REPORT NUMBER: NCAP-MGA-2010-011

NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST

GENERAL MOTORS DE MEXICO, S. DE R.L. DE C.V.
2010 CADILLAC SRX AWD
NHTSA NUMBER: MA0120

PREPARED BY:
MGA RESEARCH CORPORATION
5000 WARREN ROAD
BURLINGTON, WI 53105

Test Date: December 1, 2009

Final Report Date: December 21, 2009

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
RULEMAKING
OFFICE OF CRASHWORTHINESS STANDARDS
1200 NEW JERSEY AVENUE, SE, ROOM W43-410
WASHINGTON, D.C. 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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Joe Fleck, Project Engineer

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David Winkelbauer, Director of Operations

Technical Report Documentation Page

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15. Supplementary Notes			

16. Abstract

A frontal barrier impact was conducted on a 2010 Cadillac SRX AWD at MGA Research Corporation on December 1, 2009. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The impact velocity was 56.5 km/h. The ambient temperature at the barrier face at the time of impact was 21 degrees Celsius. The vehicle's maximum post test static crush is 698 mm located at the vehicle's centerline. The test vehicle is equipped with a 3-point continuous belt system and an airbag in both front outboard seating positions. With respect to FMVSS 208 "Occupant Crash Protection", the occupant injury criteria summary is as follows:

Measurement Description	Units	Threshold	Driver ATD	Pass. ATD
Head Injury Criteria (HIC_{36})	N/A	1000	290	835
Max. Thorax Accel. (3ms Clip)	G's	60	41	36
Left Femur Force	Newton	10009	-1607	-1962
Right Femur Force	Newton	10009	-2617	-1031

17. Key Words 56.3 km/h NCAP Frontal Barrier Impact Test New Car Assessment Program (NCAP) 2010 Cadillac SRX AWD NHTSA No: MA0120		*18. Distribution Statement* Copies of this report are available from: National Highway Traffic Safety Adm. Technical Ref. Division, 1200 New Jersey Ave, SE Washington, D.C. 20590	
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

This 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 an impact in excess of the current 48.3 kph requirements.

SUMMARY

A load cell barrier was impacted by a 2010 Cadillac SRX AWD at a velocity of 56.5 kph. The test was performed at MGA Research Corporation on December 1, 2009. Pre-and post-test photographs of the vehicle and dummies can be found in Appendix A.

One real-time camera and fourteen 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.

Two Part 572E, 50th percentile male anthropomorphic test devices (ATDs), were placed in the driver and right-front passenger seating positions according to dummy placement instructions specified in the Laboratory Indicant Test Procedure.

Both ATDs were fully instrumented with head, chest and pelvis tri-axial accelerometers, chest displacement potentiometer, upper neck transducers, right/left femur load cells, and lower leg instrumentation. The driver (position 1) ATD (Serial No. 065) and right-front passenger (position 2) ATD (Serial No. 066) were calibrated previous to this test. Certification details, along with instrumentation calibration data, are found in Appendix C.

The 100 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy head, chest, 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 698 mm and both the driver and passenger side door remained closed and latched 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 and headliner. The passenger's knees contacted the glove box.

The occupant data is summarized below:

ATD position	HIC	T^1	T^2	Clip (g)	T^1	T^2	Chest Disp. (mm)	Left Femur (N)	Right Femur (N)
Driver	290	56.6	92.6	41	73.1	76.1	-27	-1607	-2617
Passenger	835	79.3	115.3	36	75.9	78.9	-20	-1962	-1031

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

TEST NOTES

There was no valid data collected for:
Passenger Pelvis X after 140 msec.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1

CRASH TEST SUMMARY

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

DOOR OPENING AND SEAT TRACK INFORMATION

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

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	2022
Center	mm	1889
Right Side	mm	2041
Average	mm	1984

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	785	781
Lap belt length as measured on ATD	mm	500	504
Remainder of belt on reel	mm	870	870
Total belt length for continuous webbing systems	mm	2155	2155

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

TEST VEHICLE INFORMATION

Manufacturer	Cadillac
Model	SRX
Body Style	MPV
NHTSA No.	MA0120
VIN	3GYFNDEY6AS512335
Color	Gold Mist
Delivery Date	11/9/2009
Odometer Reading (mile)	63 miles
Dealer	Crest Cadillac Inc.
Transmission	Automatic
Final Drive	AWD
Number of Cylinders	6
Engine Displacement (L)	3.0
Engine Placement	Longitudinal
Automatic Door Lock (ADL)	Yes
Owners Manual Details Instructions on Disabling ADLs	N/A
Bucket Seats	Yes

TEST VEHICLE OPTIONS

Front Airbag	Yes
Driver Side Curtain Airbag	Yes
Driver Side Torso Airbag	Yes
Driver Knee Airbag	No
Passenger Side Curtain Airbag	Yes
Passenger Side Torso Airbag	Yes
Passenger Knee Airbag	No
Force Limiter	Yes
Pretensioner	Yes
Power Steering	Yes
Power Door Locks	Yes
Tilt Wheel	Yes
Air Conditioning	Yes
Anti-lock Brakes	Yes
Traction Control	Yes
All Wheel Drive	Yes
Power Seats	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	General Motors de Mexico, S. de R.L. de C.V.
Date of Manufacture	09/09

GVWR (kg)	2520
GAWR Front (kg)	1410
GAWR Rear (kg)	1300

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bucket		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				467
Cargo Wt. (RCLW) (kg)				127

DATA SHEET NO. 2... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact

NHTSA No.: MA0120
Test Date: 12/01/2009

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	605.7	435.6		634.6	547.5	
Right	kg	573.1	438.4		598.3	550.2	
Ratio	%	57.4	42.6		52.9	47.1	
Totals	kg	1178.8	874.0	2052.8	1232.9	1097.7	2330.6

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	2052.8
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	127
Calculated Vehicle Target Weight (TVTW)	kg	2335.8

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	817	818	838	844	1195
As Tested	mm	816	817	817	819	1322
Post Test	mm	858	839	815	803	

Vehicle Wheelbase (mm): 2808

Weight of Ballast secured in trunk (kg): 113.4

Vehicle Components Removed: Trunk interior, fix-a-flat, right rear taillight

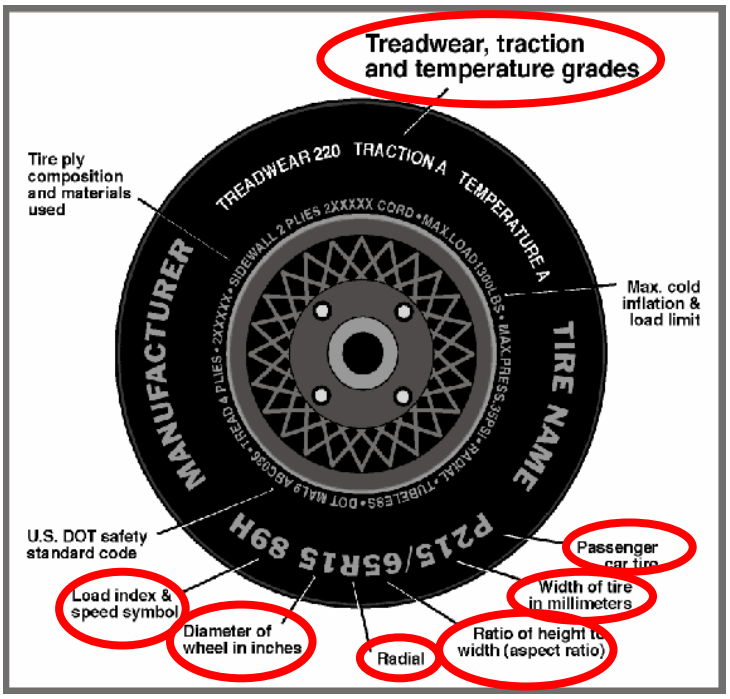
Ballast weight does not include instrumentation and data acquisition system.

DATA SHEET NO. 3

TEST VEHICLE TIRE INFORMATION

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact

NHTSA No.: MA0120
Test Date: 12/01/2009



DATA FROM TIRE AND TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	240	240
Recommended Tire Size	P235/65R18	P235/65R18
Tire Size on Vehicle	P235/65R18	P235/65R18
Tire Manufacturer	Michelin	Michelin
Tire Name	Latitude Tour	Latitude Tour
Tire Type	P	P
Tire Width (mm)	235	235
Ratio of Height to Width (aspect ratio)	65	65
Radial	R	R
Wheel Diameter	18	18
Load Index & Speed Symbol	104H	104H
Treadwear	440	440
Traction Grade	A	A
Temperature Grade	A	A

DATA SHEET NO. 4

TEST VEHICLE INFORMATION

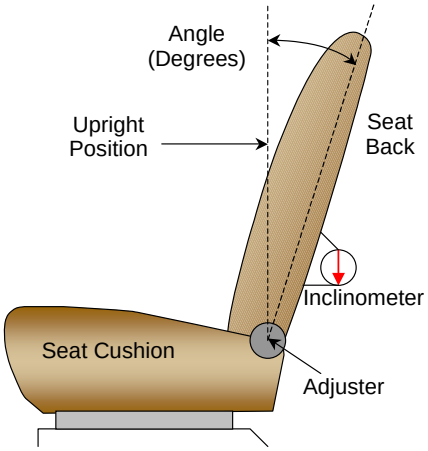
Test Vehicle: 2010 Cadillac SRX AWD
NHTSA No.: MA0120
Test Program: 35mph Frontal Impact
Test Date: 12/01/2009

NOMINAL DESIGN RIDING POSITION

The driver and passenger seat back is positioned to the manufacturer's designated angle/detent. The procedure is as follows: Set the driver and front passenger's seat backs at -13.9 degrees measured from upright position at the headrest post.

Driver seat back angle: -13.9 degrees at headrest post

Passenger seat back angle: -13.9 degrees at headrest post



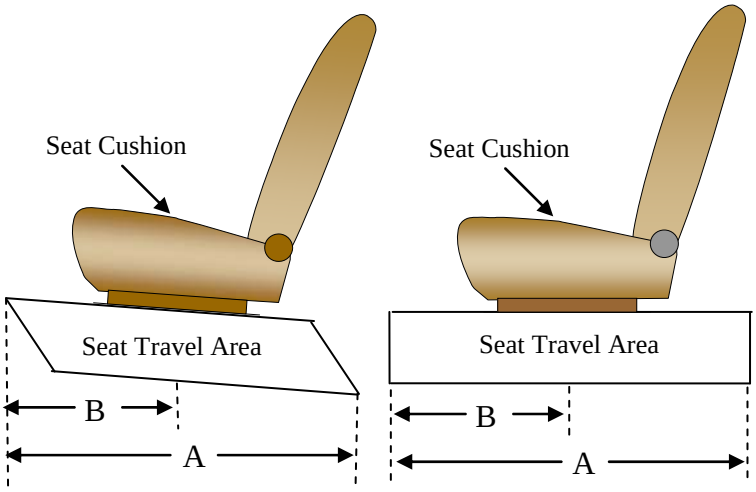
FRONT SEAT ASSEMBLY

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	340 mm	170 mm
Passenger Seat	340 mm	170 mm

ADJUSTABLE D-RING POSITION

The driver and passenger D-rings were set in the uppermost position.



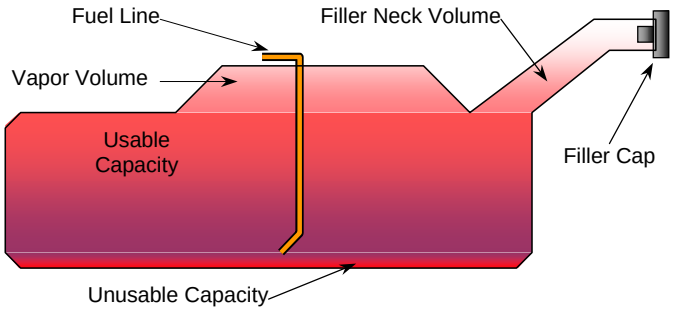
DATA SHEET NO. 4…(CONTINUED)
TEST VEHICLE INFORMATION

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	79.5
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	73.1 to 74.7
Actual Amount of Solvent used	74.5
1/3 of Usable Capacity	26.5

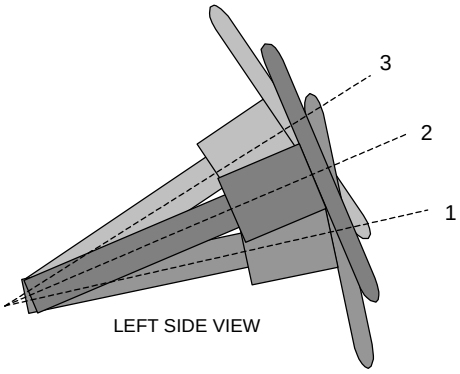
The test vehicle is equipped with an electric fuel pump. If ignition button is at "On" position and engine is not running, the fuel pump only operates for a short duration to prime the fuel system. If the engine is running, then the fuel pump will operate continuously. To pressurize the fuel system during the test, crank the engine for 30 seconds right before the test.



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 POSITIONS

	Fore/Aft Position (mm)	Degrees
Lowermost position No. 1	180	68.4
Geometric center position No. 2	155	66.8
Uppermost position No. 3	130	65.2

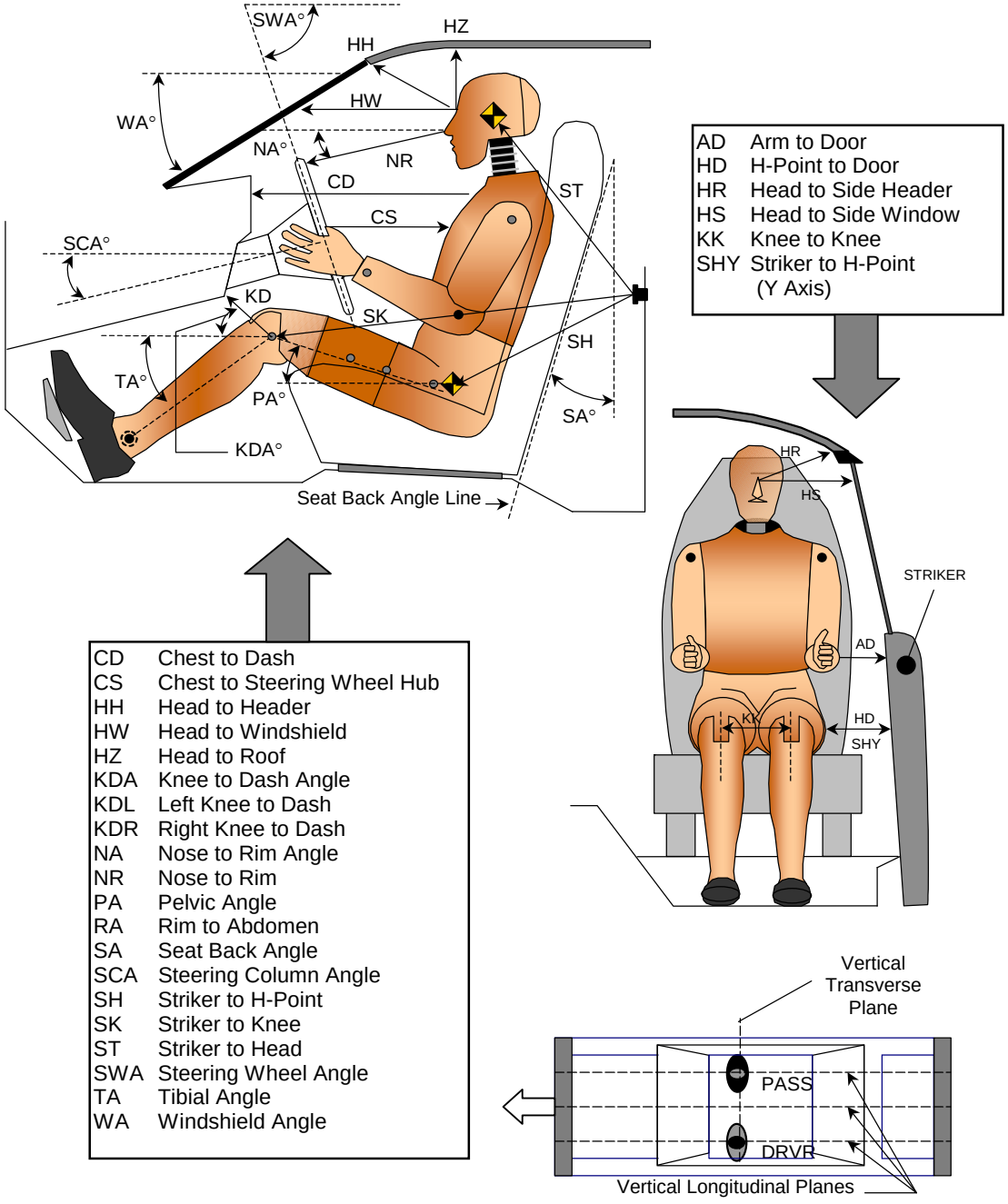
DATA SHEET NO. 5

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact

NHTSA No.: MA0120
Test Date: 12/01/2009

DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



DATA SHEET NO. 5... (CONTINUED)

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

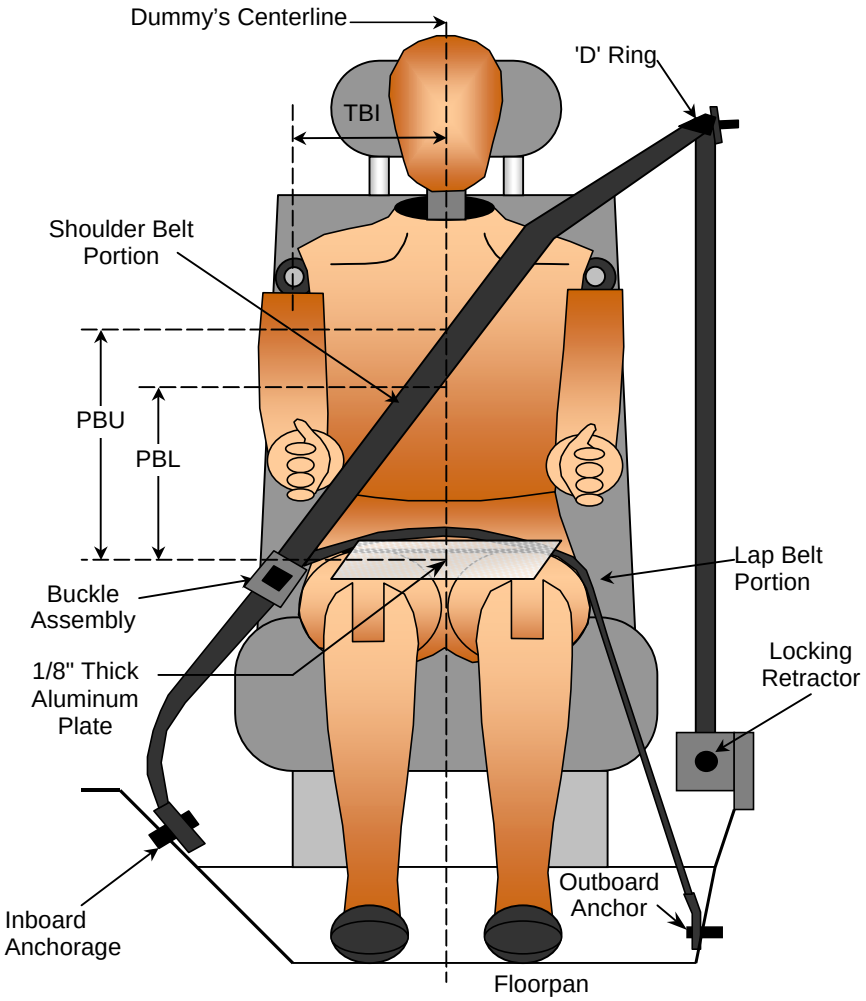
TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		24.8		
SWA	Steering Wheel Angle		66.8		
SCA	Steering Column Angle		23.2		
SA	Seat Back Angle (headrest post)		-13.9		-13.9
HZ	Head to Roof (Z)	203	90	209	90
HH	Head to Header	413	22.2	424	23.1
HW	Head to Windshield	747	0	751	0
HR	Head to Side Header (Y)	221		224	
NR	Nose to Rim	397	7.7		
CD	Chest to Dash	545		521	
CS	Chest to Steering Hub	320	2.0		
RA	Rim to Abdomen	191	0		
KDL	Left Knee to Dash	167	34.6	130	
KDR	Right Knee to Dash	123		171	38.6
PA	Pelvic Angle		24.1		23.8
TA	Tibia Angle		49.6		41.7
KK	Knee to Knee (Y)	340		269	
SK	Striker to Knee	581	88.6	587	90.3
ST	Striker to Head	540	7.3	546	8.8
SH	Striker to H-Point	212	115.6	208	117.4
SHY	Striker to H-Point (Y)	270		305	
HS	Head to Side Window	342		337	
HD	H-Point to Door (Y)	152		156	
AD	Arm to Door (Y)	140		147	
AA	Ankle to Ankle	360		231	

DATA SHEET NO. 6

SEAT BELT POSITIONING DATA

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	365	365
PBL - To surface of reference to belt lower edge	mm	270	270

DATA SHEET NO. 7

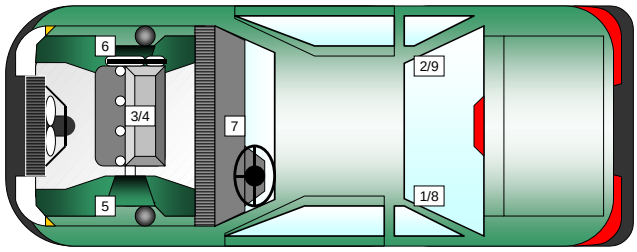
VEHICLE ACCELEROMETER LOCATIONS

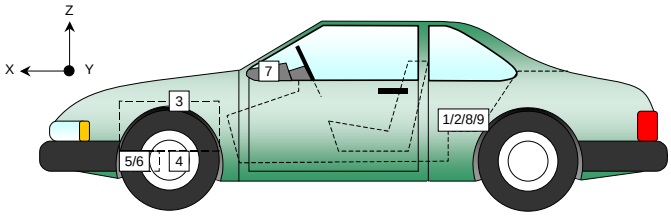
Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear X-Member X	1867	-365	-444
2	Right Rear X-Member X	1867	365	-444
3	Engine Top X	3916	0	-903
4	Engine Bottom X	4019	61	-258
5	Left Brake Caliper X	3917	-734	-325
6	Right Brake Caliper X	3917	734	-325
7	Instrument Panel X			
8	Left Rear X-Member Z	1867	-365	-444
9	Right Rear X-Member Z	1867	365	-444

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





DATA SHEET NO. 8

SUMMARY OF FMVSS 212 AND FMVSS 219 (Partial) DATA

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

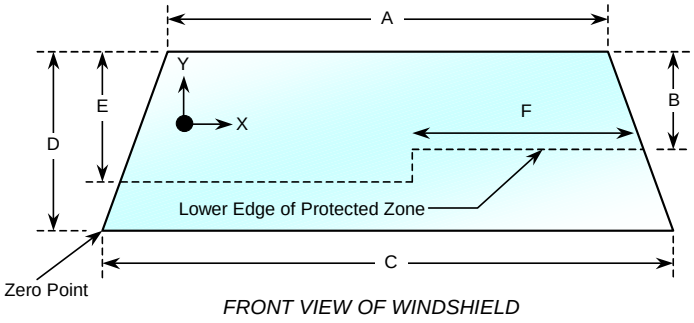
Windshield Mounting Details:
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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	2217	2217	100
Right Side	2217	2217	100
Total	4434	4434	100



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1210
B	mm	484
C	mm	1472
D	mm	876
E	mm	548
F	mm	405

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. 9

SUMMARY OF FMVSS 301 DATA

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21° C Test Time: 10:30 am

Stoddard Solvent Spillage Measurements

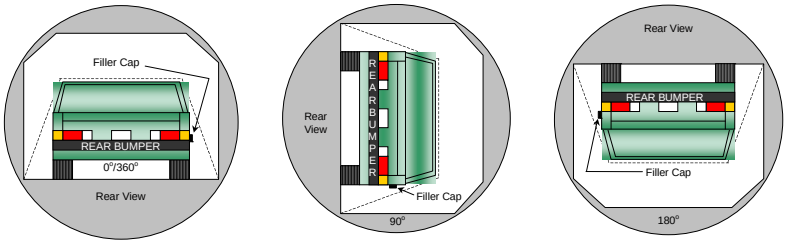
A. From impact until vehicle motion ceases: 0 oz.
(Maximum Allowable = 1 ounce)

B. For the 5 minute period after motion ceases: 0 oz.
(Maximum Allowable = 5 ounces)

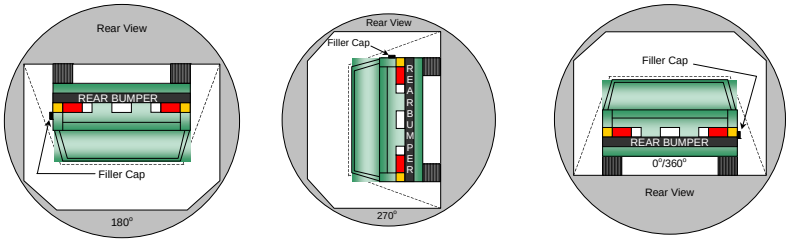
C. For the following 25 minutes: 0 oz.
(Maximum Allowable = 1 oz. /minute)

D. Spillage: None

FMVSS 301 STATIC ROLLOVER DATA



0° to 90° 90° to 180°



180° to 270° 270° to 360°

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 locations:

None

Test Phase	Rotation Time (sec.)	Hold Time (sec.)	Spillage (oz.)
0° to 90°	114	300	0
90° to 180°	109	300	0
180° to 270°	110	300	0
270° to 360°	117	300	0

DATA SHEET NO. 10

VEHICLE MEASUREMENTS

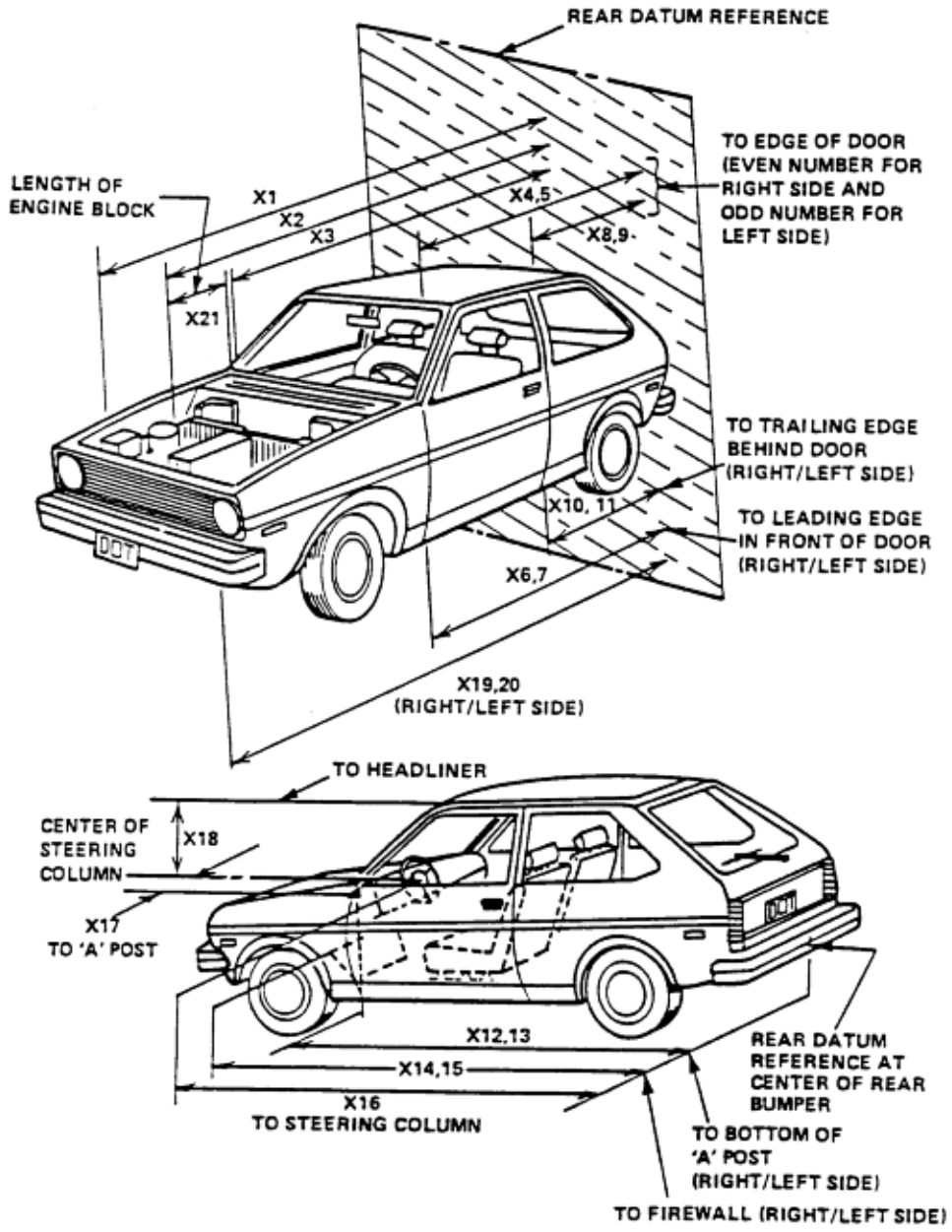
Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total length of vehicle at centerline	mm	4847	4149	698
2	RSOV to front of engine	mm	4190	3989	201
3	RSOV to firewall centerline	mm	3692	3608	84
4	RSOV to leading edge of right door	mm	3201	3196	5
5	RSOV to leading edge of left door	mm	3198	3198	0
6	RSOV to lower leading edge of right door	mm	3180	3174	6
7	RSOV to lower leading edge of left door	mm	3178	3181	-3
8	RSOV to upper leading edge of right door	mm	2151	2154	-3
9	RSOV to upper leading edge of left door	mm	2151	2140	11
10	RSOV to lower trailing edge of right door	mm	2150	2155	-5
11	RSOV to lower trailing edge of left door	mm	2150	2151	-1
12	RSOV to bottom of right 'A' pillar	mm	3185	3185	0
13	RSOV to bottom of left 'A' pillar	mm	3182	3175	7
14	RSOV to firewall on right side	mm	3626	3615	11
15	RSOV to firewall on left side	mm	3626	3582	44
16	RSOV to steering column	mm	2814	2785	29
17	Center of steering column to left 'A' pillar	mm	362	352	10
18	Center of steering column to headlining	mm	420	421	-1
19	RSOV to right side of front bumper	mm	4582	4139	443
20	RSOV to left side of front bumper	mm	4582	4133	449
21	Length of engine block	mm	535	535	0
RD	RSOV to right side of dash panel	mm	2924	2934	-10
CD	RSOV to center of dash panel	mm	2988	2968	20
LD	RSOV to left side of dash panel	mm	2924	2920	4

DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009



DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

Target Vehicle Structural Measurement

	Elements	Pre-Test (mm)
1	Total Length	4847
2	Total Width	1865
3	Bumper Top Height	620
4	Bumper Bottom Height	512
5	Longitudinal Member Top Height	866
6	Distance between Longitudinal Members	873
7	Longitudinal Member Width	83
8	Engine Top Height	897
9	Engine Bottom Height	267
10	Engine and gearbox width	608
11	Front bumper-engine distance	610
12	Front shock absorber fixing height	1039
13	Bonnet leading edge height	981
14	Front shock absorber fixing width	1220
15	Front bumper – front axle distance	1040
16	Front axle – a pillar distance	511
17	A-pillar – B-pillar distance	1112
18	B-Pillar – rear axle distance	1192
19	B-pillar – C-pillar distance	720
20	Roof sill bottom height	1514
21	Roof sill top height	1660
22	Floor sill bottom height	234
23	Floor sill top height	434

DATA SHEET NO. 11

CAMERA LOCATIONS

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

No.	Camera View	Location (mm) *			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View				13	24
2	Left Front View	1160	-5120	-1060	24	1000
3	Steering Column Top	855	-5265	-1265	25	1000
4	Steering Column Bottom	835	-5245	-890	25	1000
5	Driver Close-up	1310	-6140	-1580	35	1000
6	Driver Angle	5390	-4720	-1840	50	1000
7	On board Driver Side					
8	On board Passenger Side					
9	Right Overall	2040	6120	-1120	20	1000
10	Right Passenger Half	1165	5200	-1080	24	1000
11	Right Close-up	1330	6280	-1510	35	1000
12	Right Angle	5430	4750	-1860	50	1000
13	Windshield	-185	0	-2860	12.5	1000
14	Top Driver	-40	-470	-2270	24	1000
15	Top Passenger	-40	420	-2270	24	1000
16	Pit Front	1190	0	3150	24	1000
17	Pit Rear	3180	0	3150	24	1000

*COORDINATES:

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

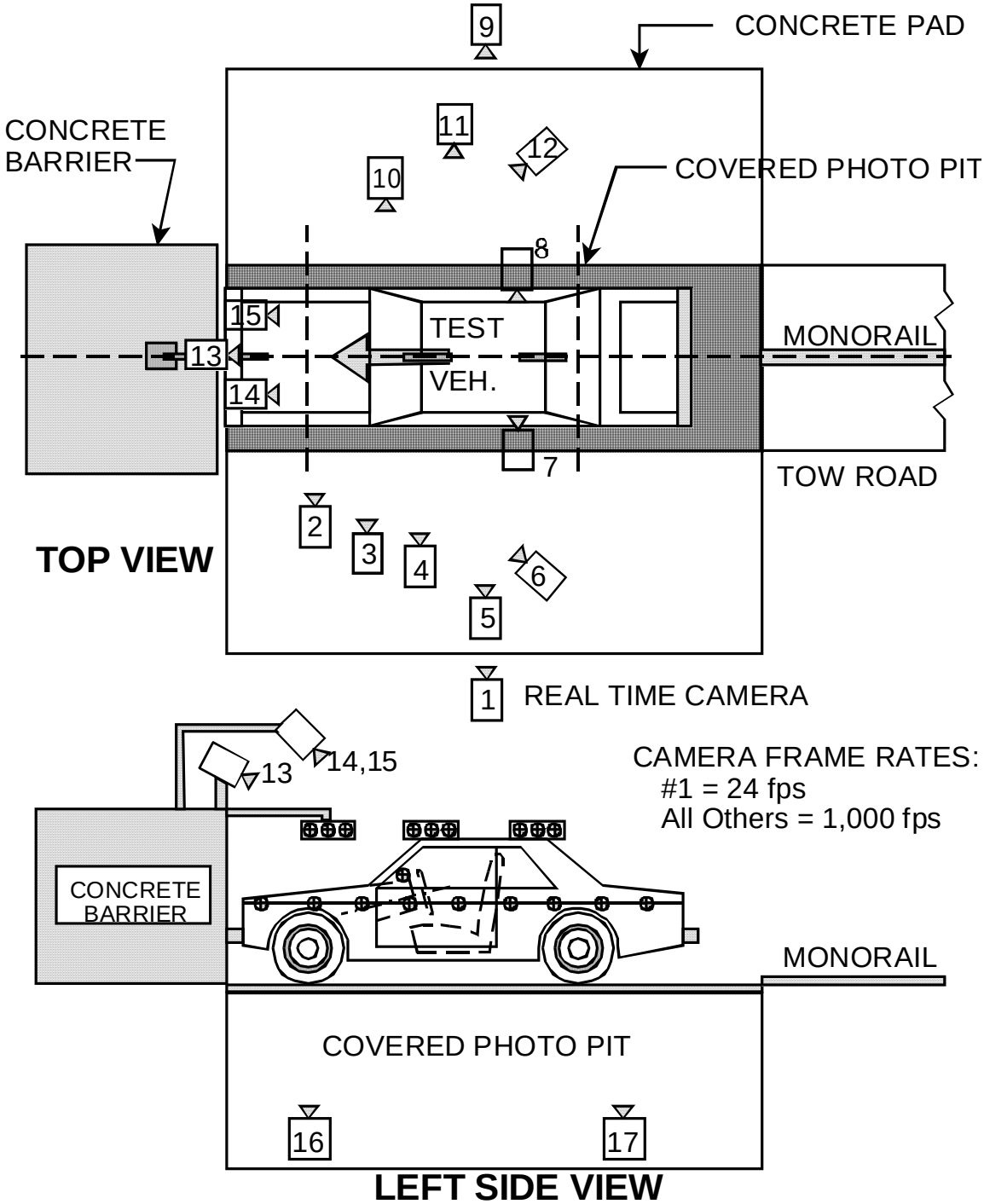
Cameras 7 & 8 were not used for this test.

DATA SHEET NO. 11... (continued)

CAMERA LOCATIONS

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

CAMERA POSITIONS FOR FRONTAL IMPACTS



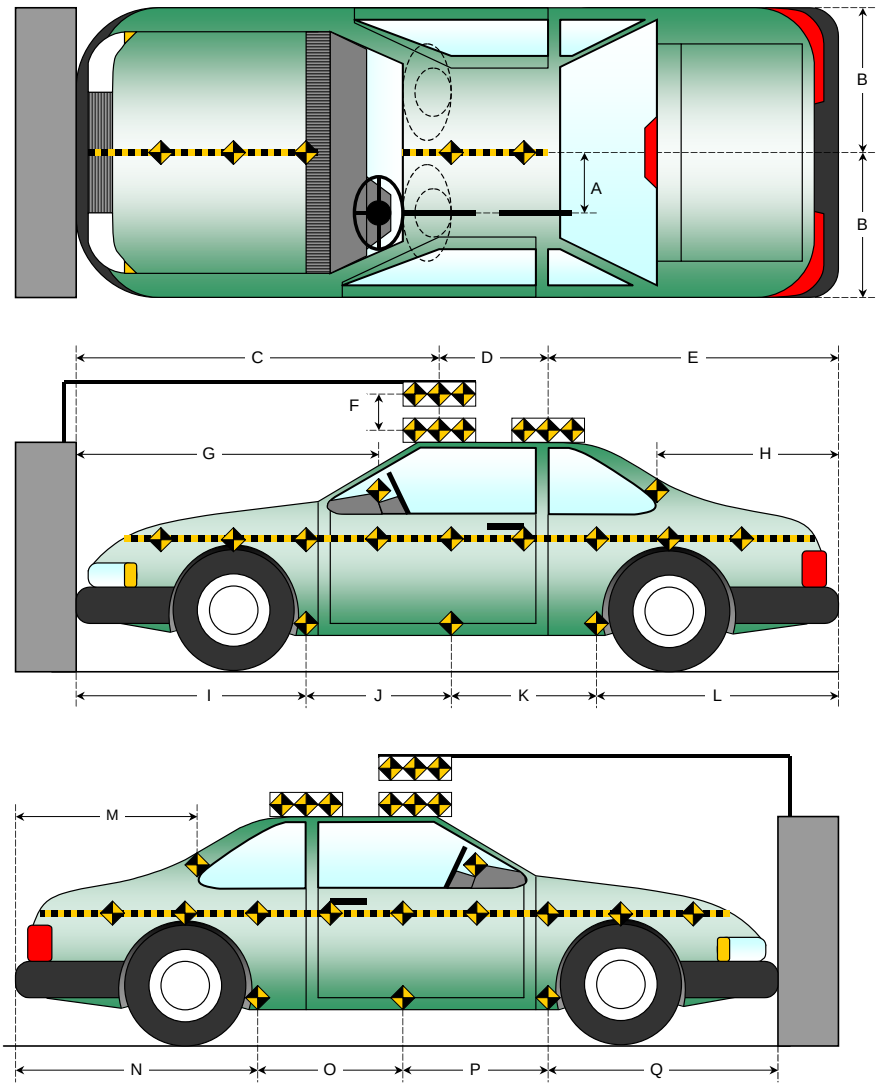
DATA SHEET NO. 12

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact

NHTSA No.: MA0120
Test Date: 12/01/2009

Item	Value
A	380
B	933
C	2492
D	915
E	1440
F	80
G	
H	979
I	1544
J	914
K	914
L	1475
M	972
N	1475
O	914
P	914
Q	1544



DATA SHEET NO. 13

VEHICLE INTRUSION MEASUREMENTS

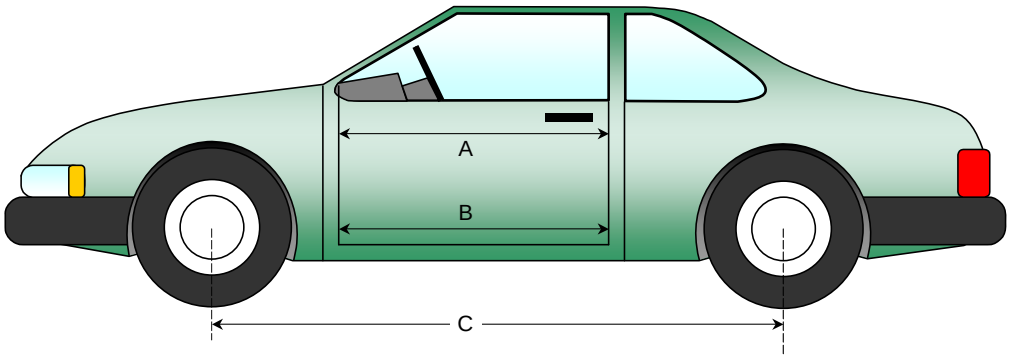
Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

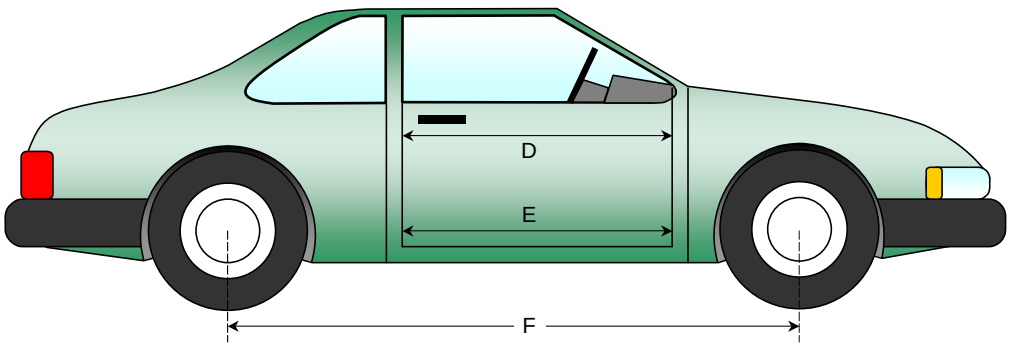
DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	944	946	-2
B	Left Side Lower	mm	783	784	-1
D	Right Side Upper	mm	944	950	-6
E	Right Side Lower	mm	783	789	-6

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2808	2782	26
F	Right Side Wheelbase	mm	2808	2799	9





DATA SHEET NO. 13... (continued)

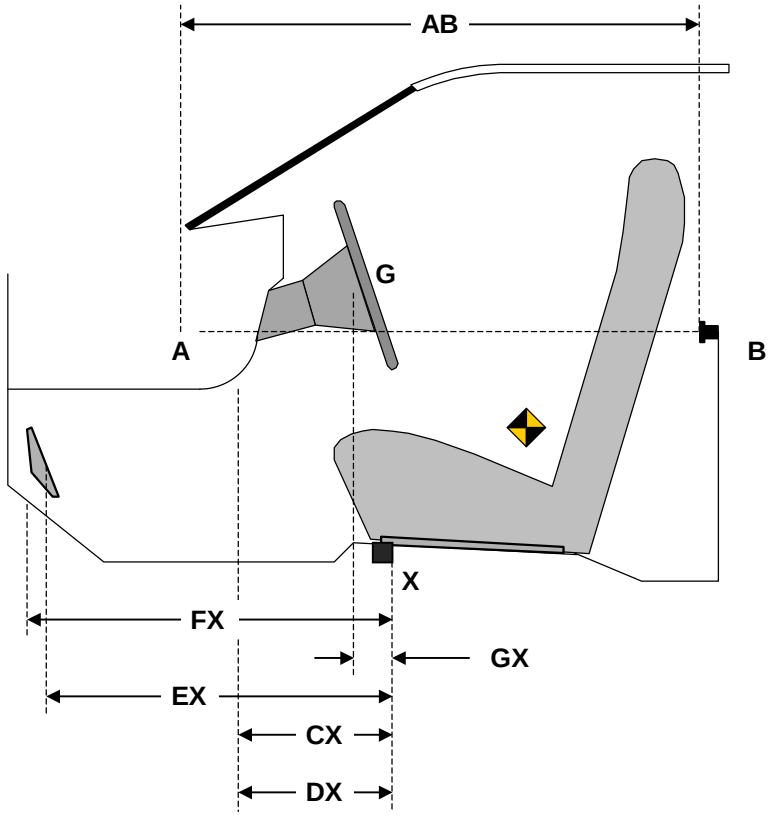
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	796	796	0
CX	Left Knee Bolster to X	mm	319	308	11
DX	Right Knee Bolster to X	mm	314	305	9
EX	Brake Pedal to X	mm	560	500	60
FX	Foot Rest to X	mm	559	551	8
GX	Center of Steering Column Wheel Hub to X	mm	95	121	-26

X = Front of Seat Track (stationary)

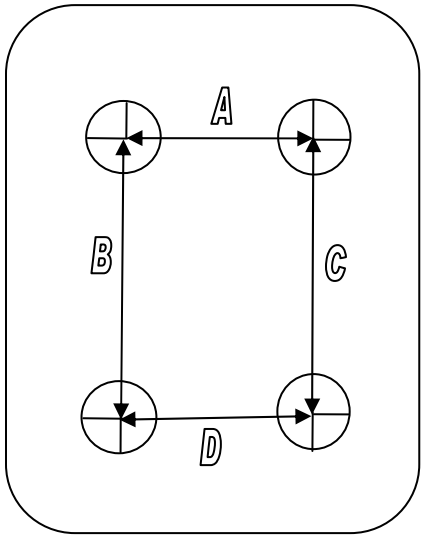


DRIVER COMPARTMENT

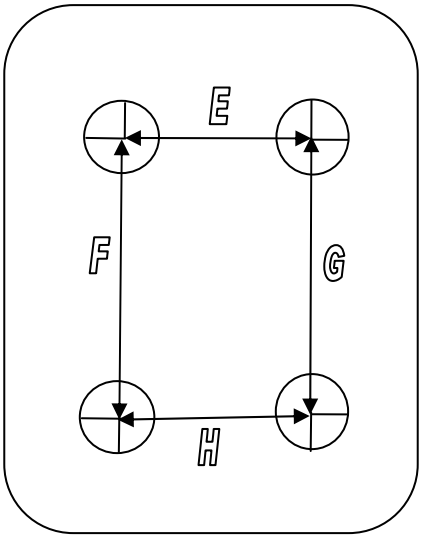
DATA SHEET NO. 13... (continued)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009



Driver



Passenger

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	430	425	5
B	446	446	0
C	455	450	5
D	340	340	0
E	420	419	1
F	446	446	0
G	460	460	0
H	330	330	0

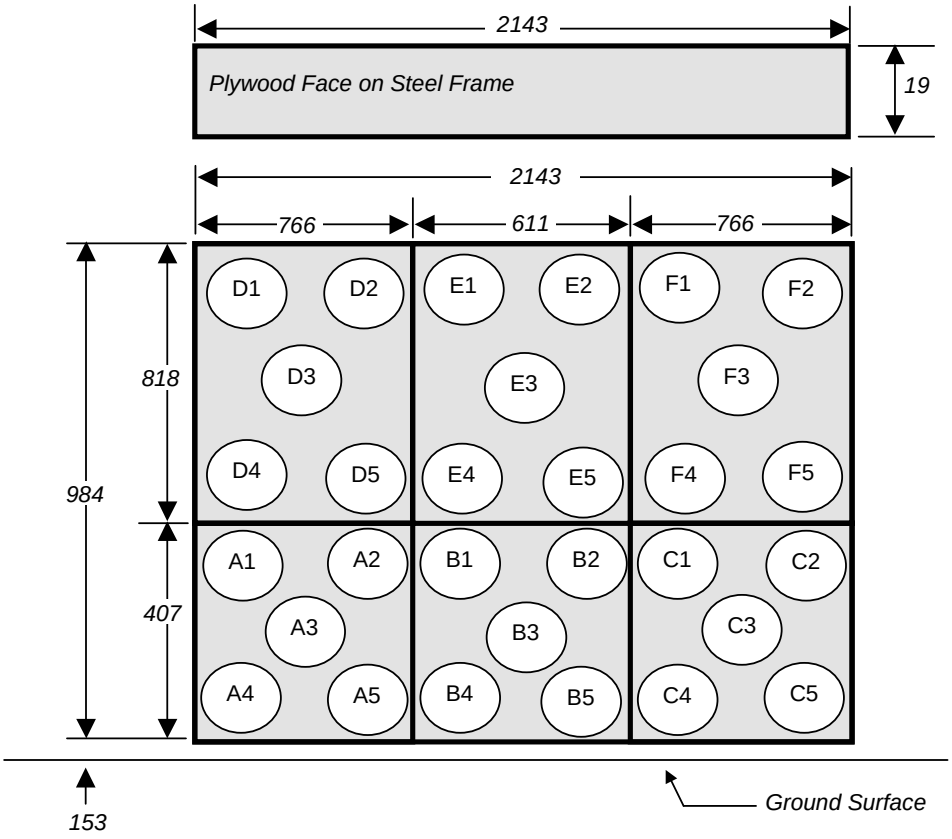
DATA SHEET NO. 14

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

30 Load Cell Rigid Barrier

Load Cell Locations on Fixed Barrier



Group 4 D1-D5	Group 5 E1-E5	Group 6 F1-F5
Group 1 A1-A5	Group 2 B1-B5	Group 3 C1-C5

6 Groups of 5 Load Cells Each

DATA SHEET NO. 15

ACCIDENT INVESTIGATION DIVISION DATA

Test Vehicle: 2010 Cadillac SRX AWD NHTSA No.: MA0120
Test Program: 35mph Frontal Impact Test Date: 12/01/2009

VEHICLE INFORMATION

VIN: 3GYFNDEY6AS512335 Wheelbase (mm): 2808
Vehicle Size Category: MPV Test Weight (kg): 2330.6

ACCELEROMETER DATA

Accelerometer Locations: As per measurements on Page 12
Cal. Procedure/Interval: MGA procedure / 6 month
Integration Algorithm: Trapezoidal Linearity: > 99%
Impact Velocity(km/h): 62.9
Velocity Change (km/h): 59.1 Time of Separation (msec): 102

CRUSH PROFILE

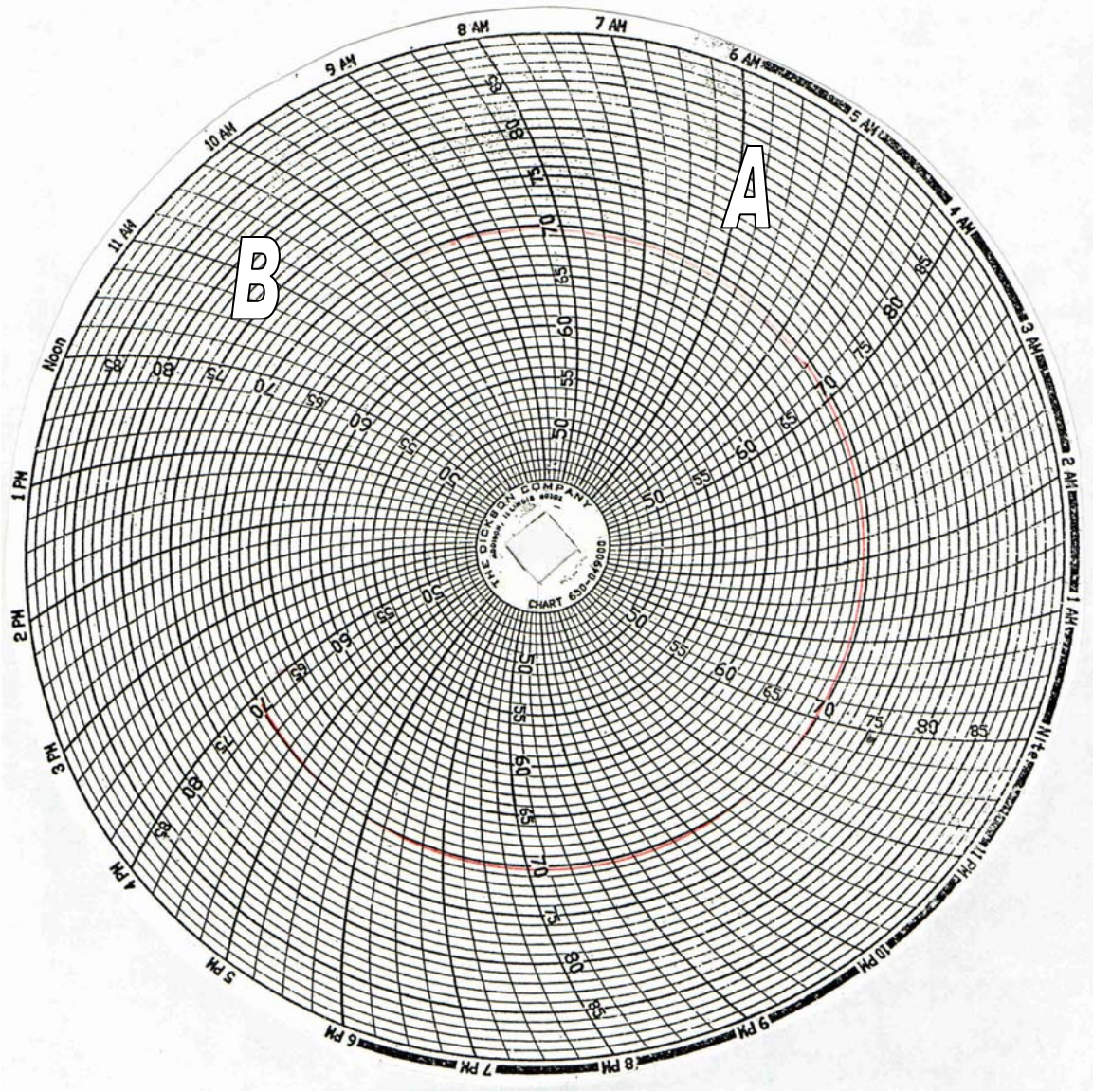
Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
Damage Region Length (mm): 1344 Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4582	4133	449
C2	Crush zone 2 at left side	mm	4705	4189	516
C3	Crush zone 3 at left side	mm	4754	4156	598
C4	Crush zone 4 at right side	mm	4754	4161	593
C5	Crush zone 5 at right side	mm	4705	4195	510
C6	Crush zone 6 at right side	mm	4582	4139	443
L	C1 TO C6	mm	1344	1152	192

DATA SHEET NO. 16

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2010 Cadillac SRX AWD
Test Program: 35mph Frontal Impact
NHTSA No.: MA0120
Test Date: 12/01/2009



A = Dummies installed in vehicle at 6:00 am

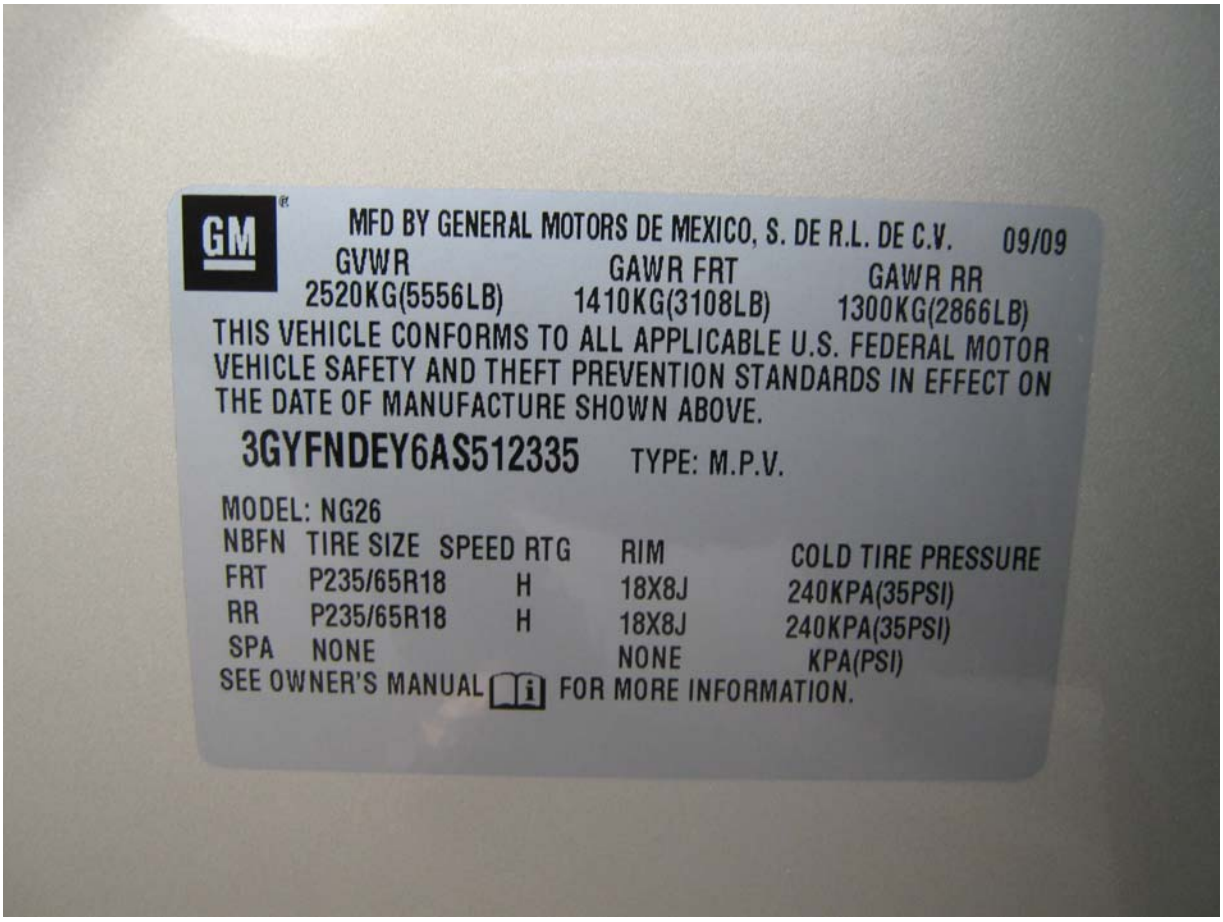
B = Test conducted at 10:30 am

APPENDIX A

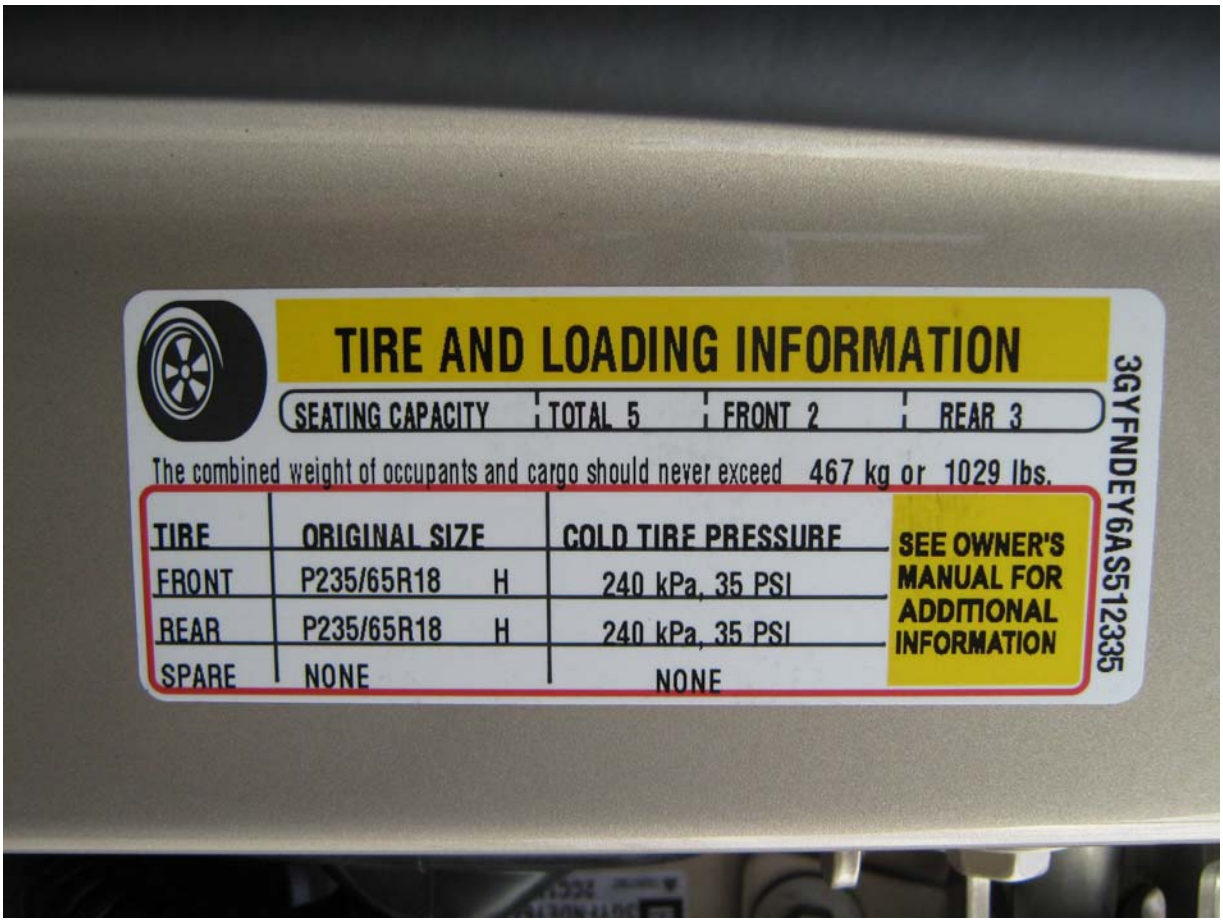
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

Load Cell Location



Manufacturer's Label



Tire Placard

Right Front ¾ View, As Received

Left Rear ¾ View, As Received

Pre-Test Front View

Post-Test Front View

Pre-Test Left Side View

Post-Test Left Side View

Pre-Test Right Side View

Post-Test Right Side View

Pre-Test Right Front ¾ View

Post-Test Right Front ¾ View

Pre-Test Left Rear ¾ View

Post-Test Left Rear ¾ View

Pre-Test Left Side ¾ View of Doors

Post-Test Left Side ¾ View of Doors After Impact

Pre-Test Right Side ¾ View of Doors

Post-Test Right Side ¾ View of Doors After Impact

Pre-Test Windshield View

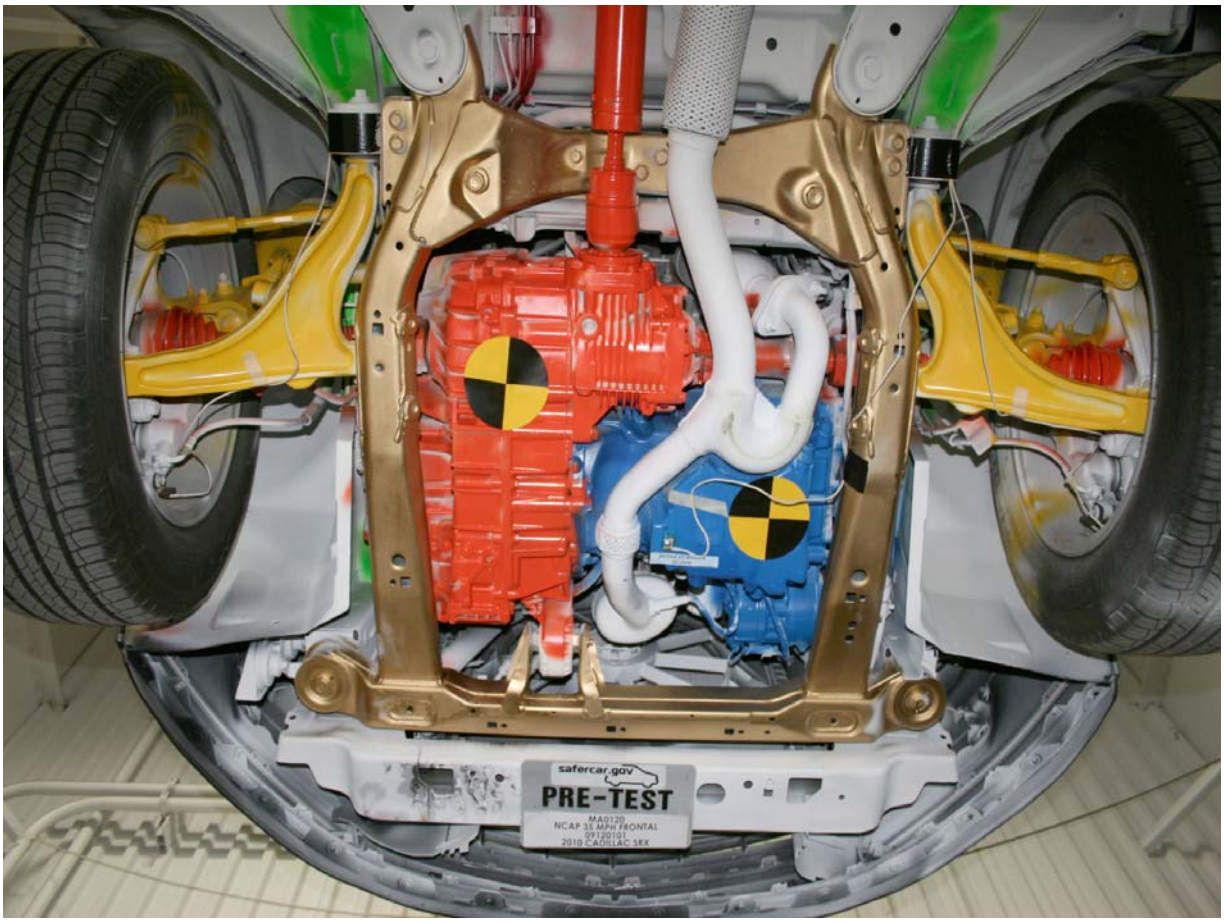
Post-Test Windshield View

Pre-Test Engine Compartment View

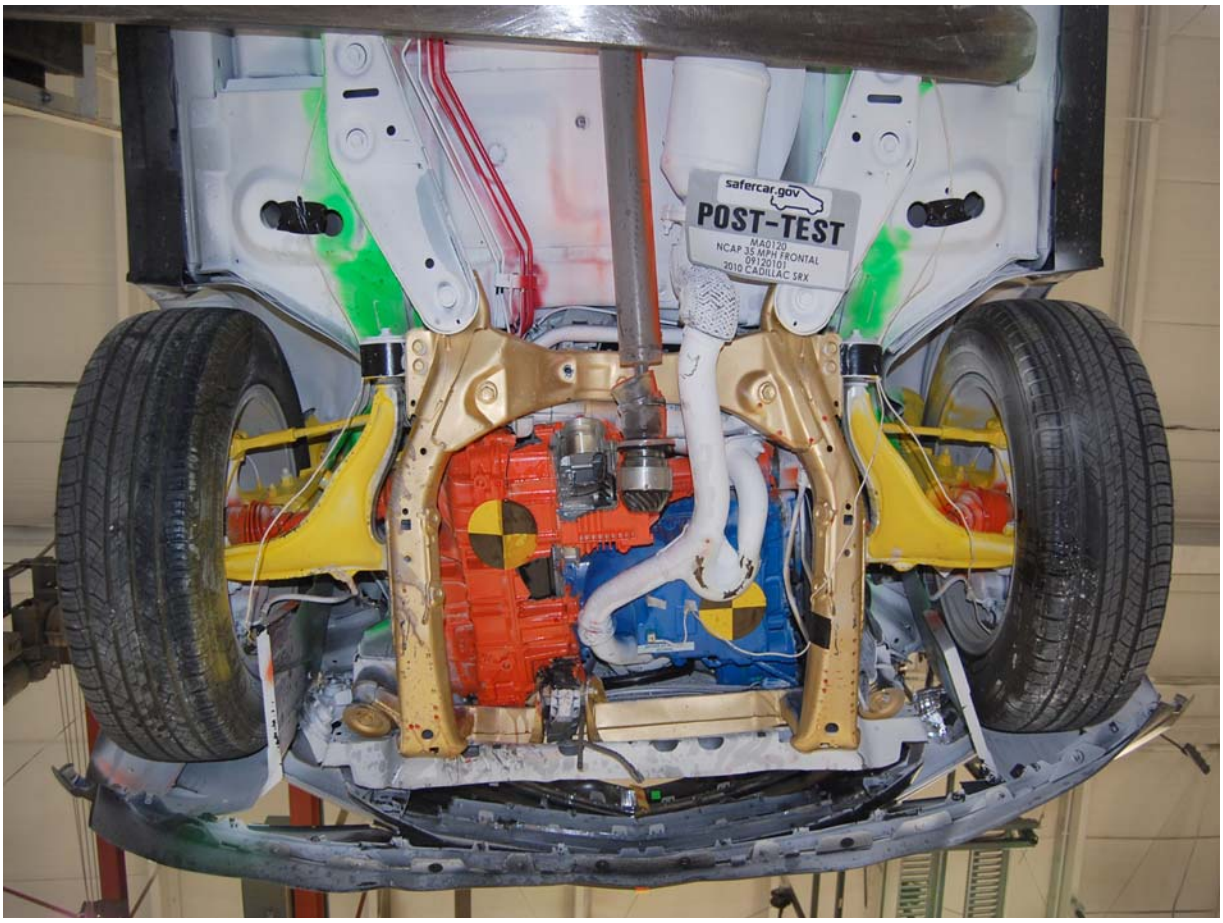
Post-Test Engine Compartment View

Pre-Test Fuel Cap View

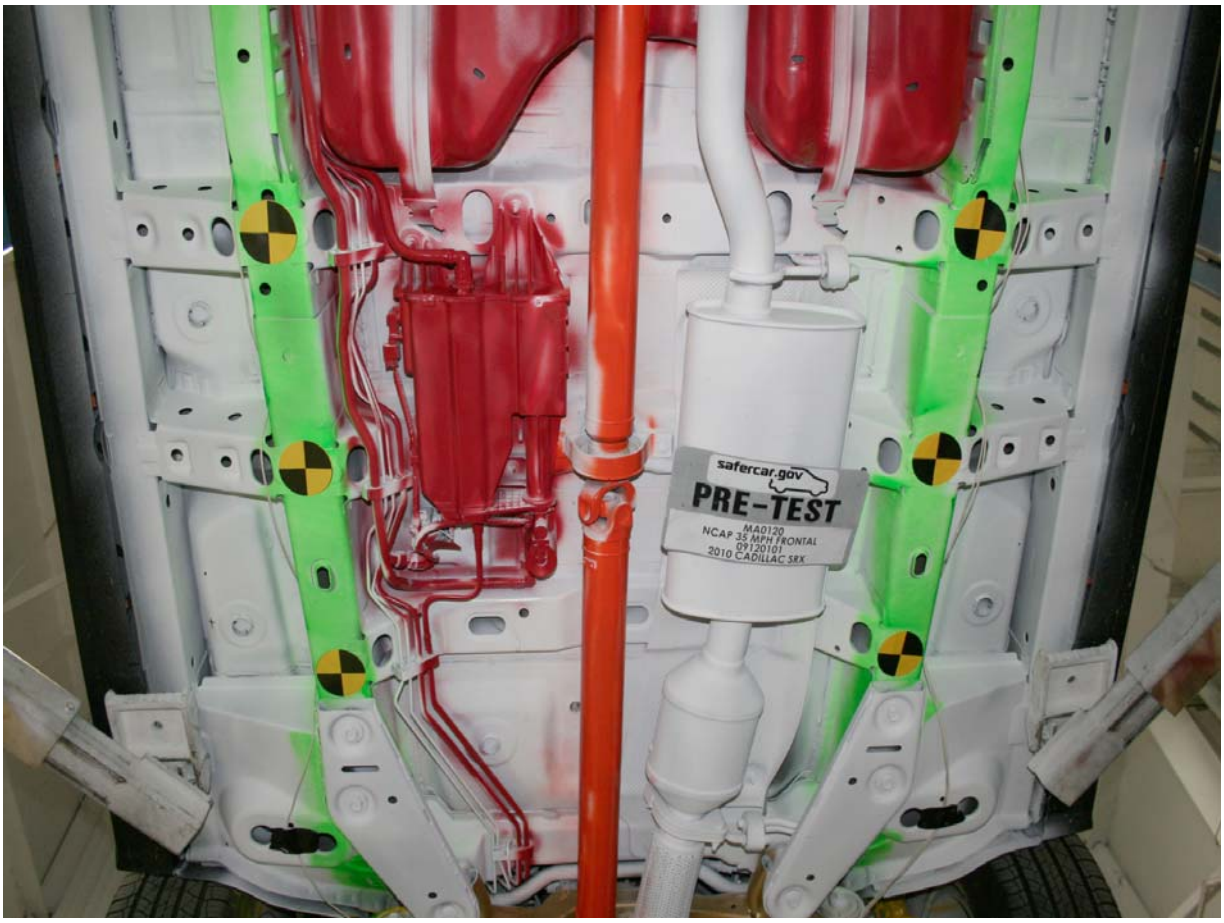
Post-Test Fuel Cap View



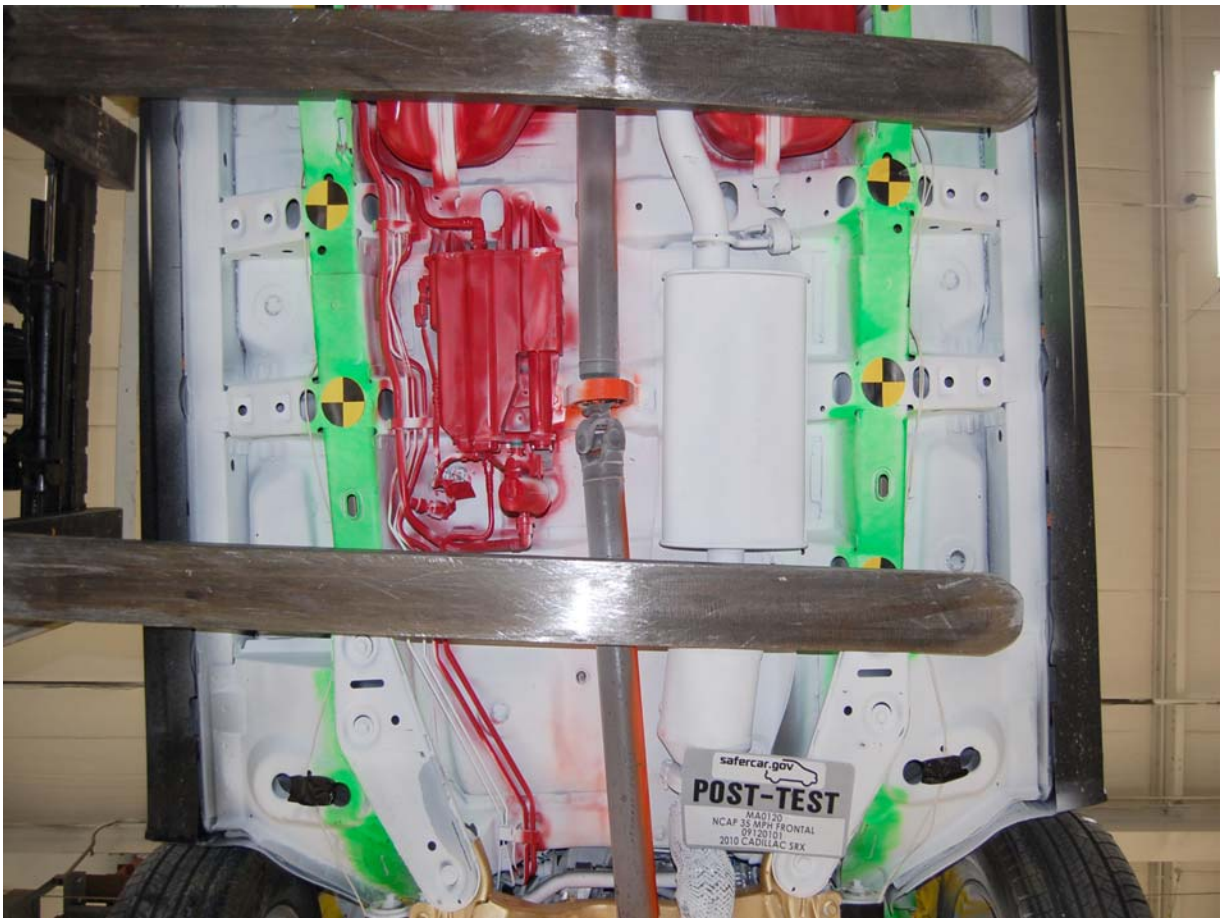
Pre-Test Front Underbody View



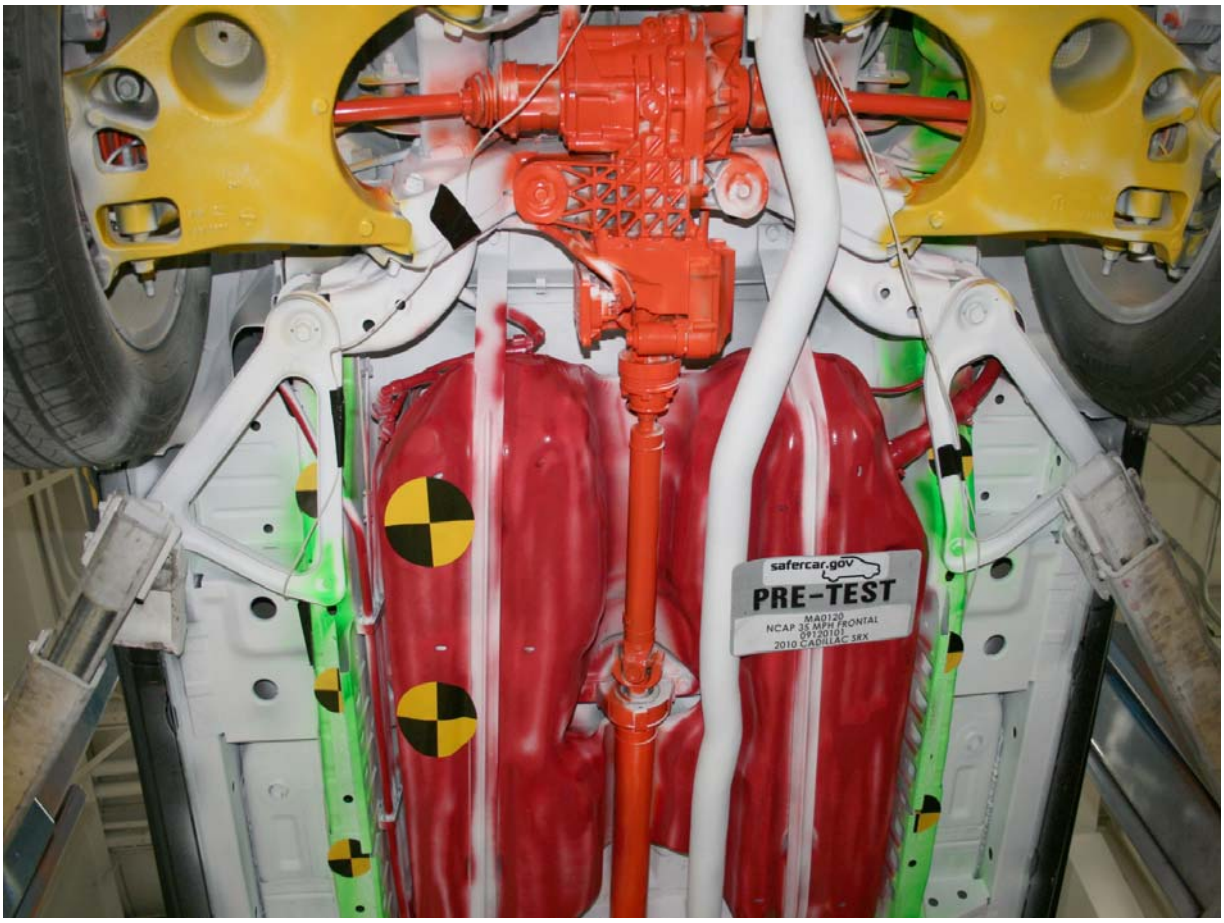
Post-Test Front Underbody View



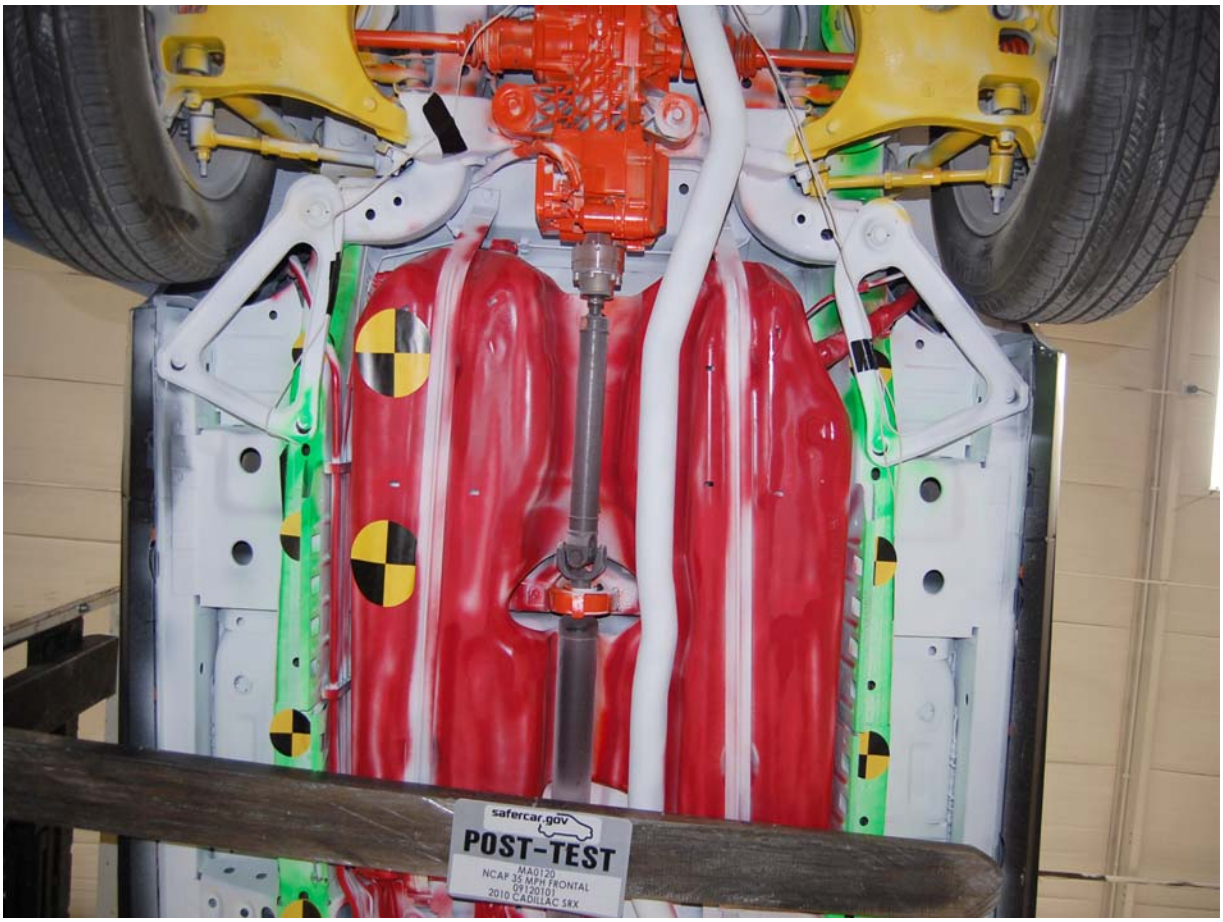
Pre-Test Front Mid Underbody View



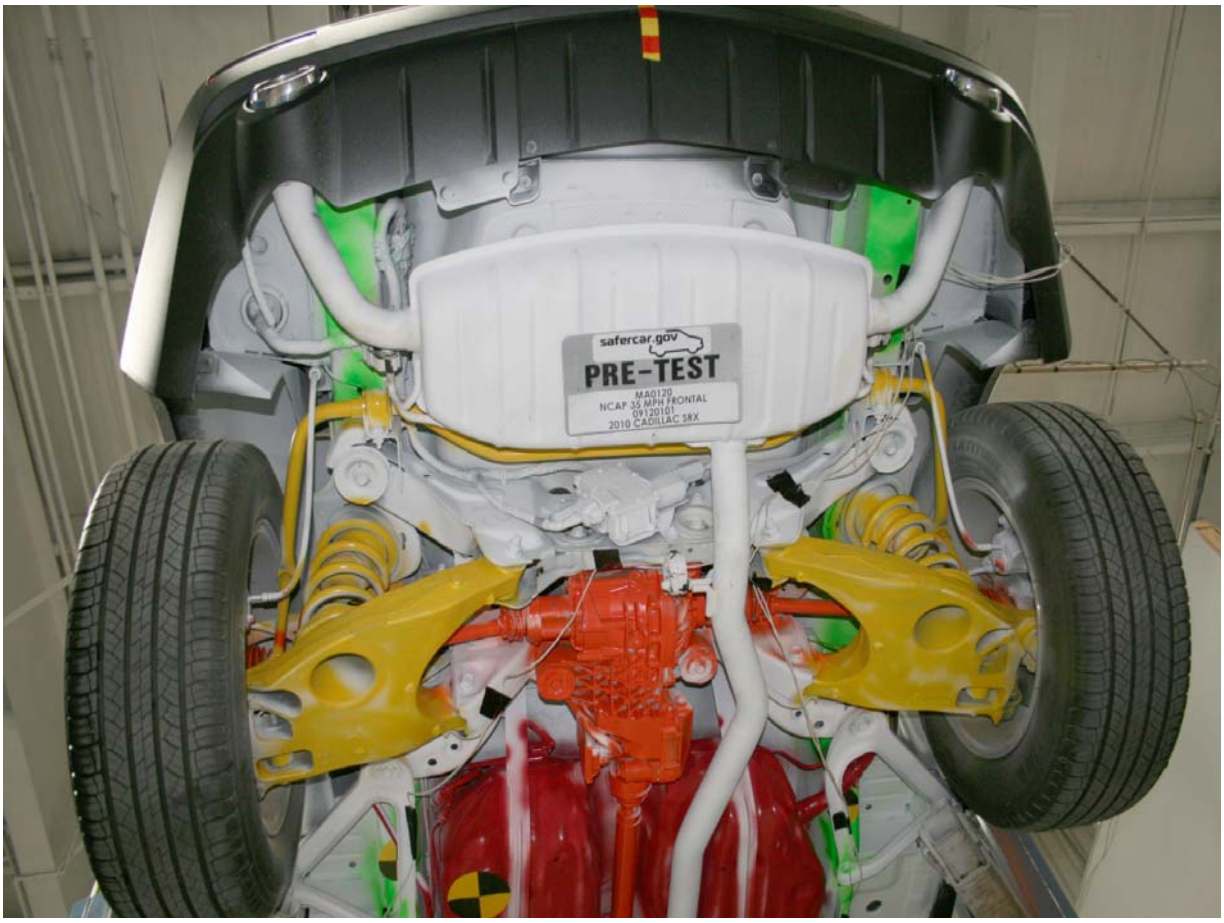
Post-Test Front Mid Underbody View



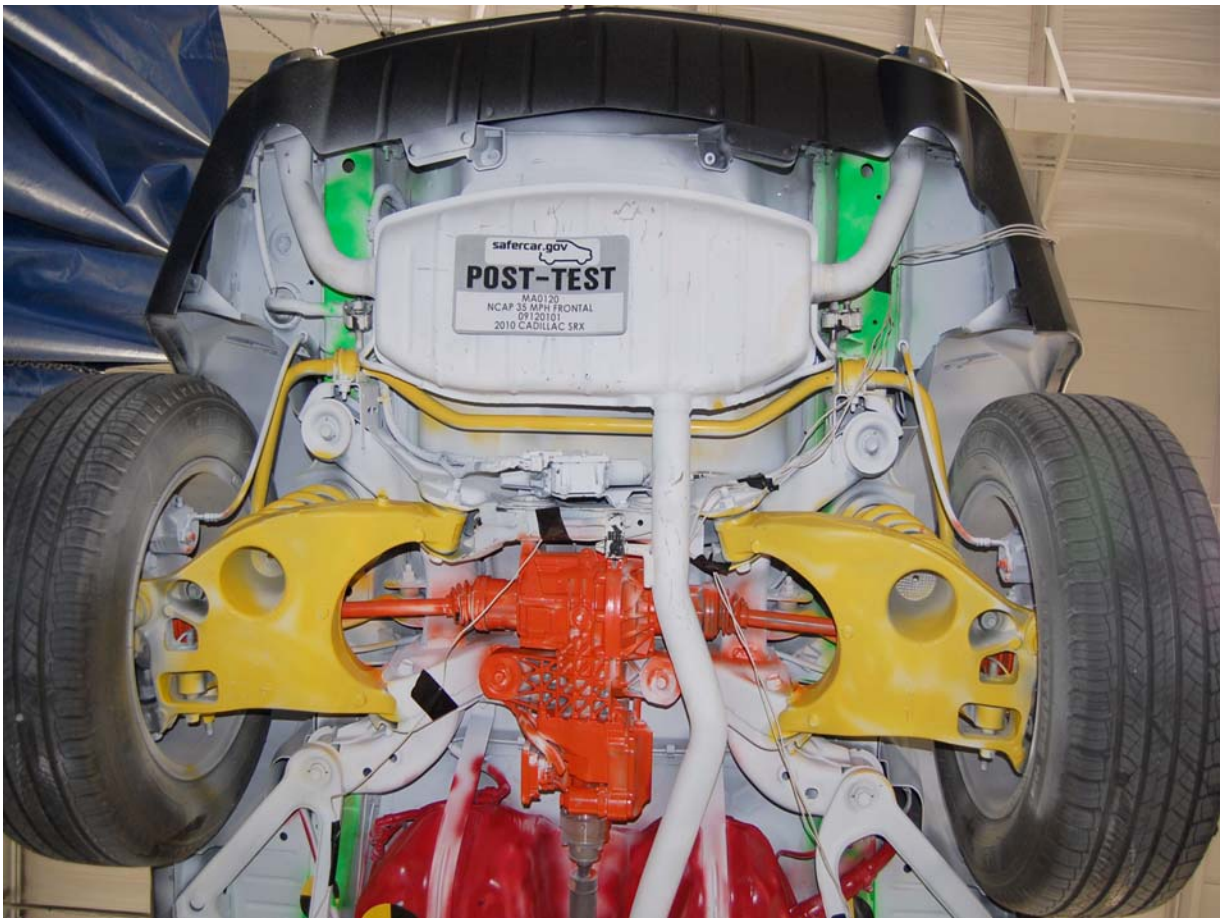
Pre-Test Rear Mid Underbody View



Post-Test Rear Mid Underbody View



Pre-Test Rear Underbody View



Post-Test Rear Underbody View

Pre-Test Driver Dummy Front View (Head Position)

Post-Test Driver Dummy Front View (Head Position)

Pre-Test Driver Dummy (Through Window)

Post-Test Driver Dummy (Through Window)

Pre-Test Driver Dummy (Door Open)

Post-Test Driver Dummy (Door Open)

Pre-Test Driver Dummy Feet

Post-Test Driver Dummy Feet

Pre-Test Driver Side Knee Bolster

Post-Test Driver Side Knee Bolster

Pre-Test Driver Side Floor Pan

Post-Test Driver Side Floor Pan

Post-Test Driver Dummy Head Contact

Post-Test Driver Dummy Knee Contact

Post-Test Driver Dummy Airbag Contact

Pre-Test Passenger Dummy Front View (Head Position)

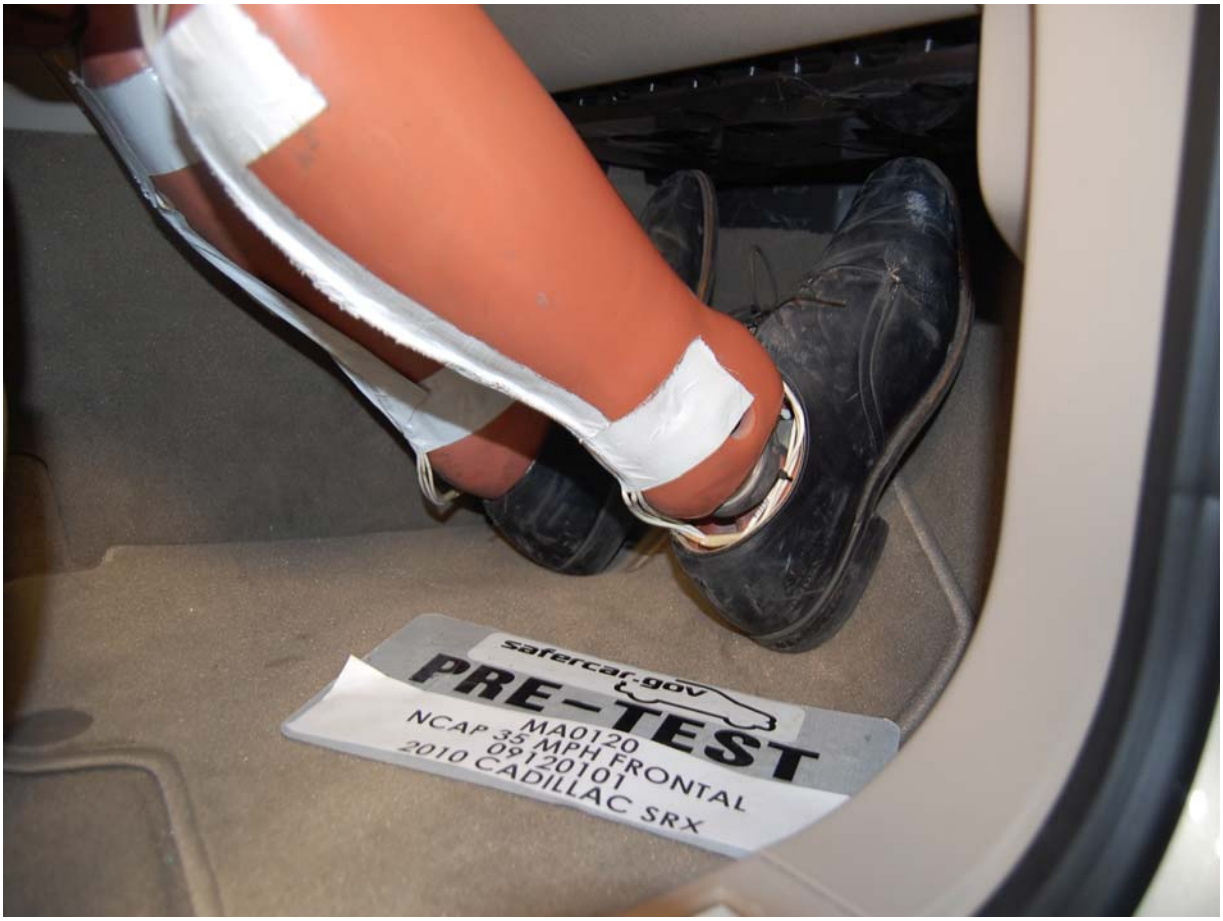
Post-Test Passenger Dummy Front View (Head Position)

Pre-Test Passenger Dummy (Through Window)

Post-Test Passenger Dummy (Through Window)

Pre-Test Passenger Dummy (Door Open)

Post-Test Passenger Dummy (Door Open)



Pre-Test Passenger Dummy Feet

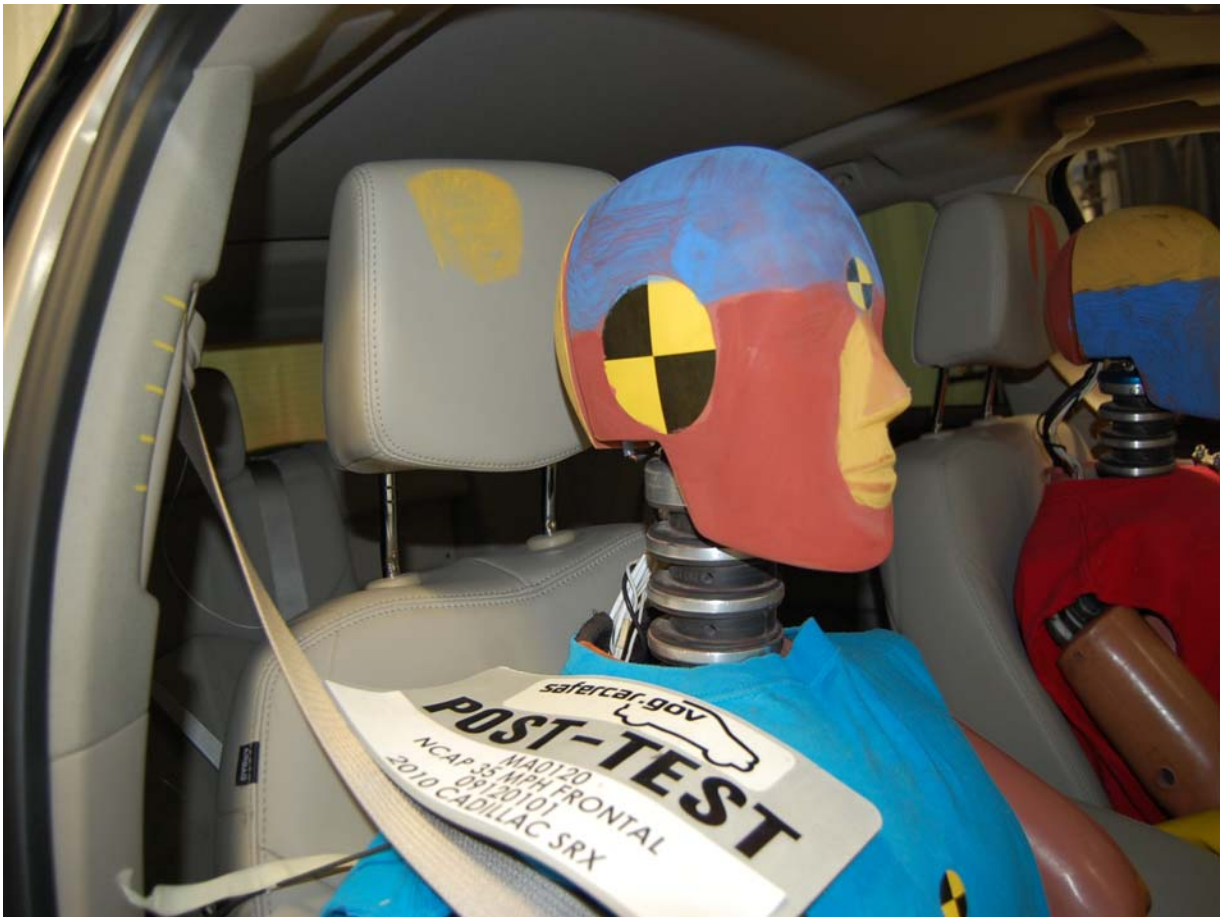
Post-Test Passenger Dummy Feet

Pre-Test Passenger Side Glove Box

Post-Test Passenger Side Glove Box

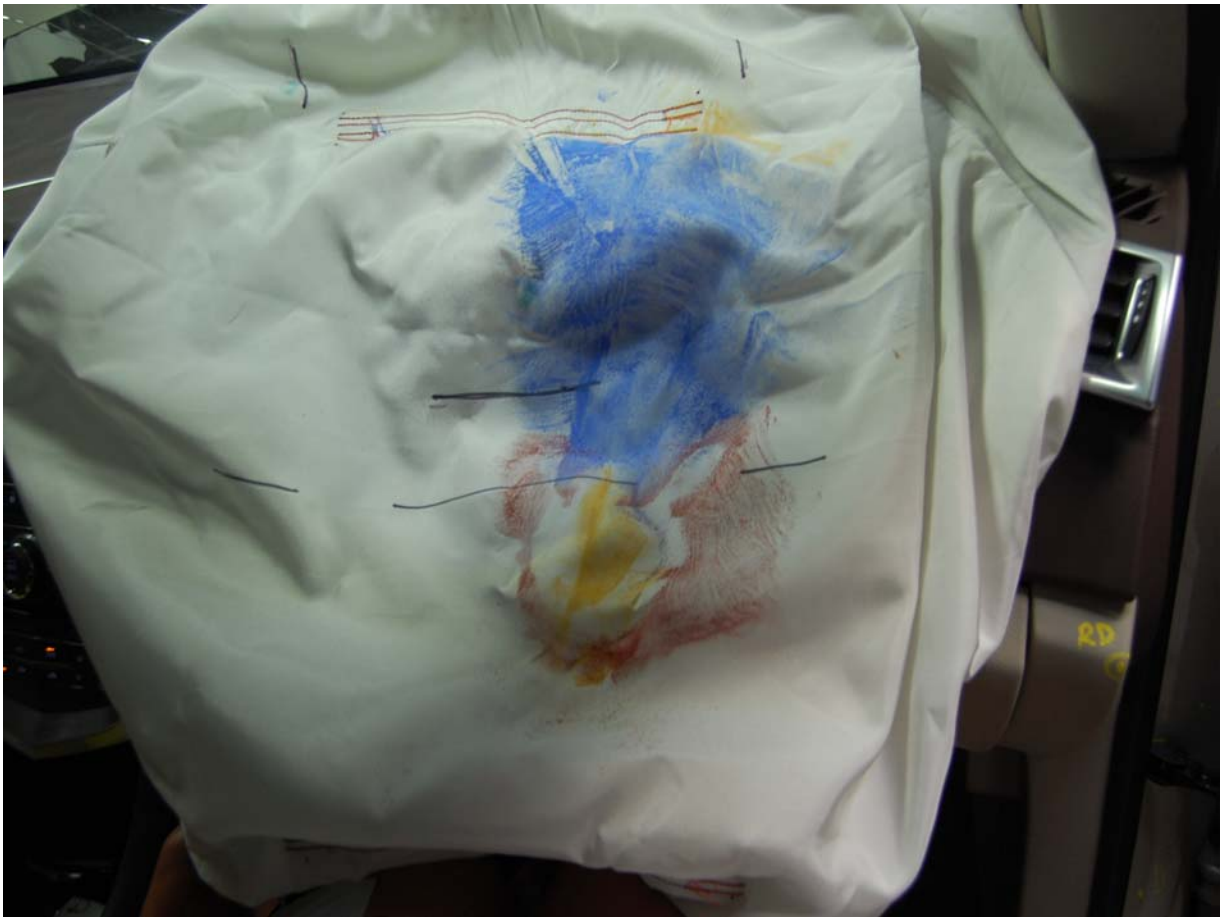
Pre-Test Passenger Side Floor Pan

Post-Test Passenger Side Floor Pan



Post-Test Passenger Dummy Head Contact

Post-Test Passenger Dummy Knee Contact



Post-Test Passenger Dummy Airbag Contact

Rollover 90 Degrees

Rollover 180 Degrees

Rollover 270 Degrees

Rollover 360 Degrees

Vehicle Impact

APPENDIX B

DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

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 X

Driver Upper Neck Force Y

Driver Upper Neck Force Z

Driver Upper Neck Moment X

Driver Upper Neck Moment Y

Driver Upper Neck Moment Z

Driver Chest X Redundant

Driver Chest Y Redundant

Driver Chest Z Redundant

Driver Chest Displacement

Driver Pelvis X

Driver Pelvis Y

Driver Pelvis Z

Driver Shoulder 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 X

Passenger Upper Neck Force Y

Passenger Upper Neck Force Z

Passenger Upper Neck Moment X

Passenger Upper Neck Moment Y

Passenger Upper Neck Moment Z

Passenger Chest X Redundant

Passenger Chest Y Redundant

Passenger Chest Z Redundant

Passenger Chest Displacement

Passenger Pelvis X

Passenger Pelvis Y

Passenger Pelvis Z

Passenger Shoulder Belt Force

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

Barrier Force – Upper Left

Barrier Force – Upper Center

Barrier Force – Upper Right

Barrier Force – Lower Left

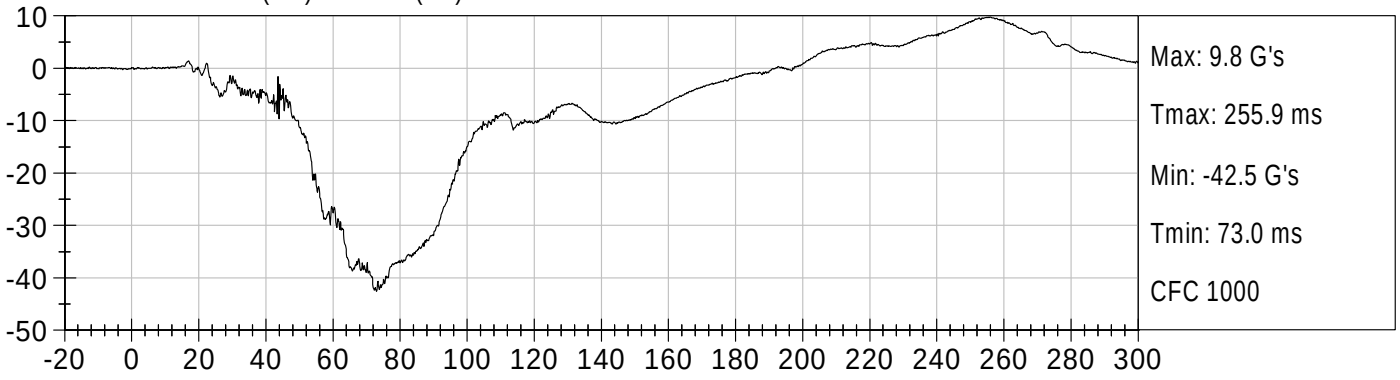
Barrier Force – Lower Center

Barrier Force – Lower Right

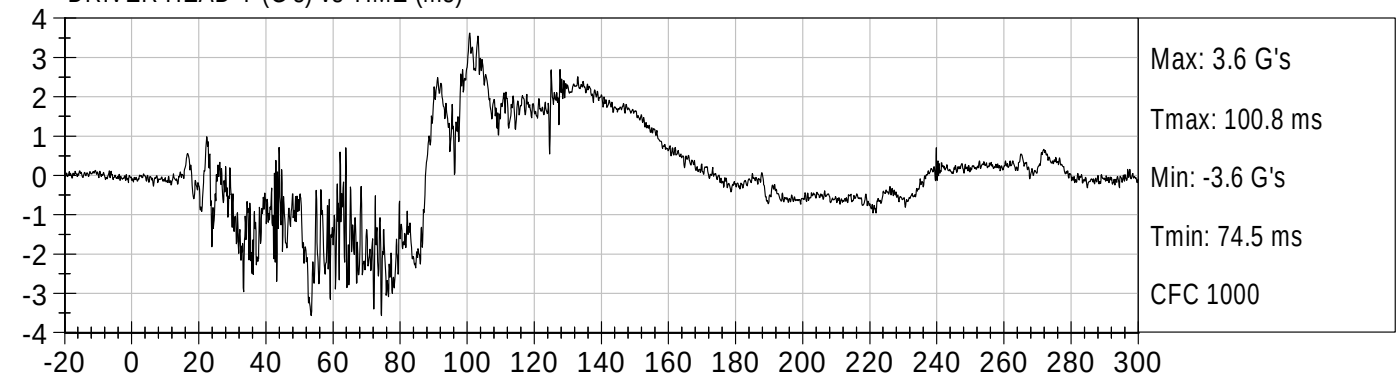
35mph NCAP Frontal
2010 Cadillac SRX - MA0120

Test Date: 12/01/2009
Speed: 35.1 mph (56.5 km/h)

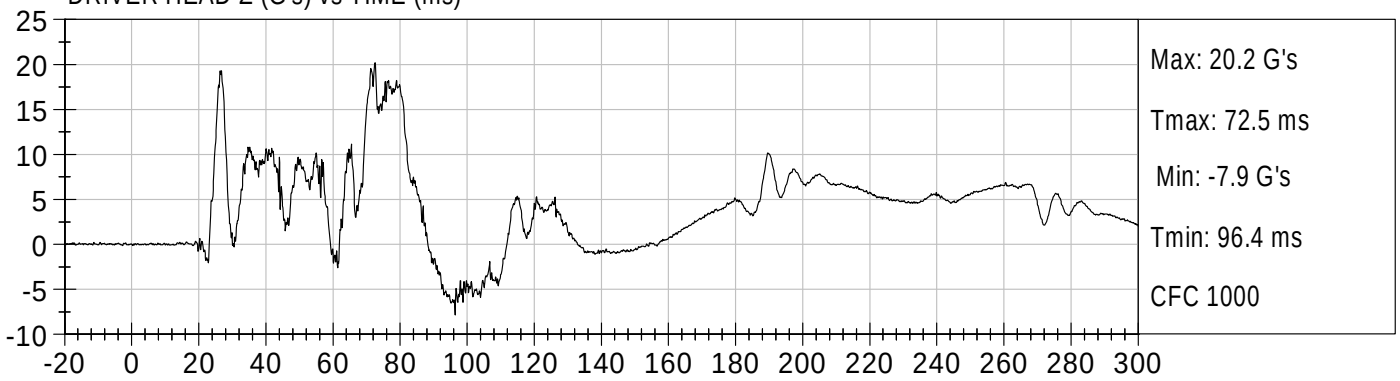
DRIVER HEAD X (G's) vs TIME (ms)



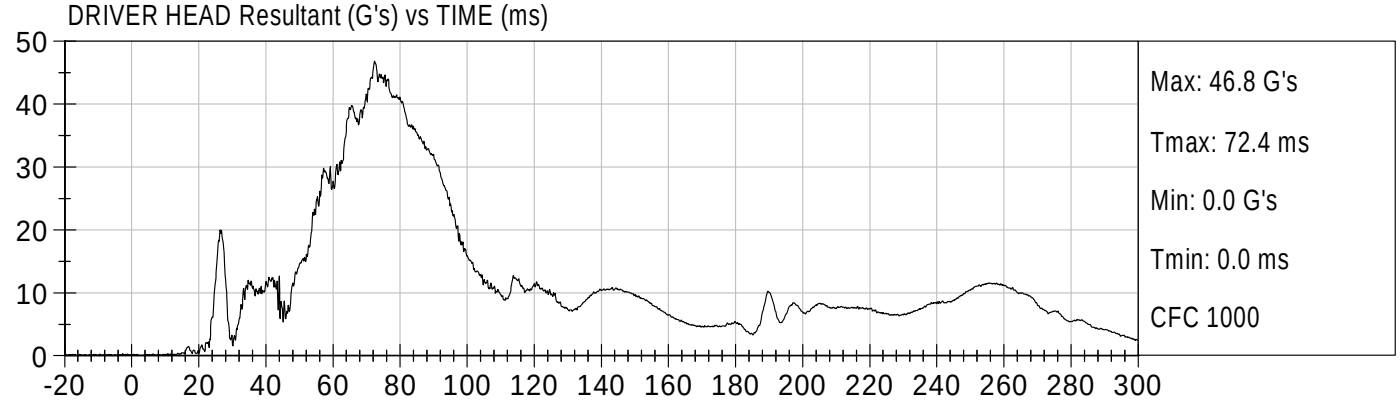
DRIVER HEAD Y (G's) vs TIME (ms)

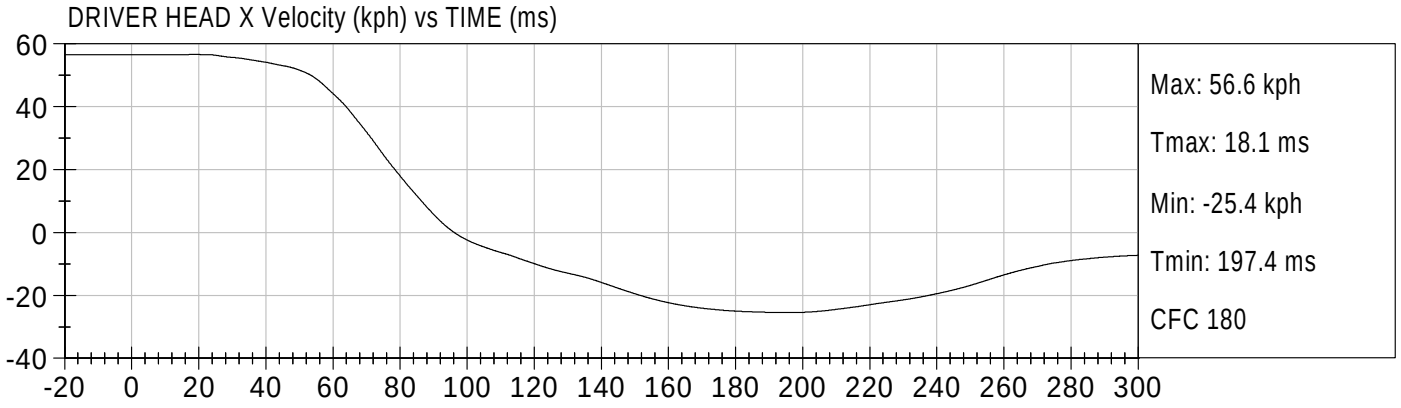


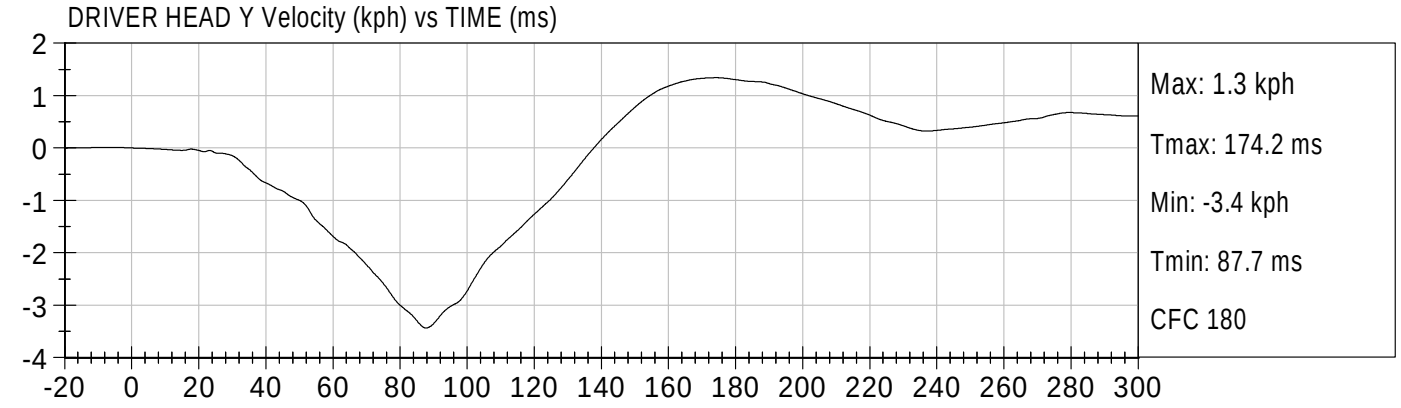
DRIVER HEAD Z (G's) vs TIME (ms)

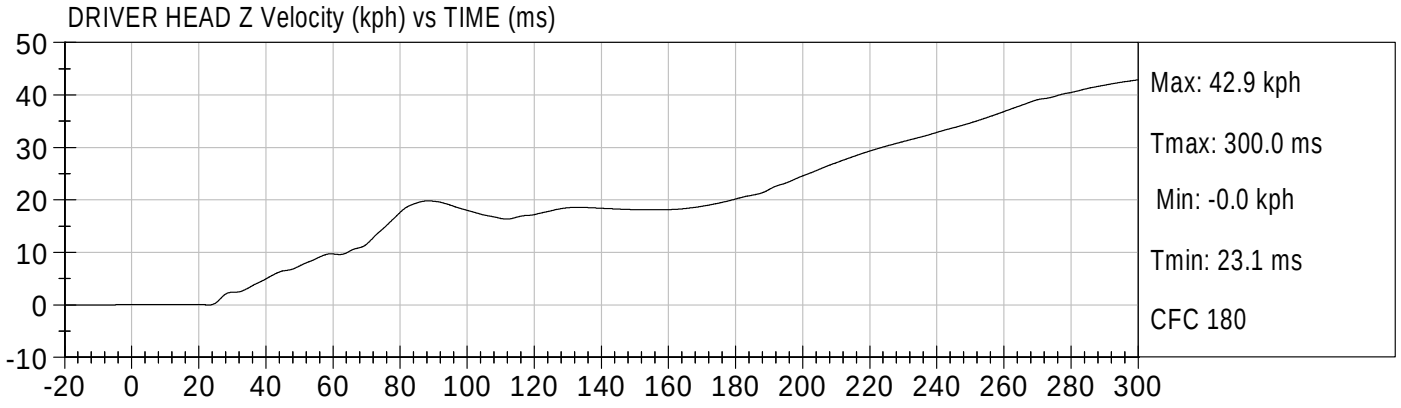


DRIVER HEAD Resultant (G's) vs TIME (ms)




DRIVER HEAD X Velocity (kph) vs TIME (ms)
60
40
20
0
-20
-40
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.6 kph
Tmax: 18.1 ms
Min: -25.4 kph
Tmin: 197.4 ms
CFC 180

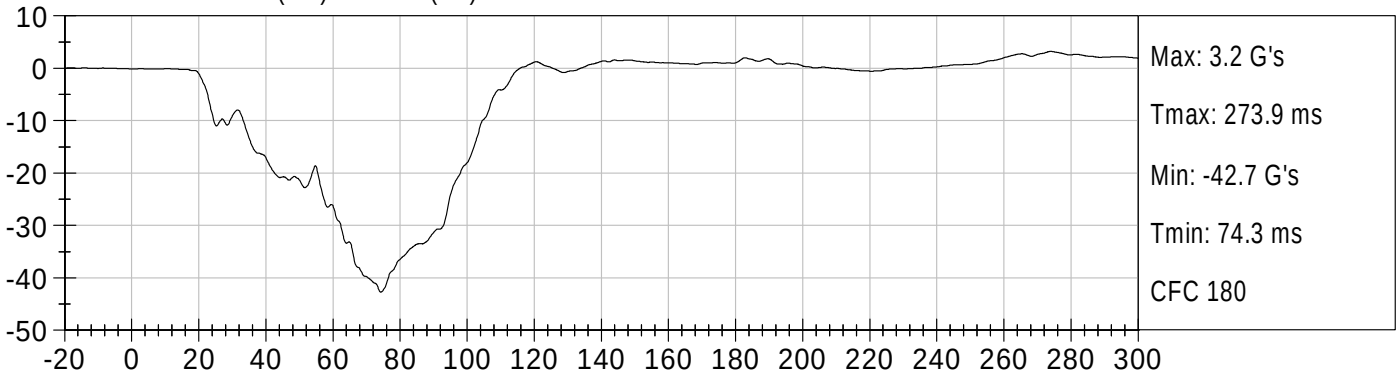

DRIVER HEAD Y Velocity (kph) vs TIME (ms)
2
1
0
-1
-2
-3
-4
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 1.3 kph
Tmax: 174.2 ms
Min: -3.4 kph
Tmin: 87.7 ms
CFC 180


DRIVER HEAD Z Velocity (kph) vs TIME (ms)
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 42.9 kph
Tmax: 300.0 ms
Min: -0.0 kph
Tmin: 23.1 ms
CFC 180

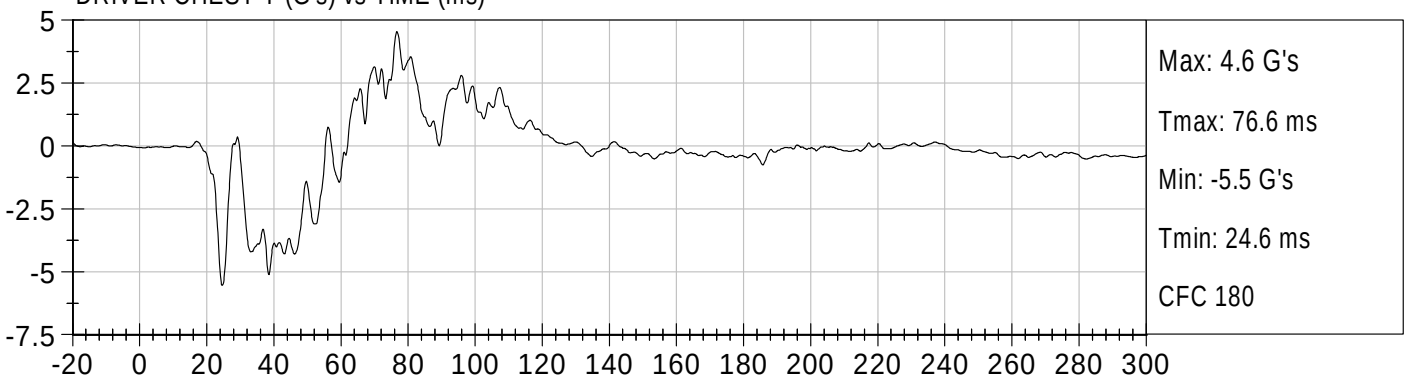
35mph NCAP Frontal
2010 Cadillac SRX - MA0120

Test Date: 12/01/2009
Speed: 35.1 mph (56.5 km/h)

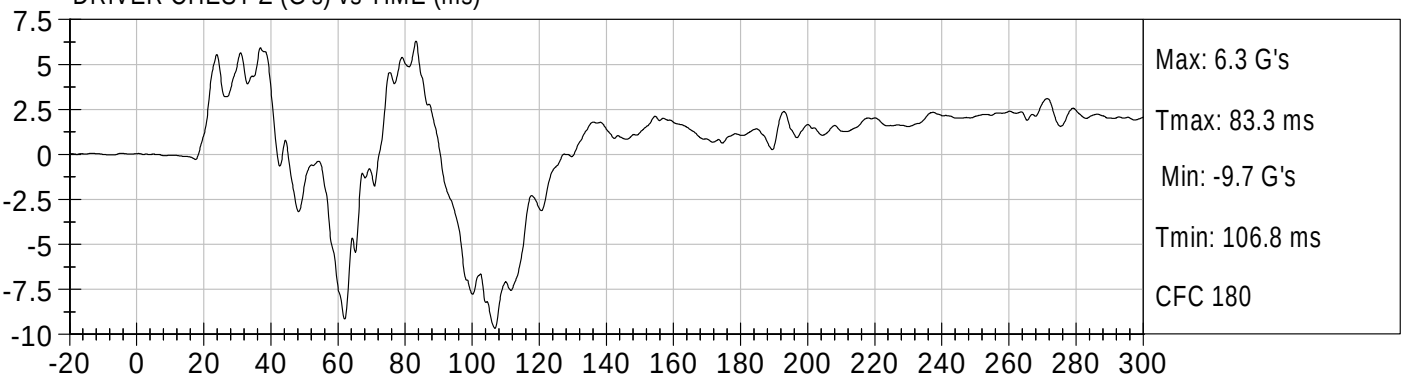
DRIVER CHEST X (G's) vs TIME (ms)



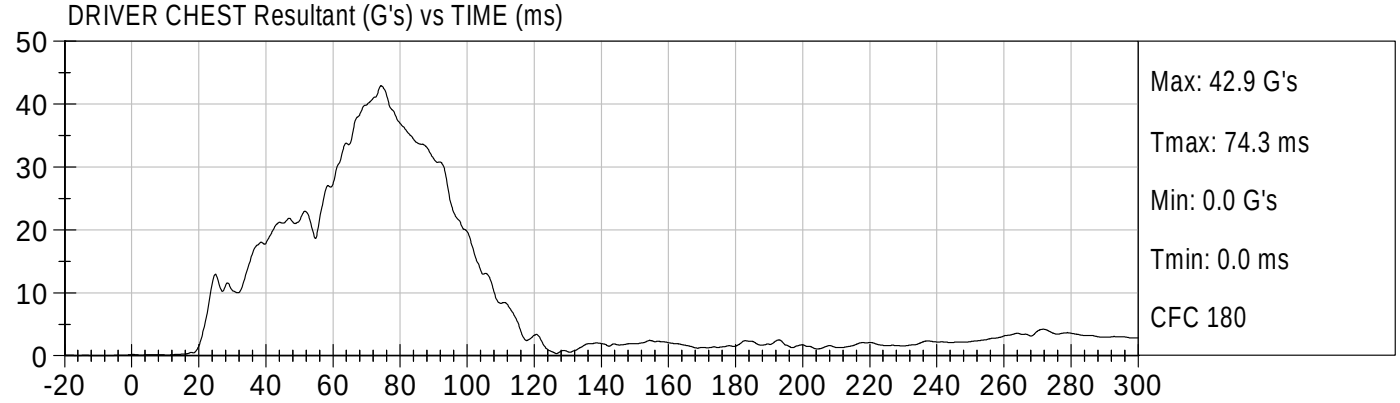
DRIVER CHEST Y (G's) vs TIME (ms)

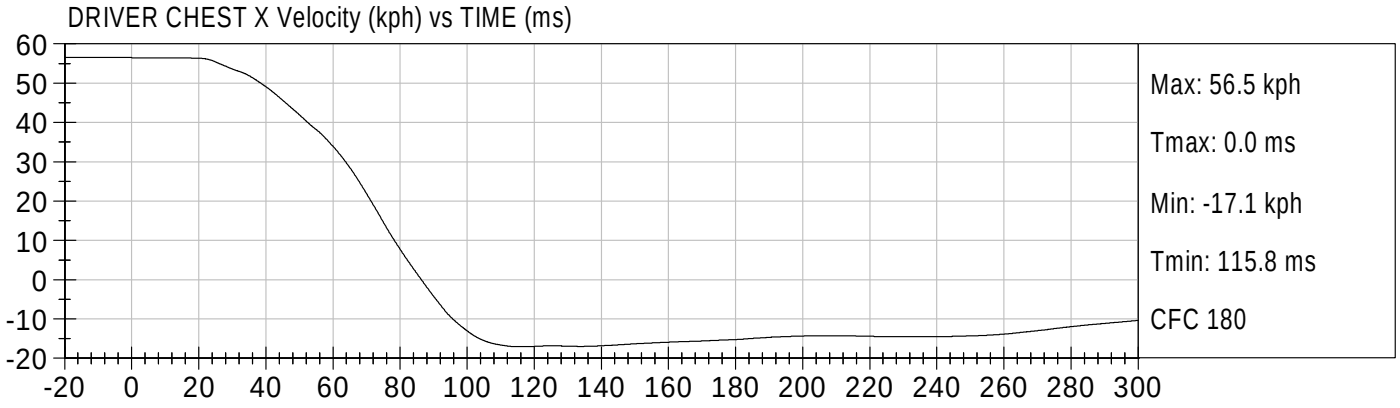


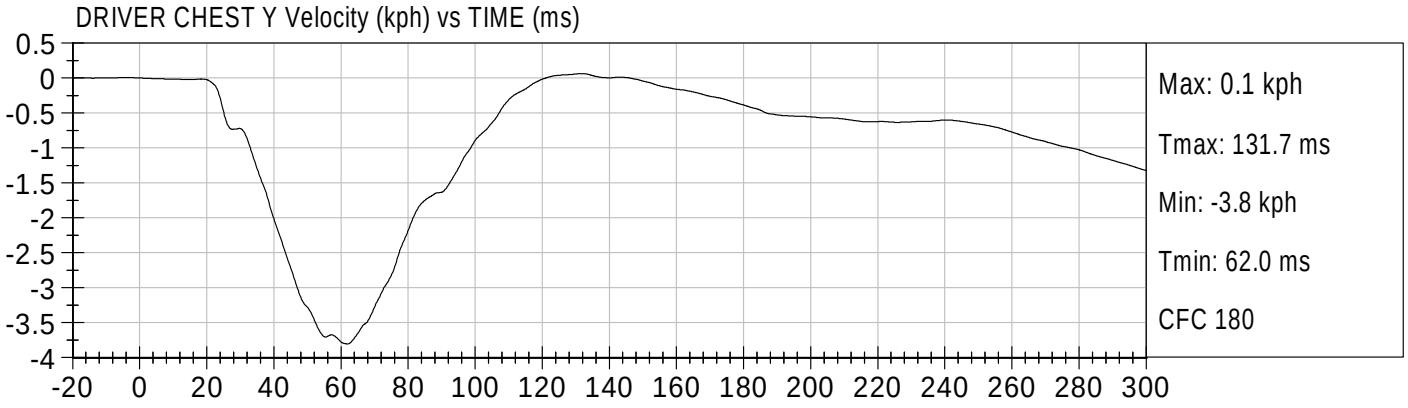
DRIVER CHEST Z (G's) vs TIME (ms)

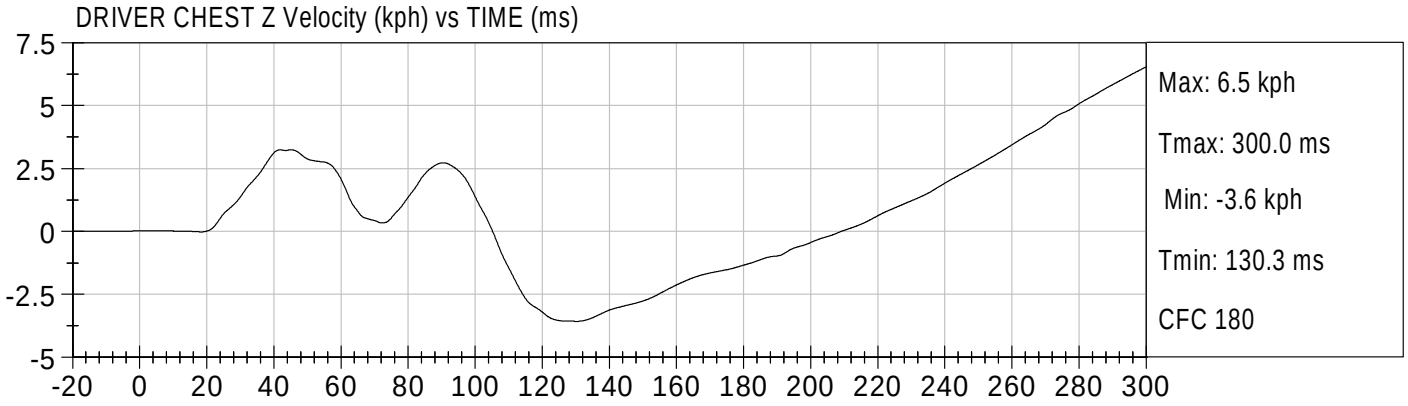


DRIVER CHEST Resultant (G's) vs TIME (ms)

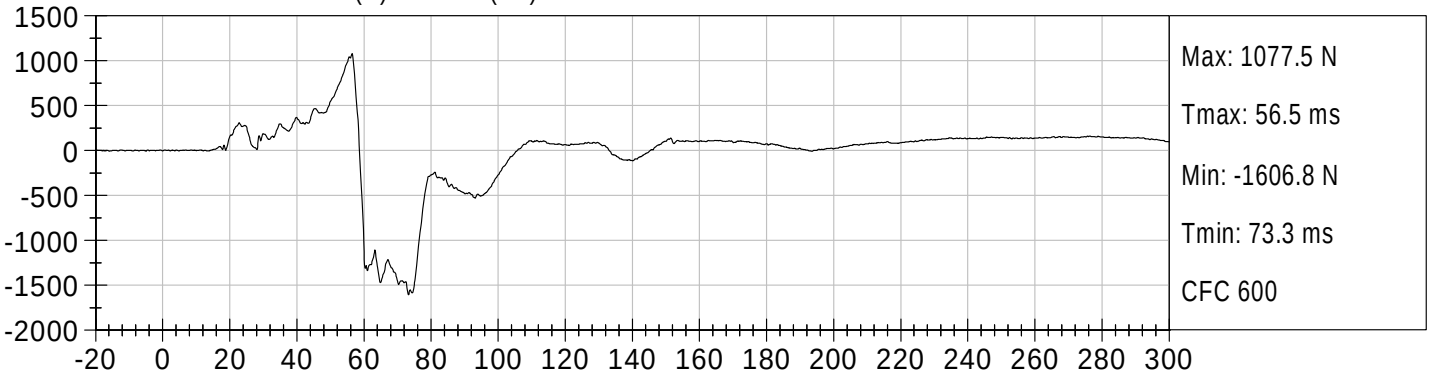



DRIVER CHEST X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.5 kph
Tmax: 0.0 ms
Min: -17.1 kph
Tmin: 115.8 ms
CFC 180

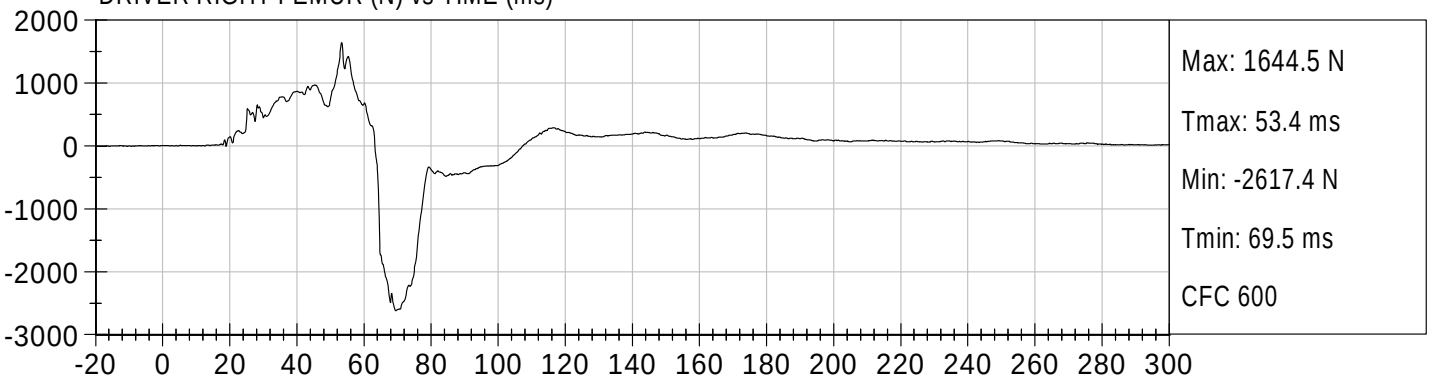

DRIVER CHEST Y Velocity (kph) vs TIME (ms)
0.5
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.1 kph
Tmax: 131.7 ms
Min: -3.8 kph
Tmin: 62.0 ms
CFC 180


DRIVER CHEST Z Velocity (kph) vs TIME (ms)
7.5
5
2.5
0
-2.5
-5
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 6.5 kph
Tmax: 300.0 ms
Min: -3.6 kph
Tmin: 130.3 ms
CFC 180

DRIVER LEFT FEMUR (N) vs TIME (ms)



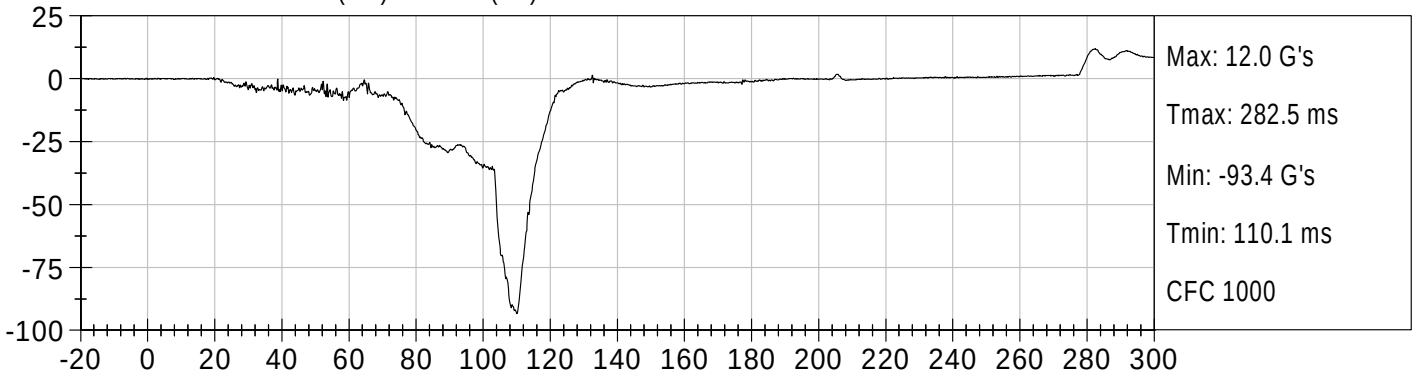
DRIVER RIGHT FEMUR (N) vs TIME (ms)



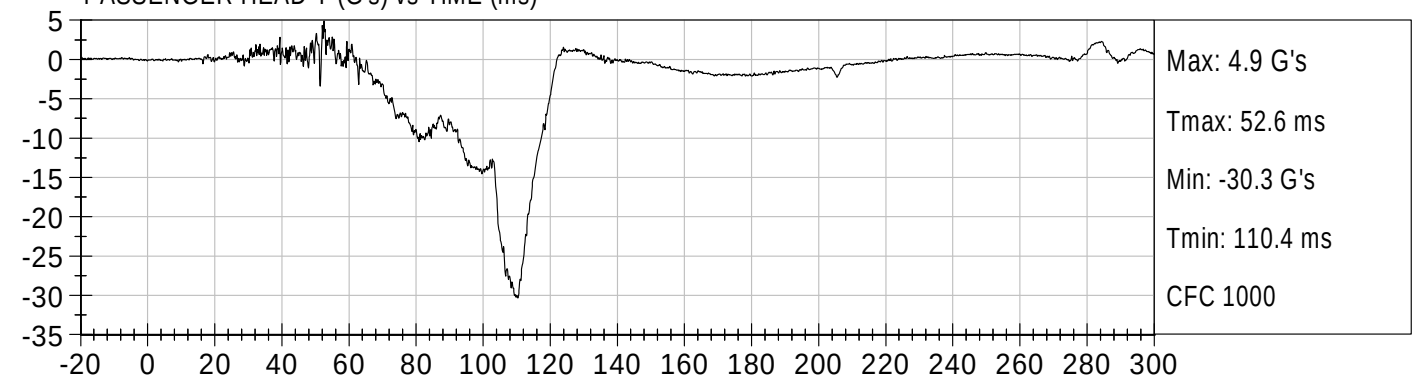
35mph NCAP Frontal
2010 Cadillac SRX - MA0120

Test Date: 12/01/2009
Speed: 35.1 mph (56.5 km/h)

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

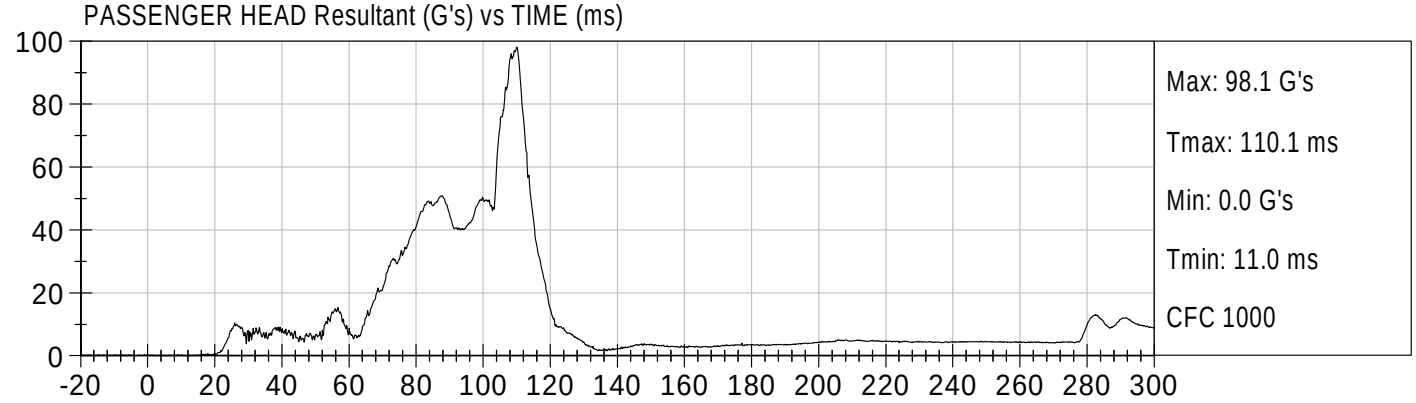


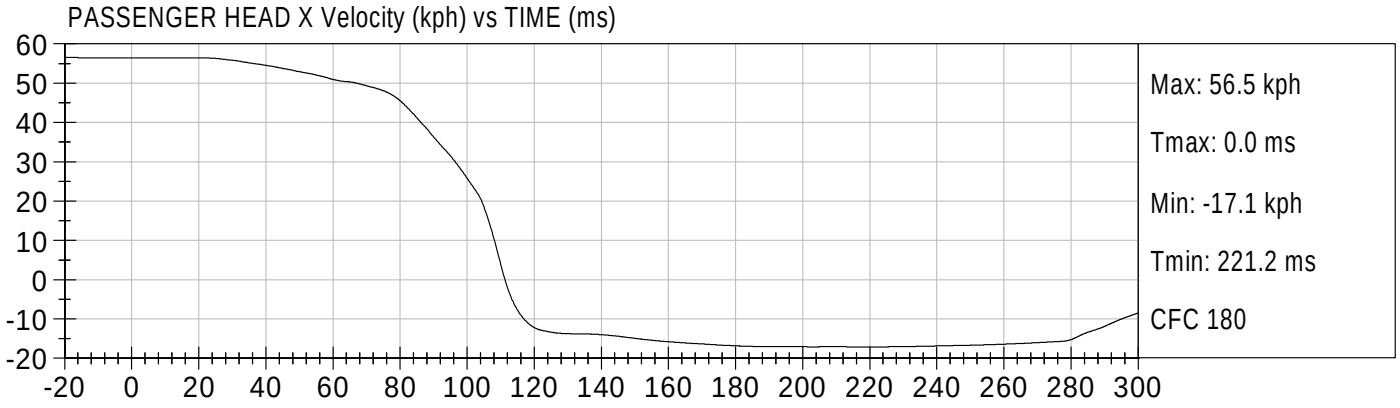
PASSENGER HEAD Y (G's) vs TIME (ms)

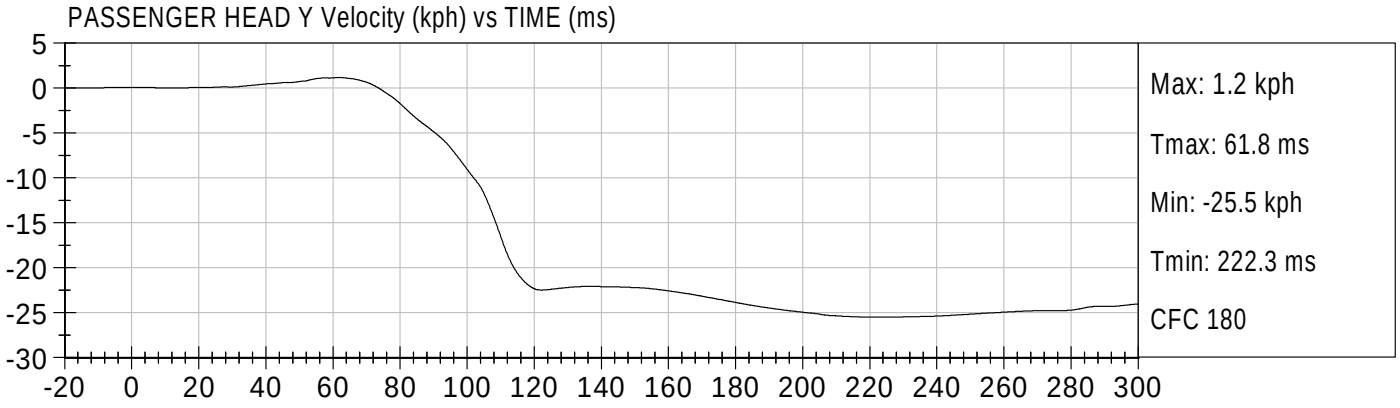


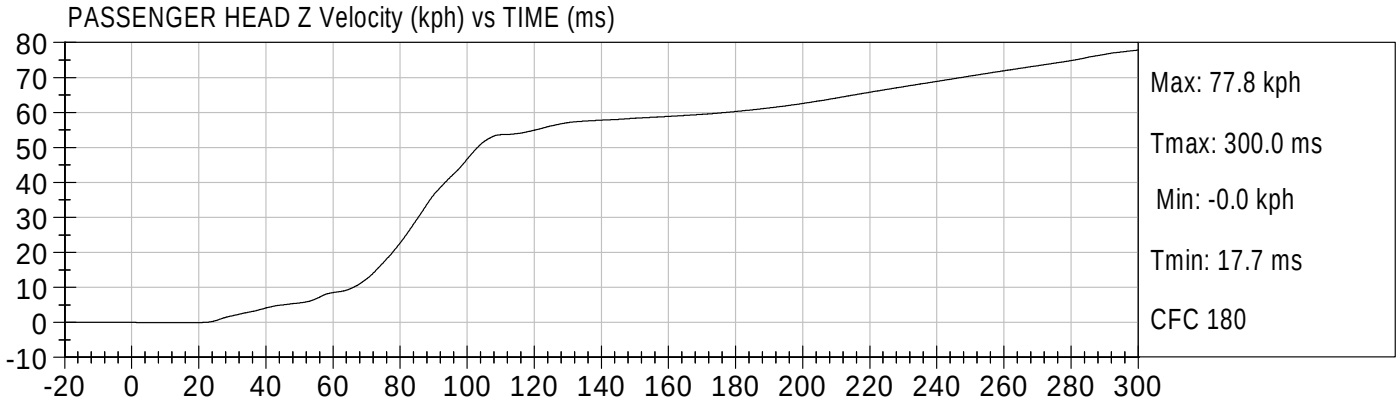
PASSENGER HEAD Z (G's) vs TIME (ms)

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




PASSENGER HEAD X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.5 kph
Tmax: 0.0 ms
Min: -17.1 kph
Tmin: 221.2 ms
CFC 180

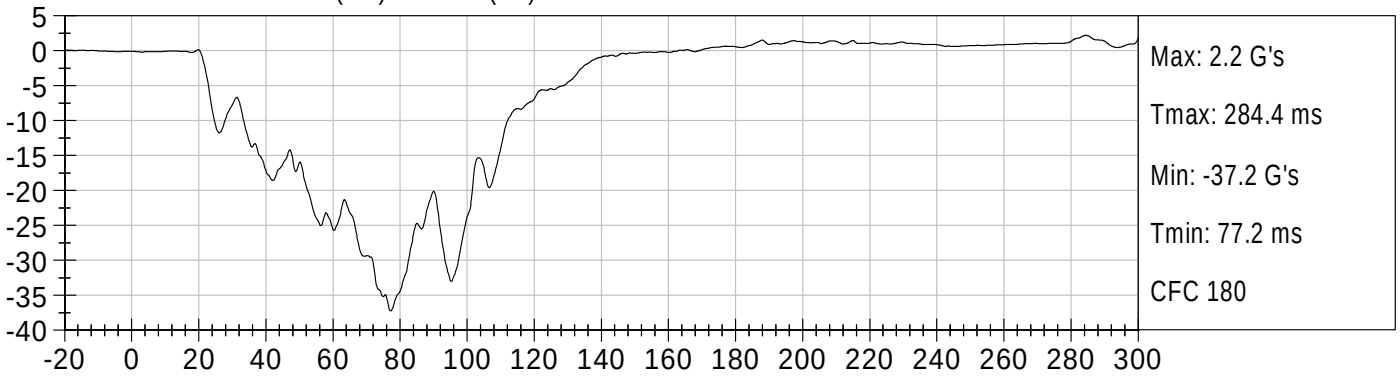

PASSENGER HEAD Y Velocity (kph) vs TIME (ms)
5
0
-5
-10
-15
-20
-25
-30
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 1.2 kph
Tmax: 61.8 ms
Min: -25.5 kph
Tmin: 222.3 ms
CFC 180


PASSENGER HEAD Z Velocity (kph) vs TIME (ms)
80
70
60
50
40
30
20
10
0
-10
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 77.8 kph
Tmax: 300.0 ms
Min: -0.0 kph
Tmin: 17.7 ms
CFC 180

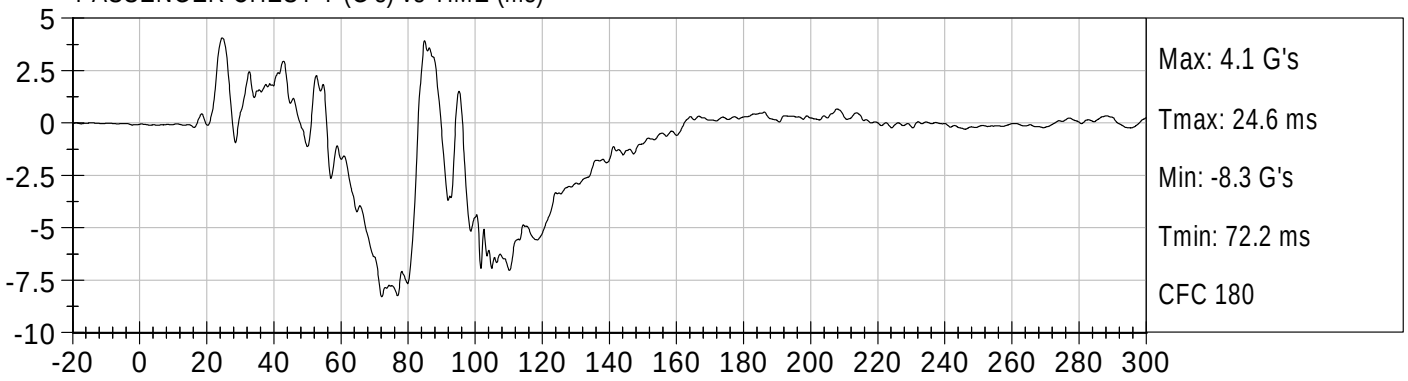
35mph NCAP Frontal
2010 Cadillac SRX - MA0120

Test Date: 12/01/2009
Speed: 35.1 mph (56.5 km/h)

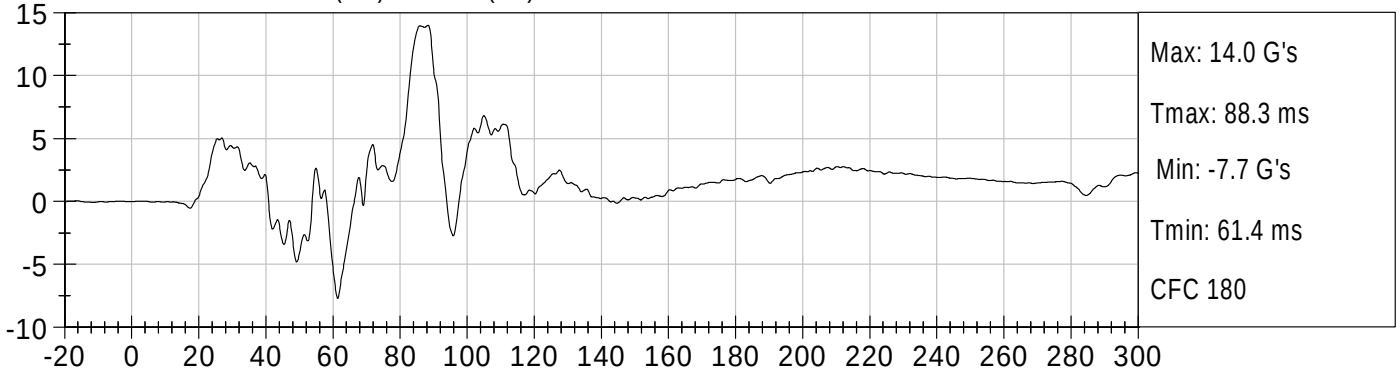
PASSENGER CHEST X (G's) vs TIME (ms)



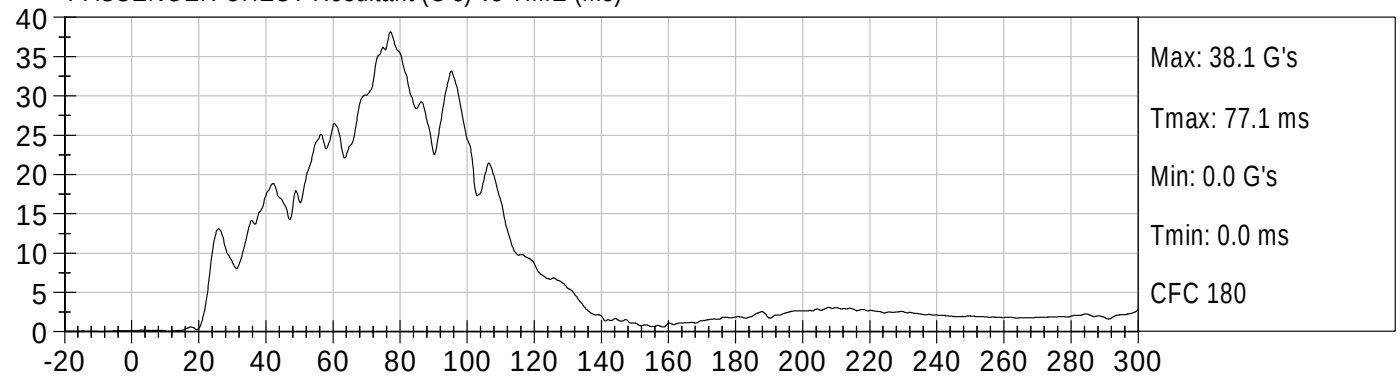
PASSENGER CHEST Y (G's) vs TIME (ms)



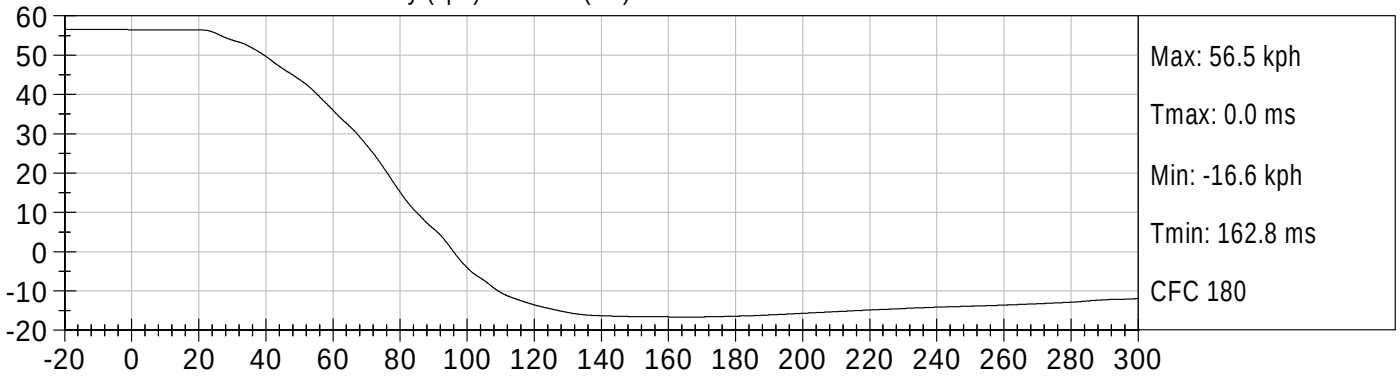
PASSENGER CHEST Z (G's) vs TIME (ms)



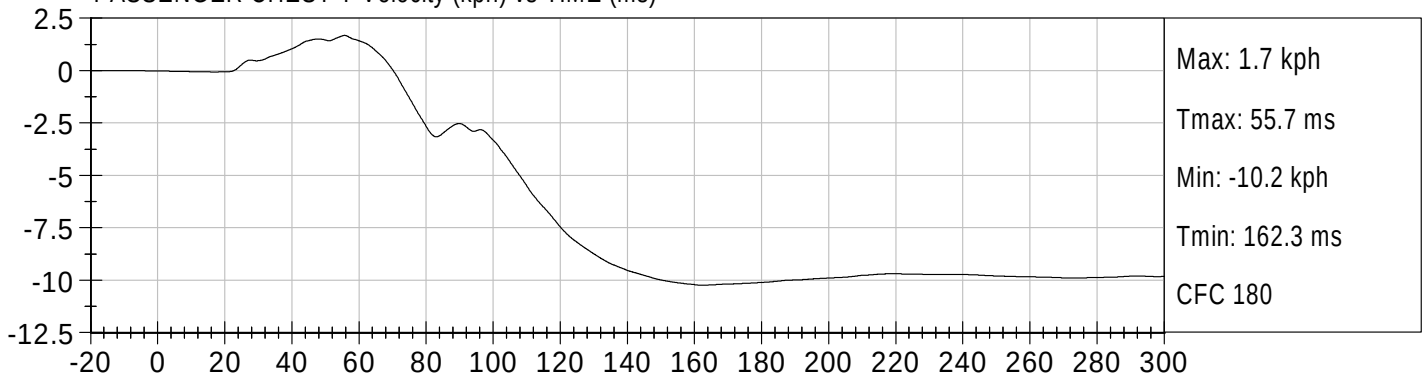
PASSENGER CHEST Resultant (G's) vs TIME (ms)



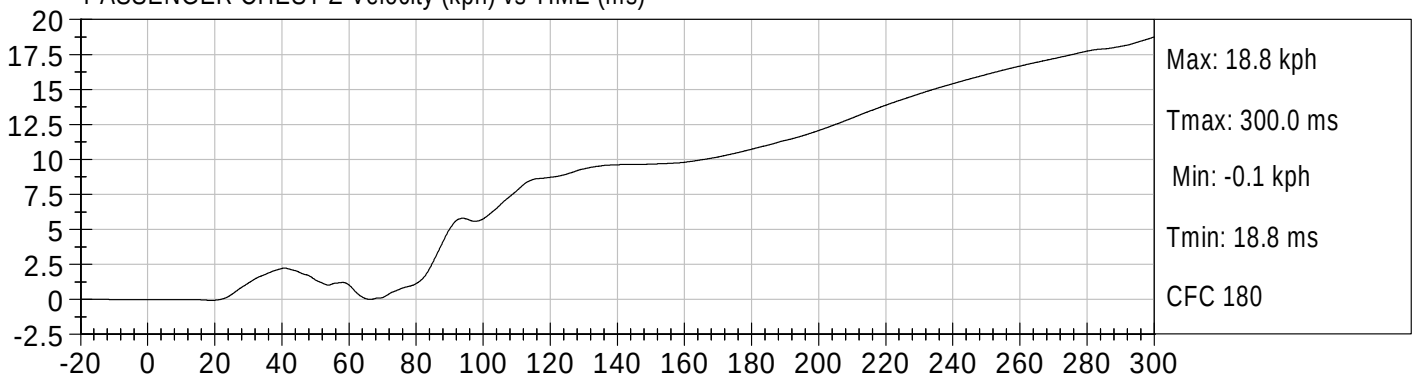
PASSENGER CHEST X Velocity (kph) vs TIME (ms)



PASSENGER CHEST Y Velocity (kph) vs TIME (ms)



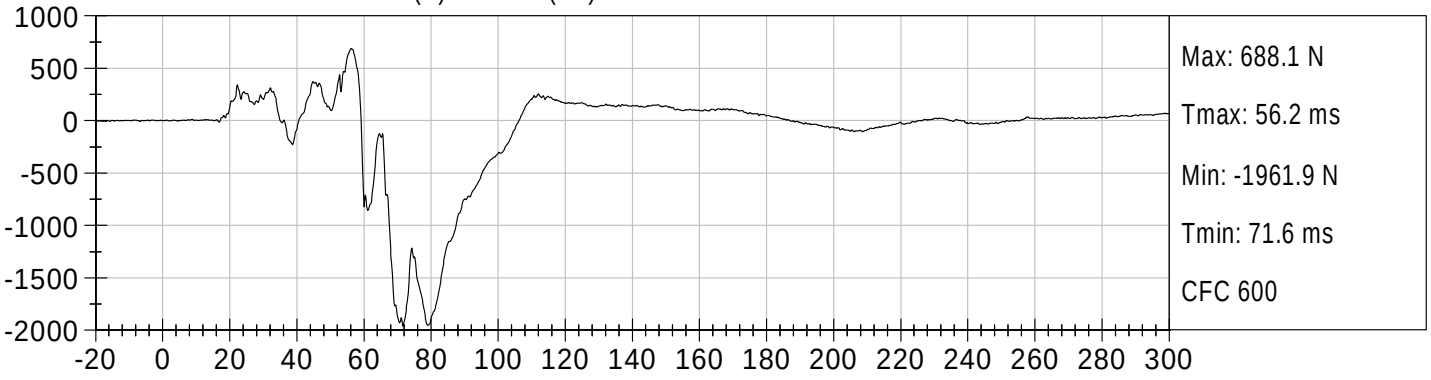
PASSENGER CHEST Z Velocity (kph) vs TIME (ms)



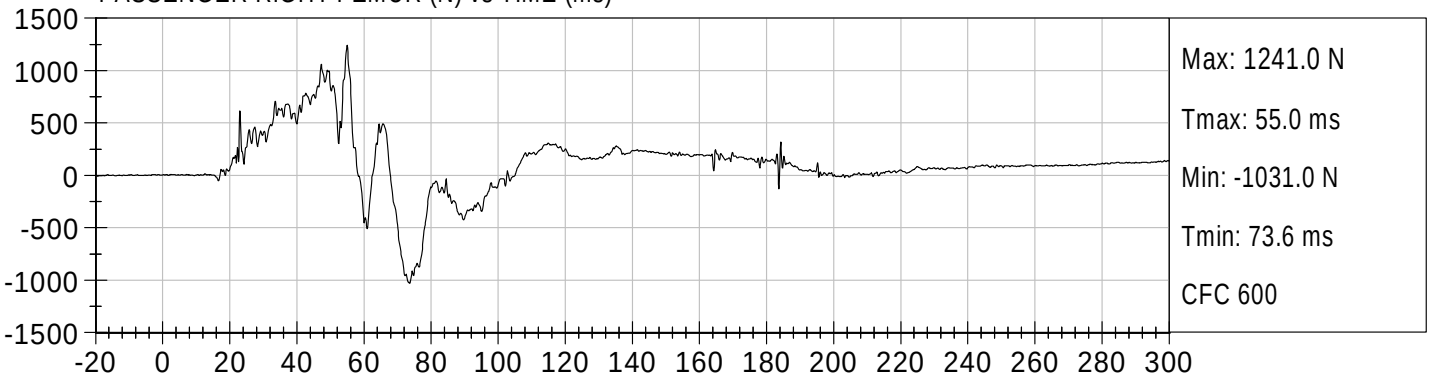
35mph NCAP Frontal
2010 Cadillac SRX - MA0120

Test Date: 12/01/2009
Speed: 35.1 mph (56.5 km/h)

PASSENGER LEFT FEMUR (N) vs TIME (ms)



PASSENGER 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: 065 **Test ID:** D092921

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Peak Resultant Acceleration	G's	225 - 275	247	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	10.4	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

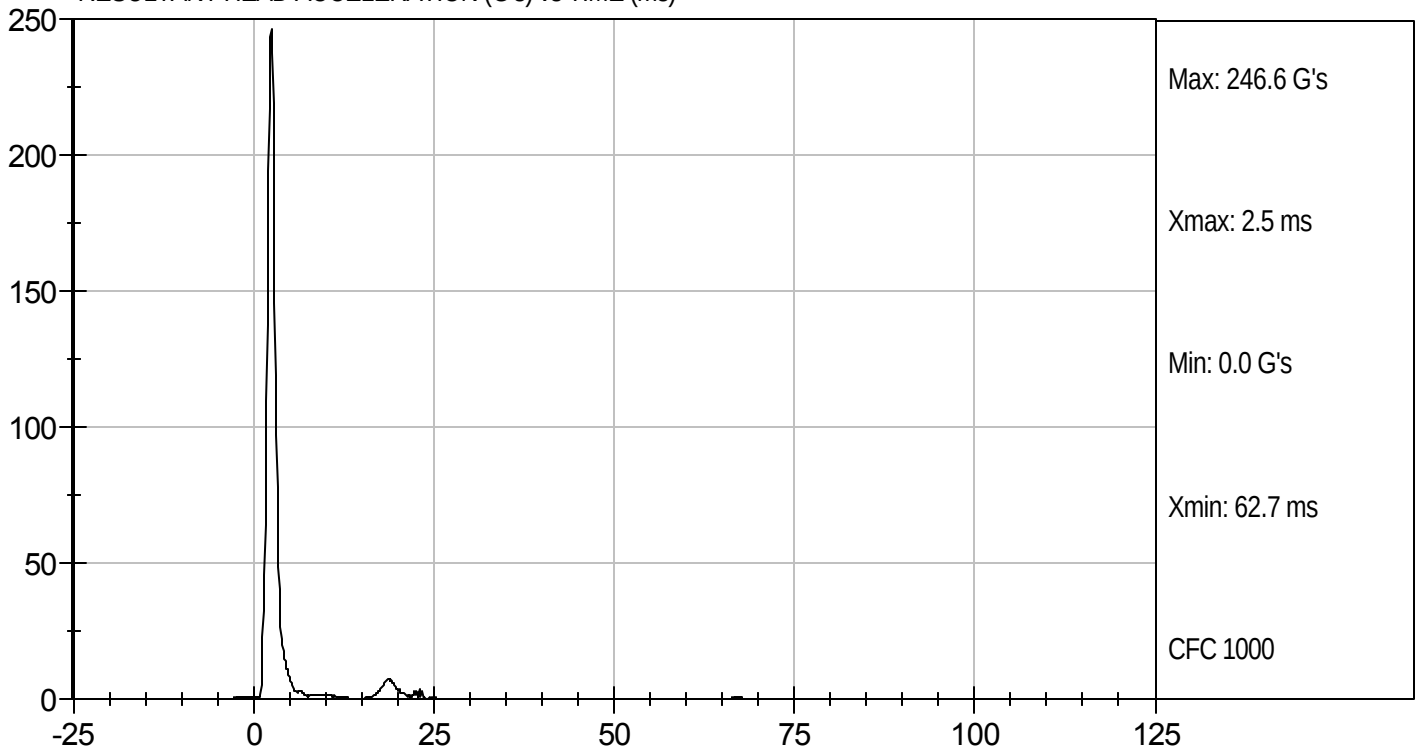
11/30/09
Test Date

David Winkelbauer
Approved By

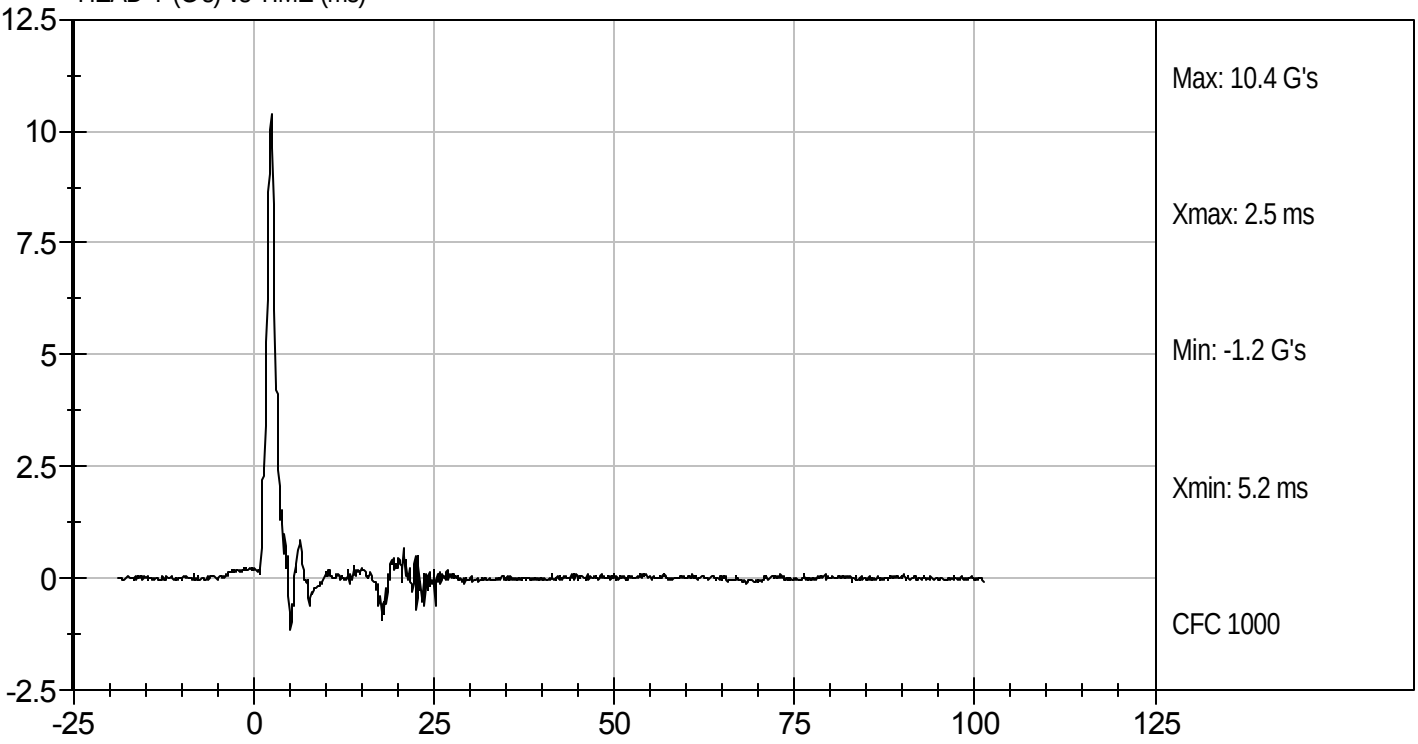
Test Desc: Head Drop
Component ID: D092921

Test Date: 11/30/09
Velocity: 0 ft/s, 0.00 m/s

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



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



MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D092922

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.05	Pass
Pendulum Deceleration	10 ms	m/s	22.50 to 27.50	23.83	Pass
	20 ms	m/s	17.60 to 22.60	17.94	Pass
	30 ms	m/s	12.50 to 18.50	13.93	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 29.0	13.90	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	38.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	67.1	Pass
	Time	ms	57.0 to 64.0	58.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	119.8	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	89.7	Pass
	Time	ms	47.0 to 58.0	51.3	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	102.1	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

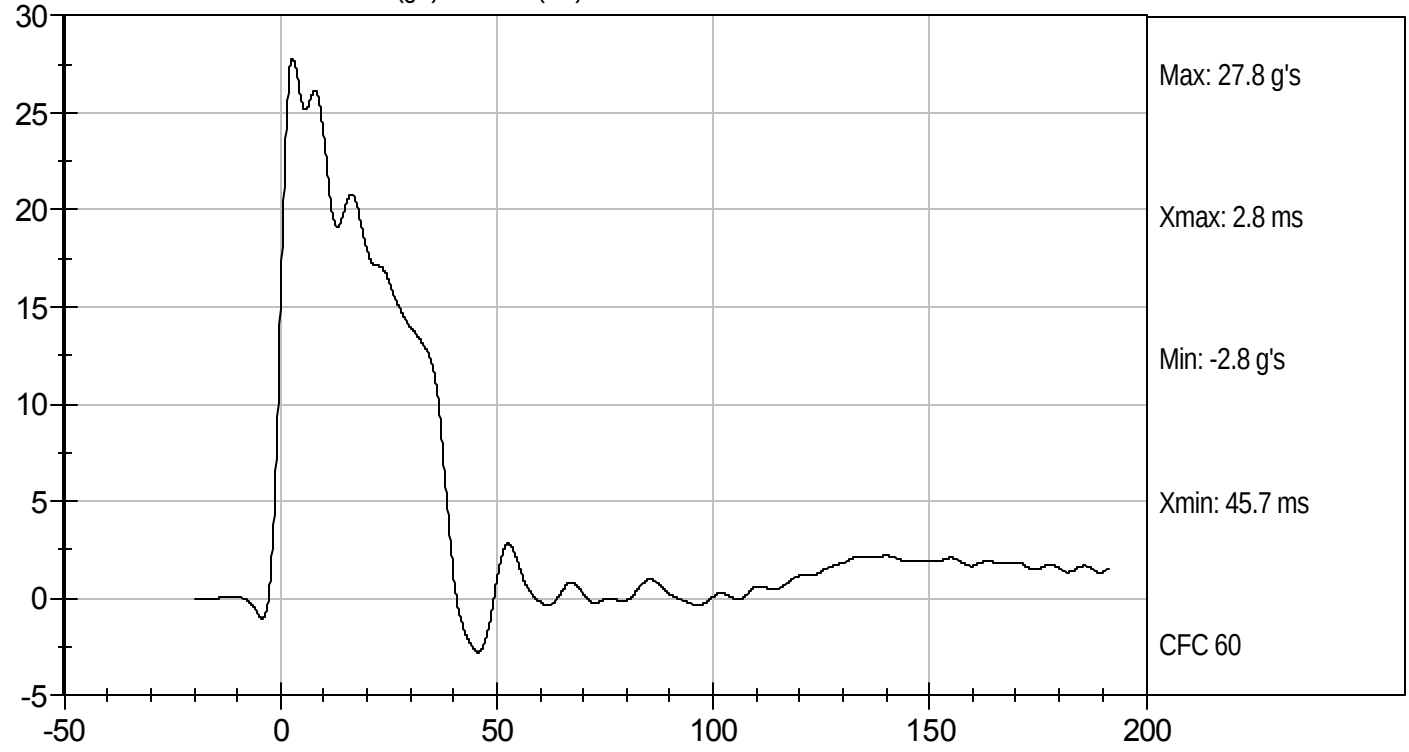
11/30/09
Test Date

David Winkelbauer
Approved By

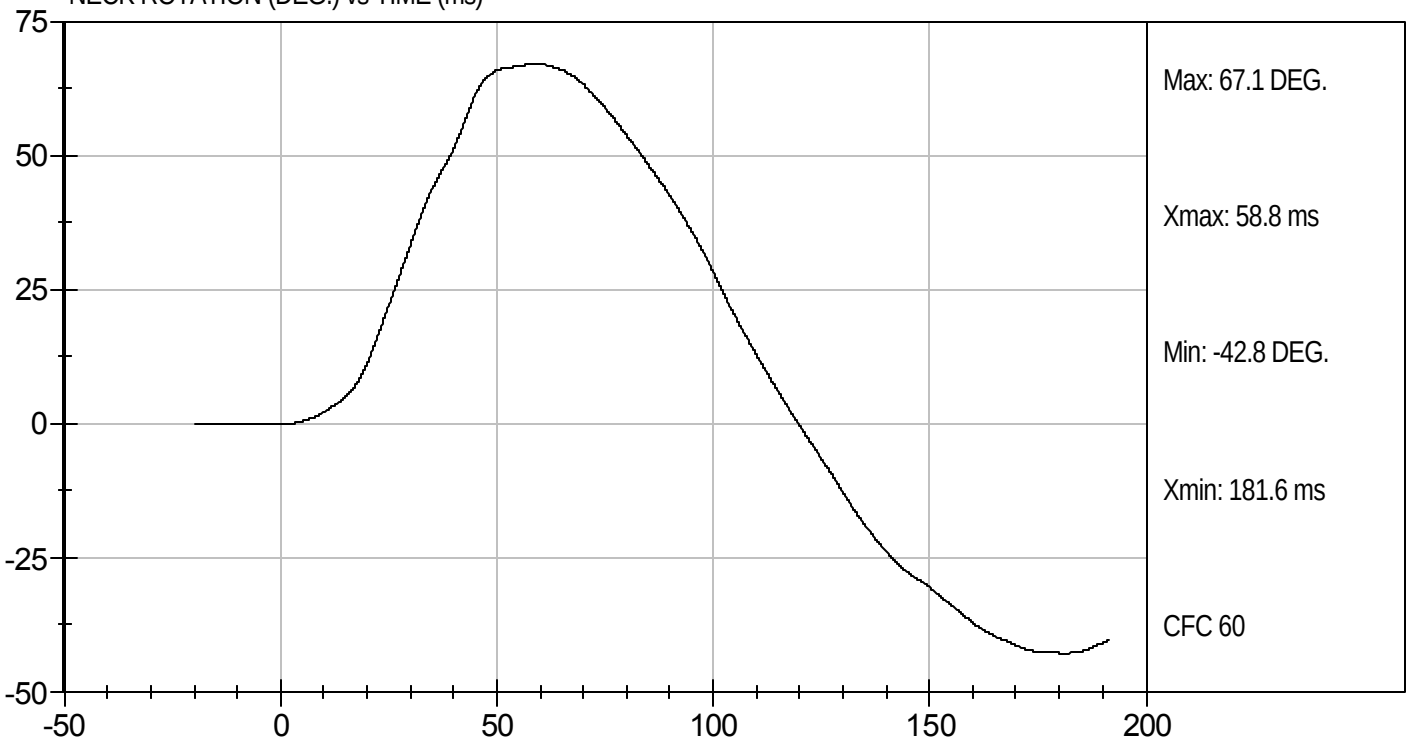
Test Desc: Neck Flexion
Component ID: D092922

Test Date: 11/30/09
Velocity: 23.14 ft/s, 7.05 m/s

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

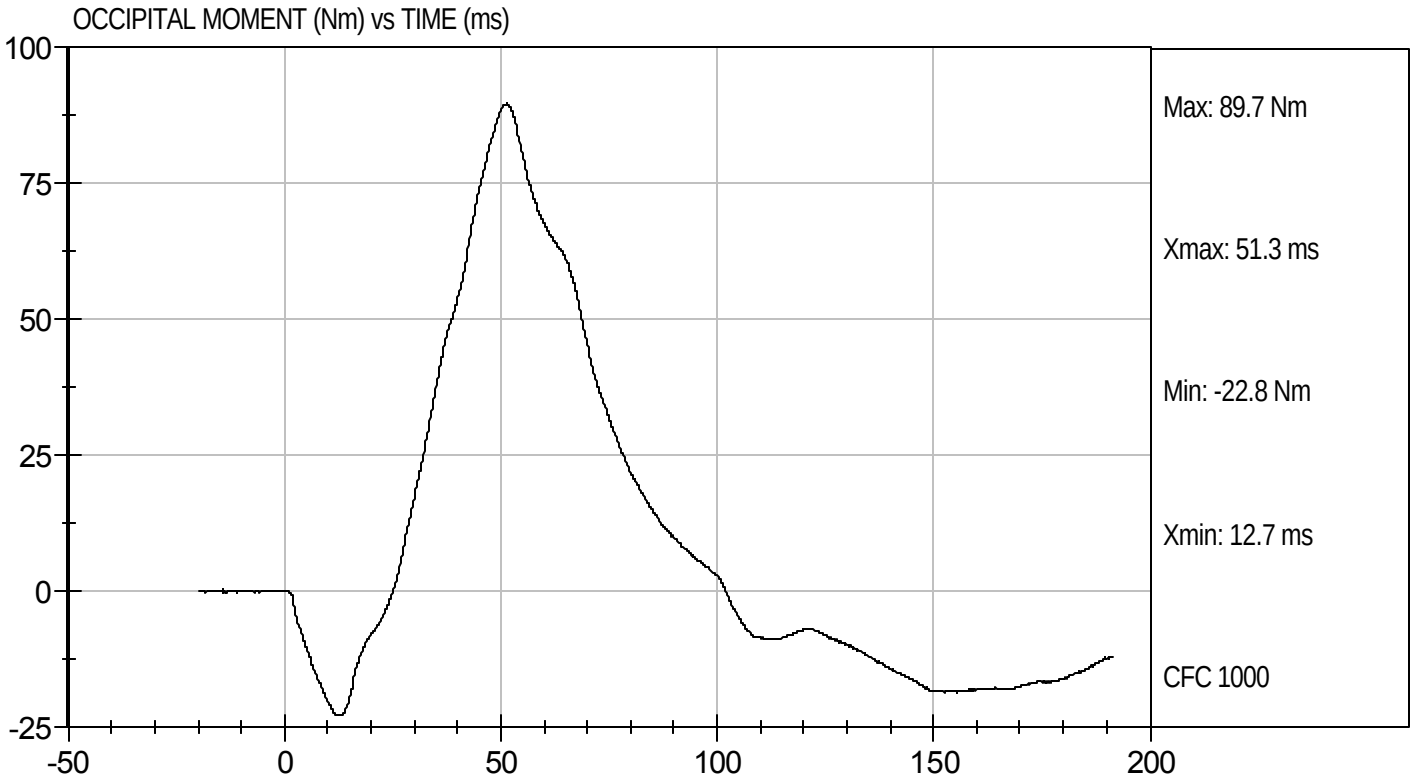


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D092922

Test Date: 11/30/09
Velocity: 23.14 ft/s, 7.05 m/s



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D092923

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 ms	m/s	17.20 to 21.20	18.08	Pass
	20 ms	m/s	14.00 to 19.00	15.33	Pass
	30 ms	m/s	11.00 to 16.00	11.41	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 22.0	12.46	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	42.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	91.7	Pass
	Time	ms	72.0 to 82.0	77.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	160.6	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.4	Pass
	Time	ms	65.0 to 79.0	71.9	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	139.7	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

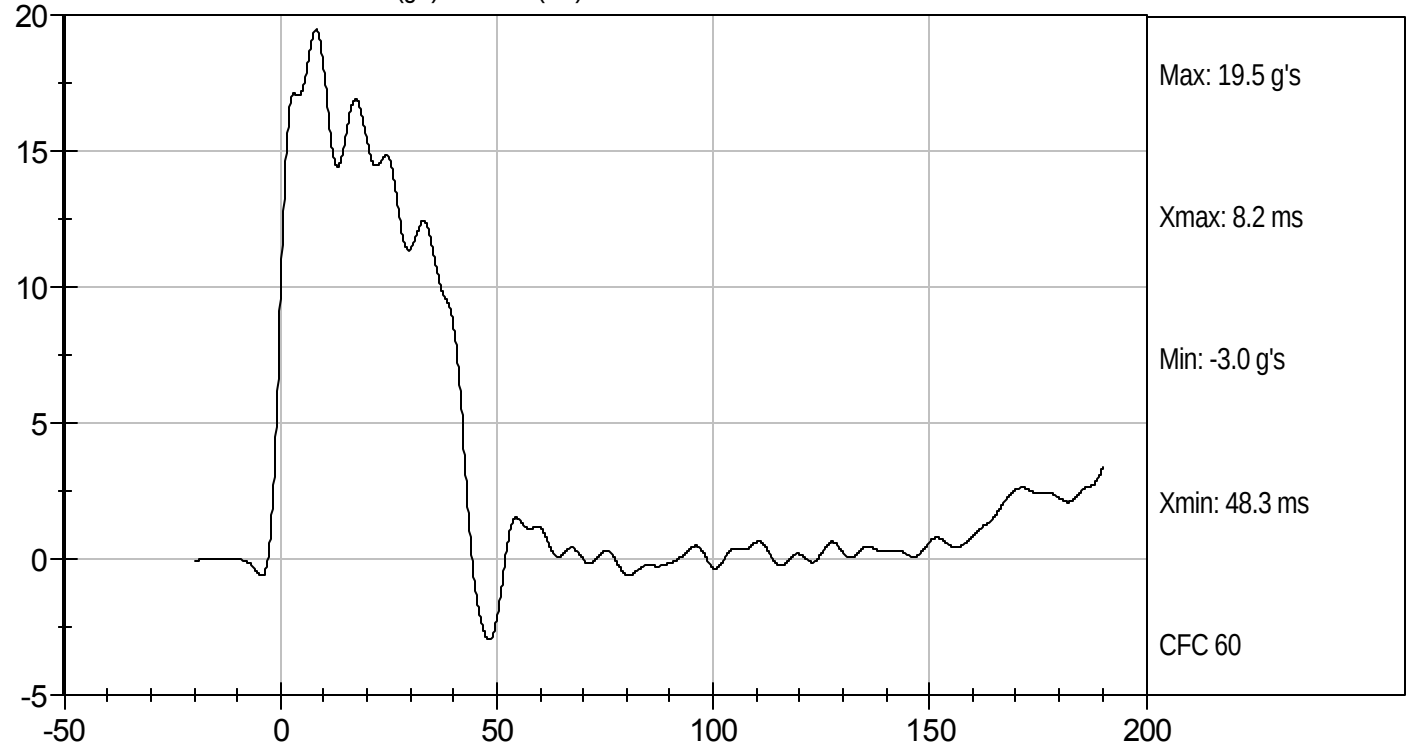
11/30/09
Test Date

David Winkelbauer
Approved By

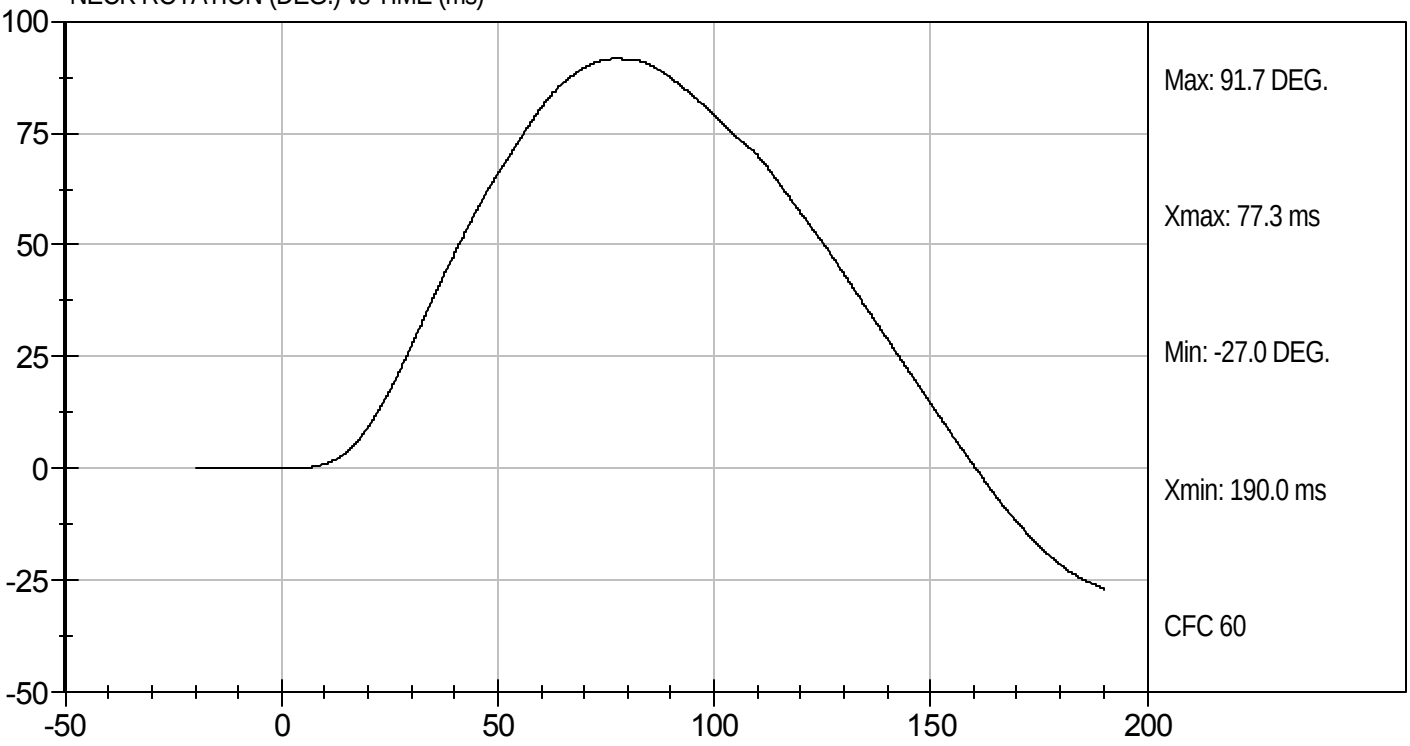
Test Desc: Neck Extension
Component ID: D092923

Test Date: 11/30/09
Velocity: 20.08 ft/s, 6.12 m/s

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

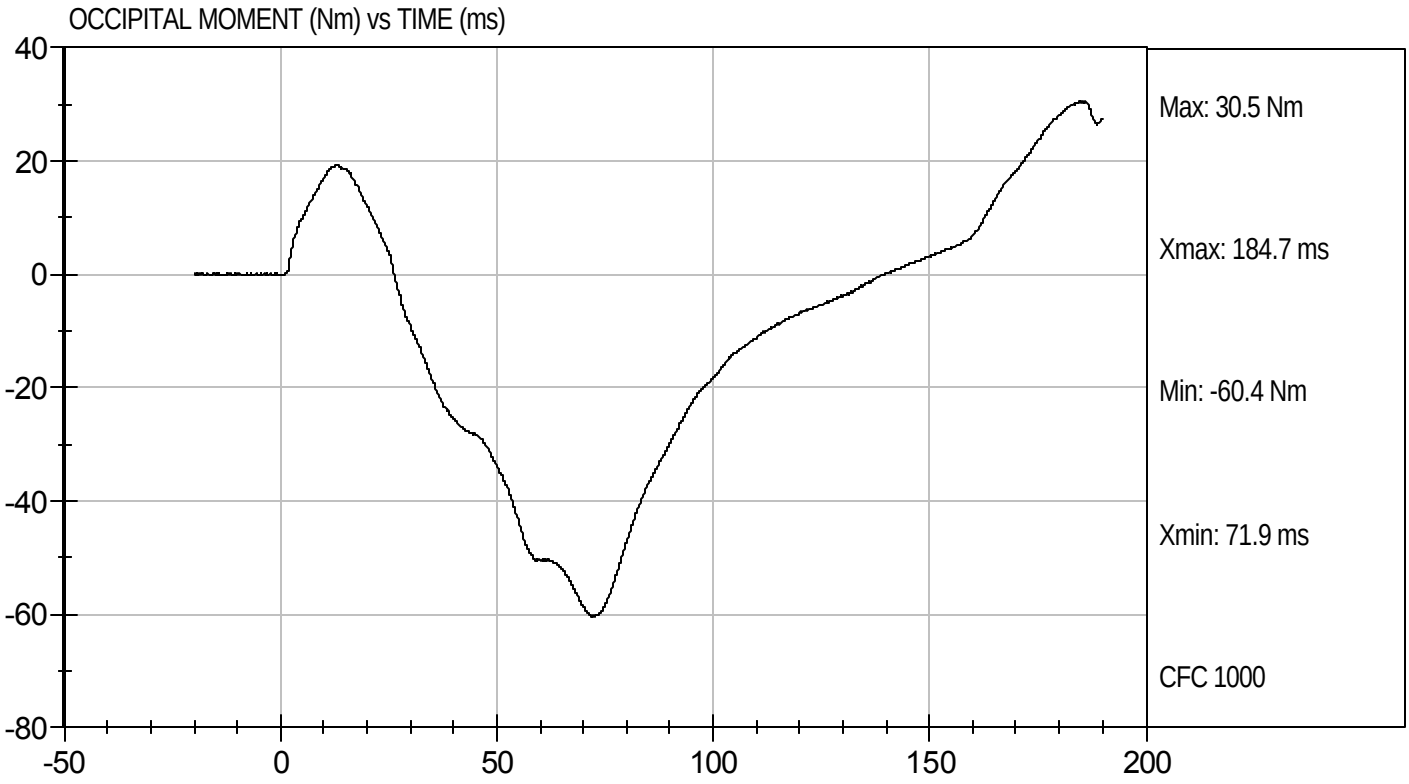


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D092923

Test Date: 11/30/09
Velocity: 20.08 ft/s, 6.12 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D092924

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,380	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.67	Pass
Internal Hysteresis	%	69 to 85	71	Pass
		Overall Test Results		Pass

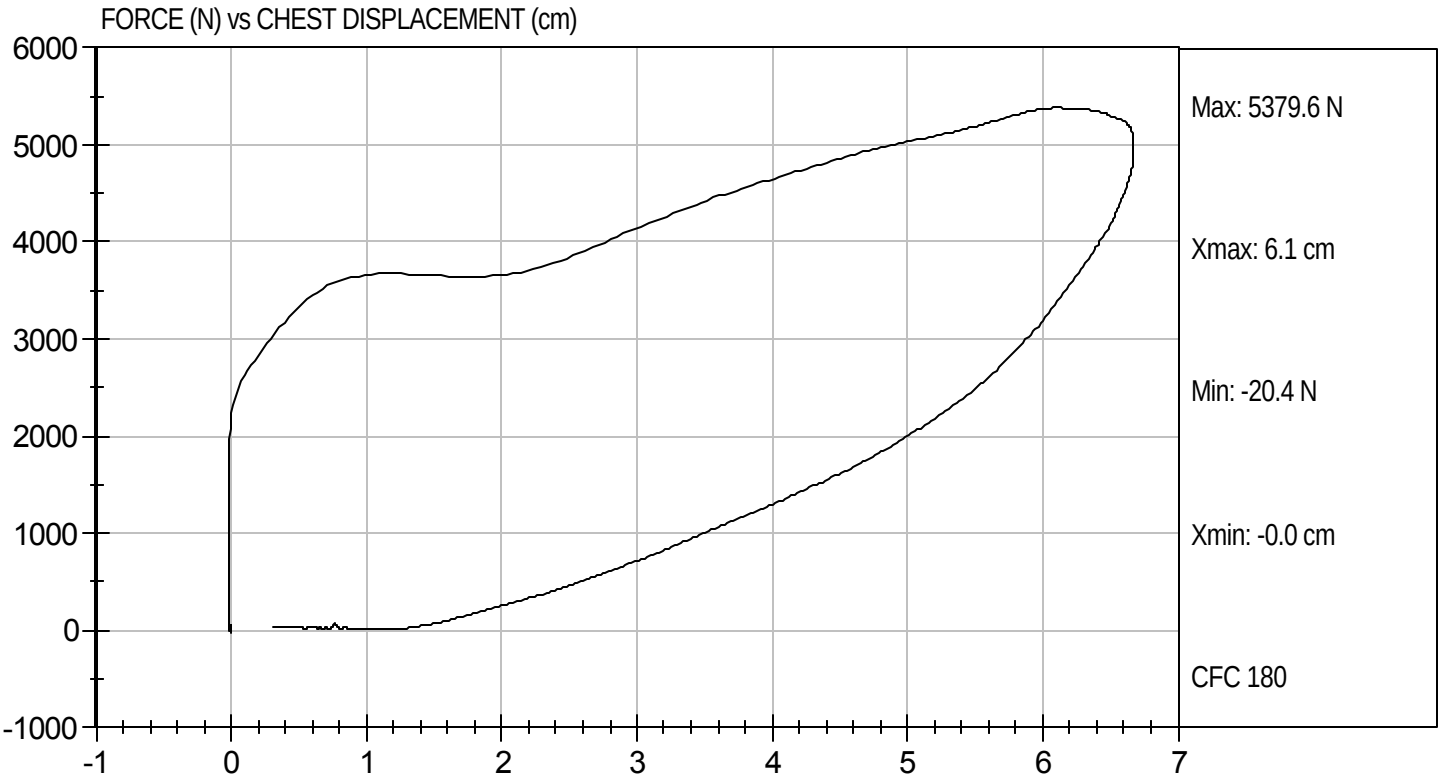
Jessica Hall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Component ID: D092924

Test Date: 11/30/09
Velocity: 22.22 ft/s, 6.77 m/s



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D092925

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	4,995	Pass
		Overall Test Results		Pass

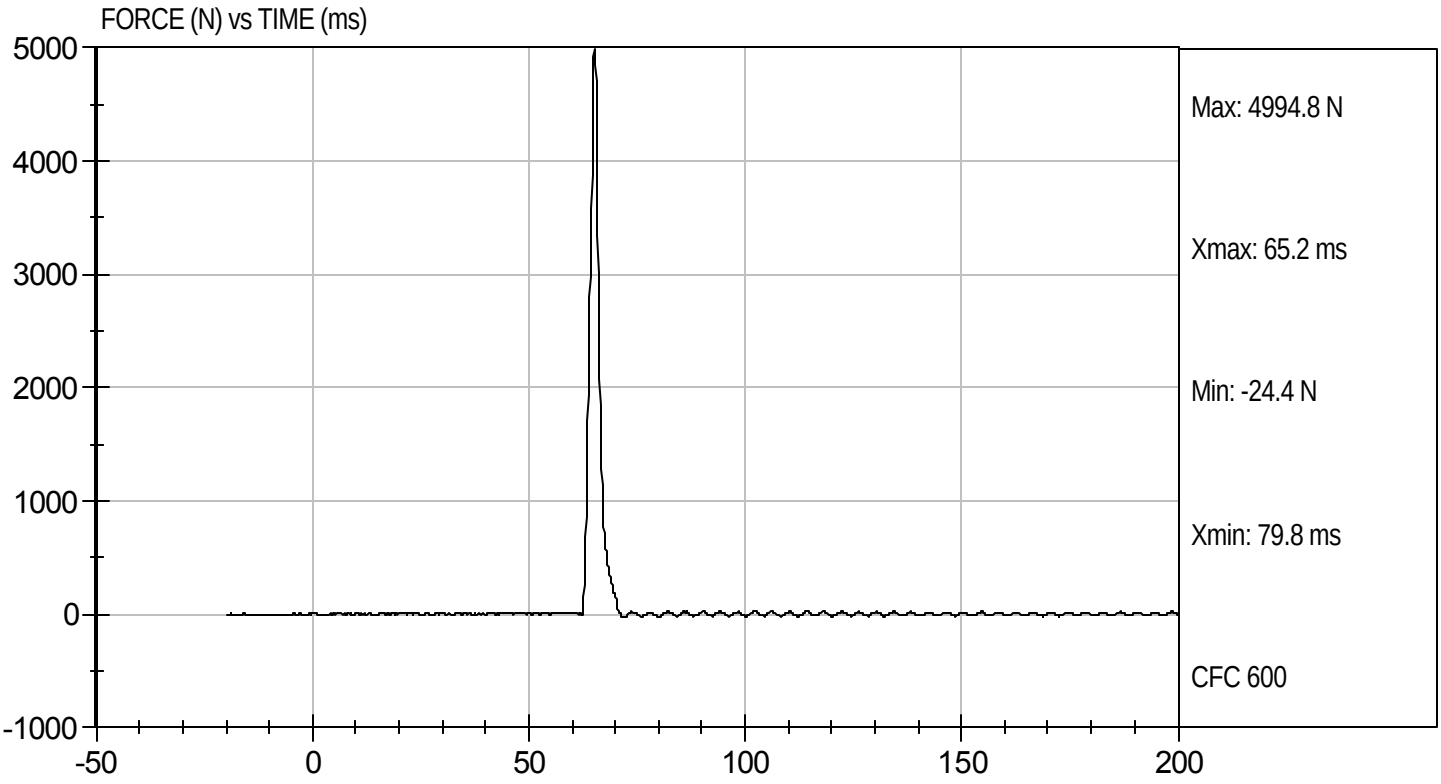
Jessica Hall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Right Knee
Component ID: D092925

Test Date: 11/30/09
Velocity: 6.83 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D092926

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	27	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	5,357	Pass
		Overall Test Results		Pass

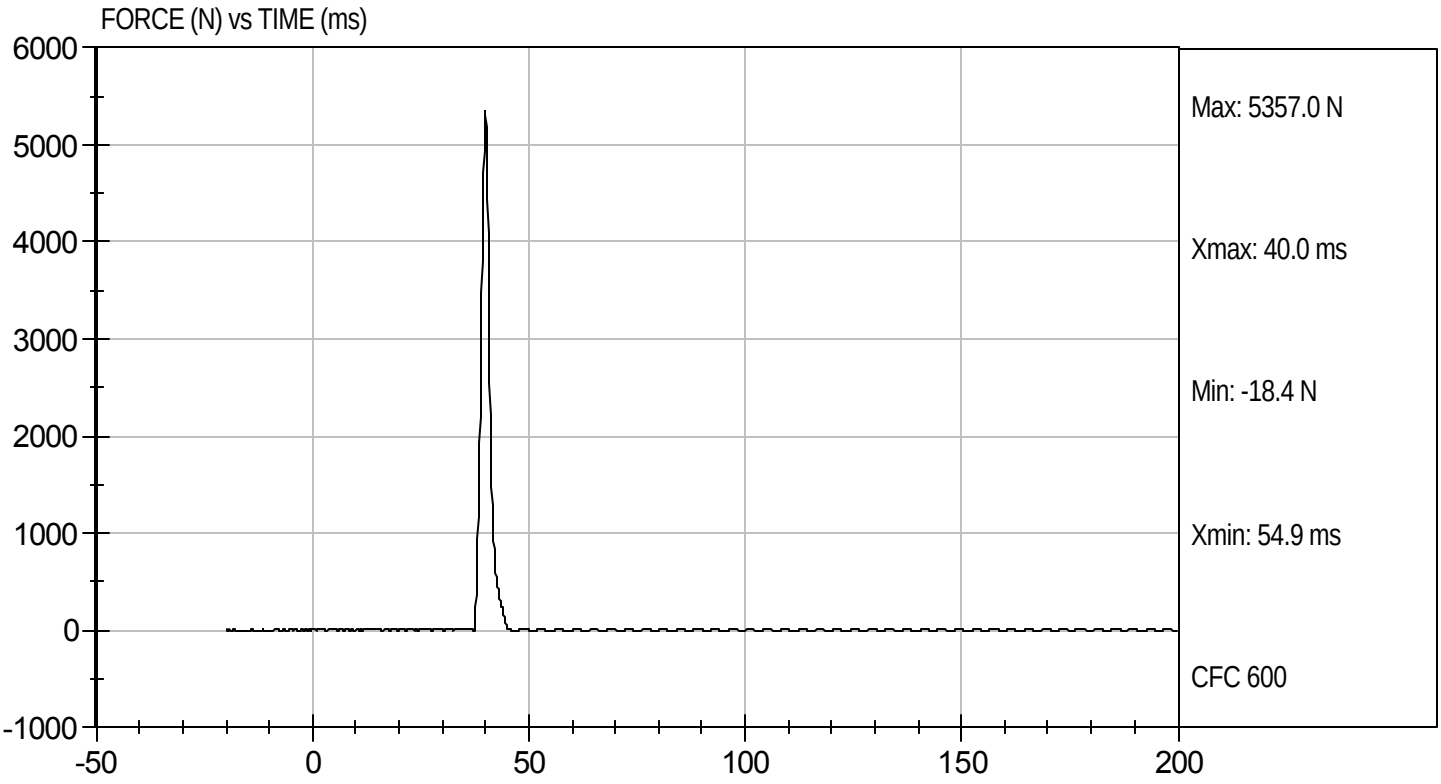
Jessica Gall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Left Knee
Component ID: D092926

Test Date: 11/30/09
Velocity: 6.83 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D092920

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	24	24	Pass
Rotation Rate	deg/s	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	64.7	52.9	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	44	43	Pass
		Overall Test Results			Pass

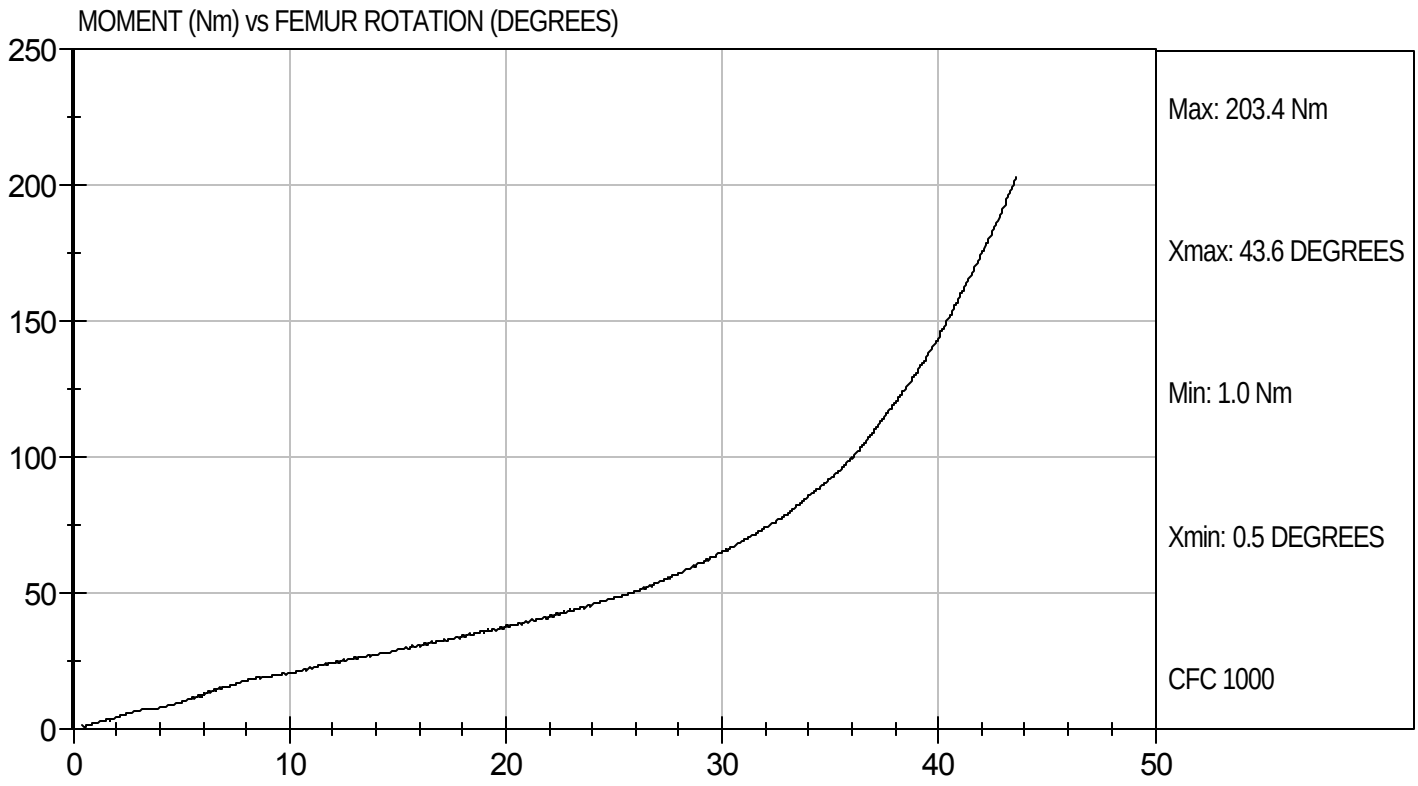
Jessica Hall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

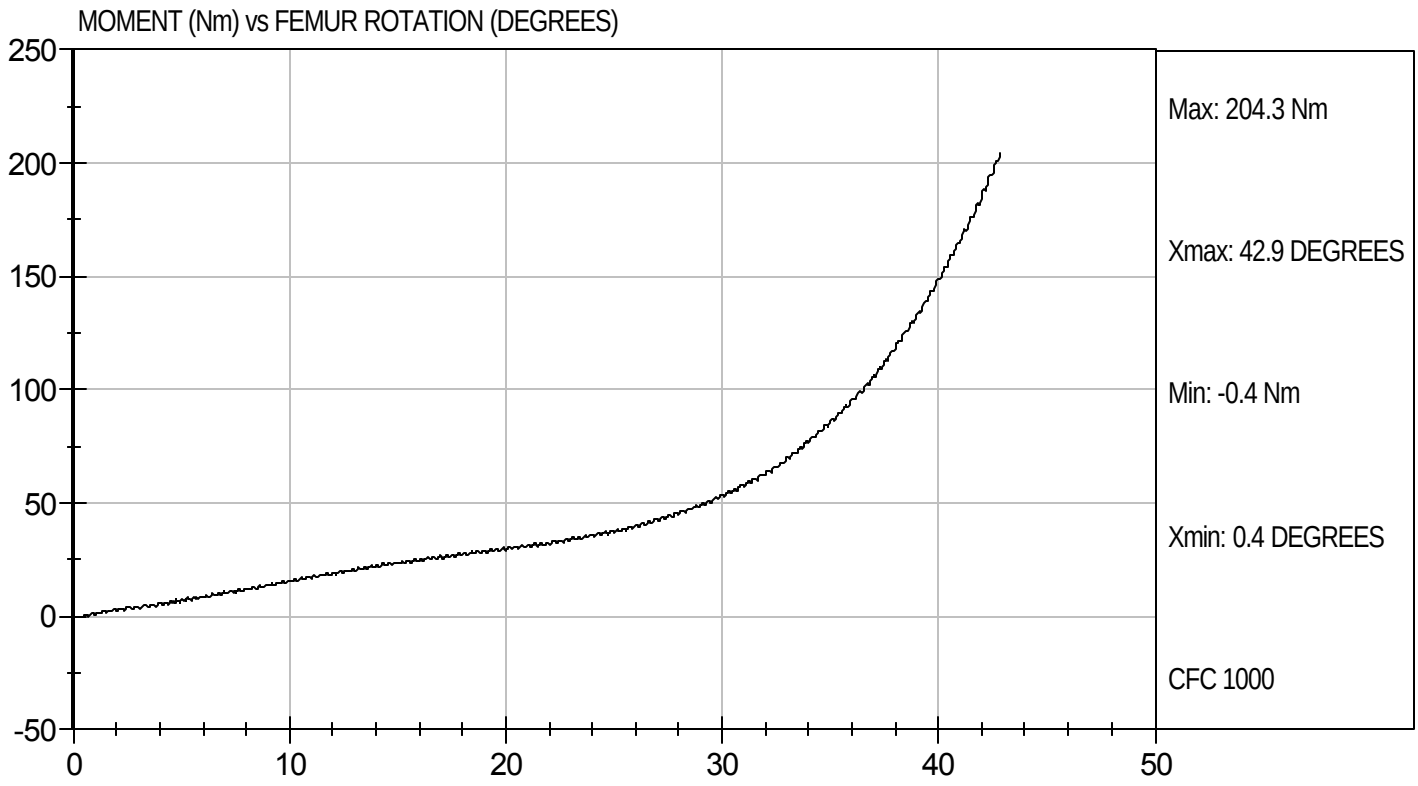
Test Desc: Hip Femur Flexion
Component ID: D092929

Test Date: 11/30/09
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D092920

Test Date: 11/30/09
Velocity: 0 ft/s, 0.00 m/s



MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test ID:** D092931

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Peak Resultant Acceleration	G's	225 - 275	247	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	2.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

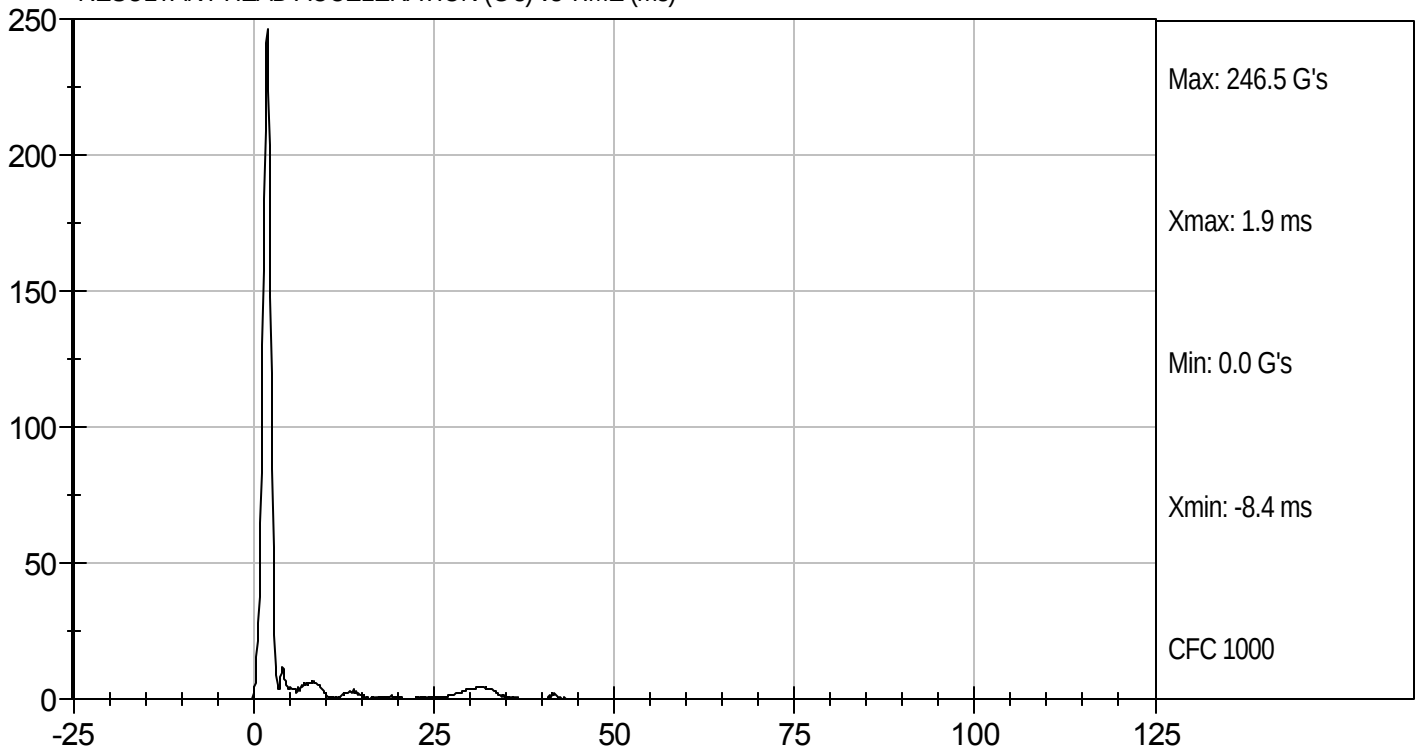
11/30/09
Test Date

David Winkelbauer
Approved By

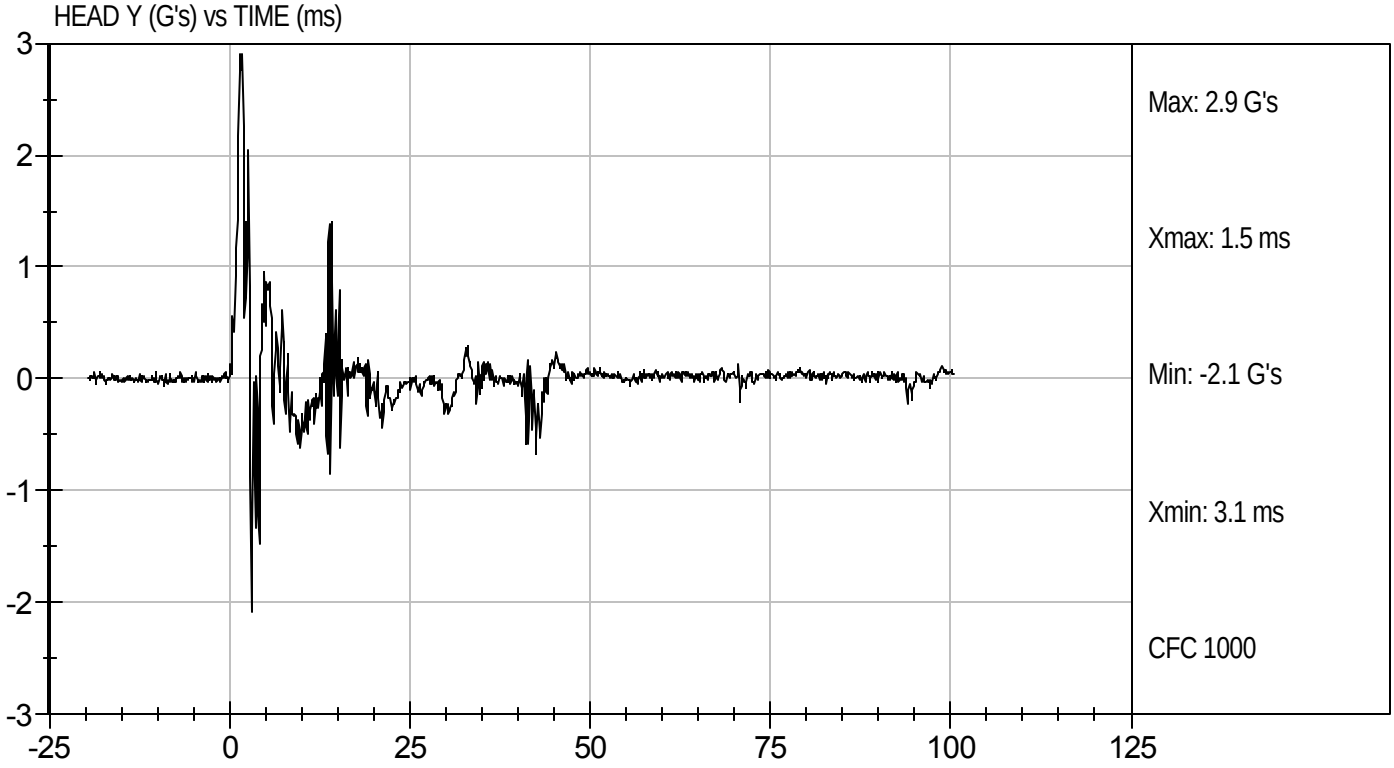
Test Desc: Head Drop
Component ID: D092931

Test Date: 11/30/09
Velocity: 0 ft/s, 0.00 m/s

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



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



MGA RESEARCH CORPORATION

NECK FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D092932

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	m/s	22.50 to 27.50	23.15	Pass
	20 ms	m/s	17.60 to 22.60	19.62	Pass
	30 ms	m/s	12.50 to 18.50	14.23	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 29.0	14.40	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	36.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	74.0	Pass
	Time	ms	57.0 to 64.0	57.2	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	117.2	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	95.7	Pass
	Time	ms	47.0 to 58.0	47.4	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	99.8	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

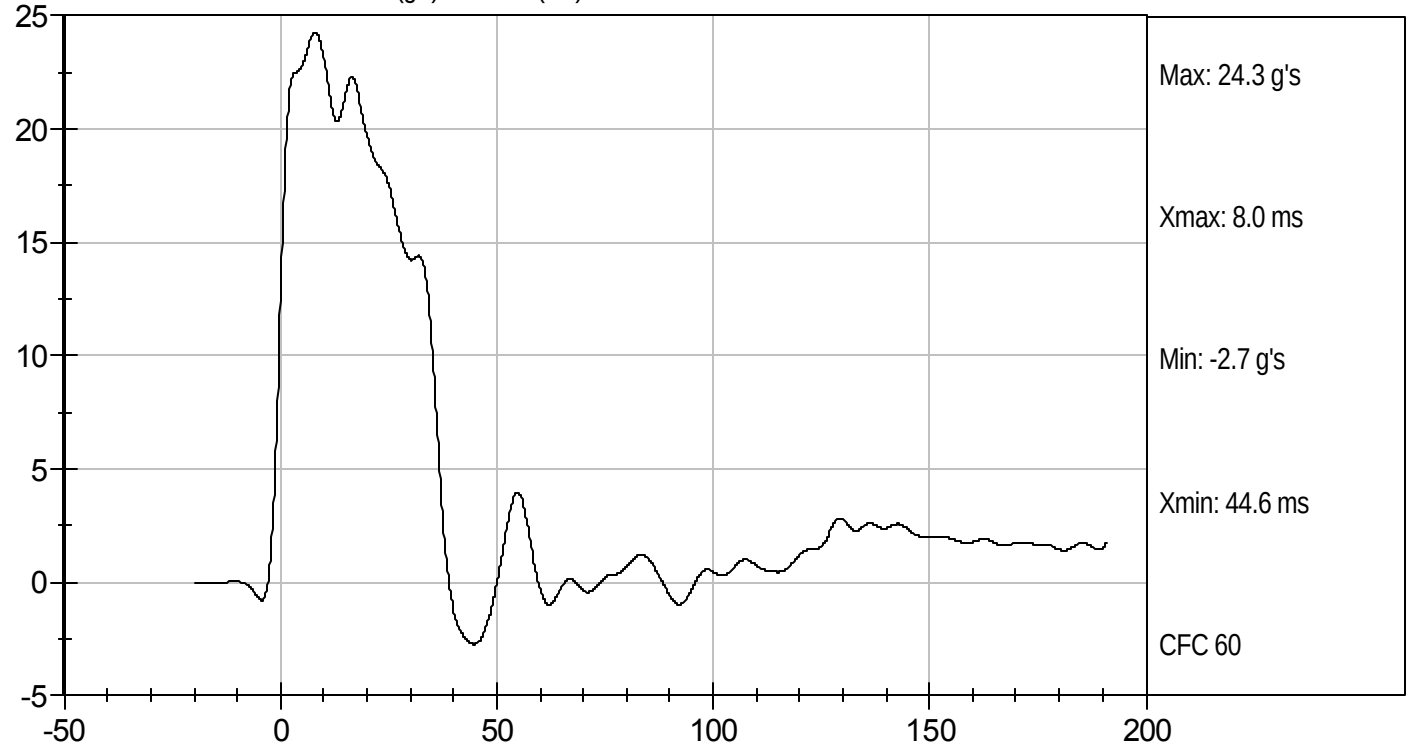
11/30/09
Test Date

David Winkelbauer
Approved By

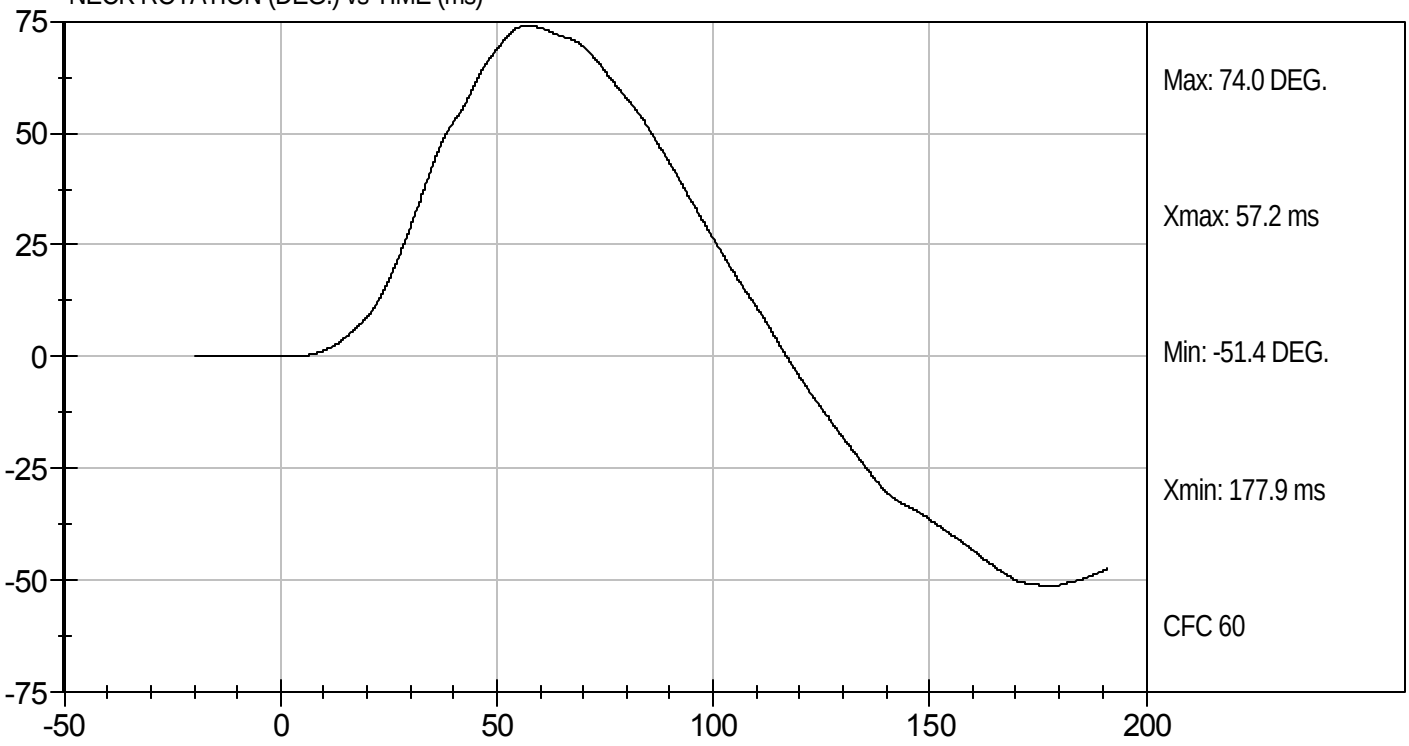
Test Desc: Neck Flexion
Component ID: D092932

Test Date: 11/30/09
Velocity: 23.15 ft/s, 7.06 m/s

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

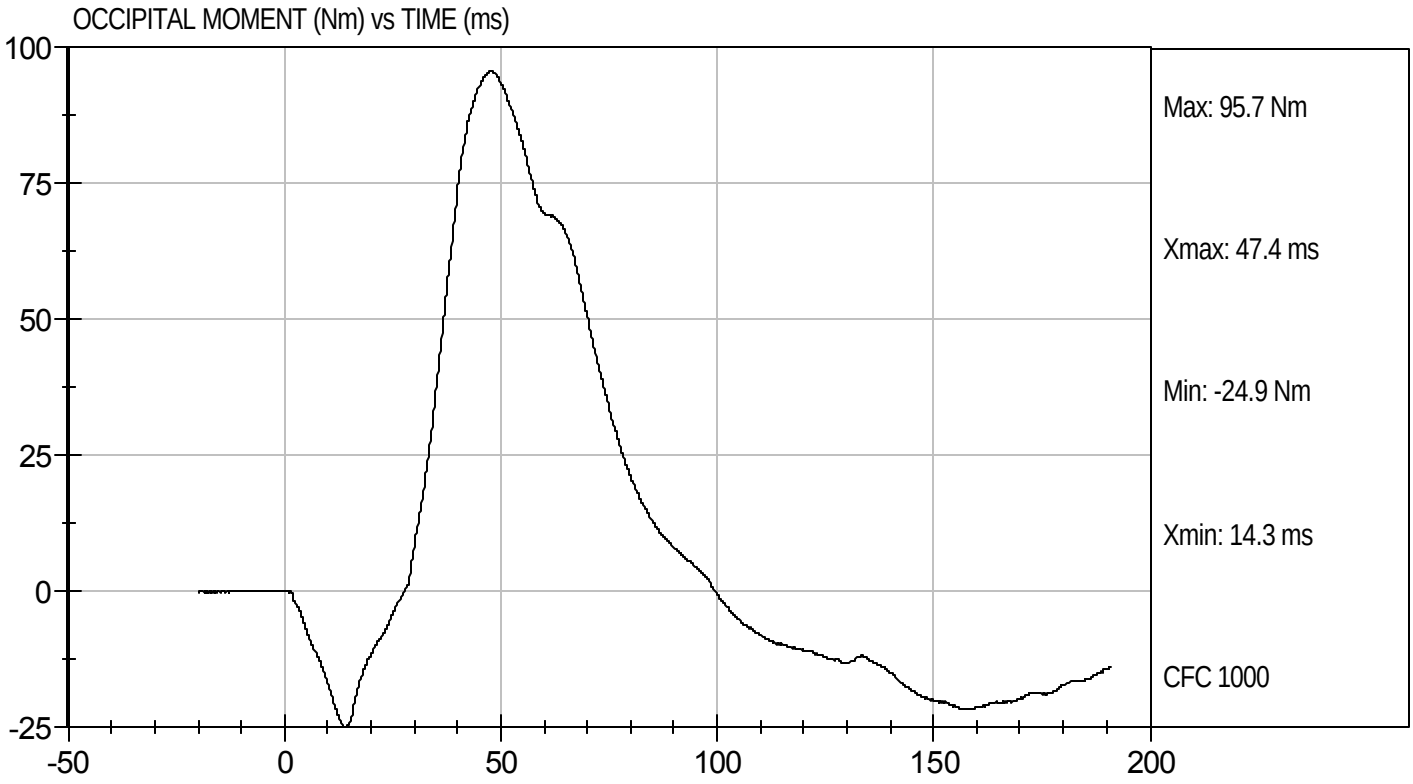


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D092932

Test Date: 11/30/09
Velocity: 23.15 ft/s, 7.06 m/s



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D092933

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.16	Pass
Pendulum Deceleration	10 ms	m/s	17.20 to 21.20	17.79	Pass
	20 ms	m/s	14.00 to 19.00	15.07	Pass
	30 ms	m/s	11.00 to 16.00	11.46	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 22.0	11.55	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	43.9	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.8	Pass
	Time	ms	72.0 to 82.0	77.4	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	-61.3	Pass
	Time	ms	65.0 to 79.0	74.6	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	147.2	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

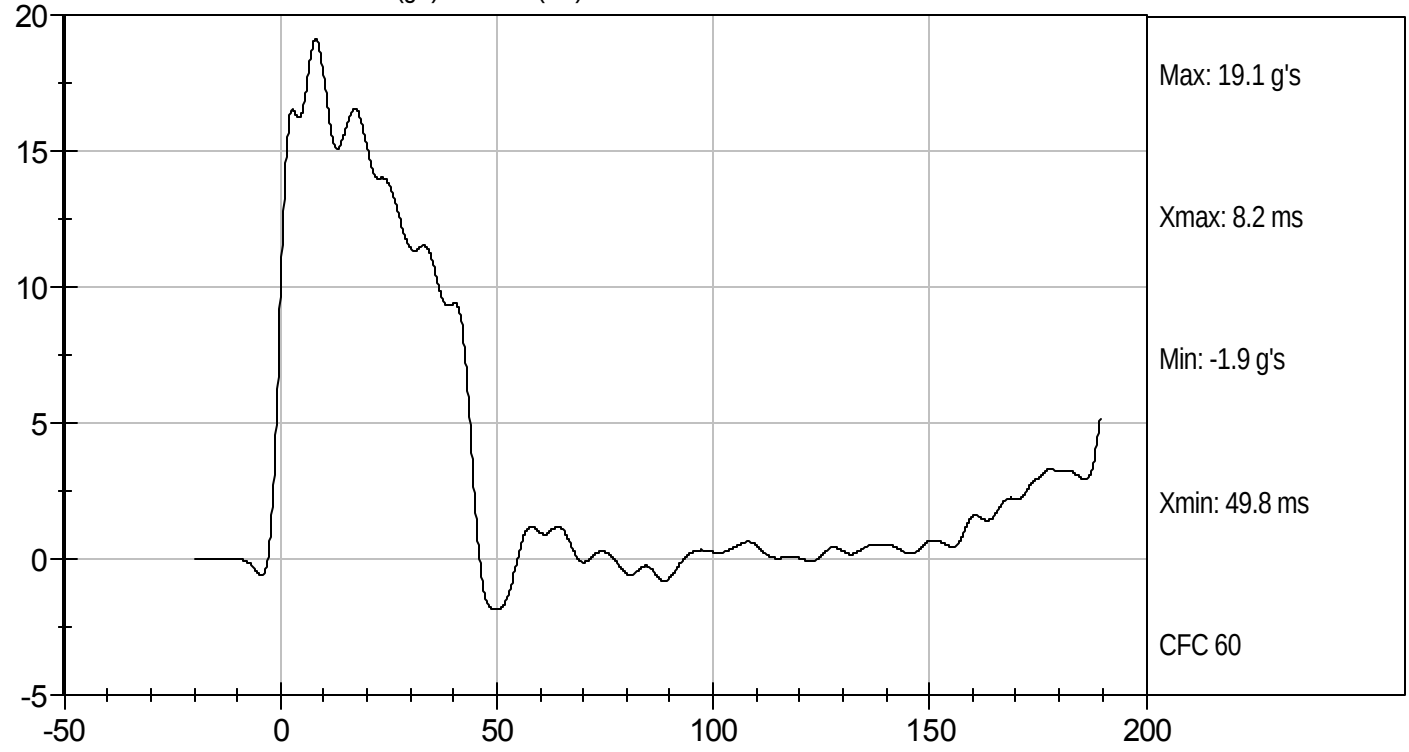
11/30/09
Test Date

David Winkelbauer
Approved By

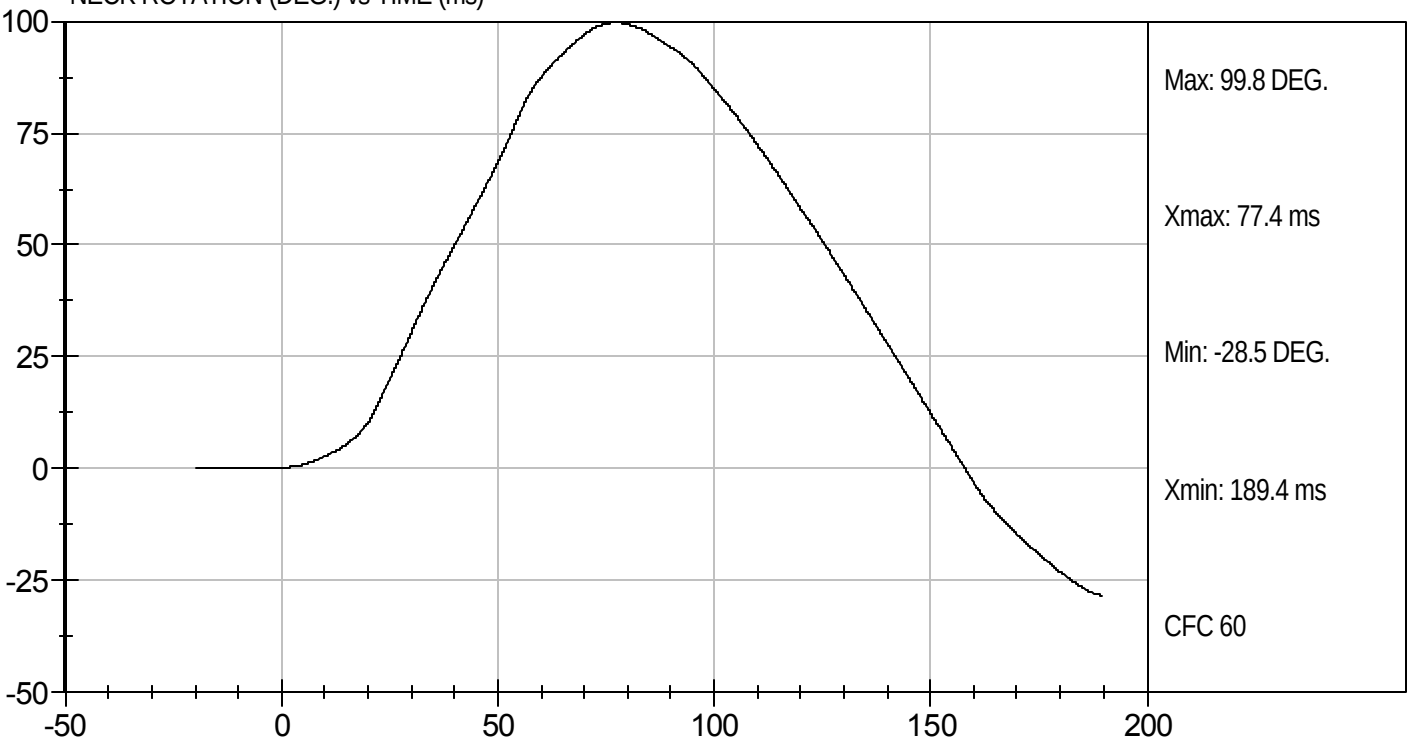
Test Desc: Neck Extension
Component ID: D092933

Test Date: 11/30/09
Velocity: 20.20 ft/s, 6.16 m/s

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

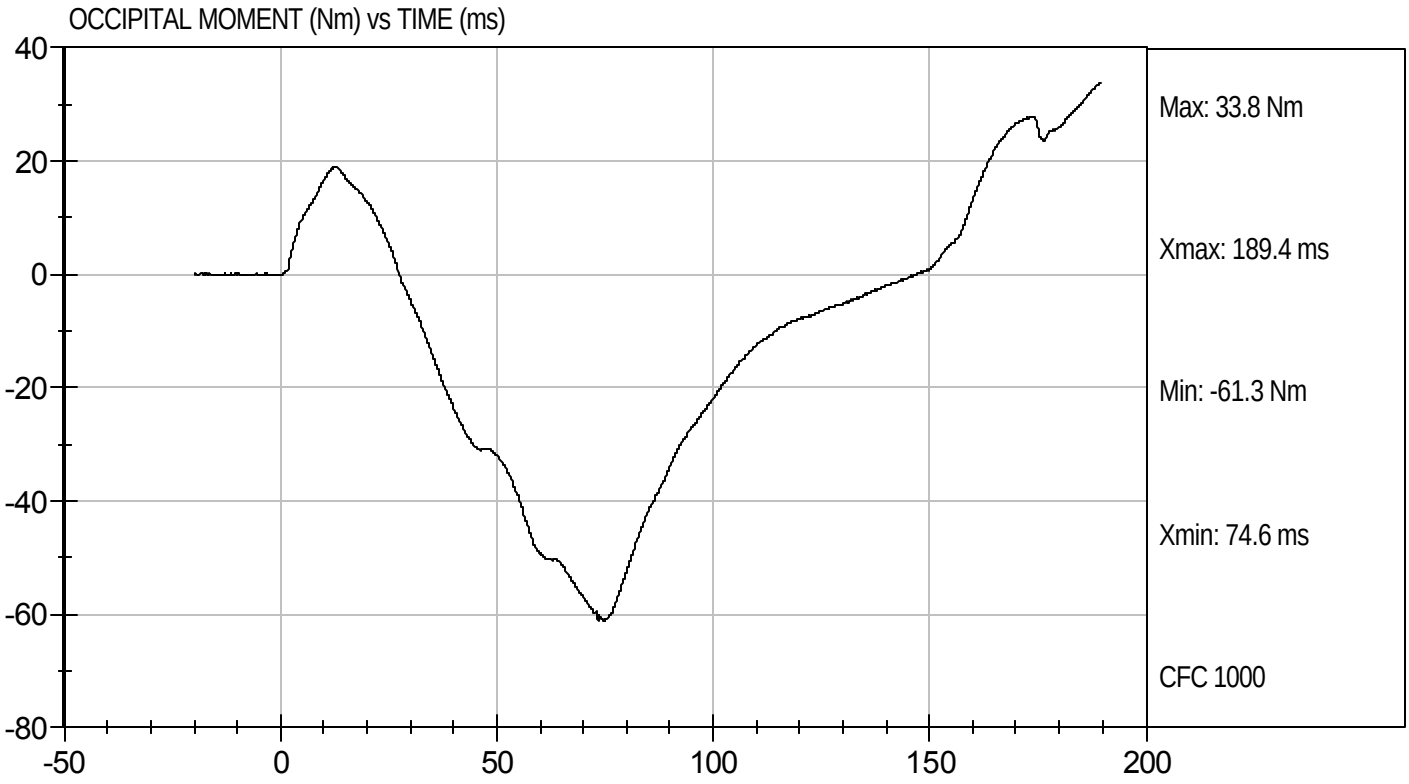


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D092933

Test Date: 11/30/09
Velocity: 20.20 ft/s, 6.16 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D092934

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,419	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.42	Pass
Internal Hysteresis	%	69 to 85	71	Pass
		Overall Test Results		Pass

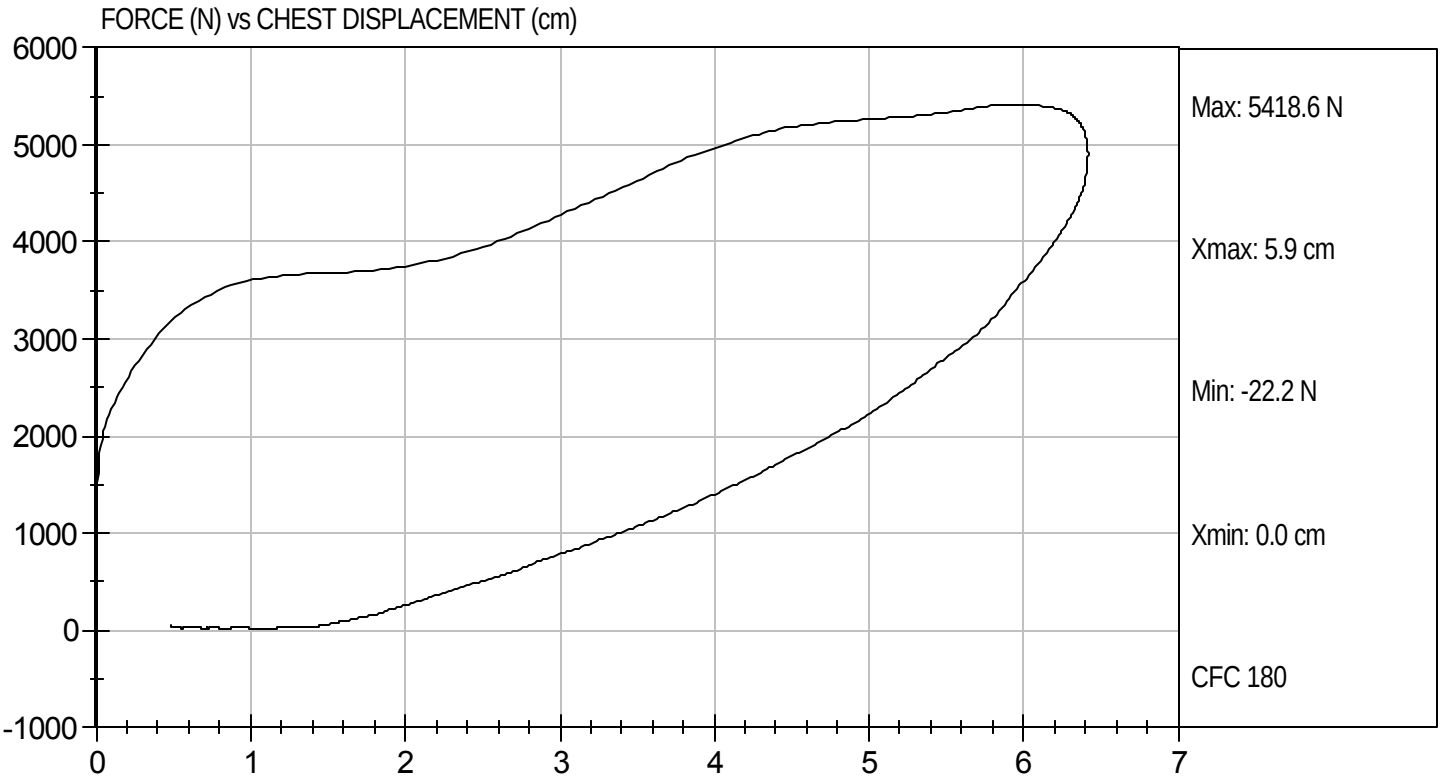
Jessica Hall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Component ID: D092934

Test Date: 11/30/09
Velocity: 21.93 ft/s, 6.68 m/s



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D092935

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.6	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	4,946	Pass
		Overall Test Results		Pass

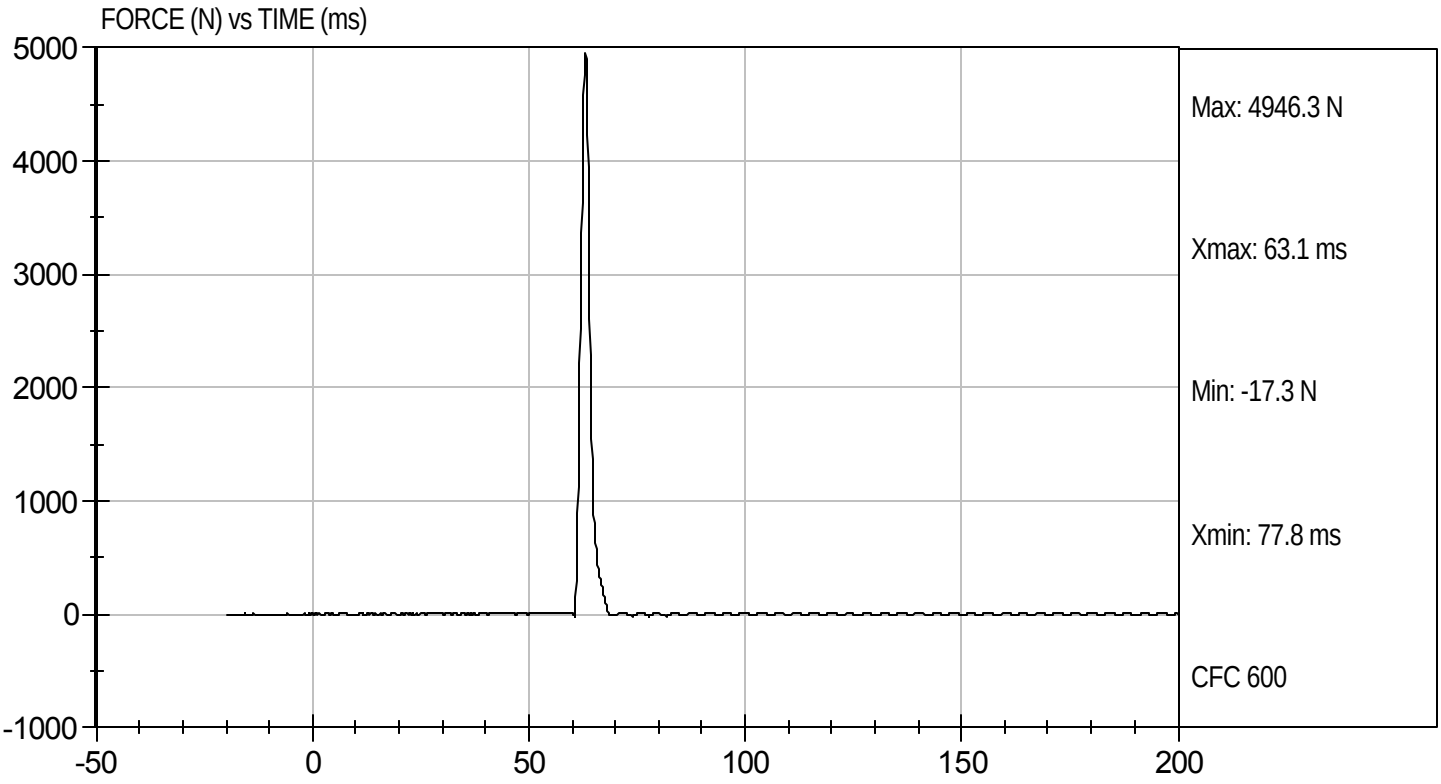
Jessica Hall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Right Knee
Component ID: D092935

Test Date: 11/30/09
Velocity: 6.83 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D092936

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.6	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	4,751	Pass
		Overall Test Results		Pass

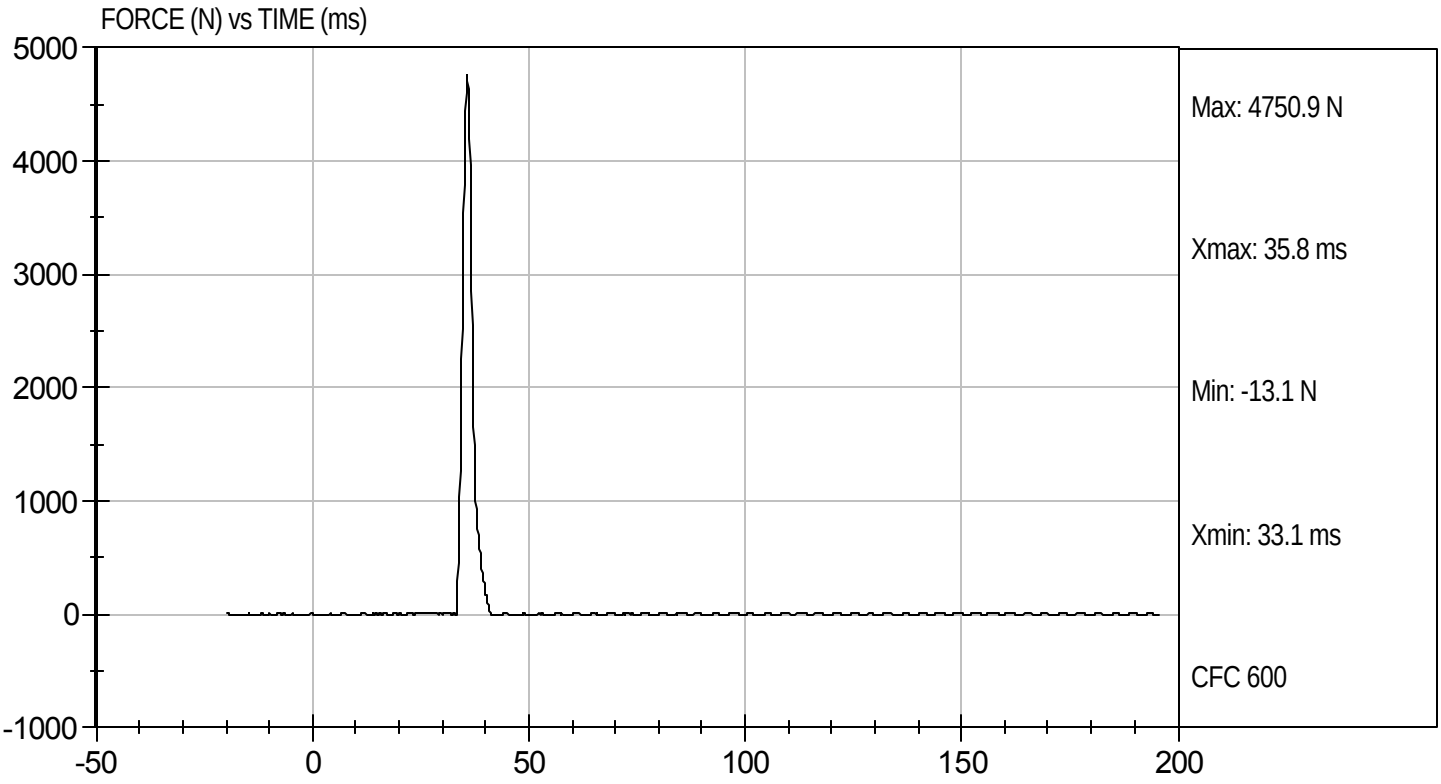
Jessica Gall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Left Knee
Component ID: D092936

Test Date: 11/30/09
Velocity: 6.83 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D092930

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	24	24	Pass
Rotation Rate	deg/s	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	78.5	70.5	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	41	40	Pass
		Overall Test Results			Pass

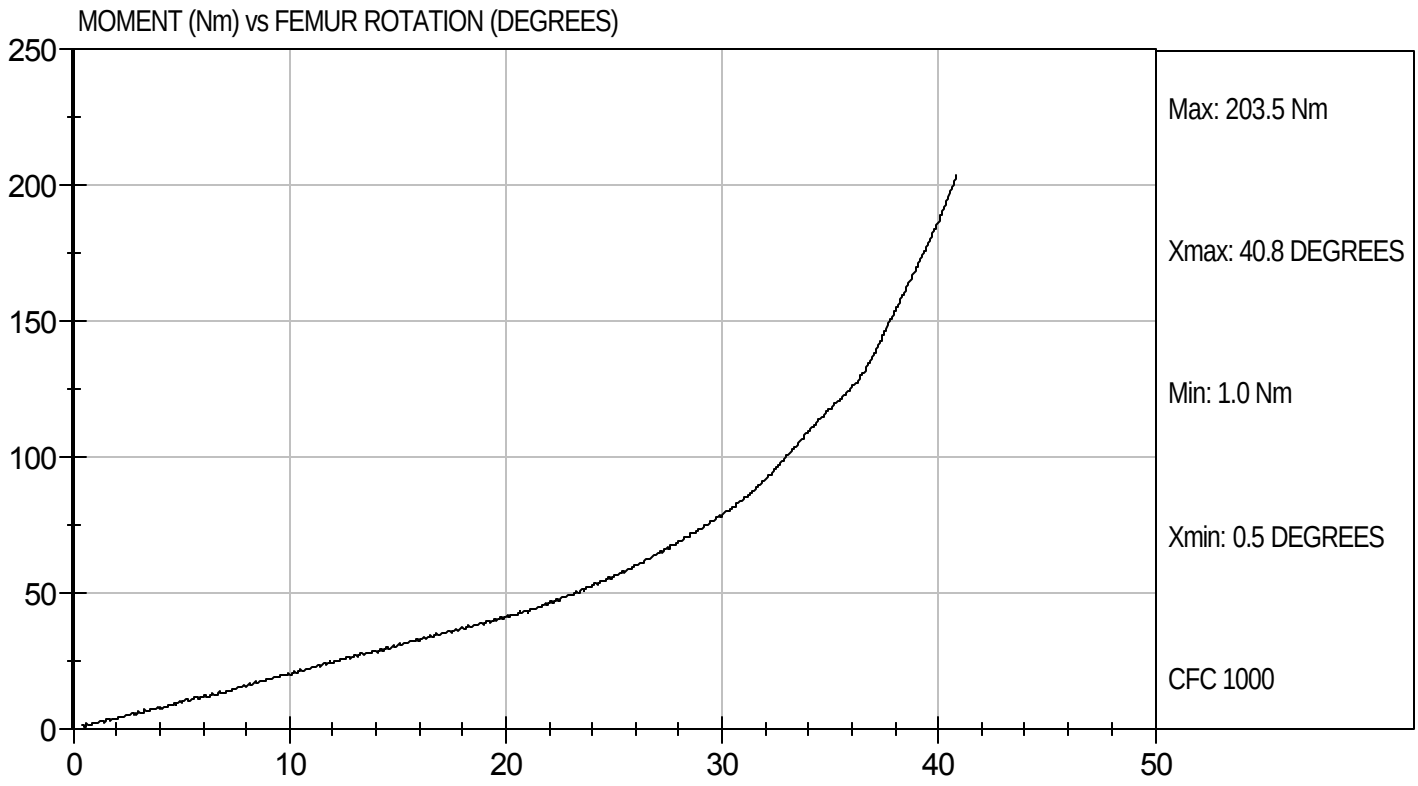
Jessica Hall
Laboratory Technician

11/30/09
Test Date

David Winkelbauer
Approved By

Test Desc: Hip Femur Flexion
Component ID: D092939

Test Date: 11/30/09
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D092930

Test Date: 11/30/09
Velocity: 0 ft/s, 0.00 m/s