

**REPORT NUMBER: NCAP-MGA-2013-047**

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

**TOYOTA MOTOR MANUFACTURING, KENTUCKY, INC.  
2013 Toyota Avalon 4-Dr Sedan  
NHTSA No.: YD5103**

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




**Test Date: January 10, 2013**

**Final Report Date: March 4, 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: March 4, 2013

FINAL REPORT ACCEPTANCE BY OCWS:

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

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

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

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

### Technical Report Documentation Page

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		<b>14. Sponsoring Agency Code</b> 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 Toyota Avalon 4-Dr Sedan 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 January 10, 2013.  The impact velocity was 56.3 km/h and the ambient temperature at the barrier face at the time of impact was 20.9°C. The target vehicle post-test maximum crush was 546 mm located to the right of 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" style="width: 35%;">Measurement Description</th> <th rowspan="2" style="width: 10%;">Units</th> <th colspan="2" style="width: 20%;">Threshold</th> <th rowspan="2" style="width: 15%;">Driver ATD</th> <th rowspan="2" style="width: 15%;">Passenger ATD</th> </tr> <tr> <th style="width: 10%;">50<sup>th</sup></th> <th style="width: 10%;">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>129</td> <td>253</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>52</td> <td>17</td> <td>11</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>1</td> <td>0.44</td> <td>0.37</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>2620</td> <td>1569</td> <td>971</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>2520</td> <td>81</td> <td>476</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>6805</td> <td>1802</td> <td>1972</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>6805</td> <td>2430</td> <td>2153</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	129	253	Maximum Chest Compression	mm	63	52	17	11	Nij	N/A	1	1	0.44	0.37	Neck Tension	N	4170	2620	1569	971	Neck Compression	N	4000	2520	81	476	Left Femur Force	N	10008	6805	1802	1972	Right Femur Force	N	10008	6805	2430	2153
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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 Toyota Avalon 4-Dr Sedan at a velocity of 56.3 km/h. The test was performed at MGA Research Corporation on January 10, 2013. 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 lap and shoulder belts and the passenger's lap belt 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. 138) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 228 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 546 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 and visor. 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 knee airbag.

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> )	129	0.44	1569	81	36	17	1802	2430
Passenger (5 <sup>th</sup> )	253	0.37	971	476	40	11	1972	2153

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

#### TEST NOTES

Passenger Right Upper Tibia MY has no valid data after 105 ms.

Barrier E-10 has questionable data.

Passenger Shoulder Belt load cell was not installed for this test.

Pre-test photos were labeled with the incorrect test reference number 13011011. The actual test reference number was 13011012 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 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**TEST VEHICLE INFORMATION AND OPTIONS**

NHTSA No.	YD5103	Traction Control System (TCS)	Yes
Model Year	2013	Power Steering	Yes
Make	Toyota	Power Window Auto-Reverse	Yes
Model	Avalon	Driver Frontal Airbag	Yes
Body Style	Sedan	Driver Curtain Airbag	Yes
VIN	4T1BK1EB1DU007116	Driver Head/Torso Airbag	No
Body Color	Cypress Pearl	Driver Torso Airbag	No
Odometer (km/mi)	153 / 95	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	3.5	Driver Pelvis Airbag	No
Type/No. Cylinders	6	Driver Knee Airbag	Yes
Engine Placement	Lateral	Front Pass. Frontal Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	6	Front Pass. Head/Torso Airbag	No
Overdrive	Yes	Front Pass. Torso Airbag	No
Final Drive	Front Wheel Drive	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	Yes	Front Pass. Knee Airbag	Yes
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	Yes	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other	N/A

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

**DATA FROM CERTIFICATION LABEL**

Manufactured By	TOYOTA MOTOR MANUFACTURING, KENTUCKY, INC.	GVWR (kg)	2082
		GAWR Front (kg)	1191
Date of Manufacture	11/12	GAWR Rear (kg)	1134

**VEHICLE SEATING AND WEIGHT CAPACITY DATA**

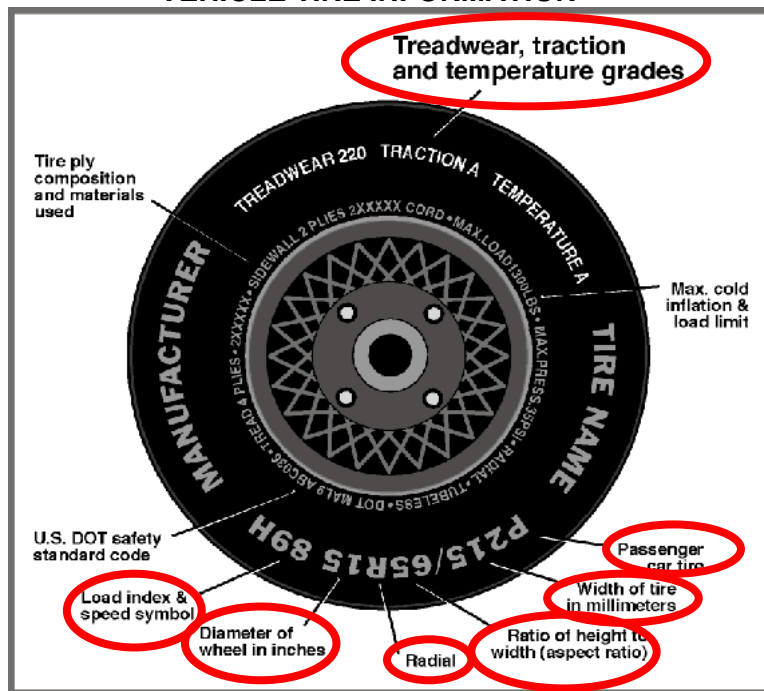
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Designated Seating Capacity (DSC)	2	3		5
Capacity Weight (VCW) (kg)				415
Cargo Weight (RCLW) (kg)				75

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**VEHICLE TIRE INFORMATION**



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	275	275
Cold Pressure (kPa)	230	230
Recommended Tire Size	P225/45R18	P225/45R18
Tire Size on Vehicle	P225/45R18	P225/45R18
Tire Manufacturer	Bridgestone	Bridgestone
Tire Model	Turanza	Turanza
Treadwear	260	260
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	3	3
Tire Plies Body	2	2
Load Index/Speed Symbol	91V	91V
Tire Material	Rubber	Rubber
DOT Safety Code Left	0BRR PM1	0BRR PM1
DOT Safety Code Right	0BRR PM1	0BRR PM1

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
Test Date: 01/10/2013

**TEST VEHICLE WEIGHTS**

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	494.4	323.9		530.3	405.1	
Right	kg	492.6	314.3		509.8	389.6	
Ratio	%	60.7	39.3		56.7	43.3	
Totals	kg	987.0	638.2	1625.2	1040.1	794.7	1834.8

**TARGET TEST WEIGHT CALCULATION**

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1625.2
Weight of 1 P572E ATD & 1 P572O ATD	kg	140.6
Rated Cargo/Luggage Weight (RCLW)	kg	75
Calculated Vehicle Target Weight (TVTW)	kg	1840.8

**TEST VEHICLE ATTITUDES AND CG**

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	717	714	728	729	1103
As Tested	mm	695	702	692	692	1217
Post Test	mm	737	683	685	679	

**GENERAL TEST VEHICLE DATA**

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2810
Total Vehicle Length at Left Side	mm	4781
Total Vehicle Length at Centerline	mm	4958
Total Vehicle Length at Right Side	mm	4781
Weight of Ballast in Cargo Area	kg	67.1
Weight of Vehicle Components Removed	kg	25.9
Amount of Stoddard Solvent in Fuel Tank	L	58.4

List of components removed: Trunk subfloor, trunk floor mat, rear sill plastic trim, trunk carpet, spare tire, right taillight, and jack and tools.

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**TARGET VEHICLE STRUCTURAL MEASUREMENT**

	Elements	Pre-Test (mm)
1	Total Length	4958
2	Total Width	1833
3	Bumper Top Height	538
4	Bumper Bottom Height	424
5	Longitudinal Member Top Height	552
6	Distance between Longitudinal Members	932
7	Longitudinal Member Width	61
8	Engine Top Height	952
9	Engine Bottom Height	147
10	Engine and Gearbox Width	901
11	Front Bumper-Engine Distance	277
12	Front Shock Absorber Fixing Height	894
13	Bonnet Leading Edge Height	738
14	Front Shock Absorber Fixing Width	1199
15	Front Bumper – Front Axle Distance	978
16	Front Axle – A-Pillar Distance	432
17	A-Pillar – B-Pillar Distance	1201
18	B-Pillar – Rear Axle Distance	1187
19	B-Pillar – C-Pillar Distance	770
20	Roof Sill Bottom Height	1305
21	Roof Sill Top Height	1425
22	Floor Sill Bottom Height	194
23	Floor Sill Top Height	380

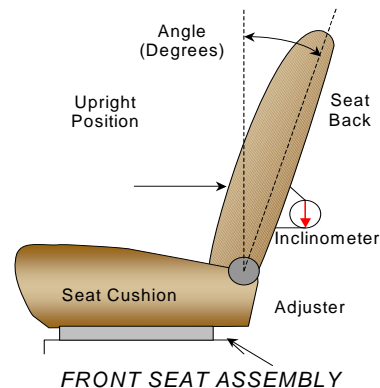
**DATA SHEET NO. 2**  
**SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA**

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**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	3.6° on headrest post
Passenger Seat Back Angle	2.7° on headrest post

**SEAT FORE/AFT POSITIONS**

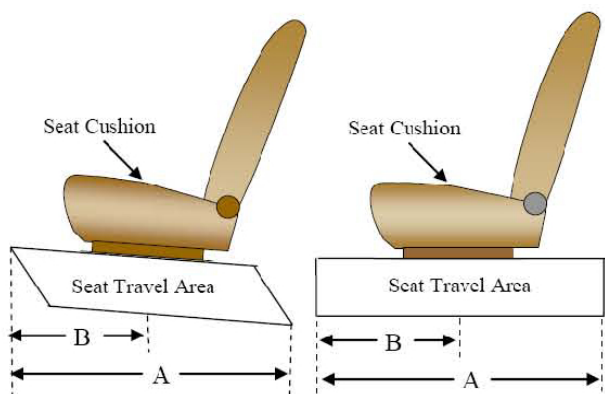
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated September 2012.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	282 mm	141 mm (foremost as 0)
Passenger Seat	240 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 0)	0 (uppermost as 0)
Passenger Seat	4 (1 <sup>st</sup> as 0)	0 (uppermost as 0)



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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

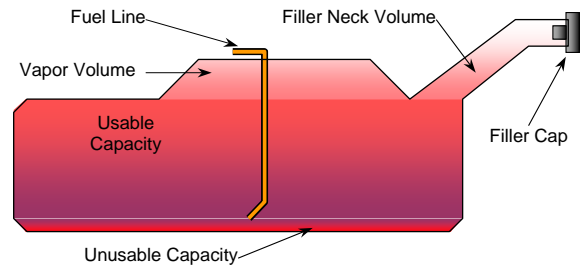
**FUEL TANK CAPACITY DATA**

	Liters
Usable Capacity of "Standard Tank"	62.8
Usable Capacity of "Optional Tank"	
92-94% of Usable Capacity	57.8 to 59.0
Actual Amount of Solvent used	58.4
1/3 of Usable Capacity	20.9

**FUEL PUMP**

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

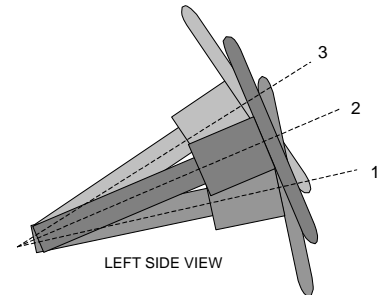
The vehicle is equipped with an electric fuel pump. The fuel pump is activated when the ignition is turned on. The fuel pipe is on the left side.



VEHICLE FUEL TANK ASSEMBLY

**STEERING COLUMN ADJUSTMENT**

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



STEERING COLUMN ASSEMBLY

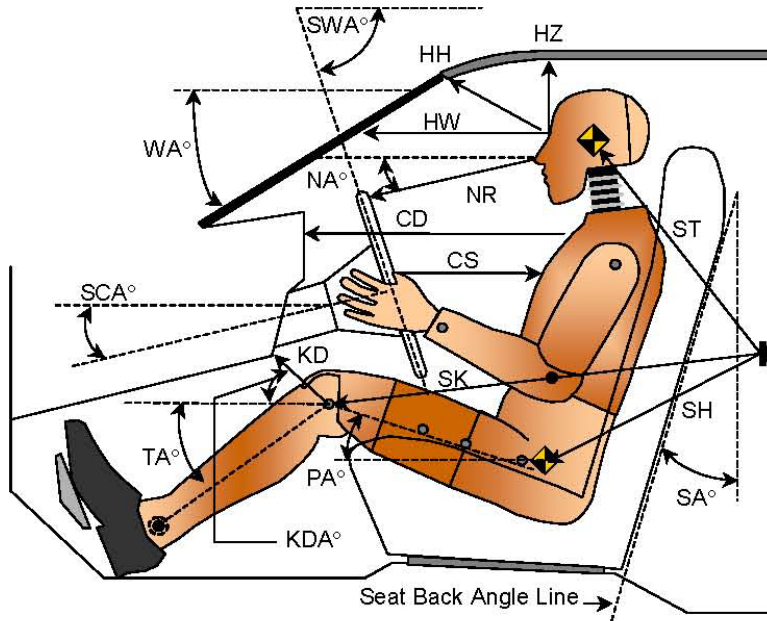
**STEERING COLUMN POSITION**

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	67.8	212
Geometric Center Position 2	65.7	192
Uppermost Position 3	63.6	172
Telescoping Steering Wheel Travel		40
Test Position	65.7	192

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013



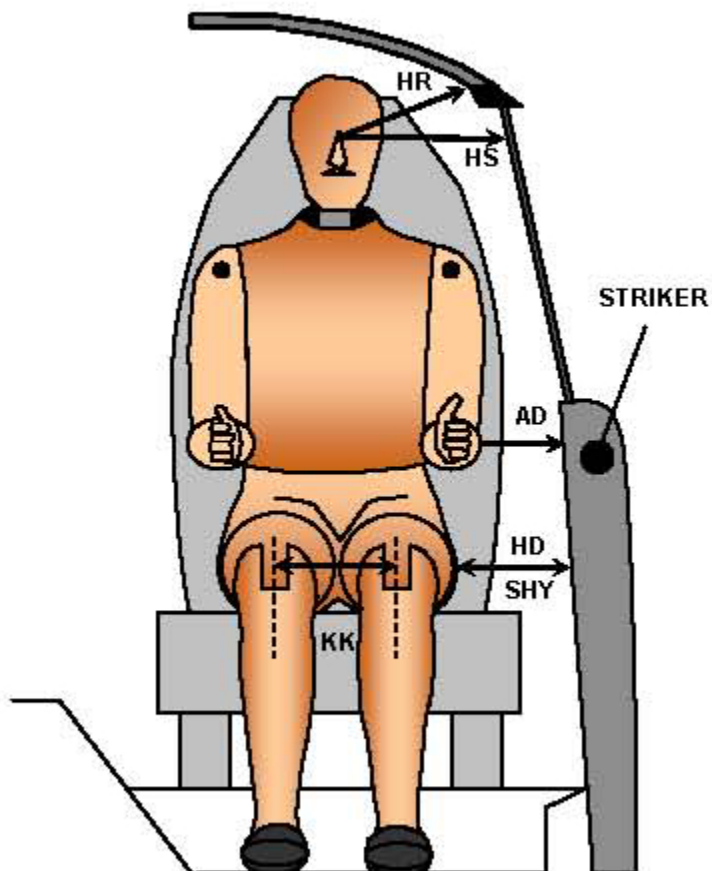
**LEFT SIDE VIEW**

Code	Measurement Description	Driver S/N 351		Passenger S/N 138	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		25.0		
SWA°	Steering Wheel Angle		65.7		
SCA°	Steering Column Angle		24.3		
SA°	Seat Back Angle (on headrest post)		3.6		2.7
HZ	Head to Roof (Z)	163	90.0	177	90.0
HH	Head to Header	351	22.1	271	42.3
HW	Head to Windshield	678	0.0	662	0.0
NR	Nose to Rim	420	9.5		
CD	Chest to Dash	532		396	
CS	Chest to Steering Hub	335	3.2		
RA	Rim to Abdomen	202	0.0		
KDL	Left Knee to Dash	170	34.5	112	30.8
KDR	Right Knee to Dash	161	29.9	115	32.1
PA°	Pelvic Angle		23.3		18.6
TA°	Tibia Angle		37.3		45.2
SK	Striker to Knee	597	99.1	698	102.4
ST	Striker to Head	462	12.1	467	28.8
SH	Striker to H-Point	303	134.6	400	117.3

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013



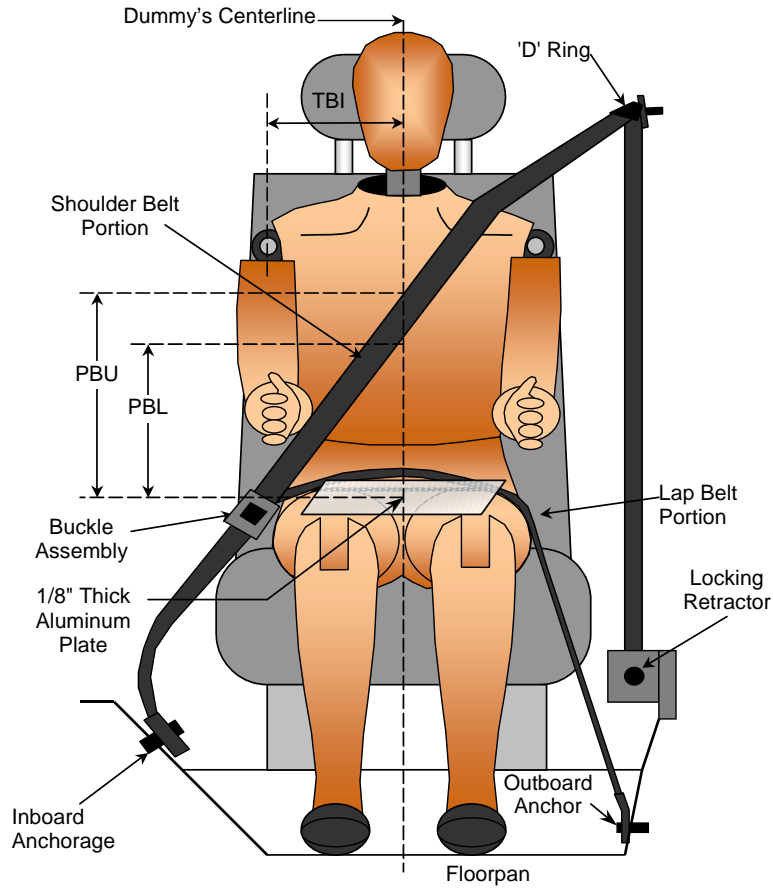
**FRONT VIEW OF DUMMY**

Code	Measurement Description	Driver S/N 351	Passenger S/N 138
		Length (mm)	
AD	Arm to Door	127	97
HD	H-Point to Door	151	188
HR	Head to Side Header	211	236
HS	Head to Side Window	330	357
KK	Knee to Knee	340	224
SHY	Striker to H-Point (Y Direction)	291	320
AA	Ankle to Ankle	340	180

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013



**FRONT VIEW OF DUMMY**

**SEAT BELT POSITIONING MEASUREMENTS**

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	370	340
PBL - Top surface of reference to belt lower edge	mm	300	260

**BELT LENGTH DATA**

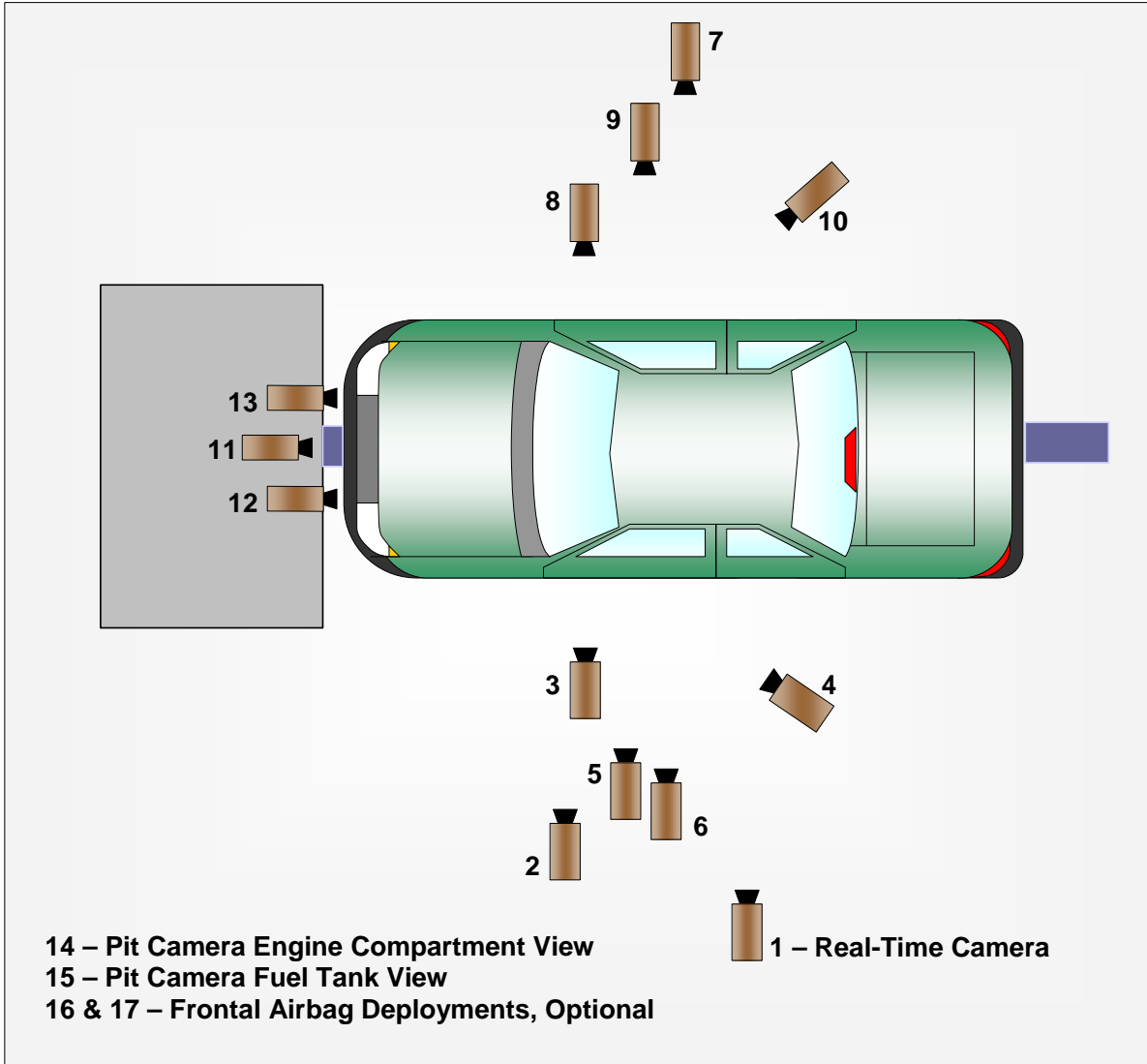
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	880	920
Lap Belt Length as measured on ATD	mm	870	930
Remainder of belt on reel	mm	1710	1560
Total Belt Length for Continuous Webbing Systems	mm	3460	3410

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
Test Date: 01/10/2013

**CAMERA POSITIONS FOR FRONTAL IMPACTS**



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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
Test Date: 01/10/2013

**CAMERA LOCATIONS**

No.	Camera View	Coordinates (mm)			Lens (mm)	Speed (fps)
		X*	Y*	Z*		
1	Real-Time Left Overall					30
2	Driver Close-Up	1410	-6220	-1730	35	1000
3	Left Front Half	1270	-5090	-1090	24	1000
4	Left Angle	5250	-4950	-1870	50	1000
5	Steering Column - Top	560	-5240	-1250	24	1000
6	Steering Column - Bottom	510	-5210	-840	24	1000
7	Right Overall	1910	6340	-1080	20	1000
8	Passenger Close-Up	1370	6340	-1830	35	1000
9	Right Front Half	1220	5030	-1060	24	1000
10	Right Angle	5320	4970	-1890	50	1000
11	Windshield	-180	0	-2810	24	1000
12	Driver Windshield	250	-450	-2030	12.5	1000
13	Passenger Windshield	250	450	-2030	12.5	1000
14	Pit Front	1290	0	3150	24	1000
15	Pit Rear	3200	0	3150	24	1000
16	Onboard Driver Side (optional)					
17	Onboard Passenger Side (optional)					
18	Real-Time Pan View					30

**\*COORDINATES:**

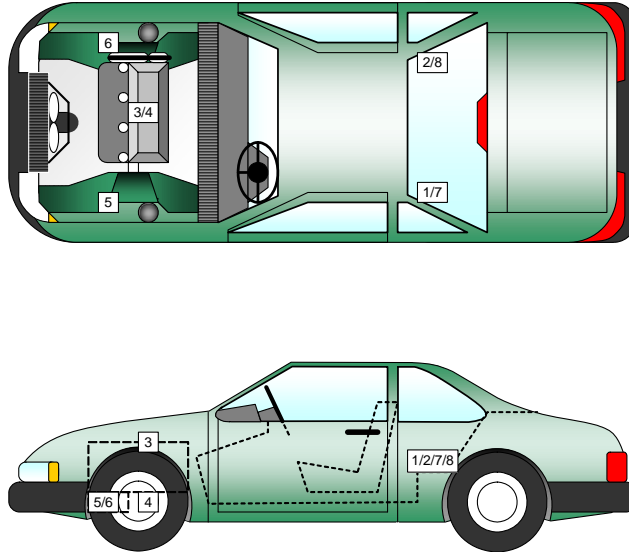
- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = below ground level

Cameras 16 & 17 were not used for this test.

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013



**VEHICLE ACCELEROMETER PRE-TEST LOCATIONS**

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Accelerometer – X Direction	2004	-444	-228
2	Right Rear Accelerometer – X Direction	1998	428	-228
3	Engine Top X	4271	16	-794
4	Engine Bottom X	4142	-230	-149
5	Left Rear Accelerometer – Z Direction	2004	-444	-228
6	Right Rear Accelerometer – Z Direction	1998	428	-228
7	Left Rear Accelerometer Redundant – X Direction	2004	-444	-228
8	Right Rear Accelerometer Redundant – X Direction	1998	428	-228

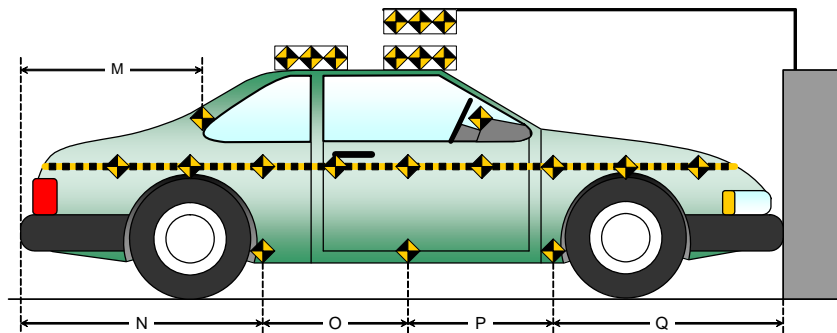
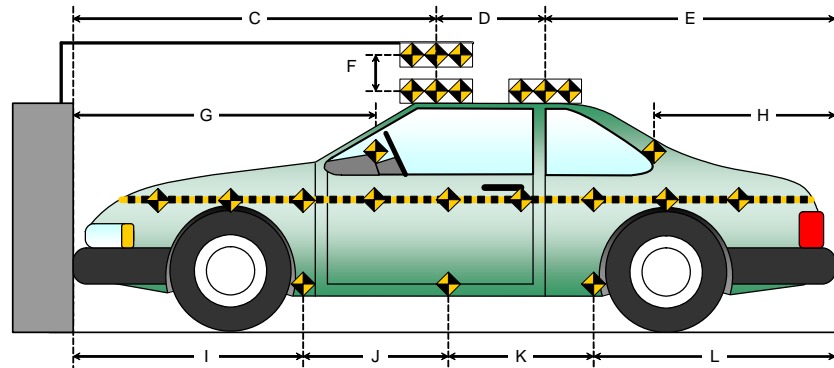
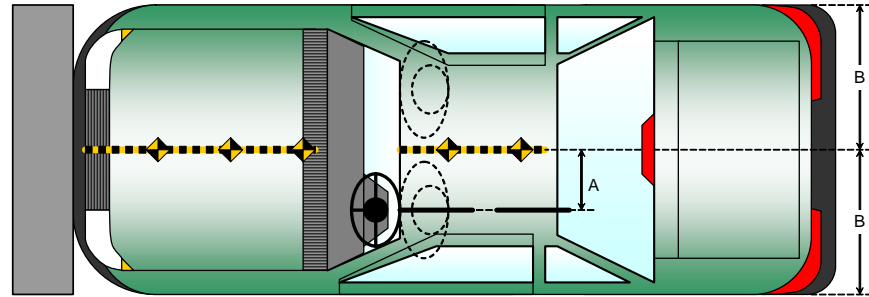
Reference Points: X - Rear Surface of Vehicle (+ forward)  
 Y - Vehicle Centerline (+ to right)  
 Z - Ground Plane (+ down)

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

Item	Value (mm)
A	375
B	916
C	2375
D	670
E	1913
F	234
G	
H	923
I	1407
J	987
K	987
L	1577
M	923
N	1577
O	987
P	987
Q	1407



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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**Advanced Research Load Cell Barrier**

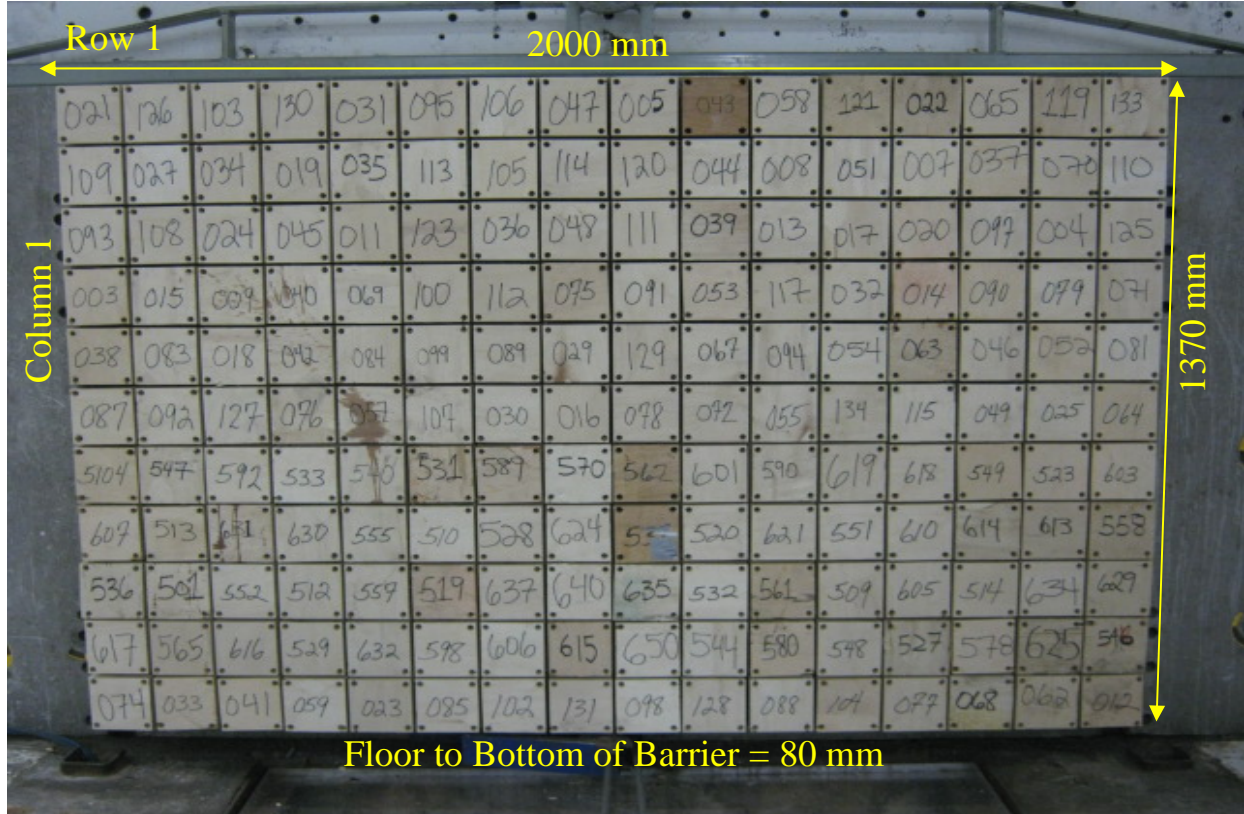


Photo for Reference Only

								Centerline								
1-1	1-2	1-3	1-4	1-5	1-6	1-7	1-8	1-9	1-10	1-11	1-12	1-13	1-14	1-15	1-16	
2-1	2-2	2-3	2-4	2-5	2-6	2-7	2-8	2-9	2-10	2-11	2-12	2-13	2-14	2-15	2-16	
3-1	3-2	3-3	3-4	3-5	3-6	3-7	3-8	3-9	3-10	3-11	3-12	3-13	3-14	3-15	3-16	
4-1	4-2	4-3	4-4	4-5	4-6	4-7	4-8	4-9	4-10	4-11	4-12	4-13	4-14	4-15	4-16	
5-1	5-2	5-3	5-4	5-5	5-6	5-7	5-8	5-9	5-10	5-11	5-12	5-13	5-14	5-15	5-16	
6-1	6-2	6-3	6-4	6-5	6-6	6-7	6-8	6-9	6-10	6-11	6-12	6-13	6-14	6-15	6-16	
7-1	7-2	7-3	7-4	7-5	7-6	7-7	7-8	7-9	7-10	7-11	7-12	7-13	7-14	7-15	7-16	
8-1	8-2	8-3	8-4	8-5	8-6	8-7	8-8	8-9	8-10	8-11	8-12	8-13	8-14	8-15	8-16	
9-1	9-2	9-3	9-4	9-5	9-6	9-7	9-8	9-9	9-10	9-11	9-12	9-13	9-14	9-15	9-16	
10-1	10-2	10-3	10-4	10-5	10-6	10-7	10-8	10-9	10-10	10-11	10-12	10-13	10-14	10-15	10-16	
11-1	11-2	11-3	11-4	11-5	11-6	11-7	11-8	11-9	11-10	11-11	11-12	11-13	11-14	11-15	11-16	

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 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
Test Date: 01/10/2013

**INSTRUMENTATION**

Driver Dummy Data Channels	46
Passenger Dummy Data Channels	46
Vehicle Structure Accelerometers	8
Barrier Channels	128
Total	228

**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 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**TEST DUMMY INFORMATION AND CONTACT LOCATIONS**

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50% / 351	HIII 5% / 138
Head Contact	Airbag, Headrest, Visor	Airbag, Headrest
Upper Torso Contact	Airbag	Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Knee Airbag
Right Knee Contact	Knee Airbag	Knee Airbag

**DOOR OPENING AND SEAT TRACK INFORMATION**

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were 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	820
Center	mm	723
Right Side	mm	790
Average	mm	778

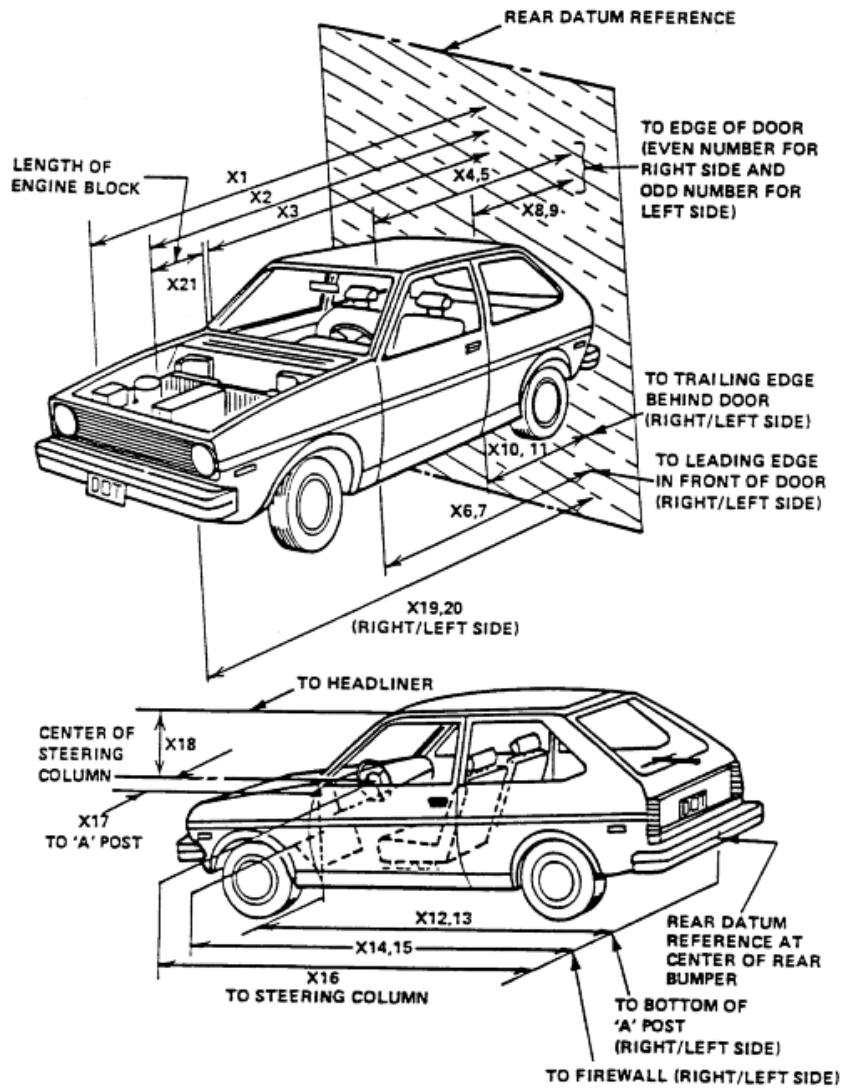
**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

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	Yes	Yes
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 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013



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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
Test Date: 01/10/2013

**RSOV (Rear Surface of Vehicle)**

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	4958	4429	529
2	RSOV to Front of Engine	mm	4444	4141	303
3	RSOV to Firewall	mm	3914	3824	90
4	RSOV to Upper Leading Edge of Right Door	mm	3471	3475	-4
5	RSOV to Upper Leading Edge of Left Door	mm	3471	3497	-26
6	RSOV to Lower Leading Edge of Right Door	mm	3440	3428	12
7	RSOV to Lower Leading Edge of Left Door	mm	3440	3435	5
8	RSOV to Upper Trailing Edge of Right Door	mm	2328	2337	-9
9	RSOV to Upper Trailing Edge of Left Door	mm	2328	2344	-16
10	RSOV to Lower Trailing Edge of Right Door	mm	2314	2309	5
11	RSOV to Lower Trailing Edge of Left Door	mm	2314	2315	-1
12	RSOV to Bottom of "A" Post of Right Side	mm	3482	3480	2
13	RSOV to Bottom of "A" Post of Left Side	mm	3482	3487	-5
14	RSOV to Firewall, Right Side	mm	3888	3777	111
15	RSOV to Firewall, Left Side	mm	3900	3802	98
16	RSOV to Steering Column	mm	2965	3017	-52
17	Center of Steering Column to "A" Post	mm	375	363	12
18	Center of Steering Column to Headliner	mm	414	430	-16
19	RSOV to Right Side of Front Bumper	mm	4781	4308	473
20	RSOV to Left Side of Front Bumper	mm	4781	4373	408
21	Length of Engine Block	mm	523	523	0
RD	RSOV to Right Side of Dash Panel	mm	3163	3168	-5
CD	RSOV to Center of Dash Panel	mm	3218	3208	10
LD	RSOV to Left Side of Dash Panel	mm	3176	3179	-3

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

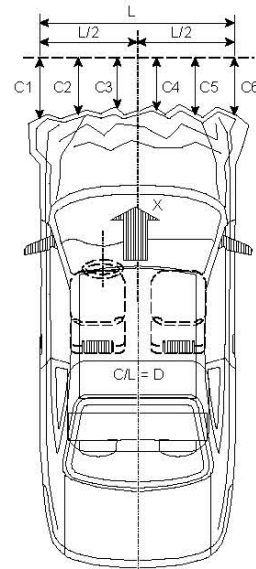
NHTSA No.: YD5103  
Test Date: 01/10/2013

**VEHICLE INFORMATION**

VIN: 4T1BK1EB1DU007116 Wheelbase (mm): 2810  
Vehicle Size Category: Passenger Test Weight (kg): 1834.8

**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): 56.3  
Velocity Change (km/h): 64.7  
Time of Separation (msec): 99.6



**CRUSH PROFILE**

Collision Deformation Classification: Frontal  
Midpoint of Damage: Centerline  
Damage Region Length (mm): 1280  
Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4781	4373	408
C2	Crush zone 2 at left side	mm	4850	4363	487
C3	Crush zone 3 at left side	mm	4900	4383	517
C4	Crush zone 4 at right side	mm	4900	4354	546
C5	Crush zone 5 at right side	mm	4850	4322	528
C6	Crush zone 6 at right side	mm	4781	4308	473
L	C1 TO C6	mm	1280	1273	7

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

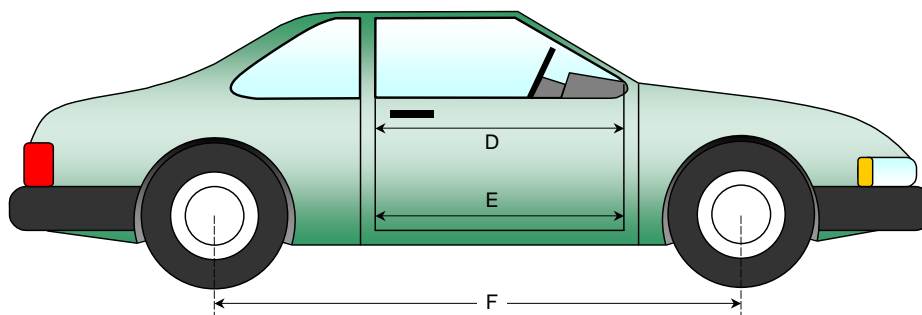
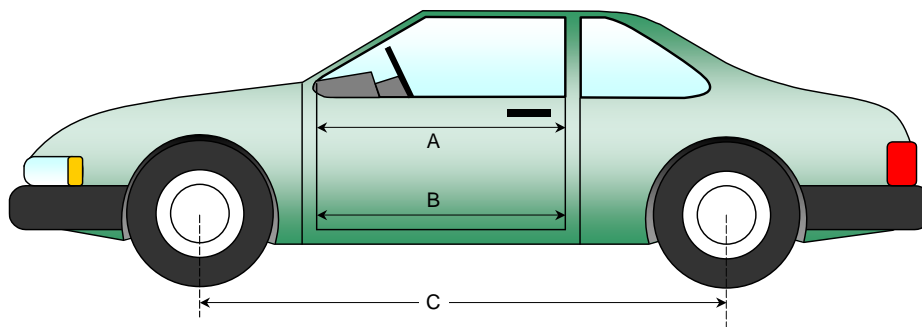
NHTSA No.: YD5103  
 Test Date: 01/10/2013

**DOOR OPENING WIDTH**

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1064	1068	-4
B	Left Side Lower	mm	922	921	1
D	Right Side Upper	mm	1064	1065	-1
E	Right Side Lower	mm	922	924	-2

**WHEELBASE MEASUREMENTS**

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2810	2732	78
F	Right Side Wheelbase	mm	2810	2731	79



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

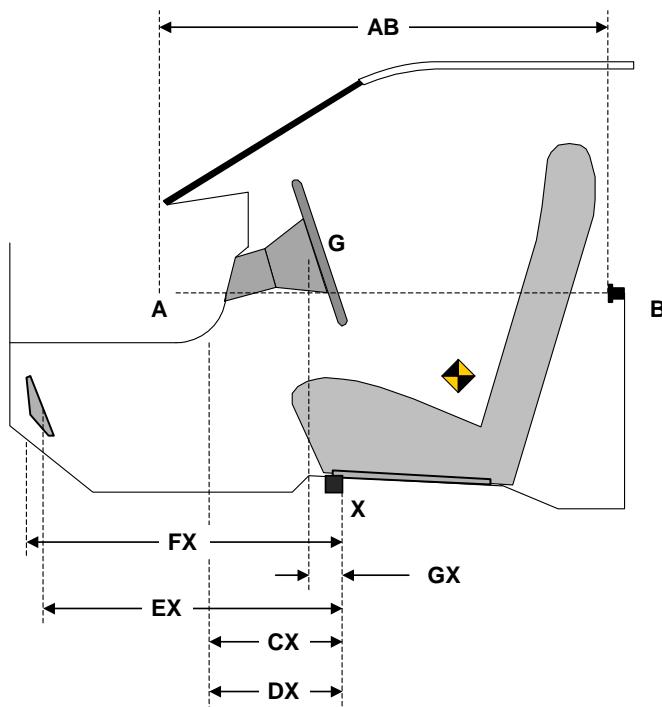
Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**DRIVER COMPARTMENT INTRUSION**

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	872	873	-1
CX	Left Knee Bolster to X	mm	240	255	-15
DX	Right Knee Bolster to X	mm	234	250	-16
EX	Brake Pedal to X	mm	595	583	12
FX	Foot Rest to X	mm	594	593	1
GX	Center of Steering Column Wheel Hub to X	mm	71	132	-61

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 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

**Windshield Mounting Details:**

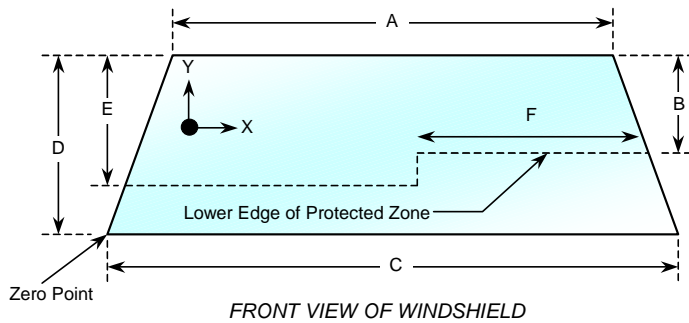
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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: 20.9°C

**WINDSHIELD PERIPHERY MEASUREMENTS**

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2187	2187	100
Right Side	2249	2249	100
Total	4436	4436	100



Item	Units	Value
A	mm	1194
B	mm	490
C	mm	1464
D	mm	889
E	mm	543
F	mm	568

**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 Toyota Avalon 4-Dr Sedan  
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
Test Date: 01/10/2013

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

Temperature at Time of Impact: 20.9°C

Test Time: 2:18 p.m.

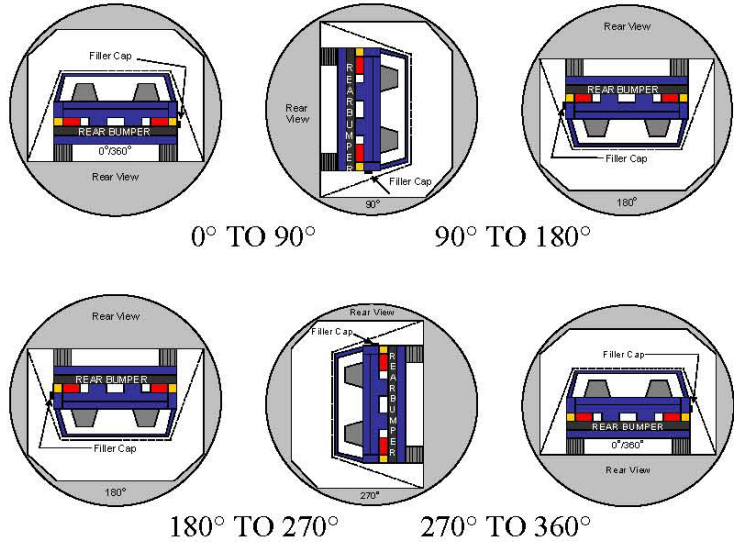
- A. From impact until vehicle motion ceases: 0 oz.  
(Maximum allowable = 1 oz.)
- B. For the 5 minute period after motion ceases: 0 oz.  
(Maximum allowable = 5 oz.)
- C. For the following 25 minutes: 0 oz.  
(Maximum allowable = 1 oz./minute)
- D. Spillage: None

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

Test Vehicle: 2013 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013

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°	113	300	413
90° to 180°	112	300	412
180° to 270°	111	300	411
270° to 360°	112	300	412

**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

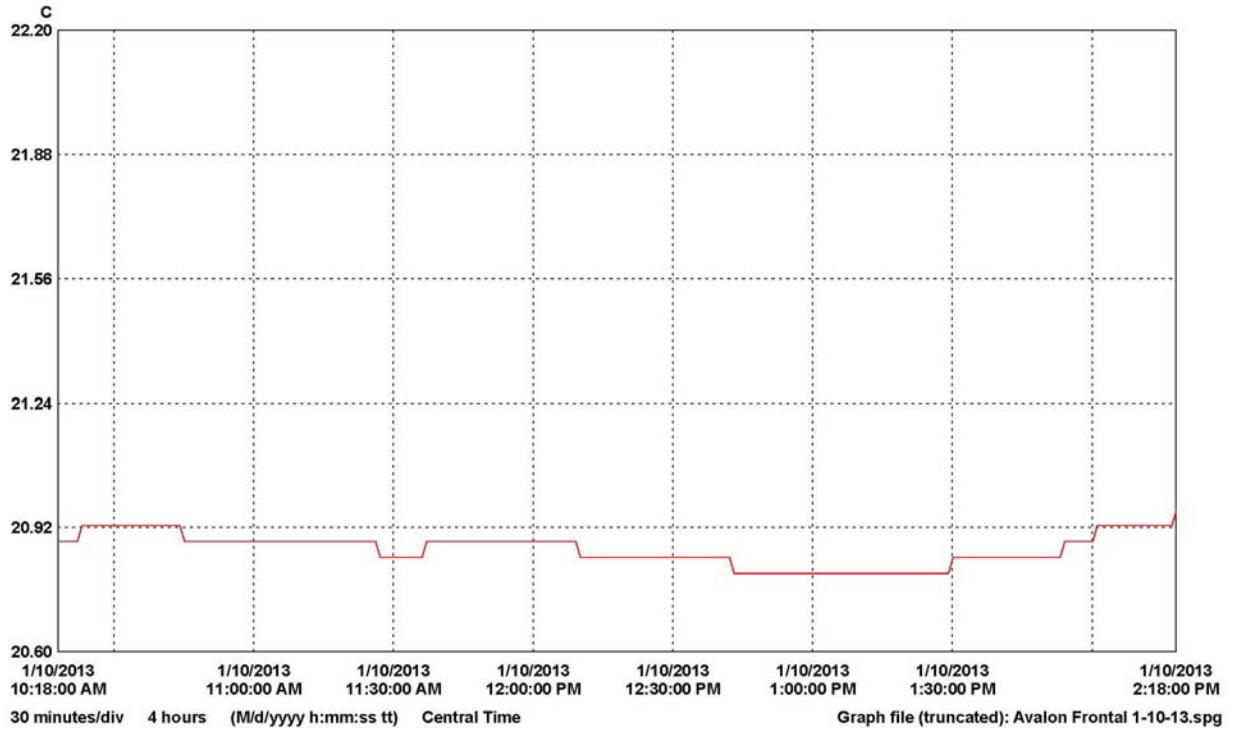
**SOLVENT SPILLAGE LOCATION TABLE**

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 Toyota Avalon 4-Dr Sedan  
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: YD5103  
 Test Date: 01/10/2013



**APPENDIX A  
PHOTOGRAPHS**

## TABLE OF PHOTOGRAPHS

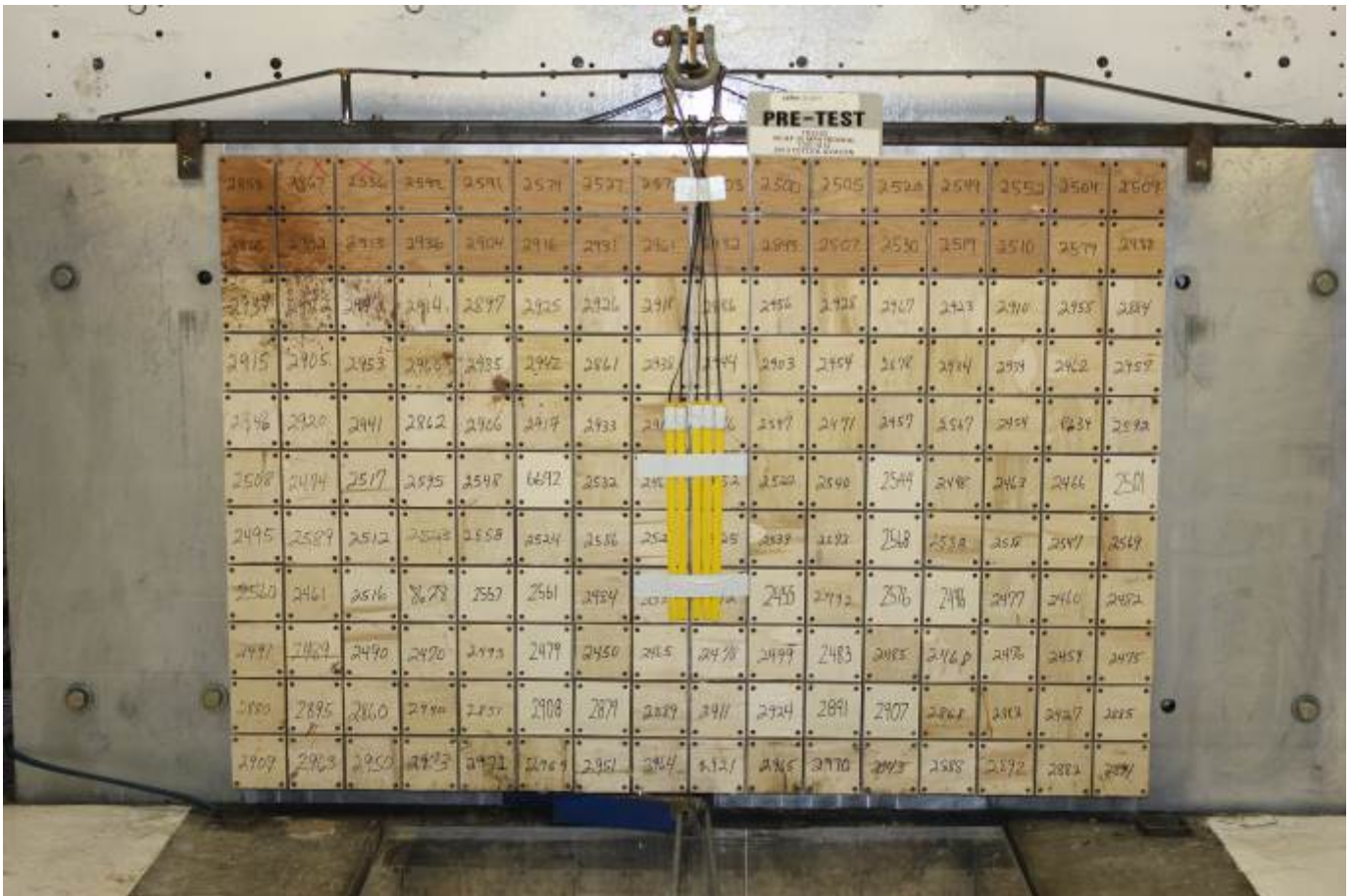
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Load Cell Location



Load Cell Wall



Manufacturer's Label



Reduced Load Carrying Capacity



Tire Placard



2013 Toyota Avalon 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 Left Rear 3-4 View



Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



Post-Test Engine Compartment View



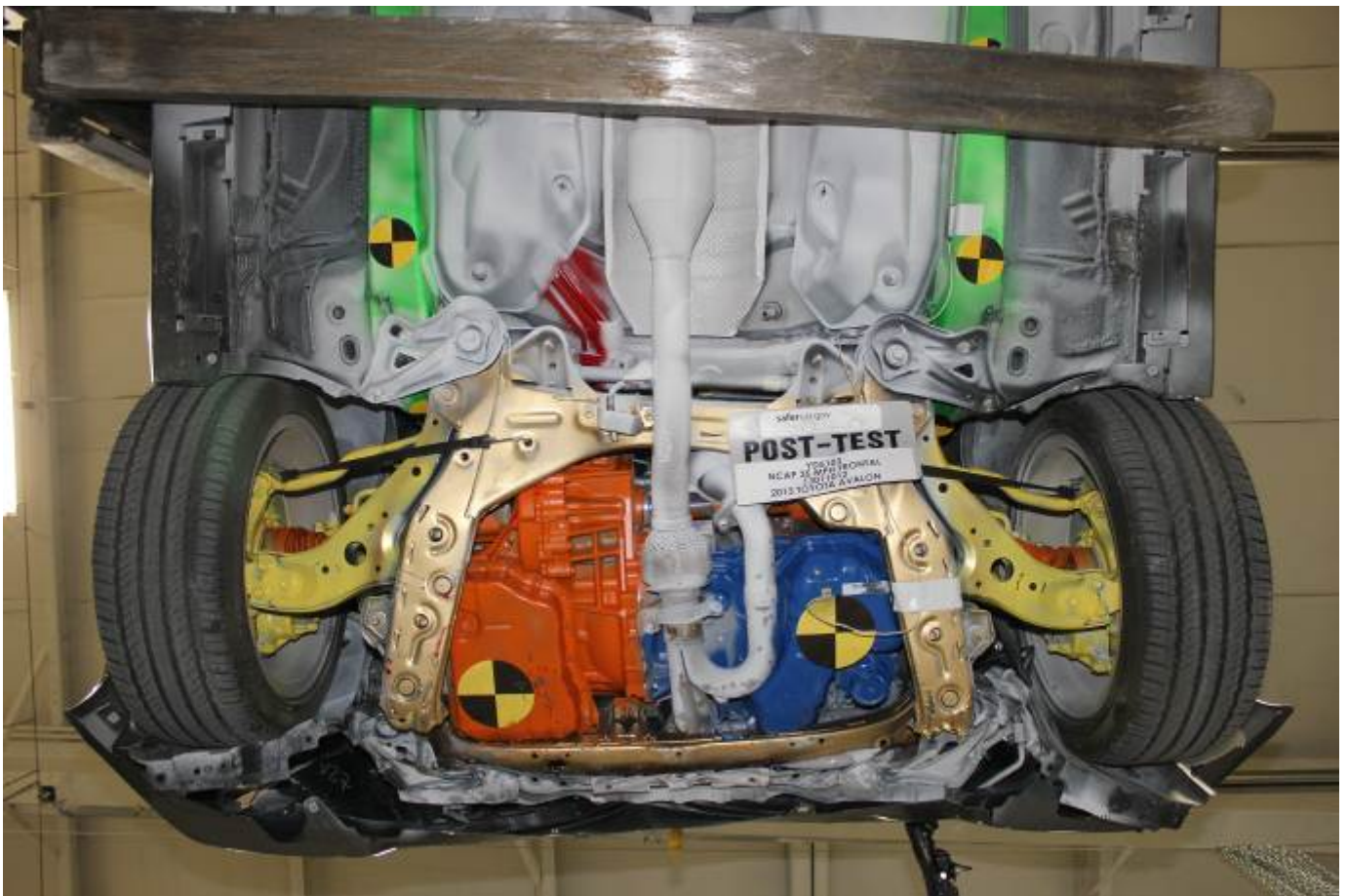
Pre-Test Fuel Filler Cap View



Post-Test Fuel Filler Cap View



Pre-Test Front Underbody View



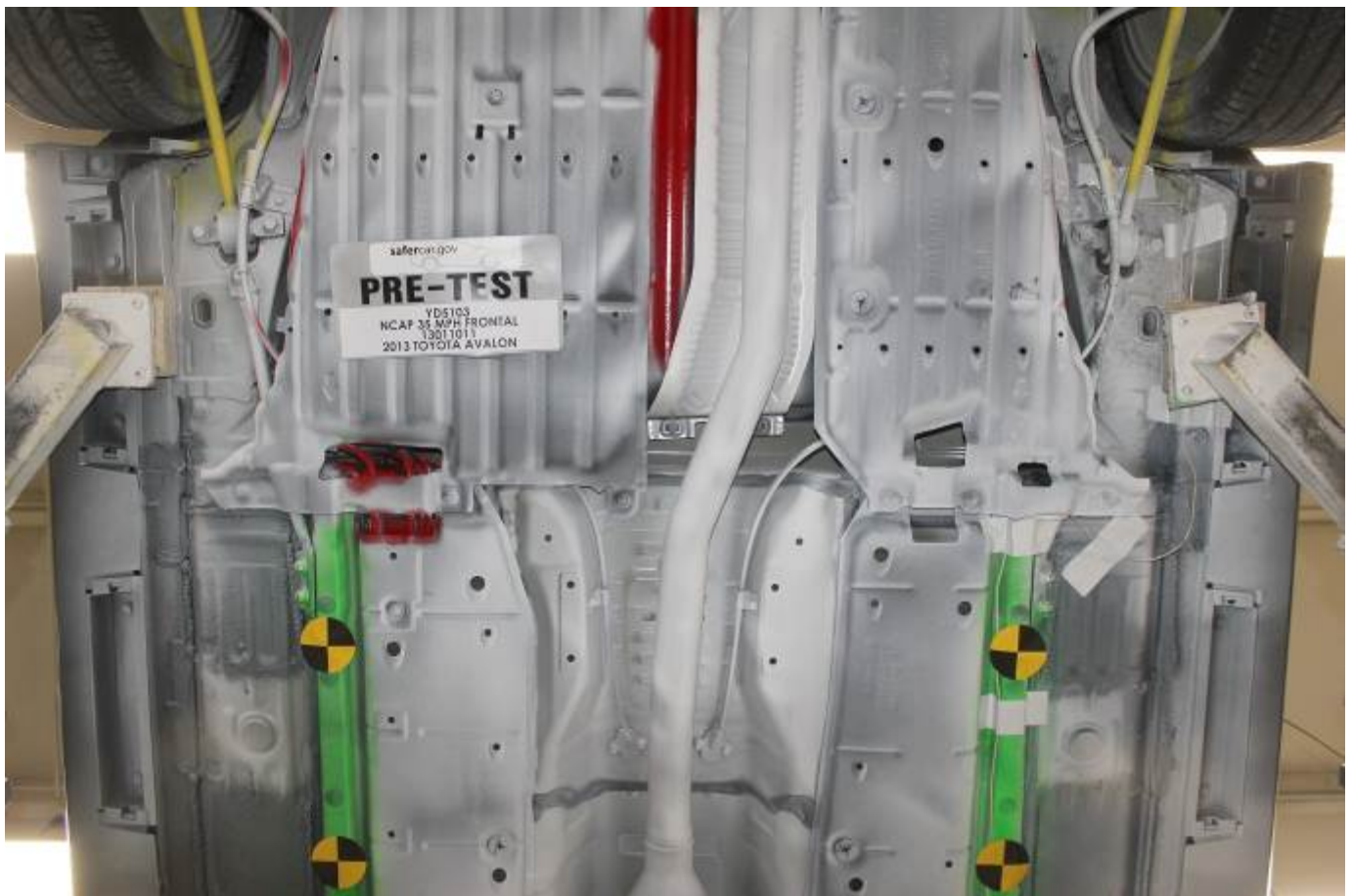
Post-Test Front Underbody View



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 Visor



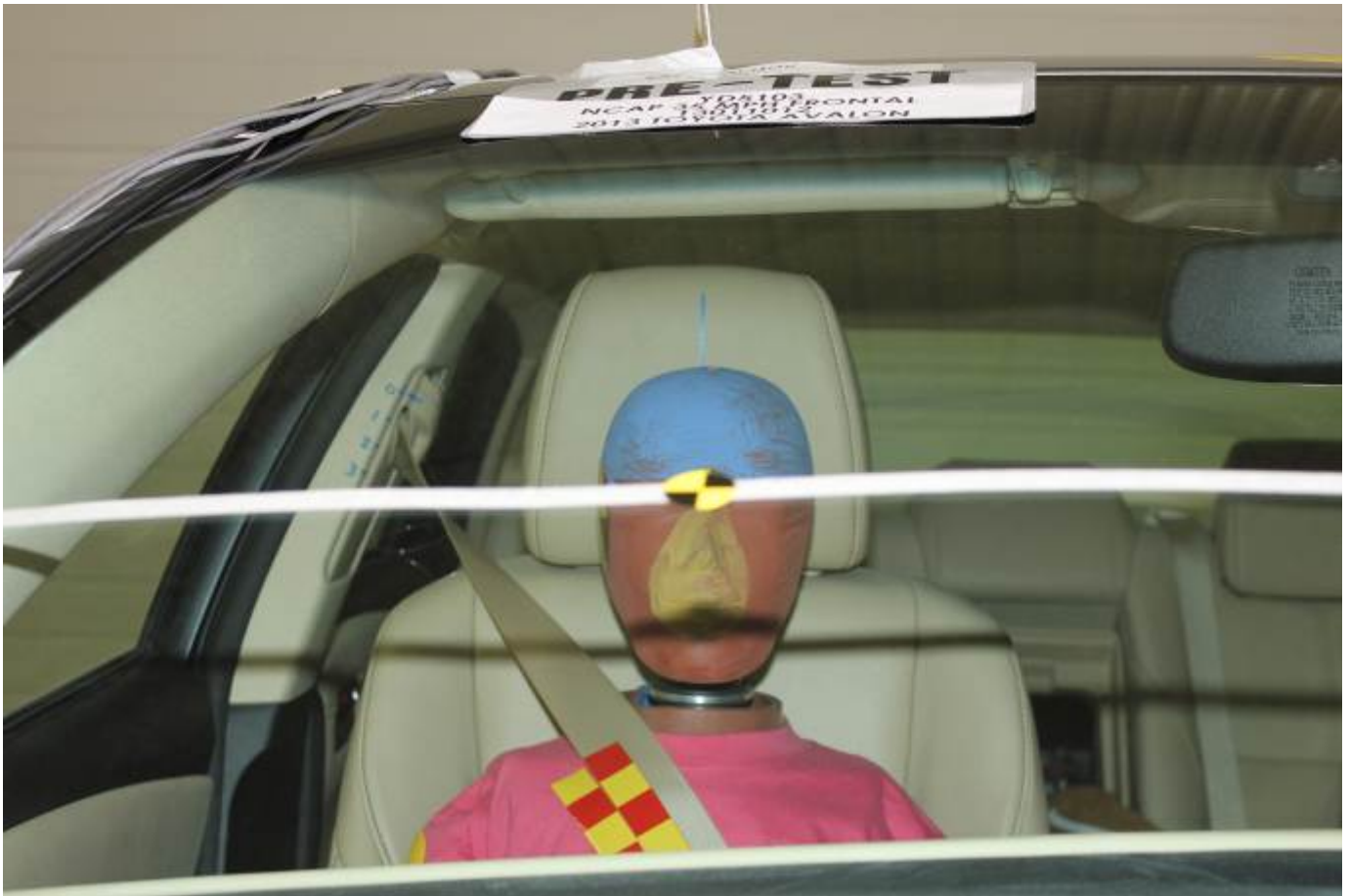
Post-Test Driver Dummy Contact with Knee Airbag



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



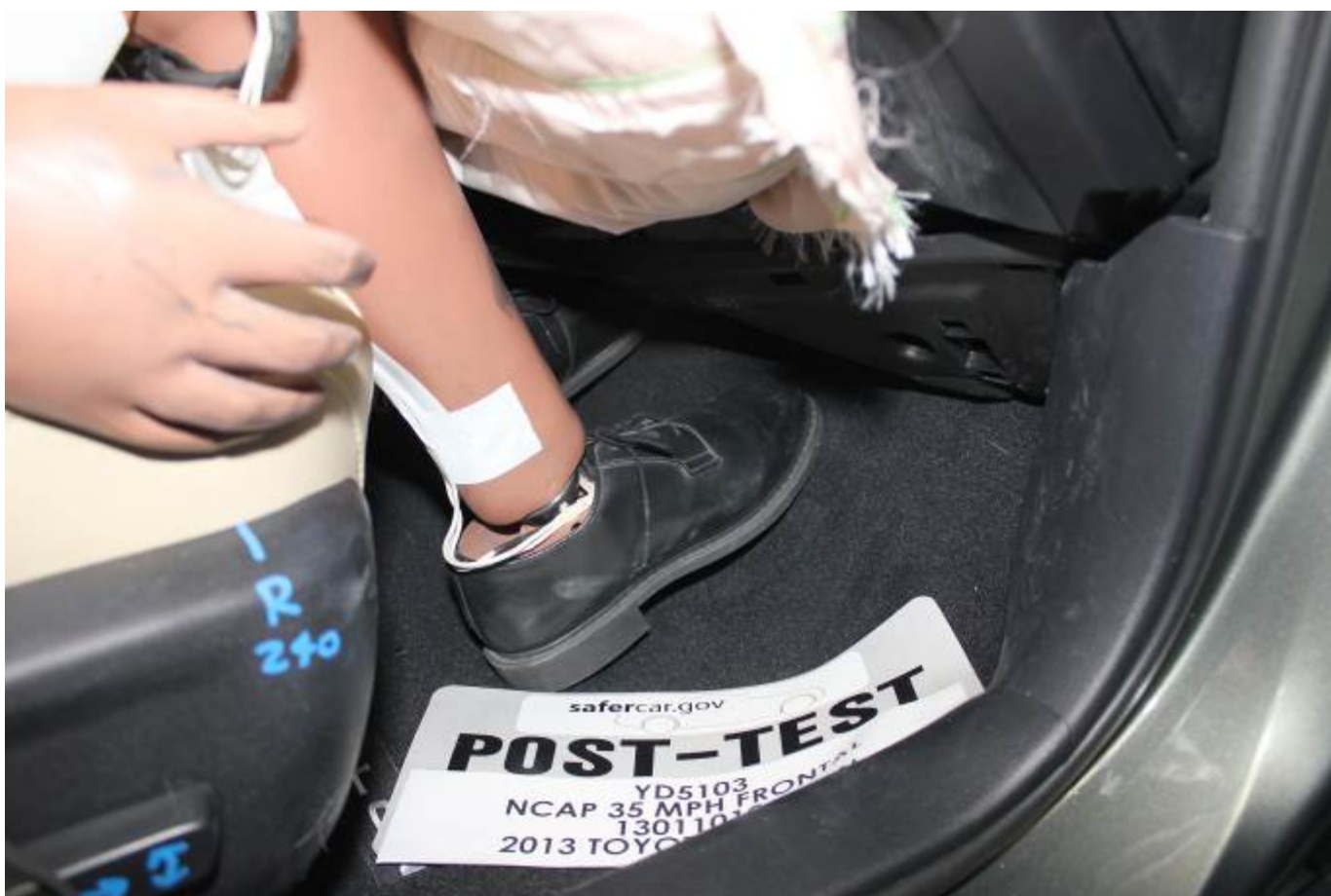
Pre-Test View of Belt Anchorage for Passenger Dummy



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



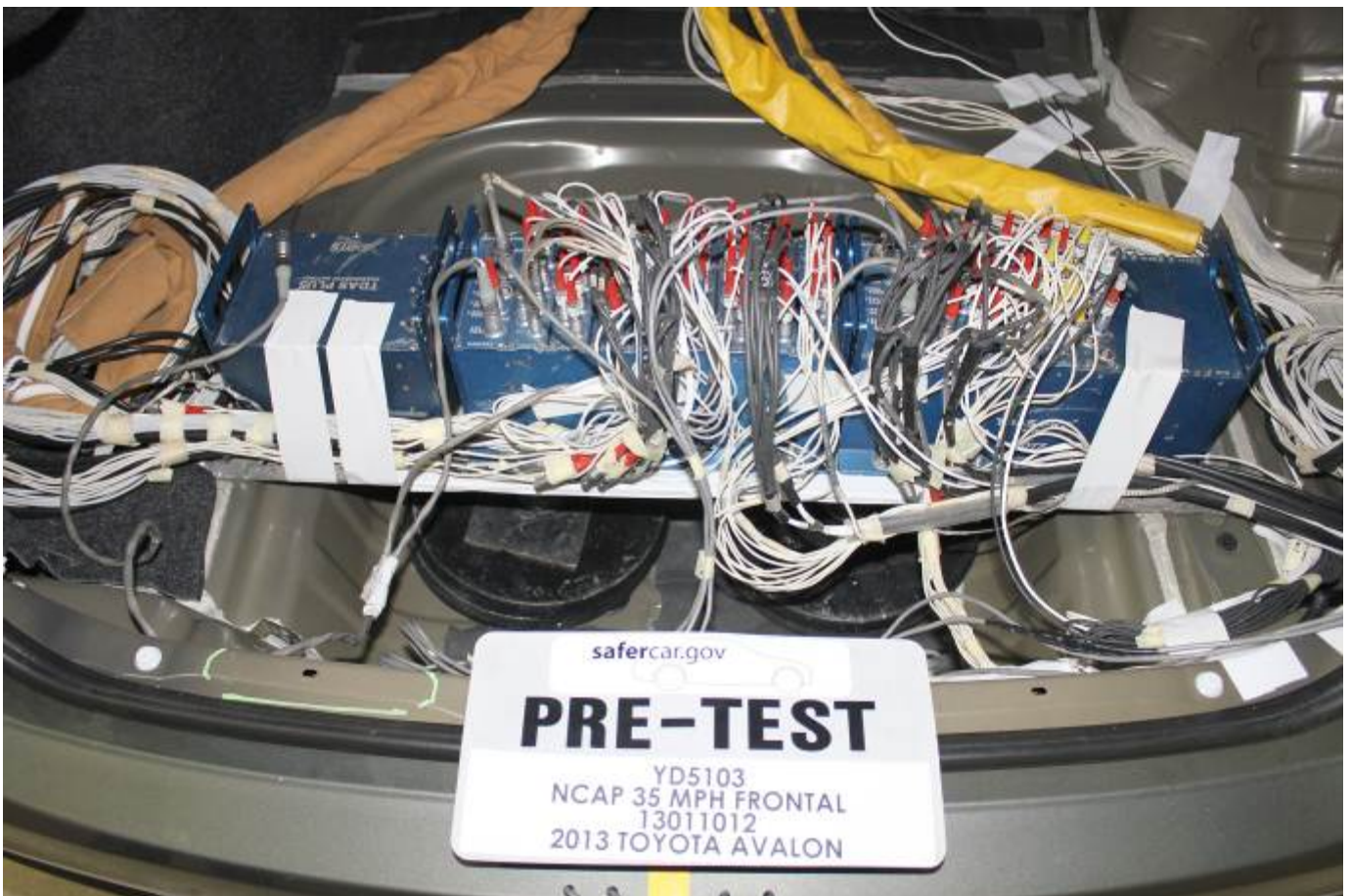
Post-Test Passenger Dummy Contact with Airbag



Post-Test Passenger Dummy Contact with Headrest



Post-Test Passenger Dummy Contact with Knee Airbag



Ballast Installed in Vehicle

**PHOTOGRAPH NOT APPLICABLE**

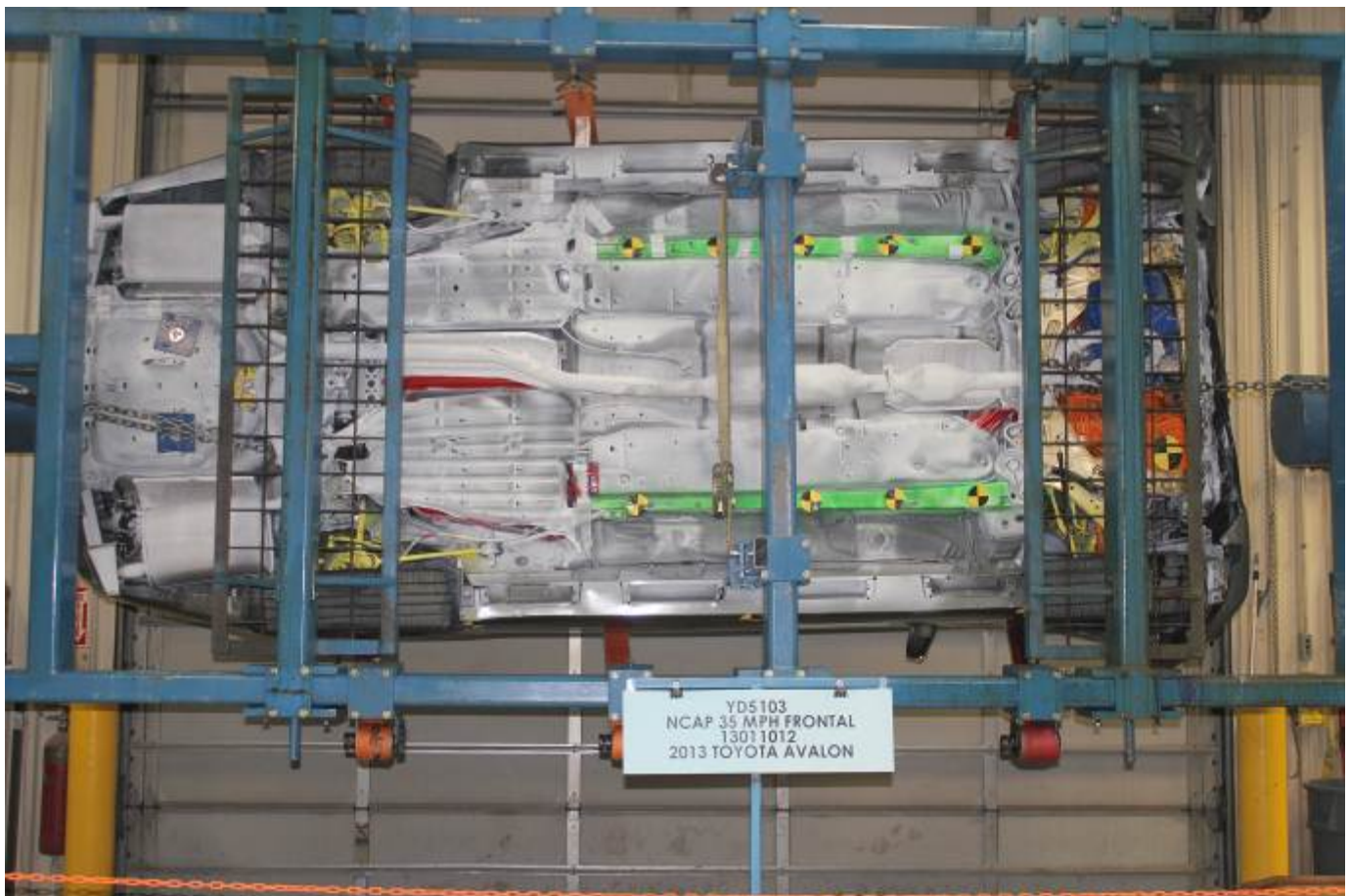
Post-Test Stoddard Solvent Spillage Location View



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 Toyota Avalon Frontal Impact Event



Let's Go Places

DESCR: **AVALON** 4-DR LIMITED  
 VIN: **4T1BK1EB1DU007116**  
 YRMODEL: 2012054A  
 CUL: CYPRESS PEARL/LALMOND (BHTYR)  
 FORTPLANT: Georgetown, KY/EMMK RAILHEAD

**GOVERNMENT 5-STAR SAFETY RATINGS**

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

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

**STANDARD EQUIPMENT**

- MECHANICAL & PERFORMANCE**
- 251 261HP DOHC 24V 5-Speed VVT-i
  - 6-Speed DCT 4-Dr w/variable drive
  - 17" Alloy Wheels w/205/55R16 Tires
  - Electric Power Steering (EPS)
  - 2nd-Row Access Portlock Br. Disk Brakes
- SAFETY AND CONVENIENCE**
- Star Safety System including VSC, TRAC, ABS and Brake Assist, (ABS)
  - Brake Assist & Rear Stop Tech (SST)
  - IS Airbag (Dr & Fr Pass Airbag Side, Dr & Fr Pass Knee & Seat-Mounted Side, Front & Rear Side Curtain, and Rear Seat-Mounted Side Airbag)
  - LATCH/Star Assist & Tethers for Children for Outboard Rear Seating Positions Only
  - Anti-Theft System w/Engine Immobilizer
  - Smart Key w/Power Windows, Lock, Unlock, Trunk Release
  - Subby Console
- EXTERIOR**
- 18" Quad-beam Headlights w/Safe Exit®
  - Fog Lights & LED Daytime Running Lights
  - Auto Dimming Mir Outside Mirrors w/Hein Signal, Parking Lights & Moving Features
  - Power Trunklid Motor
  - Rain Sensing Windshield Wipers
- INTERIOR**
- Three-Zone Climate Control w/air Purifier and Rear Seat Heater
  - 8-Spe. HD Radio w/AM/FM/HD Radio, 11-Spe. Surround Sound, 7.0" Display, HD Radio/AM/FM/HD & Bluetooth
  - 6-Speed Cruise
  - 3.5-in TFT Multi-information Display
  - Premium Parked LED® Illuminated Toyota Star Driver & Ready Exit Pass Seats
  - Per Driver's Seat Custom Rockers
  - Heated/Powered Fr Seats, 10th St. Seats
  - Dr Seat & Outside Mirrors Memory Systems
  - Sport, Eco, and Normal Drive Mode Switch
  - Smart Key System with Push Button Start
  - Power Rear Sunshade w/Auto Return
  - \*\*Full Tank of Gas\*\*

<b>MANUFACTURER'S SUGGESTED RETAIL PRICE \$39,850.00</b>	
<b>OPTIONAL EQUIPMENT</b>	
FE 30 State Emissions	
CR Carpet Floor Mats/Trunk Mat	225.00

**EPA DOT Fuel Economy and Environment**

**Fuel Economy**

**24** MPG Miles Per Gallon **21** MPG **31** MPG  
combined city/hwy city highway

**4.2** gallons per 100 miles

**You save \$ 600** in fuel costs over 5 years compared to the average new vehicle.



Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. This average fuel economy rate is based on 15,000 miles per year at 55 mph per gallon. EPA's fuel economy guide provides more information. Vehicle emissions are a significant cause of climate change and smog.

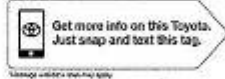
**fuel economy.gov**

Scan QR Code

DELIVERY PROCESSING AND HANDLING FEE 795.00

**TOTAL \$40,570.00**

The new Avalon Limited is available only with the 251-hp V6 engine. 2012 EPA fuel economy estimates are based on 15,000 miles per year at 55 mph per gallon. EPA's fuel economy guide provides more information. Vehicle emissions are a significant cause of climate change and smog.



Dealer Photo / Address: 4802 Ship St.  
 JACO SARGO TOYOTA  
 5015 WEST CAPITOL DRIVE  
 BROOKFIELD, WISCONSIN 53005



Monroney Label

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

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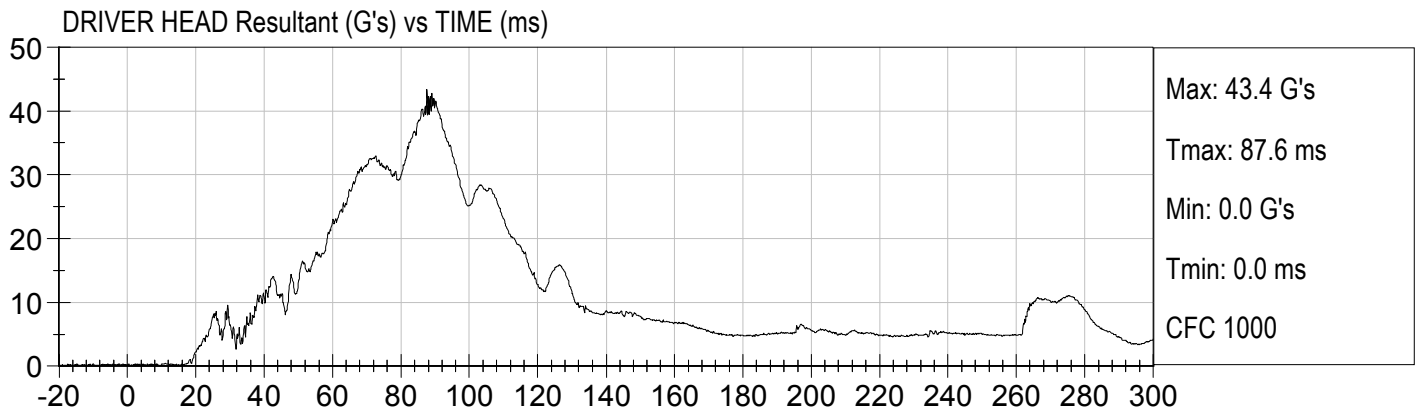
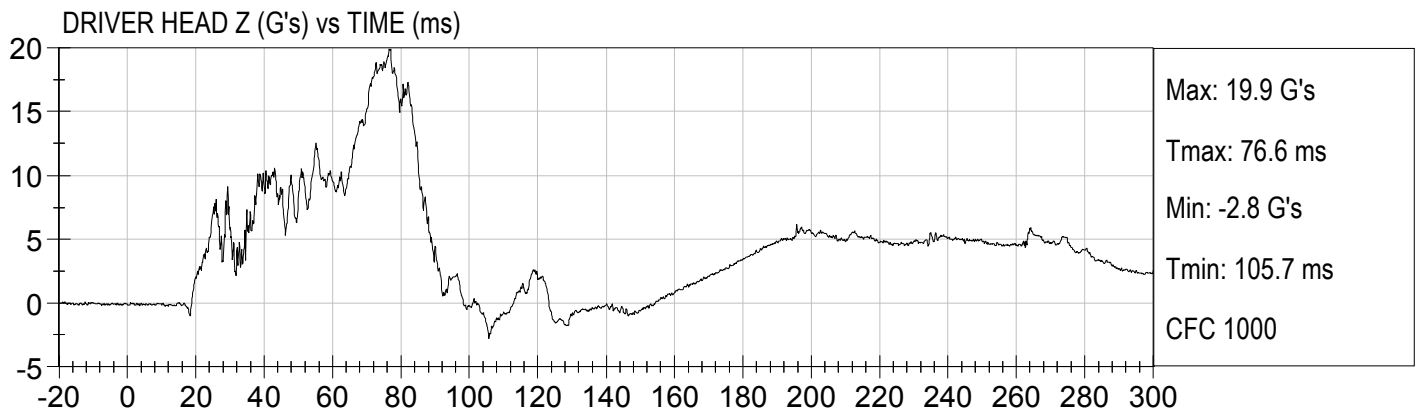
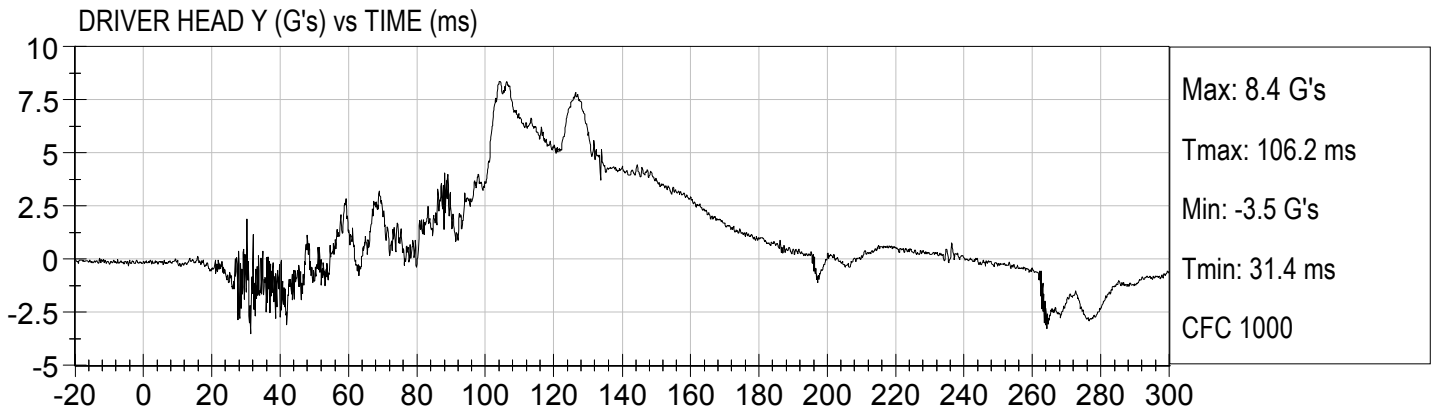
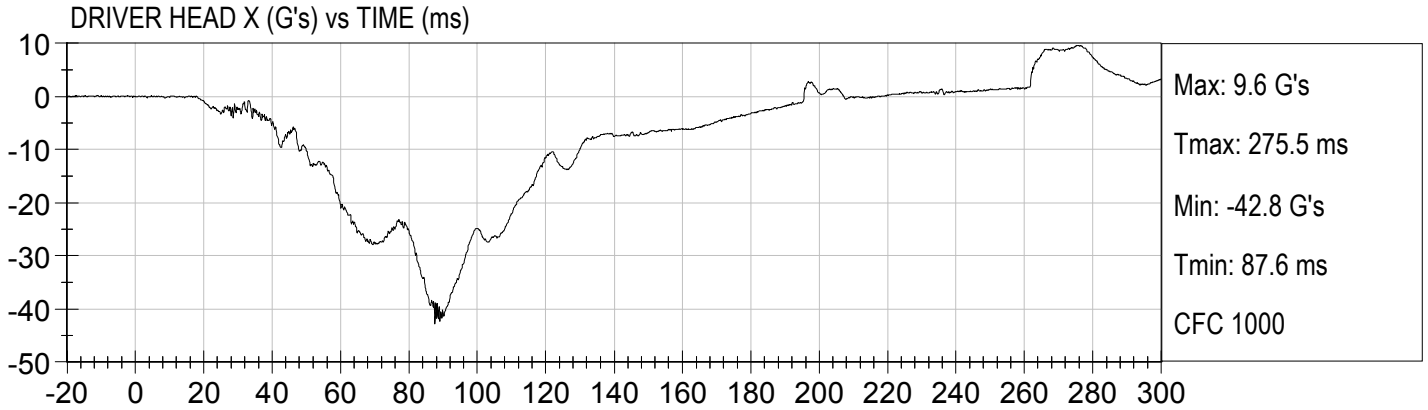
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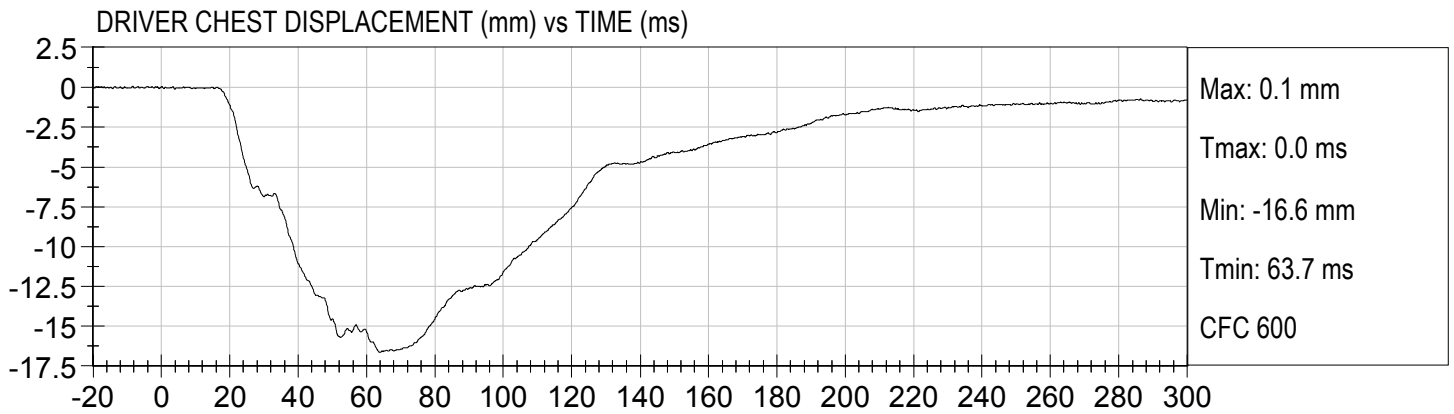
**The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at [www.nhtsa.dot.gov](http://www.nhtsa.dot.gov)**

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

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

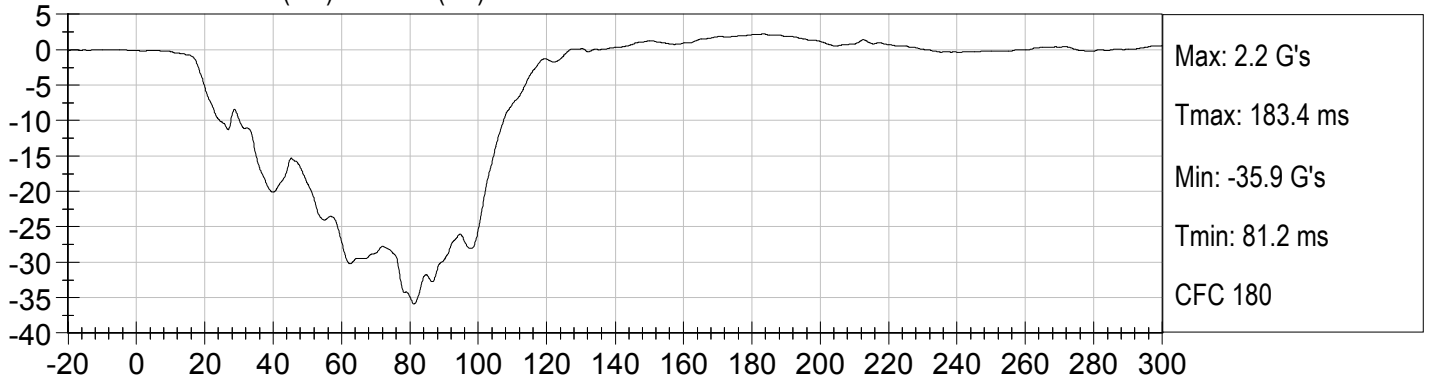
Passenger Left Upper Tibia Moment Y  
Passenger Left Upper Tibia Force Z  
Passenger Left Lower Tibia Moment X  
Passenger Left Lower Tibia Moment Y  
Passenger Left Lower Tibia Force Z  
Passenger Right Upper Tibia Moment X  
Passenger Right Upper Tibia Moment Y  
Passenger Right Upper Tibia Force Z  
Passenger Right Lower Tibia Moment X  
Passenger Right Lower Tibia Moment Y  
Passenger Right Lower Tibia Force Z  
Passenger Left Foot Fore Z  
Passenger Left Foot Aft X  
Passenger Left Foot Aft Z  
Passenger Right Foot Fore Z  
Passenger Right Foot Aft X  
Passenger Right Foot Aft Z  
Passenger Lap Belt Force  
Passenger Shoulder Belt Force – Not Installed  
Left Rear Seat Crossmember X  
Right Rear Seat Crossmember X  
Vehicle Engine Top X  
Vehicle Engine Bottom X  
Left Rear Seat Crossmember Z  
Right Rear Seat Crossmember Z  
Left Rear Seat Crossmember Xr  
Right Rear Seat Crossmember Xr



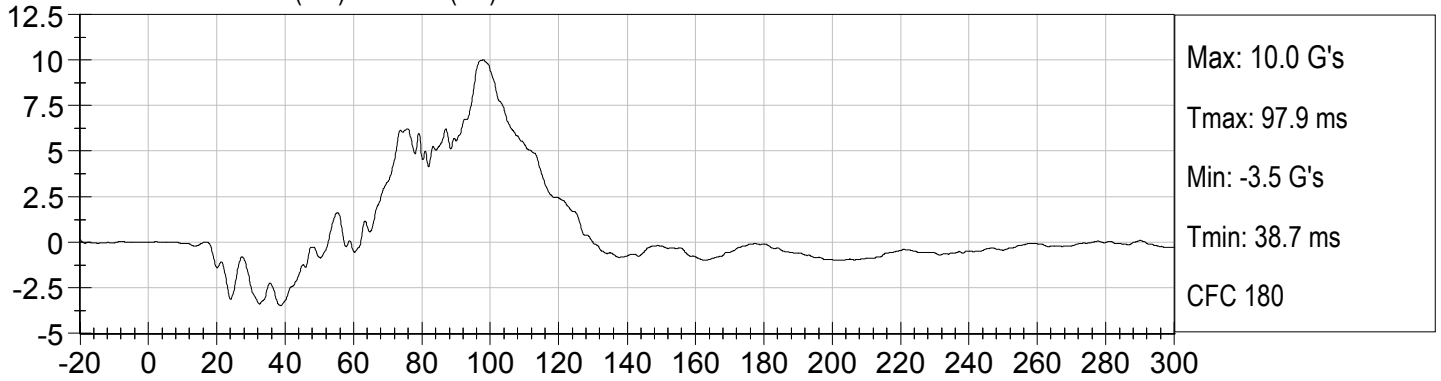




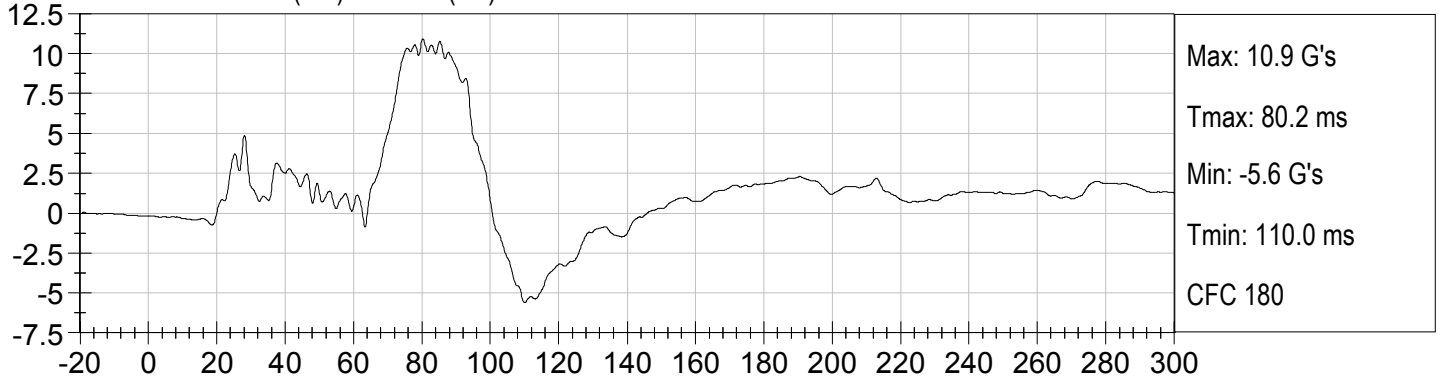
DRIVER CHEST X (G's) vs TIME (ms)



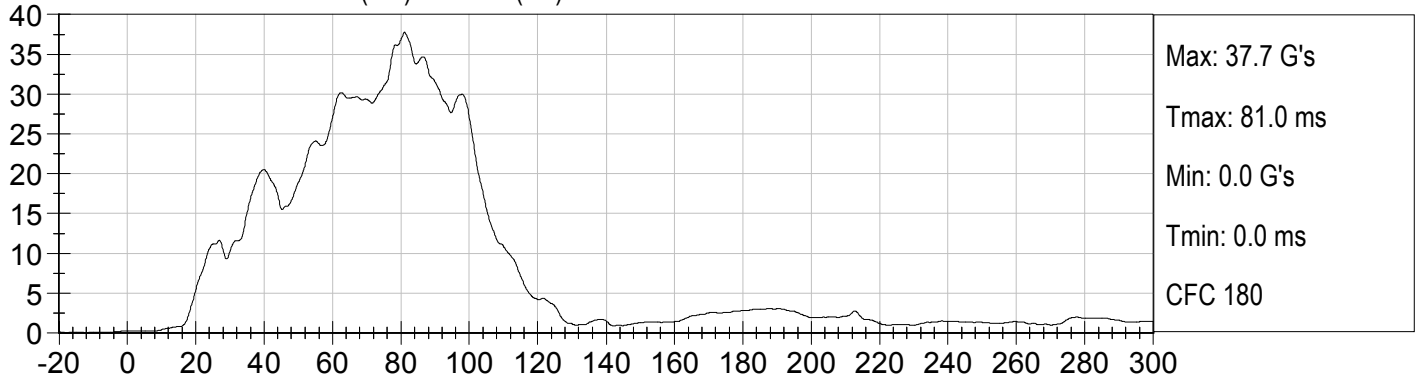
DRIVER CHEST Y (G's) vs TIME (ms)

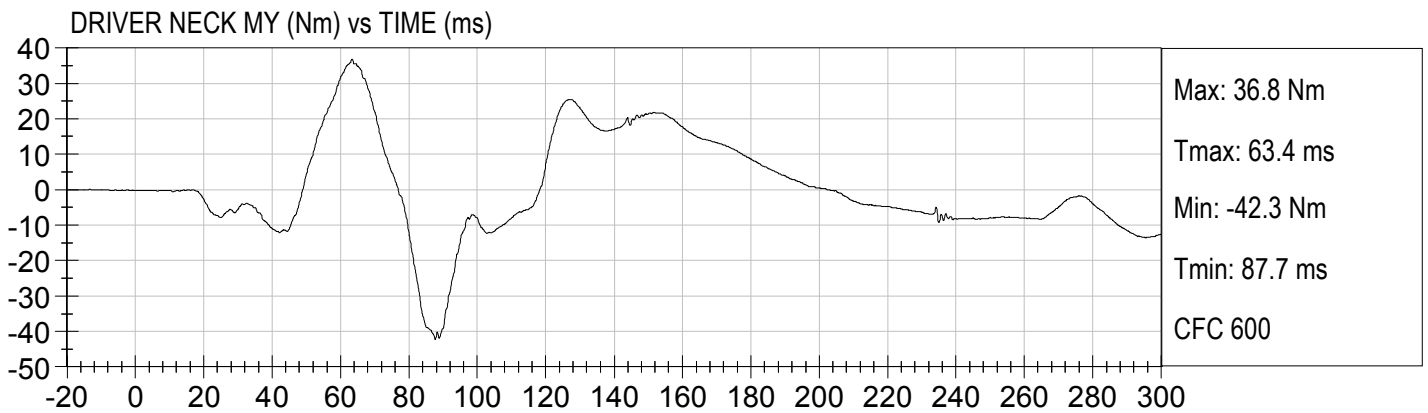
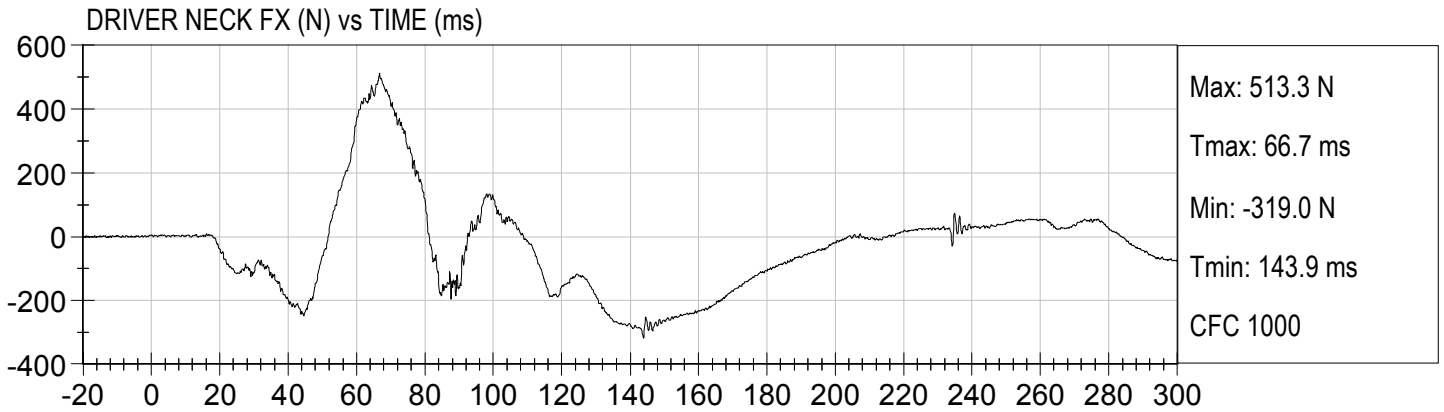


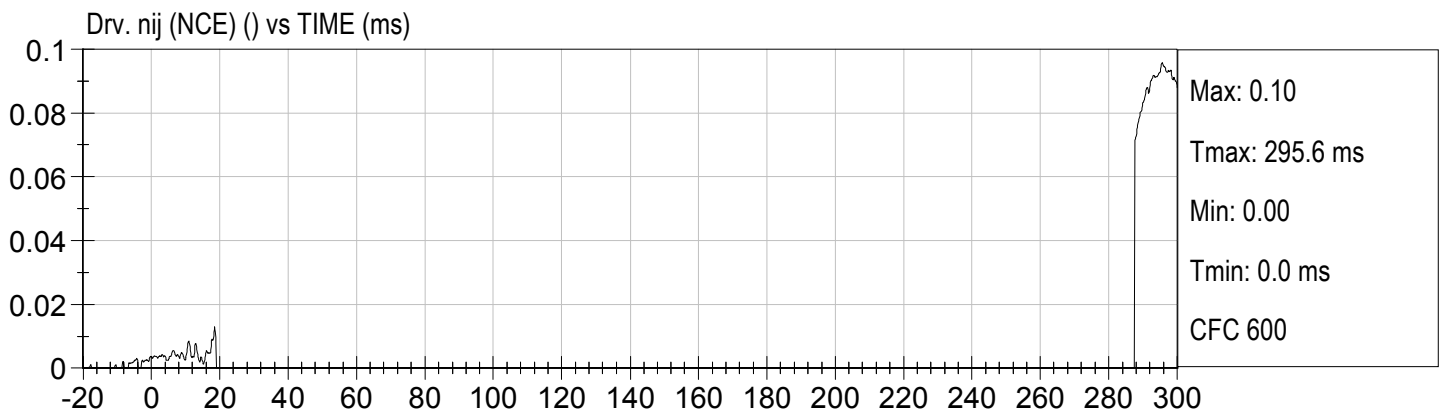
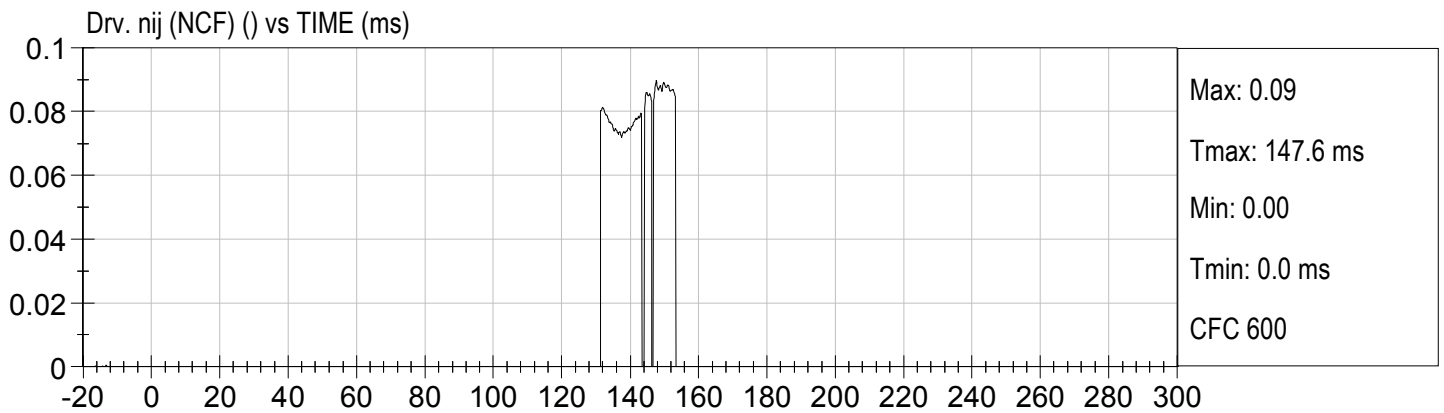
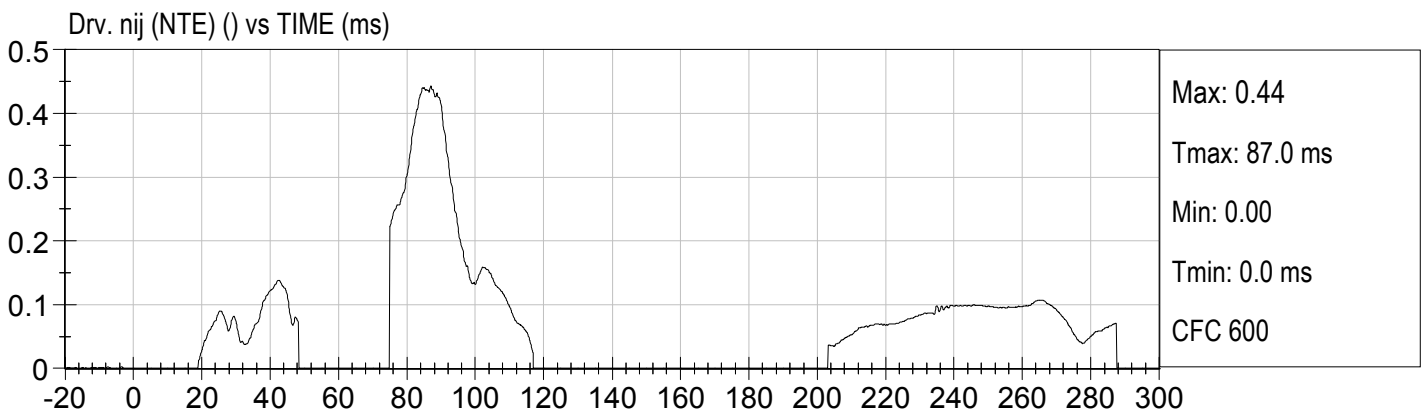
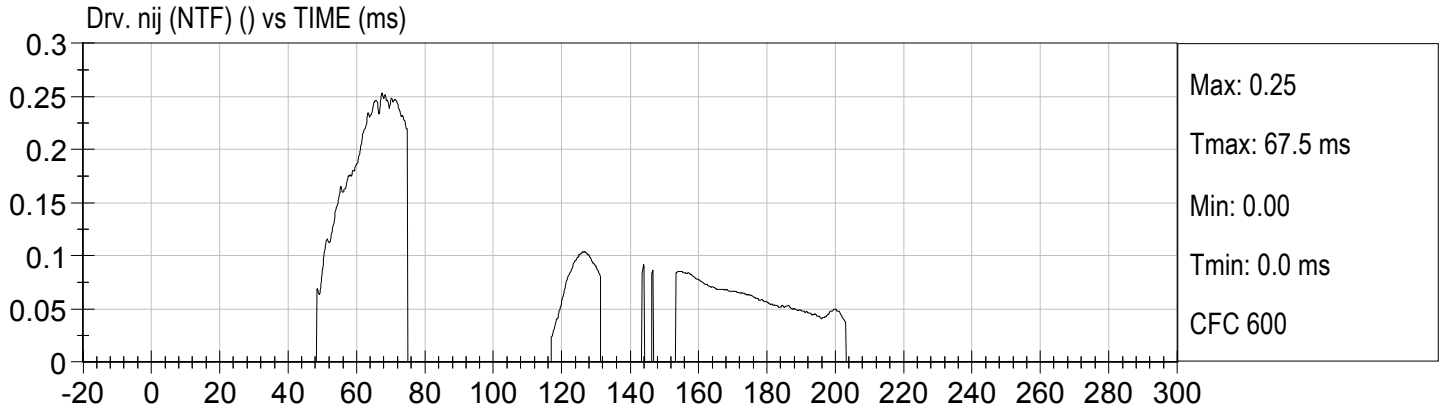
DRIVER CHEST Z (G's) vs TIME (ms)

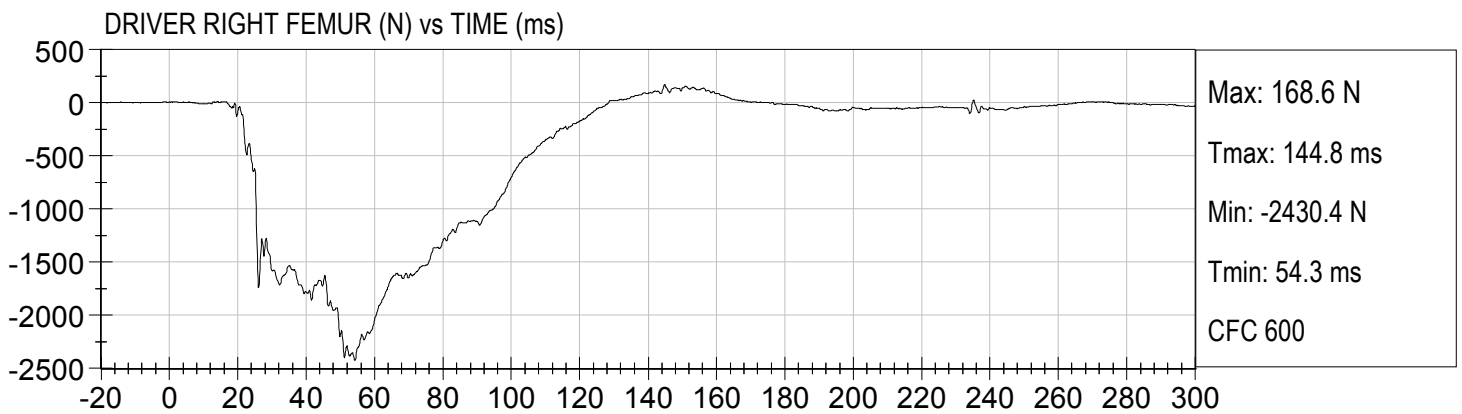
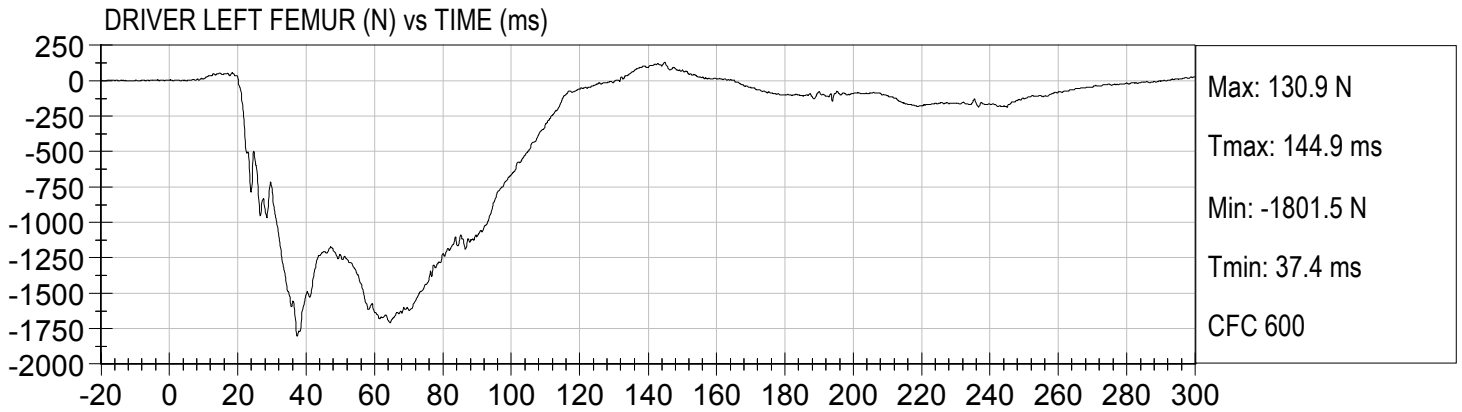


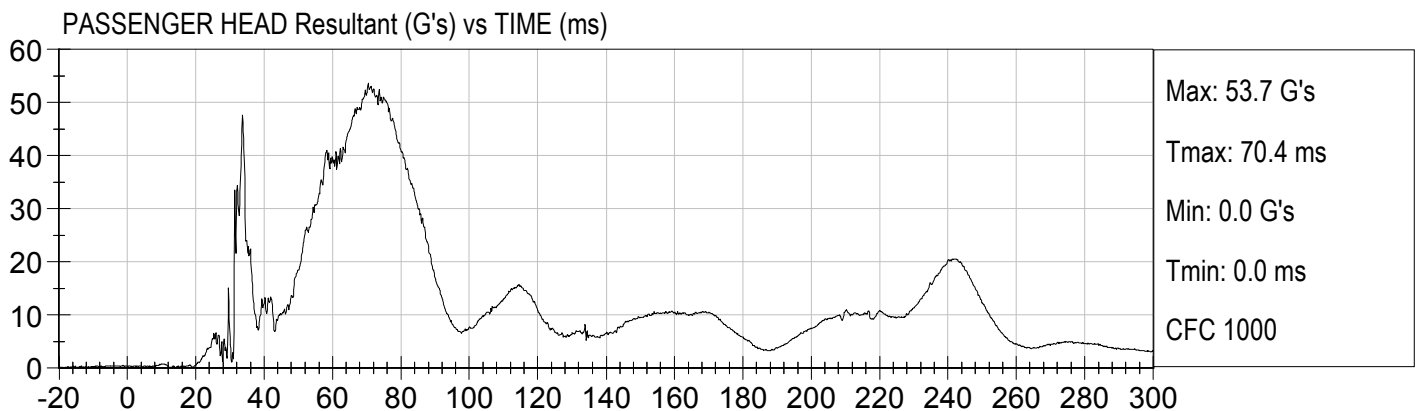
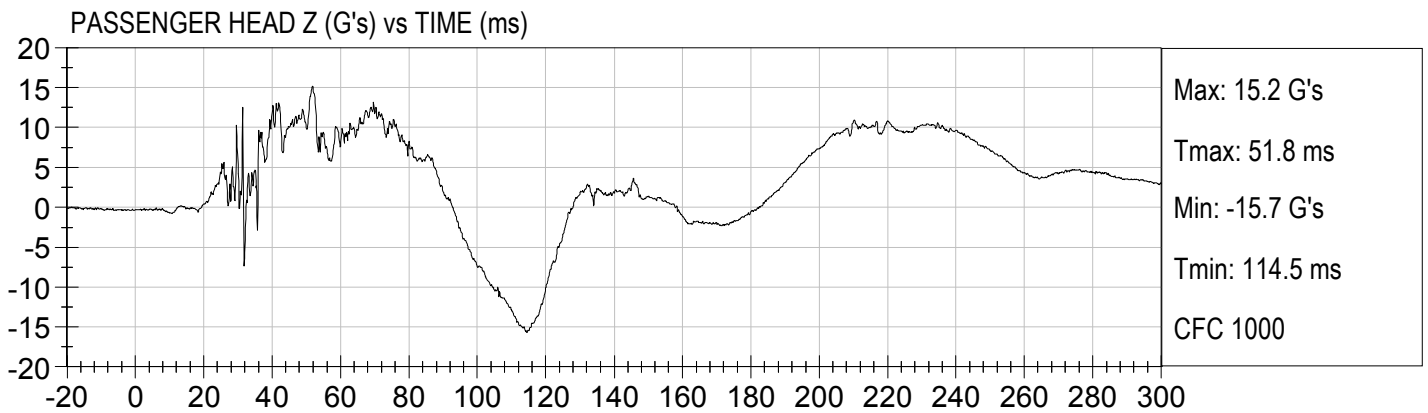
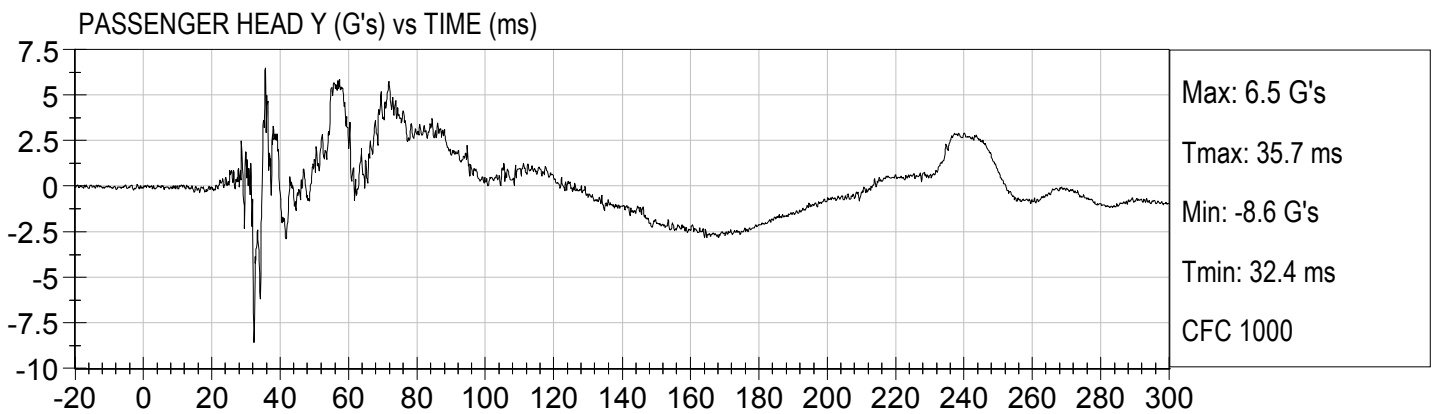
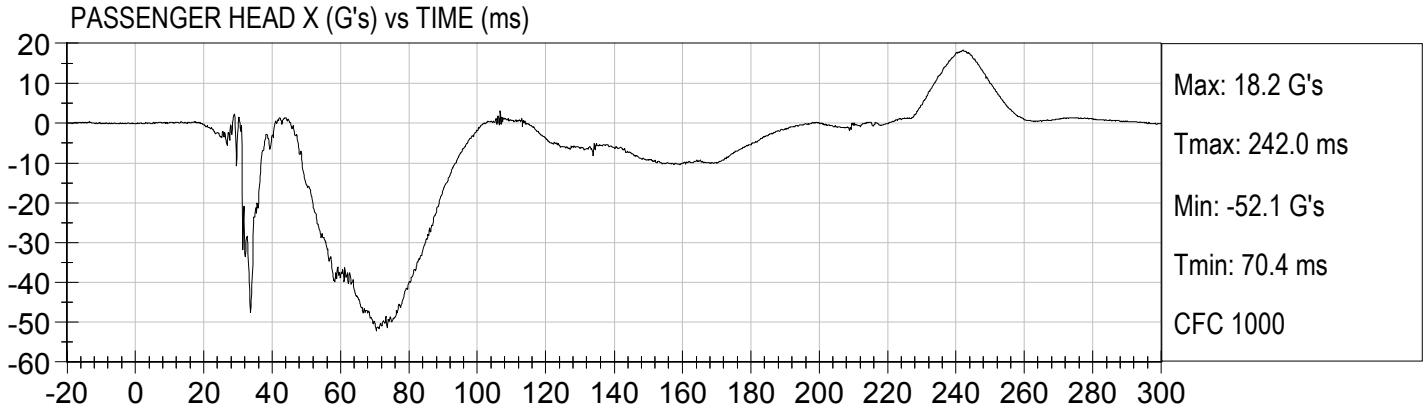
DRIVER CHEST Resultant (G's) vs TIME (ms)



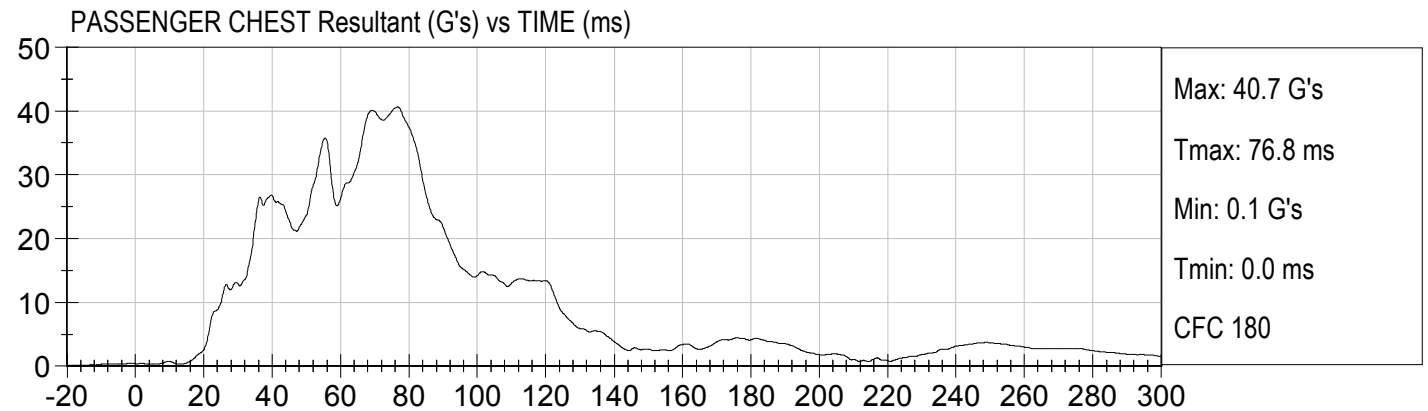
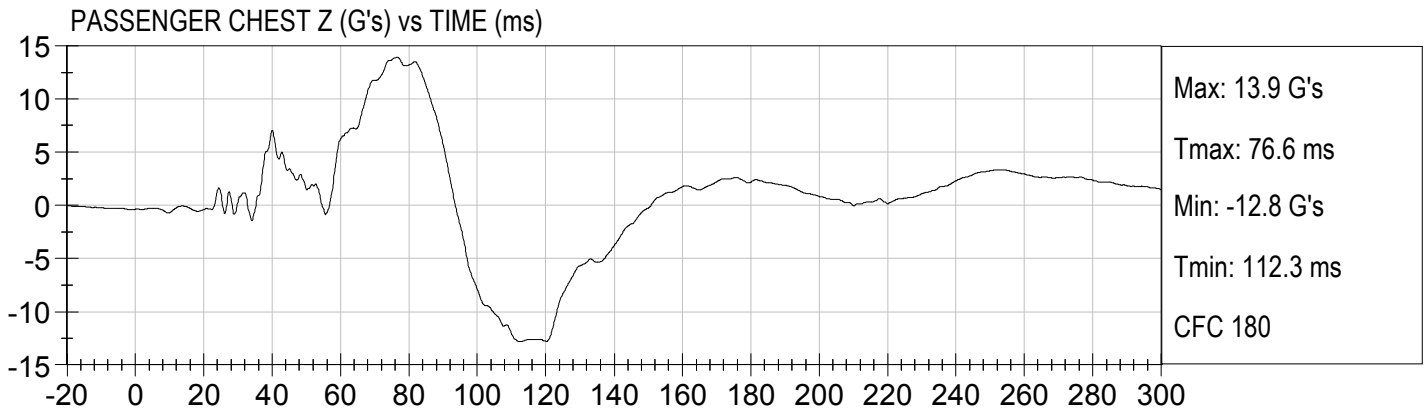
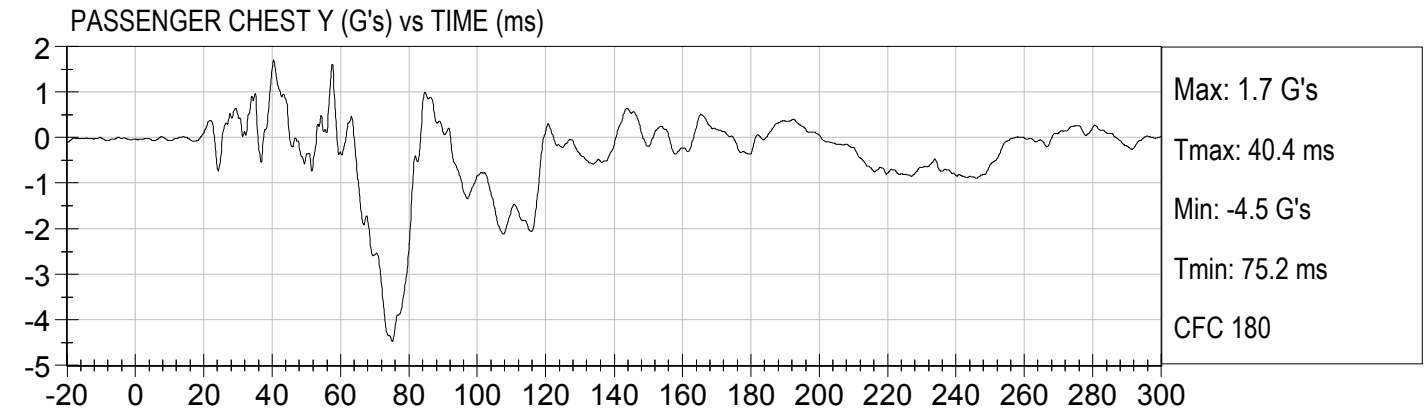
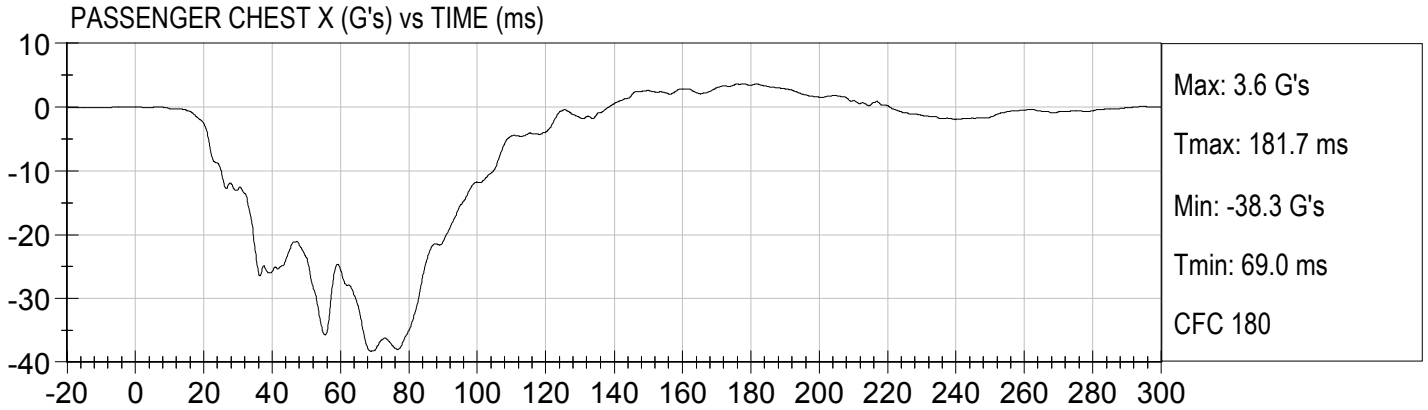


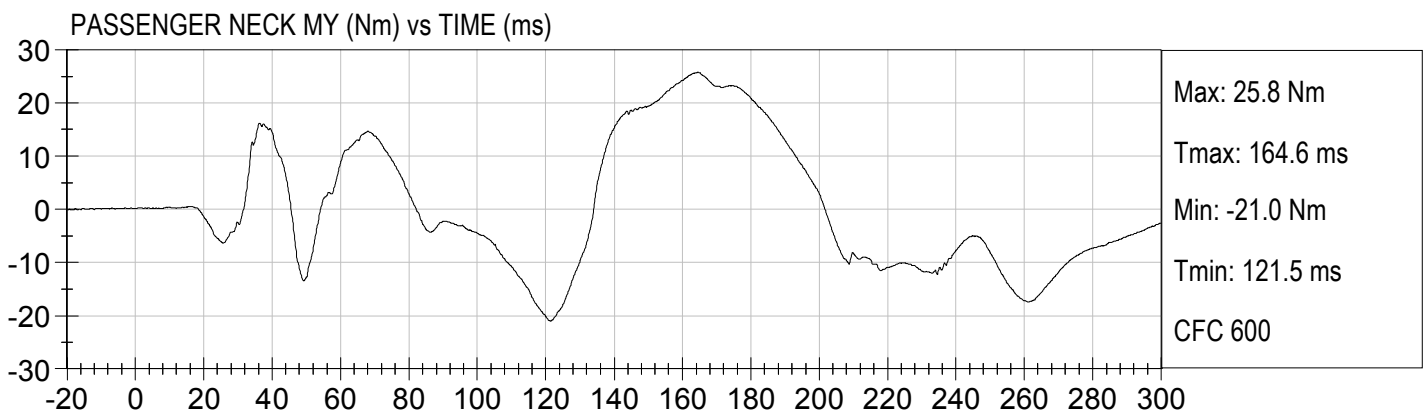
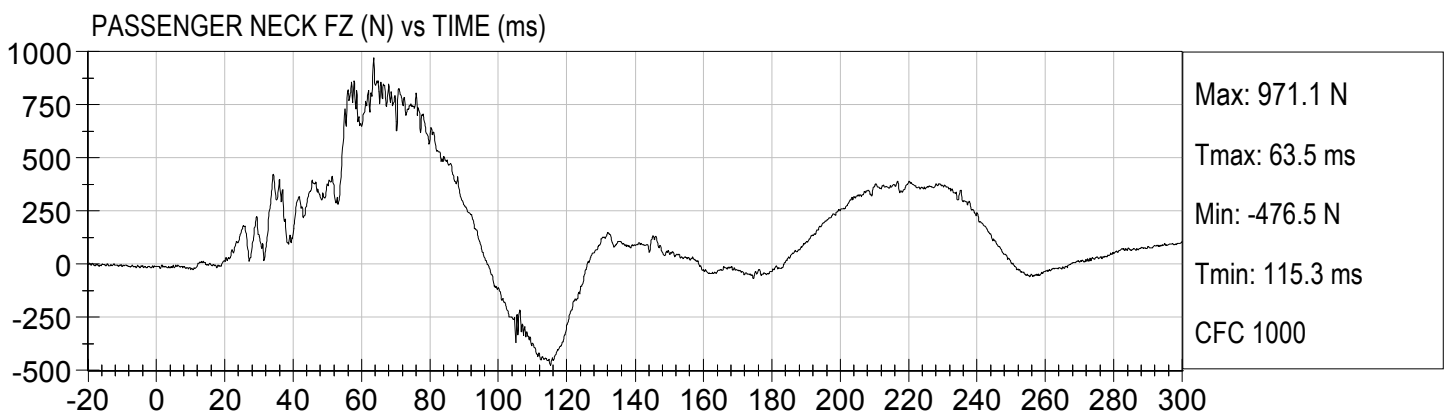
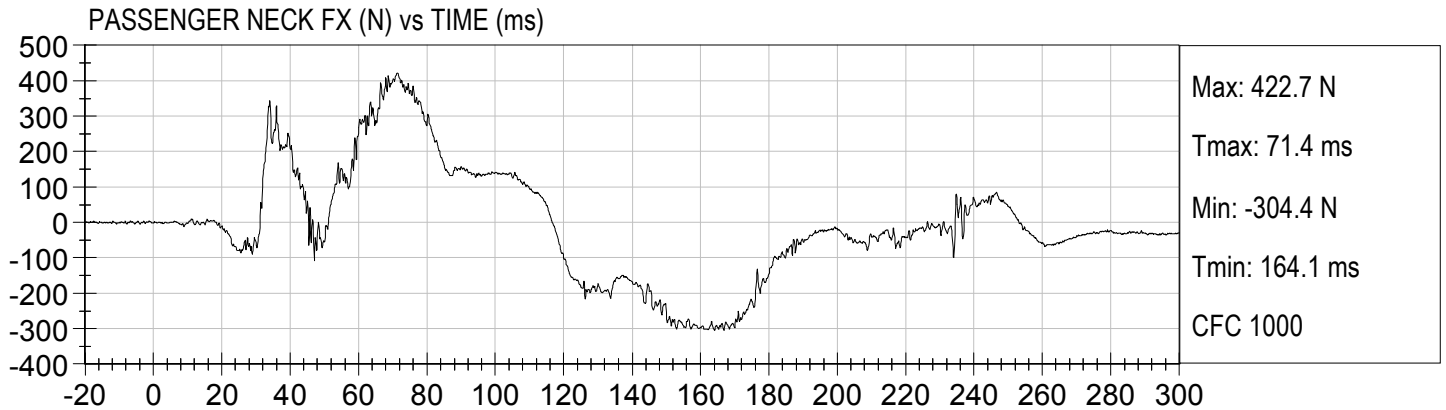


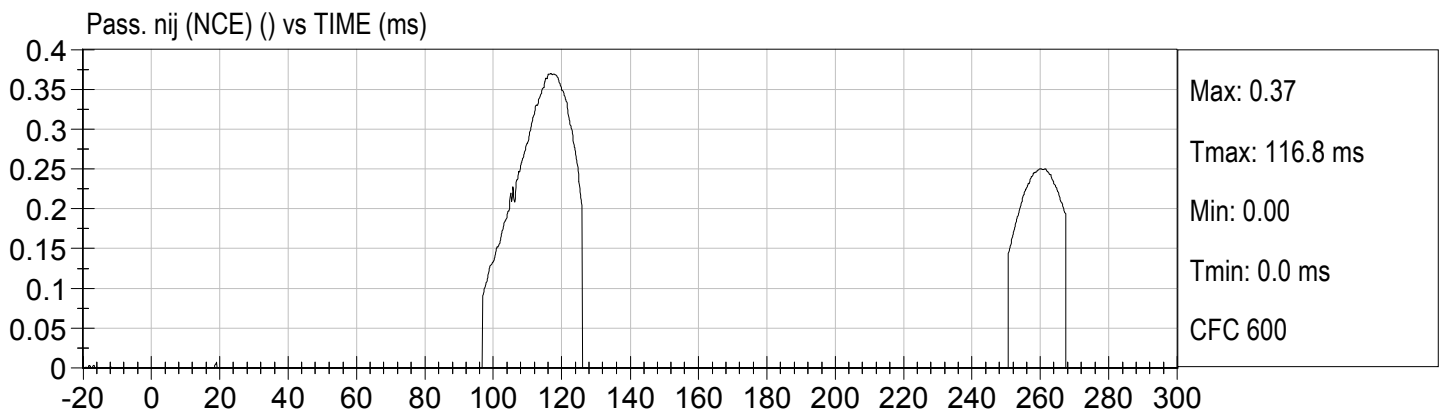
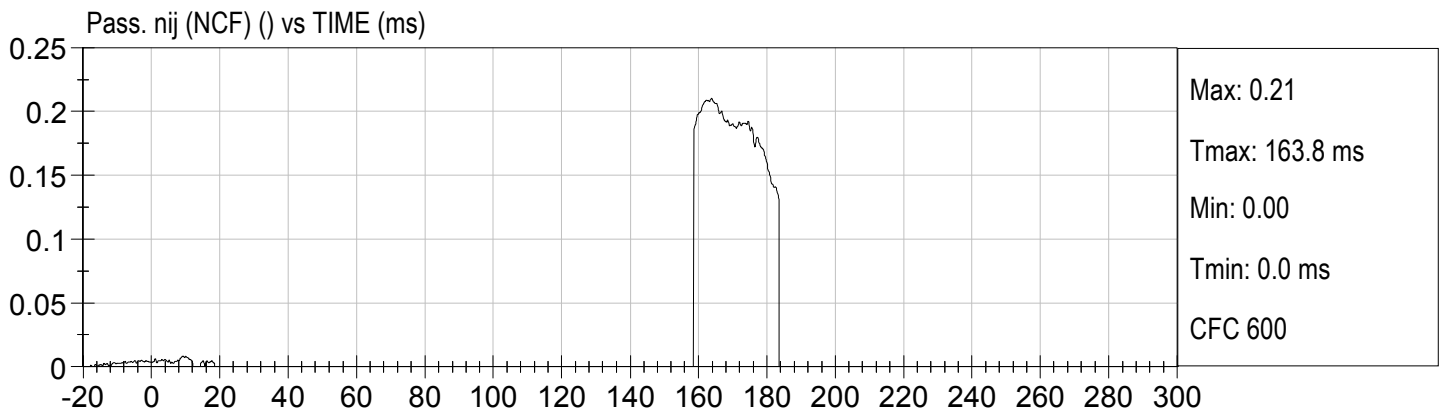
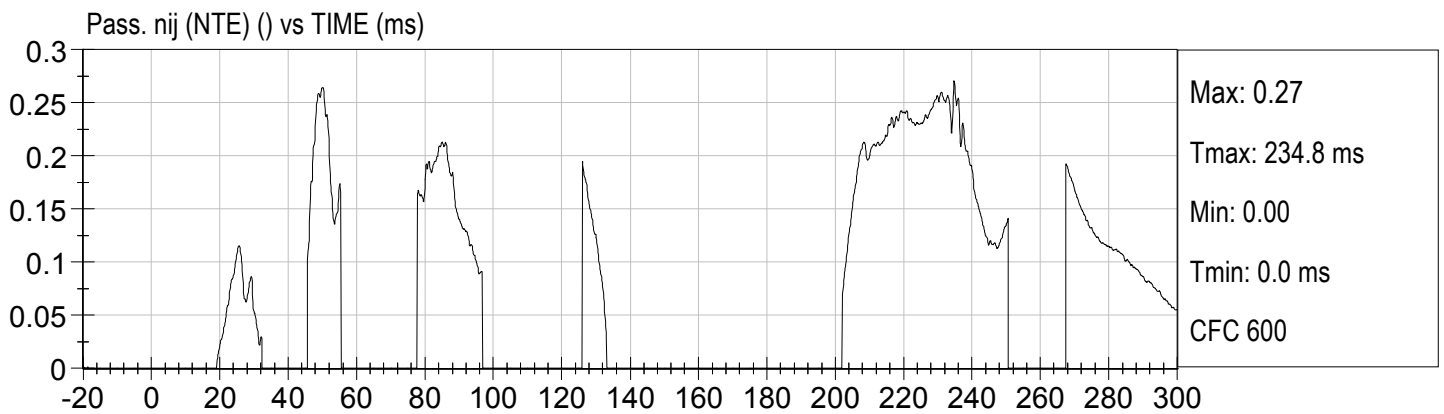
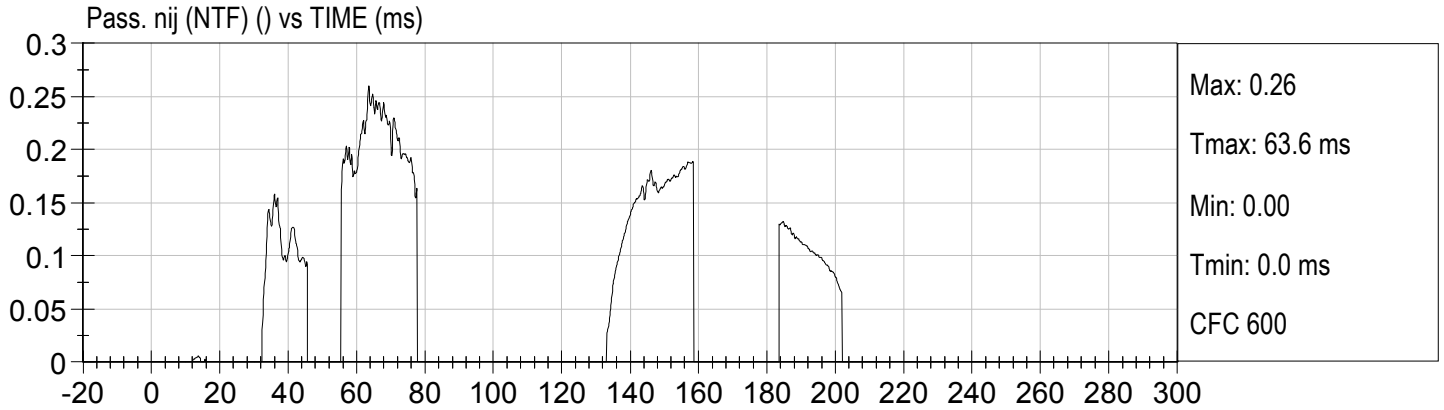


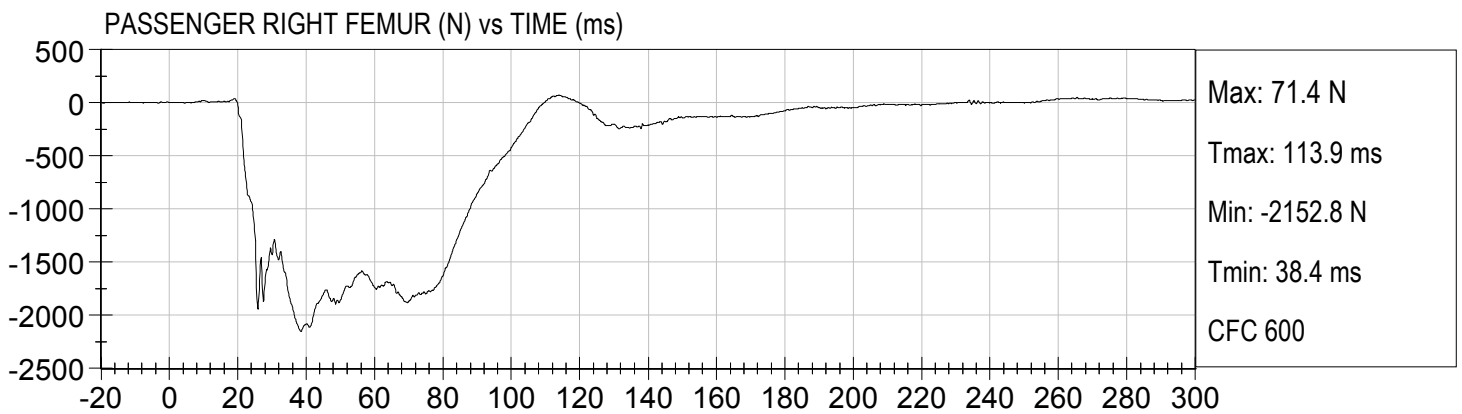
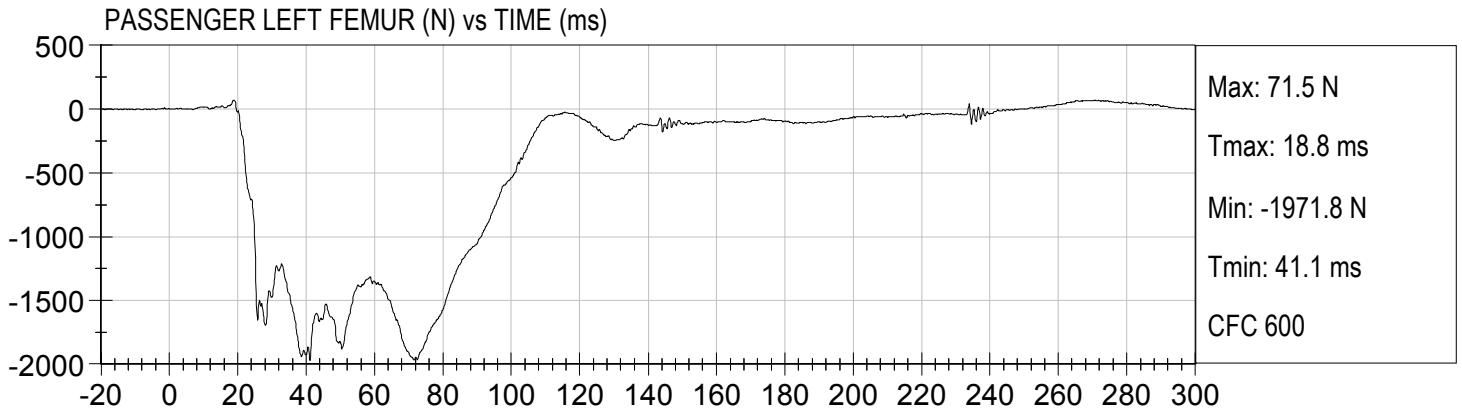












**APPENDIX C**  
**DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA**

**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

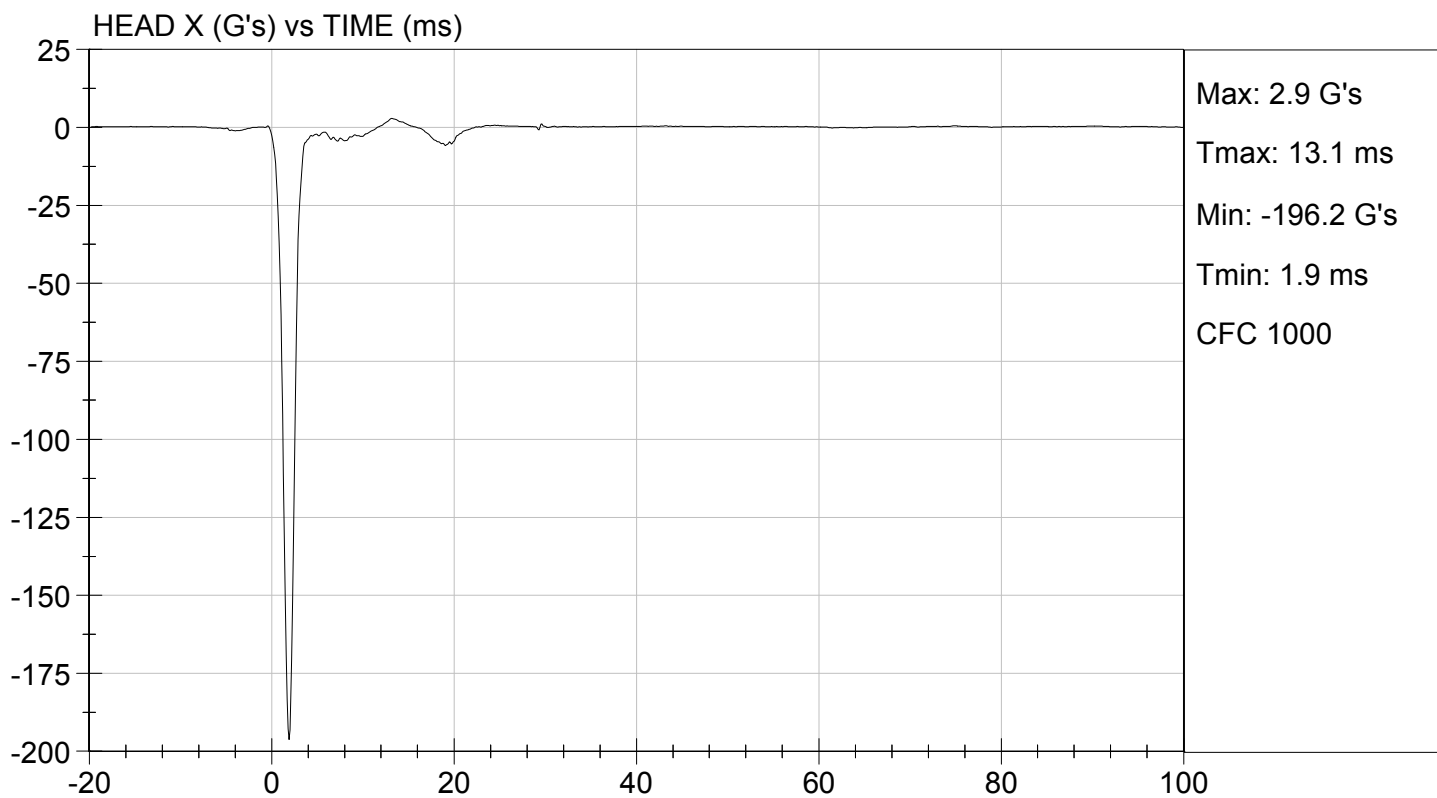
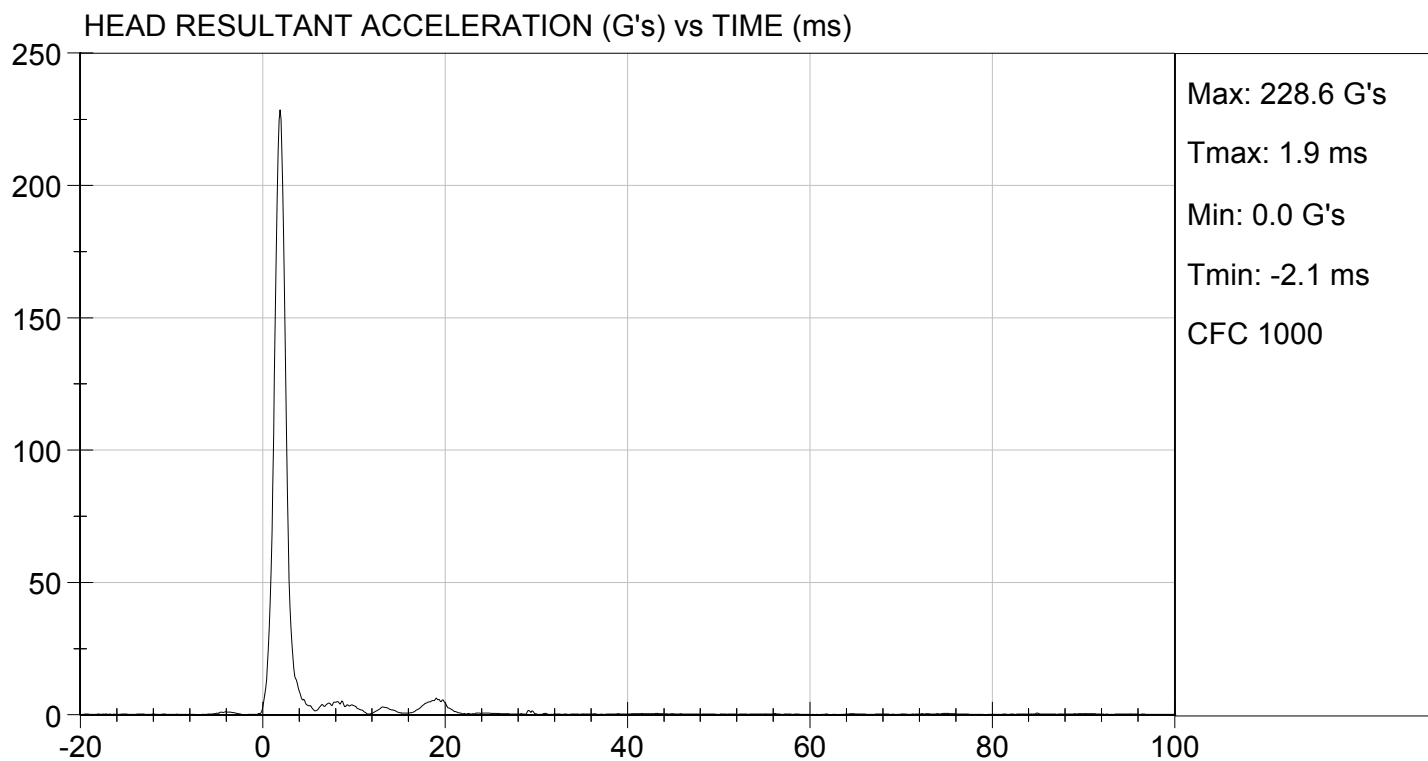
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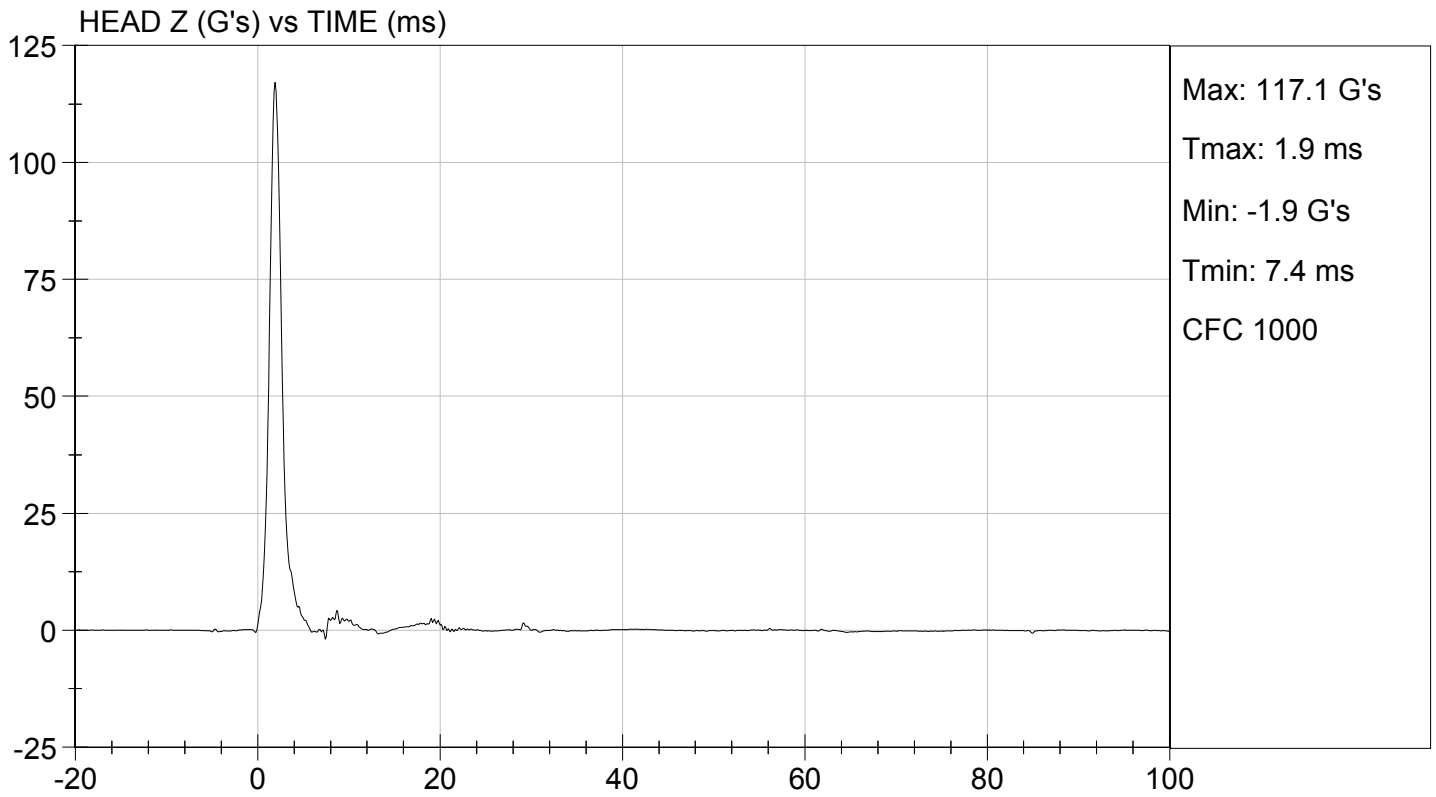
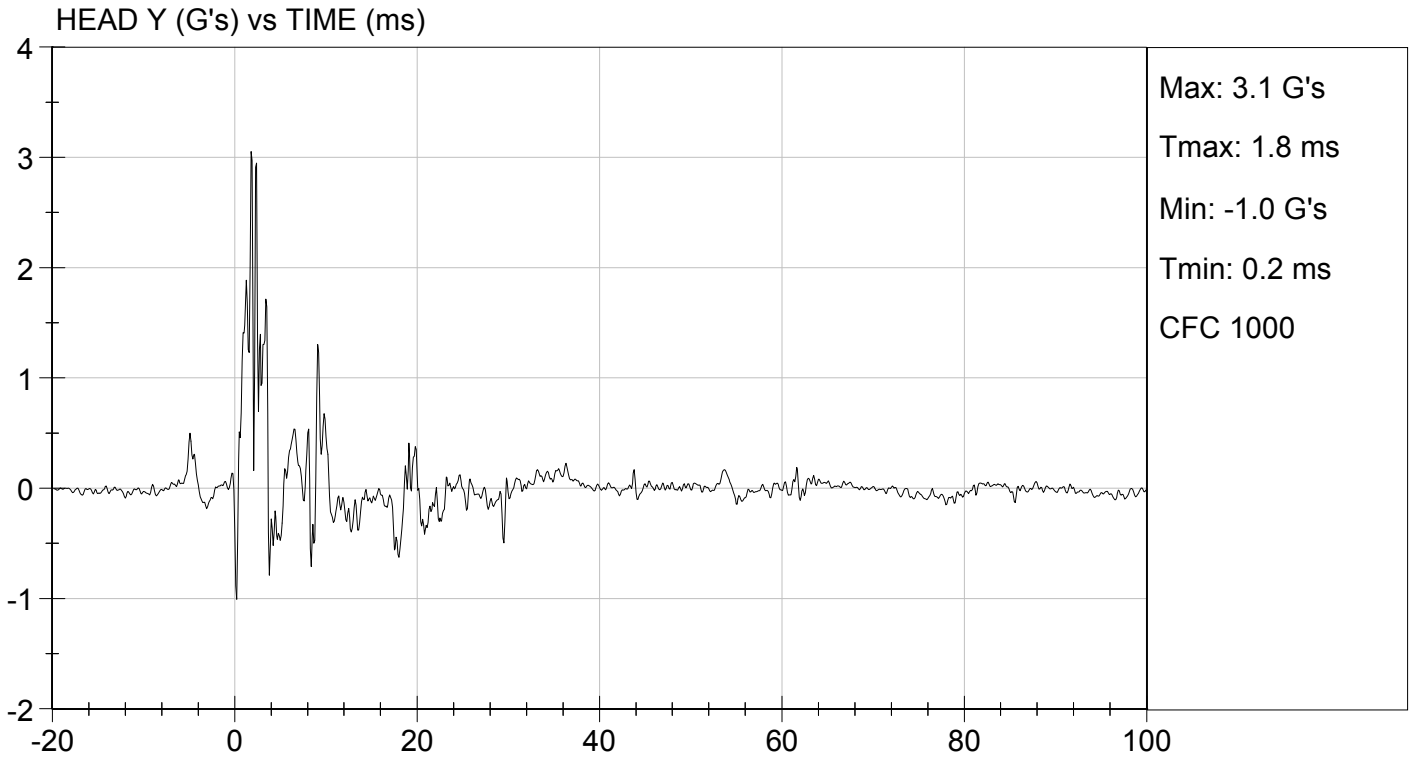
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Peak Resultant Acceleration	G's	225 to 275	229	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	3.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within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

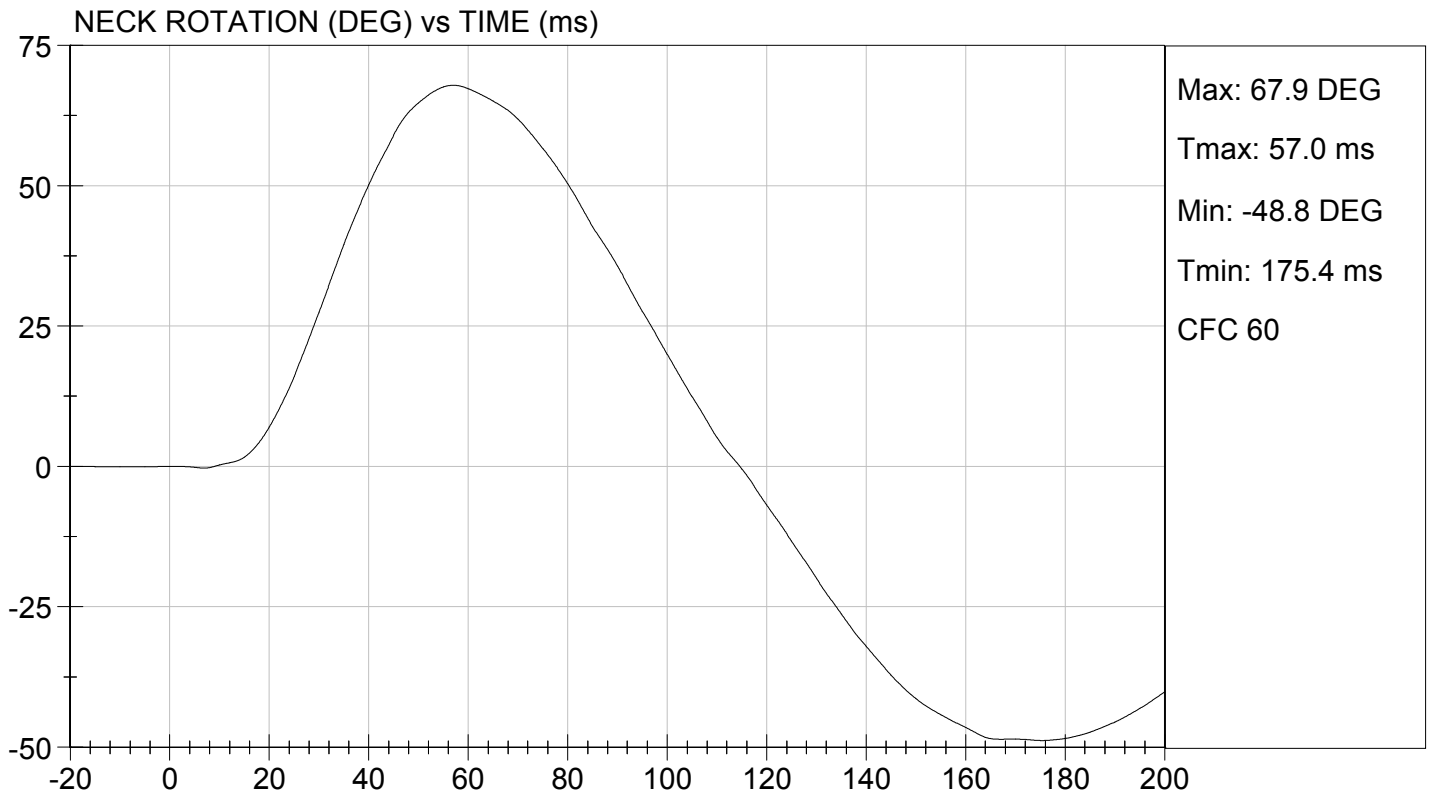
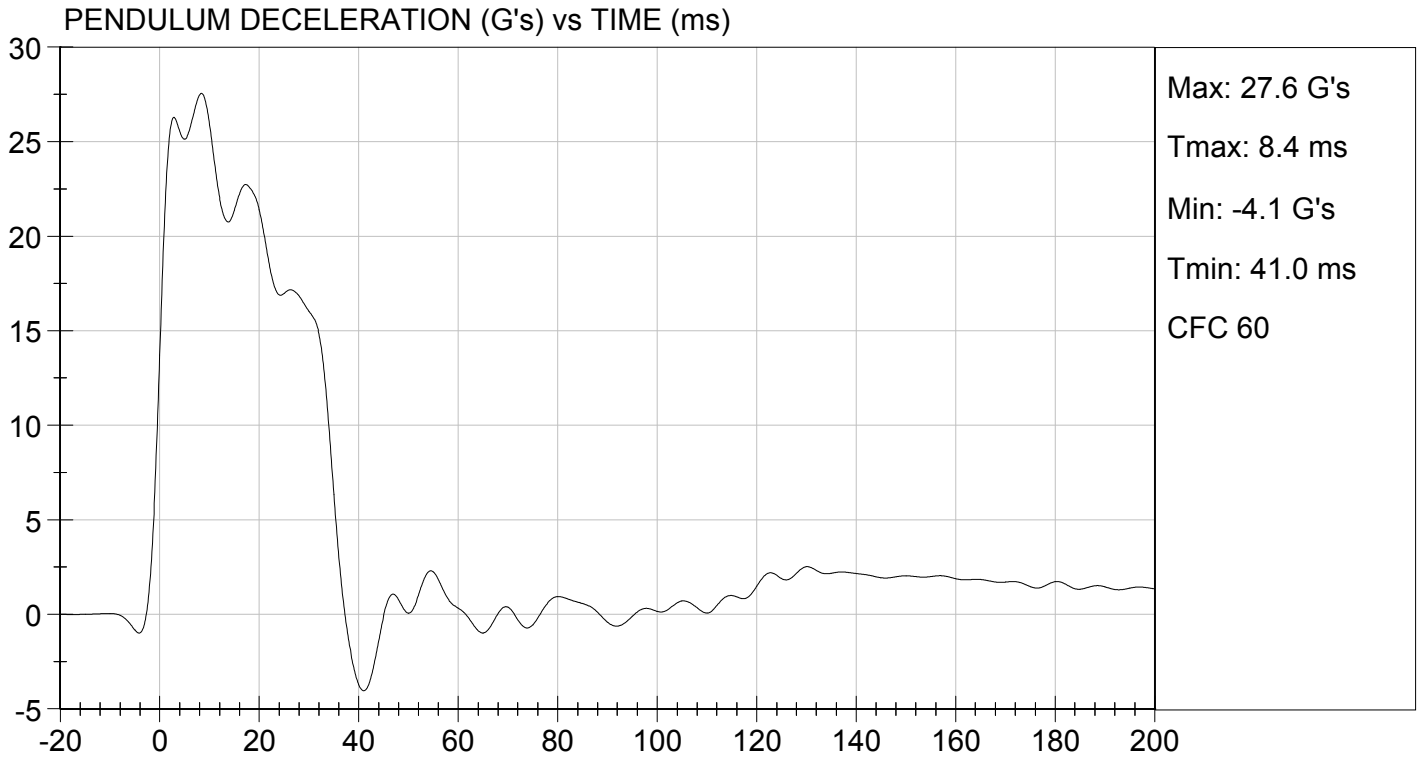
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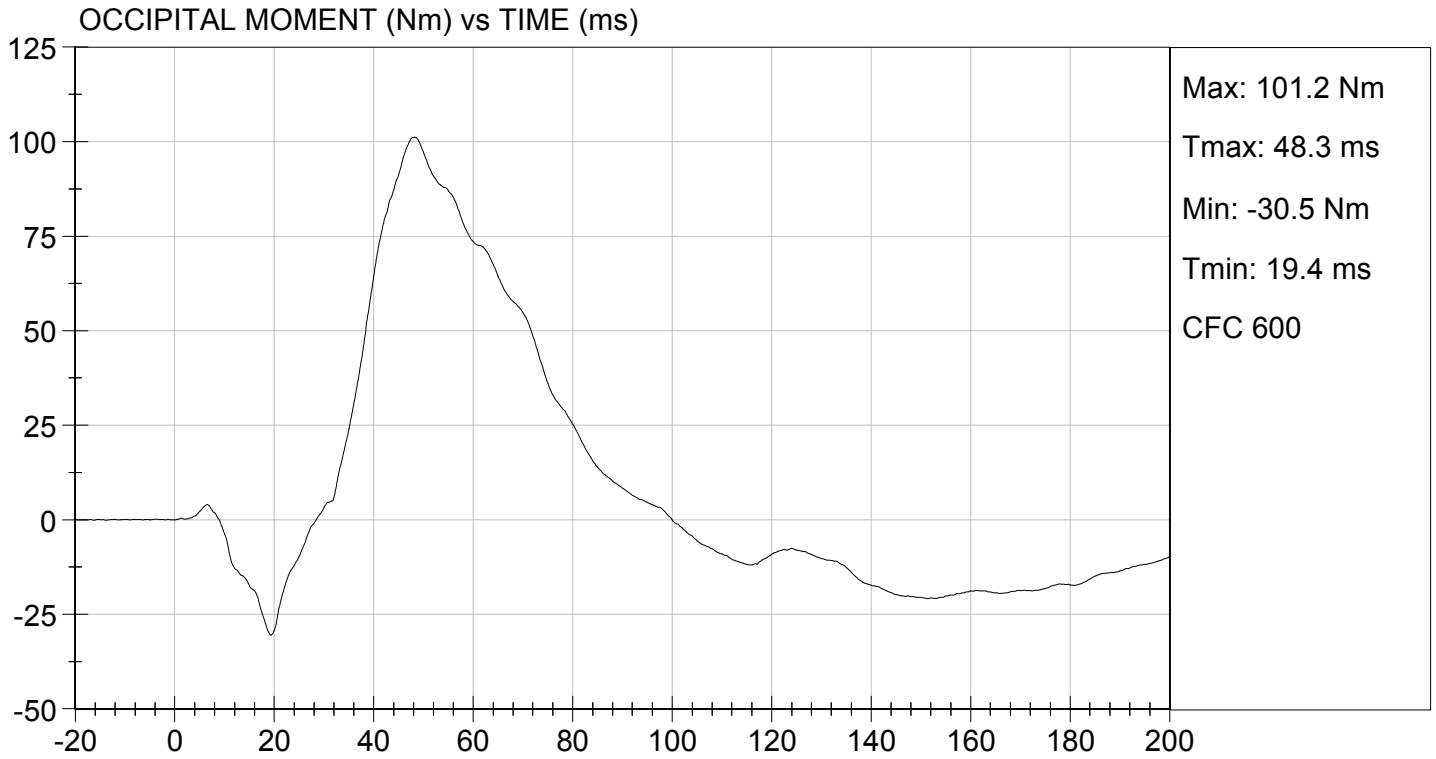
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	29	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	25.88	Pass
	20 ms	G's	17.60 to 22.60	21.40	Pass
	30 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**

ATD Serial No: 351

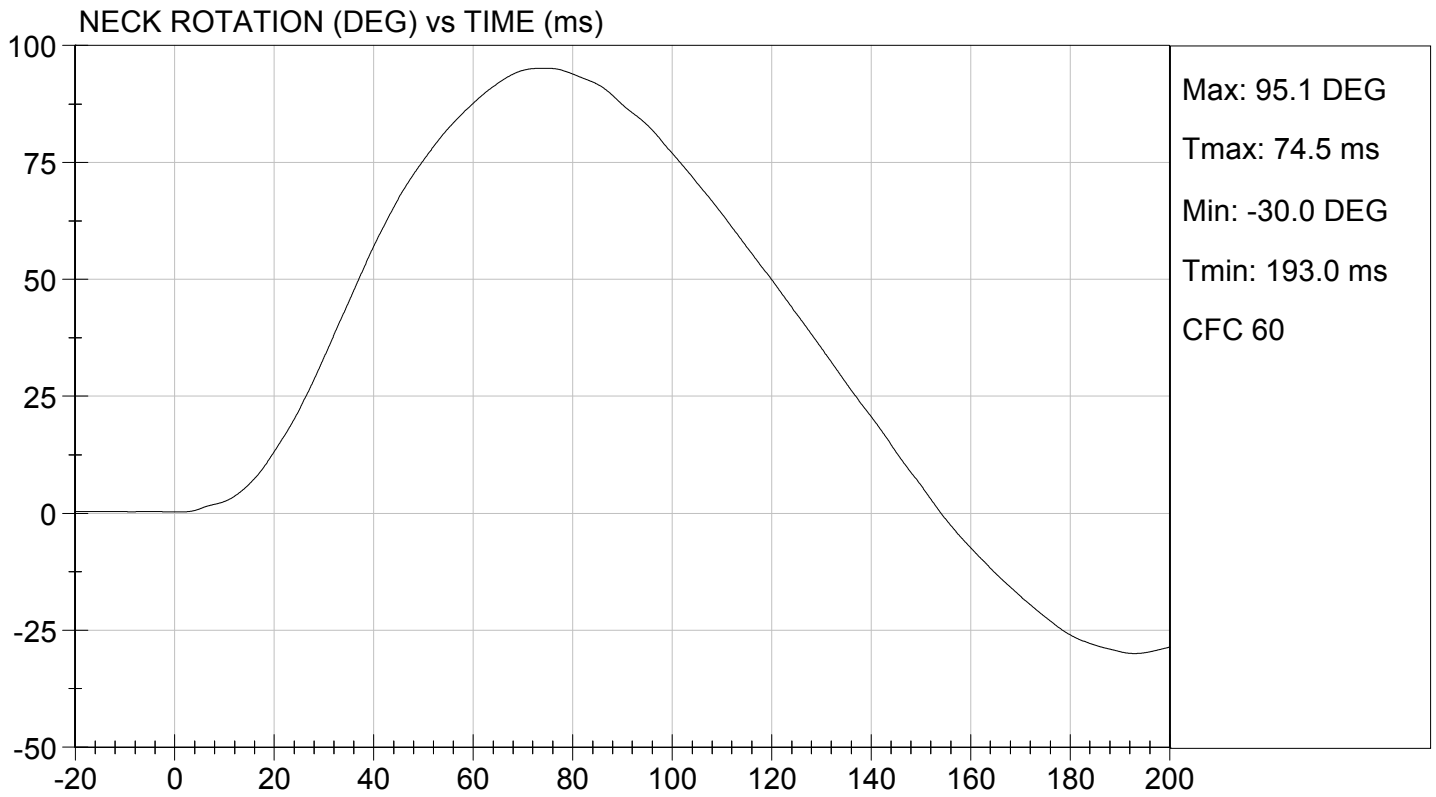
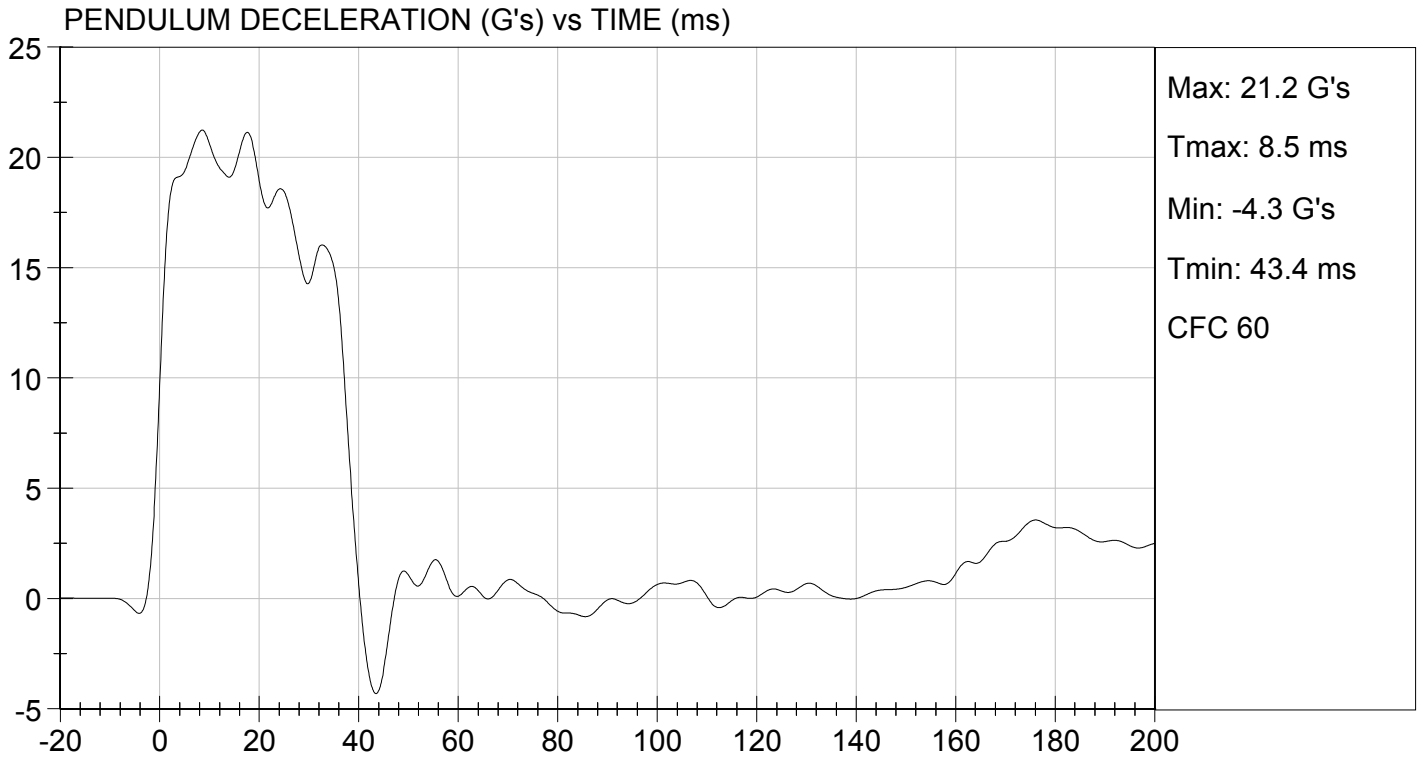
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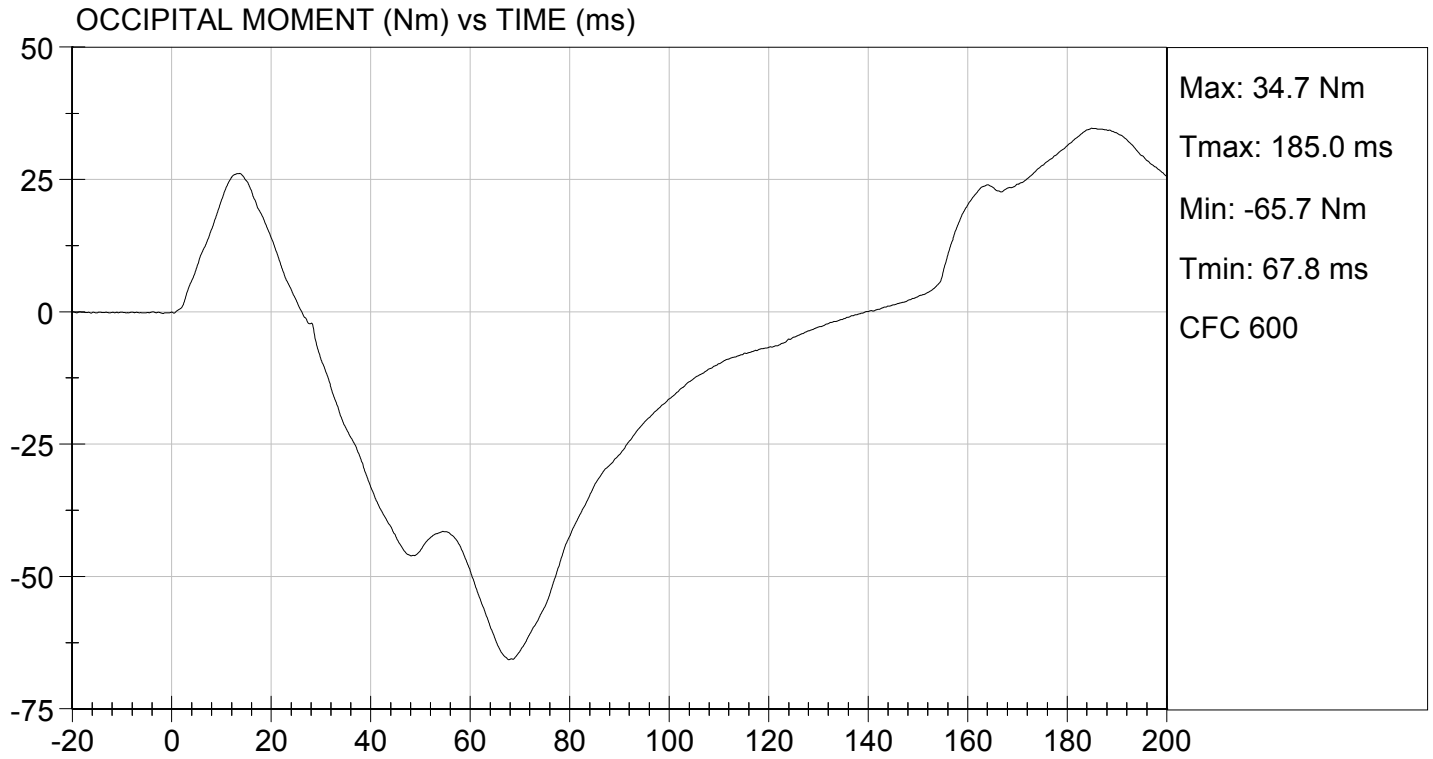
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	28	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	20.60	Pass
	20 ms	G's	14.00 to 19.00	18.95	Pass
	30 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
Overall Test Results					Pass

Jessica Gall  
Laboratory Technician

12/21/2012  
Test Date

David Winkelbauer  
Approved By





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

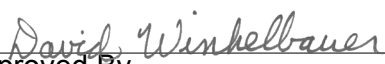
**ATD Serial No:** 351

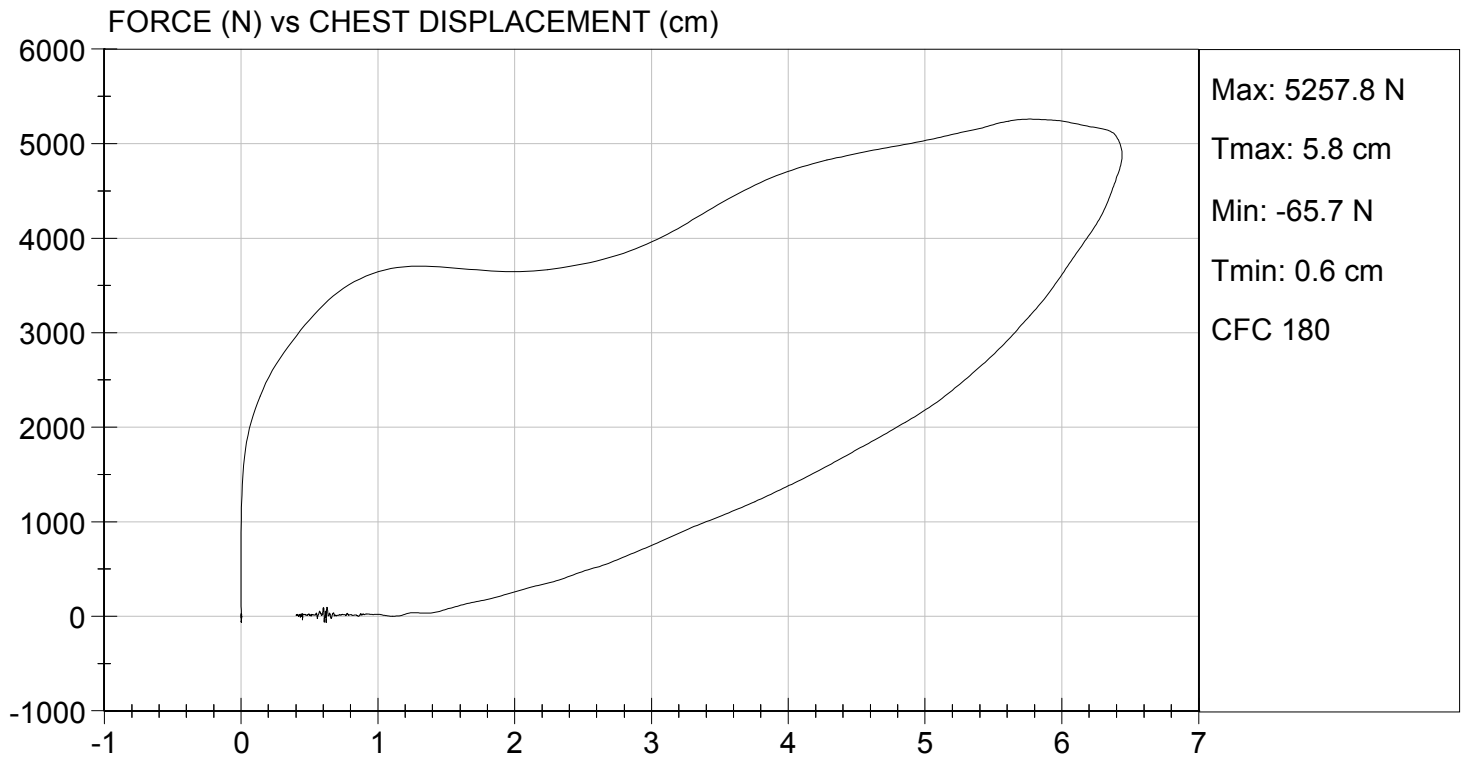
**Test I.D.:** D124824

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

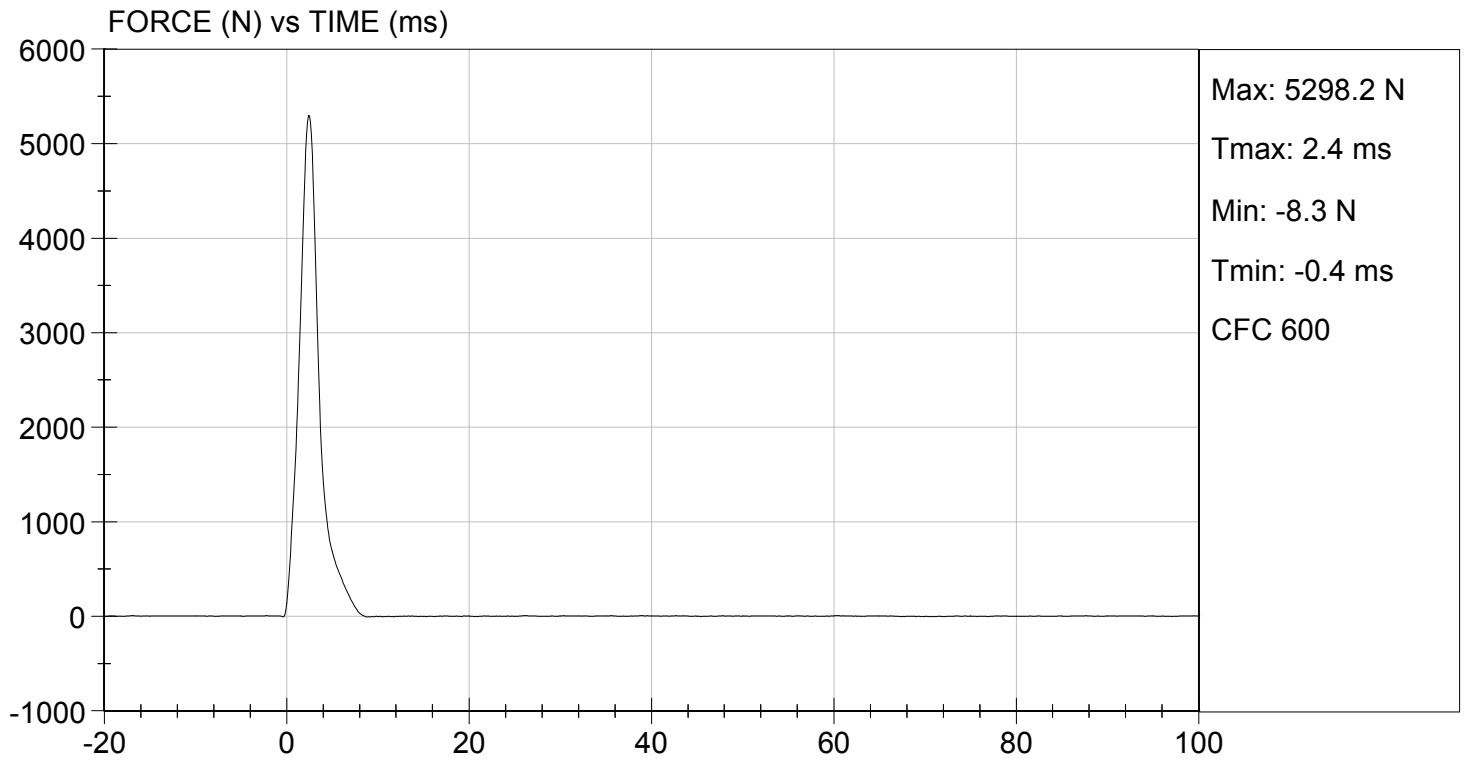
12/21/2012  
 Test Date

  
 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

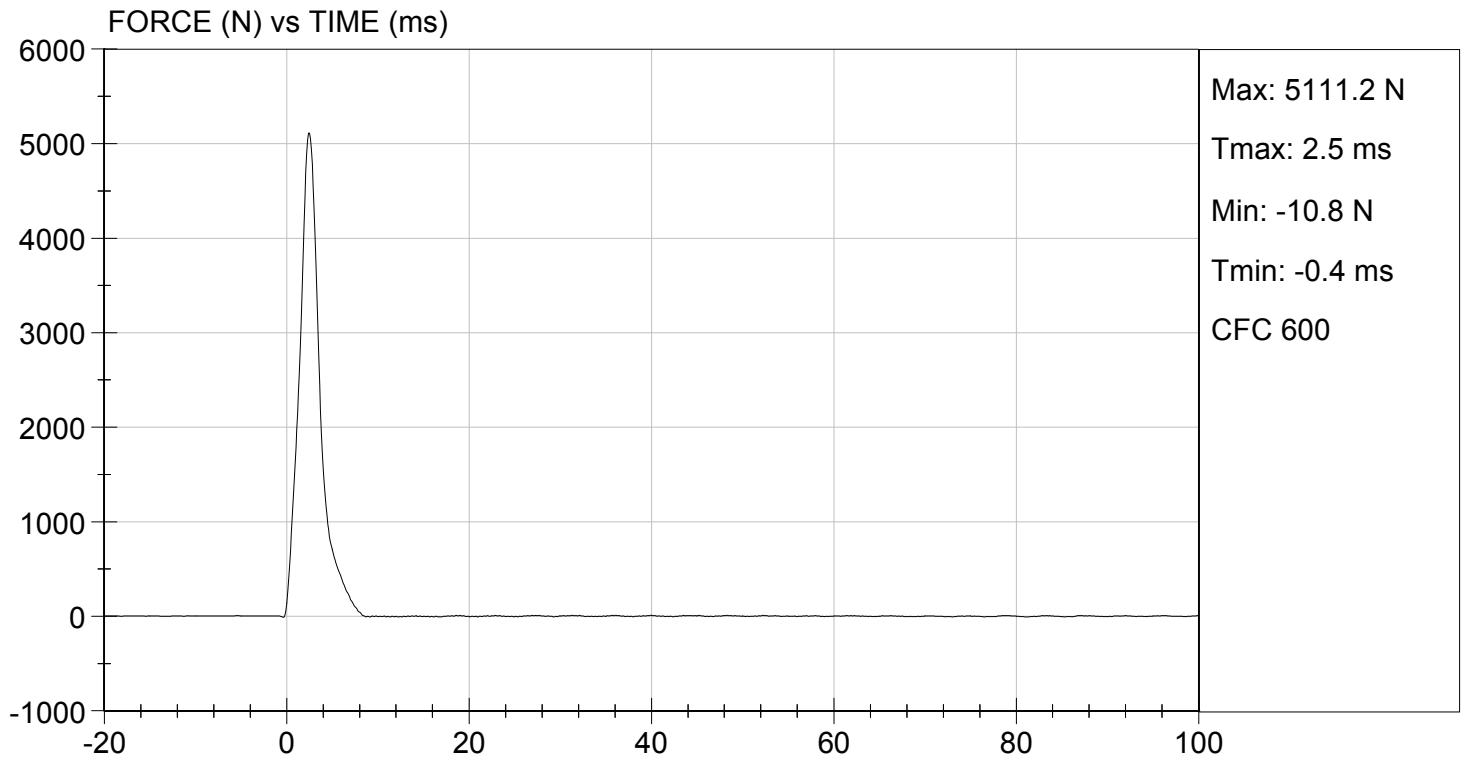
12/21/2012  
 Test Date

  
 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

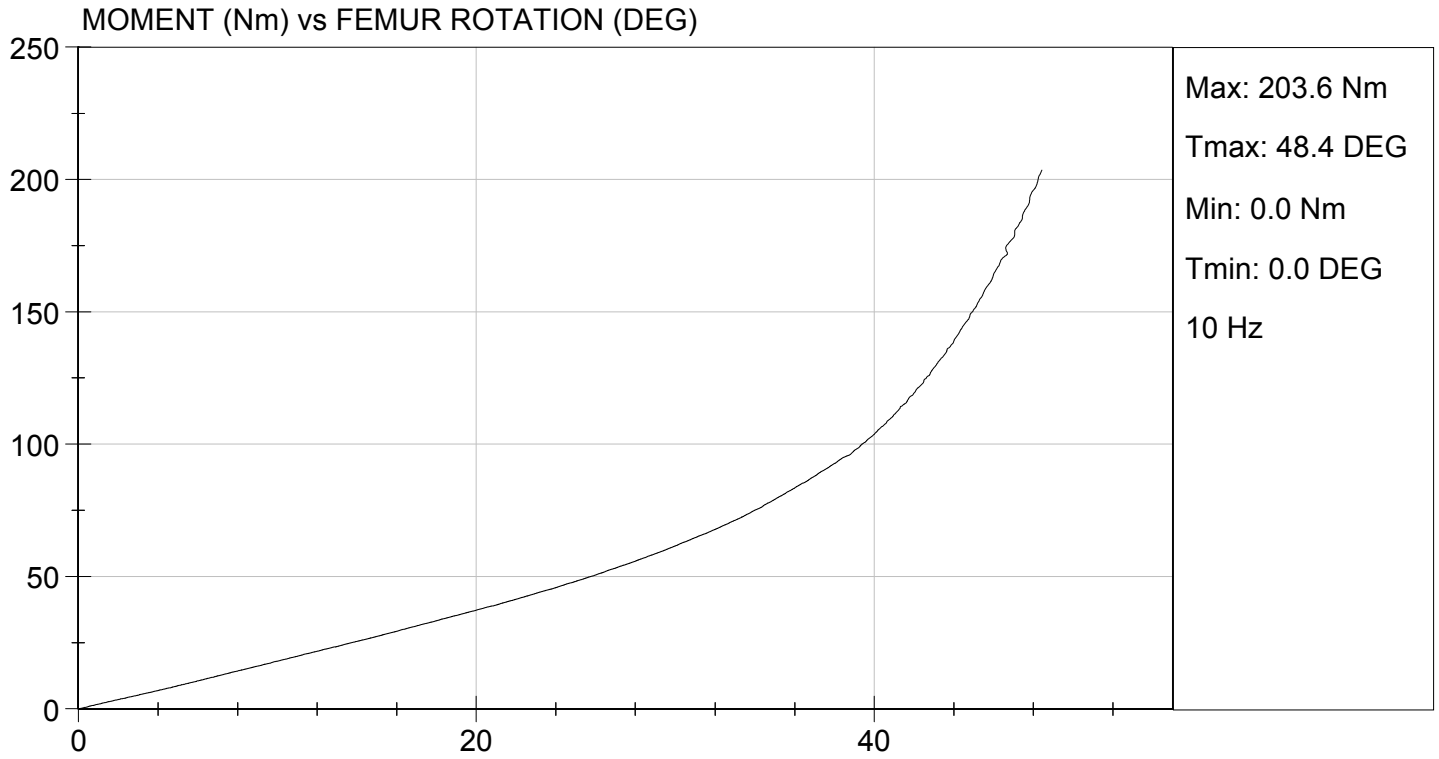
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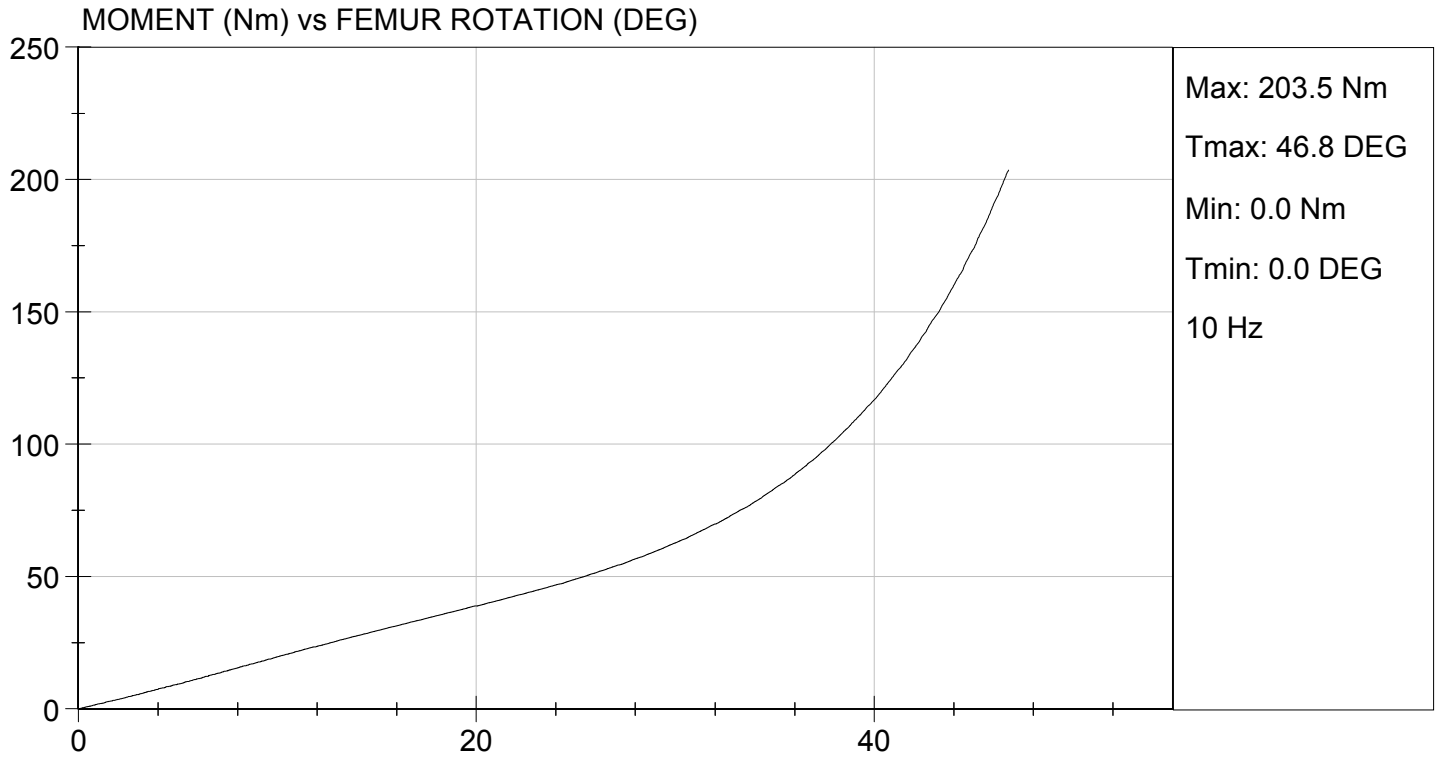
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	29	29	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.3	6.3	Pass
30 Degrees	Nm	94.9 Nm Max	61.6	62.7	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0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

  
 Laboratory Technician

12/21/2012  
 Test Date

  
 Approved By





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

ATD Serial No: 351

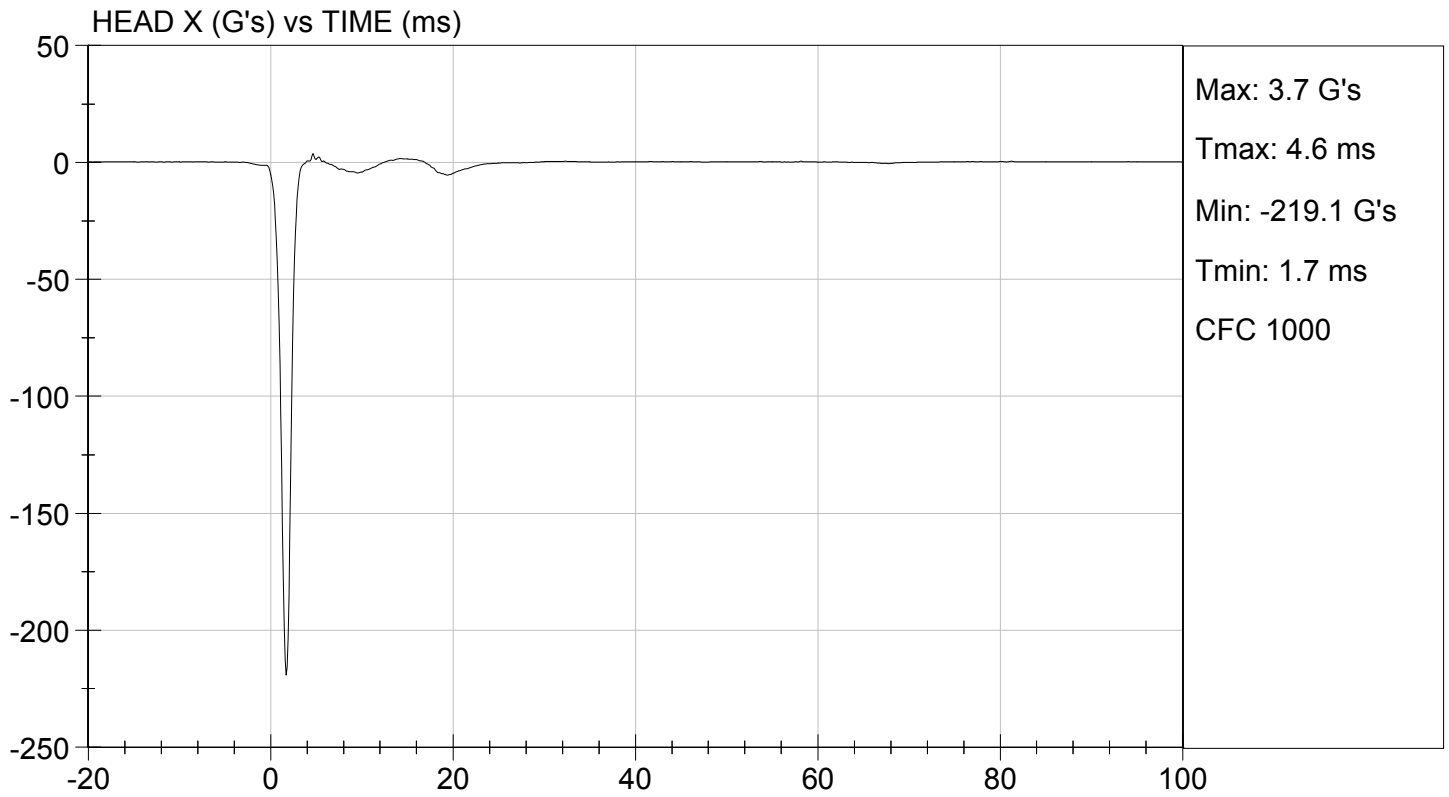
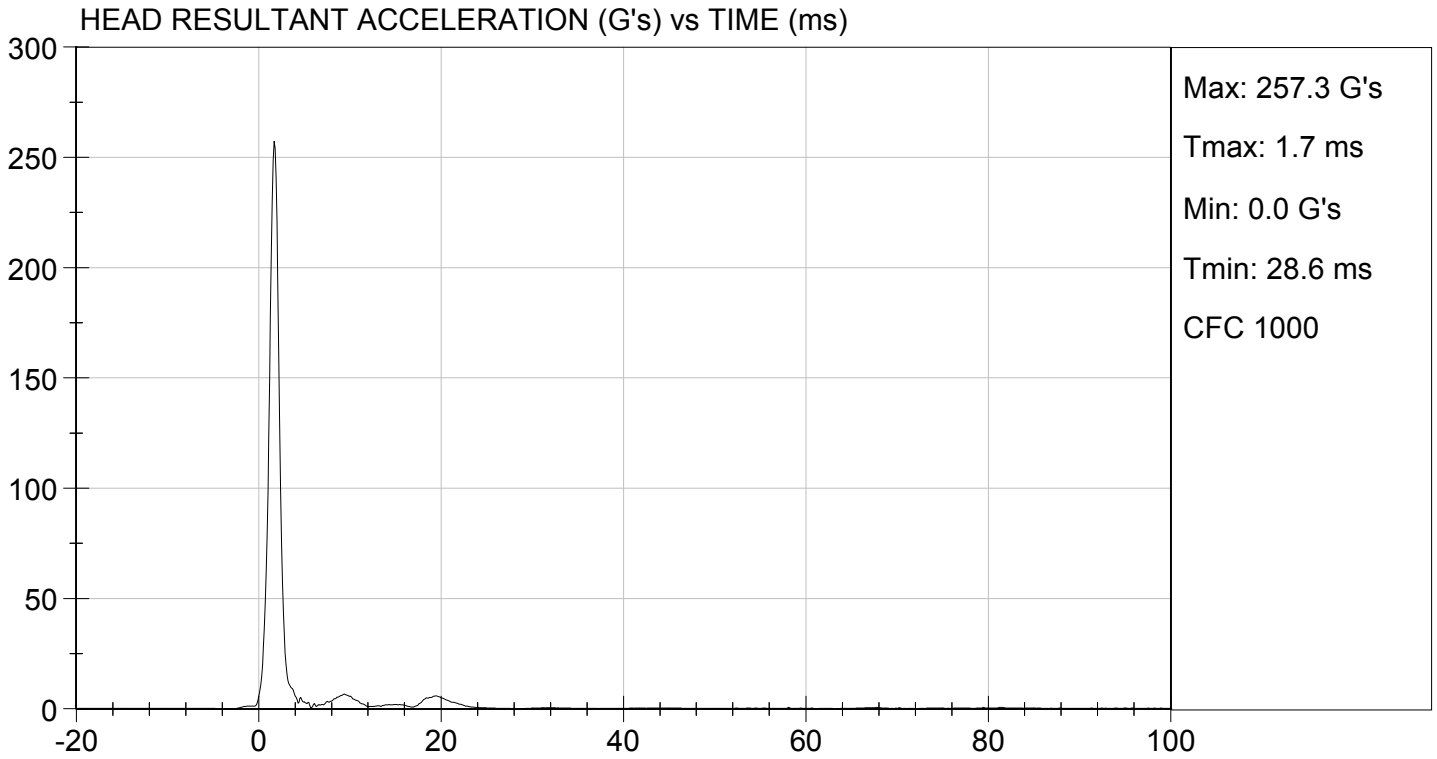
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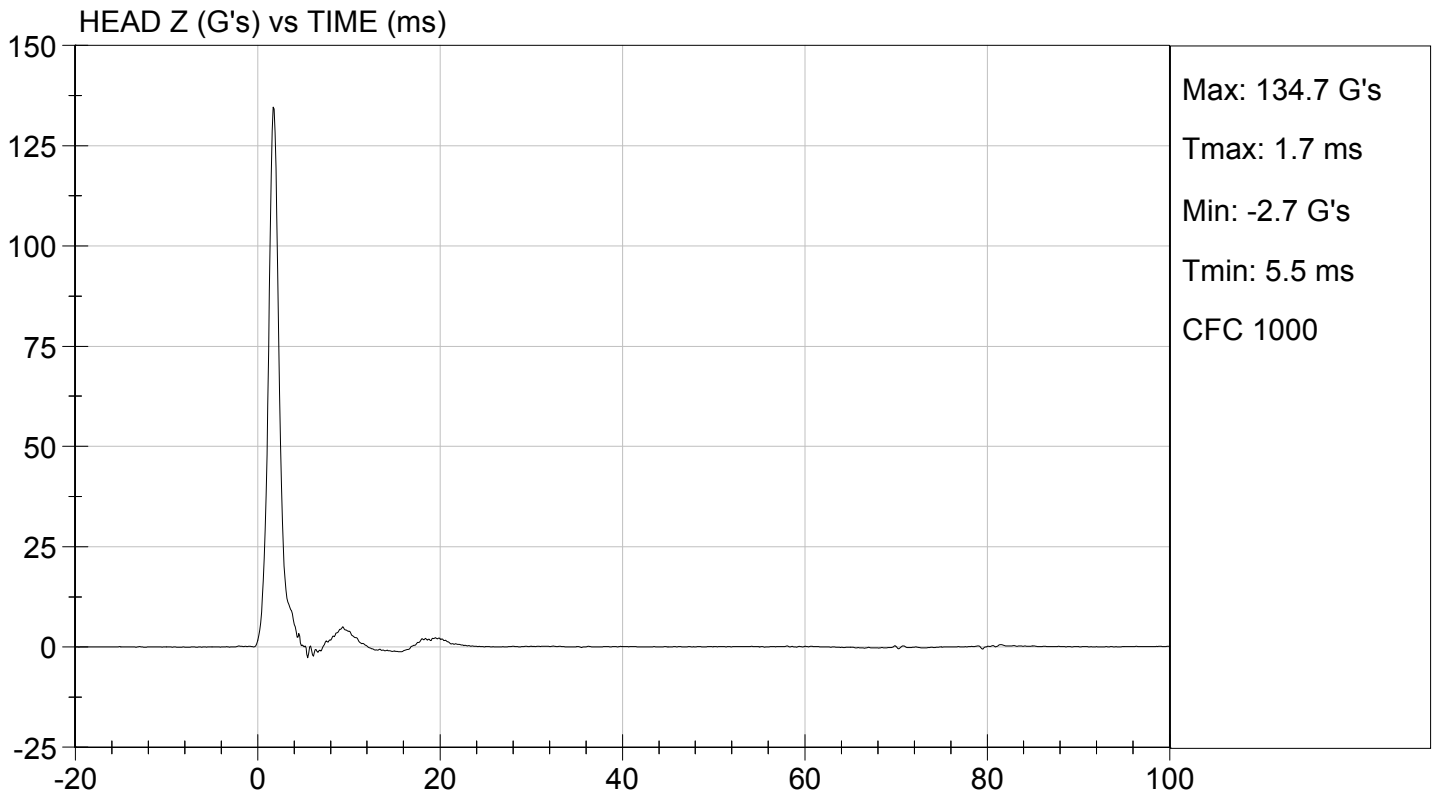
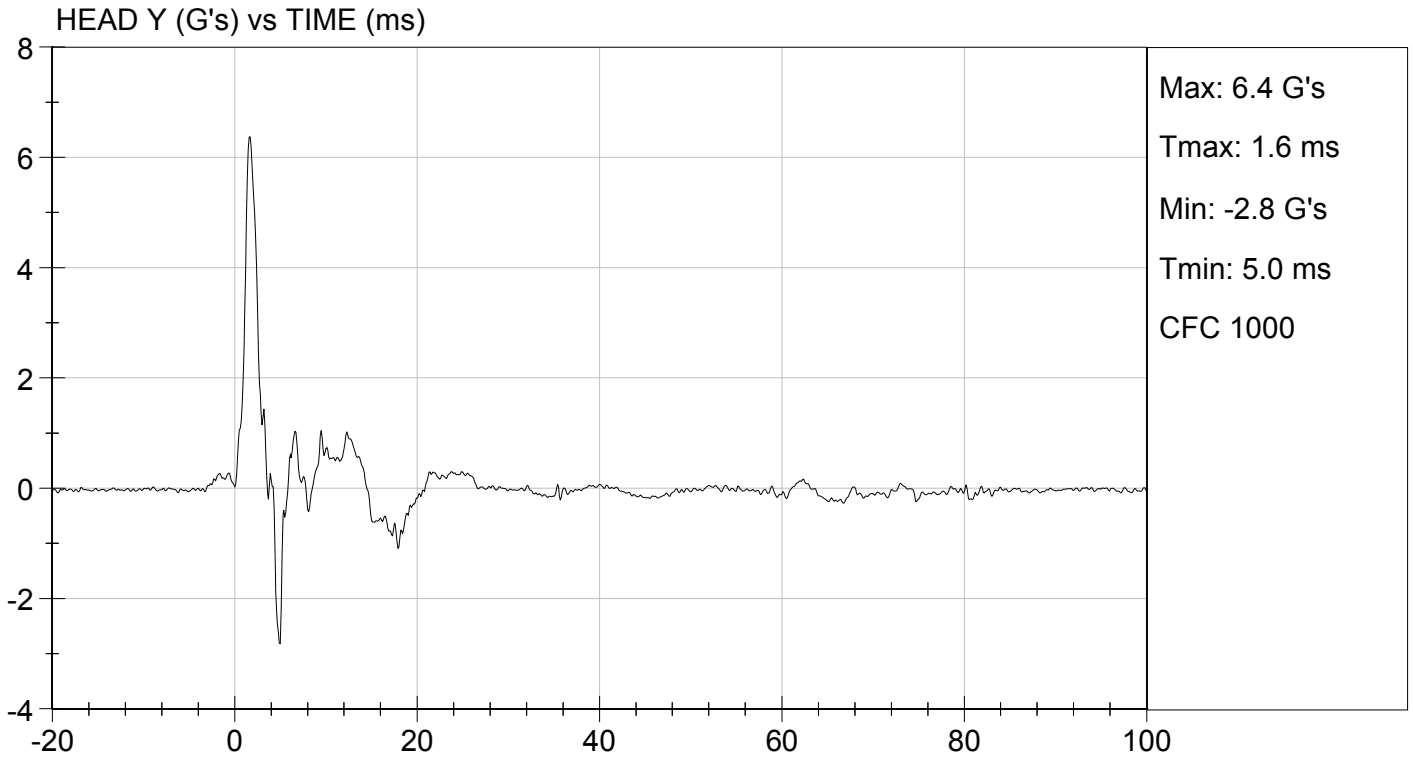
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.3	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Peak Resultant Acceleration	G's	225 to 275	257	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	6.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

Jessica Hall  
Laboratory Technician

01/10/2013  
Test Date

David Winkelbauer  
Approved By





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

**ATD Serial No:** 351

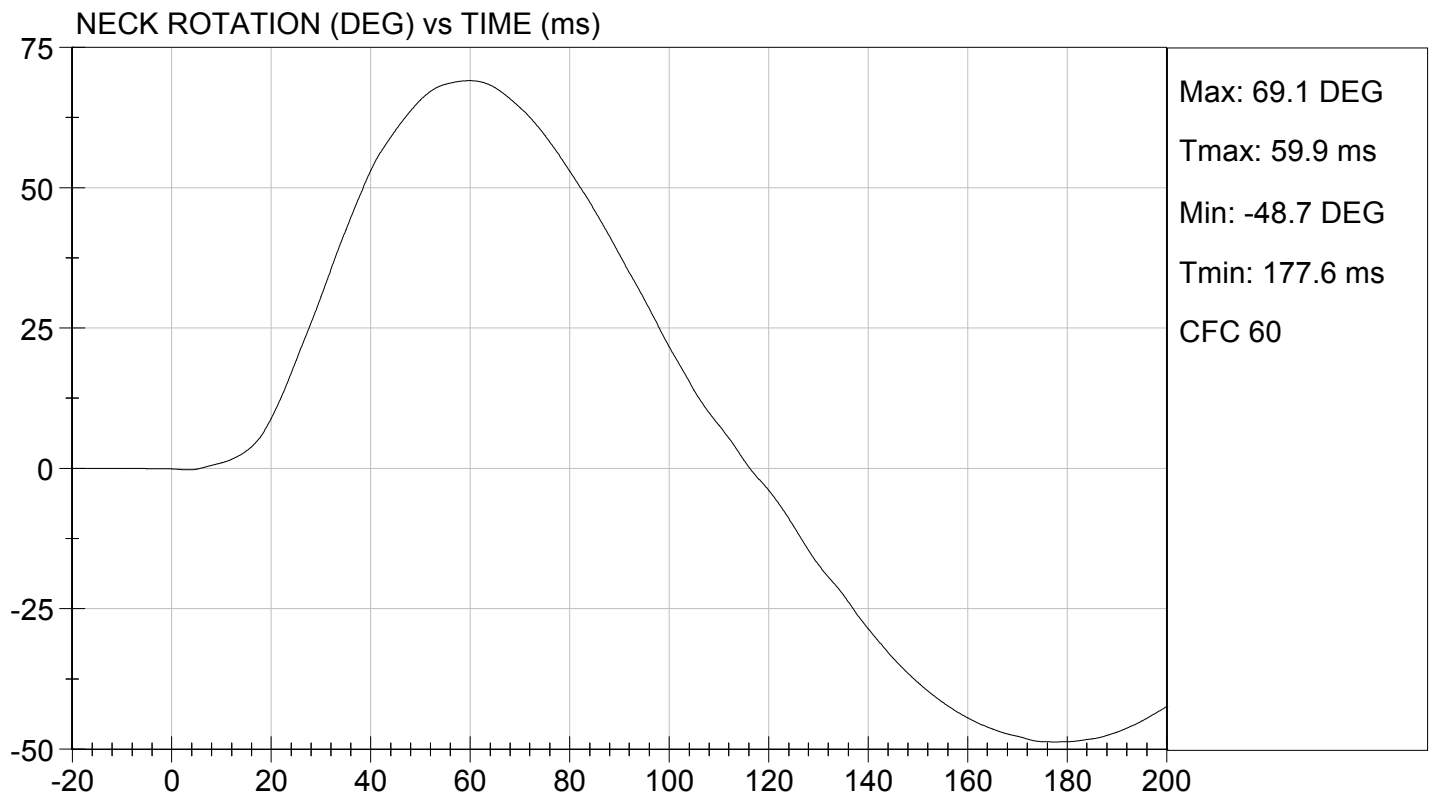
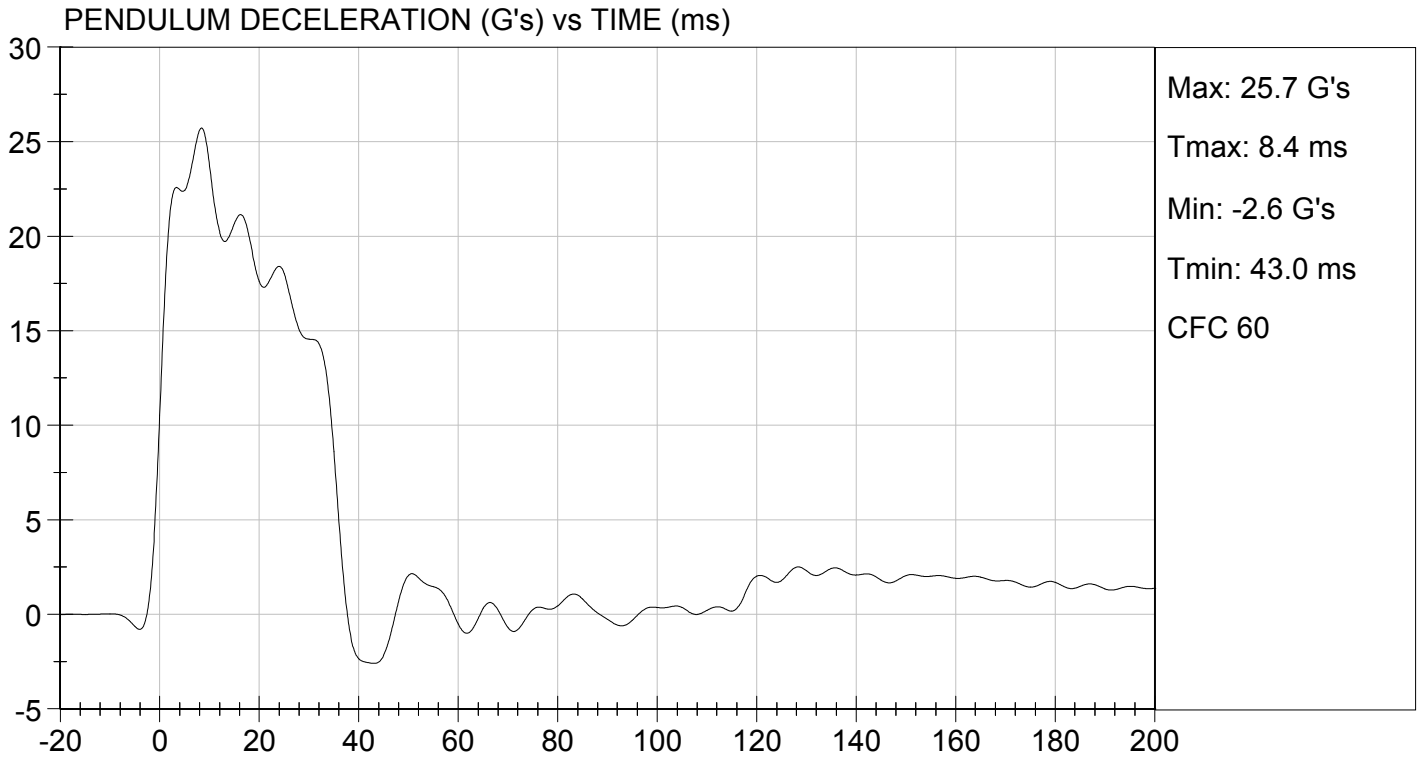
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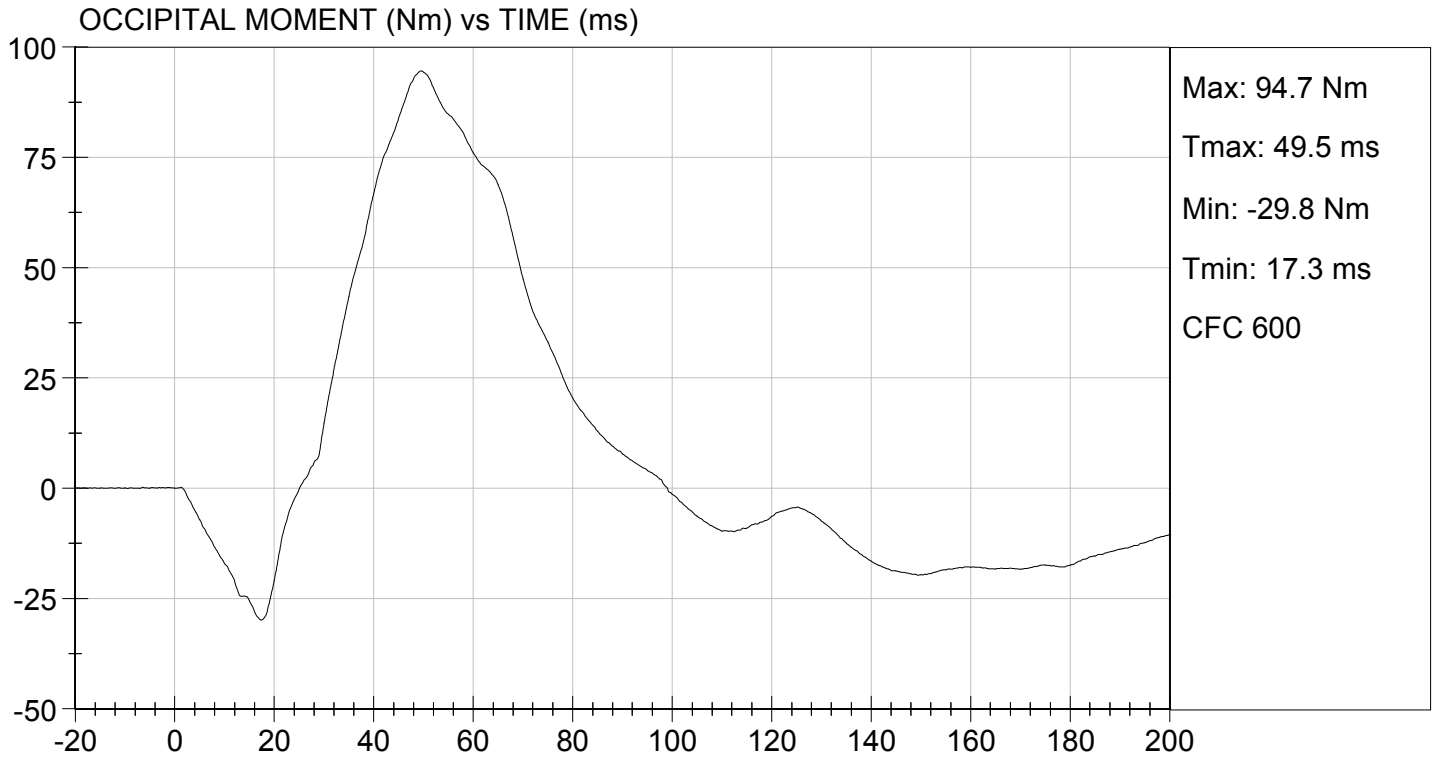
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity		%	10 to 70	33	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.69	Pass
	20 ms	G's	17.60 to 22.60	17.61	Pass
	30 ms	G's	12.50 to 18.50	14.50	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	14.5	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	36.1	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	69.1	Pass
	Time	ms	57.0 to 64.0	59.9	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.4	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	94.7	Pass
	Time	ms	47.0 to 58.0	49.5	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	99.2	Pass
<b>Overall Test Results</b>					<b>Pass</b>

Jessica Hall  
Laboratory Technician

01/11/2013  
Test Date

David Winkelbauer  
Approved By





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

**ATD Serial No:** 351

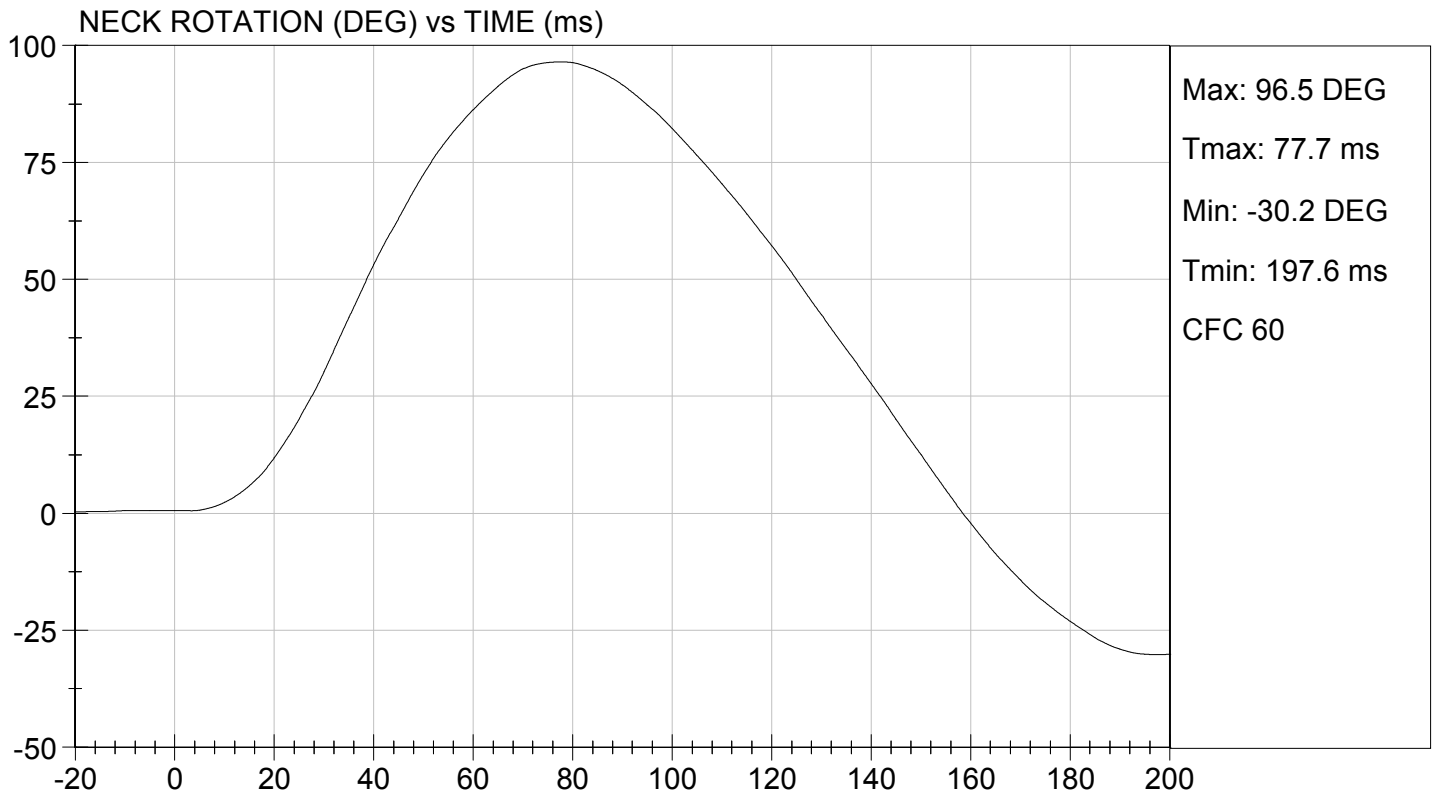
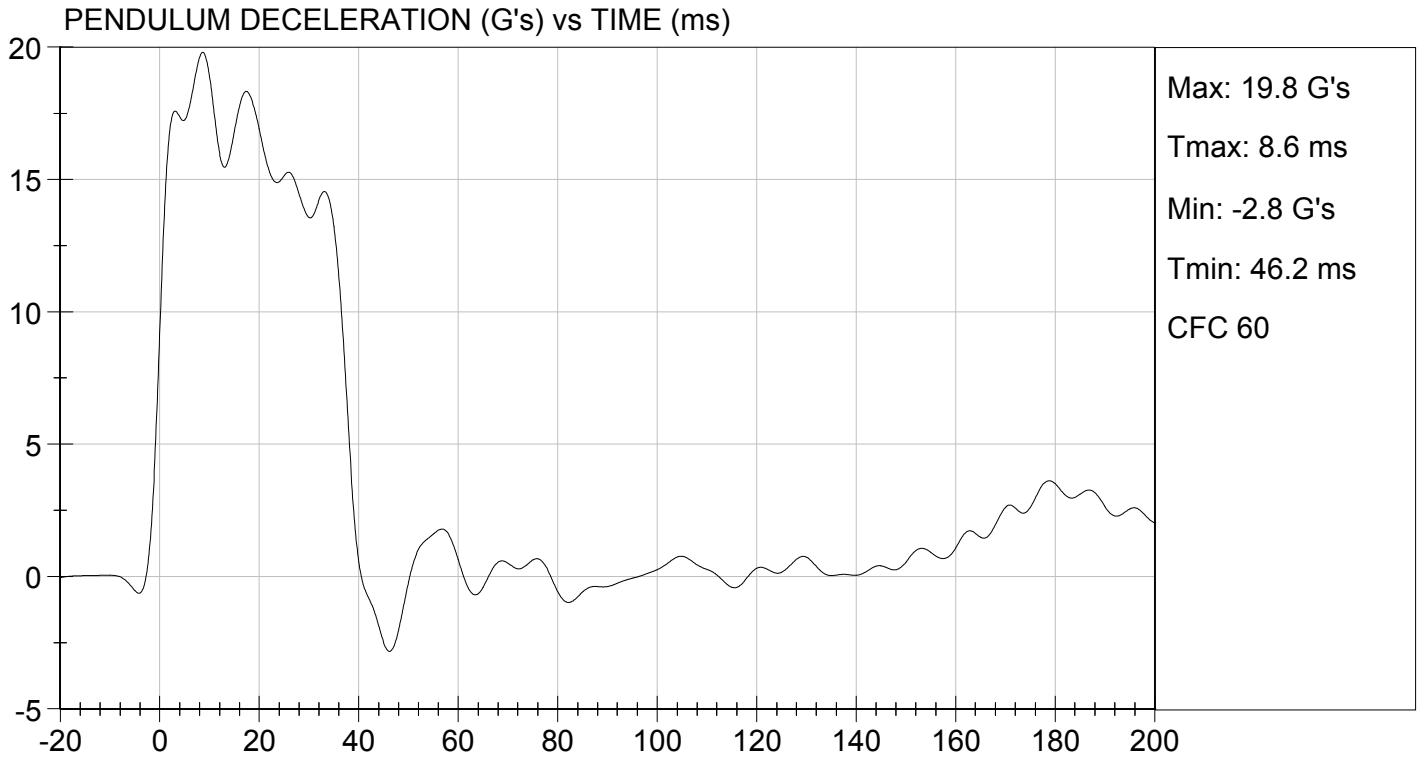
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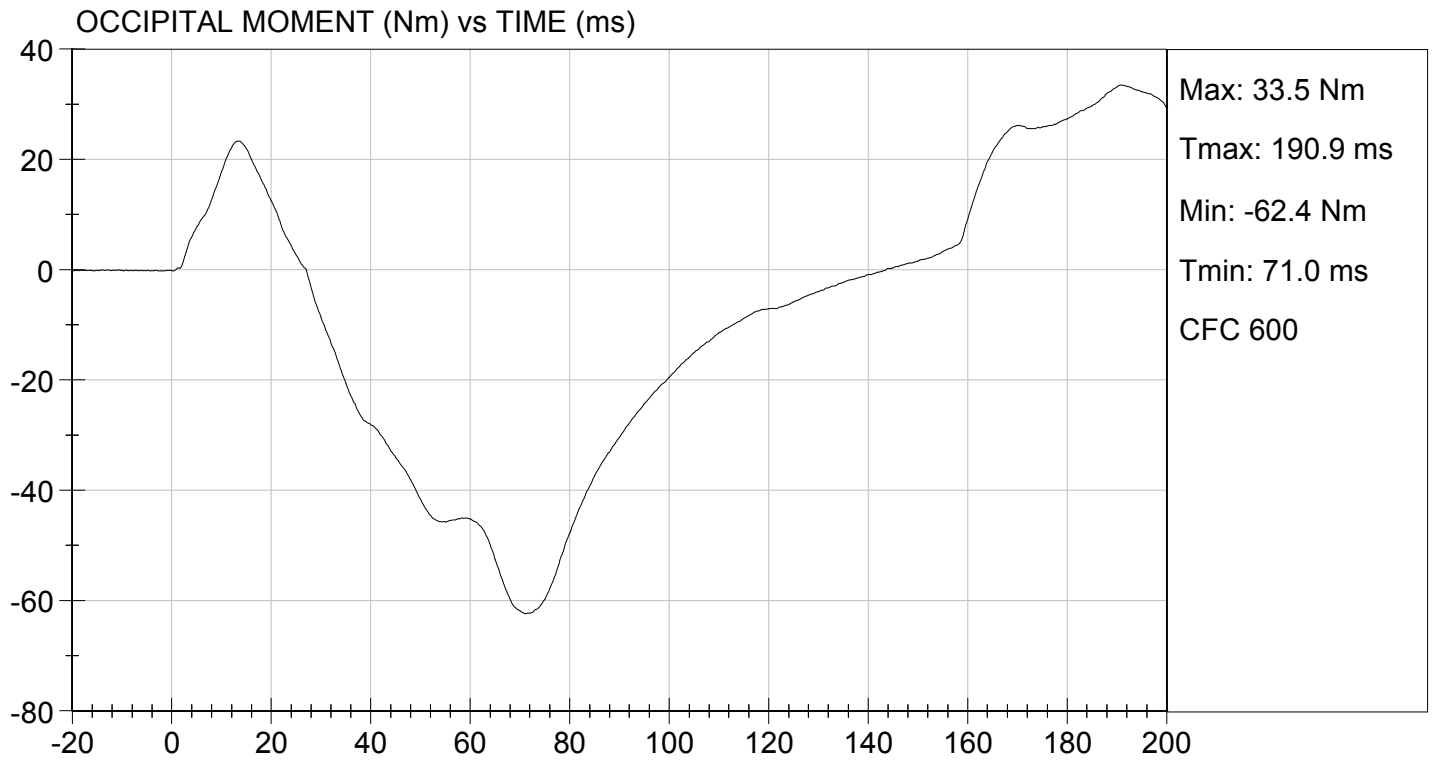
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity		%	10 to 70	33	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.13	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	18.86	Pass
	20 ms	G's	14.00 to 19.00	16.91	Pass
	30 ms	G's	11.00 to 16.00	13.56	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	14.6	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	38.2	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	96.5	Pass
	Time	ms	72.0 to 82.0	77.7	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	158.6	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-62.4	Pass
	Time	ms	65.0 to 79.0	71.0	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	143.7	Pass
Overall Test Results					Pass

Jessica Hall  
 Laboratory Technician

01/11/2013  
 Test Date

David Winkelbauer  
 Approved By





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

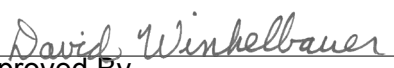
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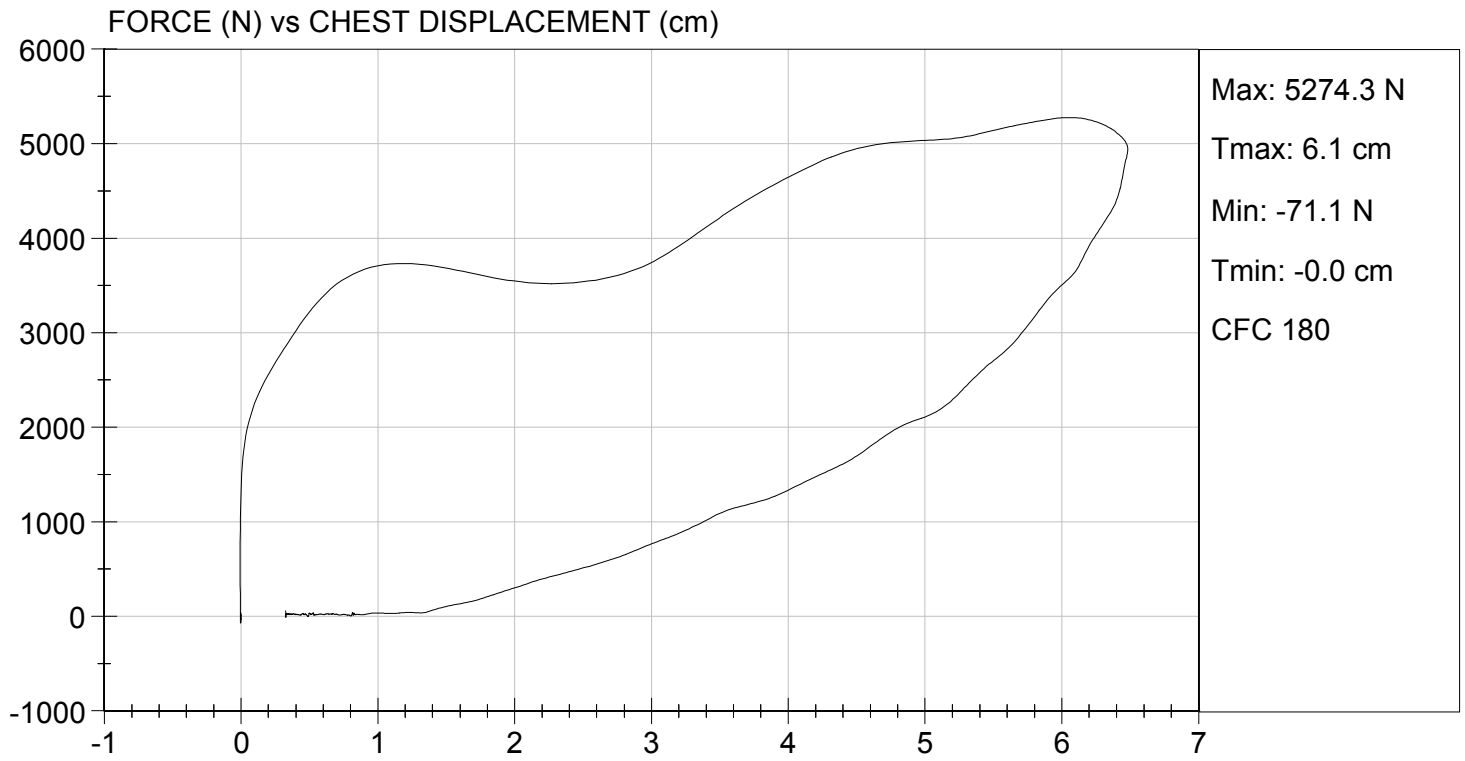
**Test I.D:** D13074

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,274	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.48	Pass
Internal Hysteresis	%	69 to 85	70	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
Laboratory Technician

01/11/2013  
Test Date

  
Approved By



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

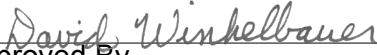
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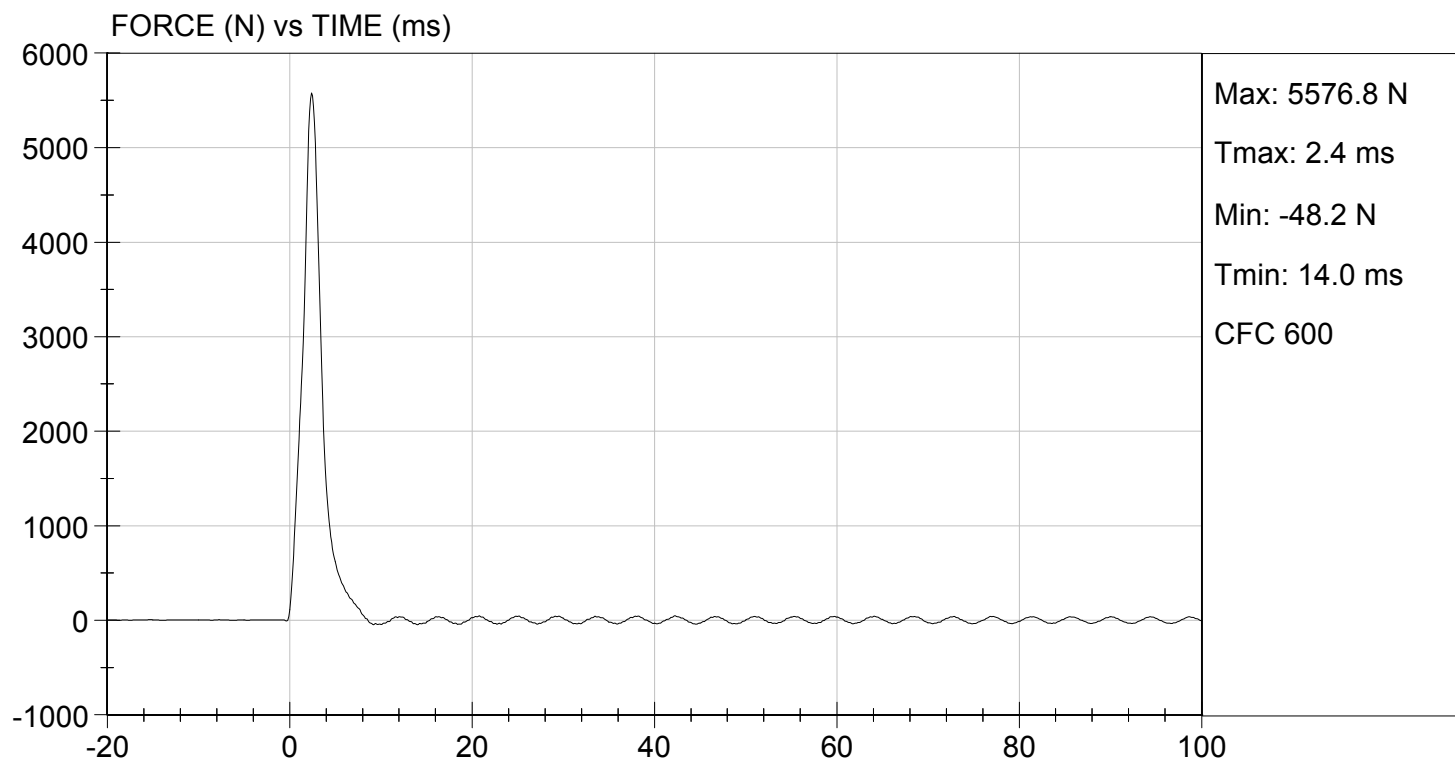
**Test I.D:** D13075

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.3	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	N	4715 to 5782	5,577	Pass
Overall Test Results				Pass

  
 Laboratory Technician

01/10/2013  
 Test Date

  
 Approved By



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


**ATD Serial No:** 351

**Test I.D:** D13076

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.3	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Probe Velocity	m/s	2.07 to 2.13	2.11	Pass
Peak Probe Force	N	4715 to 5782	5,412	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

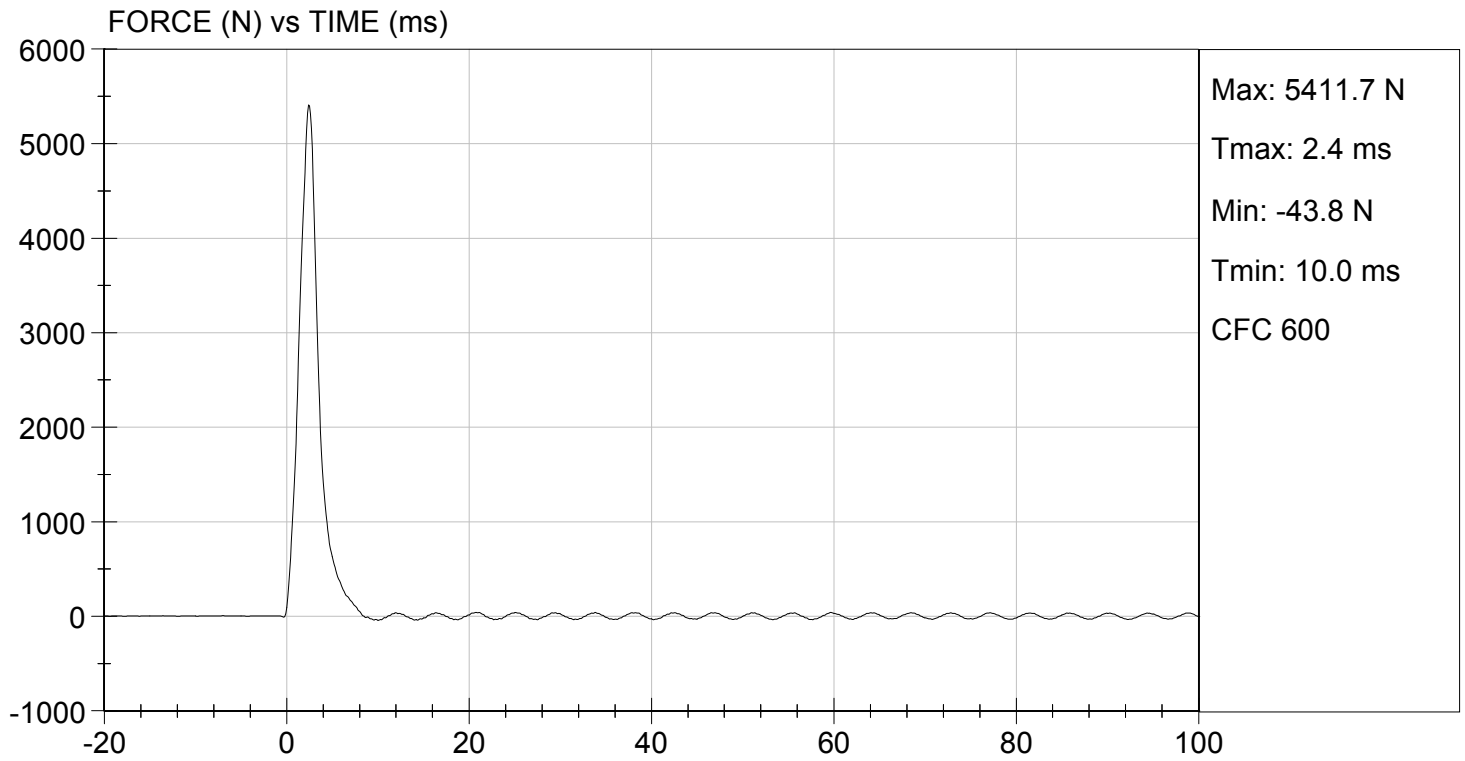
01/10/2013  
 Test Date

  
 Approved By



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

TEST DATE: 01/10/2013  
TEST #: D13076



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

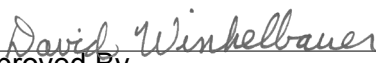
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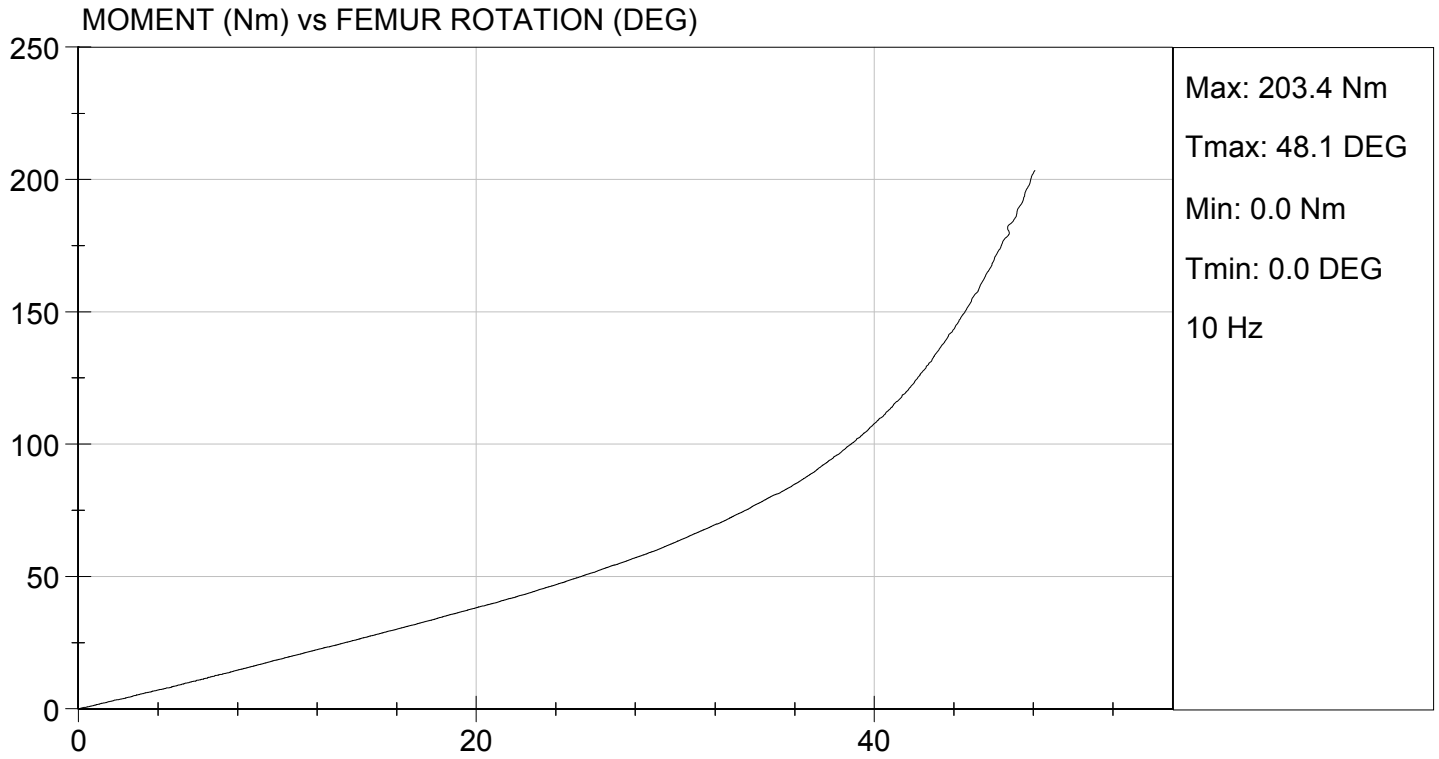
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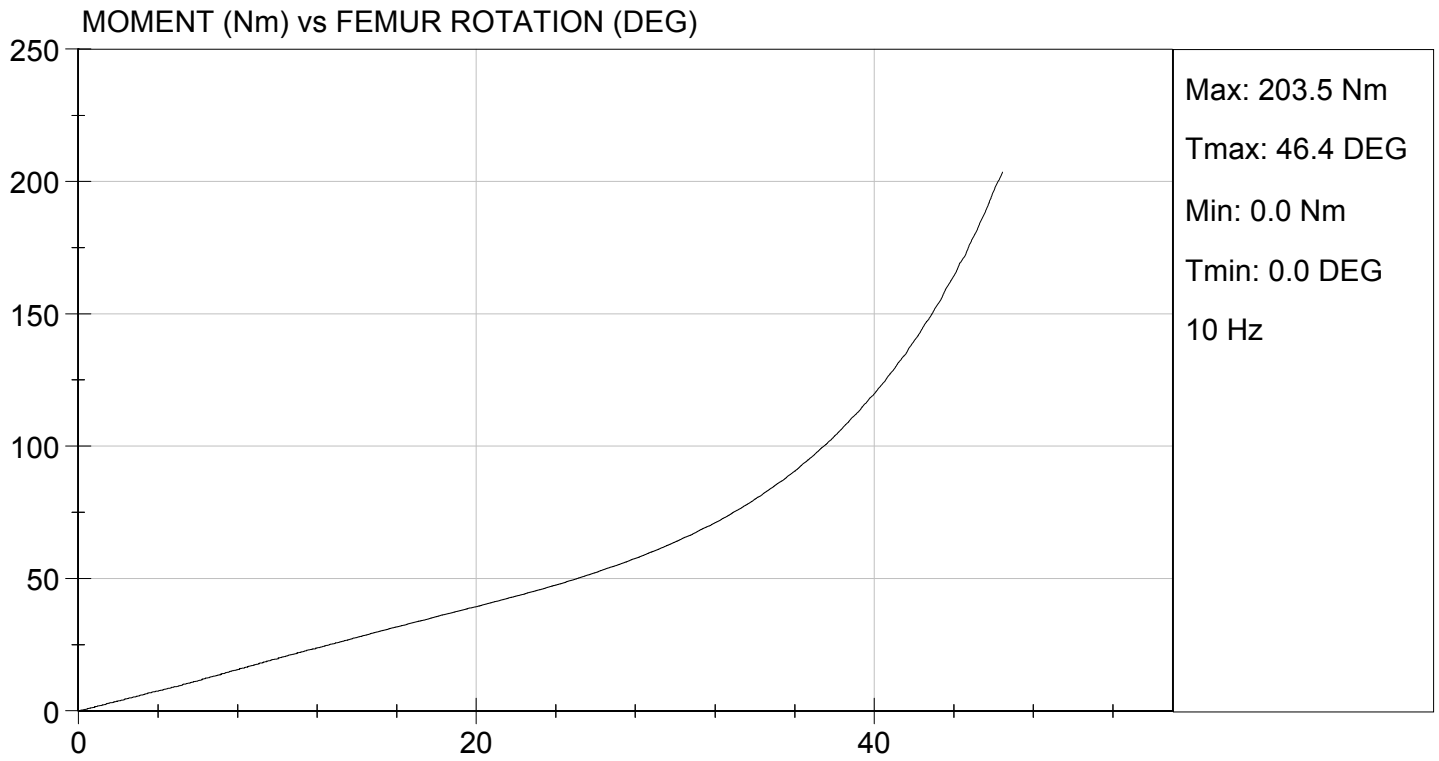
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	20.4	20.4	Pass
Laboratory Relative Humidity	%	10 to 70	30	30	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.3	6.3	Pass
30 Degrees	Nm	94.9 Nm Max	62.9	63.8	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.1	46.4	Pass
Overall Test Results					Pass

  
 Laboratory Technician

01/10/2013  
 Test Date

  
 Approved By





**Hybrid III, 5<sup>th</sup> External Measurements  
SN: 138**

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	785.1
B	SHOULDER PIVOT HEIGHT	Centerline of shoulder pivot bolt to the seat surface.	431.8-457.2	456.8
C	H-POINT HEIGHT	Reference	81.3-86.3	84.0
D	H-POINT LOCATION FROM BACKLINE	Reference	144.8-149.8	146.2
E	SHOULDER PIVOT FROM BACKLINE	Center of the shoulder clevis to the rear vertical surface of the fixture.	68.6-83.8	78.0
F	THIGH CLEARANCE	Measured at the highest point on the upper femur segment.	119.4-134.6	127.5
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	249.6
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	280.2
J	ELBOW REST HEIGHT	Measure from the flesh below the elbow pivot bolt to the seat surface.	182.8-203.2	201.9
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	526.7
L	POPLITEAL HEIGHT	Seat surface to the plane of the horizontal plane of the bottom of the feet.	355.6-376.0	362.3
M	KNEE PIVOT HEIGHT	Centerline of knee pivot bolt to the horizontal plane of the bottom of the feet.	393.7-419.1	398.0
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	430.5

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	184.6
P	FOOT LENGTH	Tip of toe to rear of heel	218.5-233.7	221.0
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	472.6
S	HEAD BREADTH	The widest part of the head	137.1-147.3	141.9
T	HEAD DEPTH	Back of the head to the forehead	177.8-188.0	184.2
U	HIP BREADTH	The widest part of the hip	299.7-314.9	307.4
V	SHOULDER BREADTH	Outside edges of right and left shoulder clevises	350.5-365.7	360.5
W	FOOT BREADTH	The widest part of the foot	78.8-94.0	85.0
X	HEAD CIRCUMFERENCE	Measured at the point as in dim. "T"	528.3-548.7	546.2
Y	CHEST CIRCUMFERENCE (WITH CHEST JACKET)	Measured 345.4 ± 12.7 mm above seat surface	850.9-881.3	875.1
Z	WAIST CIRCUMFERENCE	Measured 165.1 ± 5.1 mm above seat surface	759.5-789.9	785.4
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:** 138

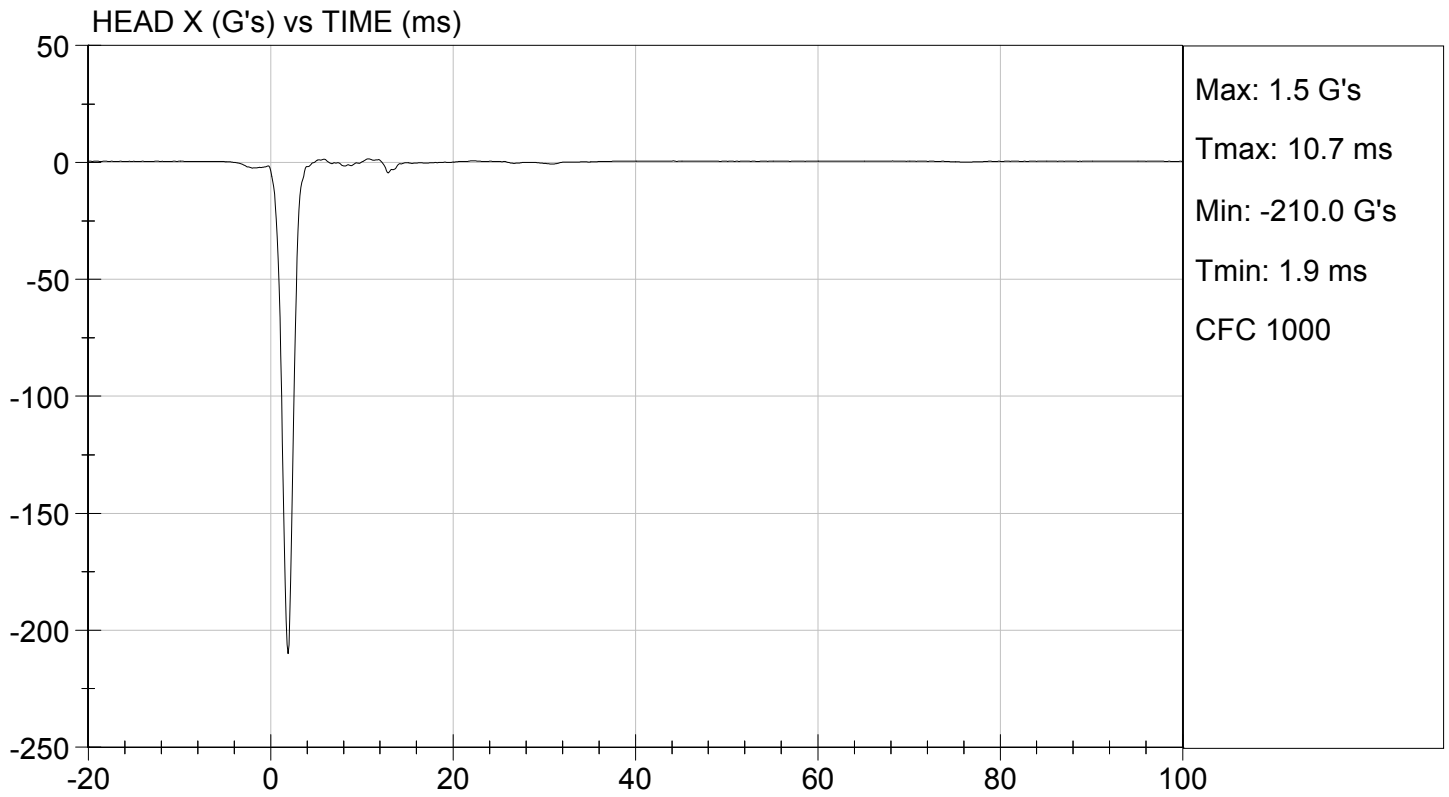
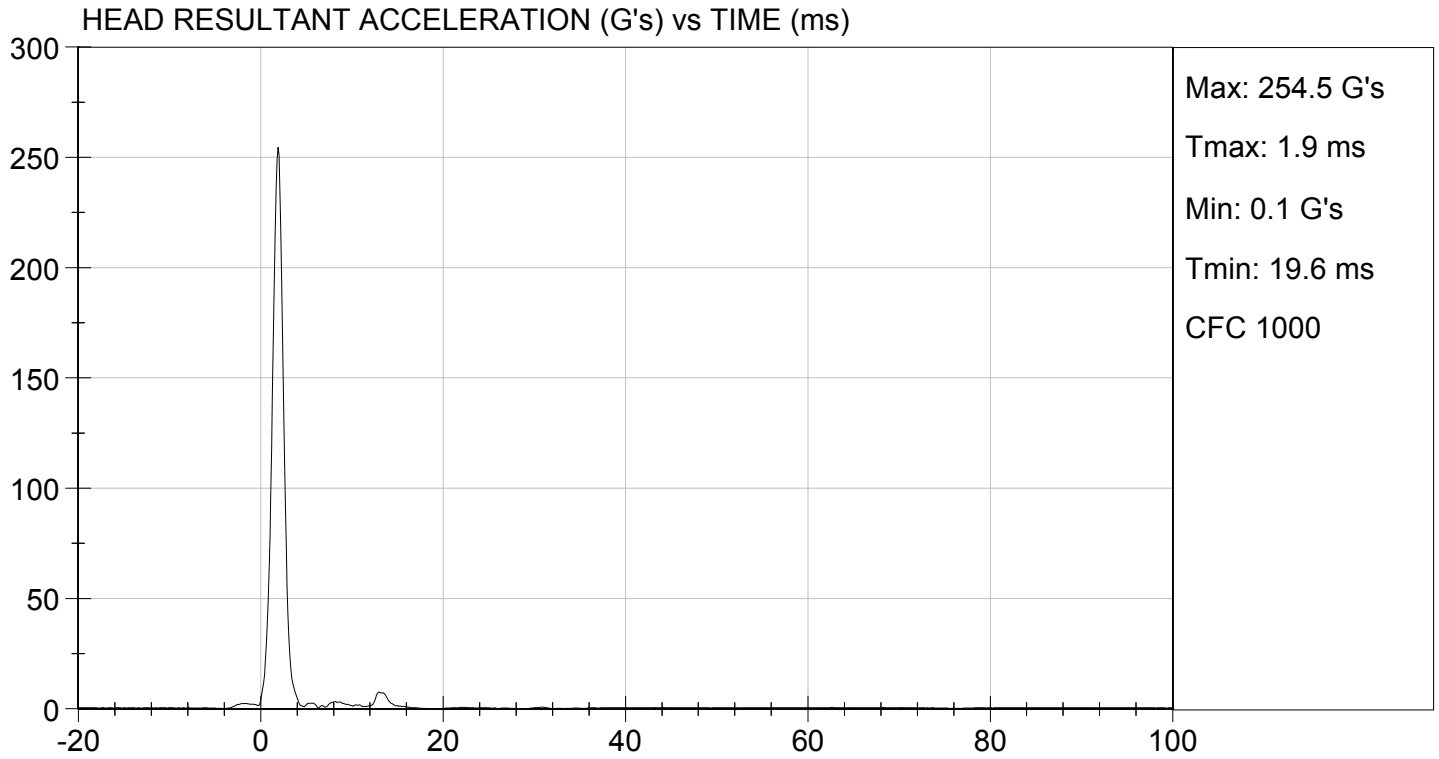
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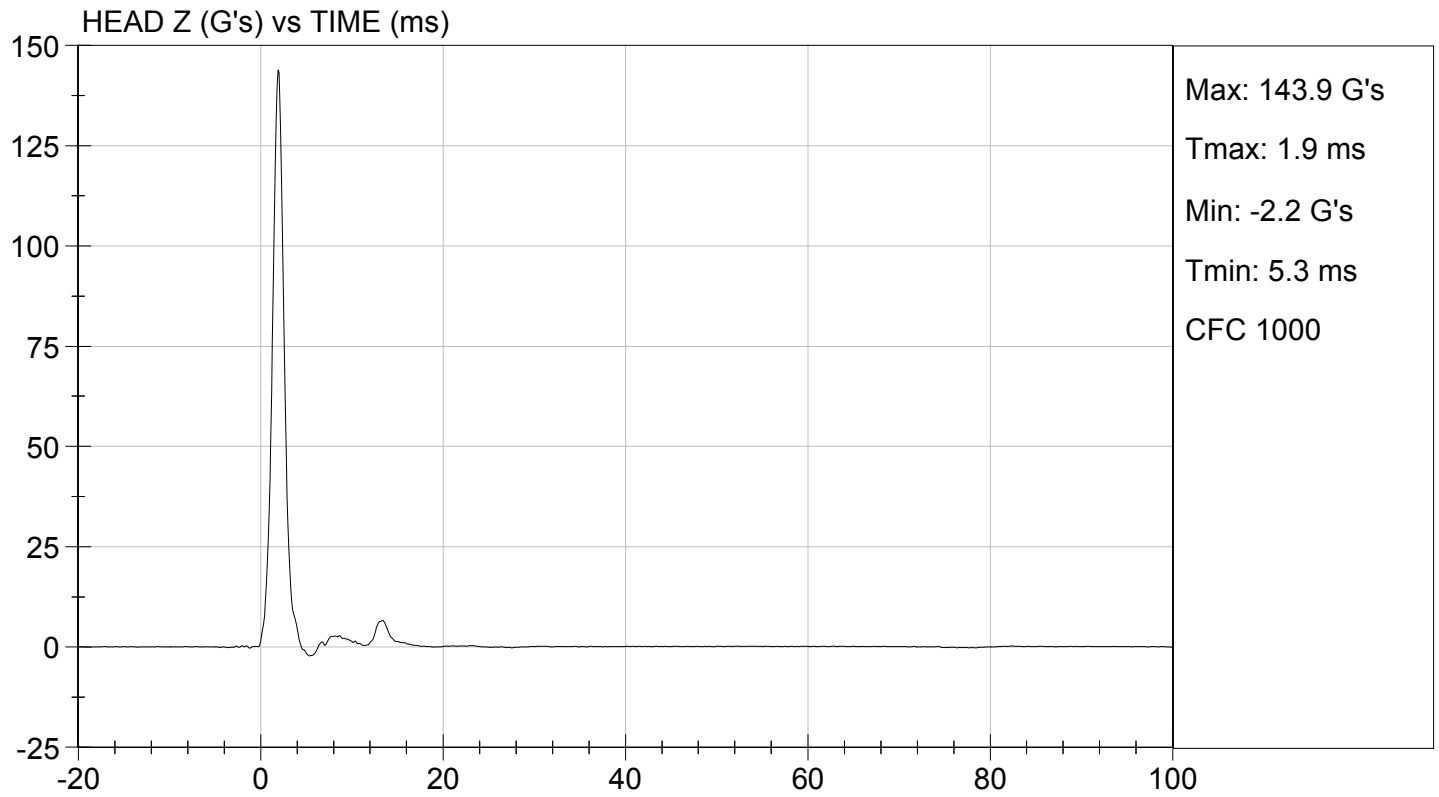
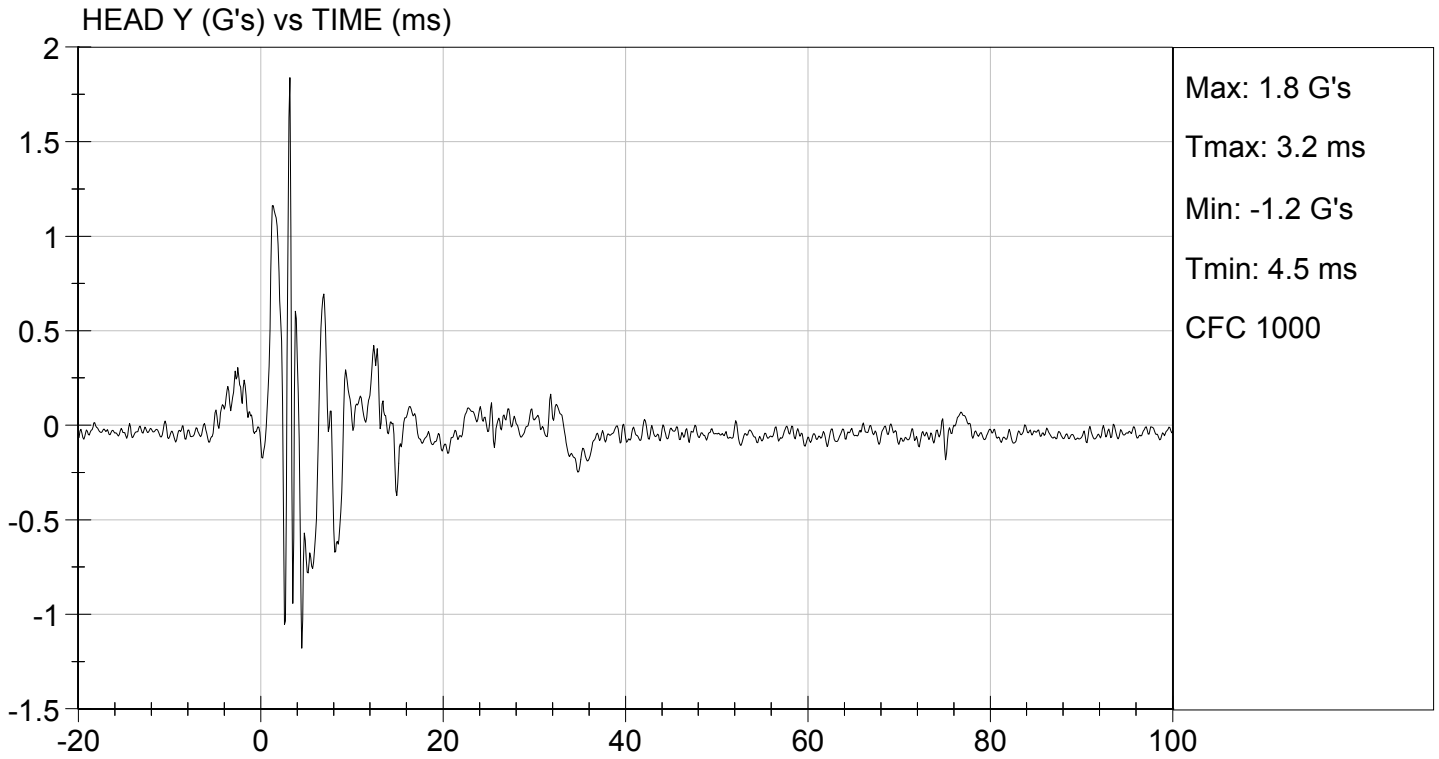
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Peak Resultant Acceleration	G's	250 to 300	255	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	1.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
<b>Overall Test Results</b>				<b>Pass</b>

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

12/13/2012  
 \_\_\_\_\_  
 Test Date

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





**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No: 138

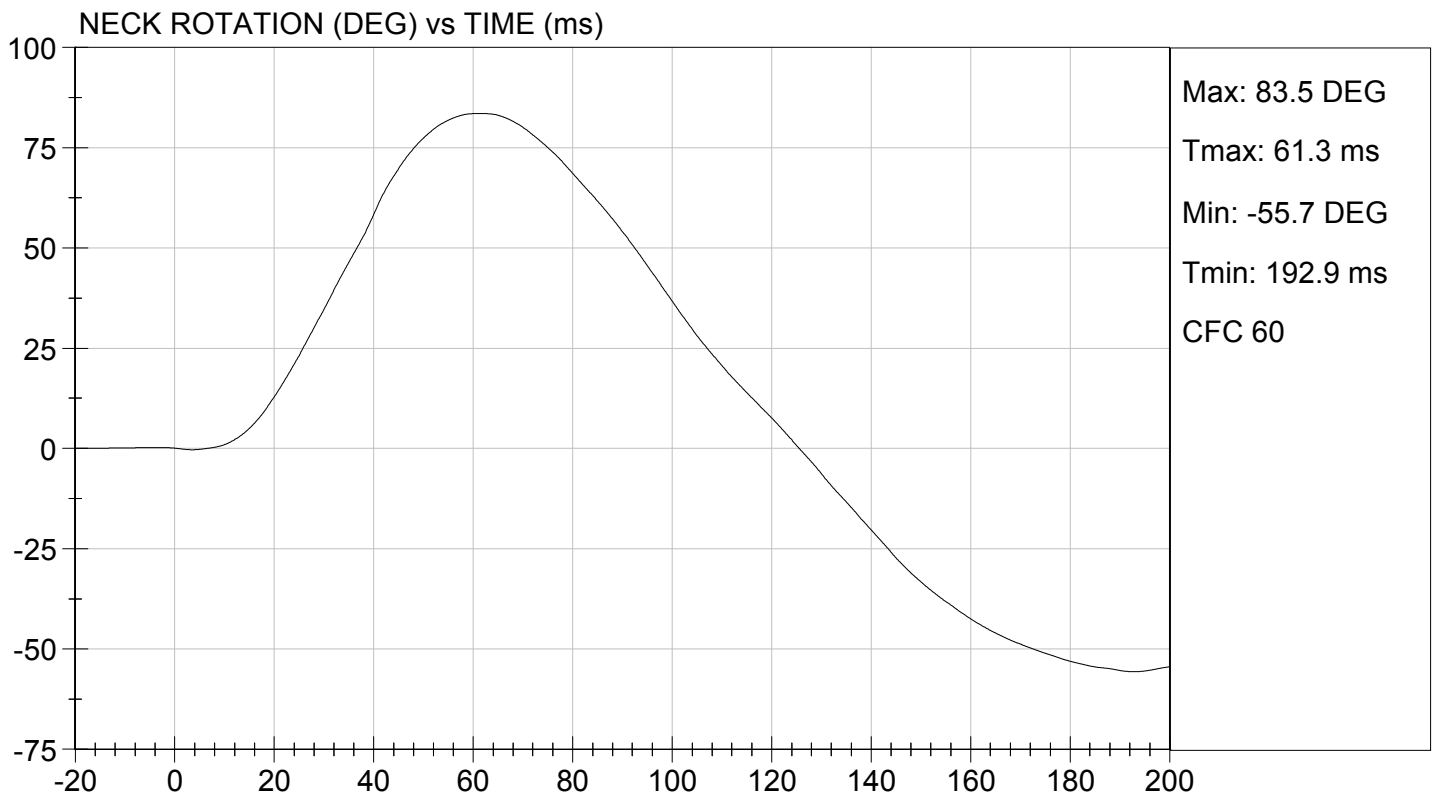
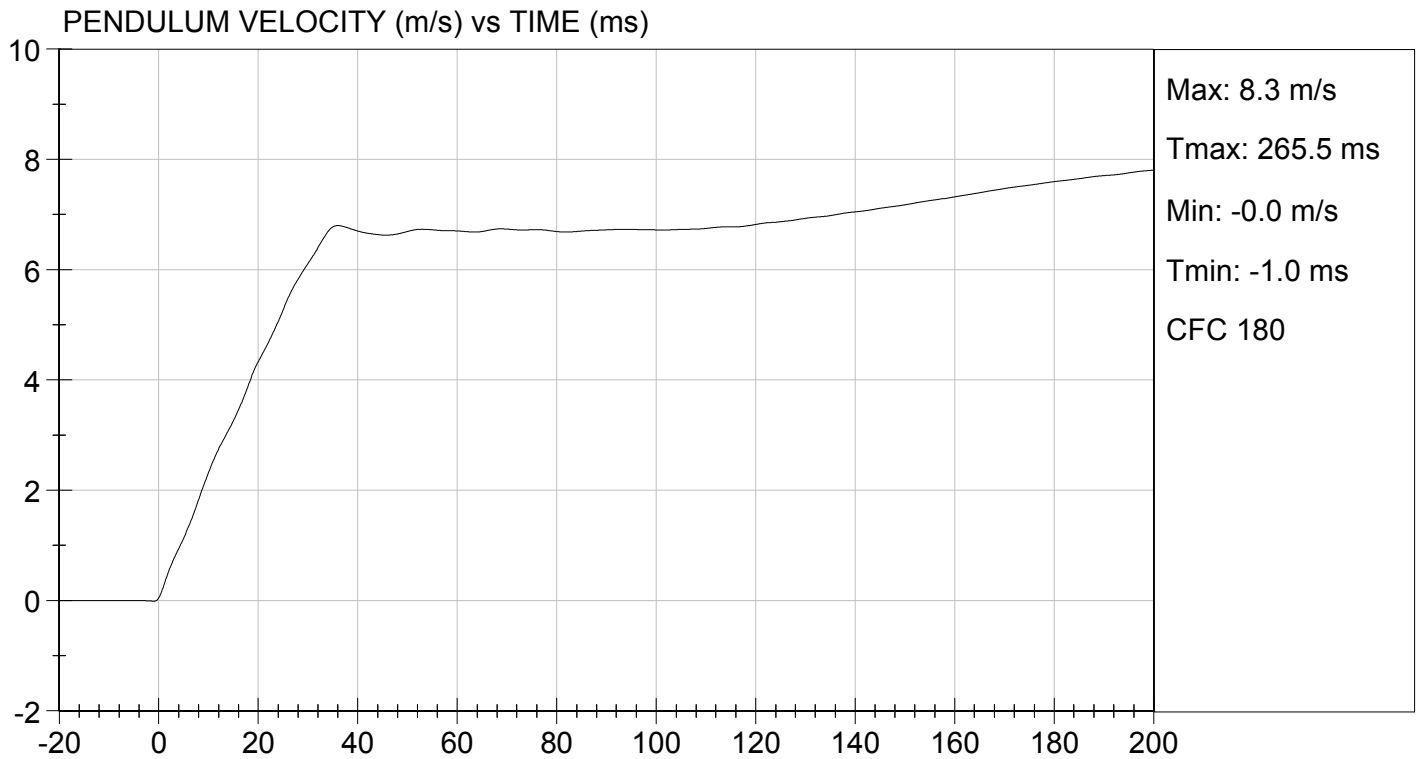
Test I.D.: D124732

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	25	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.3	Pass
	30 ms	m/s	5.8 to 7.0	6.1	Pass
D Plane Rotation	Max	deg	77 to 91	83	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	74.4	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	87	Pass
Overall Results					Pass

Jessica Hall  
Laboratory Technician

12/13/2012  
Test Date

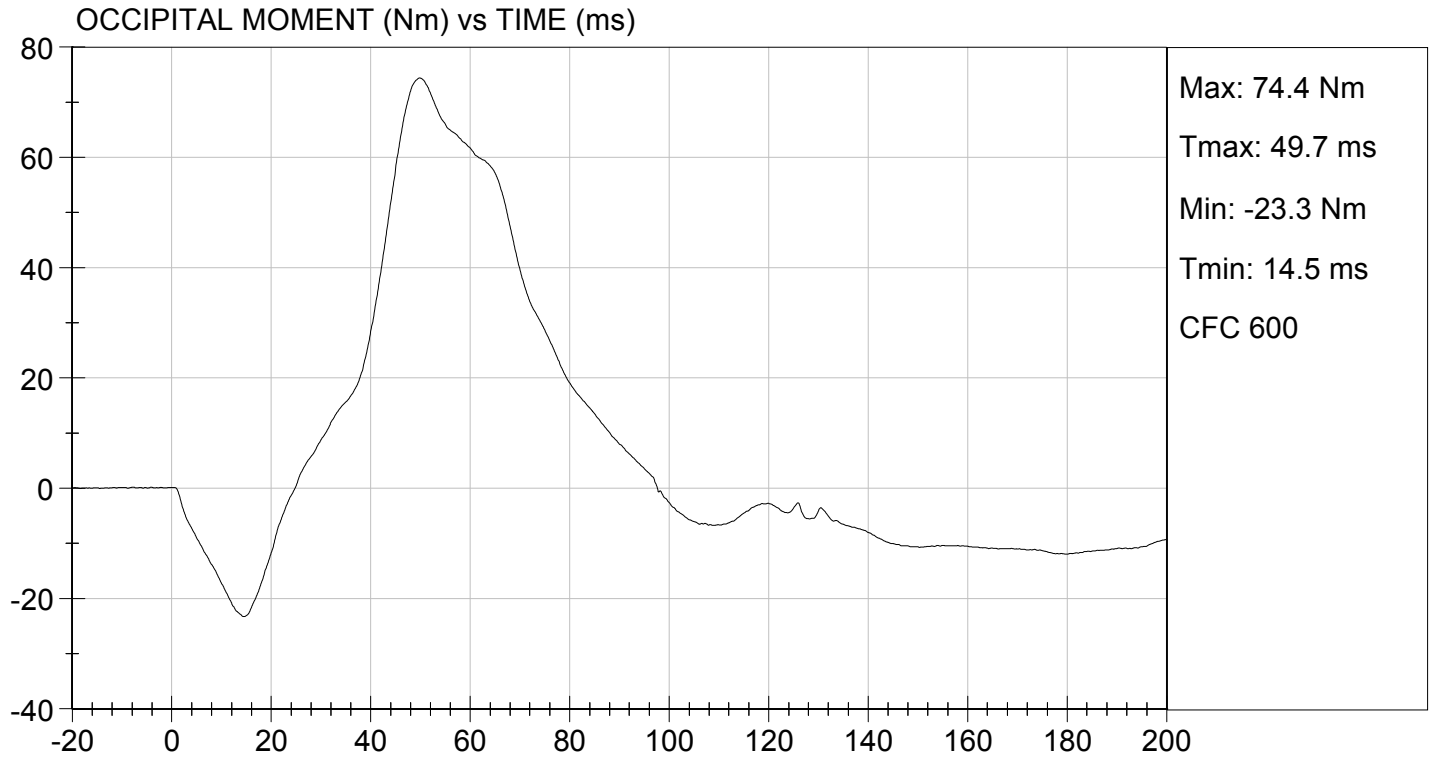
David Winkelbauer  
Approved By





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

TEST DATE: 12/13/2012  
TEST #: D124732



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

ATD Serial No: 138

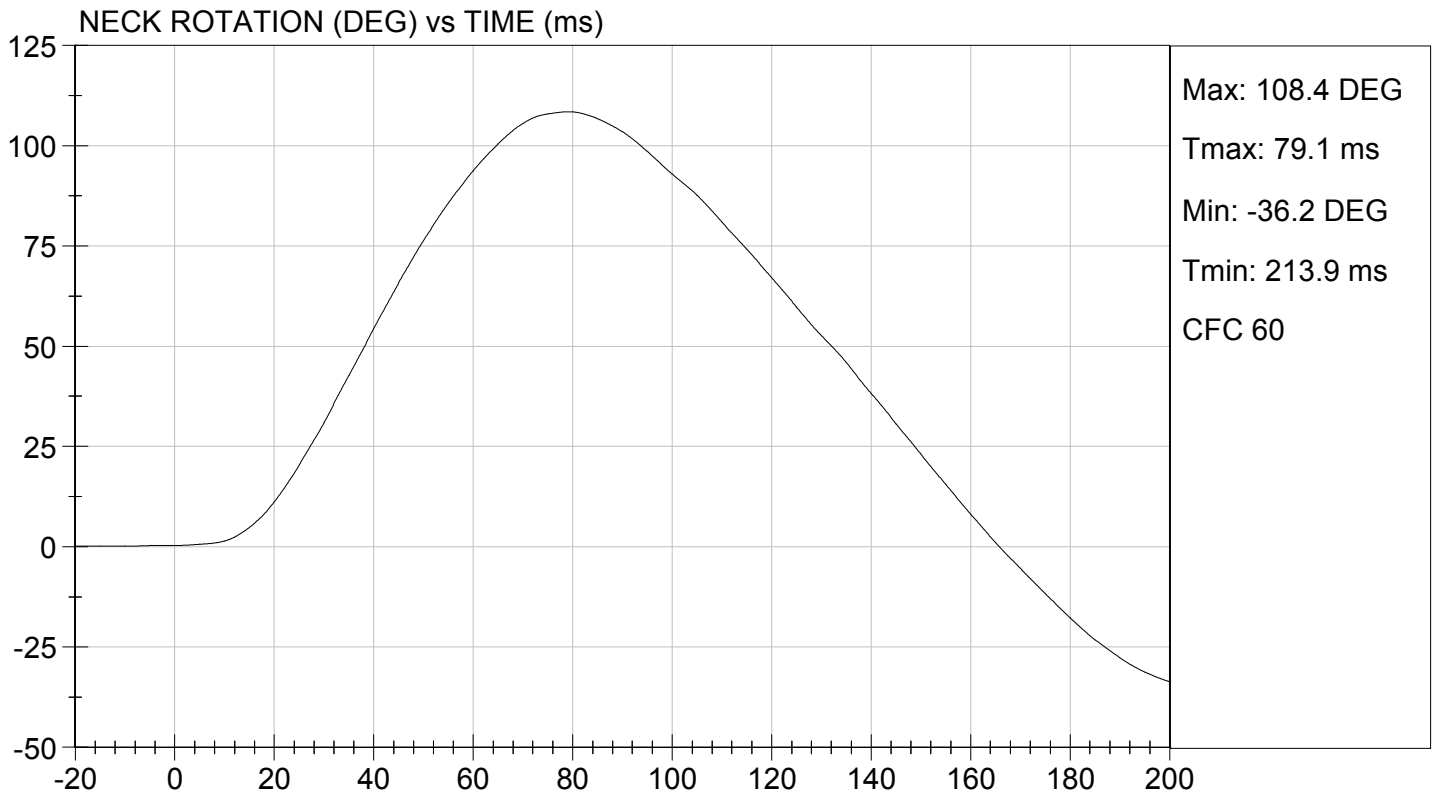
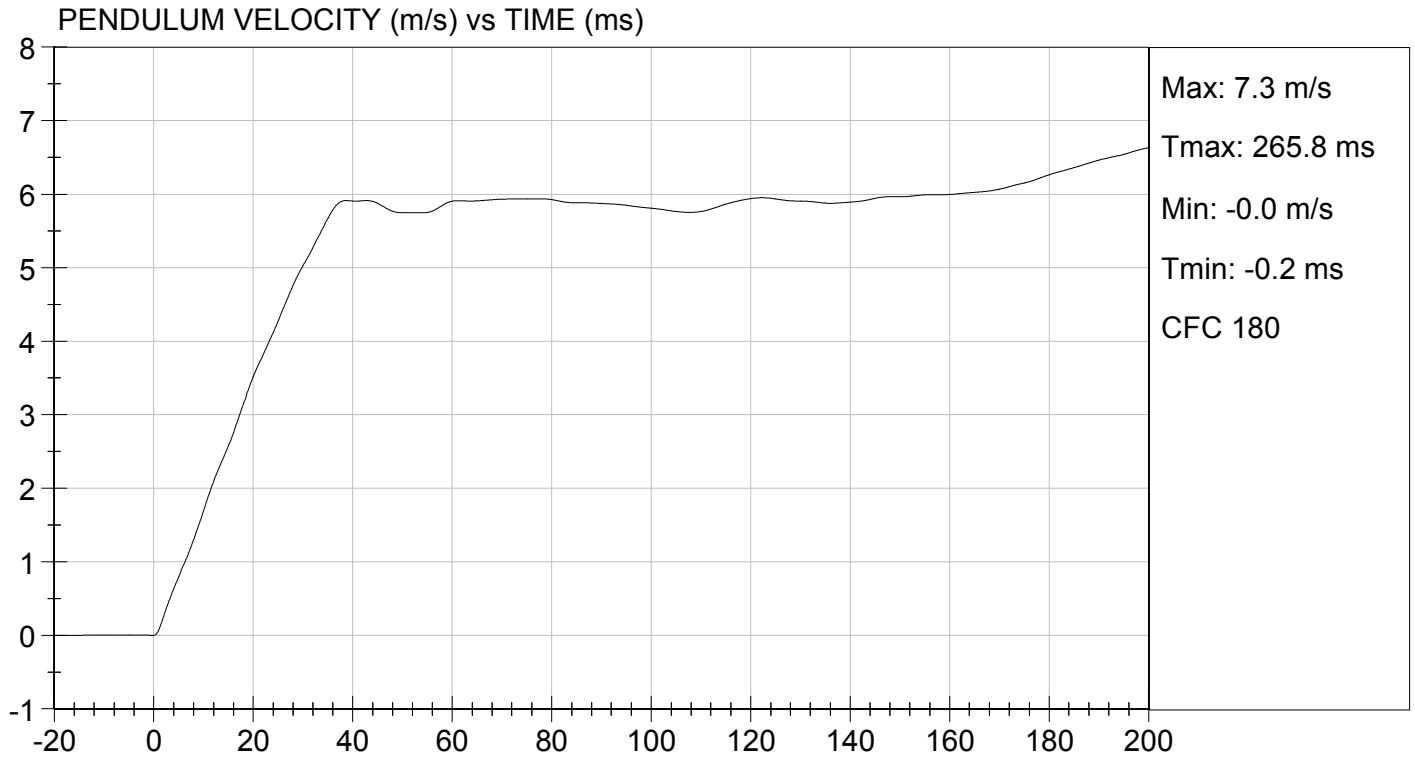
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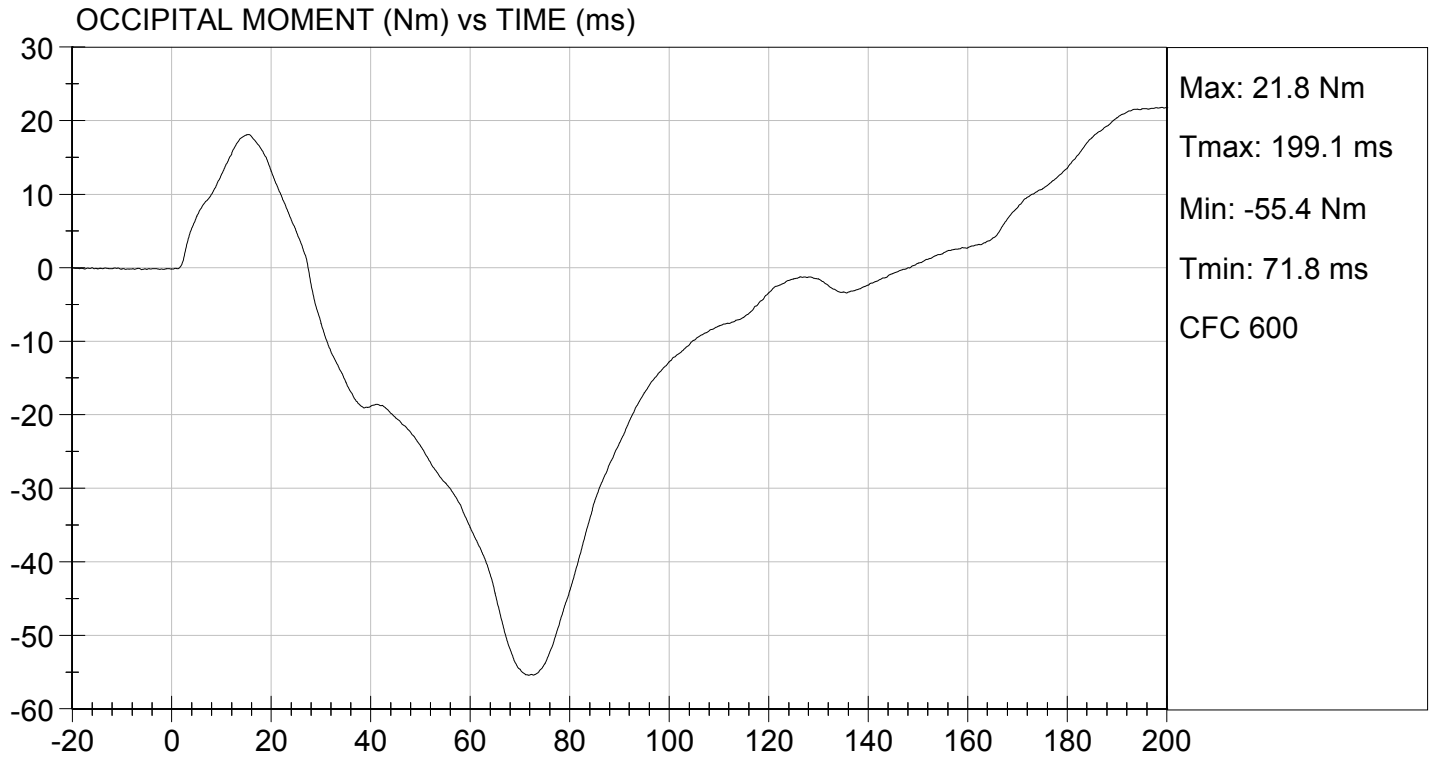
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	25	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.13	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.7	Pass
	20 ms	m/s	3.1 to 3.9	3.5	Pass
	30 ms	m/s	4.6 to 5.6	5	Pass
D Plane Rotation	Max	deg	99 to 114	108	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-55.4	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	103	Pass
Overall Results					Pass

Jessica Gall  
Laboratory Technician

12/13/2012  
Test Date

David Winkelbauer  
Approved By





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

**ATD Serial No:** 138

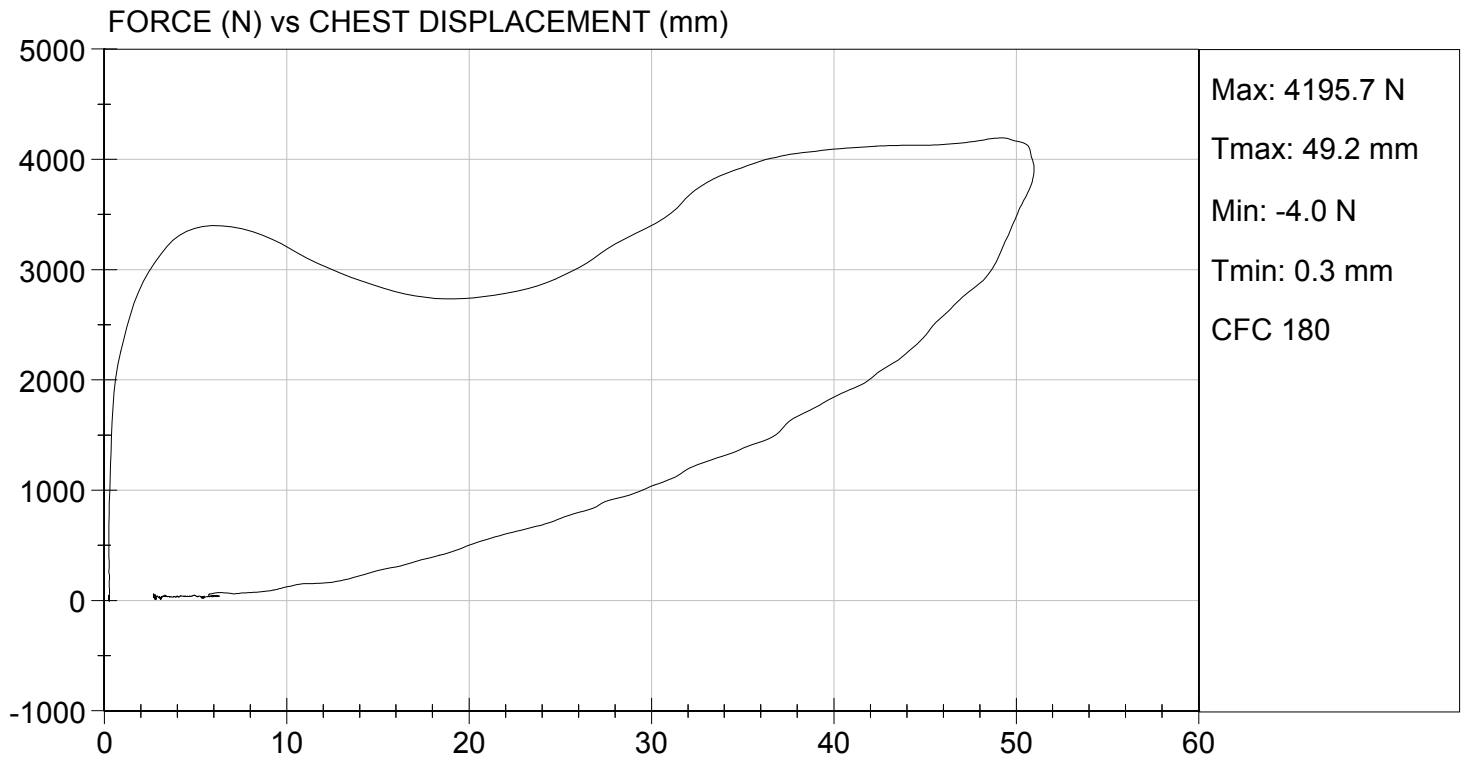
**Test I.D.:** D124734

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.1	Pass
Relative Humidity	%	10 to 70	23	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	4162	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4196	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 5TH PERCENTILE**

**ATD Serial No:** 138

**Test I.D:** D124735

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	24	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3489	Pass
Overall Test Results				Pass

Jessica Gall  
Laboratory Technician

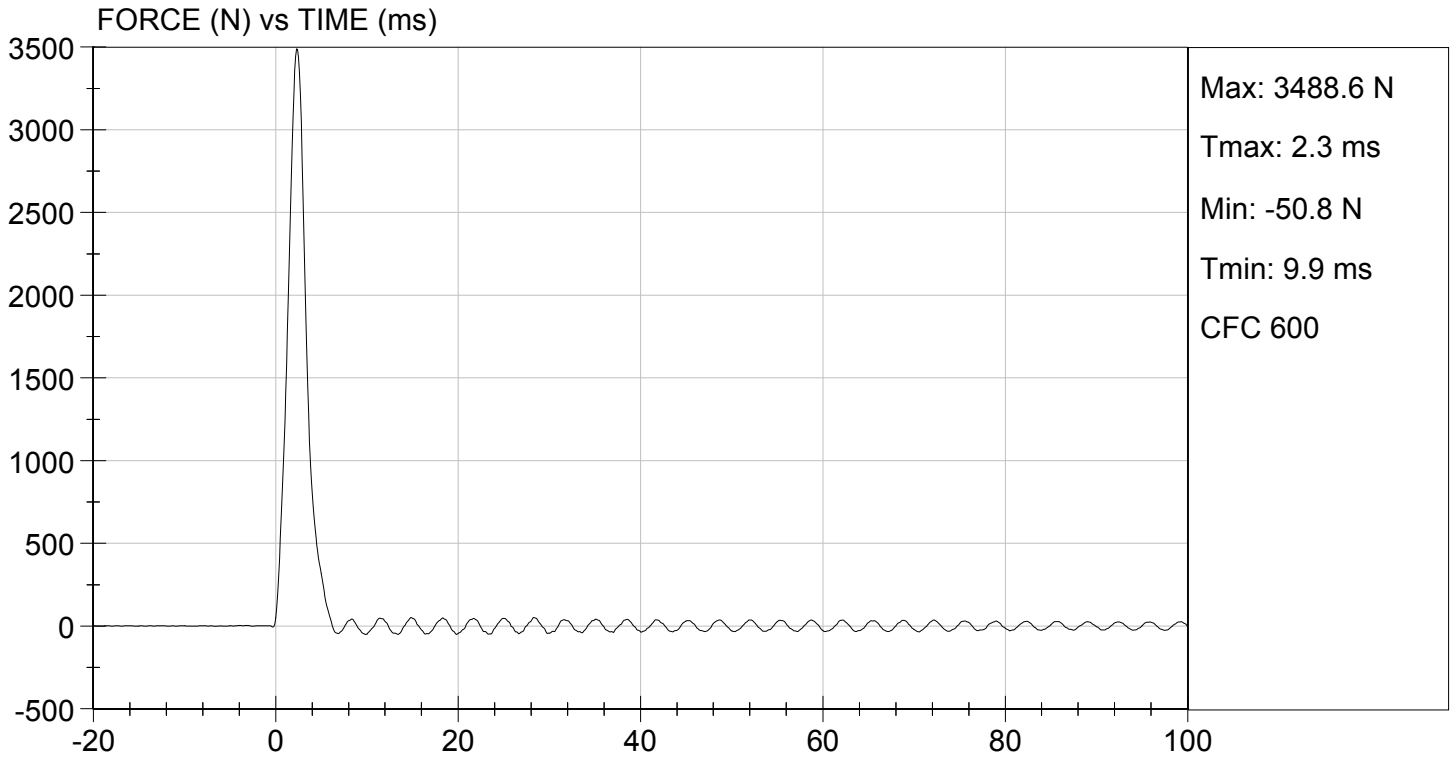
12/13/2012  
Test Date

David Winkelbauer  
Approved By



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

TEST DATE: 12/13/2012  
TEST #: D124735



**MGA RESEARCH CORPORATION**

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

**ATD Serial No:** 138

**Test I.D.:** D124736

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	24	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3525	Pass
Overall Test Results				Pass

Jessica Hall  
Laboratory Technician

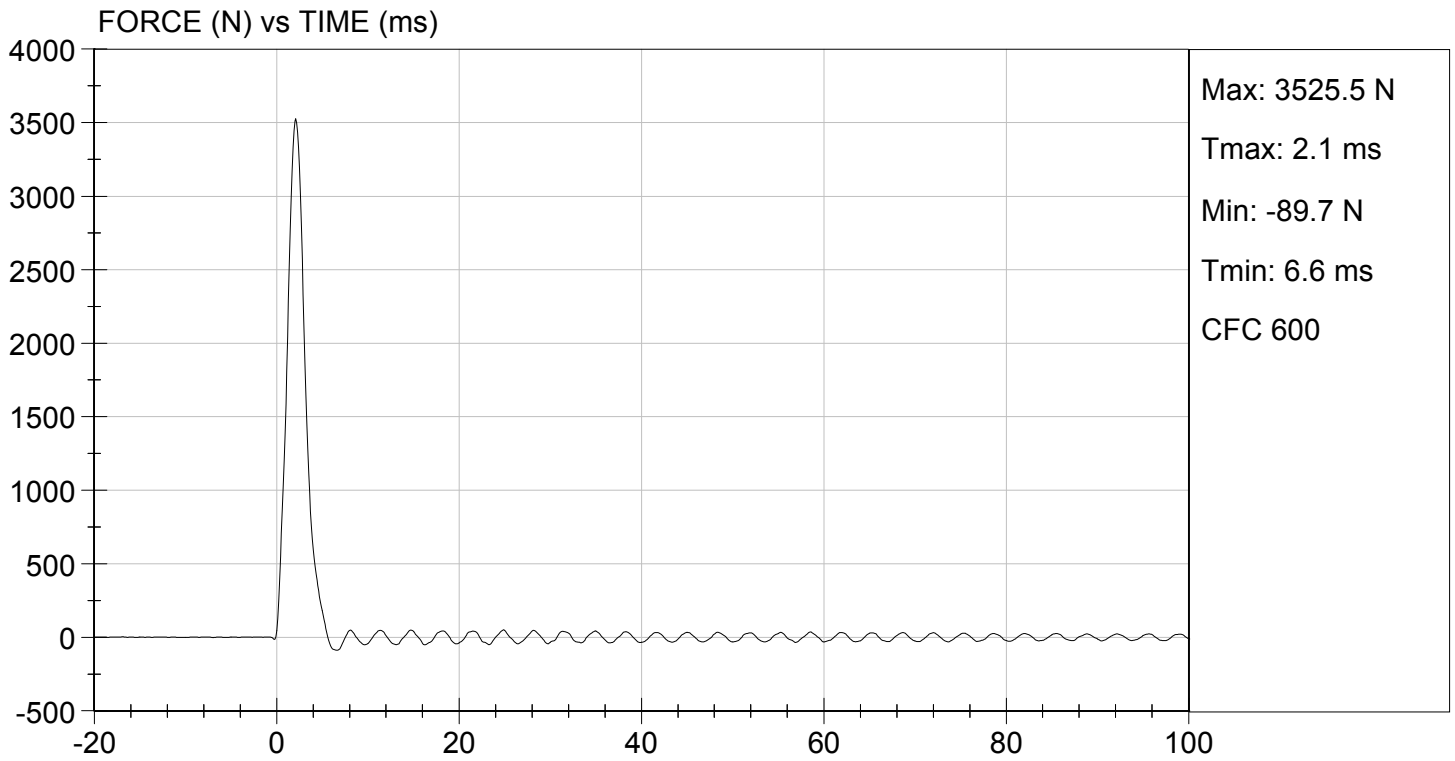
12/13/2012  
Test Date

David Winkelbauer  
Approved By



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

TEST DATE: 12/13/2012  
TEST #: D124736



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

**ATD Serial No:** 138

**Test I.D.:** D124737

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	24	Pass
Initial Angle	deg	0 to 20	18	Pass
Return Angle	deg	+/- 8	2	Pass
Force at 45 deg	N	320 to 390	368	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass

*Jessica Hall*  
 Laboratory Technician

12/13/2012  
 Test Date

*David Winkelbauer*  
 Approved By

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

ATD Serial No: 138

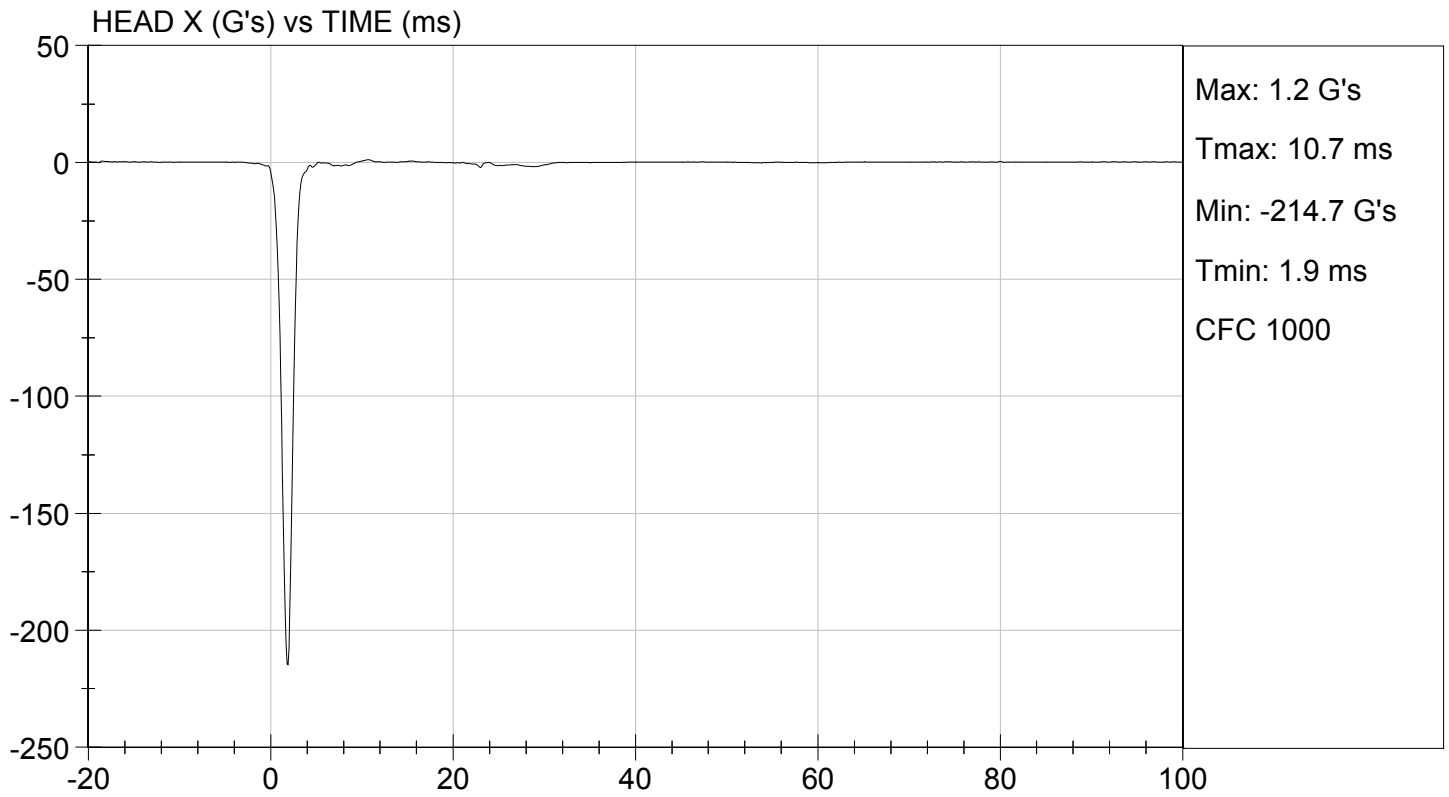
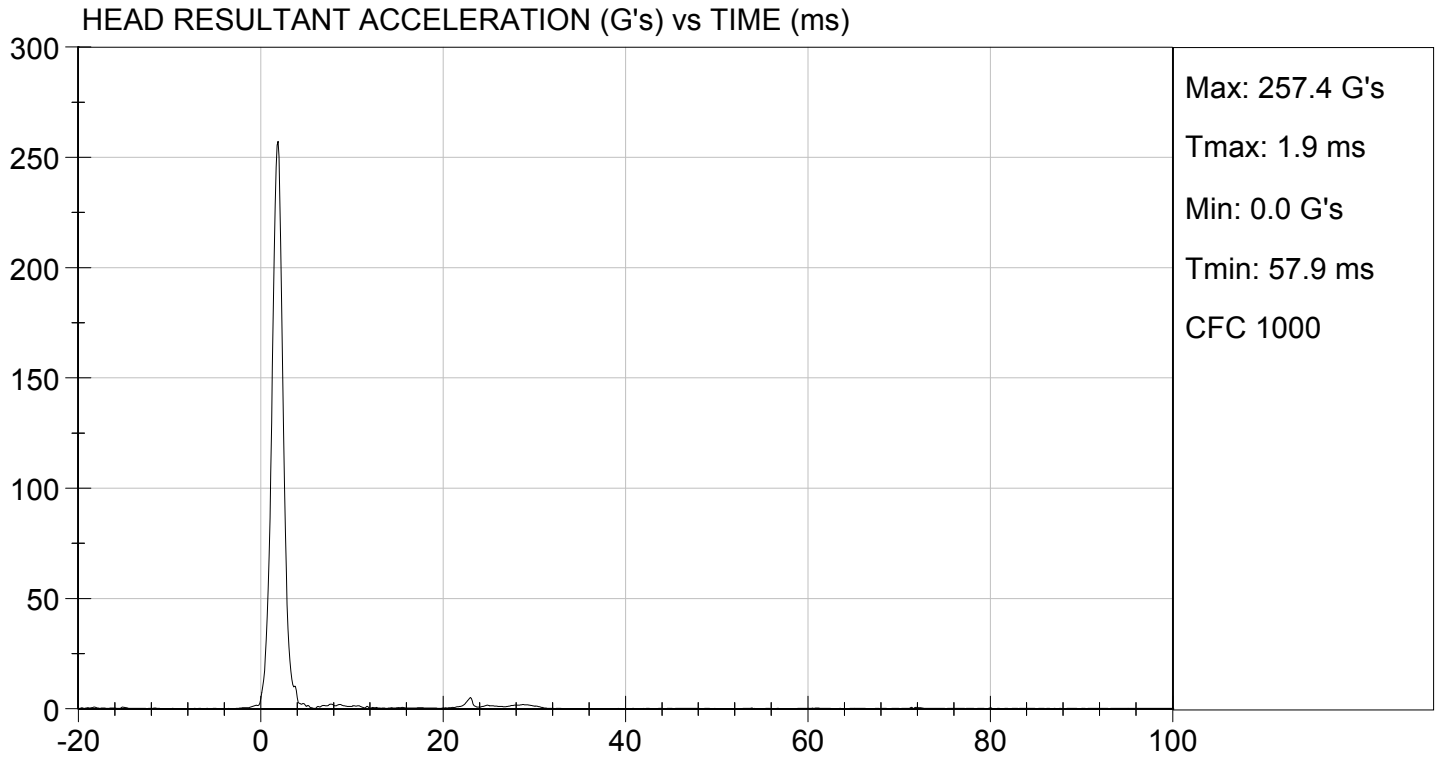
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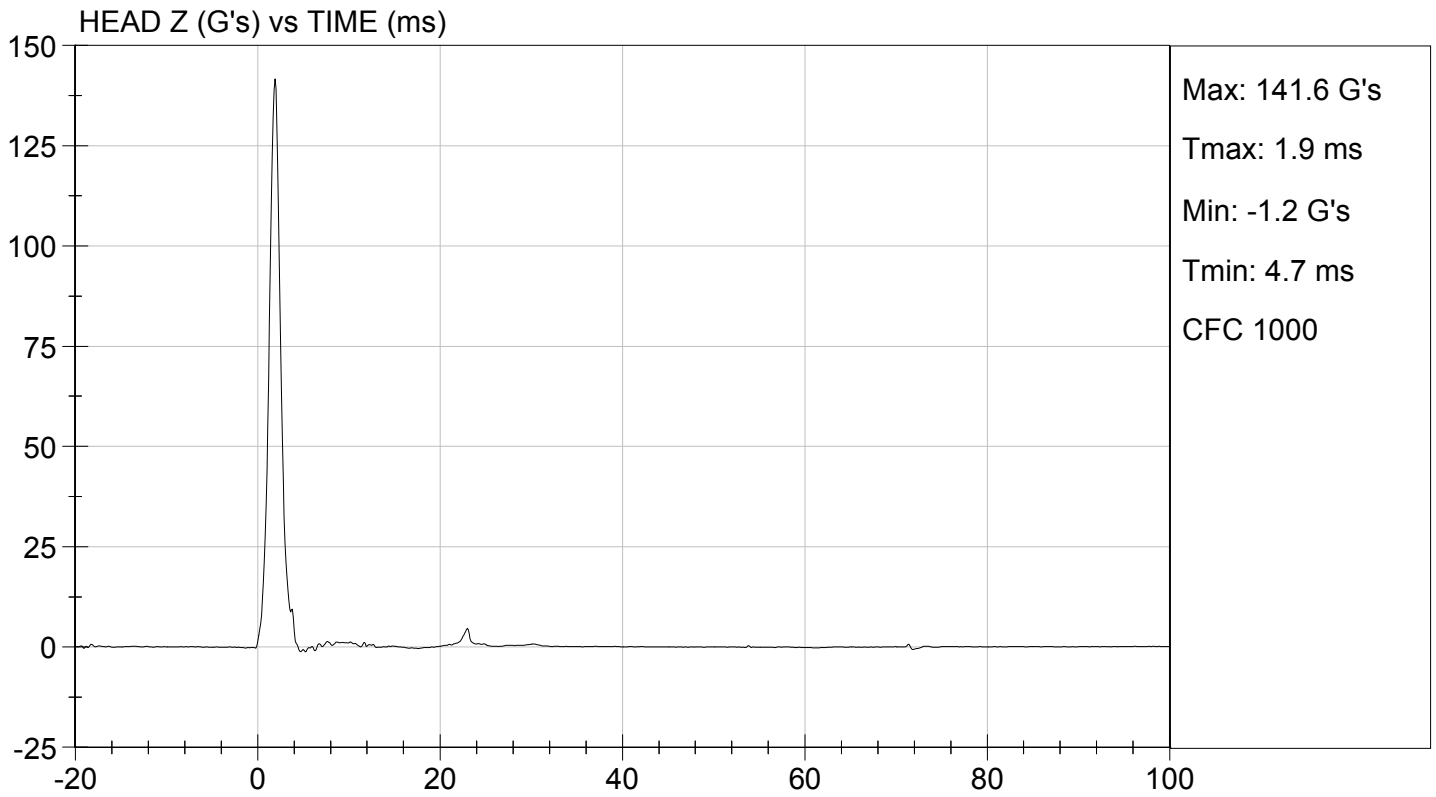
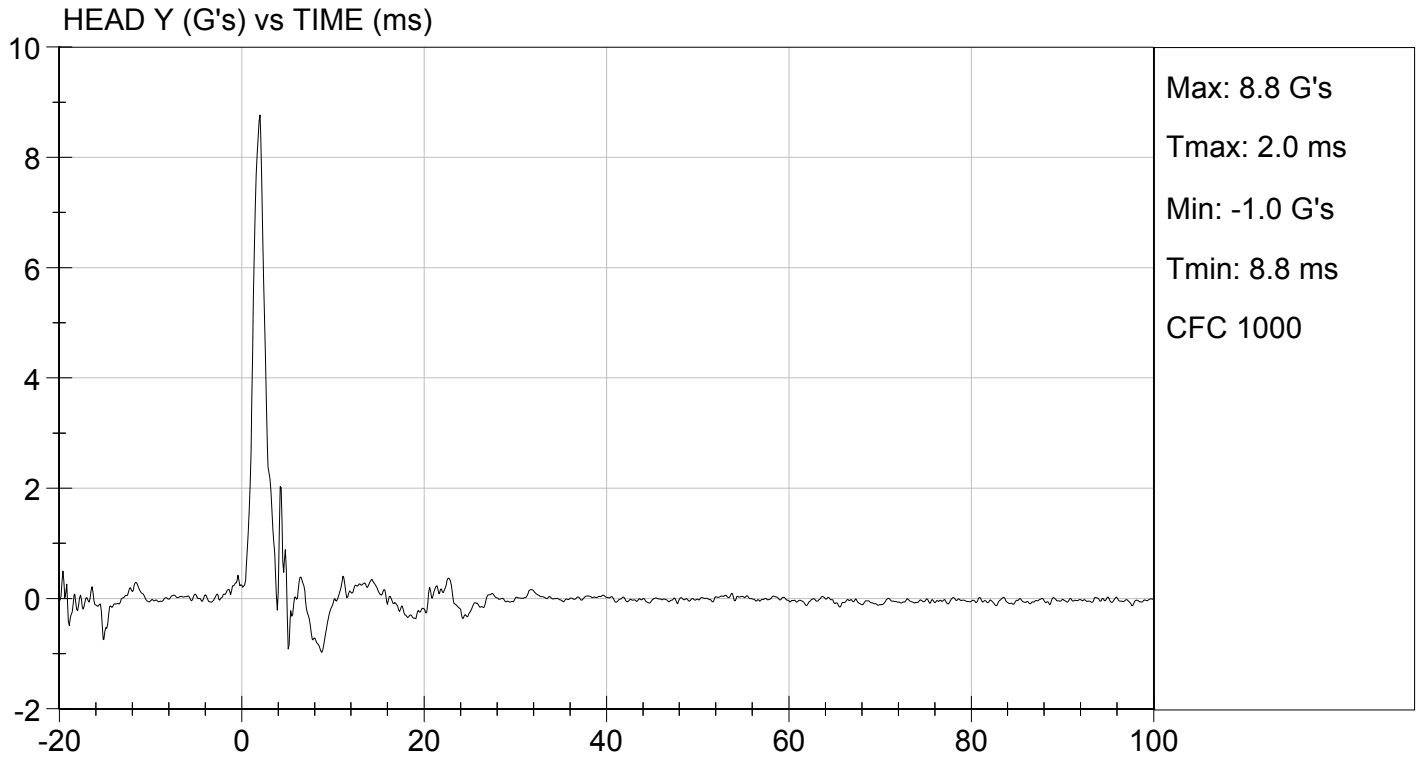
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.3	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Peak Resultant Acceleration	G's	250 to 300	257	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	8.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

  
 Laboratory Technician

01/10/2013  
 Test Date

  
 Approved By





**MGA RESEARCH CORPORATION**

**NECK FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

ATD Serial No: 138

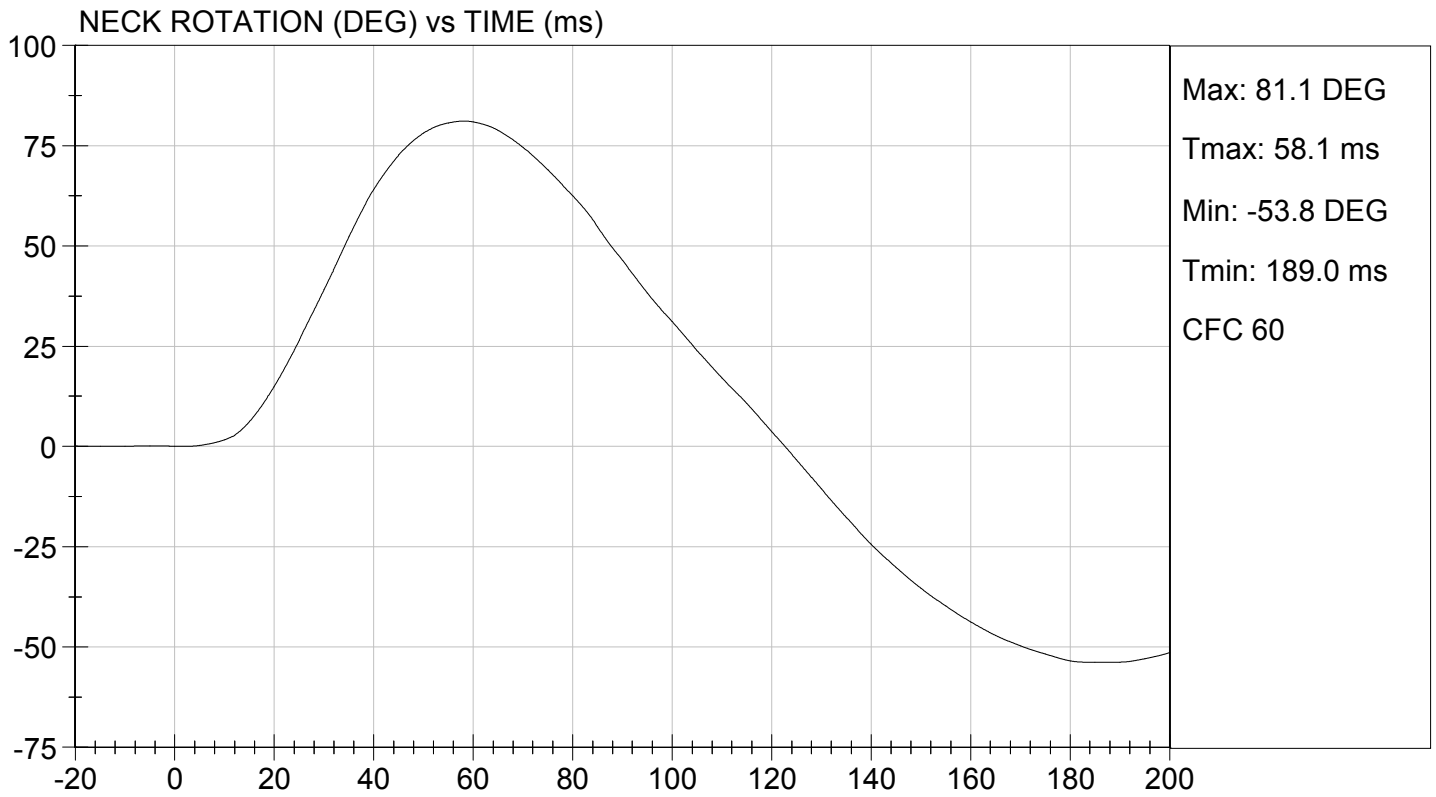
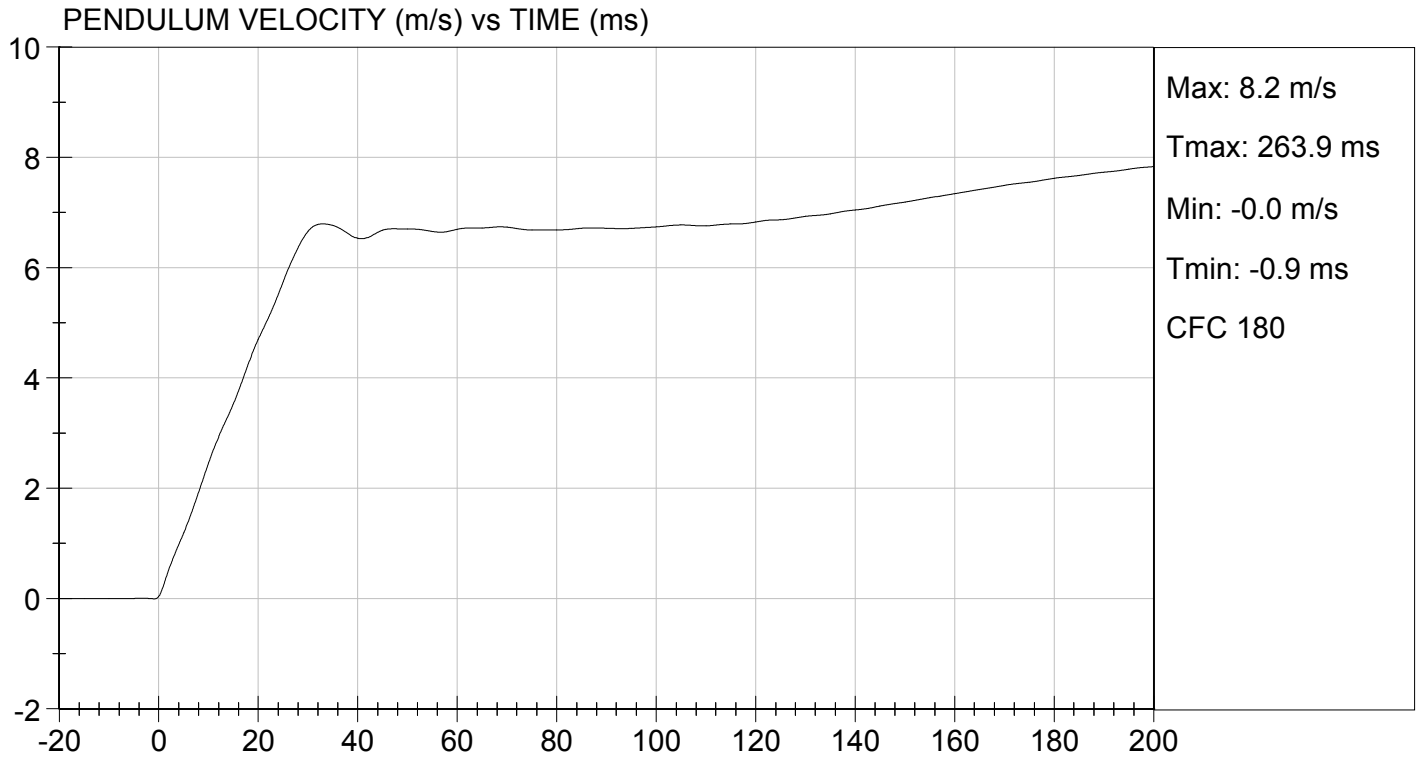
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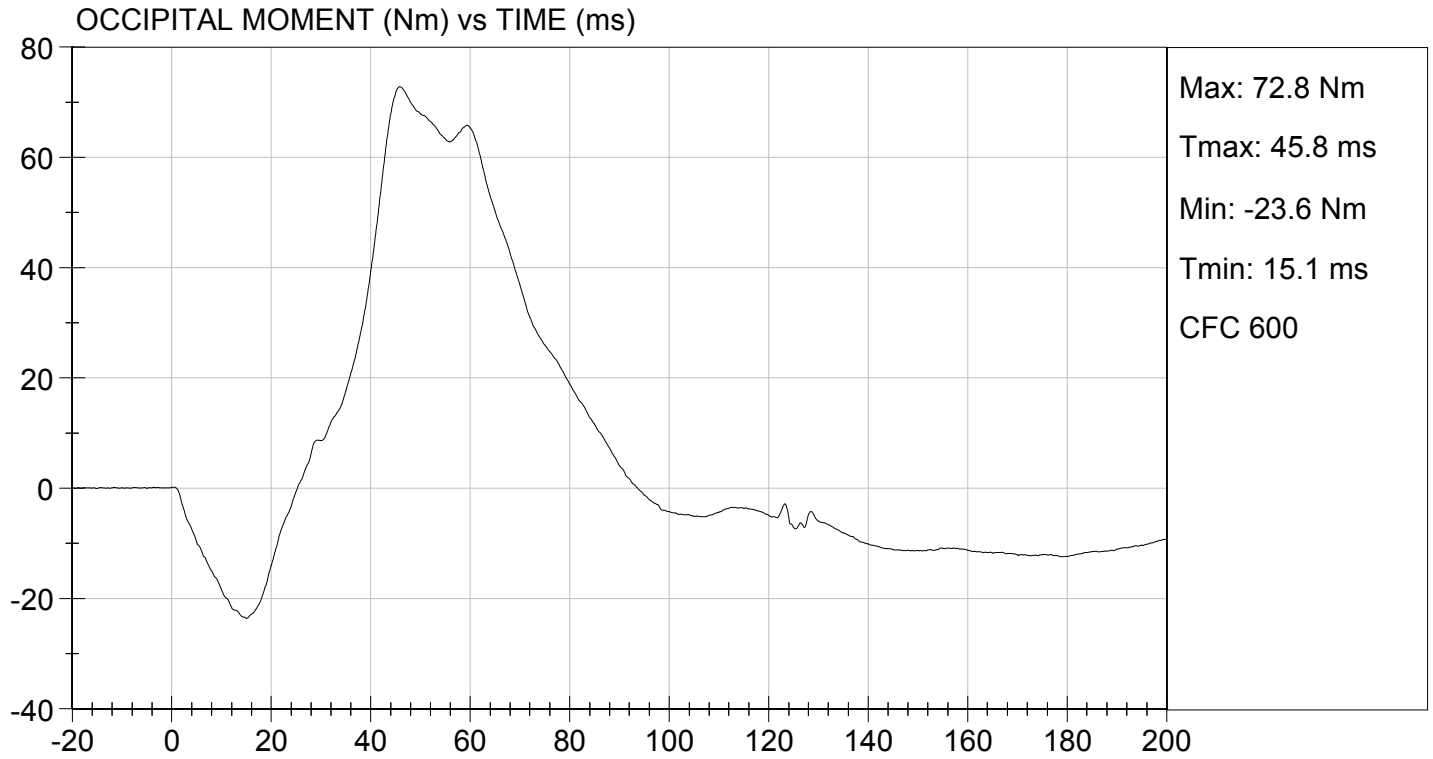
Tested Parameter	Units	Specification	Result	Pass/Fail	
Laboratory Temperature	deg C	20.6 to 22.2	21.0	Pass	
Laboratory Relative Humidity	%	10 to 70	34	Pass	
Pendulum Speed	m/s	6.89 to 7.13	7.06	Pass	
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.5	Pass
	20 ms	m/s	4.0 to 5.0	4.7	Pass
	30 ms	m/s	5.8 to 7.0	6.7	Pass
D Plane Rotation	Max	deg	77 to 91	81	Pass
Occipital Condyle Moment within Rotation Corridor	Nm	69 to 83	69	Pass	
Positive Moment Time Curve Decay to 10 Nm	ms	80 to 100	85	Pass	
Overall Results				Pass	

Jessica Gall  
Laboratory Technician

01/11/2013  
Test Date

David Winkelbauer  
Approved By





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

ATD Serial No: 138

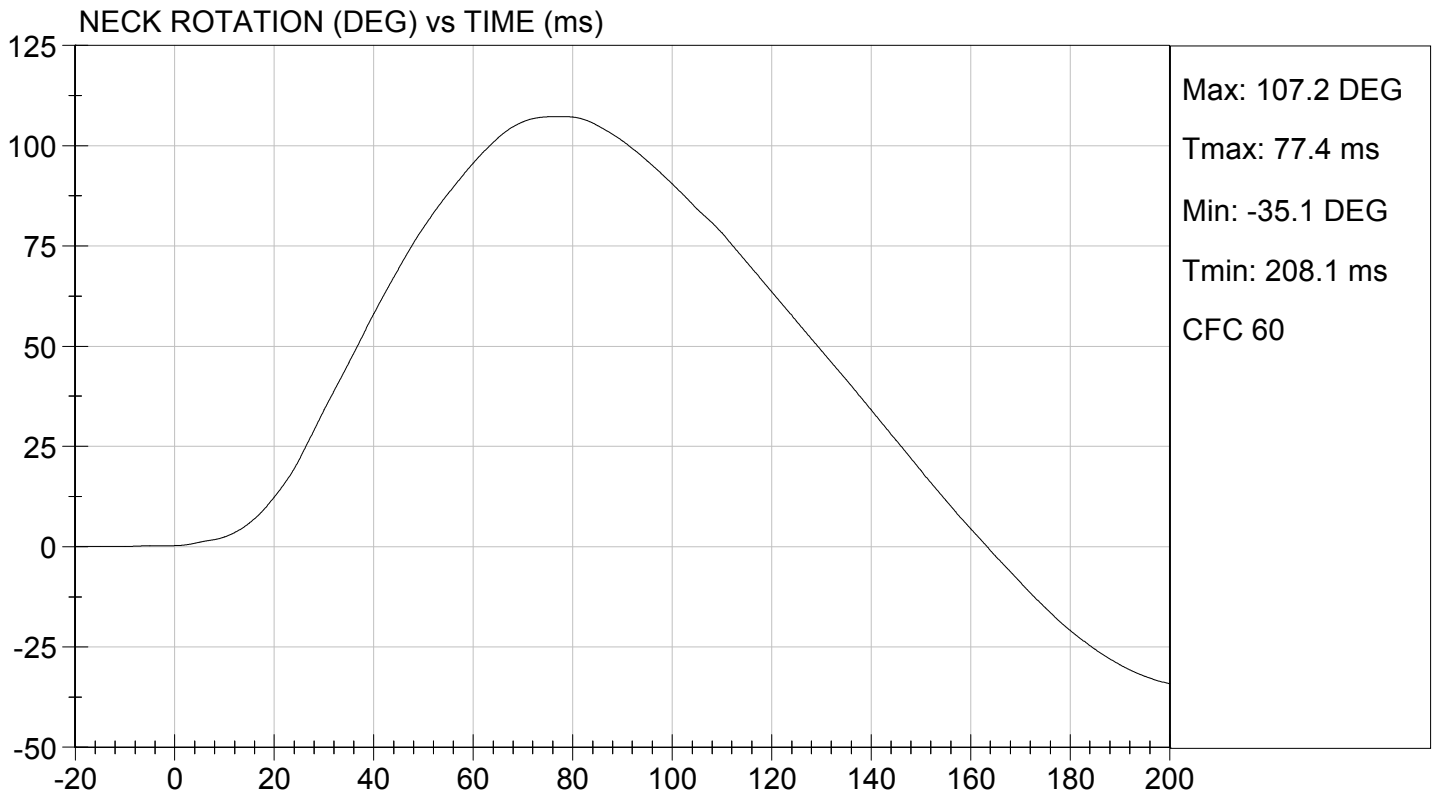
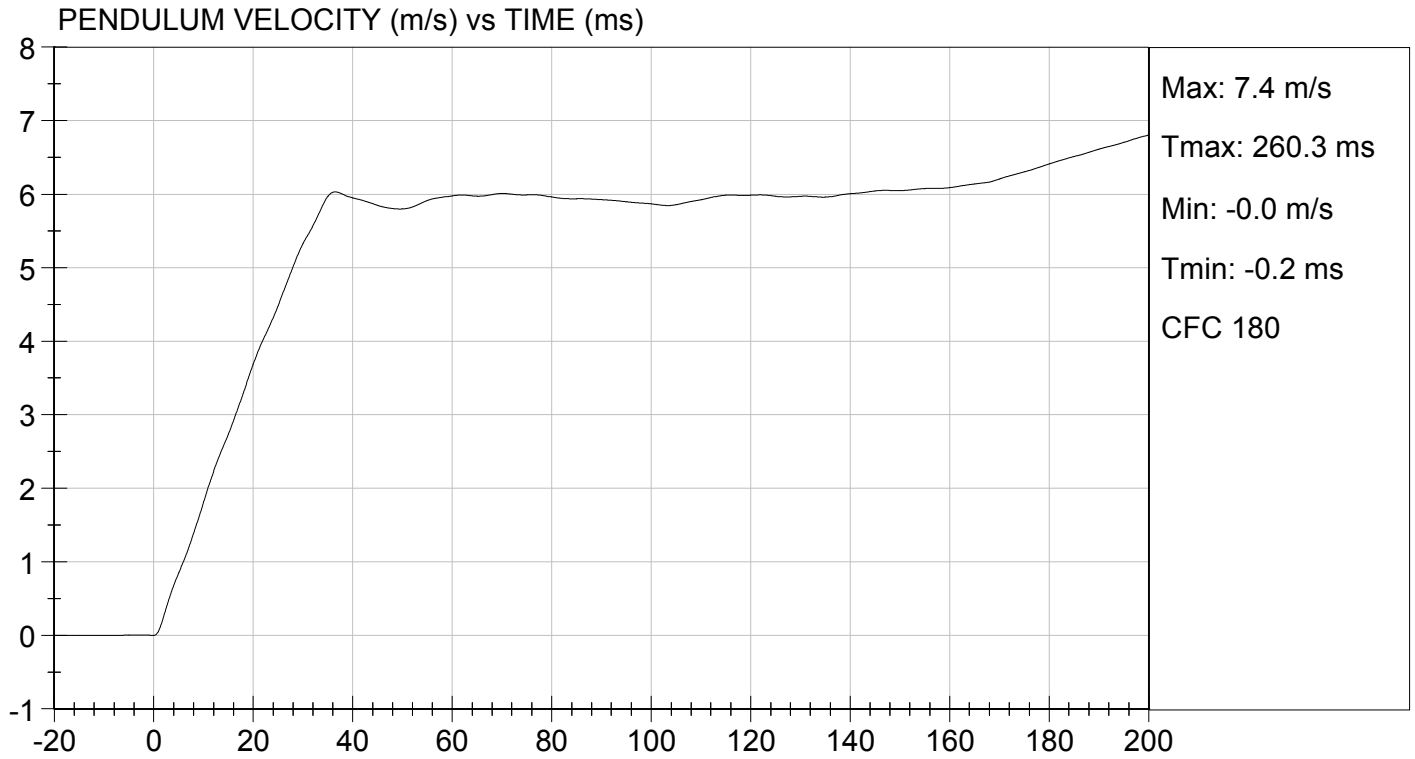
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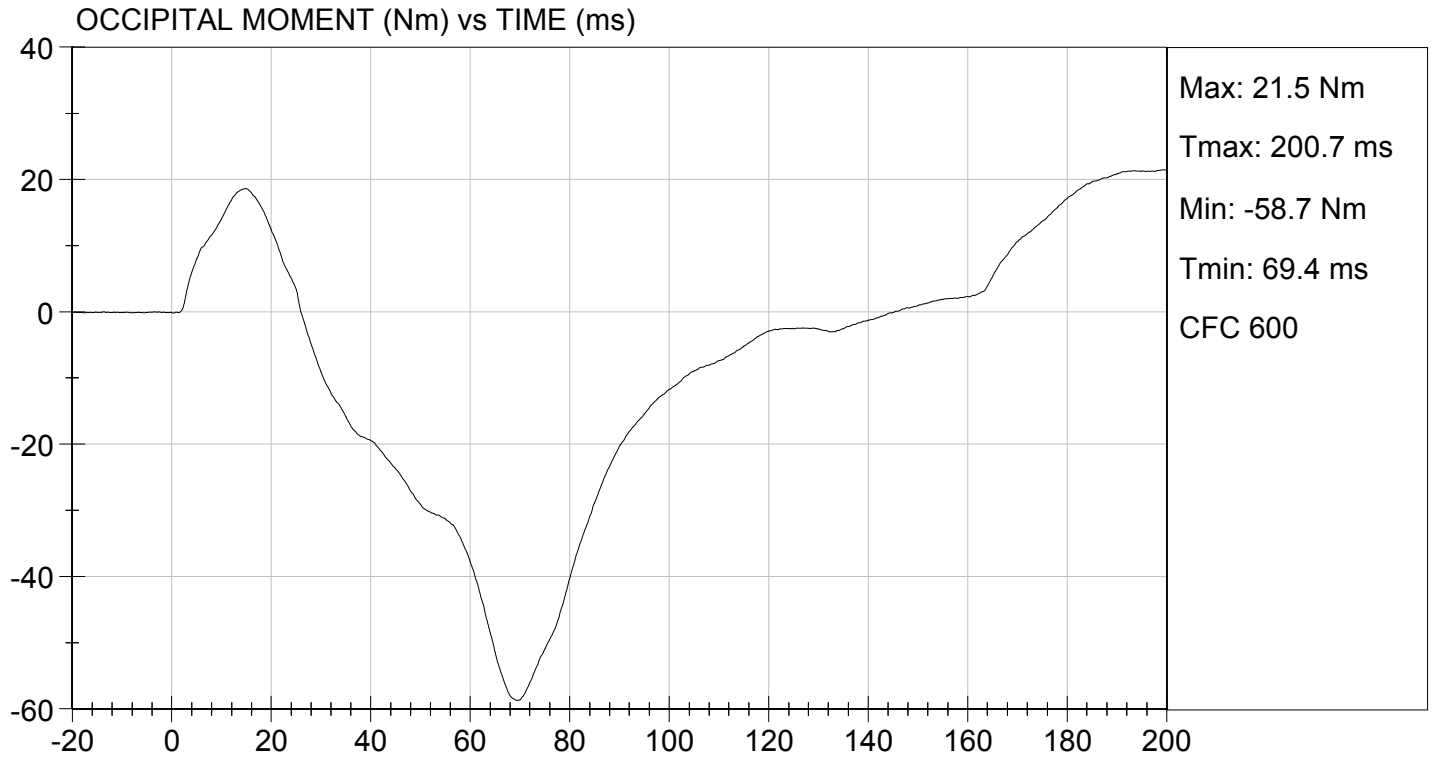
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity		%	10 to 70	34	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.13	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.8	Pass
	20 ms	m/s	3.1 to 3.9	3.7	Pass
	30 ms	m/s	4.6 to 5.6	5.3	Pass
D Plane Rotation	Max	deg	99 to 114	107	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-59	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	102	Pass
Overall Results					Pass

Jessica Hall  
Laboratory Technician

01/11/2013  
Test Date

David Winkelbauer  
Approved By





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

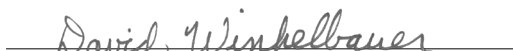
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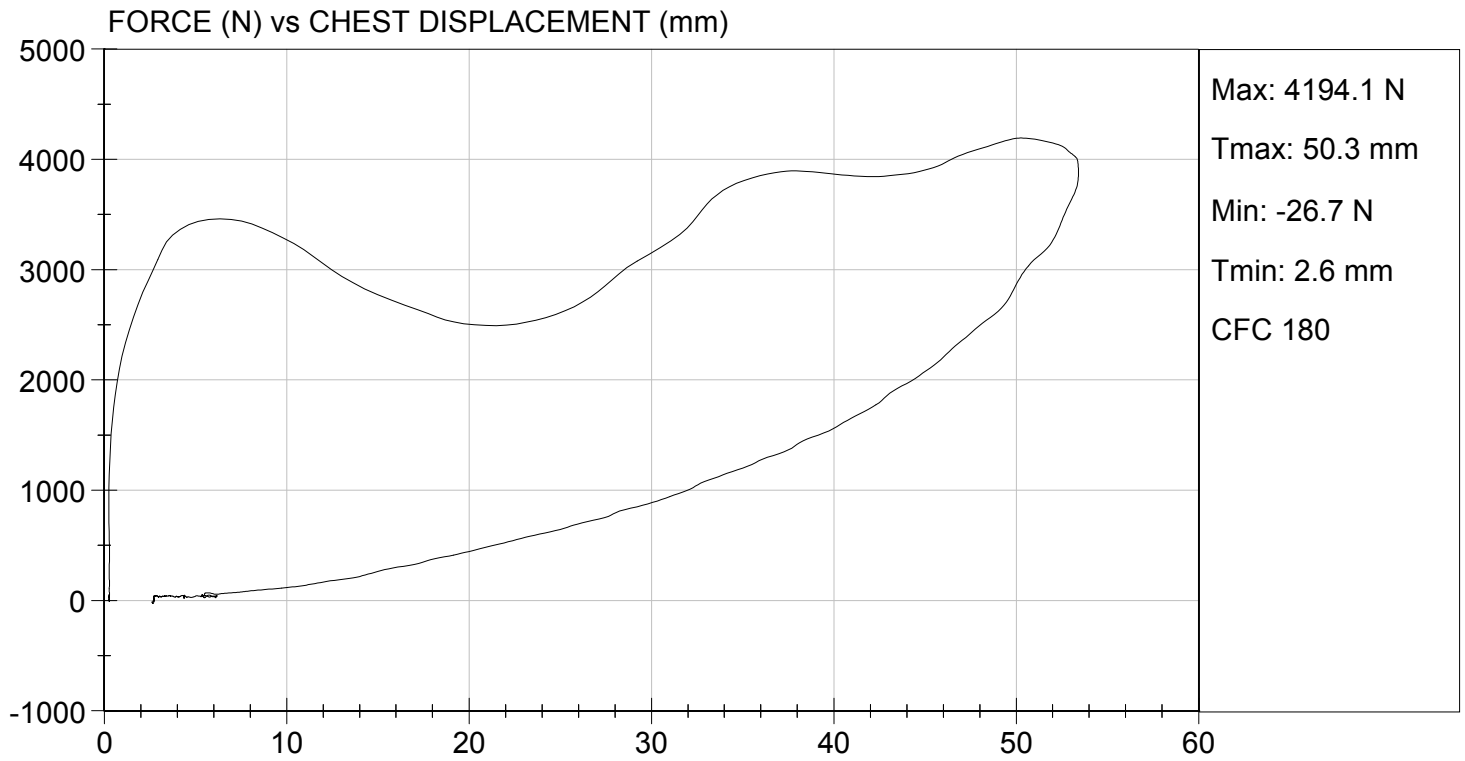
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Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.0	Pass
Relative Humidity	%	10 to 70	33	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	53	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4194	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4189	Pass
<b>Overall Test Results</b>				<b>Pass</b>

  
 Laboratory Technician

01/11/2013  
 Test Date

  
 Approved By



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

**ATD Serial No:** 138

**Test I.D:** D13085

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	N	3450 to 4060	3667	Pass
<b>Overall Test Results</b>				<b>Pass</b>

Jessica Gall  
 Laboratory Technician

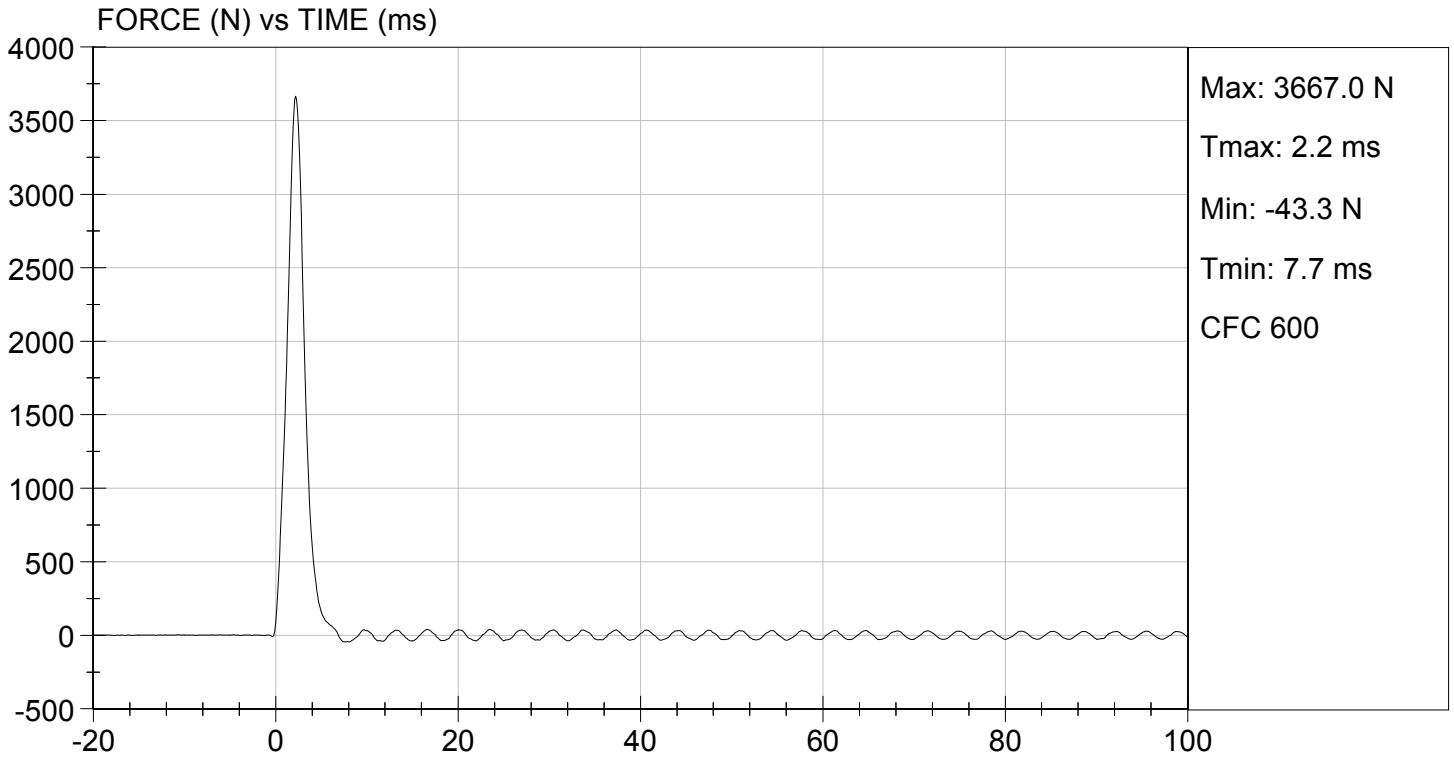
01/10/2013  
 Test Date

David Winkelbauer  
 Approved By



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

TEST DATE: 01/10/2013  
TEST #: D13085



**MGA RESEARCH CORPORATION**

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

**ATD Serial No:** 138

**Test I.D:** D13086

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	30	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

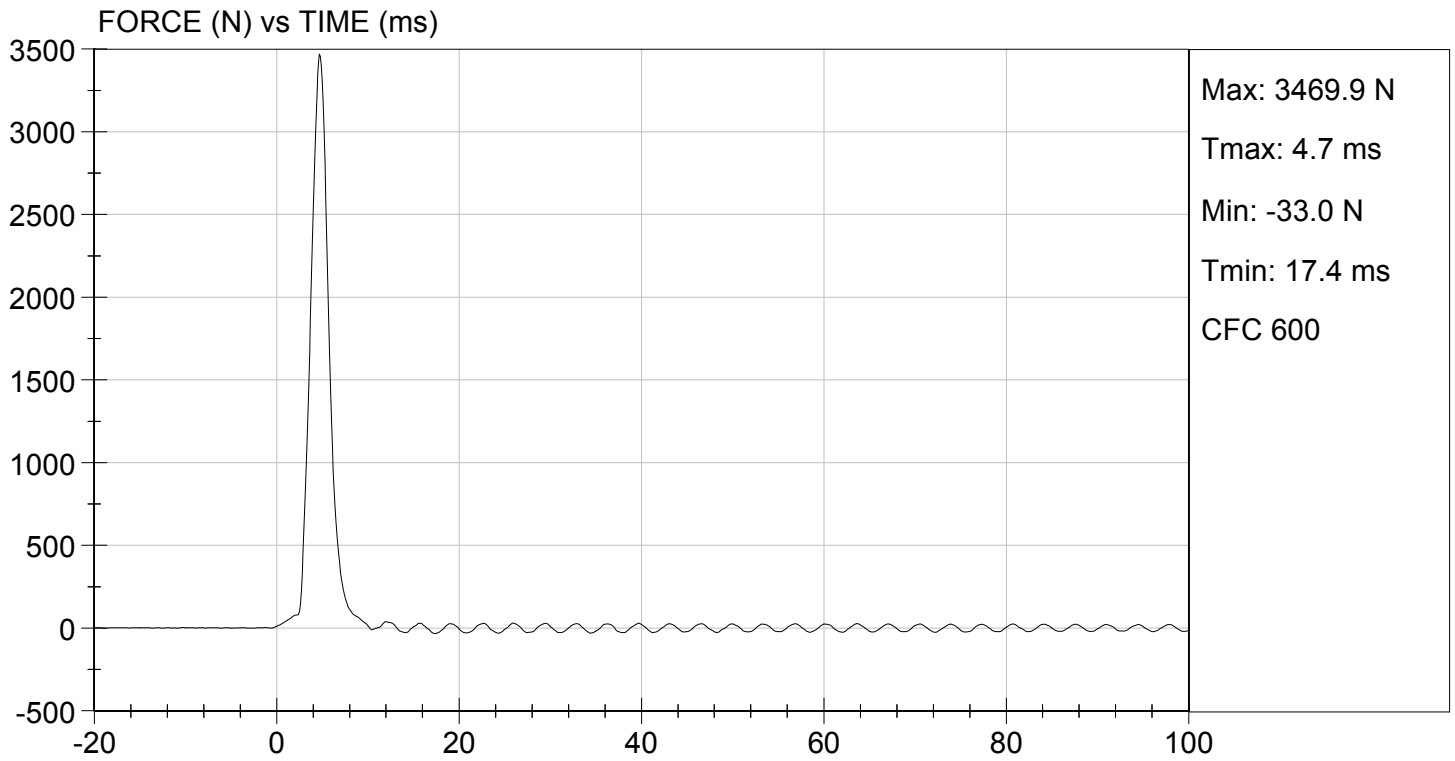
01/10/2013  
Test Date

David Winkelbauer  
Approved By



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

TEST DATE: 01/10/2013  
TEST #: D13086



**MGA RESEARCH CORPORATION**

**TORSO FLEXION TEST**

**HYBRID III 5TH PERCENTILE**

**ATD Serial No:** 138

**Test I.D.:** D13087

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	30	Pass
Initial Angle	deg	0 to 20	18	Pass
Return Angle	deg	+/- 8	2	Pass
Force at 45 deg	N	320 to 390	382	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass

Jessica Hall  
Laboratory Technician

01/10/2013  
Test Date

David Winkelbauer  
Approved By