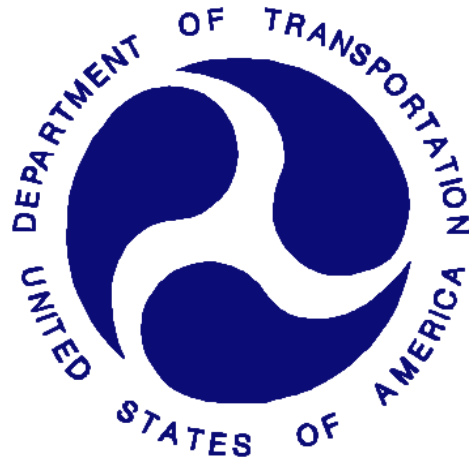


REPORT NUMBER: NCAP-MGA-2015-007

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

**HYUNDAI MOTOR MANUFACTURING ALABAMA, LLC
2015 Hyundai Sonata SE 4-Dr Sedan
NHTSA No.: O20154203**

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



Test Date: July 23, 2014

Final Report Date: August 18, 2014

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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Prepared by: 
Donna Janovicz, Project Manager

Approved by: 
Ben Fischer, Project Engineer

Approval Date: August 18, 2014

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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

Date: _____

Technical Report Documentation Page

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		13. Type of Report and Period Covered Final Test Report July 23, 2014 to August 18, 2014																																																					
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		16. Abstract A 56.3 km/h NCAP Frontal Impact Test was conducted on a 2015 Hyundai Sonata SE 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), and 301 performance. The test was conducted at MGA Research Corporation in Burlington, Wisconsin, on July 23, 2014. The impact velocity of the vehicle was 56.5 km/h and the ambient temperature at the barrier face at the time of impact was 22.0°C. The target vehicle post-test maximum crush was 488 located at the vehicle's centerline. The test vehicle's performance was as follows: <table border="1" style="width: 100%; border-collapse: collapse; text-align: center;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Driver ATD</th> <th colspan="2">Passenger ATD</th> </tr> <tr> <th>Threshold</th> <th>Result</th> <th>Threshold</th> <th>Result</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>700</td> <td>245</td> <td>700</td> <td>197</td> </tr> <tr> <td>Maximum Chest</td> <td>mm</td> <td>63</td> <td>17</td> <td>52</td> <td>9</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>0.20</td> <td>1</td> <td>0.33</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>728</td> <td>2620</td> <td>646</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>217</td> <td>2520</td> <td>227</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>881</td> <td>6805</td> <td>139</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>1926</td> <td>6805</td> <td>325</td> </tr> </tbody> </table>				Measurement Description	Units	Driver ATD		Passenger ATD		Threshold	Result	Threshold	Result	Head Injury Criteria (HIC ₁₅)	N/A	700	245	700	197	Maximum Chest	mm	63	17	52	9	Nij	N/A	1	0.20	1	0.33	Neck Tension	N	4170	728	2620	646	Neck Compression	N	4000	217	2520	227	Left Femur Force	N	10008	881	6805	139	Right Femur Force	N	10008	1926
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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 2015 Hyundai Sonata SE 4-Dr Sedan at a velocity of 56.5 km/h. The test was performed at MGA Research Corporation on July 23, 2014. Pre-test and post-test photographs of the vehicle and dummies can be found in Appendix A.

Two (2) real-time cameras and fourteen (14) high-speed cameras were used to document the frontal barrier impact event. Camera locations and other pertinent camera information can be found in this report.

One Part 572E 50th percentile male anthropomorphic test device (ATD), was placed in the driver seating position and one Part 572O 5th percentile female test device (ATD) was placed in the right-front passenger seating position according to dummy placement instructions specified in the Frontal NCAP Laboratory Test Procedure.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometers, upper neck transducers, right/left femur load cells, and lower leg instrumentation. Seat belt load cells were also installed on the driver's lap and shoulder belts and the passenger's lap and shoulder belts to measure dummy torso and pelvic section loading.

The driver (position 1) ATD (Serial No. 351) and the right-front passenger (position 2) ATD (Serial No. 138) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C of this report.

The 628 channels of data were recorded on a data acquisition system. Appendix B contains the dummy response data traces.

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

The maximum static crush of the vehicle was 488 mm and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

The driver's visible contact points were as follows: The driver's head and chest contacted the airbag. The driver's head also contacted the headrest. The driver's knees contacted the knee airbag. The passenger's visible contact points were as follows: The passenger's head and chest contacted the airbag. The passenger's head also contacted the headrest. The passenger's knees contacted the frontal airbag.

The occupant data is summarized below:

ATD position	HIC ₁₅	Nij	Neck Tension (N)	Neck Comp. (N)	3ms Chest Clip (Gs)	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver (50 th)	245	0.20	728	217	38	17	881	1926
Passenger (5 th)	197	0.33	646	227	38	9	139	325

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

TEST NOTES

Bottom of Engine X has no valid data after 34ms

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: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	O20154203	Traction Control System (TCS)	Yes
Model Year	2015	Power Steering	Yes
Make	Hyundai	Power Window Auto-Reverse	Yes
Model	Sonata	Driver Frontal Airbag	Yes
Body Style	Sedan	Driver Curtain Airbag	Yes
VIN	5NPE24AF6FH005404	Driver Head/Torso Airbag	No
Body Color	Venetian Red	Driver Torso Airbag	No
Odometer (km/mi)	100 / 62	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.4	Driver Pelvis Airbag	No
Type/No. Cylinders	4	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	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof/T-Top	No	Front Pass. Knee Airbag	No
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	Yes	Front Pass. Pretensioner	Yes
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	Yes
Automatic Door Locks (ADLs)	Yes	Other	N/A

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Manufacturing Alabama, LLC	GVWR (kg)	2040
		GAWR Front (kg)	1160
Date of Manufacture	May/22/14	GAWR Rear (kg)	1140

VEHICLE SEATING AND WEIGHT CAPACITY DATA

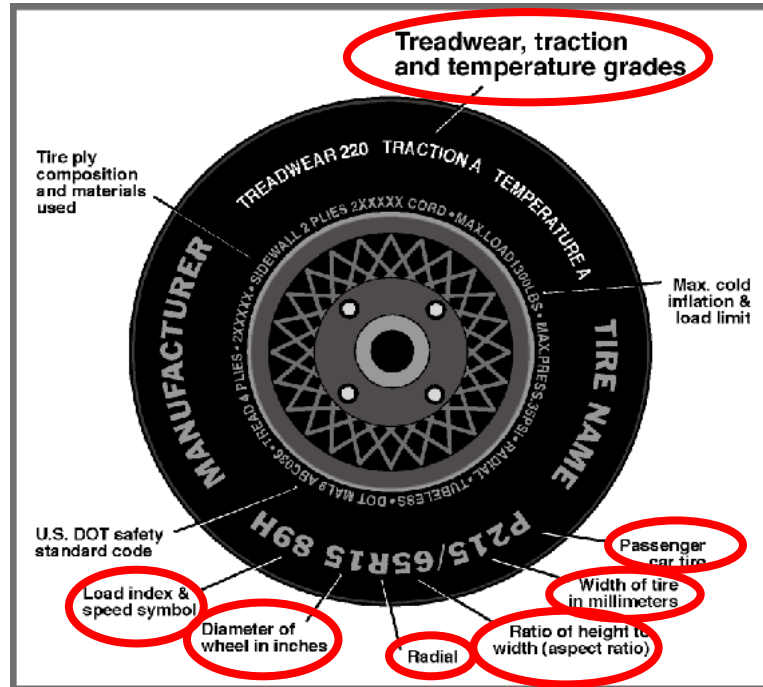
Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Designated Seating Capacity (DSC)	2	3		5
Capacity Weight (VCW) (kg)				410
Cargo Weight (RCLW) (kg)				70

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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	235	235
Recommended Tire Size	205/65R16	205/65R16
Tire Size on Vehicle	205/65R16	205/65R16
Tire Manufacturer	Kumho	Kumho
Tire Model	Solus	Solus
Treadwear	500	500
Traction	A	A
Temperature Grade	A	A
Tire Plies Sidewall	1 Polyester	1 Polyester
Tire Plies Body	2 Steel, 1 Polyester, 1 Nylon	2 Steel, 1 Polyester, 1 Nylon
Load Index/Speed Symbol	95H	95H
Tire Material	Rubber	Rubber
DOT Safety Code Left	YOER YAY1 1314	YOER YAY1 1314
DOT Safety Code Right	YOER YAY1 1314	YOER YAY1 1314

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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	459.0	305.5		487.0	392.0	
Right	kg	453.5	289.0		463.0	370.0	
Ratio	%	60.6	39.4		55.5	44.5	
Totals	kg	912.5	594.5	1507.0	950.0	762.0	1712.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1507.0
Weight of 1 P572E ATD & 1 P572O ATD	kg	140.6
Rated Cargo/Luggage Weight (RCLW)	kg	70
Calculated Test Vehicle Target Weight (TVTW)	kg	1717.6

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	698	712	713	708	1109
As Tested	mm	694	700	660	668	1251
Post Test	mm	745	753	653	676	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2810
Total Vehicle Length at Left Side	mm	4695
Total Vehicle Length at Centerline	mm	4870
Total Vehicle Length at Right Side	mm	4695
Weight of Ballast in Cargo Area	kg	57.2
Weight of Vehicle Components Removed	kg	24.5
Amount of Stoddard Solvent in Fuel Tank	L	65.1

List of components removed to meet test weight: None

List of components removed for instrumentation, data box, and equipment installation:
Spare tire, jack & tools, right taillight, trunk trim.

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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements	Pre-Test (mm)
1	Total Length	4870
2	Total Width	1820
3	Bumper Top Height	555
4	Bumper Bottom Height	440
5	Longitudinal Member Top Height	535
6	Distance between Longitudinal Members	1055
7	Longitudinal Member Width	70
8	Engine Top Height	815
9	Engine Bottom Height	200
10	Engine and Gearbox Width	790
11	Front Bumper-Engine Distance	470
12	Front Shock Absorber Fixing Height	880
13	Bonnet Leading Edge Height	810
14	Front Shock Absorber Fixing Width	1200
15	Front Bumper – Front Axle Distance	935
16	Front Axle – A-Pillar Distance	593
17	A-Pillar – B-Pillar Distance	1136
18	B-Pillar – Rear Axle Distance	1095
19	B-Pillar – C-Pillar Distance	915
20	Roof Sill Bottom Height	1400
21	Roof Sill Top Height	1455
22	Floor Sill Bottom Height	275
23	Floor Sill Top Height	315

DATA SHEET NO. 2

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

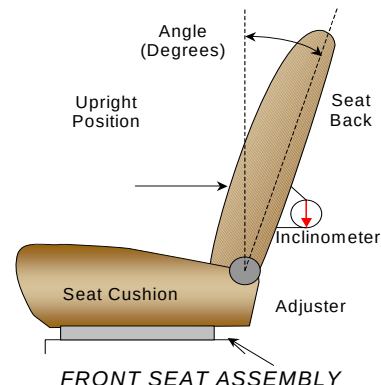
Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

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 August 2013.

	Degrees
Driver Seat Back Angle	2.8° on headrest post
Passenger Seat Back Angle	-1.0° on headrest post



SEAT FORE/AFT POSITIONS

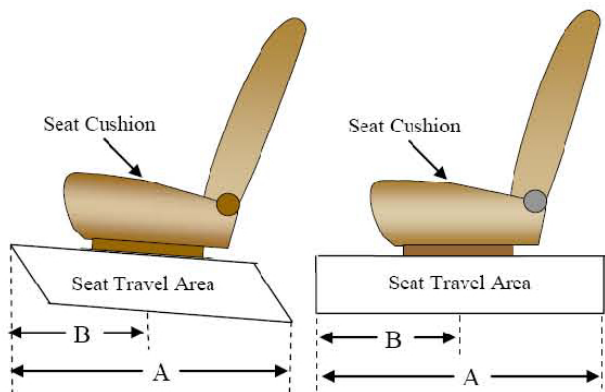
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Dummy Seating & Positioning Procedures" in the NCAP Test Procedure dated August 2013.

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	296 mm	148 mm (foremost as 0)
Passenger Seat	228 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 st as 1)	0 (1 st as 0)
Passenger Seat	4 (1 st as 1)	0 (1 st as 0)



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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

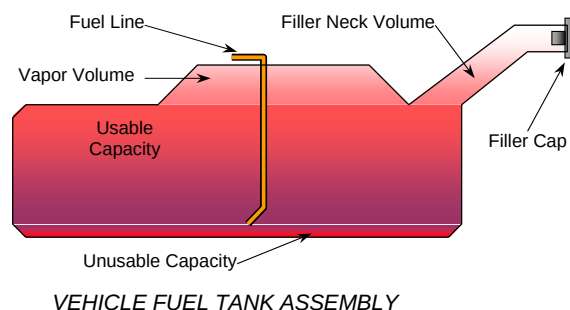
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of "Standard Tank"	76.8
Usable Capacity of "Optional Tank"	
92-94% of Usable Capacity	64.4 to 65.8
Actual Amount of Solvent used	65.1
1/3 of Usable Capacity	23.4

FUEL PUMP

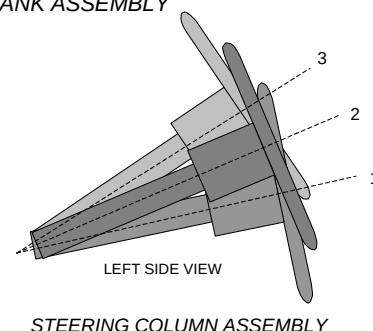
Describe the fuel pump type, its behavior, and the location of the fuel filler pipe.

The vehicle is equipped with an electric fuel pump. Fuel pump will operate when engine system is normally operating. The fuel pipe is on the left side.



STEERING COLUMN ADJUSTMENT

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



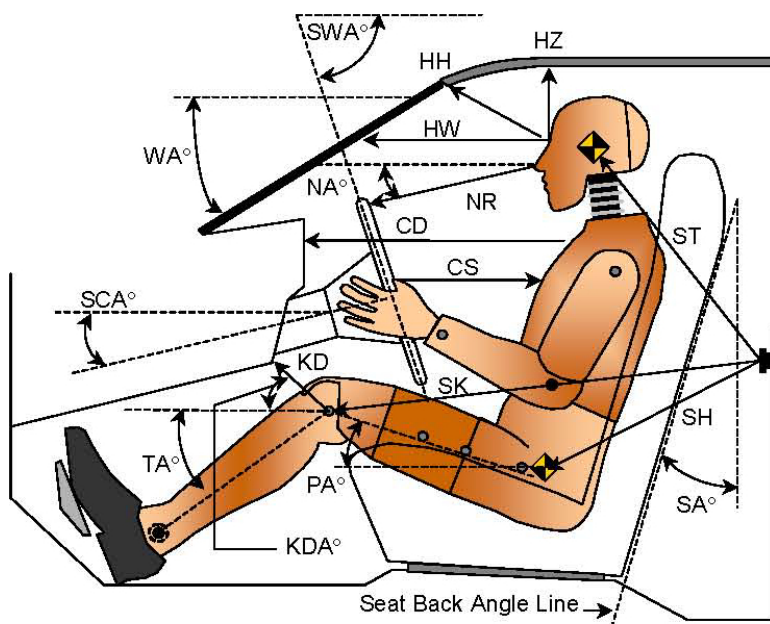
STEERING COLUMN POSITION

	Degrees	Fore/Aft Position (mm)
Lowermost Position 1	69.8	284
Geometric Center Position 2	67.3	258
Uppermost Position 3	64.8	232
Telescoping Steering Wheel Travel		52
Test Position	67.3	258

DATA SHEET NO. 3 DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014



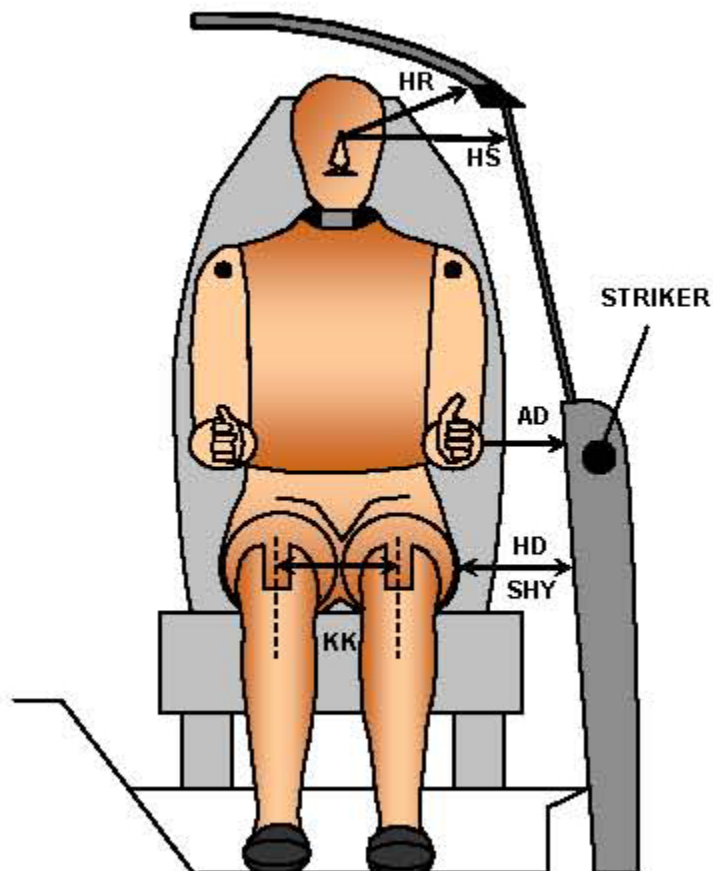
LEFT SIDE VIEW

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA°	Windshield Angle		20.4		
SWA°	Steering Wheel Angle		67.3		
SCA°	Steering Column Angle		22.7		
SA°	Seat Back Angle (on headrest post)		2.8		-1.0
HZ	Head to Roof (Z)	196	90.0	233	90.0
HH	Head to Header	344	23.4	302	43.0
HW	Head to Windshield	671	0.0	742	0.0
NR	Nose to Rim	395	5.7		
CD	Chest to Dash	563		434	
CS	Chest to Steering Hub	331	4.9		
RA	Rim to Abdomen	312	0.0		
KDL	Left Knee to Dash	229	30.5	162	34.6
KDR	Right Knee to Dash	197	27.6	166	29.7
PA°	Pelvic Angle		22.3		21.1
TA°	Tibia Angle		36.0		43.7
SK	Striker to Knee	638	105.5	714	102.4
ST	Striker to Head	435	18.8	399	39.3
SH	Striker to H-Point	369	138.9	424	122.6

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014



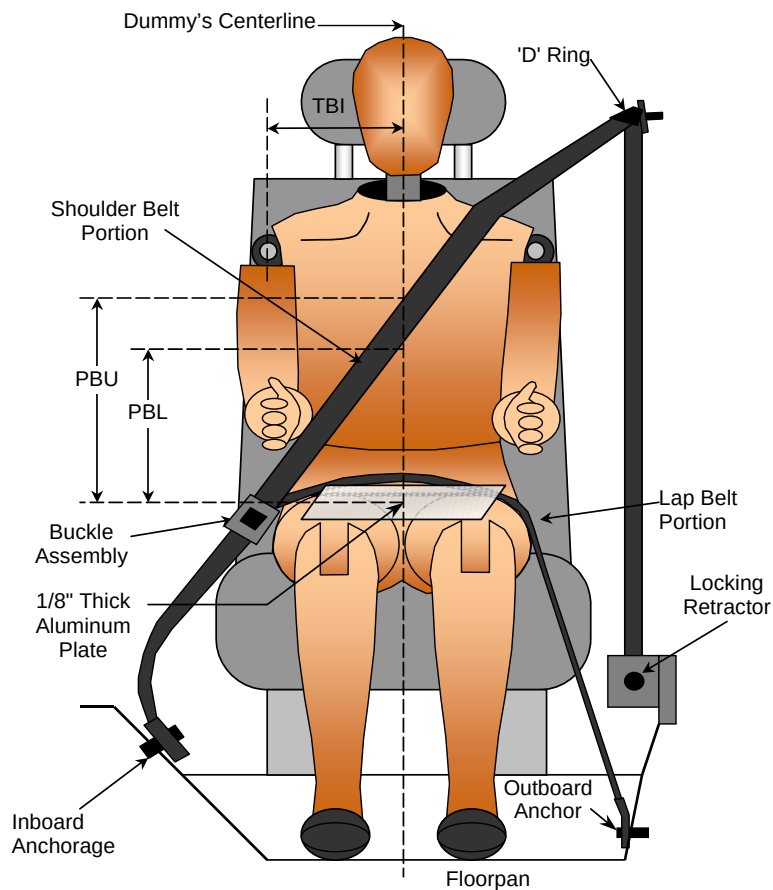
FRONT VIEW OF DUMMY

Code	Measurement Description	Driver	Passenger
		Length (mm)	
AD	Arm to Door	125	105
HD	H-Point to Door	148	187
HR	Head to Side Header	218	269
HS	Head to Side Window	336	381
KK	Knee to Knee	387	224
SHY	Striker to H-Point (Y Direction)	271	340
AA	Ankle to Ankle	394	158

DATA SHEET NO. 5 SEAT BELT POSITIONING DATA

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	360	335
PBL - Top surface of reference to belt lower edge	mm	280	260

BELT LENGTH DATA

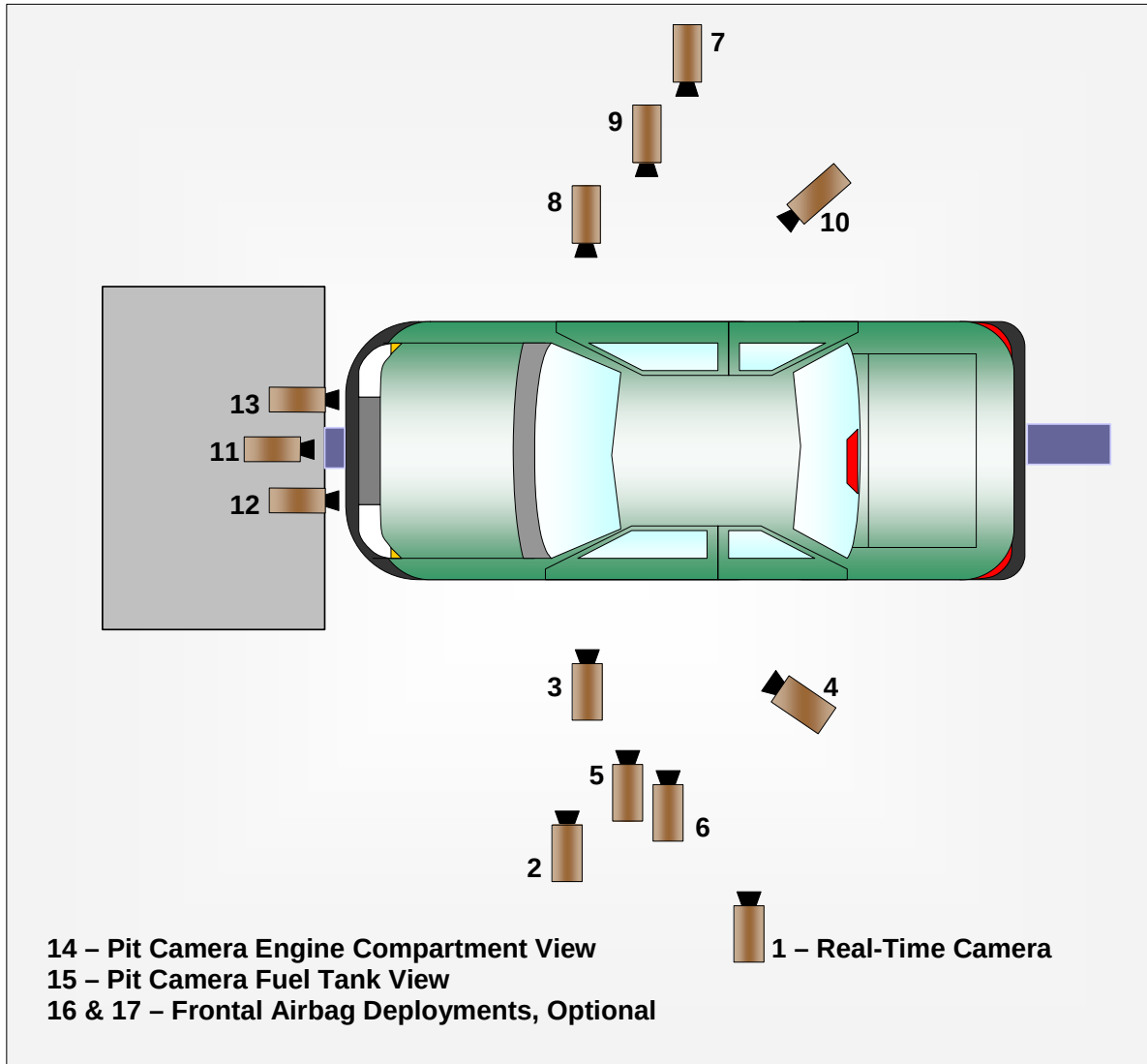
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	916	959
Lap Belt Length as measured on ATD	mm	574	596
Remainder of belt on reel	mm	1510	1445
Total Belt Length for Continuous Webbing Systems	mm	3000	3000

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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014

CAMERA POSITIONS FOR FRONTAL IMPACTS



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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

CAMERA LOCATIONS

No.	Camera View	Coordinates (mm)			Lens (mm)	Speed (fps)
		X*	Y*	Z*		
1	Real-Time Left Overall					30
2	Driver Close-Up	1580	-6960	-1880	35	1000
3	Left Front Half	1240	-5190	-2430	24	1000
4	Left Angle	5680	-5100	-1920	50	1000
5	Steering Column - Top	660	-5090	-1180	24	1000
6	Steering Column - Bottom	640	-5030	-790	24	1000
7	Right Overall	2140	6750	-1340	20	1000
8	Passenger Close-Up	1590	6900	-1940	35	1000
9	Right Front Half	1260	5230	-1280	24	1000
10	Right Angle	5700	5180	-1930	50	1000
11	Windshield	-50	0	-2810	20	1000
12	Driver Windshield	30	-450	-2030	8.5	1000
13	Passenger Windshield	30	450	-2030	8.5	1000
14	Pit Front	1010	0	3150	24	1000
15	Pit Rear	2860	0	3150	24	1000
16	Onboard Driver Side (optional)					
17	Onboard Passenger Side (optional)					
18	Real-Time Pan View					30

***COORDINATES:**

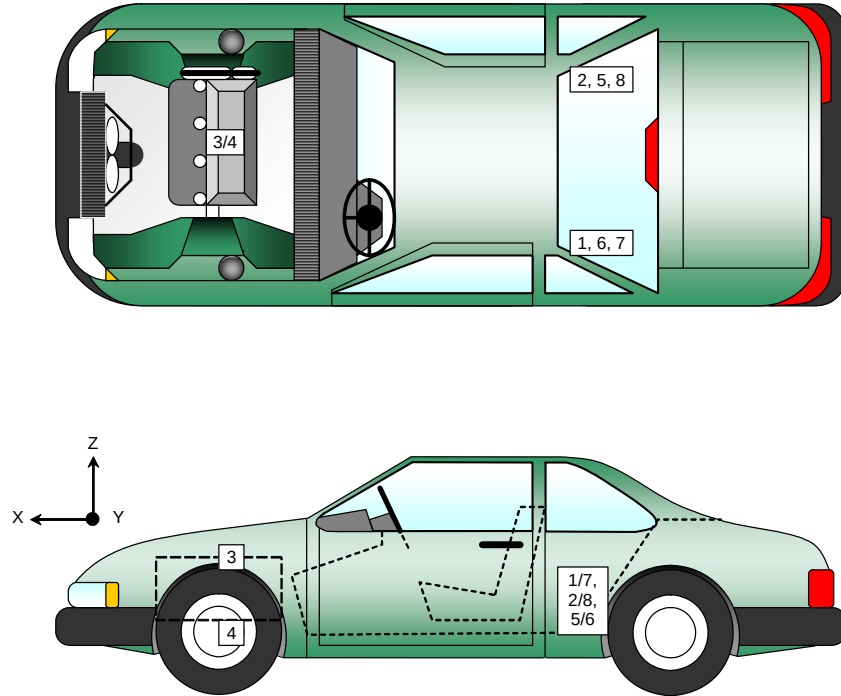
- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = below ground level

Cameras 16 & 17 were not used for this test.

DATA SHEET NO. 7 VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear Crossmember Accelerometer – X Direction	1926	-490	-210
2	Right Rear Crossmember Accelerometer – X Direction	1926	490	-210
3	Engine Top X	4065	0	-770
4	Engine Bottom X	4100	85	-190
5	Left Rear Crossmember Accelerometer – Z Direction	1926	-490	-210
6	Right Rear Crossmember Accelerometer – Z Direction	1926	490	-210
7	Left Rear Crossmember Accelerometer Redundant – X Direction	1926	-490	-210
8	Right Rear Crossmember Accelerometer Redundant – X Direction	1926	490	-210

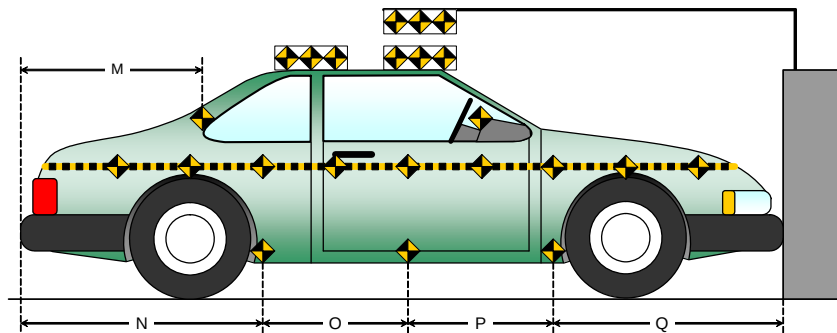
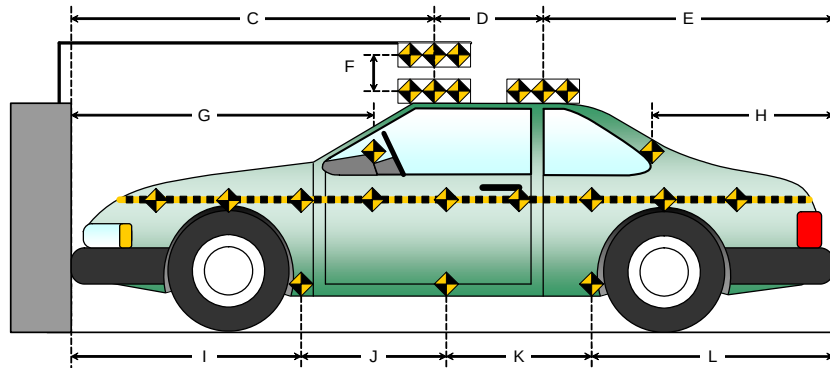
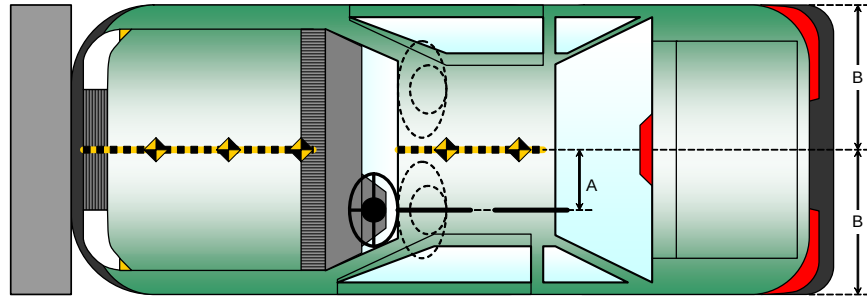
Reference Points: X - Rear Surface of Vehicle (+ forward)
 Y - Vehicle Centerline (+ to right)
 Z - Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: Q20154203
 Test Date: 7/23/2014

Item	Value (mm)
A	377
B	910
C	2370
D	614
E	1886
F	329
G	
H	1340
I	1394
J	979
K	979
L	1512
M	1340
N	1512
O	979
P	979
Q	1394



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

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

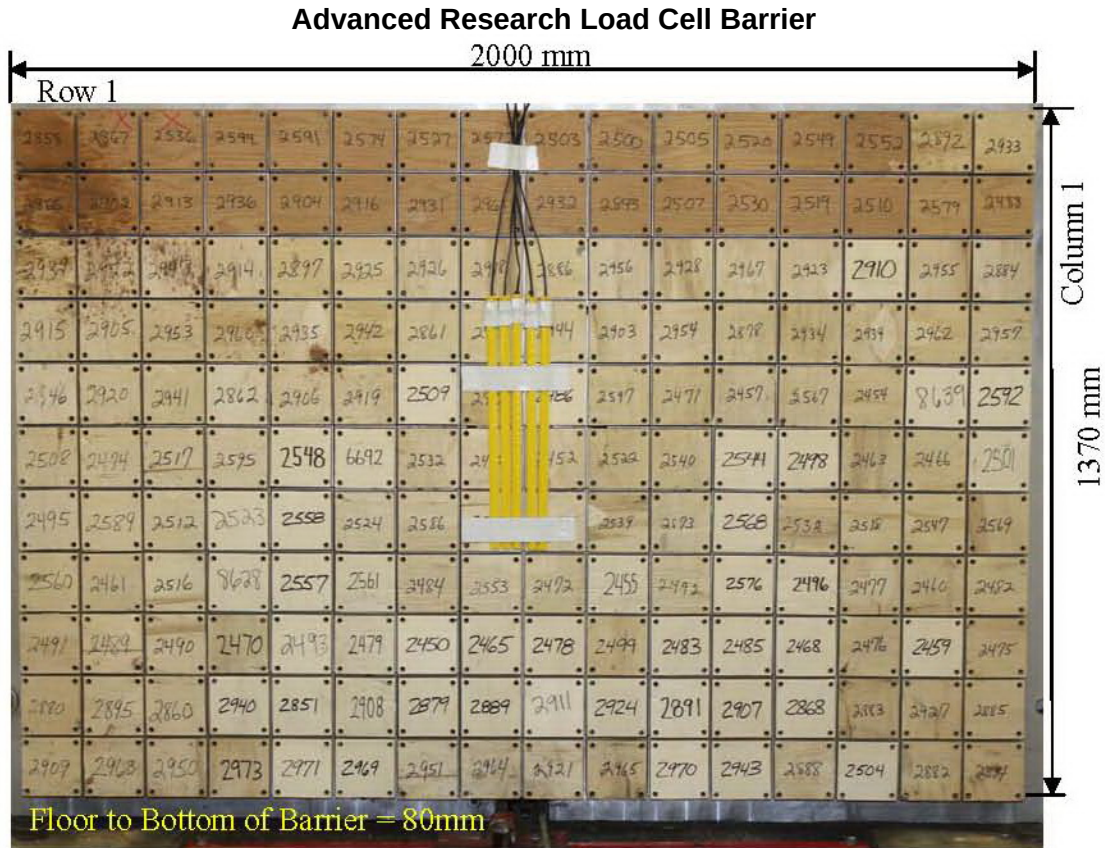


Photo for Reference Only

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

Load Cells are 121 mm x 121 mm with a 7 mm gap in between each load cell.

DATA SHEET NO. 10
TEST VEHICLE SUMMARY OF RESULTS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014

INSTRUMENTATION

Driver Dummy Data Channels	46
Passenger Dummy Data Channels	46
Vehicle Structure Accelerometers	8
Barrier Channels	528
Total	628

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: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014

TEST DUMMY INFORMATION AND CONTACT LOCATIONS

Description	Driver	Passenger
Dummy Type / Serial No.	HIIL 50% / 351	HIIL 5% / 138
Head Contact	Airbag, Headrest	Airbag, Headrest
Upper Torso Contact	Airbag	Airbag
Lower Torso Contact	None	None
Left Knee Contact	Knee Airbag	Frontal Airbag
Right Knee Contact	Knee Airbag	Frontal 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	Cracked
Window Damage	None
Other Notable Effects	None

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1060
Center	mm	975
Right Side	mm	1070
Average	mm	1035

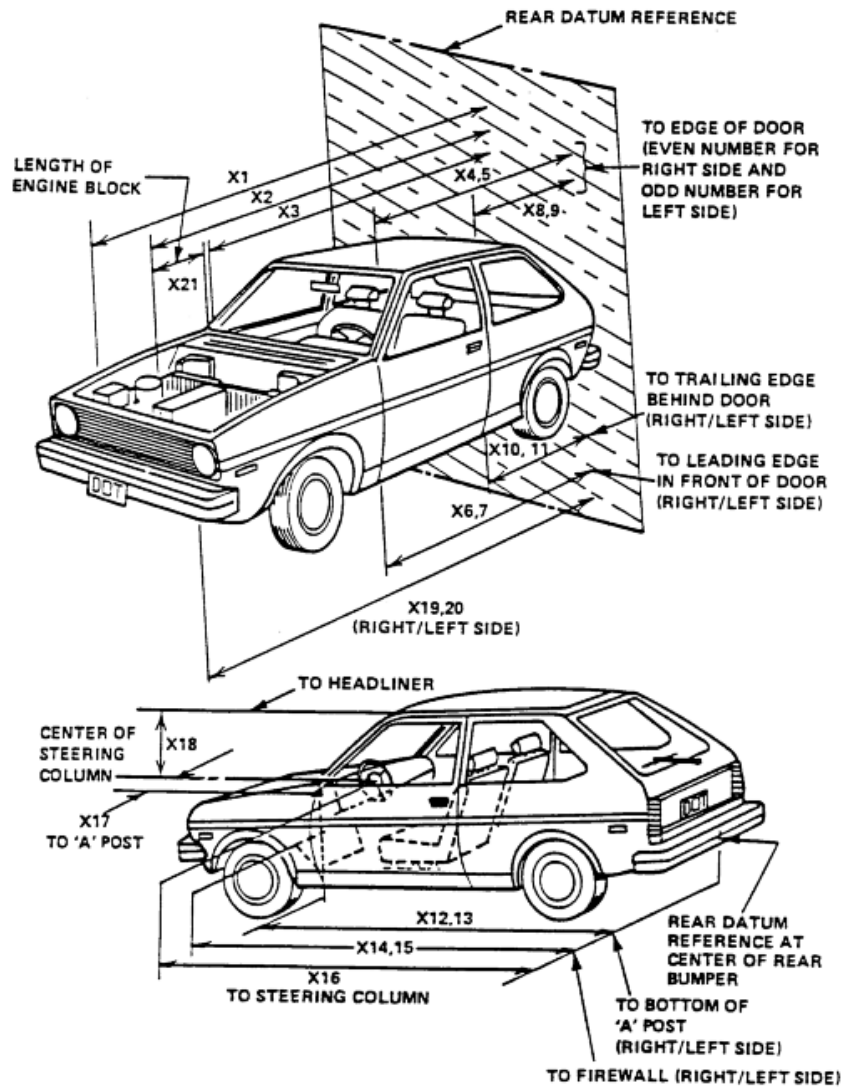
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

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

DATA SHEET NO. 12 VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014



DATA SHEET NO. 12 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

RSOV (Rear Surface of Vehicle)

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	4870	4382	488
2	RSOV to Front of Engine	mm	4155	3897	258
3	RSOV to Firewall	mm	3714	3714	0
4	RSOV to Upper Leading Edge of Right Door	mm	3323	3323	0
5	RSOV to Upper Leading Edge of Left Door	mm	3323	3323	0
6	RSOV to Lower Leading Edge of Right Door	mm	3321	3321	0
7	RSOV to Lower Leading Edge of Left Door	mm	3321	3321	0
8	RSOV to Upper Trailing Edge of Right Door	mm	2191	2191	0
9	RSOV to Upper Trailing Edge of Left Door	mm	2191	2191	0
10	RSOV to Lower Trailing Edge of Right Door	mm	2225	2225	0
11	RSOV to Lower Trailing Edge of Left Door	mm	2225	2225	0
12	RSOV to Bottom of "A" Post of Right Side	mm	3294	3294	0
13	RSOV to Bottom of "A" Post of Left Side	mm	3294	3294	0
14	RSOV to Firewall, Right Side	mm	3440	3440	0
15	RSOV to Firewall, Left Side	mm	3440	3440	0
16	RSOV to Steering Column	mm	2851	2871	-20
17	Center of Steering Column to "A" Post	mm	426	426	0
18	Center of Steering Column to Headliner	mm	434	411	23
19	RSOV to Right Side of Front Bumper	mm	4695	4320	375
20	RSOV to Left Side of Front Bumper	mm	4695	4327	368
21	Length of Engine Block	mm	296	296	0
RD	RSOV to Right Side of Dash Panel	mm	3054	3053	1
CD	RSOV to Center of Dash Panel	mm	3094	3092	2
LD	RSOV to Left Side of Dash Panel	mm	3078	3076	2

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
Test Date: 7/23/2014

VEHICLE INFORMATION

VIN: 5NPE24AF6FH005404 Wheelbase (mm): 2810
Vehicle Size Category: Sedan Test Weight (kg): 1712.0

ACCELEROMETER DATA

Accelerometer Locations: As per measurements on Page 15

Cal. Procedure/Interval: MGA procedure / 6 month

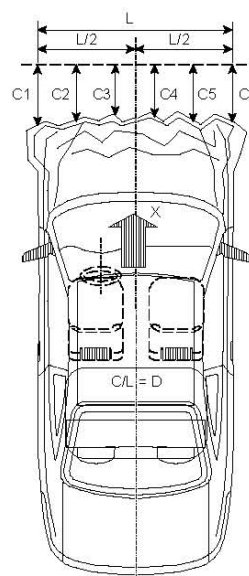
Integration Algorithm: Trapezoidal

Linearity: > 99%

Impact Velocity (km/h): 56.5

Velocity Change (km/h): 64.2

Time of Separation (msec): 114.5



CRUSH PROFILE

Collision Deformation Classification: Frontal

Midpoint of Damage: Centerline

Damage Region Length (mm): 1265

Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4695	4320	375
C2	Crush zone 2 at left side	mm	4799	4348	451
C3	Crush zone 3 at left side	mm	4826	4350	476
C4	Crush zone 4 at right side	mm	4826	4346	480
C5	Crush zone 5 at right side	mm	4799	4342	457
C6	Crush zone 6 at right side	mm	4695	4327	368
L	C1 TO C6	mm	1265	1256	9

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

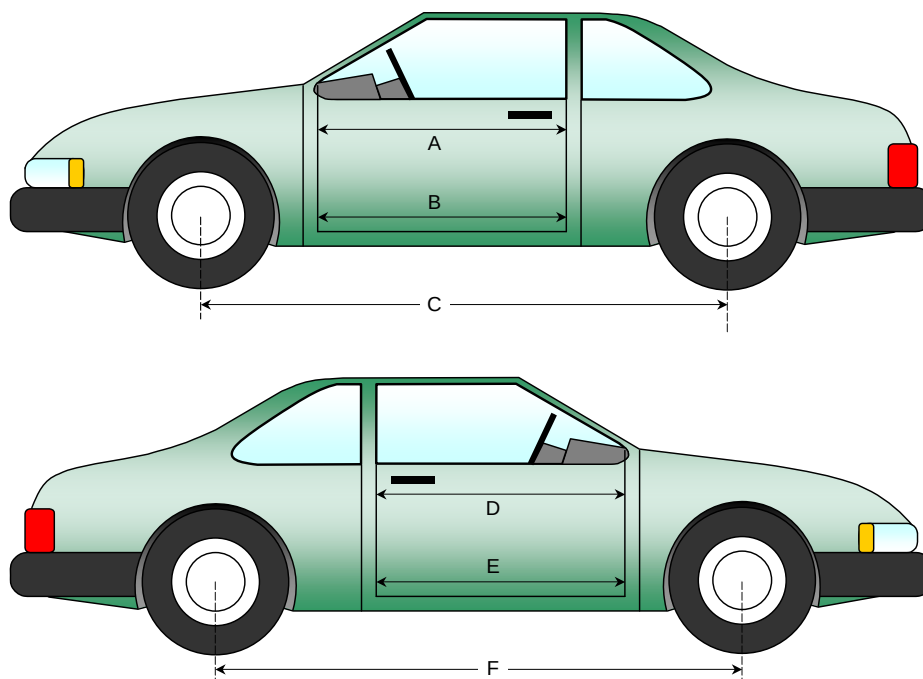
NHTSA No.: O20154203
Test Date: 7/23/2014

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1014	1014	0
B	Left Side Lower	mm	955	955	0
D	Right Side Upper	mm	1014	1014	8
E	Right Side Lower	mm	955	955	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2810	2742	68
F	Right Side Wheelbase	mm	2810	2725	85



DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

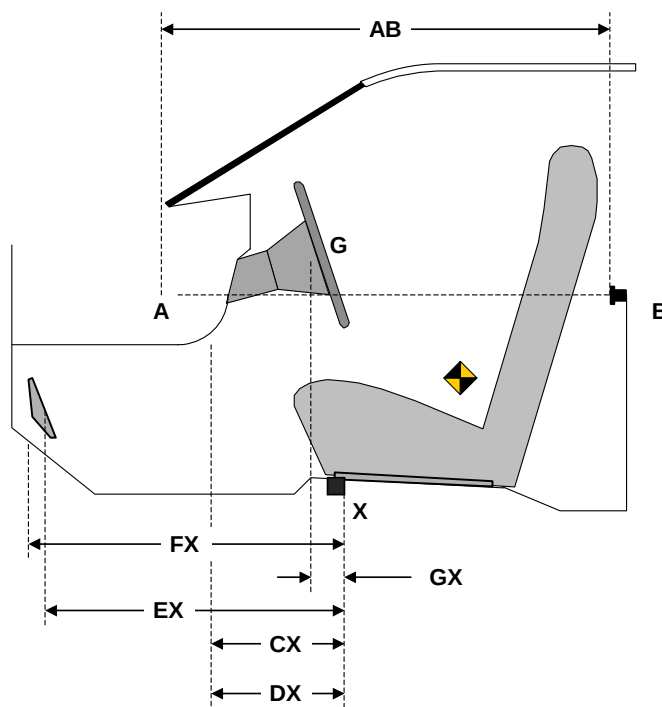
Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside Window Jam)	mm	871	871	0
CX	Left Knee Bolster to X	mm	316	315	1
DX	Right Knee Bolster to X	mm	316	315	1
EX	Brake Pedal to X	mm	594	567	27
FX	Foot Rest to X	mm	616	611	5
GX	Center of Steering Column Wheel Hub to X	mm	91	95	-4

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: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

Windshield Mounting Details:

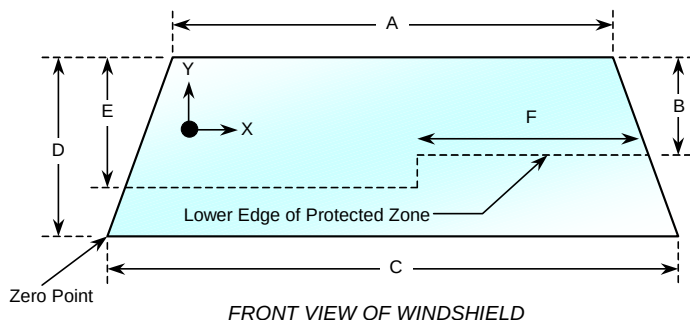
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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

Temperature of windshield molding during test: 22.0° C.

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2227	2227	100
Right Side	2227	2227	100
Total	4454	4454	100



Item	Units	Value
A	mm	1191
B	mm	427
C	mm	1527
D	mm	868
E	mm	523
F	mm	483

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:	<u>2015 Hyundai Sonata SE 4-Dr Sedan</u>	NHTSA No.:	<u>O20154203</u>
Test Program:	<u>NCAP Frontal Barrier Impact Test</u>	Test Date:	<u>7/23/2014</u>

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 22.0°C Test Time: 11:47 a.m.

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

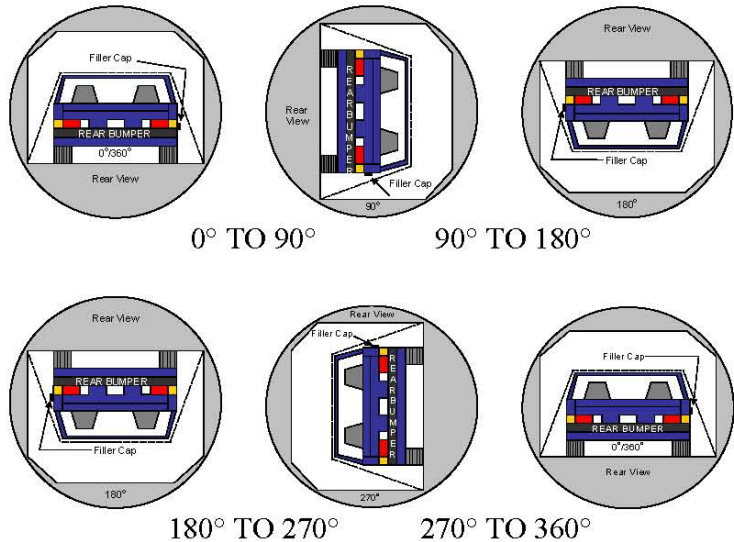
DATA SHEET NO. 16

FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014

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°	114	300	414
90° to 180°	110	300	410
180° to 270°	111	300	411
270° to 360°	108	300	408

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

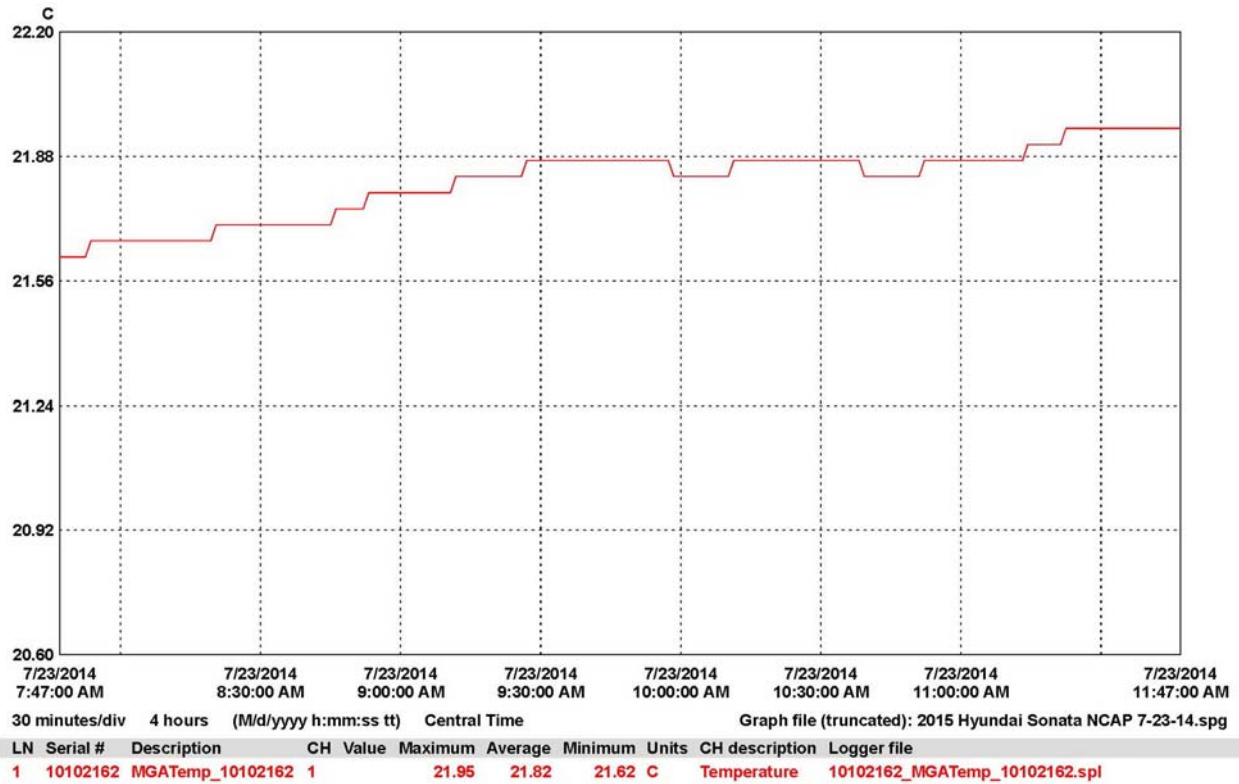
SOLVENT SPILLAGE LOCATION TABLE

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: 2015 Hyundai Sonata SE 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: O20154203
 Test Date: 7/23/2014



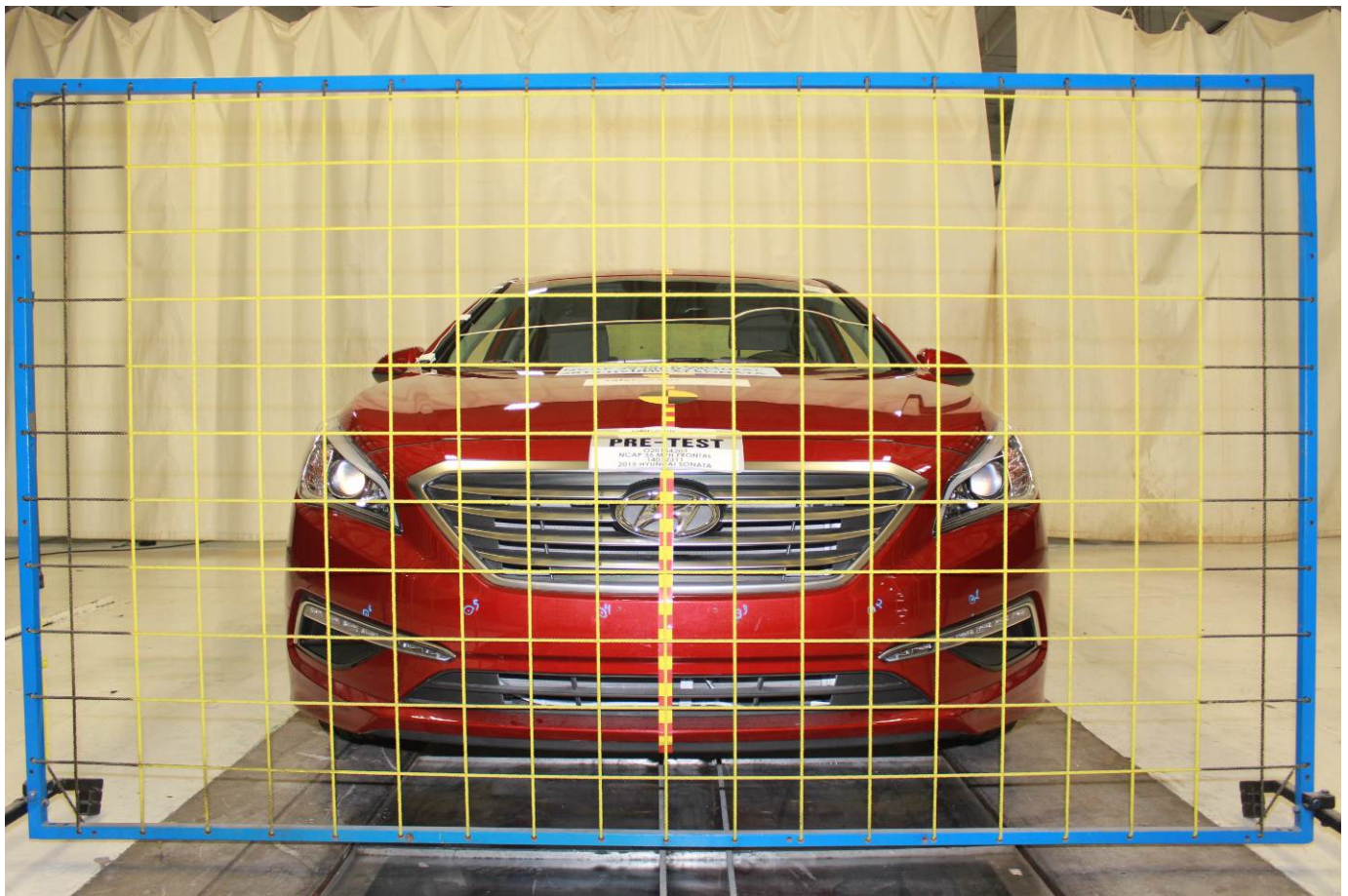
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Load Cell Location



Load Cell Wall

O20154203

 MANUFACTURED BY
HYUNDAI MOTOR-MANUFACTURING ALABAMA, LLC

May/22/14 GVWR 4497 lbs PAINT TR
GAWR FRONT 2557 lbs GAWR REAR 2513 lbs TRIM GC

THIS VEHICLE CONFORMS TO ALL APPLICABLE U.S.A. FEDERAL
MOTOR VEHICLE SAFETY, BUMPER, AND THEFT PREVENTION STANDARDS
IN EFFECT ON THE DATE OF MANUFACTURE SHOWN ABOVE

V.I.N 5NPE24AF6FH005404
PASSENGER CAR



Manufacturer's Label

 **TIRE AND LOADING INFORMATION**
RENSEIGNEMENTS SUR LES PNEUS ET LE CHARGEMENT

SEATING CAPACITY NOMBRE DE PLACES	TOTAL 5	FRONT AVANT 2	REAR ARRIÈRE 3
--------------------------------------	---------	------------------	-------------------

The combined weight of occupants and cargo should never exceed 410 kg or 904 lbs.
Le poids total des occupants et du chargement ne doit jamais dépasser 410 kg ou 904 lb.

TIRE PNEU	SIZE DIMENSIONS	COLD TIRE PRESSURE PRESSION DES PNEUS À FROID	SEE OWNER'S MANUAL FOR ADDITIONAL INFORMATION VOIR LE MANUEL DE L'USAGER POUR PLUS DE RENSEIGNEMENTS
FRONT AVANT	205/65R16	235kPa, 34psi	
REAR ARRIÈRE	205/65R16	235kPa, 34psi	
SPARE DE SECOURS	T125/80D16	420kPa, 60psi	

16L6

O20154203

Tire Placard



Load Carrying Capacity Reduced Label



2015 Hyundai Sonata Frontal As Delivered



Left Rear 3-4 View, As Received



Pre-Test Front View of Test Vehicle



Post-Test Front View of Test Vehicle



Pre-Test Left View of Test Vehicle



Post-Test Left View of Test Vehicle



Pre-Test Right View of Test Vehicle



Post-Test Right View of Test Vehicle



Pre-Test Right Front 3-4 View



Post-Test Right Front 3-4 View



Pre-Test Left Rear 3-4 View



Post-Test Left Rear 3-4 View



Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



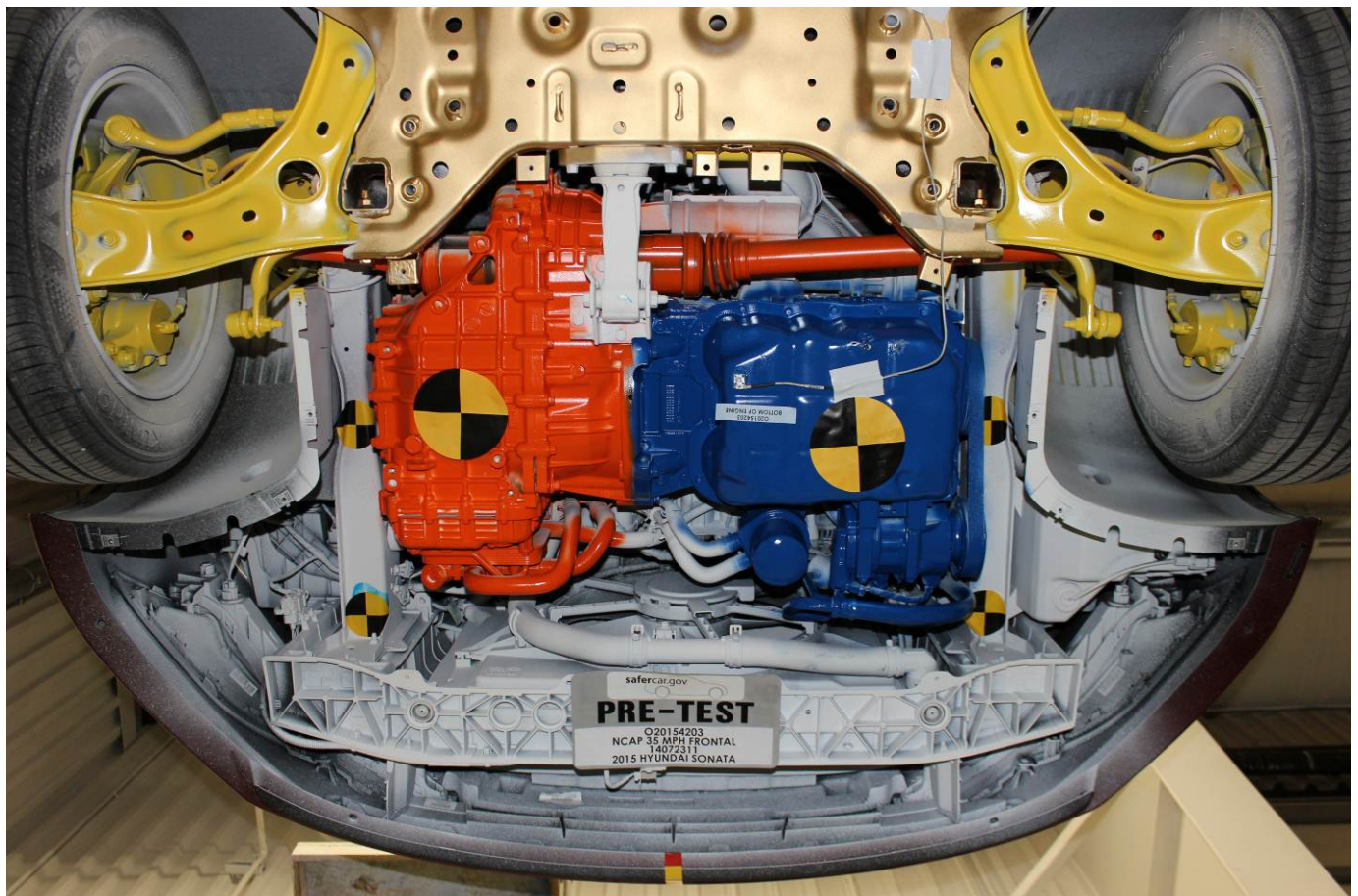
Post-Test Engine Compartment View



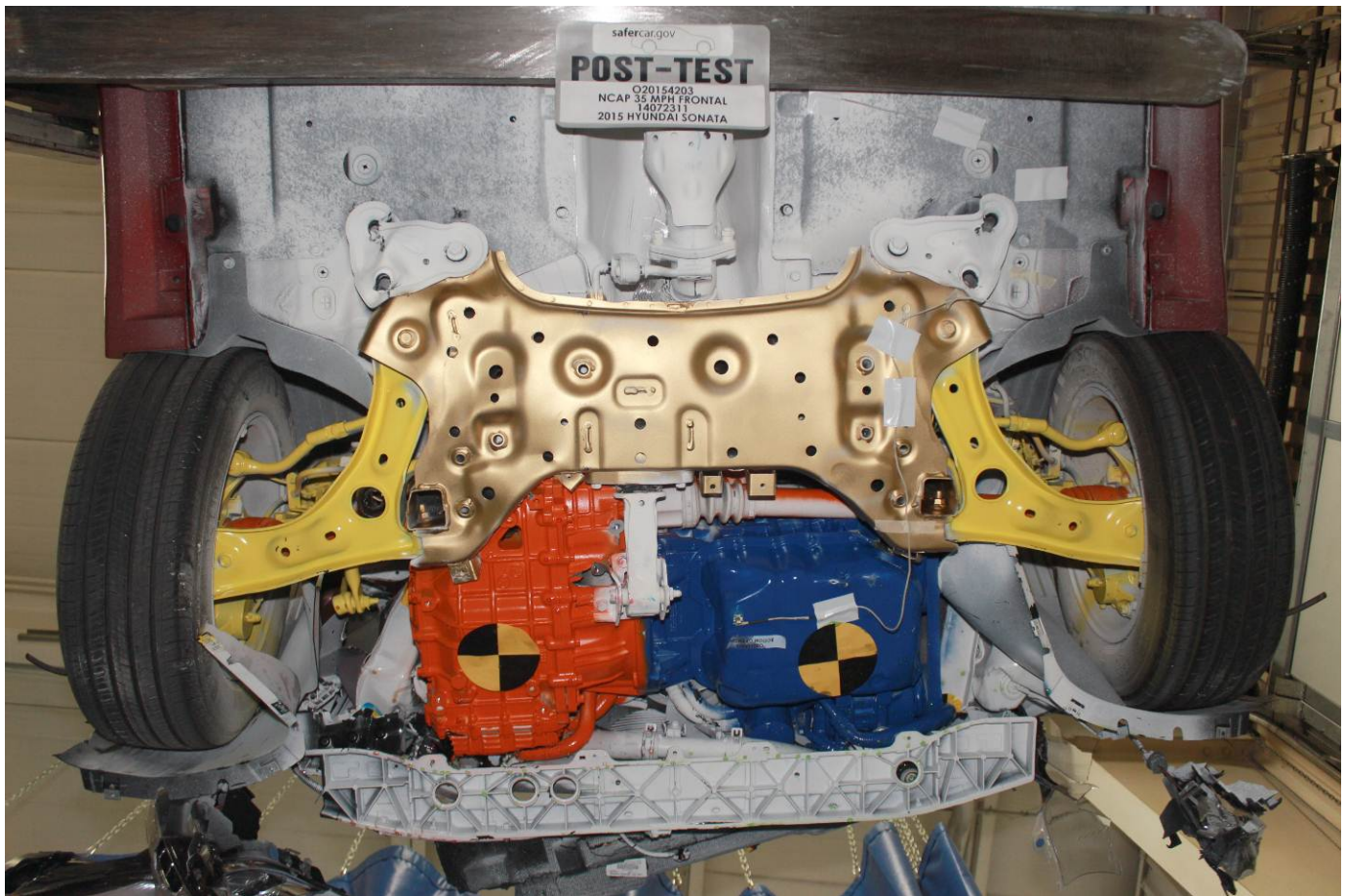
Pre-Test Fuel Filler Cap View



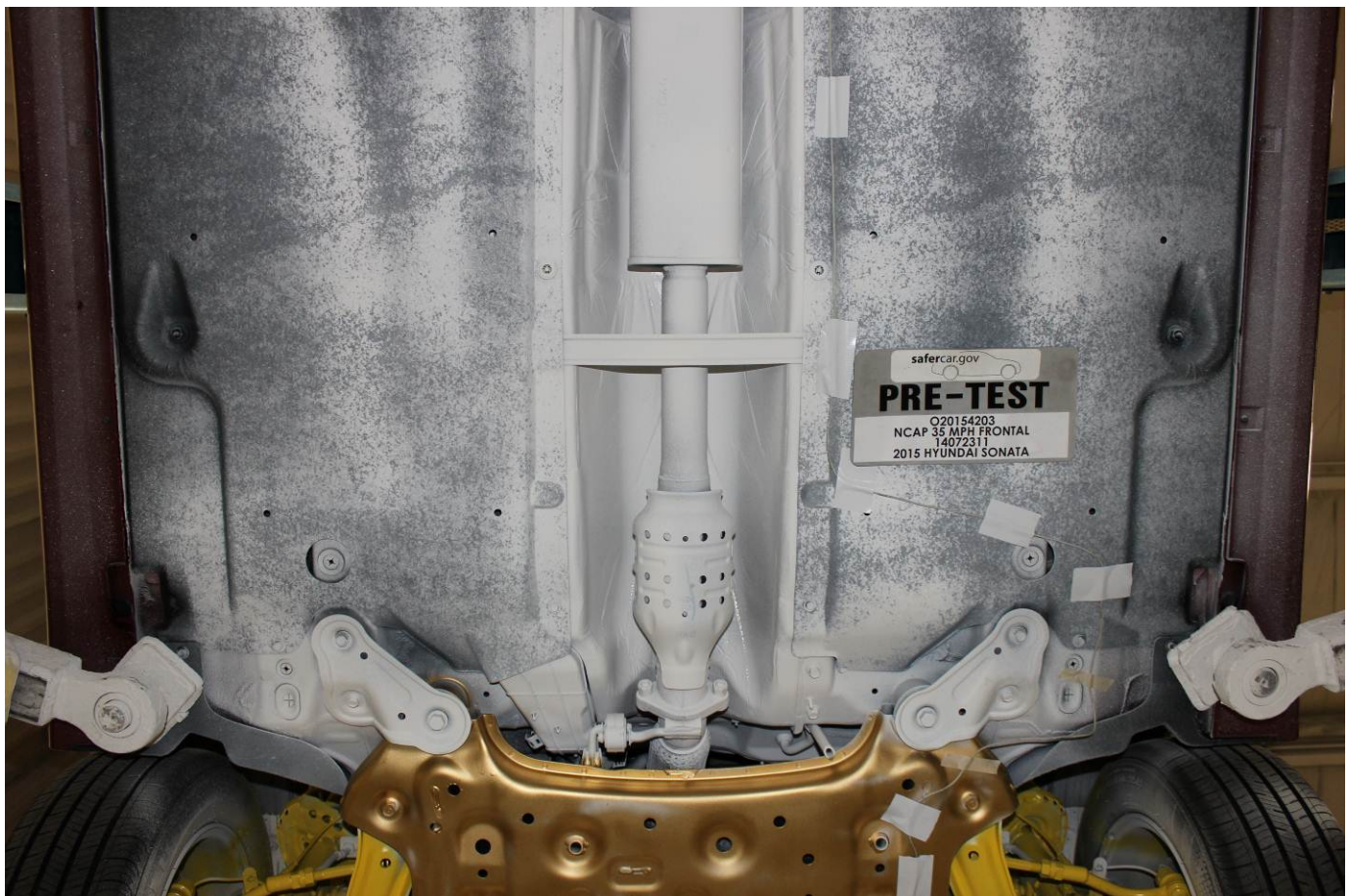
Post-Test Fuel Filler Cap View



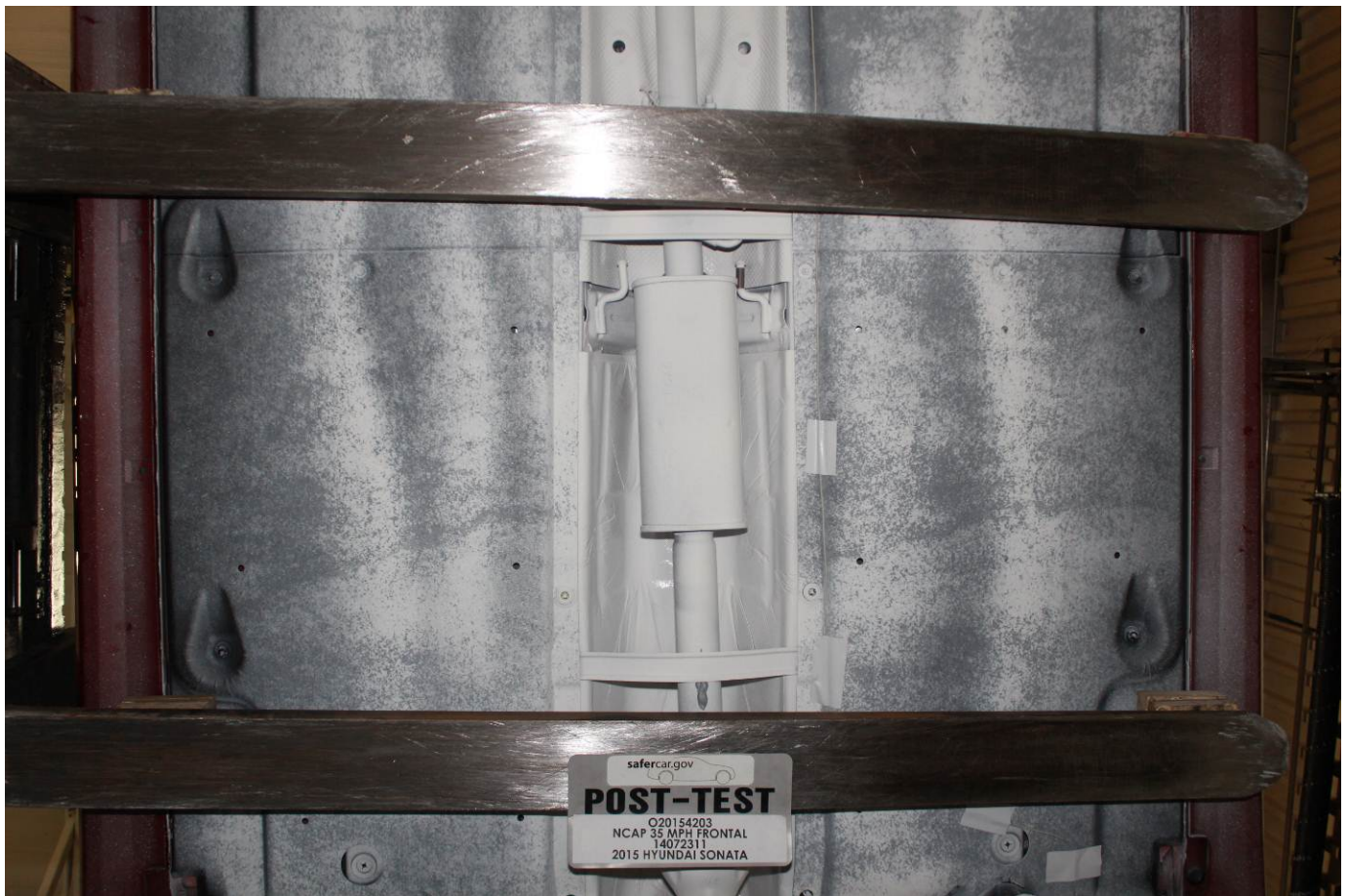
Pre-Test Front Underbody View



Post-Test Front Underbody View



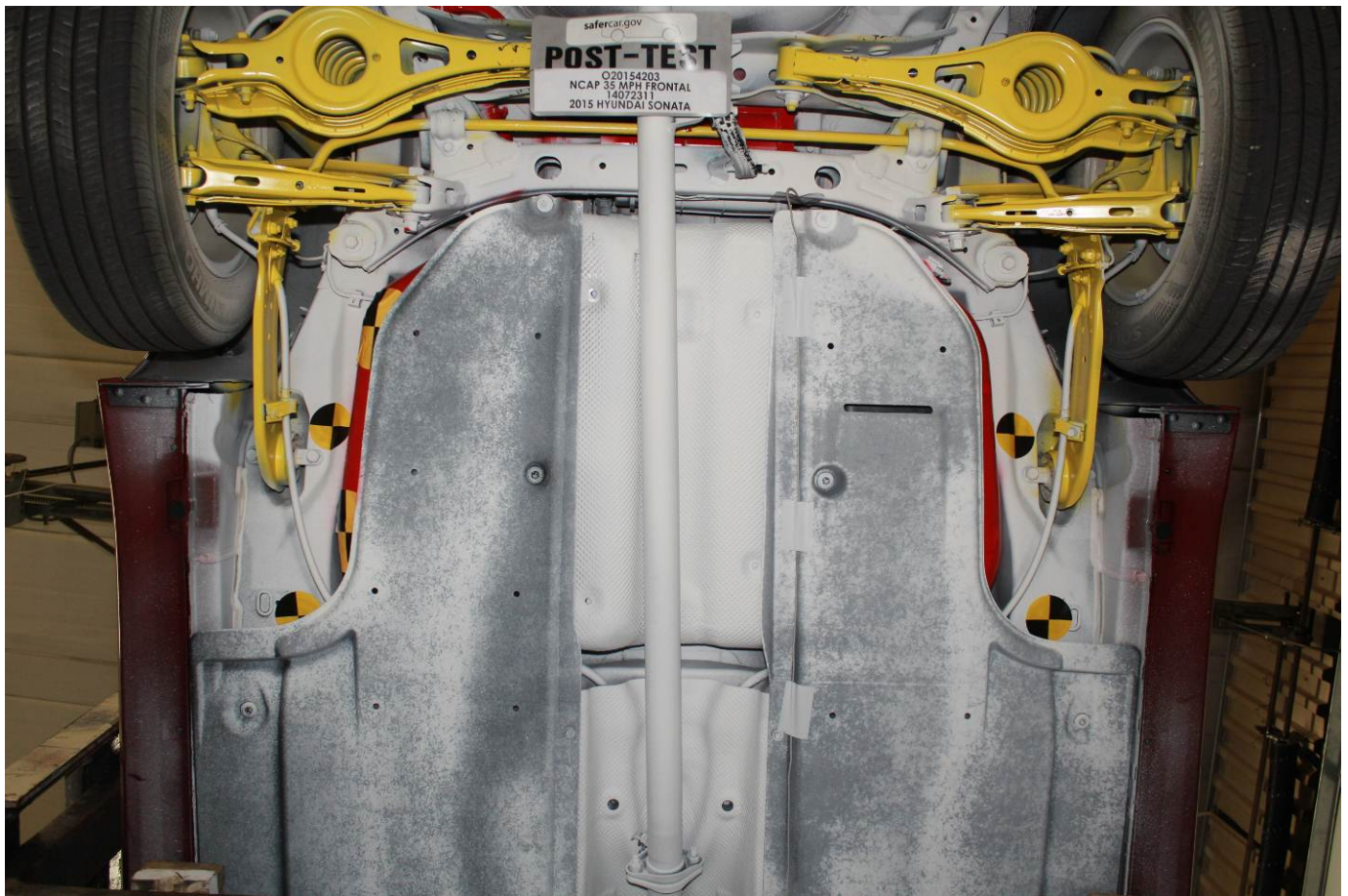
Pre-Test Mid Front Underbody View



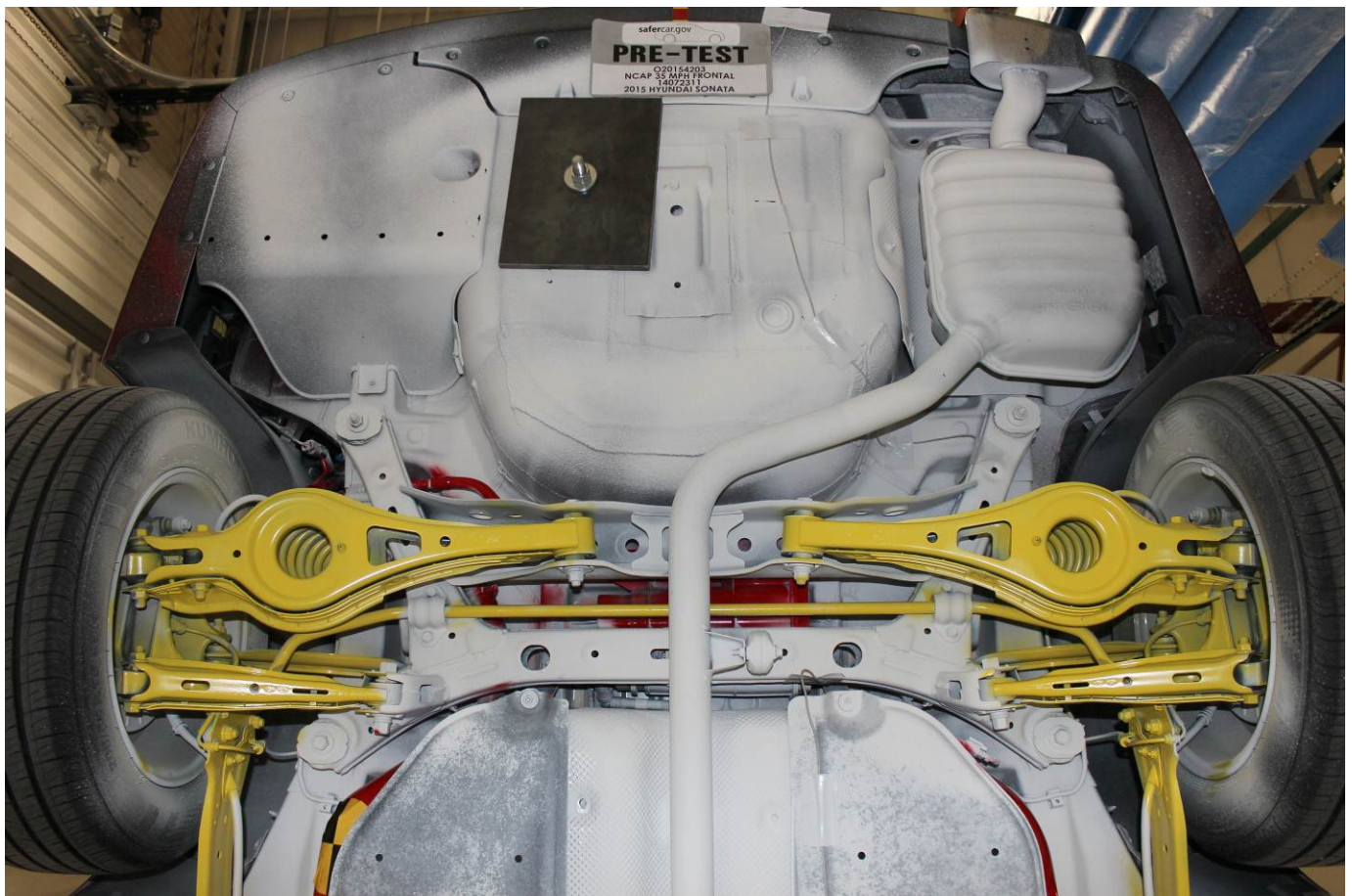
Post-Test Mid Front Underbody View



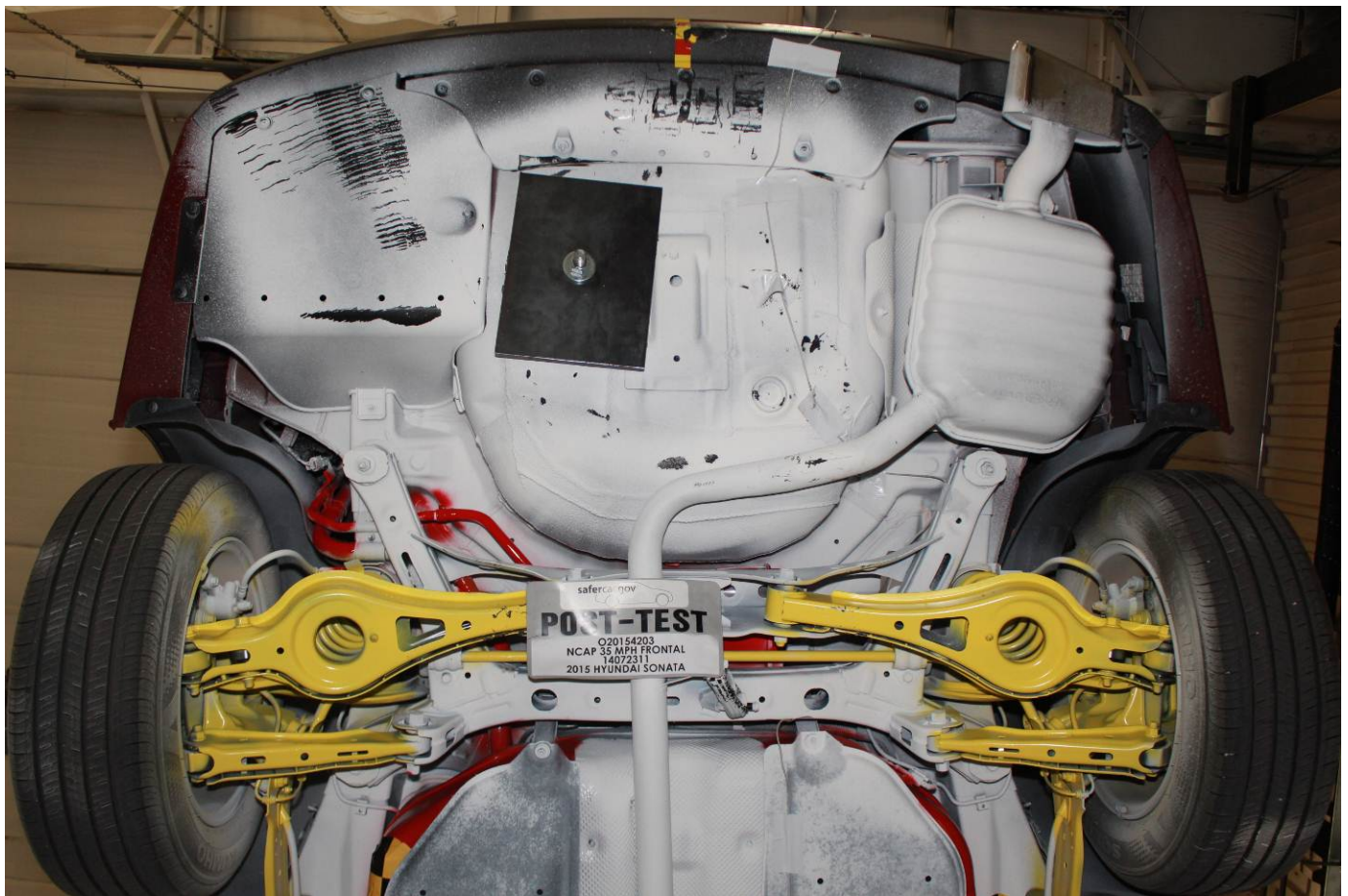
Pre-Test Mid Rear Underbody View



Post-Test Mid Rear Underbody View



Pre-Test Rear Underbody View



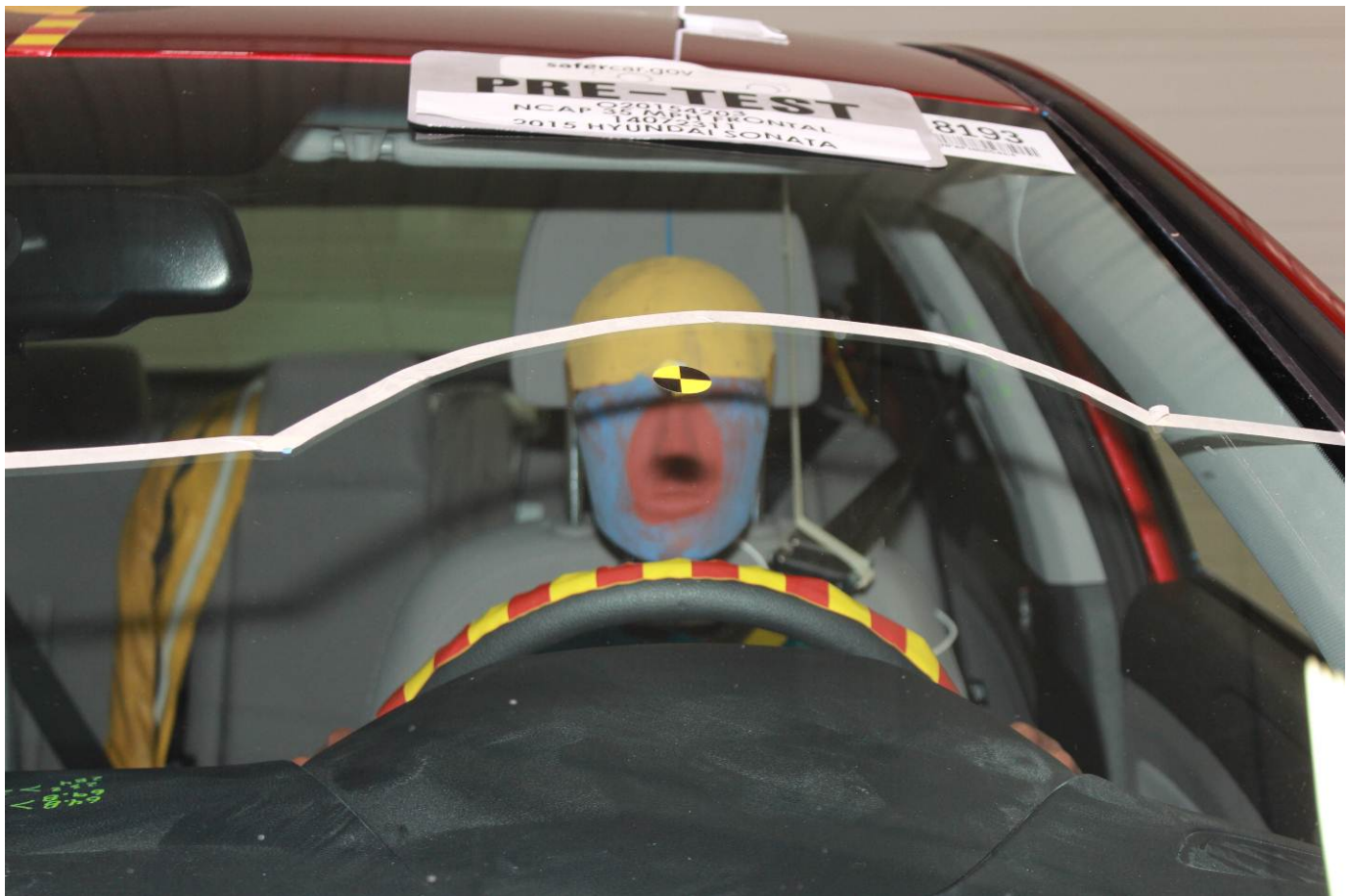
Post-Test Rear Underbody View



Pre-Test Dummy Cable Routing



Post-Test Dummy Cable Routing



Pre-Test Driver Dummy Front View



Post-Test Driver Dummy Front View



Pre-Test Driver Dummy Window View



Post-Test Driver Dummy Window View



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



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



Pre-Test Driver's Seat Fore-Aft Markings



Post-Test Driver's Seat Fore-Aft Markings



Pre-Test View of Belt Anchorage for Driver Dummy



Post-Test View of Belt Anchorage for Driver Dummy



Pre-Test Driver Dummy Feet



Post-Test Driver Dummy Feet



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



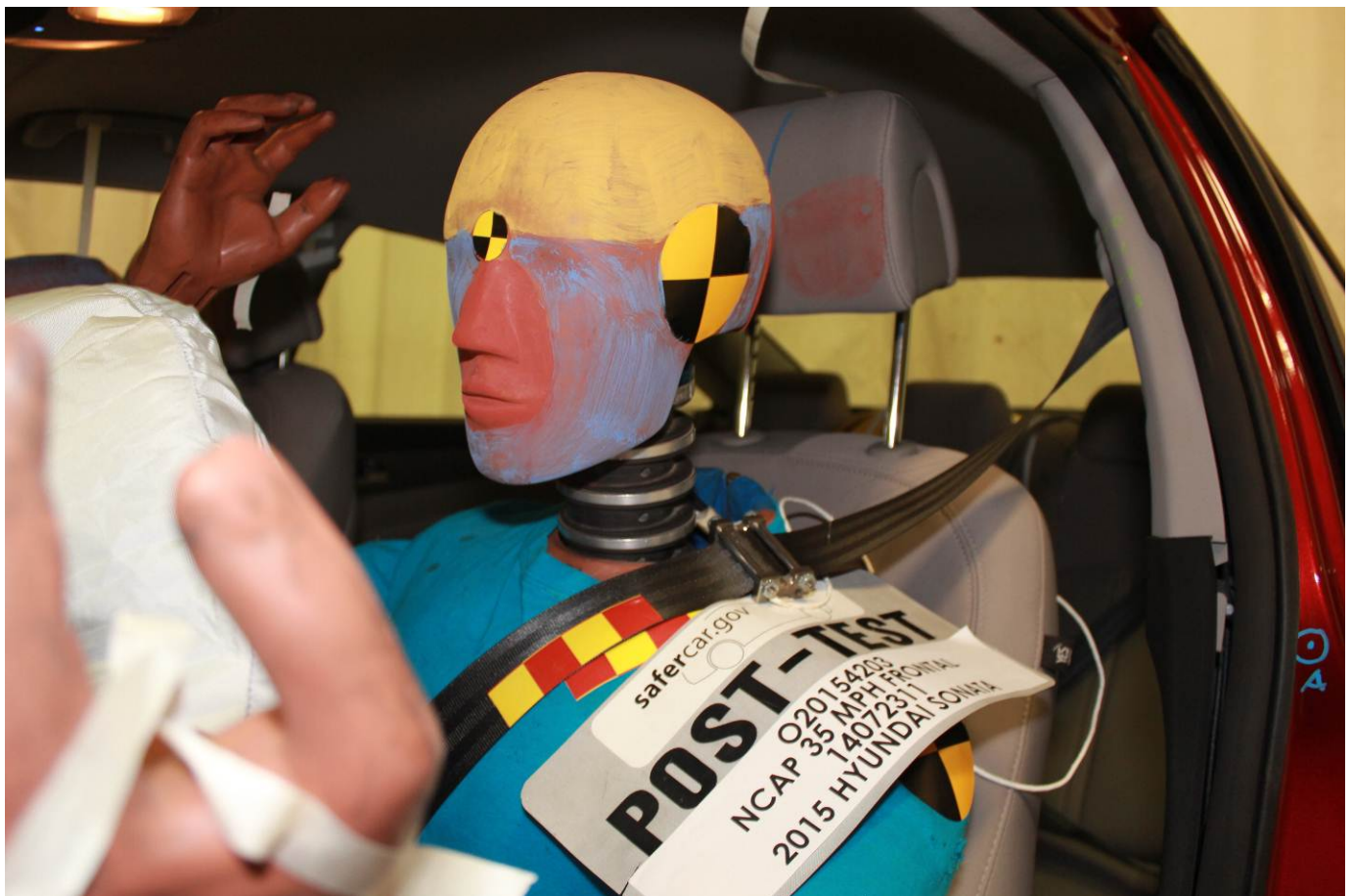
Post-Test Driver's Side Knee Bolster (without dummy)



Pre-Test Driver's Side Floorpan



Post-Test Driver's Side Floorpan



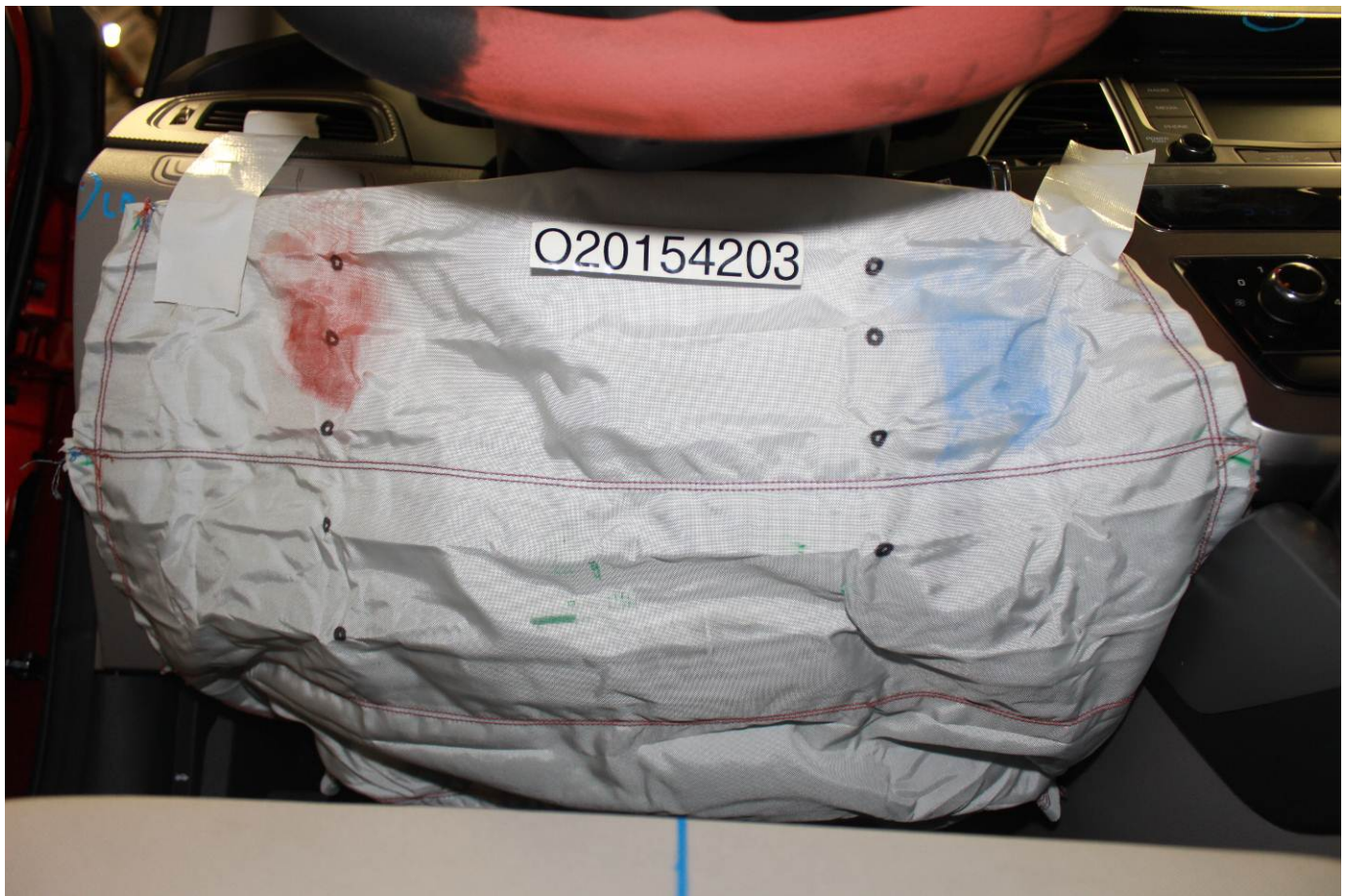
Post-Test Driver Dummy Face



Post-Test Driver Dummy Contact with Airbag



Post-Test Driver Dummy Contact with Headrest



Post-Test Driver Dummy Contact with Knee Airbag



Pre-Test View of the Steering Wheel



Post-Test View of the Steering Wheel



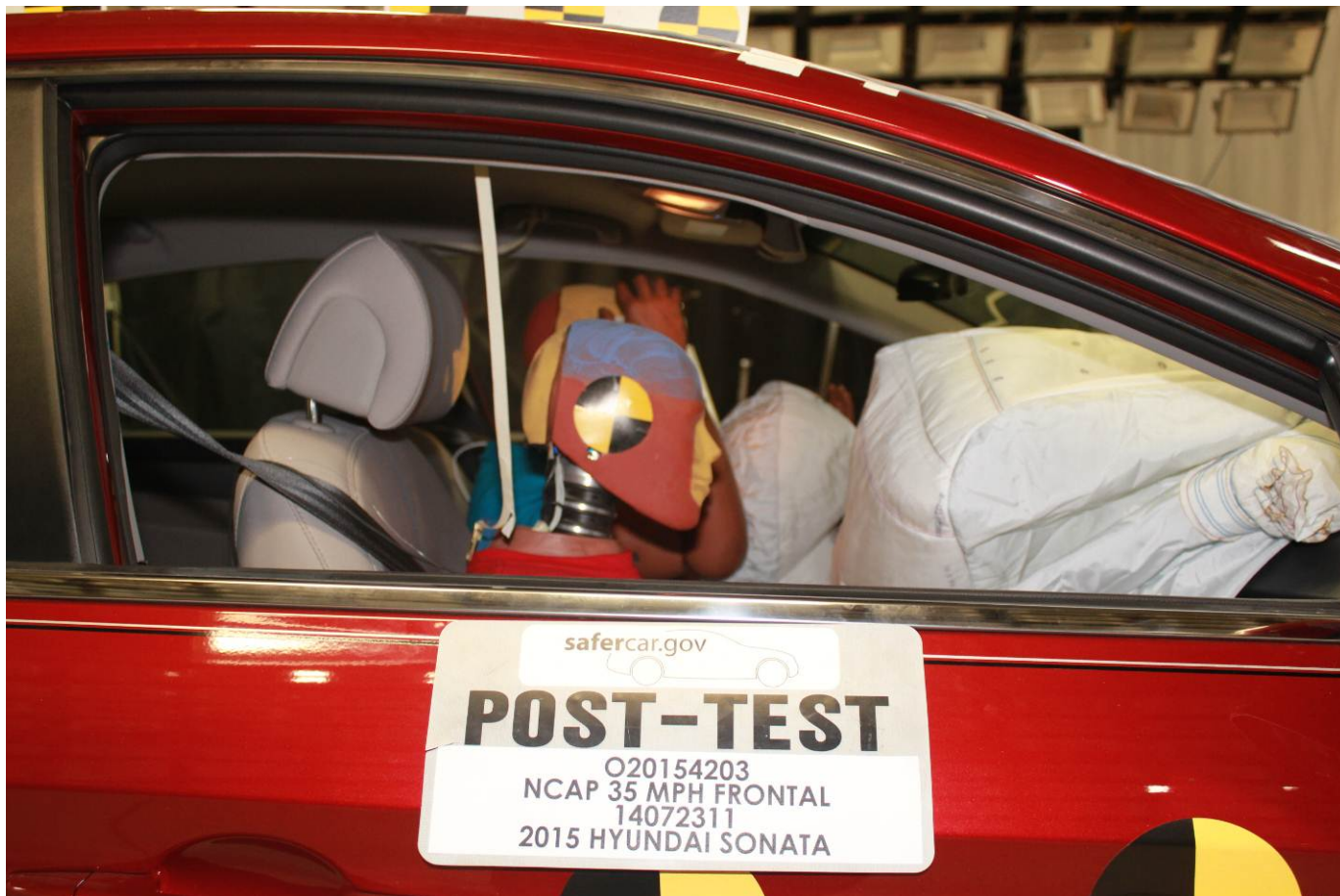
Pre-Test Passenger Dummy Front View



Post-Test Passenger Dummy Front View



Pre-Test Passenger Dummy Window View



Post-Test Passenger Dummy Window View



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



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



Pre-Test Passenger's Seat Fore-Aft Markings



Post-Test Passenger's Seat Fore-Aft Markings



Pre-Test View of Belt Anchorage for Passenger Dummy



Post-Test View of Belt Anchorage for Passenger Dummy



Pre-Test Passenger Dummy Feet



Post-Test Passenger Dummy Feet



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



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



Pre-Test Passenger's Side Floorpan



Post-Test Passenger's Side Floorpan



Post-Test Passenger Dummy Face



Post-Test Passenger Dummy Contact with Airbag



Post-Test Passenger Dummy Contact with Airbag



Post-Test Passenger Dummy Contact with Headrest



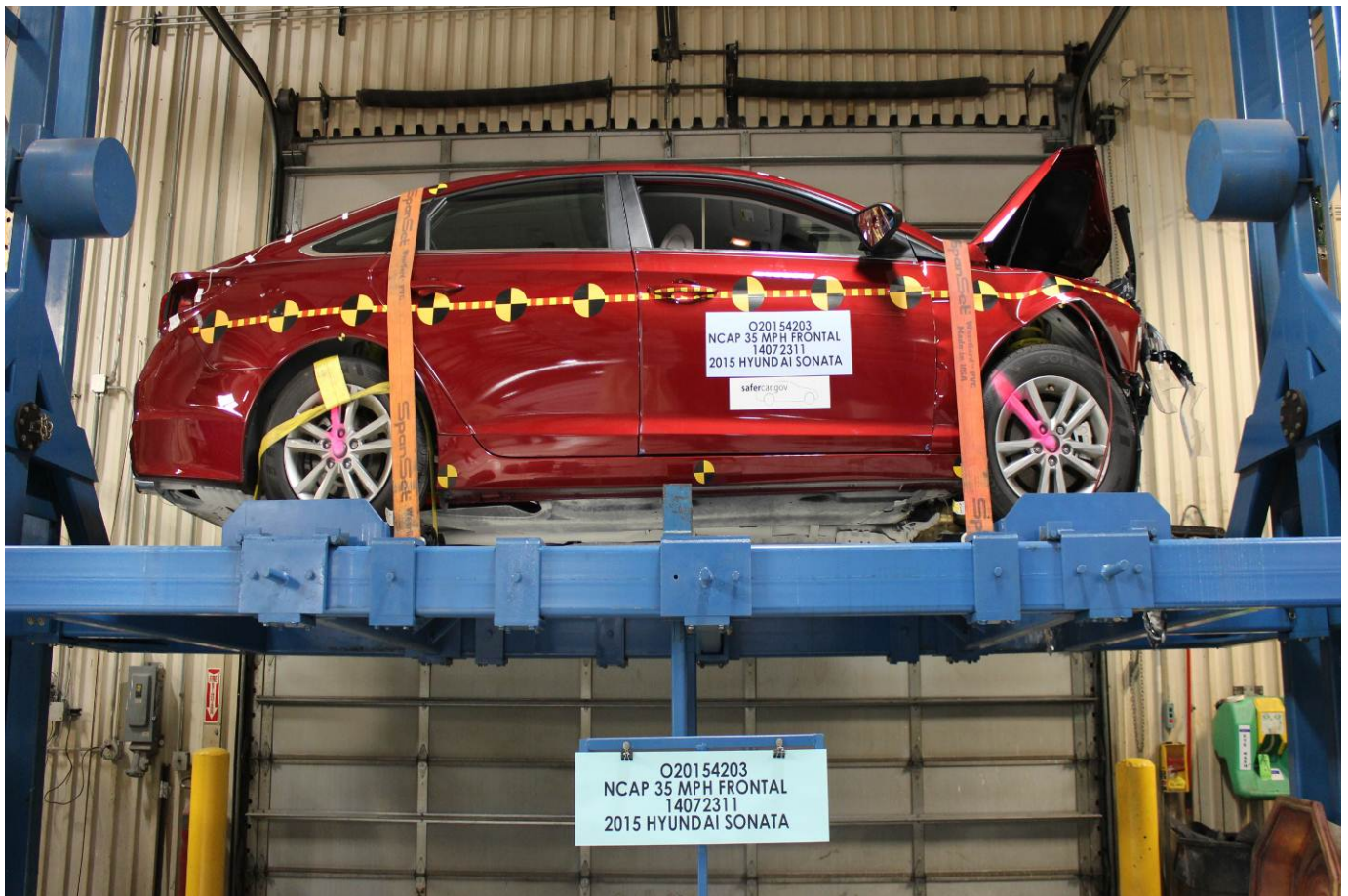
Ballast Installed in Vehicle

PHOTOGRAPH NOT APPLICABLE

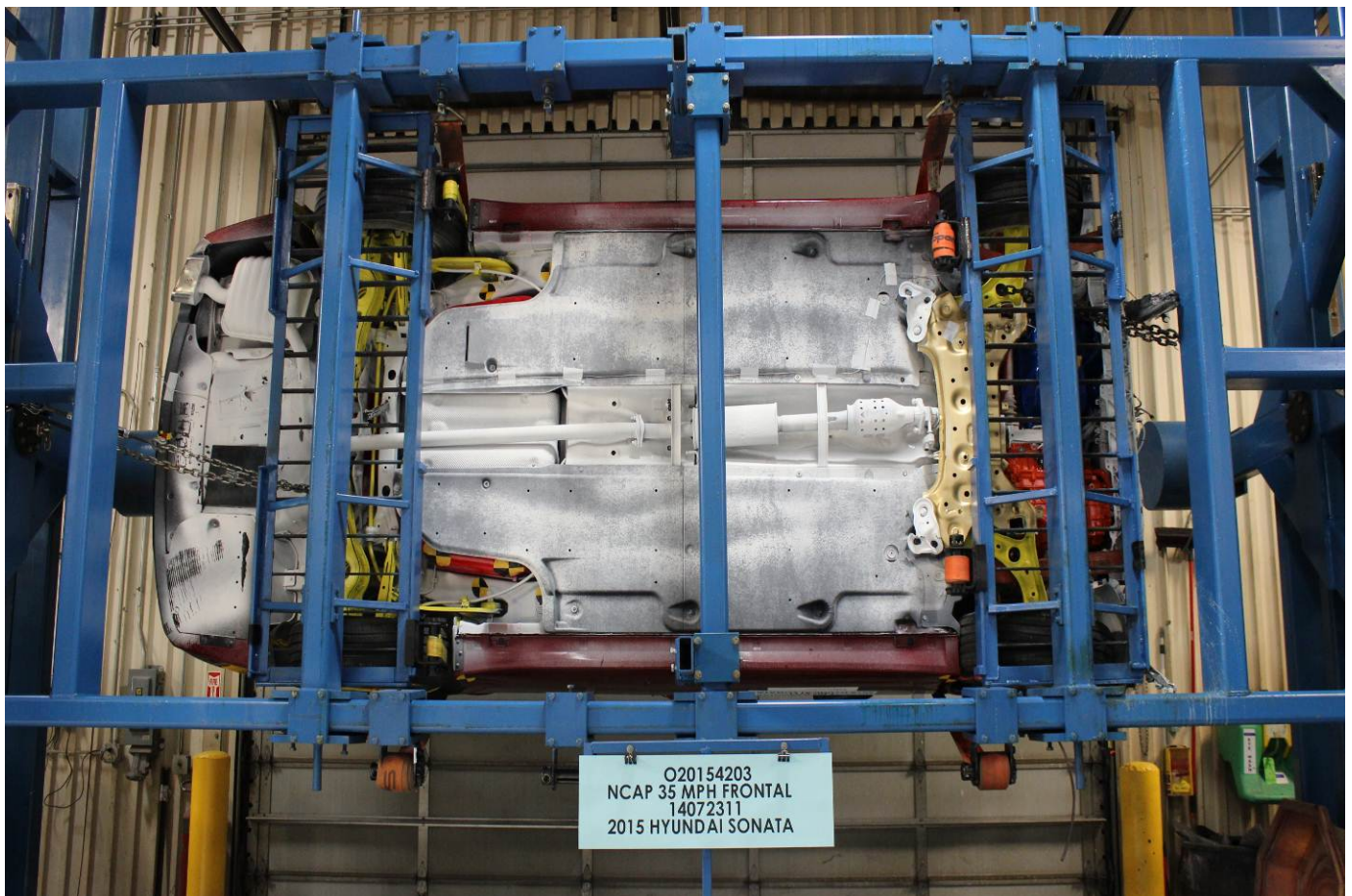
Post-Test Stoddard Solvent Spillage Location View



Post-Test Speed Trap Read-Out



Vehicle at 0 Degree on Static Rollover Device



Vehicle at 90 Degrees on Static Rollover Device



Vehicle at 180 Degrees on Static Rollover Device



Vehicle at 270 Degrees on Static Rollover Device



Vehicle at 360 Degrees on Static Rollover Device



2015 Hyundai Sonata Frontal Impact Event

APPENDIX B
DUMMY RESPONSE DATA TRACES

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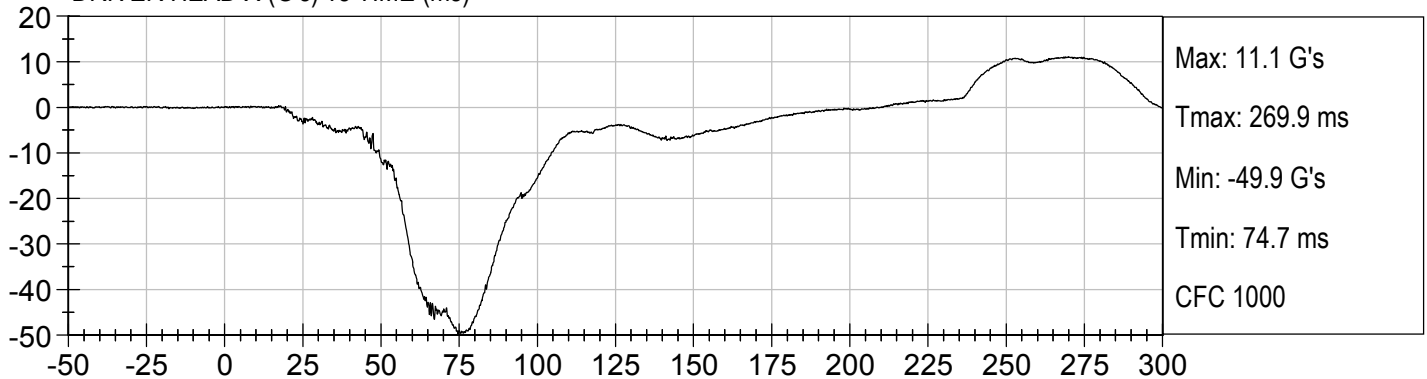
The following additional dummy and vehicle response data can be found in the R&D section of the NHTSA website at www.nhtsa.dot.gov

Driver Head X Redundant
 Driver Head Y Redundant
 Driver Head Z Redundant
 Driver 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

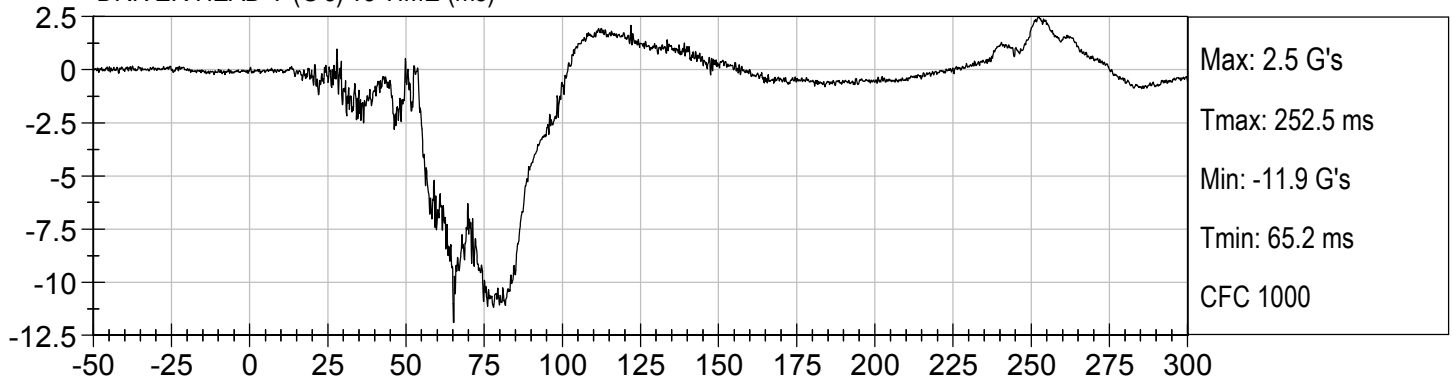
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver Left Foot Fore Z
Driver Left 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
Passenger Pelvis X
Passenger Pelvis Y
Passenger Pelvis Z
Passenger Left Femur Redundant
Passenger Right Femur Redundant
Passenger Left Upper Tibia Moment X

Passenger Left Upper Tibia Moment Y
Passenger Left Upper Tibia Force Z
Passenger Left Lower Tibia Moment X
Passenger Left Lower Tibia Moment Y
Passenger Left Lower Tibia Force Z
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right Upper Tibia Force Z
Passenger Right Lower Tibia Moment X
Passenger Right Lower Tibia Moment Y
Passenger Right Lower Tibia Force Z
Passenger Left Foot Fore Z
Passenger Left Foot Aft X
Passenger Left Foot Aft Z
Passenger Right Foot Fore Z
Passenger Right Foot Aft X
Passenger Right Foot Aft Z
Passenger Lap Belt Force
Passenger Shoulder Belt Force
Left Rear Seat Crossmember X
Right Rear Seat Crossmember X
Vehicle Engine Top X
Vehicle Engine Bottom X
Left Rear Seat Crossmember Z
Right Rear Seat Crossmember Z
Left Rear Seat Crossmember Xr
Right Rear Seat Crossmember Xr
Advanced Research Load Cell Barrier – 528 channels

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



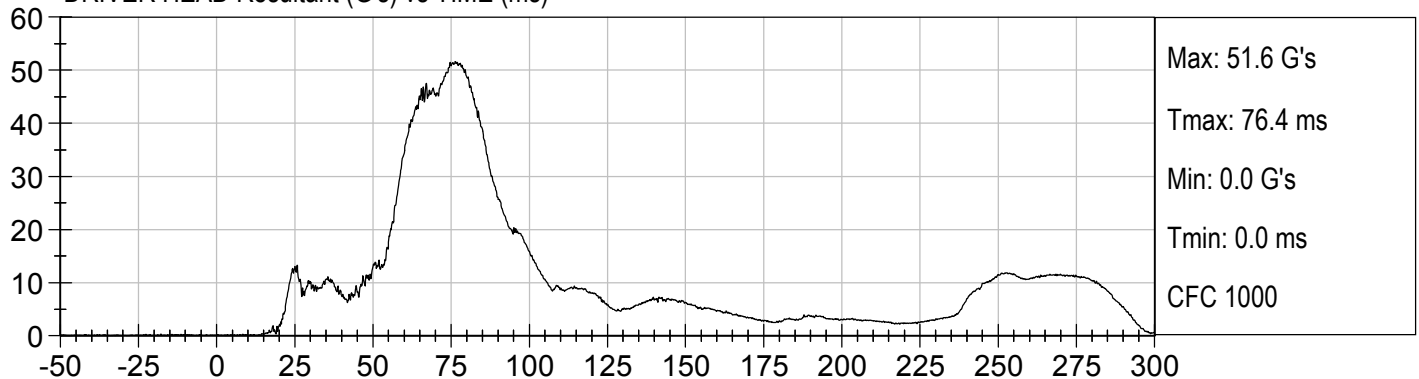
DRIVER HEAD Y (G's) vs TIME (ms)

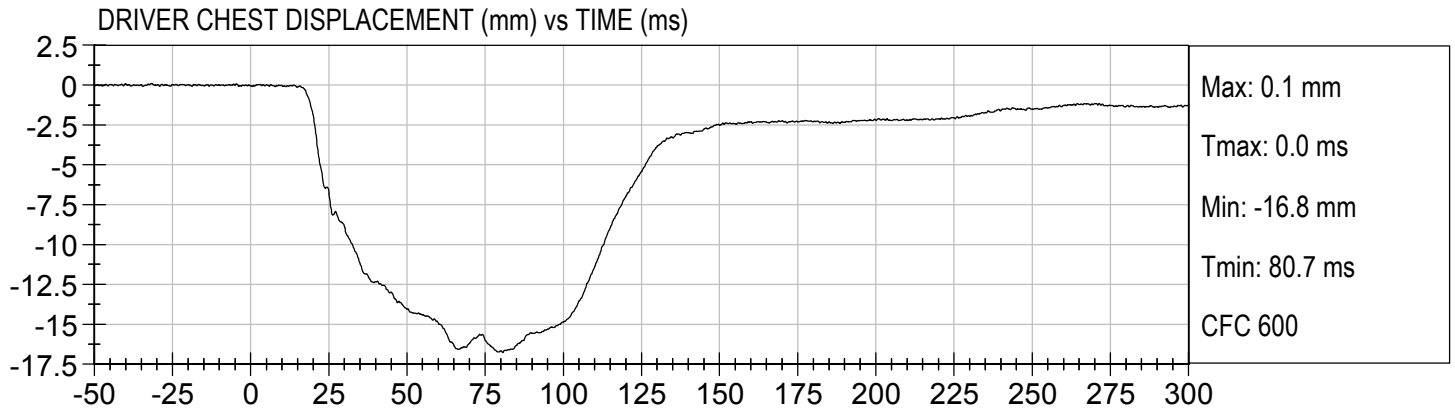


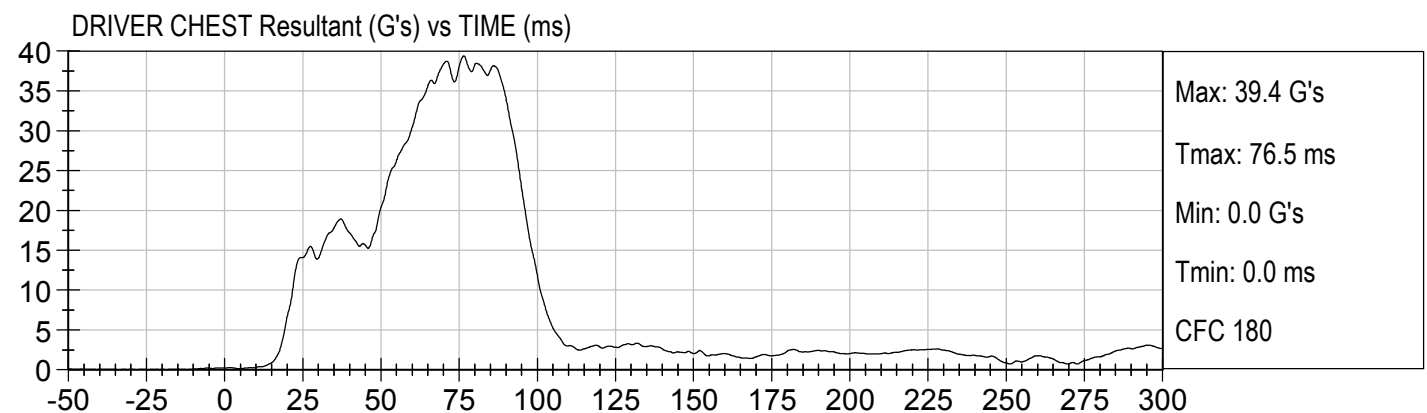
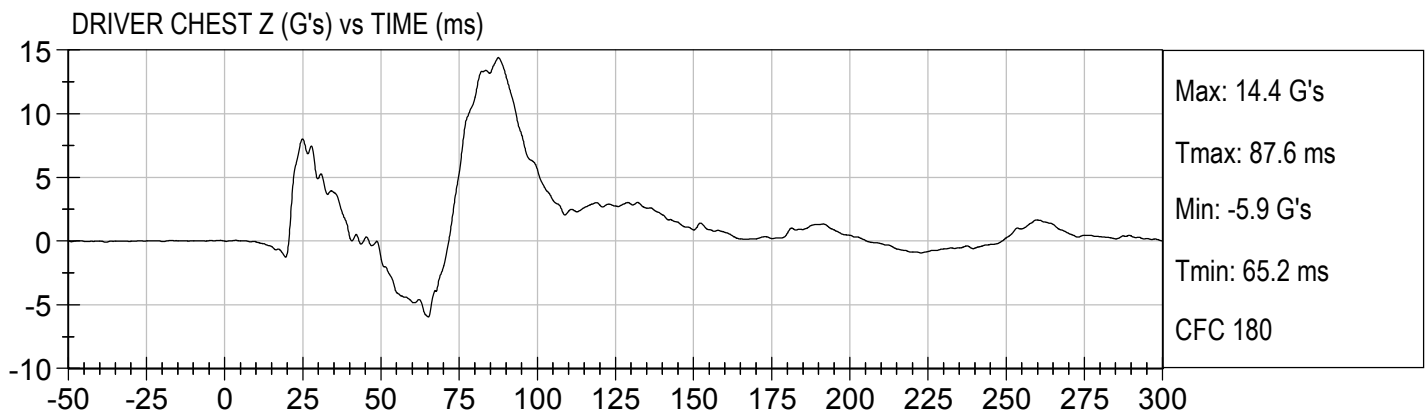
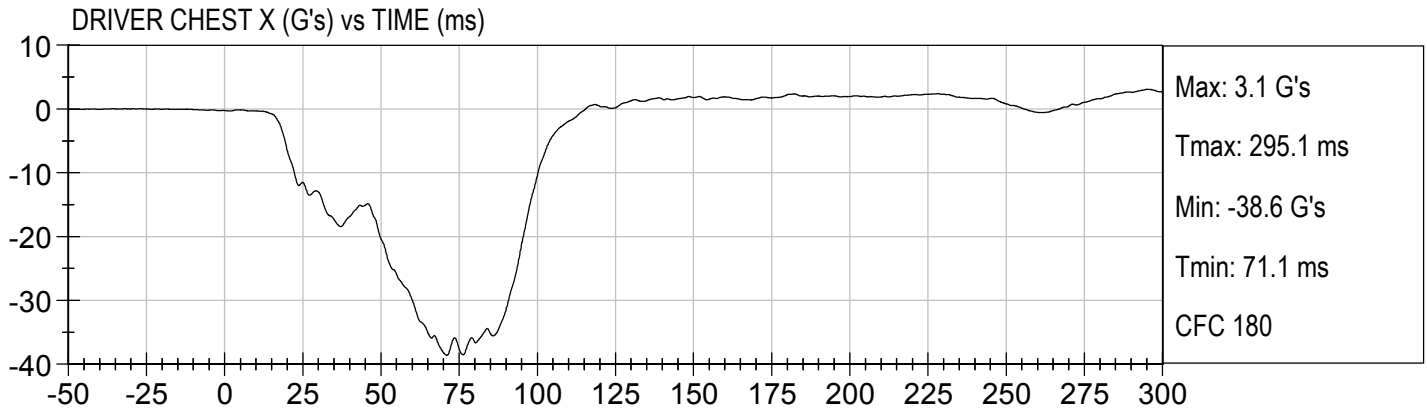
DRIVER HEAD Z (G's) vs TIME (ms)

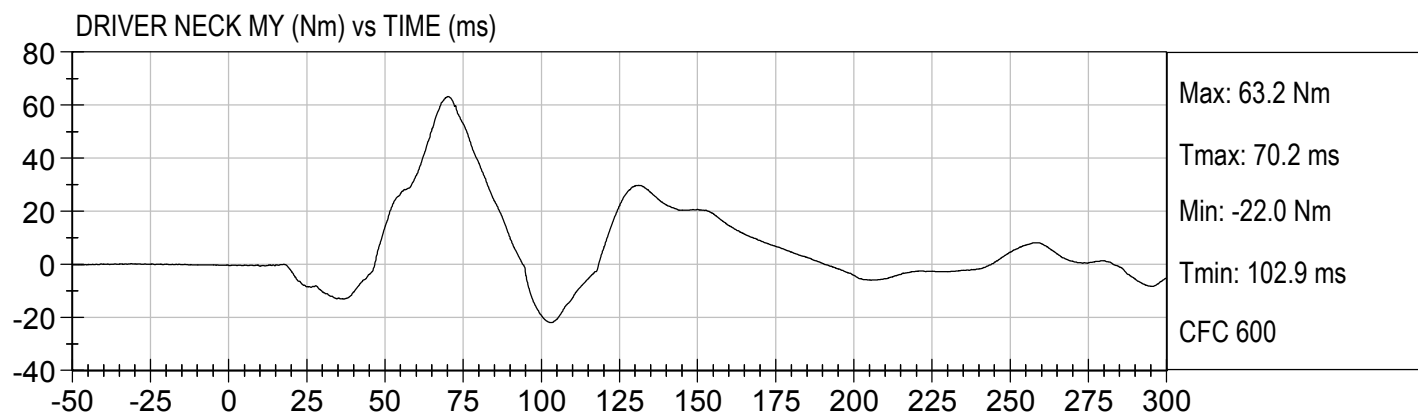
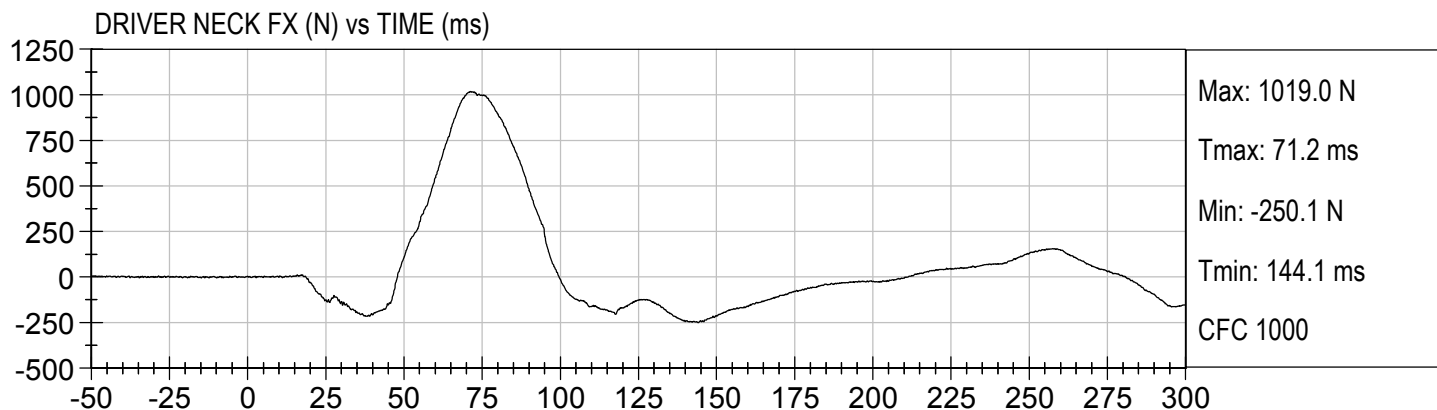


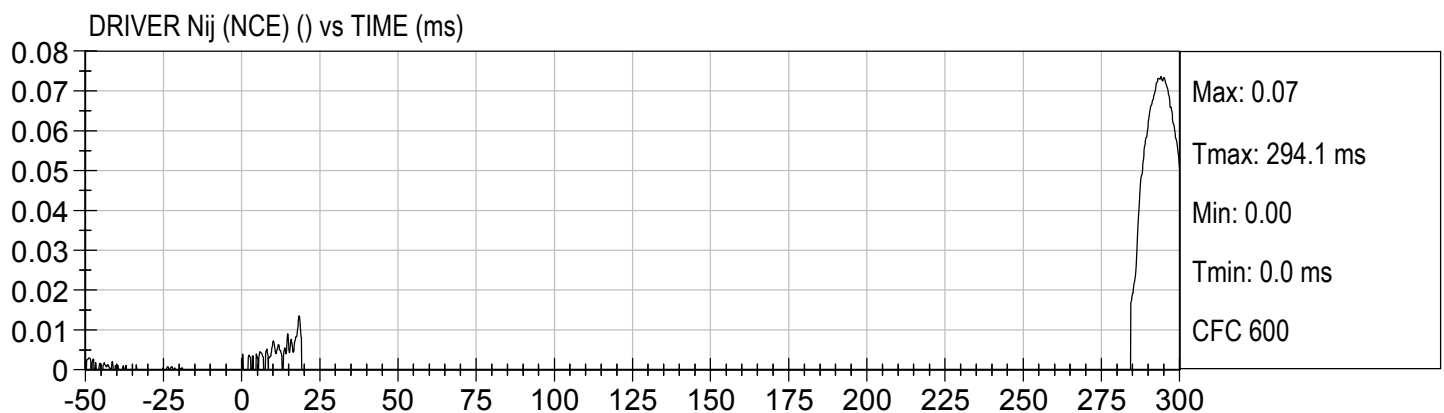
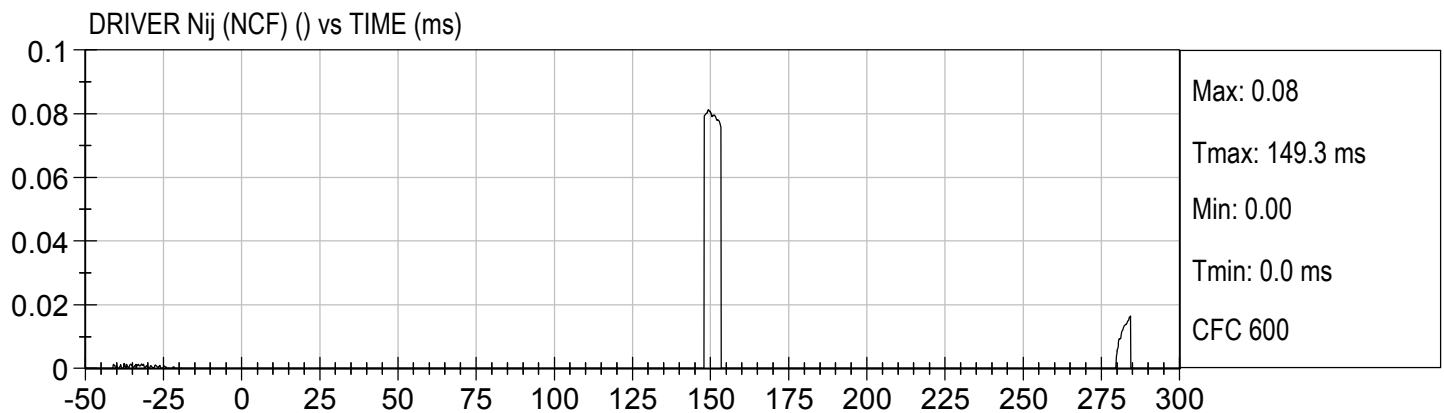
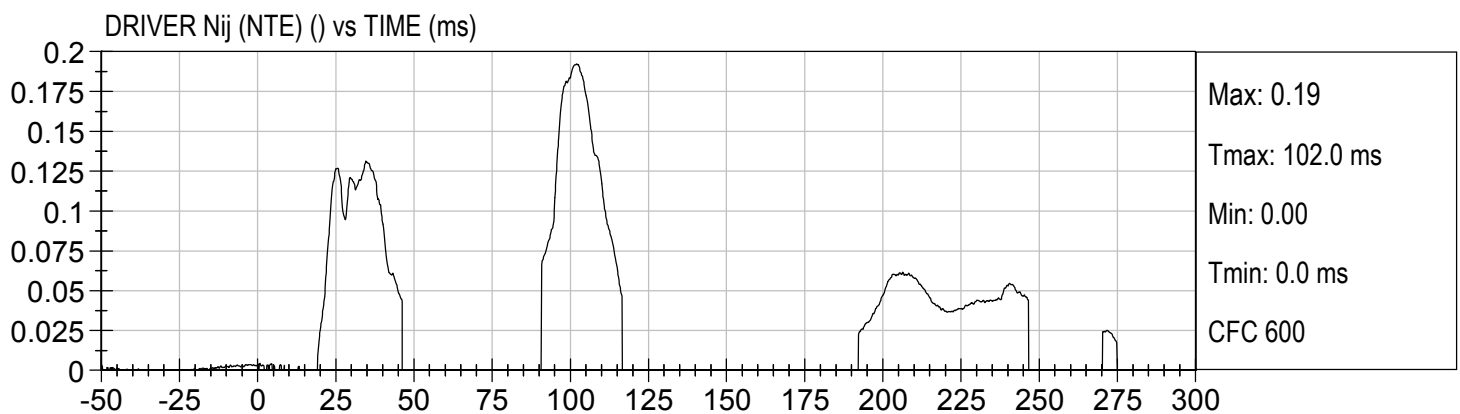
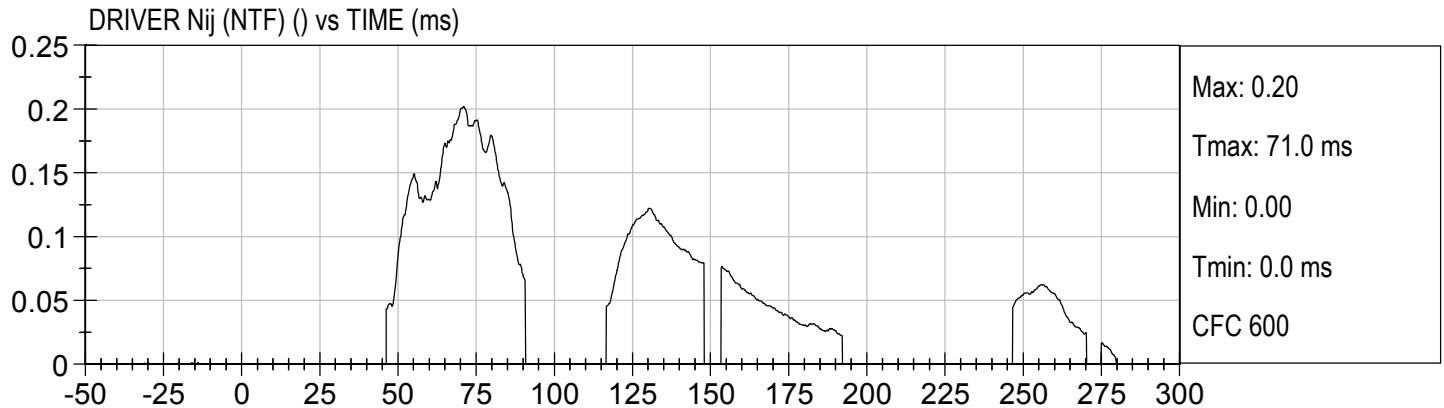
DRIVER HEAD Resultant (G's) vs TIME (ms)

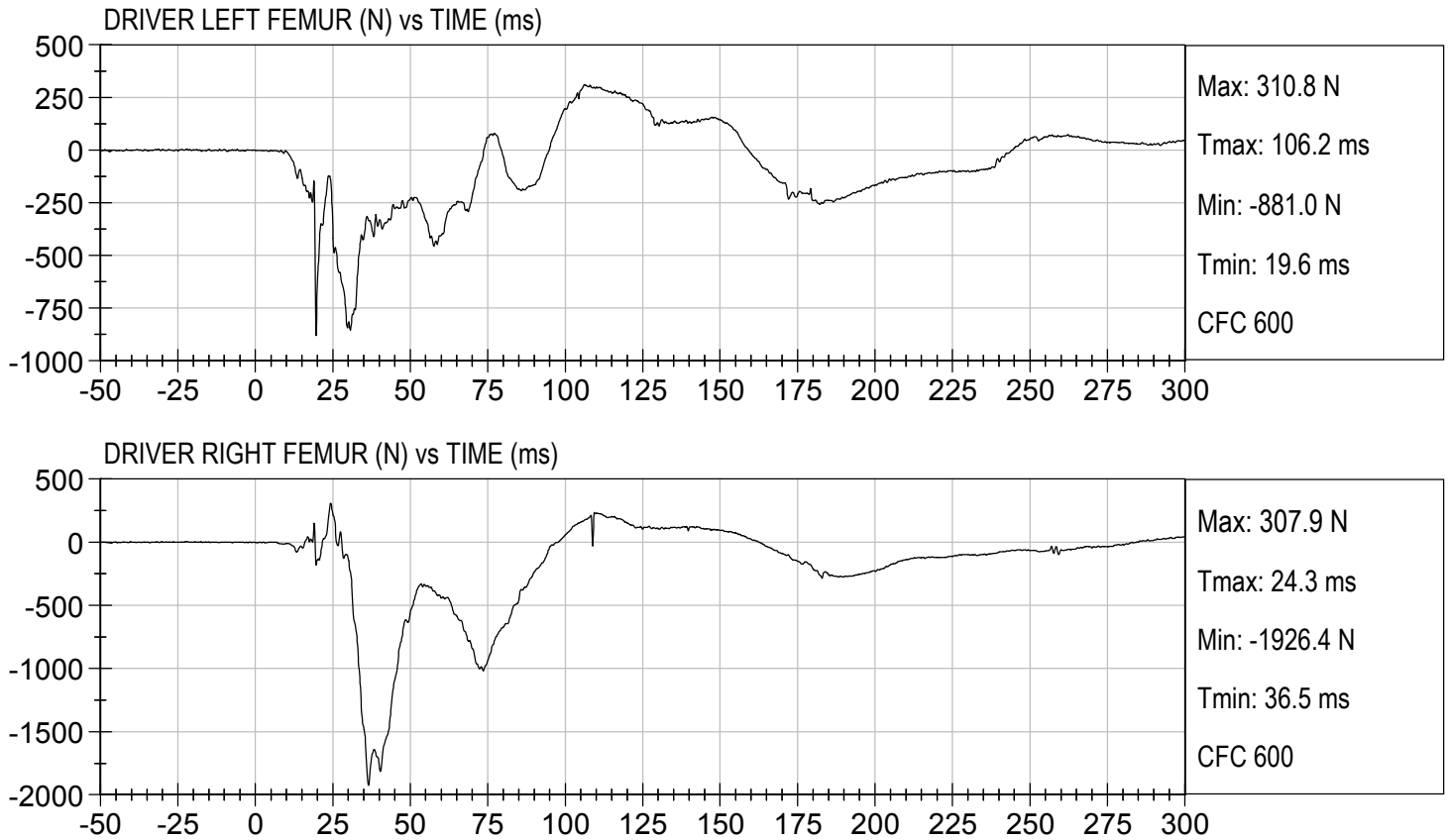




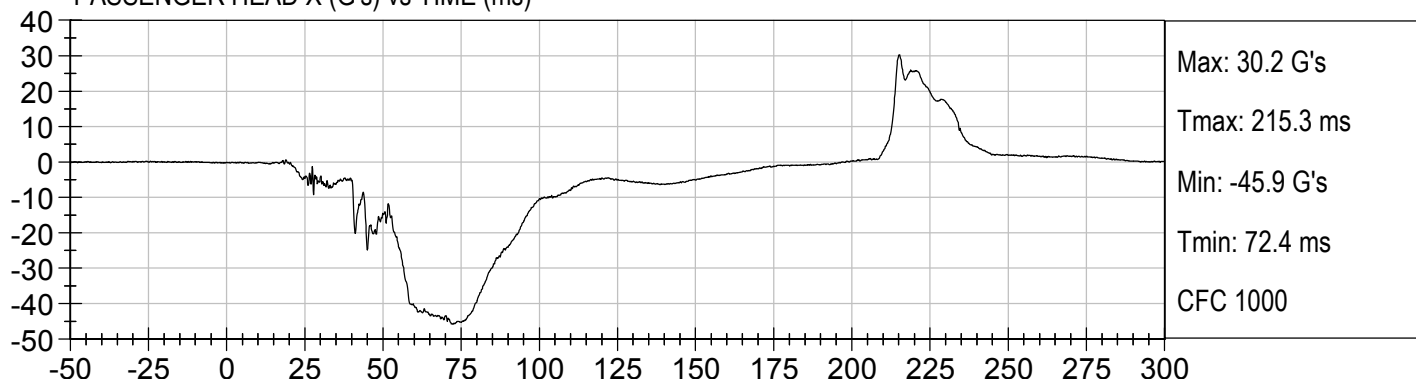




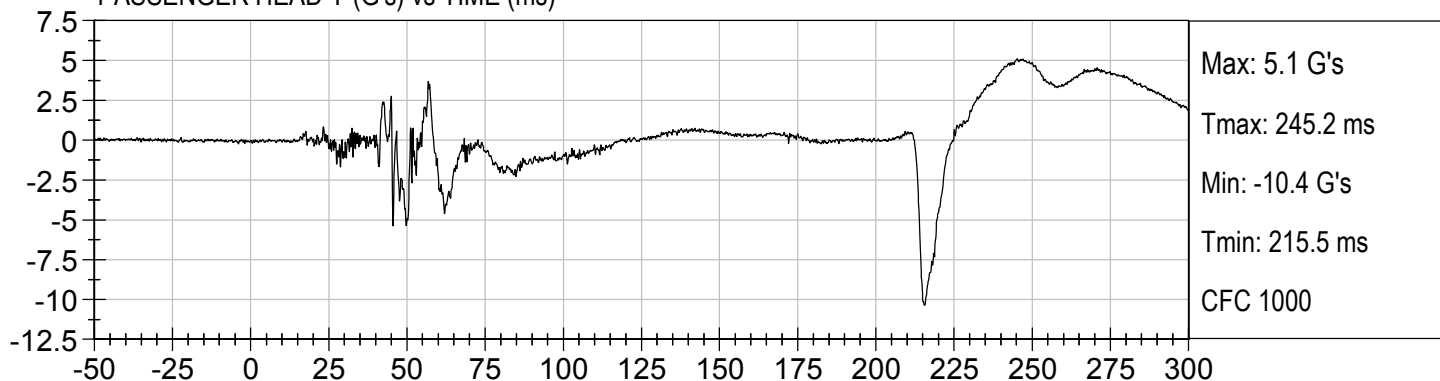




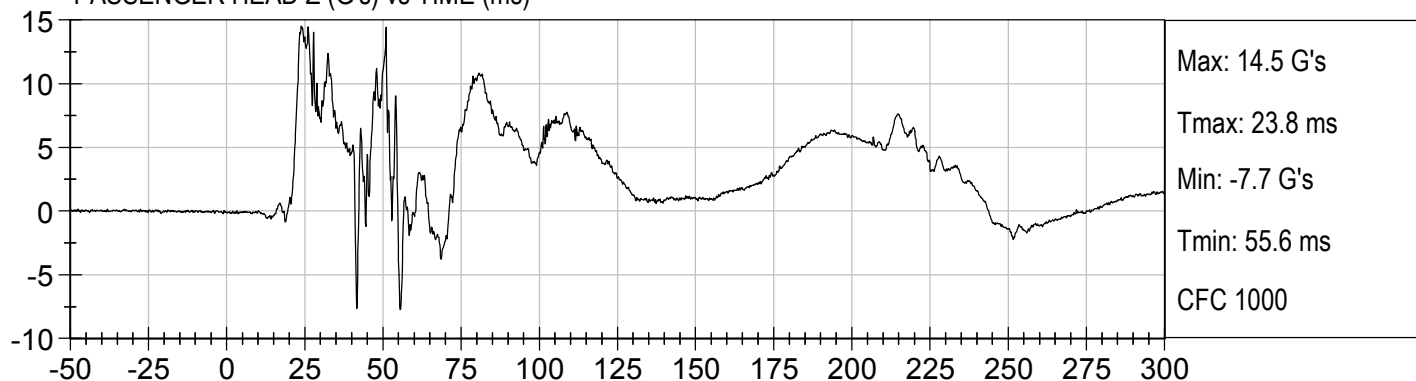
PASSENGER HEAD X (G's) vs TIME (ms)



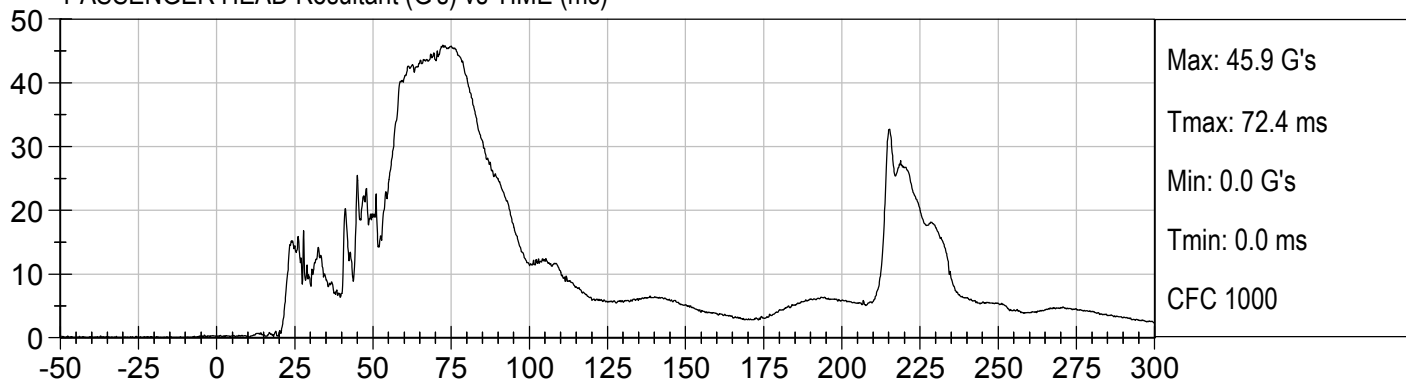
PASSENGER HEAD Y (G's) vs TIME (ms)

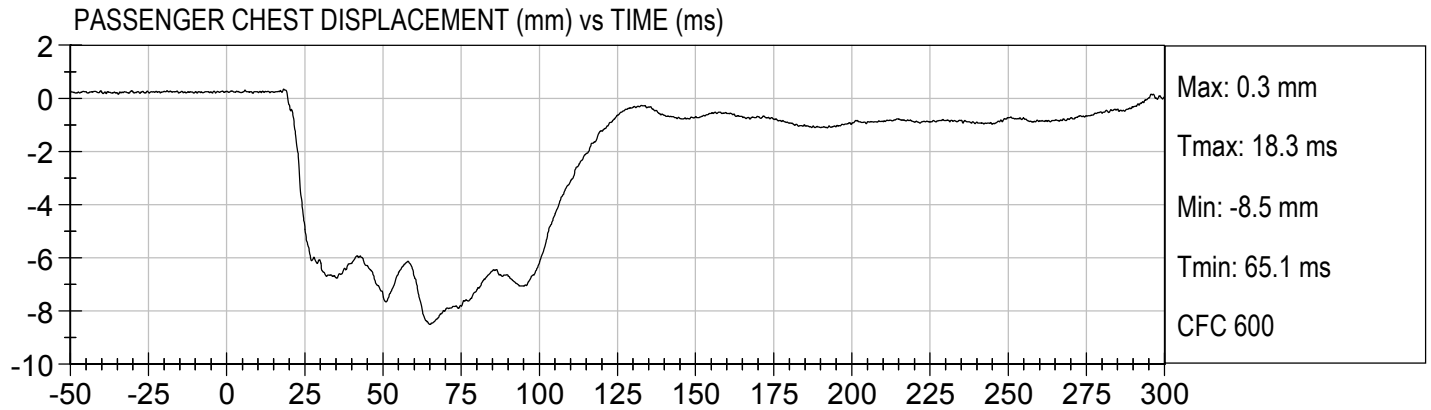


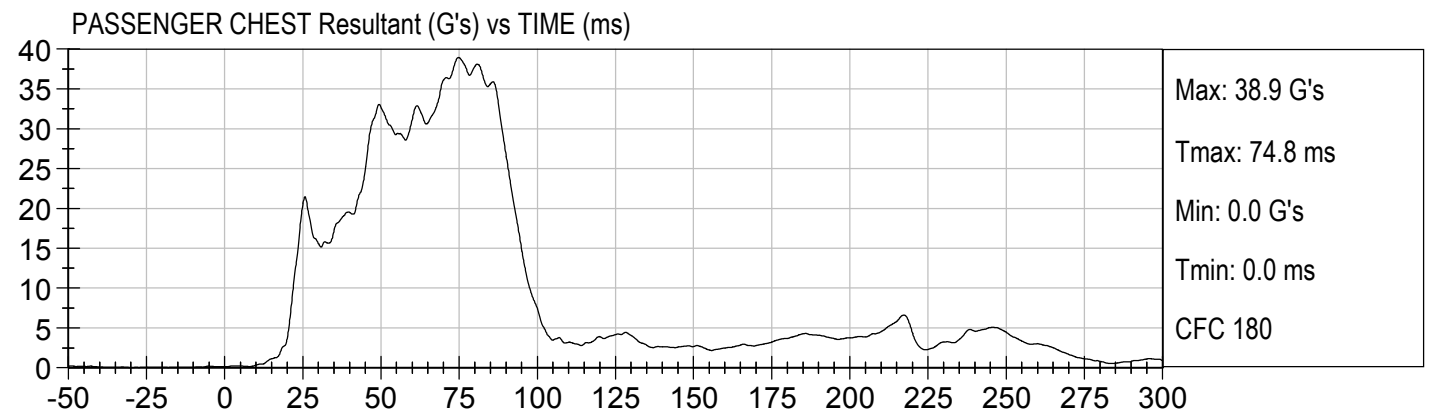
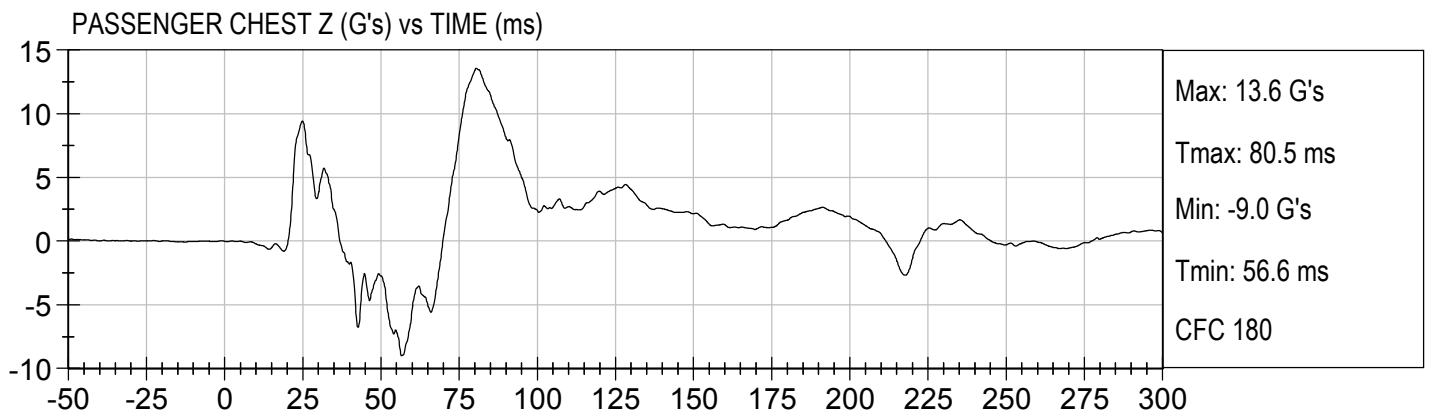
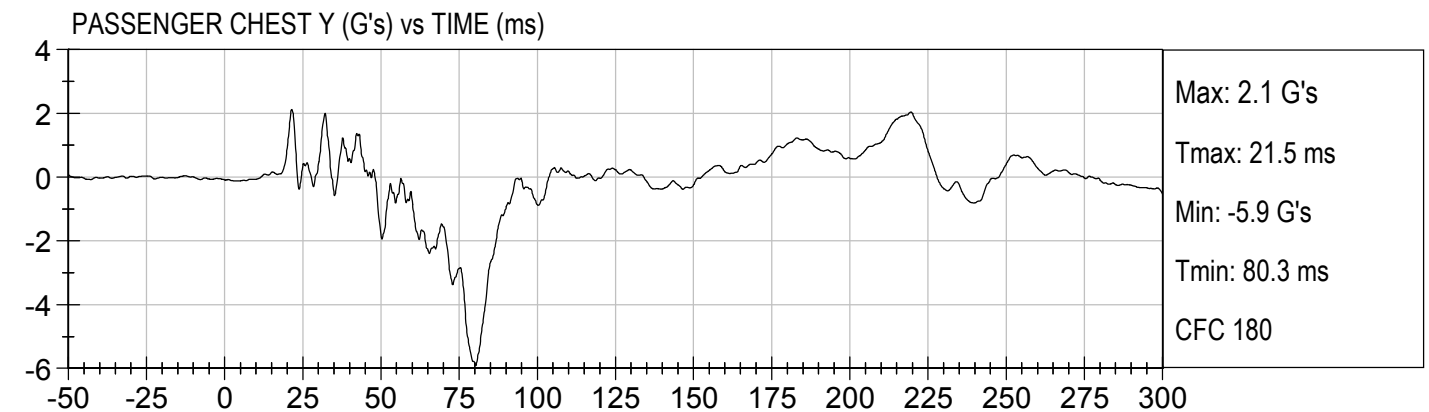
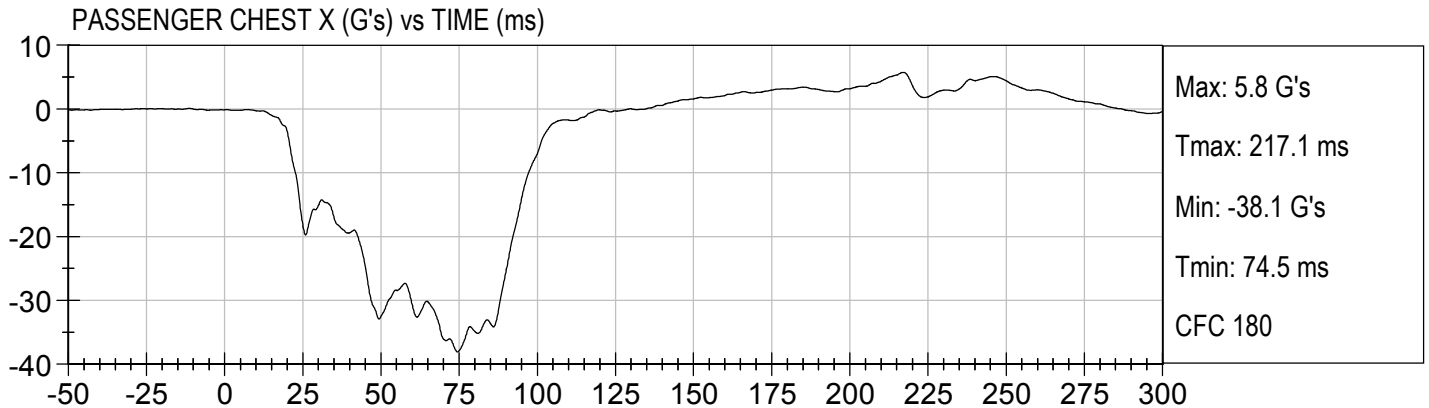
PASSENGER HEAD Z (G's) vs TIME (ms)

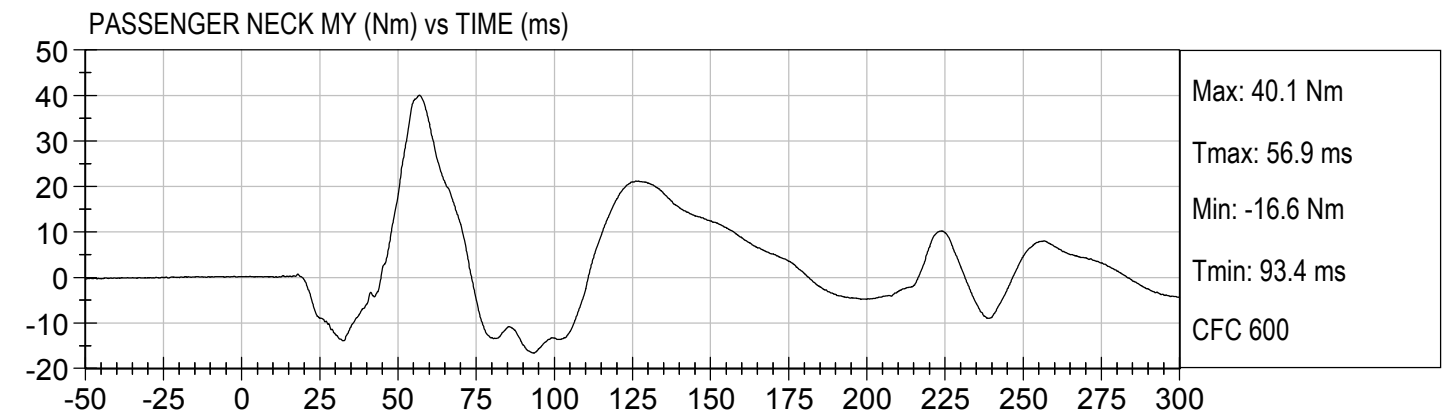
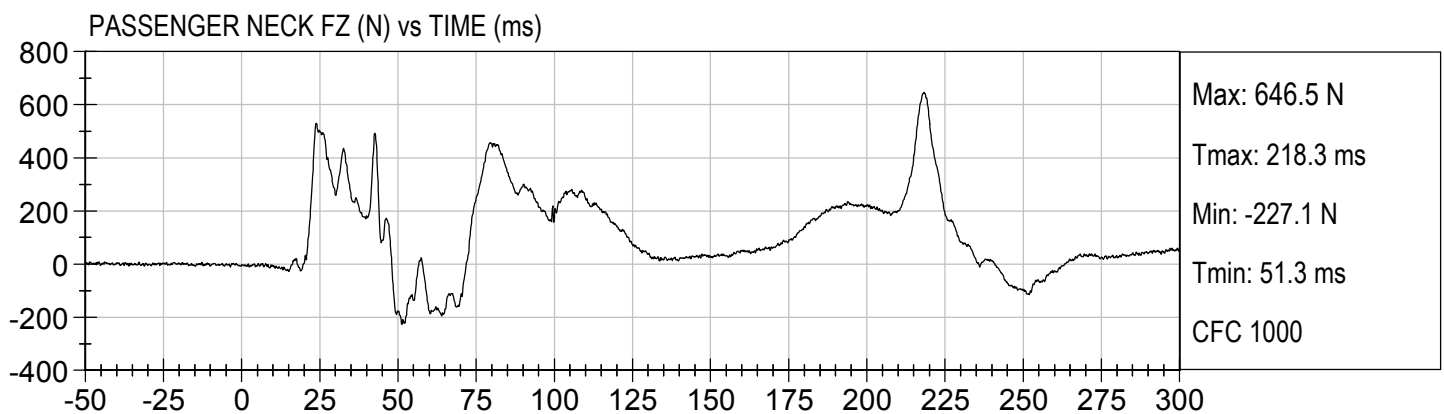
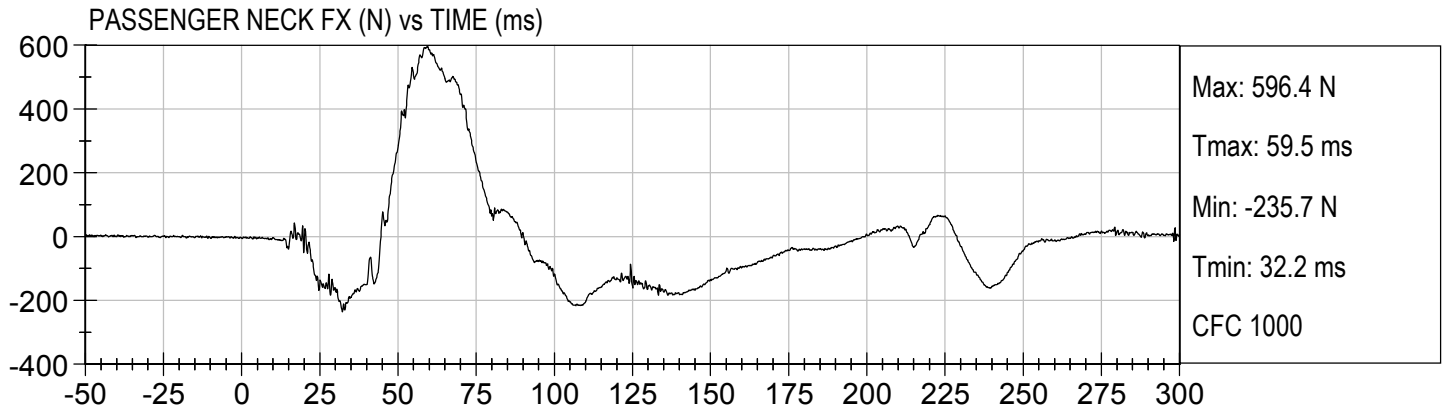


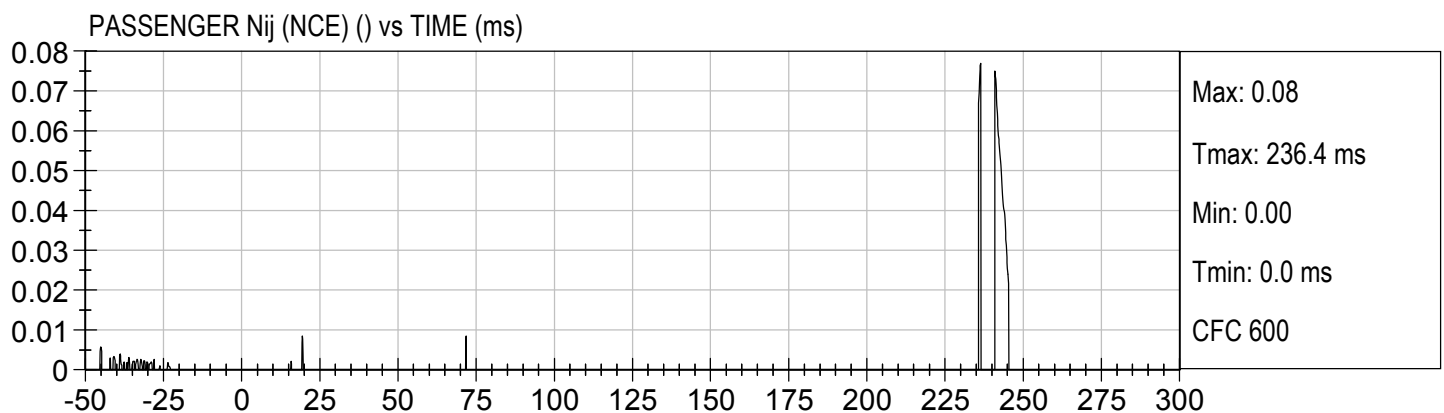
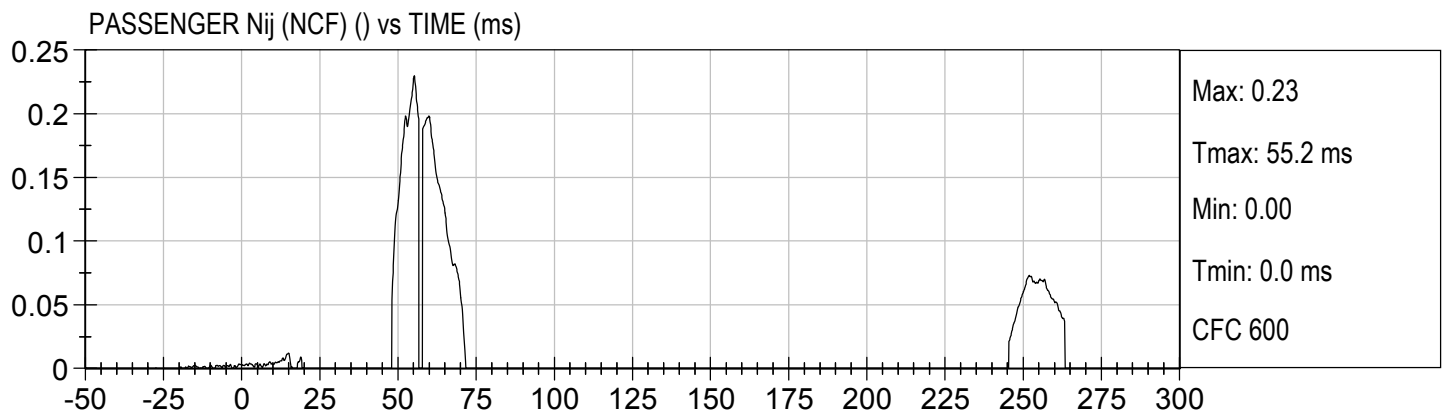
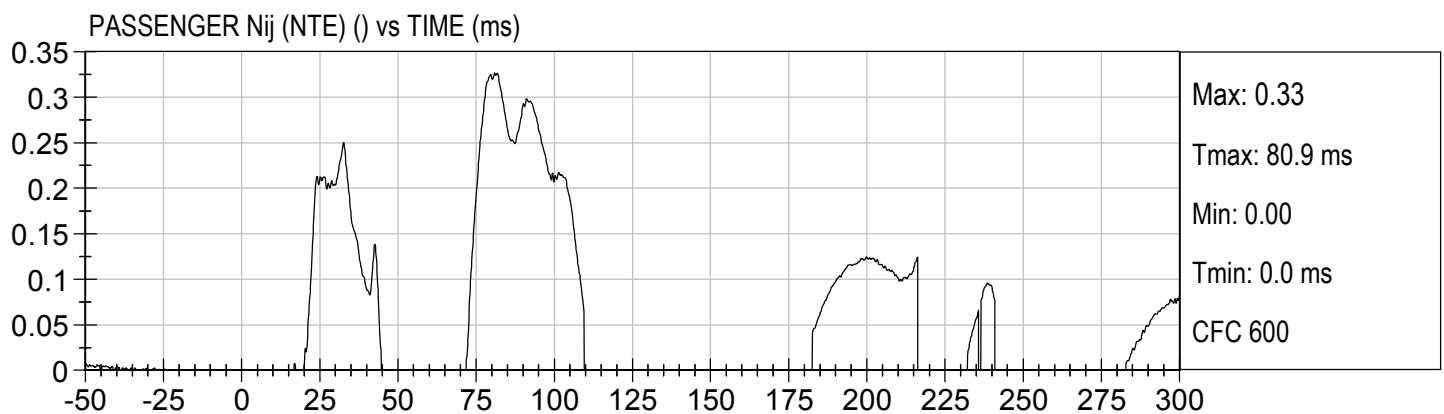
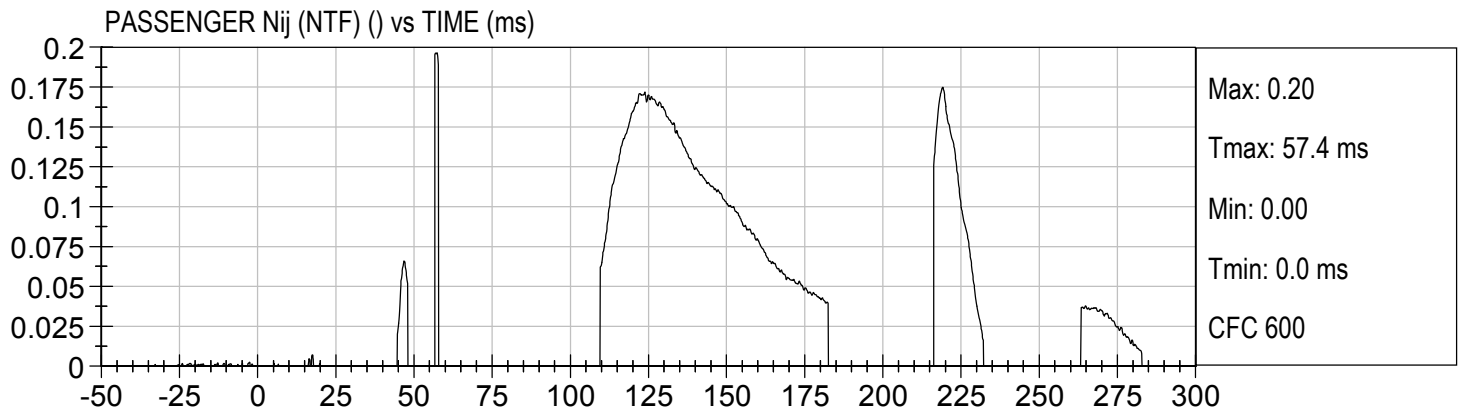
PASSENGER HEAD Resultant (G's) vs TIME (ms)

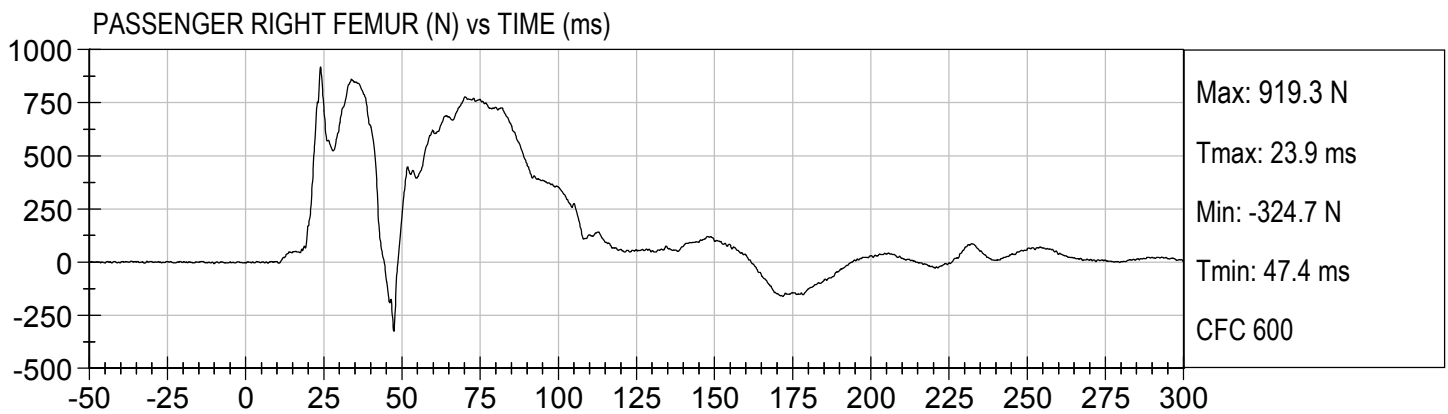
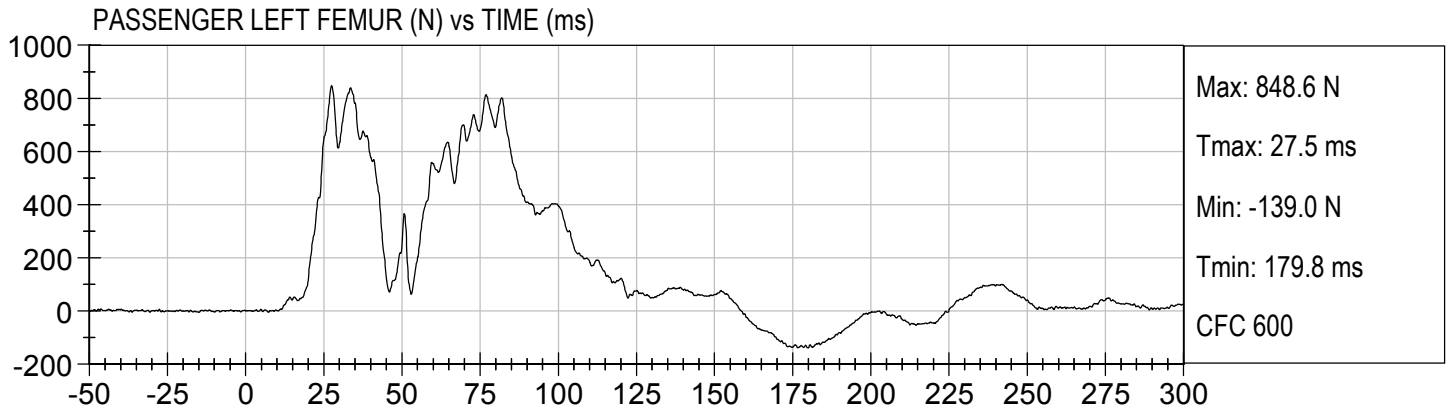












APPENDIX C
DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

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

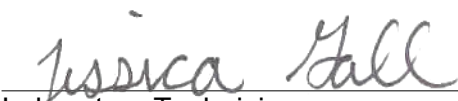
NOTE: THE H-POINT IS LOCATED 1.83 INCHES FORWARD AND 2.57 INCHES DOWN FROM THE CENTER OF THE PELVIS ANGLE REFERENCE HOLE.

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

ATD Serial No: 351

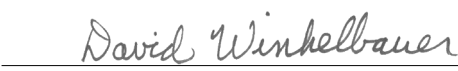
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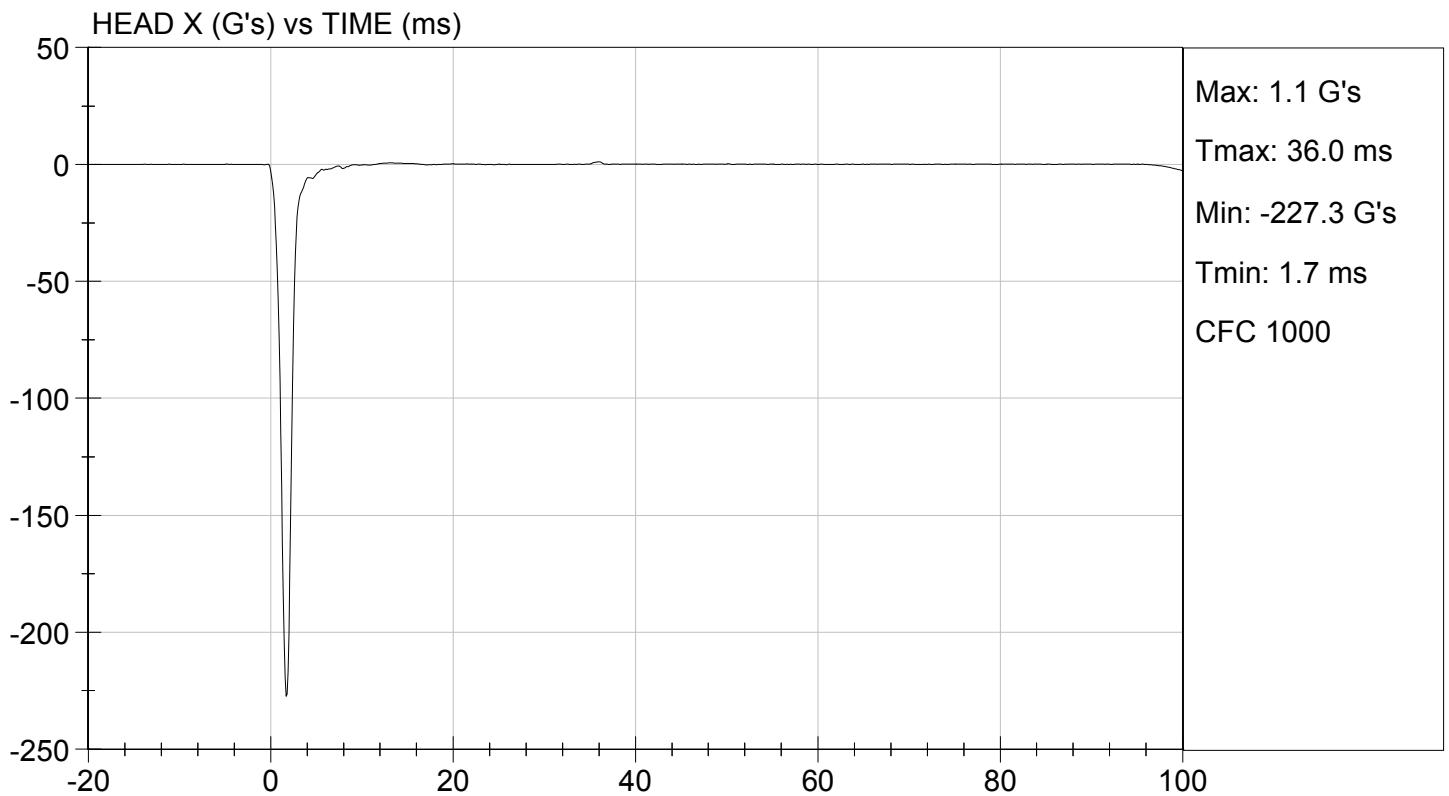
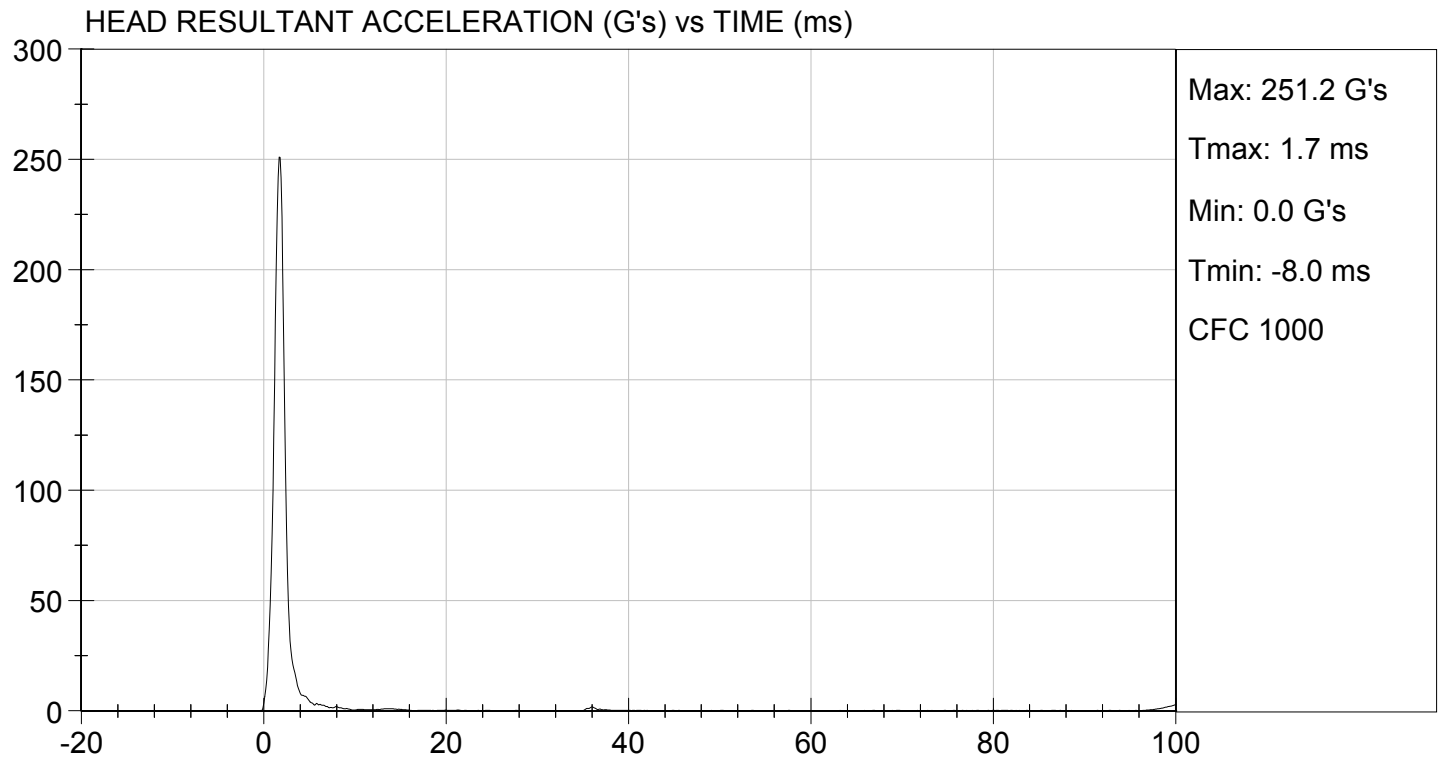
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Peak Resultant Acceleration	G's	225 to 275	251	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-8.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

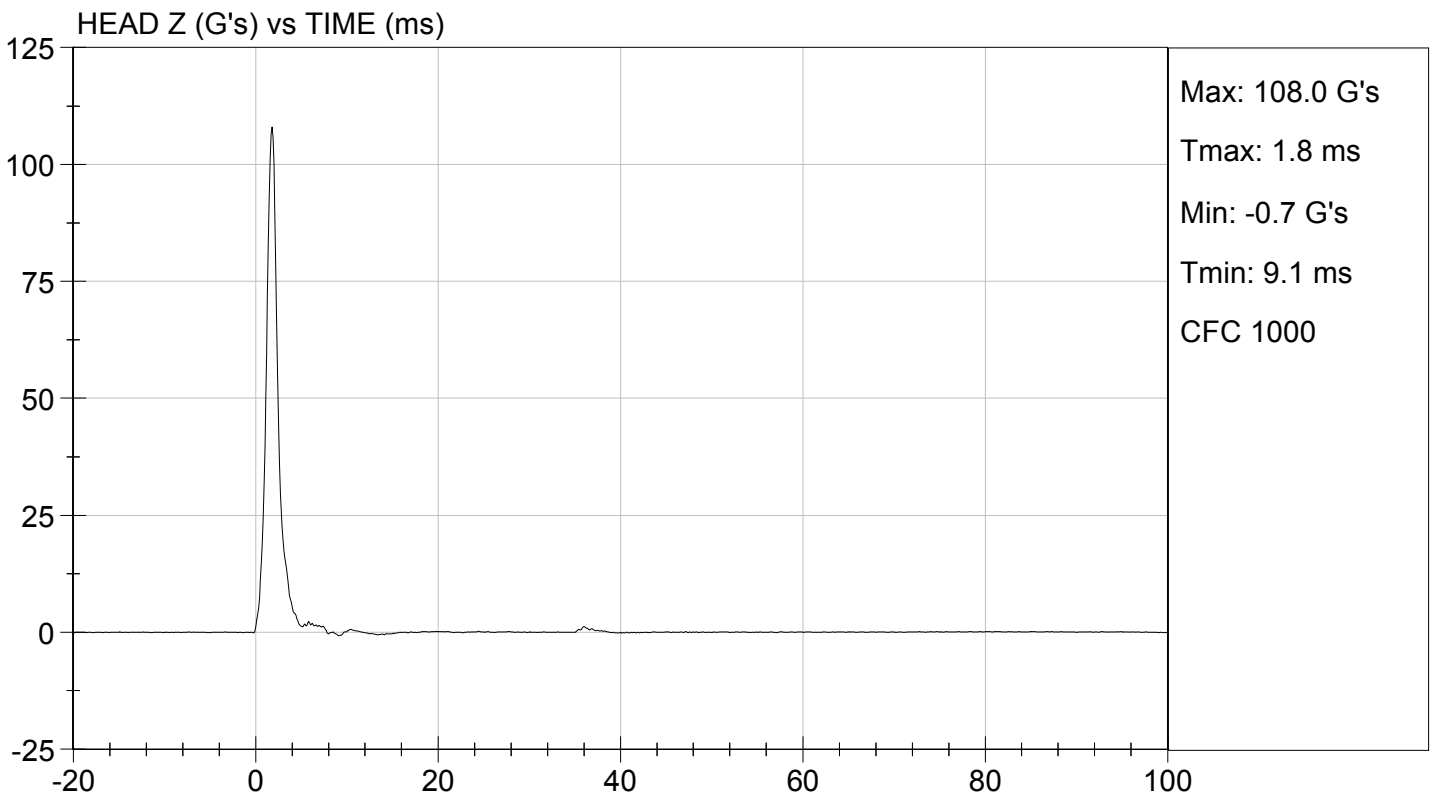
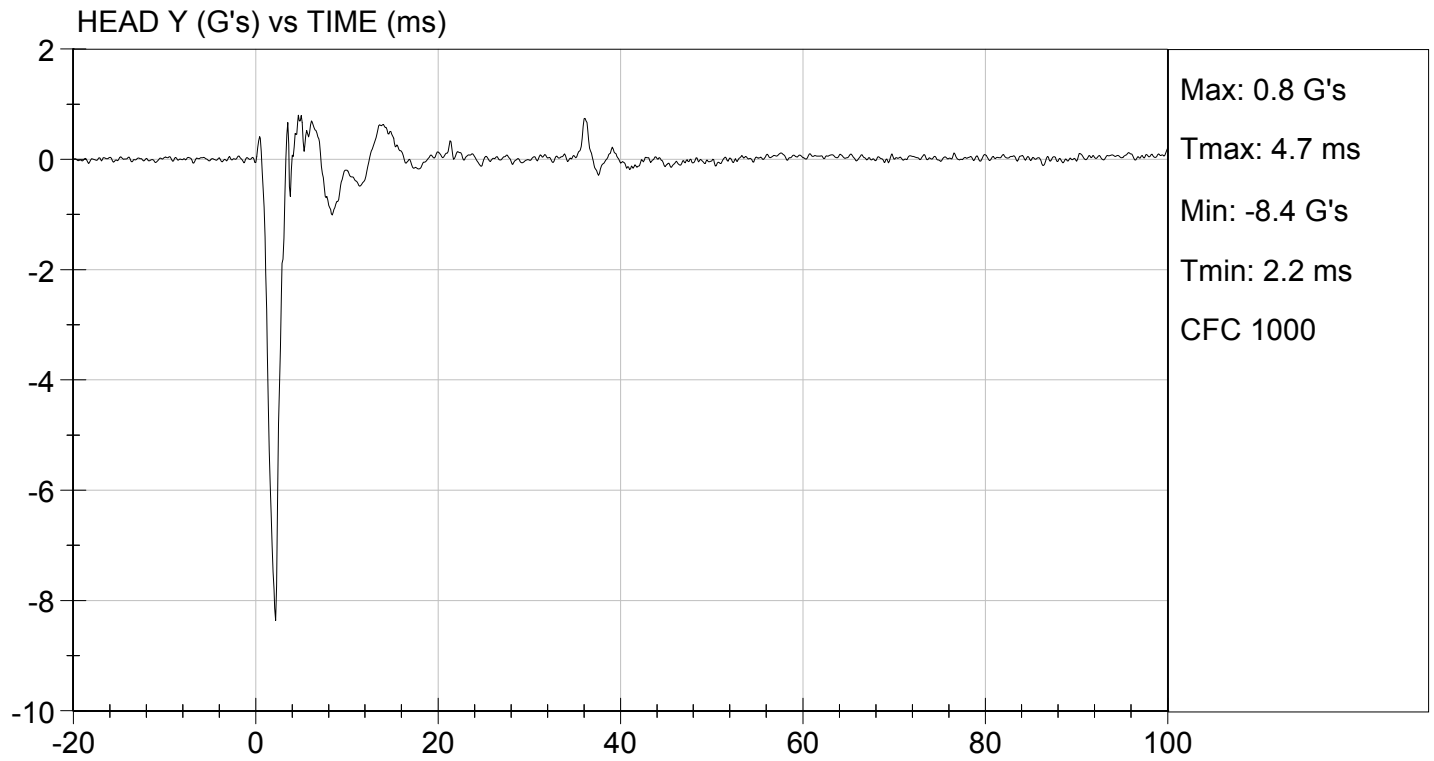

Laboratory Technician

07/17/2014

Test Date


Approved By





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

ATD Serial No: 351

Test I.D: D142492

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	49	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.13	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	24.70	Pass
	20 ms	G's	17.60 to 22.60	19.79	Pass
	30 ms	G's	12.50 to 18.50	14.59	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	34.2	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	68.7	Pass
	Time	ms	57.0 to 64.0	60.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	117.1	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	98.5	Pass
	Time	ms	47.0 to 58.0	51.2	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	105.9	Pass
Overall Test Results					Pass

Jessica Gall
Laboratory Technician

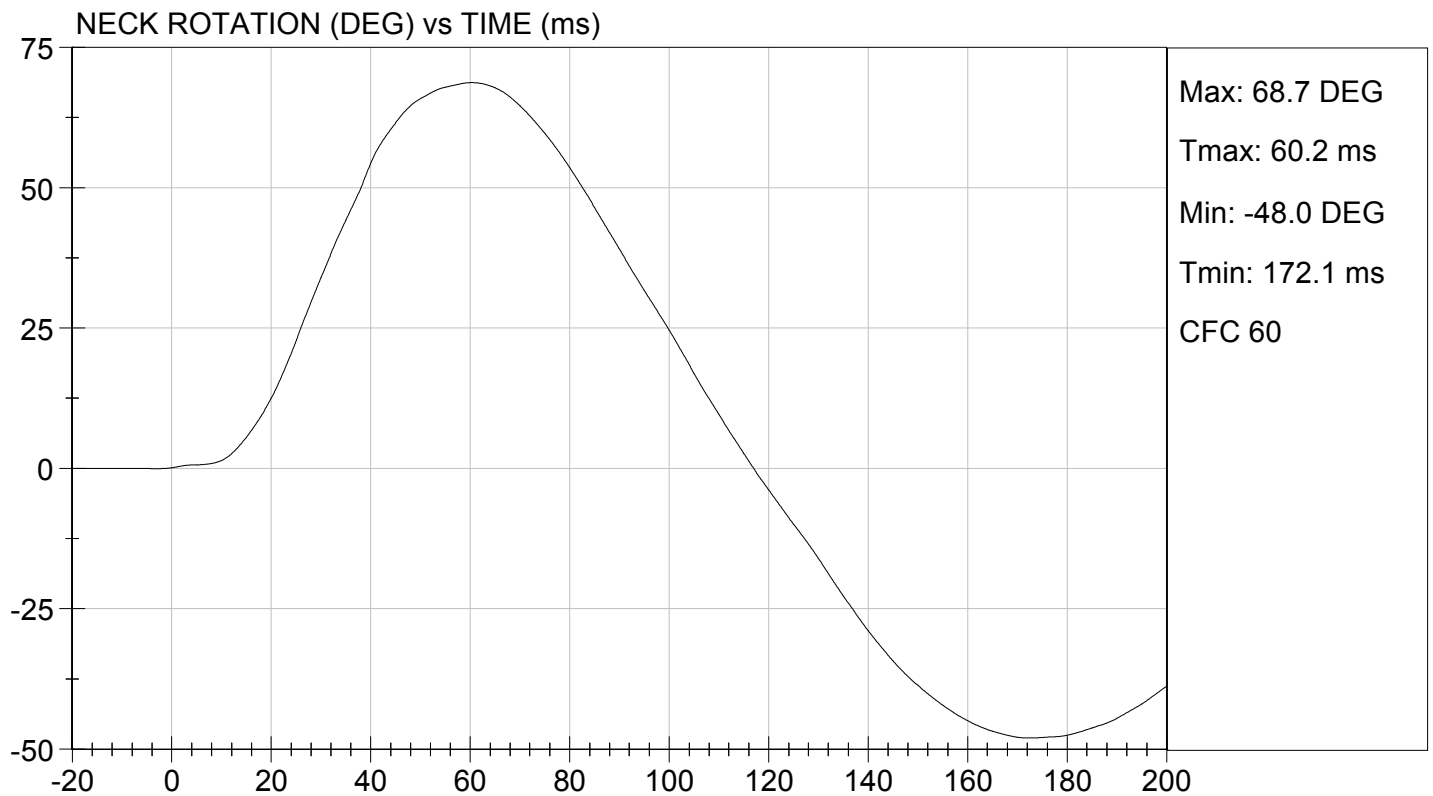
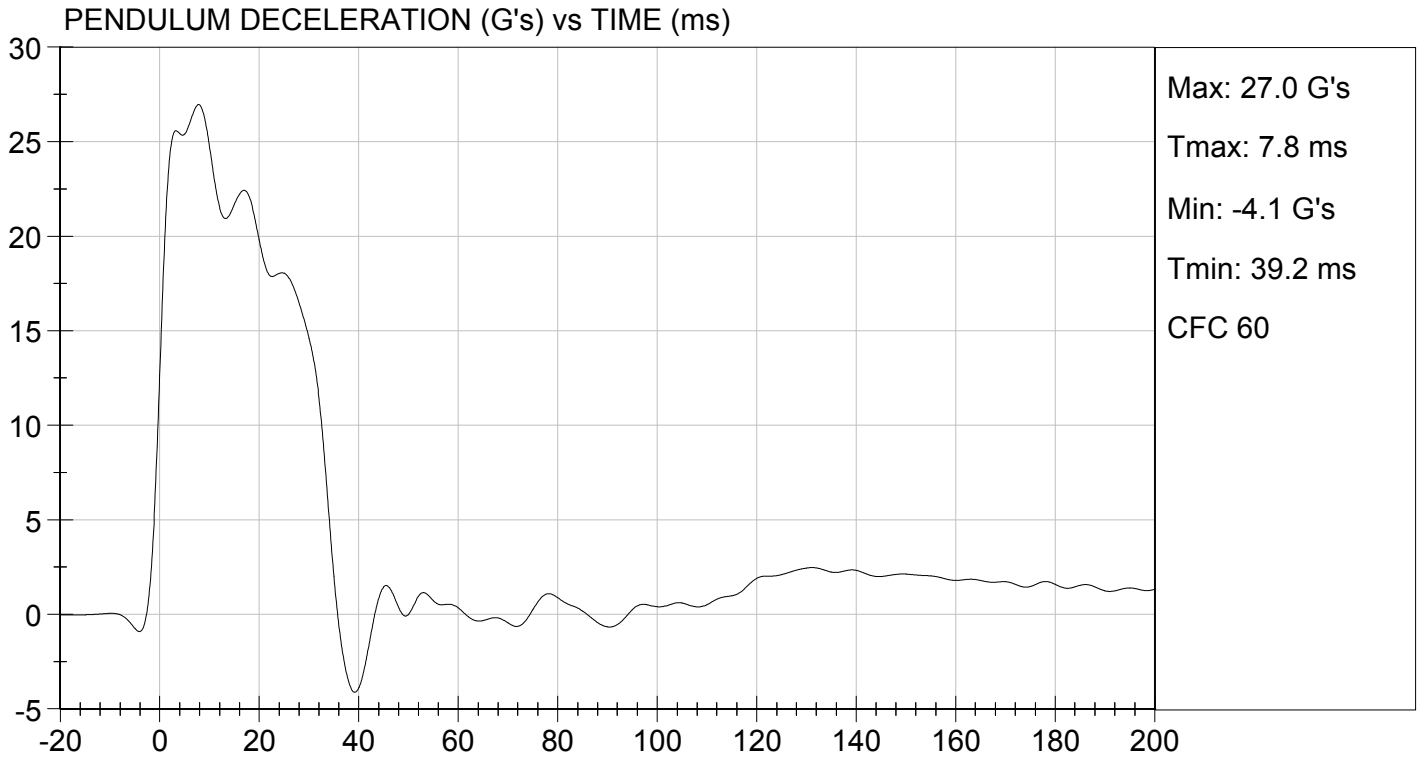
07/18/2014
Test Date

David Winkelbauer
Approved By



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

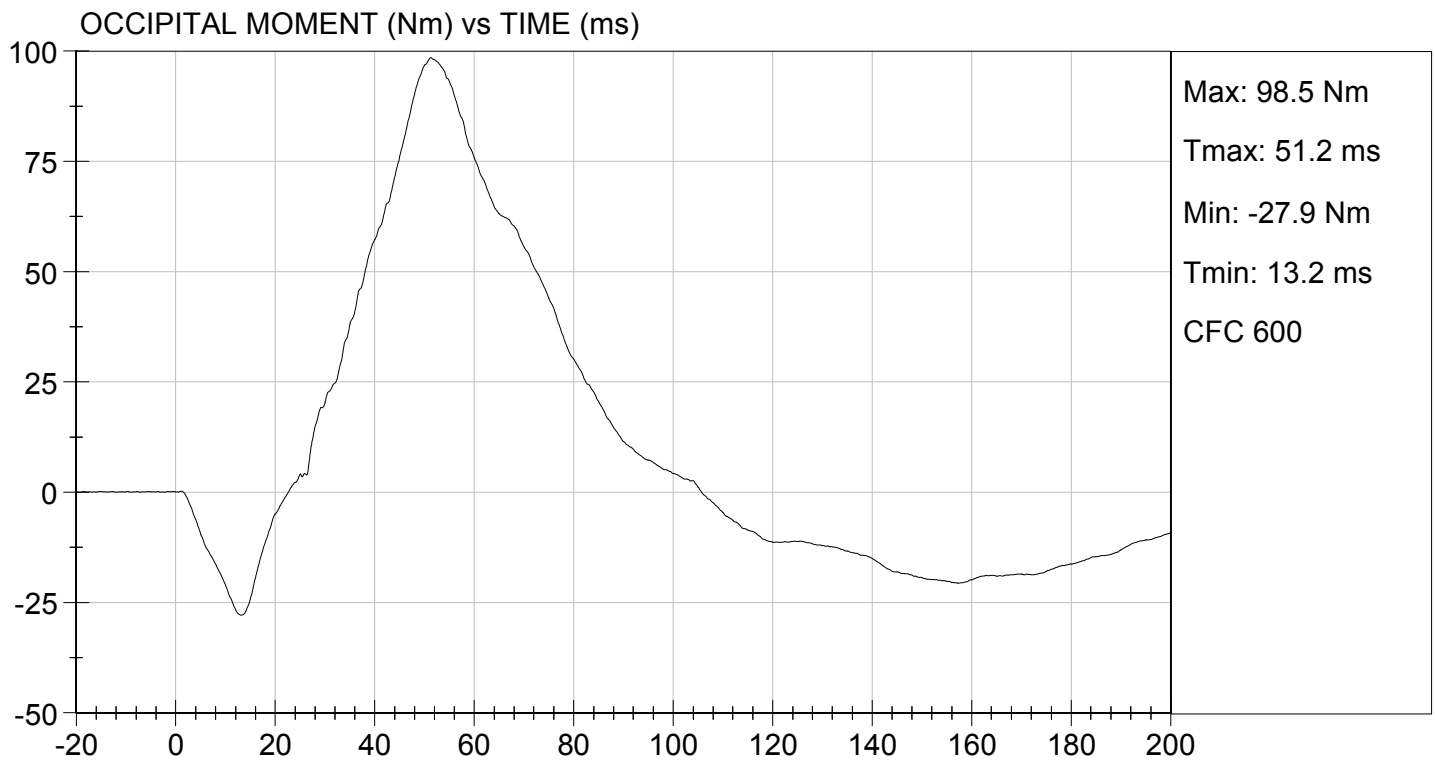
TEST DATE: 07/18/2014
TEST #: D142492





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

TEST DATE: 07/18/2014
TEST #: D142492



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

ATD Serial No: 351

Test I.D: D142493

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	49	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.18	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.31	Pass
	20 ms	G's	14.00 to 19.00	15.62	Pass
	30 ms	G's	11.00 to 16.00	15.01	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	15.5	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	40.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	95.0	Pass
	Time	ms	72.0 to 82.0	75.9	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	154.5	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-58.8	Pass
	Time	ms	65.0 to 79.0	70.3	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.1	Pass
Overall Test Results					Pass

Jessica Galt
Laboratory Technician

07/18/2014

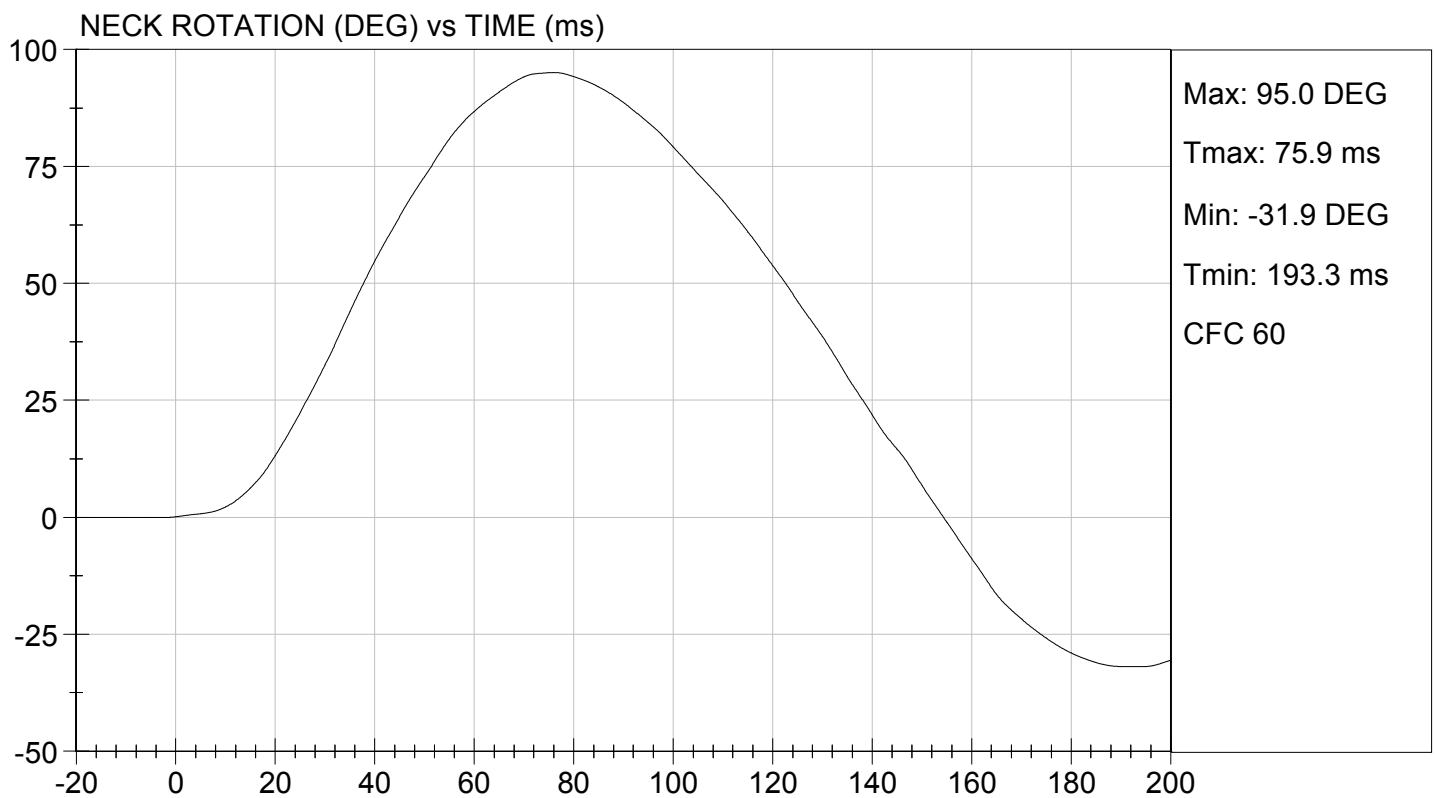
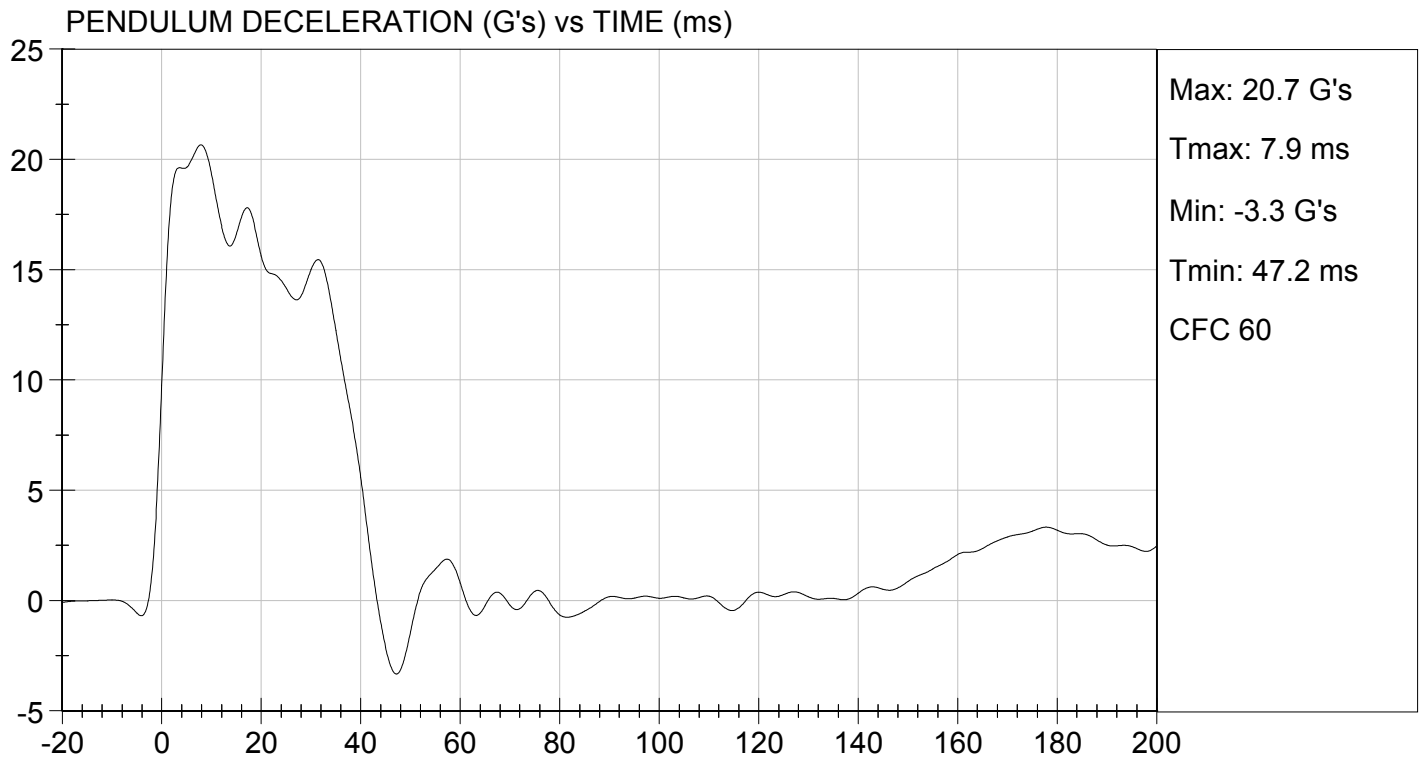
Test Date

David Winkelbauer
Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 20.30 ft/s, 6.18 m/s

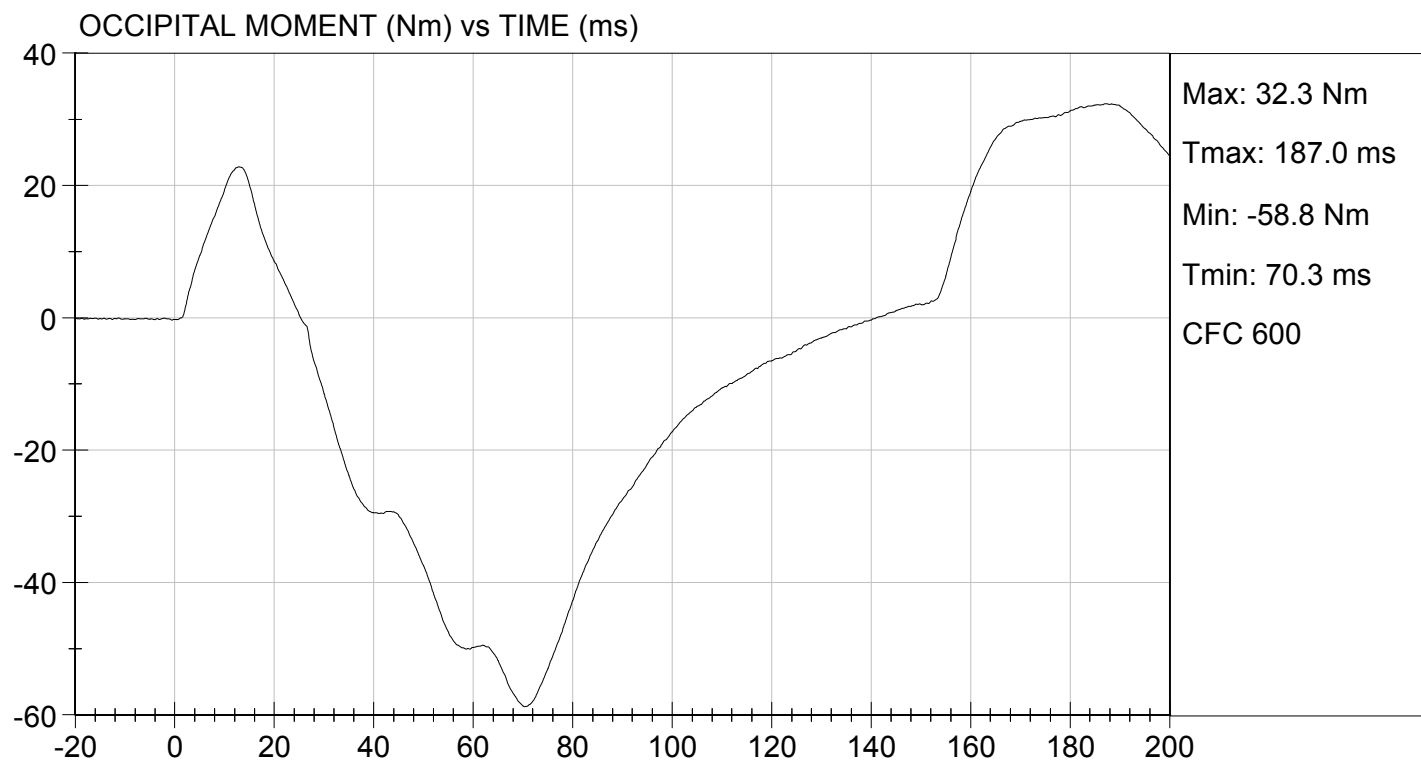
TEST DATE: 07/18/2014
TEST #: D142493





TEST DESC: NECK EXTENSION
VELOCITY: 20.30 ft/s, 6.18 m/s

TEST DATE: 07/18/2014
TEST #: D142493



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D142494

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	48	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,275	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.62	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Overall Test Results			Pass	


Laboratory Technician

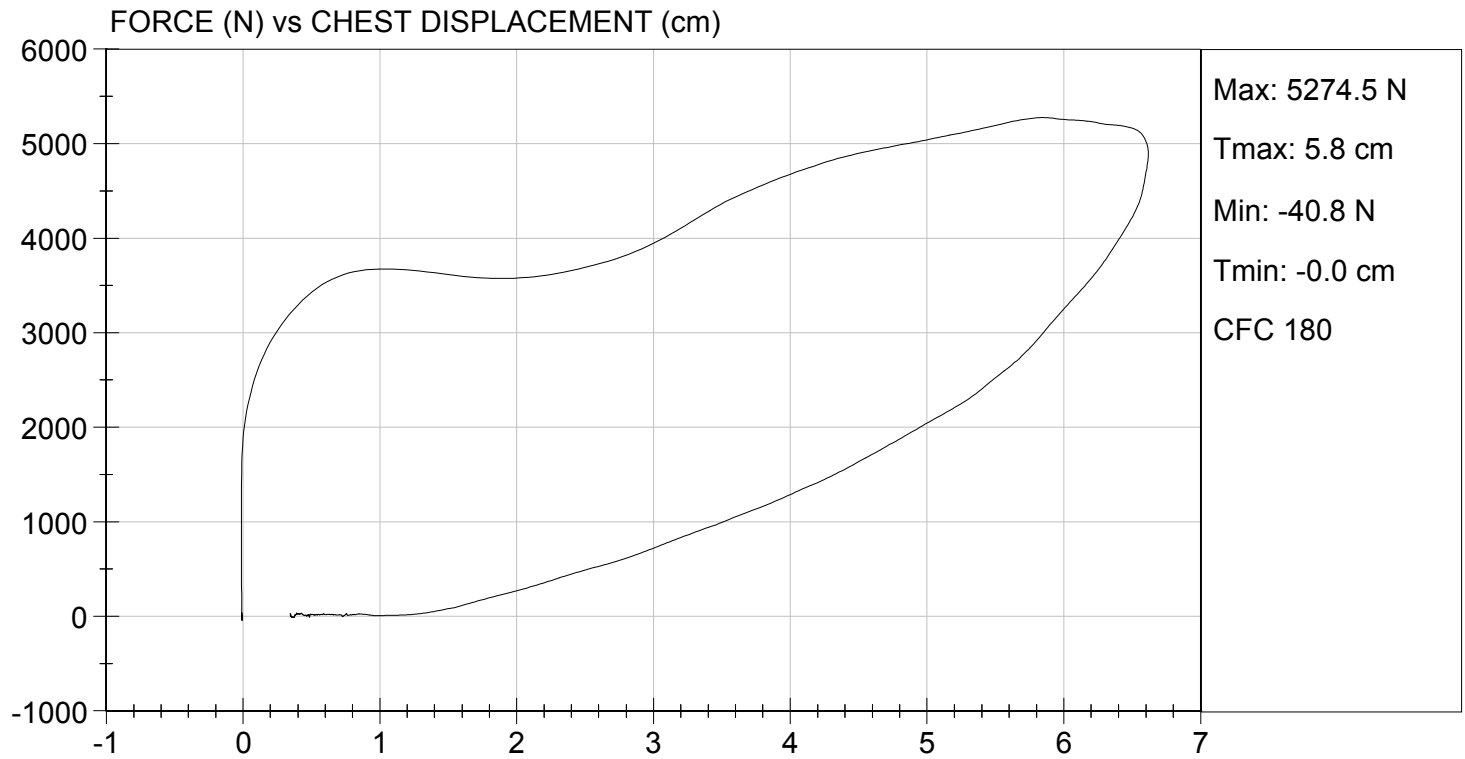
07/18/2014
Test Date


Approved By



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

TEST DATE: 07/18/2014
TEST #: D142494



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

ATD Serial No: 351

Test I.D: D142495

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	43	Pass
Probe Velocity	m/s	2.07 to 2.13	2.09	Pass
Peak Probe Force	N	4715 to 5782	4,943	Pass
Overall Test Results				Pass


Laboratory Technician

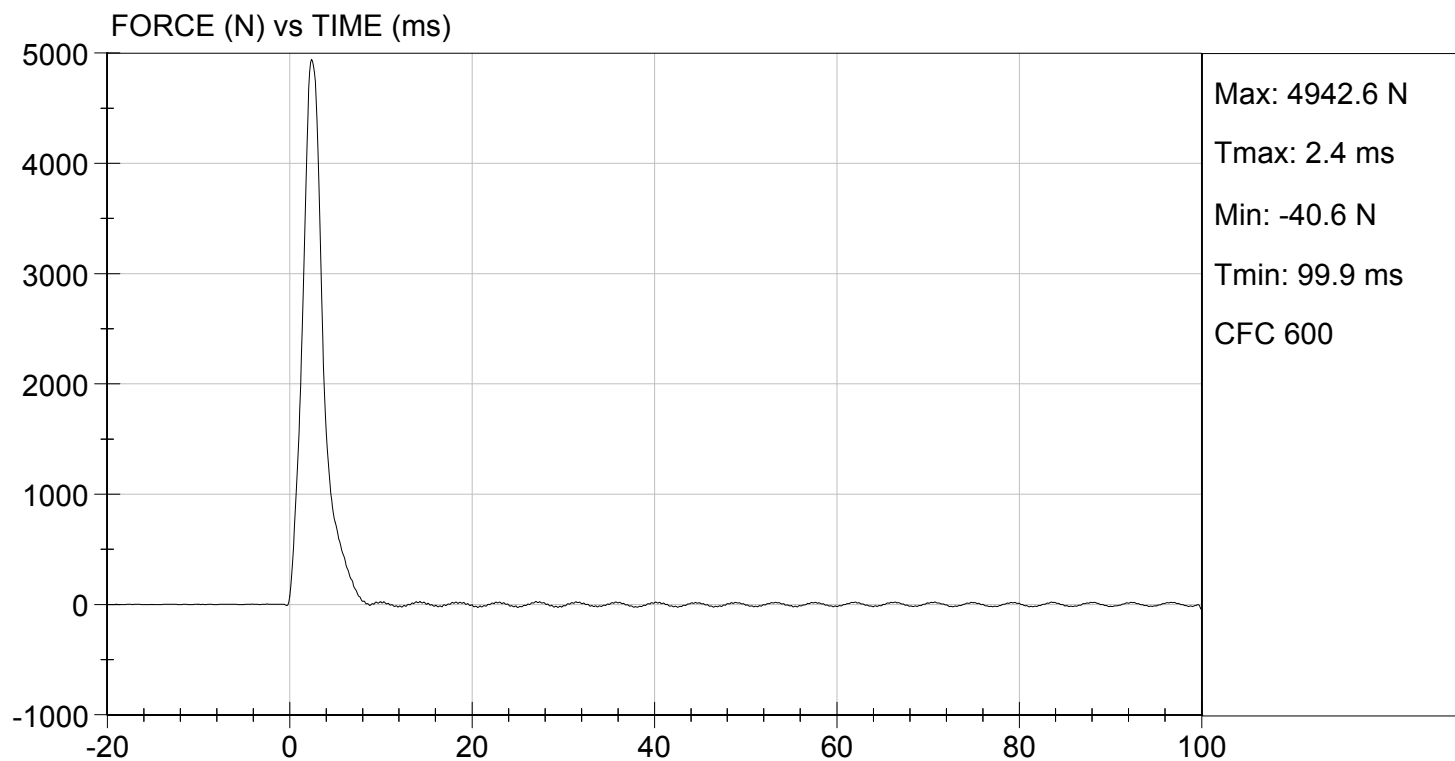
07/17/2014
Test Date


Approved By



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

TEST DATE: 07/17/2014
TEST #: D142495



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

ATD Serial No: 351

Test I.D: D142496

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	43	Pass
Probe Velocity	m/s	2.07 to 2.13	2.09	Pass
Peak Probe Force	N	4715 to 5782	5,061	Pass
Overall Test Results				Pass


Laboratory Technician

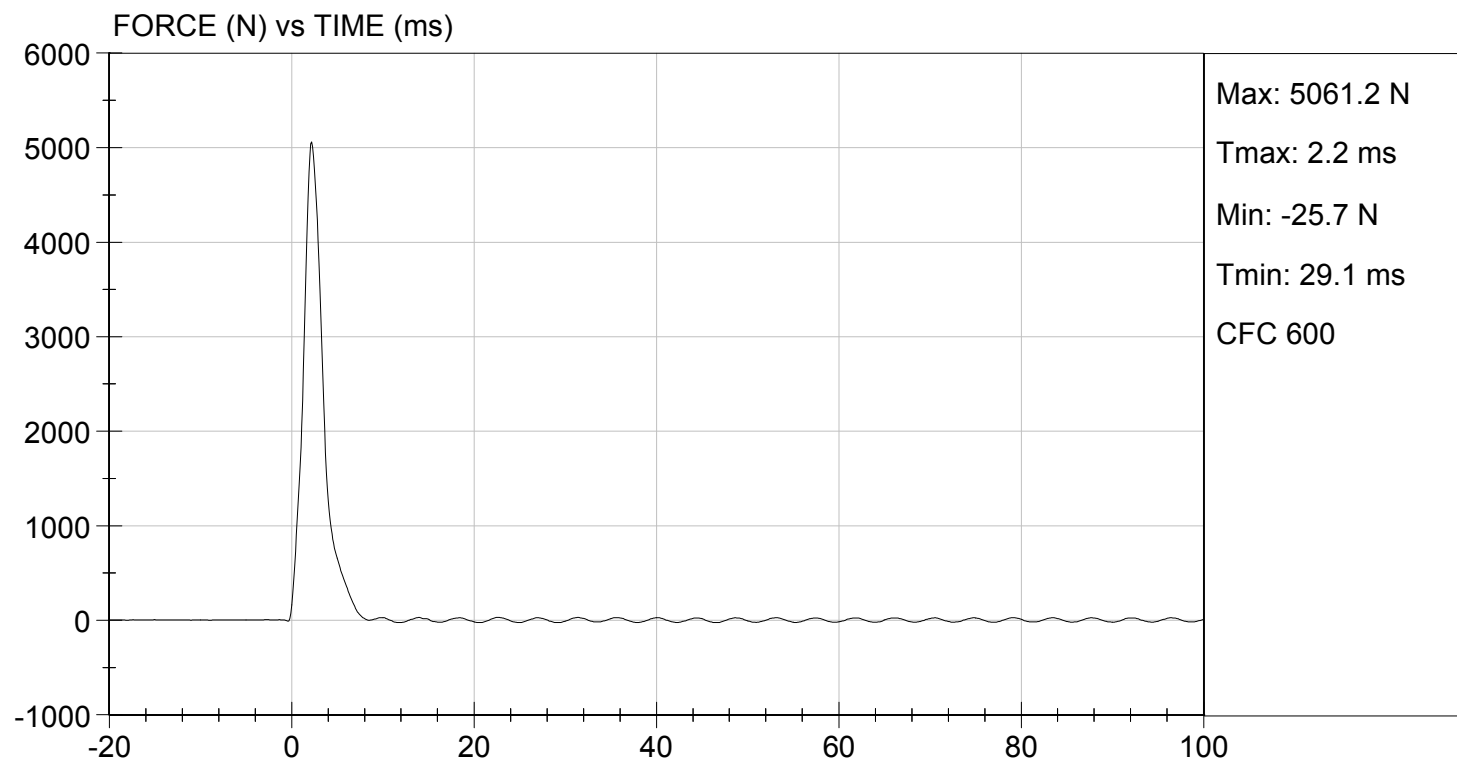
07/17/2014
Test Date


Approved By



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

TEST DATE: 07/17/2014
TEST #: D142496

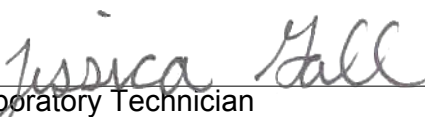


MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

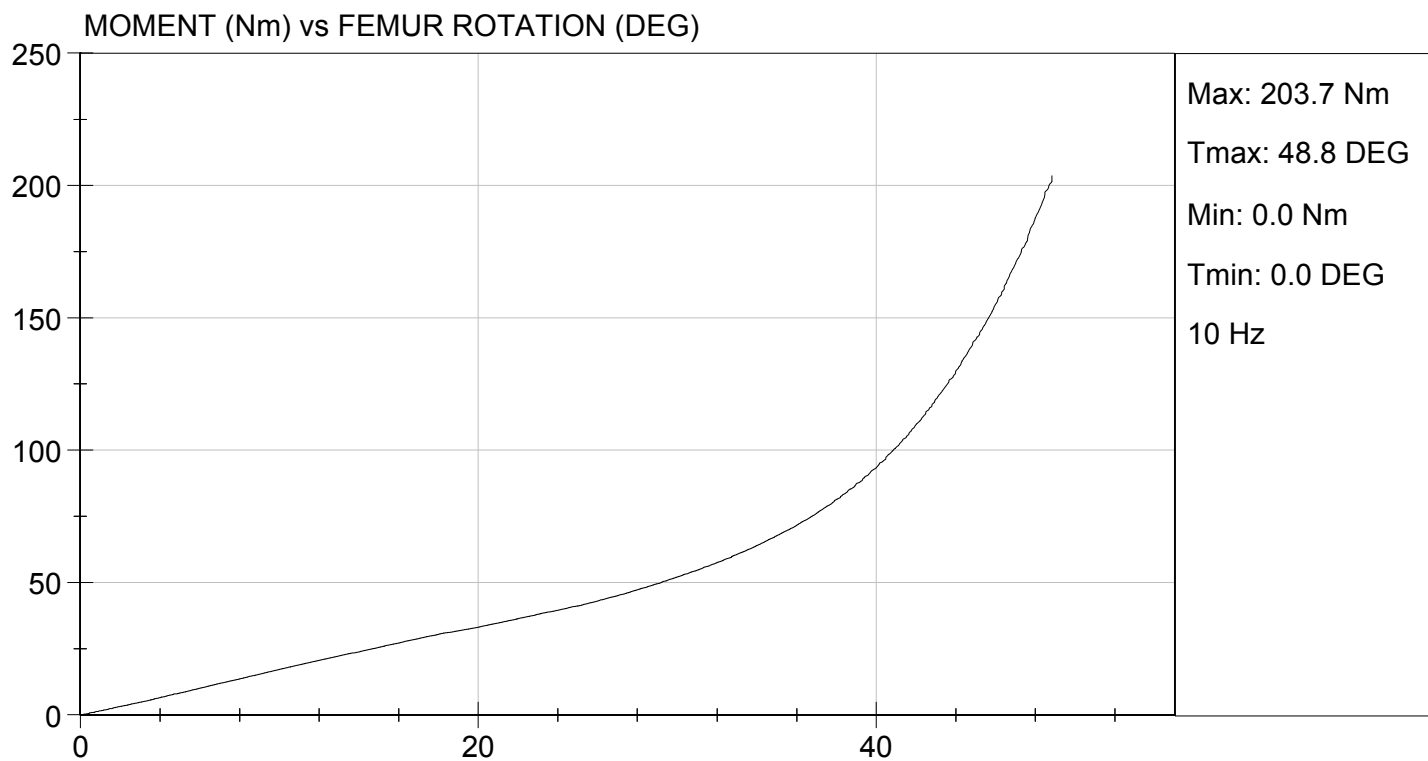
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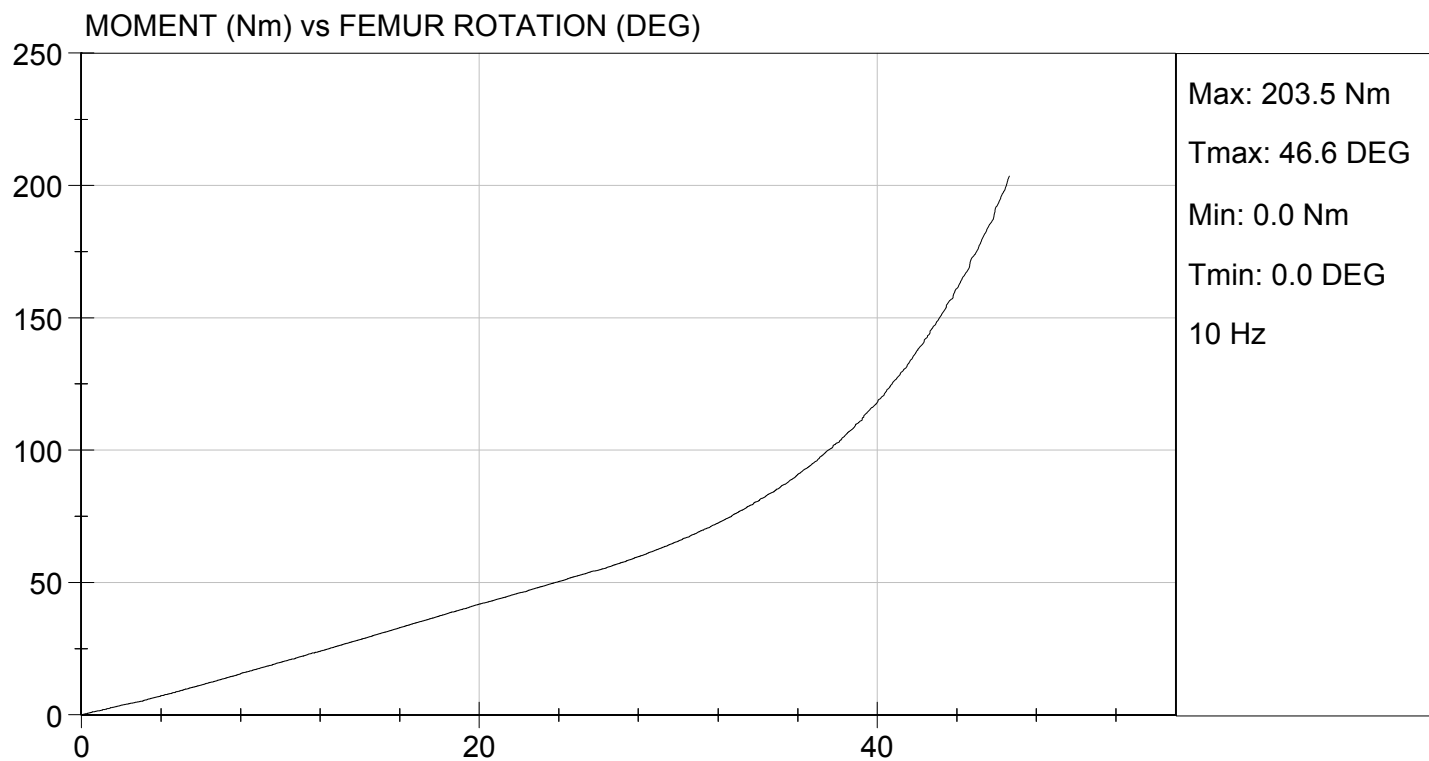
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	49	49	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.3	6.3	Pass
30 Degrees	Nm	94.9 Nm Max	52.0	65.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	48.8	46.6	Pass
Overall Test Results					Pass


 Laboratory Technician

07/17/2014
 Test Date


 Approved By



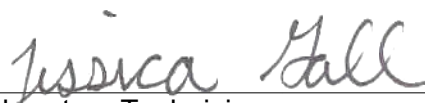


MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test ID: D142571

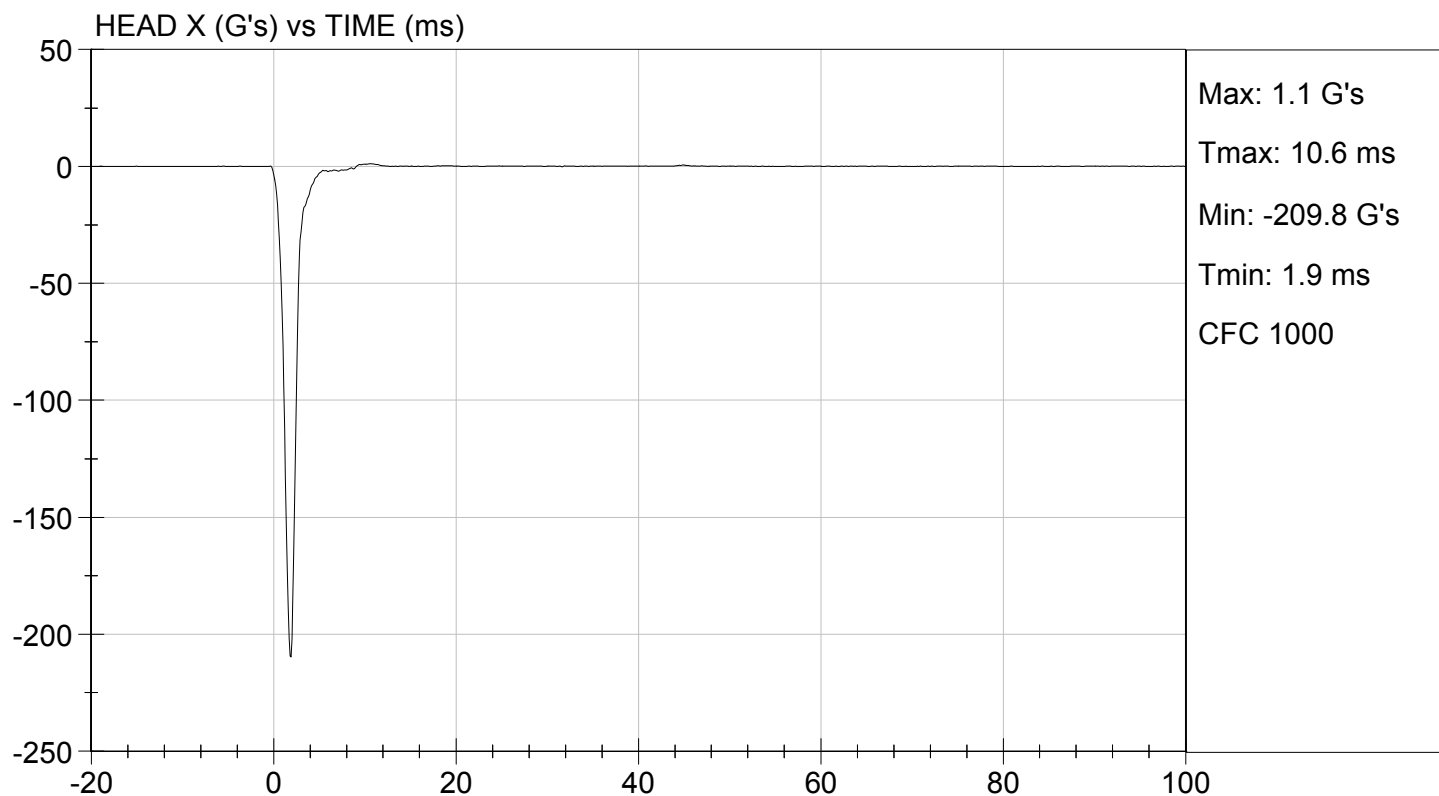
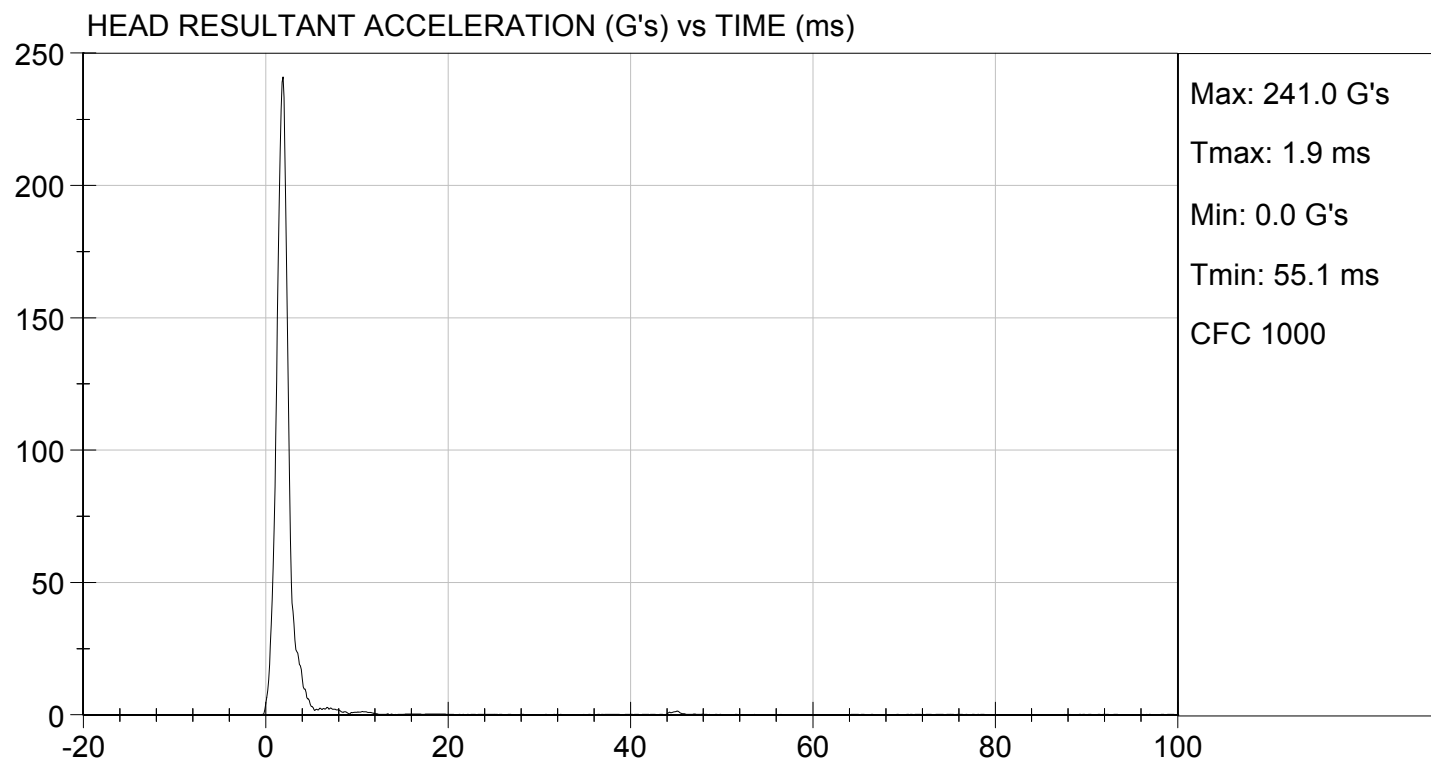
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Peak Resultant Acceleration	G's	225 to 275	241	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-7.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

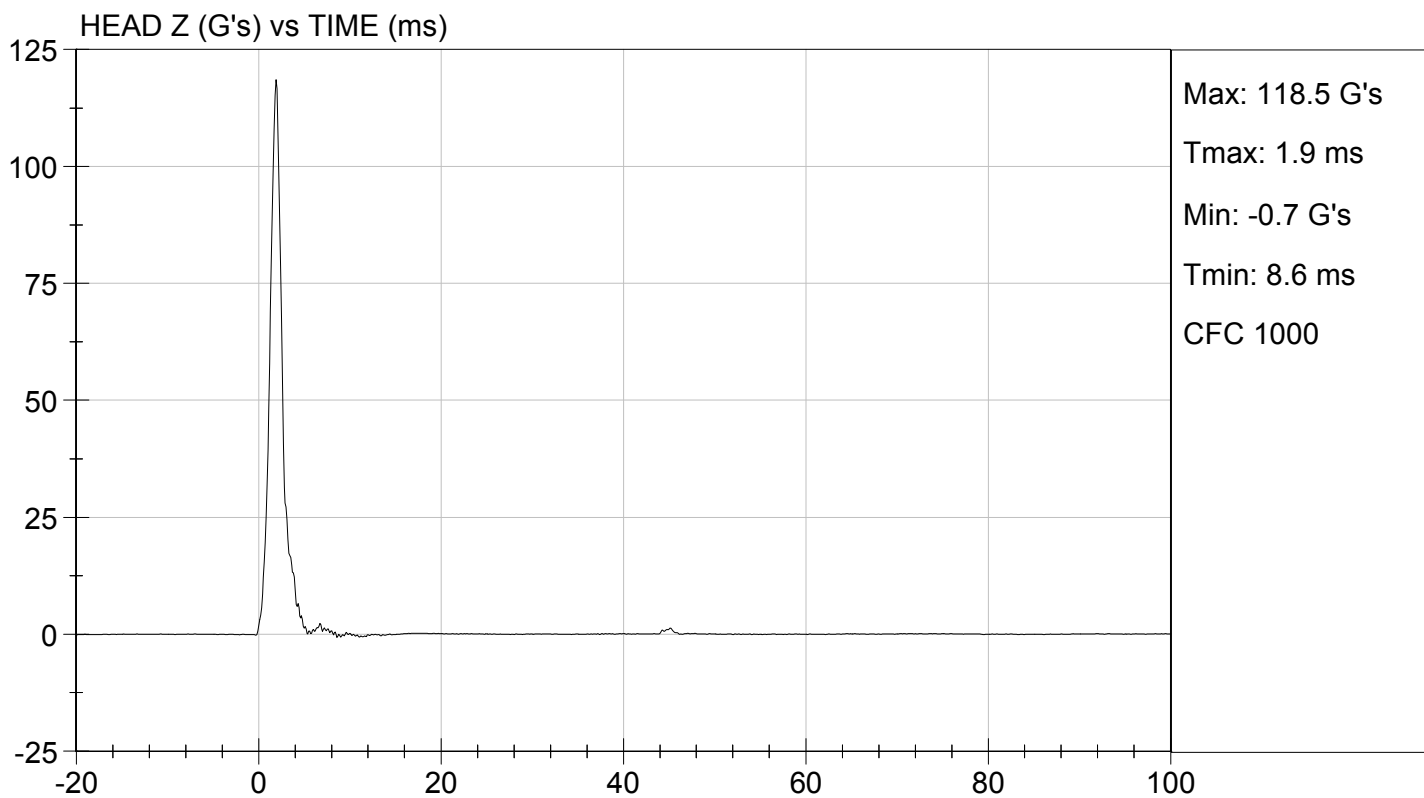
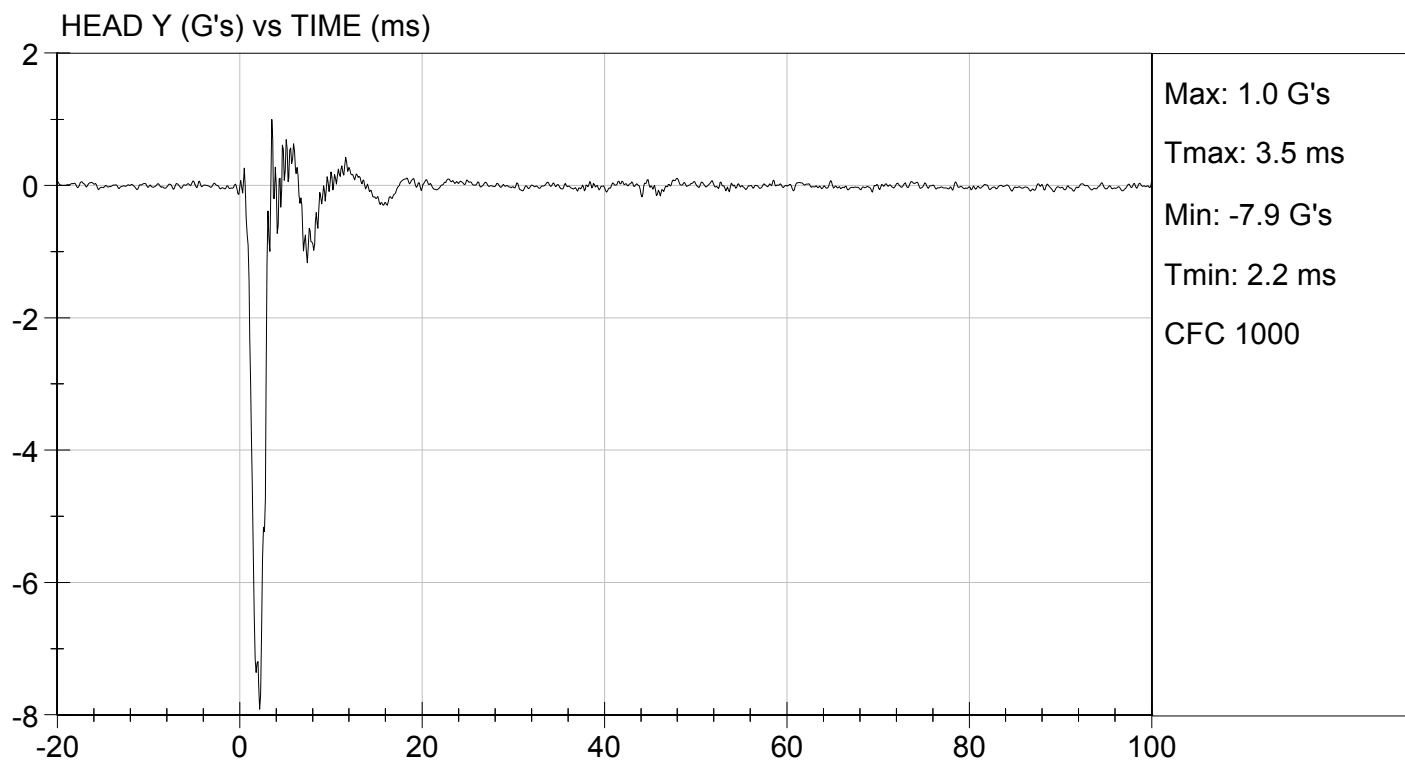

Laboratory Technician

07/23/2014

Test Date


Approved By





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

ATD Serial No: 351

Test I.D: D142572

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	46	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	25.59	Pass
	20 ms	G's	17.60 to 22.60	19.62	Pass
	30 ms	G's	12.50 to 18.50	13.02	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	13.0	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.4	Pass
Maximum "D" Plane Rotation	Maximum	Deg	64.0 to 78.0	69.3	Pass
	Time	ms	57.0 to 64.0	60.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.5	Pass
Moment About Occipital Condyle	Maximum	Nm	88.1 to 108.5	93.7	Pass
	Time	ms	47.0 to 58.0	50.9	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	104.9	Pass
Overall Test Results					Pass

Jessica Hall
Laboratory Technician

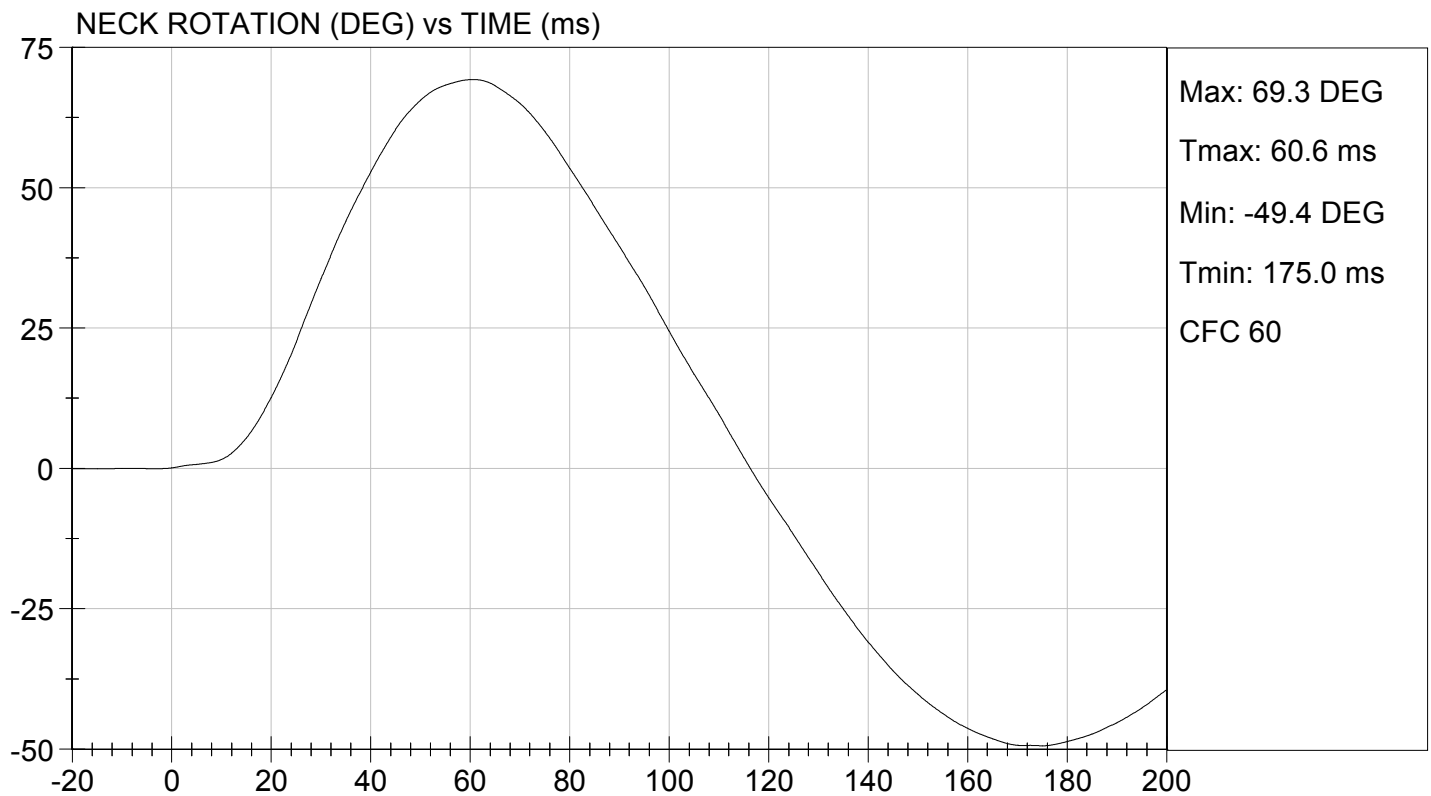
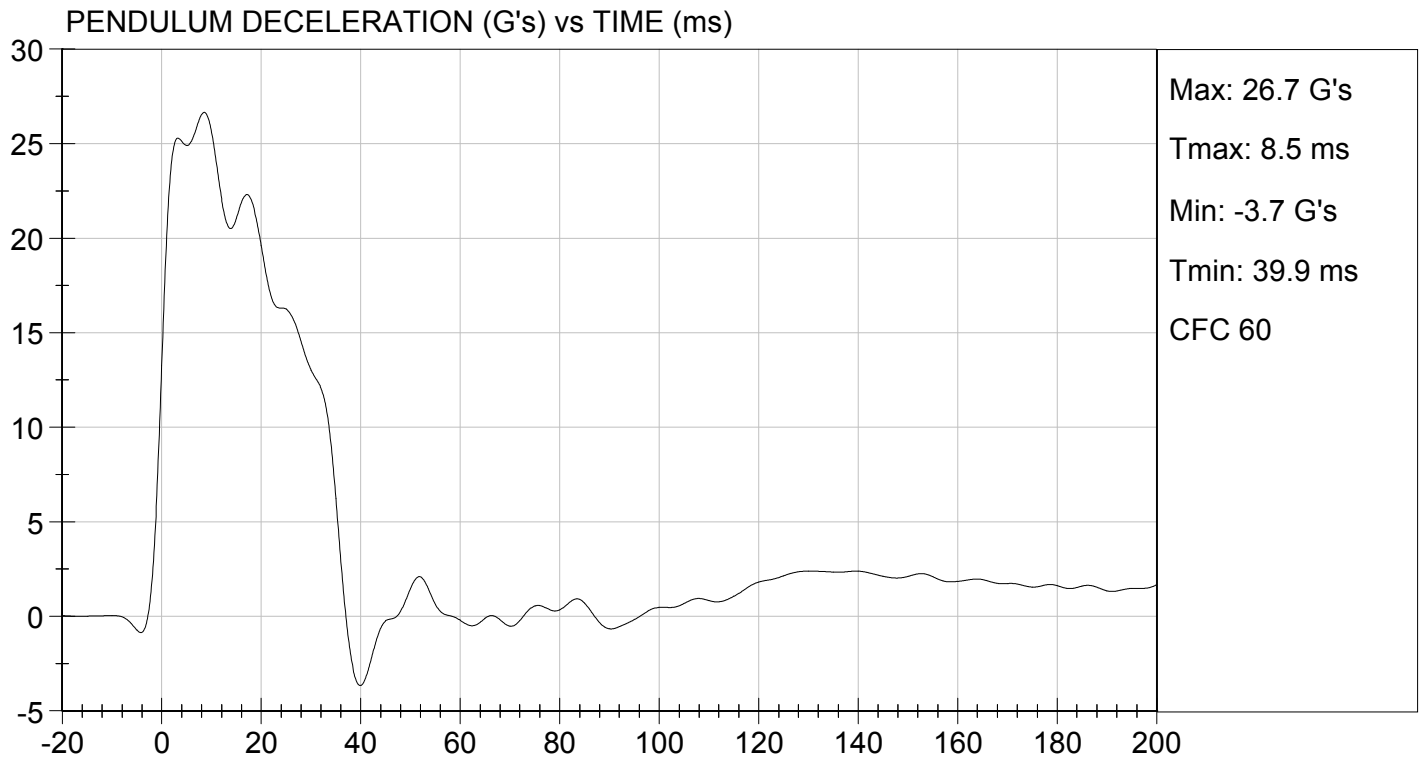
07/24/2014
Test Date

David Winkelbauer
Approved By



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

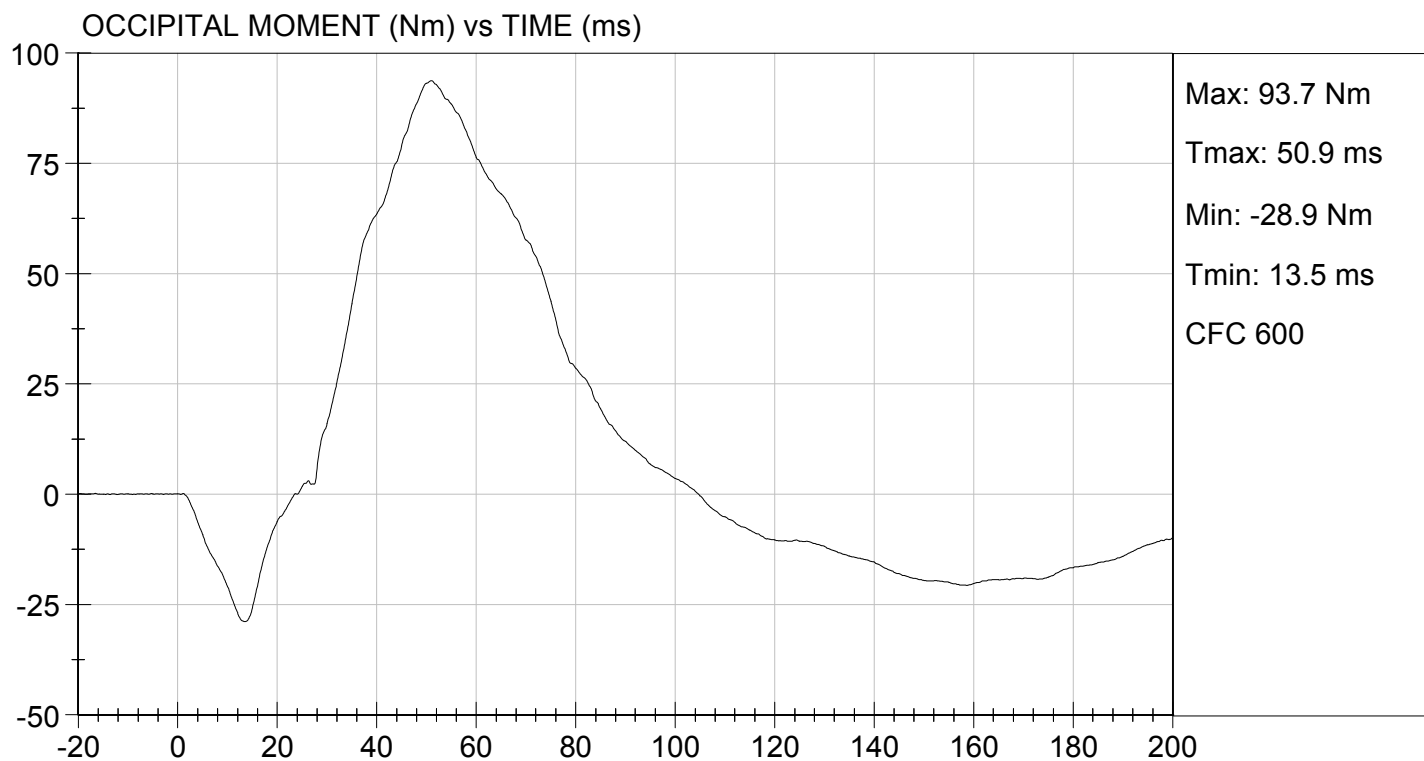
TEST DATE: 07/24/2014
TEST #: D142572





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

TEST DATE: 07/24/2014
TEST #: D142572

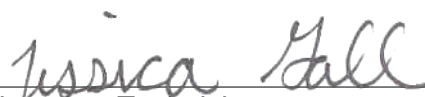


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D142573

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	46	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	20.54	Pass
	20 ms	G's	14.00 to 19.00	17.95	Pass
	30 ms	G's	11.00 to 16.00	11.98	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	14.4	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	40.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	97.8	Pass
	Time	ms	72.0 to 82.0	72.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	152.2	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-65.8	Pass
	Time	ms	65.0 to 79.0	68.5	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	140.9	Pass
Overall Test Results					Pass


 Laboratory Technician

07/24/2014

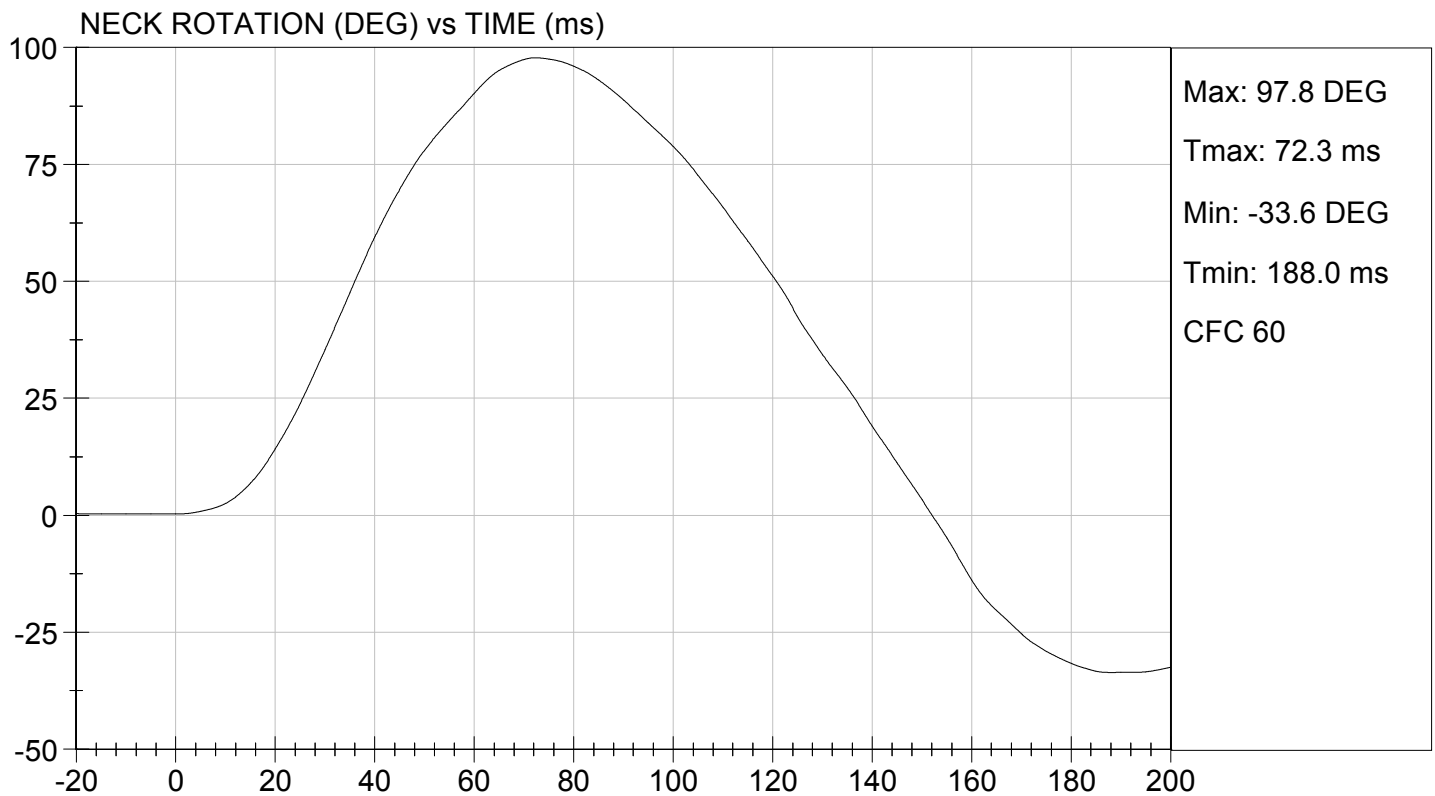
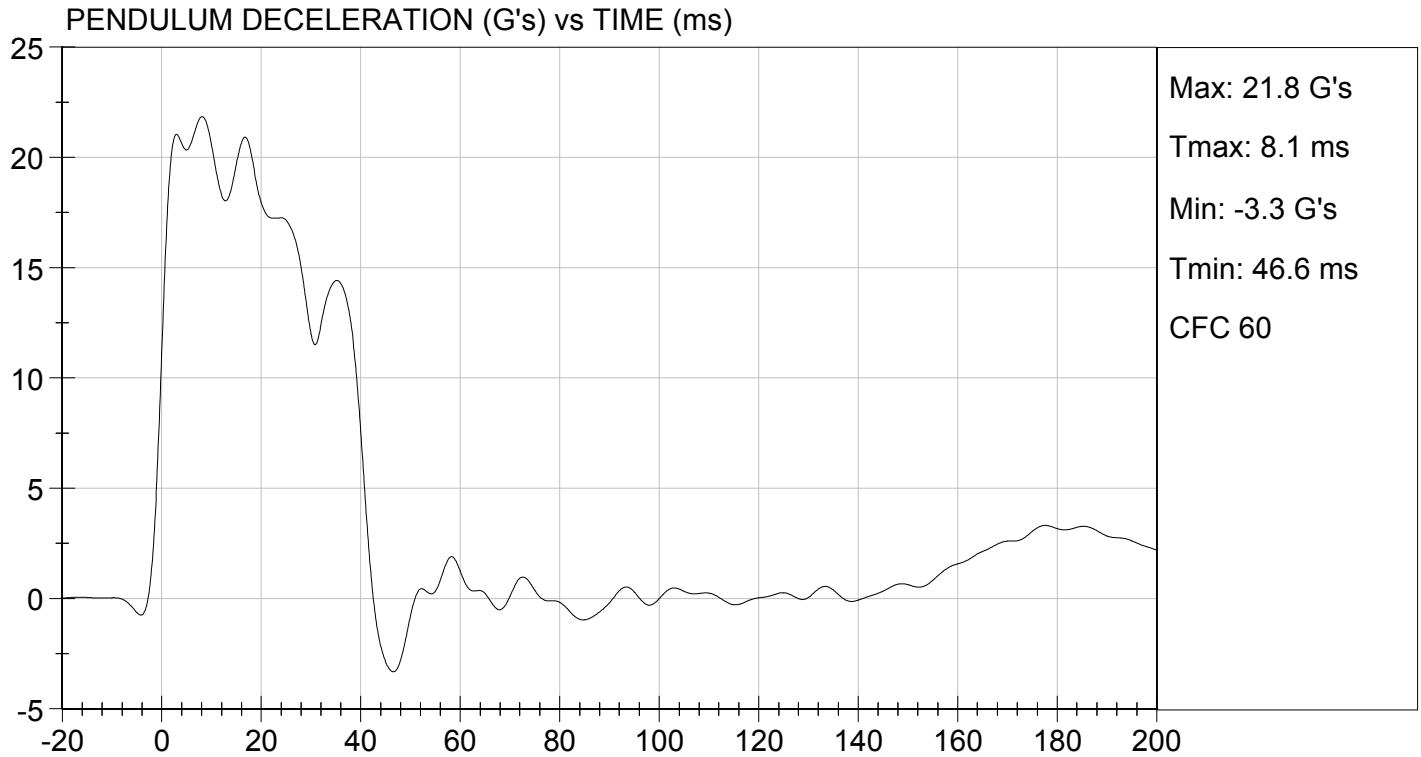
Test Date


 Approved By



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

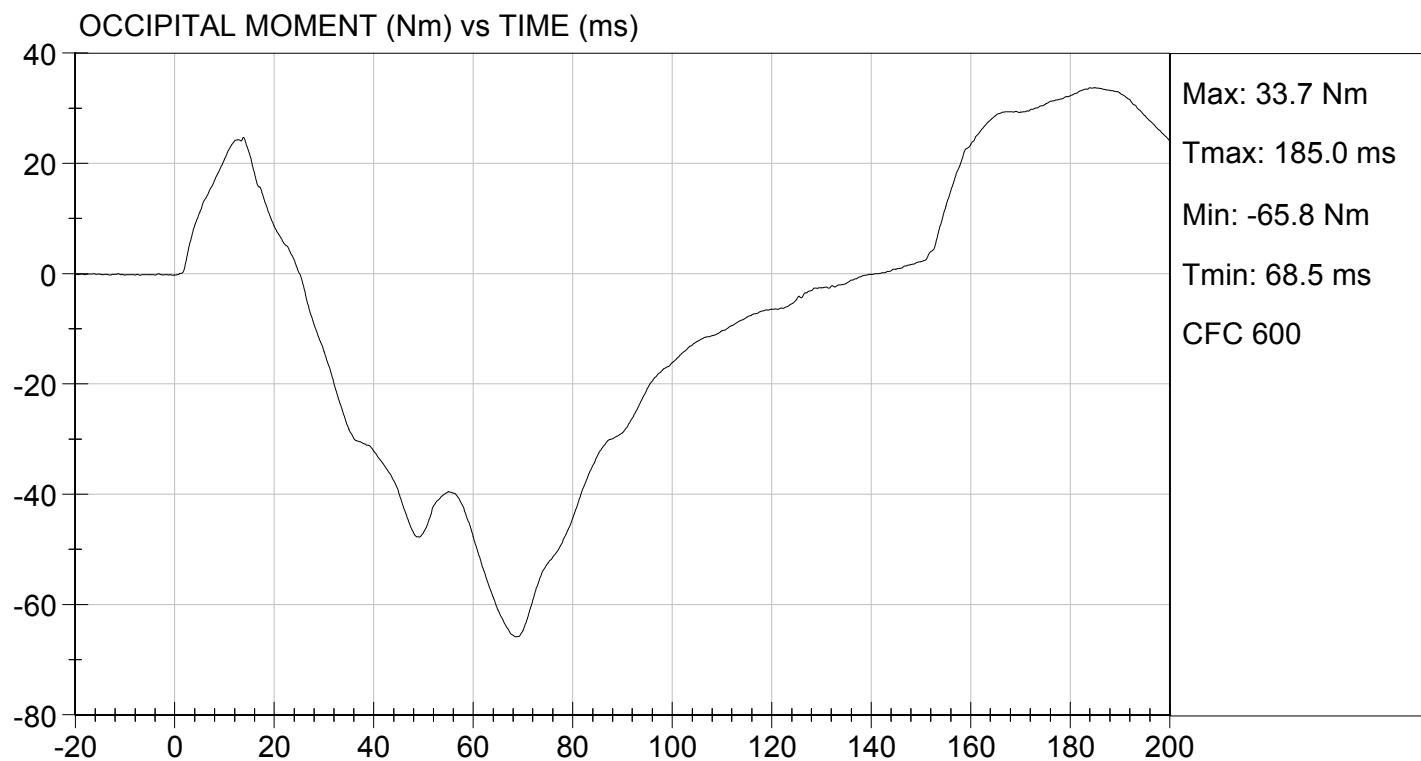
TEST DATE: 07/24/2014
TEST #: D142573





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

TEST DATE: 07/24/2014
TEST #: D142573

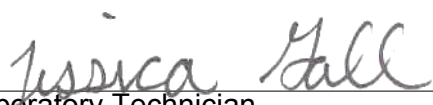


MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D142574

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,330	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.62	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Overall Test Results			Pass	


Laboratory Technician

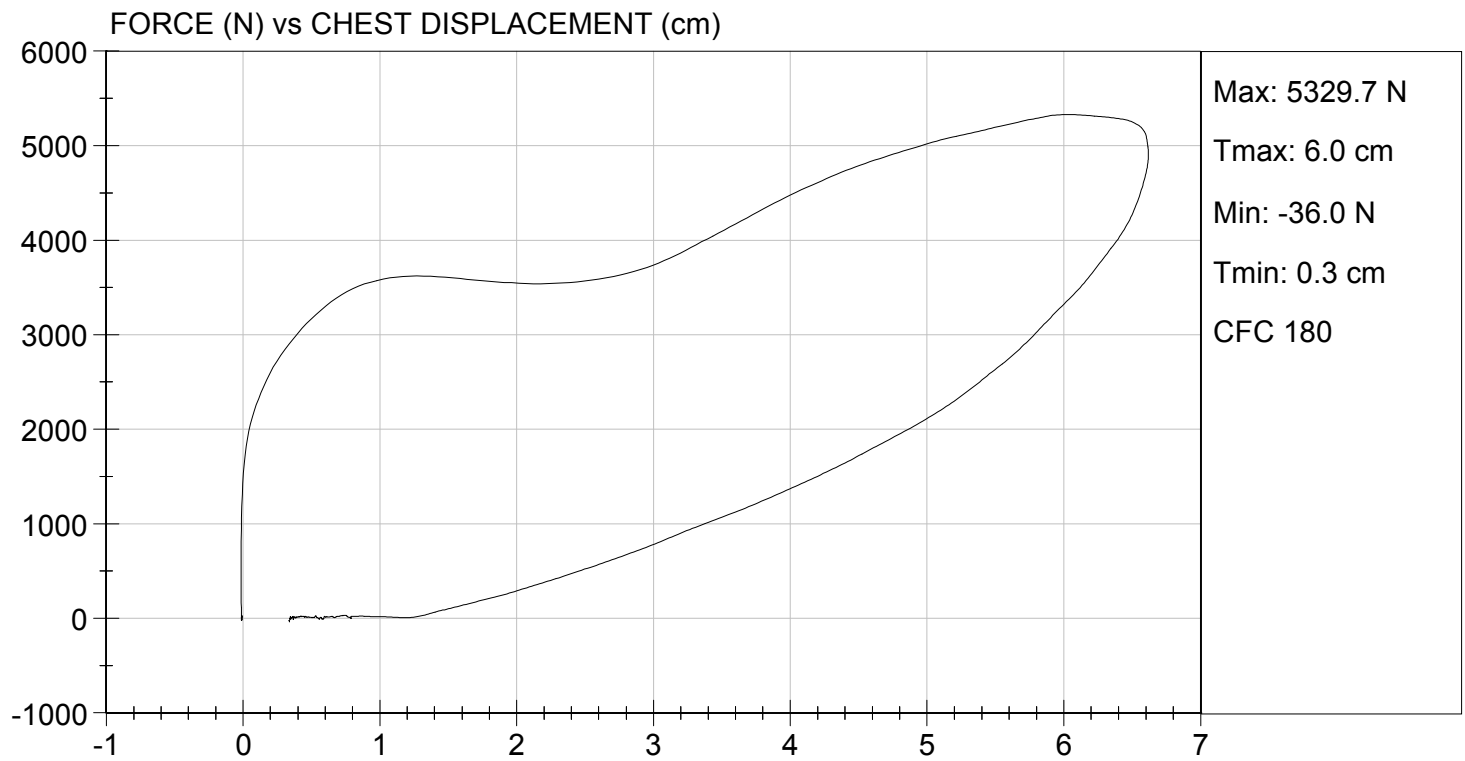
07/24/2014
Test Date


Approved By



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

TEST DATE: 07/24/2014
TEST #: D142574



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

ATD Serial No: 351

Test I.D: D142575

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	N	4715 to 5782	5,052	Pass
Overall Test Results				Pass


Laboratory Technician

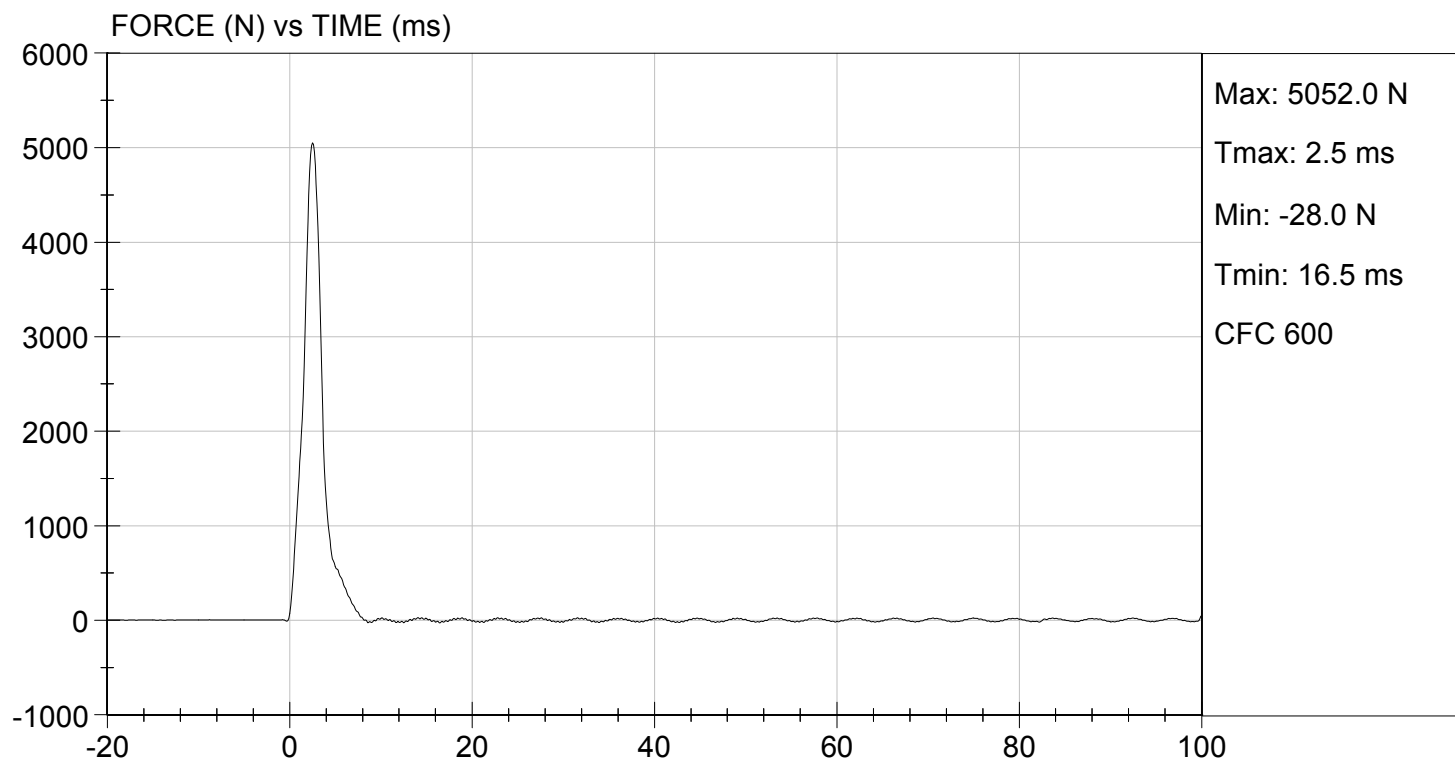
07/23/2014
Test Date


Approved By



TEST DESC: RIGHT KNEE
VELOCITY: 6.81 ft/s, 2.08 m/s

TEST DATE: 07/23/2014
TEST #: D142575

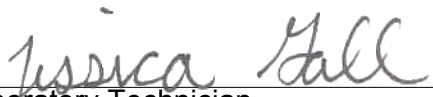


MGA RESEARCH CORPORATION
LEFT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D142576

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	N	4715 to 5782	5,443	Pass
Overall Test Results				Pass


Laboratory Technician

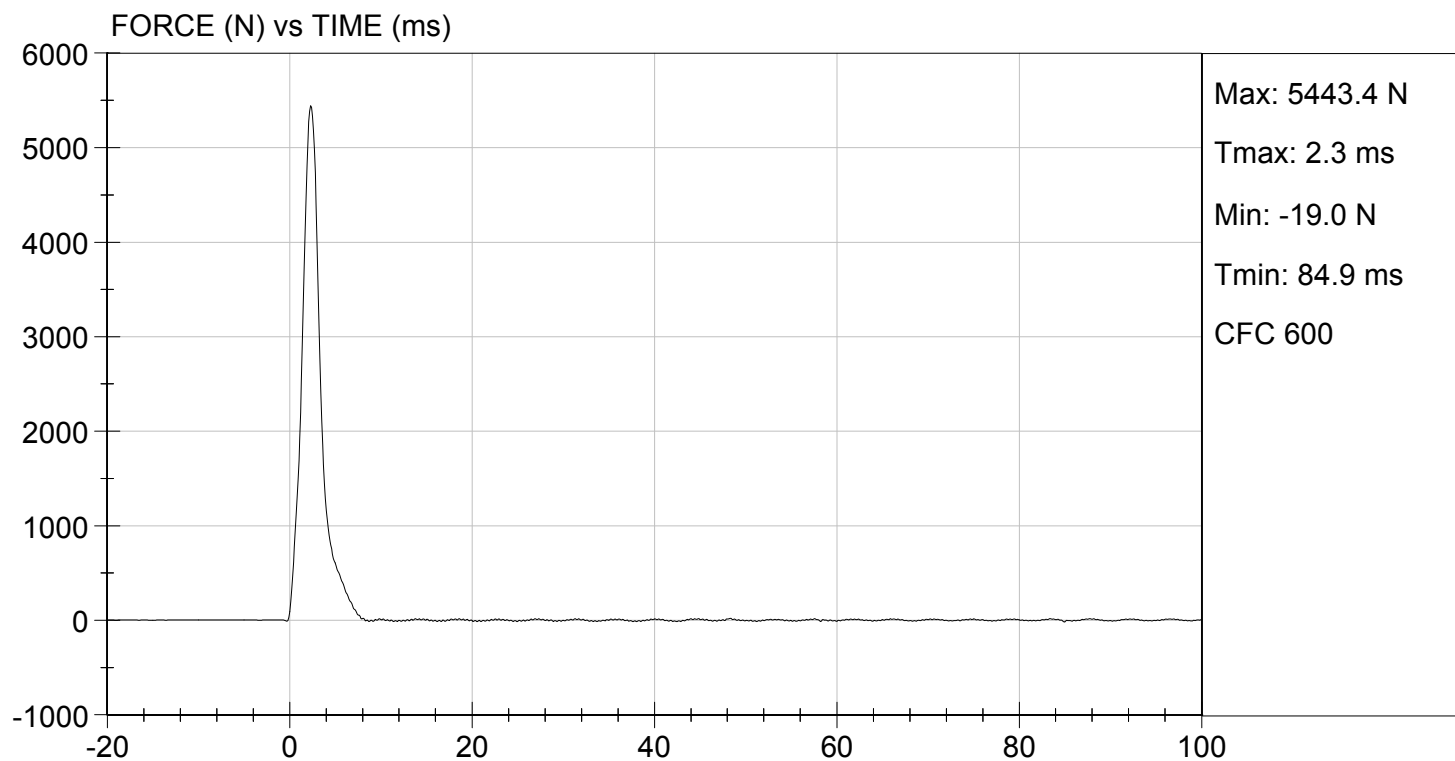
07/23/2014
Test Date


Approved By



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

TEST DATE: 07/23/2014
TEST #: D142576



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

ATD Serial No: 351

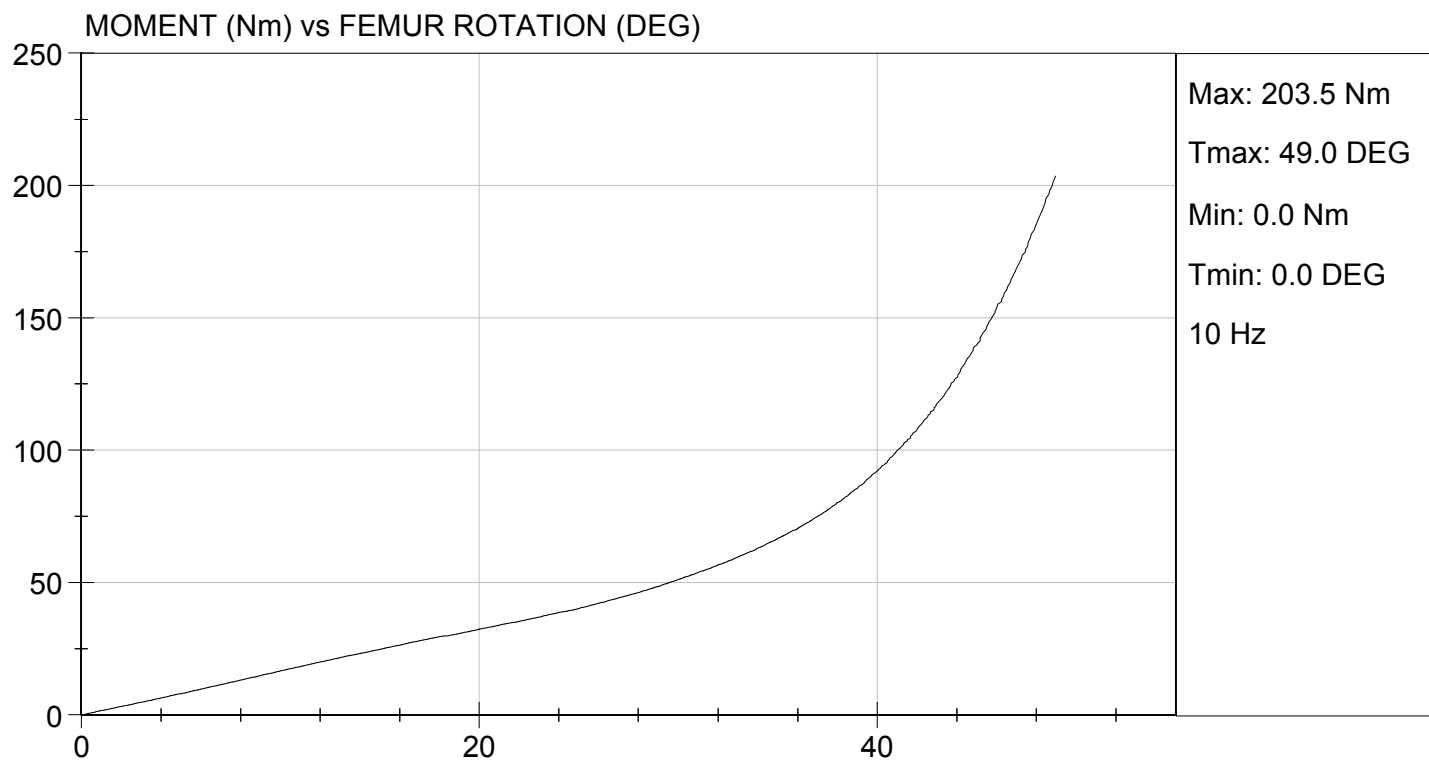
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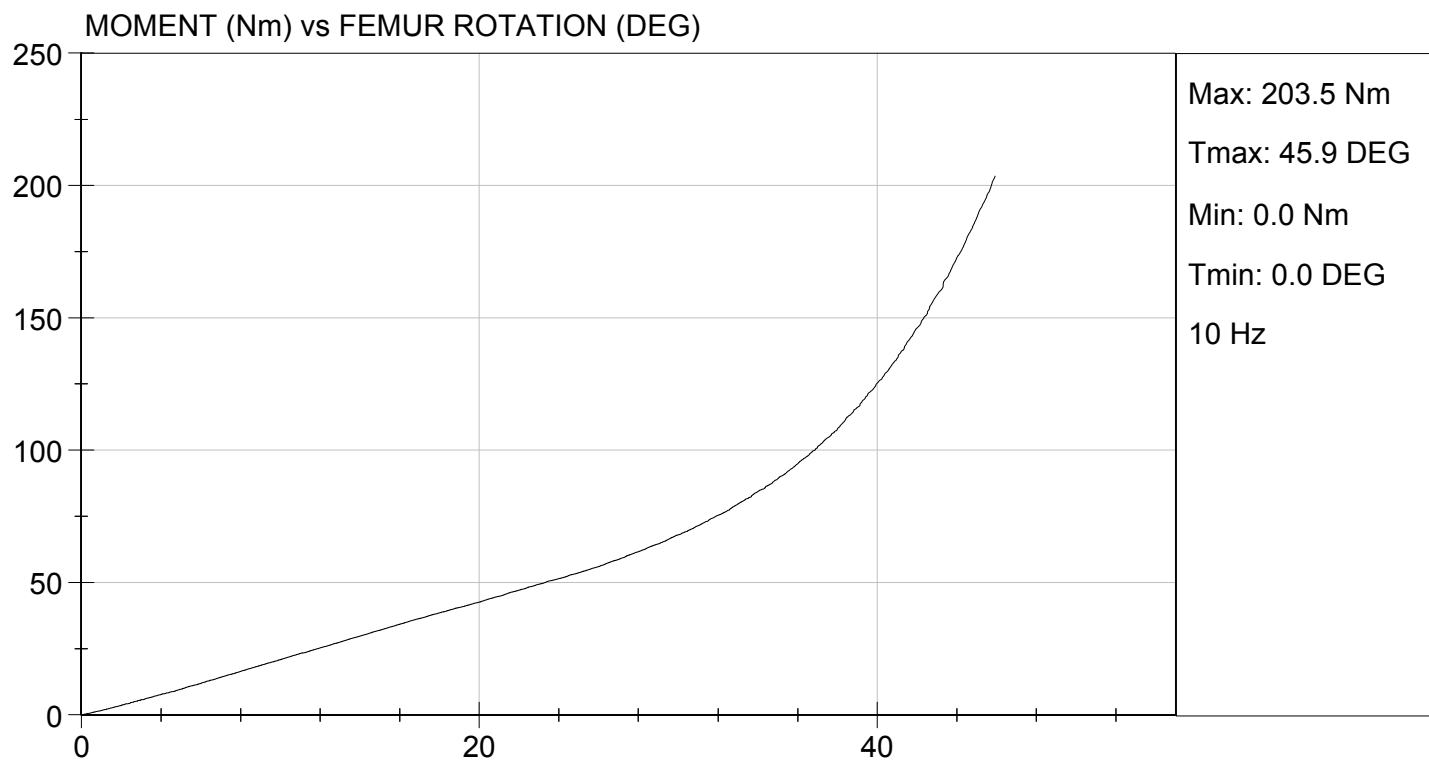
Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	20.9	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	46	46	Pass
Rotation Rate	deg/s	5.0 to 10.0	6.3	6.2	Pass
30 Degrees	Nm	94.9 Nm Max	51.1	68.0	Pass
150 ft-lbf / 203.4 Nm	Deg	40.0 to 50.0 Degree Max Rotation	49.0	45.9	Pass
Overall Test Results					Pass


 Laboratory Technician

07/23/2014
 Test Date


 Approved By





Hybrid III, 5th 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

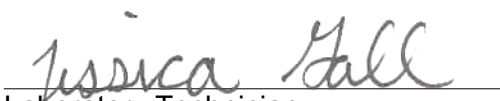
N	BUTTOCK POPLITEAL LENGTH	The rearmost surface of the lower leg to the same point on the rear surface of the buttocks used for dim. "K".	414-439.4	430.5
HYBRID III, SUBPART O EXTERNAL DIMENSIONS, continued				
DIMENSION	DESCRIPTION	DETAILS	ASSEMBLY DIMENSION (mm)	ACTUAL MEASUREMENT
O	CHEST DEPTH WITHOUT 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

Test ID: D142081

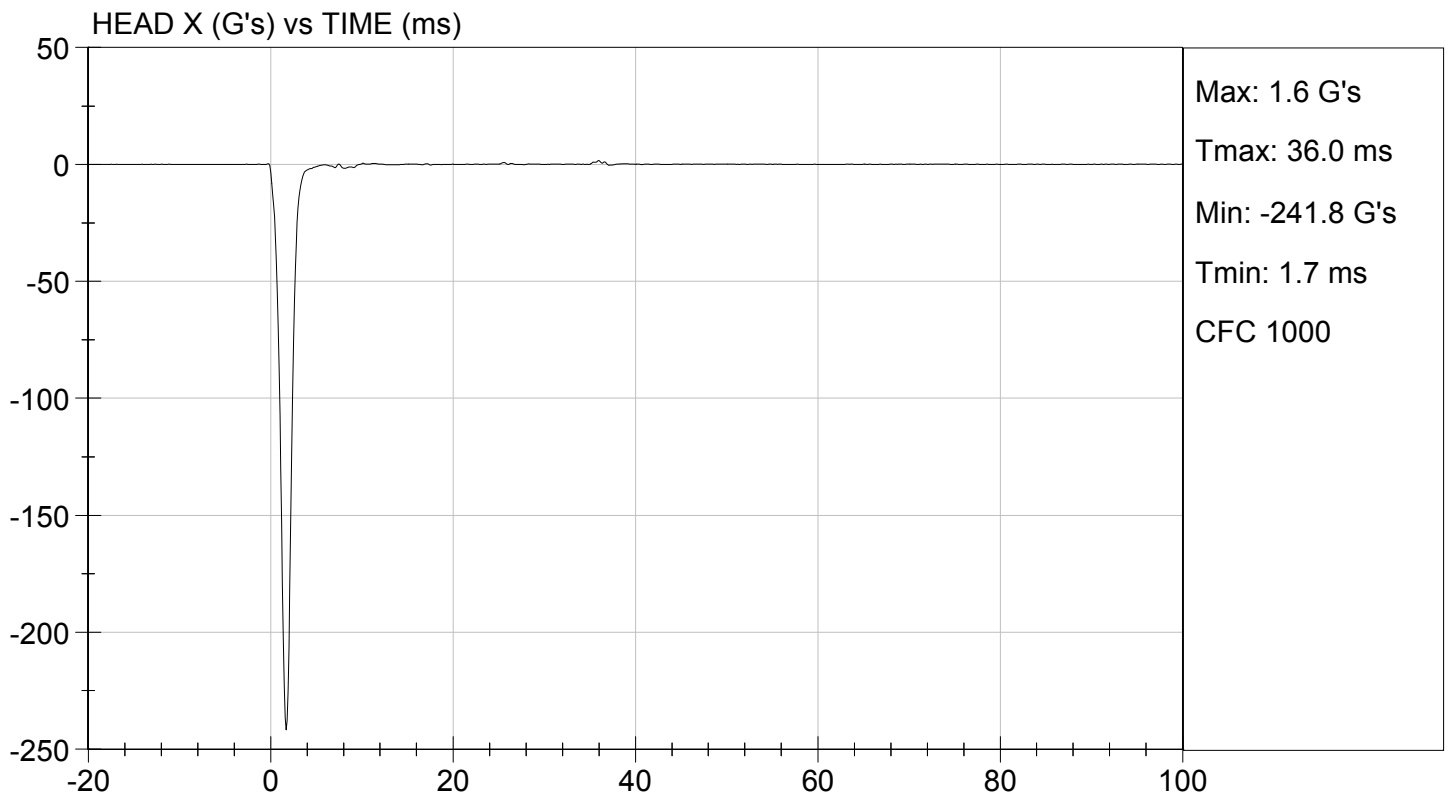
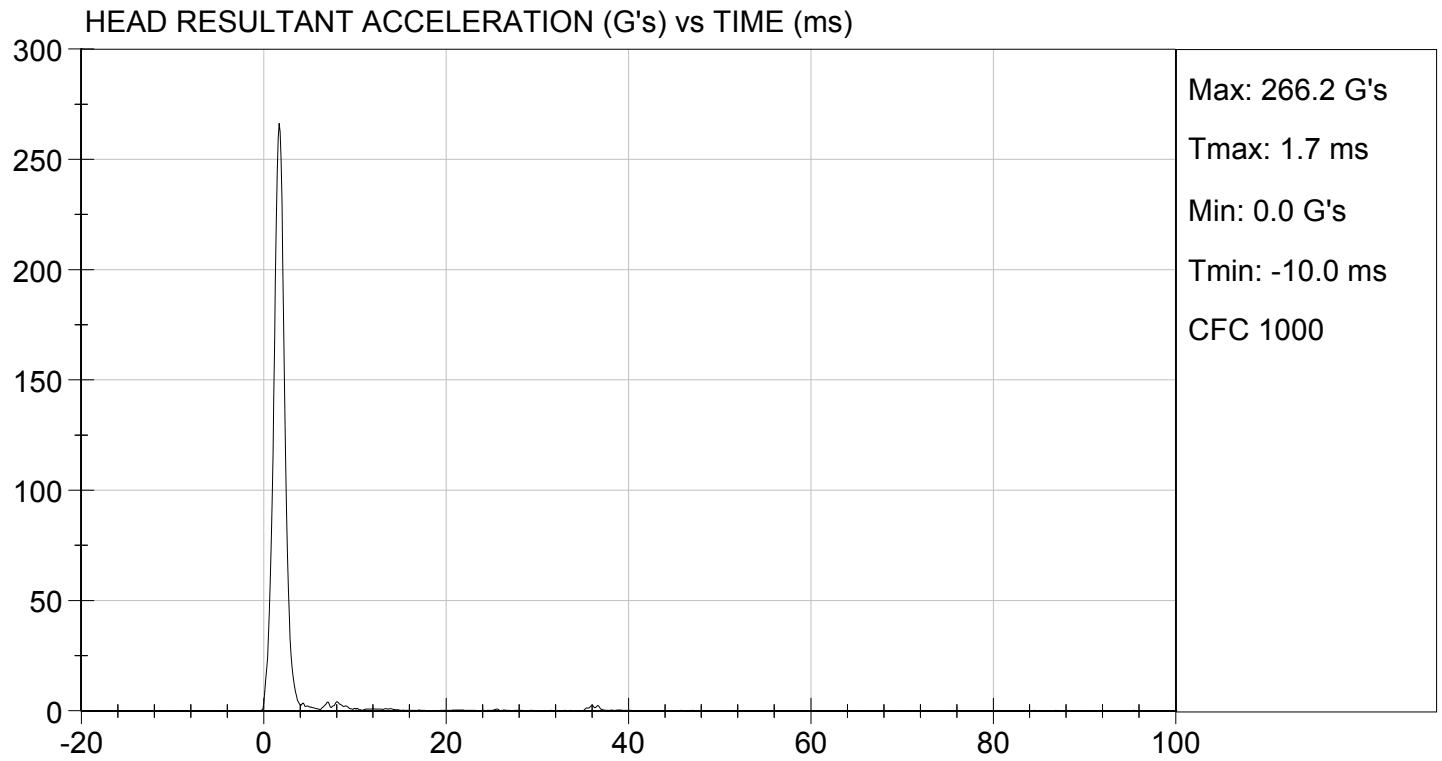
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Peak Resultant Acceleration	G's	250 to 300	266	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-11.0	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

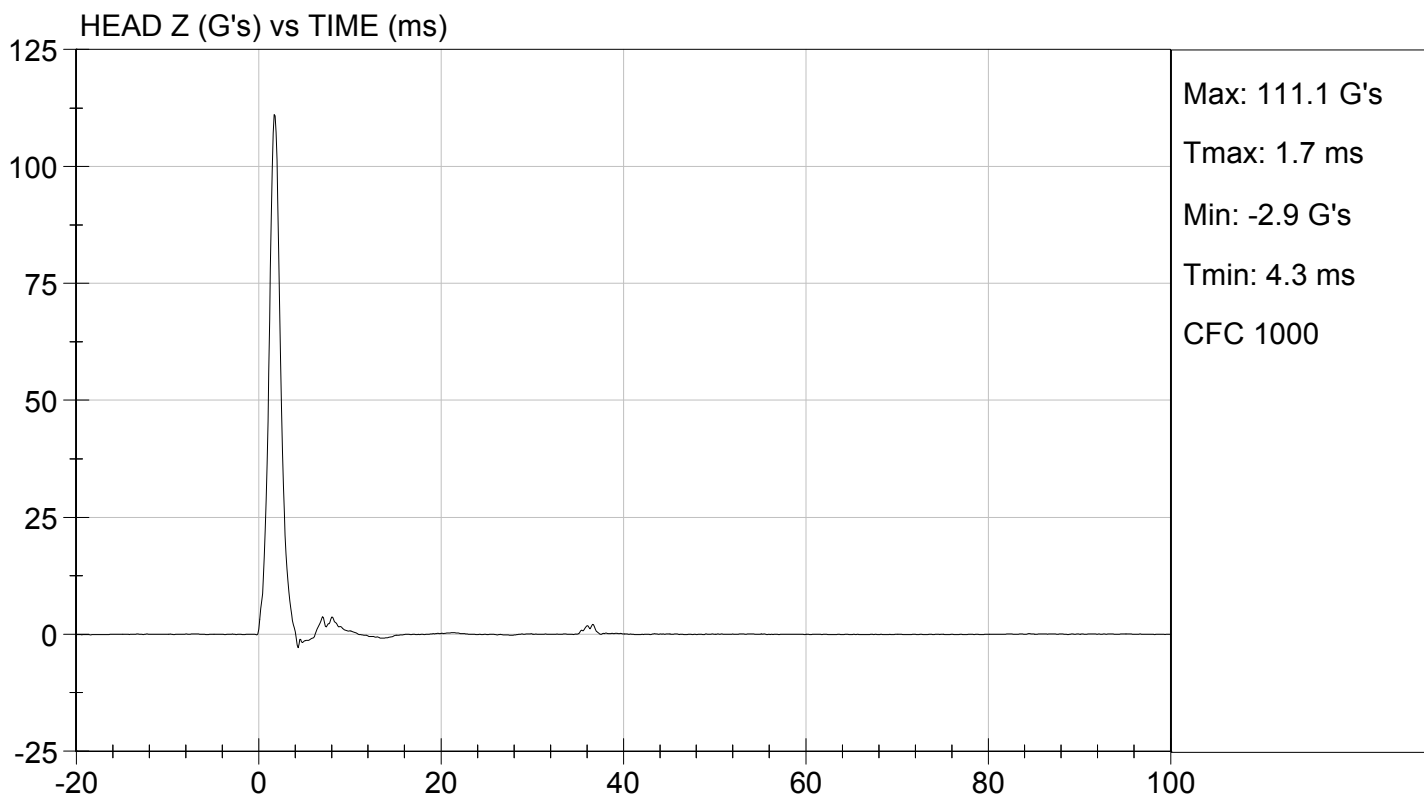
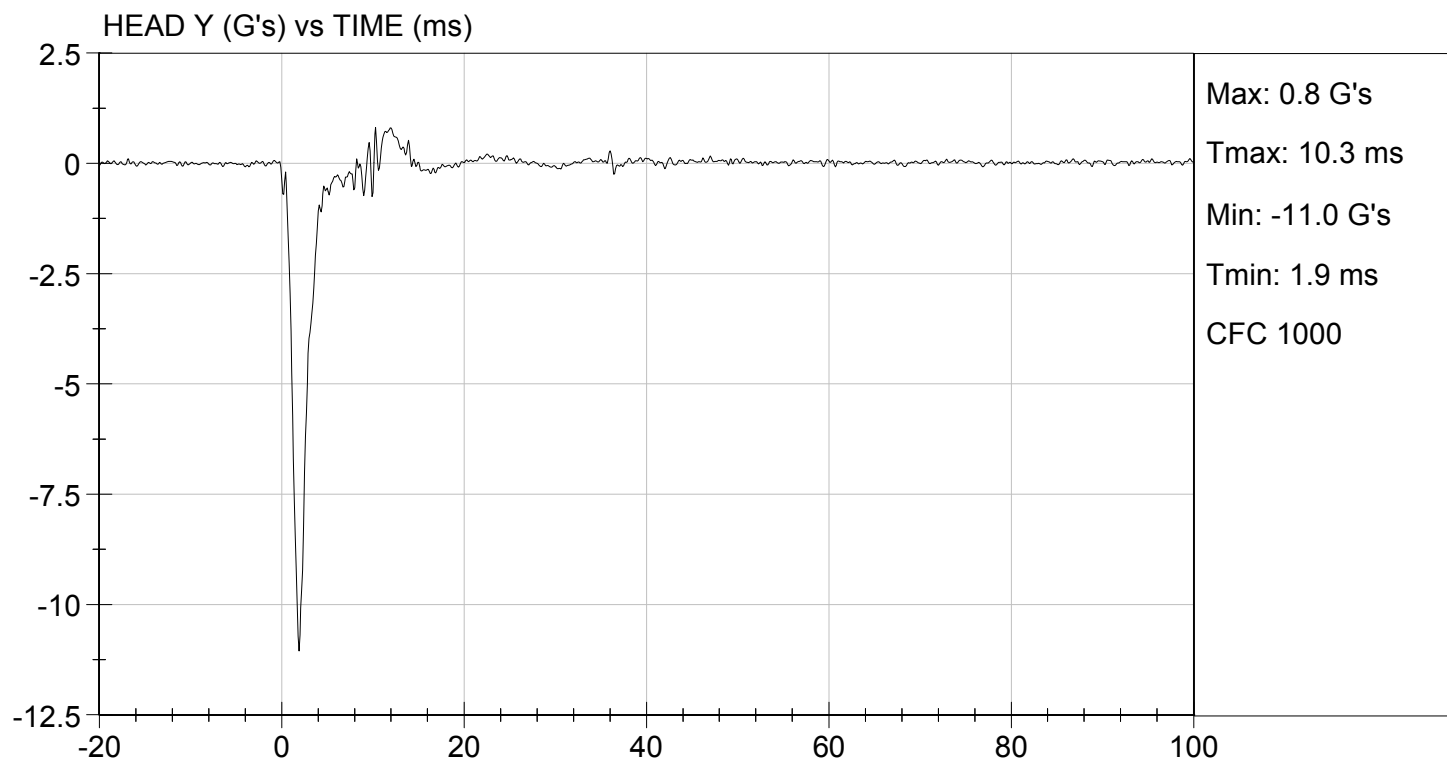

Laboratory Technician

06/05/2014

Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142082

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	42	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.13	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.5	Pass
	30 ms	m/s	5.8 to 7.0	6.0	Pass
D Plane Rotation	Max	deg	77 to 91	81	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	72	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	88	Pass
Overall Results					Pass

Jessica Hall
Laboratory Technician

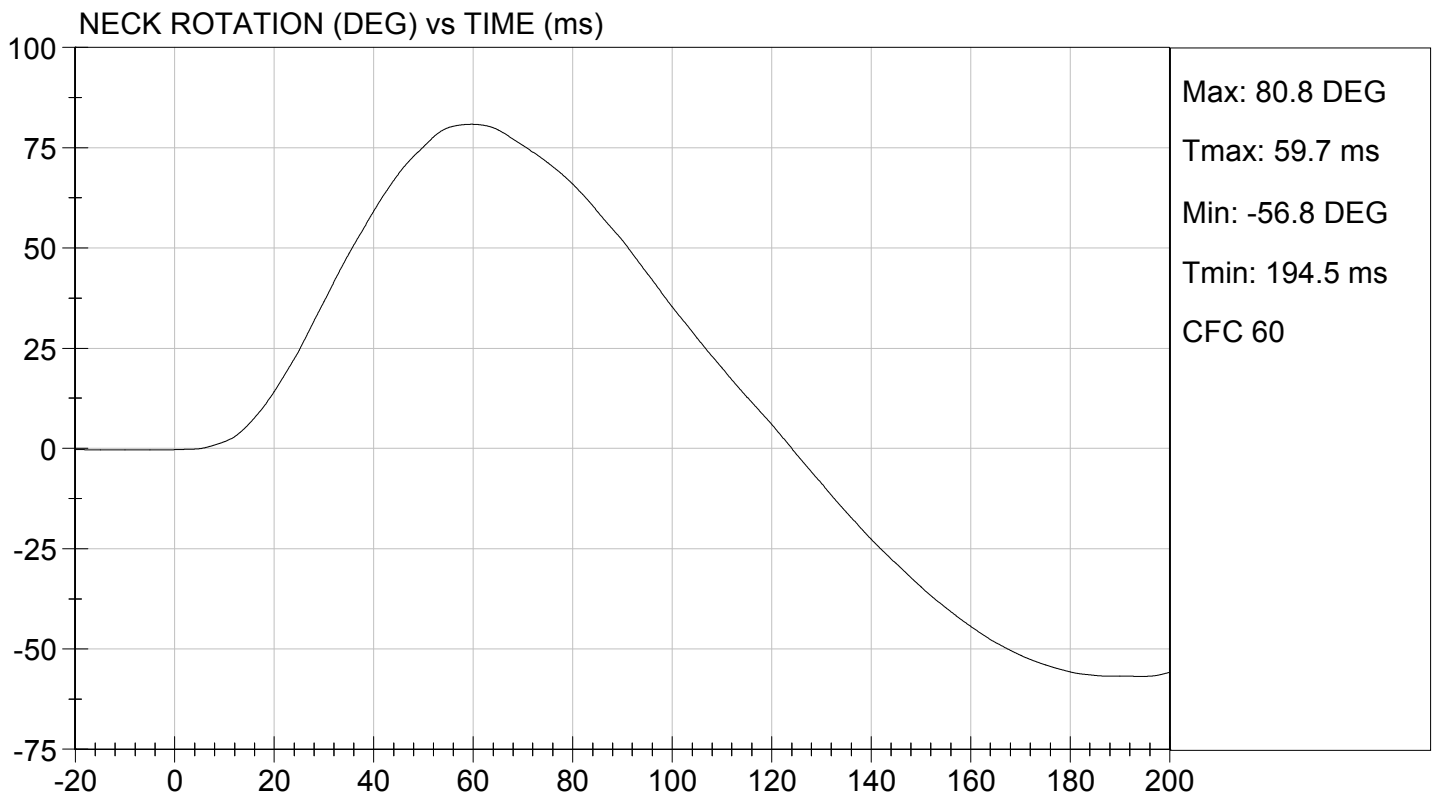
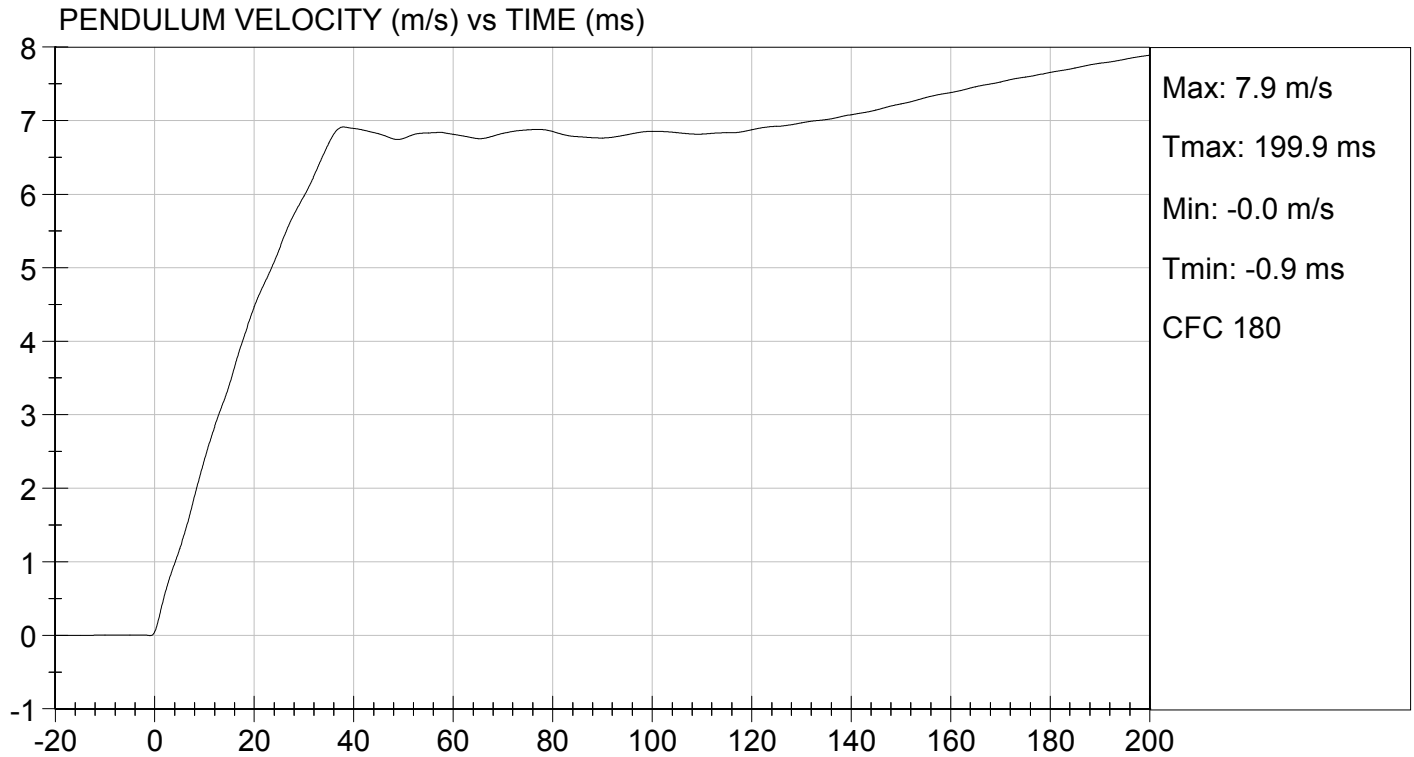
06/05/2014
Test Date

David Winkelbauer
Approved By



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

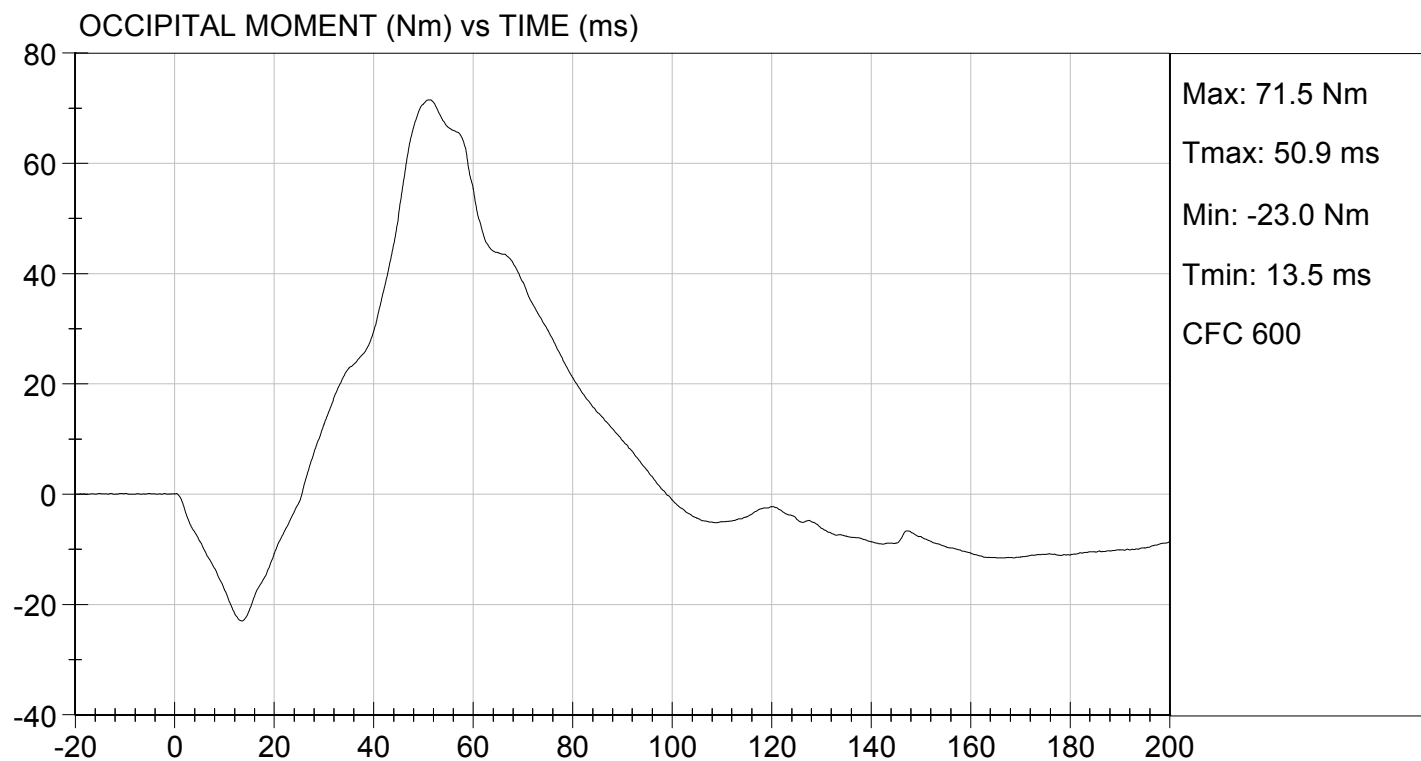
TEST DATE: 06/05/2014
TEST #: D142082





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

TEST DATE: 06/05/2014
TEST #: D142082

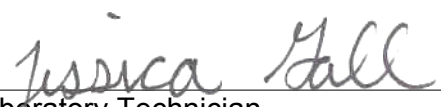


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142083

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	42	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.18	Pass
Pendulum Velocity	10 ms	m/s	1.5 to 1.9	1.6	Pass
	20 ms	m/s	3.1 to 3.9	3.4	Pass
	30 ms	m/s	4.6 to 5.6	4.9	Pass
D Plane Rotation	Max	deg	99 to 114	110	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-55	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	102	Pass
Overall Results					Pass


 Laboratory Technician

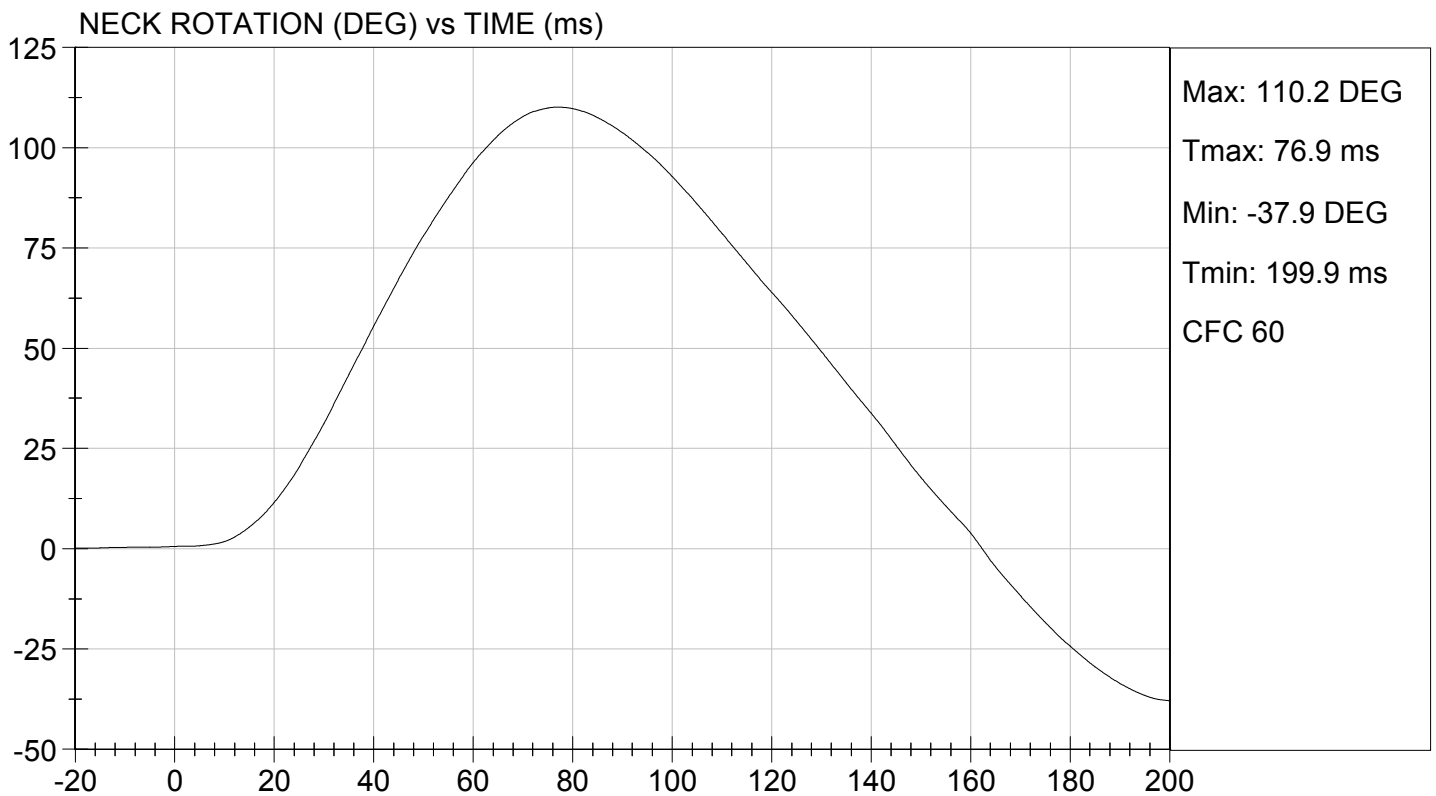
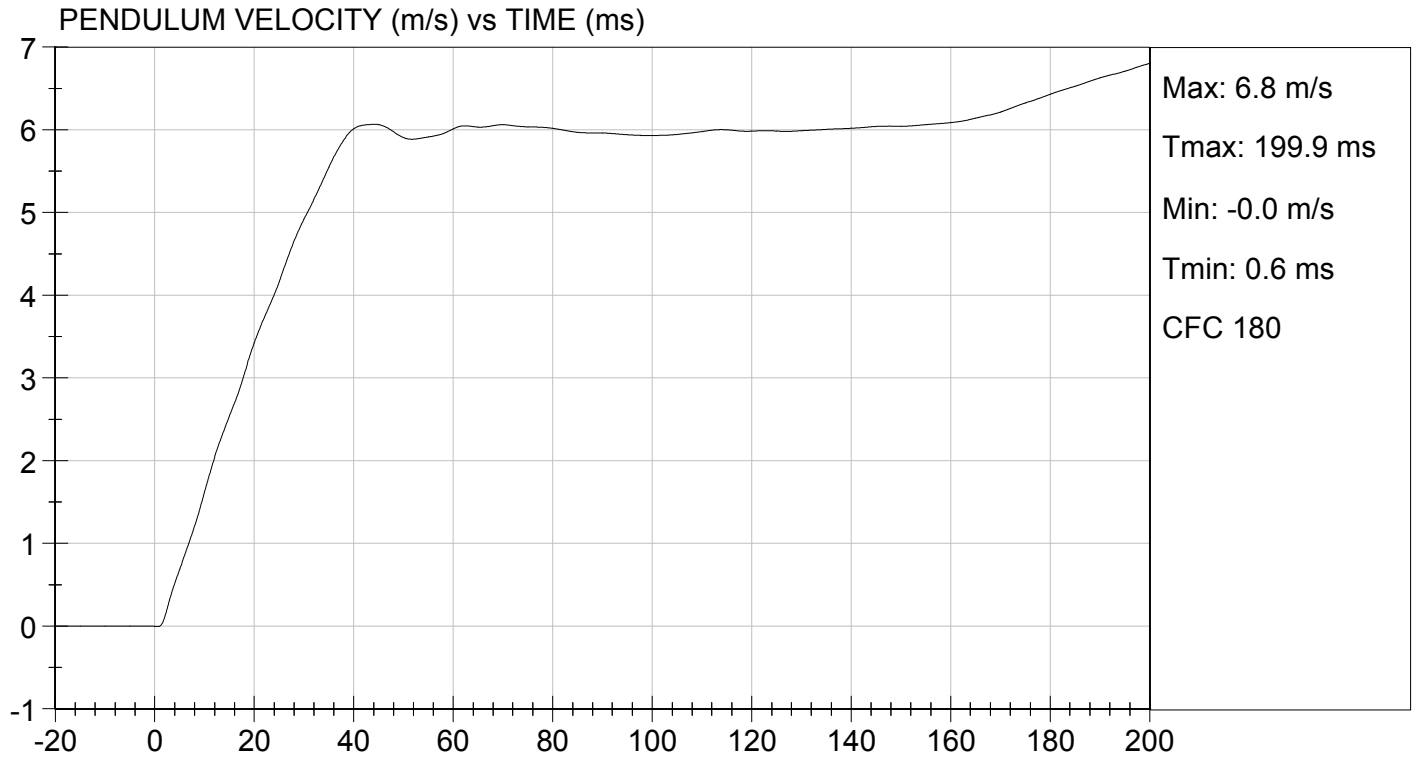
06/05/2014
 Test Date


 Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 20.30 ft/s, 6.18 m/s

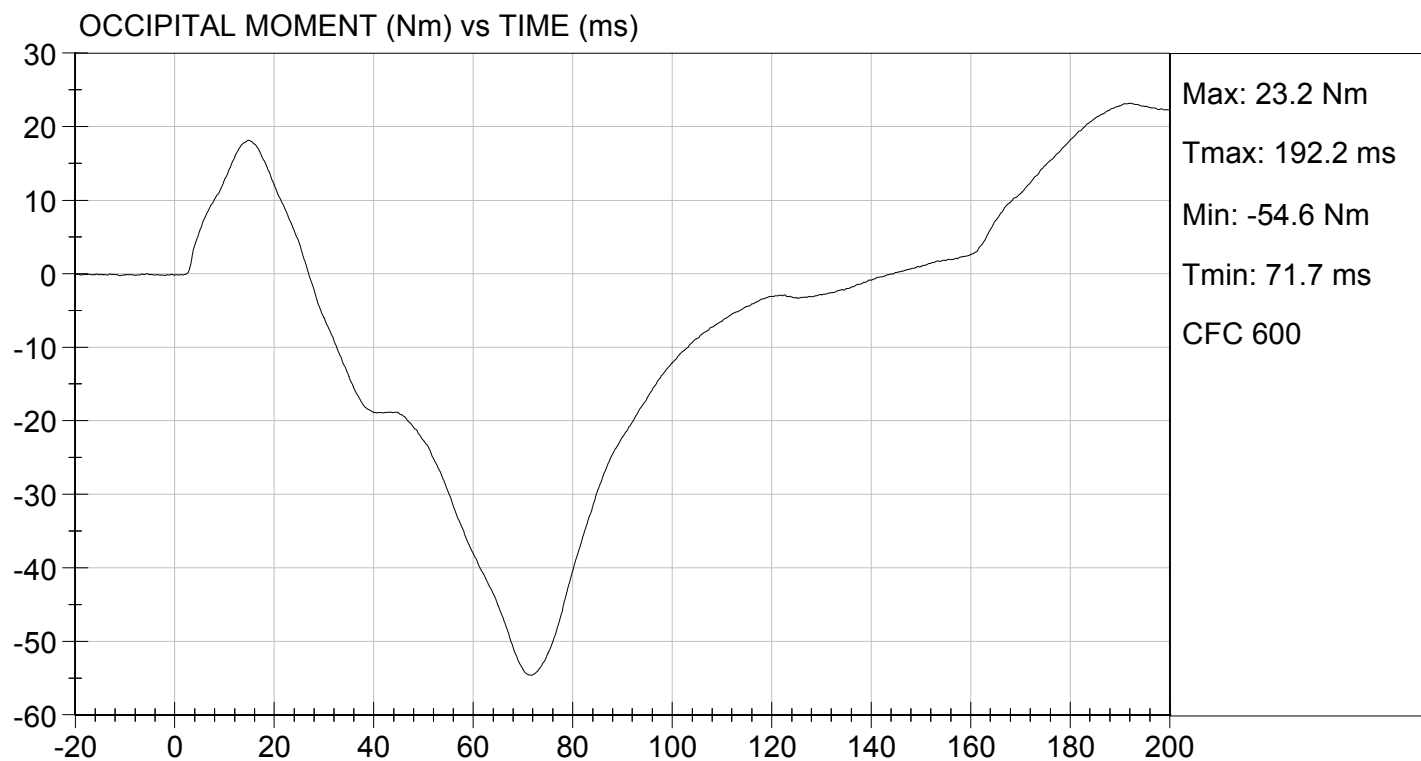
TEST DATE: 06/05/2014
TEST #: D142083





TEST DESC: NECK EXTENSION
VELOCITY: 20.30 ft/s, 6.18 m/s

TEST DATE: 06/05/2014
TEST #: D142083



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142084

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Relative Humidity	%	10 to 70	49	Pass
Probe Speed	m/s	6.59 to 6.83	6.60	Pass
Peak Deflection	mm	50 to 58	57	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4134	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4011	Pass
Overall Test Results				Pass


Laboratory Technician

06/06/2014

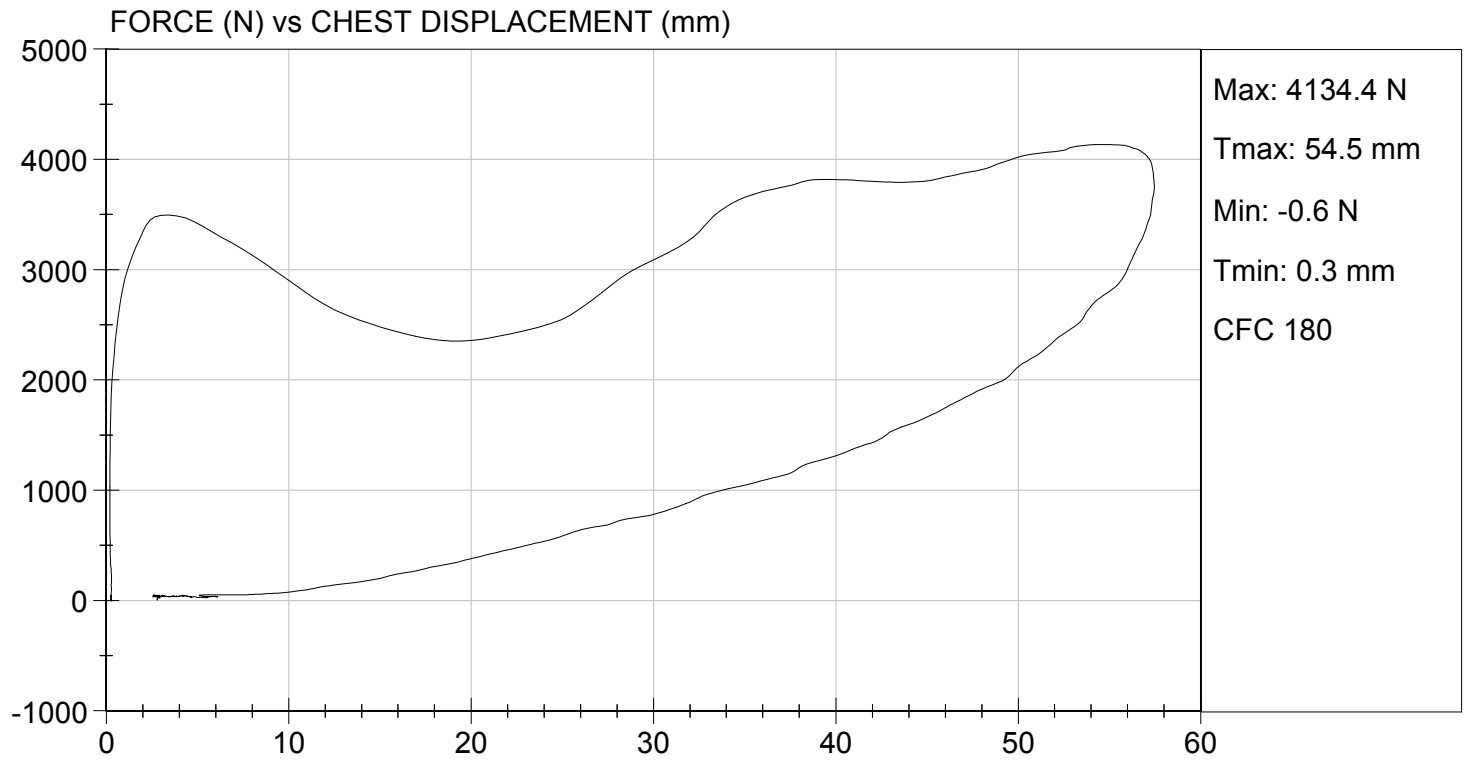
Test Date


Approved By



TEST DESC: THORAX IMPACT
VELOCITY: 21.65 ft/s, 6.60 m/s

TEST DATE: 06/06/2014
TEST #: D142084



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142085

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	50	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3645	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

06/06/2014

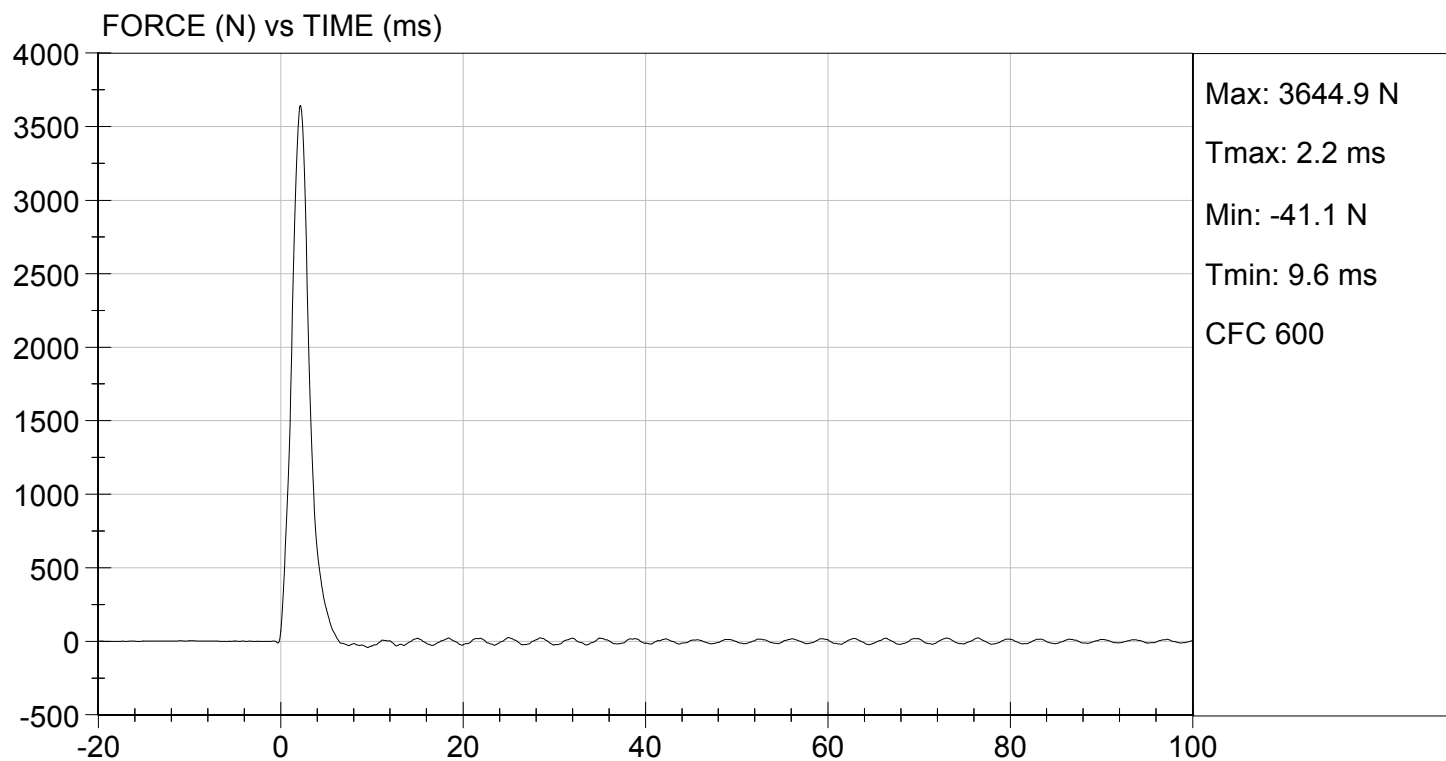
Test Date

David Winkelbauer
Approved By



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

TEST DATE: 06/06/2014
TEST #: D142085



MGA RESEARCH CORPORATION

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

ATD Serial No: 138

Test I.D: D142086

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	50	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3547	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

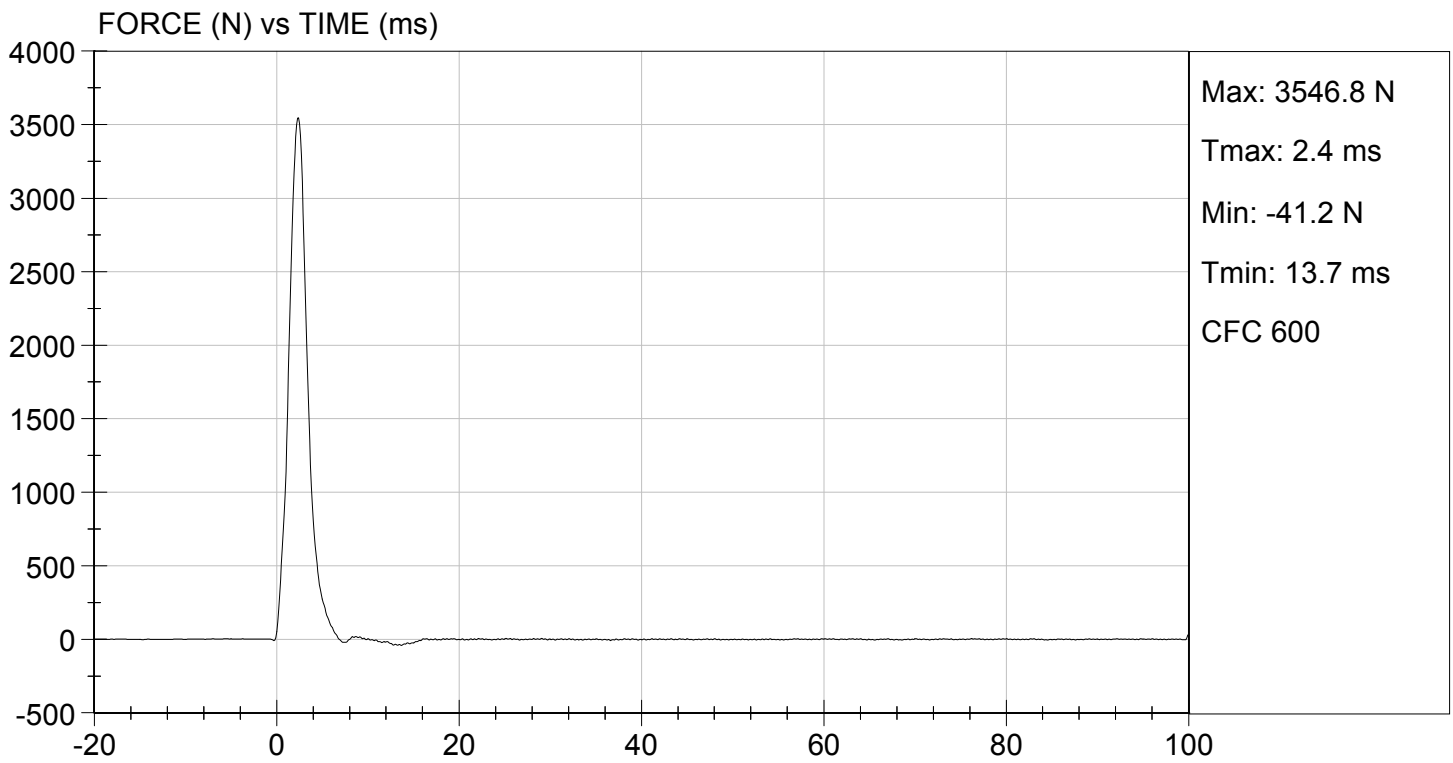
06/06/2014
Test Date

David Winkelbauer
Approved By



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

TEST DATE: 06/06/2014
TEST #: D142086



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142087

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	43	Pass
Initial Angle	deg	0 to 20	19	Pass
Return Angle	deg	+/- 8	1	Pass
Force at 45 deg	N	320 to 390	378	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result				Pass

Jessica Hall
Laboratory Technician

06/05/2014

Test Date

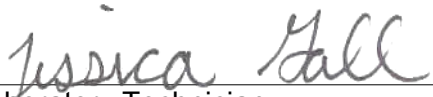
David Winkelbauer
Approved By

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test ID: D142581

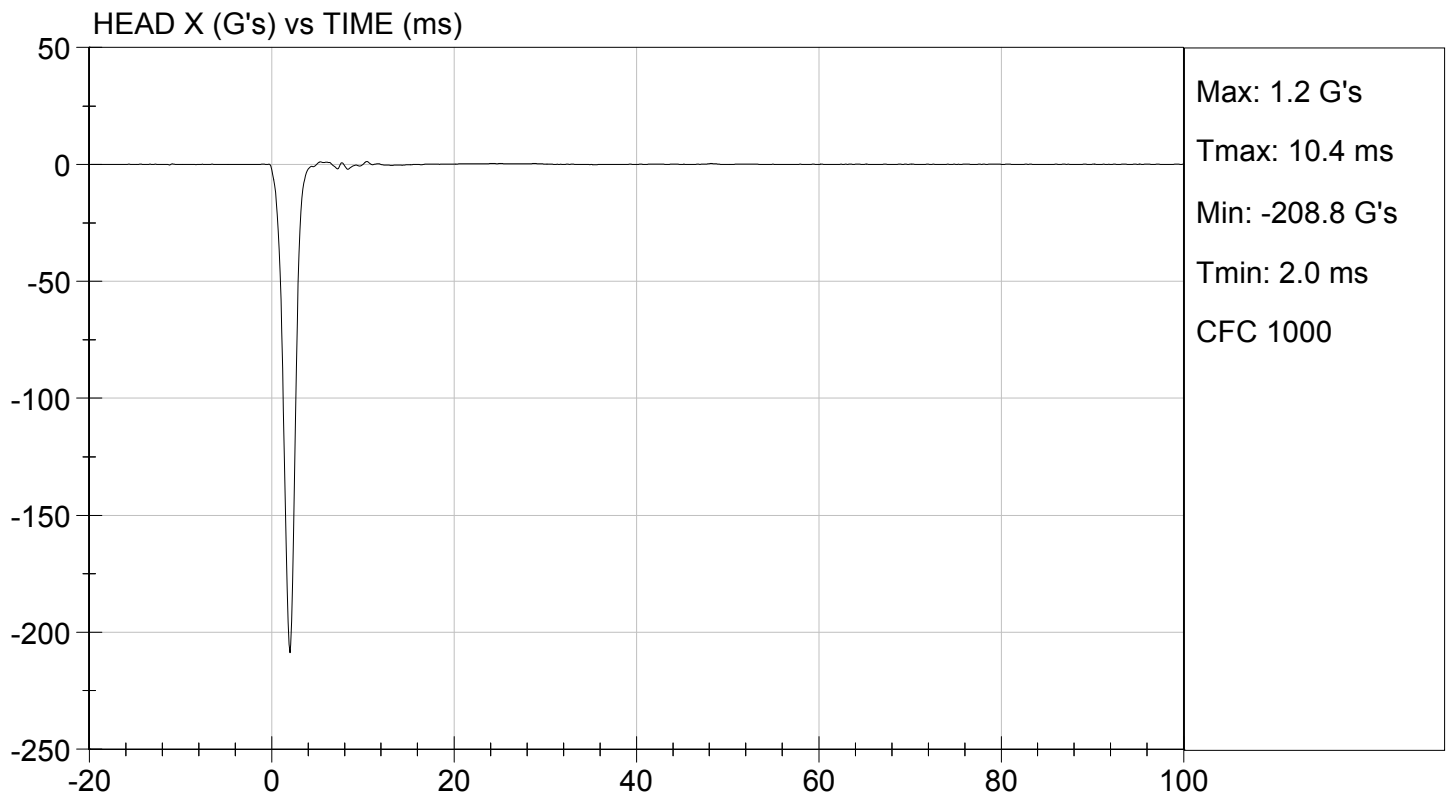
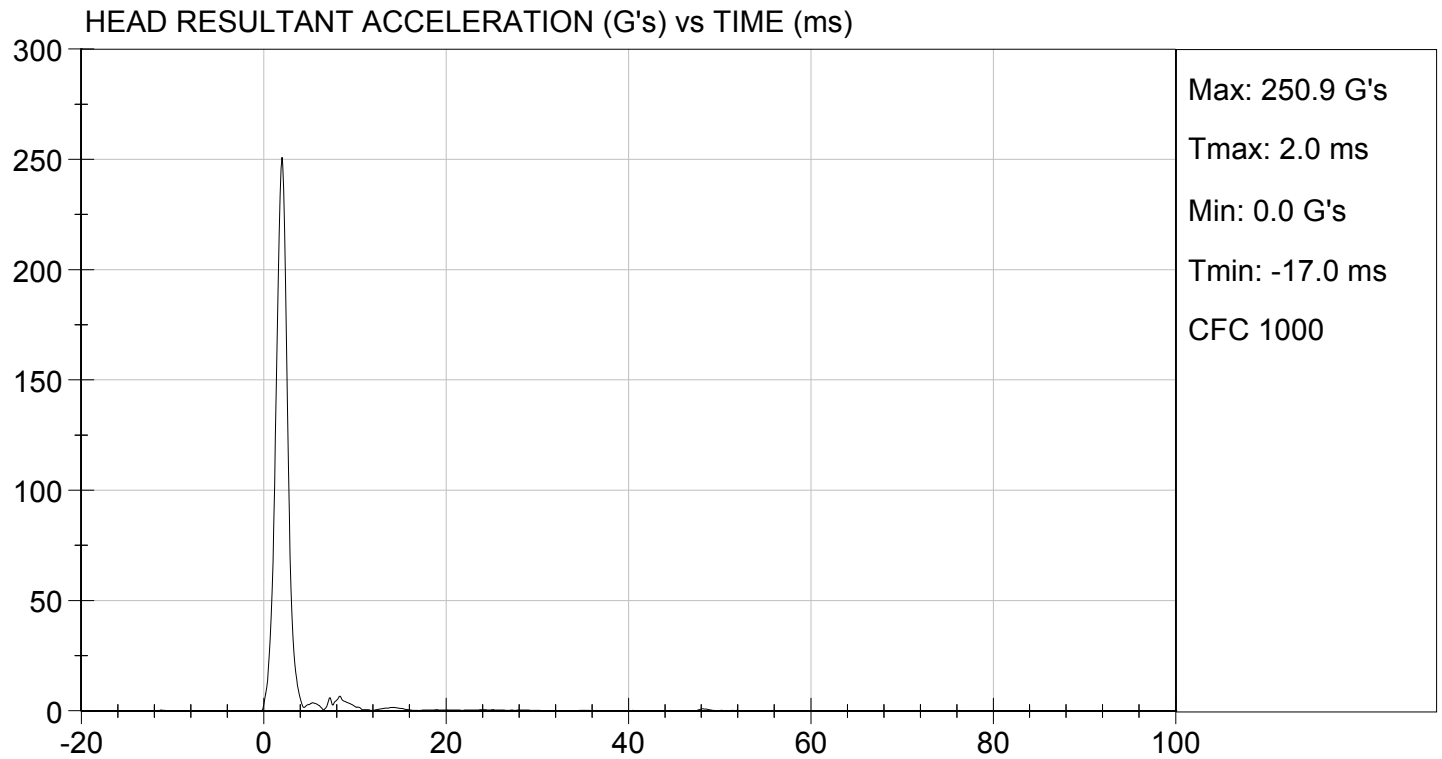
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Peak Resultant Acceleration	G's	250 to 300	251	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-8.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
			Overall Test Results	Pass

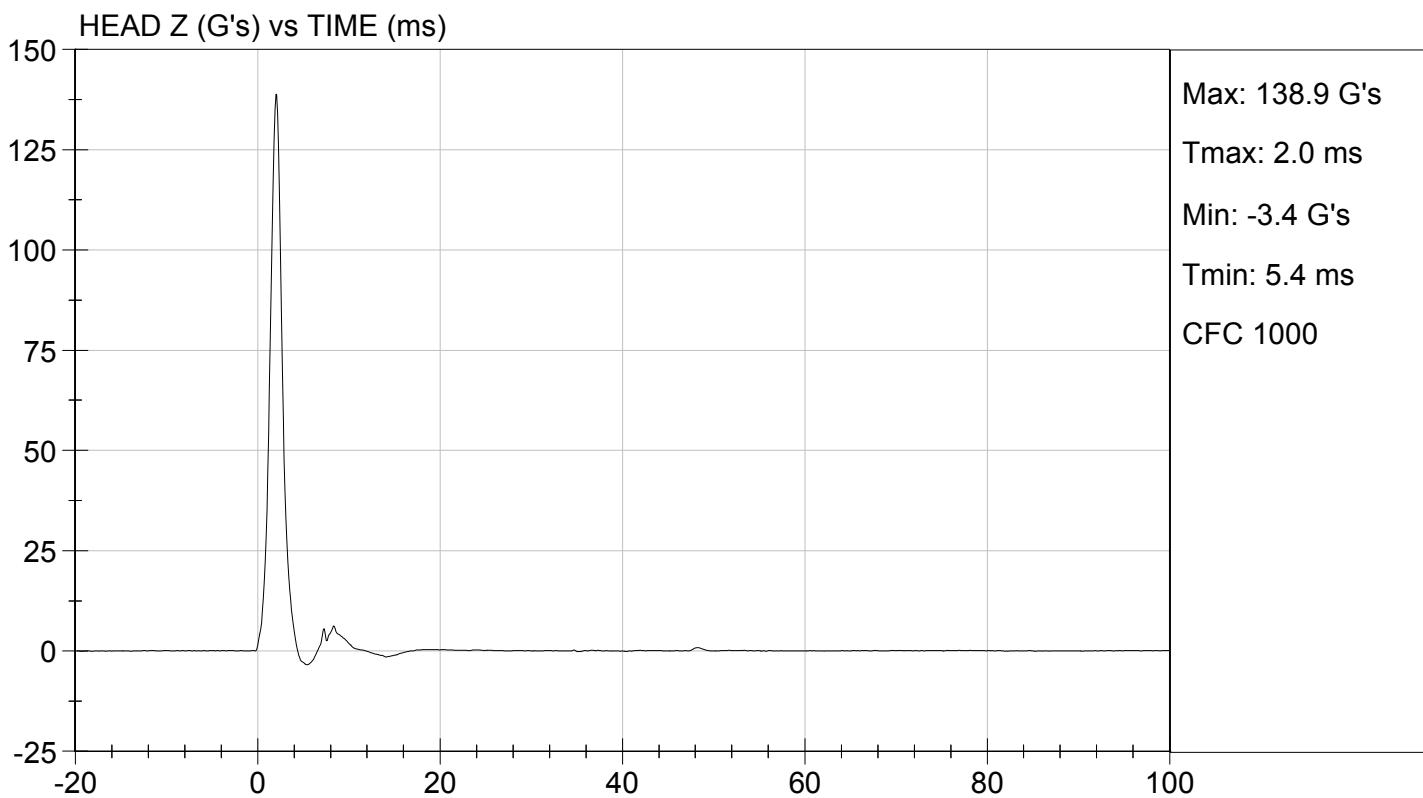
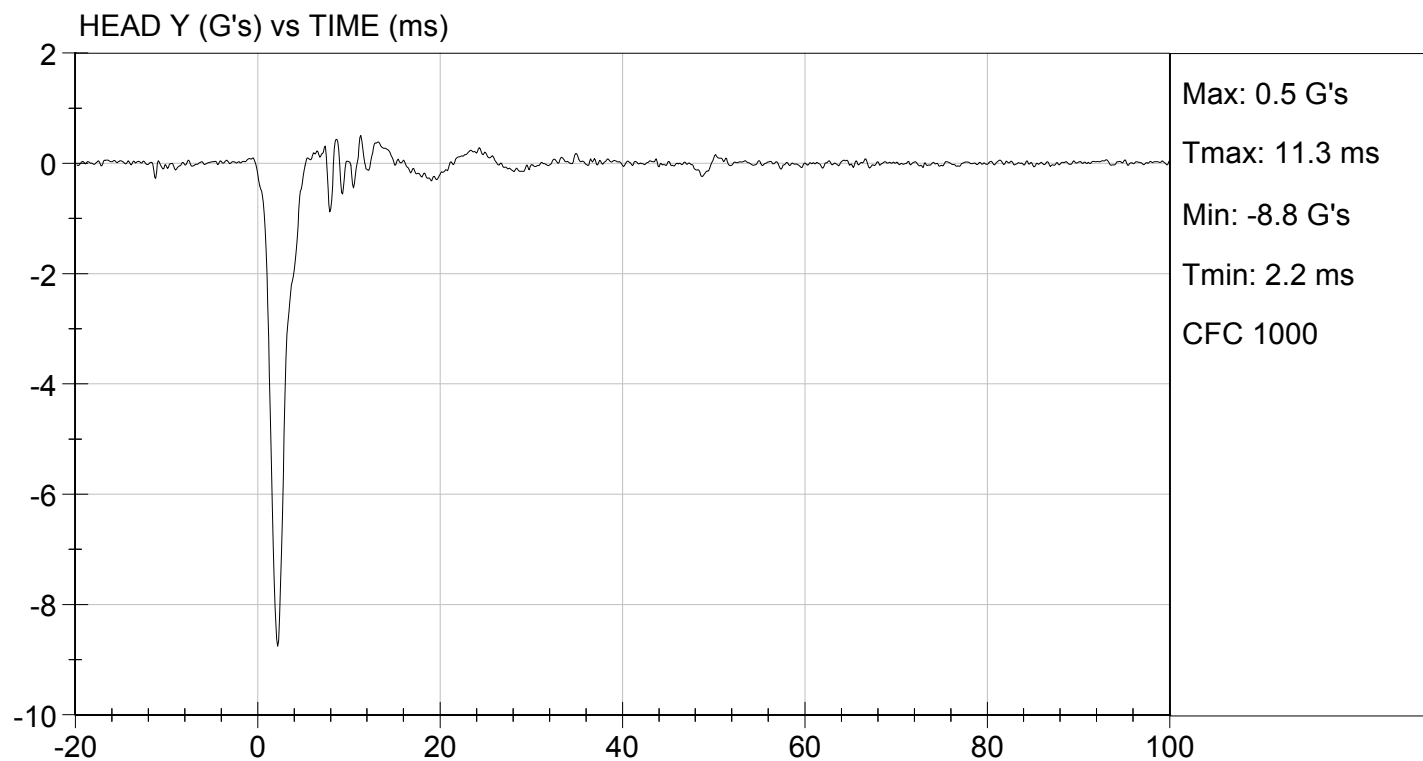

Laboratory Technician

07/23/2014

Test Date


Approved By





MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142582

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	46	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Velocity	10 ms	m/s	2.1 to 2.5	2.4	Pass
	20 ms	m/s	4.0 to 5.0	4.2	Pass
	30 ms	m/s	5.8 to 7.0	6.0	Pass
D Plane Rotation	Max	deg	77 to 91	83	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	69 to 83	72	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	83	Pass
Overall Results				Pass	


Laboratory Technician

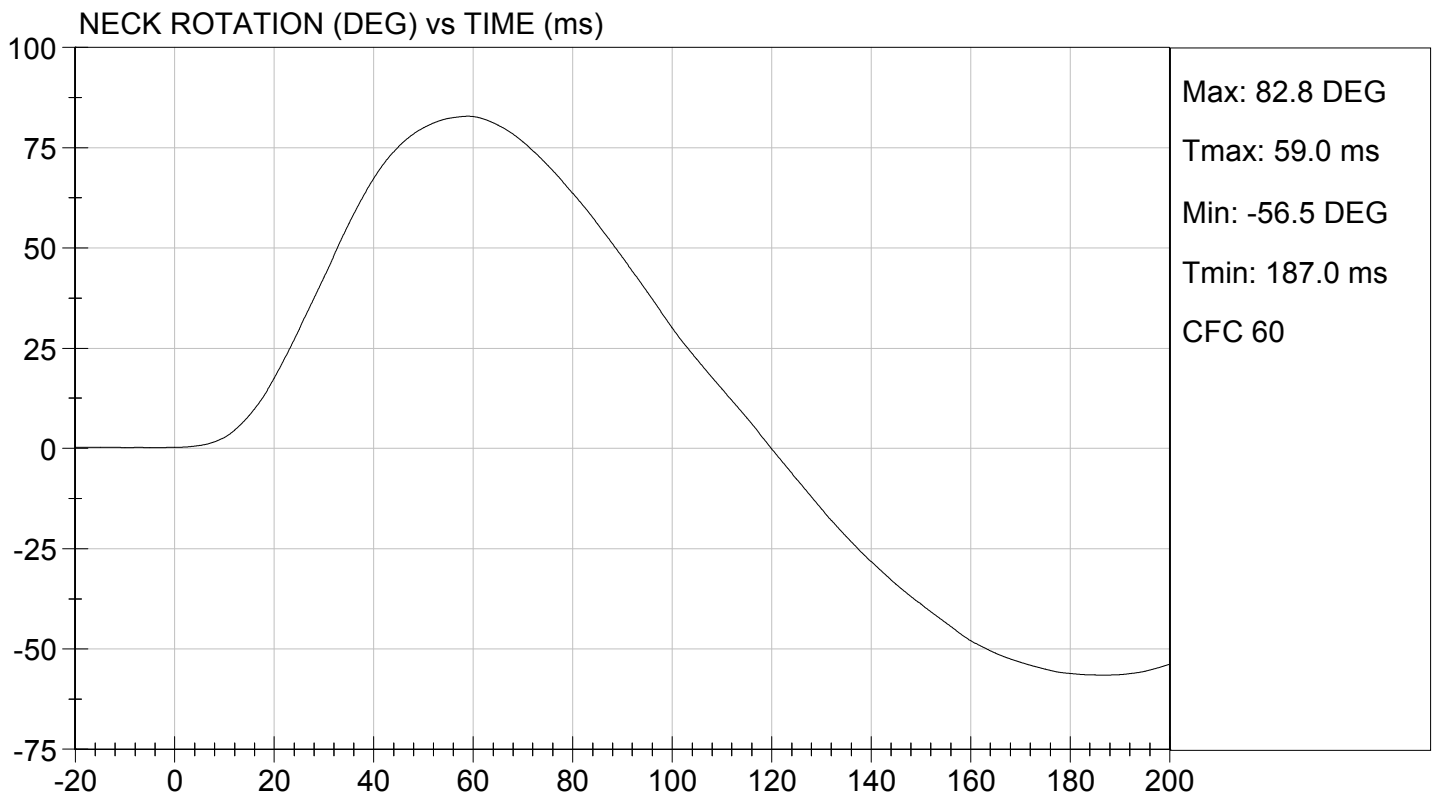
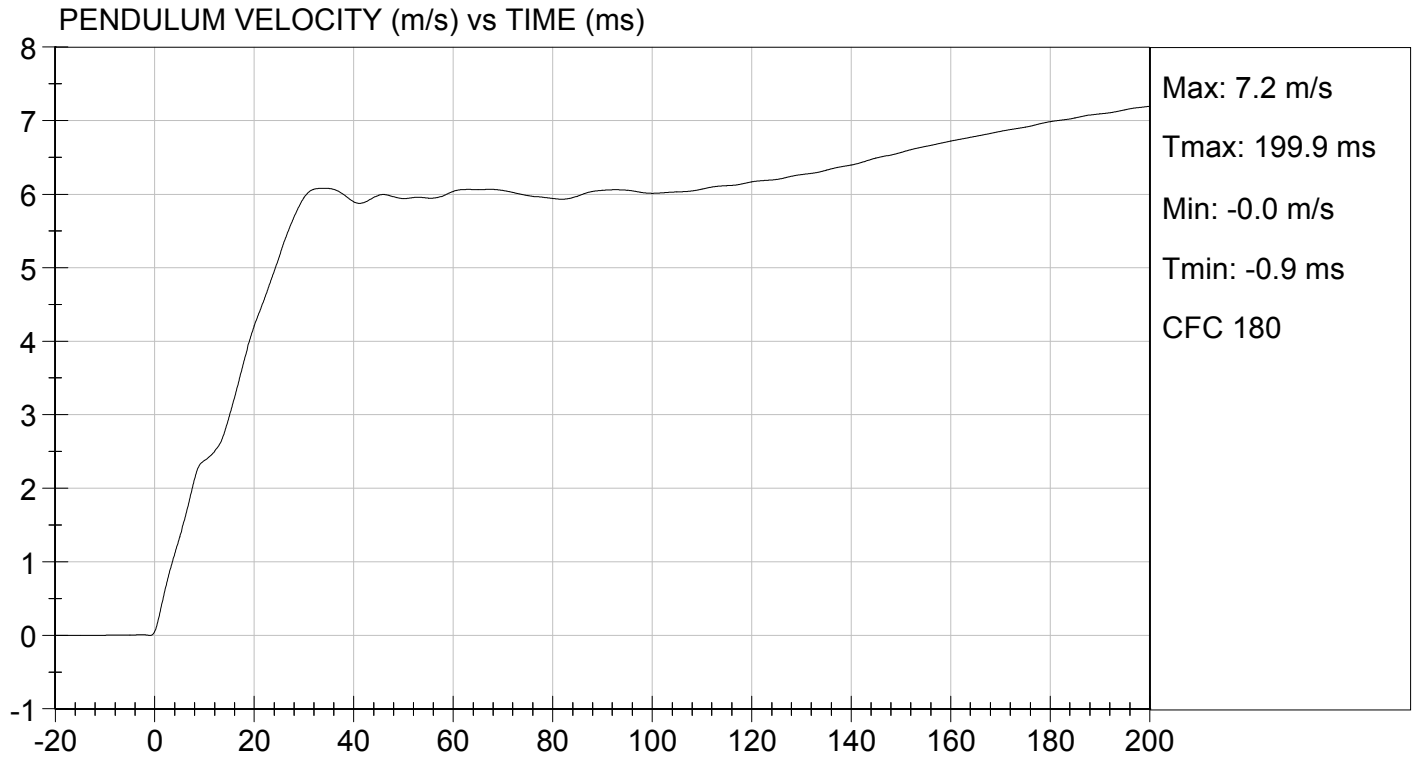
07/24/2014
Test Date


Approved By



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

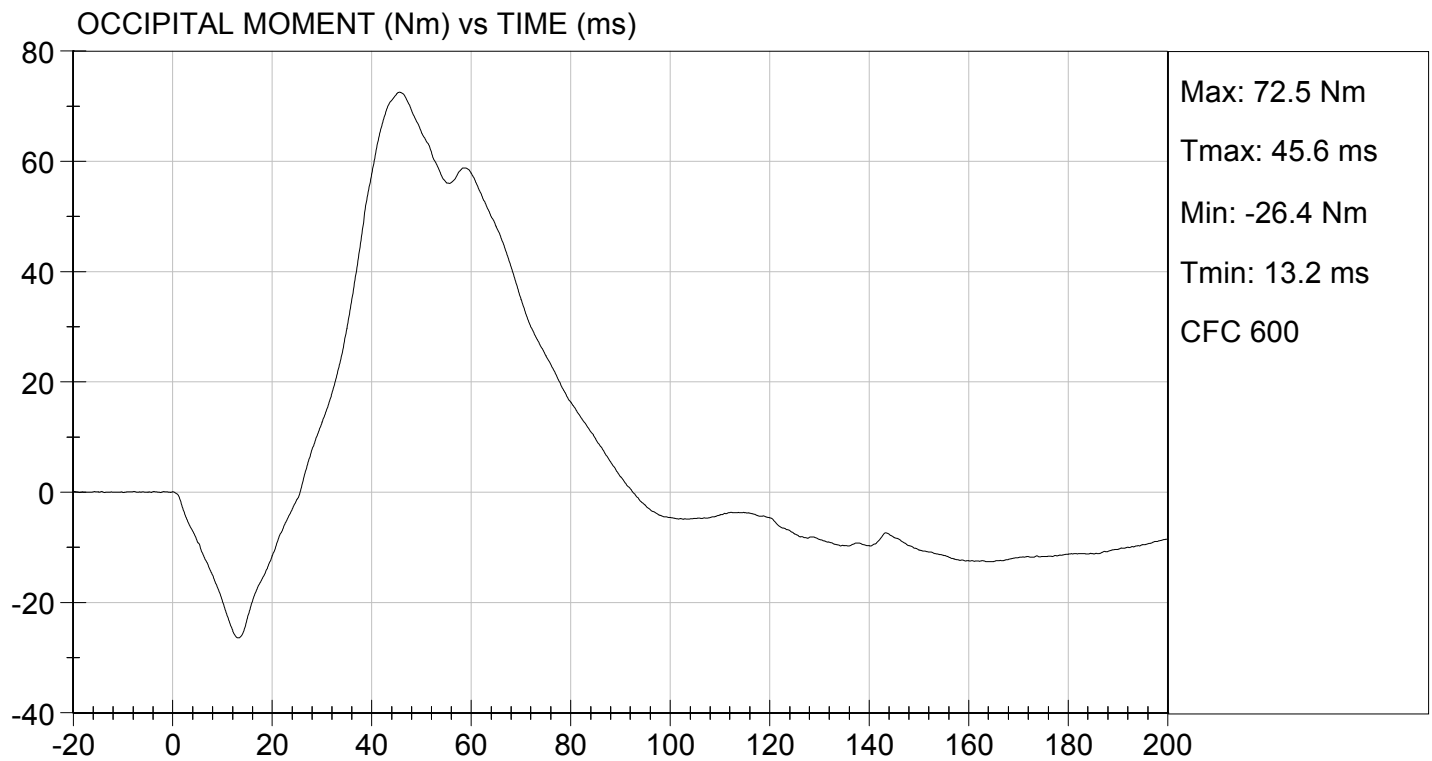
TEST DATE: 07/24/2014
TEST #: D142582





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

TEST DATE: 07/24/2014
TEST #: D142582

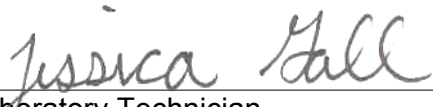


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142583

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity		%	10 to 70	46	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.18	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	5.1	Pass
D Plane Rotation	Max	deg	99 to 114	110	Pass
Occipital Condyle Moment within Rotation Corridor		Nm	-65 to -53	-56	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	99	Pass
Overall Results					Pass


 Laboratory Technician

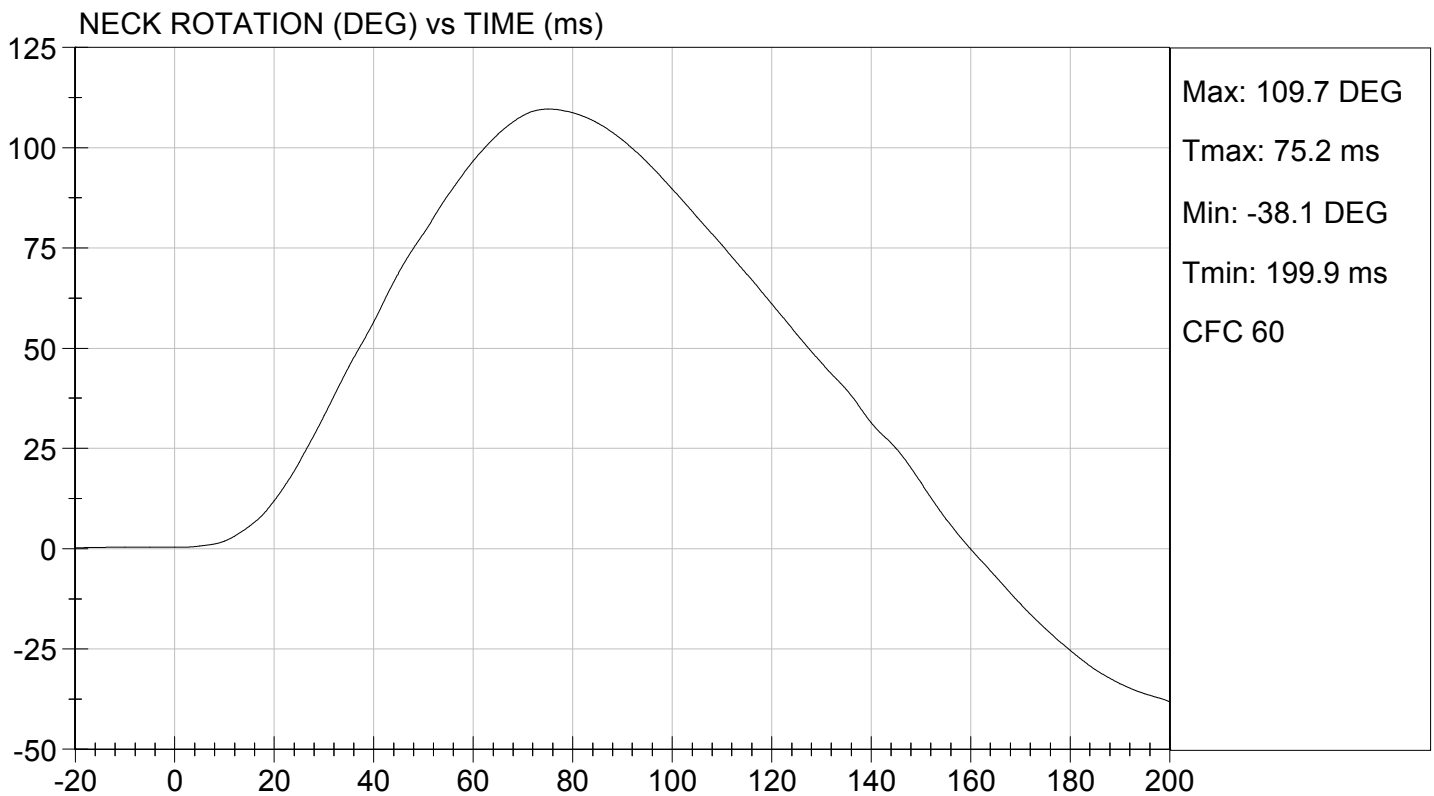
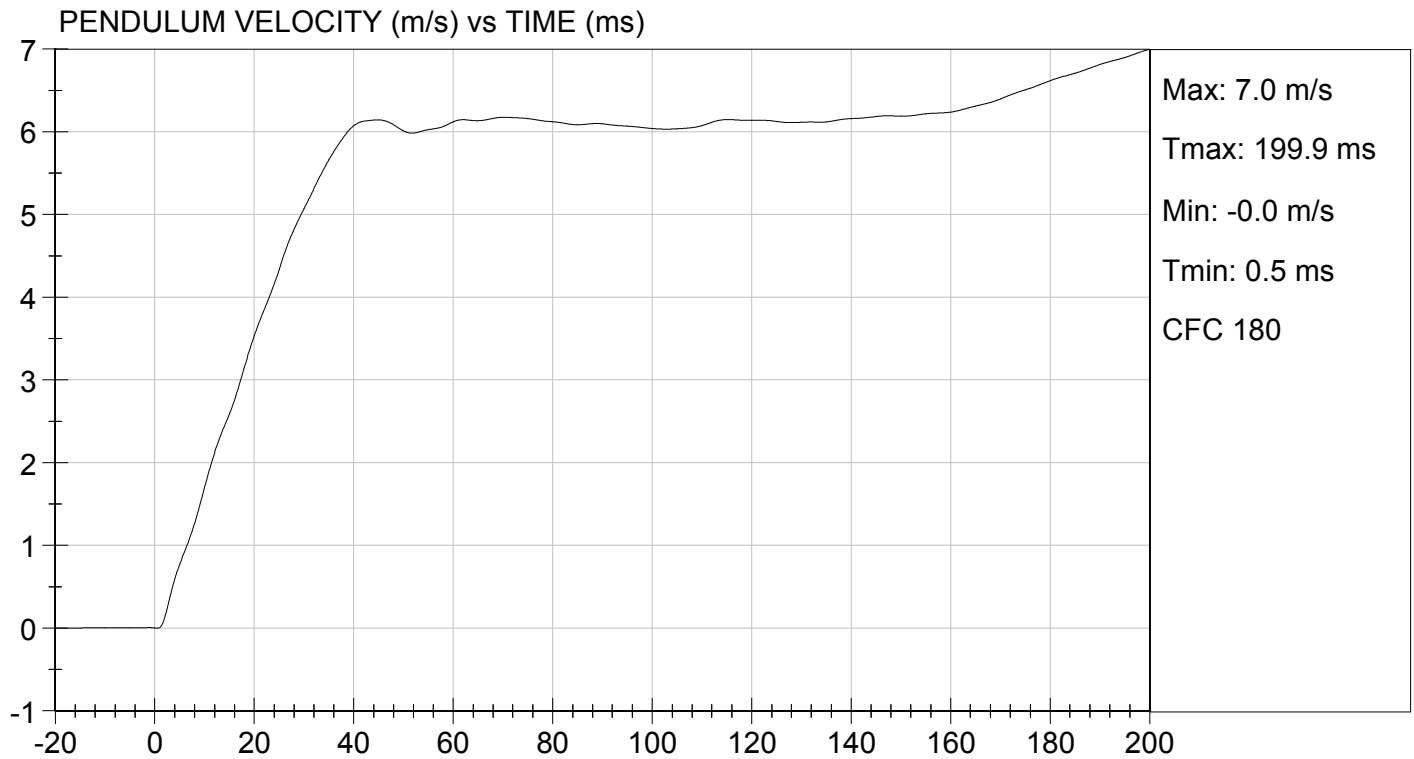
07/24/2014
 Test Date


 Approved By



TEST DESC: NECK EXTENSION
VELOCITY: 20.30 ft/s, 6.18 m/s

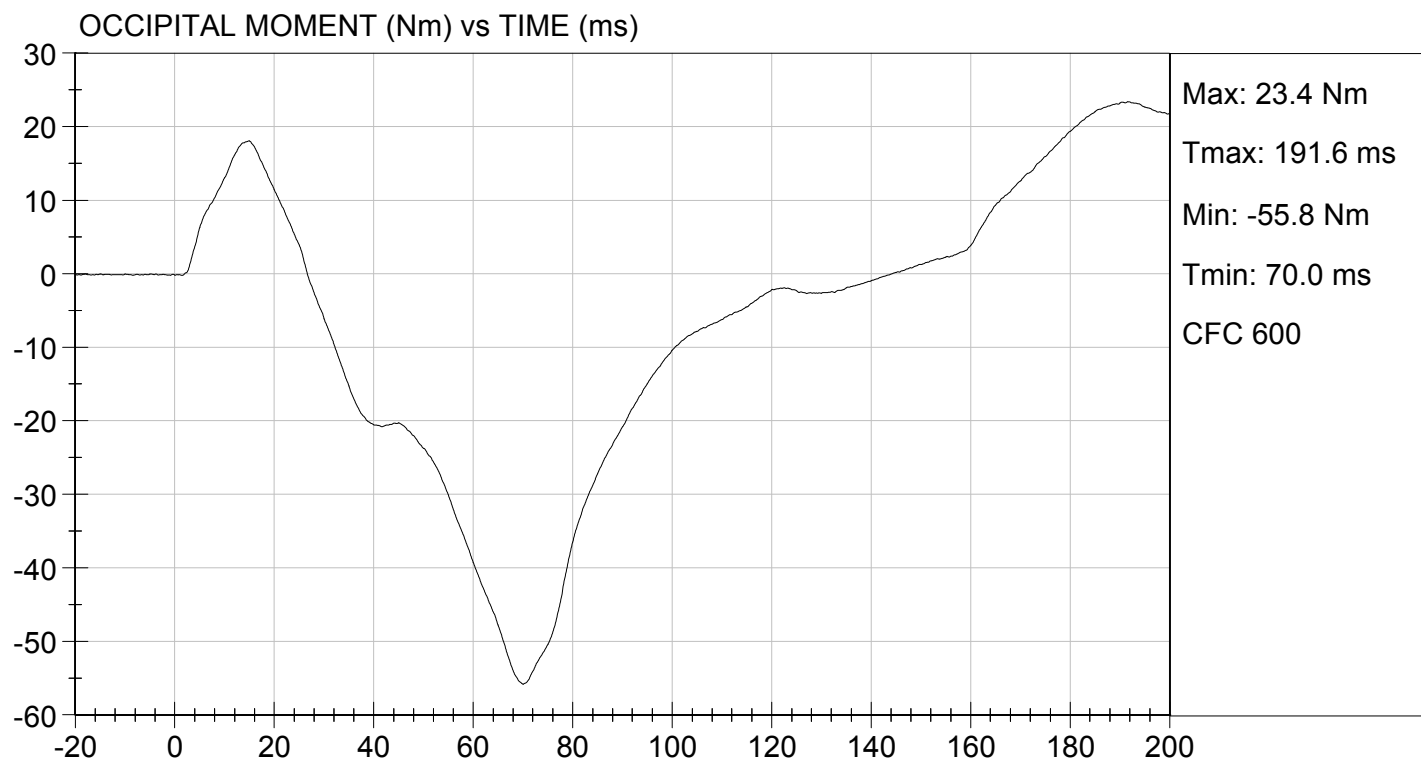
TEST DATE: 07/24/2014
TEST #: D142583





TEST DESC: NECK EXTENSION
VELOCITY: 20.30 ft/s, 6.18 m/s

TEST DATE: 07/24/2014
TEST #: D142583

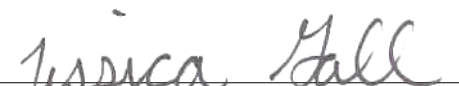


MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142584

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Relative Humidity	%	10 to 70	47	Pass
Probe Speed	m/s	6.59 to 6.83	6.77	Pass
Peak Deflection	mm	50 to 58	56	Pass
Peak Resistive Force w/in Deflection Corridor	N	3900 to 4400	4250	Pass
Internal Hysteresis	%	69 to 85	69	Pass
Peak Force 18 mm - 50 mm	N	<= 4600	4140	Pass
Overall Test Results				Pass


Laboratory Technician

07/24/2014

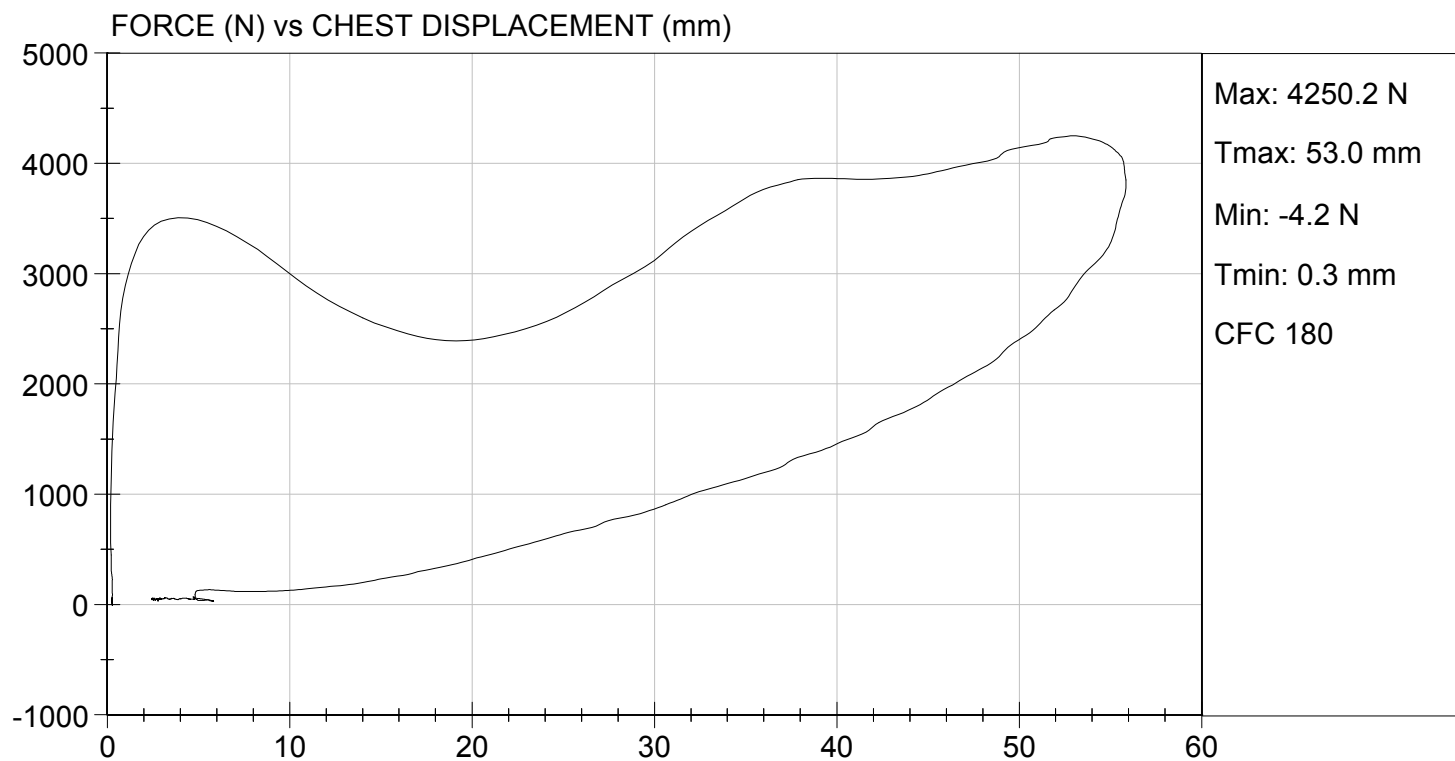
Test Date


Approved By



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

TEST DATE: 07/24/2014
TEST #: D142584



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142585

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3491	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

07/24/2014

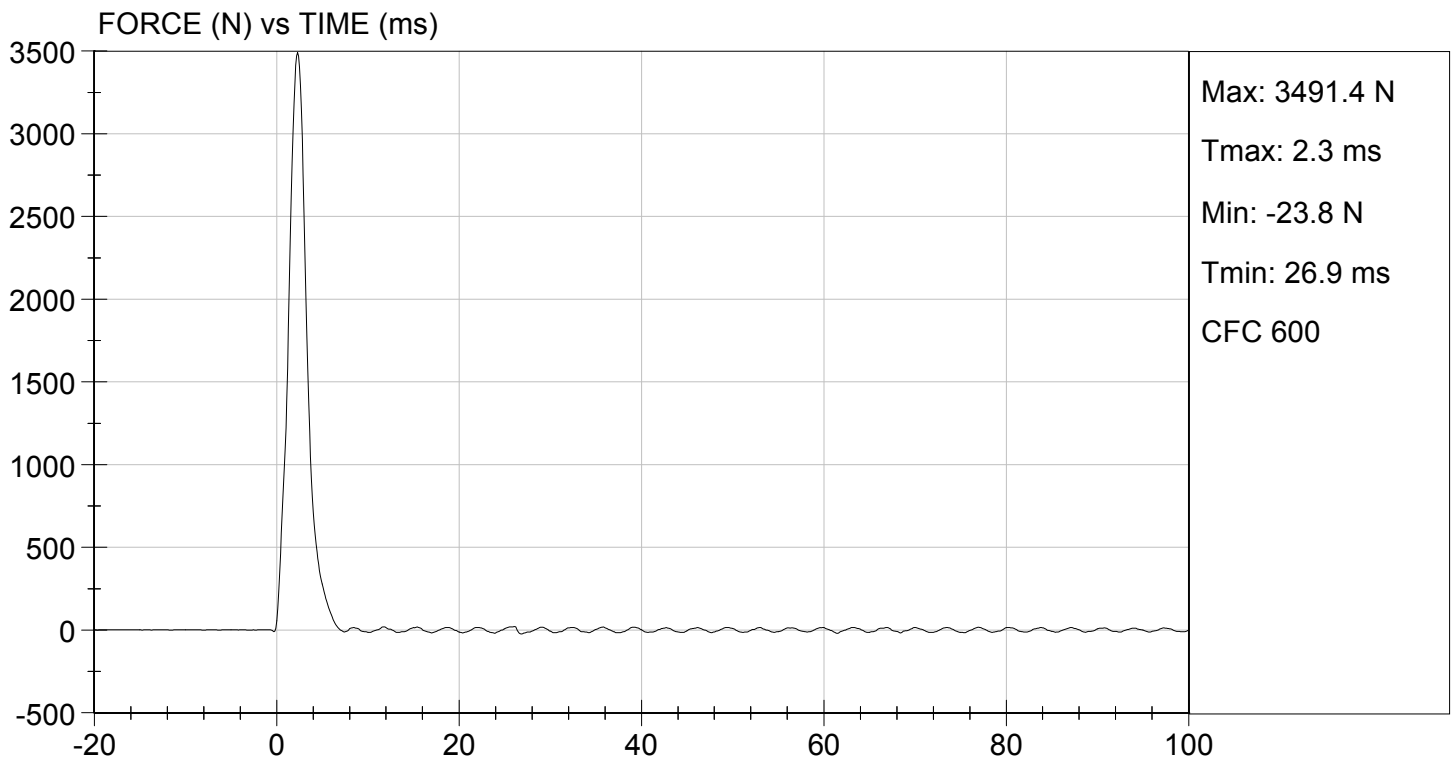
Test Date

David Winkelbauer
Approved By



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

TEST DATE: 07/24/2014
TEST #: D142585



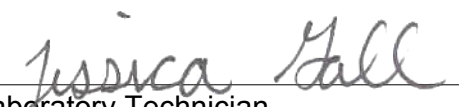
MGA RESEARCH CORPORATION

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

ATD Serial No: 138

Test I.D: D142586

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	N	3450 to 4060	3497	Pass
Overall Test Results				Pass


Laboratory Technician

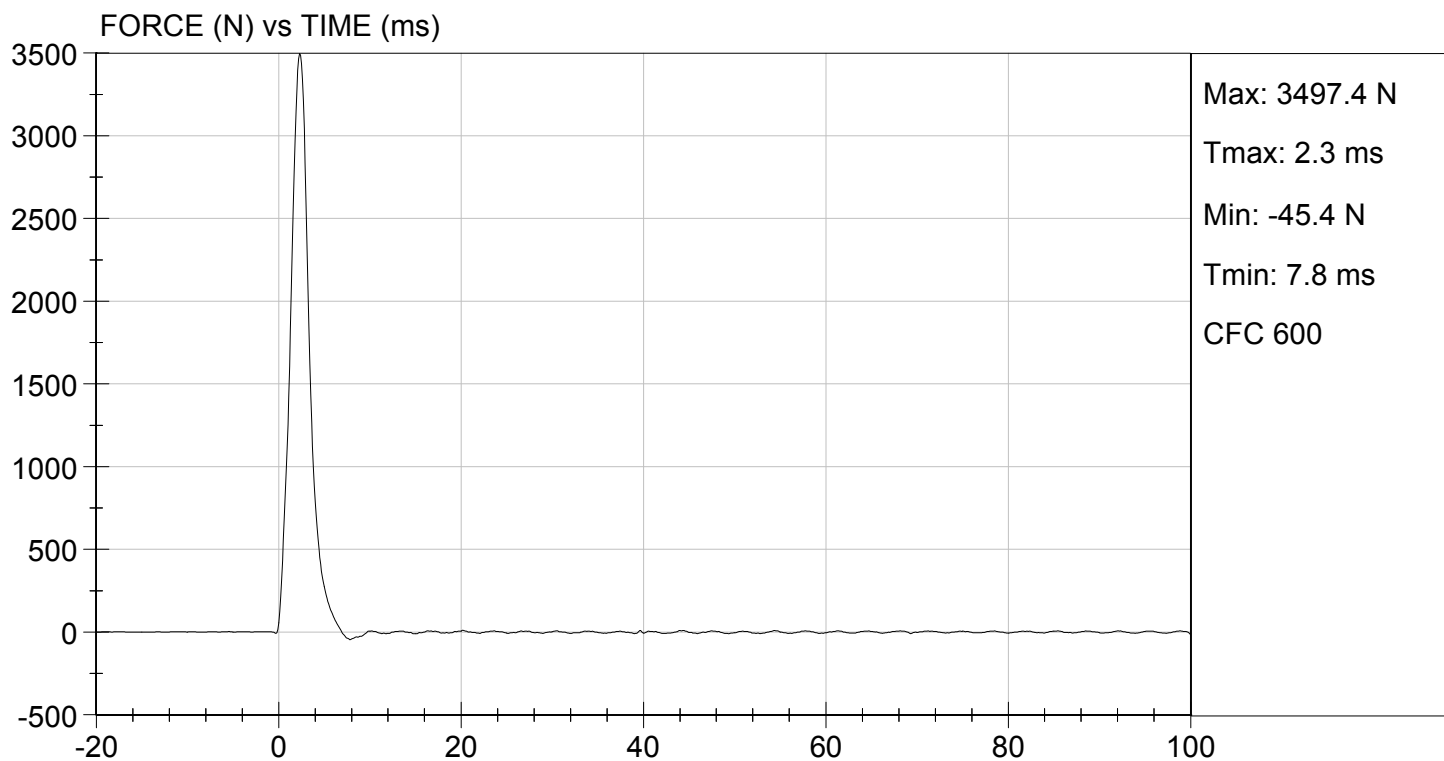
07/24/2014
Test Date


Approved By



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

TEST DATE: 07/24/2014
TEST #: D142586



MGA RESEARCH CORPORATION

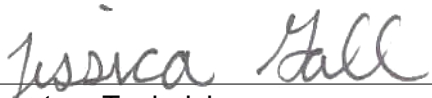
TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D142587

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	46	Pass
Initial Angle	deg	0 to 20	19	Pass
Return Angle	deg	+/- 8	2	Pass
Force at 45 deg	N	320 to 390	360	Pass
Upper Torso Deflection Rate	deg/s	0.5 to 1.5	0.9	Pass
Overall Result			Pass	


Laboratory Technician

07/23/2014

Test Date


Approved By