

REPORT NUMBER: NCAP-MGA-2009-011

**NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST**

**TOYOTA MOTOR MANUFACTURING, TEXAS, INC.
2010 TOYOTA TUNDRA DOUBLE CAB
NHTSA NUMBER: MA5111**

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



Test Date: June 29, 2009

Final Report Date: July 22, 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**

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Technical Report Documentation Page

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16. Abstract A frontal barrier impact was conducted on a 2010 Toyota Tundra Double Cab at MGA Research Corporation on June 29, 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 56.3 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 515 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: <table border="1" style="width: 100%; margin-top: 10px; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Measurement Description</u></th> <th style="text-align: left;"><u>Units</u></th> <th style="text-align: left;"><u>Threshold</u></th> <th style="text-align: left;"><u>Driver ATD</u></th> <th style="text-align: left;"><u>Pass. ATD</u></th> </tr> </thead> <tbody> <tr> <td>Head Injury Criteria (HIC₃₆)</td> <td>N/A</td> <td>1000</td> <td>362</td> <td>432</td> </tr> <tr> <td>Max. Thorax Accel. (3ms Clip)</td> <td>G's</td> <td>60</td> <td>37</td> <td>39</td> </tr> <tr> <td>Left Femur Force</td> <td>Newton</td> <td>10009</td> <td>-2223</td> <td>-2498</td> </tr> <tr> <td>Right Femur Force</td> <td>Newton</td> <td>10009</td> <td>-1955</td> <td>-3140</td> </tr> </tbody> </table>				<u>Measurement Description</u>	<u>Units</u>	<u>Threshold</u>	<u>Driver ATD</u>	<u>Pass. ATD</u>	Head Injury Criteria (HIC ₃₆)	N/A	1000	362	432	Max. Thorax Accel. (3ms Clip)	G's	60	37	39	Left Femur Force	Newton	10009	-2223	-2498	Right Femur Force	Newton	10009	-1955	-3140
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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 Toyota Tundra Double Cab at a velocity of 56.3 kph. The test was performed at MGA Research Corporation on June 29, 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 102 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 515 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 bag. The passenger's head and chest contacted the airbag. The passenger's knees contacted the knee bag.

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	362	69.1	105.1	37	66.6	69.6	-15	-2223	-1955
Passenger	432	69.3	105.3	39	77.3	81.5	-23	-2498	-3140

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

TEST NOTES

There was no valid data collected for:
Driver Pelvis X, Y, and Z after 50 msec.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
CRASH TEST SUMMARY

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

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)	None	None
Seat Back Failure	None	None
Glazing Damage	None	

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	1765
Center	mm	1665
Right Side	mm	1695
Average	mm	1708

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	912	915
Lap belt length as measured on ATD	mm	875	900
Remainder of belt on reel	mm	1563	1535
Total belt length for continuous webbing systems	mm	3350	3350

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

TEST VEHICLE INFORMATION

Manufacturer	Toyota
Model	Tundra
Body Style	Double Cab
NHTSA No.	MA5111
VIN	5TFUW5F15AX094611
Color	Black
Delivery Date	6/02/2009
Odometer Reading (mile)	79
Dealer	Andrew Toyota
Transmission	Automatic
Final Drive	4WD
Number of Cylinders	8
Engine Displacement (L)	5.7
Engine Placement	Longitudinal
Automatic Door Lock (ADL)	Yes
Owners Manual Details Instructions on Disabling ADLs	Yes
Bucket Seats	Yes

TEST VEHICLE OPTIONS

Front Airbag	Yes
Driver Side Curtain Airbag	Yes
Driver Side Torso Airbag	Yes
Rear Passenger Side Curtain Airbag	Yes
Rear Passenger Side Torso 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	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Manufacturing, Texas, Inc.
Date of Manufacture	04/09

GVWR (kg)	3220
GAWR Front (kg)	1810
GAWR Rear (kg)	1880

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				655
Cargo Wt. (RCLW) (kg)				136

DATA SHEET NO. 2... (CONTINUED)
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	757.5	530.2		799.3	627.3	
Right	kg	714.9	498.5		761.1	598.8	
Ratio	%	58.9	41.1		56.0	44.0	
Totals	kg	1472.4	1028.7	2501.1	1560.4	1226.1	2786.5

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	2501.1
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	136
Calculated Vehicle Target Weight (TVTW)	kg	2793.1

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	939	949	1023	1030	1524
As Tested	mm	935	934	1000	1006	1631
Post Test	mm	994	966	1003	969	

Vehicle Wheelbase (mm): 3706

Weight of Ballast secured in bed of truck (kg): 79.4

Vehicle Components Removed: None

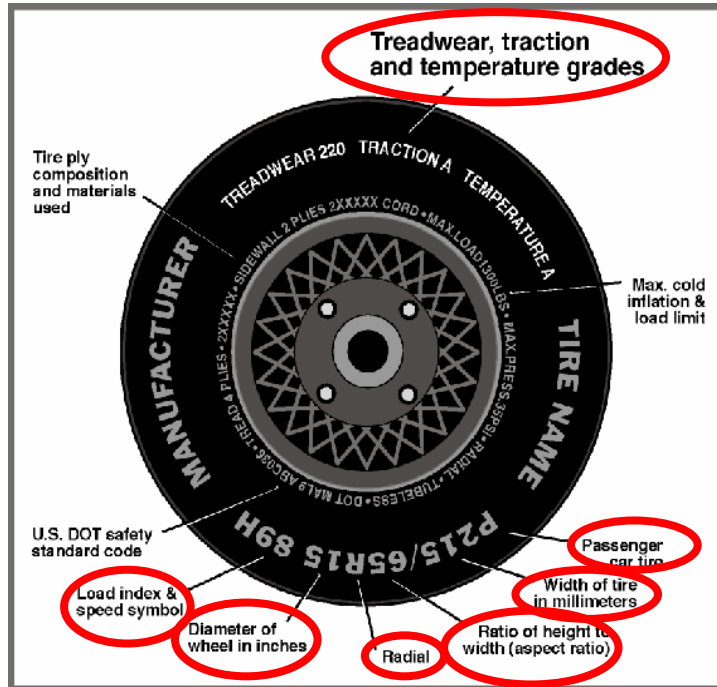
Ballast weight does not include instrumentation and data acquisition system.

DATA SHEET NO. 3

TEST VEHICLE TIRE INFORMATION

Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009



DATA FROM TIRE AND TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	450	450
Cold Pressure (kPa)	275	275
Recommended Tire Size	LT285/70R17	LT285/70R17
Tire Size on Vehicle	LT285/70R17	LT285/70R17
Tire Manufacturer	BF Goodrich	BF Goodrich
Tire Name	All-Terrain T/A	All-Terrain T/A
Tire Type	Light Truck	Light Truck
Tire Width (mm)	285	285
Ratio of Height to Width (aspect ratio)	70	70
Radial	R	R
Wheel Diameter	17	17
Load Index & Speed Symbol	118R	118R
Treadwear		
Traction Grade		
Temperature Grade		

DATA SHEET NO. 4 **TEST VEHICLE INFORMATION**

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

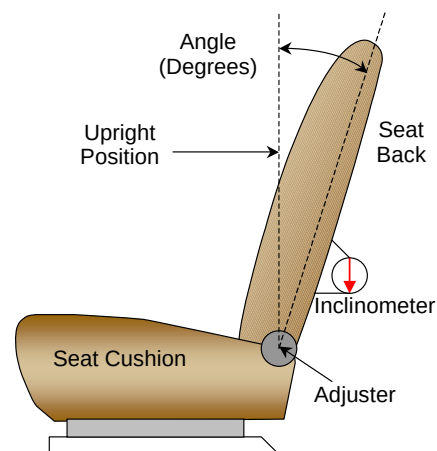
NHTSA No.: MA5111
 Test Date: 6/29/2009

NORMAL DESIGN RIDING POSITION

The driver and passenger seat back is positioned to the manufacturer's designated angle. The procedure is as follows: Set the seat back angles at 1degree (measured from upright position and at headrest post).

Driver seat back angle: 1.2° on headrest post

Passenger seat back angle: 0.3° on headrest post



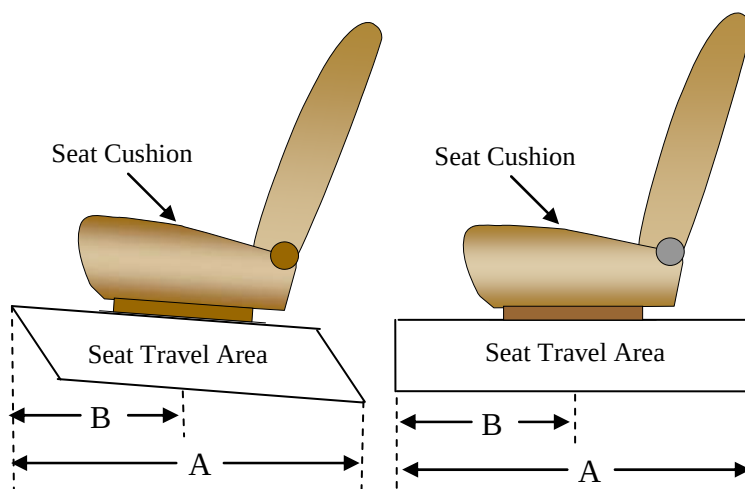
FRONT SEAT ASSEMBLY

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	15 detents	6 th detent (forward-most as 0)
Passenger Seat	15 detents	7 th detent (forward-most as 0)

ADJUSTABLE D-RING POSITION

The driver and passenger D-rings were placed in the 1st detent (uppermost as 0).



DATA SHEET NO. 4...(CONTINUED)

TEST VEHICLE INFORMATION

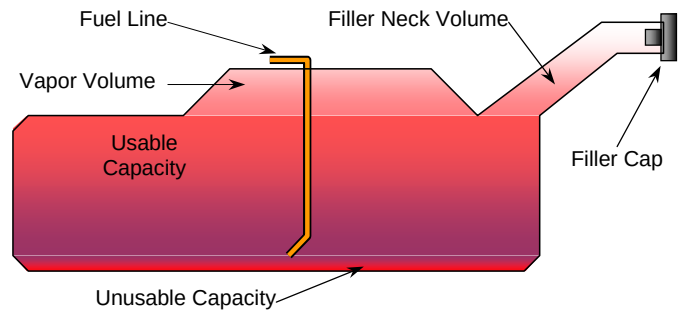
Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	99.9
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	91.9 to 93.9
Actual Amount of Solvent used	92.7
1/3 of Usable Capacity	33.3

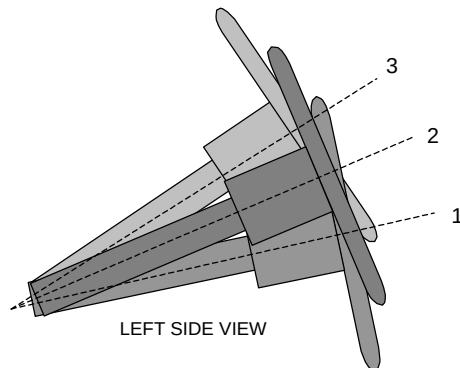
The test vehicle is equipped with an electric fuel pump. The fuel pump will pump fuel when the ignition is on. The fuel pipe is on the left side.



VEHICLE FUEL TANK ASSEMBLY

STEERING COLUMN ADJUSTMENT

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



STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONS

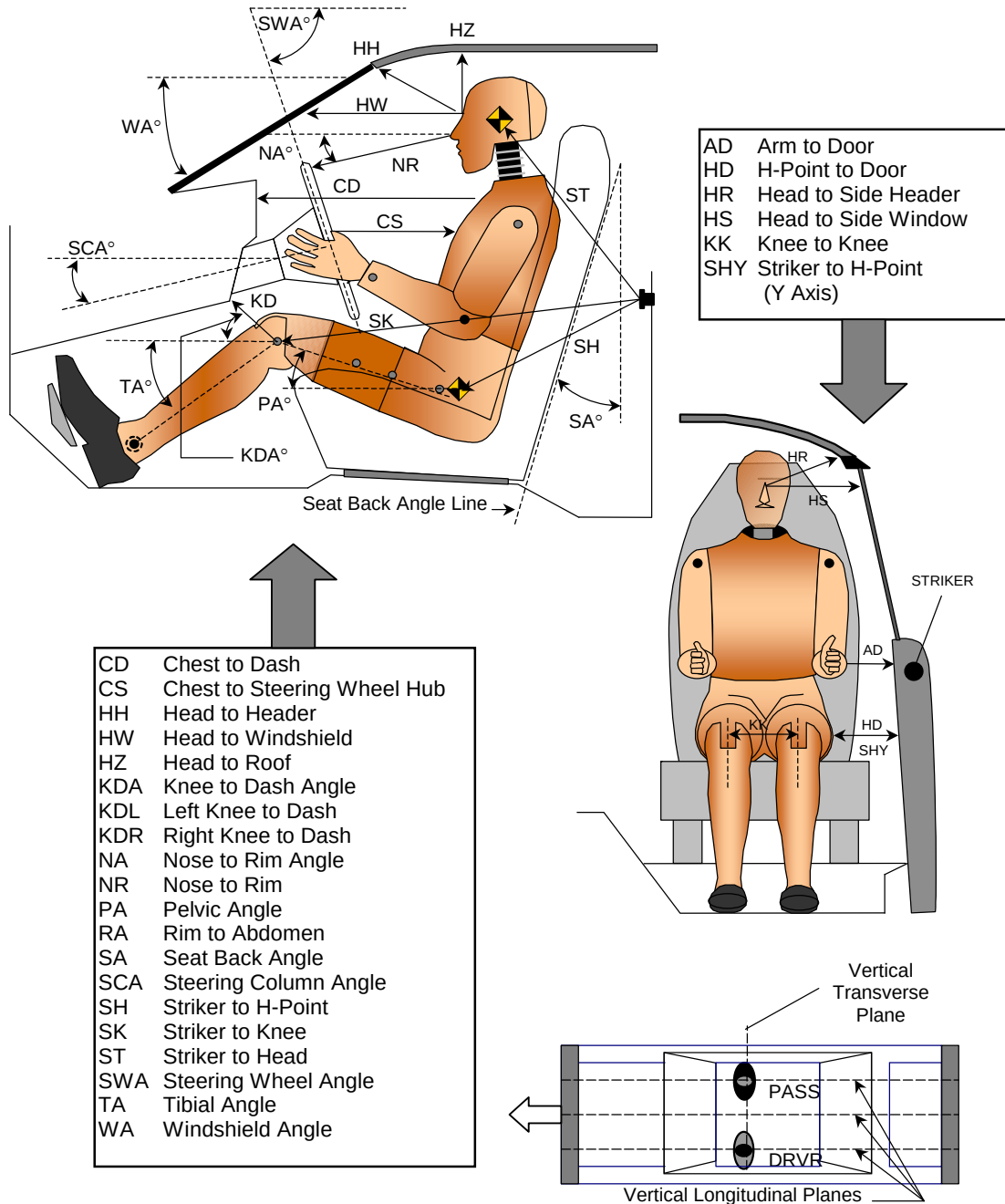
	Fore/Aft Position (mm)	Degrees
Lowermost position No. 1	155	58.6
Geometric center position No. 2	175	61.7
Uppermost position No. 3	195	64.9

DATA SHEET NO. 5 **DUMMY POSITIONING IN VEHICLE**

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



DATA SHEET NO. 5... (CONTINUED)

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

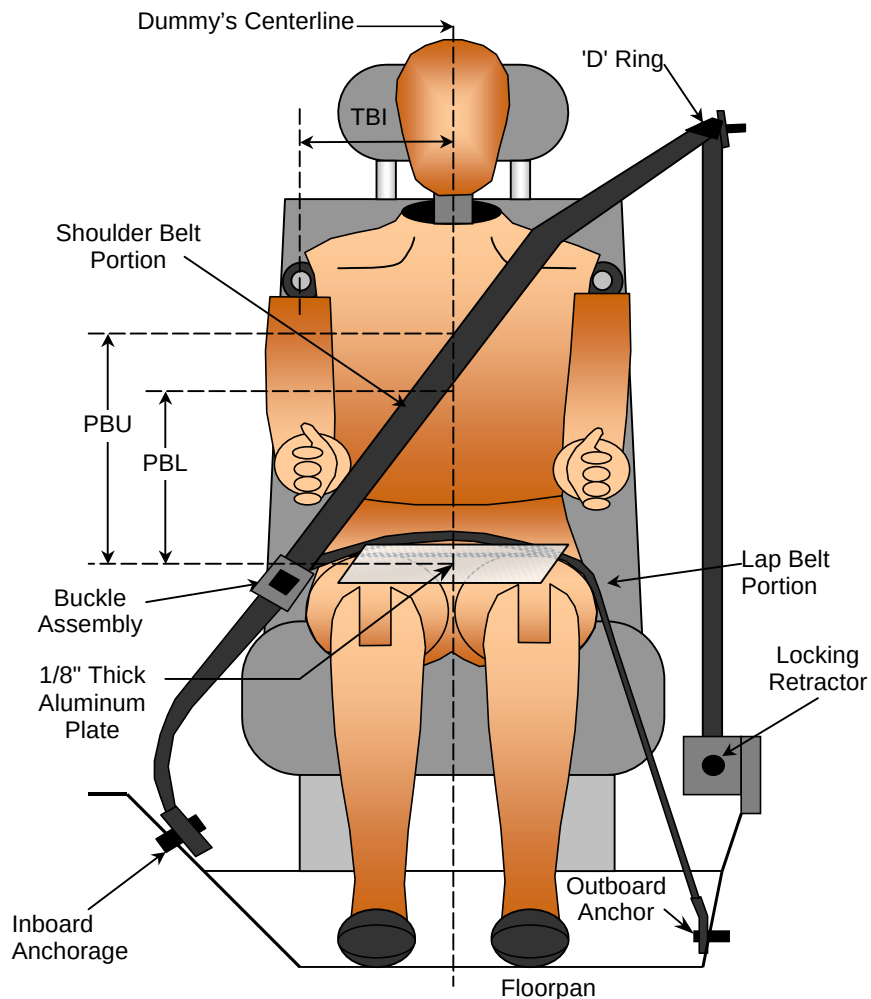
TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		34.2		
SWA	Steering Wheel Angle		61.7		
SCA	Steering Column Angle		30.0		
SA	Seat Back Angle (headrest post)		1.2		0.3
HZ	Head to Roof (Z)	236	90	208	90
HH	Head to Header	462	19.7	449	12.7
HW	Head to Windshield	678	0	674	0
HR	Head to Side Header (Y)	233		227	
NR	Nose to Rim	423	11.9		
CD	Chest to Dash	555		555	
CS	Chest to Steering Hub	330	7.2		
RA	Rim to Abdomen	208	0		
KDL	Left Knee to Dash	162	23.8	140	
KDR	Right Knee to Dash	149		150	20.2
PA	Pelvic Angle		24.7		24.7
TA	Tibia Angle		53.6		50.3
KK	Knee to Knee (Y)	242		275	
SK	Striker to Knee	664	97.0	727	98.7
ST	Striker to Head	502	19.4	525	20.2
SH	Striker to H-Point	292	125.7	296	117.9
SHY	Striker to H-Point (Y)	295		305	
HS	Head to Side Window	324		310	
HD	H-Point to Door (Y)	187		171	
AD	Arm to Door (Y)	122		142	
AA	Ankle to Ankle	280		195	

DATA SHEET NO. 6 **SEAT BELT POSITIONING DATA**

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	330	330
PBL - To surface of reference to belt lower edge	mm	250	250

DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS

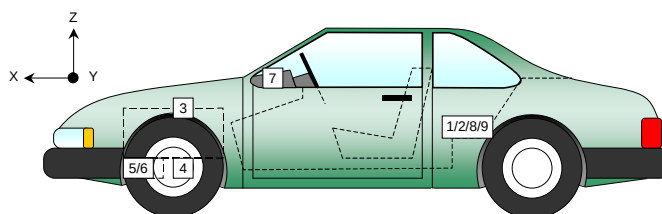
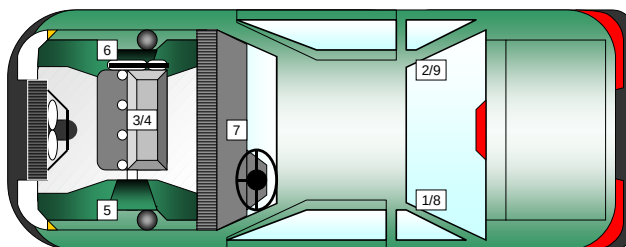
Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear X-Member X	2802	-432	700
2	Right Rear X-Member X	2802	432	700
3	Engine Top X	4935	0	1133
4	Engine Bottom X	4739	0	318
5	Left Brake Caliper X	4767	-785	305
6	Right Brake Caliper X	4767	785	304
7	Instrument Panel X			
8	Left Rear X-Member Z	2802	-432	700
9	Right Rear X-Member Z	2802	432	700

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



DATA SHEET NO. 8

SUMMARY OF FMVSS 212 AND FMVSS 219 (Partial) DATA

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

Windshield Mounting Details:

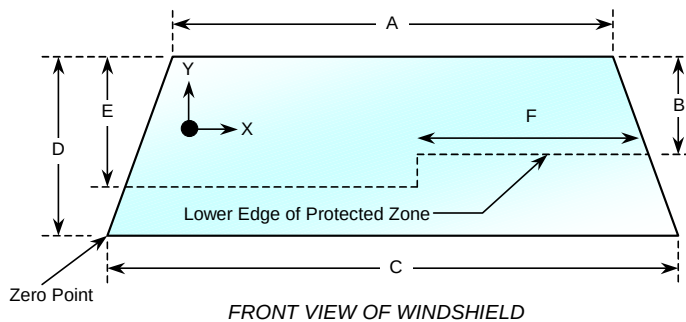
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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	2328	2328	100
Right Side	2328	2328	100
Total	4656	4656	100



Item	Units	Value
A	mm	1388
B	mm	437
C	mm	1660
D	mm	804
E	mm	511
F	mm	596

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 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

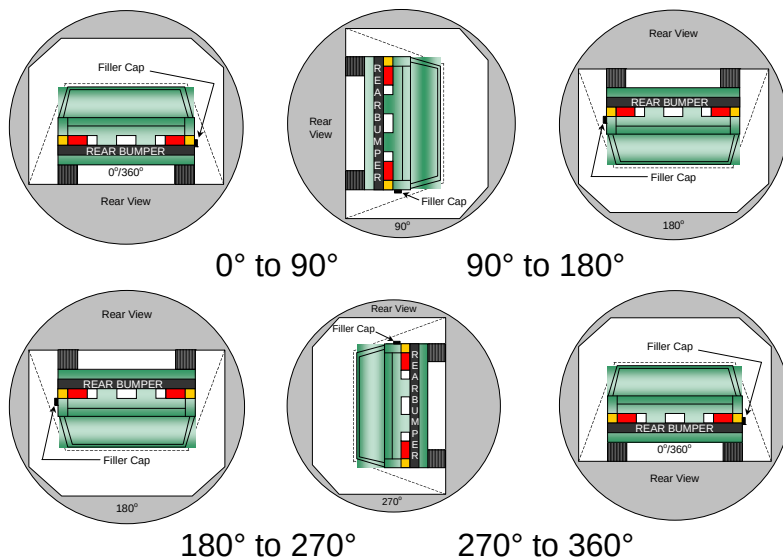
FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21° C Test Time: 10:16 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



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°	118	300	0
90° to 180°	107	300	0
180° to 270°	119	300	0
270° to 360°	107	300	0

DATA SHEET NO. 10
VEHICLE MEASUREMENTS

Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total length of vehicle at centerline	mm	5811	5296	515
2	RSOV to front of engine	mm	5224	5181	43
3	RSOV to firewall centerline	mm	4572	4561	11
4	RSOV to leading edge of right door	mm	4359	4442	-83
5	RSOV to leading edge of left door	mm	4363	4433	-70
6	RSOV to lower leading edge of right door	mm	4262	4331	-69
7	RSOV to lower leading edge of left door	mm	4275	4230	45
8	RSOV to upper leading edge of right door	mm	3199	3281	-82
9	RSOV to upper leading edge of left door	mm	3201	3271	-70
10	RSOV to lower trailing edge of right door	mm	3179	3241	-62
11	RSOV to lower trailing edge of left door	mm	3181	3231	-50
12	RSOV to bottom of right 'A' pillar	mm	4262	4244	18
13	RSOV to bottom of left 'A' pillar	mm	4275	4328	-53
14	RSOV to firewall on right side	mm	4557	4612	-55
15	RSOV to firewall on left side	mm	4554	4624	-70
16	RSOV to steering column	mm	3866	3964	-98
17	Center of steering column to left 'A' pillar	mm	392	398	-6
18	Center of steering column to headlining	mm	440	471	-31
19	RSOV to right side of front bumper	mm	5696	5266	430
20	RSOV to left side of front bumper	mm	5696	5270	426
21	Length of engine block	mm	548	548	0
RD	RSOV to right side of dash panel	mm	4083	4162	-79
CD	RSOV to center of dash panel	mm	4111	4196	-85
LD	RSOV to left side of dash panel	mm	4065	4126	-61

Note: Vehicle cab moved 66 mm forward of frame mount.

DATA SHEET NO. 10... (continued)

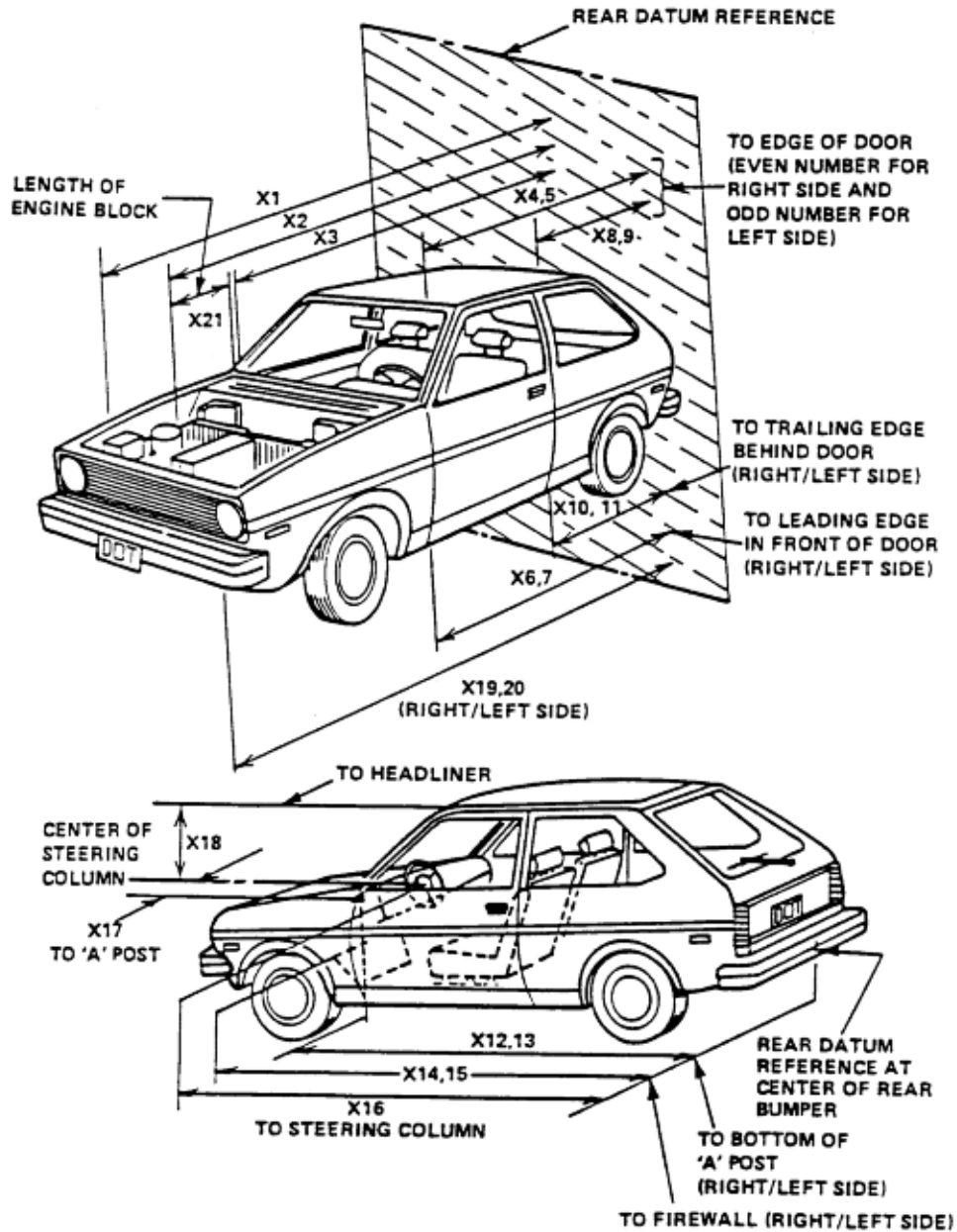
VEHICLE MEASUREMENTS

Test Vehicle: 2010 Toyota Tundra Double Cab

NHTSA No.: MA5111

Test Program: 35mph Frontal Impact

Test Date: 6/29/2009



DATA SHEET NO. 10... (continued)**VEHICLE MEASUREMENTS**

Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009

Target Vehicle Structural Measurement

	Elements	Pre-Test (mm)
1	Total Length	5811
2	Total Width	2031
3	Bumper Top Height	563
4	Bumper Bottom Height	427
5	Longitudinal Member Top Height	552
6	Distance between Longitudinal Members	786
7	Longitudinal Member Width	71
8	Engine Top Height	1125
9	Engine Bottom Height	322
10	Engine and gearbox width	1714
11	Front bumper-engine distance	559
12	Front shock absorber fixing height	839
13	Bonnet leading edge height	1154
14	Front shock absorber fixing width	925
15	Front bumper – front axle distance	900
16	Front axle – a pillar distance	566
17	A-pillar – B-pillar distance	1163
18	B-Pillar – rear axle distance	1994
19	B-pillar – C-pillar distance	844
20	Roof sill bottom height	1764
21	Roof sill top height	1882
22	Floor sill bottom height	402
23	Floor sill top height	543

DATA SHEET NO. 11
CAMERA LOCATIONS

Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009

No.	Camera View	Location (mm) *			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View				13	24
2	Left Front View	1670	-6470	1250	24	1000
3	Steering Column Top	780	-5510	1260	25	1000
4	Steering Column Bottom	780	-5450	850	25	1000
5	Driver Close-up	1410	-7210	1660	35	1000
6	Driver Angle	5940	-4900	1870	50	1000
7	On board Driver Side					
8	On board Passenger Side					
9	Right Overall	2360	7110	1230	20	1000
10	Right Passenger Half	1730	6540	1260	24	1000
11	Right Close-up	1370	7120	1600	35	1000
12	Right Angle	5560	4760	1840	50	1000
13	Windshield	-285	0	2860	12.5	1000
14	Top Driver	-135	-470	2180	24	1000
15	Top Passenger	-110	420	2180	24	1000
16	Pit Front	1250	0	-3150	24	1000
17	Pit Rear	1620	0	-3150	24	1000

***COORDINATES:**

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

Cameras 7 & 8 were not used for this test.

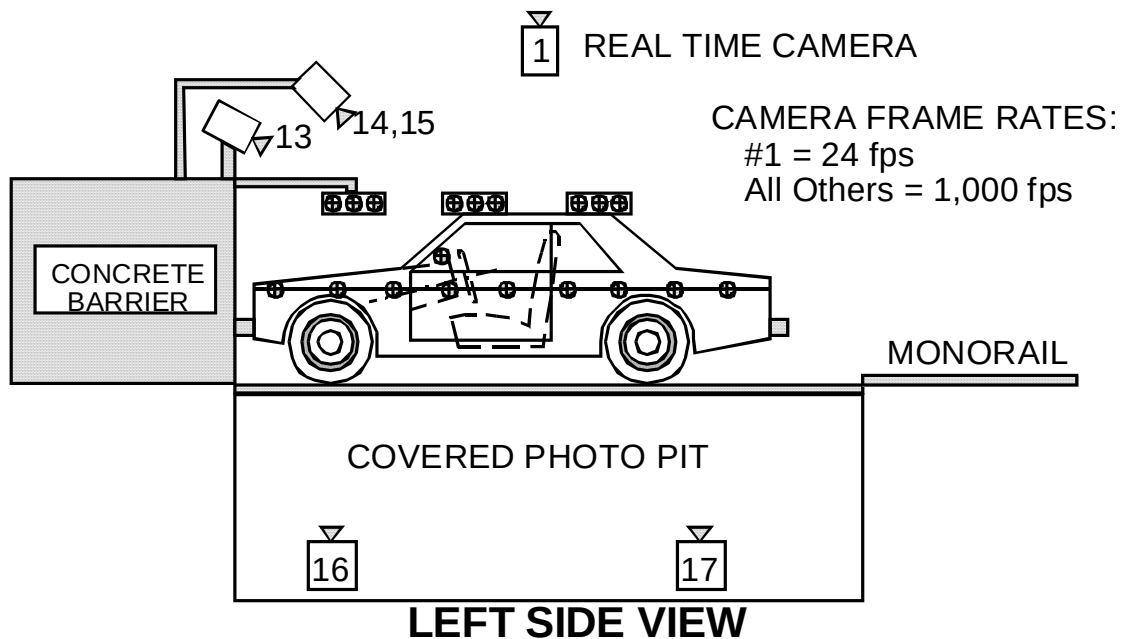
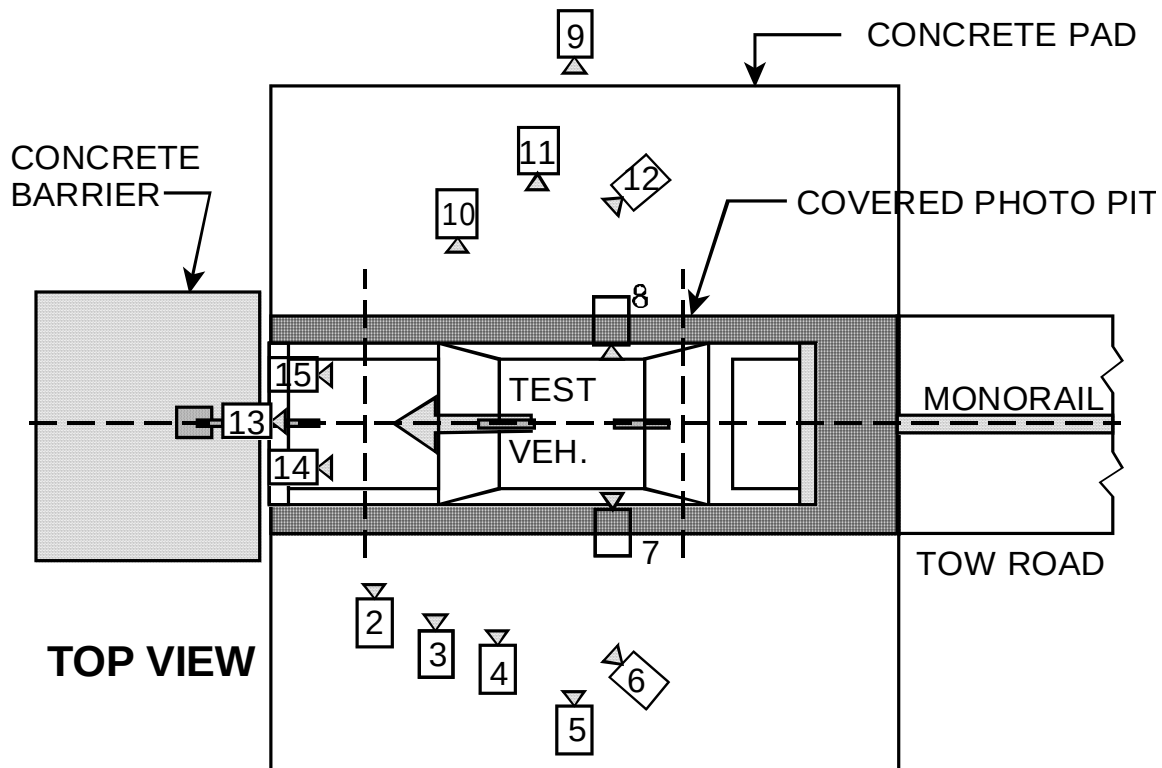
DATA SHEET NO. 11... (continued)

CAMERA LOCATIONS

Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009

CAMERA POSITIONS FOR FRONTAL IMPACTS

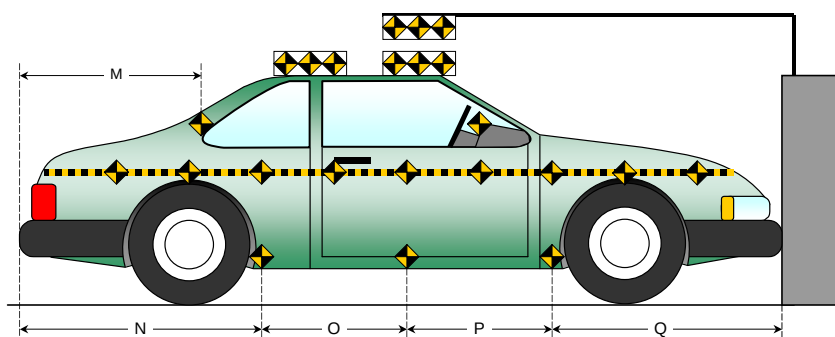
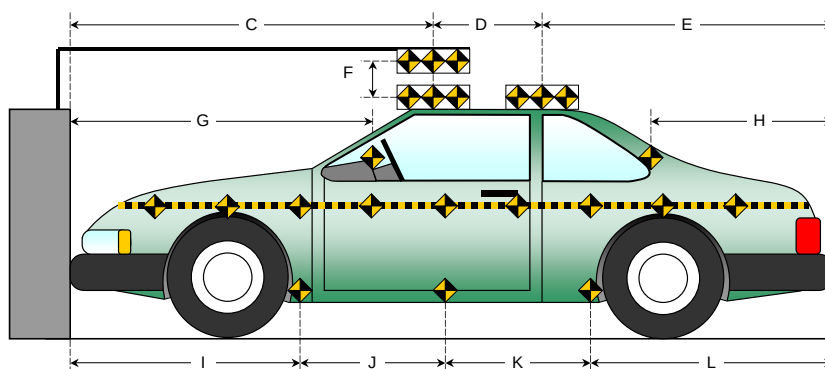
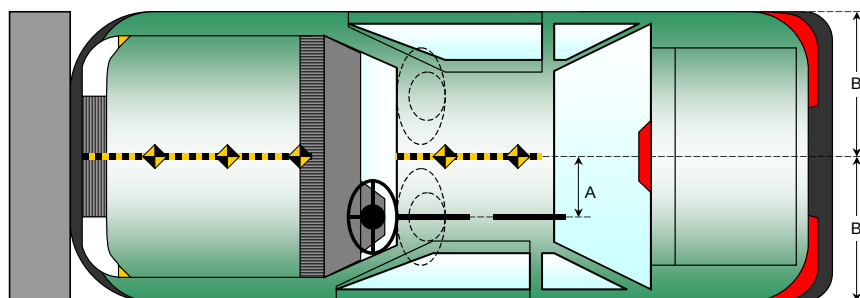


DATA SHEET NO. 12
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

Item	Value
A	467
B	1016
C	2384
D	665
E	2762
F	40
G	
H	2352
I	1454
J	999
K	999
L	2359
M	2349
N	2358
O	999
P	996
Q	1461



DATA SHEET NO. 13
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

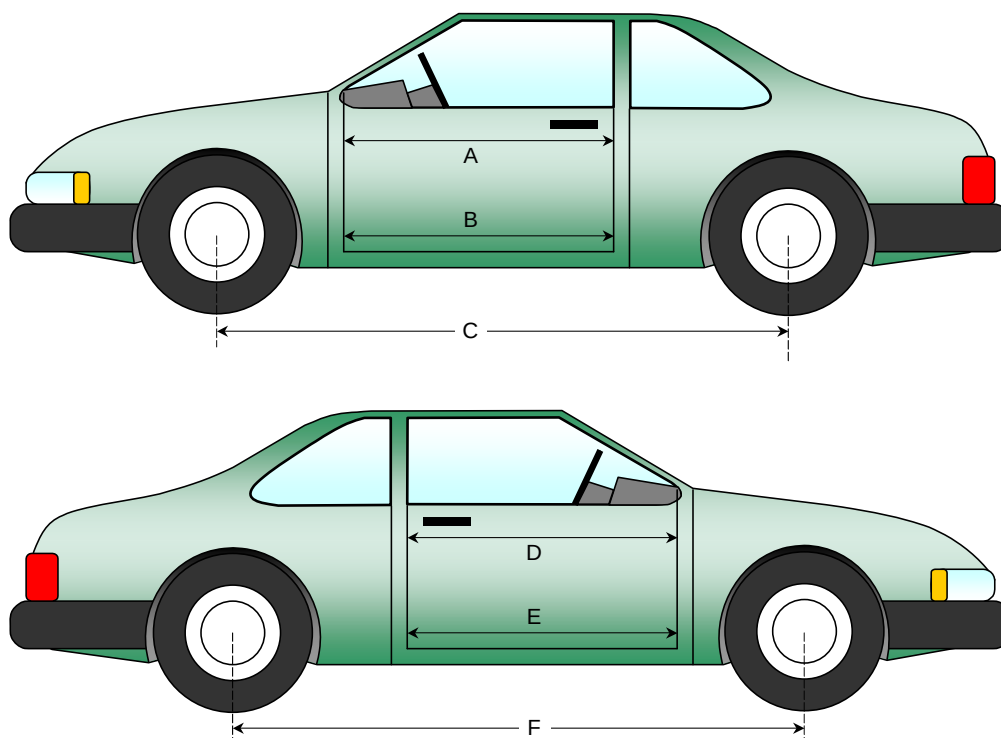
NHTSA No.: MA5111
 Test Date: 6/29/2009

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1080	1074	6
B	Left Side Lower	mm	939	938	1
D	Right Side Upper	mm	1080	1072	8
E	Right Side Lower	mm	939	937	2

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	3706	3672	34
F	Right Side Wheelbase	mm	3706	3696	10



DATA SHEET NO. 13... (continued)
VEHICLE INTRUSION MEASUREMENTS

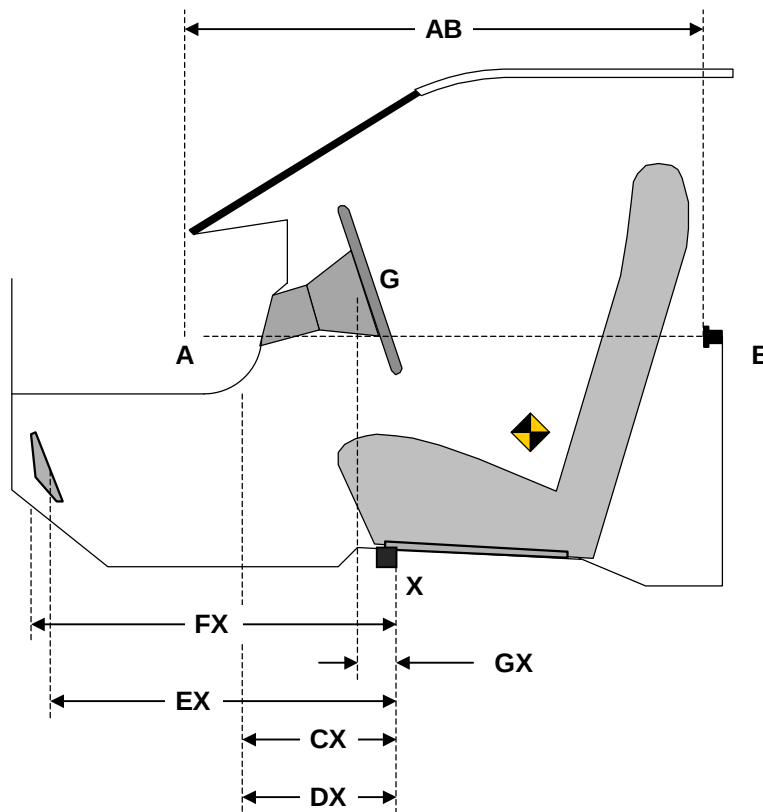
Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	786	788	-2
CX	Left Knee Bolster to X	mm	291	313	-22
DX	Right Knee Bolster to X	mm	288	304	-16
EX	Brake Pedal to X	mm	566	572	-6
FX	Foot Rest to X	mm	538	538	0
GX	Center of Steering Column Wheel Hub to X	mm	70	123	-53

X = Front of Seat Track (stationary)

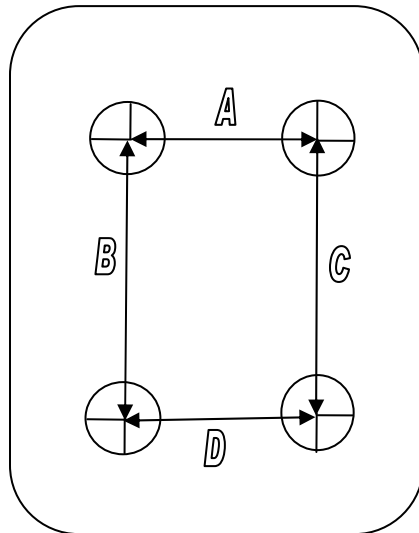


DRIVER COMPARTMENT

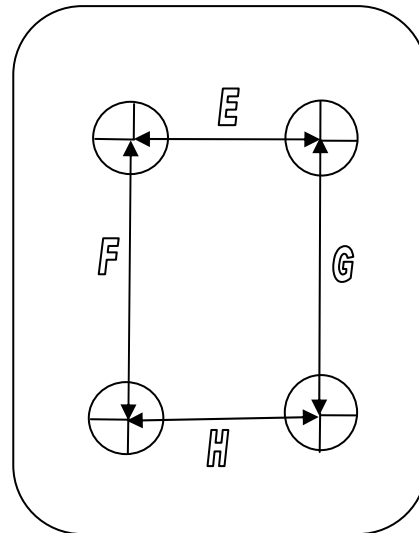
DATA SHEET NO. 13... (continued)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009



Driver



Passenger

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	384	383	1
B	256	256	0
C	315	315	0
D	434	434	0
E	418	416	2
F	322	322	0
G	346	344	2
H	470	470	0

DATA SHEET NO. 14

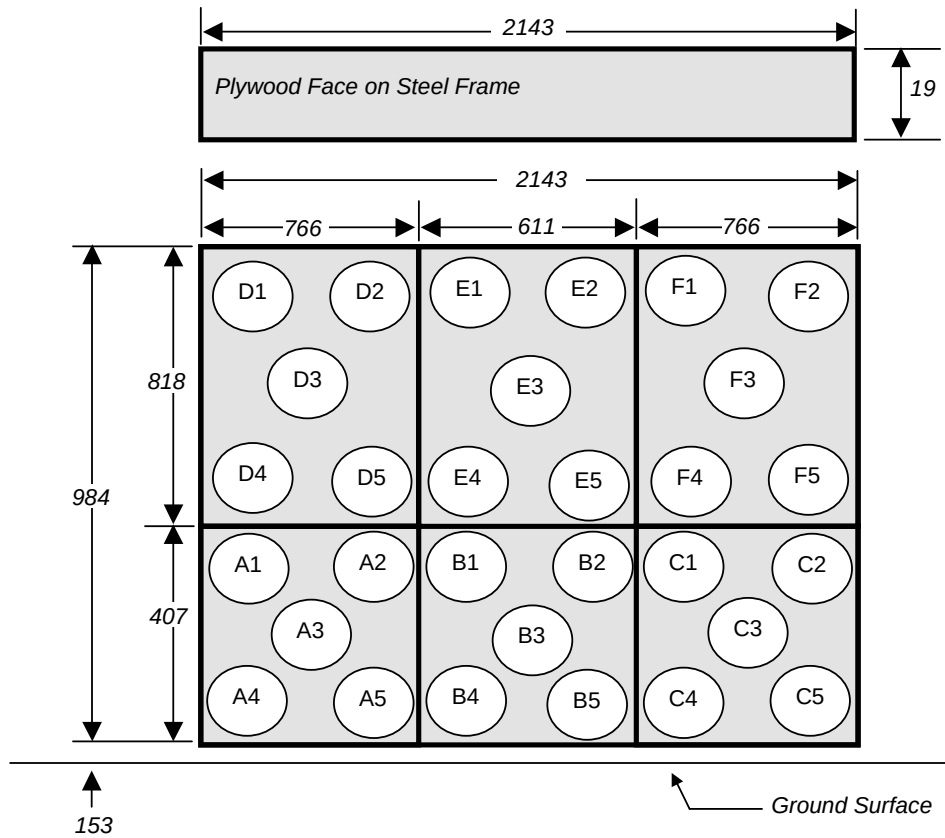
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2010 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

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 Toyota Tundra Double Cab
 Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
 Test Date: 6/29/2009

VEHICLE INFORMATION

VIN: 5TFUW5F15AX094611 Wheelbase (mm): 3706
 Vehicle Size Category: Truck Test Weight (kg): 2786.5

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): 56.3
 Velocity Change (km/h): 63.3 Time of Separation (msec): 119

CRUSH PROFILE

Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
 Damage Region Length (mm): 1524 Impact Mode: Frontal

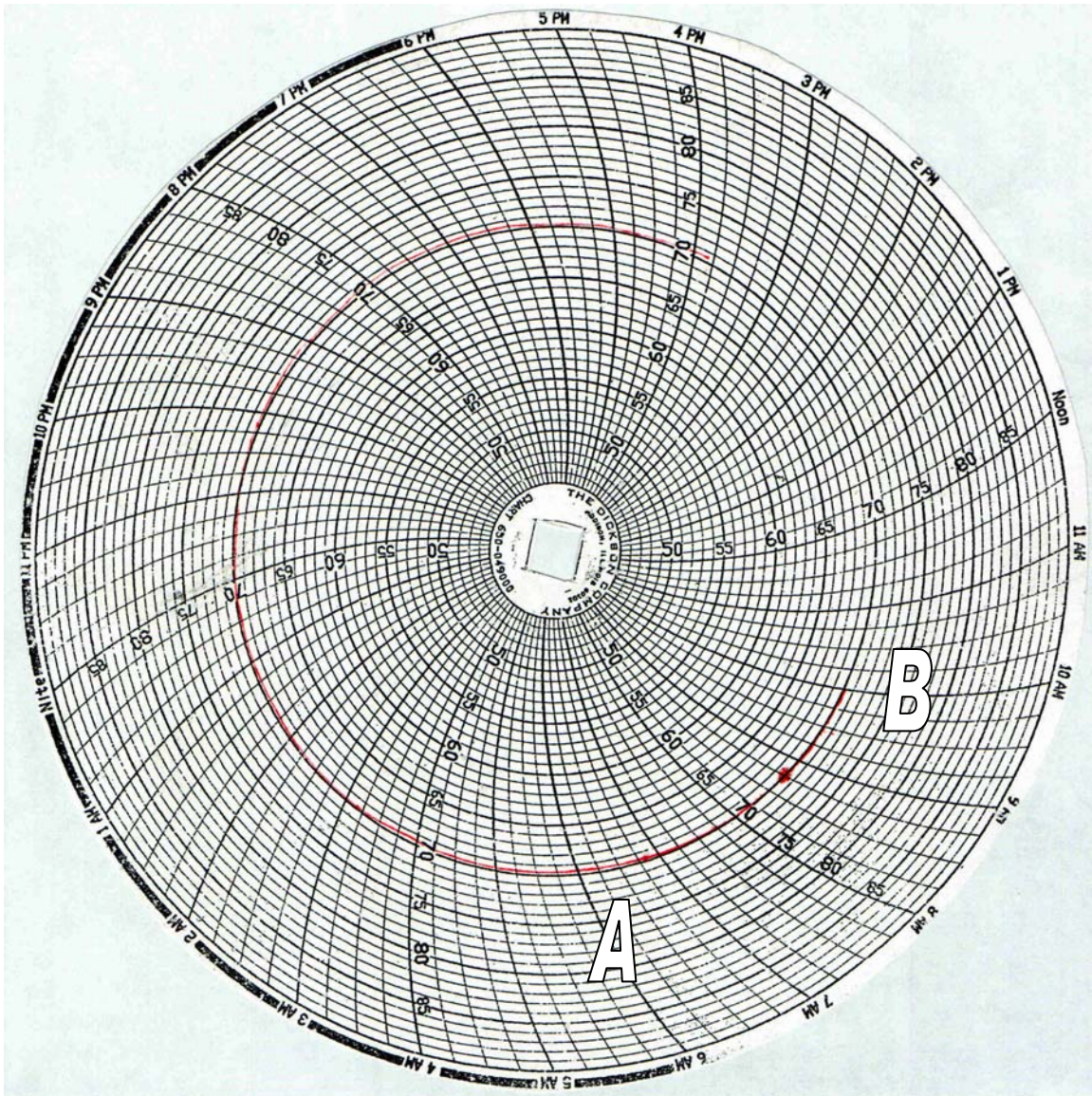
No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	5696	5270	426
C2	Crush zone 2 at left side	mm	5782	5294	488
C3	Crush zone 3 at left side	mm	5806	5299	507
C4	Crush zone 4 at right side	mm	5806	5298	508
C5	Crush zone 5 at right side	mm	5782	5291	491
C6	Crush zone 6 at right side	mm	5696	5266	430
L	C1 TO C6	mm	1524	1510	14

DATA SHEET NO. 16

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2010 Toyota Tundra Double Cab
Test Program: 35mph Frontal Impact

NHTSA No.: MA5111
Test Date: 6/29/2009



A = Dummies installed in vehicle at 6:00 am

B = Test conducted at 10:16 am

APPENDIX A
PHOTOGRAPHS

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Load Cell Location



Manufacturer's Label



Tire Placard



Right Front $\frac{3}{4}$ View, As Received



Left Rear $\frac{3}{4}$ View, As Received



Pre-Test Front View



Post-Test Front View



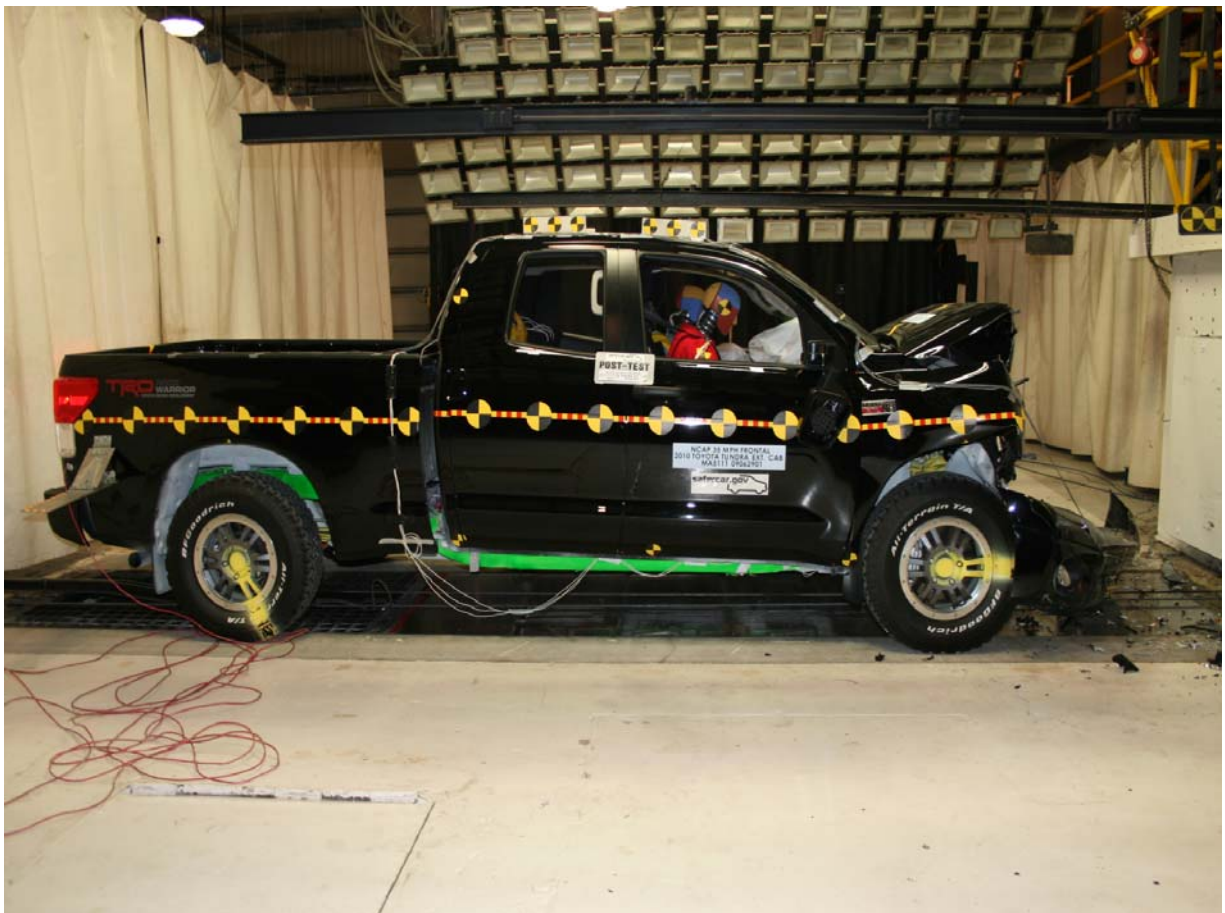
Pre-Test Left Side View



Post-Test Left Side View



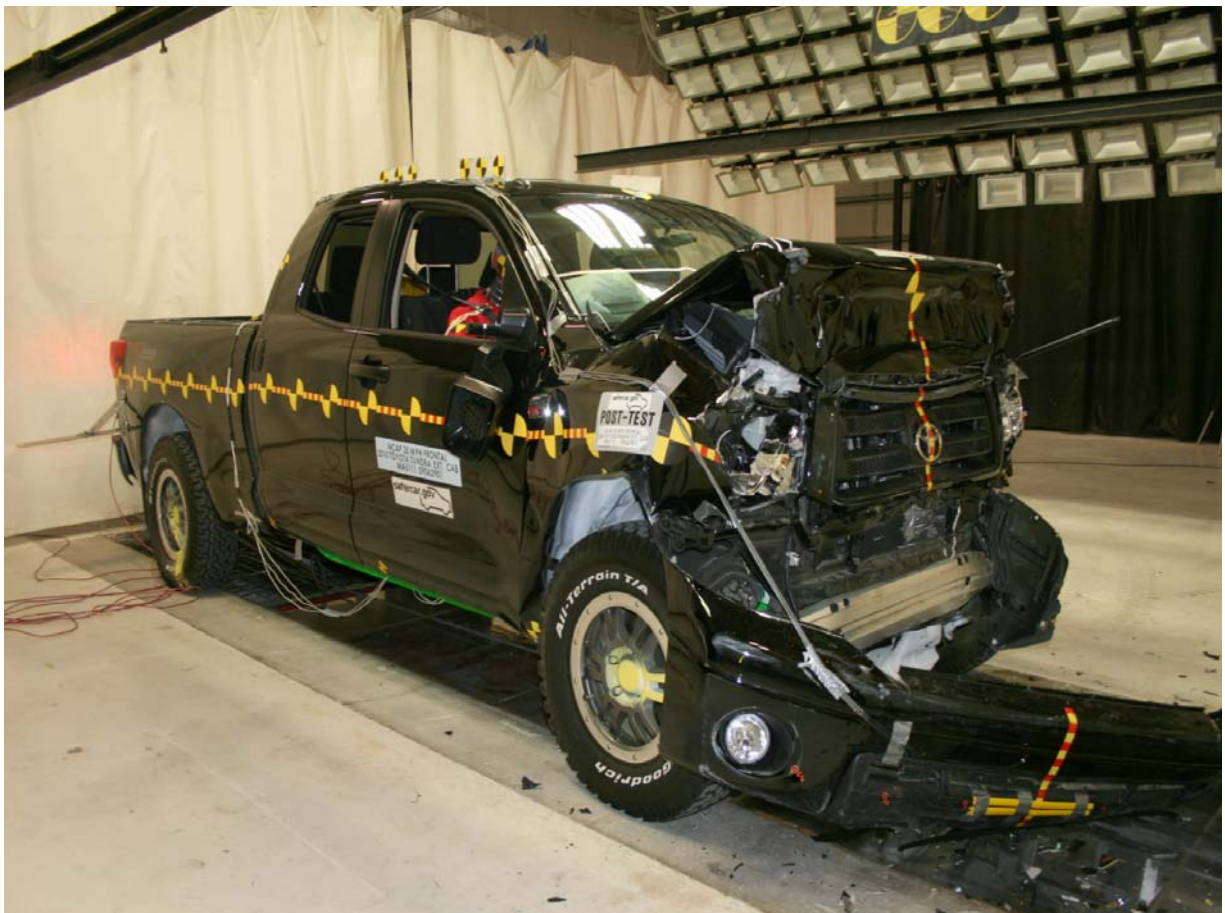
Pre-Test Right Side View



Post-Test Right Side View



Pre-Test Right Front $\frac{3}{4}$ View



Post-Test Right Front $\frac{3}{4}$ View



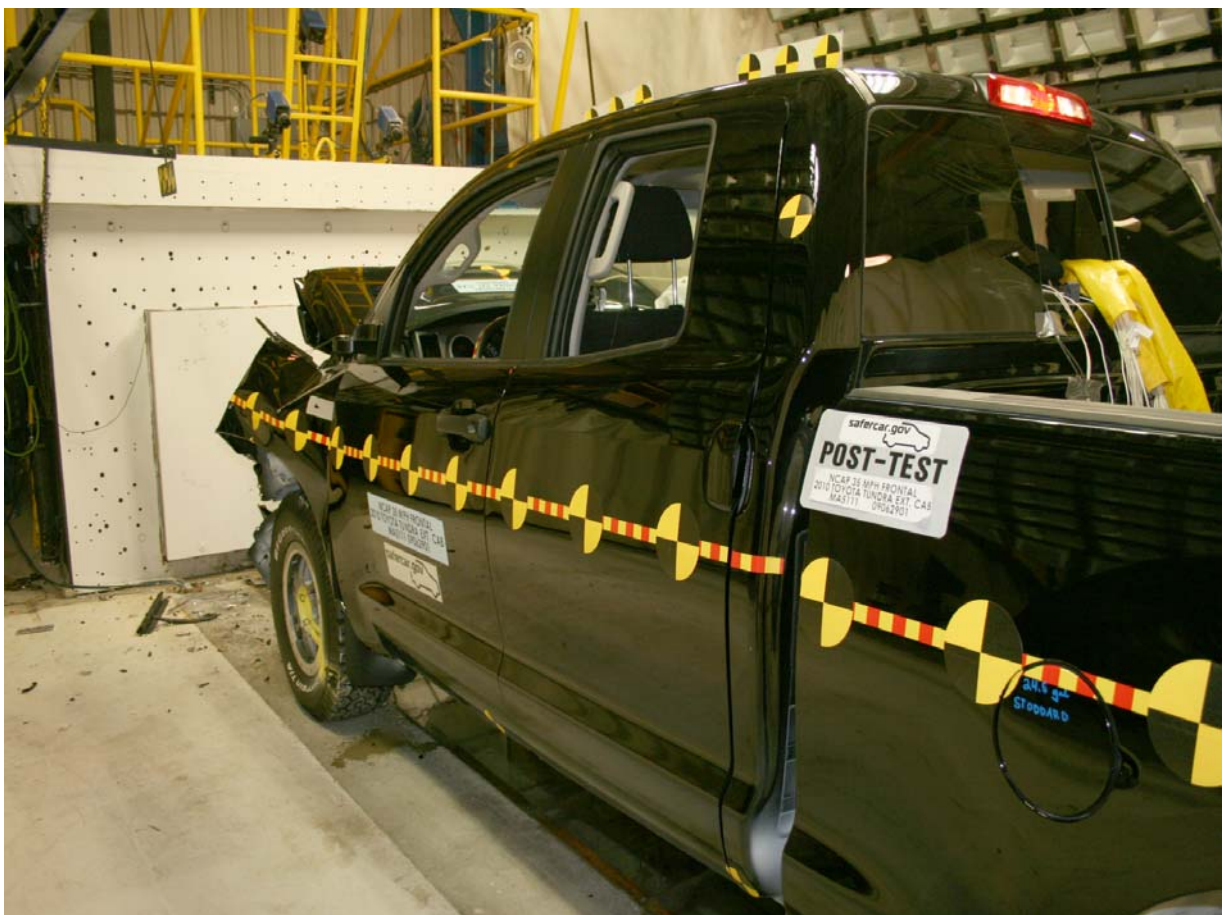
Pre-Test Left Rear $\frac{3}{4}$ View



Post-Test Left Rear $\frac{3}{4}$ View



Pre-Test Left Side $\frac{3}{4}$ View of Doors



Post-Test Left Side $\frac{3}{4}$ View of Doors After Impact



Pre-Test Right Side $\frac{3}{4}$ View of Doors



Post-Test Right Side $\frac{3}{4}$ View of Doors After Impact



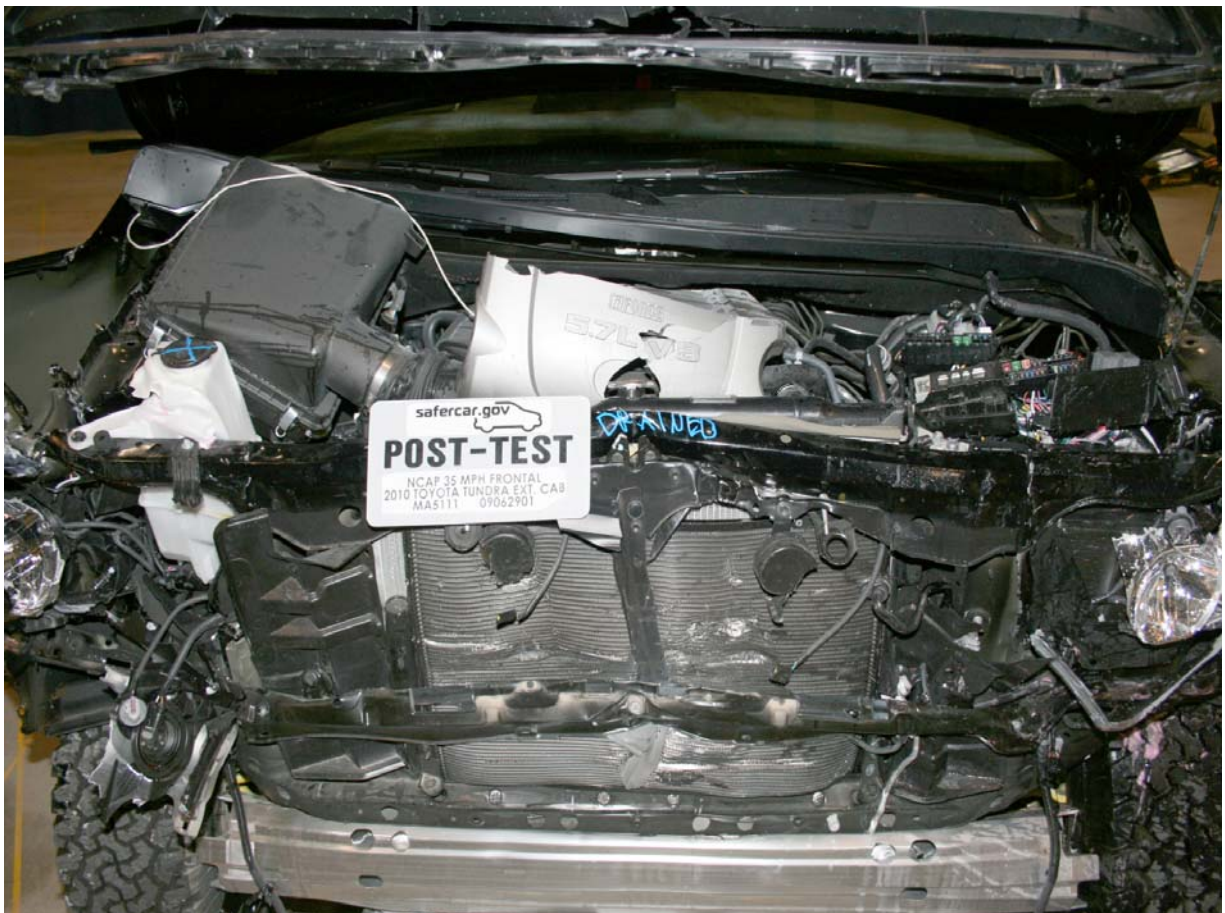
Pre-Test Windshield View



Post-Test Windshield View



Pre-Test Engine Compartment View



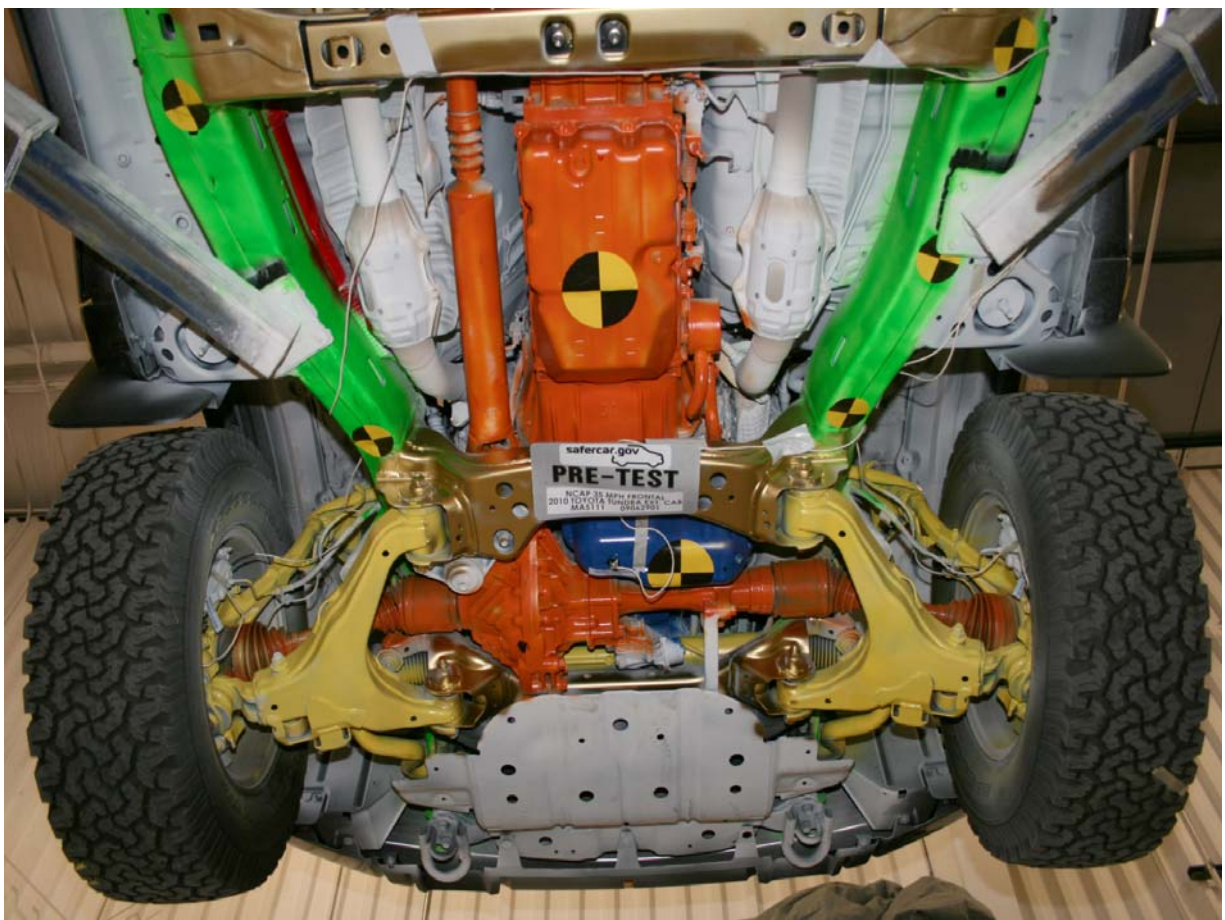
Post-Test Engine Compartment View



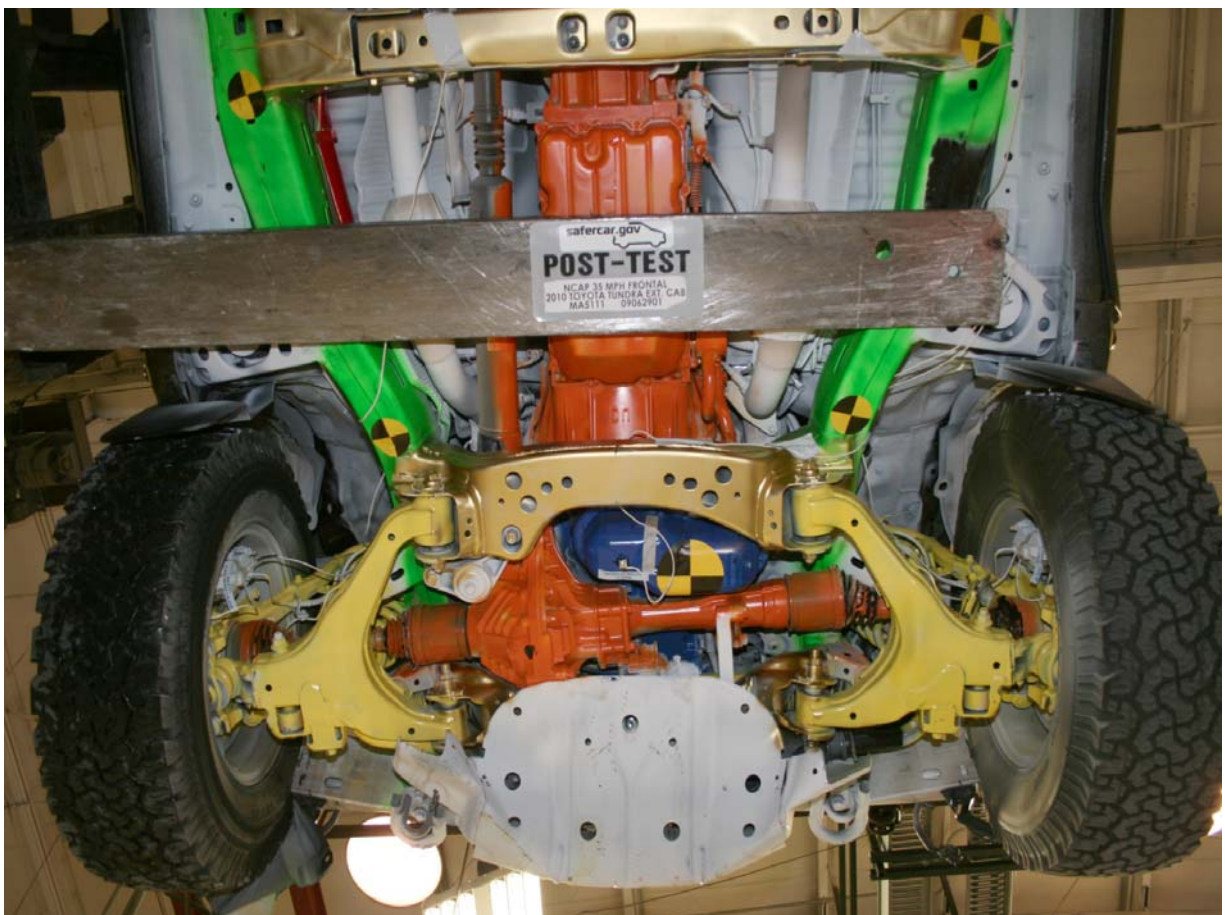
Pre-Test Fuel Cap View



Post-Test Fuel Cap View



Pre-Test Front Underbody View



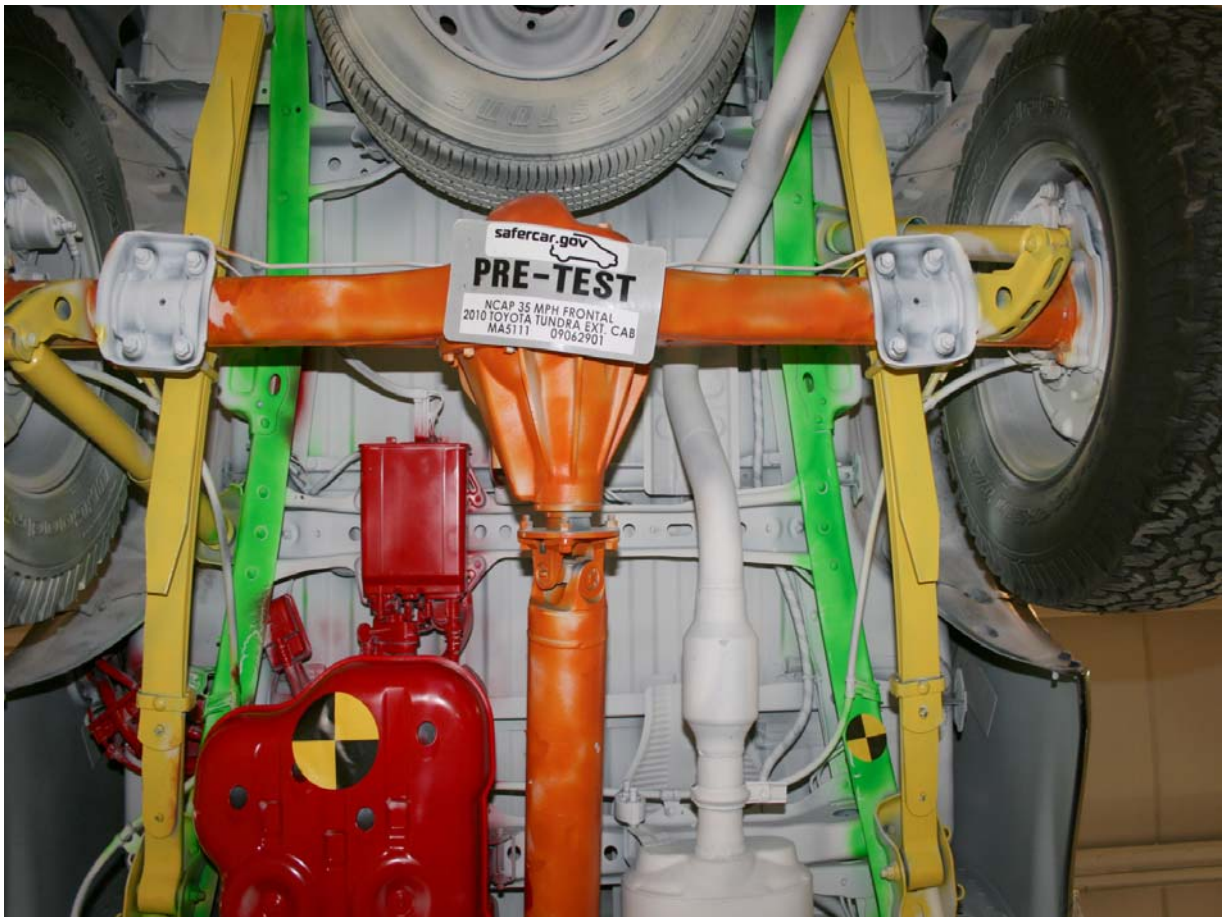
Post-Test Front Underbody View



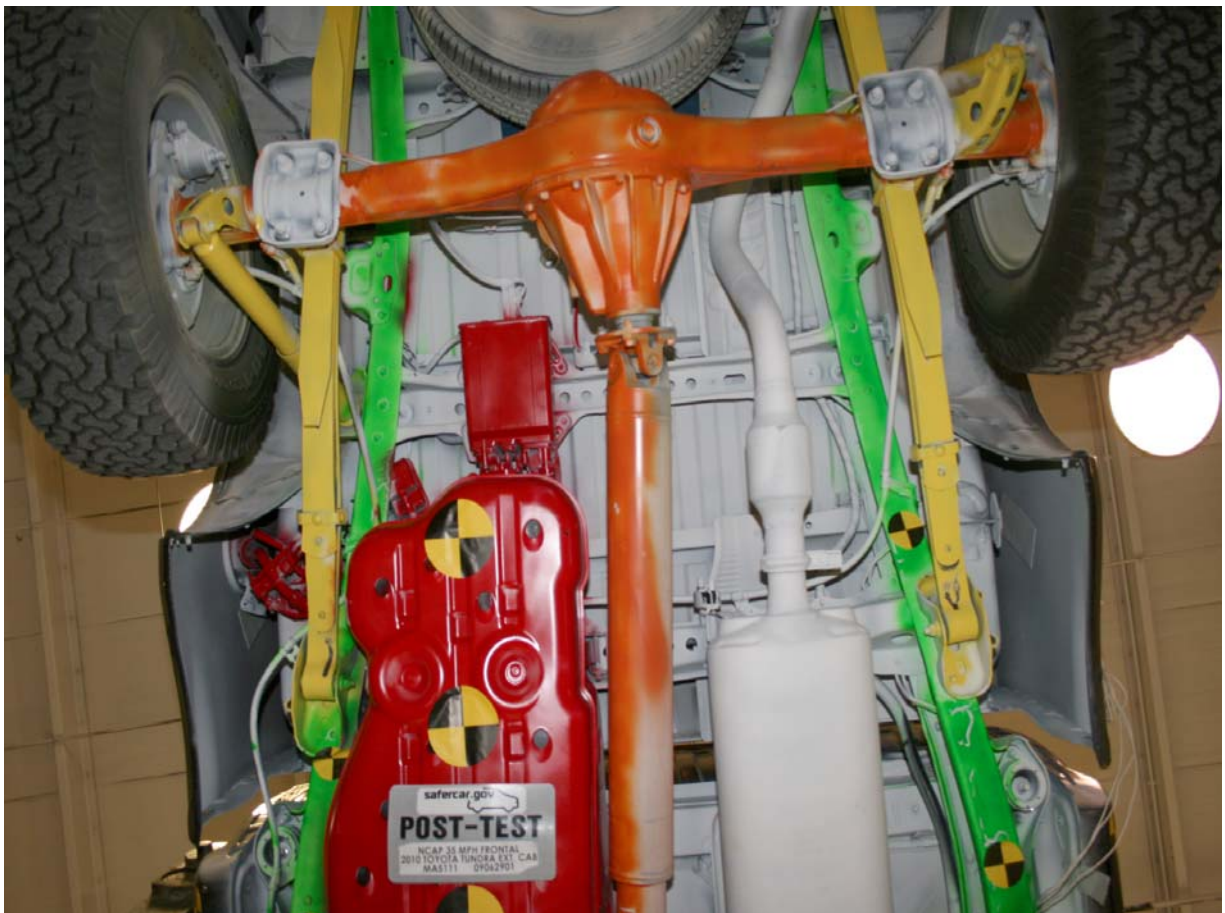
Pre-Test Mid Underbody View



Post-Test 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)



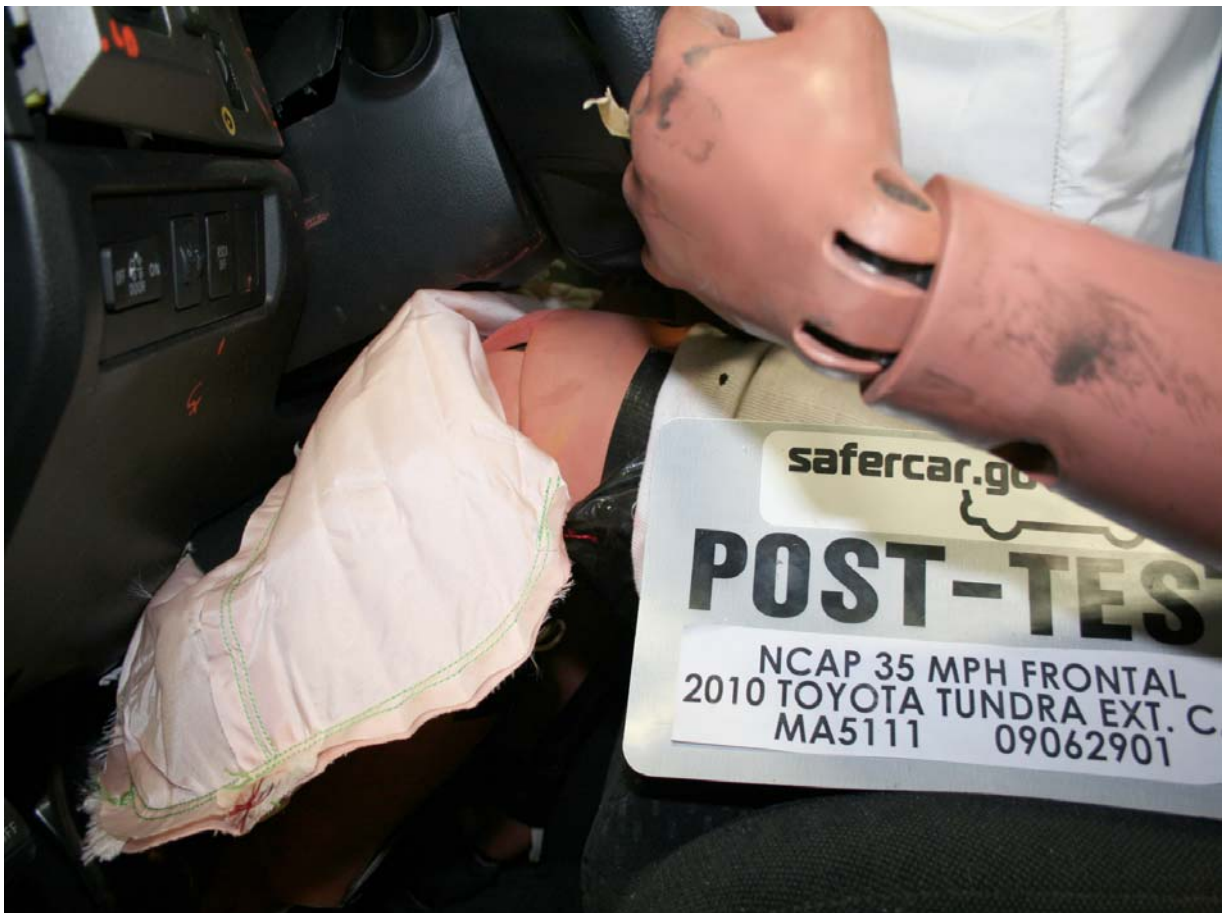
Pre-Test Driver Dummy Feet



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



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)



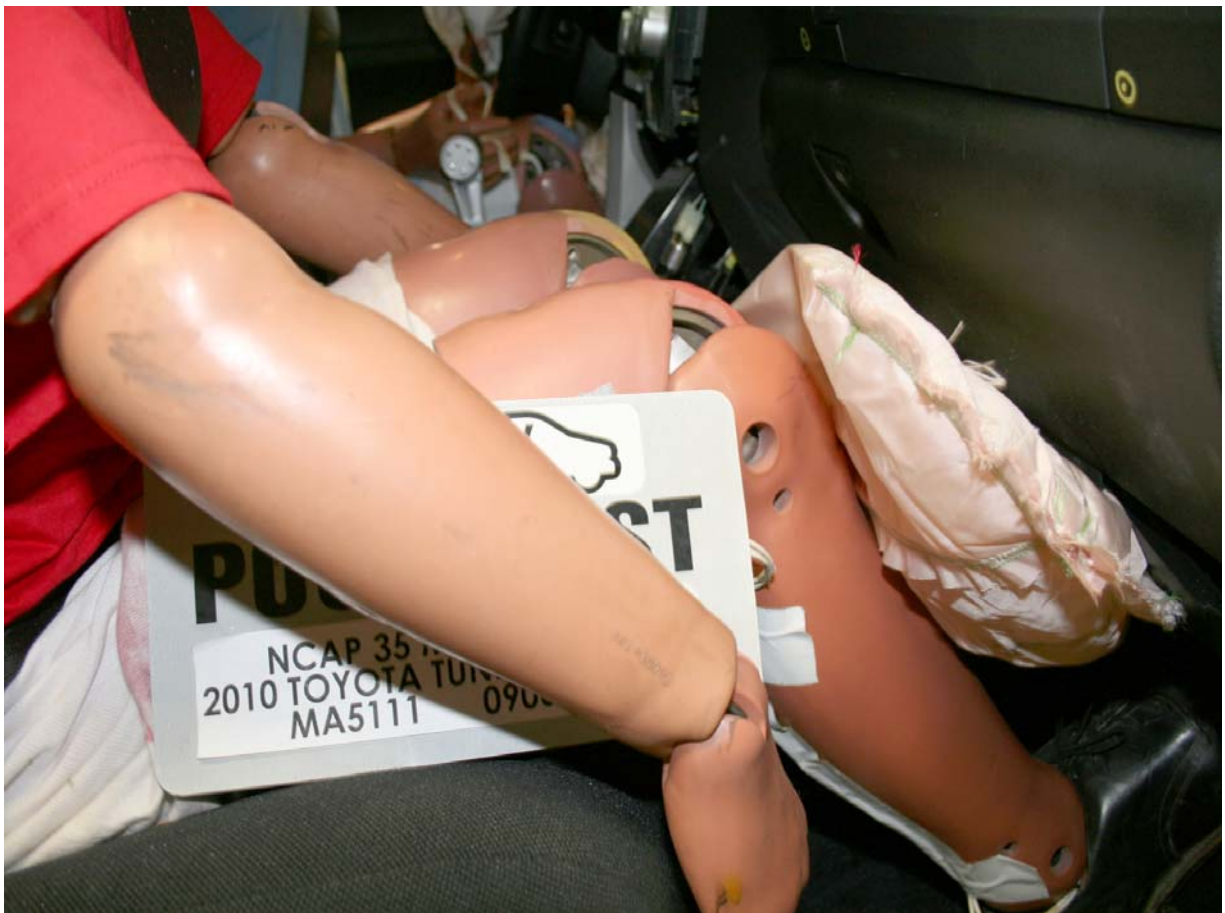
Pre-Test Passenger Dummy Feet



Post-Test Passenger Dummy Feet



Pre-Test Passenger Side Glove Box



Post-Test Passenger Side Glove Box



Pre-Test Passenger Side Floor Pan



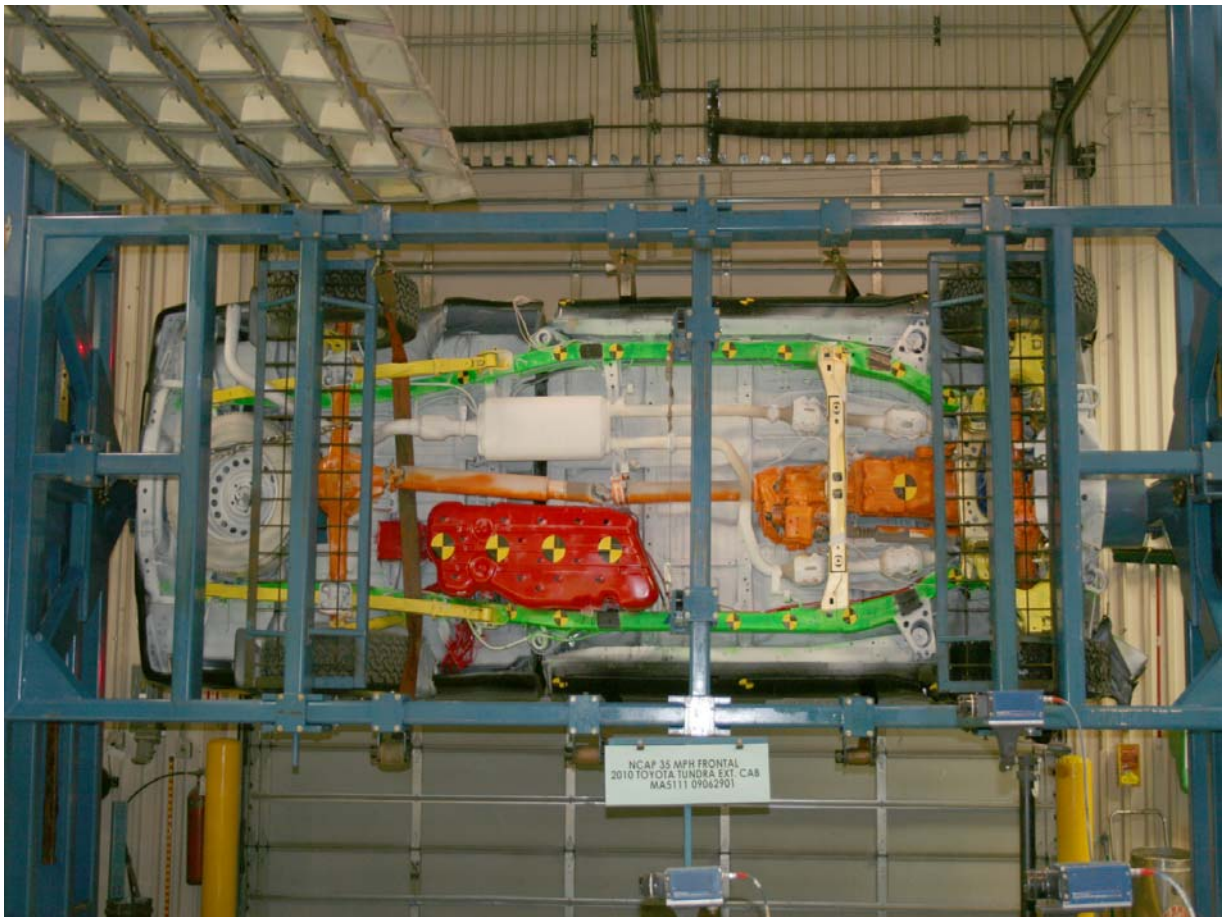
Post-Test Passenger Side Floor Pan



Post-Test Passenger Dummy Knee Contact



Post-Test Passenger Dummy Airbag Contact



Rollover 90 Degrees



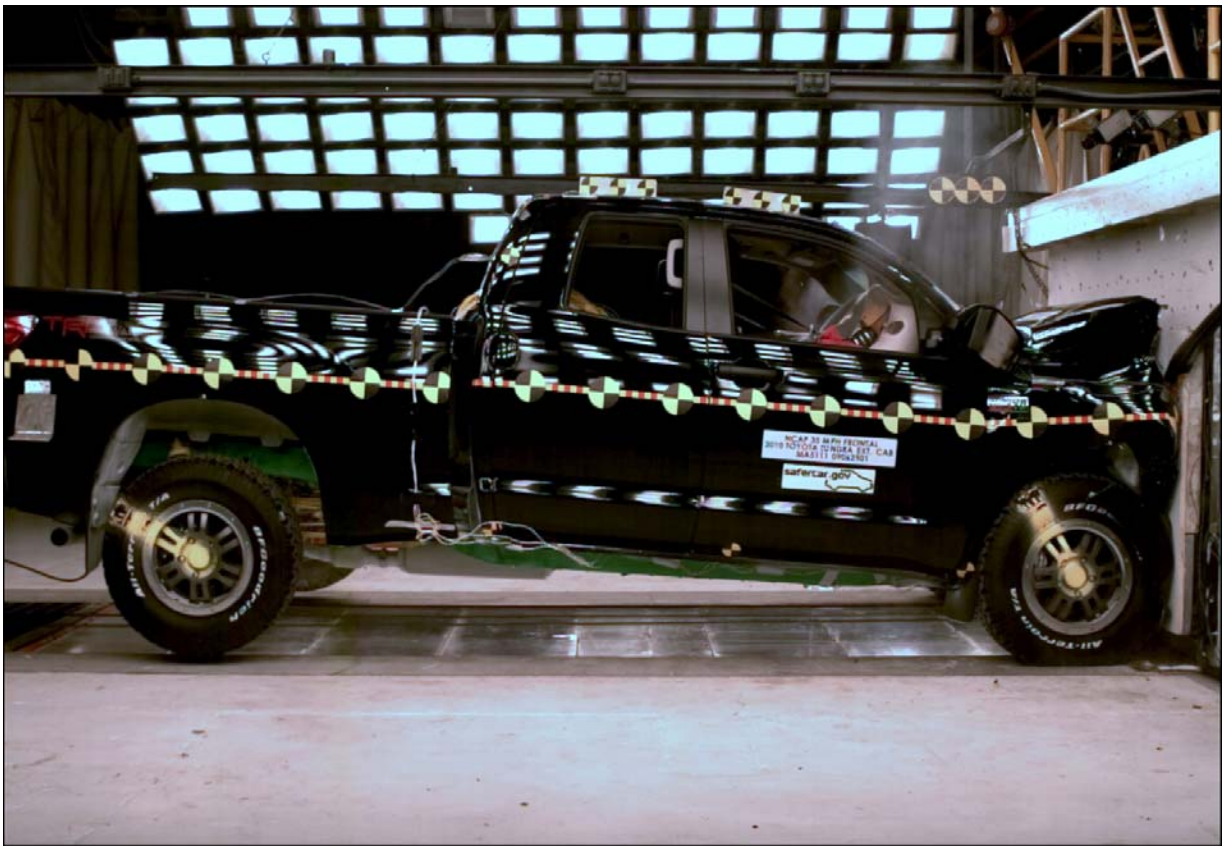
Rollover 180 Degrees



Rollover 270 Degrees



Rollover 360 Degrees



Vehicle Impact

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DUMMY RESPONSE DATA TRACES

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Figure No. 32.	Passenger Right Femur Force vs. Time	B-10

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 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

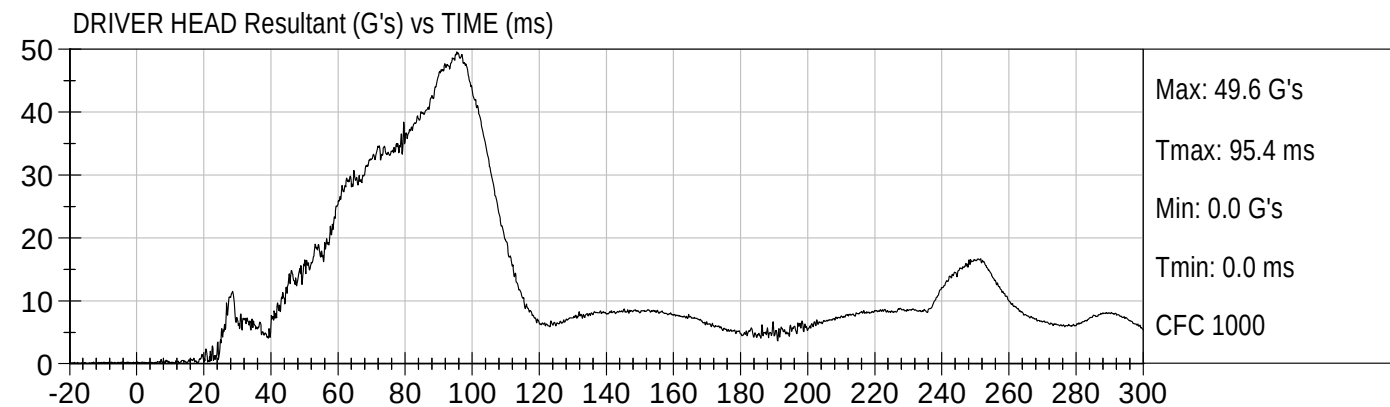
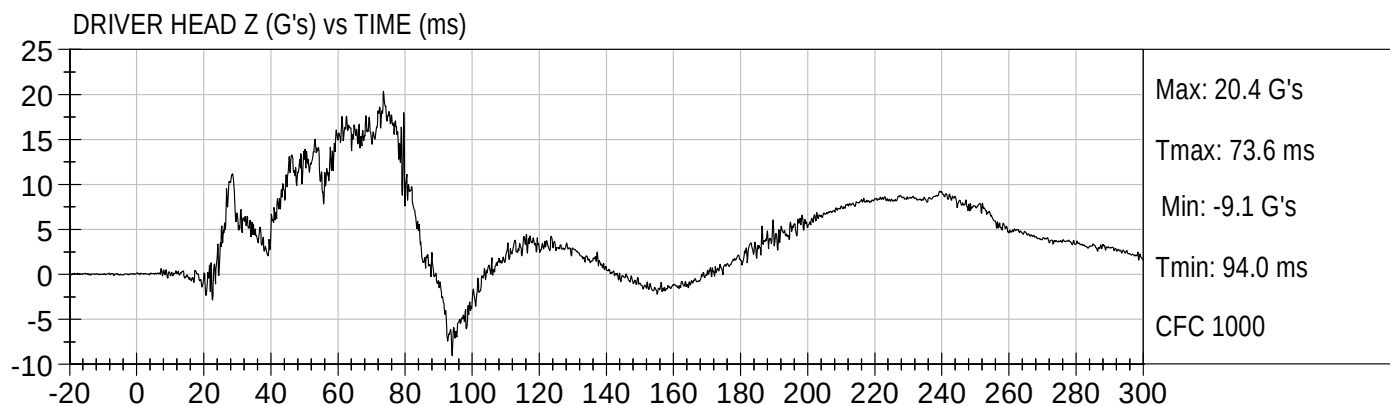
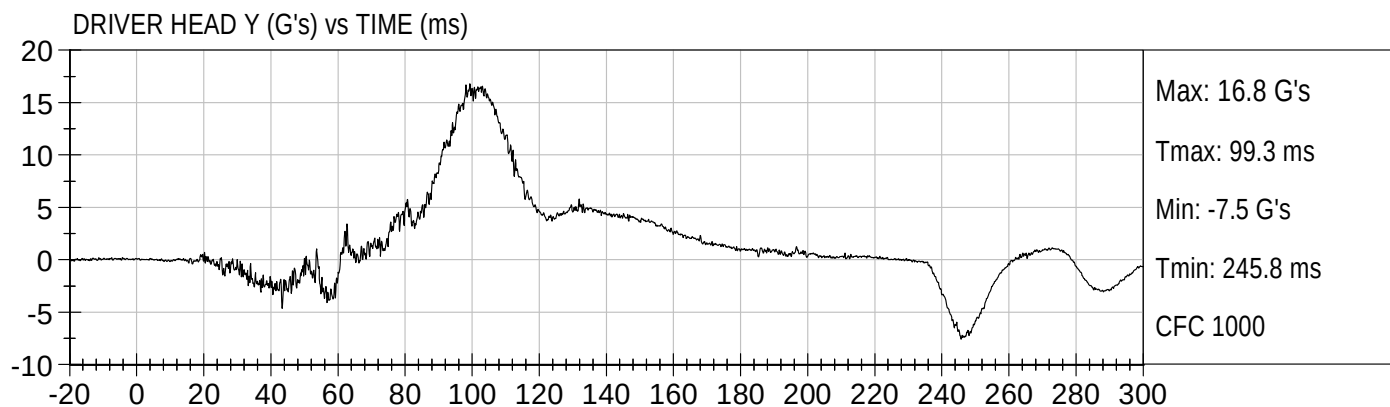
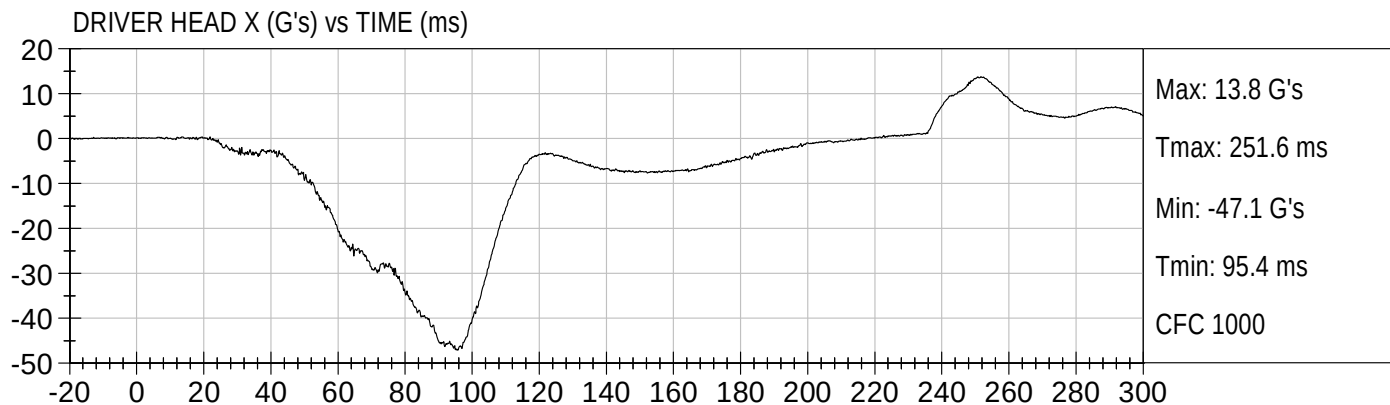
Driver Right Upper Tibia Moment X

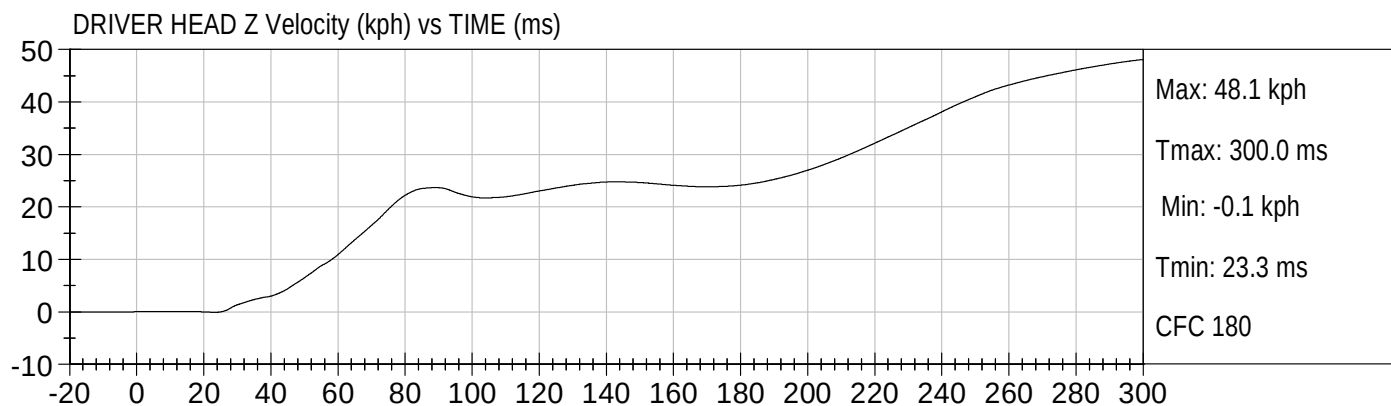
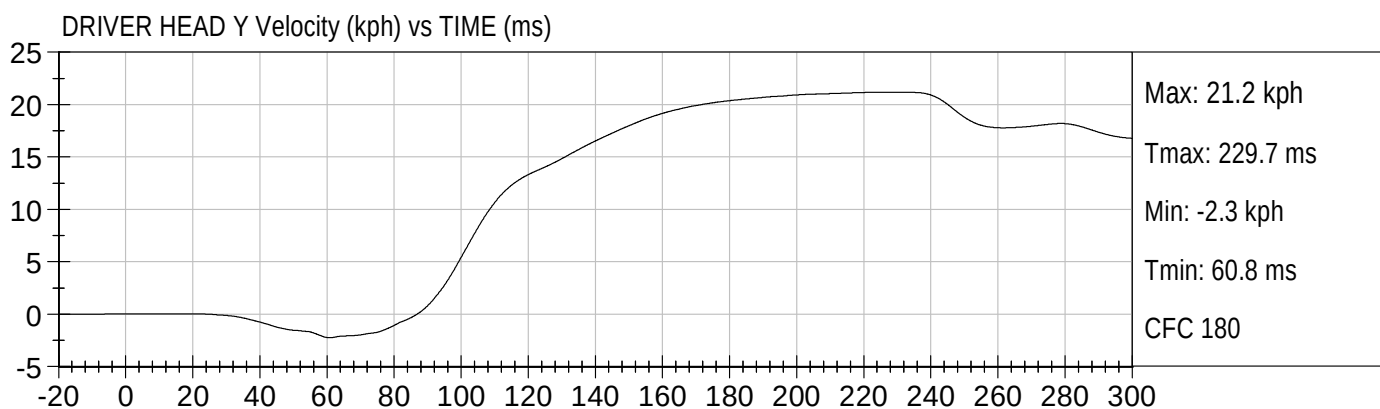
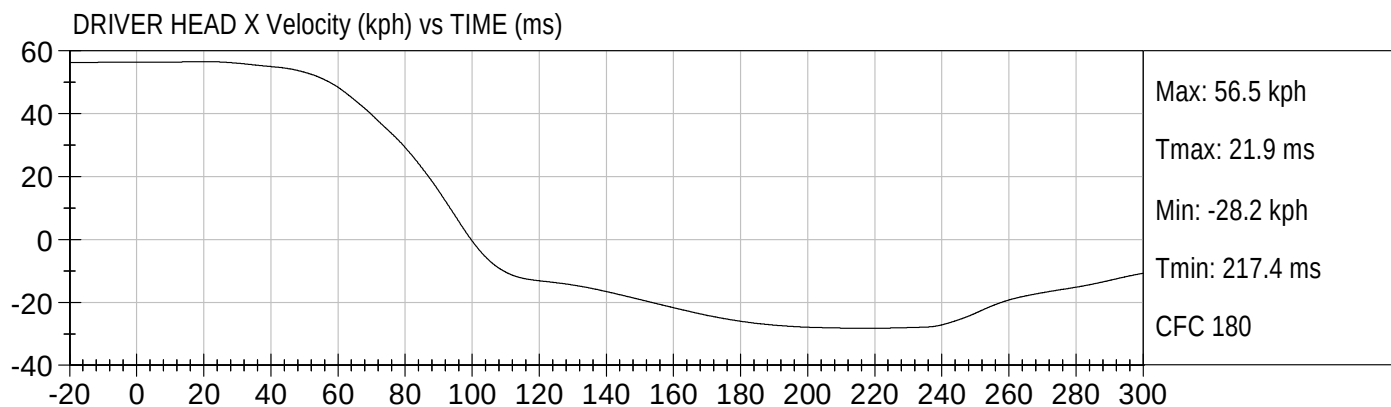
Driver Right Upper Tibia Moment Y

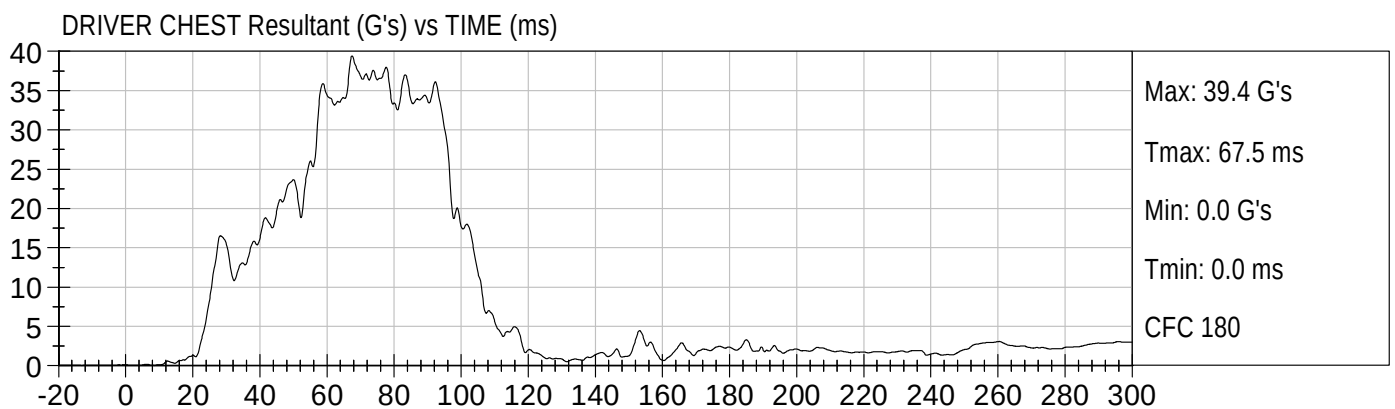
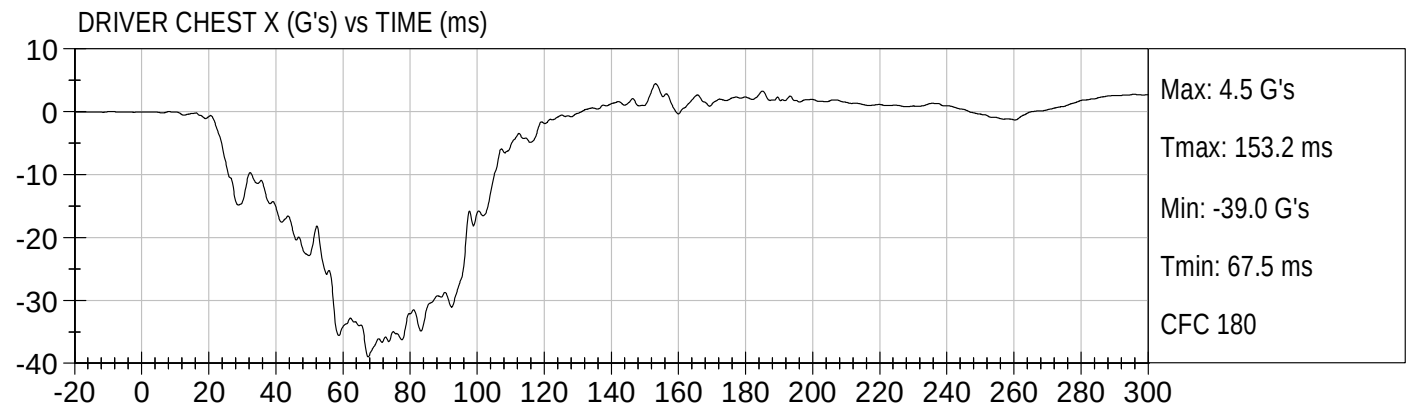
Driver Right Upper Tibia Force Z

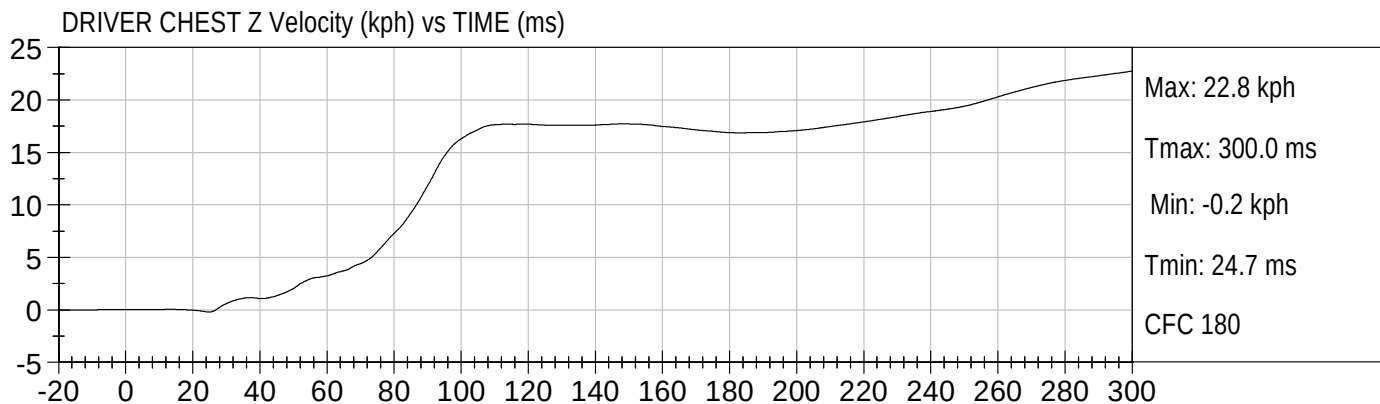
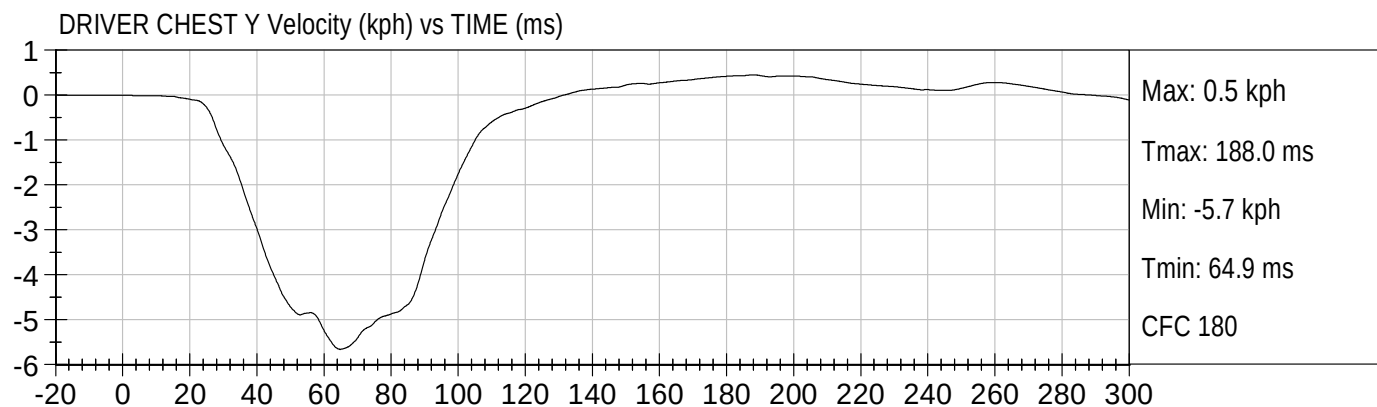
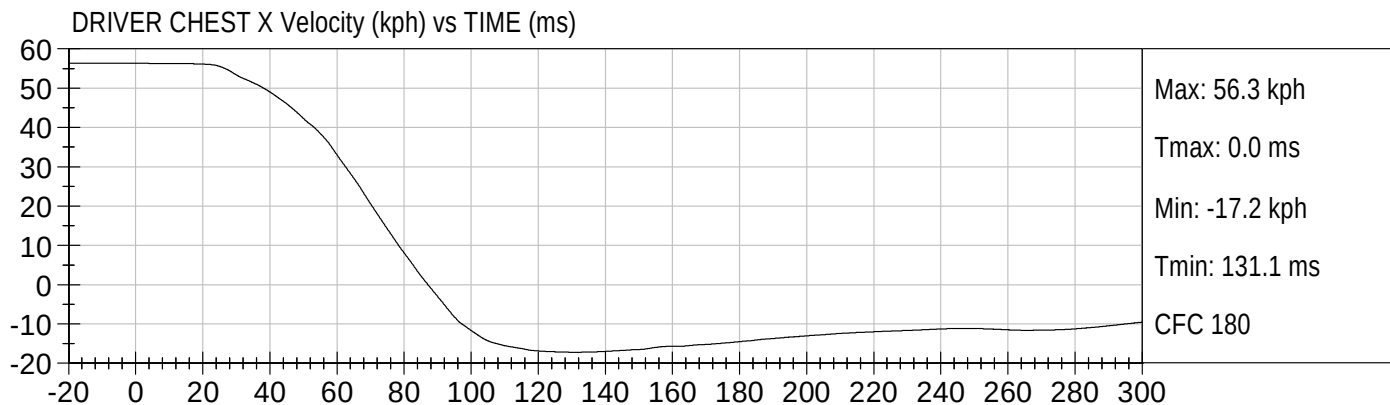
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver Left Foot Fore Z
Driver Left Foot Aft X
Driver Left Foot Aft Z
Driver Right Foot Fore Z
Driver Right Foot Aft X
Driver Right Foot Aft Z
Passenger Head X Redundant
Passenger Head Y Redundant
Passenger Head Z Redundant
Passenger Upper Neck Force 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 Lap 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

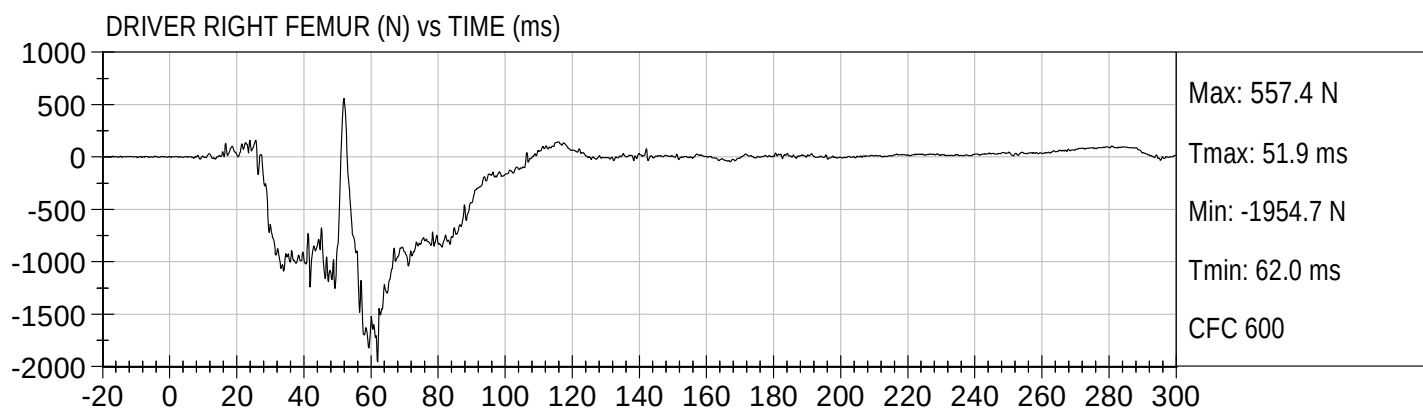
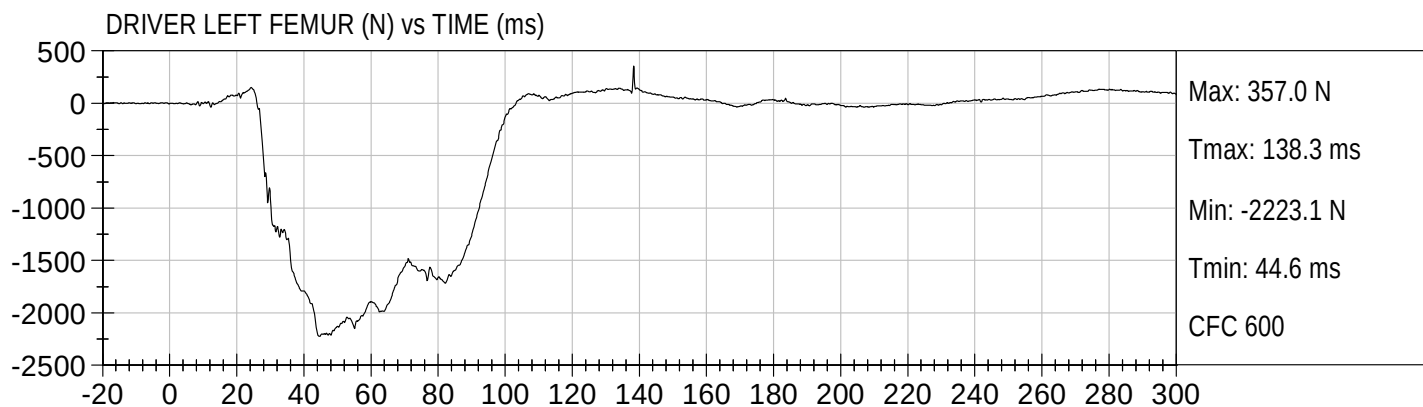
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right Upper Tibia Force Z
Passenger Right Lower Tibia Moment X
Passenger Right Lower Tibia Moment Y
Passenger Right Lower Tibia Force Z
Passenger Left Foot Fore Z
Passenger Left Foot Aft X
Passenger Left Foot Aft Z
Passenger 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

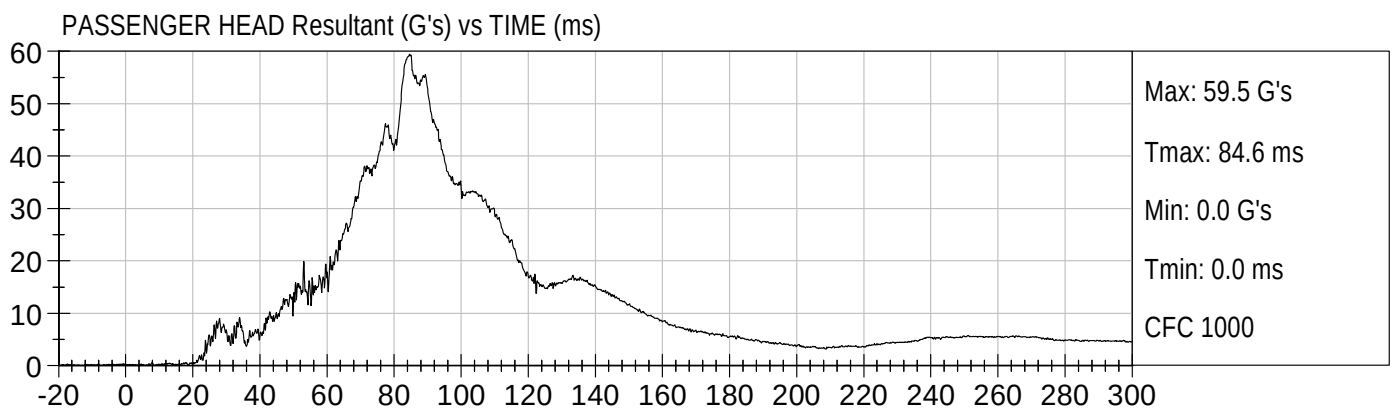
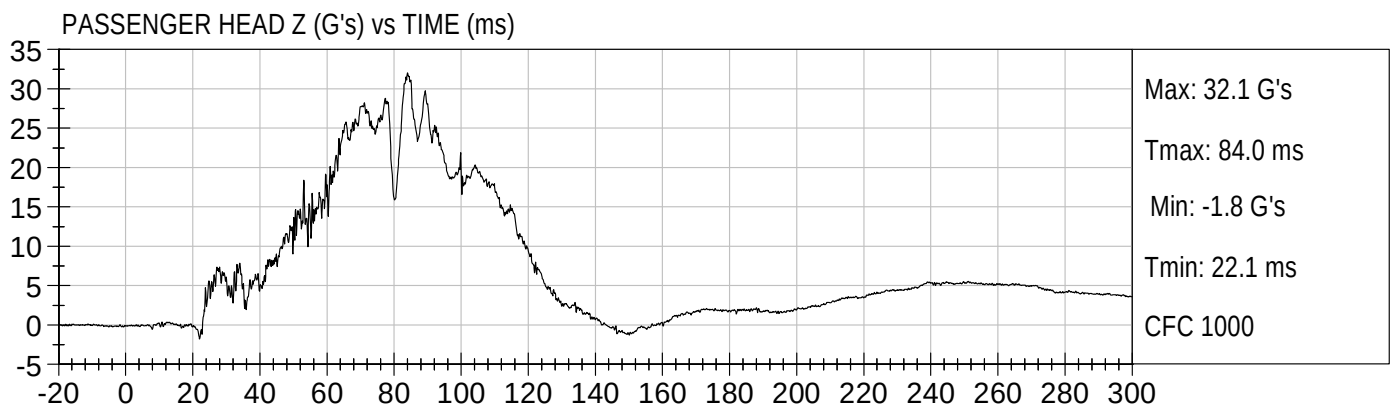
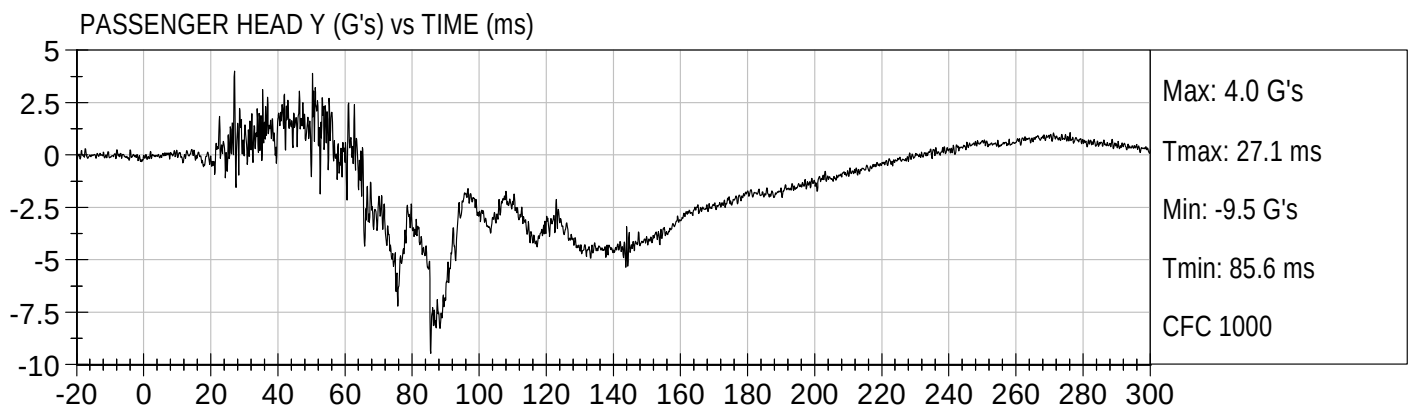
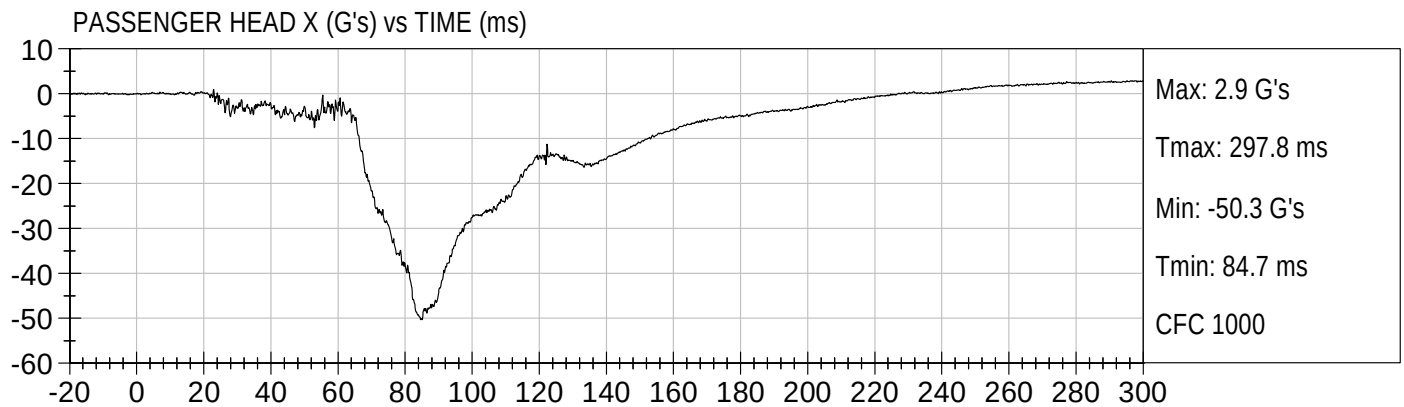


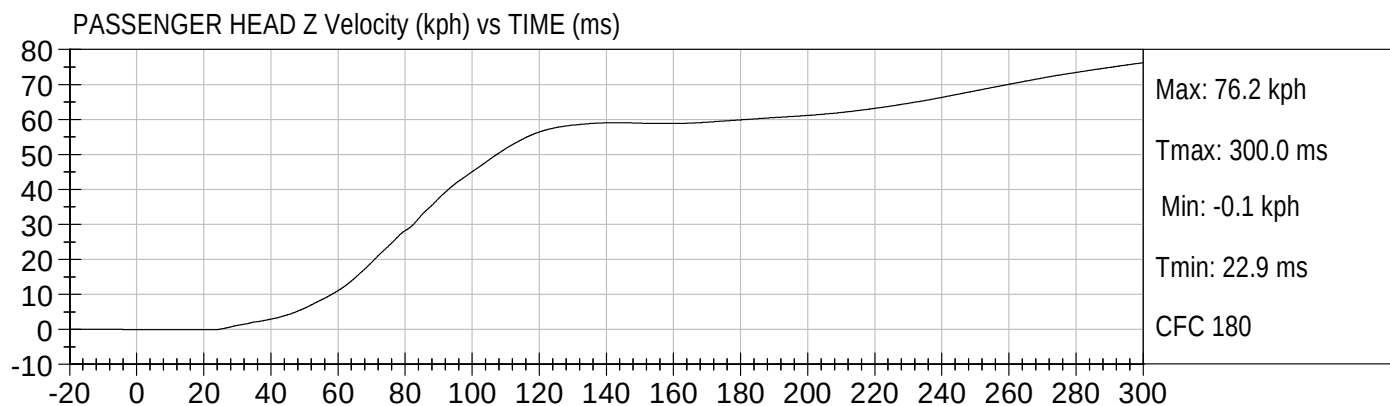
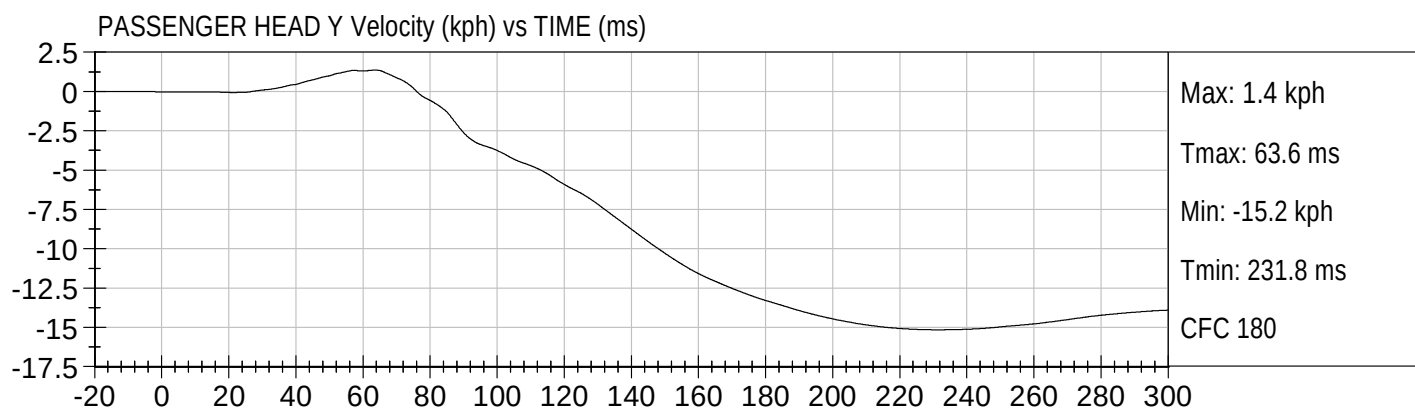
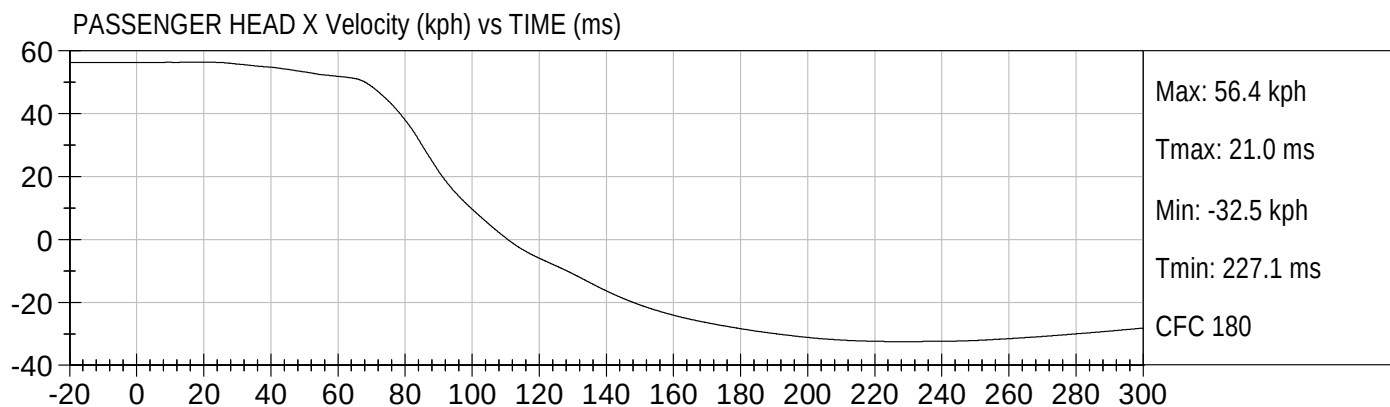


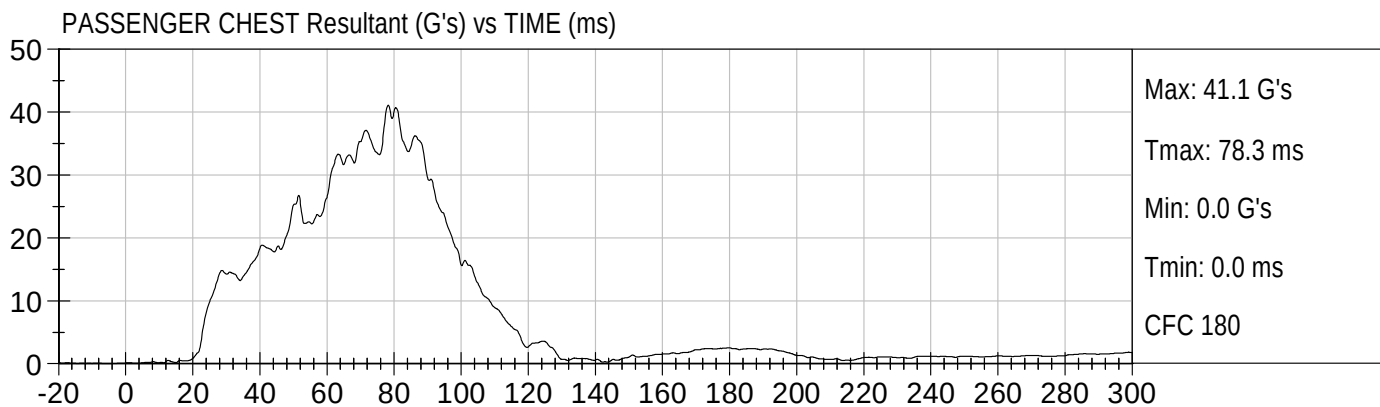
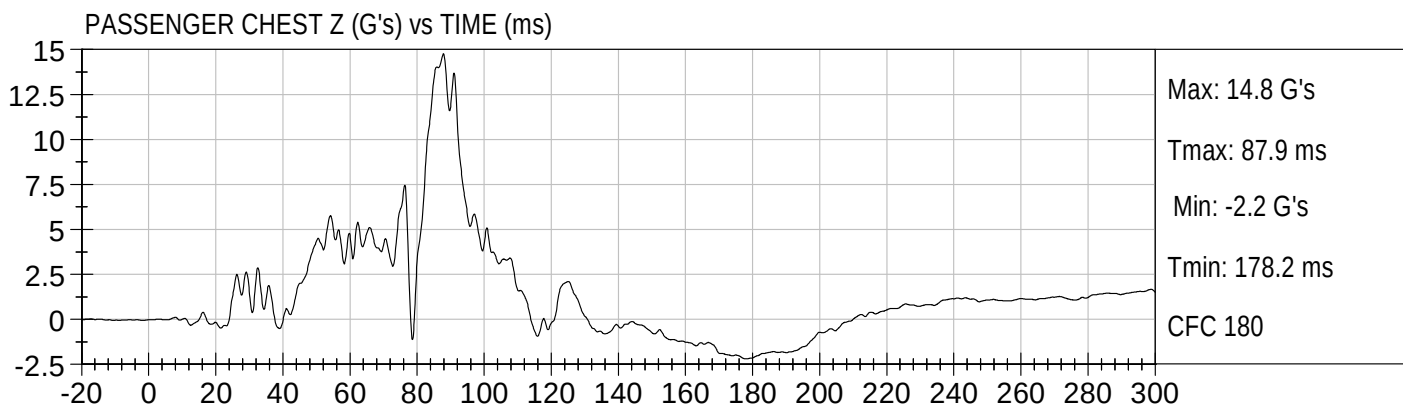
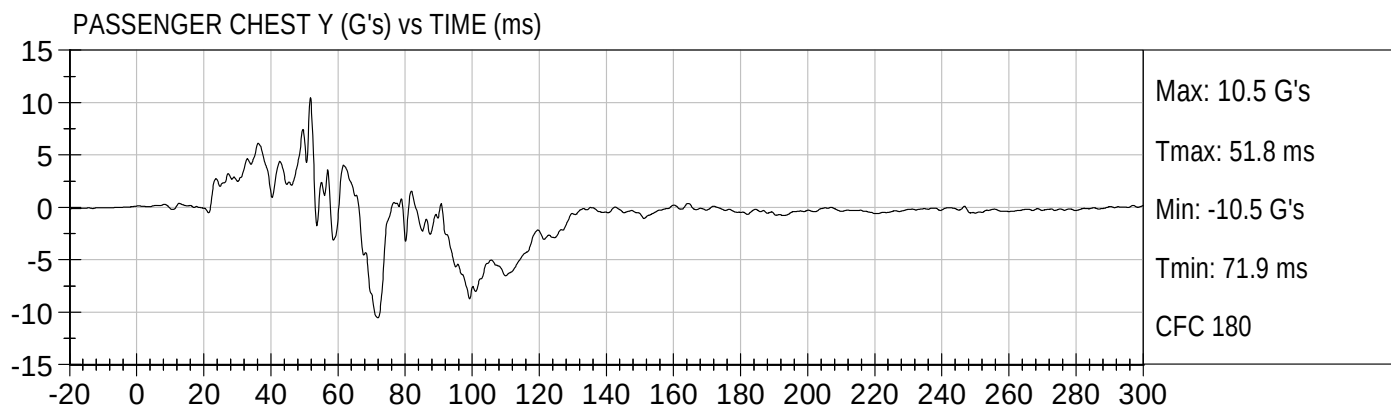
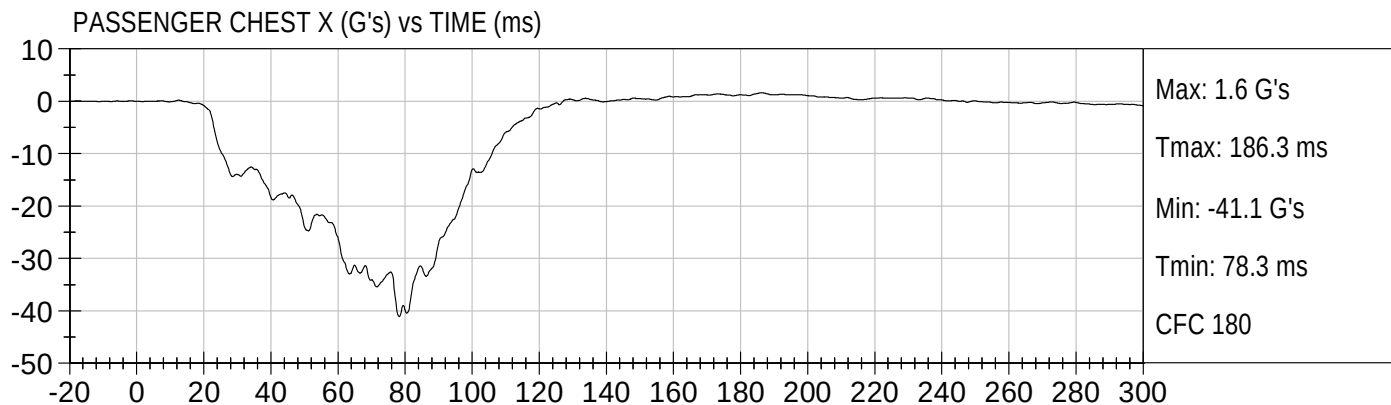


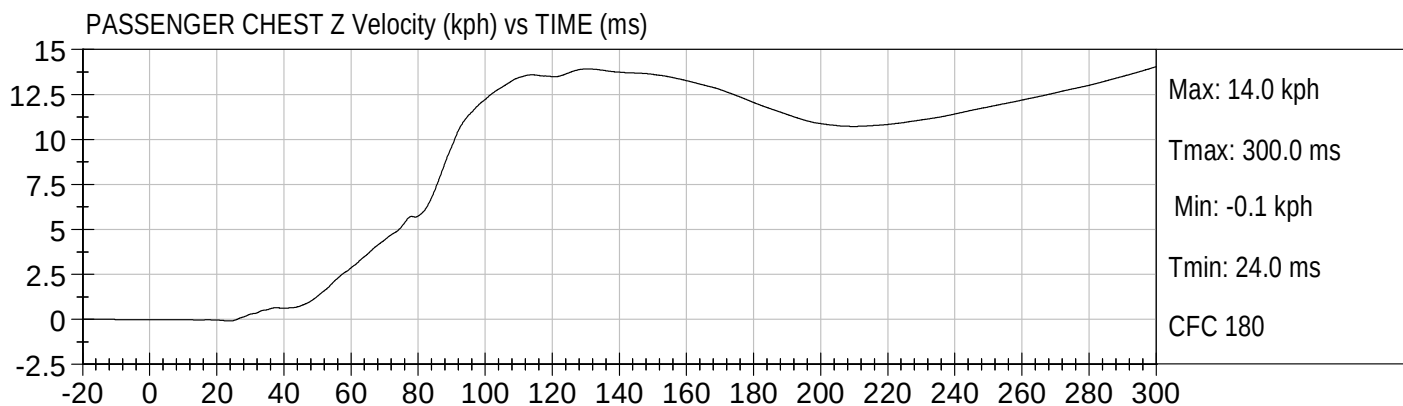
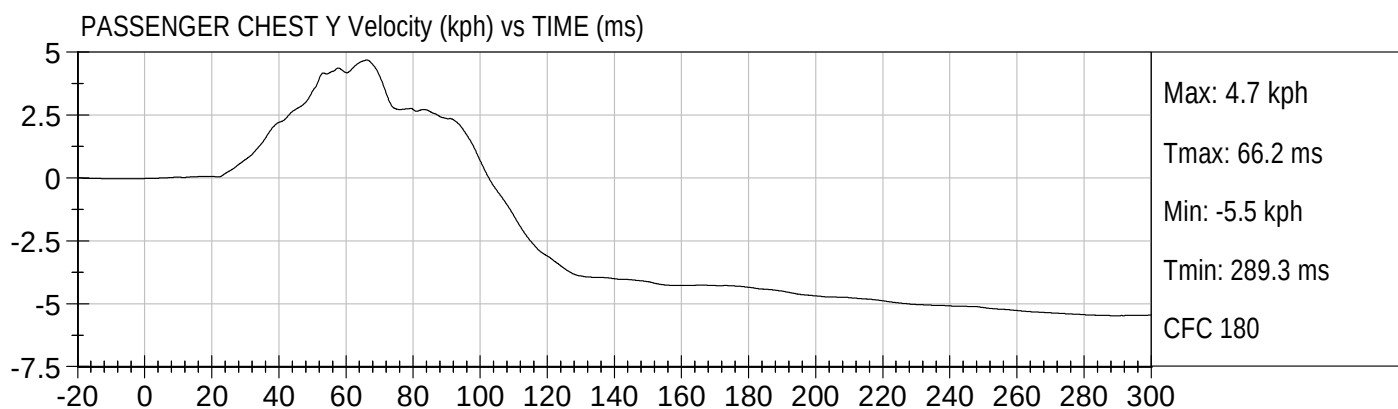
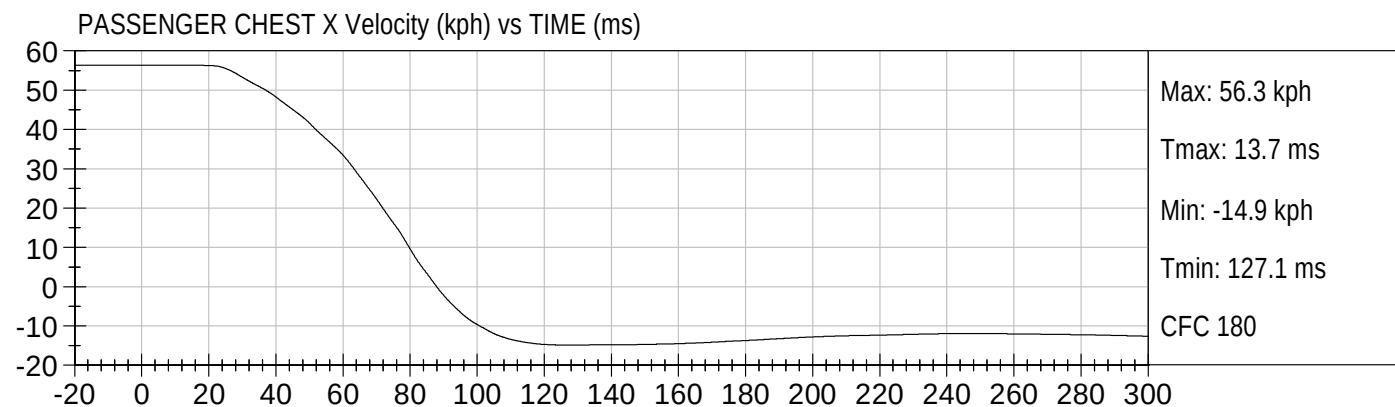


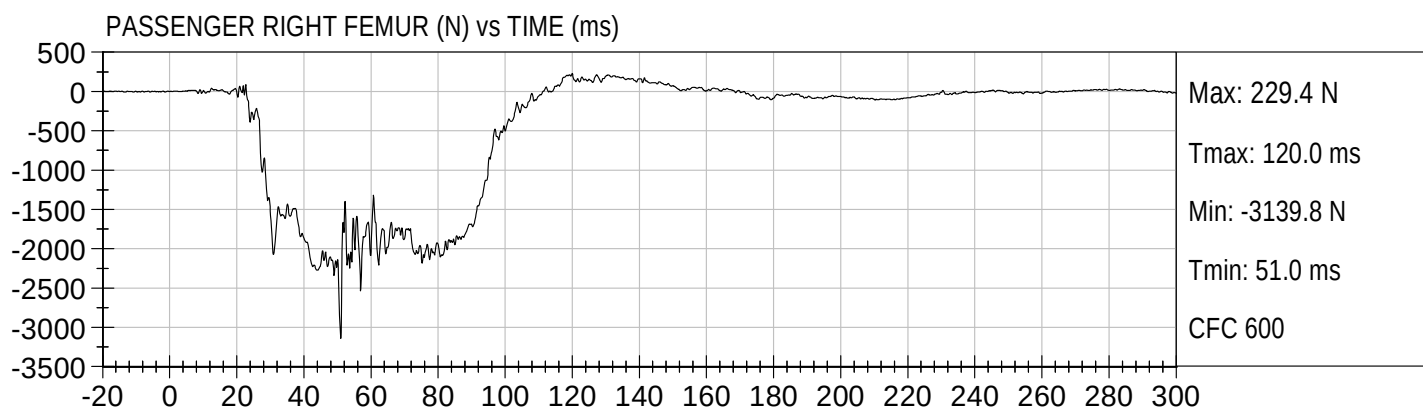
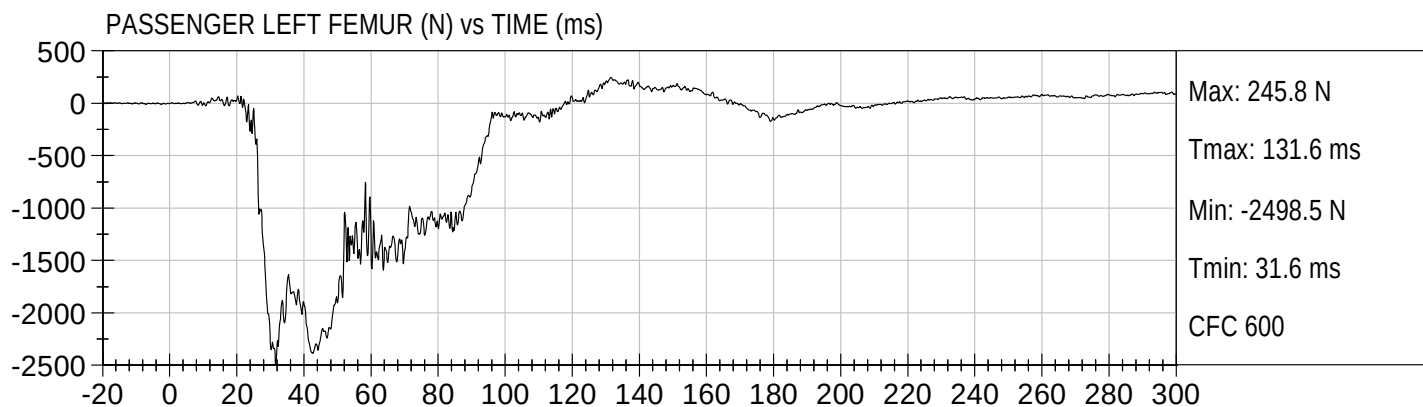












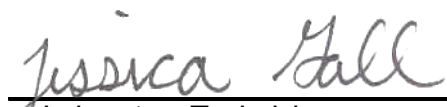
APPENDIX C
DUMMY CALIBRATION DATA

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

ATD Serial No: 065

Test ID: D09811

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Peak Resultant Acceleration	G's	225 - 275	246	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	7.2	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

4/13/09
Test Date

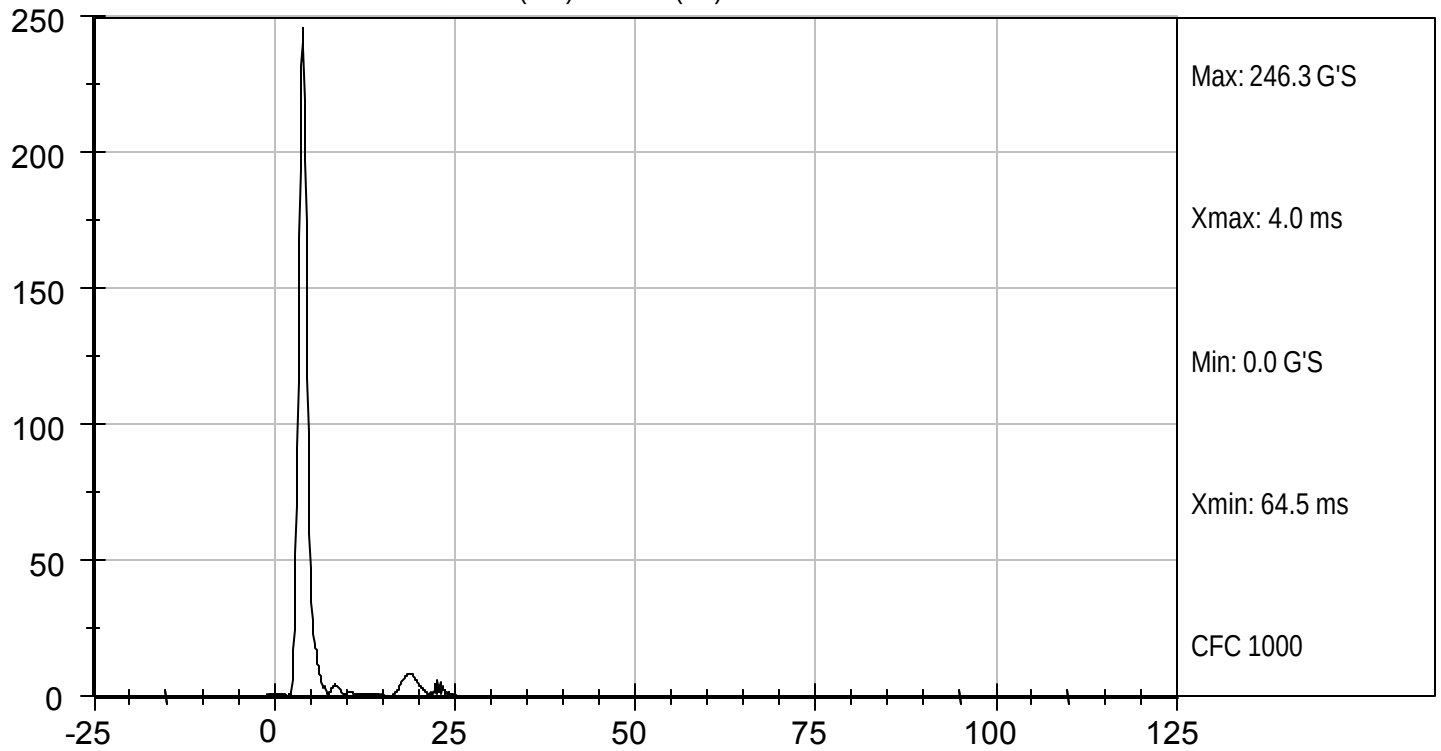

Approved By



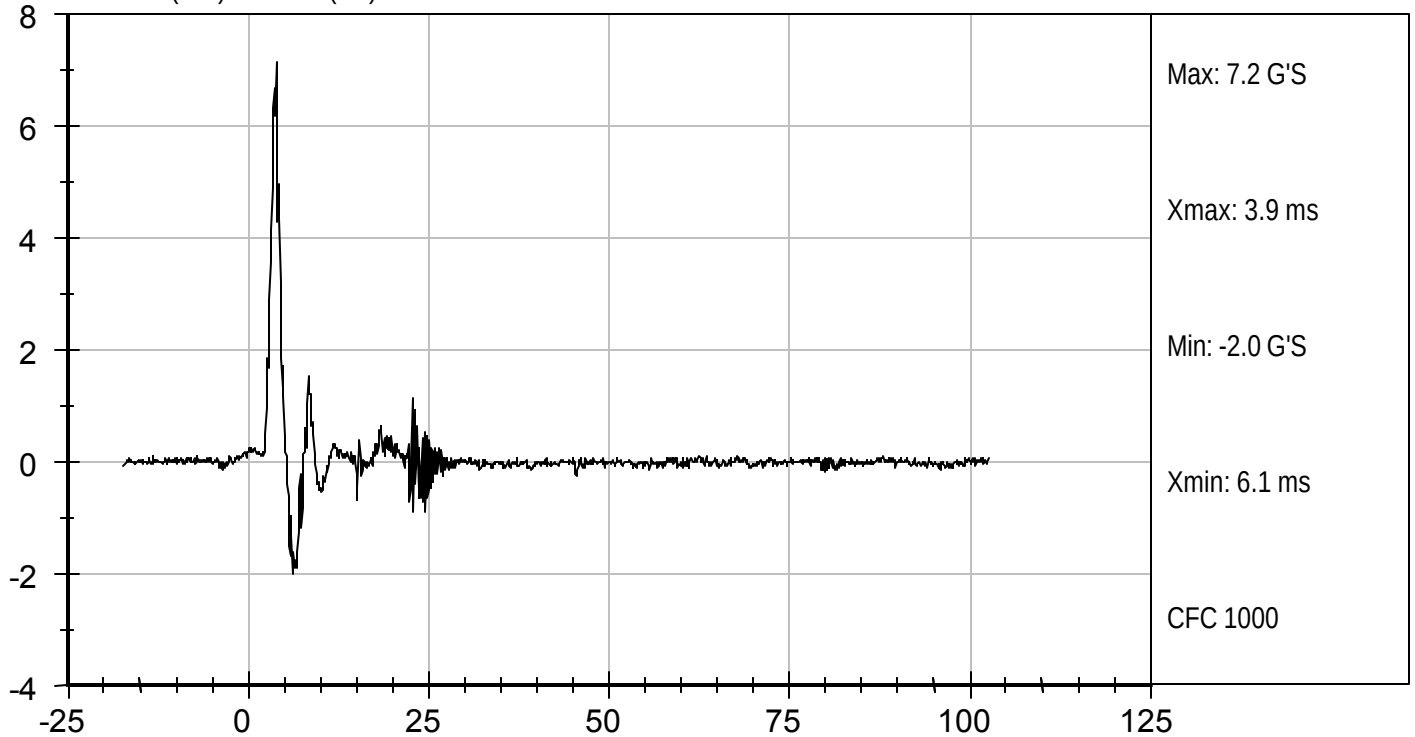
Test Desc: Head Drop
Component ID: D09811

Test Date: 4/13/09
Velocity: 0 ft/s, 0 m/s

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



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

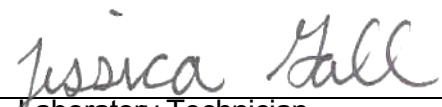


MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065

Test I.D: D09812

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	27	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.95	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	25.91	Pass
	20 msec	G's	17.60 to 22.60	18.87	Pass
	30 msec	G's	12.50 to 18.50	14.30	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	14.21	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	37.6	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	66.8	Pass
	Time	msec	57.0 to 64.0	58.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	116.1	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	95.1	Pass
	Time	msec	47.0 to 58.0	50.6	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	99.6	Pass
Overall Test Results					Pass


 Laboratory Technician

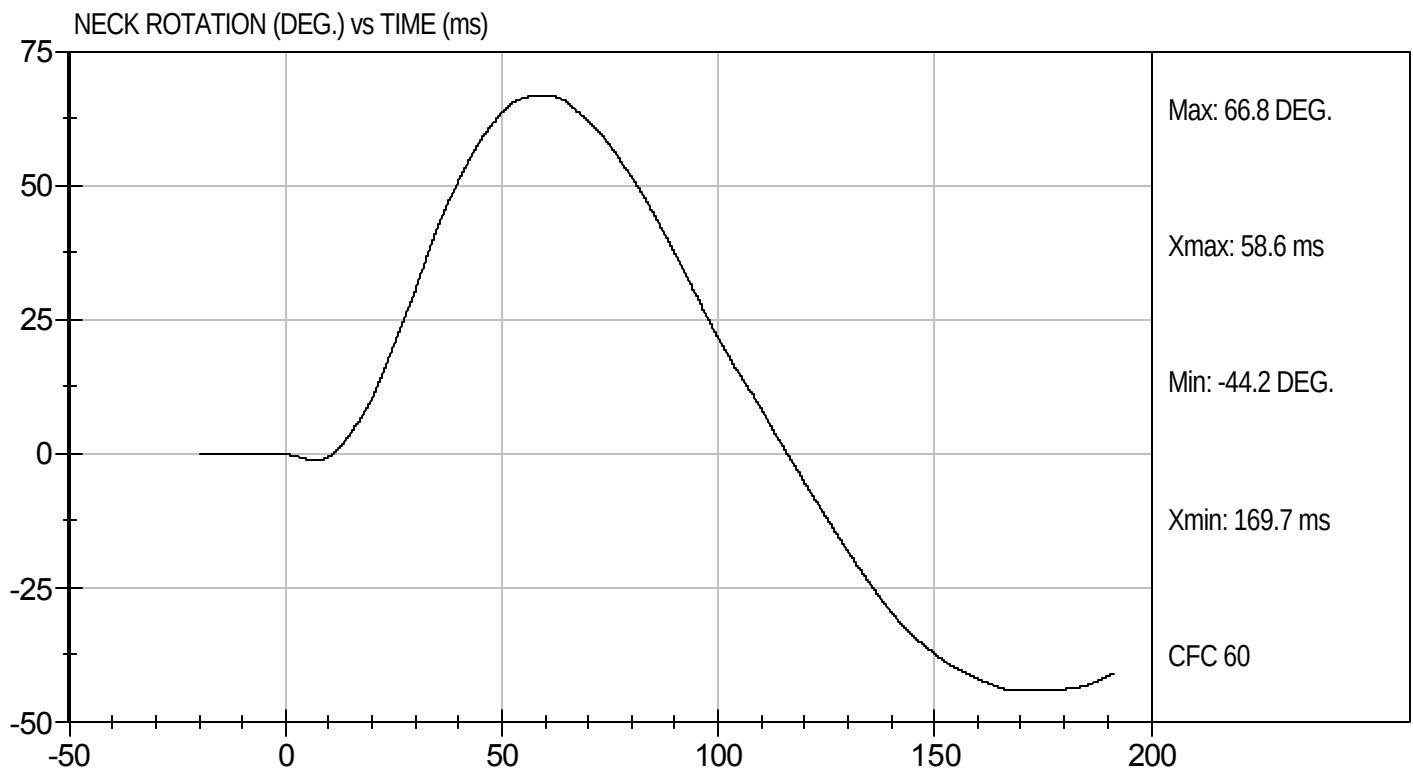
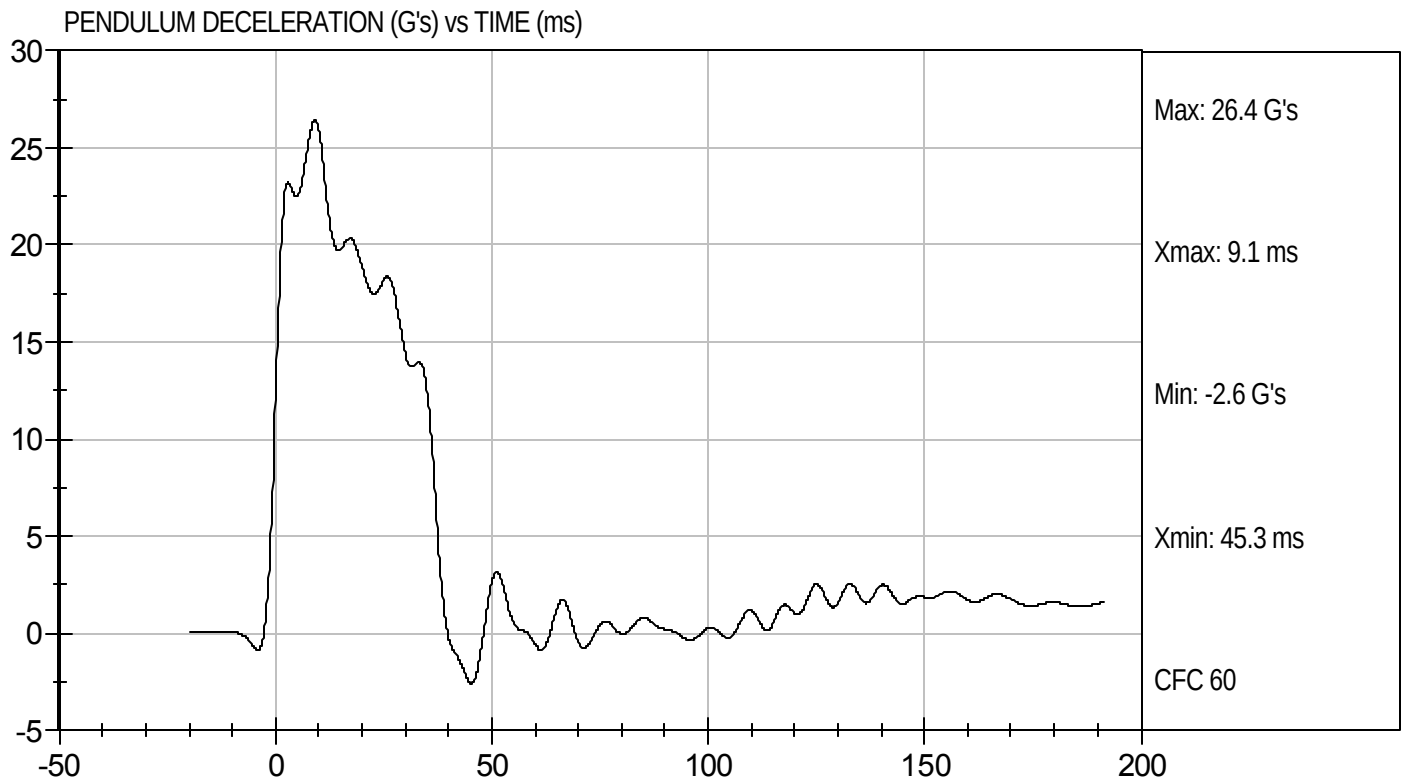
4/13/09
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D09812

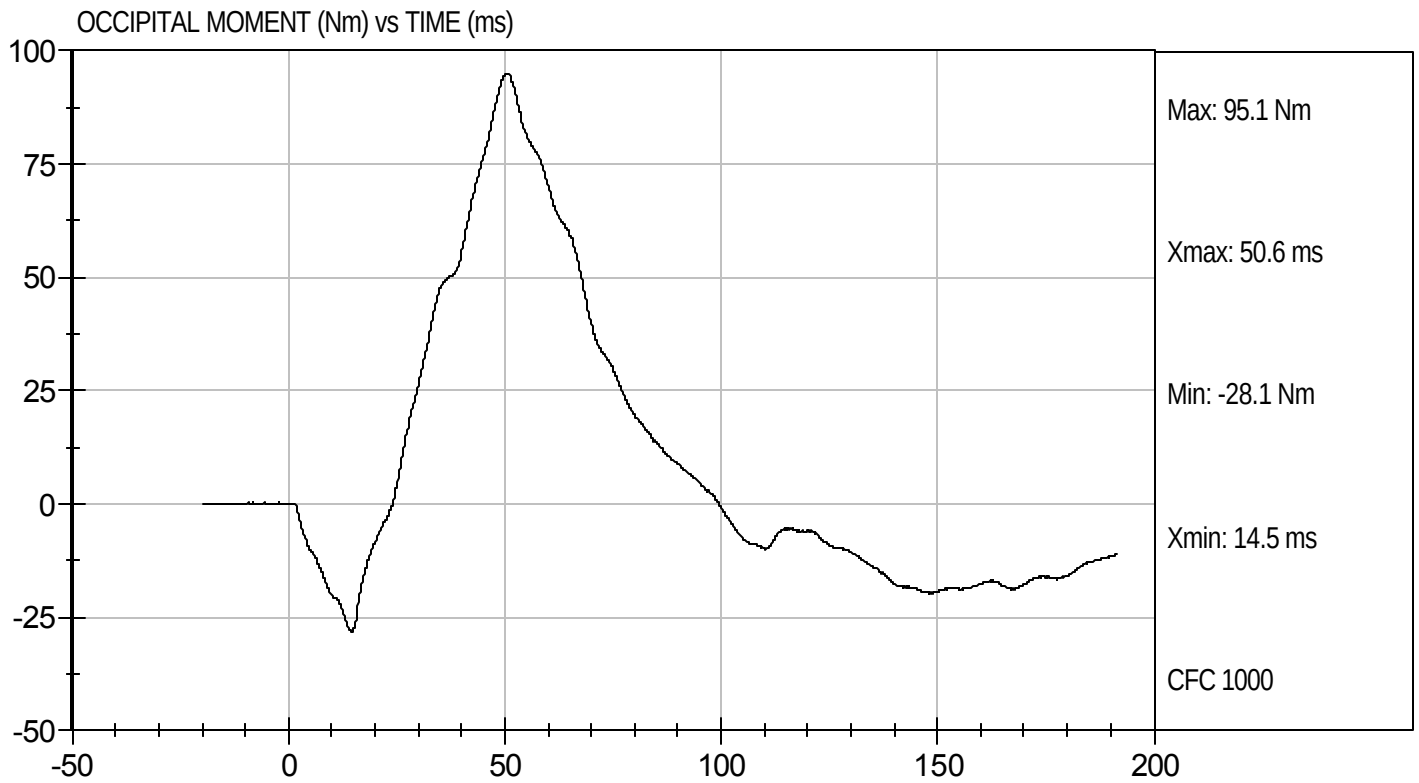
Test Date: 4/13/09
Velocity: 22.8 ft/s, 6.95 m/s





Test Desc: Neck Flexion
Component ID: D09812

Test Date: 4/13/09
Velocity: 22.8 ft/s, 6.95 m/s



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

ATD Serial No: 065

Test I.D: D09813

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.9	Pass
Laboratory Relative Humidity		%	10 to 70	26	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.19	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	19.38	Pass
	20 msec	G's	14.00 to 19.00	16.62	Pass
	30 msec	G's	11.00 to 16.00	14.50	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	14.50	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	92.8	Pass
	Time	msec	72.0 to 82.0	74.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	157.7	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-59.3	Pass
	Time	msec	65.0 to 79.0	69.8	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	141.3	Pass
Overall Test Results					Pass


 Laboratory Technician

4/14/09
 Test Date

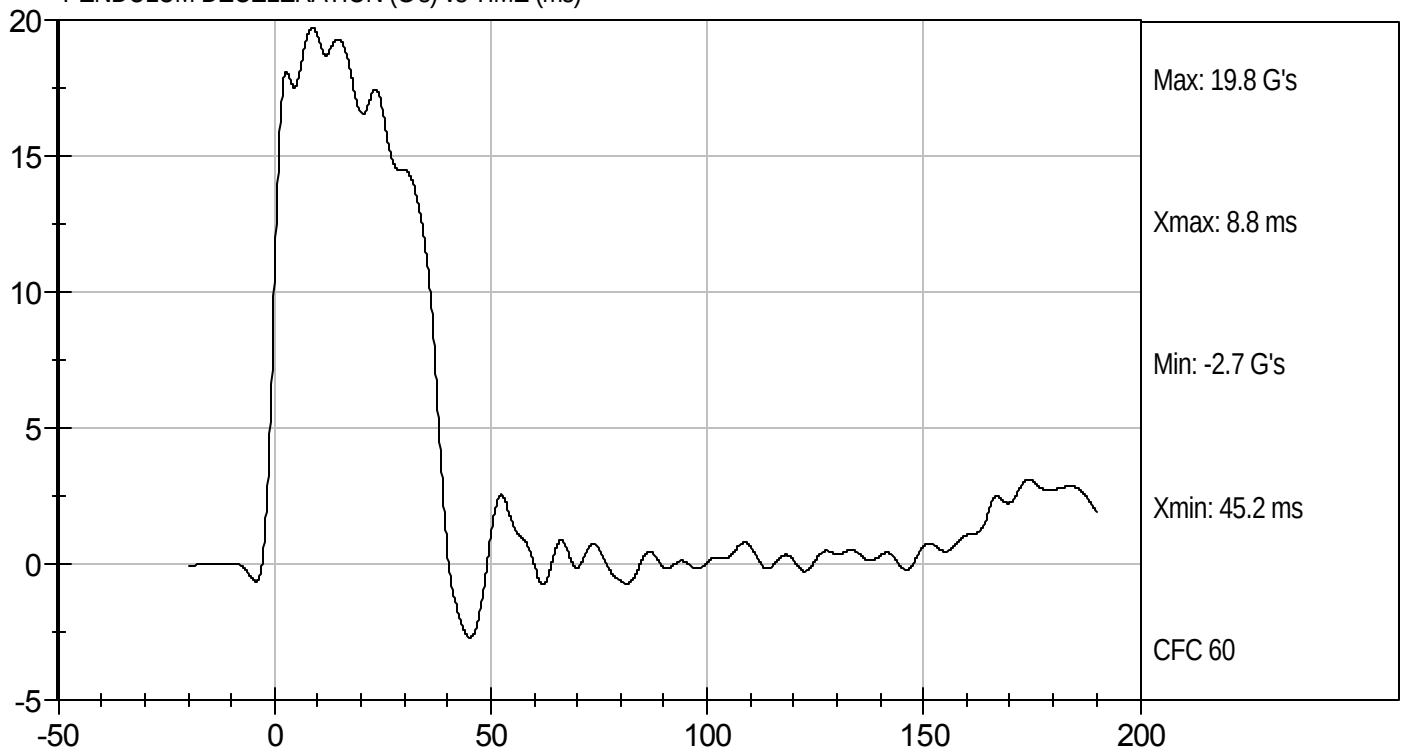

 Approved By



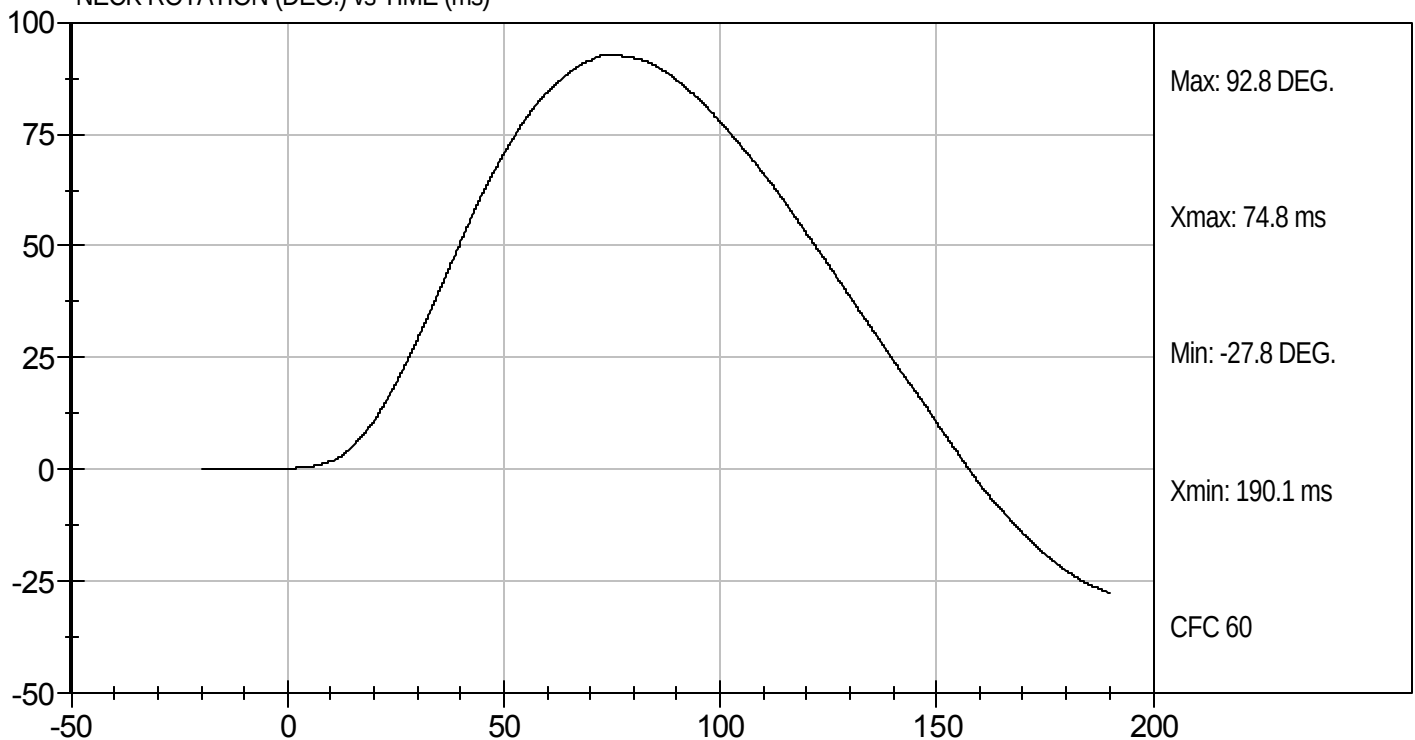
Test Desc: Neck Extension
Component ID: D09813

Test Date: 4/14/09
Velocity: 20.3 ft/s, 6.19 m/s

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



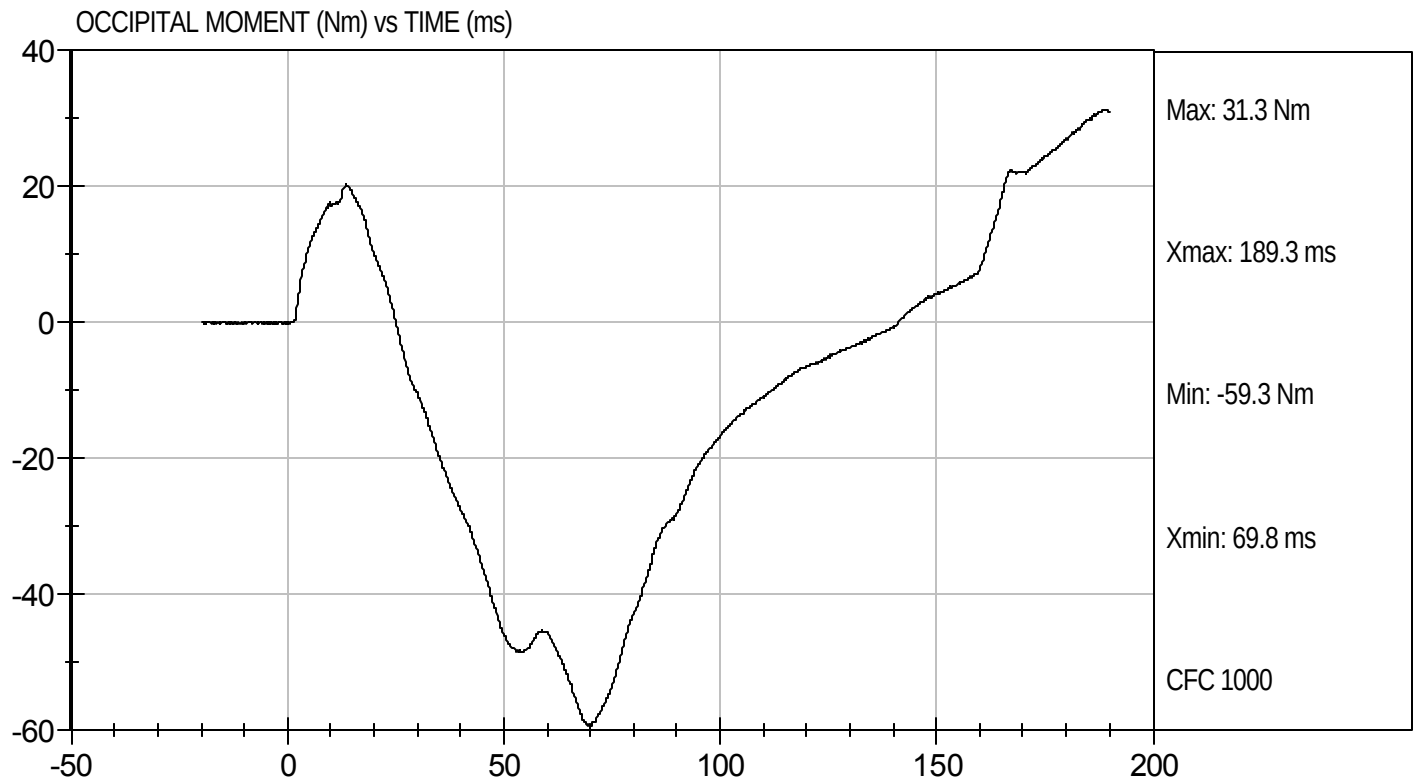
NECK ROTATION (DEG.) vs TIME (ms)





Test Desc: Neck Extension
Component ID: D09813

Test Date: 4/14/09
Velocity: 20.3 ft/s, 6.19 m/s



MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065

Test I.D: D09814

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,359	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.69	Pass
Internal Hysteresis	%	69 to 85	72	Pass
Overall Test Results			Pass	


Laboratory Technician

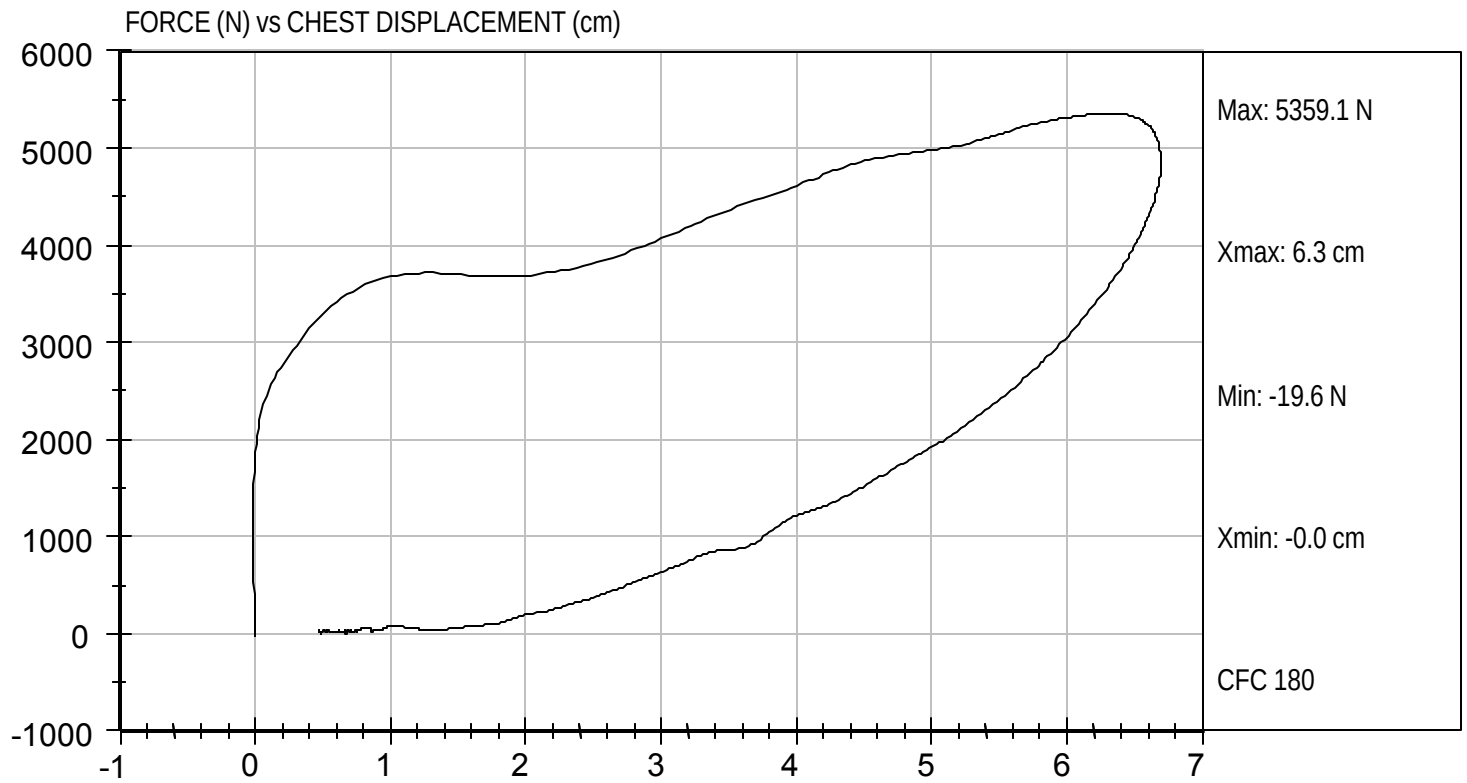
4/14/09
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D09814

Test Date: 4/14/09
Velocity: 22.2 ft/s, 6.77 m/s

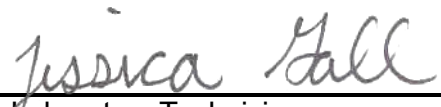


MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065

Test I.D: D09815

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.09	Pass
Peak Probe Force	Newtons	4715 to 5782	5,233	Pass
Overall Test Results				Pass



Laboratory Technician

4/13/09

Test Date

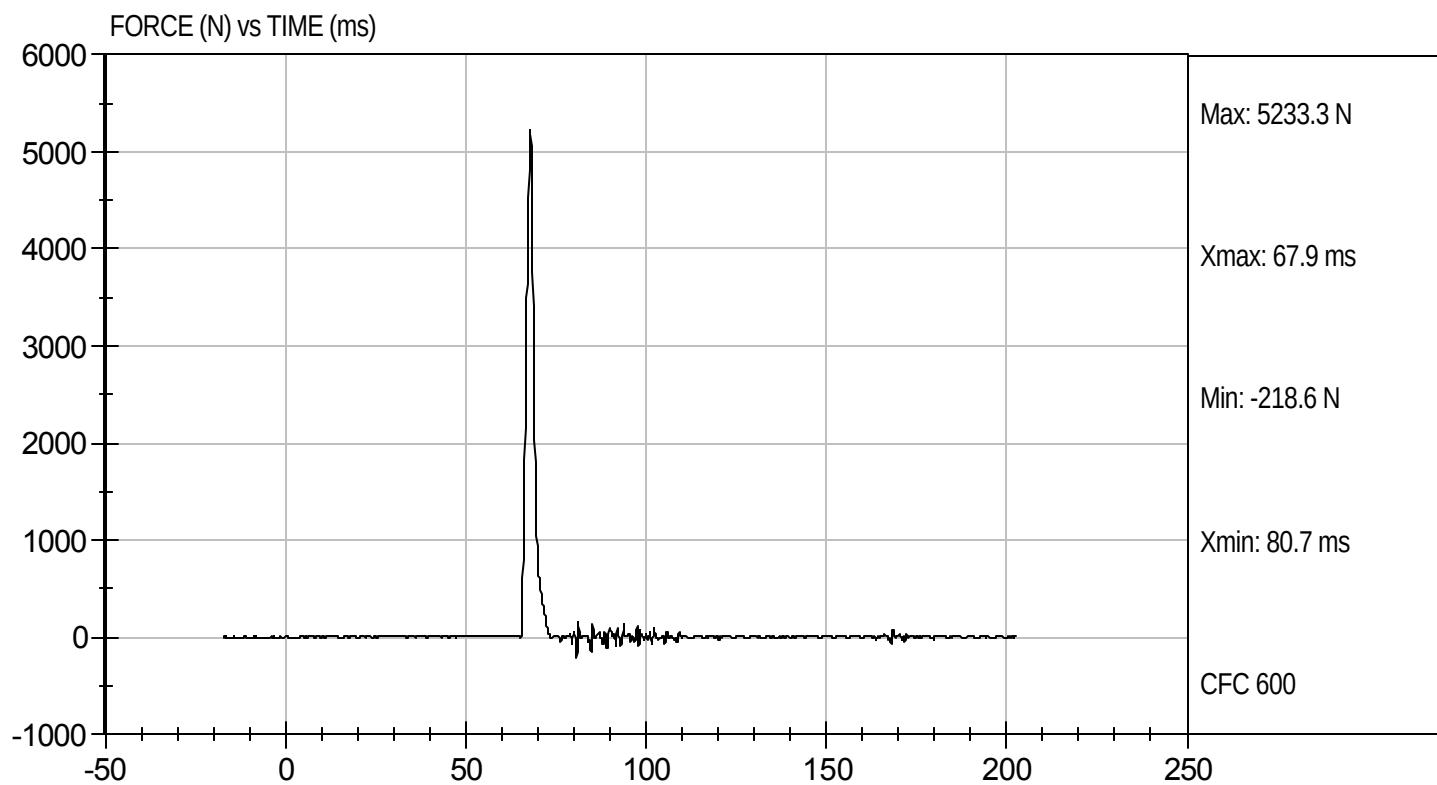


Approved By



Test Desc: Right Knee
Component ID: D09815

Test Date: 4/13/09
Velocity: 6.86 ft/s, 2.09 m/s



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

ATD Serial No: 065

Test I.D: D09816

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.07	Pass
Peak Probe Force	Newtons	4715 to 5782	5,262	Pass
Overall Test Results				Pass



Laboratory Technician

4/13/09

Test Date

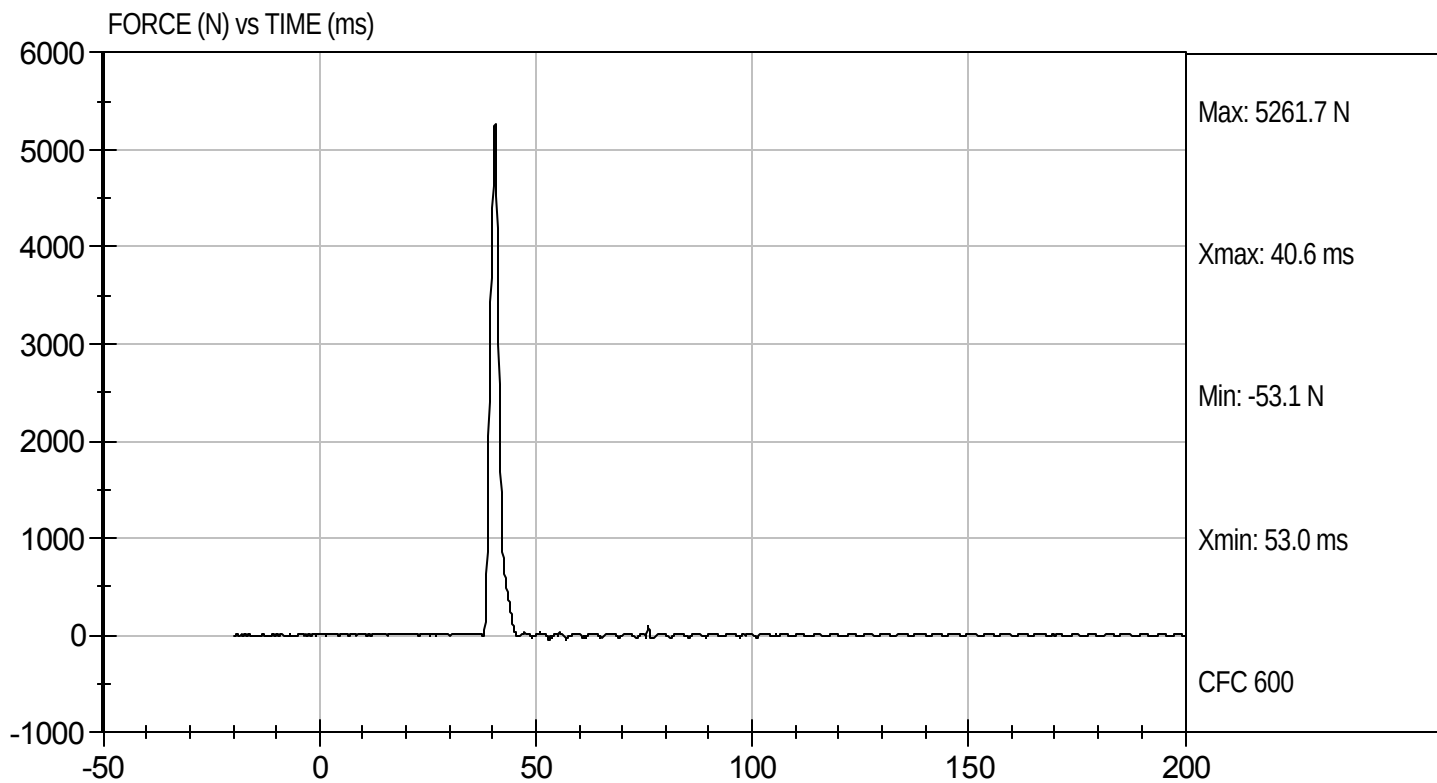


Approved By



Test Desc: Left Knee
Component ID: D09816

Test Date: 4/13/09
Velocity: 6.80 ft/s, 2.07 m/s

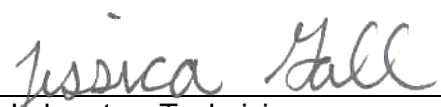


MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065

Test I.D: D09810

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	27	27	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	59.5	54.8	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	43	42	Pass
Overall Test Results					Pass


 Laboratory Technician

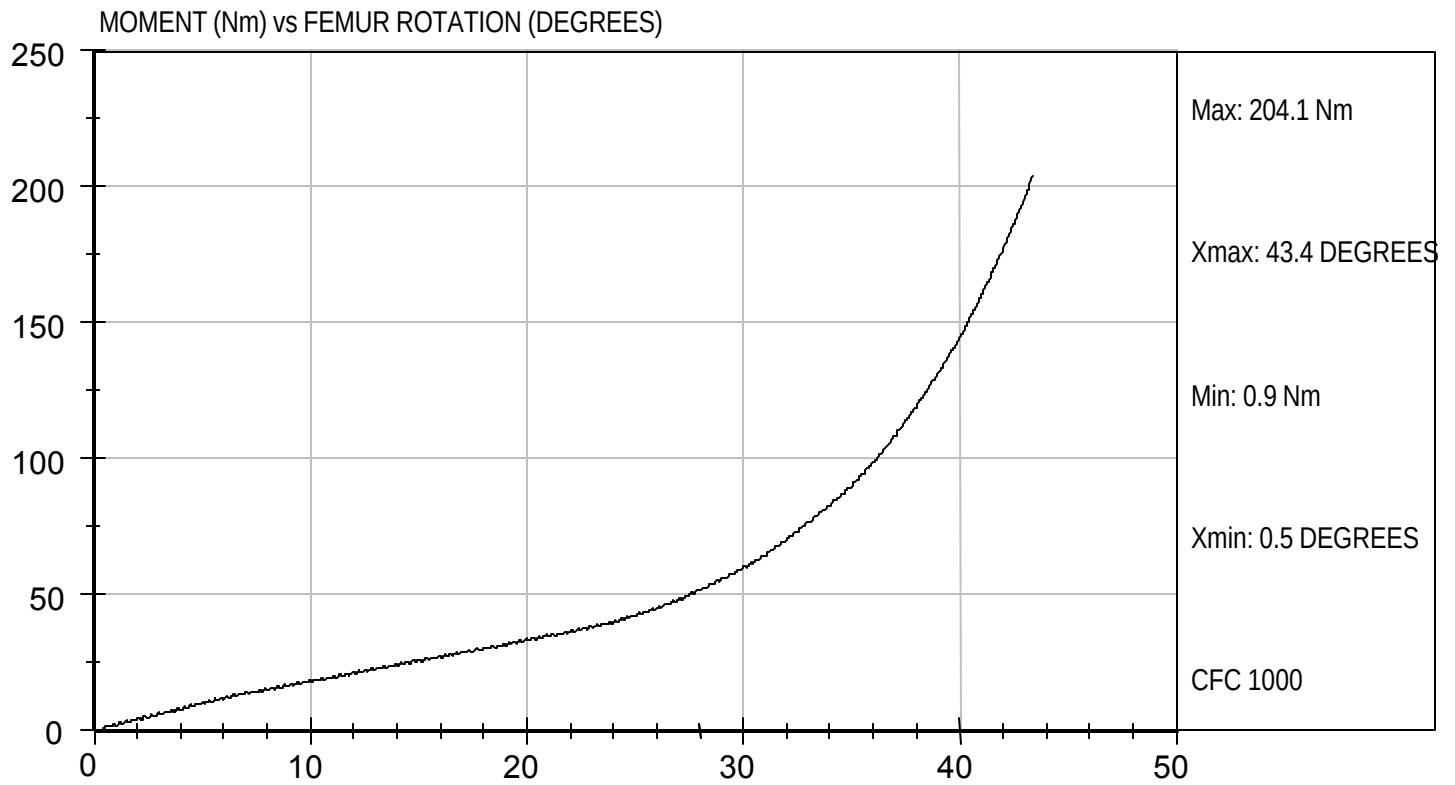
4/13/09
 Test Date


 Approved By



Test Desc: Hip Femur Flexion
Component ID: D09819

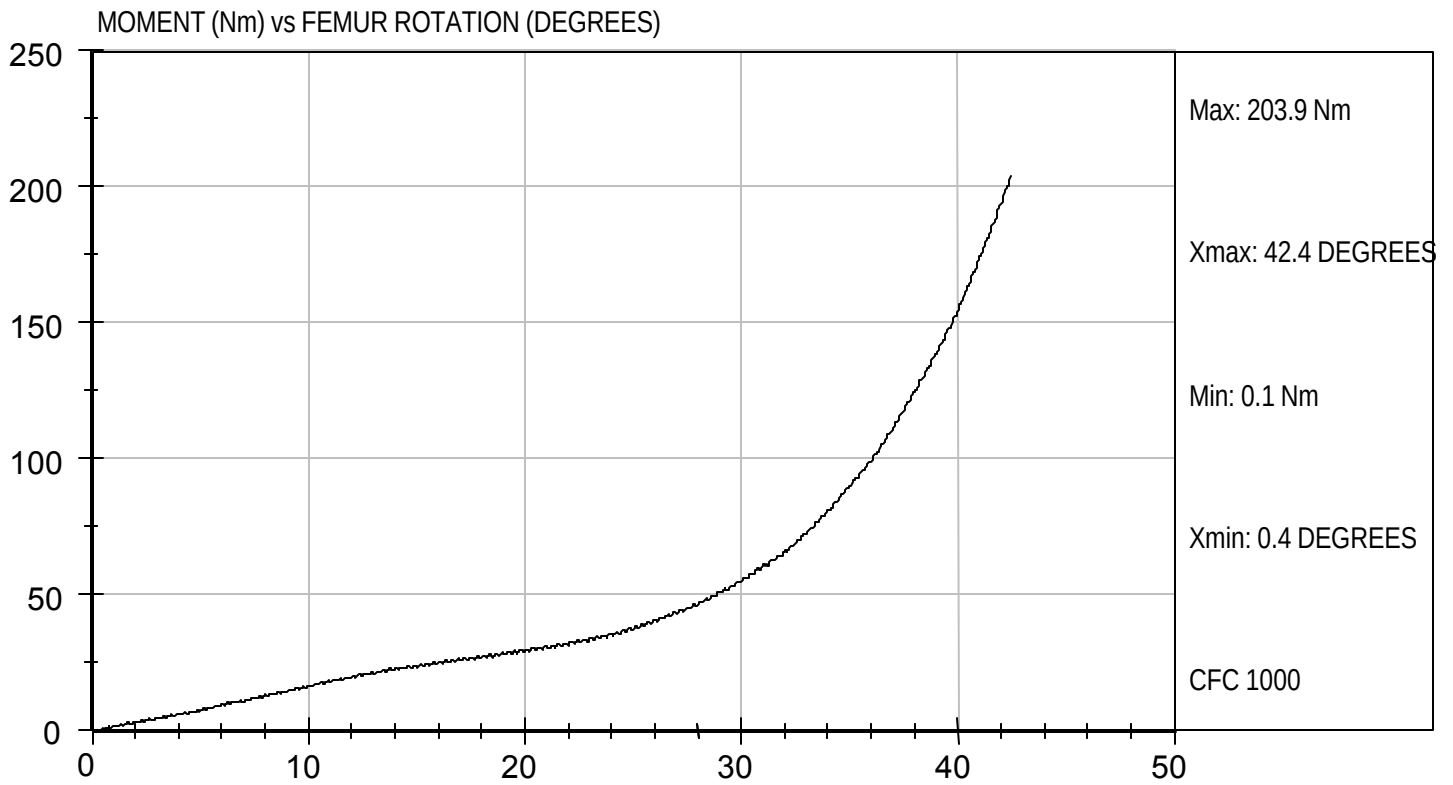
Test Date: 4/13/09
Velocity: 0 ft/s, 0 m/s





Test Desc: Hip Femur Flexion
Component ID: D09810

Test Date: 4/13/09
Velocity: 0 ft/s, 0 m/s

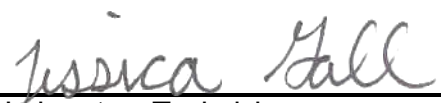


MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066

Test ID: D09821

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Peak Resultant Acceleration	G's	225 - 275	240	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-11.9	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

4/13/09
Test Date

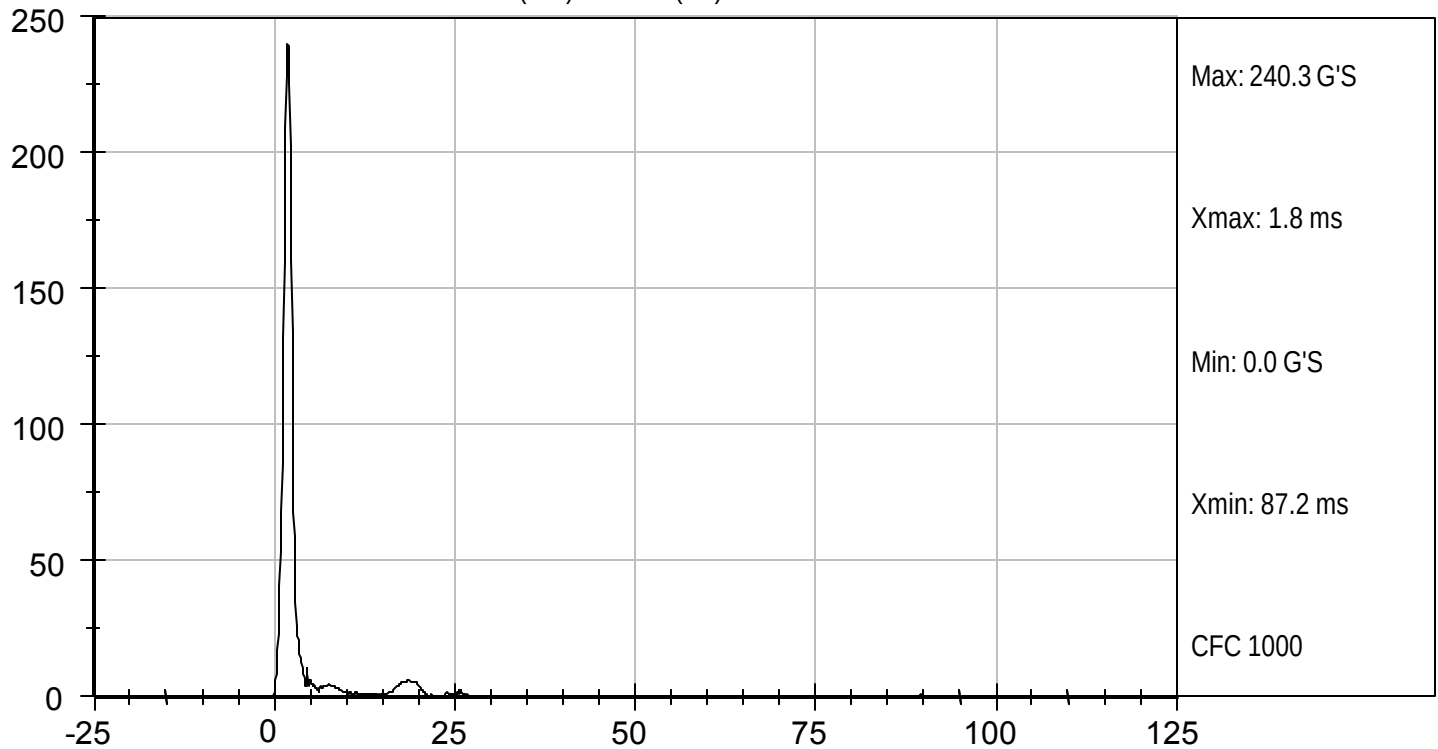

Approved By



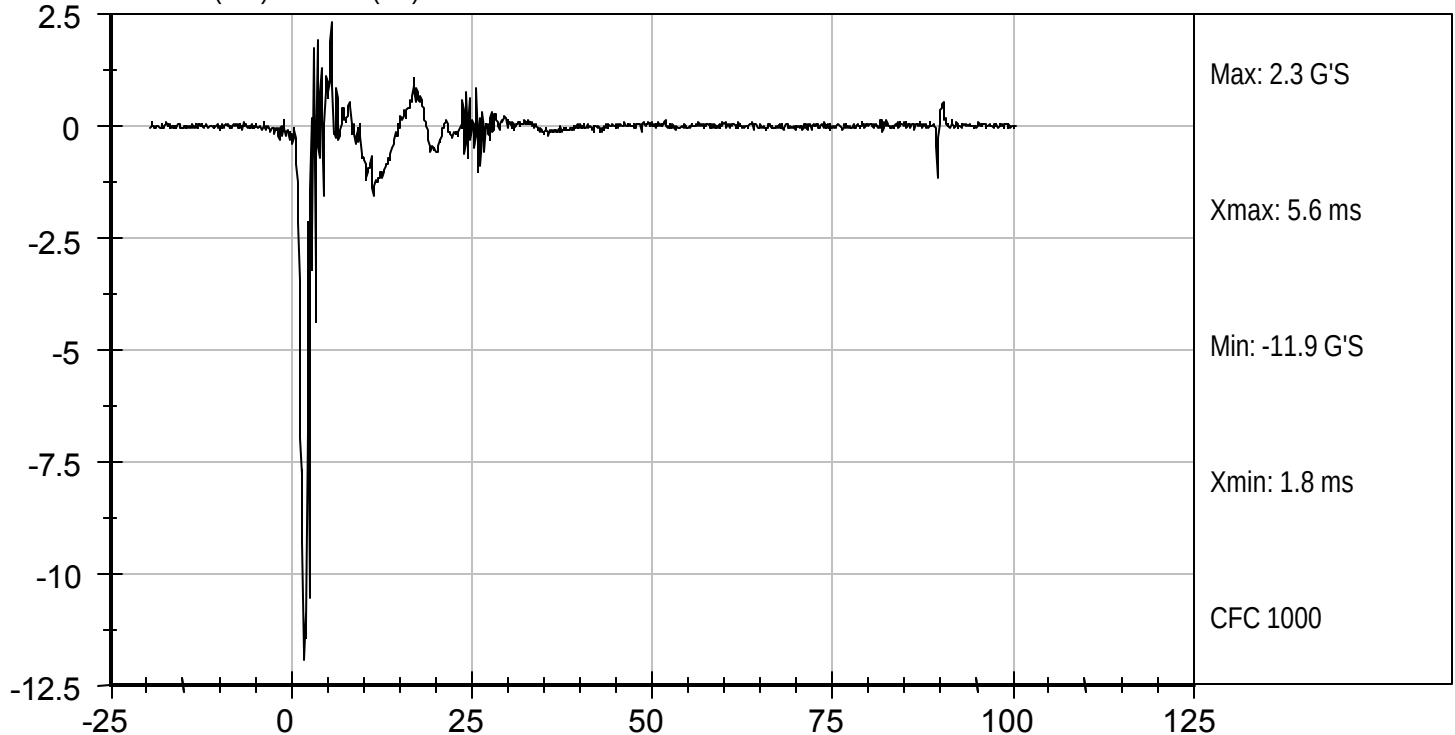
Test Desc: Head Drop
Component ID: D09821

Test Date: 4/13/09
Velocity: 0 ft/s, 0 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: D09822

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	27	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.04	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	22.52	Pass
	20 msec	G's	17.60 to 22.60	18.43	Pass
	30 msec	G's	12.50 to 18.50	15.03	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	15.3	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	40.6	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	68.9	Pass
	Time	msec	57.0 to 64.0	58.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	113.1	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	98.2	Pass
	Time	msec	47.0 to 58.0	53.1	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	99.9	Pass
Overall Test Results					Pass


 Laboratory Technician

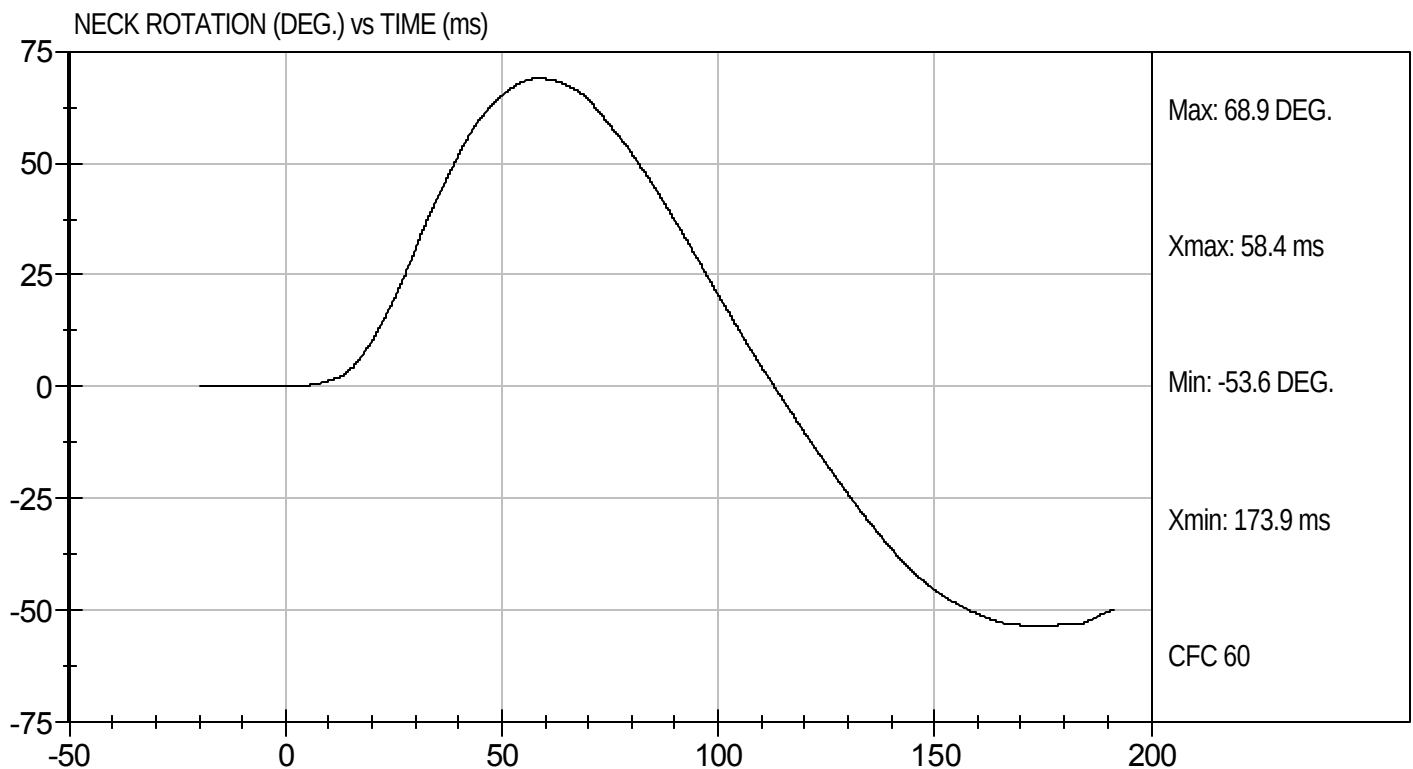
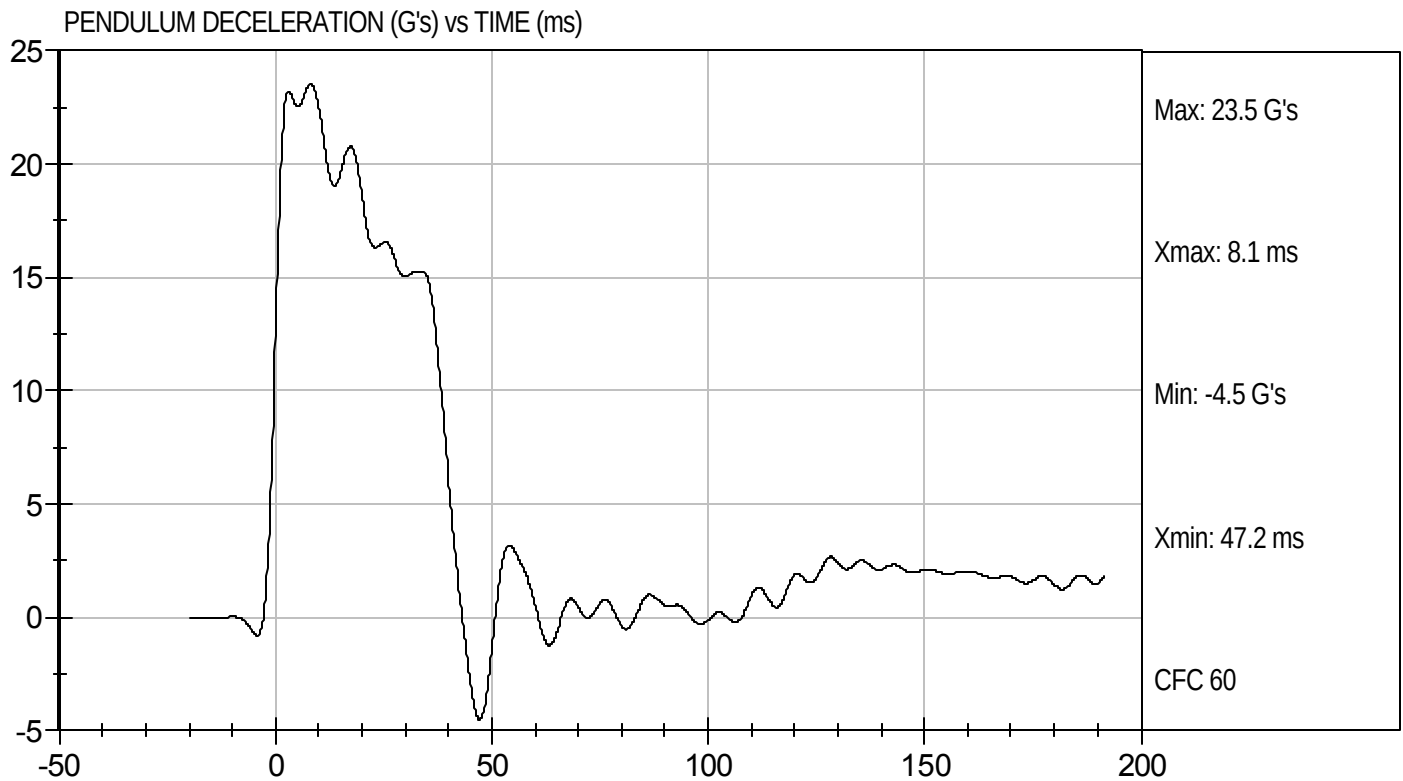
4/14/09
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D09822

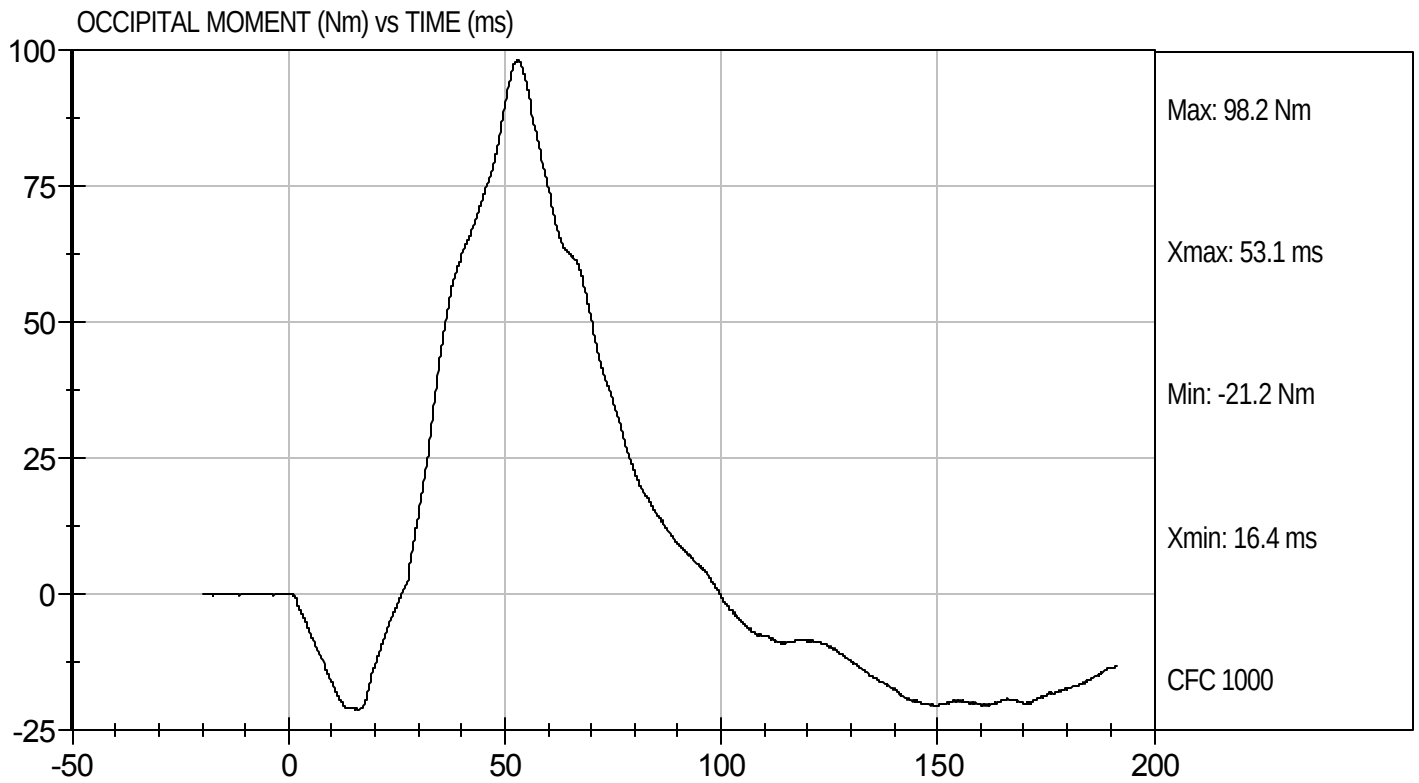
Test Date: 4/14/09
Velocity: 23.1 ft/s, 7.04 m/s





Test Desc: Neck Flexion
Component ID: D09822

Test Date: 4/14/09
Velocity: 23.1 ft/s, 7.04 m/s



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

ATD Serial No: 066

Test I.D: D09823

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	29	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.04	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	20.13	Pass
	20 msec	G's	14.00 to 19.00	14.97	Pass
	30 msec	G's	11.00 to 16.00	13.89	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.85	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	41.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	95.0	Pass
	Time	msec	72.0 to 82.0	76.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	156.1	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-58.9	Pass
	Time	msec	65.0 to 79.0	74.3	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	145.7	Pass
Overall Test Results					Pass


 Laboratory Technician

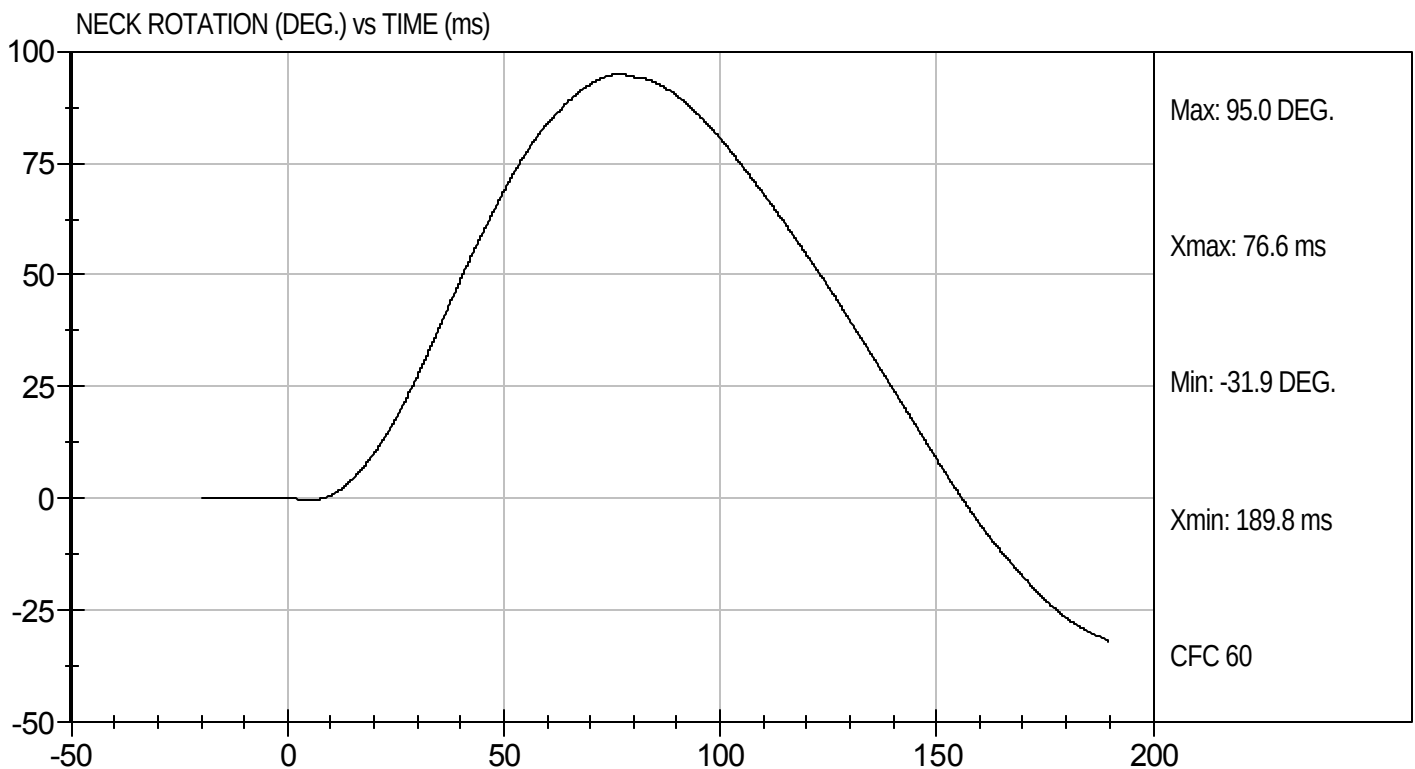
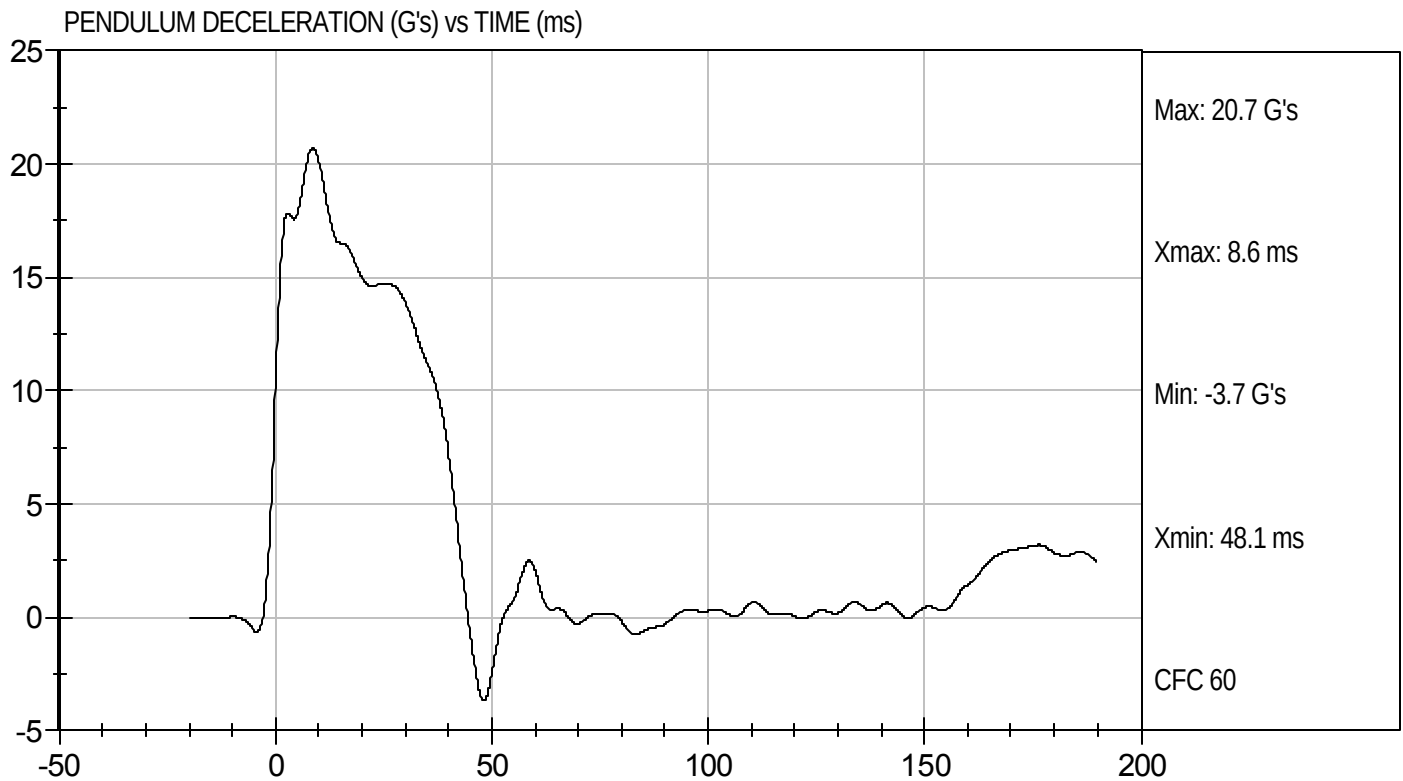
4/14/09
 Test Date


 Approved By



Test Desc: Neck Extension
Component ID: D09823

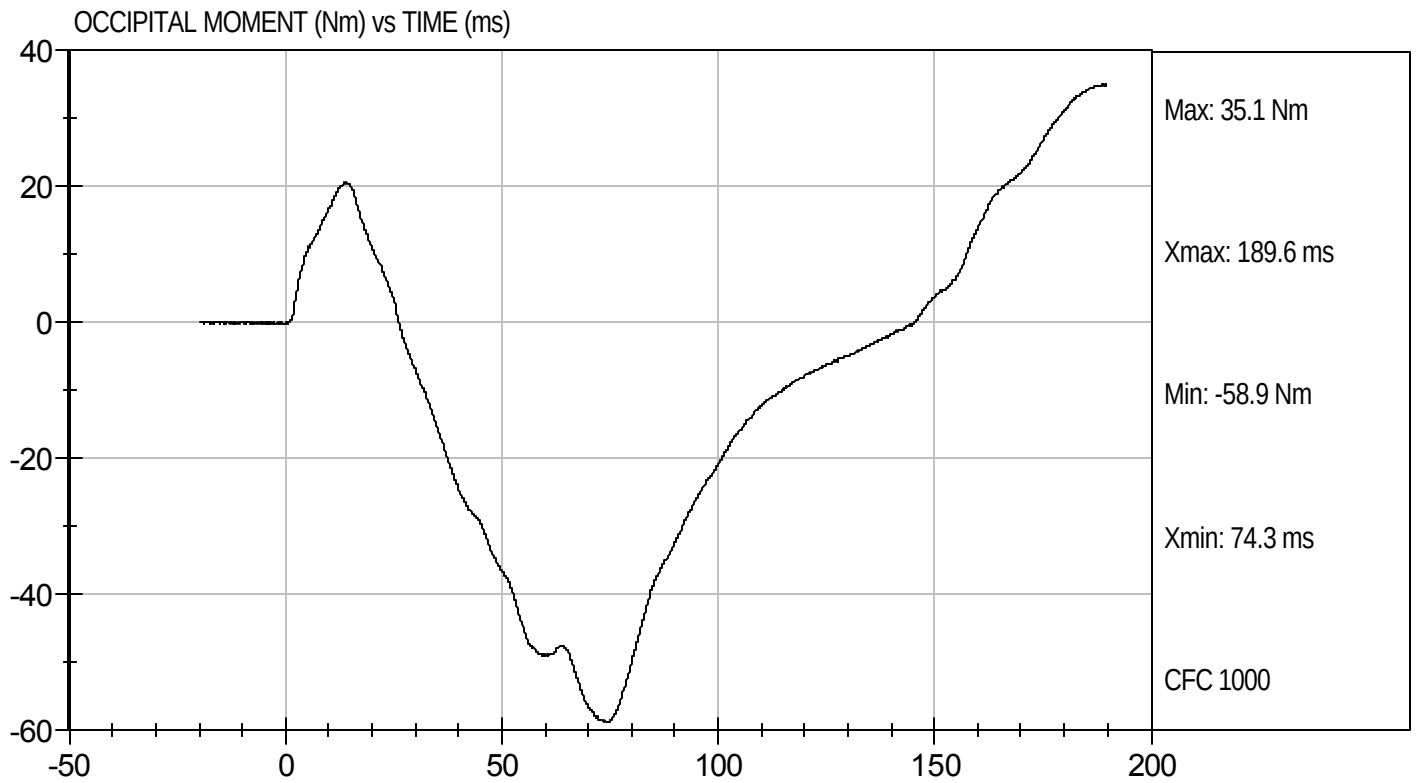
Test Date: 4/14/09
Velocity: 19.8 ft/s, 6.04 m/s





Test Desc: Neck Extension
Component ID: D09823

Test Date: 4/14/09
Velocity: 19.8 ft/s, 6.04 m/s

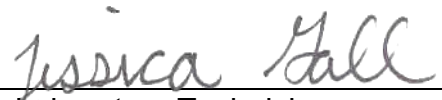


MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066

Test I.D: D09824

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	22	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,409	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.41	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Overall Test Results			Pass	


Laboratory Technician

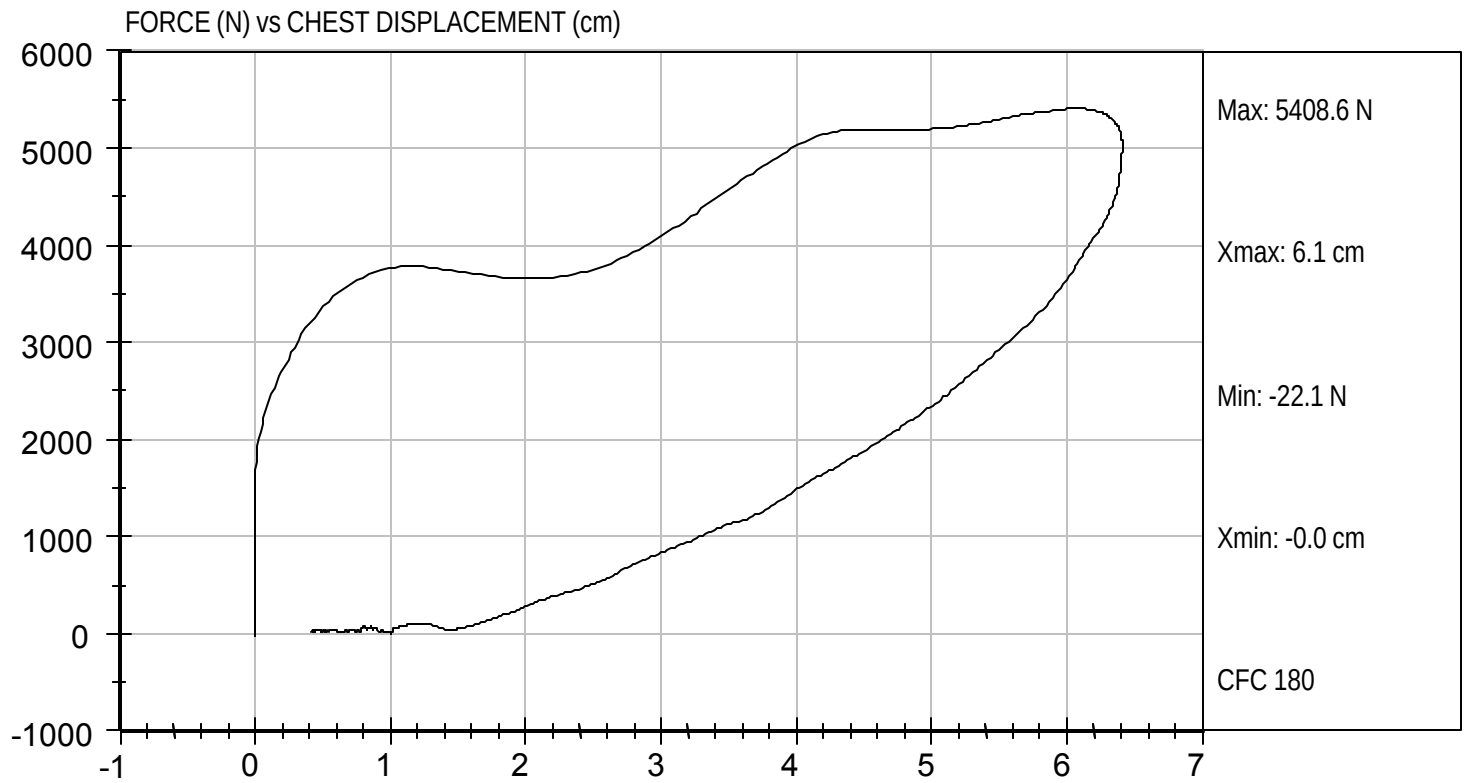
4/14/09
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D09824

Test Date: 4/14/09
Velocity: 22.2 ft/s, 6.77 m/s

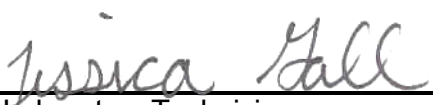


MGA RESEARCH CORPORATION
RIGHT KNEE IMPACT TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066

Test I.D: D09825

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.13	Pass
Peak Probe Force	Newtons	4715 to 5782	5,724	Pass
Overall Test Results				Pass



Laboratory Technician

4/13/09
Test Date

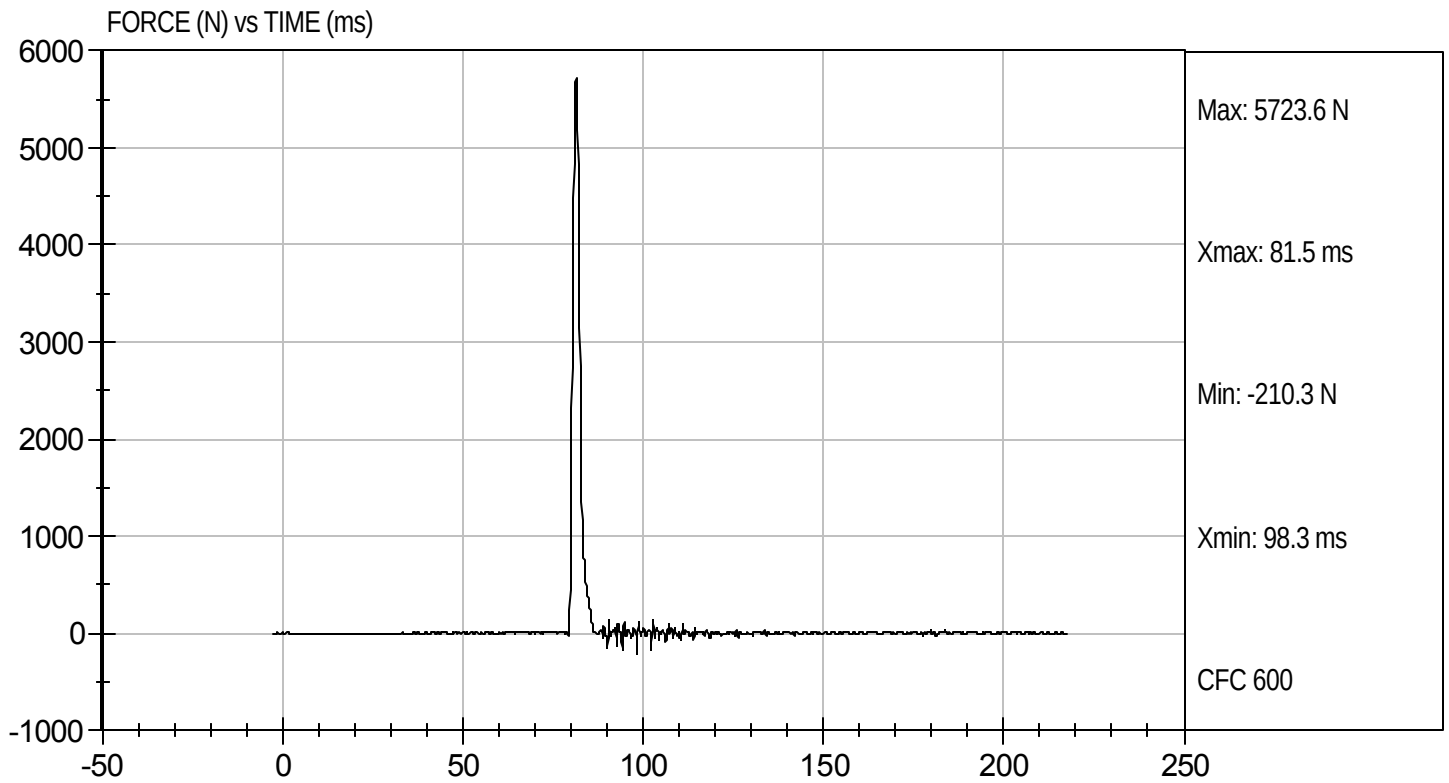


Approved By



Test Desc: Right Knee
Component ID: D09825

Test Date: 4/13/09
Velocity: 7.00 ft/s, 2.13 m/s



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

ATD Serial No: 066

Test I.D: D09826

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	25	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.10	Pass
Peak Probe Force	Newtons	4715 to 5782	4,962	Pass
Overall Test Results				Pass



Laboratory Technician

4/13/09
Test Date

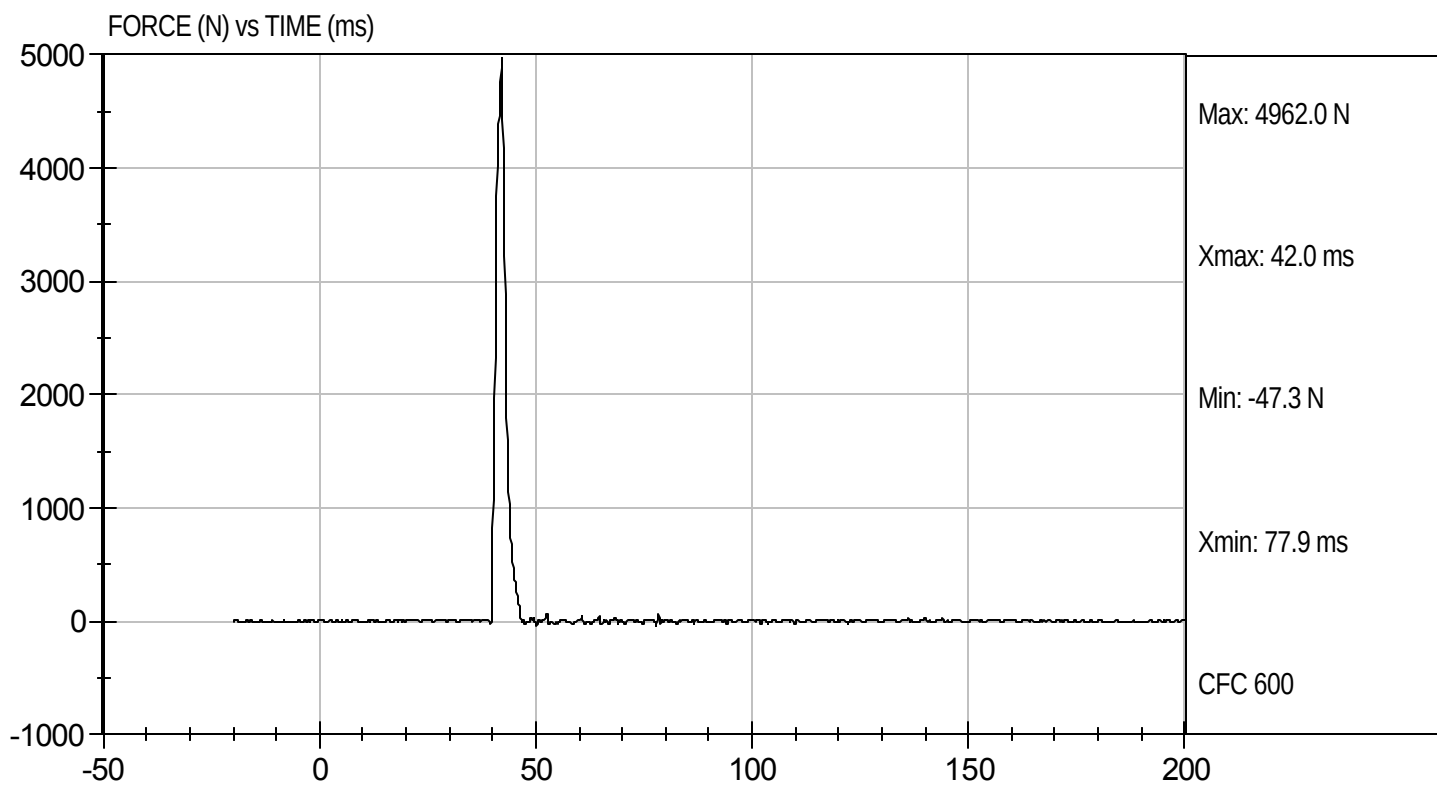


Approved By



Test Desc: Left Knee
Component ID: D09826

Test Date: 4/13/09
Velocity: 6.89 ft/s, 2.10 m/s

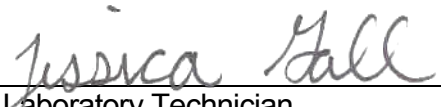


MGA RESEARCH CORPORATION
HIP-FEMUR FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066

Test I.D: D09820

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	27	27	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	78.3	86.1	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	42	41	Pass
Overall Test Results					Pass


 Laboratory Technician

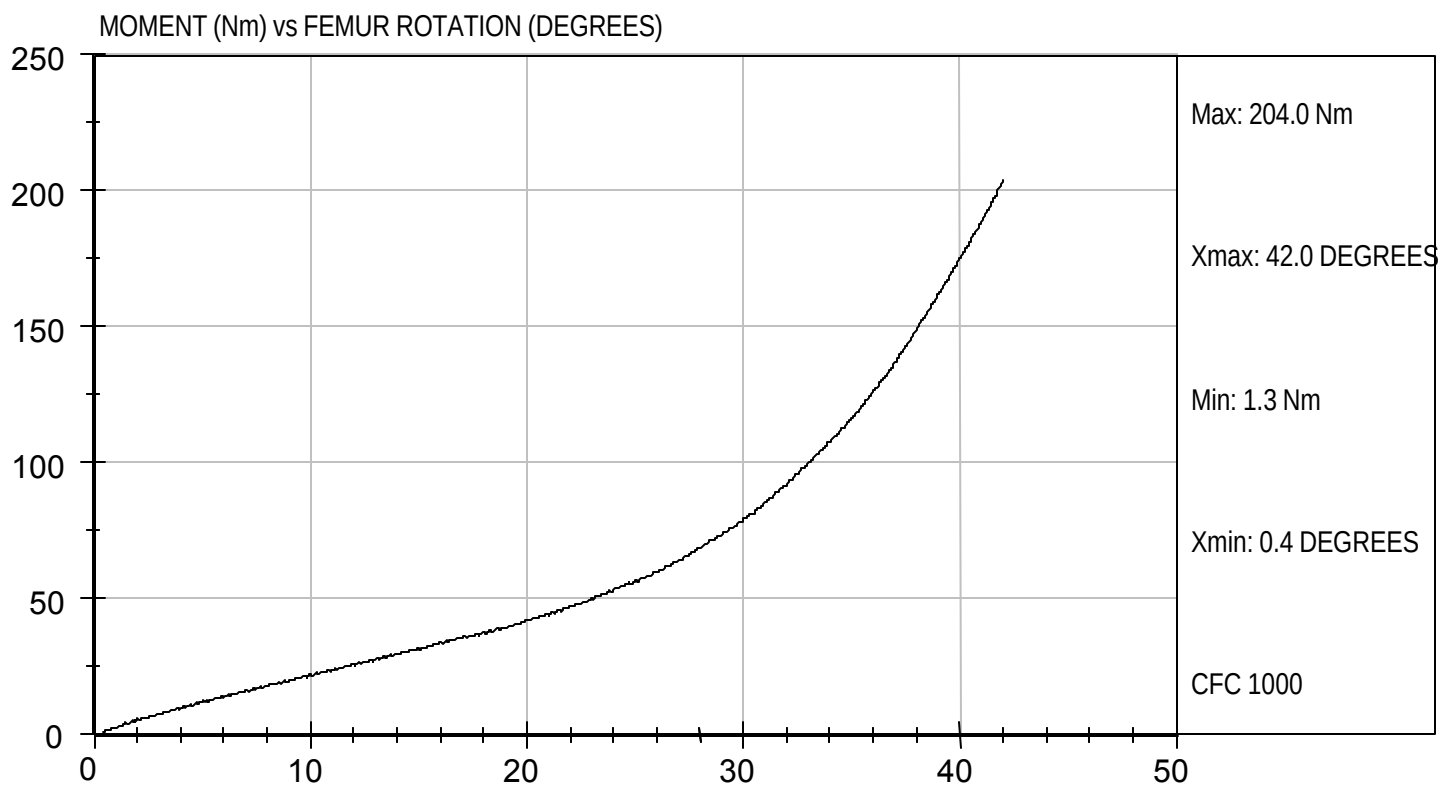
4/13/09
 Test Date


 Approved By



Test Desc: Hip Femur Flexion
Component ID: D09829

Test Date: 4/13/09
Velocity: 0 ft/s, 0 m/s





Test Desc: Hip Femur Flexion
Component ID: D09820

Test Date: 4/13/09
Velocity: 0 ft/s, 0.00 m/s

