REPORT NUMBER: NCAP-MGA-2018-019

NEW CAR ASSESSMENT PROGRAM (NCAP)
Frontal Barrier Impact Test

BAYERISCHE MOTOREN WERKE AG
2018 BMW X1 xDrive28i 5-Door SUV
NHTSA No.: M20184100

MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105

Test Date: November 30, 2017

Final Report Date: January 8, 2018

FINAL REPORT

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

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Approval Date: January 8, 2018

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

_____
COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

Technical Report Documentation Page

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16. Abstract

A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2018 BMW X1 xDrive28i 5-Door SUV in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), and 301 performance. The test was conducted at MGA Research Corporation in Burlington, Wisconsin on November 30, 2017.

The impact velocity of the vehicle was 56.27 km/h and the ambient temperature at the barrier face at the time of impact was 21.7°C. The target vehicle post-test maximum crush was 424mm 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})	N/A	700	328	700	187
Maximum Chest	mm	63	28	52	12
Nij	N/A	1	0.32	1	0.31
Neck Tension	N	4170	1601	2620	777
Neck Compression	N	4000	265	2520	303
Left Femur Force	N	10008	1145	6805	1375
Right Femur Force	N	10008	1463	6805	1193

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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 DTNH22-12-D-00258. 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 Frontal NCAP Laboratory Test Procedure.

SUMMARY

A load cell barrier consisting of 176 load cells was impacted by a 2018 BMW X1 xDrive28i 5-Door SUV at a velocity of 56.27 km/h. The test was performed at MGA Research Corporation on November 30, 2017. Pre-test and post-test photographs of the vehicle and dummies can be found in Appendix A.

Two (2) real-time cameras and fourteen (14) 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 Frontal NCAP Laboratory Test Procedure.

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.

The driver (position 1) ATD (Serial No. 351) and the right-front passenger (position 2) ATD (Serial No. 634) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 630 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 424mm 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 contact 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 (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50^{th})	328	0.32	1601	265	50	28	1145	1463
Passenger (5^{th})	187	0.31	777	303	42	12	1375	1193

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

TEST NOTES

Top of Engine X recorded no valid data after 58ms.
Barrier K-16 My recorded no valid data.
Barrier F-01 Fx recorded no valid data.
Barrier F-01 My recorded no valid data.
Barrier F-01 Mz recorded no valid data.
Barrier C-04 Fx recorded no valid data.
Barrier C-04 My recorded no valid data.
Barrier C-04 Mz recorded no valid data.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	M20184100	Traction Control System (TCS)	Yes
Model Year	2018	Power Steering	Yes
Make	BMW	Power Window Auto-Reverse	Yes
Model	X1 xDrive28i	Driver Frontal Airbag	Yes
Body Style	5-Door SUV	Driver Curtain Airbag	Yes
VIN	WBXHT3C33J5F91601	Driver Head/Torso Airbag	No
Body Color	Mineral Grey Metallic	Driver Torso Airbag	No
Odometer (km/mi)	116km / 72mi	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	8	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	AWD	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	No	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	BAYERISCHE MOTOREN WERKE AG
Date of Manufacture	08/17

GVWR (kg)	2145
GAWR Front (kg)	1120
GAWR Rear (kg)	1080

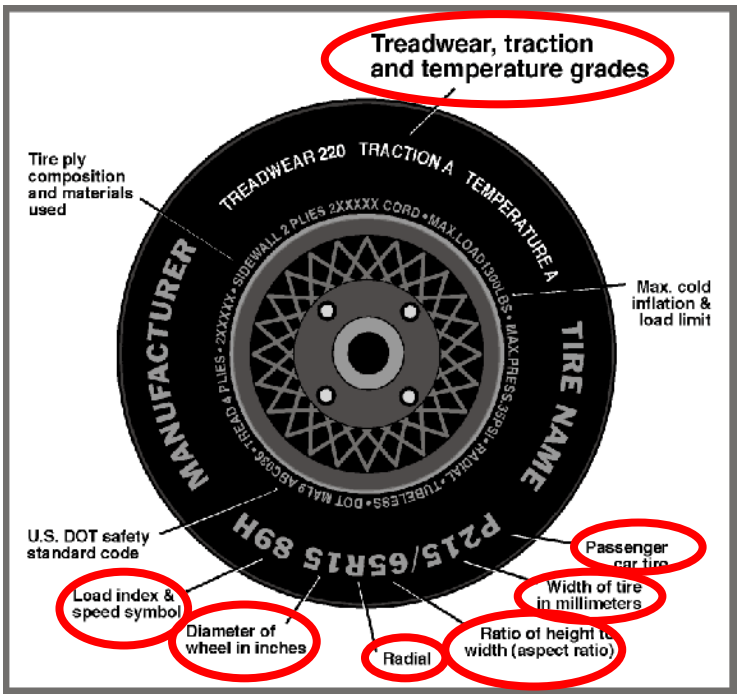
VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Designated Seating Capacity (DSC)	2	3		5
Capacity Weight (VCW) (kg)				408
Cargo Weight (RCLW) (kg)				68

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

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	220	220
Recommended Tire Size	225/50R18	225/50R18
Tire Size on Vehicle	225/50R18	225/50R18
Tire Manufacturer	Goodyear	Goodyear
Tire Model	Eagle	Eagle
Treadwear	400	400
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	1 Polyester, 2 Steel, 1 Polyamide	1 Polyester, 2 Steel, 1 Polyamide
Load Index/Speed Symbol	95V	95V
Tire Material	Rubber	Rubber
DOT Safety Code Left	K578 JNIR 3317	K578 JNIR 3317
DOT Safety Code Right	K578 JNIR 3317	K578 JNIR 3317

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

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	468.5	359.0		506.0	433.5	
Right	kg	472.0	350.5		494.5	419.5	
Ratio	%	57.0%	43.0%		54.0%	46.0%	
Totals	kg	940.5	709.5	1650.0	1000.5	853.0	1853.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1650.0
Weight of 1 P572E ATD & 1 P572O ATD	kg	141
Rated Cargo/Luggage Weight (RCLW)	kg	68
Calculated Test Vehicle Target Weight (TVTW)	kg	1859.0

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	747	748	750	752	1149
As Tested	mm	738	745	723	727	1229
Post Test	mm	761	767	716	733	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2672
Total Vehicle Length at Left Side	mm	4274
Total Vehicle Length at Centerline	mm	4446
Total Vehicle Length at Right Side	mm	4274
Weight of Ballast in Cargo Area	kg	0
Weight of Vehicle Components Removed	kg	28
Amount of Stoddard Solvent in Fuel Tank	L	56.8

List of components removed to meet test weight: Left rear and right rear headrests, cargo area door trim panel, left rear tail light, rear window wiper and motor.

List of components removed for instrumentation, data box, and equipment installation: Cargo area carpet and trim, left rear and right rear floor mats, right rear tail light, left and right C-pillar and D-pillar trims.

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

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

TARGET VEHICLE STRUCTURAL MEASUREMENT

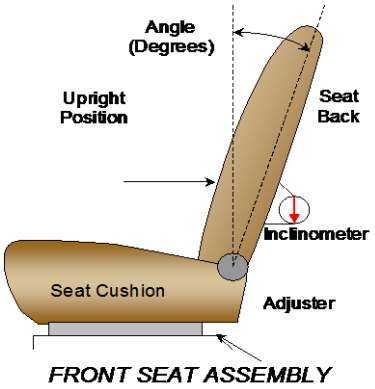
	Elements	Pre-Test (mm)
1	Total Length	4446
2	Total Width	1822
3	Bumper Top Height	554
4	Bumper Bottom Height	452
5	Longitudinal Member Top Height	618
6	Distance between Longitudinal Members	874
7	Longitudinal Member Width	68
8	Engine Top Height	870
9	Engine Bottom Height	197
10	Engine and Gearbox Width	790
11	Front Bumper-Engine Distance	330
12	Front Shock Absorber Fixing Height	898
13	Bonnet Leading Edge Height	840
14	Front Shock Absorber Fixing Width	1235
15	Front Bumper – Front Axle Distance	798
16	Front Axle – A-Pillar Distance	456
17	A-Pillar – B-Pillar Distance	1088
18	B-Pillar – Rear Axle Distance	1141
19	B-Pillar – C-Pillar Distance	696
20	Roof Sill Bottom Height	1424
21	Roof Sill Top Height	1550
22	Floor Sill Bottom Height	188
23	Floor Sill Top Height	370

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

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

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 October 2015.



	Degrees
Driver Seat Back Angle	22.4° on seat back center
Passenger Seat Back Angle	18.1° on seat back center

SEAT FORE/AFT POSITIONS

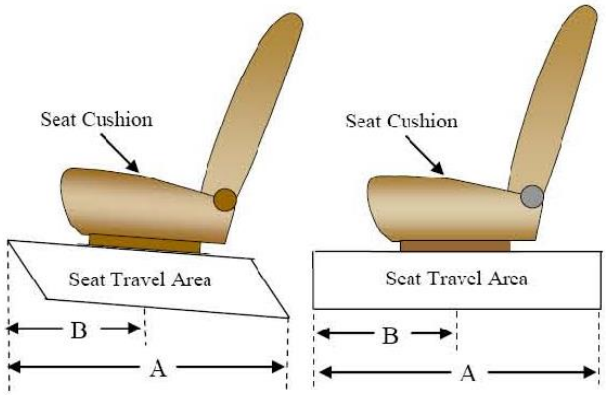
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated October 2015.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	304 mm	152 mm
Passenger Seat	190 mm	0 mm

SEAT BELT UPPER ANCHORAGES

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

	Total # of Positions	Placed in Position #
Driver Seat	Fixed	Fixed
Passenger Seat	Fixed	Fixed



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

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

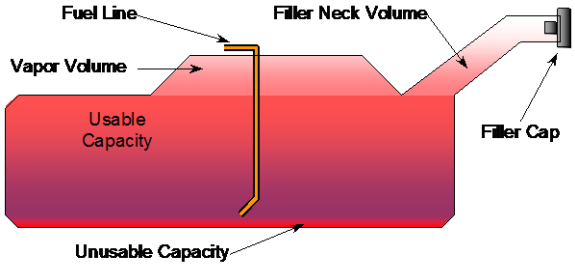
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of "Standard Tank"	60.9
Usable Capacity of "Optional Tank"	
92-94% of Usable Capacity	56.0 to 57.2
Actual Amount of Solvent used	56.8
1/3 of Usable Capacity	20.3

FUEL PUMP

Describe the fuel pump type, its behavior, and the location of the fuel filler pipe.

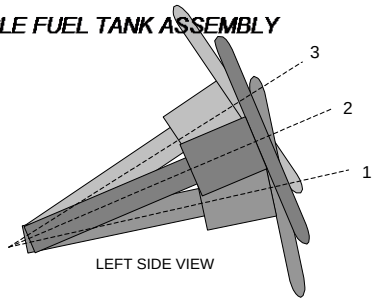
The vehicle is equipped with an electronic fuel pump. Fuel pump starts when ignition is on. The fuel pump will operate for 5 seconds. After pressure has been built up the fuel pump switches to sleep mode until the engine will be started or the pressure decreases. The filler neck is located on the passenger's side.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

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



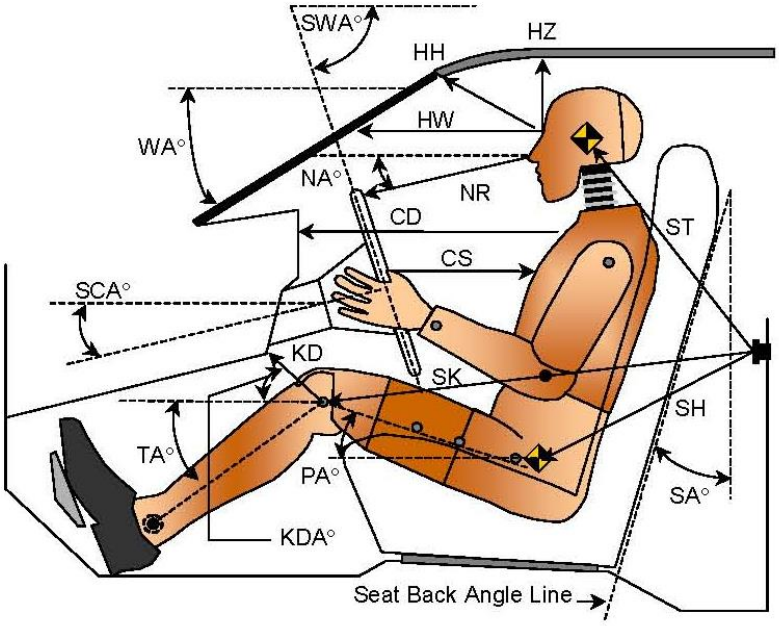
STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITION

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	67.1	170
Geometric Center Position 2	64.8	202
Uppermost Position 3	62.5	233
Telescoping Steering Wheel Travel		63
Test Position	64.8	202

DATA SHEET NO. 3
DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017

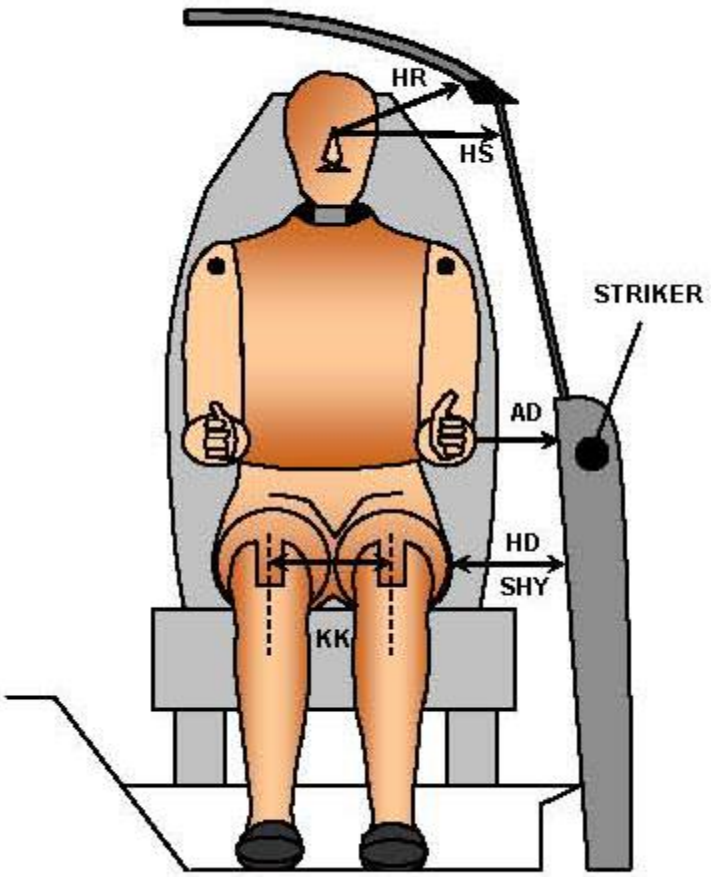


LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		29.0		
SWA°	Steering Wheel Angle		64.8		
SCA°	Steering Column Angle		25.2		
SA°	Seat Back Angle		22.4		18.1
HZ	Head to Roof (Z)	236	90	234	90
HH	Head to Header	366	38.1	323	46.1
HW	Head to Windshield	675	0	662	0
NR	Nose to Rim	420	8.1		
CD	Chest to Dash	547		398	
CS	Chest to Steering Hub	330	0.8		
RA	Rim to Abdomen	212	0		
KDL	Left Knee to Dash	198	41.0	125	28.9
KDR	Right Knee to Dash	147	43.1	127	29.6
PA°	Pelvic Angle		23.2		20.9
TA°	Tibia Angle		46.2		54.0
SK	Striker to Knee	496	96.7	588	99.6
ST	Striker to Head	468	90.4	411	18.2
SH	Striker to H-Point	227	121.3	283	119.9

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017

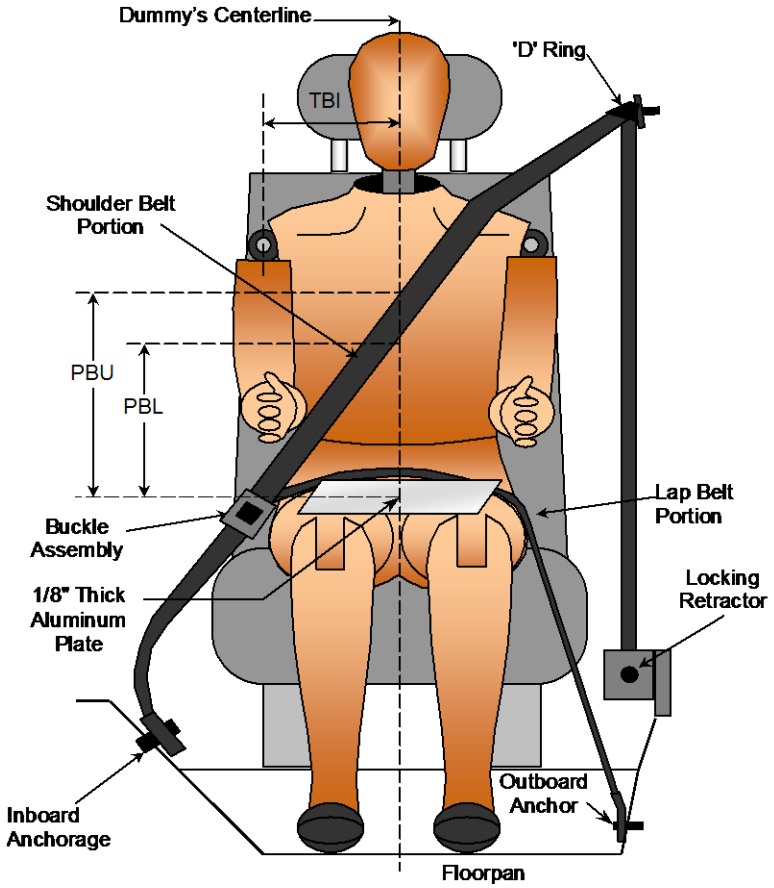


FRONT VIEW OF DUMMY

Code	Measurement Description	Driver	Passenger
		Length (mm)	
AD	Arm to Door	68	117
HD	H-Point to Door	138	167
HR	Head to Side Header	253	283
HS	Head to Side Window	357	385
KK	Knee to Knee	333	227
SHY	Striker to H-Point (Y Direction)	294	315
AA	Ankle to Ankle	303	169

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	340	340
PBL - Top surface of reference to belt lower edge	mm	260	255

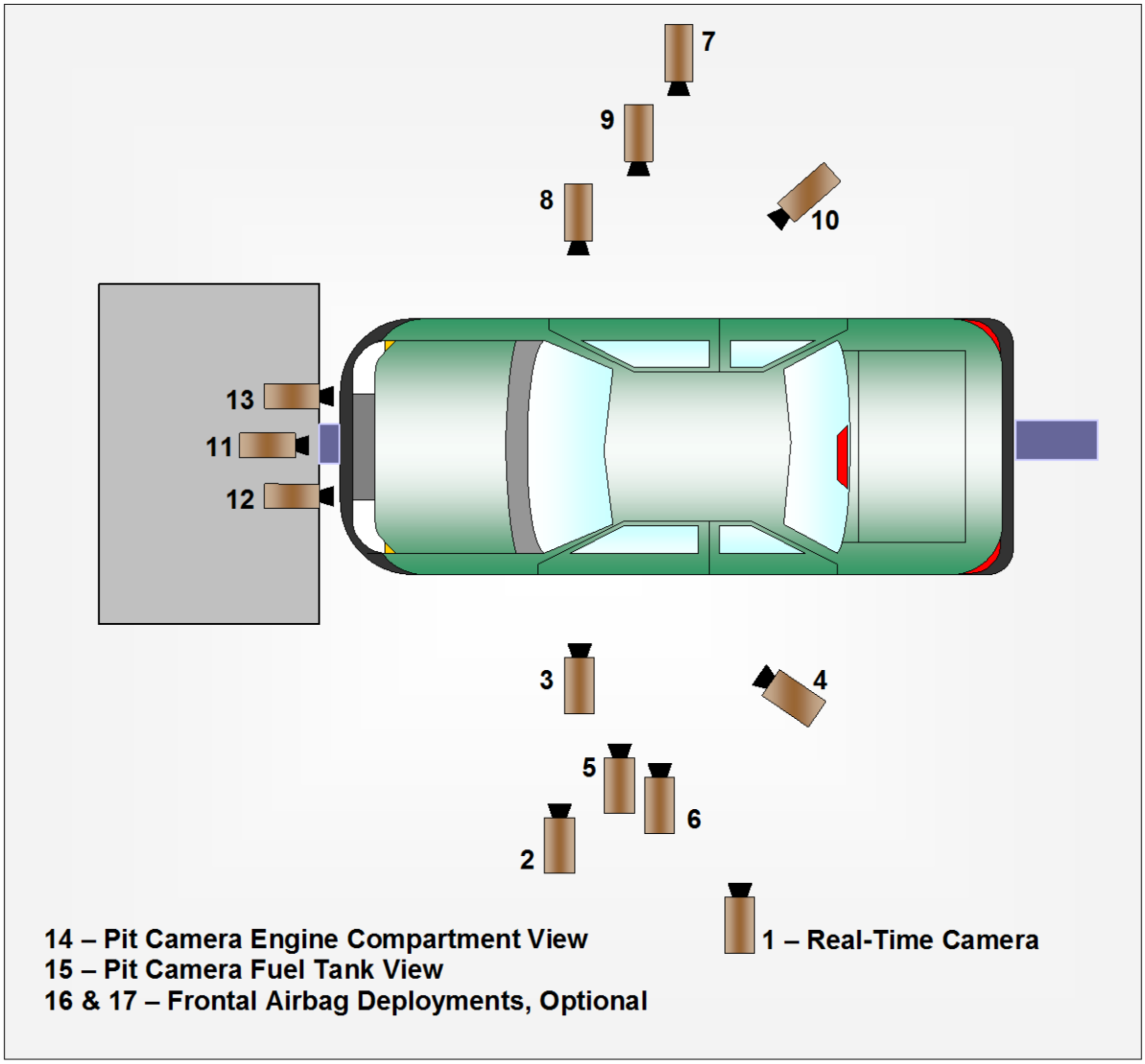
BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	880	925
Lap Belt Length as measured on ATD	mm	565	600
Remainder of belt on reel	mm	1155	1075
Total Belt Length for Continuous Webbing Systems	mm	3400	3400

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

Test Vehicle:	2018 BMW X1 xDrive28i 5-Door SUV	NHTSA No.:	M20184100
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	11/30/2017

CAMERA POSITIONS FOR FRONTAL IMPACTS



DATA SHEET NO. 6 (CONTINUED)
CAMERA LOCATIONS AND DATA

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

CAMERA LOCATIONS

No.	Camera View	Coordinates (mm)			Lens (mm)	Speed (fps)
		X*	Y*	Z*		
1	Real-Time Left Overall					30
2	Driver Close-Up	-1710	-6550	-1960	50	1000
3	Left Front Half	-1120	-5640	-1390	25	1000
4	Left Angle	-6680	-5370	-2040	75	1000
5	Steering Column - Top					
6	Steering Column - Bottom					
7	Right Overall	-1710	6030	-1400	16	1000
8	Passenger Close-Up	-1500	6500	-1970	50	1000
9	Right Front Half	-950	5460	-1360	25	1000
10	Right Angle	-6450	5290	-2060	75	1000
11	Windshield	150	0	-2310	16	1000
12	Driver Windshield	-280	-370	-2230	25	1000
13	Passenger Windshield	240	370	-2230	25	1000
14	Pit Front	-940	0	3340	24	1000
15	Pit Rear	-2950	0	3340	24	1000
16	Onboard Driver Side				12	1000
17	Onboard Passenger Side				12	1000
18	Real-Time Pan View					30

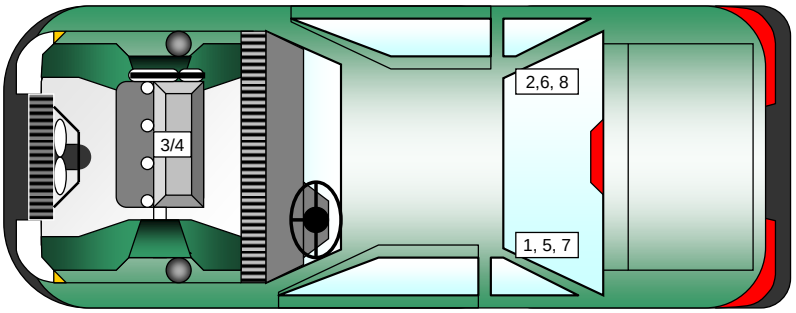
*COORDINATES:

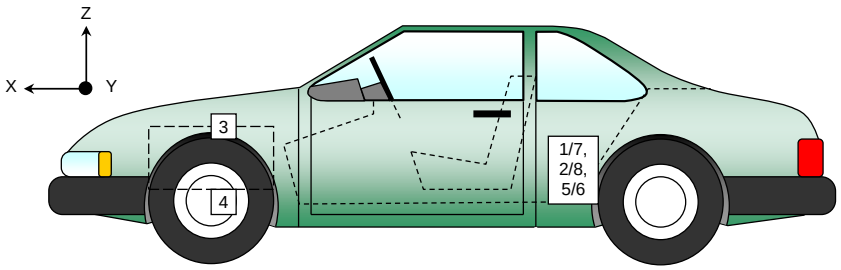
+X = forward of impact plane
+Y = right of monorail centerline
+Z = below ground level

Cameras 5 & 6 were not used for this test.

DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017





VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	1744	-342	-250
2	Right Rear Crossmember Accelerometer – X Direction	1744	352	-250
3	Engine Top X	3734	10	-870
4	Engine Bottom X	3837	0	-194
5	Left Rear Crossmember Accelerometer – Z Direction	1744	-342	-250
6	Right Rear Crossmember Accelerometer – Z Direction	1744	352	-250
7	Left Rear Crossmember Accelerometer Redundant – X Direction	1769	-342	-250
8	Right Rear Crossmember Accelerometer Redundant – X Direction	1769	352	-250

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

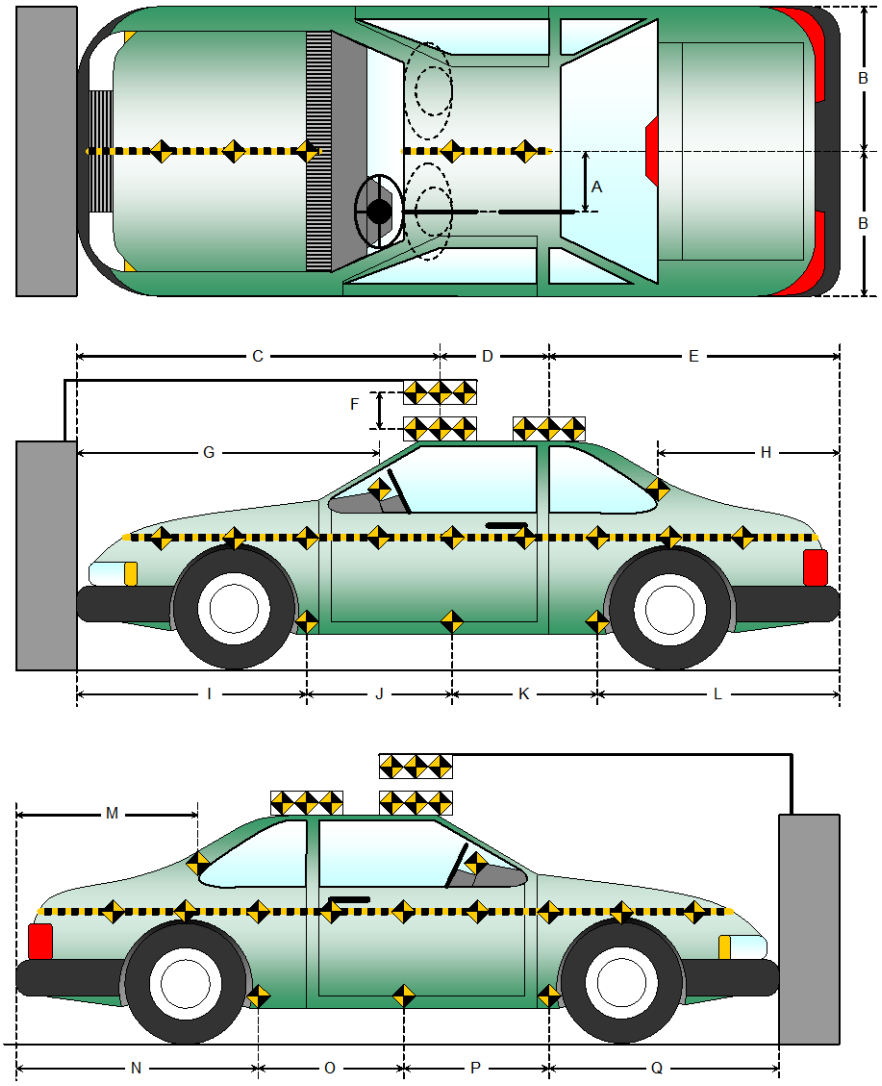
DATA SHEET NO. 8

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: M20184100
Test Date: 11/30/2017

Item	Value (mm)
A	365
B	911
C	2265
D	615
E	1566
F	200
G	
H	1217
I	1292
J	890
K	890
L	1374
M	1217
N	1374
O	890
P	890
Q	1292



DATA SHEET NO. 9
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017

Advanced Research Load Cell Barrier

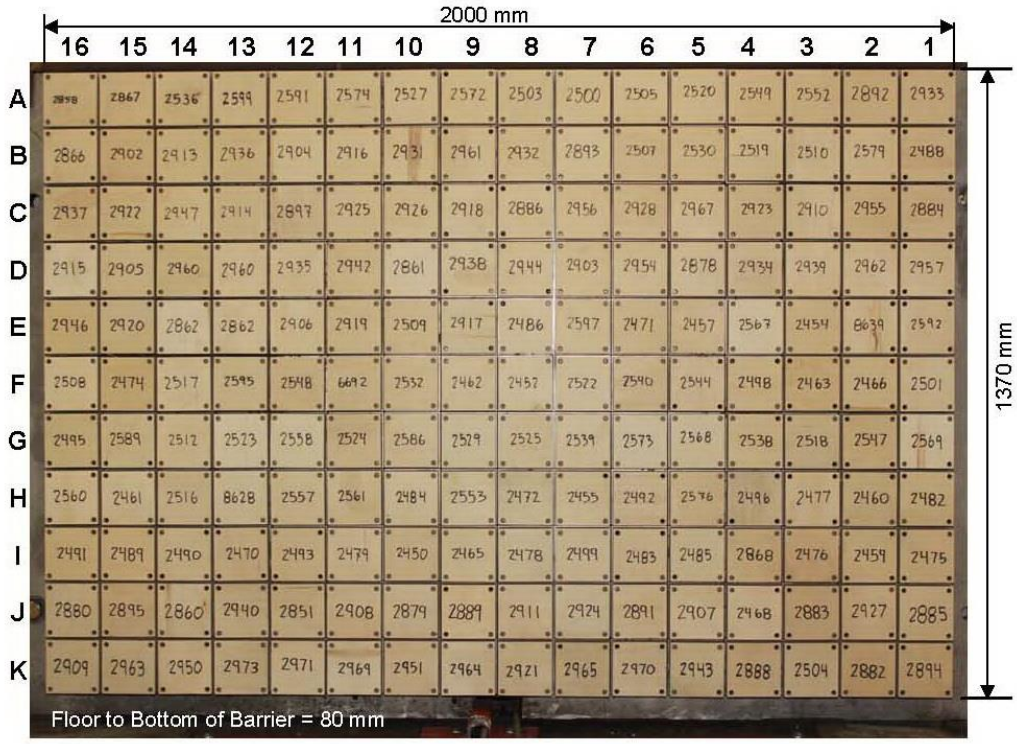


Photo for Reference Only

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: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

INSTRUMENTATION

Driver Dummy Data Channels	47
Passenger Dummy Data Channels	47
Vehicle Structure Accelerometers	8
Barrier Channels	528
Total	630

CAMERA COVERAGE

High-Speed Vehicle Onboard	2
High-Speed Offboard	12
Real-Time	2
Total	16

DATA SHEET NO. 11
POST-TEST OBSERVATIONS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50% / 351	HIII 5% / 634
Head Contact	Airbag, Headrest	Airbag, Headrest
Upper Torso Contact	Airbag	Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Knee Airbag
Right Knee Contact	Knee Airbag	Knee Airbag

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were locked	Doors were locked
Front Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Rear Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Seat Track Shift (mm)	0	0
Seat Back Failure	None	None

POST TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Windshield Damage	Cracked
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

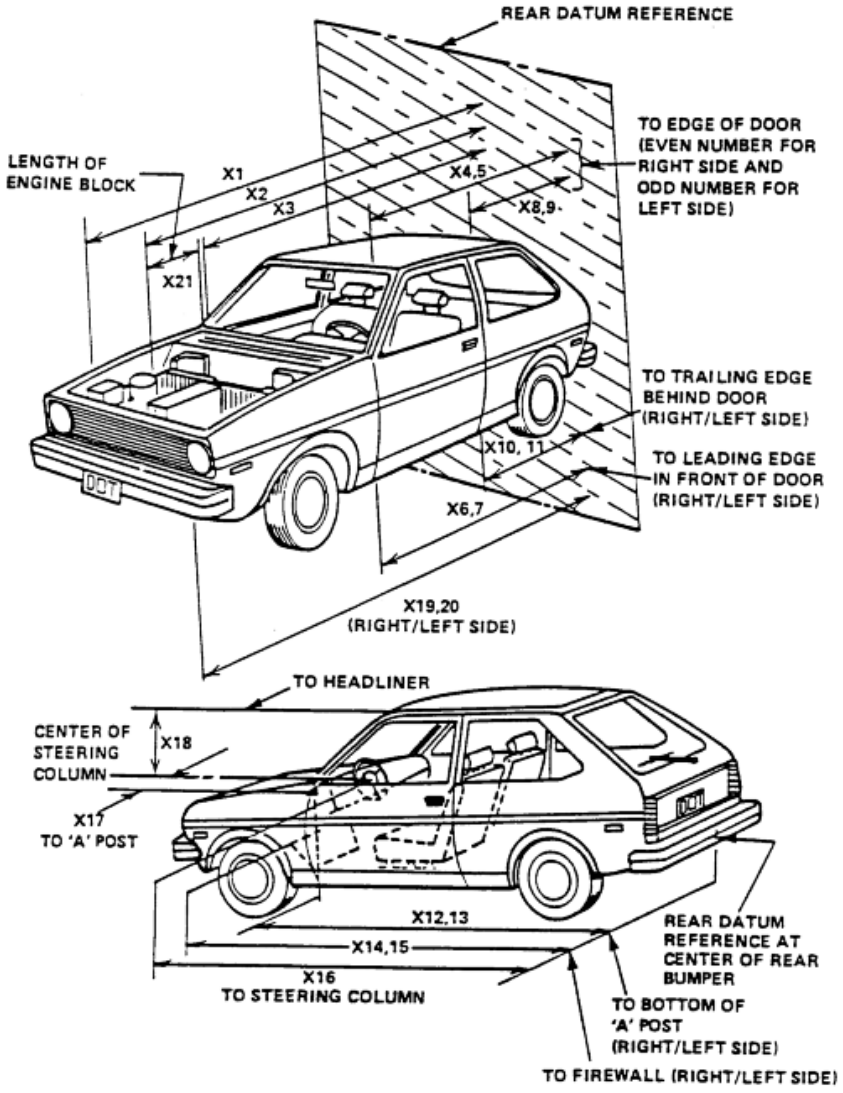
Measured Parameter	Units	Value
Left Side	mm	926
Center	mm	894
Right Side	mm	885
Average	mm	902

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Driver (Occupant 1)		Passenger (Occupant 2)	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	Yes	Yes	Yes
Curtain Side Airbag	Yes	No	Yes	No
Torso/Pelvis Side Airbag	Yes	No	Yes	No
Knee Airbag	Yes	Yes	Yes	Yes
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle:	2018 BMW X1 xDrive28i 5-Door SUV	NHTSA No.:	M20184100
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	11/30/2017



DATA SHEET NO. 12 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

RSOV (Rear Surface of Vehicle)

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	4446	4022	424
2	RSOV to Front of Engine	mm	3958	3664	294
3	RSOV to Firewall	mm	3254	3242	12
4	RSOV to Upper Leading Edge of Right Door	mm	3020	3015	5
5	RSOV to Upper Leading Edge of Left Door	mm	3020	3016	4
6	RSOV to Lower Leading Edge of Right Door	mm	3044	3039	5
7	RSOV to Lower Leading Edge of Left Door	mm	3044	3034	10
8	RSOV to Upper Trailing Edge of Right Door	mm	1995	1989	6
9	RSOV to Upper Trailing Edge of Left Door	mm	1995	1986	9
10	RSOV to Lower Trailing Edge of Right Door	mm	2051	2045	6
11	RSOV to Lower Trailing Edge of Left Door	mm	2051	2041	10
12	RSOV to Bottom of “A” Post of Right Side	mm	3042	3024	18
13	RSOV to Bottom of “A” Post of Left Side	mm	3042	3034	8
14	RSOV to Firewall, Right Side	mm	3211	3201	10
15	RSOV to Firewall, Left Side	mm	3240	3204	36
16	RSOV to Steering Column	mm	2550	2602	-52
17	Center of Steering Column to “A” Post	mm	380	362	18
18	Center of Steering Column to Headliner	mm	450	472	-22
19	RSOV to Right Side of Front Bumper	mm	4274	3970	304
20	RSOV to Left Side of Front Bumper	mm	4274	3952	322
21	Length of Engine Block	mm	490	490	0
RD	RSOV to Right Side of Dash Panel	mm	2878	2859	19
CD	RSOV to Center of Dash Panel	mm	2786	2759	27
LD	RSOV to Left Side of Dash Panel	mm	2863	2868	-5

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

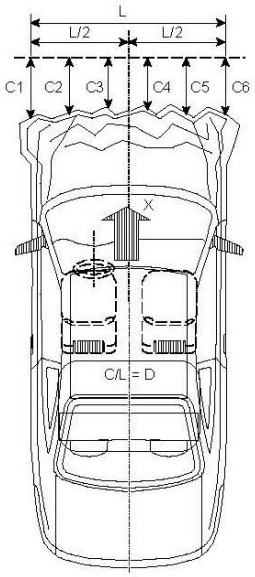
Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

VEHICLE INFORMATION

VIN: WBXHT3C33J5F91601 Wheelbase (mm): 2672
Vehicle Size Category: MPV Test Weight (kg): 1853.5

ACCELEROMETER DATA

Accelerometer Locations: As per measurements on Page 15
Cal. Procedure/Interval: MGA procedure / 6 month
Integration Algorithm: Trapezoidal
Linearity: > 99%
Impact Velocity (km/h): 56.27
Velocity Change (km/h): 64.5
Time of Separation (msec): 87



CRUSH PROFILE

Collision Deformation Classification: 12FDEW2
Midpoint of Damage: Centerline
Damage Region Length (mm): 1410
Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4274	3952	322
C2	Crush zone 2 at left side	mm	4385	3965	420
C3	Crush zone 3 at left side	mm	4418	3994	424
C4	Crush zone 4 at right side	mm	4418	3999	419
C5	Crush zone 5 at right side	mm	4385	3977	408
C6	Crush zone 6 at right side	mm	4274	3970	304
L	C1 TO C6	mm	1410	1399	11

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

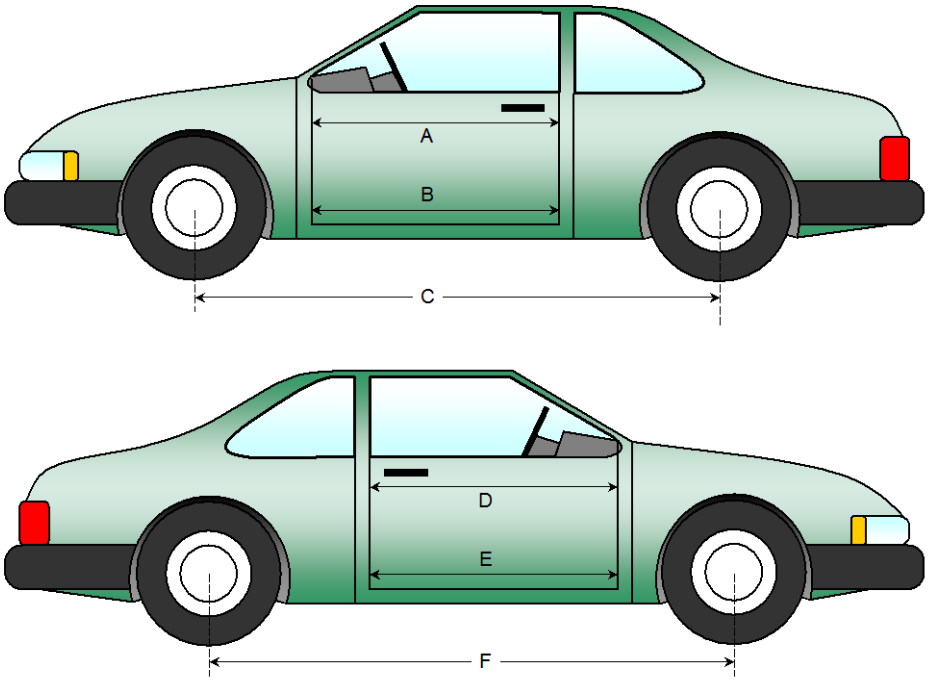
Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	876	876	0
B	Left Side Lower	mm	820	820	0
D	Right Side Upper	mm	876	876	0
E	Right Side Lower	mm	820	820	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2672	2603	69
F	Right Side Wheelbase	mm	2672	2607	65



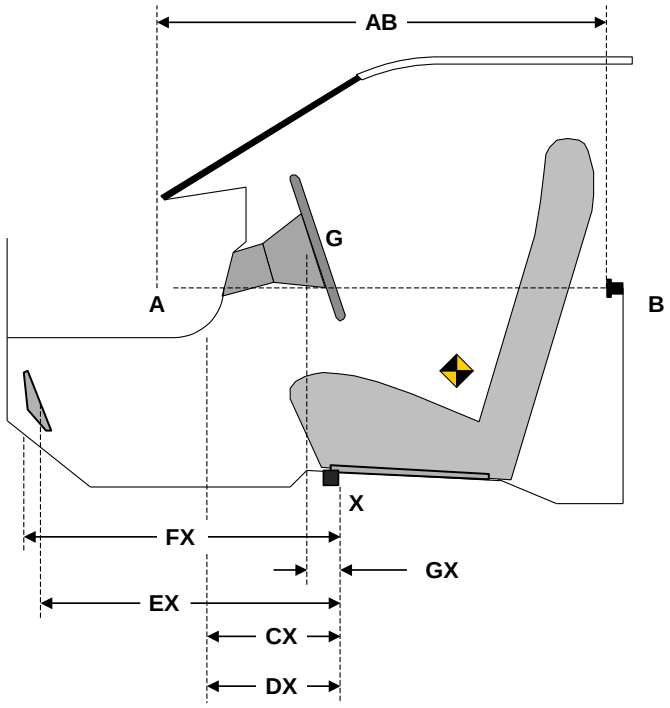
DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	674	674	0
CX	Left Knee Bolster to X	mm	246	240	6
DX	Right Knee Bolster to X	mm	252	241	11
EX	Brake Pedal to X	mm	546	498	48
FX	Foot Rest to X	mm	570	549	21
GX	Center of Steering Column Wheel Hub to X	mm	33	92	-59

X = Front of Seat Track (stationary)



DRIVER COMPARTMENT

DATA SHEET NO. 15
SUMMARY OF FMVSS 212, FMVSS 219 (PARTIAL) DATA, AND 301 DATA

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

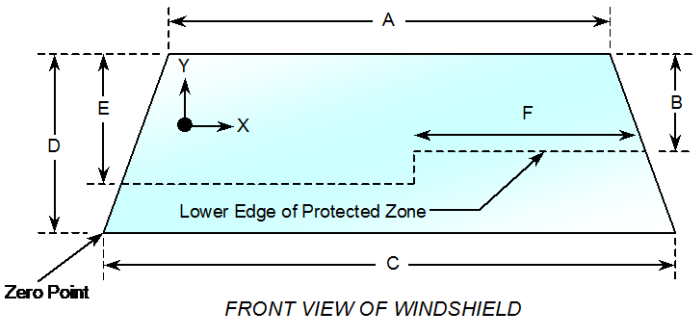
Windshield Mounting Details:
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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

Temperature of windshield molding during test: 21.7° C.

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2169	2169	100.0
Right Side	2169	2169	100.0
Total	4338	4338	100.0



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1222
B	mm	561
C	mm	1454
D	mm	826
E	mm	560
F	mm	549

AREA OF PROTECTED ZONE FAILURES - NONE

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. 15 (CONTINUED)
SUMMARY OF FMVSS 212, FMVSS 219 (PARTIAL), AND 301 DATA

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV NHTSA No.: M20184100
Test Program: NCAP Frontal Barrier Impact Test Test Date: 11/30/2017

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

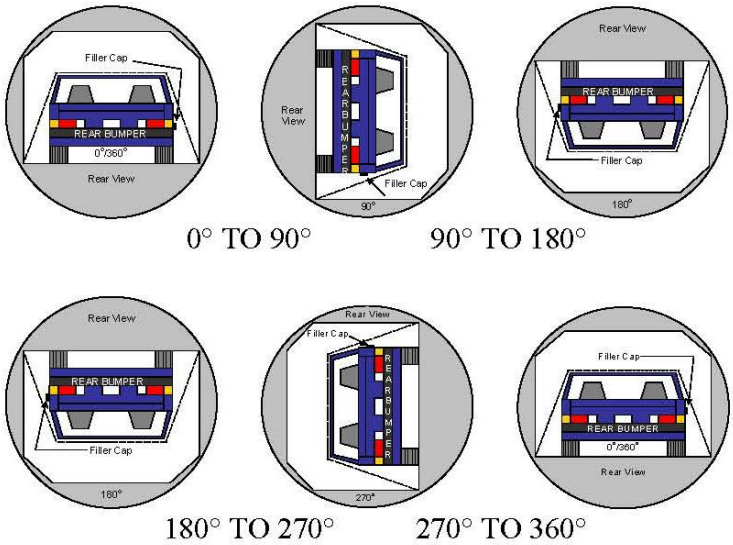
Temperature at Time of Impact: 21.7°C Test Time: 10:25 a.m.

A. From impact until vehicle motion ceases: 0 oz.
(Maximum allowable = 1 oz.)
B. For the 5 minute period after motion ceases: 0 oz.
(Maximum allowable = 5 oz.)
C. For the following 25 minutes: 0 oz.
(Maximum allowable = 1 oz./minute)
D. Spillage: None

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2018 BMW X1 xDrive28i 5-Door SUV
Test Program: NCAP Frontal Barrier Impact Test
NHTSA No.: M20184100
Test Date: 11/30/2017

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°	94	300	394
90° to 180°	92	300	392
180° to 270°	83	300	383
270° to 360°	86	300	386

FMVSS 301 SPILLAGE TABLE (units in ounces)

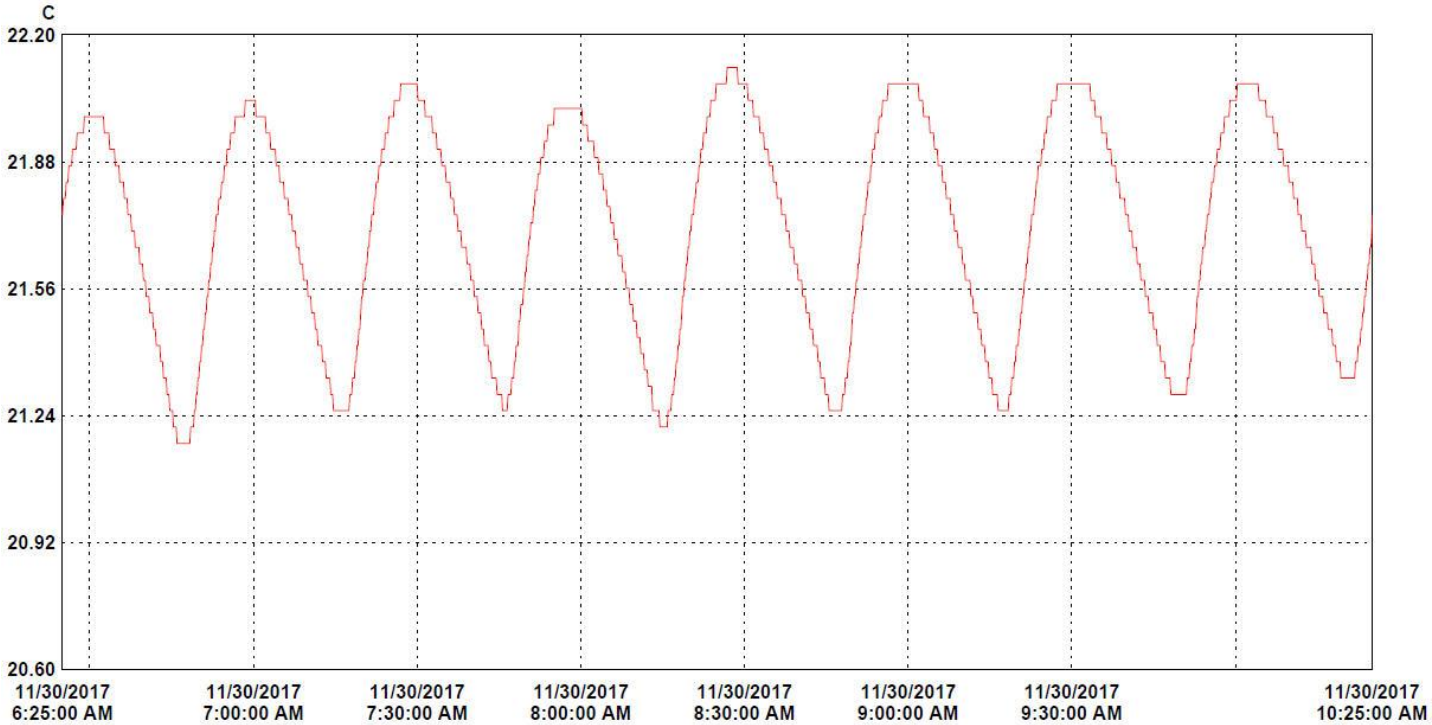
Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eight Minute
0° to 90°	0	0	0	0
90° to 180°	0	0	0	0
180° to 270°	0	0	0	0
270° to 360°	0	0	0	0

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:	2018 BMW X1 xDrive28i 5-Door SUV	NHTSA No.:	M20184100
Test Program:	NCAP Frontal Barrier Impact Test	Test Date:	11/30/2017



LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	17162078	CrashPrep	1		22.12	21.71	21.17	C	Temperature	M20184100 2018 BMW X1 AWD 5-Door SUV NCAP - Temp.spl

APPENDIX A
PHOTOGRAPHS

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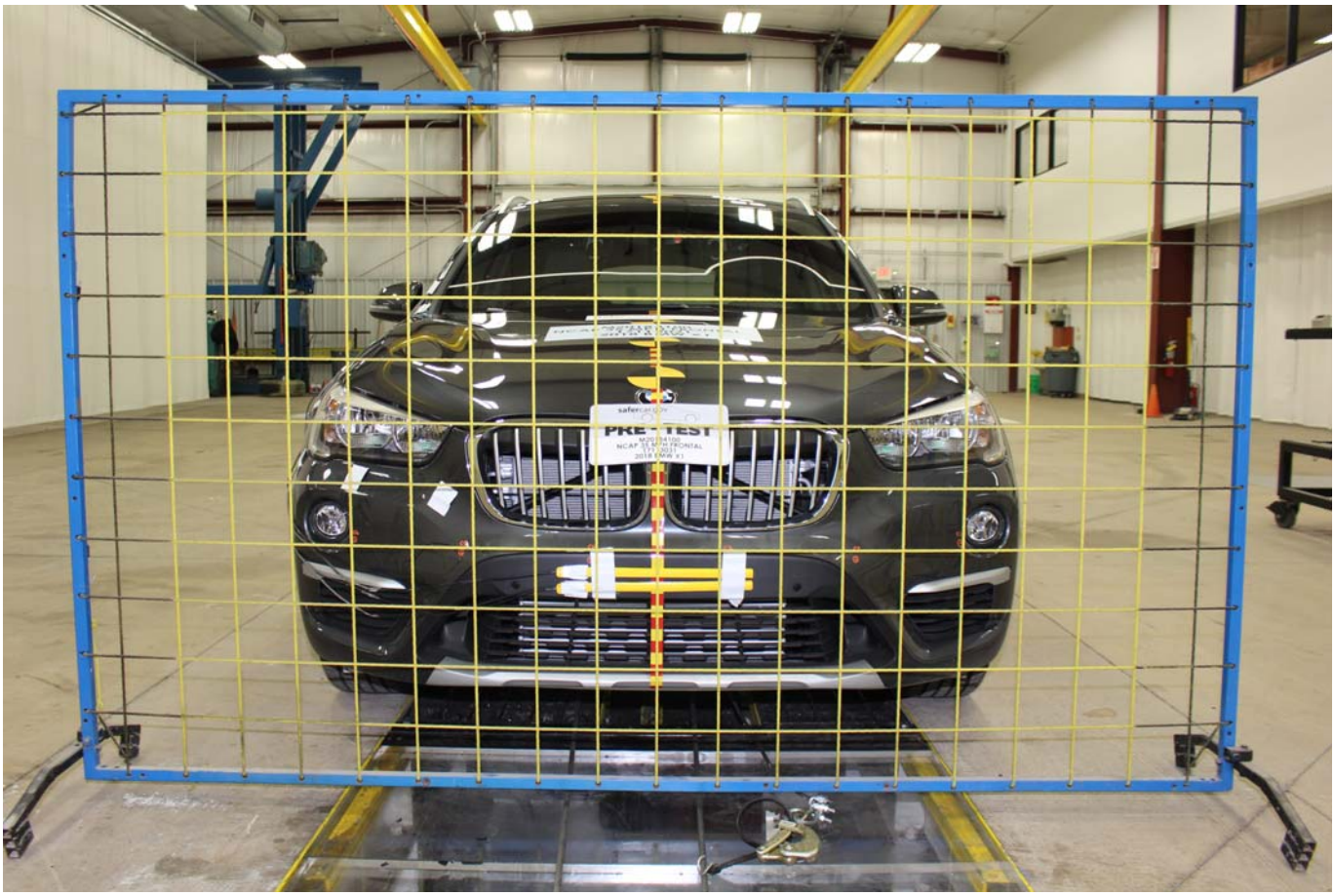

Photo No. 001 - Load Cell Location

Photo No. 002 - Pre-Test Load Cell Wall

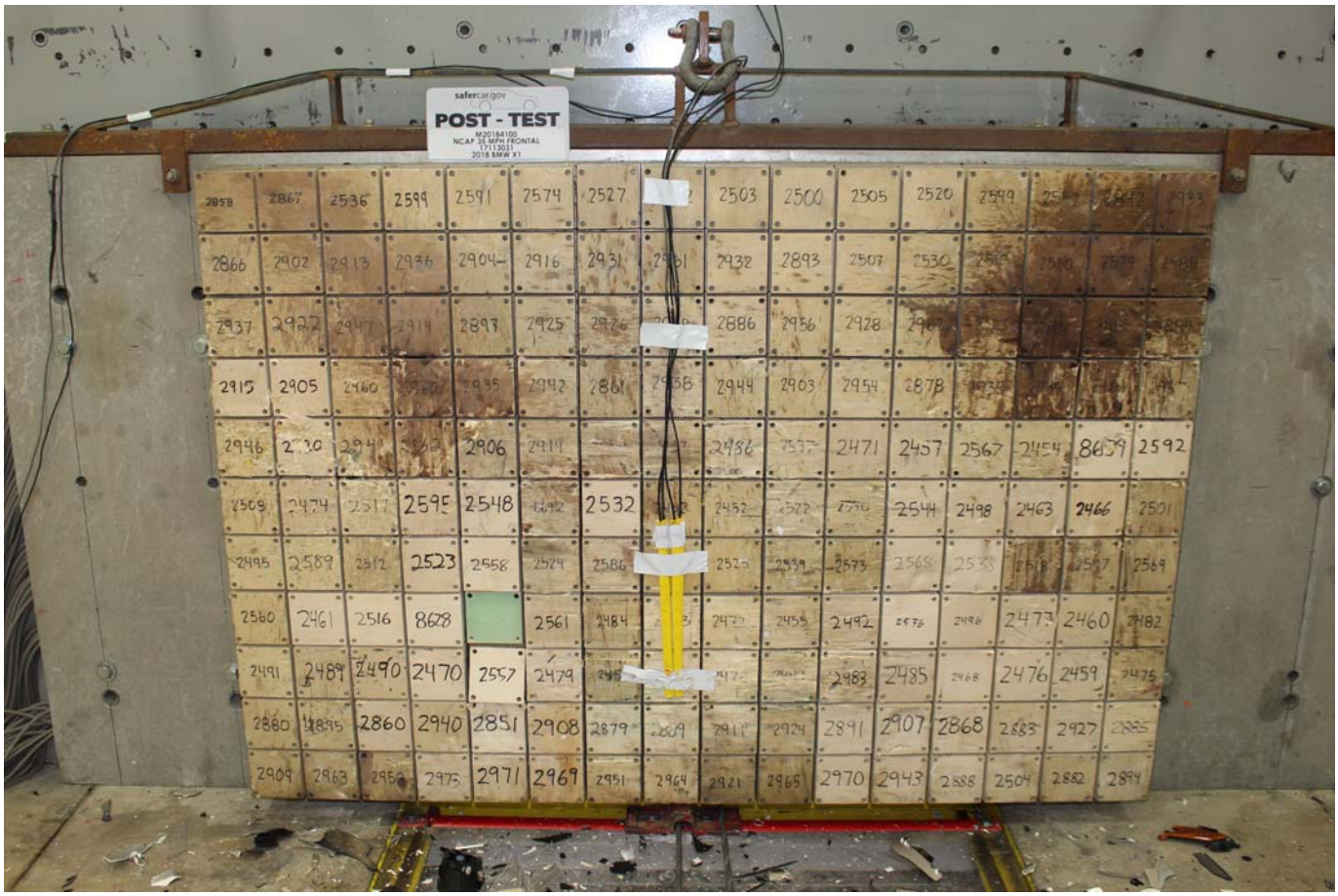

Photo No. 003 - Post-Test Load Cell Wall

Photo No. 004 - Manufacturer Label

Photo No. 005 - Tire Placard


Photo No. 006 - 2018 BMW X1 xDrive28i 5-Door SUV Frontal As Delivered

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

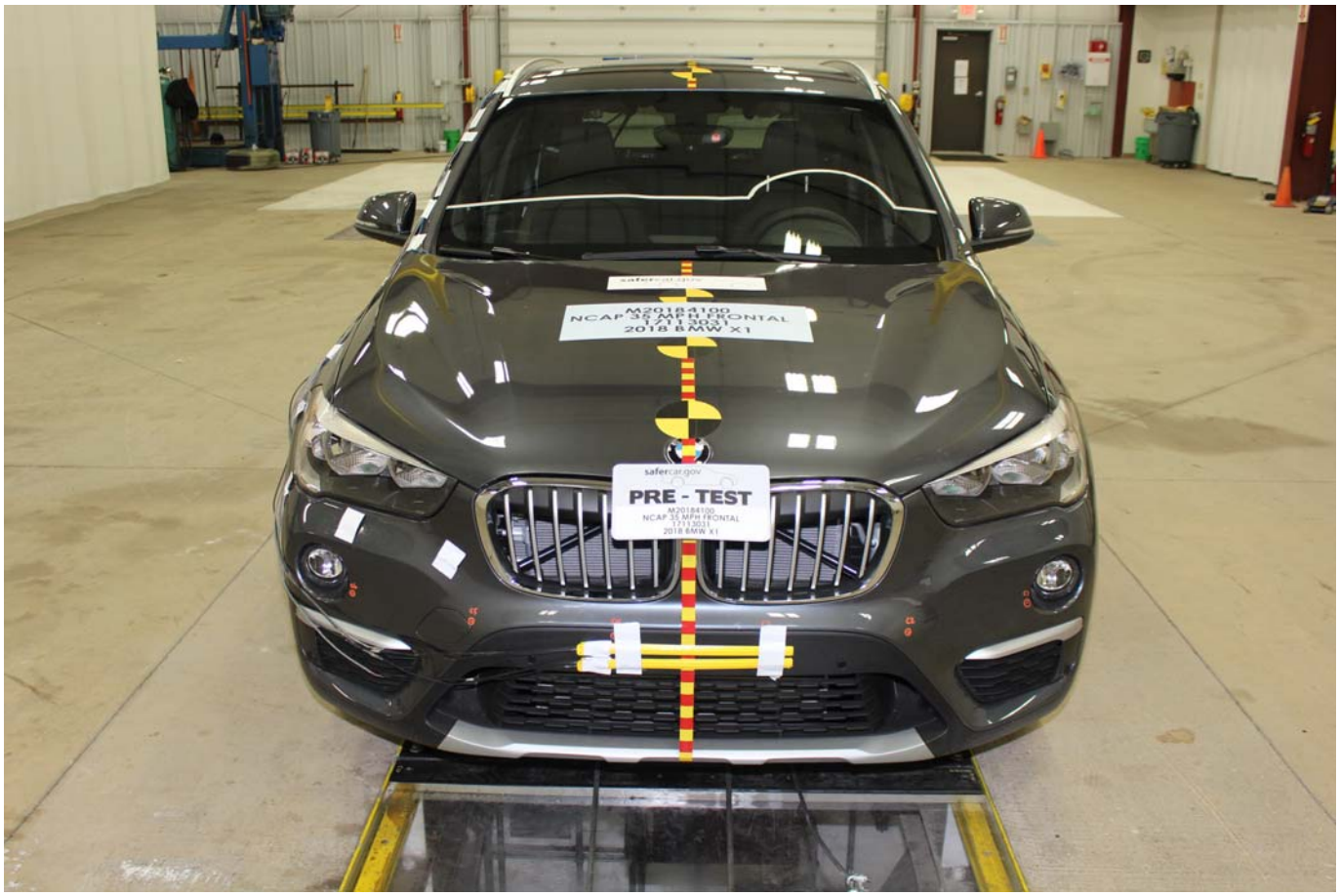

Photo No. 008 - Pre-Test Front View of Test Vehicle

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

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

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

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

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

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

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

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

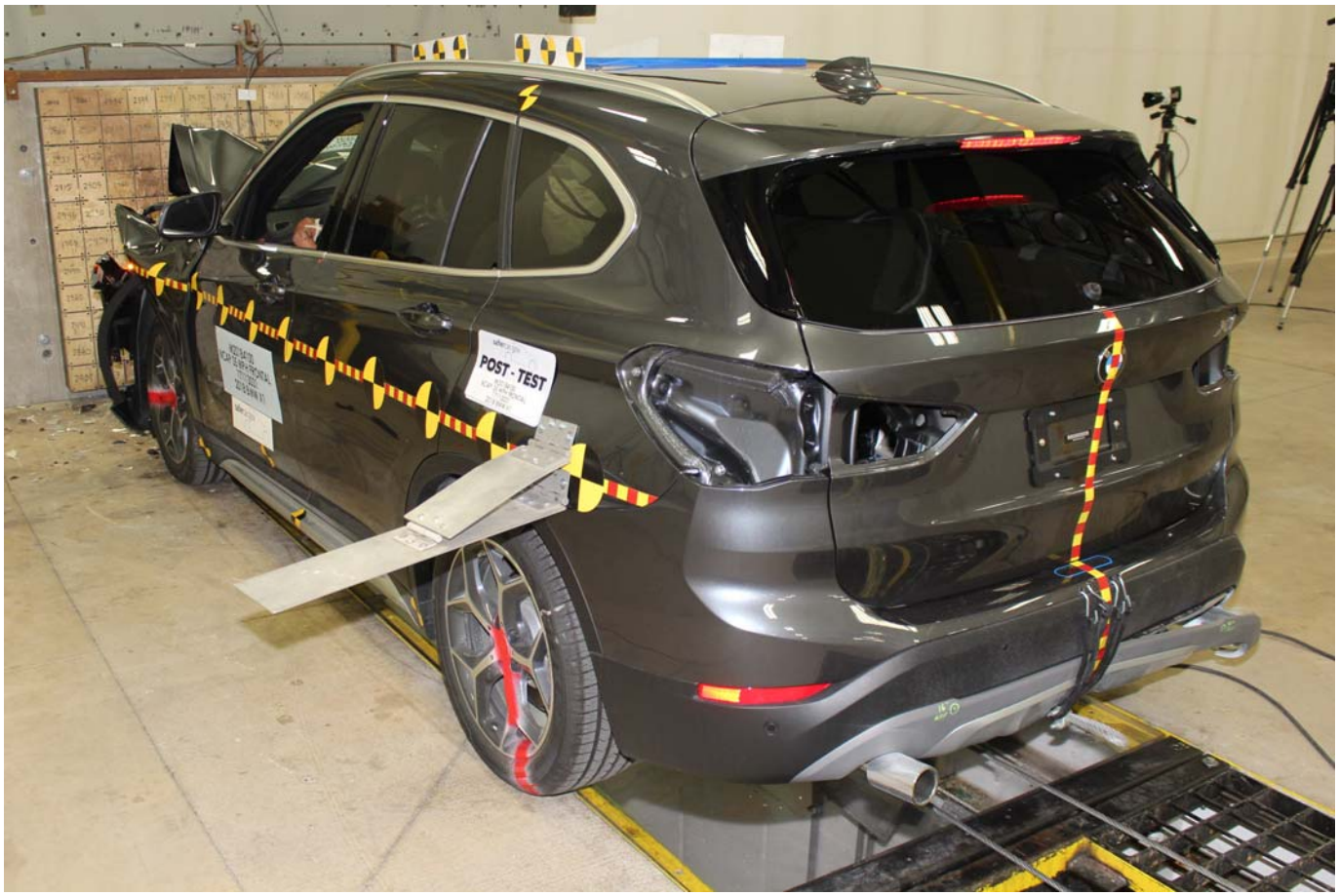

Photo No. 017 - Post-Test Left Rear 3-4 View

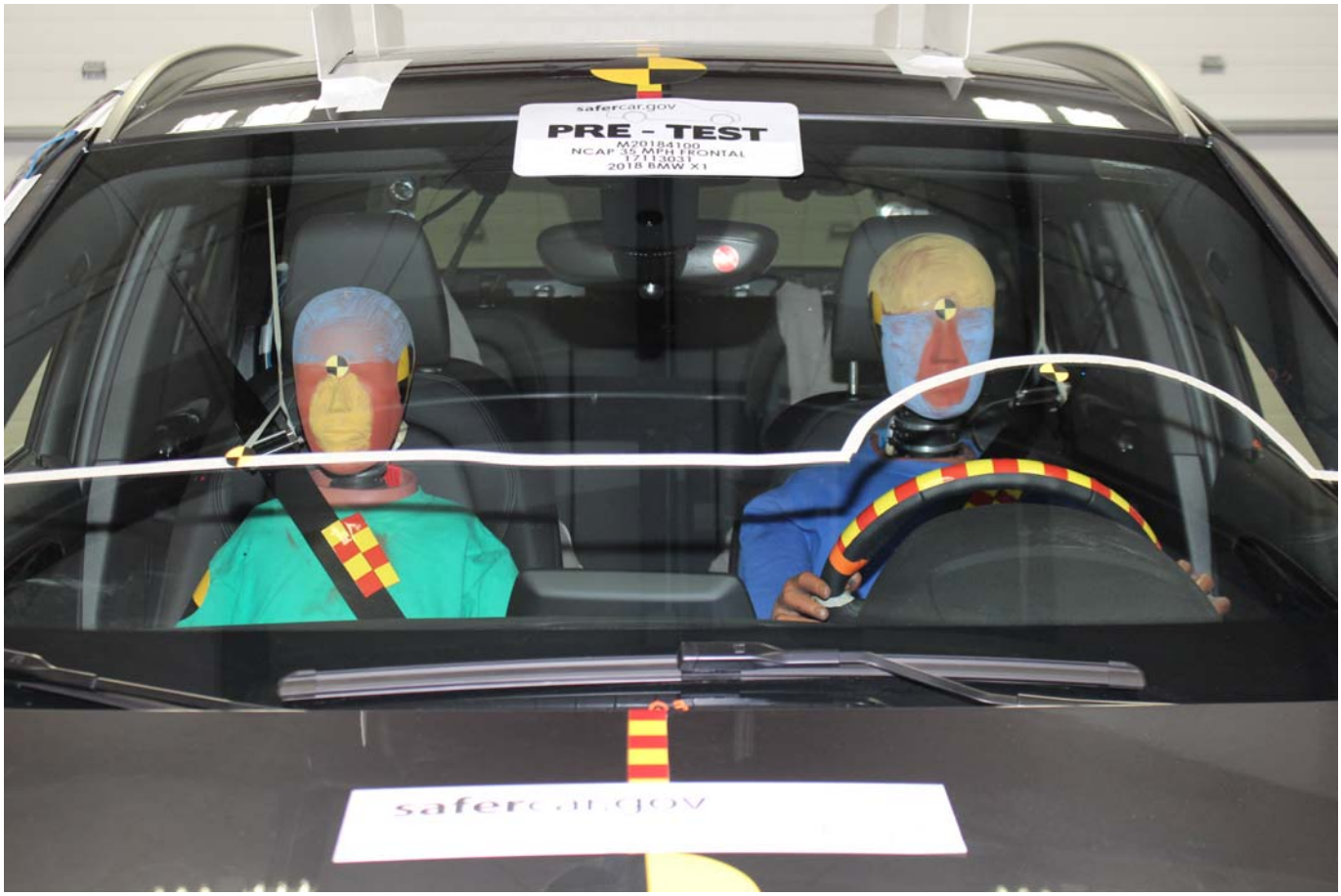

Photo No. 018 - Pre-Test Windshield View

Photo No. 019 - Post-Test Windshield View

Photo No. 020 - Pre-Test Engine Compartment View

Photo No. 021 - Post-Test Engine Compartment View

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

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

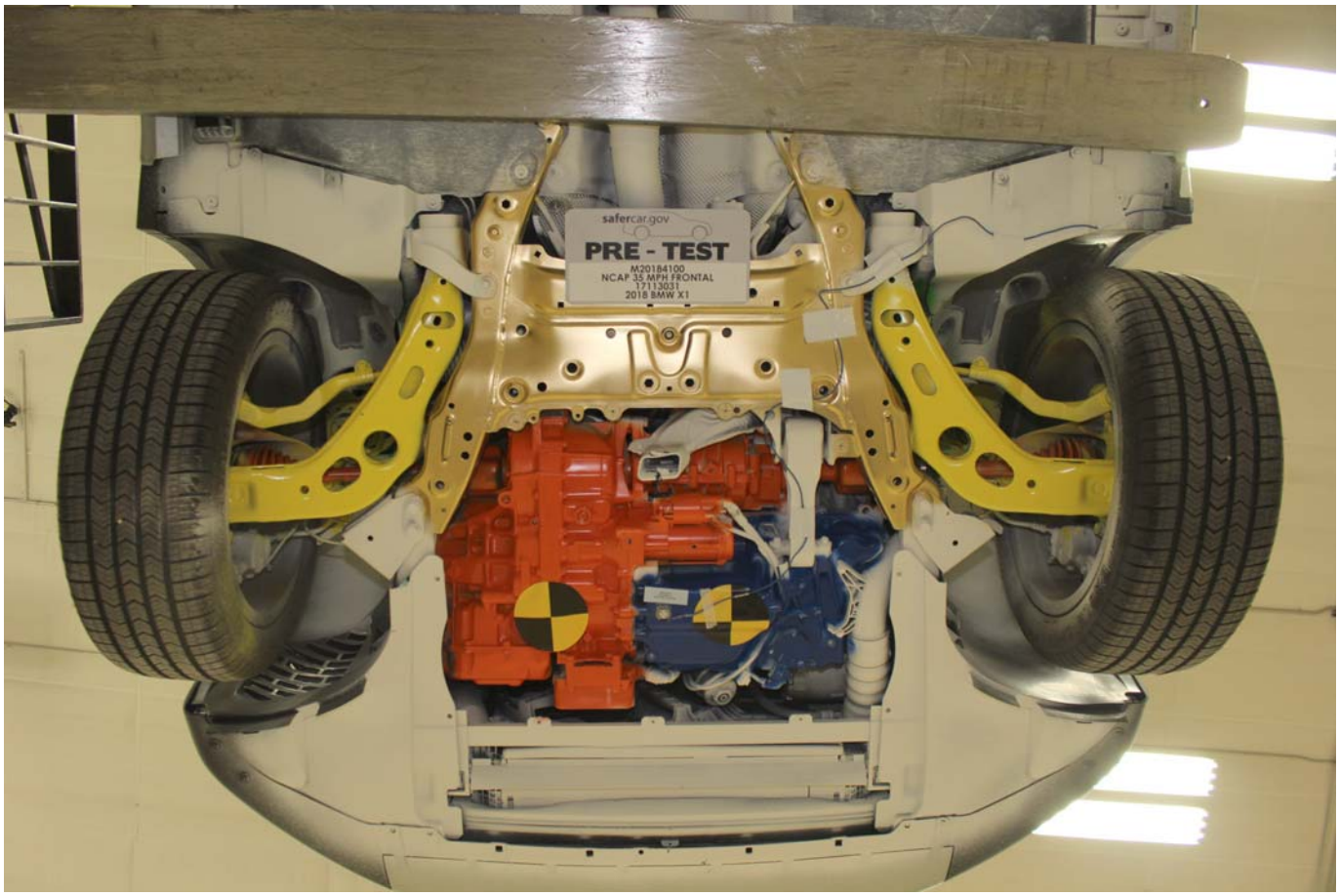

Photo No. 024 - Pre-Test Front Underbody View

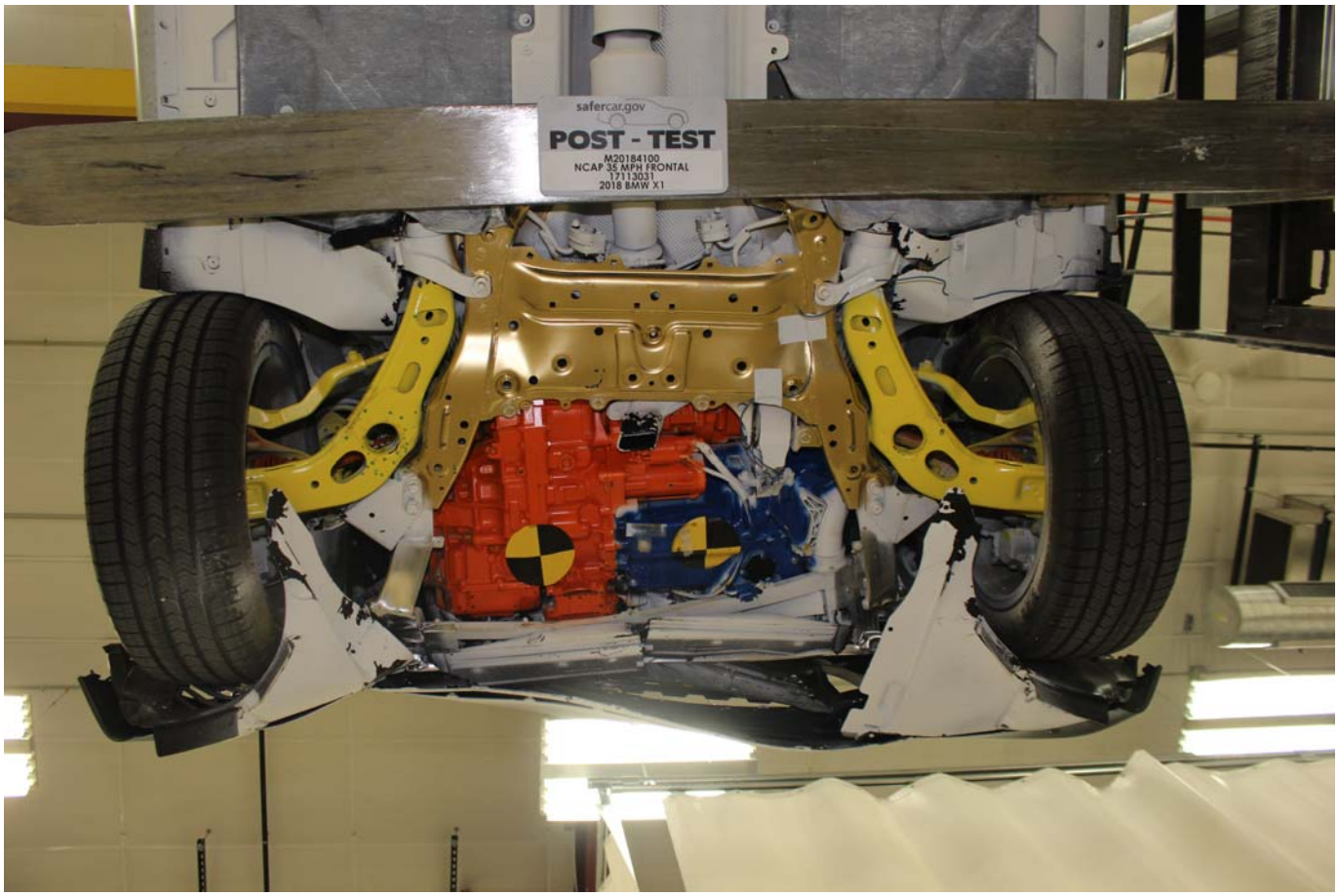

Photo No. 025 - Post-Test Front Underbody View

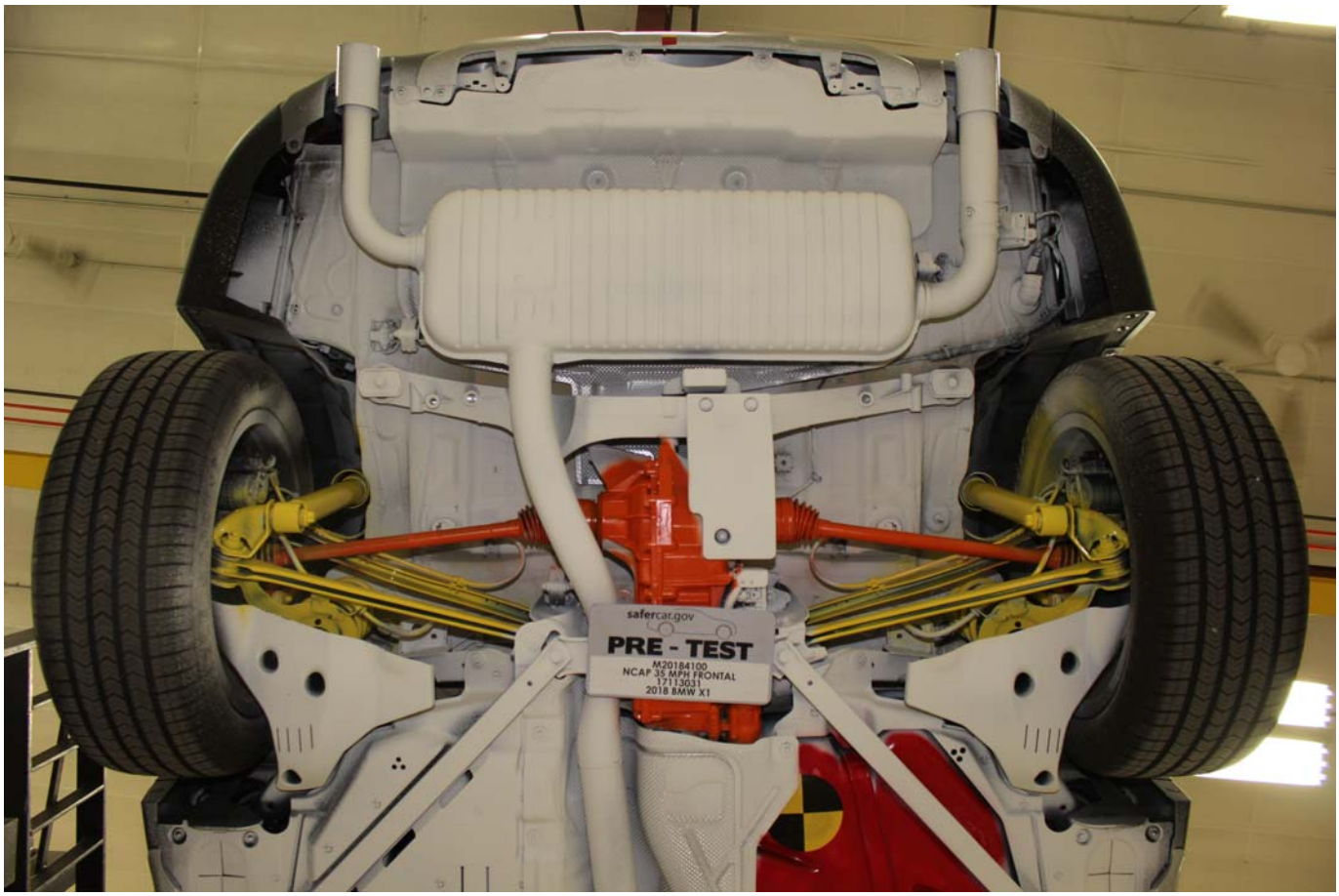

Photo No. 026 - Pre-Test Rear Underbody View

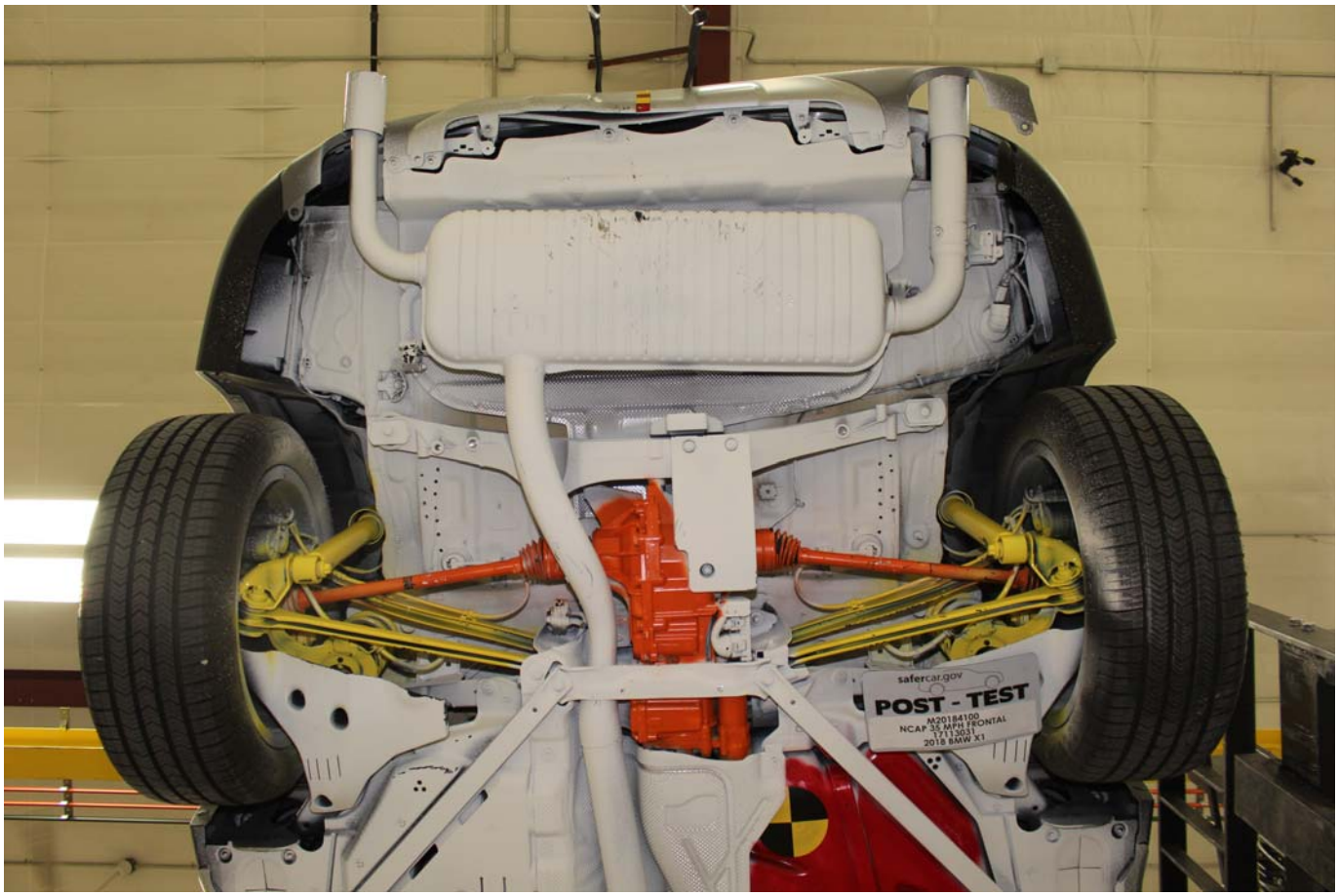

Photo No. 027 - Post-Test Rear Underbody View

Photo No. 028 - Pre-Test Dummy Cable Routing

Photo No. 029 - Post-Test Dummy Cable Routing

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

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

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

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

Photo No. 034 - Pre-Test Driver Dummy and Vehicle Interior (Door Open)

Photo No. 035 - Post-Test Driver Dummy and Vehicle Interior (Door Open)

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 Driver Dummy Feet

Photo No. 041 - Post-Test Driver Dummy Feet

Photo No. 042 - Pre-Test Driver Side Knee Bolster (without dummy)

Photo No. 043 - Post-Test Driver Side Knee Bolster (without dummy)

Photo No. 044 - Pre-Test Driver Side Floorpan

Photo No. 045 - Post-Test Driver Side Floorpan

Photo No. 046 - Post-Test Driver Dummy Face

Photo No. 047 - Post-Test Driver Dummy Contact with Airbag

Photo No. 048 - Post-Test Driver Dummy Contact with Headrest

Photo No. 049 - Pre-Test View of the Steering Wheel

Photo No. 050 - Post-Test View of the Steering Wheel

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Photo No. 052 - Post-Test Passenger Dummy Front View

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

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

Photo No. 055 - Pre-Test Passenger Dummy and Vehicle Interior (Door Open)

Photo No. 056 - Post-Test Passenger Dummy and Vehicle Interior (Door Open)

Photo No. 057 - Pre-Test Passenger Seat Fore-Aft Markings

Photo No. 058 - Post-Test Passenger Seat Fore-Aft Markings

Photo No. 059 - Pre-Test View of Belt Anchorage for Passenger Dummy

Photo No. 060 - Post-Test View of Belt Anchorage for Passenger Dummy

Photo No. 061 - Pre-Test Passenger Dummy Feet

Photo No. 062 - Post-Test Passenger Dummy Feet

Photo No. 063 - Pre-Test Passenger Side Knee Bolster (without dummy)

Photo No. 064 - Post-Test Passenger Side Knee Bolster (without dummy)

Photo No. 065 - Pre-Test Passenger Side Floorpan

Photo No. 066 - Post-Test Passenger Side Floorpan

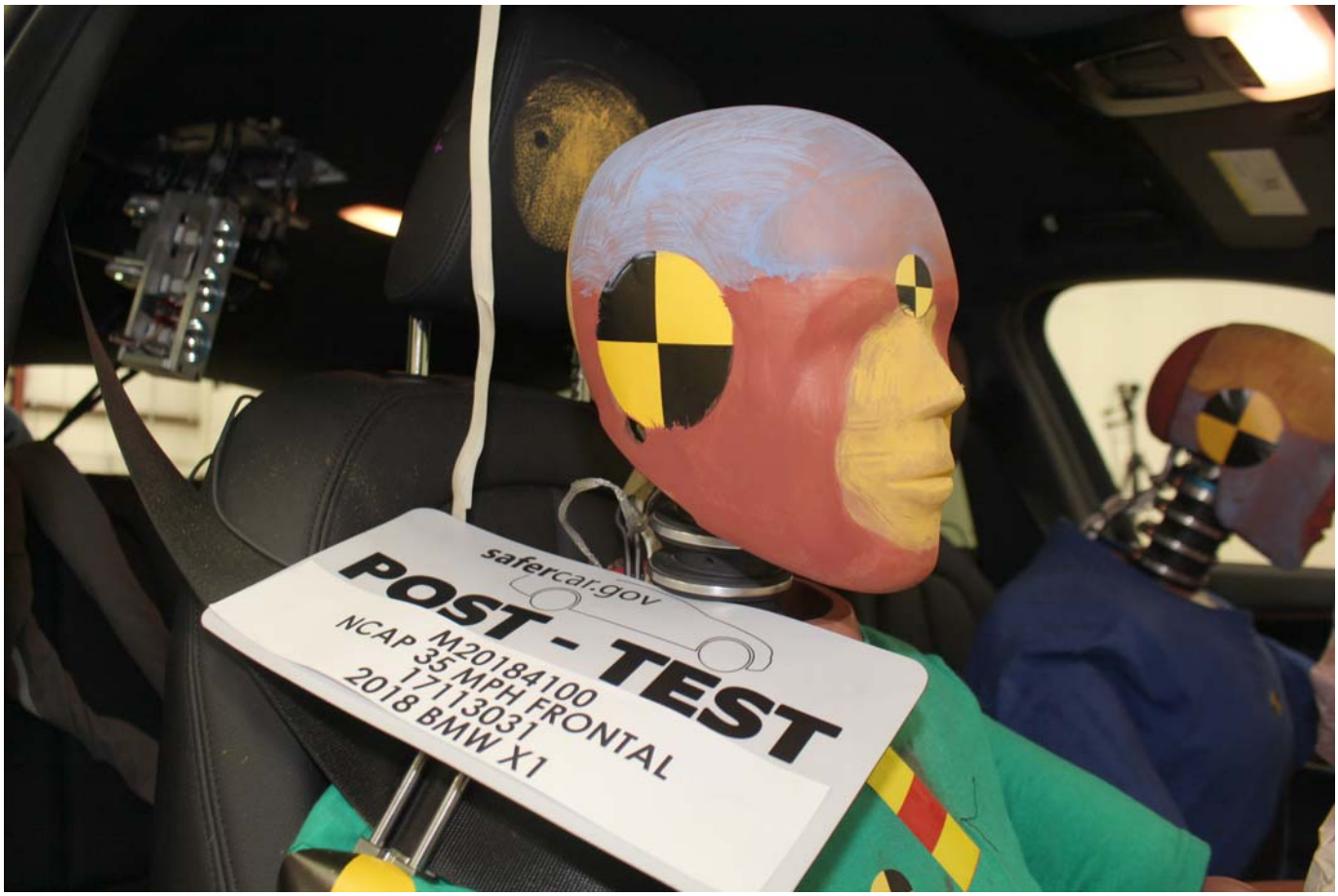


Photo No. 067 - Post-Test Passenger Dummy Face

Photo No. 068 - Post-Test Passenger Dummy Contact with Airbag

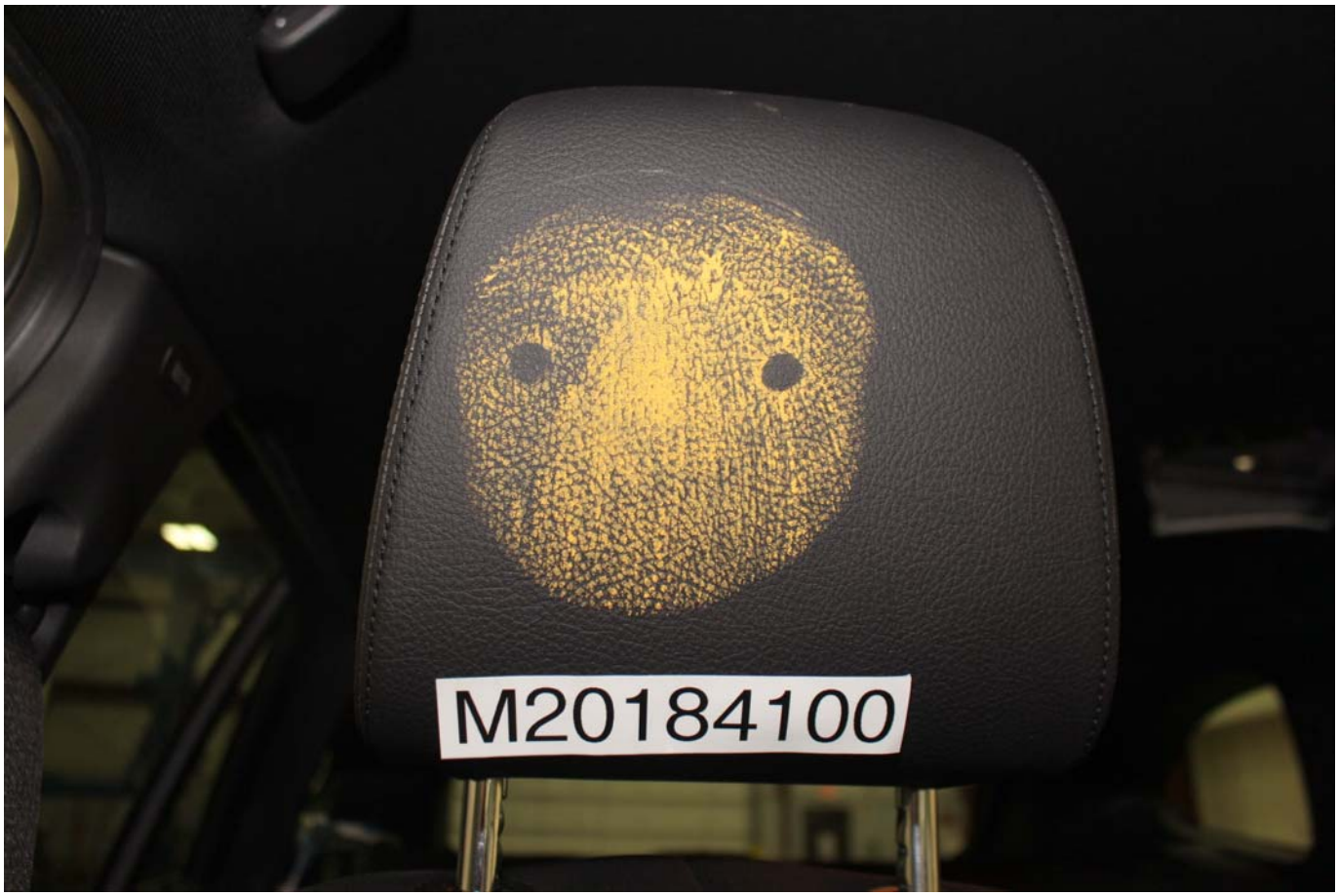


Photo No. 069 - Post-Test Passenger Dummy Contact with Headrest

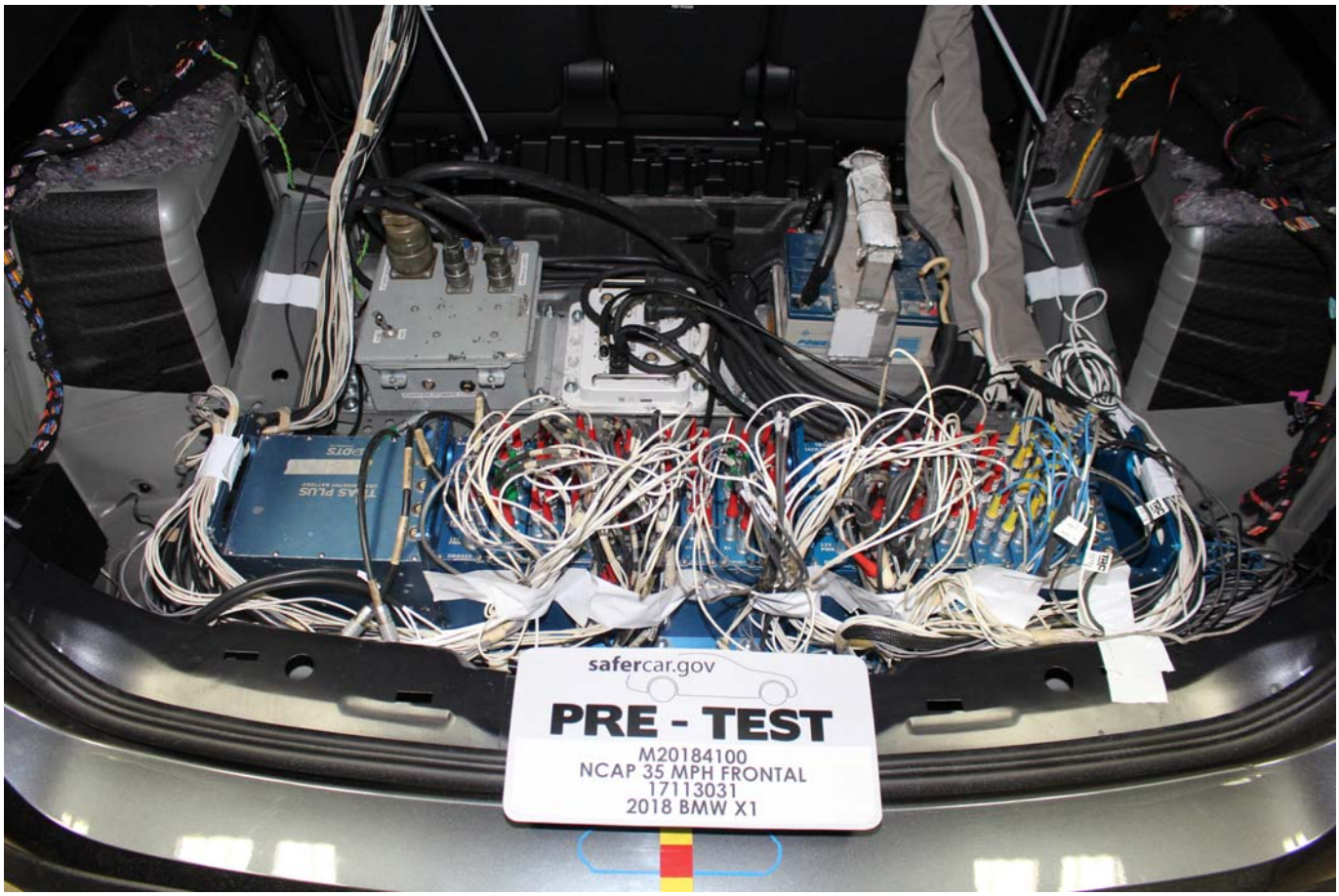


Photo No. 070 - Ballast Installed in Vehicle

PHOTOGRAPH NOT APPLICABLE

Photo No. 071 - Post-Test Stoddard Solvent Spillage Location View

Photo No. 072 - Post-Test Speed Trap Read-Out

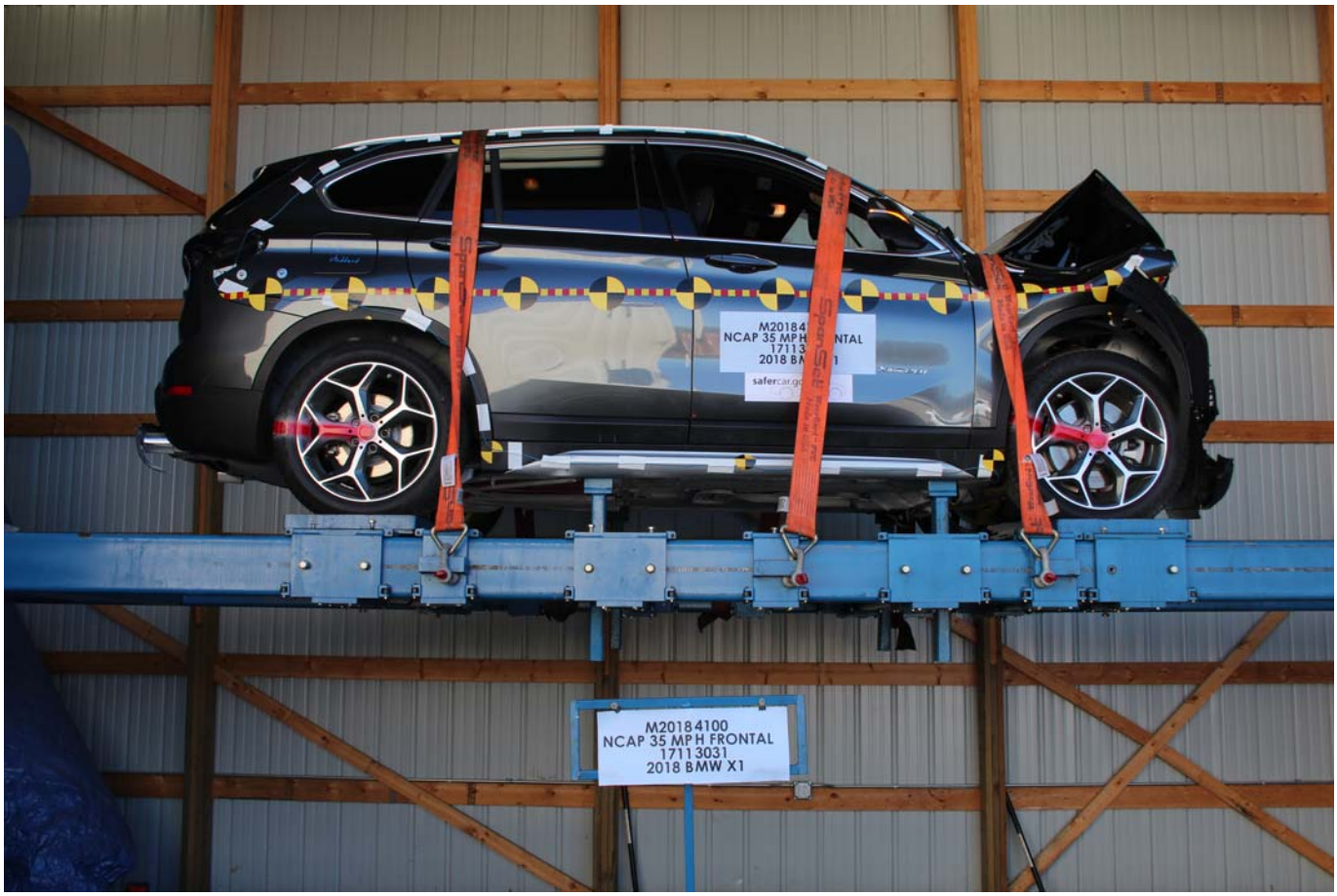


Photo No. 073 - Vehicle at 0 Degree on Static Rollover Device

Photo No. 074 - Vehicle at 90 Degrees on Static Rollover Device

Photo No. 075 - Vehicle at 180 Degrees on Static Rollover Device

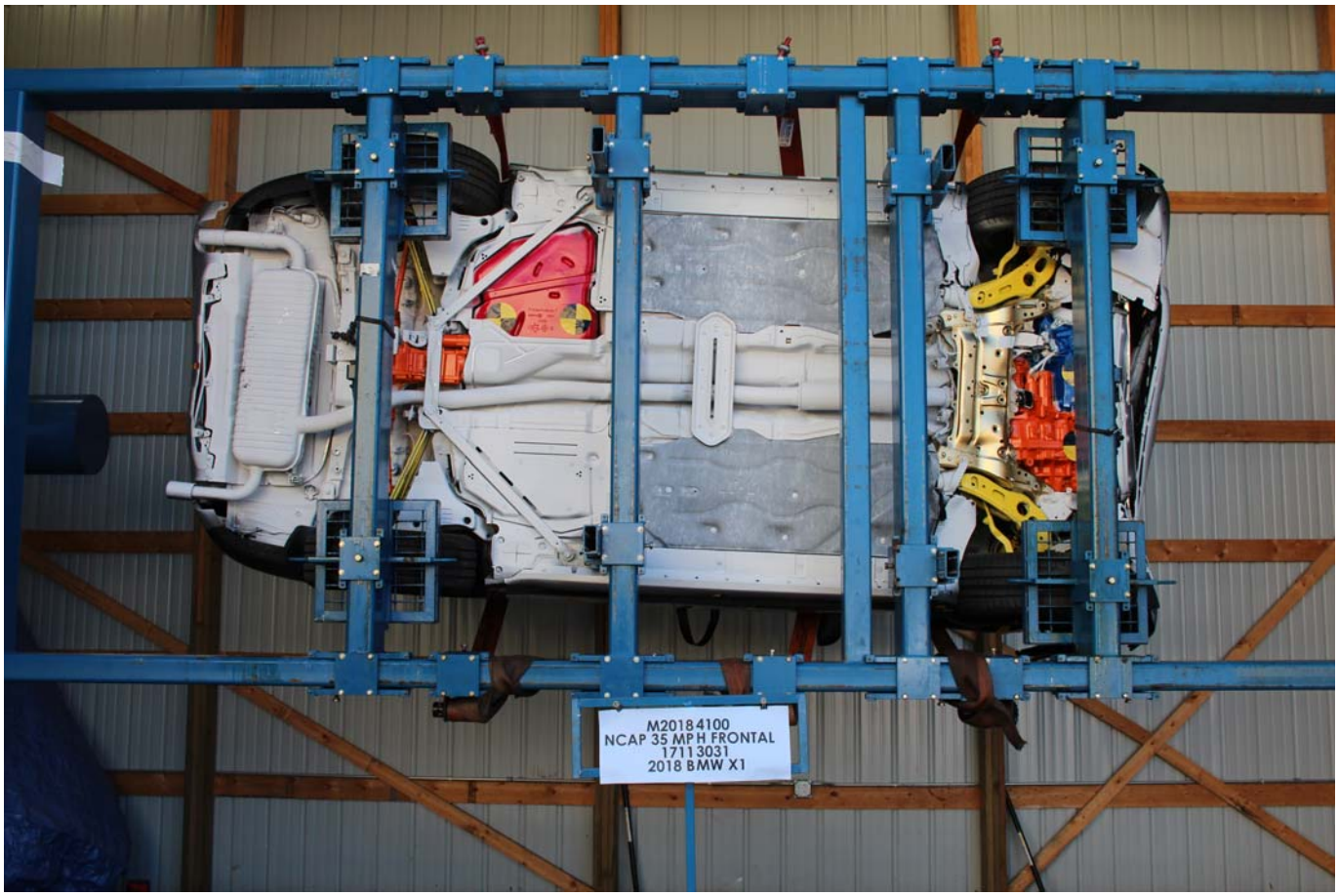


Photo No. 076 - Vehicle at 270 Degrees on Static Rollover Device

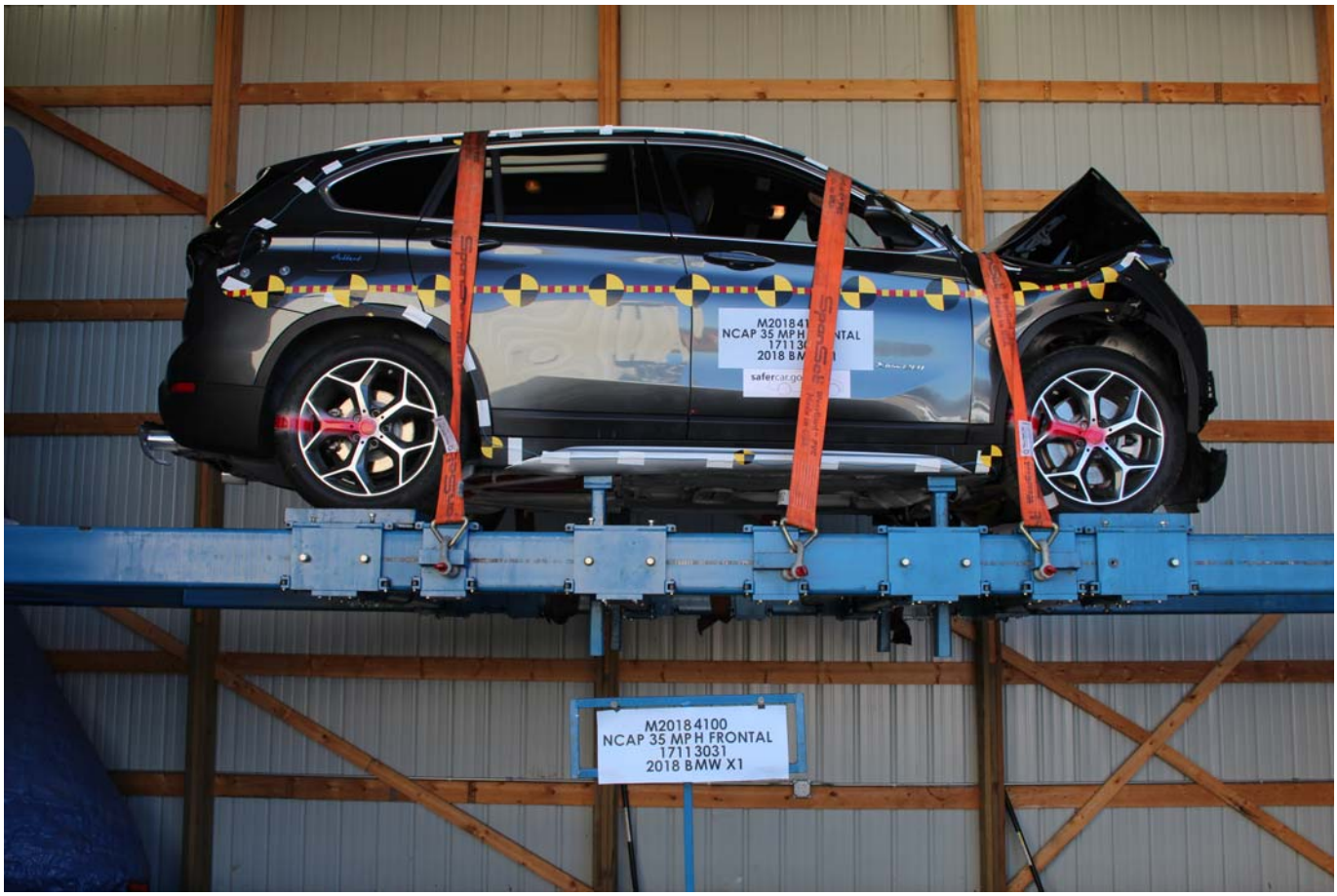
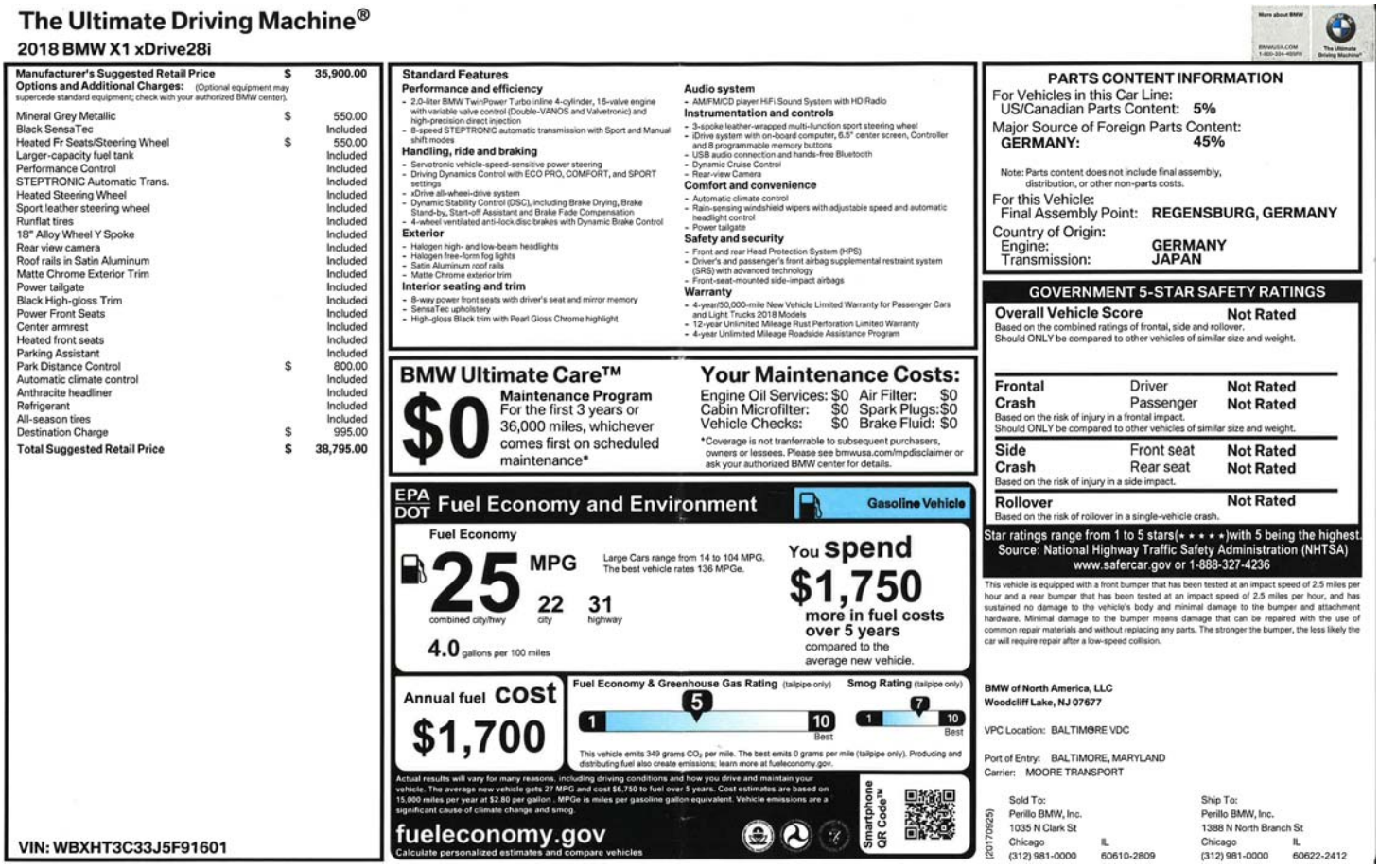


Photo No. 077 - Vehicle at 360 Degrees on Static Rollover Device

Photo No. 078 - 2018 BMW X1 xDrive28i 5-Door SUV Frontal Impact Event



The Ultimate Driving Machine®

2018 BMW X1 xDrive28i

Manufacturer's Suggested Retail Price	**$**	**35,900.00**
Options and Additional Charges: (Optional equipment may supercede standard equipment; check with your authorized BMW center).		
Mineral Grey Metallic	$	550.00
Black SensaTec		Included
Heated Fr Seats/Steering Wheel	$	550.00
Larger-capacity fuel tank		Included
Performance Control		Included
STEPTRONIC Automatic Trans.		Included
Heated Steering Wheel		Included
Sport leather steering wheel		Included
Runflat tires		Included
18" Alloy Wheel Y Spoke		Included
Rear view camera		Included
Roof rails in Satin Aluminum		Included
Matte Chrome Exterior Trim		Included
Power tailgate		Included
Black High-gloss Trim		Included
Power Front Seats		Included
Center armrest		Included
Heated front seats		Included
Parking Assistant		Included
Park Distance Control	$	800.00
Automatic climate control		Included
Anthracite headliner		Included
Refrigerant		Included
All-season tires		Included
Destination Charge	$	995.00
Total Suggested Retail Price	**$**	**38,795.00**

VIN: WBXHT3C33J5F91601

Standard Features

Performance and efficiency
- 2.0-liter BMW TwinPower Turbo inline 4-cylinder, 16-valve engine with variable valve control (Double-VANOS and Valvetronic) and high-precision direct injection
- 8-speed STEPTRONIC automatic transmission with Sport and Manual shift modes

Handling, ride and braking
- Servotronic vehicle-speed-sensitive power steering
- Driving Dynamics Control with ECO PRO, COMFORT, and SPORT settings
- xDrive all-wheel-drive system
- Dynamic Stability Control (DSC), including Brake Drying, Brake Stand-by, Start-off Assistant and Brake Fade Compensation
- 4-wheel ventilated anti-lock disc brakes with Dynamic Brake Control

Exterior
- Halogen high- and low-beam headlights
- Halogen free-form fog lights
- Satin Aluminum roof rails
- Matte Chrome exterior trim

Interior seating and trim
- 8-way power front seats with driver's seat and mirror memory
- SensaTec upholstery
- High-gloss Black trim with Pearl Gloss Chrome highlight

Audio system
- AM/FM/CD player HiFi Sound System with HD Radio

Instrumentation and controls
- 3-spoke leather-wrapped multi-function sport steering wheel
- iDrive system with on-board computer, 6.5" center screen, Controller and 8 programmable memory buttons
- USB audio connection and hands-free Bluetooth
- Dynamic Cruise Control
- Rear-view Camera

Comfort and convenience
- Automatic climate control
- Rain-sensing windshield wipers with adjustable speed and automatic headlight control
- Power tailgate

Safety and security
- Front and rear Head Protection System (HPS)
- Driver's and passenger's front airbag supplemental restraint system (SRS) with advanced technology
- Front-seat-mounted side-impact airbags

Warranty
- 4-year/50,000-mile New Vehicle Limited Warranty for Passenger Cars and Light Trucks 2018 Models
- 12-year Unlimited Mileage Rust Perforation Limited Warranty
- 4-year Unlimited Mileage Roadside Assistance Program

BMW Ultimate Care™

$0 Maintenance Program
For the first 3 years or 36,000 miles, whichever comes first on scheduled maintenance*

Your Maintenance Costs:

Engine Oil Services:	$0	Air Filter:	$0
Cabin Microfilter:	$0	Spark Plugs:	$0
Vehicle Checks:	$0	Brake Fluid:	$0

*Coverage is not tranferrable to subsequent purchasers, owners or lessees. Please see bmwusa.com/mpdisclaimer or ask your authorized BMW center for details.

EPA DOT Fuel Economy and Environment

Gasoline Vehicle

Fuel Economy

25 MPG combined city/hwy — 22 city, 31 highway

4.0 gallons per 100 miles

Large Cars range from 14 to 104 MPG. The best vehicle rates 136 MPGe.

You spend **$1,750** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel cost **$1,700**

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1 — 10 Best)

Smog Rating (tailpipe only): 7 (1 — 10 Best)

This vehicle emits 349 grams CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions; learn more at fueleconomy.gov.

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and cost $6,750 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $2.80 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code™

PARTS CONTENT INFORMATION

For Vehicles in this Car Line:
US/Canadian Parts Content: **5%**
Major Source of Foreign Parts Content:
GERMANY: 45%

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

For this Vehicle:
Final Assembly Point: **REGENSBURG, GERMANY**
Country of Origin:
Engine: **GERMANY**
Transmission: **JAPAN**

GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score **Not Rated**
Based on the combined ratings of frontal, side and rollover.
Should ONLY be compared to other vehicles of similar size and weight.

Frontal Crash	Driver	**Not Rated**
	Passenger	**Not Rated**

Based on the risk of injury in a frontal impact.
Should ONLY be compared to other vehicles of similar size and weight.

Side Crash	Front seat	**Not Rated**
	Rear seat	**Not Rated**

Based on the risk of injury in a side impact.

Rollover **Not Rated**
Based on the risk of rollover in a single-vehicle crash.

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

This vehicle is equipped with a front bumper that has been tested at an impact speed of 2.5 miles per hour and a rear bumper that has been tested at an impact speed of 2.5 miles per hour, and has sustained no damage to the vehicle's body and minimal damage to the bumper and attachment hardware. Minimal damage to the bumper means damage that can be repaired with the use of common repair materials and without replacing any parts. The stronger the bumper, the less likely the car will require repair after a low-speed collision.

BMW of North America, LLC
Woodcliff Lake, NJ 07677

VPC Location: BALTIMØRE VDC

Port of Entry: BALTIMORE, MARYLAND
Carrier: MOORE TRANSPORT

Sold To:		Ship To:	
Perillo BMW, Inc.		Perillo BMW, Inc.	
1035 N Clark St		1388 N North Branch St	
Chicago	IL	Chicago	IL
(312) 981-0000	60610-2809	(312) 981-0000	60622-2412

(20170925)

Photo No. 079 - Monroney Label Photograph

APPENDIX B
DUMMY RESPONSE DATA TRACES

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The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.nhtsa.dot.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

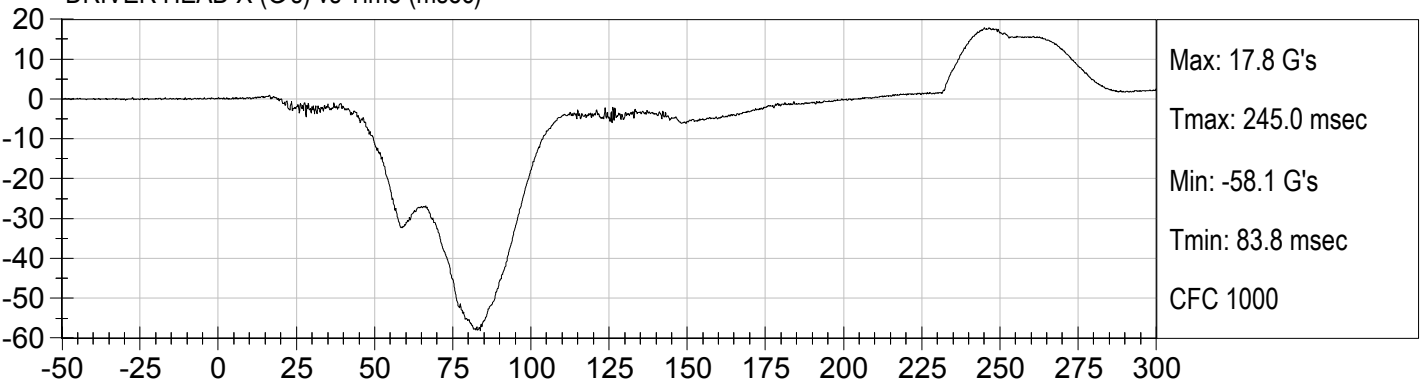
Right Rear Seat Crossmember Z

Left Rear Seat Crossmember Xr

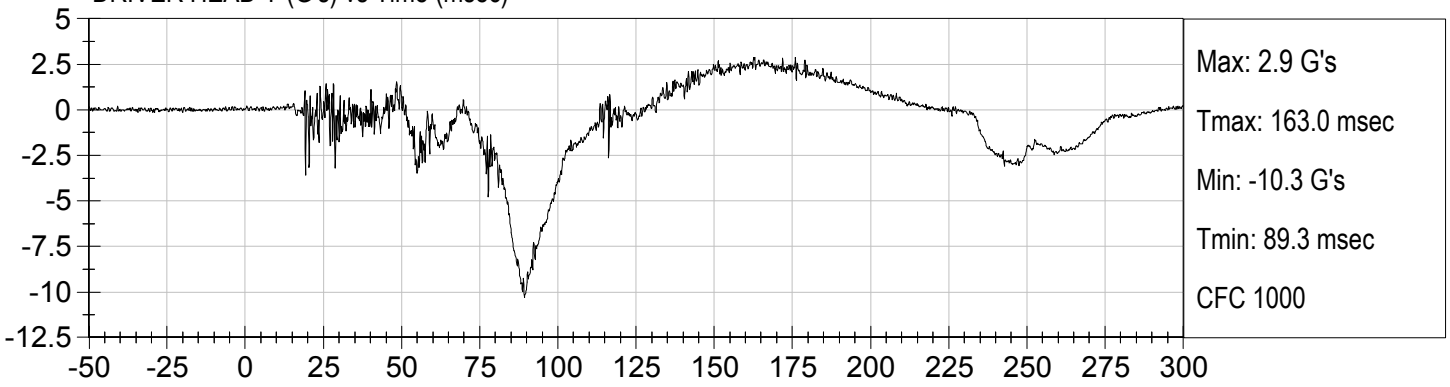
Right Rear Seat Crossmember Xr

Advanced Research Load Cell Barrier – 528 channels

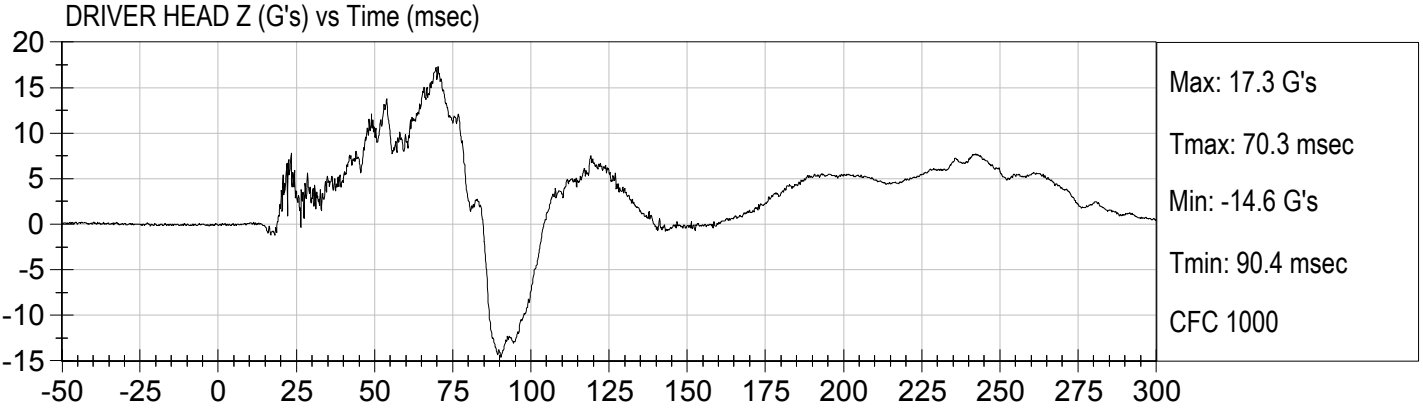
DRIVER HEAD X (G's) vs Time (msec)



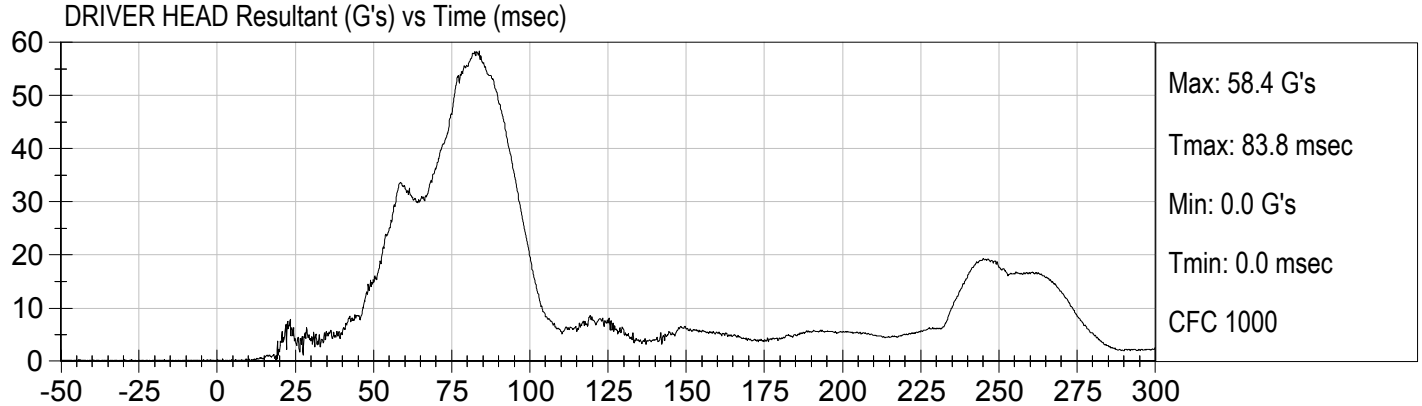
DRIVER HEAD Y (G's) vs Time (msec)



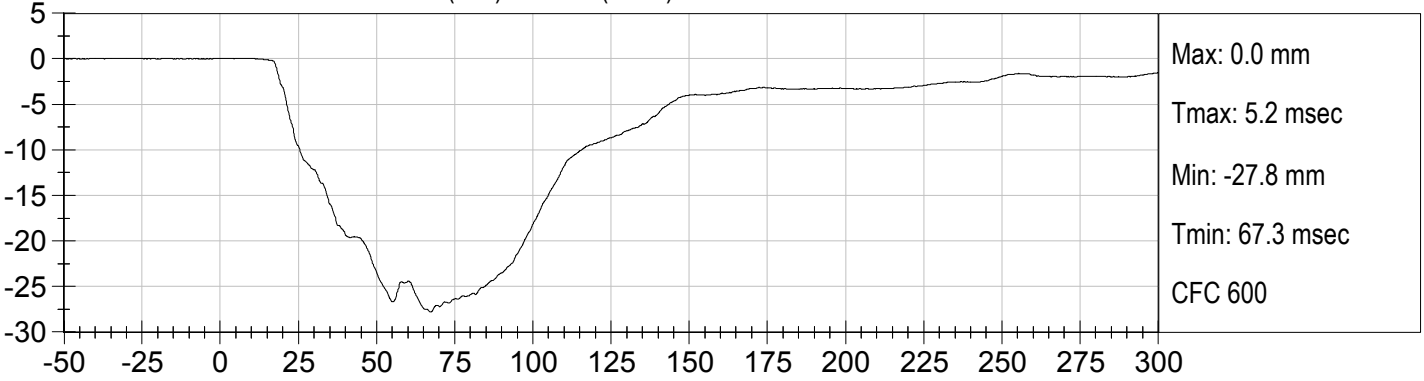
DRIVER HEAD Z (G's) vs Time (msec)

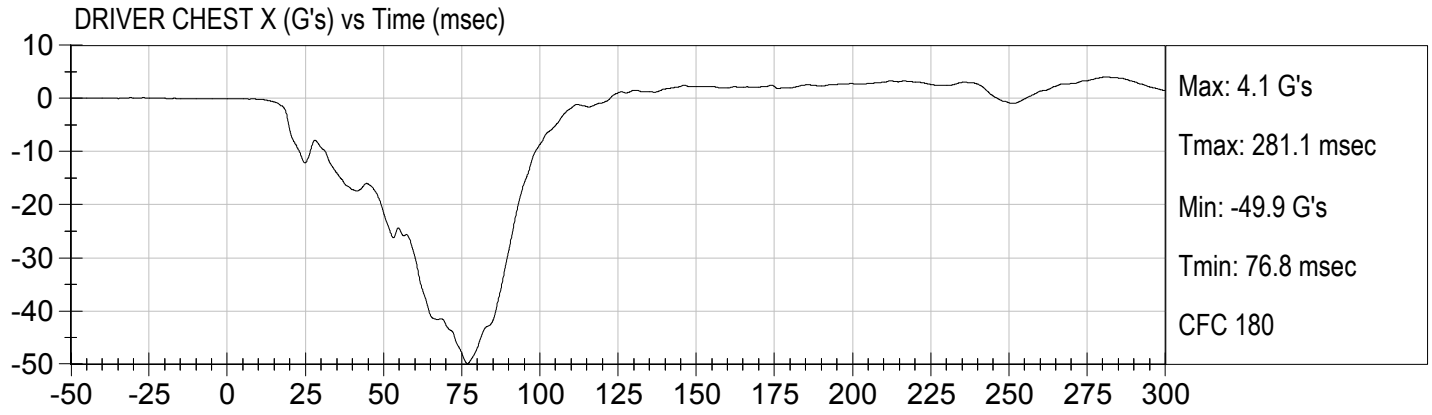


DRIVER HEAD Resultant (G's) vs Time (msec)

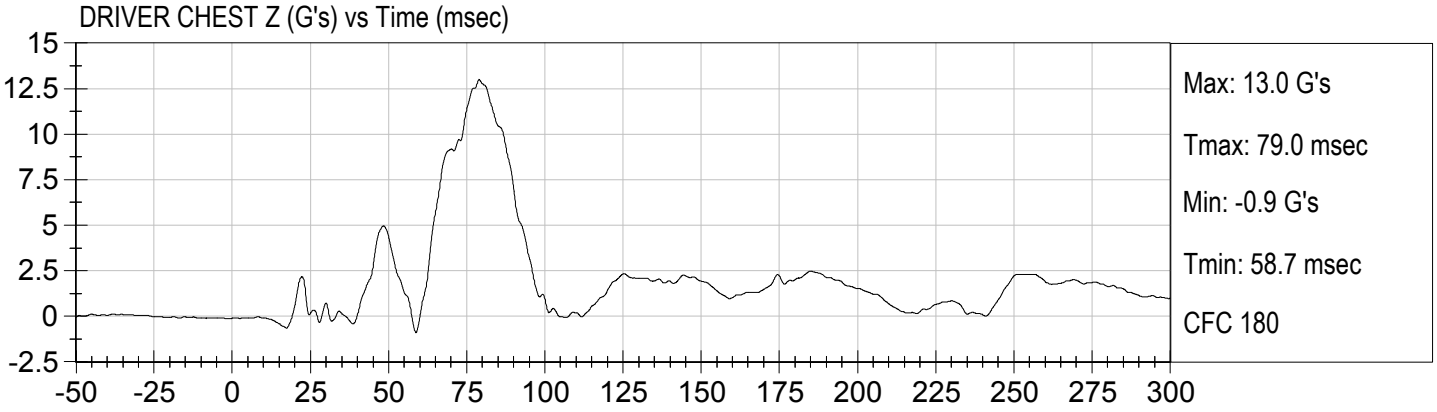


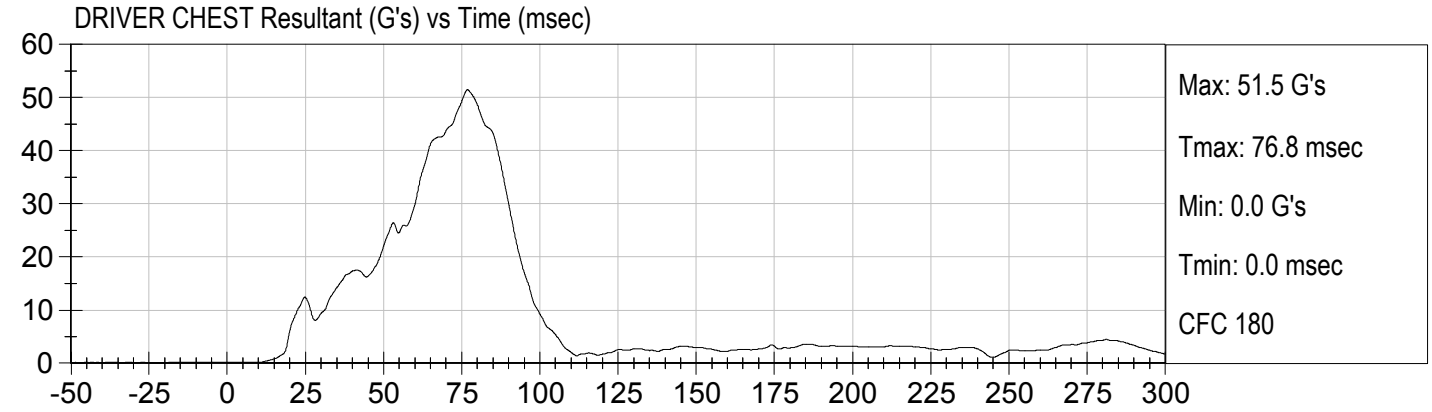
DRIVER CHEST DISPLACEMENT (mm) vs Time (msec)



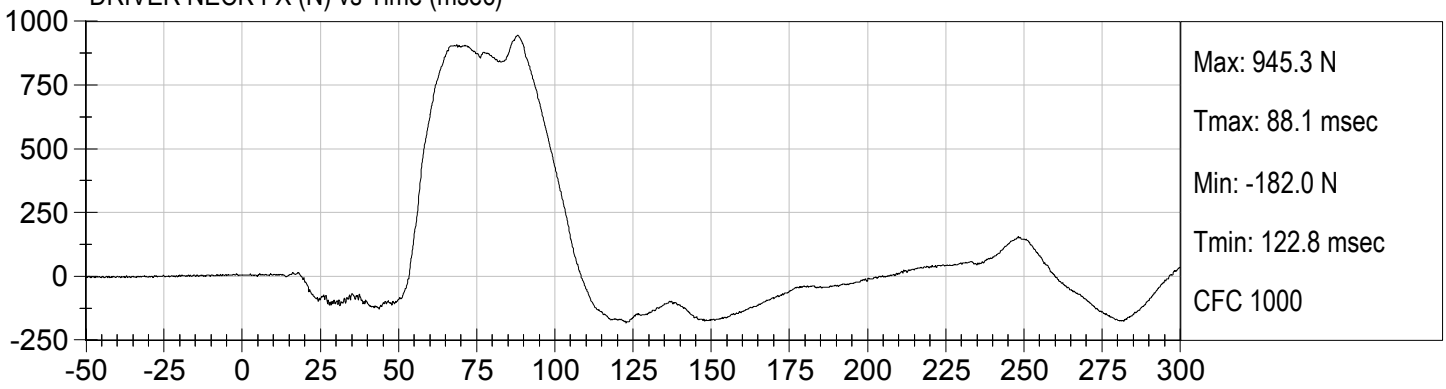

DRIVER CHEST X (G's) vs Time (msec)
10
0
-10
-20
-30
-40
-50
-50 -25 0 25 50 75 100 125 150 175 200 225 250 275 300
Max: 4.1 G's
Tmax: 281.1 msec
Min: -49.9 G's
Tmin: 76.8 msec
CFC 180


DRIVER CHEST Y (G's) vs Time (msec)
6
4
2
0
-2
-4
-50 -25 0 25 50 75 100 125 150 175 200 225 250 275 300
Max: 5.4 G's
Tmax: 93.3 msec
Min: -2.9 G's
Tmin: 38.0 msec
CFC 180

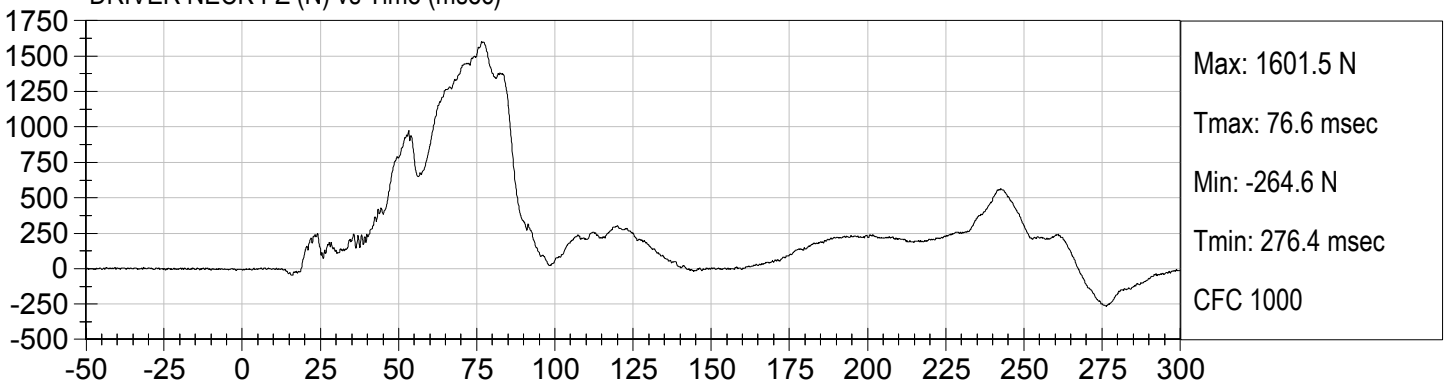

DRIVER CHEST Z (G's) vs Time (msec)
15
12.5
10
7.5
5
2.5
0
-2.5
-50 -25 0 25 50 75 100 125 150 175 200 225 250 275 300
Max: 13.0 G's
Tmax: 79.0 msec
Min: -0.9 G's
Tmin: 58.7 msec
CFC 180


DRIVER CHEST Resultant (G's) vs Time (msec)
60
50
40
30
20
10
0
-50 -25 0 25 50 75 100 125 150 175 200 225 250 275 300
Max: 51.5 G's
Tmax: 76.8 msec
Min: 0.0 G's
Tmin: 0.0 msec
CFC 180

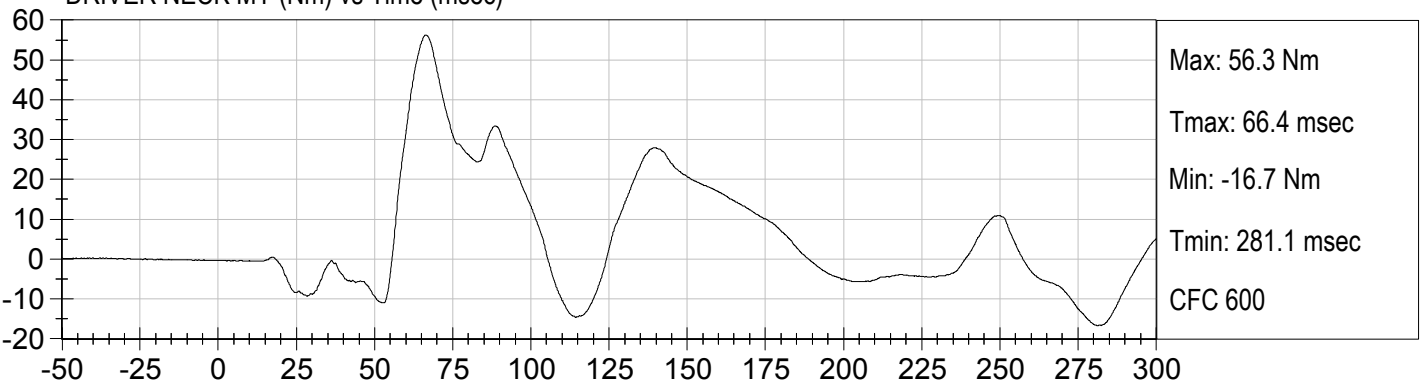
DRIVER NECK FX (N) vs Time (msec)



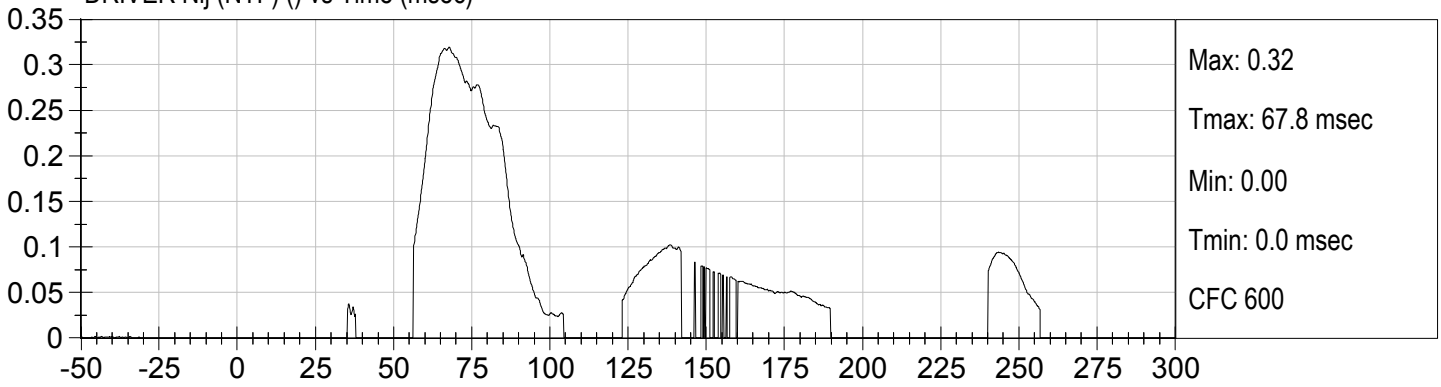
DRIVER NECK FZ (N) vs Time (msec)



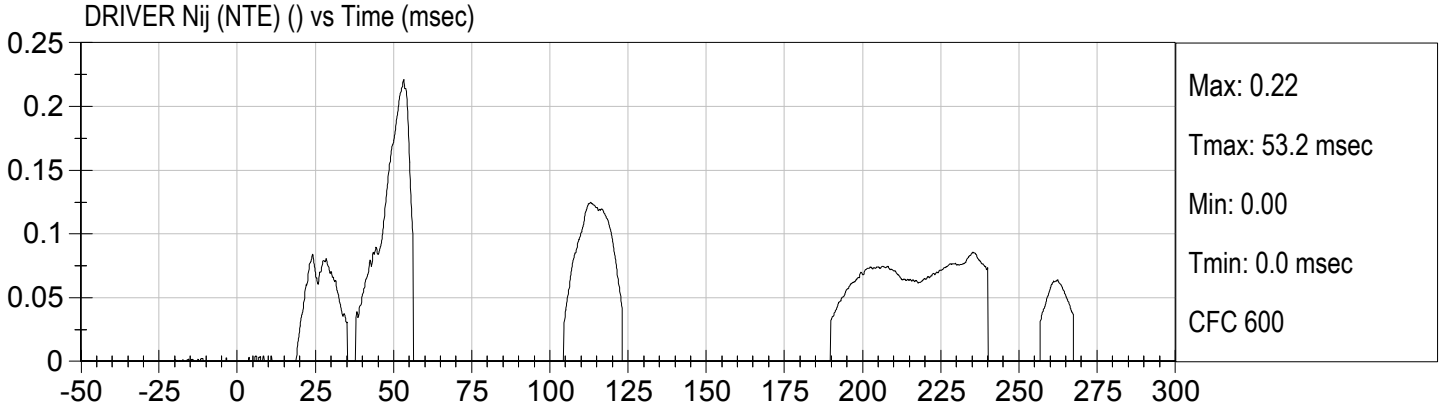
DRIVER NECK MY (Nm) vs Time (msec)



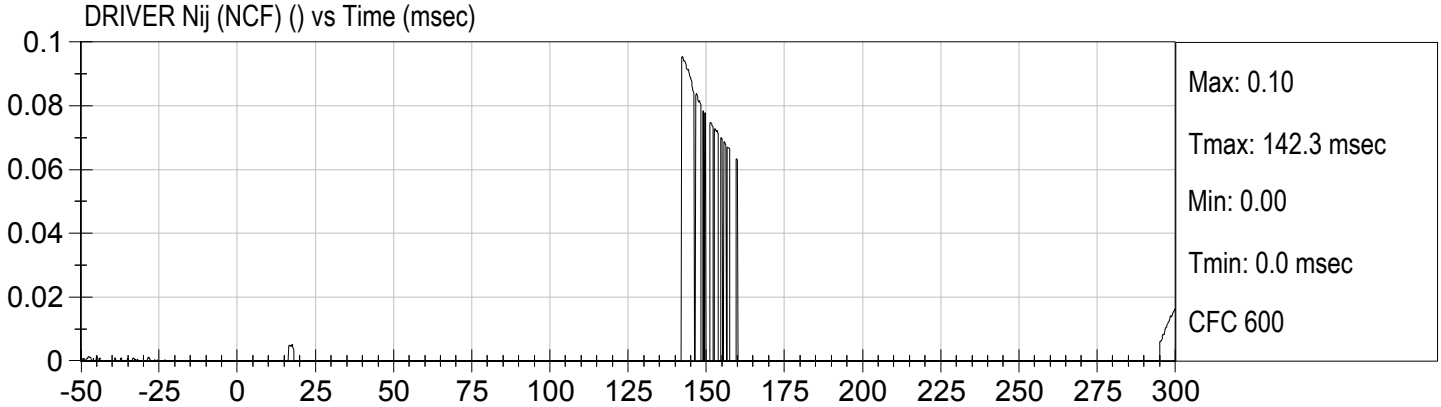
DRIVER Nij (NTF) () vs Time (msec)



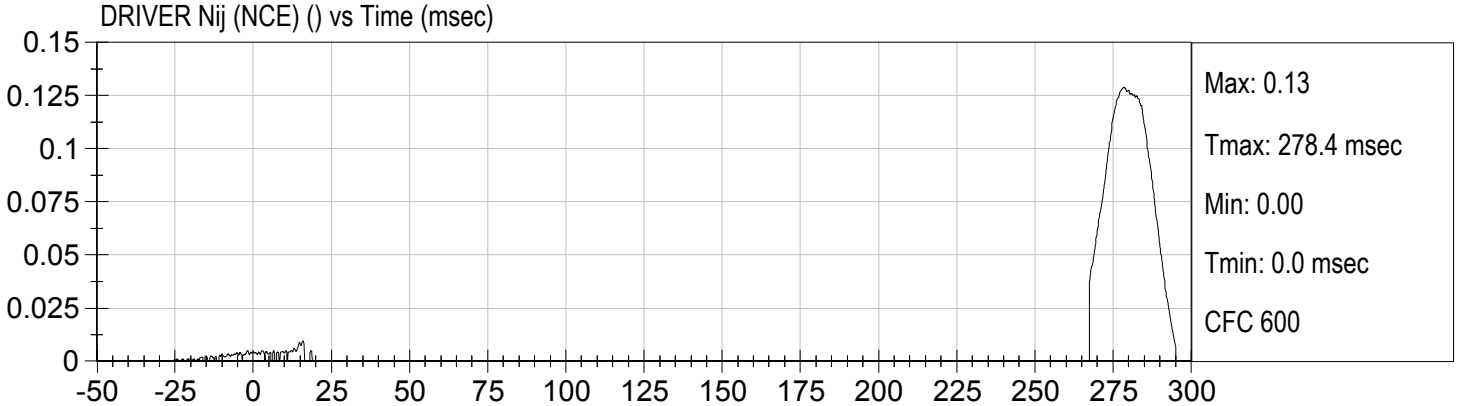
DRIVER Nij (NTE) () vs Time (msec)

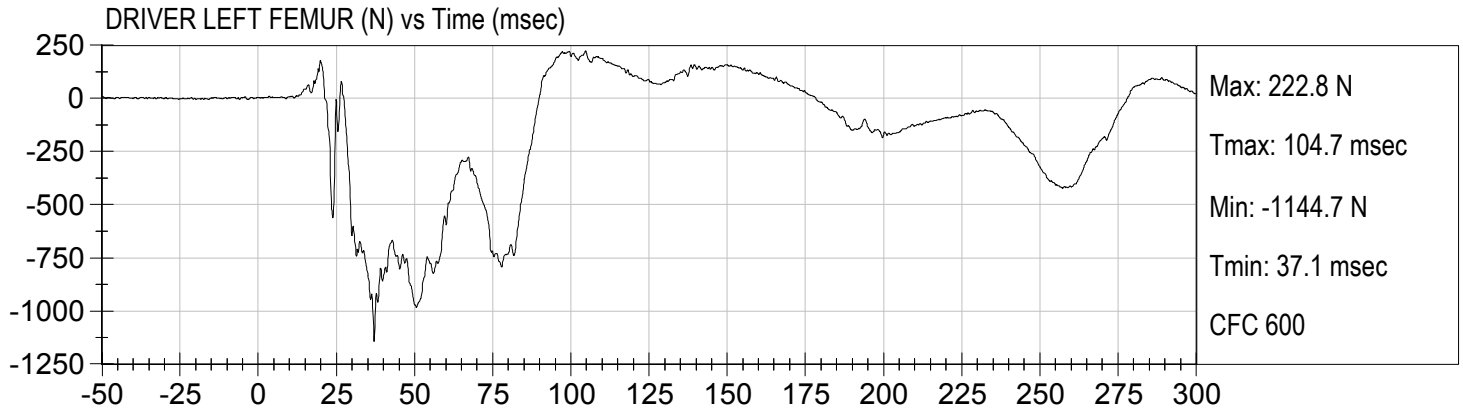


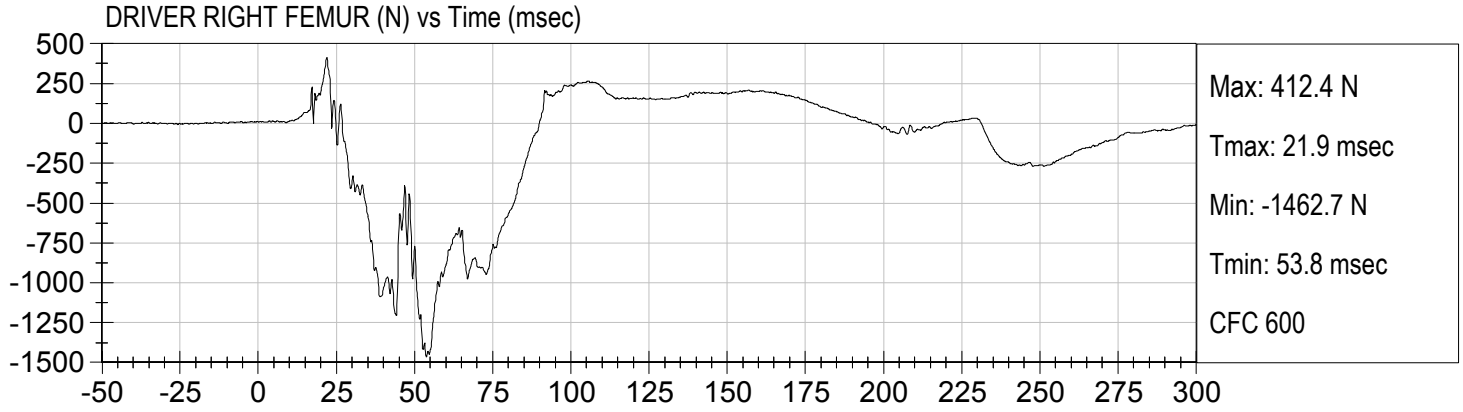
DRIVER Nij (NCF) () vs Time (msec)



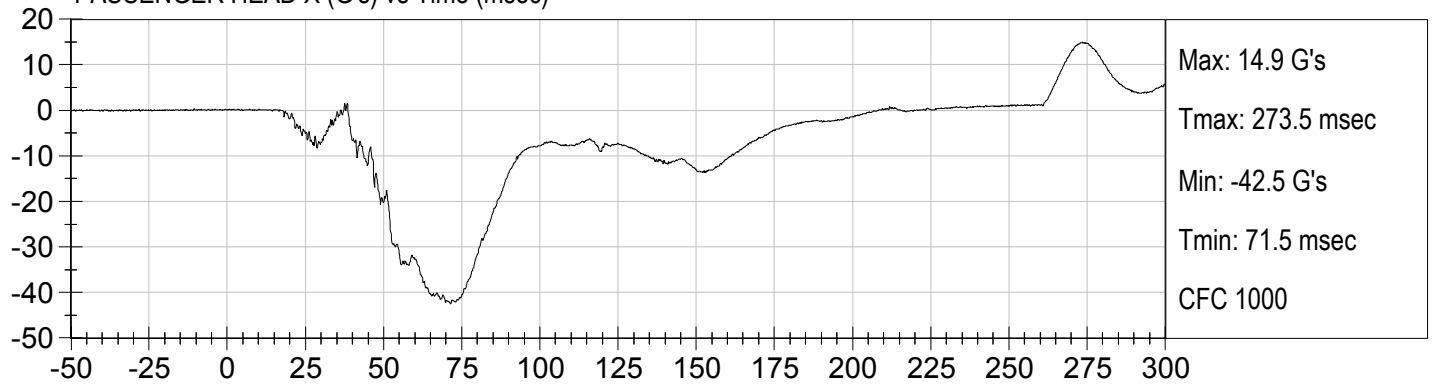
DRIVER Nij (NCE) () vs Time (msec)



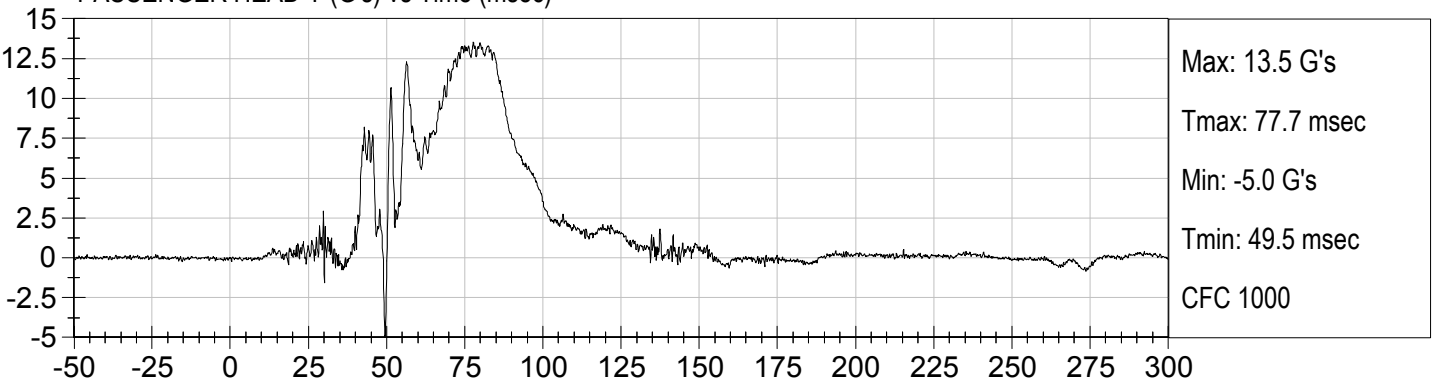

DRIVER LEFT FEMUR (N) vs Time (msec)
250
0
-250
-500
-750
-1000
-1250
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
Max: 222.8 N
Tmax: 104.7 msec
Min: -1144.7 N
Tmin: 37.1 msec
CFC 600


DRIVER RIGHT FEMUR (N) vs Time (msec)
500
250
0
-250
-500
-750
-1000
-1250
-1500
-50
-25
0
25
50
75
100
125
150
175
200
225
250
275
300
Max: 412.4 N
Tmax: 21.9 msec
Min: -1462.7 N
Tmin: 53.8 msec
CFC 600

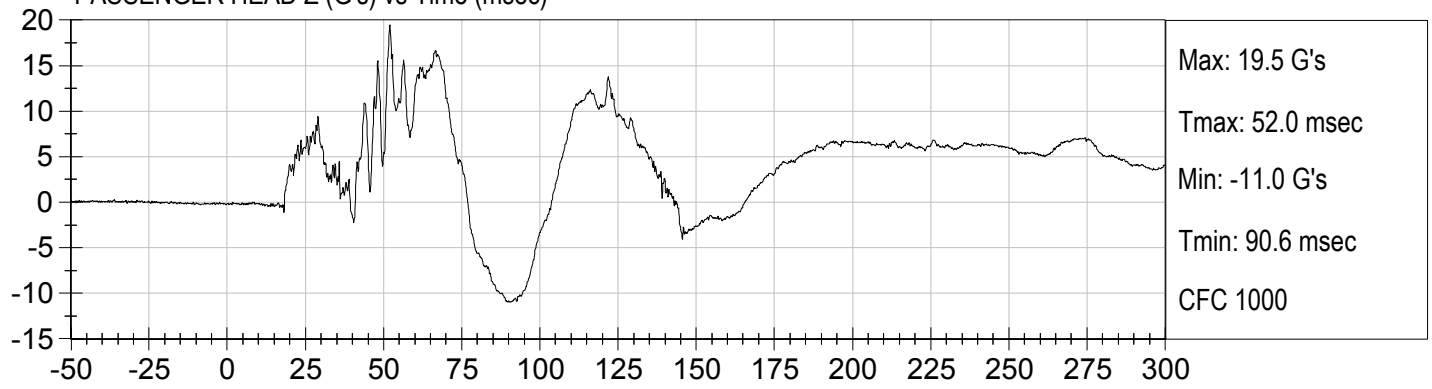
PASSENGER HEAD X (G's) vs Time (msec)



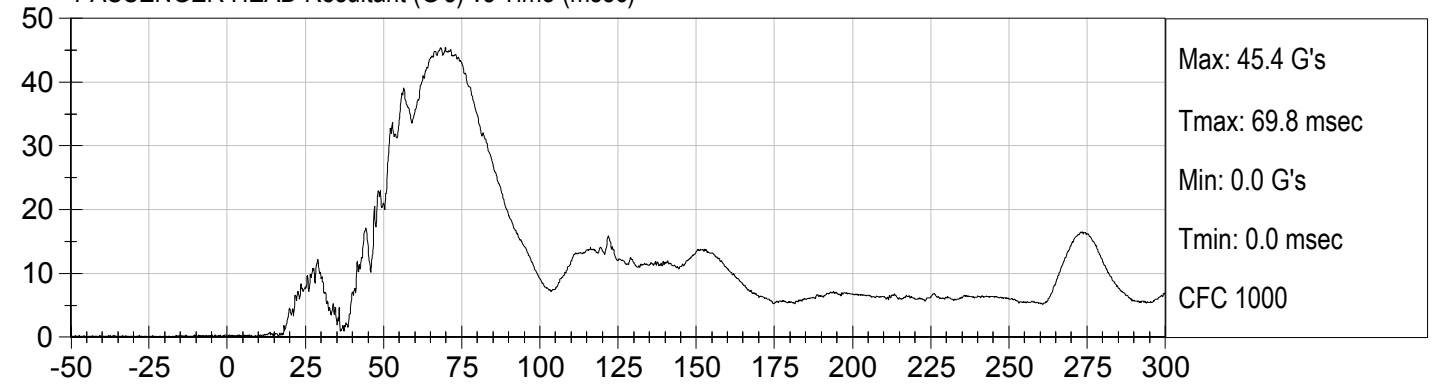
PASSENGER HEAD Y (G's) vs Time (msec)



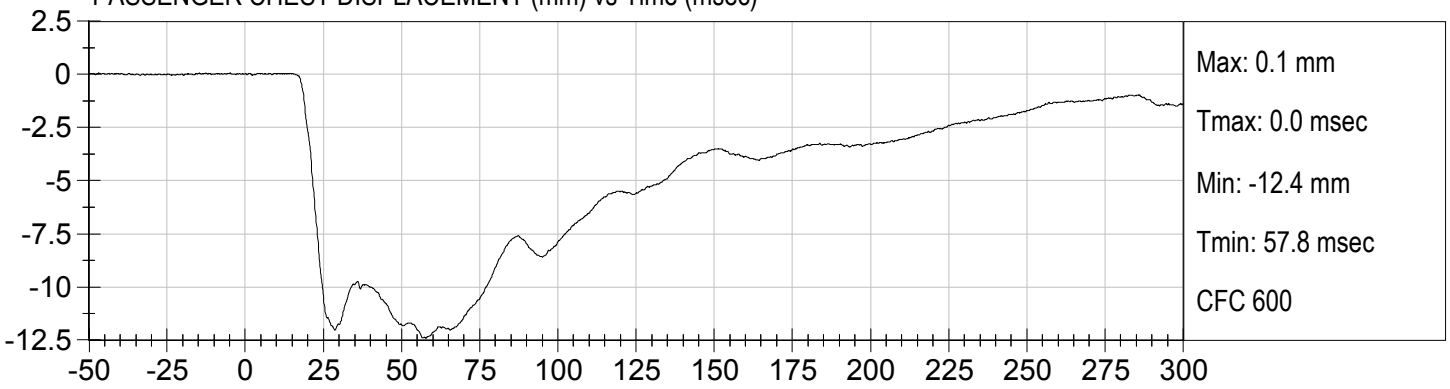
PASSENGER HEAD Z (G's) vs Time (msec)



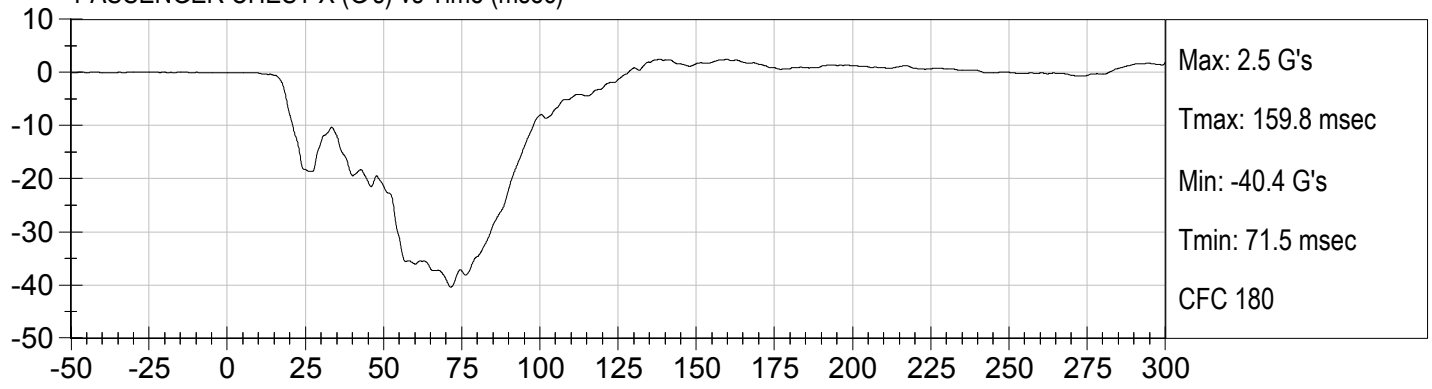
PASSENGER HEAD Resultant (G's) vs Time (msec)



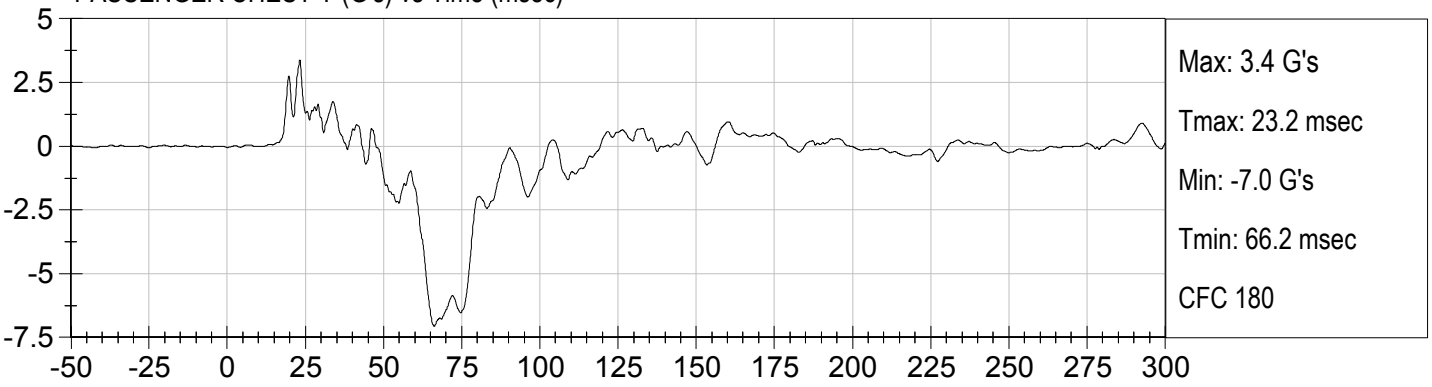
PASSENGER CHEST DISPLACEMENT (mm) vs Time (msec)



PASSENGER CHEST X (G's) vs Time (msec)

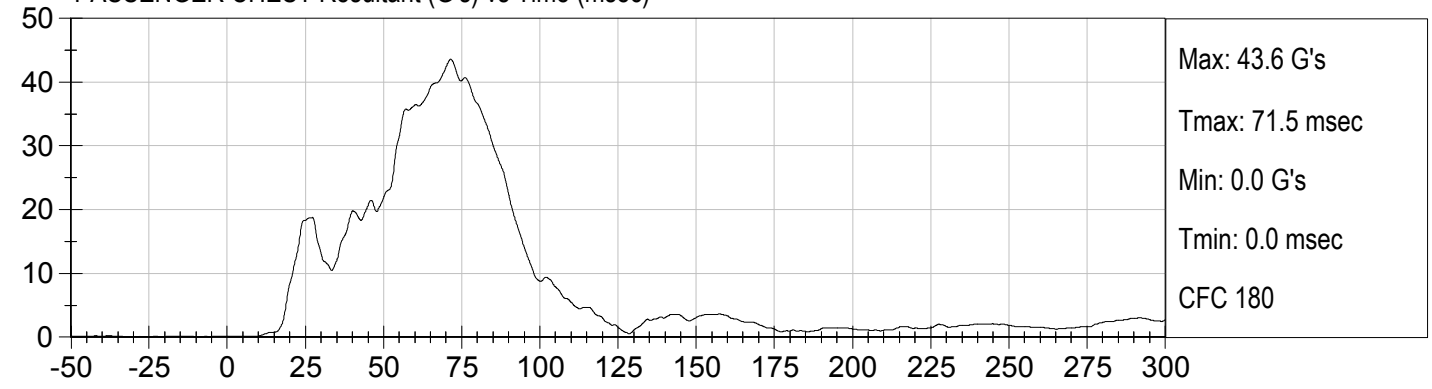


PASSENGER CHEST Y (G's) vs Time (msec)

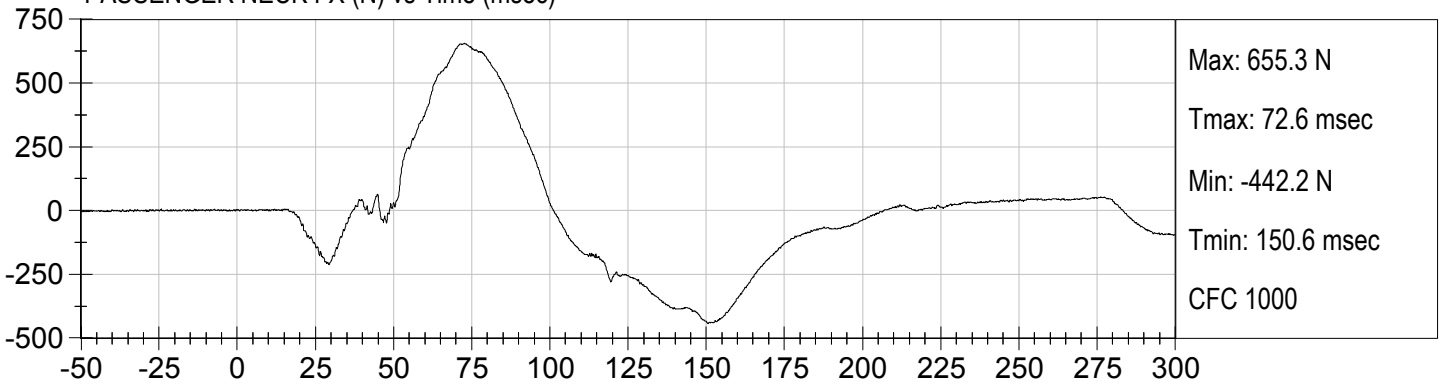


PASSENGER CHEST Z (G's) vs Time (msec)

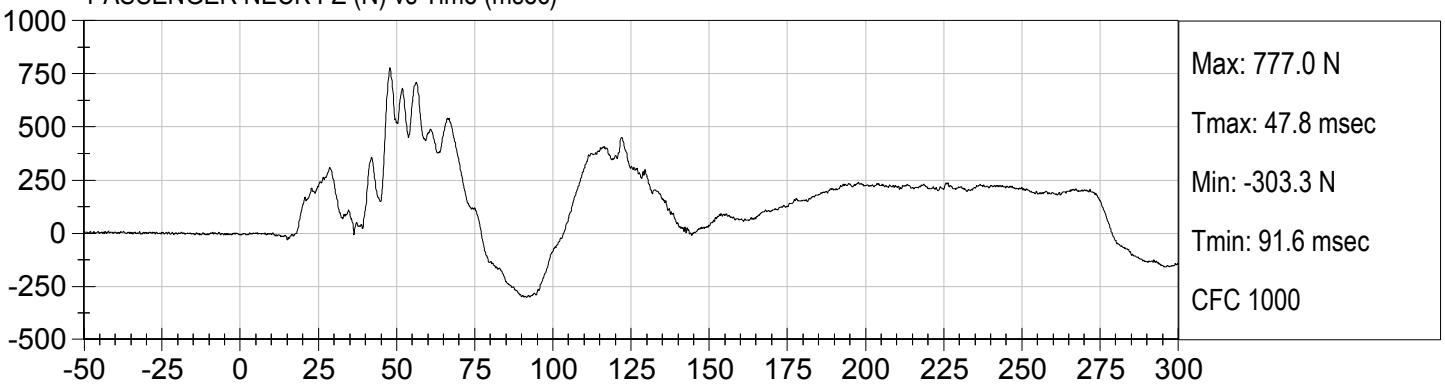
PASSENGER CHEST Resultant (G's) vs Time (msec)



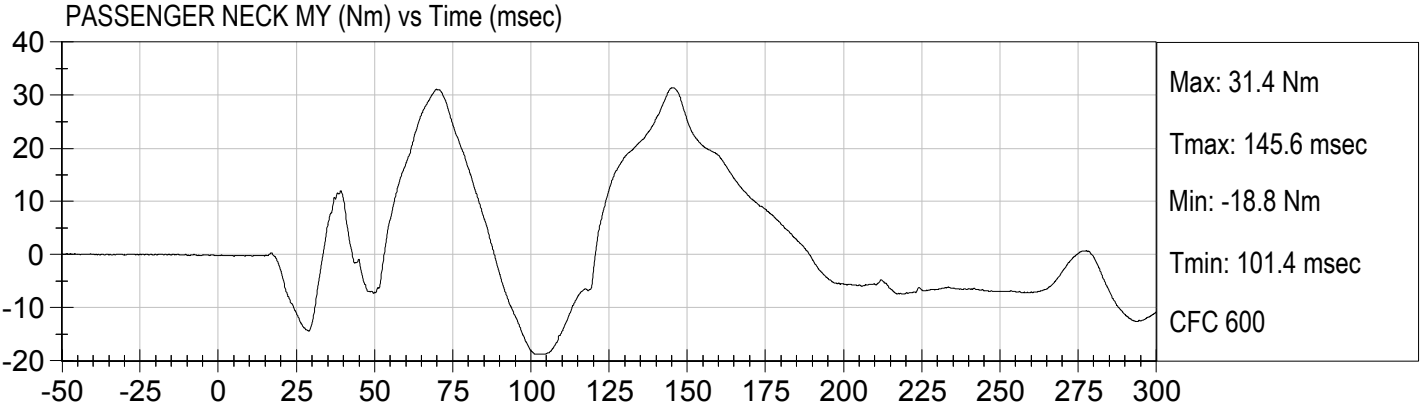
PASSENGER NECK FX (N) vs Time (msec)



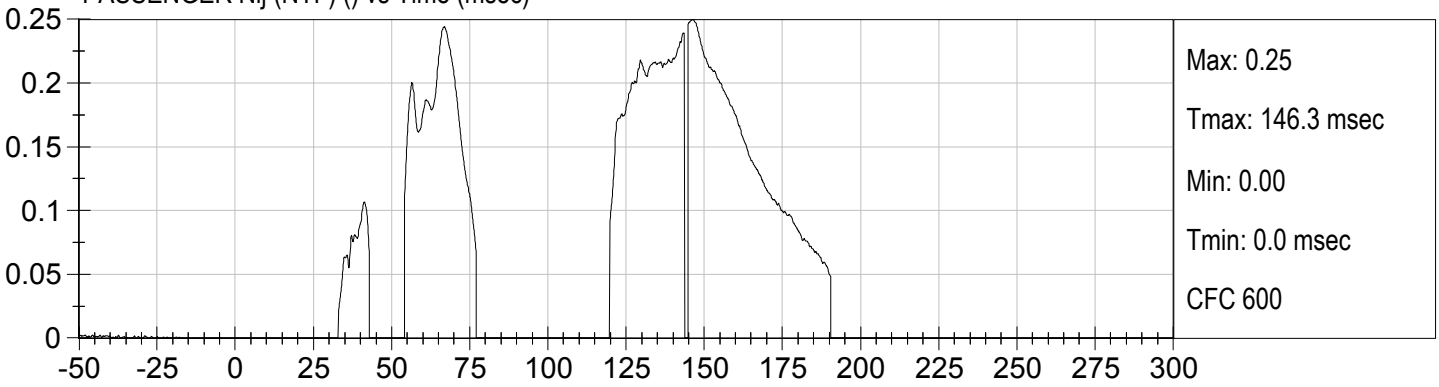
PASSENGER NECK FZ (N) vs Time (msec)



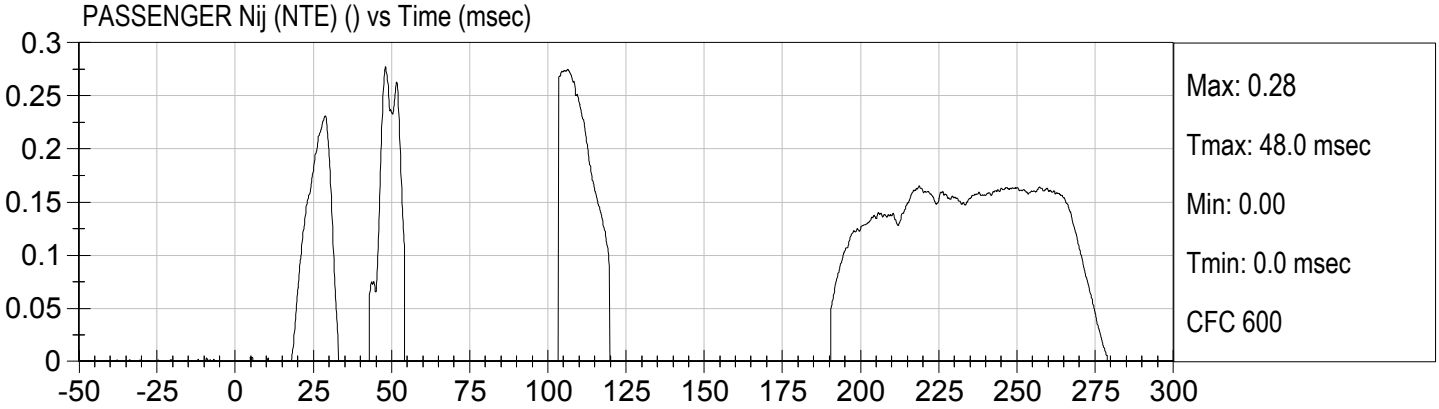
PASSENGER NECK MY (Nm) vs Time (msec)



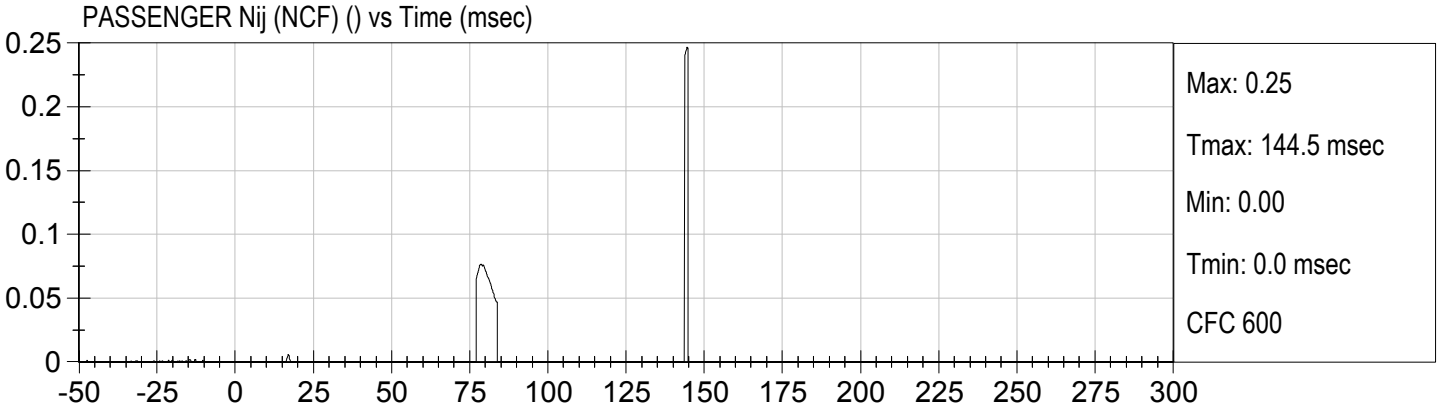
PASSENGER Nij (NTF) () vs Time (msec)



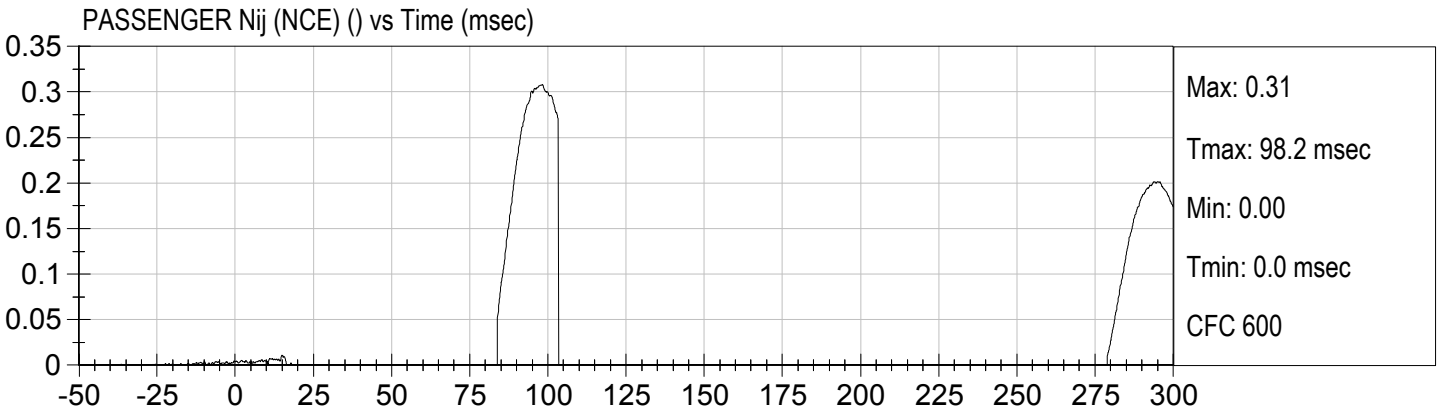
PASSENGER Nij (NTE) () vs Time (msec)



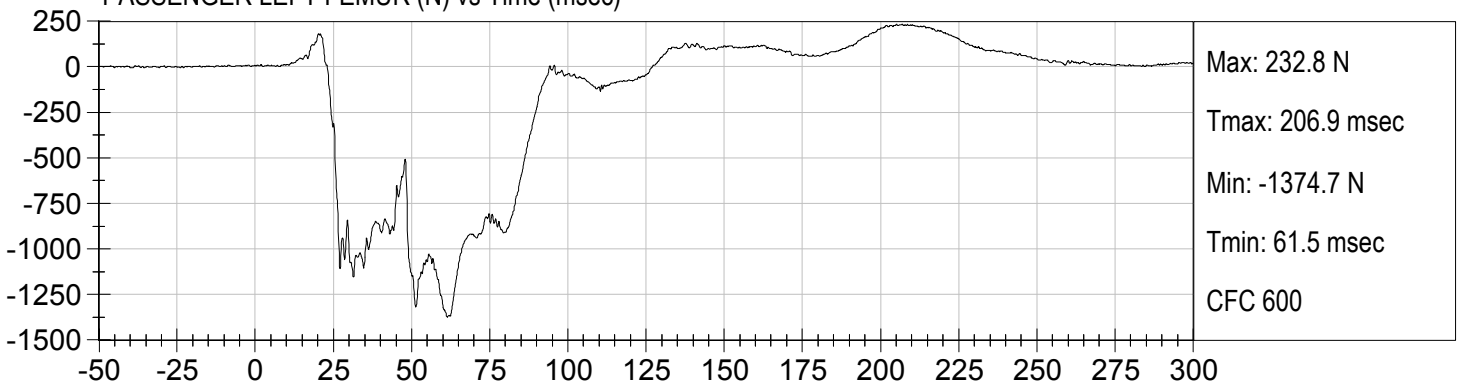
PASSENGER Nij (NCF) () vs Time (msec)



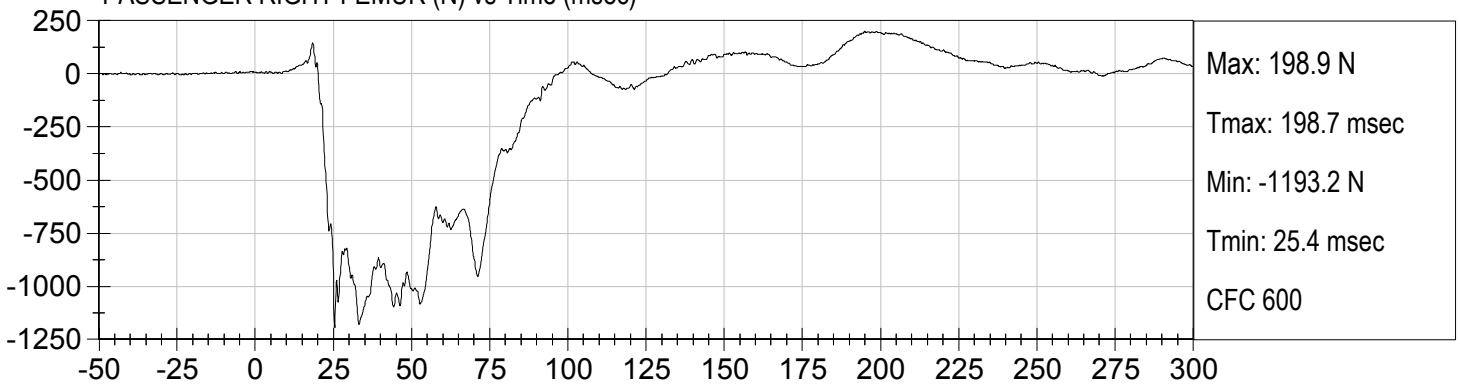
PASSENGER Nij (NCE) () vs Time (msec)



PASSENGER LEFT FEMUR (N) vs Time (msec)



PASSENGER RIGHT FEMUR (N) vs Time (msec)



APPENDIX C
DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

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:** D173341

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	34	Pass
Peak Resultant Acceleration	G's	225 to 275	270	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	4.3	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Emily Fliess
Laboratory Technician

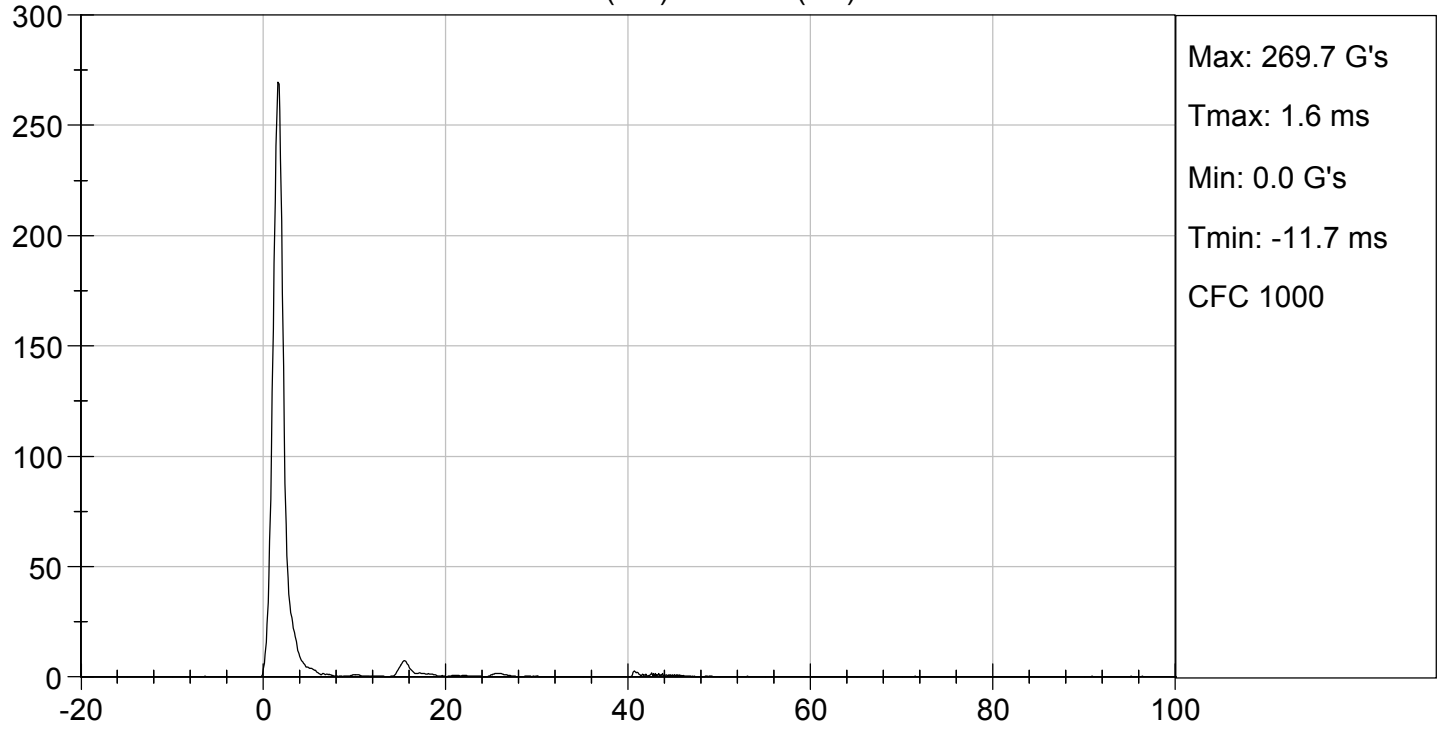
11/16/2017
Test Date

Robert Schmidt
Approved By

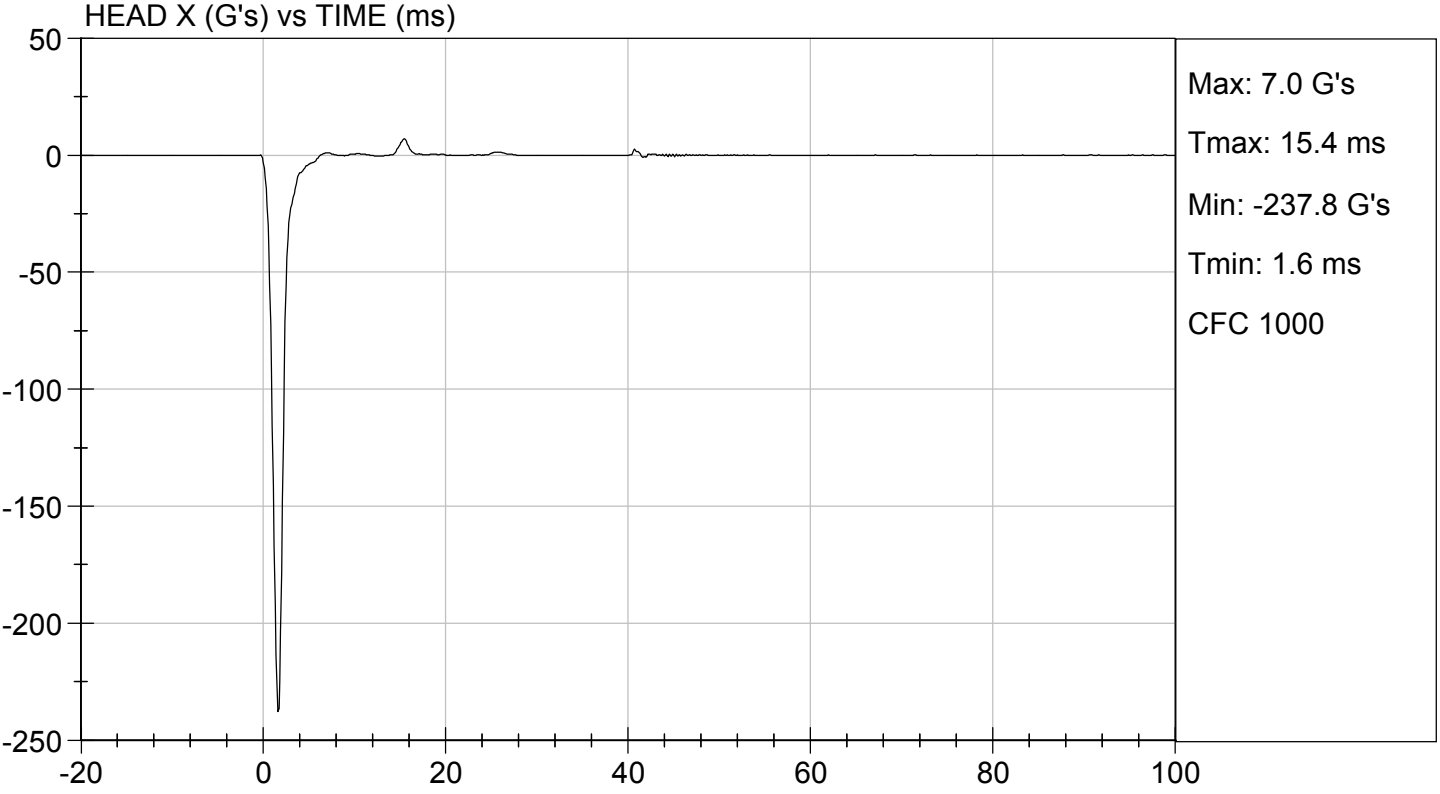
TEST DESC: HEAD DROP

TEST DATE: 11/16/2017
TEST #: D173341

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

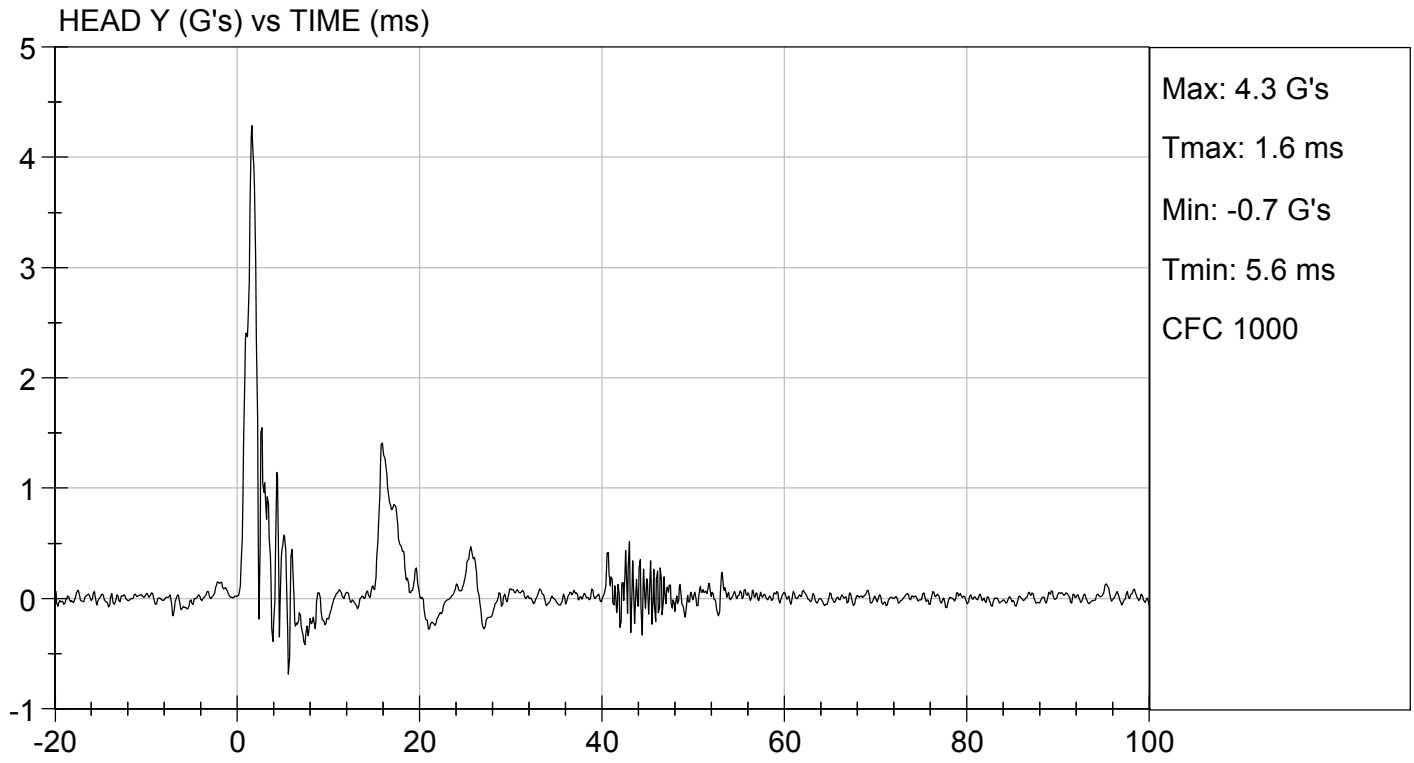


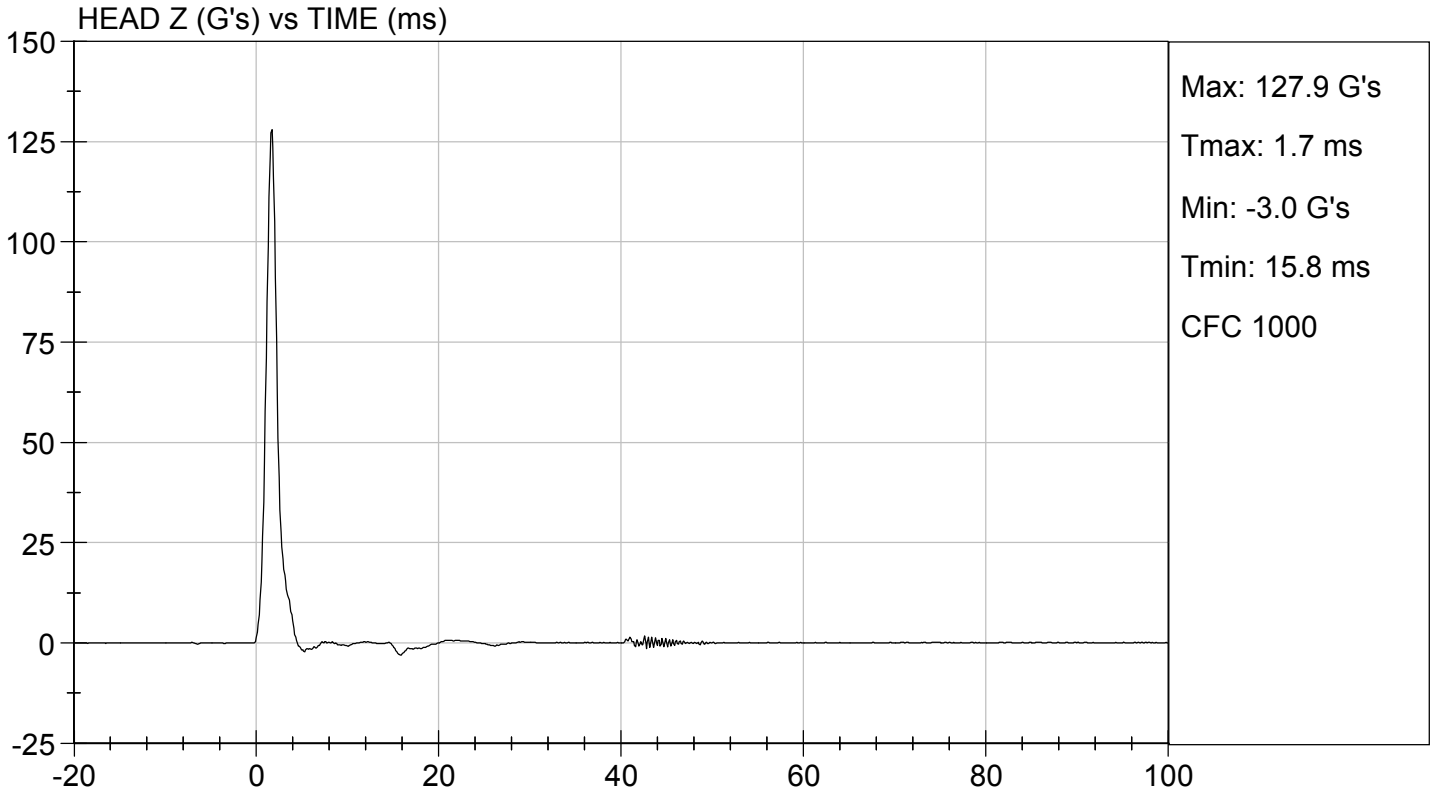
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 11/16/2017
TEST #: D173341





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173342

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	30	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	25.63	Pass
	20 ms	G's	17.60 to 22.60	21.18	Pass
	30 ms	G's	12.50 to 18.50	15.41	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	15.3	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	34.9	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	76.9	Pass
	Time	ms	57.0 to 64.0	60.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	121.4	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	91.9	Pass
	Time	ms	47.0 to 58.0	48.6	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	98.0	Pass
			Overall Test Results		Pass

Emily Fliess

Laboratory Technician

11/17/2017

Test Date

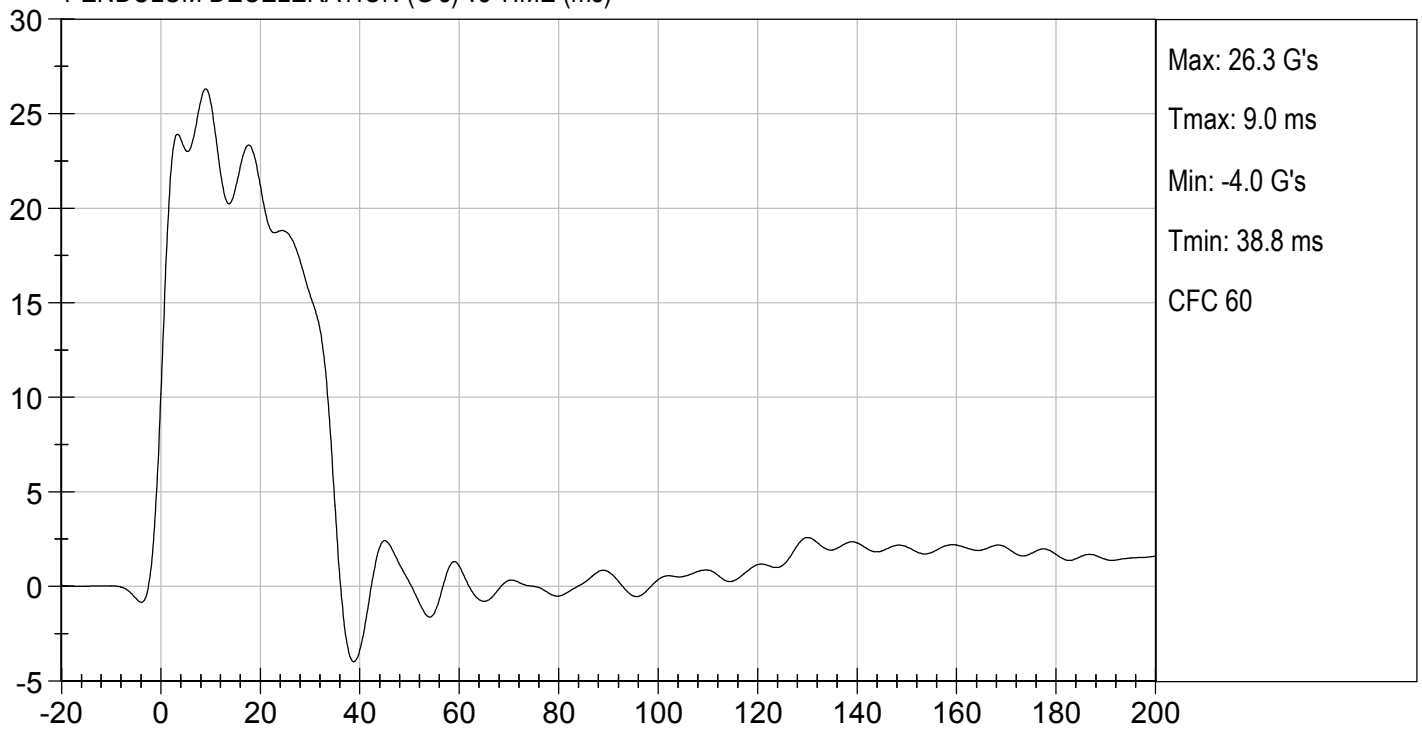
Robert Schmidt

Approved By

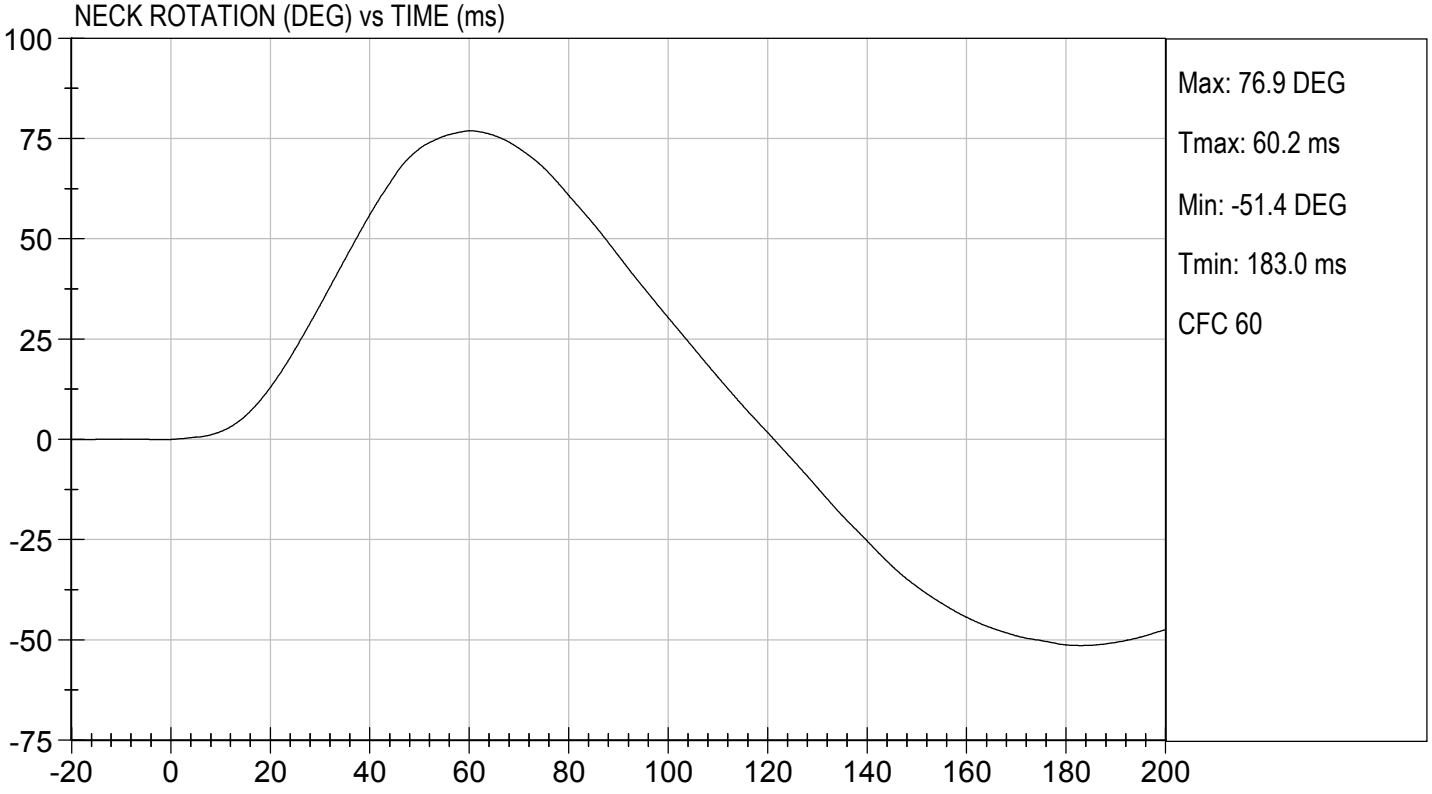
TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 11/17/2017
TEST #: D173342

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

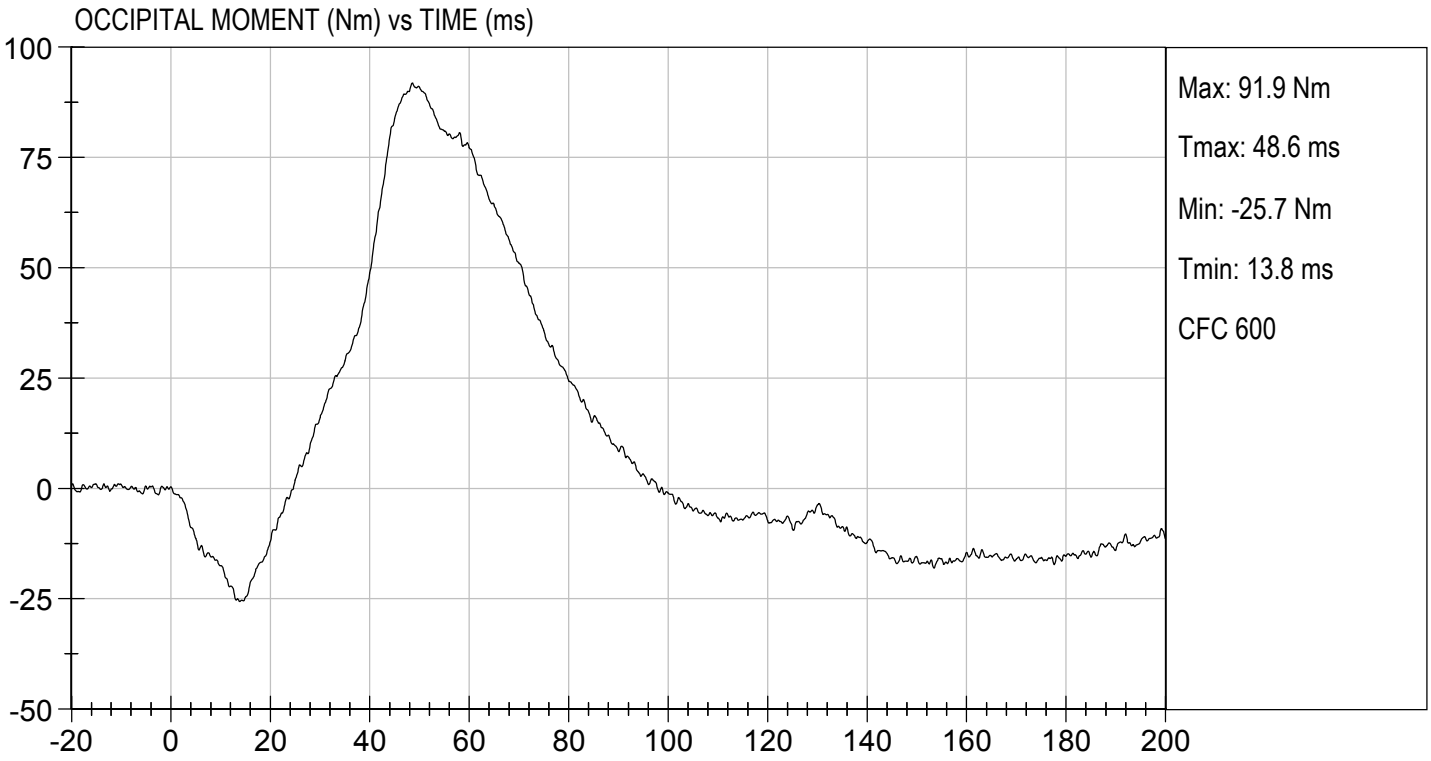


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 11/17/2017
TEST #: D173342



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173343

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	30	Pass
Pendulum Velocity		m/s	5.95 to 6.19	5.98	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	20.10	Pass
	20 ms	G's	14.00 to 19.00	16.80	Pass
	30 ms	G's	11.00 to 16.00	11.67	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	12.2	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	39.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	102.3	Pass
	Time	ms	72.0 to 82.0	77.7	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	164.5	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.7	Pass
	Time	ms	65.0 to 79.0	75.1	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	144.7	Pass
			Overall Test Results		Pass

Emily Fliess

Laboratory Technician

11/17/2017

Test Date

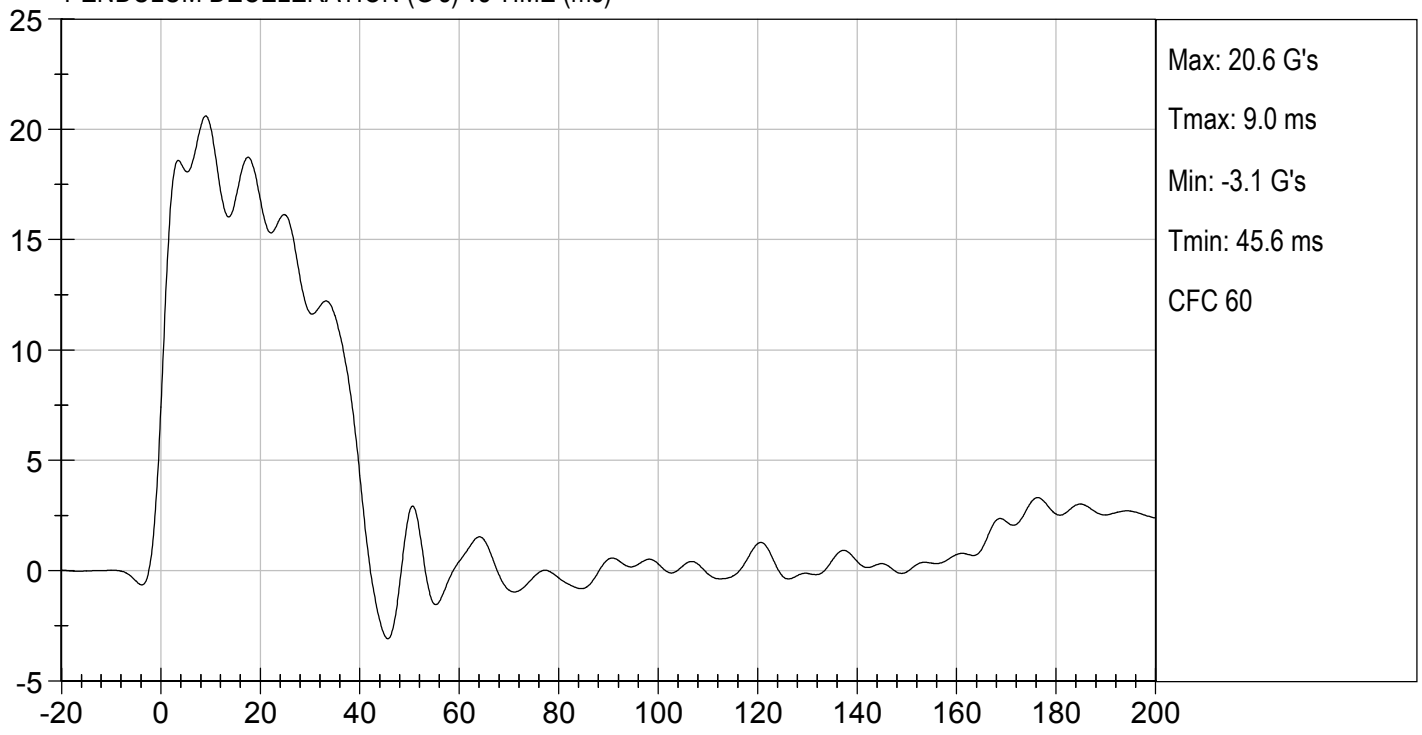
Robert Schmidt

Approved By

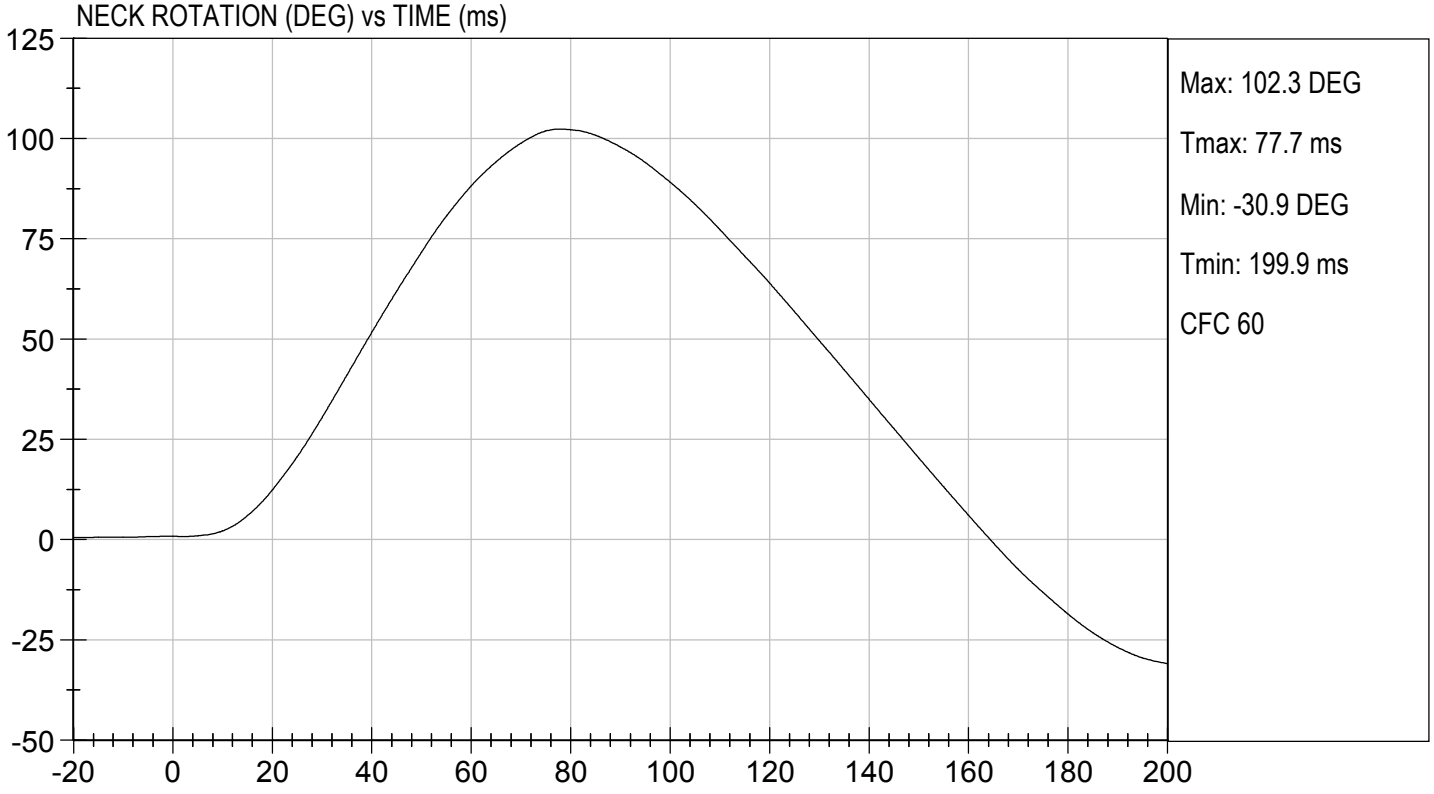
TEST DESC: NECK EXTENSION
VELOCITY: 19.61 ft/s, 5.98 m/s

TEST DATE: 11/17/2017
TEST #: D173343

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

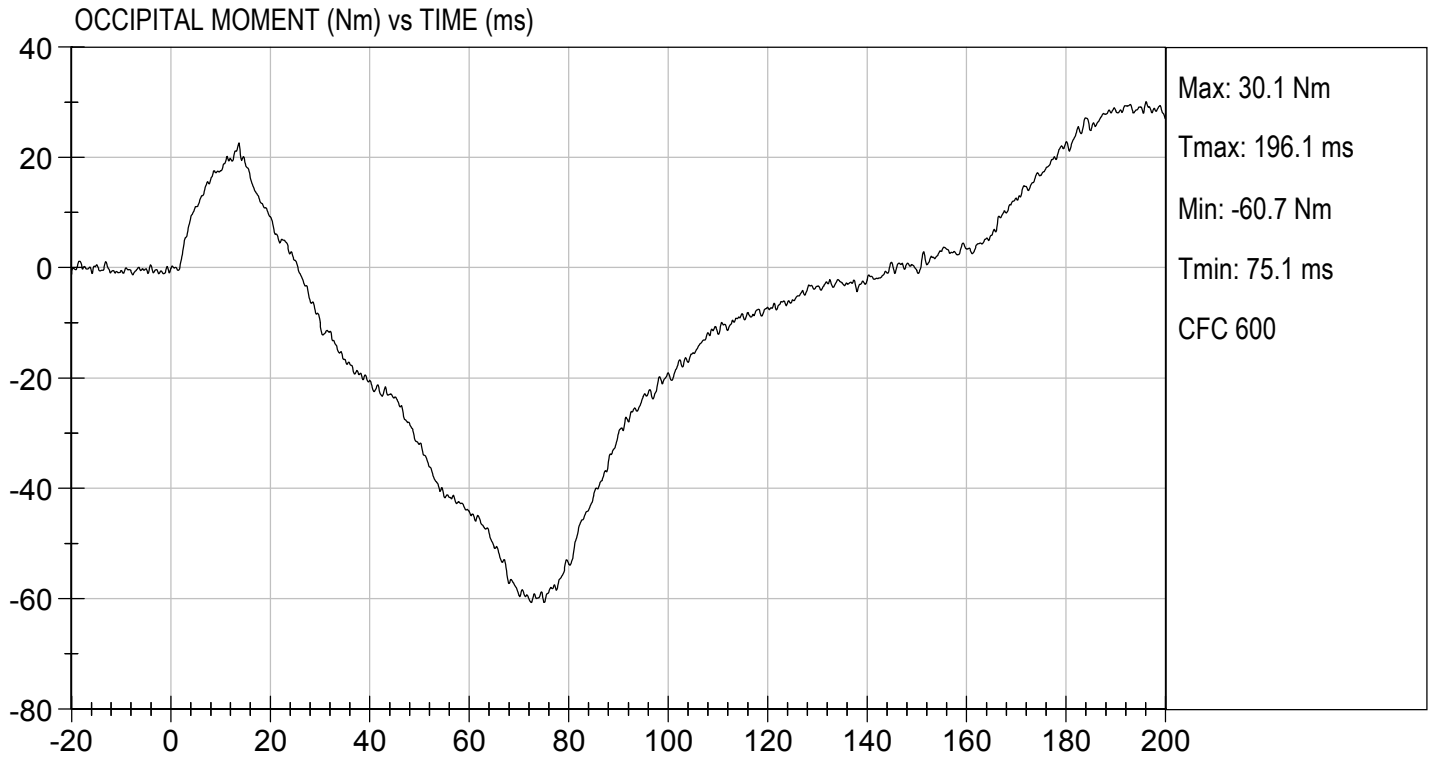


NECK ROTATION (DEG) vs TIME (ms)



TEST DESC: NECK EXTENSION
VELOCITY: 19.61 ft/s, 5.98 m/s

TEST DATE: 11/17/2017
TEST #: D173343



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173344

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,536	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.60	Pass
Internal Hysteresis	%	69 to 85	71	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

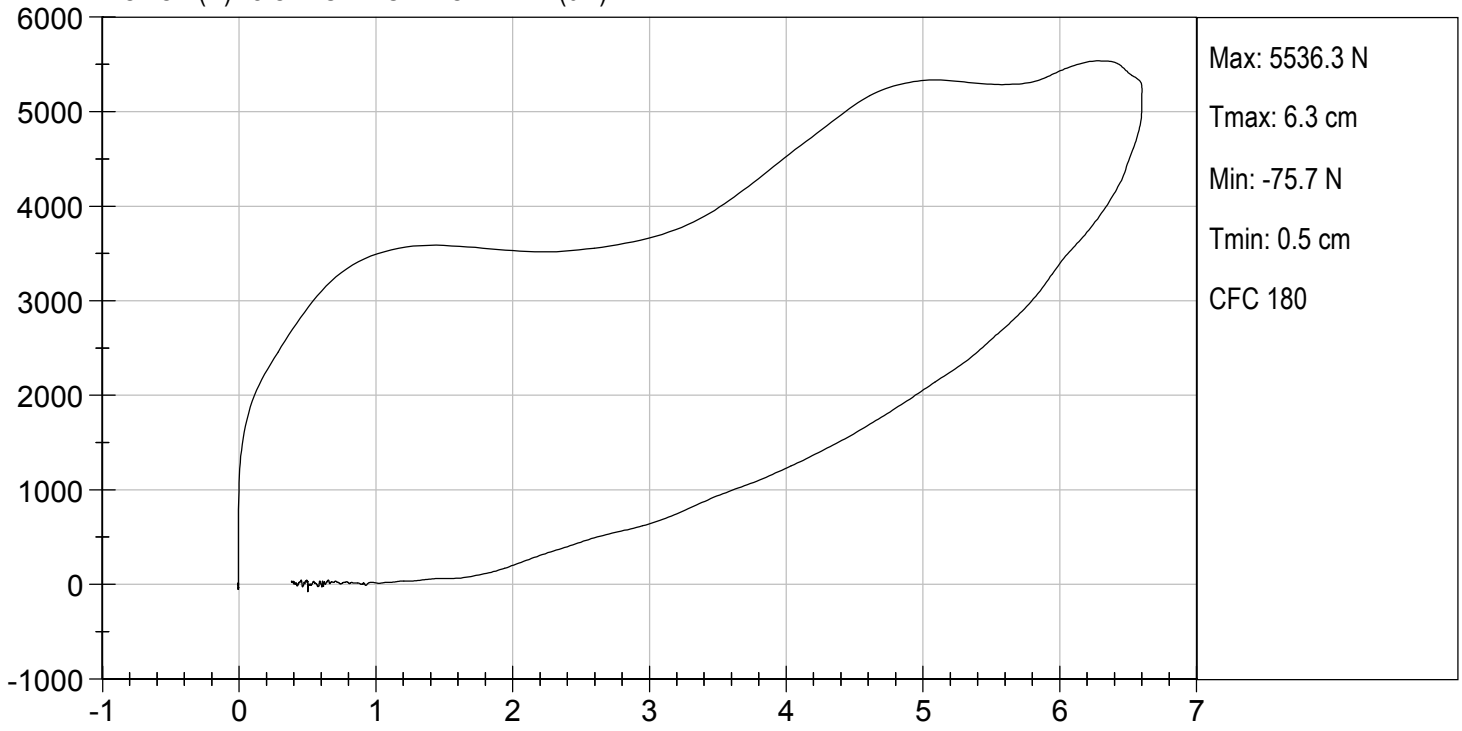
11/17/2017
Test Date

Approved By

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

TEST DATE: 11/17/2017
TEST #: D173344

FORCE (N) vs CHEST DISPLACEMENT (cm)



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 531 **Test I.D:** D173345

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Velocity	m/s	2.07 to 2.13	2.07	Pass
Peak Probe Force	N	4715 to 5782	5,583	Pass
		Overall Test Results		Pass

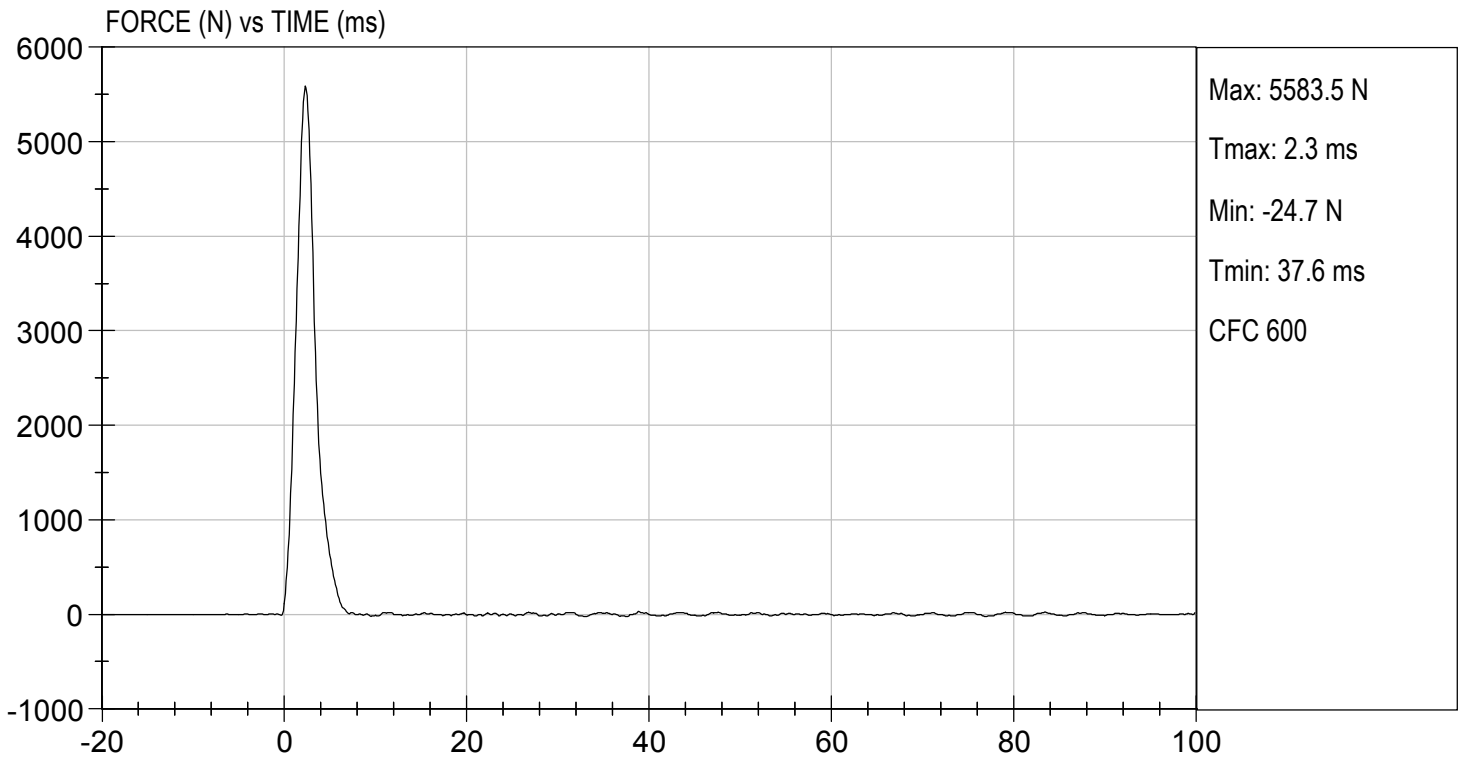
Emily Fliess
Laboratory Technician

11/16/2017
Test Date

Robert Schmidt
Approved By

TEST DESC: RIGHT KNEE
VELOCITY: 6.78 ft/s, 2.07 m/s

TEST DATE: 11/16/2017
TEST #: D173345



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 531 **Test I.D:** D173346

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Probe Velocity	m/s	2.07 to 2.13	2.09	Pass
Peak Probe Force	N	4715 to 5782	5,061	Pass
		Overall Test Results		Pass

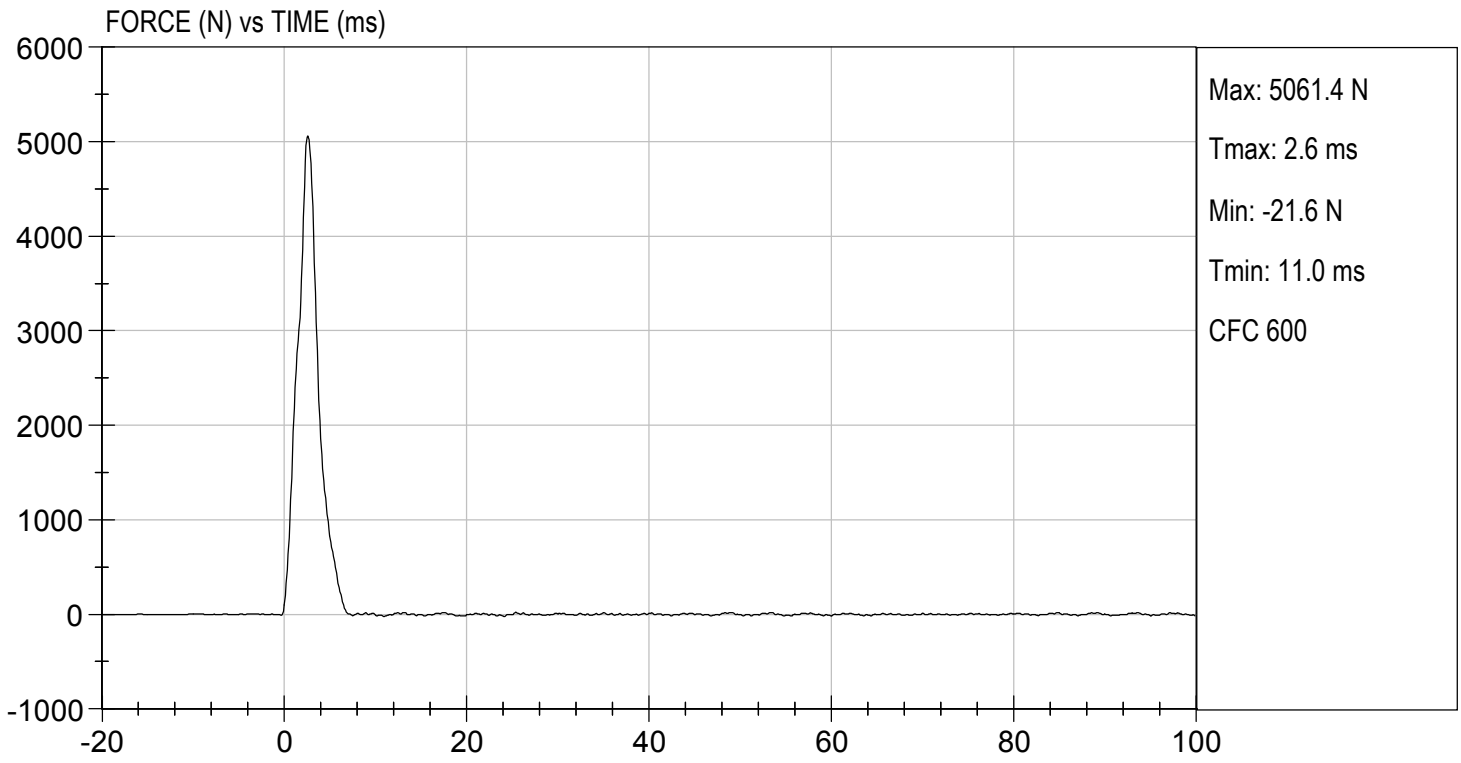
Emily Fliess
Laboratory Technician

11/16/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 11/16/2017
TEST #: D173346



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173340

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.9	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	34	34	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.5	6.4	Pass
30 Degrees	Nm	94.9 Nm Max	84.0	89.7	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	46.4	43.0	Pass
		Overall Test Results			Pass

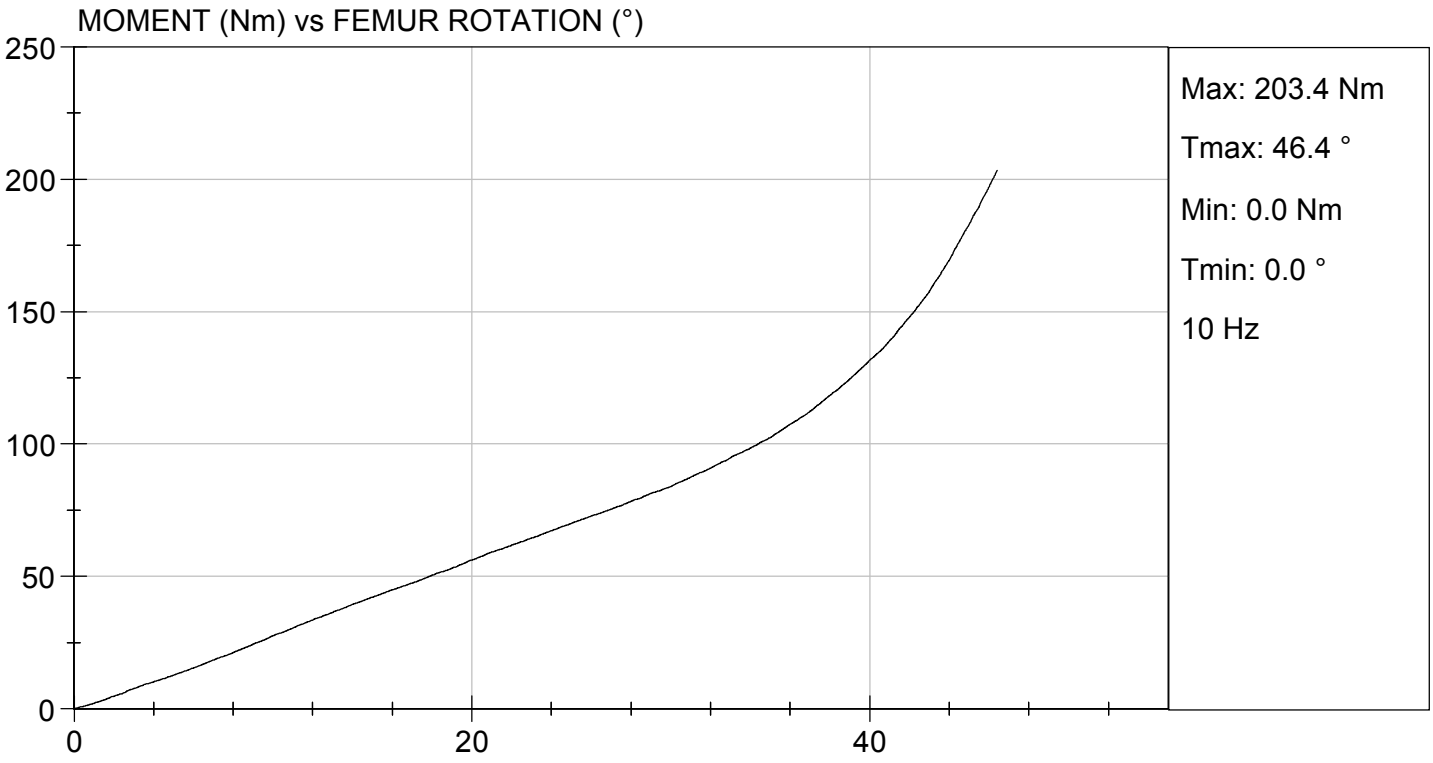
Emily Fliess
Laboratory Technician

11/16/2017
Test Date

Robert Schmulsky
Approved By

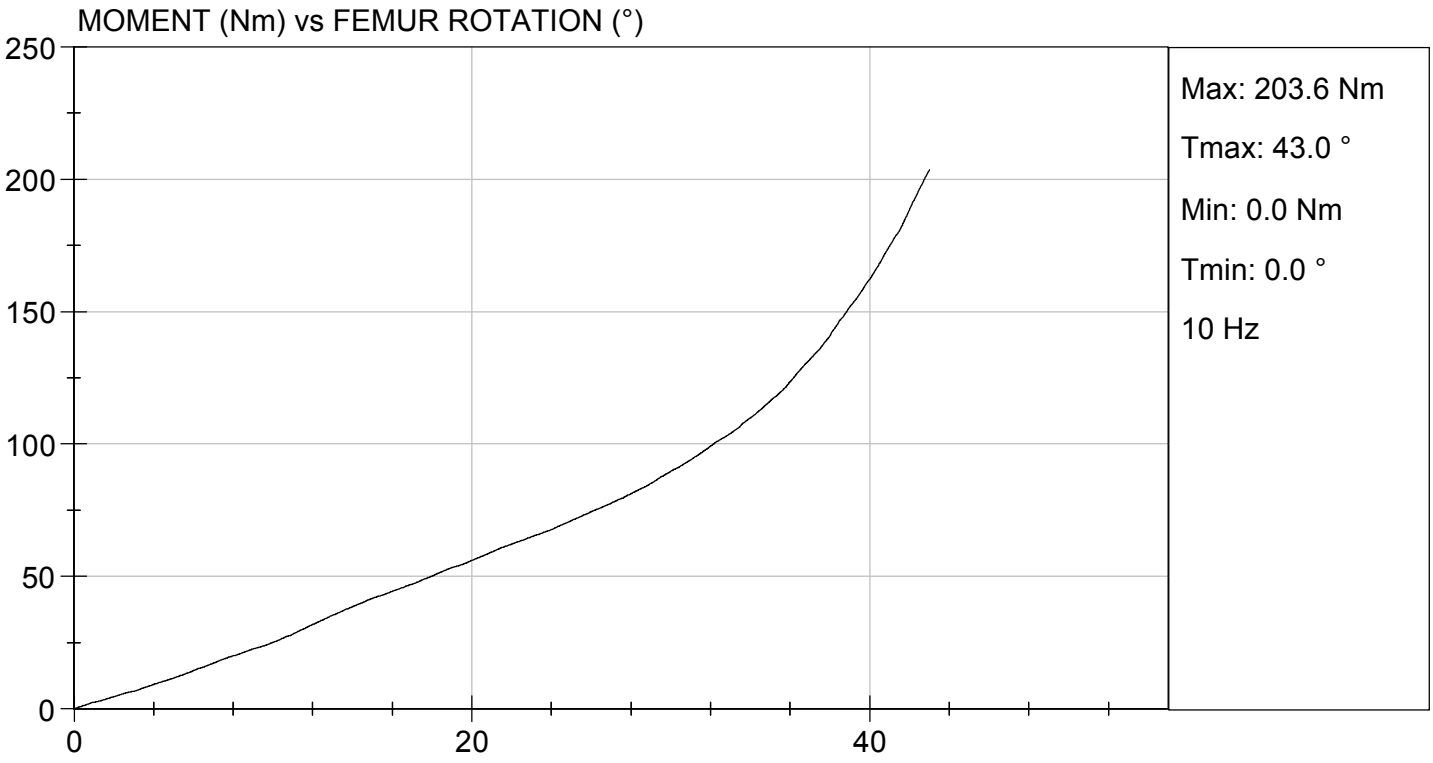
TEST DESC: RIGHT HIP FEMUR FLEXION

TEST DATE: 11/16/2017
TEST #: D173349



TEST DESC: LEFT HIP FEMUR FLEXION

TEST DATE: 11/16/2017
TEST #: D173340



MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test ID:** D173521

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	29	Pass
Peak Resultant Acceleration	G's	225 to 275	253	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	5.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Laboratory Technician

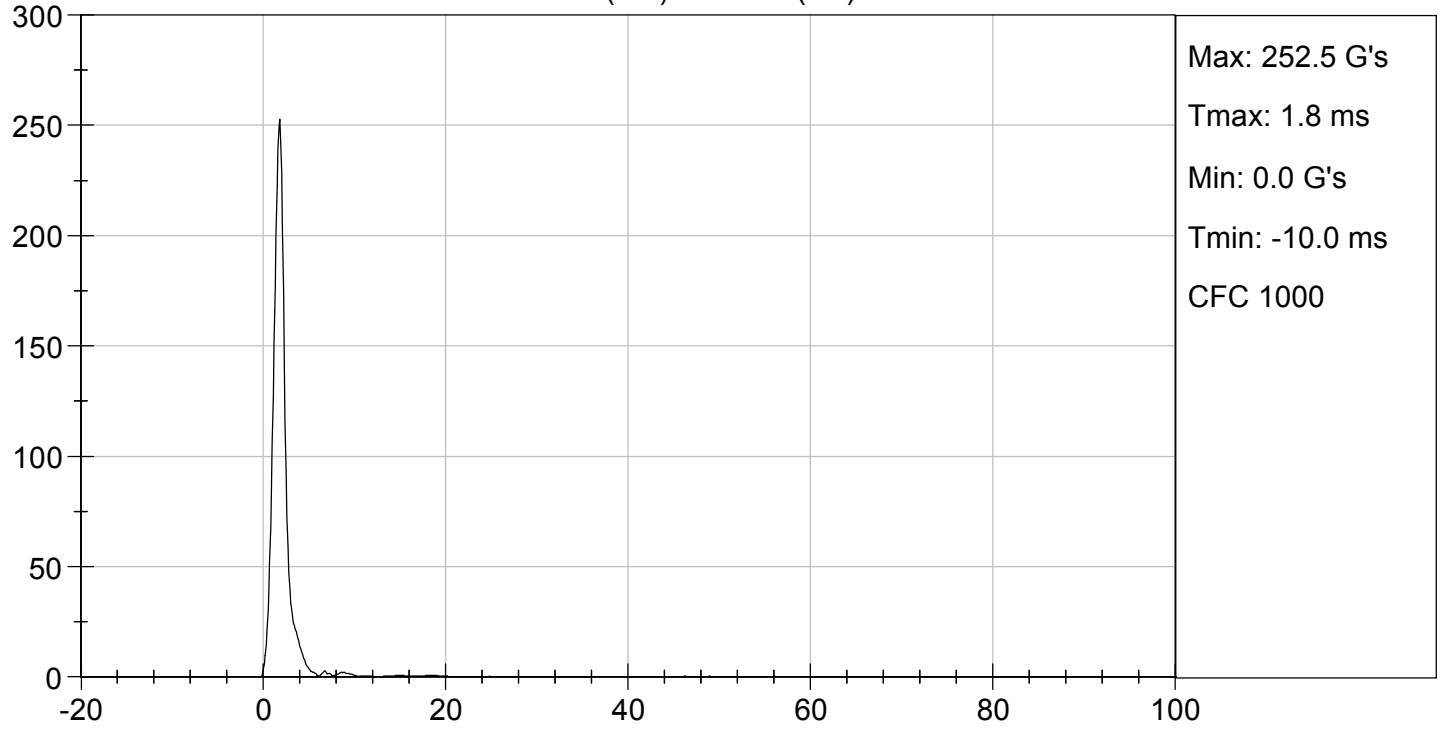
12/01/2017
Test Date

Approved By

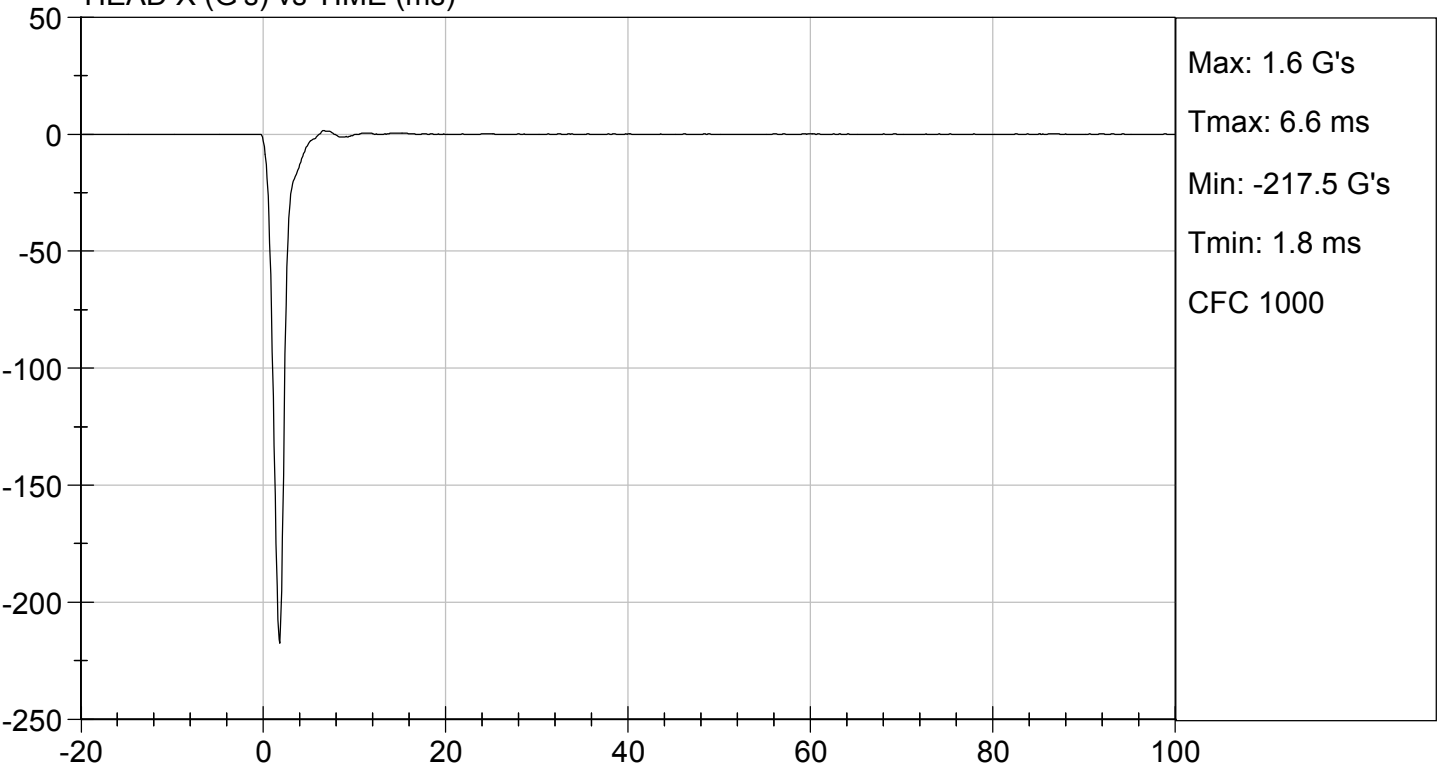
TEST DESC: HEAD DROP

TEST DATE: 12/01/2017
TEST #: D173521

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

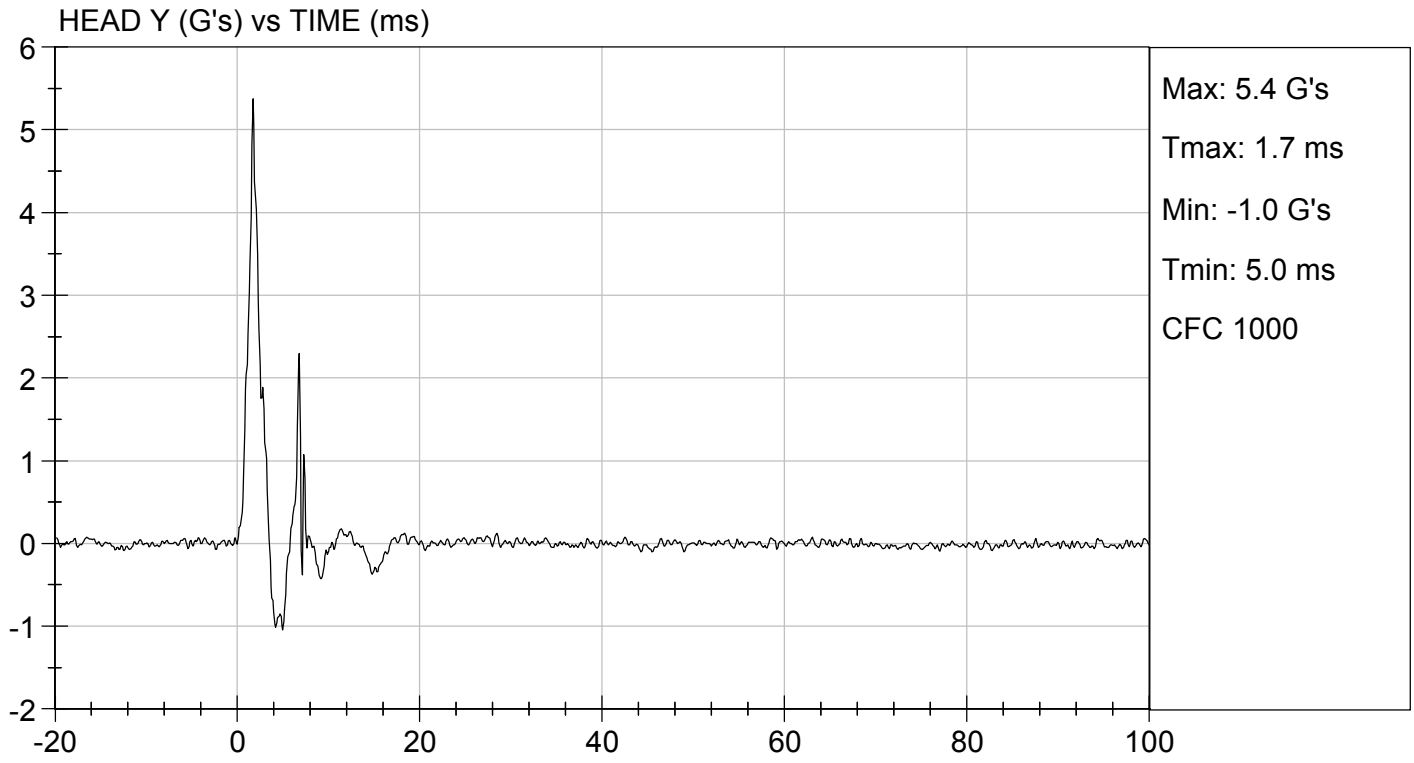


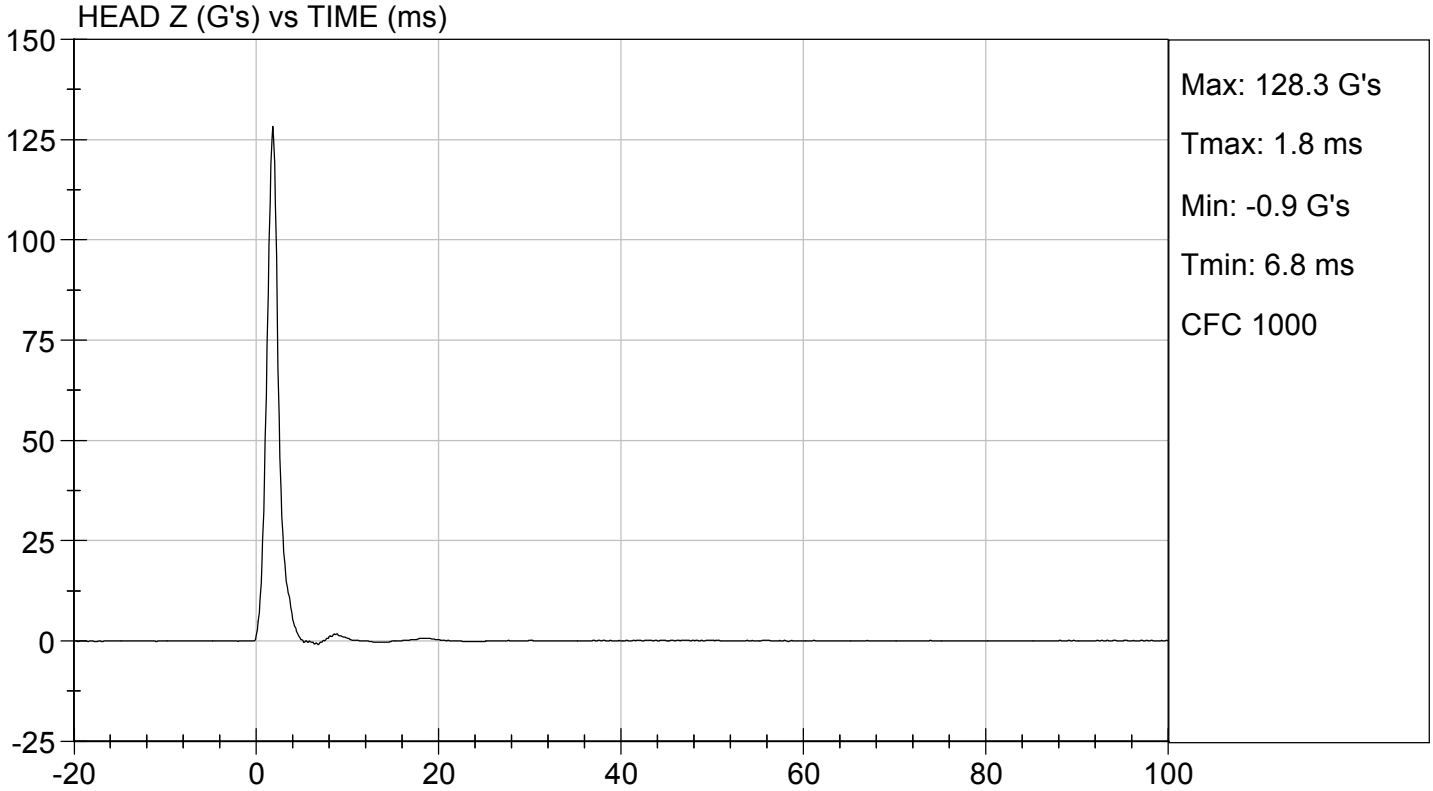
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 12/01/2017
TEST #: D173521





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173522

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	29	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.39	Pass
	20 ms	G's	17.60 to 22.60	20.00	Pass
	30 ms	G's	12.50 to 18.50	14.82	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	14.7	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	37.8	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	71.2	Pass
	Time	ms	57.0 to 64.0	60.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	121.2	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	92.7	Pass
	Time	ms	47.0 to 58.0	50.2	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	100.6	Pass
			Overall Test Results		Pass

Laboratory Technician

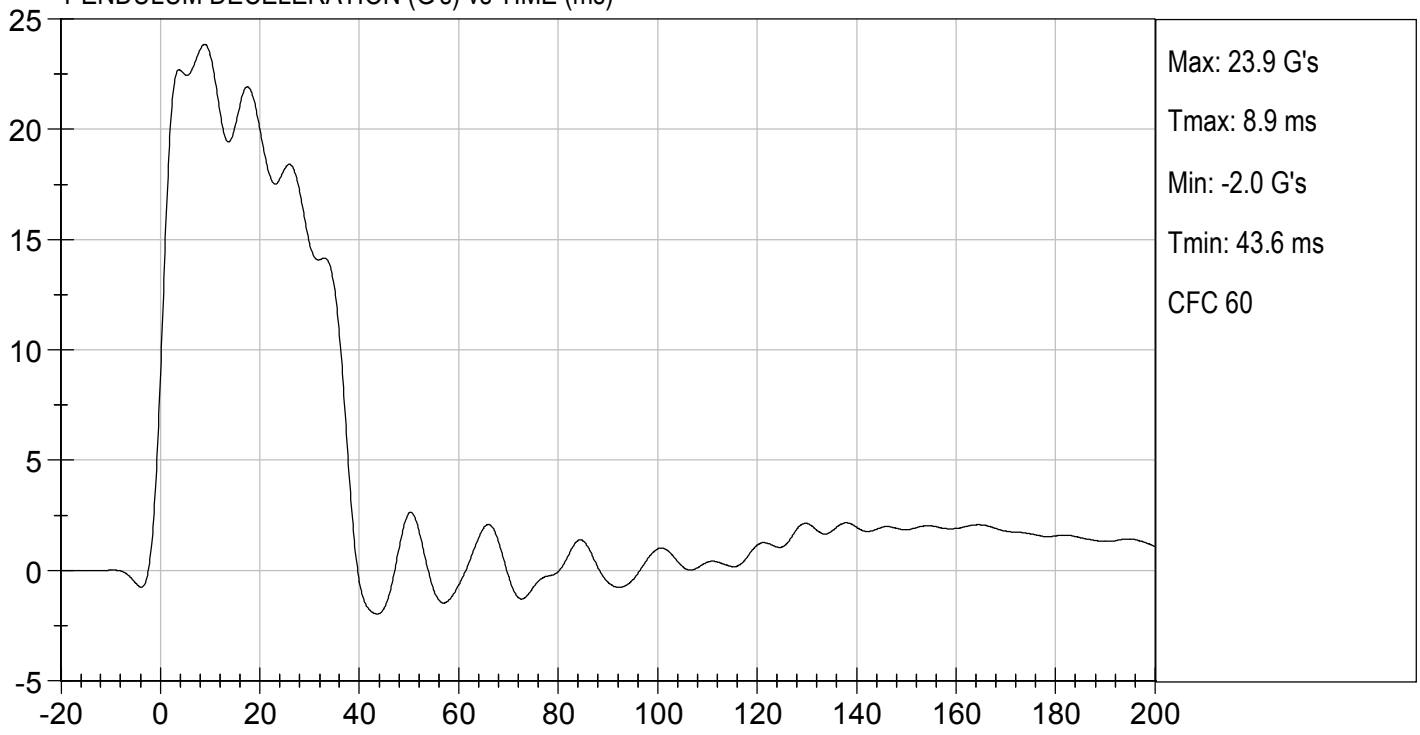
12/01/2017
Test Date

Approved By

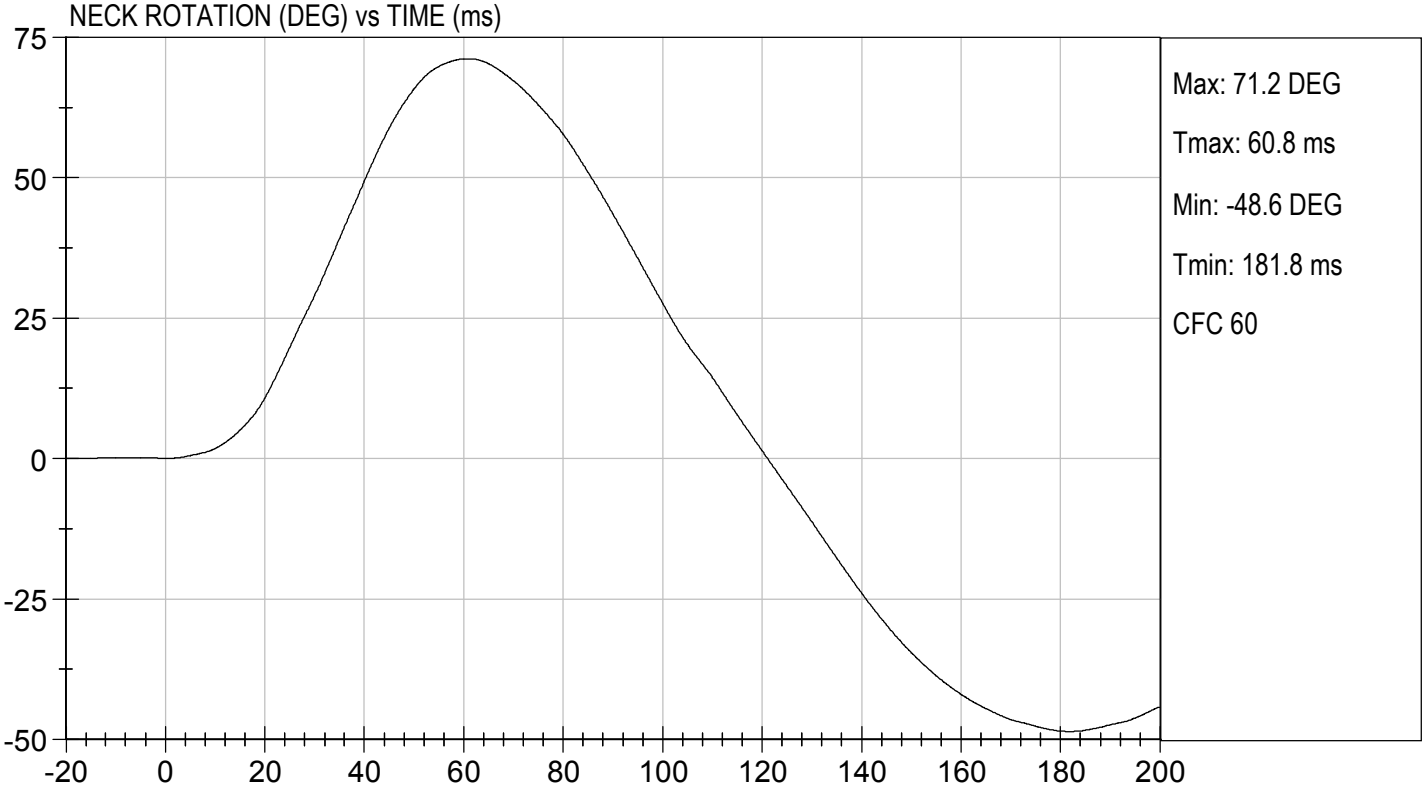
TEST DESC: NECK FLEXION
VELOCITY: 22.83 ft/s, 6.96 m/s

TEST DATE: 12/01/2017
TEST #: D173522

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

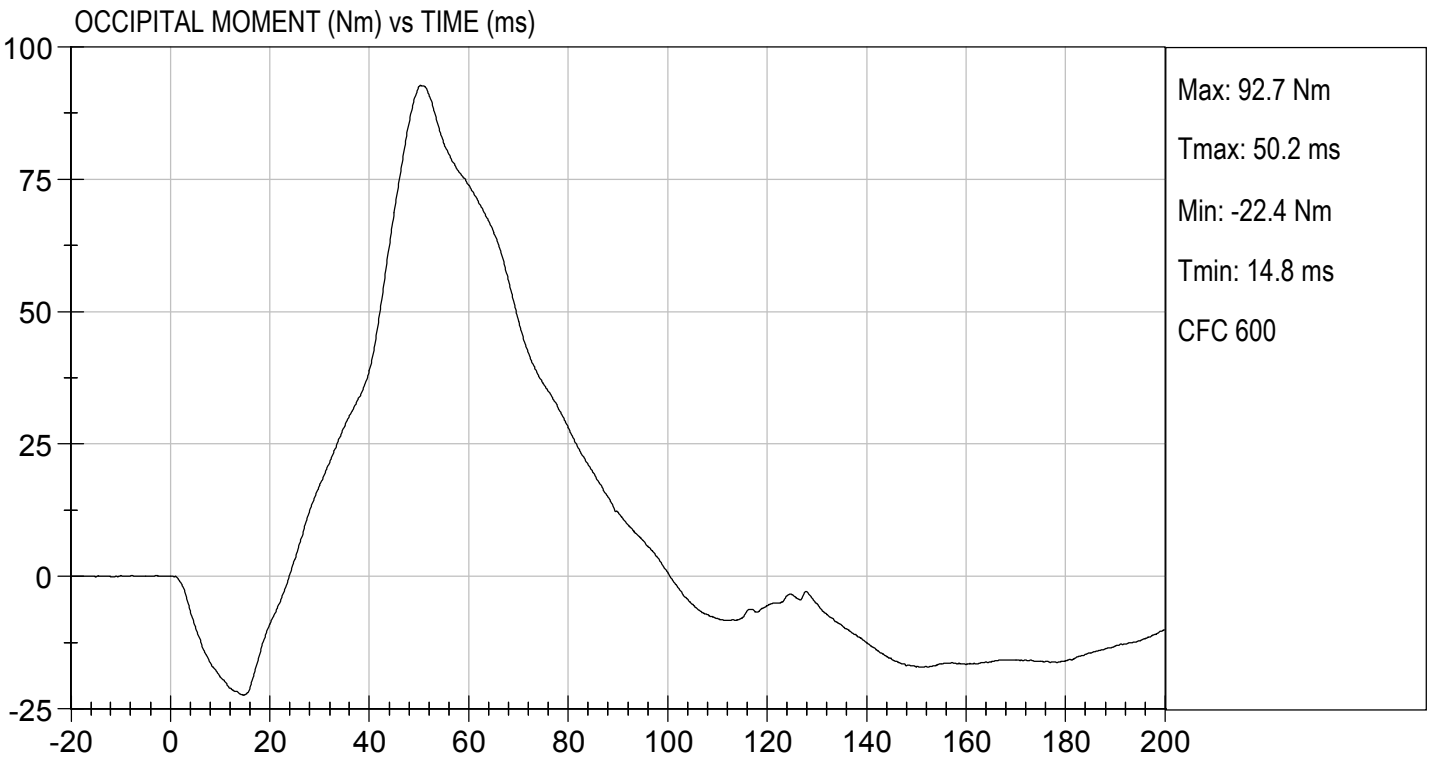


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 12/01/2017
TEST #: D173522



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173523

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	29	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.07	Pass
	20 ms	G's	14.00 to 19.00	16.80	Pass
	30 ms	G's	11.00 to 16.00	13.56	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.5	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	94.9	Pass
	Time	ms	72.0 to 82.0	79.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	166.1	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.0	Pass
	Time	ms	65.0 to 79.0	73.2	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	144.5	Pass
			Overall Test Results		Pass

Laboratory Technician

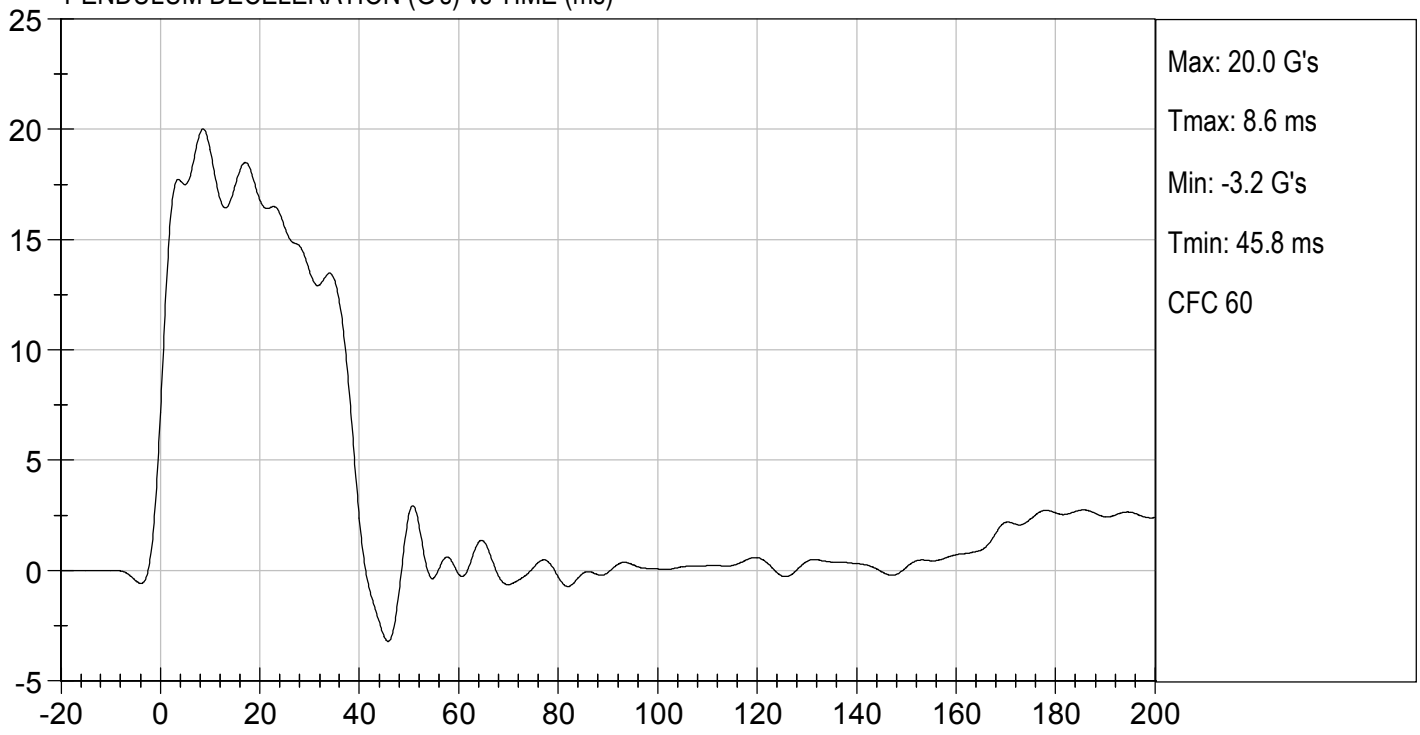
12/01/2017
Test Date

Approved By

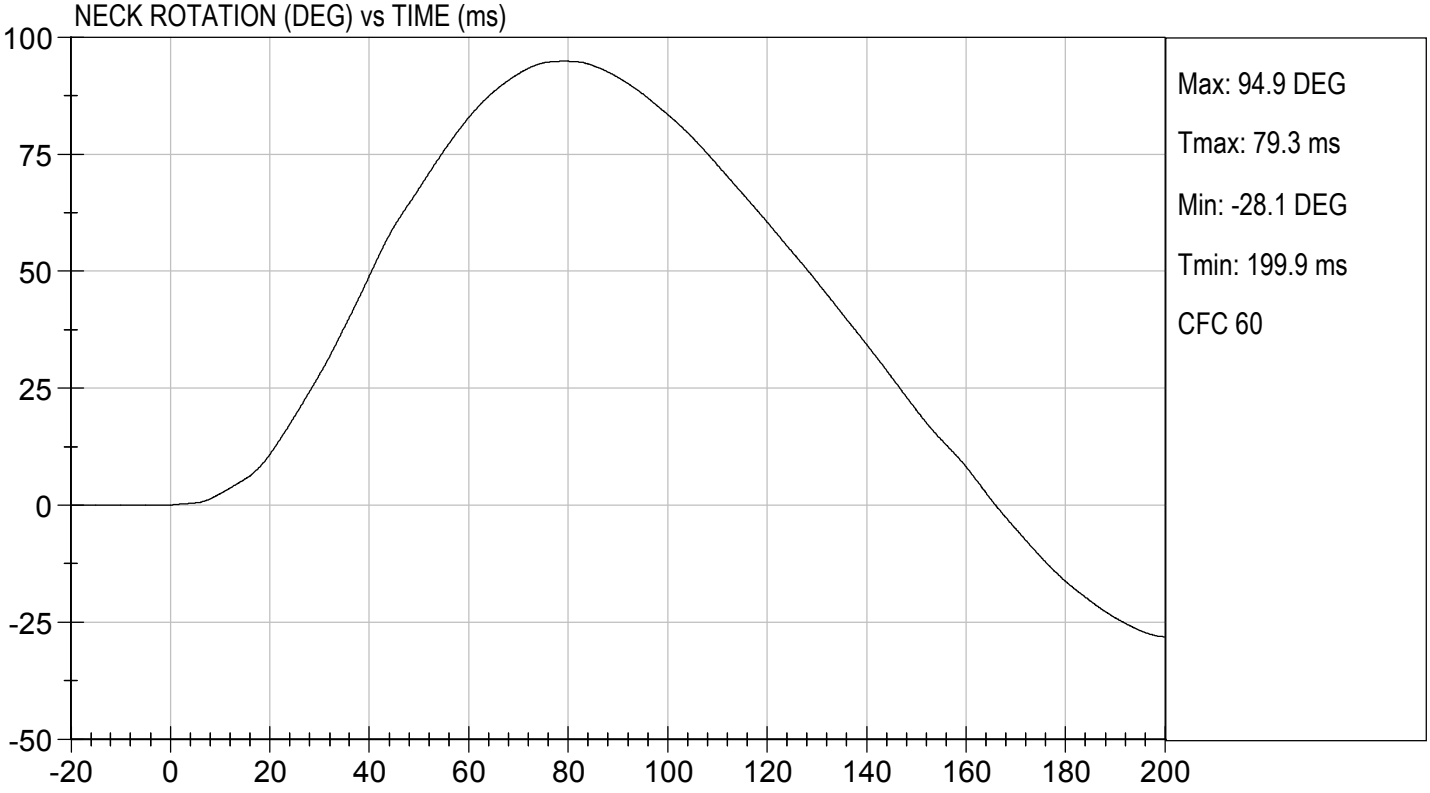
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 12/01/2017
TEST #: D173523

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

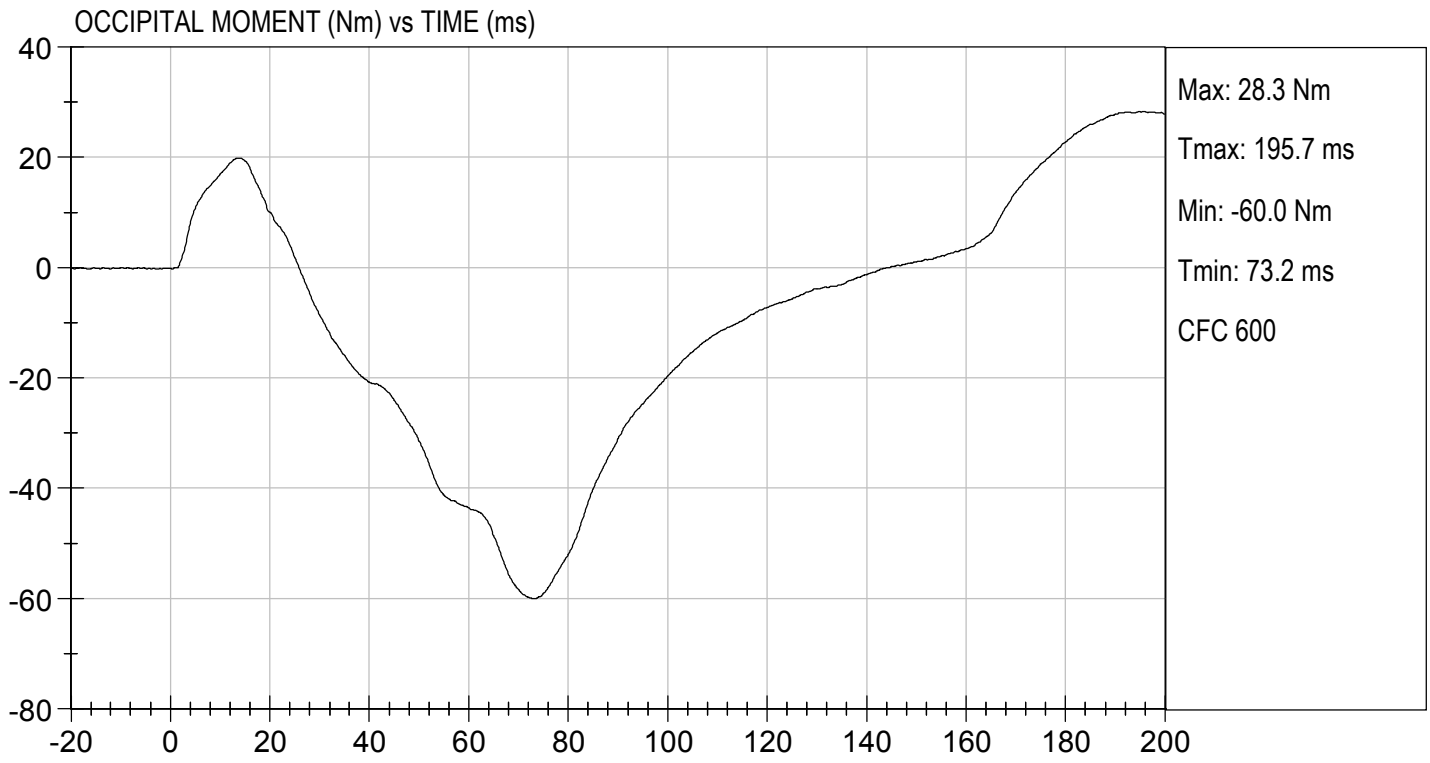


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 12/01/2017
TEST #: D173523



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173524

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,633	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.79	Pass
Internal Hysteresis	%	69 to 85	70	Pass
		Overall Test Results		Pass

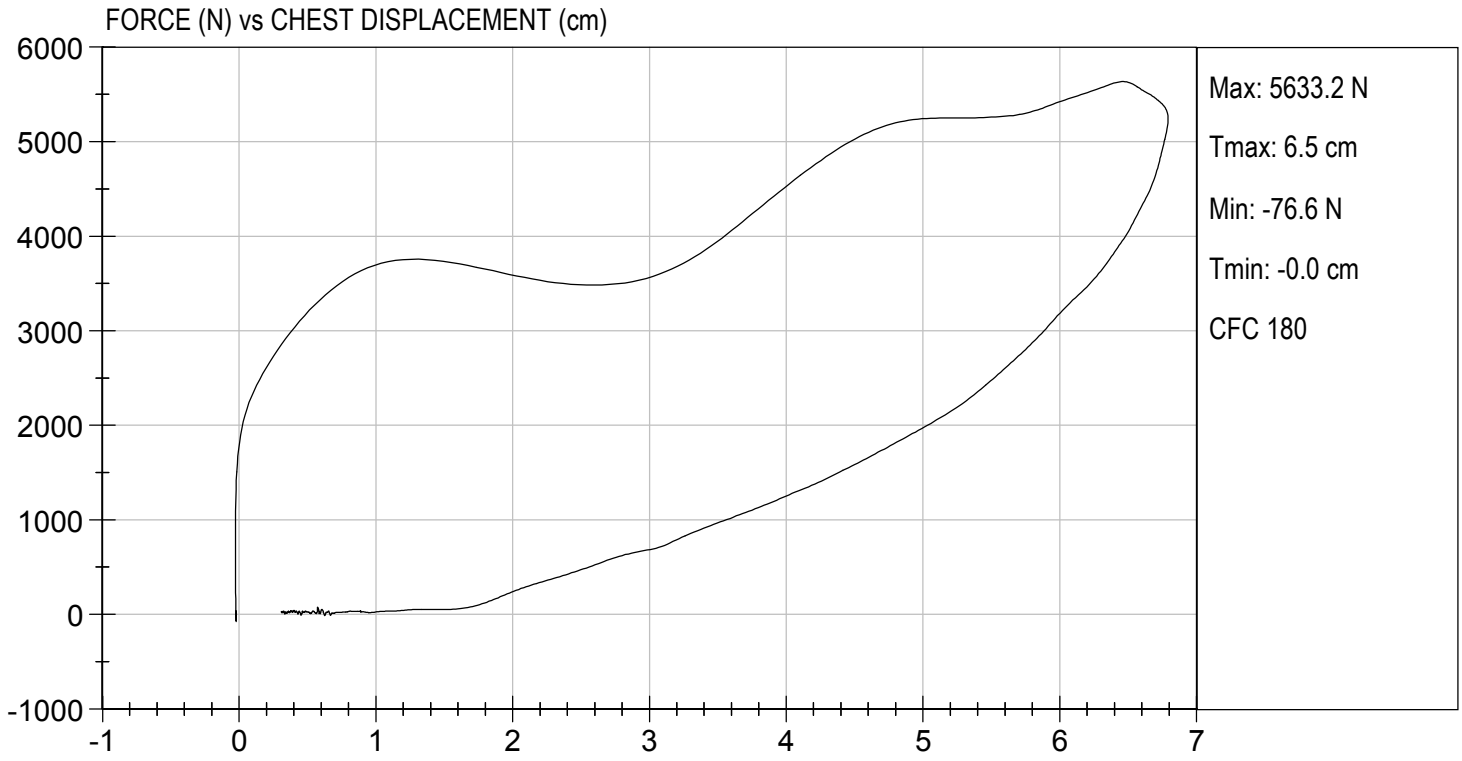
Danielle Redenbaugh
Laboratory Technician

12/01/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 12/01/2017
TEST #: D173524



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173525

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	29	Pass
Probe Velocity	m/s	2.07 to 2.13	2.09	Pass
Peak Probe Force	N	4715 to 5782	5,255	Pass
		Overall Test Results		Pass

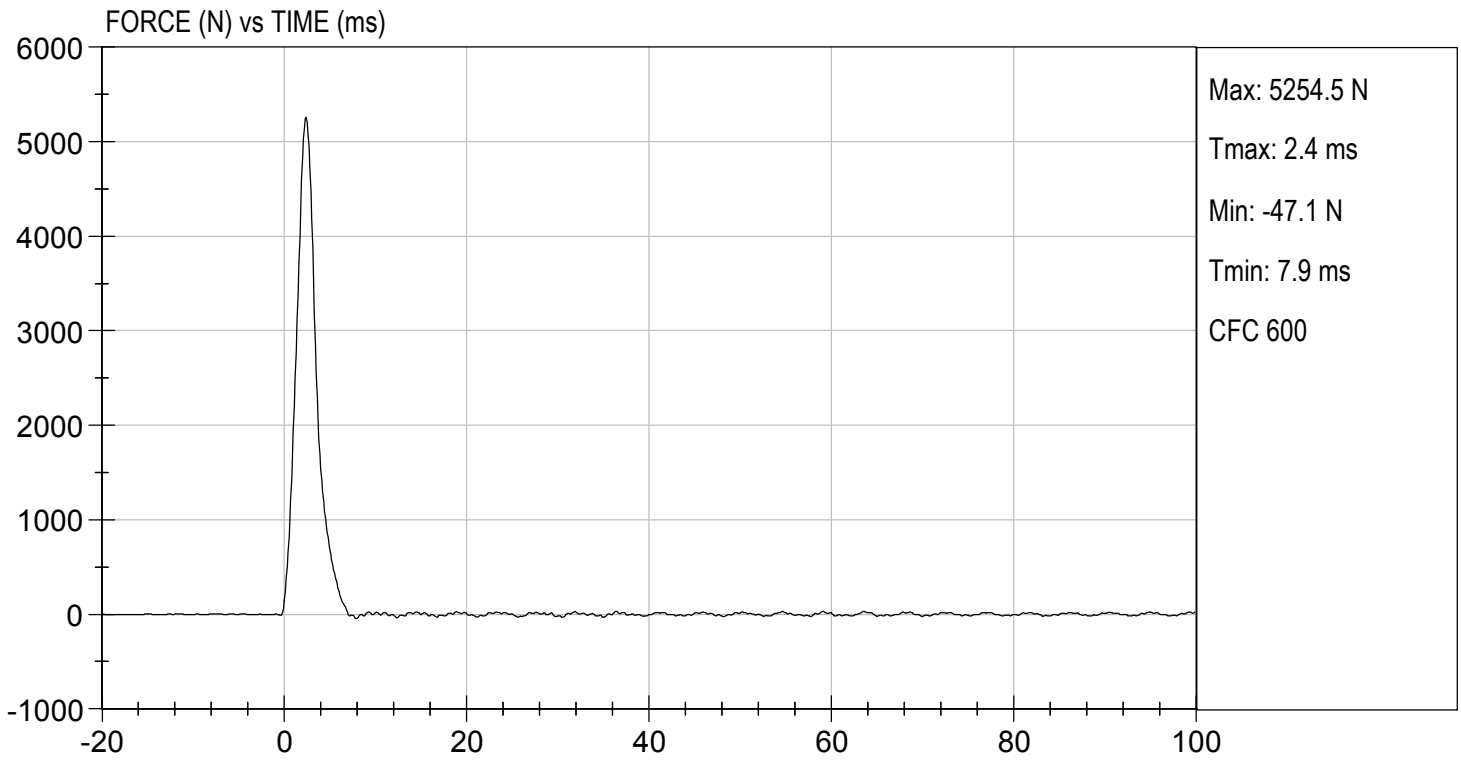
Danielle Redenbaugh
Laboratory Technician

12/01/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 12/01/2017
TEST #: D173525



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173526

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	29	Pass
Probe Velocity	m/s	2.07 to 2.13	2.07	Pass
Peak Probe Force	N	4715 to 5782	5,176	Pass
		Overall Test Results		Pass

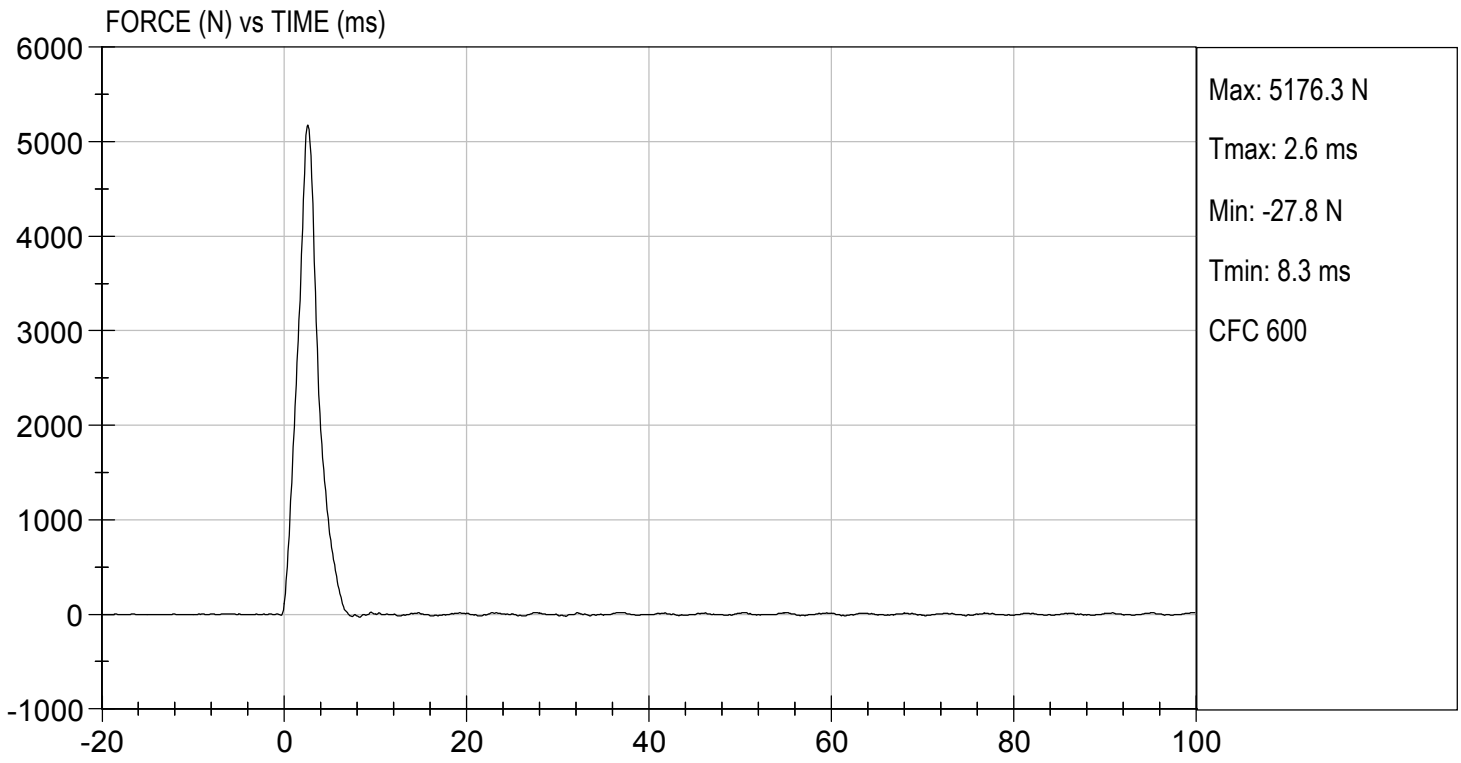
Danielle Redinbaugh
Laboratory Technician

12/01/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 12/01/2017
TEST #: D173526



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351 **Test I.D:** D173520

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.9	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	29	29	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.5	6.4	Pass
30 Degrees	Nm	94.9 Nm Max	94.9	90.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	45.9	43.3	Pass
		Overall Test Results			Pass

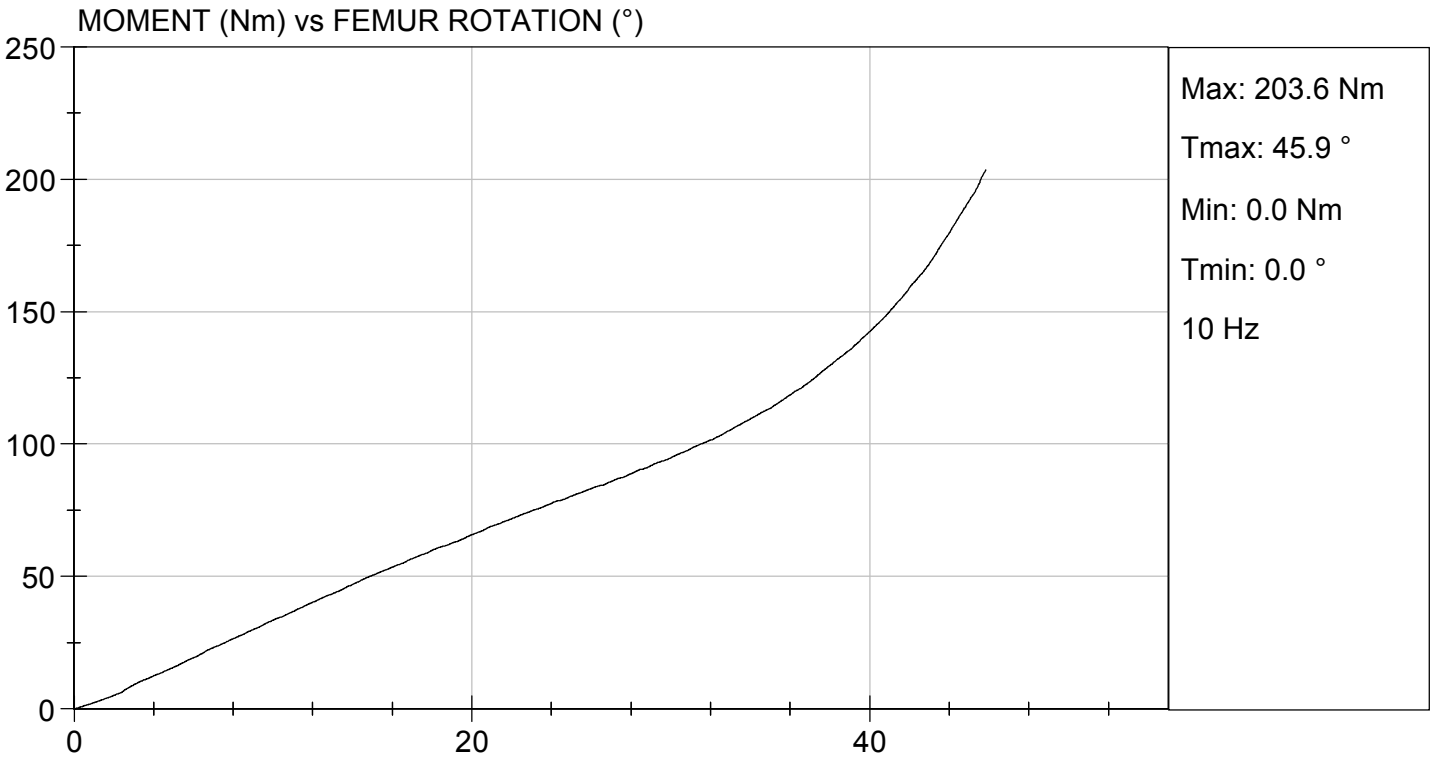
Danielle Redinbaugh
Laboratory Technician

12/01/2017
Test Date

Robert Schmidt
Approved By

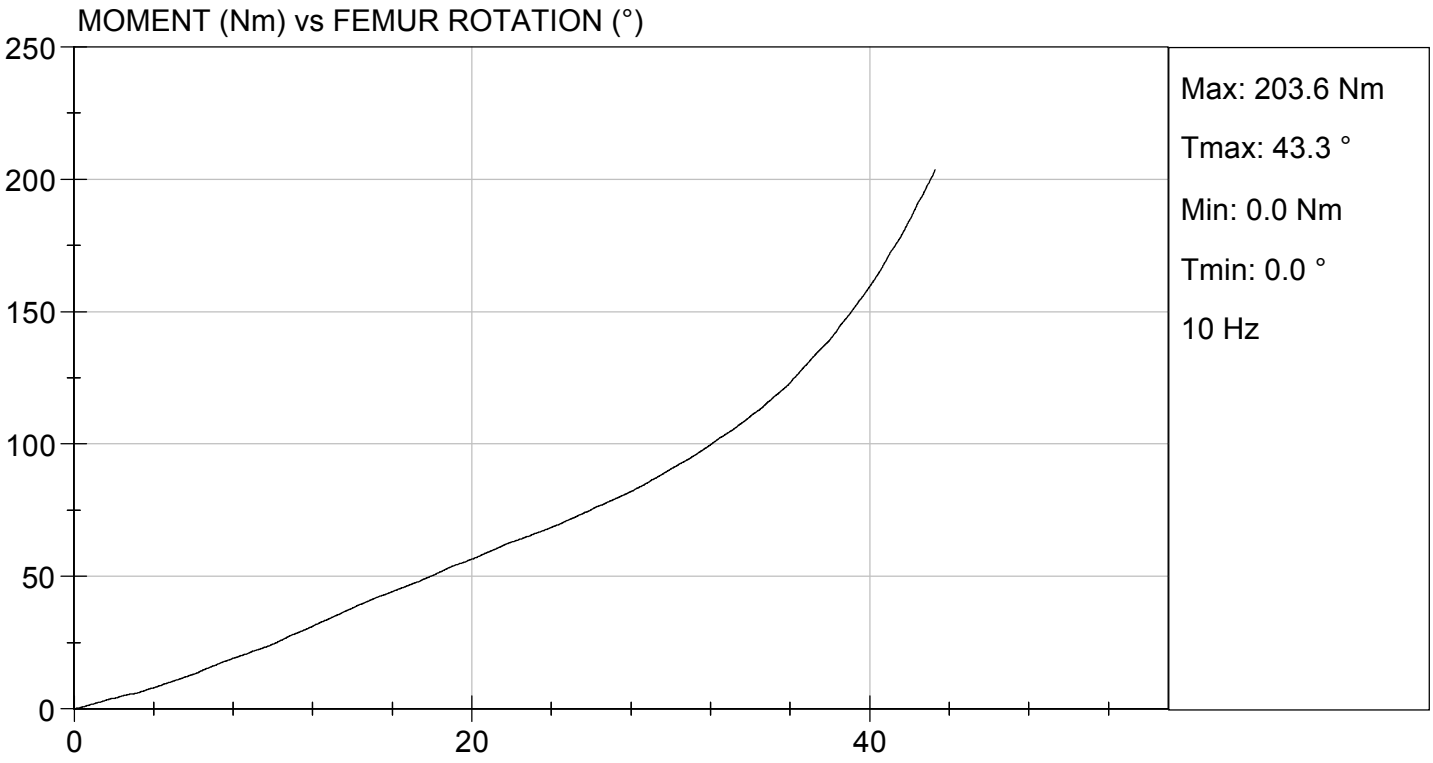
TEST DESC: RIGHT HIP FEMUR FLEXION

TEST DATE: 12/01/2017
TEST #: D173529



TEST DESC: LEFT HIP FEMUR FLEXION

TEST DATE: 12/01/2017
TEST #: D173520



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:** D173201

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Peak Resultant Acceleration	G's	250 to 300	281	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-4.2	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

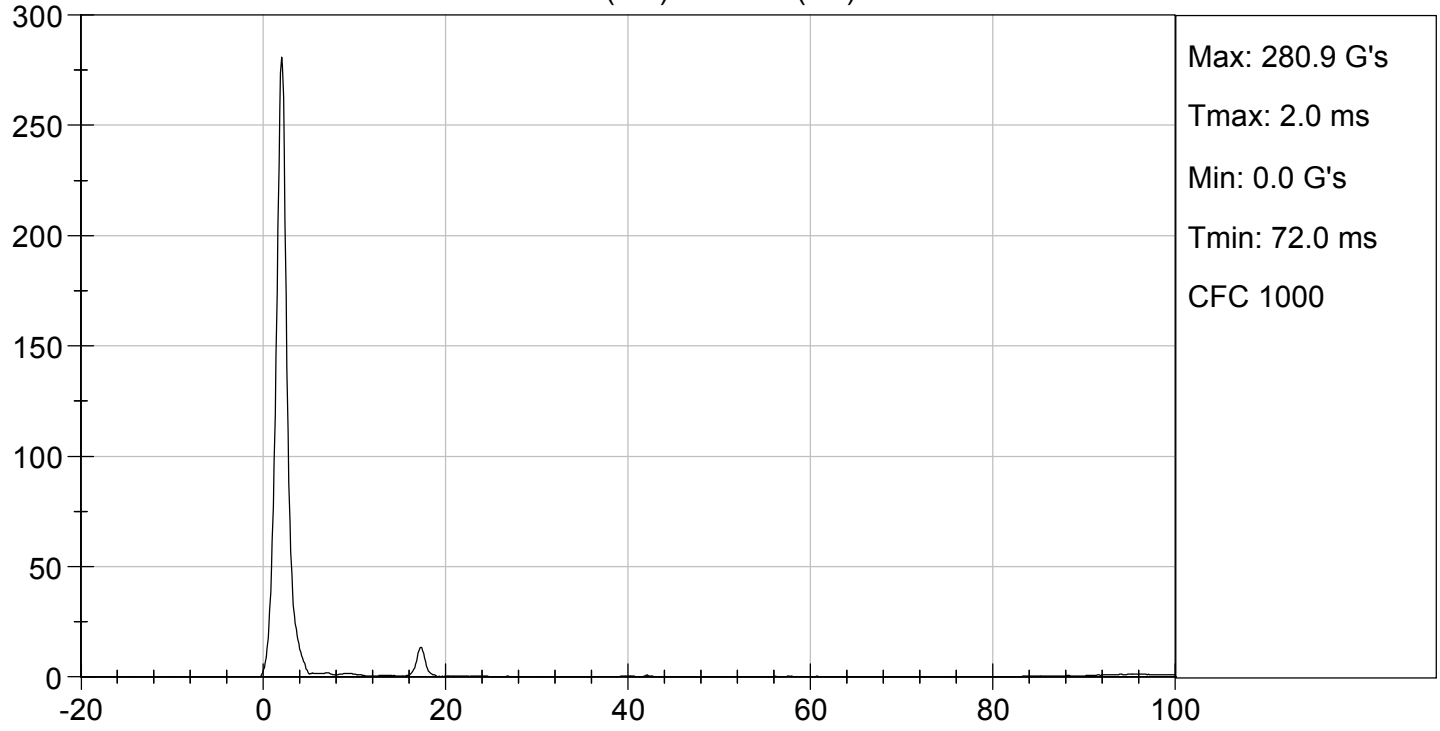
11/02/2017
Test Date

Robert Schwabey
Approved By

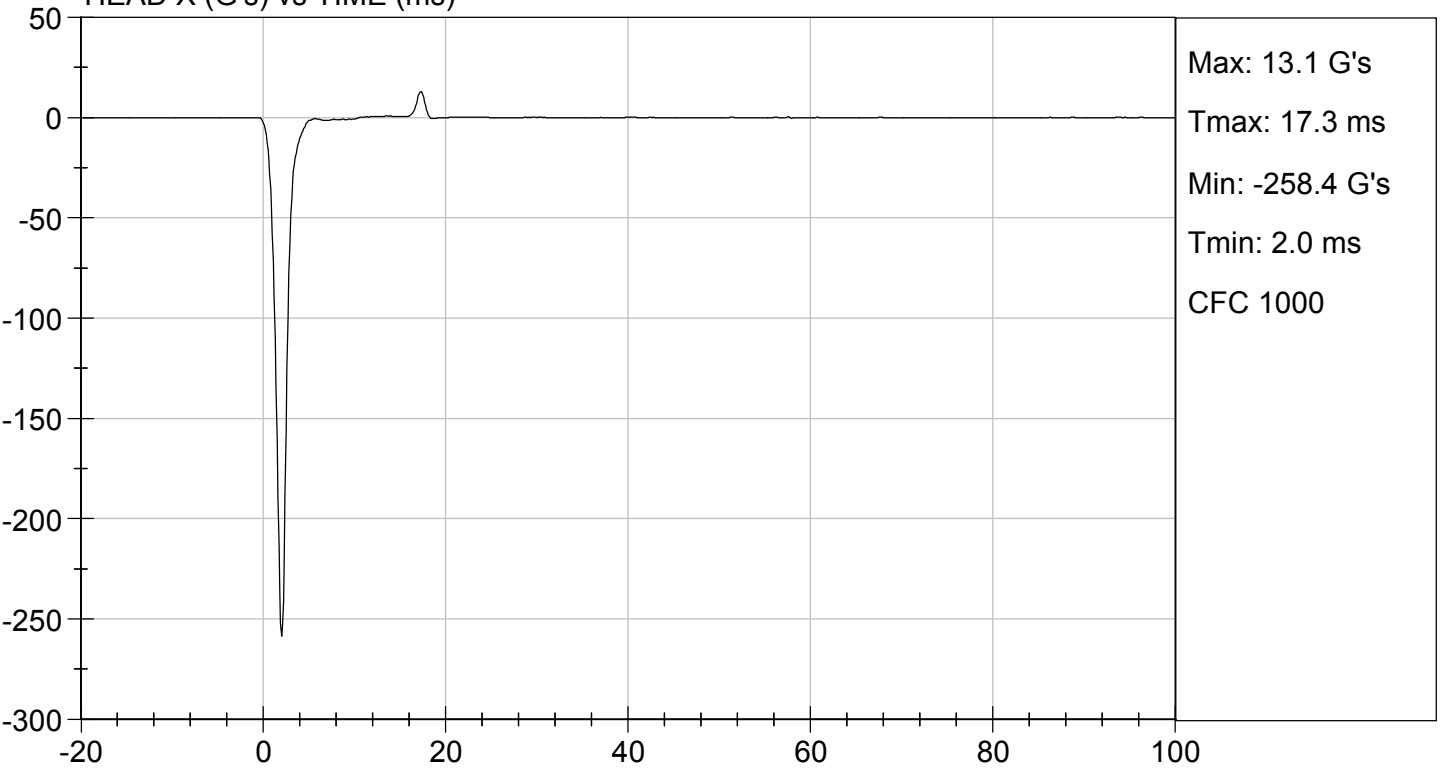
TEST DESC: HEAD DROP

TEST DATE: 11/02/2017
TEST #: D173201

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

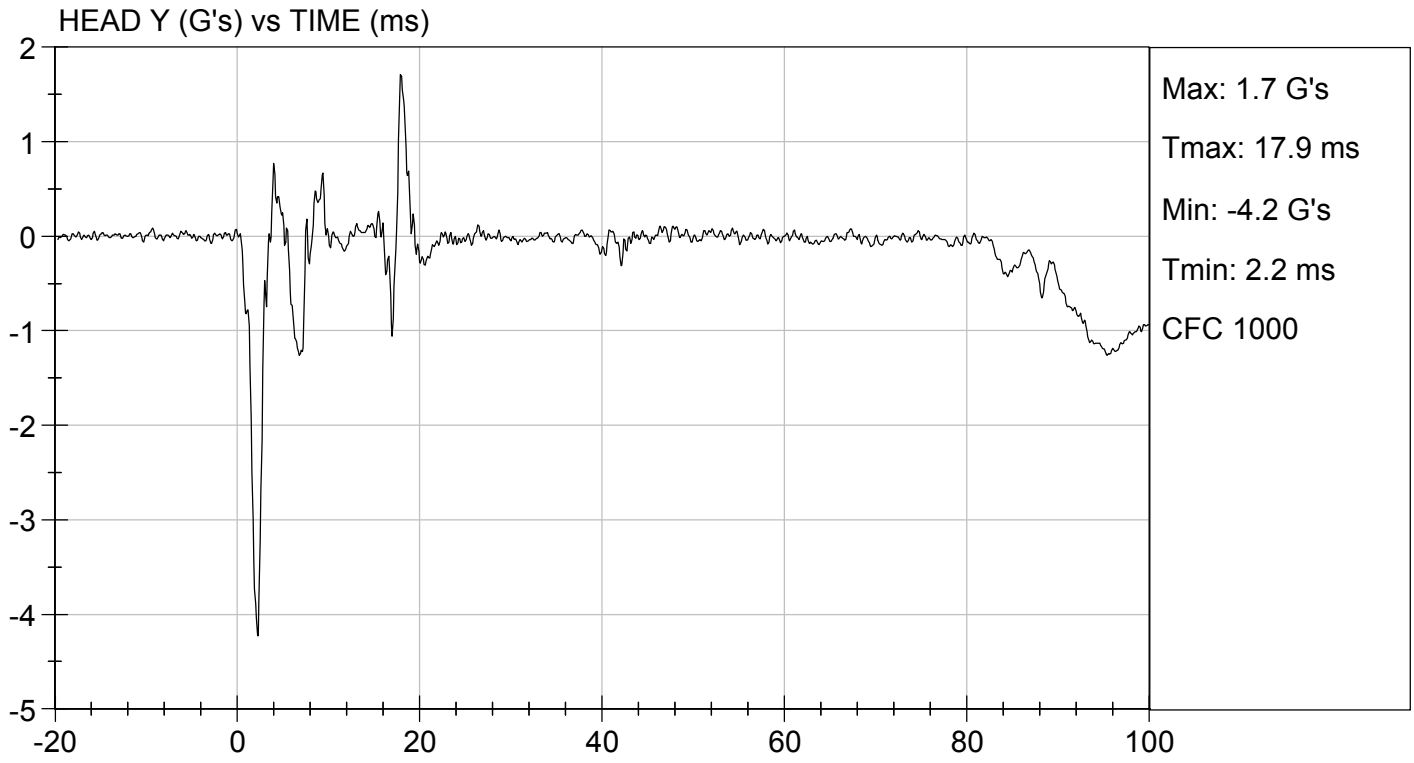


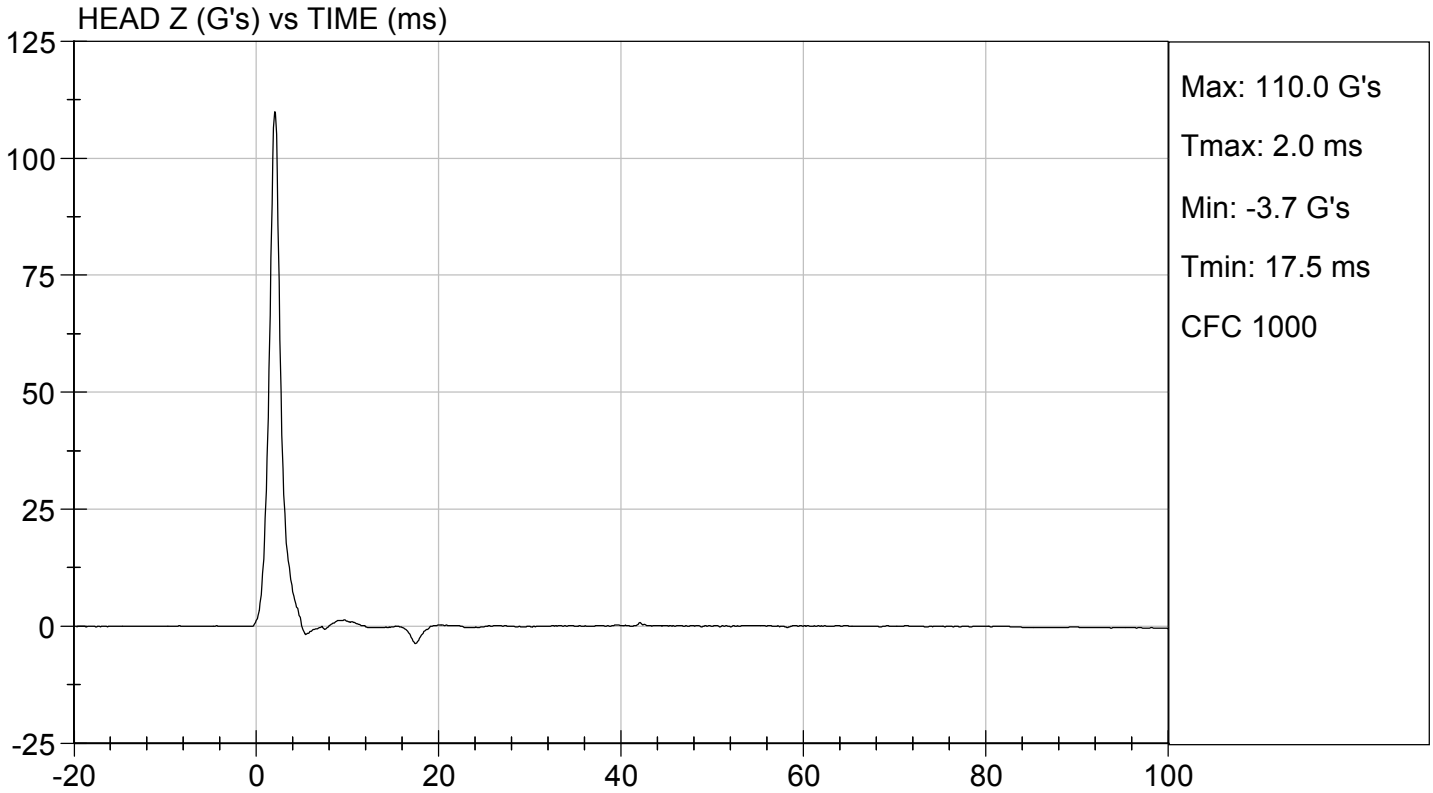
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 11/02/2017
TEST #: D173201





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173202A

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	33	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.07	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.6	Pass
	30 ms	m/s	5.8 to 7.0	6.7	Pass
D Plane Rotation	Max	deg	77 to 91	86	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	70	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	86	Pass
			Overall Results		Pass

Danielle Redinbaugh
Laboratory Technician

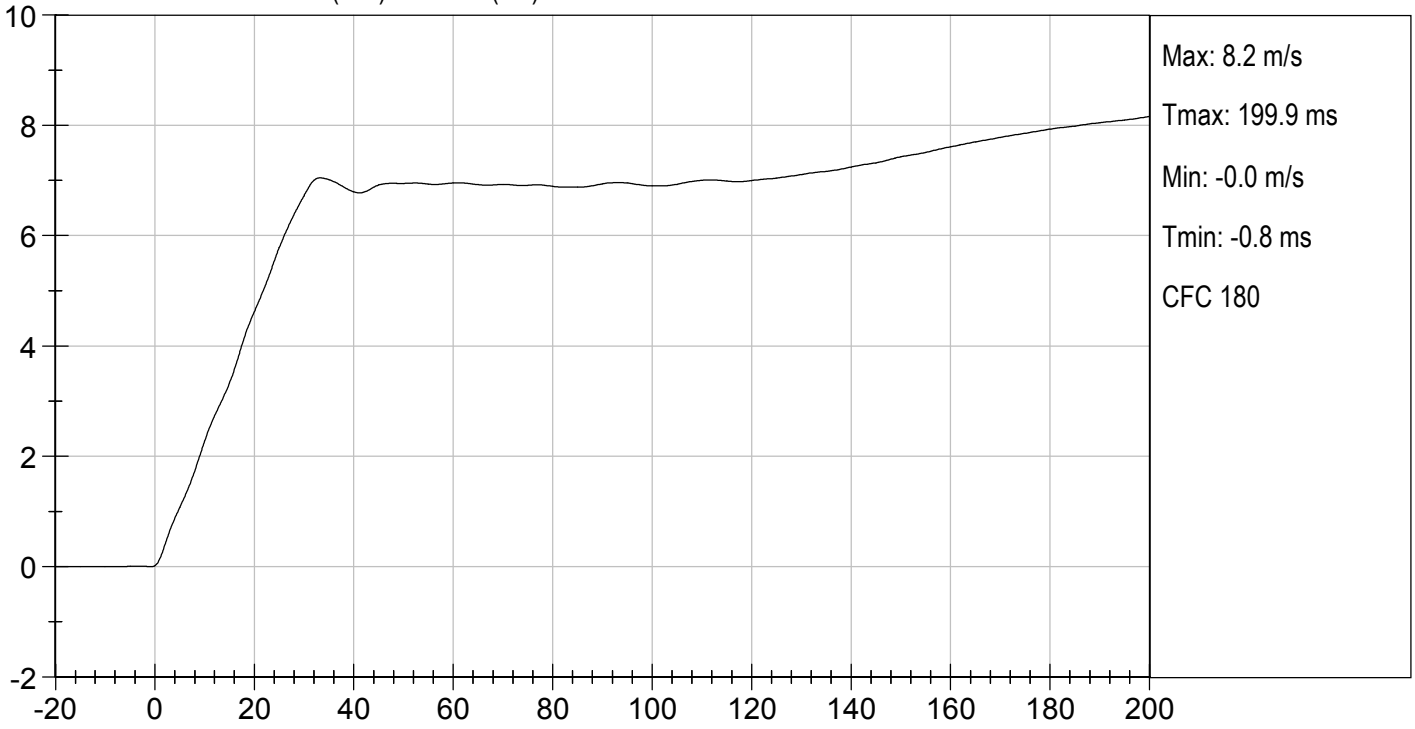
11/03/2017
Test Date

Robert Schnabel
Approved By

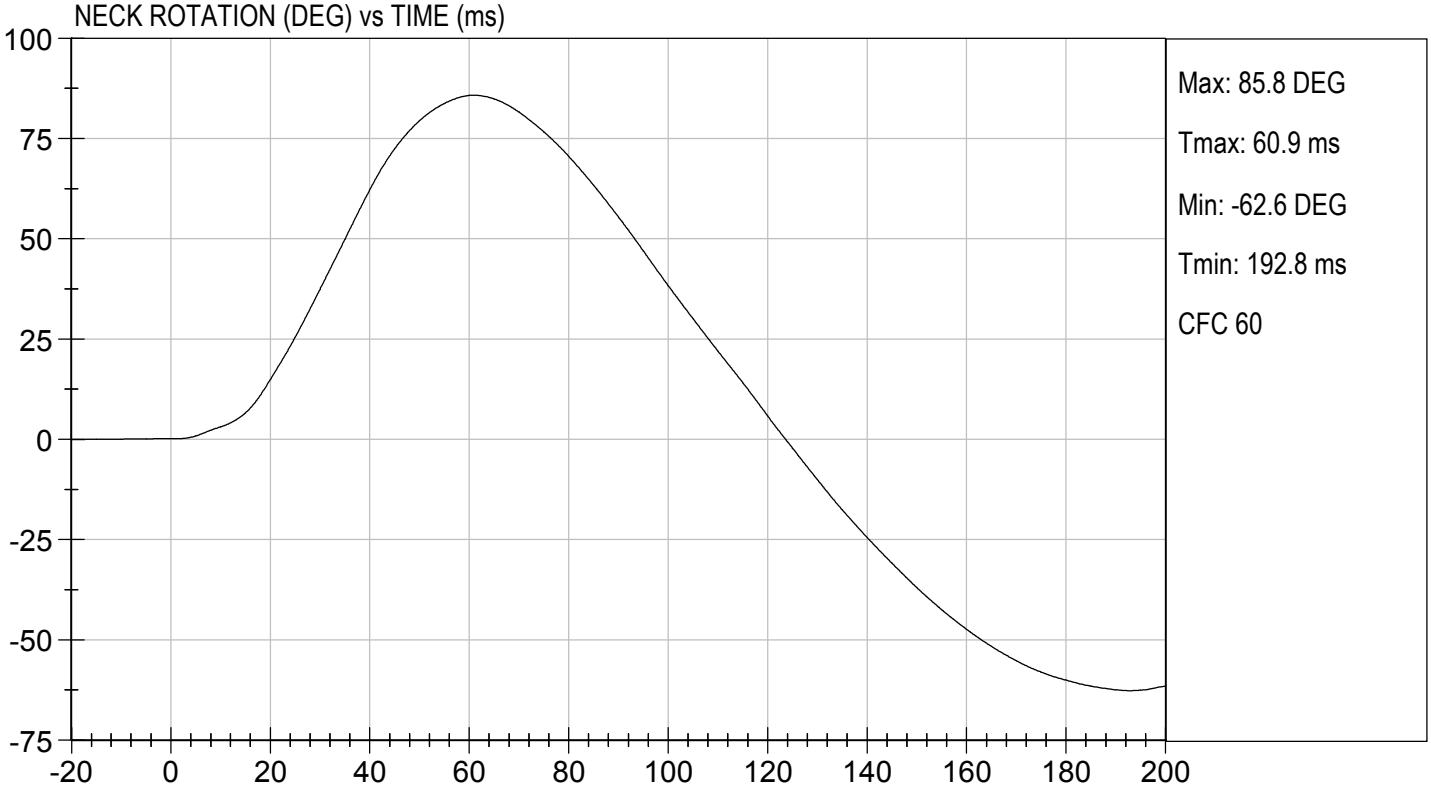
TEST DESC: NECK FLEXION
VELOCITY: 23.20 ft/s, 7.07 m/s

TEST DATE: 11/03/2017
TEST #: D173202A

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

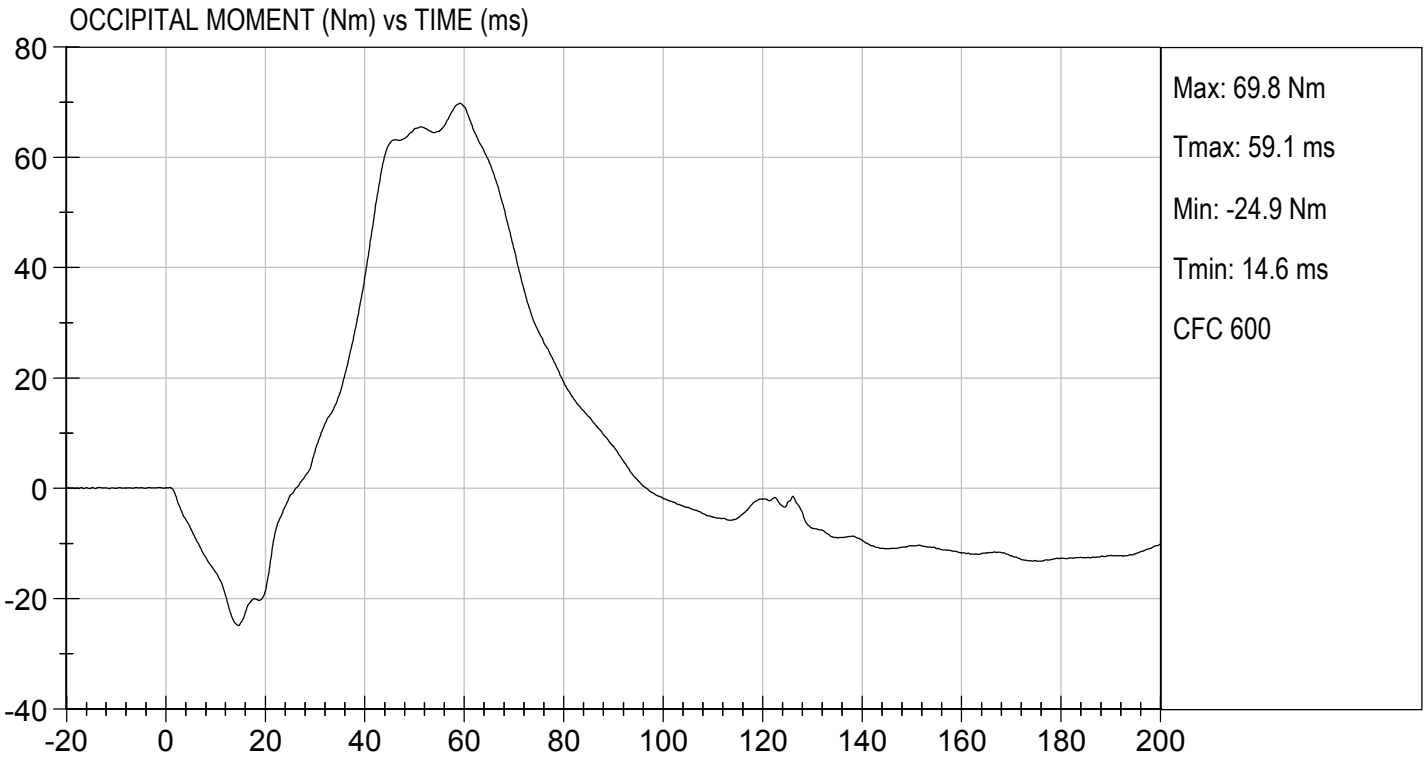


NECK ROTATION (DEG) vs TIME (ms)



TEST DESC: NECK FLEXION
VELOCITY: 23.20 ft/s, 7.07 m/s

TEST DATE: 11/03/2017
TEST #: D173202A



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173203

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	33	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	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.4	Pass
D Plane Rotation	Max	deg	99 to 114	111	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-56	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	104	Pass
			Overall Results		Pass

Danielle Redinbaugh
Laboratory Technician

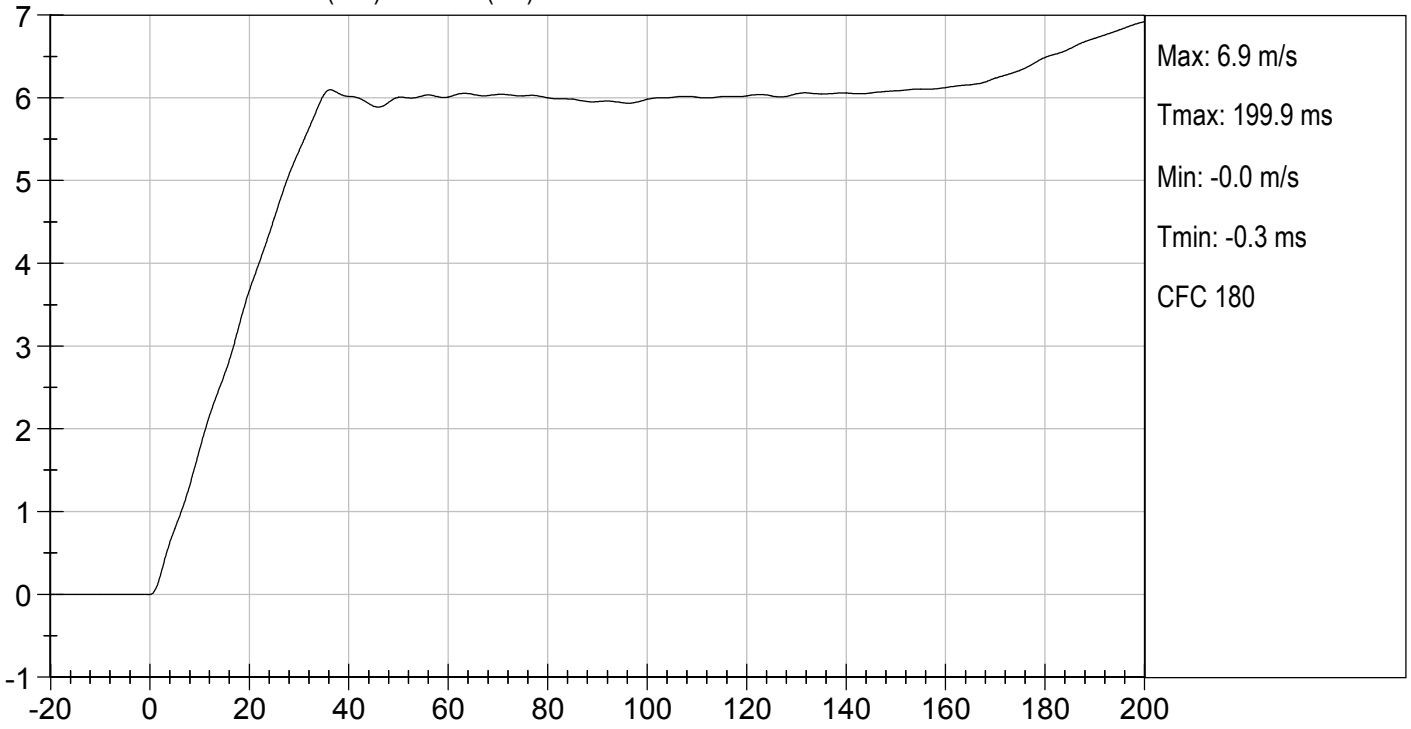
11/03/2017
Test Date

Robert Schmidt
Approved By

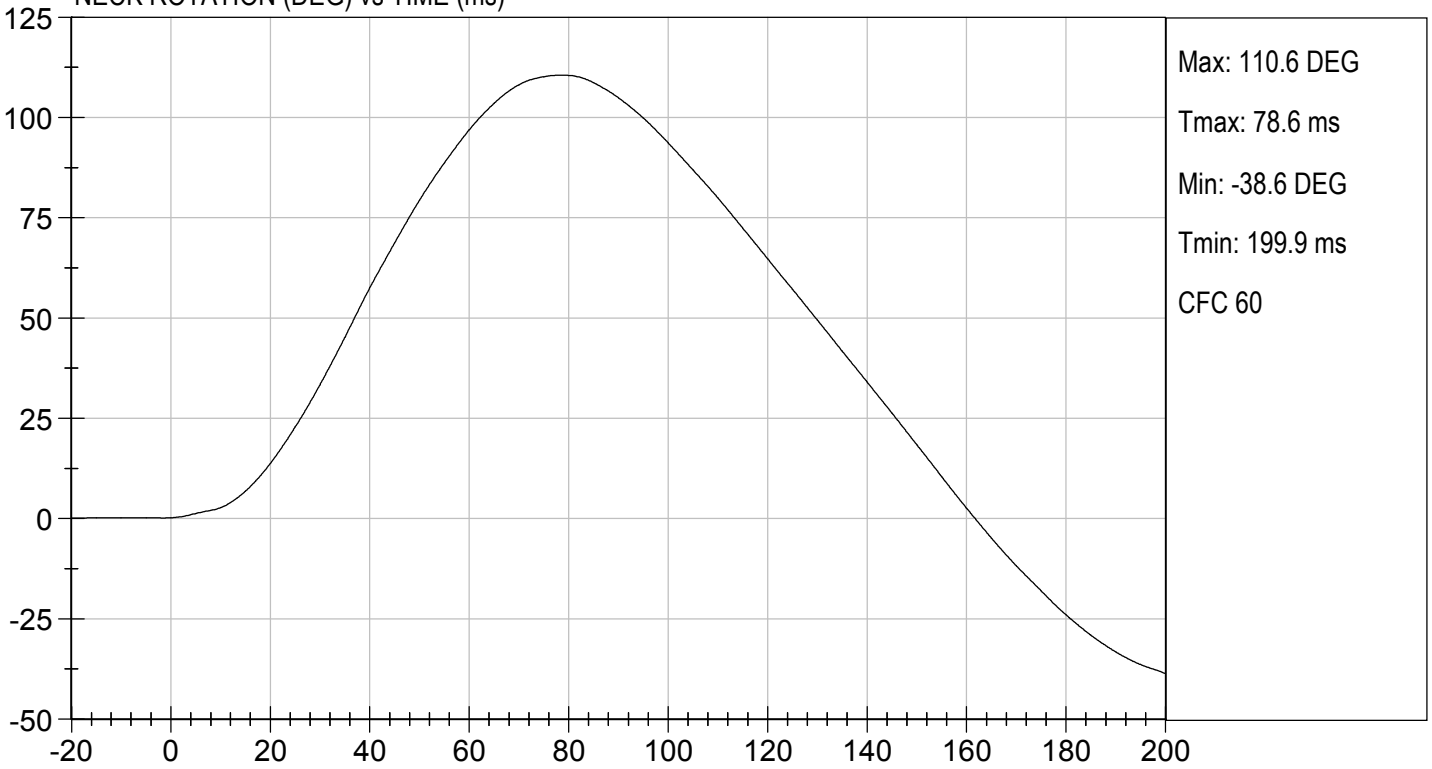
TEST DESC: NECK EXTENSION
VELOCITY: 20.22 ft/s, 6.16 m/s

TEST DATE: 11/03/2017
TEST #: D173203

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

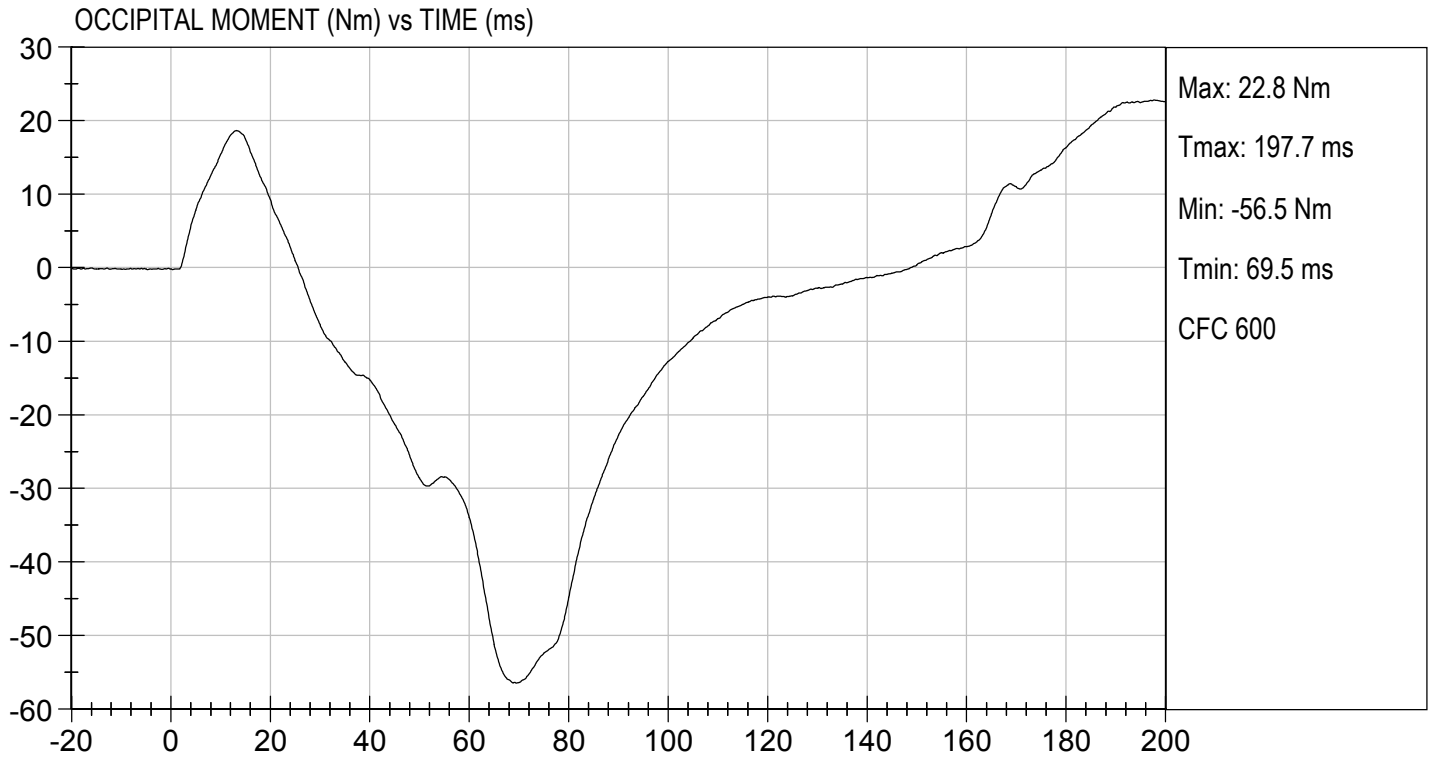


NECK ROTATION (DEG) vs TIME (ms)



TEST DESC: NECK EXTENSION
VELOCITY: 20.22 ft/s, 6.16 m/s

TEST DATE: 11/03/2017
TEST #: D173203



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173204

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	20.8	Pass
Relative Humidity	%	10 to 70	27	Pass
Probe Speed	m/s	6.59 to 6.83	6.68	Pass
Peak Deflection	mm	50 to 58	52	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4129	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4114	Pass
		Overall Test Results		Pass

Danielle Redinbaugh
Laboratory Technician

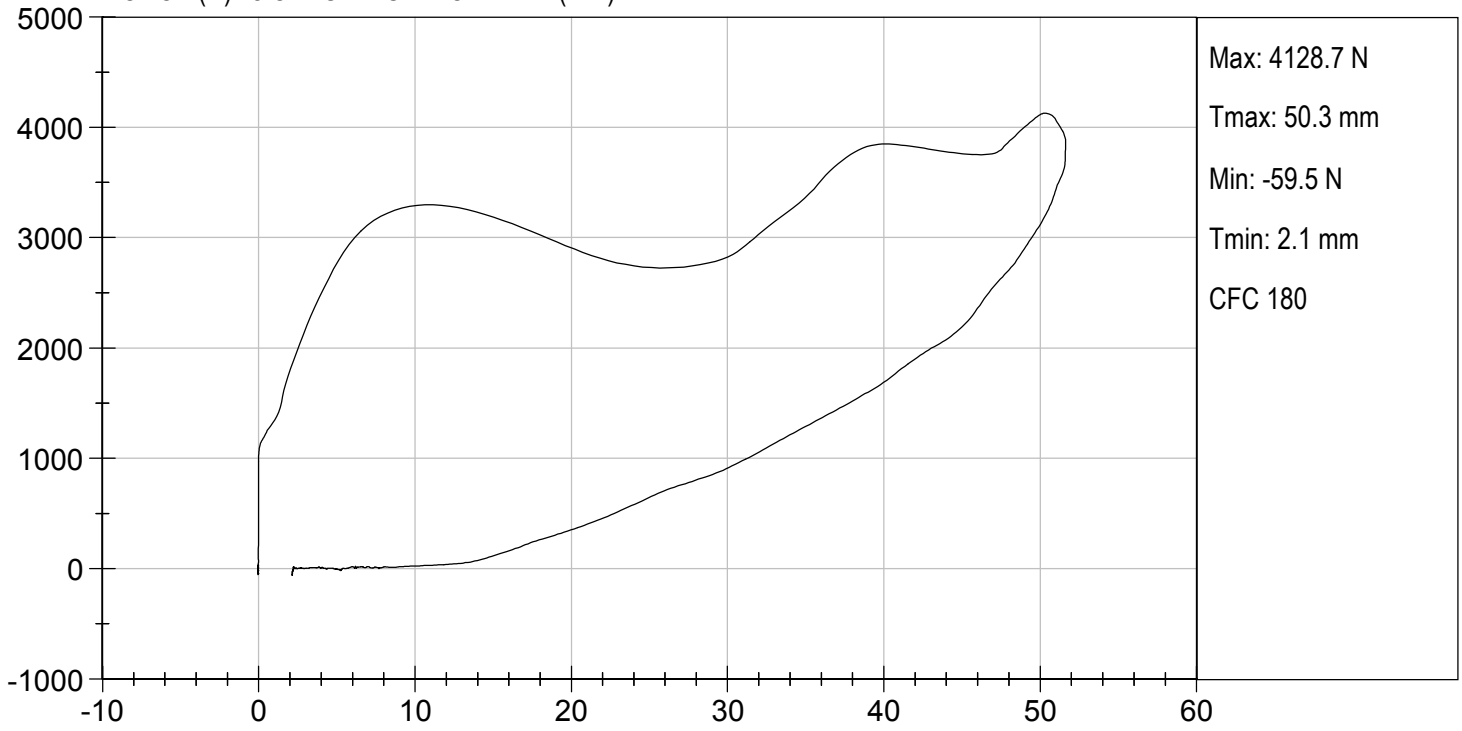
11/03/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 11/03/2017
TEST #: D173204

FORCE (N) vs CHEST DISPLACEMENT (mm)



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173205

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	N	3450 to 4060	3805	Pass
		Overall Test Results		Pass

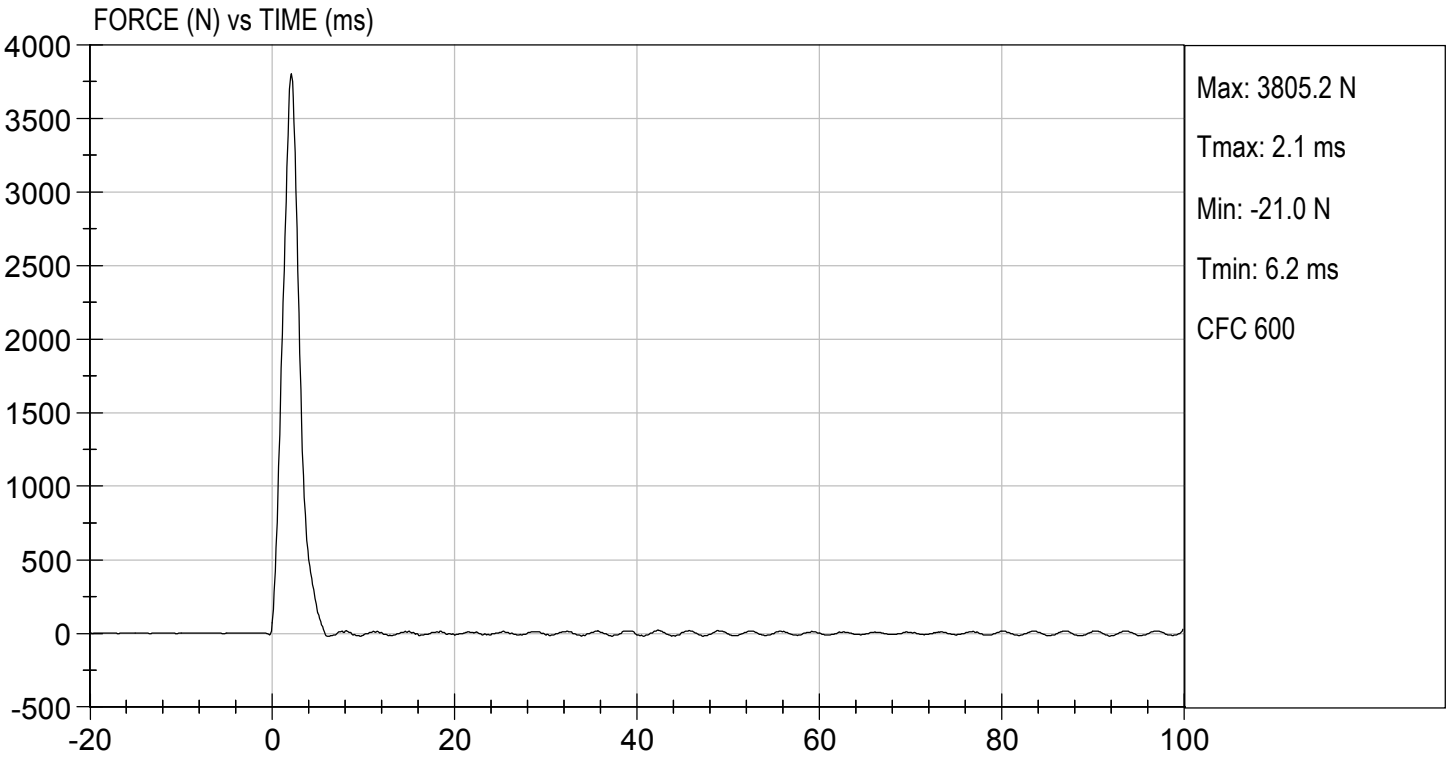
Danielle Redinbaugh
Laboratory Technician

11/03/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 11/03/2017
TEST #: D173205



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173206

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Speed	m/s	2.07 to 2.13	2.07	Pass
Maximum Force	N	3450 to 4060	3696	Pass
		Overall Test Results		Pass

Danielle Redinbaugh

Laboratory Technician

11/03/2017

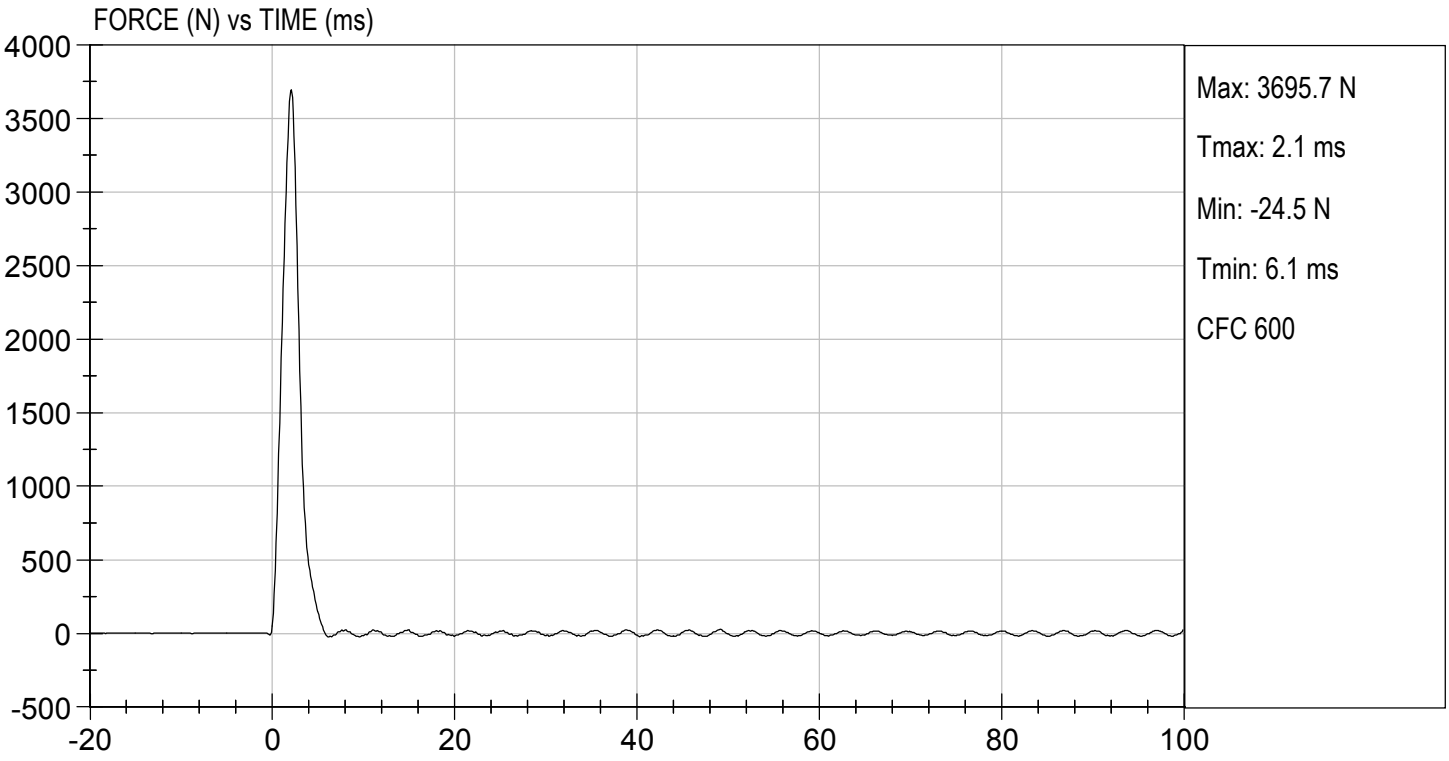
Test Date

Robert Schmidt

Approved By

TEST DESC: LEFT KNEE
VELOCITY: 6.78 ft/s, 2.07 m/s

TEST DATE: 11/03/2017
TEST #: D173206



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173207

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Initial Angle	deg	0 to 20	17	Pass
Return Angle	deg	+/- 8	5	Pass
Force at 45 deg	N	320 to 390	379	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
		Overall Result		Pass

Danielle Redenbaugh
Laboratory Technician

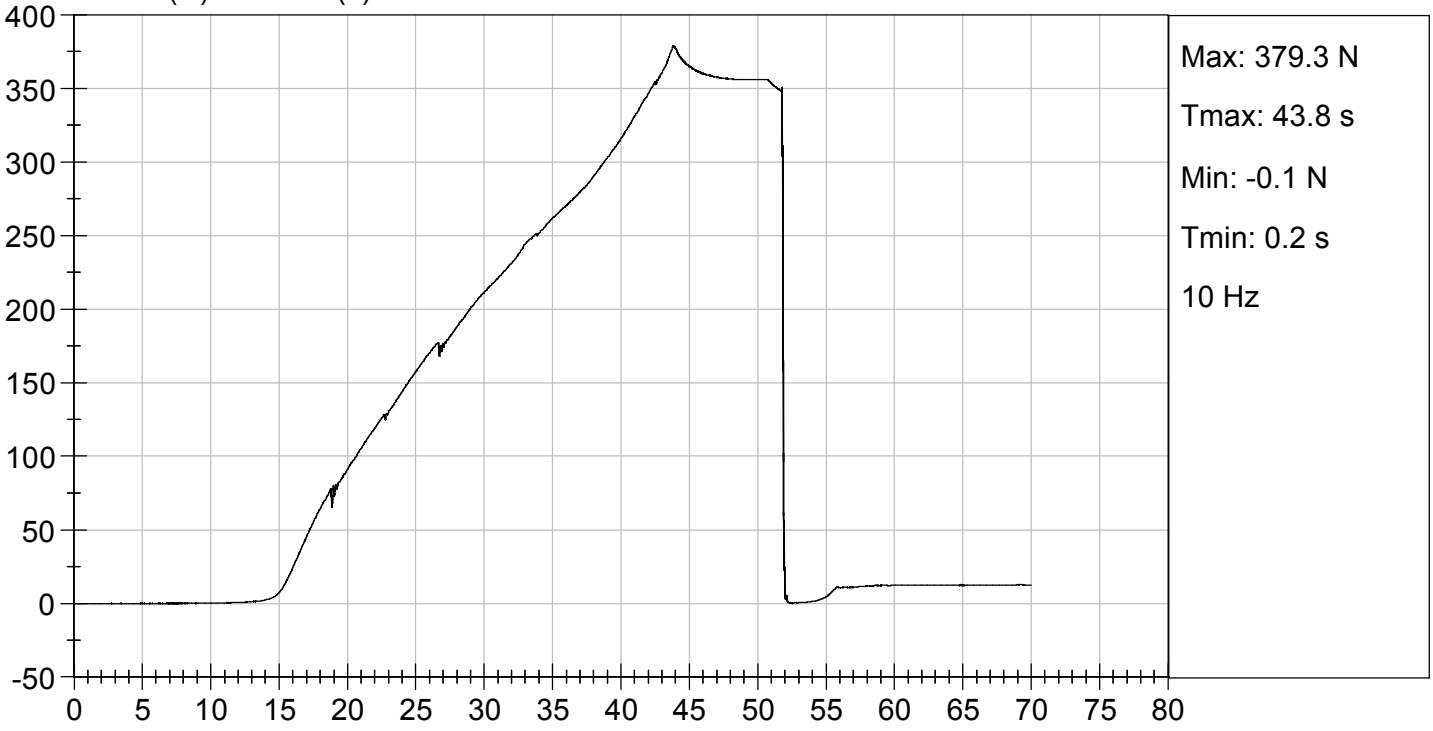
11/02/2017
Test Date

Robert Schmidt
Approved By

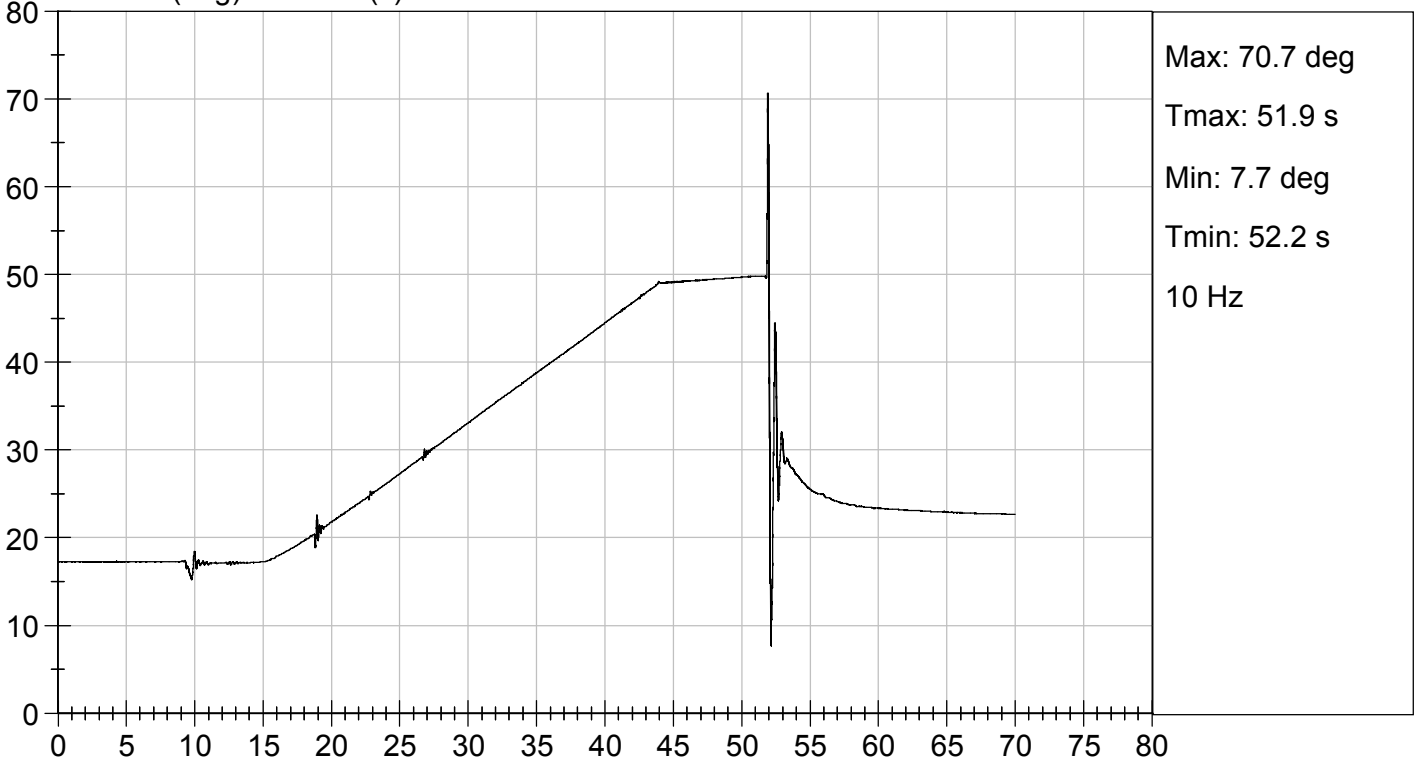
TEST DESC: LUMBAR FLEXION

TEST DATE: 11/02/2017
TEST #: D173207

LOAD (N) vs TIME (s)



ANGLE (deg) vs TIME (s)



MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test ID:** D173511

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	29	Pass
Peak Resultant Acceleration	G's	250 to 300	269	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-6.0	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Emily Fliess
Laboratory Technician

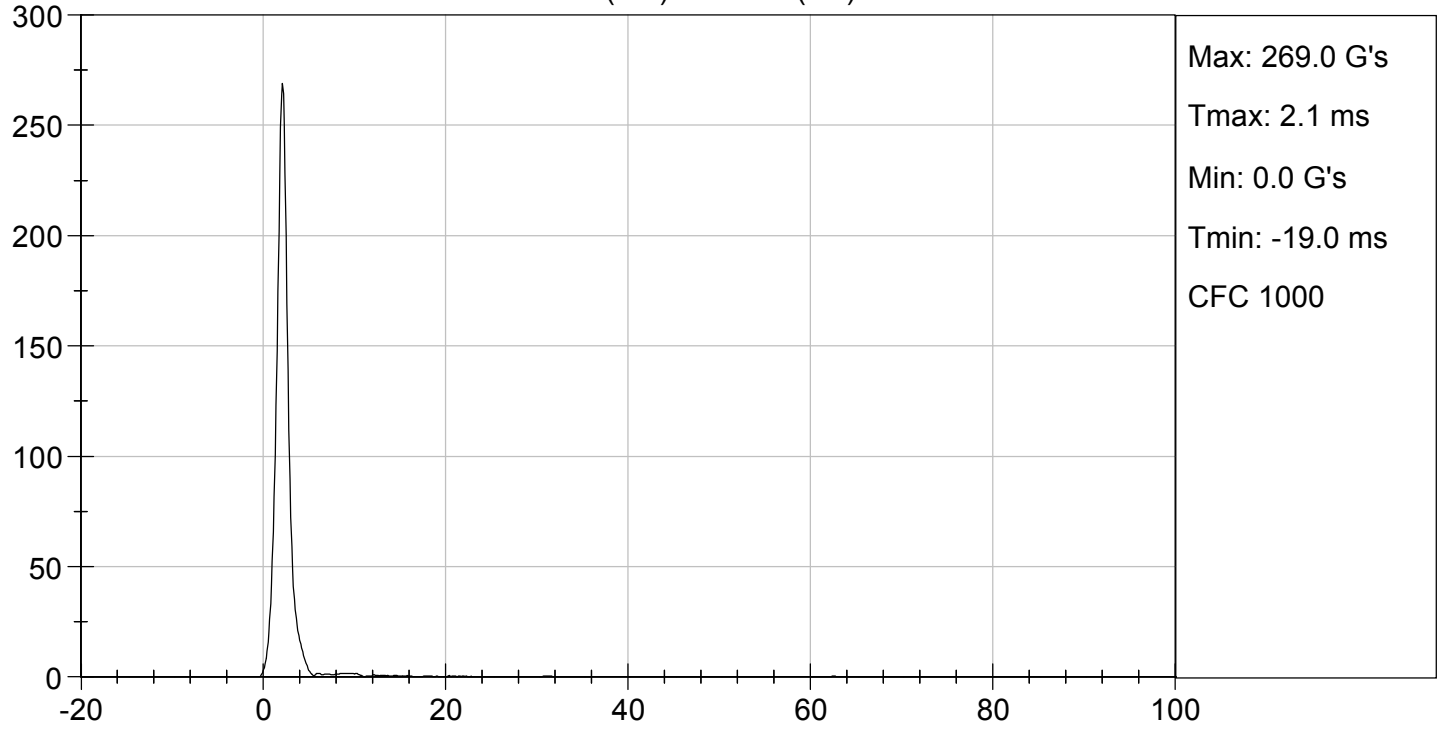
11/30/2017
Test Date

Robert Schmidt
Approved By

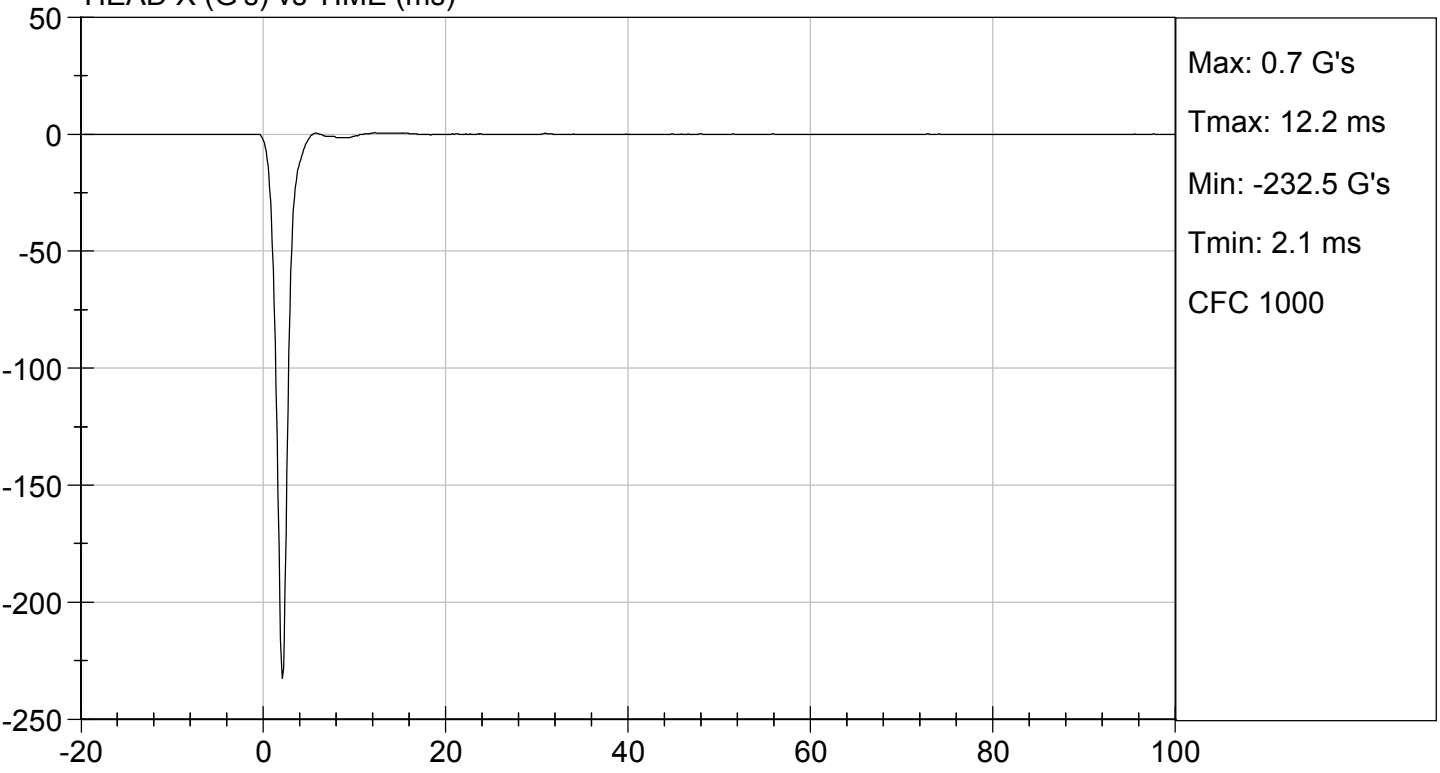
TEST DESC: HEAD DROP

TEST DATE: 11/30/2017
TEST #: D173511

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

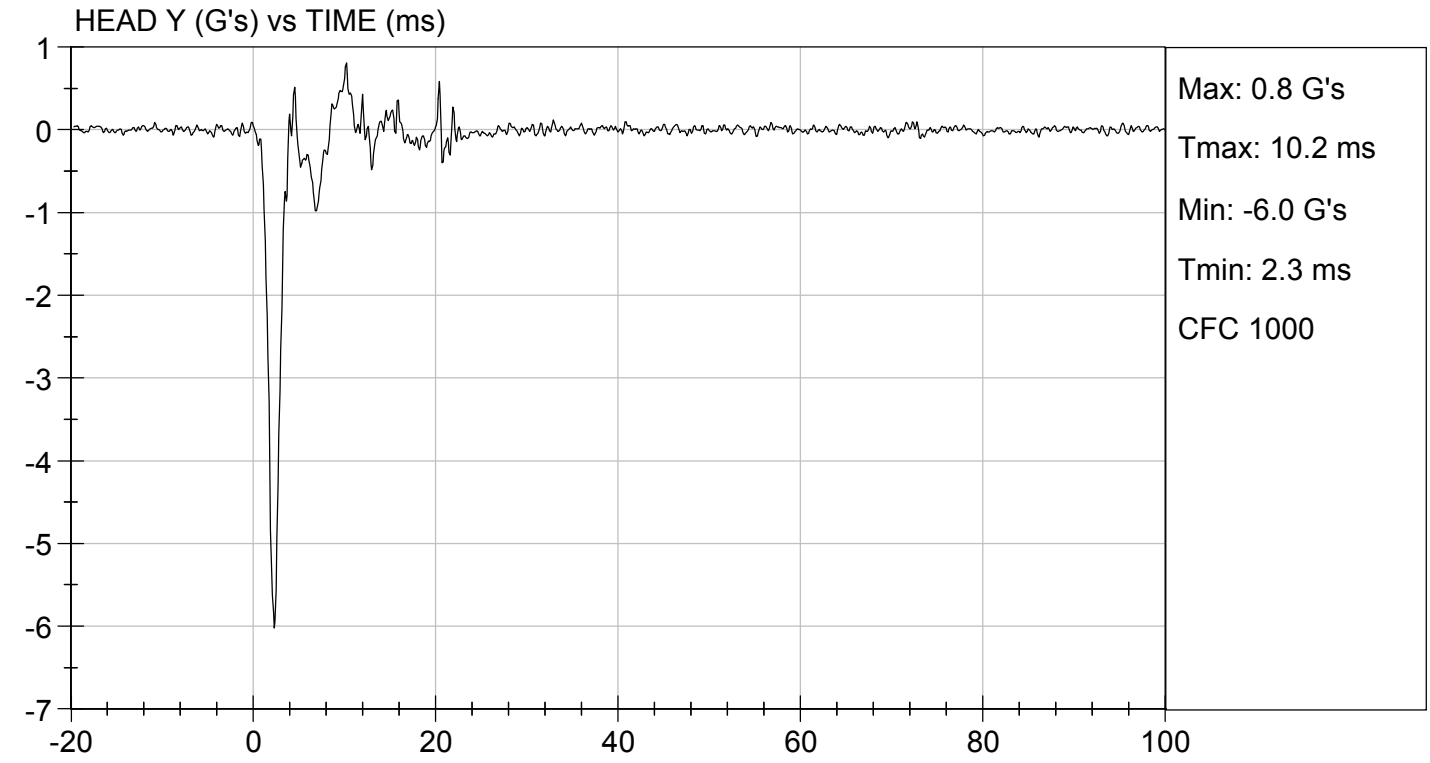


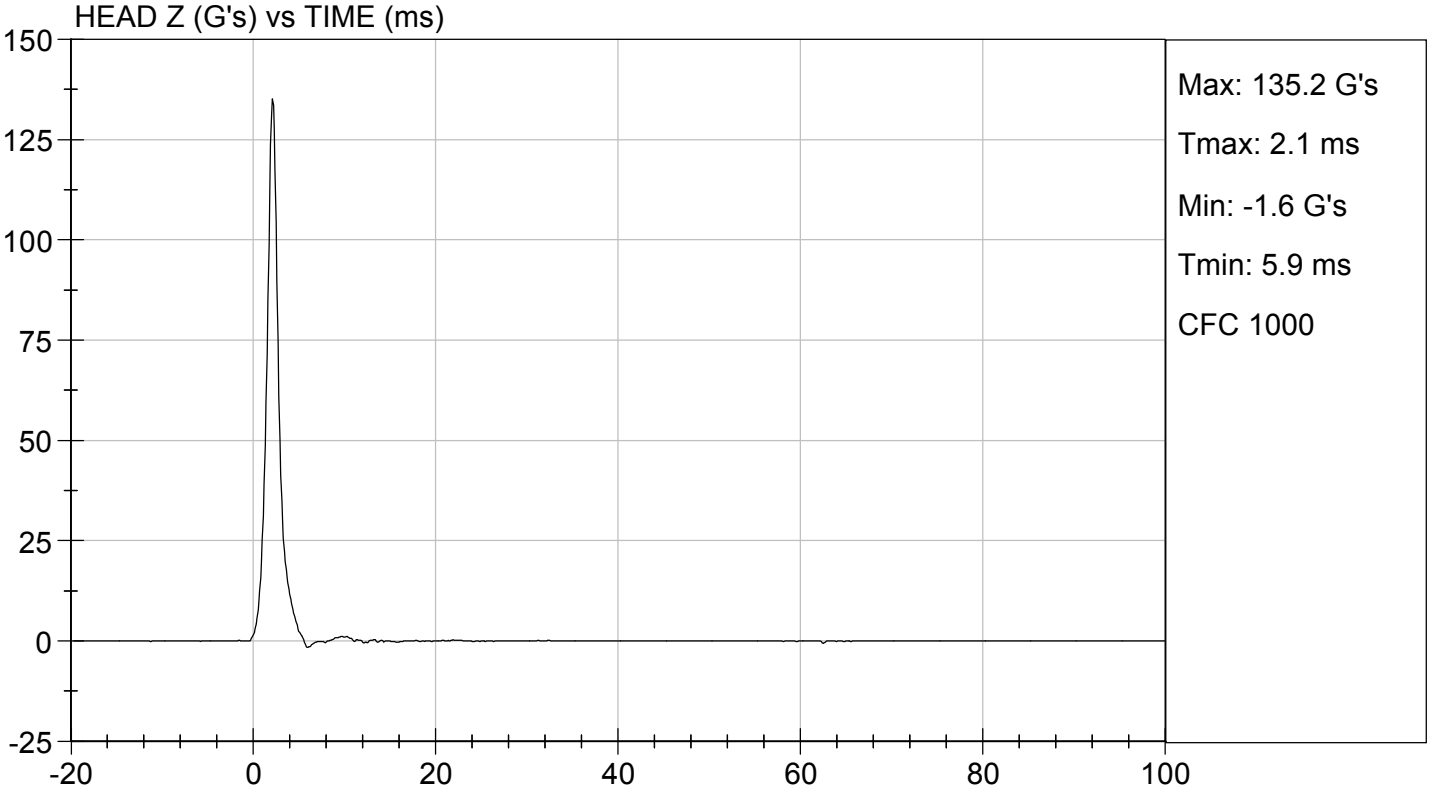
HEAD X (G's) vs TIME (ms)



TEST DESC: HEAD DROP

TEST DATE: 11/30/2017
TEST #: D173511





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173512

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	25	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.6	Pass
	30 ms	m/s	5.8 to 7.0	6.6	Pass
D Plane Rotation	Max	deg	77 to 91	84	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	72	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	87	Pass
			Overall Results		Pass

Emily Fliess
Laboratory Technician

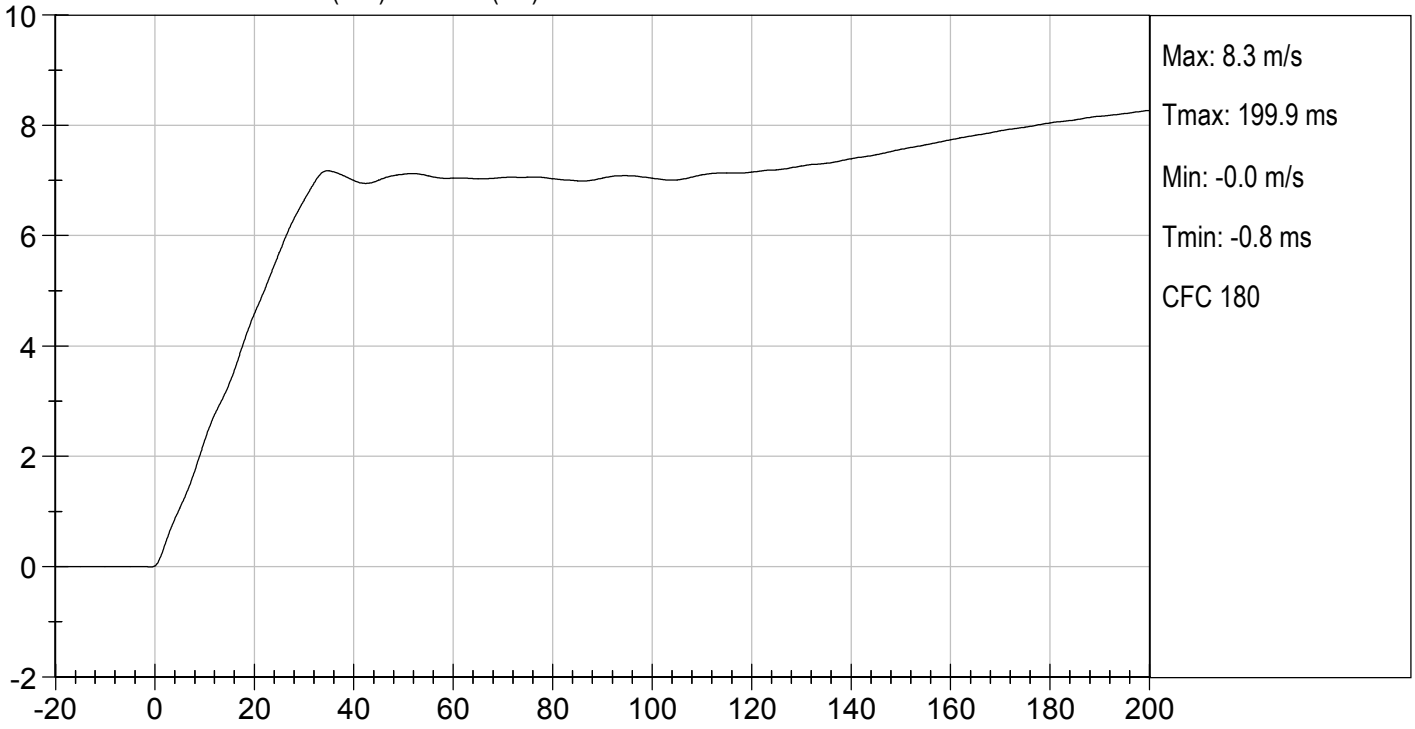
11/30/2017
Test Date

Robert Schmidt
Approved By

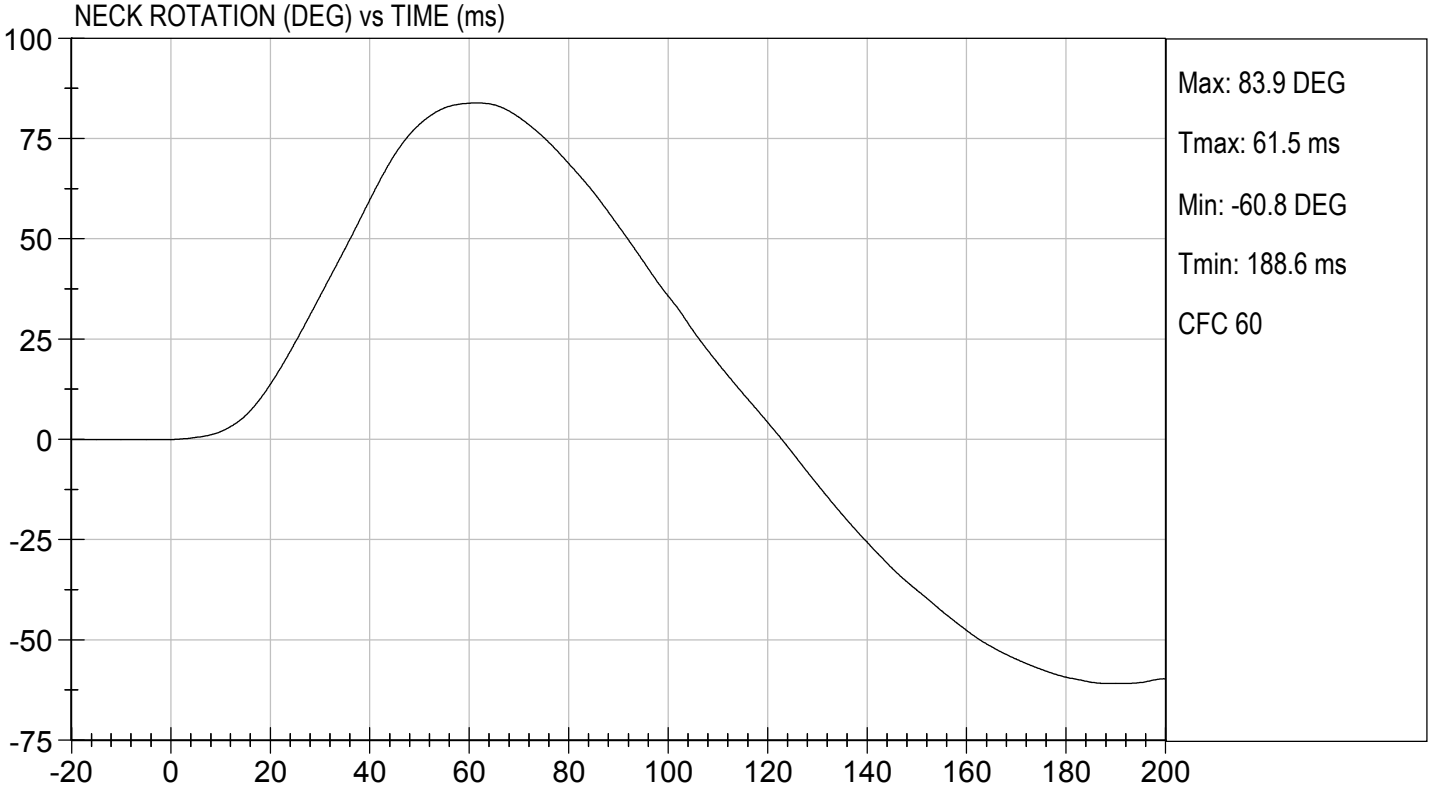
TEST DESC: NECK FLEXION
VELOCITY: 23.15 ft/s, 7.06 m/s

TEST DATE: 11/30/2017
TEST #: D173512

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

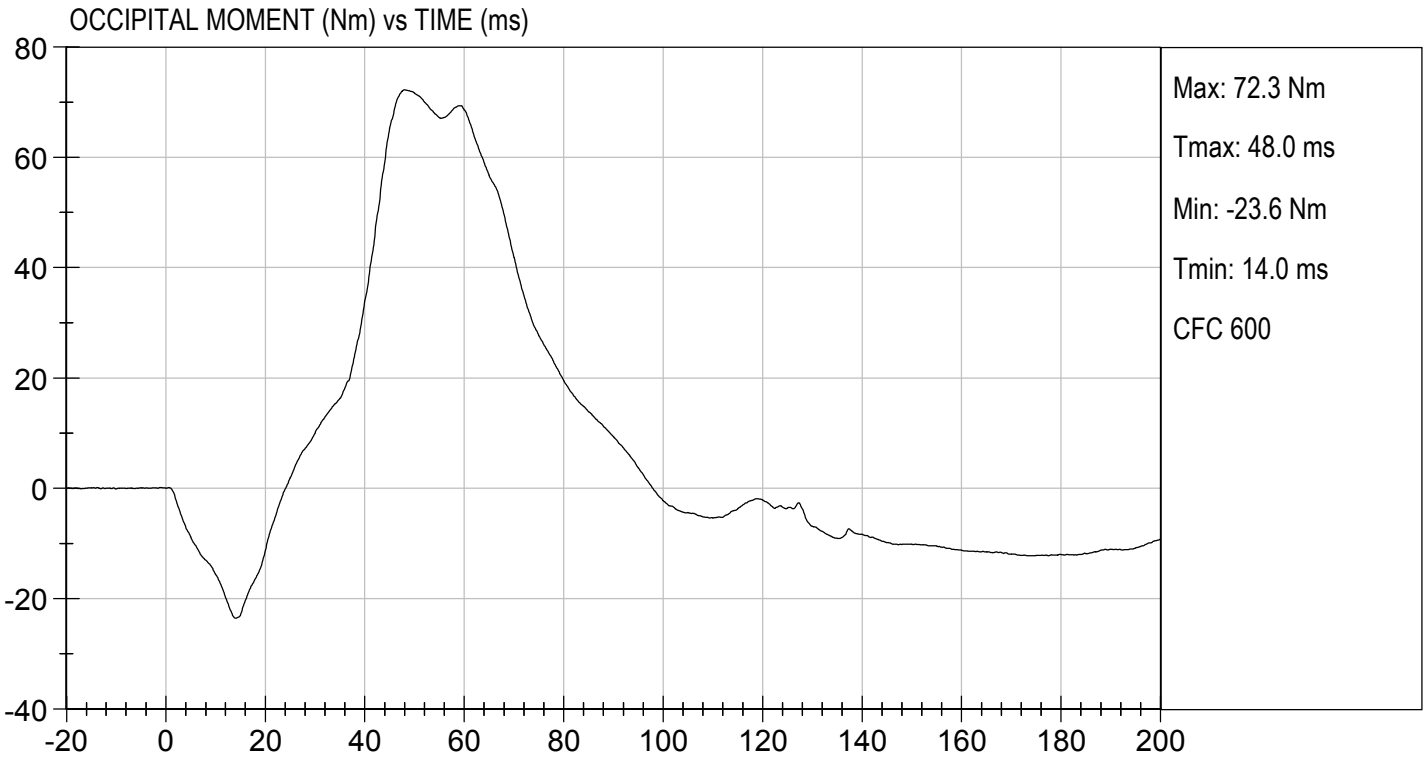


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 11/30/2017
TEST #: D173512



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173513

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	25	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.6	Pass
	20 ms	m/s	3.1 to 3.9	3.5	Pass
	30 ms	m/s	4.6 to 5.6	5.2	Pass
D Plane Rotation	Max	deg	99 to 114	111	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-54	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	105	Pass
			Overall Results		Pass

Emily Fliess

Laboratory Technician

11/30/2017

Test Date

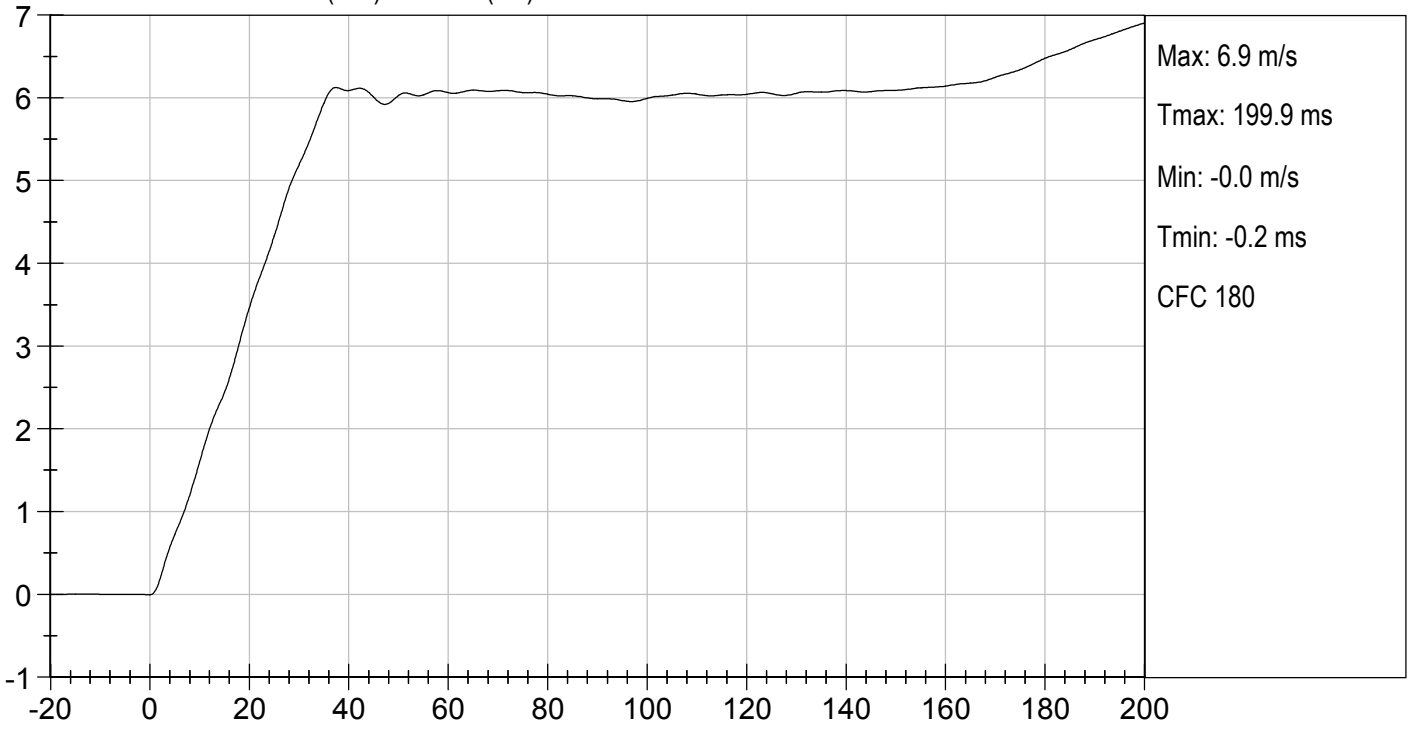
Robert Schmidt

Approved By

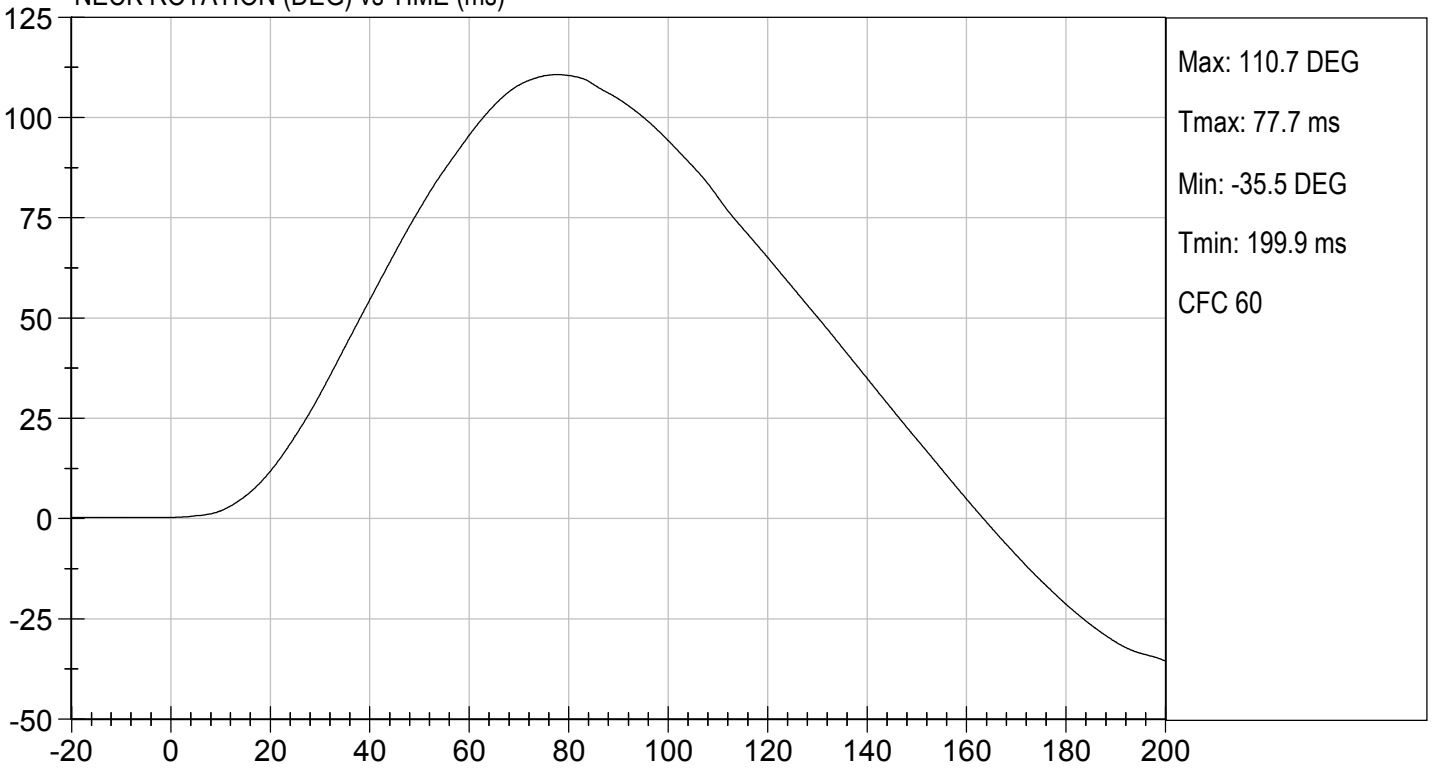
TEST DESC: NECK EXTENSION
VELOCITY: 20.08 ft/s, 6.12 m/s

TEST DATE: 11/30/2017
TEST #: D173513

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

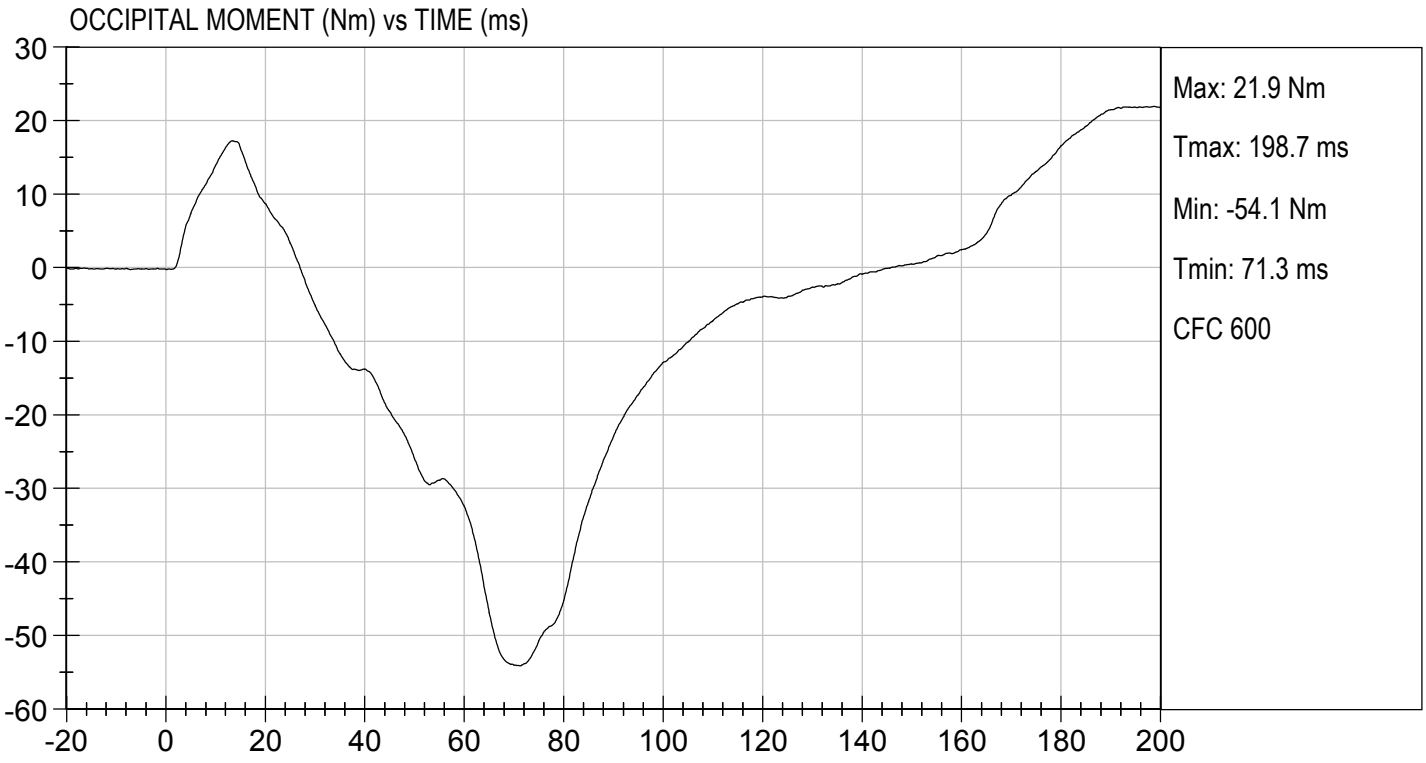


NECK ROTATION (DEG) vs TIME (ms)



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

TEST DATE: 11/30/2017
TEST #: D173513



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173514

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.9	Pass
Relative Humidity	%	10 to 70	29	Pass
Probe Speed	m/s	6.59 to 6.83	6.68	Pass
Peak Deflection	mm	50 to 58	51	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4295	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4390	Pass
		Overall Test Results		Pass

Emily Fliess
Laboratory Technician

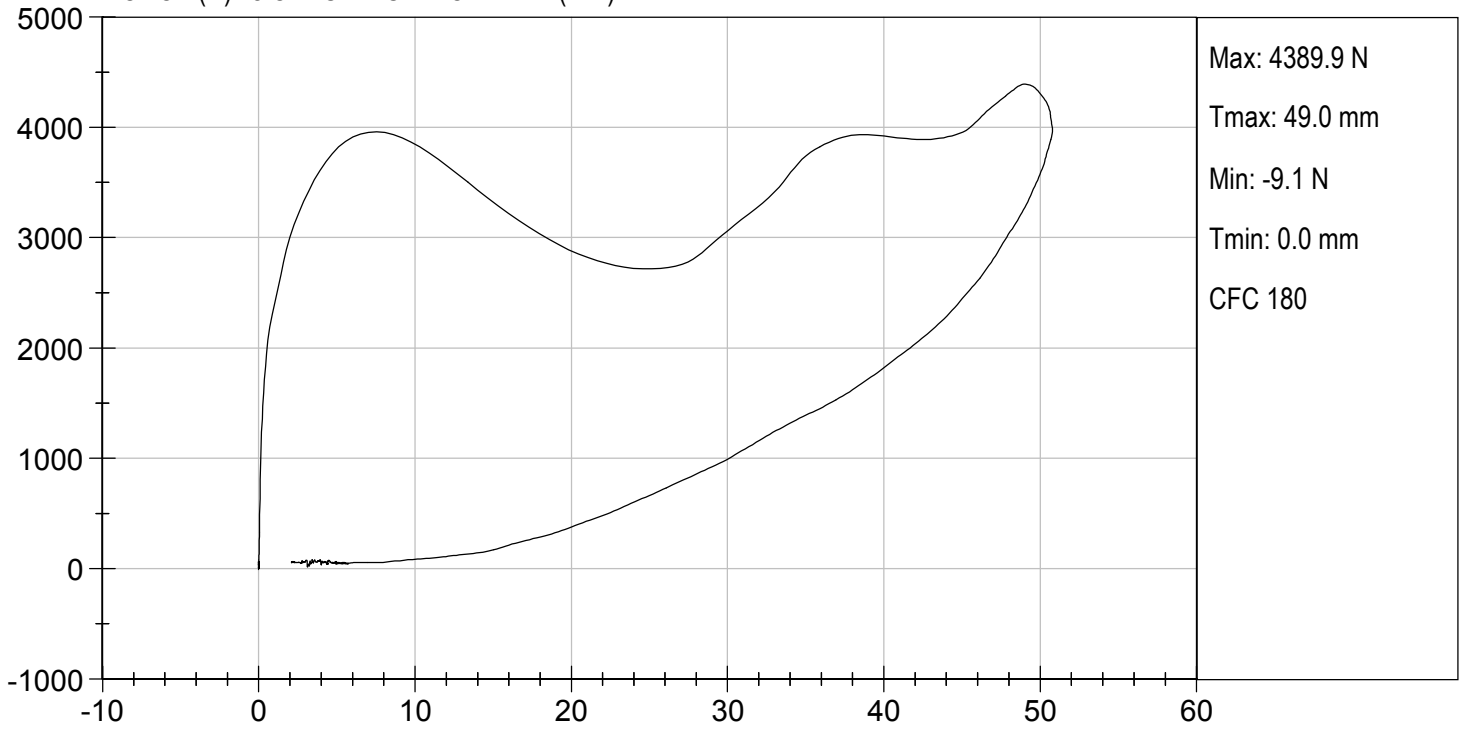
12/01/2017
Test Date

Robert Schmidt
Approved By

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

TEST DATE: 12/01/2017
TEST #: D173514

FORCE (N) vs CHEST DISPLACEMENT (mm)



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173515

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	29	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3544	Pass
		Overall Test Results		Pass

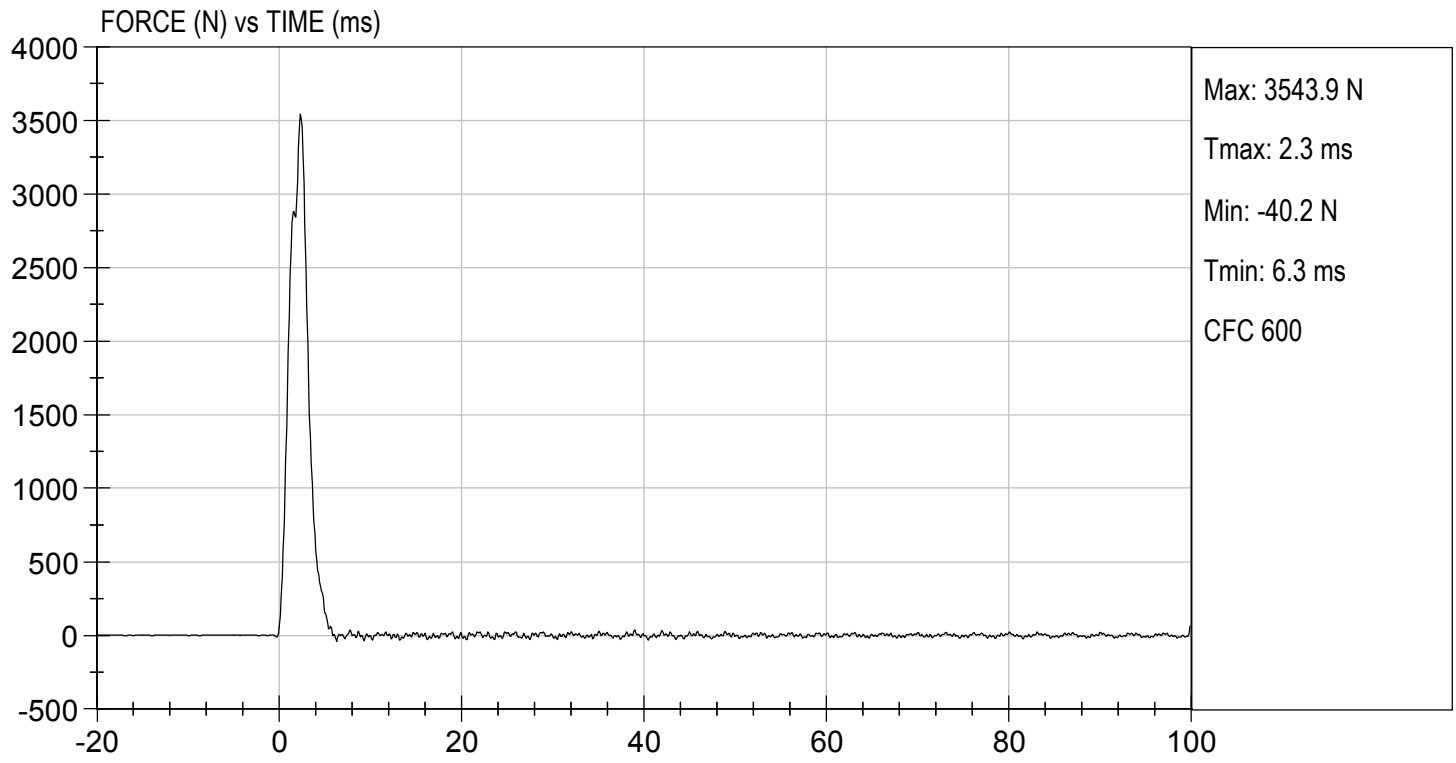
Emily Fliess
Laboratory Technician

11/30/2017
Test Date

Robert Schmidt
Approved By

TEST DESC: RIGHT KNEE
VELOCITY: 7.00 ft/s, 2.13 m/s

TEST DATE: 11/30/2017
TEST #: D173515



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173516

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	29	Pass
Probe Speed	m/s	2.07 to 2.13	2.07	Pass
Maximum Force	N	3450 to 4060	3890	Pass
		Overall Test Results		Pass

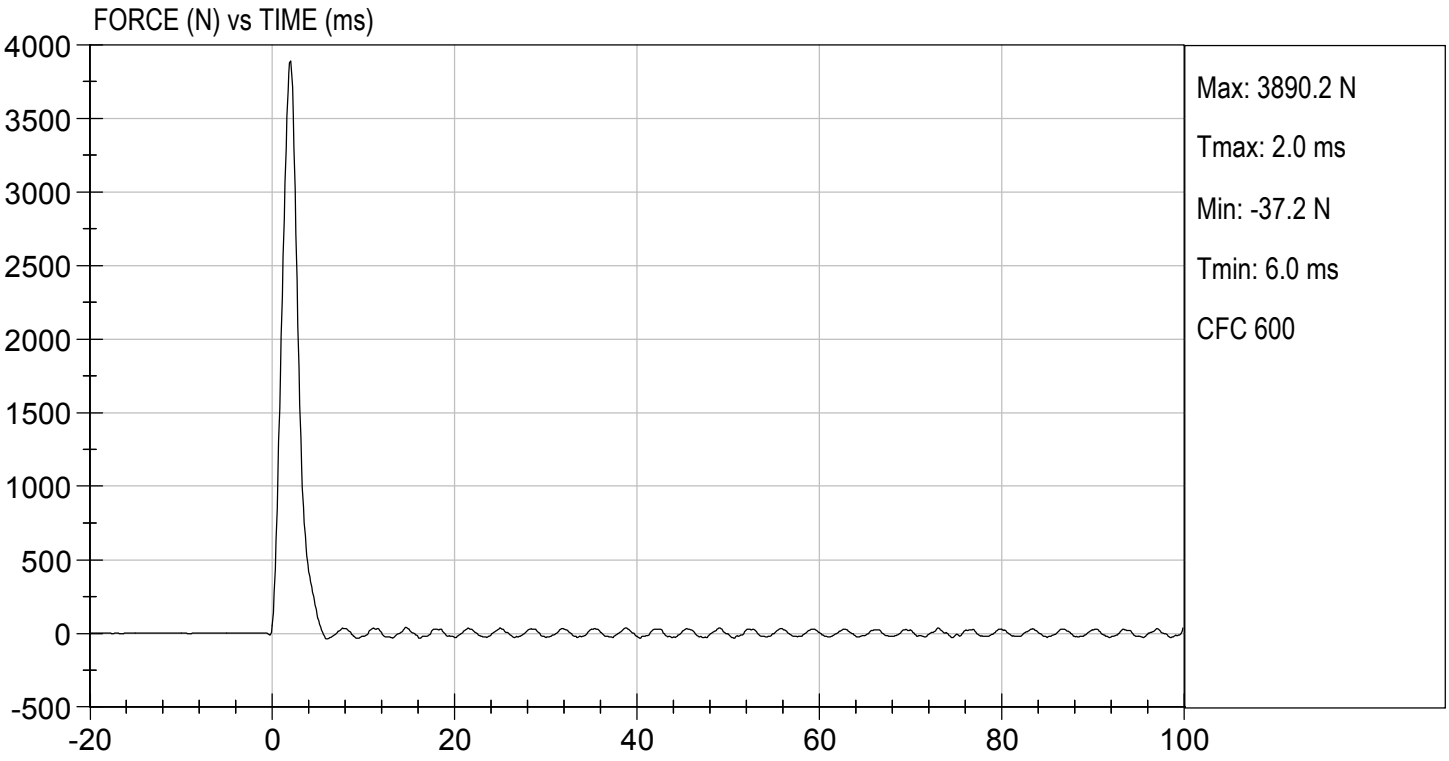
Emily Fliess
Laboratory Technician

11/30/2017
Test Date

Robert Schmidt
Approved By

TEST DESC: LEFT KNEE
VELOCITY: 6.78 ft/s, 2.07 m/s

TEST DATE: 11/30/2017
TEST #: D173516



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 634 **Test I.D:** D173517

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	29	Pass
Initial Angle	deg	0 to 20	17	Pass
Return Angle	deg	+/- 8	5	Pass
Force at 45 deg	N	320 to 390	369	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.6	Pass
		Overall Result		Pass

Emily Fliess
Laboratory Technician

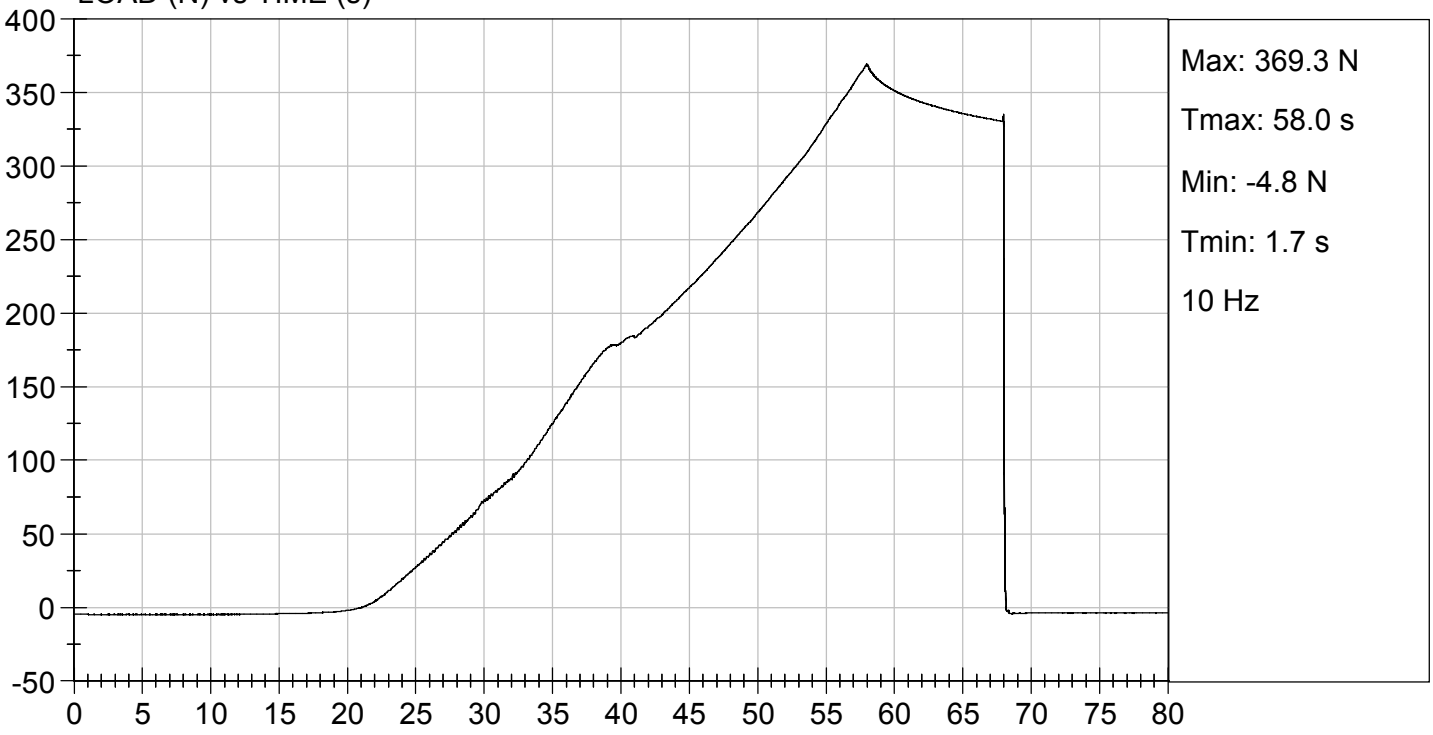
12/01/2017
Test Date

Robert Schmidt
Approved By

TEST DESC: LUMBAR FLEXION

TEST DATE: 12/01/2017
TEST #: D173517

LOAD (N) vs TIME (s)



ANGLE (deg) vs TIME (s)