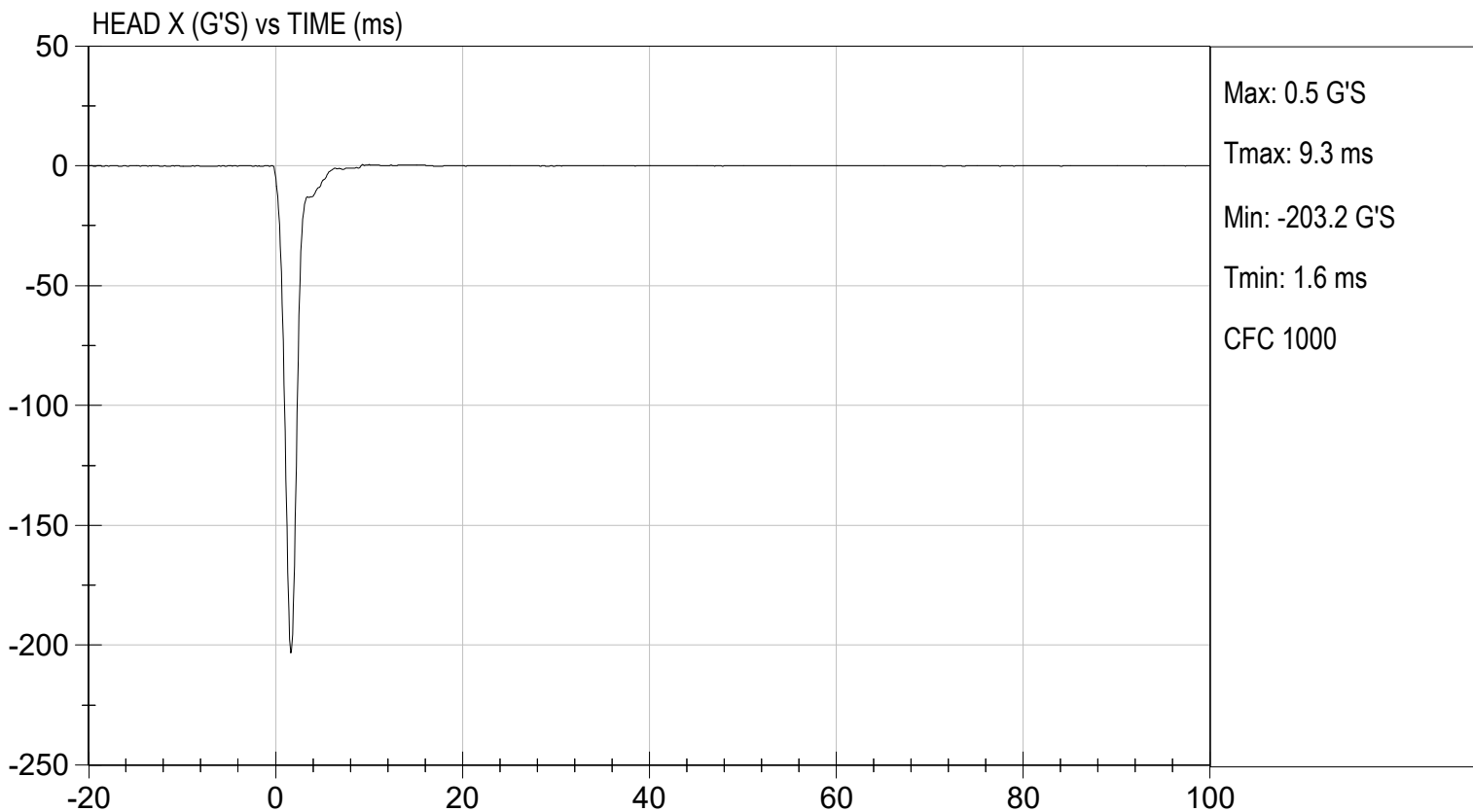
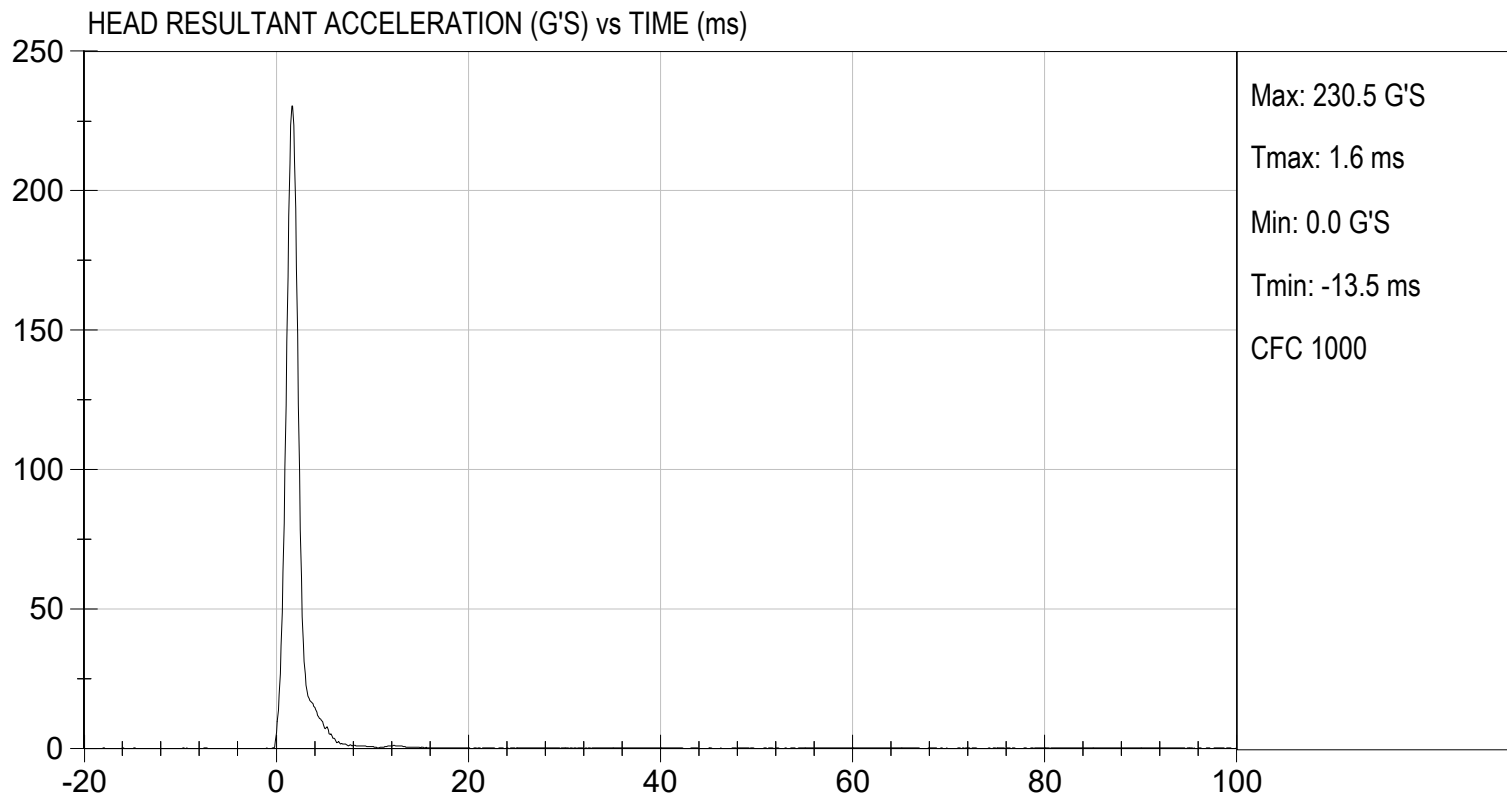
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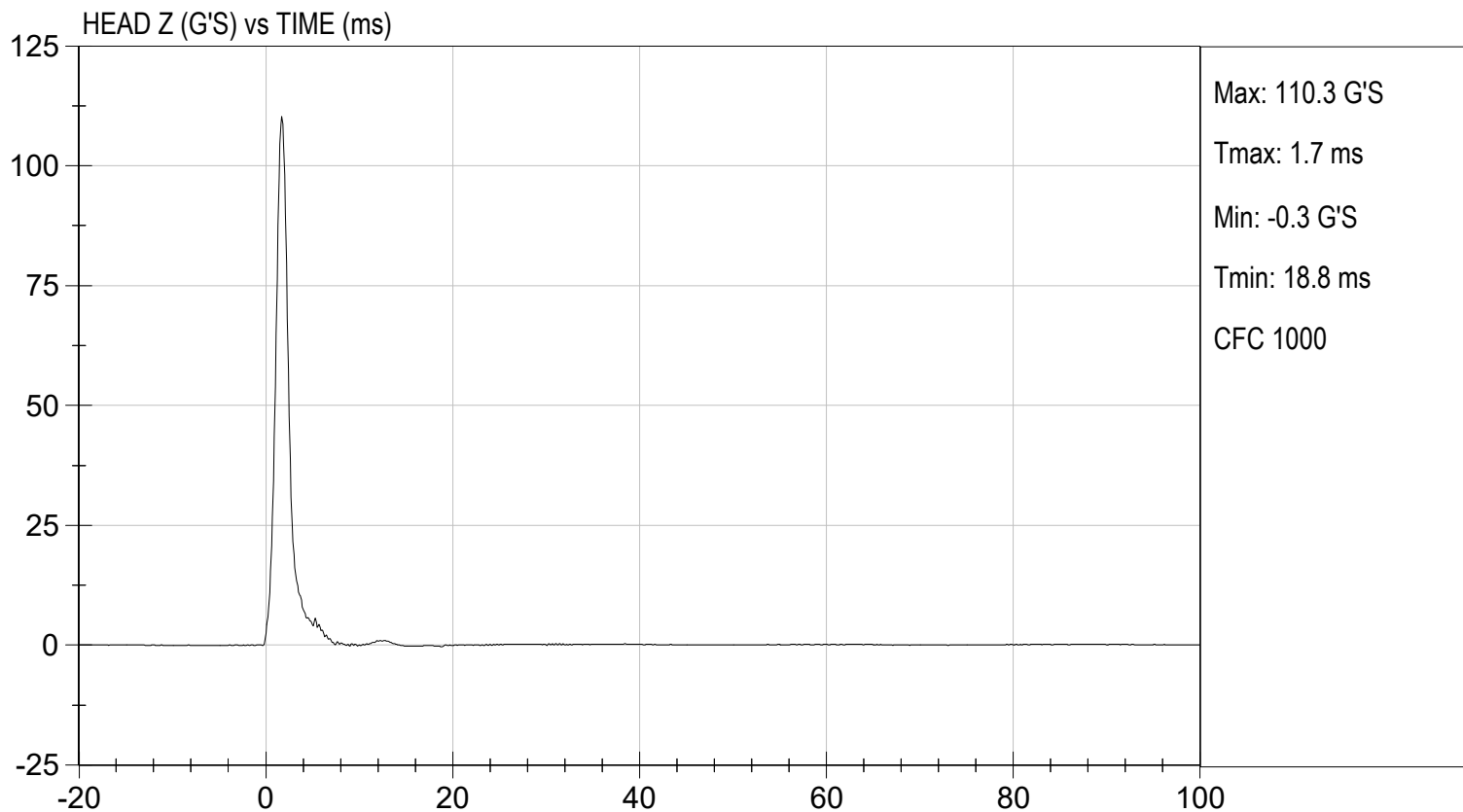
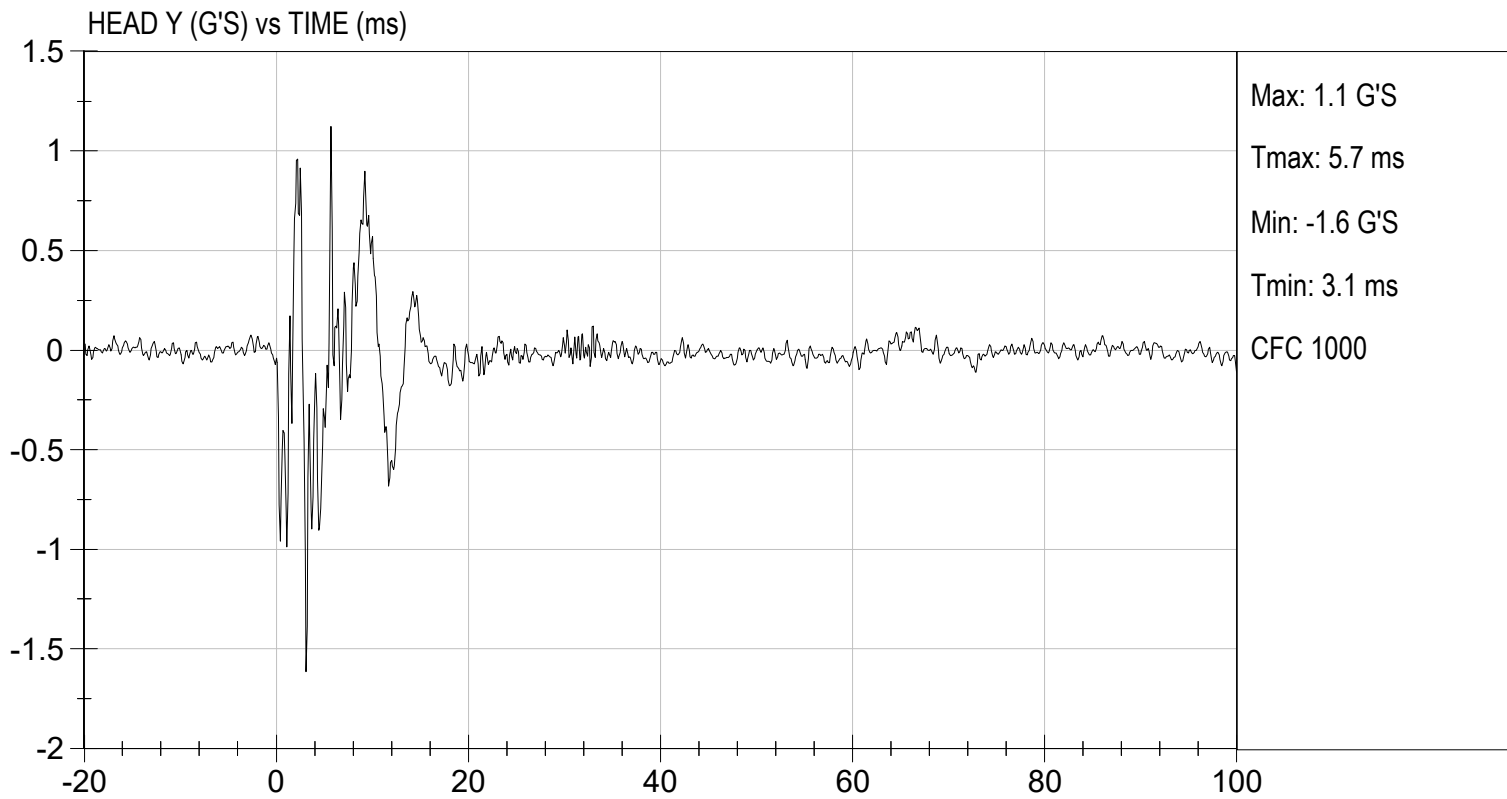
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Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Peak Resultant Acceleration	G's	225 to 275	231	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-1.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
			Overall Test Results	Pass


Laboratory Technician

06/03/2024
Test Date


Approved By





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

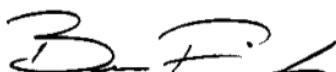
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Test I.D: D241332

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	46	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.91	Pass
	20 ms	G's	17.60 to 22.60	20.55	Pass
	30 ms	G's	12.50 to 18.50	16.59	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	16.6	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	38.2	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	72.3	Pass
	Time	ms	57.0 to 64.0	60.7	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.3	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	100.2	Pass
	Time	ms	47.0 to 58.0	50.1	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	97.1	Pass
Overall Test Results					Pass


 Laboratory Technician

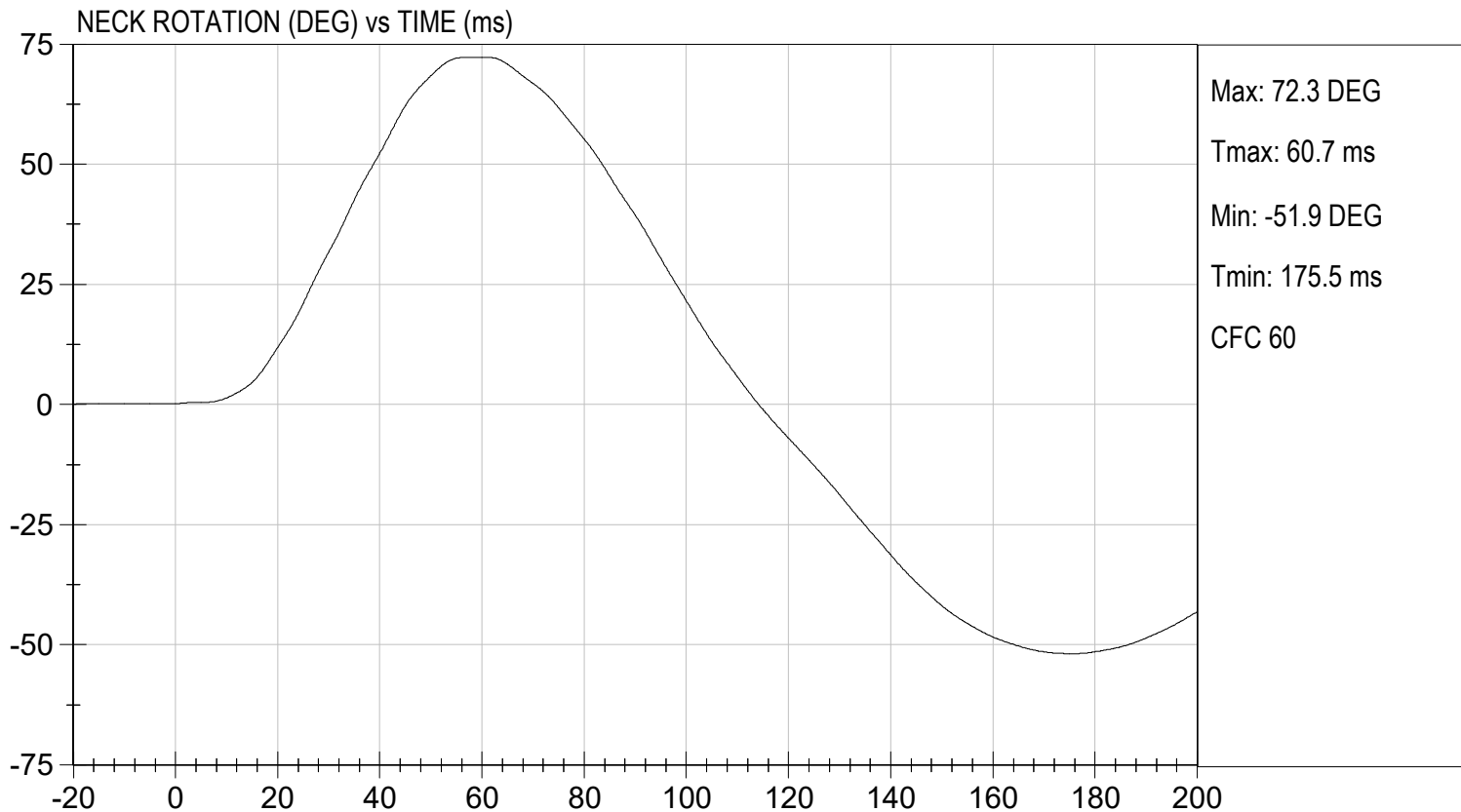
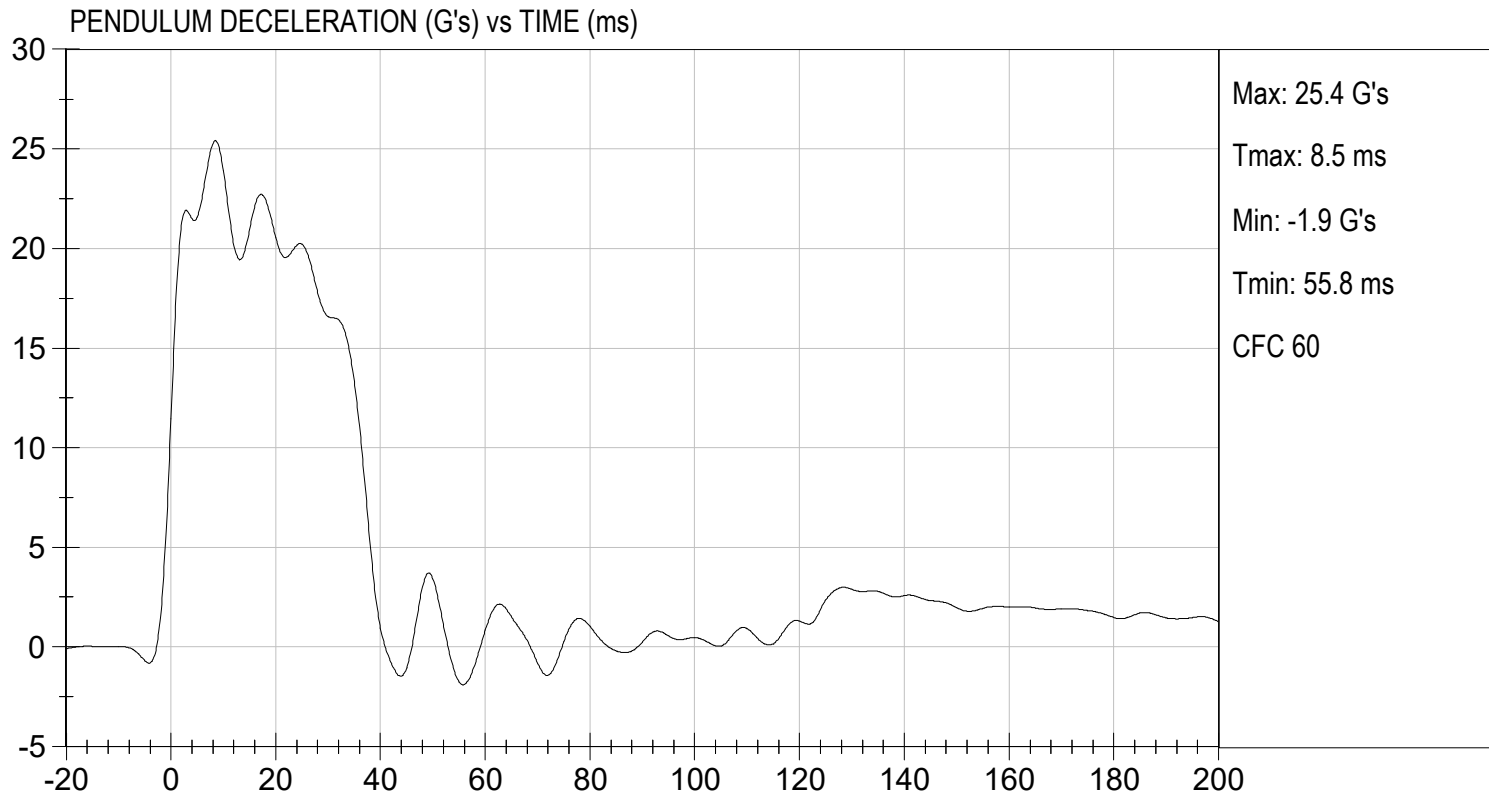
06/03/2024
 Test Date


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

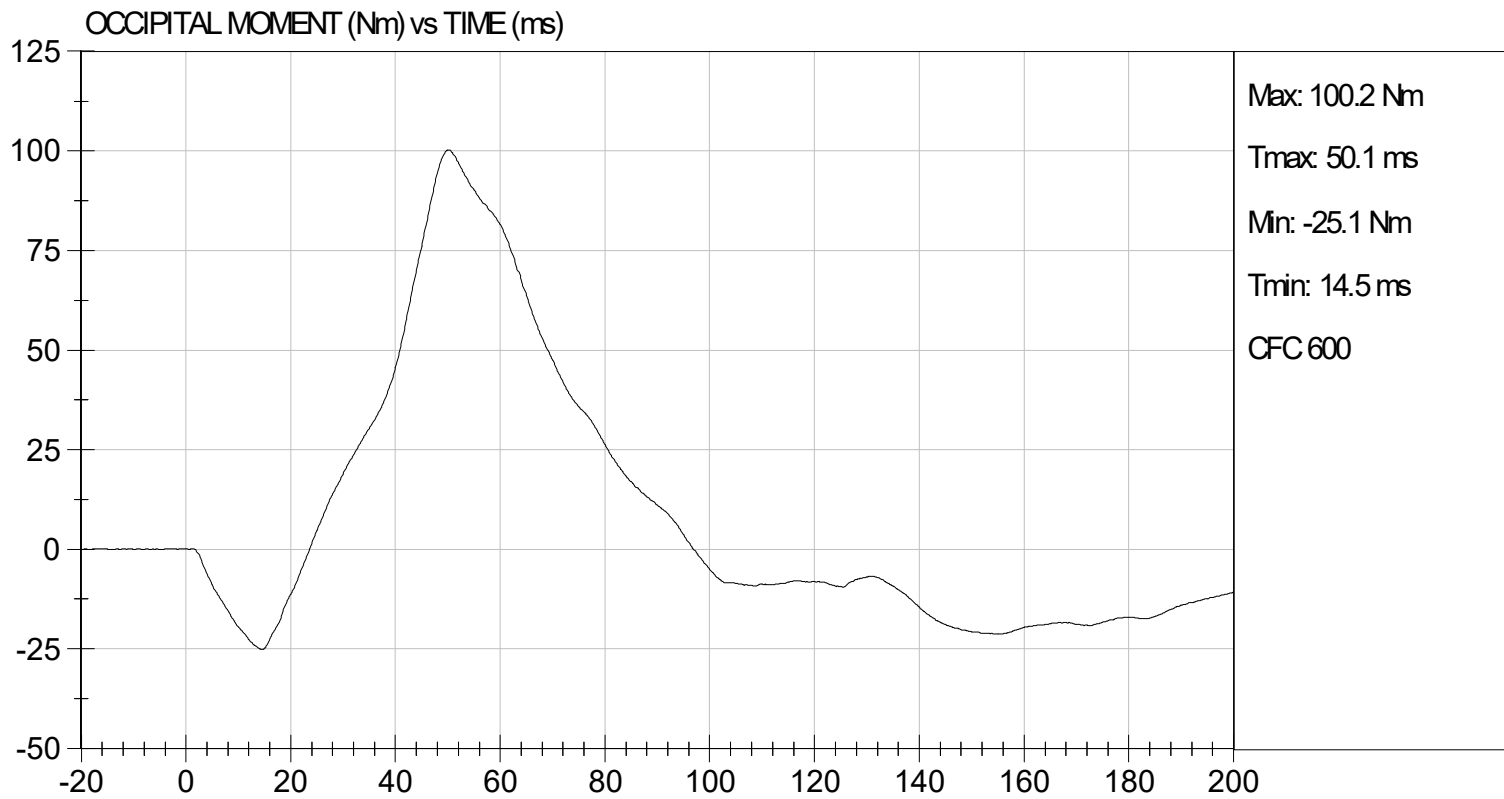
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TEST #: D241332





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

TEST DATE: 06/03/2024
TEST #: D241332



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

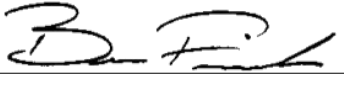
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Test I.D: D241333

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	45	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.05	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	17.88	Pass
	20 ms	G's	14.00 to 19.00	16.15	Pass
	30 ms	G's	11.00 to 16.00	15.90	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	15.9	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	38.7	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.5	Pass
	Time	ms	72.0 to 82.0	76.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	157.6	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-63.2	Pass
	Time	ms	65.0 to 79.0	73.0	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	143.6	Pass
Overall Test Results					Pass


 Laboratory Technician

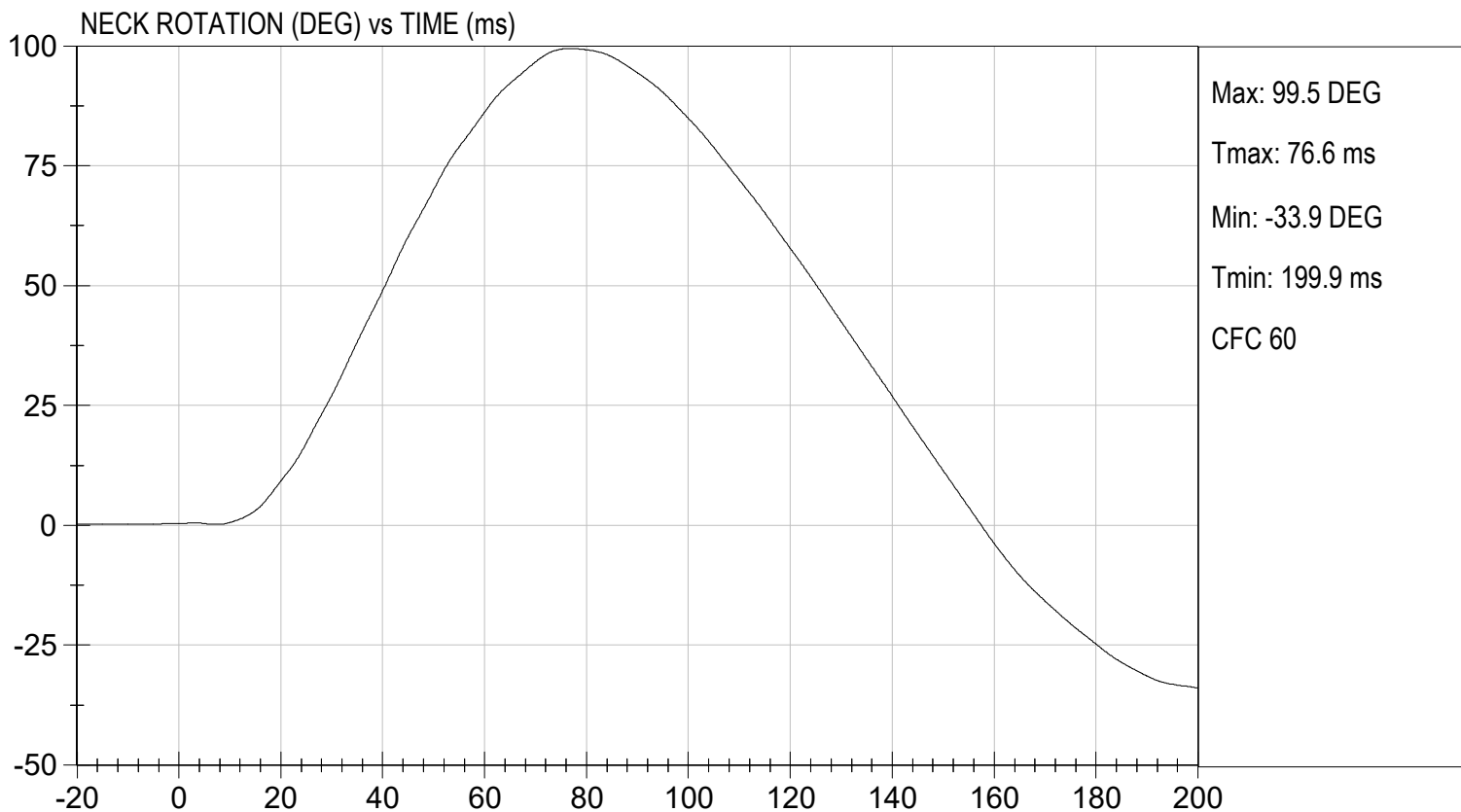
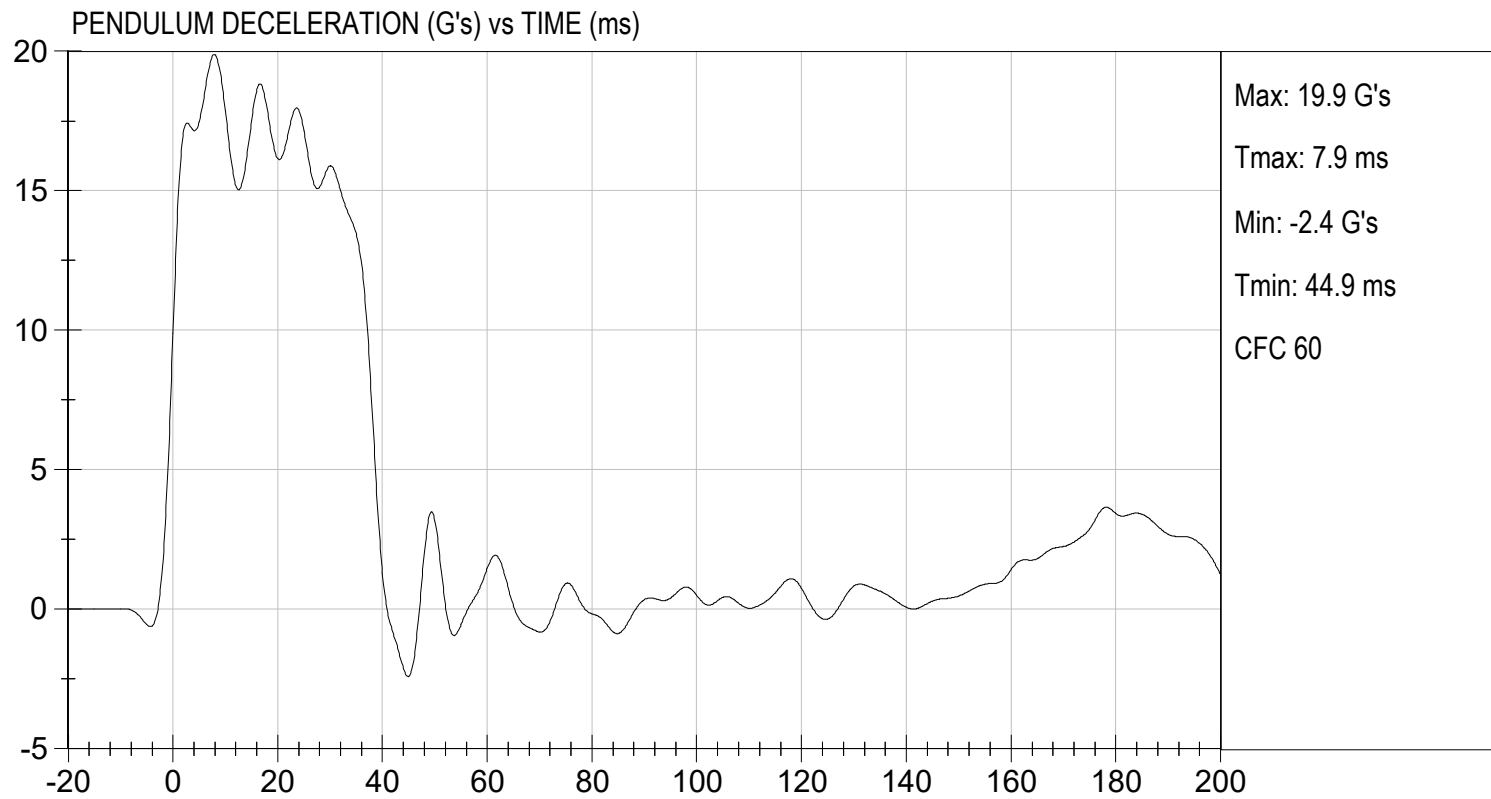
06/03/2024
 Test Date


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TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

TEST DATE: 06/03/2024
TEST #: D241333





TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

TEST DATE: 06/03/2024
TEST #: D241333



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

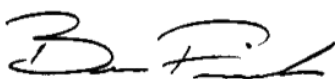
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Test I.D: D241334

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	49	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,279	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.93	Pass
Internal Hysteresis	%	69 to 85	72	Pass
			Overall Test Results	Pass


Laboratory Technician

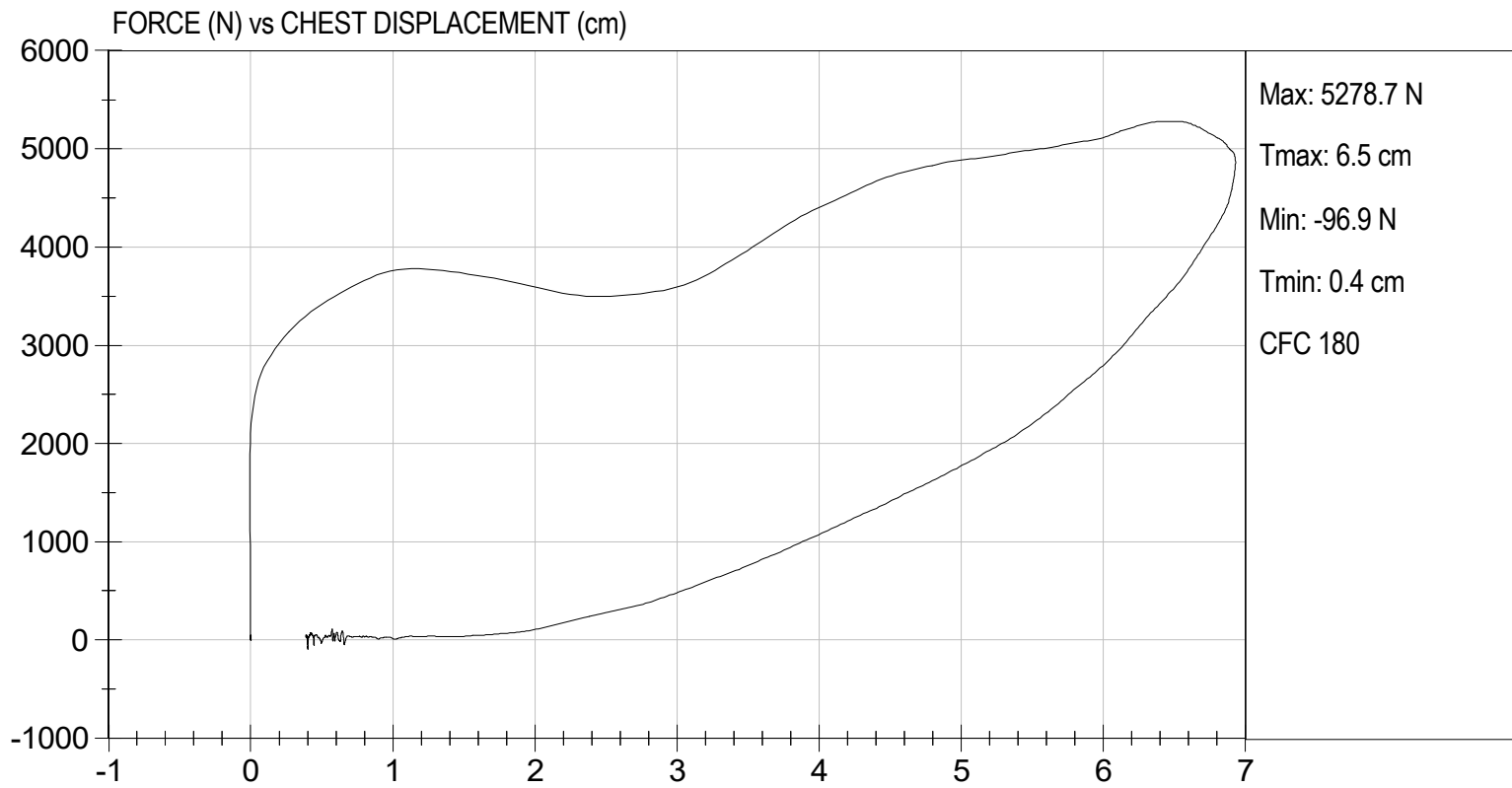
06/03/2024
Test Date


Approved By



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

TEST DATE: 06/03/2024
TEST #: D241334



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

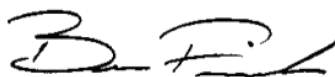
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Test I.D: D241335

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	48	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	N	4715 to 5782	4,759	Pass
			Overall Test Results	Pass


Laboratory Technician

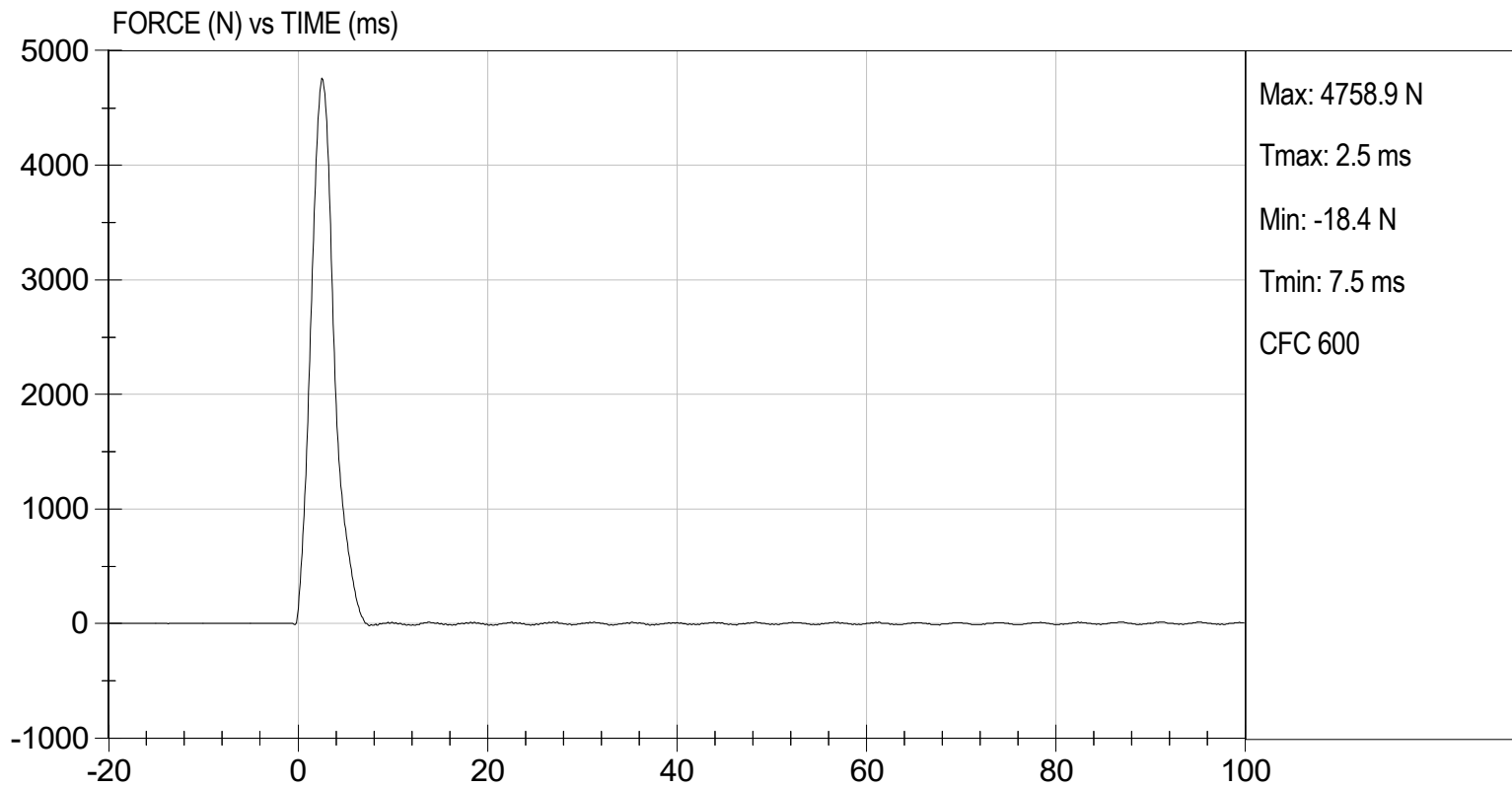
06/03/2024
Test Date


Approved By



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

TEST DATE: 06/03/2024
TEST #: D241335



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

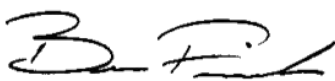
ATD Serial No: 064

Test I.D: D241336

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	48	Pass
Probe Velocity	m/s	2.07 to 2.13	2.11	Pass
Peak Probe Force	N	4715 to 5782	5,179	Pass
			Overall Test Results	Pass


Laboratory Technician

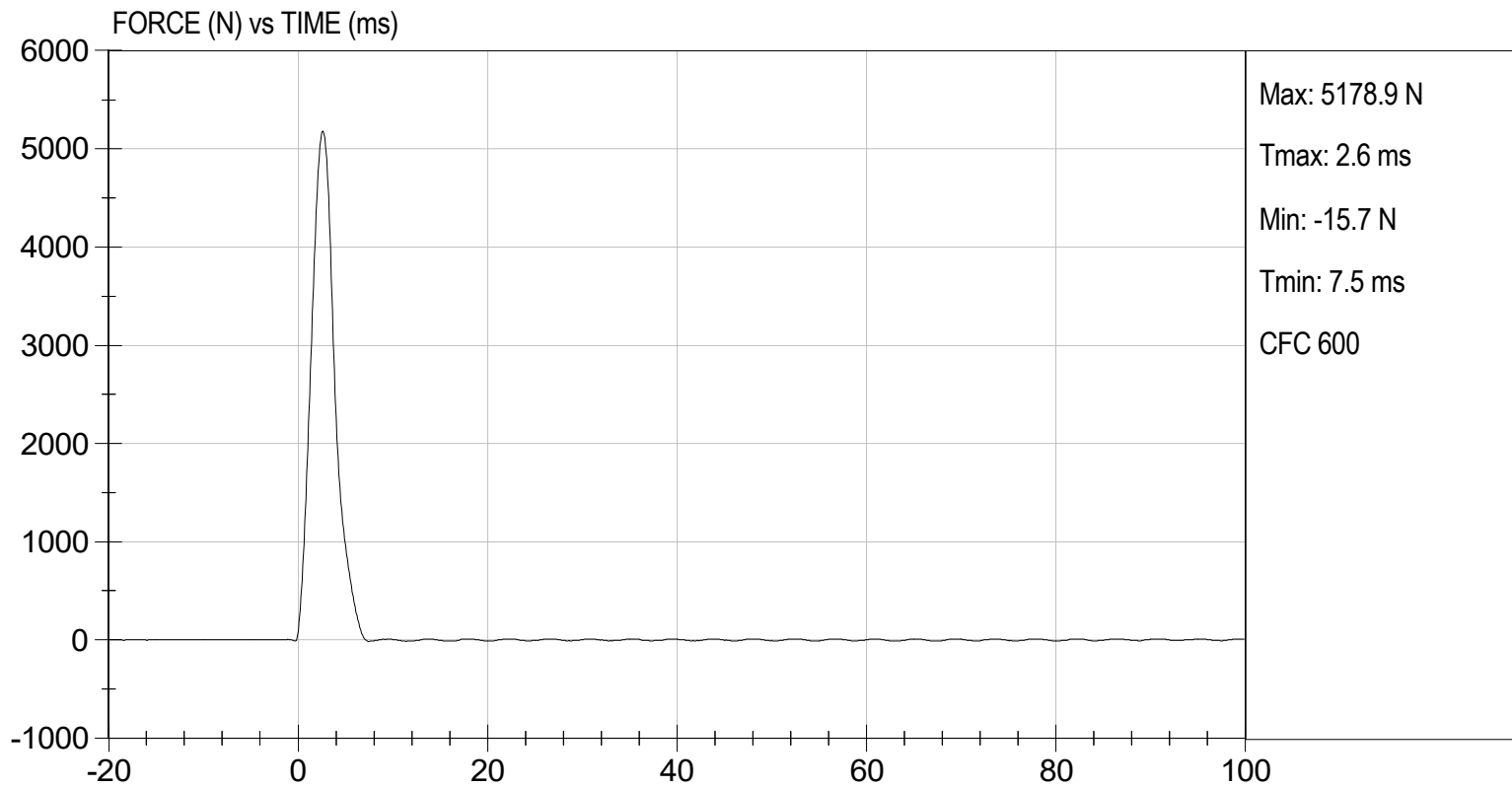
06/03/2024
Test Date


Approved By



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

TEST DATE: 06/03/2024
TEST #: D241336



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

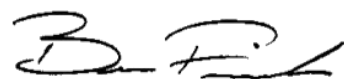
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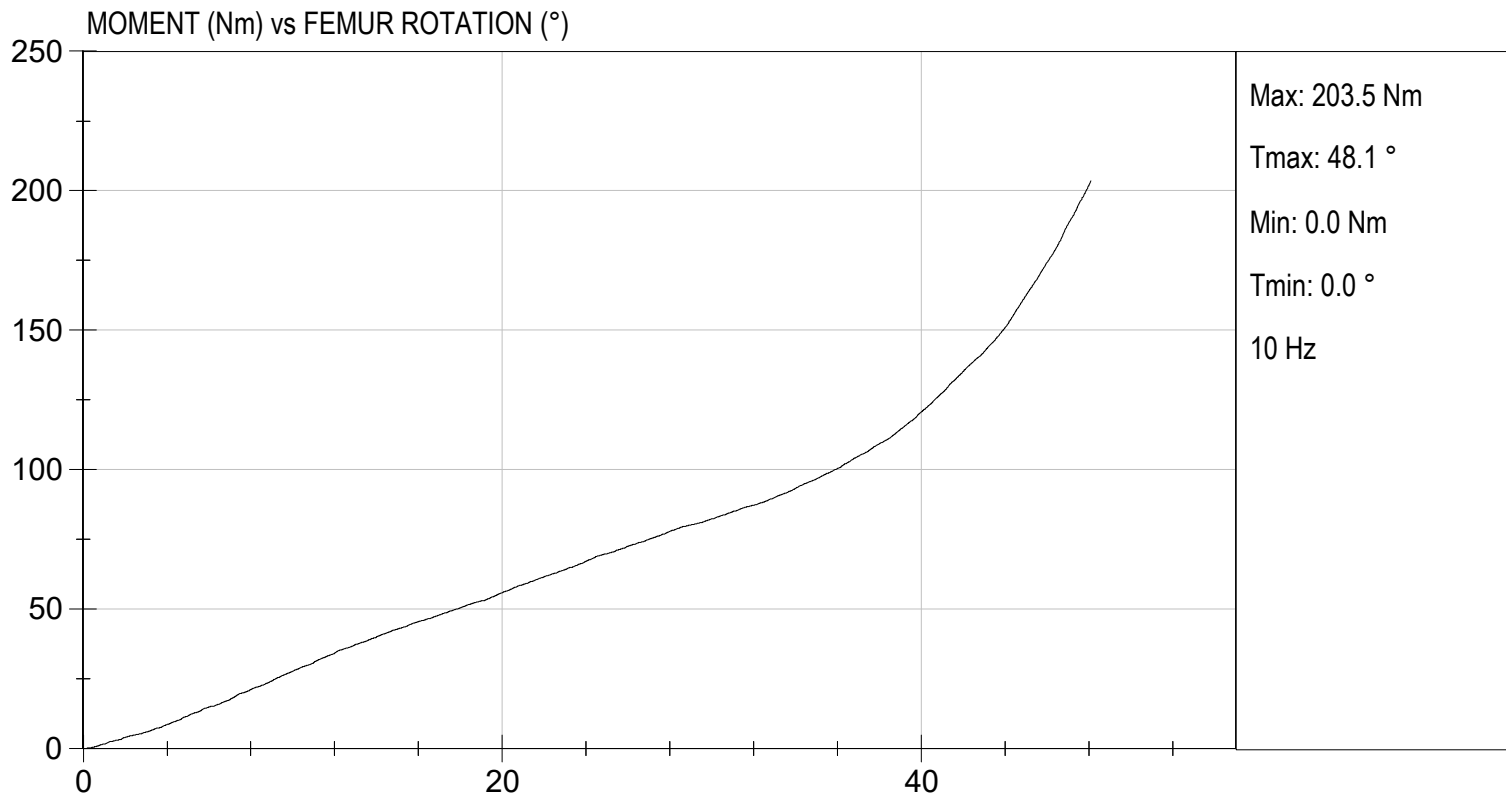
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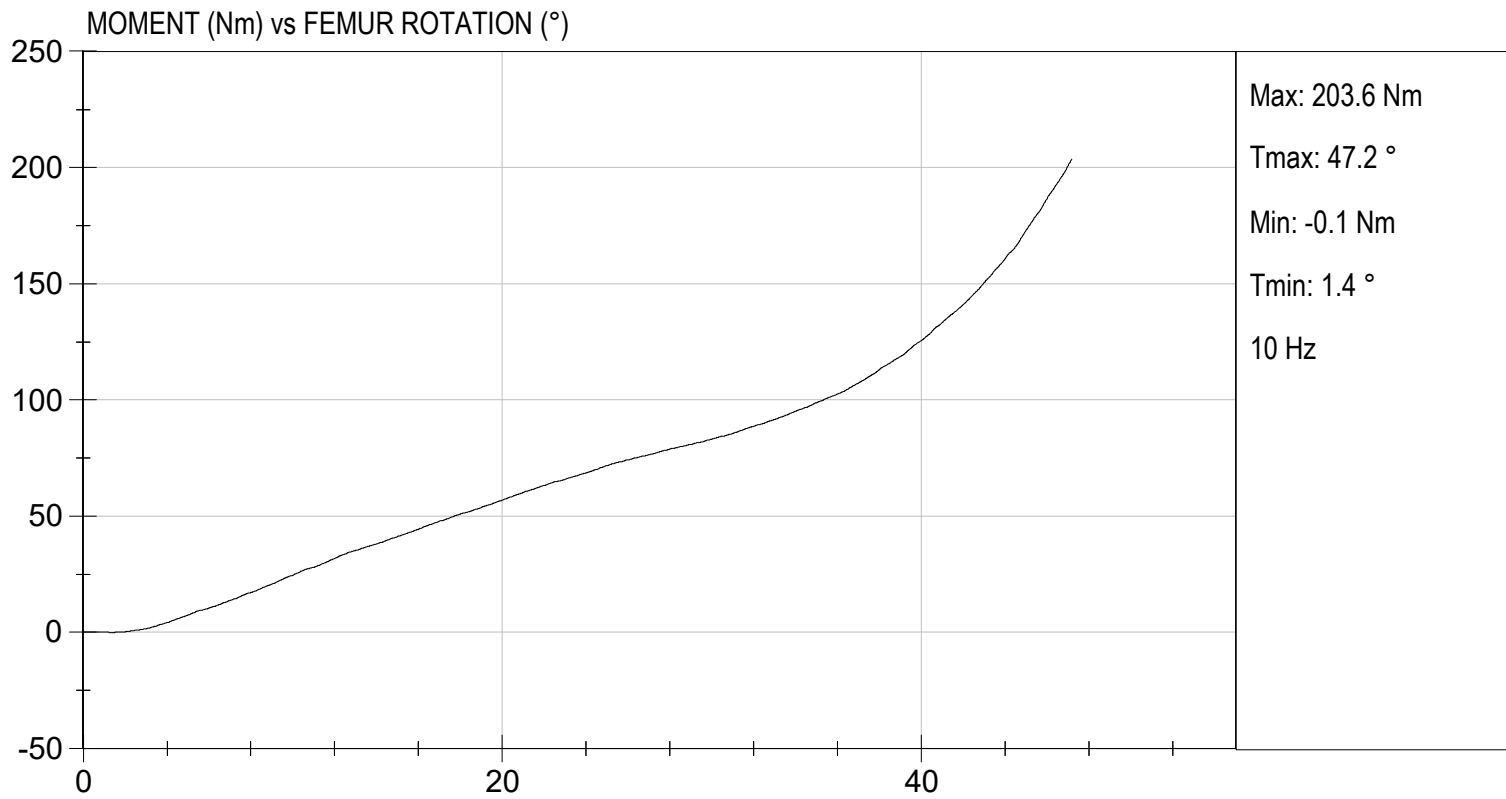
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.4	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	45	45	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.5	6.5	Pass
30 Degrees	Nm	94.9 Nm Max	82.3	83.1	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.1	47.2	Pass
Overall Test Results					Pass


 Laboratory Technician

06/03/2024
 Test Date


 Approved By





QUALIFICATION TEST RESULTS

POST-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

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

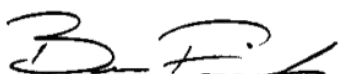
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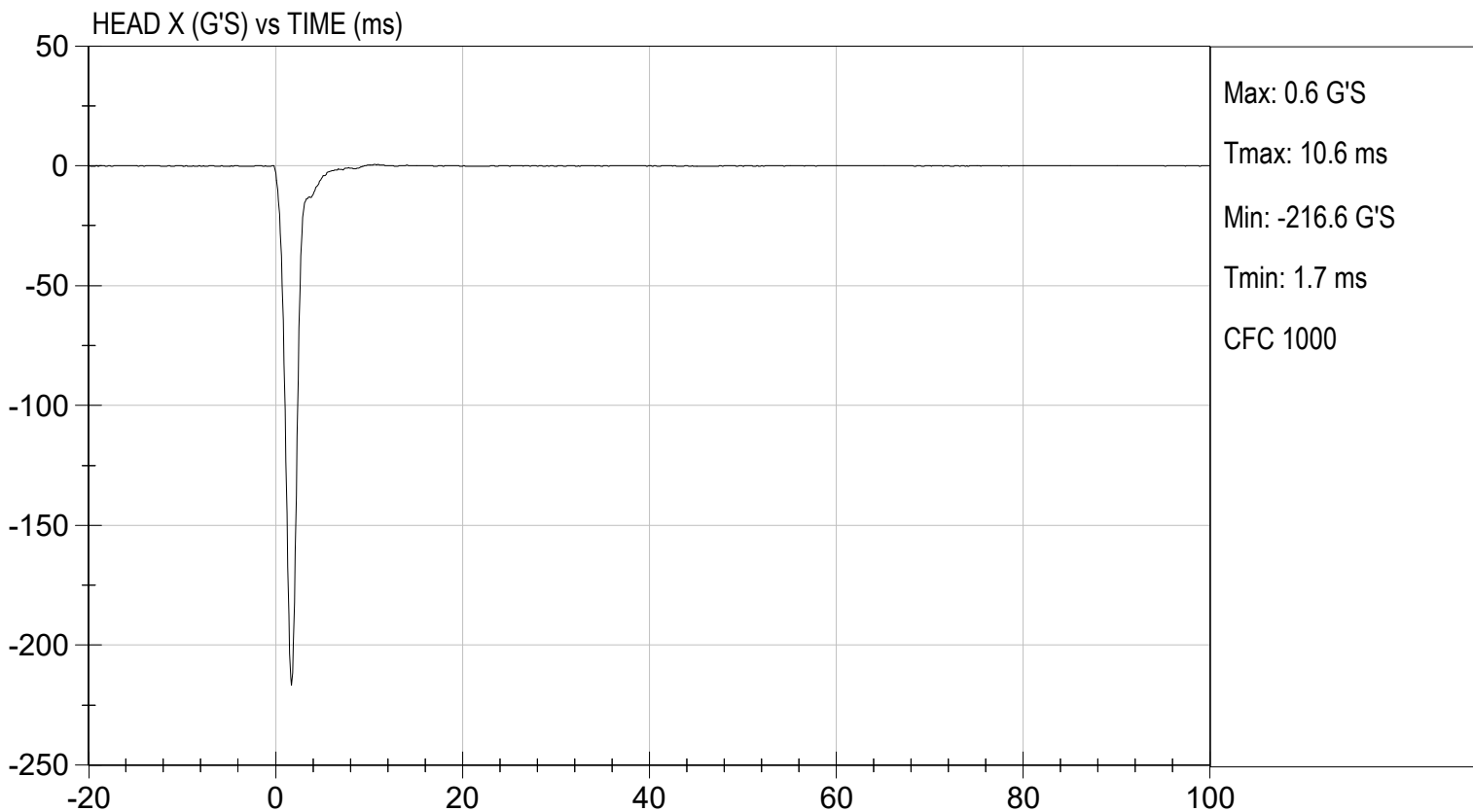
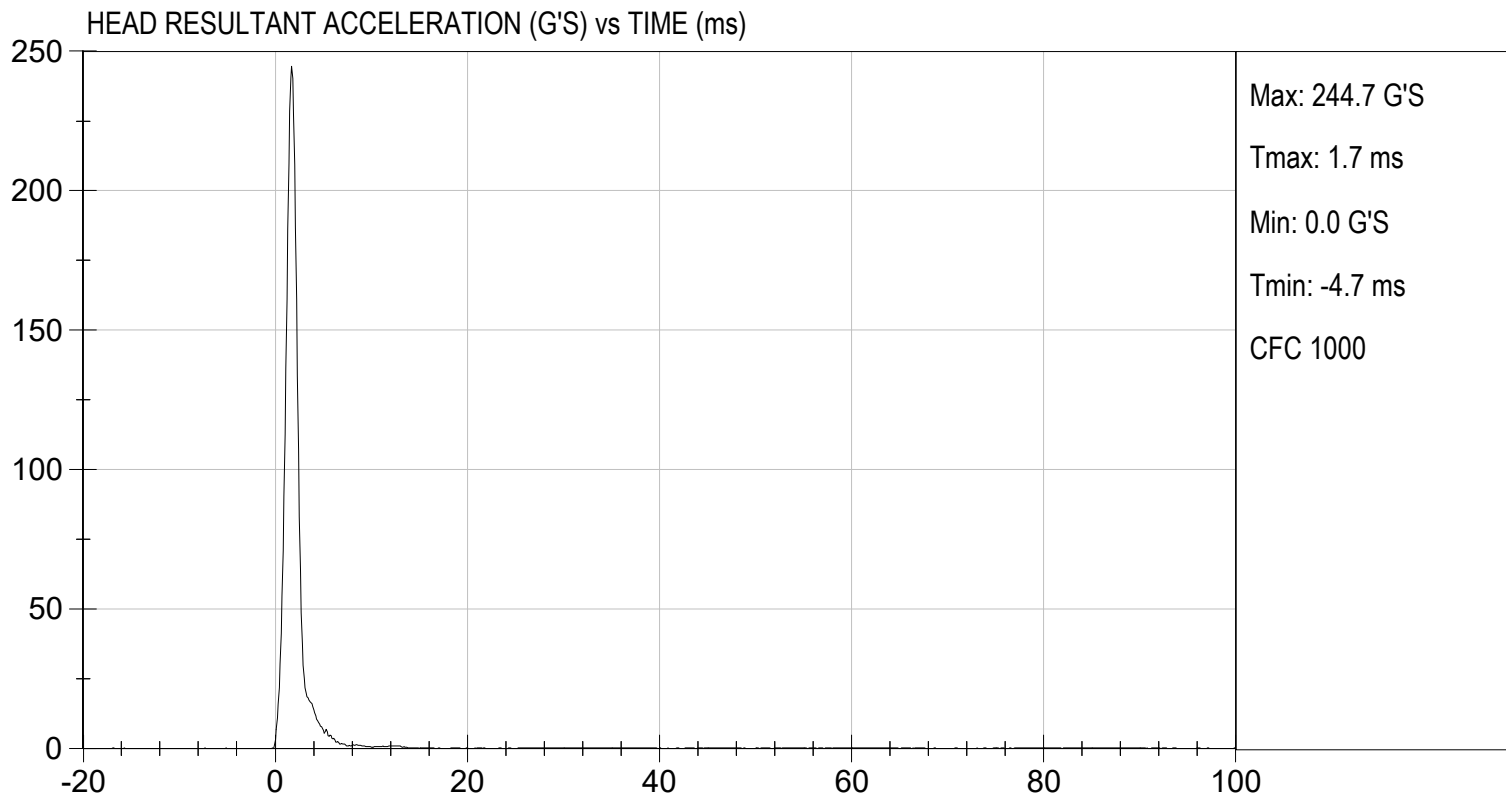
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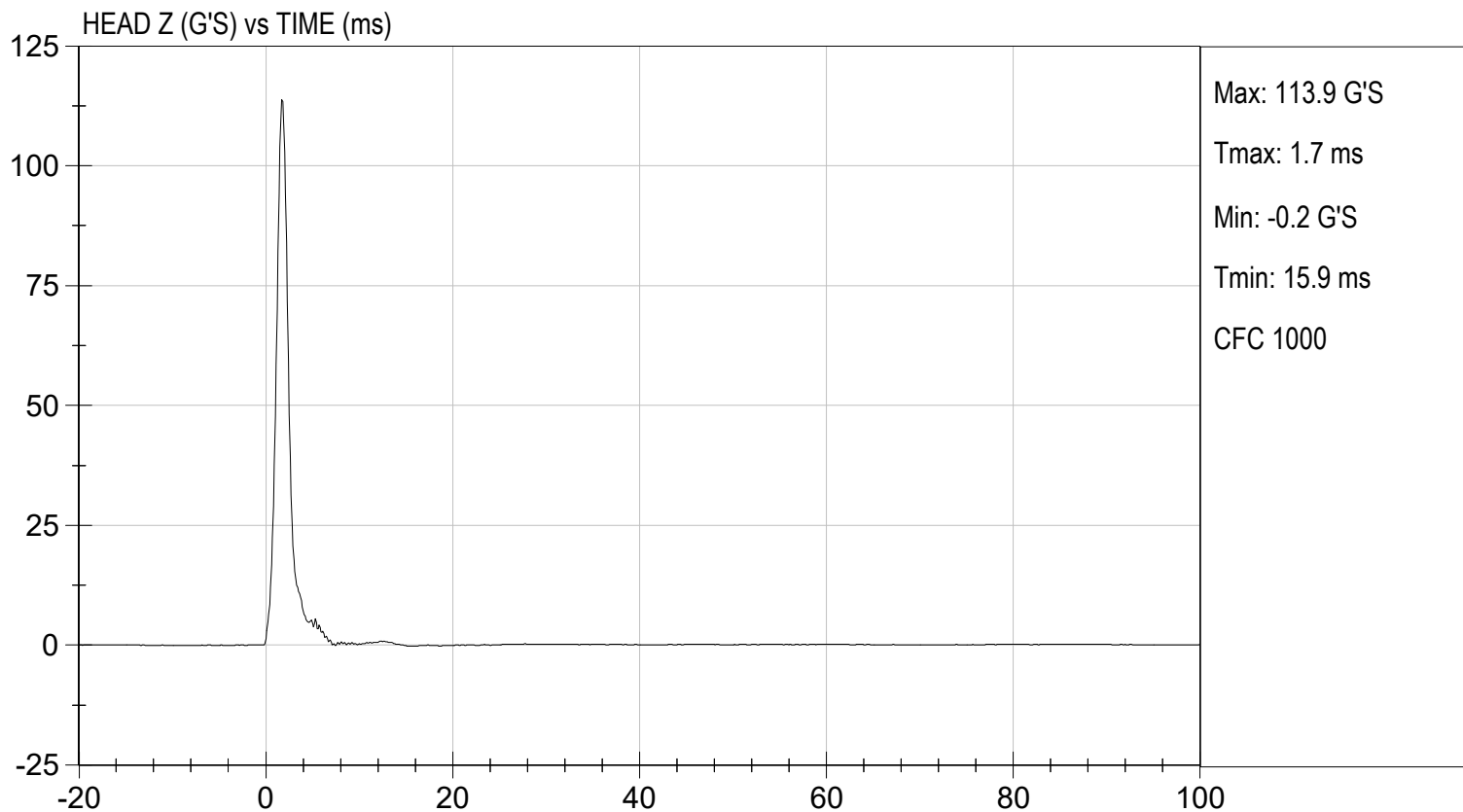
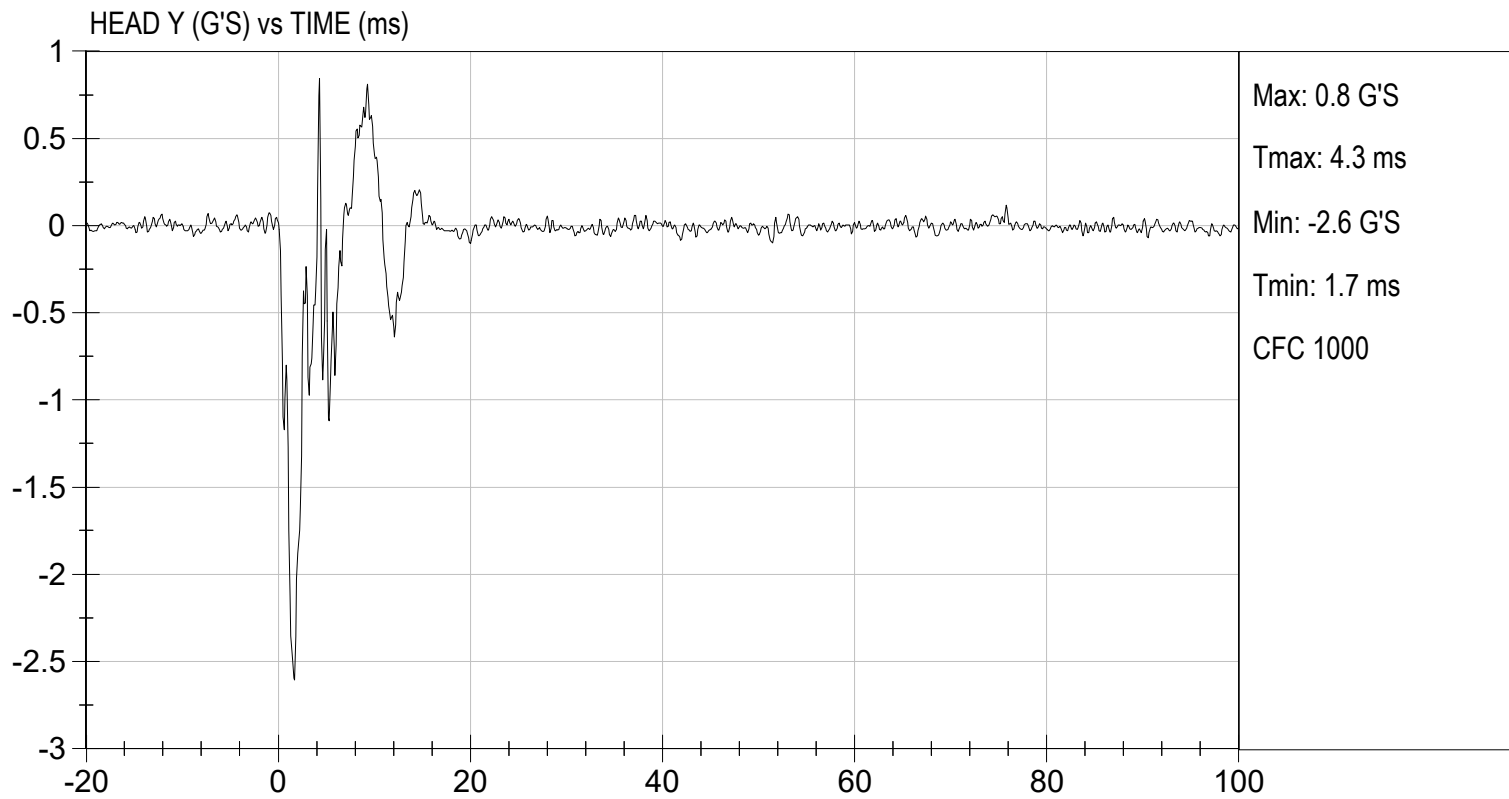
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	49	Pass
Peak Resultant Acceleration	G's	225 to 275	245	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-2.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
			Overall Test Results	Pass


Laboratory Technician

06/19/2024
Test Date


Approved By





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

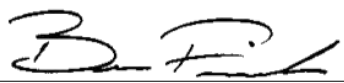
ATD Serial No: 064

Test I.D: D241492

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	50	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.65	Pass
	20 ms	G's	17.60 to 22.60	20.77	Pass
	30 ms	G's	12.50 to 18.50	16.35	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	16.3	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	38.7	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	74.1	Pass
	Time	ms	57.0 to 64.0	59.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.2	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	101.7	Pass
	Time	ms	47.0 to 58.0	51.3	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	97.7	Pass
Overall Test Results					Pass


 Laboratory Technician

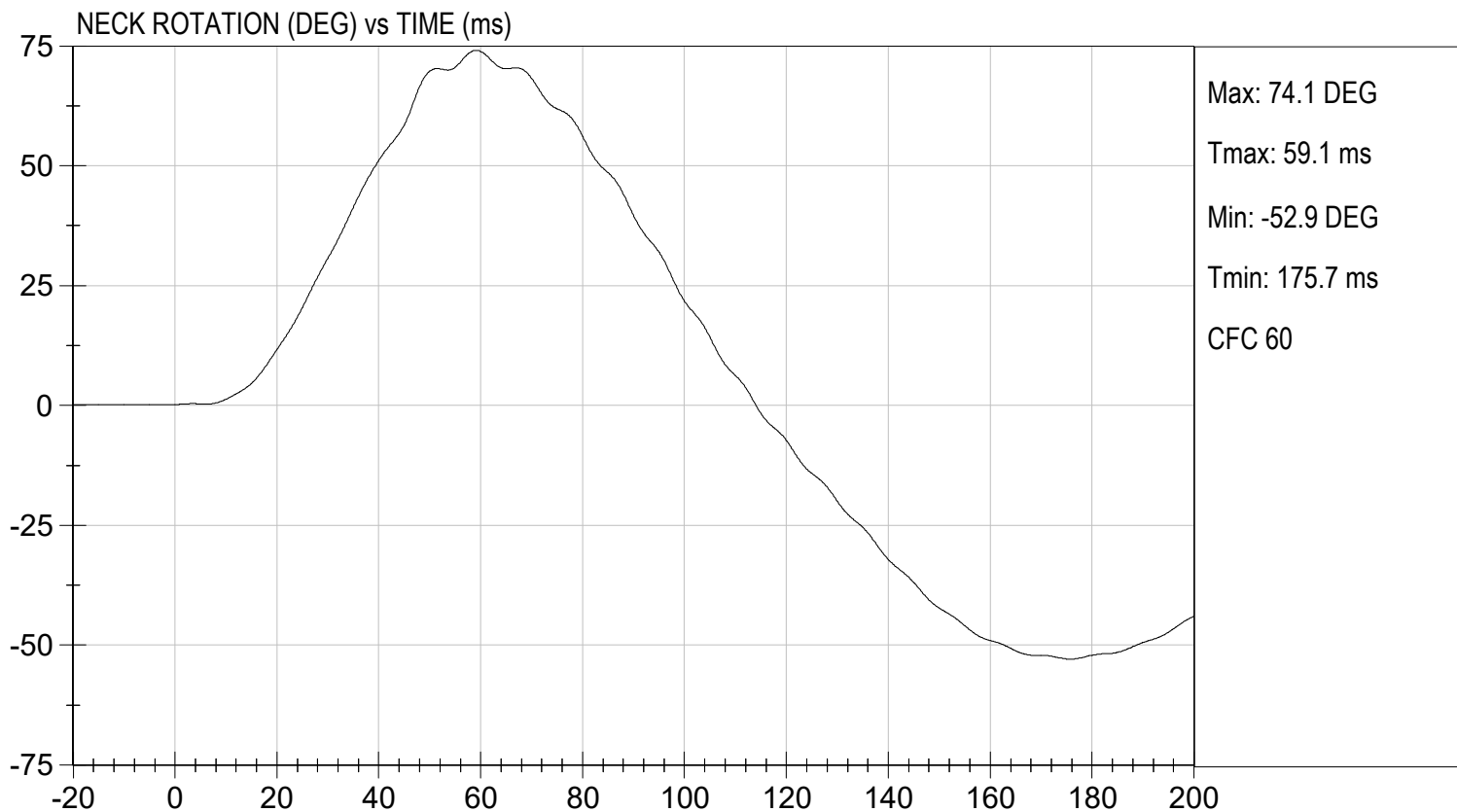
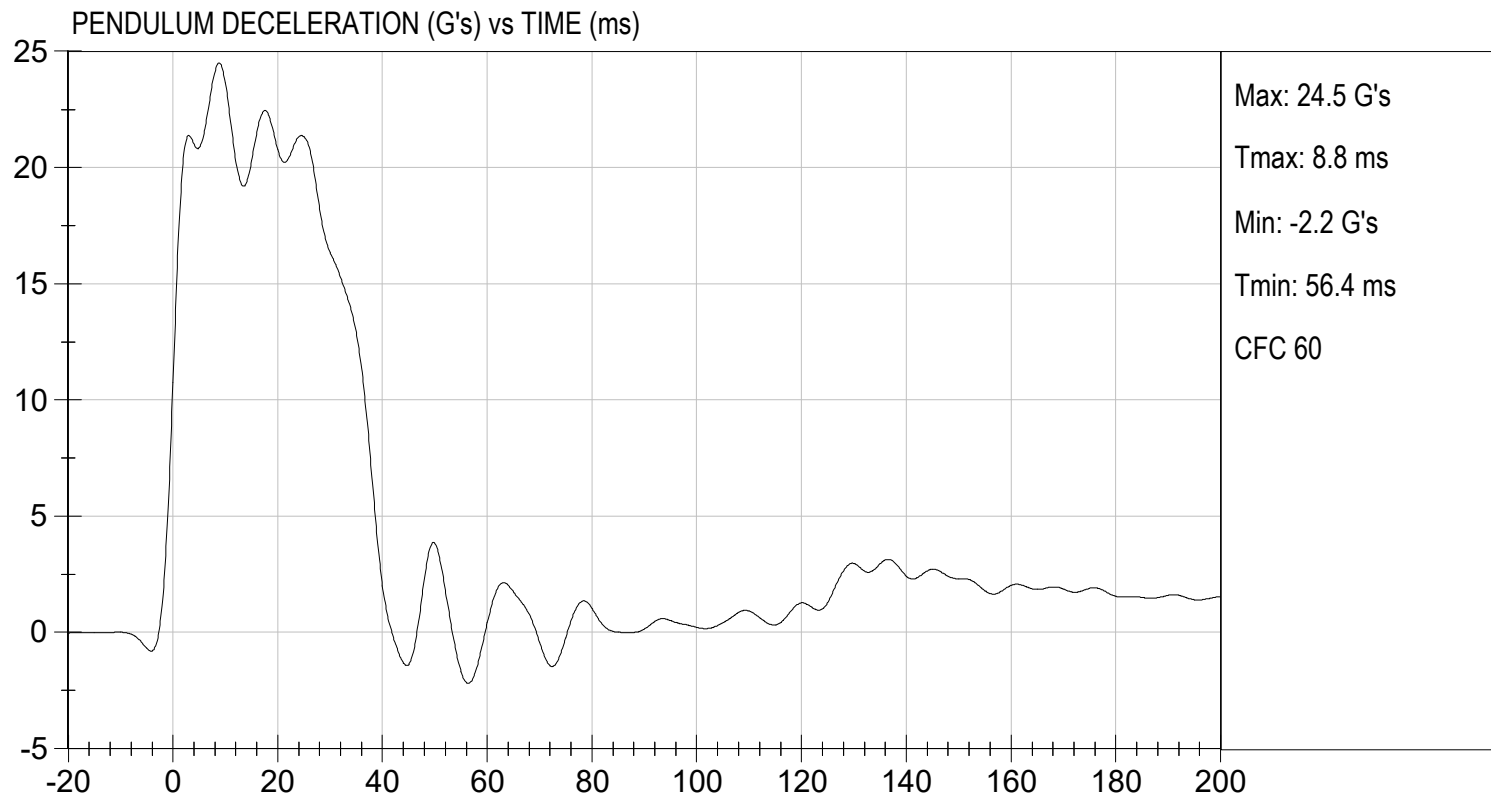
06/19/2024
 Test Date


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

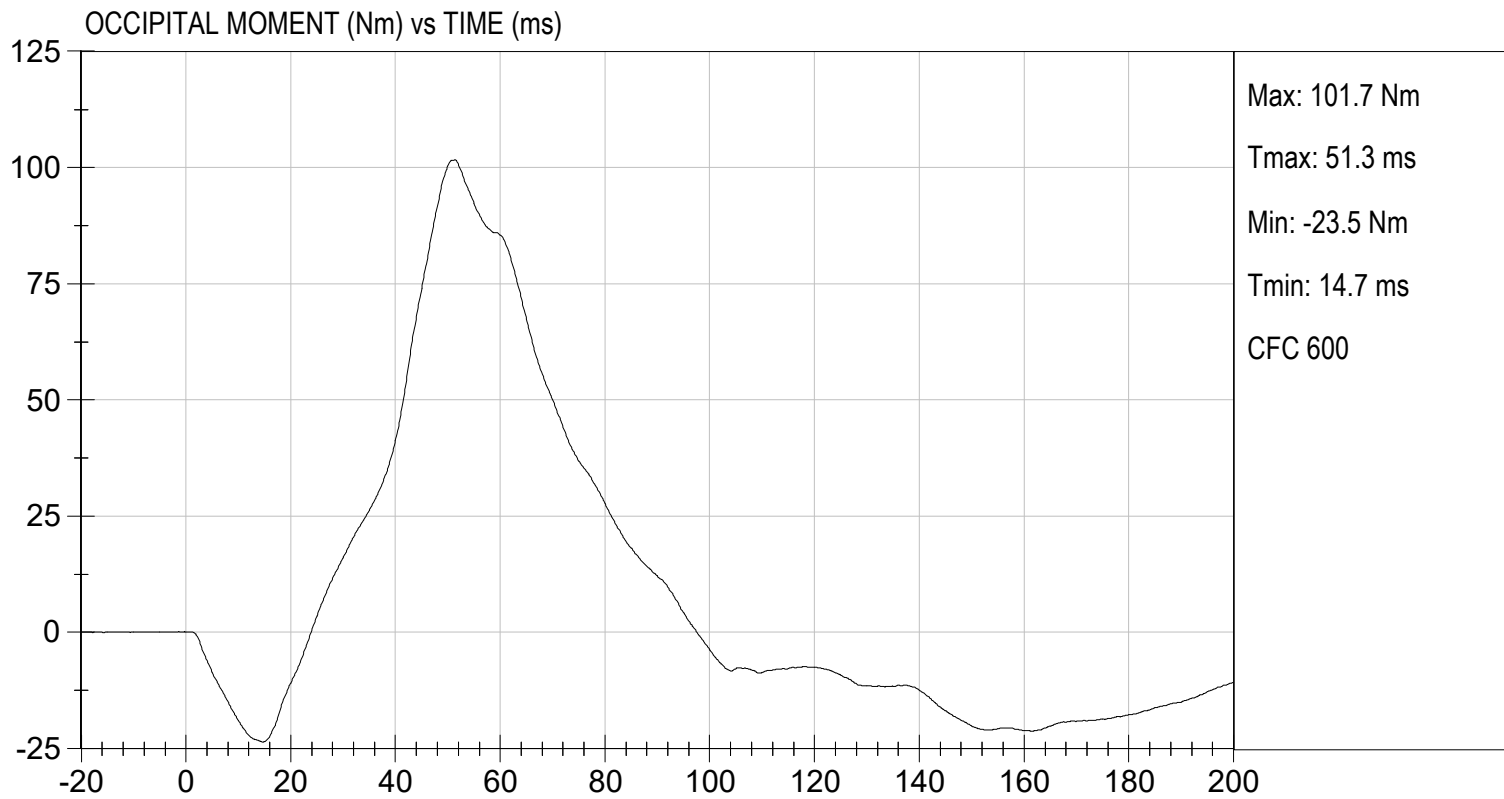
TEST DATE: 06/19/2024
TEST #: D241492





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

TEST DATE: 06/19/2024
TEST #: D241492



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

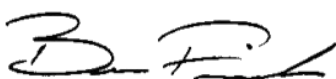
ATD Serial No: 064

Test I.D: D241493

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	51	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.05	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.53	Pass
	20 ms	G's	14.00 to 19.00	16.16	Pass
	30 ms	G's	11.00 to 16.00	13.15	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	15.2	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	39.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.2	Pass
	Time	ms	72.0 to 82.0	78.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	159.0	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.8	Pass
	Time	ms	65.0 to 79.0	73.7	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	144.1	Pass
Overall Test Results					Pass


Laboratory Technician

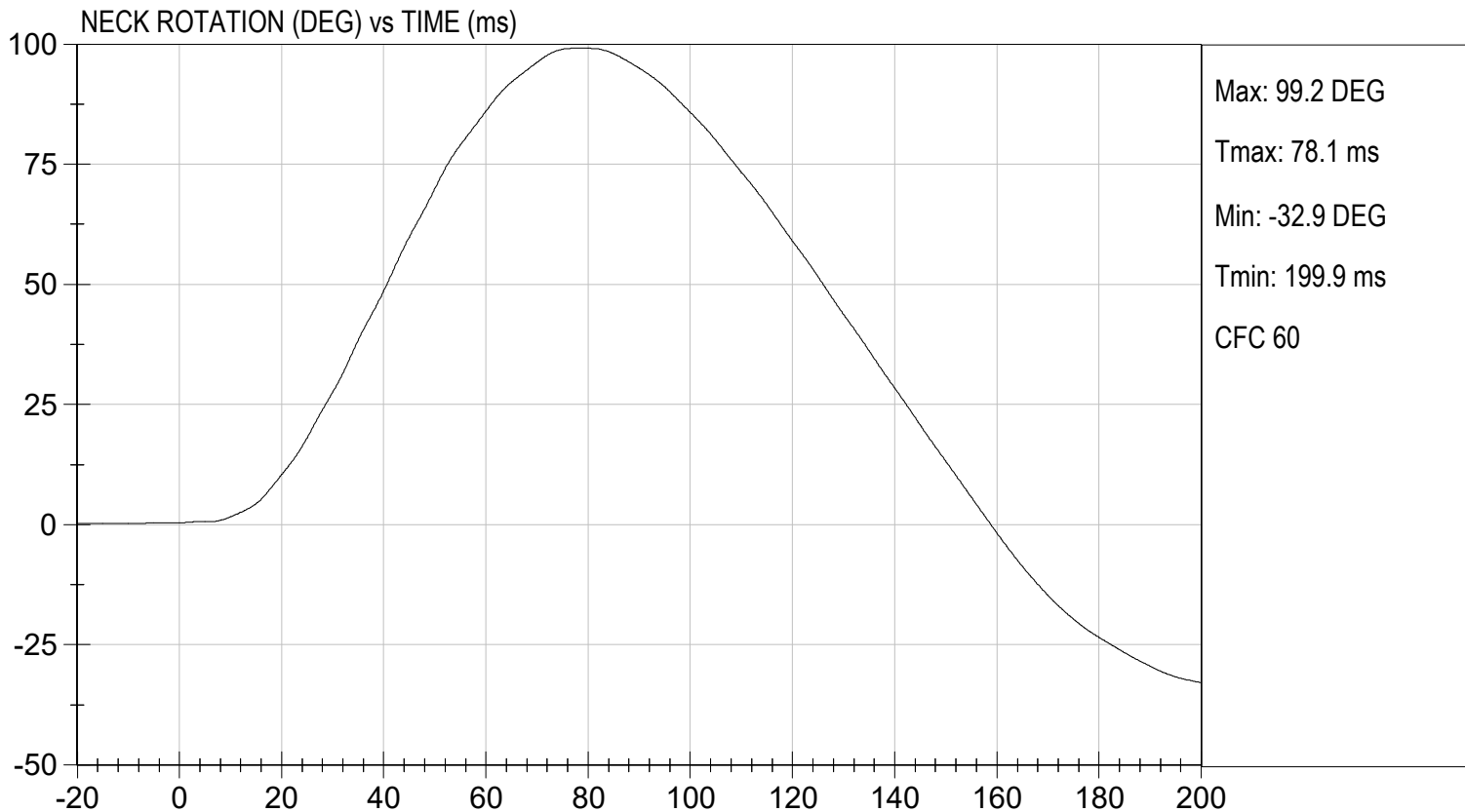
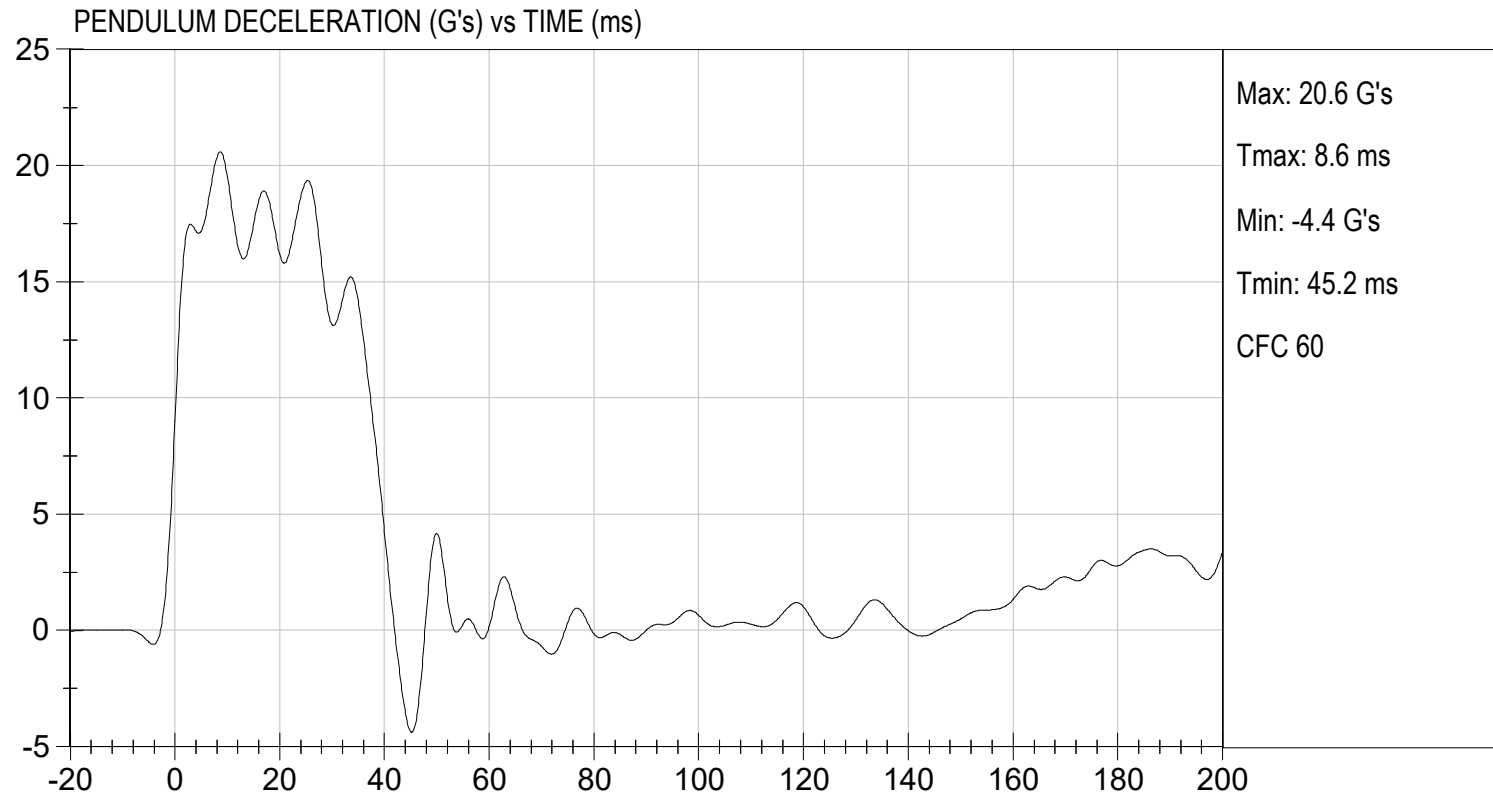
06/19/2024
Test Date


Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

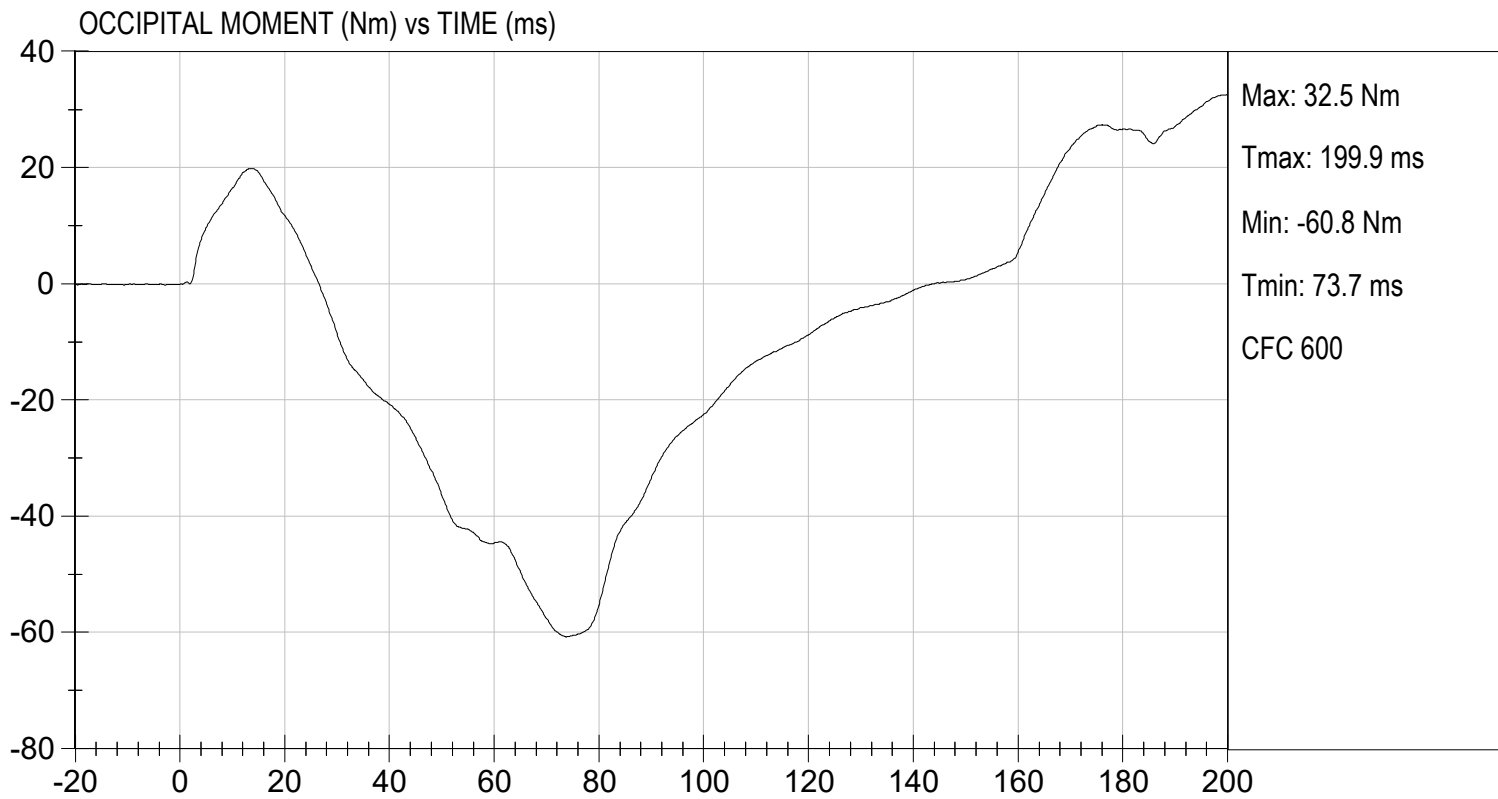
TEST DATE: 06/19/2024
TEST #: D241493





TEST DESC: NECK EXTENSION
VELOCITY: 19.84 ft/s, 6.05 m/s

TEST DATE: 06/19/2024
TEST #: D241493



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

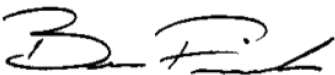
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Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,275	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	7.07	Pass
Internal Hysteresis	%	69 to 85	72	Pass
			Overall Test Results	Pass


Laboratory Technician

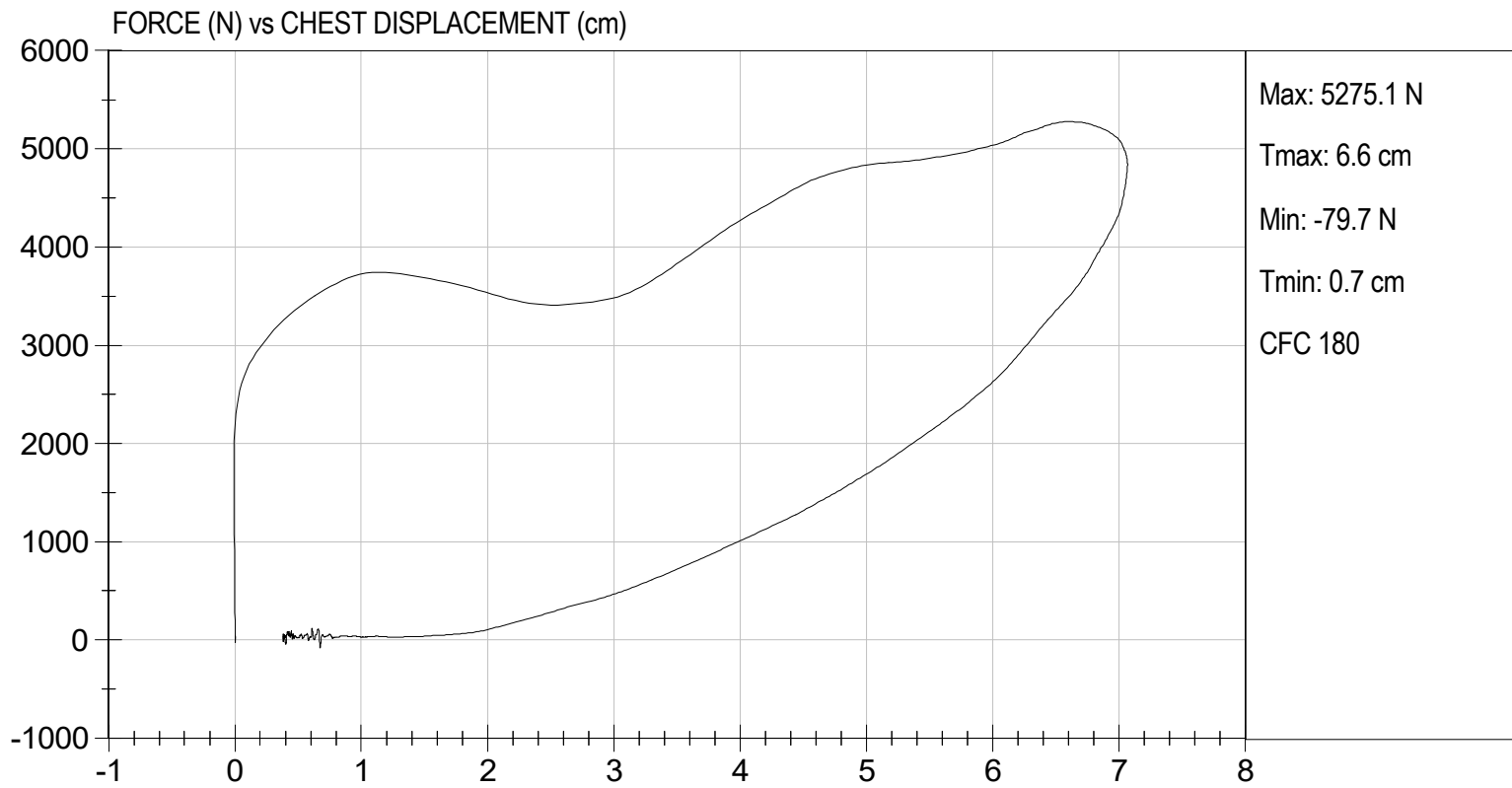
06/19/2024
Test Date


Approved By



TEST DESC: THORAX IMPACT
VELOCITY: 21.93 ft/s, 6.68 m/s

TEST DATE: 06/19/2024
TEST #: D241494



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

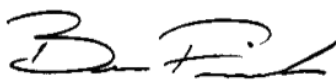
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Test I.D: D241495

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Velocity	m/s	2.07 to 2.13	2.10	Pass
Peak Probe Force	N	4715 to 5782	4,911	Pass
			Overall Test Results	Pass


Laboratory Technician

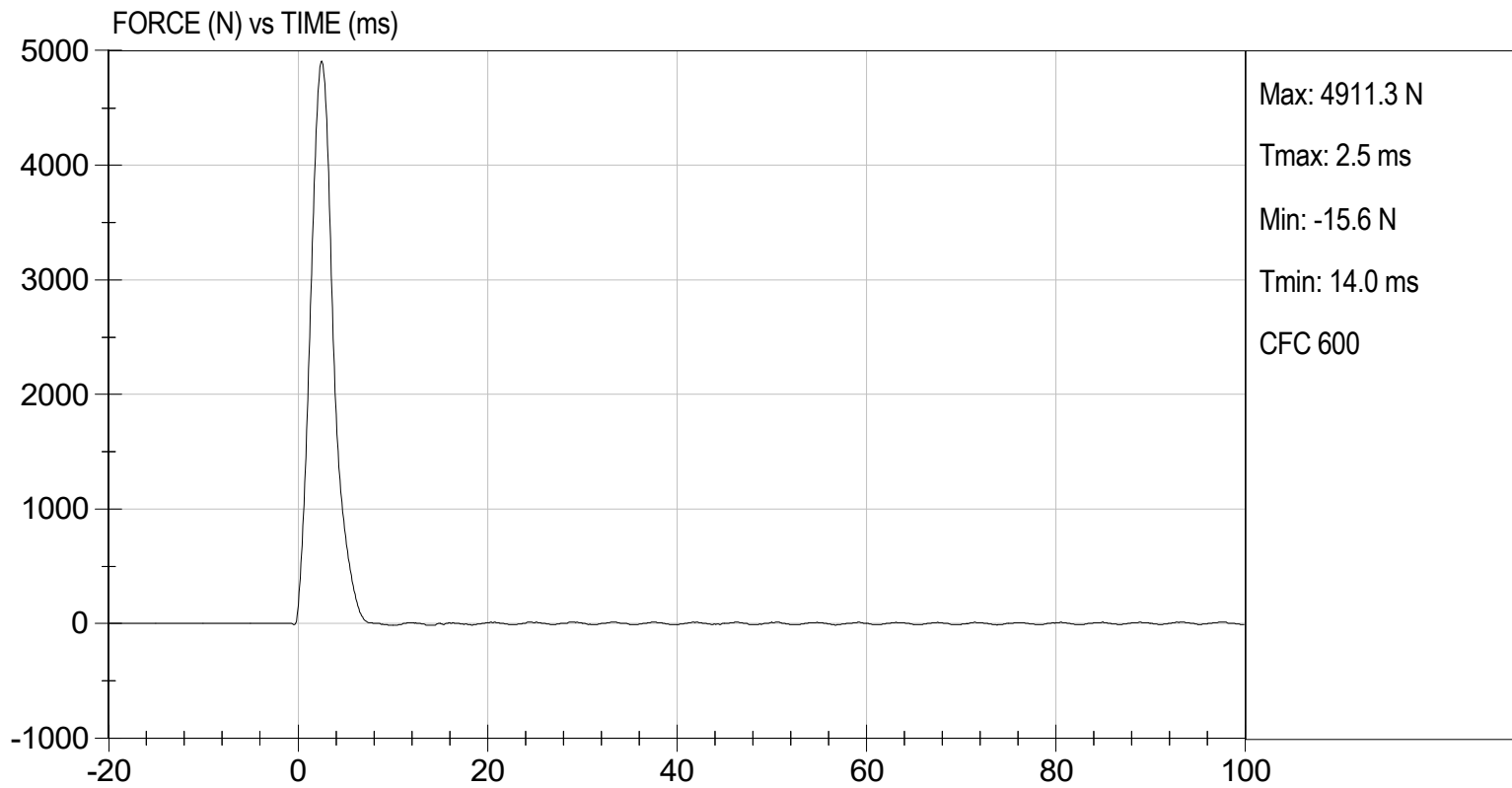
06/19/2024
Test Date


Approved By



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

TEST DATE: 06/19/2024
TEST #: D241495



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

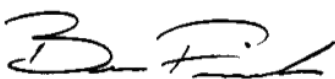
ATD Serial No: 064

Test I.D: D241496

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	47	Pass
Probe Velocity	m/s	2.07 to 2.13	2.10	Pass
Peak Probe Force	N	4715 to 5782	4,854	Pass
			Overall Test Results	Pass


Laboratory Technician

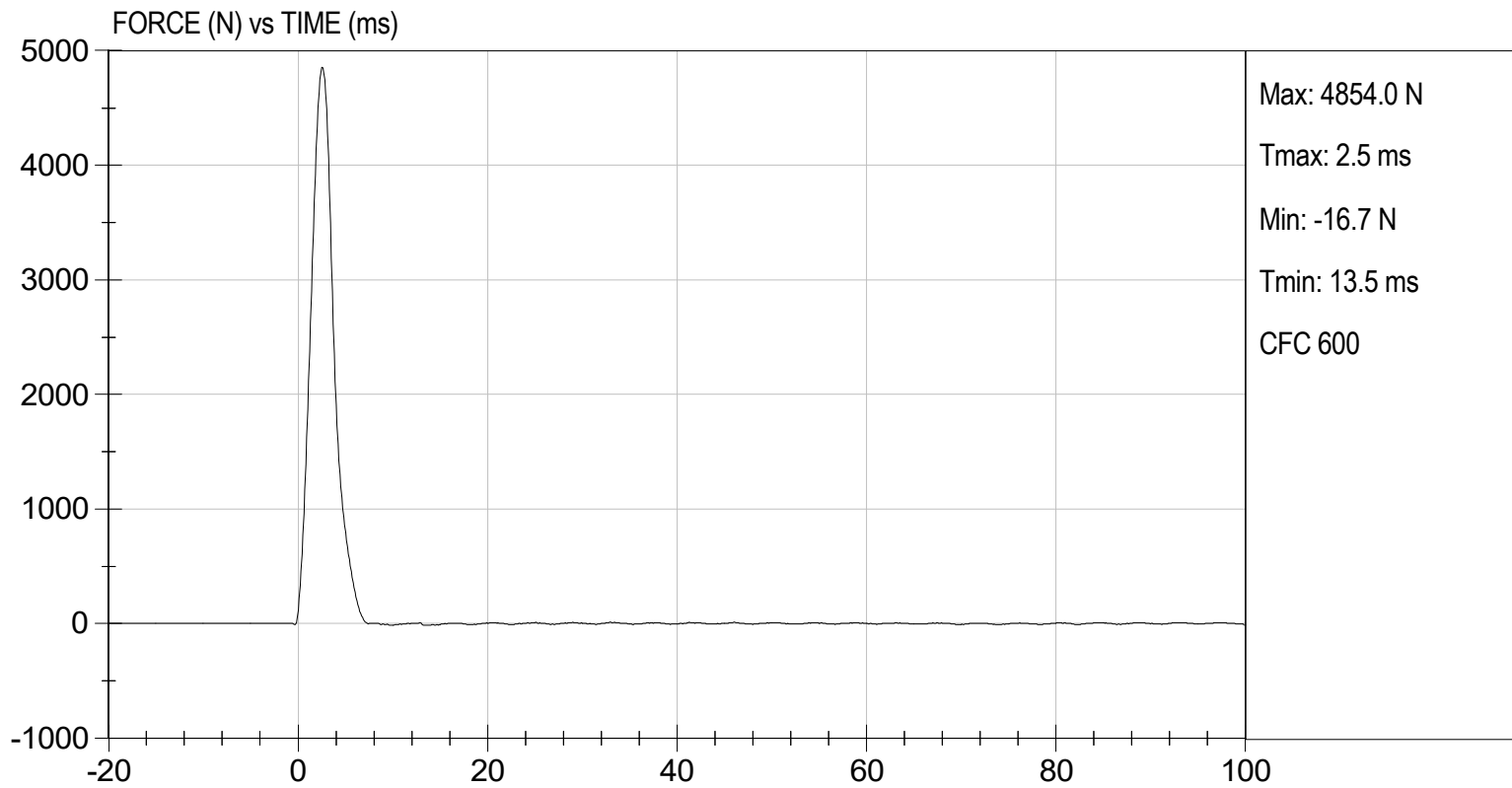
06/19/2024
Test Date


Approved By



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

TEST DATE: 06/19/2024
TEST #: D241496



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

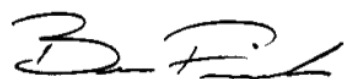
ATD Serial No: 064

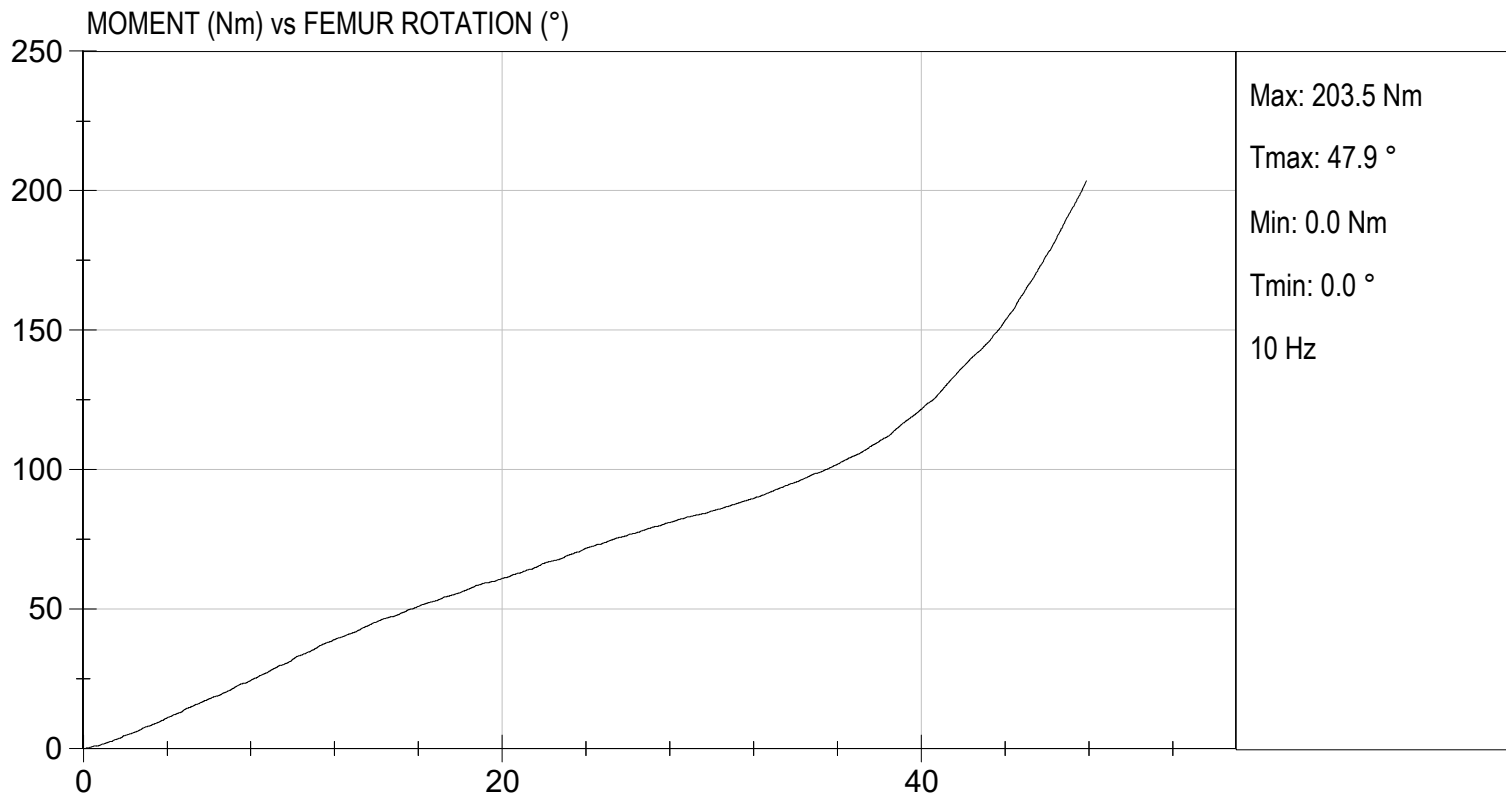
Test I.D: D241490

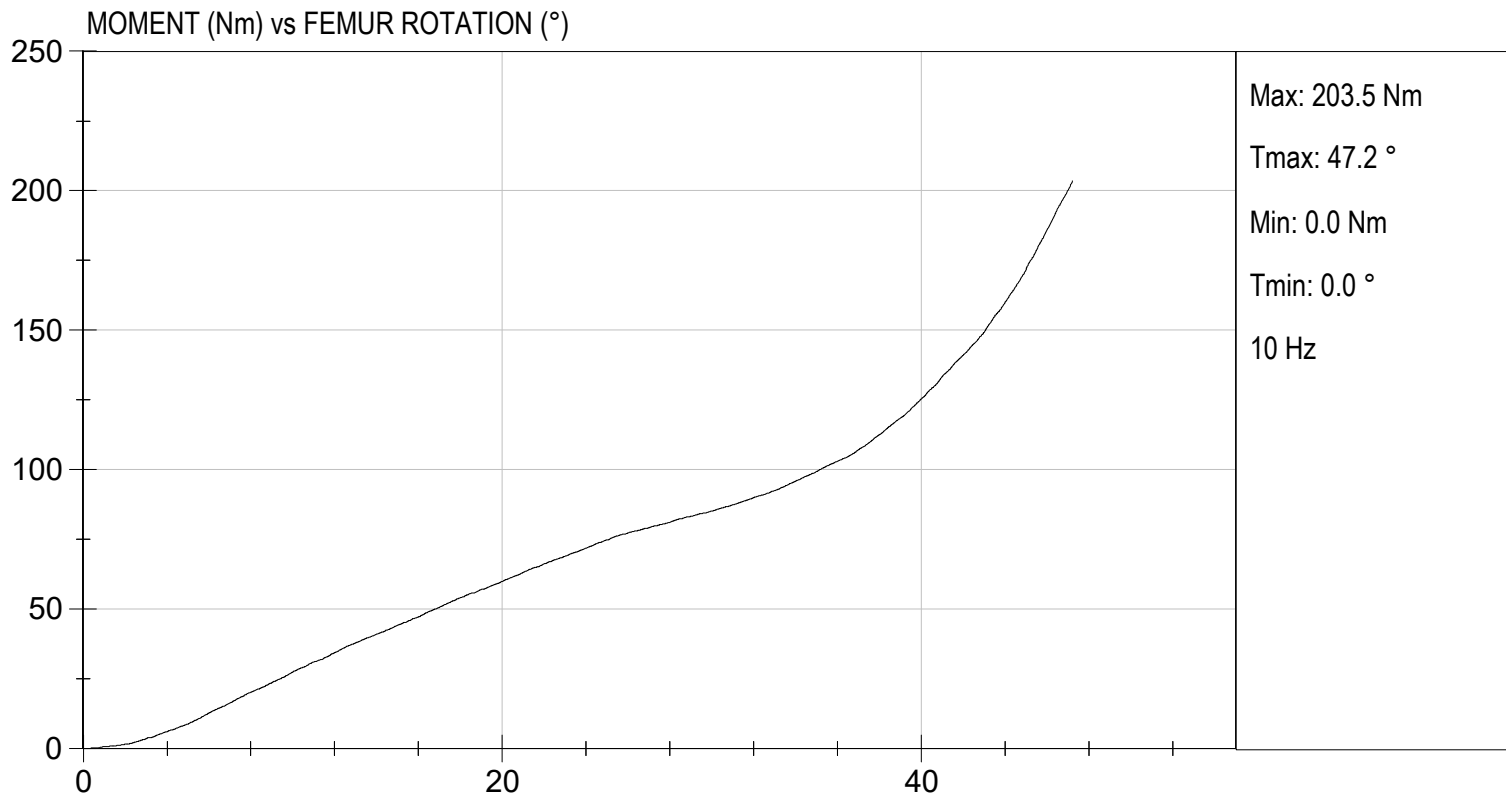
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.4	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	45	45	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.5	6.5	Pass
30 Degrees	Nm	94.9 Nm Max	85.2	85.2	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	47.9	47.2	Pass
Overall Test Results					Pass


 Laboratory Technician

06/19/2024
 Test Date


 Approved By





QUALIFICATION TEST RESULTS

PRE-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

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 heal	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

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 5TH PERCENTILE

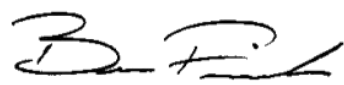
ATD Serial No: 142

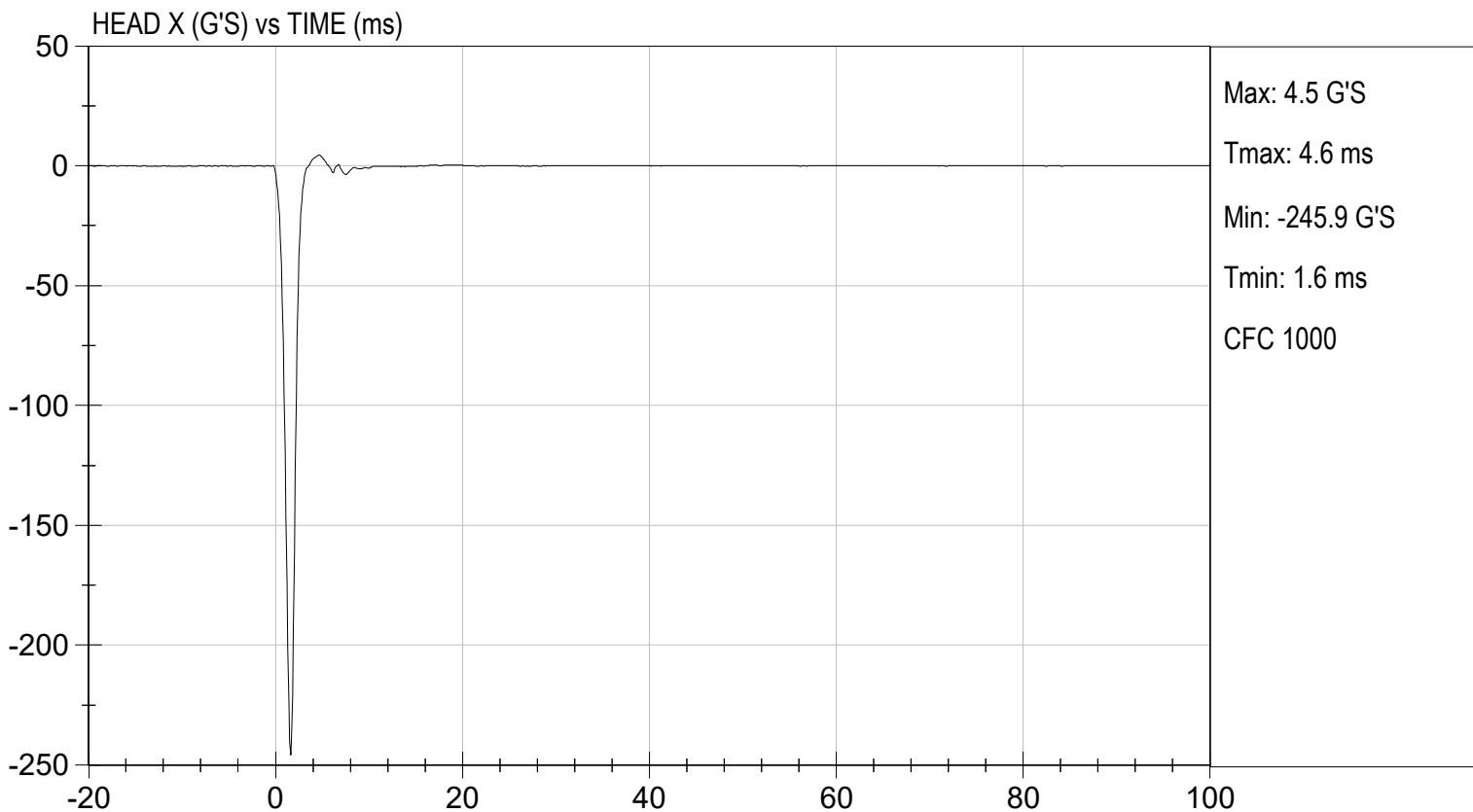
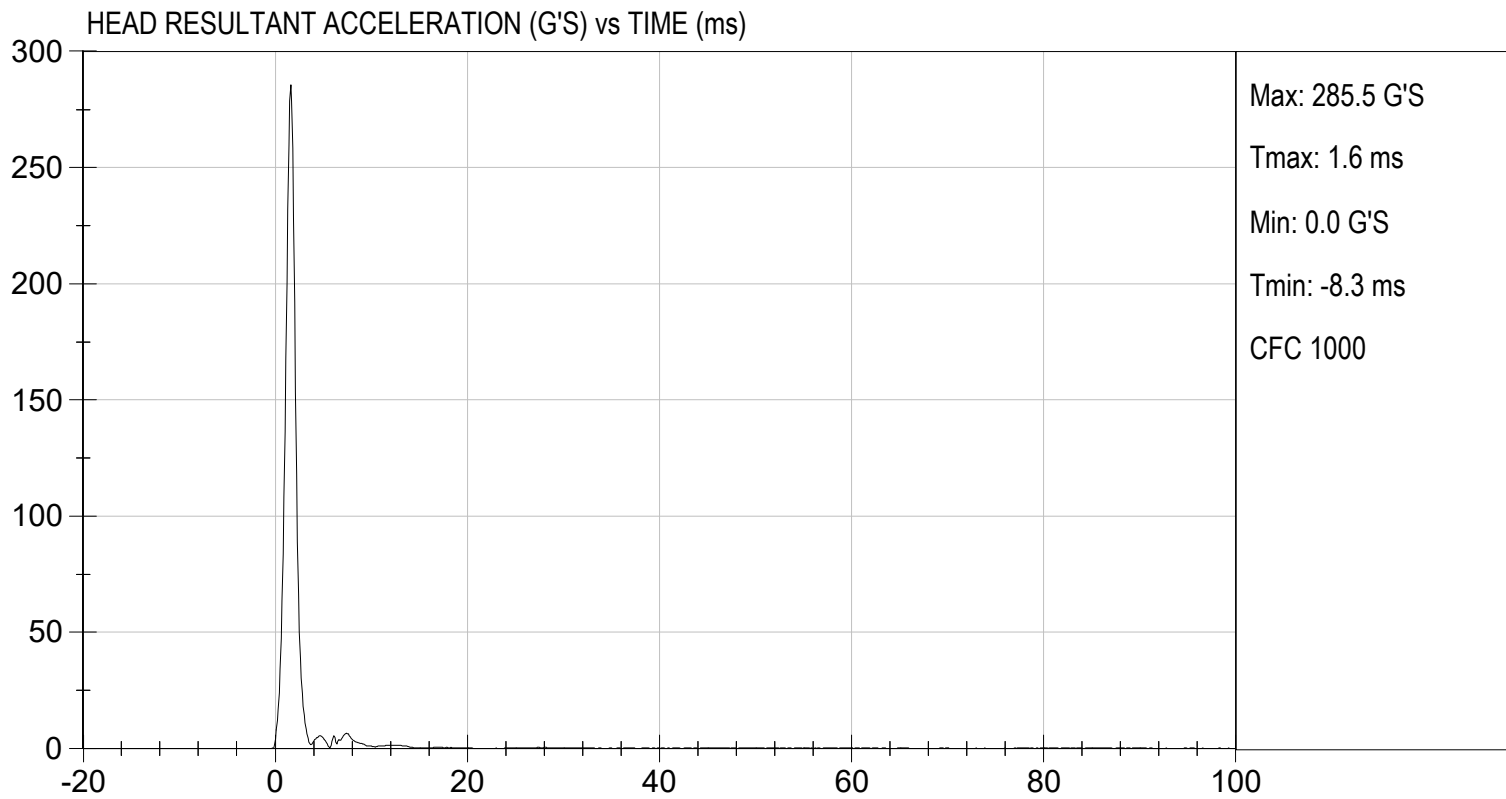
Test ID: D241341

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Peak Resultant Acceleration	G's	250 to 300	286	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	5.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

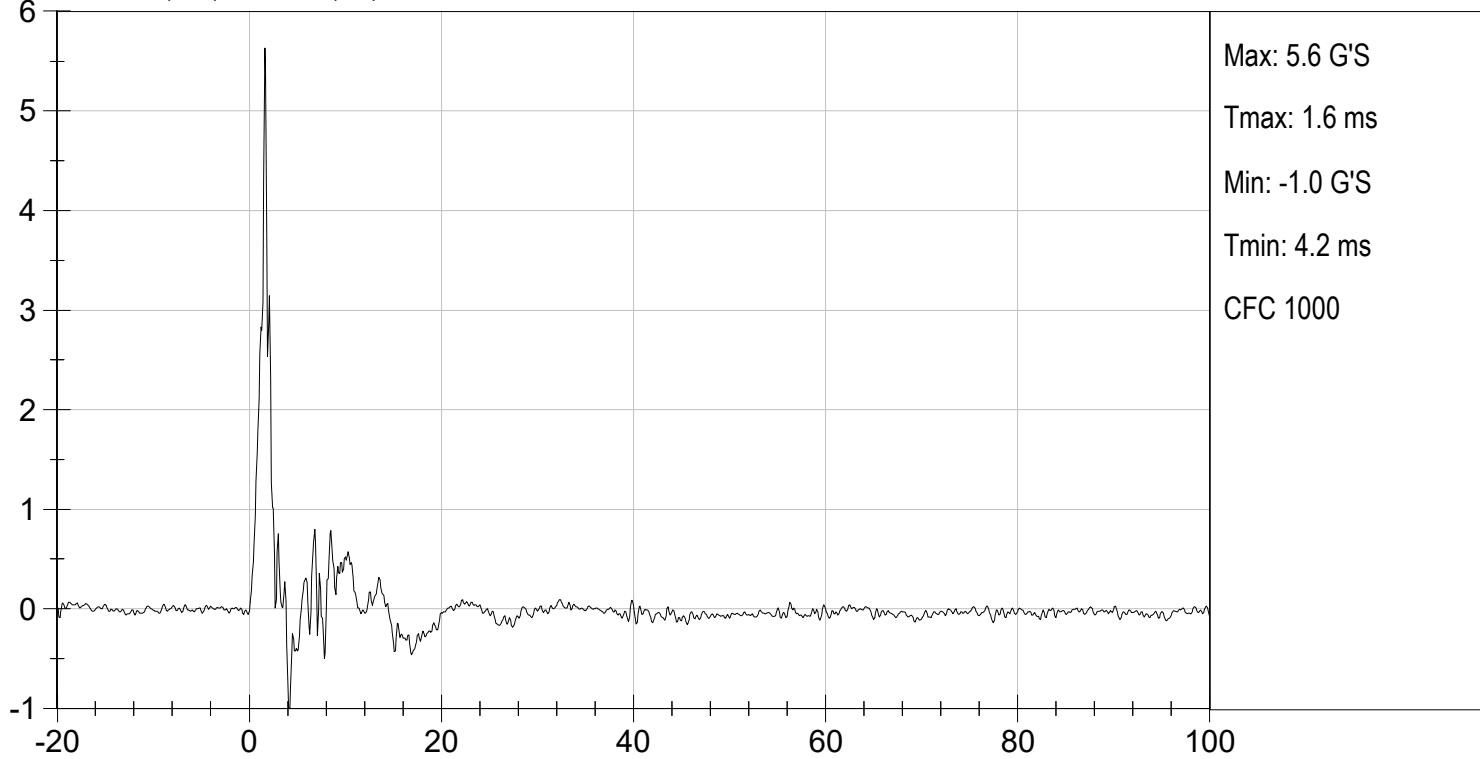

Laboratory Technician

06/03/2024
Test Date

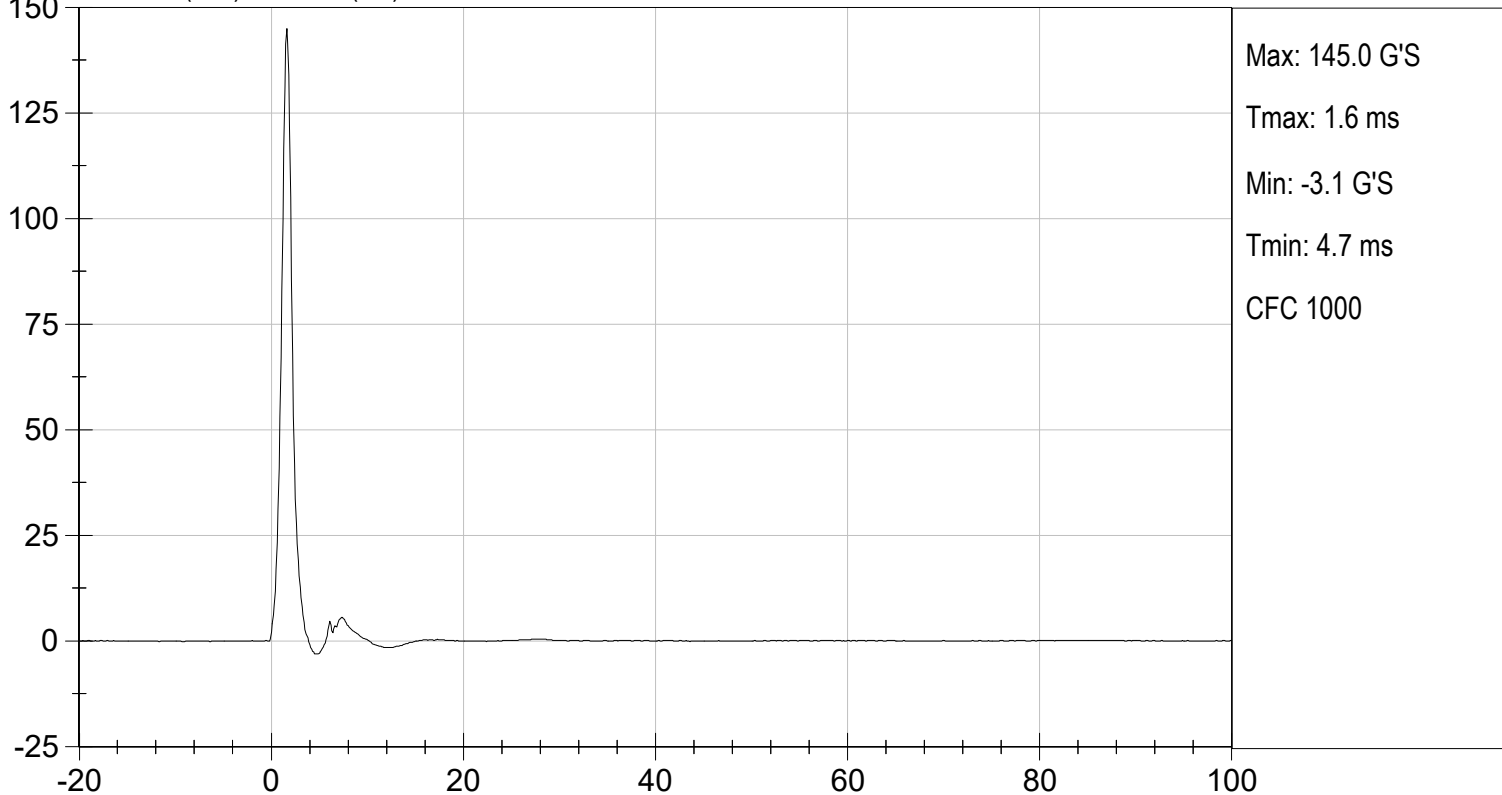

Approved By



HEAD Y (G'S) vs TIME (ms)



HEAD Z (G'S) vs TIME (ms)



MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

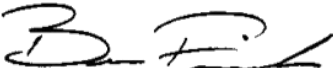
ATD Serial No: 142

Test I.D: D241342

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	46	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.6	Pass
	30 ms	m/s	5.8 to 7.0	6.8	Pass
D Plane Rotation	Max	deg	77 to 91	79	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	71	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	85	Pass
Overall Results					Pass


Laboratory Technician

06/03/2024
Test Date

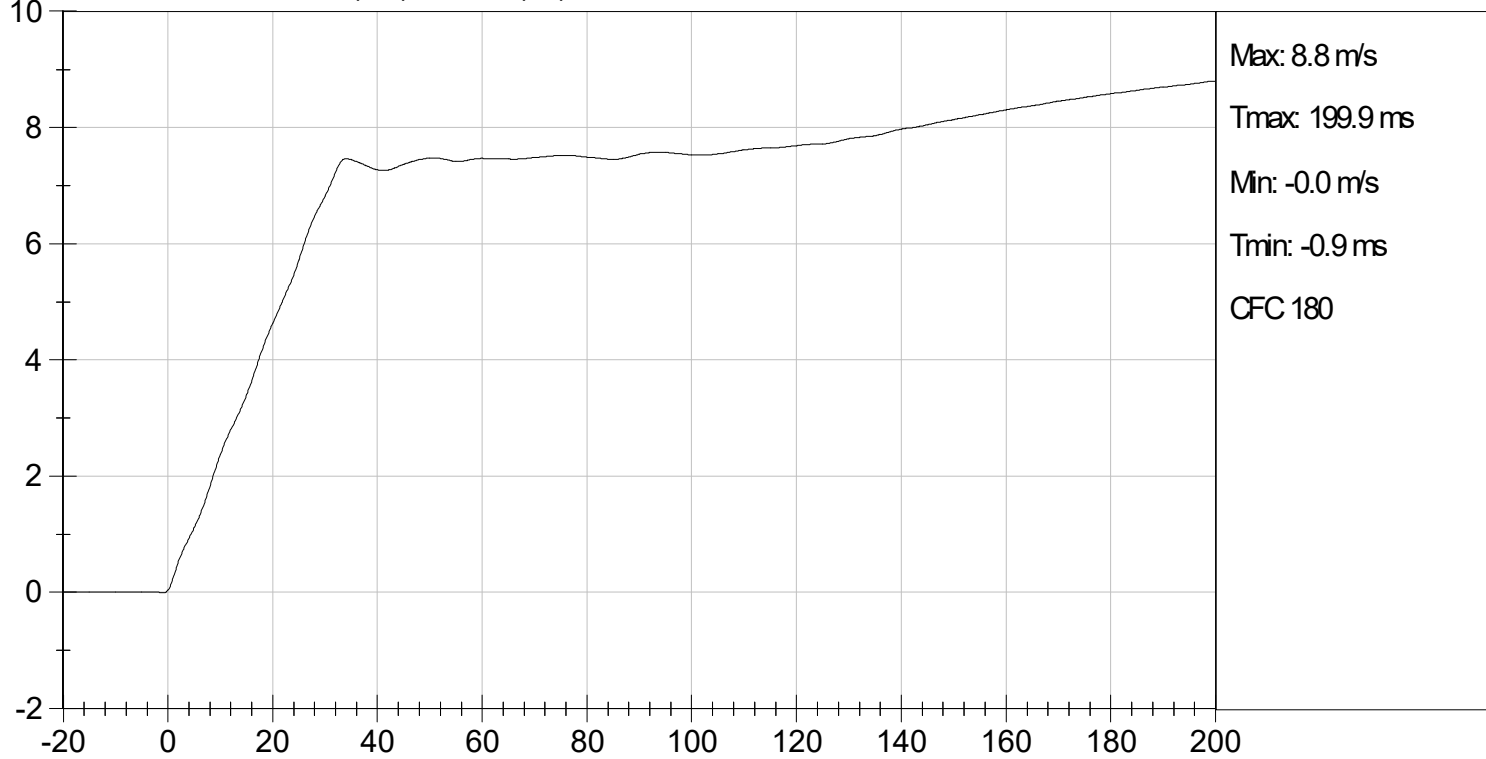

Approved By



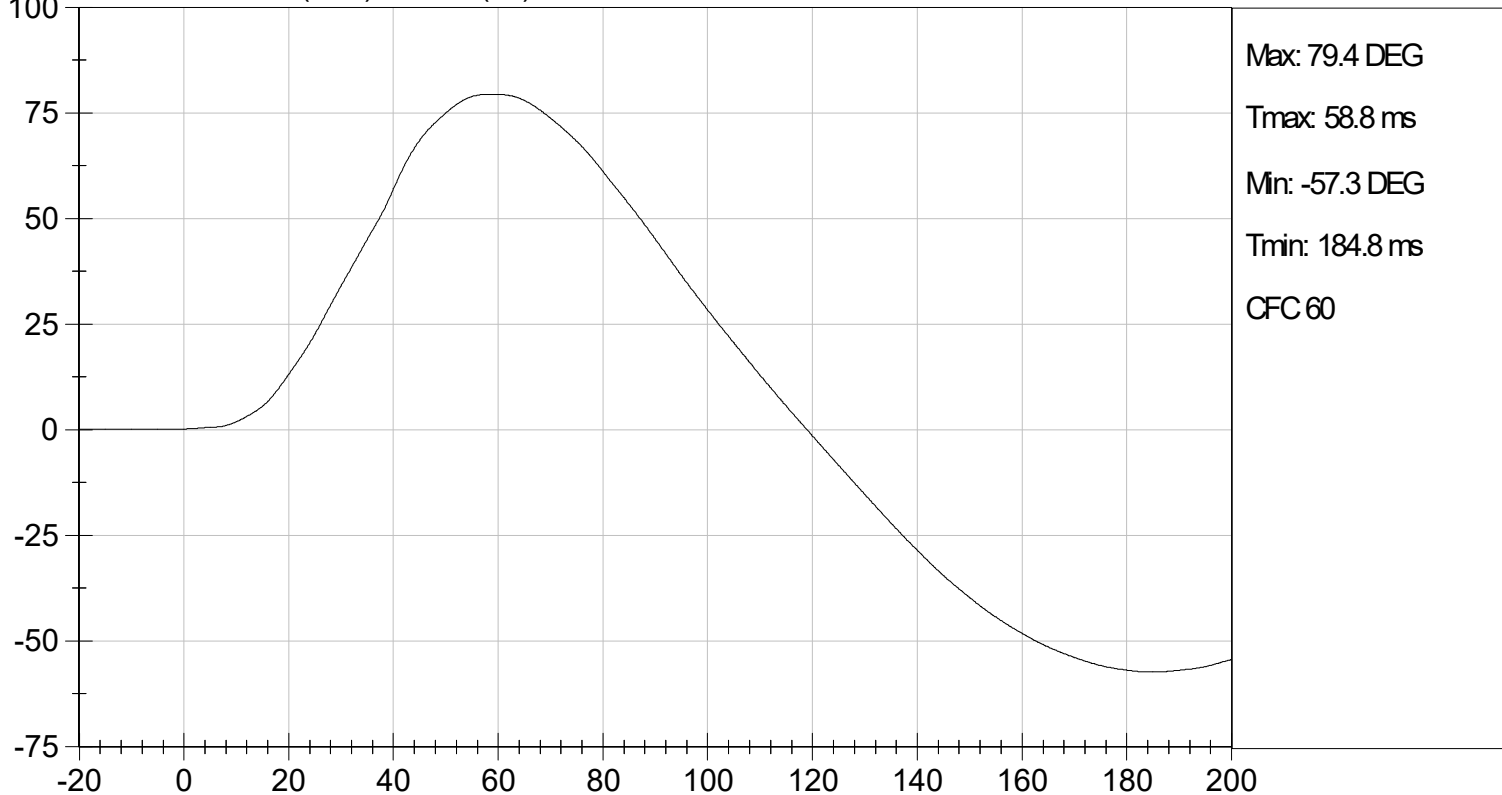
TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 06/03/2024
TEST #: D241342

PENDULUM VELOCITY (m/s) vs TIME (ms)



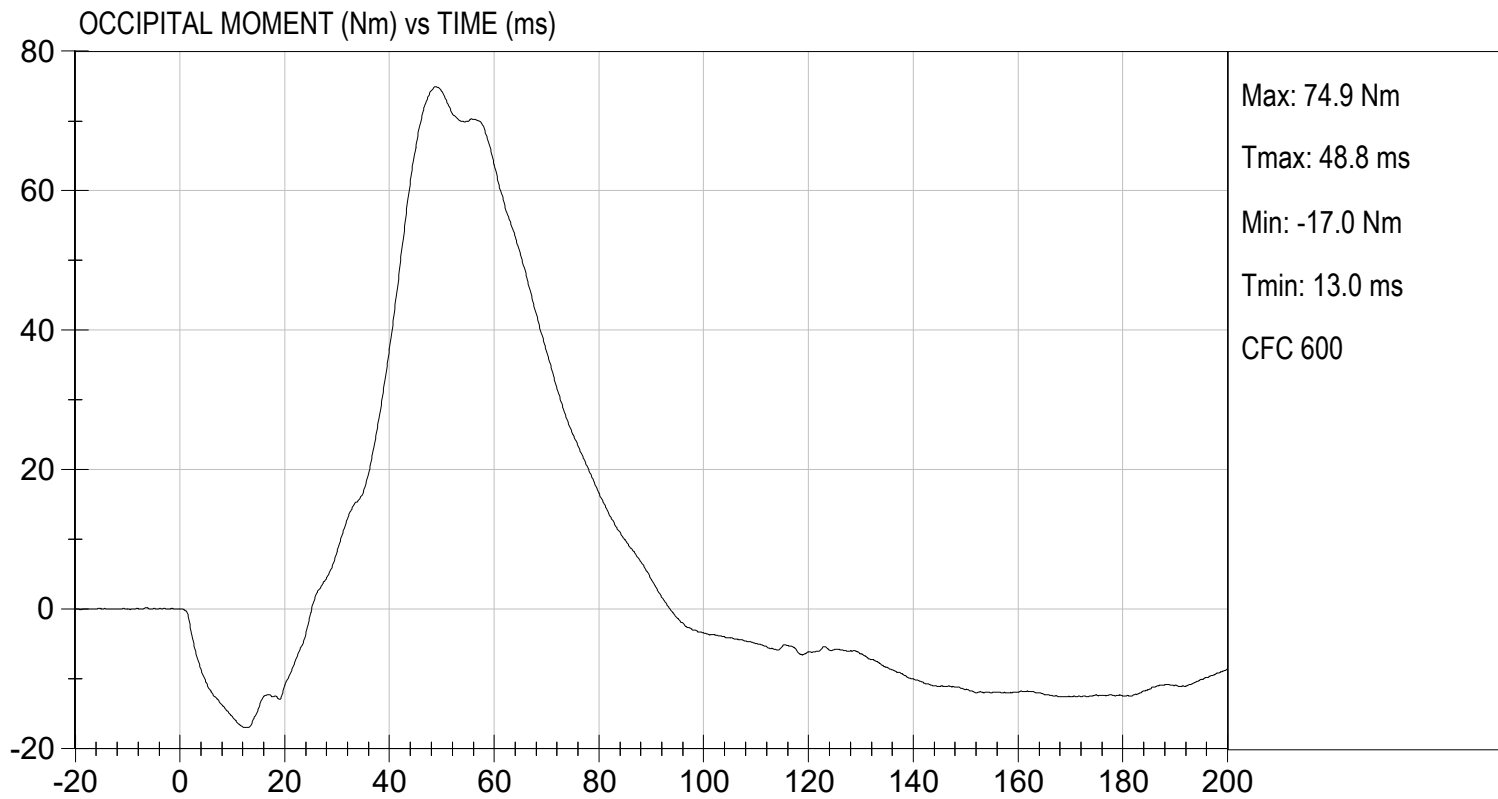
NECK ROTATION (DEG) vs TIME (ms)





TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 06/03/2024
TEST #: D241342



MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

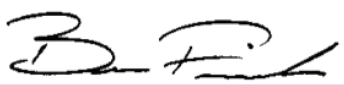
ATD Serial No: 142

Test I.D: D241343

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	46	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.4	Pass
D Plane Rotation	Max	deg	99 to 114	109	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	106	Pass
Overall Results					Pass


 Laboratory Technician

06/03/2024
 Test Date

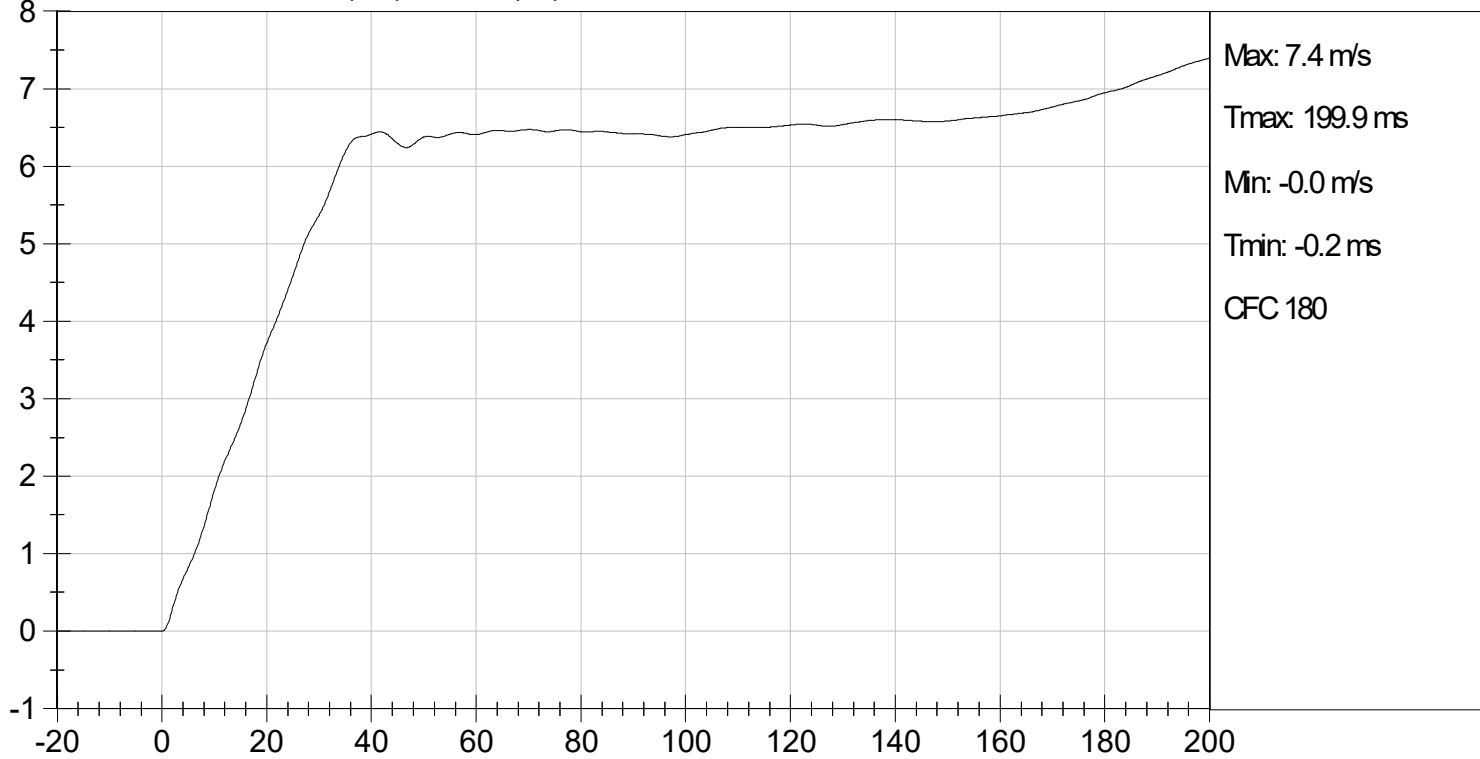

 Approved By



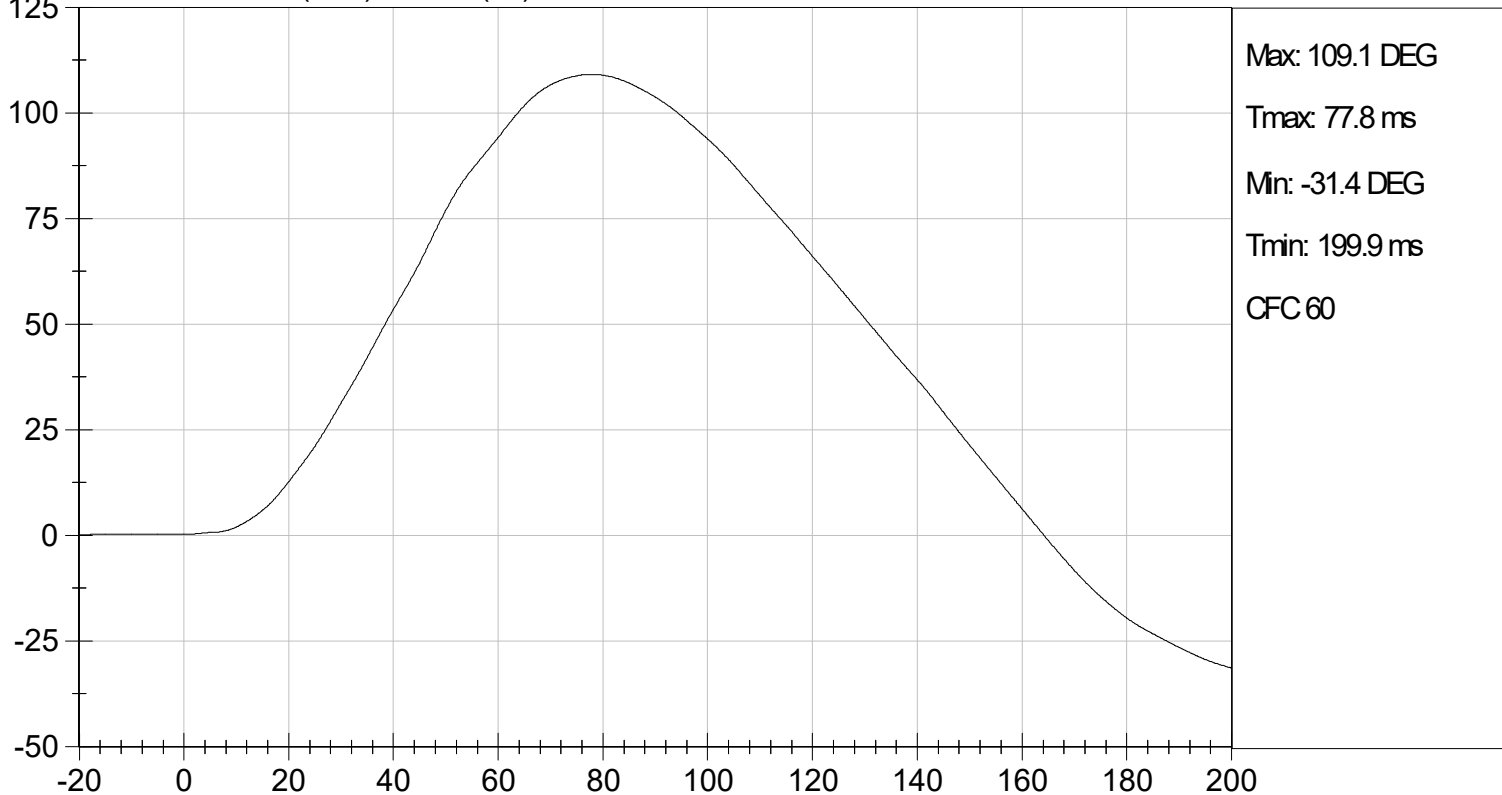
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 06/03/2024
TEST #: D241343

PENDULUM VELOCITY (m/s) vs TIME (ms)



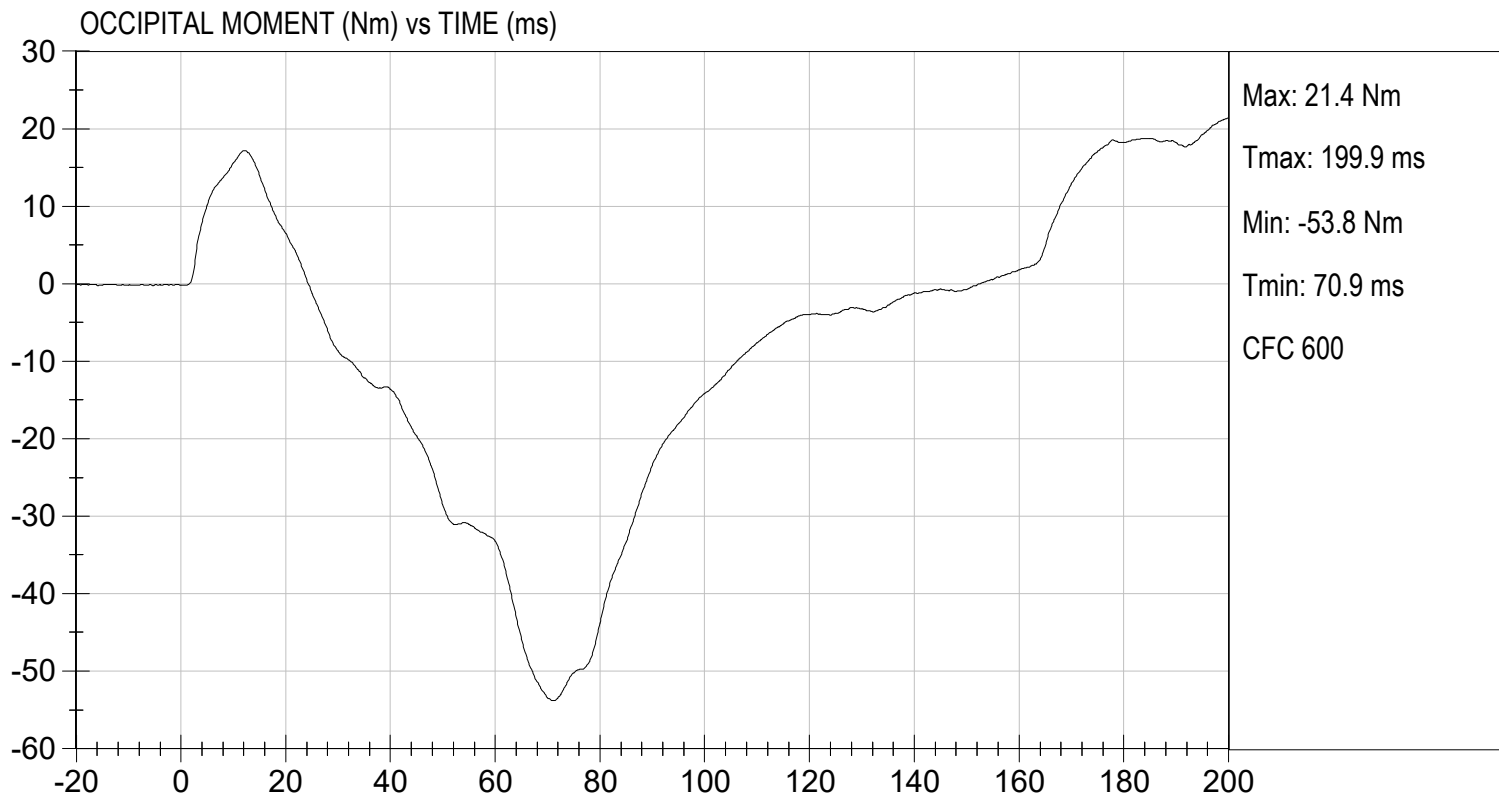
NECK ROTATION (DEG) vs TIME (ms)





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

TEST DATE: 06/03/2024
TEST #: D241343



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 5TH PERCENTILE

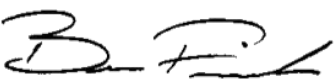
ATD Serial No: 142

Test I.D: D241344

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Relative Humidity	%	10 to 70	49	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	53	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4321	Pass
Internal Hysteresis	%	69 to 85	75	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4320	Pass
Overall Test Results			Pass	


Laboratory Technician

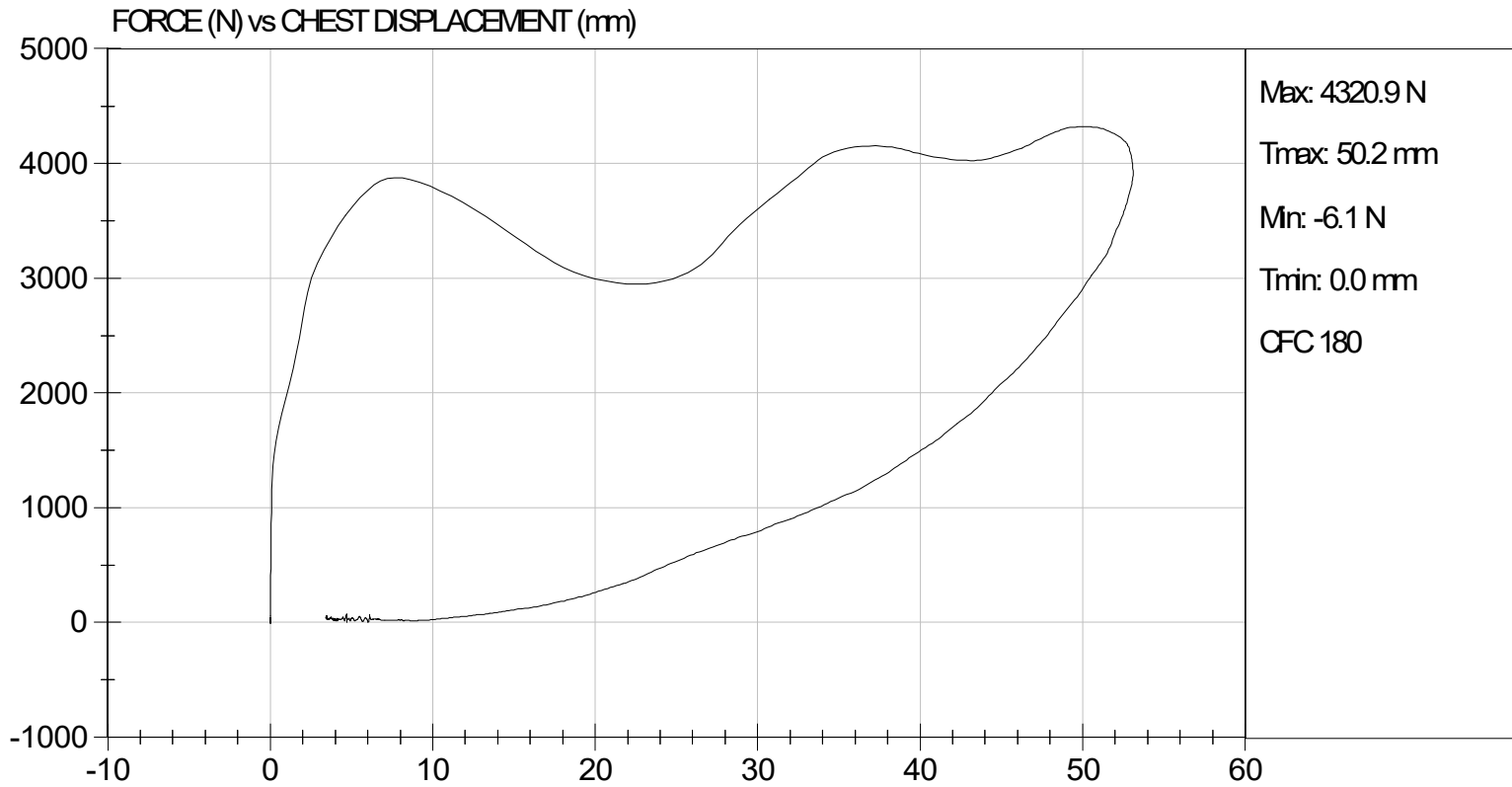
06/03/2024
Test Date


Approved By



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

TEST DATE: 06/03/2024
TEST #: D241344



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

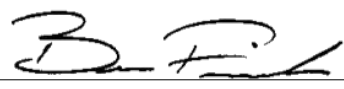
ATD Serial No: 142

Test I.D: D241345

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Probe Speed	m/s	2.07 to 2.13	2.09	Pass
Maximum Force	N	3450 to 4060	3789	Pass
			Overall Test Results	Pass


Laboratory Technician

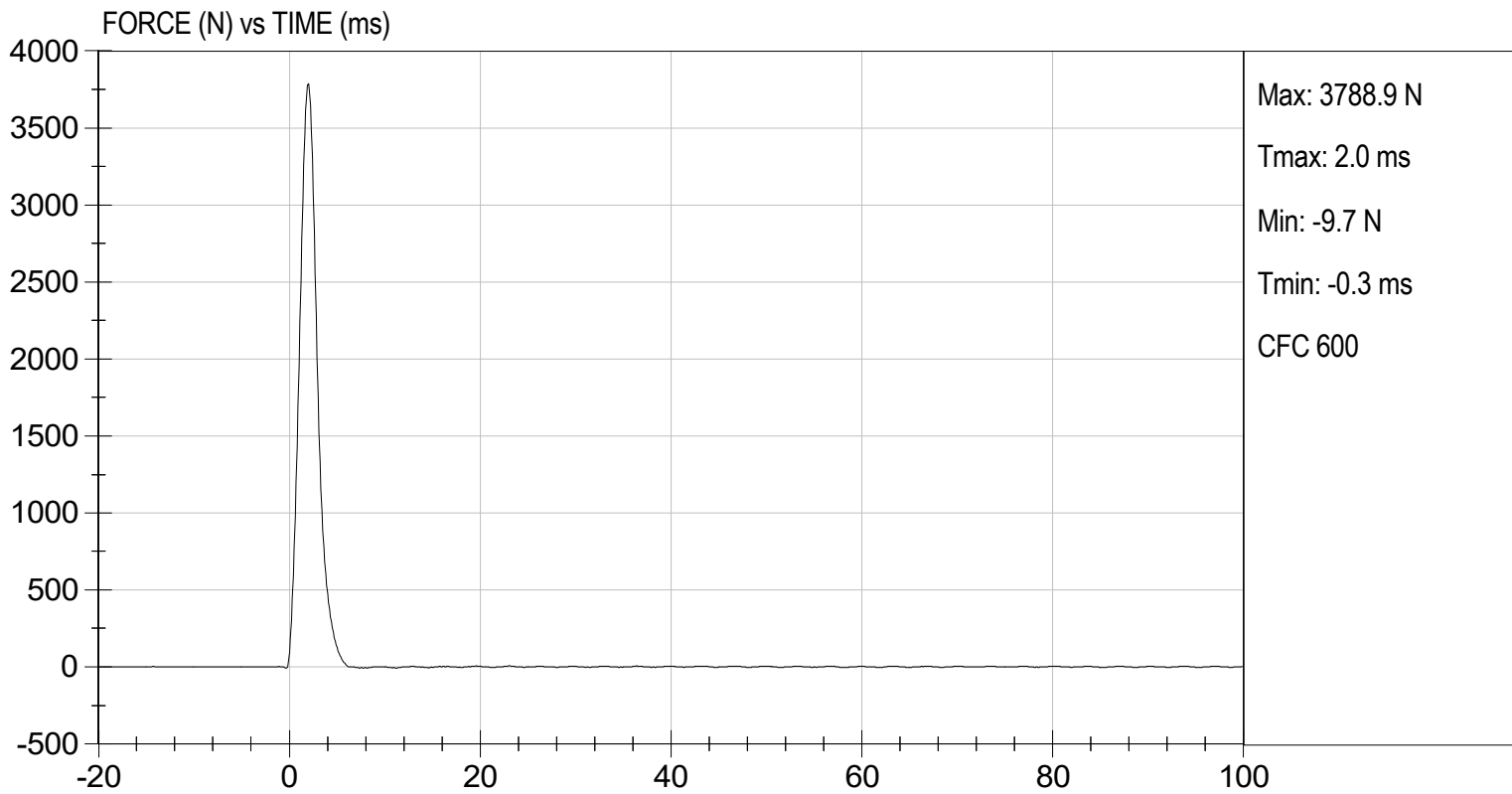
06/03/2024
Test Date


Approved By



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

TEST DATE: 06/03/2024
TEST #: D241345



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

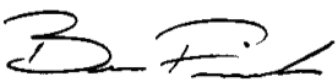
ATD Serial No: 142

Test I.D: D241346

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	3812	Pass
Overall Test Results			Pass	


Laboratory Technician

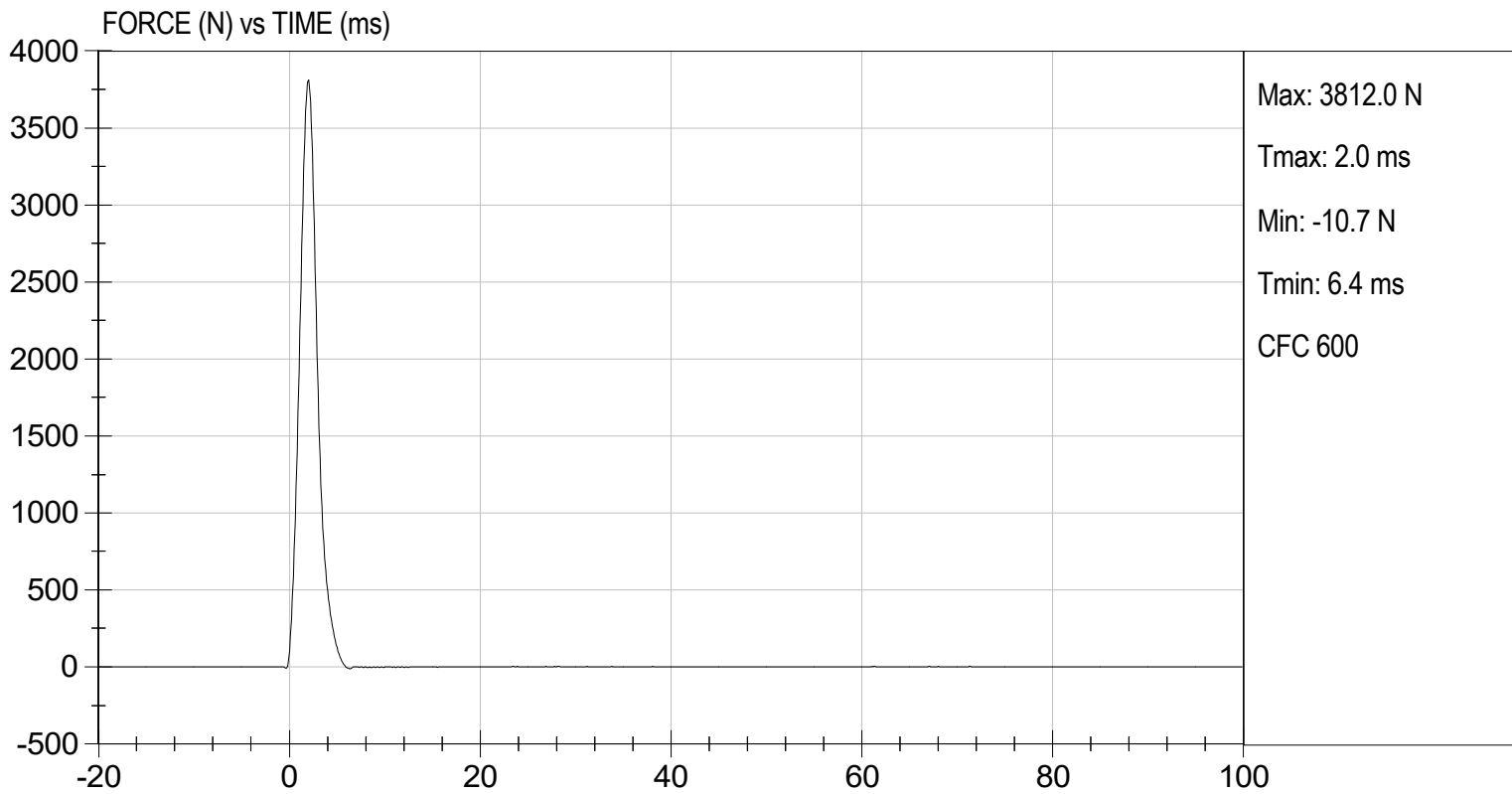
06/03/2024
Test Date


Approved By



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

TEST DATE: 06/03/2024
TEST #: D241346



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

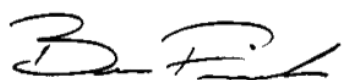
ATD Serial No: 142

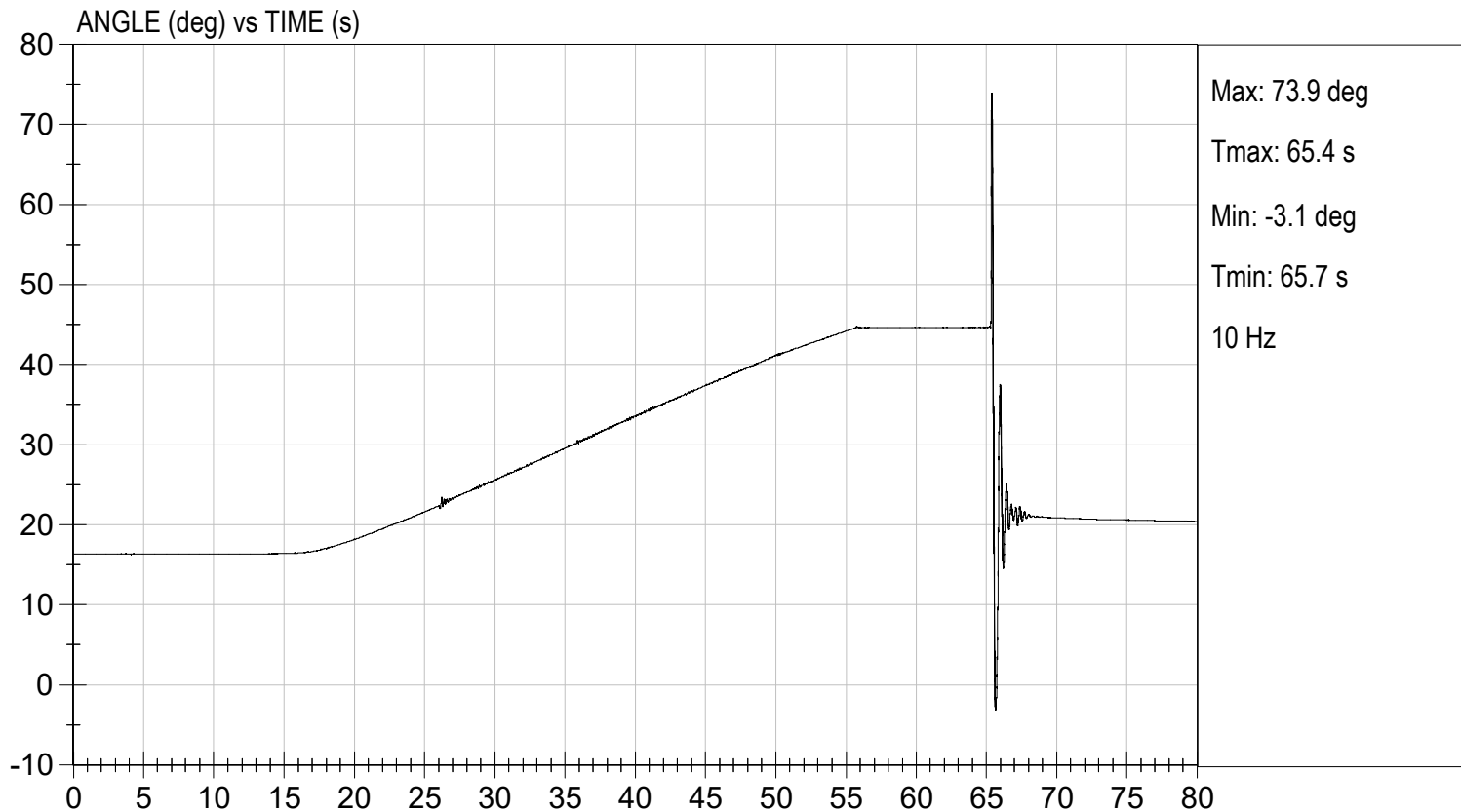
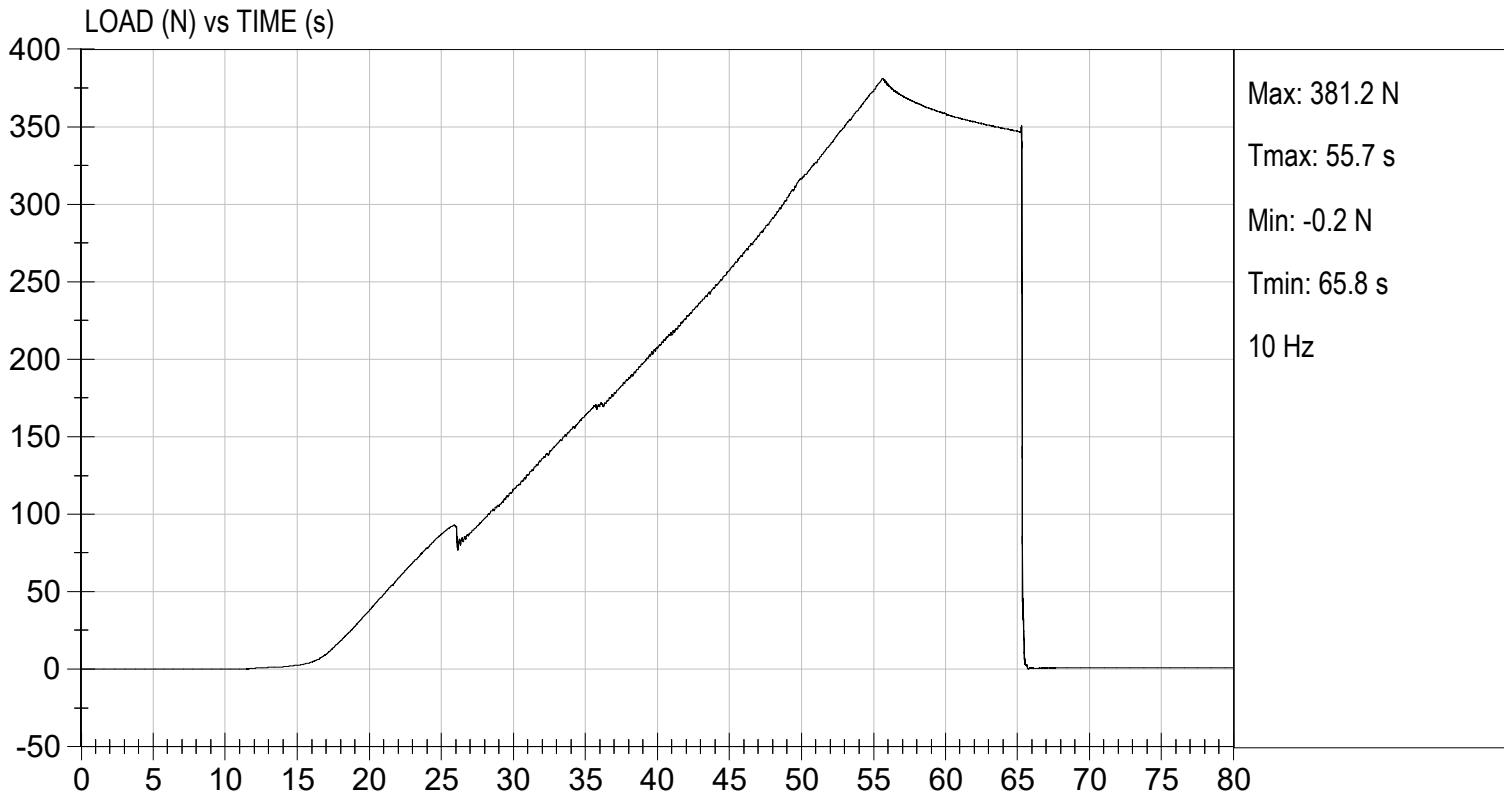
Test I.D: D241347

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	46	Pass
Initial Angle	deg	0 to 20	16	Pass
Return Angle	deg	+/- 8	4	Pass
Force at 45 deg	N	320 to 390	381	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.7	Pass
Overall Result			Pass	


Laboratory Technician

06/03/2024
Test Date


Approved By



QUALIFICATION TEST RESULTS

POST-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 142

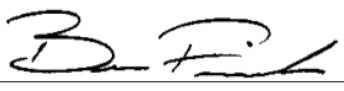
Test ID: D241481

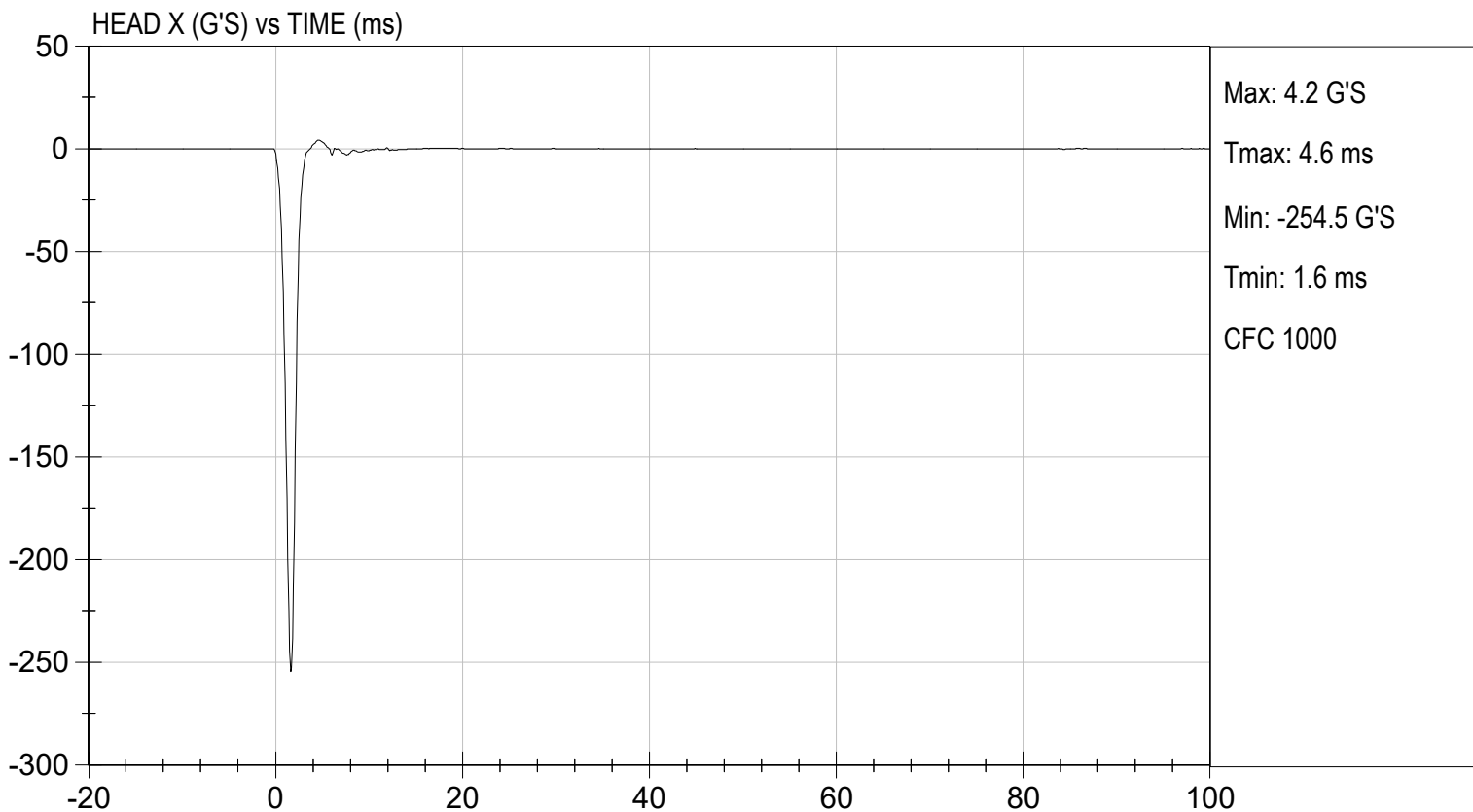
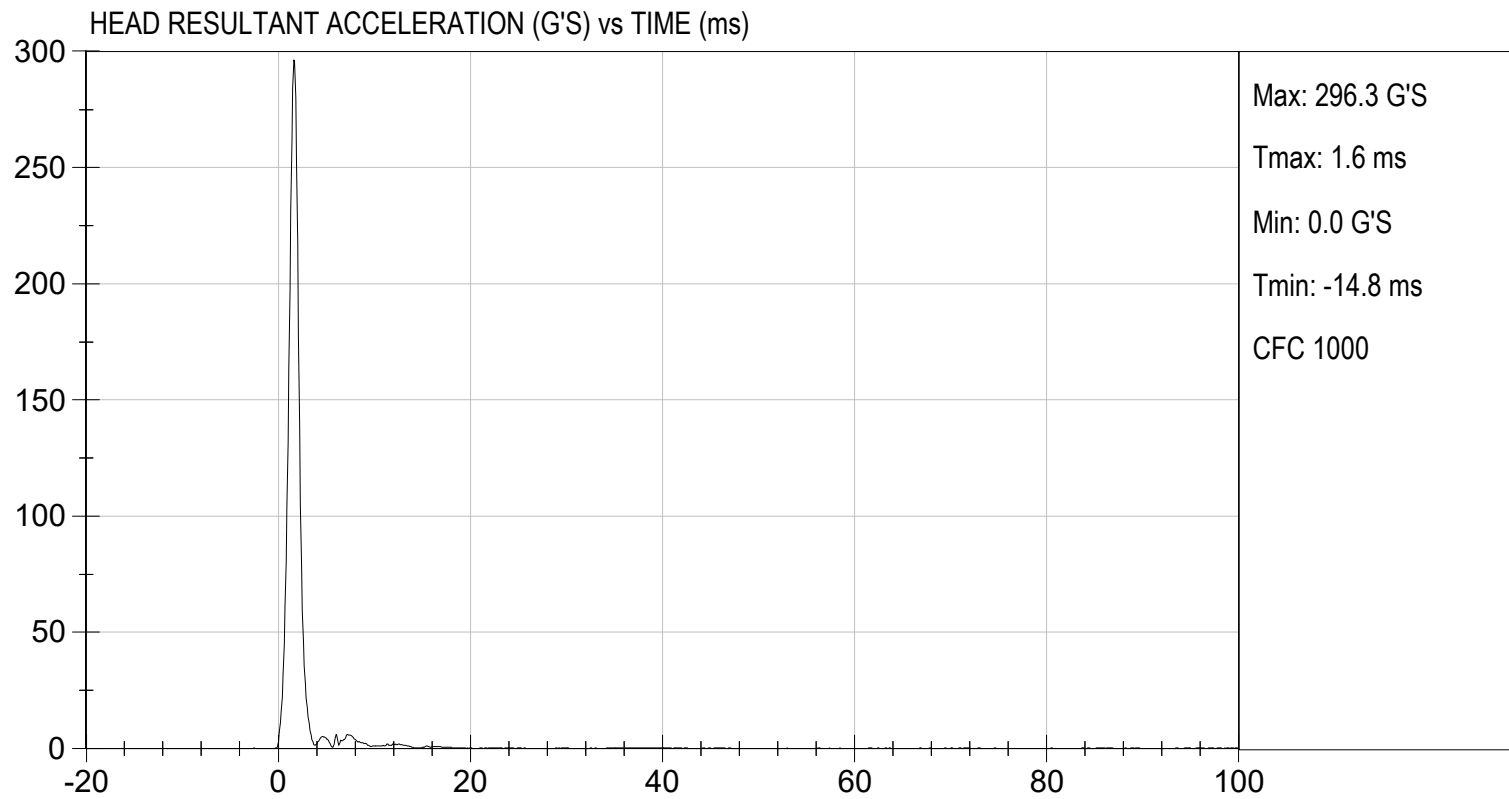
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	50	Pass
Peak Resultant Acceleration	G's	250 to 300	296	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	9.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

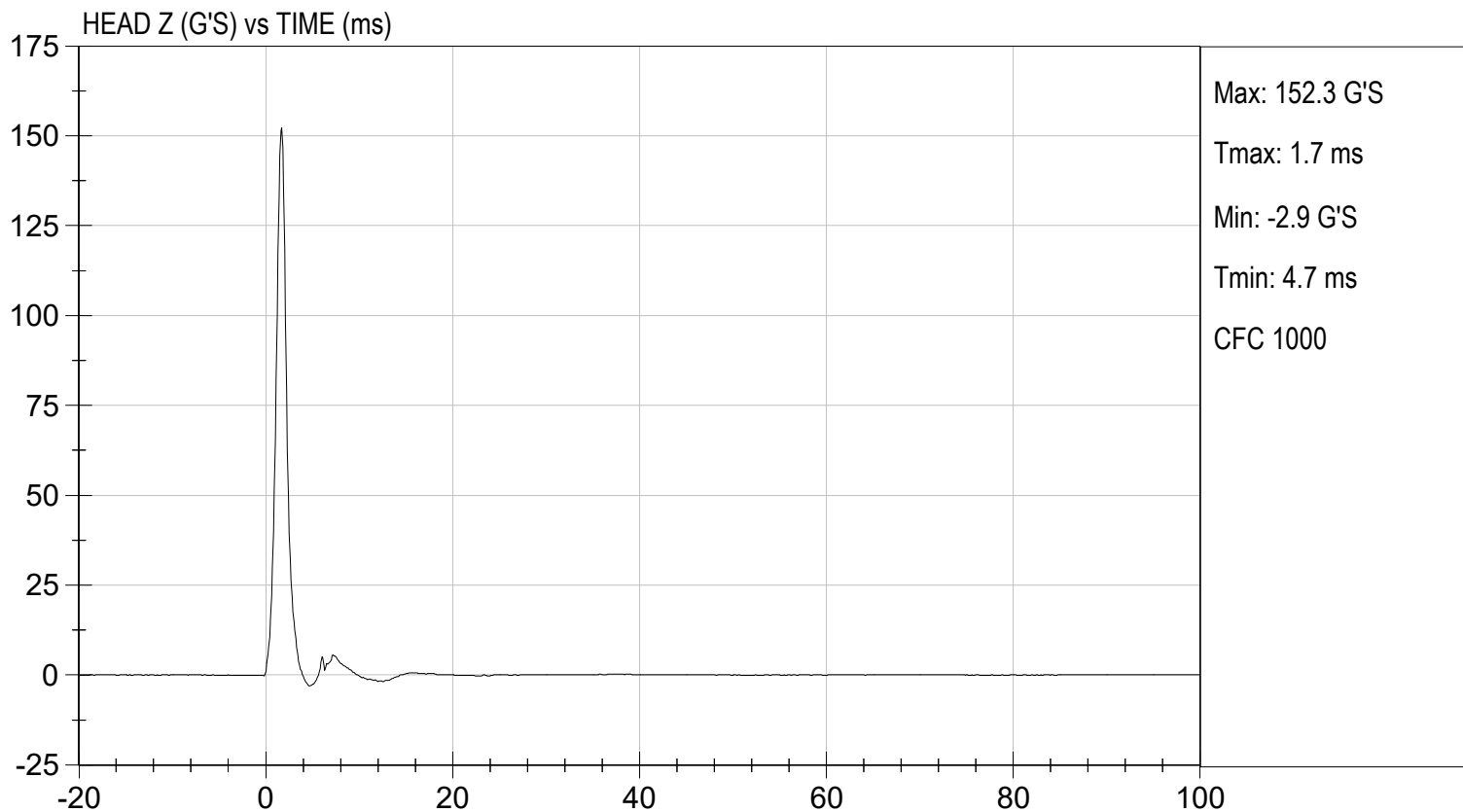
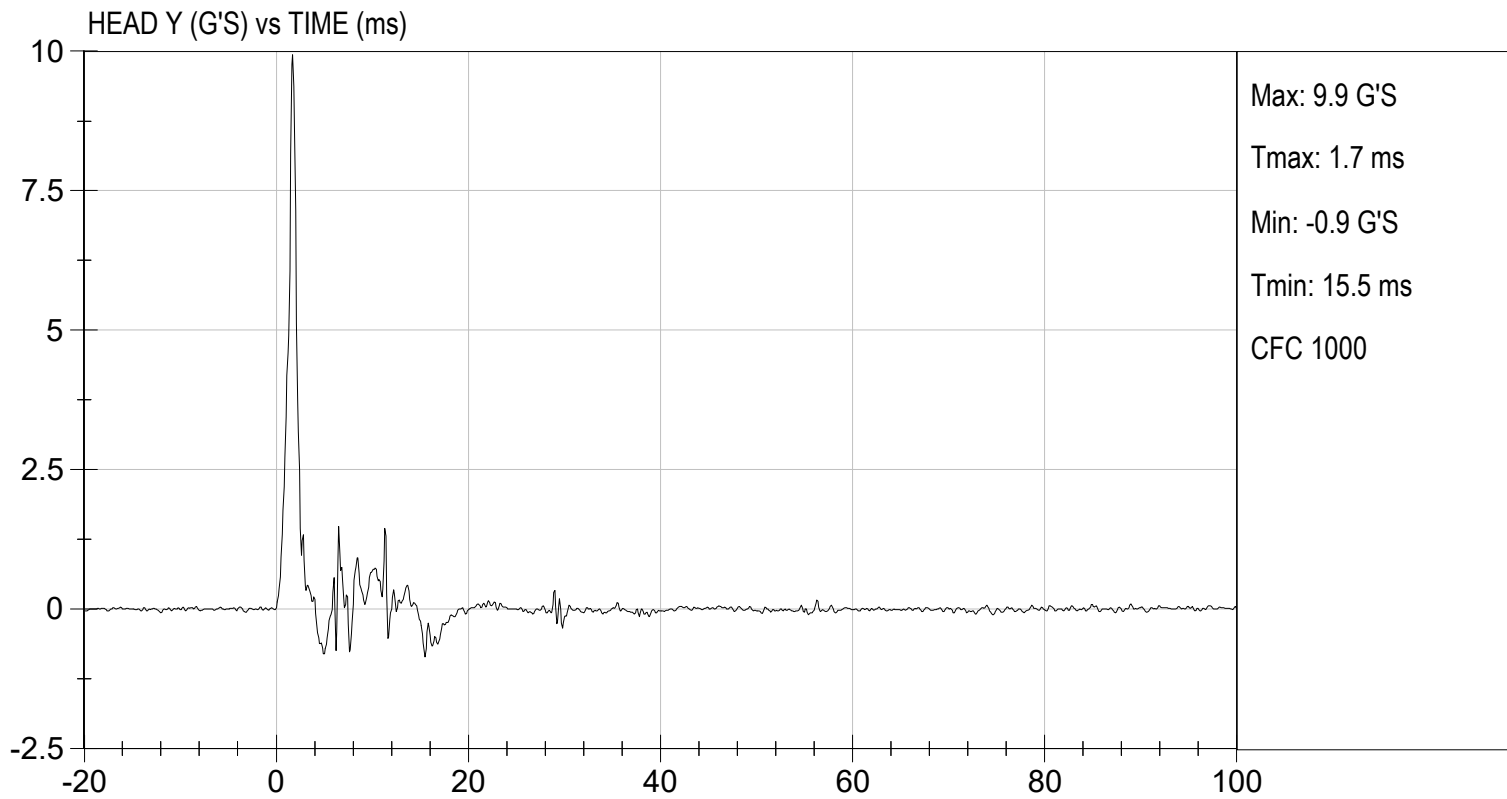

Laboratory Technician

06/19/2024

Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

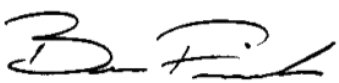
ATD Serial No: 142

Test I.D: D241482

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	46	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	6.8	Pass
D Plane Rotation	Max	deg	77 to 91	80	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	76	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	85	Pass
Overall Results					Pass


Laboratory Technician

06/19/2024
Test Date

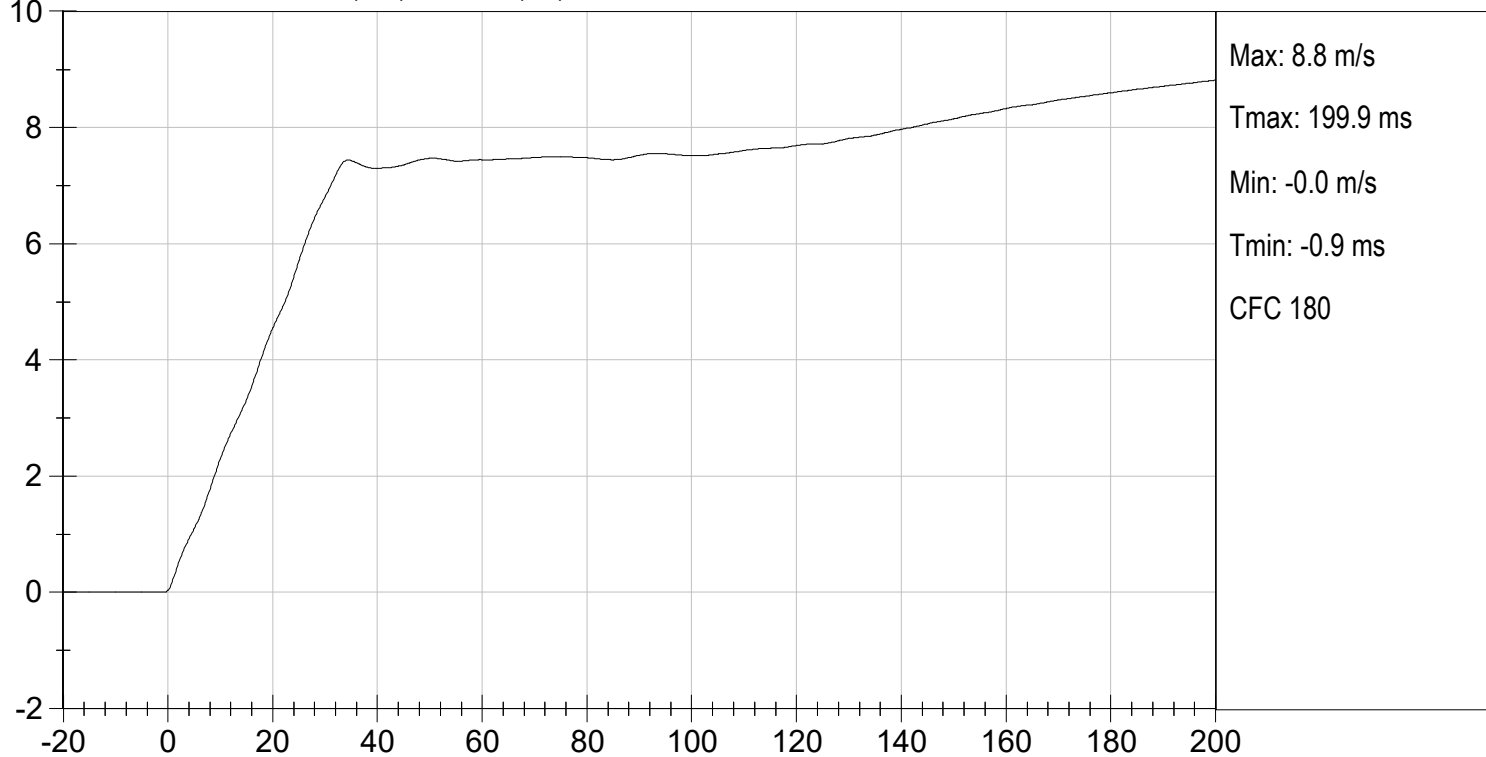

Approved By



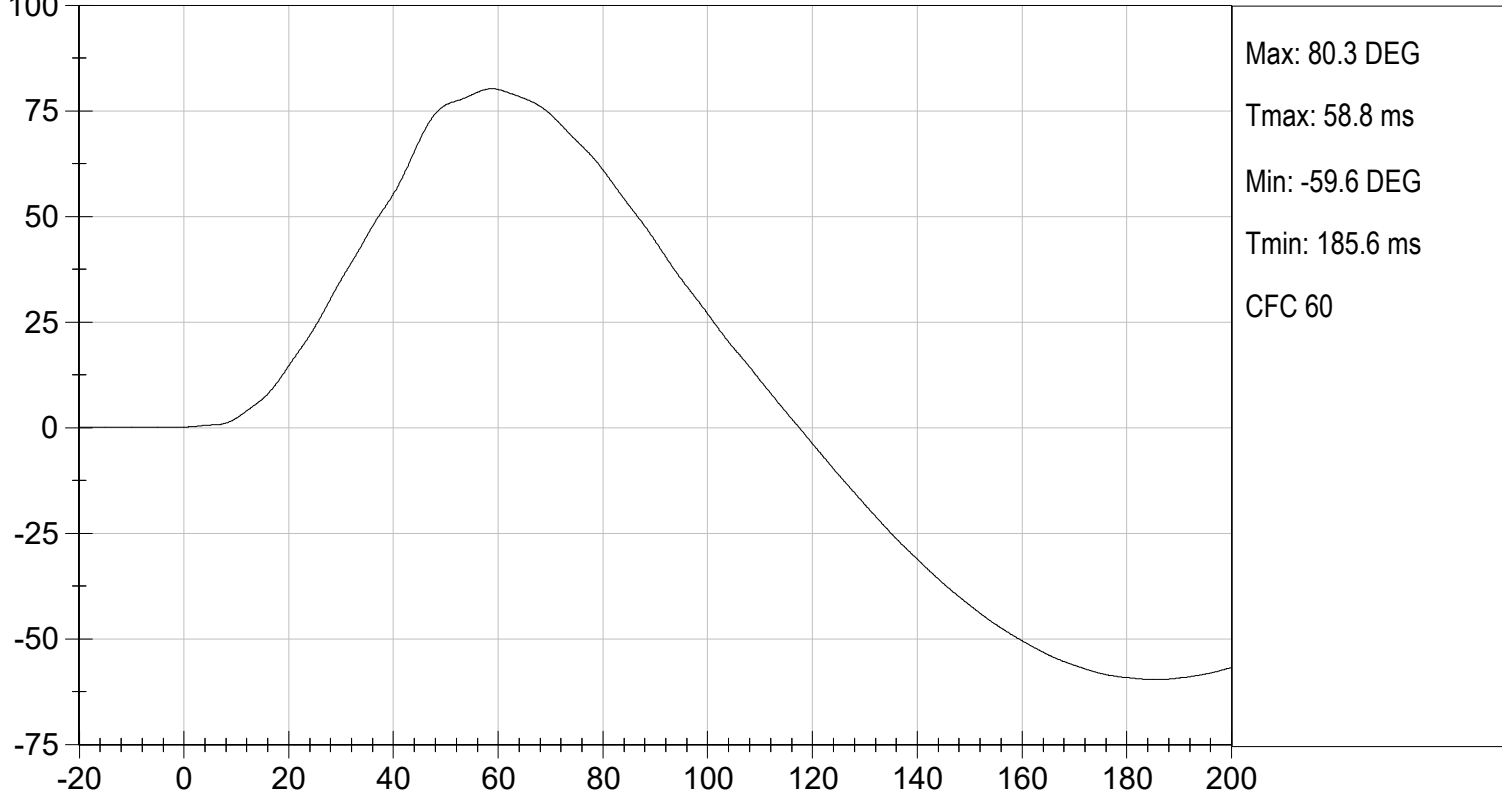
TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 06/19/2024
TEST #: D241482

PENDULUM VELOCITY (m/s) vs TIME (ms)



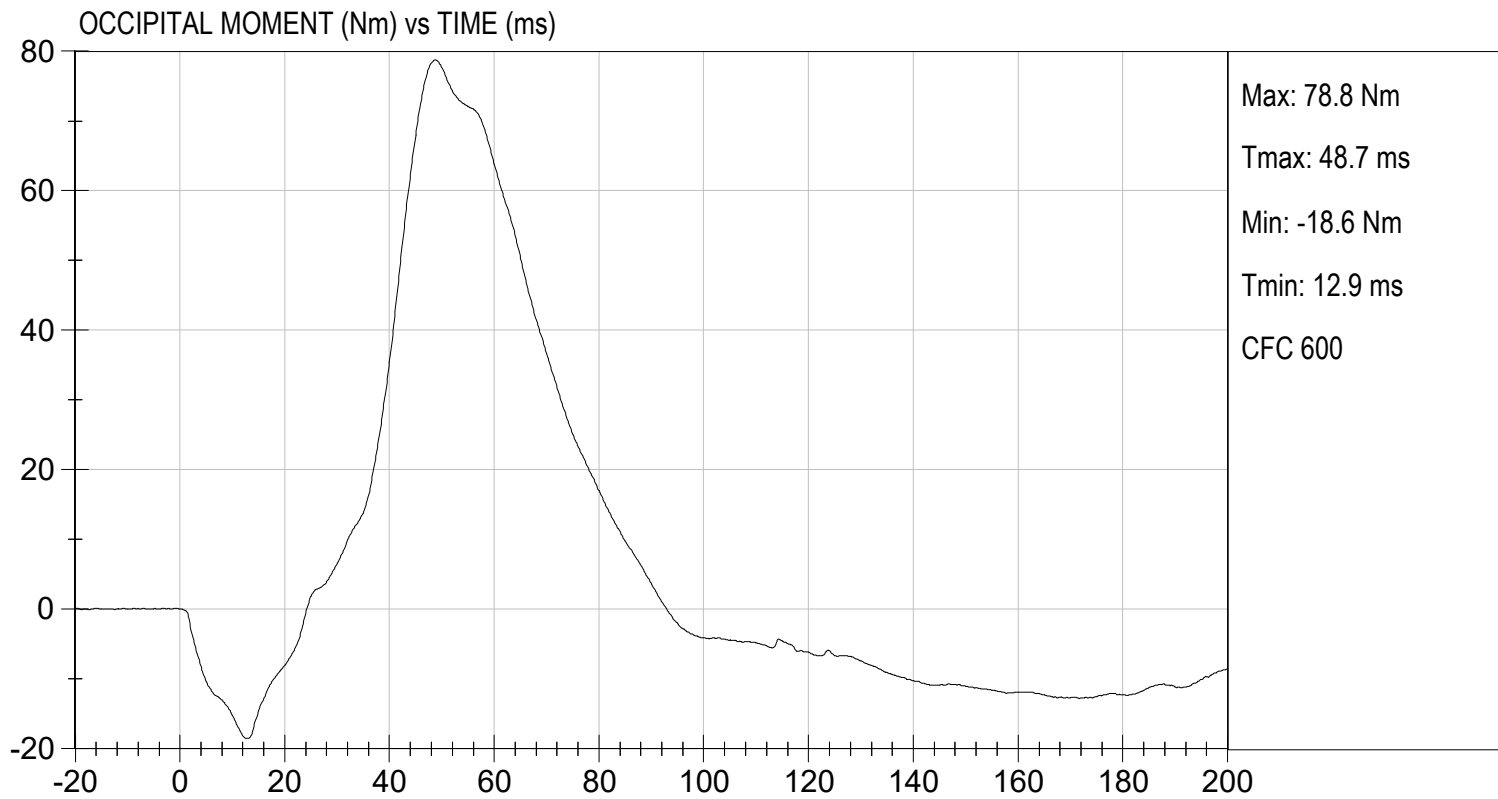
NECK ROTATION (DEG) vs TIME (ms)





TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 06/19/2024
TEST #: D241482



MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

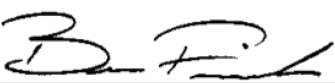
ATD Serial No: 142

Test I.D: D241483

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	49	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.3	Pass
D Plane Rotation	Max	deg	99 to 114	110	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-53	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	108	Pass
Overall Results					Pass


Laboratory Technician

06/19/2024
Test Date

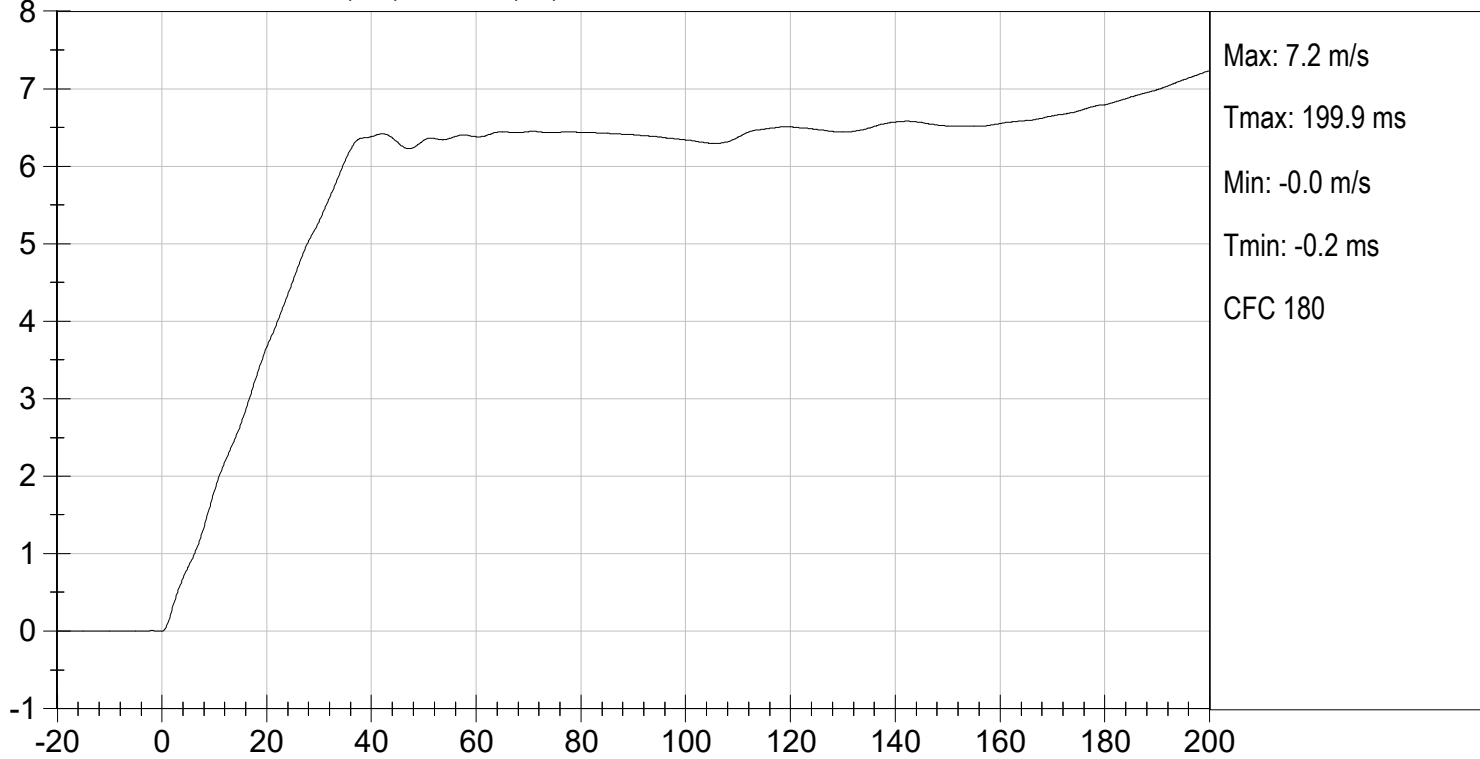

Approved By



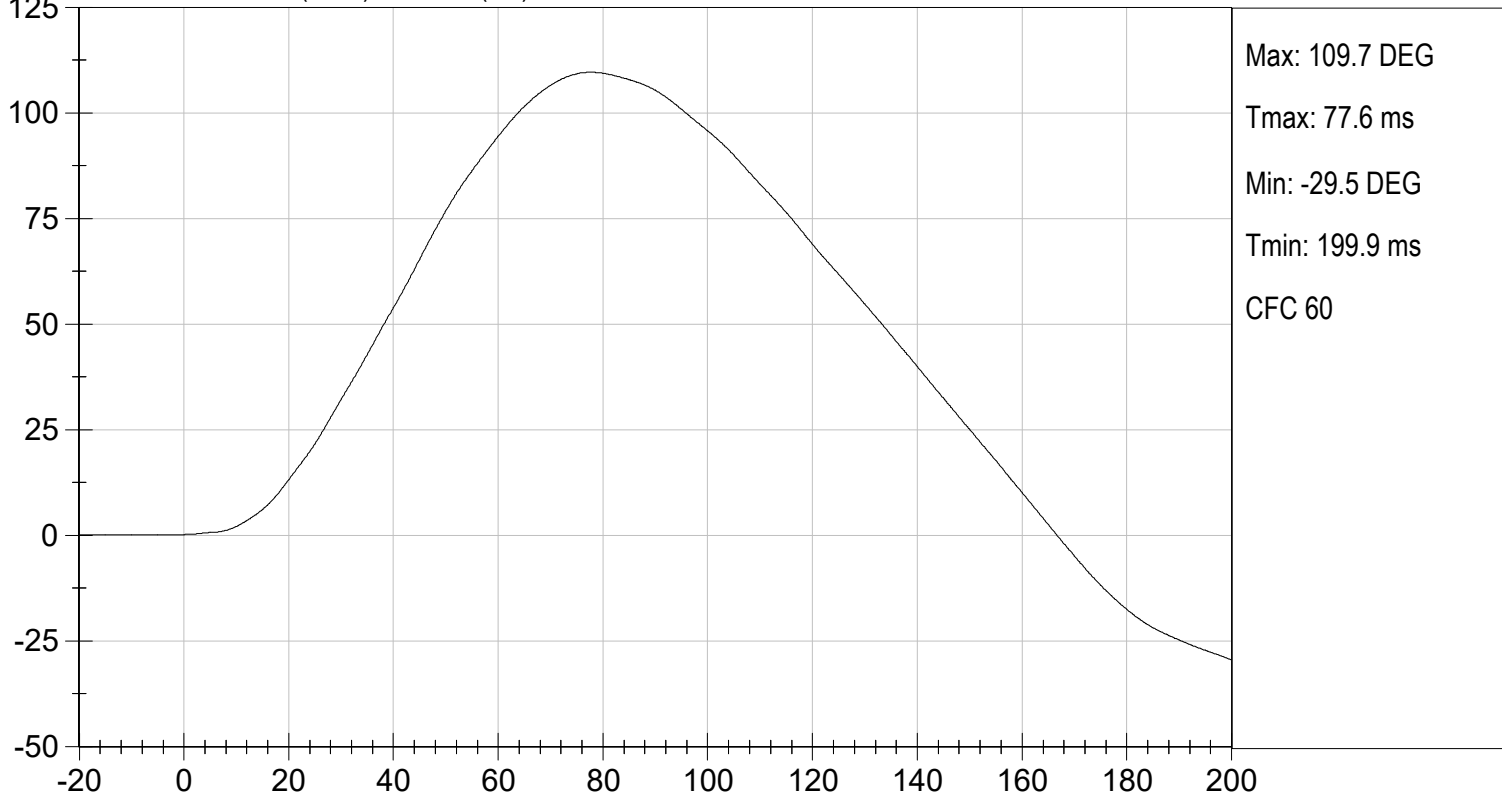
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 06/19/2024
TEST #: D241483

PENDULUM VELOCITY (m/s) vs TIME (ms)



NECK ROTATION (DEG) vs TIME (ms)





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

TEST DATE: 06/19/2024
TEST #: D241483



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 5TH PERCENTILE

ATD Serial No: 142

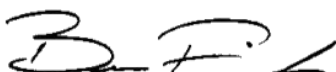
Test I.D: D241484

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Relative Humidity	%	10 to 70	49	Pass
Probe Speed	m/s	6.59 to 6.83	6.68	Pass
Peak Deflection	mm	50 to 58	51	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4175	Pass
Internal Hysteresis	%	69 to 85	75	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4271	Pass
Overall Test Results			Pass	


Laboratory Technician

06/19/2024

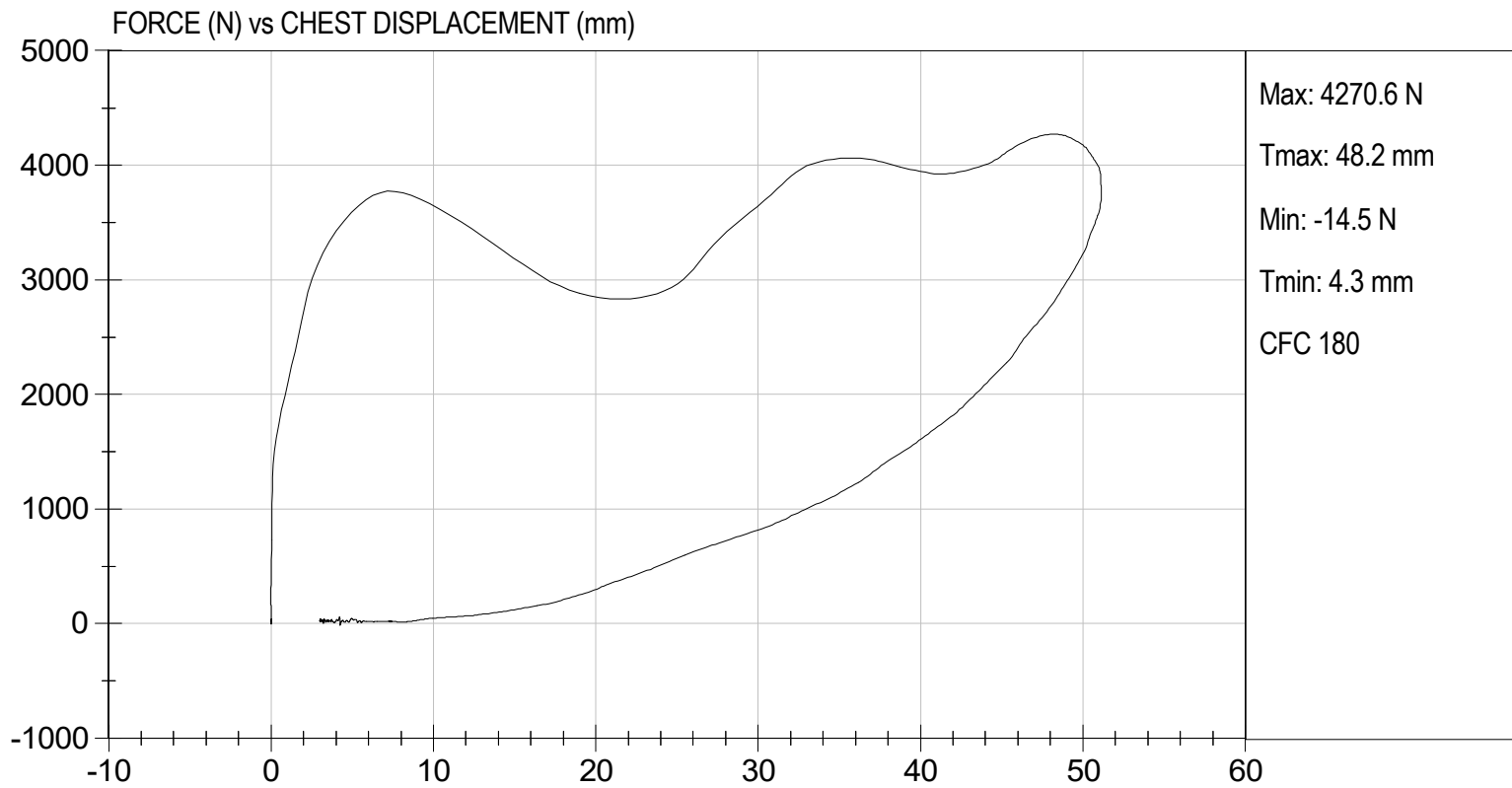
Test Date


Approved By



TEST DESC: THORAX IMPACT
VELOCITY: 21.93 ft/s, 6.68 m/s

TEST DATE: 06/19/2024
TEST #: D241484



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

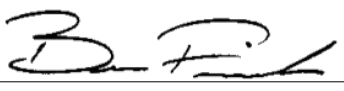
ATD Serial No: 142

Test I.D: D241485

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	3875	Pass
Overall Test Results				Pass


Laboratory Technician

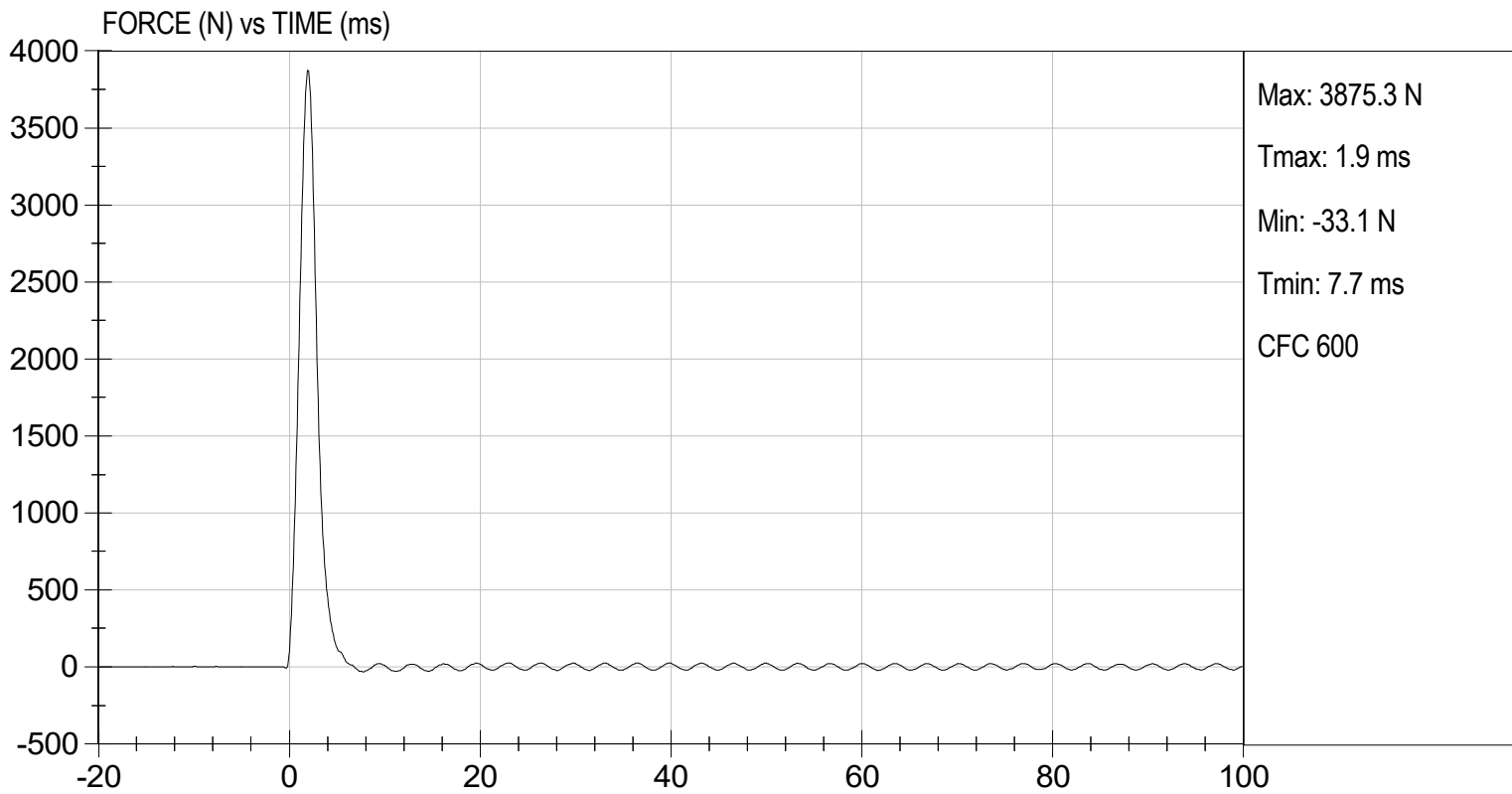
06/19/2024
Test Date


Approved By



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

TEST DATE: 06/19/2024
TEST #: D241485



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

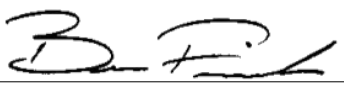
ATD Serial No: 142

Test I.D: D241486

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	4043	Pass
Overall Test Results				Pass


Laboratory Technician

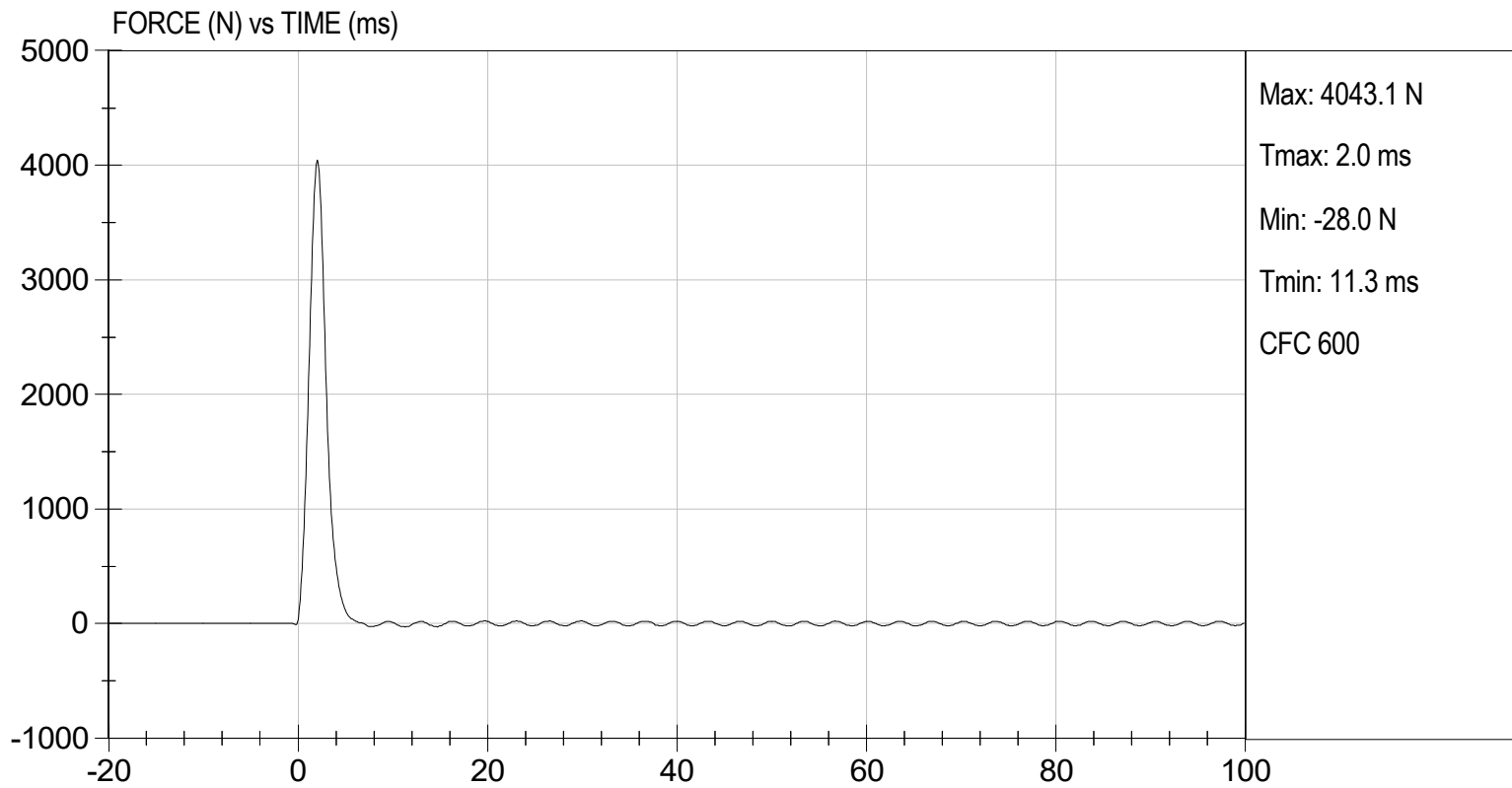
06/19/2024
Test Date


Approved By



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

TEST DATE: 06/19/2024
TEST #: D241486



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

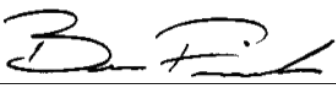
ATD Serial No: 142

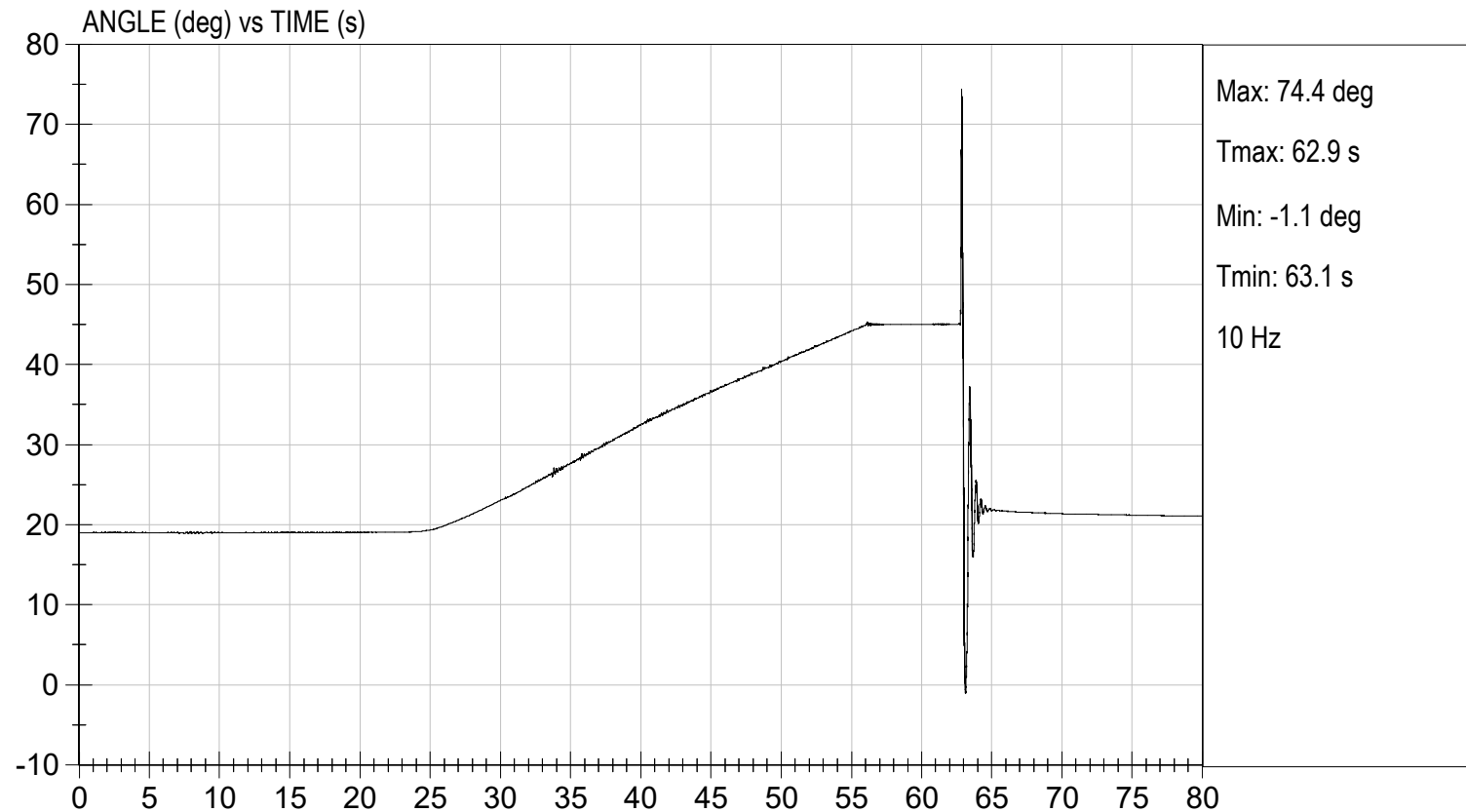
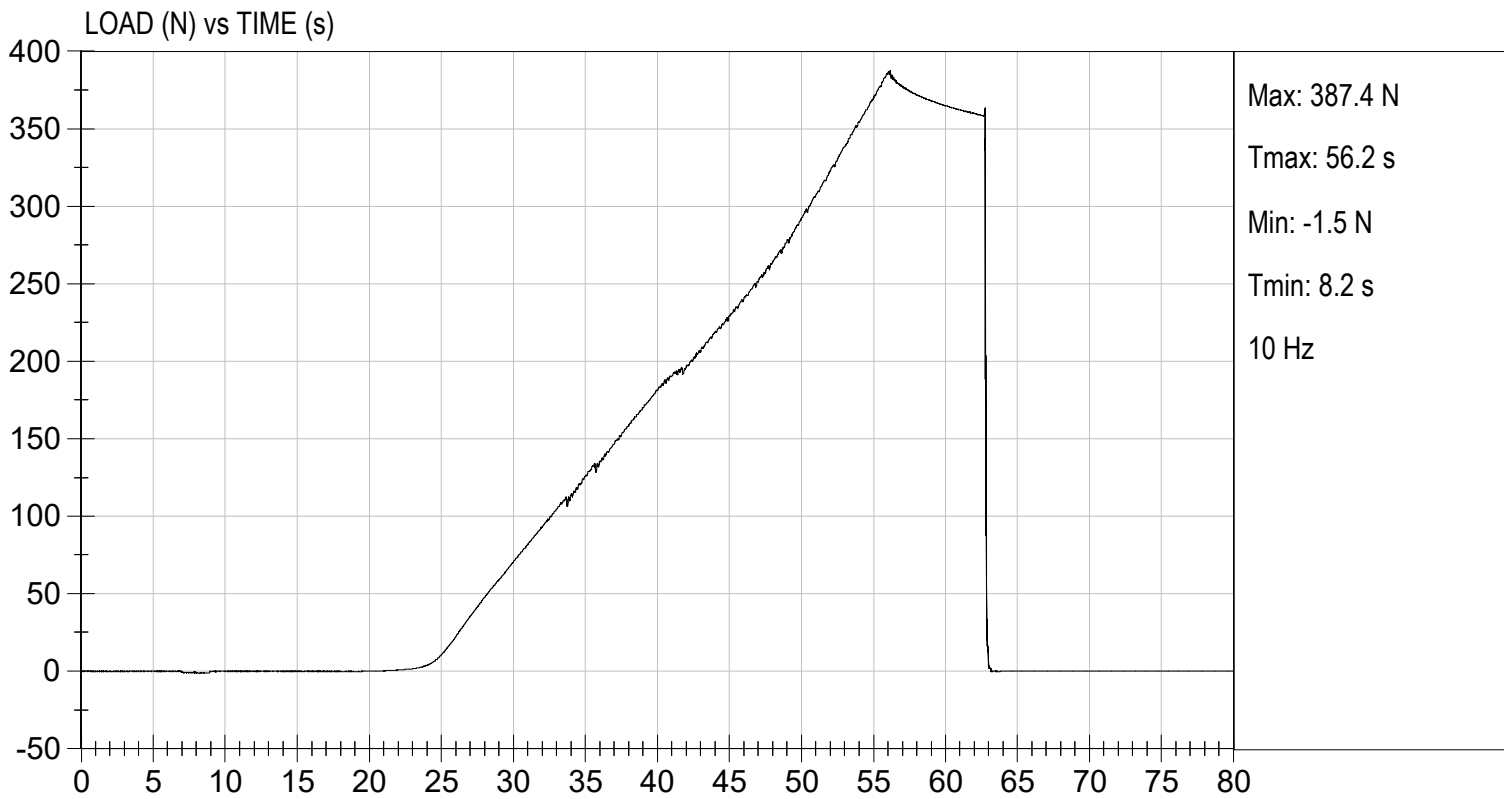
Test I.D: D241487

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Initial Angle	deg	0 to 20	19	Pass
Return Angle	deg	+/- 8	2	Pass
Force at 45 deg	N	320 to 390	387	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.8	Pass
Overall Result			Pass	


Laboratory Technician

06/19/2024
Test Date


Approved By



APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

TABLE 1 – DRIVER DUMMY INSTRUMENTATION

Instrument Location			Axis	Hybrid III 50 th S/N 064		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary		X	T30960	Endevco	05/23/2024
			Y	P79743	Endevco	05/23/2024
			Z	P79741	Endevco	05/23/2024
	Redundant		X	P79744	Endevco	05/23/2024
			Y	P94834	Endevco	05/23/2024
			Z	P94856	Endevco	05/23/2024
Head Angular Rate Sensors			X	ARS7325	DTS	11/17/2023
			Y	ARS7340	DTS	11/17/2023
			Z	ARS7354	DTS	11/17/2023
Upper Neck Load Cell			Fx, Fy, Fz Mx, My, Mz	NG1911	Denton	06/23/2023
Chest Accelerometers	Primary		X	P86793	Endevco	05/23/2024
			Y	P88348	Endevco	05/23/2024
			Z	P86792	Endevco	05/23/2024
	Redundant		X	P88667	Endevco	05/23/2024
			Y	P94109	Endevco	05/23/2024
			Z	P88666	Endevco	05/23/2024
Chest Potentiometer			X	064	Humanetics	05/23/2024
Pelvis Accelerometers			X	P97742	Endevco	05/23/2024
			Y	P96038	Endevco	05/23/2024
			Z	P95526	Endevco	05/23/2024
Femur Load Cells	Right	Primary	Z	FG121P	Denton	05/22/2024
		Redundant	Z	FG121R	Denton	05/22/2024
	Left	Primary	Z	FG122P	Denton	05/22/2024
		Redundant	Z	FG122R	Denton	05/22/2024
Tibia Load Cells	Right	Upper	Mx, My, Fz	TG408	Denton	11/28/2023
		Lower	Mx, My, Fz	AG116	Denton	11/28/2023
	Left	Upper	Mx, My, Fz	TG480	Denton	11/28/2023
		Lower	Mx, My, Fz	AG502	Denton	11/28/2023
Foot Accelerometers	Right	Rear	X	T22486	Endevco	05/23/2024
			Z	P97382	Endevco	05/23/2024
		Front	Z	P82120	Endevco	05/23/2024
	Left	Rear	X	T16468	Endevco	05/23/2024
			Z	T32154	Endevco	05/23/2024
		Front	Z	T32190	Endevco	05/23/2024
Seat Belt Load Cells		Lap		SBG161	FTSS	08/22/2023
		Shoulder		SBG157	FTSS	08/22/2023

TABLE 2 – FRONT PASSENGER DUMMY INSTRUMENTATION

Instrument Location			Axis	Hybrid III 5 th S/N 142		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers	Primary		X	P94799	Endevco	04/15/2024
			Y	P94800	Endevco	04/15/2024
			Z	P94801	Endevco	04/15/2024
	Redundant		X	P94802	Endevco	04/15/2024
			Y	P94803	Endevco	04/15/2024
			Z	P97377	Endevco	04/15/2024
Head Angular Rate Sensors			X	ARS7371	DTS	11/17/2023
			Y	ARS7357	DTS	11/17/2023
			Z	ARS7366	DTS	11/17/2023
Upper Neck Load Cell		Fx, Fy, Fz Mx, My, Mz		NG2203	Denton	01/22/2024
Chest Accelerometers	Primary		X	P88719	Endevco	04/15/2024
			Y	P94785	Endevco	04/15/2024
			Z	P94793	Endevco	04/15/2024
	Redundant		X	P95322	Endevco	04/15/2024
			Y	P95370	Endevco	04/15/2024
			Z	T30901	Endevco	04/15/2024
Chest Potentiometer			X	142	Humanetics	04/15/2024
Pelvis Accelerometers			X	P94798	Endevco	04/15/2024
			Y	P82646	Endevco	04/15/2024
			Z	P97705	Endevco	04/15/2024
Femur Load Cells	Right	Primary	Z	FG126P	Denton	04/15/2024
		Redundant	Z	FG126R	Denton	04/15/2024
	Left	Primary	Z	FG127P	Denton	04/15/2024
		Redundant	Z	FG127R	Denton	04/15/2024
Tibia Load Cells	Right	Upper	Mx, My, Fz	TG467	Denton	01/22/2024
		Lower	Mx, My, Fz	AG500	Denton	01/22/2024
	Left	Upper	Mx, My, Fz	TG478	Denton	01/22/2024
		Lower	Mx, My, Fz	AG491	Denton	01/22/2024
Foot Accelerometers	Right	Rear	X	P94795	Endevco	04/16/2024
			Z	P94796	Endevco	04/16/2024
		Front	Z	P94797	Endevco	04/16/2024
	Left	Rear	X	P83167	Endevco	04/16/2024
			Z	P83168	Endevco	04/16/2024
		Front	Z	P83169	Endevco	04/15/2024
Seat Belt Load Cells		Lap		SBG273	FTSS	08/22/2023
		Shoulder		SBG272	FTSS	08/22/2023

TABLE 3 – VEHICLE INSTRUMENTATION

Instrument Location			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember / Rear Seat Accelerometers	Left	Primary	X	T39071	Endevco	10/30/2023
			Z	T16433	Endevco	04/26/2024
		Redundant	X	T37936	Endevco	06/04/2024
	Right	Primary	X	A383118	MSI	06/04/2024
			Z	T29887	Endevco	11/16/2023
		Redundant	X	T38330	Endevco	06/04/2024
Engine Accelerometers		Top	X	A383144	MSI	05/30/2024
		Bottom	X	A340611	MSI	05/29/2024