

REPORT NUMBER: NCAP-MGA-2011-060

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

**HYUNDAI MOTOR MANUFACTURING ALABAMA, LLC
2011 Hyundai Sonata GLS 4-Dr Sedan
NHTSA No.: UB0501**

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



Test Date: January 5, 2011

Final Report Date: February 11, 2011

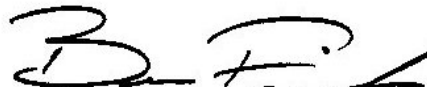
FINAL REPORT

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

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-06-D-00028.

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Approval Date: February 11, 2011

FINAL REPORT ACCEPTANCE BY OCWS:

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

Date: _____

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NHTSA, Office of Crashworthiness Standards

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16. Abstract A 56.3 km/h NCAP Frontal Impact Test was conducted on the 2011 Hyundai Sonata GLS 4-Dr Sedan in accordance with the specifications of the Office of Crashworthiness Standards Frontal NCAP Laboratory Test Procedure for the generation of consumer information on vehicle frontal crash protection. 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 5, 2011. The impact velocity was 56.5 km/h and the ambient temperature at the barrier face at the time of impact was 21°C. The target vehicle post-test maximum crush was 542 mm located at the vehicle's centerline. The test vehicle's performance was as follows: <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <thead> <tr> <th rowspan="2">Measurement Description</th> <th rowspan="2">Units</th> <th colspan="2">Threshold</th> <th rowspan="2">Driver ATD</th> <th rowspan="2">Passenger ATD</th> </tr> <tr> <th>50th</th> <th>5th</th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₁₅)</td> <td>N/A</td> <td>700</td> <td>700</td> <td>173</td> <td>183</td> </tr> <tr> <td>Maximum Chest Compression</td> <td>mm</td> <td>63</td> <td>52</td> <td>16</td> <td>14</td> </tr> <tr> <td>Nij</td> <td>N/A</td> <td>1</td> <td>1</td> <td>0.28</td> <td>0.56</td> </tr> <tr> <td>Neck Tension</td> <td>N</td> <td>4170</td> <td>2620</td> <td>1222</td> <td>1045</td> </tr> <tr> <td>Neck Compression</td> <td>N</td> <td>4000</td> <td>2520</td> <td>256</td> <td>105</td> </tr> <tr> <td>Left Femur Force</td> <td>N</td> <td>10008</td> <td>6805</td> <td>305</td> <td>559</td> </tr> <tr> <td>Right Femur Force</td> <td>N</td> <td>10008</td> <td>6805</td> <td>3376</td> <td>244</td> </tr> </tbody> </table>				Measurement Description	Units	Threshold		Driver ATD	Passenger ATD	50 th	5 th	Head Injury Criteria (HIC ₁₅)	N/A	700	700	173	183	Maximum Chest Compression	mm	63	52	16	14	Nij	N/A	1	1	0.28	0.56	Neck Tension	N	4170	2620	1222	1045	Neck Compression	N	4000	2520	256	105	Left Femur Force	N	10008	6805	305	559	Right Femur Force	N	10008	6805	3376	244
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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 DTNH22-06-D-00028. 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 Standard's NCAP Frontal Laboratory Test Procedure dated January 2010.

SUMMARY

A load cell barrier was impacted by a 2011 Hyundai Sonata GLS 4-Dr Sedan at a velocity of 56.5 kph. The test was performed at MGA Research Corporation on January 5, 2011. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

Two 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 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 verification data, are found in Appendix C of this report.

The 227 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy head, chest displacement, neck, and femur 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 542 mm and both the driver and passenger side doors remained closed during the impact event and were operable after the impact.

The driver's head and chest contacted the airbag. The driver's head also contacted the headrest. The driver's knees contacted the knee bolster. The passenger's head and chest contacted the airbag. The passenger's head also contacted the headrest. The passenger's knees contacted the glovebox.

The occupant data is summarized below:

ATD position	HIC ₁₅	T ¹	T ²	Chest Disp. (mm)	Nij	Neck Tension (N)	Neck Comp. (N)	Left Femur (N)	Right Femur (N)
Driver (50 th)	173	76.7	91.7	16	0.28	1222	256	305	3376
Passenger (5 th)	183	69.7	84.7	14	0.56	1045	105	559	244

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

TEST NOTES

There was no valid data collected for:
Right Brake Caliper X after 30 msec.

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: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	UB0501	Anti-Lock Brakes	Yes
Model Year	2011	All Wheel Drive	No
Make	Hyundai	Power Steering	Yes
Model	Sonata	Driver Front Airbag	Yes
Body Style	Sedan	Driver Curtain Airbag	Yes
VIN	5NPEB4AC0BH159820	Driver Head/Torso Airbag	No
Body Color	Radiant Silver	Driver Torso Airbag	No
Delivery Date	11/22/2010	Driver Torso/Pelvis Airbag	Yes
Odometer (mi)	44	Driver Pelvis Airbag	No
Odometer (km)	71	Driver Knee Airbag	No
Dealer	Boucher Fleet Group	Pass. Front Airbag	Yes
Transmission	Manual	Pass. Curtain Airbag	Yes
Final Drive	Front	Pass. Head/Torso Airbag	No
Type/No. Cylinders	4	Pass. Torso Airbag	No
Engine Displacement (L)	2.4	Pass. Torso/Pelvis Airbag	Yes
Engine Placement	Lateral	Pass. Pelvis Airbag	No
Roof Rack	No	Pass. Knee Airbag	No
Sunroof/T-Top	No	Pretensioners	Yes
Tinted Glass	No	Load Limiters	Yes
Traction Control	Yes	Automatic Door Locks	Yes
Power Brakes	Yes	Bucket Seats	Yes
Front Disc	Yes	Tilt Steering	Yes
Rear Disc	Yes	Other	
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)	1950
Date of Manufacture	Sep/20/10	GAWR Front (kg)	1100
		GAWR Rear (kg)	960

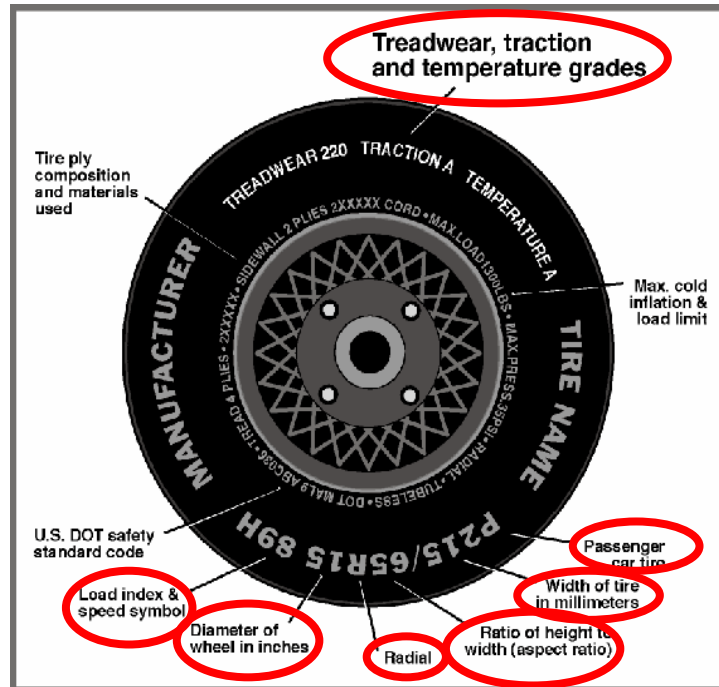
VEHICLE SEATING AND WEIGHT CAPACITY DATA

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

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

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011



Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	225	225
Recommended Tire Size	P205/65R16	P205/65R16
Tire Size on Vehicle	P205/65R16	P205/65R16
Tire Manufacturer	Kumho	Kumho
Tire Model	Solus KH25	Solus KH25
Treadwear	480	480
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	1	1
Tire Plies Body	4	4
Load Index & Speed Symbol	94H	94H
Tire Material	Rubber	Rubber
DOT Safety Code Right	Y0L4 YPL8	Y0L4 YPL8
DOT Safety Code Left	Y0L4 YPL8	Y0L4 YPL8

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

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	436.8	300.3		465.4	387.4	
Right	kg	442.2	286.7		454.5	362.9	
Ratio	%	60.0	40.0		55.1	44.9	
Totals	kg	879.0	587.0	1466.0	919.9	750.3	1670.2

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1466.0
Weight of 1 P572E ATD & 1 P572O ATD	kg	140.6
Rated Cargo/Luggage Weight (RCLW)	kg	70
Calculated Target Vehicle Target Weight (TVTW)	kg	1676.6

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	698	705	705	692	1120
As Tested	mm	700	701	667	664	1256
Post Test	mm	638	652	668	660	

GENERAL TEST VEHICLE DATA

Measurement Description	Units	Value
Total Vehicle Wheel Base	mm	2796
Total Vehicle Length at Left Side	mm	4604
Total Vehicle Length at Centerline	mm	4820
Total Vehicle Length at Right Side	mm	4604
Weight of Ballast in Cargo Area	kg	56.7
Weight of Vehicle Components Removed	kg	22.2
Amount of Stoddard Solvent in Fuel Tank	L	65.1

List of components removed to meet test weight: Spare tire, right tail light, tool kit, skid plates, trunk carpet.

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

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

TARGET VEHICLE STRUCTURAL MEASUREMENT

	Elements	Pre-Test (mm)
1	Total Length	4820
2	Total Width	1821
3	Bumper Top Height	525
4	Bumper Bottom Height	445
5	Longitudinal Member Top Height	545
6	Distance between Longitudinal Members	945
7	Longitudinal Member Width	60
8	Engine Top Height	821
9	Engine Bottom Height	280
10	Engine and Gearbox Width	833
11	Front Bumper-Engine Distance	380
12	Front Shock Absorber Fixing Height	905
13	Bonnet Leading Edge Height	773
14	Front Shock Absorber Fixing Width	1210
15	Front Bumper – Front Axle Distance	945
16	Front Axle – A-Pillar Distance	435
17	A-Pillar – B-Pillar Distance	1225
18	B-Pillar – Rear Axle Distance	1146
19	B-Pillar – C-Pillar Distance	715
20	Roof Sill Bottom Height	1315
21	Roof Sill Top Height	1425
22	Floor Sill bottom Height	190
23	Floor Sill Top Height	340

DATA SHEET NO. 2

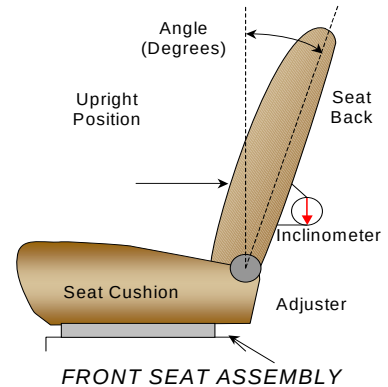
SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

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 Seating & Positioning Procedures" in the NCAP Test Procedure dated January 2010.



SEAT BACK ANGLE	Degrees
Driver Seat Back Angle	9.2° on headrest post
Passenger Seat Back Angle	3.5° on headrest post

SEAT FORE/AFT POSITIONS

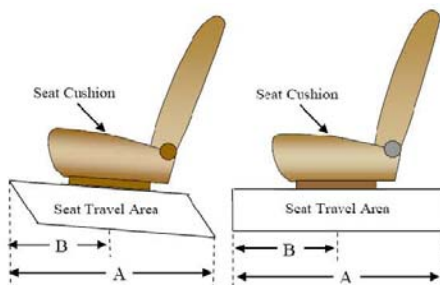
The driver and passenger seat fore/aft positions are adjusted following Appendix F, "Driver & Passenger Seating & Positioning Procedures" in the NCAP Test Procedure dated January 2010.

SEAT FORE/AFT POSITIONS	Total Fore/Aft Travel	Placed in Position #
Driver Seat	24 detents (1 st as 0)	10 th detent (forward-most as 0)
Passenger Seat	24 detents (1 st as 0)	0 detent (forward-most as 0)

SEAT BELT UPPER ANCHORAGES

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

SEAT BELT UPPER ANCHORAGES	Total # of Positions	Placed in Position #
Driver Seat	4	0 (uppermost as 0)
Passenger Seat	4	1 (uppermost as 0)



DATA SHEET NO. 2 (CONTINUED)

SEAT ADJUSTMENT, FUEL SYSTEM, AND STEERING WHEEL DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

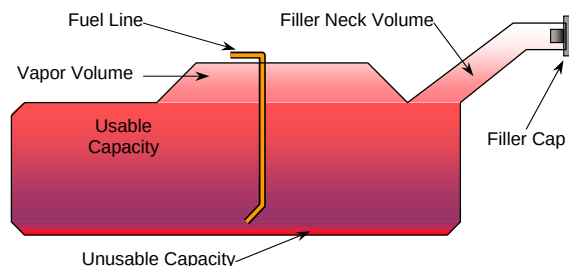
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of "Standard Tank"	70.0
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	23.3

FUEL PUMP

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

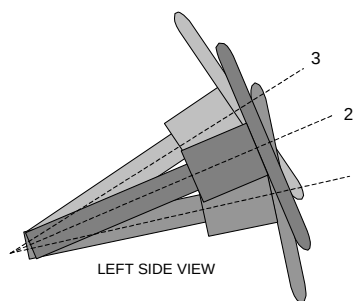
The vehicle is equipped with an electric fuel pump. Fuel pump will operate when engine system is normally operating. The fuel pipe is on the left side.



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

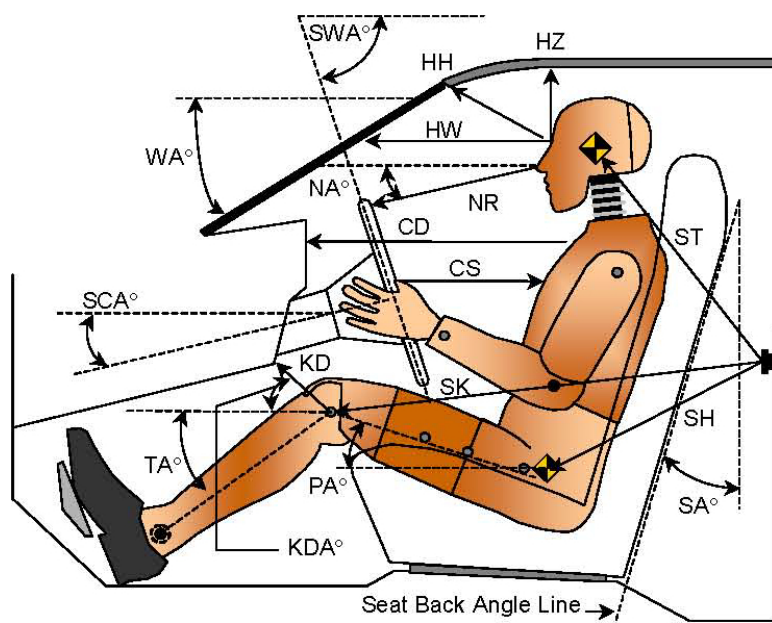
STEERING COLUMN POSITION

	Degrees	Fore/Aft Position (mm)
Lowermost – Position 1	68.0	225
Geometric Center – Position 2	66.1	205
Uppermost – Position 3	64.2	185
Telescoping Steering Wheel Travel		40
Test Position	66.1	205

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

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

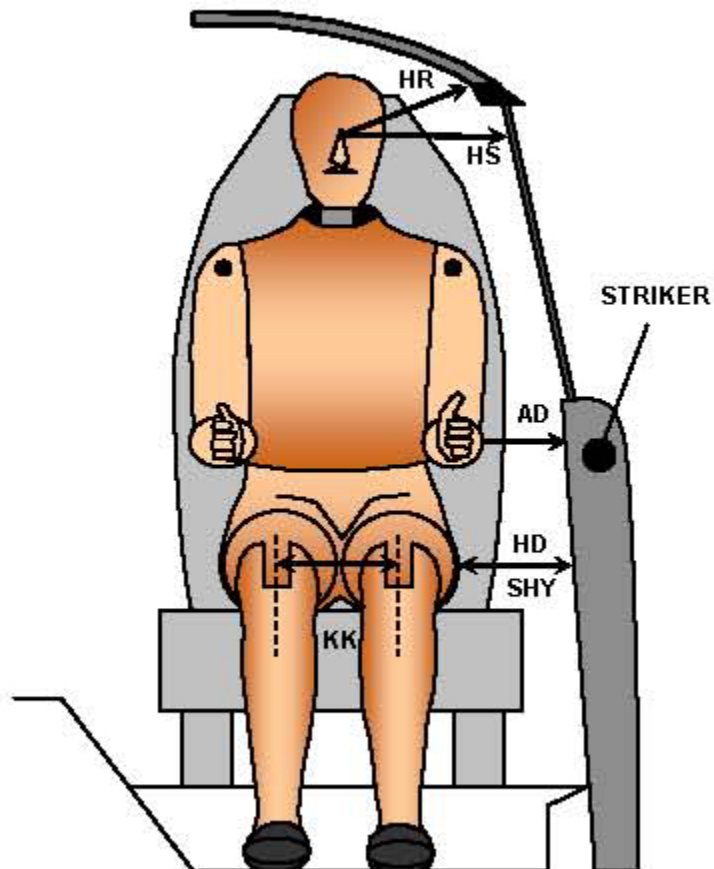


Code	Measurement Description	Driver S/N 351		Passenger S/N 138	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		21.3		
SWA	Steering Wheel Angle		66.1		
SCA	Steering Column Angle		23.9		
SA	Seat Back Angle		9.2		3.5
HZ	Head to Roof (Z)	190	90	253	90
HH	Head to Header	368	20.2	328	40.6
HW	Head to Windshield	674	0	761	0
NR	Nose to Rim	430	10.6		
CD	Chest to Dash	563		459	
CS	Chest to Steering Hub	354	3.2		
RA	Rim to Abdomen	214	0		
KDL	Left Knee to Dash	212	25.4	163	36.1
KDR	Right Knee to Dash	174	30.3	177	31.4
PA	Pelvic Angle		24.3		19.1
TA	Tibia Angle		42.6		44.1
SK	Striker to Knee	629	106.2	690	104.8
ST	Striker to Head	391	11.8	360	37.1
SH	Striker to H-Point	354	143.3	438	130.0

DATA SHEET NO. 4
DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011



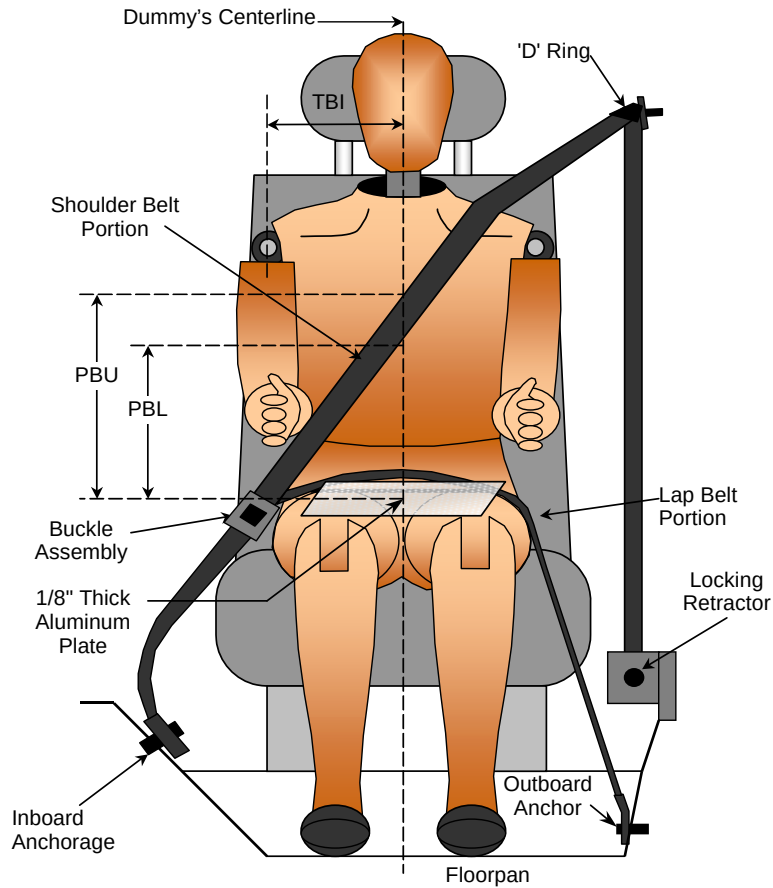
FRONT VIEW OF DUMMY

Code	Measurement Description	Driver S/N 351	Passenger S/N 138
		Length (mm)	
AD	Arm to Door	150	97
HD	H-Point to Door	157	184
HR	Head to Side Header	210	258
HS	Head to Side Window	333	370
KK	Knee to Knee	340	213
SHY	Striker to H-Point (Y Direction)	305	323
AA	Ankle to Ankle	360	203

DATA SHEET NO. 5
SEAT BELT POSITIONING DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011



FRONT VIEW OF DUMMY

SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	395	330
PBL - To surface of reference to belt lower edge	mm	340	265

BELT LENGTH DATA

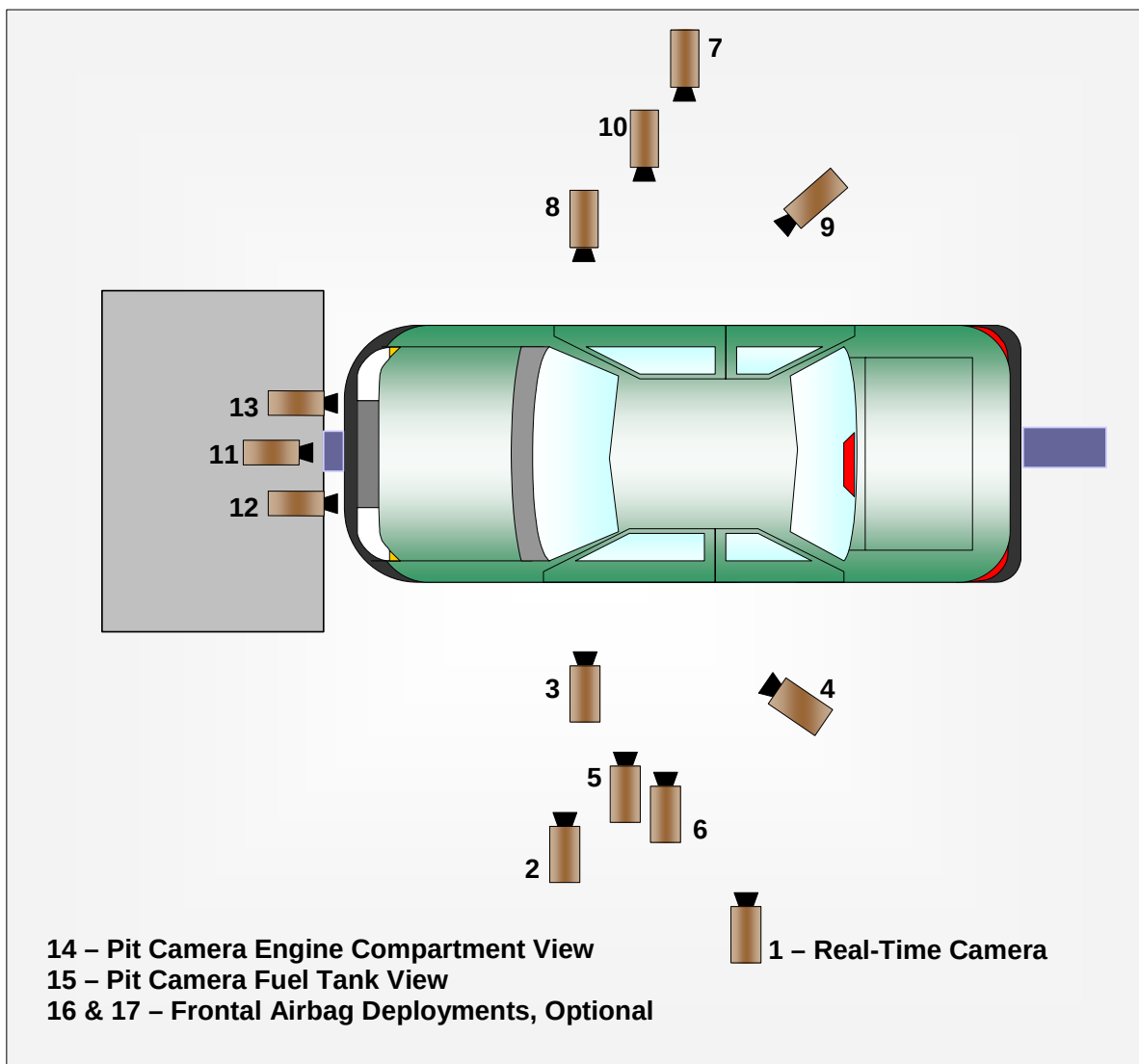
Measurement Description	Units	Driver	Passenger
Shoulder Belt Length as measured on ATD	mm	885	945
Lap Belt Length as measured on ATD	mm	705	720
Remainder of belt of reel	mm	1580	1535
Total Belt Length for Continuous Webbing Systems	mm	3170	3200

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

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
Test Date: 1/05/2011

CAMERA POSITIONS FOR FRONTAL IMPACTS



DATA SHEET NO. 6 (CONTINUED)

CAMERA LOCATIONS AND DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

CAMERA LOCATIONS

No.	Camera View	Coordinates (mm)			Lens (mm)	Speed (fps)
		X*	Y*	Z*		
1	Real-Time Left Side View					30
2	Left Front Half	1340	-5170	-1220	24	1000
3	Driver Close-Up	1680	-6280	-1570	35	1000
4	Driver Angle	5410	-4910	-1910	50	1000
5	Steering Column Top	880	-5140	-1250	24	1000
6	Steering Column Bottom	850	-5110	-870	24	1000
7	Right Overall	2240	6410	-1280	20	1000
8	Passenger Close-Up	1710	6260	-1540	35	1000
9	Passenger Angle	5450	4900	-1930	50	1000
10	Right Front Half	1320	5150	-1240	24	1000
11	Windshield	-260	0	-2860	24	1000
12	Top Driver	-20	-310	-2270	12	1000
13	Top Passenger	-20	310	-2270	12	1000
14	Pit Front	1270	0	3150	24	1000
15	Pit Rear	3290	0	3150	24	1000
16	Onboard Driver Side (optional)					
17	Onboard Passenger Side (optional)					
18	Real-Time Pan View					30

***COORDINATES:**

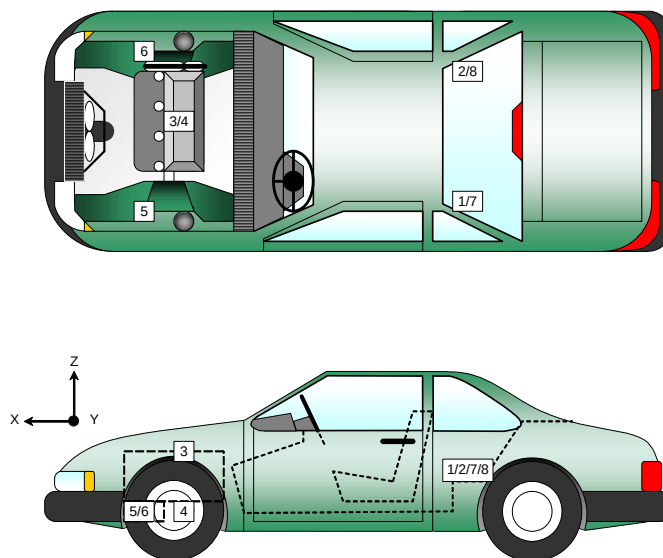
- +X = forward of impact plane
- +Y = right of monorail centerline
- +Z = below ground level

Cameras 16 & 17 were not used for this test.

DATA SHEET NO. 7
VEHICLE ACCELEROMETER DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011



VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear X-Member X	1037	-425	-210
2	Right Rear X-Member X	1037	425	-210
3	Engine Top X	4038	0	-821
4	Engine Bottom X	4055	0	-280
5	Left Brake Caliper X	3725	-710	-295
6	Right Brake Caliper X	3725	710	-295
7	Left Rear X-Member Z	1037	-425	-210
8	Right Rear X-Member Z	1037	425	-210

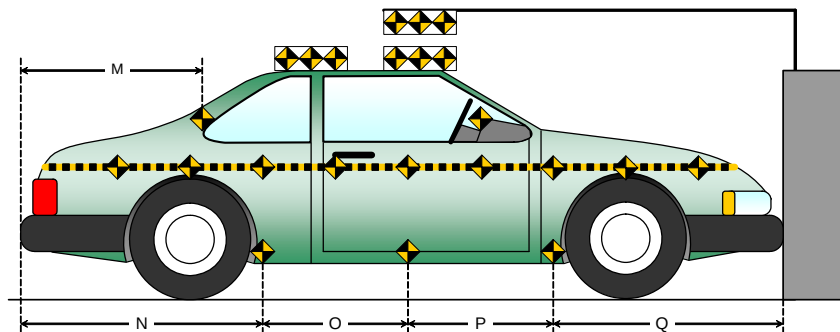
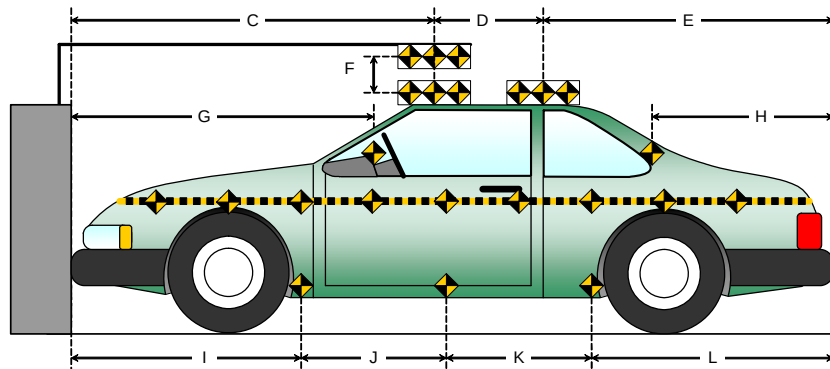
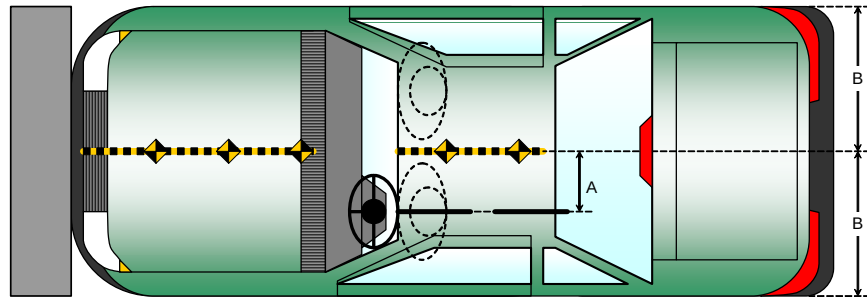
Reference Points: X - Rear Surface of Vehicle (+ forward)
 Y - Vehicle Centerline (+ to right)
 Z - Ground Plane (+ down)

DATA SHEET NO. 8
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

Item	Value (mm)
A	364
B	912
C	2450
D	679
E	1691
F	155
G	
H	1200
I	1401
J	967
K	967
L	1485
M	1195
N	1485
O	967
P	967
Q	1401



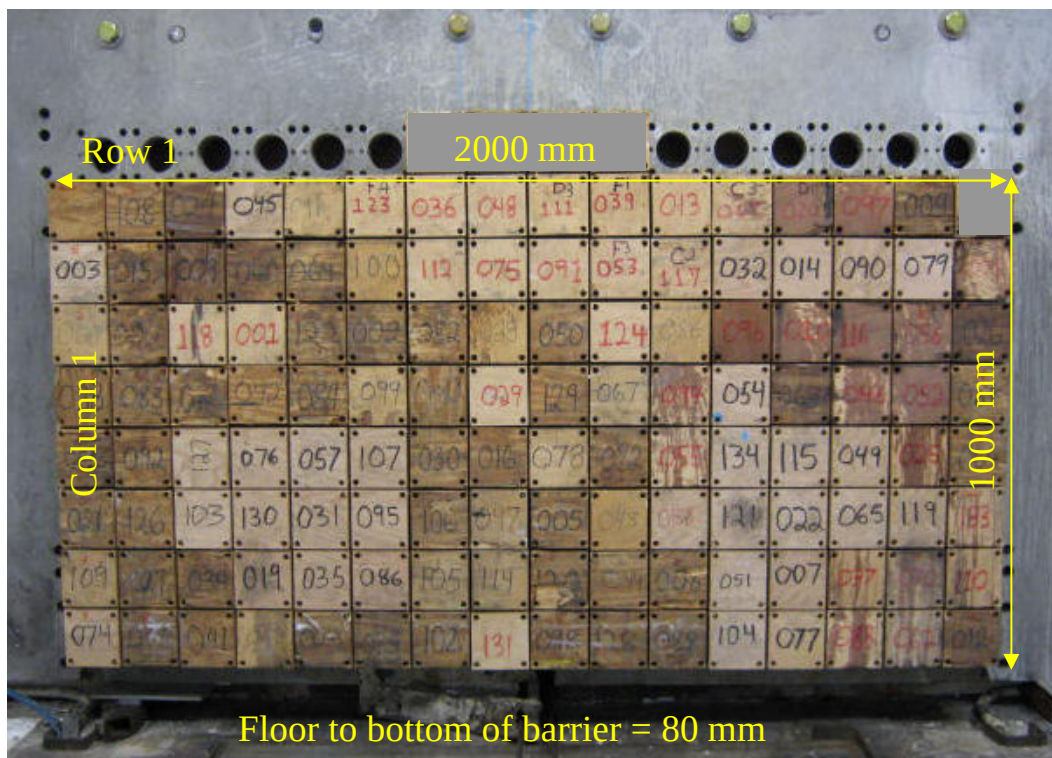
DATA SHEET NO. 9

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

Advanced Research Load Cell Barrier



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

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: 2011 Hyundai Sonata GLS 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
Test Date: 1/05/2011

INSTRUMENTATION

Driver Dummy Data Channels	46
Passenger Dummy Data Channels	46
Vehicle Structure Accelerometers	8
Barrier Channels	127
Total	227

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: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

TEST DUMMY INFORMATION AND CONTACT

Description	Driver	Passenger
Dummy Type / Serial No.	HIII 50% / 351	HIII 5% / 138
Head Contact	Airbag, Headrest	Airbag, Headrest
Upper Torso Contact	Airbag	Airbag
Lower Torso Contact	Airbag	Airbag
Left Knee Contact	Knee Bolster	Glovebox
Right Knee Contact	Knee Bolster	Glovebox

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	2540
Center	mm	2435
Right Side	mm	2488
Average	mm	2488

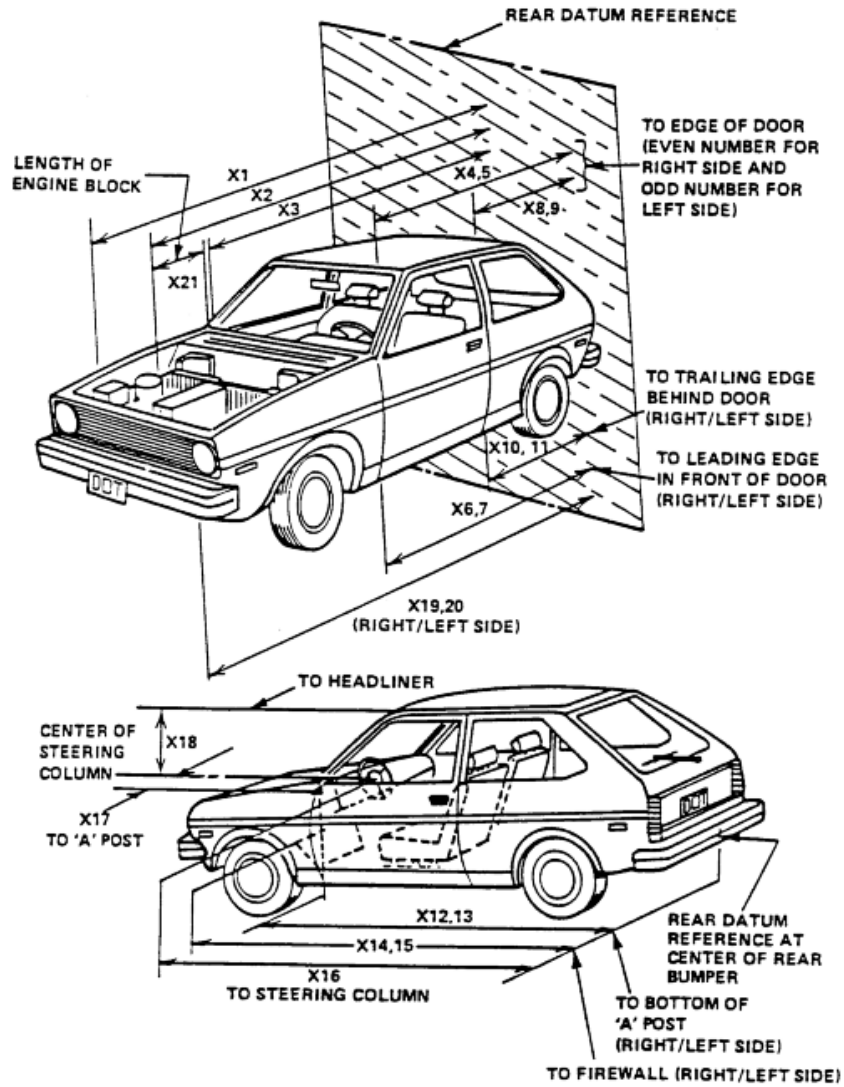
SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Left Front (Driver) P1		Left Front (Passenger) P2	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	Yes	Yes	Yes
Knee Airbag	No		No	
Curtain Side Airbag	Yes	No	Yes	No
Torso/Pelvis Side Airbag	Yes	No	Yes	No
Seat Belt Pretensioner	Yes	Yes	Yes	Yes
Seat Belt Load Limiter	Yes		Yes	

DATA SHEET NO. 12
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
Test Date: 1/05/2011



DATA SHEET NO. 12 (CONTINUED)
VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

RSOV (Rear Surface of Vehicle)

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total Length of Vehicle at Centerline	mm	4820	4278	542
2	RSOV to Front of Engine	mm	4311	4038	273
3	RSOV to Firewall	mm	3692	3665	27
4	RSOV to Upper Leading Edge of Right Door	mm	3295	3314	-19
5	RSOV to Upper Leading Edge of Left Door	mm	3295	3317	-22
6	RSOV to Lower Leading Edge of Right Door	mm	3290	3278	12
7	RSOV to Lower Leading Edge of Left Door	mm	3290	3283	7
8	RSOV to Upper Trailing Edge of Right Door	mm	2174	2194	-20
9	RSOV to Upper Trailing Edge of Left Door	mm	2174	2212	-38
10	RSOV to Lower Trailing Edge of Right Door	mm	2200	2188	12
11	RSOV to Lower Trailing Edge of Left Door	mm	2200	2197	3
12	RSOV to Bottom of "A" Post of Right Side	mm	3314	3285	29
13	RSOV to Bottom of "A" Post of Left Side	mm	3307	3286	21
14	RSOV to Firewall, Right Side	mm	3672	3688	-16
15	RSOV to Firewall, Left Side	mm	3703	3645	58
16	RSOV to Steering Column	mm	2835	2882	-47
17	Center of Steering Column to "A" Post	mm	360	370	-10
18	Center of Steering Column to Headliner	mm	407	447	-40
19	RSOV to Right Side of Front Bumper	mm	4604	4280	324
20	RSOV to Left Side of Front Bumper	mm	4604	4283	321
21	Length of Engine Block	mm	478	478	0
RD	RSOV to Right Side of Dash Panel	mm	3032	3047	-15
CD	RSOV to Center of Dash Panel	mm	3063	3025	38
LD	RSOV to Left Side of Dash Panel	mm	3030	3068	-38

DATA SHEET NO. 13
ACCIDENT INVESTIGATION DIVISION DATA

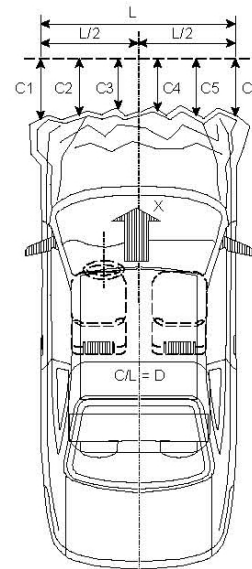
Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No.: UB0501
 Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/05/2011

VEHICLE INFORMATION

VIN: 5NPEB4AC0BH159820 Wheelbase (mm): 2796
 Vehicle Size Category: Sedan Test Weight (kg): 1670.2

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): 63.3
 Time of Separation (msec): 110.3



CRUSH PROFILE

Collision Deformation Classification: Frontal
 Midpoint of Damage: Centerline
 Damage Region Length (mm): 1450
 Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4604	4283	321
C2	Crush zone 2 at left side	mm	4706	4311	395
C3	Crush zone 3 at left side	mm	4770	4268	502
C4	Crush zone 4 at right side	mm	4770	4259	511
C5	Crush zone 5 at right side	mm	4706	4271	435
C6	Crush zone 6 at right side	mm	4604	4280	324
L	C1 TO C6	mm	1450	1437	13

DATA SHEET NO. 14
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

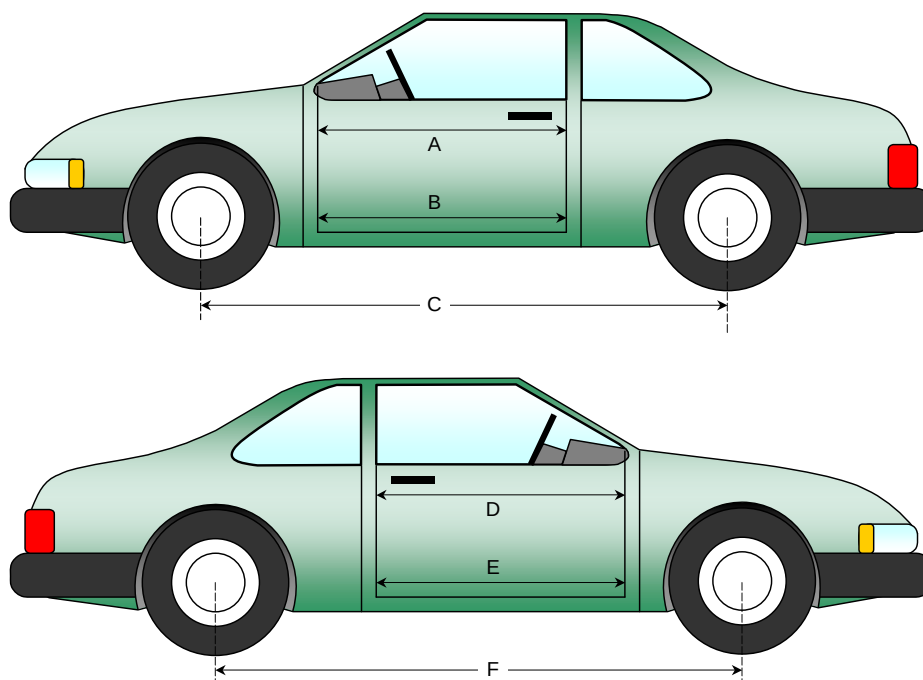
NHTSA No.: UB0501
 Test Date: 1/05/2011

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1035	1034	1
B	Left Side Lower	mm	975	974	1
D	Right Side Upper	mm	1035	1035	0
E	Right Side Lower	mm	975	970	5

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2796	2808	-12
F	Right Side Wheelbase	mm	2796	2720	76



DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

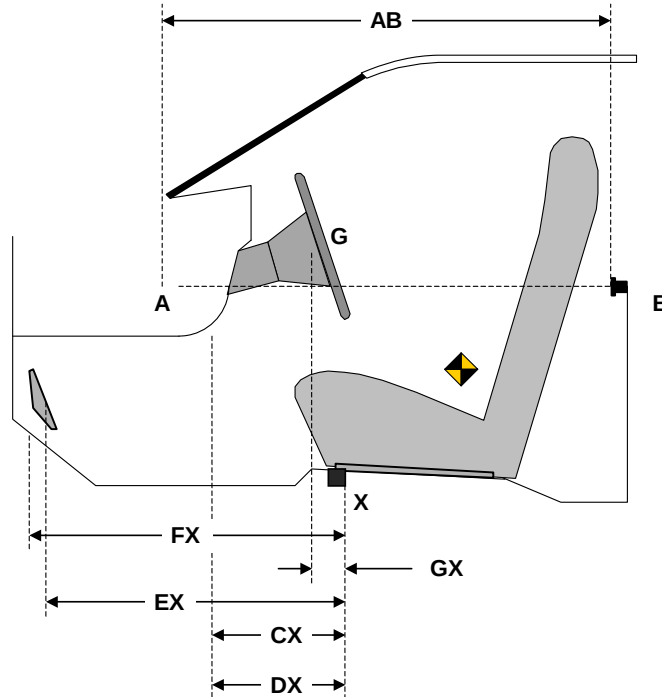
Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	865	861	4
CX	Left Knee Bolster to X	mm	285	300	-15
DX	Right Knee Bolster to X	mm	215	231	-16
EX	Brake Pedal to X	mm	585	507	78
FX	Foot Rest to X	mm	610	597	13
GX	Center of Steering Column Wheel Hub to X	mm	85	146	-61

X = Front of Seat Track (stationary)

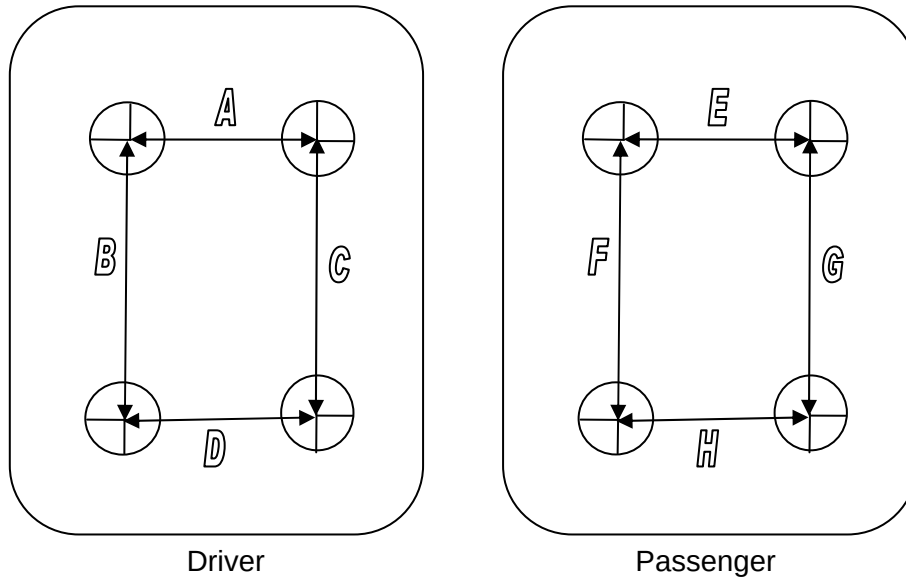


DRIVER COMPARTMENT

DATA SHEET NO. 14 (CONTINUED)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011



TOP VIEW THROUGH FLOOR PAN

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Units	Pre-Test	Post-Test	Difference
A	mm	375	375	0
B	mm	375	372	3
C	mm	375	373	2
D	mm	375	374	1
E	mm	375	378	-3
F	mm	375	377	-2
G	mm	375	376	-1
H	mm	375	379	-4

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

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

Windshield Mounting Details:

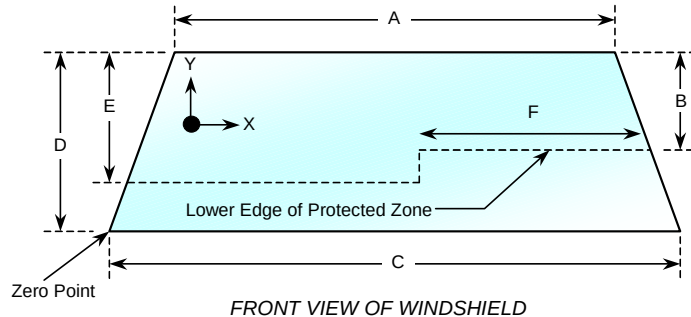
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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

Temperature of windshield molding during test: 21°C

WINDSHIELD PERIPHERY MEASUREMENTS

Measurement	Pre-Test (mm)	Post-Test (mm)	% of Retention
Left Side	2157	2157	100
Right Side	2157	2157	100
Total	4314	4314	100



Item	Units	Value
A	mm	1190
B	mm	474
C	mm	1470
D	mm	827
E	mm	536
F	mm	475

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, 219 (PARTIAL), AND 301 DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No.: UB0501
Test Program: NCAP Frontal Barrier Impact Test Test Date: 1/05/2011

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Test Time: 10:29 am Temperature: 21° C

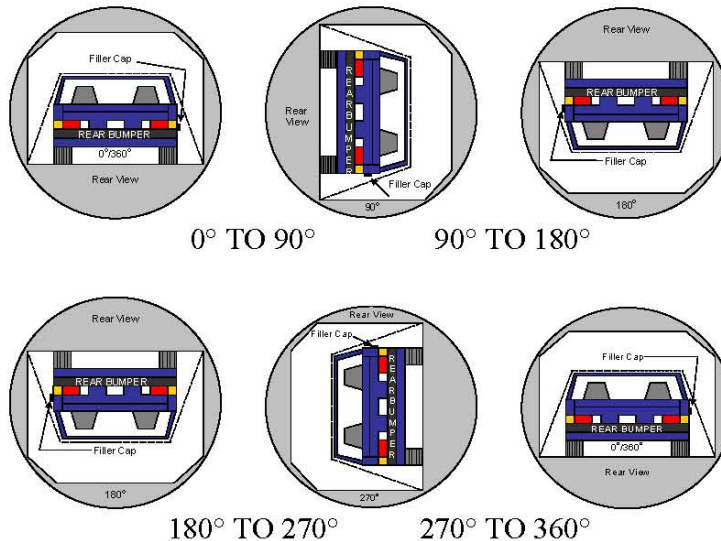
- A. From impact until vehicle motion ceases: 0 oz.
(Maximum Allowable = 1 ounce)
- B. For the 5 minute period after motion ceases: None
(Maximum allowable = 5 ounces)
- C. For the following 25 minutes: None
(Maximum allowable = 1 oz/minute)
- D. Spillage Details: None

DATA SHEET NO. 16
FMVSS 301 STATIC ROLLOVER RESULTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan
 Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
 Test Date: 1/05/2011

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°	110	300	410
90° to 180°	111	300	411
180° to 270°	103	300	403
270° to 360°	116	300	416

FMVSS 301 ROLLOVER 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

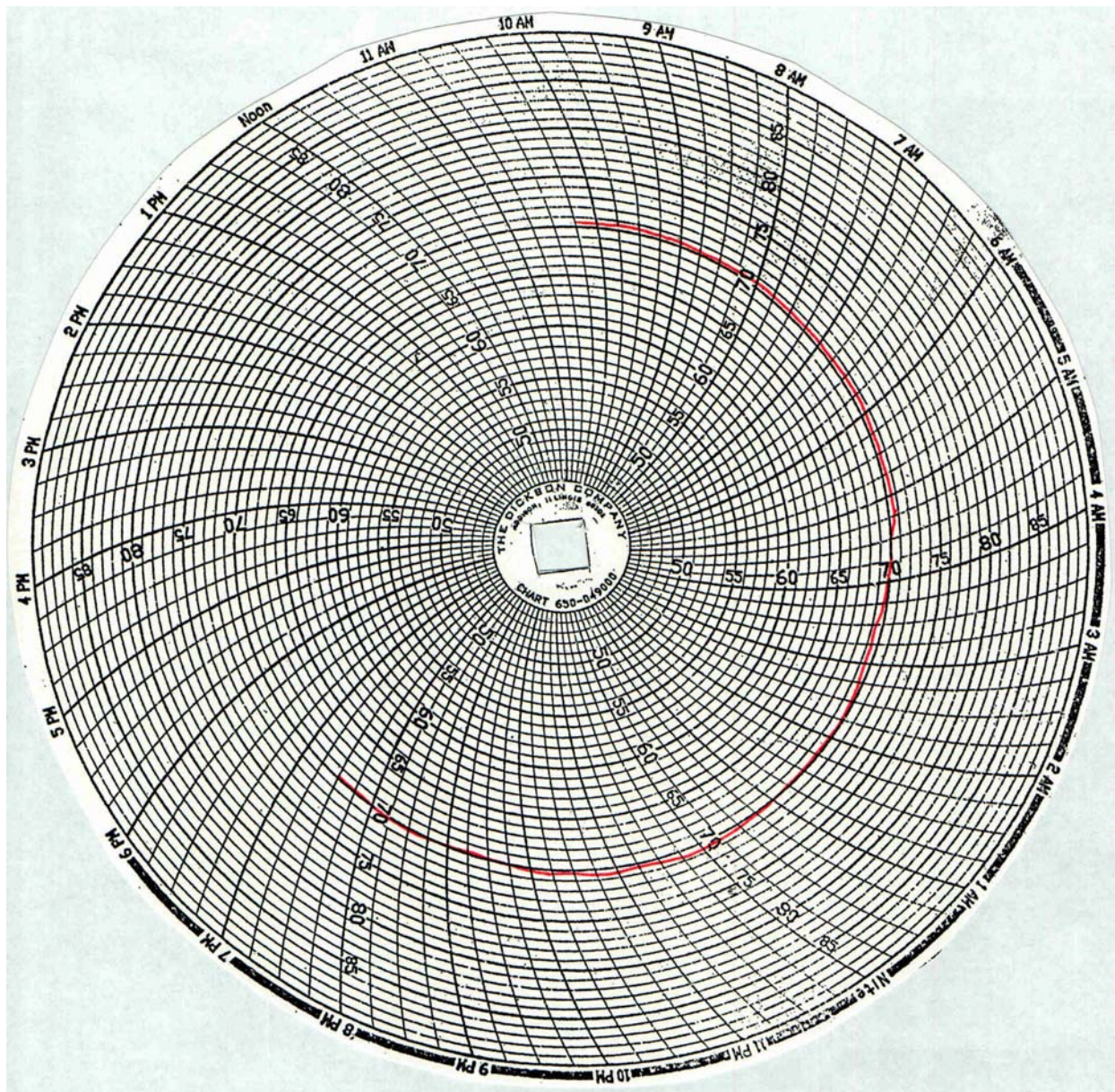
ROLLOVER SOLVENT SPILLAGE LOCATION TABLE

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: 2011 Hyundai Sonata GLS 4-Dr Sedan
Test Program: NCAP Frontal Barrier Impact Test

NHTSA No.: UB0501
Test Date: 1/05/2011



APPENDIX A
PHOTOGRAPHS

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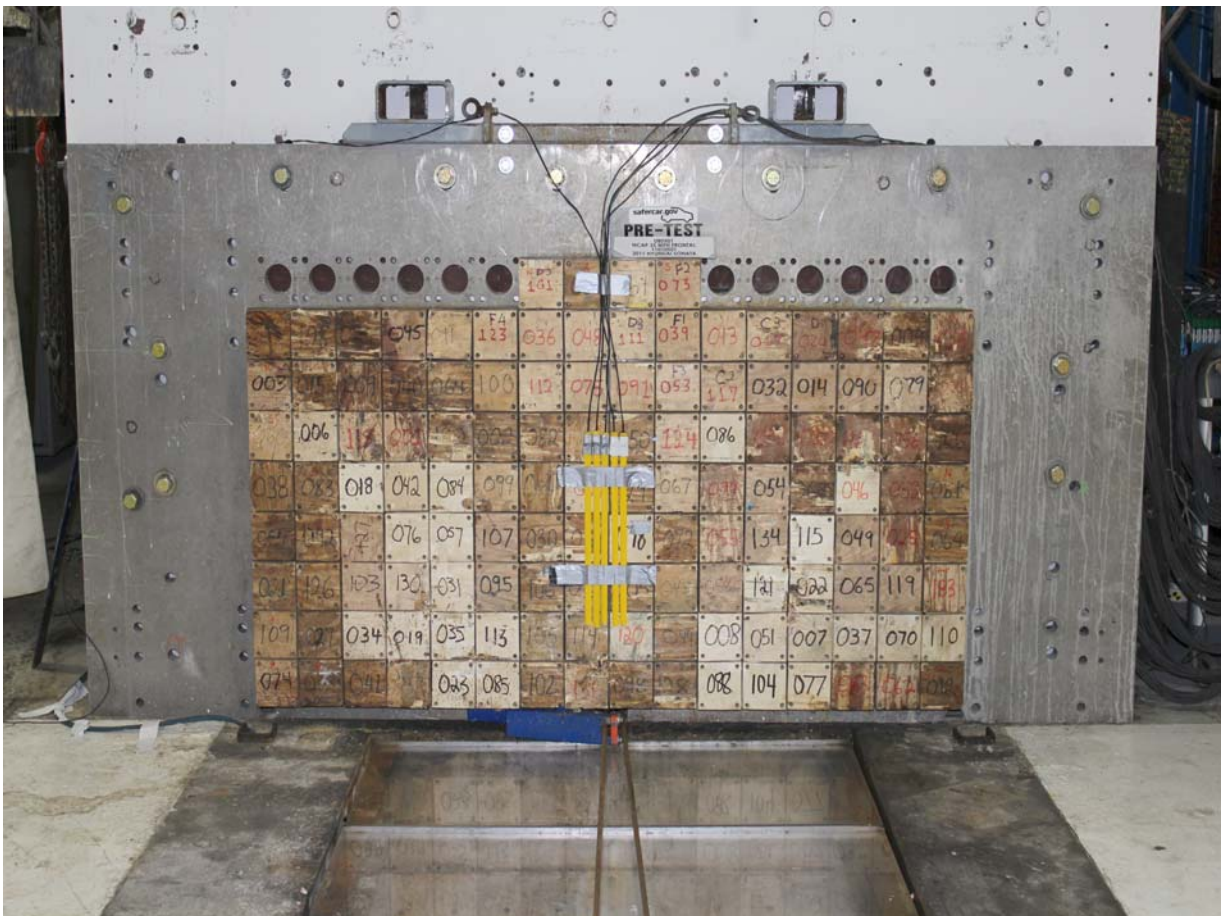
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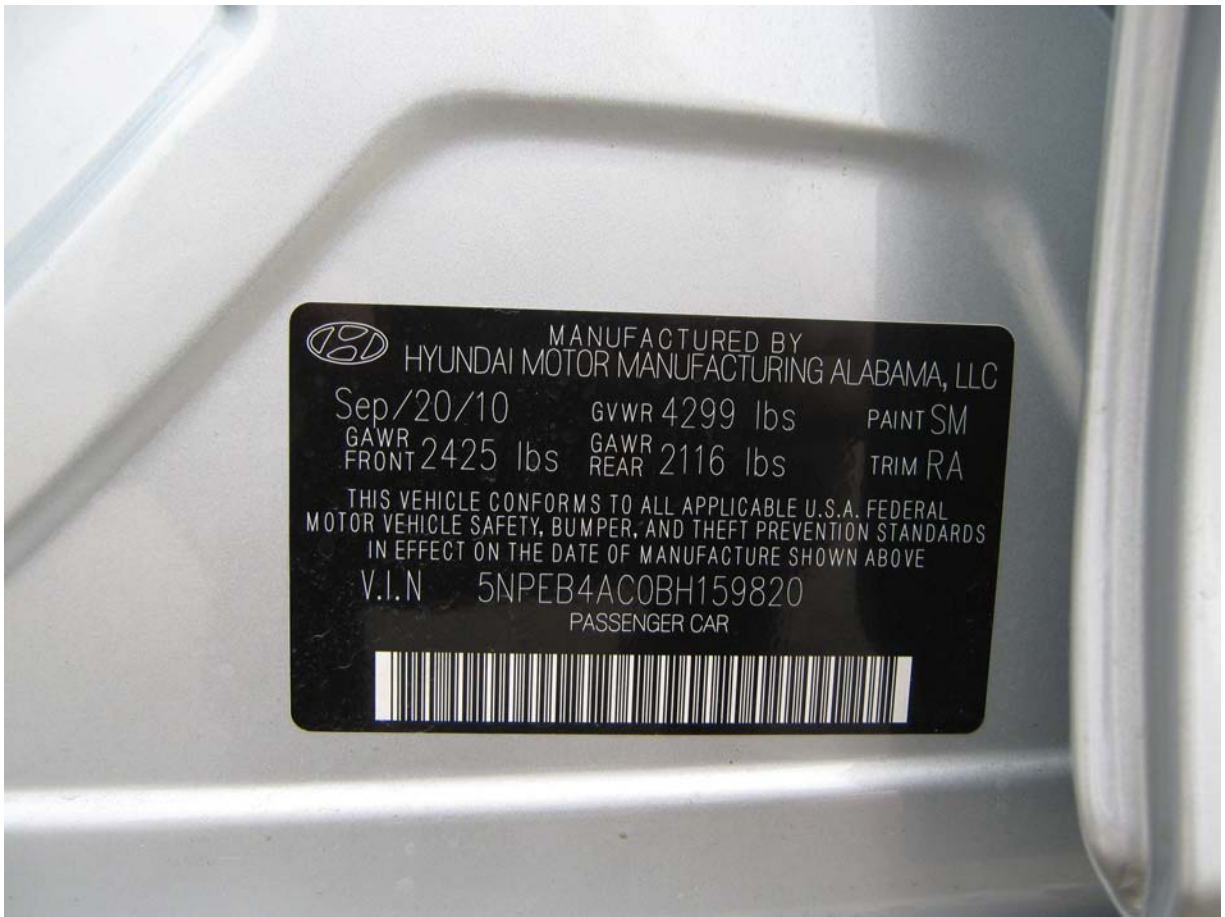
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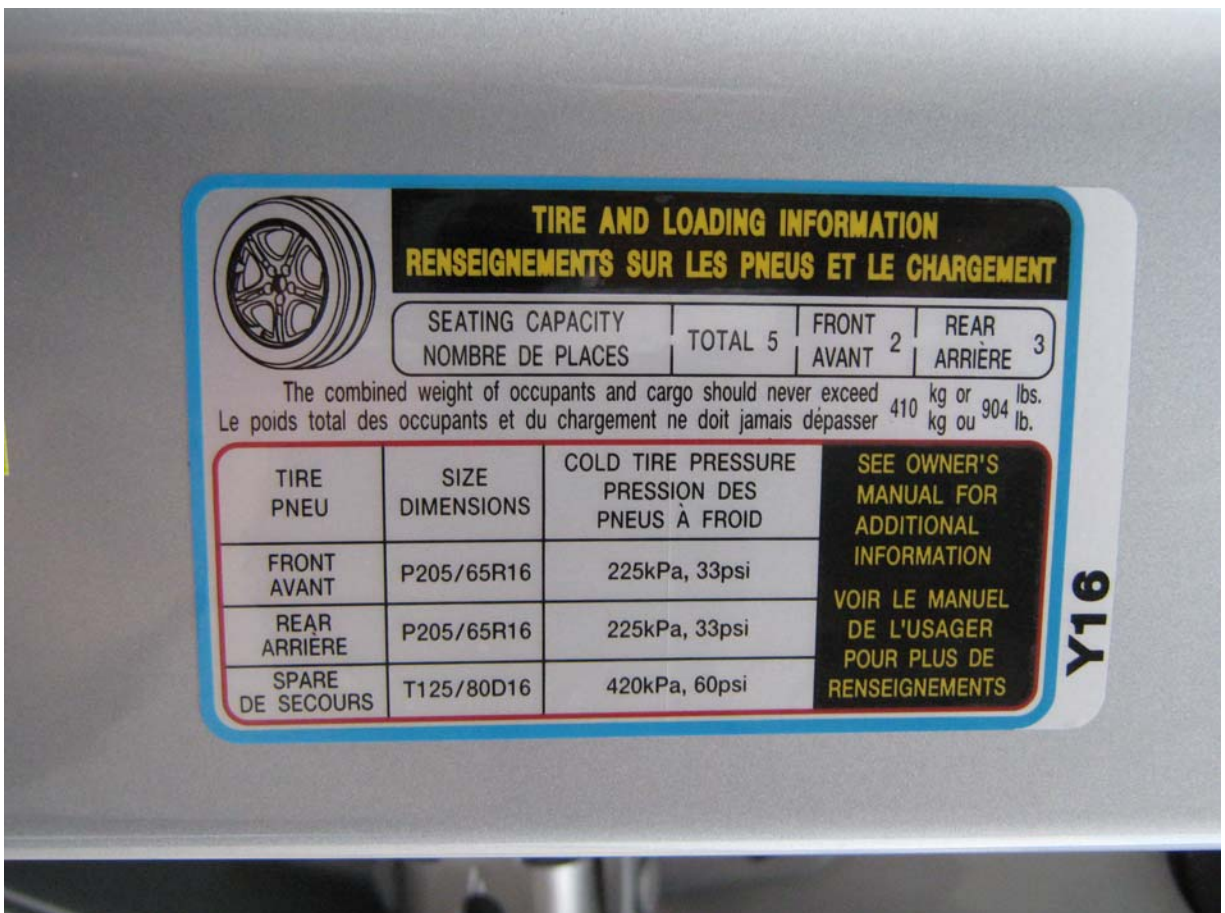
Load Cell Location



Load Cell Wall



Manufacturer's Label



Tire Placard



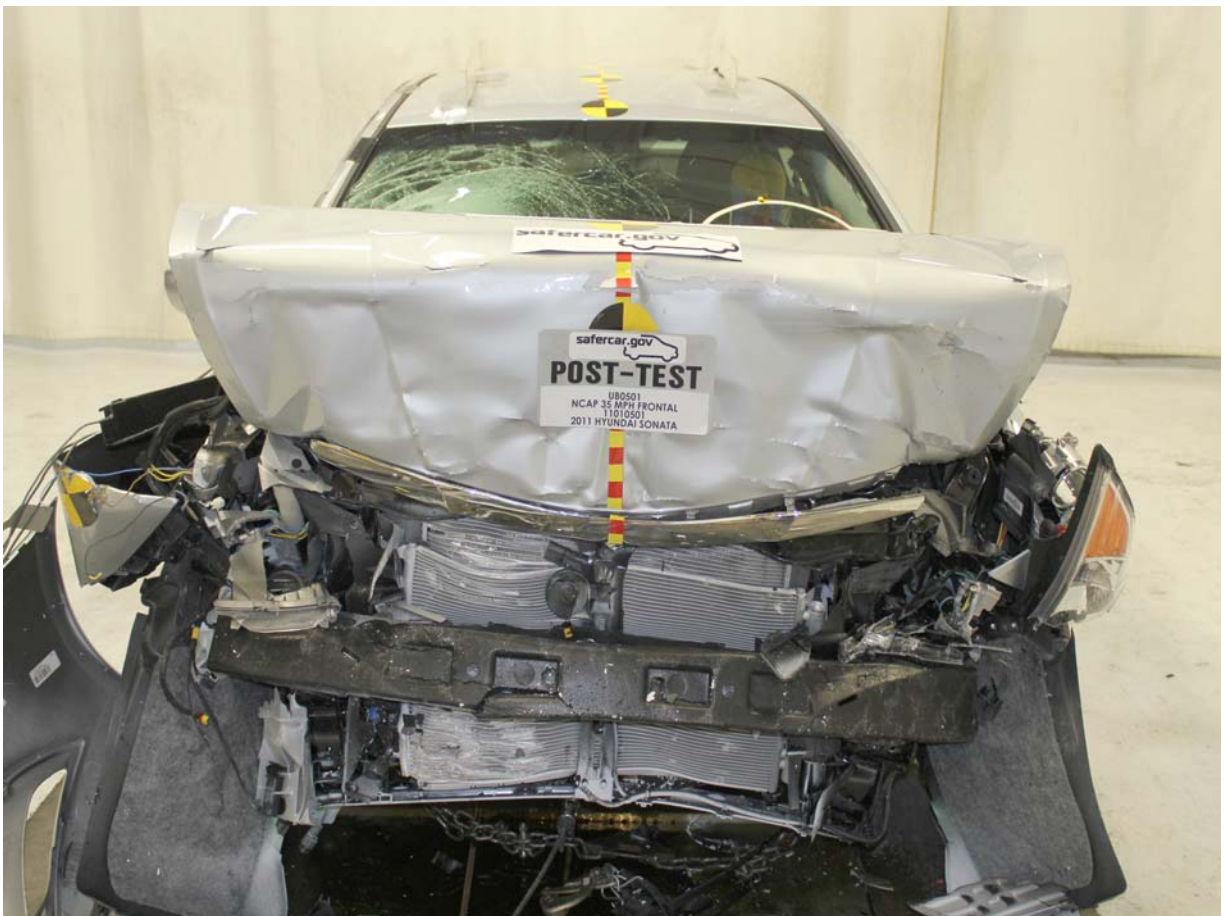
Right Front Three-Quarter View, As Received



Left Rear Three-Quarter View, As Received



Pre-Test Front View



Post-Test Front View



Pre-Test Left Side View (with vehicle at barrier)



Post-Test Left Side View



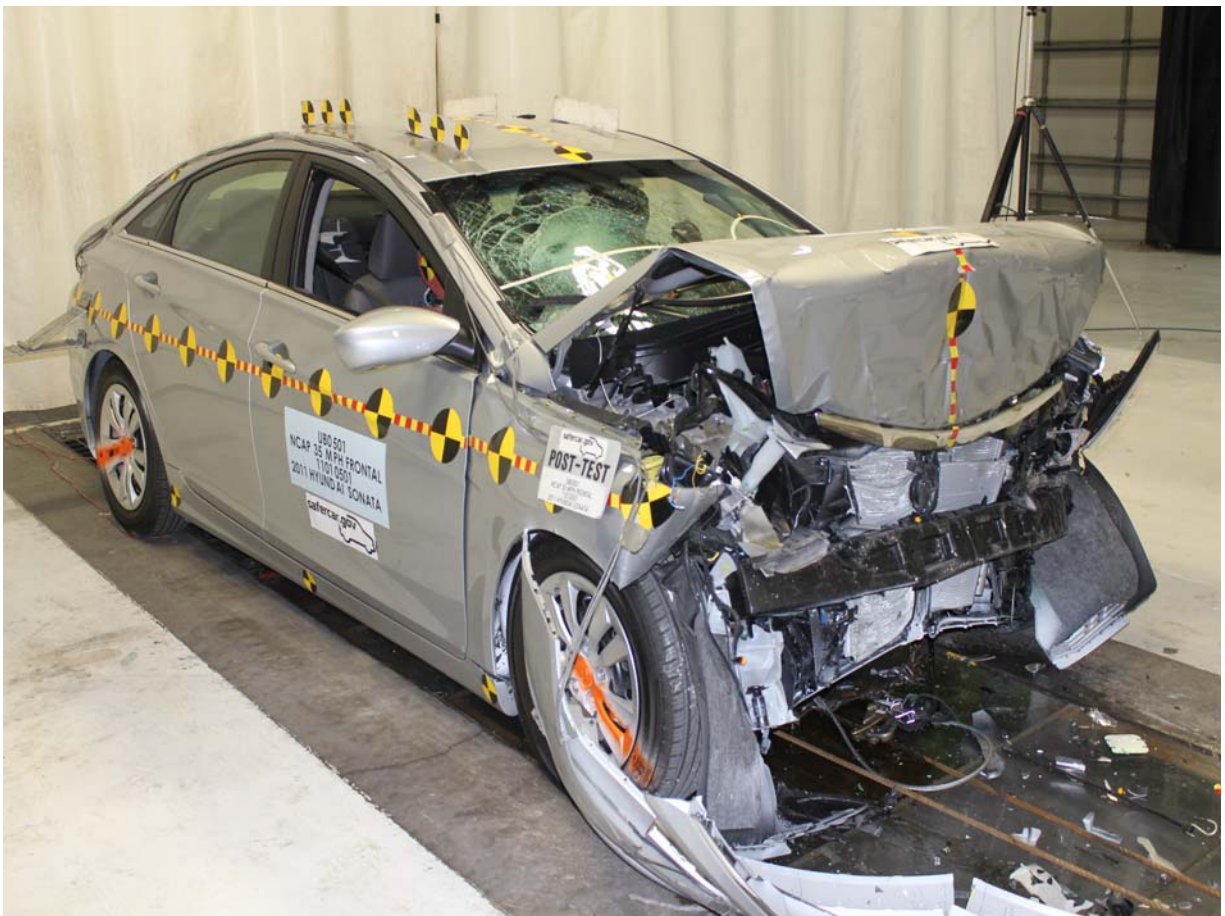
Pre-Test Right Side View (with vehicle at barrier)



Post-Test Right Side View



Pre-Test Right Front Three-Quarter View



Post-Test Right Front Three-Quarter View



Pre-Test Left Rear Three-Quarter View (with vehicle at barrier)



Post-Test Left Rear Three-Quarter View



Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



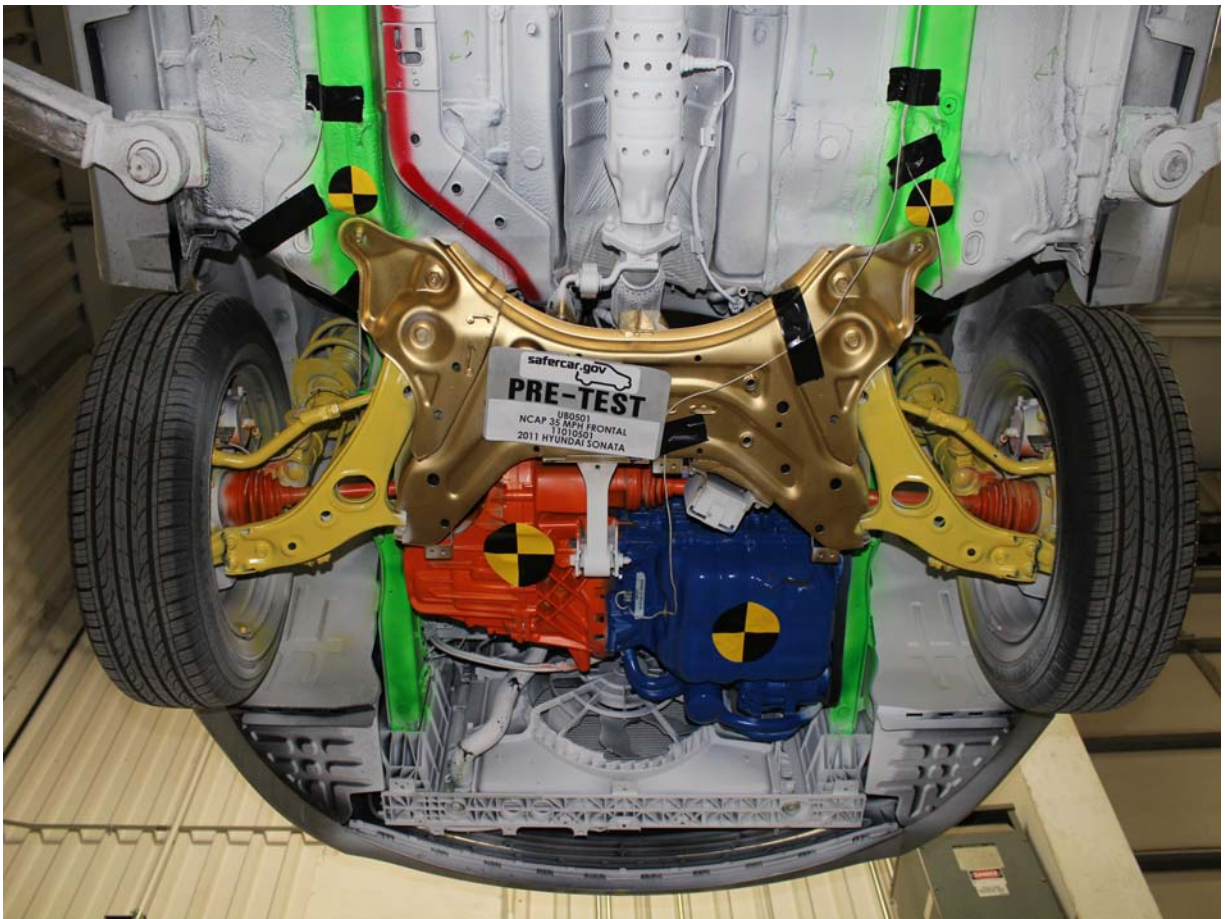
Post-Test Engine Compartment View



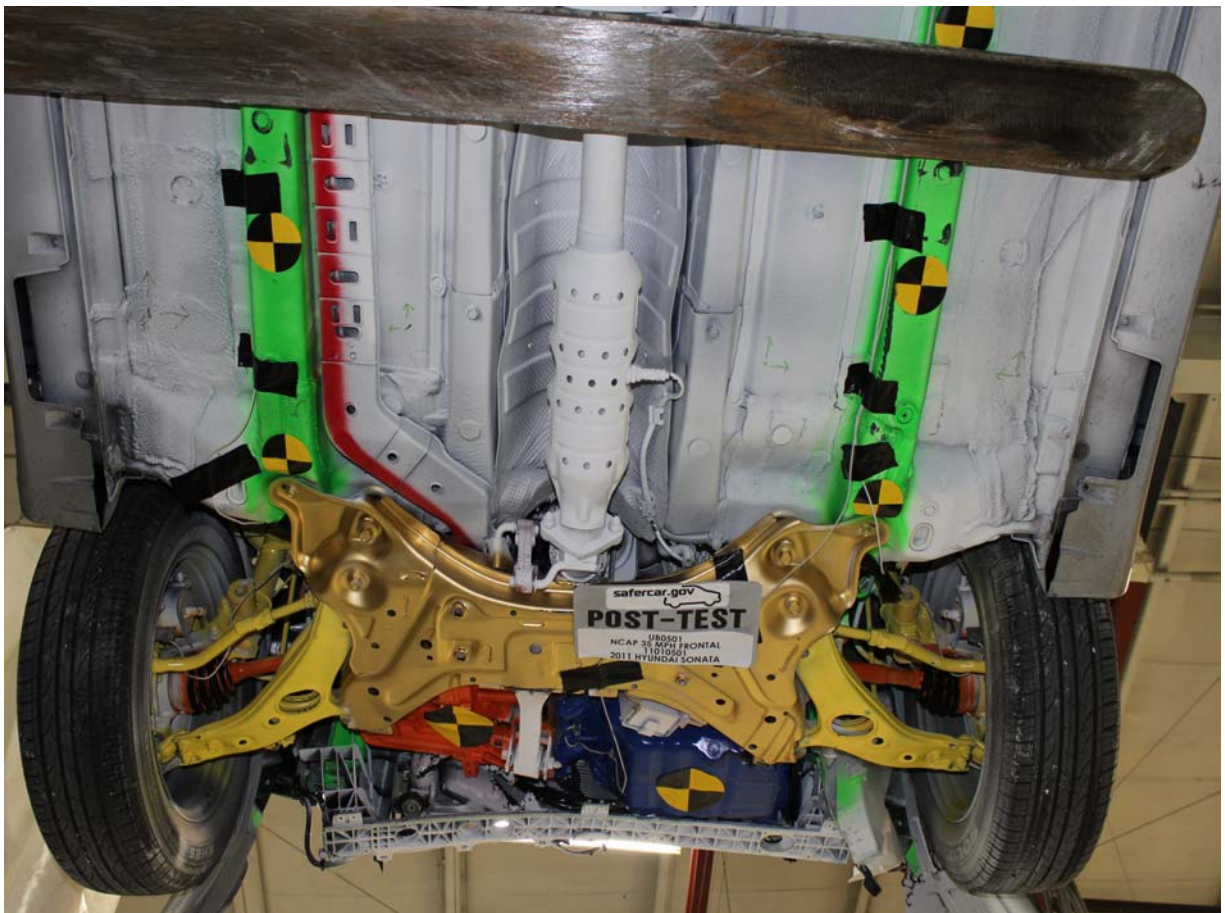
Pre-Test Fuel Cap View



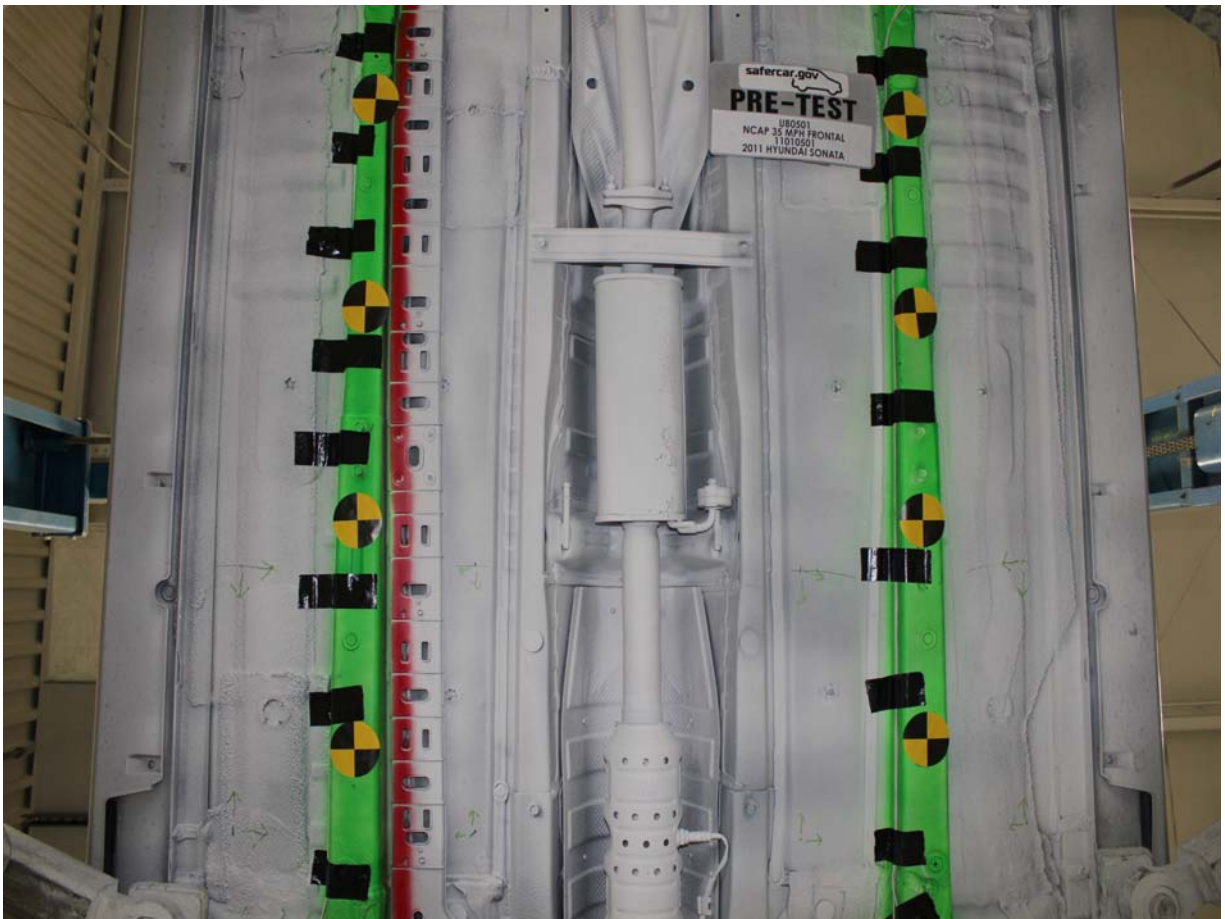
Post-Test Fuel Cap View



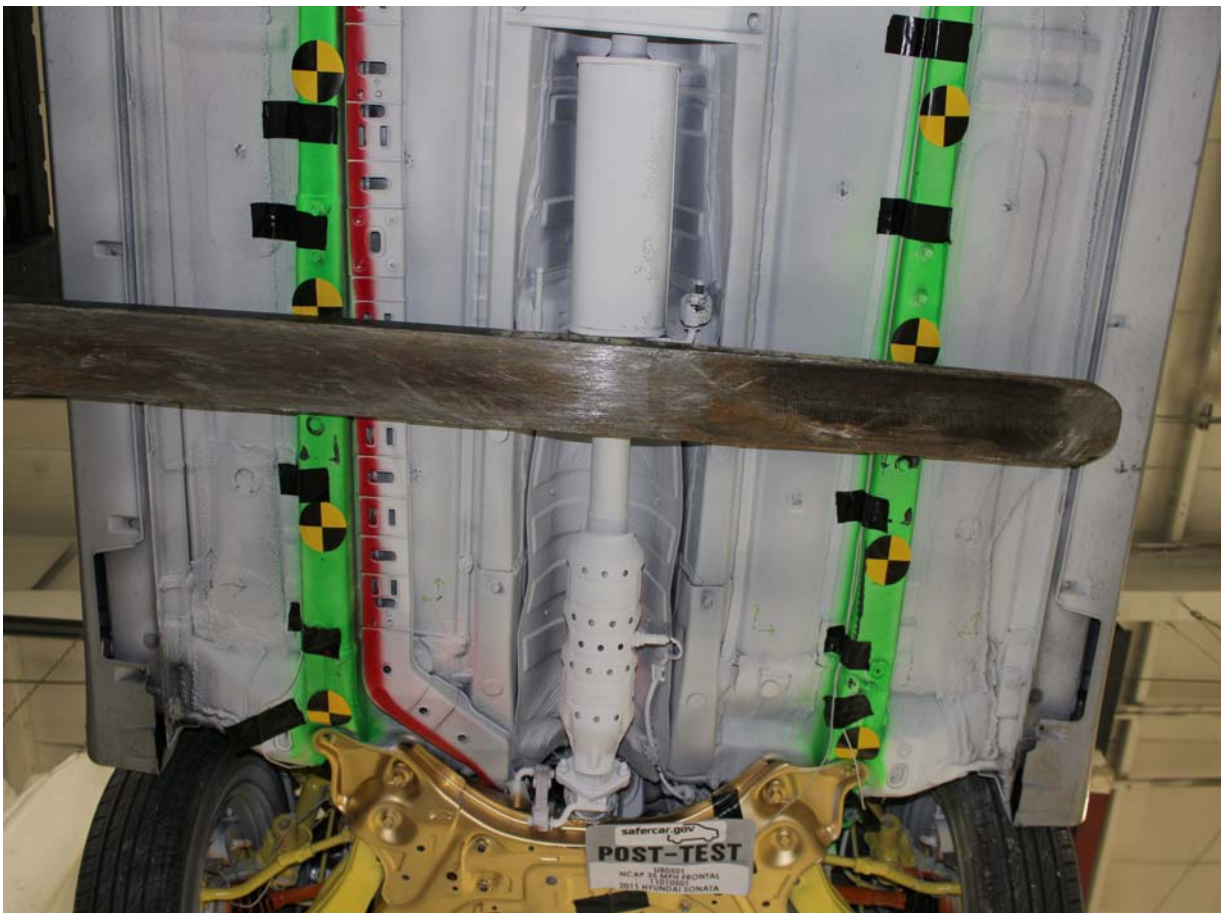
Pre-Test Front Underbody View



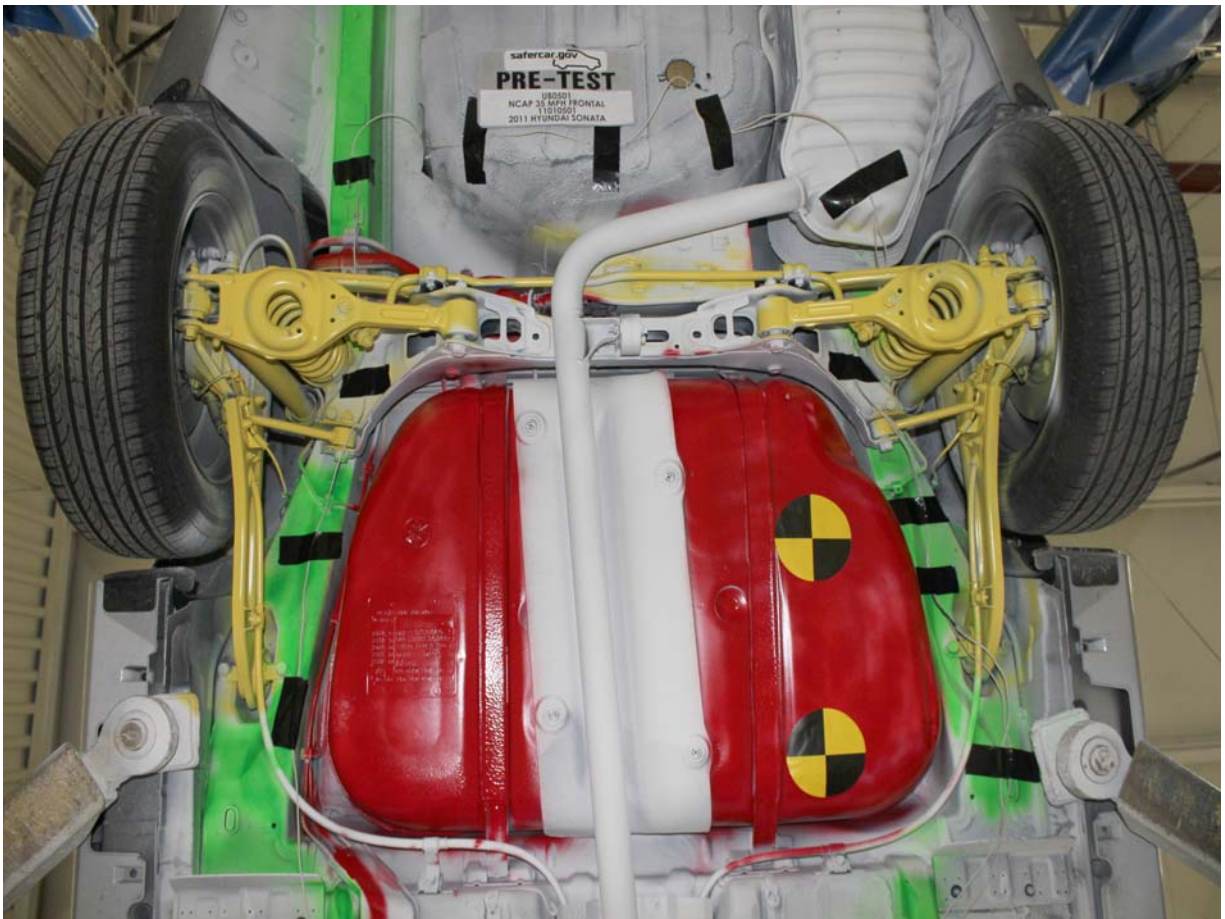
Post-Test Front Underbody View



Pre-Test Mid Front Underbody View



Post-Test Mid Front Underbody View



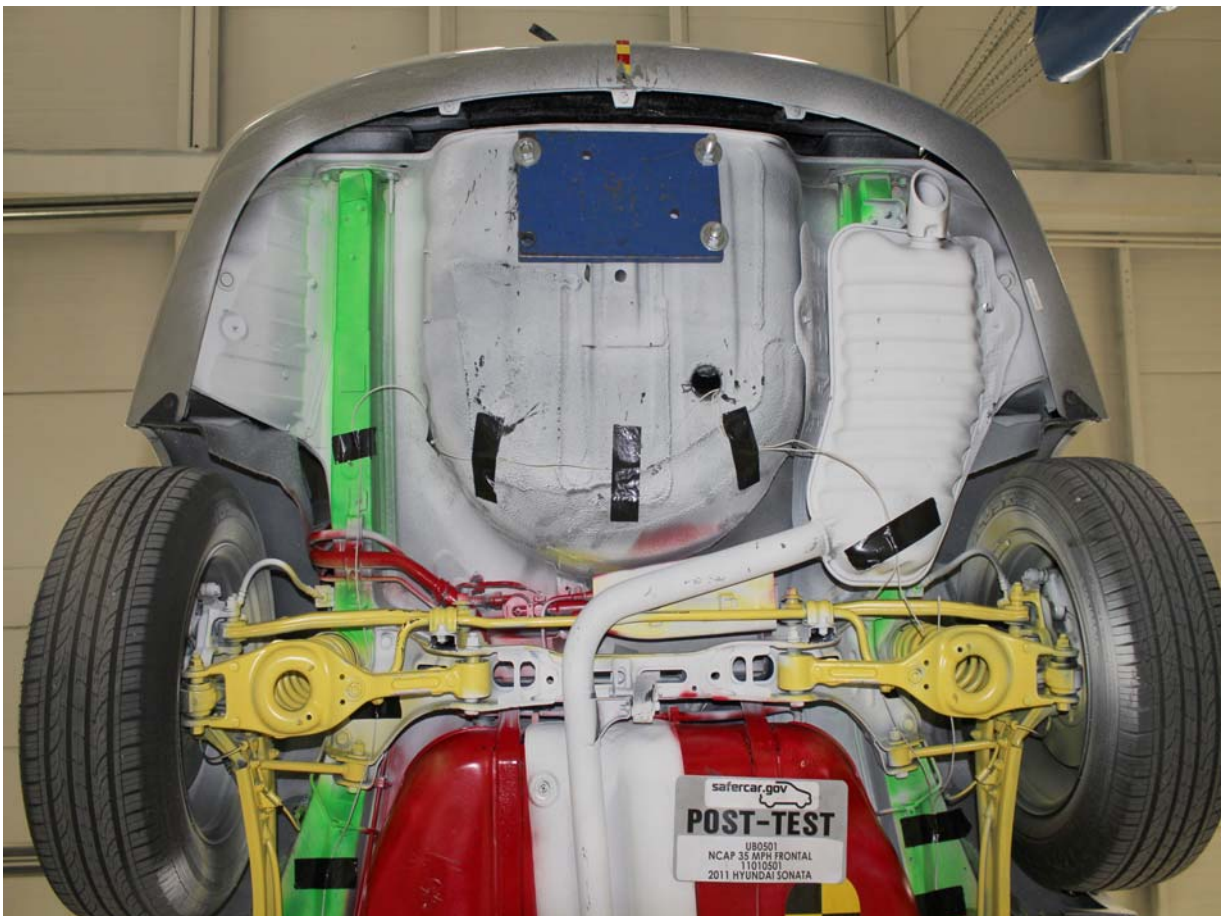
Pre-Test Mid Rear Underbody View



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



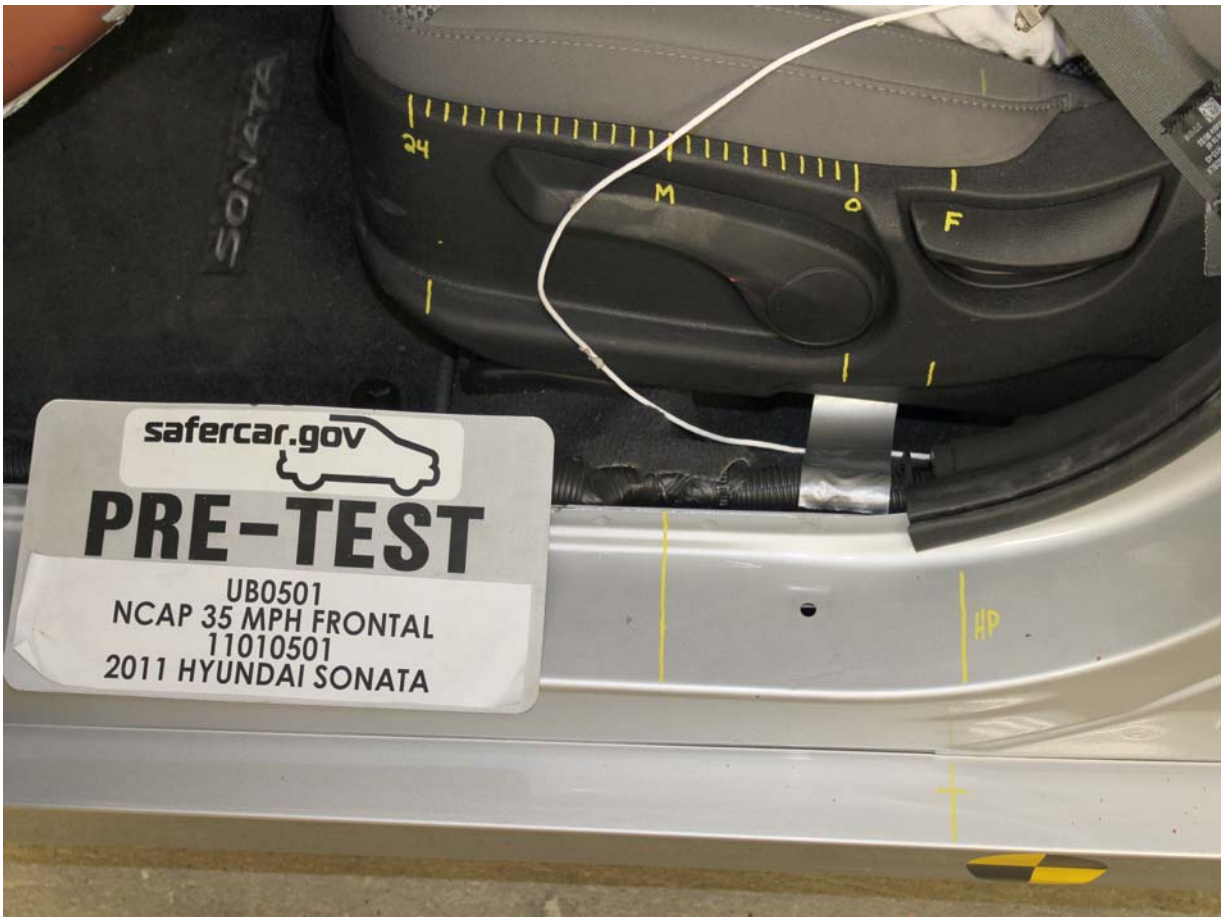
Post-Test Driver Dummy Window View



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 Driver Dummy Feet



Post-Test Driver Dummy Feet



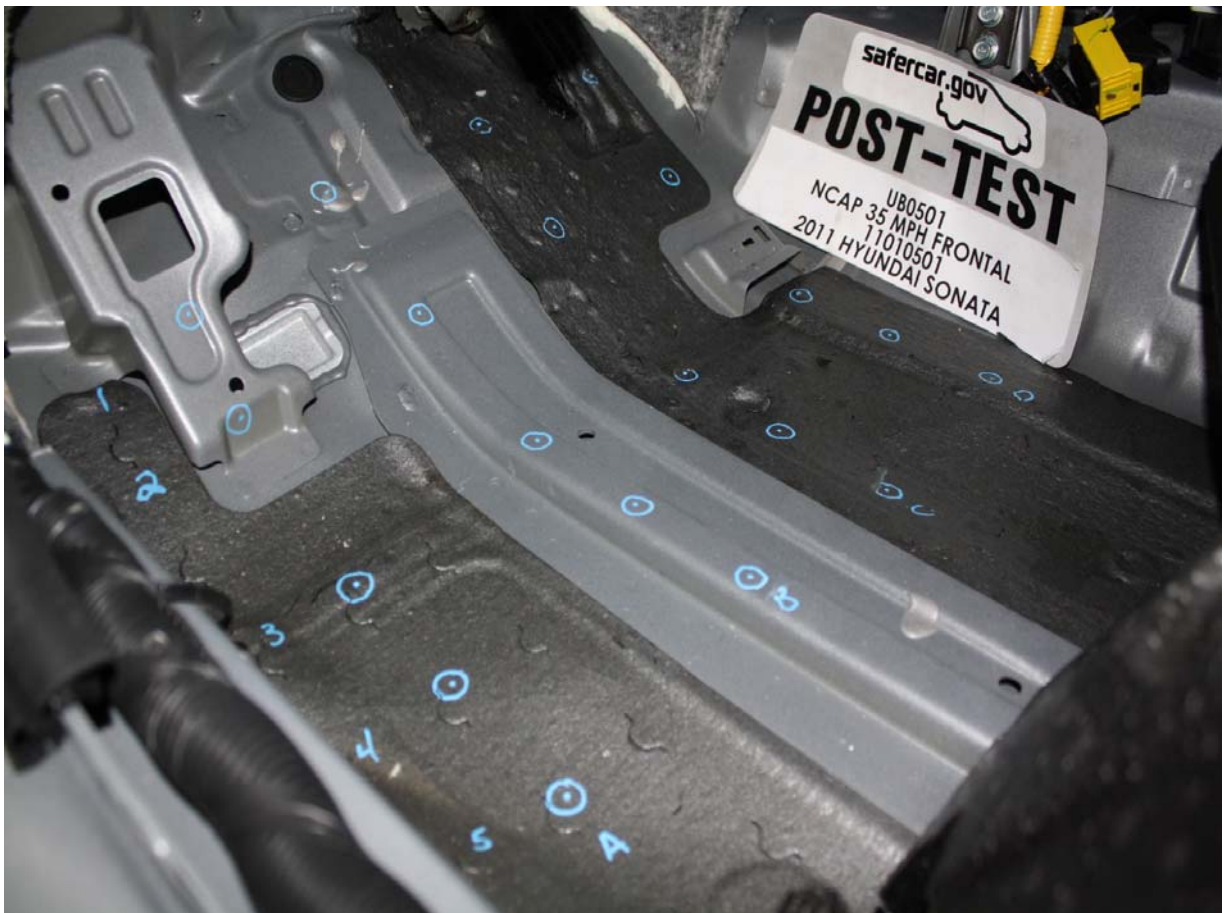
Pre-Test Driver's Side Knee Bolster (without dummy)



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



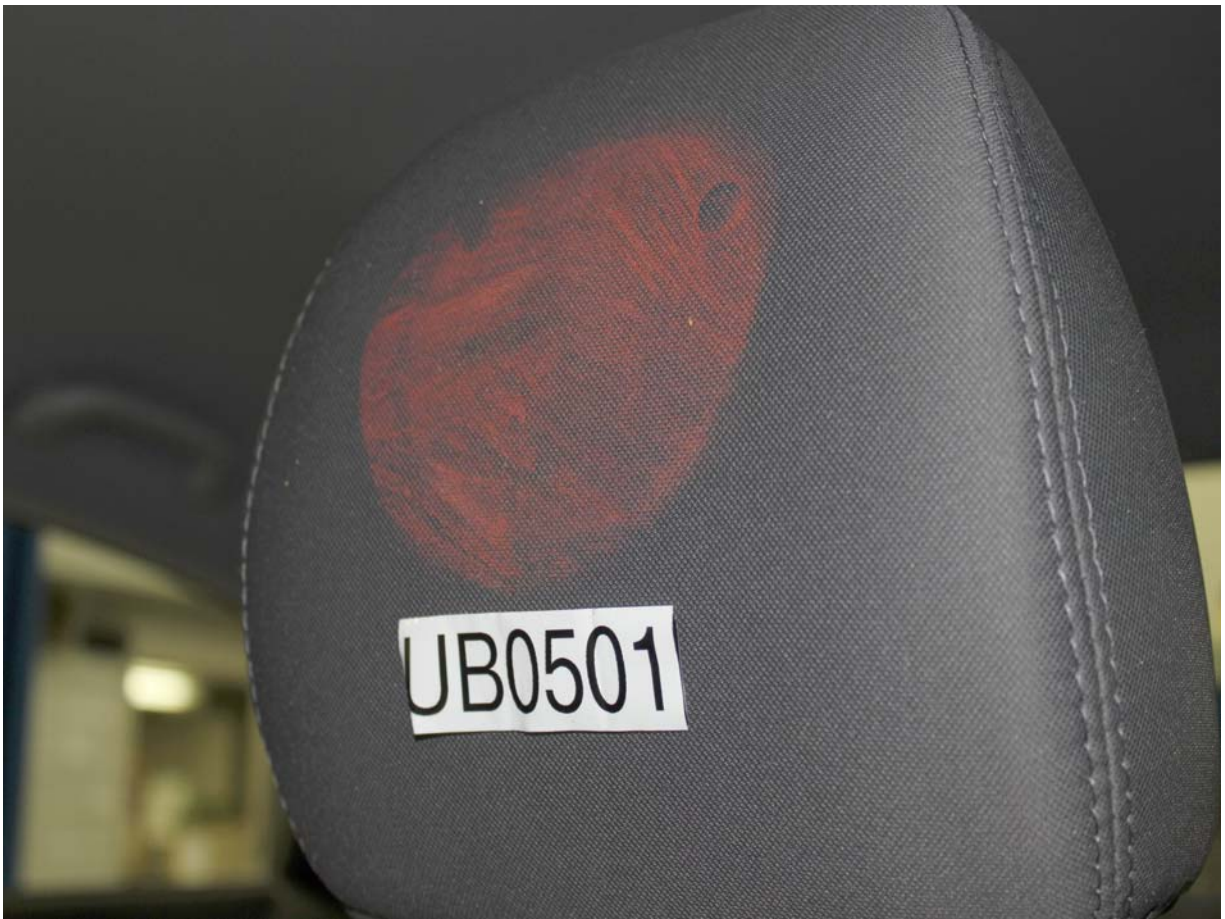
Pre-Test Driver's Side Floorpan



Post-Test Driver's Side Floorpan



Post-Test Driver Dummy Contact with Airbag



Post-Test Driver Dummy Contact with Headrest



Post-Test Driver Dummy Contact with Knee Bolster



Pre-Test View of Steering Column Shear Capsule



Post-Test View of Steering Column Shear Capsule



Pre-Test Passenger Dummy Front View



Post-Test Passenger Dummy Front View



Pre-Test Passenger Dummy Window View



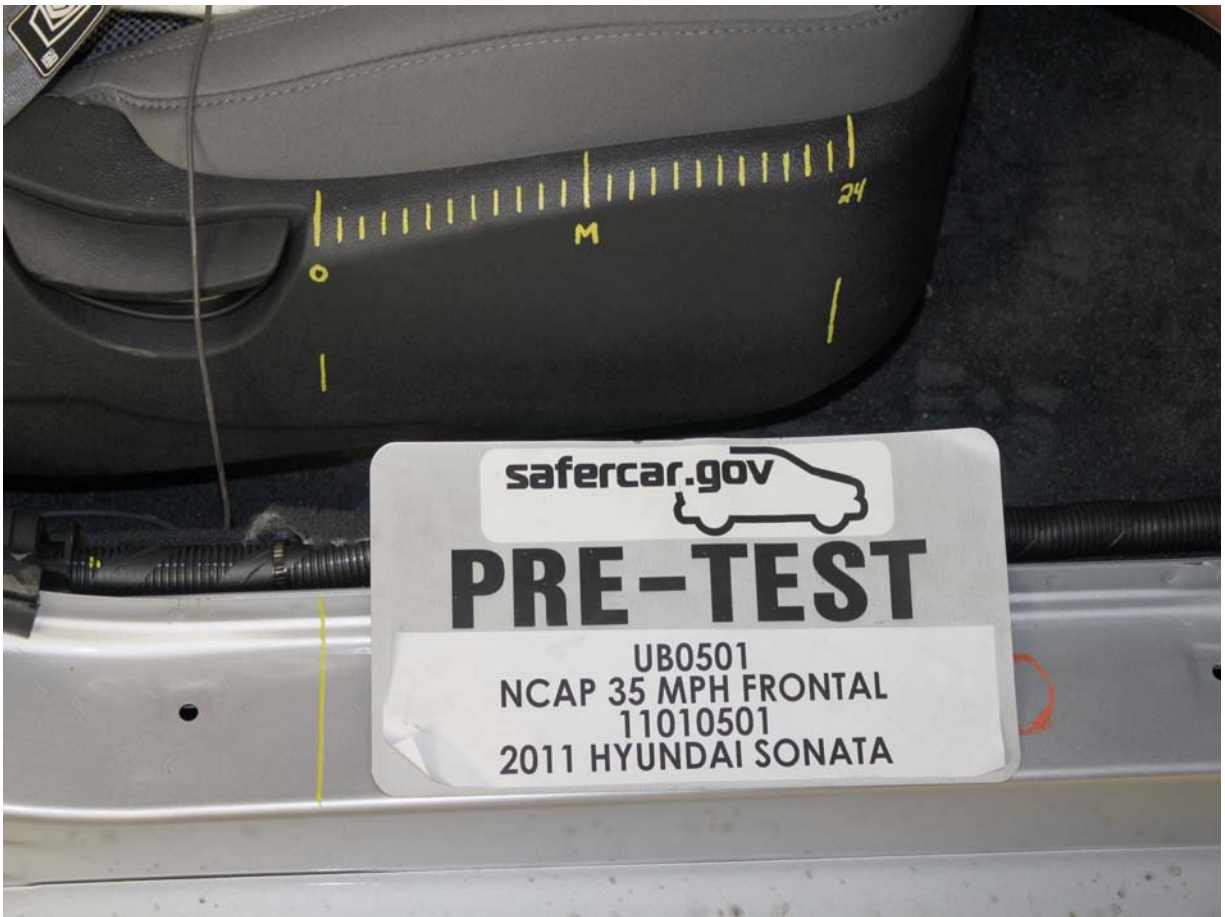
Post-Test Passenger Dummy Window View



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 Passenger Dummy Feet



Post-Test Passenger Dummy Feet



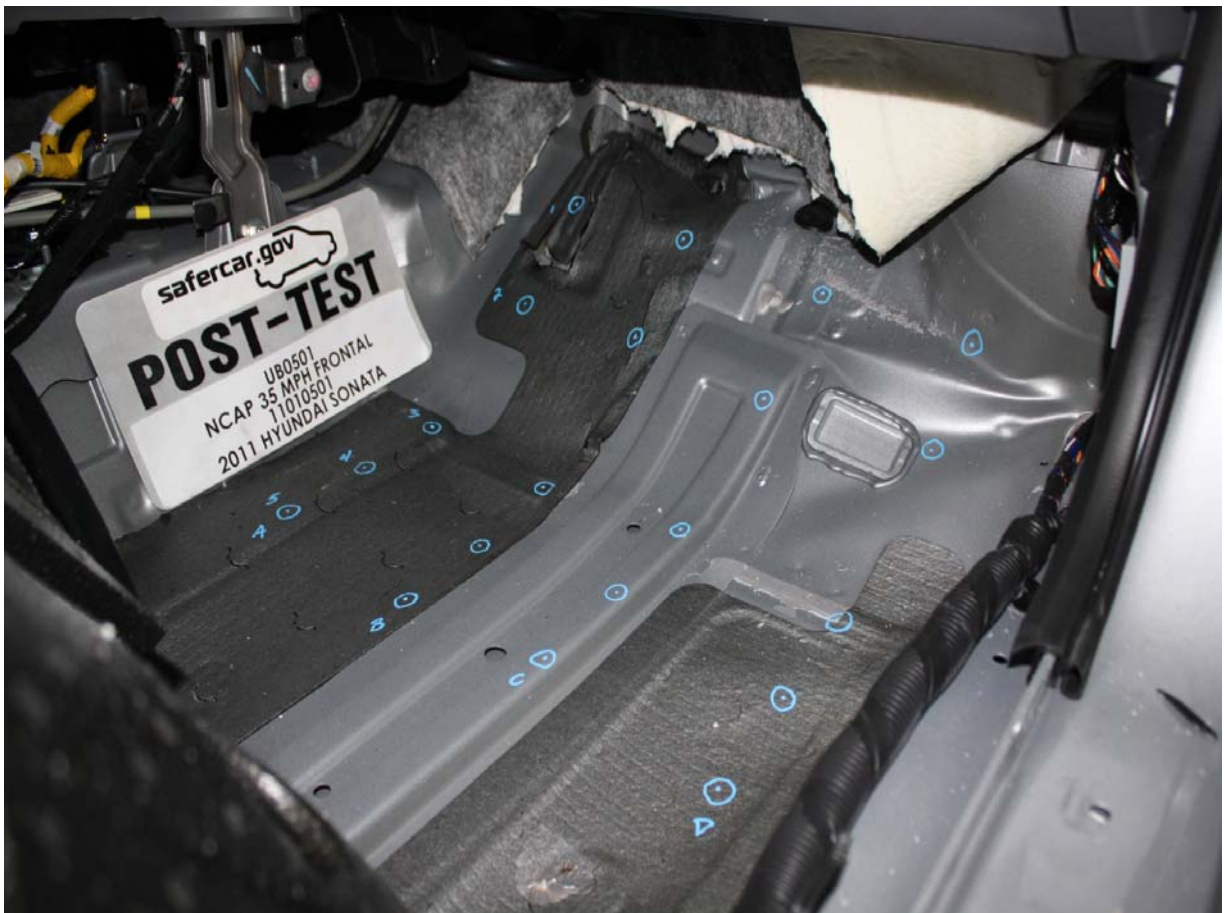
Pre-Test Passenger's Side Knee Bolster (without dummy)



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



Pre-Test Passenger's Side Floorpan



Post-Test Passenger's Side Floorpan



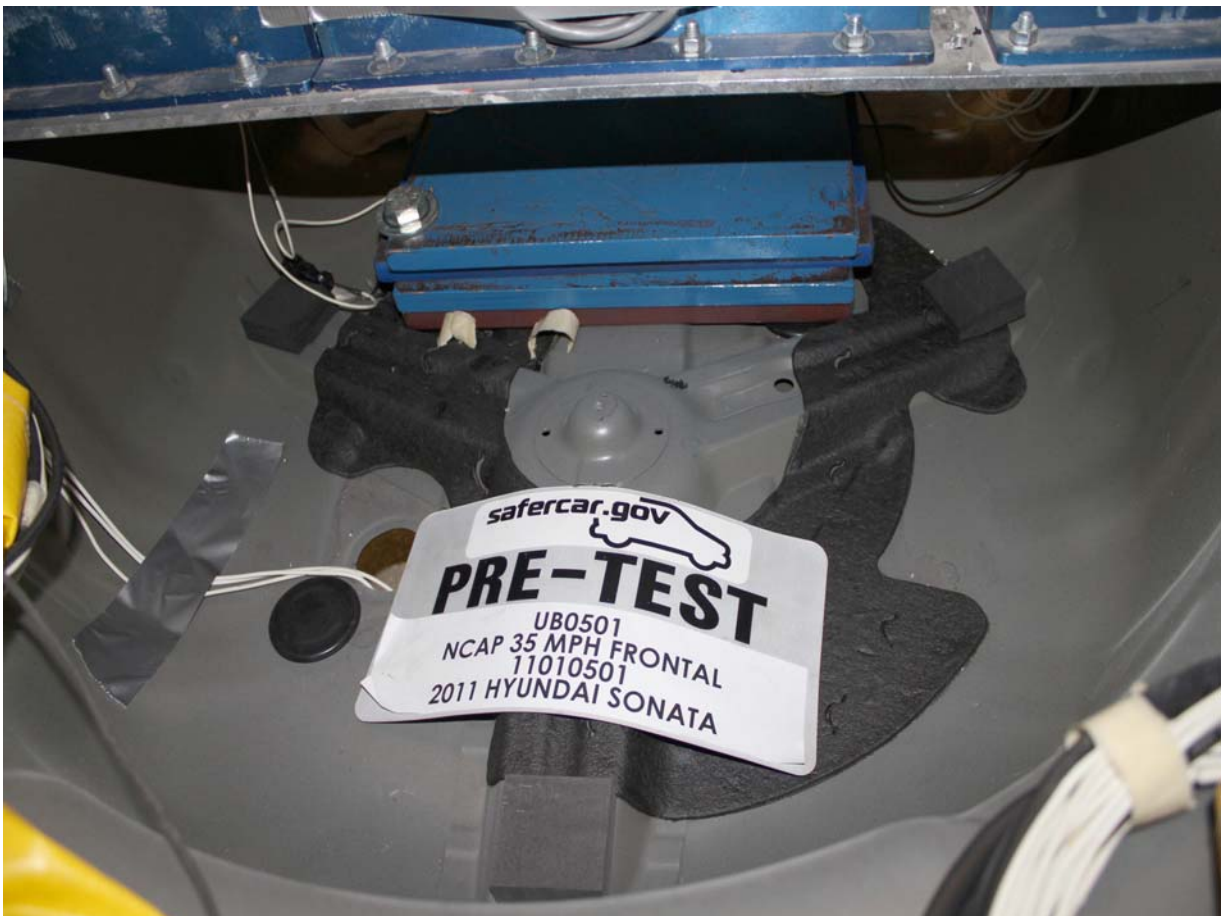
Post-Test Passenger Dummy Contact with Airbag



Post-Test Passenger Dummy Contact with Headrest



Post-Test Passenger Dummy Contact with Glovebox



Ballast Installed in Vehicle

PHOTOGRAPH NOT APPLICABLE

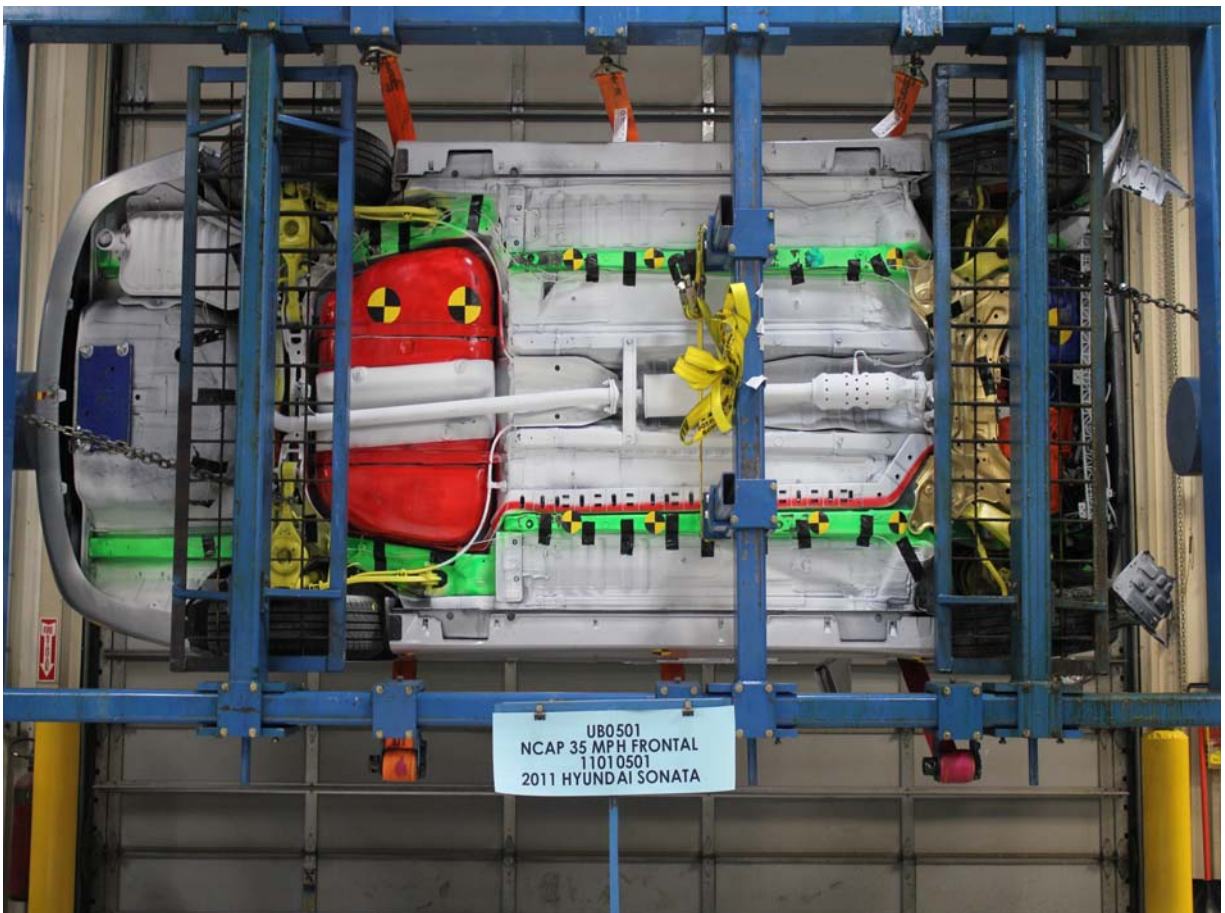
Post-Test Stoddard Solvent Spillage Location View



Post-Test Speed Trap Read-Out



Vehicle at 0 Degrees 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



Vehicle Impact

APPENDIX B
DUMMY RESPONSE DATA

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The following 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 Shoulder Belt Force

Driver Lap Belt Force

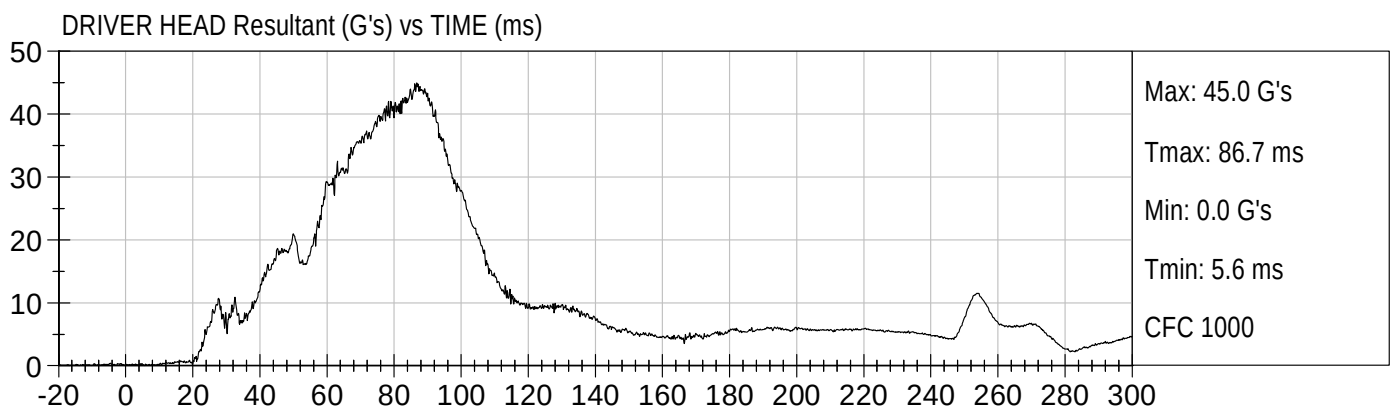
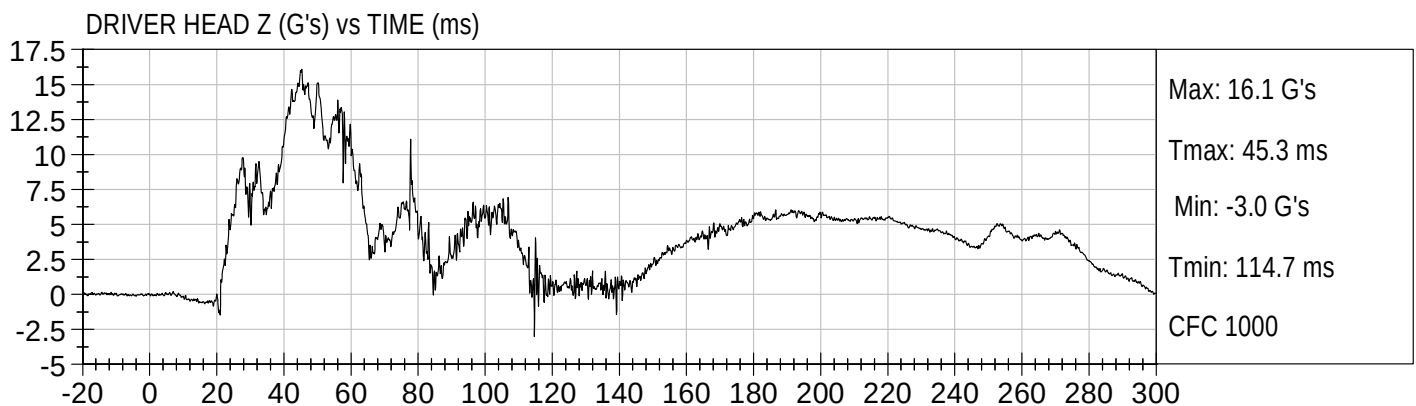
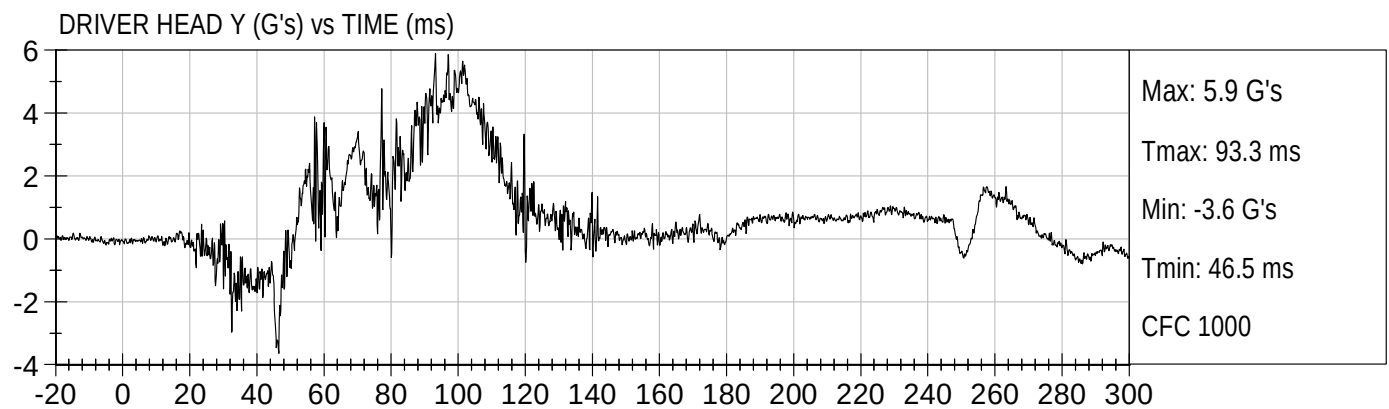
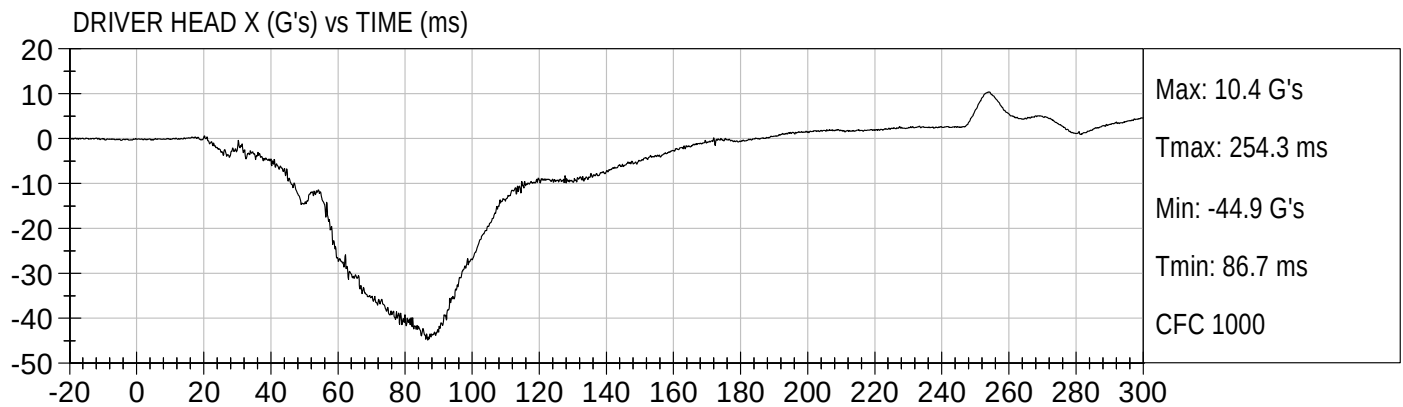
Driver Left Upper Tibia Moment X

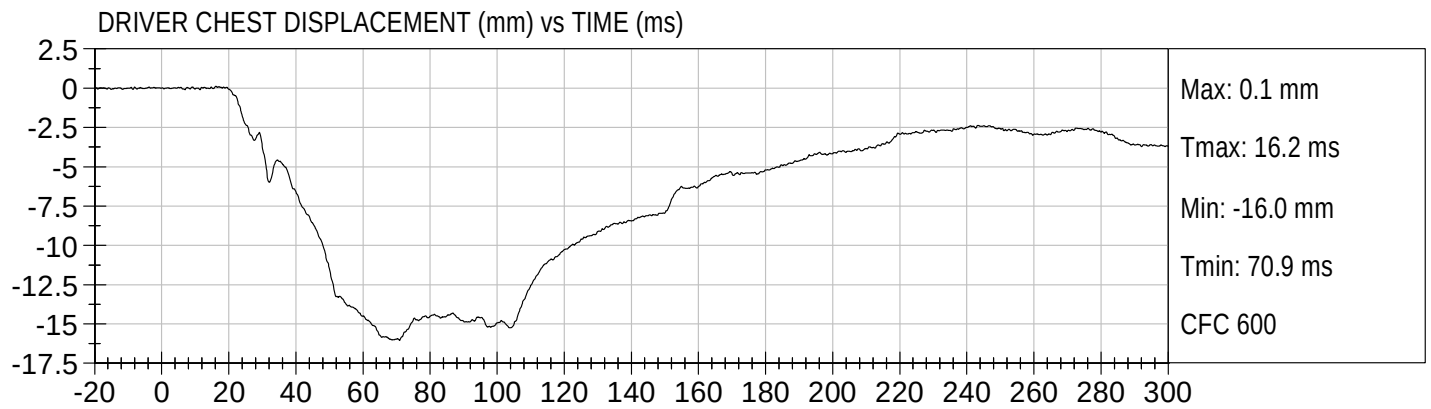
Driver Left Upper Tibia Moment Y

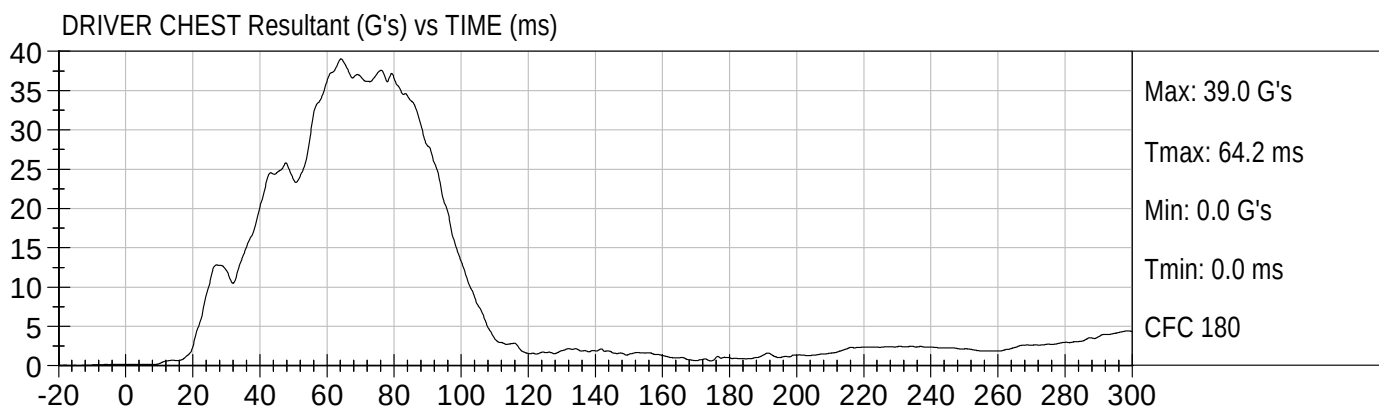
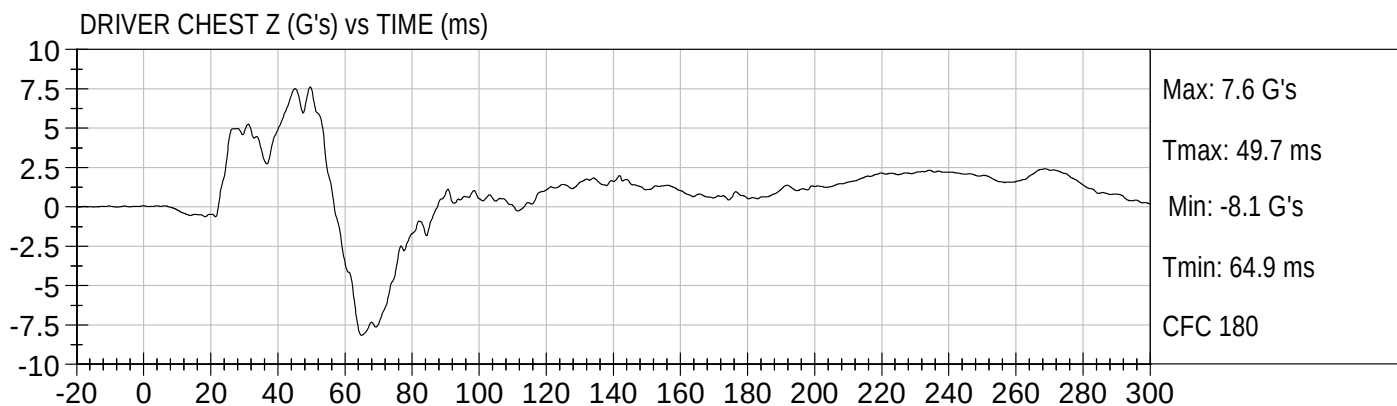
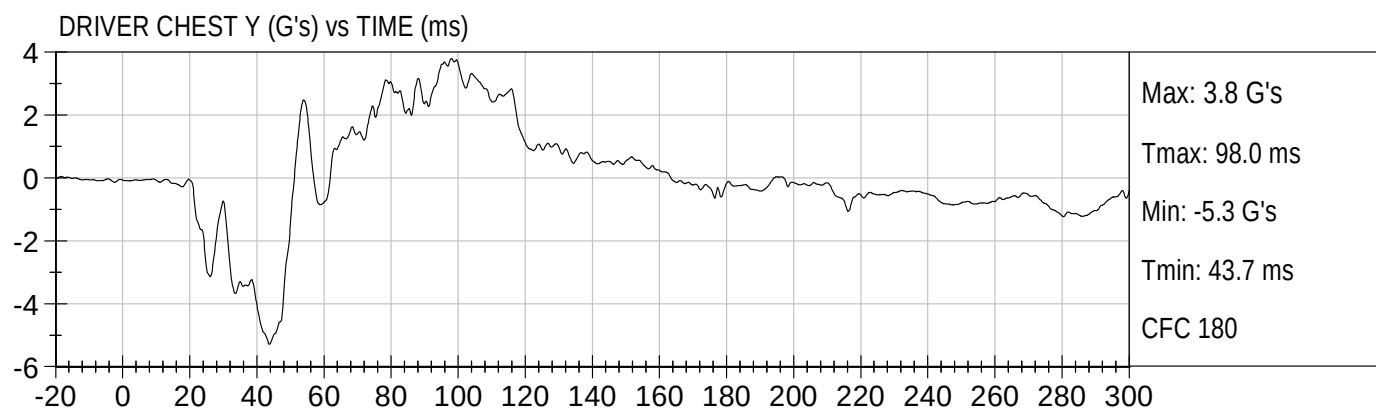
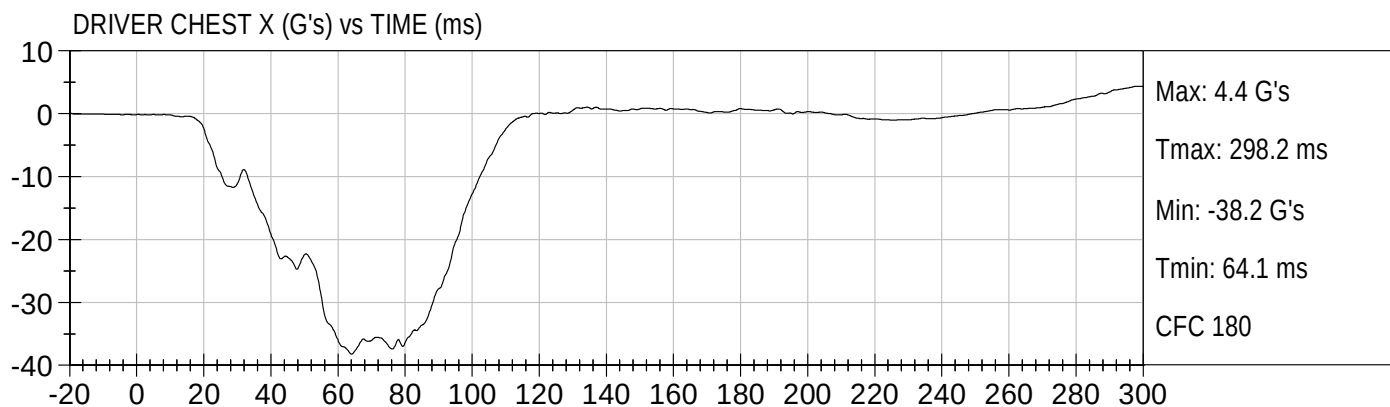
Driver Left Upper Tibia Force Z

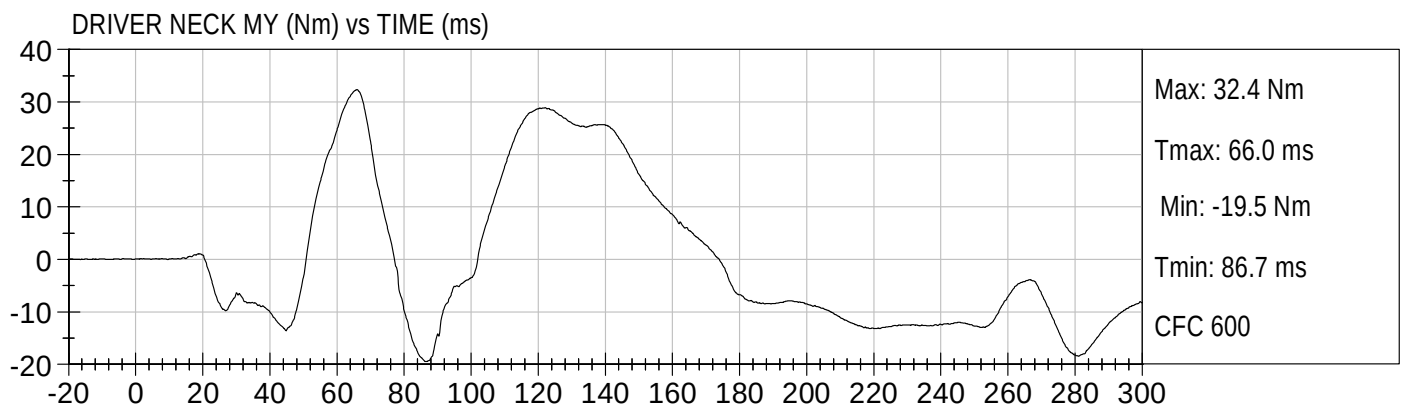
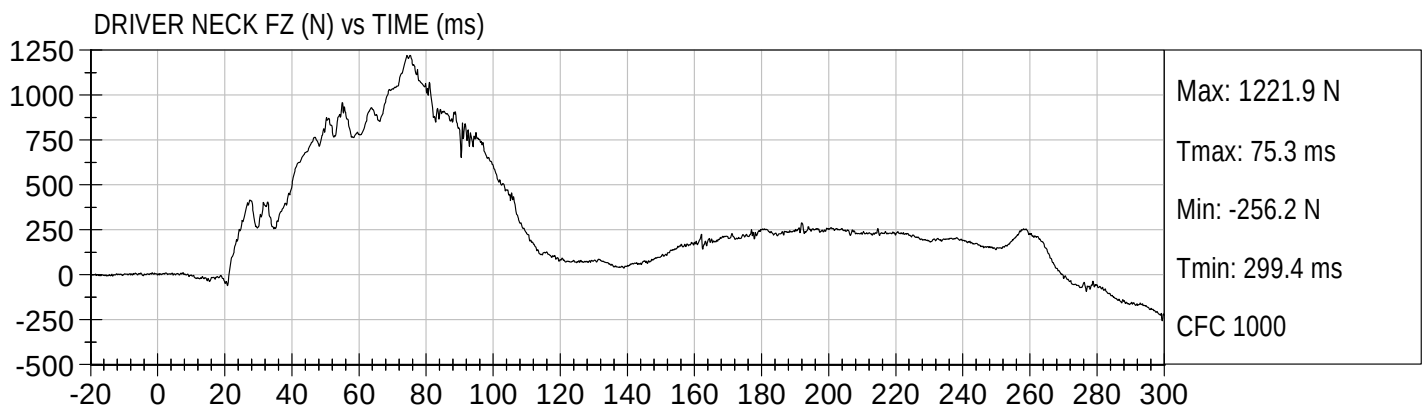
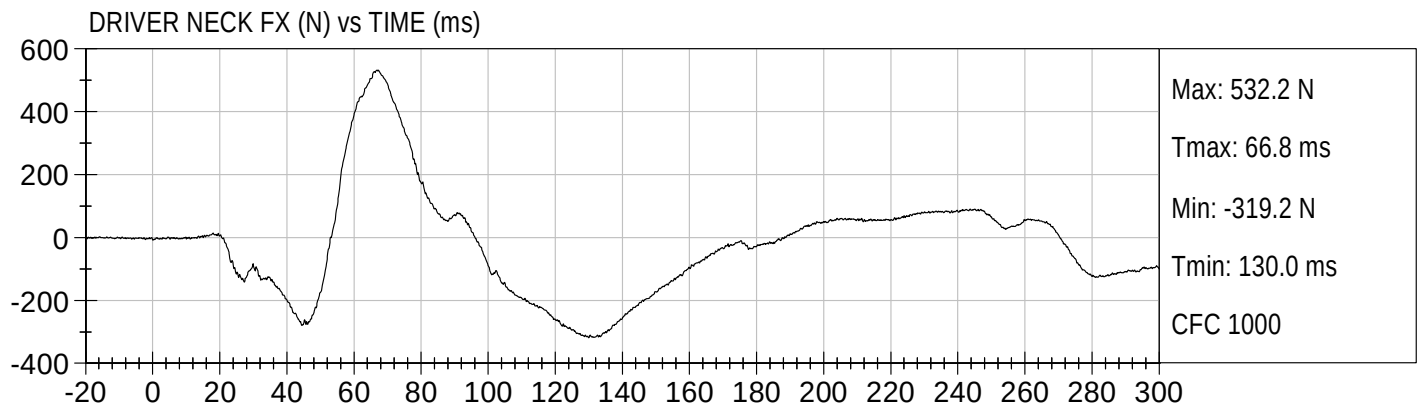
Driver Left Lower Tibia Moment X
Driver Left Lower Tibia Moment Y
Driver Left Lower Tibia Force Z
Driver Right Upper Tibia Moment X
Driver Right Upper Tibia Moment Y
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver 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
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 Lap Belt Force
Passenger Shoulder Belt Force – not installed

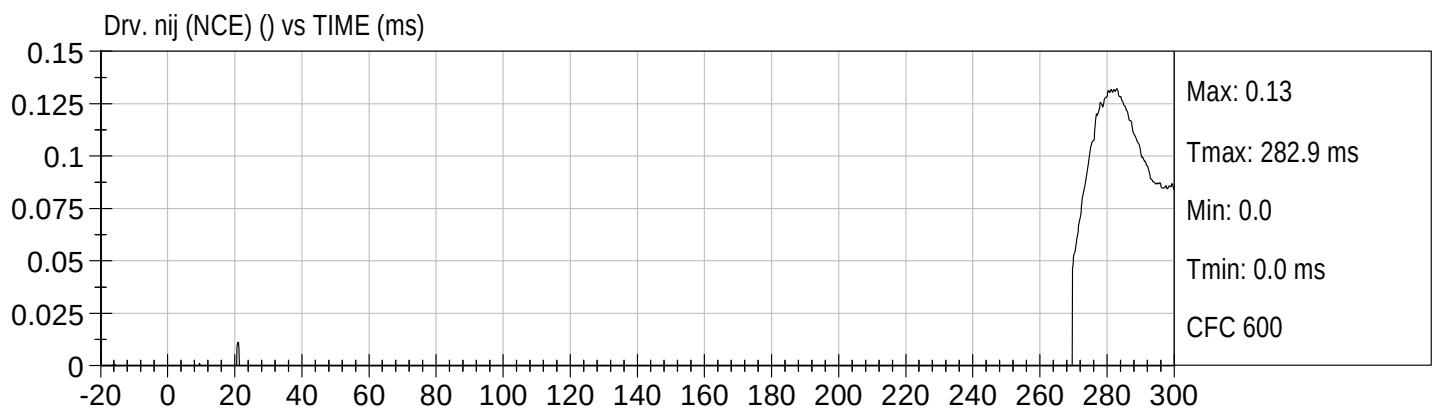
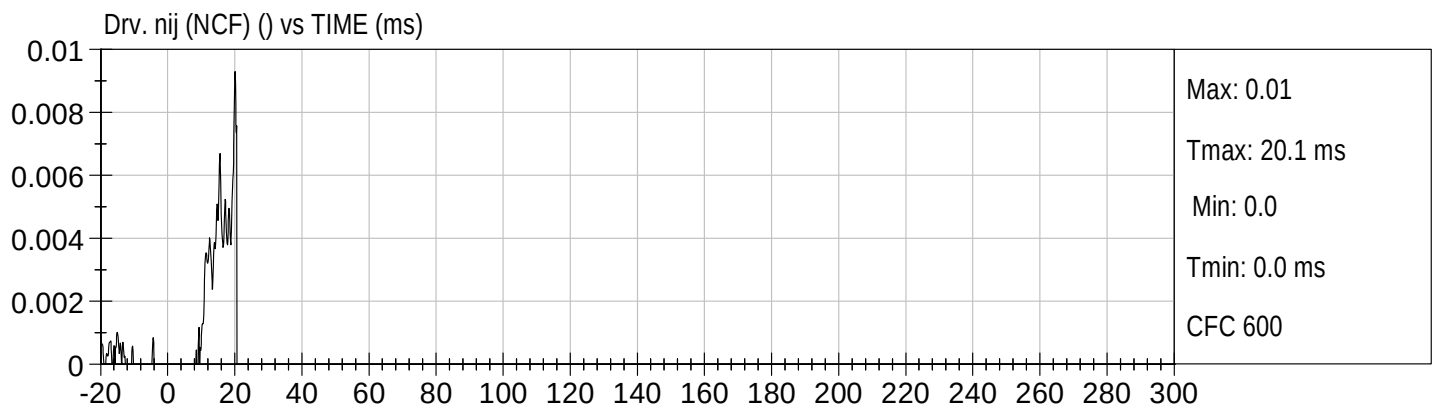
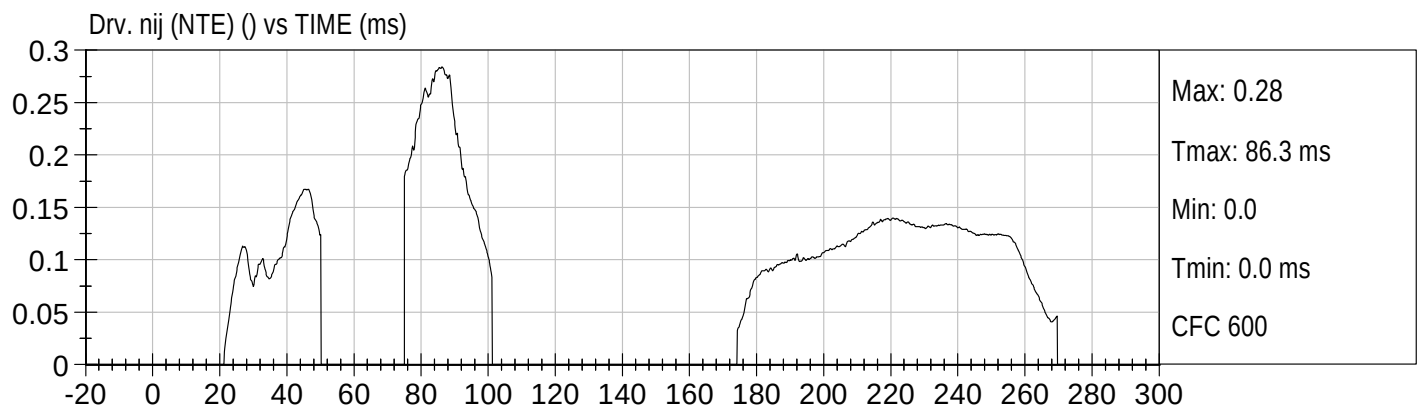
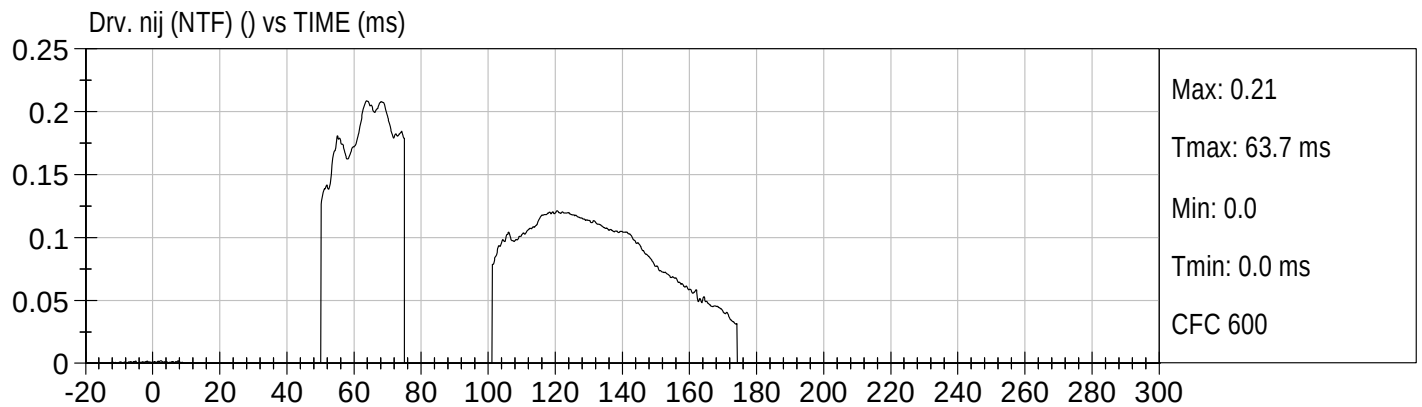
Passenger Left Upper Tibia Moment X
Passenger Left Upper Tibia Moment Y
Passenger Left Upper Tibia Force Z
Passenger Left Lower Tibia Moment X
Passenger Left Lower Tibia Moment Y
Passenger Left Lower Tibia Force Z
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right 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
Left Rear Seat Crossmember X
Left Rear Seat Crossmember Z
Right Rear Seat Crossmember X
Right Rear Seat Crossmember Z
Vehicle Engine Top X
Vehicle Engine Bottom X
Vehicle Left Brake Caliper X
Vehicle Right Brake Caliper X
Advanced Research Load Cell Barrier – 127 channels





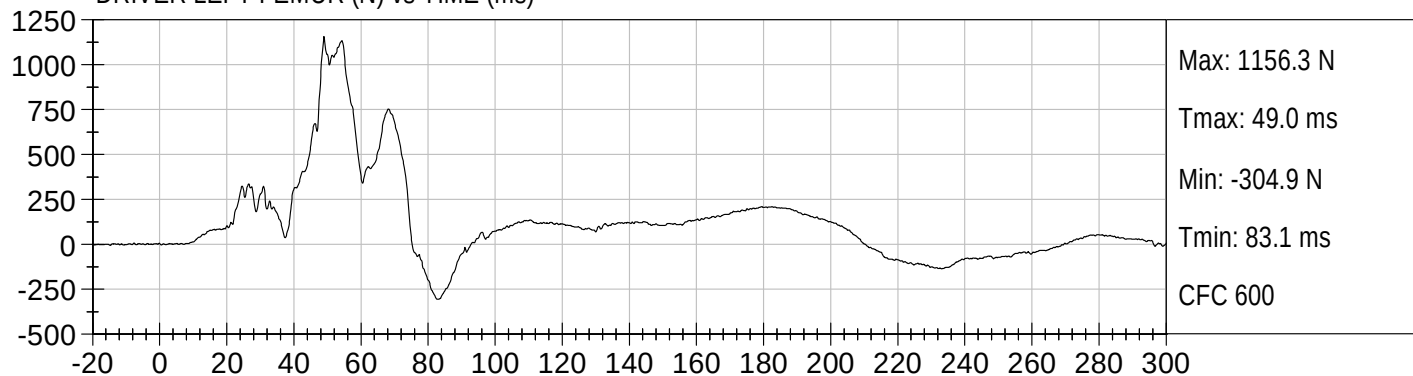




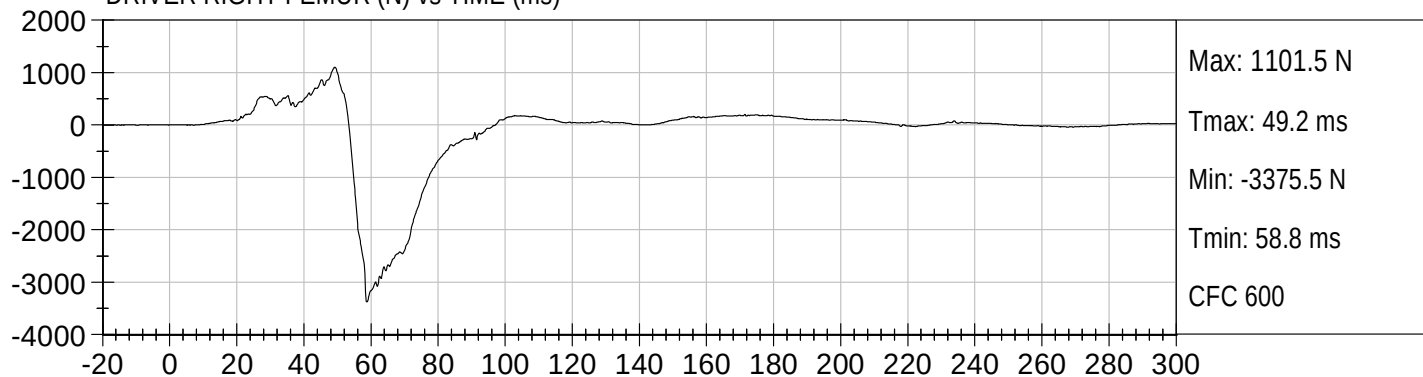


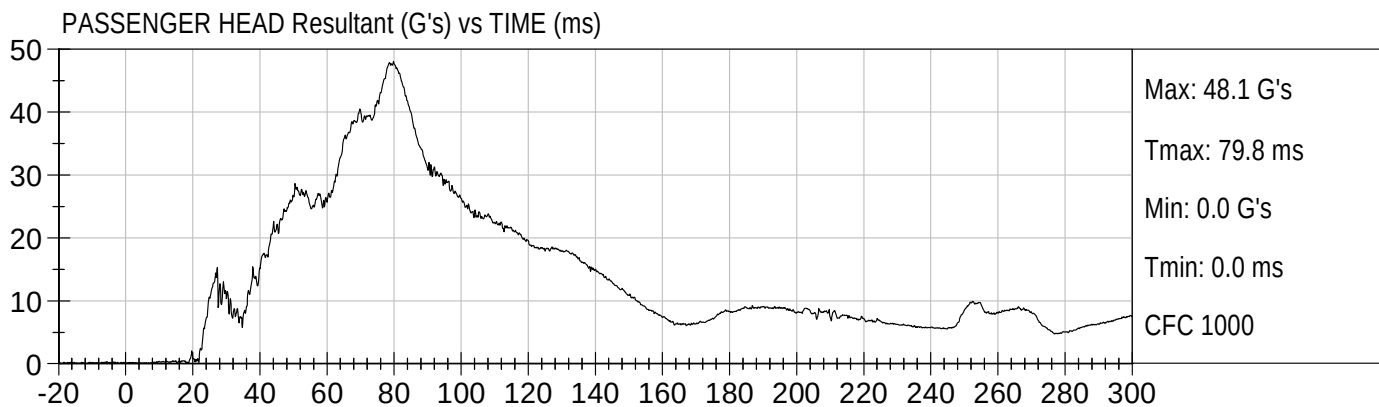
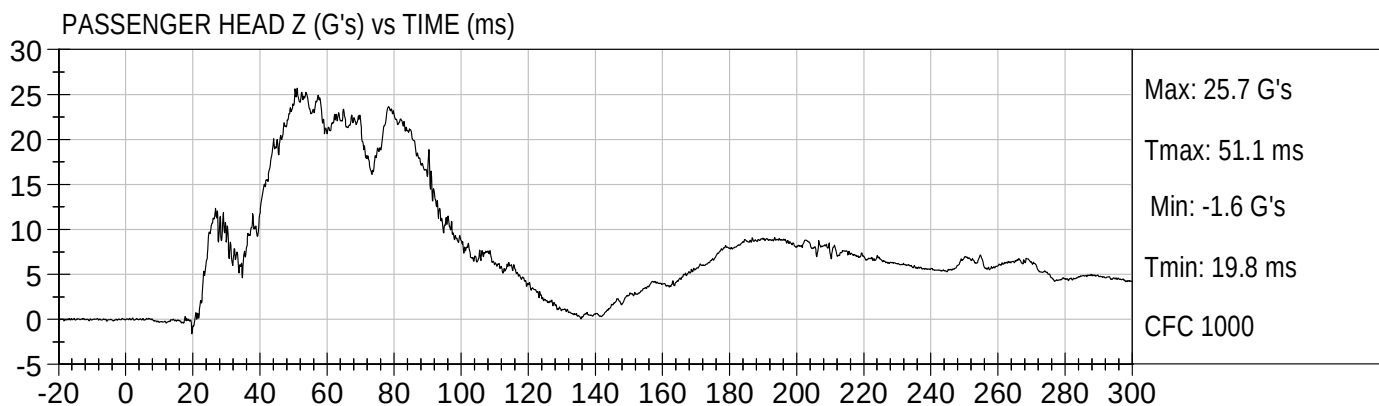
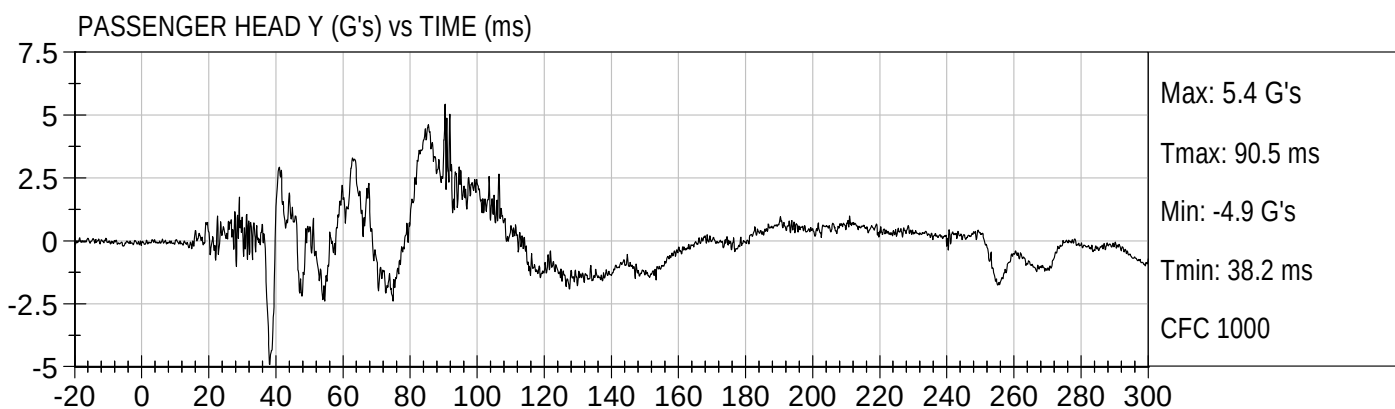
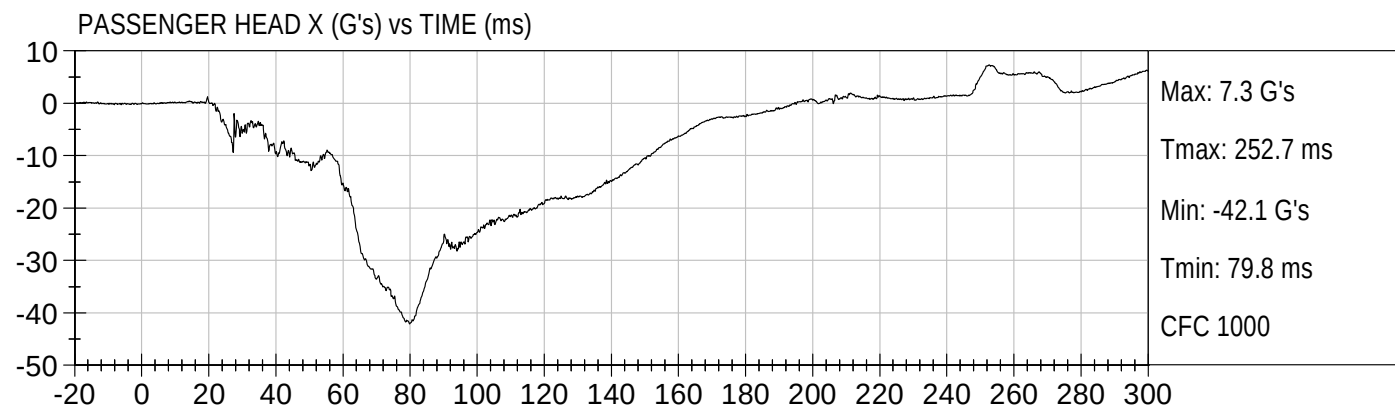


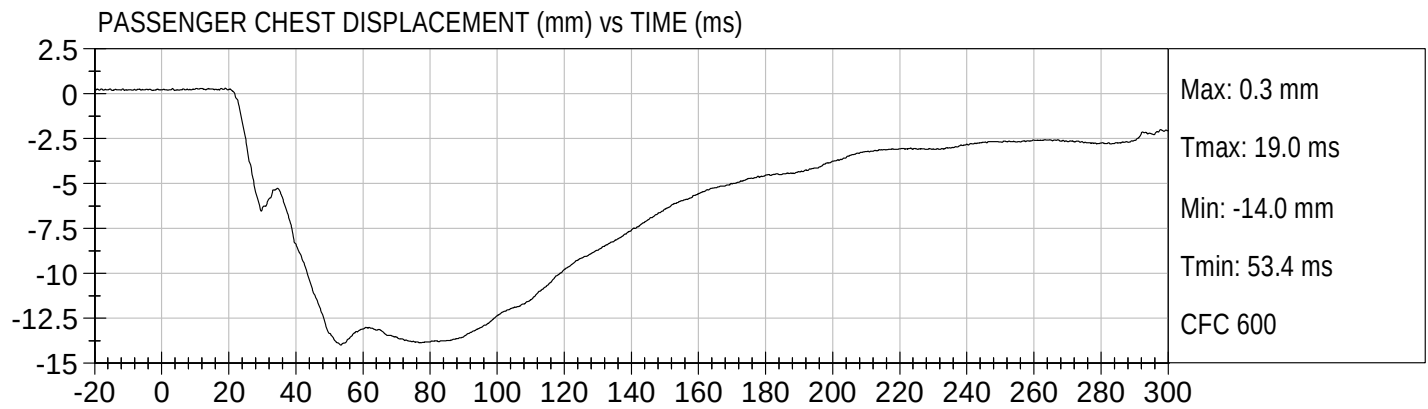
DRIVER LEFT FEMUR (N) vs TIME (ms)

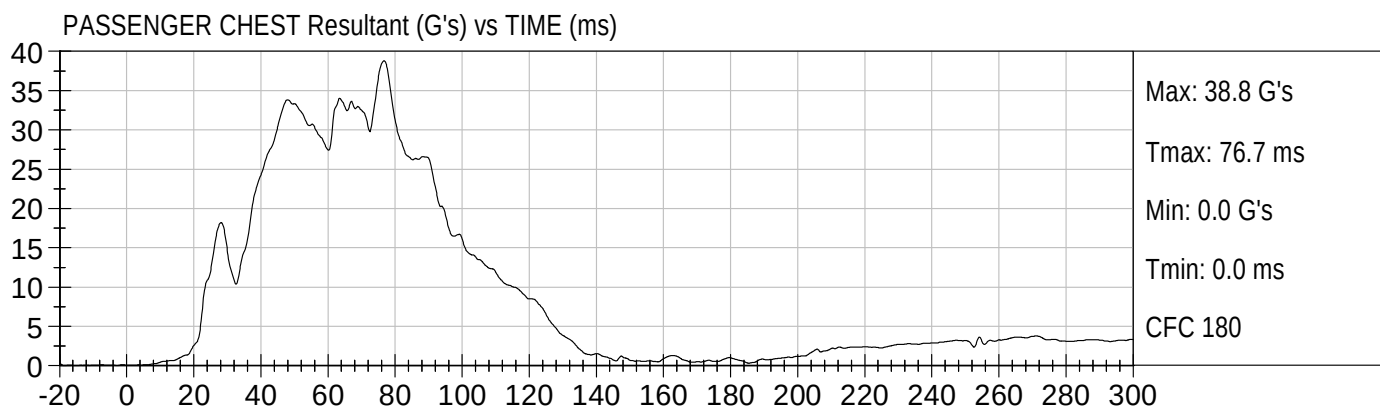
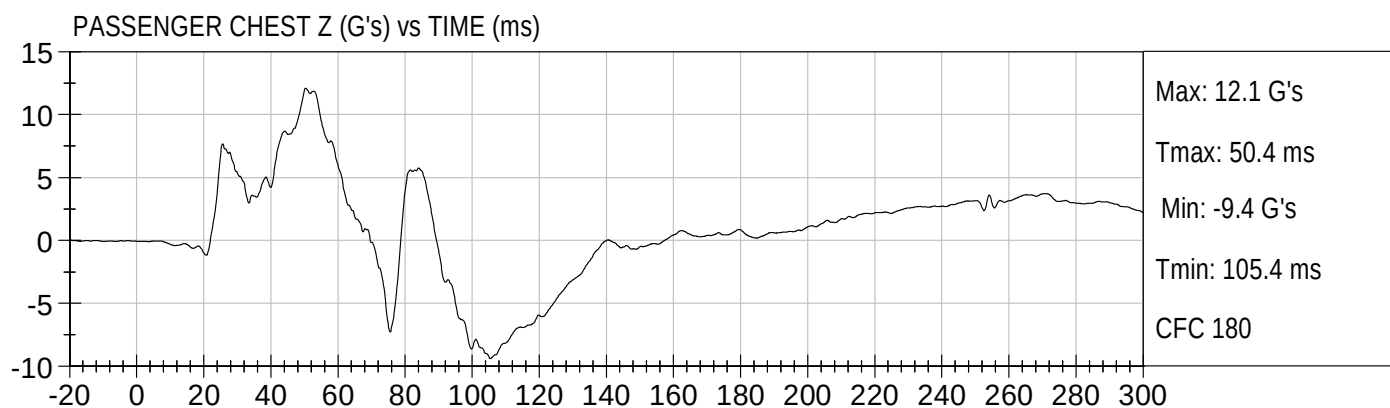
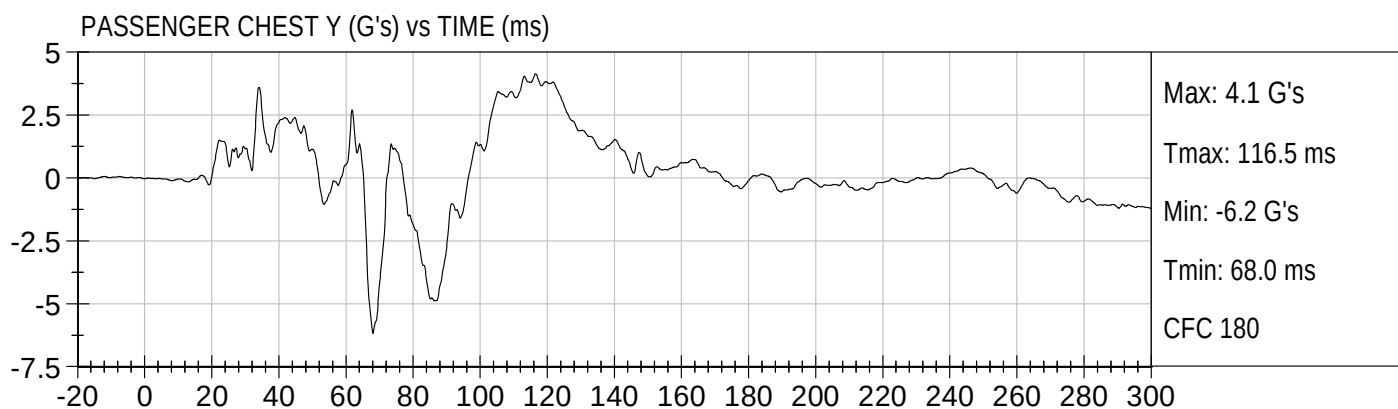
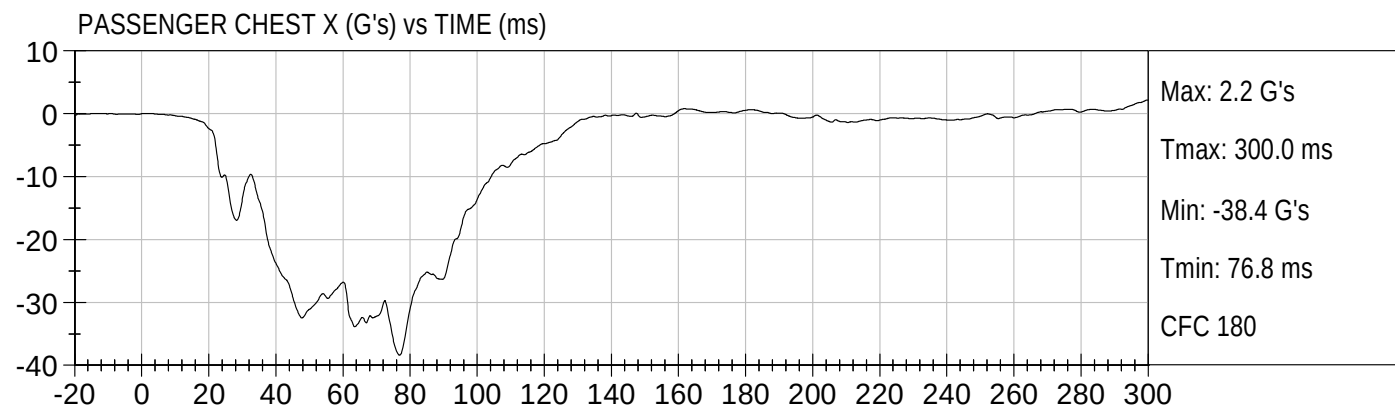


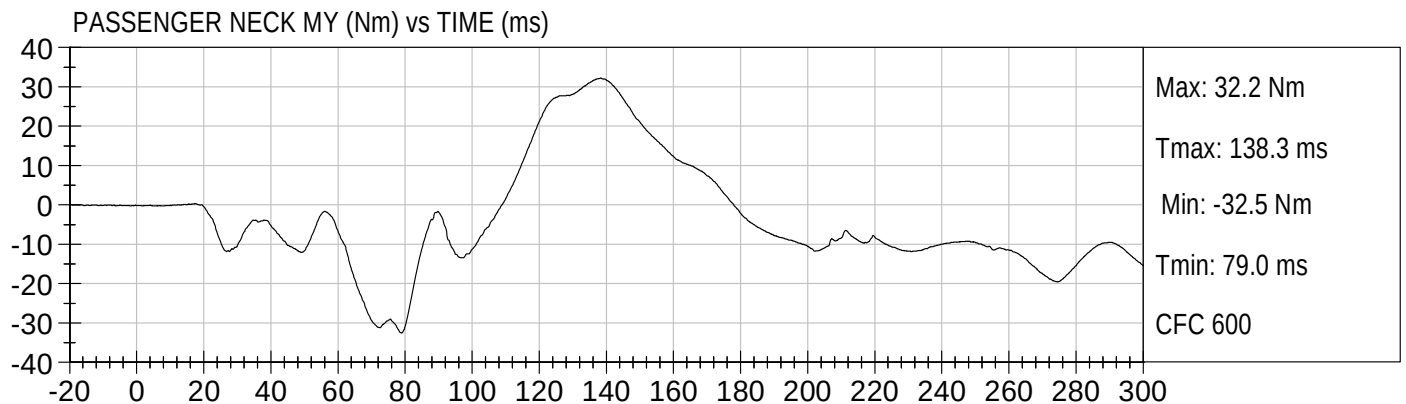
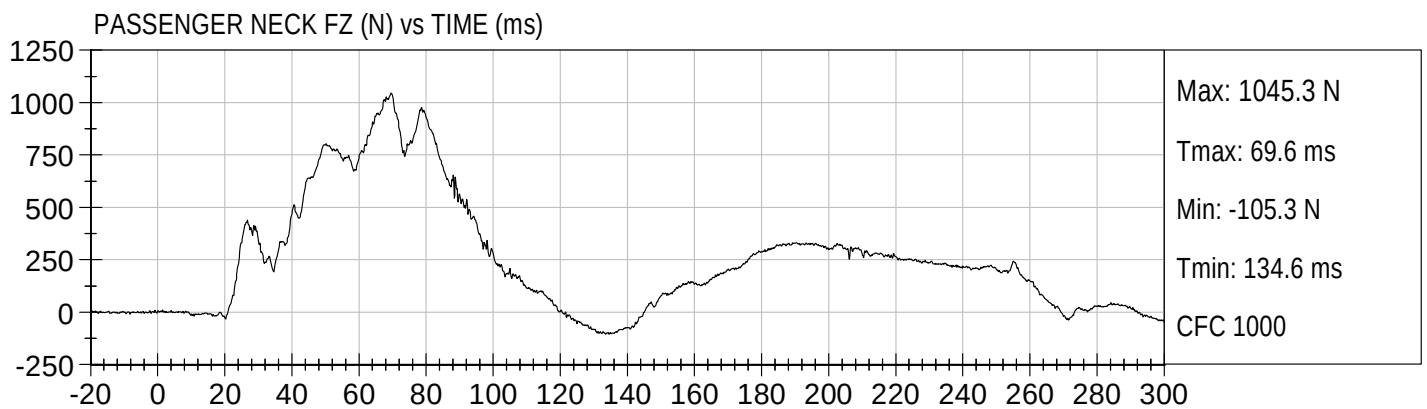
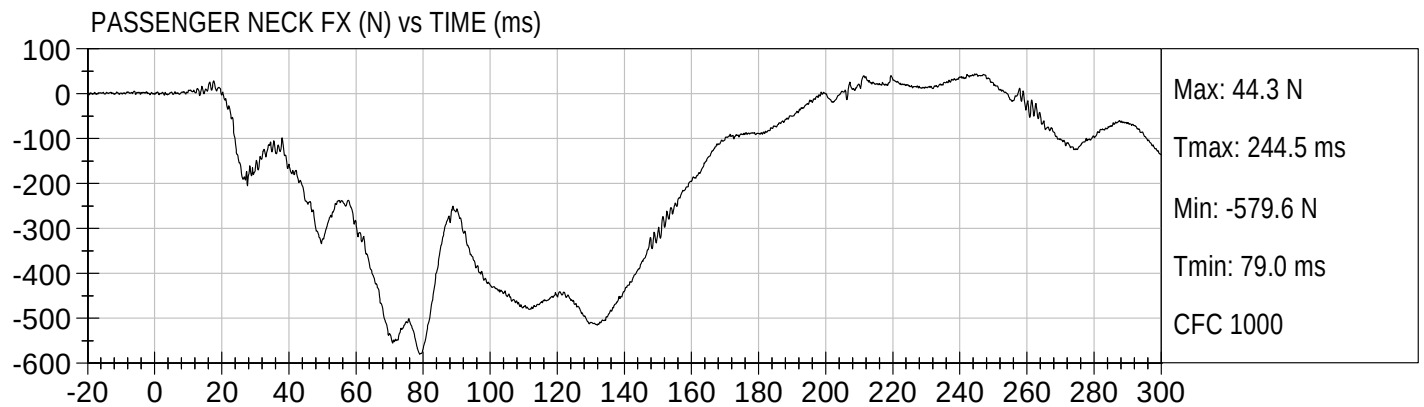
DRIVER RIGHT FEMUR (N) vs TIME (ms)

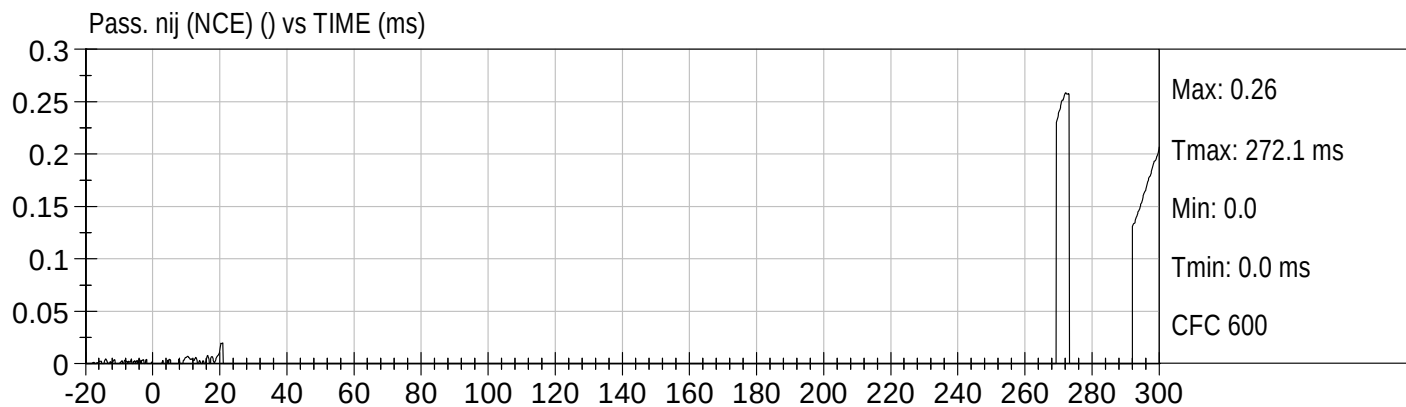
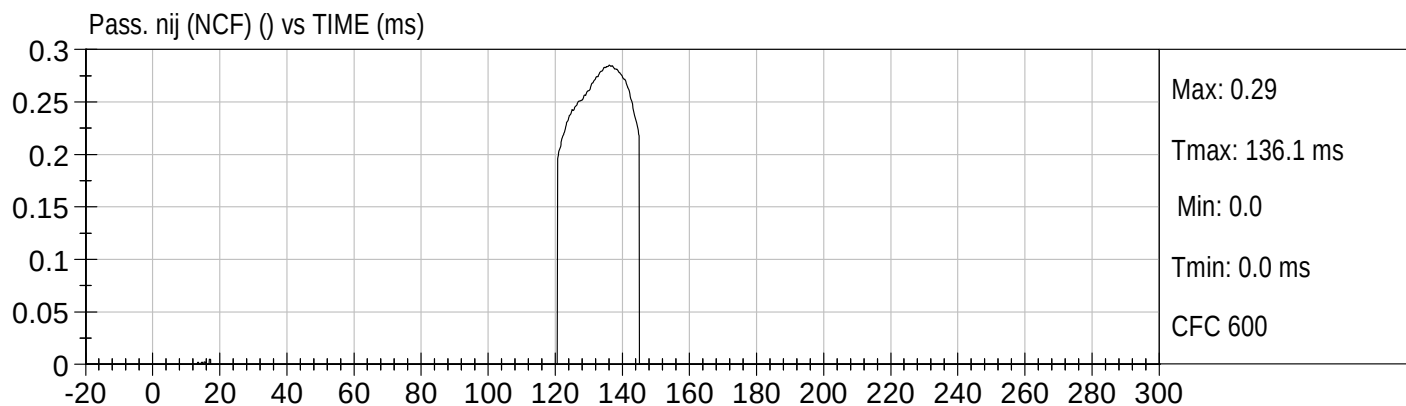
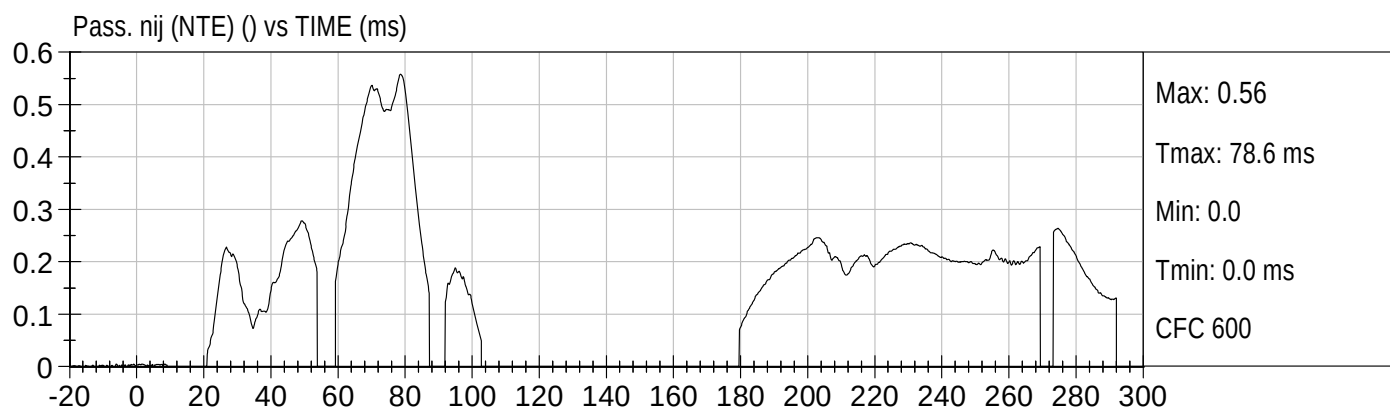
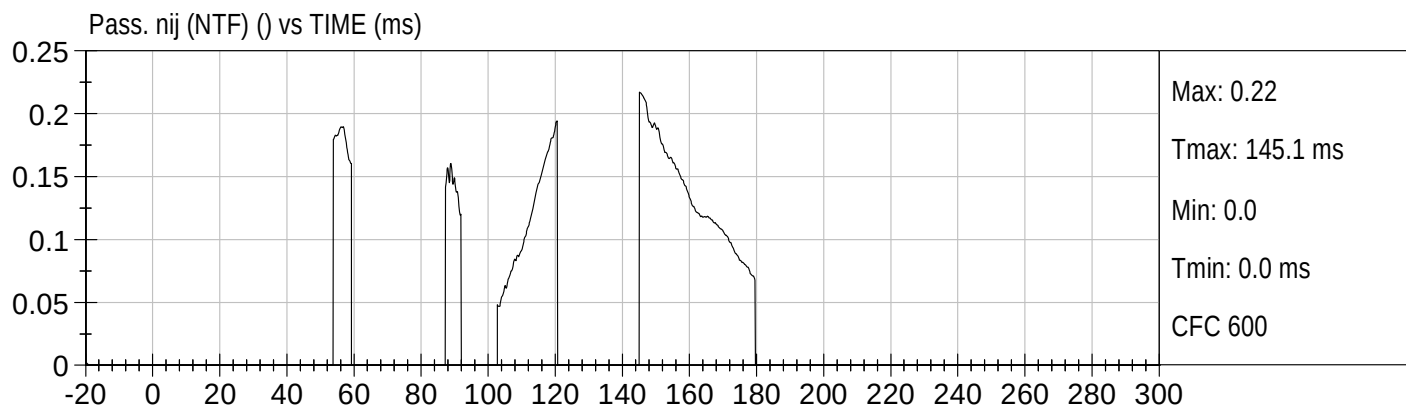


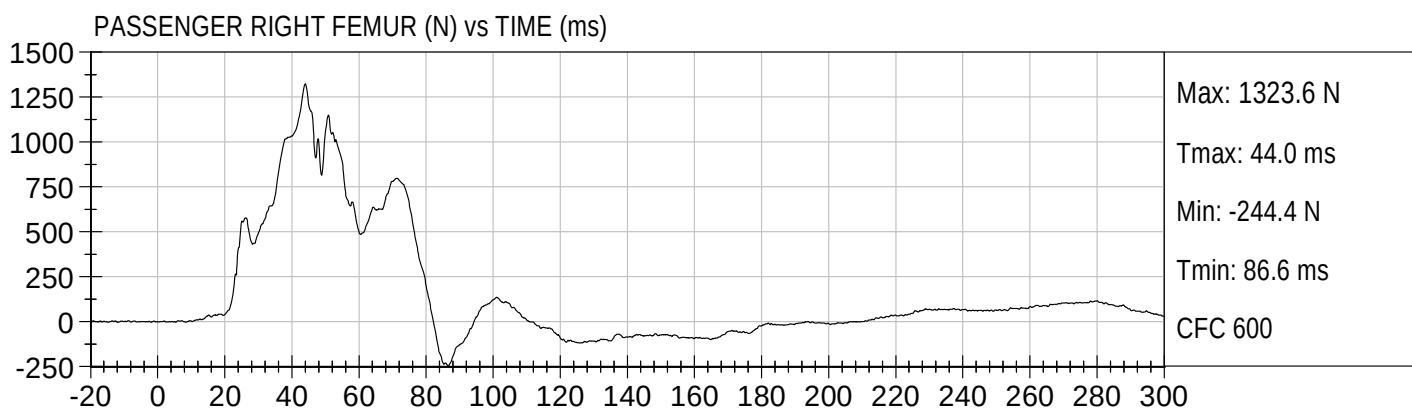
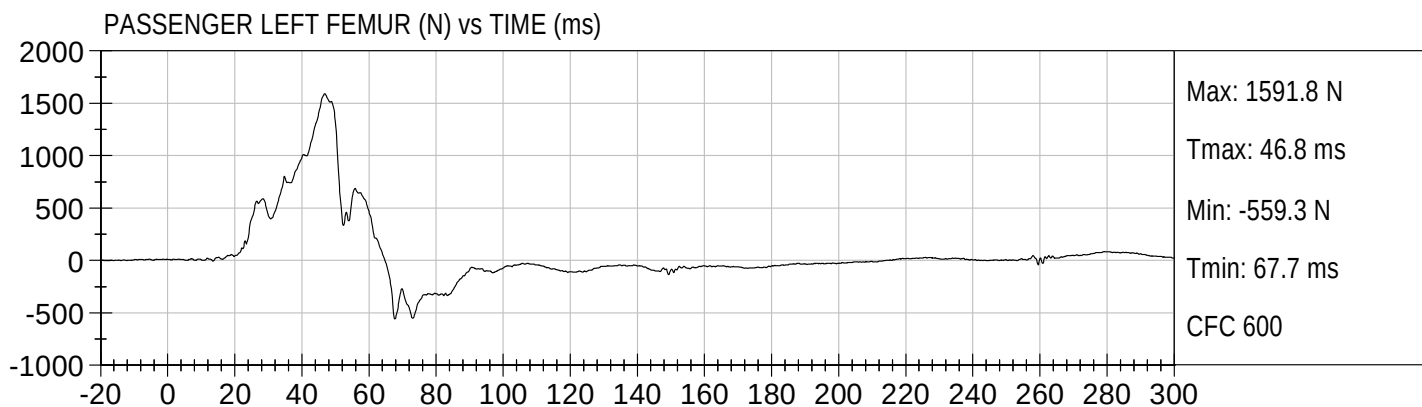












APPENDIX C
DUMMY CALIBRATION DATA

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

ATD Serial No: 351

Test ID: D104531

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Peak Resultant Acceleration	G's	225 - 275	274	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-5.2	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

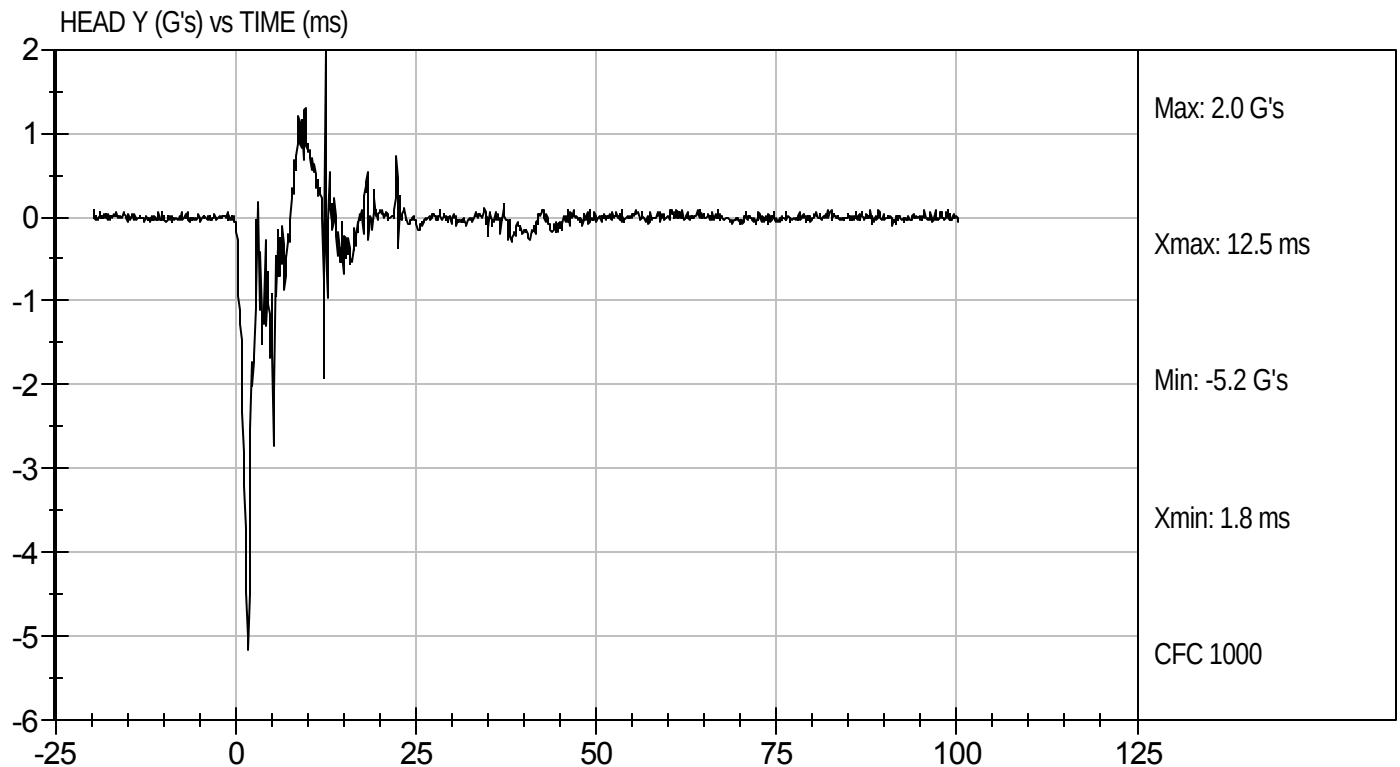
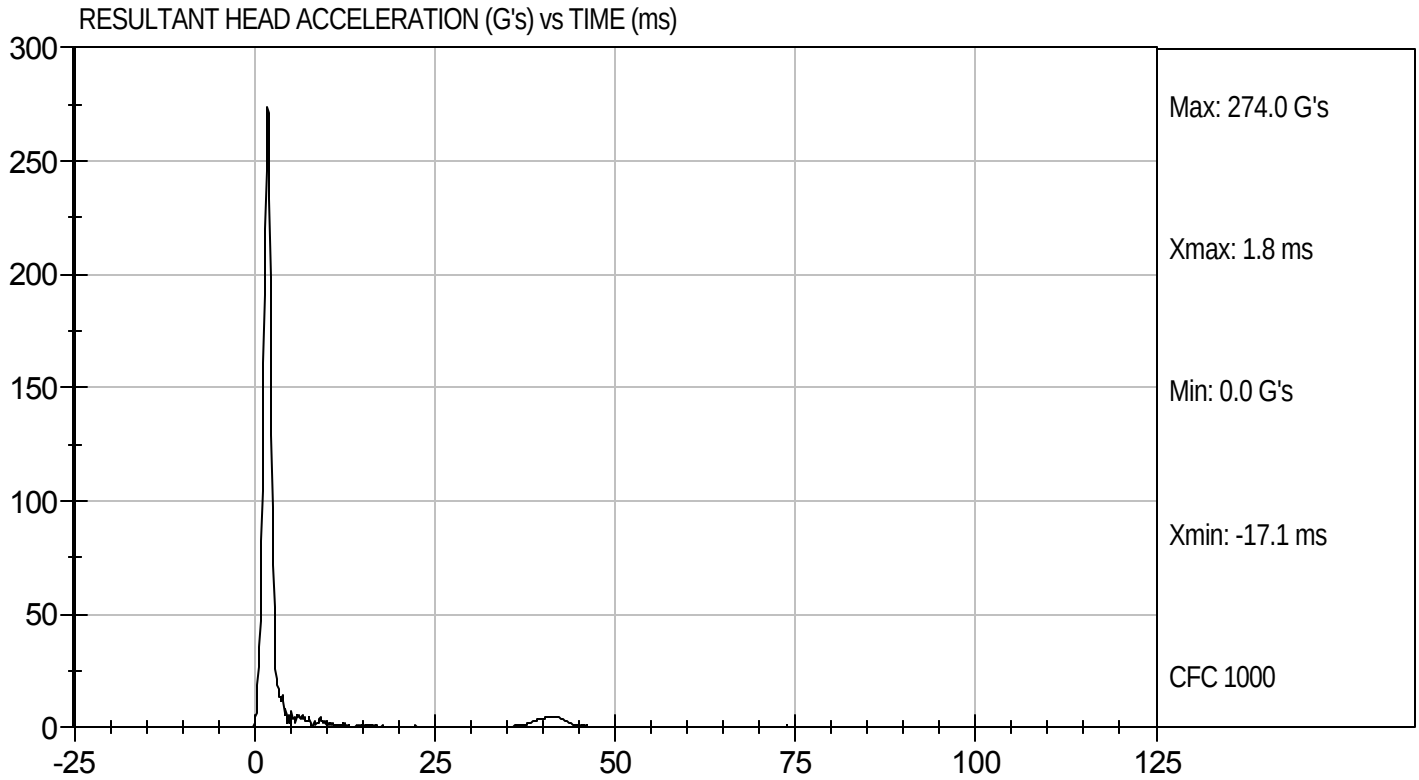
12/21/10
Test Date


Approved By



Test Desc: Head Drop
Component ID: D104531

Test Date: 12/21/10
Velocity: 0 ft/s, 0.00 m/s



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

ATD Serial No: 351

Test I.D.: D104532

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	27	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.39	Pass
	20 ms	G's	17.60 to 22.60	19.30	Pass
	30 ms	G's	12.50 to 18.50	17.02	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	16.9	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	34.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	69.3	Pass
	Time	ms	57.0 to 64.0	57.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	113.2	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	98.2	Pass
	Time	ms	47.0 to 58.0	47.3	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	101.3	Pass
Overall Test Results					Pass


 Laboratory Technician

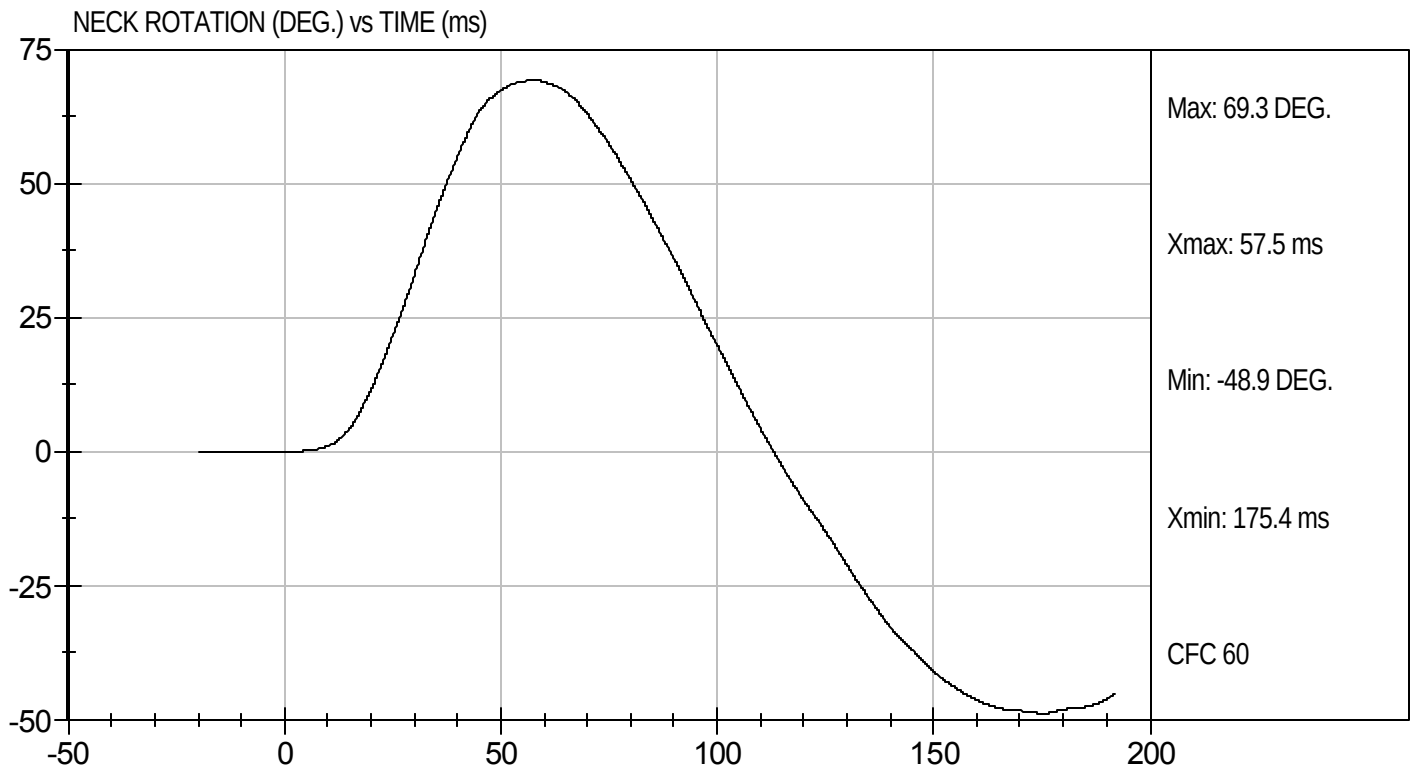
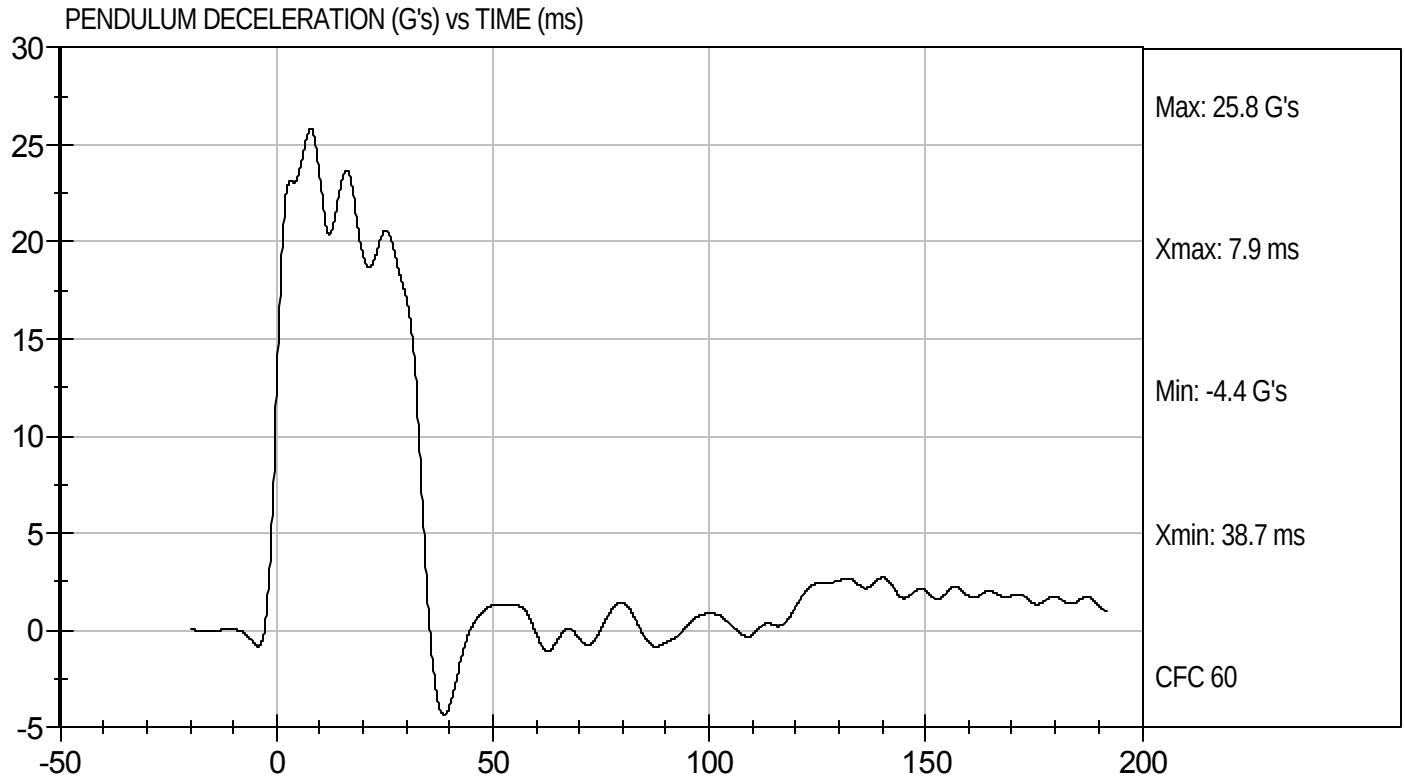
12/21/10
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D104532

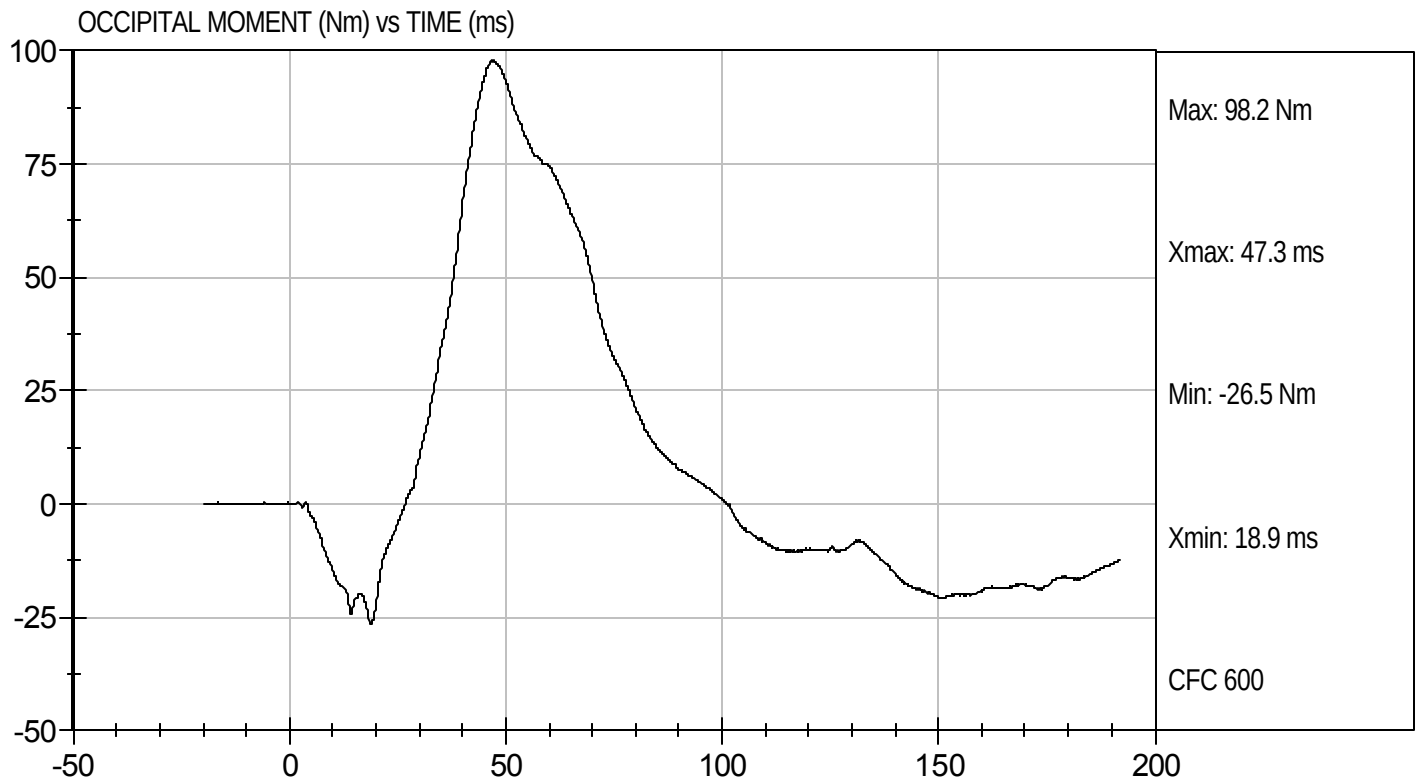
Test Date: 12/21/10
Velocity: 23.15 ft/s, 7.06 m/s





Test Desc: Neck Flexion
Component ID: D104532

Test Date: 12/21/10
Velocity: 23.15 ft/s, 7.06 m/s



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

ATD Serial No: 351

Test I.D.: D104533

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	26	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.16	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	20.05	Pass
	20 ms	G's	14.00 to 19.00	16.50	Pass
	30 ms	G's	11.00 to 16.00	13.69	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.5	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	38.3	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	94.7	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	155.6	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-63.5	Pass
	Time	ms	65.0 to 79.0	69.8	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.4	Pass
Overall Test Results					Pass


 Laboratory Technician

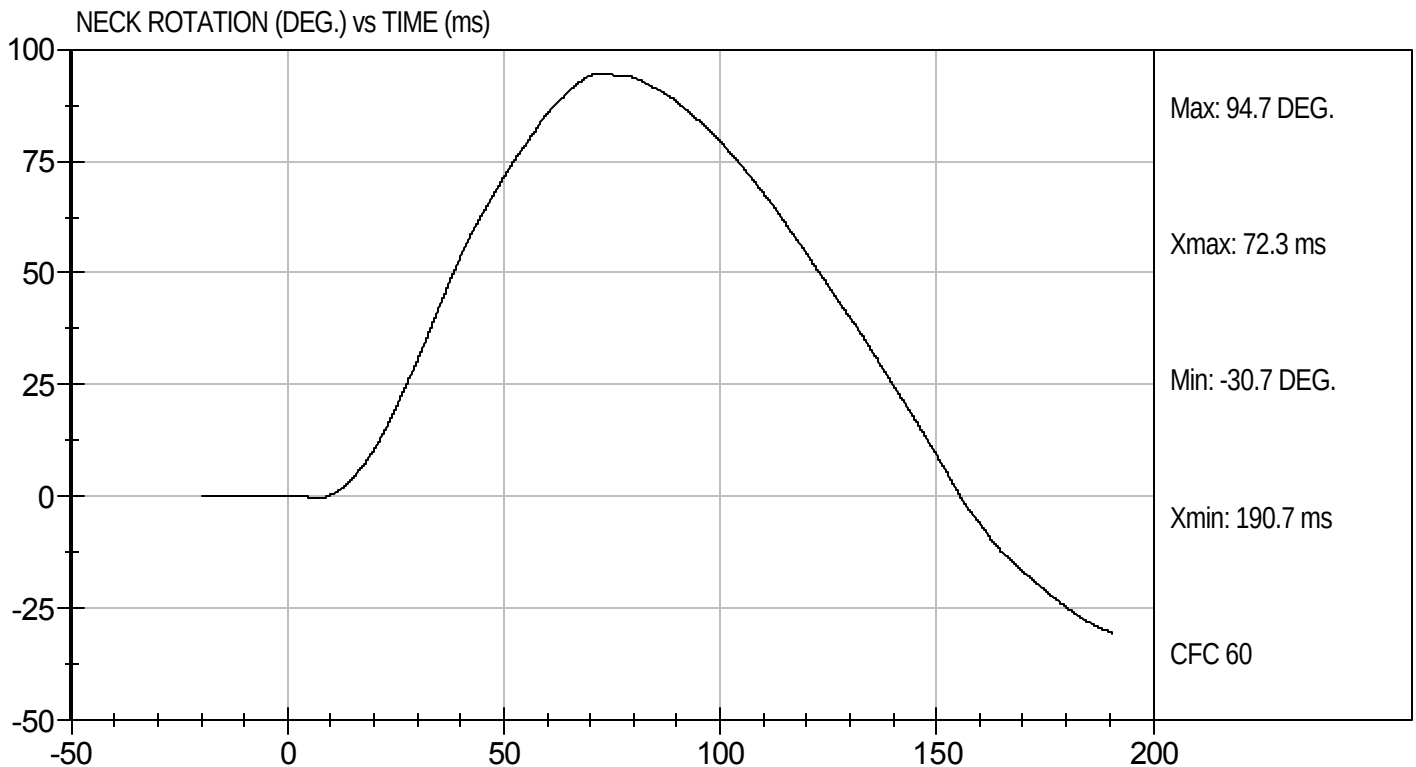
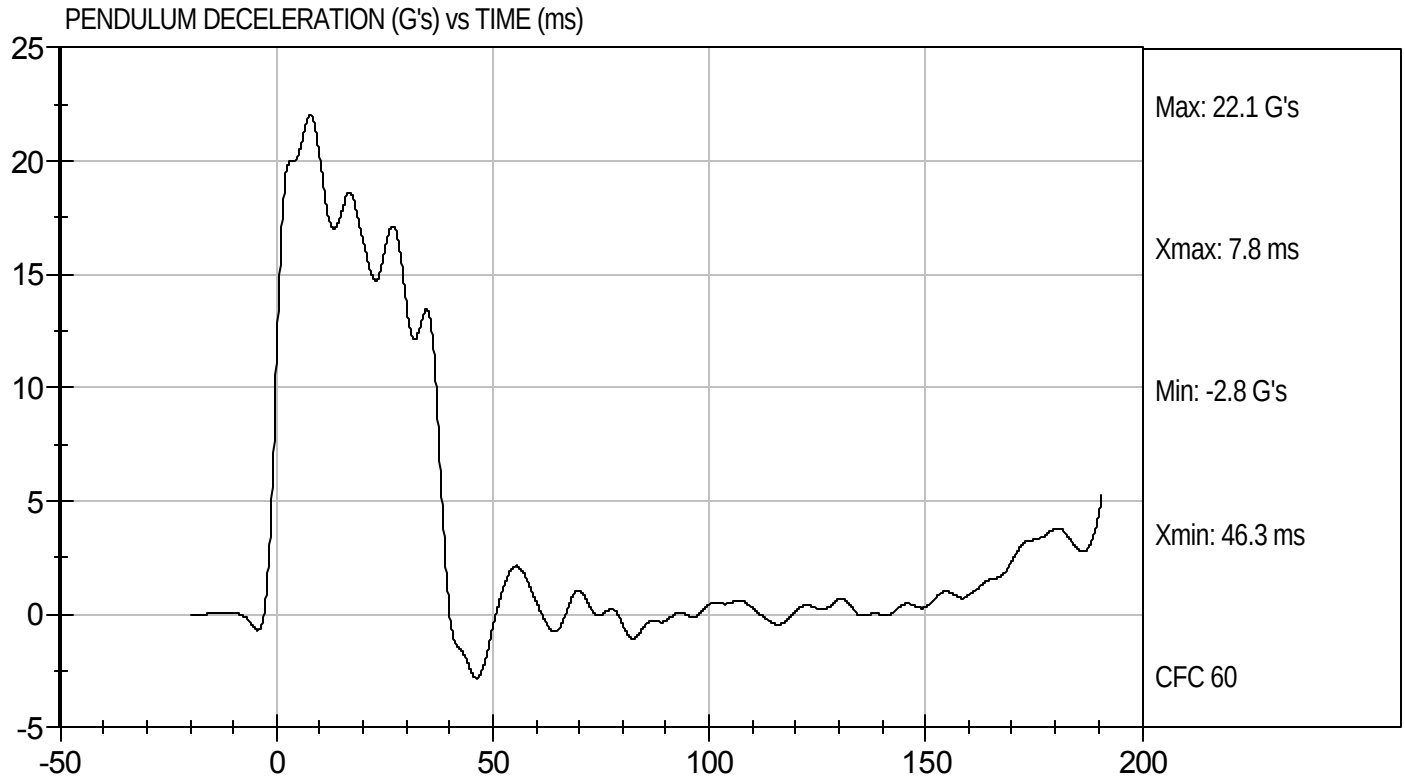
12/21/10
 Test Date


 Approved By



Test Desc: Neck Extension
Component ID: D104533

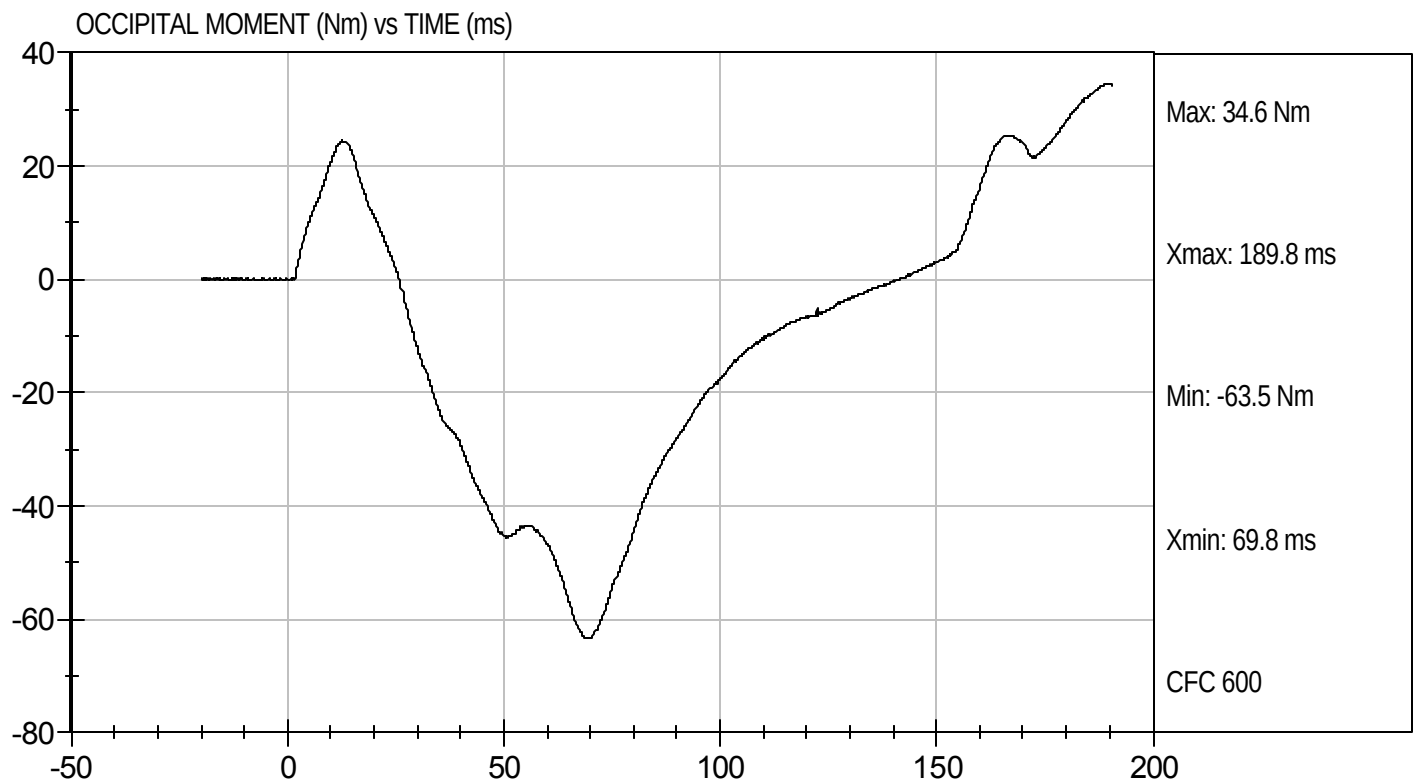
Test Date: 12/21/10
Velocity: 20.20 ft/s, 6.16 m/s





Test Desc: Neck Extension
Component ID: D104533

Test Date: 12/21/10
Velocity: 20.20 ft/s, 6.16 m/s



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D104534

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	23	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,260	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.55	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Overall Test Results			Pass	


Laboratory Technician

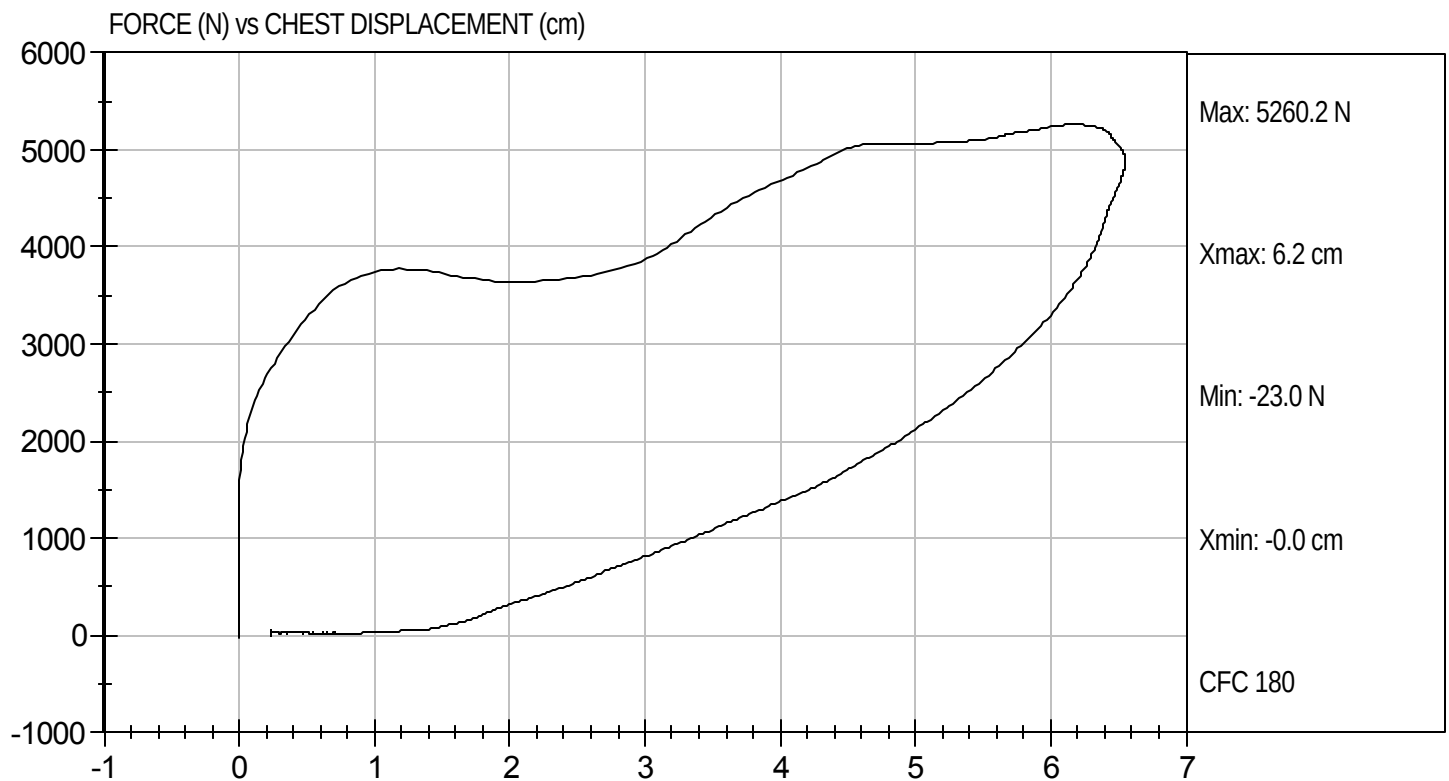
12/22/10
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D104534

Test Date: 12/22/10
Velocity: 22.2 ft/s, 6.77 m/s



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

ATD Serial No: 351

Test I.D: D104535

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,102	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

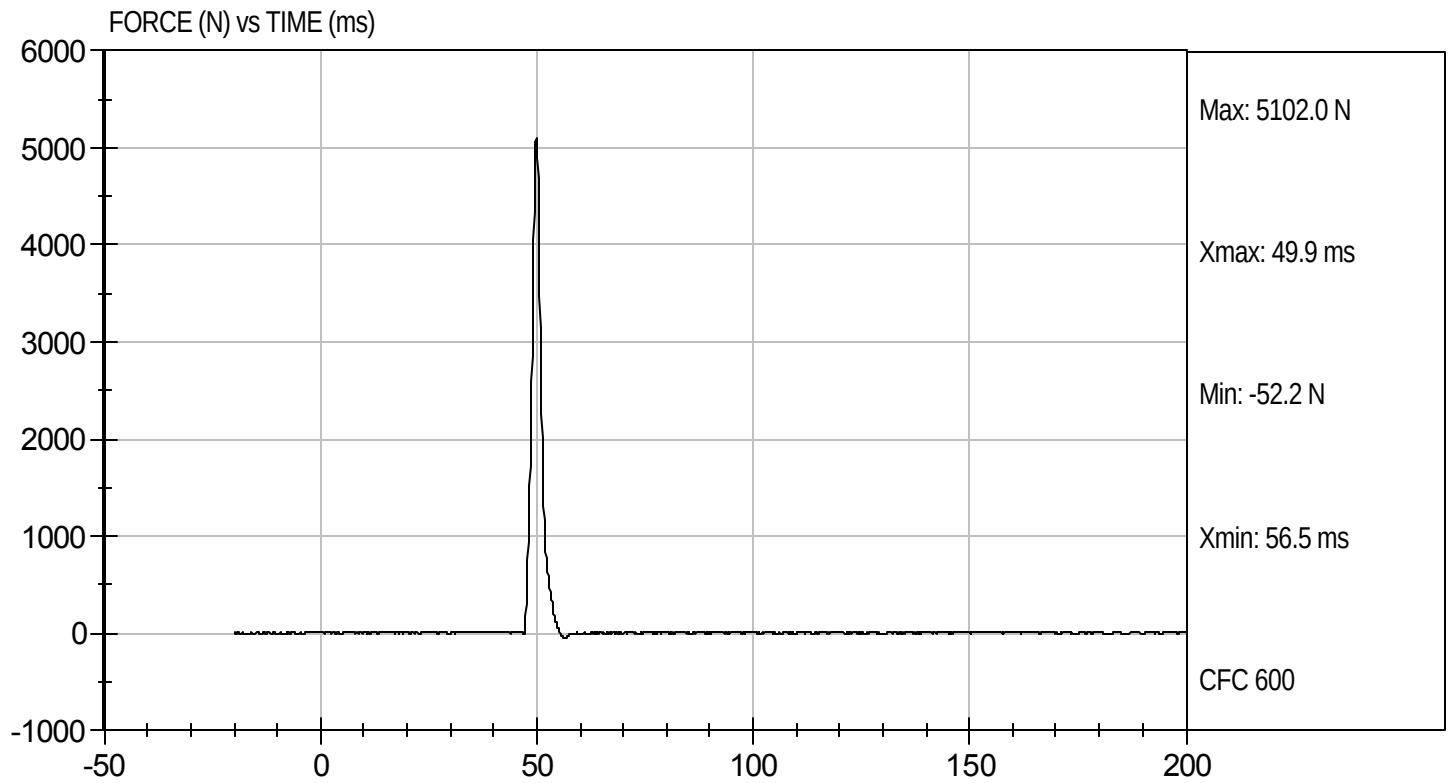
12/21/10
Test Date

David Winkelbauer
Approved By



Test Desc: Right Knee
Component ID: D104535

Test Date: 12/21/10
Velocity: 6.97 ft/s, 2.12 m/s



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

ATD Serial No: 351

Test I.D: D104536

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,369	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

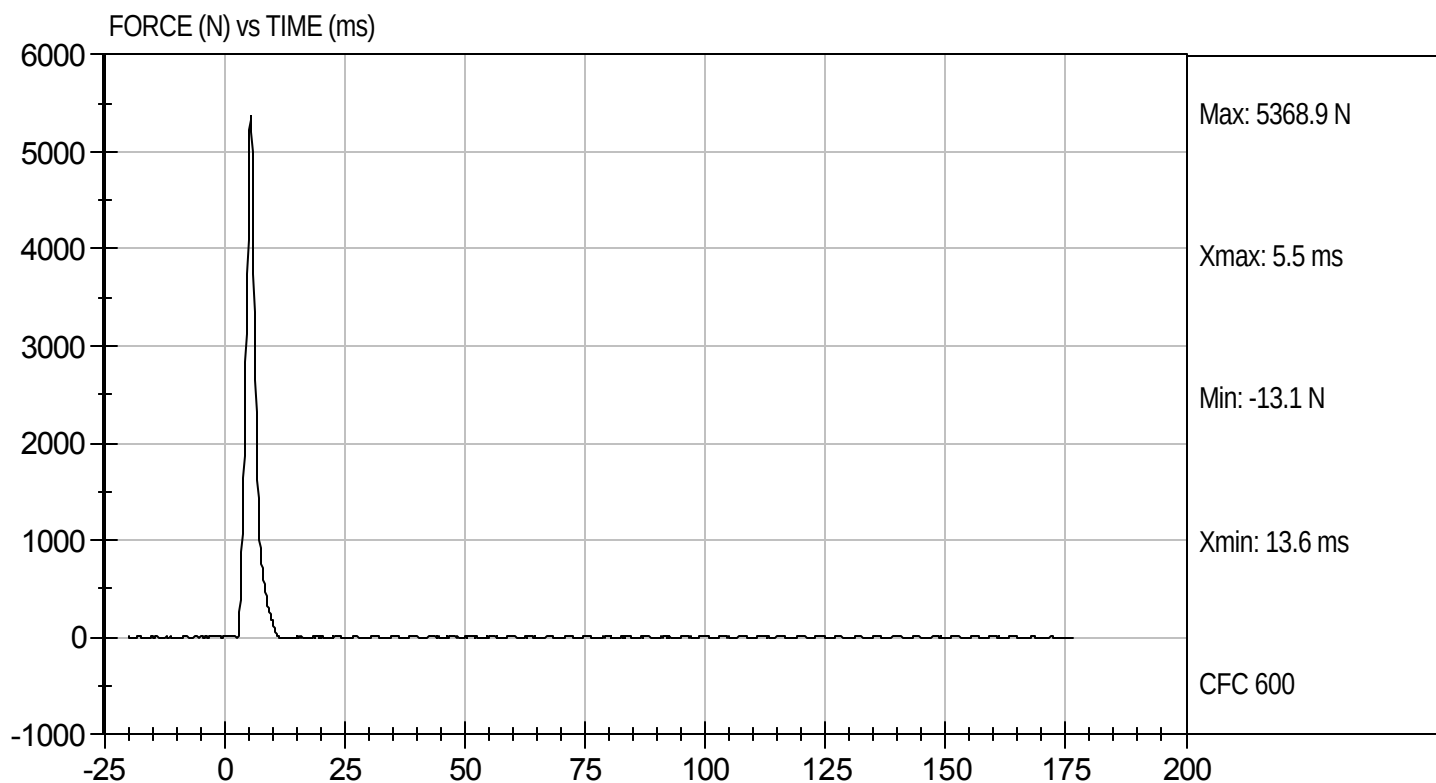
12/21/10
Test Date

David Winkelbauer
Approved By



Test Desc: Left Knee
Component ID: D104536

Test Date: 12/21/10
Velocity: 6.94 ft/s, 2.12 m/s



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

ATD Serial No: 351

Test I.D: D104530

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.1	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	27	27	Pass
Rotation Rate	deg/s	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	48.8	42.9	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	47	48	Pass
Overall Test Results					Pass


 Laboratory Technician

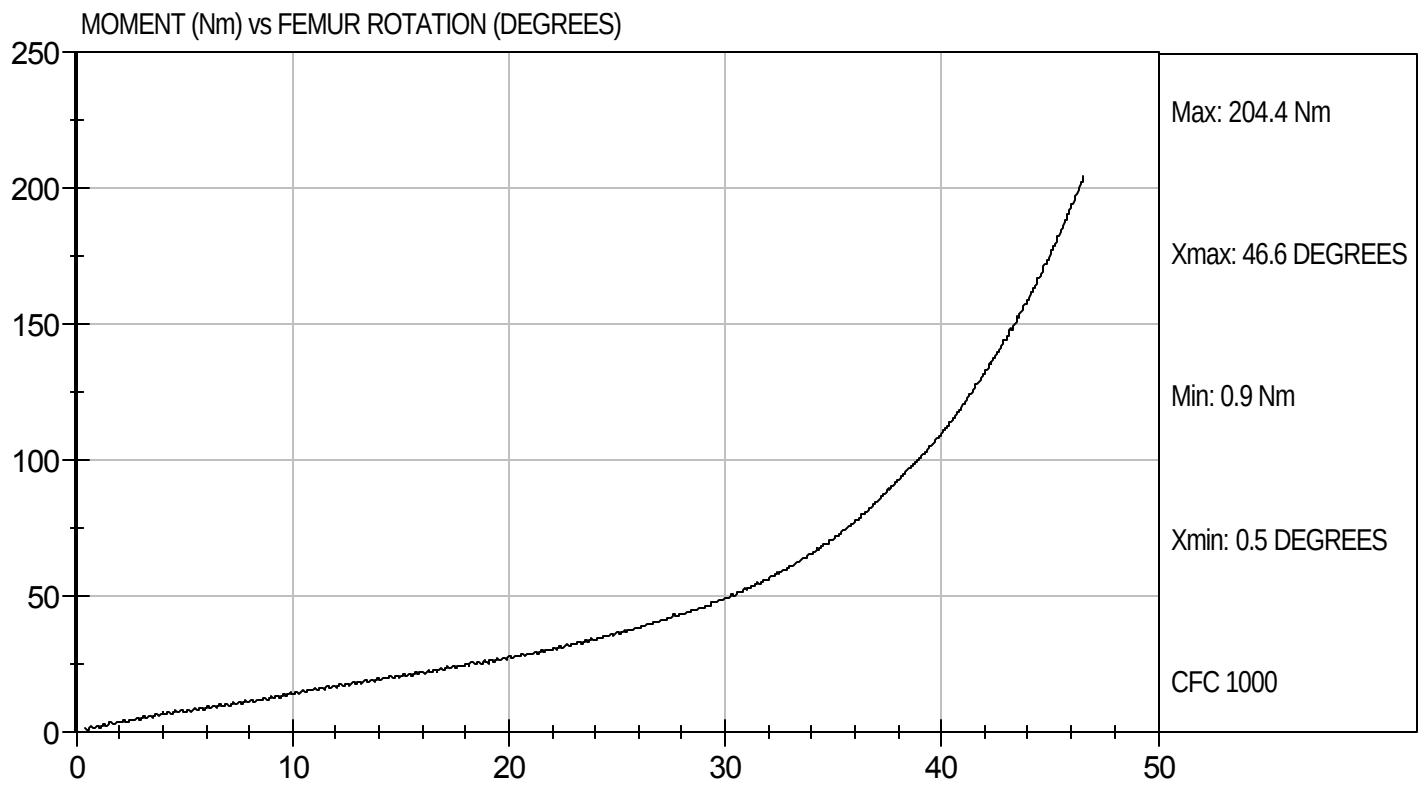
12/21/10
 Test Date


 Approved By



Test Desc: Hip Femur Flexion
Component ID: D104539

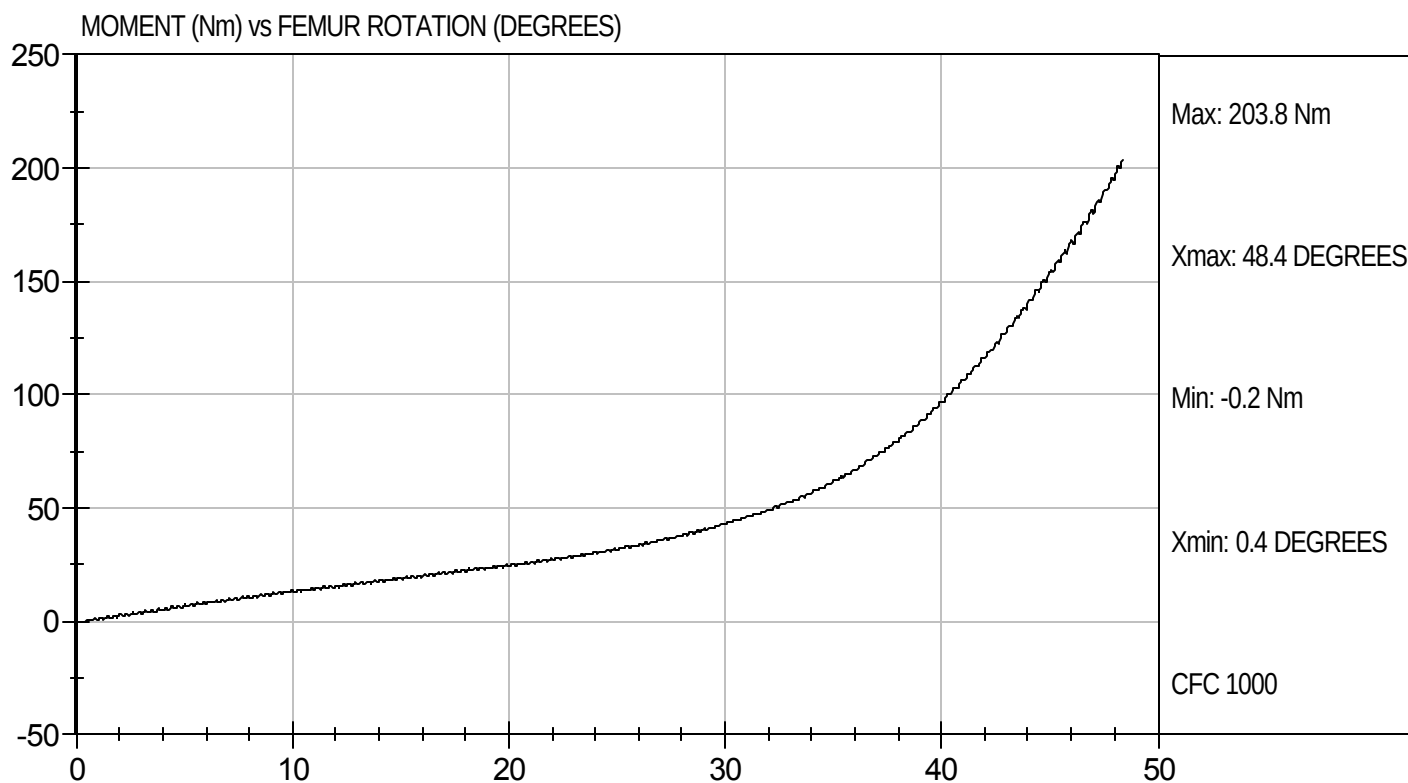
Test Date: 12/21/10
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D104530

Test Date: 12/21/10
Velocity: 0 ft/s, 0.00 m/s



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

ATD Serial No: 351

Test ID: D11091

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Peak Resultant Acceleration	G's	225 - 275	259	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	5.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

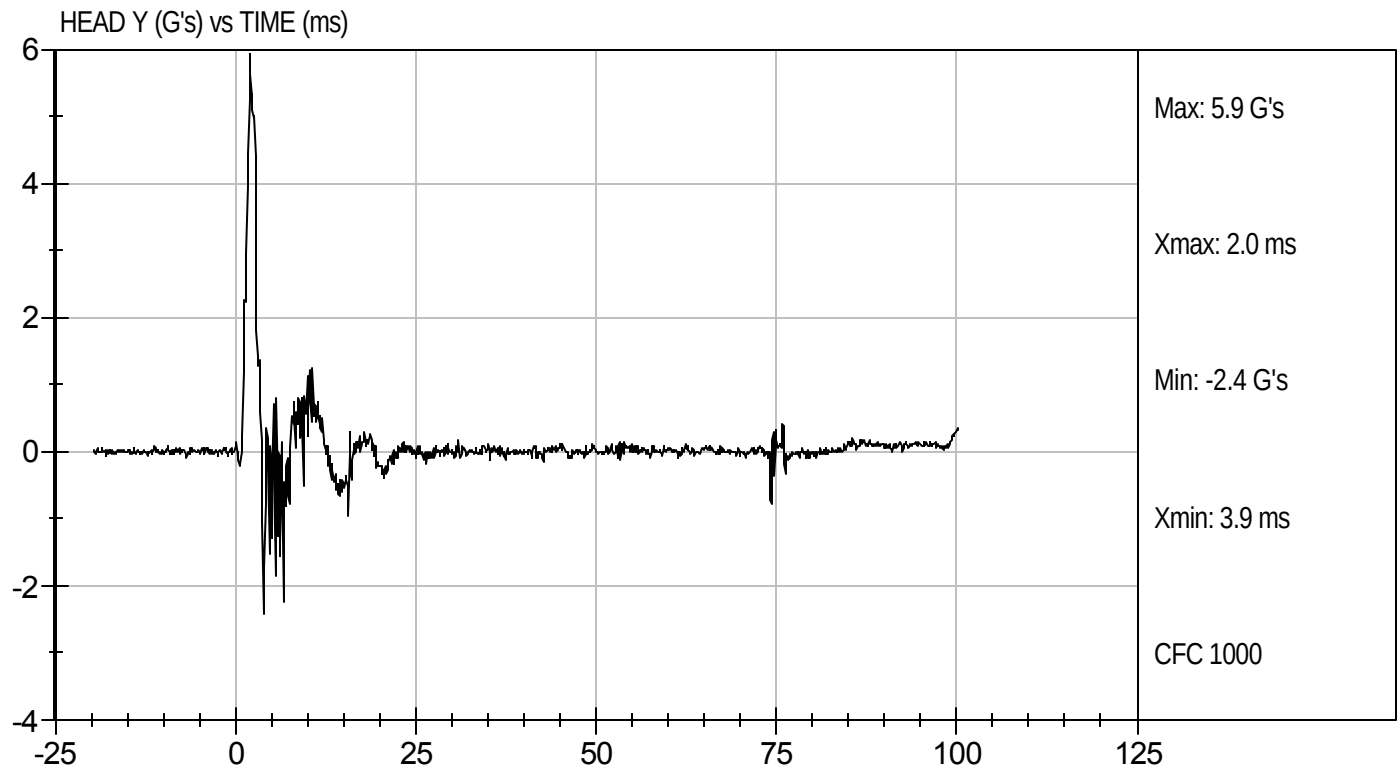
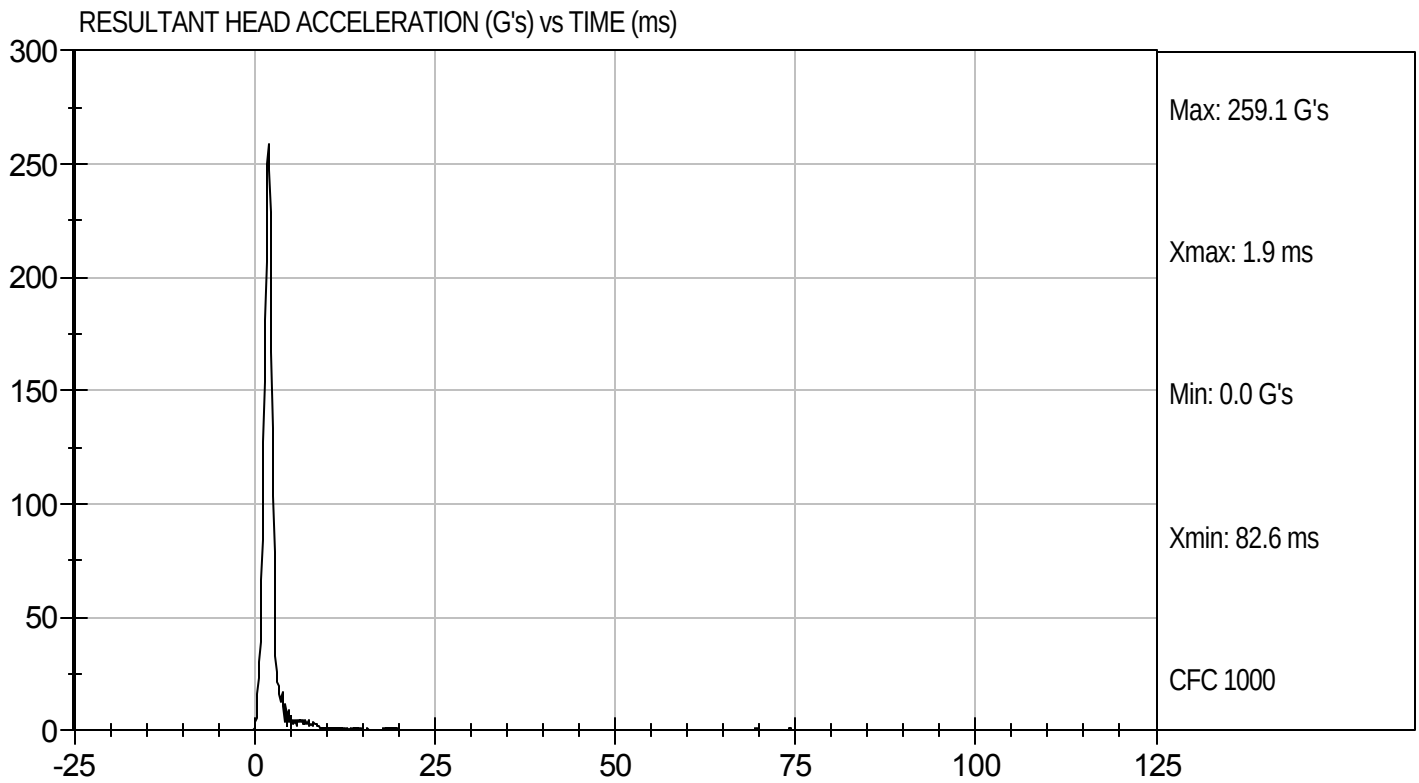
1/5/11
Test Date

David Winkelbauer
Approved By



Test Desc: Head Drop
Component ID: D11091

Test Date: 1/5/11
Velocity: 0 ft/s, 0.00 m/s

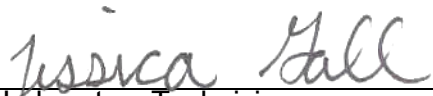


MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D.: D11092

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	20	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	G's	22.50 to 27.50	23.35	Pass
	20 ms	G's	17.60 to 22.60	19.21	Pass
	30 ms	G's	12.50 to 18.50	13.12	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 29.0	13.1	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	37.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	68.6	Pass
	Time	ms	57.0 to 64.0	59.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	113.0	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	96.1	Pass
	Time	ms	47.0 to 58.0	51.1	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	100.5	Pass
Overall Test Results					Pass


 Laboratory Technician

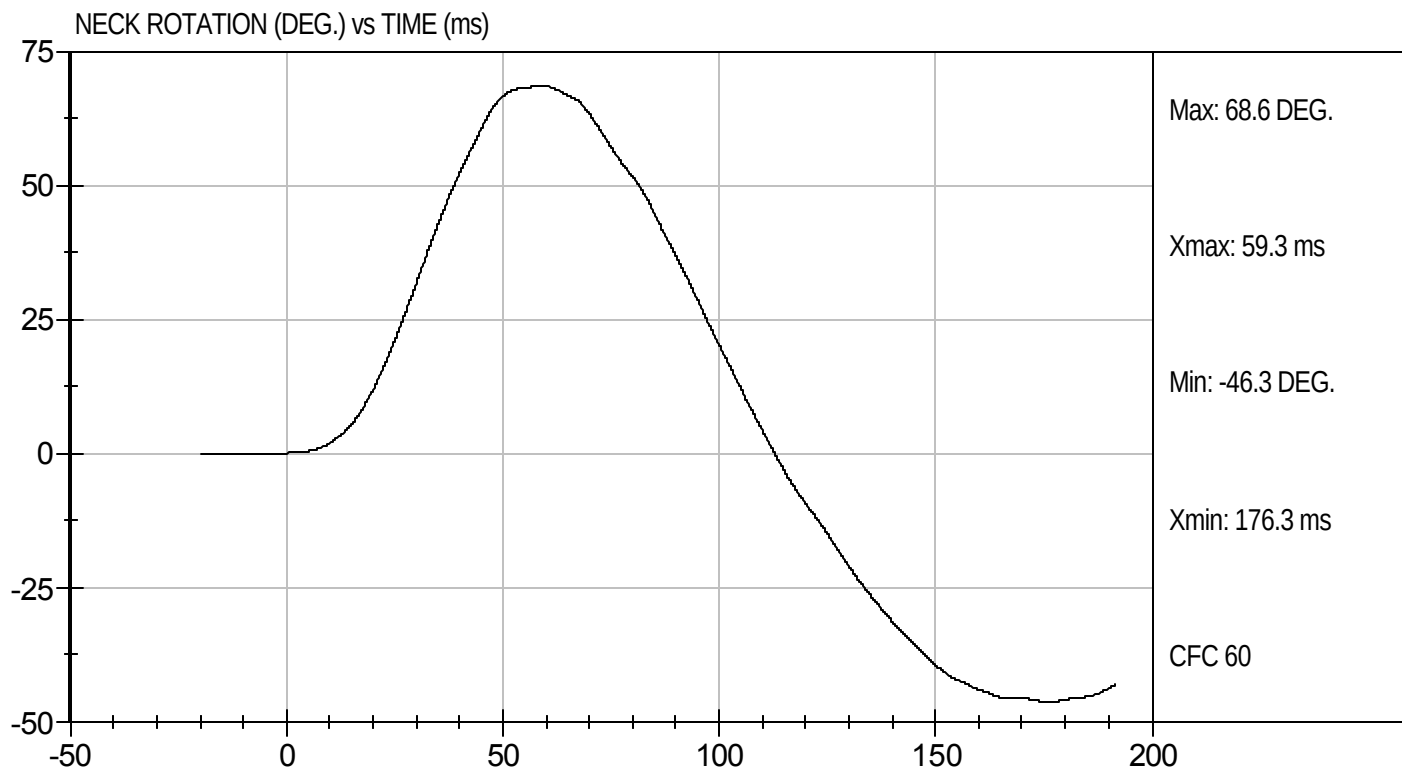
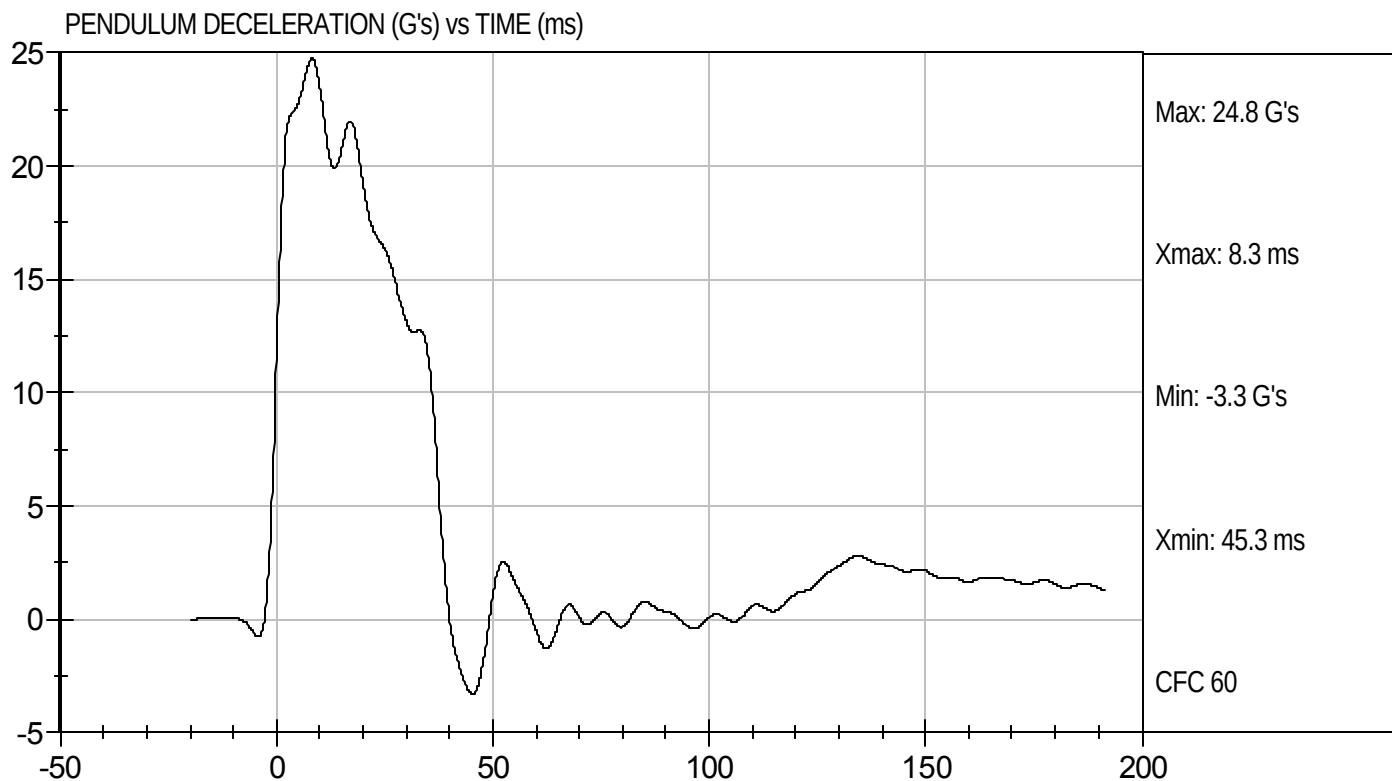
1/6/11
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D11092

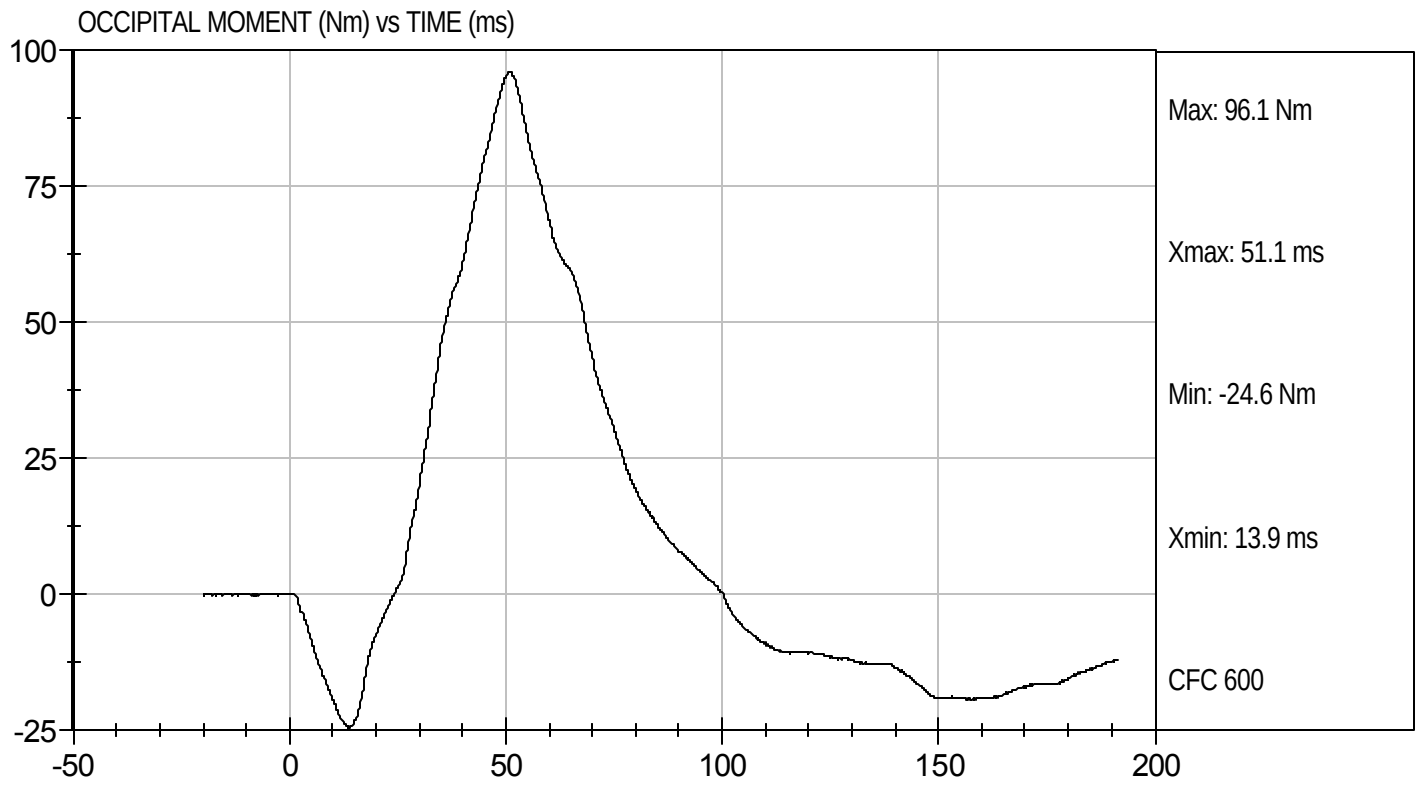
Test Date: 1/6/11
Velocity: 23.15 ft/s, 7.06 m/s





Test Desc: Neck Flexion
Component ID: D11092

Test Date: 1/6/11
Velocity: 23.15 ft/s, 7.06 m/s

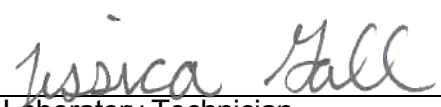


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D.: D11093

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	20	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	G's	17.20 to 21.20	19.40	Pass
	20 ms	G's	14.00 to 19.00	16.45	Pass
	30 ms	G's	11.00 to 16.00	13.11	Pass
Peak Pendulum Deceleration After 30 ms		G's	<= 22.0	13.2	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	38.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	95.4	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	158.1	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-63.6	Pass
	Time	ms	65.0 to 79.0	71.9	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	143.1	Pass
Overall Test Results					Pass


 Laboratory Technician

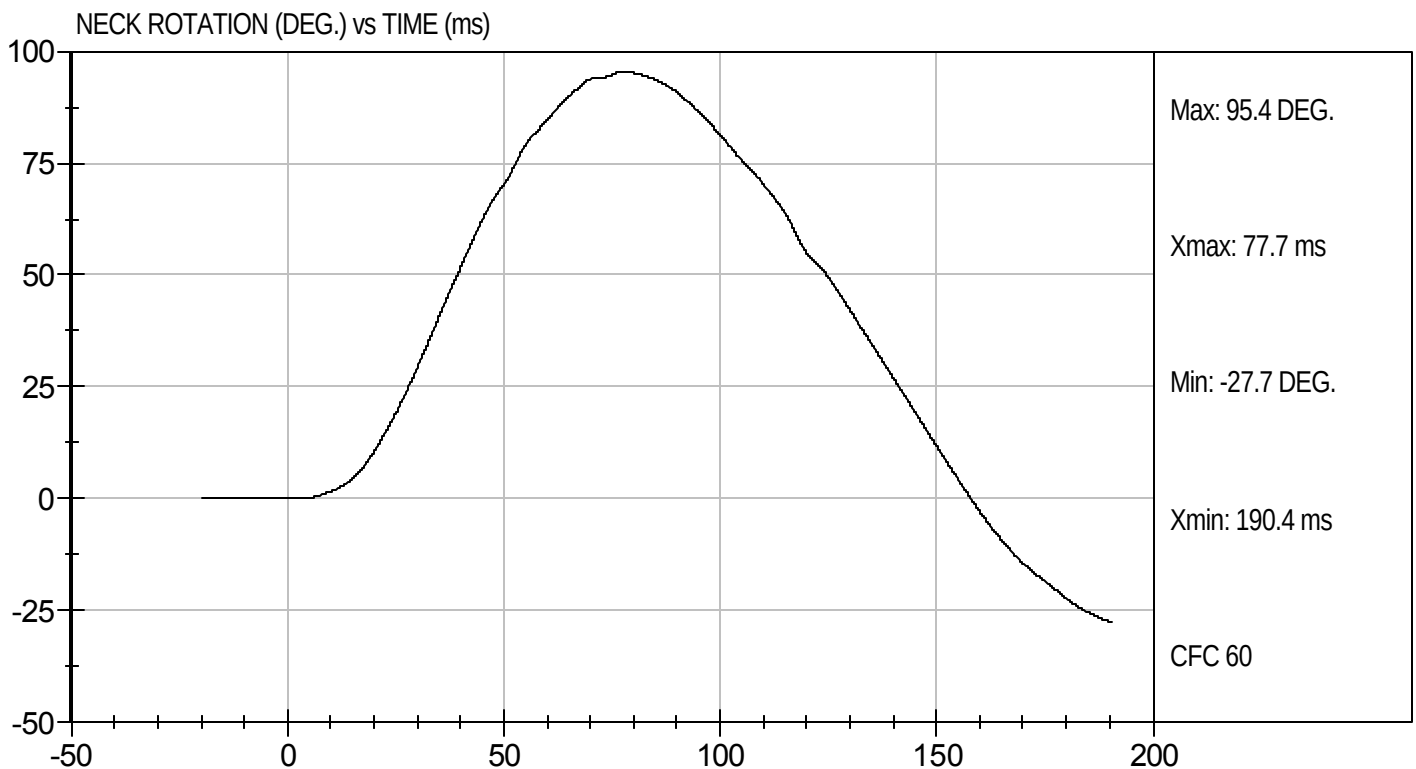
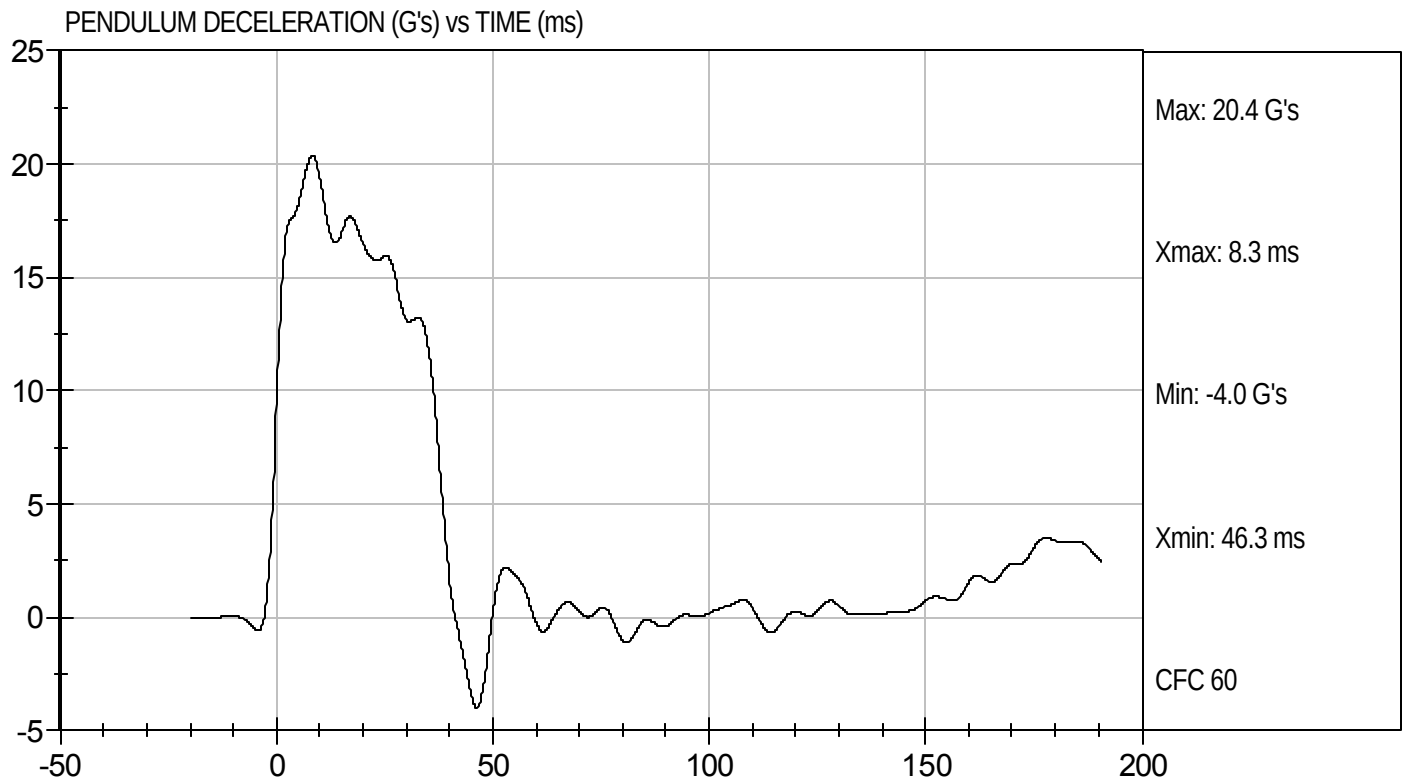
1/6/11
 Test Date


 Approved By



Test Desc: Neck Extension
Component ID: D11093

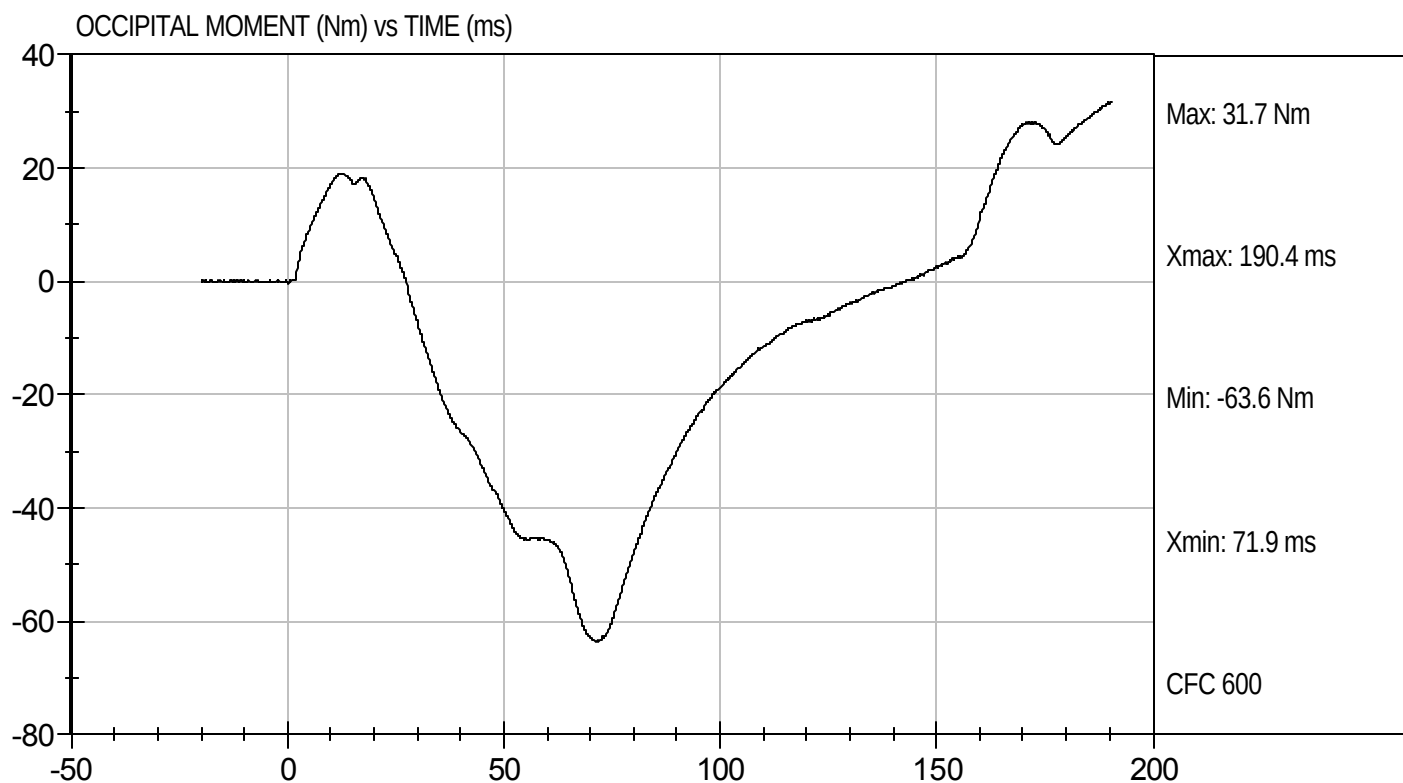
Test Date: 1/6/11
Velocity: 20.08 ft/s, 6.12 m/s





Test Desc: Neck Extension
Component ID: D11093

Test Date: 1/6/11
Velocity: 20.08 ft/s, 6.12 m/s



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 351

Test I.D: D11094

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	20	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,303	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.36	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Overall Test Results			Pass	


Laboratory Technician

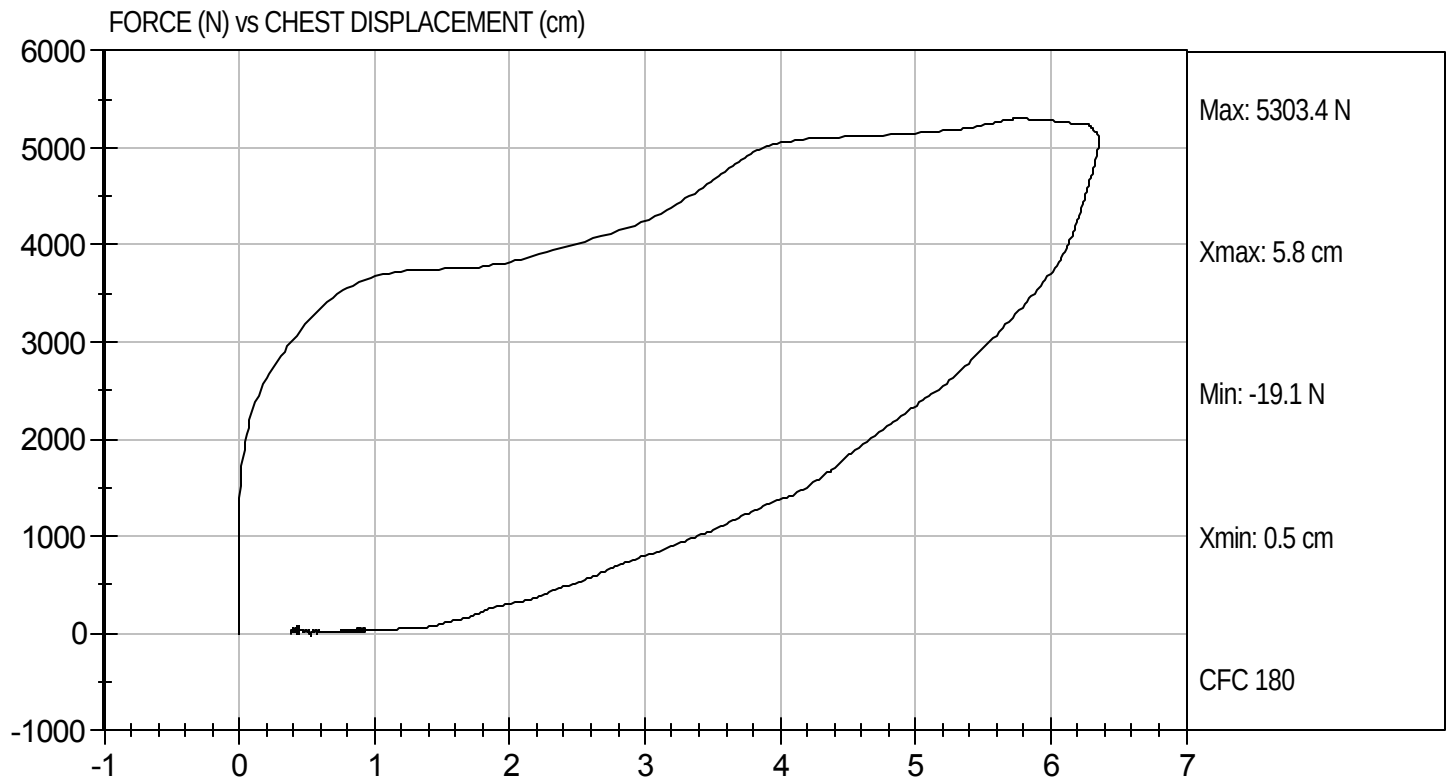
1/6/11
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D11094

Test Date: 1/6/11
Velocity: 22.22 ft/s, 6.77 m/s



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

ATD Serial No: 351

Test I.D: D11095

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/s	2.07 to 2.13	2.13	Pass
Peak Probe Force	Newtons	4715 to 5782	5,334	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

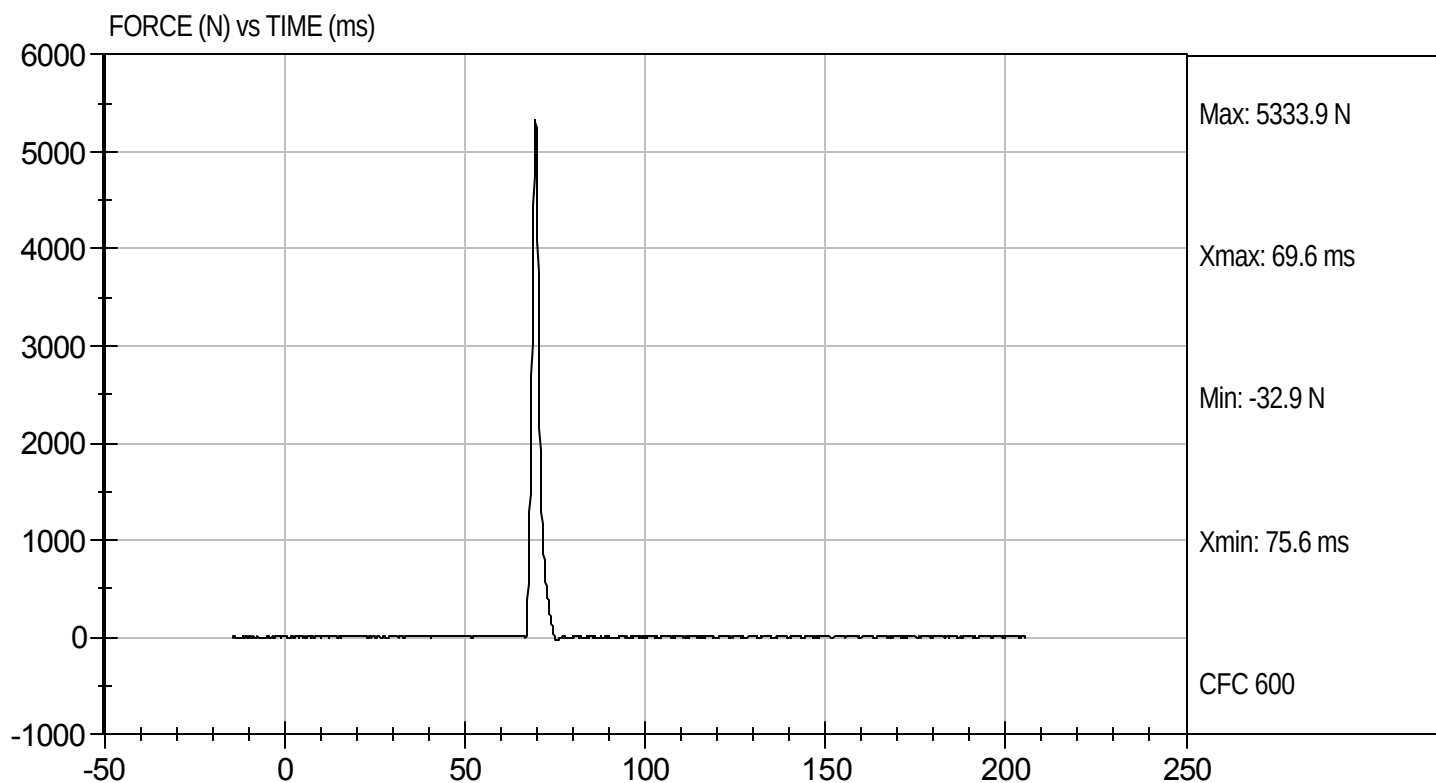
1/5/11
Test Date

David Winkelbauer
Approved By



Test Desc: Right Knee
Component ID: D11095

Test Date: 1/5/11
Velocity: 6.99 ft/s, 2.13 m/s



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

ATD Serial No: 351

Test I.D: D11096

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,583	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

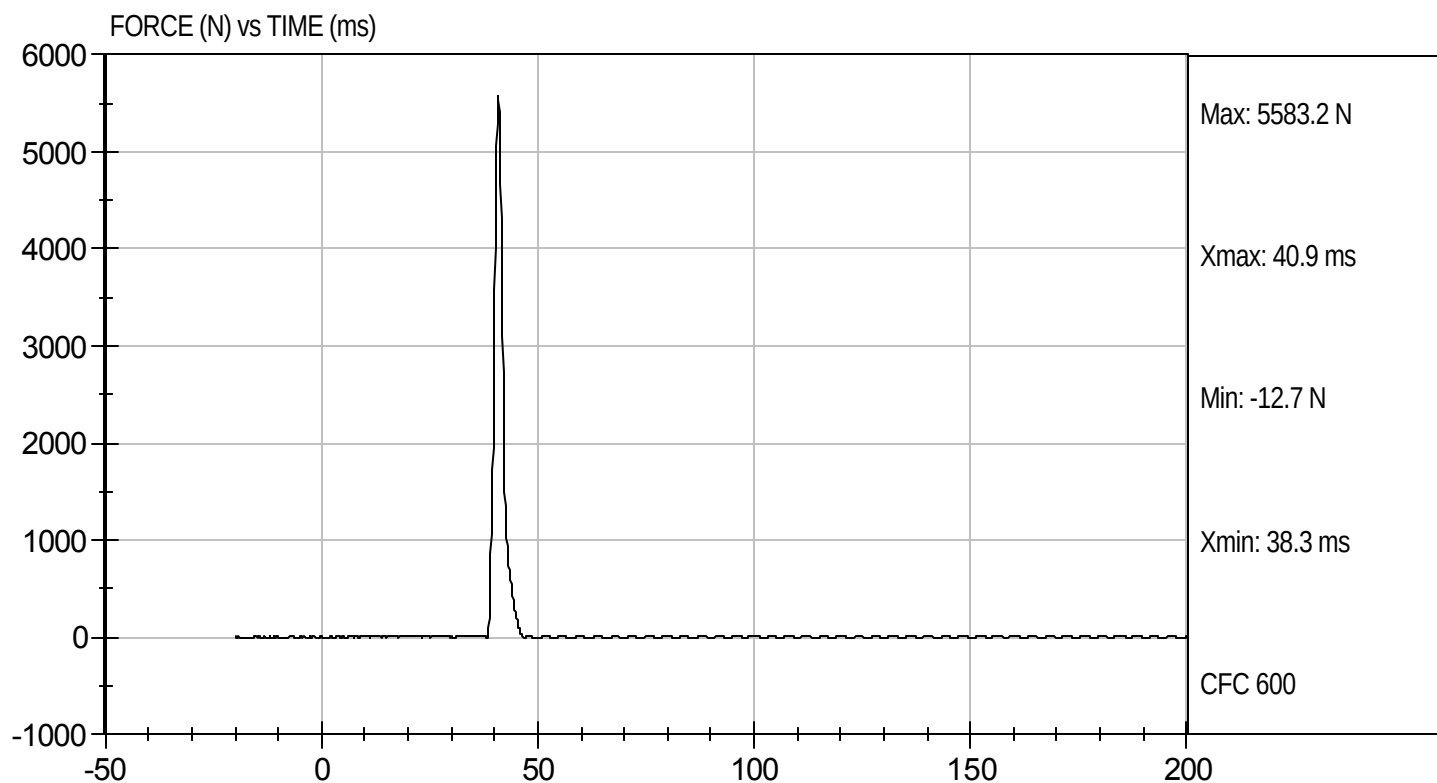
1/5/11
Test Date

David Winkelbauer
Approved By



Test Desc: Left Knee
Component ID: D11096

Test Date: 1/5/11
Velocity: 6.94 ft/s, 2.12 m/s



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

ATD Serial No: 351

Test I.D: D11090

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.3	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	18	18	Pass
Rotation Rate	deg/s	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	47.6	45.2	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	47	48	Pass
Overall Test Results					Pass

Jessica Galt
Laboratory Technician

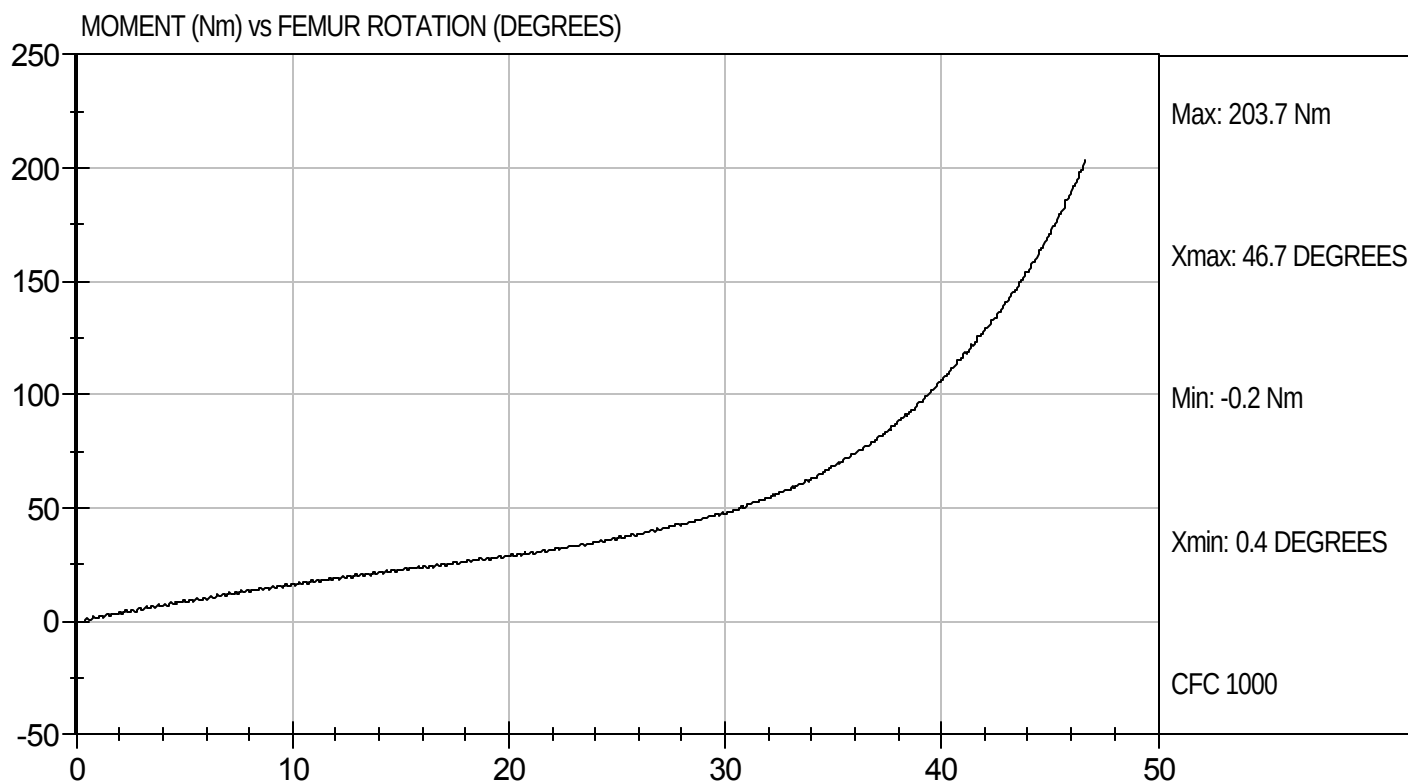
1/6/11
Test Date

David Winkelbauer
Approved By



Test Desc: Hip Femur Flexion
Component ID: D11099

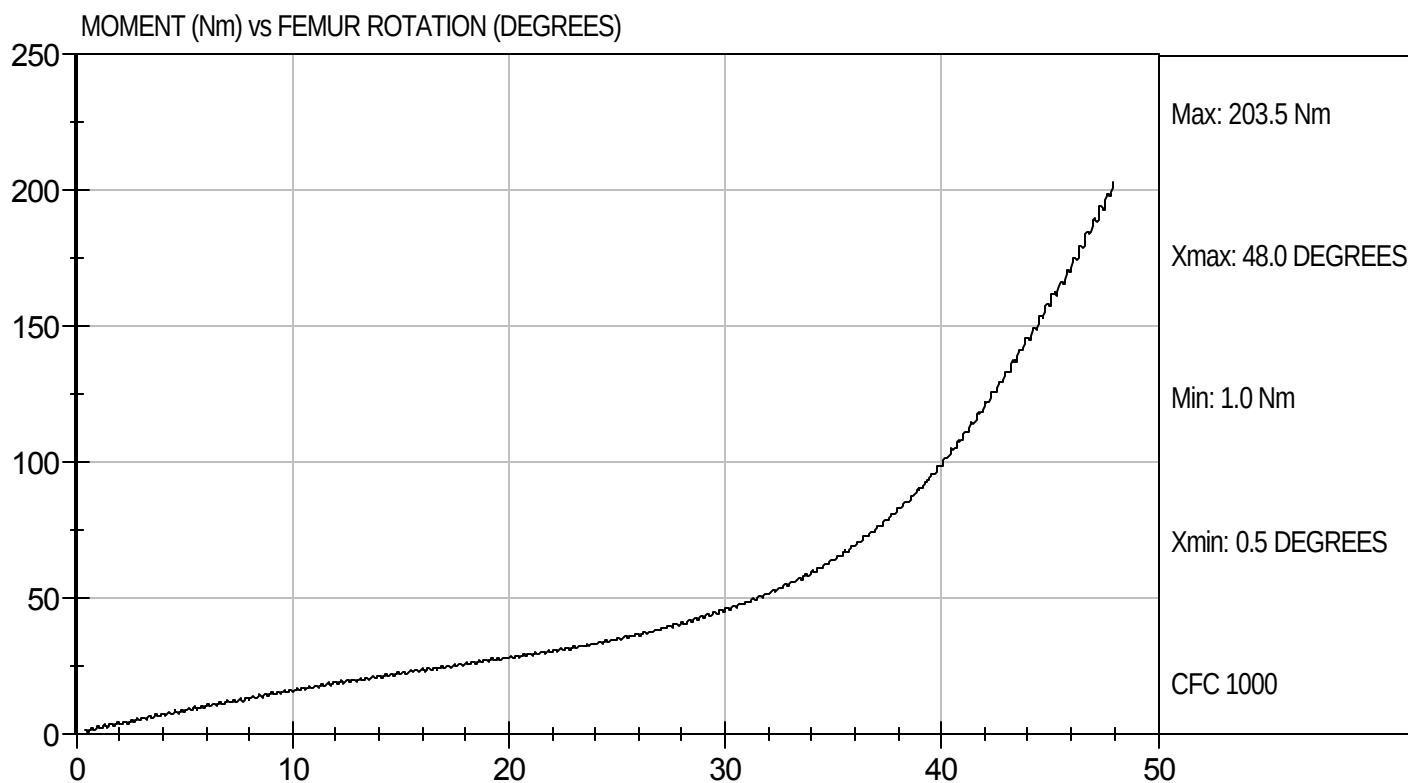
Test Date: 1/6/11
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D11090

Test Date: 1/6/11
Velocity: 0 ft/s, 0.00 m/s

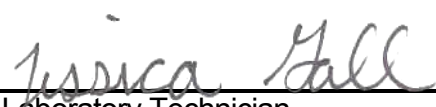


MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test ID: D104541

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Peak Resultant Acceleration	G's	250 to 300	274	Pass
Peak Lateral Acceleration	G's	+/- 15	-4.3	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

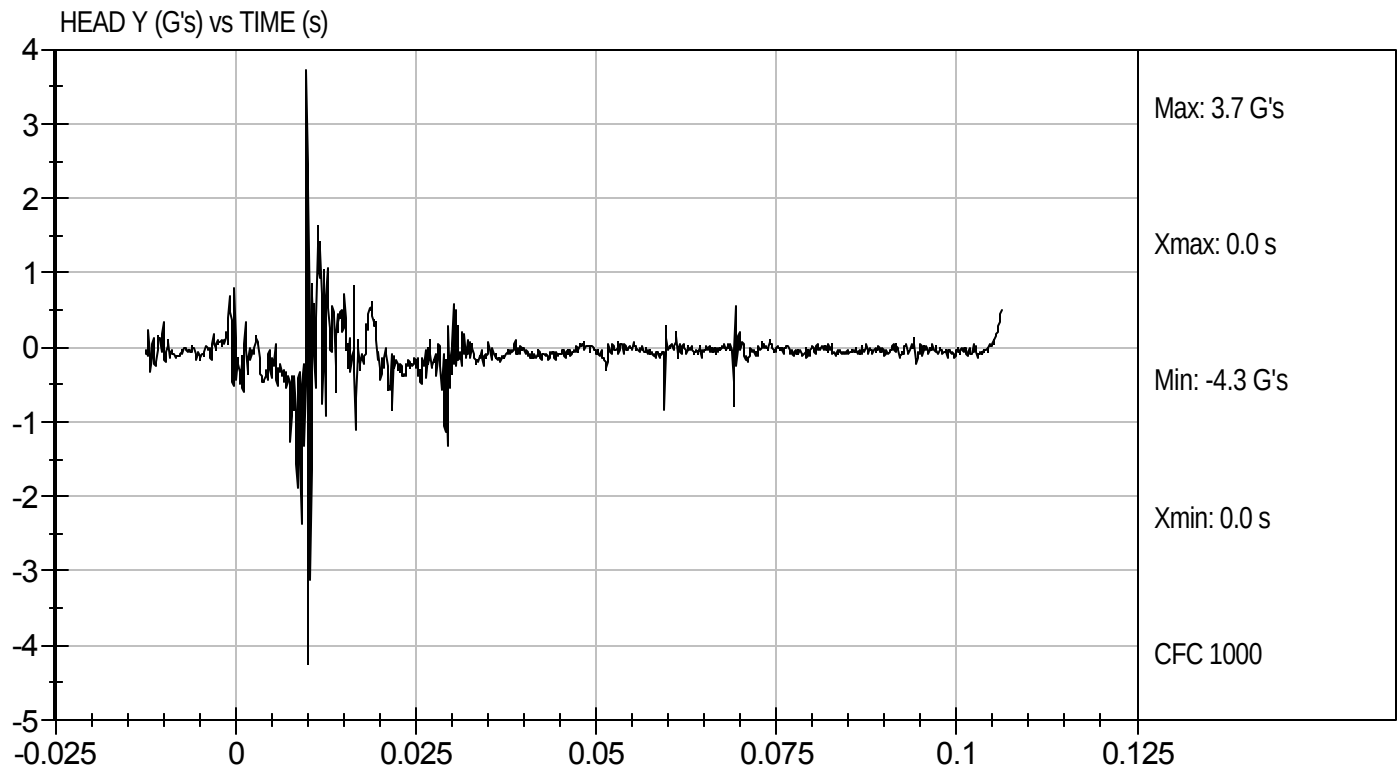
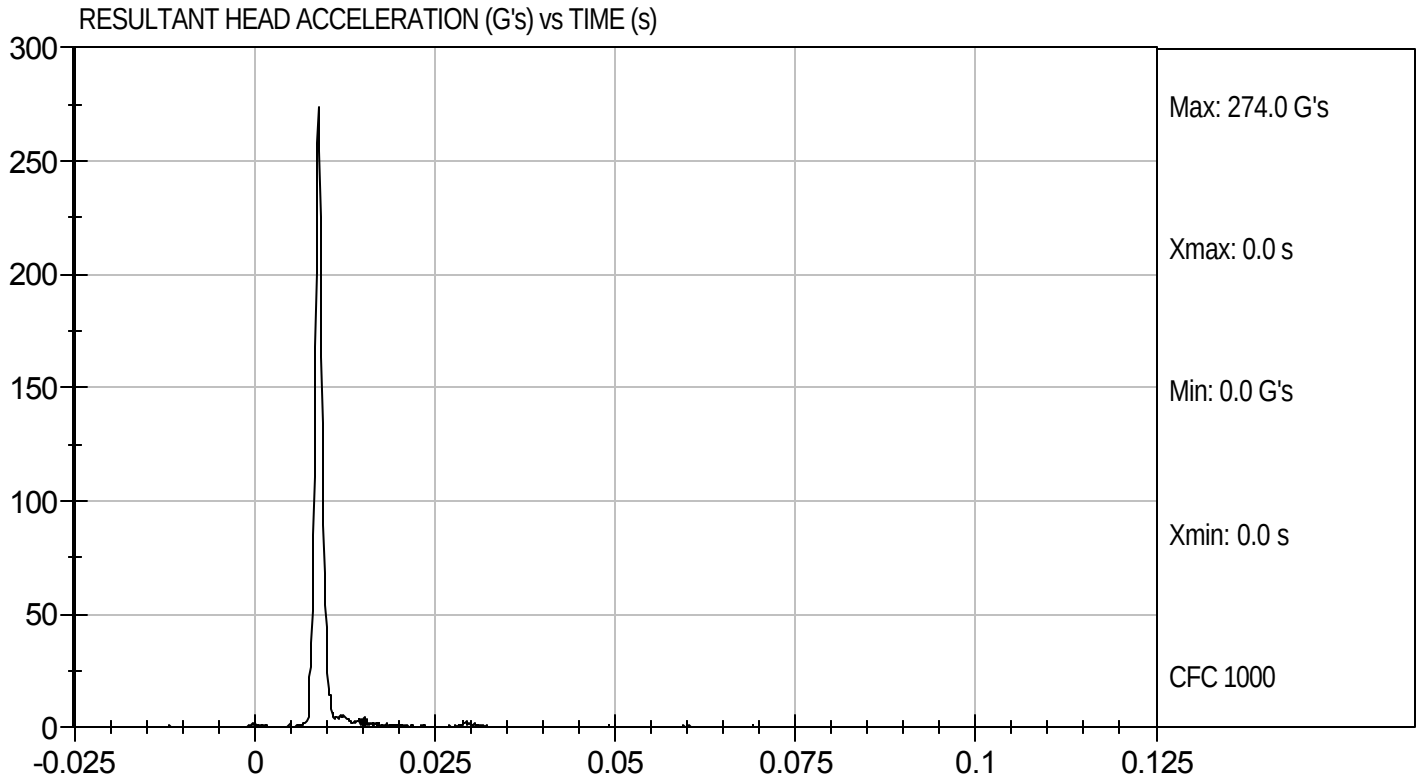
12/21/10
Test Date


Approved By



Test Desc: Head Drop
Component ID: D104541

Test Date: 12/21/10
Velocity: 0 ft/s, 0 m/s



MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D104542

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	27	Pass
Pendulum Speed		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.2	Pass
	30 ms	m/s	5.8 to 7.0	5.8	Pass
D Plane Rotation	Max	deg	77 to 91	77	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	69 to 83	78	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	88	Pass
Overall Results					Pass

Jessica Hall
Laboratory Technician

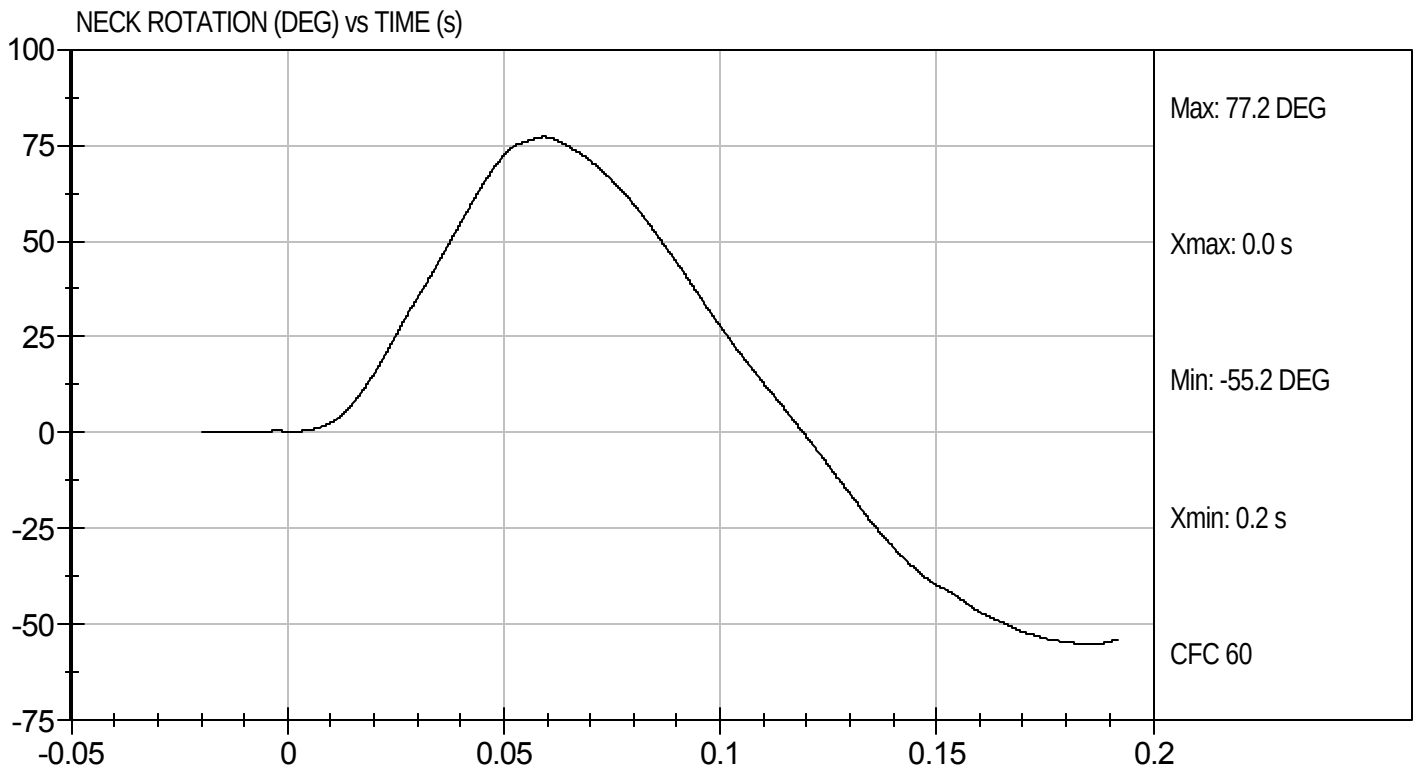
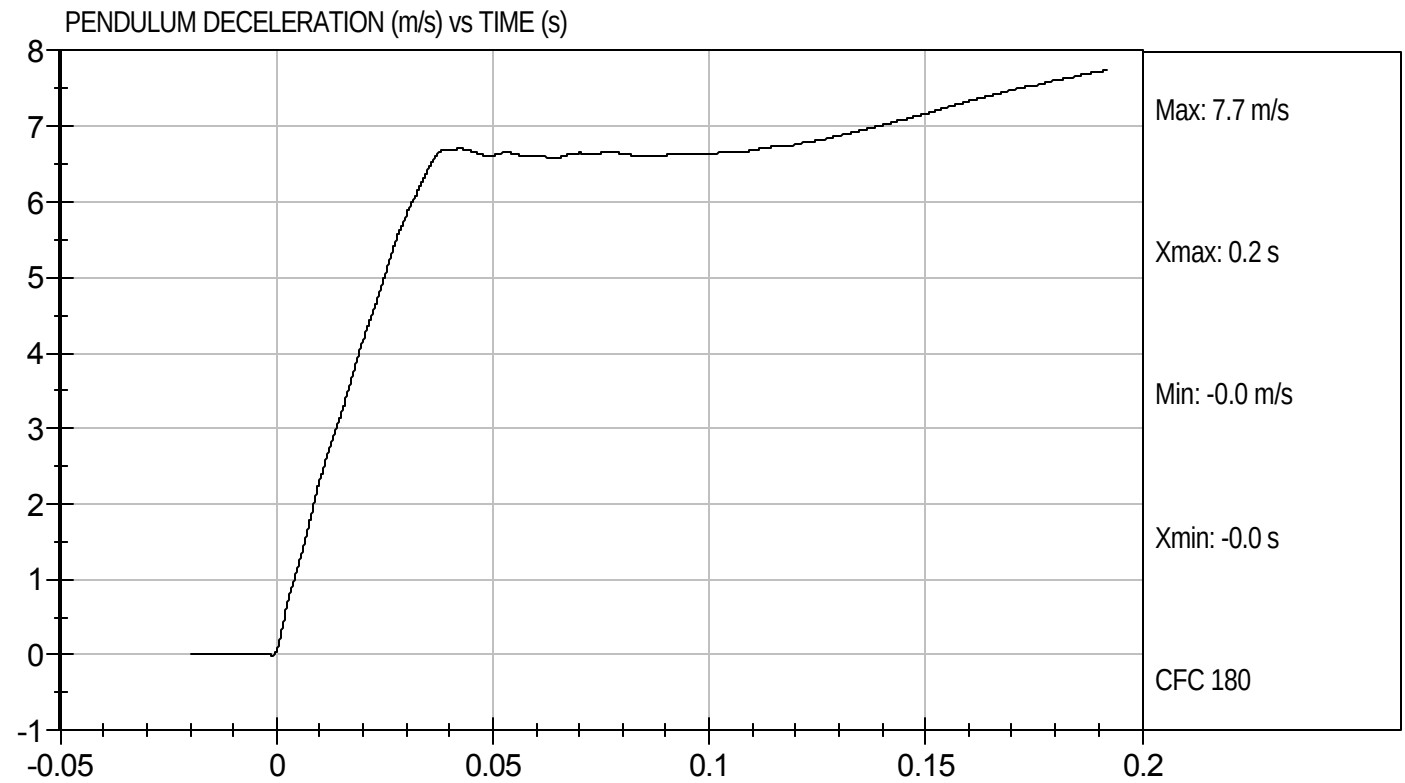
12/21/10
Test Date

David Winkelbauer
Approved By



Test Desc: Neck Flexion
Component ID: D104542

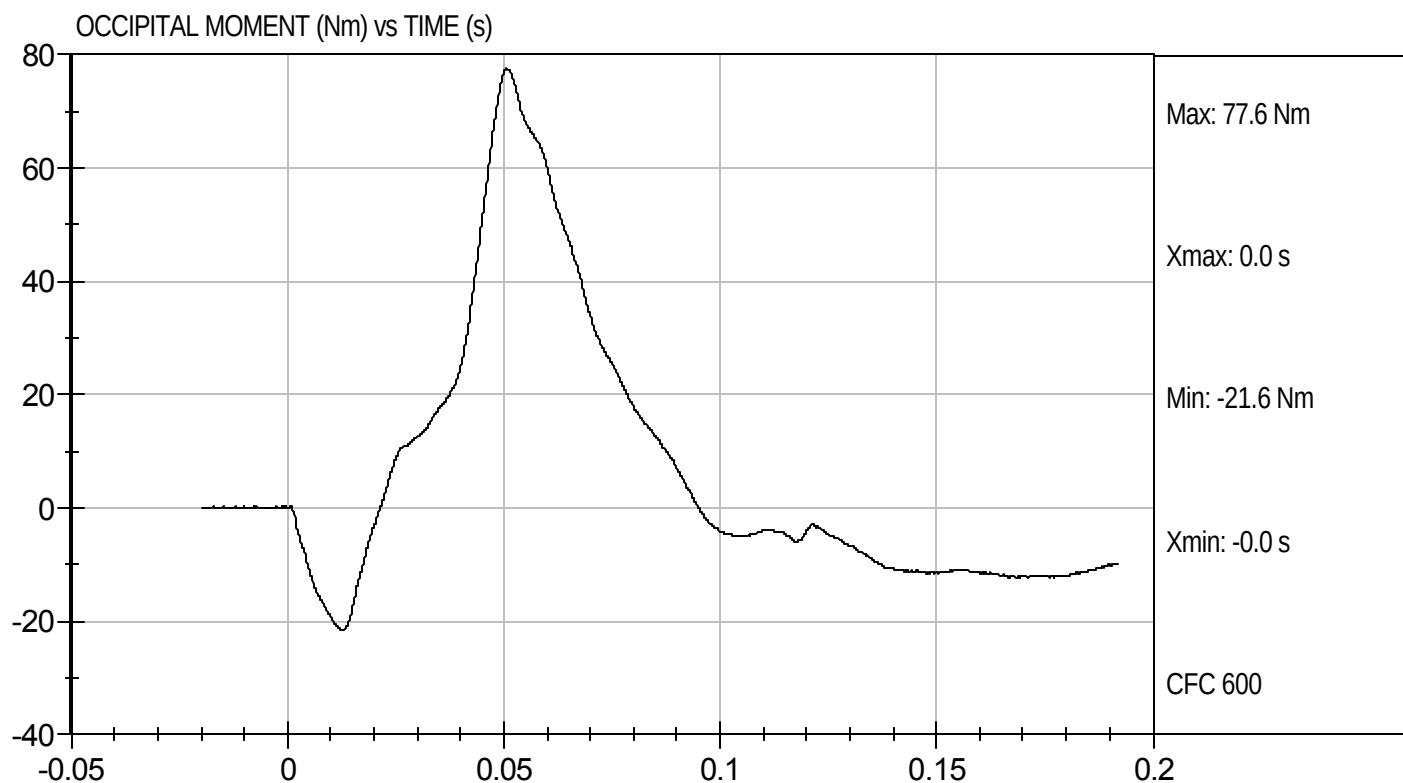
Test Date: 12/21/10
Velocity: 23.15 ft/s, 7.06 m/s





Test Desc: Neck Flexion
Component ID: D104542

Test Date: 12/21/10
Velocity: 23.15 ft/s, 7.06 m/s



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138Test I.D: D104543

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity		%	10 to 70	27	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.13	Pass
Pendulum Deceleration	10 ms	m/s	1.5 to 1.9	1.9	Pass
	20 ms	m/s	3.1 to 3.9	3.6	Pass
	30 ms	m/s	4.6 to 5.6	5.2	Pass
D Plane Rotation	Max	deg	99 to 114	99	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	-65 to -53	-53	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	100	Pass
Overall Results					Pass

Jessica Hall
Laboratory Technician

12/21/10

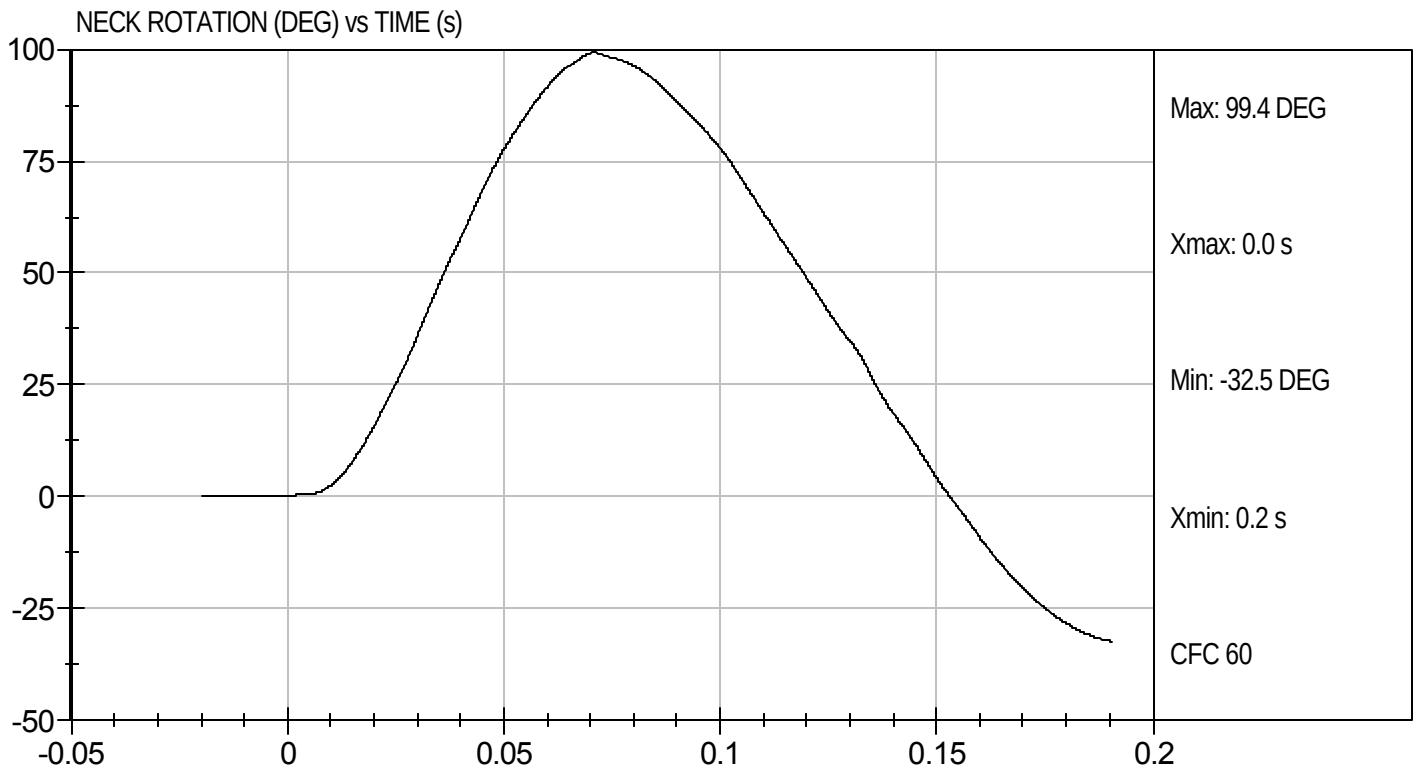
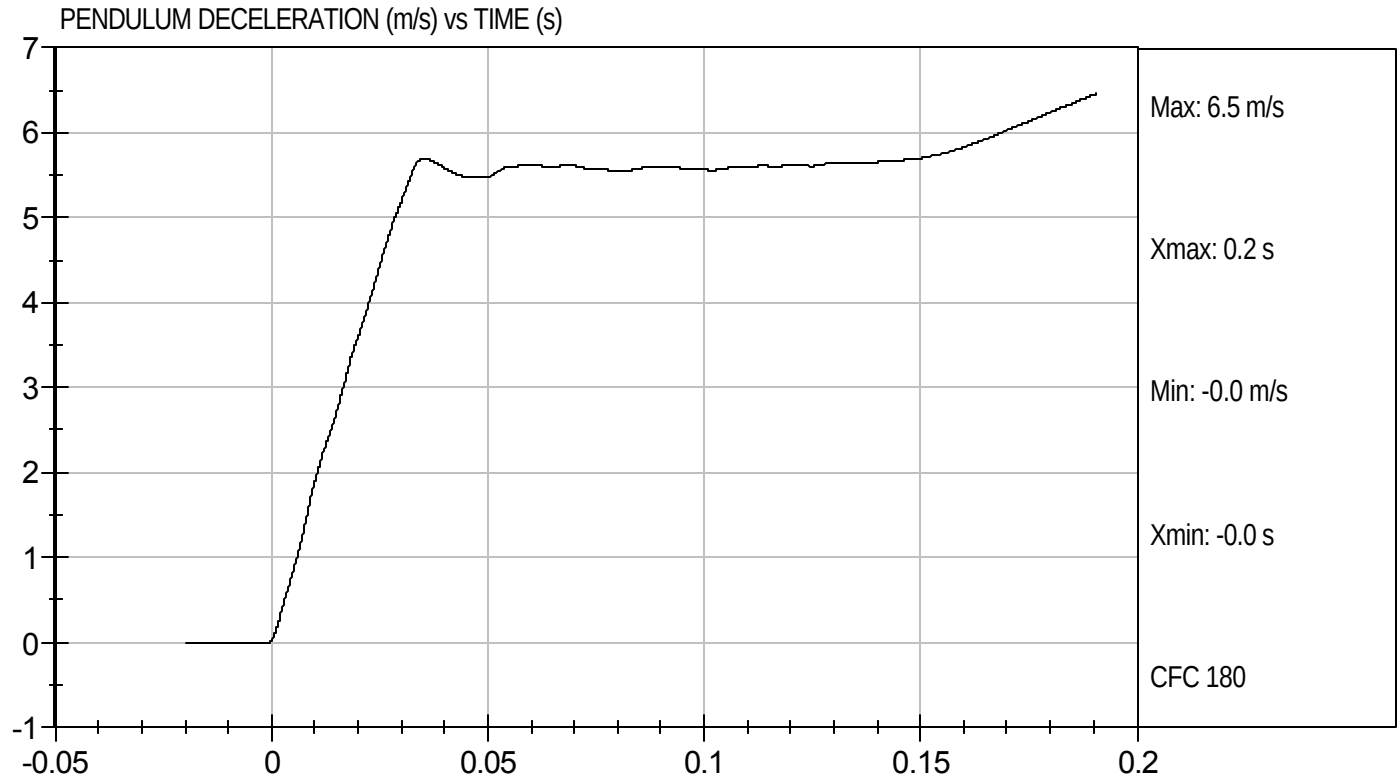
Test Date

David Winkelbauer
Approved By



Test Desc: Neck Extension
Component ID: D104543

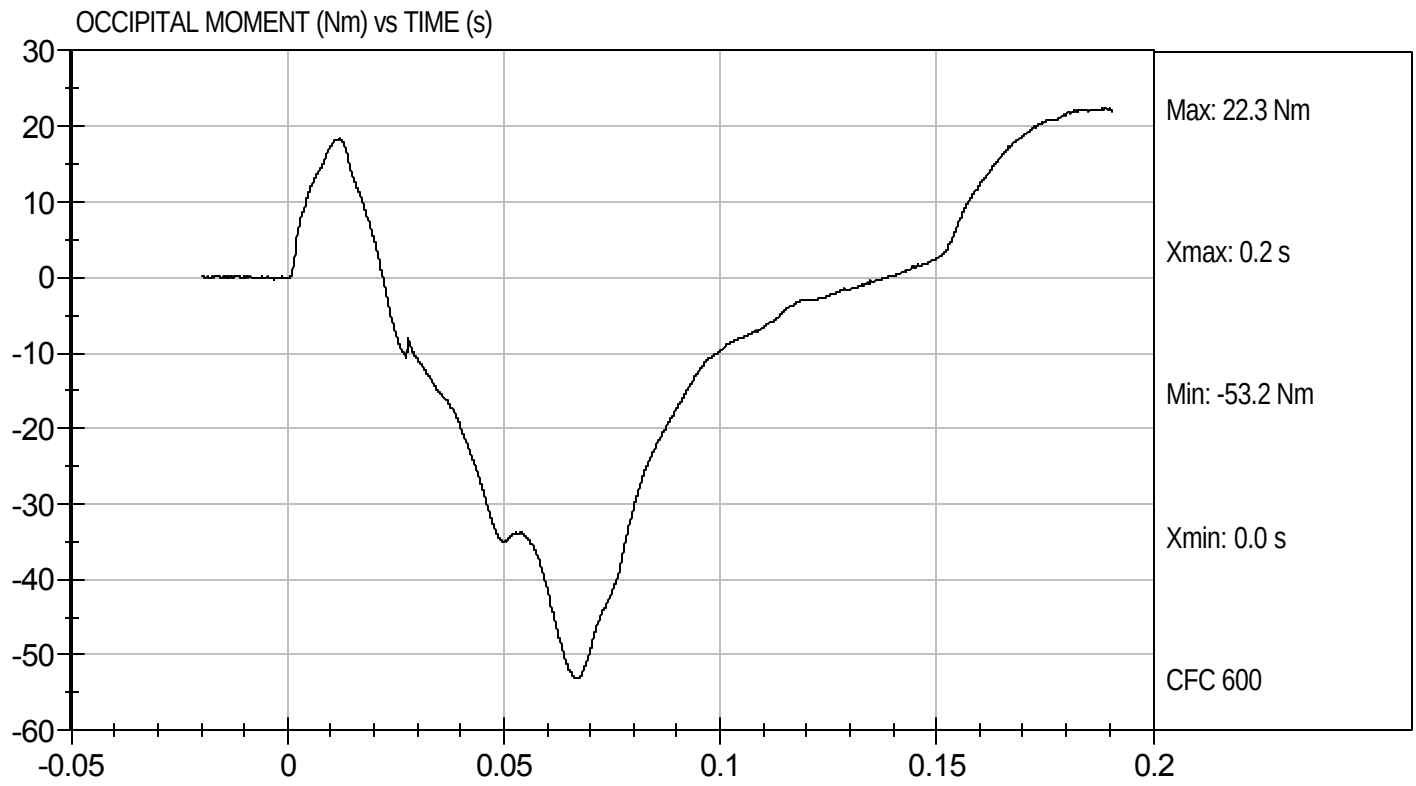
Test Date: 12/21/10
Velocity: 20.10 ft/s, 6.13 m/s





Test Desc: Neck Extension
Component ID: D104543

Test Date: 12/21/10
Velocity: 20.10 ft/s, 6.13 m/s



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D104544

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Relative Humidity	%	10 to 70	23	Pass
Probe Speed	m/s	6.59 to 6.83	6.68	Pass
Peak Deflection	mm	50 to 58	52	Pass
Peak Resistive Force w/in Deflection Corridor	kN	3.9 to 4.4	4.2	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Peak Force 18 mm - 50 mm	N	<= 4,600 N	4229	Pass
Overall Test Results				Pass


Laboratory Technician

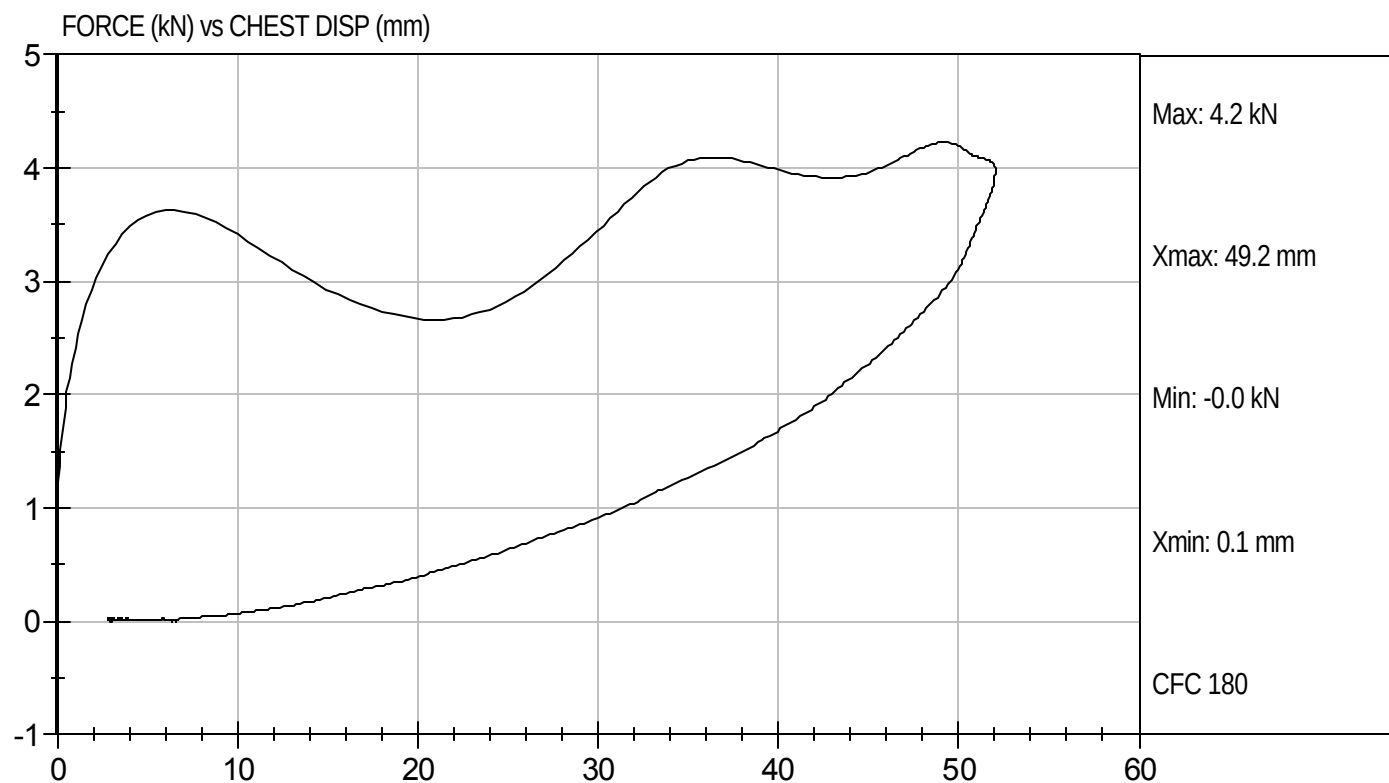
12/22/10
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D104544

Test Date: 12/22/10
Velocity: 21.9 ft/s, 6.68 m/s



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

ATD Serial No: 138

Test I.D: D104545

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Speed	m/s	2.07 to 2.13	2.12	Pass
Maximum Force	kN	3.45 to 4.06	3.64	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

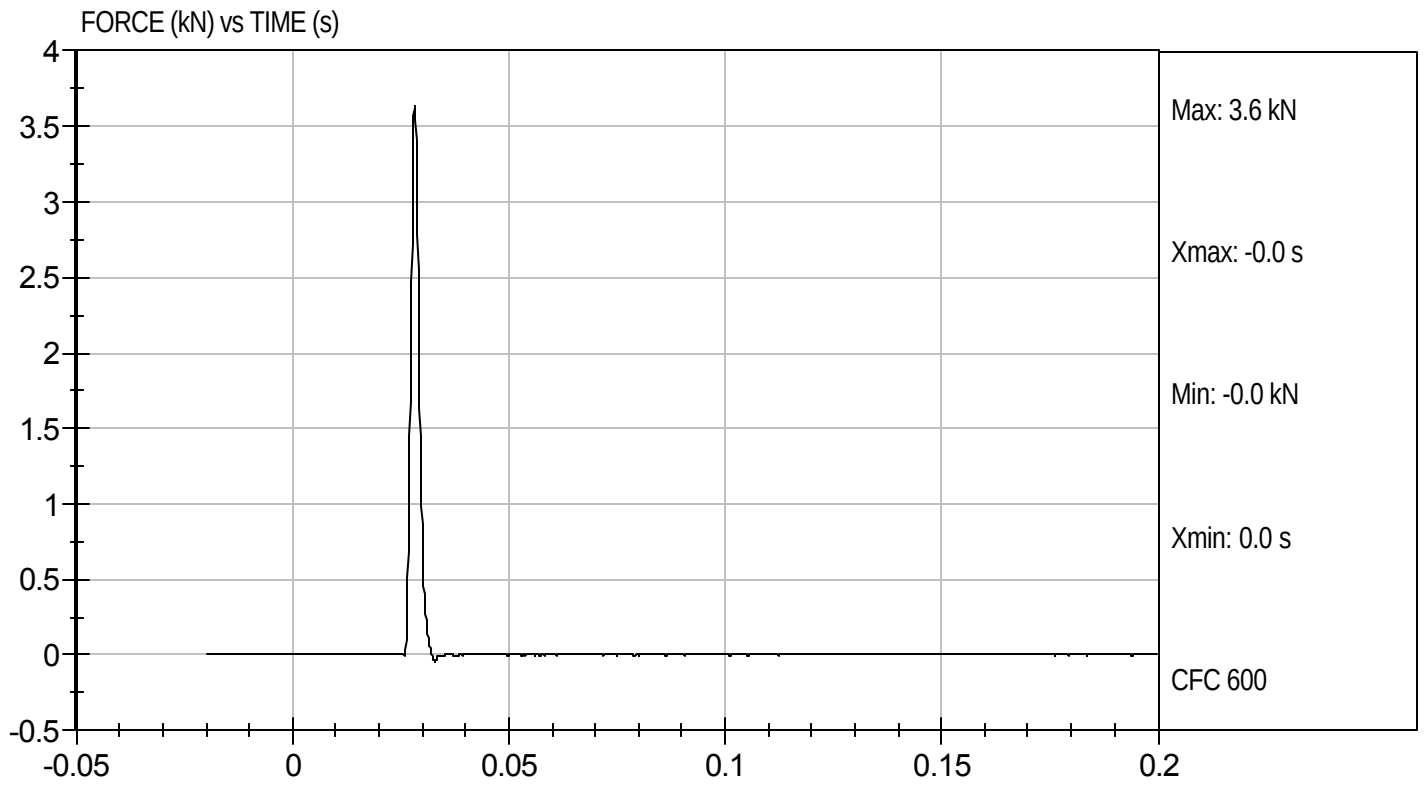
12/21/10
Test Date

David Winkelbauer
Approved By



Test Desc: Right Knee
Component ID: D104545

Test Date: 12/21/10
Velocity: 6.94 ft/s, 2.12 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D104546

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Speed	m/s	2.07 to 2.13	2.10	Pass
Maximum Force	kN	3.45 to 4.06	3.68	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

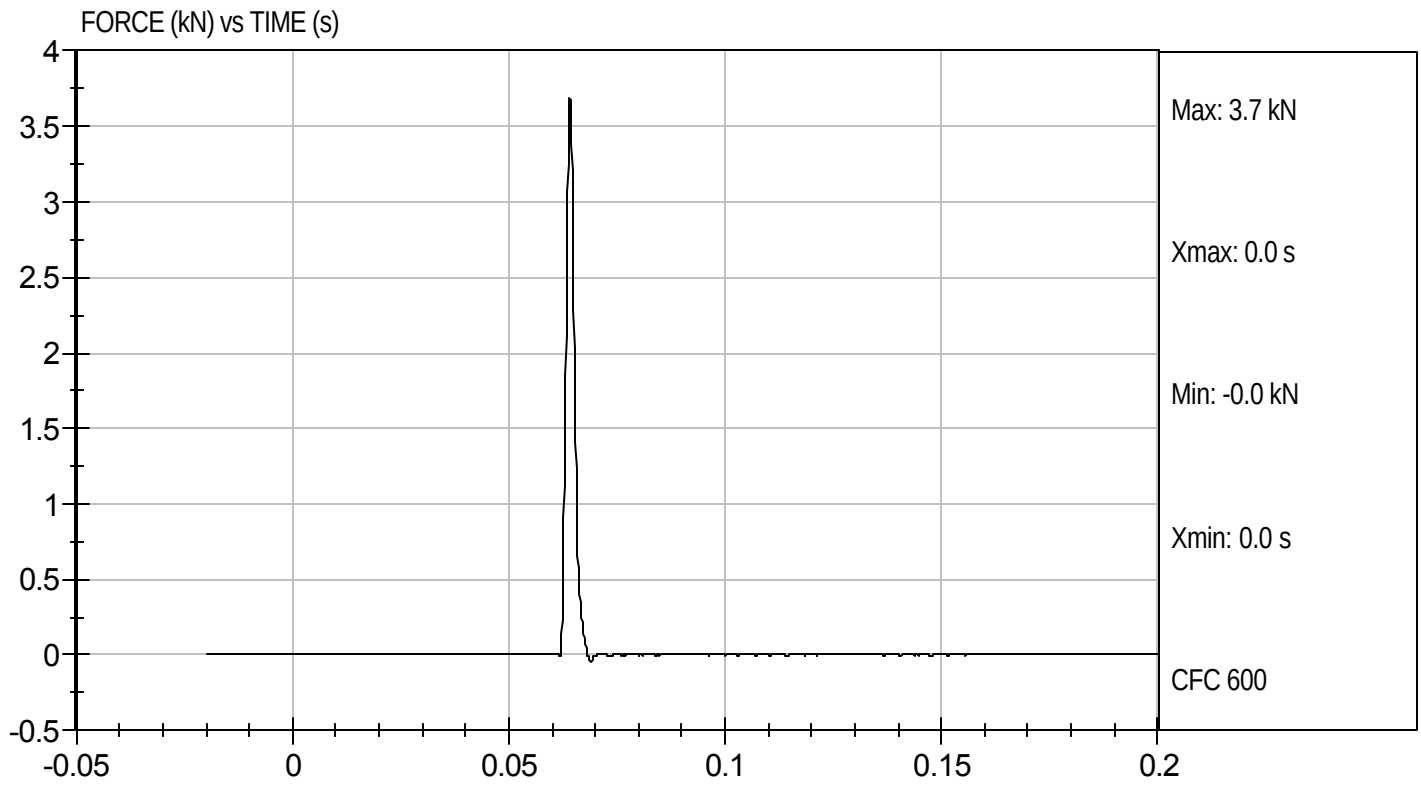
12/21/10
Test Date

David Winkelbauer
Approved By



Test Desc: Left Knee
Component ID: D104546

Test Date: 12/21/10
Velocity: 6.89 ft/s, 2.10 m/s



MGA RESEARCH CORPORATION
TORSO FLEXION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D104547

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Initial Angle	deg	0 to 20	19	Pass
Return Angle	deg	+/- 8	1	Pass
Force at 45 deg	N	320 to 390	335	Pass
Upper Torso Deflection Rate	Deg/sec	0.5 - 1.5	1.0	Pass
Overall Result				Pass

Jessica Hall
Laboratory Technician

12/21/2010
Test Date

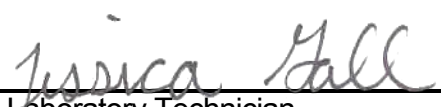
David Winkelbauer
Approved By

MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test ID: D11081

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	18	Pass
Peak Resultant Acceleration	G's	250 to 300	253	Pass
Peak Lateral Acceleration	G's	+/- 15	9.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

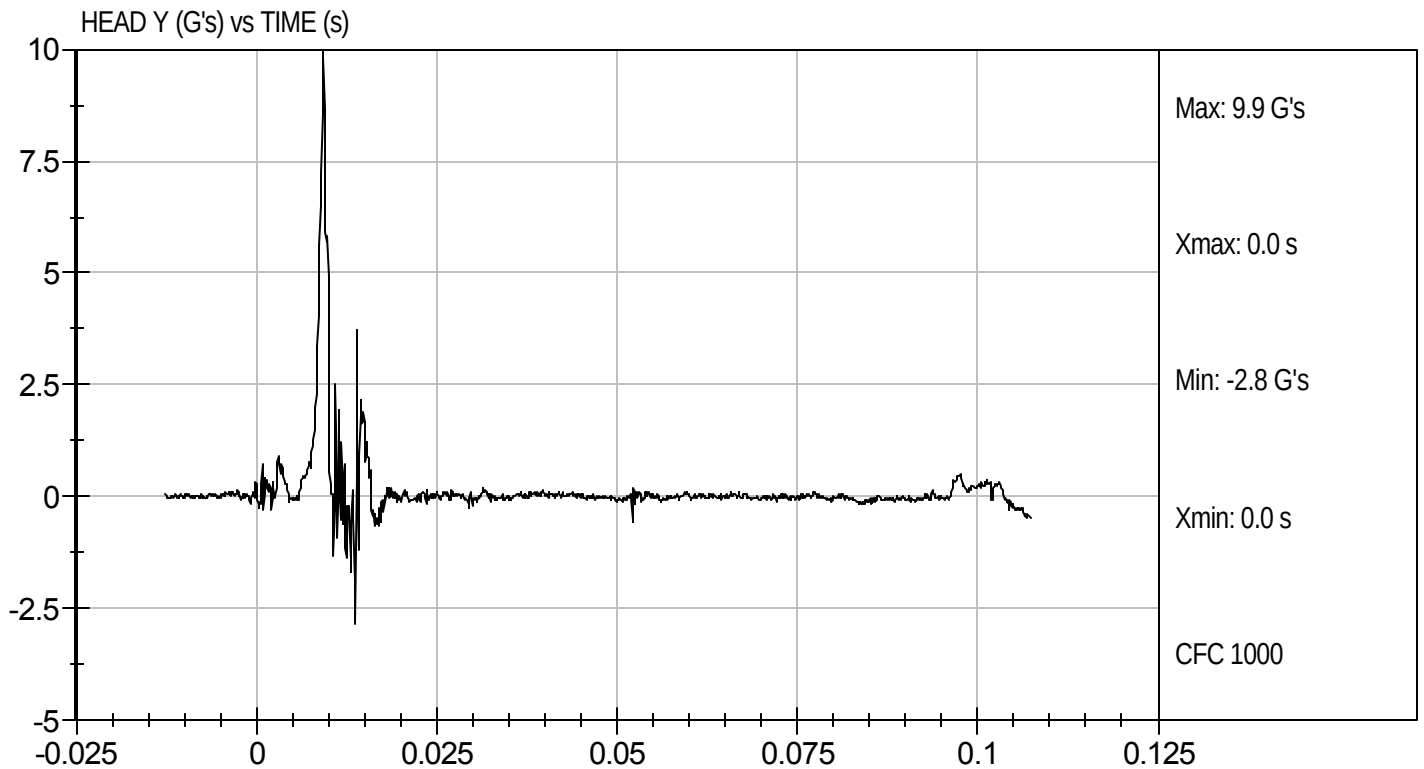
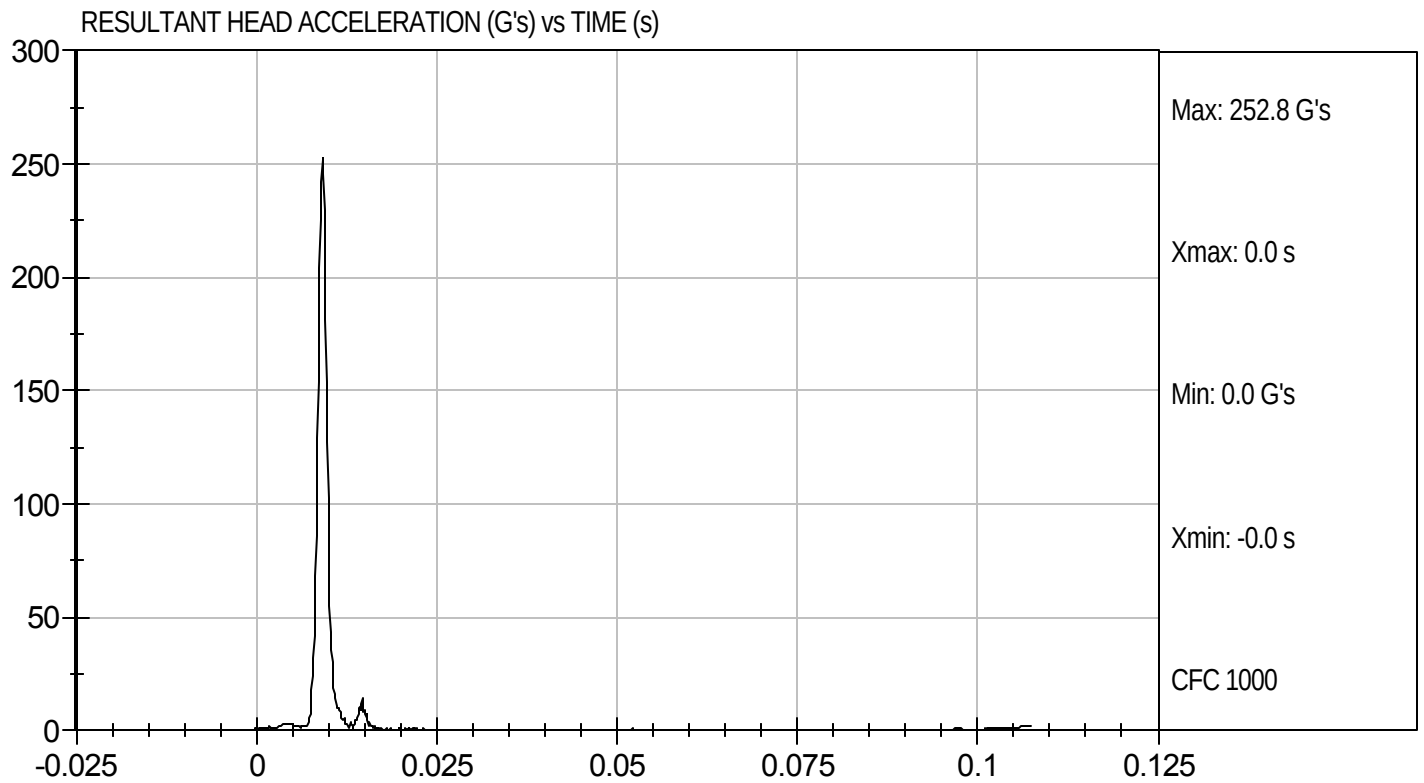
1/5/11
Test Date


Approved By



Test Desc: Head Drop
Component ID: D11081

Test Date: 1/5/11
Velocity: 0 ft/s, 0 m/s



MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D11082

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity		%	10 to 70	18	Pass
Pendulum Speed		m/s	6.89 to 7.13	6.95	Pass
Pendulum Deceleration	10 ms	m/s	2.1 to 2.5	2.3	Pass
	20 ms	m/s	4.0 to 5.0	4.4	Pass
	30 ms	m/s	5.8 to 7.0	6.2	Pass
D Plane Rotation	Max	deg	77 to 91	80	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	69 to 83	80	Pass
Positive Moment Time Curve Decay to 10 Nm		ms	80 to 100	86	Pass
Overall Results				Pass	

Jessica Hall
Laboratory Technician

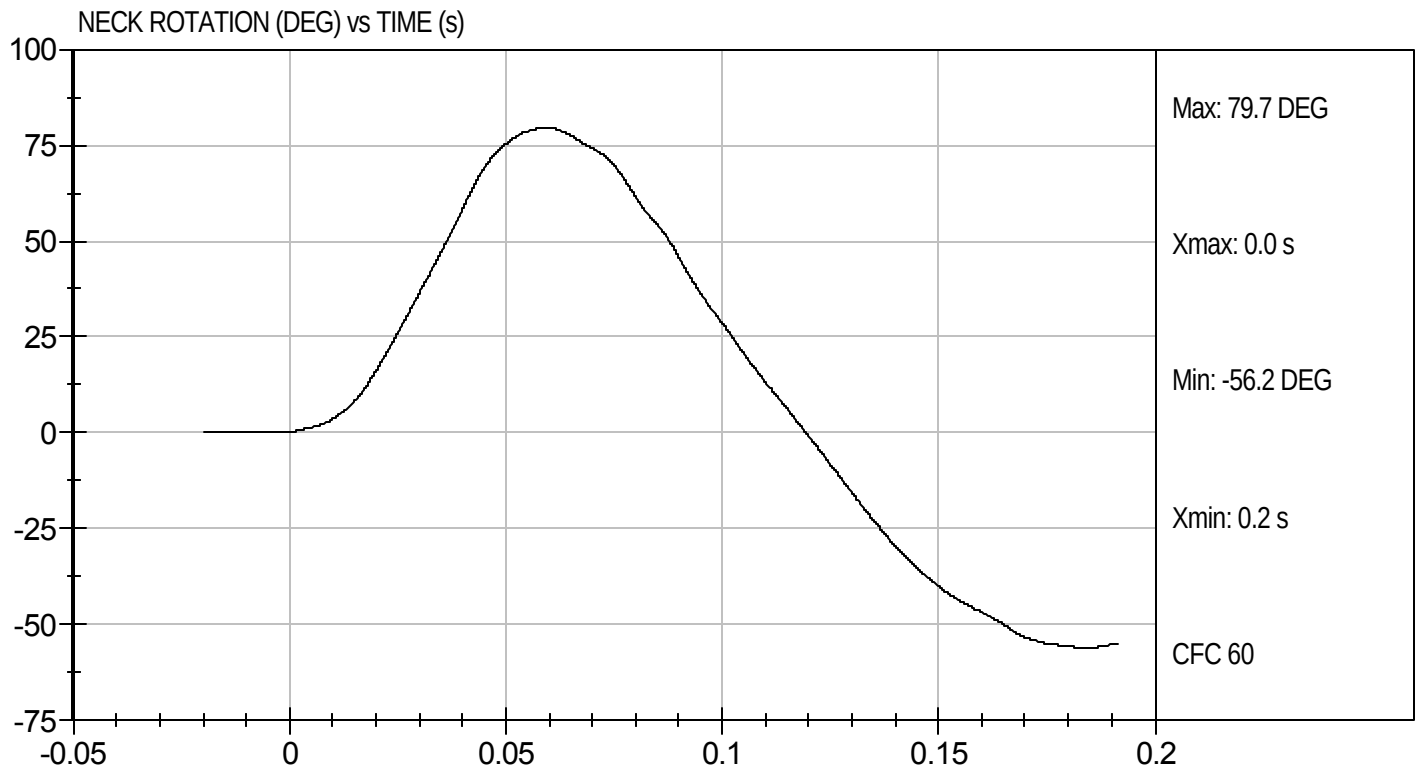
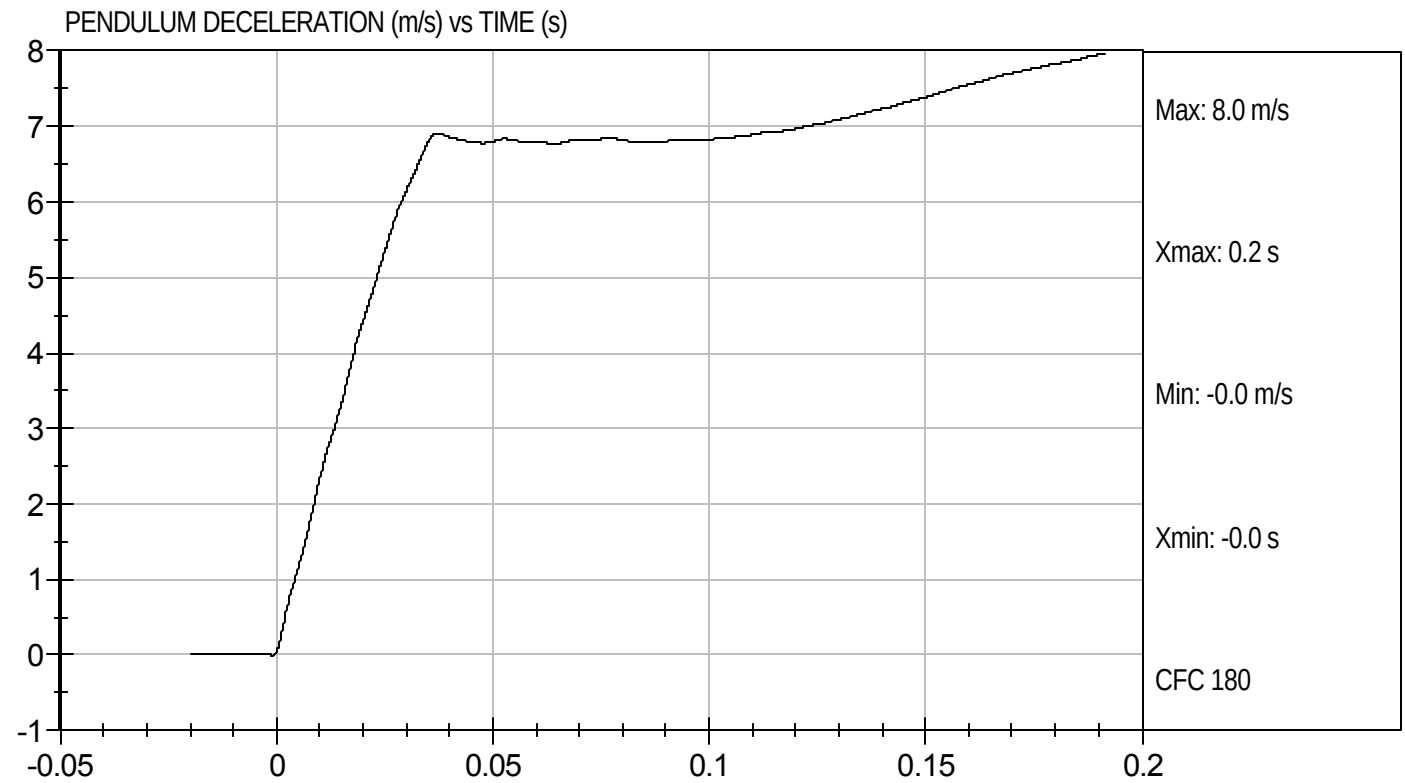
1/6/11
Test Date

David Winkelbauer
Approved By



Test Desc: Neck Flexion
Component ID: D11082

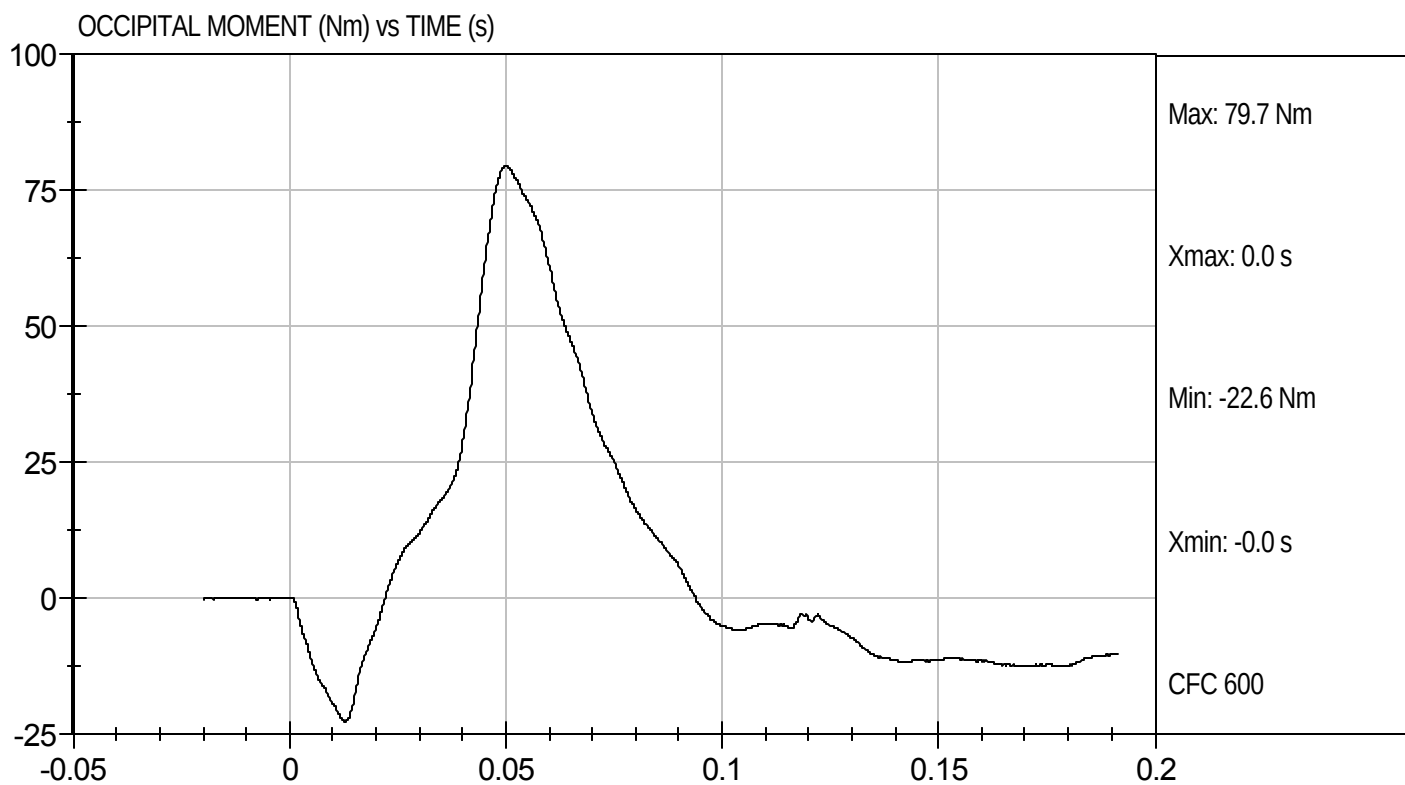
Test Date: 1/6/11
Velocity: 22.8 ft/s, 6.95 m/s





Test Desc: Neck Flexion
Component ID: D11082

Test Date: 1/6/11
Velocity: 22.8 ft/s, 6.95 m/s



MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D11083

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity		%	10 to 70	18	Pass
Pendulum Speed		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	m/s	1.5 to 1.9	1.9	Pass
	20 ms	m/s	3.1 to 3.9	3.6	Pass
	30 ms	m/s	4.6 to 5.6	5.2	Pass
D Plane Rotation	Max	deg	99 to 114	105	Pass
Occipital Condyle Moment within Deflection Corridor		Nm	-65 to -53	-61	Pass
Negative Moment Time Curve Decay to -10 Nm		ms	94 to 114	99	Pass
Overall Results					Pass

Jessica Hall
Laboratory Technician

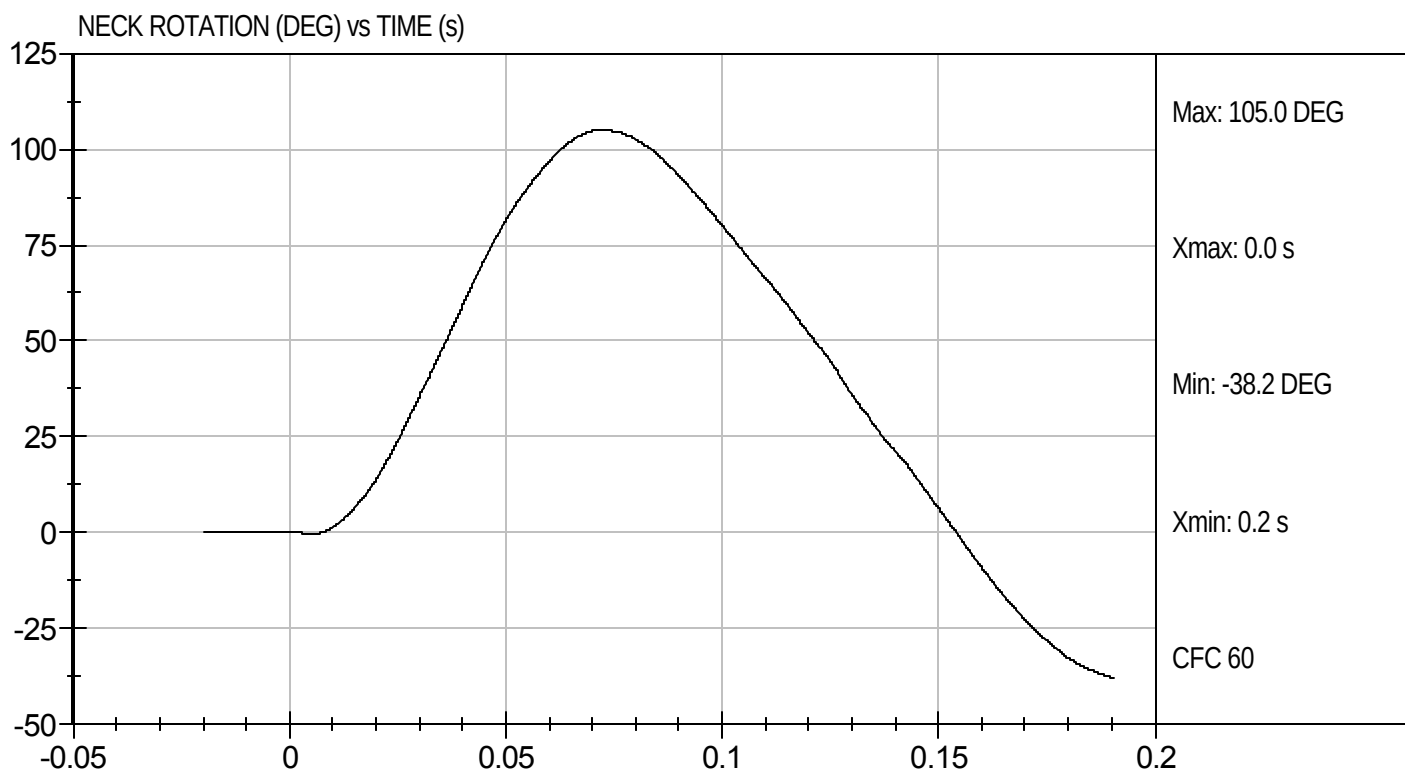
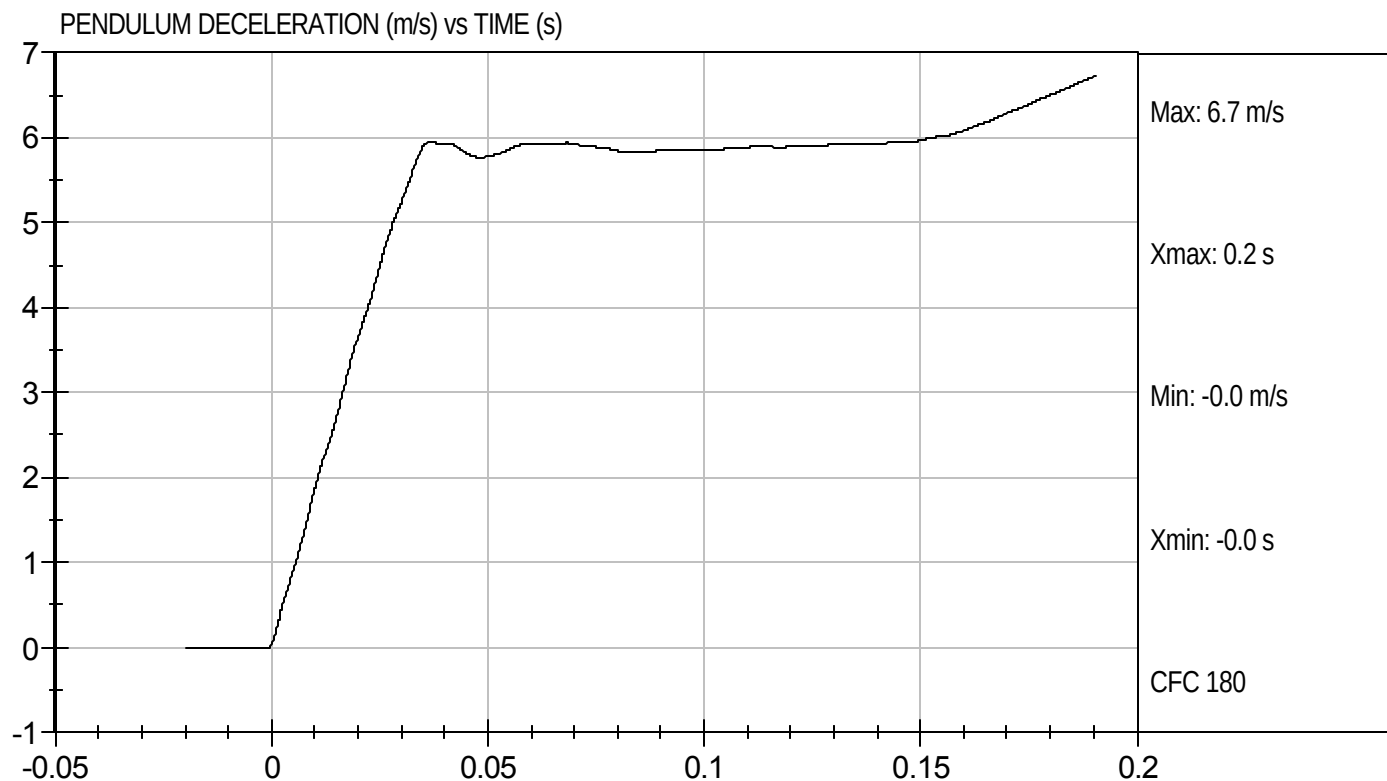
1/6/11
Test Date

David Winkelbauer
Approved By



Test Desc: Neck Extension
Component ID: D11083

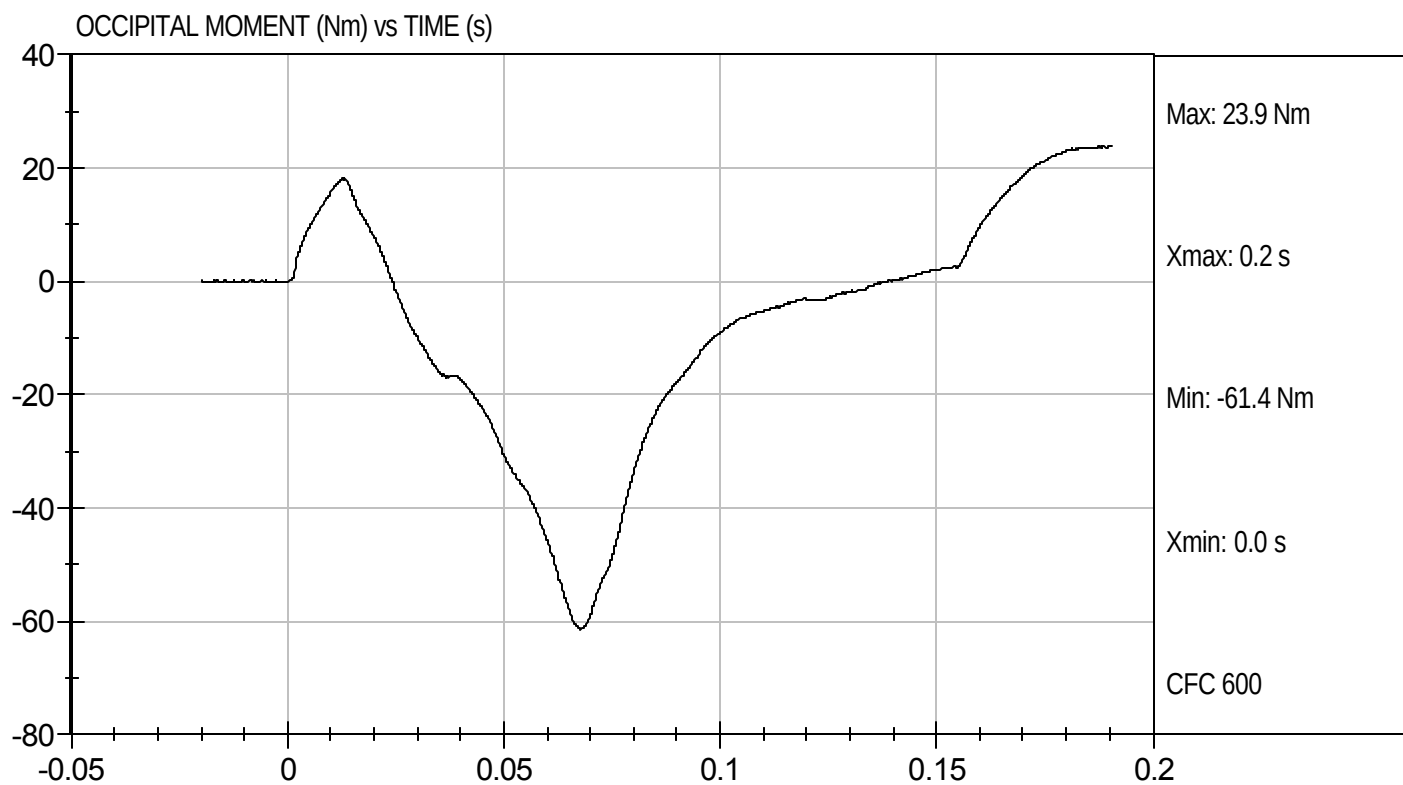
Test Date: 1/6/11
Velocity: 20.08 ft/s, 6.12 m/s





Test Desc: Neck Extension
Component ID: D11083

Test Date: 1/6/11
Velocity: 20.08 ft/s, 6.12 m/s



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D11084

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Relative Humidity	%	10 to 70	19	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	kN	3.9 to 4.4	4.22	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Peak Force 18 mm - 50 mm	N	<= 4,600 N	4217	Pass
			Overall Test Results	Pass

Jessica Hall
Laboratory Technician

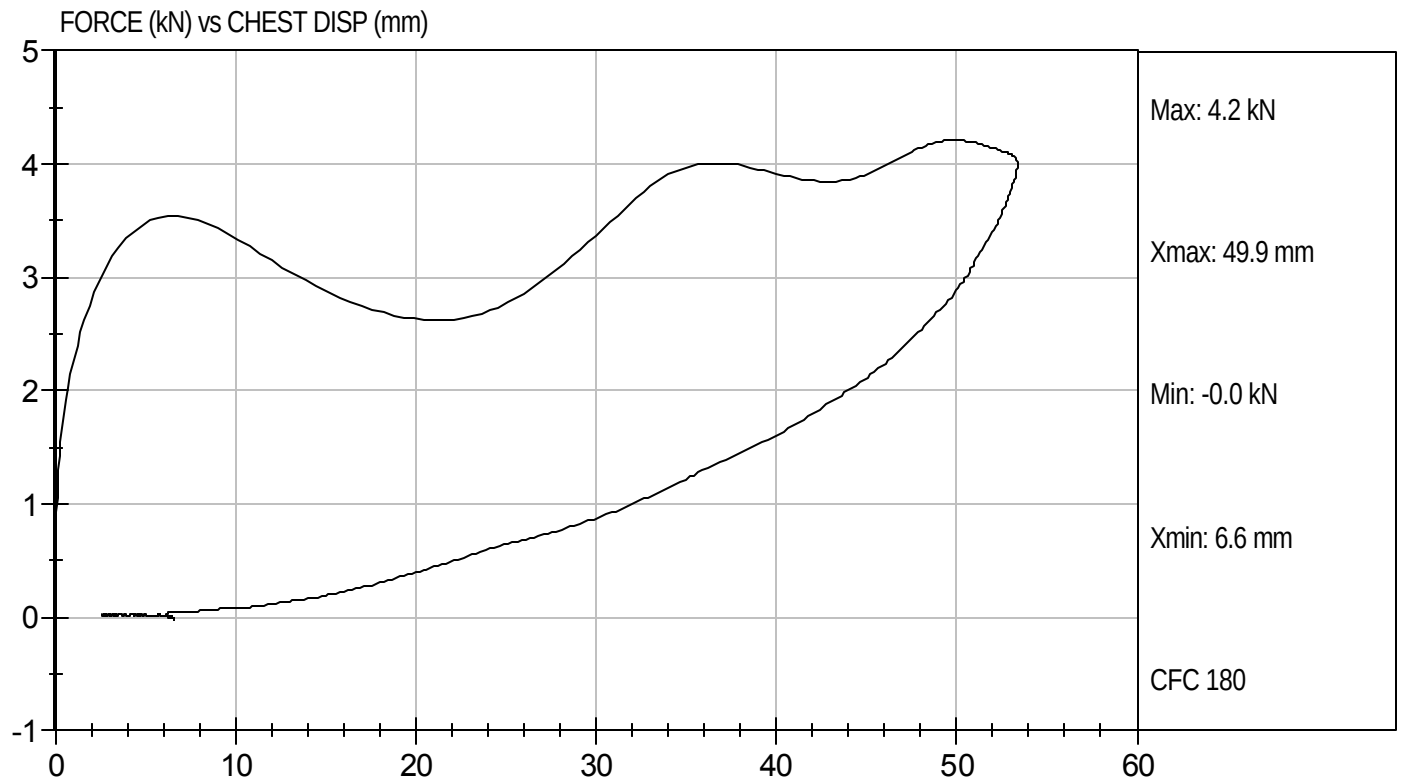
1/6/11
Test Date

David Winkelbauer
Approved By



Test Desc: Thorax Impact
Component ID: D11084

Test Date: 1/6/11
Velocity: 22.22 ft/s, 6.77 m/s

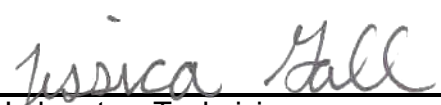


MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D11085

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	kN	3.45 to 4.06	3.59	Pass
Overall Test Results				Pass


Laboratory Technician

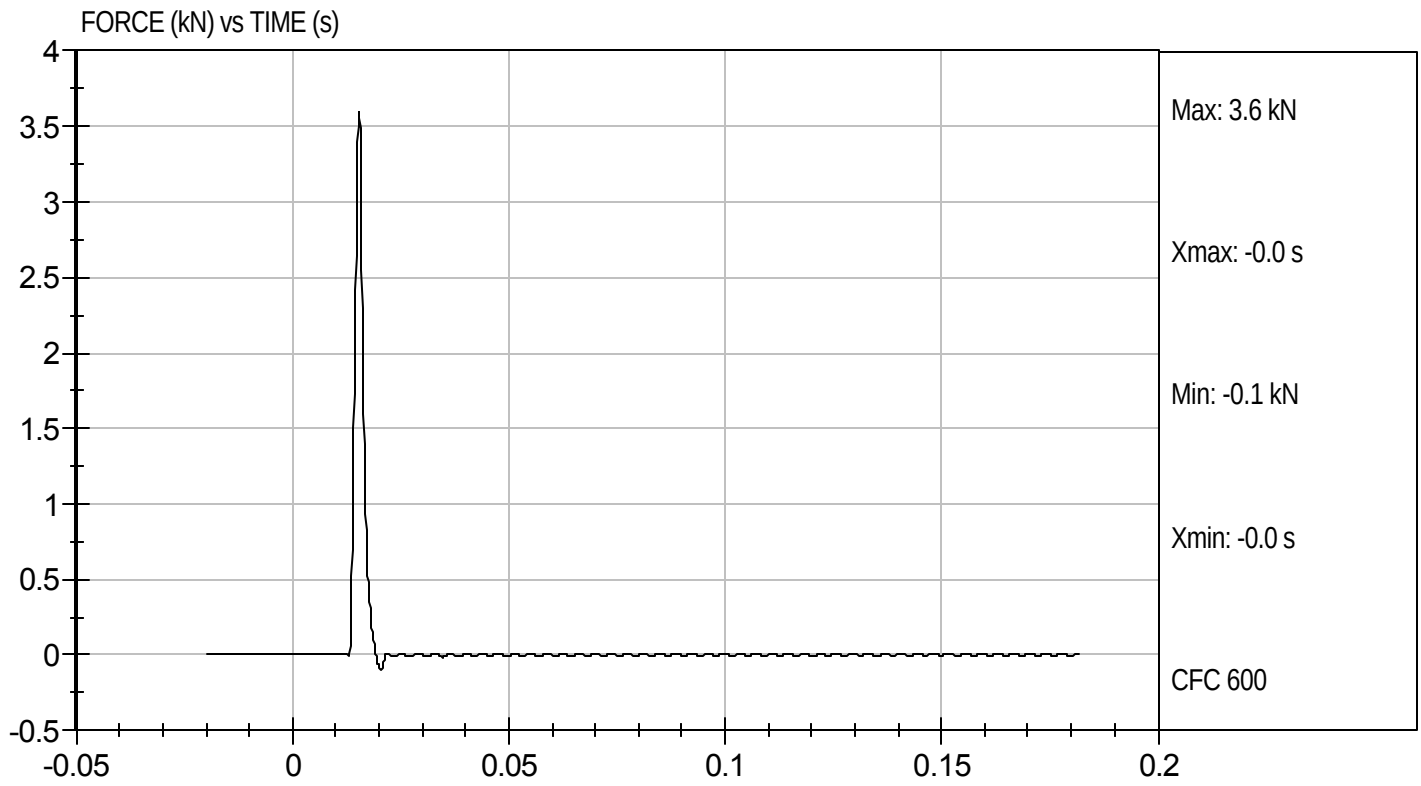
1/5/11
Test Date


Approved By



Test Desc: Right Knee
Component ID: D11085

Test Date: 1/5/11
Velocity: 6.99 ft/s, 2.13 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138

Test I.D: D11086

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	18	Pass
Probe Speed	m/s	2.07 to 2.13	2.13	Pass
Maximum Force	kN	3.45 to 4.06	3.67	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

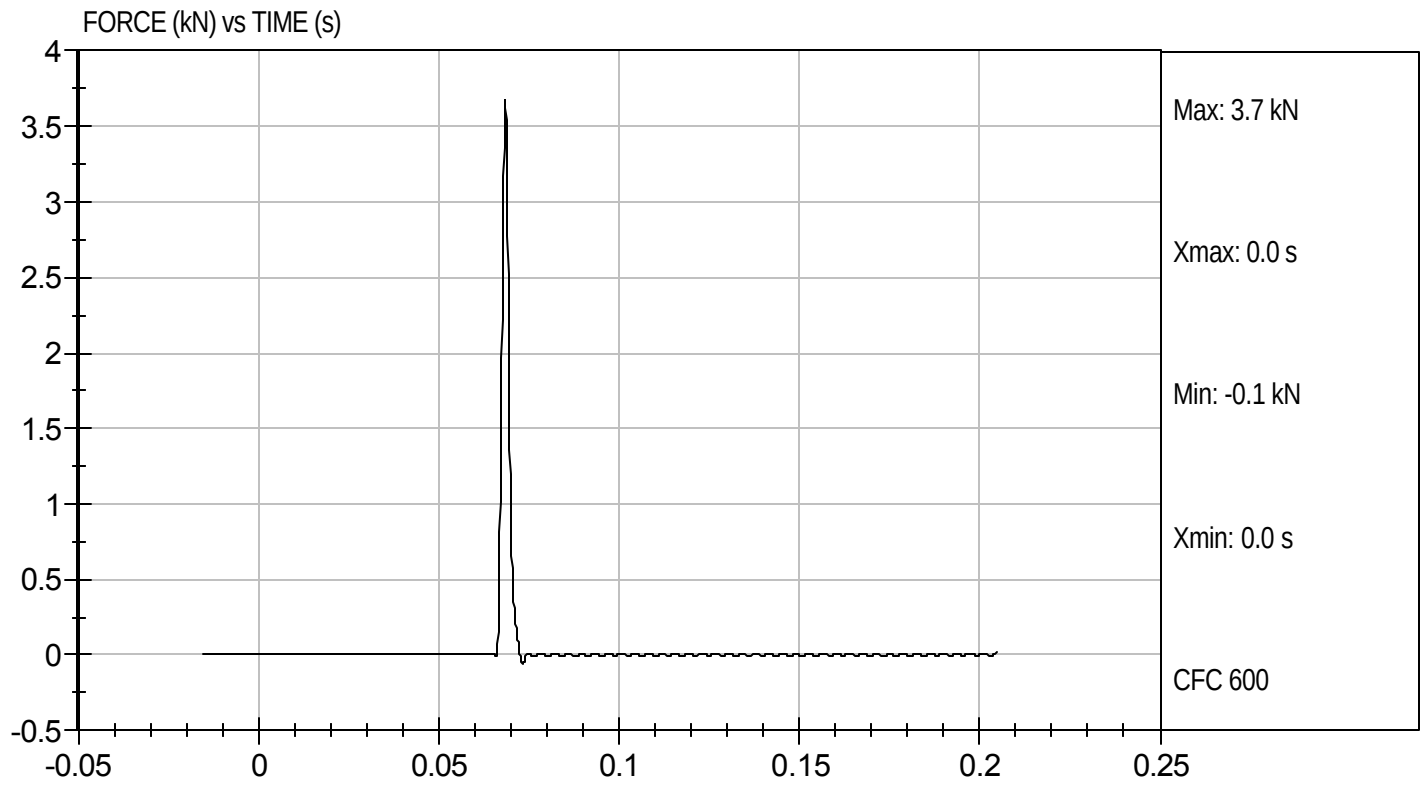
1/5/11
Test Date

David Winkelbauer
Approved By



Test Desc: Left Knee
Component ID: D11086

Test Date: 1/5/11
Velocity: 6.99 ft/s, 2.13 m/s



MGA RESEARCH CORPORATION

TORSO FLEXION TEST

HYBRID III 5TH PERCENTILE

ATD Serial No: 138Test I.D: D11087

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.6	Pass
Laboratory Relative Humidity	%	10 to 70	20	Pass
Initial Angle	deg	0 to 20	18	Pass
Return Angle	deg	+/- 8	6	Pass
Force at 45 deg	N	320 to 390	348	Pass
Upper Torso Deflection Rate	Deg/sec	0.5 to 1.5	1.0	Pass
Overall Result				Pass

Jessica Hall
Laboratory Technician

1/6/11
Test Date

David Winkelbauer
Approved By