REPORT NUMBER: NCAP-MGA-2008-019

NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST

HYUNDAI MOTOR COMPANY
2009 HYUNDAI GENESIS
NHTSA NUMBER: U90500

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

Test Date: August 12, 2008

Final Report Date: October 10, 2008

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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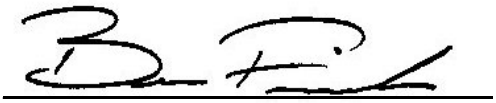
Prepared by:  Date: 10/10/08

Ben Fischer, Project Engineer

Reviewed by:  Date: 10/10/08

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Technical Report Documentation Page

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16. Abstract

A frontal barrier impact was conducted on a 2009 Hyundai Genesis at MGA Research Corporation on August 12, 2008. This test was conducted to obtain data indicant of FMVSS 208, 212, 219 (partial), 301, and foot well intrusion performance. The impact velocity was 56.5 km/h. The ambient temperature at the barrier face at the time of impact was 21 degrees Celsius. The vehicle's maximum post test static crush is 606 mm located at the vehicle's centerline. The test vehicle is equipped with a 3-point continuous belt system and an airbag in both front outboard seating positions. With respect to FMVSS 208 "Occupant Crash Protection", the occupant injury criteria summary is as follows:

Measurement Description	Units	Threshold	Driver ATD	Pass. ATD
Head Injury Criteria (HIC)	N/A	1000	370	432
Max. Thorax Accel. (3ms Clip)	G's	60	40	39
Left Femur Force	Newton	10009	-4922	-6107
Right Femur Force	Newton	10009	-5611	-2444

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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 2009 Hyundai Genesis at a velocity of 56.5 kph. The test was performed at MGA Research Corporation on August 12, 2008. 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 606 mm and both the driver and passenger side doors remained closed and latched during the impact event and were operable after the impact.

The driver's head and chest contacted the airbag. The driver's head also contacted the headrest. The driver's knees contacted the knee bolster. The passenger's head and chest contacted the airbag. The passenger's head also contacted the headrest, grab handle, headliner, and visor. 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	370	53.7	89.7	40	52.4	55.4	-37	-4922	-5611
Passenger	432	78.1	114.1	39	62.1	65.1	-27	-6107	-2444

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

TEST NOTES

There was no valid data collected for:

Bottom of Engine X after 60 msec.

Right Rear Seat Crossmember Z after 120 msec.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1

CRASH TEST SUMMARY

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact
NHTSA No.: U90500
Test Date: 8/12/2008

DOOR OPENING AND SEAT TRACK INFORMATION

Description	Driver	Passenger
Locked/Unlocked Doors	Doors were locked	Doors were locked
Front Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Rear Door Opening	Door remained closed and latched; Door opened without tools	Door remained closed and latched; Door opened without tools
Seat Track Shift (mm)	0	0
Seat Back Failure	None	None
Glazing Damage	Windshield cracked	

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	441
Center	mm	357
Right Side	mm	418
Average	mm	405

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	885	885
Lap belt length as measured on ATD	mm	590	590
Remainder of belt on reel	mm	1895	1895
Total belt length for continuous webbing systems	mm	3370	3370

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008

TEST VEHICLE INFORMATION

Manufacturer	Hyundai
Model	Genesis
Body Style	Sedan
NHTSA No.	U90500
VIN	KMHGC46E69U018861
Color	Black Noir Pearl
Delivery Date	7/31/2008
Odometer Reading (mile)	181
Dealer	John Amato
Transmission	Automatic
Final Drive	Rear
Number of Cylinders	6
Engine Displacement (L)	3.8
Engine Placement	Longitudinal
Automatic Door Lock (ADL)	Yes
Owners Manual Details Instructions on Disabling ADLs	No
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	Yes
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	No
Power Seats	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Company
Date of Manufacture	MAY/13/08

GVWR (kg)	2200
GAWR Front (kg)	1200
GAWR Rear (kg)	1250

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				390
Cargo Wt. (RCLW) (kg)				50

DATA SHEET NO. 2... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	457.7	428.2		498.0	488.1	
Right	kg	448.1	423.2		483.1	487.6	
Ratio	%	51.5	48.5		50.1	49.9	
Totals	kg	905.8	851.4	1757.2	981.1	975.7	1956.8

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1757.2
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	50
Calculated Vehicle Target Weight (TVTW)	kg	1963.2

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	706	711	708	715	1426
As Tested	mm	707	710	684	691	1467
Post Test	mm	730	723	707	686	

Vehicle Wheelbase (mm): 2943
Weight of Ballast secured in cargo area (kg): 18.1

Vehicle Components Removed: Jack, spare tire, trunk floor cover/carpet, right rear taillight

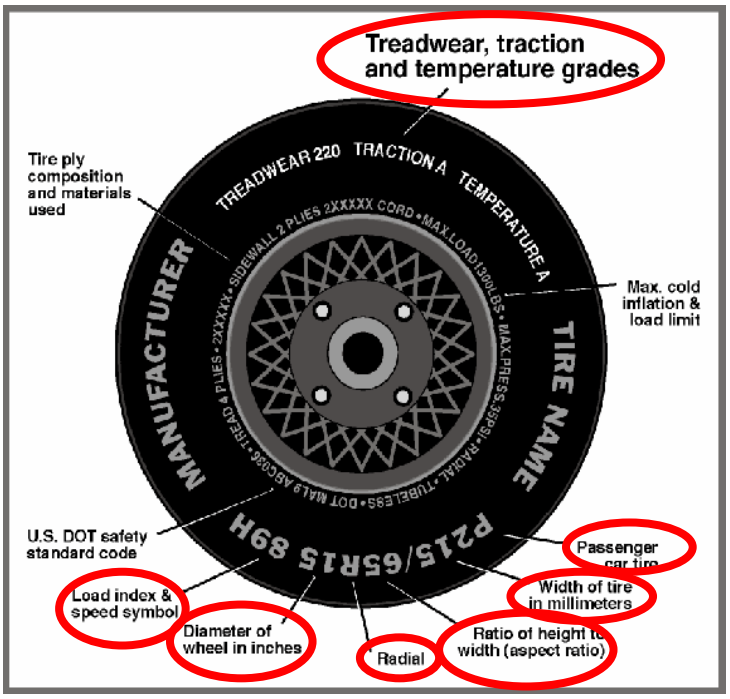
Ballast weight does not include instrumentation and data acquisition system.

DATA SHEET NO. 3

TEST VEHICLE TIRE INFORMATION

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008



DATA FROM TIRE AND TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	230	230
Recommended Tire Size	P235/50R18	P235/50R18
Tire Size on Vehicle	P235/50R18	P235/50R18
Tire Manufacturer	Dunlop	Dunlop
Tire Name	SP Sport	SP Sport
Tire Type	Passenger	Passenger
Tire Width (mm)	235	235
Ratio of Height to Width (aspect ratio)	50	50
Radial	R	R
Wheel Diameter	18	18
Load Index & Speed Symbol	97V	97V
Treadwear	340	340
Traction Grade	A	A
Temperature Grade	A	A

DATA SHEET NO. 4

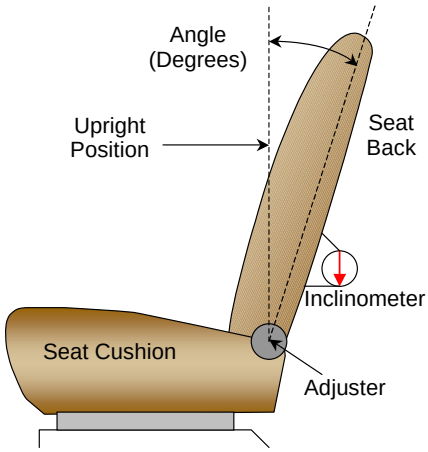
TEST VEHICLE INFORMATION

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

NORMAL DESIGN RIDING POSITION

The driver and passenger seat back is positioned to the manufacturer's designated angle. The procedure is as follows: Set at 25 degrees measured from upright position (11.5° on headrest post).

Driver seat back angle: 11.5° (on headrest post)
Passenger seat back angle: 11.4° (on headrest post)



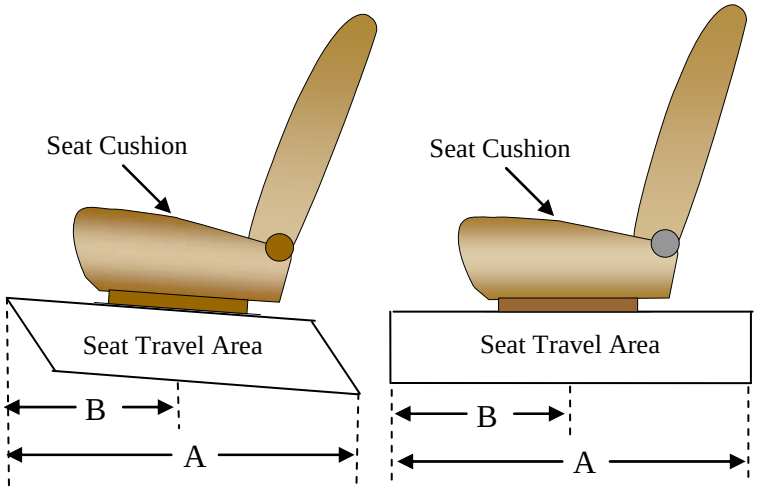
FRONT SEAT ASSEMBLY

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	266 mm	133 mm
Passenger Seat	240 mm	120 mm

ADJUSTABLE D-RING POSITION

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



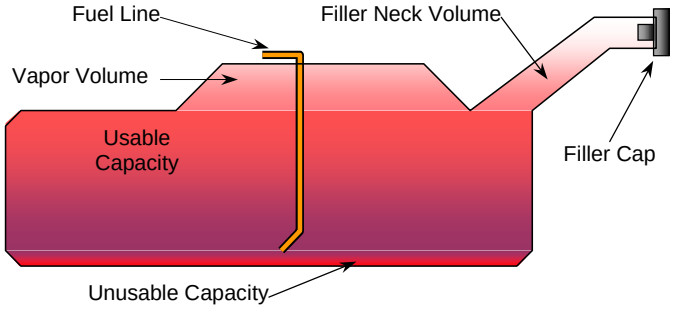
DATA SHEET NO. 4…(CONTINUED)
TEST VEHICLE INFORMATION

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	73.0
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	67.2 to 68.6
Actual Amount of Solvent used	68.1
1/3 of Usable Capacity	24.3

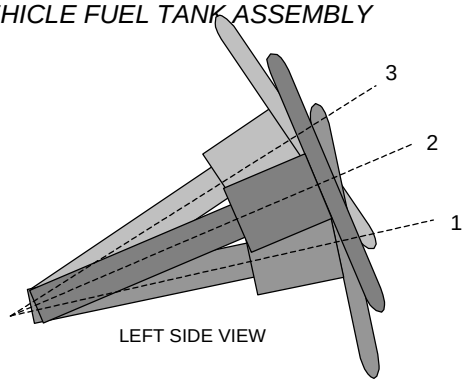
The test vehicle is equipped with an electric fuel pump. Fuel pump will operate when engine system is normally operating.



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	0	18.0
Geometric center position No. 2	15	24.7
Uppermost position No. 3	30	31.5

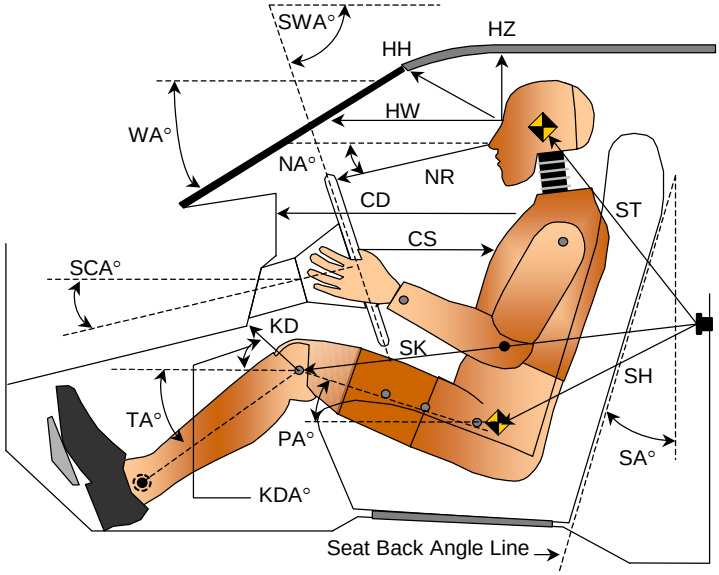
DATA SHEET NO. 5

DUMMY POSITIONING IN VEHICLE

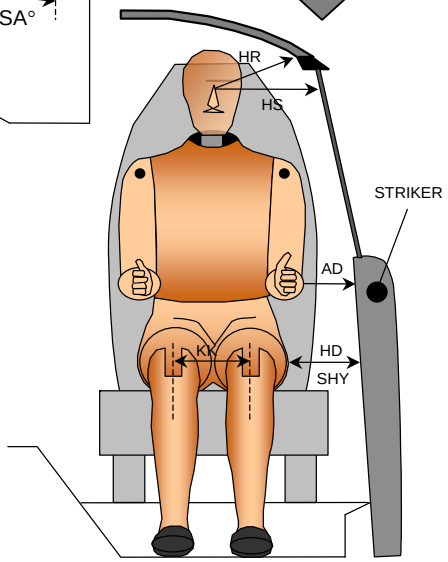
Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008

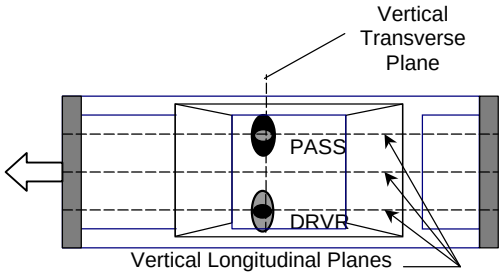
DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



AD	Arm to Door
HD	H-Point to Door
HR	Head to Side Header
HS	Head to Side Window
KK	Knee to Knee
SHY	Striker to H-Point (Y Axis)



CD	Chest to Dash
CS	Chest to Steering Wheel Hub
HH	Head to Header
HW	Head to Windshield
HZ	Head to Roof
KDA	Knee to Dash Angle
KDL	Left Knee to Dash
KDR	Right Knee to Dash
NA	Nose to Rim Angle
NR	Nose to Rim
PA	Pelvic Angle
RA	Rim to Abdomen
SA	Seat Back Angle
SCA	Steering Column Angle
SH	Striker to H-Point
SK	Striker to Knee
ST	Striker to Head
SWA	Steering Wheel Angle
TA	Tibial Angle
WA	Windshield Angle



DATA SHEET NO. 5... (CONTINUED)

DUMMY POSITIONING IN VEHICLE

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

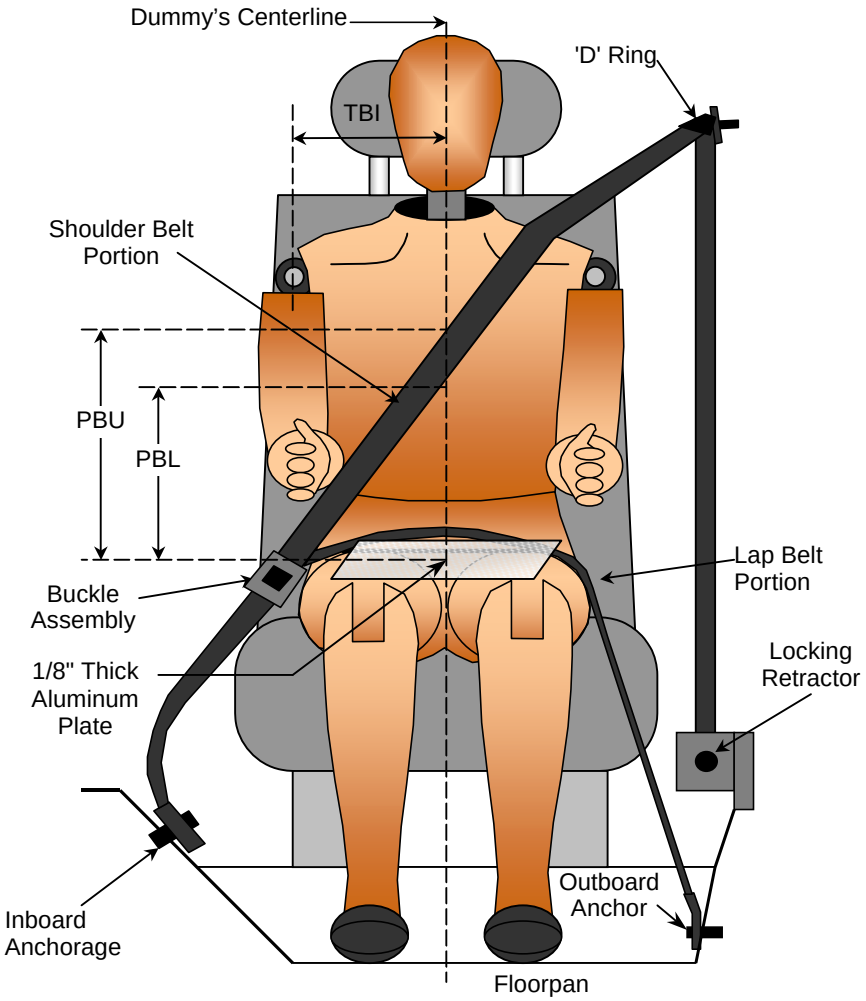
TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		27.4		
SWA	Steering Wheel Angle		65.3		
SCA	Steering Column Angle		24.7		
SA	Seat Back Angle		11.5		11.4
HZ	Head to Roof (Z)	166	90	166	90
HH	Head to Header	329	22.4	358	23.1
HW	Head to Windshield	584	0	631	0
HR	Head to Side Header (Y)	220		210	
NR	Nose to Rim	372	11.2		
CD	Chest to Dash	508		542	
CS	Chest to Steering Hub	281	4.3		
RA	Rim to Abdomen	155	0		
KDL	Left Knee to Dash	135	18.6	164	
KDR	Right Knee to Dash	129		172	30.6
PA	Pelvic Angle		24.4		24.5
TA	Tibia Angle		40.8		46.3
KK	Knee to Knee (Y)	355		260	
SK	Striker to Knee	656	103.7	639	105.7
ST	Striker to Head	423	14.2	386	17.4
SH	Striker to H-Point	330	133.5	323	137.4
SHY	Striker to H-Point (Y)	295		295	
HS	Head to Side Window	335		331	
HD	H-Point to Door (Y)	149		154	
AD	Arm to Door (Y)	128		125	
AA	Ankle to Ankle	370		244	

DATA SHEET NO. 6

SEAT BELT POSITIONING DATA

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact
NHTSA No.: U90500
Test Date: 8/12/2008



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	348	351
PBL - To surface of reference to belt lower edge	mm	260	260

DATA SHEET NO. 7

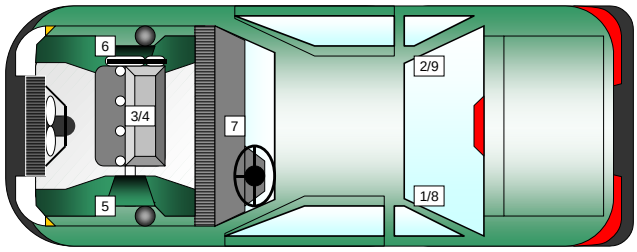
VEHICLE ACCELEROMETER LOCATIONS

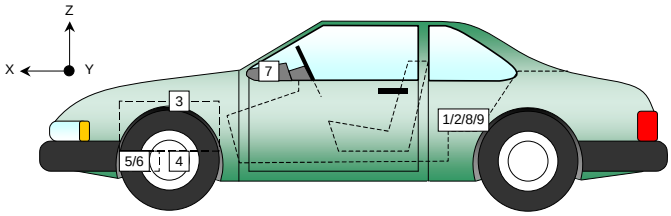
Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact
NHTSA No.: U90500
Test Date: 8/12/2008

VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear X-Member X	1986	-355	384
2	Right Rear X-Member X	1986	360	384
3	Engine Top X	4073	45	865
4	Engine Bottom X	4191	0	169
5	Left Brake Caliper X	3908	-701	255
6	Right Brake Caliper X	3908	701	255
7	Instrument Panel X			
8	Left Rear X-Member Z	1986	-355	384
9	Right Rear X-Member Z	1986	360	384

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: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

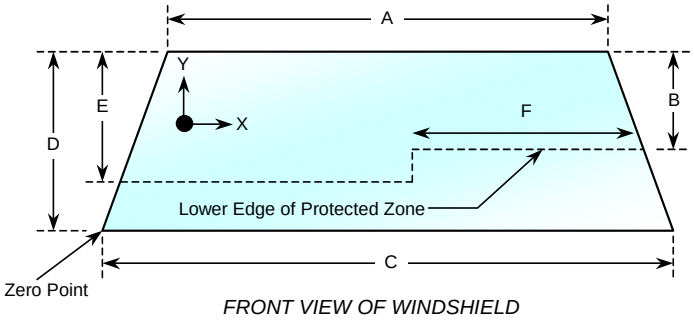
Windshield Mounting Details:
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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	2131	2131	100
Right Side	2131	2131	100
Total	4262	4262	100



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1216
B	mm	450
C	mm	1478
D	mm	784
E	mm	479
F	mm	510

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: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21° C Test Time: 12:45 pm

Stoddard Solvent Spillage Measurements

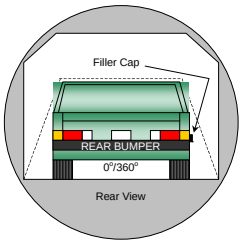
A. From impact until vehicle motion ceases: 0 oz.
(Maximum Allowable = 1 ounce)

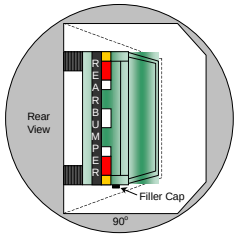
B. For the 5 minute period after motion ceases: 0 oz.
(Maximum Allowable = 5 ounces)

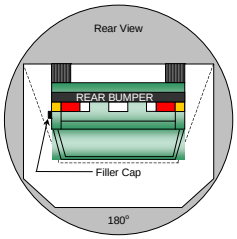
C. For the following 25 minutes: 0 oz.
(Maximum Allowable = 1 oz. /minute)

D. Spillage: None

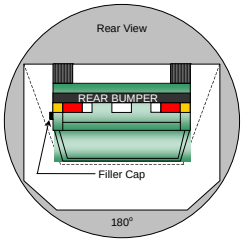
FMVSS 301 STATIC ROLLOVER DATA

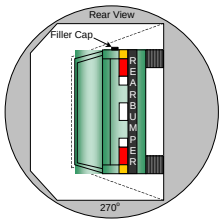


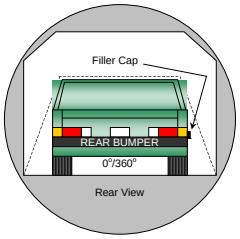




0° to 90° 90° to 180°







180° to 270° 270° to 360°

1. The specified fixture rollover rate for each 90° of rotation is 60 to 180 seconds.

2. The position hold time at each position is 300 seconds (minimum).

3. Details of Stoddard Solvent spillage locations:

None

Test Phase	Rotation Time (sec.)	Hold Time (sec.)	Spillage (oz.)
0° to 90°	122	300	0
90° to 180°	114	300	0
180° to 270°	111	300	0
270° to 360°	118	300	0

DATA SHEET NO. 10

VEHICLE MEASUREMENTS

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

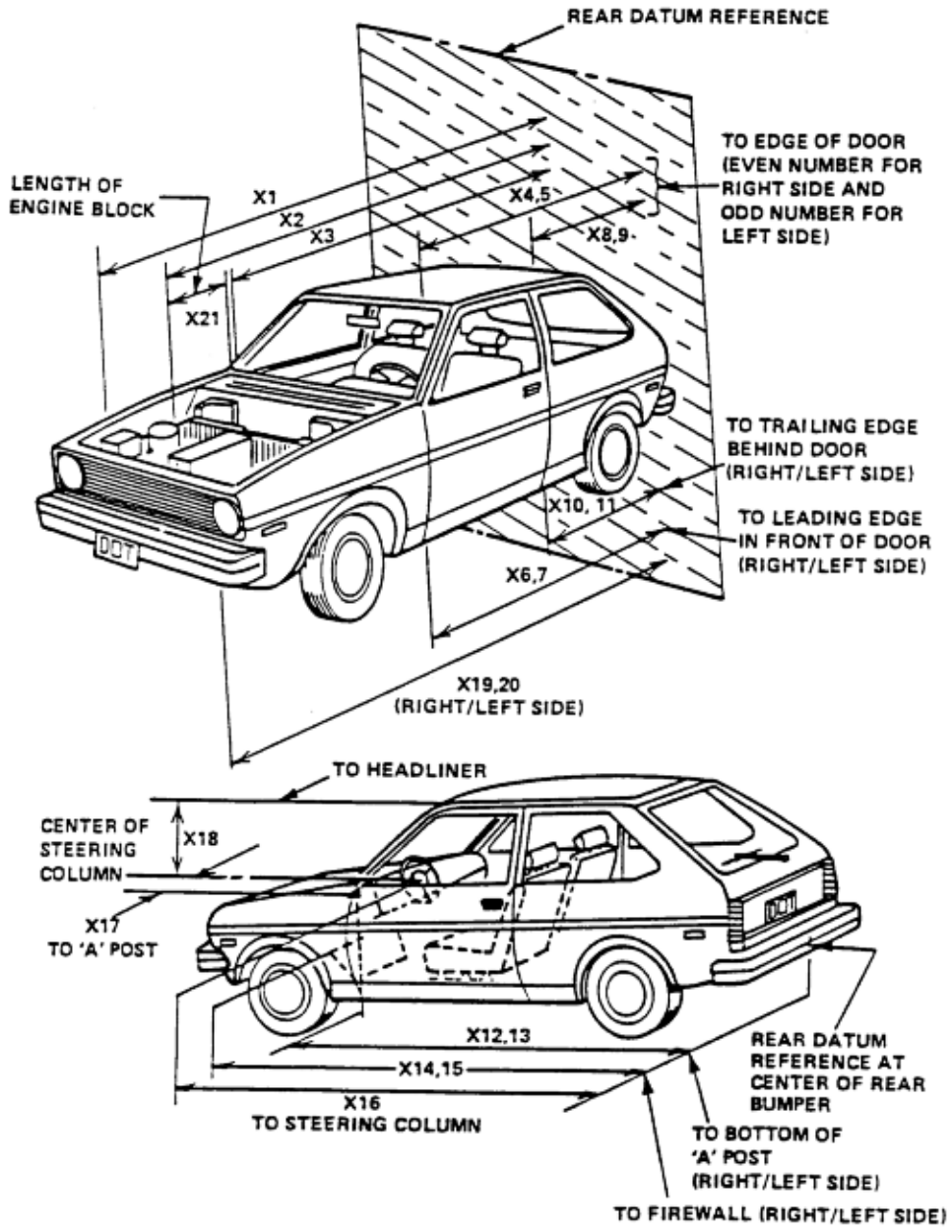
NHTSA No.: U90500
Test Date: 8/12/2008

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total length of vehicle at centerline	mm	4941	4335	606
2	RSOV to front of engine	mm	4373	4206	167
3	RSOV to firewall centerline	mm	3761	3718	43
4	RSOV to leading edge of right door	mm	3373	3386	-13
5	RSOV to leading edge of left door	mm	3378	3404	-26
6	RSOV to lower leading edge of right door	mm	3443	3431	12
7	RSOV to lower leading edge of left door	mm	3446	3428	18
8	RSOV to upper leading edge of right door	mm	2298	2320	-30
9	RSOV to upper leading edge of left door	mm	2298	2318	-20
10	RSOV to lower trailing edge of right door	mm	2331	2318	13
11	RSOV to lower trailing edge of left door	mm	2334	2318	16
12	RSOV to bottom of right 'A' pillar	mm	3442	3430	12
13	RSOV to bottom of left 'A' pillar	mm	3441	3424	17
14	RSOV to firewall on right side	mm	3653	3638	15
15	RSOV to firewall on left side	mm	3736	3716	20
16	RSOV to steering column	mm	2938	2953	-15
17	Center of steering column to left 'A' pillar	mm	391	393	-2
18	Center of steering column to headlining	mm	442	430	12
19	RSOV to right side of front bumper	mm	4783	4304	479
20	RSOV to left side of front bumper	mm	4788	4284	504
21	Length of engine block	mm	448	448	0
RD	RSOV to right side of dash panel	mm	3162	3164	-2
CD	RSOV to center of dash panel	mm	3186	3183	3
LD	RSOV to left side of dash panel	mm	3154	3159	-5

DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008



DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

Target Vehicle Structural Measurement

	Elements	Pre-Test (mm)
1	Total Length	4941
2	Total Width	1858
3	Bumper Top Height	530
4	Bumper Bottom Height	405
5	Longitudinal Member Top Height	495
6	Distance between Longitudinal Members	935
7	Longitudinal Member Width	69
8	Engine Top Height	865
9	Engine Bottom Height	169
10	Engine and gearbox width	692
11	Front bumper-engine distance	556
12	Front shock absorber fixing height	836
13	Bonnet leading edge height	752
14	Front shock absorber fixing width	1298
15	Front bumper – front axle distance	875
16	Front axle – a pillar distance	573
17	A-pillar – B-pillar distance	1165
18	B-Pillar – rear axle distance	1186
19	B-pillar – C-pillar distance	1015
20	Roof sill bottom height	1421
21	Roof sill top height	1462
22	Floor sill bottom height	197
23	Floor sill top height	346

DATA SHEET NO. 11

CAMERA LOCATIONS

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008

No.	Camera View	Location (mm) *			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View				13	24
2	Left Front View	1235	-4980	1190	24	1000
3	Steering Column Top	810	-5090	1270	25	1000
4	Steering Column Bottom	810	-5090	875	25	1000
5	Driver Close-up	1650	-5570	1500	35	1000
6	Driver Angle	5925	-5220	2080	50	1000
7	On board Driver Side					
8	On board Passenger Side					
9	Right Overall	2165	6290	1220	24	1000
10	Right Passenger Half	1360	5000	1230	24	1000
11	Right Close-up	1670	5450	1520	35	1000
12	Right Angle	6045	4830	2105	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	1130	0	-3150	24	1000
17	Pit Rear	3470	0	-3150	24	1000

*COORDINATES:

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

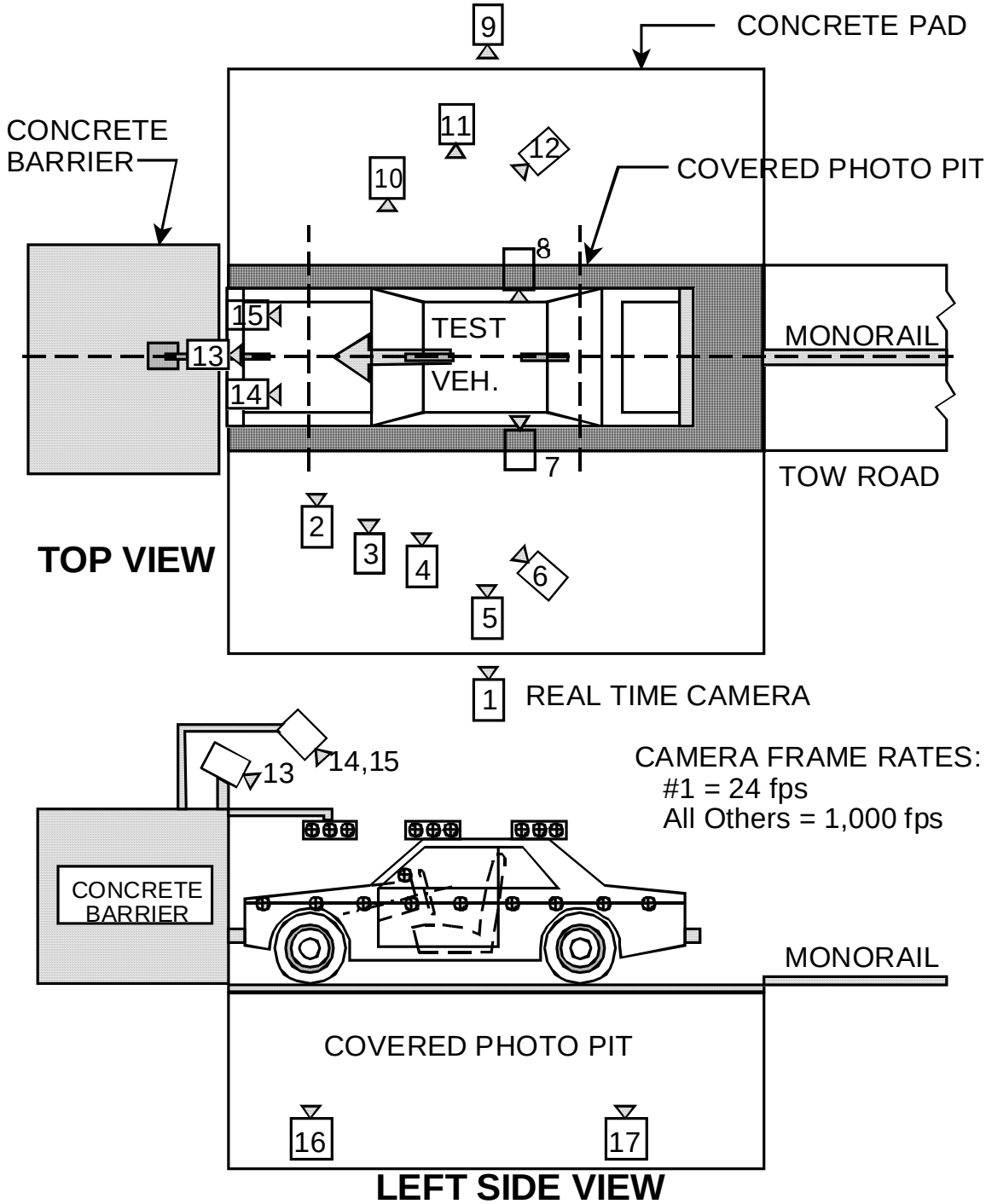
Cameras 7 & 8 were not used for this test.

DATA SHEET NO. 11... (continued)

CAMERA LOCATIONS

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

CAMERA POSITIONS FOR FRONTAL IMPACTS



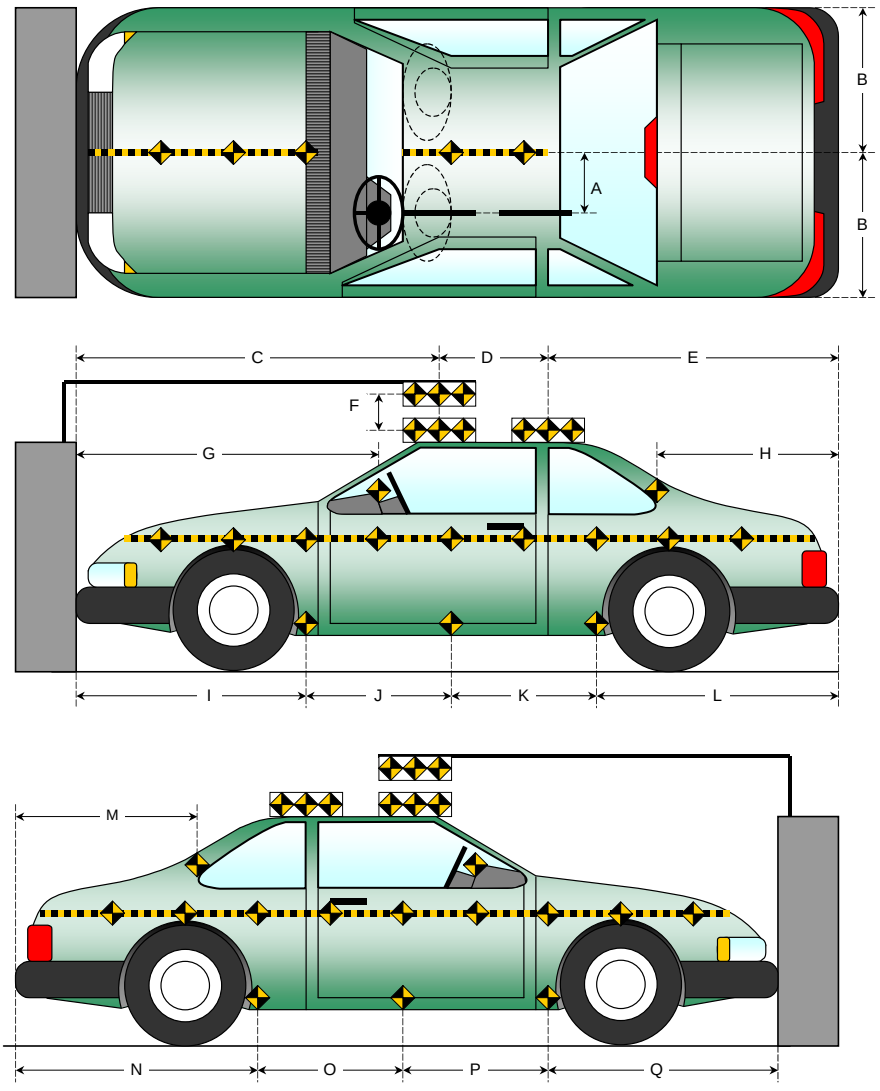
DATA SHEET NO. 12

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008

Item	Value
A	400
B	929
C	2315
D	660
E	1966
F	34
G	
H	1106
I	1331
J	1027
K	1023
L	1560
M	1104
N	1562
O	1028
P	1025
Q	1326



DATA SHEET NO. 13

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

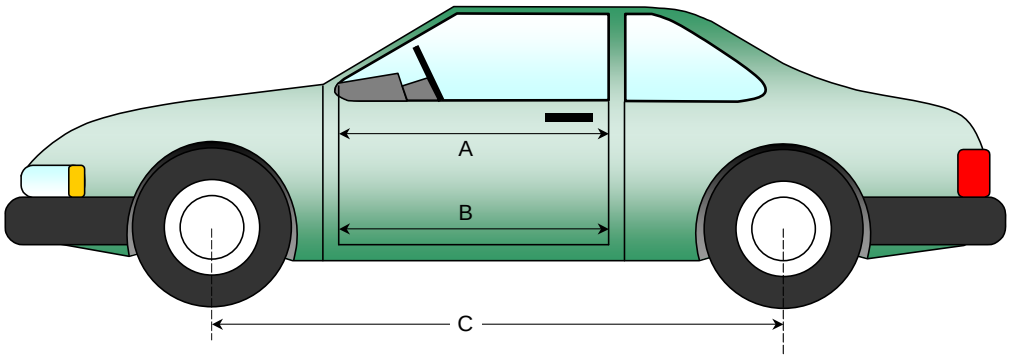
NHTSA No.: U90500
Test Date: 8/12/2008

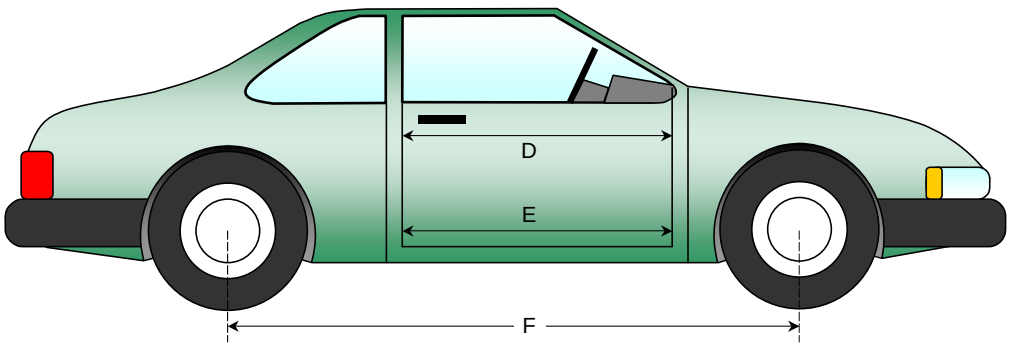
DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	1030	1027	3
B	Left Side Lower	mm	885	885	0
D	Right Side Upper	mm	1025	1024	1
E	Right Side Lower	mm	903	901	2

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2943	2844	99
F	Right Side Wheelbase	mm	2943	2877	66





DATA SHEET NO. 13... (continued)

VEHICLE INTRUSION MEASUREMENTS

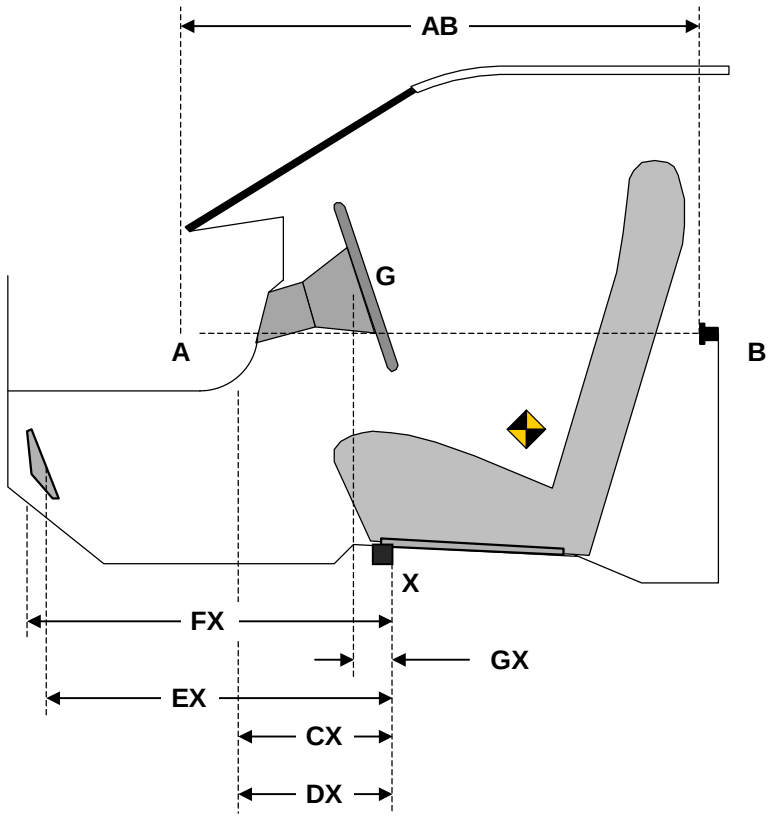
Test Vehicle: 2009 Hyundai Genesis
Test Program: 35mph Frontal Impact

NHTSA No.: U90500
Test Date: 8/12/2008

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	758	756	2
CX	Left Knee Bolster to X	mm	295	309	-14
DX	Right Knee Bolster to X	mm	316	315	1
EX	Brake Pedal to X	mm	555	548	7
FX	Foot Rest to X	mm	618	613	5
GX	Center of Steering Column Wheel Hub to X	mm	48	105	-57

X = Front of Seat Track (stationary)

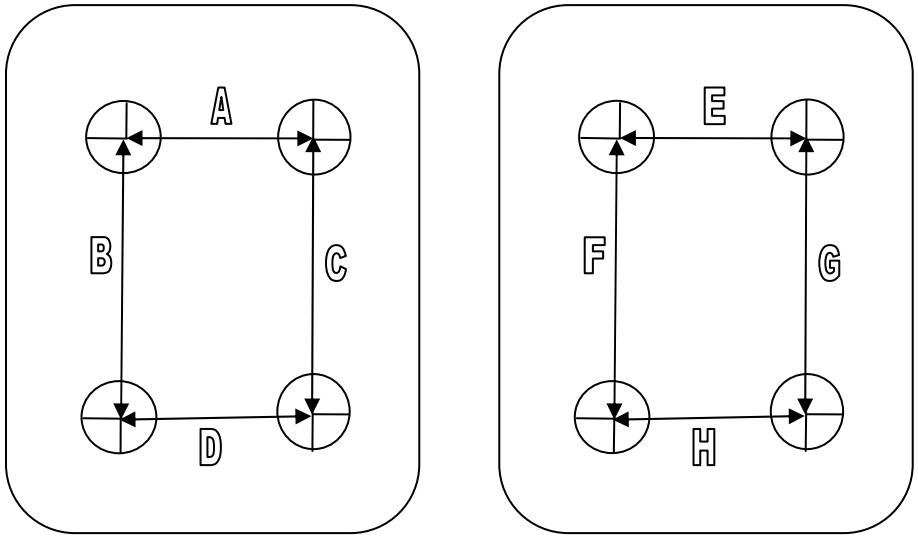


DRIVER COMPARTMENT

DATA SHEET NO. 13... (continued)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008



Driver Passenger

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	246	244	2
B	275	273	2
C	288	288	0
D	236	236	0
E	216	214	2
F	286	280	6
G	282	282	0
H	221	221	0

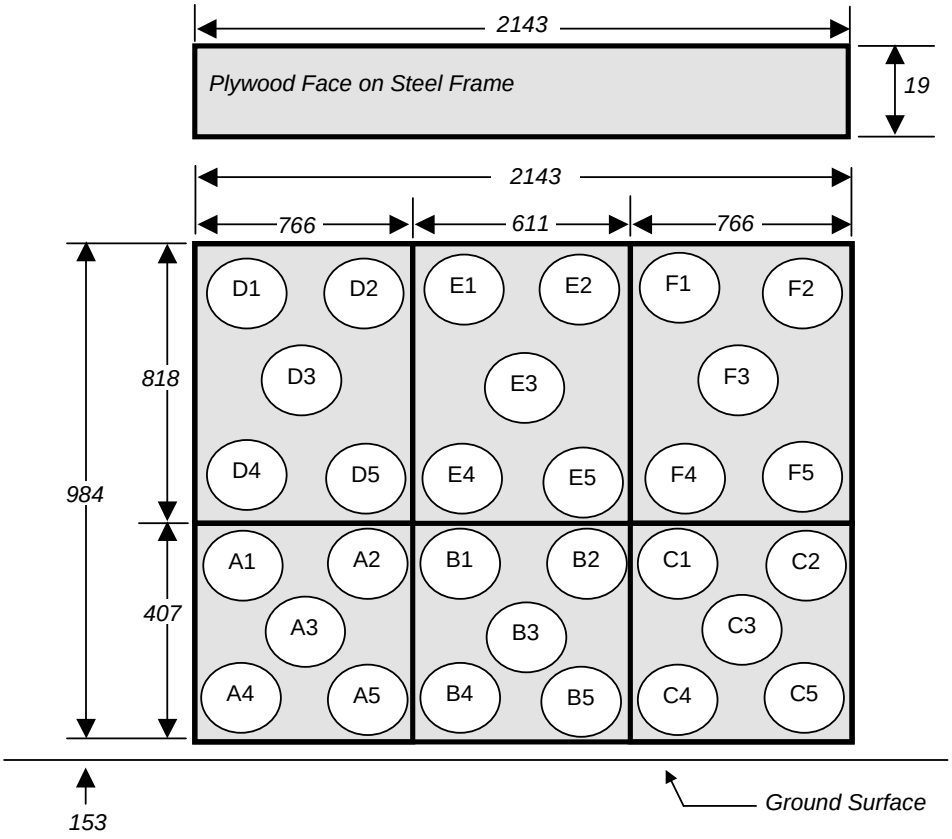
DATA SHEET NO. 14

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

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: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008

VEHICLE INFORMATION

VIN: KMHGC46E69U018861 Wheelbase (mm): 2943
Vehicle Size Category: Sedan Test Weight (kg): 1956.8

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): 56.5
Velocity Change (km/h): 62.9 Time of Separation (msec): 100

CRUSH PROFILE

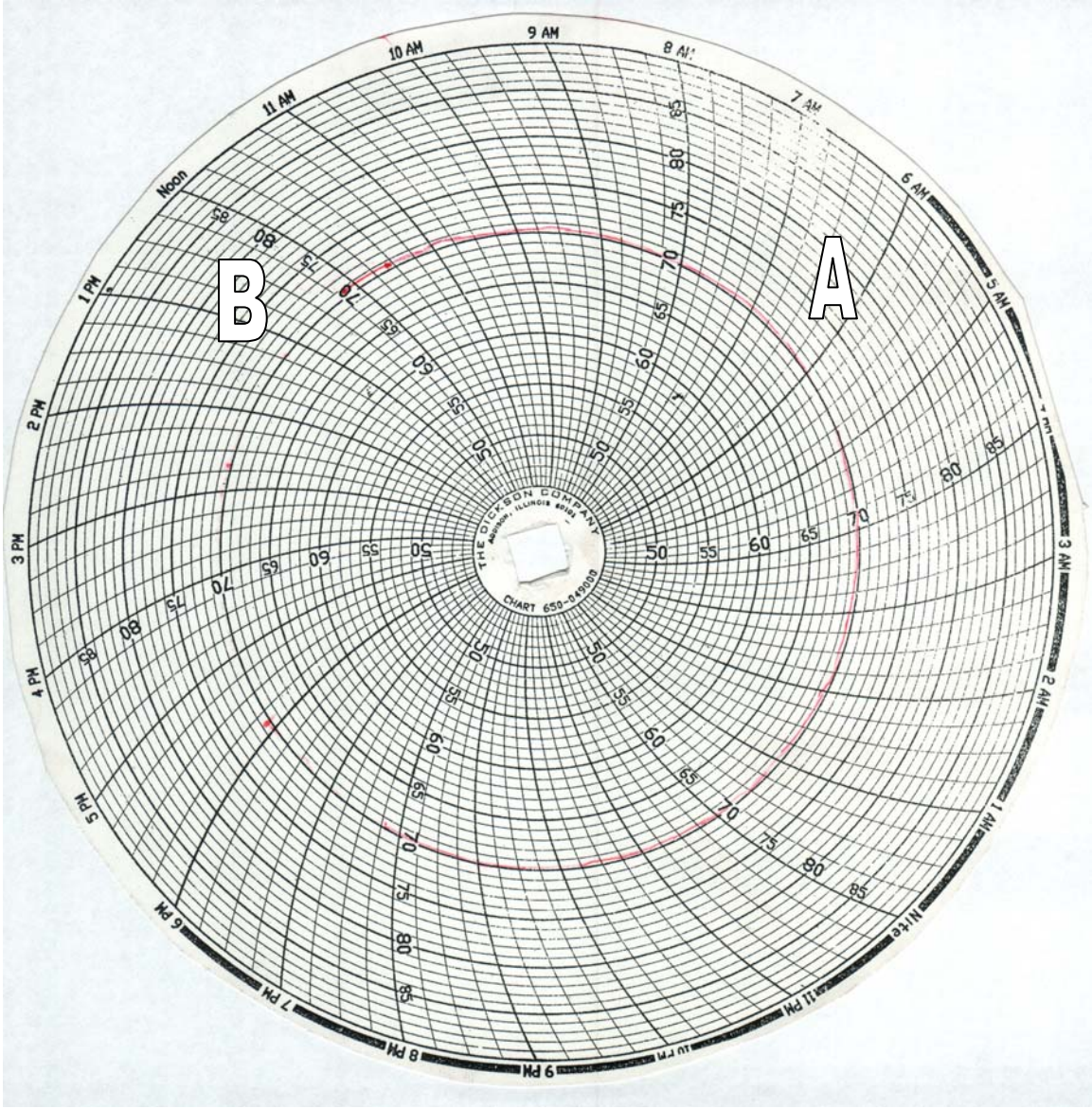
Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
Damage Region Length (mm): 1219 Impact Mode: Frontal

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4788	4284	504
C2	Crush zone 2 at left side	mm	4876	4354	522
C3	Crush zone 3 at left side	mm	4922	4349	573
C4	Crush zone 4 at right side	mm	4922	4338	584
C5	Crush zone 5 at right side	mm	4876	4331	545
C6	Crush zone 6 at right side	mm	4783	4304	479
L	C1 TO C6	mm	1379	1399	-20

DATA SHEET NO. 16

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2009 Hyundai Genesis NHTSA No.: U90500
Test Program: 35mph Frontal Impact Test Date: 8/12/2008



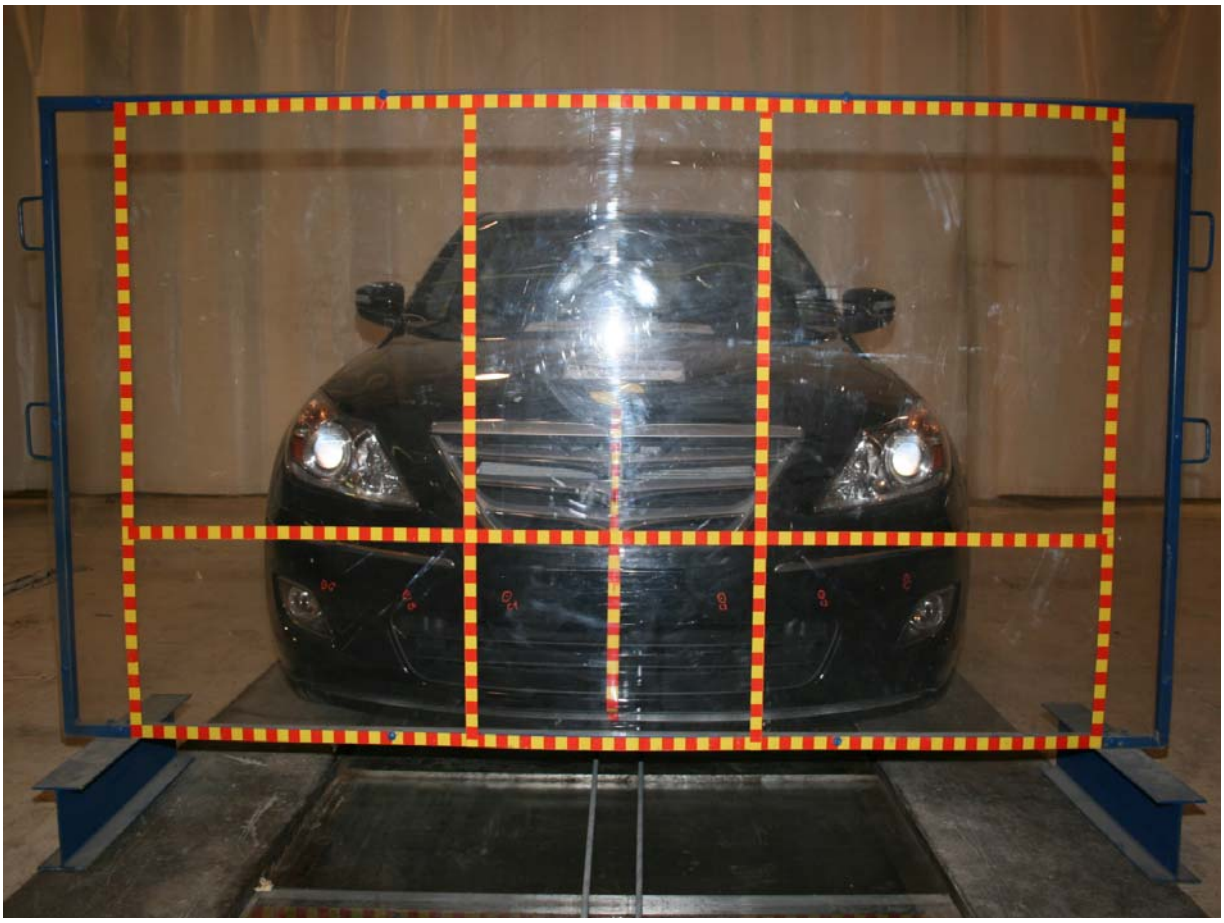
A = Dummies installed in vehicle at 6:00 am

B = Test conducted at 12:45 pm

APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS



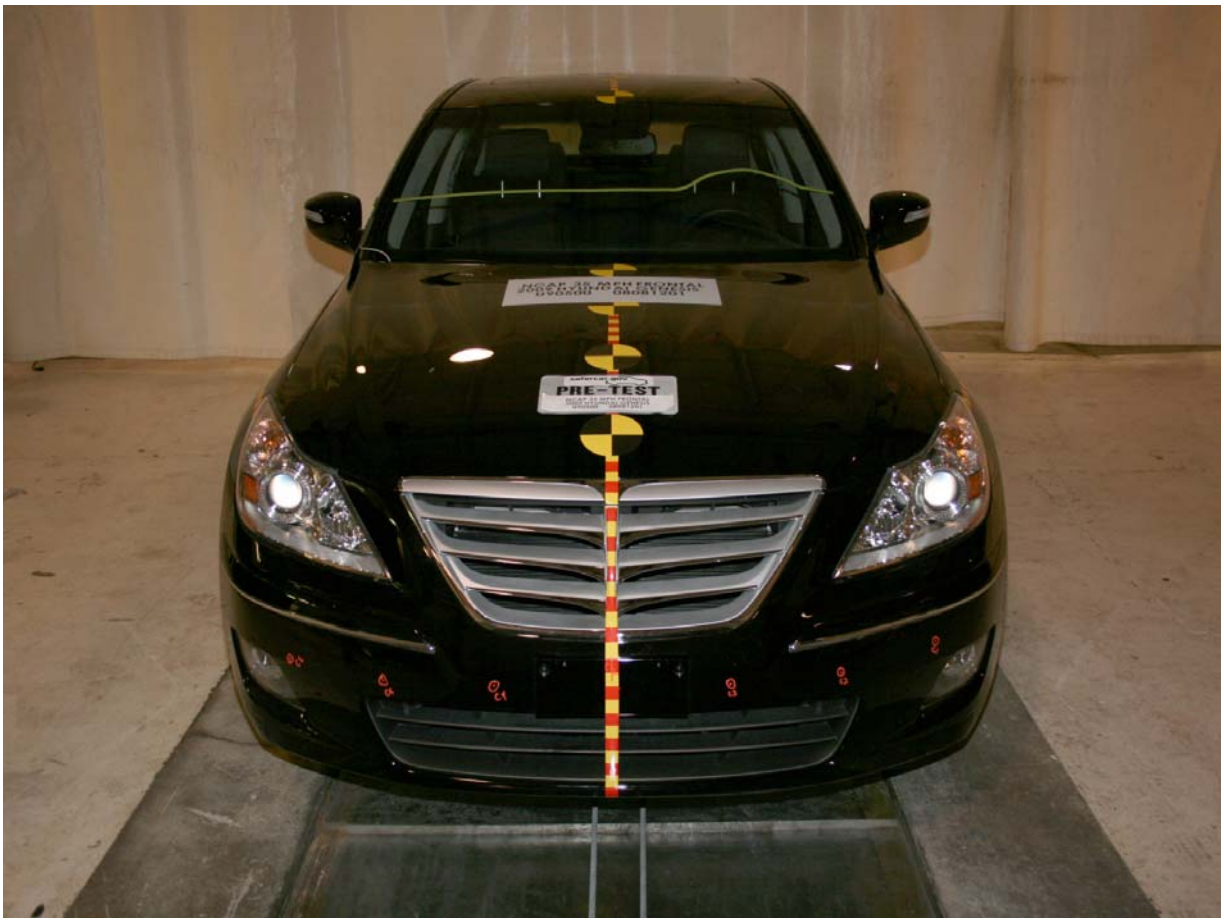
Load Cell Location

Manufacturer's Label

Tire Placard

Left Front ¾ View, As Received

Right Rear ¾ View, As Received



Pre-Test Front View

Post-Test Front View

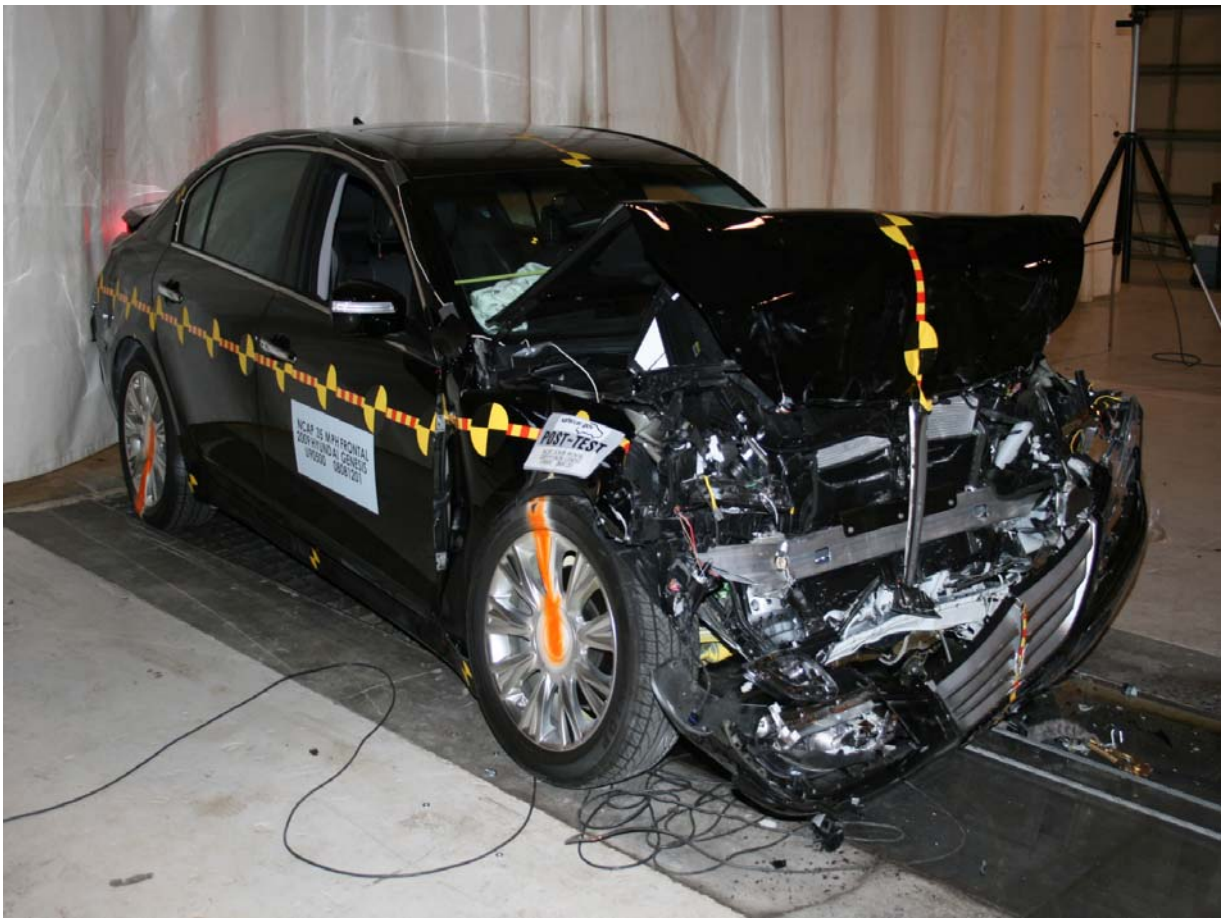
Pre-Test Left Side View

Post-Test Left Side View

Pre-Test Right Side View

Post-Test Right Side View

Pre-Test Right Front ¾ View



Post-Test Right Front ¾ View

Pre-Test Left Rear ¾ View

Post-Test Left Rear ¾ View

Pre-Test Left Side ¾ View of Doors

Post-Test Left Side ¾ View of Doors After Impact

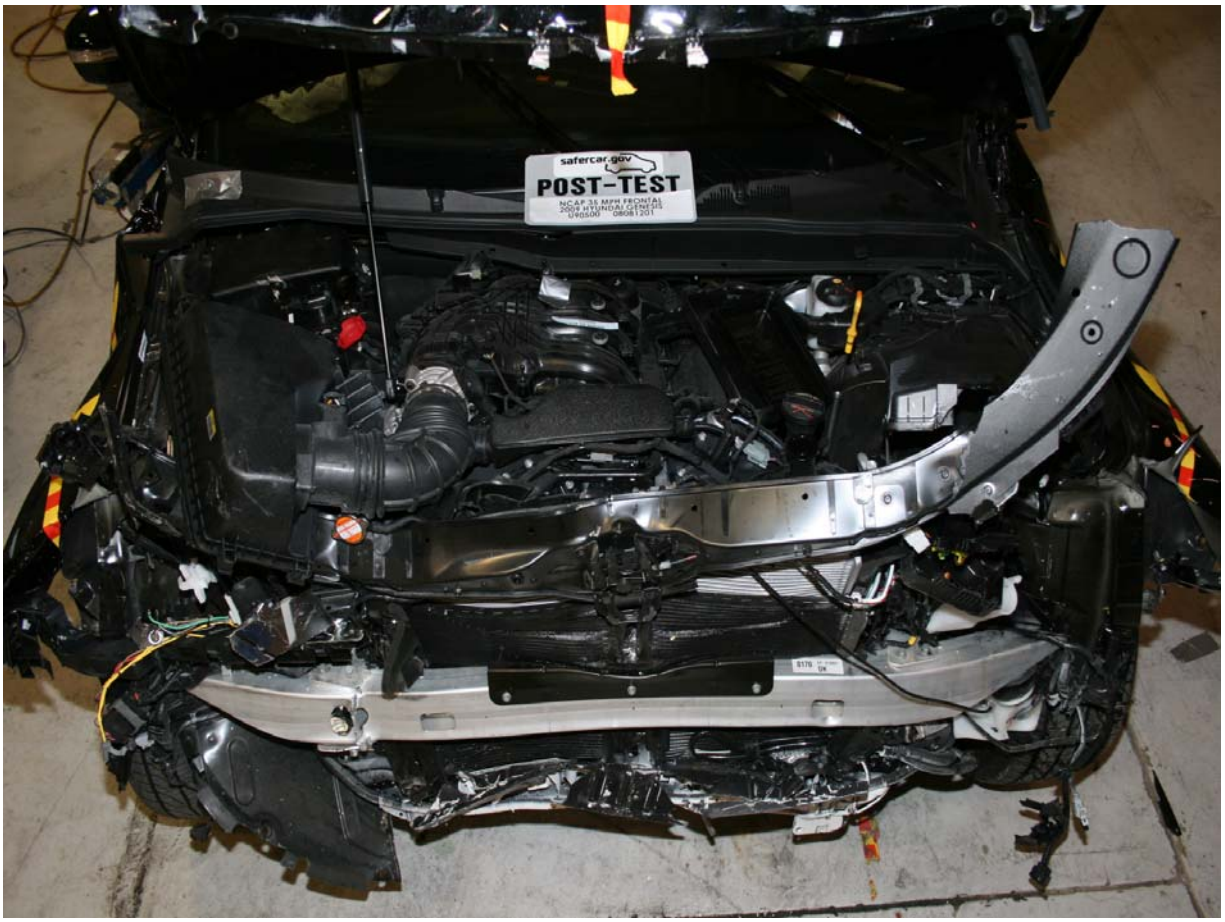
Pre-Test Right Side ¾ View of Doors

Post-Test Right Side ¾ View of Doors After Impact

Pre-Test Windshield View

Post-Test Windshield View

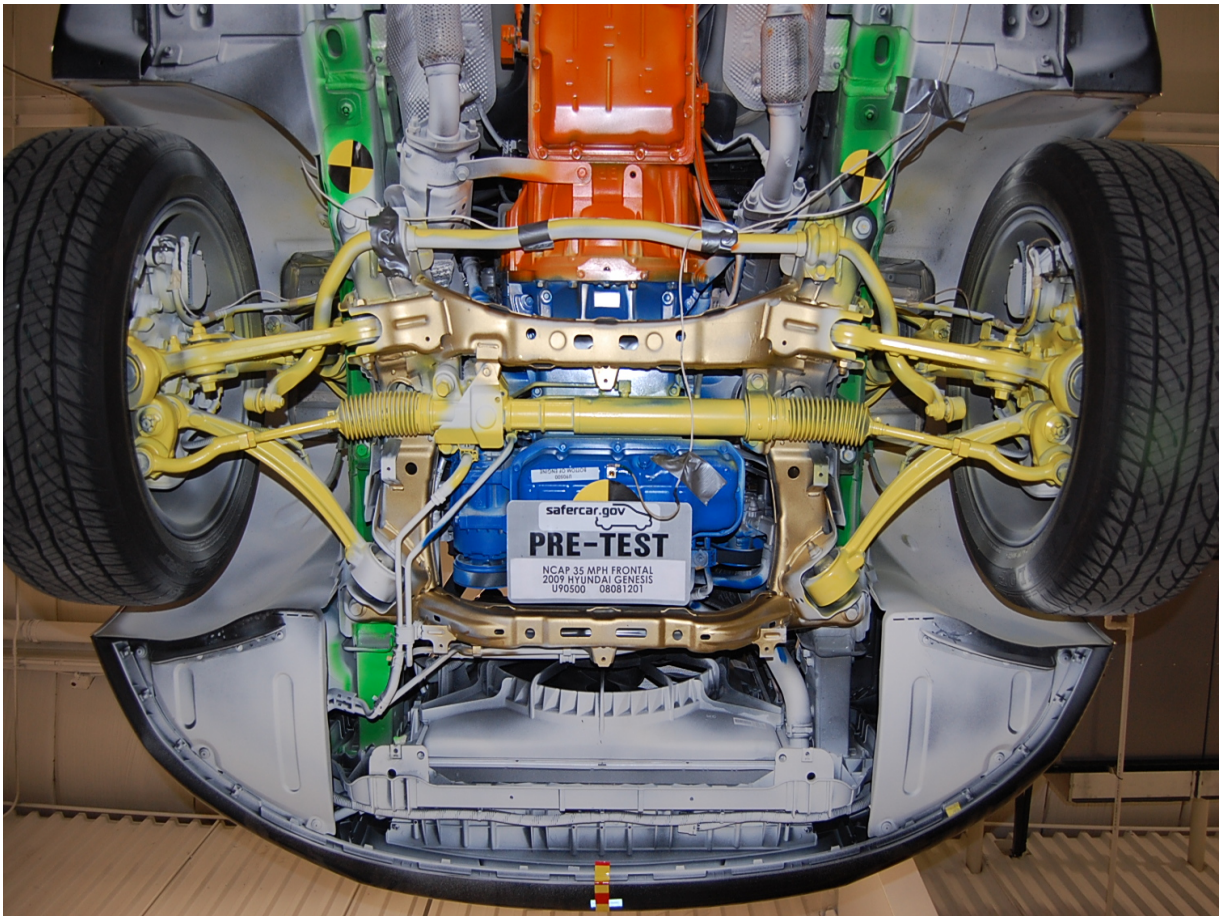
Pre-Test Engine Compartment View



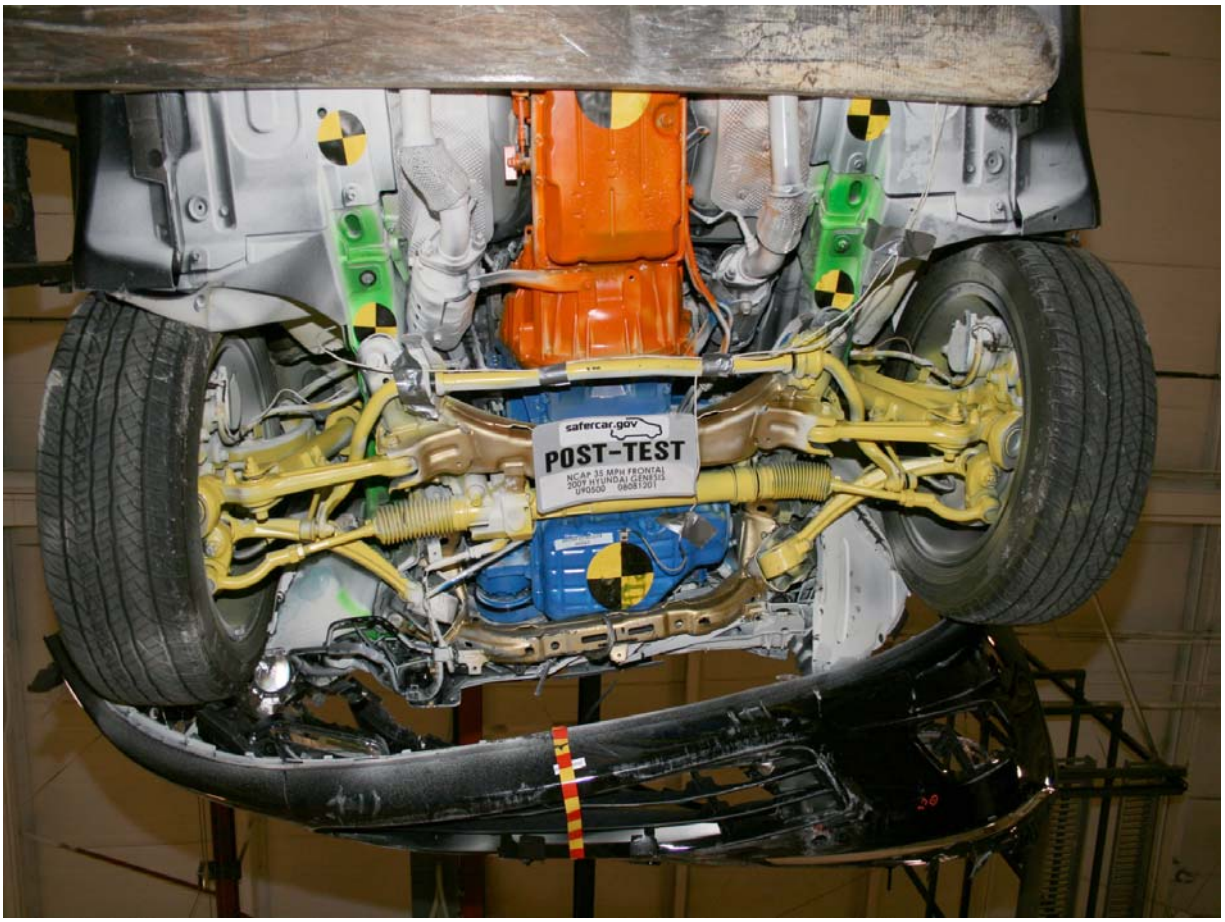
Post-Test Engine Compartment View

Pre-Test Fuel Cap View

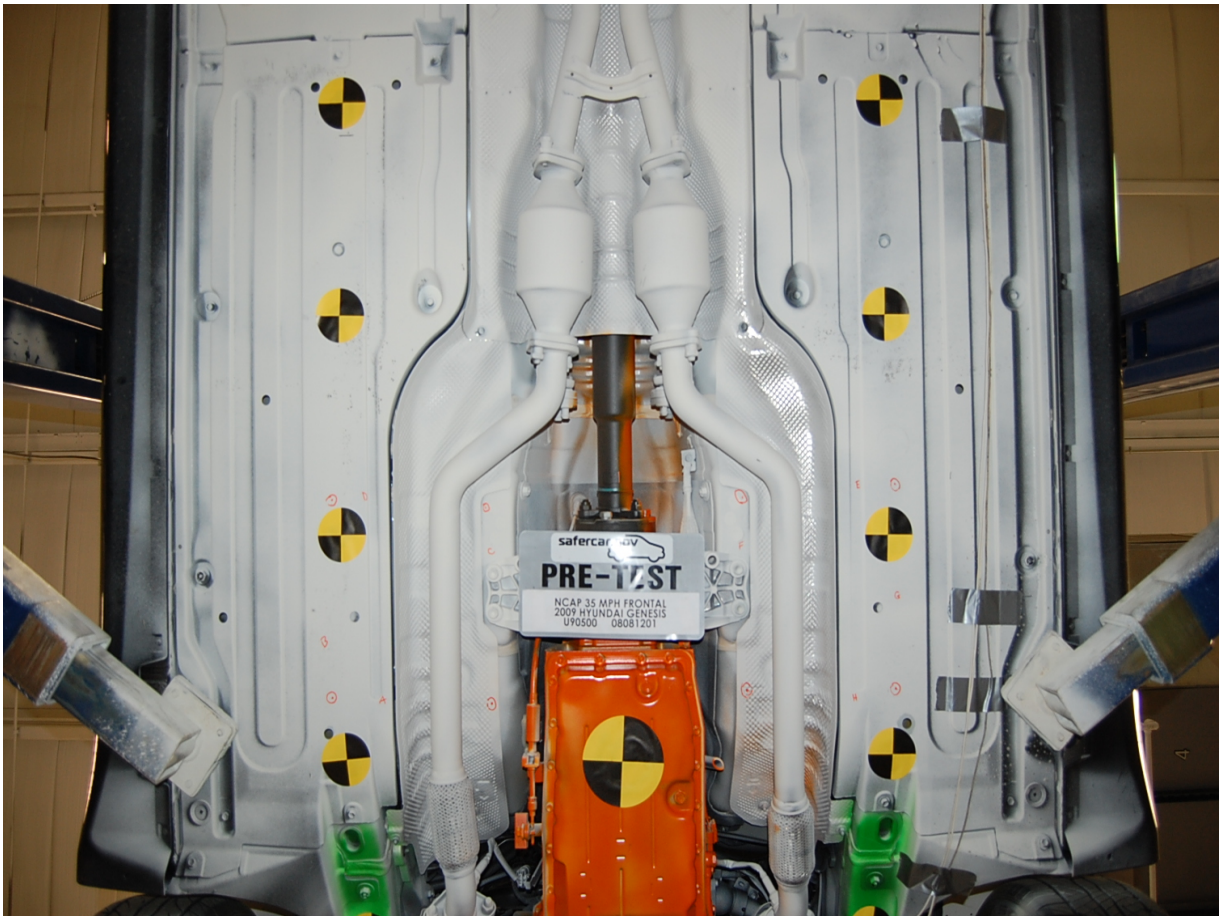
Post-Test Fuel Cap View



Pre-Test Front Underbody View

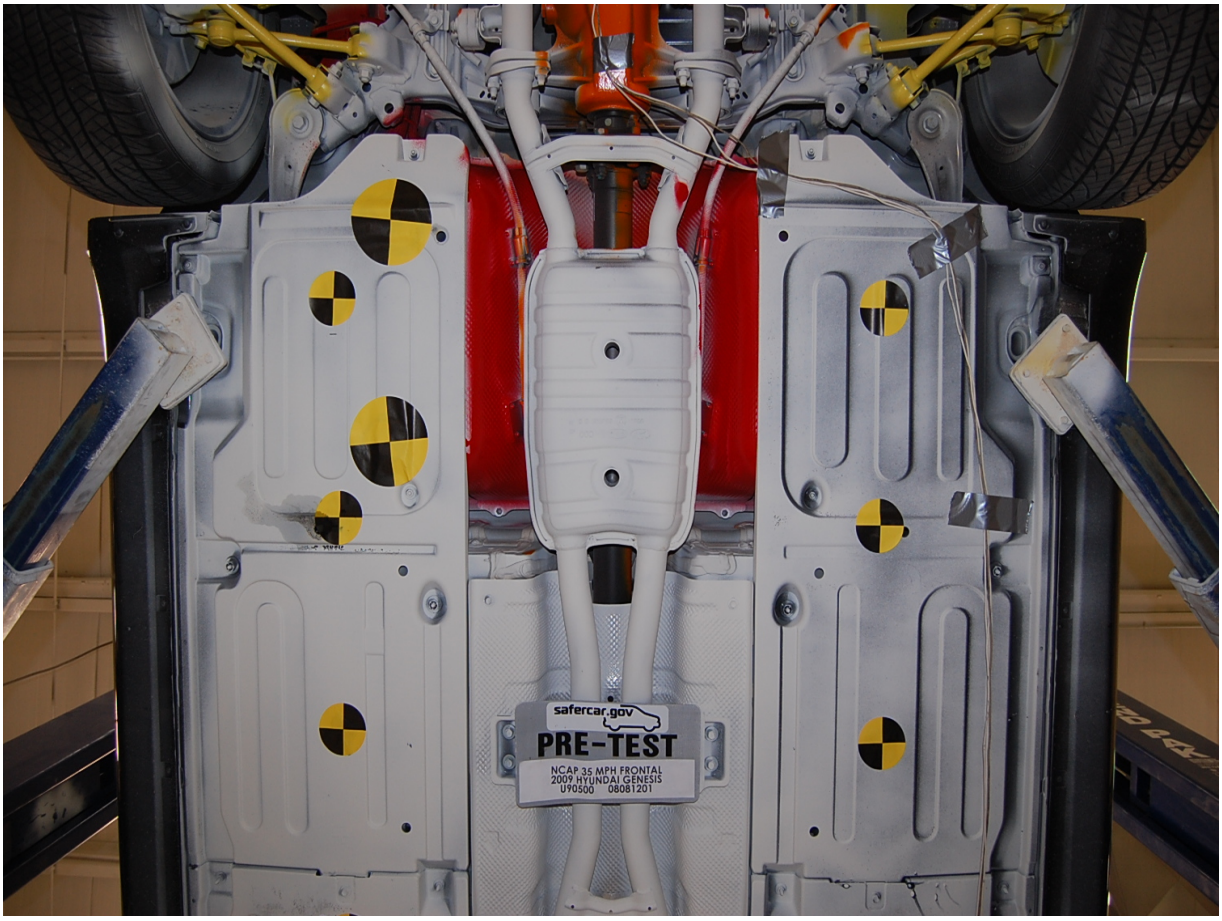


Post-Test Front Underbody View

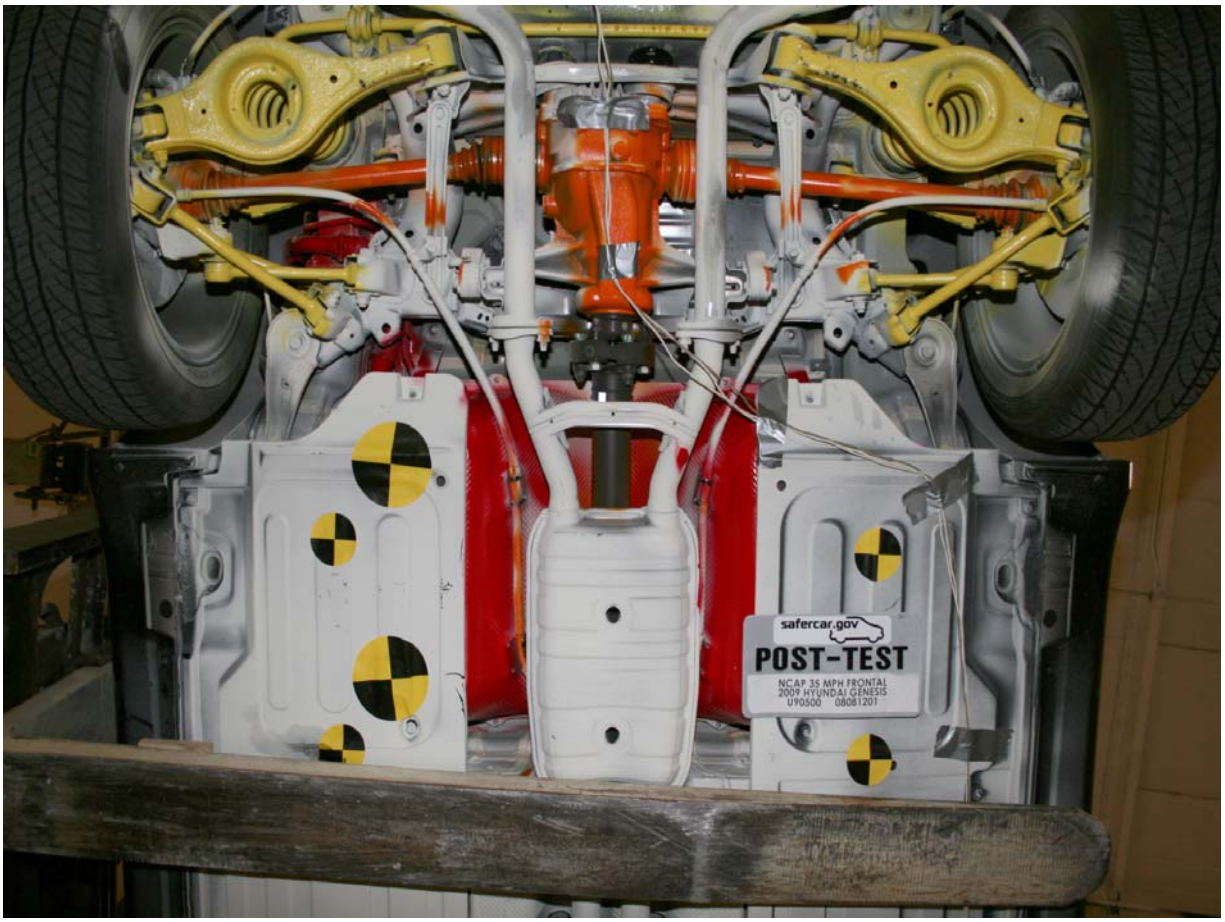


Pre-Test Mid Front Underbody View

Post-Test Mid Front Underbody View

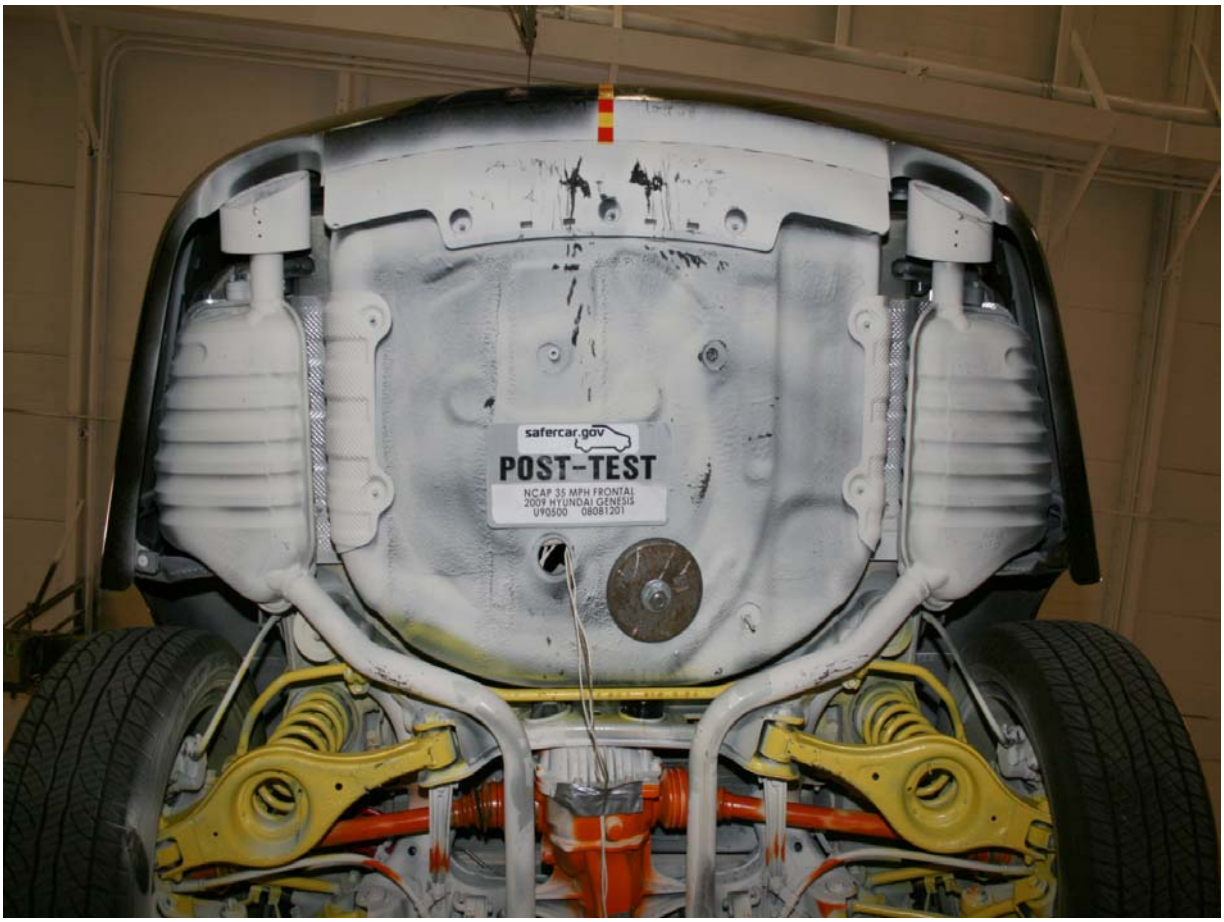


Pre-Test Mid Rear Underbody View

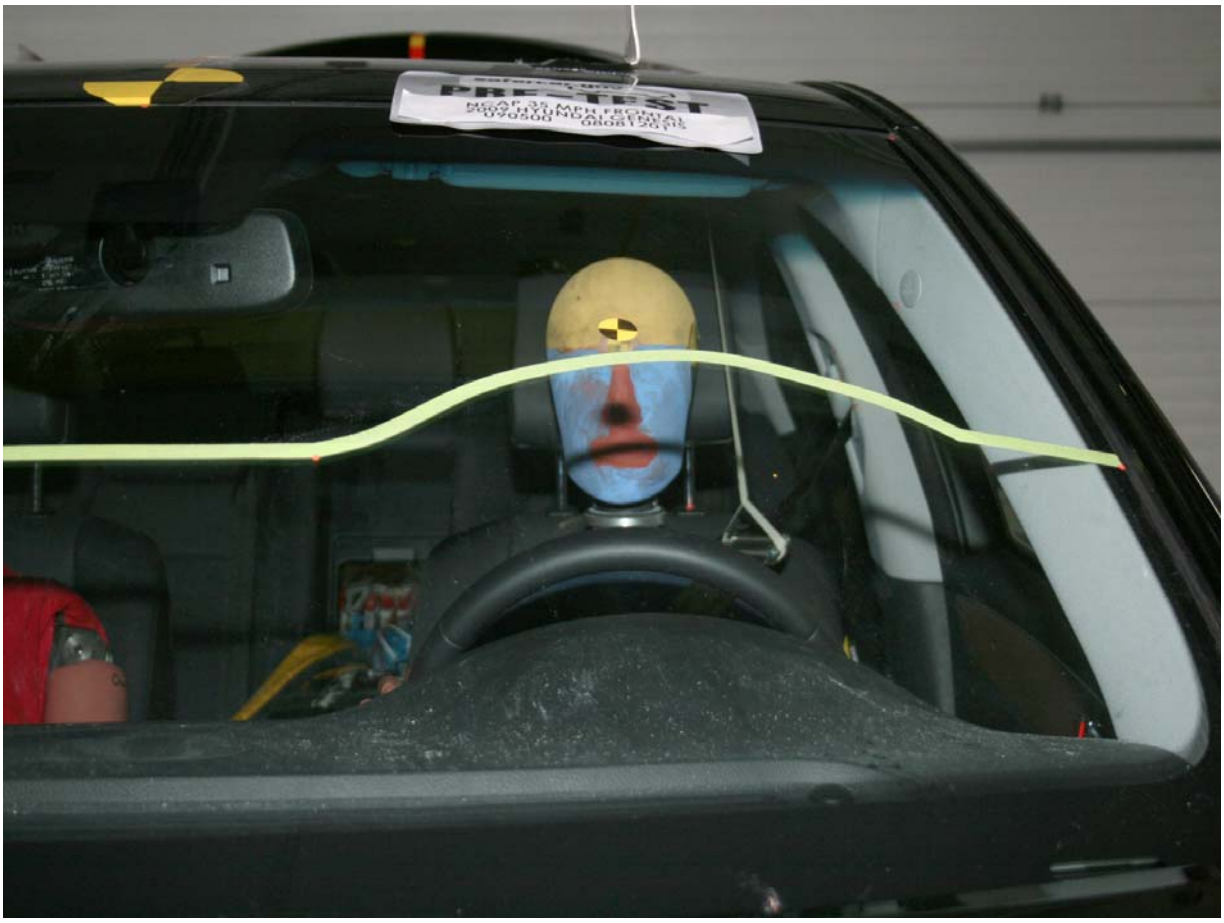


Post-Test Mid Rear Underbody View

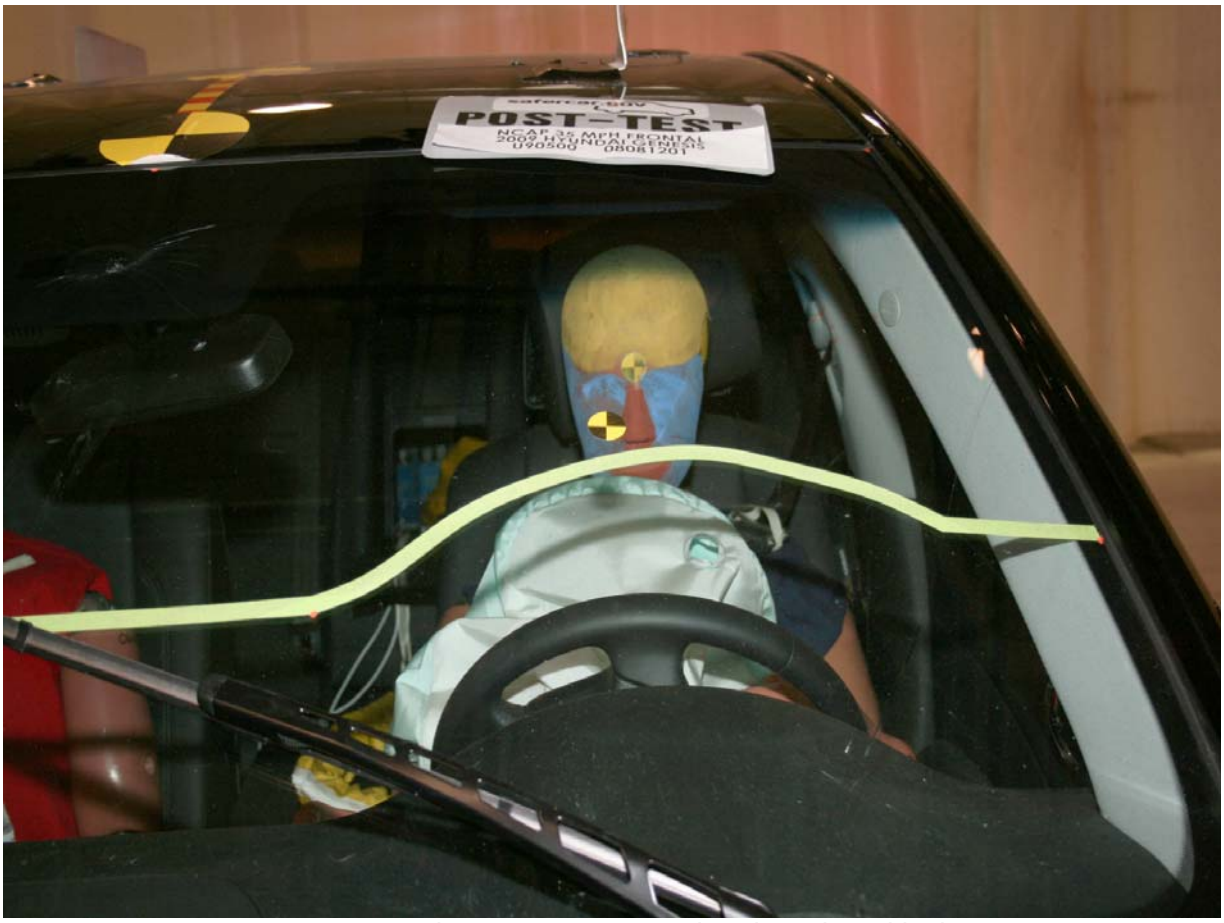
Pre-Test Rear Underbody View



Post-Test Rear Underbody View



Pre-Test Driver Dummy Front View (Head Position)



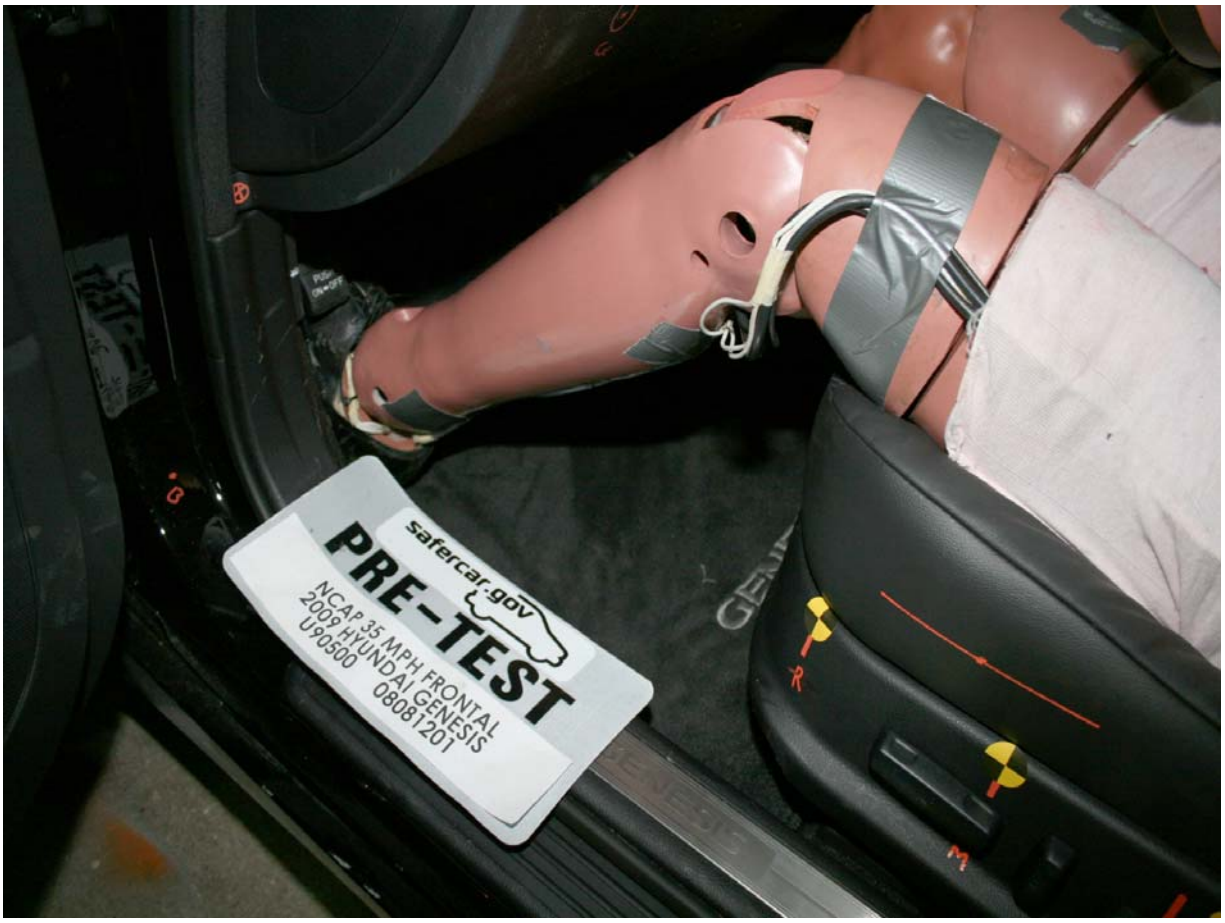
Post-Test Driver Dummy Front View (Head Position)

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 Right Knee Contact


Post-Test Driver Dummy Airbag Contact

Pre-Test Passenger Dummy Front View (Head Position)

Post-Test Passenger Dummy Front View (Head Position)

Pre-Test Passenger Dummy (Through Window)

Post-Test Passenger Dummy (Through Window)

Pre-Test Passenger Dummy (Door Open)

Post-Test Passenger Dummy (Door Open)

Pre-Test Passenger Dummy Feet

Post-Test Passenger Dummy Feet

Pre-Test Passenger Side Glove Box

Post-Test Passenger Side Glove Box

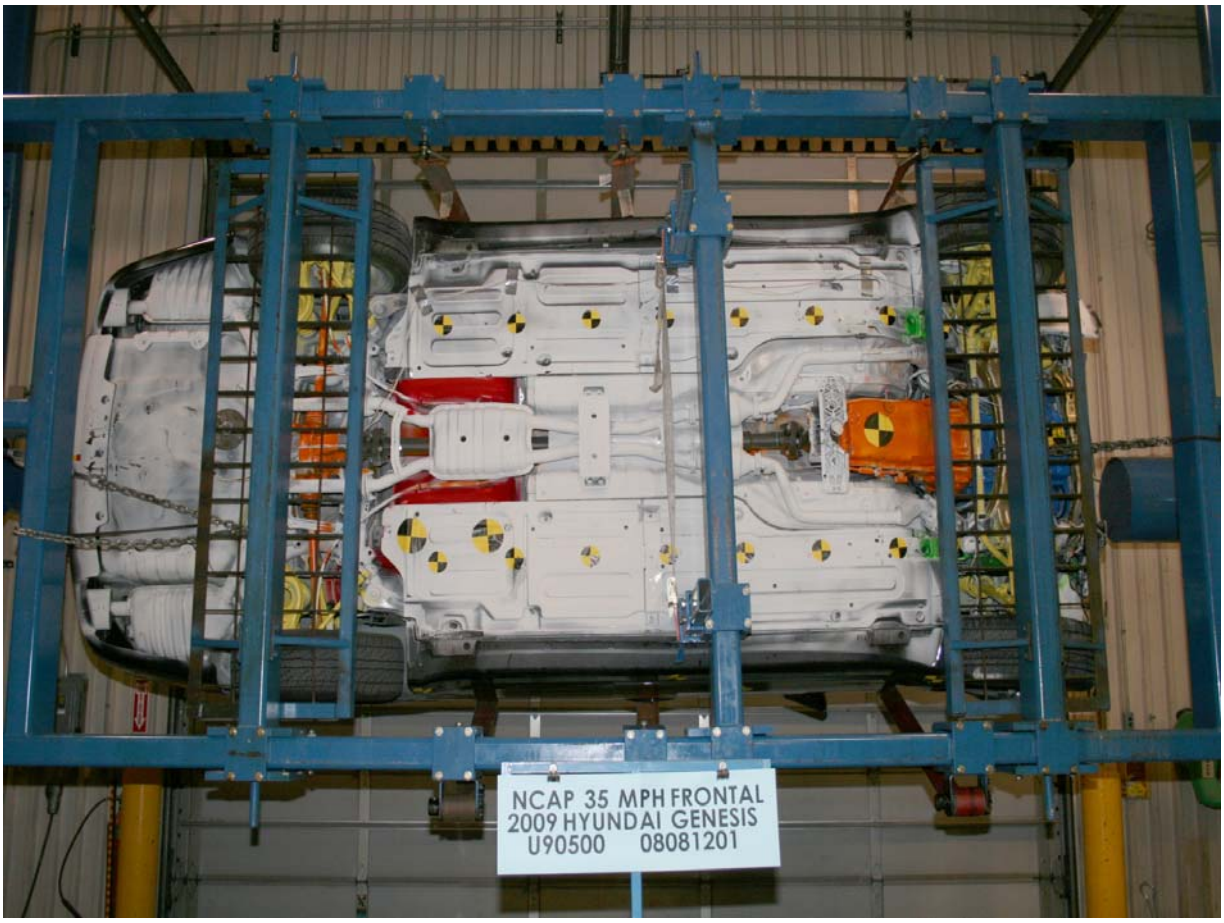
Pre-Test Passenger Side Floor Pan


Post-Test Passenger Side Floor Pan

Post-Test Passenger Dummy Head Contact

Post-Test Passenger Dummy Knee Contact

Post-Test Passenger Dummy Airbag Contact



Rollover 90 Degrees

Rollover 180 Degrees

Rollover 270 Degrees

Rollover 360 Degrees

Vehicle Impact

APPENDIX B

DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

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

Driver Head X Redundant

Driver Head Y Redundant

Driver Head Z Redundant

Driver Upper Neck Force X

Driver Upper Neck Force Y

Driver Upper Neck Force Z

Driver Upper Neck Moment X

Driver Upper Neck Moment Y

Driver Upper Neck Moment Z

Driver Chest X Redundant

Driver Chest Y Redundant

Driver Chest Z Redundant

Driver Chest Displacement

Driver Pelvis X

Driver Pelvis Y

Driver Pelvis Z

Driver Shoulder Belt Force

Driver 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 Shoulder Belt Force

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

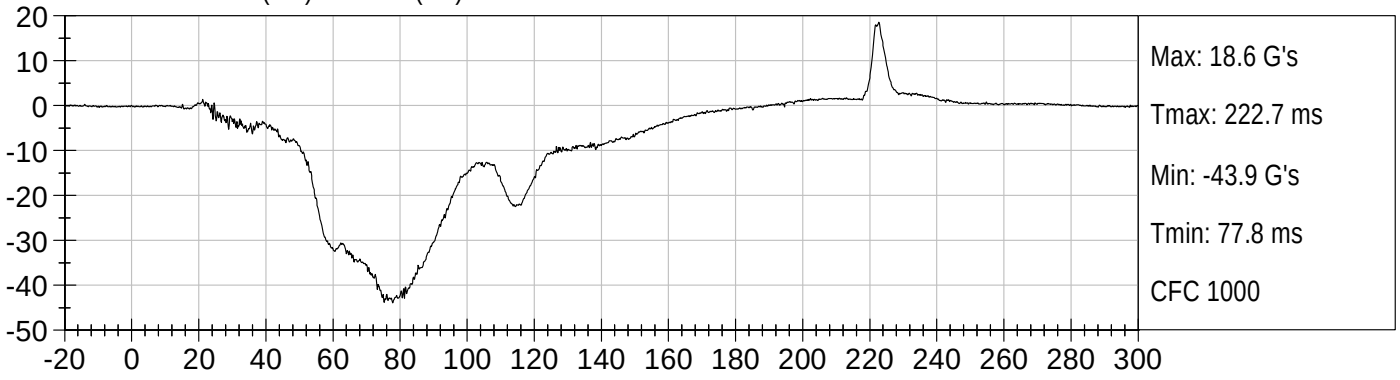
Barrier Force – Lower Center

Barrier Force – Lower Right

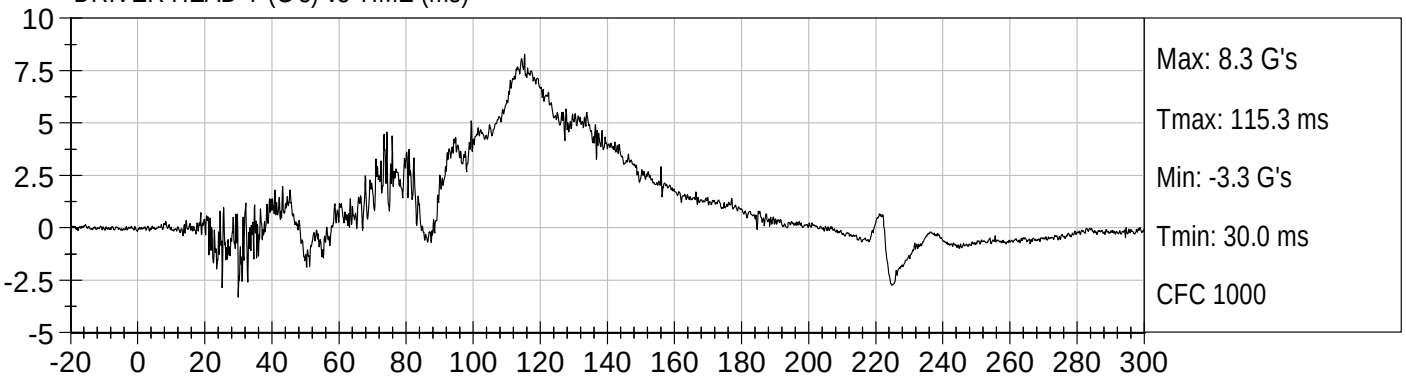
NCAP FRONTAL
2009 HYUNDAI GENESIS U90500

Test Date: 08/12/2008
Speed: 35.1 mph (56.5 km/h)

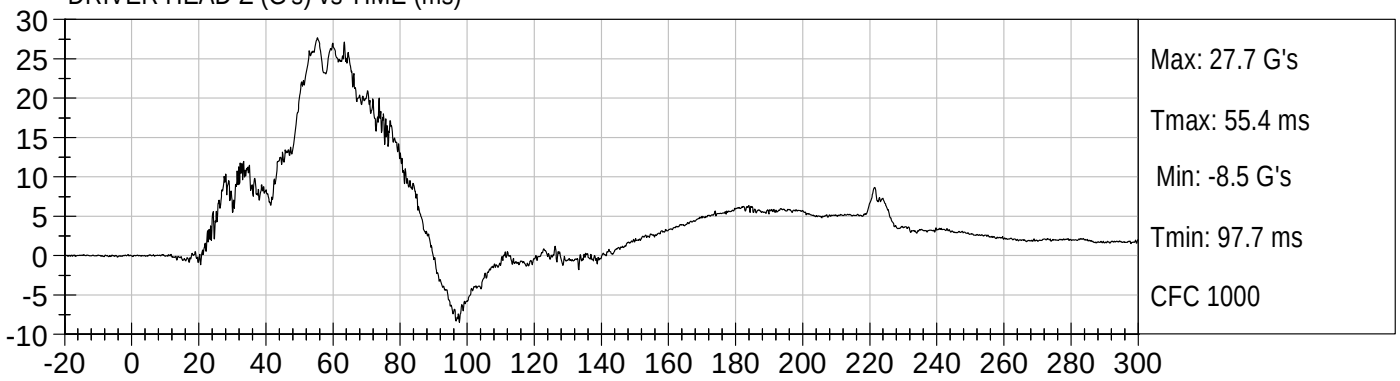
DRIVER HEAD X (G's) vs TIME (ms)



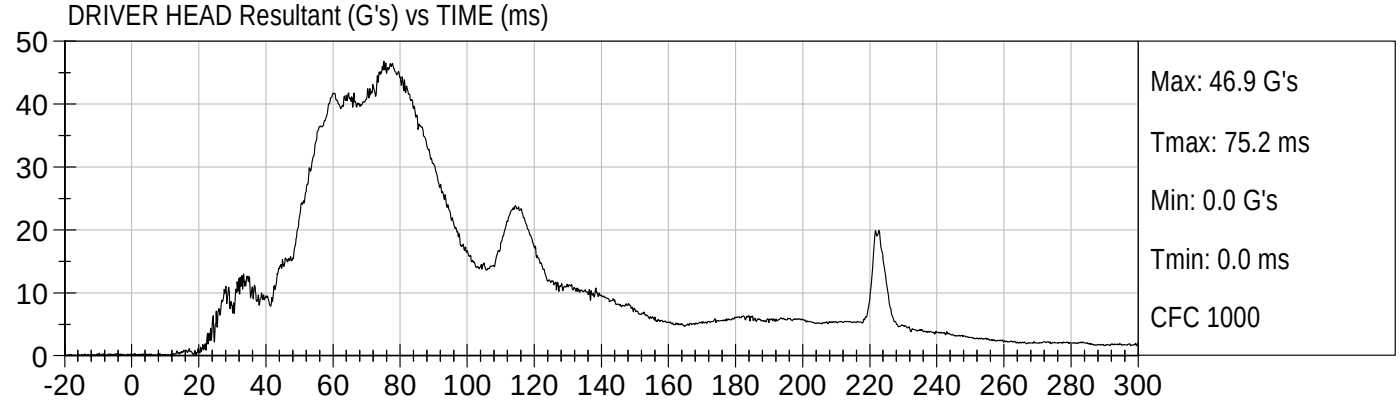
DRIVER HEAD Y (G's) vs TIME (ms)



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

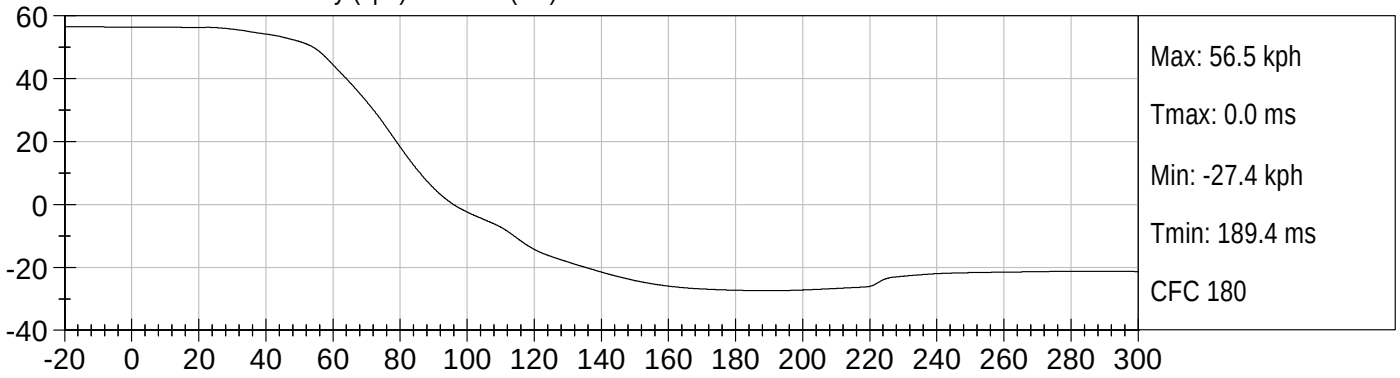


DRIVER HEAD Resultant (G's) vs TIME (ms)

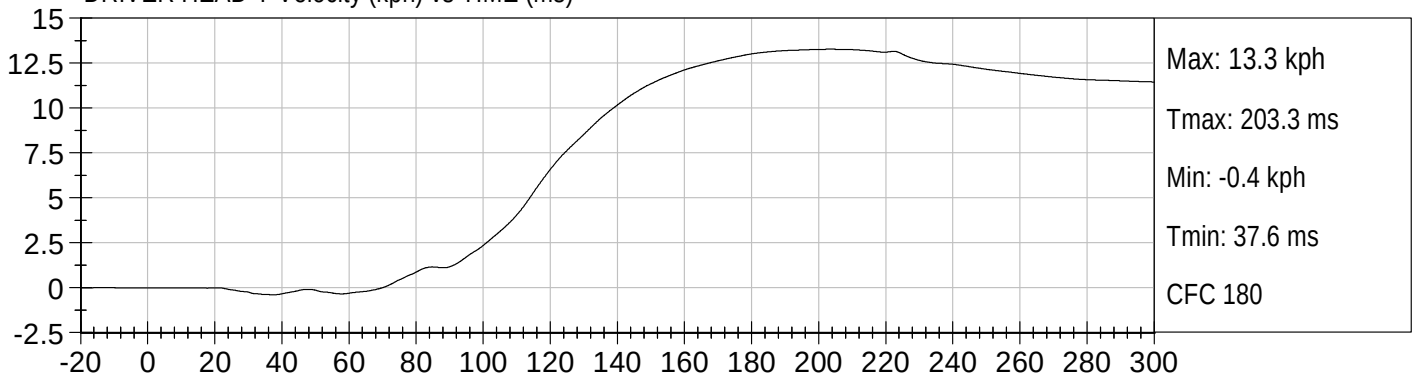


NCAP FRONTAL
2009 HYUNDAI GENESIS U90500
Test Date: 08/12/2008
Speed: 35.1 mph (56.5 km/h)

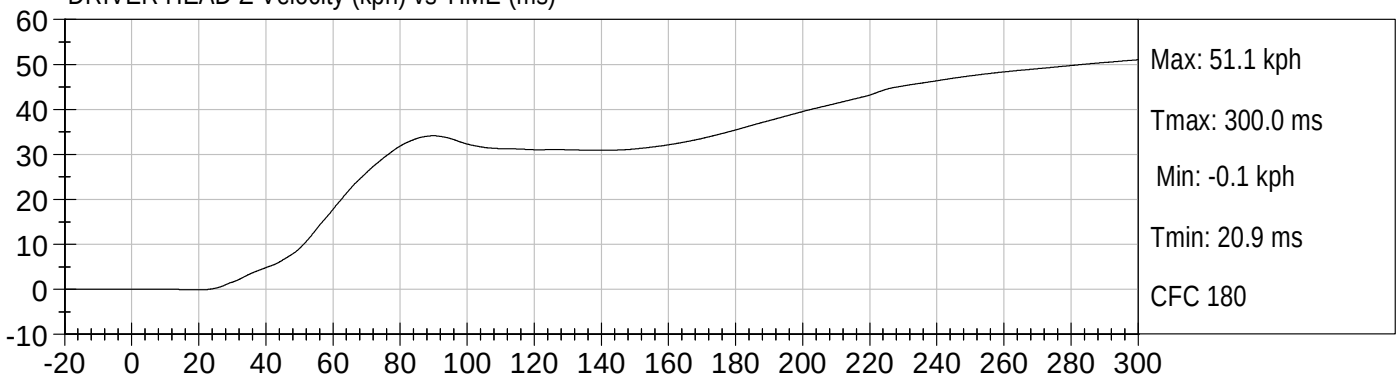
DRIVER HEAD X Velocity (kph) vs TIME (ms)



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



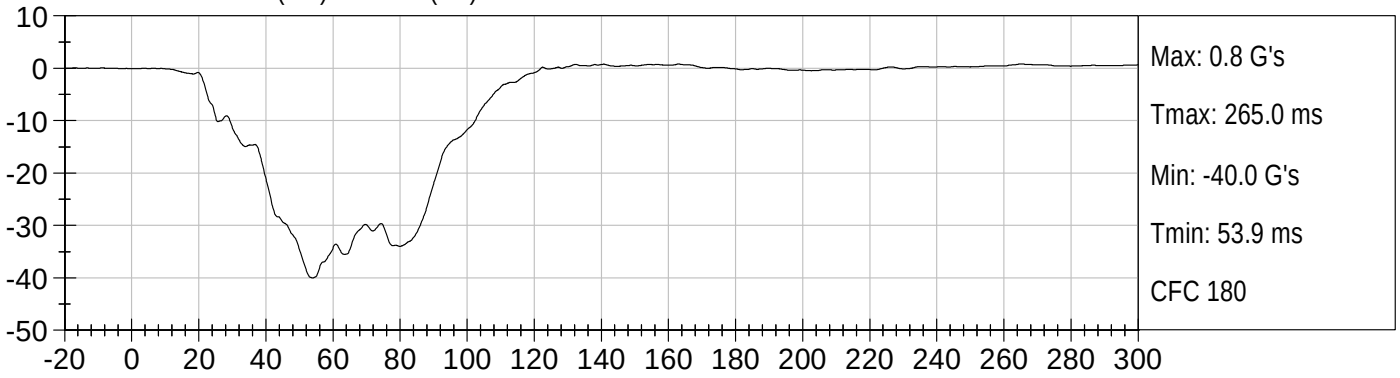
DRIVER HEAD Z Velocity (kph) vs TIME (ms)



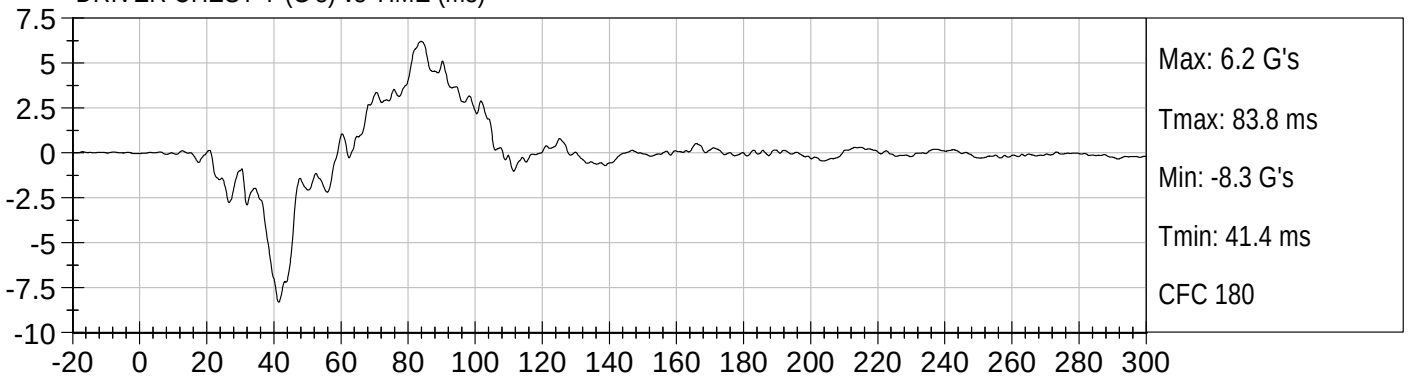
NCAP FRONTAL
2009 HYUNDAI GENESIS U90500

Test Date: 08/12/2008
Speed: 35.1 mph (56.5 km/h)

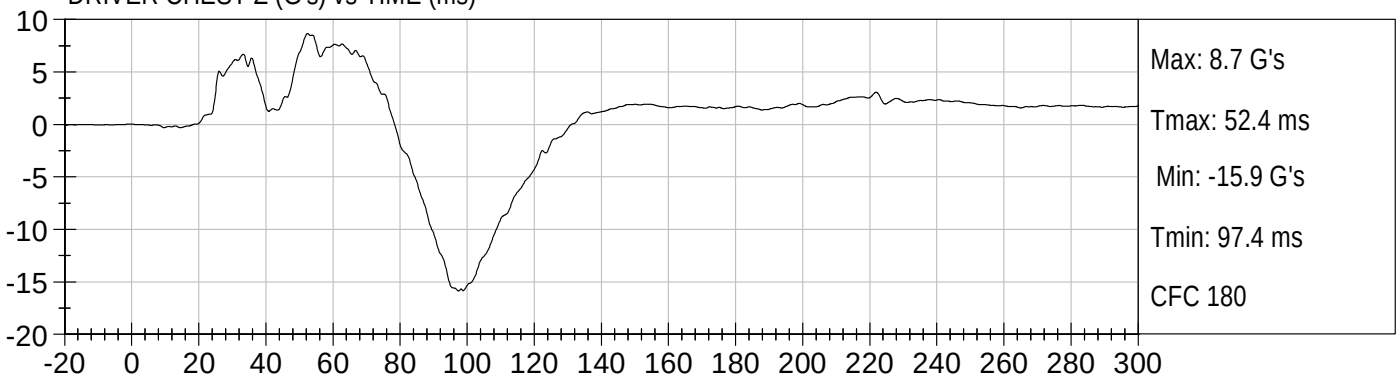
DRIVER CHEST X (G's) vs TIME (ms)



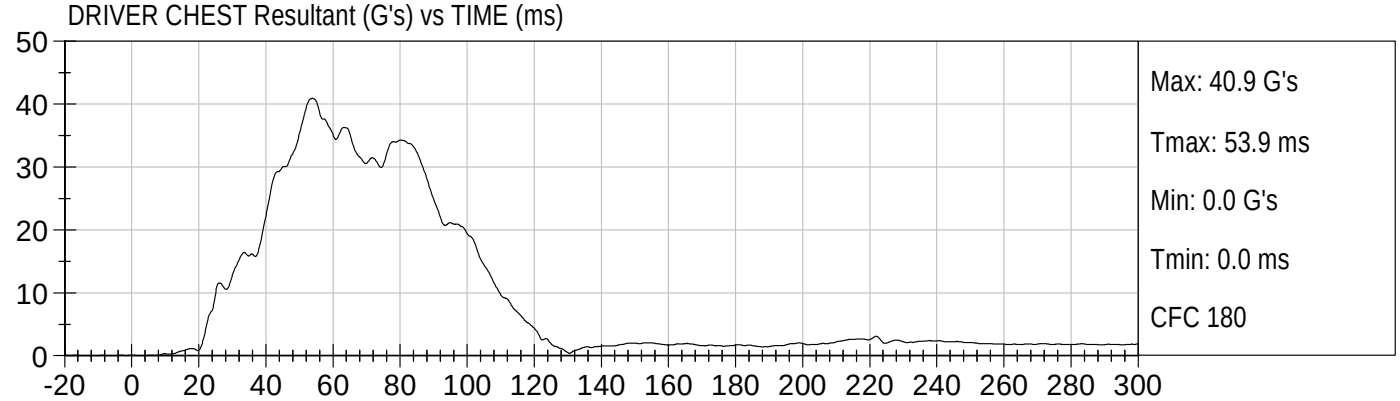
DRIVER CHEST Y (G's) vs TIME (ms)

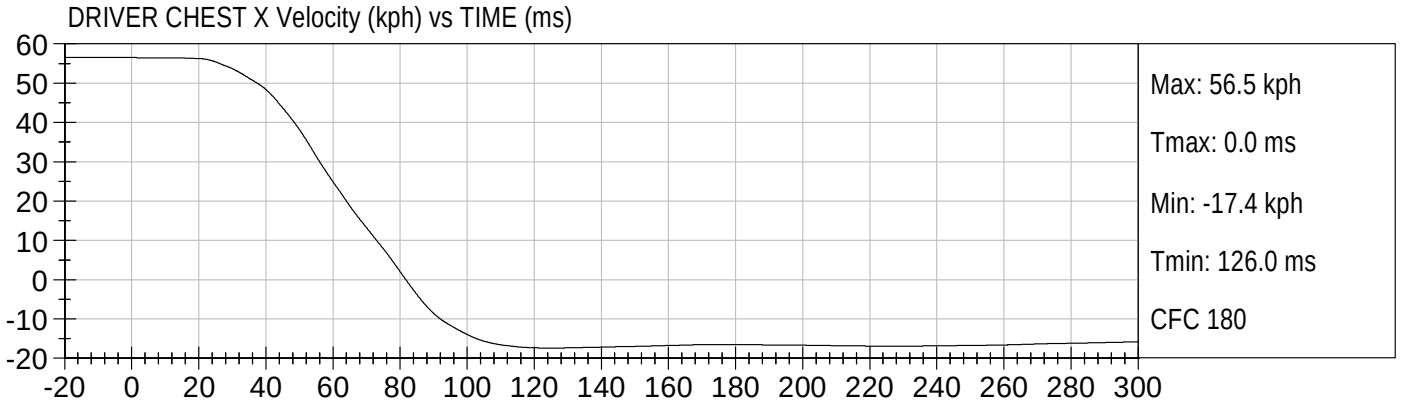


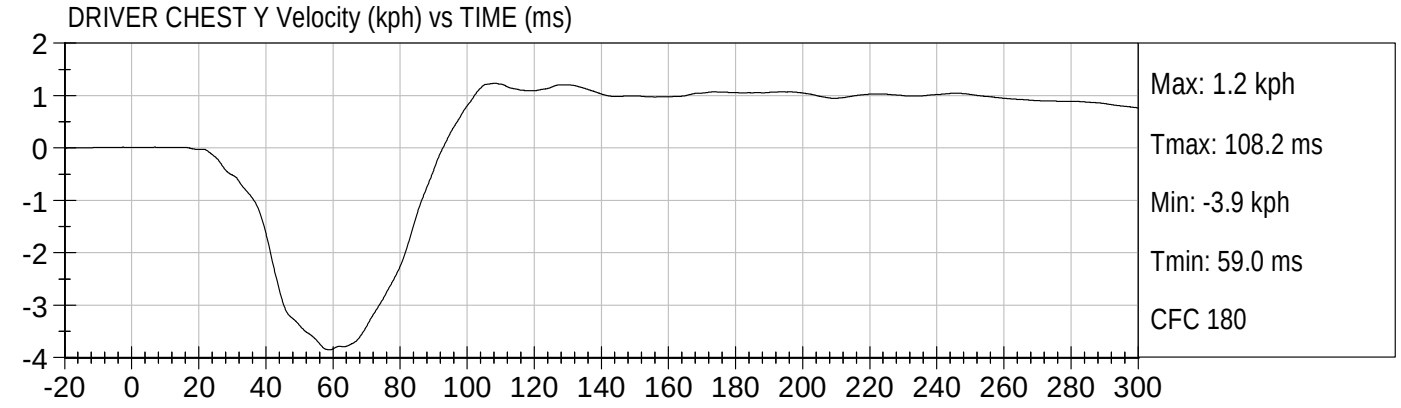
DRIVER CHEST Z (G's) vs TIME (ms)

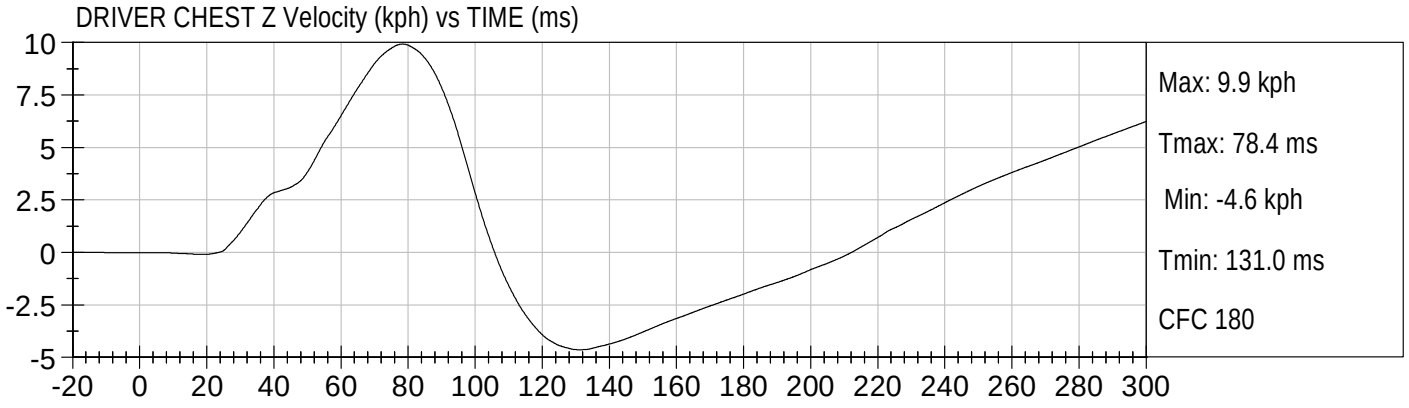


DRIVER CHEST Resultant (G's) vs TIME (ms)

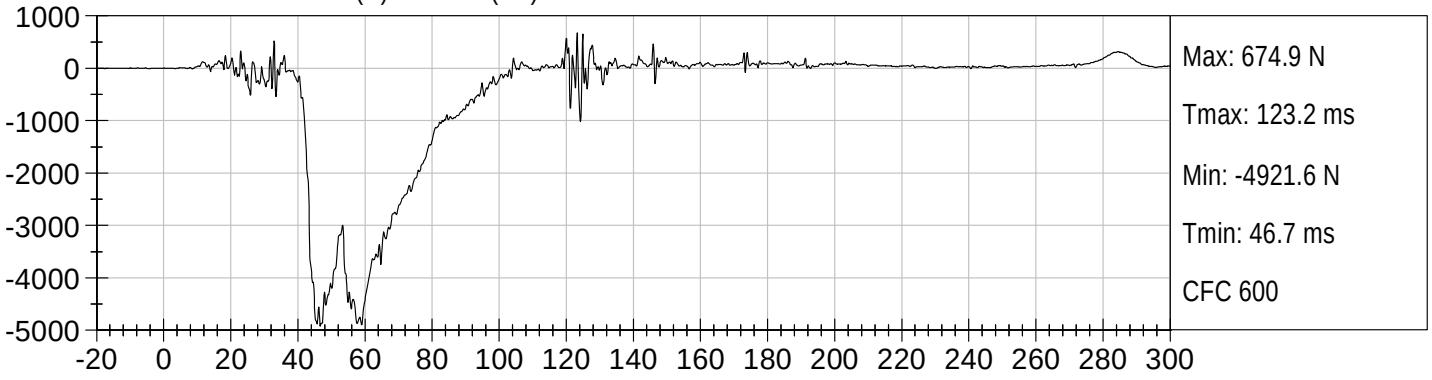



DRIVER CHEST X Velocity (kph) vs TIME (ms)
60
50
40
30
20
10
0
-10
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.5 kph
Tmax: 0.0 ms
Min: -17.4 kph
Tmin: 126.0 ms
CFC 180

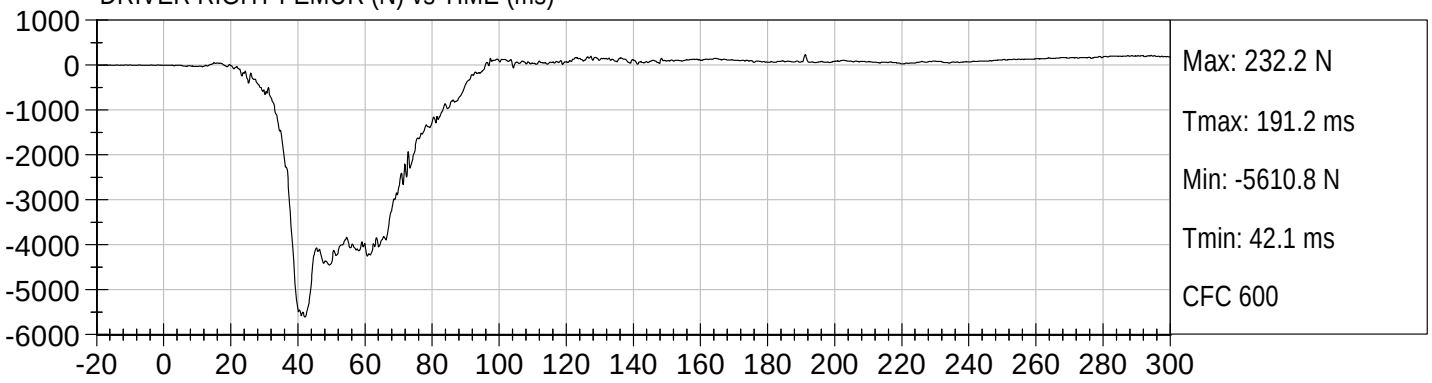

DRIVER CHEST Y Velocity (kph) vs TIME (ms)
2
1
0
-1
-2
-3
-4
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 1.2 kph
Tmax: 108.2 ms
Min: -3.9 kph
Tmin: 59.0 ms
CFC 180


DRIVER CHEST Z Velocity (kph) vs TIME (ms)
10
7.5
5
2.5
0
-2.5
-5
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 9.9 kph
Tmax: 78.4 ms
Min: -4.6 kph
Tmin: 131.0 ms
CFC 180

DRIVER LEFT FEMUR (N) vs TIME (ms)



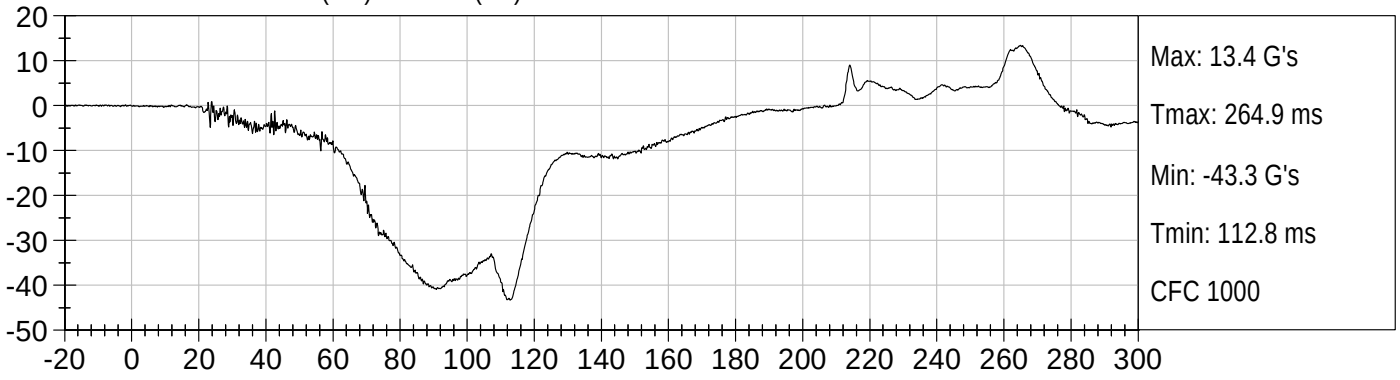
DRIVER RIGHT FEMUR (N) vs TIME (ms)



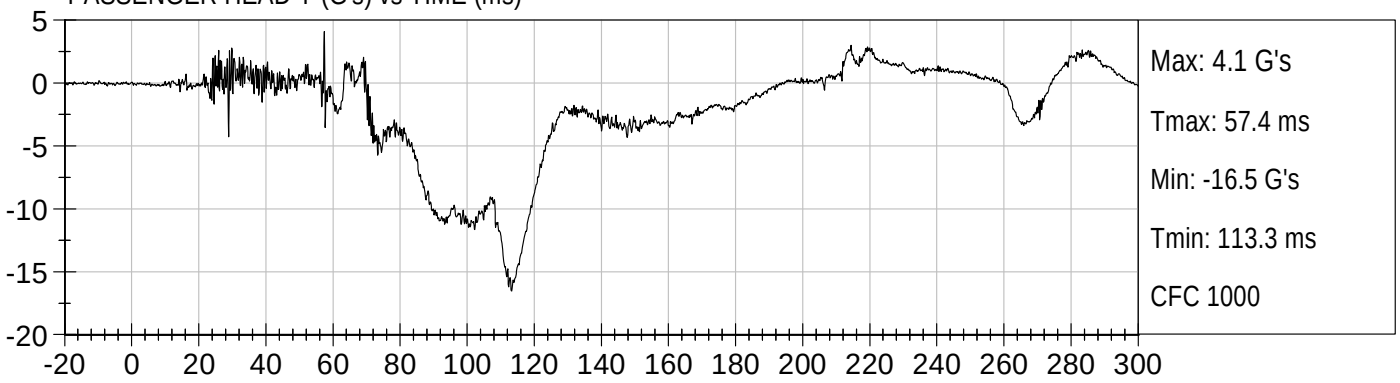
NCAP FRONTAL
2009 HYUNDAI GENESIS U90500

Test Date: 08/12/2008
Speed: 35.1 mph (56.5 km/h)

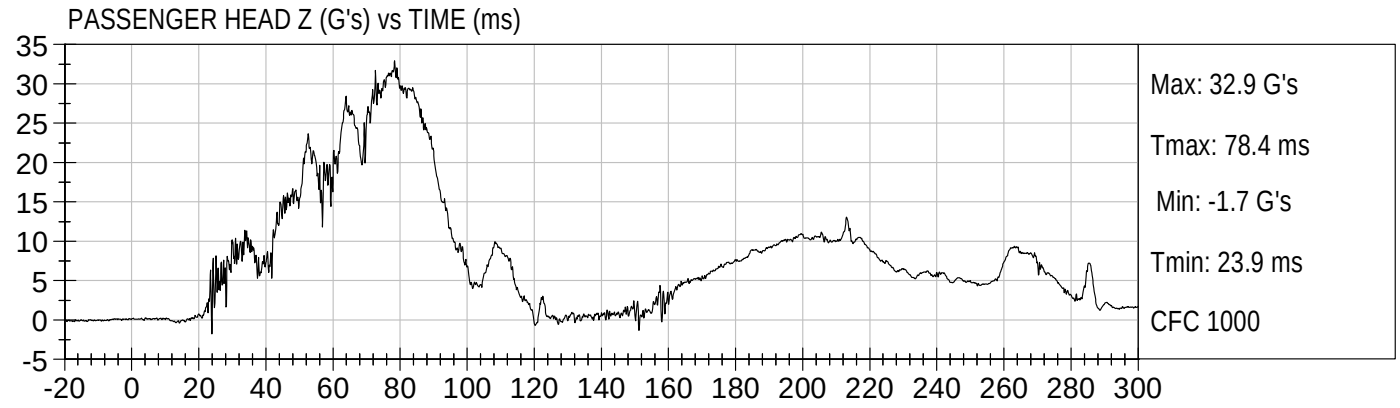
PASSENGER HEAD X (G's) vs TIME (ms)



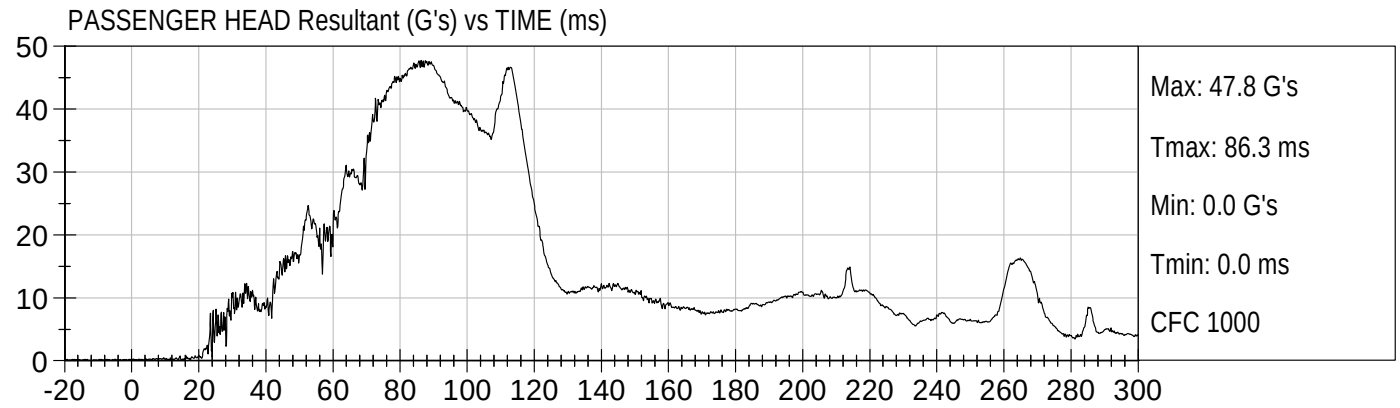
PASSENGER HEAD Y (G's) vs TIME (ms)

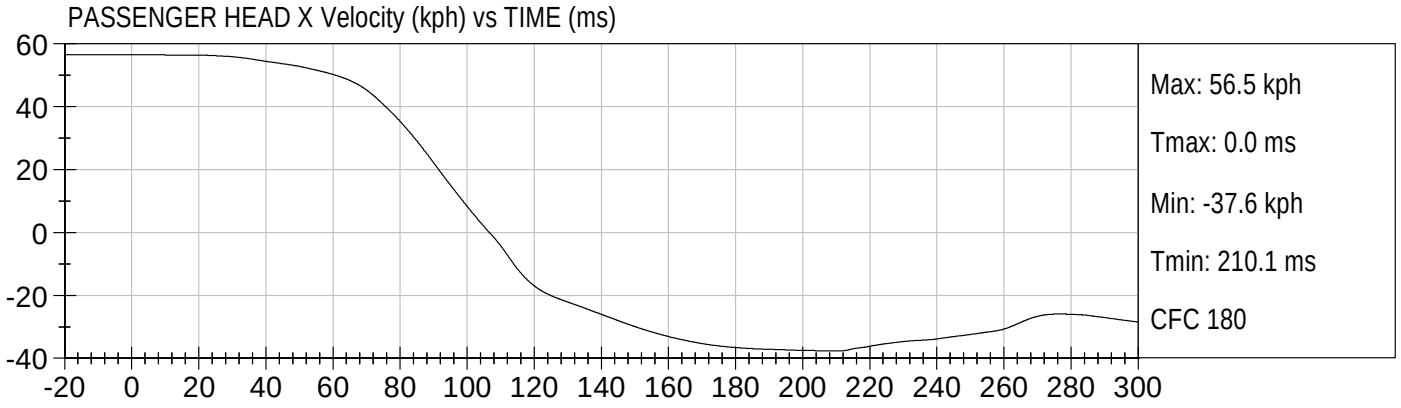


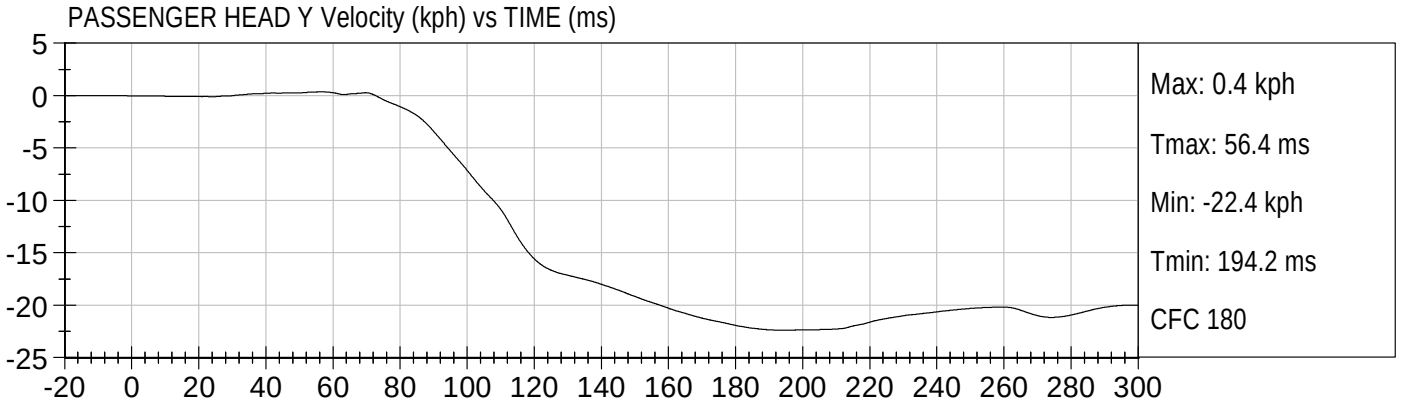
PASSENGER HEAD Z (G's) vs TIME (ms)

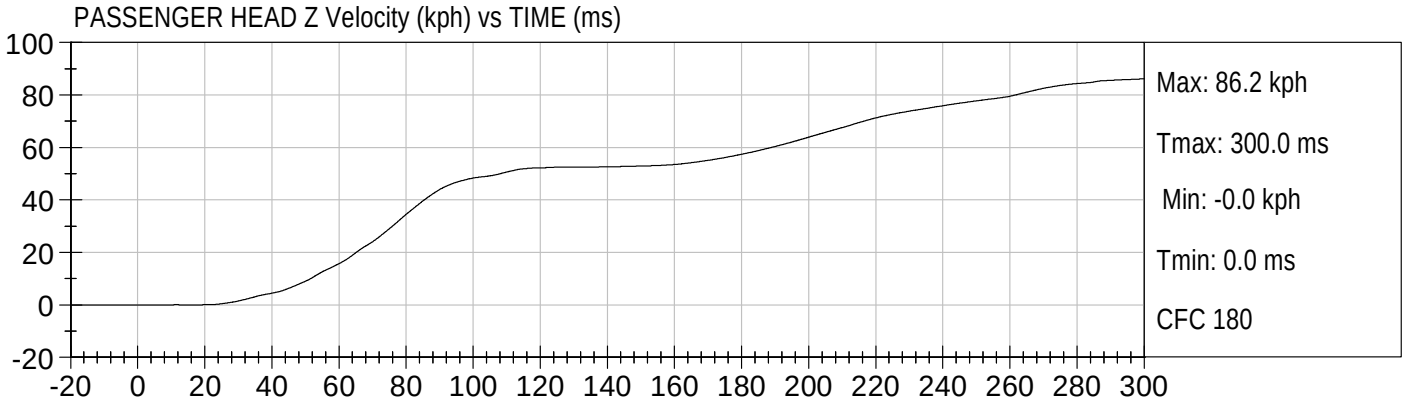


PASSENGER HEAD Resultant (G's) vs TIME (ms)




PASSENGER HEAD X Velocity (kph) vs TIME (ms)
60
40
20
0
-20
-40
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 56.5 kph
Tmax: 0.0 ms
Min: -37.6 kph
Tmin: 210.1 ms
CFC 180

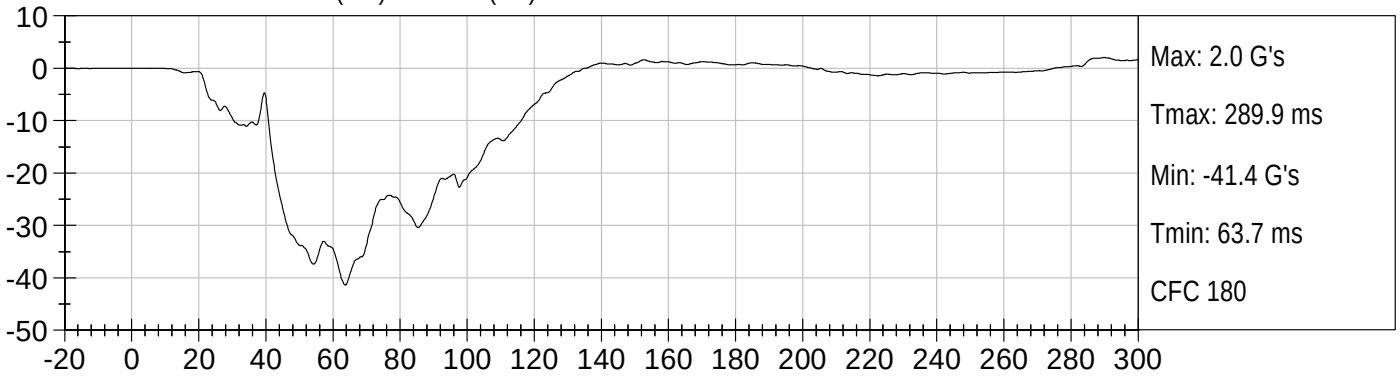

PASSENGER HEAD Y Velocity (kph) vs TIME (ms)
5
0
-5
-10
-15
-20
-25
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 0.4 kph
Tmax: 56.4 ms
Min: -22.4 kph
Tmin: 194.2 ms
CFC 180


PASSENGER HEAD Z Velocity (kph) vs TIME (ms)
100
80
60
40
20
0
-20
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 86.2 kph
Tmax: 300.0 ms
Min: -0.0 kph
Tmin: 0.0 ms
CFC 180

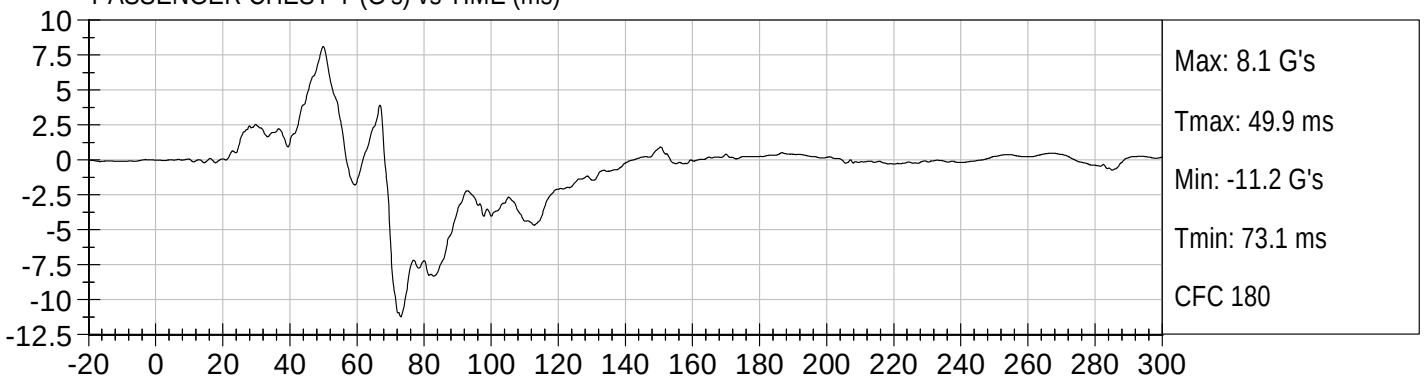
NCAP FRONTAL
2009 HYUNDAI GENESIS U90500

Test Date: 08/12/2008
Speed: 35.1 mph (56.5 km/h)

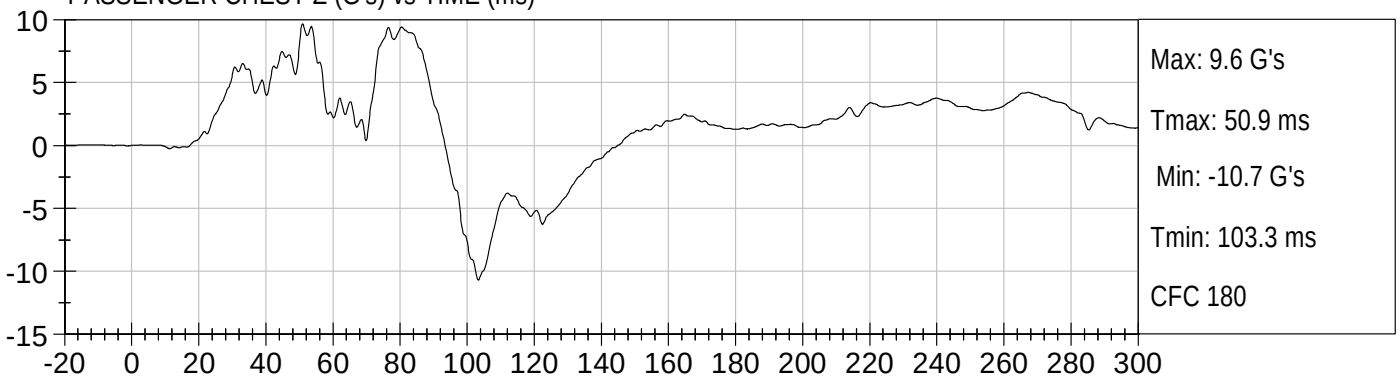
PASSENGER CHEST X (G's) vs TIME (ms)



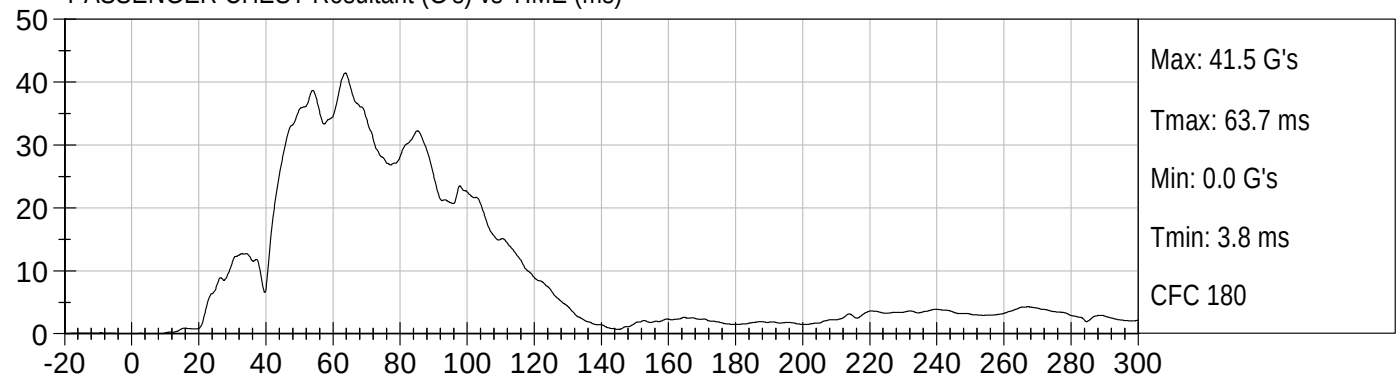
PASSENGER CHEST Y (G's) vs TIME (ms)



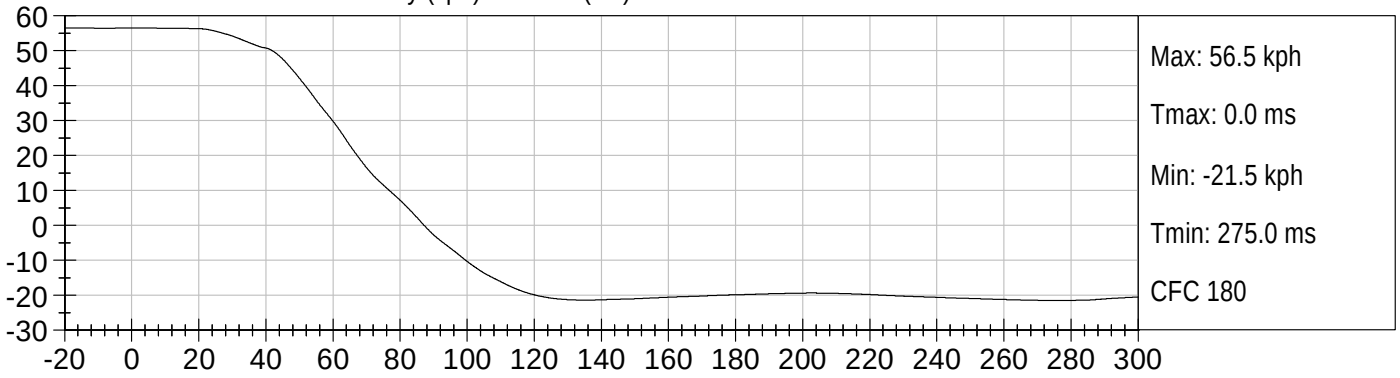
PASSENGER CHEST Z (G's) vs TIME (ms)



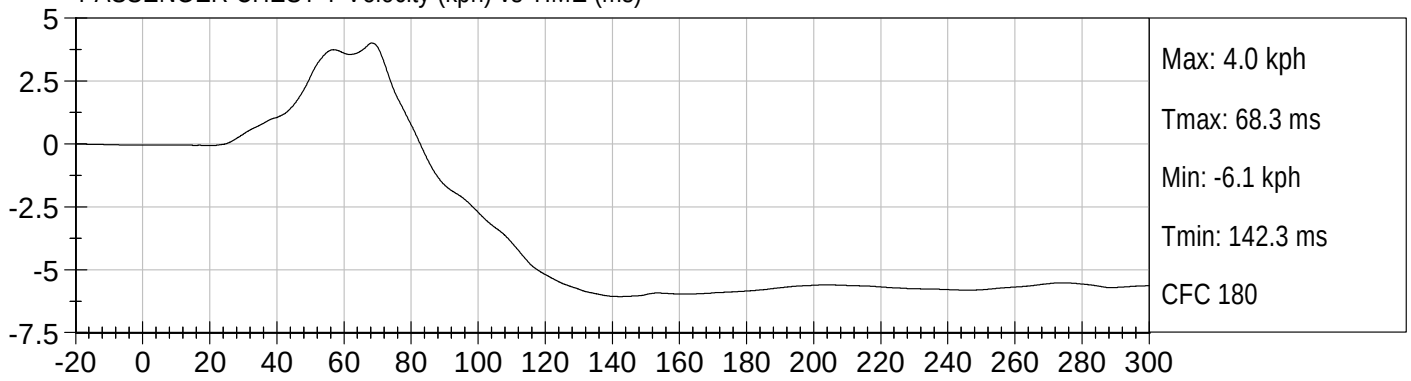
PASSENGER CHEST Resultant (G's) vs TIME (ms)



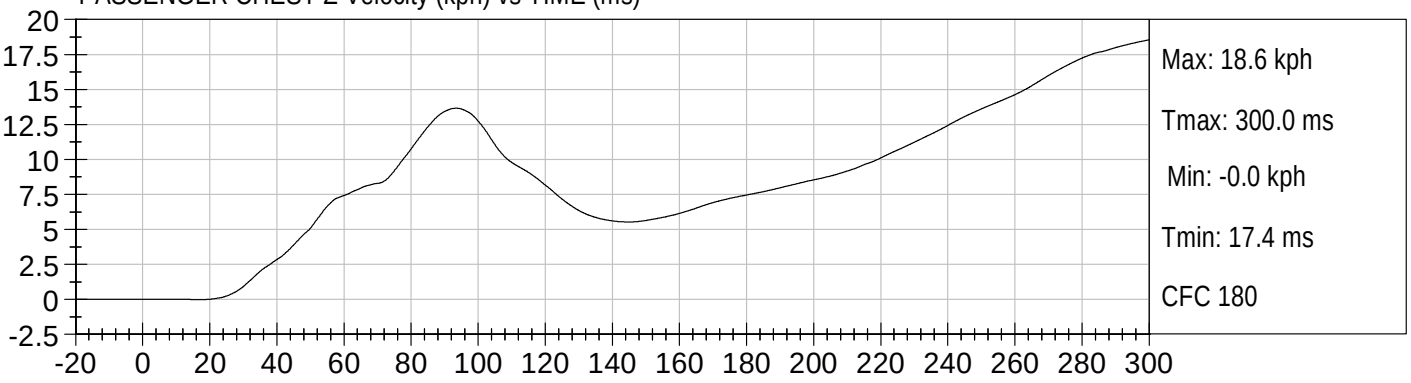
PASSENGER CHEST X Velocity (kph) vs TIME (ms)



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

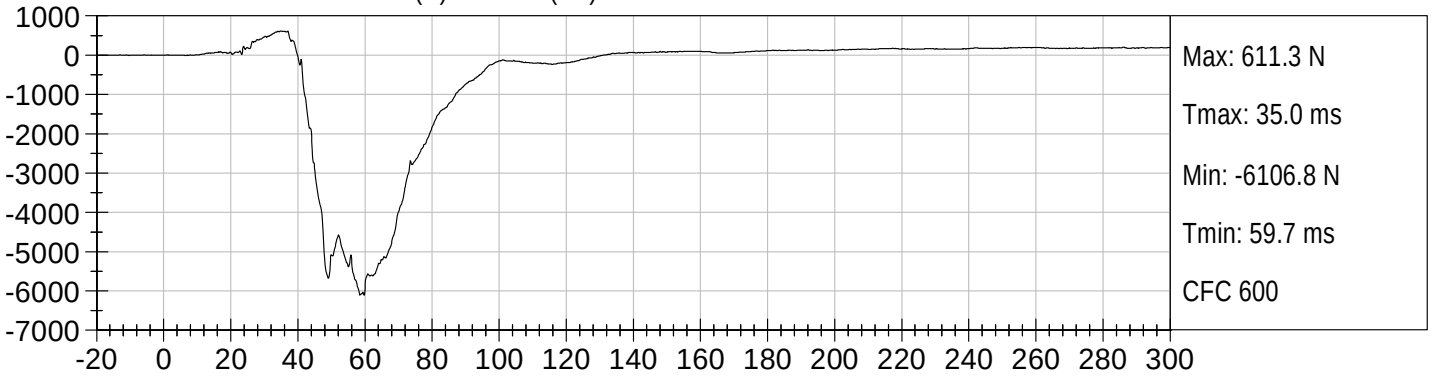


PASSENGER CHEST Z Velocity (kph) vs TIME (ms)

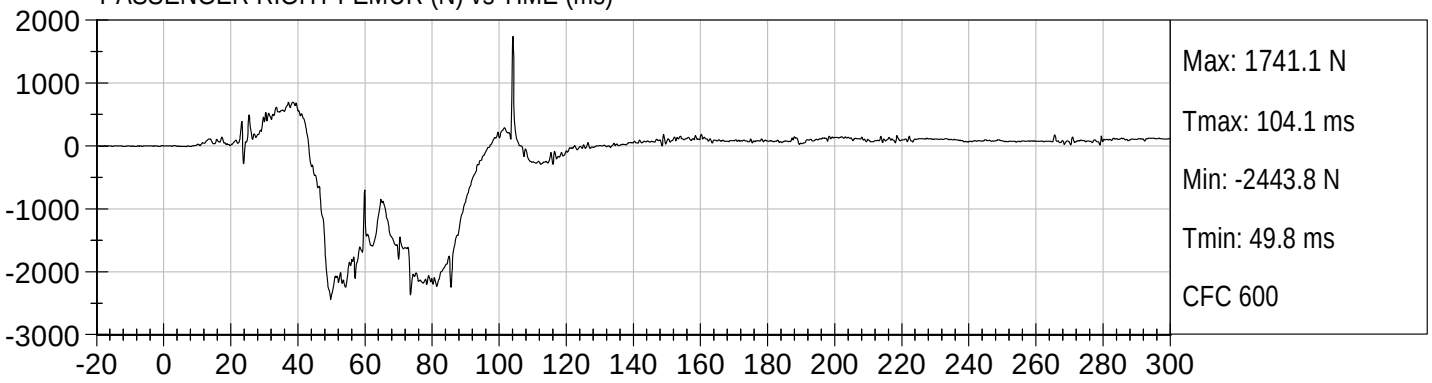


NCAP FRONTAL
2009 HYUNDAI GENESIS U90500
Test Date: 08/12/2008
Speed: 35.1 mph (56.5 km/h)

PASSENGER LEFT FEMUR (N) vs TIME (ms)



PASSENGER RIGHT FEMUR (N) vs TIME (ms)



APPENDIX C

DUMMY CALIBRATION DATA

MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test ID:** D082221

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	39	Pass
Peak Resultant Acceleration	G's	225 - 275	249	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-2.2	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Laboratory Technician

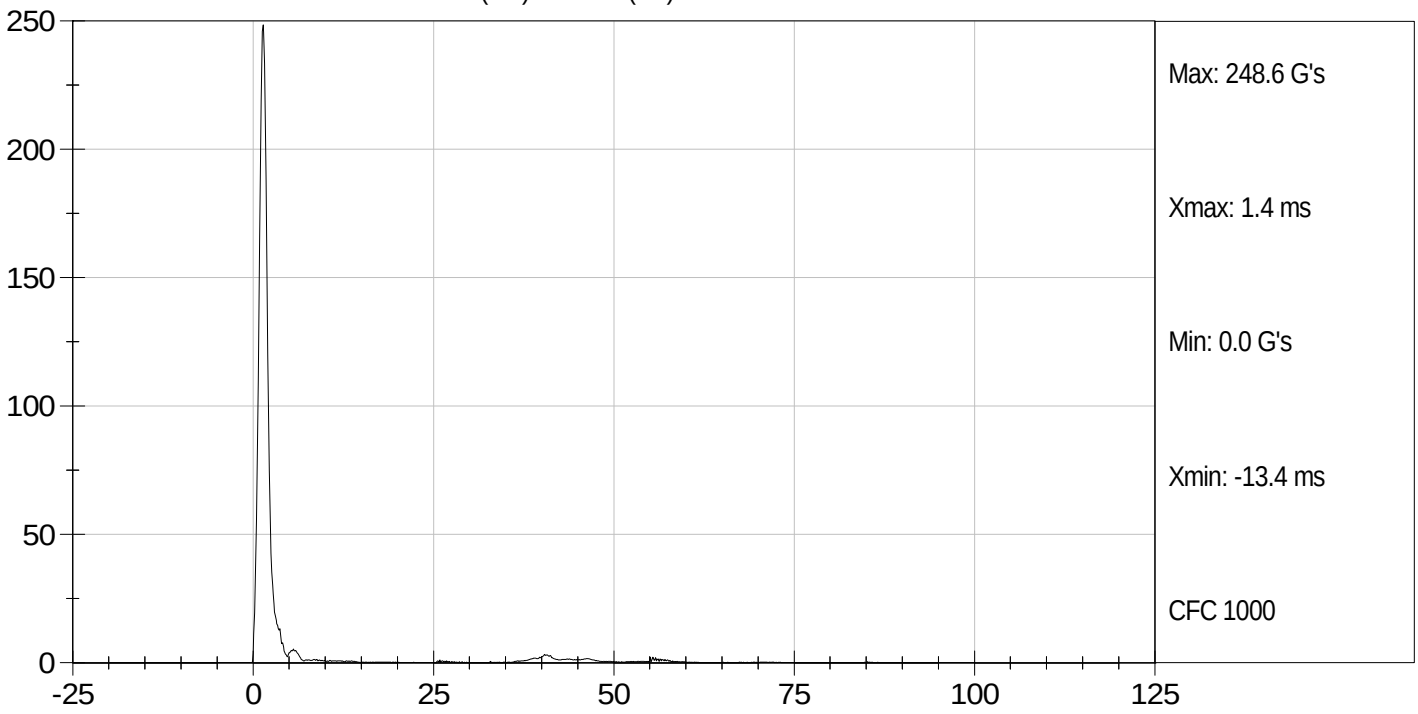
8/6/08
Test Date

Approved By

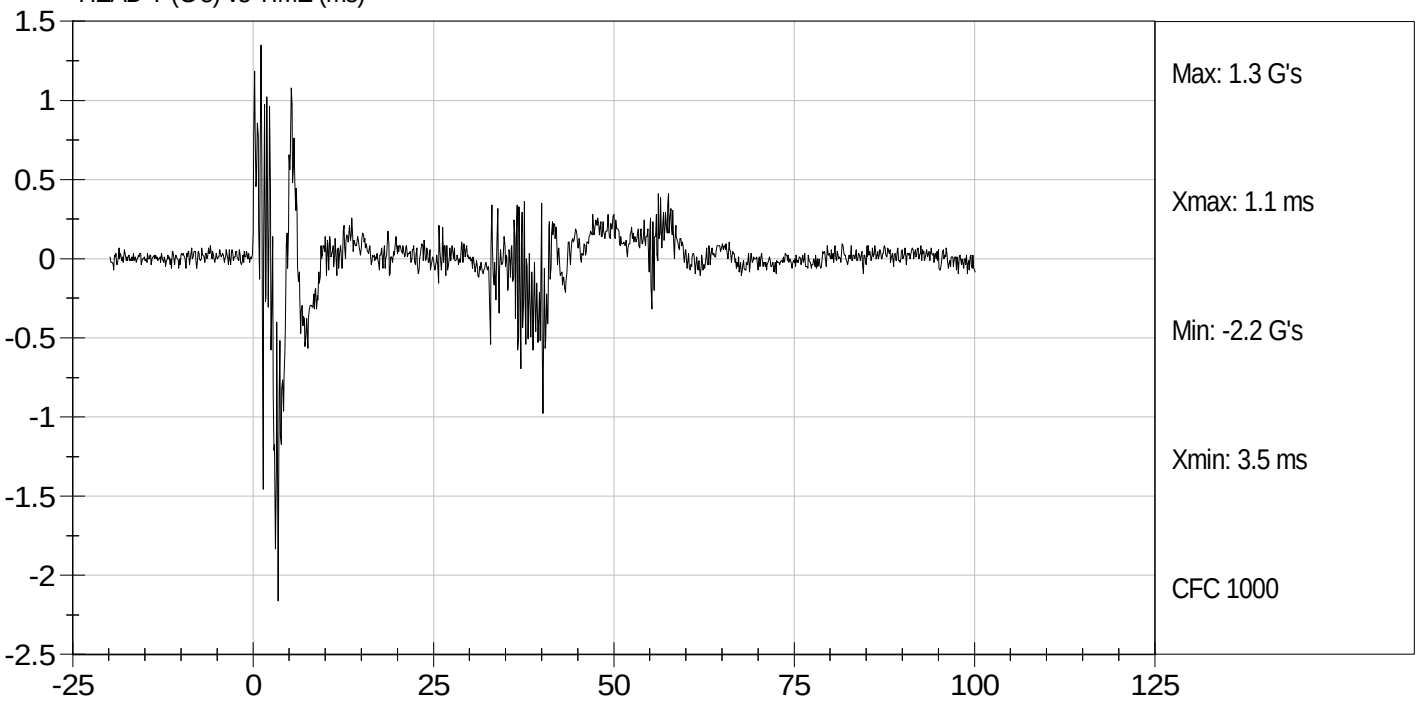
Test Desc: Head Drop
Component ID: D082221

Test Date: 8/6/08
Velocity: 0 ft/s, 0.00 m/s

HEAD RESULTANT 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:** D082222

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	36	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	25.48	Pass
	20 msec	G's	17.60 to 22.60	19.78	Pass
	30 msec	G's	12.50 to 18.50	17.97	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	17.83	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	35.3	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	69.9	Pass
	Time	msec	57.0 to 64.0	57.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	116.4	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	102.8	Pass
	Time	msec	47.0 to 58.0	47.0	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	100.0	Pass
			Overall Test Results		Pass

Laboratory Technician

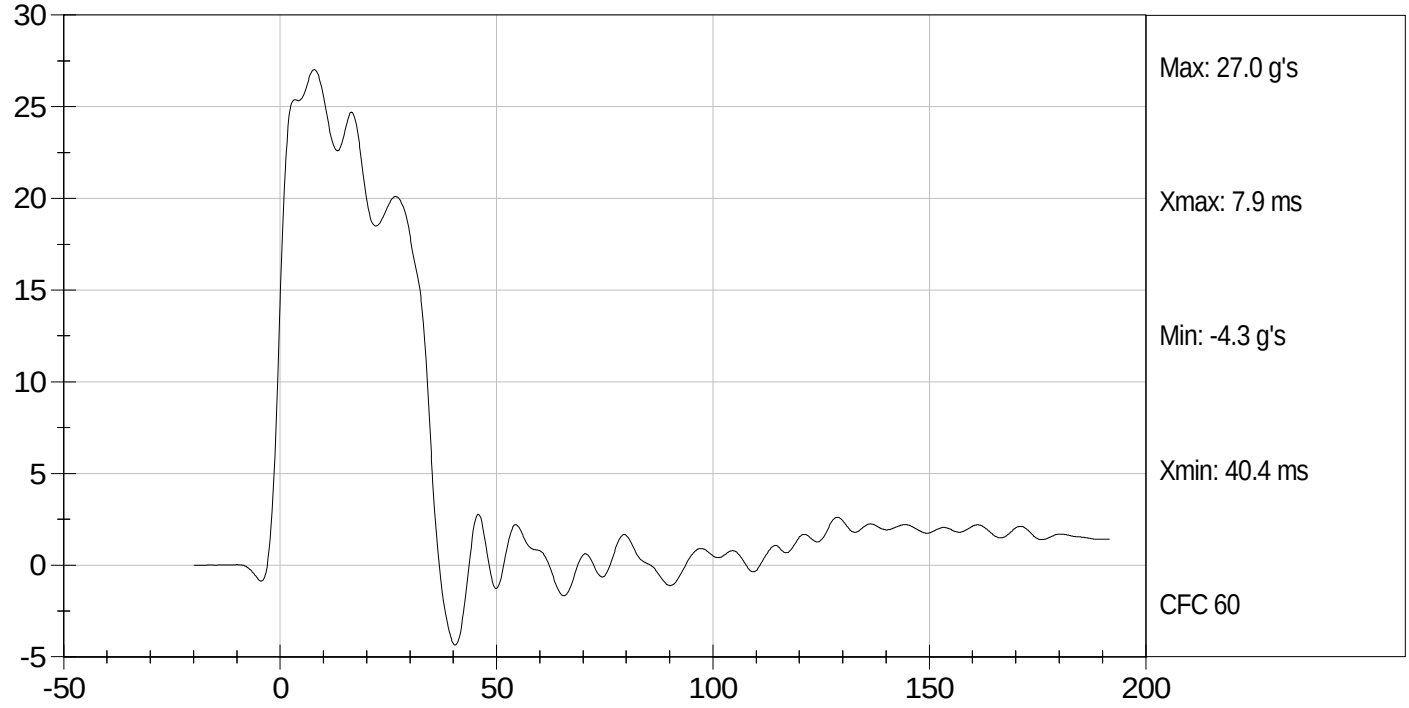
8/6/08
Test Date

Approved By

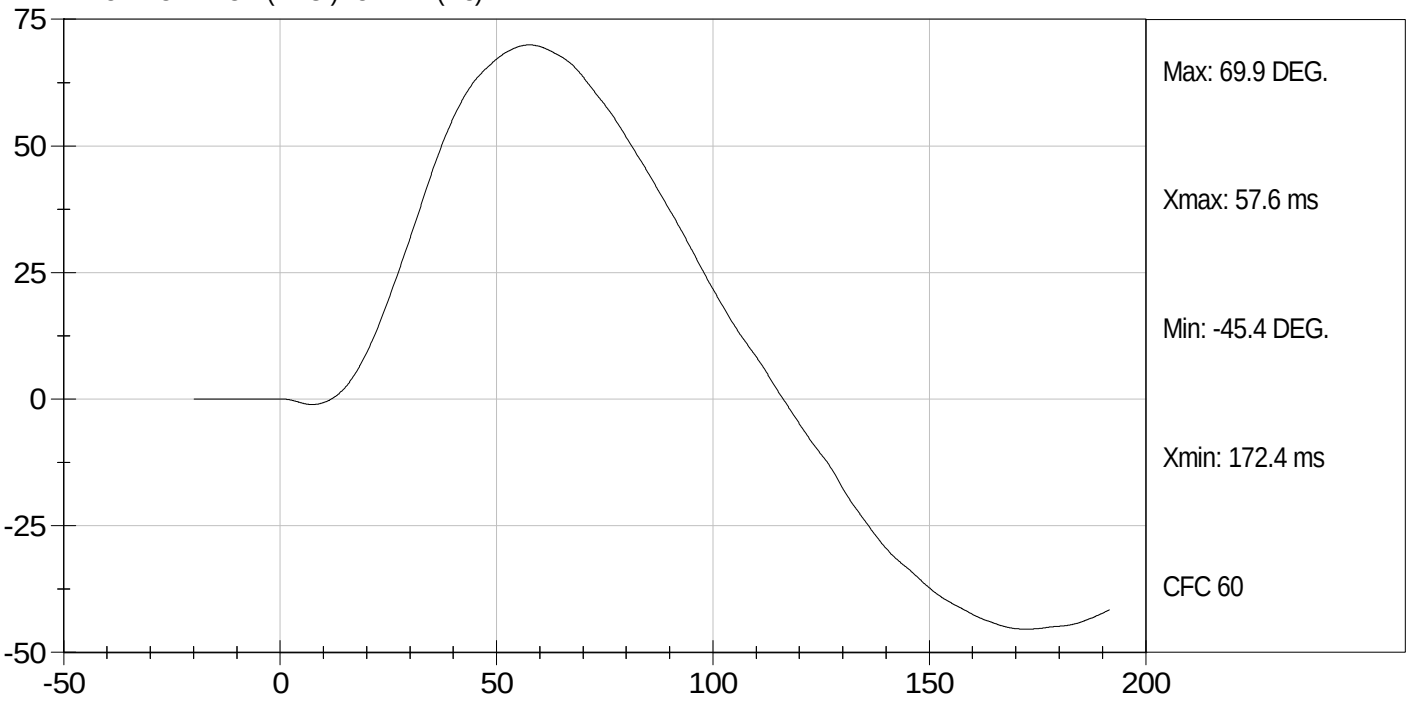
Test Desc: Neck Flexion
Component ID: D082222

Test Date: 8/6/08
Velocity: 23.15 ft/s, 7.06 m/s

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

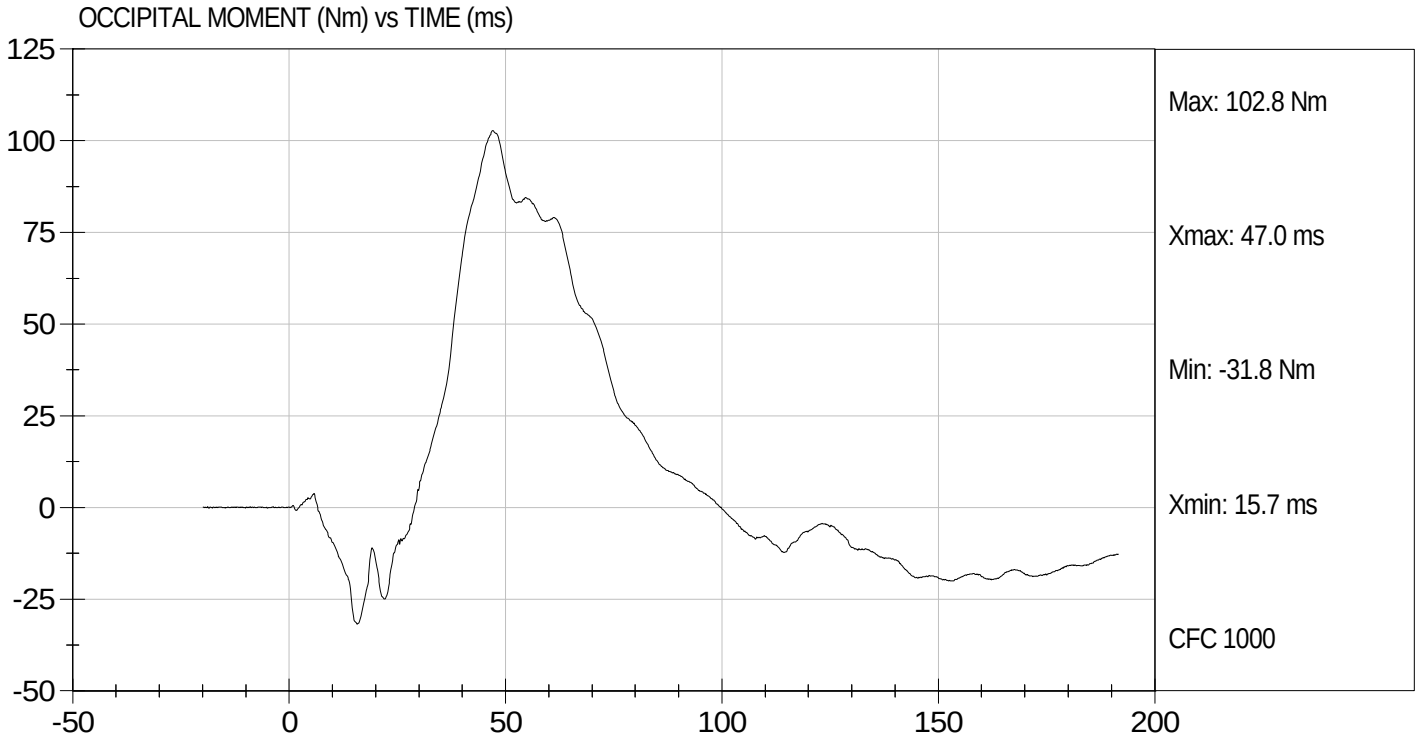


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D082222

Test Date: 8/6/08
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:** D082223

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	36	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.16	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	20.18	Pass
	20 msec	G's	14.00 to 19.00	18.19	Pass
	30 msec	G's	11.00 to 16.00	15.91	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	17.62	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	39.1	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	94.8	Pass
	Time	msec	72.0 to 82.0	72.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	157.2	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-65.8	Pass
	Time	msec	65.0 to 79.0	67.1	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	133.3	Pass
			Overall Test Results		Pass

Laboratory Technician

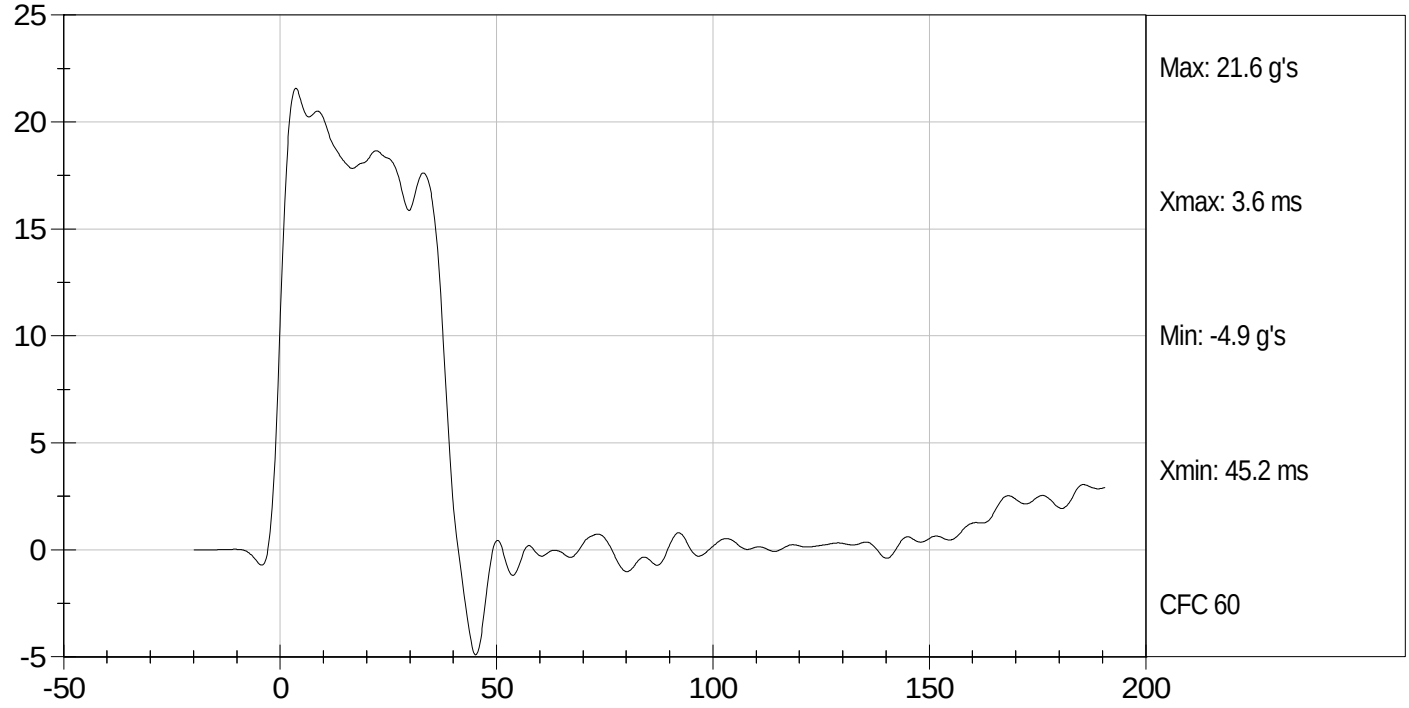
8/6/08
Test Date

Approved By

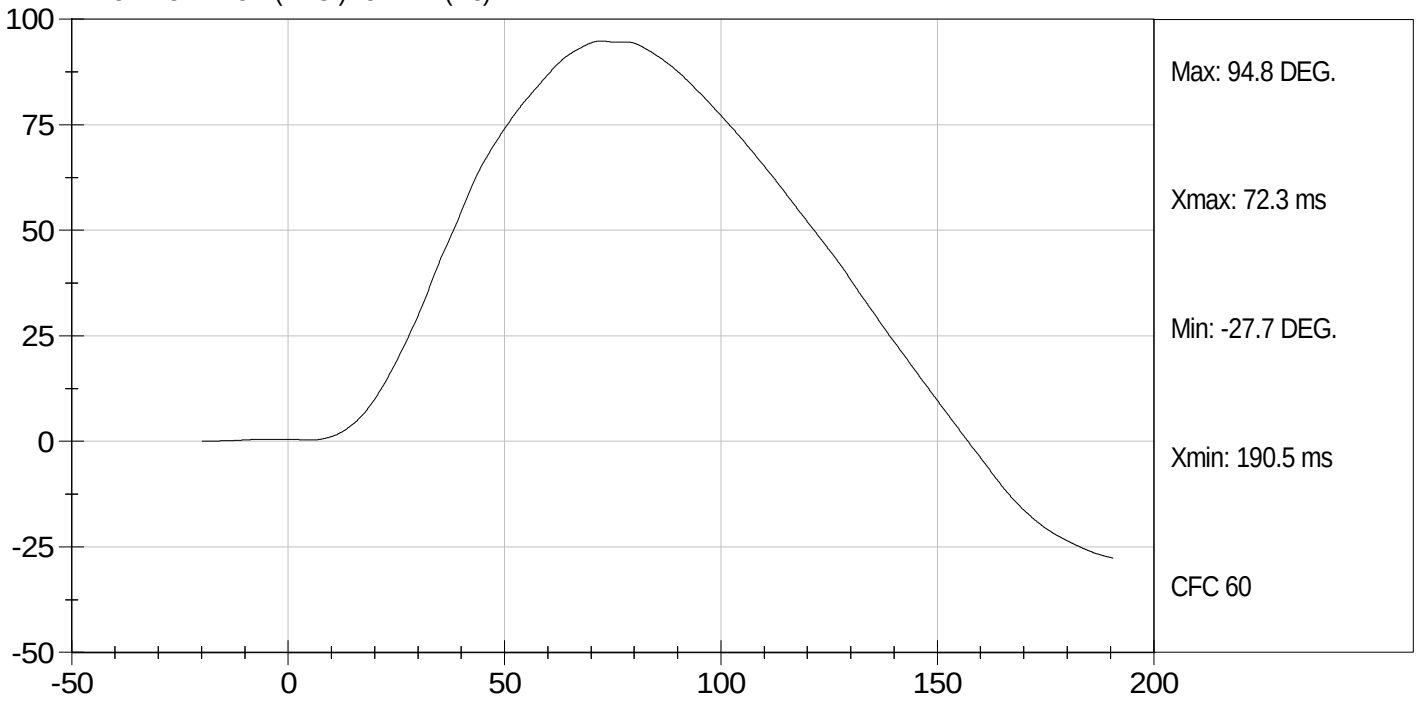
Test Desc: Neck Extension
Component ID: D082223

Test Date: 8/6/08
Velocity: 20.20 ft/s, 6.16 m/s

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

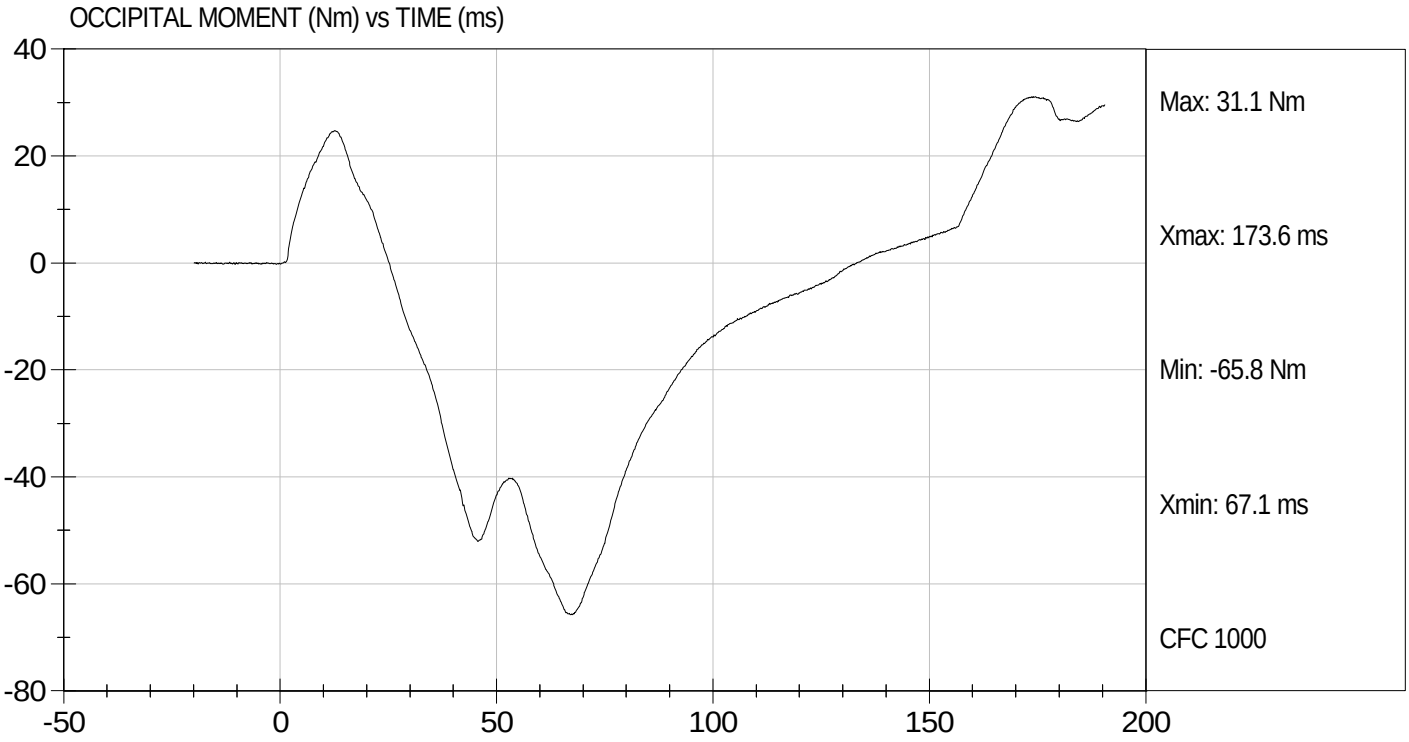


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D082223

Test Date: 8/6/08
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:** D082224

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.2	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	5,426	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.80	Pass
Internal Hysteresis	%	69 to 85	72	Pass
		Overall Test Results		Pass

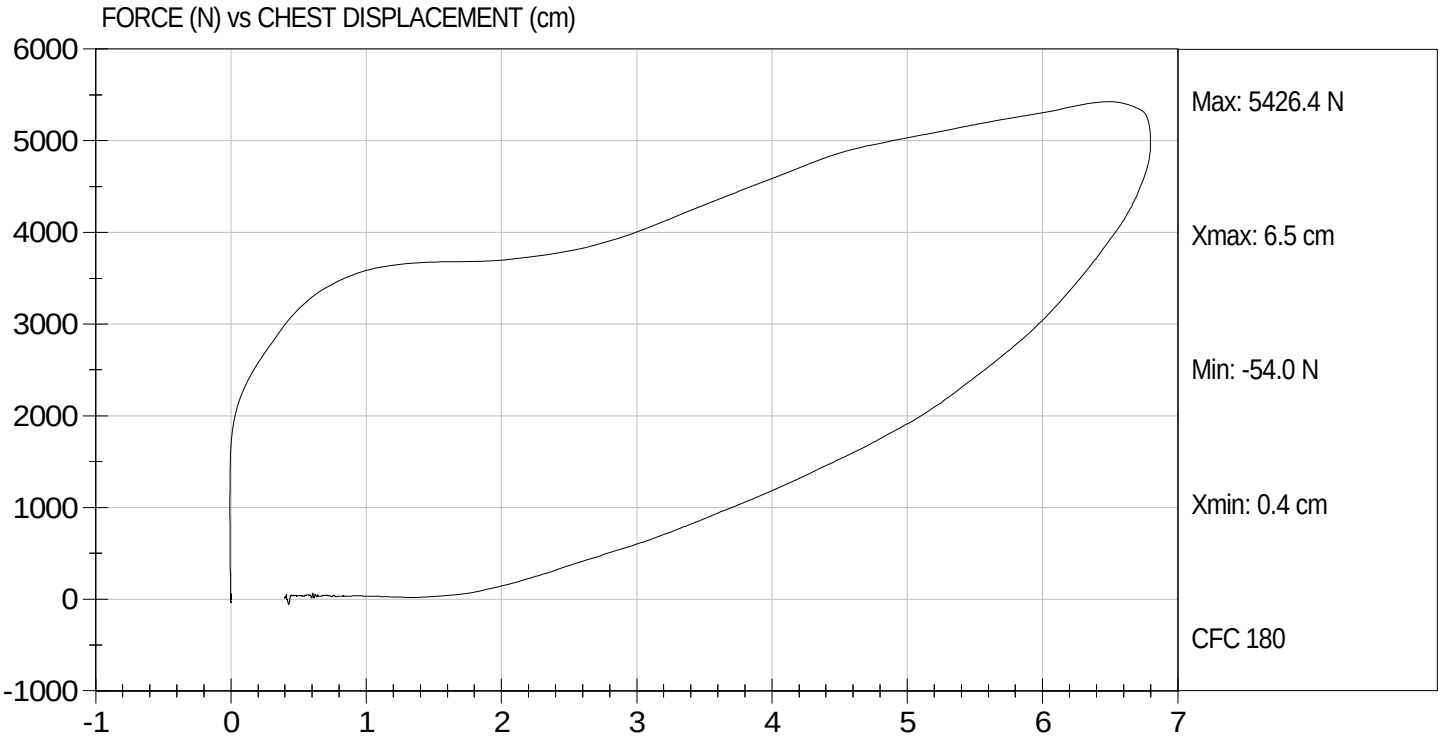
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Thorax Impact
Component ID: D082224

Test Date: 8/7/08
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:** D082225

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	39	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.11	Pass
Peak Probe Force	Newtons	4715 to 5782	5,413	Pass
		Overall Test Results		Pass

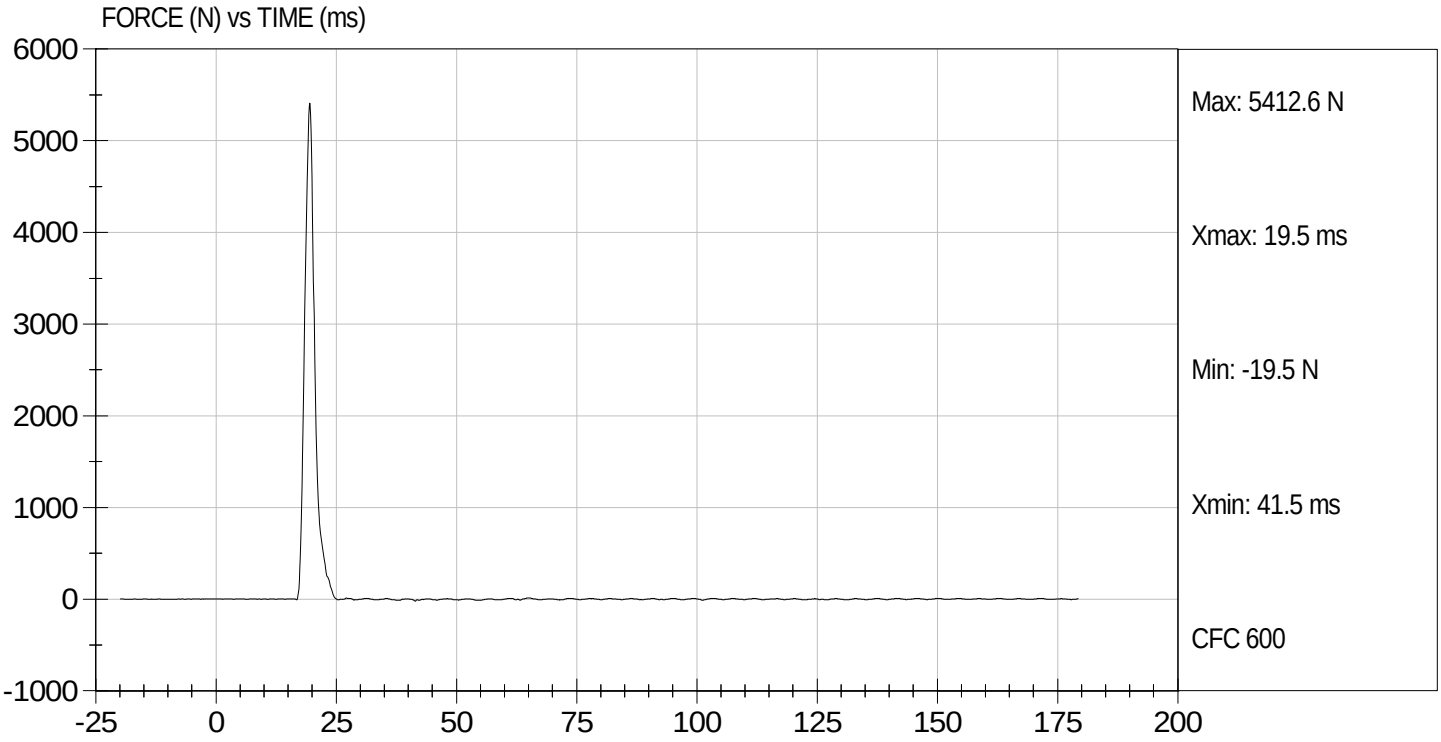
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Right Knee
Component ID: D082225

Test Date: 8/7/08
Velocity: 6.92 ft/s, 2.11 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D082226

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	39	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.09	Pass
Peak Probe Force	Newtons	4715 to 5782	5,667	Pass
		Overall Test Results		Pass

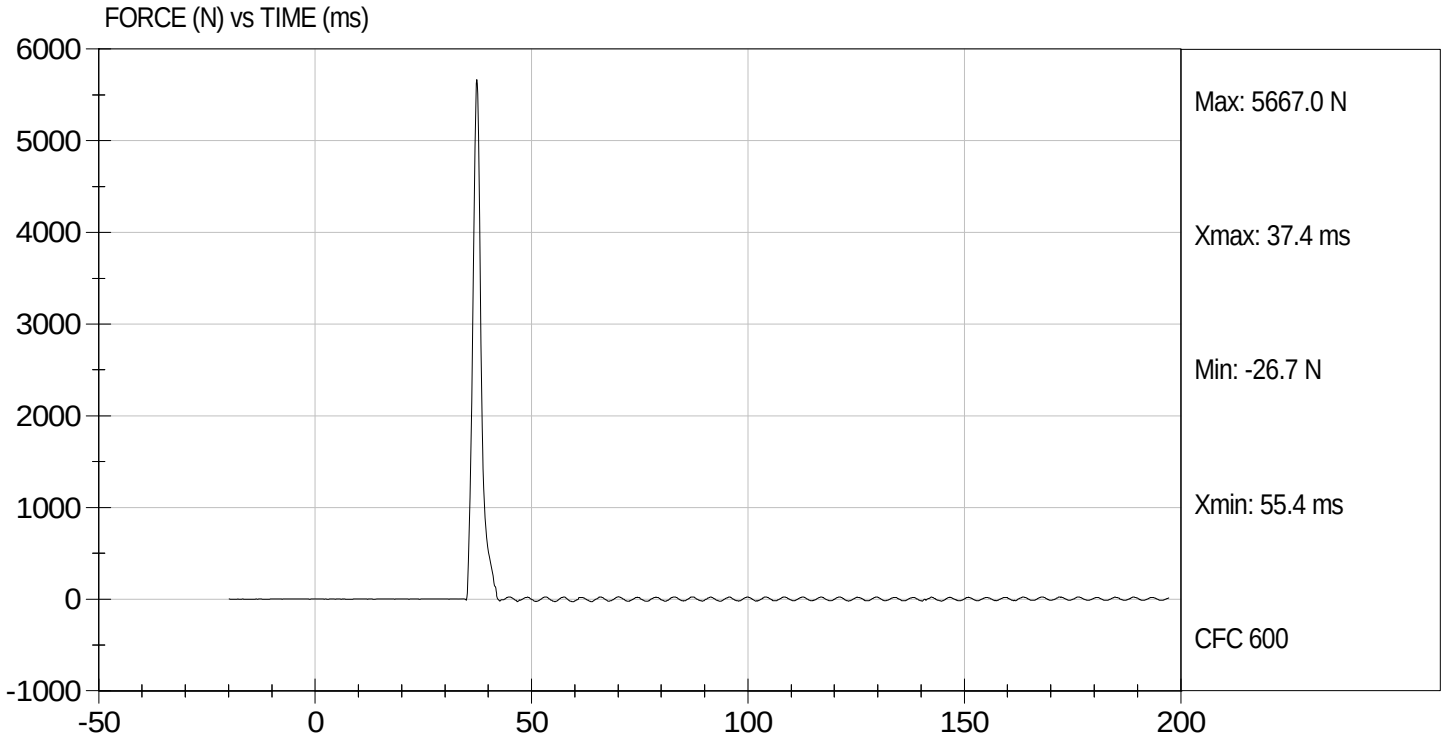
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Left Knee
Component ID: D082226

Test Date: 8/7/08
Velocity: 6.86 ft/s, 2.09 m/s



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D082220

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	38	38	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	56.4	54.6	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	44	43	Pass
		Overall Test Results			Pass

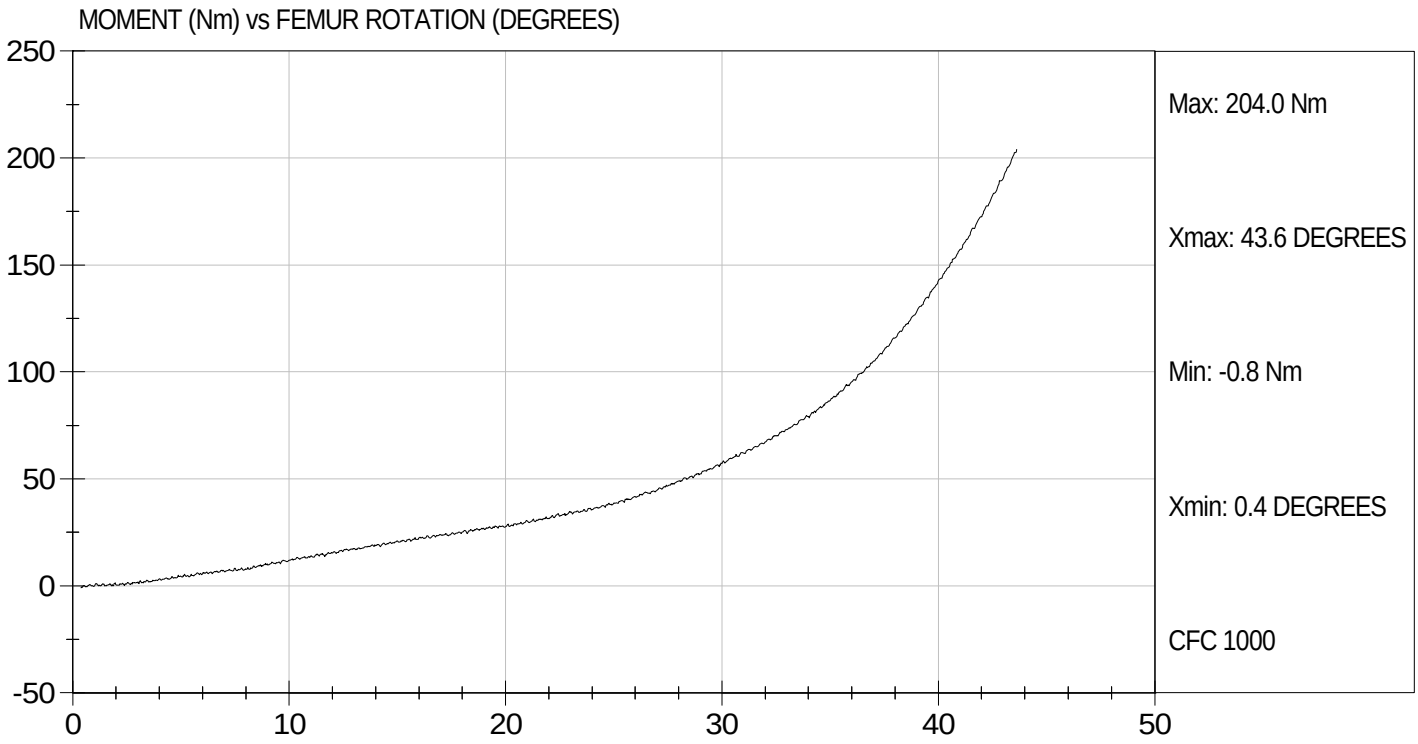
Laboratory Technician

8/7/08
Test Date

Approved By

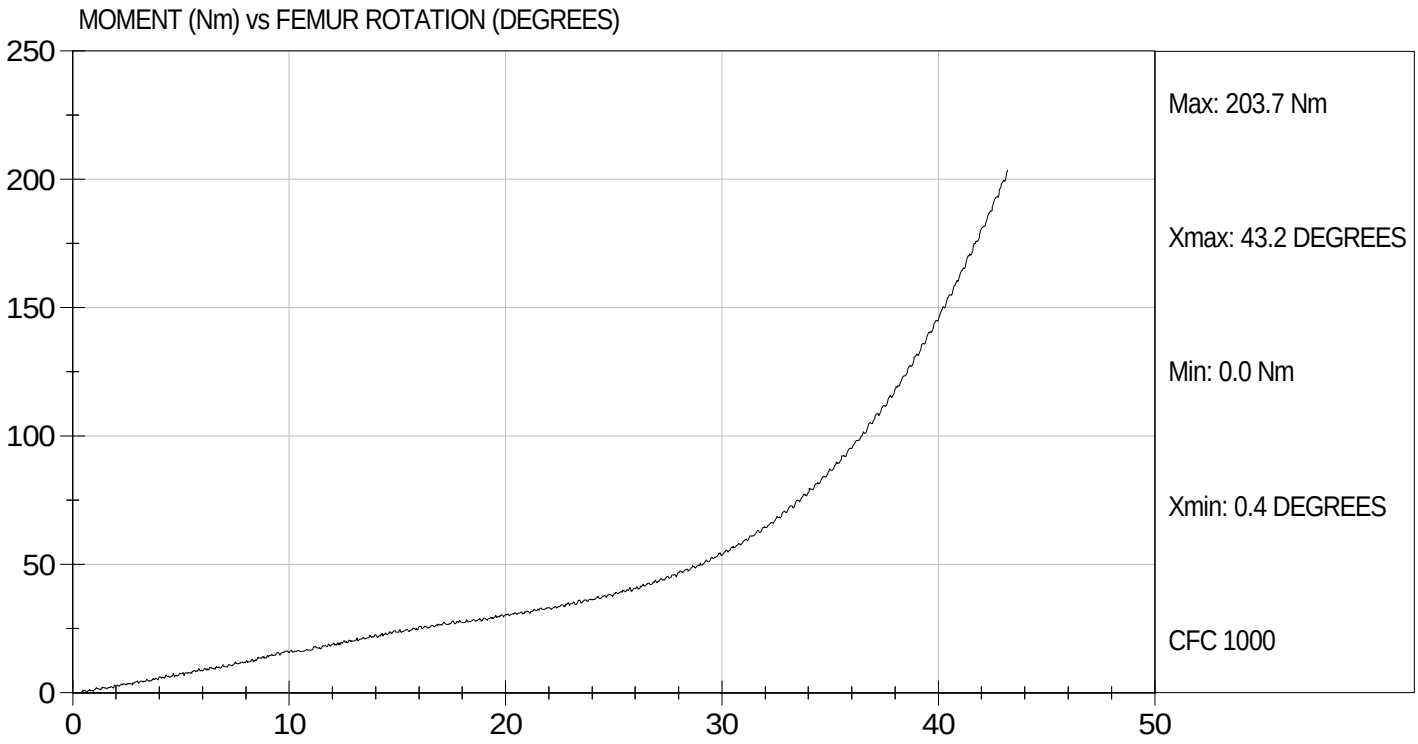
Test Desc: Hip Femur Flexion
Component ID: D082229

Test Date: 8/7/08
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D082220

Test Date: 8/7/08
Velocity: 0 ft/s, 0.00 m/s



MGA RESEARCH CORPORATION

HEAD DROP TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test ID:** D082231

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	39	Pass
Peak Resultant Acceleration	G's	225 - 275	237	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

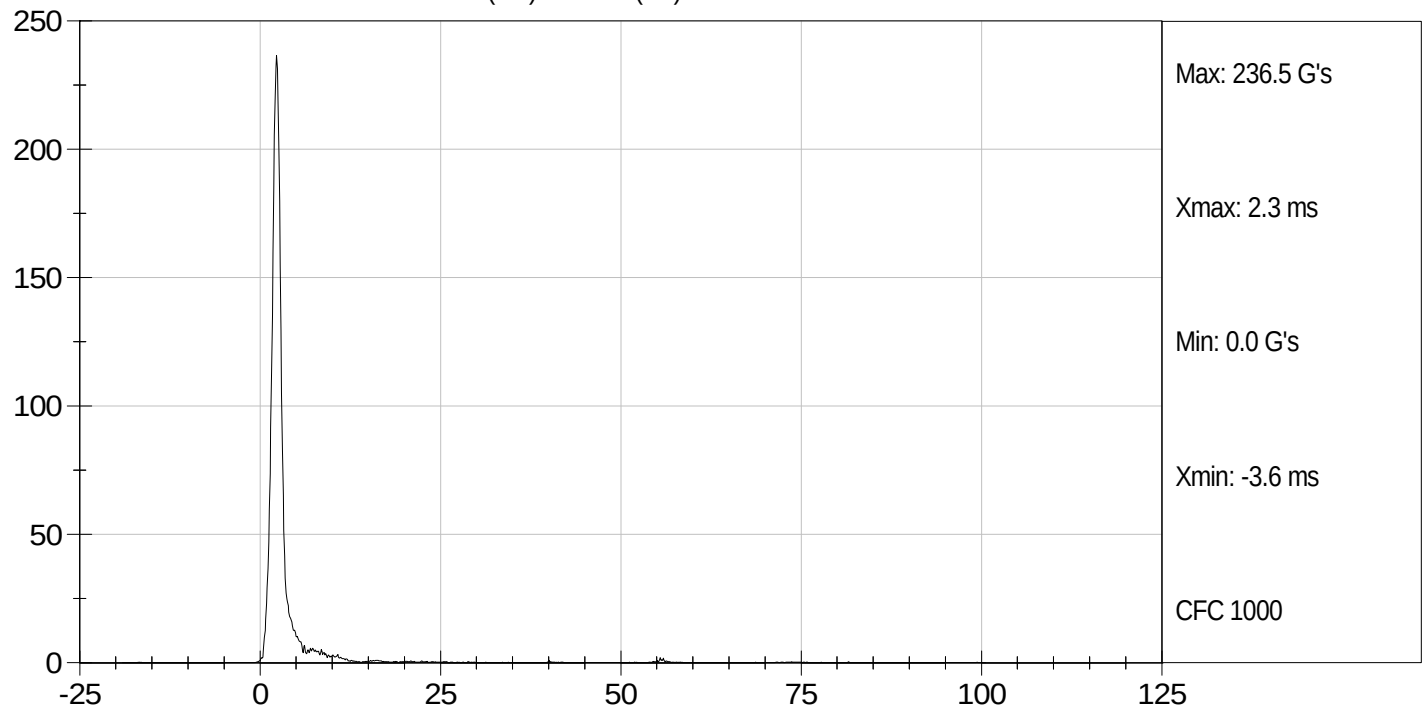
8/6/08
Test Date

Approved By

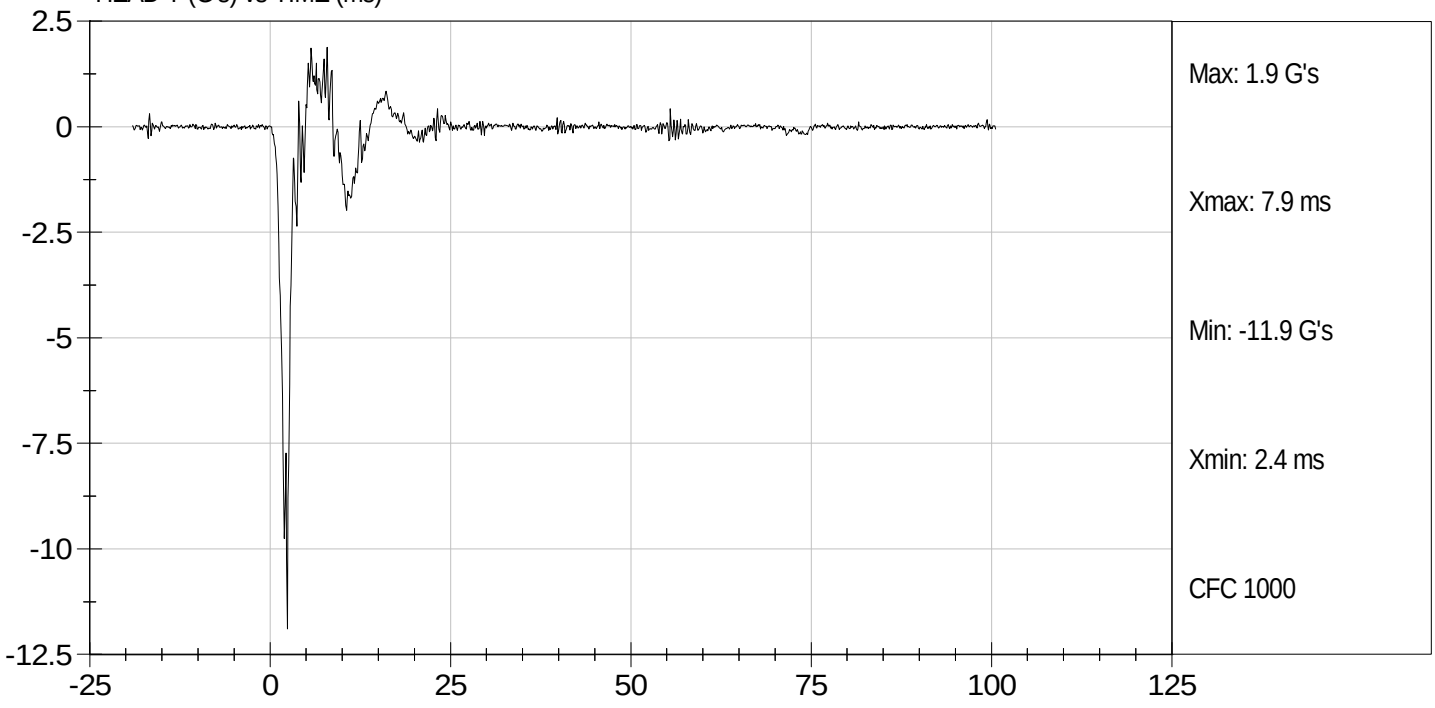
Test Desc: Head Drop
Component ID: D082231

Test Date: 8/6/08
Velocity: 0 ft/s, 0.00 m/s

HEAD RESULTANT 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:** D082232

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	36	Pass
Pendulum Velocity		m/s	6.89 to 7.13	6.96	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	26.25	Pass
	20 msec	G's	17.60 to 22.60	20.69	Pass
	30 msec	G's	12.50 to 18.50	17.23	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	17.28	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	34.7	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	70.9	Pass
	Time	msec	57.0 to 64.0	62.8	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	113.0	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	106.6	Pass
	Time	msec	47.0 to 58.0	47.3	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	102.6	Pass
			Overall Test Results		Pass

Laboratory Technician

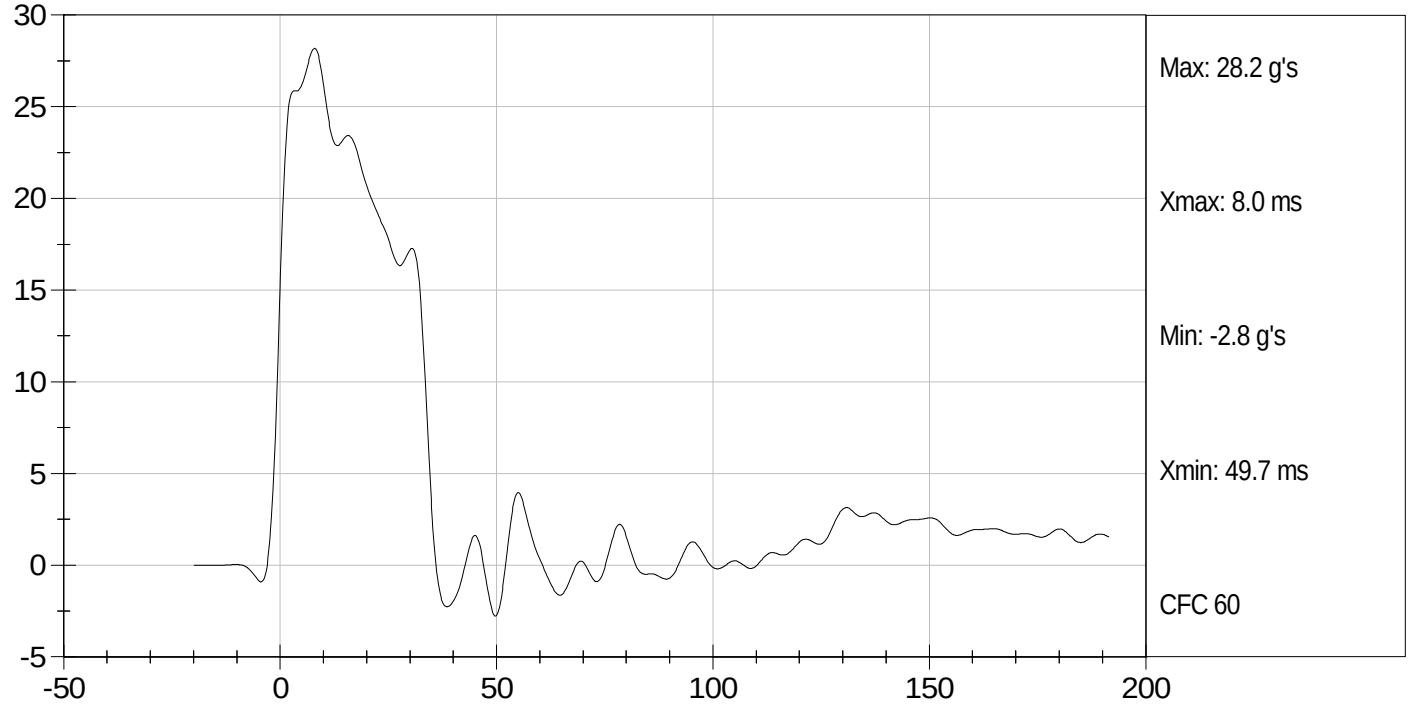
8/6/08
Test Date

Approved By

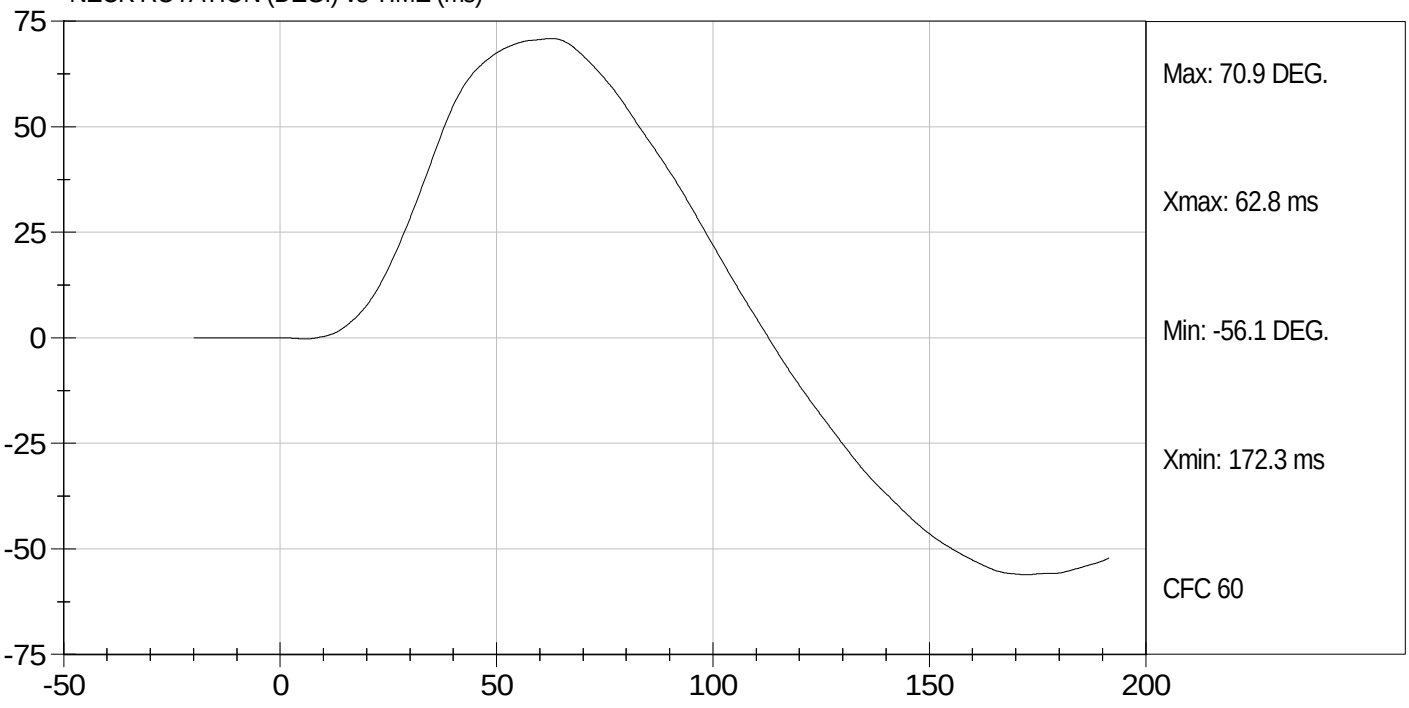
Test Desc: Neck Flexion
Component ID: D082232

Test Date: 8/6/08
Velocity: 22.83 ft/s, 6.96 m/s

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

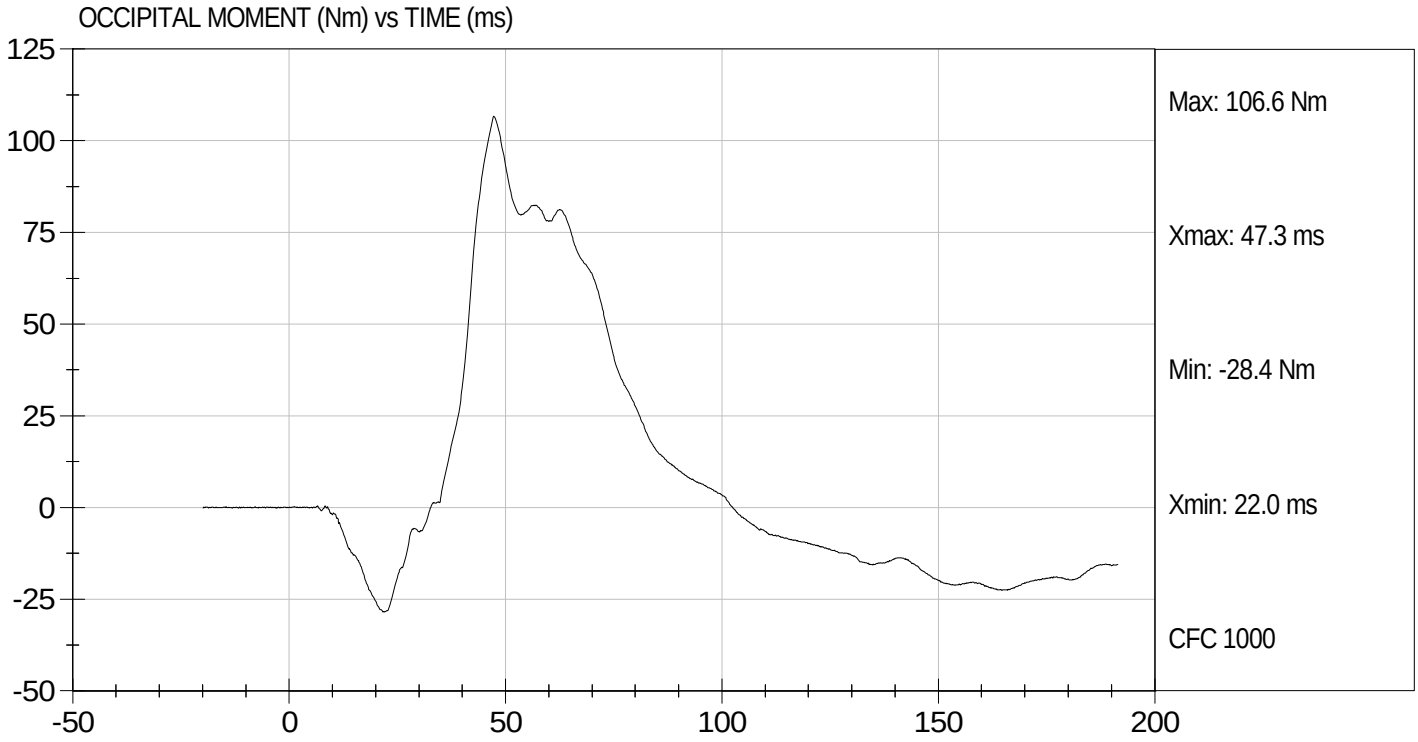


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D082232

Test Date: 8/6/08
Velocity: 22.83 ft/s, 6.96 m/s



MGA RESEARCH CORPORATION

NECK EXTENSION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D082233

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	36	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.16	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	20.41	Pass
	20 msec	G's	14.00 to 19.00	17.83	Pass
	30 msec	G's	11.00 to 16.00	14.81	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	15.72	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.0	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	98.3	Pass
	Time	msec	72.0 to 82.0	72.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	150.3	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-68.3	Pass
	Time	msec	65.0 to 79.0	68.7	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	139.0	Pass
			Overall Test Results		Pass

Laboratory Technician

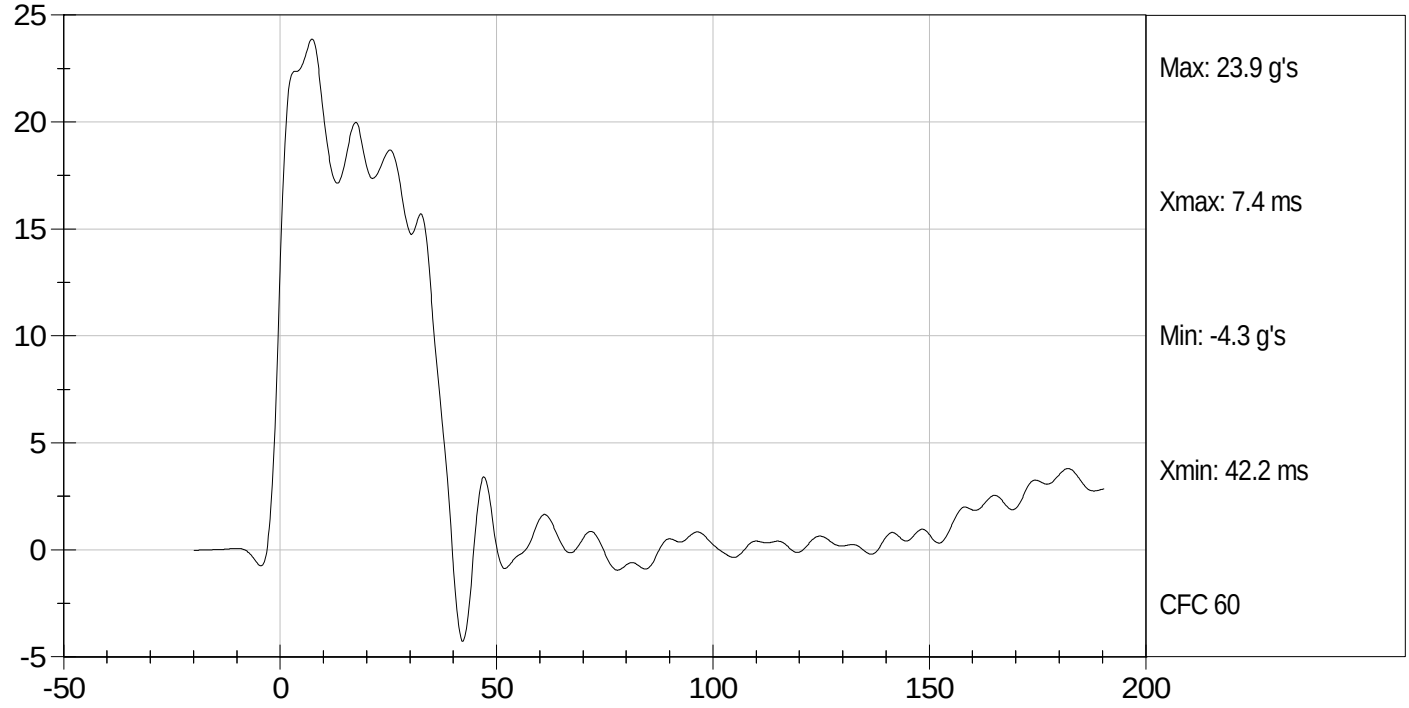
8/7/08
Test Date

Approved By

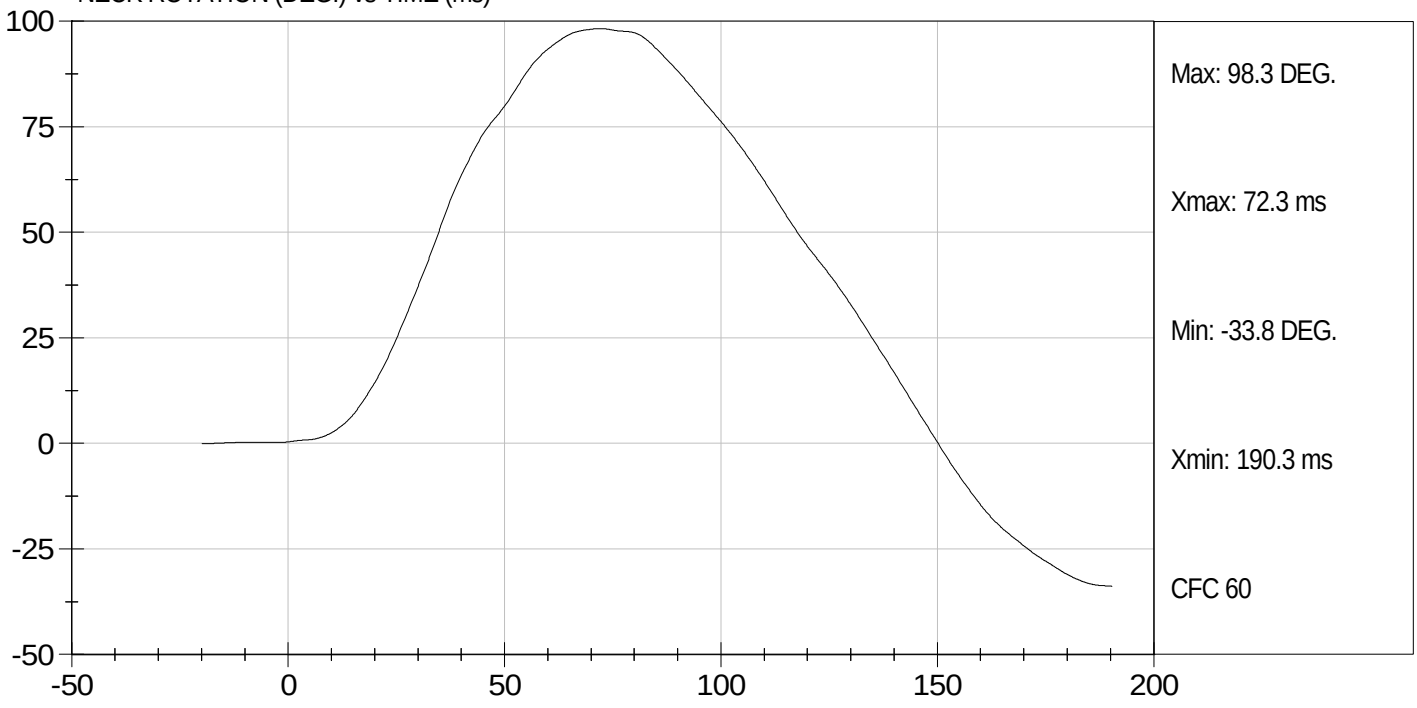
Test Desc: Neck Extension
Component ID: D082233

Test Date: 8/7/08
Velocity: 20.20 ft/s, 6.16 m/s

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

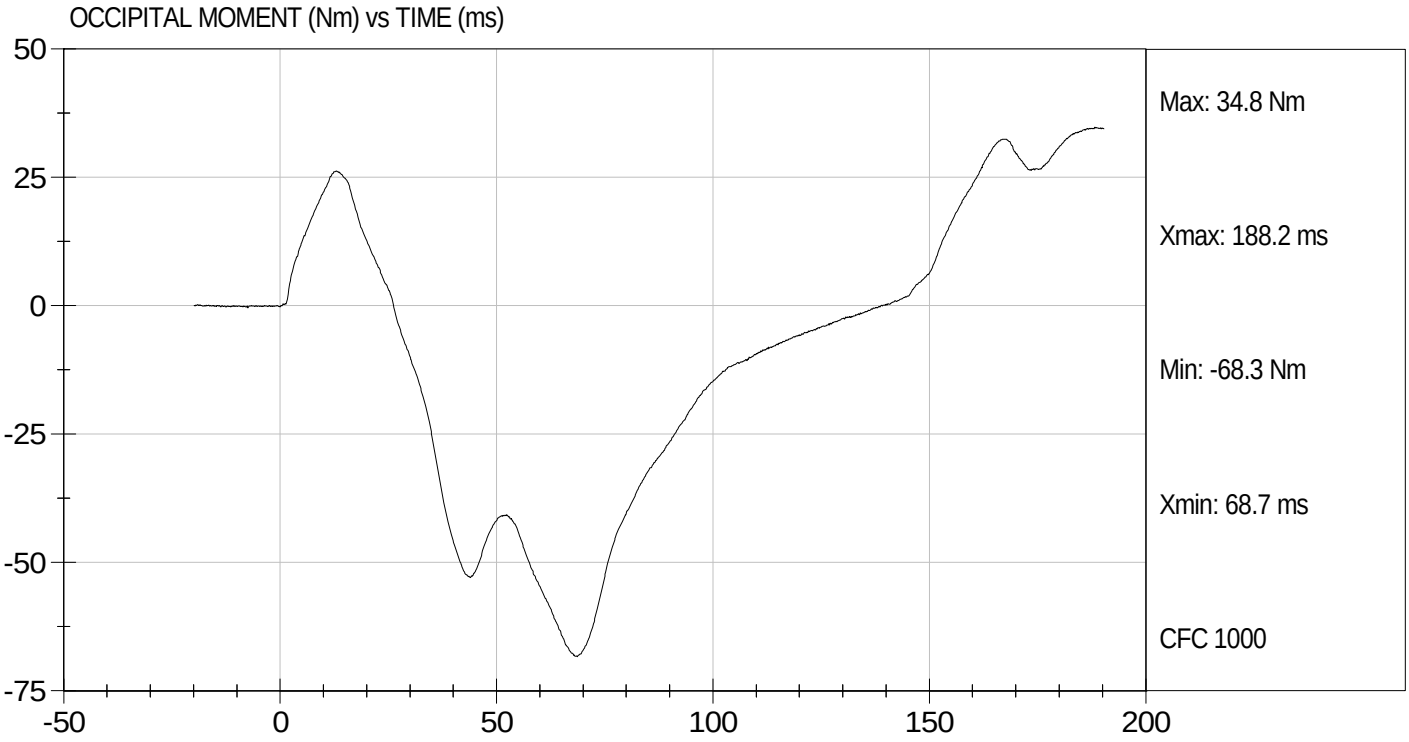


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D082233

Test Date: 8/7/08
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:** D082234

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	38	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,524	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.41	Pass
Internal Hysteresis	%	69 to 85	72	Pass
		Overall Test Results		Pass

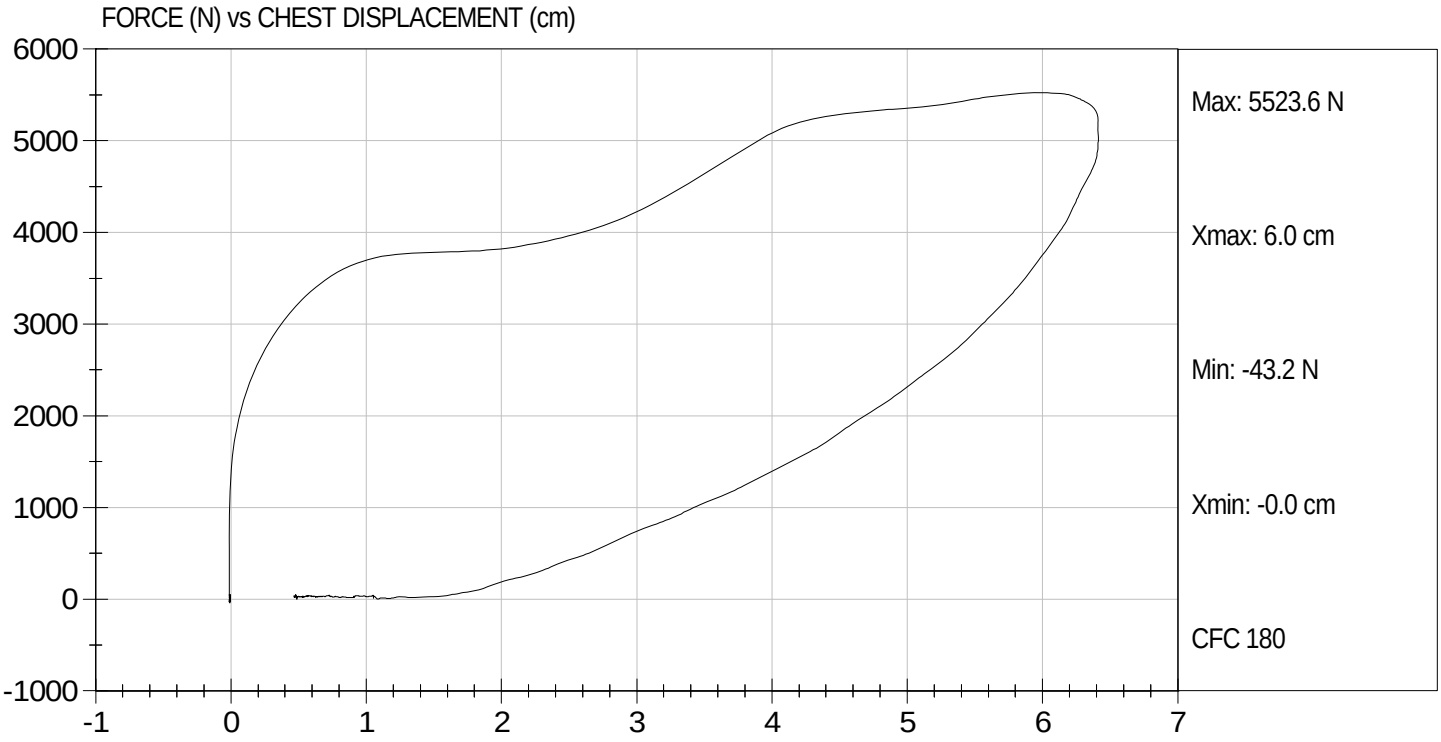
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Thorax Impact
Component ID: D082234

Test Date: 8/7/08
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:** D082235

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	39	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.09	Pass
Peak Probe Force	Newtons	4715 to 5782	5,099	Pass
		Overall Test Results		Pass

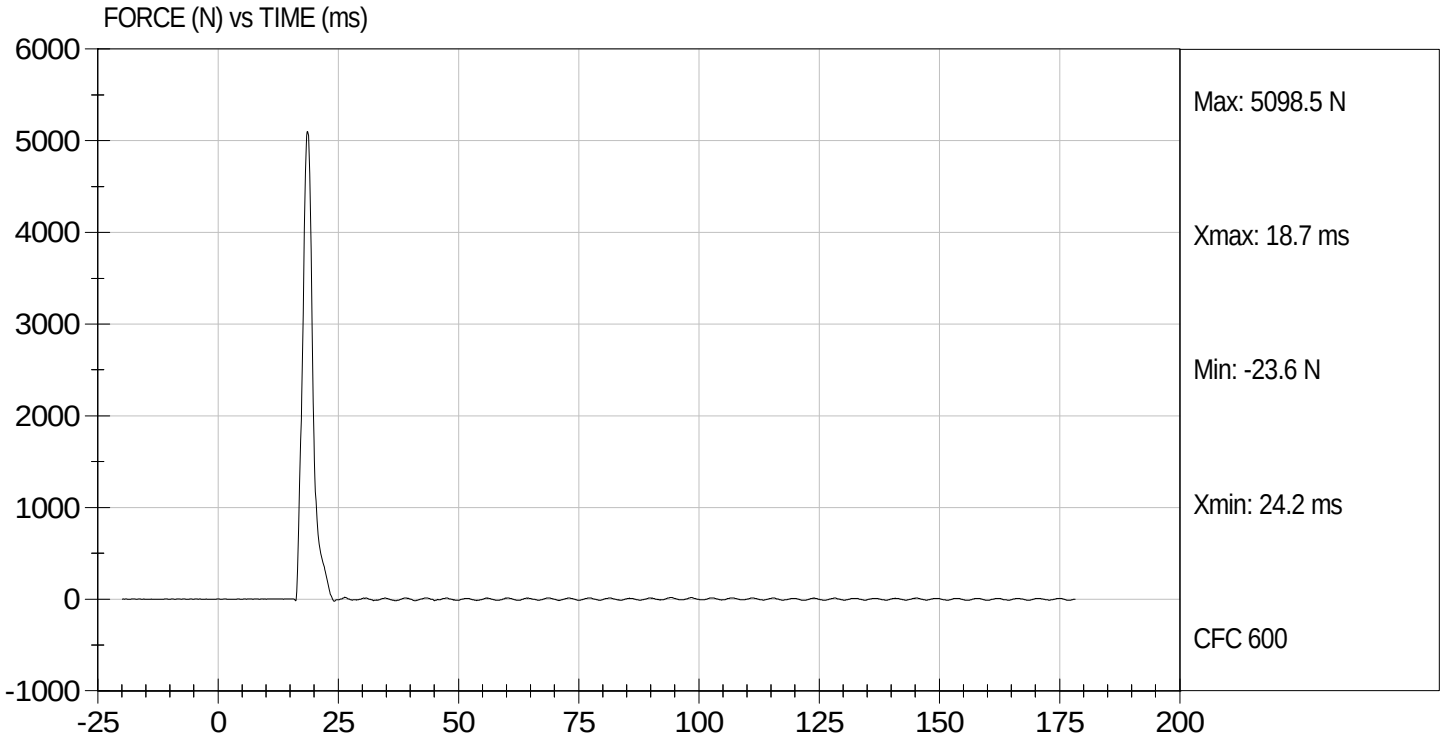
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Right Knee
Component ID: D082235

Test Date: 8/7/08
Velocity: 6.86 ft/s, 2.09 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D082236

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	38	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.10	Pass
Peak Probe Force	Newtons	4715 to 5782	4,908	Pass
		Overall Test Results		Pass

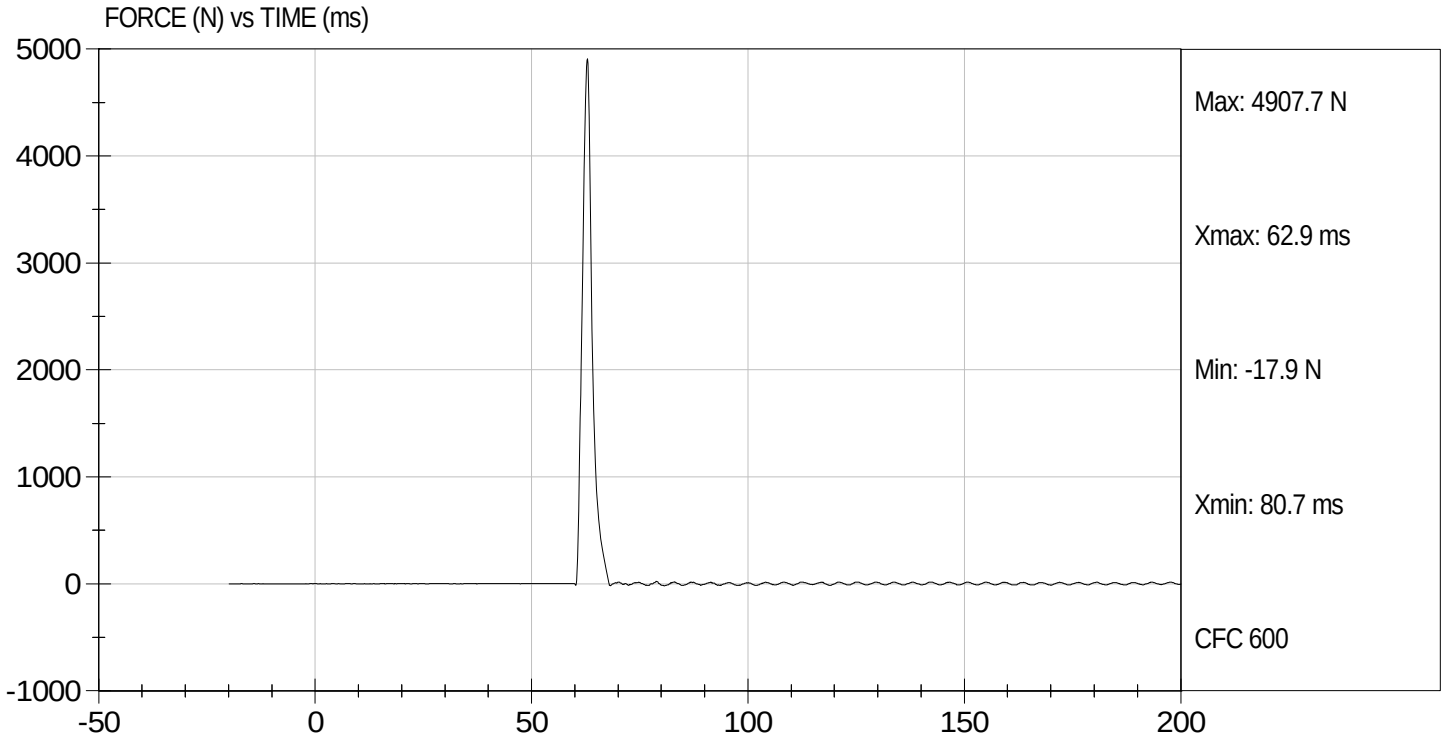
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Left Knee
Component ID: D082236

Test Date: 8/7/08
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:** D082230

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	38	38	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	83.5	84.9	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	40	41	Pass
		Overall Test Results			Pass

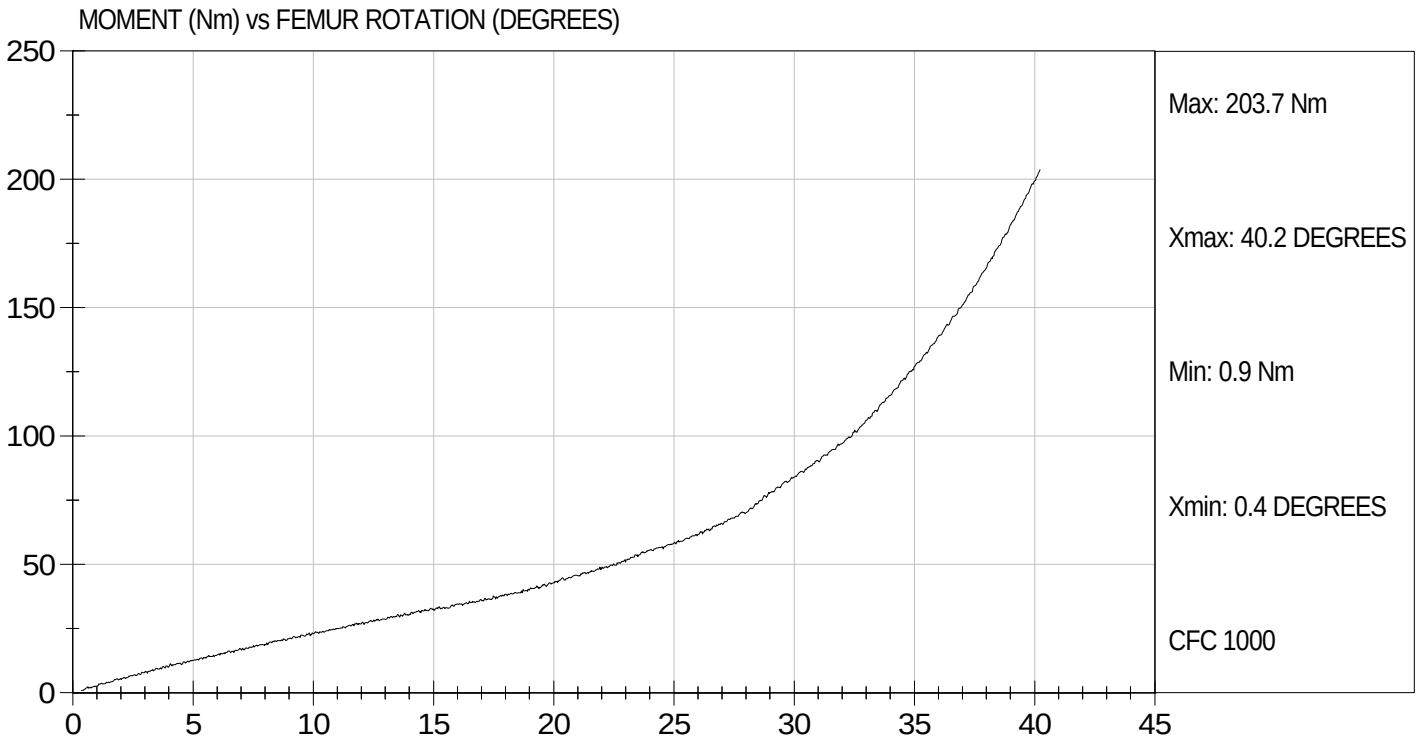
Laboratory Technician

8/7/08
Test Date

Approved By

Test Desc: Hip Femur Flexion
Component ID: D082239

Test Date: 8/7/08
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D082230

Test Date: 8/7/08
Velocity: 0 ft/s, 0.00 m/s