

REPORT NUMBER: NCAP-MGA-2010-010

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

**BAYERISCHE MOTORENWERKE
2010 BMW 328i COUPE
NHTSA NUMBER: MA0515**

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



Test Date: November 19, 2009

Final Report Date: December 10, 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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Technical Report Documentation Page

1. Report No. NCAP-MGA-2010-010	2. Government Accession No.	3. Recipient's Catalog No.																										
4. Title and Subtitle Final Report of New Car Assessment Program Testing of a 2010 BMW 328i Coupe NHTSA No.: MA0515		5. Report Date December 10, 2009																										
		6. Performing Organization Code MGA																										
7. Author(s) Joe Fleck, Project Engineer David Winkelbauer, Director of Operations		8. Performing Organization Report No. NCAP-MGA-2010-010																										
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		10. Work Unit No.																										
		11. Contract or Grant No. DTNH22-06-D-00028																										
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Rulemaking, Office of Crashworthiness Standards 1200 New Jersey Ave, SE, Room W43-410, NVS-111 Washington, D.C. 20590		13. Type of Report and Period Covered Final Report 11/19/2009 to 12/10/2009																										
		14. Sponsoring Agency Code NVS-111																										
15. Supplementary Notes																												
16. Abstract A frontal barrier impact was conducted on a 2010 BMW 328i Coupe at MGA Research Corporation on November 19, 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 569 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 style="width: 100%; margin-top: 10px;"> <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>444</td> <td>405*</td> </tr> <tr> <td>Max. Thorax Accel. (3ms Clip)</td> <td>G's</td> <td>60</td> <td>50</td> <td>48</td> </tr> <tr> <td>Left Femur Force</td> <td>Newton</td> <td>10009</td> <td>-1748</td> <td>**</td> </tr> <tr> <td>Right Femur Force</td> <td>Newton</td> <td>10009</td> <td>-1119</td> <td>-729</td> </tr> </tbody> </table> * Redundant Head X and Z curves used in the Passenger HIC calculation ** See Test Notes on Page 2.				<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	444	405*	Max. Thorax Accel. (3ms Clip)	G's	60	50	48	Left Femur Force	Newton	10009	-1748	**	Right Femur Force	Newton	10009	-1119	-729
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17. Key Words 56.3 km/h NCAP Frontal Barrier Impact Test New Car Assessment Program (NCAP) 2010 BMW 328i Coupe NHTSA No: MA0515		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																										
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 121	22. Price																									

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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 2010 BMW 328i Coupe at a velocity of 56.3 kph. The test was performed at MGA Research Corporation on November 19, 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. 066) and right-front passenger (position 2) ATD (Serial No. 065) 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 569 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 A-Post. 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	444	58.2	94.2	50	73.9	77.3	-24	-1748	-1119
Passenger	405*	62.9	98.0	48	70.6	73.6	-24	**	-729

* Redundant Head X and Z curves used in the Passenger HIC calculation

** See Test Notes below.

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 Y after 25 msec.

Passenger Left Femur after 80 msec.

Right Brake Caliper X

Left Rear Seat Crossmember Z after 220 msec.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
CRASH TEST SUMMARY

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Door was unlocked	Door was 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		
Seat Track Shift (mm)	None	None
Seat Back Failure	None	None
Glazing Damage	Windshield Cracked	

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	572
Center	mm	512
Right Side	mm	550
Average	mm	545

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	1035	1040
Lap belt length as measured on ATD	mm	800	800
Remainder of belt on reel	mm	965	960
Total belt length for continuous webbing systems	mm	2800	2800

DATA SHEET NO. 2
GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

TEST VEHICLE INFORMATION

Manufacturer	BMW
Model	328i
Body Style	Coupe
NHTSA No.	MA0515
VIN	WBAWC3C54APC88009
Color	Jet Black
Delivery Date	11/09/2009
Odometer Reading (mile)	37
Dealer	Anderson
Transmission	Manual
Final Drive	AWD
Number of Cylinders	6
Engine Displacement (L)	3.0
Engine Placement	Longitudinal
Automatic Door Lock (ADL)	No
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	Bayerische Motorenwerke
Date of Manufacture	10/09

GVWR (kg)	2045
GAWR Front (kg)	1025
GAWR Rear (kg)	1055

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	2		4
Capacity Wt. (VCW) (kg)				420
Cargo Wt. (RCLW) (kg)				148

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

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	396.9	382.8		440.9	494.0	
Right	kg	425.5	376.5		441.8	500.3	
Ratio	%	52.0	48.0		47.0	53.0	
Totals	kg	822.4	759.3	1581.7	882.7	994.3	1877.0

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1581.7
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	148
Calculated Vehicle Target Weight (TVTW)	kg	1885.7

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	679	681	672	661	1327
As Tested	mm	680	675	630	628	1465
Post Test	mm	720	688	611	641	

Vehicle Wheelbase (mm): 2765

Weight of Ballast secured in trunk (kg): 102.1

Vehicle Components Removed: Right rear taillight, trunk carpet, and tools

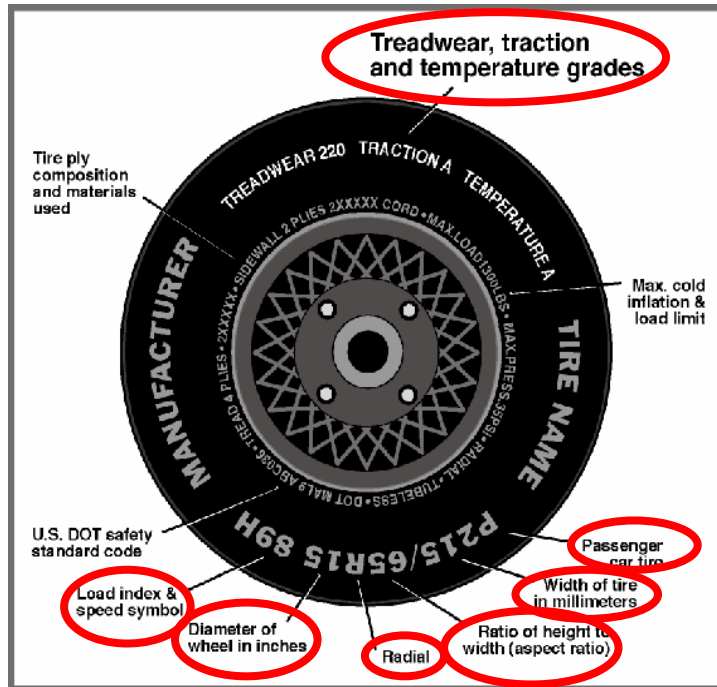
Ballast weight does not include instrumentation and data acquisition system.

DATA SHEET NO. 3

TEST VEHICLE TIRE INFORMATION

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009



DATA FROM TIRE AND TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	220	240
Recommended Tire Size	P225/45R17	P225/45R17
Tire Size on Vehicle	P225/45R17	P225/45R17
Tire Manufacturer	Continental	Continental
Tire Name	ContiPro Contact	ContiPro Contact
Tire Type	P	P
Tire Width (mm)	225	225
Ratio of Height to Width (aspect ratio)	45	45
Radial	R	R
Wheel Diameter	17	17
Load Index & Speed Symbol	91H	91H
Treadwear	400	400
Traction Grade	AA	AA
Temperature Grade	A	A

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

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

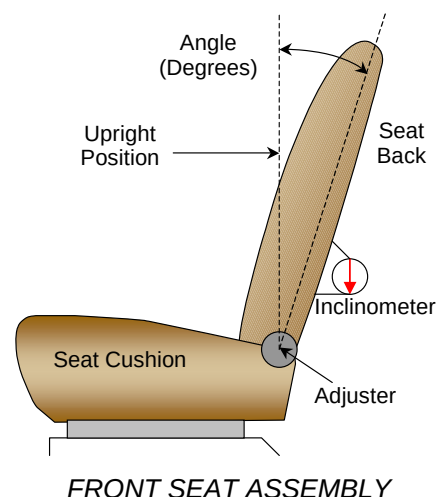
NHTSA No.: MA0515
 Test Date: 11/19/2009

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 seat backs at 25 degrees measured on the seat back relative to upright position.

Driver seat back angle: 25 degrees

Passenger seat back angle: 25 degrees

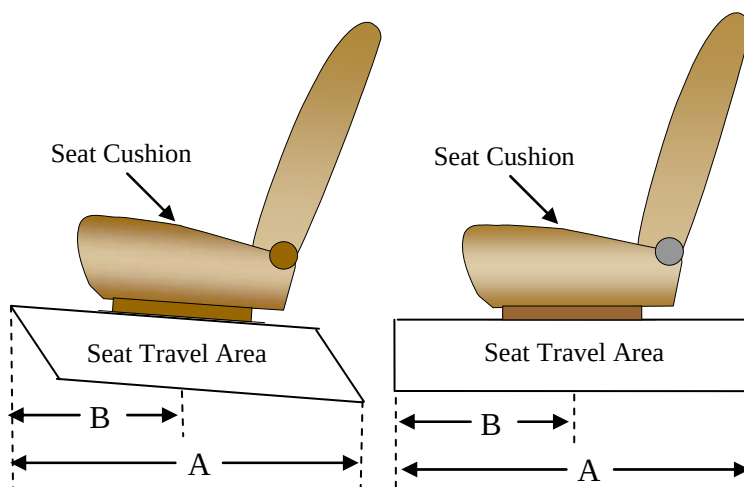


SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	313 mm	157 mm from forward-most
Passenger Seat	313 mm	157 mm from forward-most

ADJUSTABLE D-RING POSITION

The driver and passenger D-rings were non-adjustable.



DATA SHEET NO. 4...(CONTINUED)

TEST VEHICLE INFORMATION

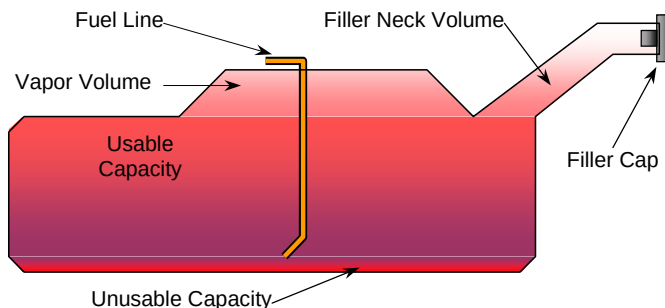
Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	60.9
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	56.0 to 57.2
Actual Amount of Solvent used	56.4
1/3 of Usable Capacity	20.3

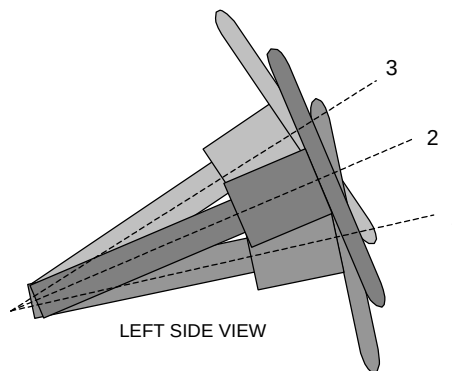
The test vehicle is equipped with an electric fuel pump. When the ignition is on, the fuel pump starts to work until the target pressure is reached. Then the fuel pump stops when the engine is started.



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

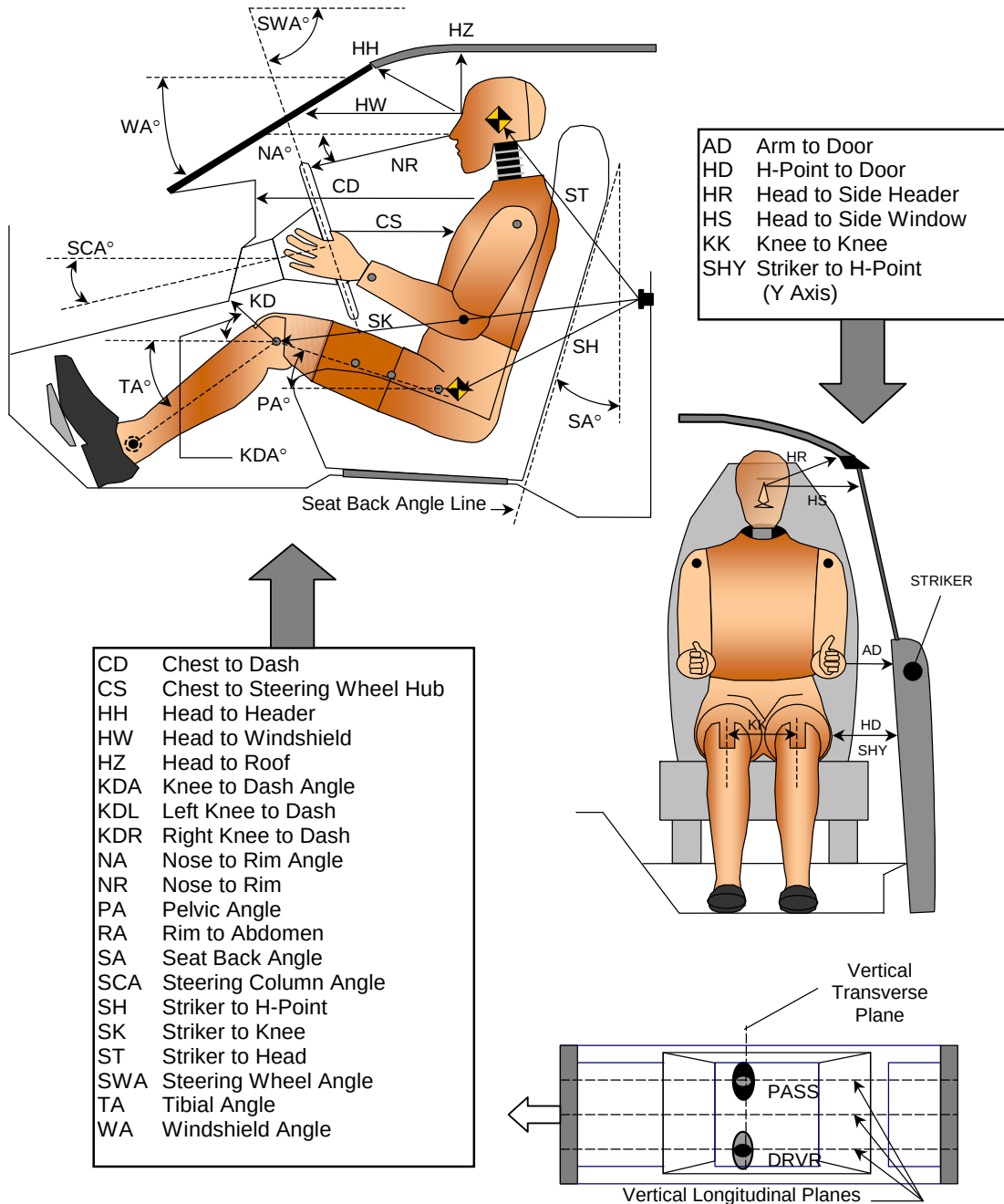
	Fore/Aft Position (mm)	Degrees
Lowermost position No. 1	190	67.6
Geometric center position No. 2	210	69.6
Uppermost position No. 3	230	71.6

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

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



DATA SHEET NO. 5... (CONTINUED)

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

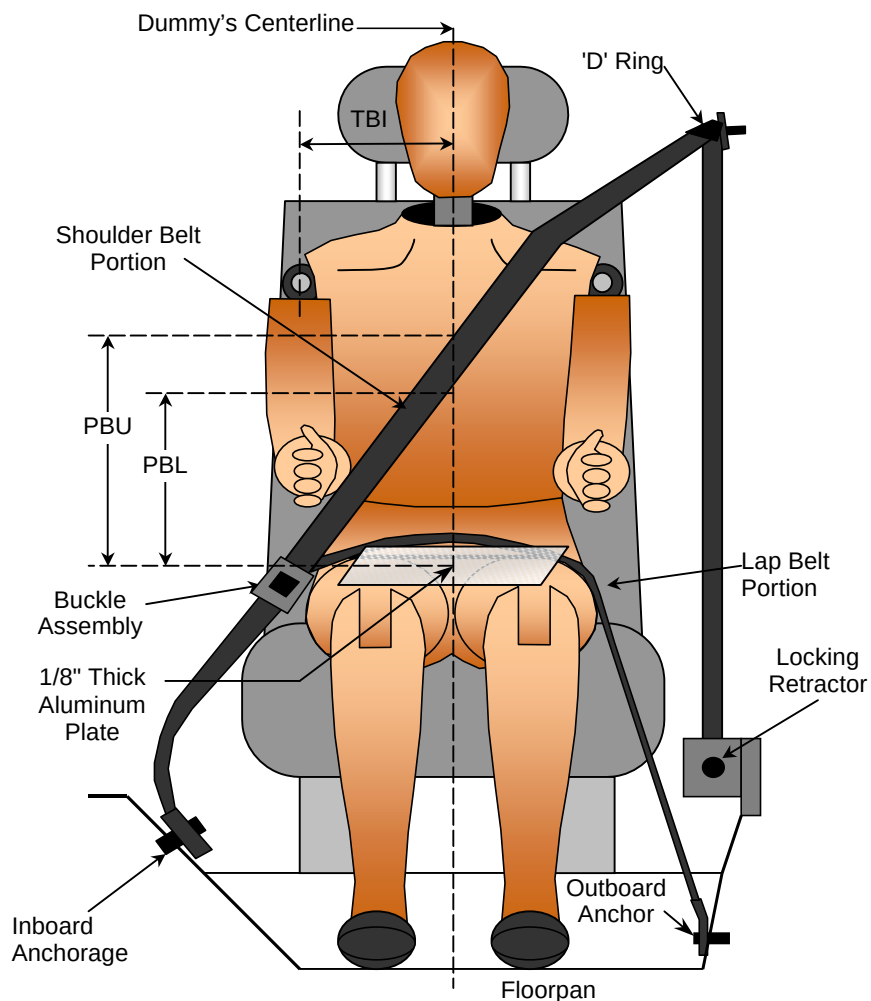
TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		26.1		
SWA	Steering Wheel Angle		69.6		
SCA	Steering Column Angle		20.4		
SA	Seat Back Angle		25.0		25.0
HZ	Head to Roof (Z)	160	90	165	90
HH	Head to Header	343	22.7	340	23.1
HW	Head to Windshield	605	0	609	0
HR	Head to Side Header (Y)	185		194	
NR	Nose to Rim	395	6.1		
CD	Chest to Dash	533		469	
CS	Chest to Steering Hub	324	1.4		
RA	Rim to Abdomen	220	0		
KDL	Left Knee to Dash	228	32.3	174	
KDR	Right Knee to Dash	200		201	31.6
PA	Pelvic Angle		23.3		23.5
TA	Tibia Angle		38.4		37.4
KK	Knee to Knee (Y)	315		270	
SK	Striker to Knee	853	105.6	861	102.4
ST	Striker to Head	484	39.2	492	40.9
SH	Striker to H-Point	531	122.8	525	123.9
SHY	Striker to H-Point (Y)	244		244	
HS	Head to Side Window	278		290	
HD	H-Point to Door (Y)	148		136	
AD	Arm to Door (Y)	114		50	
AA	Ankle to Ankle	320		200	

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

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	345	345
PBL - To surface of reference to belt lower edge	mm	260	260

DATA SHEET NO. 7
VEHICLE ACCELEROMETER LOCATIONS

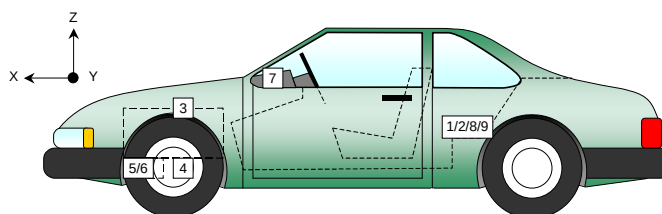
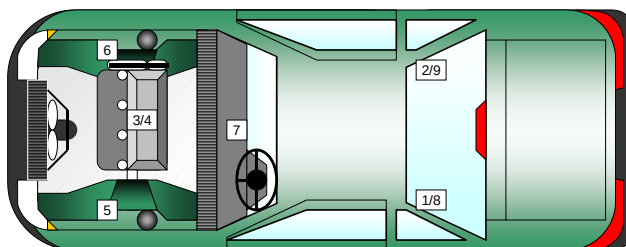
Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear X-Member X	1802	-375	-412
2	Right Rear X-Member X	1802	355	-418
3	Engine Top X	3889	-55	-800
4	Engine Bottom X	3770	0	-191
5	Left Brake Caliper X	3678	-631	-252
6	Right Brake Caliper X	3678	631	-252
7	Instrument Panel X			
8	Left Rear X-Member Z	1802	-375	-412
9	Right Rear X-Member Z	1802	355	-418

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 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

Windshield Mounting Details:

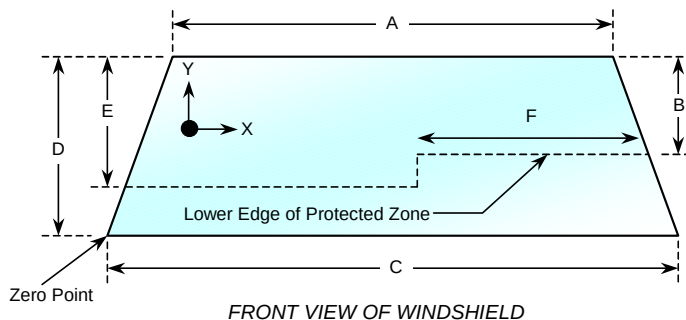
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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	1982	1982	100
Right Side	1982	1982	100
Total	3964	3964	100



Item	Units	Value
A	mm	1104
B	mm	358
C	mm	1400
D	mm	730
E	mm	440
F	mm	487

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 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

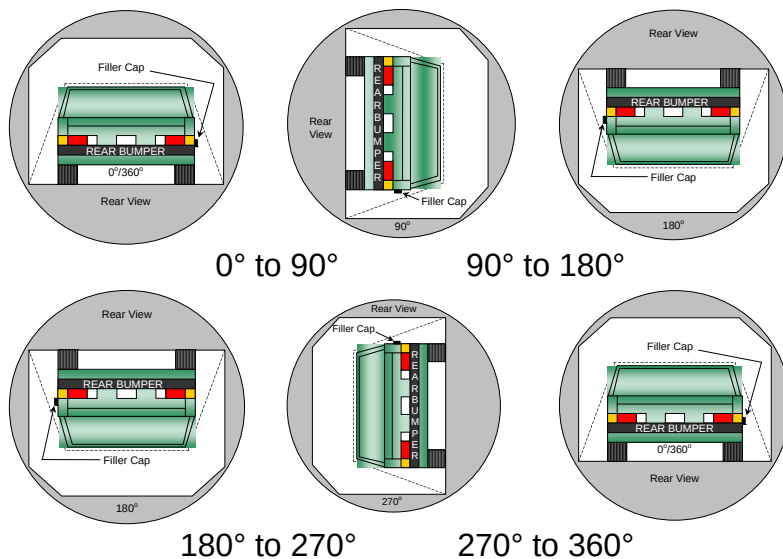
FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21° C Test Time: 11:21 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°	117	300	0
90° to 180°	110	300	0
180° to 270°	105	300	0
270° to 360°	117	300	0

DATA SHEET NO. 10
VEHICLE MEASUREMENTS

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009

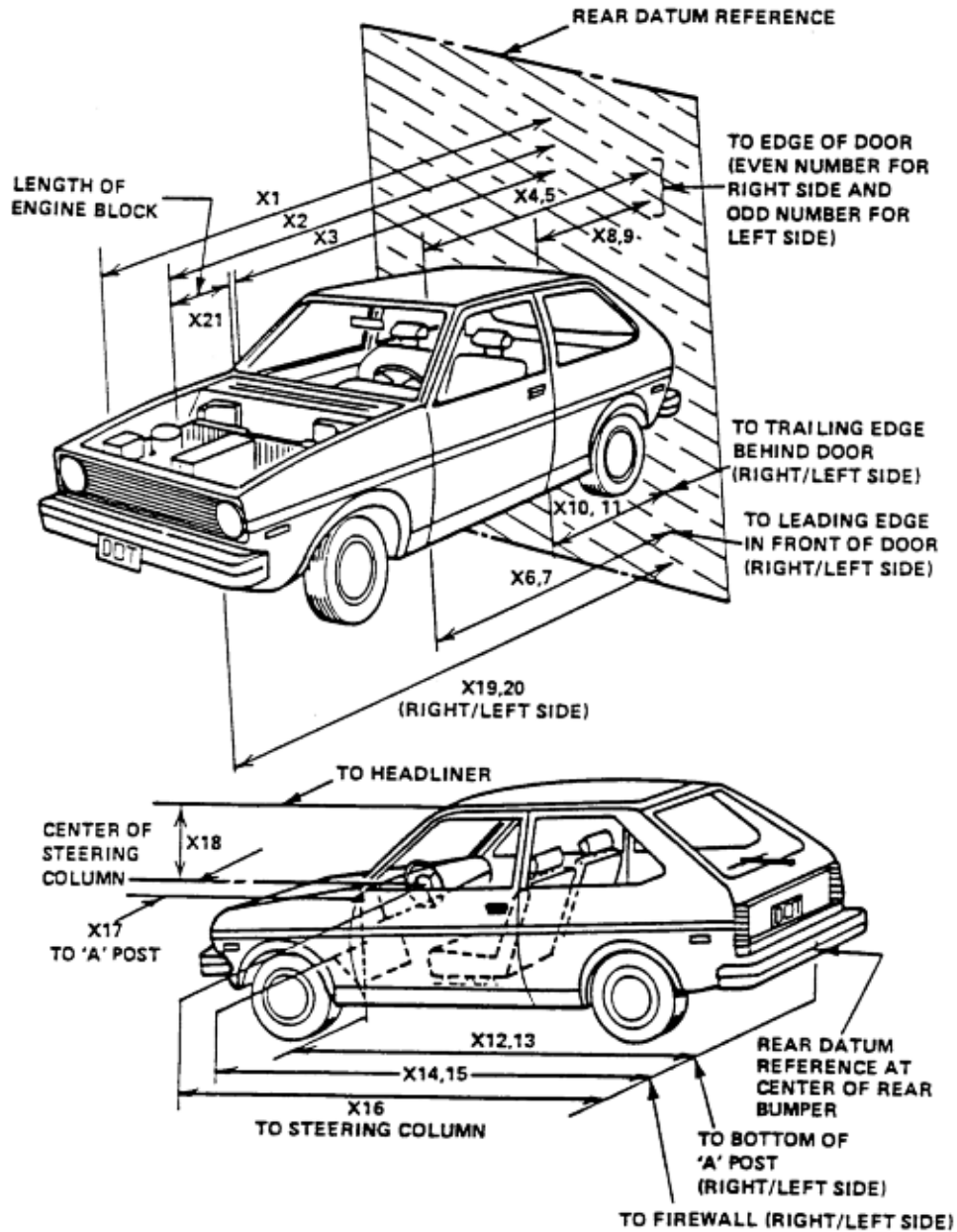
No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total length of vehicle at centerline	mm	4543	3974	569
2	RSOV to front of engine	mm	4044	3845	199
3	RSOV to firewall centerline	mm	3305	3282	23
4	RSOV to leading edge of right door	mm	3050	3042	8
5	RSOV to leading edge of left door	mm	3056	3058	-2
6	RSOV to lower leading edge of right door	mm	3126	3122	4
7	RSOV to lower leading edge of left door	mm	3122	3123	-1
8	RSOV to upper leading edge of right door	mm	1836	1822	14
9	RSOV to upper leading edge of left door	mm	1828	1840	-12
10	RSOV to lower trailing edge of right door	mm	1930	1924	6
11	RSOV to lower trailing edge of left door	mm	1923	1934	-11
12	RSOV to bottom of right 'A' pillar	mm	3124	3120	4
13	RSOV to bottom of left 'A' pillar	mm	3118	3122	-4
14	RSOV to firewall on right side	mm	3630	3545	85
15	RSOV to firewall on left side	mm	3628	3578	50
16	RSOV to steering column	mm	2662	2679	-17
17	Center of steering column to left 'A' pillar	mm	321	300	21
18	Center of steering column to headlining	mm	395	382	13
19	RSOV to right side of front bumper	mm	4401	3929	472
20	RSOV to left side of front bumper	mm	4401	3924	477
21	Length of engine block	mm	690	690	0
RD	RSOV to right side of dash panel	mm	2822	2814	8
CD	RSOV to center of dash panel	mm	2753	2750	3
LD	RSOV to left side of dash panel	mm	2834	2834	0

DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009



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

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009

Target Vehicle Structural Measurement

	Elements	Pre-Test (mm)
1	Total Length	4543
2	Total Width	1780
3	Bumper Top Height	518
4	Bumper Bottom Height	379
5	Longitudinal Member Top Height	515
6	Distance between Longitudinal Members	870
7	Longitudinal Member Width	70
8	Engine Top Height	848
9	Engine Bottom Height	195
10	Engine and gearbox width	582
11	Front bumper-engine distance	475
12	Front shock absorber fixing height	822
13	Bonnet leading edge height	675
14	Front shock absorber fixing width	1100
15	Front bumper – front axle distance	765
16	Front axle – a pillar distance	650
17	A-pillar – B-pillar distance	1280
18	B-Pillar – rear axle distance	800
19	B-pillar – C-pillar distance	850
20	Roof sill bottom height	1212
21	Roof sill top height	1365
22	Floor sill bottom height	170
23	Floor sill top height	373

DATA SHEET NO. 11
CAMERA LOCATIONS

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009

No.	Camera View	Location (mm) *			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View				13	24
2	Left Front View	1155	-5040	-1080	24	1000
3	Steering Column Top	895	-5210	-1250	25	1000
4	Steering Column Bottom	875	-5235	-890	25	1000
5	Driver Close-up	1260	-6060	-1510	35	1000
6	Driver Angle	5420	-4610	-1830	50	1000
7	On board Driver Side					
8	On board Passenger Side					
9	Right Overall	2060	6130	-1120	20	1000
10	Right Passenger Half	1130	5290	-1010	24	1000
11	Right Close-up	1495	6540	-1560	35	1000
12	Right Angle	5460	4750	-1890	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	1140	0	3150	24	1000
17	Pit Rear	3090	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.

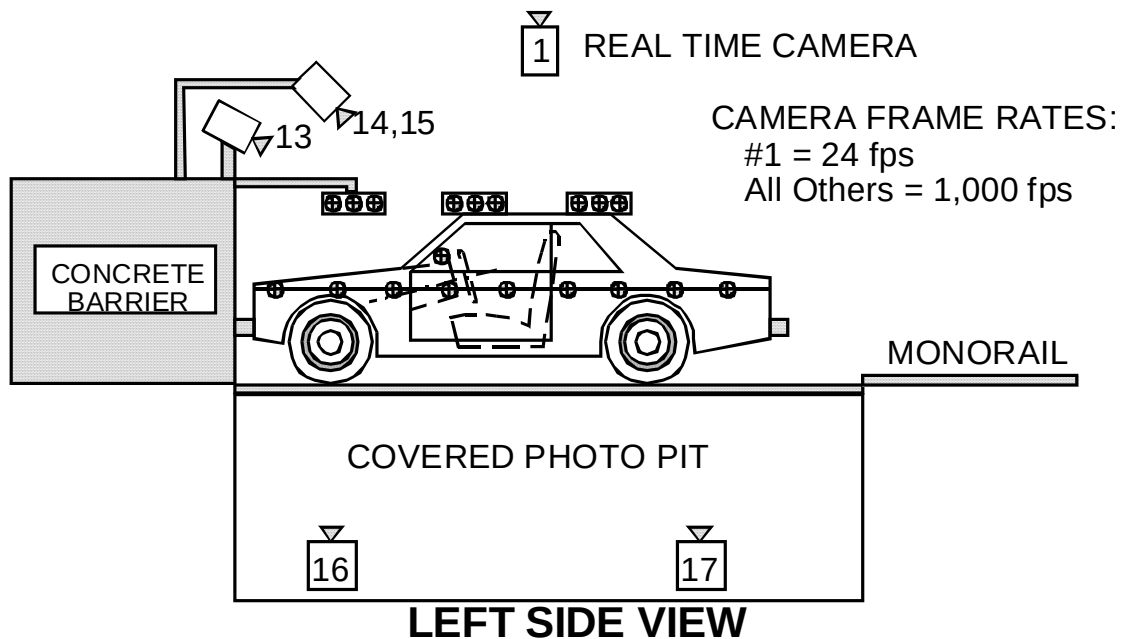
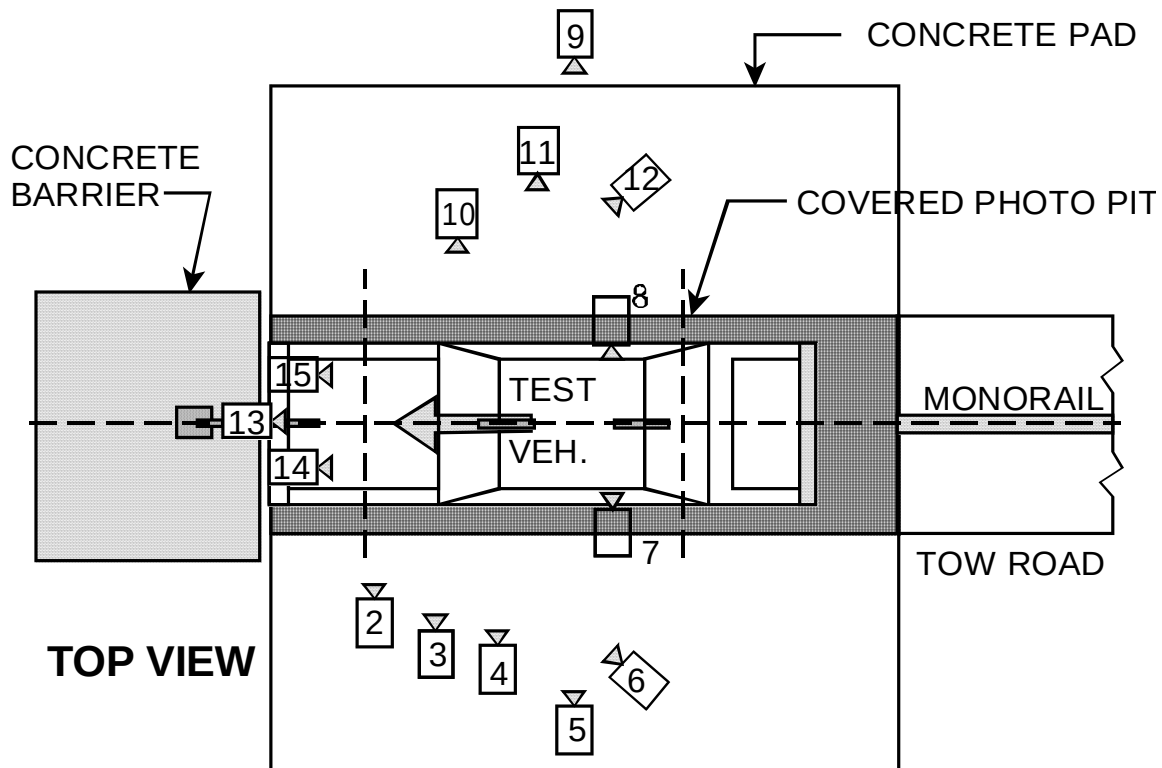
DATA SHEET NO. 11... (continued)

CAMERA LOCATIONS

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009

CAMERA POSITIONS FOR FRONTAL IMPACTS

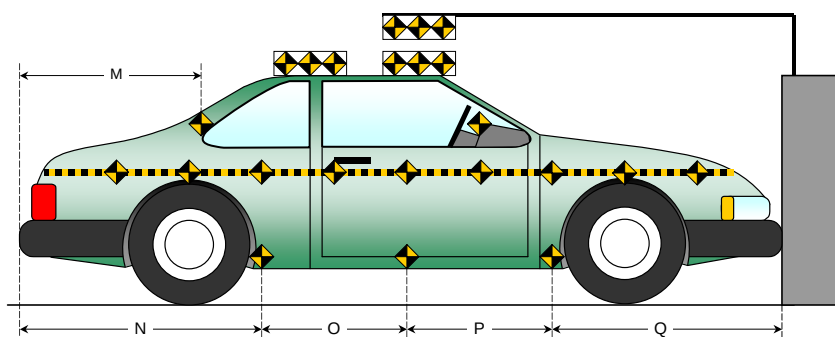
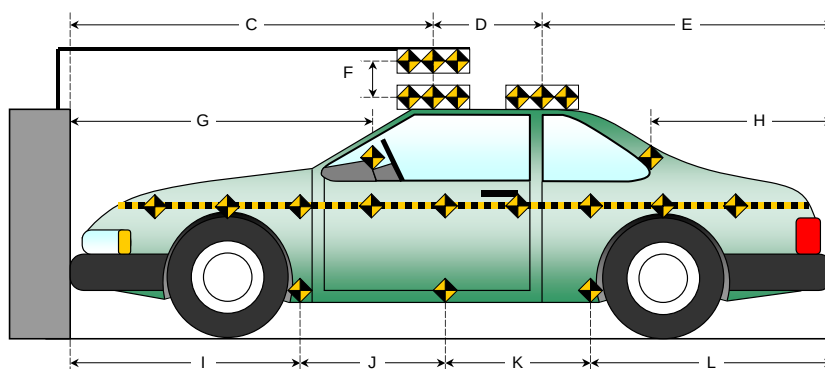
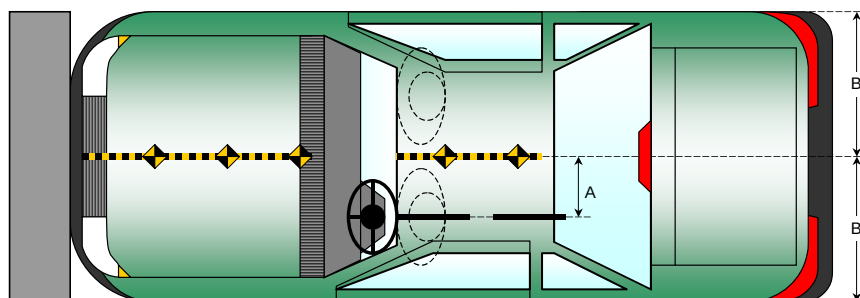


DATA SHEET NO. 12
PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

Item	Value
A	375
B	890
C	2385
D	660
E	1498
F	140
G	
H	991
I	1189
J	961
K	959
L	1434
M	996
N	1435
O	954
P	964
Q	1190



DATA SHEET NO. 13
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

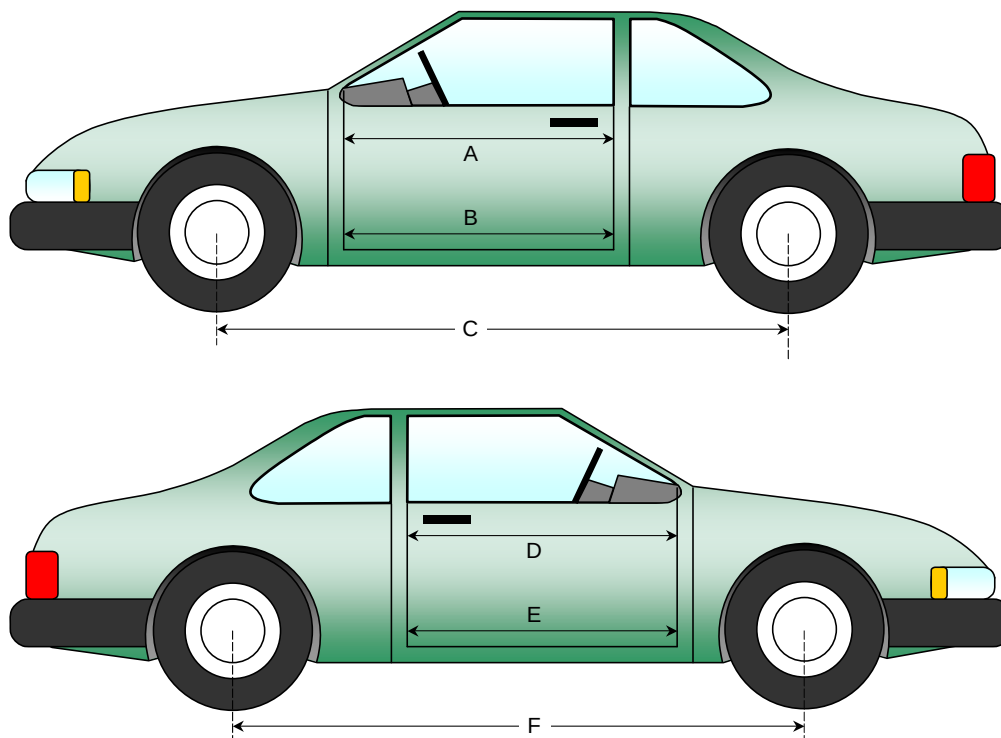
NHTSA No.: MA0515
 Test Date: 11/19/2009

DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1025	1030	-5
B	Left Side Lower	mm	845	846	-1
D	Right Side Upper	mm	1030	1038	-8
E	Right Side Lower	mm	820	824	-4

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2765	2683	82
F	Right Side Wheelbase	mm	2765	2684	81



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

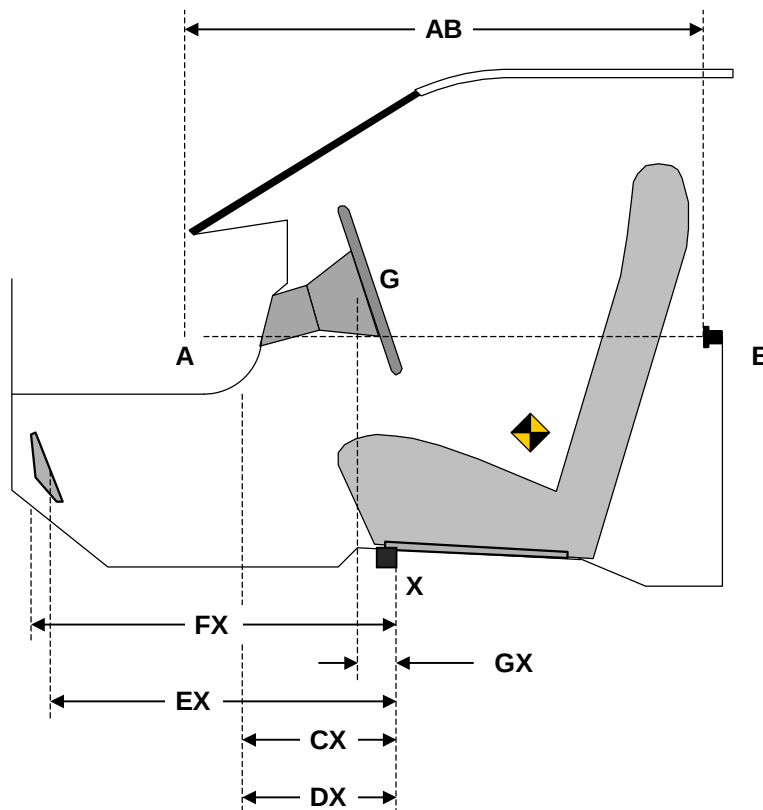
Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	952	947	5
CX	Left Knee Bolster to X	mm	295	280	15
DX	Right Knee Bolster to X	mm	282	265	17
EX	Brake Pedal to X	mm	571	555	16
FX	Foot Rest to X	mm	610	608	2
GX	Center of Steering Column Wheel Hub to X	mm	53	70	17

X = Front of Seat Track (stationary)

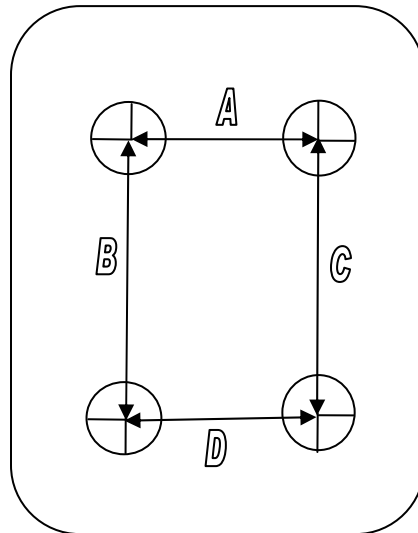


DRIVER COMPARTMENT

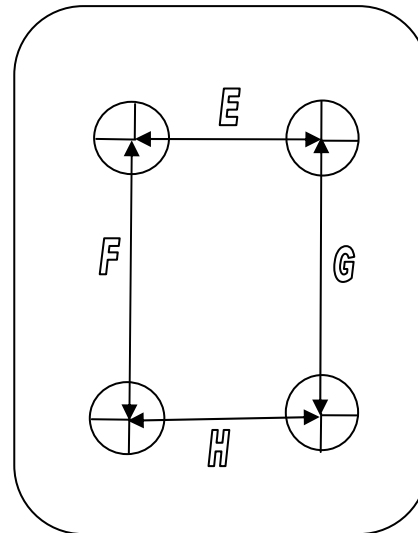
DATA SHEET NO. 13... (continued)
VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009



Driver



Passenger

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	220	220	0
B	220	220	0
C	220	220	0
D	220	220	0
E	220	212	8
F	220	217	3
G	220	220	0
H	220	218	2

DATA SHEET NO. 14

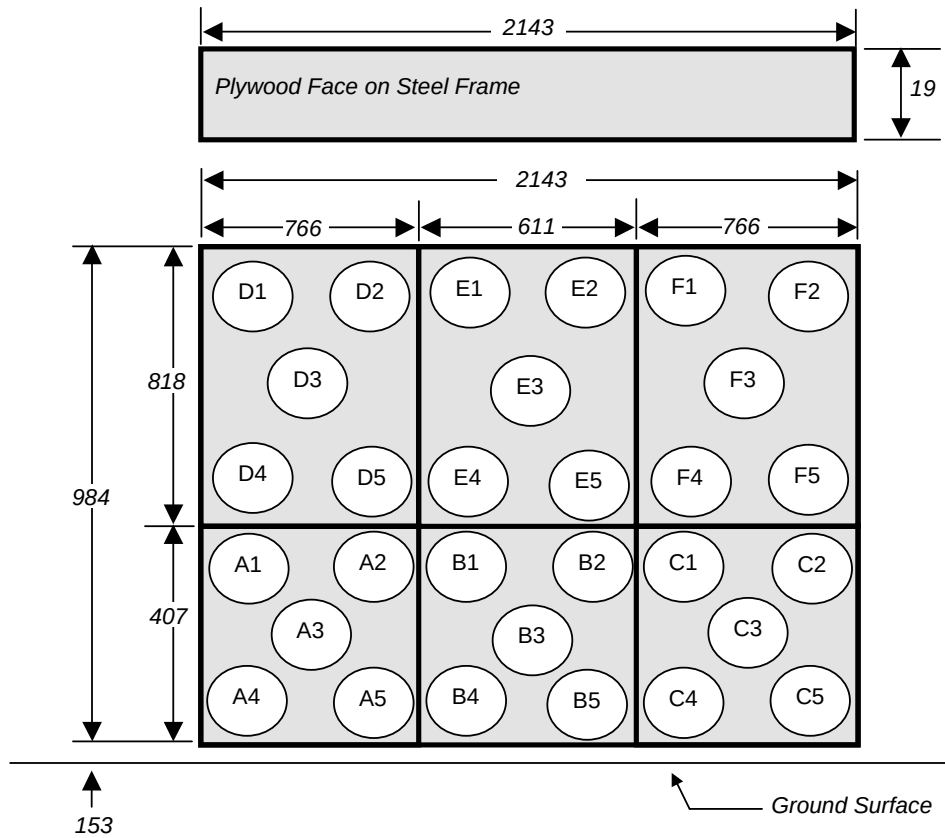
LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2010 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

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 BMW 328i Coupe
 Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
 Test Date: 11/19/2009

VEHICLE INFORMATION

VIN: WBAWC3C54APC88009 Wheelbase (mm): 2765
 Vehicle Size Category: Coupe Test Weight (kg): 1877.0

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): 61.2 Time of Separation (msec): 110

CRUSH PROFILE

Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
 Damage Region Length (mm): 1370 Impact Mode: Frontal

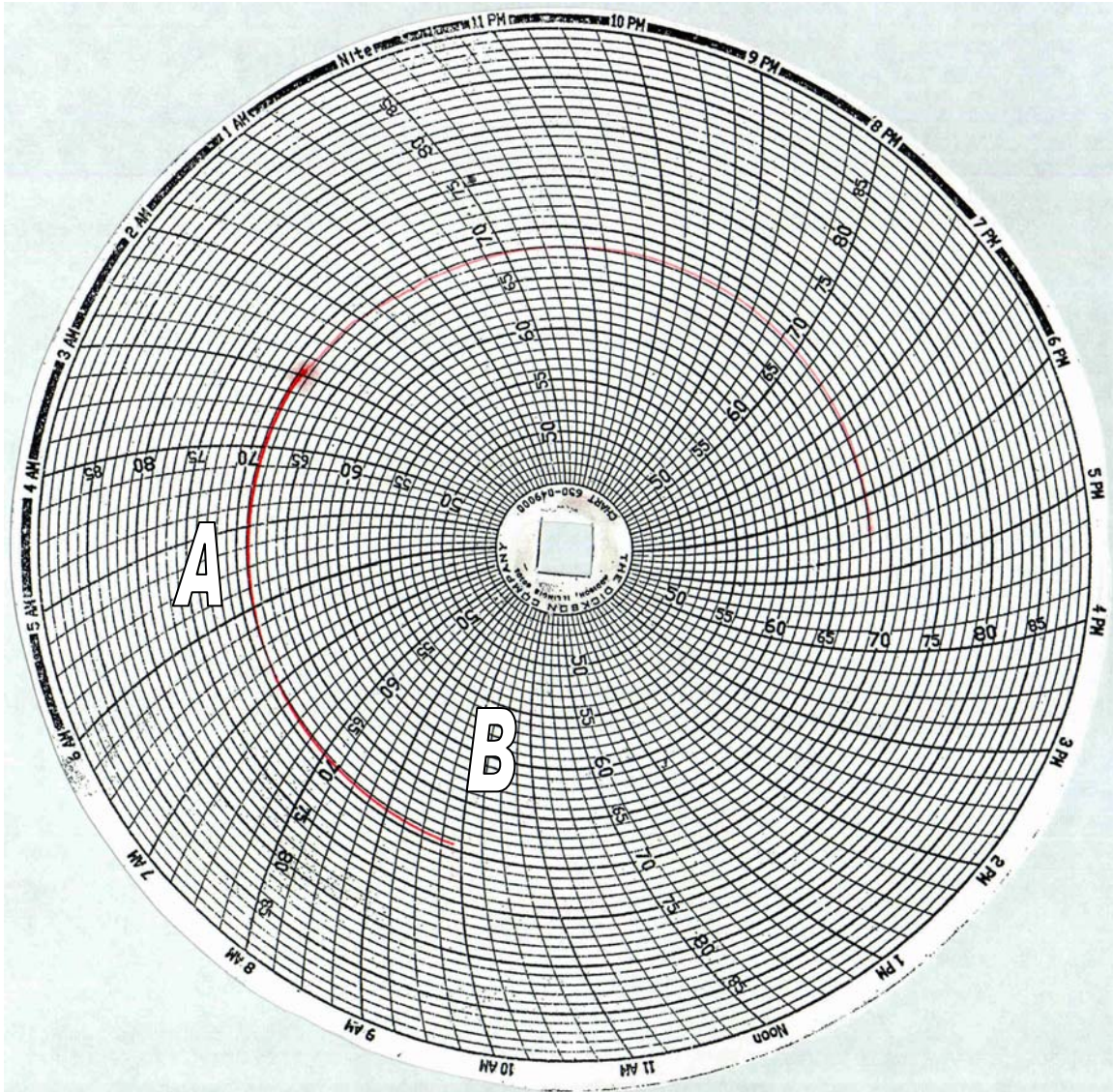
No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4401	3929	472
C2	Crush zone 2 at left side	mm	4480	3954	526
C3	Crush zone 3 at left side	mm	4525	3970	555
C4	Crush zone 4 at right side	mm	4525	3972	553
C5	Crush zone 5 at right side	mm	4480	3950	530
C6	Crush zone 6 at right side	mm	4401	3924	477
L	C1 TO C6	mm	1370	1340	30

DATA SHEET NO. 16

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2010 BMW 328i Coupe
Test Program: 35mph Frontal Impact

NHTSA No.: MA0515
Test Date: 11/19/2009



A = Dummies installed in vehicle at 6:00 am

B = Test conducted at 11:21 am

APPENDIX A
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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



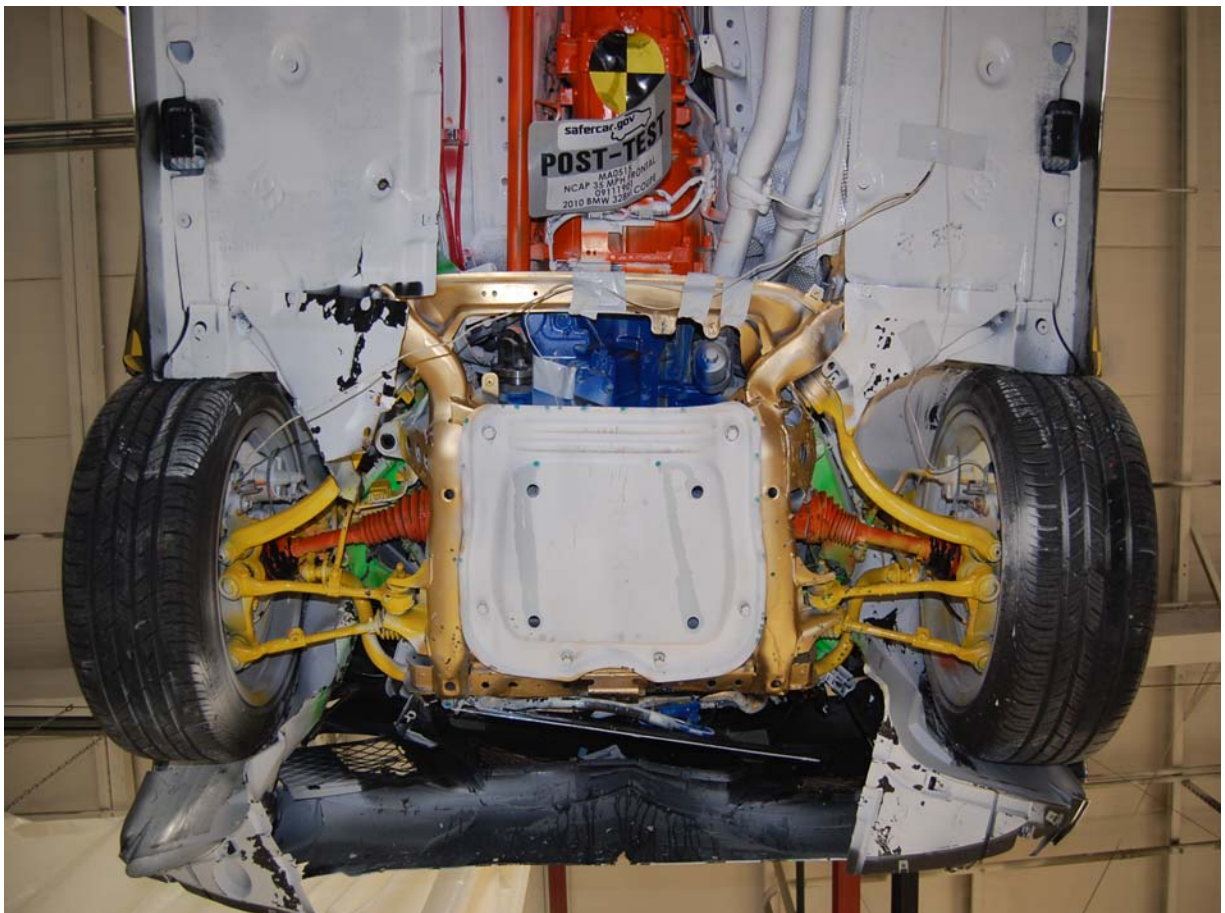
Pre-Test Fuel Cap View



Post-Test Fuel Cap View



Pre-Test Front Underbody View



Post-Test Front Underbody View



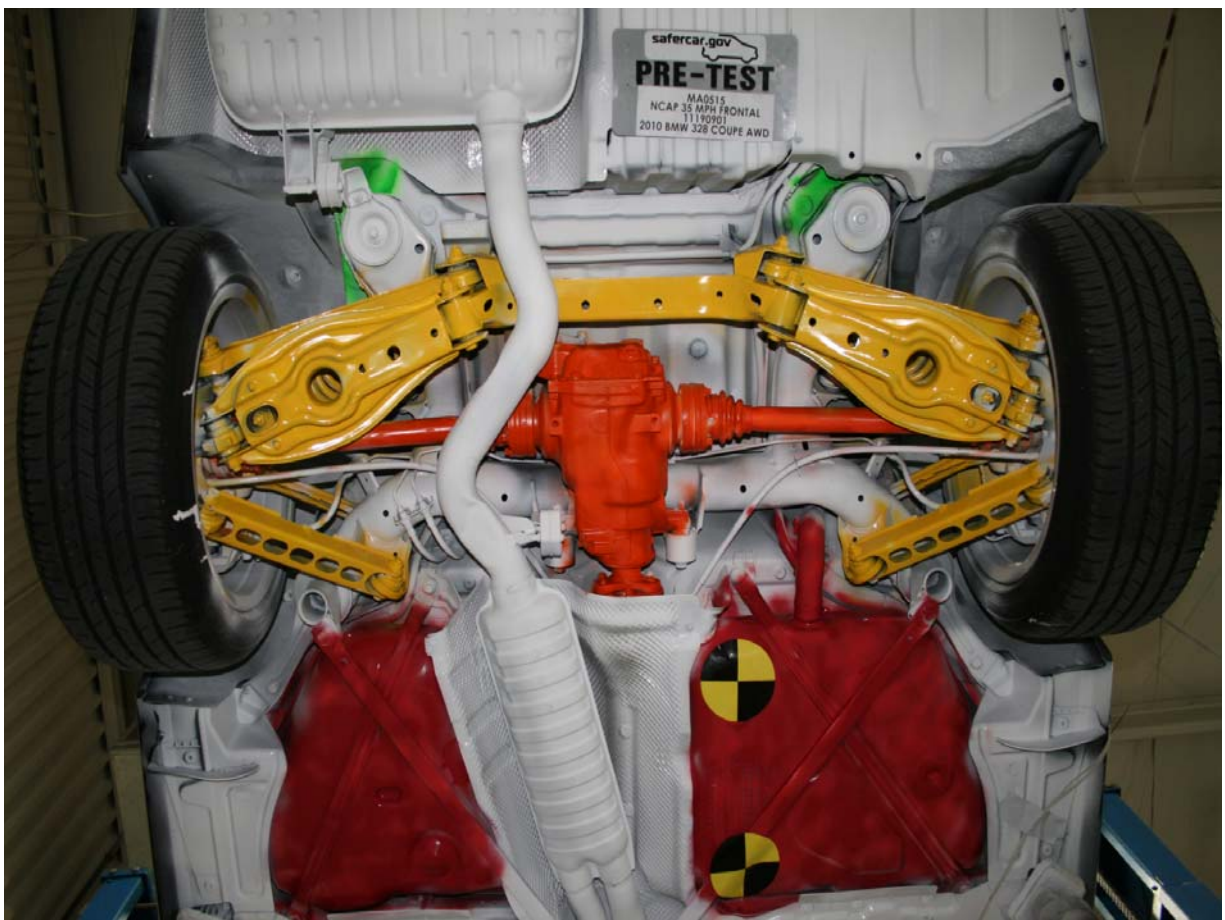
Pre-Test Mid Underbody View



Post-Test Mid Underbody View



Post-Test Mid Underbody View



Pre-Test Rear Underbody View



Post-Test Rear Underbody View



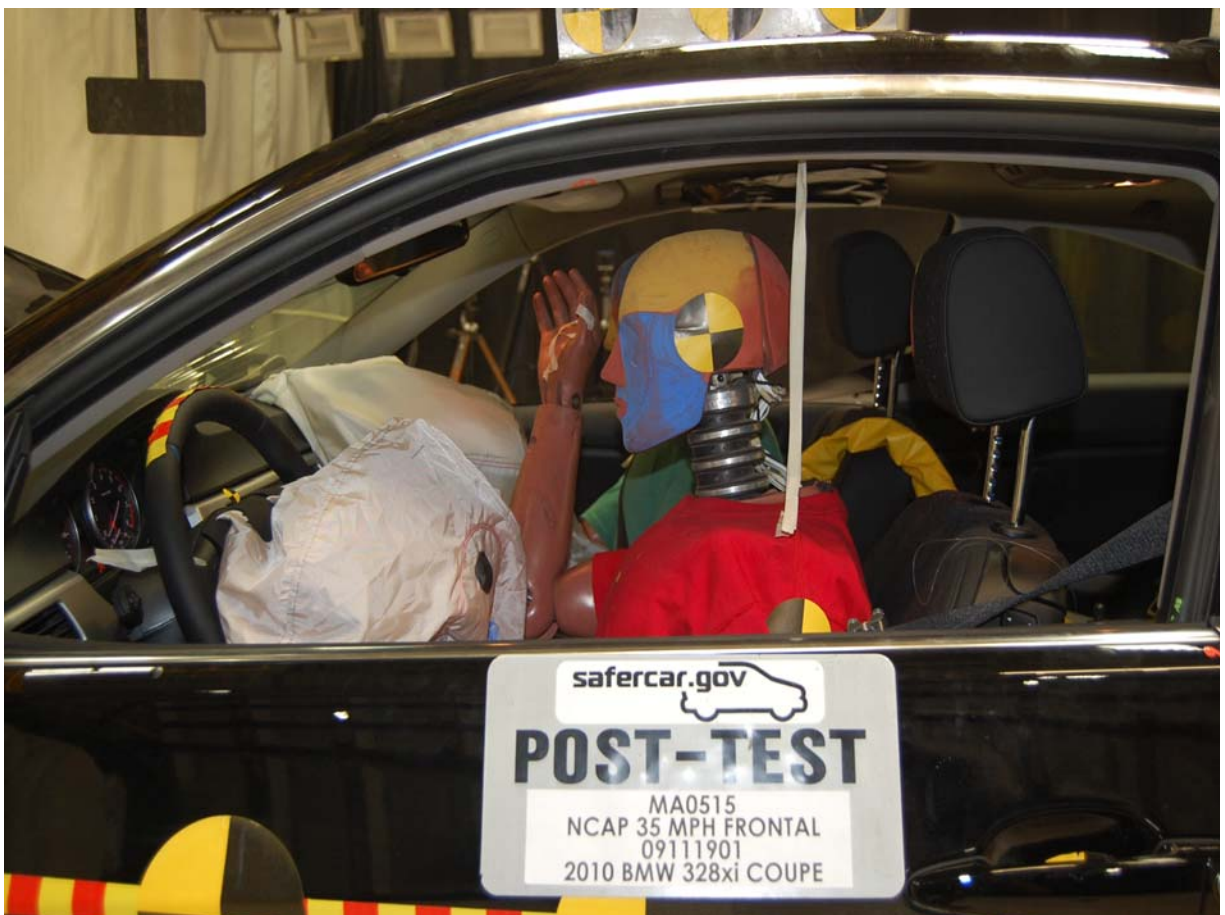
Pre-Test Driver Dummy Front View (Head Position)



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



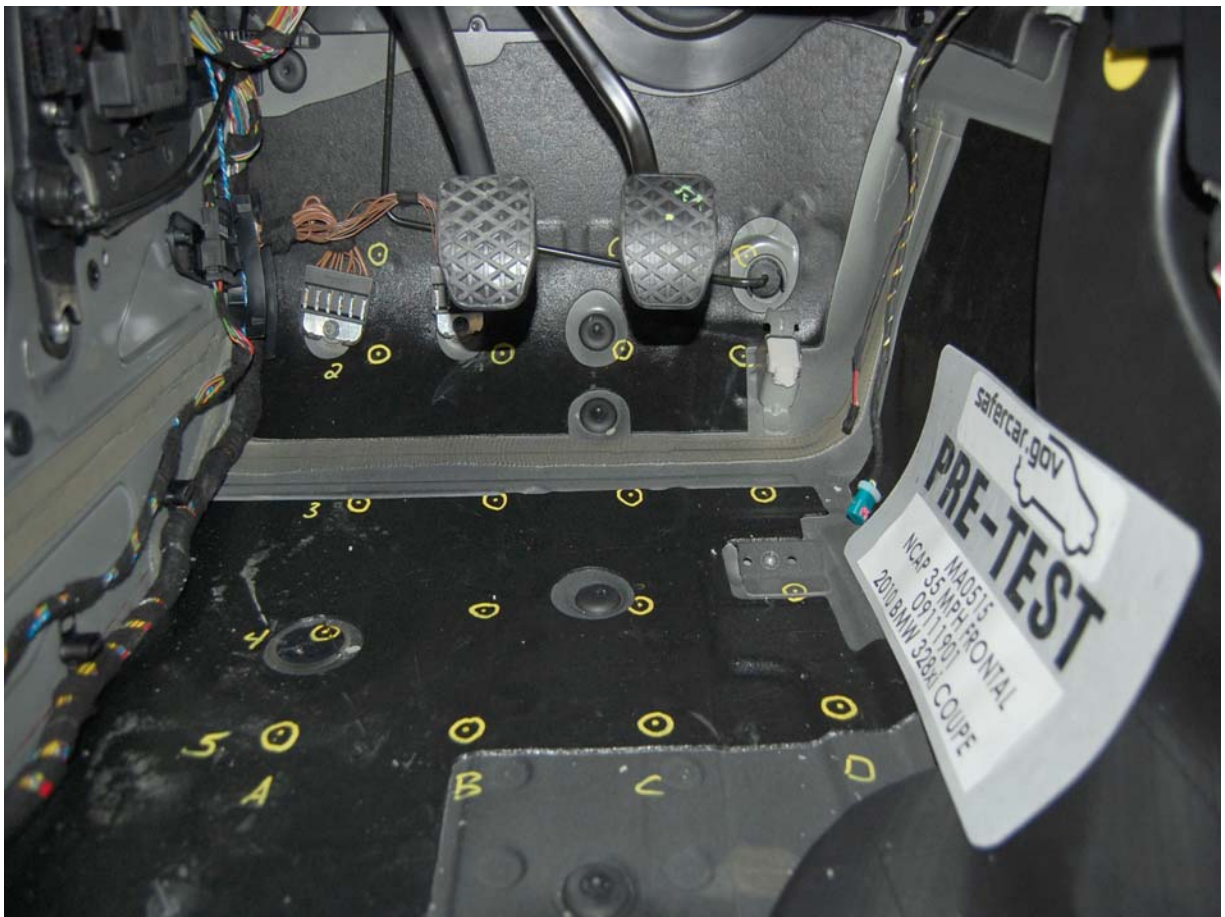
Post-Test Driver Dummy Feet



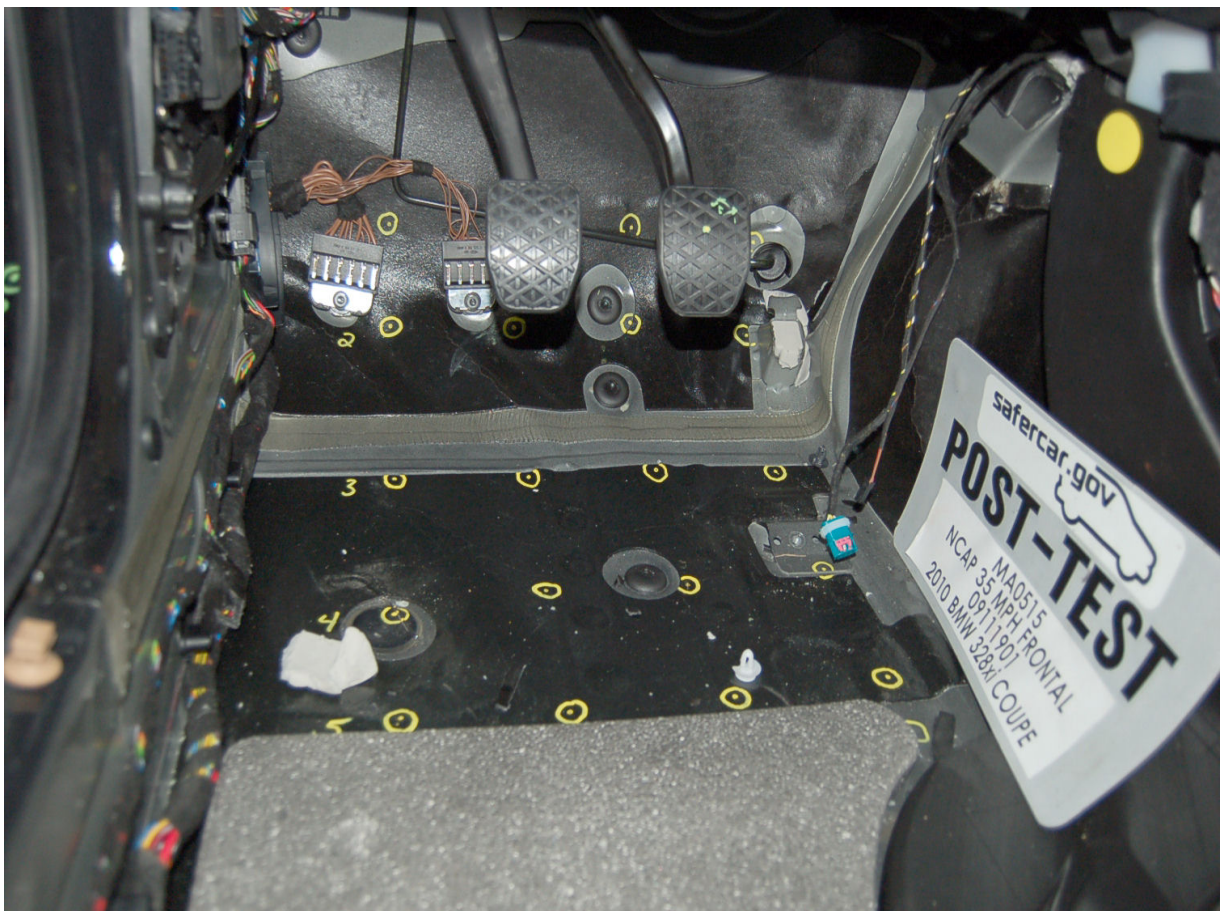
Pre-Test Driver Side Knee Bolster



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



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 Head Contact



Post-Test Passenger Dummy Knee Contact



Post-Test Passenger Dummy Knee Contact w/Airbag



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

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

Driver Head X Redundant

Driver Head Y Redundant

Driver Head Z Redundant

Driver Upper Neck Force 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 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

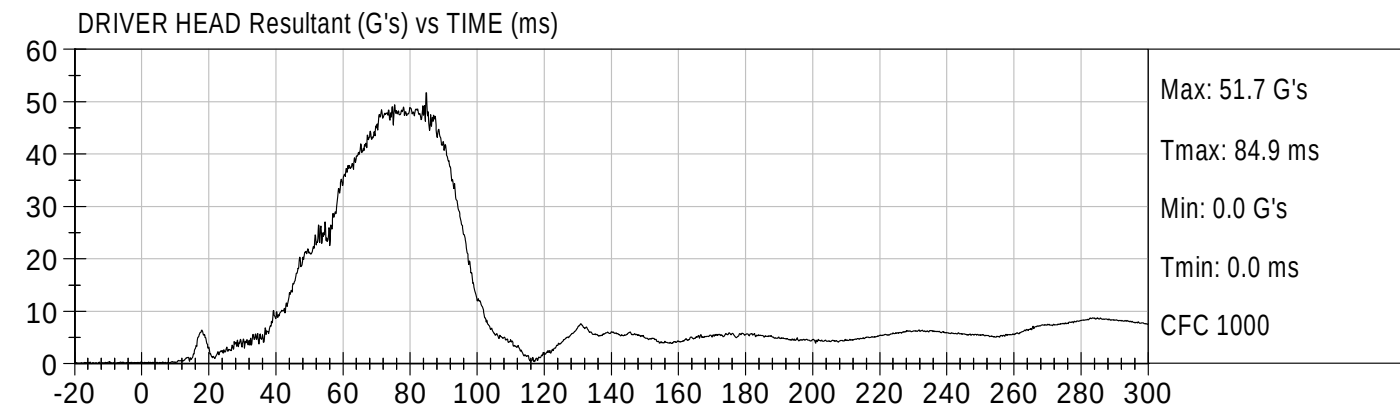
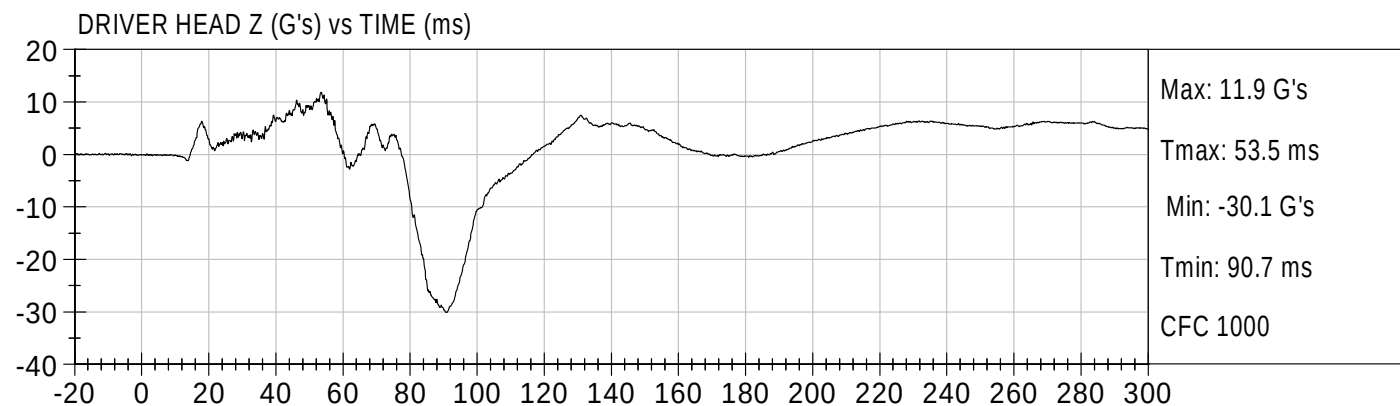
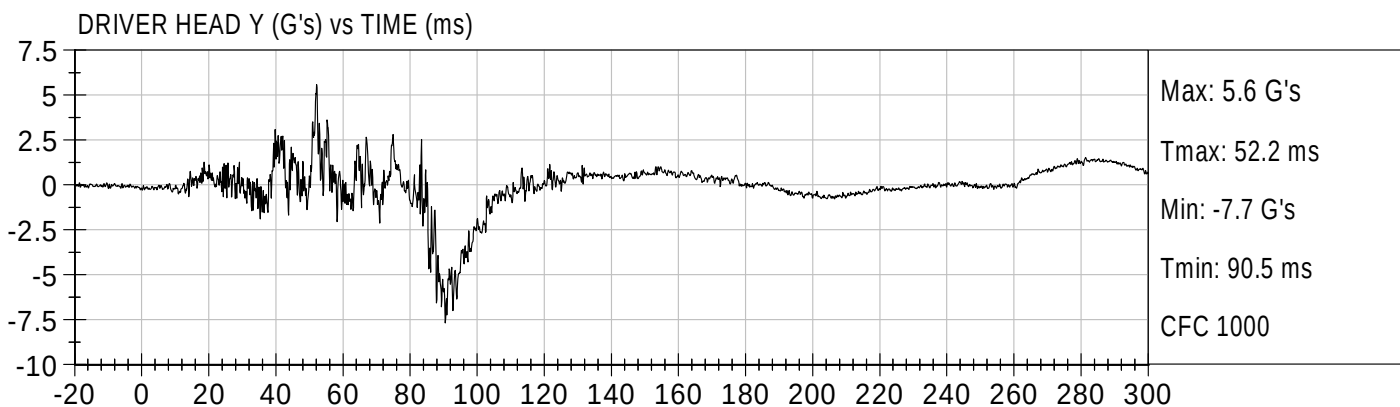
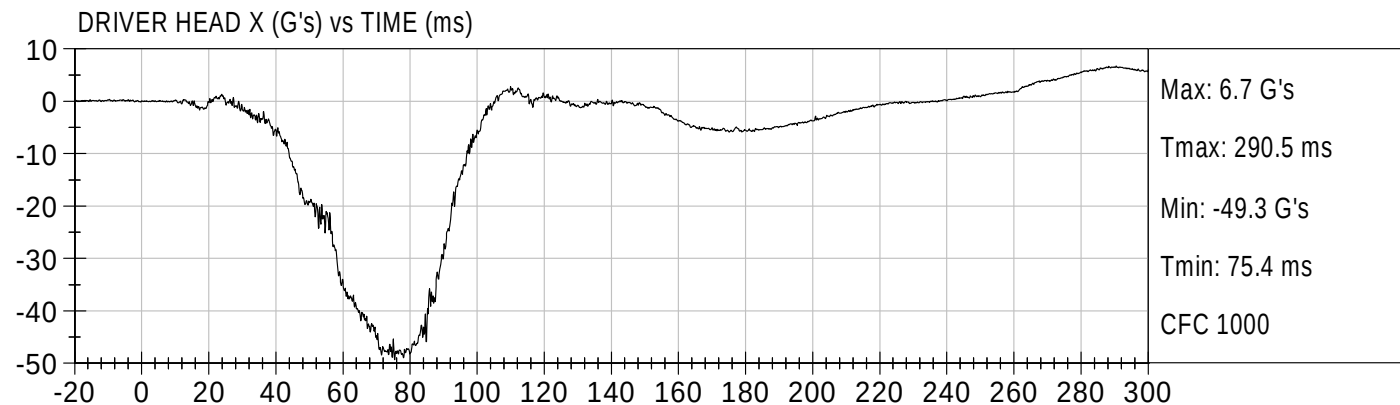
Driver Left Lower Tibia Force Z

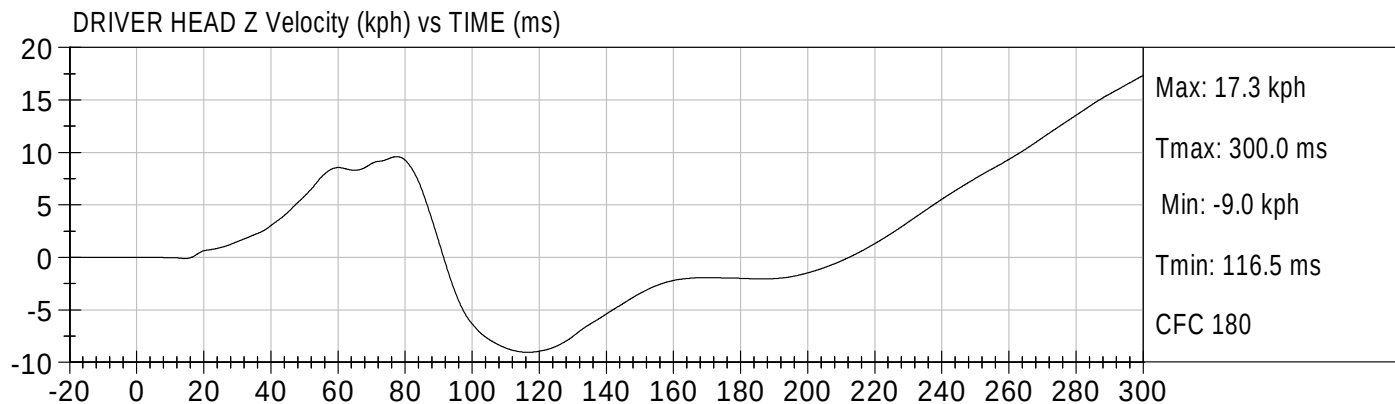
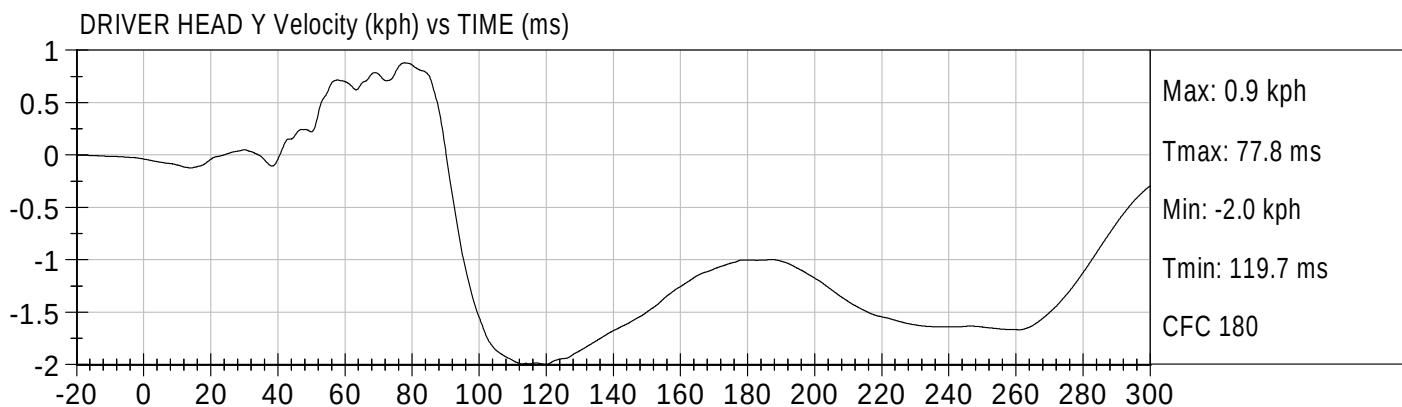
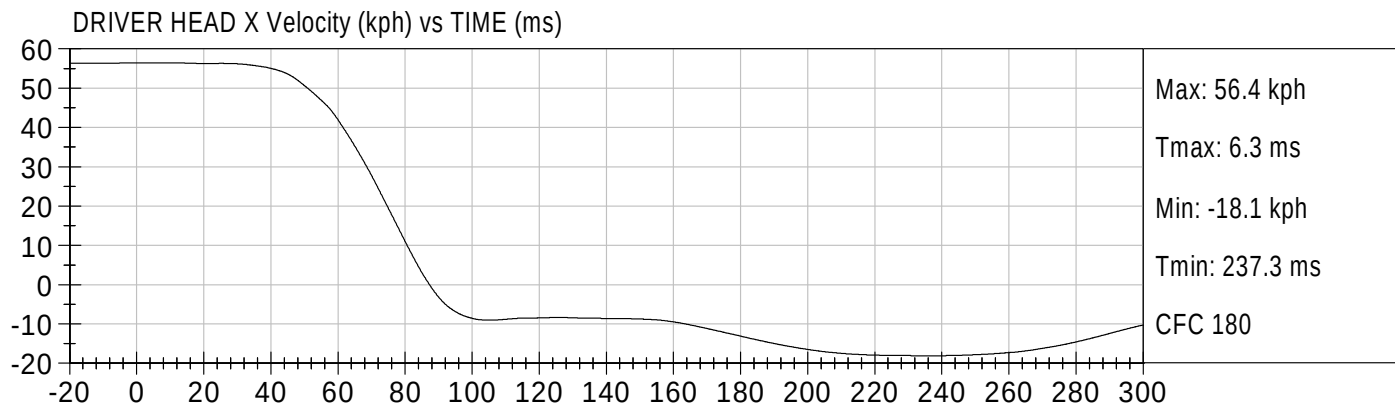
Driver Right Upper Tibia Moment X

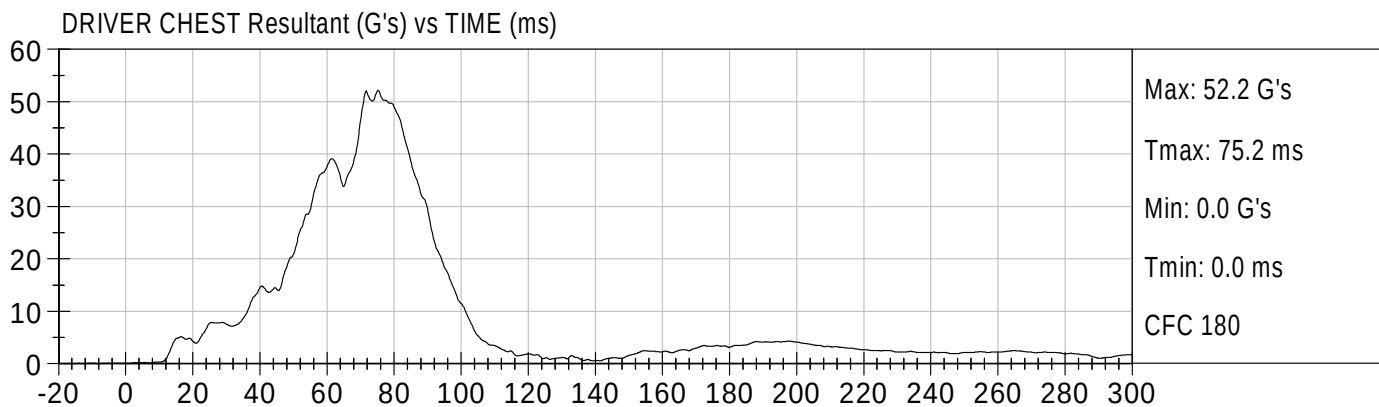
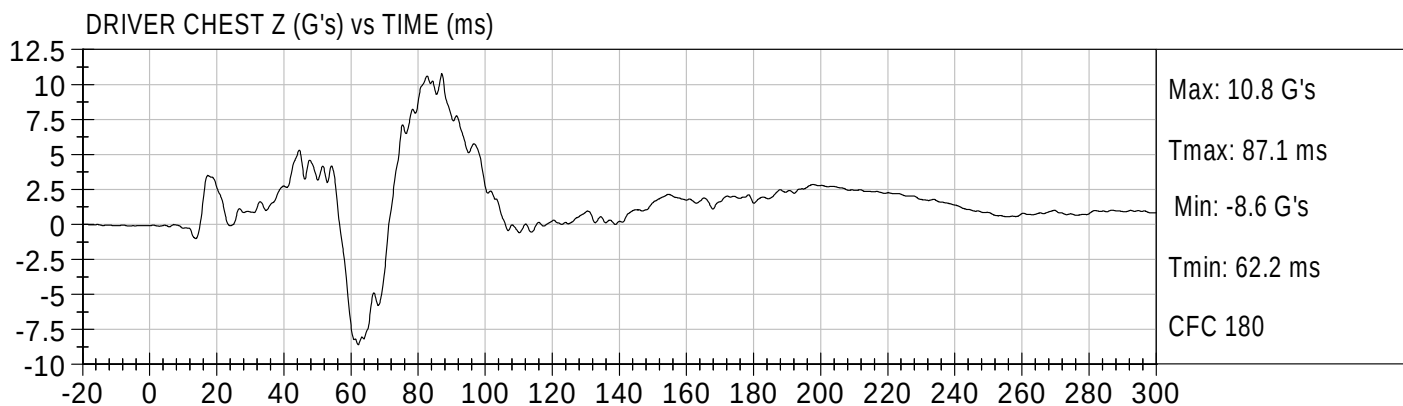
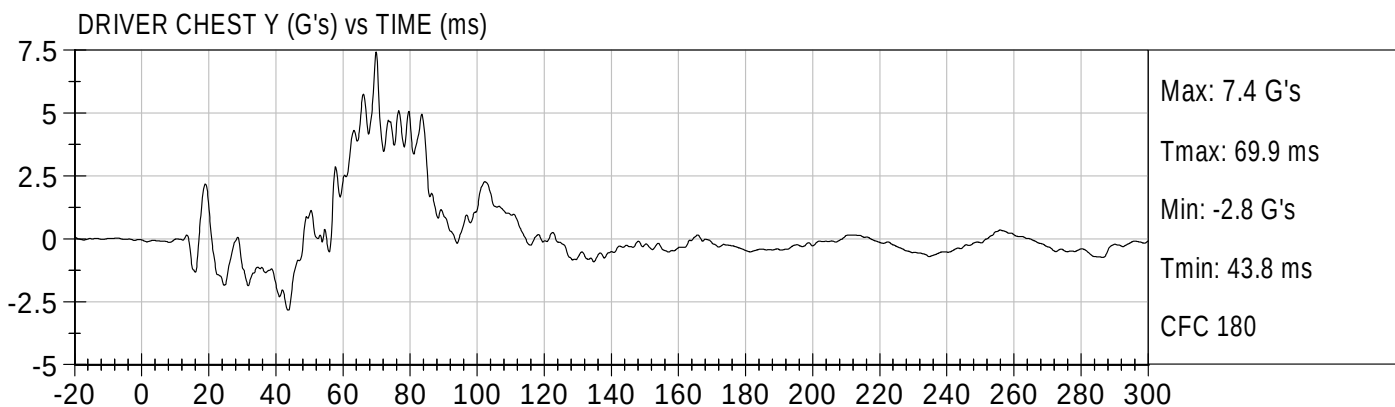
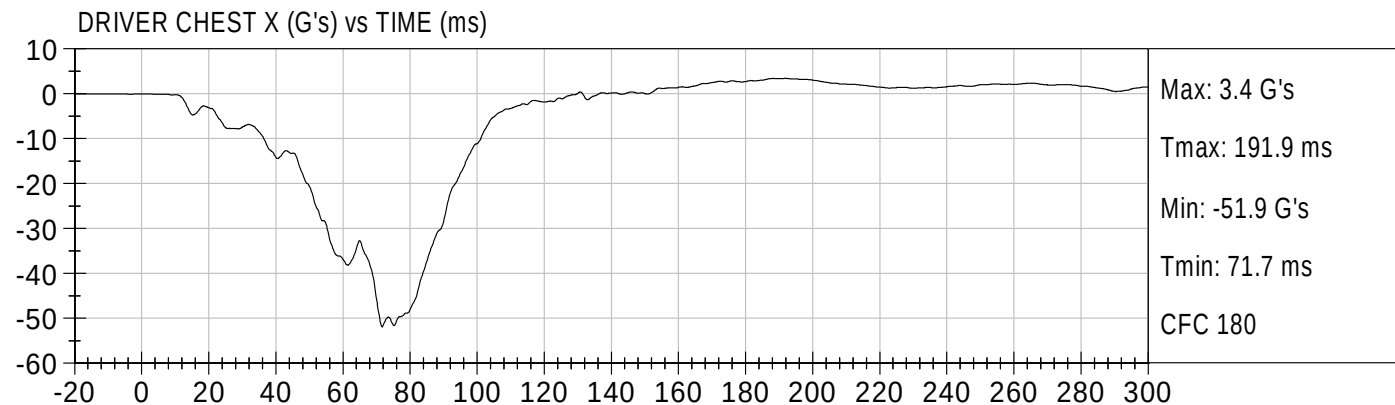
Driver Right Upper Tibia Moment Y

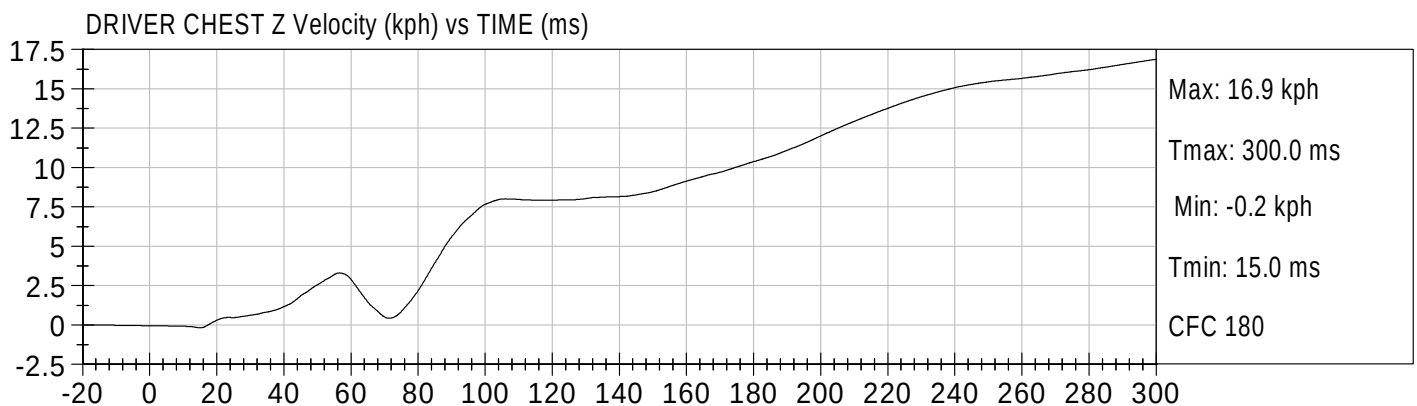
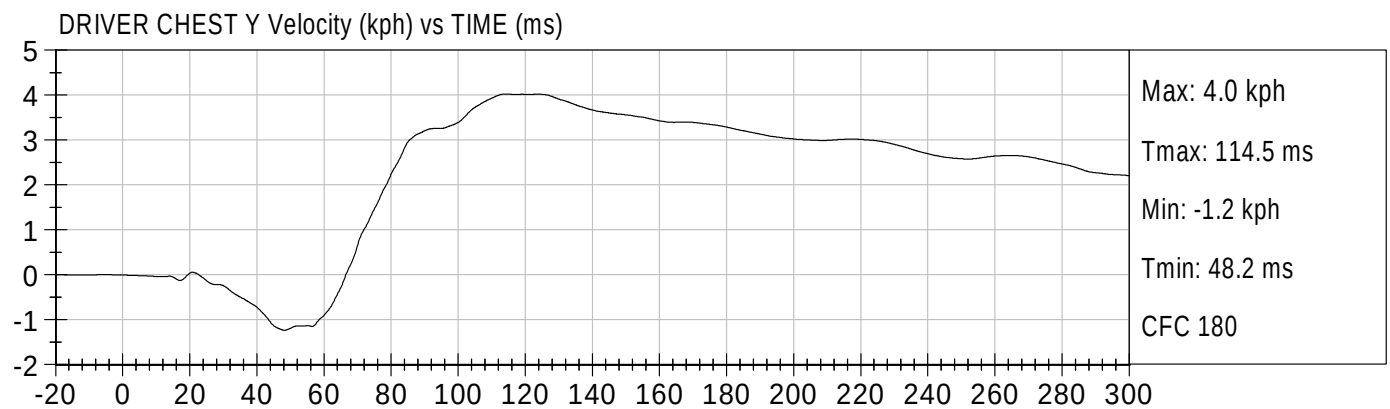
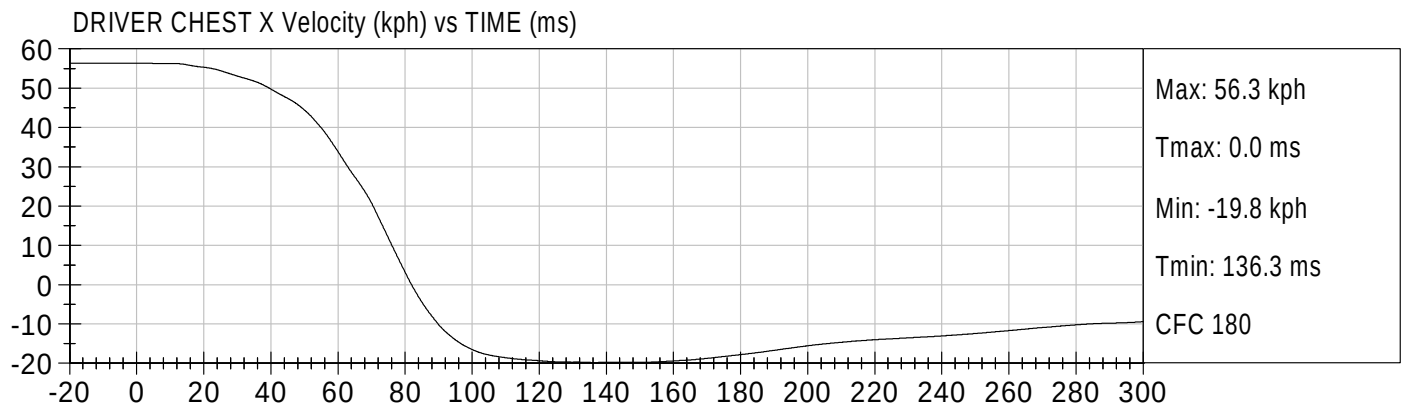
Driver Right Upper Tibia Force Z
Driver Right Lower Tibia Moment X
Driver Right Lower Tibia Moment Y
Driver Right Lower Tibia Force Z
Driver Left Foot Fore Z
Driver Left Foot Aft X
Driver Left Foot Aft Z
Driver Right Foot Fore Z
Driver Right Foot Aft X
Driver Right Foot Aft Z
Passenger Head X
Passenger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

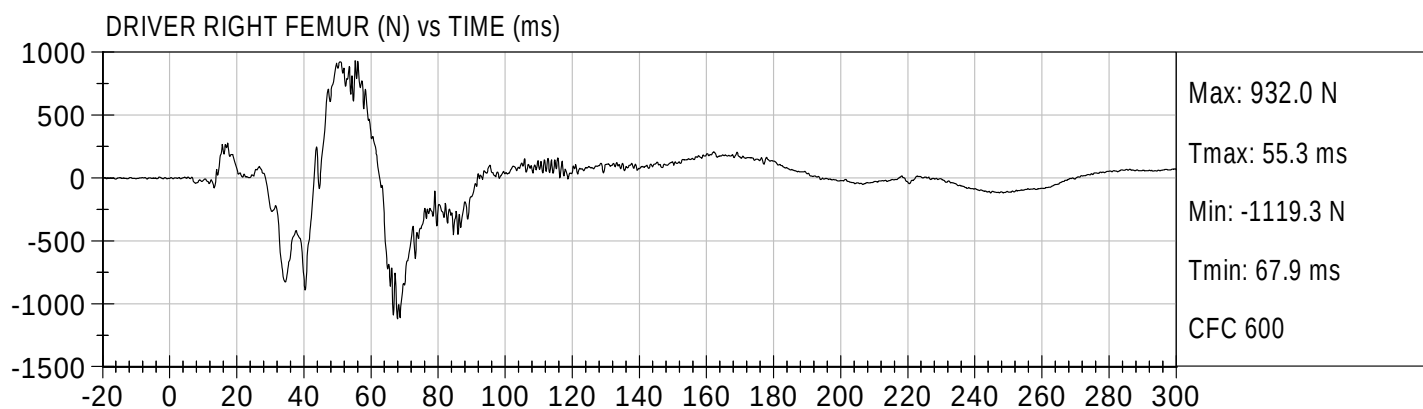
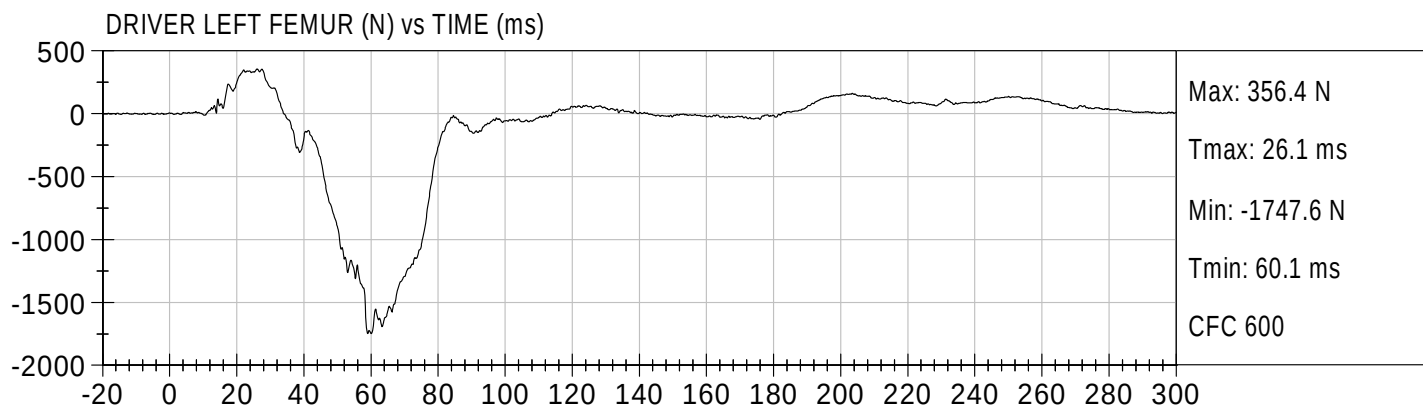
Passenger Left Lower Tibia Moment Y
Passenger Left Lower Tibia Force Z
Passenger Right Upper Tibia Moment X
Passenger Right Upper Tibia Moment Y
Passenger Right Upper Tibia Force Z
Passenger Right Lower Tibia Moment X
Passenger Right Lower Tibia Moment Y
Passenger Right Lower Tibia Force Z
Passenger 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







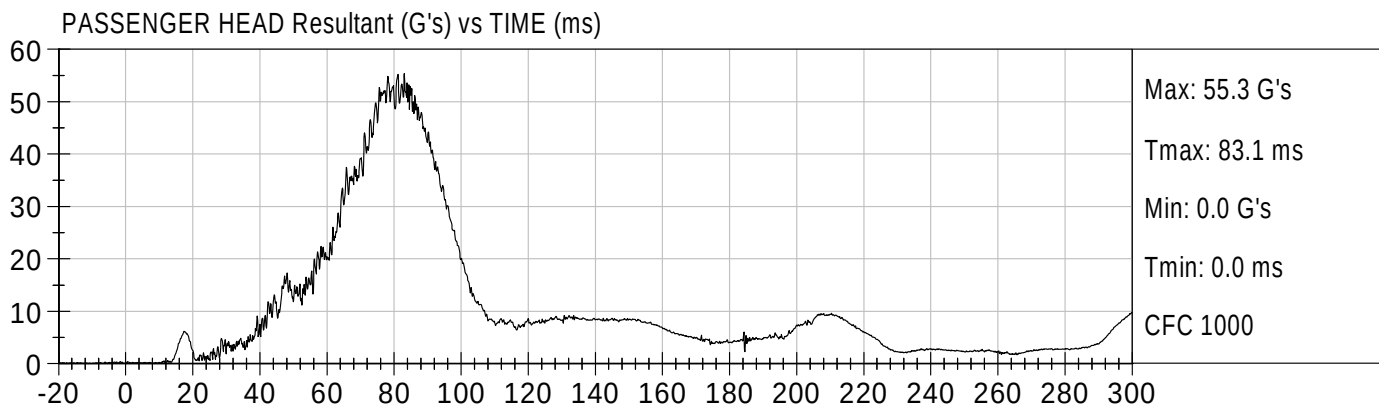
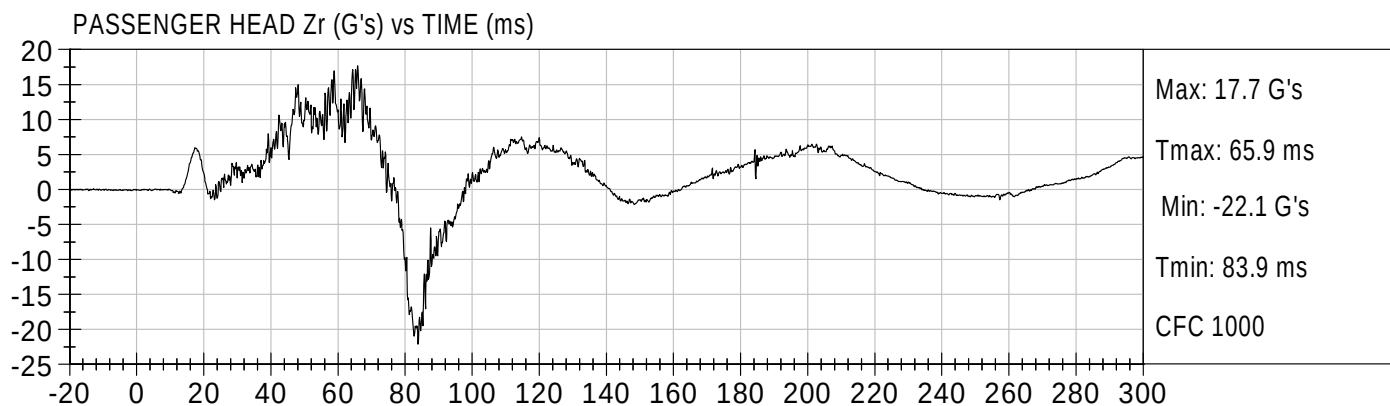
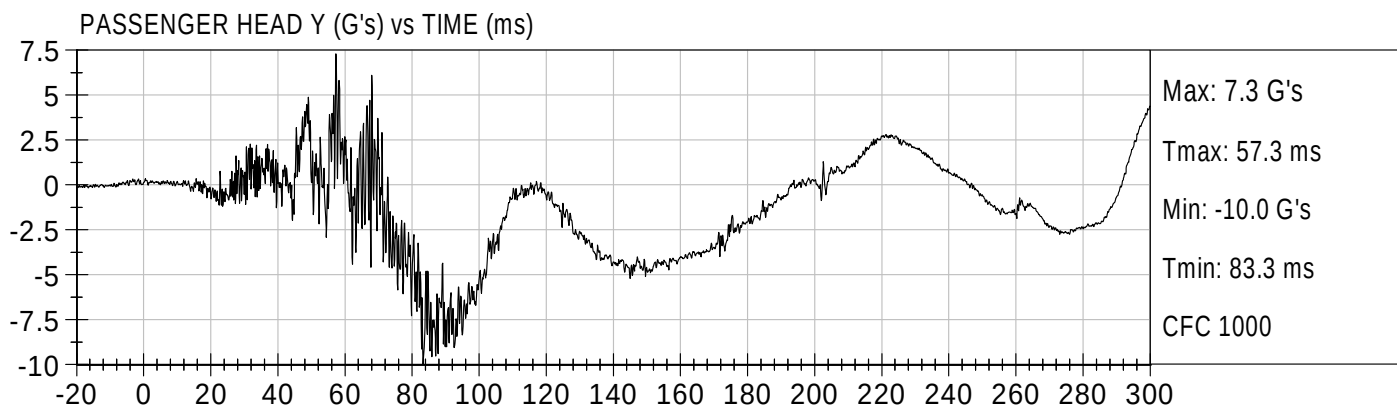
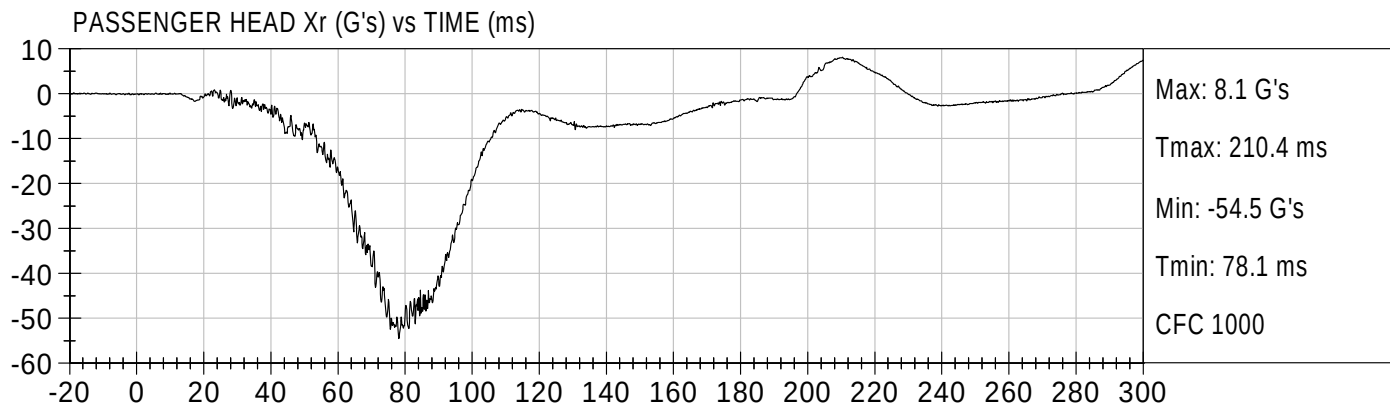






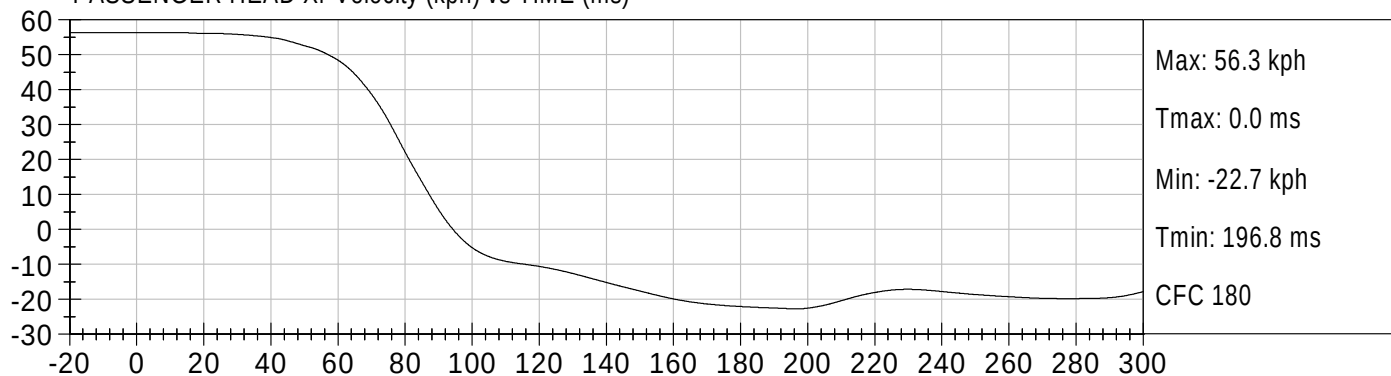
35mph NCAP Frontal
2010 BMW 328xi Coupe - MA0515

Test Date: 11/19/2009
Speed: 35.0 mph (56.3 km/h)

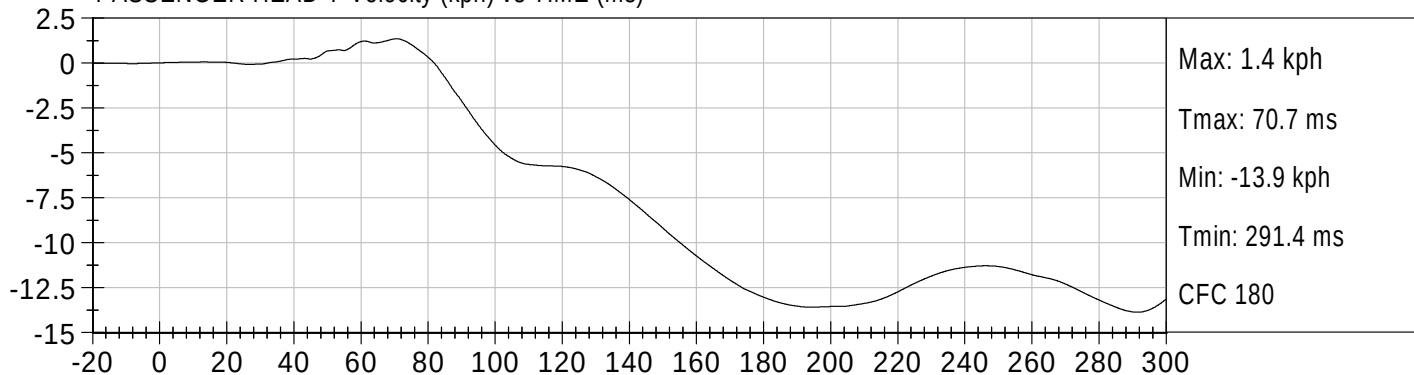




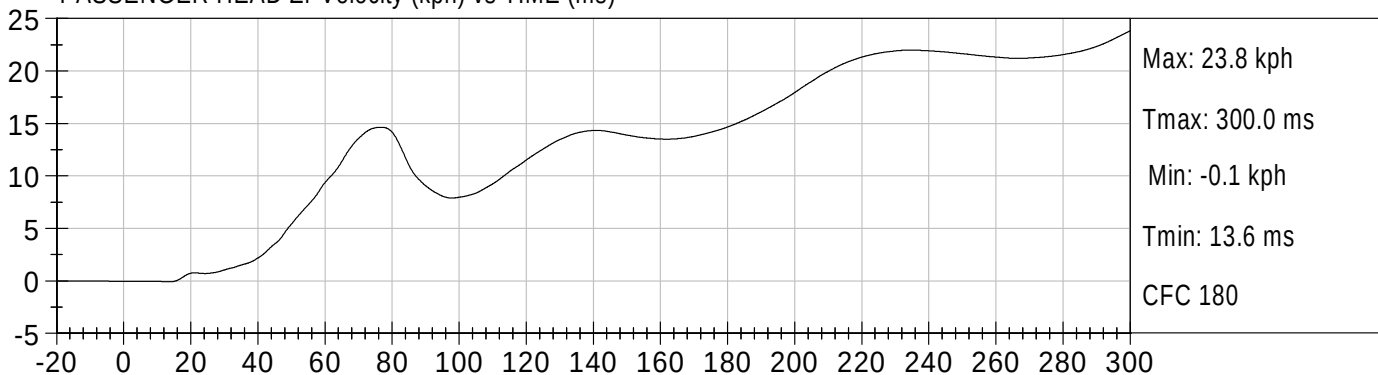
PASSENGER HEAD Xr Velocity (kph) vs TIME (ms)

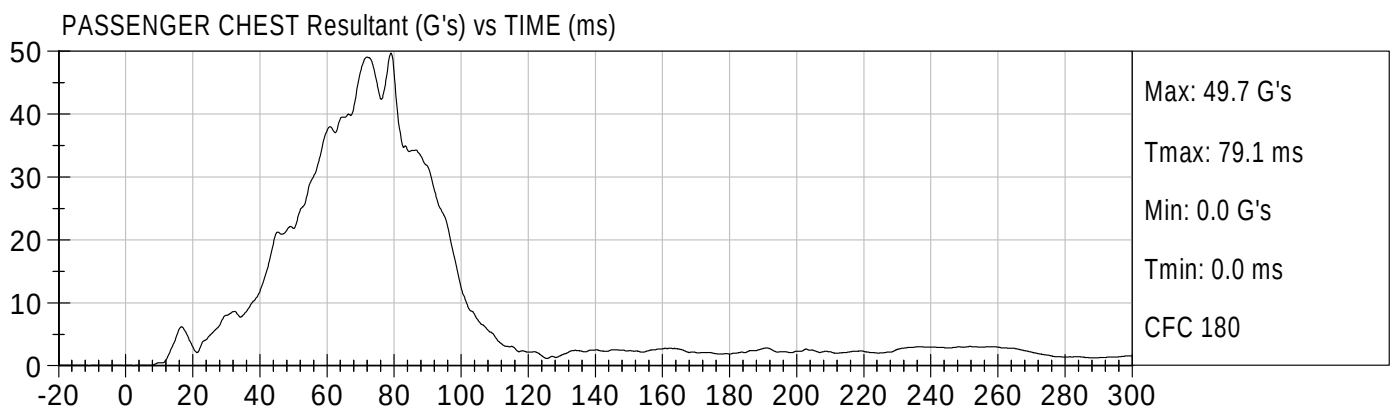
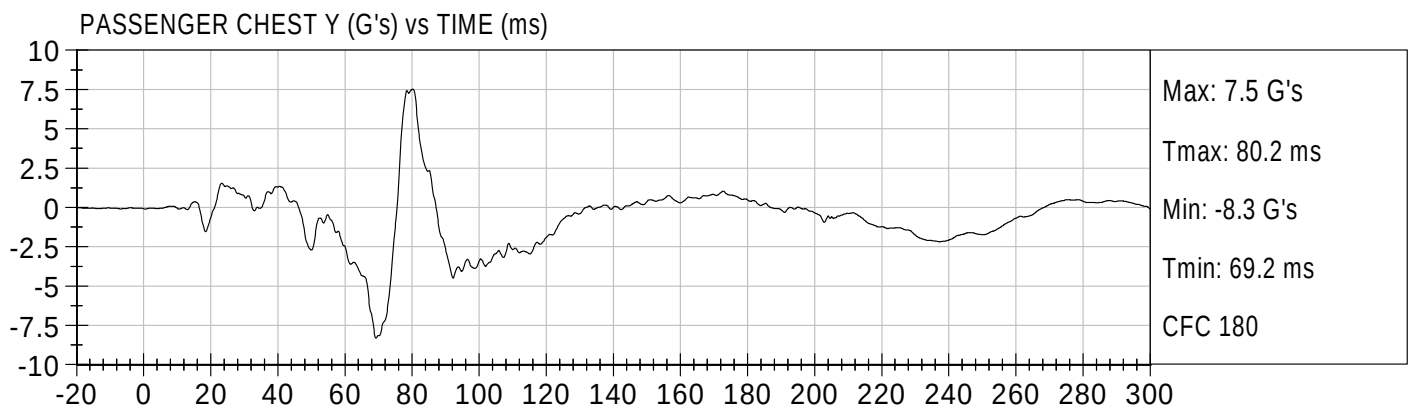
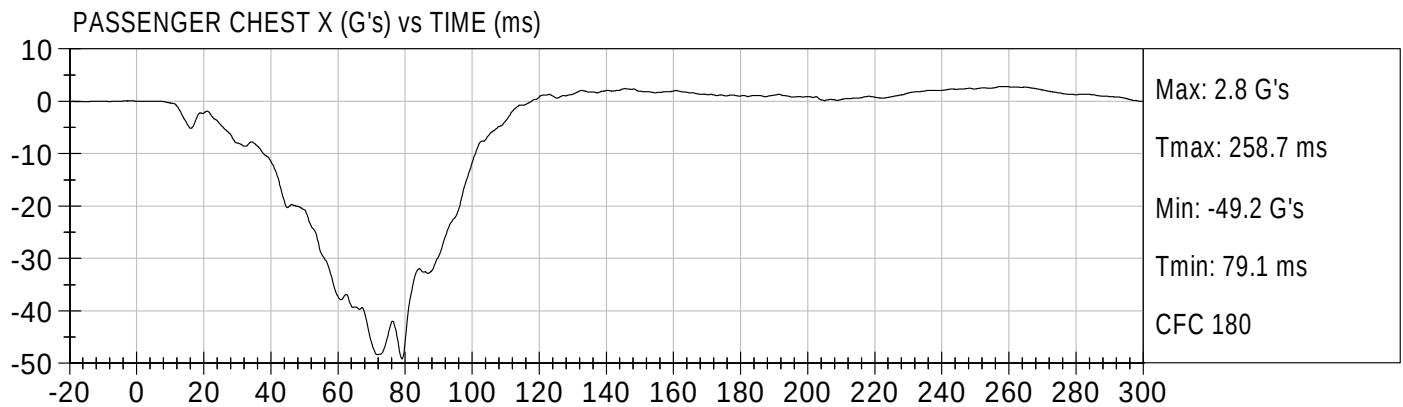


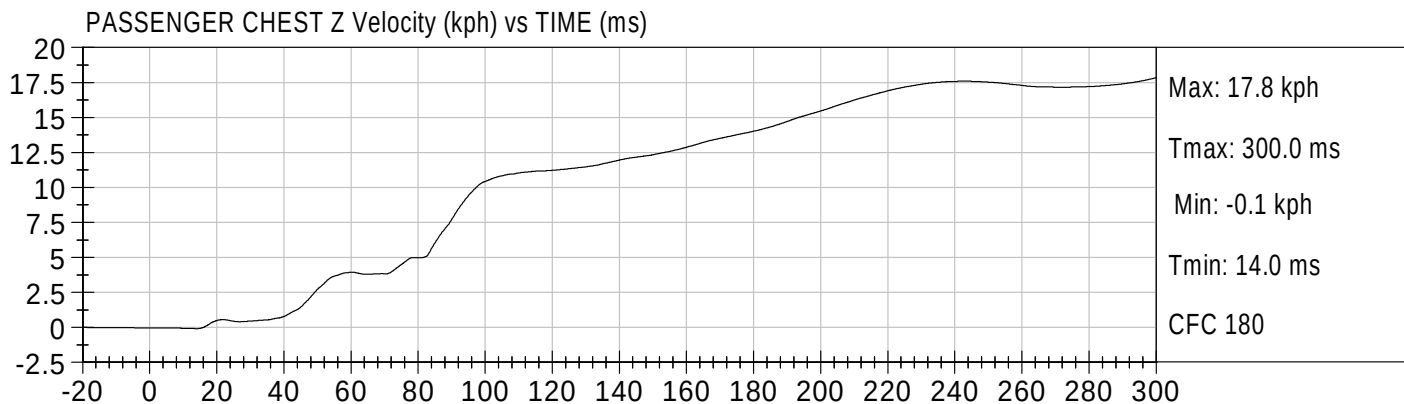
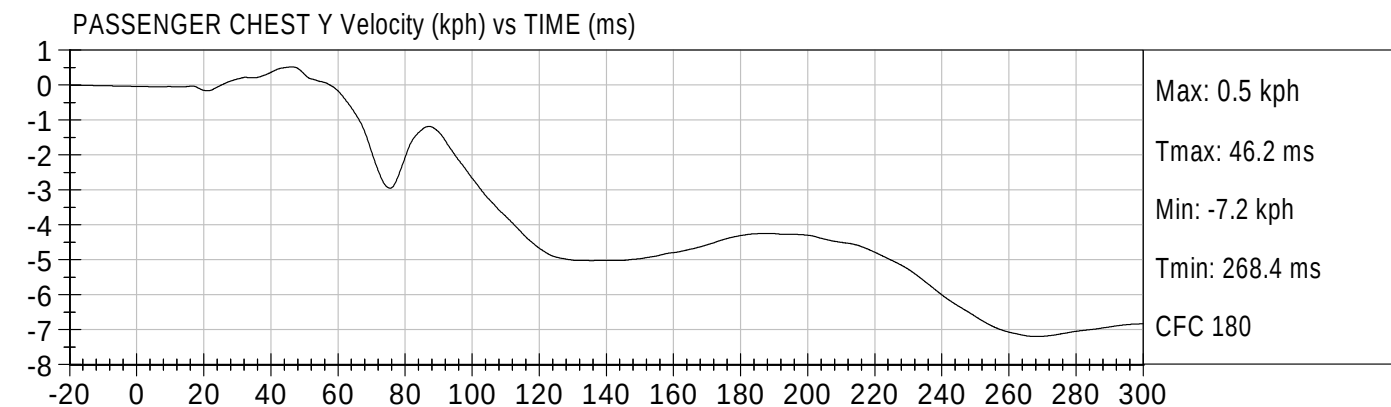
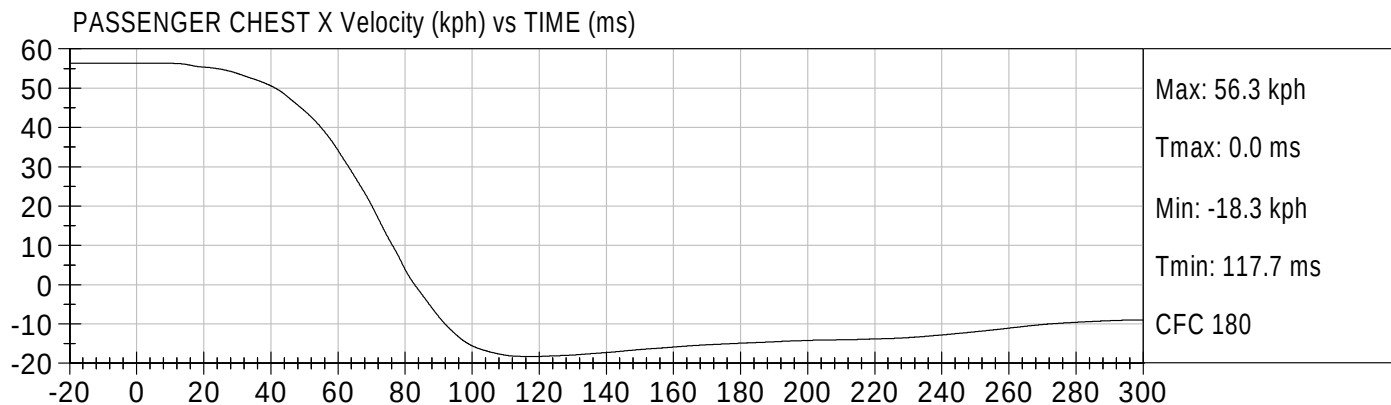
PASSENGER HEAD Y Velocity (kph) vs TIME (ms)

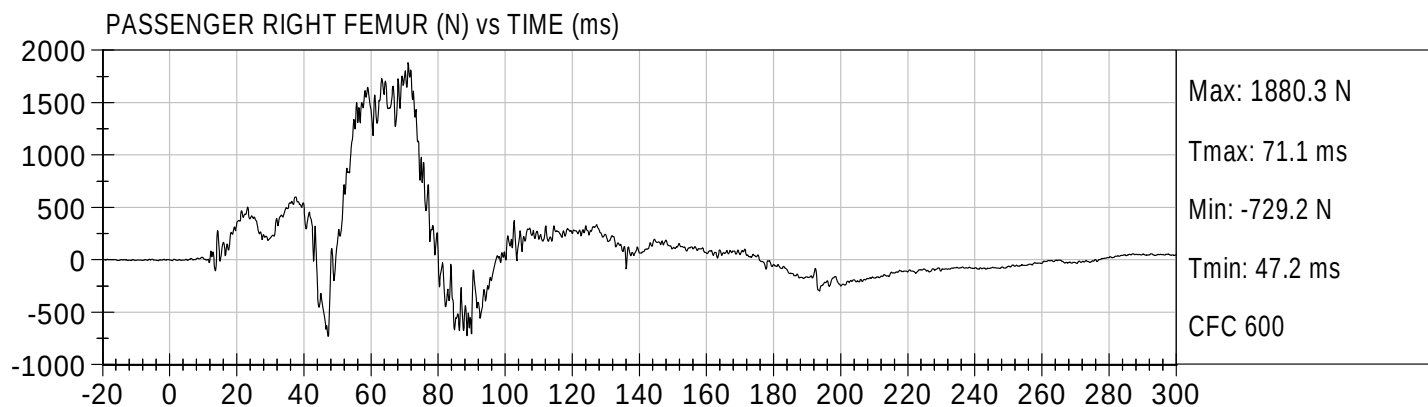
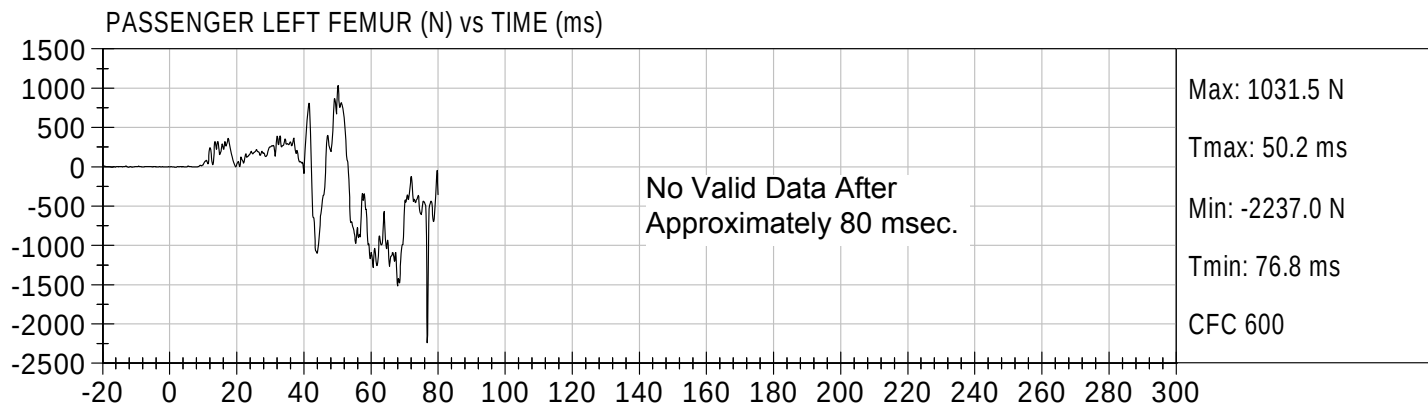


PASSENGER HEAD Zr Velocity (kph) vs TIME (ms)









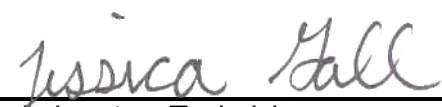
APPENDIX C
DUMMY CALIBRATION DATA

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

ATD Serial No: 066

Test ID: D092651

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Peak Resultant Acceleration	G's	225 - 275	246	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-12.7	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

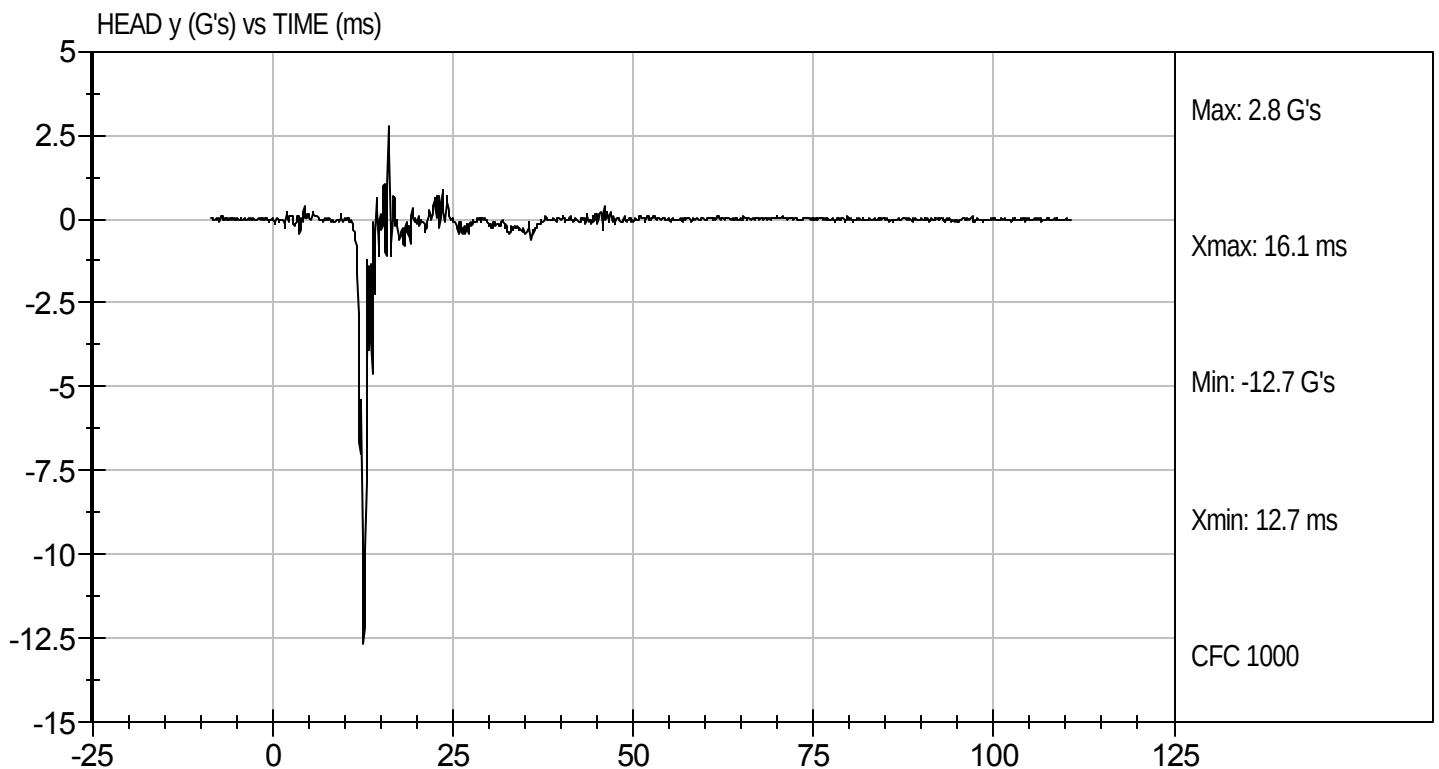
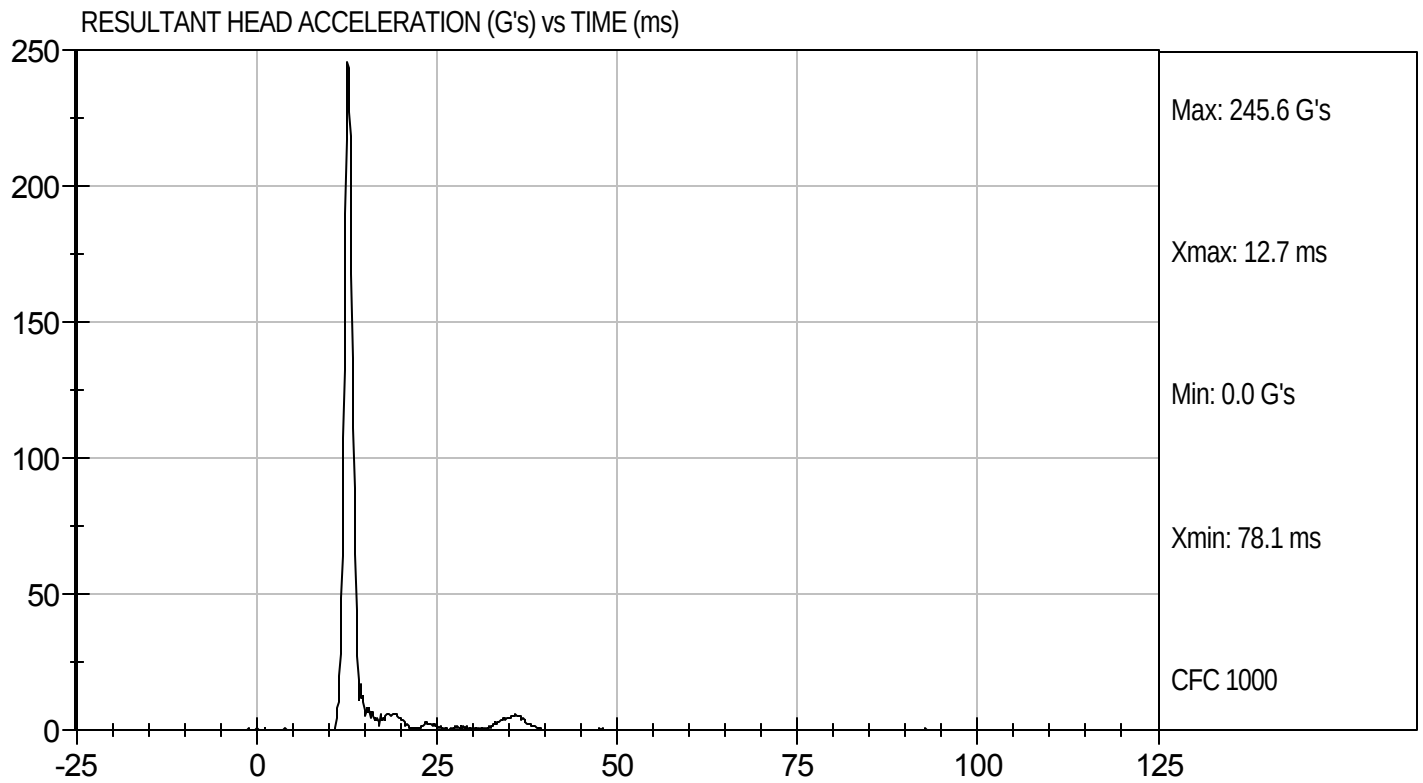
10/20/09
Test Date


Approved By



Test Desc: Head Drop
Component ID: D092651

Test Date: 10/20/09
Velocity: 0 ft/s, 0.00 m/s

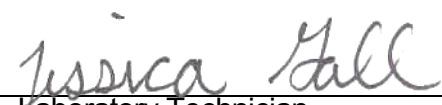


MGA RESEARCH CORPORATION
NECK FLEXION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066

Test I.D: D092652

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	45	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	m/s	22.50 to 27.50	23.74	Pass
	20 ms	m/s	17.60 to 22.60	19.07	Pass
	30 ms	m/s	12.50 to 18.50	15.34	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 29.0	15.34	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	34.7	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	69.5	Pass
	Time	ms	57.0 to 64.0	62.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	114.0	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	98.7	Pass
	Time	ms	47.0 to 58.0	47.7	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	101.9	Pass
Overall Test Results					Pass


 Laboratory Technician

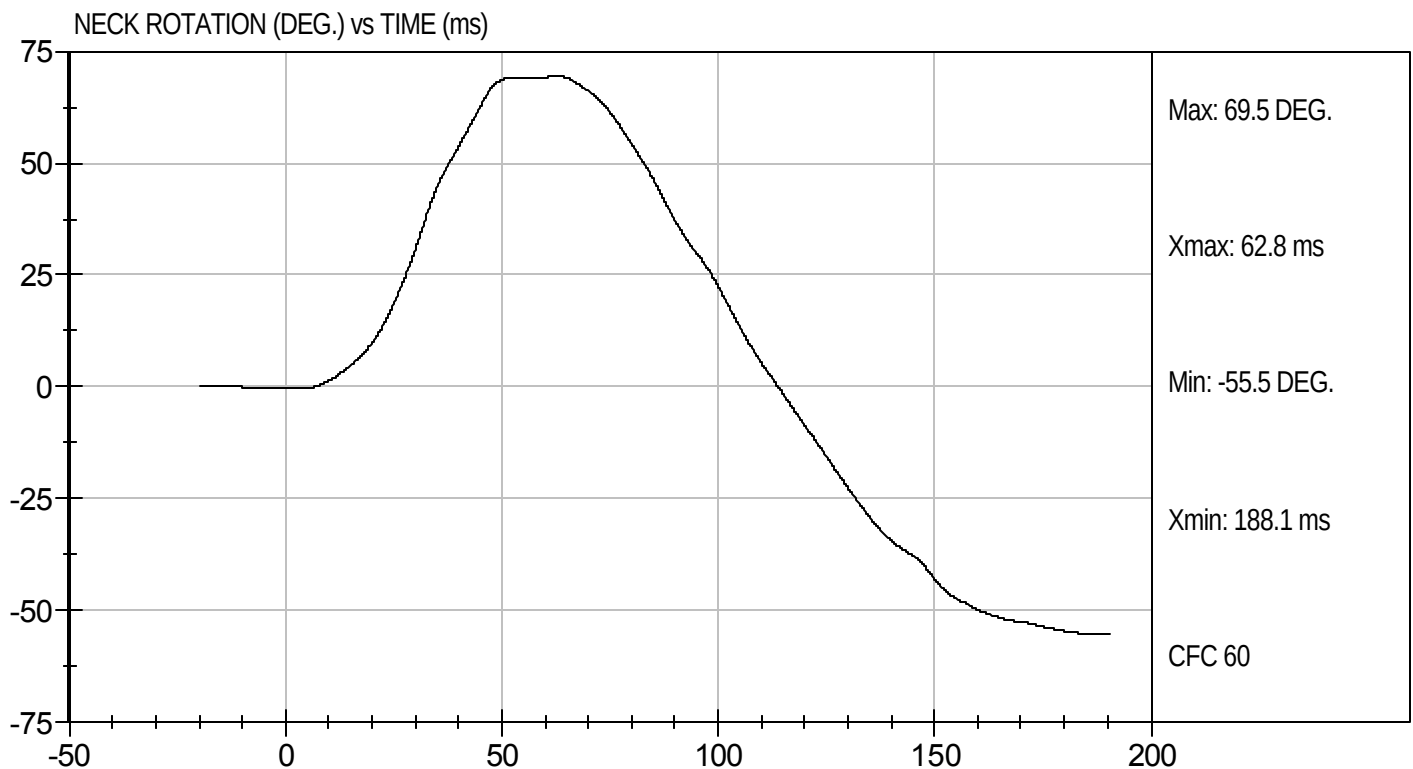
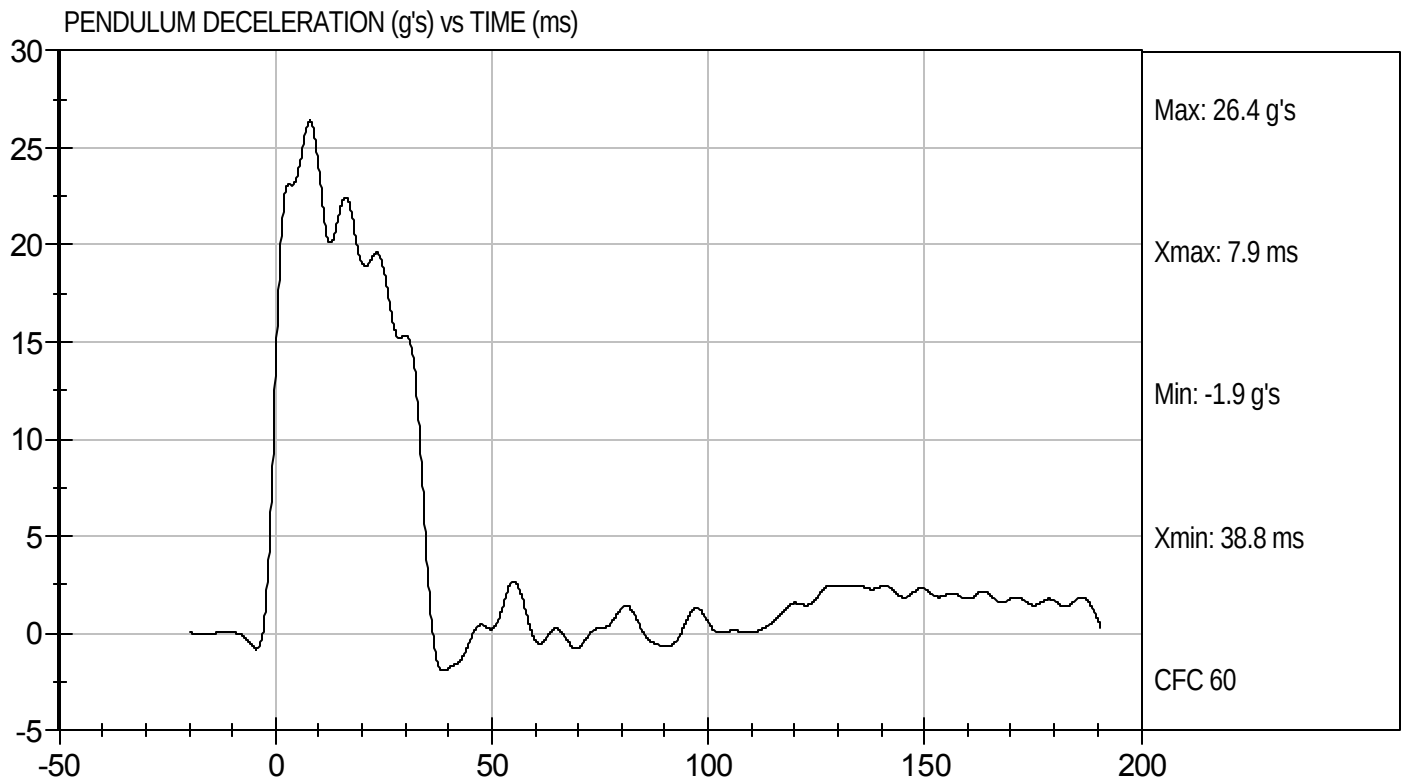
10/20/09
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D092652

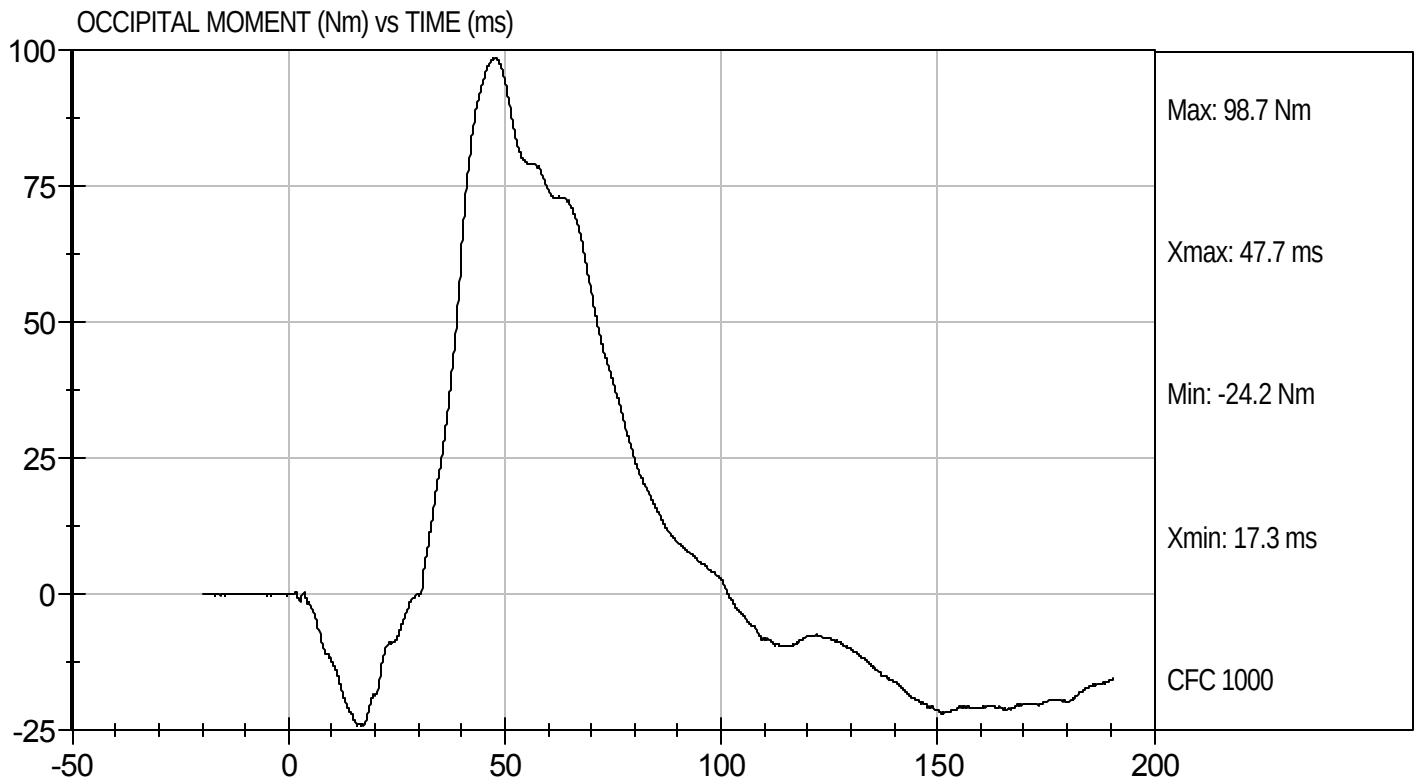
Test Date: 10/20/09
Velocity: 23.15 ft/s, 7.06 m/s





Test Desc: Neck Flexion
Component ID: D092652

Test Date: 10/20/09
Velocity: 23.15 ft/s, 7.06 m/s

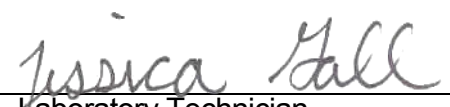


MGA RESEARCH CORPORATION
NECK EXTENSION TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066

Test I.D: D092653

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	45	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.16	Pass
Pendulum Deceleration	10 ms	m/s	17.20 to 21.20	18.47	Pass
	20 ms	m/s	14.00 to 19.00	17.53	Pass
	30 ms	m/s	11.00 to 16.00	15.20	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 22.0	15.11	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	42.4	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	99.7	Pass
	Time	ms	72.0 to 82.0	76.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	155.2	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-61.7	Pass
	Time	ms	65.0 to 79.0	72.0	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	144.8	Pass
Overall Test Results					Pass


 Laboratory Technician

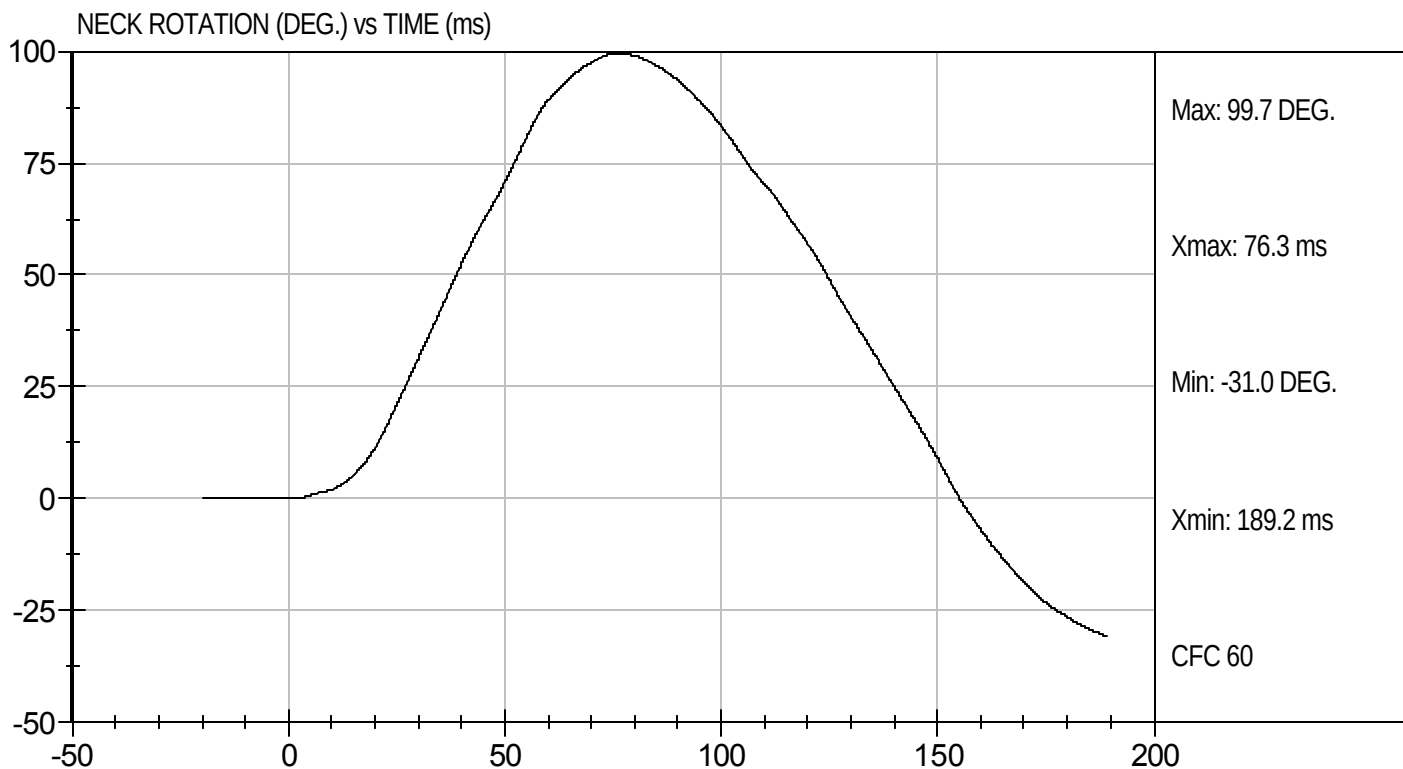
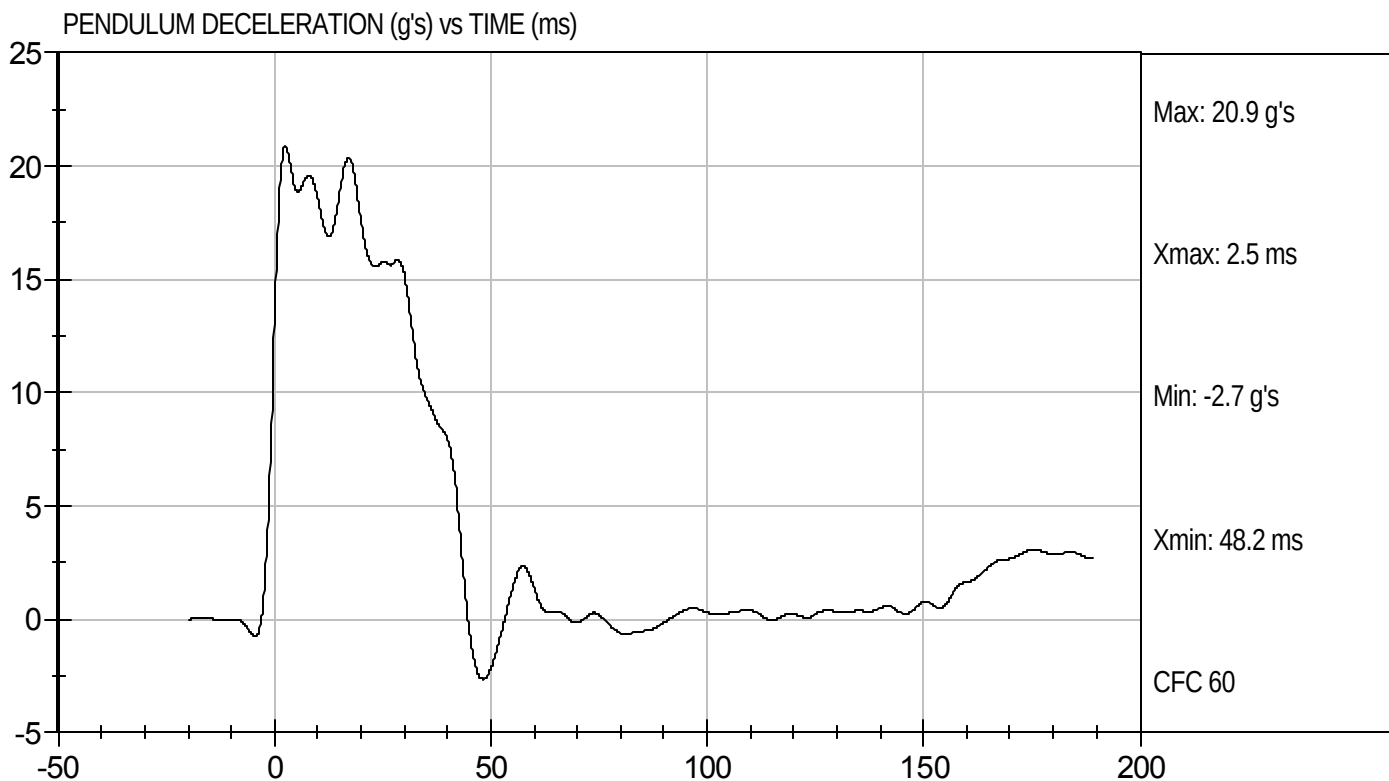
10/20/09
 Test Date


 Approved By



Test Desc: Neck Extension
Component ID: D092653

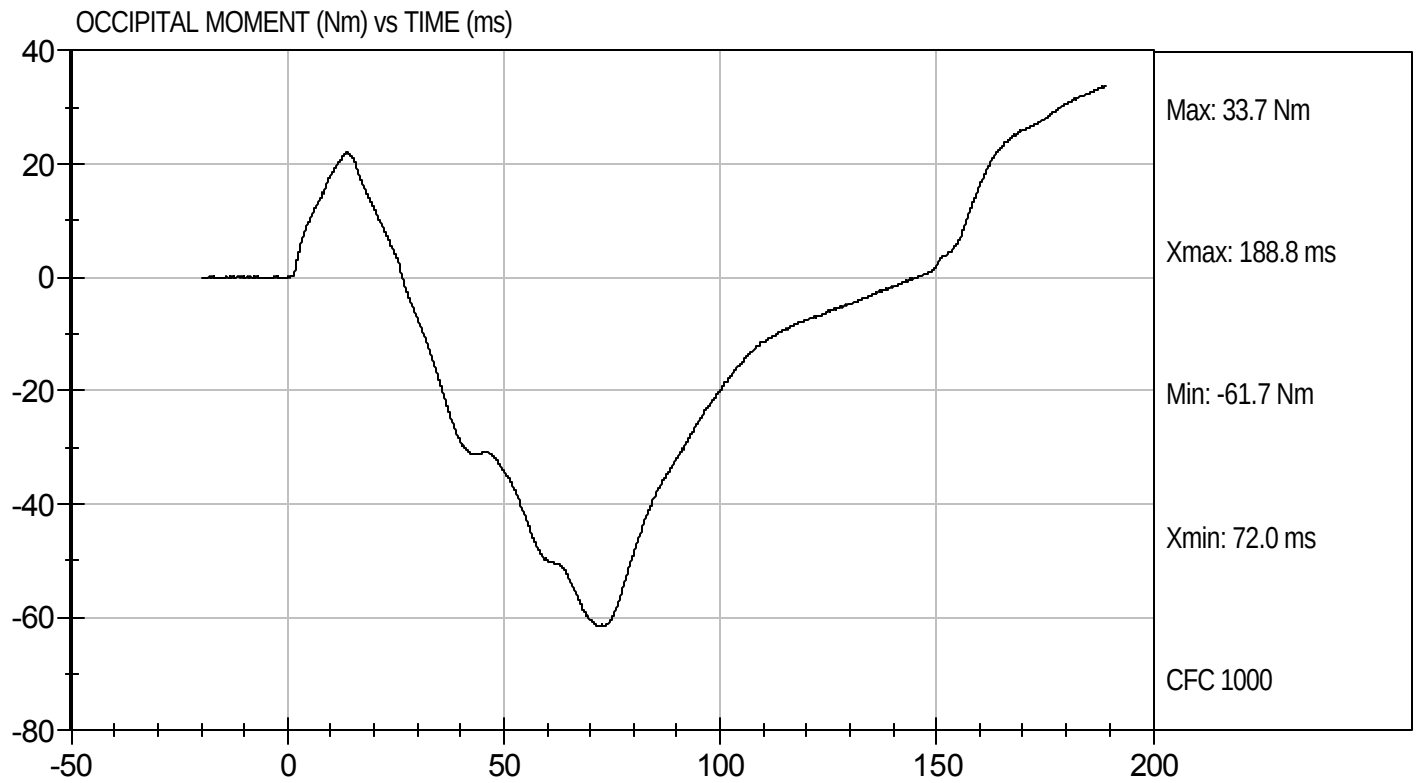
Test Date: 10/20/09
Velocity: 20.20 ft/s, 6.16 m/s





Test Desc: Neck Extension
Component ID: D092653

Test Date: 10/20/09
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: D092654

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	38	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	6.75	Pass
Internal Hysteresis	%	69 to 85	70	Pass
Overall Test Results			Pass	


Laboratory Technician

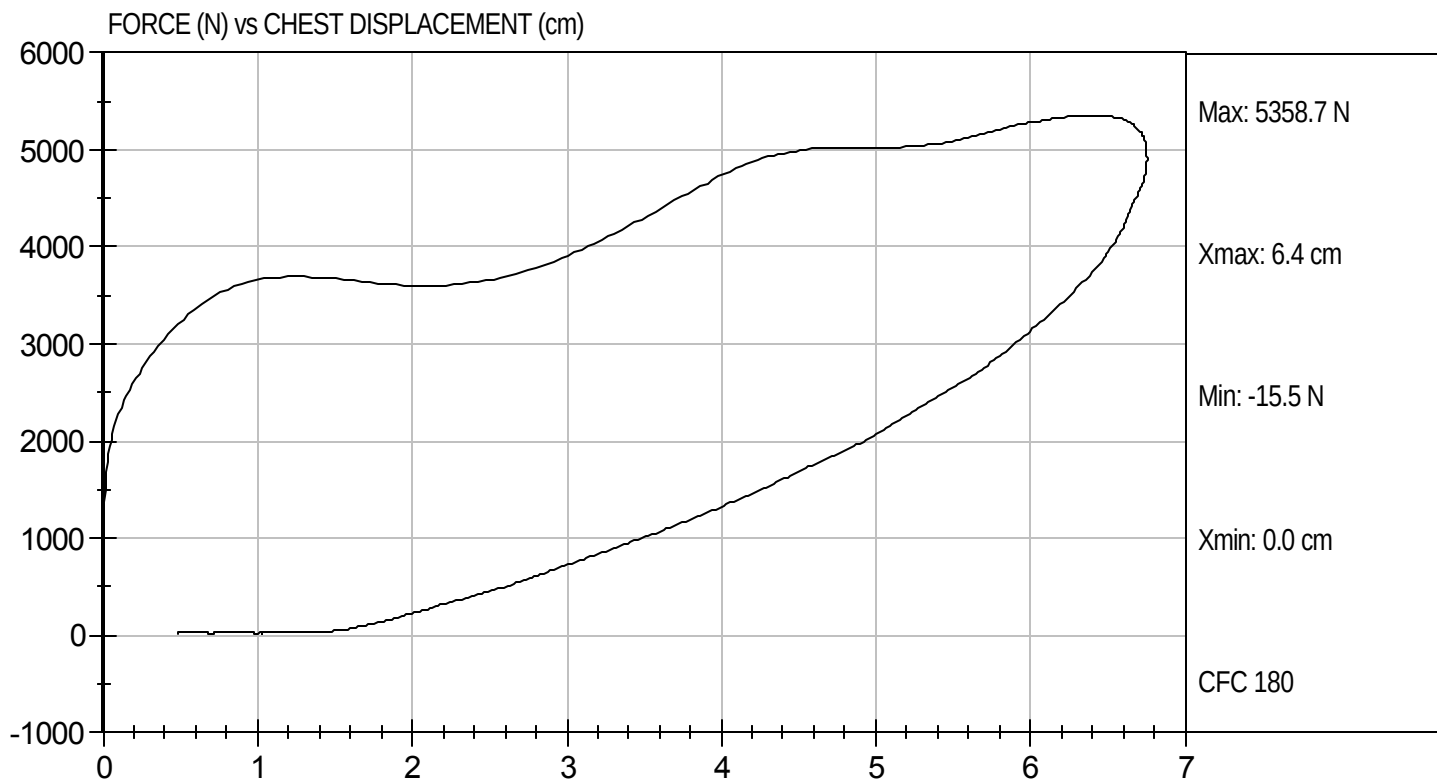
10/21/09
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D092654

Test Date: 10/21/09
Velocity: 22.22 ft/s, 6.77 m/s



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

ATD Serial No: 066

Test I.D: D092655

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,215	Pass
Overall Test Results				Pass



Laboratory Technician

10/20/09
Test Date

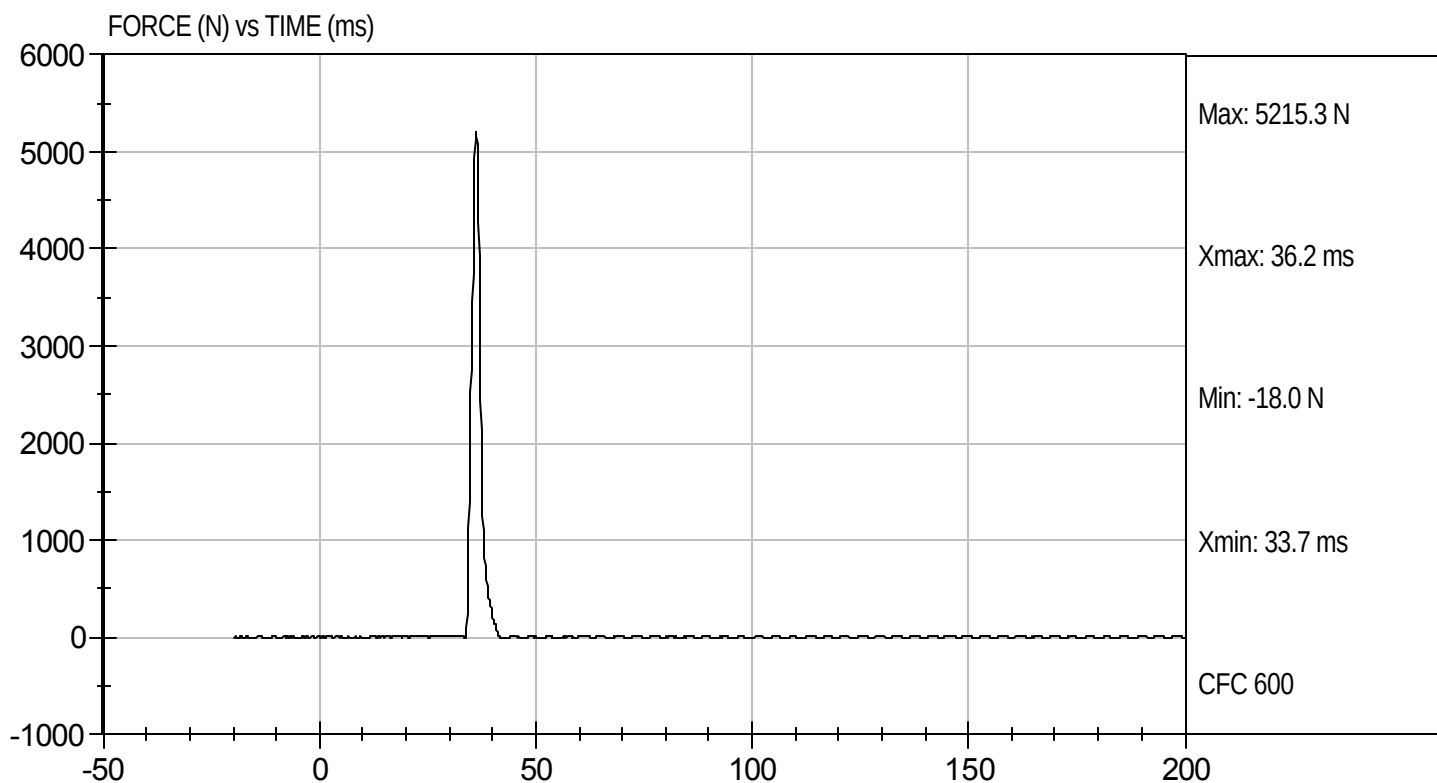


Approved By



Test Desc: Right Knee
Component ID: D092655

Test Date: 10/20/09
Velocity: 6.97 ft/s, 2.12 m/s



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

ATD Serial No: 066

Test I.D: D092656

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	4,770	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

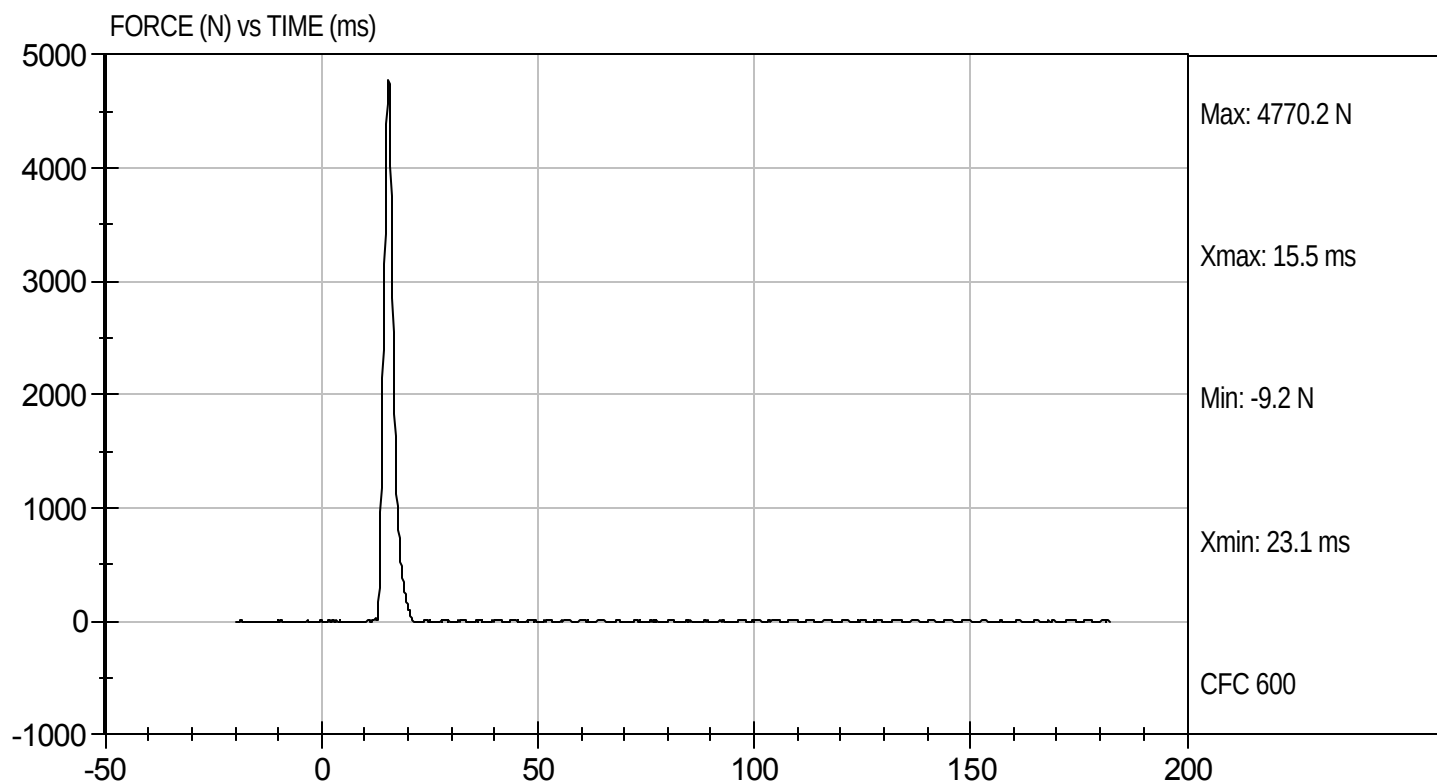
10/20/09
Test Date

David Winkelbauer
Approved By



Test Desc: Left Knee
Component ID: D092656

Test Date: 10/20/09
Velocity: 6.97 ft/s, 2.12 m/s



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

ATD Serial No: 066

Test I.D: D092650

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.7	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	45	45	Pass
Rotation Rate	deg/s	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	69.3	68.9	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	42	41	Pass
Overall Test Results					Pass

Jessica Hall
Laboratory Technician

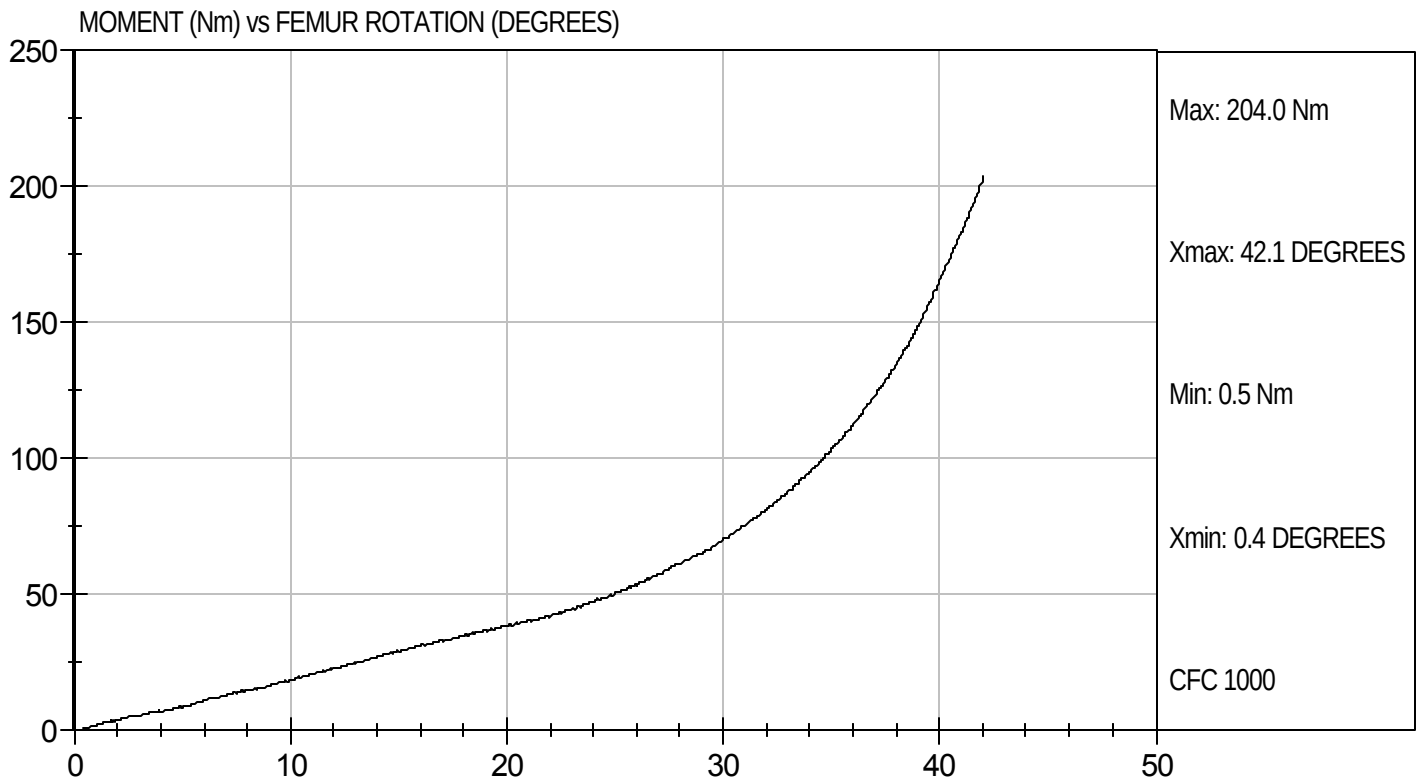
10/20/09
Test Date

David Winkelbauer
Approved By



Test Desc: Hip Femur Flexion
Component ID: D092659

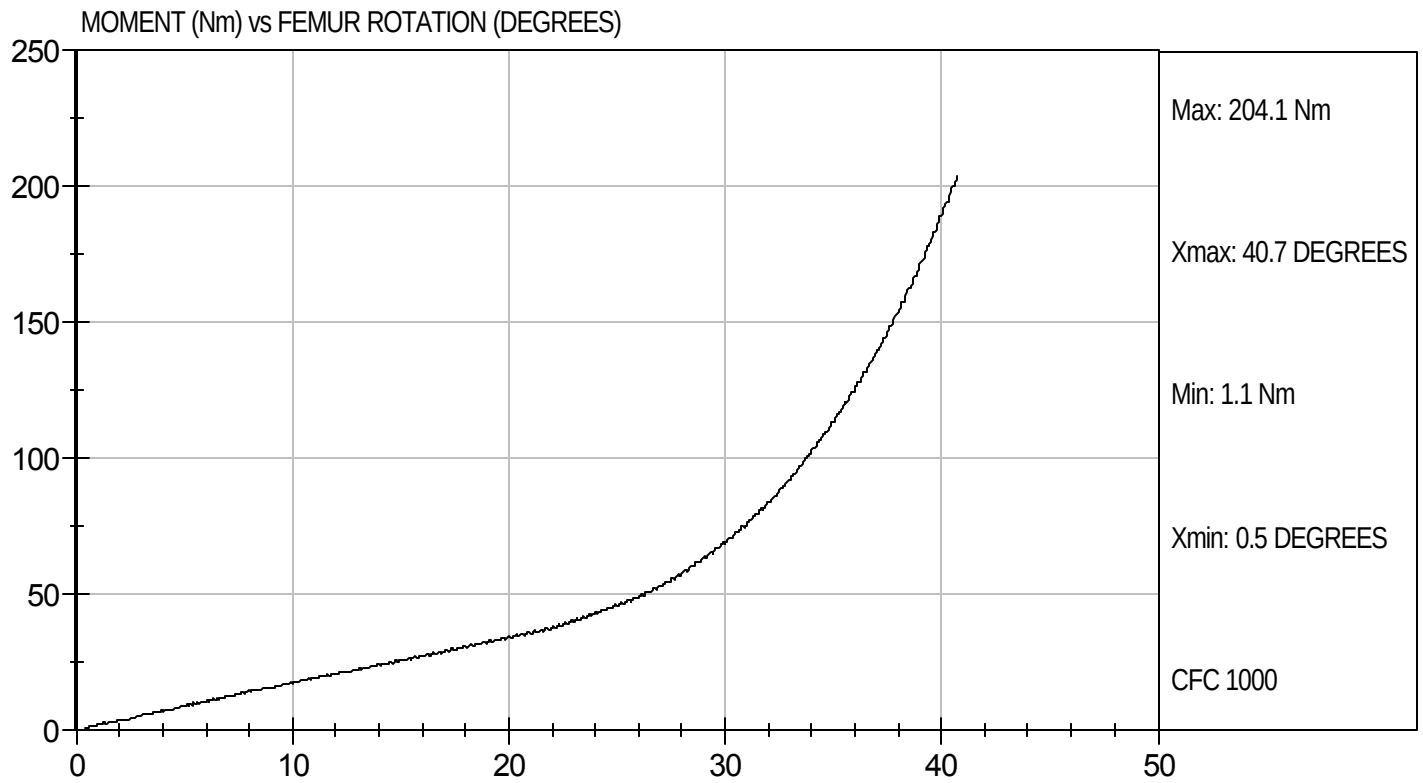
Test Date: 10/20/09
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D092650

Test Date: 10/20/09
Velocity: 0 ft/s, 0.00 m/s

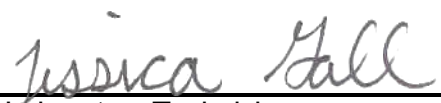


MGA RESEARCH CORPORATION
HEAD DROP TEST
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065

Test ID: D092641

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Peak Resultant Acceleration	G's	225 - 275	249	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-4.2	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
Overall Test Results				Pass


Laboratory Technician

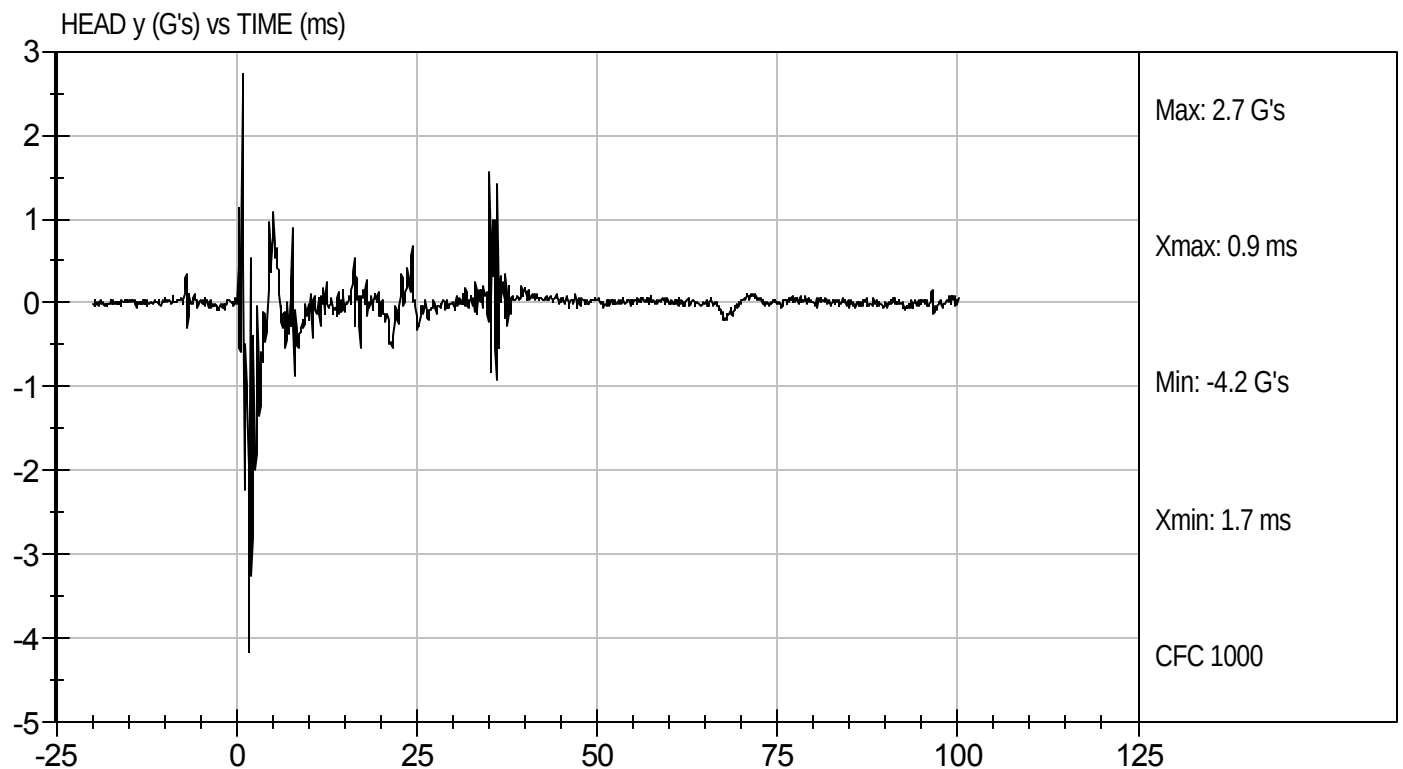
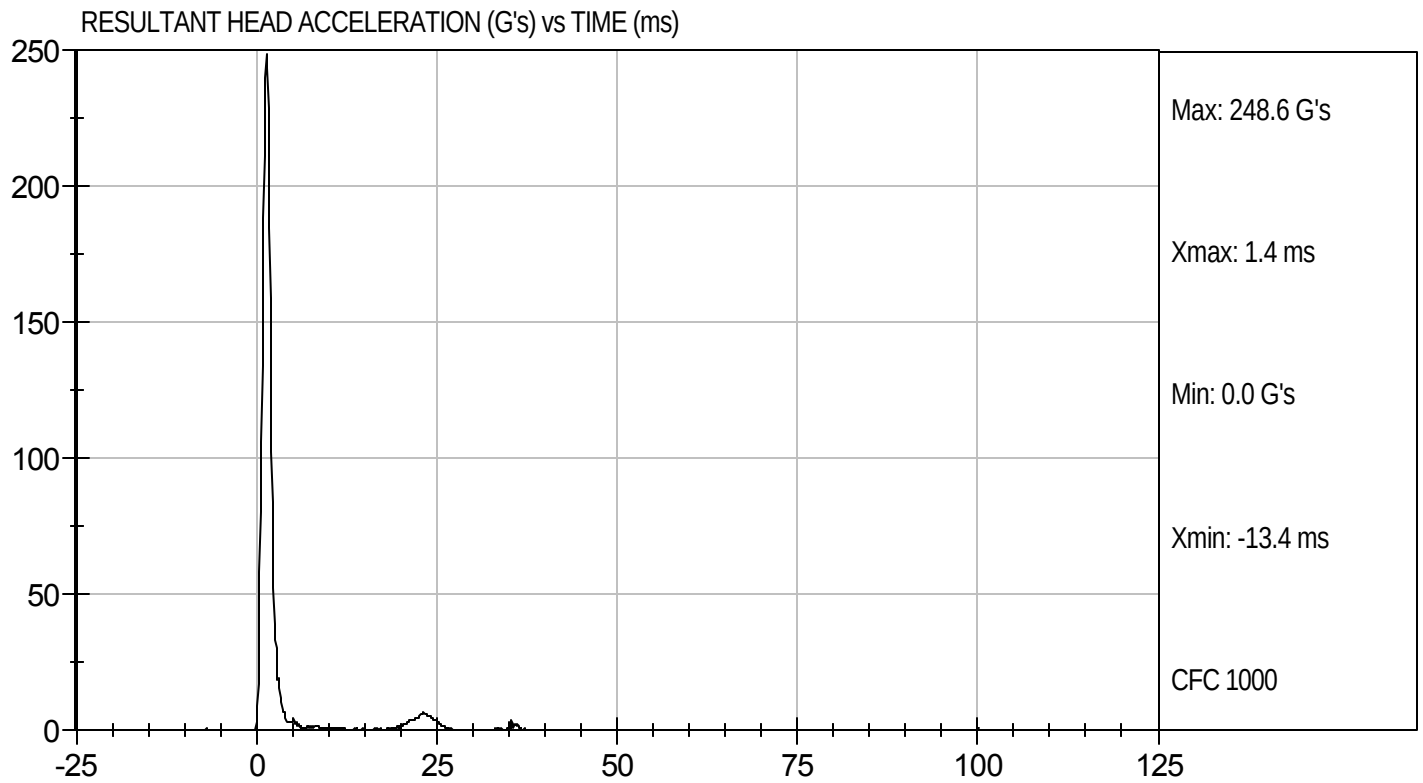
10/20/09
Test Date


Approved By



Test Desc: Head Drop
Component ID: D092641

Test Date: 10/20/09
Velocity: 0 ft/s, 0.00 m/s



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

ATD Serial No: 065

Test I.D: D092642

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	45	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 ms	m/s	22.50 to 27.50	23.10	Pass
	20 ms	m/s	17.60 to 22.60	20.00	Pass
	30 ms	m/s	12.50 to 18.50	13.88	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 29.0	14.03	Pass
Deceleration Decay Time to Cross 5 G's		ms	34.0 to 42.0	35.4	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	70.4	Pass
	Time	ms	57.0 to 64.0	63.5	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	113.0 to 128.0	116.7	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	92.1	Pass
	Time	ms	47.0 to 58.0	47.5	Pass
Positive Moment Decay Time To Zero Crossing		ms	97.0 to 107.0	100.3	Pass
Overall Test Results					Pass


 Laboratory Technician

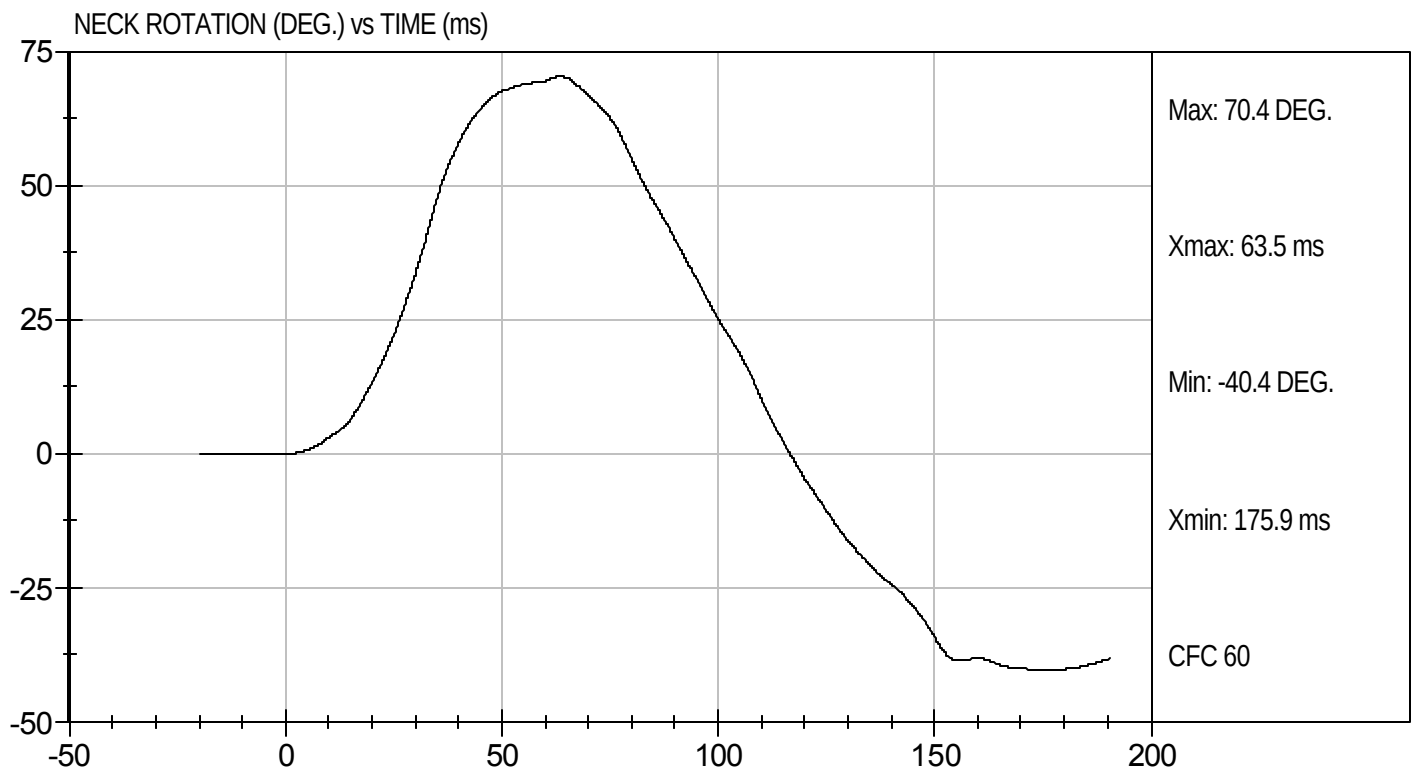
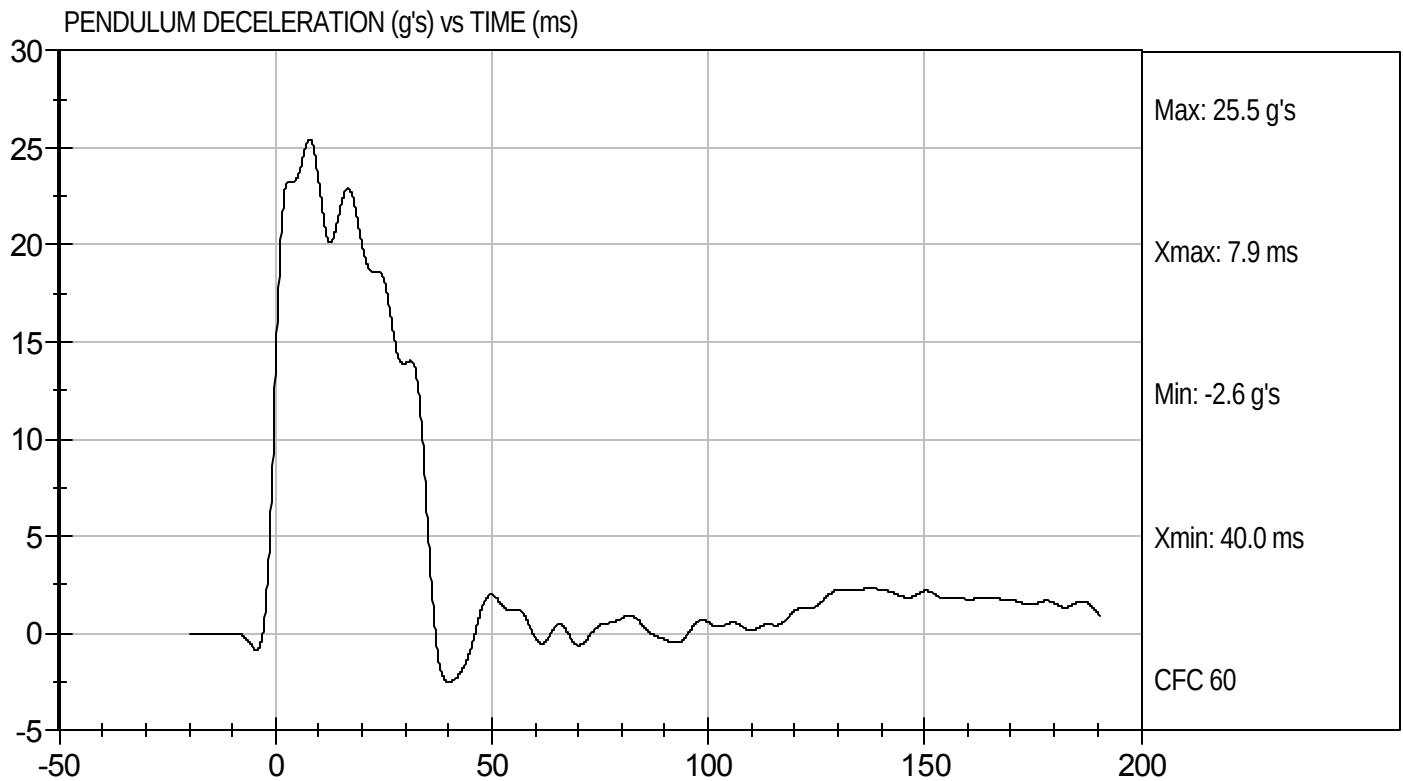
10/20/09
 Test Date


 Approved By



Test Desc: Neck Flexion
Component ID: D092642

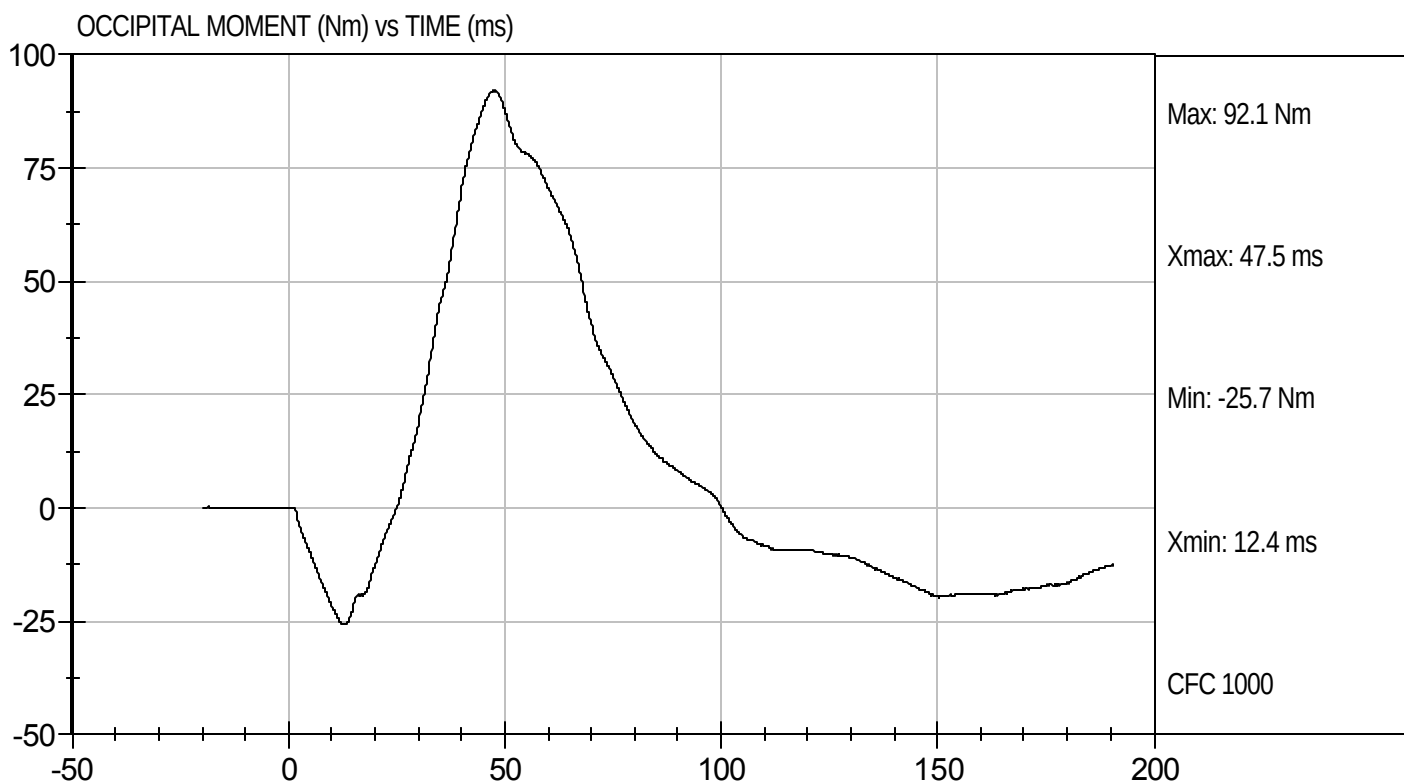
Test Date: 10/20/09
Velocity: 23.15 ft/s, 7.06 m/s





Test Desc: Neck Flexion
Component ID: D092642

Test Date: 10/20/09
Velocity: 23.15 ft/s, 7.06 m/s



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

ATD Serial No: 065

Test I.D: D092643

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	46	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.16	Pass
Pendulum Deceleration	10 ms	m/s	17.20 to 21.20	17.59	Pass
	20 ms	m/s	14.00 to 19.00	16.01	Pass
	30 ms	m/s	11.00 to 16.00	11.92	Pass
Peak Pendulum Deceleration After 30 ms		m/s	<= 22.0	12.89	Pass
Deceleration Decay Time to Cross 5 G's		ms	38.0 to 46.0	39.5	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	93.0	Pass
	Time	ms	72.0 to 82.0	74.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		ms	147.0 to 174.0	157.5	Pass
Moment About Occipital Condyle	Maximum	Nm	-52.9 to -79.9	-60.6	Pass
	Time	ms	65.0 to 79.0	70.8	Pass
Negative Moment Decay Time To Zero Crossing		ms	120.0 to 148.0	141.4	Pass
Overall Test Results					Pass


 Laboratory Technician

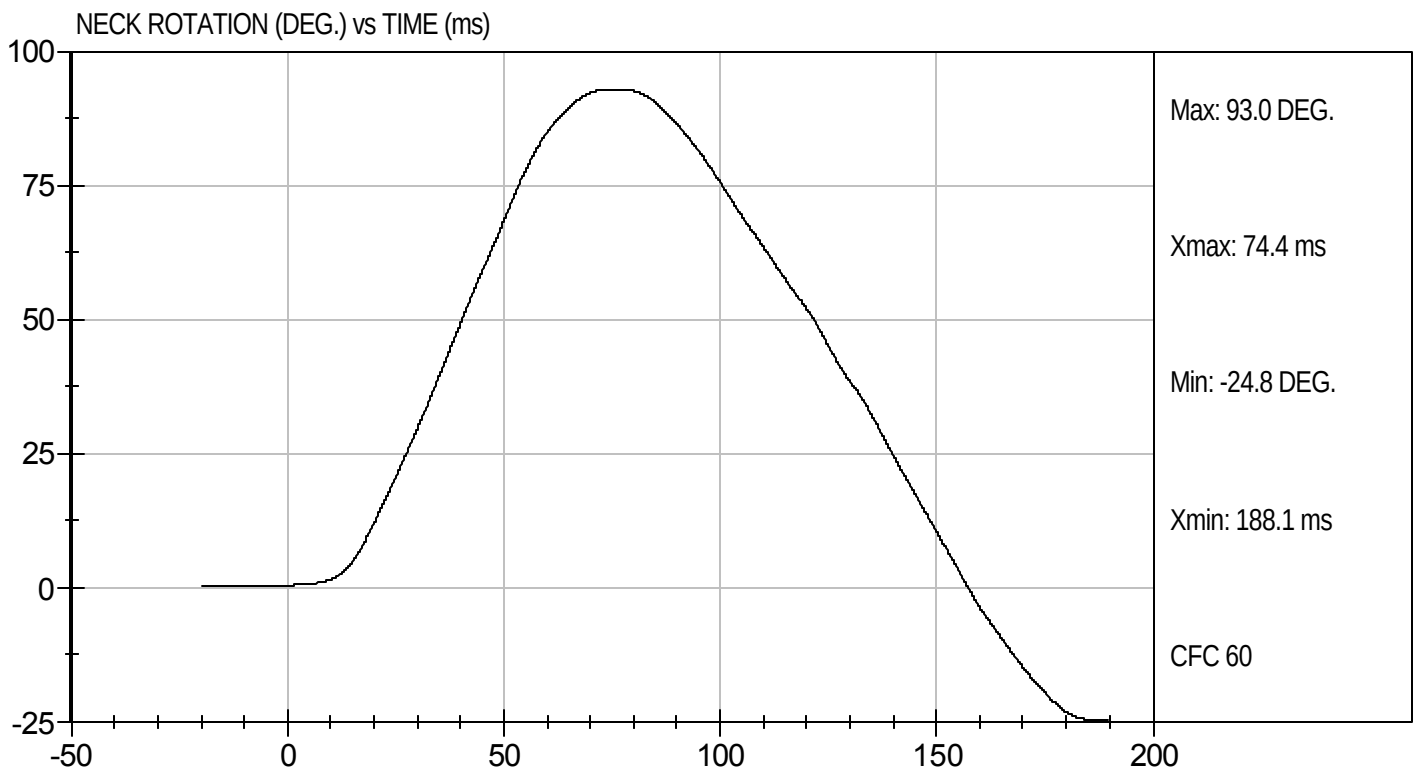
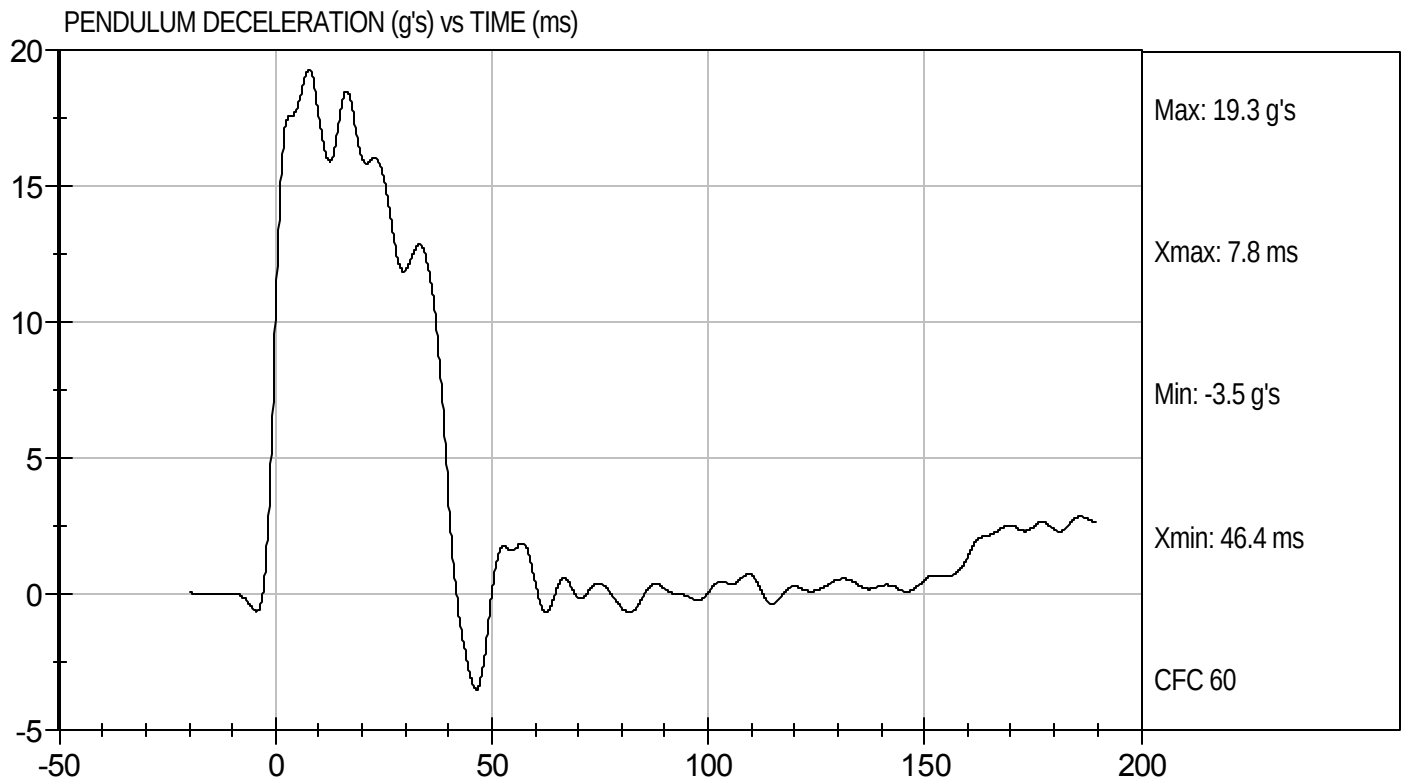
10/21/09
 Test Date


 Approved By



Test Desc: Neck Extension
Component ID: D092643

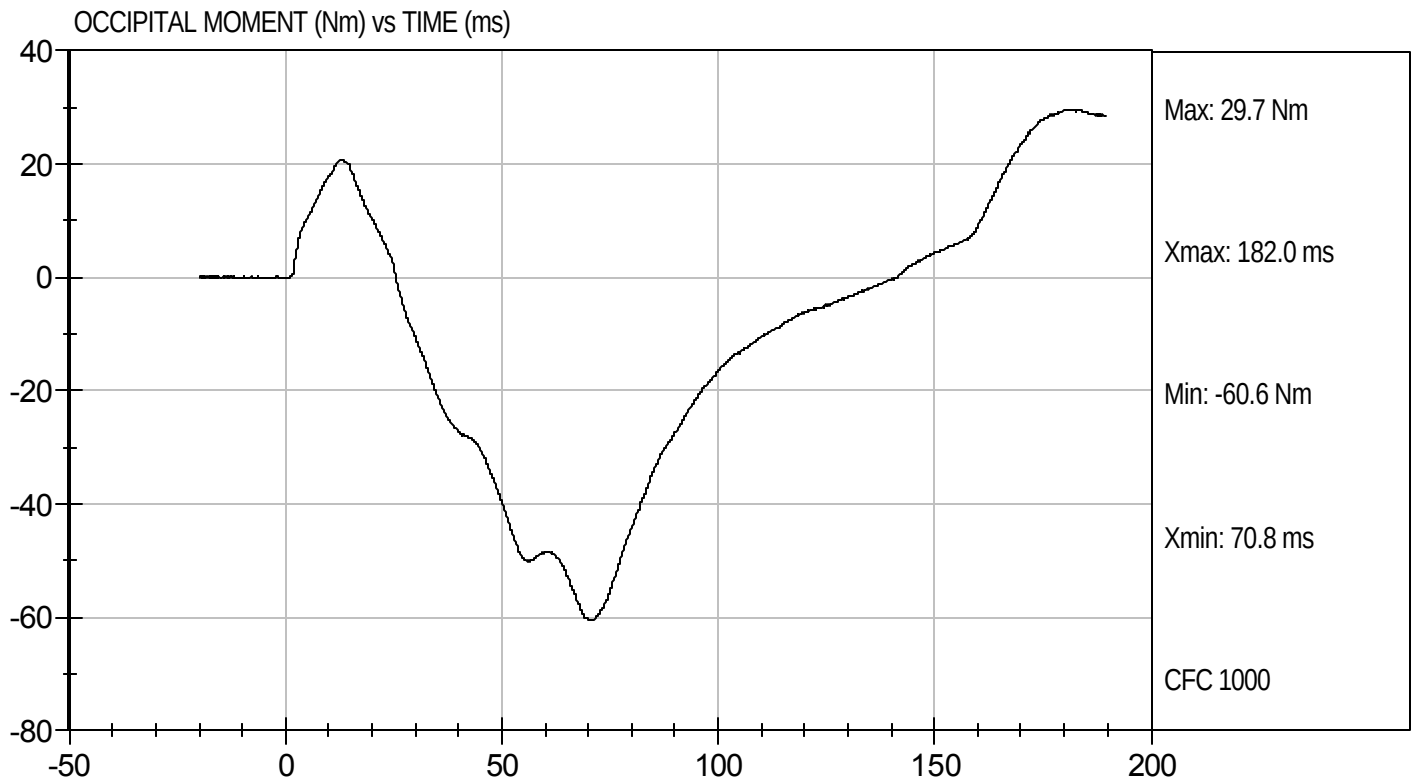
Test Date: 10/21/09
Velocity: 20.20 ft/s, 6.16 m/s





Test Desc: Neck Extension
Component ID: D092643

Test Date: 10/21/09
Velocity: 20.20 ft/s, 6.16 m/s

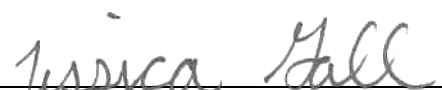


MGA RESEARCH CORPORATION
THORAX IMPACT
HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065

Test I.D: D092644

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.8	Pass
Laboratory Relative Humidity	%	10 to 70	38	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,286	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	7.01	Pass
Internal Hysteresis	%	69 to 85	71	Pass
Overall Test Results			Pass	


Laboratory Technician

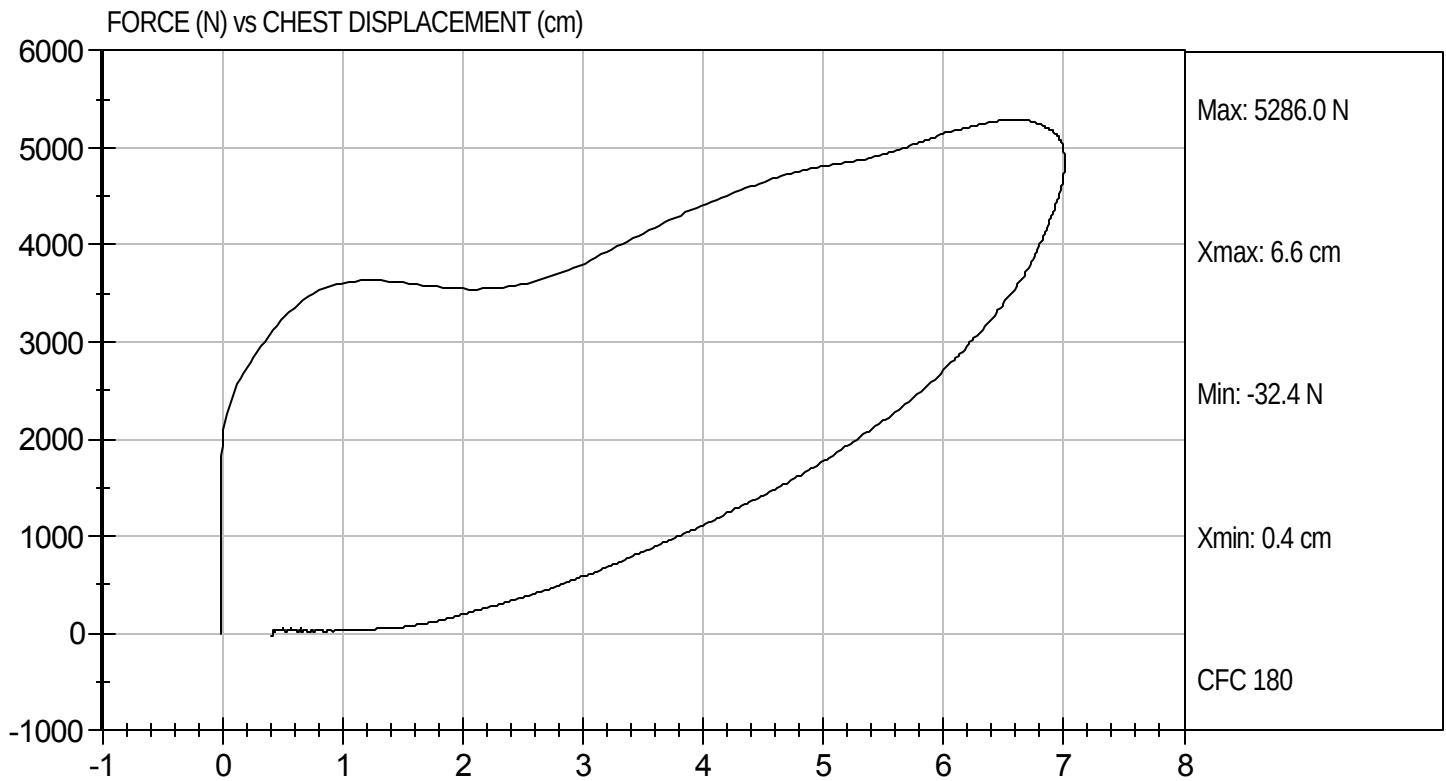
10/21/09
Test Date


Approved By



Test Desc: Thorax Impact
Component ID: D092644

Test Date: 10/21/09
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: D092645

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Velocity	m/s	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	5,190	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

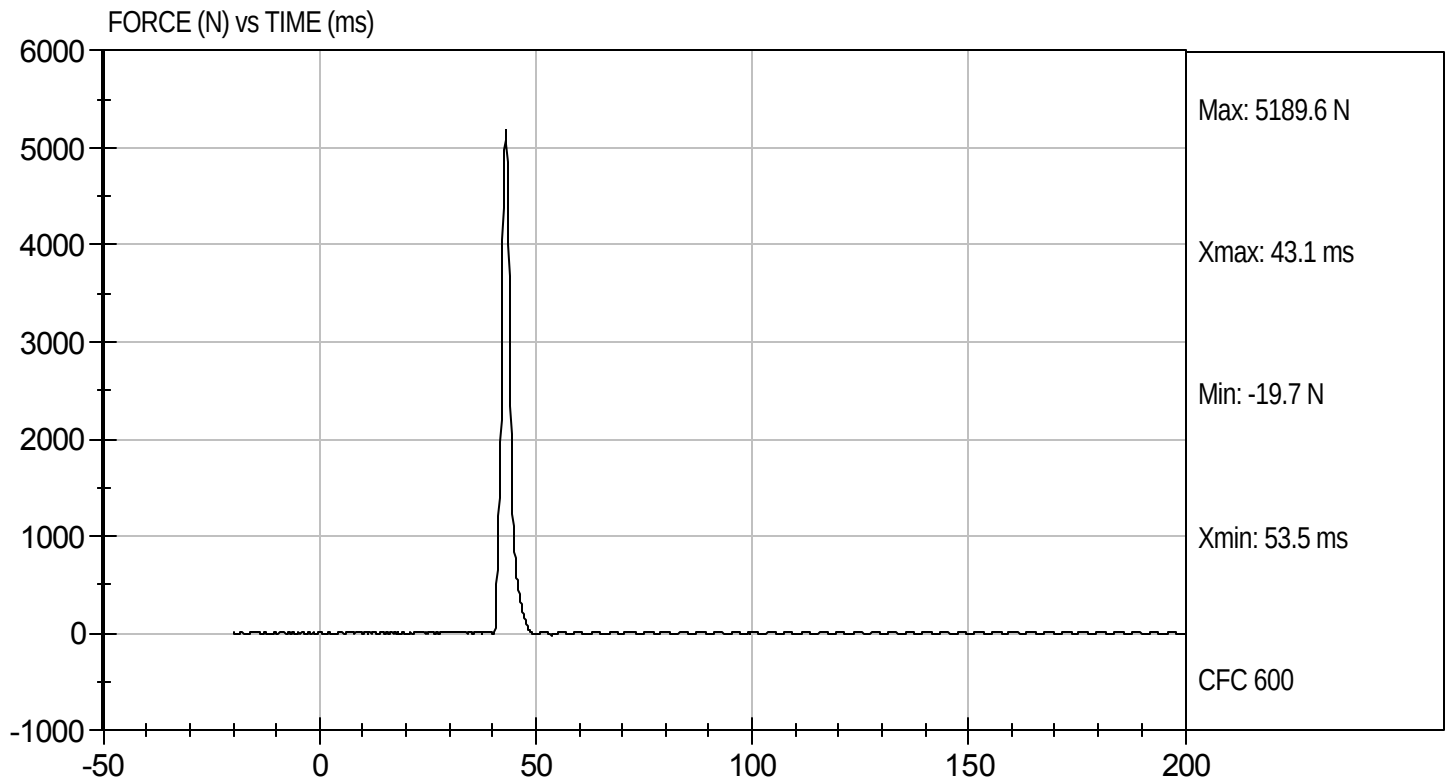
10/20/09
Test Date

David Winkelbauer
Approved By



Test Desc: Right Knee
Component ID: D092645

Test Date: 10/20/09
Velocity: 6.84 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: D092646

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Probe Velocity	m/s	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	5,637	Pass
Overall Test Results				Pass


Laboratory Technician

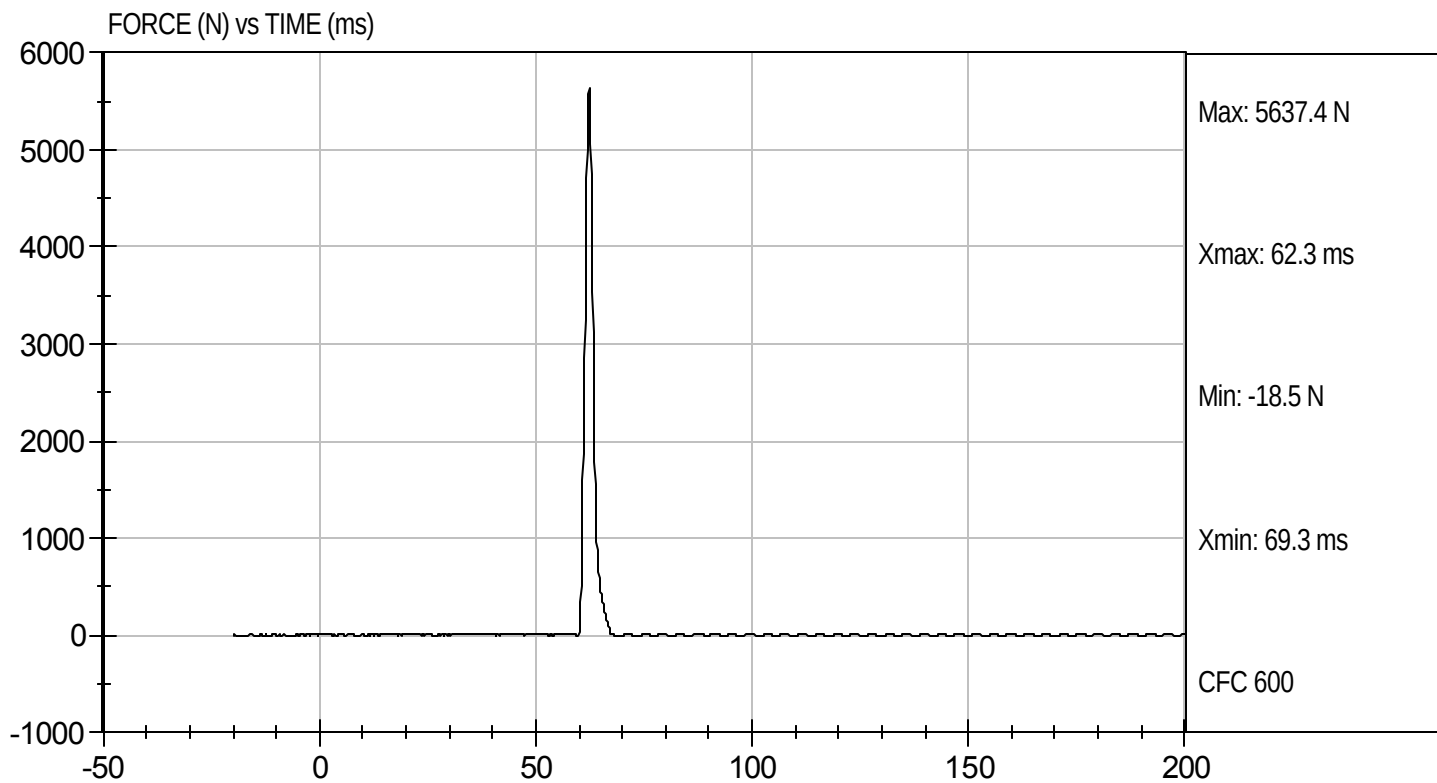
10/20/09
Test Date


Approved By



Test Desc: Left Knee
Component ID: D092646

Test Date: 10/20/09
Velocity: 6.94 ft/s, 2.12 m/s



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

ATD Serial No: 065

Test I.D: D092640

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.7	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	45	45	Pass
Rotation Rate	deg/s	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	58.9	57.0	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	45	42	Pass
Overall Test Results					Pass


 Laboratory Technician

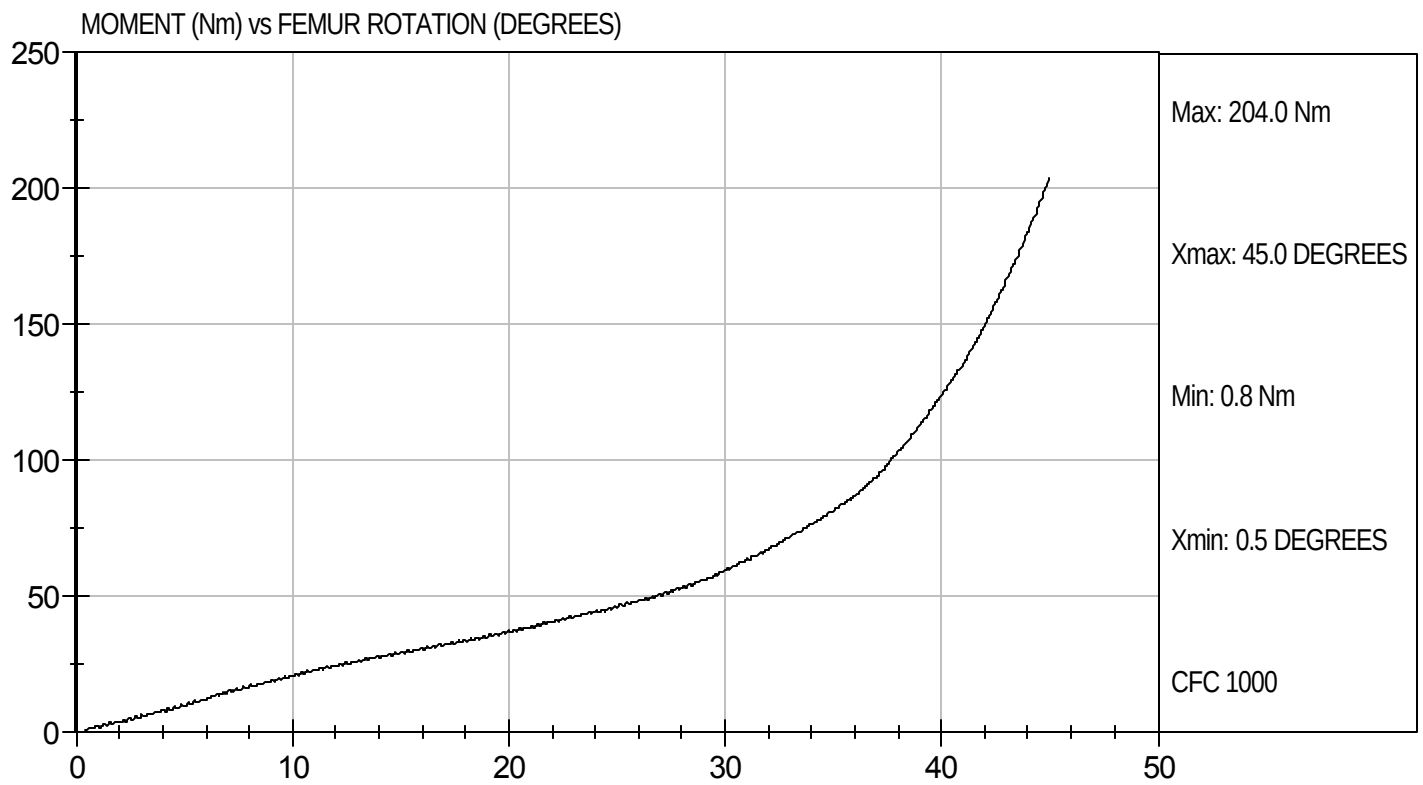
10/20/09
 Test Date


 Approved By



Test Desc: Hip Femur Flexion
Component ID: D092649

Test Date: 10/20/09
Velocity: 0 ft/s, 0.00 m/s





Test Desc: Hip Femur Flexion
Component ID: D092640

Test Date: 10/20/09
Velocity: 0 ft/s, 0.00 m/s

