REPORT NUMBER: NCAP-MGA-21-016

NEW CAR ASSESSMENT PROGRAM (NCAP)
Frontal Barrier Impact Test

HONDA OF AMERICA MFG., INC.
2021 Acura TLX SH-AWD 4-Door Sedan
NHTSA No.: O20215300

MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105

Test Date: January 6, 2021

Final Report Date: March 15, 2021

FINAL REPORT

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

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Approval Date: March 15, 2021

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: _____

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Final Report of New Car Assessment Program Frontal Impact Testing of a 2021 Acura TLX SH-AWD 4-Door Sedan, NHTSA No.: O20215300	March 15, 2021
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15. Supplementary Notes

16. Abstract

A 56.3 km/h NCAP Frontal Rigid Barrier Impact Test was conducted on a 2021 Acura TLX SH-AWD 4-Door Sedan 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 January 6, 2021.

The impact velocity of the vehicle was 56.39 km/h and the ambient temperature at the barrier face at the time of impact was 22.0°C. The target vehicle post-test maximum crush was 473 mm located at the vehicle centerline. The test vehicle's performance was as follows:

Measurement Description	Units	Driver ATD		Passenger ATD	
		Threshold	Result	Threshold	Result
Head Injury Criteria (HIC_{15})		700	143	700	358
Maximum Chest Compression	mm	63	24	52	16
Nij		1	0.20	1	0.32
Neck Tension	N	4170	778	2620	829
Neck Compression	N	4000	122	2520	295
Left Femur Force	N	10008	1147	6805	1850
Right Femur Force	N	10008	1187	6805	2106

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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 2021 Acura TLX SH-AWD 4-Door Sedan at a velocity of 56.39 km/h. The test was performed at MGA Research Corporation on January 6, 2021. 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. 351) and the right-front passenger (position 2) ATD (Serial No. 634) were qualified previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 634 channels of data were recorded on a data acquisition system. Appendix B contains the dummy response data traces.

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

The maximum static crush of the vehicle was 473 mm located at 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 knee airbag.

The occupant data is summarized below:

ATD position	HIC_{15}	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (g)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50^{th})	143	0.20	778	122	36.1	24	1147	1187
Passenger (5^{th})	358	0.32	829	295	41.3	16	1850	2106

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

TEST NOTES

Top of Engine X recorded no valid data after 33 ms.
Barrier C-01 Fx recorded no valid data.
Barrier C-02 Fx, My recorded no valid data.
Barrier D-01 Mz recorded questionable data.
Barrier E-01 Mz recorded questionable data.
Barrier I-05 My recorded questionable data.
Barrier K-03 Fx recorded questionable data.
Barrier K-15 My recorded no valid data.

The passenger shoulder belt D-ring was obscured by the side curtain airbag in Photo No. 062. The D-ring was later verified to have remained in its design test position (uppermost) during the test.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20215300	Traction Control System (TCS)	Yes
Model Year	2021	Power Steering	Yes
Make	Acura	Power Window Auto-Reverse	Yes
Model	TLX SH-AWD	Driver Frontal Airbag	Yes
Body Style	4-Door Sedan	Driver Curtain Airbag	Yes
VIN	19UUB6F30MA002994	Driver Head/Torso Airbag	No
Body Color	Modern Steel Metallic	Driver Torso Airbag	No
Odometer (km/mi)	161 km / 100 mi	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.0 L	Driver Pelvis Airbag	No
Type/No. Cylinders	Inline 4	Driver Knee Airbag	Yes
Engine Placement	Lateral	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	10	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	AWD	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	Yes	Front Pass. Knee Airbag	Yes
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	Yes	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other	N/A

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

DATA FROM CERTIFICATION LABEL

Manufactured By	HONDA OF AMERICA MFG., INC.
Date of Manufacture	10/20

GVWR (kg)	2270
GAWR Front (kg)	1190
GAWR Rear (kg)	1100

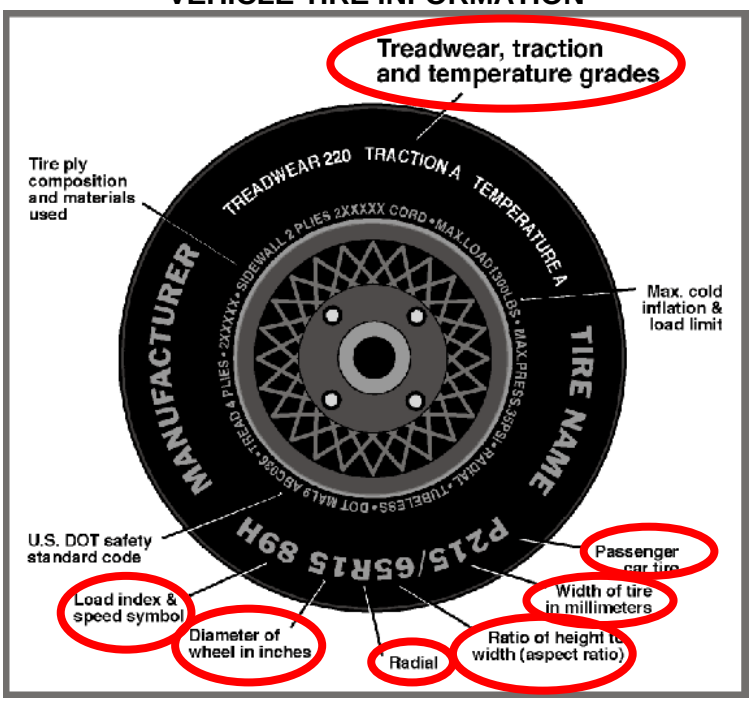
VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Contoured		
Designated Seating Capacity (DSC)	2	3		5
Capacity Weight (VCW) (kg)				380
Cargo Weight (RCLW) (kg)				40

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	220	210
Recommended Tire Size	235/50R18	235/50R18
Tire Size on Vehicle	235/50R18	235/50R18
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Turanza EL440	Turanza EL440
Treadwear	480	480
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	2 Polyester	2 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Nylon	1 Polyester, 2 Steel, 1 Nylon
Load Index/Speed Symbol	97V	97V
Tire Material	Rubber	Rubber
DOT Safety Code Left	1W2 1PJB21	1W2 1PJB21
DOT Safety Code Right	1W2 1PJB21	1W2 1PJB21

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	511.0	385.0		546.0	442.0	
Right	kg	517.5	369.5		543.0	425.5	
Ratio	%	57.7%	42.3%		55.7%	44.3%	
Totals	kg	1028.5	754.5	1783.0	1089.0	867.5	1956.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1783.0
Weight of 1 P572E ATD & 1 P572O ATD	kg	141
Rated Cargo/Luggage Weight (RCLW)	kg	40
Calculated Test Vehicle Target Weight (TVTW)	kg	1964.0

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	729	724	720	728	1217
As Tested	mm	718	720	703	709	1275
Post Test	mm	770	803	718	722	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2875
Total Vehicle Length at Left Side	mm	4722
Total Vehicle Length at Centerline	mm	4966
Total Vehicle Length at Right Side	mm	4722
Weight of Ballast in Cargo Area	kg	0
Weight of Vehicle Components Removed	kg	20
Amount of Stoddard Solvent in Fuel Tank	L	55.6

List of components removed to meet test weight: LR/RR headrest, RR seat, LR tail light.

List of components removed for instrumentation, data box, and equipment installation: Cargo area carpet/trim/divider, LR/RR floor mat, RR tail light, underbody plastic.

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

TARGET VEHICLE STRUCTURAL MEASUREMENT

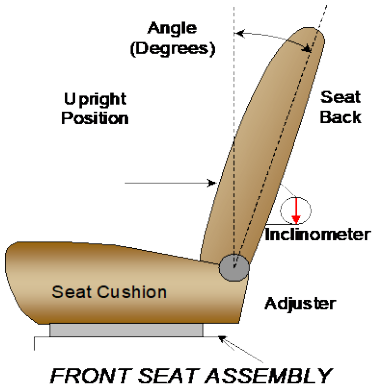
	Elements	Pre-Test (mm)
1	Total Length	4966
2	Total Width	1849
3	Bumper Top Height	565
4	Bumper Bottom Height	435
5	Longitudinal Member Top Height	530
6	Distance between Longitudinal Members	940
7	Longitudinal Member Width	80
8	Engine Top Height	805
9	Engine Bottom Height	175
10	Engine and Gearbox Width	770
11	Front Bumper-Engine Distance	580
12	Front Shock Absorber Fixing Height	874
13	Bonnet Leading Edge Height	794
14	Front Shock Absorber Fixing Width	940
15	Front Bumper – Front Axle Distance	1074
16	Front Axle – A-Pillar Distance	440
17	A-Pillar – B-Pillar Distance	1285
18	B-Pillar – Rear Axle Distance	1153
19	B-Pillar – C-Pillar Distance	721
20	Roof Sill Bottom Height	1250
21	Roof Sill Top Height	1340
22	Floor Sill Bottom Height	185
23	Floor Sill Top Height	365

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

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	3.8° on outboard headrest post
Passenger Seat Back Angle	-1.7° on outboard headrest post

SEAT FORE/AFT POSITIONS

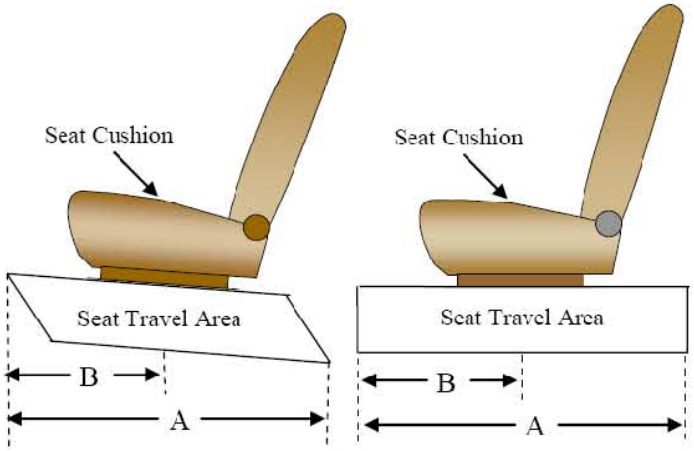
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated May 2018.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	272 mm	136 mm
Passenger Seat	202 mm	0 mm

SEAT BELT UPPER ANCHORAGES

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

	Total # of Positions	Placed in Position #
Driver Seat	4 (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

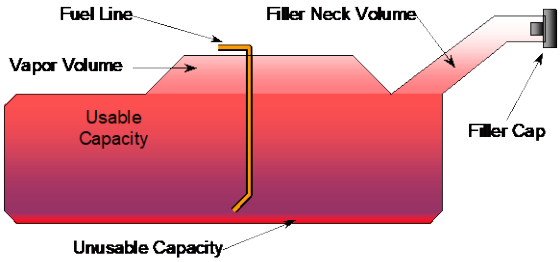
Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of "Standard Tank"	60.0
Usable Capacity of "Optional Tank"	
92-94% of Usable Capacity	55.2 to 56.4
Actual Amount of Solvent used	55.6
1/3 of Usable Capacity	20.0

FUEL PUMP

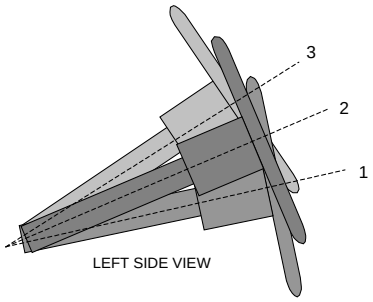
T he vehicle is equipped with an electronic fuel pump. With IG2 ignition position the fuel pump will run for less than 5 seconds. With vehicle running, the fuel pump will continue to run. The filler neck is located on the driver's side.



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.



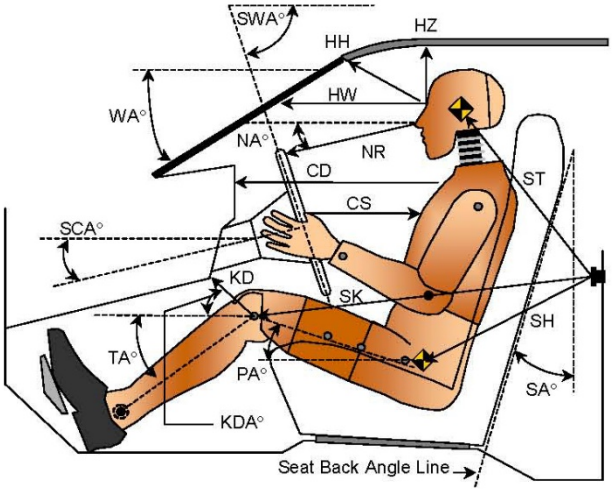
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITION

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	74.0	
Geometric Center Position 2	71.5	
Uppermost Position 3	69.0	
Telescoping Steering Wheel Travel		60
Test Position	71.5	30

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

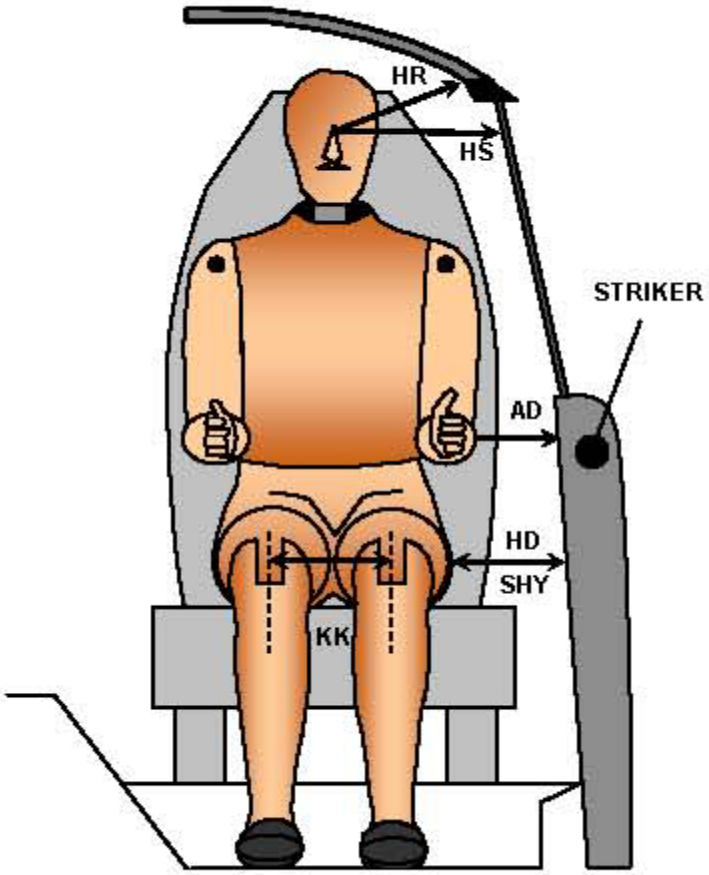


LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		24.5		
SWA°	Steering Wheel Angle		71.5		
SCA°	Steering Column Angle		18.5		
SA°	Seat Back Angle		3.8		-1.7
HZ	Head to Roof (Z)	143	90	160	90
HH	Head to Header	315	21.6	259	44.4
HW	Head to Windshield	647	0	617	0
NR	Nose to Rim	362	15.4		
CD	Chest to Dash	518		398	
CS	Chest to Steering Hub	301	2.1		
RA	Rim to Abdomen	204	0		
KDL	Left Knee to Dash	185	44.2	114	34.5
KDR	Right Knee to Dash	179	38.1	116	33.8
PA°	Pelvic Angle		23.4		22.2
TA°	Tibia Angle		37.5		43.9
SK	Striker to Knee	578	104.8	651	82.6
ST	Striker to Head	405	10.2	289	28.5
SH	Striker to H-Point	335	146.7	356	124.5

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

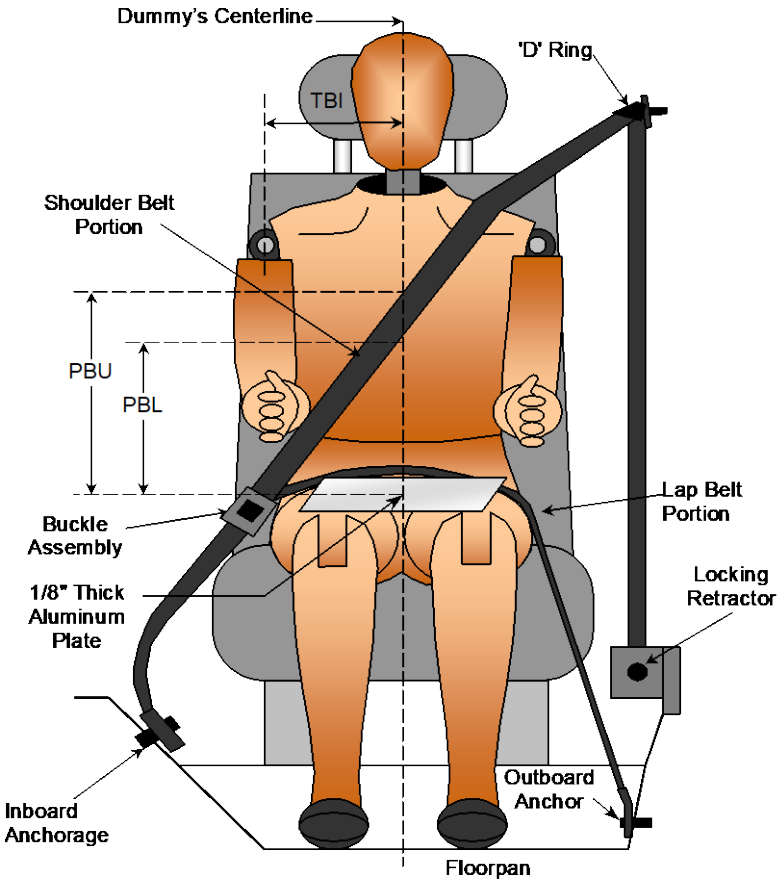


FRONT VIEW OF DUMMY

Code	Measurement Description	Driver	Passenger
		Length (mm)	
AD	Arm to Door	125	91
HD	H-Point to Door	146	185
HR	Head to Side Header	188	215
HS	Head to Side Window	342	345
KK	Knee to Knee	342	227
SHY	Striker to H-Point (Y Direction)	142	322
AA	Ankle to Ankle	345	170

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle:	2021 Acura TLX SH-AWD 4-Door Sedan	NHTSA No.:	O20215300
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	1/6/2021



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	370	300
PBL - Top surface of reference to belt lower edge	mm	290	210

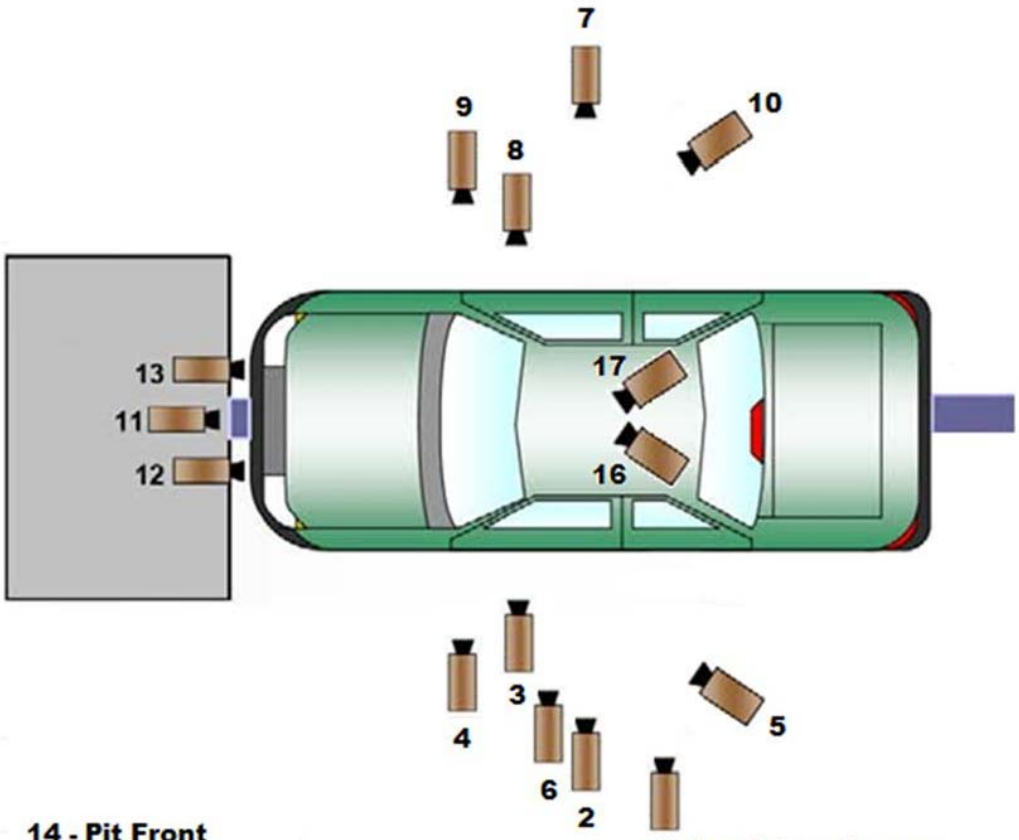
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	880	880
Lap Belt Length as measured on ATD	mm	560	645
Remainder of belt on reel	mm	820	735
Total Belt Length for Continuous Webbing Systems	mm	2840	2840

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

Test Vehicle:	2021 Acura TLX SH-AWD 4-Door Sedan	NHTSA No.:	O20215300
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	1/6/2021

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: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

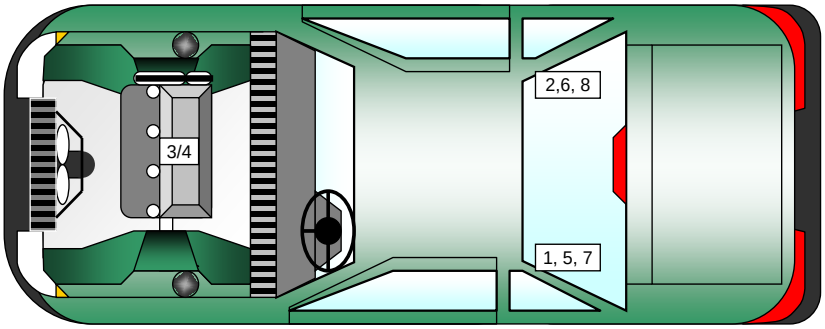
CAMERA LOCATIONS

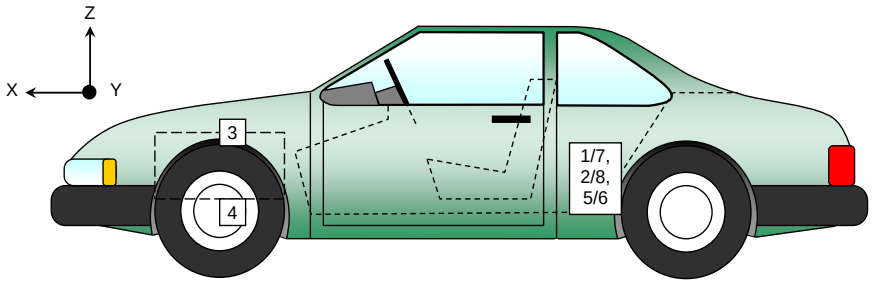
No.	Camera View	Coordinates* (mm)			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Overall					30
2	Left Overall	-2270	-5710	-1200	12	1000
3	Driver Close-Up	-2030	-6760	-1790	50	1000
4	Left Front Half	-1430	-5650	-1220	24	1000
5	Left Angle	-7320	-5780	-1800	75	1000
6	Steering Column	-1270	-5650	-1260	50	1000
7	Right Overall	-2220	5890	-1210	12	1000
8	Passenger Close-Up	-1750	6780	-1790	50	1000
9	Right Front Half	-1170	5610	-1240	24	1000
10	Right Angle	-7580	5530	-1800	75	1000
11	Windshield	130	0	-2310	12	1000
12	Driver Windshield	180	-370	-2230	25	1000
13	Passenger Windshield	180	370	-2230	25	1000
14	Pit Front	-1050	0	3340	24	1000
15	Pit Rear	-3260	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: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

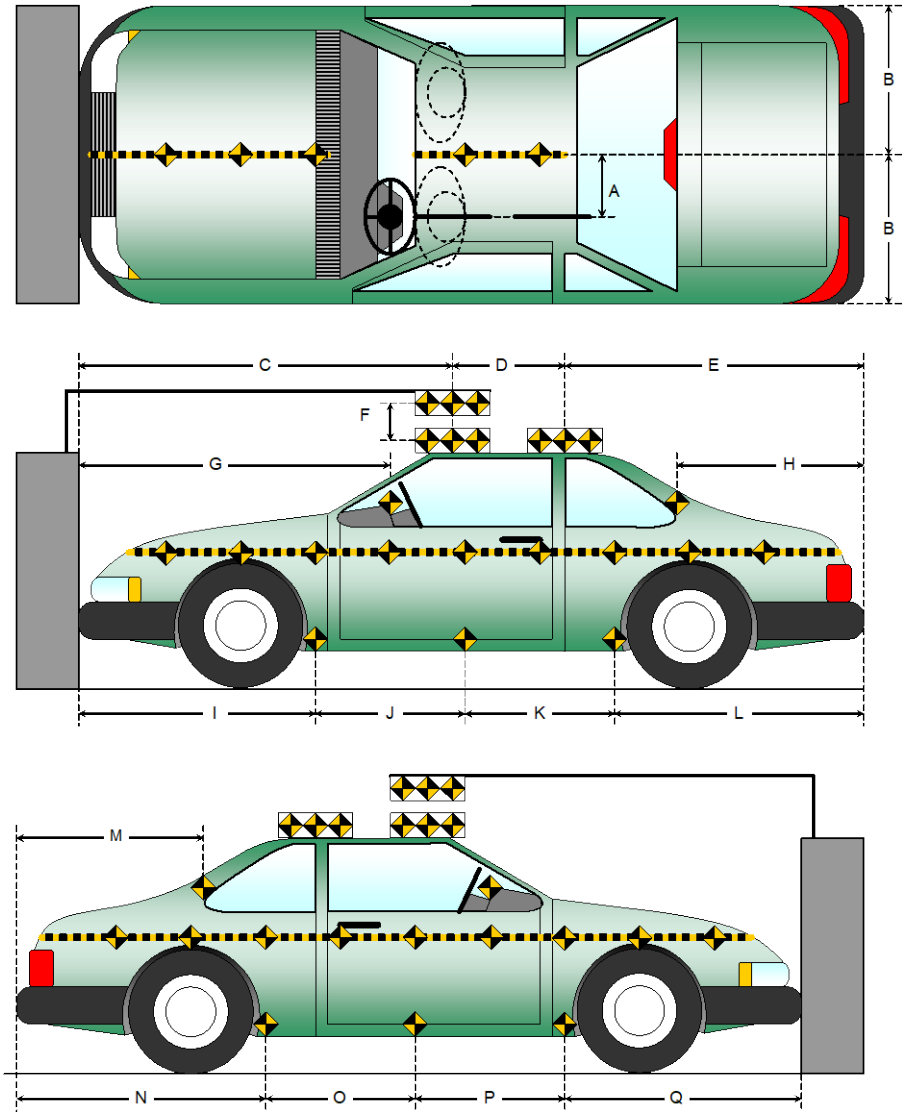
No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	1974	-390	-230
2	Right Rear Crossmember Accelerometer – X Direction	1974	390	-233
3	Engine Top X	4145	0	-810
4	Engine Bottom X	4132	135	-175
5	Left Rear Crossmember Accelerometer – Z Direction	1974	-390	-230
6	Right Rear Crossmember Accelerometer – Z Direction	1974	390	-233
7	Left Rear Crossmember Accelerometer Redundant – X Direction	1974	-420	-230
8	Right Rear Crossmember Accelerometer Redundant – X Direction	1974	420	-233

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: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

Item	Value (mm)
A	375
B	925
C	2505
D	610
E	1851
F	180
G	
H	1367
I	1467
J	1003
K	1003
L	1493
M	1367
N	1493
O	1003
P	1003
Q	1467



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

ADVANCED RESEARCH LOAD CELL BARRIER

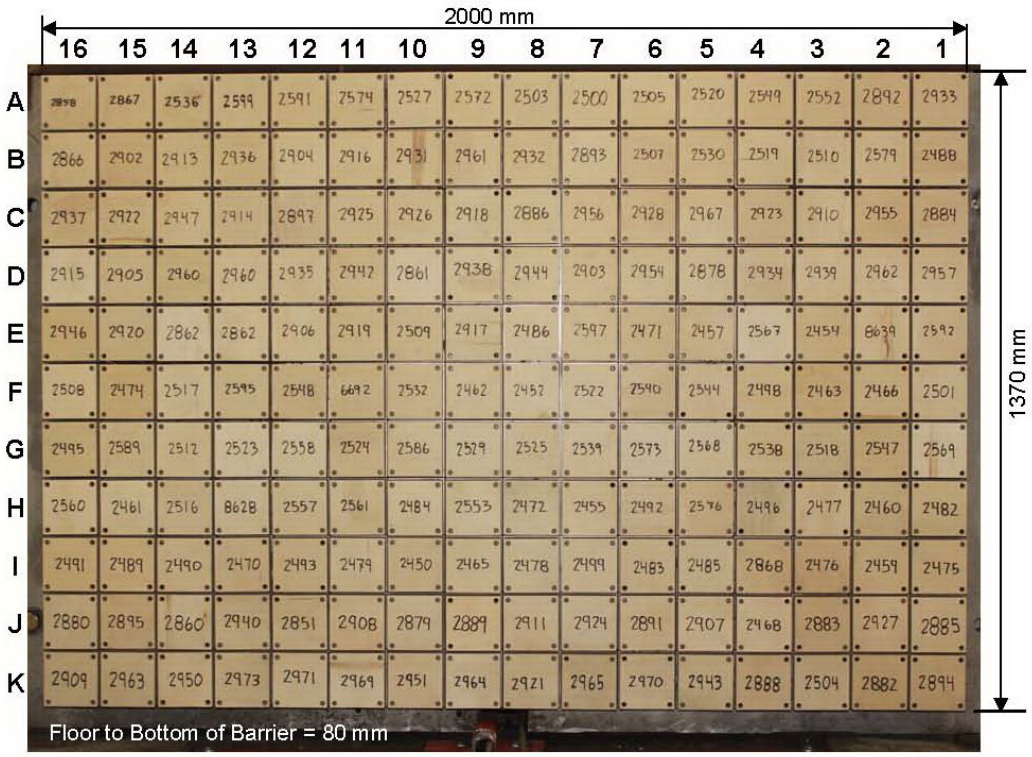


Photo for Reference Only

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: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

INSTRUMENTATION

Instrumentation	Number of Channels Collected
Driver Dummy Data Channels	49
Passenger Dummy Data Channels	49
Vehicle Structure Accelerometers	8
Barrier Channels	528
Total	634

CAMERA COVERAGE

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

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50% / 351	HIII 5% / 634
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	Knee Airbag
Right Knee Contact	Knee Airbag	Knee Airbag

DOOR OPENING, TRUNK OPENING, AND SEAT TRACK INFORMATION

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

OTHER VEHICLE POST-TEST OBSERVATIONS

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

VEHICLE REBOUND FROM BARRIER

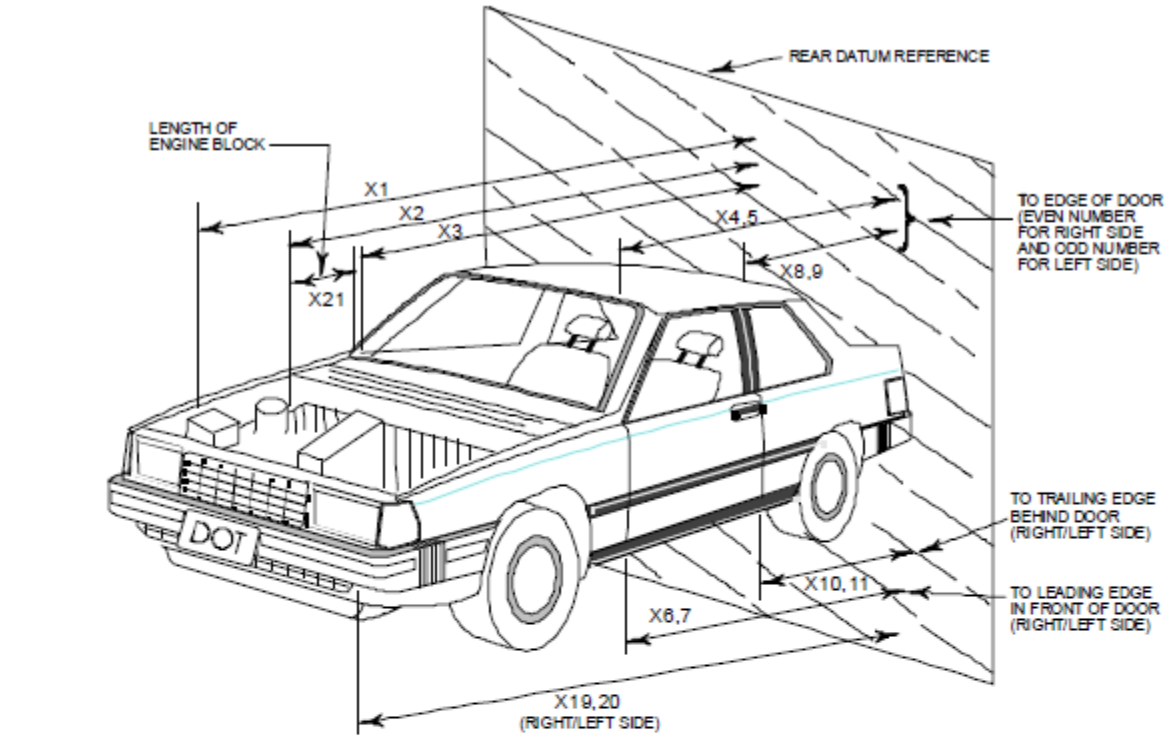
Measured Parameter	Units	Value
Left Side	mm	605
Center	mm	675
Right Side	mm	605
Average	mm	628

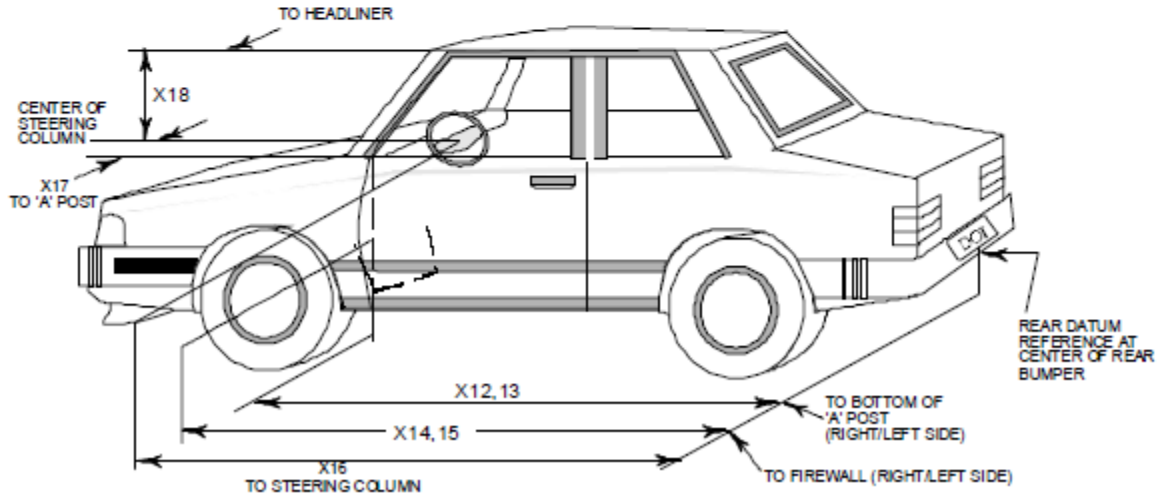
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2021 Acura TLX SH-AWD 4-Door Sedan	NHTSA No.:	O20215300
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	1/6/2021





DATA SHEET NO. 12 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

No.	Measurement Description	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	4966	4493	473
2	RSOV to Front of Engine	4209	3934	275
3	RSOV to Firewall	3601	3597	4
4	RSOV to Upper Leading Edge of Right Door	3187	3171	16
5	RSOV to Upper Leading Edge of Left Door	3187	3170	17
6	RSOV to Lower Leading Edge of Right Door	3269	3269	0
7	RSOV to Lower Leading Edge of Left Door	3269	3270	-1
8	RSOV to Upper Trailing Edge of Right Door	2156	2136	20
9	RSOV to Upper Trailing Edge of Left Door	2156	2140	16
10	RSOV to Lower Trailing Edge of Right Door	2172	2170	2
11	RSOV to Lower Trailing Edge of Left Door	2172	2164	8
12	RSOV to Bottom of “A” Post of Right Side	3274	3280	-6
13	RSOV to Bottom of “A” Post of Left Side	3274	3274	0
14	RSOV to Firewall, Right Side	3558	3536	22
15	RSOV to Firewall, Left Side	3554	3540	14
16	RSOV to Steering Column	2727	2810	-83
17	Center of Steering Column to “A” Post	337	330	7
18	Center of Steering Column to Headliner	395	428	-33
19	RSOV to Right Side of Front Bumper	4722	4365	357
20	RSOV to Left Side of Front Bumper	4722	4435	287
21	Length of Engine Block	546	546	0
RD	RSOV to Right Side of Dash Panel	2931	2906	25
CD	RSOV to Center of Dash Panel	2985	3015	-30
LD	RSOV to Left Side of Dash Panel	2929	2925	4

All Dimensions in mm

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

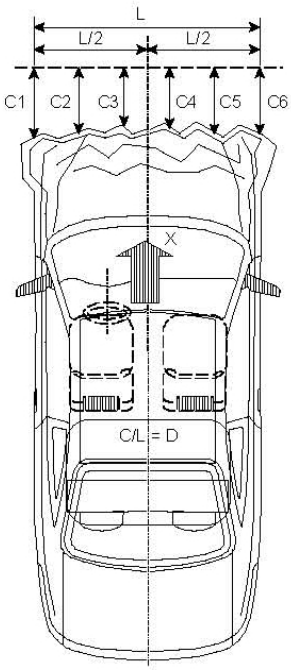
Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

VEHICLE INFORMATION

VIN: 19UUB6F30MA002994
Vehicle Size Category: Passenger Car
Wheelbase (mm): 2875
Test Weight (kg): 1956.5

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): 56.39
Velocity Change (km/h): 67.6
Time of Separation (msec) 98



CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
Midpoint of Damage: Centerline
Damage Region Length (mm): 1448
Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4722	4435	287
C2	Crush zone 2 at left side	mm	4866	4433	433
C3	Crush zone 3 at left side	mm	4902	4465	437
C4	Crush zone 4 at right side	mm	4902	4467	435
C5	Crush zone 5 at right side	mm	4866	4426	440
C6	Crush zone 6 at right side	mm	4722	4365	357
L	C1 TO C6	mm	1448	1436	12

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

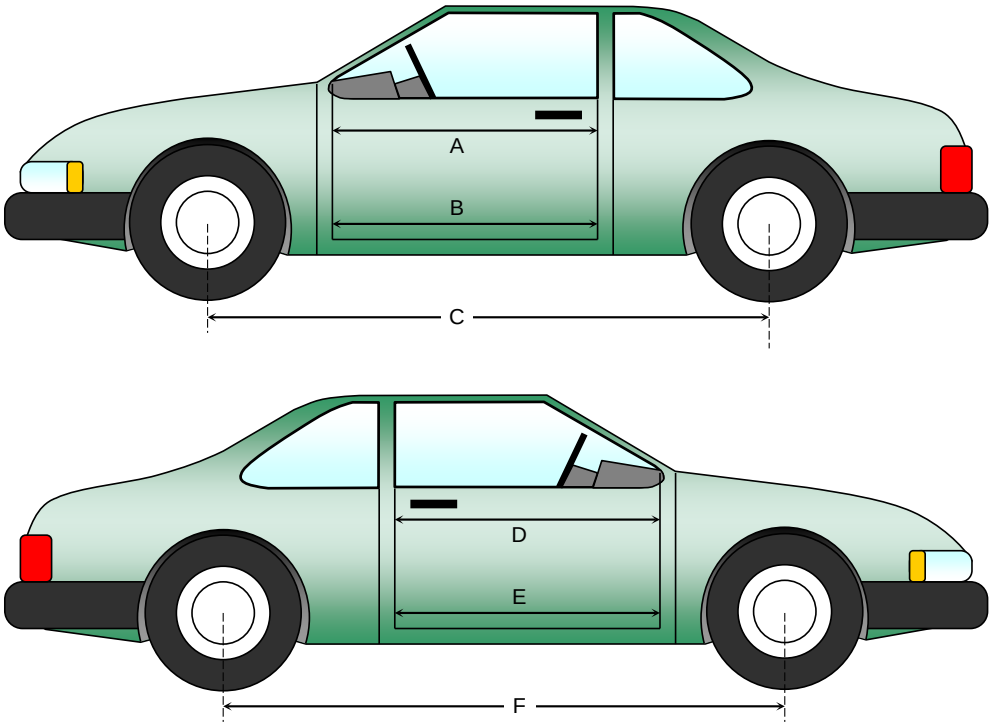
Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: O20215300
Test Date: 1/6/2021

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1046	1046	0
B	Left Side Lower	mm	978	978	0
D	Right Side Upper	mm	1053	1053	0
E	Right Side Lower	mm	981	981	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2875	2718	157
F	Right Side Wheelbase	mm	2875	2716	159



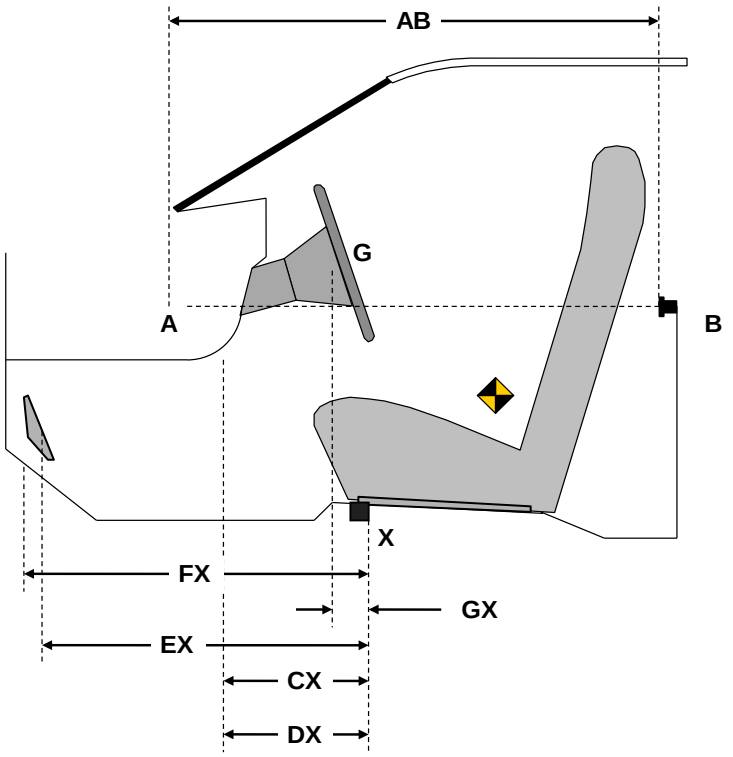
DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	748	748	0
CX	Left Knee Bolster to X	mm	280	273	7
DX	Right Knee Bolster to X	mm	273	274	-1
EX	Brake Pedal to X	mm	596	546	50
FX	Foot Rest to X	mm	603	589	14
GX	Center of Steering Column Wheel Hub to X	mm	56	109	-53

X = Front of Seat Track (stationary)



DRIVER COMPARTMENT

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

WINDSHIELD MOUNTING DETAILS

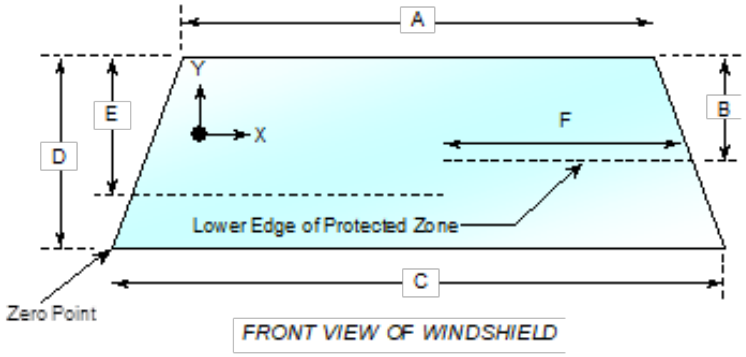
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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: 22.0°C.

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2230	2230	100
Right Side	2230	2230	100
Total	4460	4460	100



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1206
B	mm	465
C	mm	1674
D	mm	790
E	mm	547
F	mm	534

AREA OF PROTECTED ZONE FAILURES

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

X	Y

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

X	Y

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 22.0°C Test Time: 12:33 p.m.

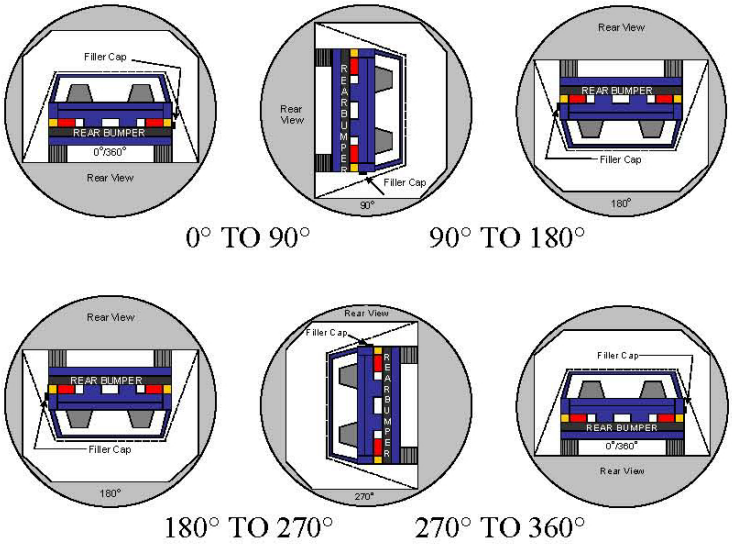
A. From impact until vehicle motion ceases: (Maximum Allowable = 1 ounce) 0.0 oz.

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°	112	300	412
90° to 180°	110	300	410
180° to 270°	107	300	407
270° to 360°	109	300	409

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

Test Vehicle: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021

FMVSS 301 SPILLAGE TABLE (UNITS IN OUNCES)

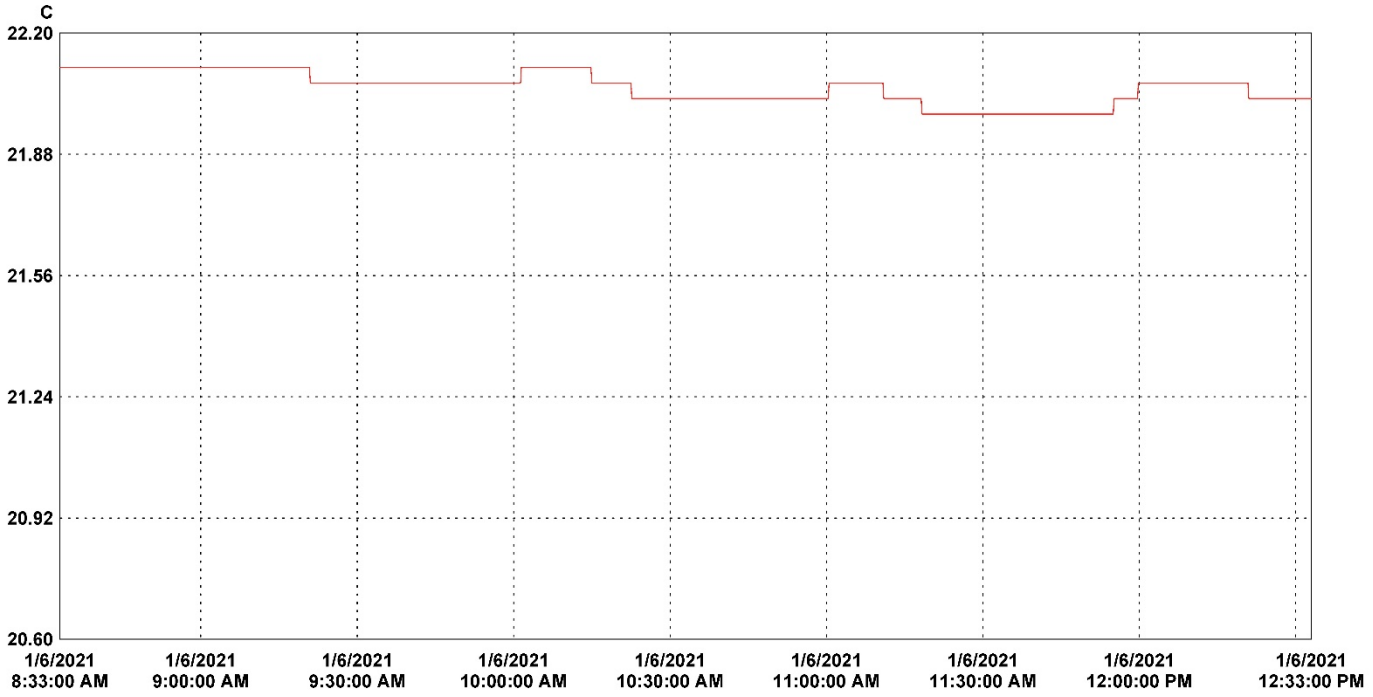
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eight Minute
0° to 90°	0	0	0	
90° to 180°	0	0	0	
180° to 270°	0	0	0	
270° to 360°	0	0	0	

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: 2021 Acura TLX SH-AWD 4-Door Sedan NHTSA No.: O20215300
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/6/2021



LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	15212045	VSC_Prep_Room	1		22.11	22.06	21.99	C	Temperature	15212045_VSC_Prep_Room.spl

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

The passenger shoulder belt D-ring was obscured by the side curtain airbag in Photo No. 062. The D-ring was later verified to have remained in its design test position (uppermost) during the test.

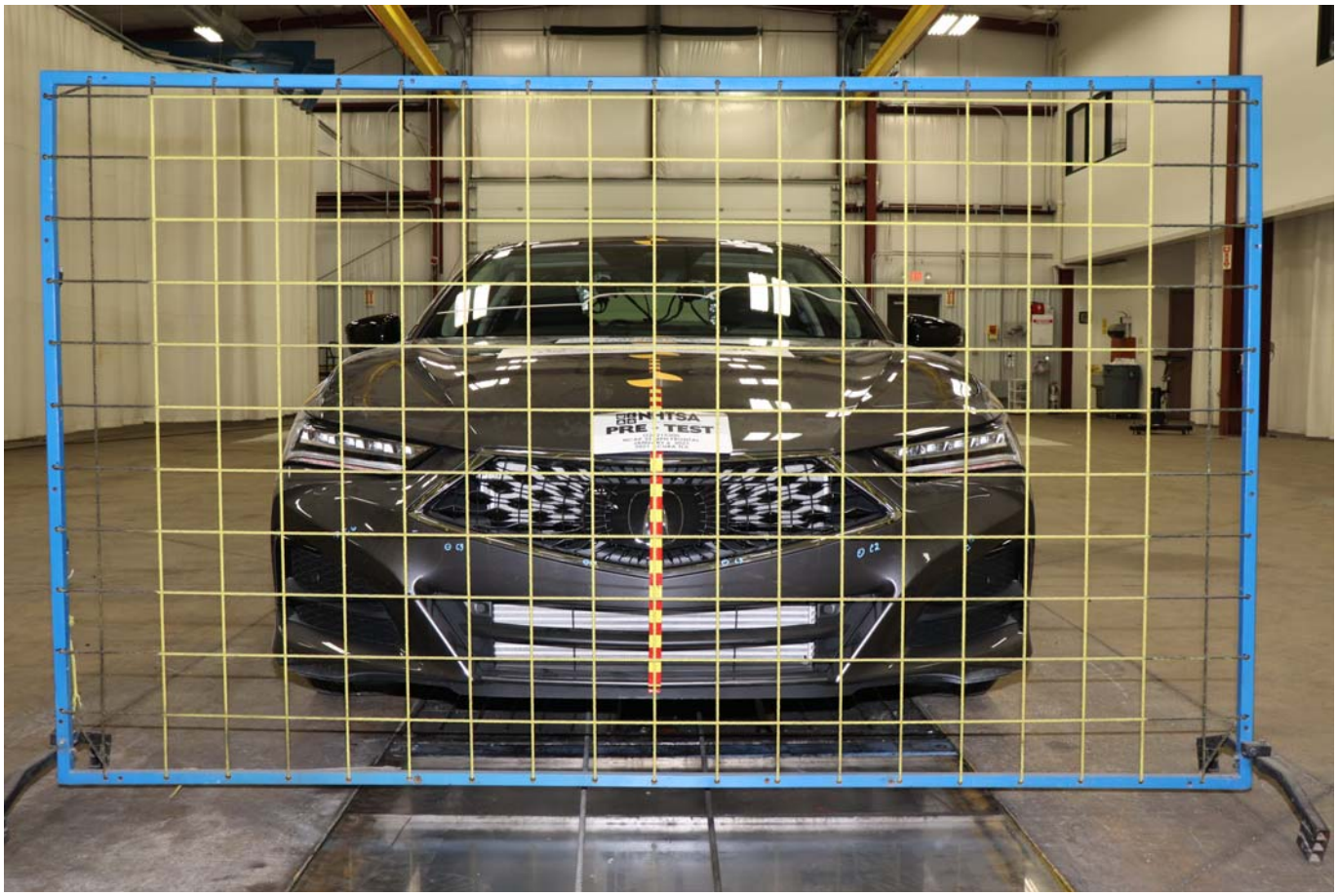


Photo No. 001 - Load Cell Location

Photo No. 002 - Pre-Test Load Cell Wall

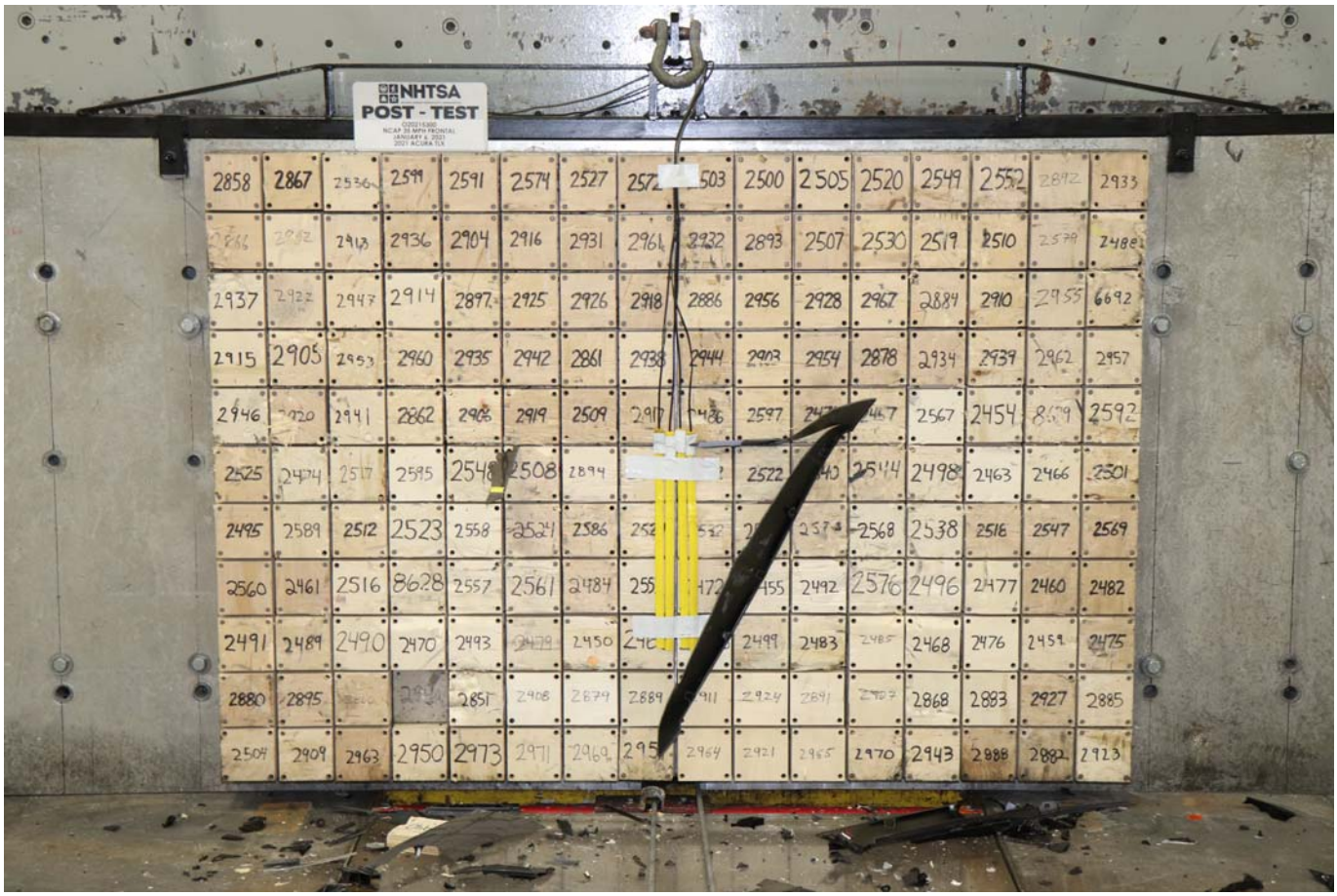


Photo No. 003 - Post-Test Load Cell Wall

Photo No. 004 - Manufacturer Label

Photo No. 005 - Tire Placard


Photo No. 006 - 2021 Acura TLX SH-AWD 4-Door Sedan Frontal As Delivered

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

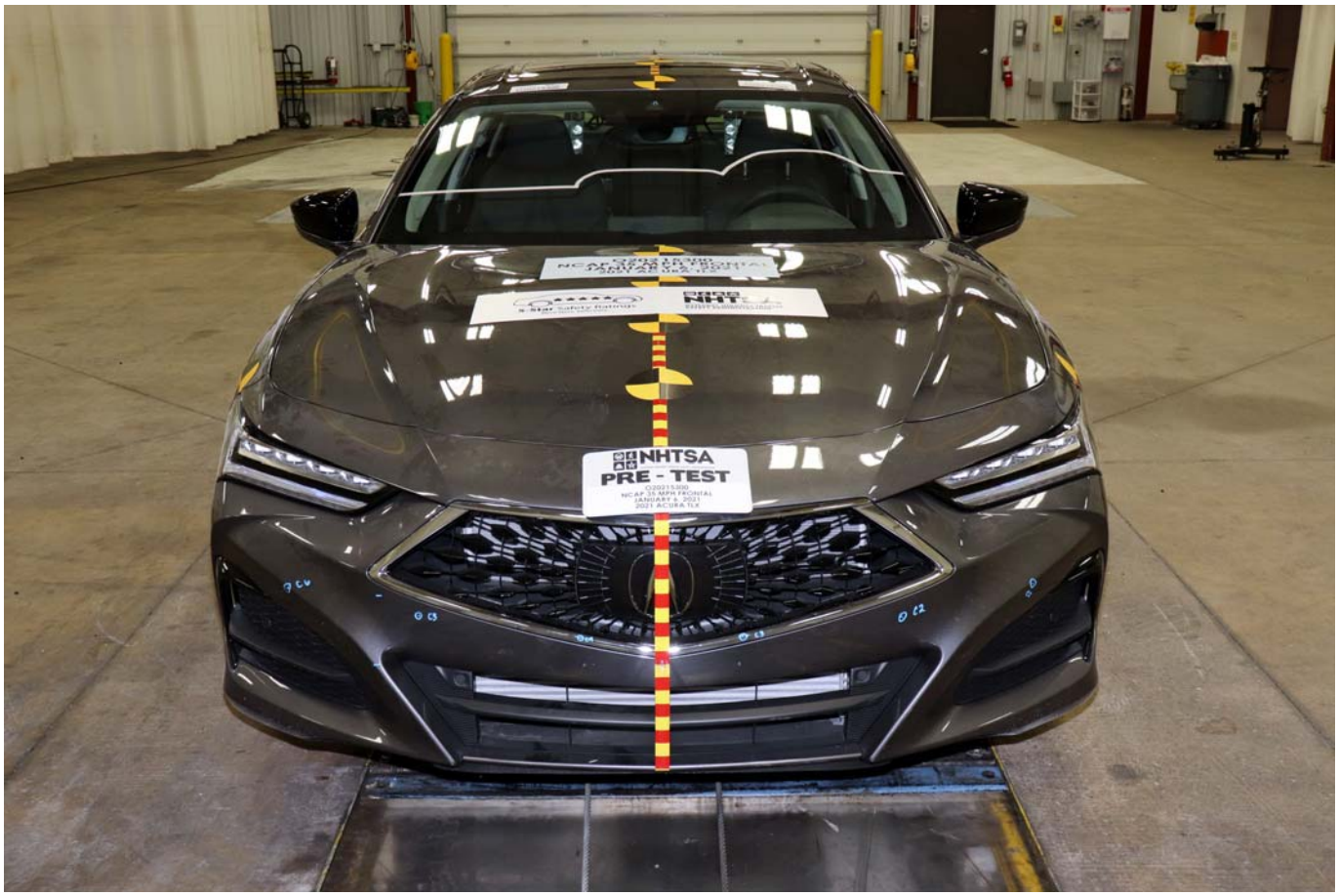


Photo No. 008 - Pre-Test Front View of Test Vehicle

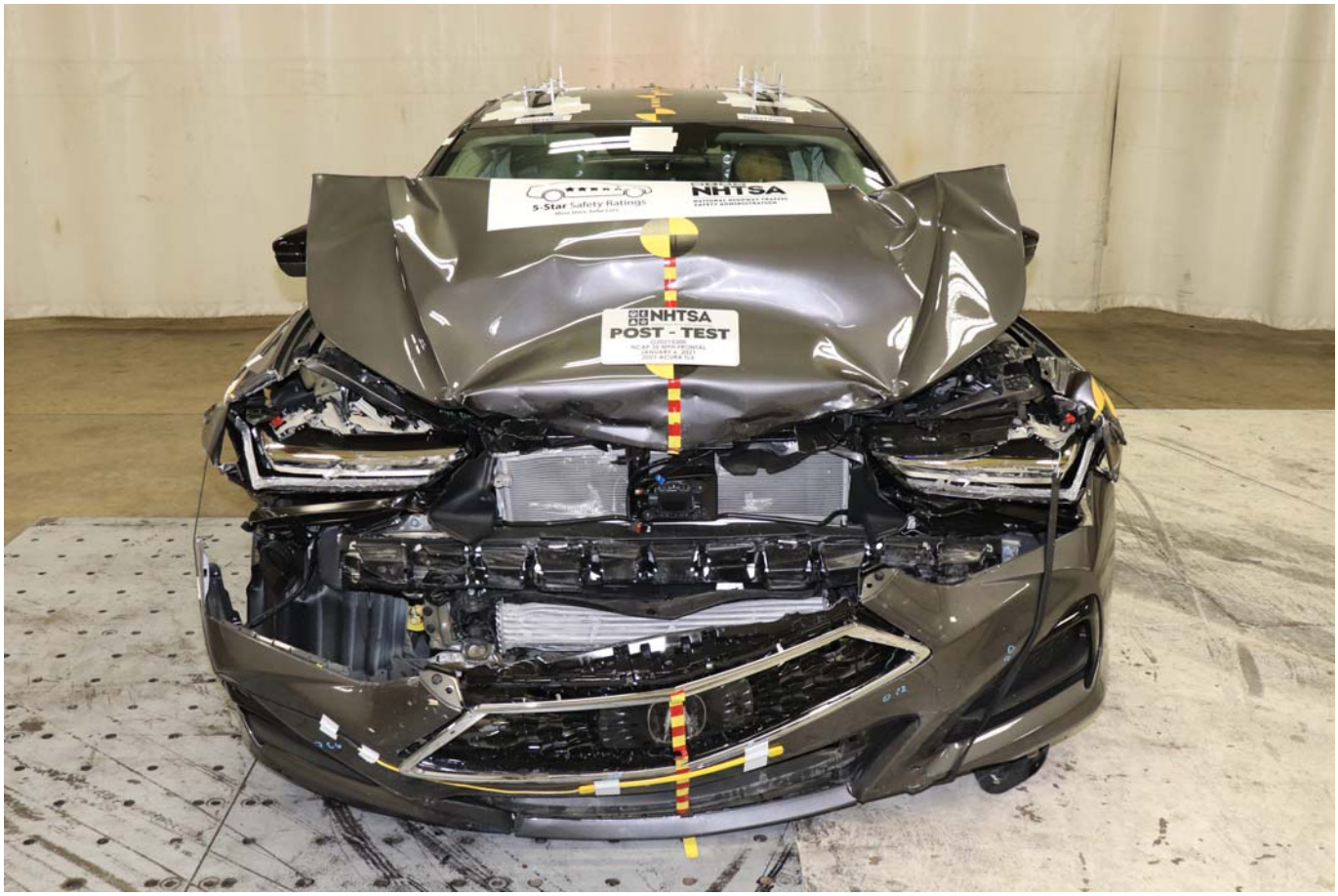


Photo No. 009 - Post-Test Front View of Test Vehicle

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

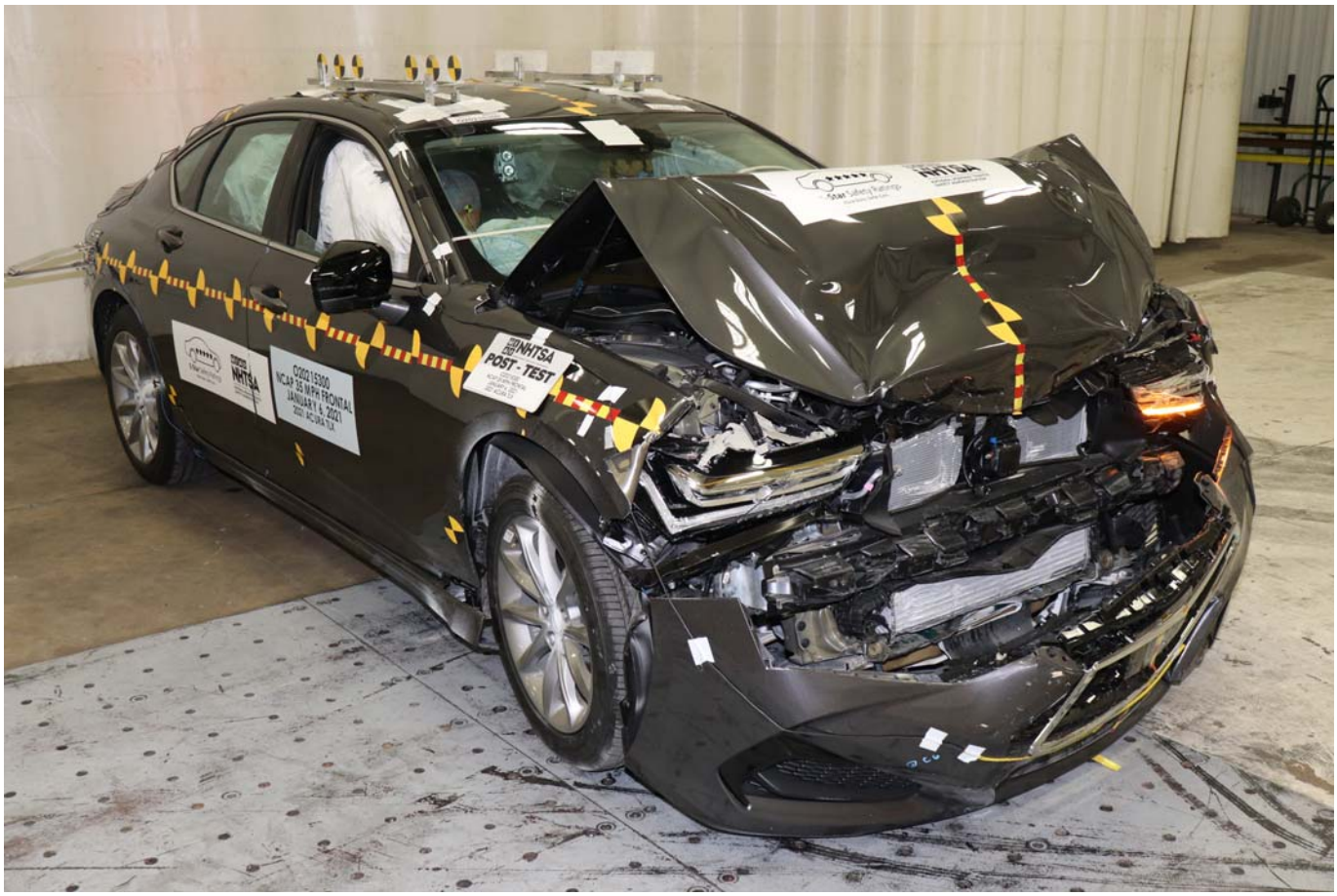


Photo No. 015 - Post-Test Right Front 3-4 View

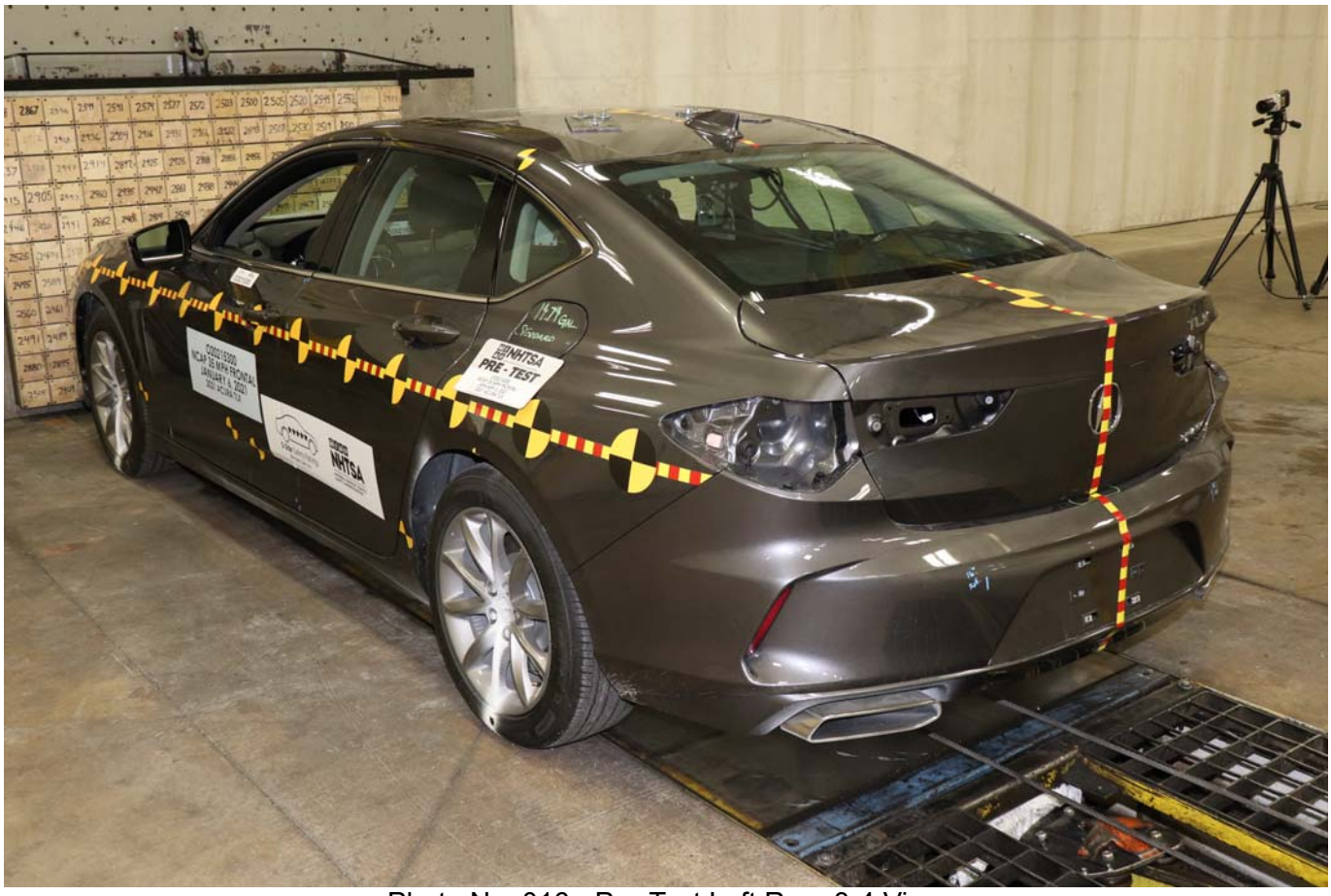


Photo No. 016 - Pre-Test Left Rear 3-4 View

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

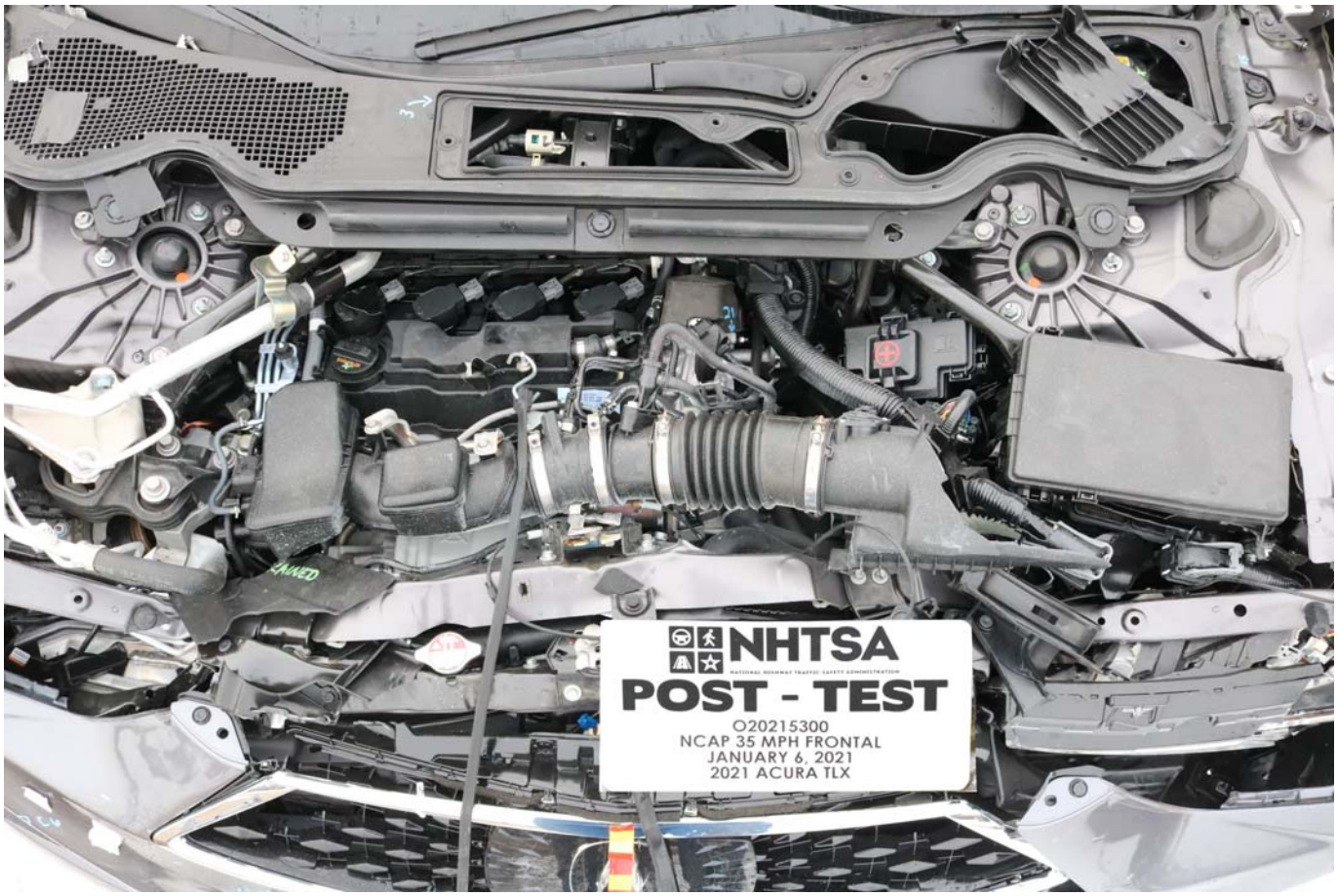


Photo No. 021 - Post-Test Engine Compartment View

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

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

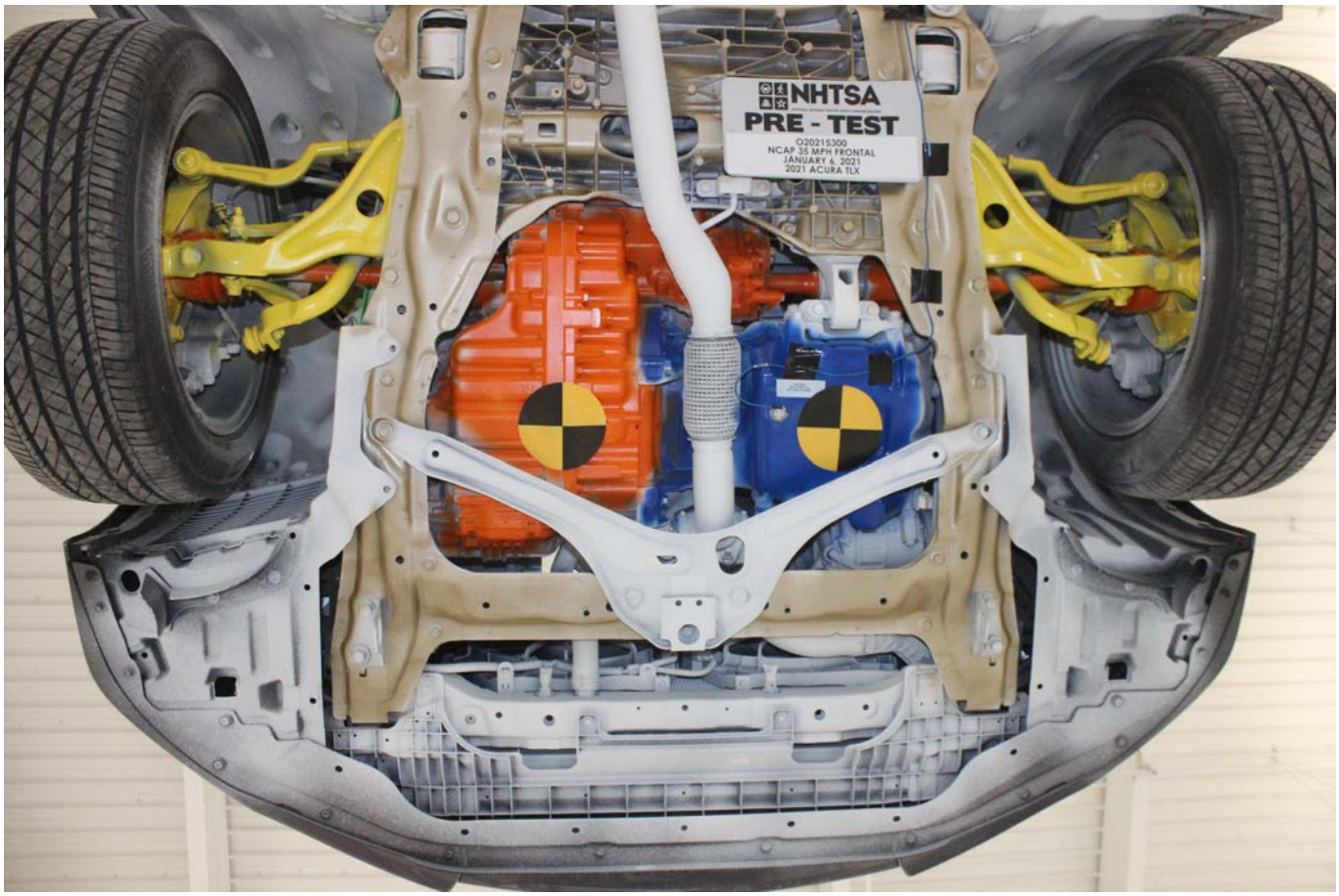


Photo No. 024 - Pre-Test Front Underbody View

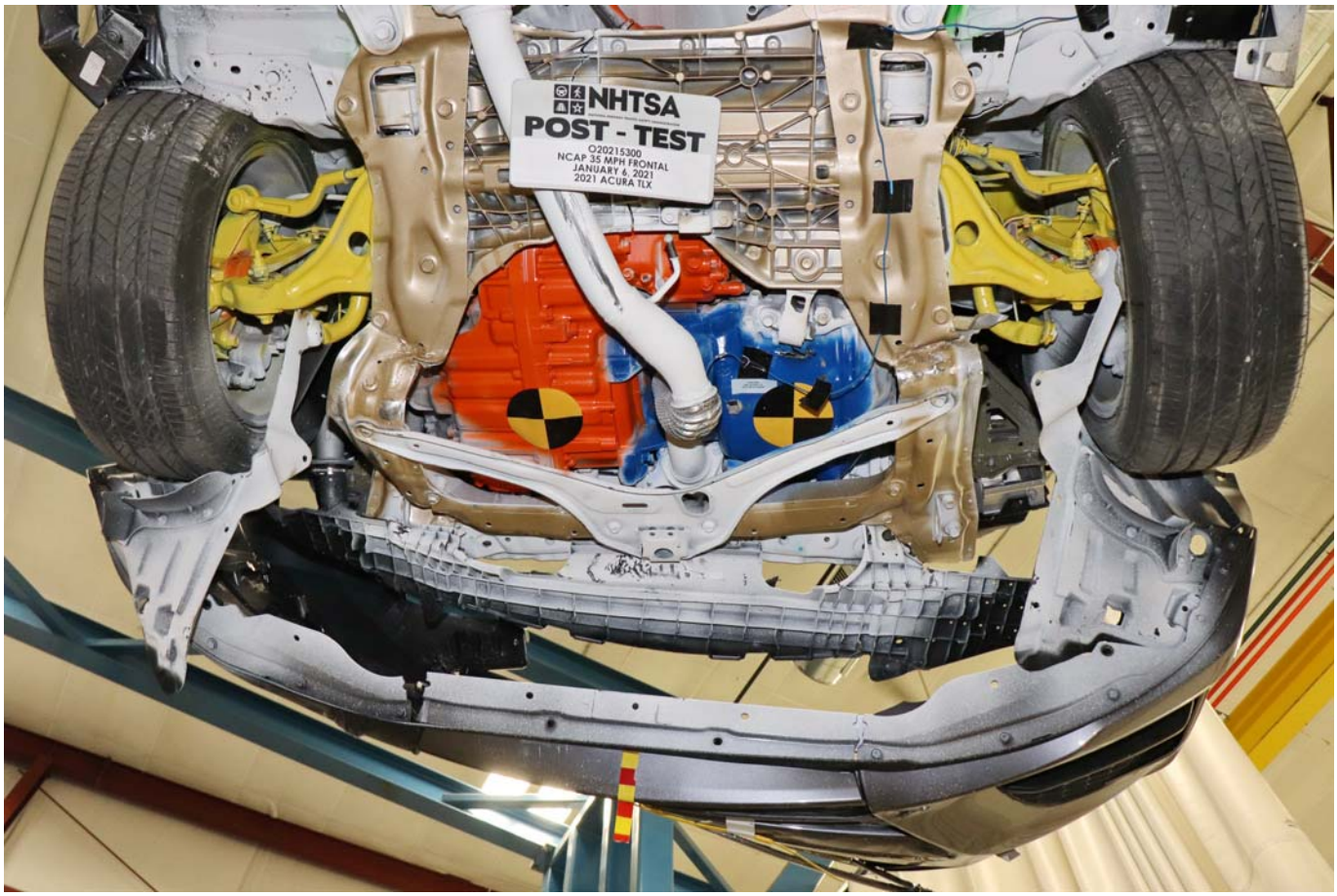


Photo No. 025 - Post-Test Front Underbody View

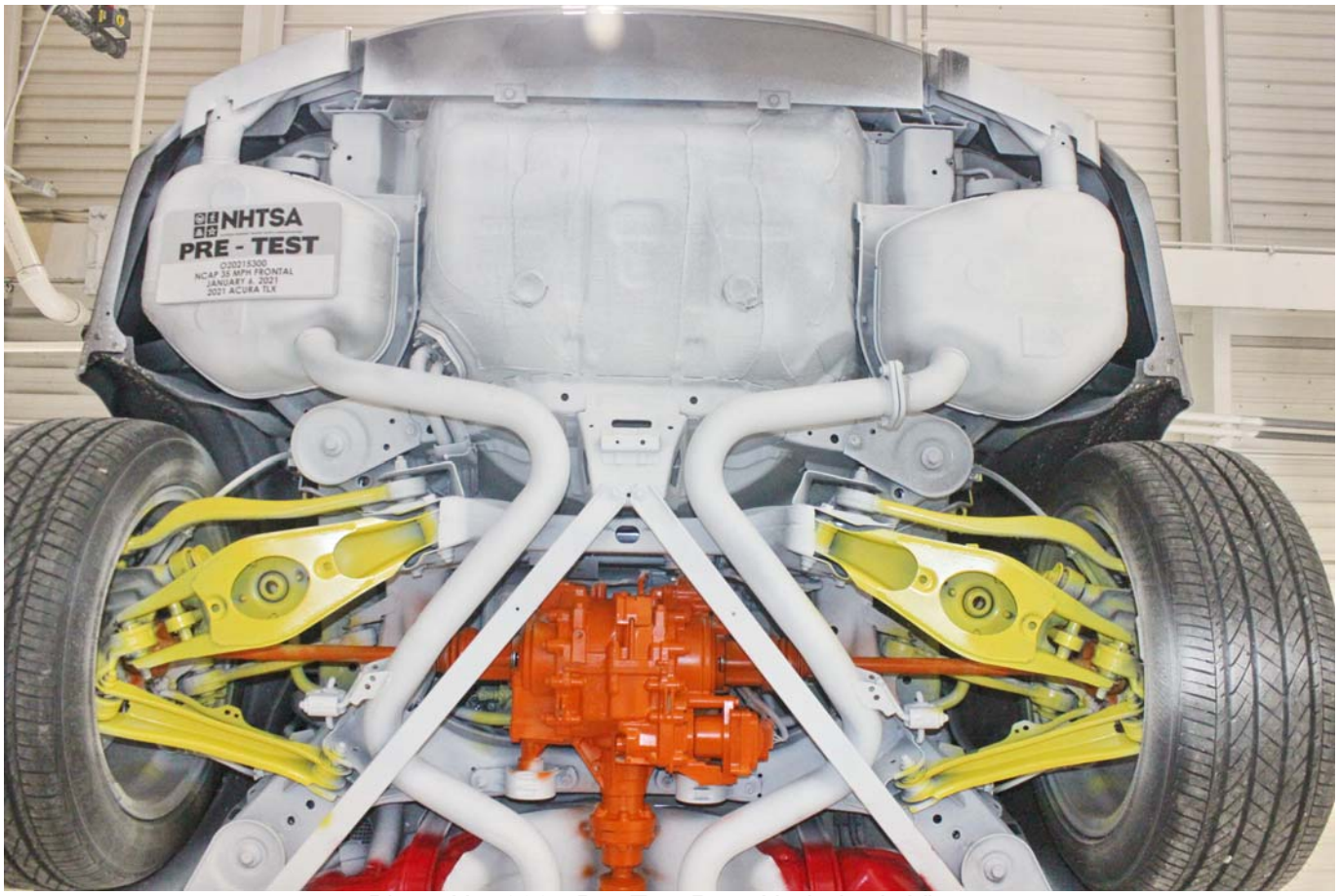


Photo No. 026 - Pre-Test Rear Underbody View

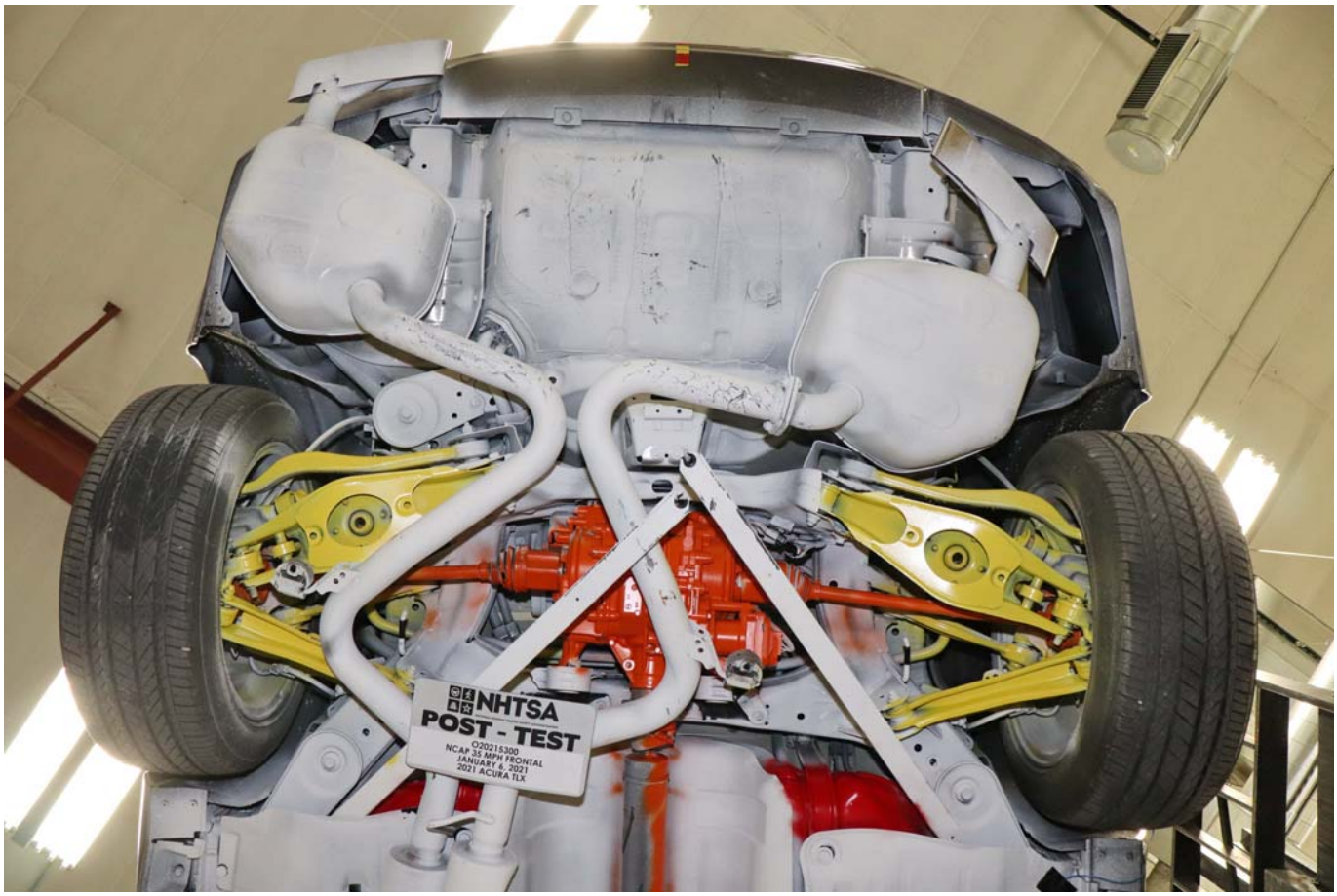


Photo No. 027 - Post-Test Rear Underbody View

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

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

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

Photo No. 037 - Post-Test Driver 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 Side Knee Bolster

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

Photo No. 046 - Pre-Test Driver Side Floorpan

PHOTOGRAPH NOT AVAILABLE

Photo No. 047 - Post-Test Driver 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

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

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

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

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

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

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

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

Photo No. 065 - Pre-Test Passenger Dummy Feet

Photo No. 066 - Post-Test Passenger Dummy Feet

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

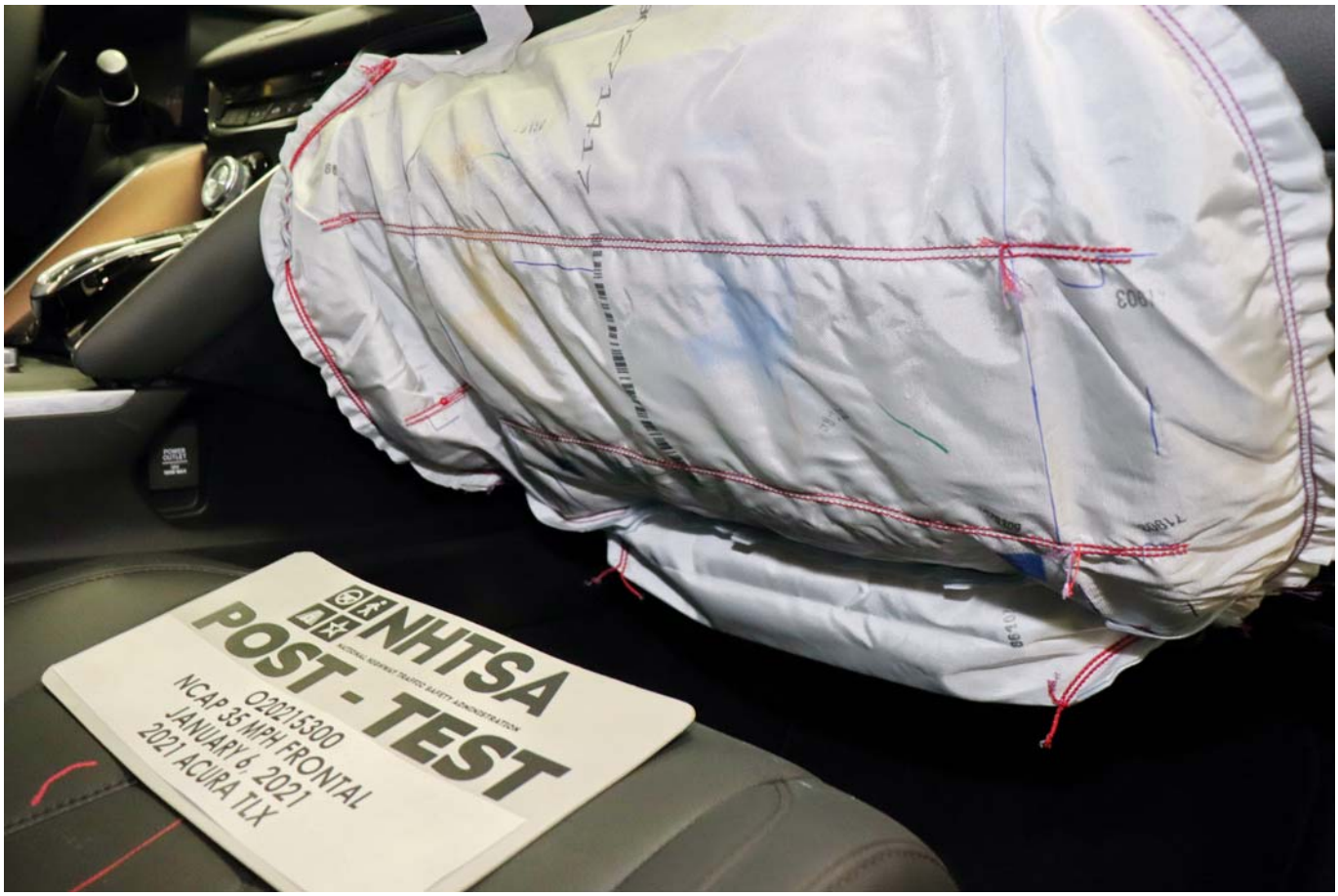


Photo No. 068 - Post-Test Passenger Side Knee Bolster

Photo No. 069 - Pre-Test Passenger Side Floorpan

Photo No. 070 - Post-Test Passenger 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

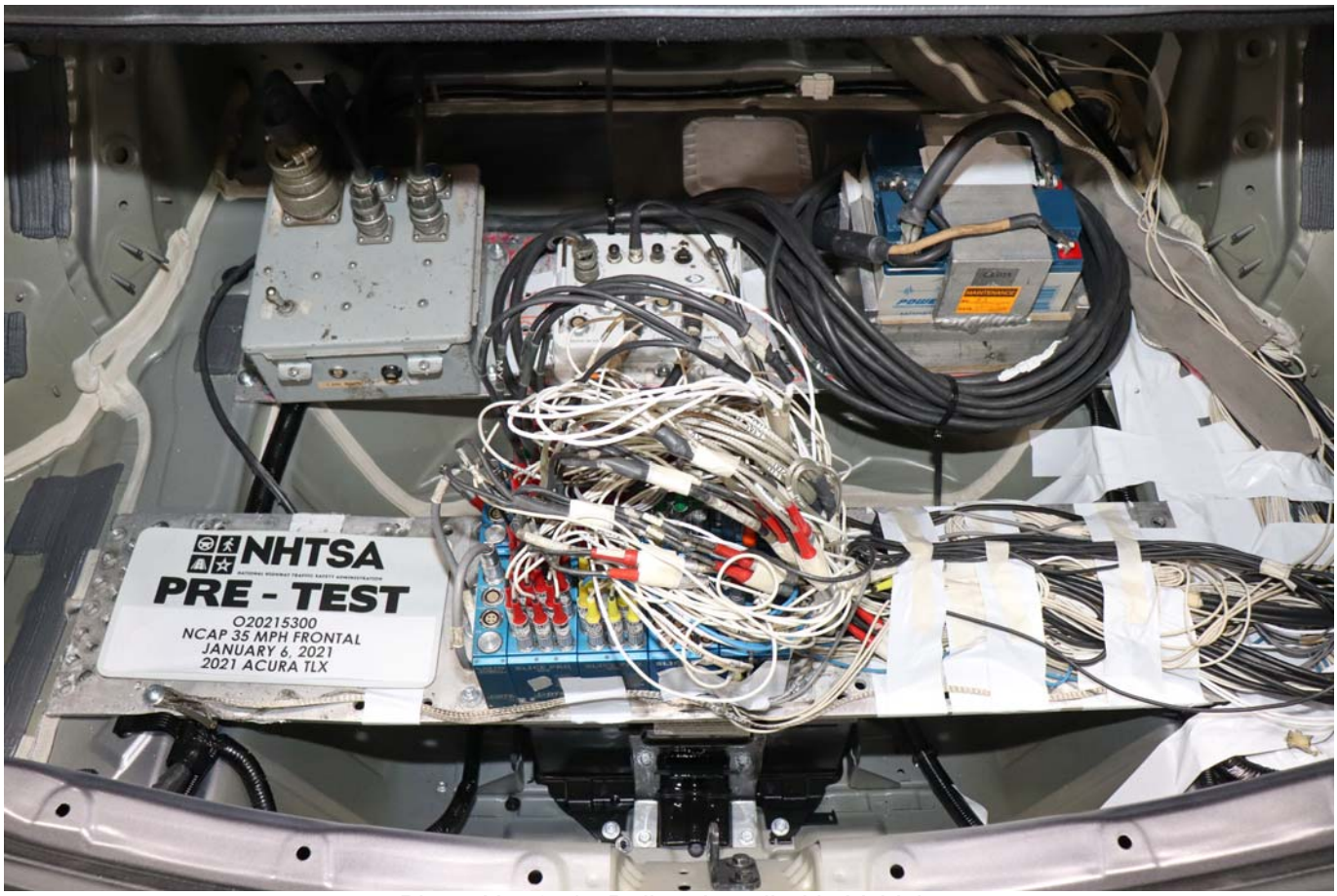


Photo No. 074 - Ballast Installed in Vehicle

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

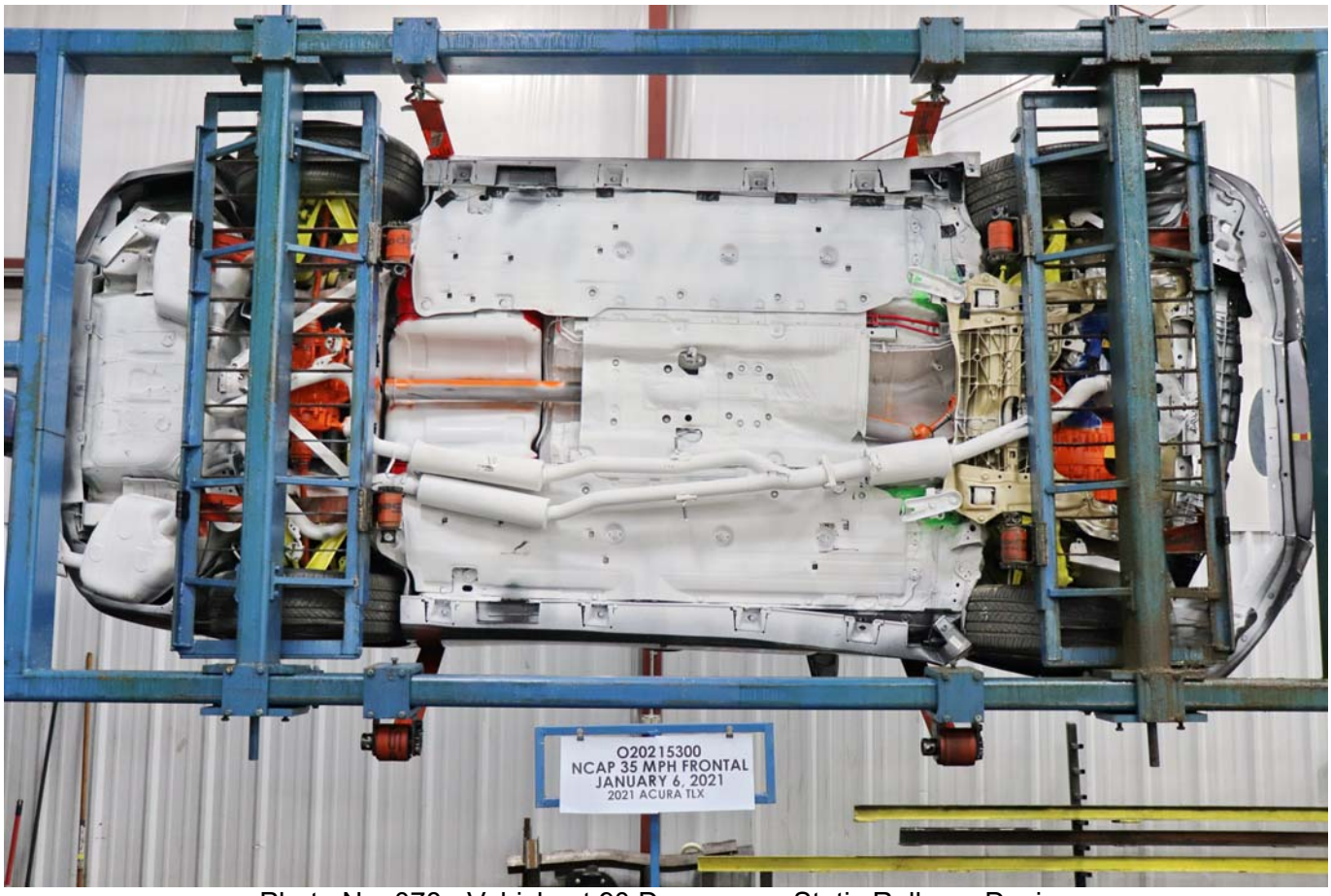


Photo No. 078 - Vehicle at 90 Degrees on Static Rollover Device

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 - 2021 Acura TLX SH-AWD 4-Door Sedan Frontal Impact Event

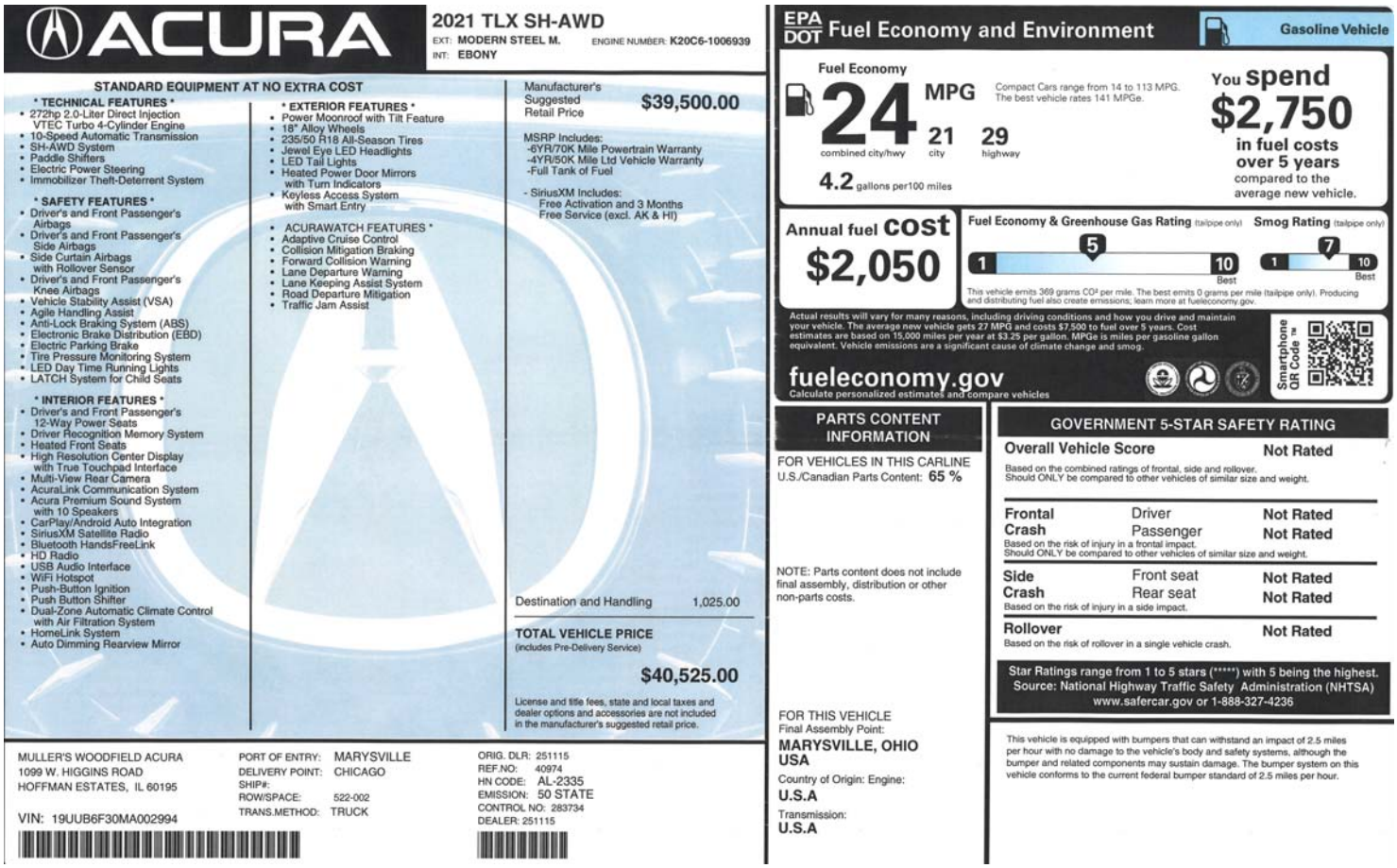


Photo No. 083 - Monroney Label Photograph

APPENDIX B
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

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

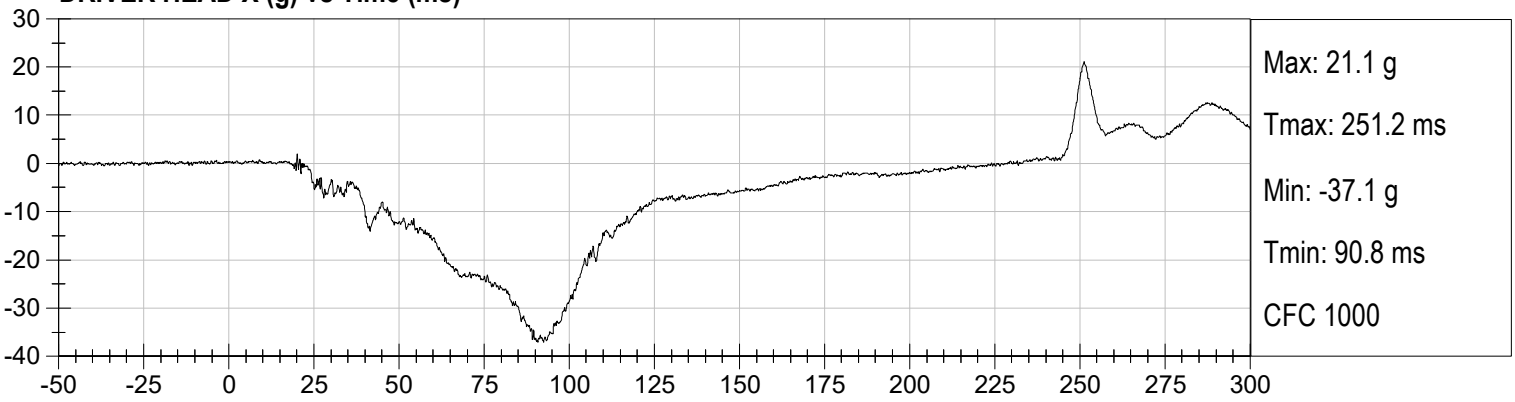
Right Rear Seat Crossmember Z

Left Rear Seat Crossmember Xr

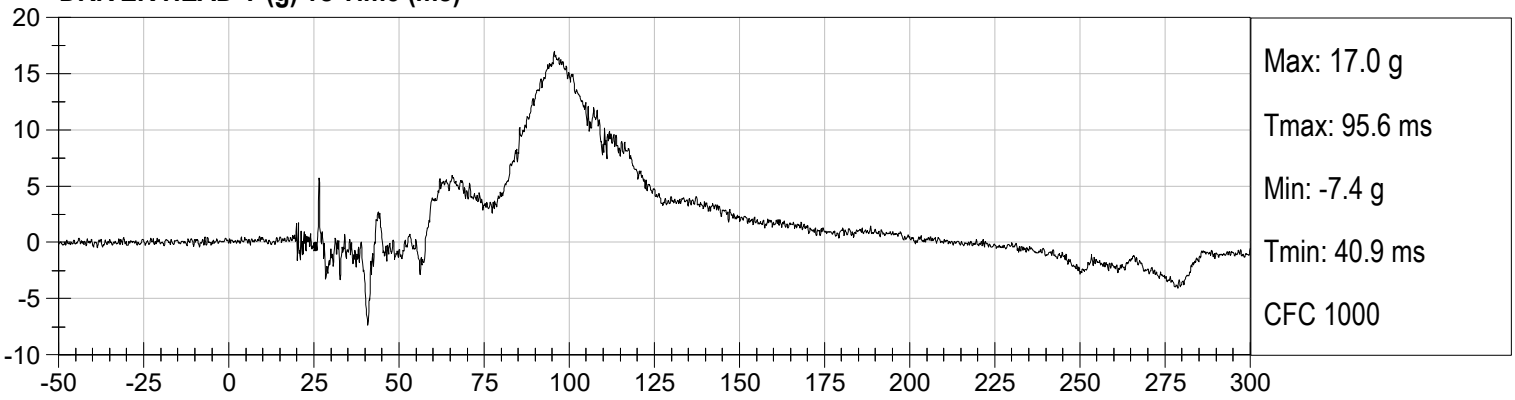
Right Rear Seat Crossmember Xr

Advanced Research Load Cell Barrier – 528 channels

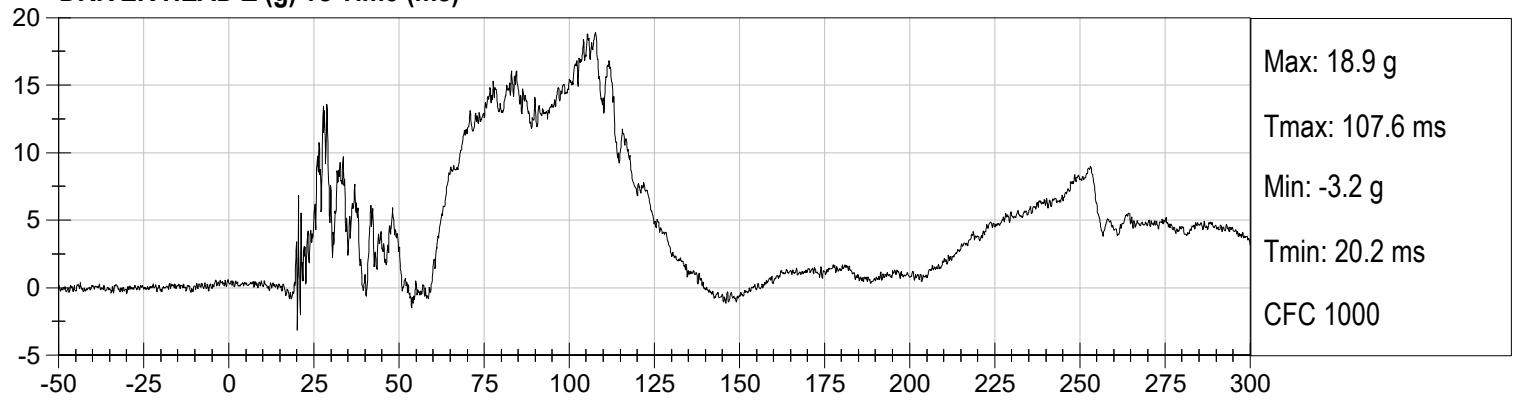
DRIVER HEAD X (g) vs Time (ms)



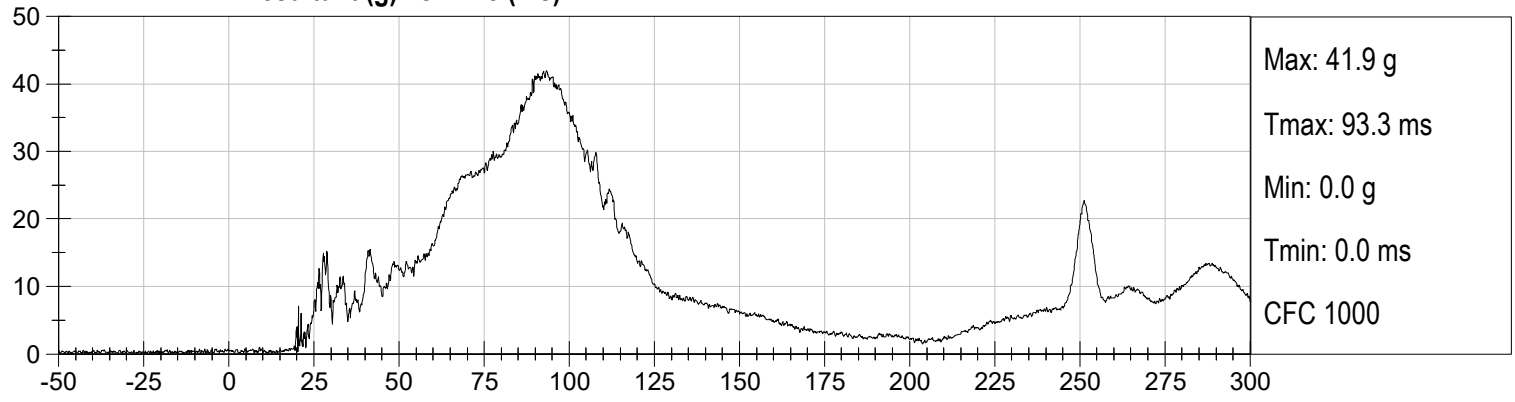
DRIVER HEAD Y (g) vs Time (ms)



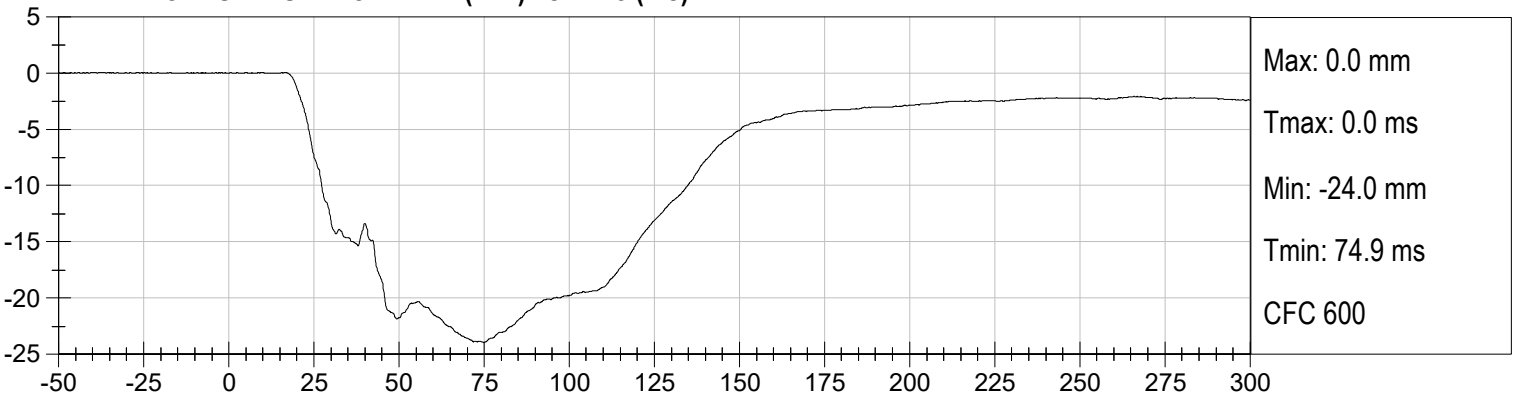
DRIVER HEAD Z (g) vs Time (ms)



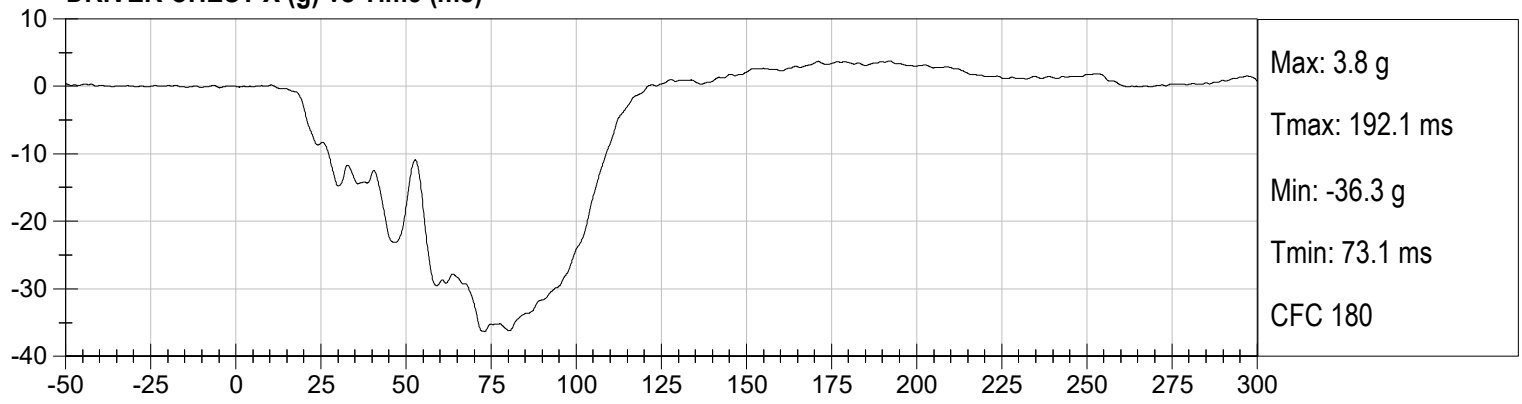
DRIVER HEAD Resultant (g) vs Time (ms)



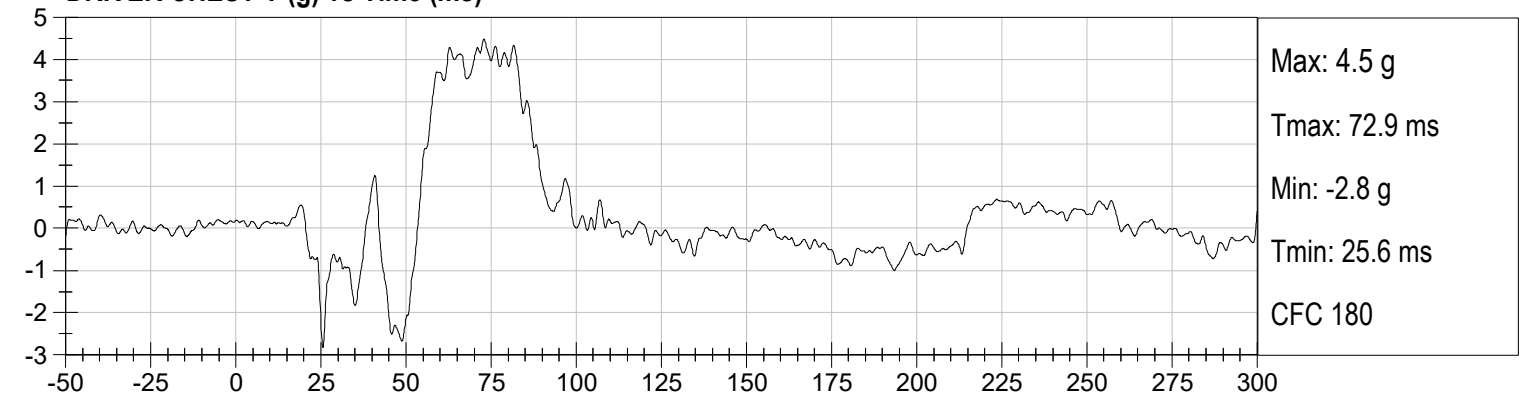
DRIVER CHEST DISPLACEMENT (mm) vs Time (ms)



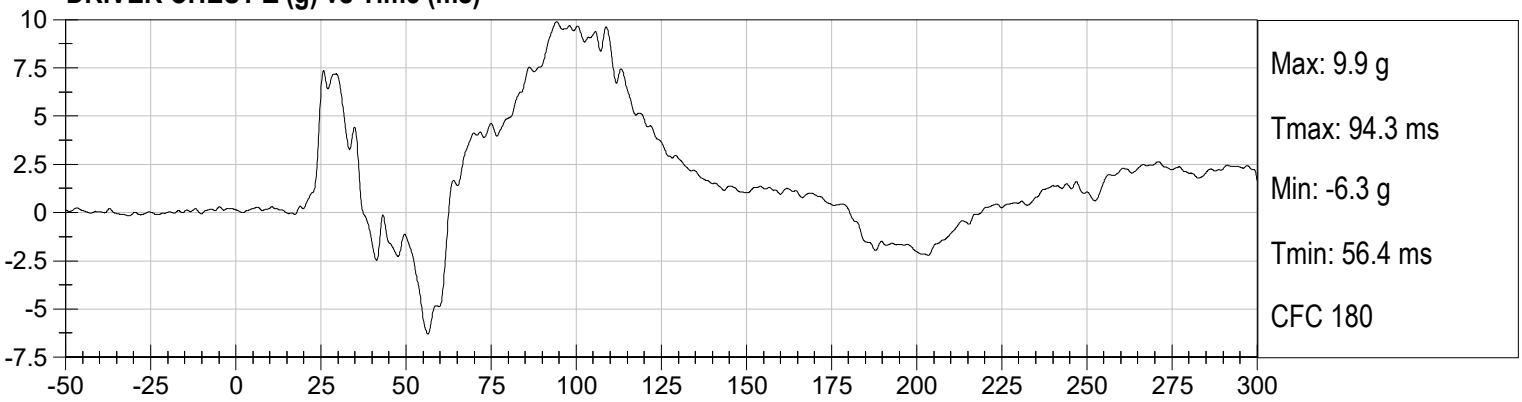
DRIVER CHEST X (g) vs Time (ms)



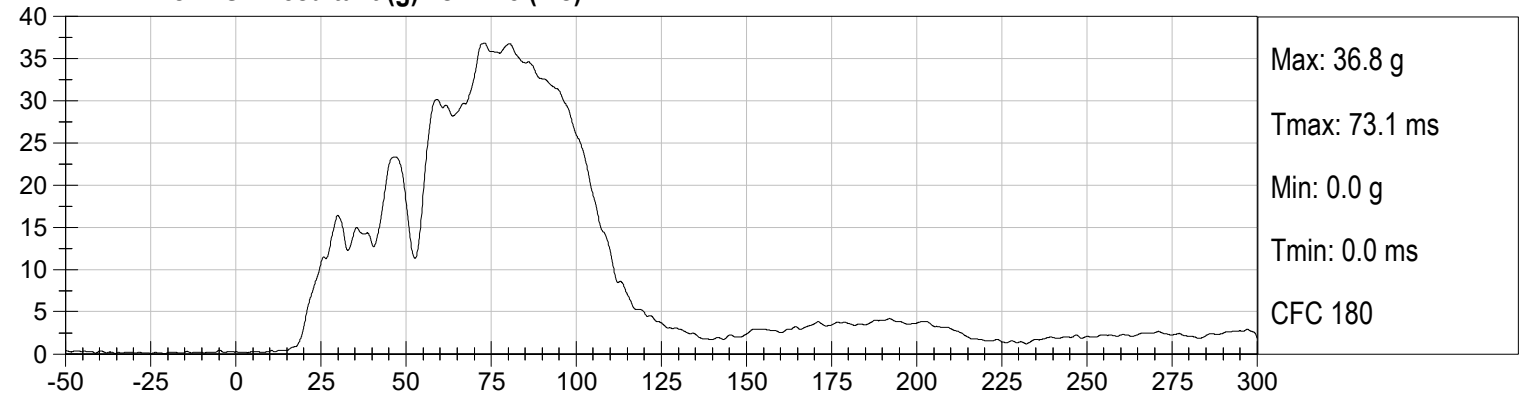
DRIVER CHEST Y (g) vs Time (ms)



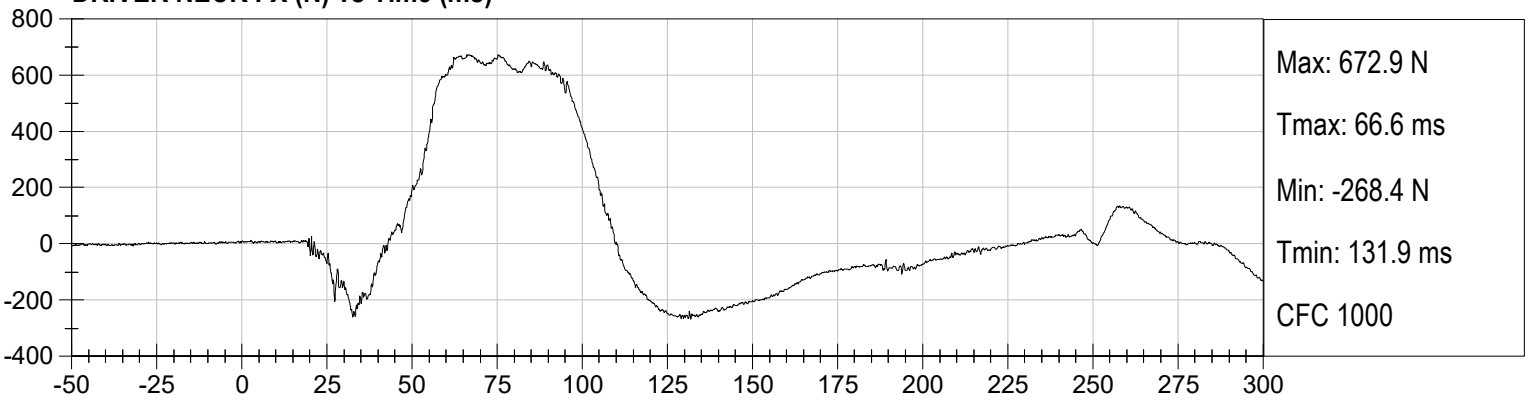
DRIVER CHEST Z (g) vs Time (ms)



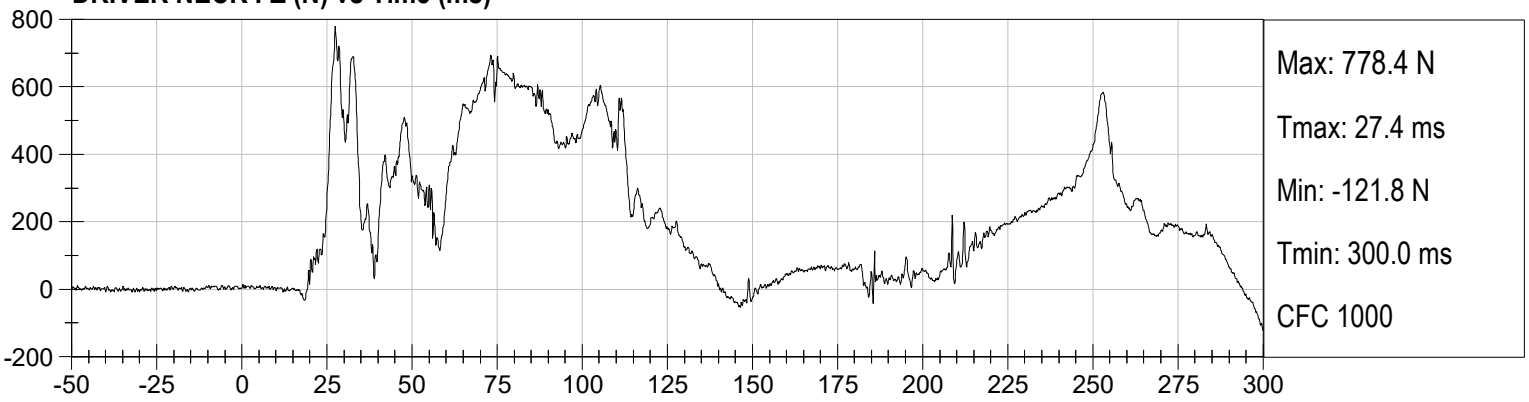
DRIVER CHEST Resultant (g) vs Time (ms)



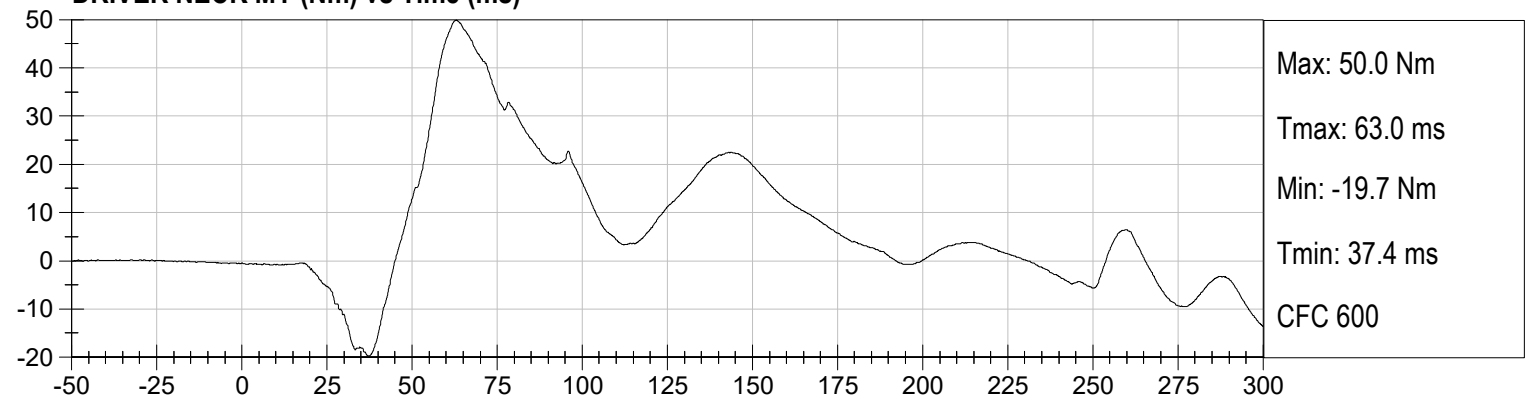
DRIVER NECK FX (N) vs Time (ms)



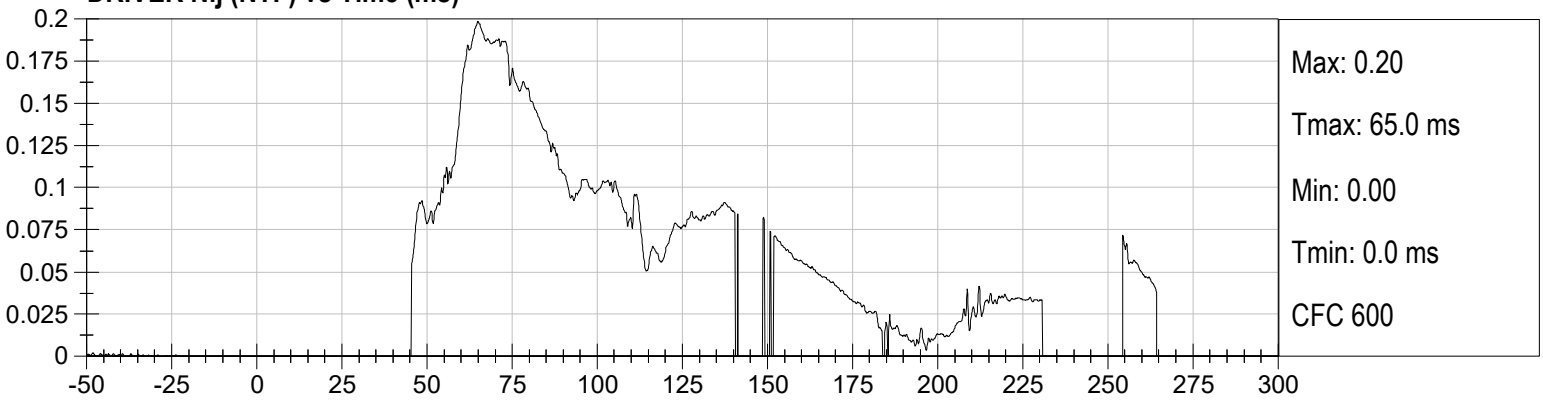
DRIVER NECK FZ (N) vs Time (ms)



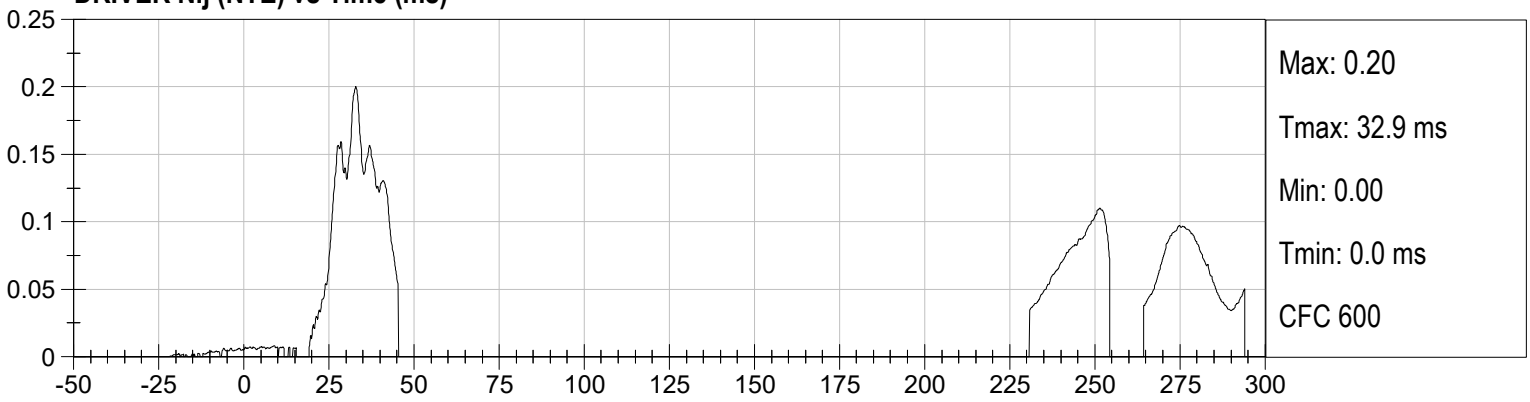
DRIVER NECK MY (Nm) vs Time (ms)



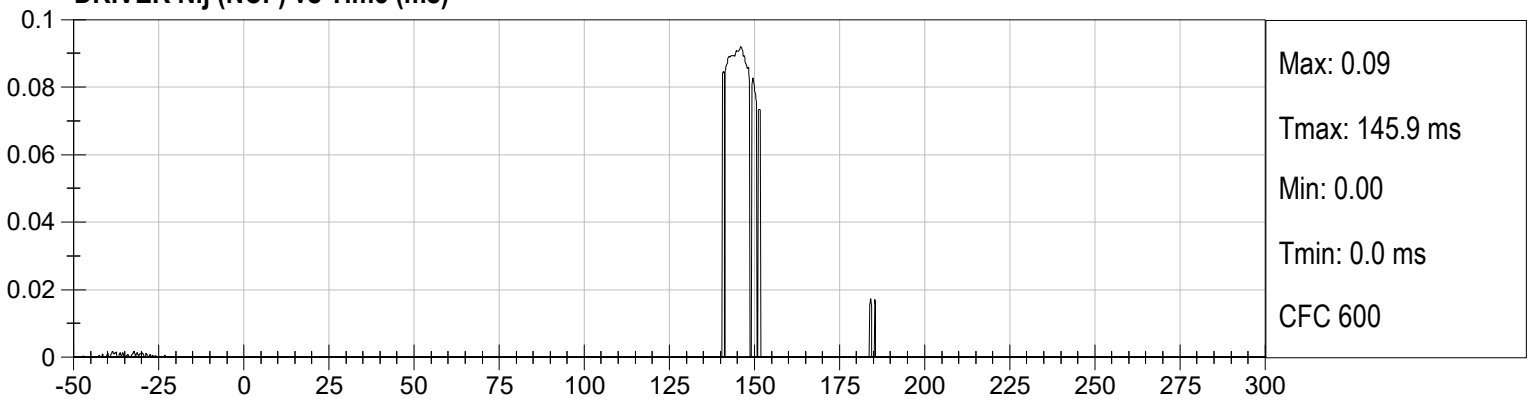
DRIVER Nij (NTF) vs Time (ms)



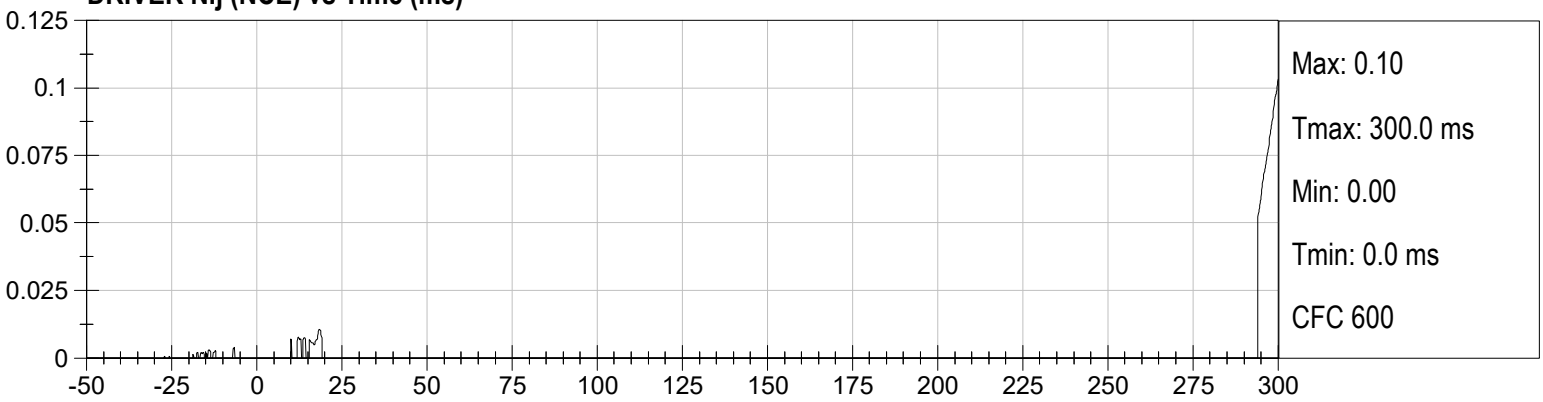
DRIVER Nij (NTE) vs Time (ms)



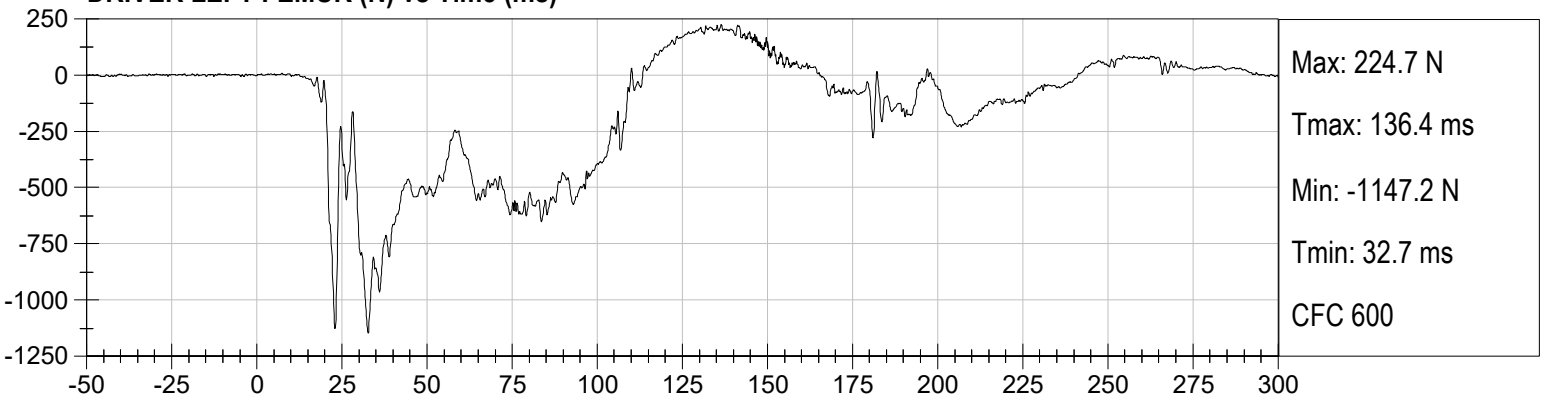
DRIVER Nij (NCF) vs Time (ms)



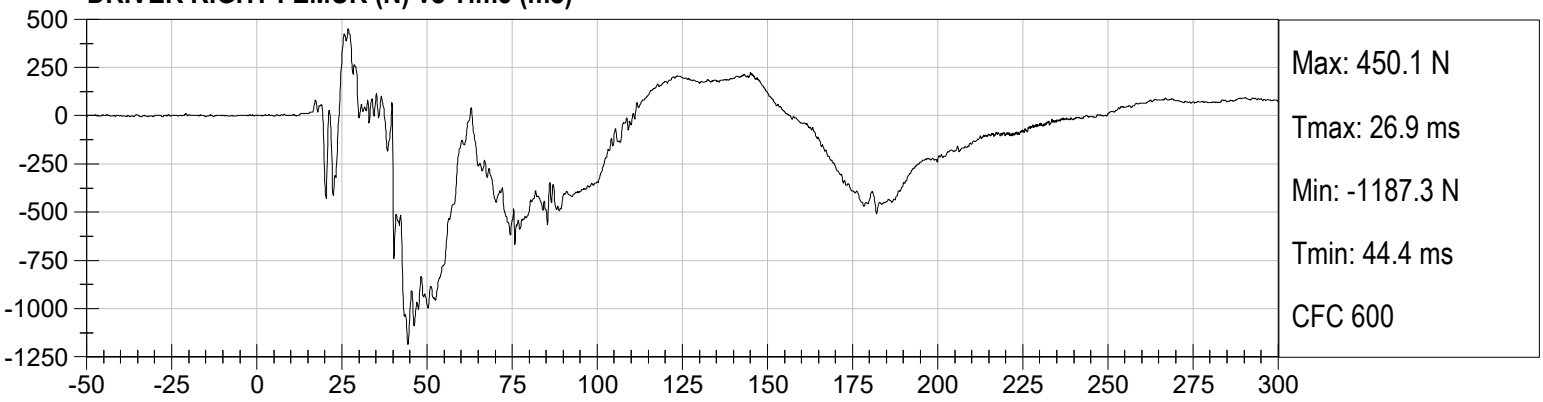
DRIVER Nij (NCE) vs Time (ms)



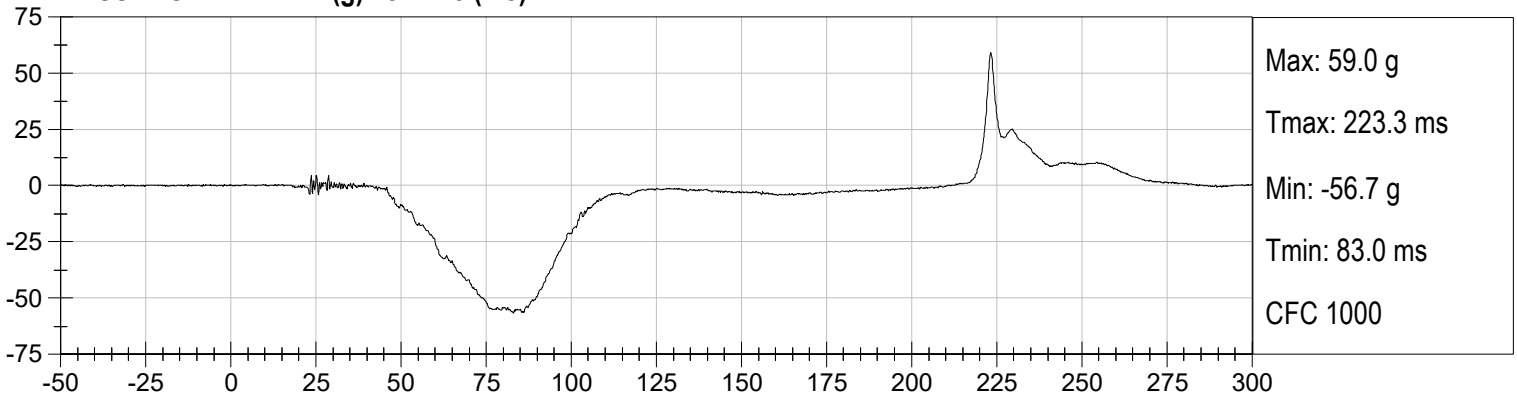
DRIVER LEFT FEMUR (N) vs Time (ms)



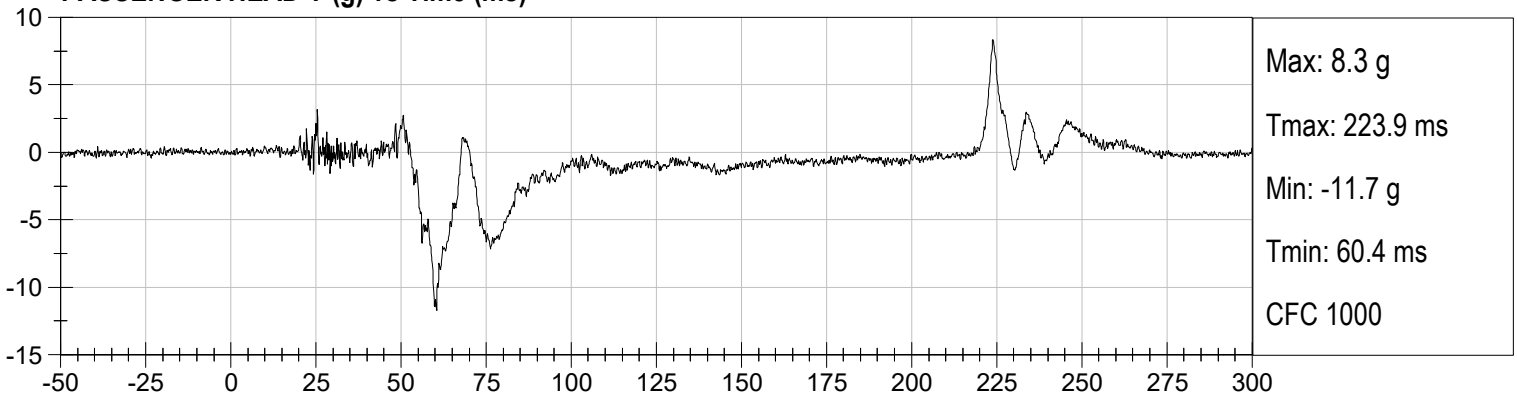
DRIVER RIGHT FEMUR (N) vs Time (ms)



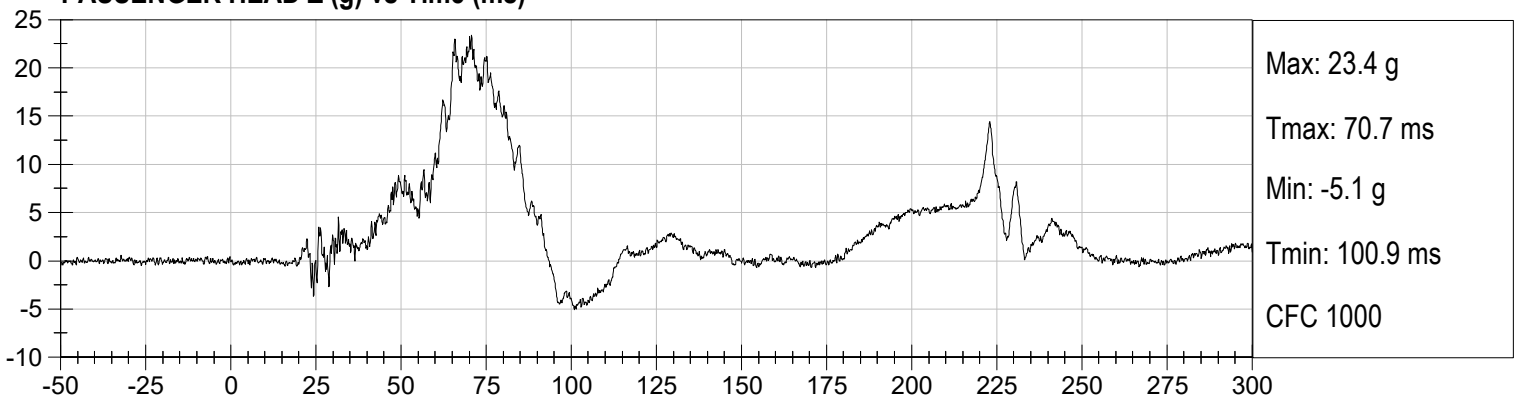
PASSENGER HEAD X (g) vs Time (ms)



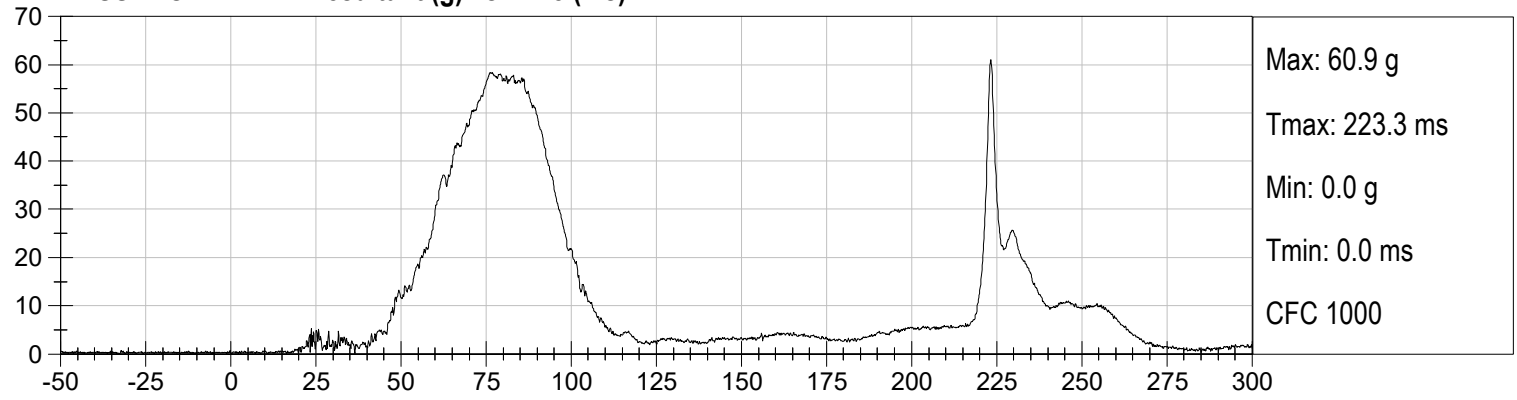
PASSENGER HEAD Y (g) vs Time (ms)



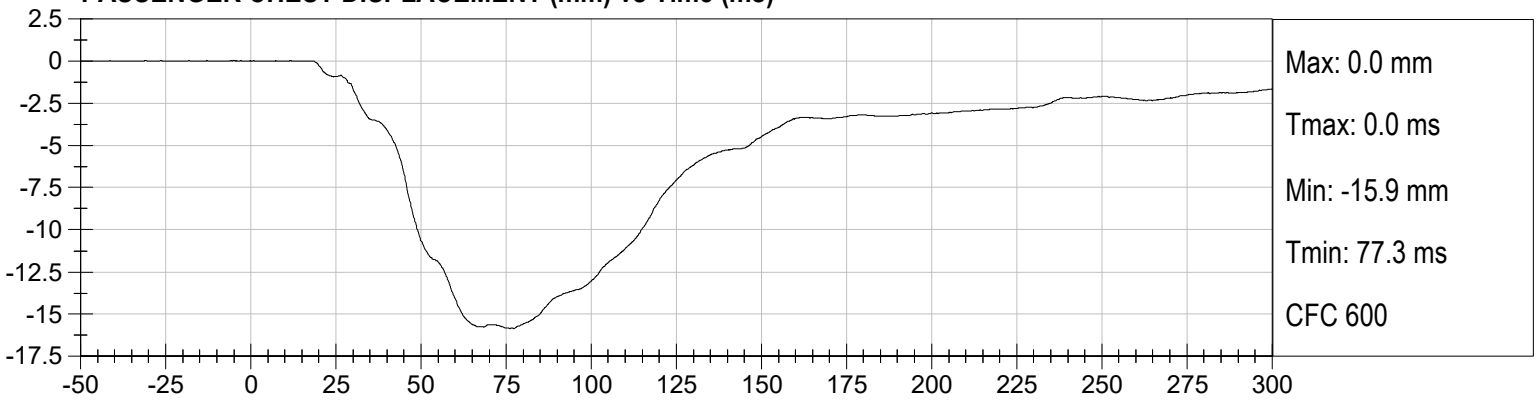
PASSENGER HEAD Z (g) vs Time (ms)



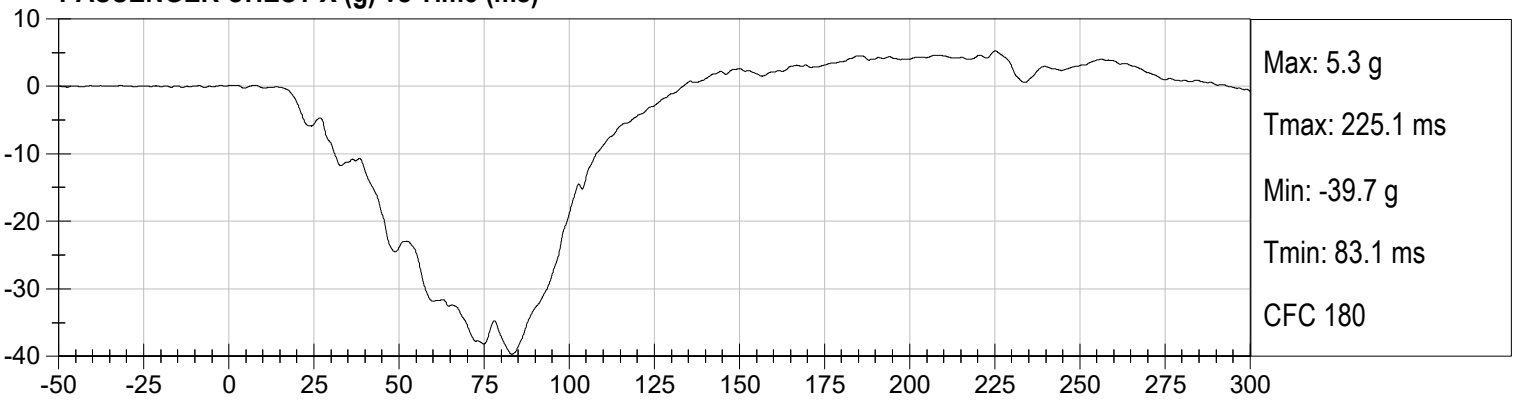
PASSENGER HEAD Resultant (g) vs Time (ms)



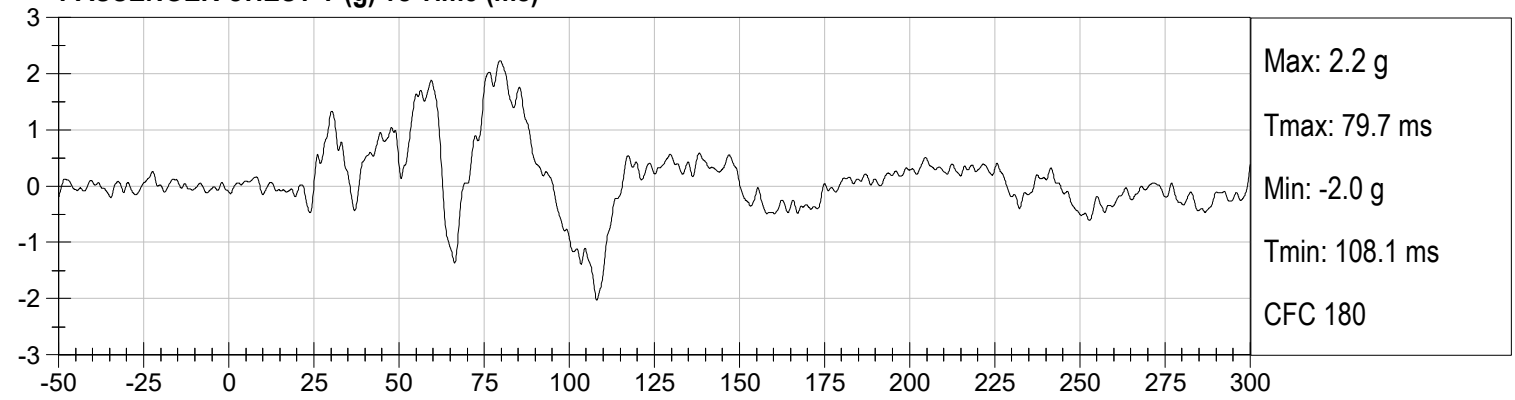
PASSENGER CHEST DISPLACEMENT (mm) vs Time (ms)



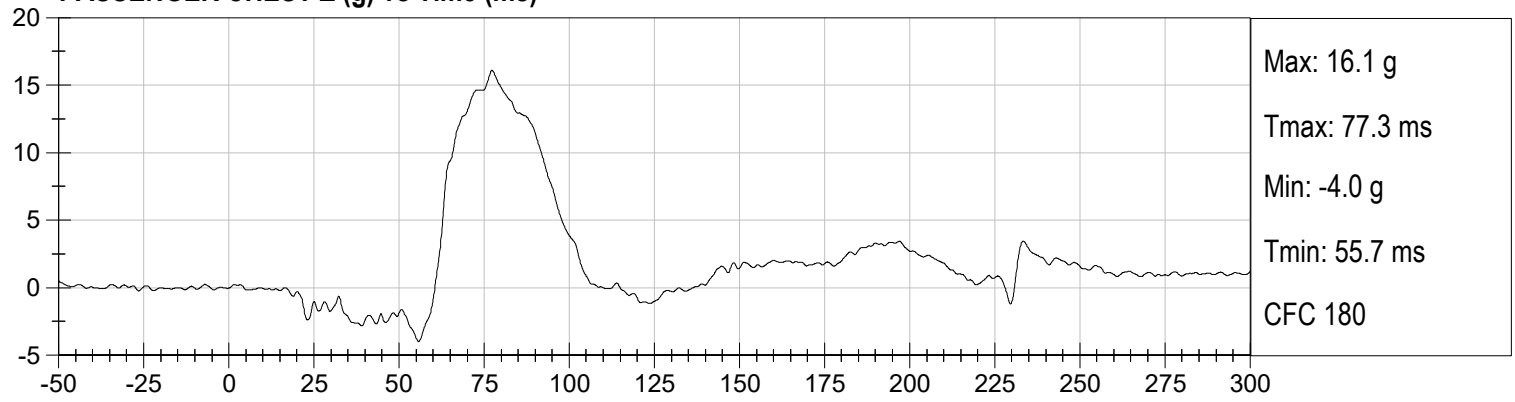
PASSENGER CHEST X (g) vs Time (ms)



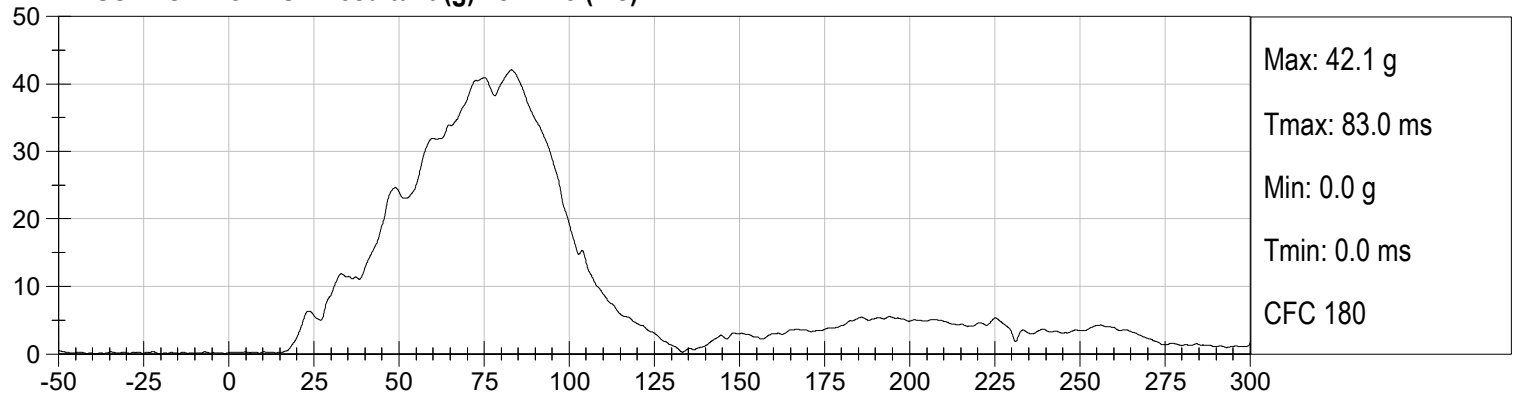
PASSENGER CHEST Y (g) vs Time (ms)



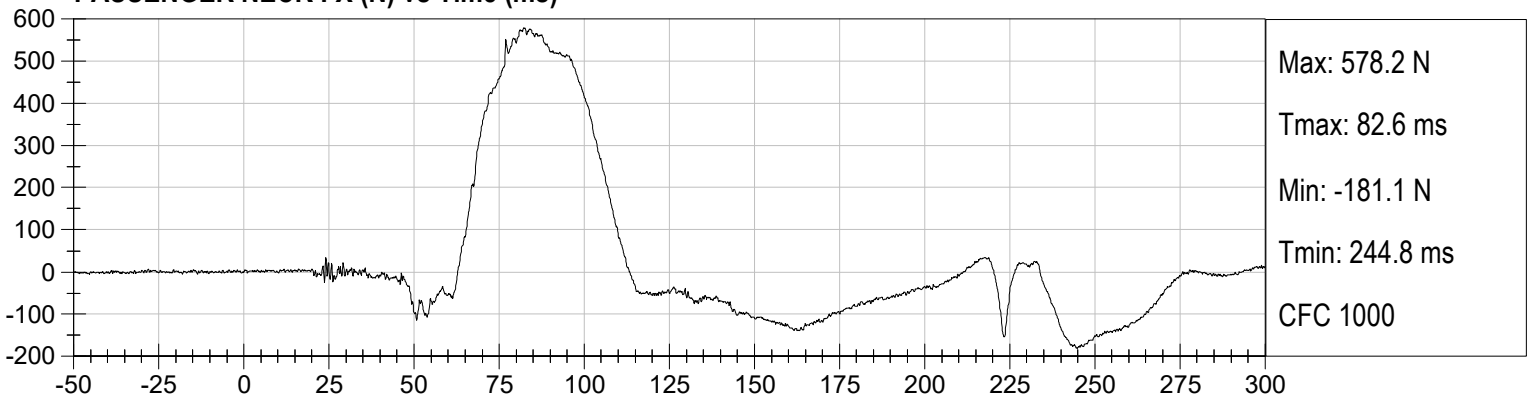
PASSENGER CHEST Z (g) vs Time (ms)



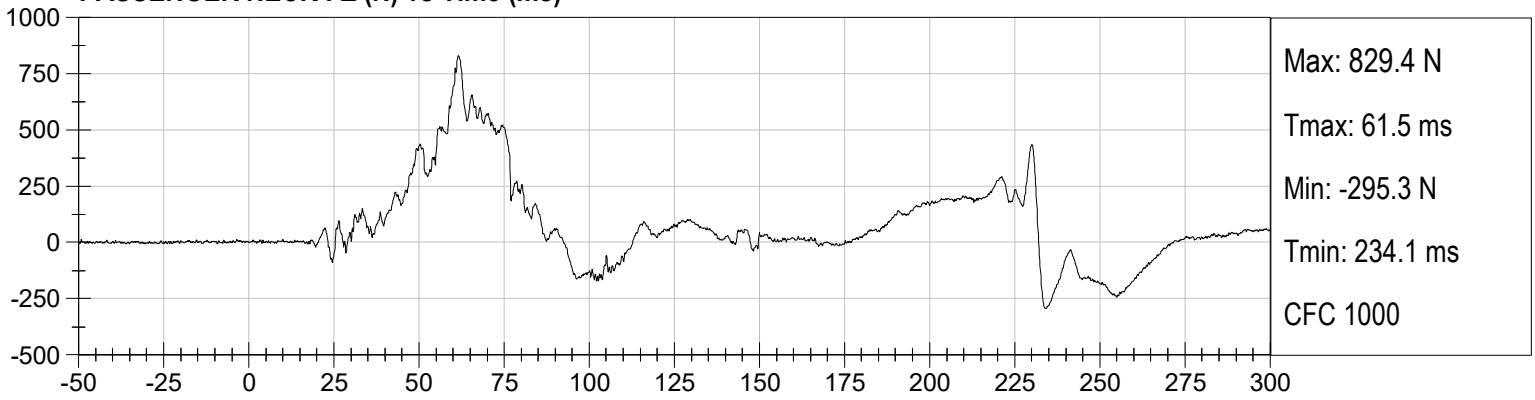
PASSENGER CHEST Resultant (g) vs Time (ms)



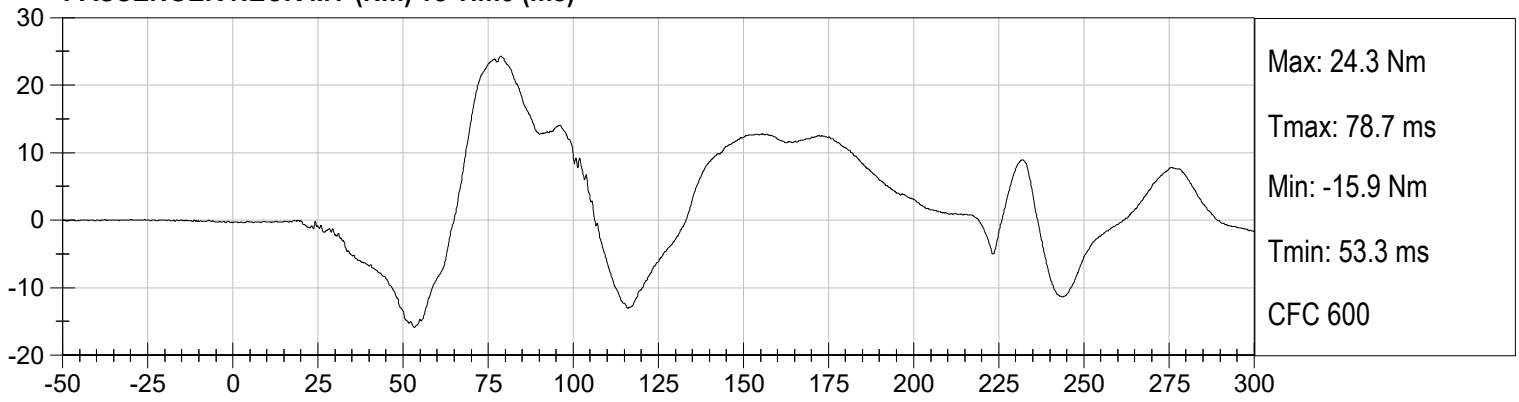
PASSENGER NECK FX (N) vs Time (ms)



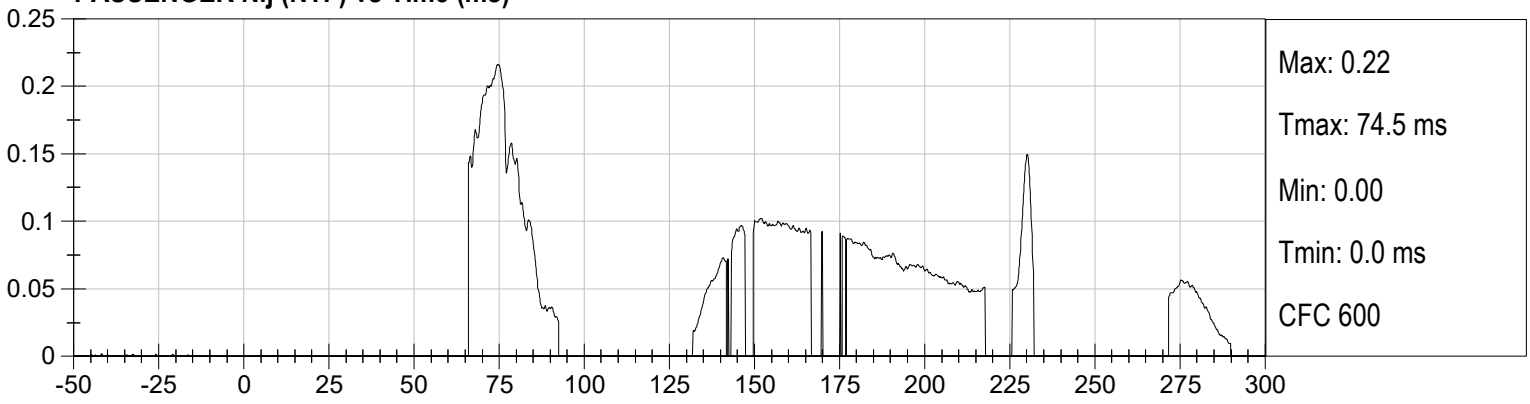
PASSENGER NECK FZ (N) vs Time (ms)



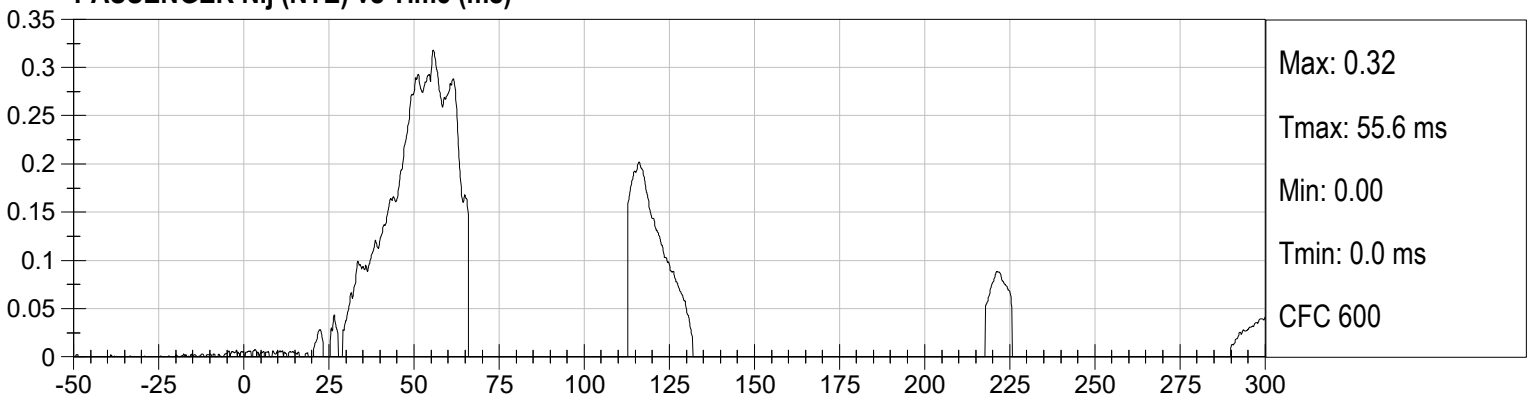
PASSENGER NECK MY (Nm) vs Time (ms)



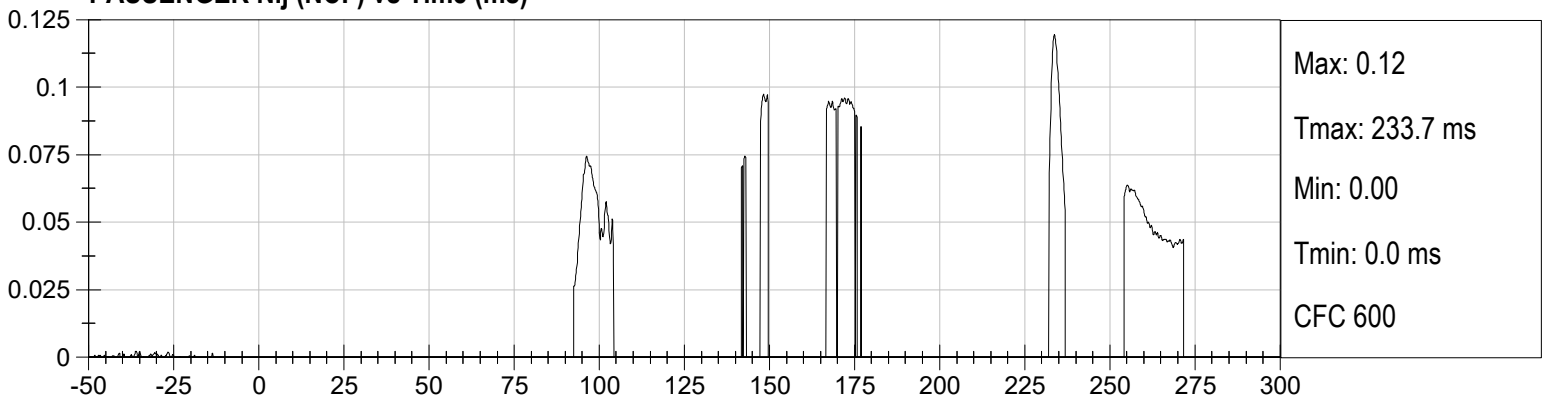
PASSENGER Nij (NTF) vs Time (ms)



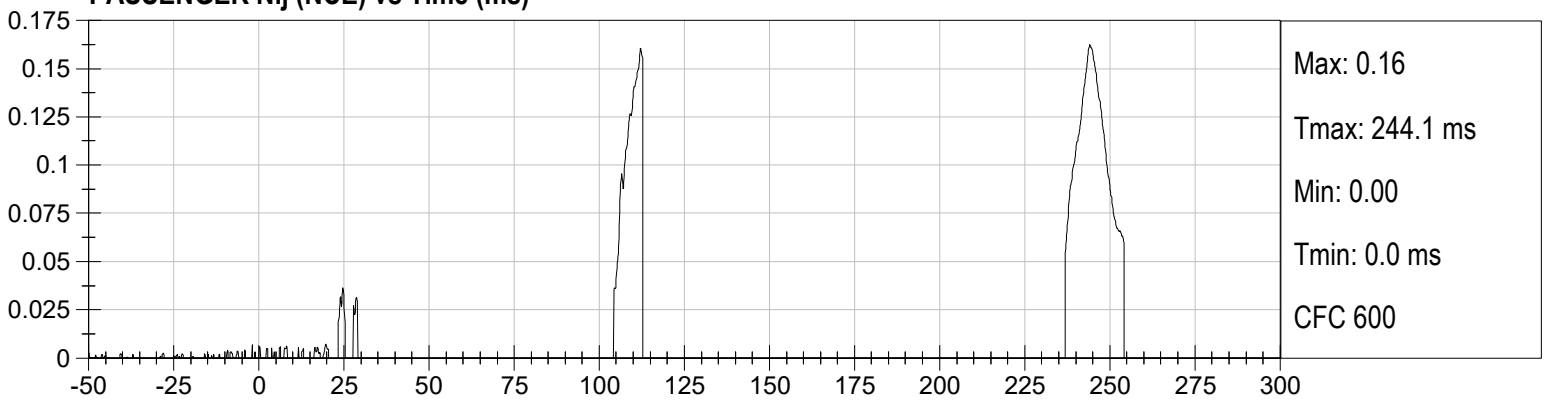
PASSENGER Nij (NTE) vs Time (ms)



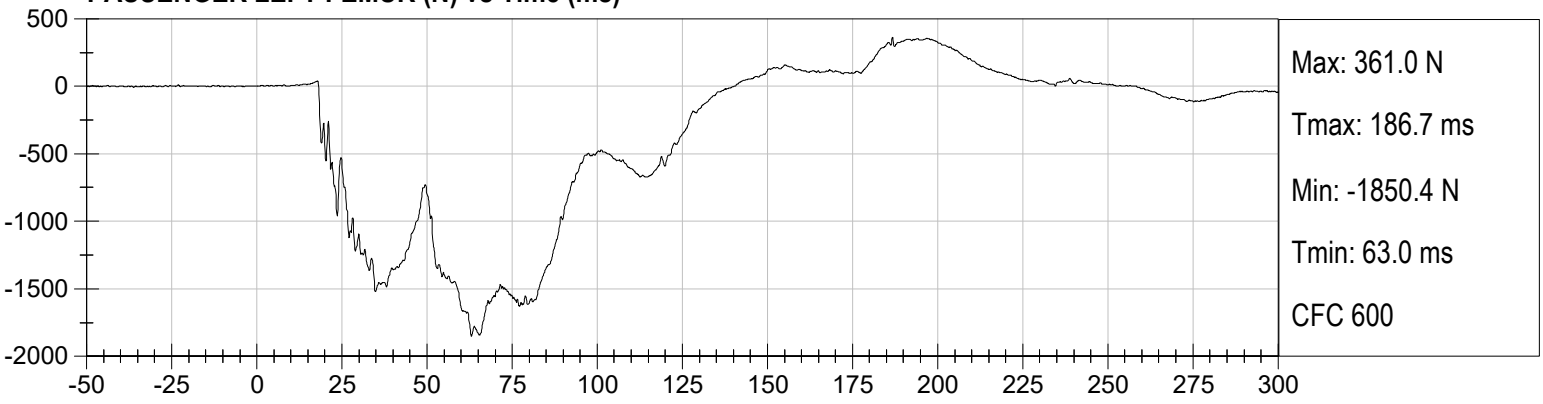
PASSENGER Nij (NCF) vs Time (ms)



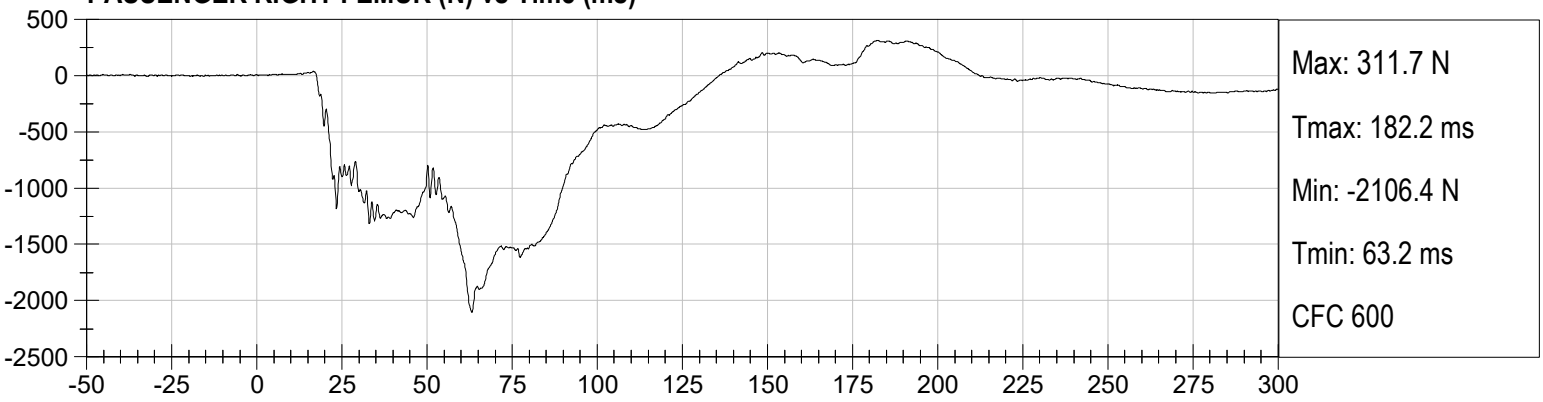
PASSENGER Nij (NCE) vs Time (ms)



PASSENGER LEFT FEMUR (N) vs Time (ms)



PASSENGER RIGHT FEMUR (N) vs Time (ms)



APPENDIX C
DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

Hybrid III, 50th External Measurements
SN: 351

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

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

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

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test ID:** D203131

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Peak Resultant Acceleration	G's	225 to 275	253	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-1.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

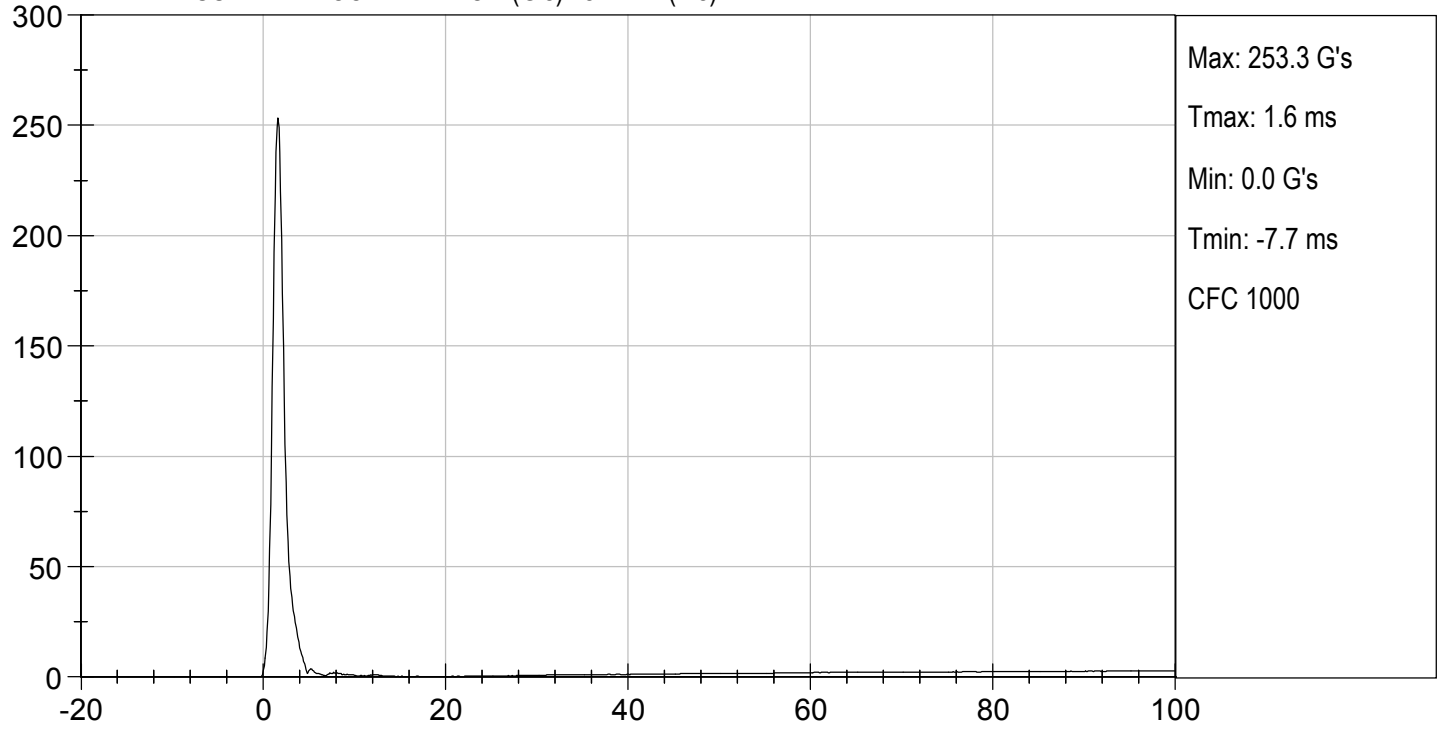
12/04/2020
Test Date

Approved By

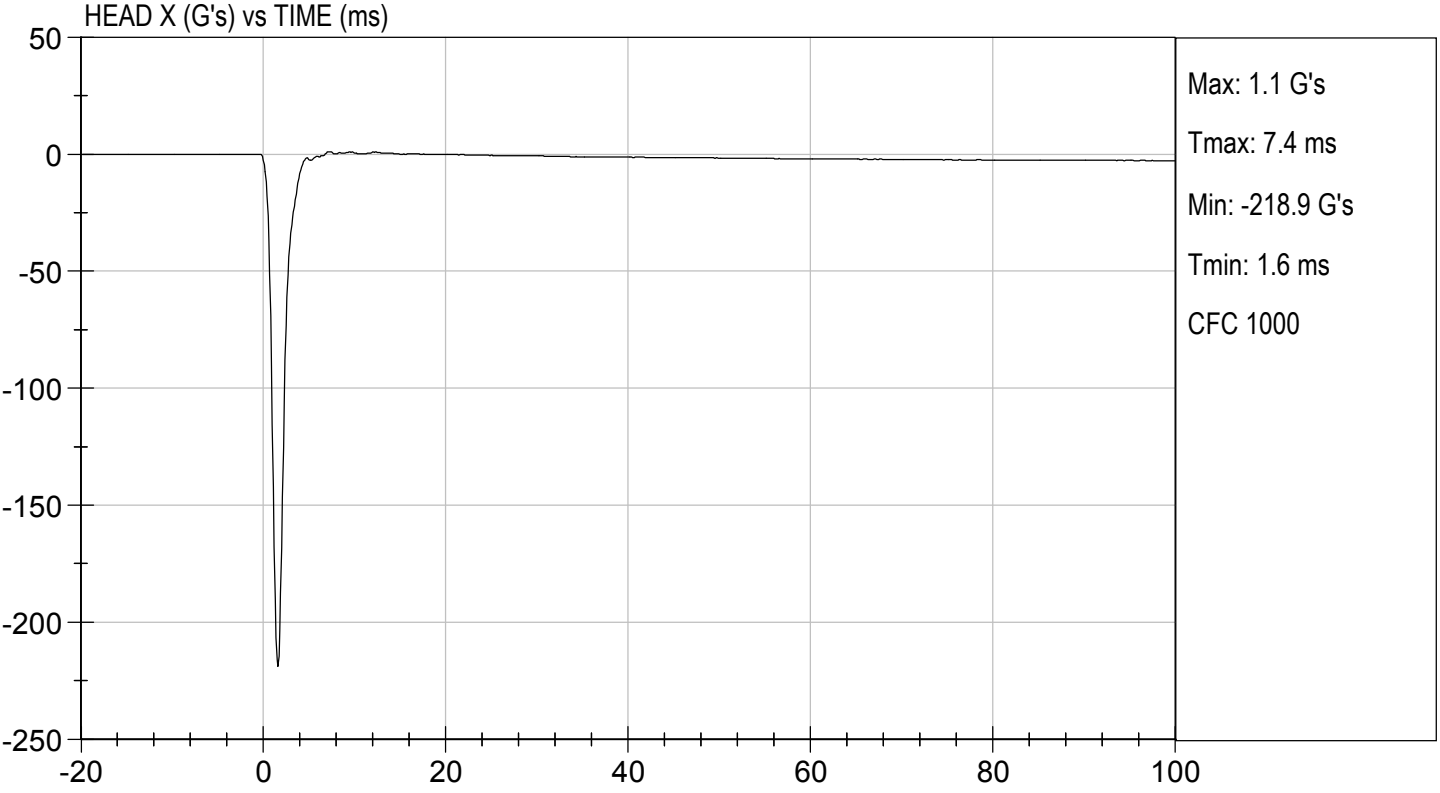
TEST DESC: HEAD DROP

TEST DATE: 12/04/2020
TEST #: D203131

HEAD RESULTANT ACCELERATION (G's) vs TIME (ms)

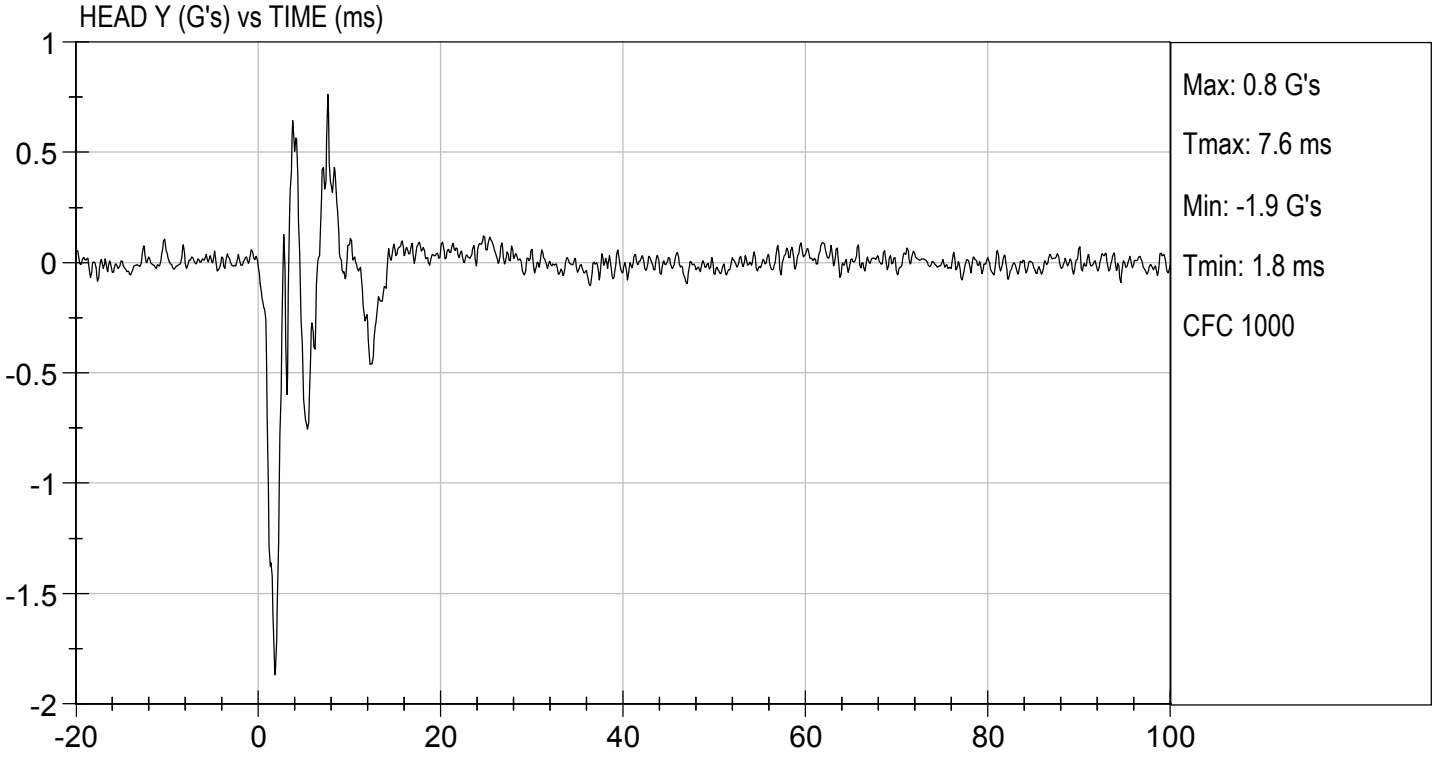


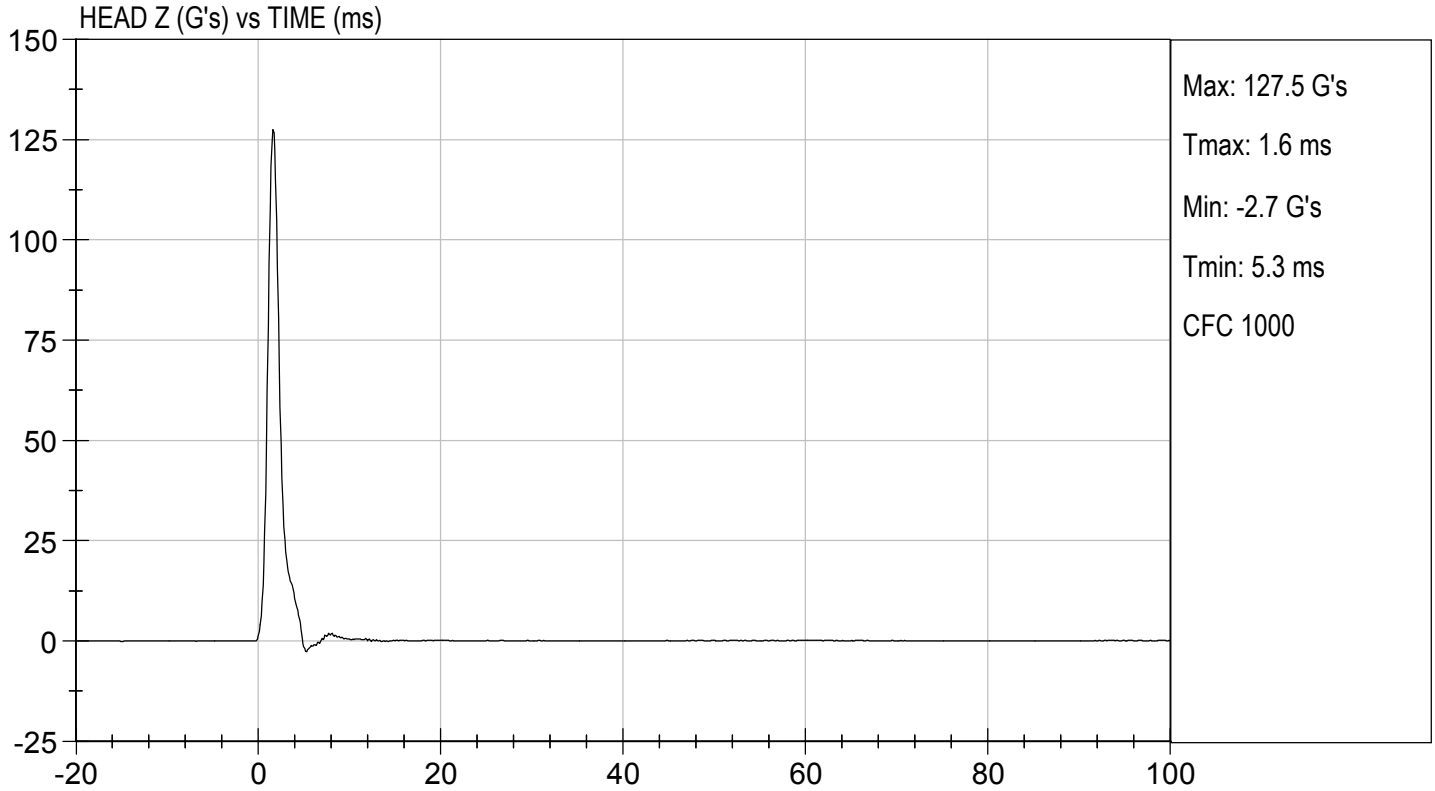
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 12/04/2020
TEST #: D203131





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D203132

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	32	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.82	Pass
	20 ms	G's	17.60 to 22.60	20.61	Pass
	30 ms	G's	12.50 to 18.50	15.82	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	15.8	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.9	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	71.8	Pass
	Time	ms	57.0 to 64.0	58.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.1	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	96.2	Pass
	Time	ms	47.0 to 58.0	47.7	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	99.3	Pass
			Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

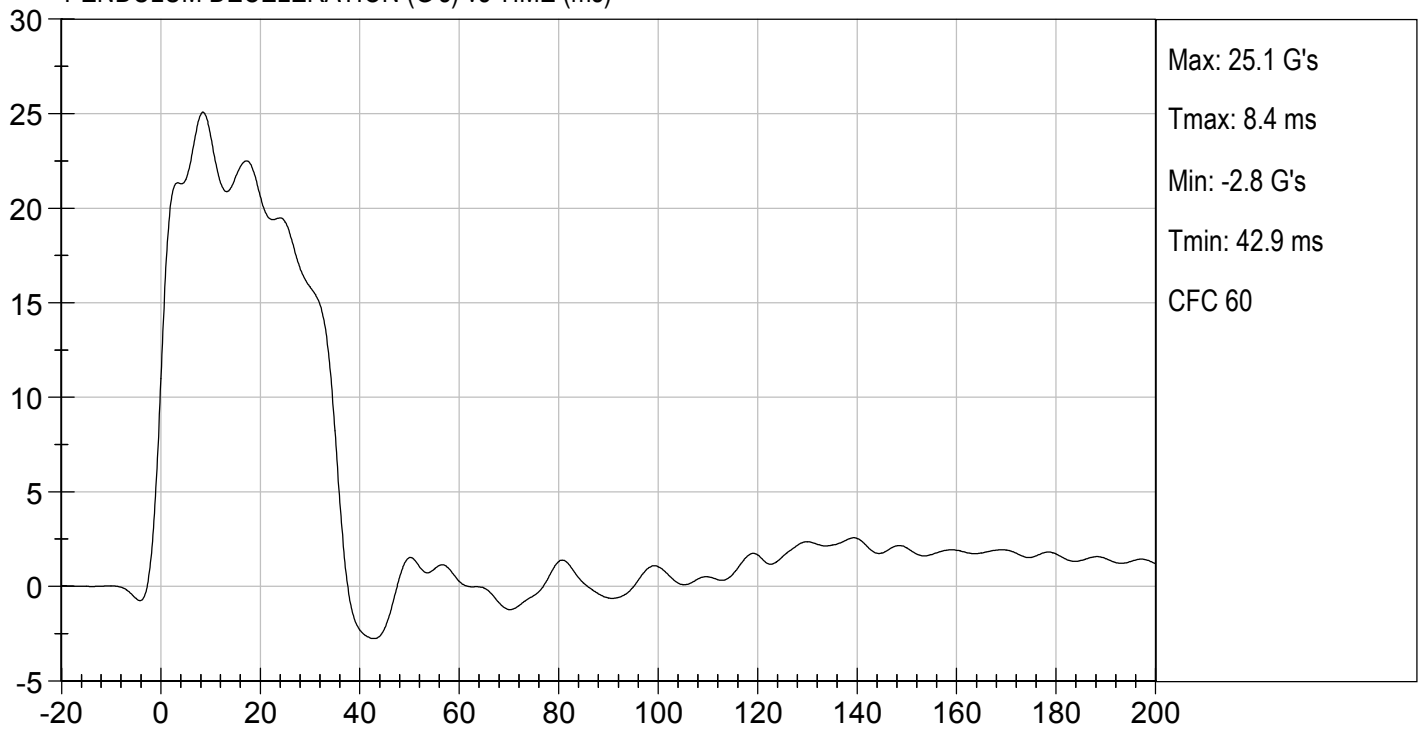
12/04/2020
Test Date

Approved By

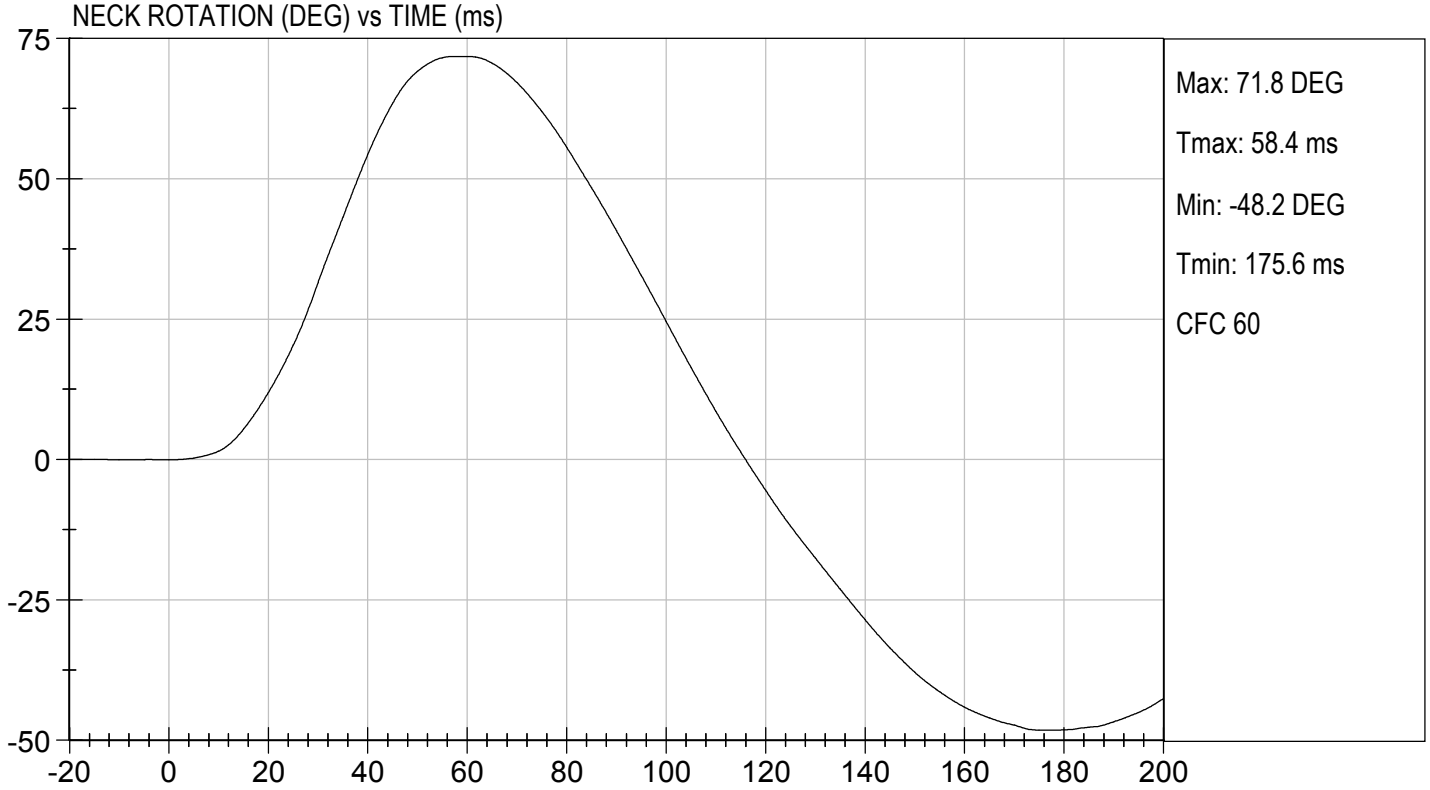
TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 12/04/2020
TEST #: D203132

PENDULUM DECELERATION (G's) vs TIME (ms)

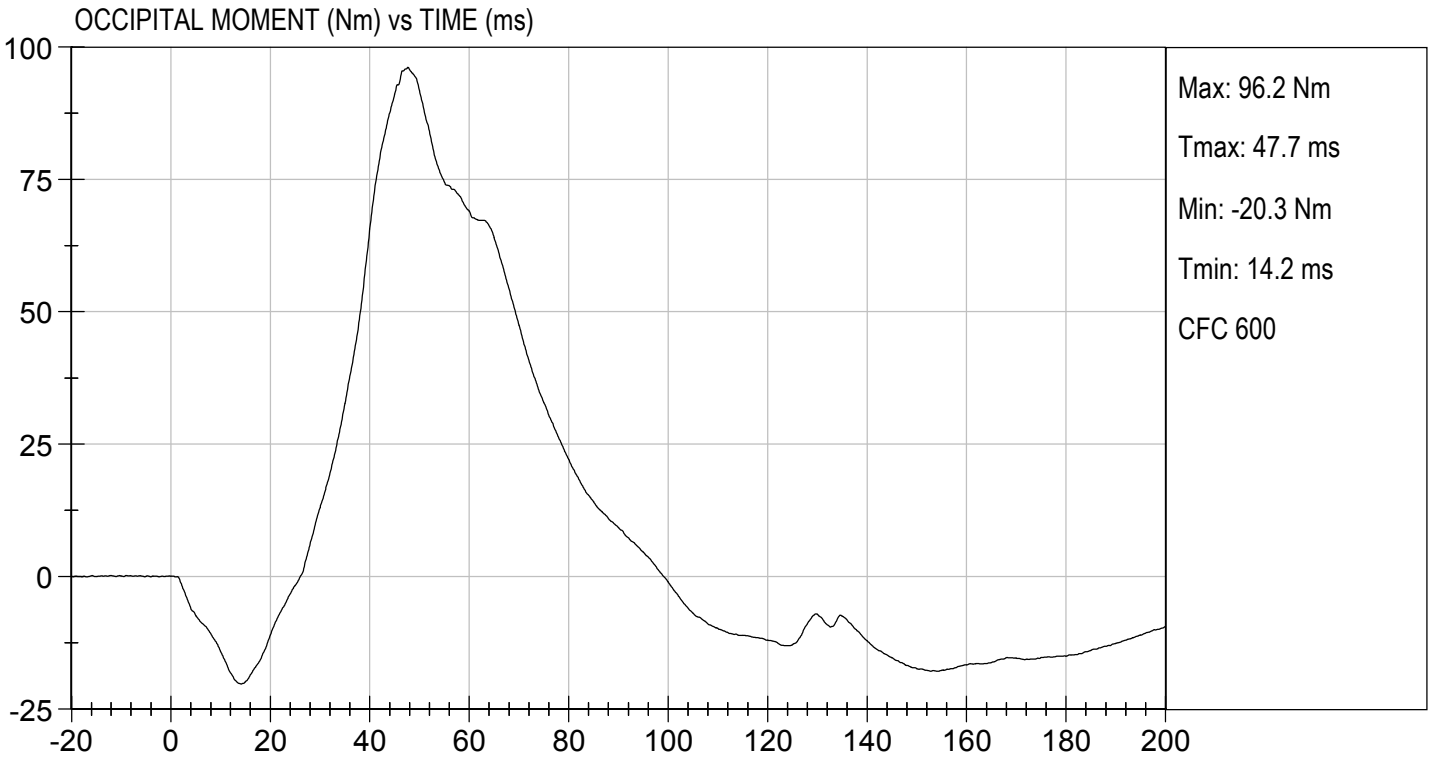


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 12/04/2020
TEST #: D203132



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D203133

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	32	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	17.64	Pass
	20 ms	G's	14.00 to 19.00	17.46	Pass
	30 ms	G's	11.00 to 16.00	14.95	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	15.6	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	39.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	96.2	Pass
	Time	ms	72.0 to 82.0	77.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	159.2	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-64.4	Pass
	Time	ms	65.0 to 79.0	71.9	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.8	Pass
			Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

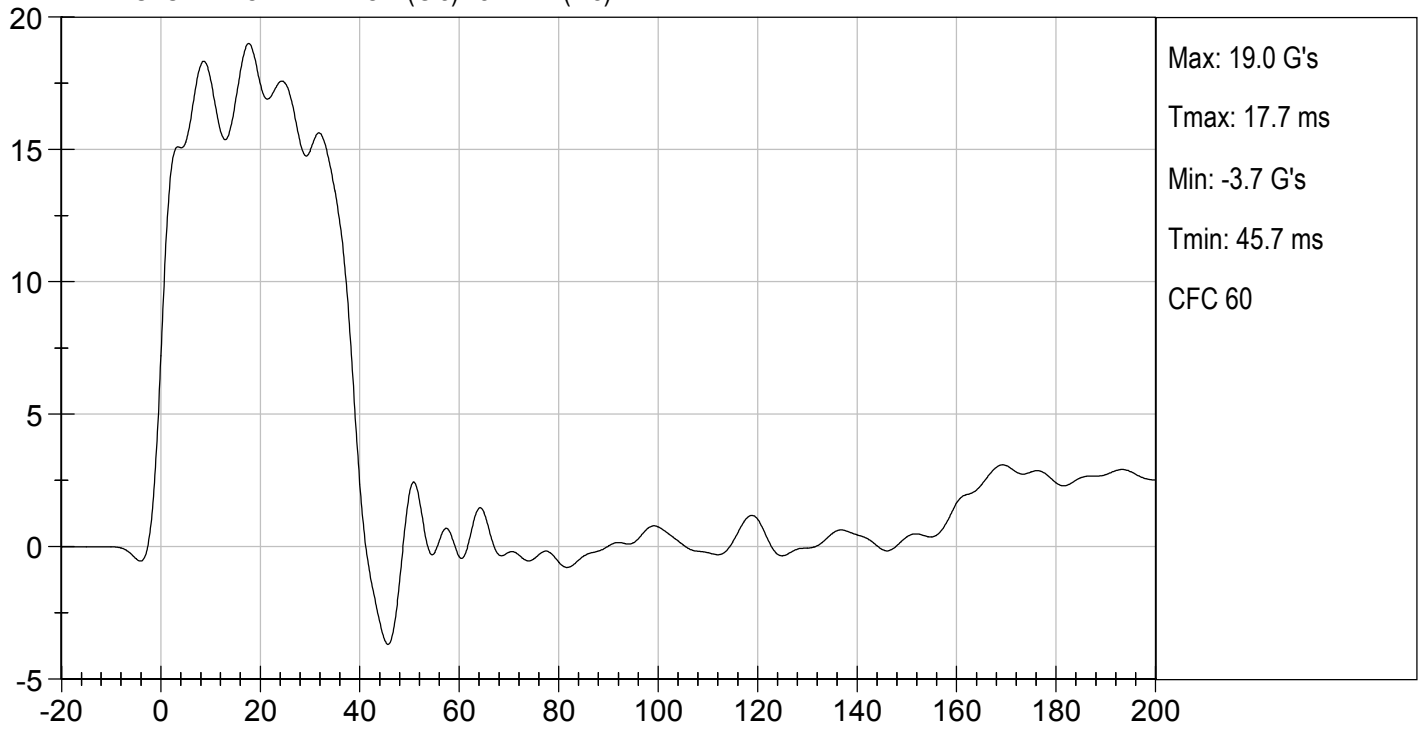
12/04/2020
Test Date

Approved By

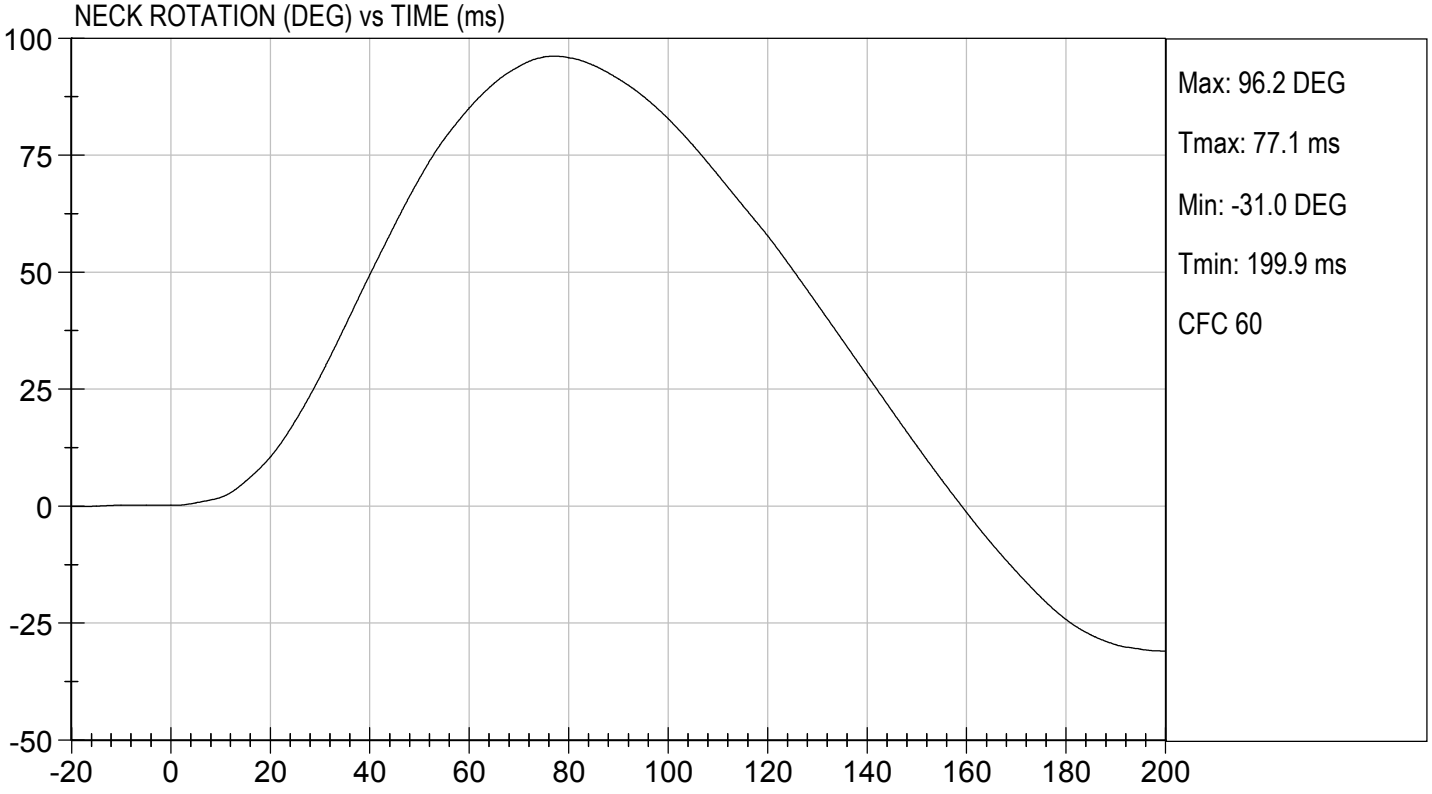
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 12/04/2020
TEST #: D203133

PENDULUM DECELERATION (G's) vs TIME (ms)

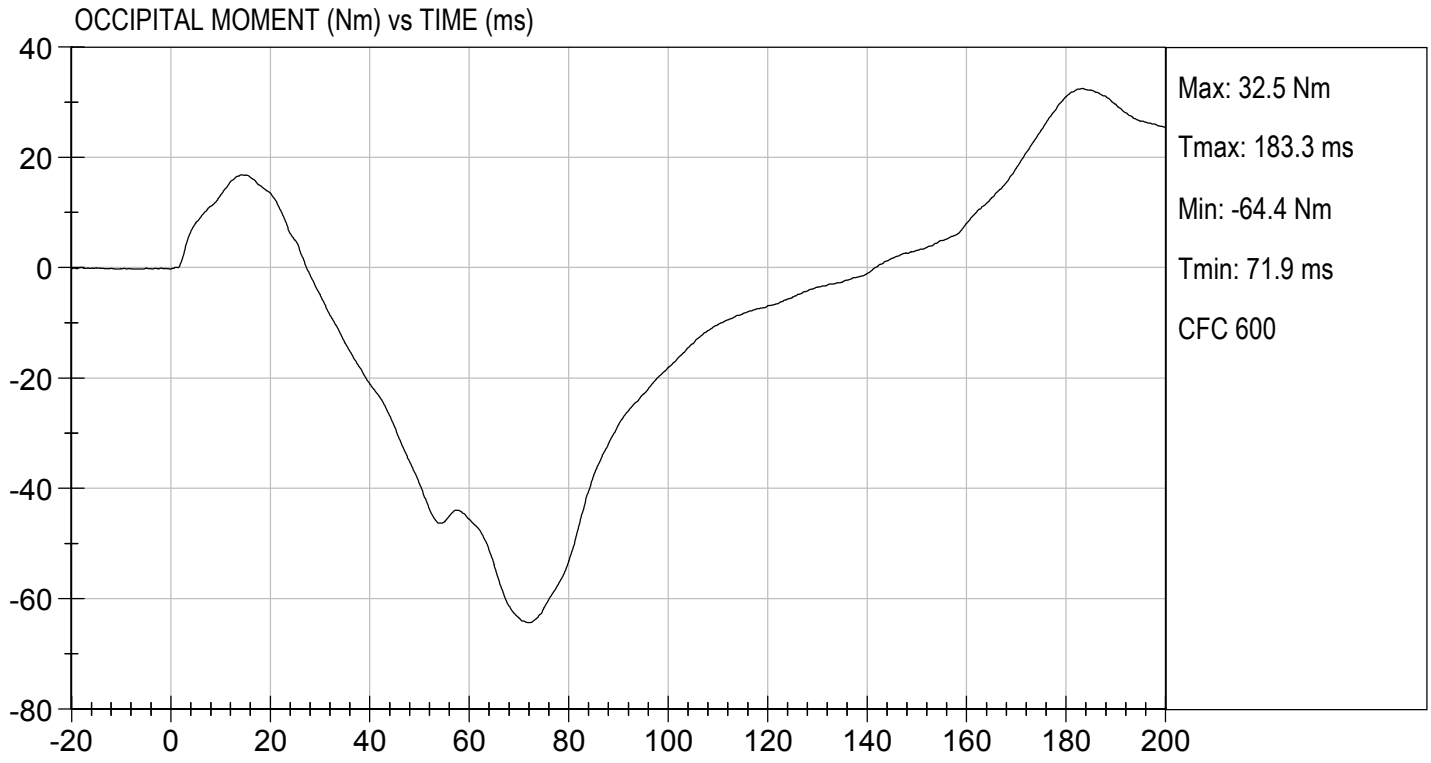


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 12/04/2020
TEST #: D203133



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D203134

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	21	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,414	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	7.03	Pass
Internal Hysteresis	%	69 to 85	70	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

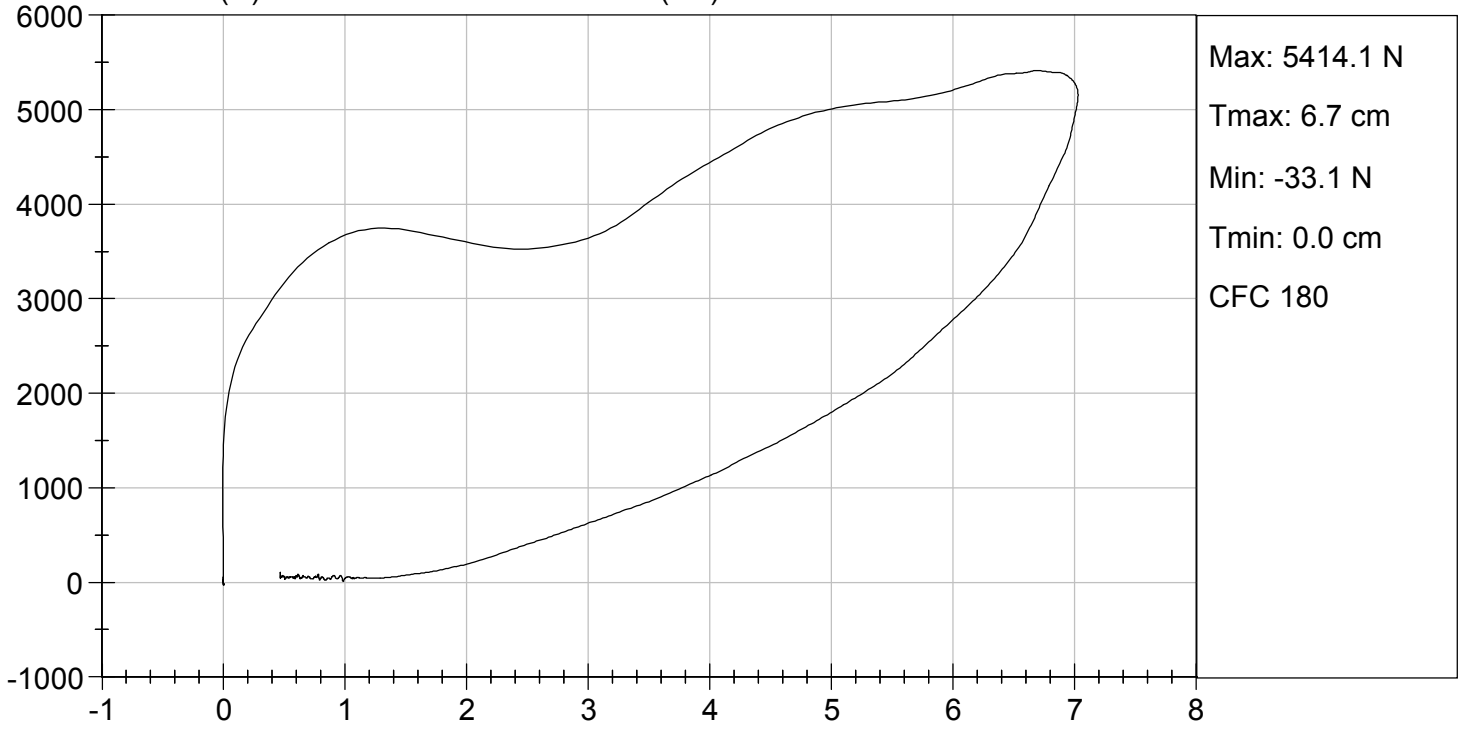
12/03/2020
Test Date

Approved By

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

TEST DATE: 12/03/2020
TEST #: D203134

FORCE (N) vs CHEST DISPLACEMENT (cm)



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D203135

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,453	Pass
		Overall Test Results		Pass

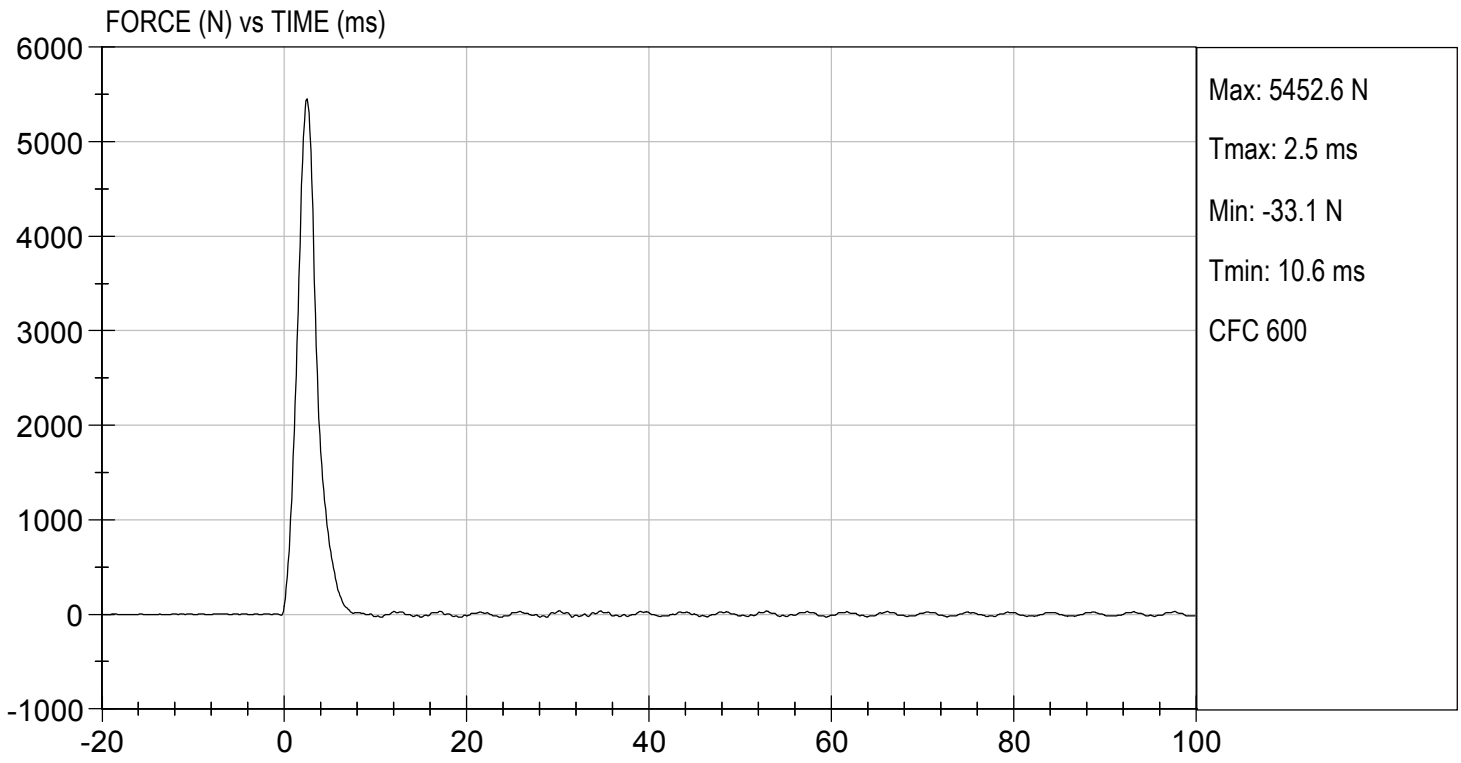
Gerald Guerrero
Laboratory Technician

12/04/2020
Test Date

Approved By

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

TEST DATE: 12/04/2020
TEST #: D203135



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D203136

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Velocity	m/s	2.07 to 2.13	2.11	Pass
Peak Probe Force	N	4715 to 5782	5,664	Pass
		Overall Test Results		Pass

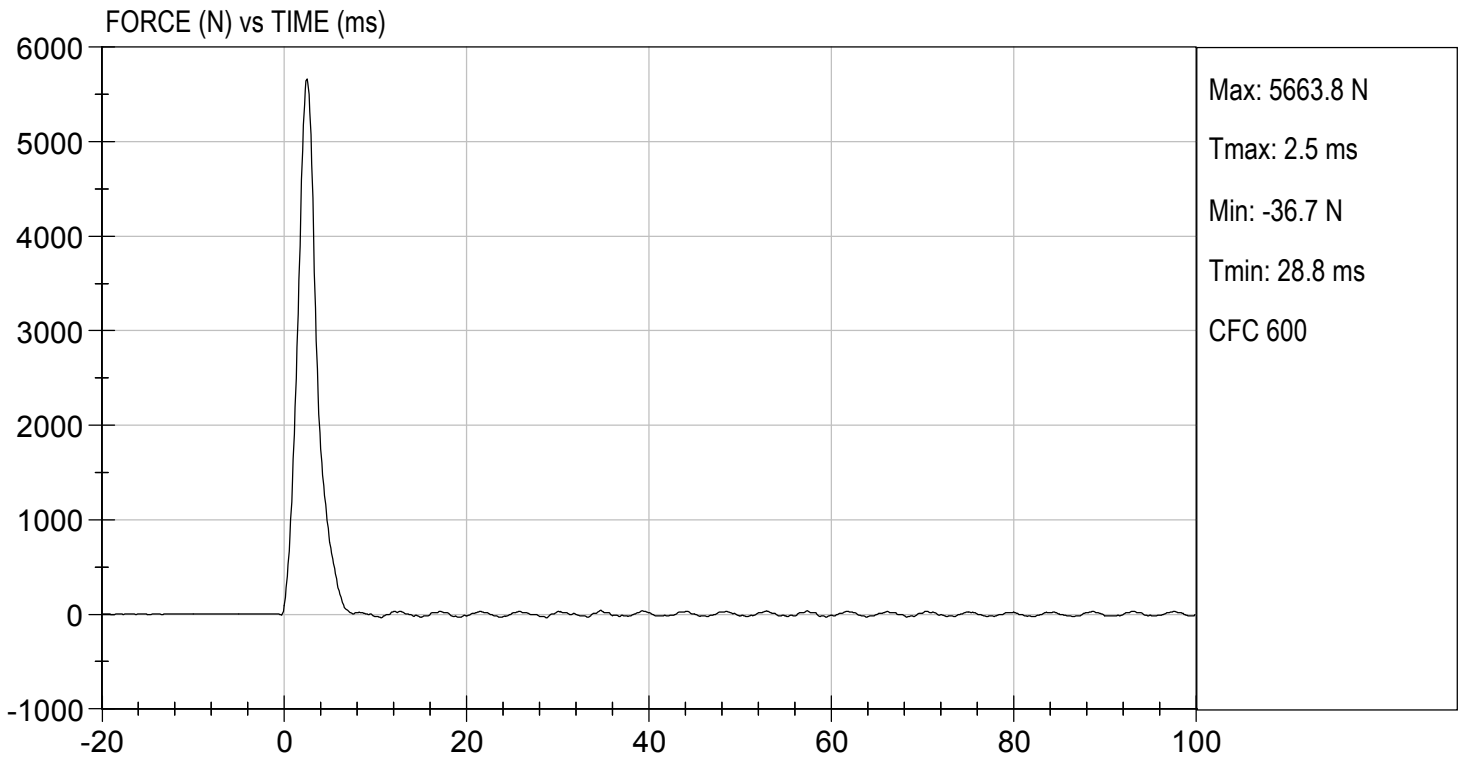
Gerald Guerrero
Laboratory Technician

12/04/2020
Test Date

Approved By

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

TEST DATE: 12/04/2020
TEST #: D203136



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D203130

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.7	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	32	32	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.4	6.4	Pass
30 Degrees	Nm	94.9 Nm Max	80.4	84.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	44.9	45.0	Pass
		Overall Test Results			Pass

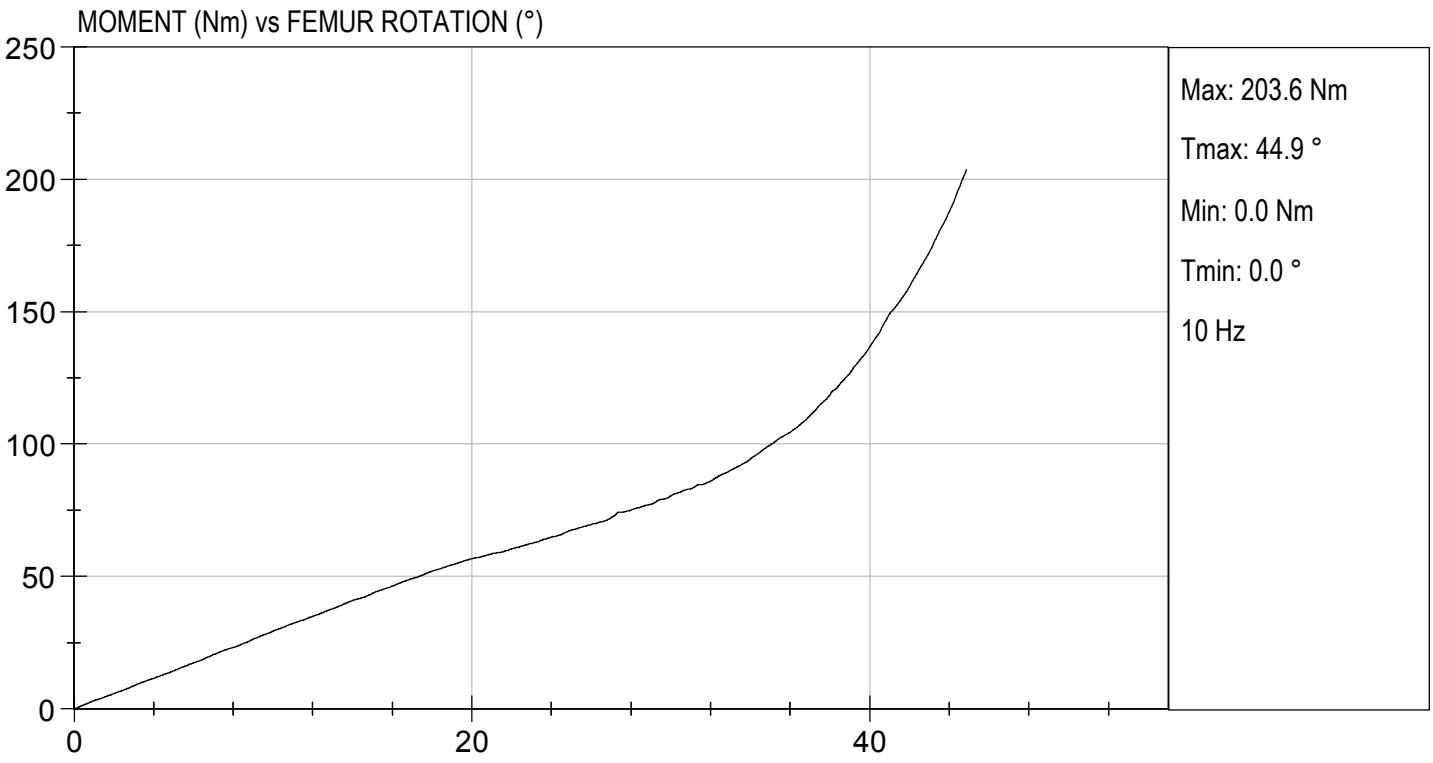
Gerald Guerrero
Laboratory Technician

12/04/2020
Test Date

Approved By

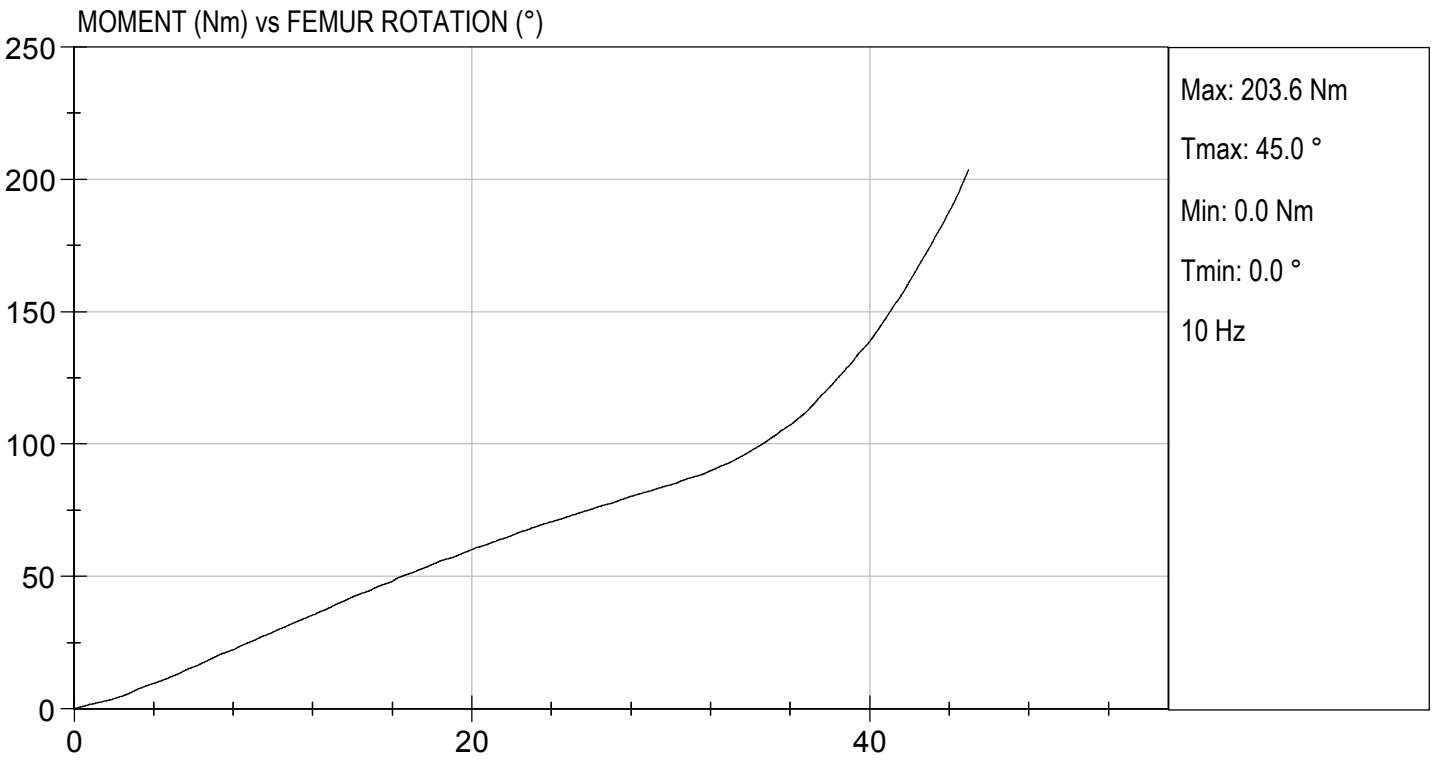
TEST DESC: RIGHT HIP FEMUR FLEXION

TEST DATE: 12/04/2020
TEST #: D203139



TEST DESC: LEFT HIP FEMUR FLEXION

TEST DATE: 12/04/2020
TEST #: D203130



CALIBRATION TEST RESULTS

POST-TEST

HYBRID III 50TH PERCENTILE MALE - DRIVER ATD

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test ID:** D210081

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Peak Resultant Acceleration	G's	225 to 275	256	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	1.0	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

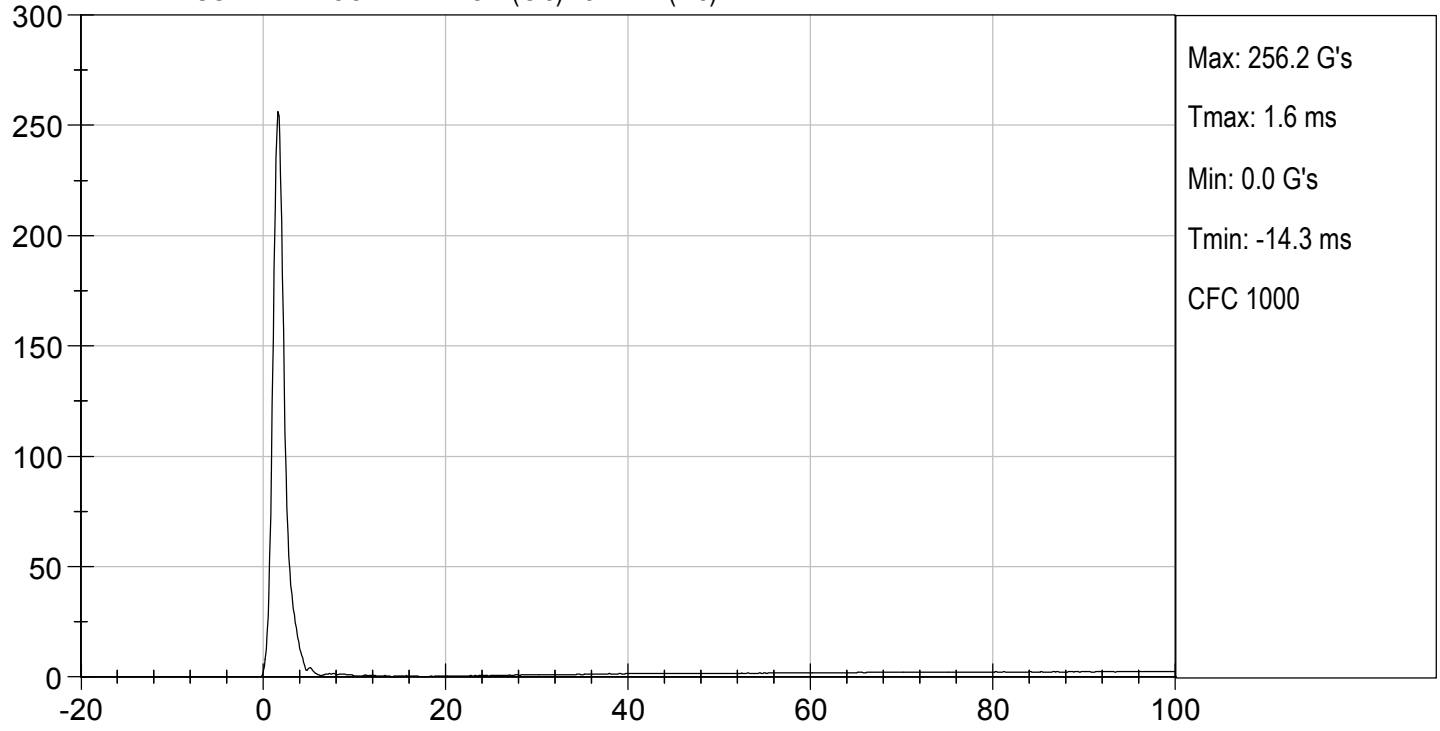
01/07/2021
Test Date

Approved By

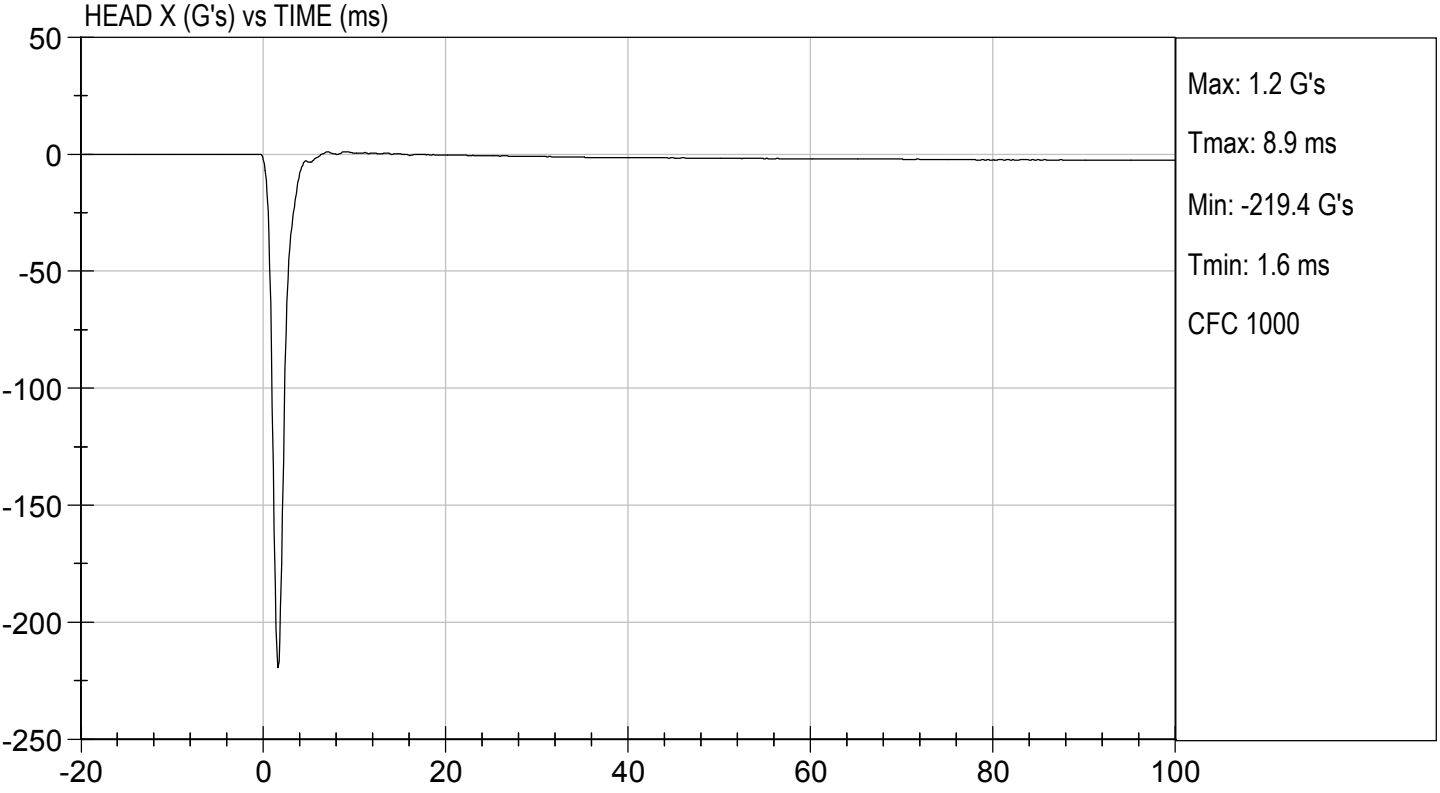
TEST DESC: HEAD DROP

TEST DATE: 01/07/2021
TEST #: D210081

HEAD RESULTANT ACCELERATION (G's) vs TIME (ms)

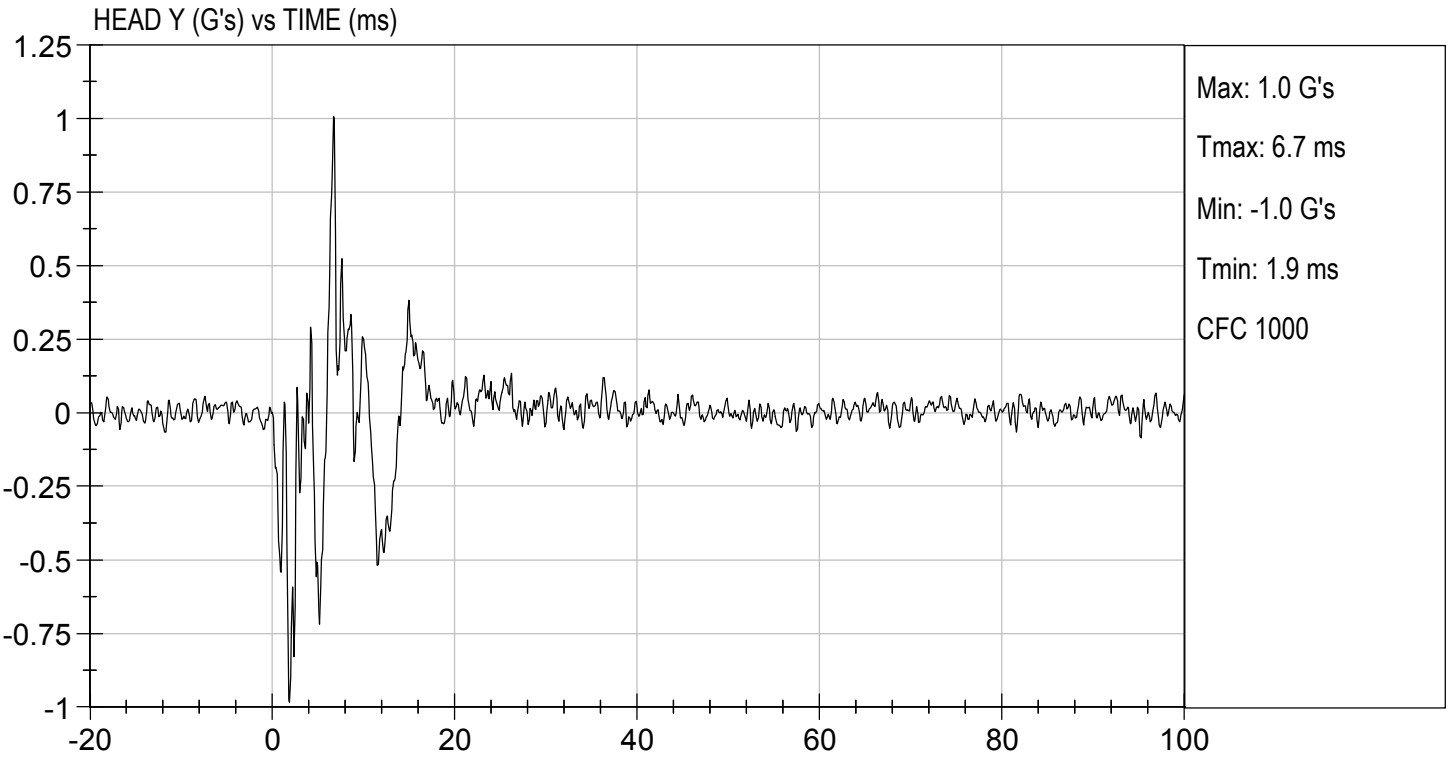


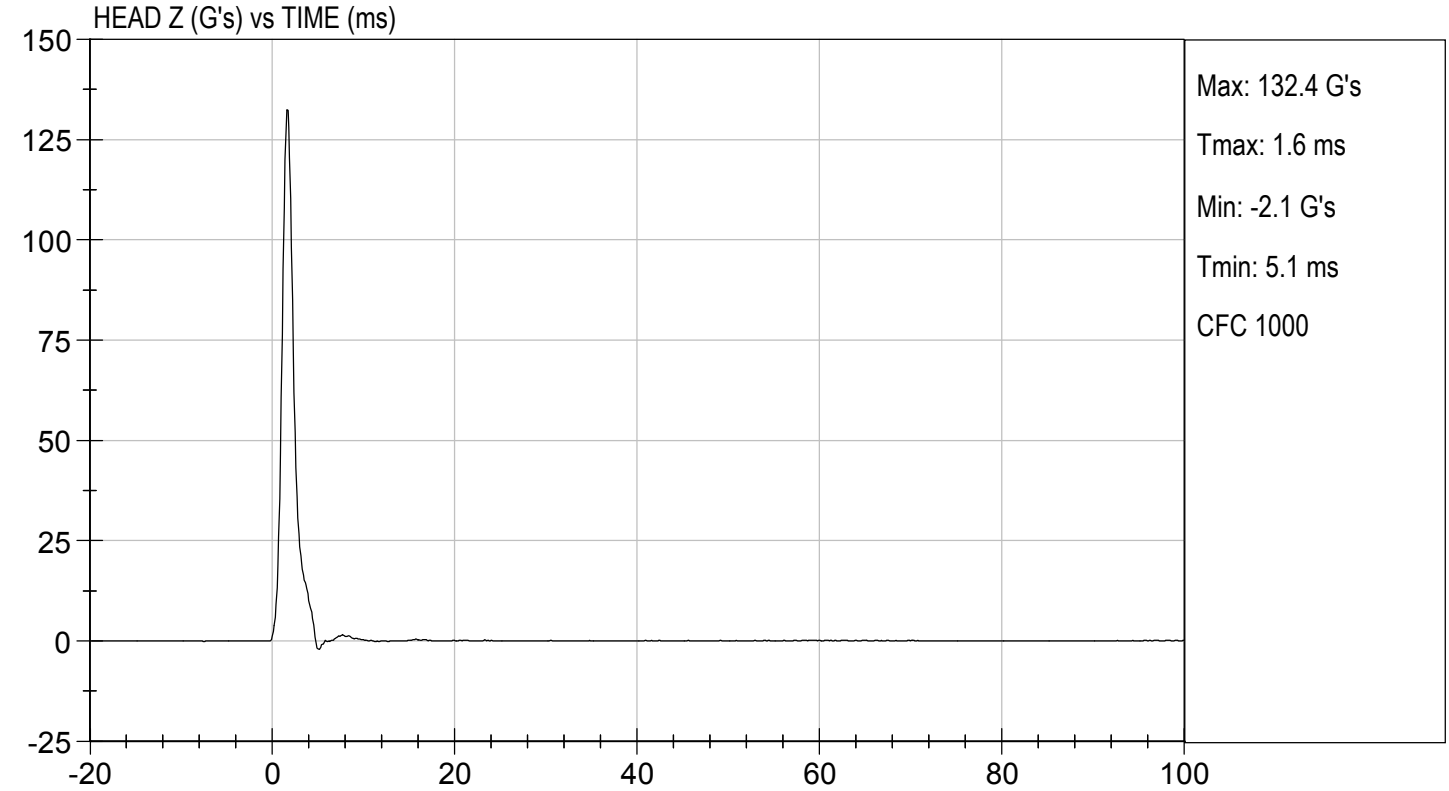
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 01/07/2021
TEST #: D210081





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D210082

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	23	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.71	Pass
	20 ms	G's	17.60 to 22.60	20.27	Pass
	30 ms	G's	12.50 to 18.50	15.47	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	15.9	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	36.6	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	69.4	Pass
	Time	ms	57.0 to 64.0	60.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.7	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	89.3	Pass
	Time	ms	47.0 to 58.0	49.3	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	100.2	Pass
			Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

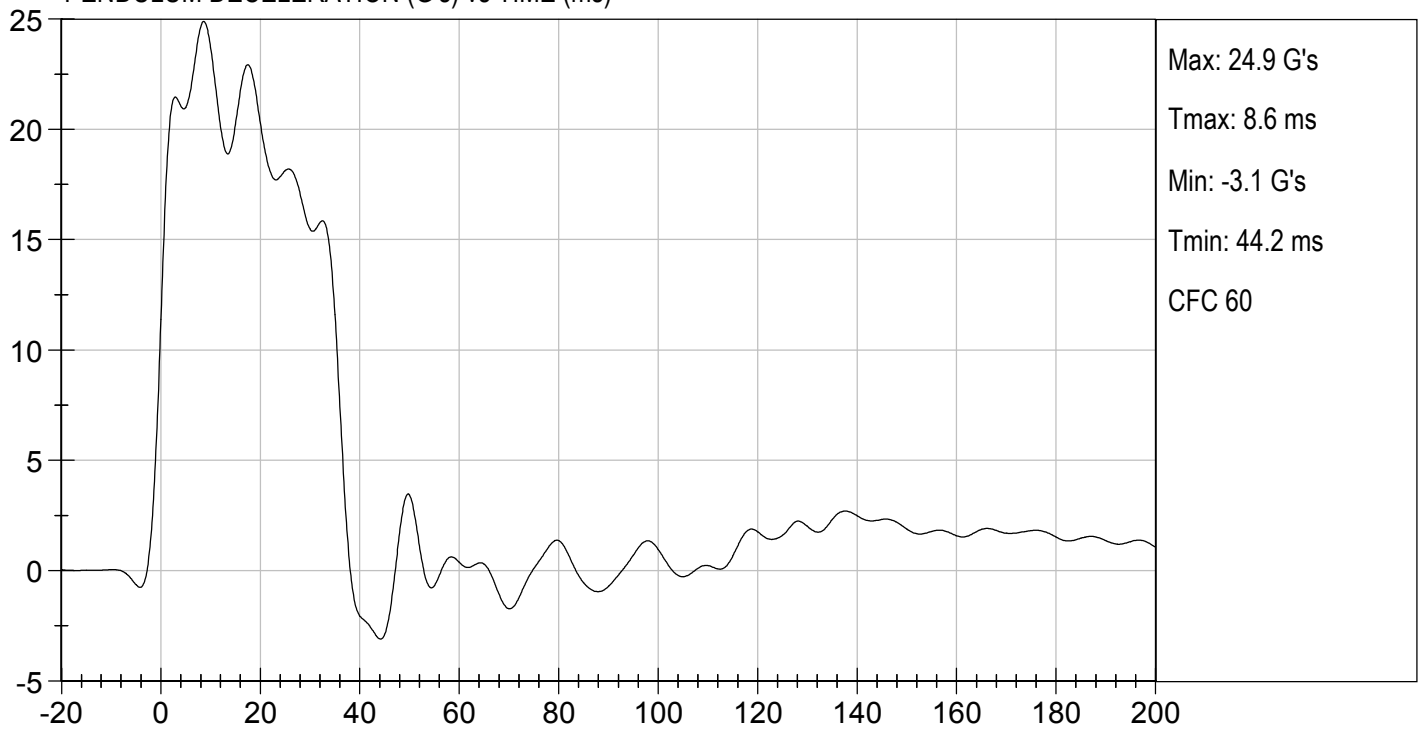
01/07/2021
Test Date

Approved By

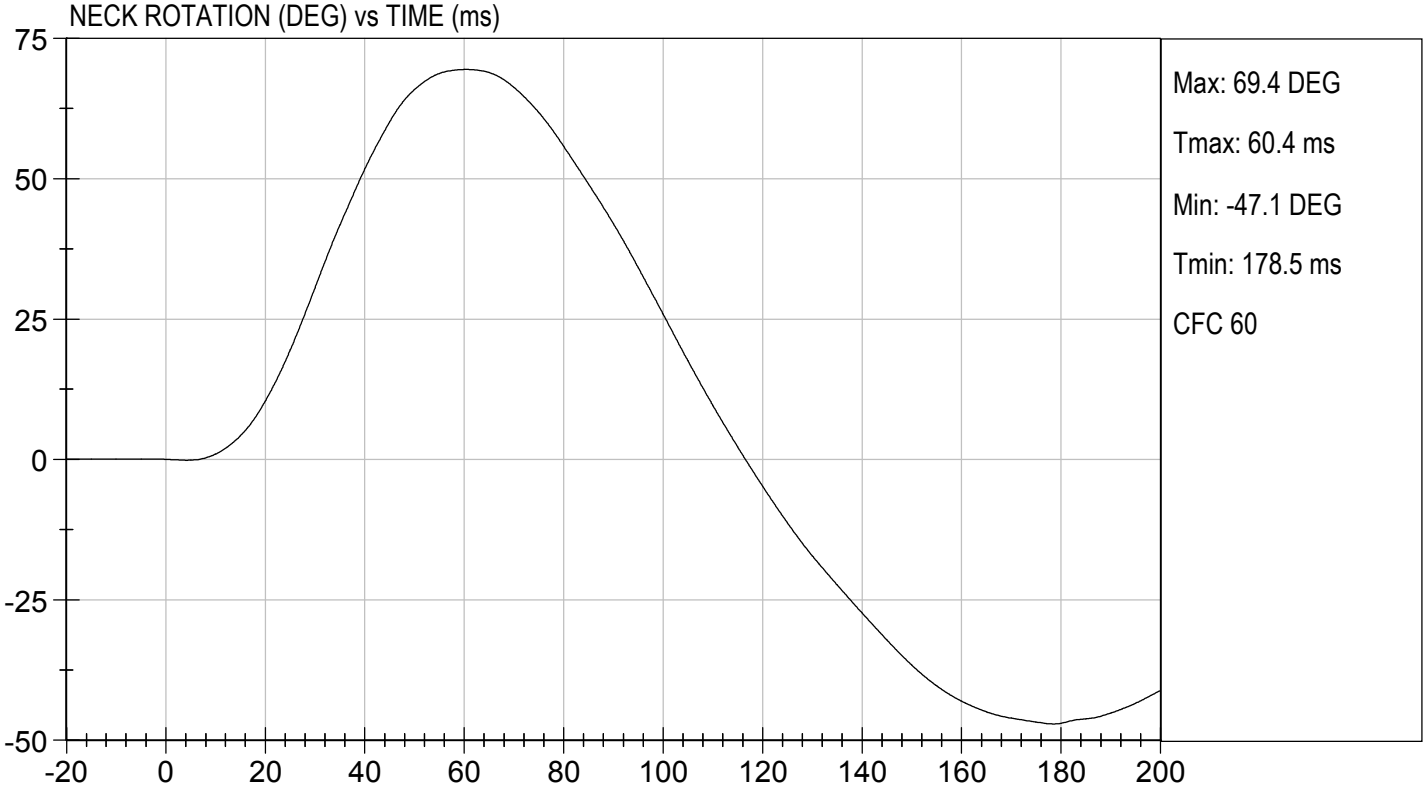
TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 01/07/2021
TEST #: D210082

PENDULUM DECELERATION (G's) vs TIME (ms)

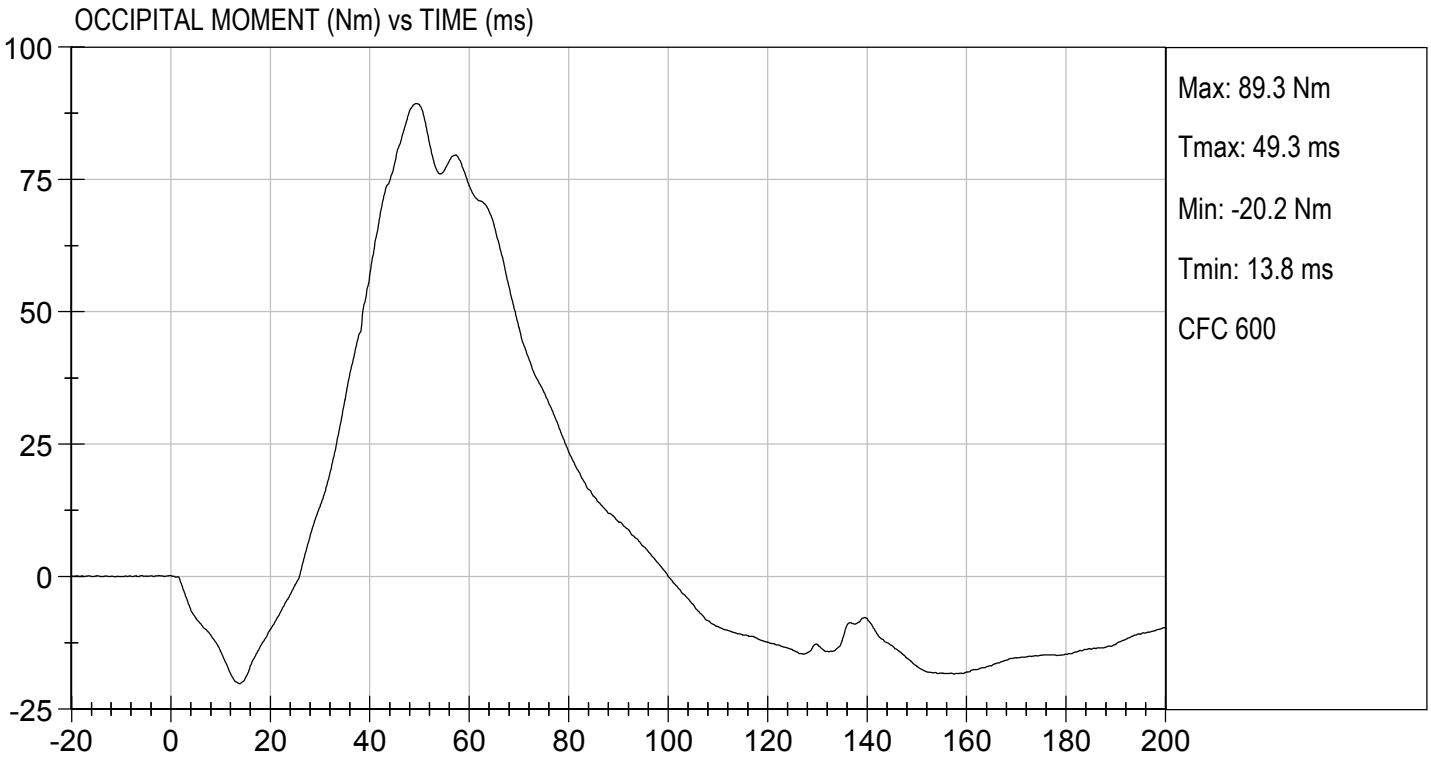


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 01/07/2021
TEST #: D210082



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D210083

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	23	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	17.58	Pass
	20 ms	G's	14.00 to 19.00	17.08	Pass
	30 ms	G's	11.00 to 16.00	12.75	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	12.7	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	41.0	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.5	Pass
	Time	ms	72.0 to 82.0	76.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	160.0	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-64.8	Pass
	Time	ms	65.0 to 79.0	72.0	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	142.8	Pass
			Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

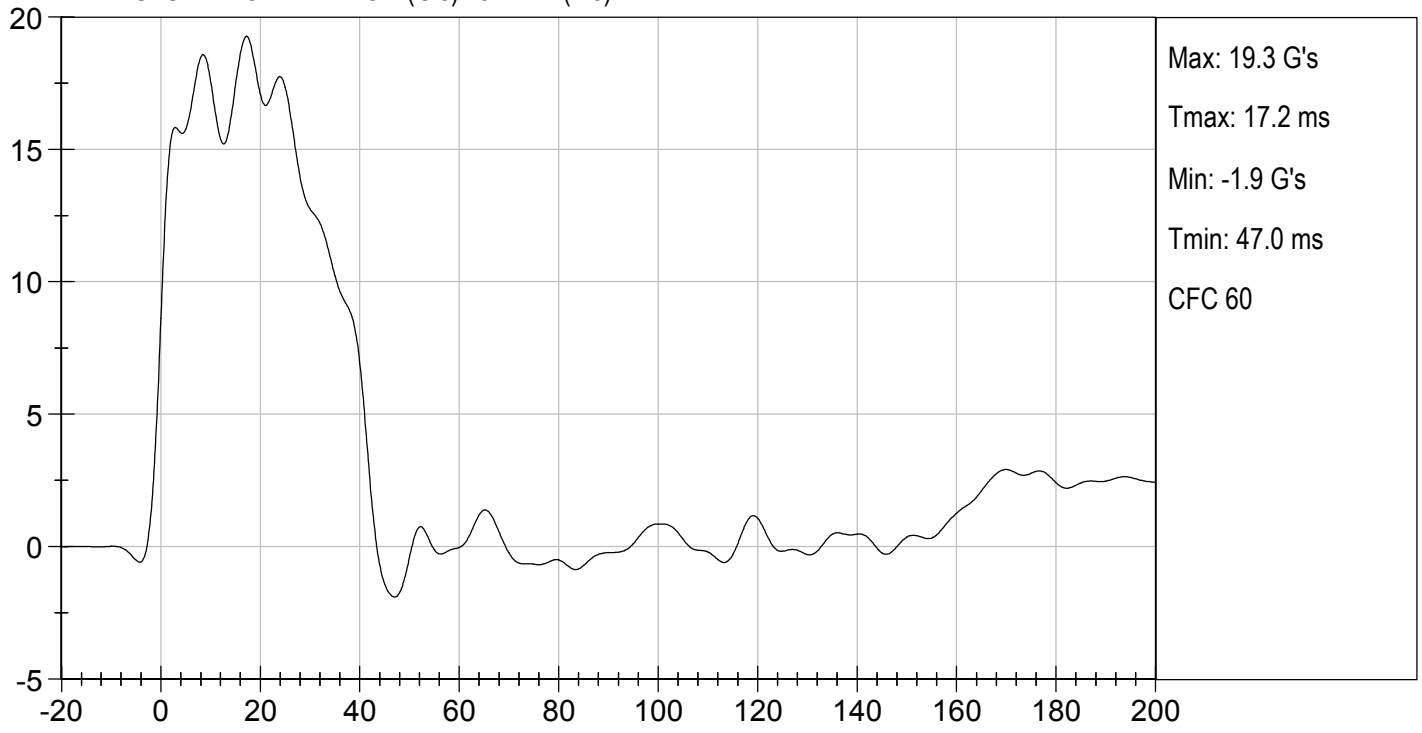
01/07/2021
Test Date

Approved By

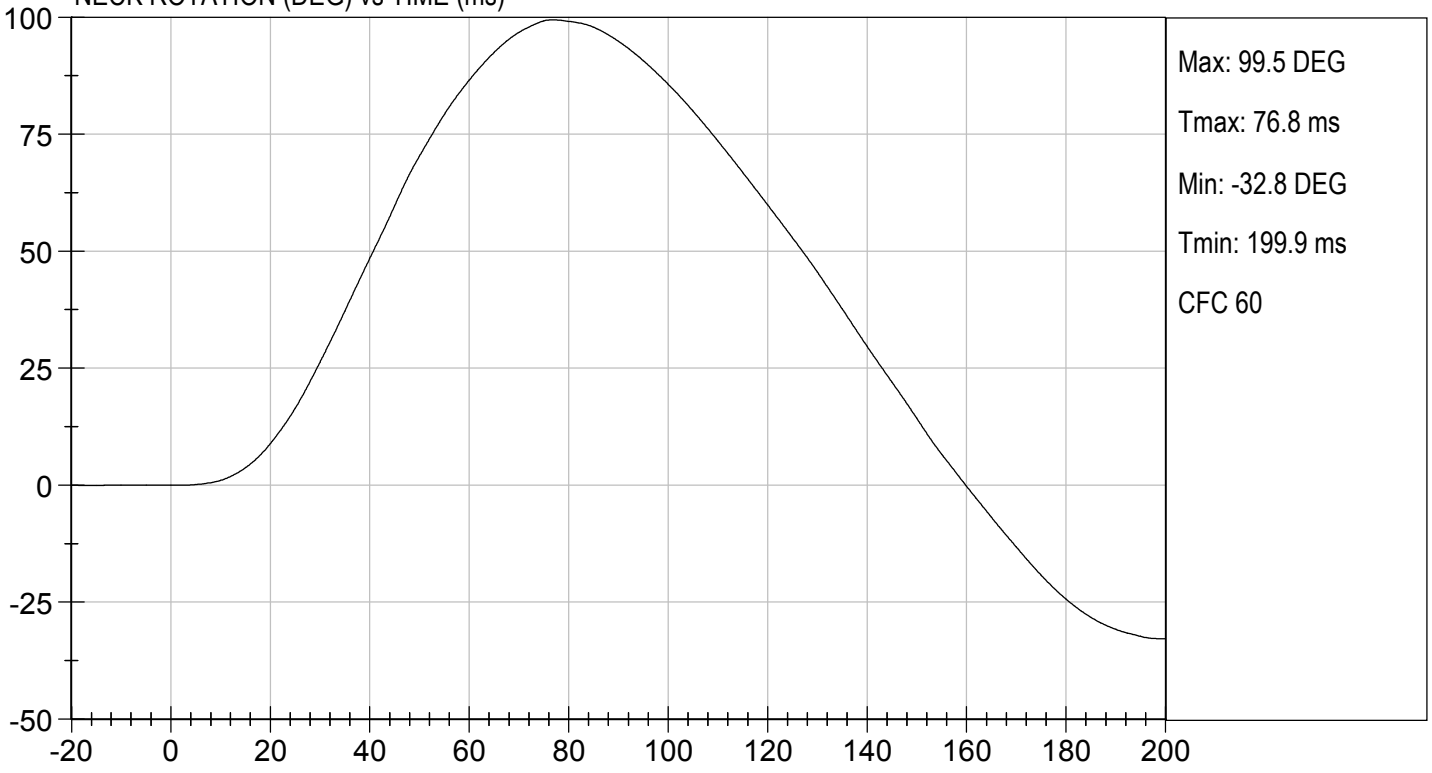
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 01/07/2021
TEST #: D210083

PENDULUM DECELERATION (G's) vs TIME (ms)

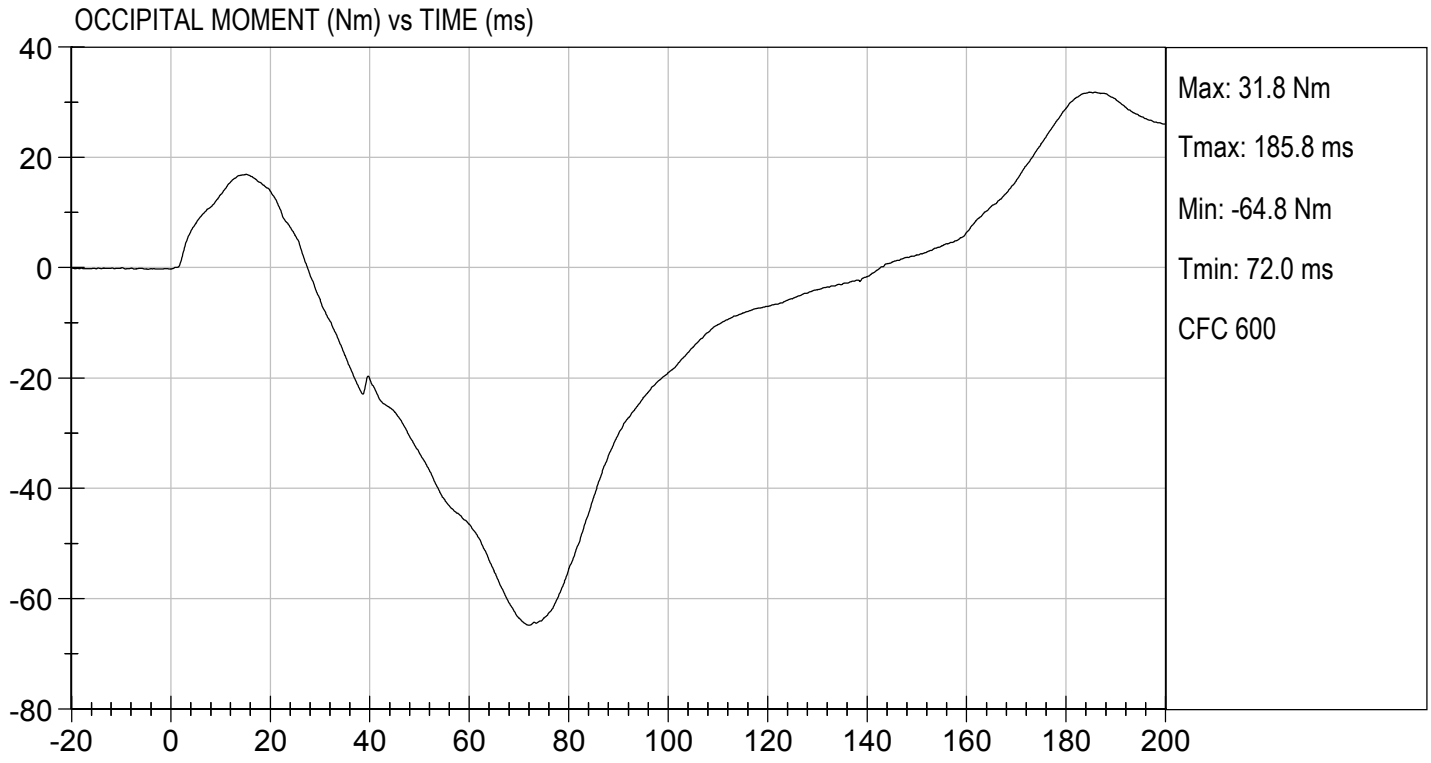


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 01/07/2021
TEST #: D210083



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D210084

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,390	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	7.10	Pass
Internal Hysteresis	%	69 to 85	69	Pass
		Overall Test Results		Pass

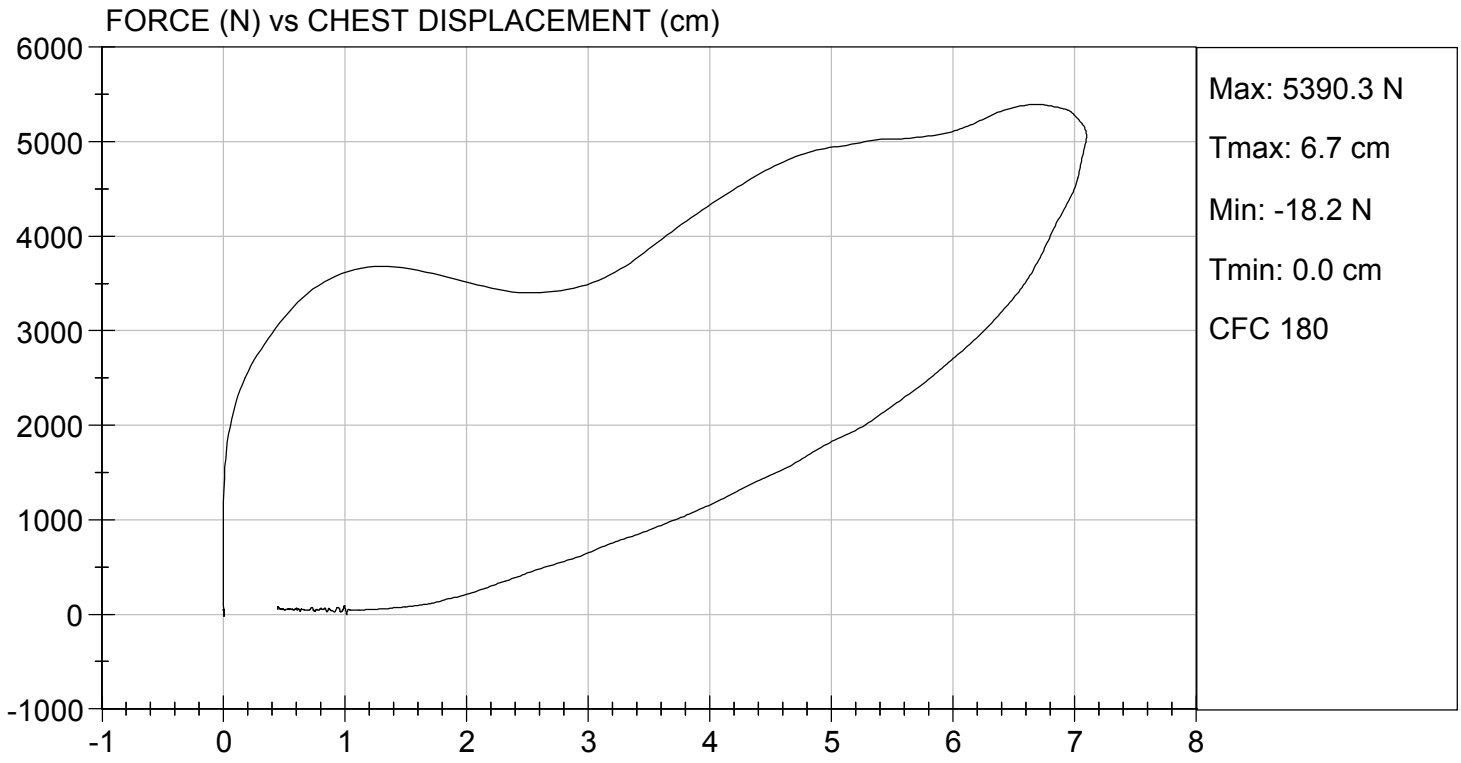
Gerald Guerrero
Laboratory Technician

01/08/2021
Test Date

Approved By

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

TEST DATE: 01/08/2021
TEST #: D210084



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D210085

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Velocity	m/s	2.07 to 2.13	2.07	Pass
Peak Probe Force	N	4715 to 5782	5,475	Pass
		Overall Test Results		Pass

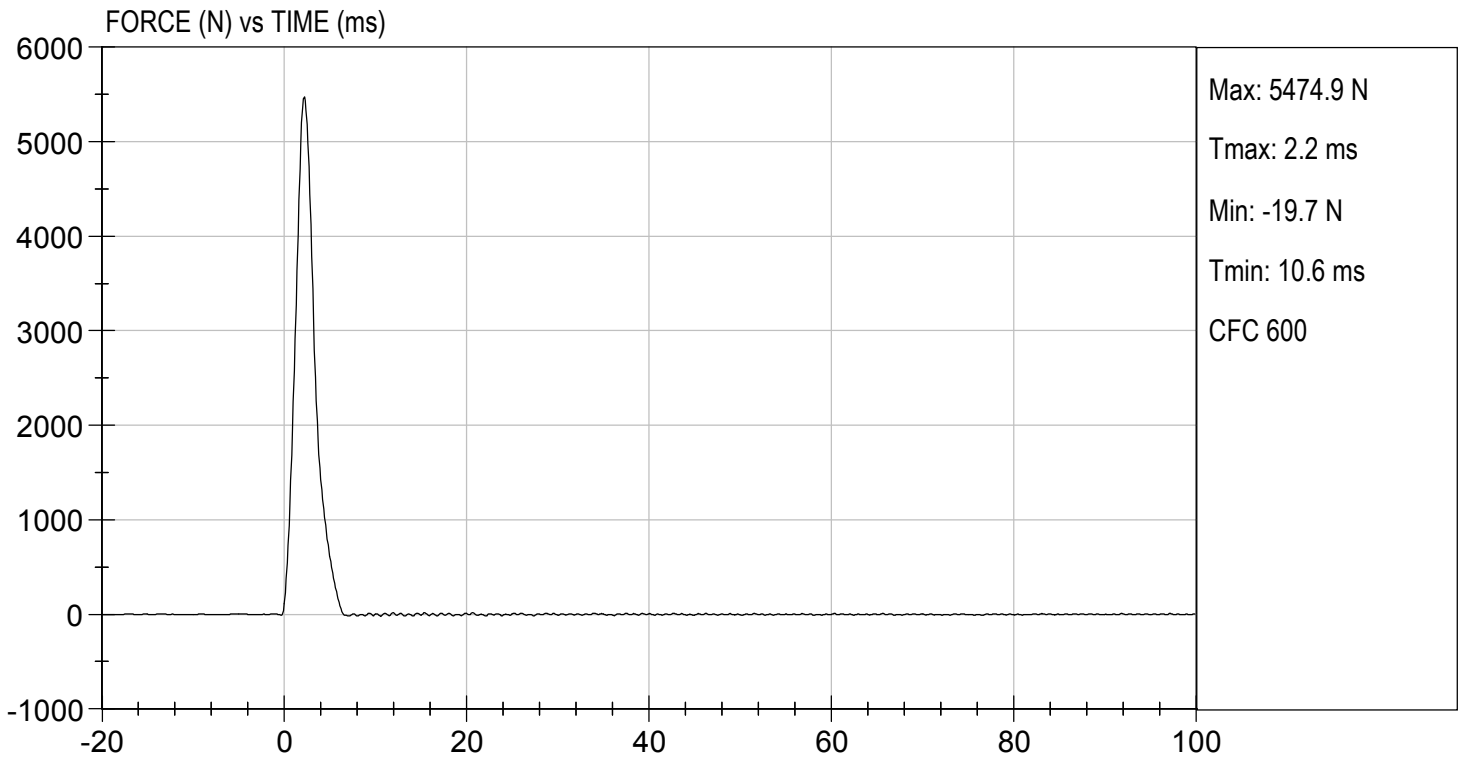
Gerald Guerrero
Laboratory Technician

01/07/2021
Test Date

Approved By

TEST DESC: RIGHT KNEE
VELOCITY: 6.80 ft/s, 2.07 m/s

TEST DATE: 01/07/2021
TEST #: D210085



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D210086

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Velocity	m/s	2.07 to 2.13	2.07	Pass
Peak Probe Force	N	4715 to 5782	5,327	Pass
		Overall Test Results		Pass

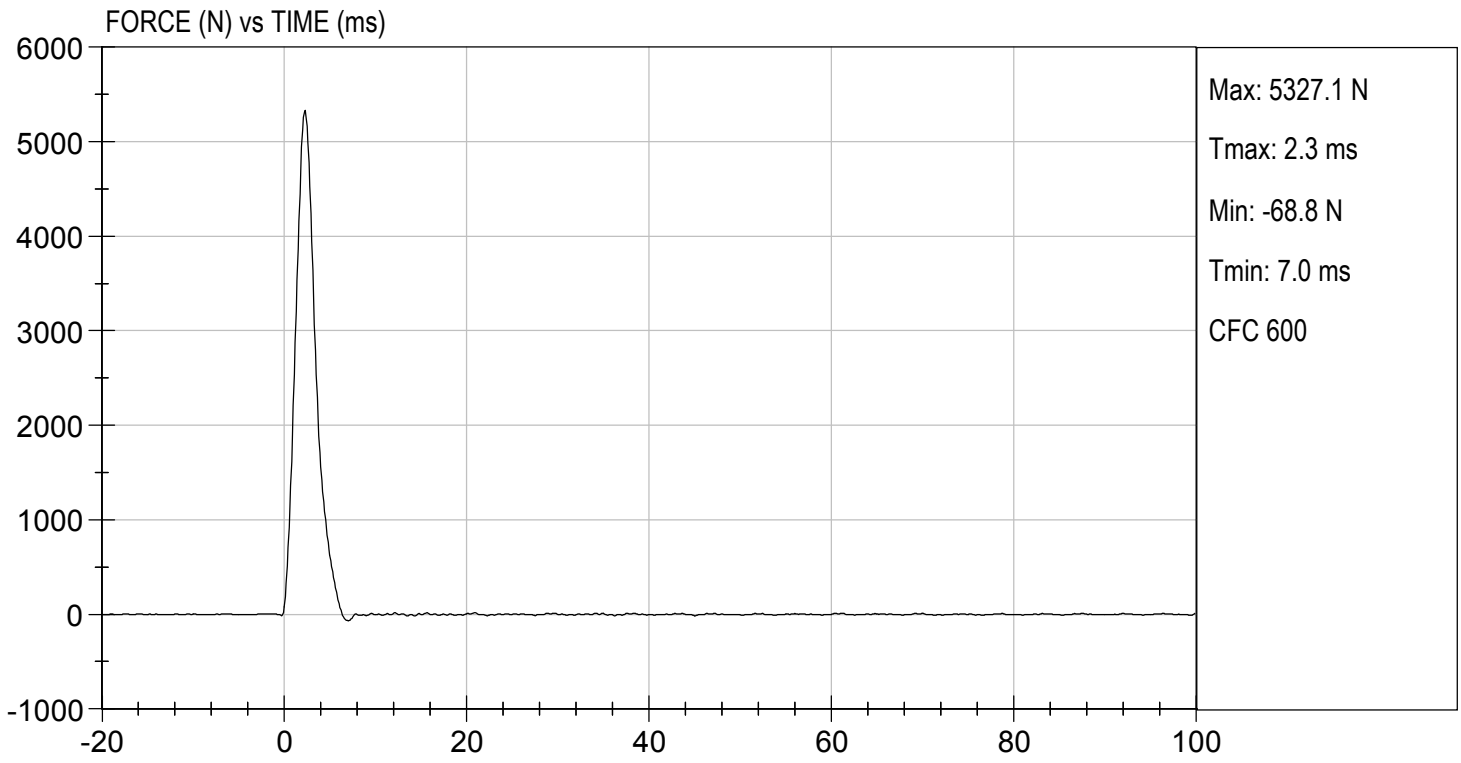
Gerald Guerrero
Laboratory Technician

01/07/2021
Test Date

Approved By

TEST DESC: LEFT KNEE
VELOCITY: 6.80 ft/s, 2.07 m/s

TEST DATE: 01/07/2021
TEST #: D210086



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D210080

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21	21	Pass
Laboratory Relative Humidity	%	10 to 70	22	22	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.4	6.4	Pass
30 Degrees	Nm	94.9 Nm Max	84.7	86.7	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	44.3	44.6	Pass
		Overall Test Results			Pass

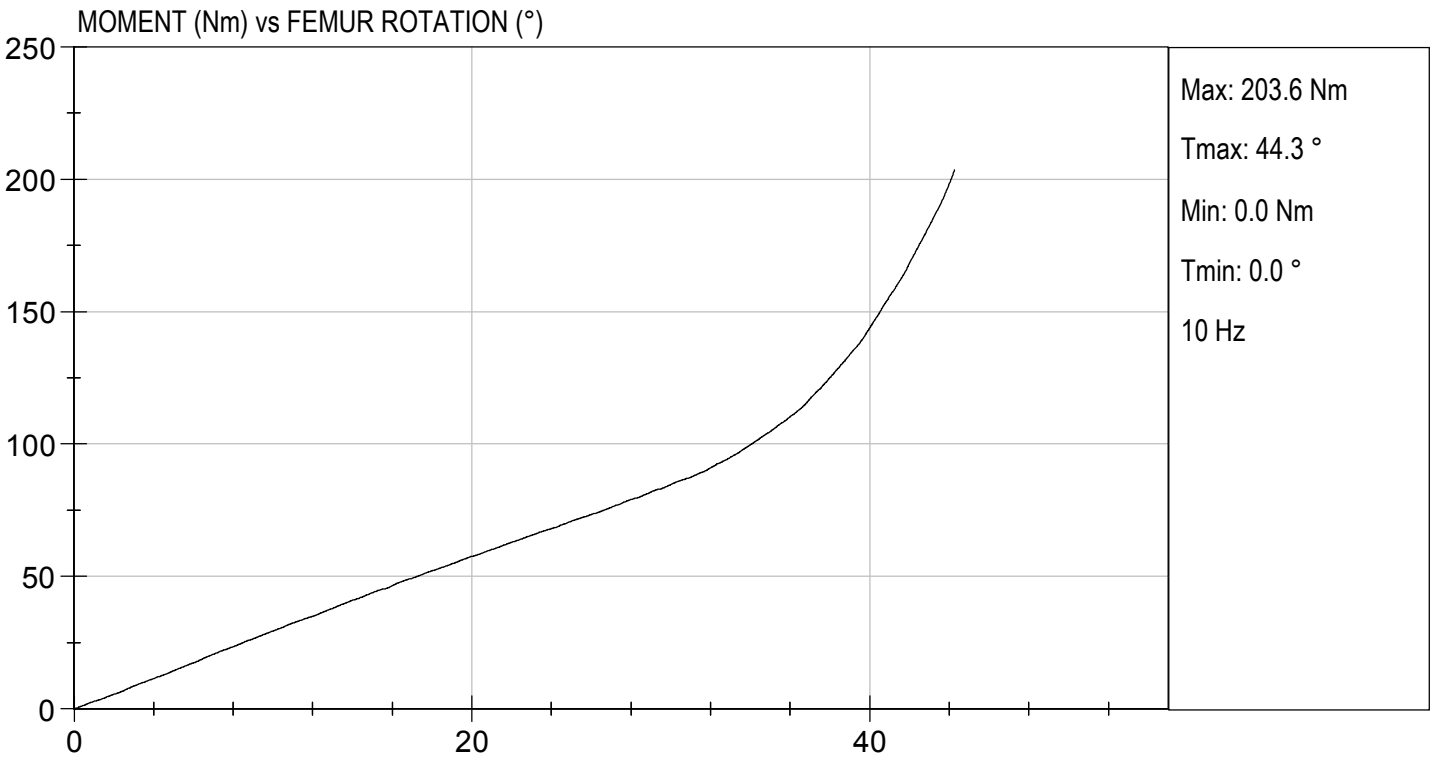
Gerald Guerrero
Laboratory Technician

01/08/2021
Test Date

Approved By

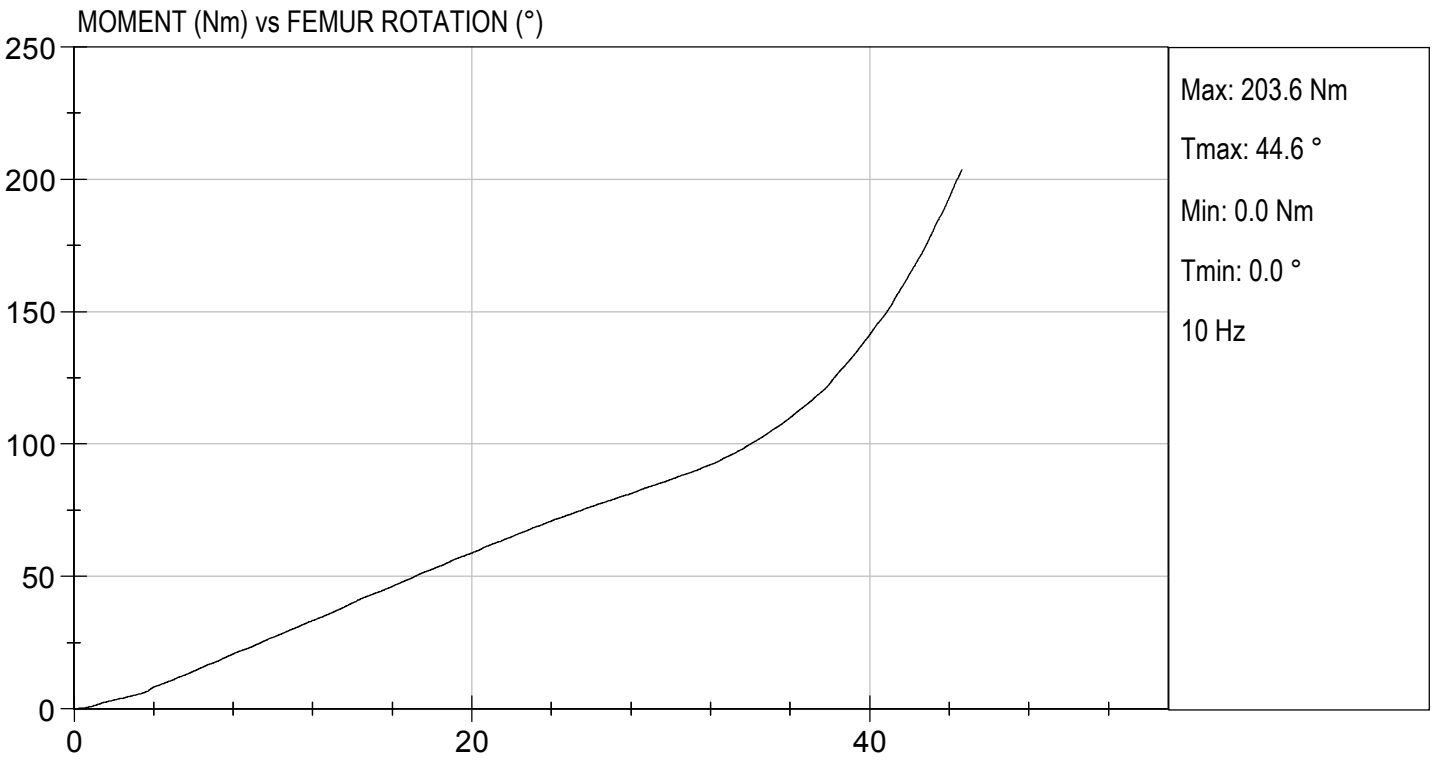
TEST DESC: RIGHT HIP FEMUR FLEXION

TEST DATE: 01/08/2021
TEST #: D210089



TEST DESC: LEFT HIP FEMUR FLEXION

TEST DATE: 01/08/2021
TEST #: D210080



CALIBRATION TEST RESULTS

PRE-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

Hybrid III, 5th External Measurements
SN: 634

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	784.6
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	431.8-457.2	449.0
C	H-POINT HEIGHT	Reference	81.3-86.3	85.0
D	H-POINT LOCATION FROM BACKLINE	Reference	144.8-149.8	145.0
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	68.6-83.8	79.2
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	119.4-134.6	125.6
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	253.4
H	HEAD BACK TO BACKLINE	Back of Skull cap skin to seat rear vertical surface (Reference)	43.2-48.2	45.0
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	277.8
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	182.8-203.2	197.5
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	541.4
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	355.6-376.0	362.1
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	393.7-419.1	400.4
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	428.6

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	181.6
P	FOOT LENGTH	Tip of toe to rear of heal	218.5-233.7	224.7
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	482.0
S	HEAD BREADTH	The widest part of the head	137.1-147.3	139.6
T	HEAD DEPTH	Back of the head to the forehead	177.8-188.0	179.2
U	HIP BREADTH	The widest part of the hip	299.7-314.9	306.1
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	350.5-365.7	355.5
W	FOOT BREADTH	The widest part of the foot	78.8-94.0	90.0
X	HEAD CIRCUMFERENCE	Measured at the point as in dim. “T”	528.3-548.7	540.6
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 345.4 ± 12.7 mm above seat surface	850.9-881.3	868.7
Z	WAIST CIRCUMFERENCE	Measured 165.1 ± 5.1 mm above seat surface	759.5-789.9	786.8
AA	REFERENCE LOCATION FOR MEASUREMENT OF CHEST CIRCUMFERENCE	Reference	332.7-358.1	345.4
BB	REFERENCE LOCATION FOR MEASUREMENT OF WAIST CIRCUMFERENCE	Reference	160.1-170.2	165.1

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test ID:** D203421

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	21	Pass
Peak Resultant Acceleration	G's	250 to 300	273	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	5.5	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Alex Thomas
Laboratory Technician

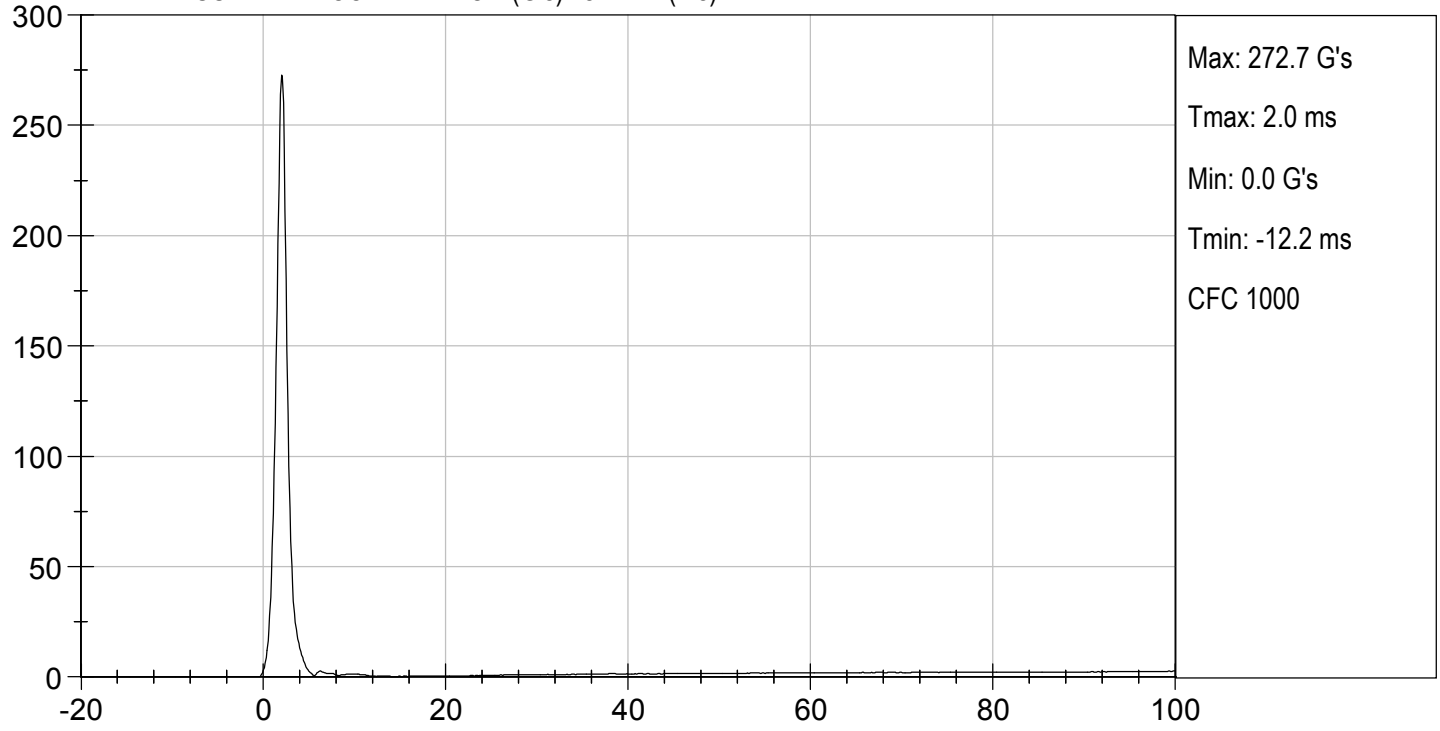
12/29/2020
Test Date

Approved By

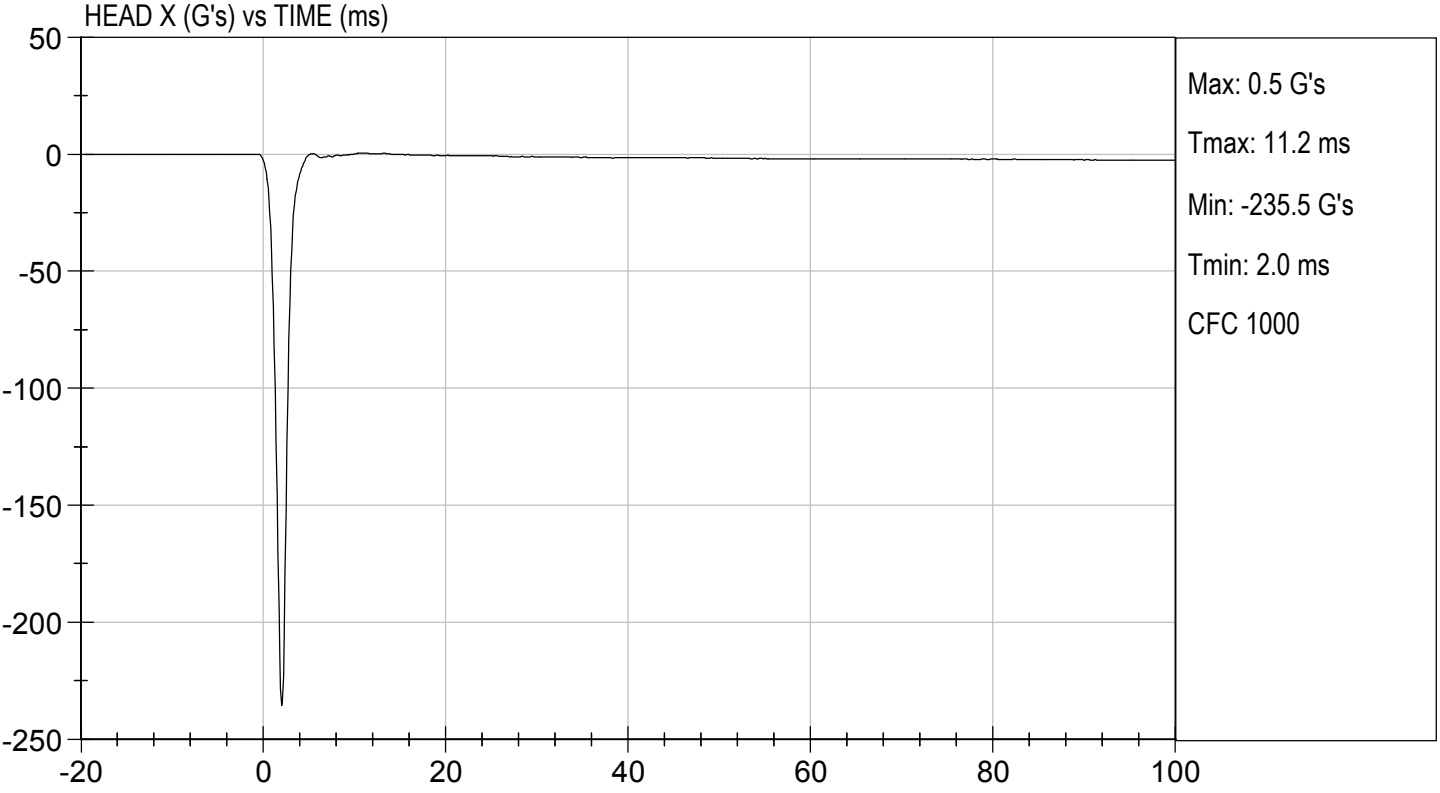
TEST DESC: HEAD DROP

TEST DATE: 12/29/2020
TEST #: D203421

HEAD RESULTANT ACCELERATION (G's) vs TIME (ms)

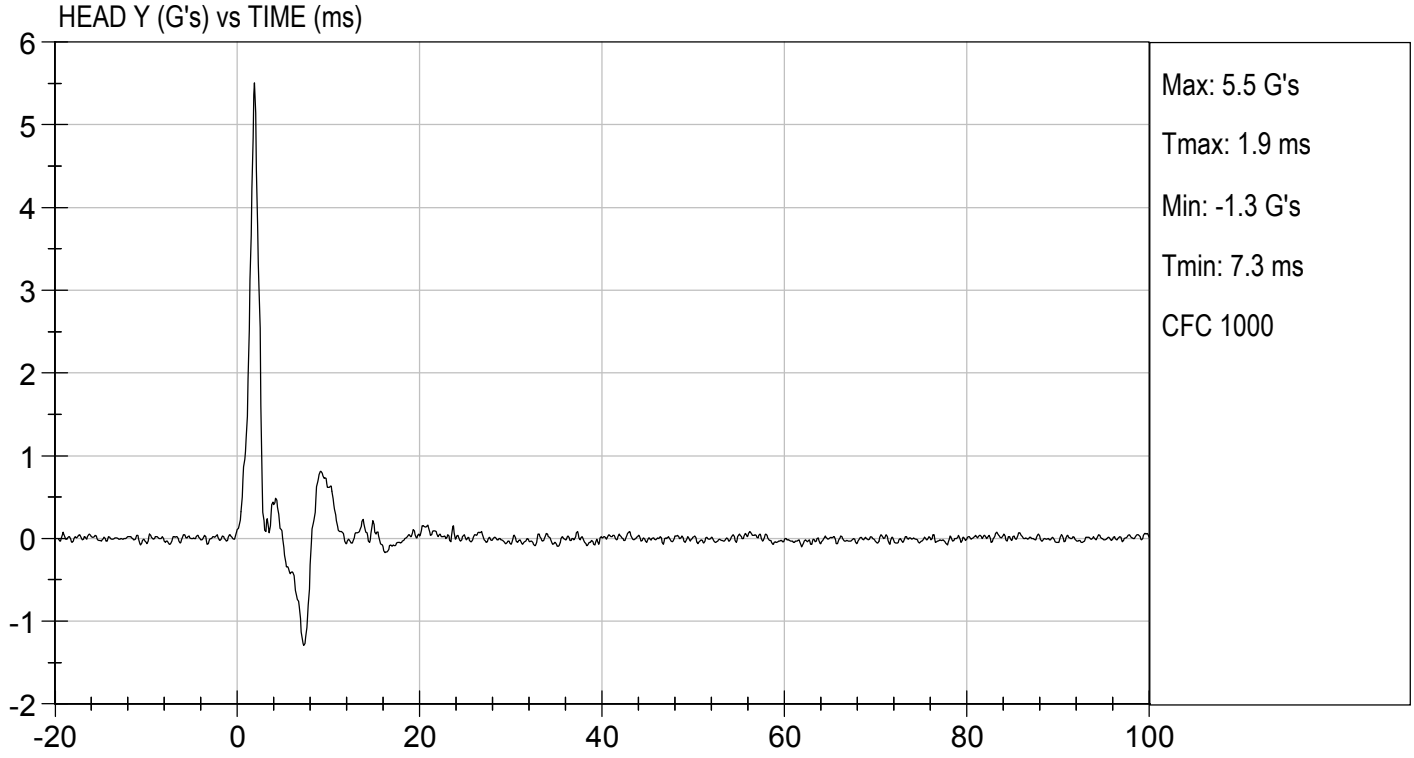


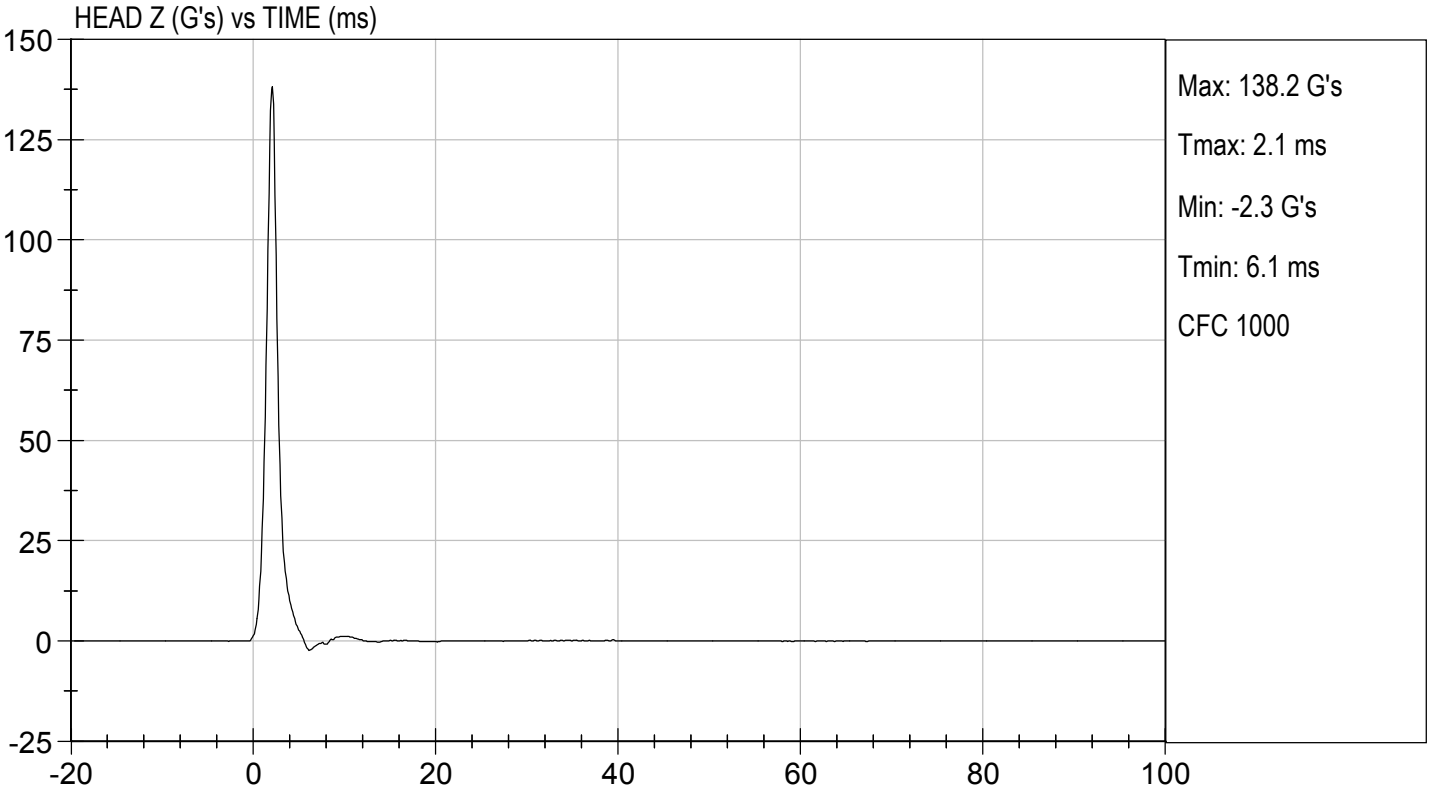
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 12/29/2020
TEST #: D203421





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D203422

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.13	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.2	Pass
	20 ms	m/s	4.0 to 5.0	4.6	Pass
	30 ms	m/s	5.8 to 7.0	6.8	Pass
D Plane Rotation	Max	deg	77 to 91	84	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	74	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	87	Pass
			Overall Results		Pass

Alex Thomas

Laboratory Technician

12/30/2020

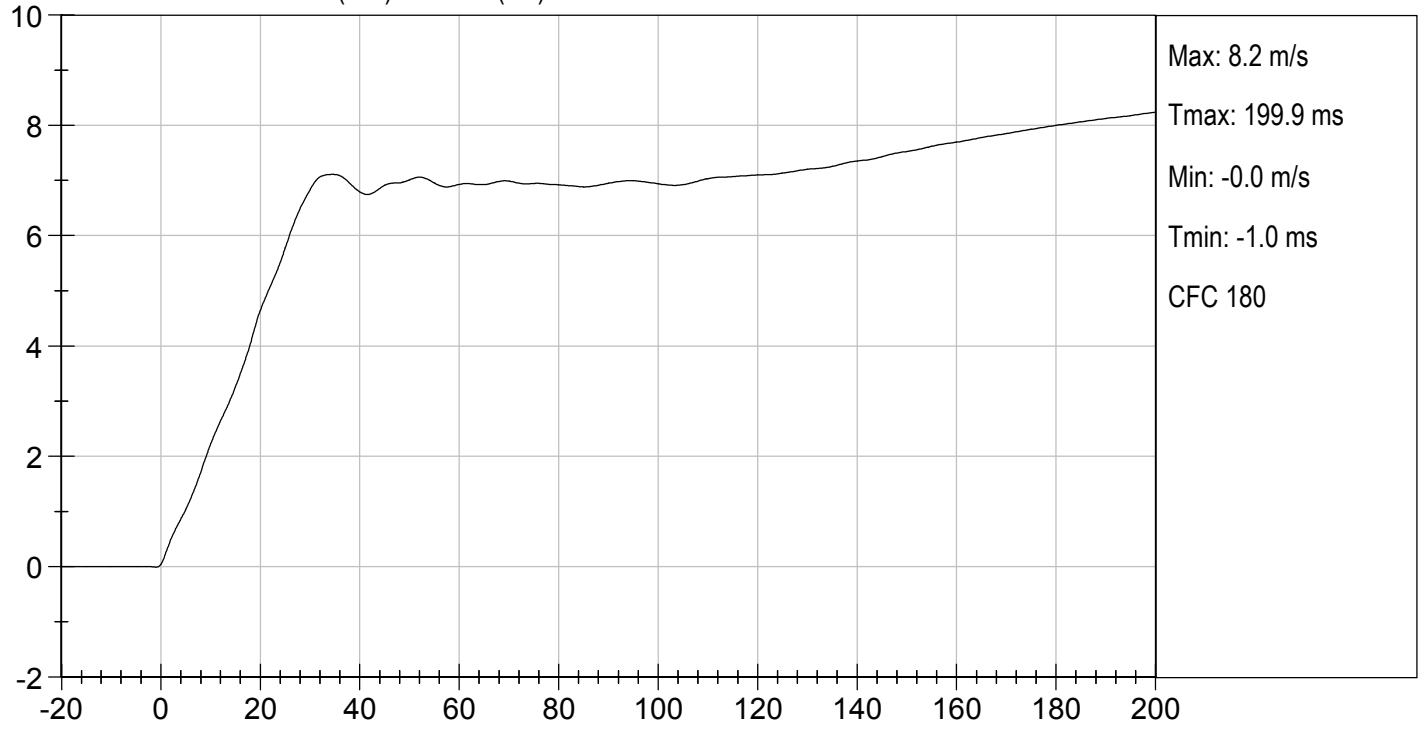
Test Date

Approved By

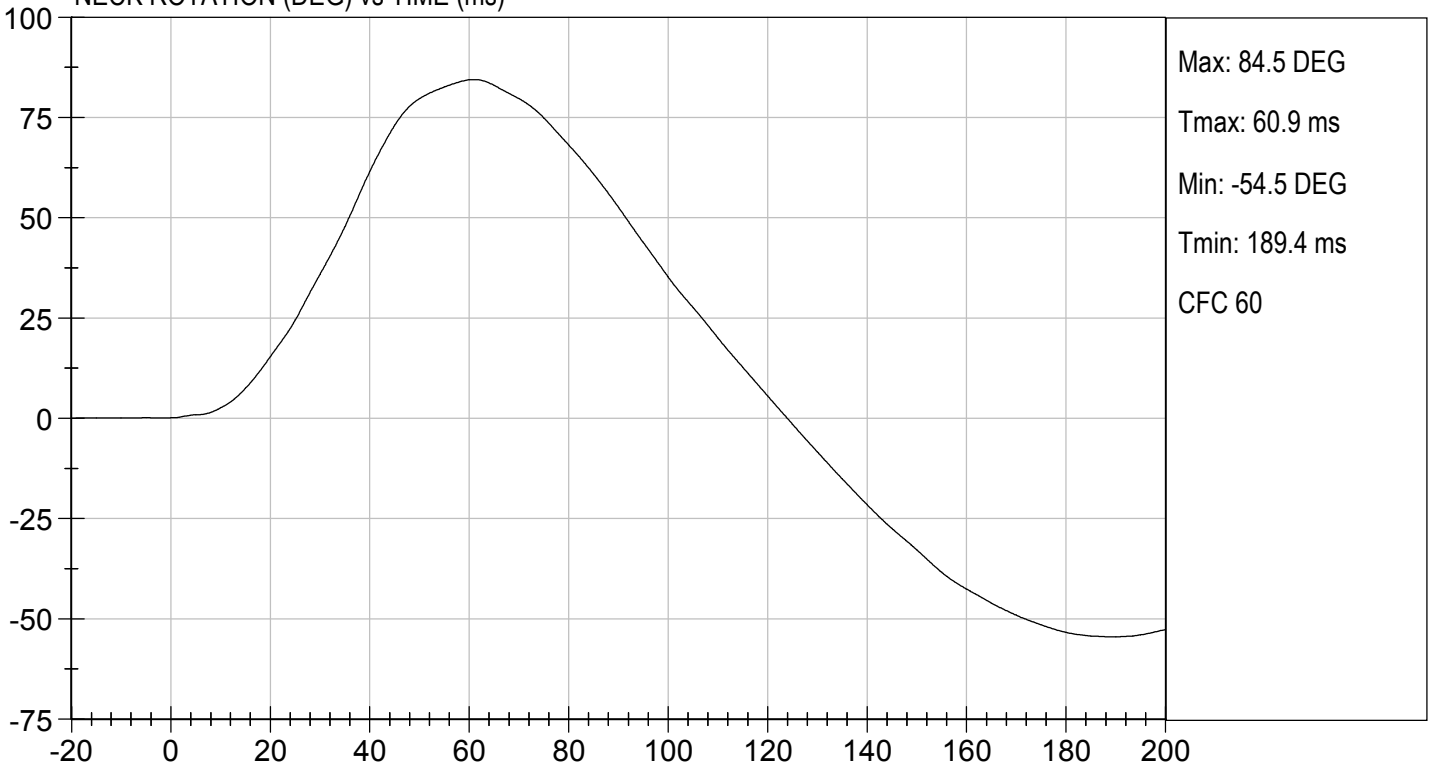
TEST DESC: NECK FLEXION
VELOCITY: 23.40 ft/s, 7.13 m/s

TEST DATE: 12/30/2020
TEST #: D203422

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

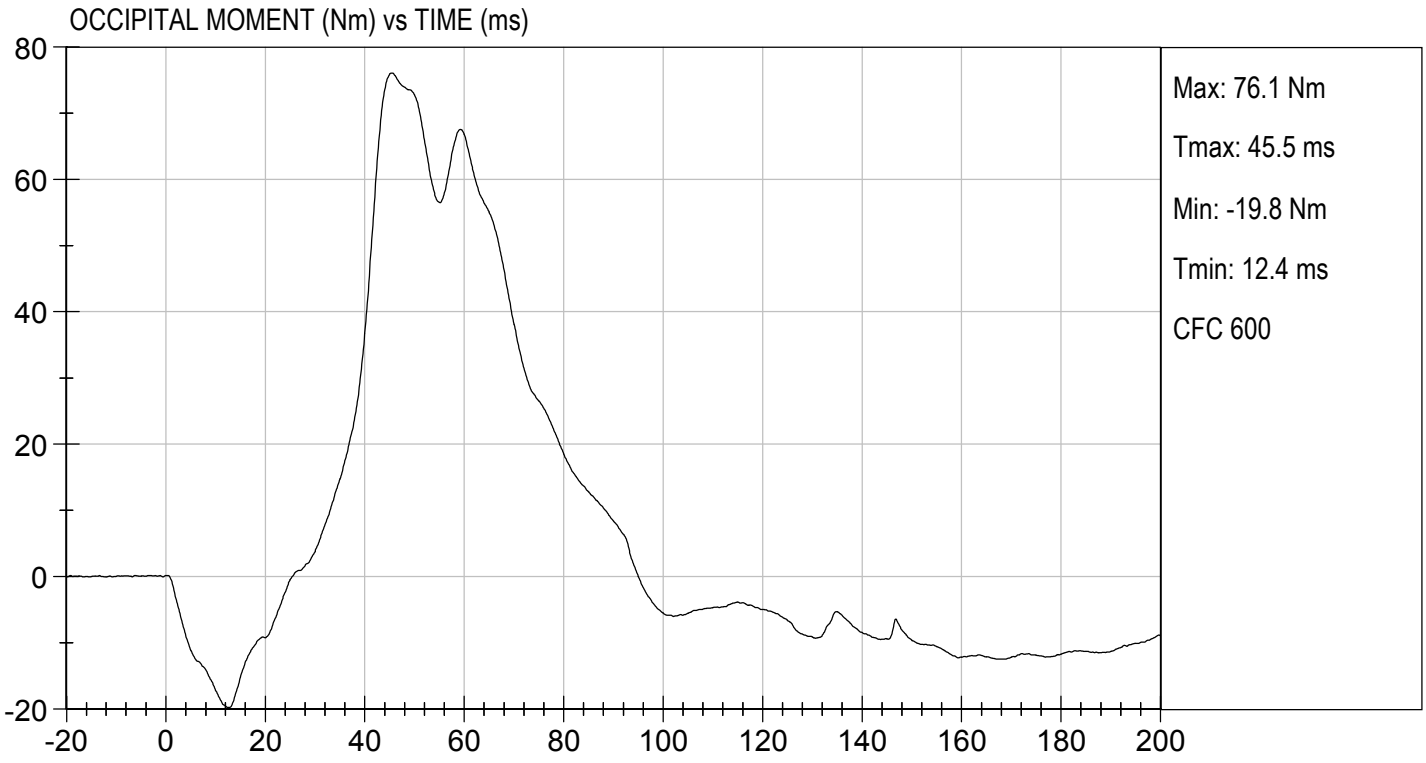


NECK ROTATION (DEG) vs TIME (ms)



TEST DESC: NECK FLEXION
VELOCITY: 23.40 ft/s, 7.13 m/s

TEST DATE: 12/30/2020
TEST #: D203422



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D203423

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	21	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.16	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.5	Pass
	30 ms	m/s	4.6 to 5.6	5.5	Pass
D Plane Rotation	Max	deg	99 to 114	99	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-59	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	98	Pass
			Overall Results		Pass

Alex Thomas

Laboratory Technician

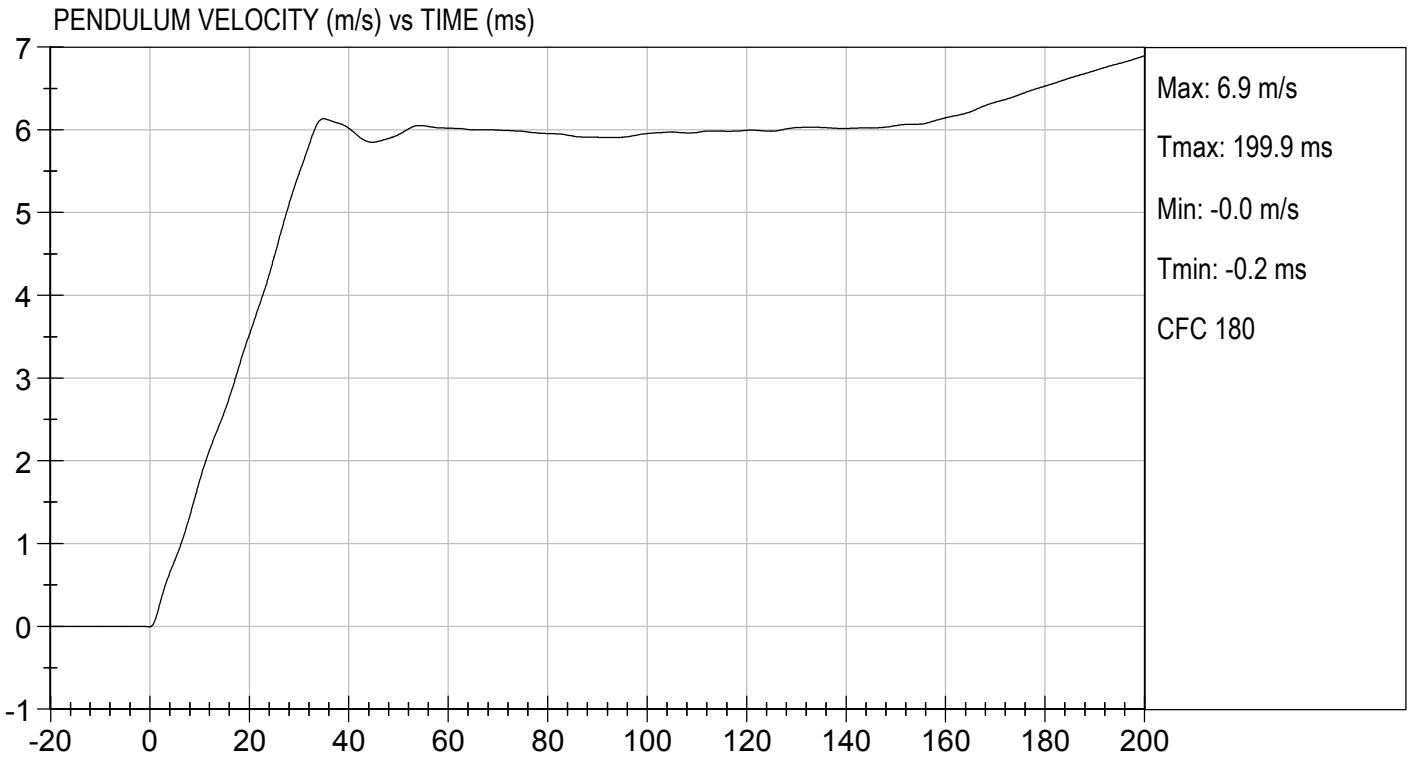
12/30/2020

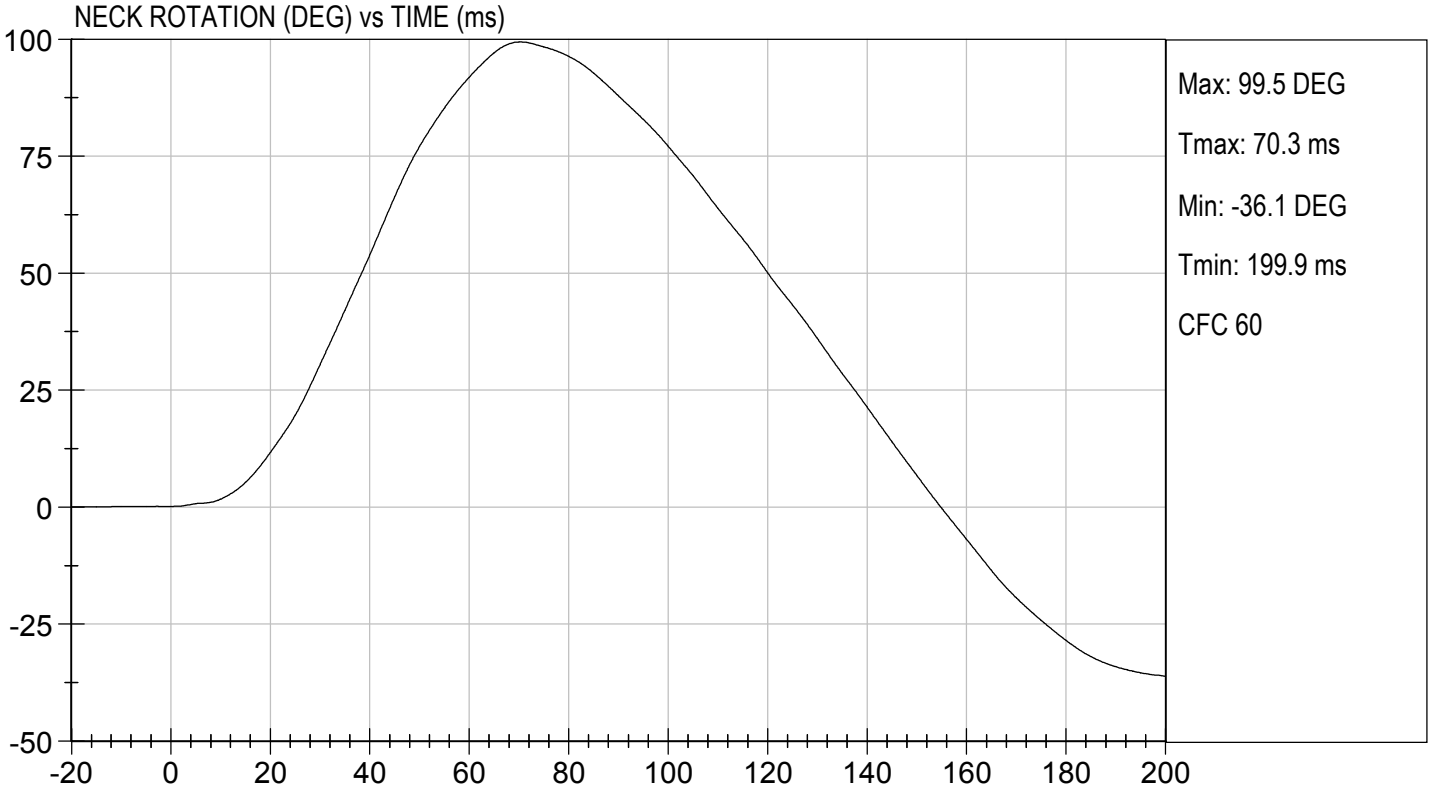
Test Date

Approved By

TEST DESC: NECK EXTENSION
VELOCITY: 20.20 ft/s, 6.16 m/s

TEST DATE: 12/30/2020
TEST #: D203423





MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D203424

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Relative Humidity	%	10 to 70	21	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	52	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4373	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4373	Pass
		Overall Test Results		Pass

Alex Thomas
Laboratory Technician

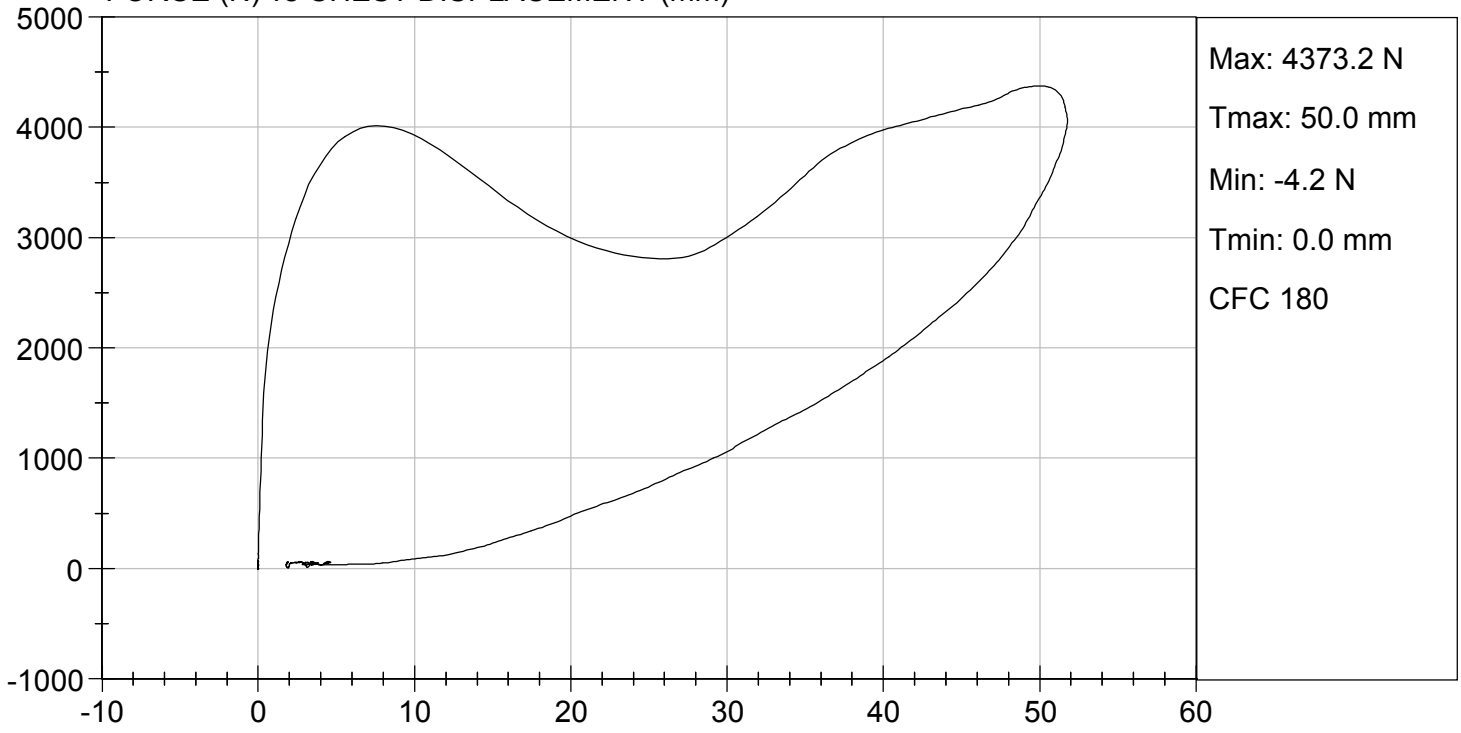
12/29/2020
Test Date

Approved By

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

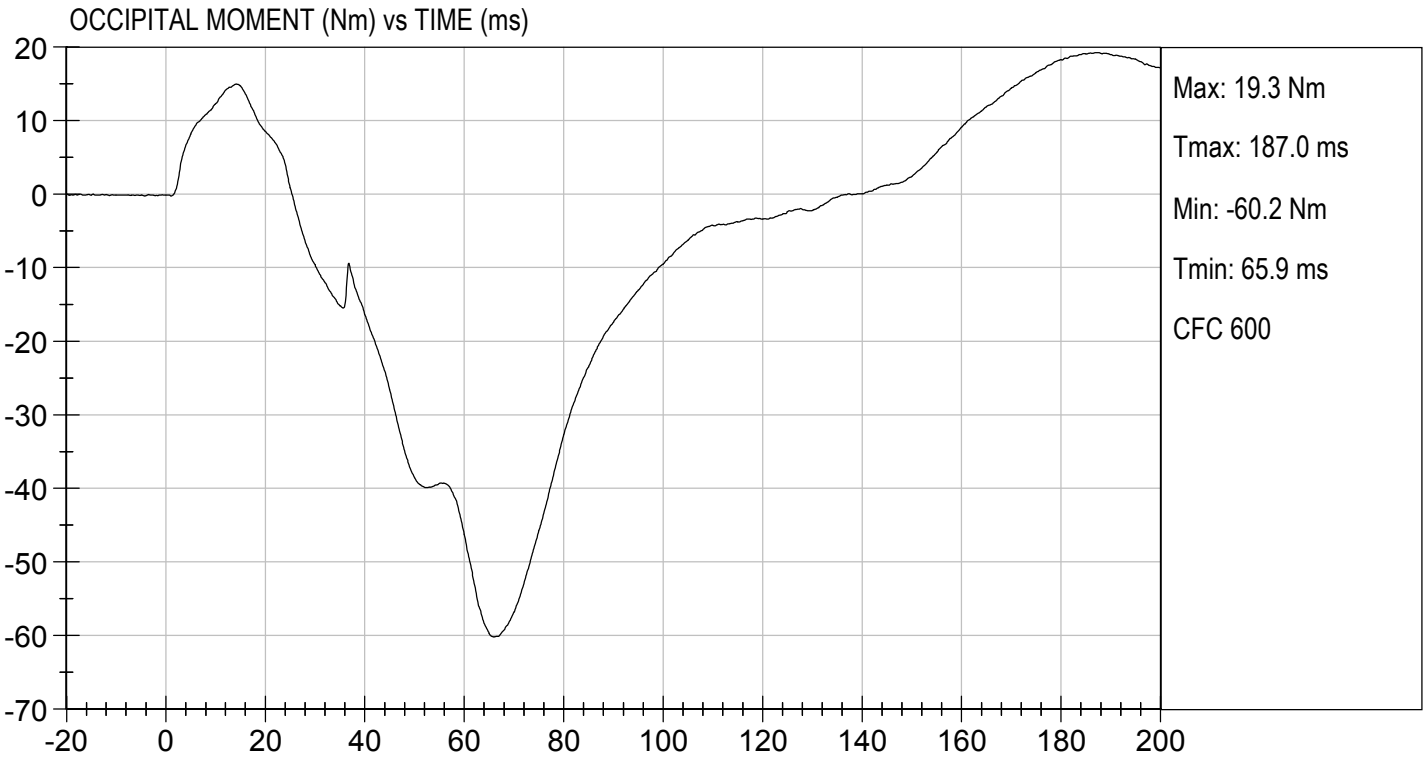
TEST DATE: 12/29/2020
TEST #: D203424

FORCE (N) vs CHEST DISPLACEMENT (mm)



TEST DESC: NECK EXTENSION
VELOCITY: 20.20 ft/s, 6.16 m/s

TEST DATE: 12/30/2020
TEST #: D203423



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D203425

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3685	Pass
		Overall Test Results		Pass

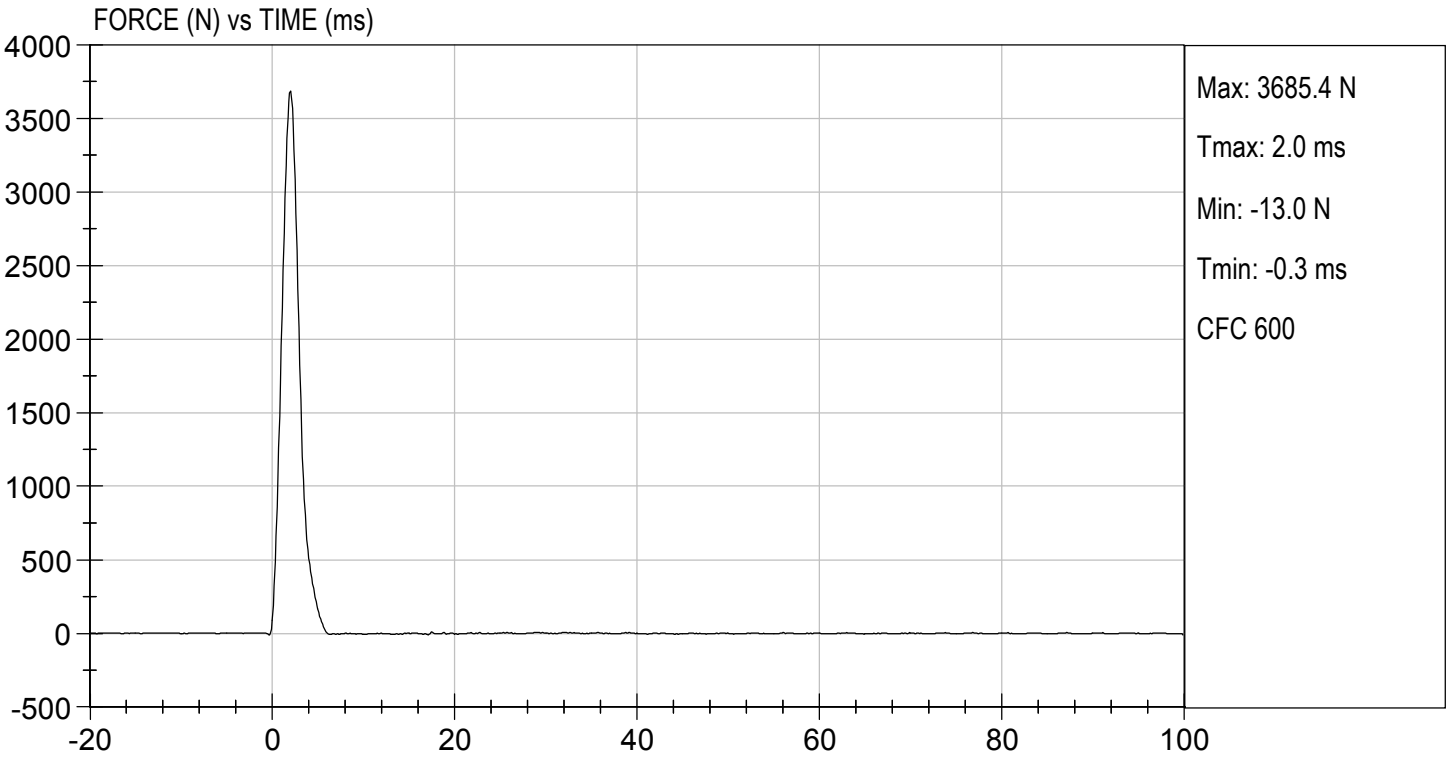
Laboratory Technician

12/30/2020
Test Date

Approved By

TEST DESC: RIGHT KNEE
VELOCITY: 6.94 ft/s, 2.12 m/s

TEST DATE: 12/30/2020
TEST #: D203425



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D203426

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	3665	Pass
		Overall Test Results		Pass

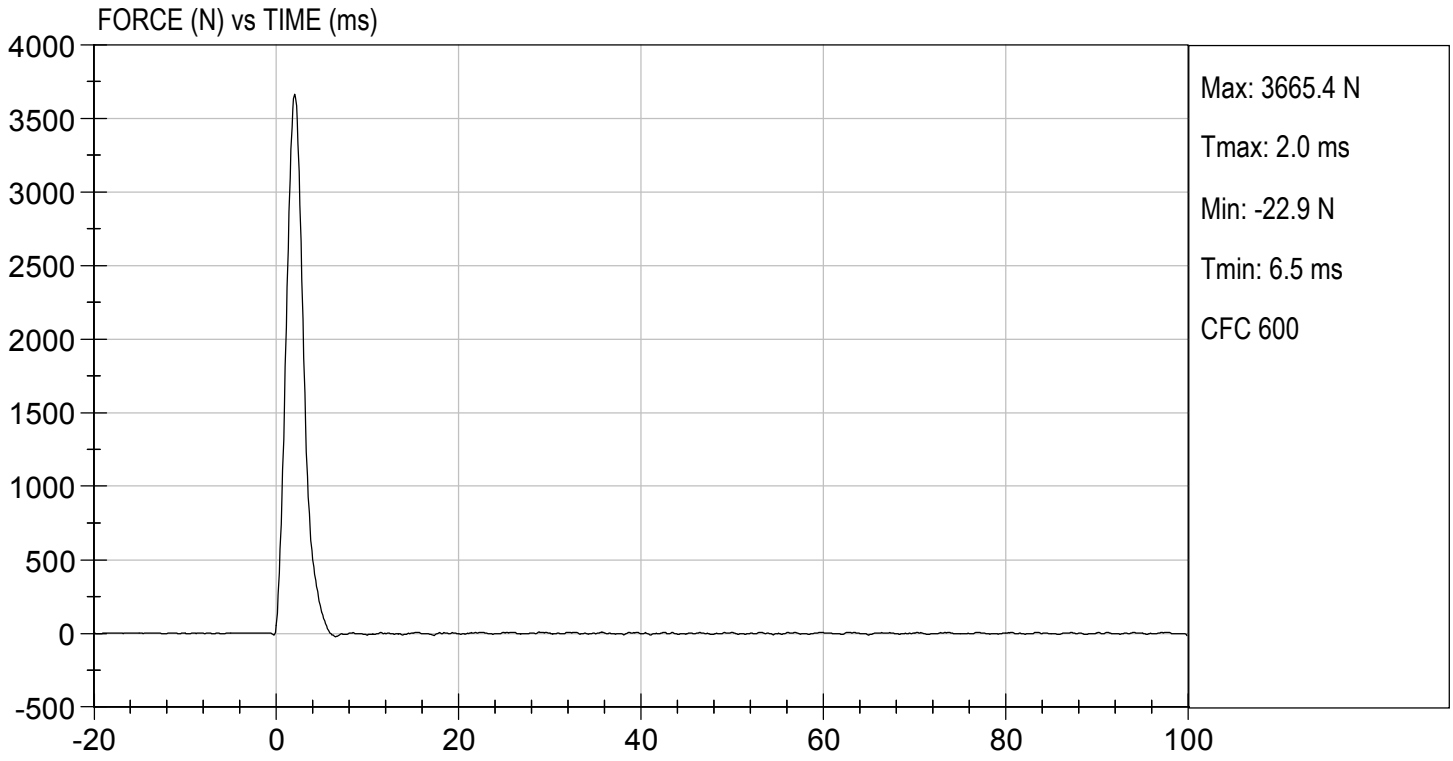
Laboratory Technician

12/30/2020
Test Date

Approved By

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

TEST DATE: 12/30/2020
TEST #: D203426



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D203427

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Initial Angle	deg	0 to 20	19	Pass
Return Angle	deg	+/- 8	3	Pass
Force at 45 deg	N	320 to 390	382	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.7	Pass
		Overall Result		Pass

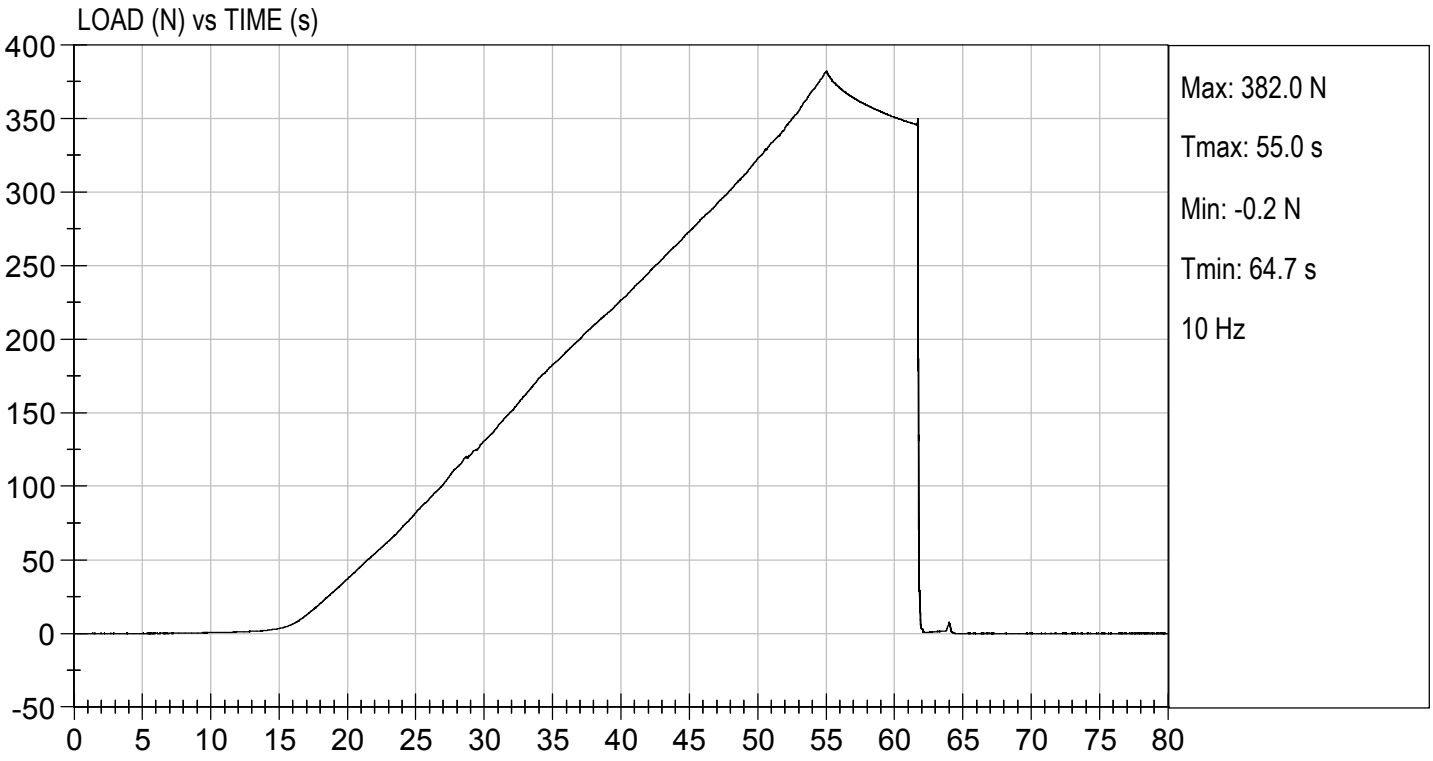
Laboratory Technician

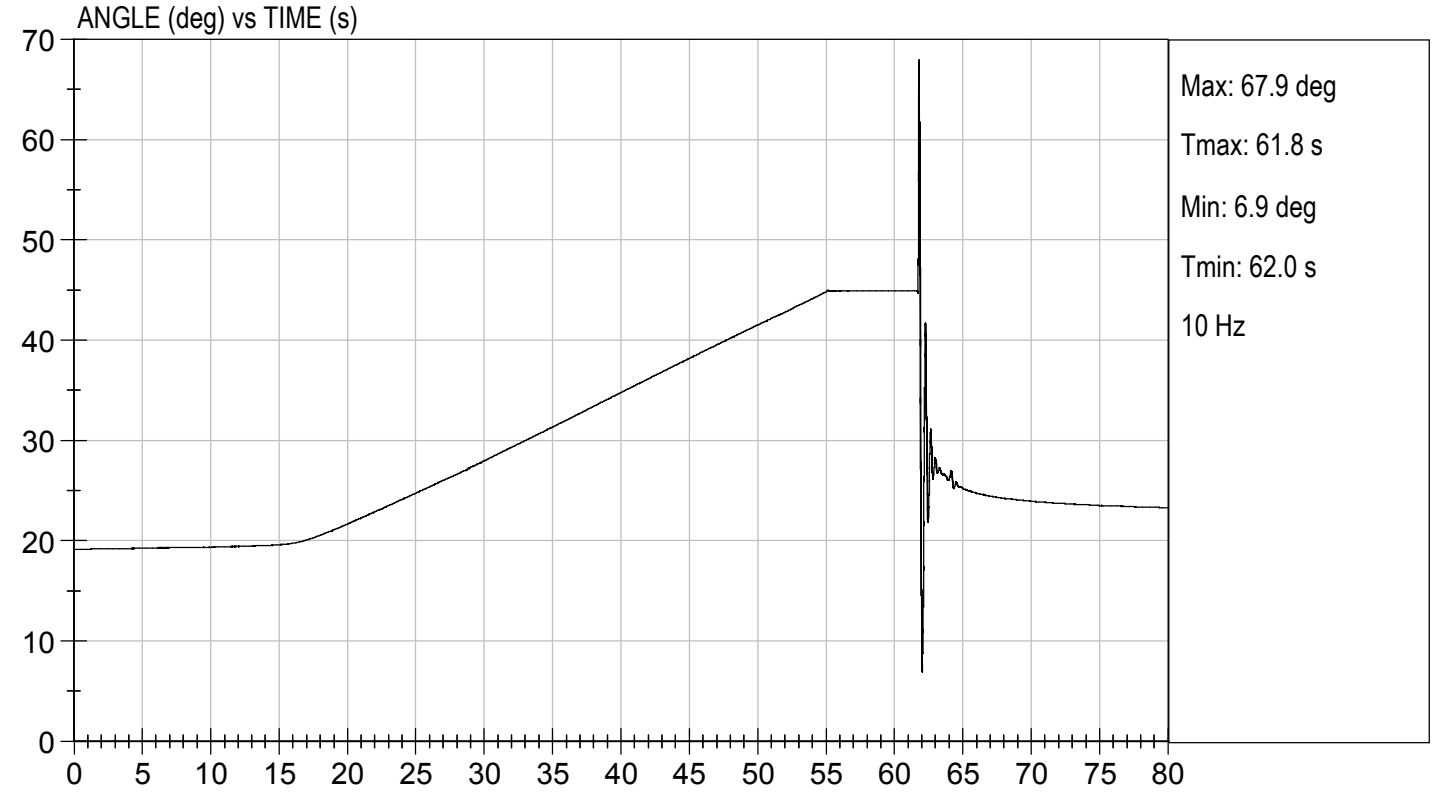
12/30/2020
Test Date

Approved By

TEST DESC: LUMBAR FLEXION

TEST DATE: 12/30/2020
TEST #: D203427





CALIBRATION TEST RESULTS

POST-TEST

HYBRID III 5TH PERCENTILE FEMALE - PASSENGER ATD

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test ID:** D210071

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Peak Resultant Acceleration	G's	250 to 300	276	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	6.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

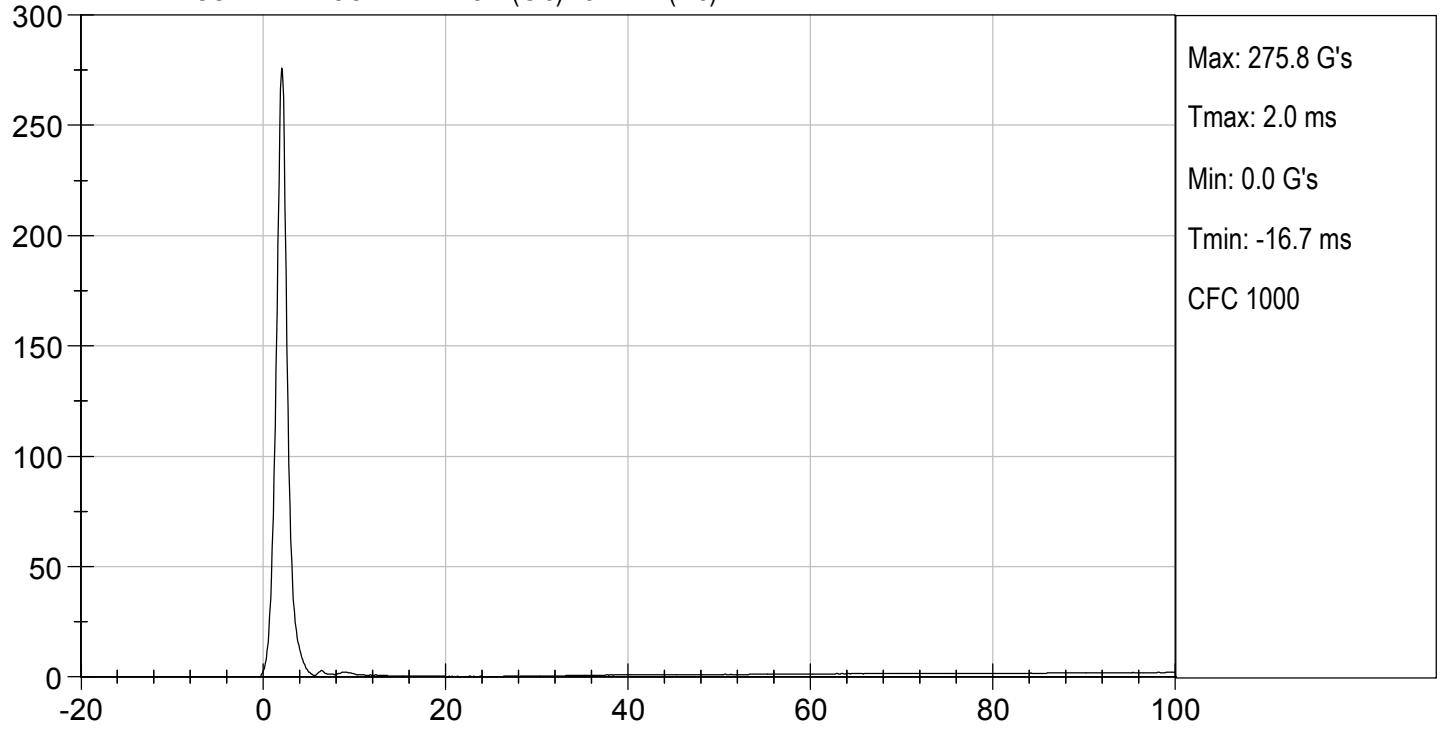
01/07/2021
Test Date

Approved By

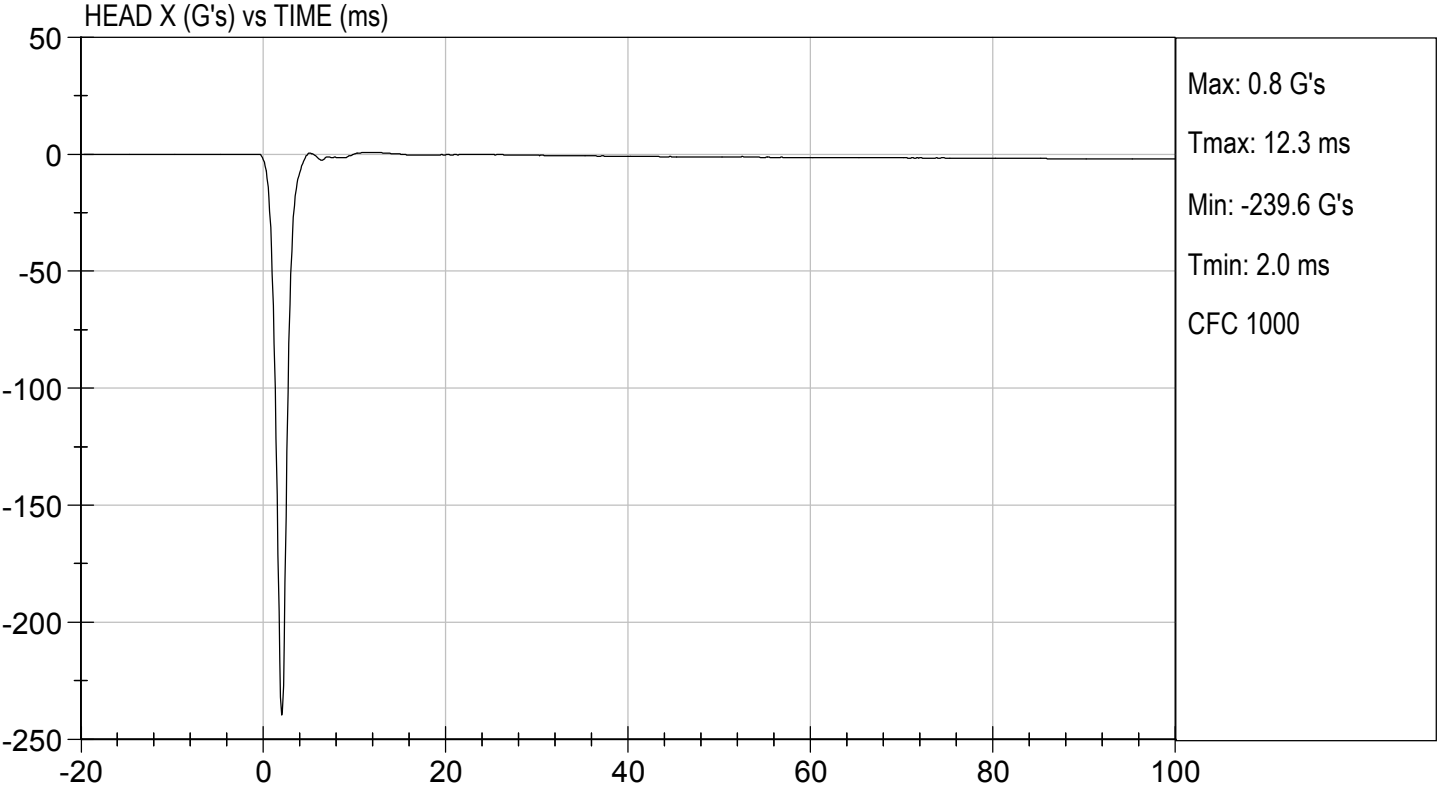
TEST DESC: HEAD DROP

TEST DATE: 01/07/2021
TEST #: D210071

HEAD RESULTANT ACCELERATION (G's) vs TIME (ms)

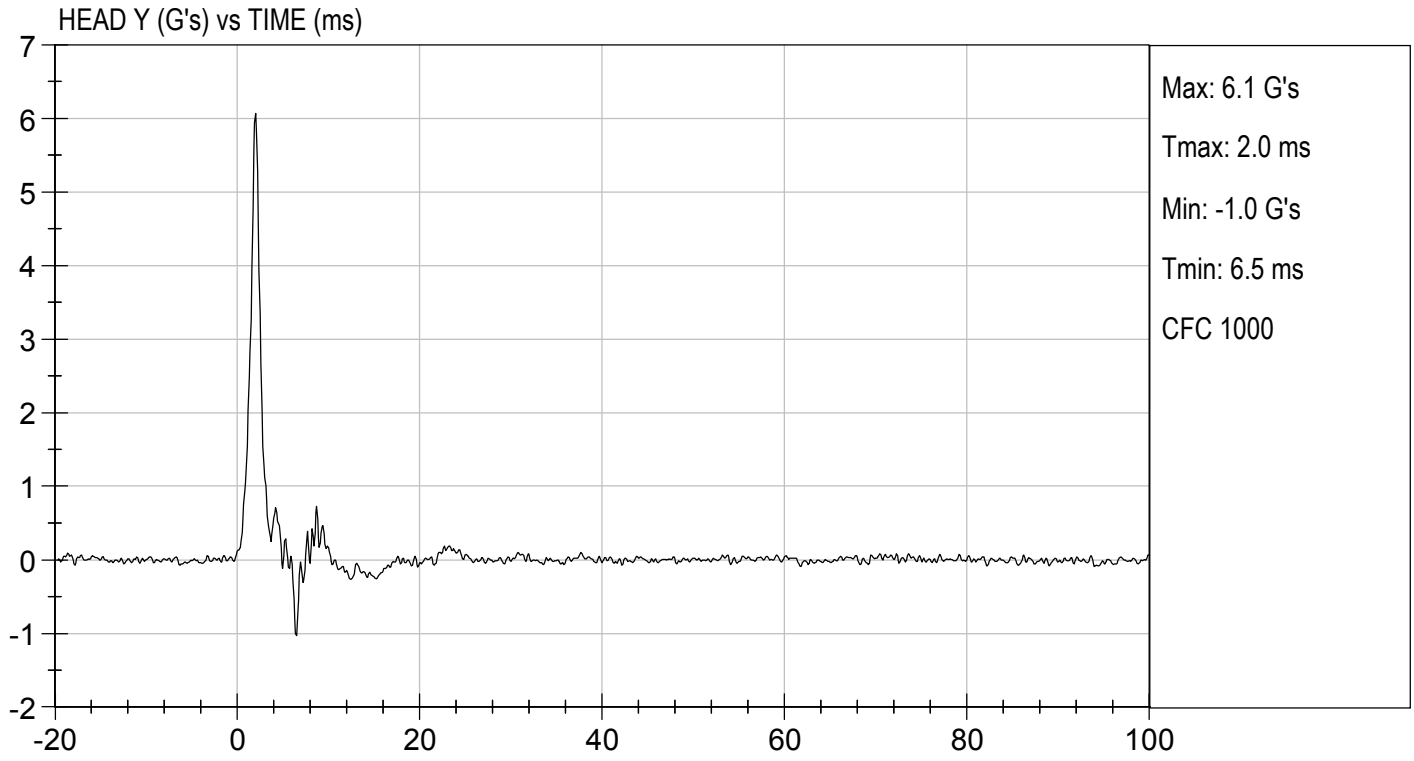


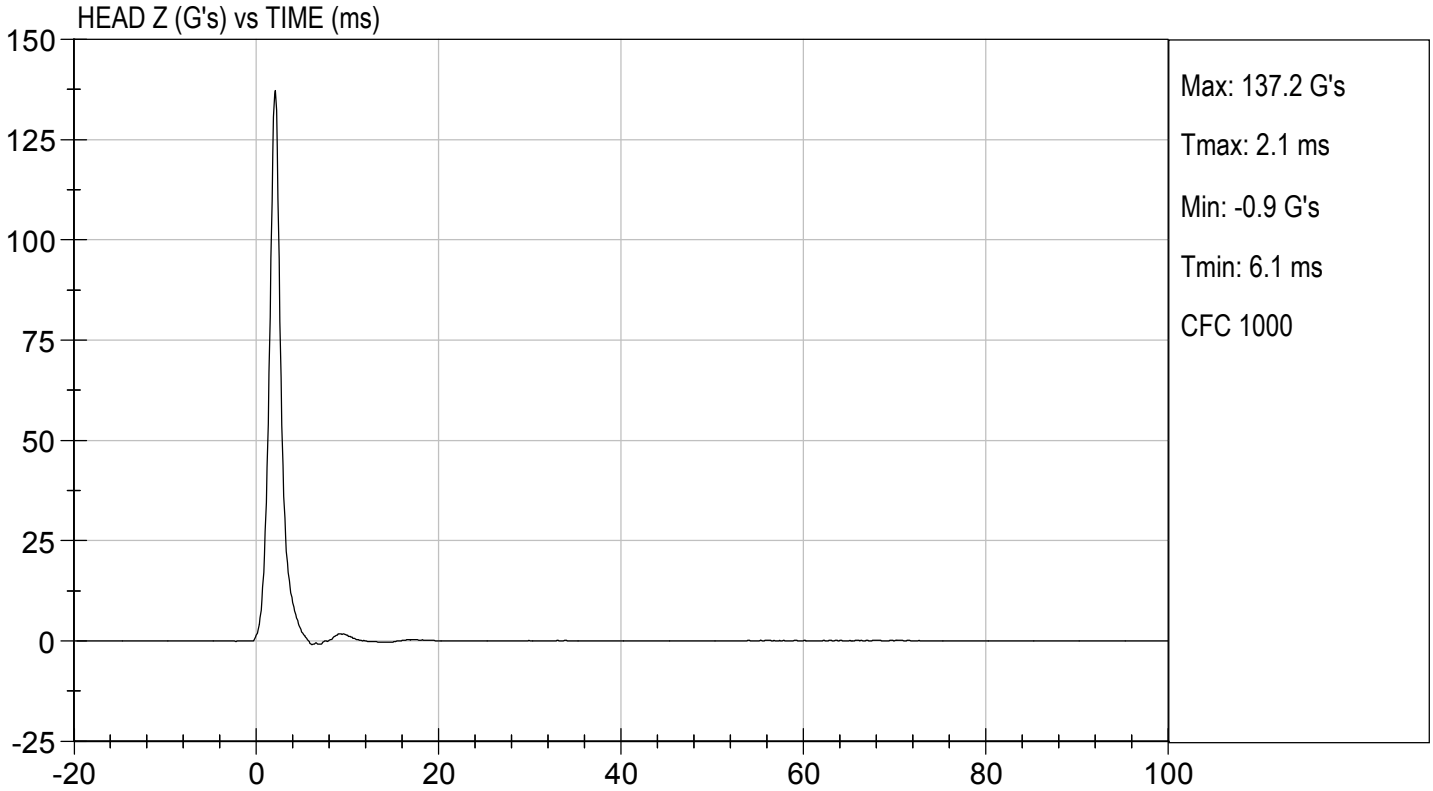
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 01/07/2021
TEST #: D210071





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D210072

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	23	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.2	Pass
	20 ms	m/s	4.0 to 5.0	4.4	Pass
	30 ms	m/s	5.8 to 7.0	6.4	Pass
D Plane Rotation	Max	deg	77 to 91	83	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	88	Pass
			Overall Results		Pass

Gerald Guerrero
Laboratory Technician

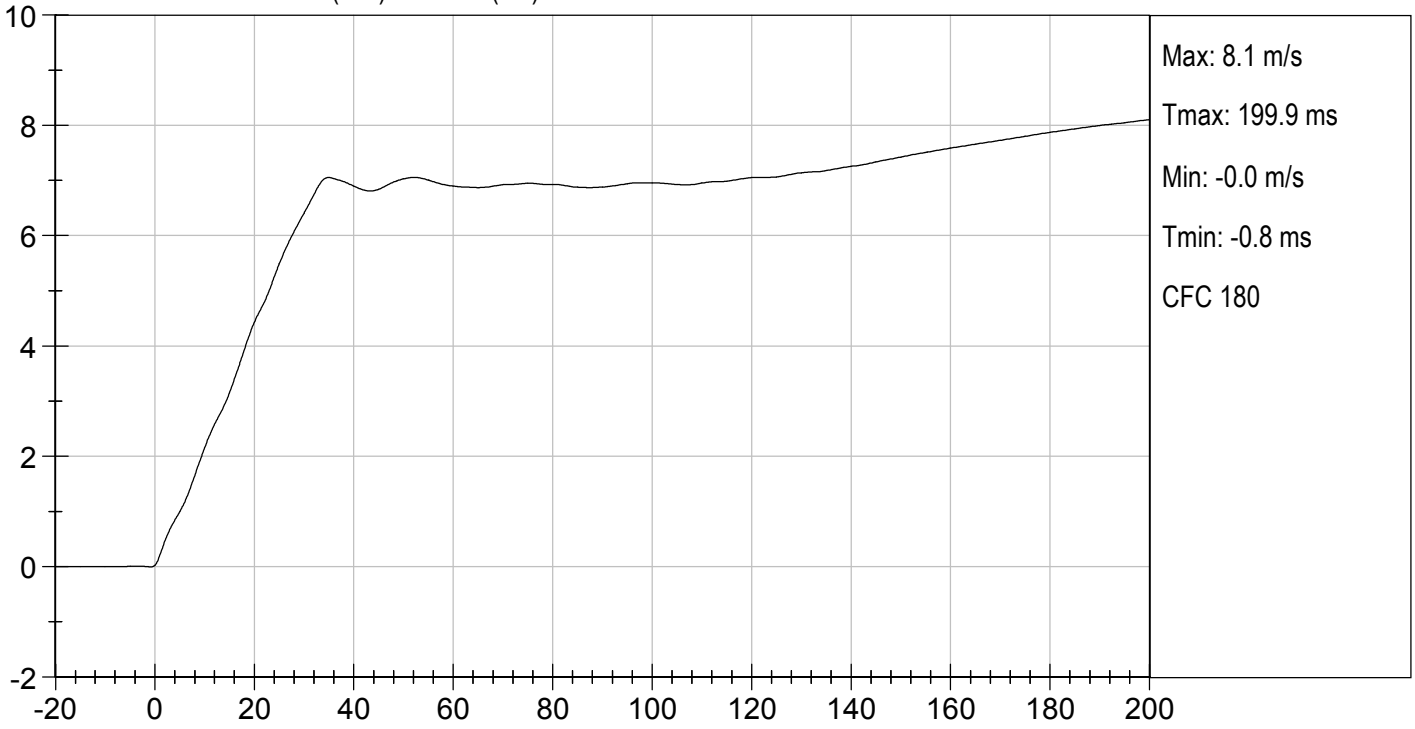
01/07/2021
Test Date

Approved By

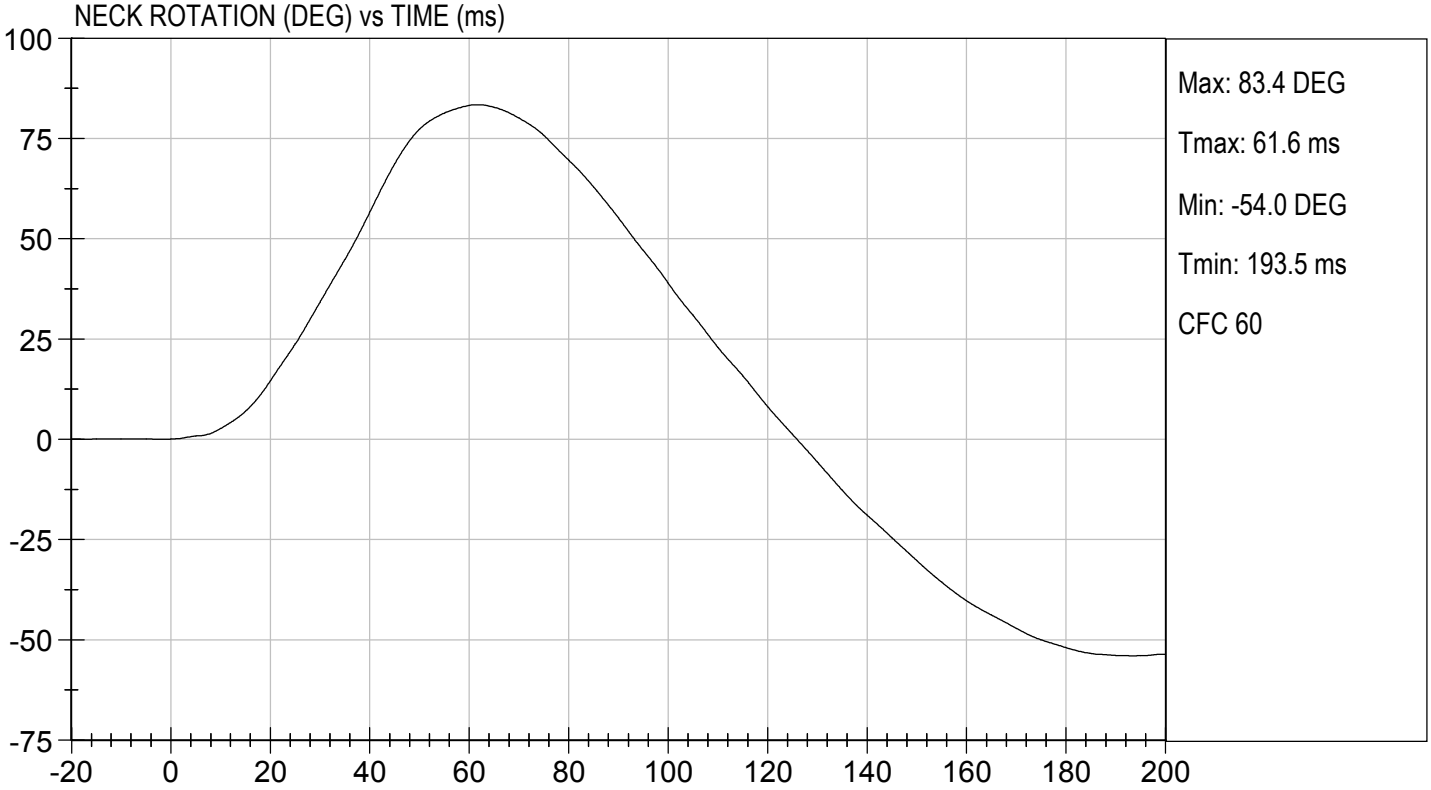
TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 01/07/2021
TEST #: D210072

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

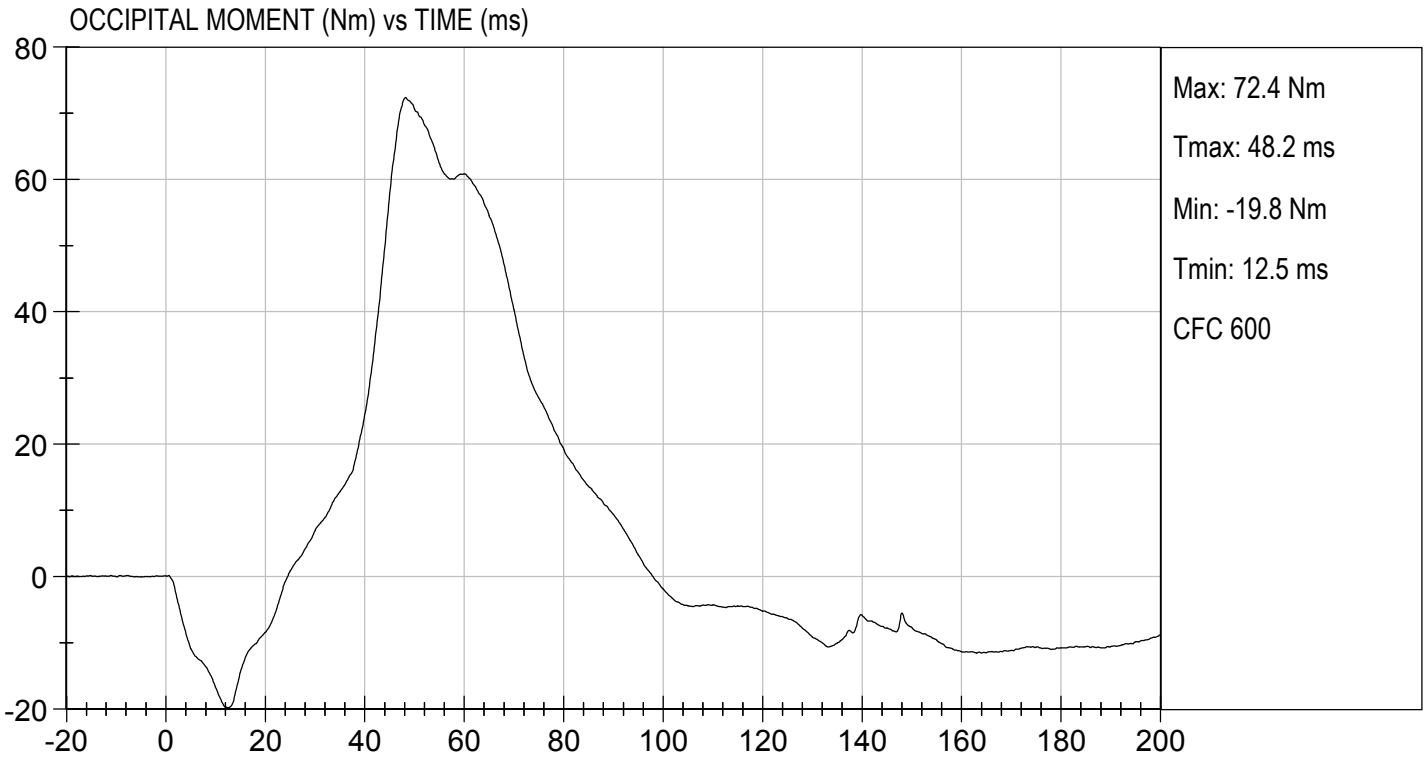


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 01/07/2021
TEST #: D210072



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D210073

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	23	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.9	Pass
	20 ms	m/s	3.1 to 3.9	3.8	Pass
	30 ms	m/s	4.6 to 5.6	5.5	Pass
D Plane Rotation	Max	deg	99 to 114	108	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-61	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	99	Pass
			Overall Results		Pass

Gerald Guerrero
Laboratory Technician

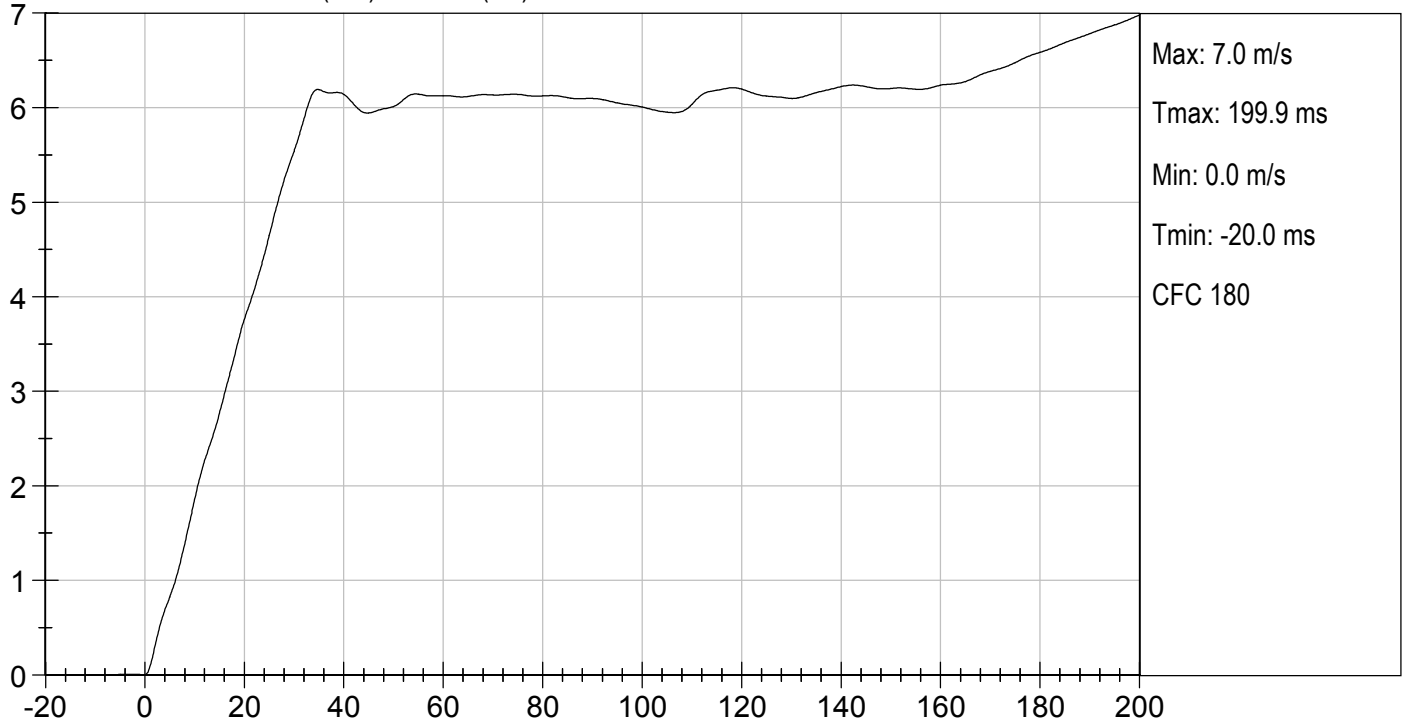
01/07/2021
Test Date

Approved By

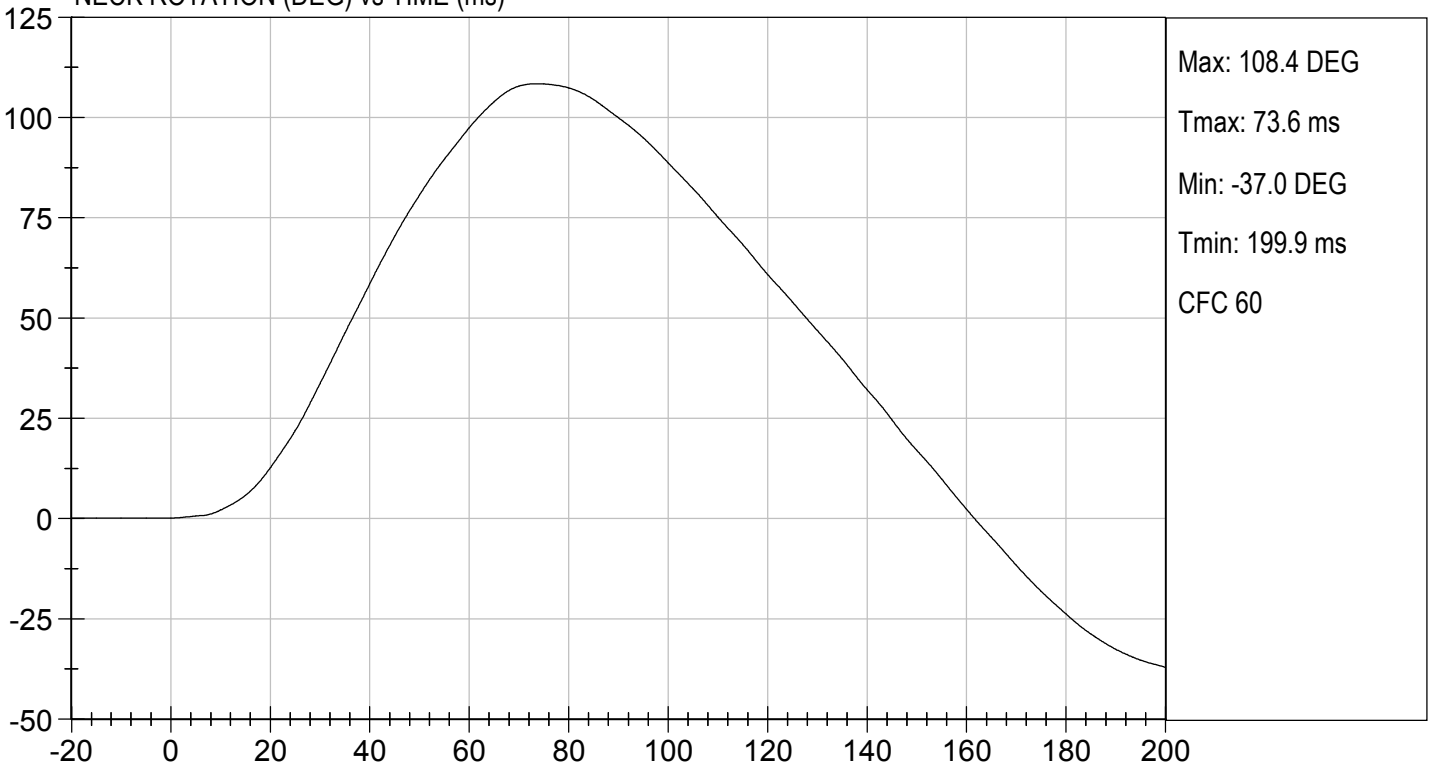
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 01/07/2021
TEST #: D210073

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

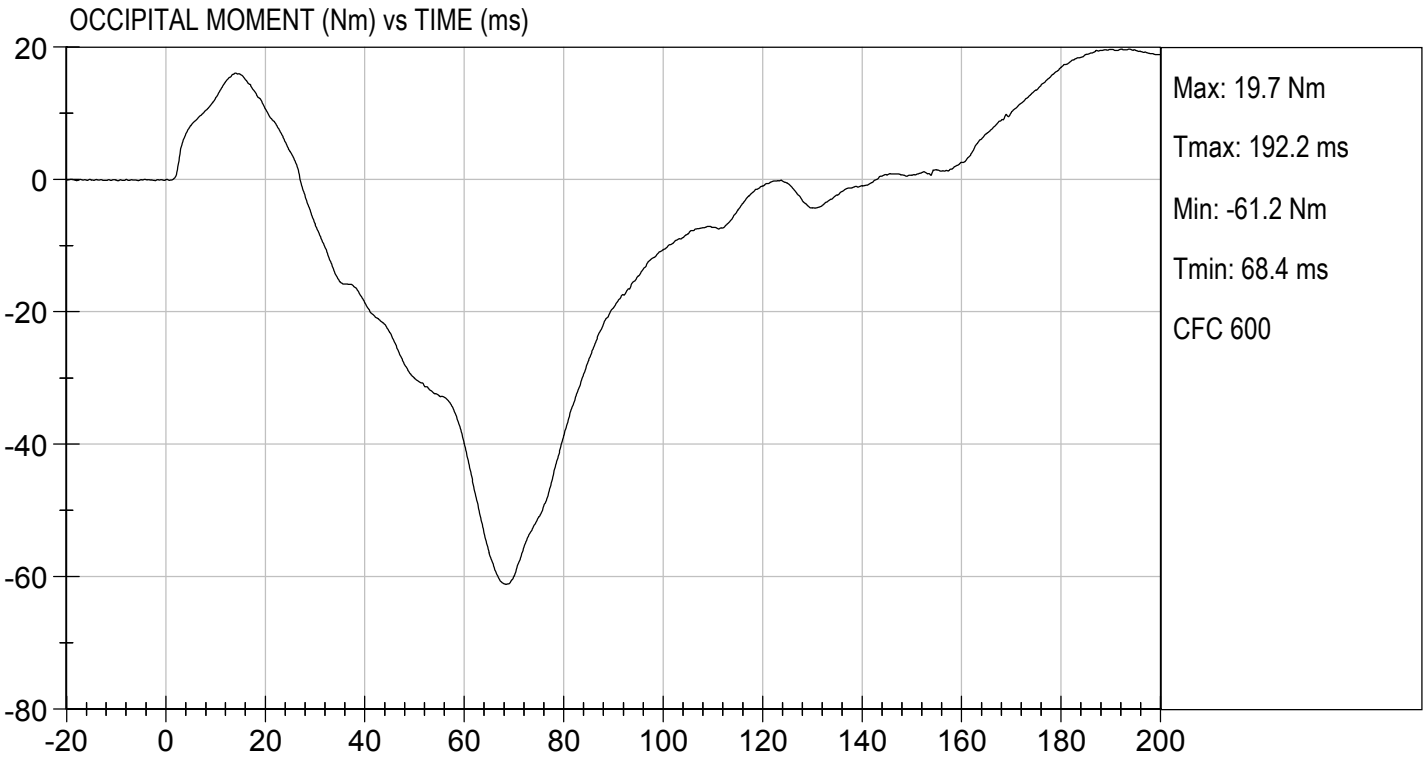


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 01/07/2021
TEST #: D210073



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D210074

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.1	Pass
Relative Humidity	%	10 to 70	22	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	52	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4370	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4366	Pass
		Overall Test Results		Pass

Gerald Guerrero
Laboratory Technician

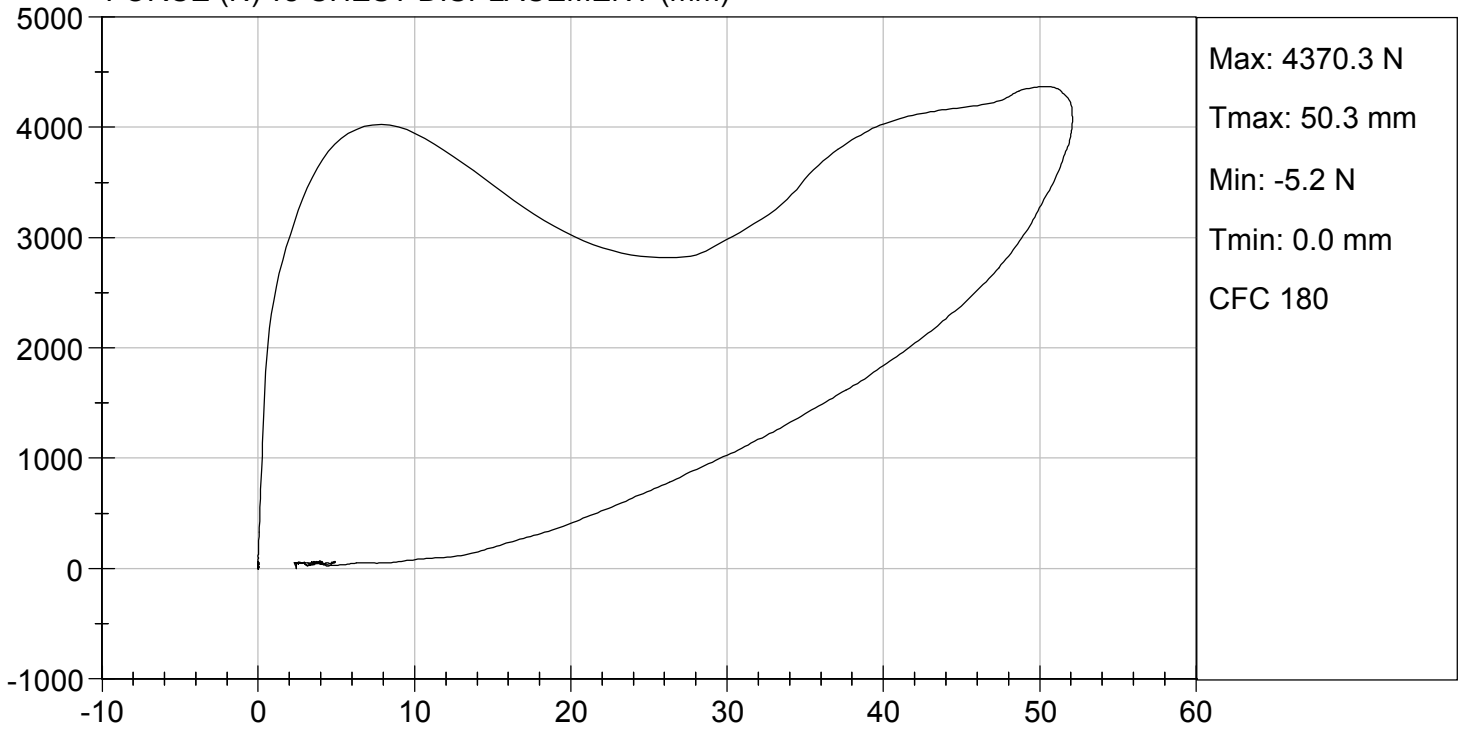
01/08/2021
Test Date

Approved By

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

TEST DATE: 01/08/2021
TEST #: D210074

FORCE (N) vs CHEST DISPLACEMENT (mm)



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D210075

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3753	Pass
		Overall Test Results		Pass

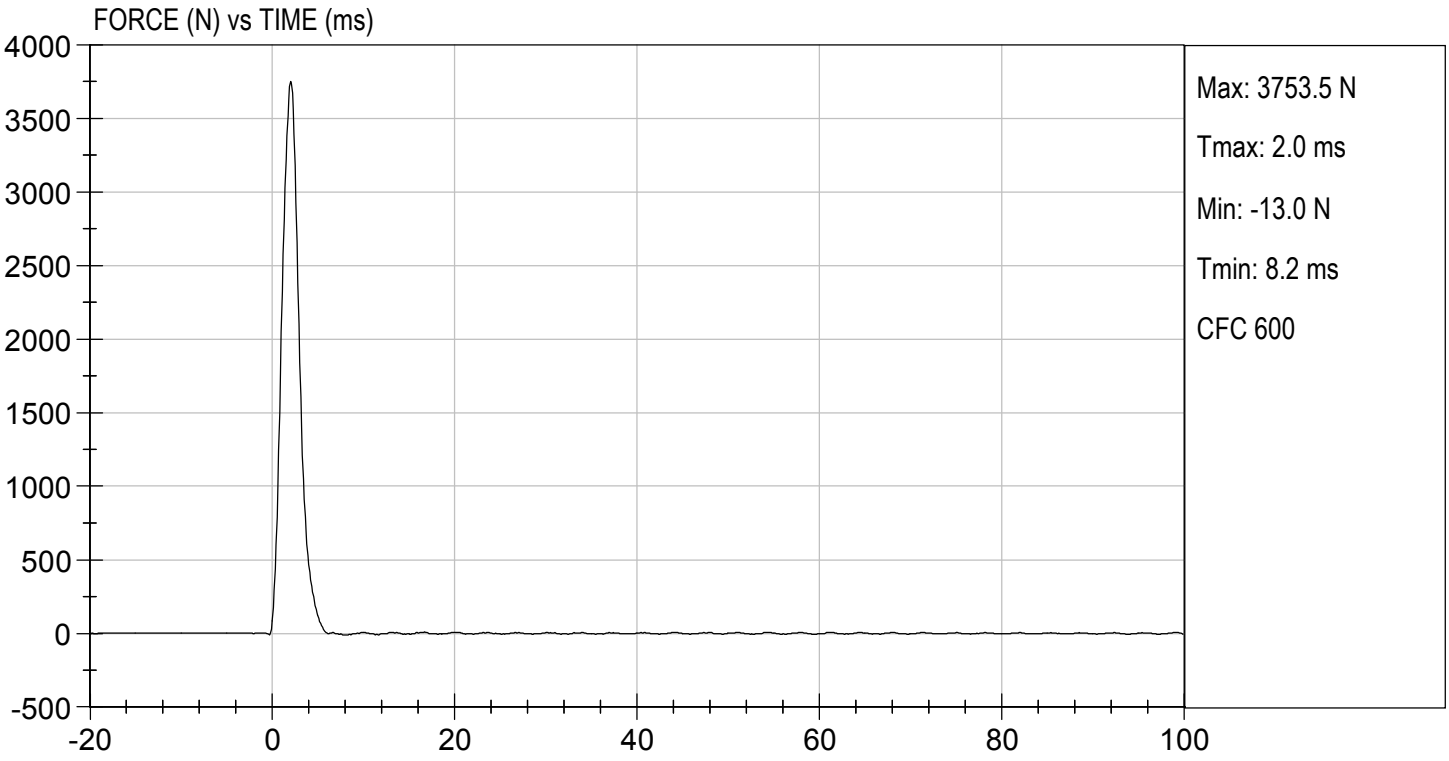
Gerald Guerrero
Laboratory Technician

01/07/2021
Test Date

Approved By

TEST DESC: RIGHT KNEE
VELOCITY: 6.94 ft/s, 2.12 m/s

TEST DATE: 01/07/2021
TEST #: D210075



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D210076

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3878	Pass
		Overall Test Results		Pass

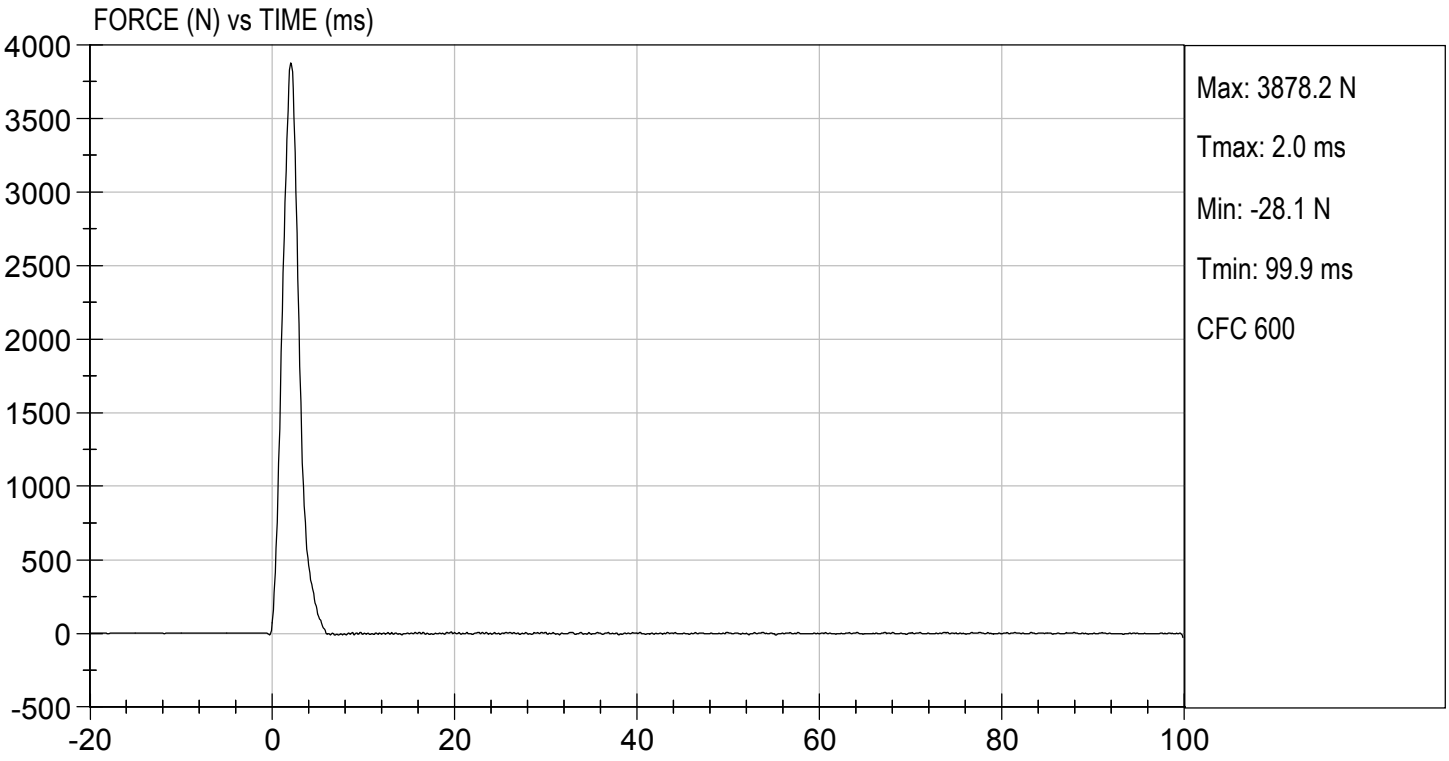
Gerald Guerrero
Laboratory Technician

01/07/2021
Test Date

Approved By

TEST DESC: LEFT KNEE
VELOCITY: 6.94 ft/s, 2.12 m/s

TEST DATE: 01/07/2021
TEST #: D210076



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D210077

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Initial Angle	deg	0 to 20	19	Pass
Return Angle	deg	+/- 8	4	Pass
Force at 45 deg	N	320 to 390	383	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.5	Pass
		Overall Result		Pass

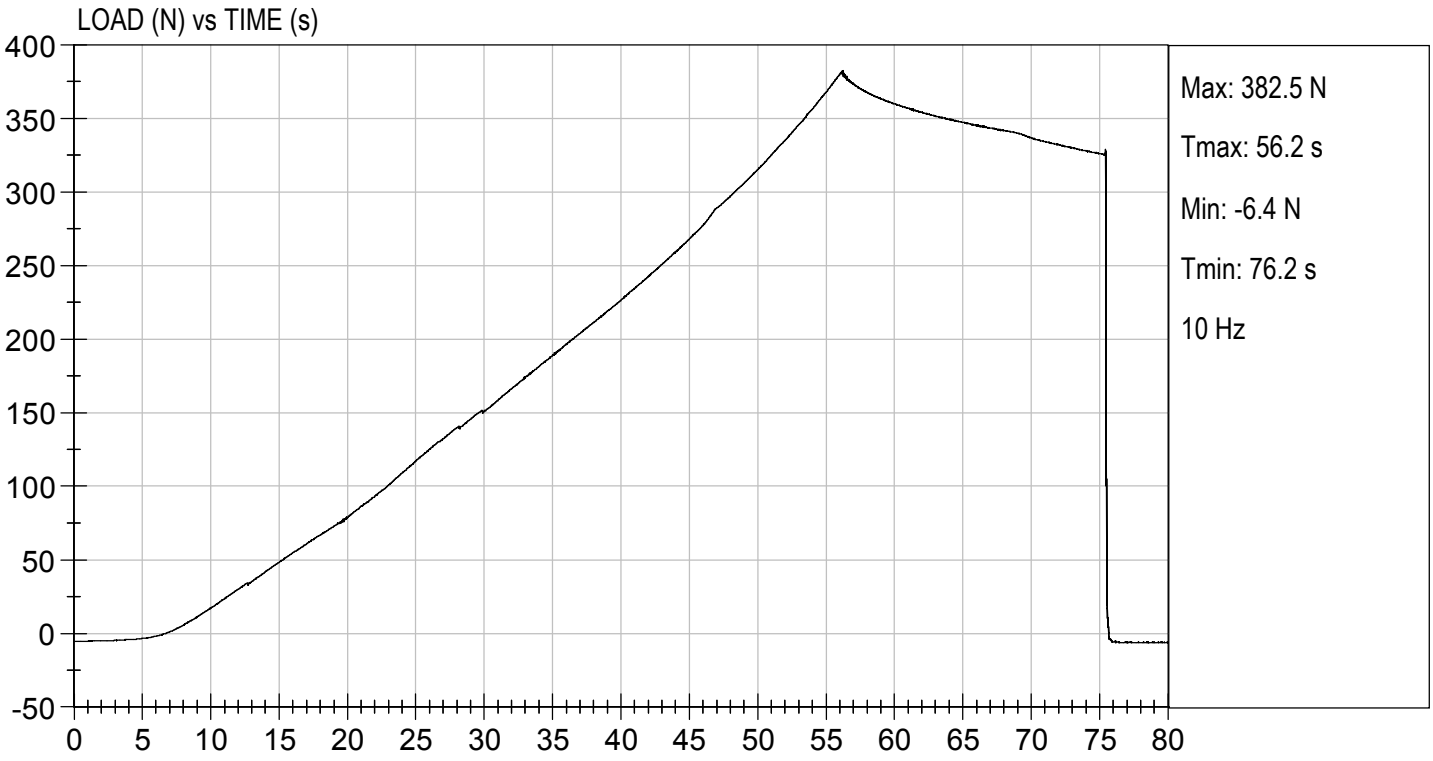
Gerald Guerrero
Laboratory Technician

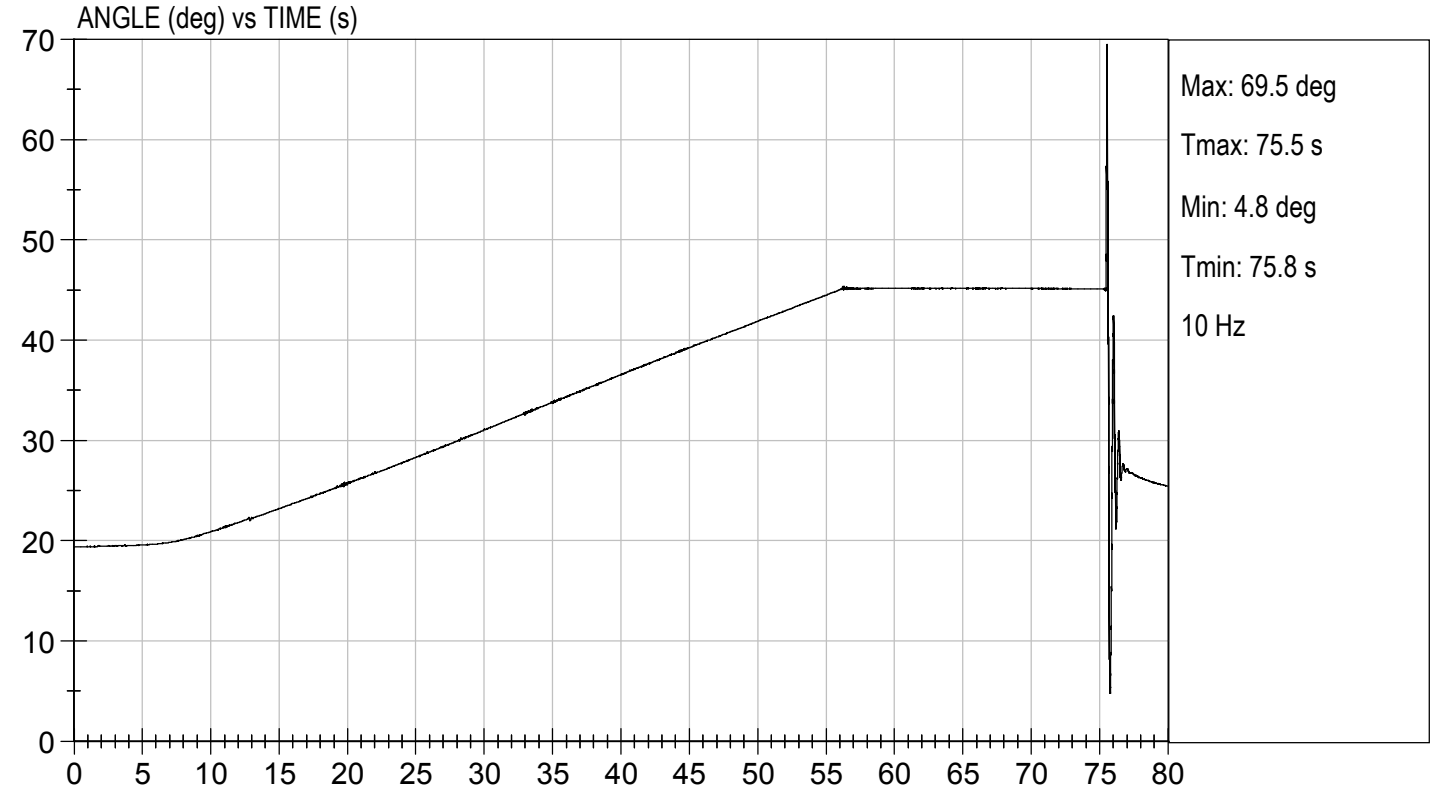
01/08/2021
Test Date

Approved By

TEST DESC: LUMBAR FLEXION

TEST DATE: 01/08/2021
TEST #: D210077





APPENDIX D
TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION DATA

TABLE 1 – DRIVER DUMMY INSTRUMENTATION

Instrument Location			Axis	Hybrid III 50th S/N 351		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers		Primary	X	P79741	Endevco	09/02/2020
			Y	P79743	Endevco	09/02/2020
			Z	P79744	Endevco	09/02/2020
		Redundant	X	P94834	Endevco	09/02/2020
			Y	P94856	Endevco	09/02/2020
			Z	P97412	Endevco	09/02/2020
Head Angular Rate Sensors			X	ARS7402	DTS	08/04/2020
			Y	ARS7416	DTS	08/04/2020
			Z	ARS7366	DTS	08/04/2020
Upper Neck Load Cell			Fx, Fy, Fz Mx, My, Mz	NG1915	Denton	03/05/2020
Chest Accelerometers		Primary	X	P86792	Endevco	09/02/2020
			Y	P86793	Endevco	09/02/2020
			Z	P88348	Endevco	09/02/2020
		Redundant	X	P88666	Endevco	09/02/2020
			Y	P88667	Endevco	09/02/2020
			Z	P94109	Endevco	09/02/2020
Chest Potentiometer			X	351	Servo	09/02/2020
Pelvis Accelerometers			X	P95526	Endevco	09/01/2020
			Y	P96038	Endevco	09/01/2020
			Z	P97742	Endevco	09/01/2020
Femur Load Cells	Right	Primary	Z	FG121P	Denton	09/02/2020
		Redundant	Z	FG121R	Denton	09/02/2020
	Left	Primary	Z	FG122P	Denton	09/02/2020
		Redundant	Z	FG122R	Denton	09/02/2020
Tibia Load Cells	Right	Upper	Mx, My, Fz	TGDH3308	FTSS	03/05/2020
		Lower	Mx, My, Fz	AGDI4208	FTSS	03/05/2020
	Left	Upper	Mx, My, Fz	TGDG6744	FTSS	03/05/2020
		Lower	Mx, My, Fz	AGDI4273	FTSS	03/05/2020
Foot Accelerometers	Right	Rear	X	T22486	Endevco	10/06/2020
			Z	P97382	Endevco	10/01/2020
		Front	Z	P82120	Endevco	09/02/2020
	Left	Rear	X	T16468	Endevco	09/01/2020
			Z	T16496	Endevco	09/01/2020
		Front	Z	T16501	Endevco	09/01/2020
Seat Belt Load Cells		Lap		SBG161	FTSS	11/13/2019
		Shoulder		SBG157	FTSS	11/13/2019

TABLE 2 – FRONT PASSENGER DUMMY INSTRUMENTATION

Instrument Location			Axis	Hybrid III 5th S/N 634		
				Serial Number	Manufacturer	Calibration Date
Head Accelerometers		Primary	X	P82304	Endevco	08/11/2020
			Y	P88172	Endevco	08/11/2020
			Z	T16400	Endevco	08/12/2020
		Redundant	X	T16403	Endevco	08/11/2020
			Y	T16406	Endevco	08/11/2020
			Z	T16413	Endevco	08/12/2020
Head Angular Rate Sensors			X	ARS7340	DTS	08/04/2020
			Y	ARS7357	DTS	08/04/2020
			Z	ARS7442	DTS	08/04/2020
Upper Neck Load Cell			Fx, Fy, Fz Mx, My, Mz	NG174	Denton	05/04/2020
Chest Accelerometers		Primary	X	T24796	Endevco	08/12/2020
			Y	T16416	Endevco	08/12/2020
			Z	T16420	Endevco	08/12/2020
		Redundant	X	T16423	Endevco	08/12/2020
			Y	T24766	Endevco	08/12/2020
			Z	T22499	Endevco	08/12/2020
Chest Potentiometer			X	634	Servo	12/28/2020
Pelvis Accelerometers			X	T16434	Endevco	08/11/2020
			Y	T16435	Endevco	08/11/2020
			Z	T16436	Endevco	08/11/2020
Femur Load Cells	Right	Primary	Z	FG139P	Denton	12/28/2020
		Redundant	Z	FG141P	Denton	12/28/2020
	Left	Primary	Z	FG139R	Denton	12/28/2020
		Redundant	Z	FG141R	Denton	12/28/2020
Tibia Load Cells	Right	Upper	Mx, My, Fz	TG405	Denton	05/05/2020
		Lower	Mx, My, Fz	AG368	Denton	05/04/2020
	Left	Upper	Mx, My, Fz	TG475	Denton	05/05/2020
		Lower	Mx, My, Fz	AG504	Denton	05/04/2020
Foot Accelerometers	Right	Rear	X	T16437	Endevco	08/11/2020
			Z	T16438	Endevco	08/11/2020
		Front	Z	T22258	Endevco	08/11/2020
	Left	Rear	X	T16441	Endevco	08/11/2020
			Z	T16444	Endevco	08/11/2020
		Front	Z	T16445	Endevco	08/11/2020
Seat Belt Load Cells		Lap		SBG273	FTSS	11/13/2019
		Shoulder		SBG272	FTSS	11/13/2019

TABLE 3 – VEHICLE INSTRUMENTATION

Instrument Location			Axis	Serial Number	Manufacturer	Calibration Date
Crossmember / Rear Seat Accelerometers	Left	Primary	X	A340748	MSI	10/08/2020
			Z	A340753	MSI	09/23/2020
		Redundant	X	A340743	MSI	09/23/2020
	Right	Primary	X	A305699	MSI	06/02/2020
			Z	A337170	MSI	11/12/2020
		Redundant	X	T21426	Endevco	09/09/2020
Engine Accelerometers		Top	X	A305729	MSI	12/30/2020
		Bottom	X	PCB1438	PCB	12/30/2020