

**REPORT NUMBER: NCAP-MGA-2013-045**

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

**MERCEDES-BENZ U.S. INTL., INC  
2013 Mercedes-Benz ML350 AWD SUV  
NHTSA No.: MD0509**

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




**Test Date: December 20, 2012**

**Final Report Date: February 27, 2013**

**FINAL REPORT**

**U.S. DEPARTMENT OF TRANSPORTATION  
National Highway Traffic Safety Administration  
Office of Crashworthiness Standards  
Mail Code: NVS-111  
1200 New Jersey Ave, SE  
Room W43-410  
Washington, DC 20590**

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Approval Date: February 27, 2013

FINAL REPORT ACCEPTANCE BY OCWS:

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NHTSA, Office of Crashworthiness Standards

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

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

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

### Technical Report Documentation Page

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		<b>14. Sponsoring Agency Code</b> NVS-111																																																			
<b>15. Supplementary Notes</b>																																																					
<b>16. Abstract</b> A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2013 Mercedes-Benz ML350 AWD 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), 301, and foot well intrusion performance. The test was conducted at MGA Research Corporation in Burlington, Wisconsin, on December 20, 2012.  The impact velocity was 56.2 km/h and the ambient temperature at the barrier face at the time of impact was 20.8°C. The target vehicle post-test maximum crush was 554 mm located at the vehicle's centerline. The test vehicle's performance was as follows:																																																					
<table border="1" style="width: 100%; border-collapse: collapse; background-color: #ffff00;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Threshold</th> <th rowspan="2">Driver ATD</th> <th rowspan="2">Passenger ATD</th> </tr> <tr> <th>50<sup>th</sup></th> <th>5<sup>th</sup></th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC<sub>15</sub>)</td> <td>N/A</td> <td>700</td> <td>700</td> <td>168</td> <td>268</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>52</td> <td>20</td> <td>13</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>1</td> <td>0.25</td> <td>0.35</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>2620</td> <td>1495</td> <td>683</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>2520</td> <td>123</td> <td>510</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>6805</td> <td>1689</td> <td>1444</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>6805</td> <td>1537</td> <td>1649</td> </tr> </tbody> </table>				Measurement Description	Units	Threshold		Driver ATD	Passenger ATD	50 <sup>th</sup>	5 <sup>th</sup>	Head Injury Criteria (HIC <sub>15</sub> )	N/A	700	700	168	268	Maximum Chest Compression	mm	63	52	20	13	Nij	N/A	1	1	0.25	0.35	Neck Tension	N	4170	2620	1495	683	Neck Compression	N	4000	2520	123	510	Left Femur Force	N	10008	6805	1689	1444	Right Femur Force	N	10008	6805	1537	1649
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<b>17. Key Words</b>  35 mph Frontal Barrier Impact Test New Car Assessment Program (NCAP)		<b>18. Distribution Statement</b> Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services Division, NPO-411 1200 New Jersey Ave, SE Washington, DC 20590 Email: <a href="mailto:tis@nhtsa.dot.gov">tis@nhtsa.dot.gov</a> FAX: 202-493-2833																																																			
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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 2013 Mercedes-Benz ML350 AWD SUV at a velocity of 56.2 km/h. The test was performed at MGA Research Corporation on December 20, 2012. 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 50<sup>th</sup> percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5<sup>th</sup> percentile female test device (ATD) was placed in the right-front passenger seating position according to dummy placement instructions specified in the 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. Seat belt load cells were also installed on the driver's and passenger's shoulder belts to measure dummy torso and pelvic section loading.

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

The 240 channels of data were recorded on an on-board data acquisition system. Appendix B contains the vehicle, load cell barrier, and 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 554 mm 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 and chest contacted the airbag. The driver's head also contacted the headrest. The driver's knees contacted the knee airbag. The passenger's visible contact points were as follows: The passenger's head and chest contacted the airbag. The passenger's head also contacted the headrest. The passenger's knees contacted the glove box.

The occupant data is summarized below:

ATD position	HIC <sub>15</sub>	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50 <sup>th</sup> )	168	0.25	1495	123	43	20	1689	1537
Passenger (5 <sup>th</sup> )	268	0.35	683	510	45	13	1444	1649

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

#### TEST NOTES

Load Cell E-10 FX has no valid data.

Load Cell K-03 FX has questionable data from 25-35ms.

The driver and passenger lap belt load cells were not installed for this test.

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

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

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**TEST VEHICLE INFORMATION AND OPTIONS**

NHTSA No.	MD0509	Traction Control System (TCS)	Yes
Model Year	2013	Power Steering	Yes
Make	Mercedes-Benz	Power Window Auto-Reverse	Yes
Model	ML350	Driver Frontal Airbag	Yes
Body Style	SUV	Driver Curtain Airbag	Yes
VIN	4JGDA5HB8DA142352	Driver Head/Torso Airbag	No
Body Color	Cinnabar Red Metallic	Driver Torso Airbag	No
Odometer (km/mi)	129 / 80	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	3.5	Driver Pelvis Airbag	No
Type/No. Cylinders	6	Driver Knee Airbag	Yes
Engine Placement	Longitudinal	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	7	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	All-Wheel Drive	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	Yes	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	Yes	Front Pass. Knee Airbag	No
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	Yes	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other	N/A

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

**DATA FROM CERTIFICATION LABEL**

Manufactured By	MERCEDES-BENZ U.S. INTL., INC	GVWR (kg)	2850
		GAWR Front (kg)	1400
Date of Manufacture	10/12	GAWR Rear (kg)	1600

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

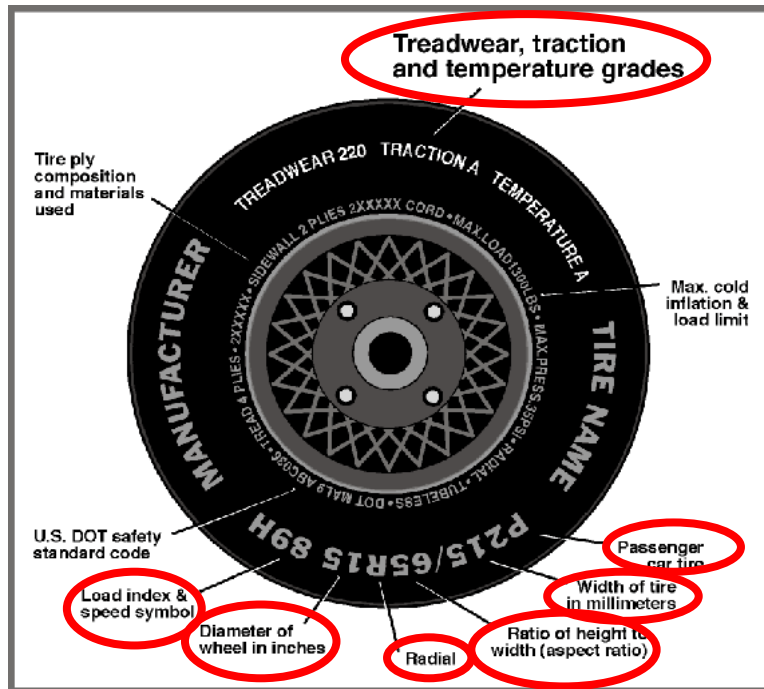
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Designated Seating Capacity (DSC)	2	3		5
Capacity Weight (VCW) (kg)				490
Cargo Weight (RCLW) (kg)				150

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**VEHICLE TIRE INFORMATION**



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	340	340
Cold Pressure (kPa)	310	330
Recommended Tire Size	255/50R19	255/50R19
Tire Size on Vehicle	255/50R19	255/50R19
Tire Manufacturer	Dunlop	Dunlop
Tire Model	Grandtek Touring	Grandtek Touring
Treadwear	200	200
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	2	2
Tire Plies Body	5	5
Load Index/Speed Symbol	107H	107H
Tire Material	Rubber	Rubber
DOT Safety Code Left	M6LH JM1R	M6LH JM1R
DOT Safety Code Right	M6LH JM1R	M6LH JM1R

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

**TEST VEHICLE WEIGHTS**

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	542.5	529.4		589.7	627.3	
Right	kg	593.8	494.8		591.5	622.3	
Ratio	%	52.6	47.4		48.6	51.4	
Totals	kg	1136.3	1024.2	2160.5	1181.2	1249.6	2430.8

**TARGET TEST WEIGHT CALCULATION**

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	2160.5
Weight of 1 P572E ATD & 1 P572O ATD	kg	140.6
Rated Cargo/Luggage Weight (RCLW)	kg	136
Calculated Vehicle Target Weight (TVTW)	kg	2437.1

**TEST VEHICLE ATTITUDES AND CG**

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	819	824	839	827	1382
As Tested	mm	823	821	798	797	1499
Post Test	mm	832	835	800	790	

**GENERAL TEST VEHICLE DATA**

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2915
Total Vehicle Length at Left Side	mm	4628
Total Vehicle Length at Centerline	mm	4807
Total Vehicle Length at Right Side	mm	4628
Weight of Ballast in Cargo Area	kg	137.0
Weight of Vehicle Components Removed	kg	39.5
Amount of Stoddard Solvent in Fuel Tank	L	86.5

List of components removed to meet test weight: Right taillight, cargo carpet, cargo floor, jack and tool kit, spare tire, and cargo screen.

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**TARGET VEHICLE STRUCTURAL MEASUREMENT**

	Elements	Pre-Test (mm)
1	Total Length	4807
2	Total Width	1916
3	Bumper Top Height	560
4	Bumper Bottom Height	465
5	Longitudinal Member Top Height	613
6	Distance between Longitudinal Members	773
7	Longitudinal Member Width	75
8	Engine Top Height	1025
9	Engine Bottom Height	260
10	Engine and Gearbox Width	1280
11	Front Bumper-Engine Distance	180
12	Front Shock Absorber Fixing Height	1022
13	Bonnet Leading Edge Height	951
14	Front Shock Absorber Fixing Width	940
15	Front Bumper – Front Axle Distance	868
16	Front Axle – A-Pillar Distance	499
17	A-Pillar – B-Pillar Distance	1230
18	B-Pillar – Rear Axle Distance	1191
19	B-Pillar – C-Pillar Distance	693
20	Roof Sill Bottom Height	1608
21	Roof Sill Top Height	1726
22	Floor Sill Bottom Height	224
23	Floor Sill Top Height	506

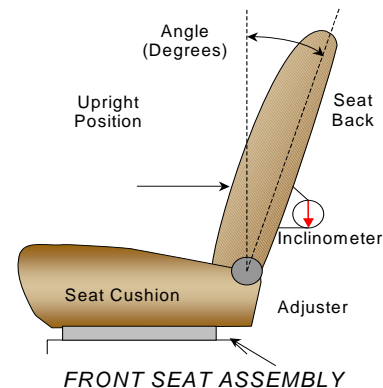
**DATA SHEET NO. 2**  
**SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA**

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**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 September 2012.



	Degrees
Driver Seat Back Angle	17.6° on headrest post
Passenger Seat Back Angle	7.0° on headrest post

**SEAT FORE/AFT POSITIONS**

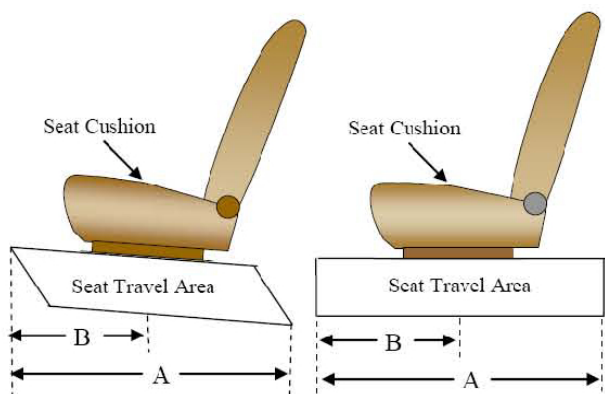
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated September 2012.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	322 mm	161 mm (foremost as 0)
Passenger Seat	264 mm	0 mm (foremost as 0)

**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	4 (1 <sup>st</sup> as 1)	0 (uppermost as 0)
Passenger Seat	4 (1 <sup>st</sup> as 1)	0 (uppermost as 0)



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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

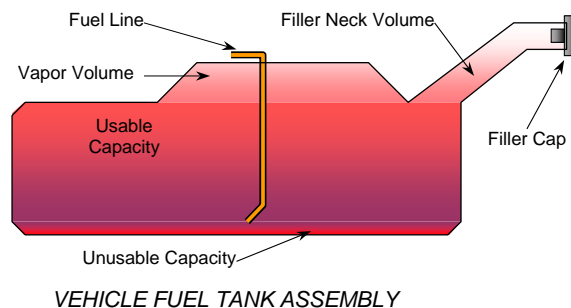
**FUEL TANK CAPACITY DATA**

	Liters
Usable Capacity of "Standard Tank"	78.0
Usable Capacity of "Optional Tank"	93.0
92-94% of Usable Capacity	85.6 to 87.4
Actual Amount of Solvent used	86.5
1/3 of Usable Capacity	31.0

**FUEL PUMP**

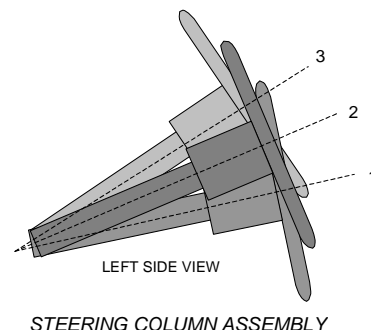
Describe the fuel pump type, its behavior, and the location of the fuel filler pipe.

The vehicle is equipped with an electric fuel pump. The fuel pump operates until the internal pressure achieves its designed level. Then it turns off and keeps the pressure. The fuel pipe is on the right side.



**STEERING COLUMN ADJUSTMENT**

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



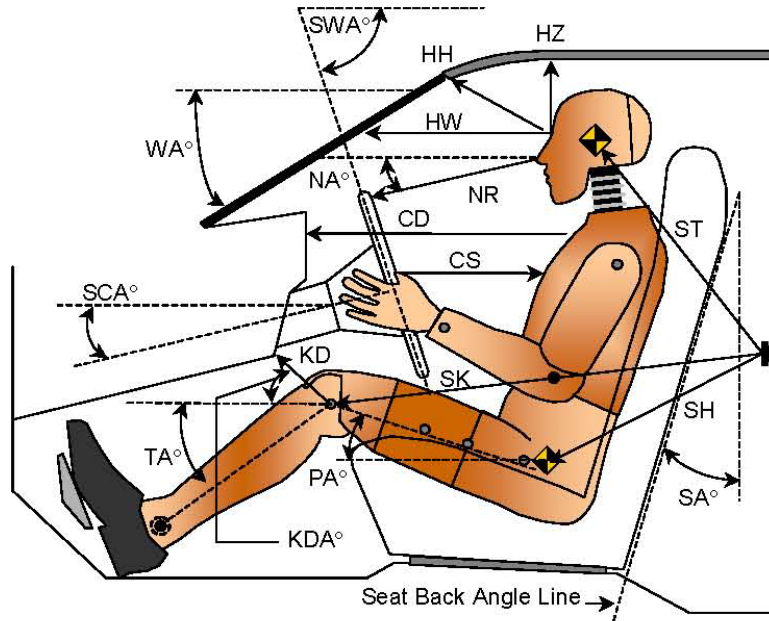
**STEERING COLUMN POSITION**

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	72.4	263
Geometric Center Position 2	70.2	234
Uppermost Position 3	68.0	205
Telescoping Steering Wheel Travel		58
Test Position	70.2	234

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012



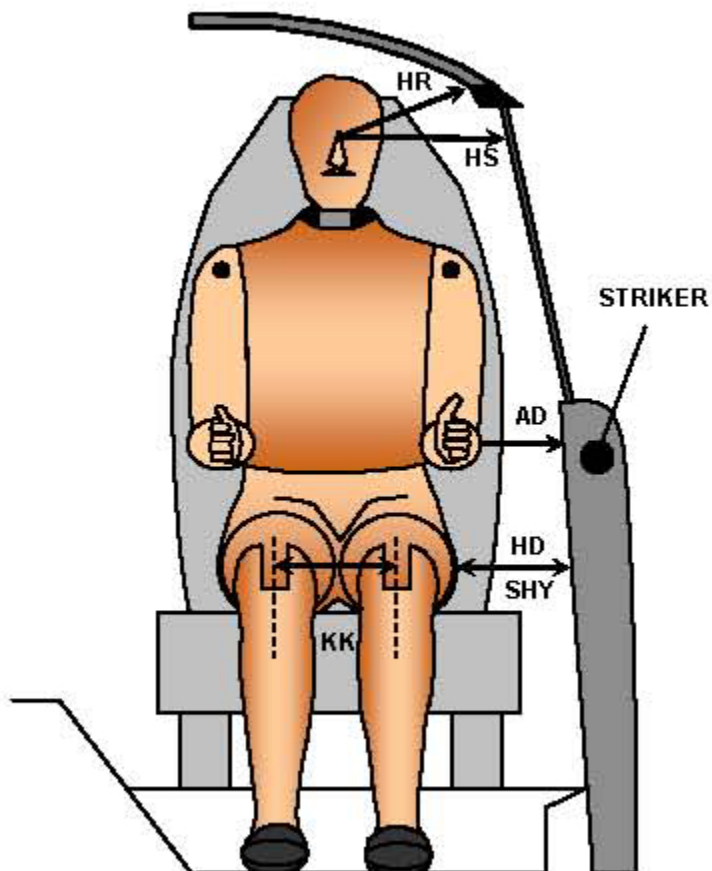
**LEFT SIDE VIEW**

Code	Measurement Description	Driver S/N 351		Passenger S/N 634	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		28.2		
SWA°	Steering Wheel Angle		70.2		
SCA°	Steering Column Angle		29.8		
SA°	Seat Back Angle (on headrest post)		17.6		7.0
HZ	Head to Roof (Z)	207	90	206	90
HH	Head to Header	361	26.1	280	49.6
HW	Head to Windshield	670	0	663	0
NR	Nose to Rim	365	14.5		
CD	Chest to Dash	515		397	
CS	Chest to Steering Hub	283	0.9		
RA	Rim to Abdomen	186	0		
KDL	Left Knee to Dash	186	37.6	91	27.8
KDR	Right Knee to Dash	155	29.5	98	29.7
PA°	Pelvic Angle		22.5		21.5
TA°	Tibia Angle		43.1		60.2
SK	Striker to Knee	587	89.1	664	96.9
ST	Striker to Head	558	14.3	538	18.7
SH	Striker to H-Point	257	127.0	363	105.4

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012



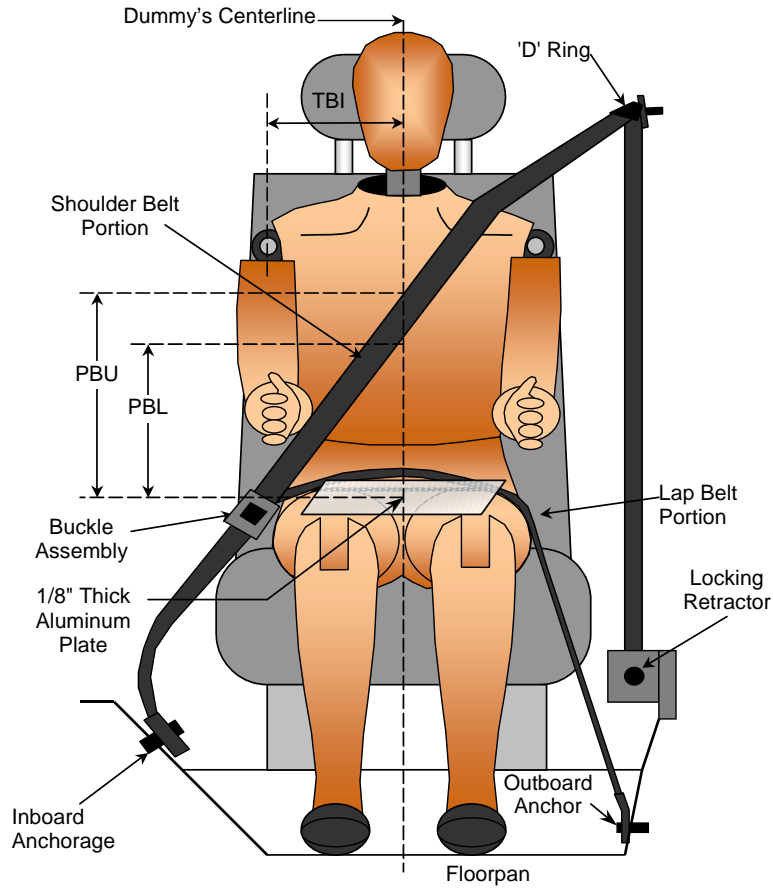
**FRONT VIEW OF DUMMY**

Code	Measurement Description	Driver S/N 351	Passenger S/N 634
		Length (mm)	
AD	Arm to Door	112	182
HD	H-Point to Door	125	169
HR	Head to Side Header	245	265
HS	Head to Side Window	351	379
KK	Knee to Knee	324	225
SHY	Striker to H-Point (Y Direction)	265	325
AA	Ankle to Ankle	313	160

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012



**FRONT VIEW OF DUMMY**

**SEAT BELT POSITIONING MEASUREMENTS**

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	370	330
PBL - Top surface of reference to belt lower edge	mm	300	240

**BELT LENGTH DATA**

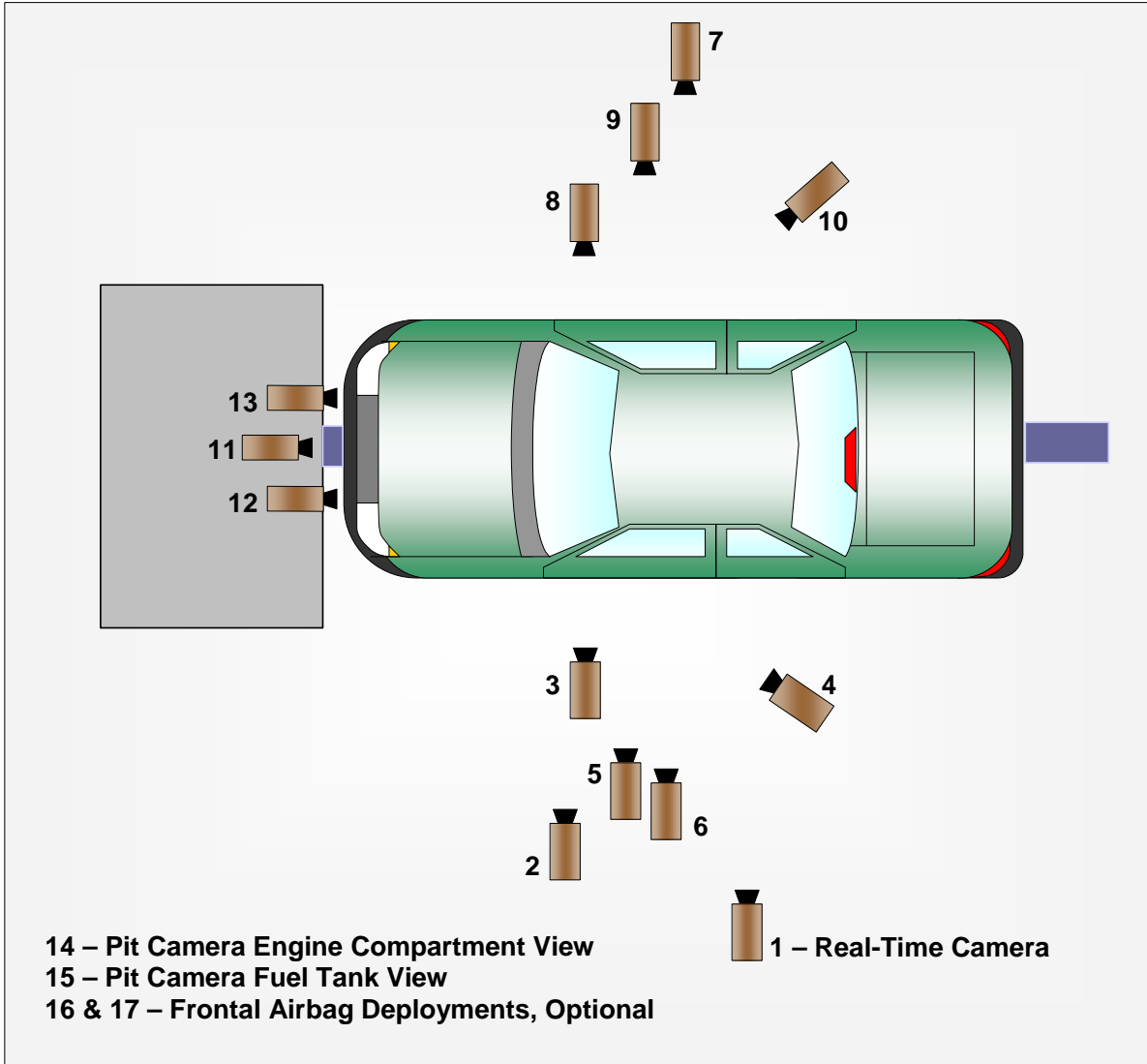
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	915	925
Lap Belt Length as measured on ATD	mm	620	555
Remainder of belt on reel	mm	1615	1620
Total Belt Length for Continuous Webbing Systems	mm	3150	3100

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

**CAMERA POSITIONS FOR FRONTAL IMPACTS**



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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

**CAMERA LOCATIONS**

No.	Camera View	Coordinates (mm)			Lens (mm)	Speed (fps)
		X*	Y*	Z*		
1	Real-Time Left Overall					30
2	Driver Close-Up	1480	-6290	-1930	35	1000
3	Left Front Half	1150	-4850	-1290	24	1000
4	Left Angle	5220	-5320	-2030	50	1000
5	Steering Column - Top	680	-4980	-1260	24	1000
6	Steering Column - Bottom	670	-4980	-860	24	1000
7	Right Overall	1920	6200	-1420	20	1000
8	Passenger Close-Up	1580	6910	-1890	35	1000
9	Right Front Half	1170	5130	-1300	24	1000
10	Right Angle	5540	4740	-1920	50	1000
11	Windshield	-130	0	-2810	20	1000
12	Driver Windshield	250	-450	-2030	8.5	1000
13	Passenger Windshield	250	450	-2030	8.5	1000
14	Pit Front	1060	0	3150	24	1000
15	Pit Rear	3140	0	3150	24	1000
16	Onboard Driver Side (optional)					
17	Onboard Passenger Side (optional)					
18	Real-Time Pan View					30

**\*COORDINATES:**

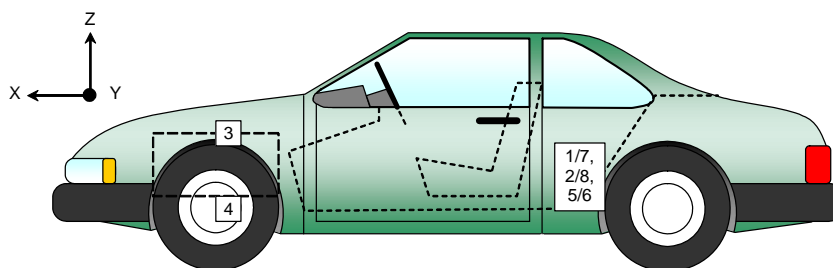
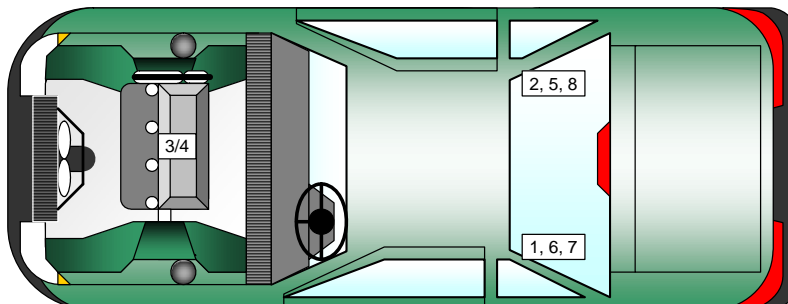
- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = below ground level

Cameras 16 & 17 were not used for this test.

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012



**VEHICLE ACCELEROMETER PRE-TEST LOCATIONS**

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	1877	-400	-442
2	Right Rear Crossmember Accelerometer – X Direction	1877	400	-442
3	Engine Top X	3804	0	-1030
4	Engine Bottom X	3931	0	-463
5	Left Rear Crossmember Accelerometer – Z Direction	1877	-400	-442
6	Right Rear Crossmember Accelerometer – Z Direction	1877	400	-442
7	Left Rear Crossmember Accelerometer Redundant – X Direction	1877	-400	-442
8	Right Rear Crossmember Accelerometer Redundant – X Direction	1877	400	-442

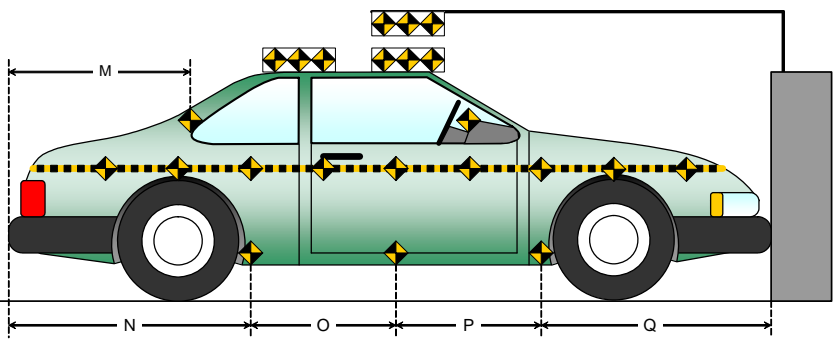
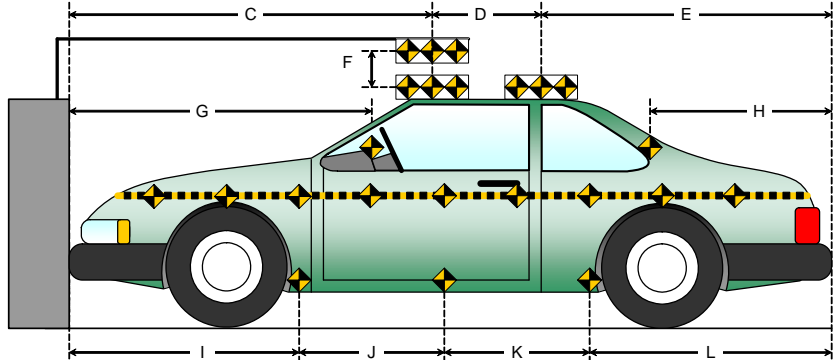
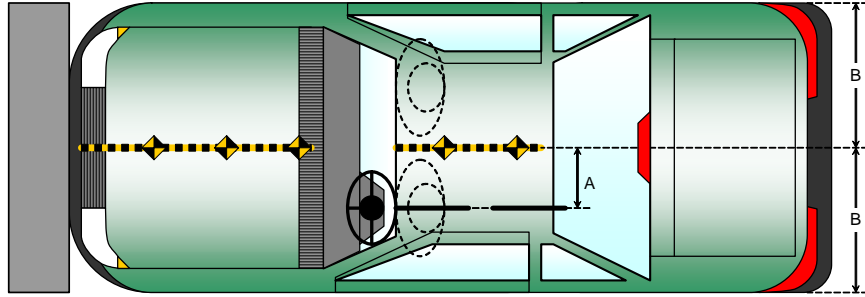
Reference Points: X - Rear Surface of Vehicle (+ forward)  
 Y - Vehicle Centerline (+ to right)  
 Z - Ground Plane (+ down)

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

Item	Value (mm)
A	390
B	958
C	2515
D	670
E	1622
F	132
G	
H	1311
I	1367
J	964
K	964
L	1512
M	1311
N	1512
O	964
P	964
Q	1367



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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**Advanced Research Load Cell Barrier**

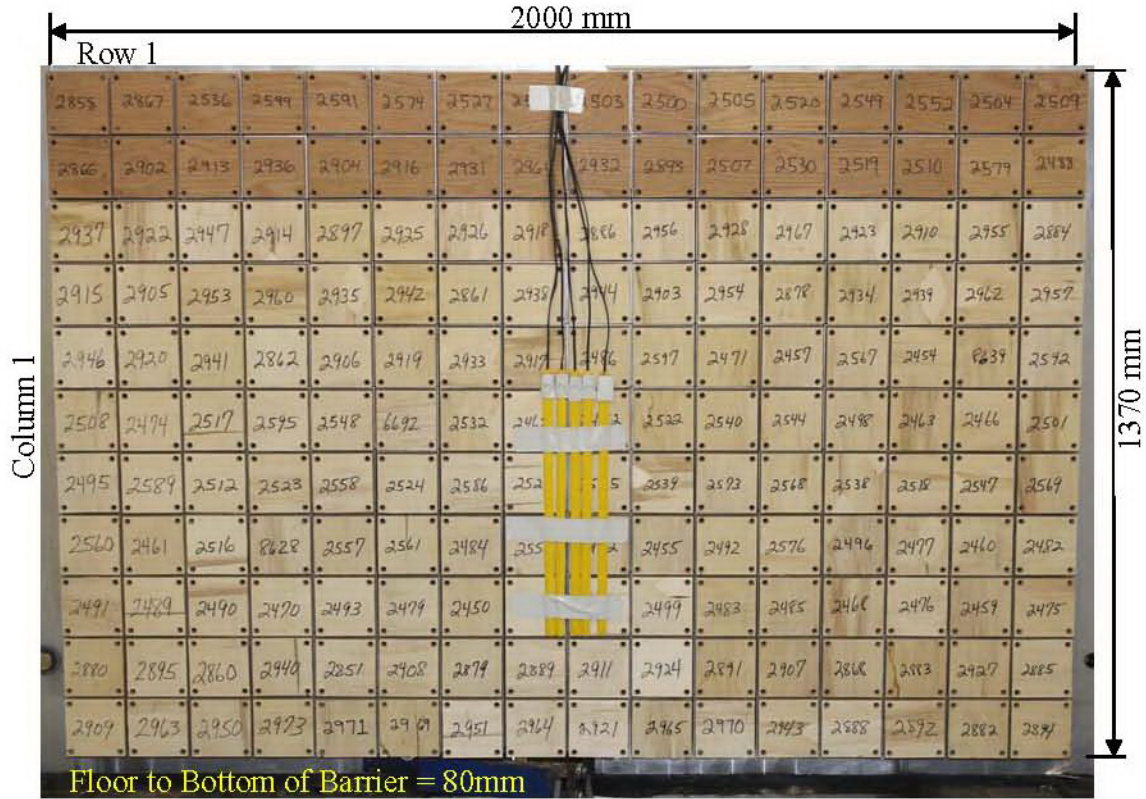


Photo for Reference Only

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

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: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

**INSTRUMENTATION**

Driver Dummy Data Channels	52
Passenger Dummy Data Channels	52
Vehicle Structure Accelerometers	8
Barrier Channels	128
Total	240

**CAMERA COVERAGE**

High-Speed Vehicle Onboard	0
High-Speed Offboard	14
Real-Time	2
Total	16

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**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	Glove Box
Right Knee Contact	Knee Airbag	Glove Box

**DOOR OPENING AND SEAT TRACK INFORMATION**

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

**VEHICLE REBOUND FROM BARRIER**

Measured Parameter	Units	Value
Left Side	mm	900
Center	mm	942
Right Side	mm	946
Average	mm	929

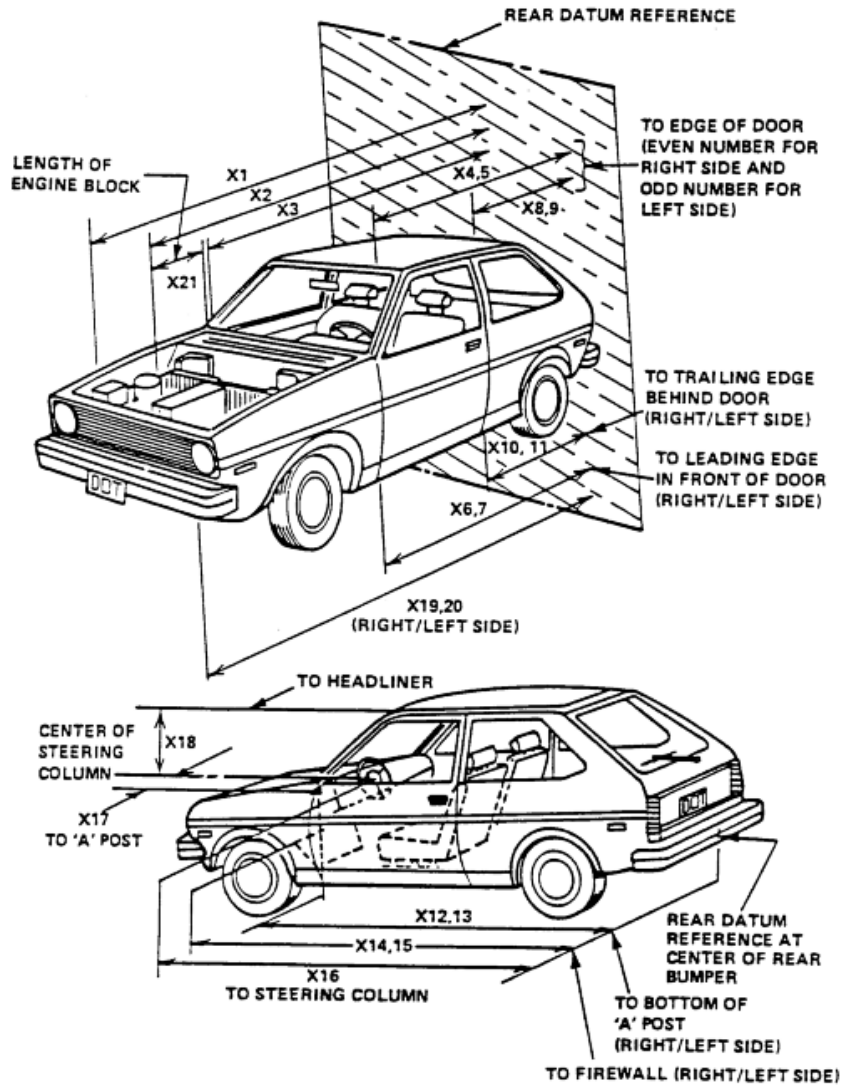
**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

Restraint Type	Left Front (Driver) P1		Right Front (Passenger) P2	
	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	No	
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	
Other	No		No	

## DATA SHEET NO. 12 VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012



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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

**RSOV (Rear Surface of Vehicle)**

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	4807	4253	554
2	RSOV to Front of Engine	mm	4201	3989	212
3	RSOV to Firewall	mm	3744	3675	69
4	RSOV to Upper Leading Edge of Right Door	mm	3260	3277	-17
5	RSOV to Upper Leading Edge of Left Door	mm	3260	3283	-23
6	RSOV to Lower Leading Edge of Right Door	mm	3280	3276	4
7	RSOV to Lower Leading Edge of Left Door	mm	3280	3280	0
8	RSOV to Upper Trailing Edge of Right Door	mm	2146	2142	4
9	RSOV to Upper Trailing Edge of Left Door	mm	2146	2141	5
10	RSOV to Lower Trailing Edge of Right Door	mm	2184	2179	5
11	RSOV to Lower Trailing Edge of Left Door	mm	2184	2175	9
12	RSOV to Bottom of "A" Post of Right Side	mm	3260	3249	11
13	RSOV to Bottom of "A" Post of Left Side	mm	3274	3274	0
14	RSOV to Firewall, Right Side	mm	3431	3418	13
15	RSOV to Firewall, Left Side	mm	3436	3426	10
16	RSOV to Steering Column	mm	2753	2618	135
17	Center of Steering Column to "A" Post	mm	395	376	19
18	Center of Steering Column to Headliner	mm	435	444	-9
19	RSOV to Right Side of Front Bumper	mm	4628	4221	407
20	RSOV to Left Side of Front Bumper	mm	4628	4271	357
21	Length of Engine Block	mm	490	490	0
RD	RSOV to Right Side of Dash Panel	mm	3011	3024	-13
CD	RSOV to Center of Dash Panel	mm	2990	2978	12
LD	RSOV to Left Side of Dash Panel	mm	3011	3027	-16

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

**VEHICLE INFORMATION**

VIN: 4JGDA5HB8DA142352 Wheelbase (mm): 2915  
Vehicle Size Category: MPV Test Weight (kg): 2430.8

**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): 56.2

Velocity Change (km/h): 64.9

Time of Separation (msec): 112.8

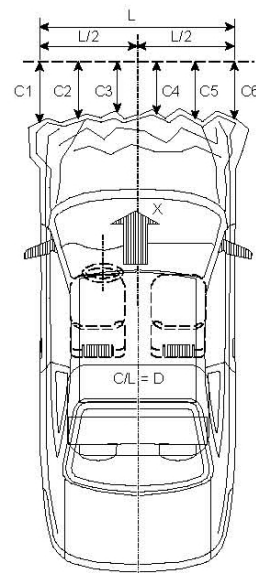
**CRUSH PROFILE**

Collision Deformation Classification: Frontal

Midpoint of Damage: Centerline

Damage Region Length (mm): 1400

Impact Mode: Frontal



No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4628	4271	357
C2	Crush zone 2 at left side	mm	4716	4247	469
C3	Crush zone 3 at left side	mm	4755	4245	510
C4	Crush zone 4 at right side	mm	4755	4226	529
C5	Crush zone 5 at right side	mm	4716	4217	499
C6	Crush zone 6 at right side	mm	4628	4221	407
L	C1 TO C6	mm	1400	1378	22

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

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

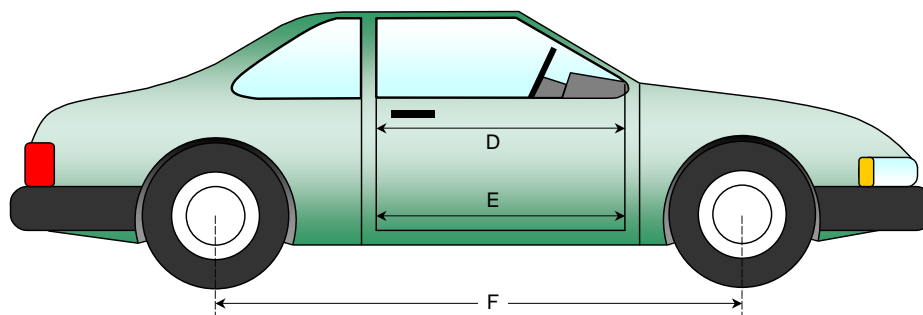
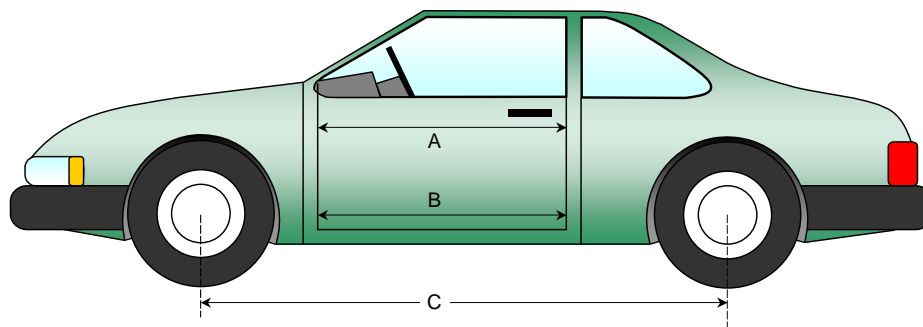
NHTSA No.: MD0509  
 Test Date: 12/20/2012

**DOOR OPENING WIDTH**

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	930	933	-3
B	Left Side Lower	mm	848	848	0
D	Right Side Upper	mm	930	930	0
E	Right Side Lower	mm	848	848	0

**WHEELBASE MEASUREMENTS**

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2915	2830	85
F	Right Side Wheelbase	mm	2915	2835	80



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

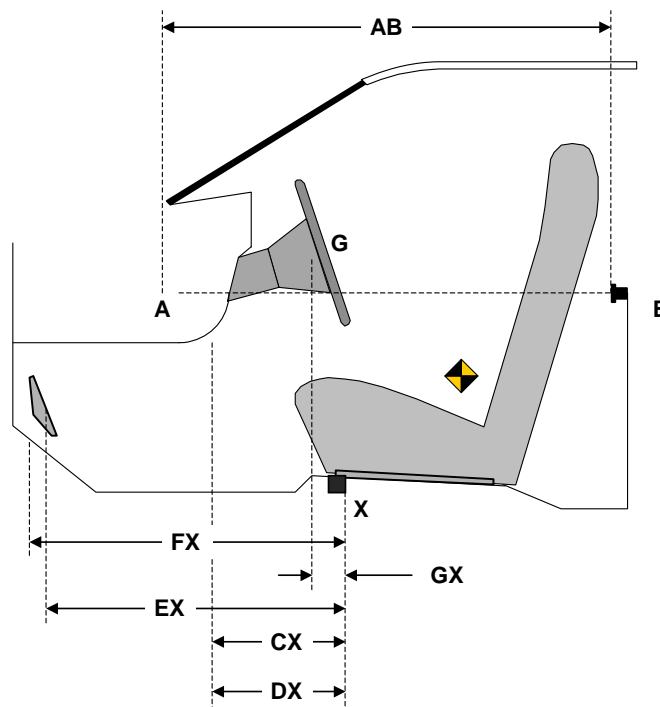
Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**DRIVER COMPARTMENT INTRUSION**

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	770	770	0
CX	Left Knee Bolster to X	mm	313	313	0
DX	Right Knee Bolster to X	mm	293	293	0
EX	Brake Pedal to X	mm	592	568	24
FX	Foot Rest to X	mm	636	615	21
GX	Center of Steering Column Wheel Hub to X	mm	72	159	-87

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: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

**Windshield Mounting Details:**

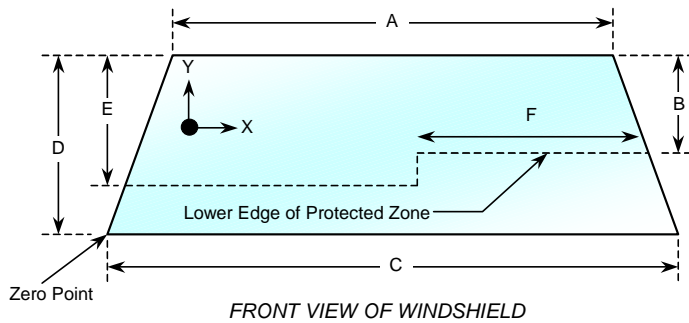
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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: 20.8°C

**WINDSHIELD PERIPHERY MEASUREMENTS**

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2220	2220	100
Right Side	2220	2220	100
Total	4440	4440	100



Item	Units	Value
A	mm	1262
B	mm	510
C	mm	1510
D	mm	834
E	mm	512
F	mm	524

**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: 2013 Mercedes-Benz ML350 AWD SUV  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
Test Date: 12/20/2012

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

Temperature at Time of Impact: 20.8°C      Test Time: 3:44 p.m.

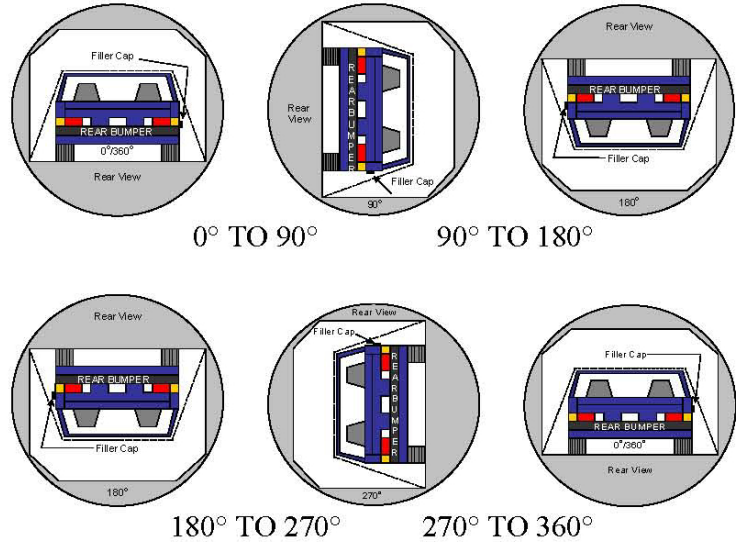
- A. From impact until vehicle motion ceases:      0 oz.  
(Maximum allowable = 1 oz.)
- B. For the 5 minute period after motion ceases:      0 oz.  
(Maximum allowable = 5 oz.)
- C. For the following 25 minutes:      0 oz.  
(Maximum allowable = 1 oz./minute)
- D. Spillage:      None

**DATA SHEET NO. 16  
FMVSS 301 STATIC ROLLOVER RESULTS**

Test Vehicle: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012

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



**SOLVENT COLLECTION TIME TABLE IN SECONDS**

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	109	300	409
90° to 180°	109	300	409
180° to 270°	110	300	410
270° to 360°	110	300	410

**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

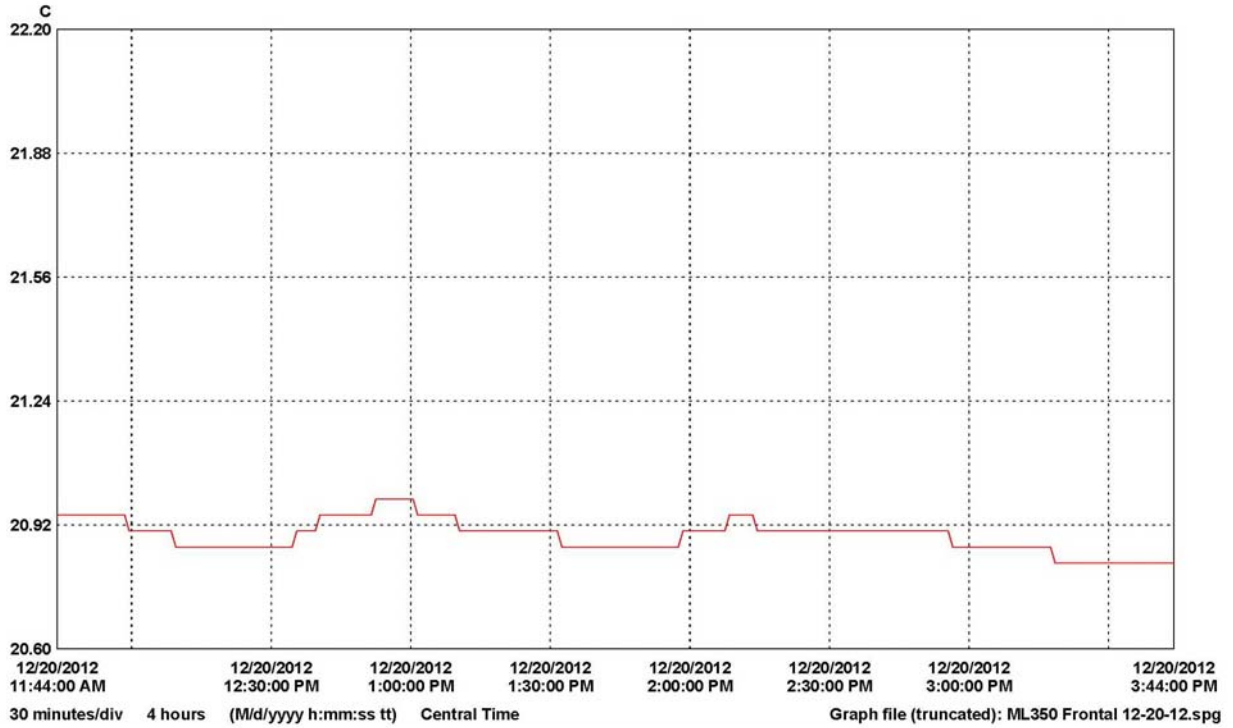
**SOLVENT SPILLAGE LOCATION TABLE**

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: 2013 Mercedes-Benz ML350 AWD SUV  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: MD0509  
 Test Date: 12/20/2012



LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	10102056	Crash Prep 1	1	20.99	20.89	20.82	C	Temperature	10102056_Crash_Prep_1.spl	
LN Logger file										
1	C:\Program Files (x86)\Veriteq Instruments\Log 4.4\2013 NCAP\10102056_Crash_Prep_1.spl									ID # Security Created by Creation time

**APPENDIX A  
PHOTOGRAPHS**

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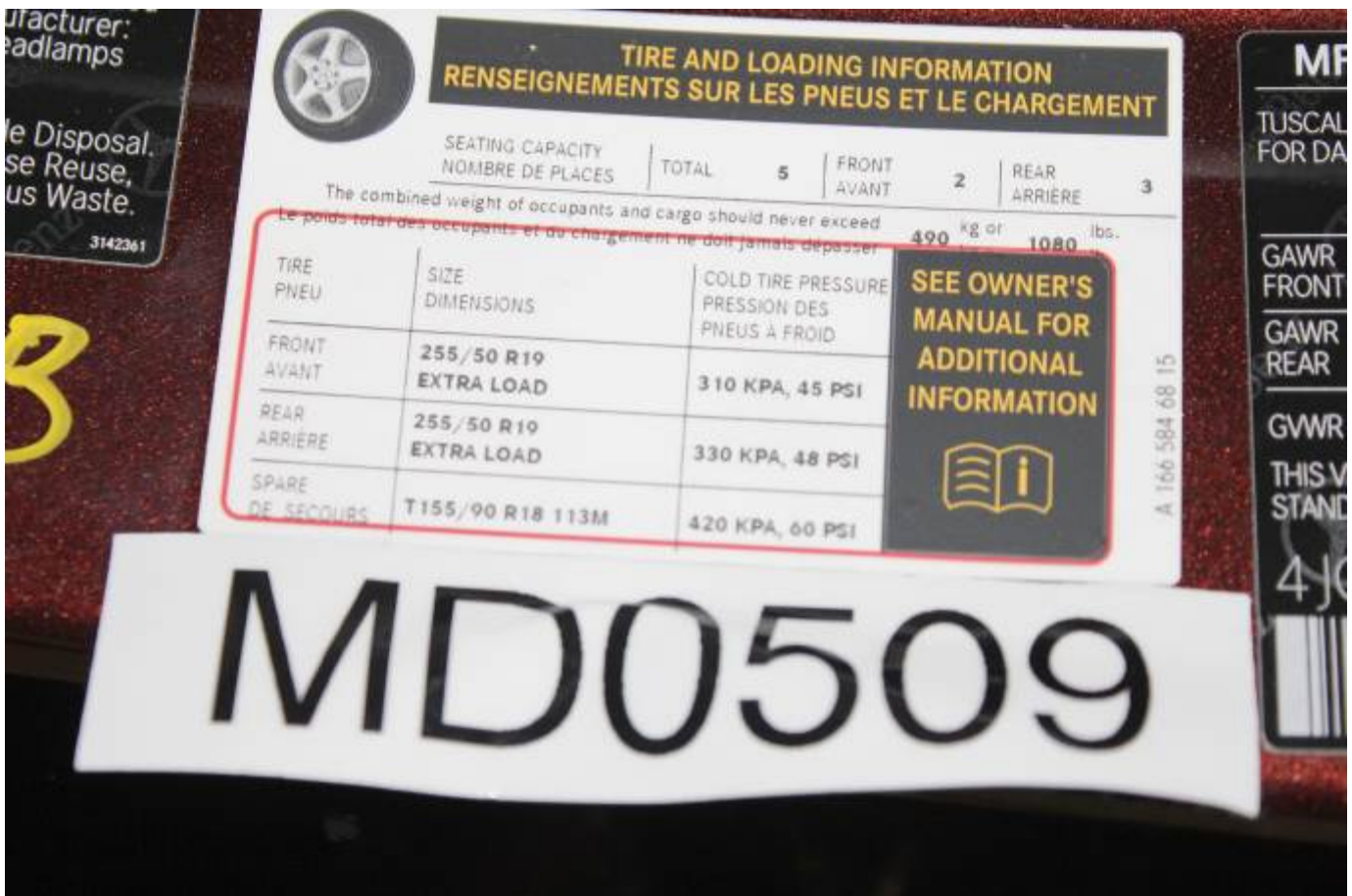
Load Cell Location



Load Cell Wall



Manufacturer's Label



Tire Placard



2013 Mercedes-Benz ML350 AWD Frontal As Delivered



Left Rear 3-4 View, As Received



Pre-Test Front View of Test Vehicle



Post-Test Front View of Test Vehicle



Pre-Test Left View of Test Vehicle



Post-Test Left View of Test Vehicle



Pre-Test Right View of Test Vehicle



Post-Test Right View of Test Vehicle



Pre-Test Right Front 3-4 View



Post-Test Right Front 3-4 View



Pre-Test Left Rear 3-4 View



Post-Test Left Rear 3-4 View



Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



Post-Test Engine Compartment View



Pre-Test Fuel Filler Cap View



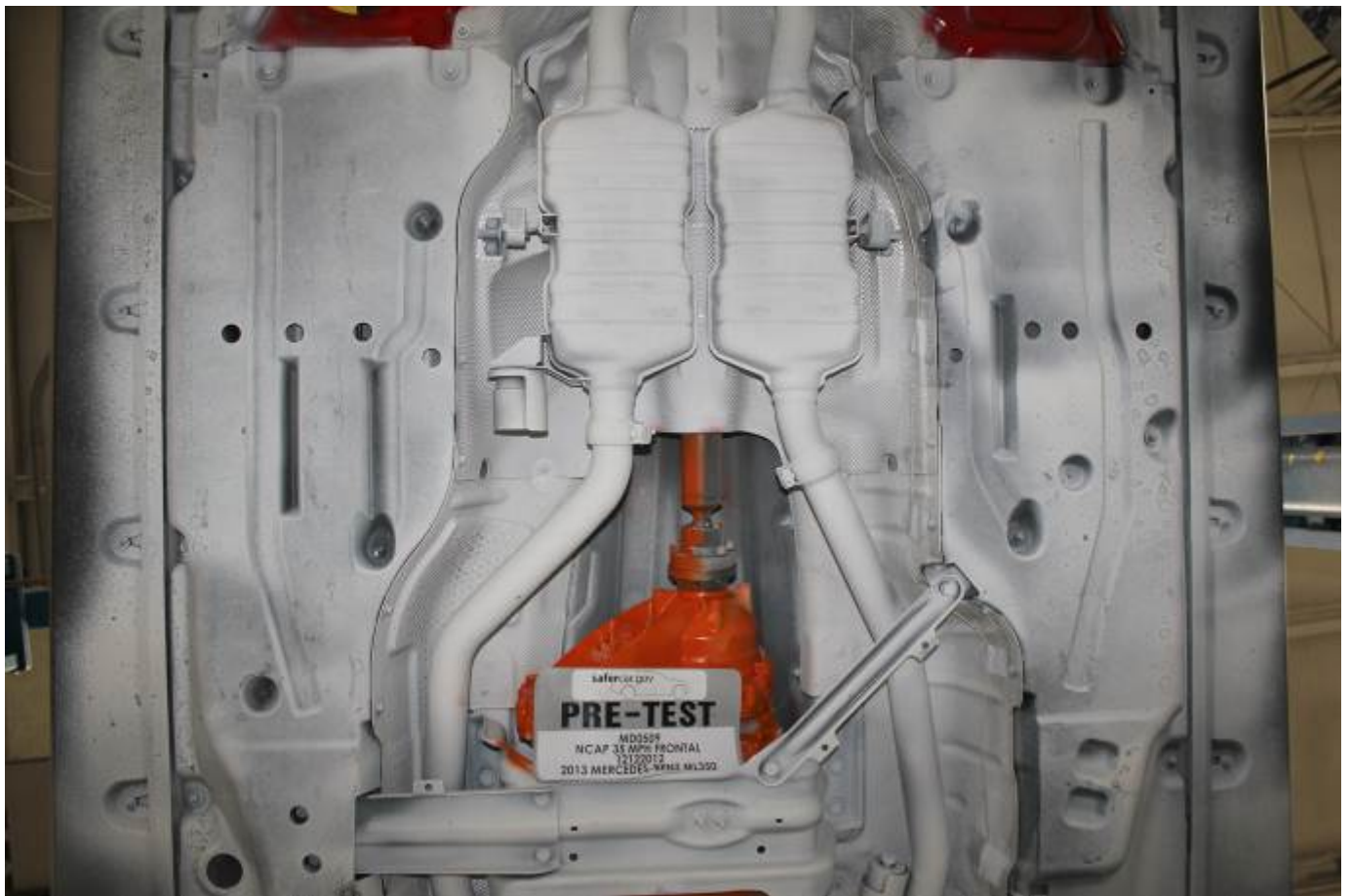
Post-Test Fuel Filler Cap View



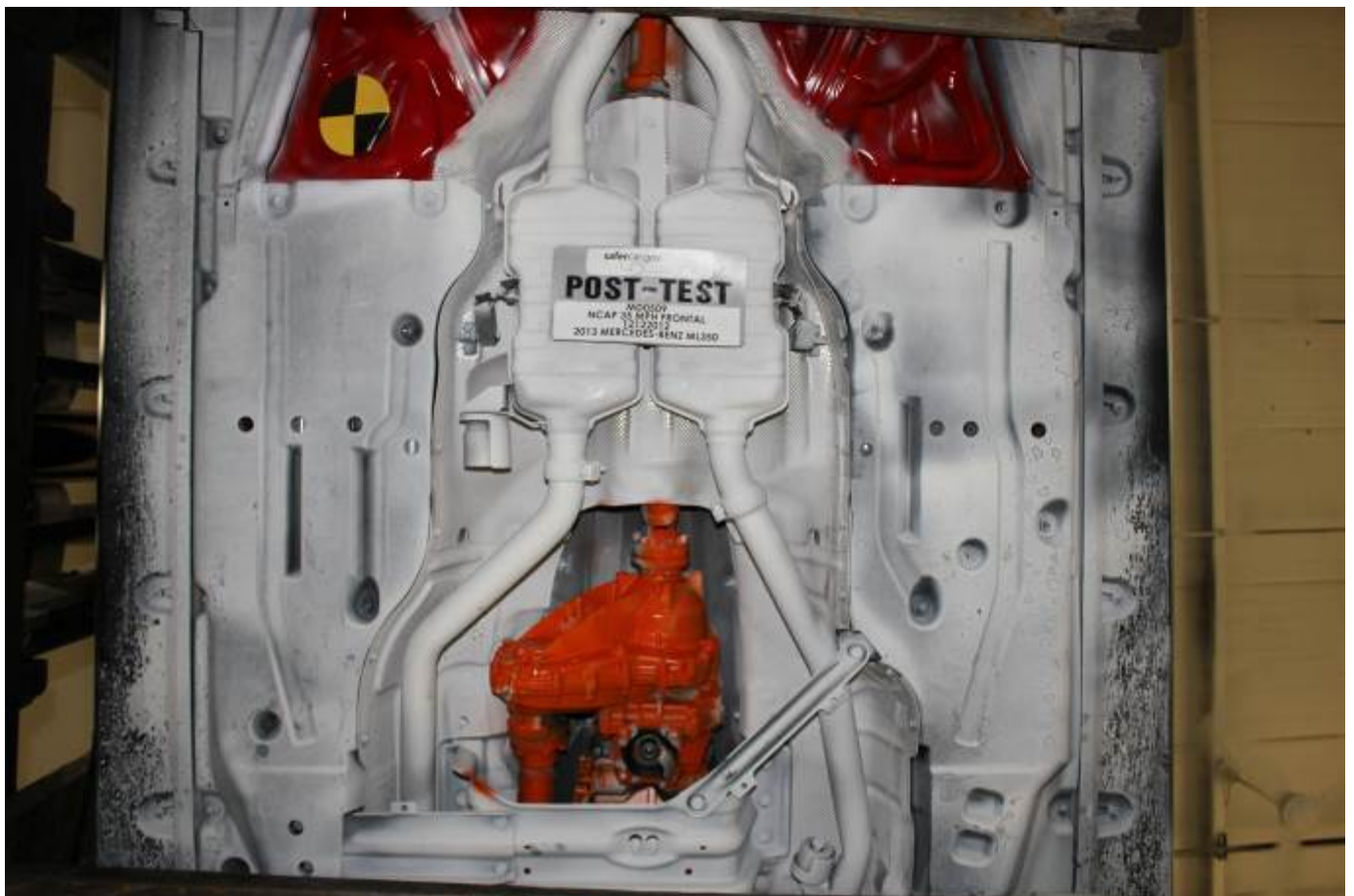
Pre-Test Front Underbody View



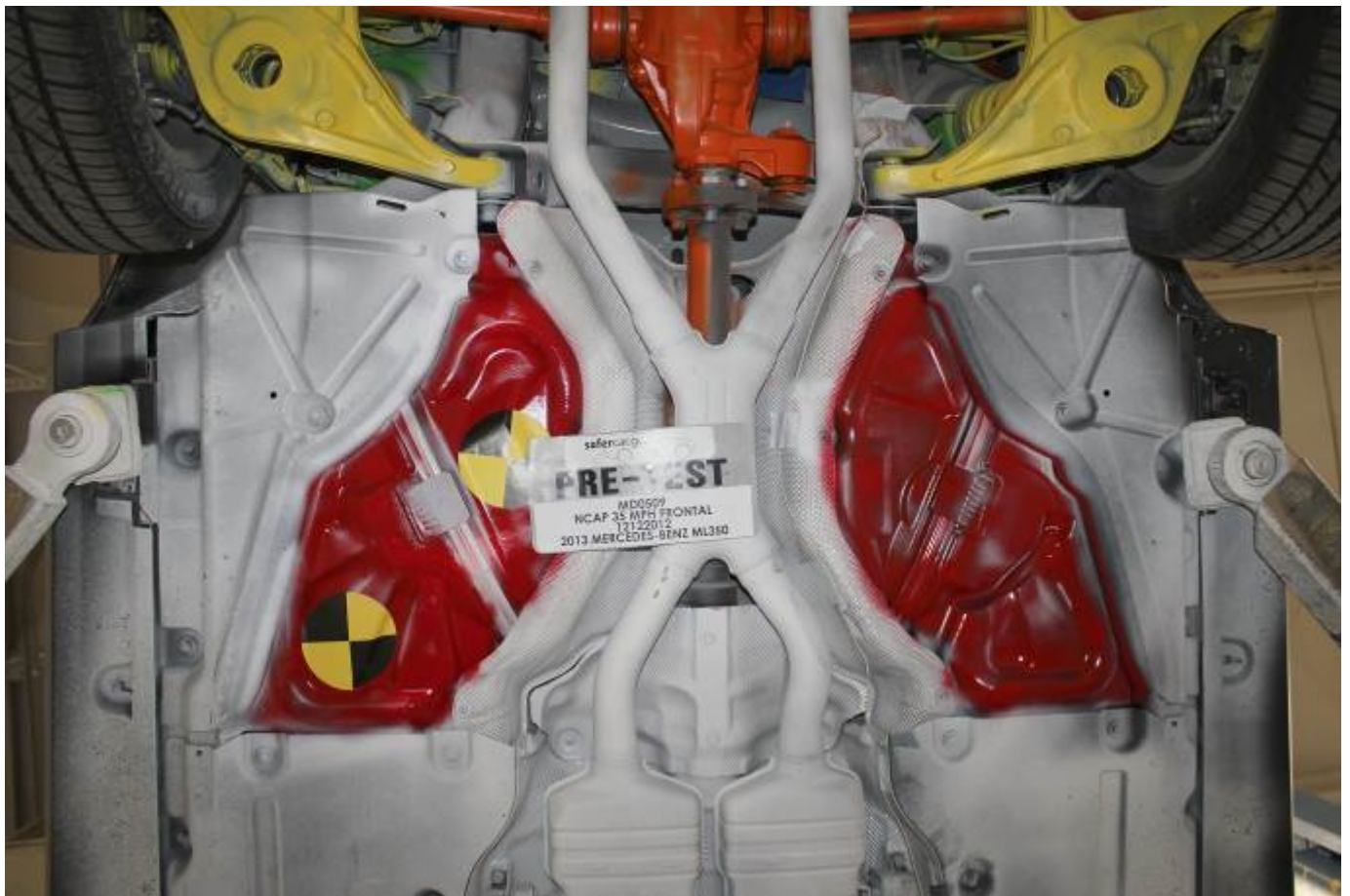
Post-Test Front Underbody View



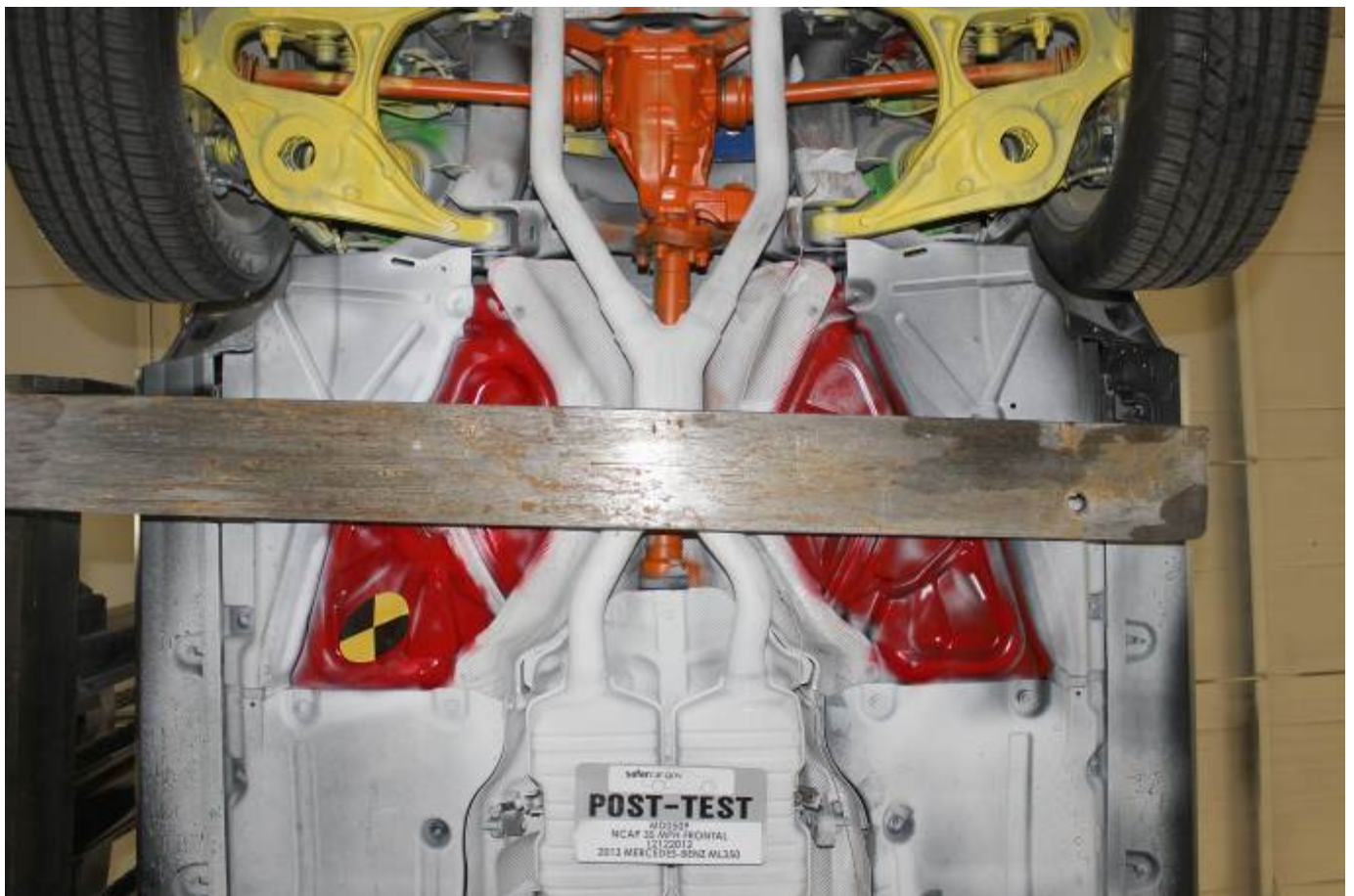
Pre-Test Mid Front Underbody View



Post-Test Mid Front Underbody View



Pre-Test Mid Rear Underbody View



Post-Test Mid Rear Underbody View



Pre-Test Rear Underbody View



Post-Test Rear Underbody View



Pre-Test Dummy Cable Routing



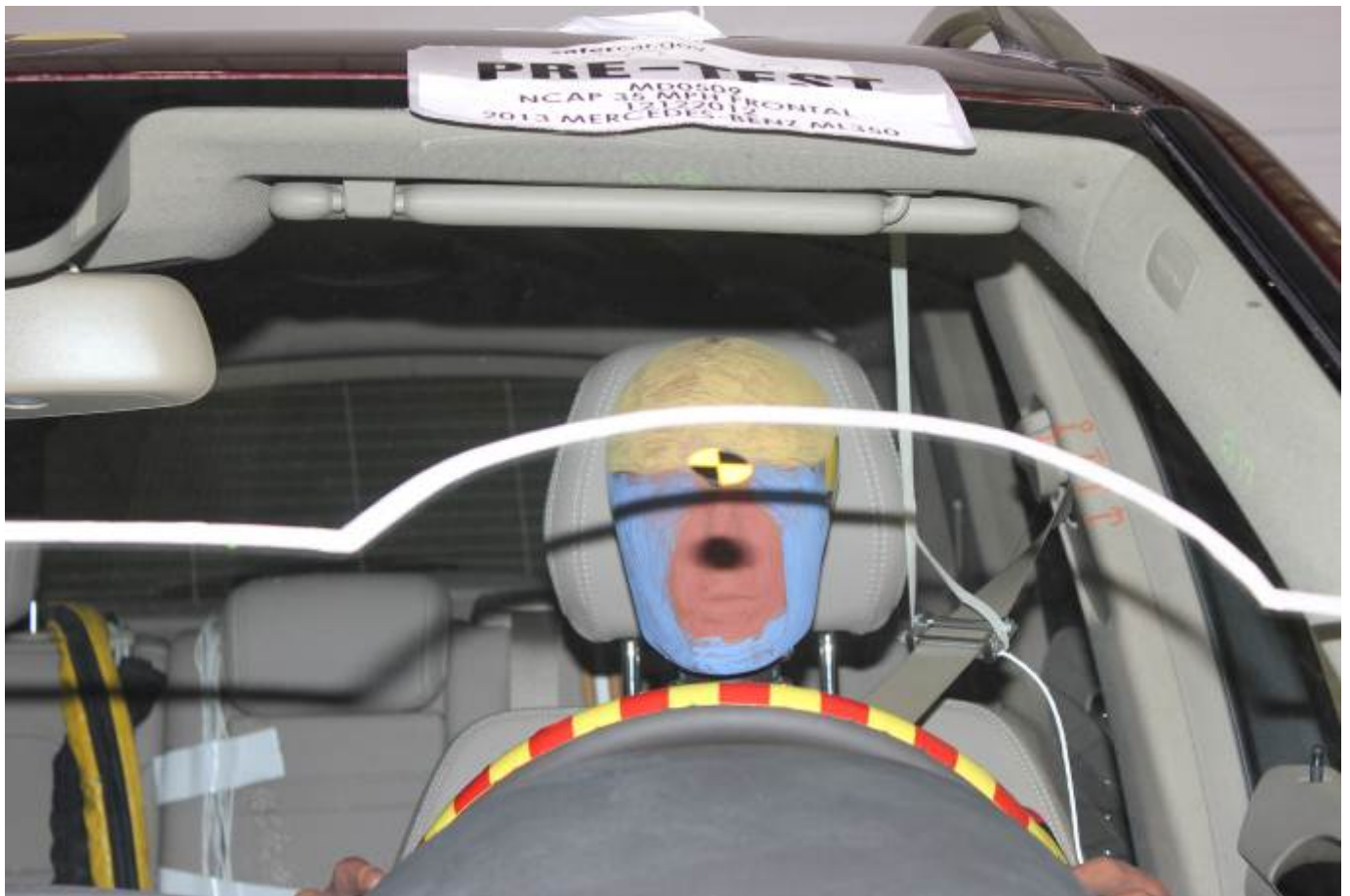
Pre-Test Dummy Cable Routing



Post-Test Dummy Cable Routing



Post-Test Dummy Cable Routing



Pre-Test Driver Dummy Front View



Post-Test Driver Dummy Front View



Pre-Test Driver Dummy Window View



Post-Test Driver Dummy Window View



Pre-Test Driver Dummy and Vehicle Interior (Door Open)



Post-Test Driver Dummy and Vehicle Interior (Door Open)



Pre-Test Driver's Seat Fore-Aft Markings



Post-Test Driver's Seat Fore-Aft Markings



Pre-Test View of Belt Anchorage for Driver Dummy



Post-Test View of Belt Anchorage for Driver Dummy



Pre-Test Driver Dummy Feet



Post-Test Driver Dummy Feet



Pre-Test Driver's Side Knee Bolster (without dummy)



Post-Test Driver's Side Knee Bolster (without dummy)



Pre-Test Driver's Side Floorpan



Post-Test Driver's Side Floorpan



Post-Test Driver Dummy Face



Post-Test Driver Dummy Contact with Airbag



Post-Test Driver Dummy Contact with Headrest



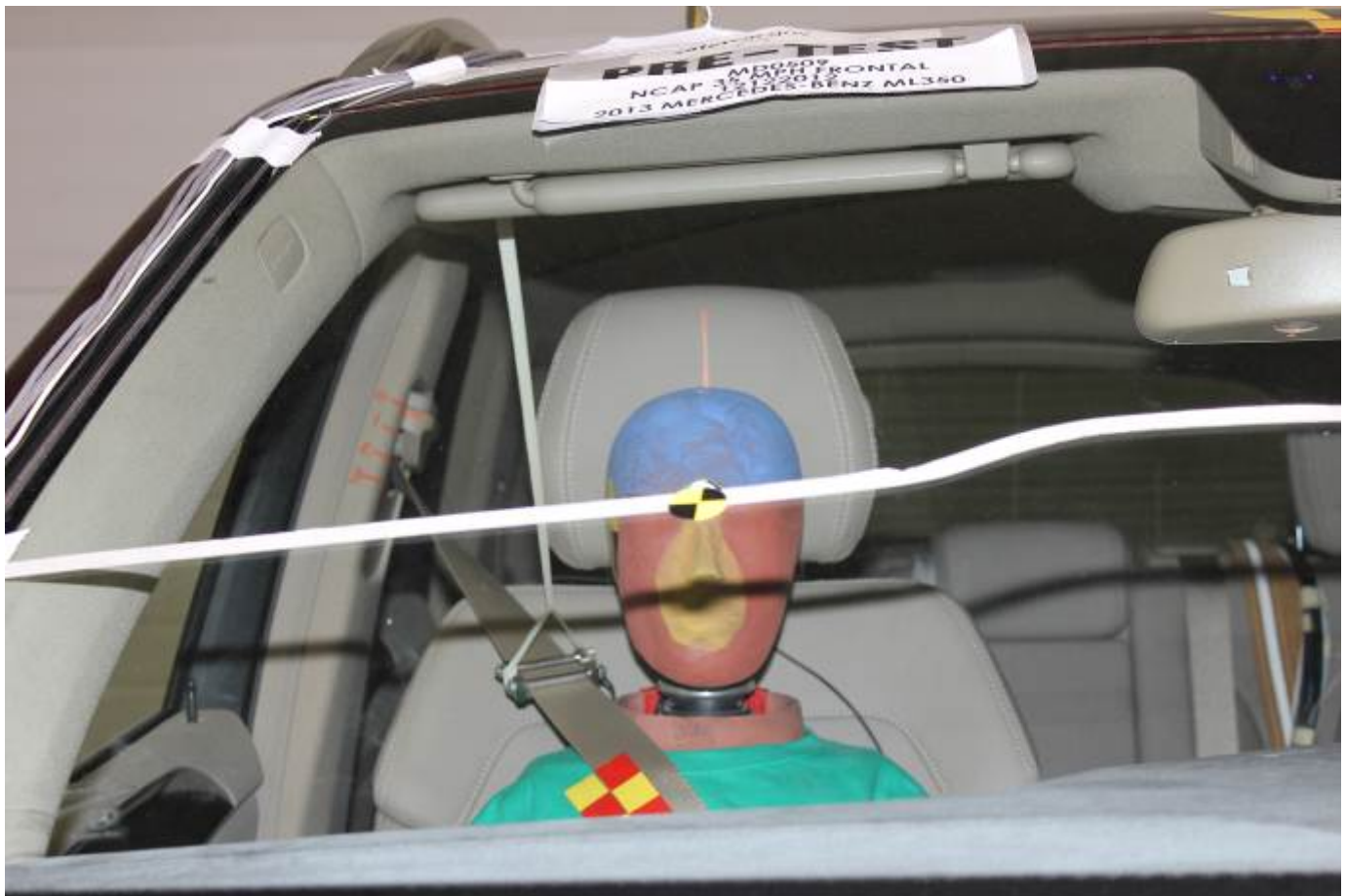
Post-Test Driver Dummy Contact with Knee Airbag



Pre-Test View of the Steering Wheel



Post-Test View of the Steering Wheel



Pre-Test Passenger Dummy Front View



Post-Test Passenger Dummy Front View



Pre-Test Passenger Dummy Window View



Post-Test Passenger Dummy Window View



Pre-Test Passenger Dummy and Vehicle Interior (Door Open)



Post-Test Passenger Dummy and Vehicle Interior (Door Open)



Pre-Test Passenger's Seat Fore-Aft Markings



Post-Test Passenger's Seat Fore-Aft Markings



Pre-Test View of Belt Anchorage for Passenger Dummy



Post-Test View of Belt Anchorage for Passenger Dummy



Pre-Test Passenger Dummy Feet



Post-Test Passenger Dummy Feet



Pre-Test Passenger's Side Knee Bolster (without dummy)



Post-Test Passenger's Side Knee Bolster (without dummy)



Pre-Test Passenger's Side Floorpan



Post-Test Passenger's Side Floorpan



Post-Test Passenger Dummy Contact with Airbag



Post-Test Passenger Dummy Contact with Headrest



Post-Test Passenger Dummy Contact with Glove Box



Ballast Installed in Vehicle

**PHOTOGRAPH NOT APPLICABLE**

Post-Test Stoddard Solvent Spillage Location View



Post-Test Speed Trap Read-Out



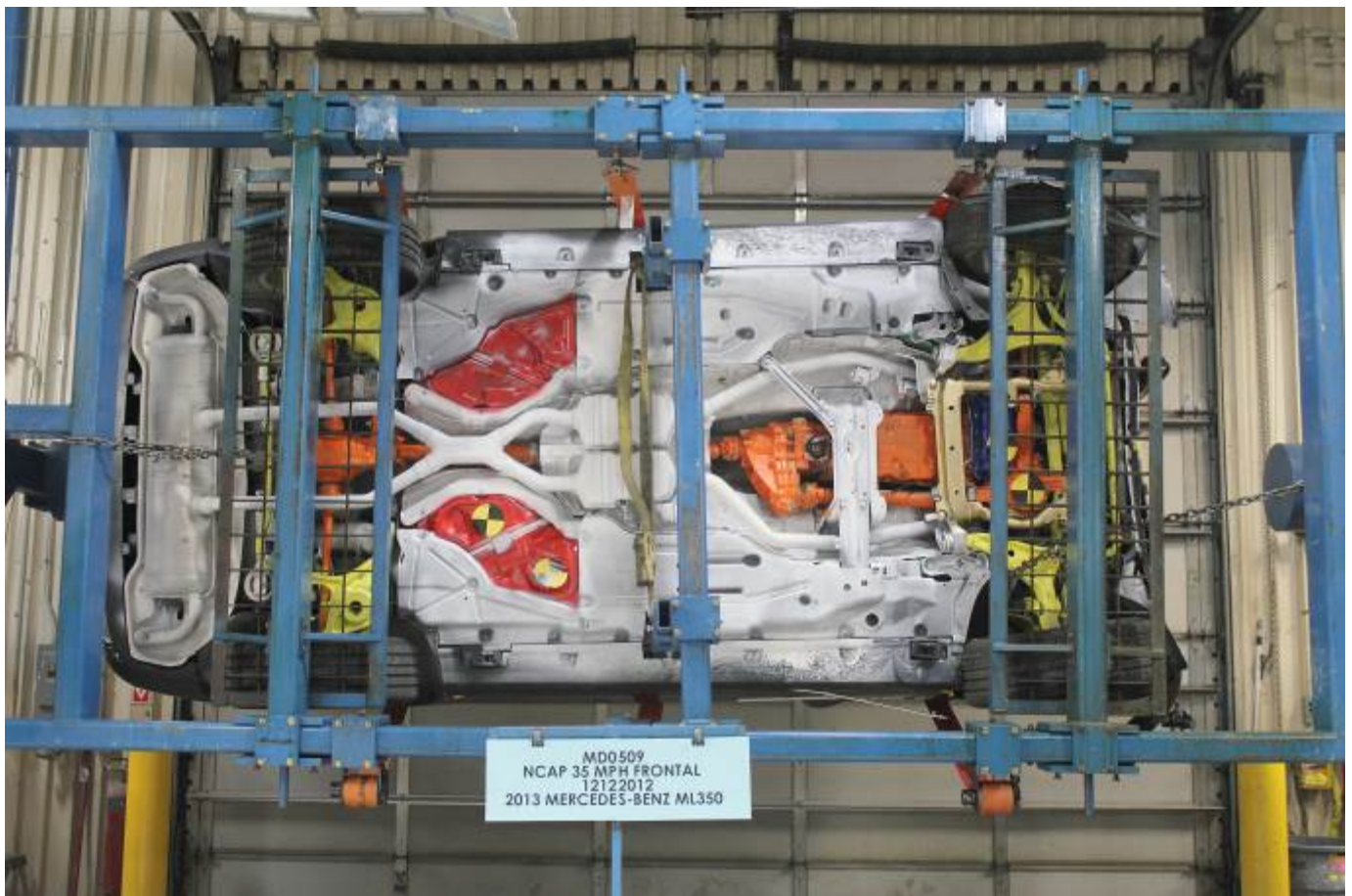
Vehicle at 0° on Static Rollover Device



Vehicle at 90° on Static Rollover Device



Vehicle at 180° on Static Rollover Device



Vehicle at 270° on Static Rollover Device



Vehicle at 360° on Static Rollover Device



2013 Mercedes-Benz ML350 AWD Frontal Impact Event



# 2013 ML350 4MATIC

Mercedes-Benz

PO#: 0570676382  
VIN: 4JGDA3HBD0A142352



www.NMUSA.com

## Standard Features

## Suggested Retail Price

\$49,770

### PERFORMANCE/HANDLING

3.5 liter, V6 engine with Direct Injection  
302 Horsepower  
273 lb-ft Torque  
7-Speed automatic Transmission with Shift Padlock  
4MATIC Permanent All-wheel Drive  
AGILITY CONTROL Suspension System  
Electromechanical Power Steering  
Independent Front/Rear Suspension  
18-inch Wheels  
ABS with TCS

### PAINT/UPHOLSTERY & TRIM

191 Cavalier Red Metallic  
150 Almond beige MB Teal  
734 Eschylus Wood Trim

316.00  
N/C  
N/C

### OPTIONAL EQUIPMENT AND VALUE ADDED PACKAGES

815 1P Teal Sapote Wheel  
520 COMAND® with Navigation  
660 Wheel Locking Bolt  
Destination and Delivery

15.00  
N/C  
149.00  
\$65.00

### Total Retail Price

\$51,535.00

### COMFORT/CONVENIENCE

Power Tilt/Steering Steering Wheel  
Auto-dimming Interior and Exterior Mirrors  
Central Controller with Cruise Engine  
SteuerSonic® Steerassist for Hands-Free Driving  
SteuerSonic® CruiseControl with Audio Streaming  
Power Liftgate  
Blind Spot Assist  
CD/DVD audio/video Player  
Steering Wheel with Audio Controls  
180-Speakers Surround Sound System  
Power Adjustable Front Seats with Driver's Lumbar Support  
7-Speakers Surround Sound System  
Rear Window Entertainment System and Window Shade  
Cruise Control  
Privacy Glass  
Automatic Headlamps with Turn Signal  
Sensor and Locomotor Lighting  
intelligent™ - a trial period by Bluetooth

### SAFETY/SECURITY

COLLISION PREVENTION ASSIST  
ATTENTION ASSIST  
PRE-SAFE®  
Advanced Air Bag Protection System  
LED Daytime Running Lamps and Tail Lamps  
Rear Cross-Traffic Alert  
LATCH System (Child Seat Anchors) Securi  
ISOFIX Anchor System (Child Seat) with  
Electronic Stability Program (ESP®) with  
Anti-Lock Braking System (ABS)  
Brake Assist System (BAS)  
ACTIVE BRAKE Technology  
New Vehicle 4-year/50,000 Mile Warranty  
24-Hour Roadside Assistance Program

**Special Services:** Prepaid Maintenance Plan available for this vehicle; see dealer for details.

This vehicle is equipped with tires that are without an impact of 2.5 miles per hour with no damage to the vehicle's body and safety systems, although the bumper and related components may sustain damage. The bumper system on this vehicle conforms to the current federal bumper standard of 2.5 miles per hour.

## EPA DOT Fuel Economy and Environment

Flexible-Fuel Vehicle Gasoline-Ethanol (E85)



Standard SVA range from 13 to 28 MPG. The best vehicle rates 113 MPG. Values are based on gasoline and do not reflect performance and ratings based on E85.

**You spend \$2,650**

more in fuel costs over 5 years compared to the average new vehicle.

**Annual fuel cost \$2,850**



Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle emits 223 grams CO<sub>2</sub> per mile and costs \$13,380 to fuel over 5 years. CO<sub>2</sub> emissions are based on 16,000 miles per year at 55.00 per gallon. This is a fuel economy estimate. Emissions are based on gasoline (gasoline equivalent). Vehicle emissions are a significant cause of climate change and smog.

**fueleconomy.gov**

Calculate personalized estimates and compare vehicles.

## 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.

<b>Frontal Crash</b>	<b>Driver Passenger</b>	<b>Not Rated</b>
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.		

<b>Side Crash</b>	<b>Front seat Rear seat</b>	<b>Not Rated</b>
Based on the risk of injury in a side impact.		

<b>Rollover</b>	<b>Not Rated</b>
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 1-888-327-4228

## PARTS CONTENT INFORMATION

For vehicles in this carline:  
U.S./Canadian Parts Content:  
42 %

Major Sources of Foreign Parts Content:  
GERMANY: 30 %

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

For this vehicle:  
Final Assembly Plant:  
VANCE, ALABAMA USA  
Country of Origin:  
Engine: GERMANY  
Transmission: GERMANY

Ship To: **NEW ORLEANS, LA**

Port of Entry: **MOBILE-Alabama**  
Transport:

Monroney Label

**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](http://www.nhtsa.dot.gov)**

Driver Head CG X Redundant  
Driver Head CG Y Redundant  
Driver Head CG Z Redundant  
Driver 9 Axis Head X Arm Y  
Driver 9 Axis Head X Arm Z  
Driver 9 Axis Head Y Arm X  
Driver 9 Axis Head Y Arm Z  
Driver 9 Axis Head Z Arm X  
Driver 9 Axis Head Z Arm Y  
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 – Not Installed  
Driver Shoulder Belt Force  
Passenger Head CG X Redundant  
Passenger Head CG Y Redundant  
Passenger Head CG Z Redundant  
Passenger 9 Axis Head X Arm Y  
Passenger 9 Axis Head X Arm Z  
Passenger 9 Axis Head Y Arm X  
Passenger 9 Axis Head Y Arm Z  
Passenger 9 Axis Head Z Arm X  
Passenger 9 Axis Head Z Arm Y  
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 – Not Installed  
Passenger Shoulder Belt Force  
Left Rear Seat Crossmember X  
Right Rear Seat Crossmember X  
Vehicle Engine Top X  
Vehicle Engine Bottom X

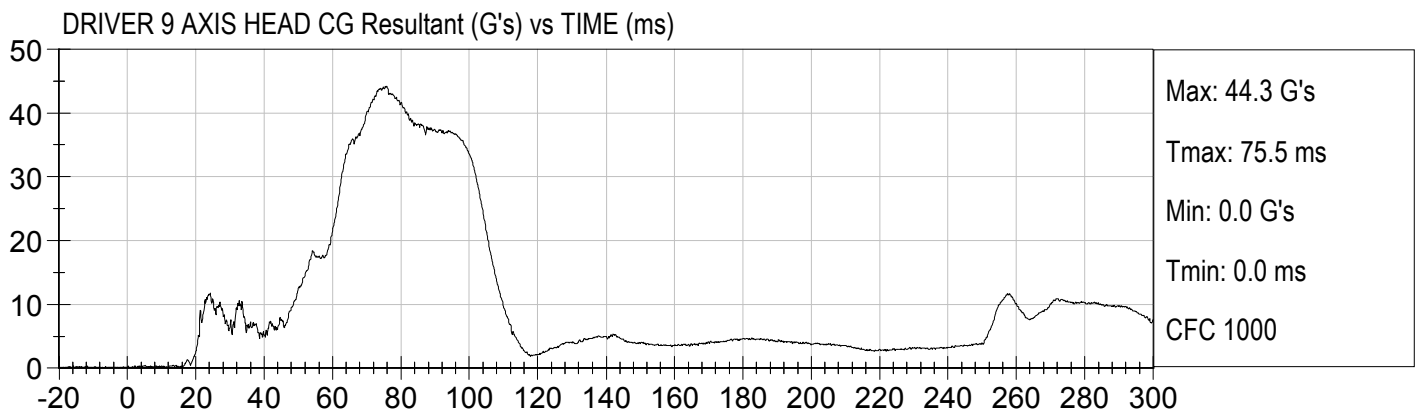
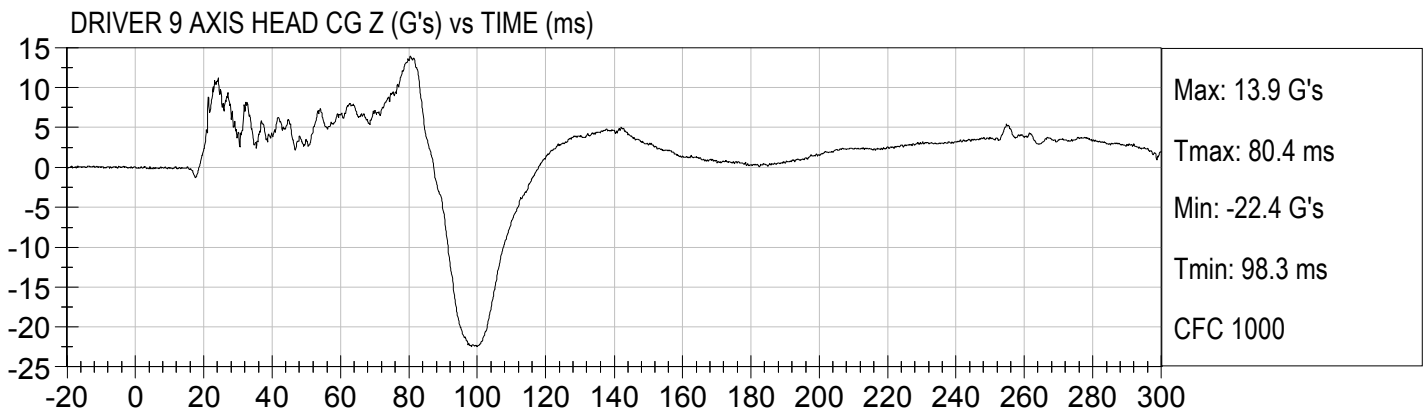
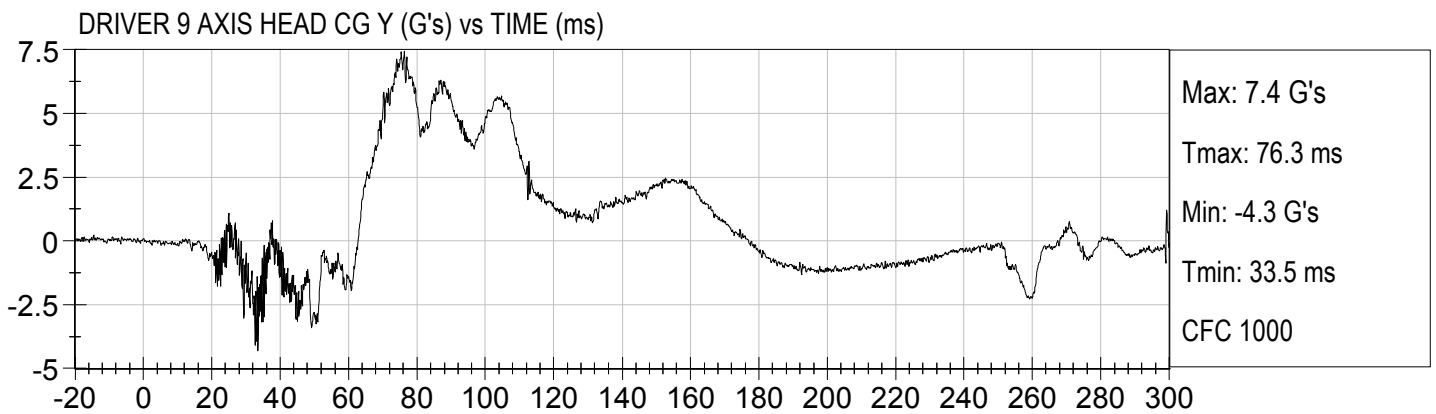
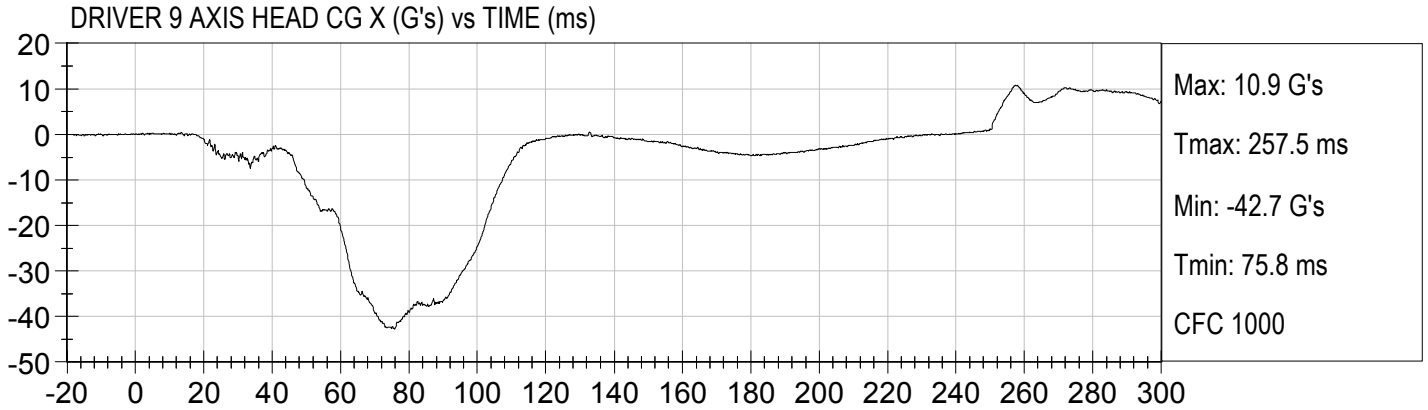
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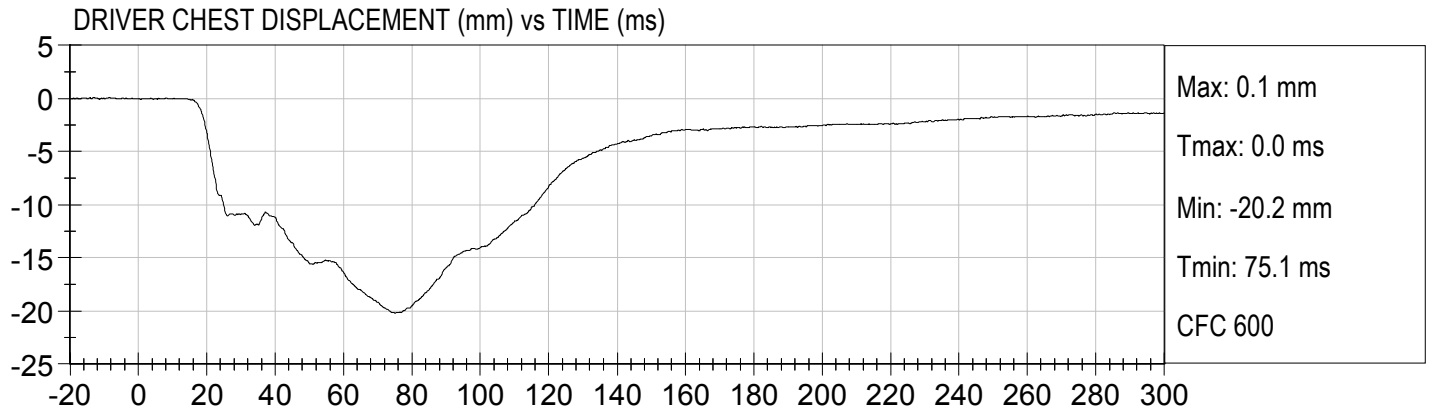
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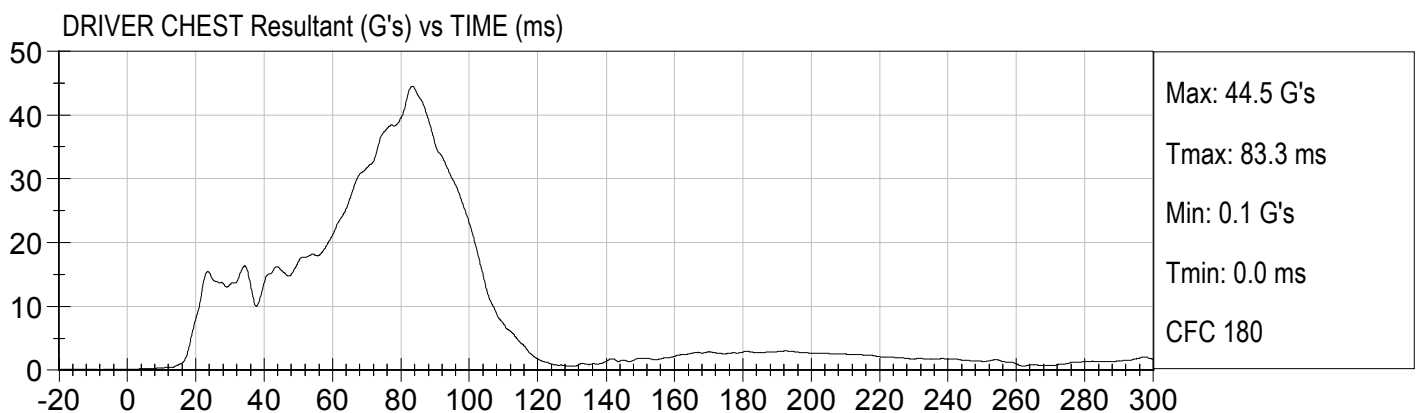
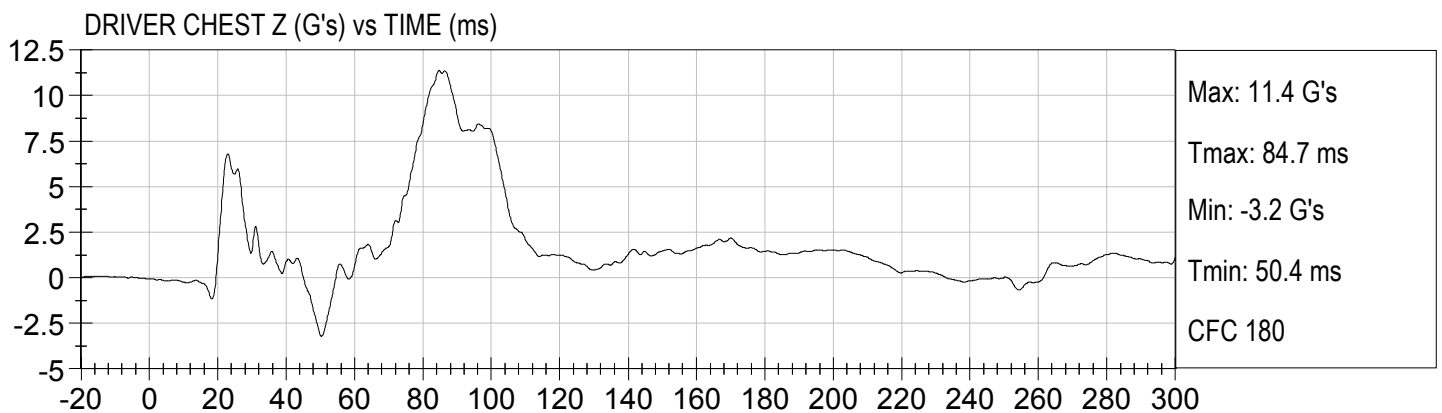
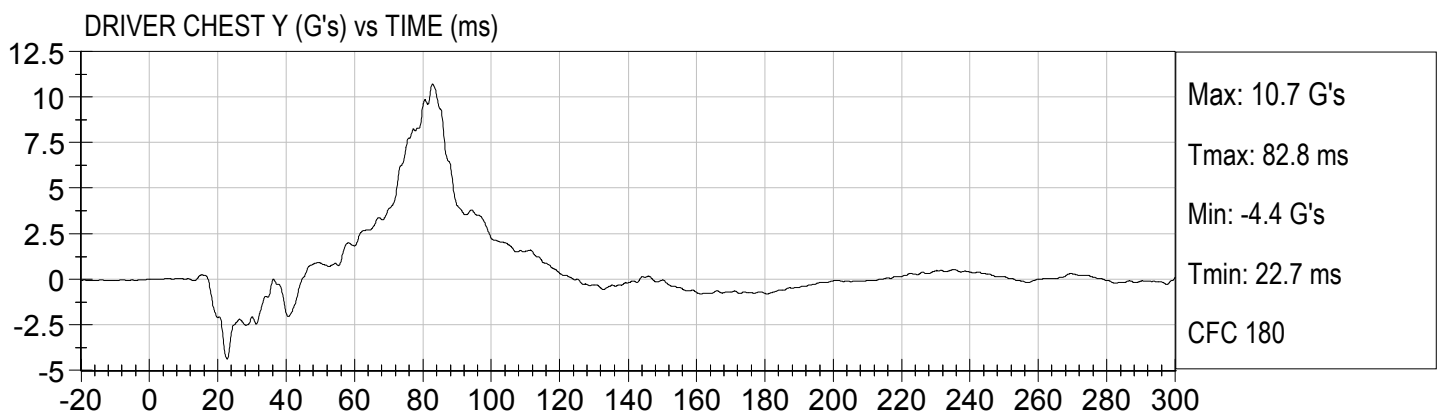
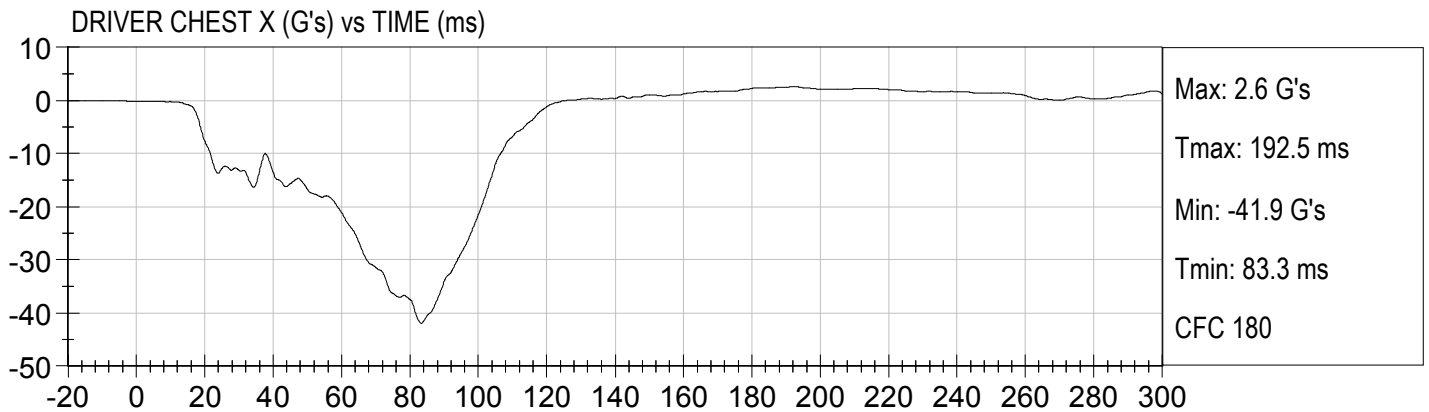
Left Rear Seat Crossmember Xr

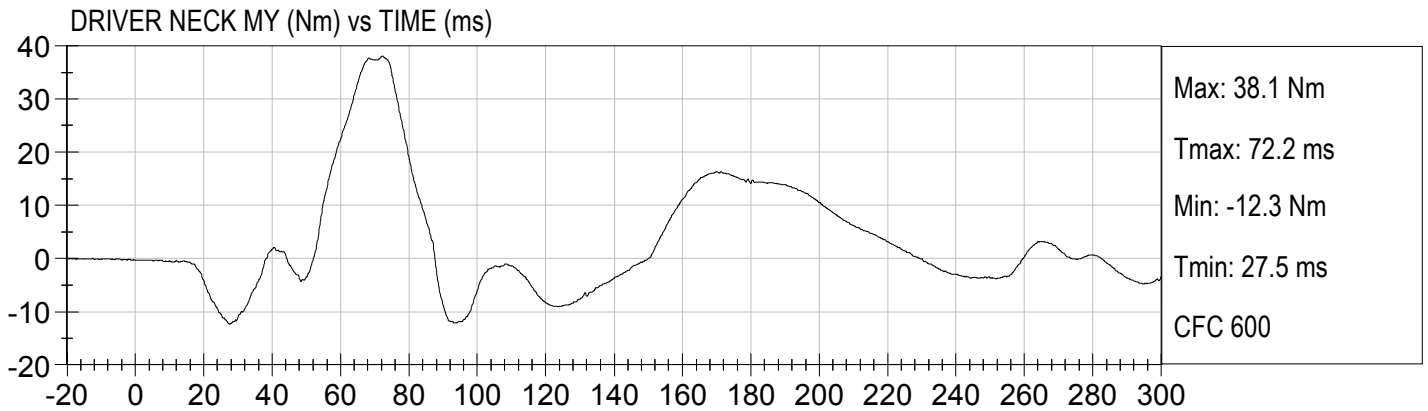
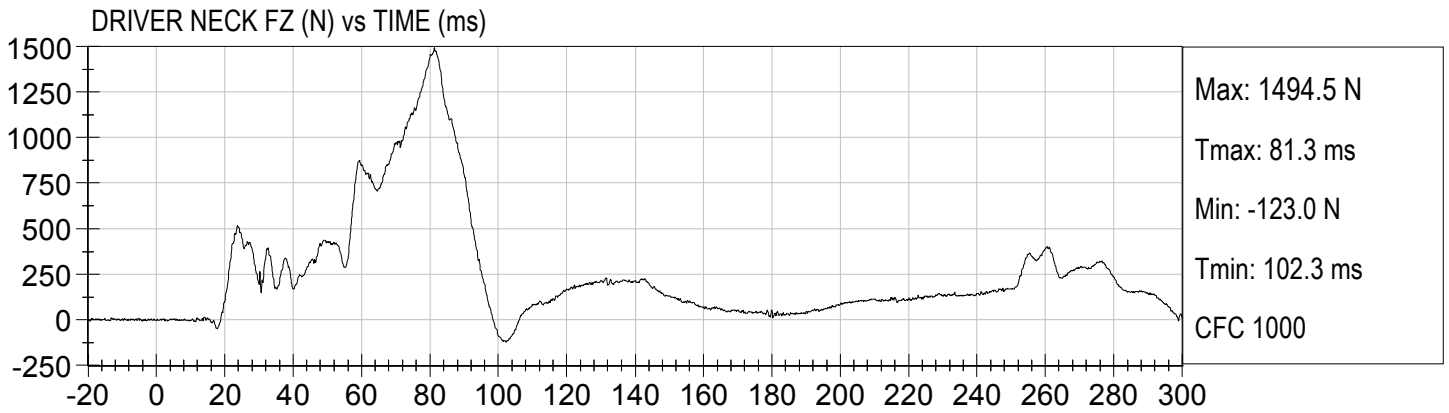
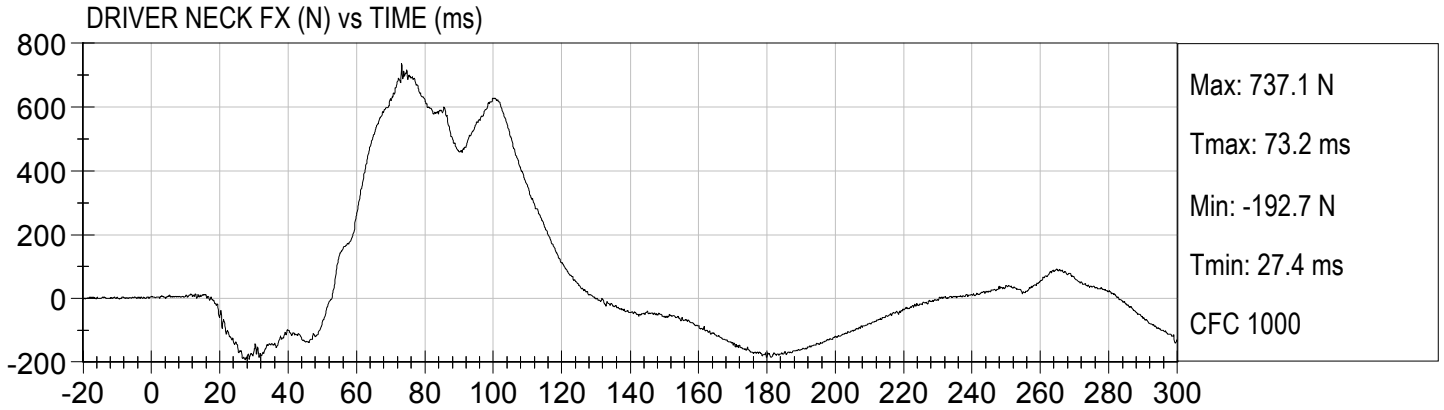
Right Rear Seat Crossmember Xr

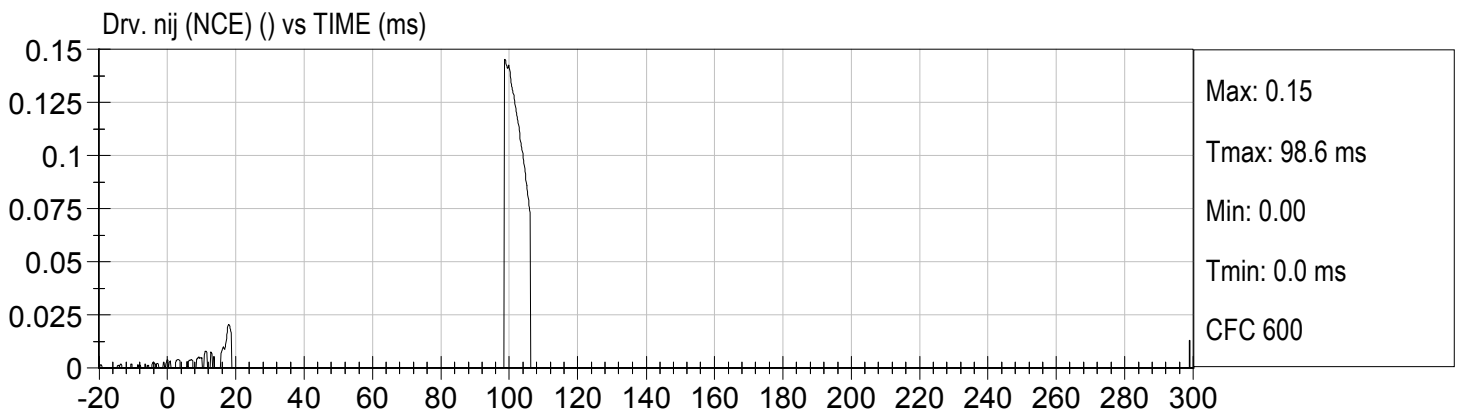
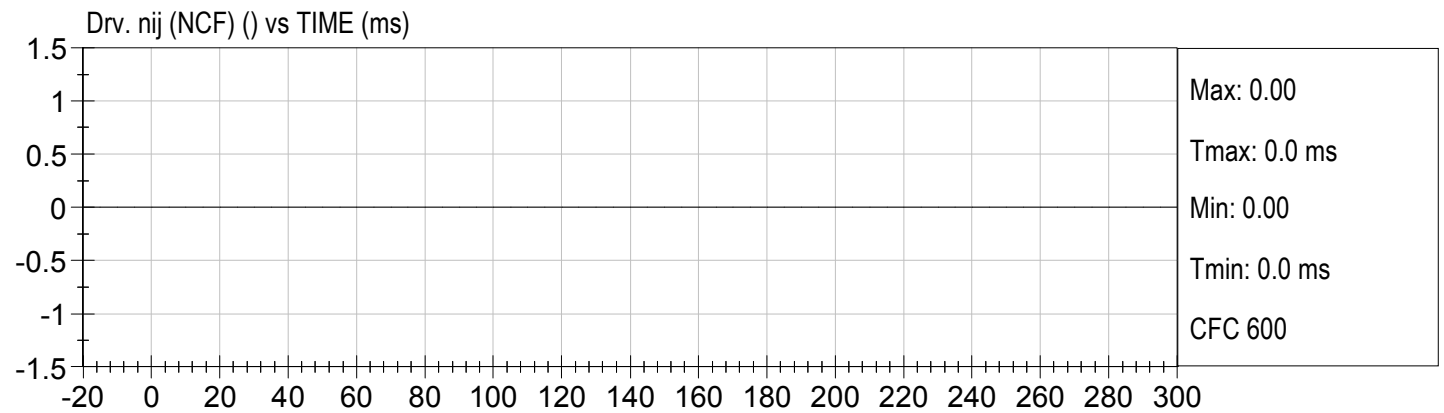
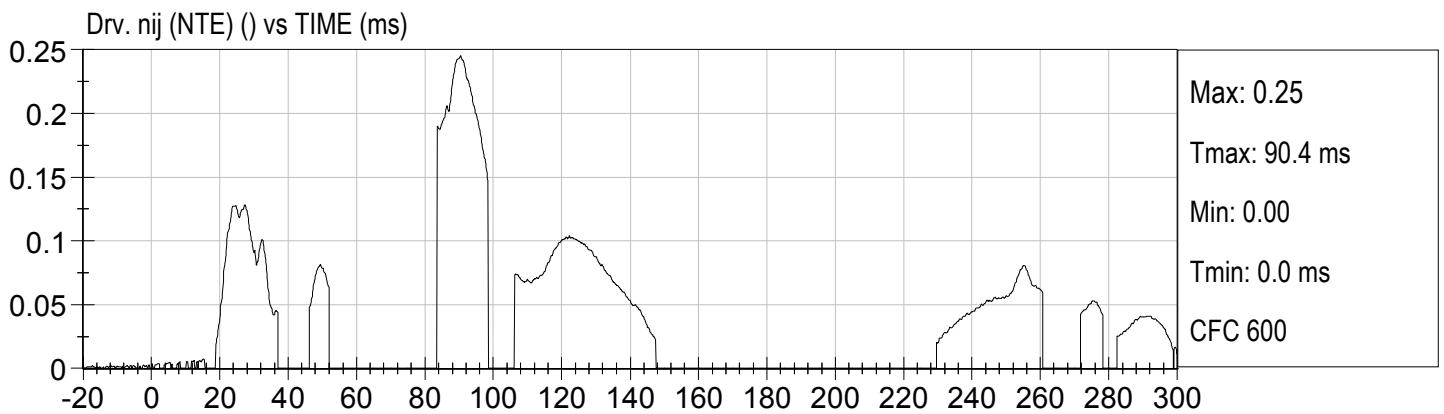
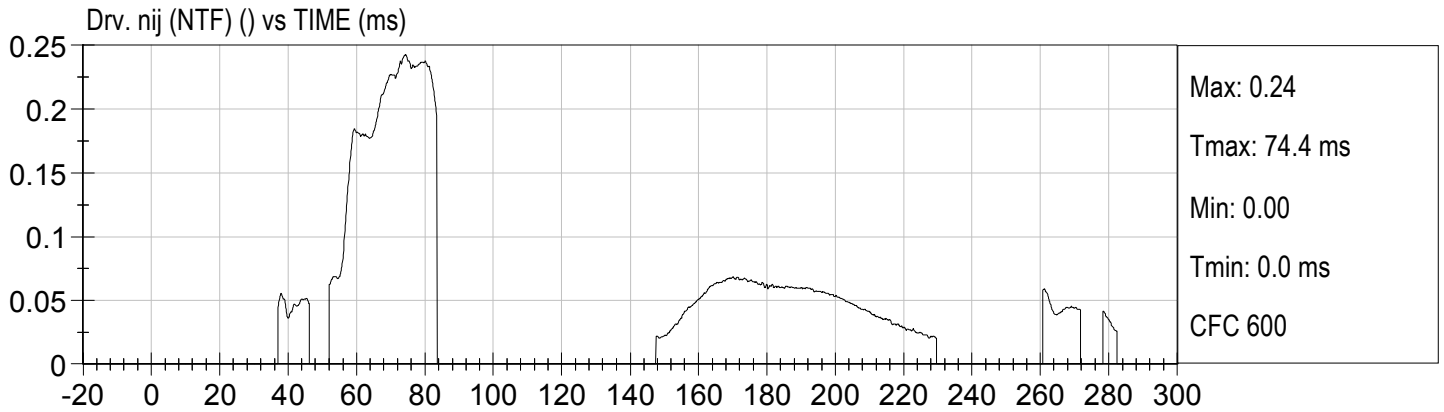
Advanced Research Load Cell Barrier – 128 channels

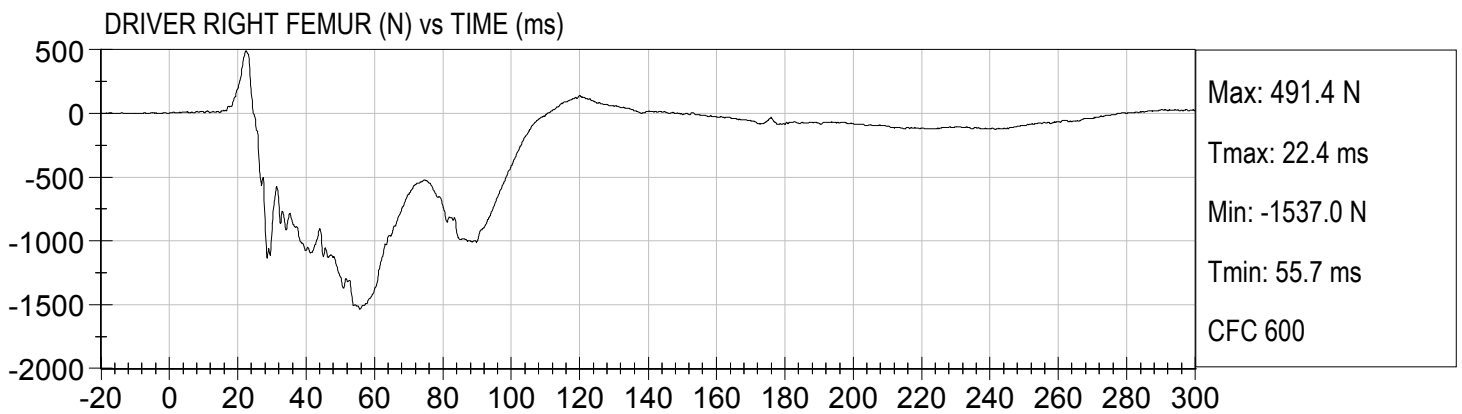
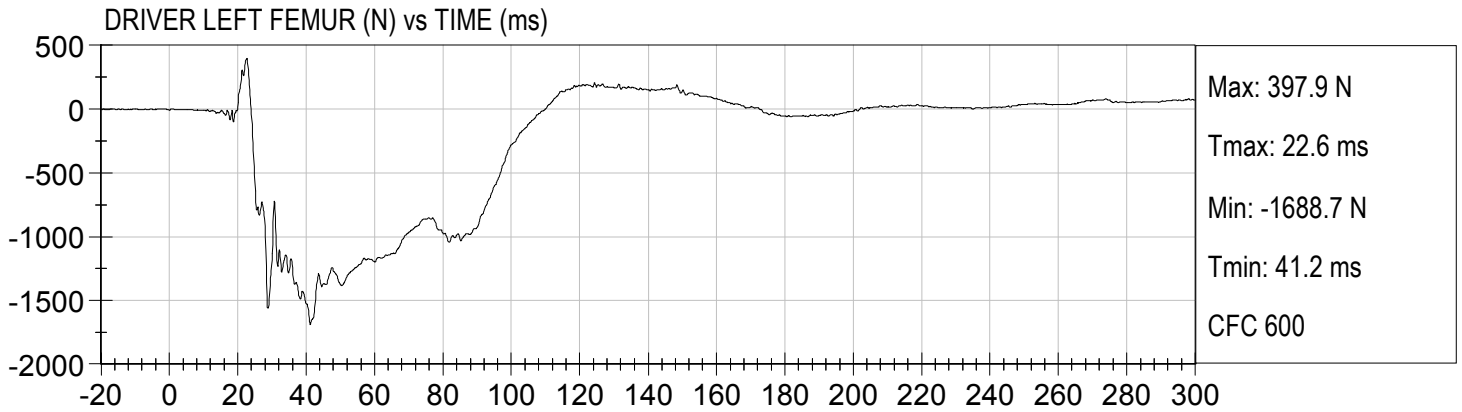


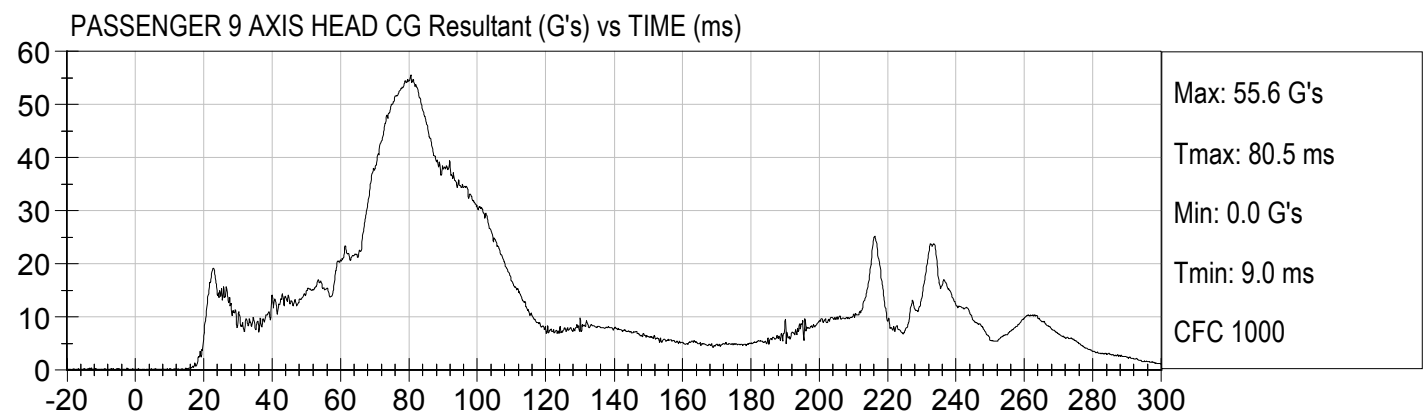
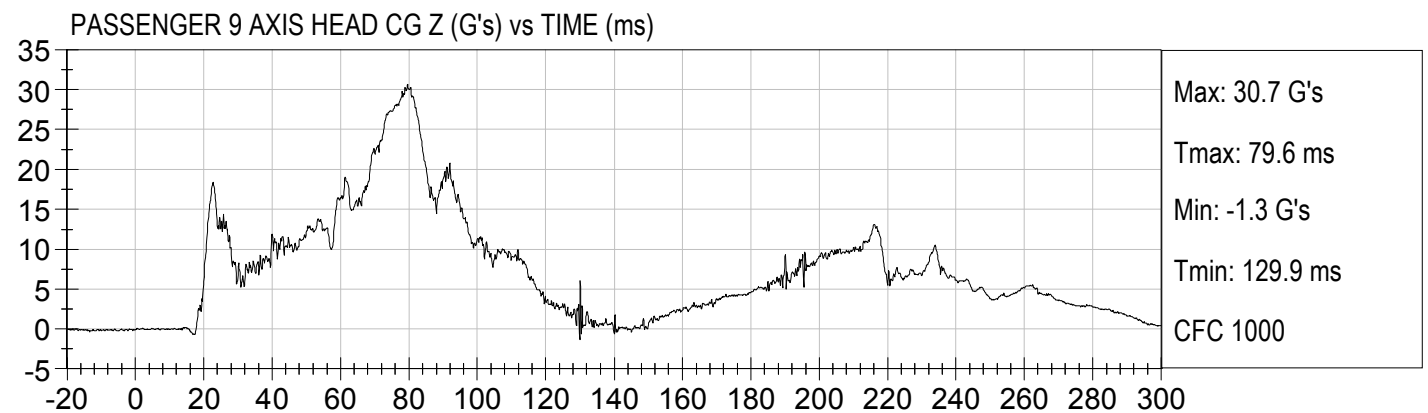
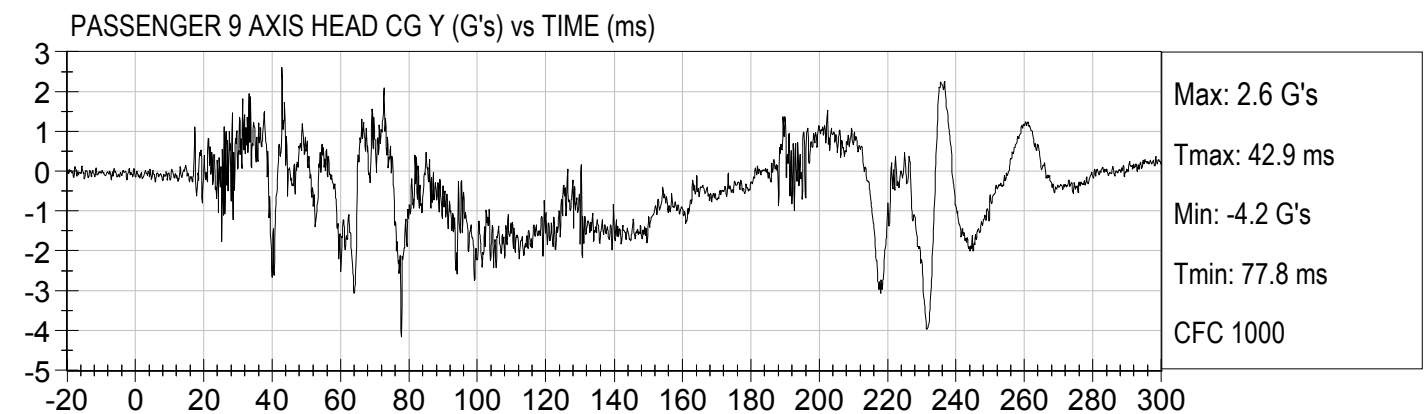
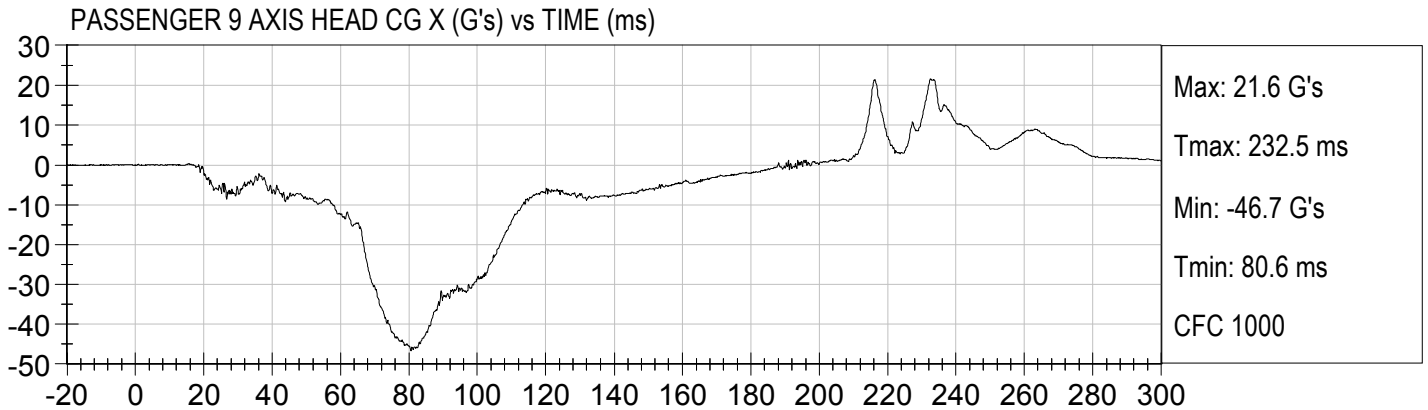


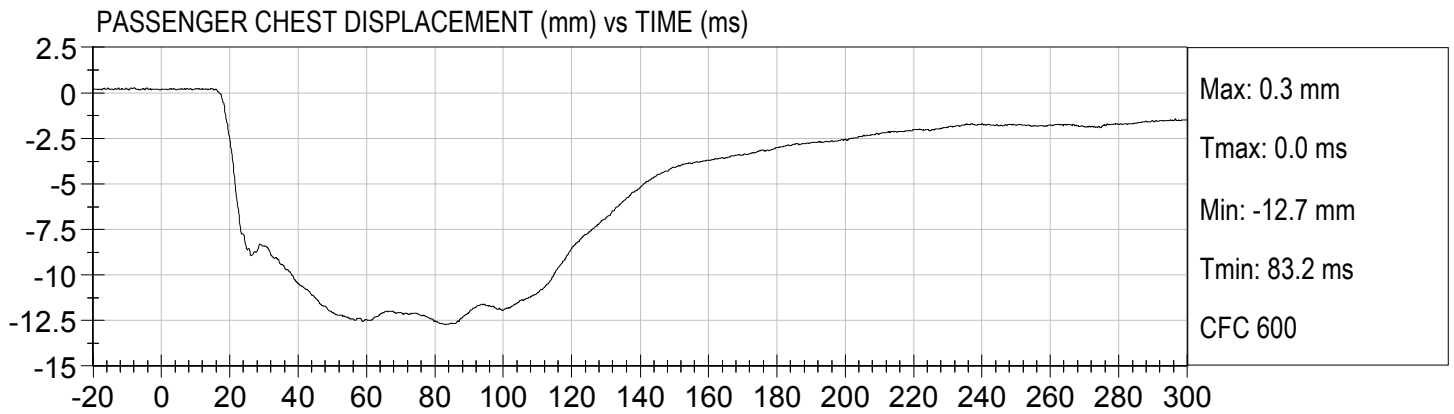


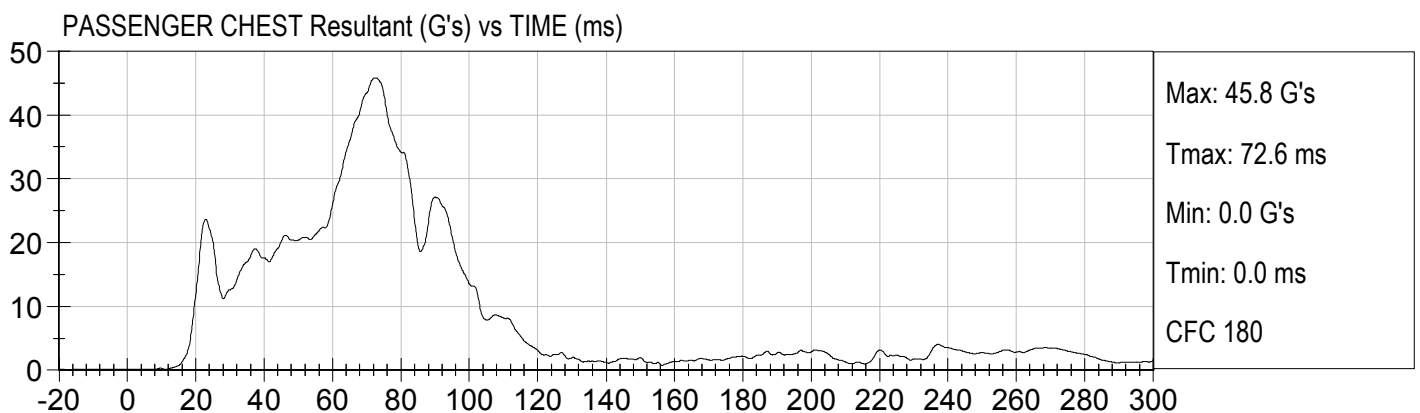
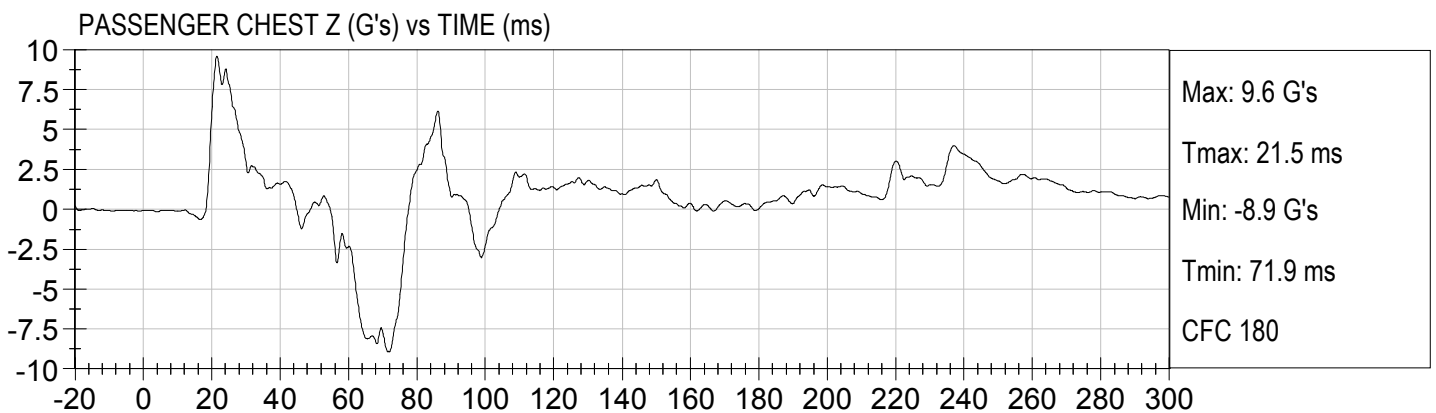
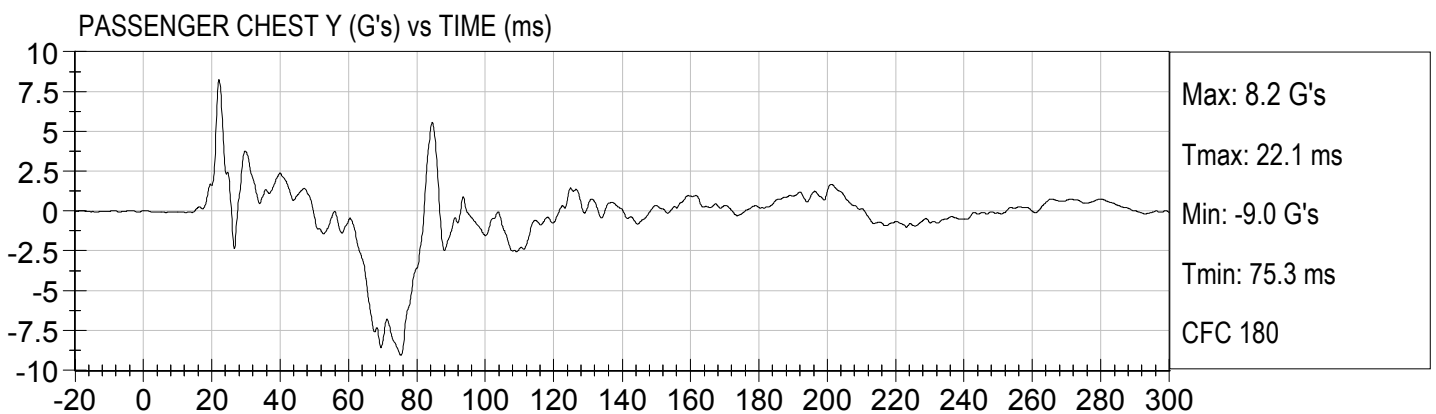
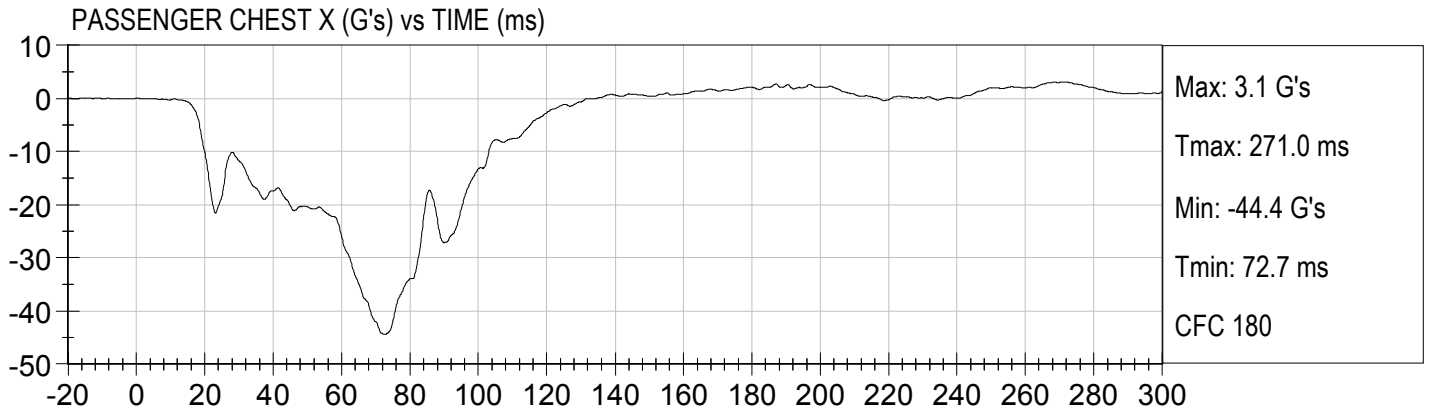


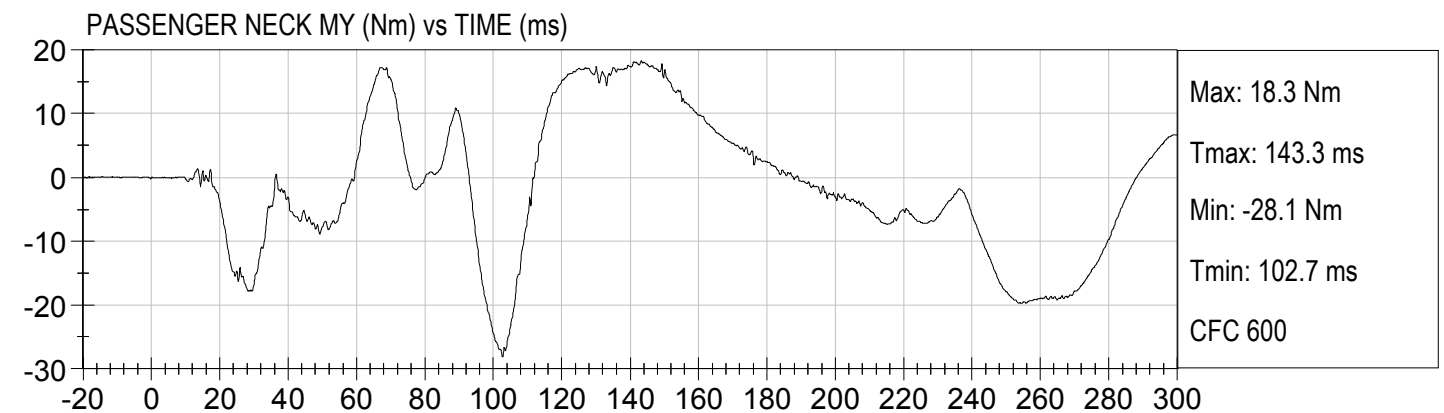
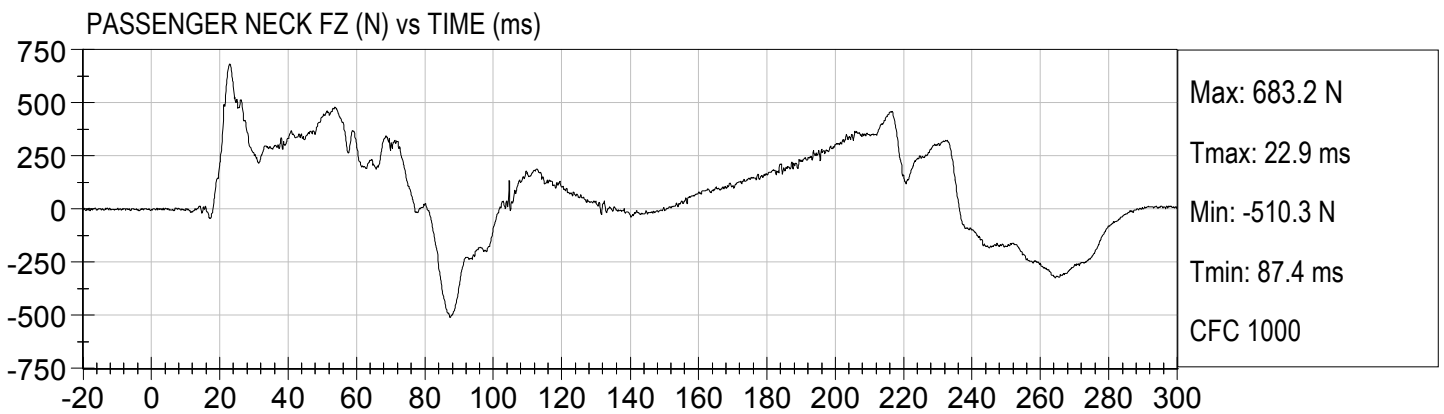
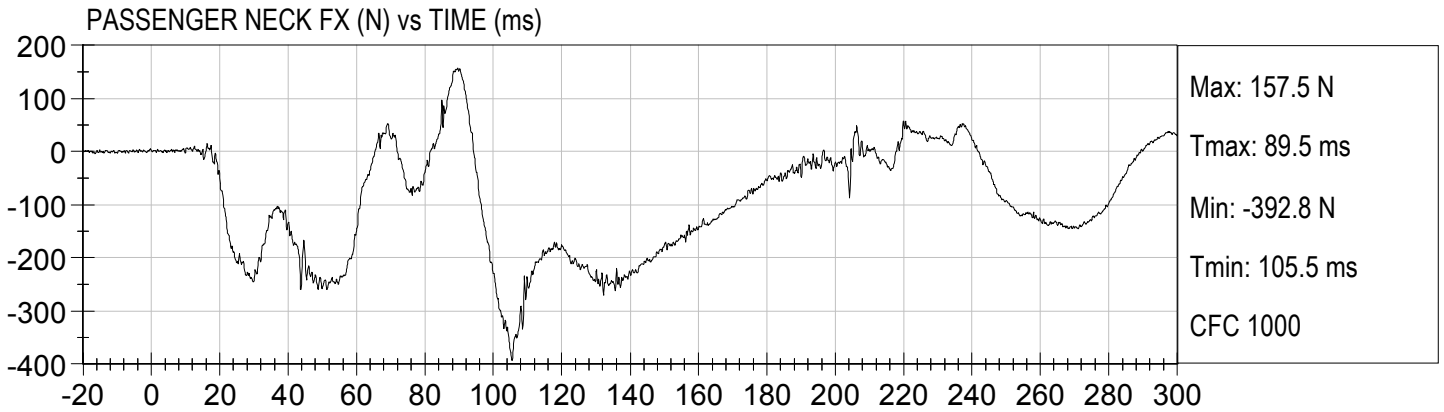


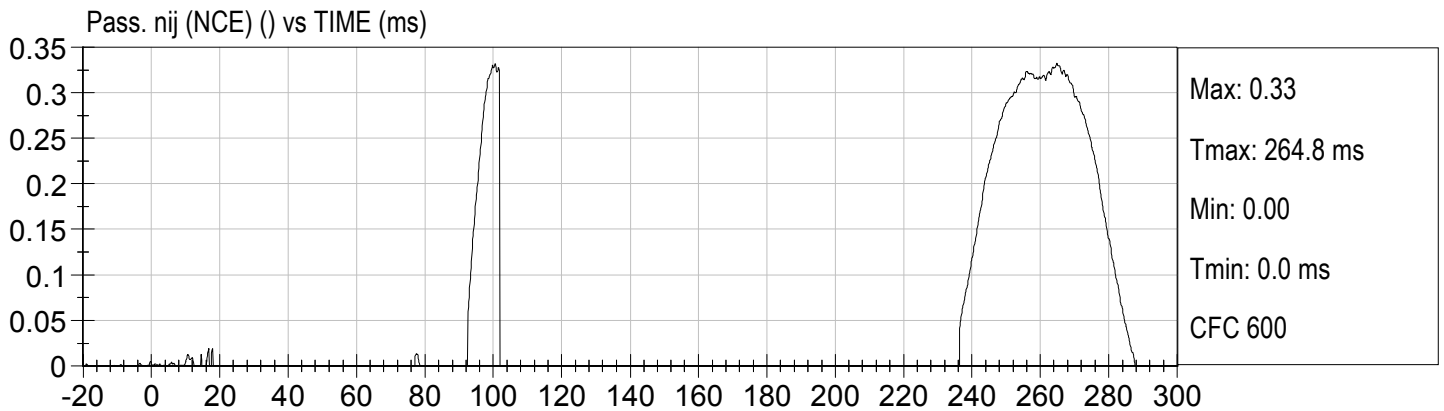
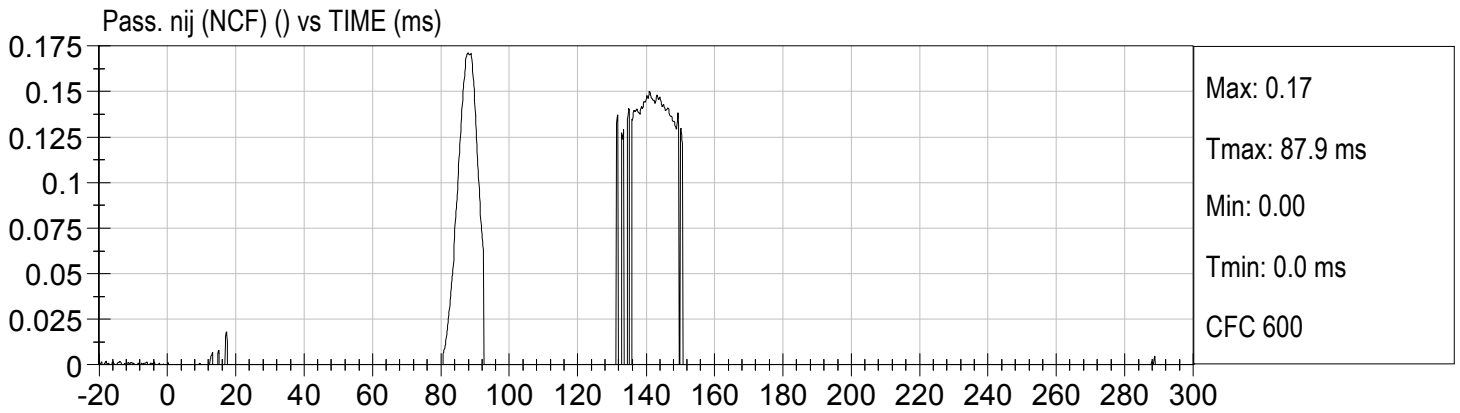
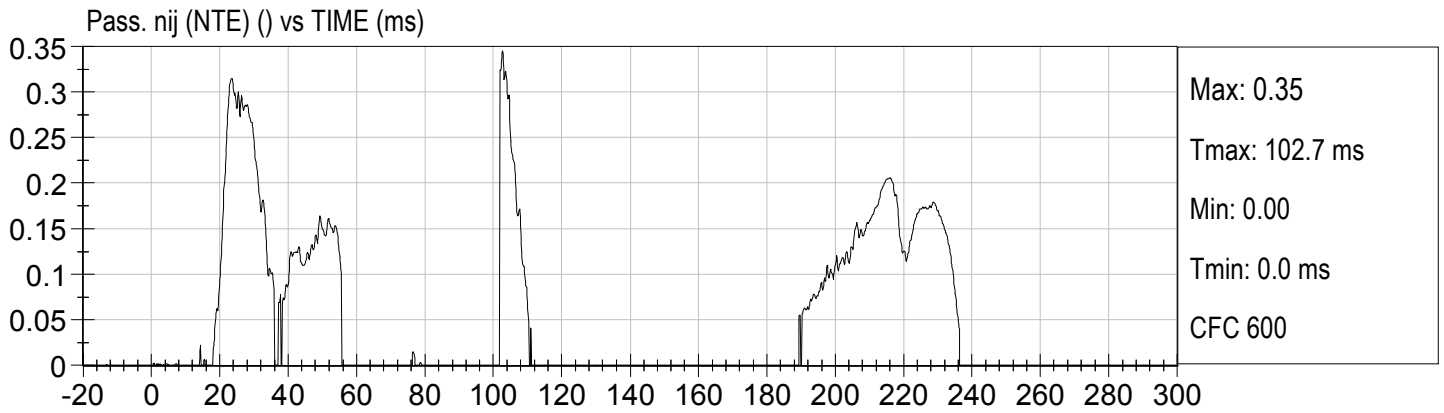
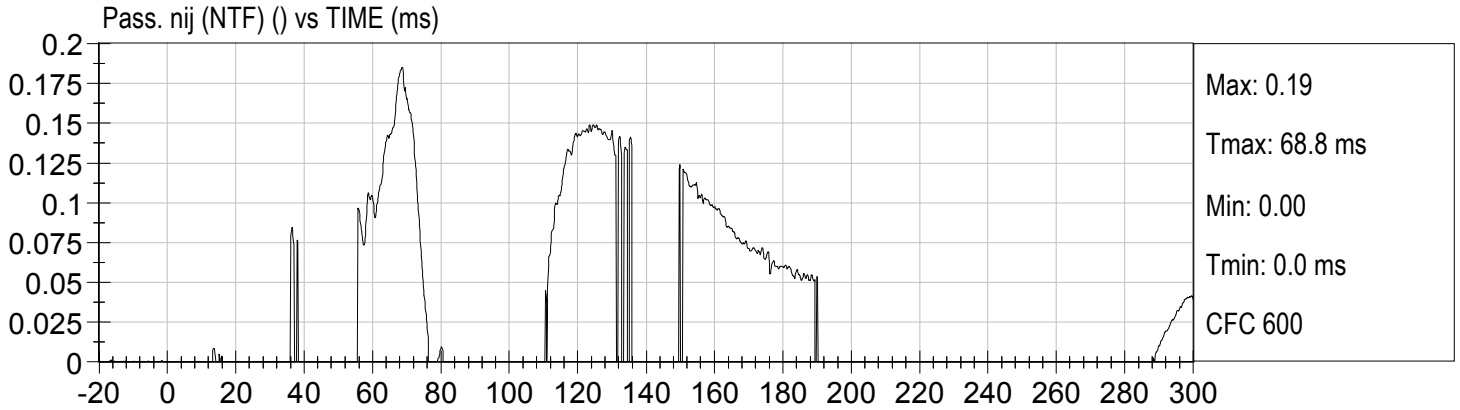


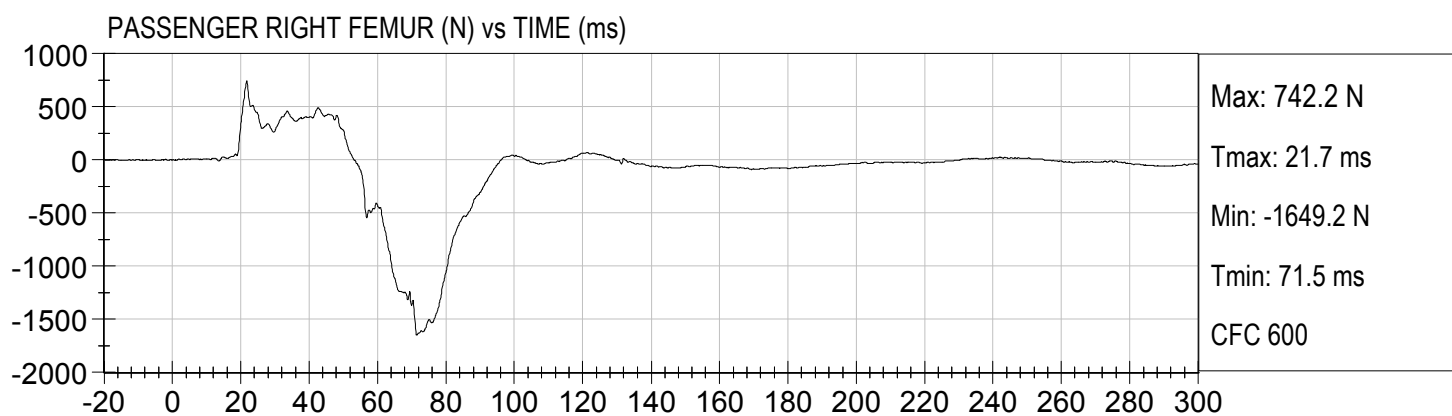
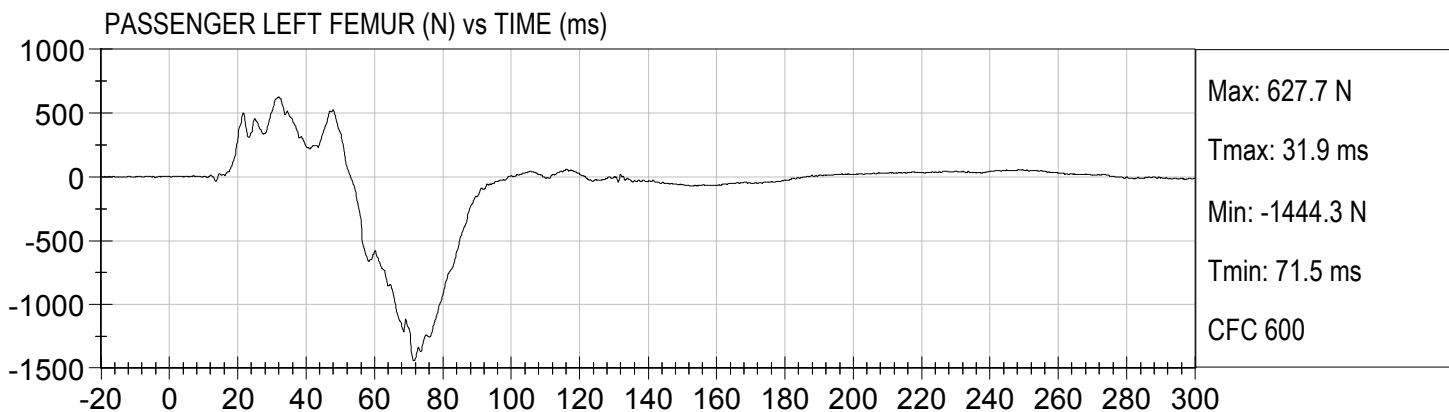












**APPENDIX C**  
**DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA**

**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

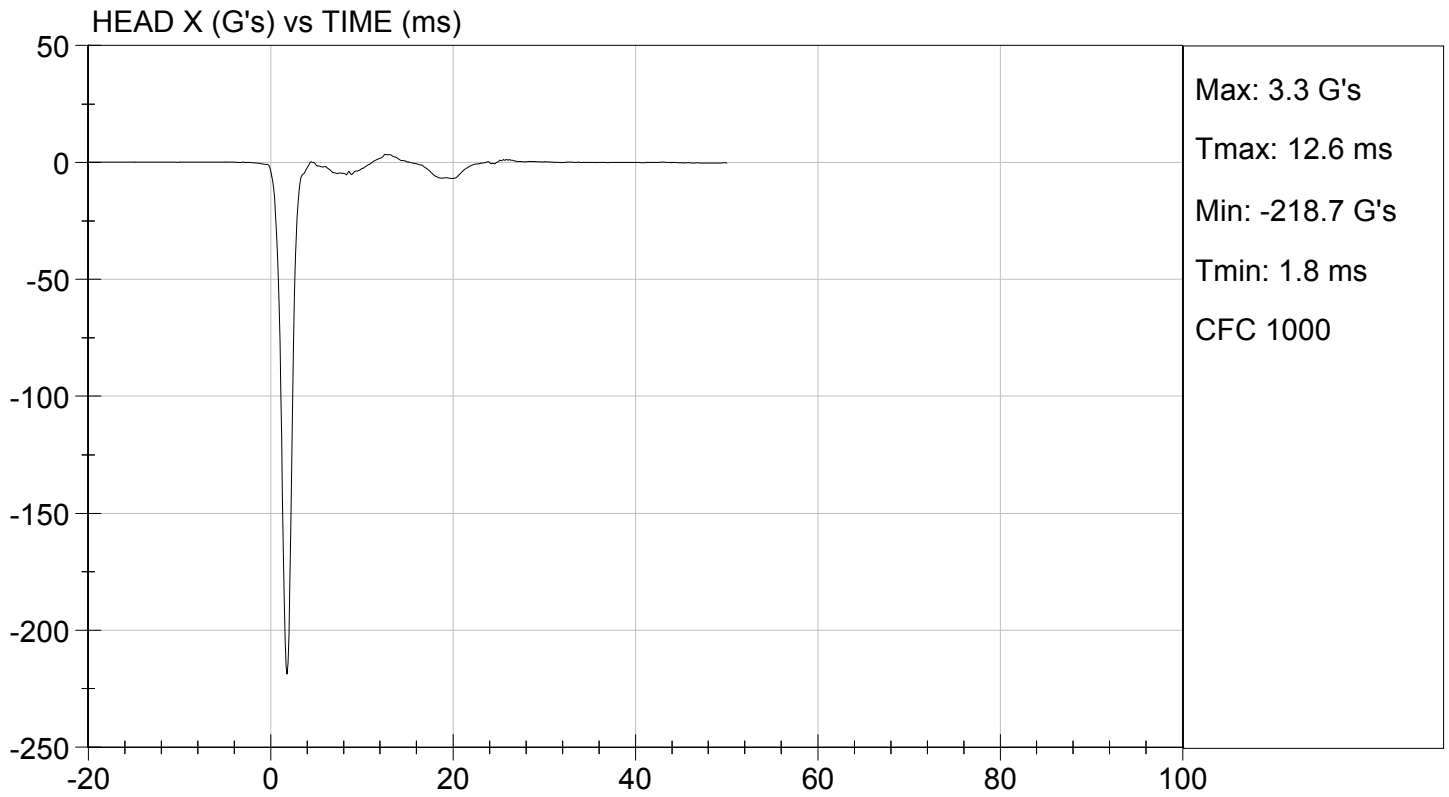
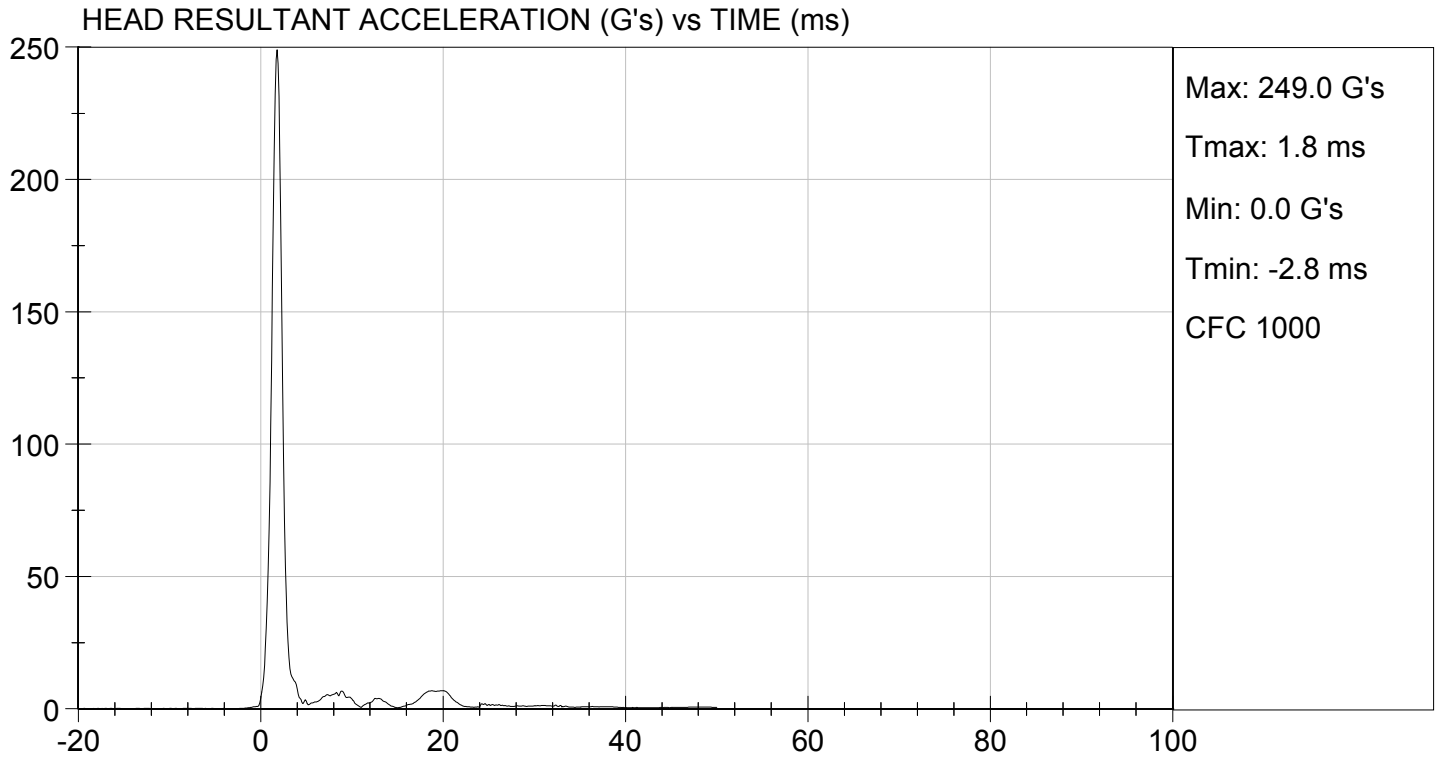
**Test ID:** D124741

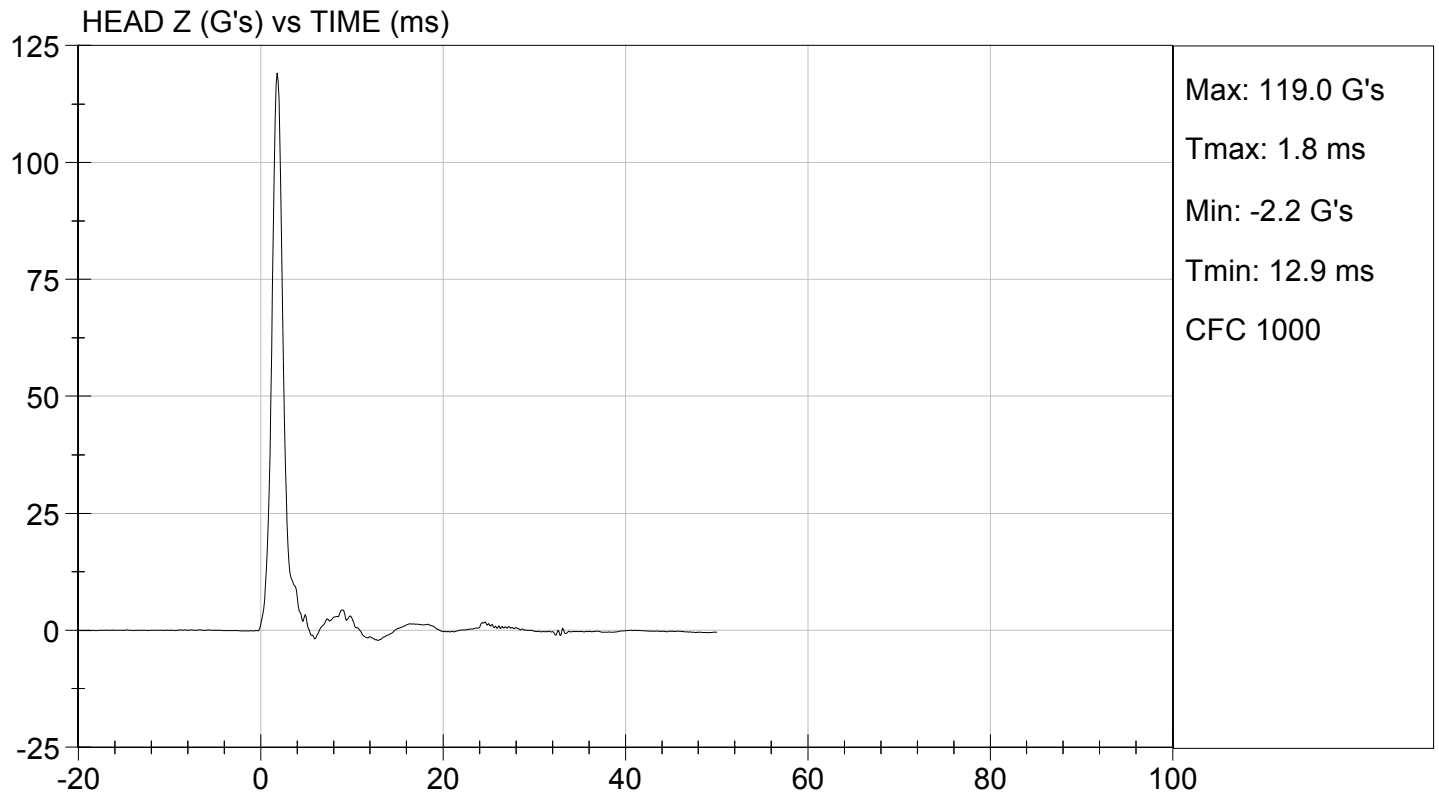
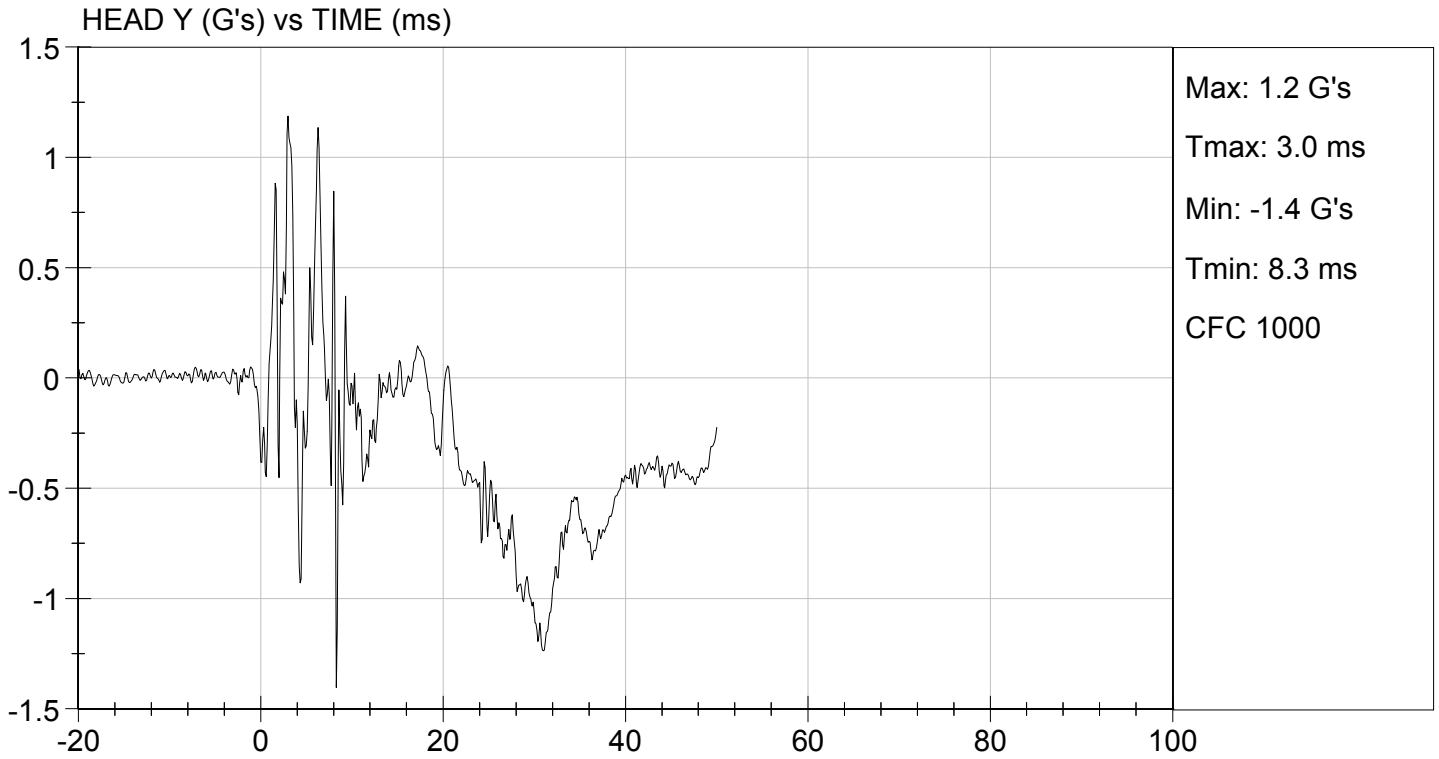
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Peak Resultant Acceleration	G's	225 to 275	249	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-1.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
<b>Overall Test Results</b>				<b>Pass</b>

Jessica Gall  
Laboratory Technician

12/13/2012  
Test Date

David Winkelbauer  
Approved By





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

**ATD Serial No:** 351

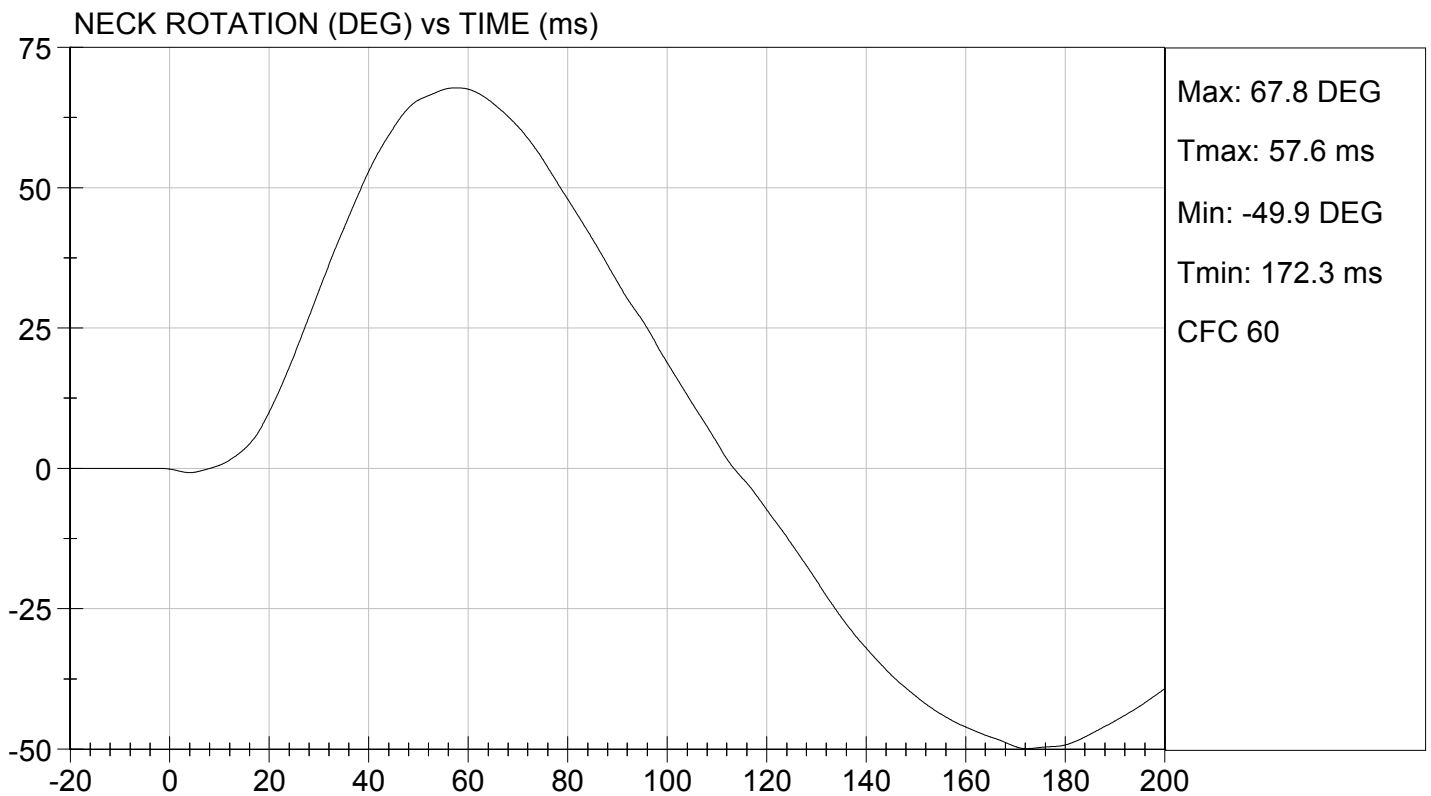
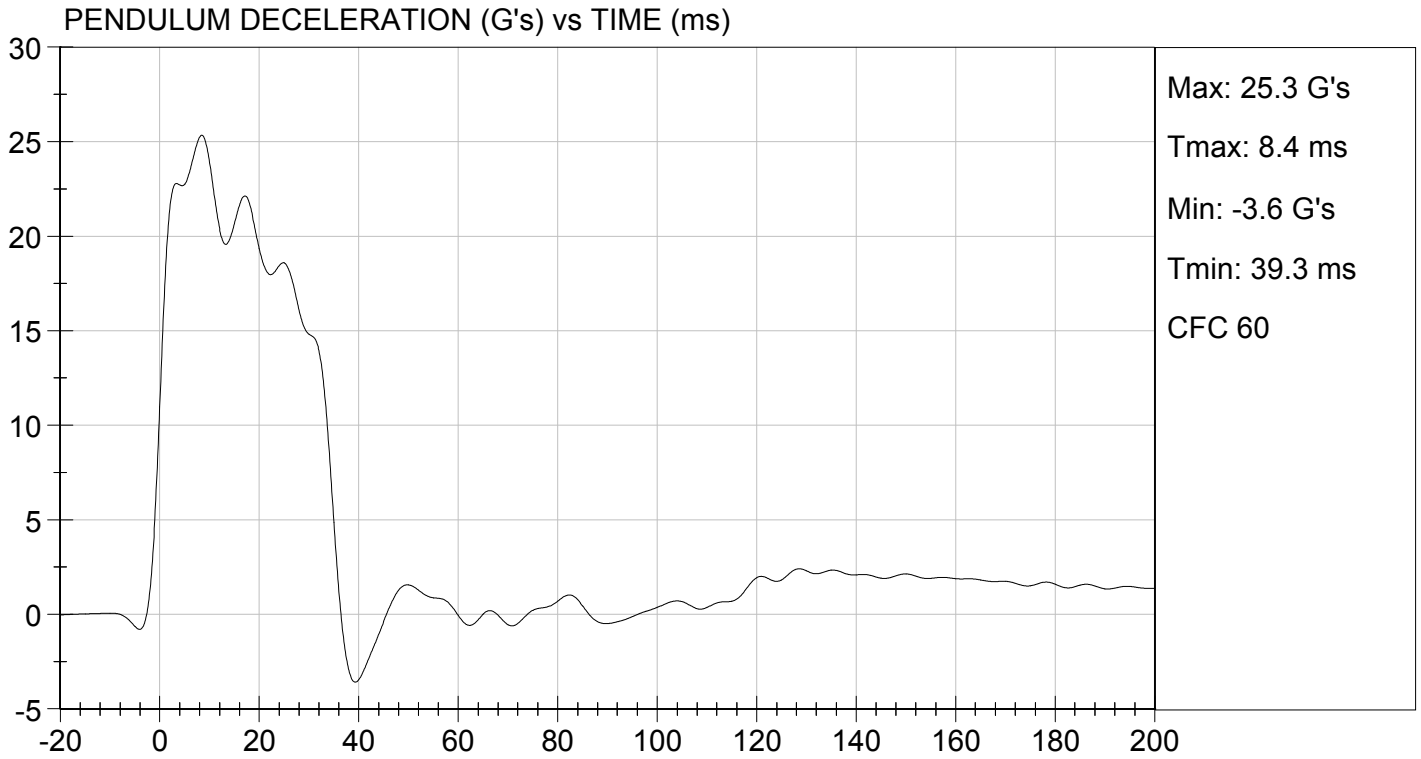
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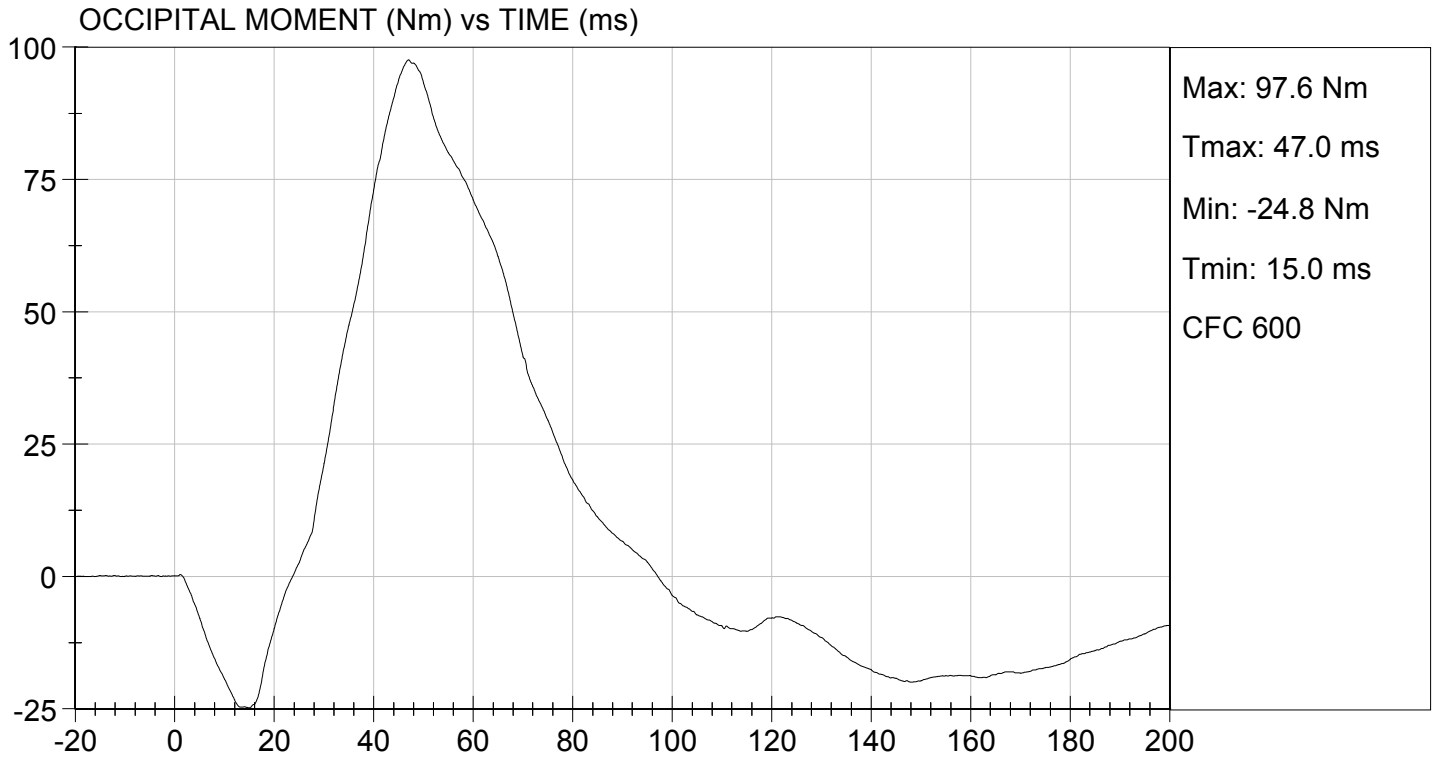
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.89	Pass
	20 ms	G's	17.60 to 22.60	19.34	Pass
	30 ms	G's	12.50 to 18.50	14.8	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	14.8	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.0	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	67.8	Pass
	Time	ms	57.0 to 64.0	57.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	113.6	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	97.6	Pass
	Time	ms	47.0 to 58.0	47.0	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	97.2	Pass
<b>Overall Test Results</b>					<b>Pass</b>

Jessica Hall  
Laboratory Technician

12/13/2012  
Test Date

David Winkelbauer  
Approved By





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

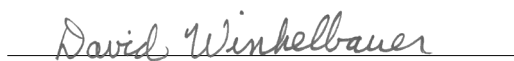
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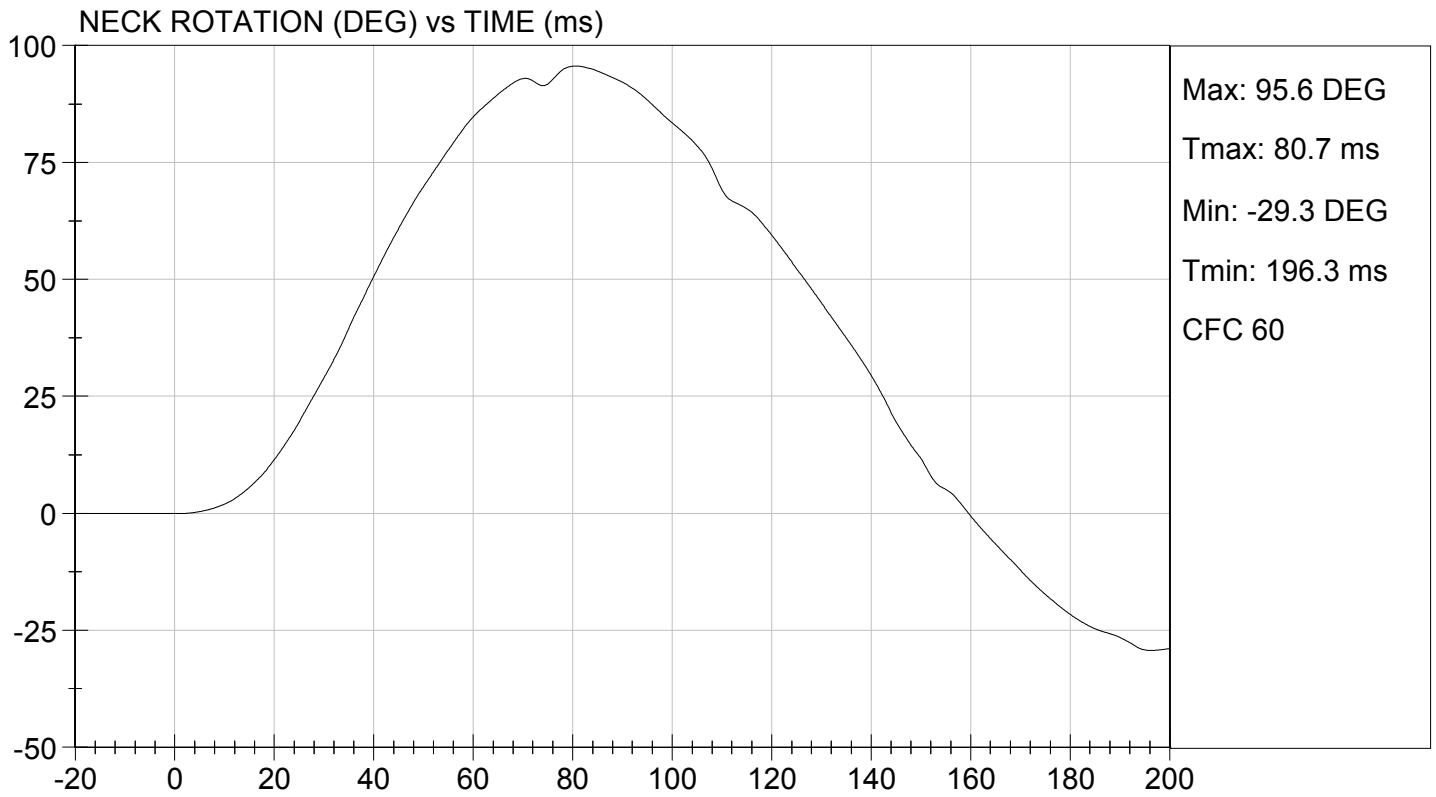
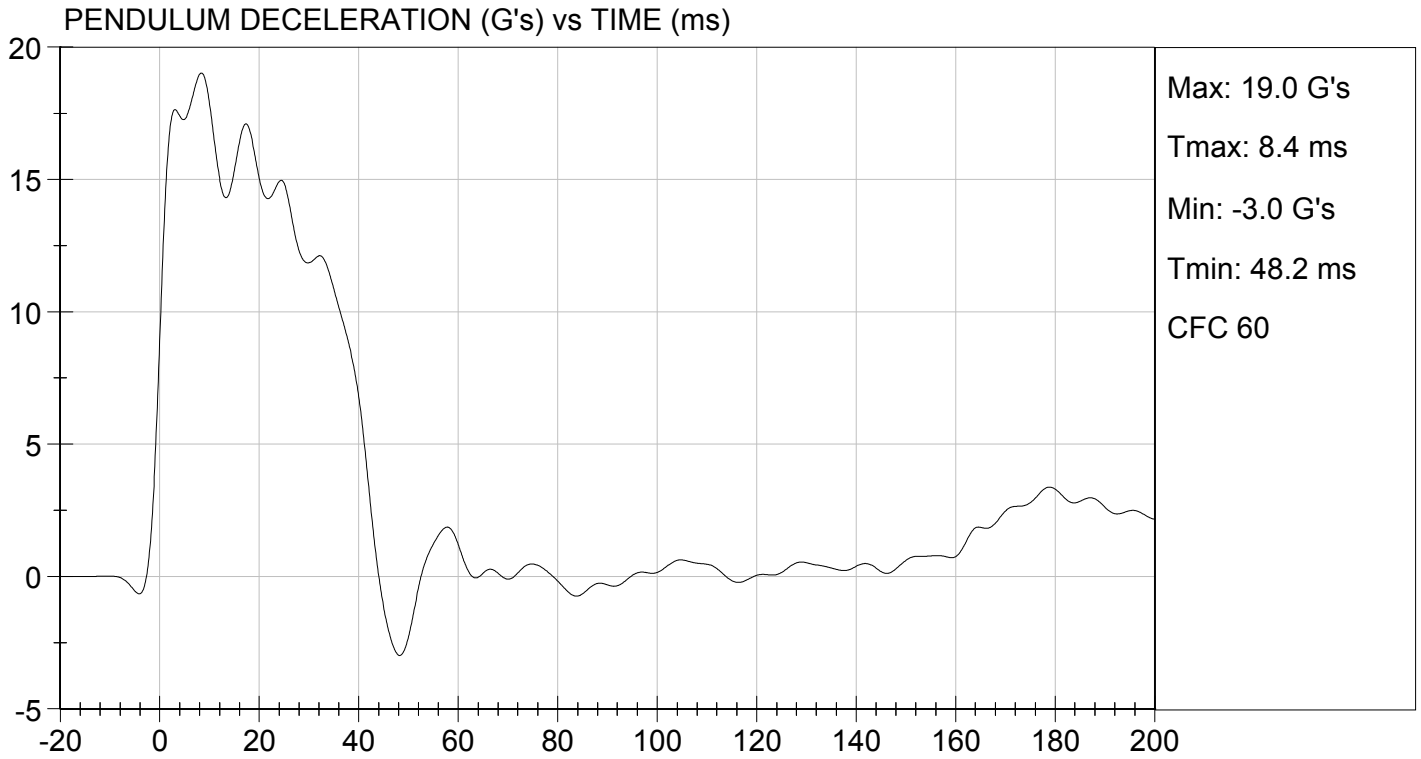
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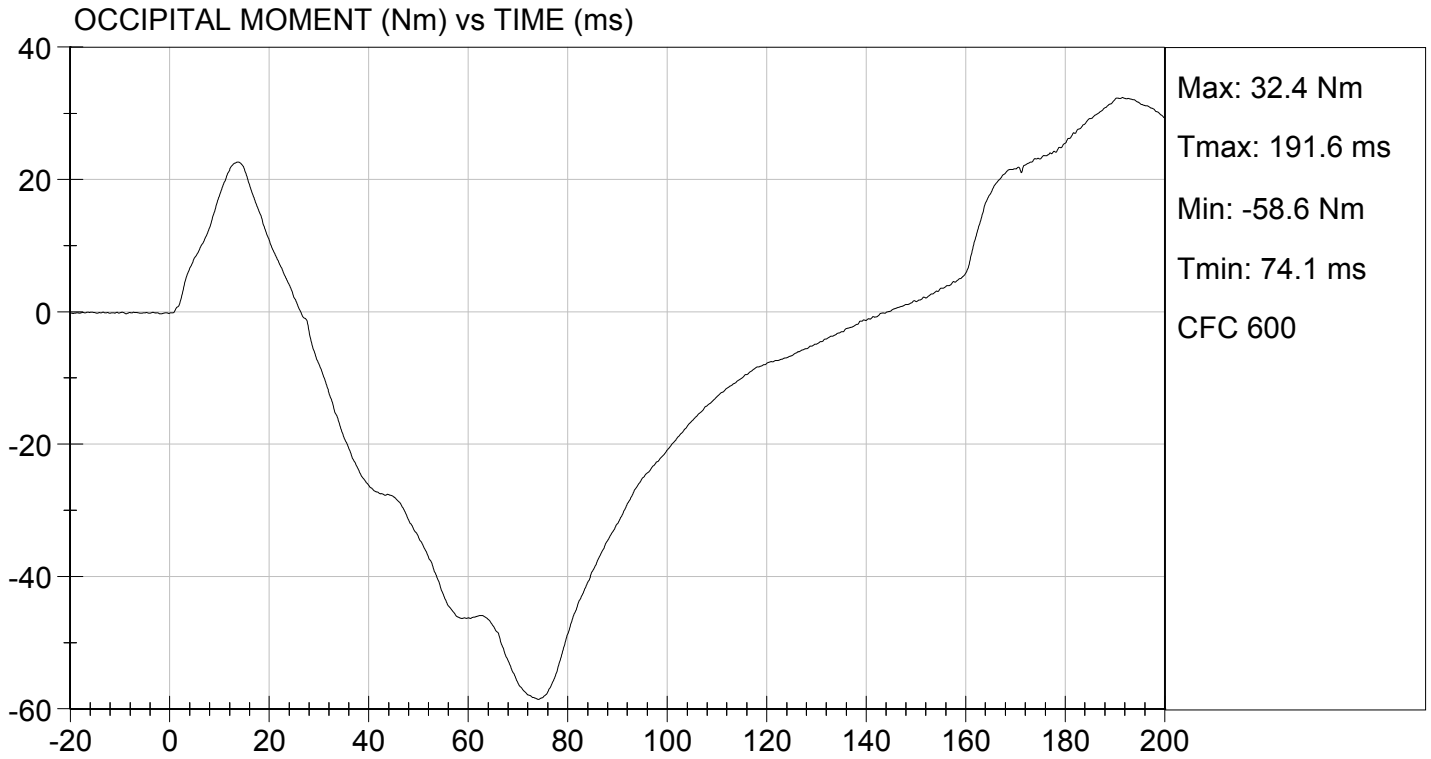
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Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	17.84	Pass
	20 ms	G's	14.00 to 19.00	15.05	Pass
	30 ms	G's	11.00 to 16.00	11.86	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	12.1	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	41.2	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	95.6	Pass
	Time	ms	72.0 to 82.0	80.7	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	159.7	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-58.6	Pass
	Time	ms	65.0 to 79.0	74.1	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	144.4	Pass
Overall Test Results					Pass

  
 Laboratory Technician

12/13/2012  
 Test Date

  
 Approved By





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

**ATD Serial No:** 351

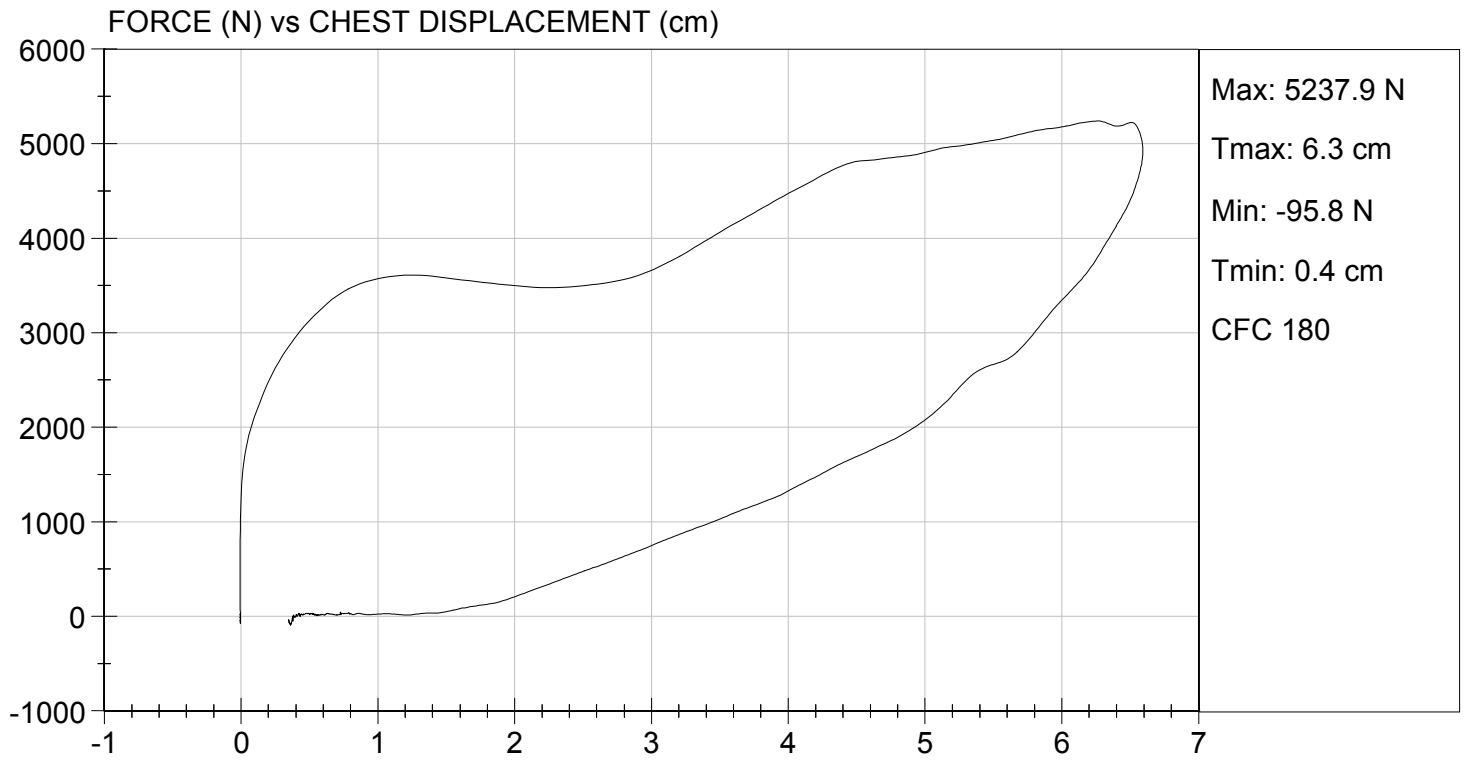
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Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,238	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.59	Pass
Internal Hysteresis	%	69 to 85	69	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
Laboratory Technician

12/13/2012  
Test Date

  
Approved By



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

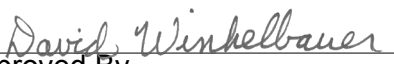
**ATD Serial No:** 351

**Test I.D:** D124745

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,062	Pass
Overall Test Results				Pass

  
 Laboratory Technician

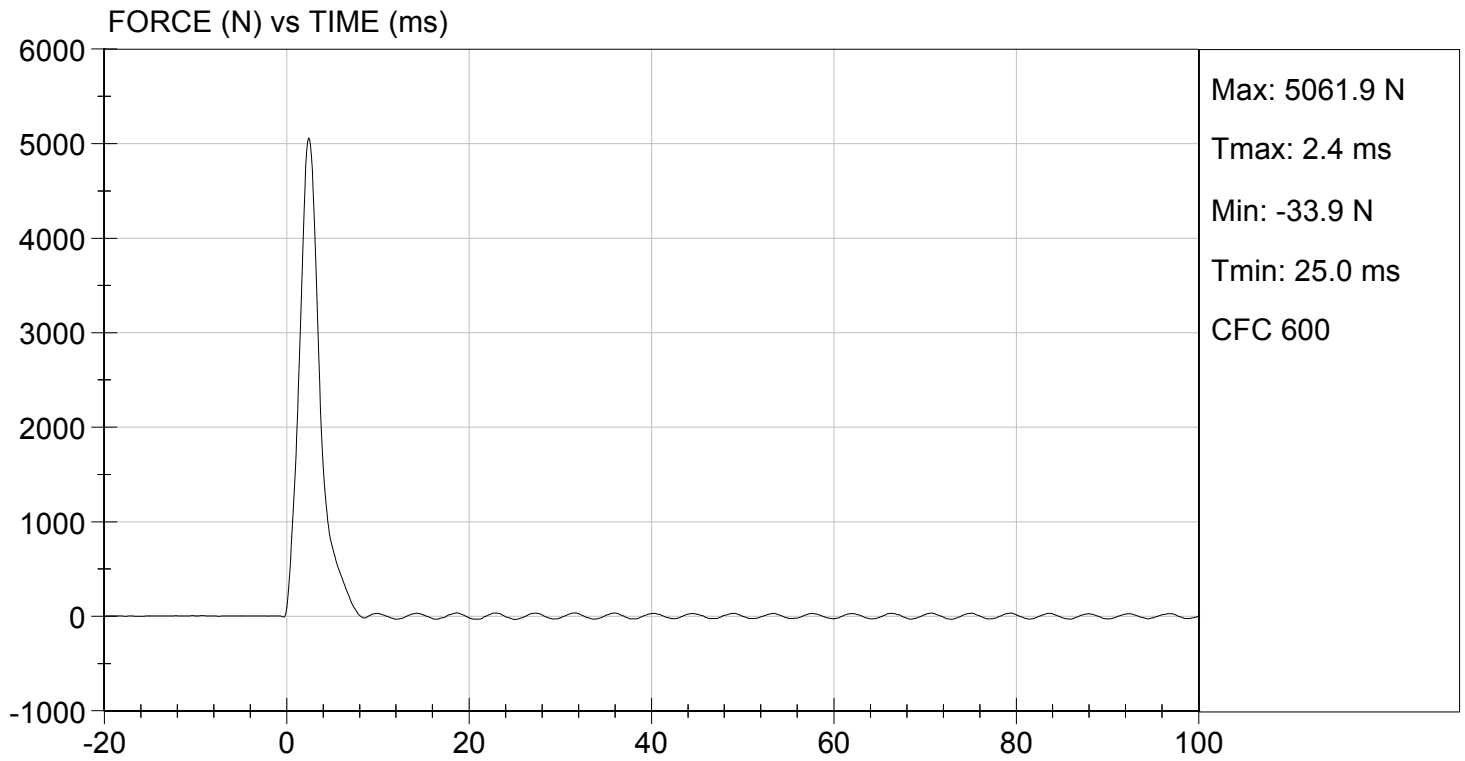
12/13/2012  
 Test Date

  
 Approved By



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

TEST DATE: 12/13/2012  
TEST #: D124745



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

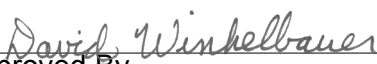
**ATD Serial No:** 351

**Test I.D:** D124746

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,037	Pass
Overall Test Results				Pass

  
 Laboratory Technician

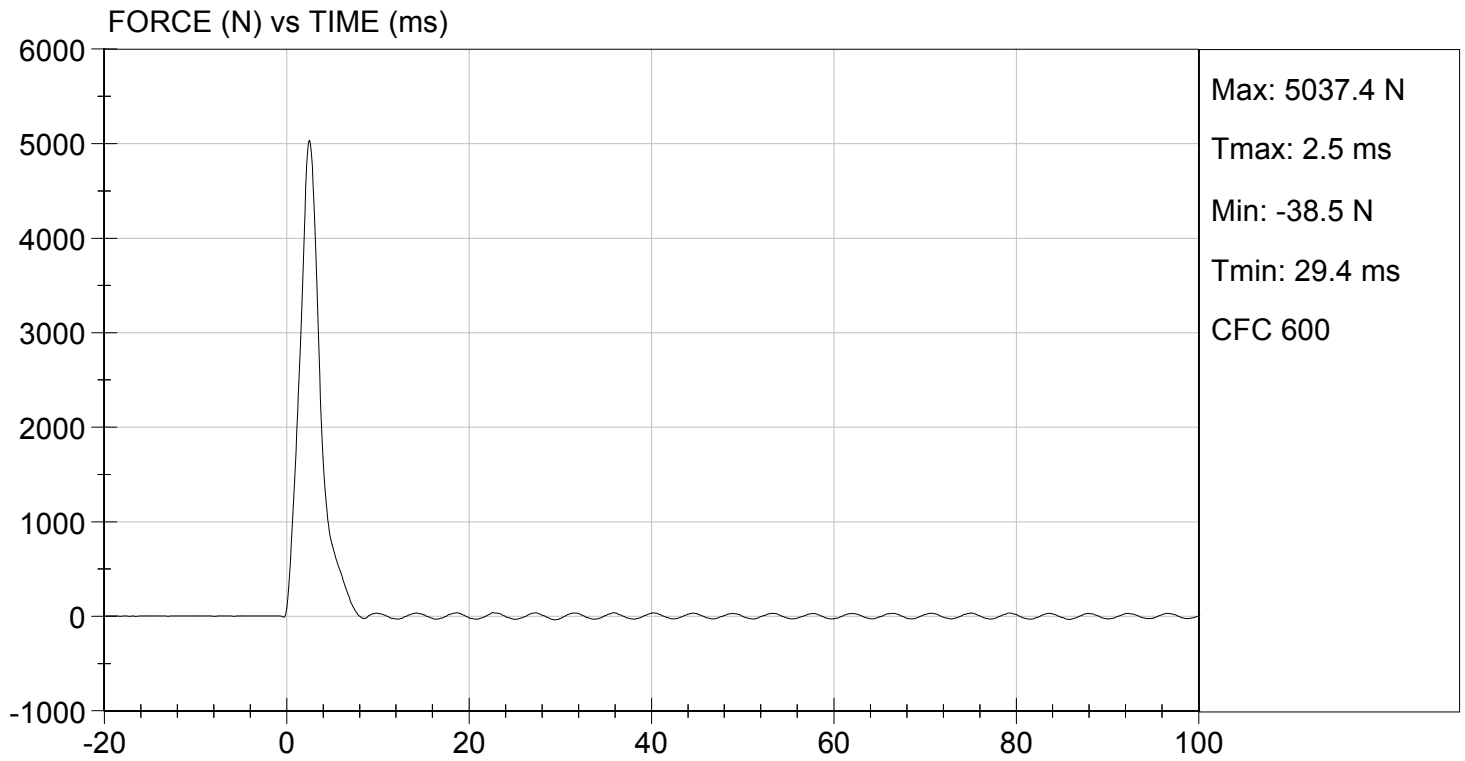
12/13/2012  
 Test Date

  
 Approved By



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

TEST DATE: 12/13/2012  
TEST #: D124746



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


**ATD Serial No:** 351

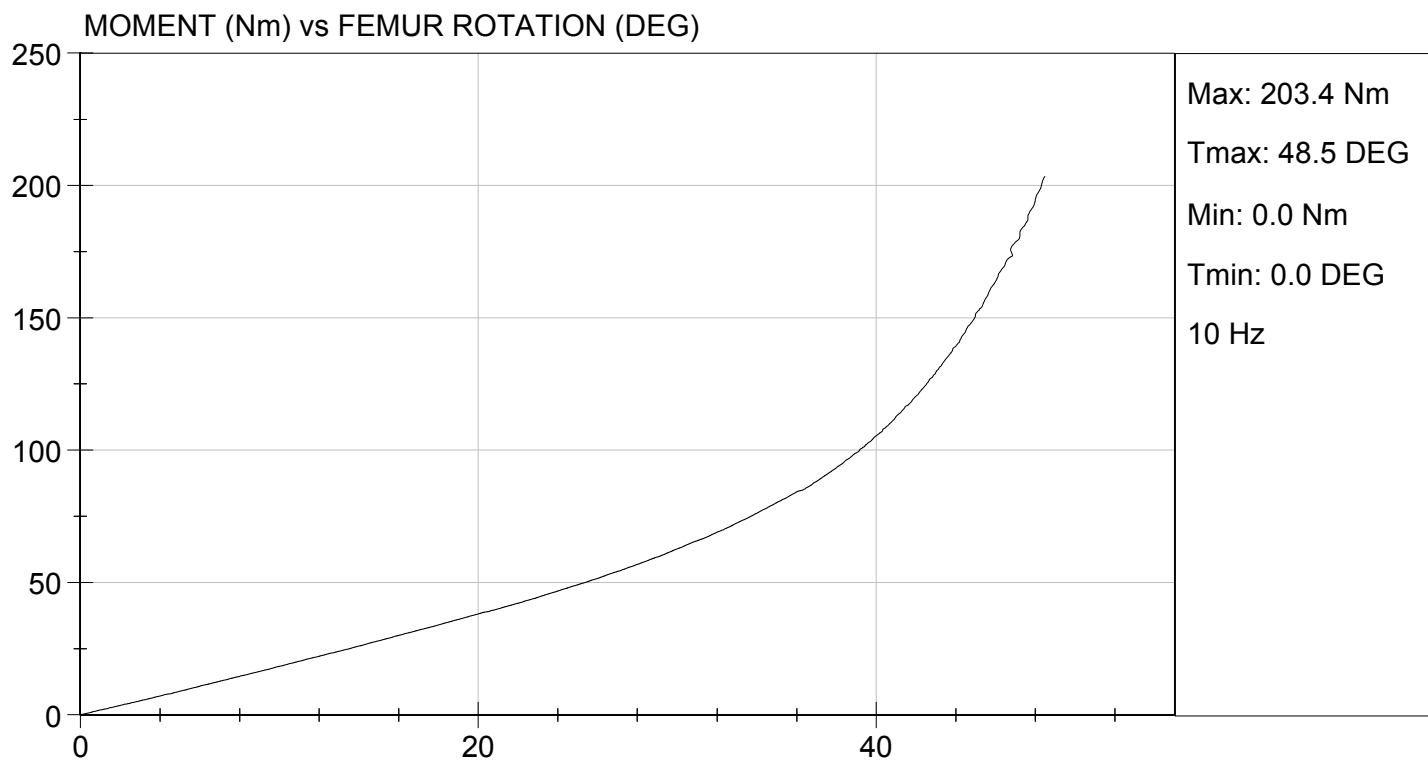
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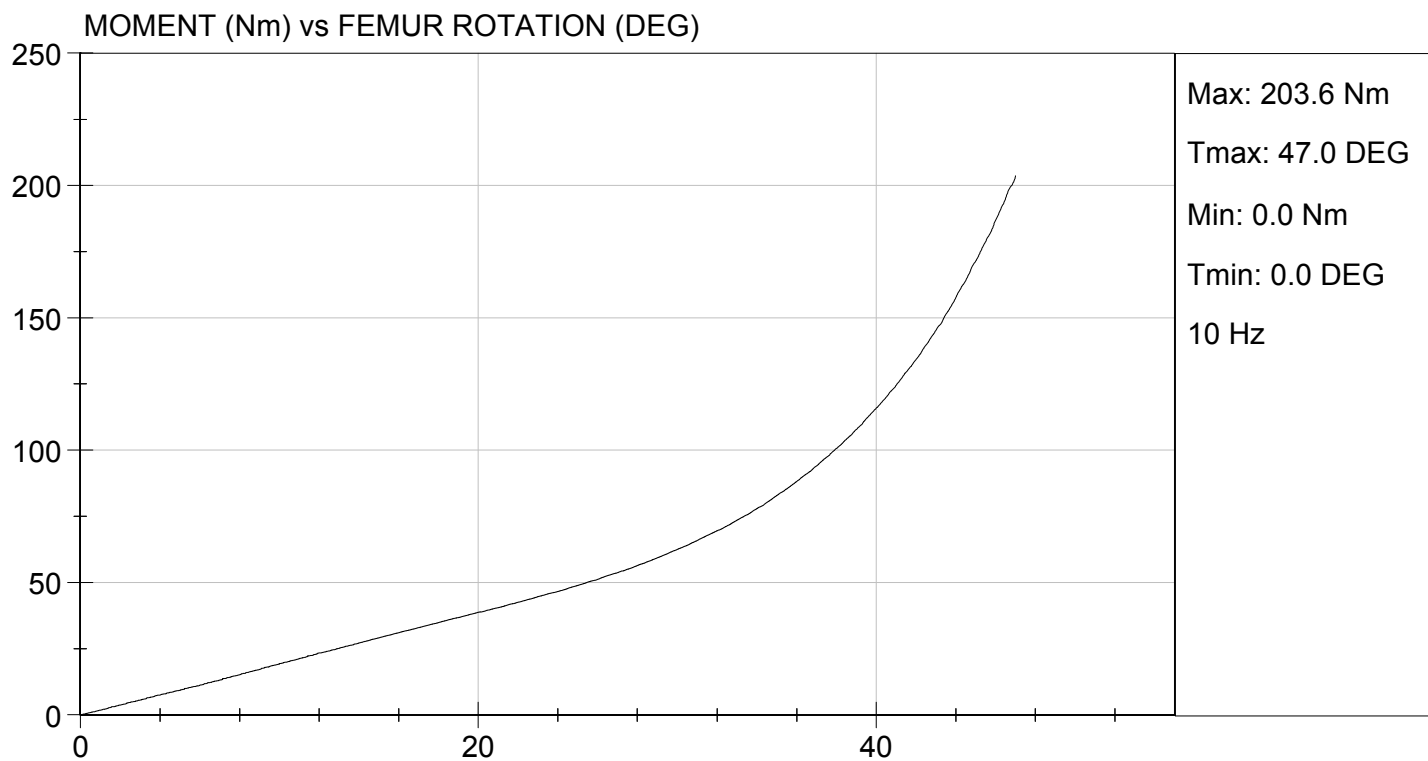
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.3	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	24	24	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.3	6.3	Pass
30 Degrees	Nm	94.9 Nm Max	62.7	62.5	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.5	47.0	Pass
Overall Test Results					Pass

  
 Laboratory Technician

12/13/2012  
 Test Date

  
 Approved By





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

**ATD Serial No:** 351

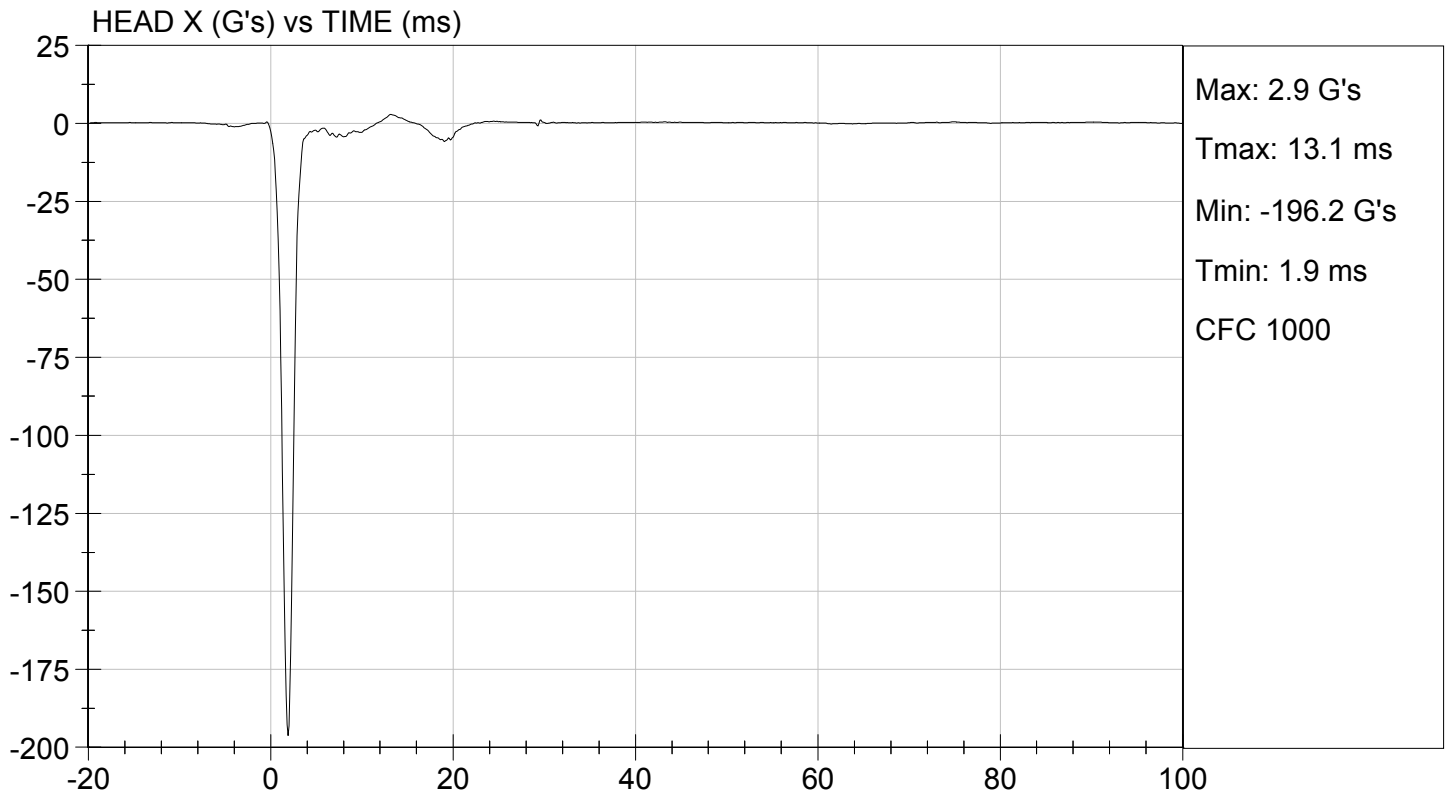
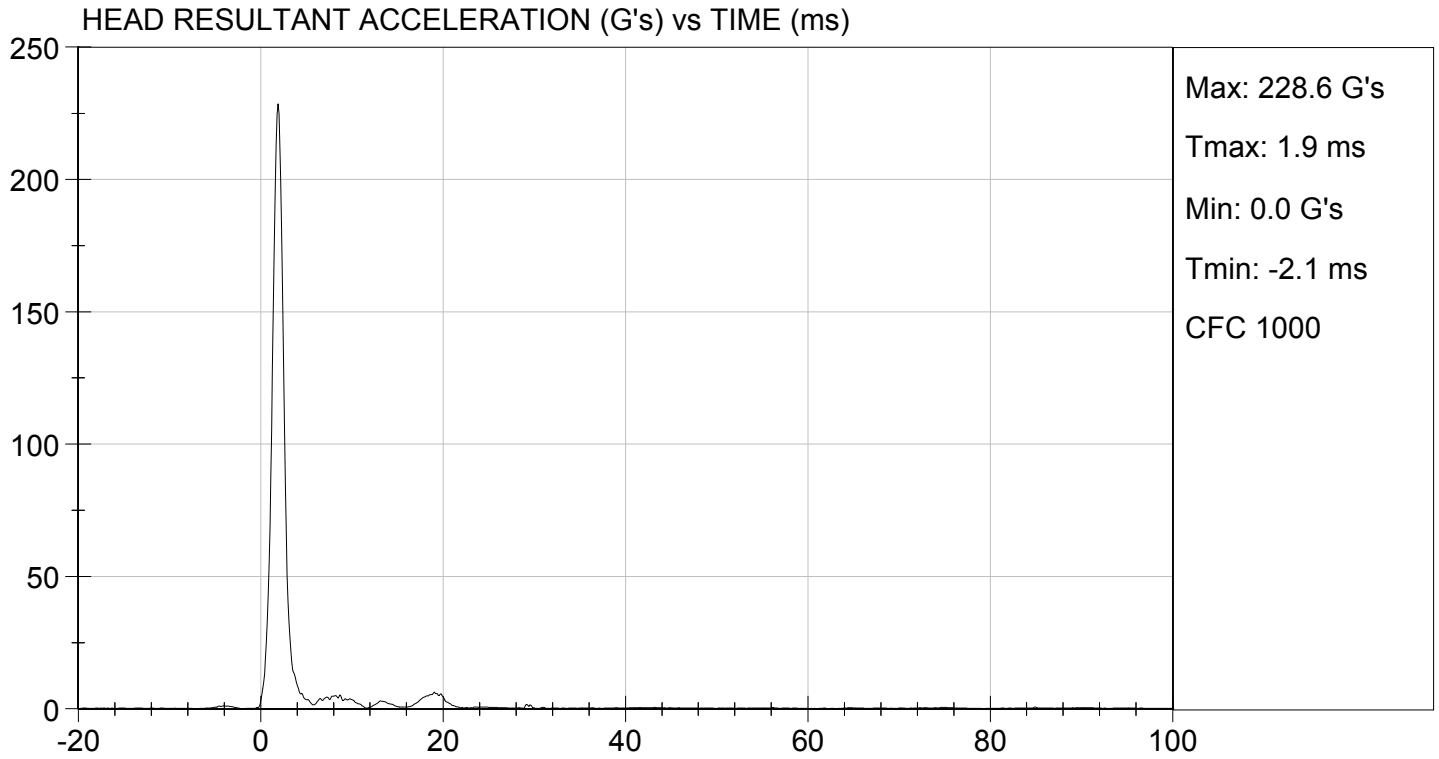
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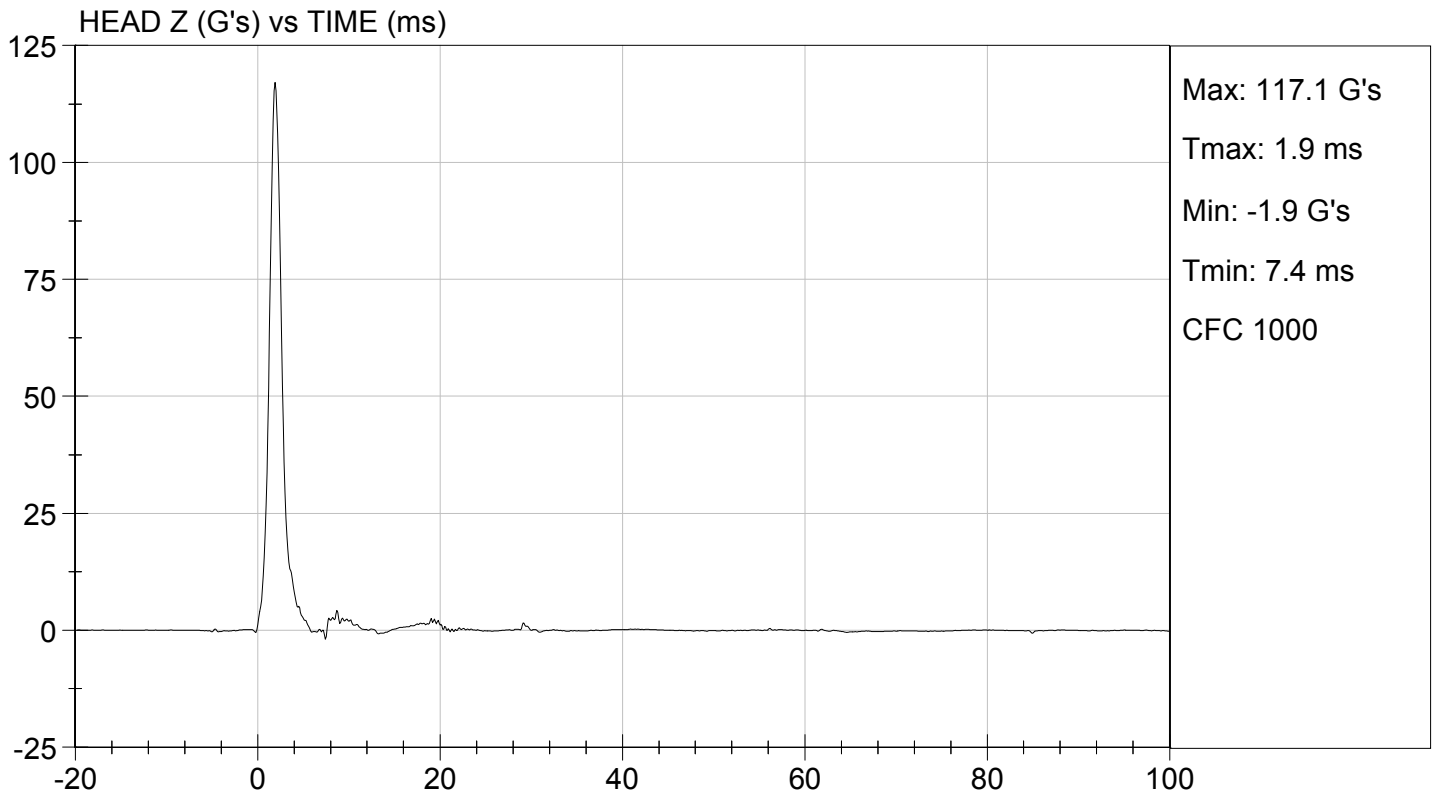
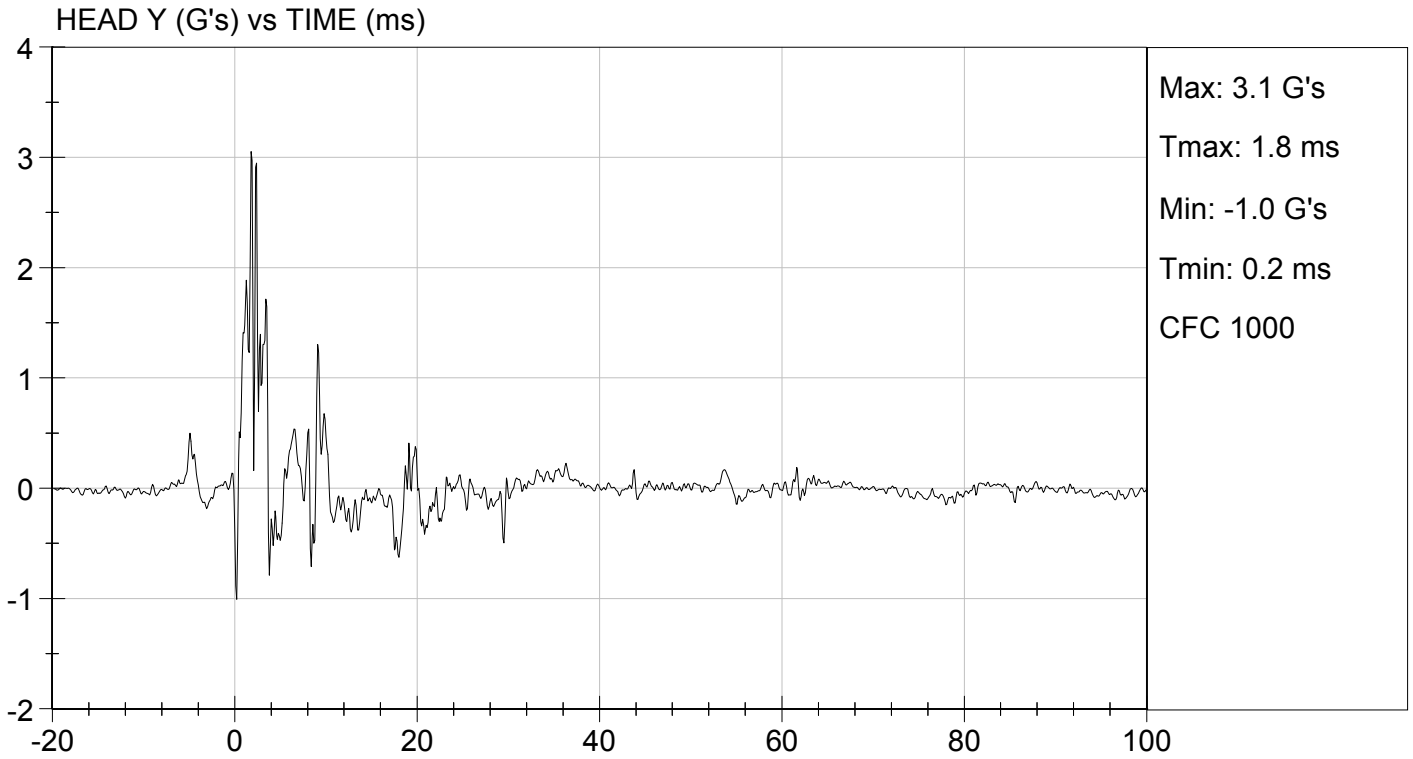
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Peak Resultant Acceleration	G's	225 to 275	229	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	3.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
<b>Overall Test Results</b>				<b>Pass</b>

Jessica Hall  
Laboratory Technician

12/21/2012  
Test Date

David Winkelbauer  
Approved By





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

**ATD Serial No:** 351

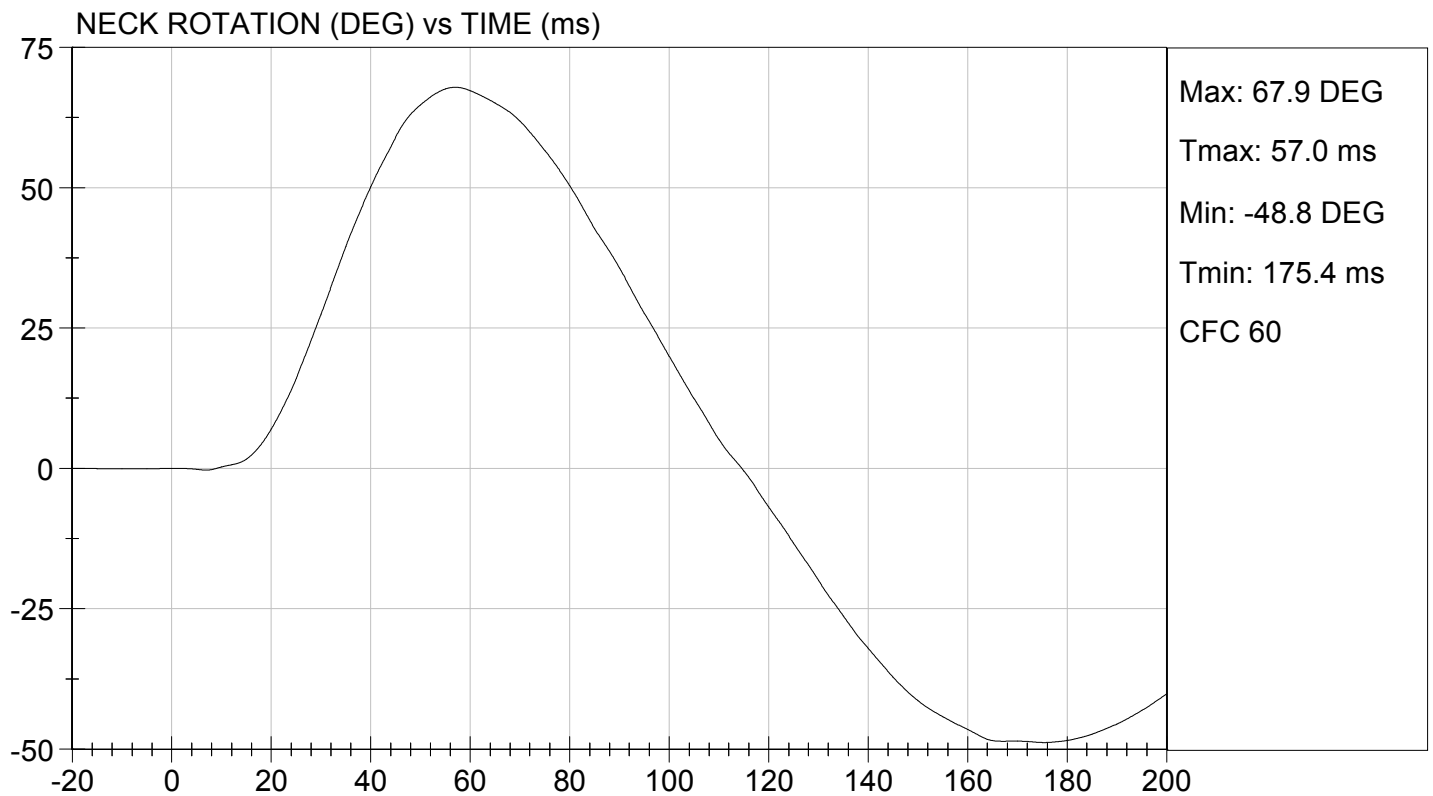
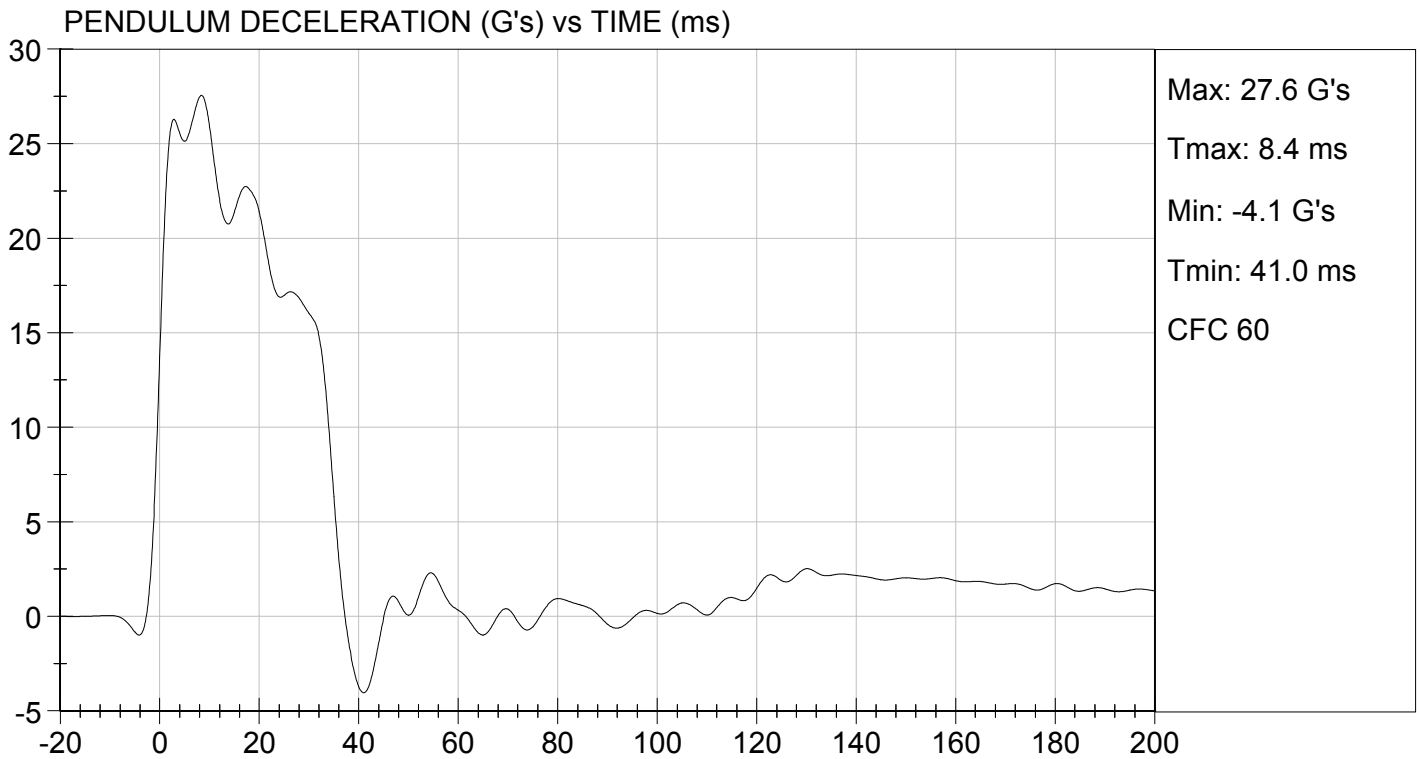
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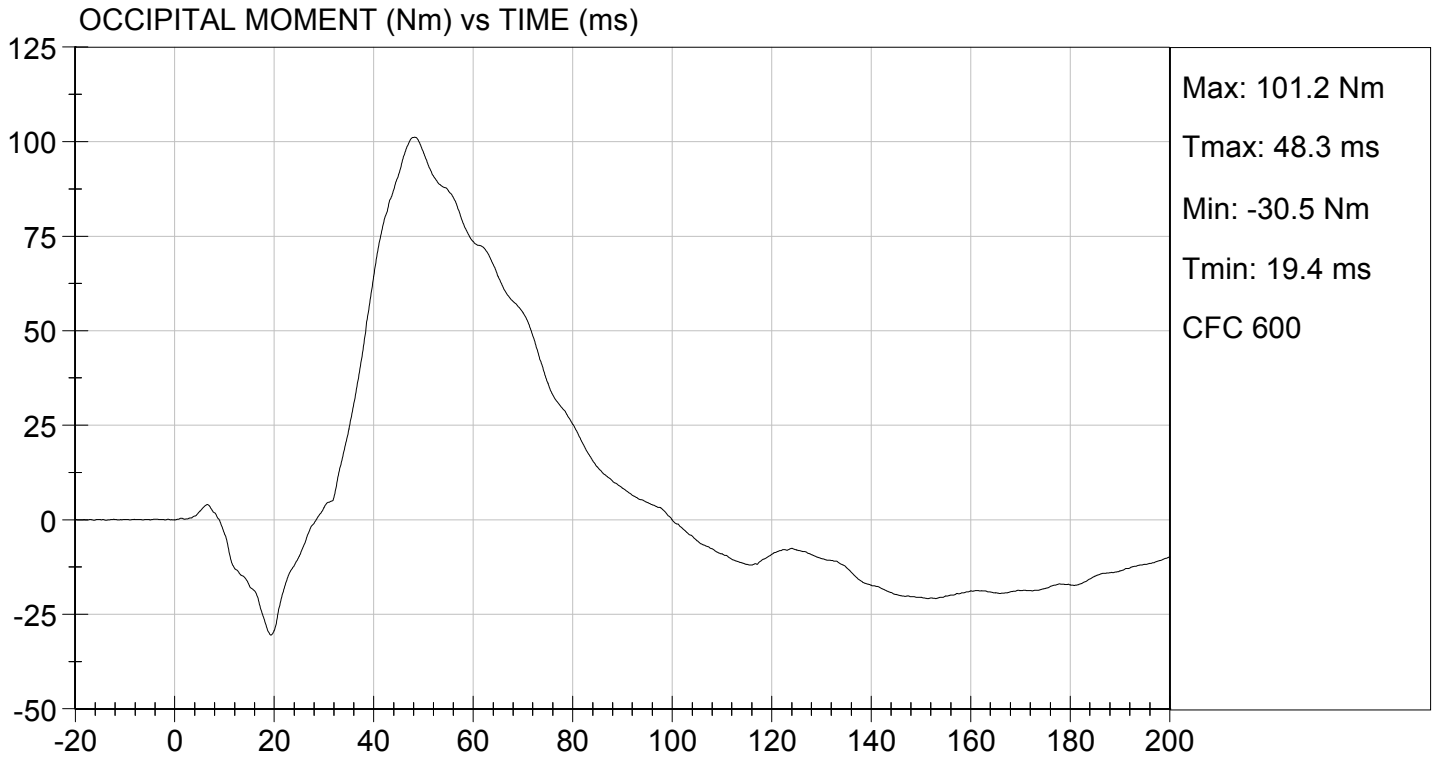
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	29	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	25.88	Pass
	20 ms	G's	17.60 to 22.60	21.40	Pass
	30 ms	G's	12.50 to 18.50	16.0	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	16.0	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.5	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	67.9	Pass
	Time	ms	57.0 to 64.0	57.0	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.8	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	101.2	Pass
	Time	ms	47.0 to 58.0	48.3	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	100.1	Pass
<b>Overall Test Results</b>					<b>Pass</b>

Jessica Hall  
 Laboratory Technician

12/21/2012  
 Test Date

David Winkelbauer  
 Approved By





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

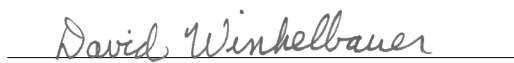
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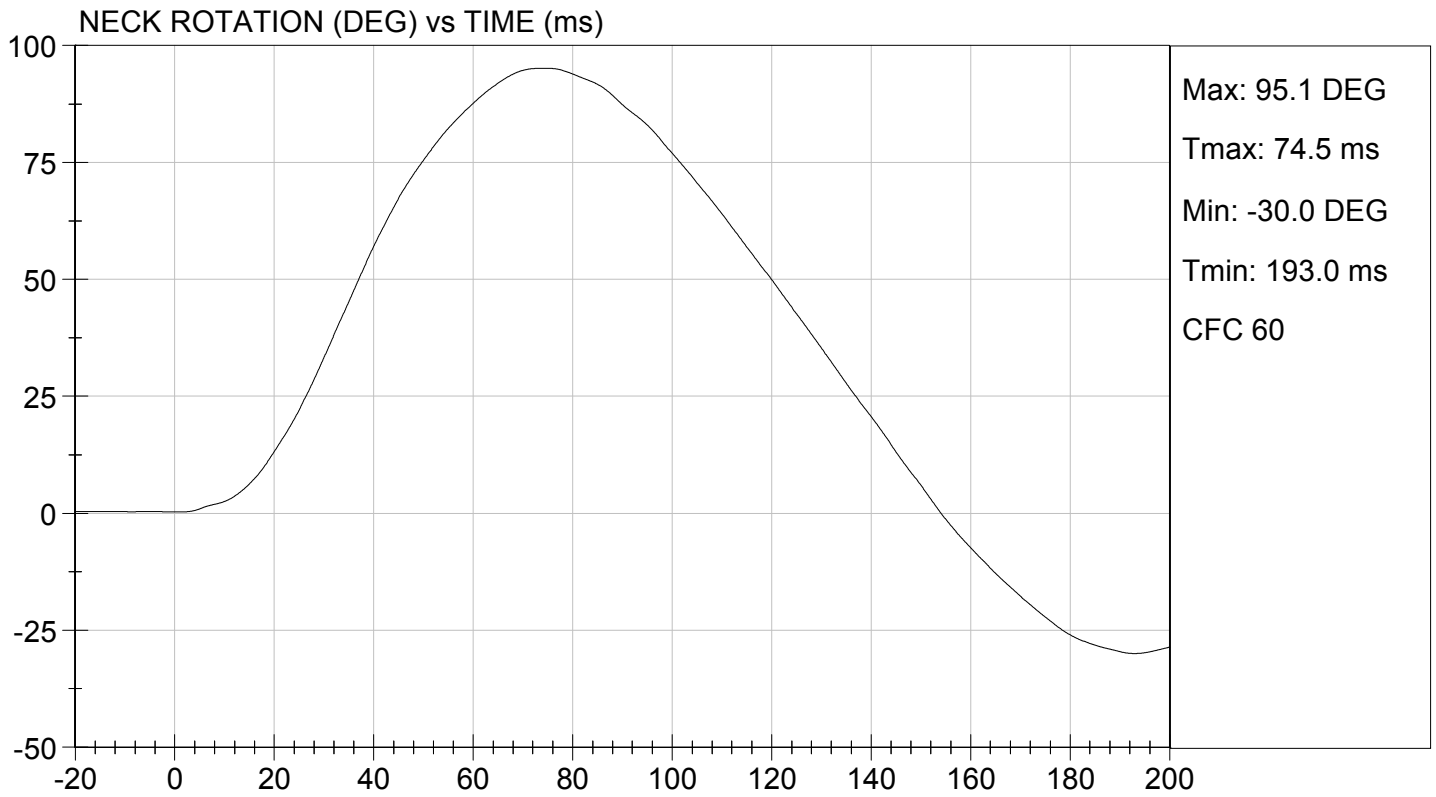
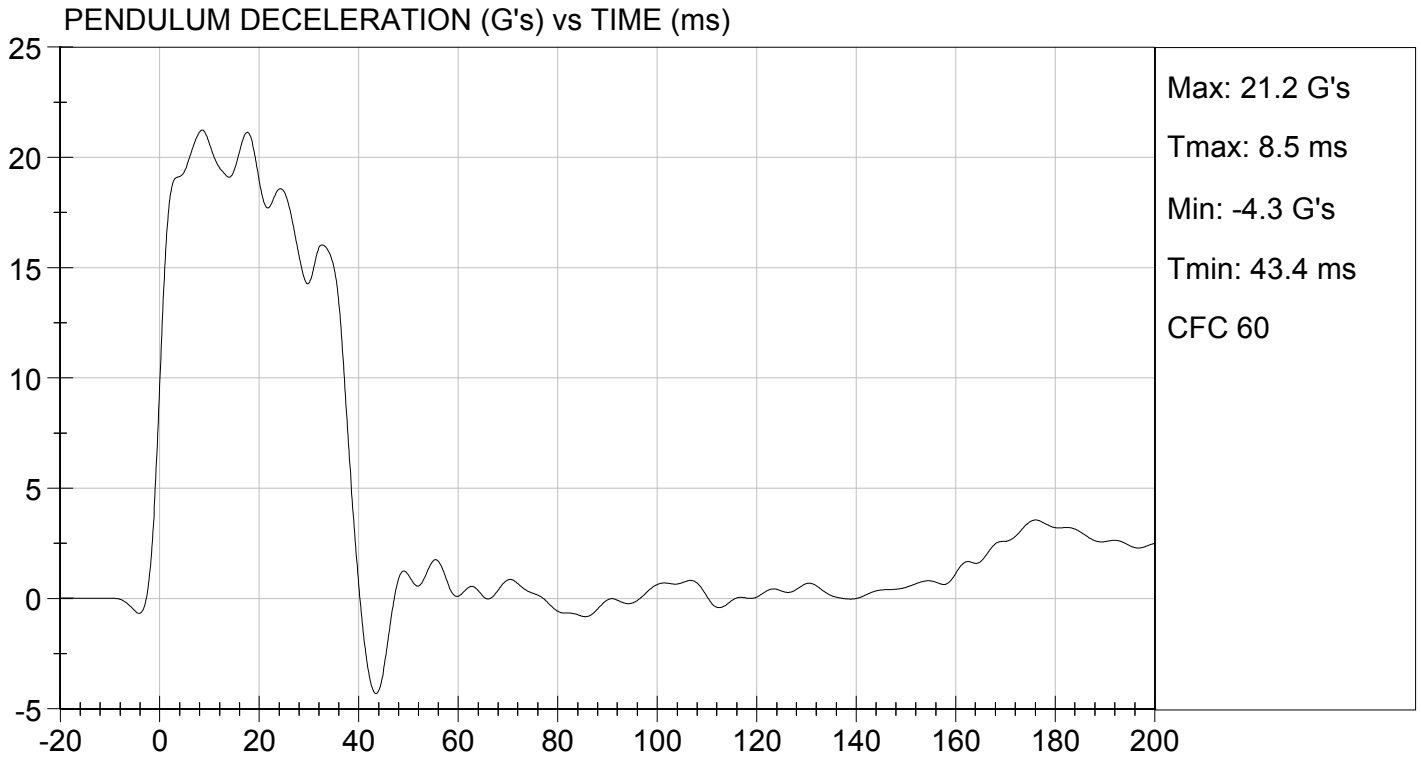
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Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	28	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	20.60	Pass
	20 ms	G's	14.00 to 19.00	18.95	Pass
	30 ms	G's	11.00 to 16.00	14.31	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	16.0	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	38.6	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	95.1	Pass
	Time	ms	72.0 to 82.0	74.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	154.2	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-65.7	Pass
	Time	ms	65.0 to 79.0	67.8	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	139.6	Pass
<b>Overall Test Results</b>					<b>Pass</b>

  
 Laboratory Technician

12/21/2012  
 Test Date

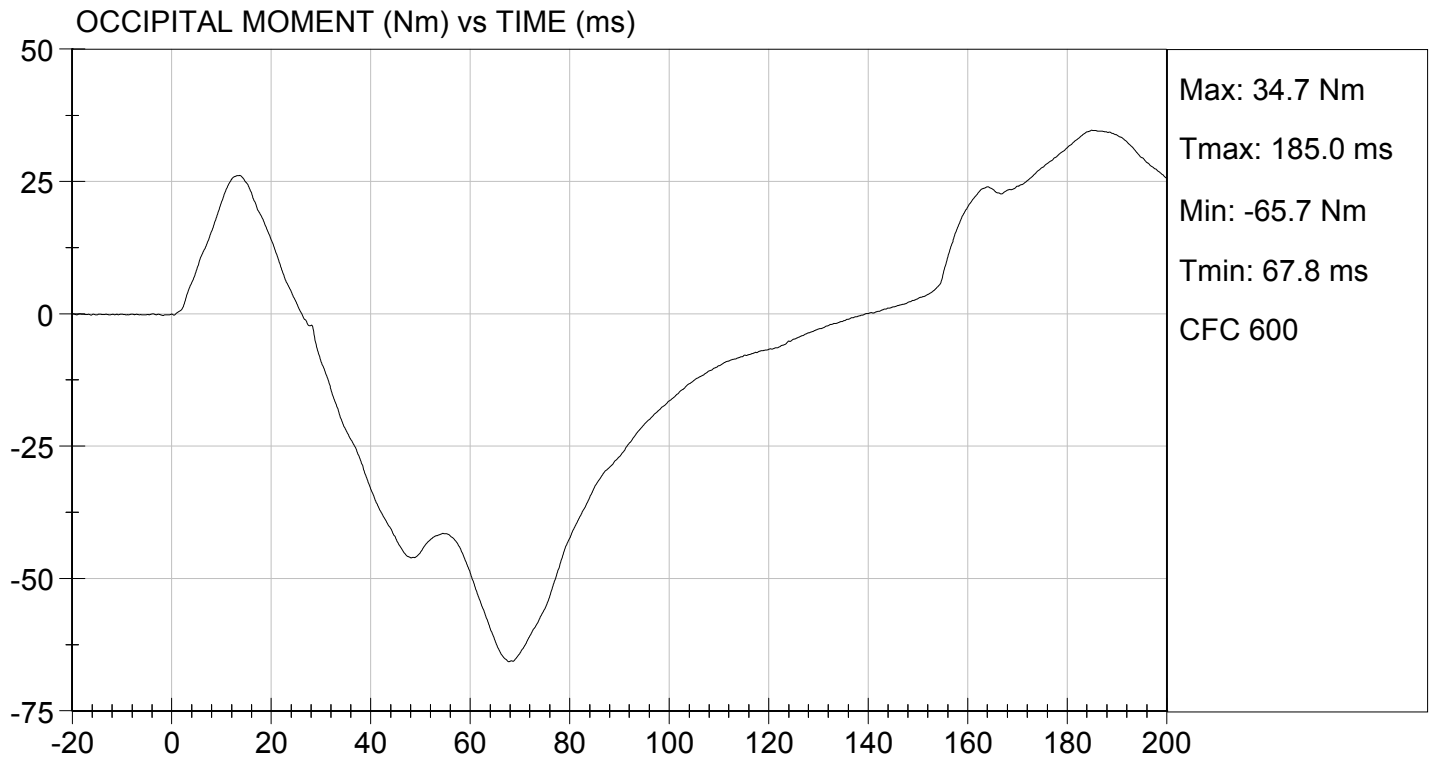
  
 Approved By





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

TEST DATE: 12/21/2012  
TEST #: D124823



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

**ATD Serial No:** 351

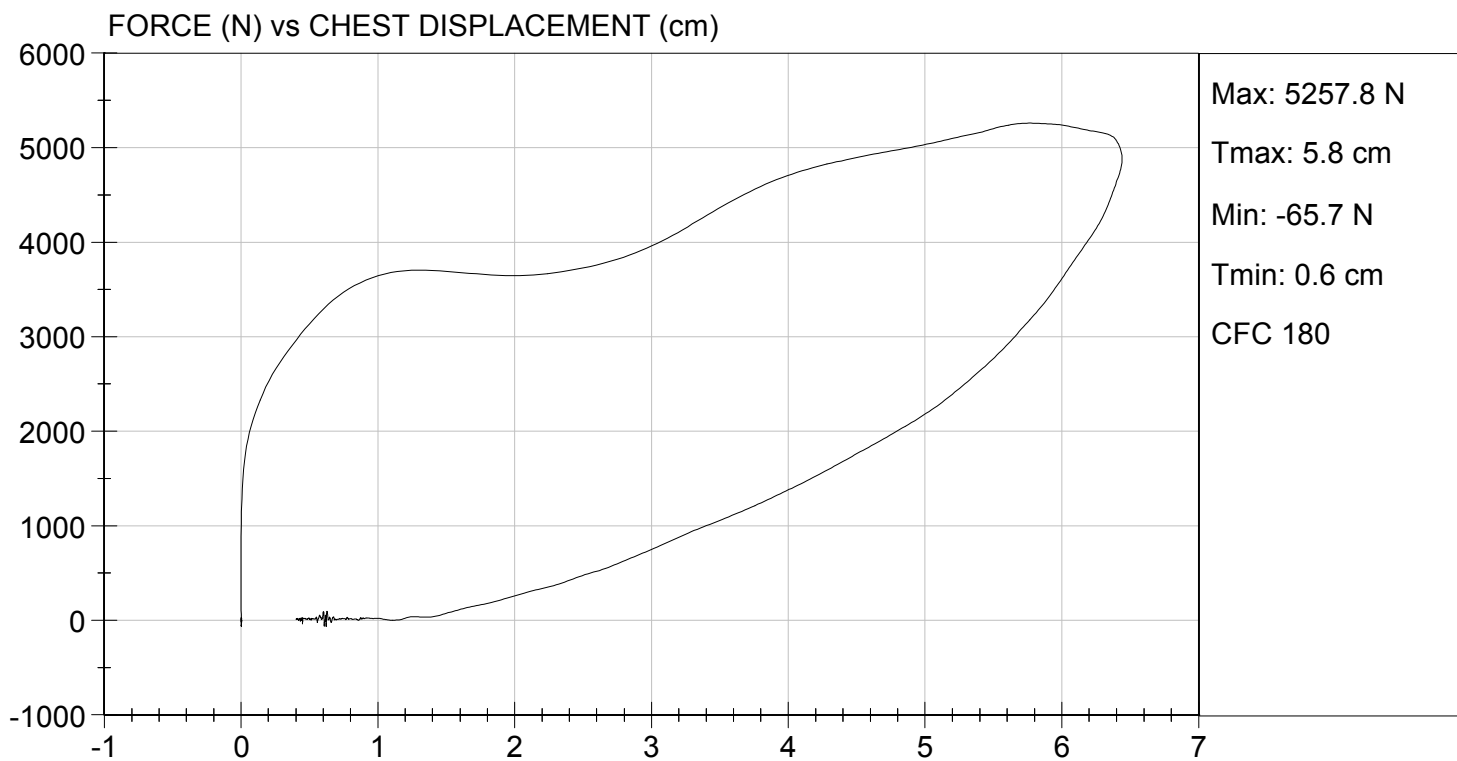
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Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,258	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.44	Pass
Internal Hysteresis	%	69 to 85	70	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
Laboratory Technician

12/21/2012  
Test Date

  
Approved By



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

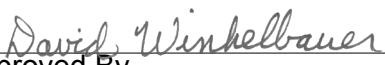
**ATD Serial No:** 351

**Test I.D:** D124825

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,298	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

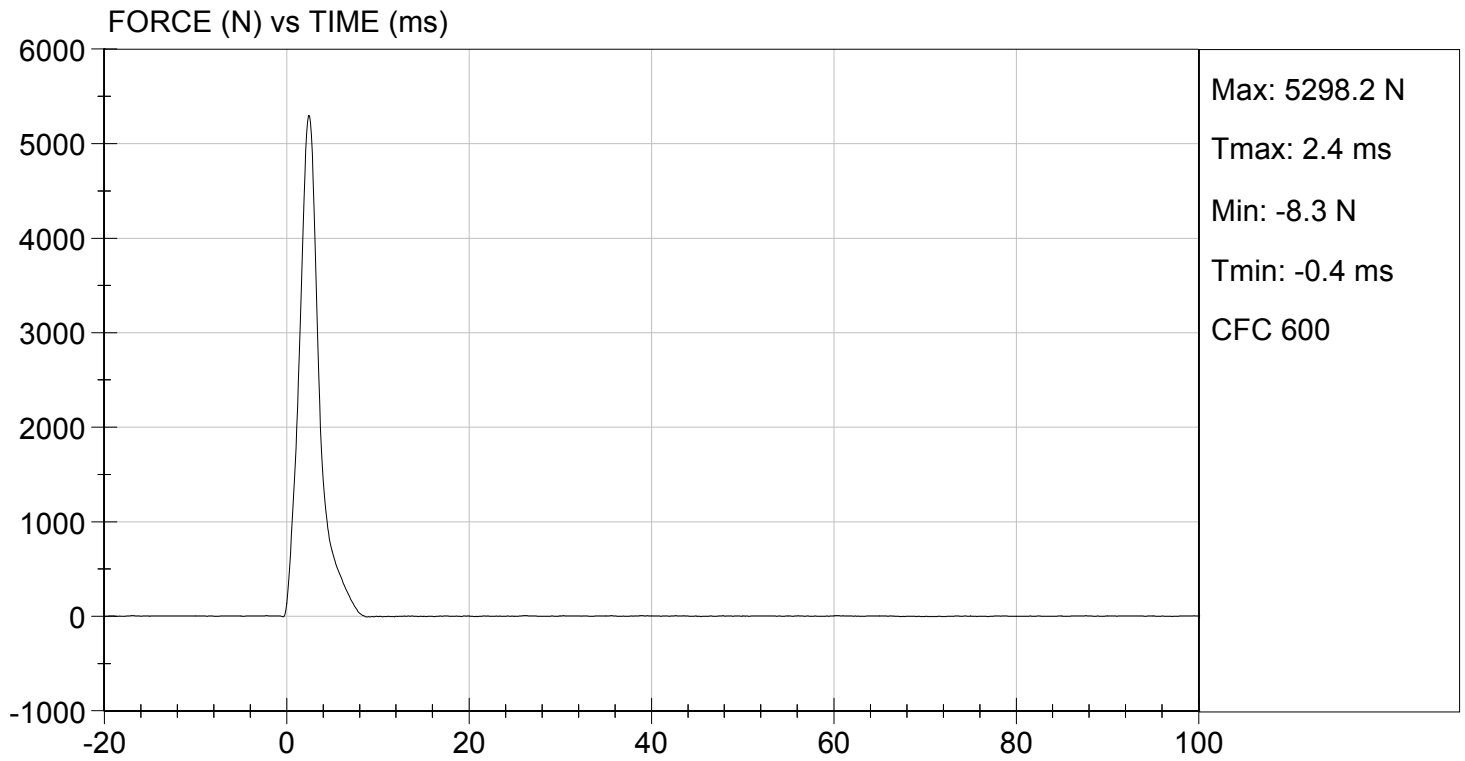
12/21/2012  
 Test Date

  
 Approved By



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

TEST DATE: 12/21/2012  
TEST #: D124825



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

**ATD Serial No:** 351

**Test I.D:** D124826

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,111	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

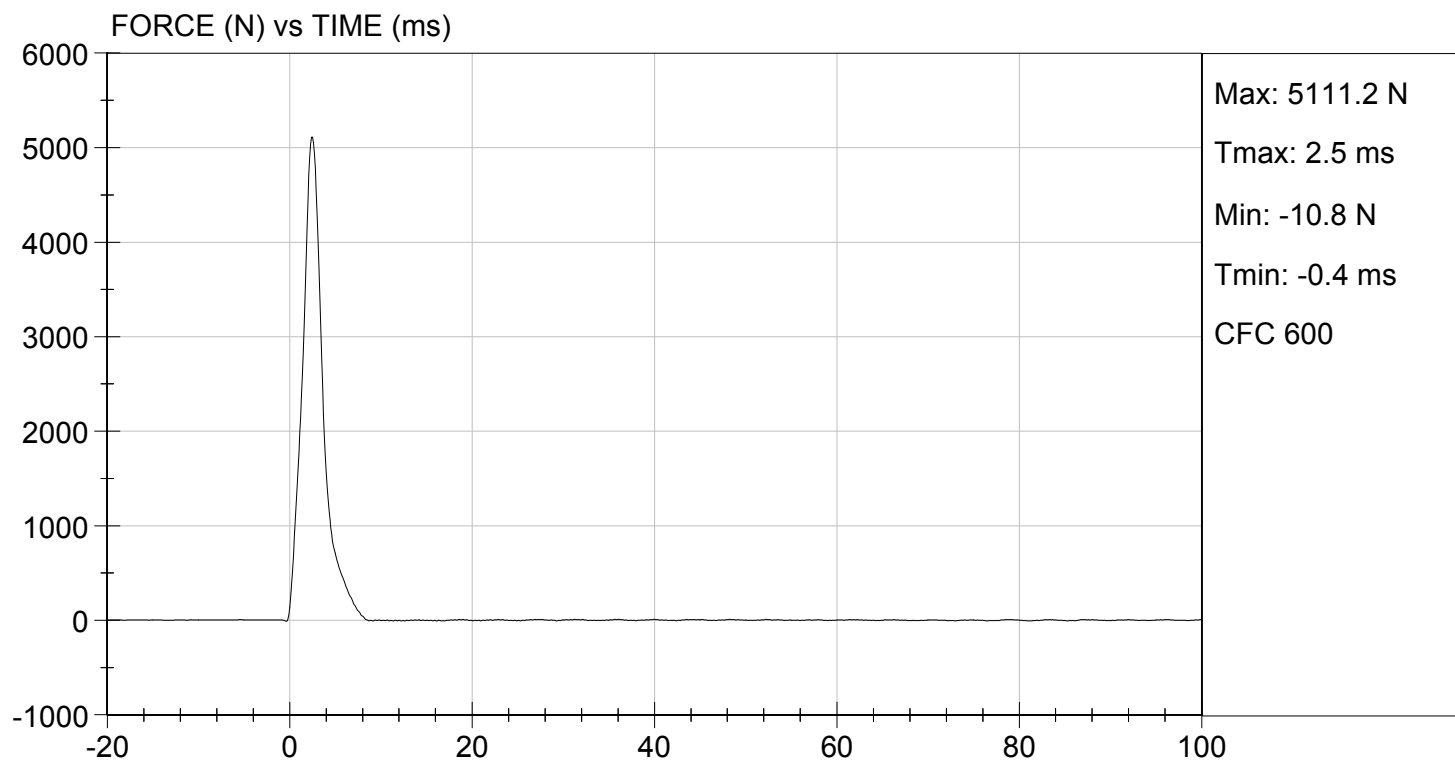
12/21/2012  
 Test Date

  
 Approved By



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

TEST DATE: 12/21/2012  
TEST #: D124826



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

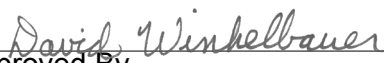
**ATD Serial No:** 351

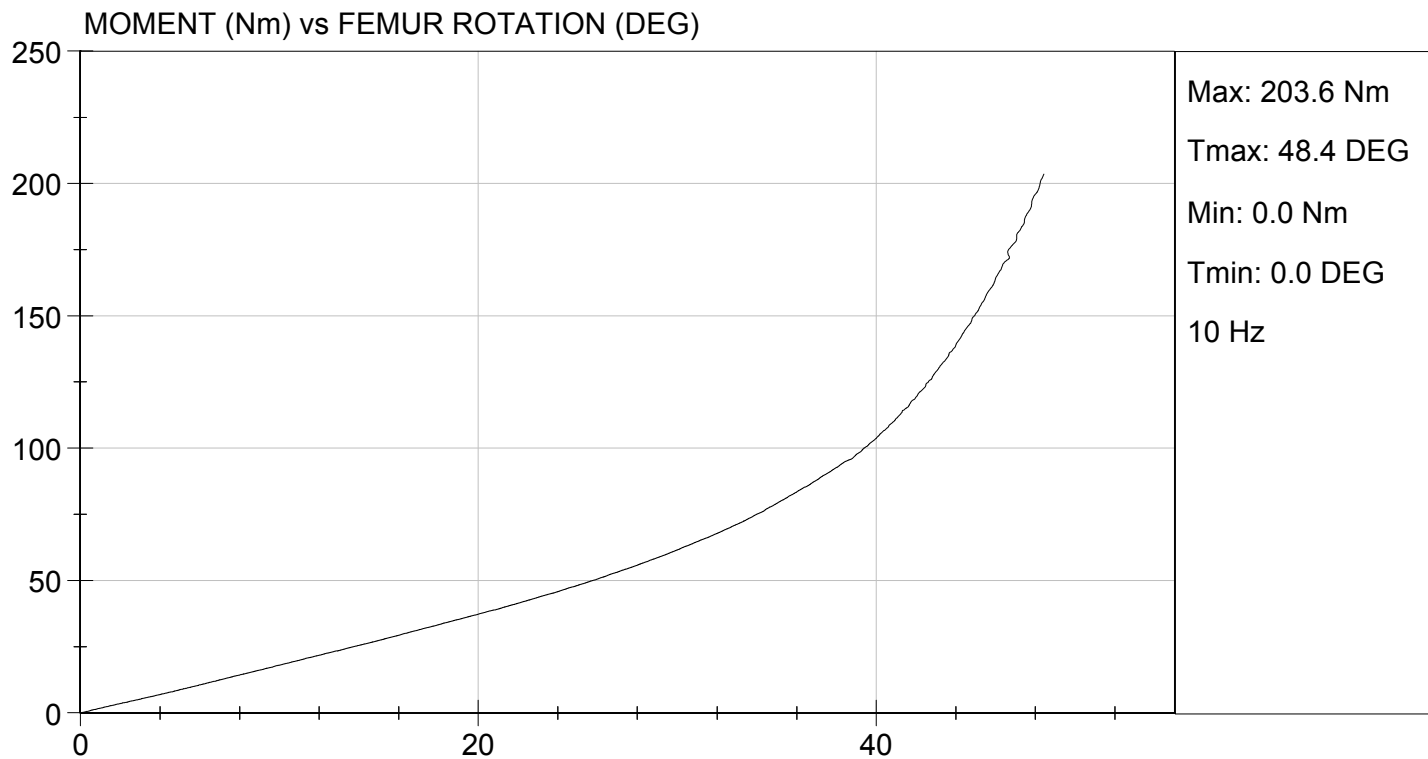
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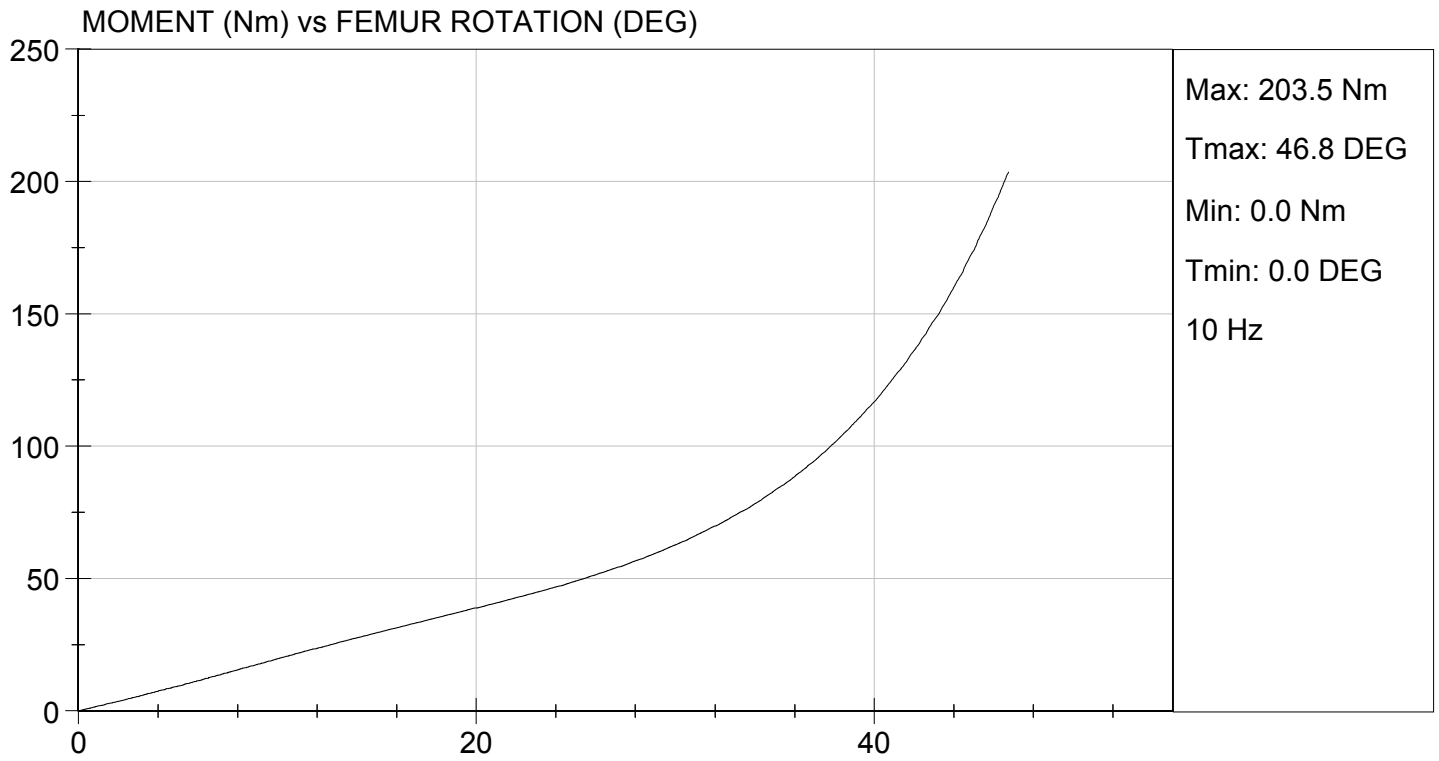
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	29	29	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.3	6.3	Pass
30 Degrees	Nm	94.9 Nm Max	61.6	62.7	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.4	46.8	Pass
Overall Test Results					Pass

  
 Laboratory Technician

12/21/2012  
 Test Date

  
 Approved By





**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
eP	FOOT LENGTH	Tip of toe to rear of heel	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

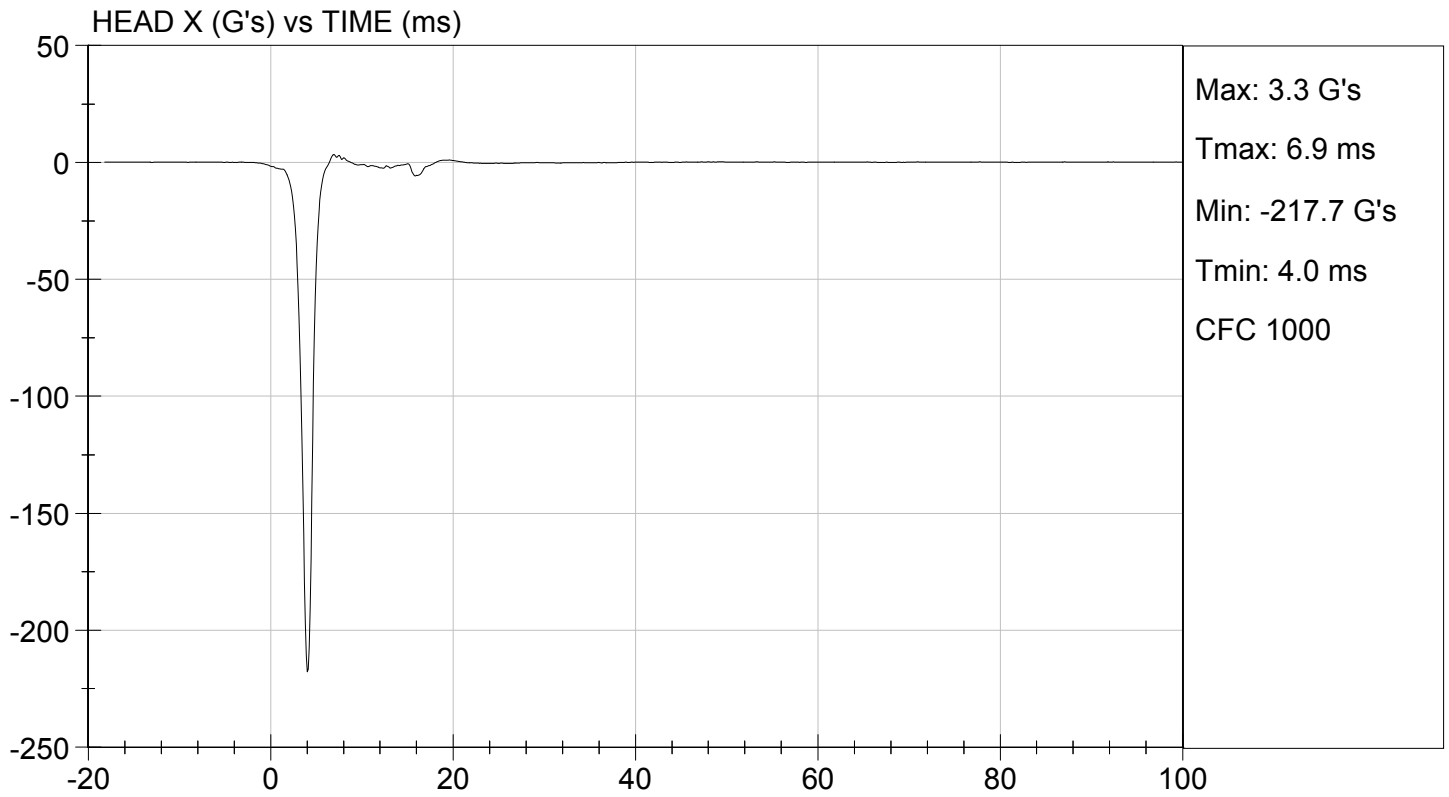
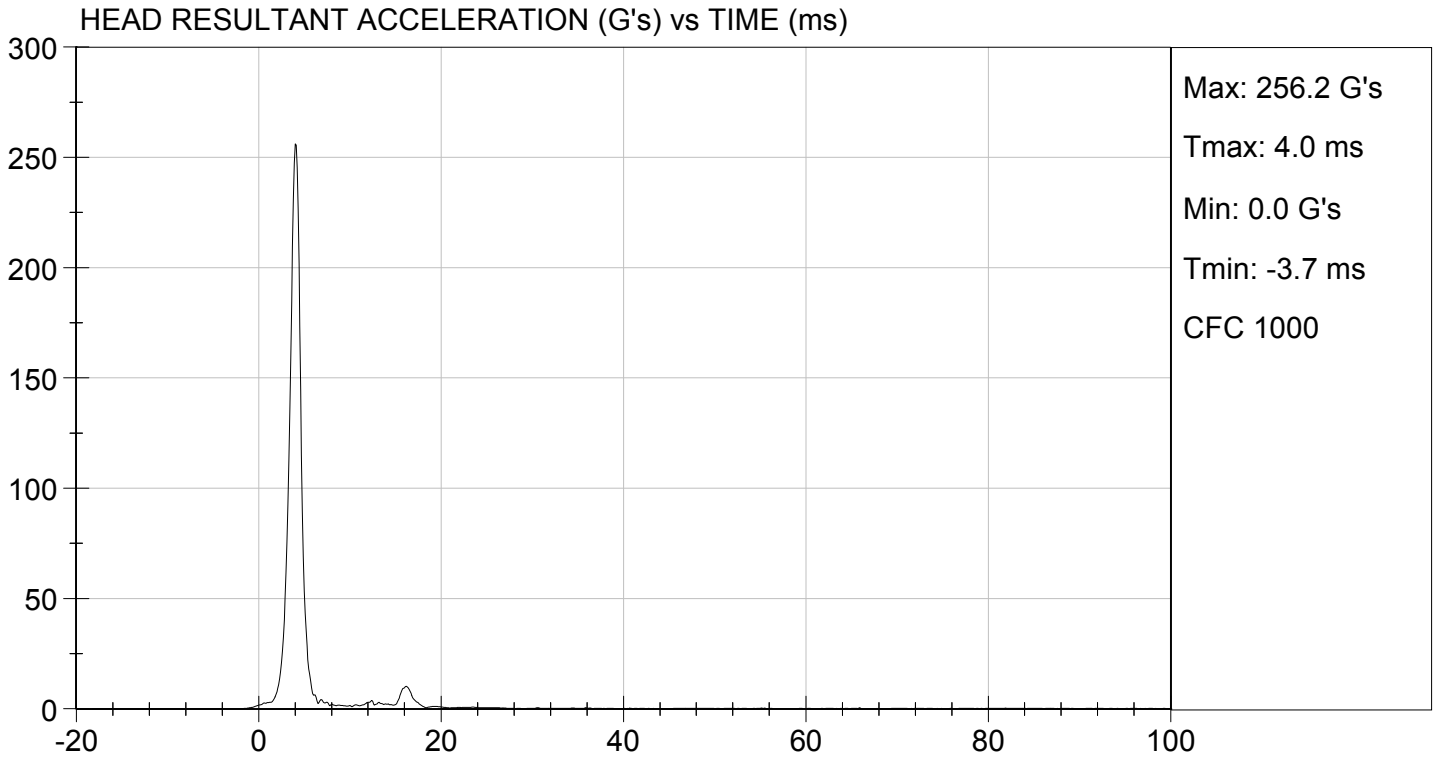
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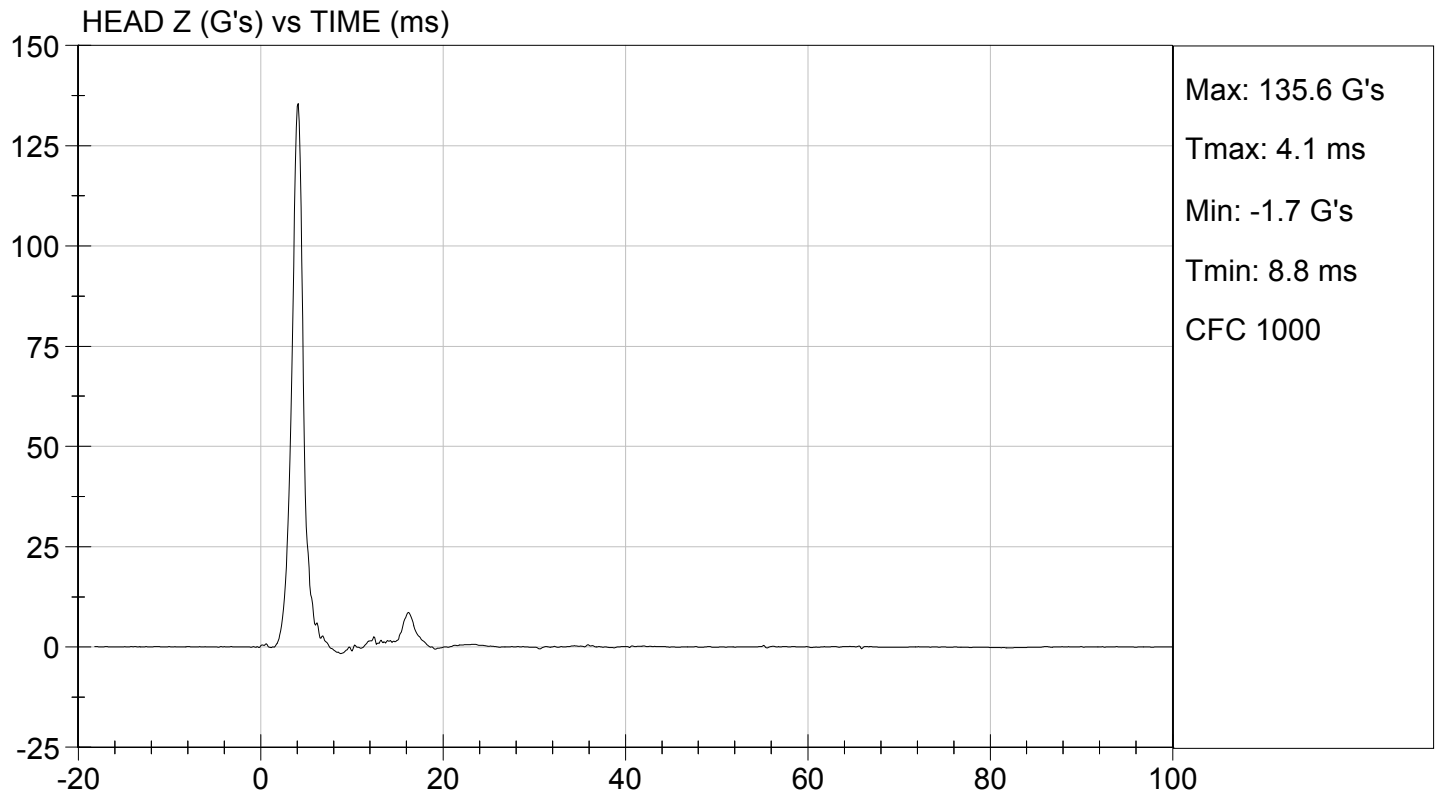
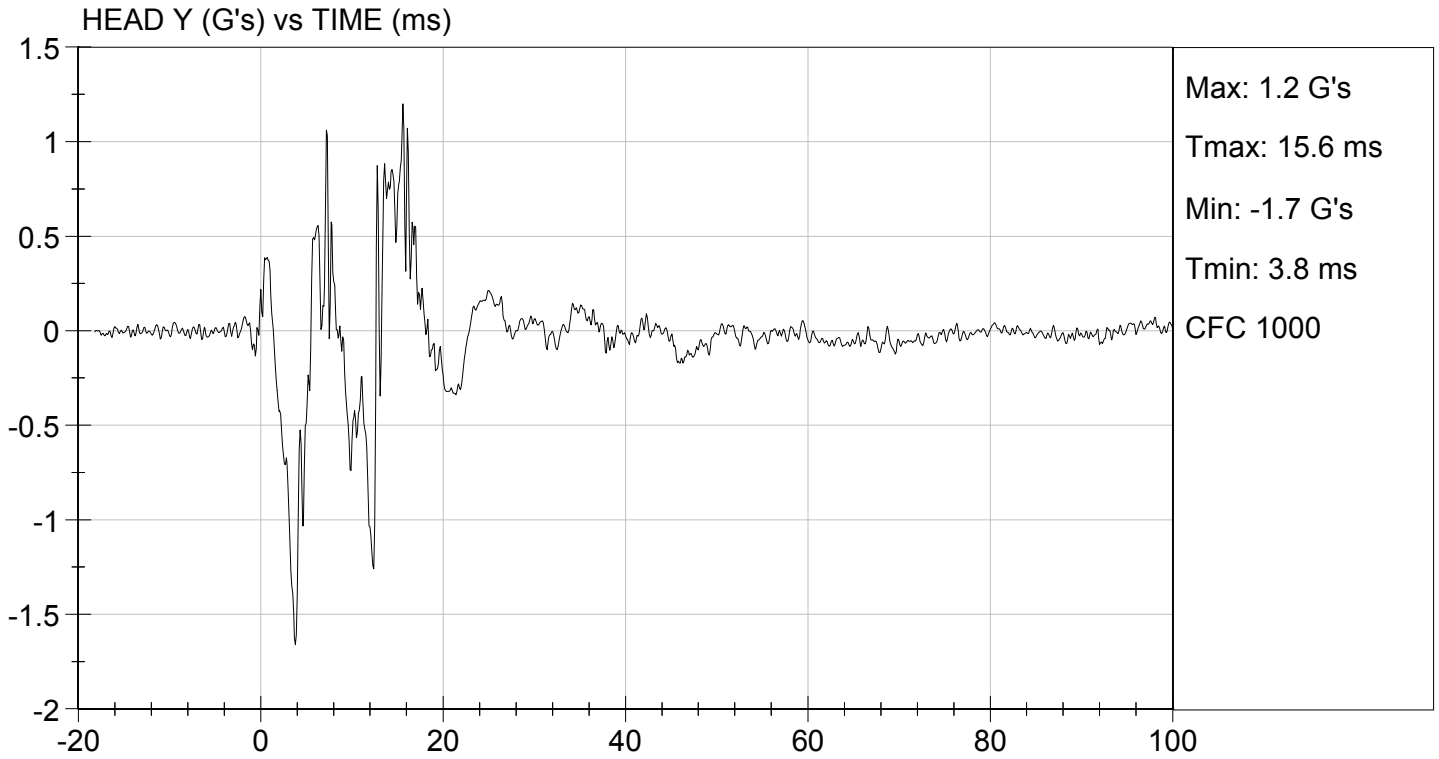
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Peak Resultant Acceleration	G's	250 to 300	256	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-1.7	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
<b>Overall Test Results</b>				<b>Pass</b>

*Jessica Hall*  
 \_\_\_\_\_  
 Laboratory Technician

11/28/2012  
 \_\_\_\_\_  
 Test Date

*David Winkelbauer*  
 \_\_\_\_\_  
 Approved By





**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No: 634

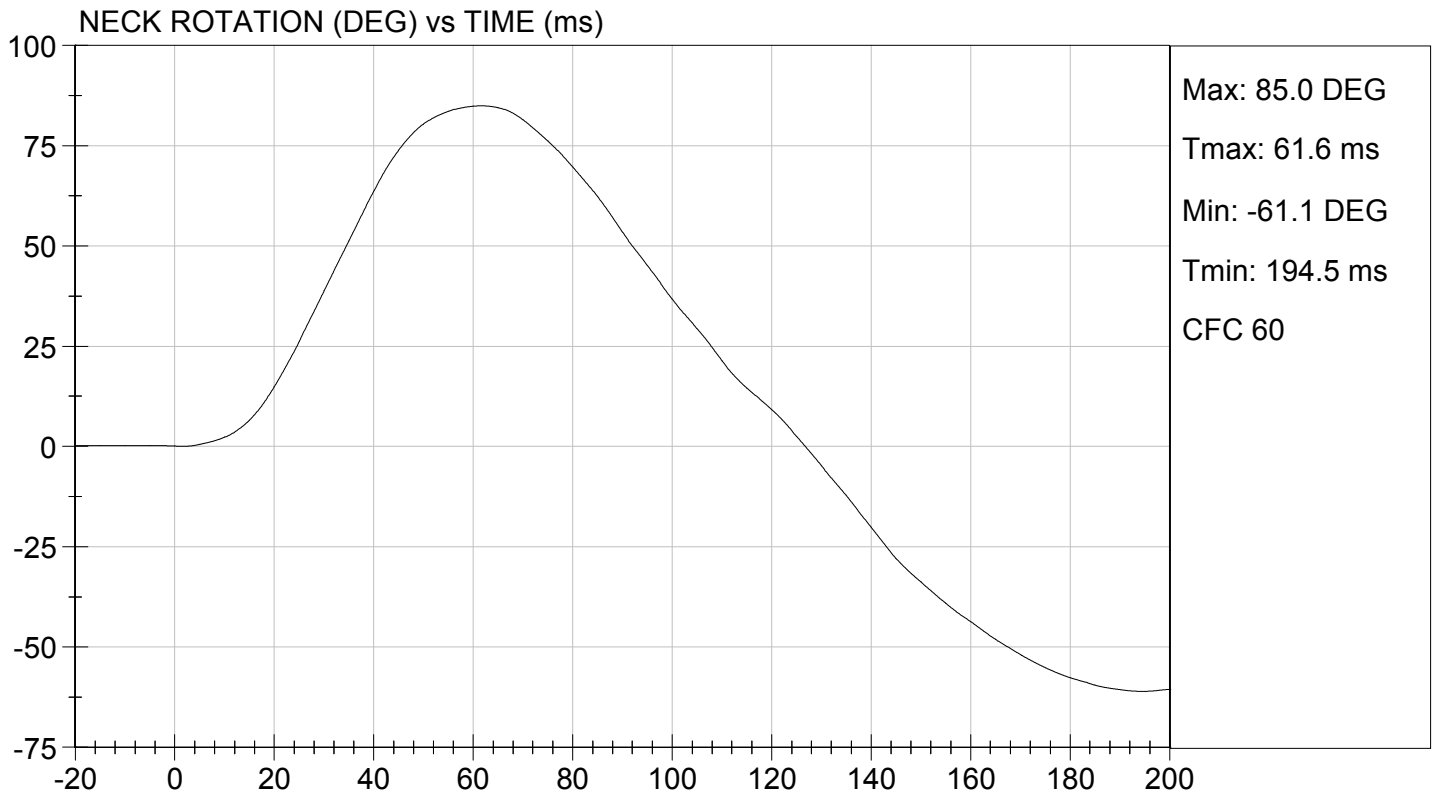
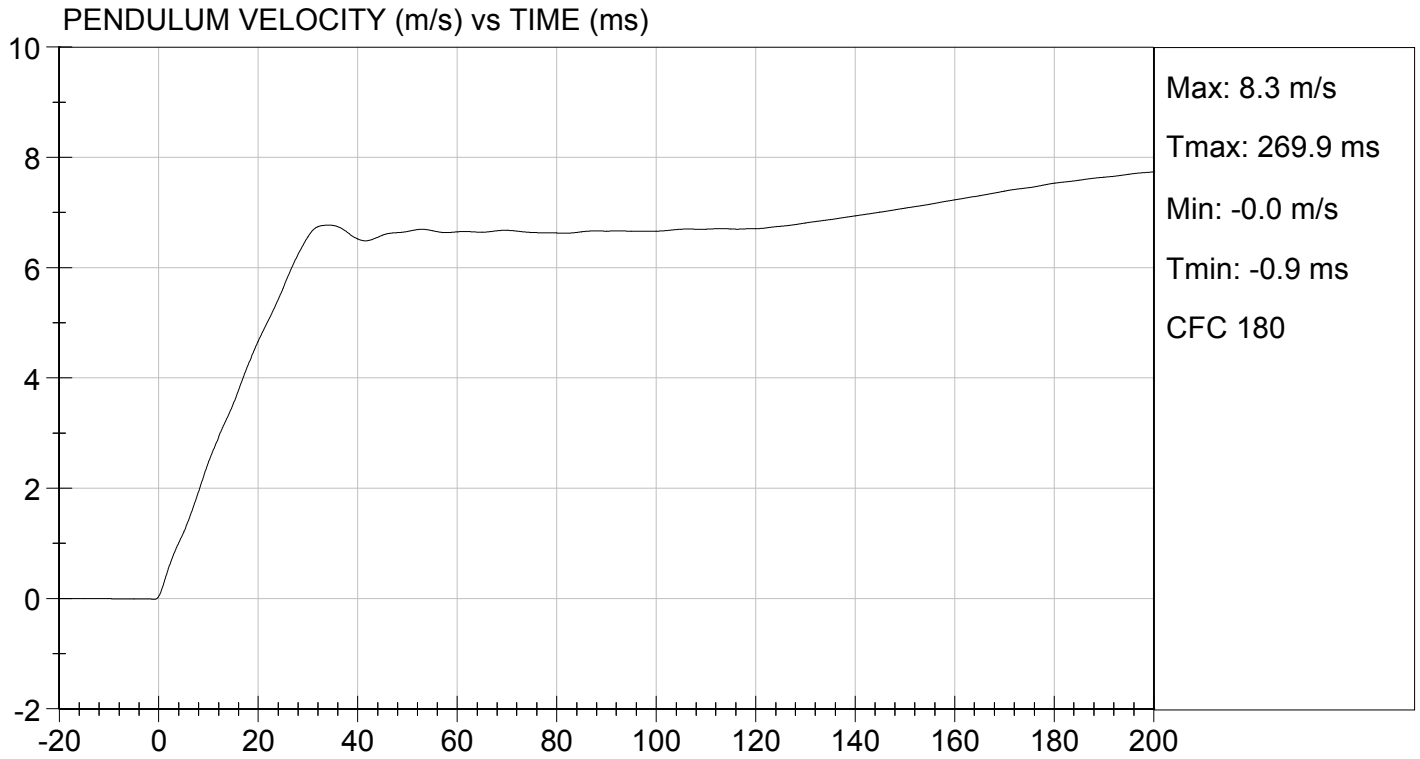
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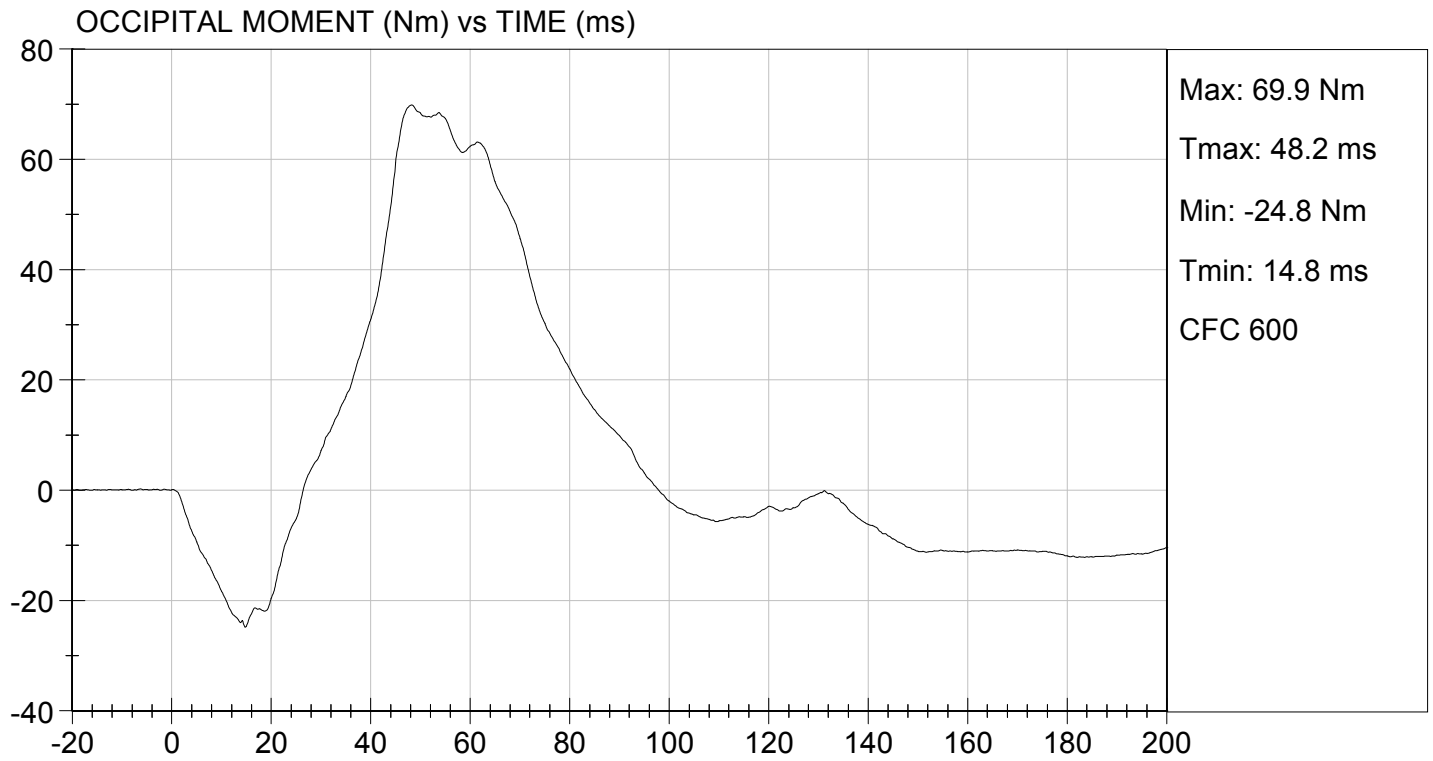
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	19	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.5	Pass
	20 ms	m/s	4.0 to 5.0	4.7	Pass
	30 ms	m/s	5.8 to 7.0	6.6	Pass
D Plane Rotation	Max	deg	77 to 91	85	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	70	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	88	Pass
Overall Results					Pass

Jessica Gall  
Laboratory Technician

11/28/2012  
Test Date

David Winkelbauer  
Approved By





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

ATD Serial No: 634

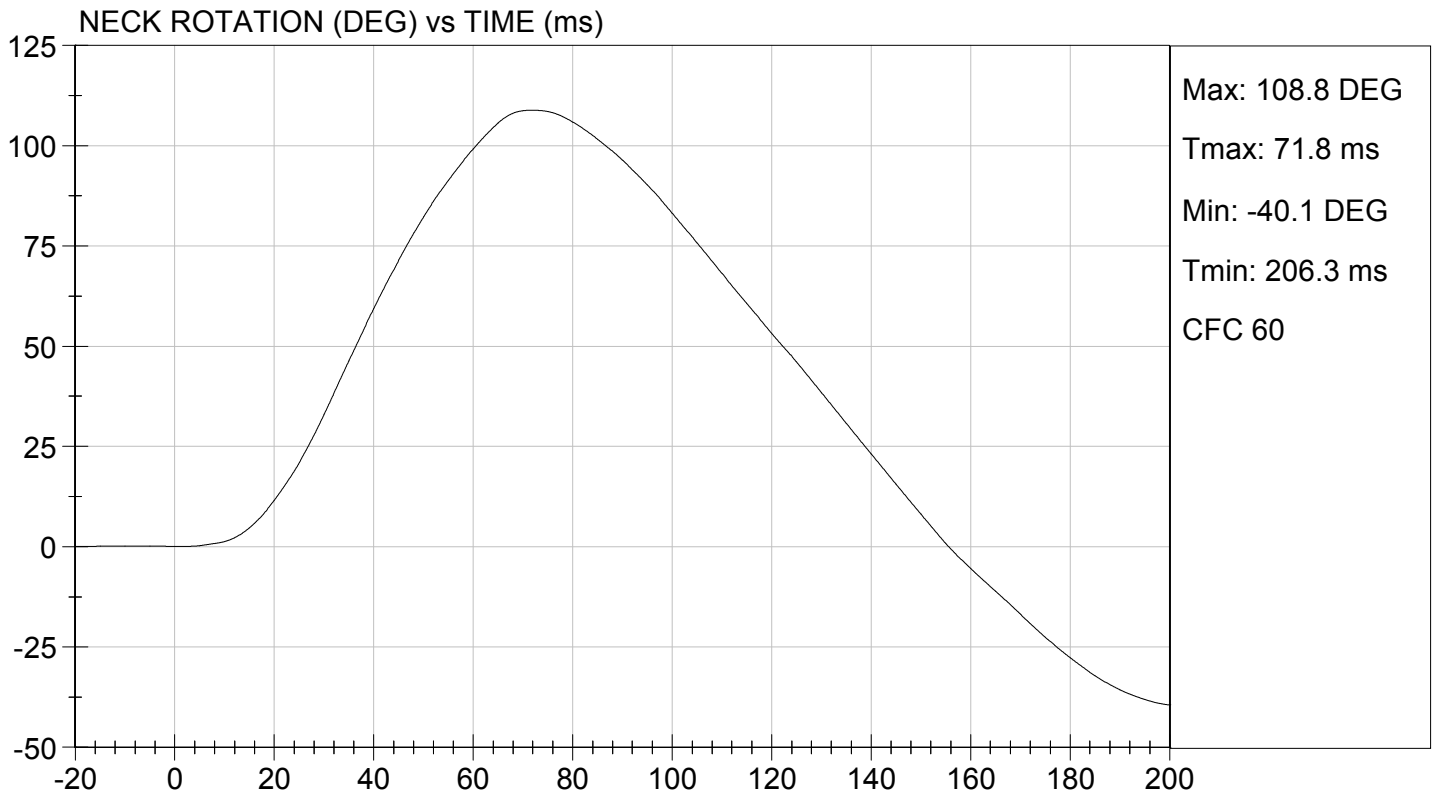
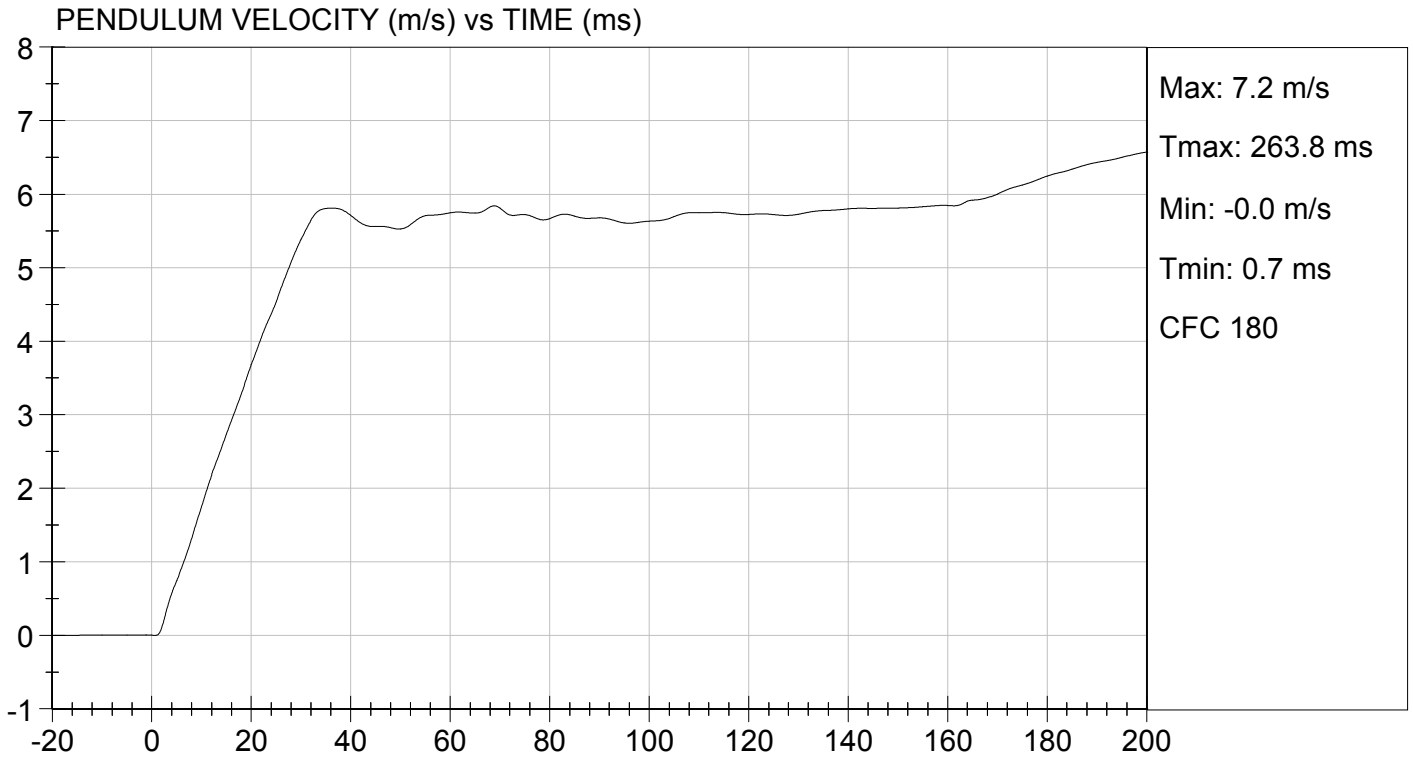
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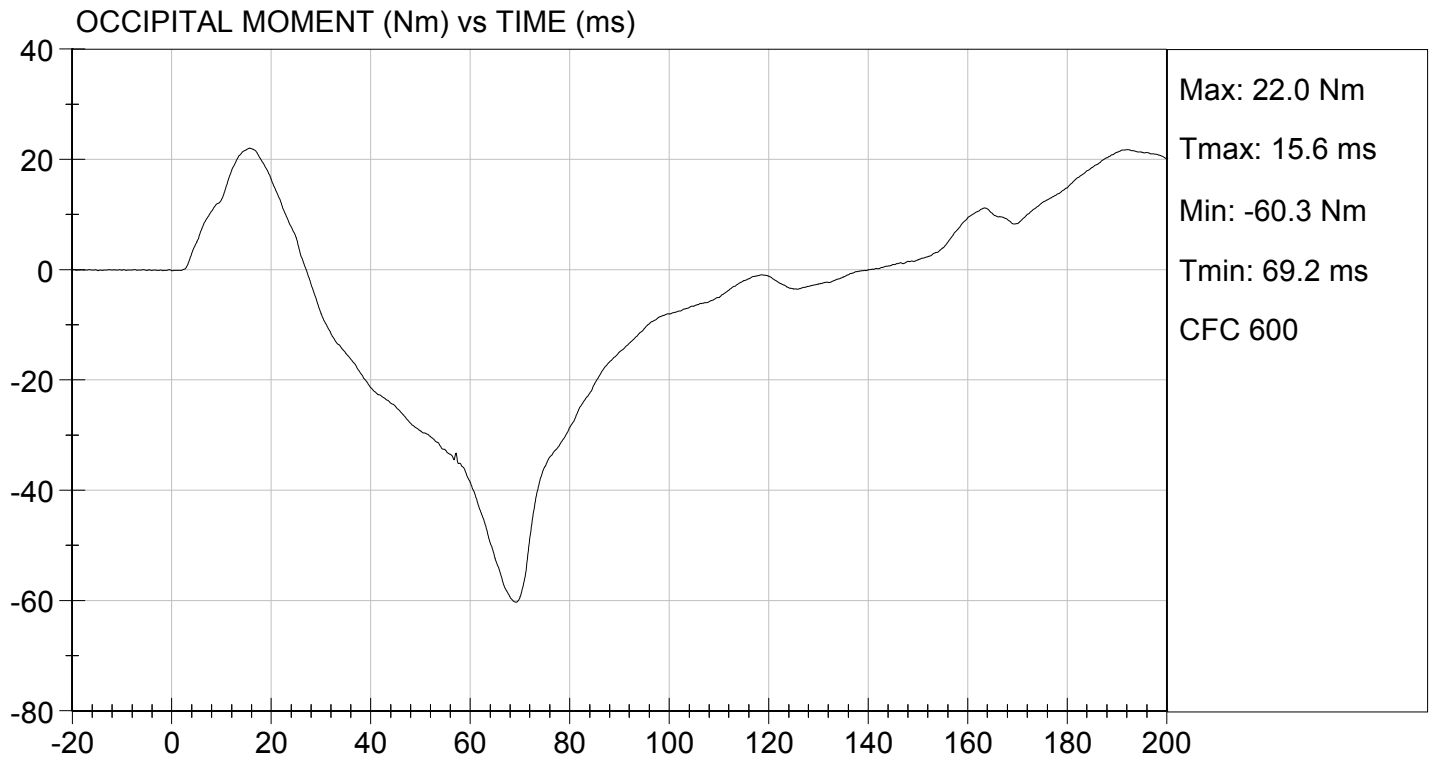
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	19	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.4	Pass
D Plane Rotation	Max	deg	99 to 114	109	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-60	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	95	Pass
Overall Results					Pass

Jessica Gall  
Laboratory Technician

11/28/2012  
Test Date

David Winkelbauer  
Approved By





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

**ATD Serial No:** 634

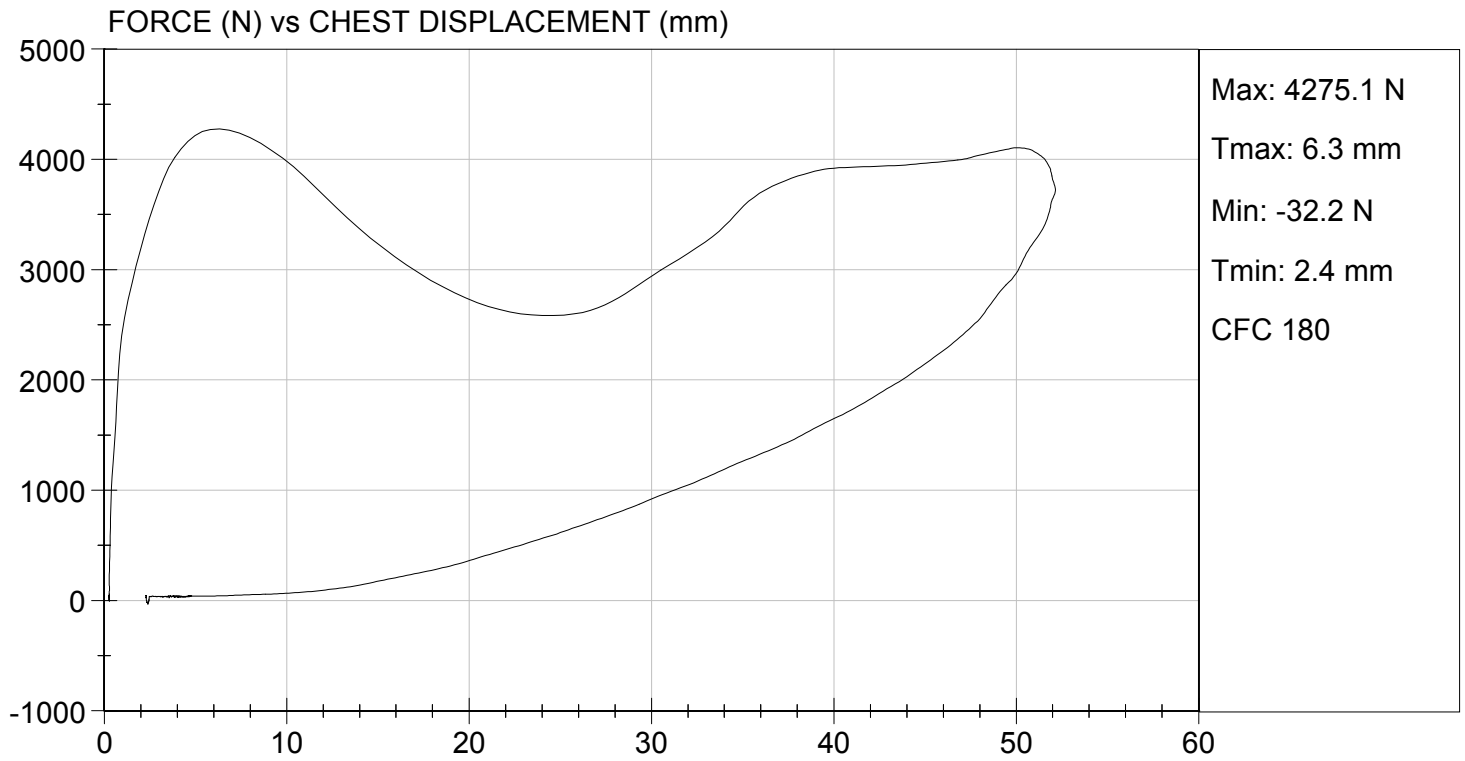
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Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Relative Humidity	%	10 to 70	21.1	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	52	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4107	Pass
Internal Hysteresis	%	69 to 85	72	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4106	Pass
<b>Overall Test Results</b>				<b>Pass</b>

*Jessica Hall*  
 Laboratory Technician

11/29/2012  
 Test Date

*David Winkelbauer*  
 Approved By



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

**ATD Serial No:** 634

**Test I.D:** D124545

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3556	Pass
<b>Overall Test Results</b>				<b>Pass</b>

Jessica Gall  
 Laboratory Technician

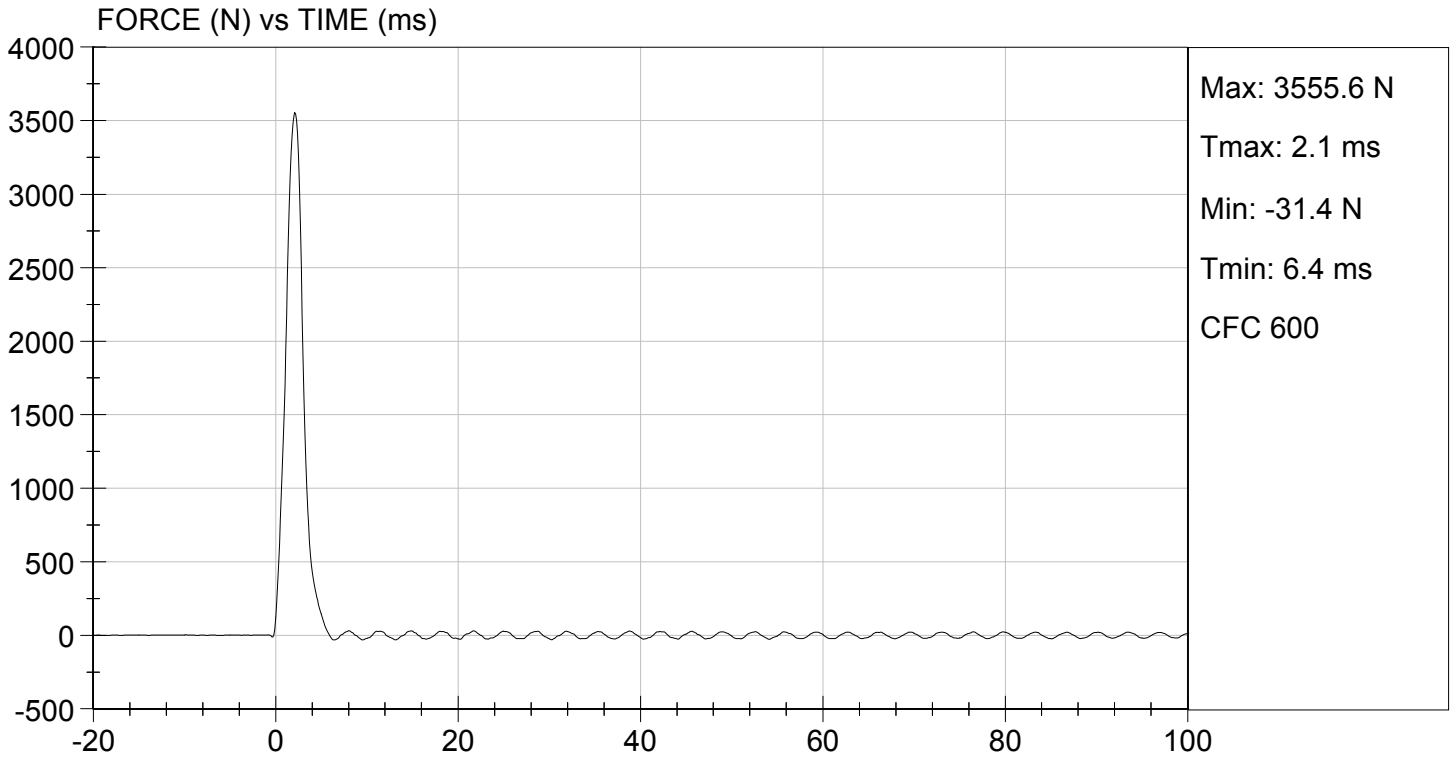
11/28/2012  
 Test Date

David Winkelbauer  
 Approved By



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

TEST DATE: 11/28/2012  
TEST #: D124545



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST  
HYBRID III 5TH PERCENTILE

ATD Serial No: 634

Test I.D: D124546

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3698	Pass
Overall Test Results				Pass

Jessica Hall  
Laboratory Technician

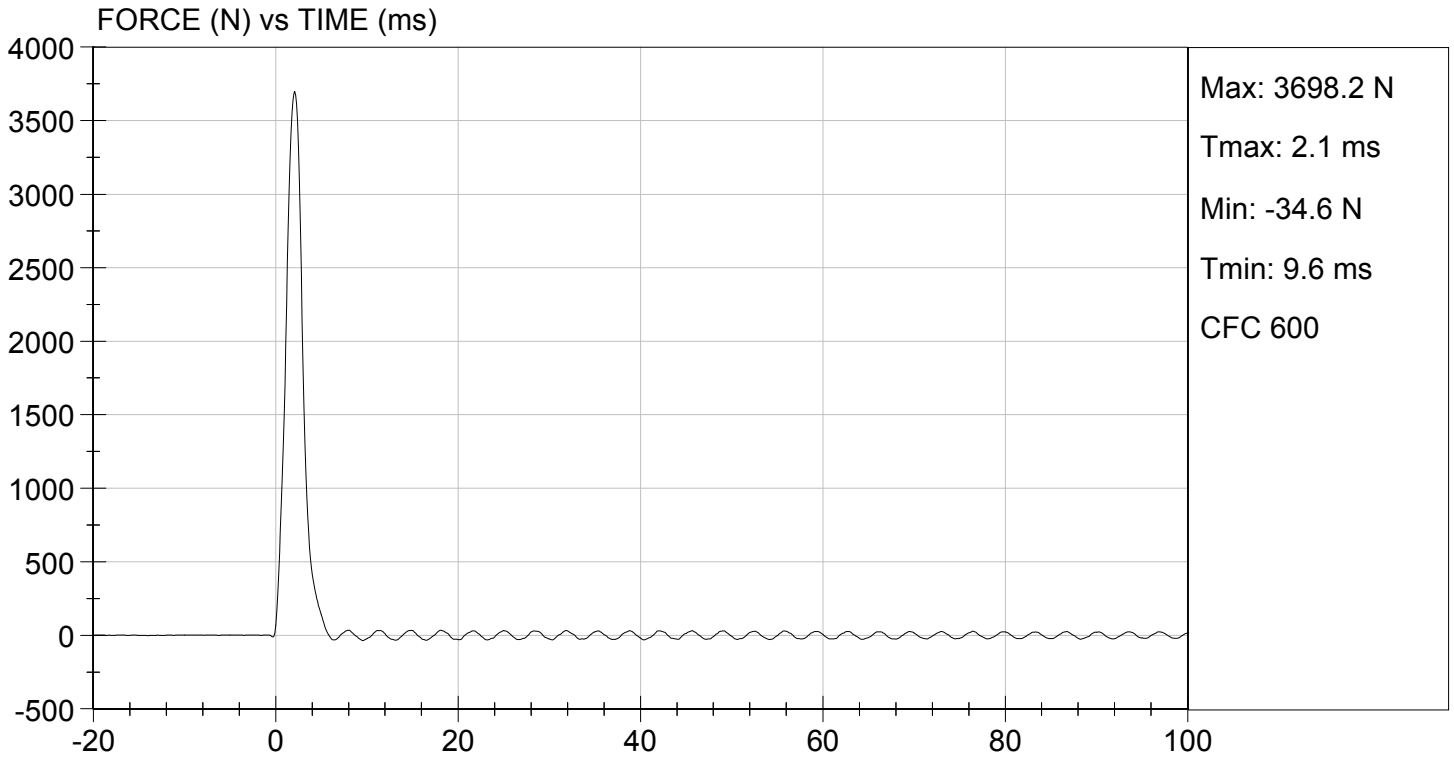
11/28/2012  
Test Date

David Winkelbauer  
Approved By



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

TEST DATE: 11/28/2012  
TEST #: D124546



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

**ATD Serial No:** 634

**Test I.D:** D124547

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	21.1	Pass
Initial Angle	deg	0 to 20	17	Pass
Return Angle	deg	+/- 8	4	Pass
Force at 45 deg	N	320 to 390	341	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
<b>Overall Result</b>				<b>Pass</b>

Jessica Hall  
 Laboratory Technician

11/29/2012  
 Test Date

David Winkelbauer  
 Approved By

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

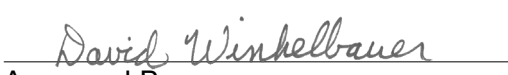
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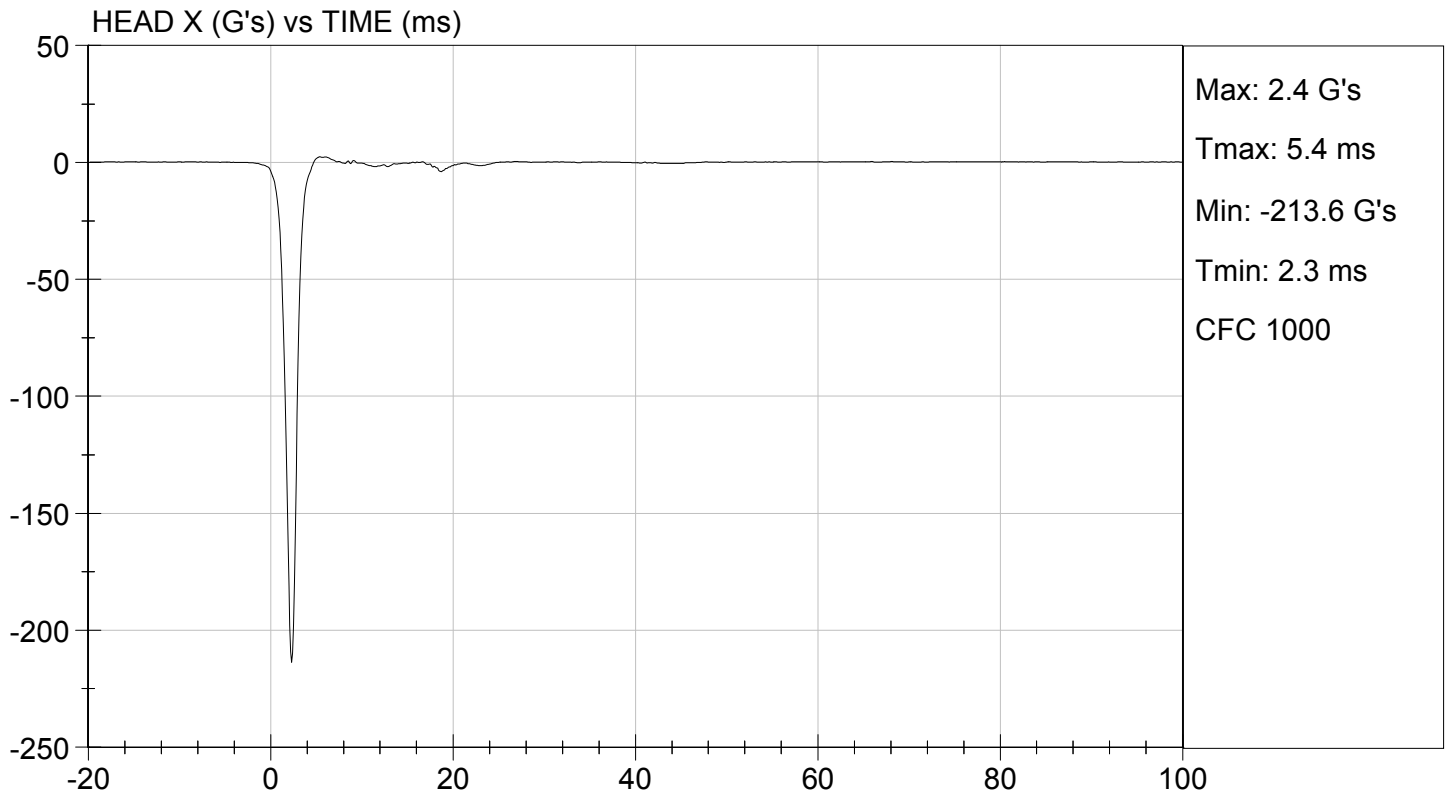
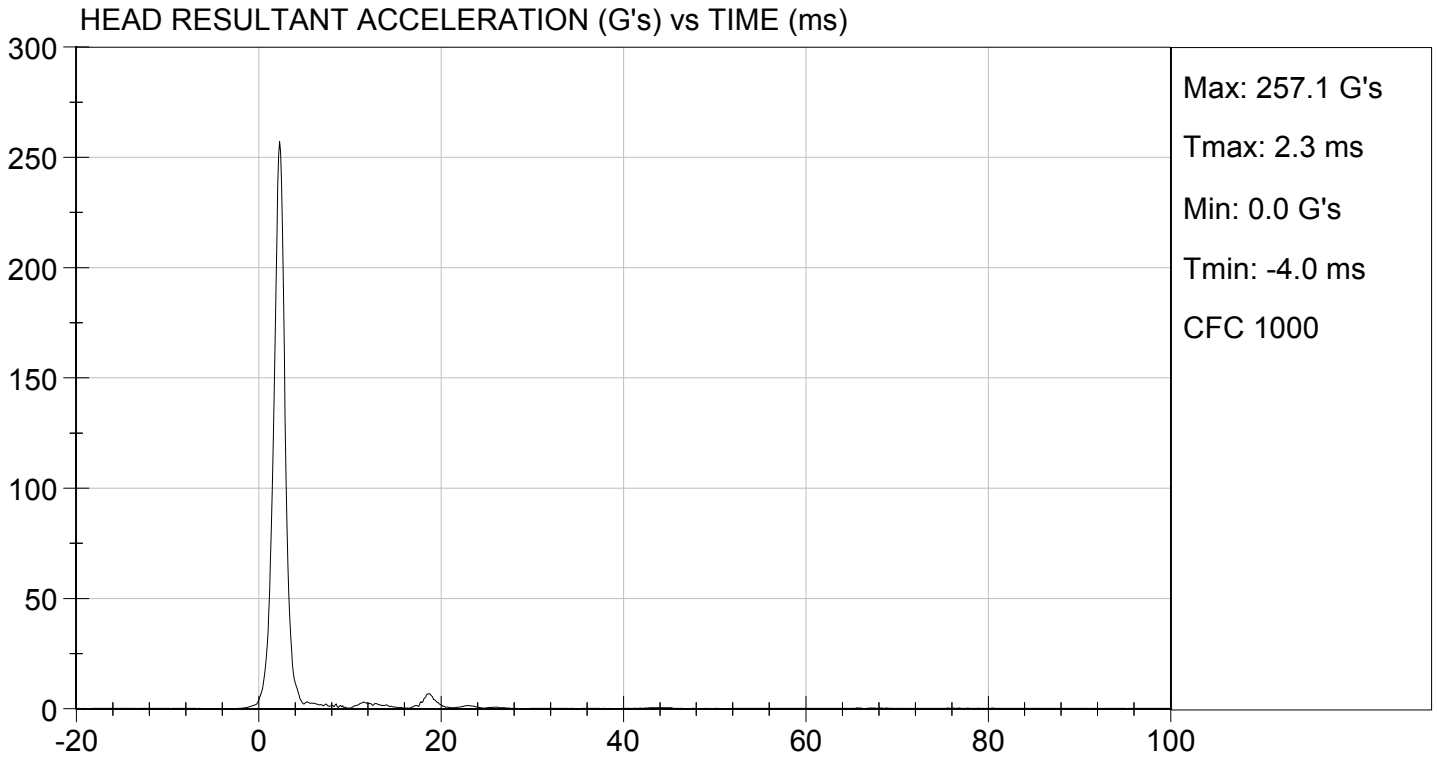
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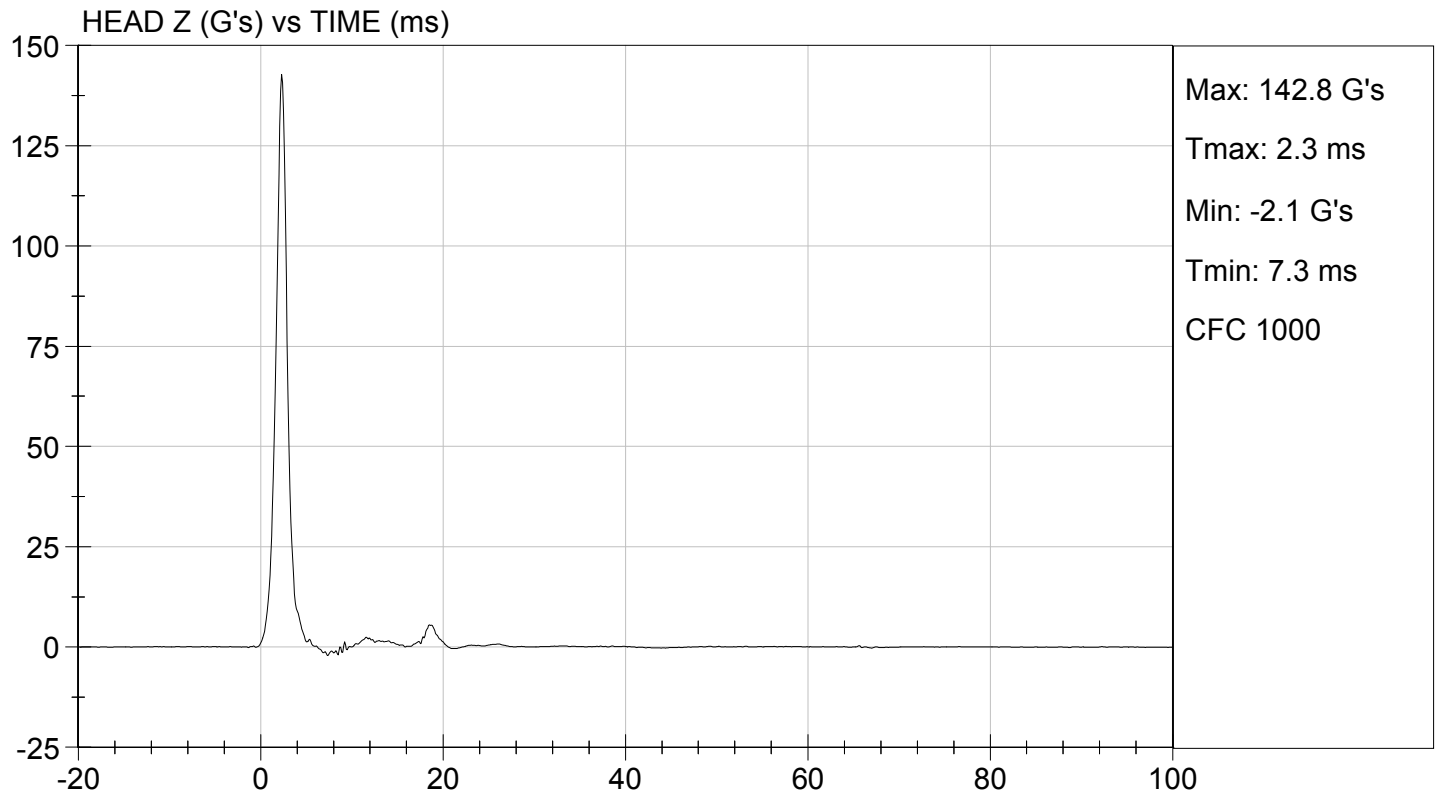
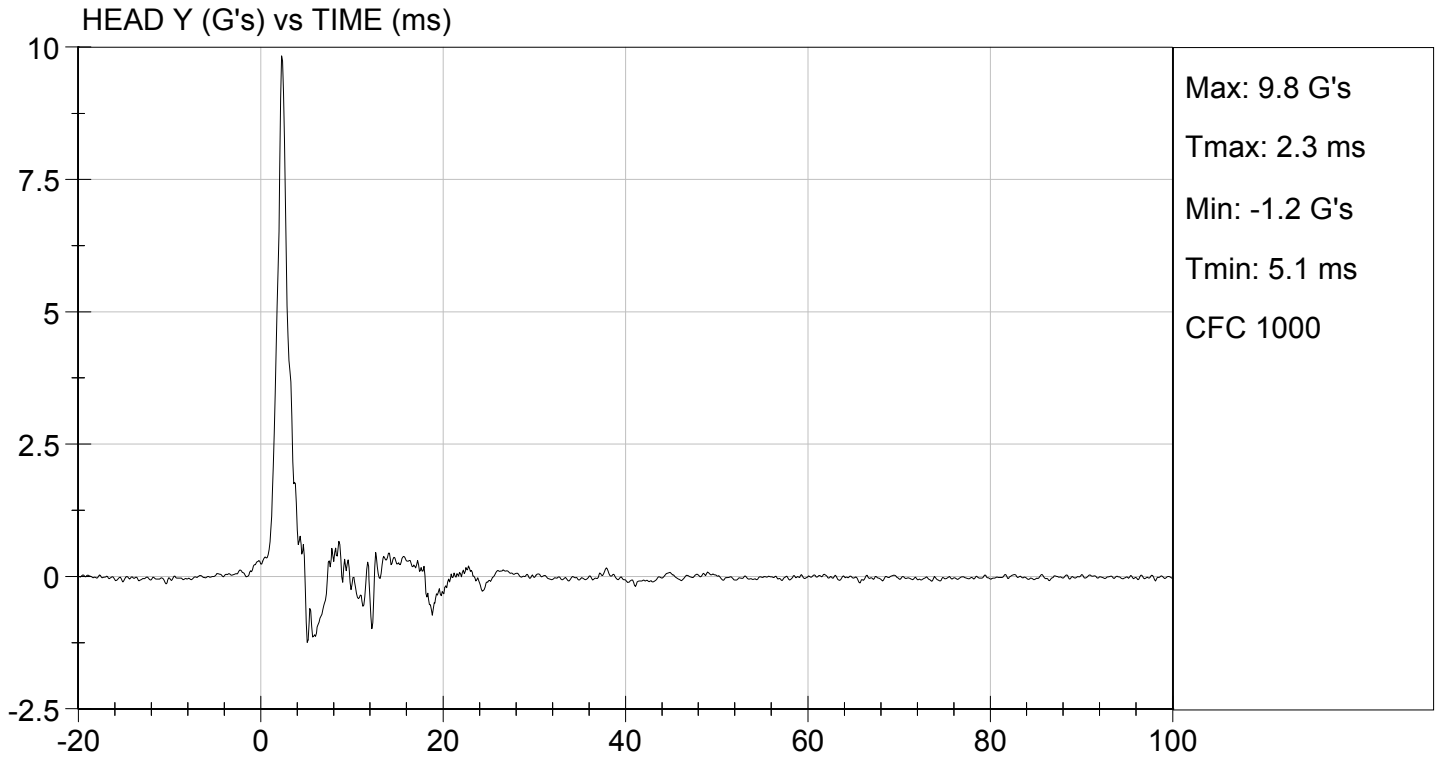
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Peak Resultant Acceleration	G's	250 to 300	257	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	9.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

12/21/2012  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No: 634

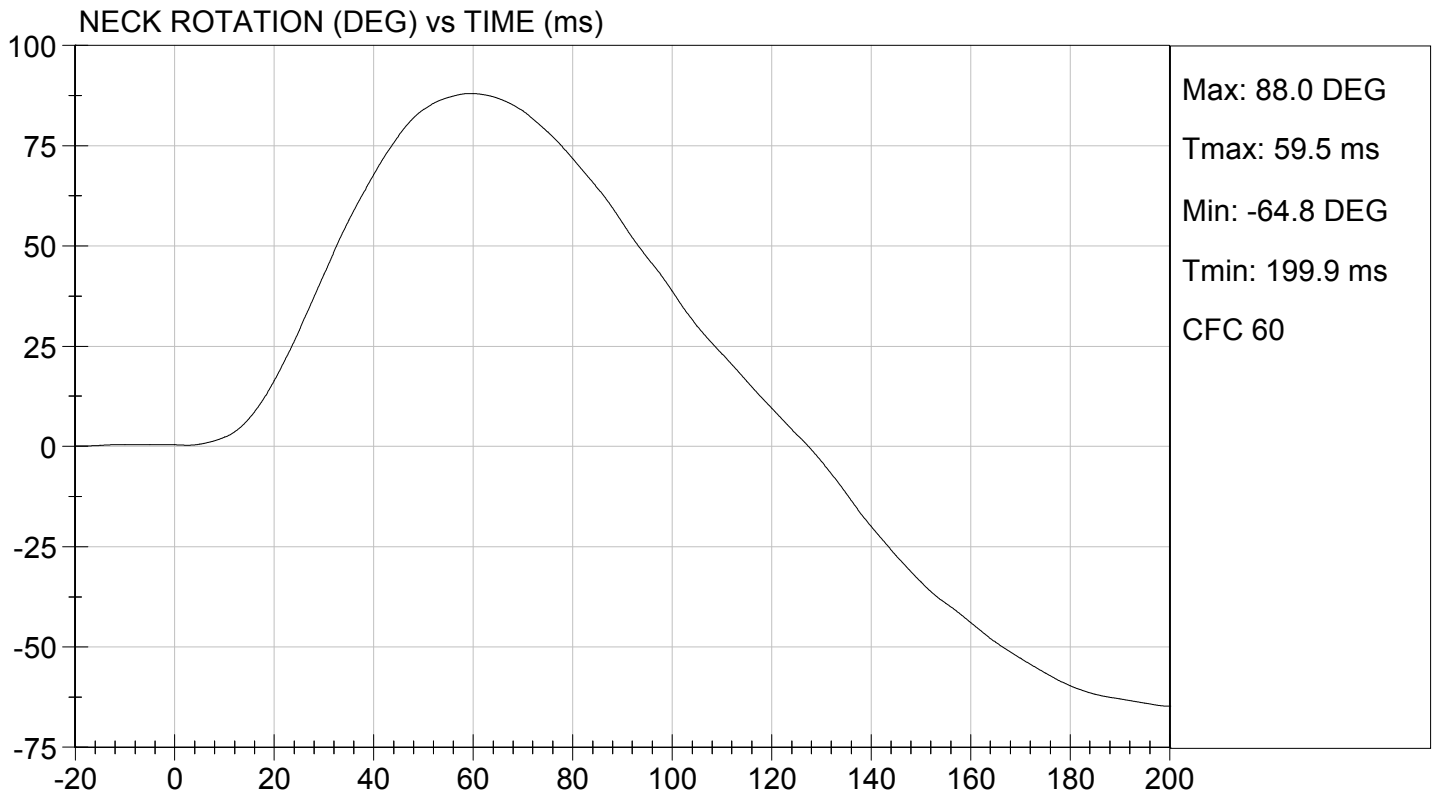
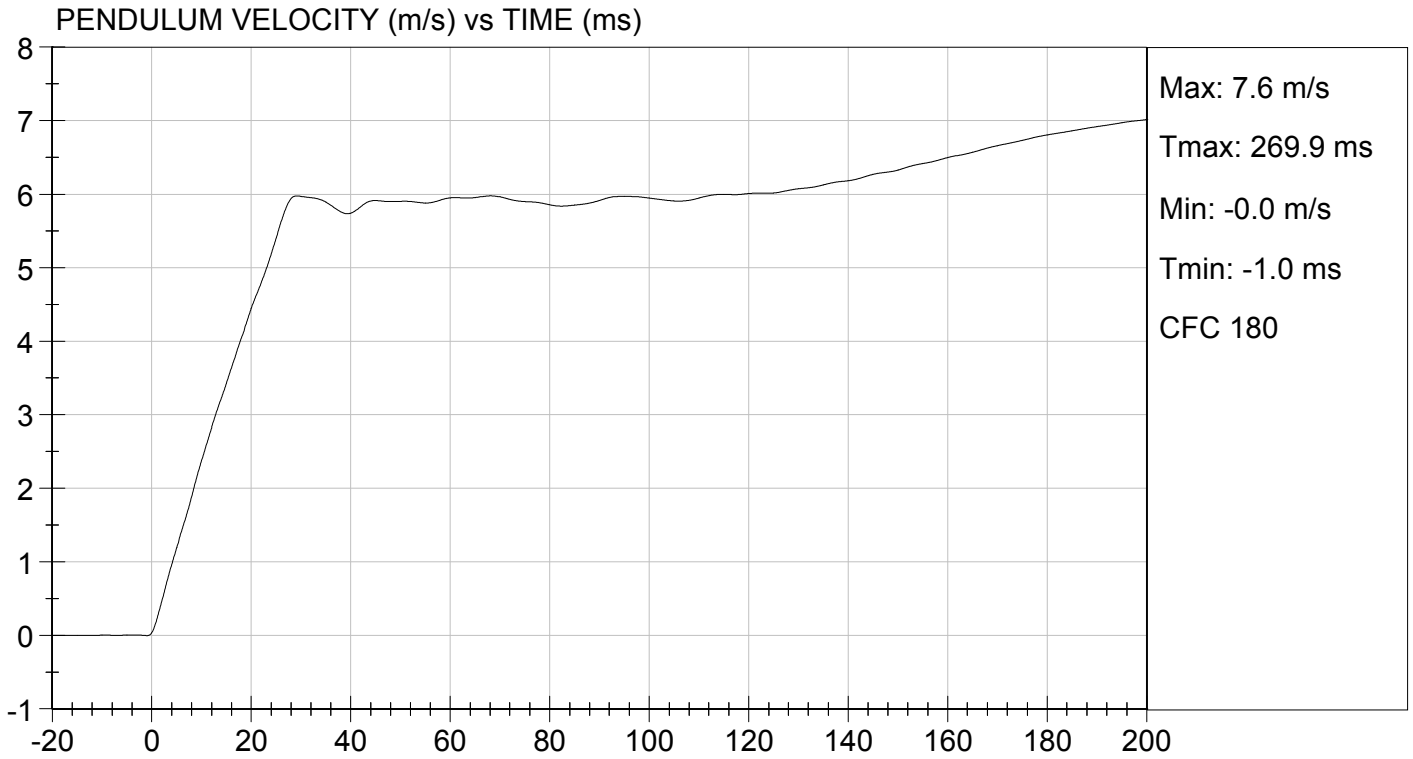
Test I.D.: D124832

Tested Parameter	Units	Specification	Result	Pass/Fail	
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass	
Laboratory Relative Humidity	%	10 to 70	27	Pass	
Pendulum Speed	m/s	6.89 to 7.13	7.06	Pass	
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.4	Pass
	30 ms	m/s	5.8 to 7.0	6.0	Pass
D Plane Rotation	Max	deg	77 to 91	88	Pass
Occipital Condyle Moment within Rotation Corridor	Nm	69 to 83	69.4	Pass	
Positive Moment Time Curve Decay to 10 Nm	ms	80 to 100	86	Pass	
Overall Results				Pass	

Jessica Gall  
Laboratory Technician

12/21/2012  
Test Date

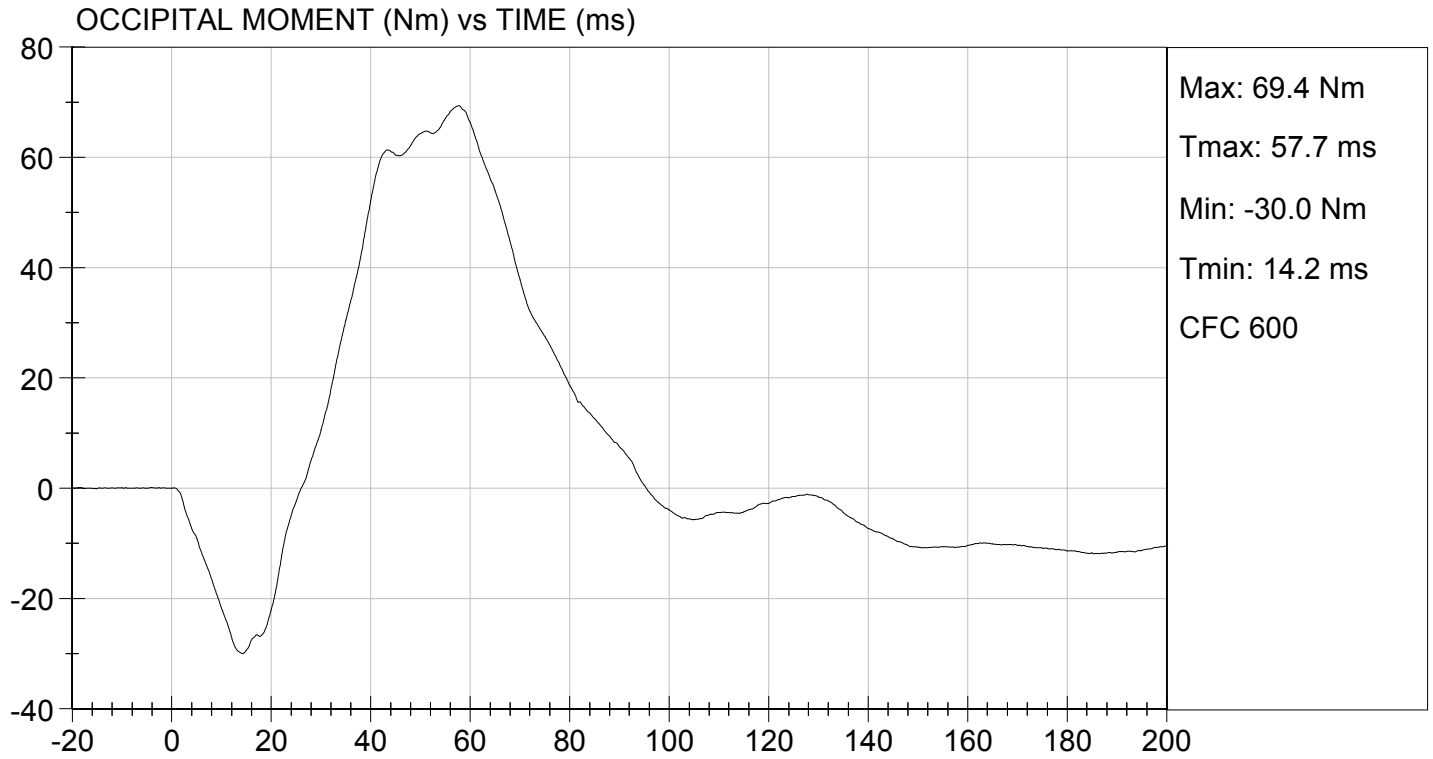
David Winkelbauer  
Approved By





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

TEST DATE: 12/21/2012  
TEST #: D124832



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

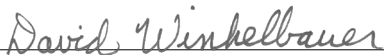
ATD Serial No: 634

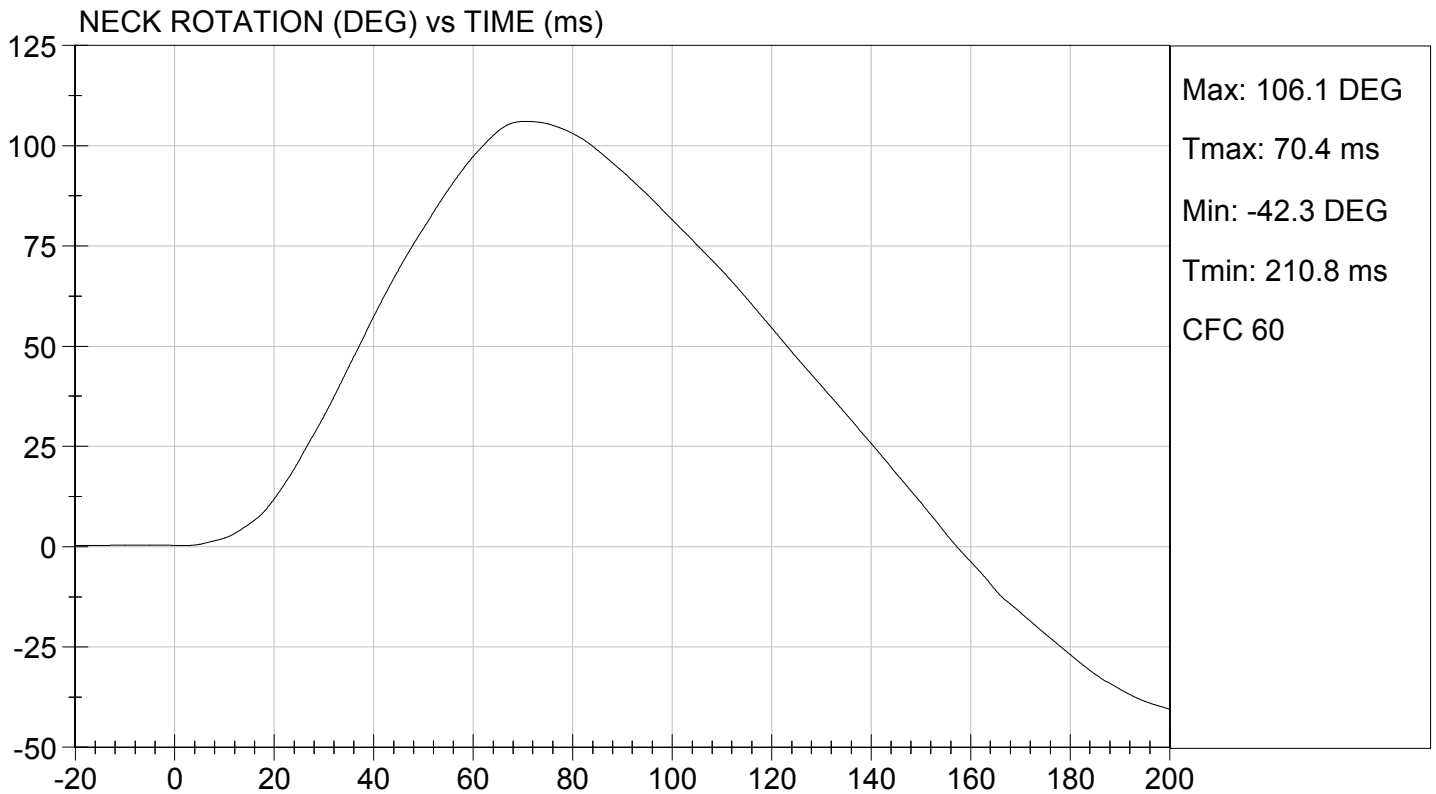
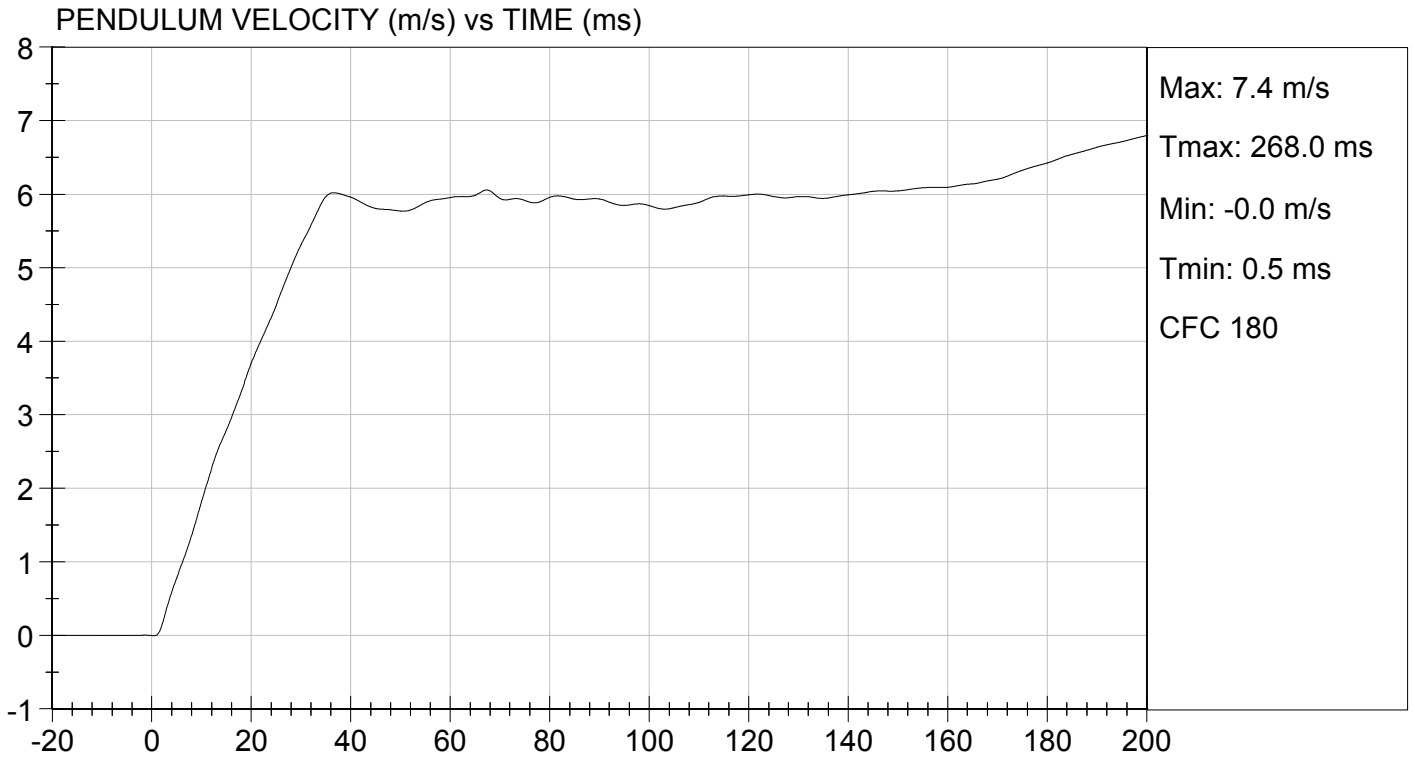
Test I.D: D124833

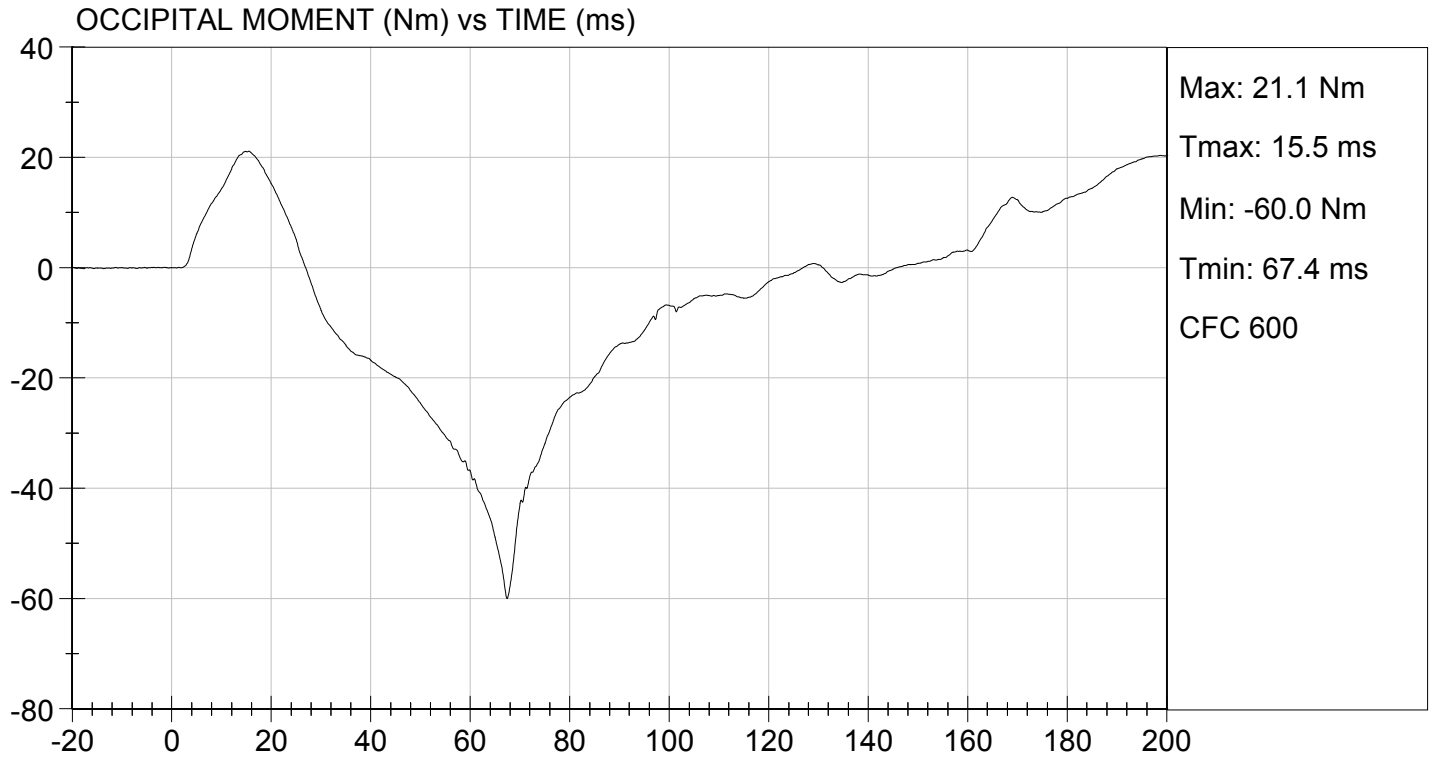
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	27	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.3	Pass
D Plane Rotation	Max	deg	99 to 114	106	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-60.0	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	95	Pass
Overall Results					Pass

  
 Laboratory Technician

12/21/2012  
 Test Date

  
 Approved By





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

**ATD Serial No:** 634

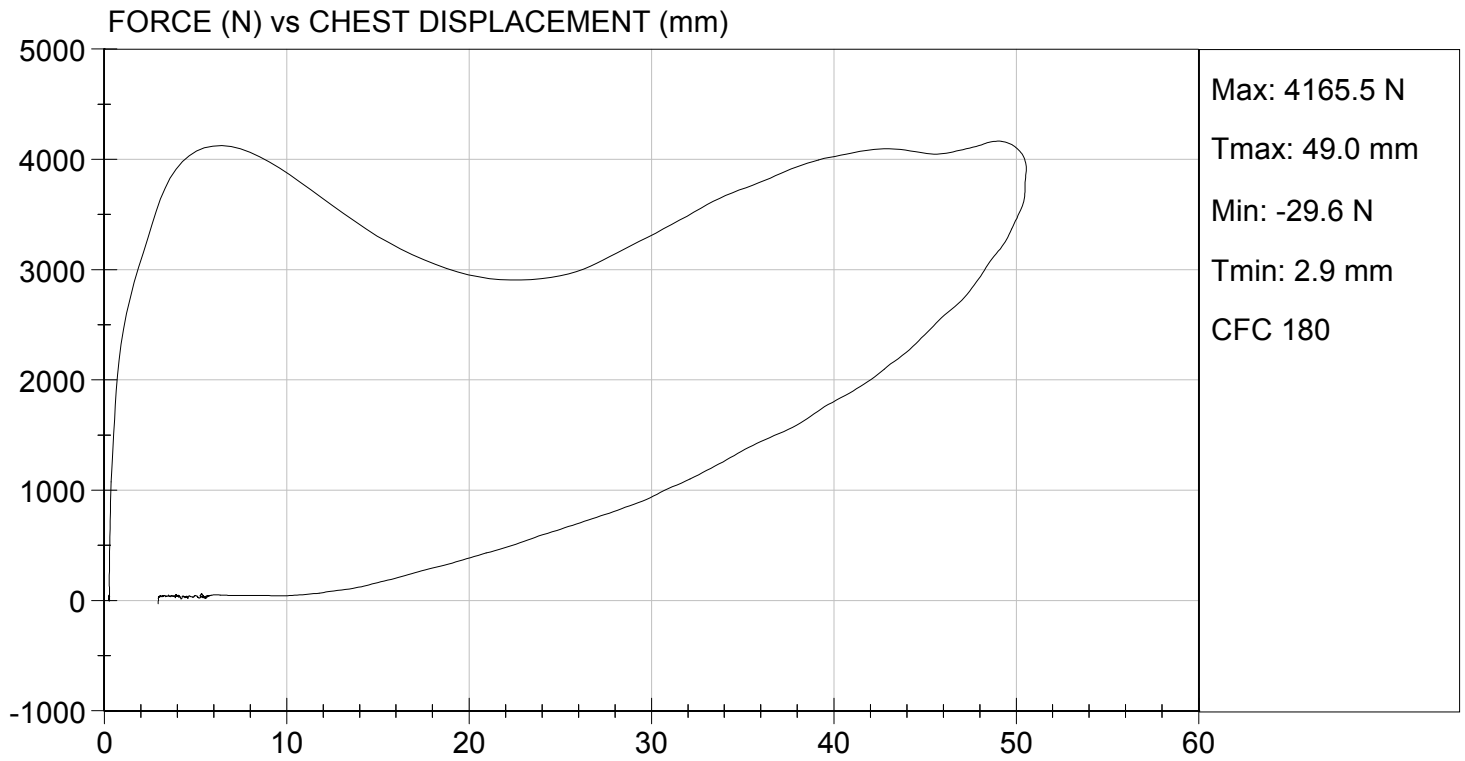
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Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22.0	Pass
Relative Humidity	%	10 to 70	28	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	51	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4100	Pass
Internal Hysteresis	%	69 to 85	73	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4165	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

12/21/2012  
 Test Date

  
 Approved By



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

**ATD Serial No:** 634

**Test I.D:** D124835

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3470	Pass
Overall Test Results				Pass

Jessica Gall  
Laboratory Technician

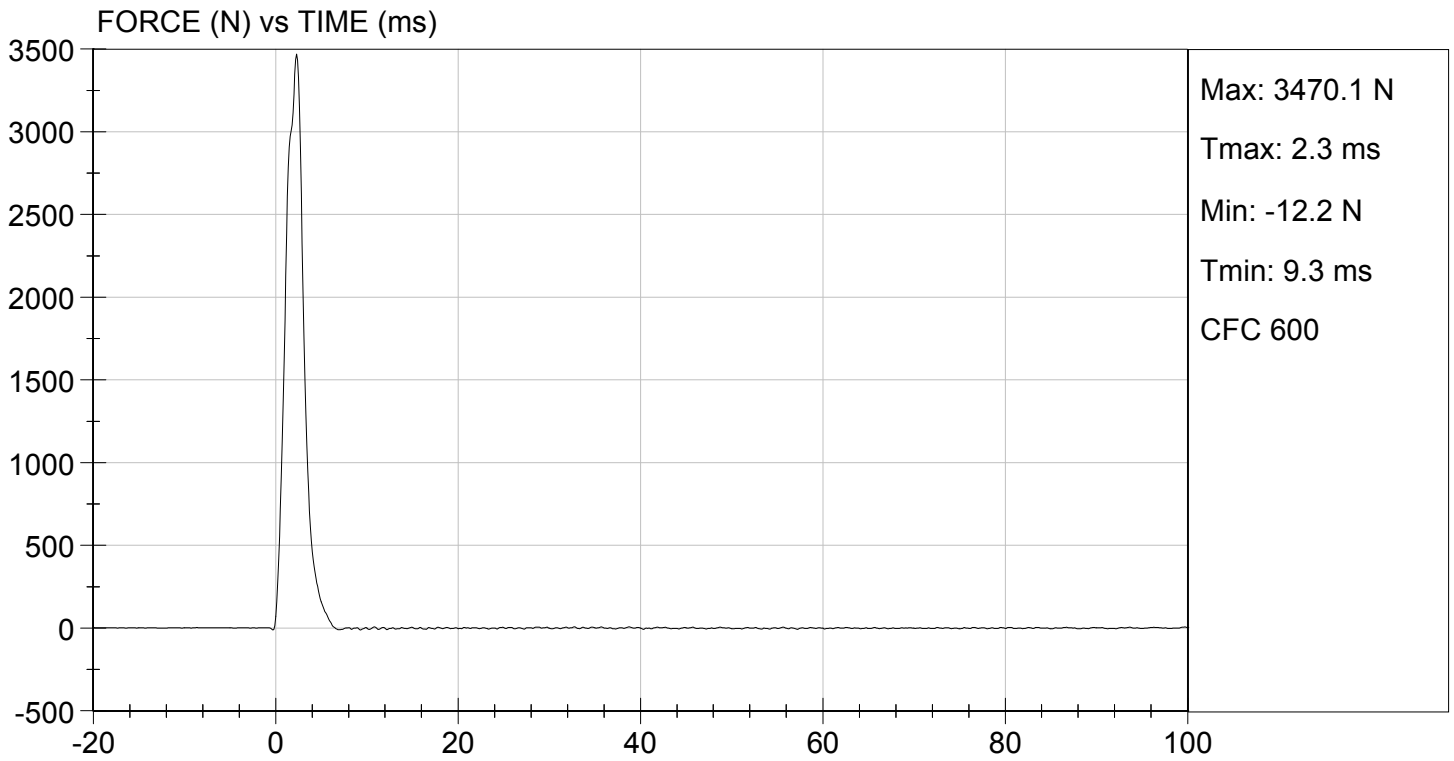
12/21/2012  
Test Date

David Winkelbauer  
Approved By



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

TEST DATE: 12/21/2012  
TEST #: D124835



**MGA RESEARCH CORPORATION**

**LEFT KNEE IMPACT TEST  
HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 634

**Test I.D.:** D124836

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3804	Pass
Overall Test Results				Pass

Jessica Gall  
Laboratory Technician

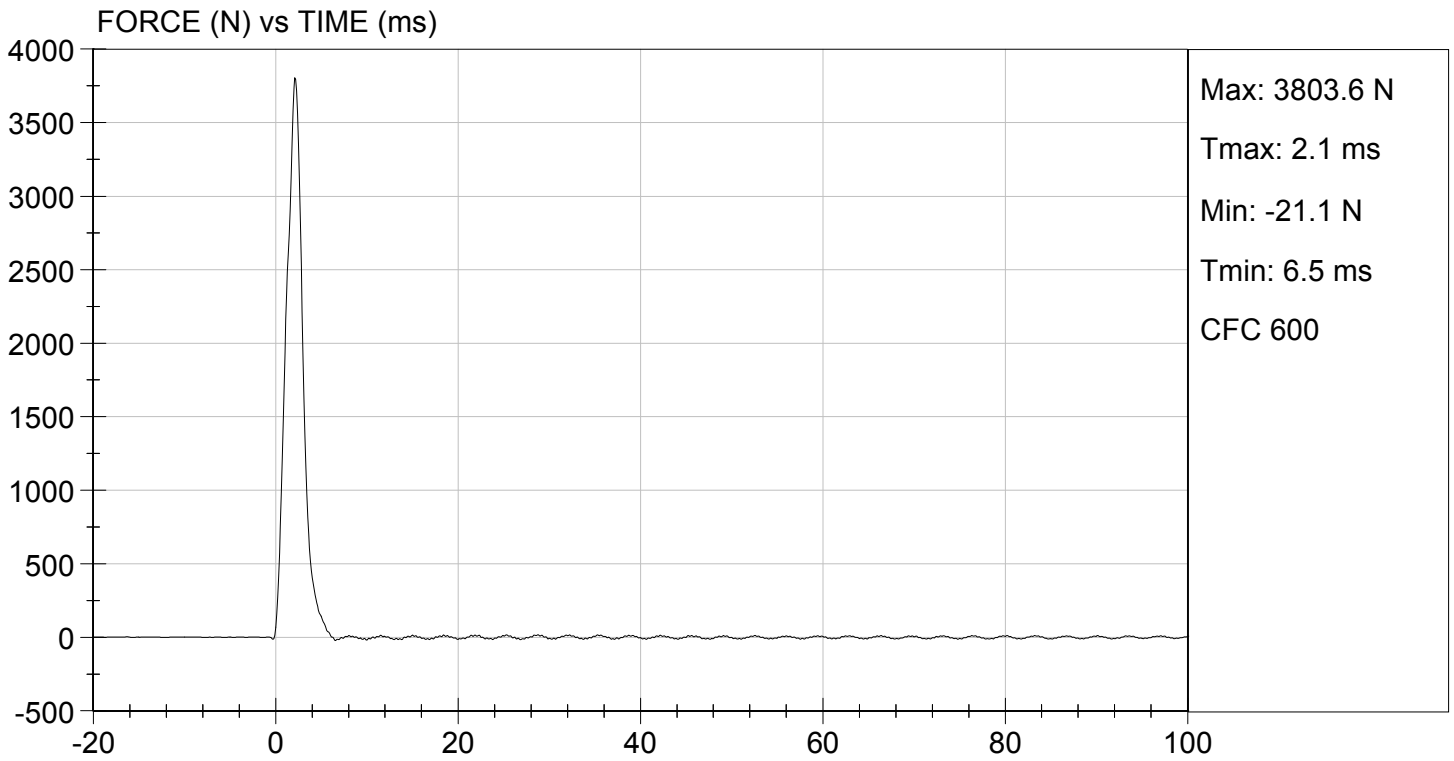
12/21/2012  
Test Date

David Winkelbauer  
Approved By



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

TEST DATE: 12/21/2012  
TEST #: D124836



**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 634

**Test I.D:** D124837

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Initial Angle	deg	0 to 20	18	Pass
Return Angle	deg	+/- 8	1	Pass
Force at 45 deg	N	320 to 390	342	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	1.0	Pass
Overall Result				Pass

Jessica Hall  
Laboratory Technician

12/21/2012  
Test Date

David Winkelbauer  
Approved By