REPORT NUMBER: NCAP-MGA-2008-016

NEW CAR ASSESSMENT PROGRAM
FRONTAL BARRIER IMPACT TEST

FUJI HEAVY INDUSTRIES LTD.
2009 SUBARU FORESTER
NHTSA NUMBER: M95500

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

Test Date: April 14, 2008

Final Report Date: May 6, 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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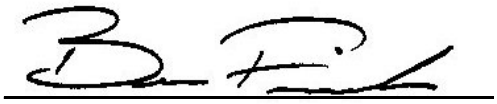
Prepared by:  Date: 5/06/08
Ben Fischer, Project Engineer

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Technical Report Documentation Page

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15. Supplementary Notes			

16. Abstract

A frontal barrier impact was conducted on a 2009 Subaru Forester at MGA Research Corporation on April 14, 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 56.3 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 576 mm located to the right of 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	356	261
Max. Thorax Accel. (3ms Clip)	G's	60	37	42
Left Femur Force	Newton	10009	-3436	-1632
Right Femur Force	Newton	10009	-3035	-1895

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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 Subaru Forester at a velocity of 56.3 kph. The test was performed at MGA Research Corporation on April 14, 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. 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 576 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. 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	356	57.7	93.7	37	71.3	74.3	-19	-3436	-3035
Passenger	261	59.5	95.5	42	70.0	73.0	-23	-1632	-1895

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

TEST NOTES

There was no valid data collected for:
Top of Engine X after 30 msec.

Hood was unlatched after impact.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1

CRASH TEST SUMMARY

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact
NHTSA No.: M95500
Test Date: 4/14/2008

DOOR OPENING AND SEAT TRACK INFORMATION

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

VEHICLE REBOUND FROM BARRIER

Measured Parameter	Units	Value
Left Side	mm	521
Center	mm	406
Right Side	mm	502
Average	mm	476

BELT LENGTH DATA

Measurement Description	Units	Driver	Passenger
Shoulder belt length as measured on ATD	mm	810	840
Lap belt length as measured on ATD	mm	755	795
Remainder of belt on reel	mm	1820	1777
Total belt length for continuous webbing systems	mm	3385	3412

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008

TEST VEHICLE INFORMATION

Manufacturer	Subaru
Model	Forester
Body Style	MPV
NHTSA No.	M95500
VIN	JF2SH61619H703050
Color	Newport Blue Pearl
Delivery Date	3/28/08
Odometer Reading (mile)	74
Dealer	Don Jacobs Subaru
Transmission	Automatic
Final Drive	AWD
Number of Cylinders	4
Engine Displacement (L)	2.5
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
Rear Passenger Side Curtain Airbag	Yes
Rear Passenger Side Torso Airbag	No
Force Limiter	Yes
Pretensioner	Yes
Power Steering	Yes
Power Door Locks	Yes
Tilt Wheel	Yes
Air Conditioning	Yes
Anti-lock Brakes	Yes
Traction Control	Yes
All Wheel Drive	Yes
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Fuji Heavy Industries Ltd.
Date of Manufacture	1/08

GVWR (kg)	2035
GAWR Front (kg)	1050
GAWR Rear (kg)	1095

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				408
Cargo Wt. (RCLW) (kg)				68

DATA SHEET NO. 2... (CONTINUED)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW) (Axle)			As Tested (ATW) (Axle)		
		Front	Rear	Total	Front	Rear	Total
Left	kg	416.9	340.2		450.0	416.9	
Right	kg	409.1	325.2		442.2	398.7	
Ratio	%	55.4	44.6		52.2	47.8	
Totals	kg	826.0	665.4	1491.4	892.2	815.6	1707.8

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value
Total Delivered Weight (UVW)	kg	1491.4
Weight of 2 P572E ATDs	kg	156.0
Rated Cargo/Luggage Weight (RCLW)	kg	68
Calculated Vehicle Target Weight (TVTW)	kg	1715.4

TEST VEHICLE ATTITUDES AND CG

	Units	LF	RF	LR	RR	CG (aft of front axle)
As Delivered	mm	788	788	785	794	1164
As Tested	mm	759	761	738	740	1246
Post Test	mm	835	771	728	713	

Vehicle Wheelbase (mm): 2610
Weight of Ballast secured in cargo area (kg): 31.1

Vehicle Components Removed: Right rear tail light, spare tire, cargo net and foam, rear floor mats

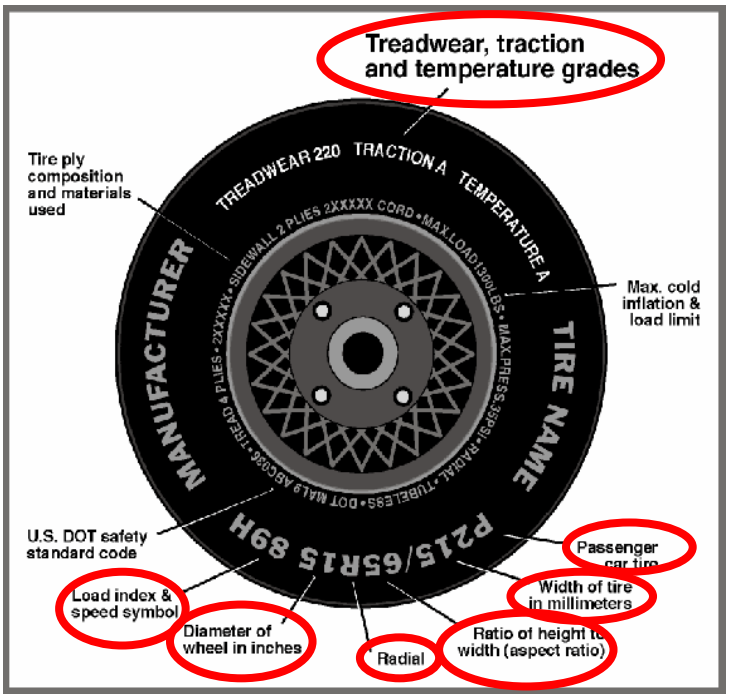
Ballast weight does not include instrumentation and data acquisition system.

DATA SHEET NO. 3

TEST VEHICLE TIRE INFORMATION

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008



DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	210	210
Recommended Tire Size	P215/65/R16	P215/65/R16
Tire Size on Vehicle	P215/65/R16	P215/65/R16
Tire Manufacturer	Bridgestone	Bridgestone
Tire Name	Dueler H/T	Dueler H/T
Tire Type	Passenger	Passenger
Tire Width (mm)	215	215
Ratio of Height to Width (aspect ratio)	65	65
Radial	R	R
Wheel Diameter	16	16
Load Index & Speed Symbol	96H	96H
Treadwear	300	300
Traction Grade	B	B
Temperature Grade	A	A

DATA SHEET NO. 4

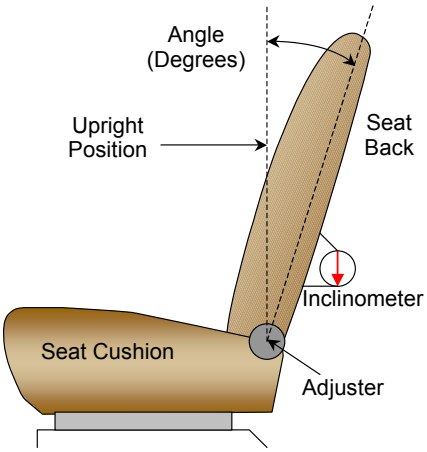
TEST VEHICLE INFORMATION

Test Vehicle: 2009 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008

NORMAL DESIGN RIDING POSITION

The driver and passenger seat back is positioned to the manufacturer's designated angle. The procedure is as follows: Set the driver and right front passenger seat back angles at the 6th detent out of 41 detents total with forward-most detent defined as 0.

Driver seat back angle: 6th detent (forward-most as 0)
Passenger seat back angle: 6th detent (forward-most as 0)



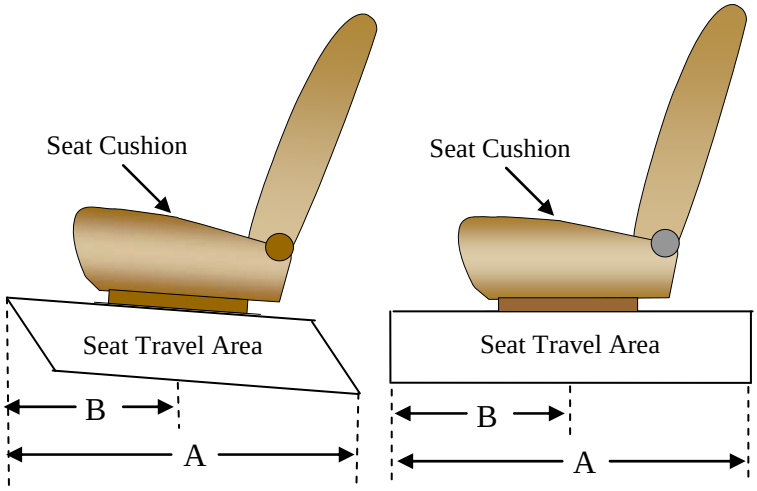
FRONT SEAT ASSEMBLY

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Driver Seat	19 detents	8th detent
Passenger Seat	20 detents	10th detent

ADJUSTABLE D-RING POSITION

The driver and passenger D-rings were set at the 1st notch with the upper-most detent defined as 0.



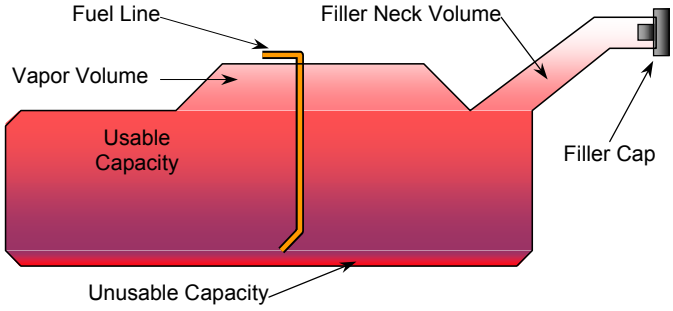
DATA SHEET NO. 4…(CONTINUED)
TEST VEHICLE INFORMATION

Test Vehicle: 2009 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008

FUEL TANK CAPACITY

	Liters
Usable Capacity of "Standard Tank"	64.0
Usable Capacity of "Optional" Tank	
92-94% of Usable Capacity	58.9 to 60.1
Actual Amount of Solvent used	59.1
1/3 of Usable Capacity	21.3

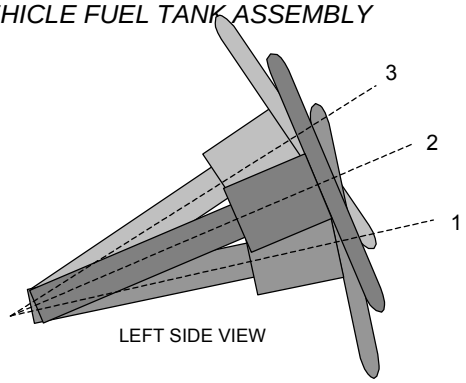
The test vehicle is equipped with an electric fuel pump. Pump operates a few seconds after an ignition switch is turned ON. After that, the pump operates only while engine is running.



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		62.2
Geometric center position No. 2		63.7
Uppermost position No. 3		65.2

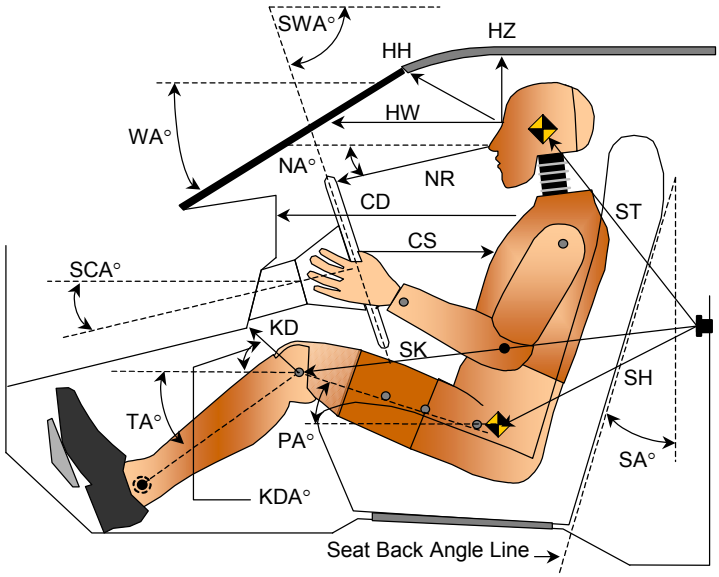
DATA SHEET NO. 5

DUMMY POSITIONING IN VEHICLE

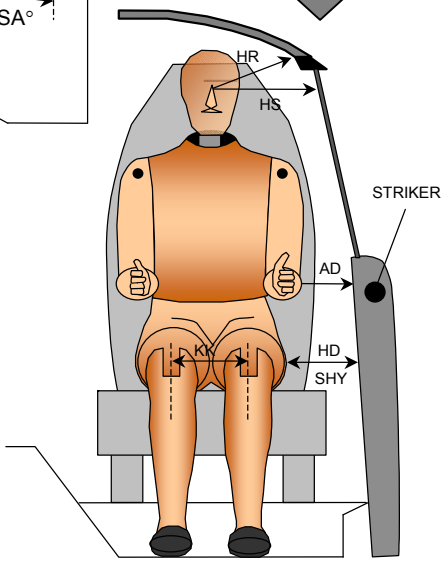
Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008

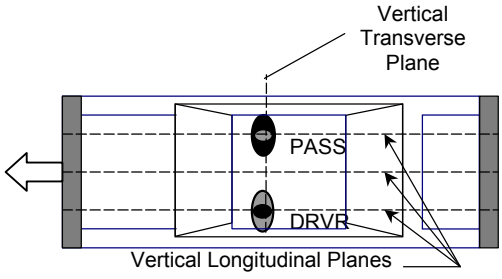
DUMMY MEASUREMENTS FOR FRONT SEAT OCCUPANTS



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 Subaru Forester
Test Program: 35mph Frontal Impact
NHTSA No.: M95500
Test Date: 4/14/2008

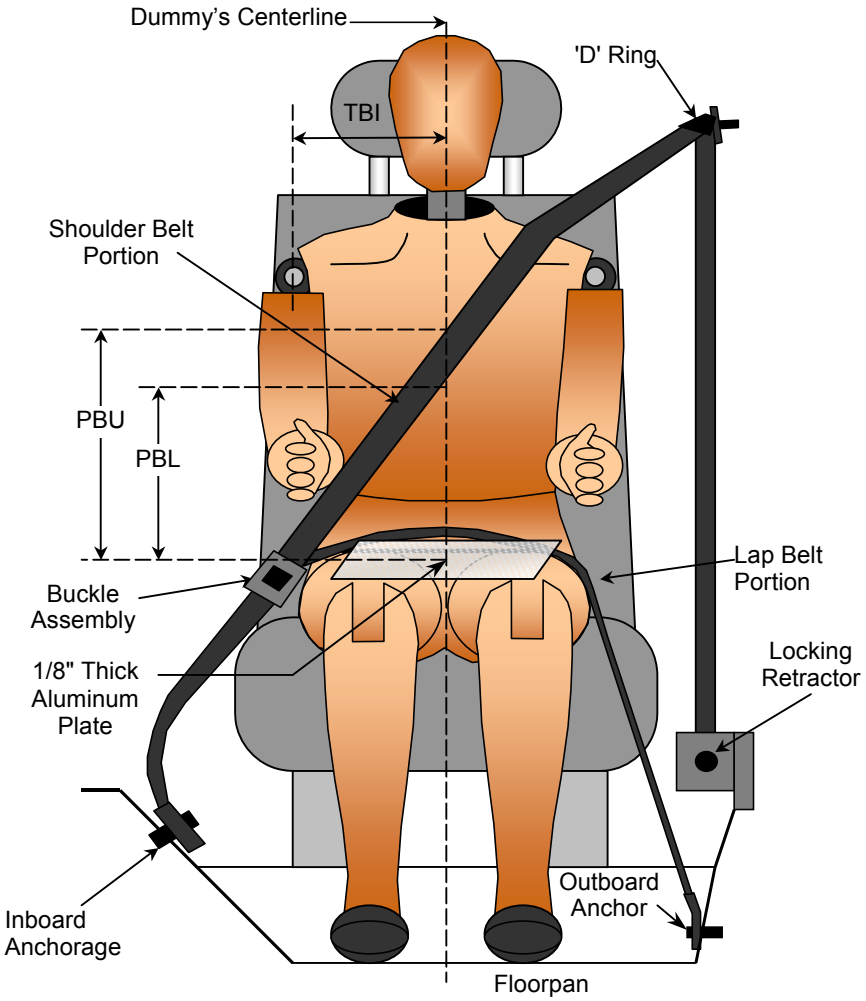
TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Driver		Passenger	
		Length (mm)	Angle (°)	Length (mm)	Angle (°)
WA	Windshield Angle		34.4		
SWA	Steering Wheel Angle		63.7		
SCA	Steering Column Angle		24.6		
SA	Seat Back Angle		7.9		8.4
HZ	Head to Roof (Z)	248	90	250	90
HH	Head to Header	375	25.6	411	31.7
HW	Head to Windshield	651	0	656	0
HR	Head to Side Header (Y)	263		255	
NR	Nose to Rim	408	10.4		
CD	Chest to Dash	517		532	
CS	Chest to Steering Hub	315	3.2		
RA	Rim to Abdomen	194	0		
KDL	Left Knee to Dash	154	34.4	160	
KDR	Right Knee to Dash	140		162	21.2
PA	Pelvic Angle		23.8		22.6
TA	Tibia Angle		43.6		45.6
KK	Knee to Knee (Y)	325		272	
SK	Striker to Knee	570	95.5	578	94.2
ST	Striker to Head	496	11.1	471	8.6
SH	Striker to H-Point	240	132.4	257	130.0
SHY	Striker to H-Point (Y)	246		251	
HS	Head to Side Window	352		355	
HD	H-Point to Door (Y)	146		132	
AD	Arm to Door (Y)	131		132	
AA	Ankle to Ankle	308		215	

DATA SHEET NO. 6

SEAT BELT POSITIONING DATA

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact
NHTSA No.: M95500
Test Date: 4/14/2008



SEAT BELT POSITIONING MEASUREMENTS

Measurement Description	Units	Driver	Passenger
PBU - Top surface of reference to belt upper edge	mm	340	340
PBL - To surface of reference to belt lower edge	mm	280	280

DATA SHEET NO. 7

VEHICLE ACCELEROMETER LOCATIONS

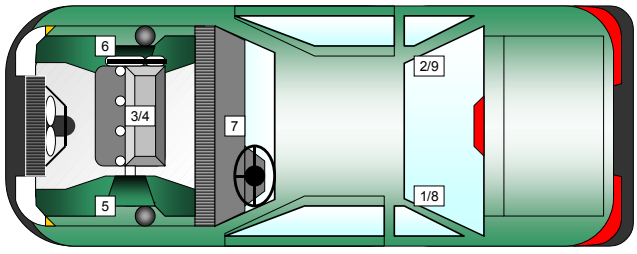
Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

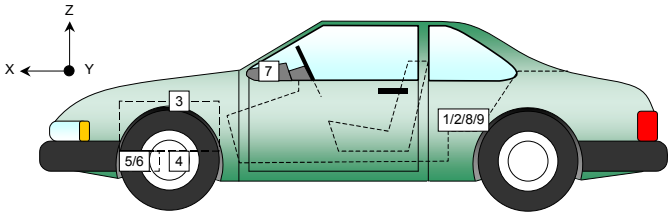
NHTSA No.: M95500
Test Date: 4/14/2008

VEHICLE ACCELEROMETER PRE-TEST LOCATIONS

No.	Accelerometer Location	Measurements (mm)		
		X	Y	Z
1	Left Rear X-Member X	1768	-370	425
2	Right Rear X-Member X	1768	364	425
3	Engine Top X	3798	0	914
4	Engine Bottom X	3866	0	266
5	Left Brake Caliper X	3472	-687	250
6	Right Brake Caliper X	3472	687	250
7	Instrument Panel X			
8	Left Rear X-Member Z	1768	-370	425
9	Right Rear X-Member Z	1768	364	425

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 Subaru Forester
Test Program: 35mph Frontal Impact
NHTSA No.: M95500
Test Date: 4/14/2008

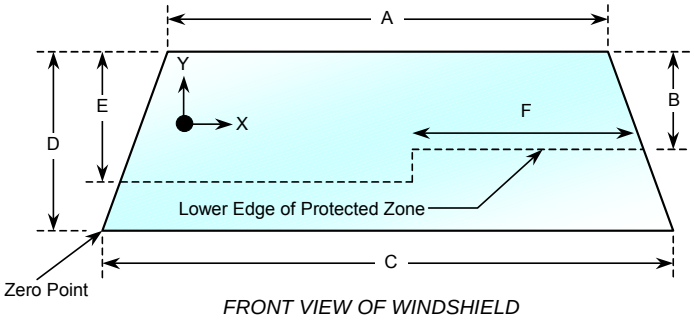
Windshield Mounting Details:
Windshield glass is secured to the vehicle frame with a rubber trim and glue.

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	2104	2104	100
Right Side	2104	2104	100
Total	4208	4208	100



FRONT VIEW OF WINDSHIELD

Item	Units	Value
A	mm	1514
B	mm	500
C	mm	1210
D	mm	742
E	mm	496
F	mm	467

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 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008

FMVSS 301 FUEL SYSTEM INTEGRITY POST IMPACT DATA

Temperature at Time of Impact: 21° C Test Time: 10:45 am

Stoddard Solvent Spillage Measurements

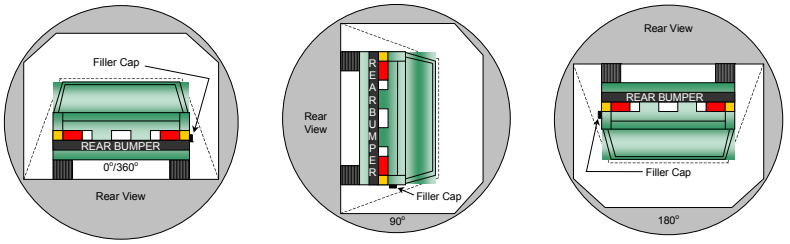
A. From impact until vehicle motion ceases: 0 oz.
(Maximum Allowable = 1 ounce)

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

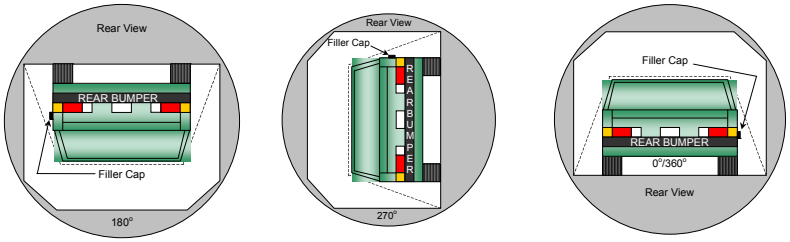
C. For the following 25 minutes: 0 oz.
(Maximum Allowable = 1 oz. /minute)

D. Spillage: None

FMVSS 301 STATIC ROLLOVER DATA



0° to 90° 90° to 180°



180° to 270° 270° to 360°

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

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

3. Details of Stoddard Solvent spillage locations:

None

Test Phase	Rotation Time (sec.)	Hold Time (sec.)	Spillage (oz.)
0° to 90°	120	300	0
90° to 180°	113	300	0
180° to 270°	111	300	0
270° to 360°	118	300	0

DATA SHEET NO. 10

VEHICLE MEASUREMENTS

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

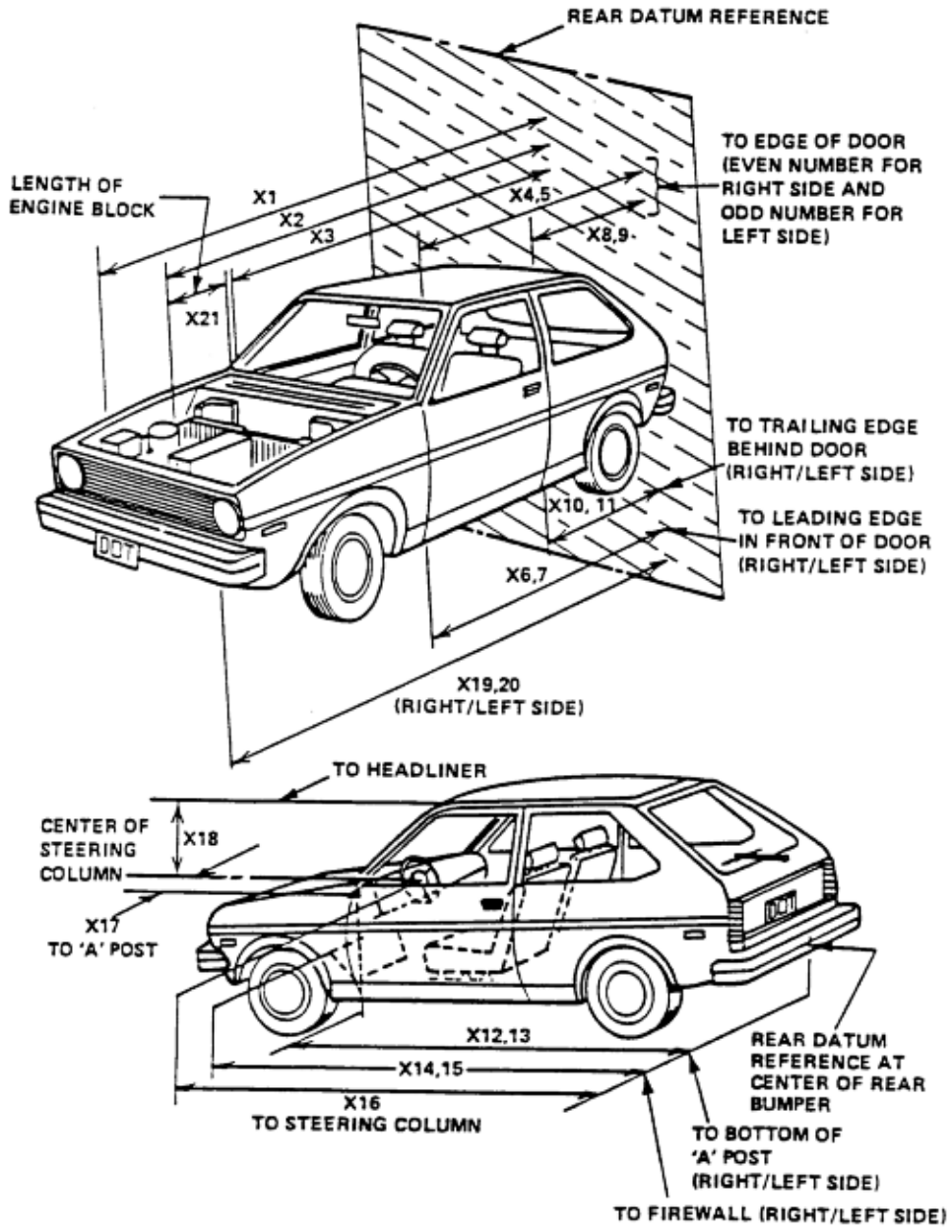
NHTSA No.: M95500
Test Date: 4/14/2008

No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
1	Total length of vehicle at centerline	mm	4530	3994	536
2	RSOV to front of engine	mm	3869	3609	260
3	RSOV to firewall centerline	mm	3471	3332	139
4	RSOV to leading edge of right door	mm	3046	3048	-2
5	RSOV to leading edge of left door	mm	3041	3044	-3
6	RSOV to lower leading edge of right door	mm	3078	3070	8
7	RSOV to lower leading edge of left door	mm	3068	3070	-2
8	RSOV to upper leading edge of right door	mm	2010	2005	5
9	RSOV to upper leading edge of left door	mm	2016	2019	-3
10	RSOV to lower trailing edge of right door	mm	2021	2015	6
11	RSOV to lower trailing edge of left door	mm	2014	2012	2
12	RSOV to bottom of right 'A' pillar	mm	3054	3052	2
13	RSOV to bottom of left 'A' pillar	mm	3055	3052	3
14	RSOV to firewall on right side	mm	3442	3350	92
15	RSOV to firewall on left side	mm	3437	3367	70
16	RSOV to steering column	mm	2629	2648	-19
17	Center of steering column to left 'A' pillar	mm	386	366	20
18	Center of steering column to headlining	mm	456	440	16
19	RSOV to right side of front bumper	mm	4402	3947	455
20	RSOV to left side of front bumper	mm	4406	3992	414
21	Length of engine block	mm	409	409	0
RD	RSOV to right side of dash panel	mm	2788	2784	4
CD	RSOV to center of dash panel	mm	2864	2844	20
LD	RSOV to left side of dash panel	mm	2804	2788	16

DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2009 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008



DATA SHEET NO. 10... (continued)

VEHICLE MEASUREMENTS

Test Vehicle: 2009 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008

Target Vehicle Structural Measurement

	Elements	Pre-Test (mm)
1	Total Length	4530
2	Total Width	1762
3	Bumper Top Height	659
4	Bumper Bottom Height	562
5	Longitudinal Member Top Height	584
6	Distance between Longitudinal Members	1040
7	Longitudinal Member Width	70
8	Engine Top Height	909
9	Engine Bottom Height	270
10	Engine and gearbox width	740
11	Front bumper-engine distance	446
12	Front shock absorber fixing height	936
13	Bonnet leading edge height	902
14	Front shock absorber fixing width	1115
15	Front bumper – front axle distance	940
16	Front axle – a pillar distance	478
17	A-pillar – B-pillar distance	1063
18	B-Pillar – rear axle distance	1064
19	B-pillar – C-pillar distance	1000
20	Roof sill bottom height	1532
21	Roof sill top height	1599
22	Floor sill bottom height	298
23	Floor sill top height	382

DATA SHEET NO. 11

CAMERA LOCATIONS

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008

No.	Camera View	Location (mm) *			Lens (mm)	Speed (fps)
		X	Y	Z		
1	Real-Time Left Side View				13	24
2	Left Front View	1295	-4655	1200	24	1000
3	Steering Column Top	1105	-5215	1205	25	1000
4	Steering Column Bottom	1100	-5220	1210	25	1000
5	Driver Close-up	1380	-5190	1280	35	1000
6	Driver Angle	6855	-5115	2225	50	1000
7	On board Driver Side					
8	On board Passenger Side					
9	Right Overall	1660	6800	1270	24	1000
10	Right Passenger Half	1310	4690	1230	24	1000
11	Right Close-up	1395	5305	1325	35	1000
12	Right Angle	6795	5175	2205	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	1210	0	-3150	24	1000
17	Pit Rear	3220	0	-3150	24	1000

*COORDINATES:

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

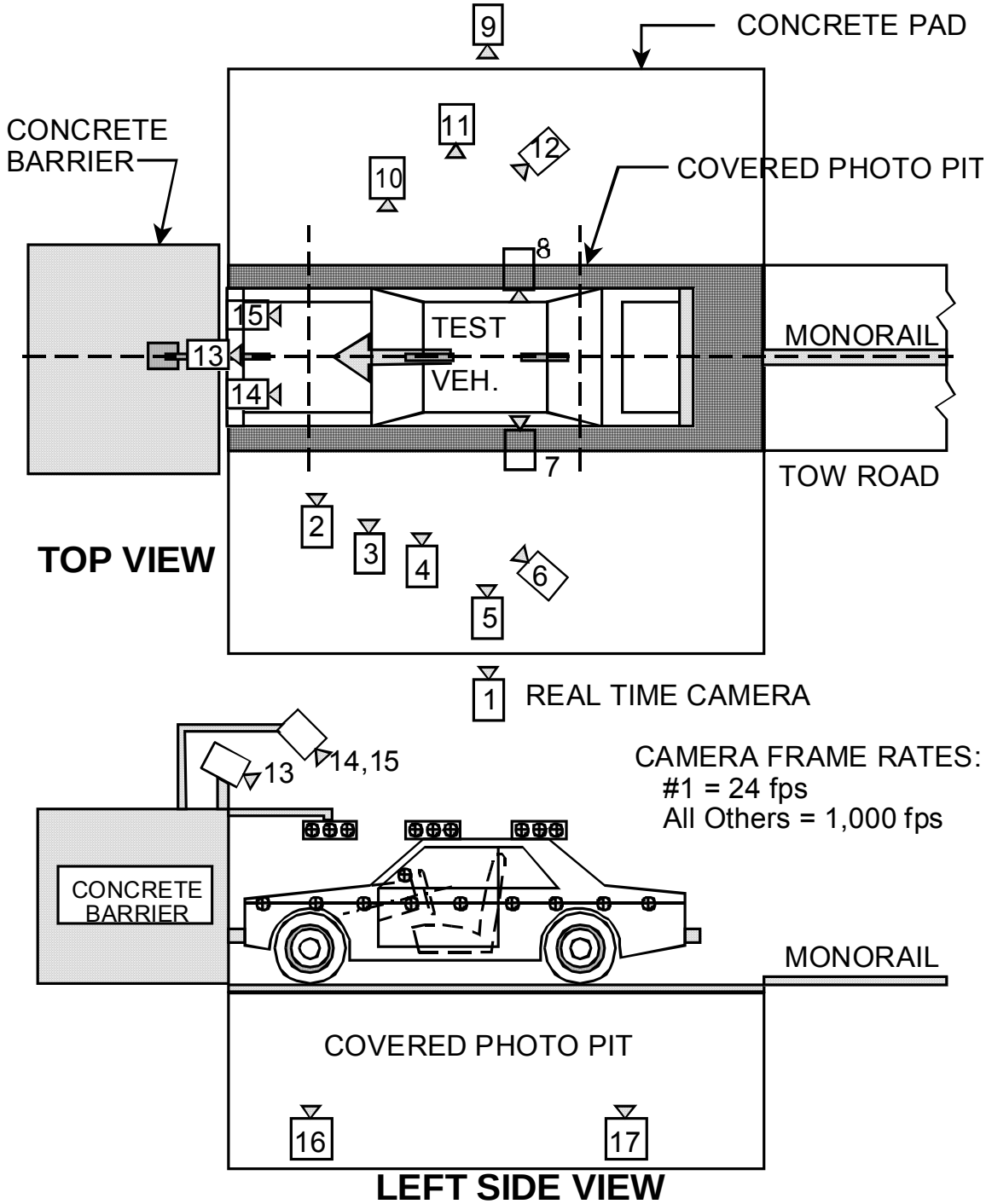
Cameras 7 & 8 were not used for this test.

DATA SHEET NO. 11... (continued)

CAMERA LOCATIONS

Test Vehicle: 2009 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008

CAMERA POSITIONS FOR FRONTAL IMPACTS



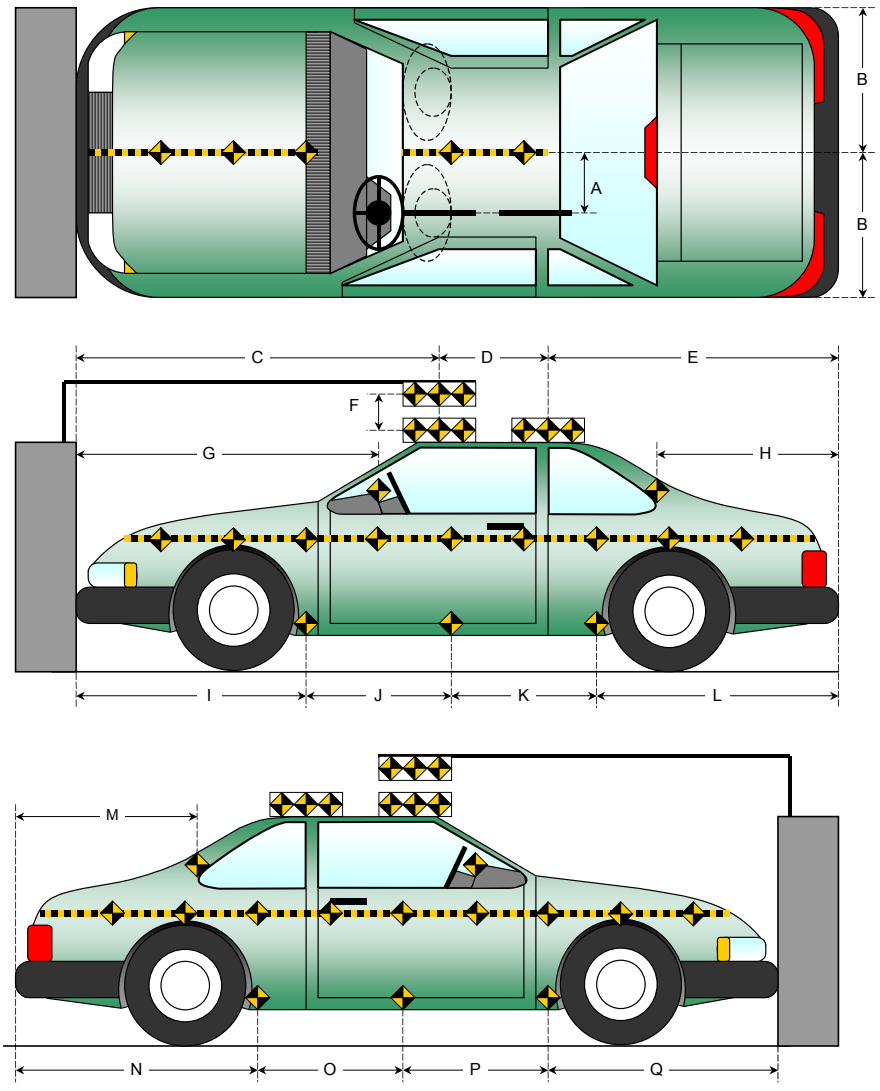
DATA SHEET NO. 12

PHOTOGRAPHIC REFERENCE TARGET LOCATIONS

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008

Item	Value
A	368
B	881
C	2347
D	668
E	1515
F	103
G	
H	496
I	1392
J	868
K	868
L	1402
M	502
N	1404
O	873
P	868
Q	1385



DATA SHEET NO. 13

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

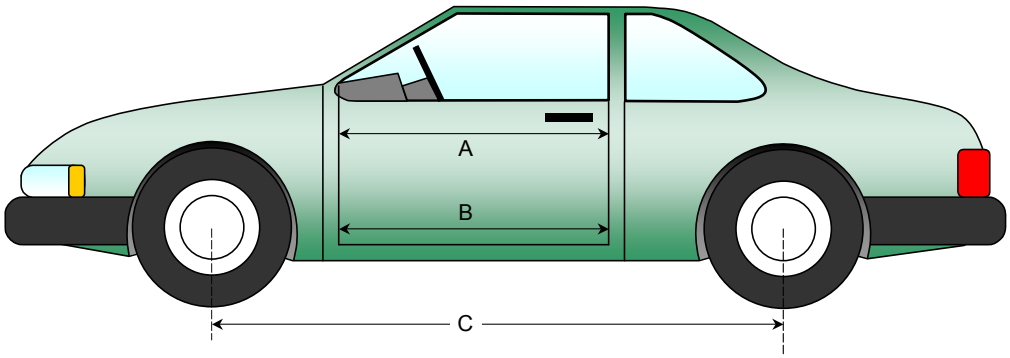
NHTSA No.: M95500
Test Date: 4/14/2008

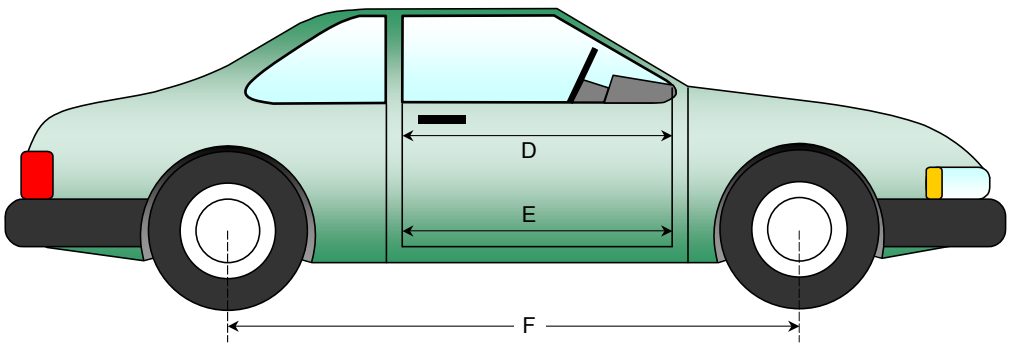
DOOR OPENING WIDTH

Item	Description	Units	Pre-Test	Post-Test	Difference
A	Left Side Upper	mm	924	924	0
B	Left Side Lower	mm	833	833	0
D	Right Side Upper	mm	932	930	2
E	Right Side Lower	mm	852	852	0

WHEELBASE MEASUREMENTS

Item	Description	Units	Pre-Test	Post-Test	Difference
C	Left Side Wheelbase	mm	2610	2615	-5
F	Right Side Wheelbase	mm	2610	2579	31





DATA SHEET NO. 13... (continued)

VEHICLE INTRUSION MEASUREMENTS

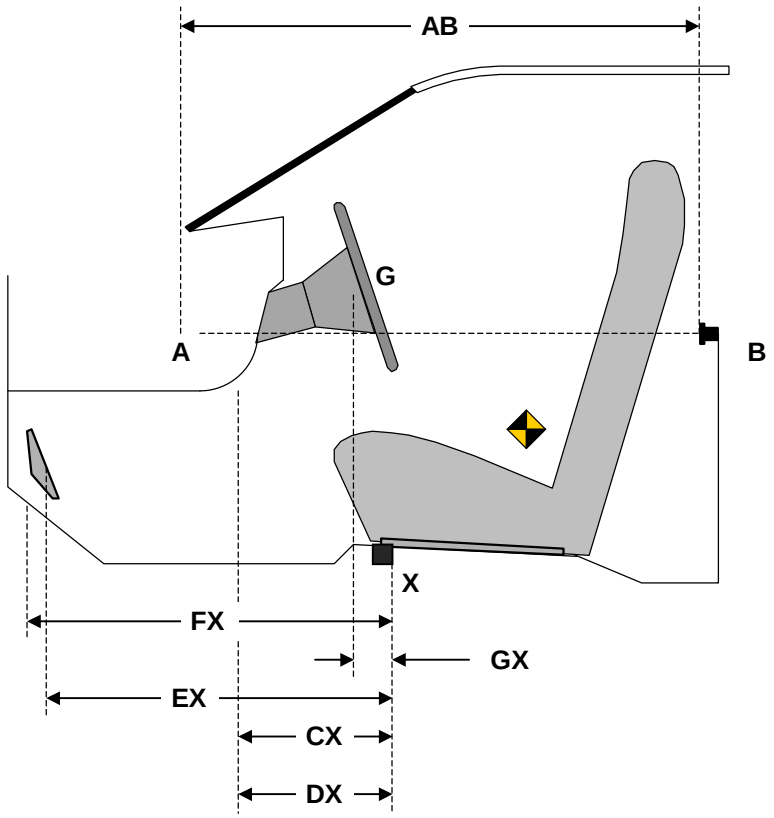
Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008

DRIVER COMPARTMENT INTRUSION

Item	Description	Units	Pre-Test	Post-Test	Difference
AB	Door Opening (Inside window jam)	mm	777	775	2
CX	Left Knee Bolster to X	mm	317	310	7
DX	Right Knee Bolster to X	mm	303	299	4
EX	Brake Pedal to X	mm	541	556	-15
FX	Foot Rest to X	mm	568	563	5
GX	Center of Steering Column Wheel Hub to X	mm	72	99	-27

X = Front of Seat Track (stationary)



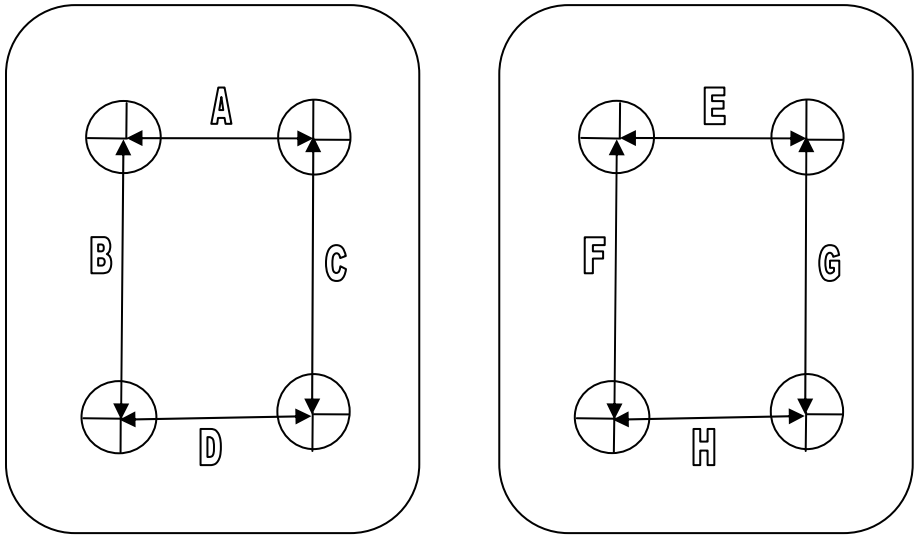
DRIVER COMPARTMENT

DATA SHEET NO. 13... (continued)

VEHICLE INTRUSION MEASUREMENTS

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008



Driver Passenger

UNDERBODY FLOORBOARD DEFORMATION

Measurement	Pre-Test	Post-Test	Difference
A	388	390	-2
B	388	387	1
C	388	386	2
D	388	388	0
E	388	387	1
F	388	386	2
G	388	384	4
H	388	388	0

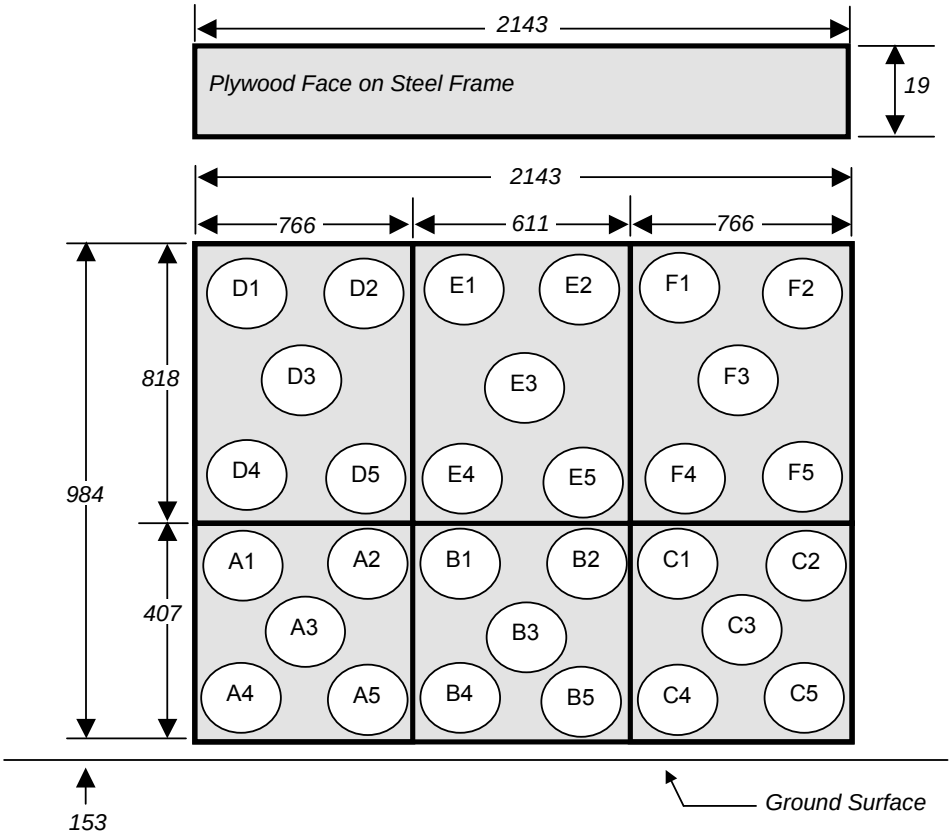
DATA SHEET NO. 14

LOAD CELL LOCATIONS ON FIXED BARRIER

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact
NHTSA No.: M95500
Test Date: 4/14/2008

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 Subaru Forester NHTSA No.: M95500
Test Program: 35mph Frontal Impact Test Date: 4/14/2008

VEHICLE INFORMATION

VIN: JF2SH61619H703050 Wheelbase (mm): 2610
Vehicle Size Category: MPV Test Weight (kg): 1707.8

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): 56.3 Velocity Change (km/h): 63.9
Time of Separation (msec): 108.2

CRUSH PROFILE

Collision Deformation Classification: Frontal Midpoint of Damage: Centerline
Damage Region Length (mm): 1266 Impact Mode: Frontal

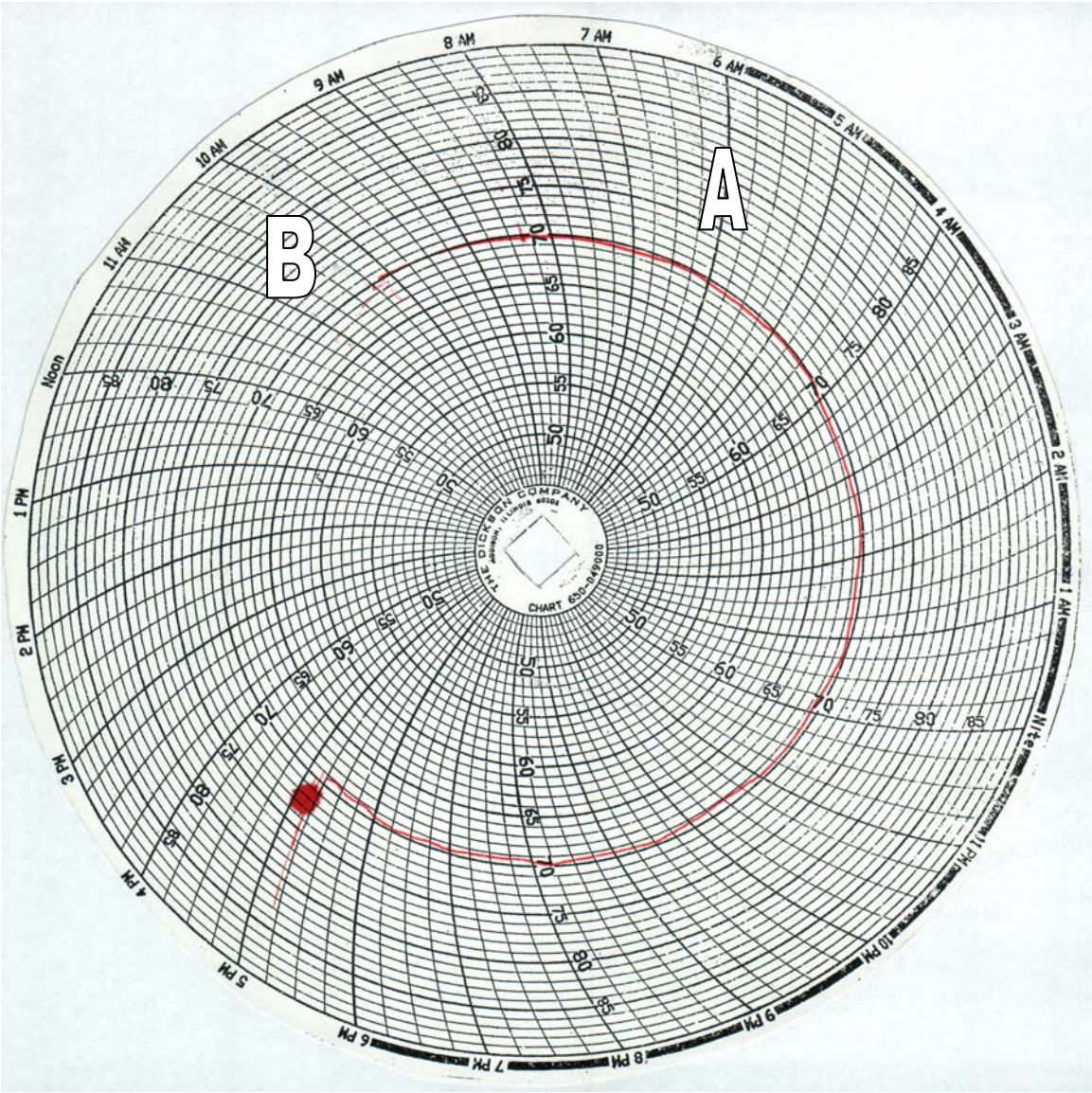
No.	Measurement Description	Units	Pre-Test	Post-Test	Difference
C1	Crush zone 1 at left side	mm	4400	3992	408
C2	Crush zone 2 at left side	mm	4513	3964	549
C3	Crush zone 3 at left side	mm	4527	3984	543
C4	Crush zone 4 at right side	mm	4528	3978	550
C5	Crush zone 5 at right side	mm	4518	3942	576
C6	Crush zone 6 at right side	mm	4402	3947	455
L	C1 TO C6	mm	1266	1232	34

DATA SHEET NO. 16

DUMMY / VEHICLE TEMPERATURE STABILIZATION CHART

Test Vehicle: 2009 Subaru Forester
Test Program: 35mph Frontal Impact

NHTSA No.: M95500
Test Date: 4/14/2008



A = Dummies installed in vehicle at 6:00 am

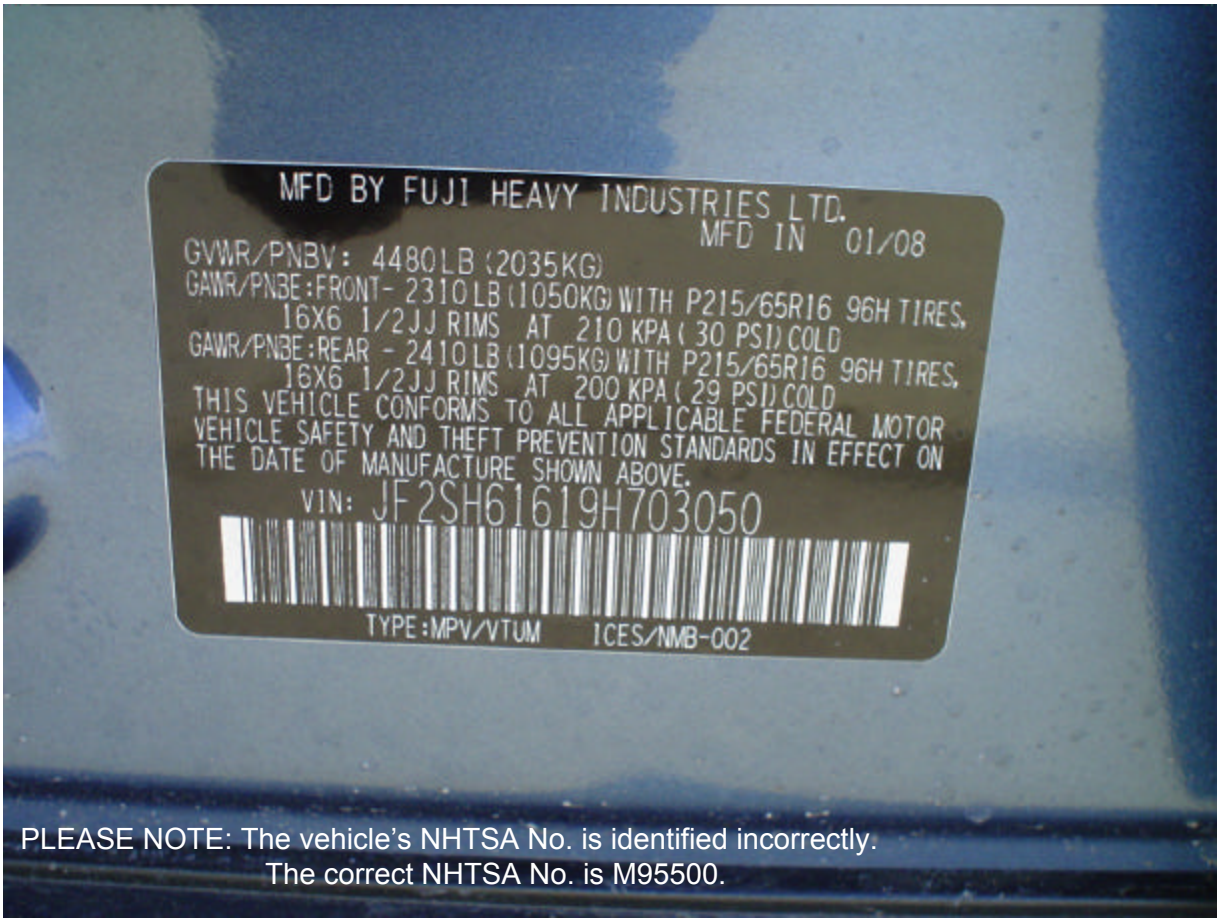
B = Test conducted at 10:45 am

APPENDIX A

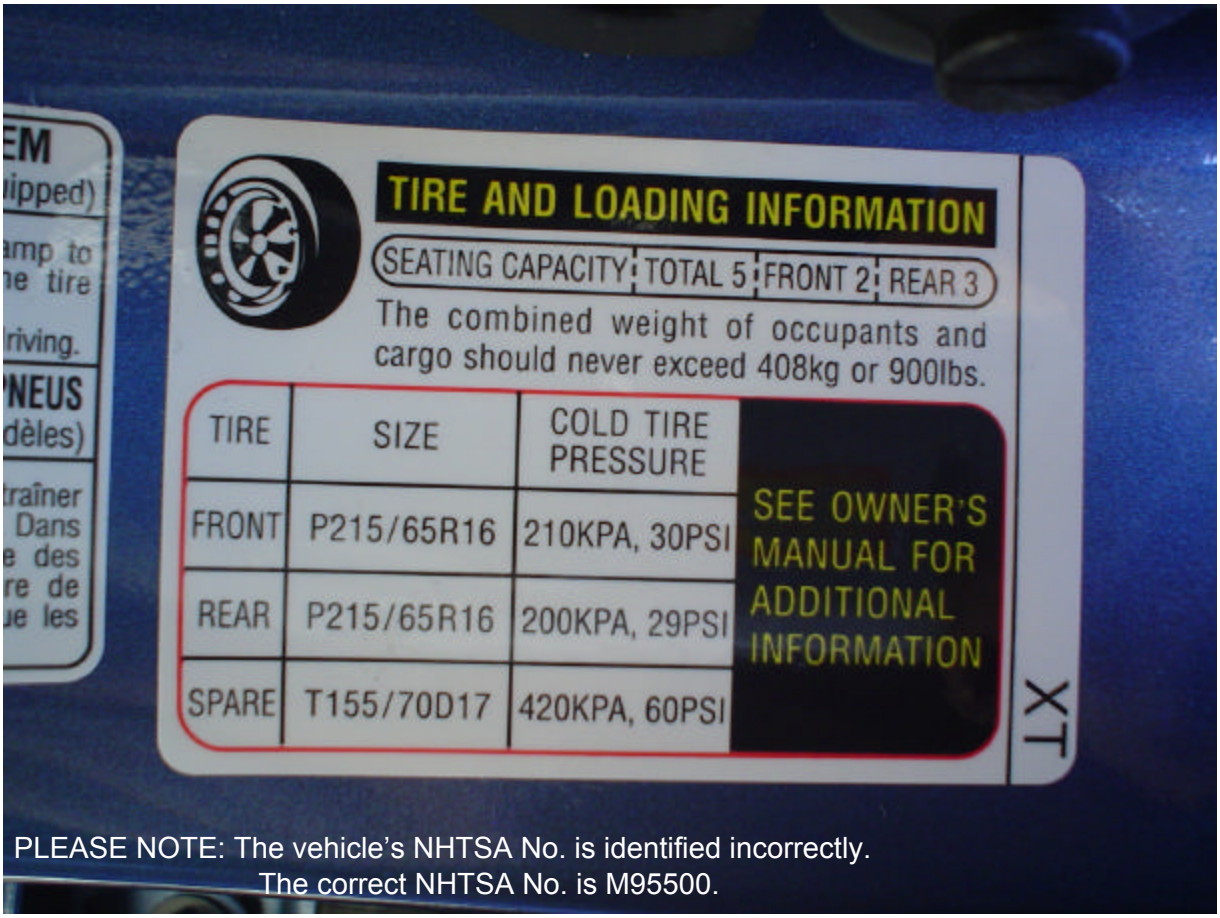
PHOTOGRAPHS

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

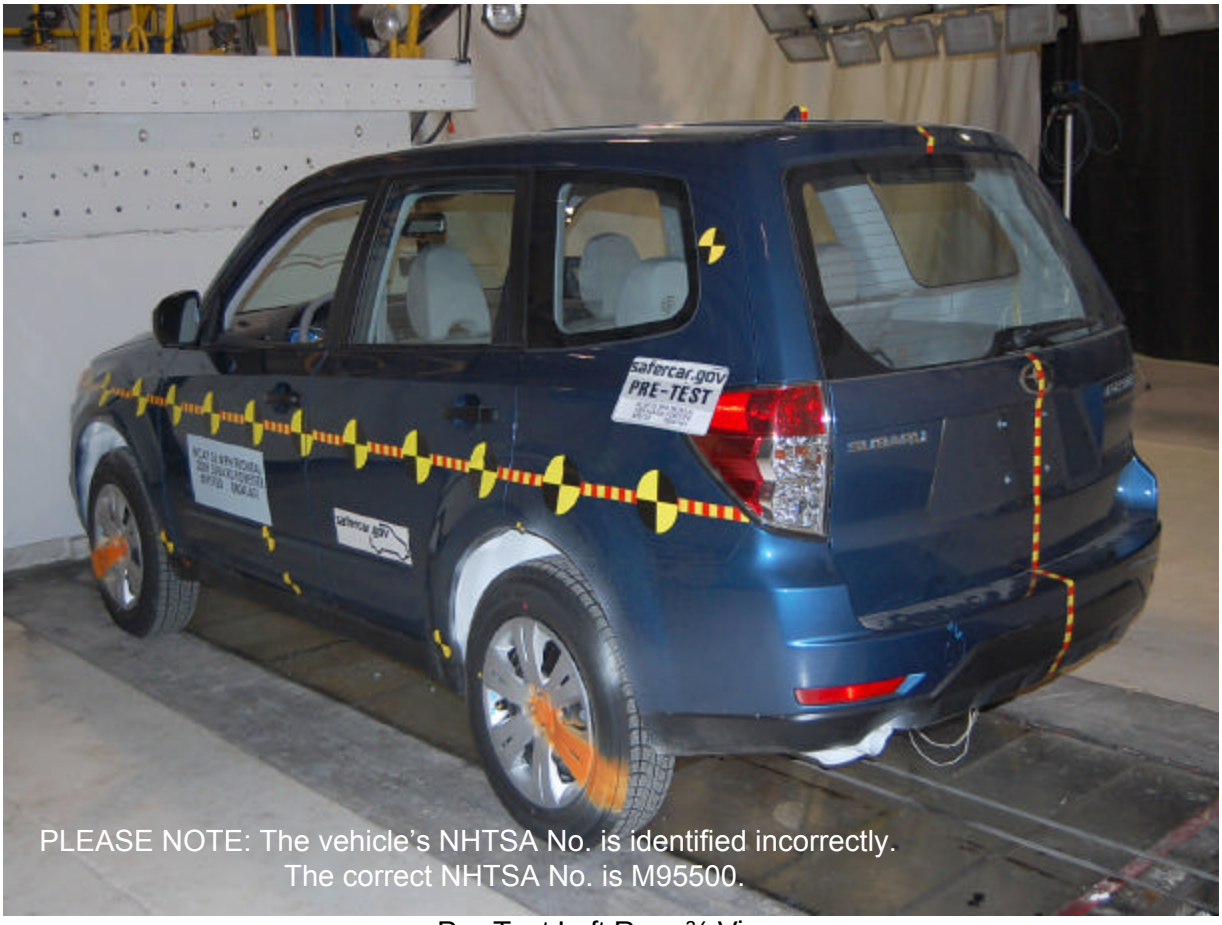
Post-Test Left Side View

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

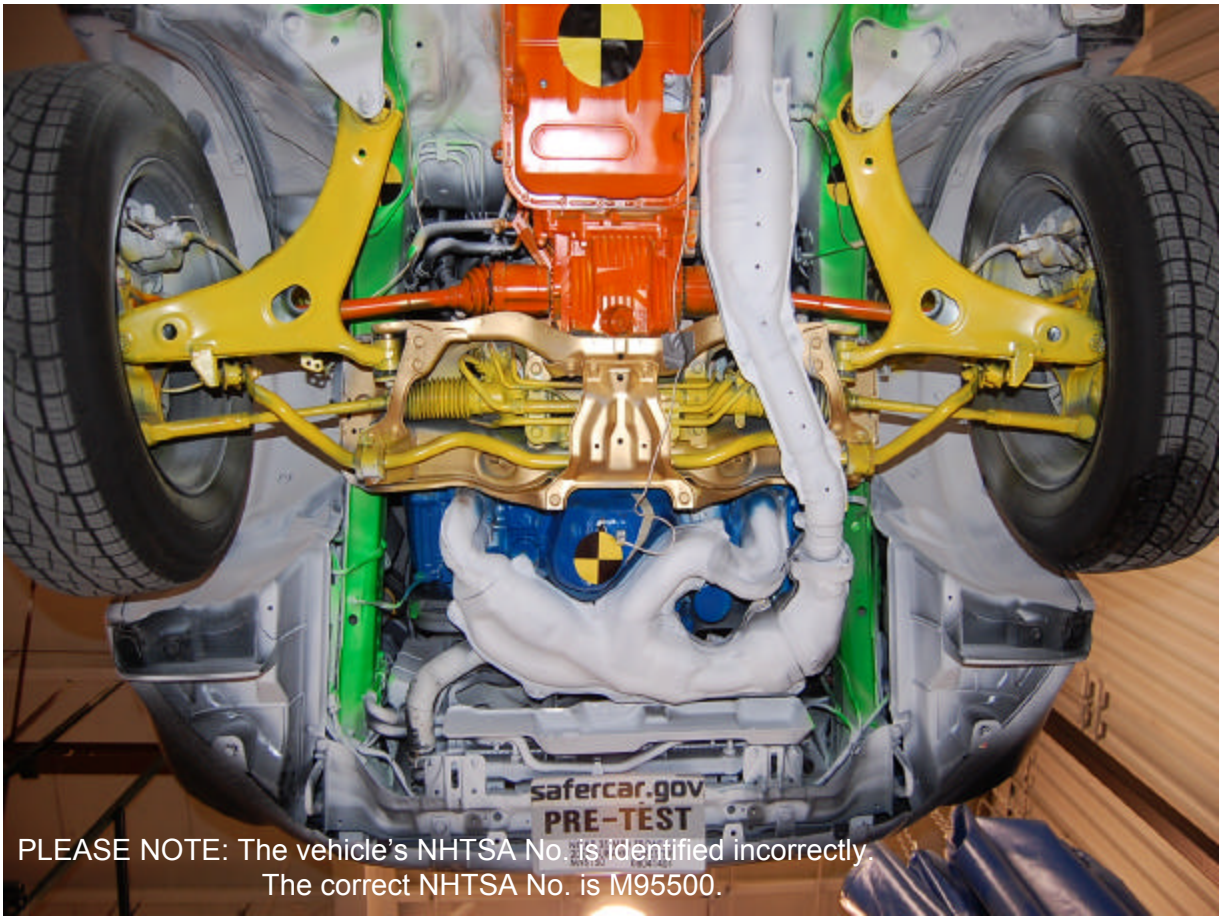
Post-Test Windshield View

Pre-Test Engine Compartment View

Post-Test Engine Compartment View

Pre-Test Fuel Cap View

Post-Test Fuel Cap View

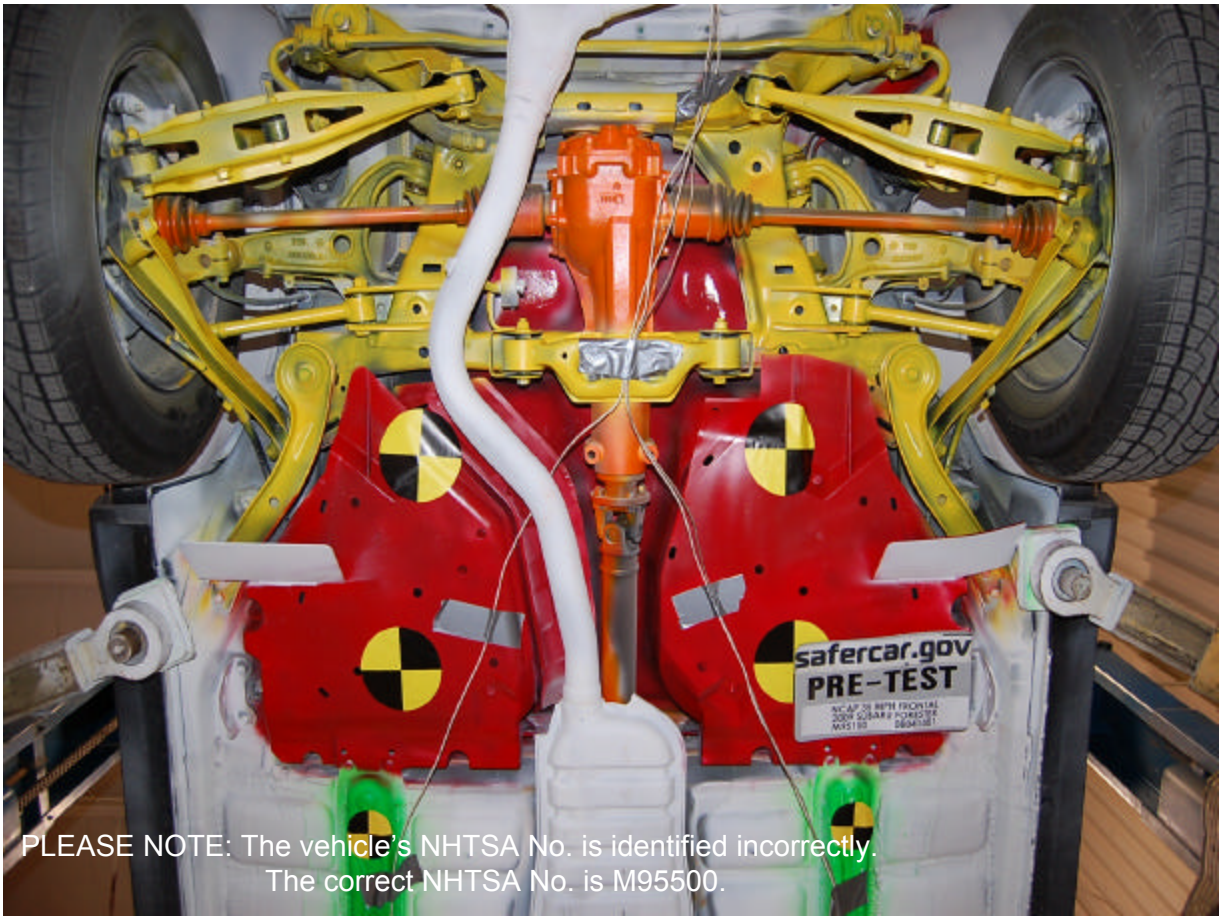


Pre-Test Front Underbody View

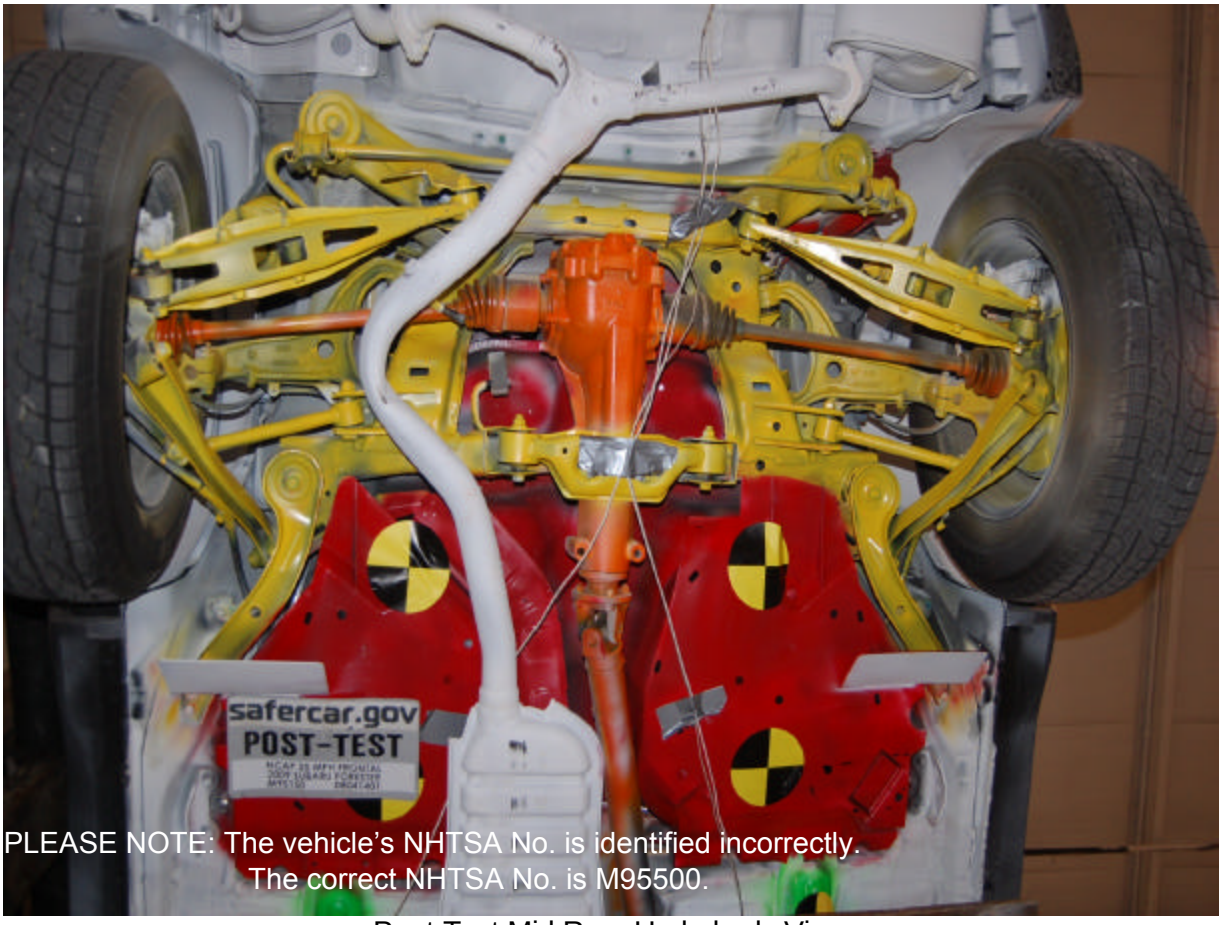
Post-Test Front Underbody View

Pre-Test Mid Front Underbody View

Post-Test Mid Front Underbody View

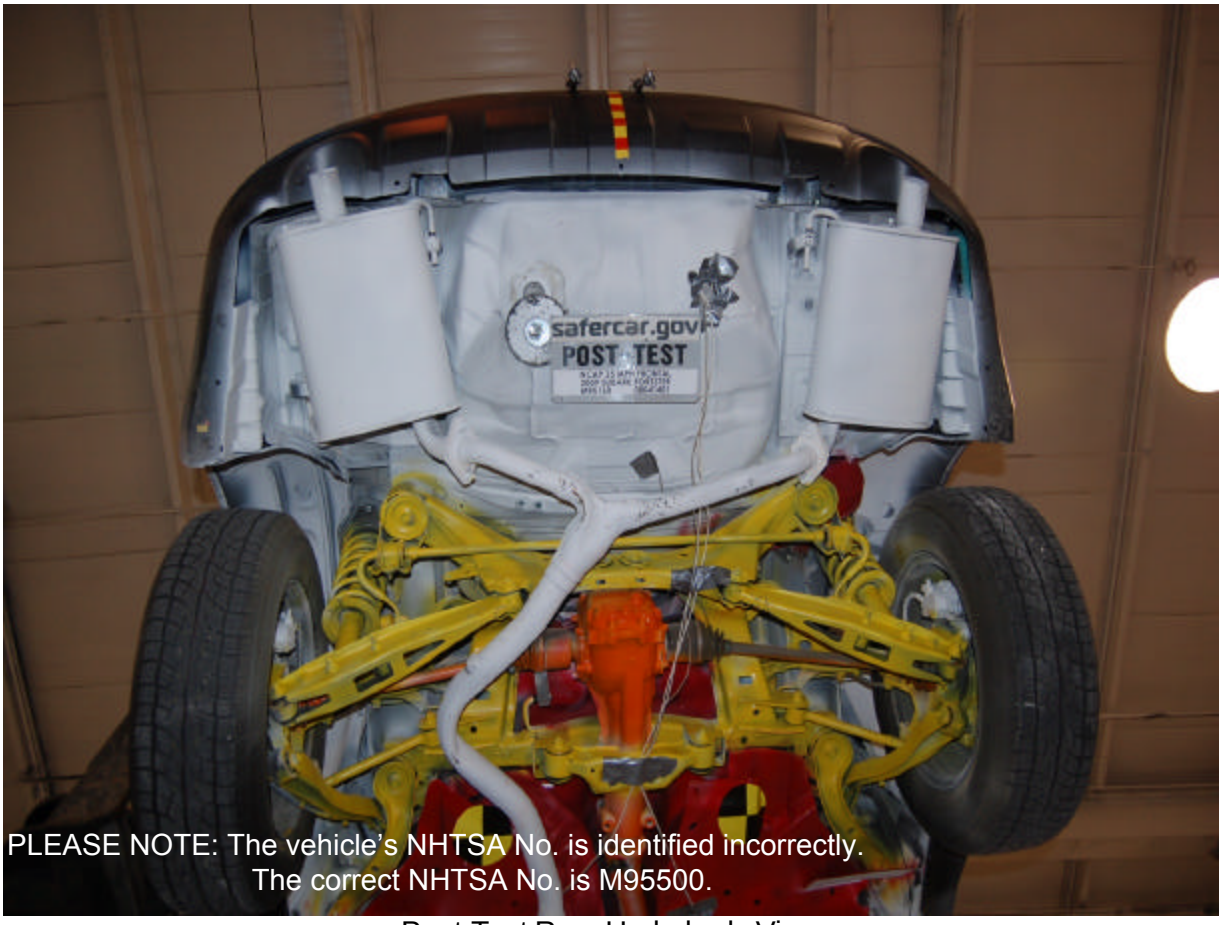


Pre-Test Mid Rear Underbody View

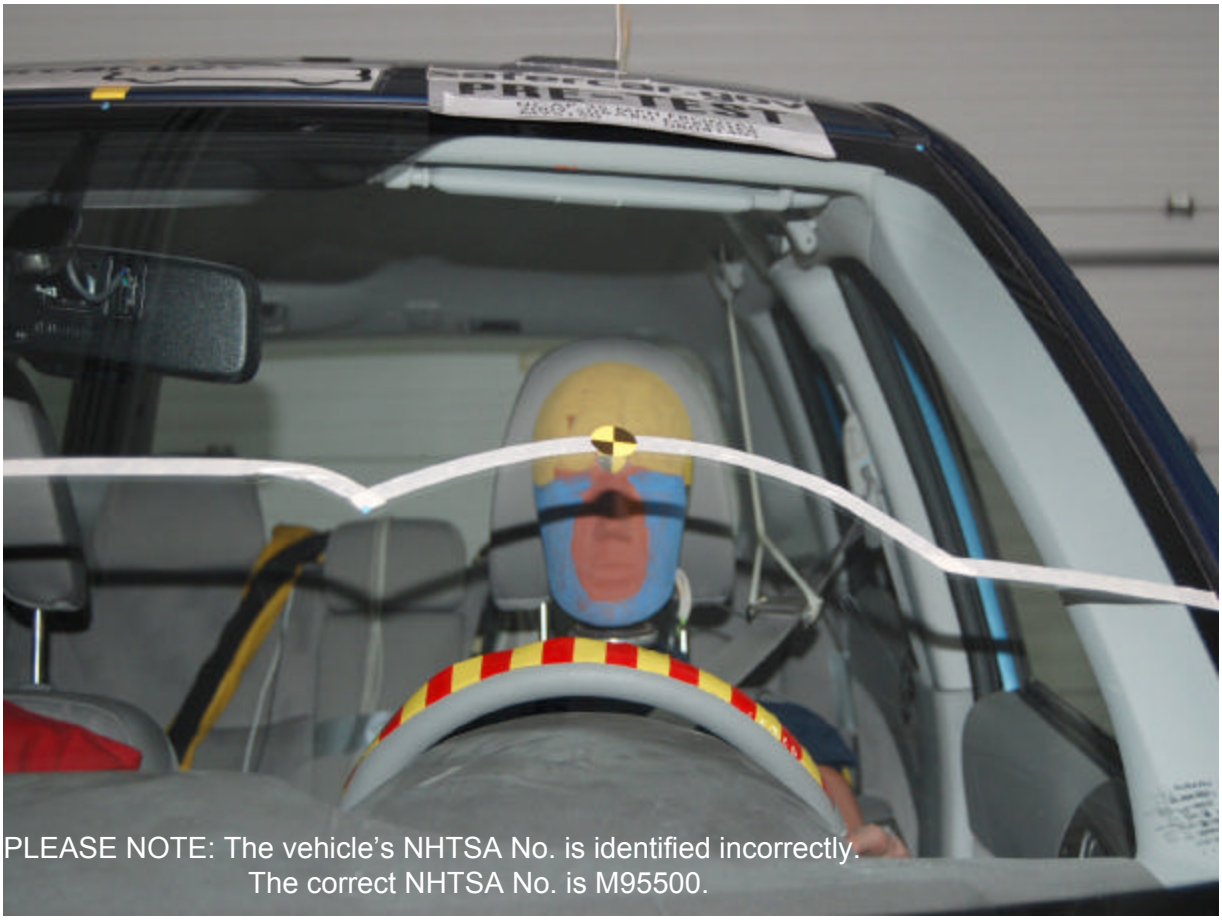


Post-Test Mid Rear Underbody View

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

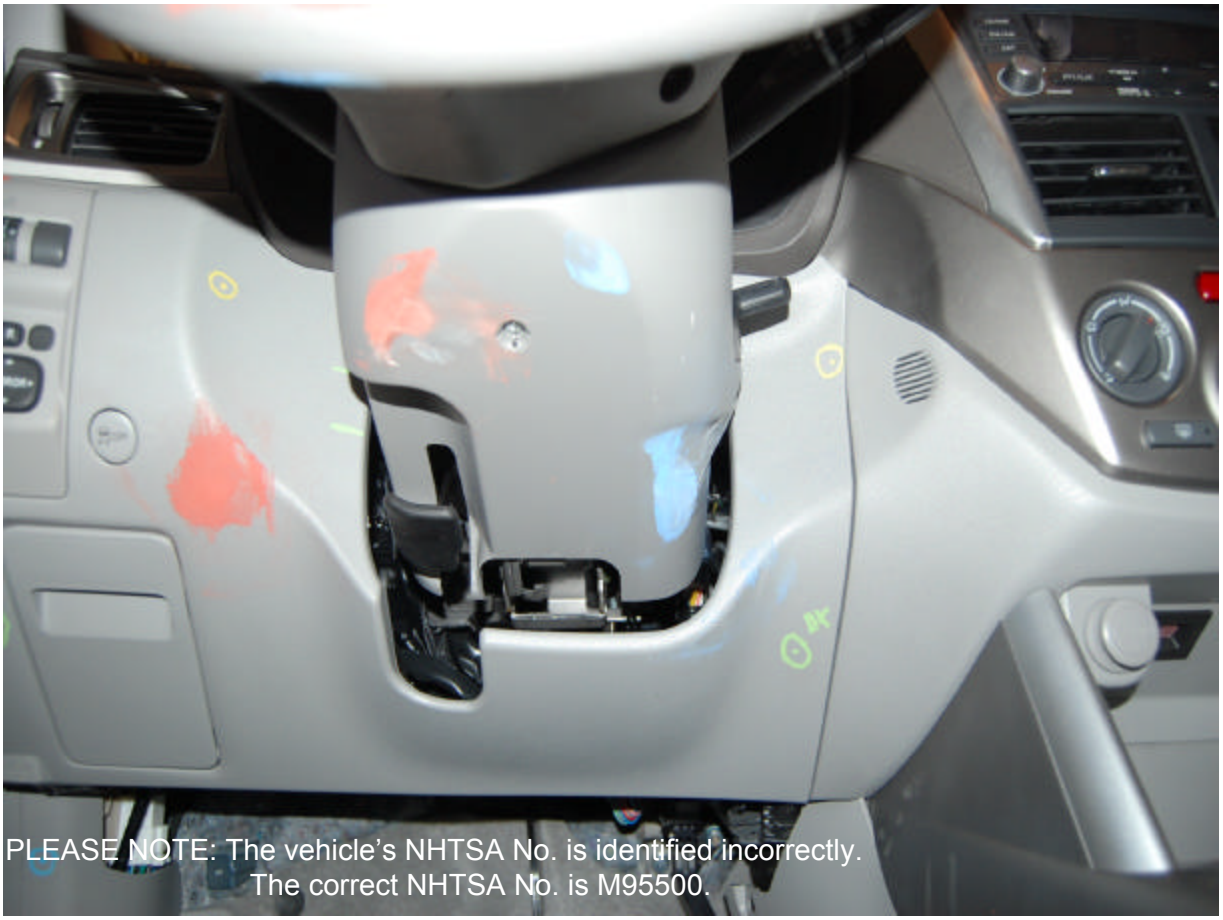
Pre-Test Driver Side Knee Bolster

Post-Test Driver Side Knee Bolster

Pre-Test Driver Side Floor Pan

Post-Test Driver Side Floor Pan

Post-Test Driver Dummy Head Contact (Headrest)



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)

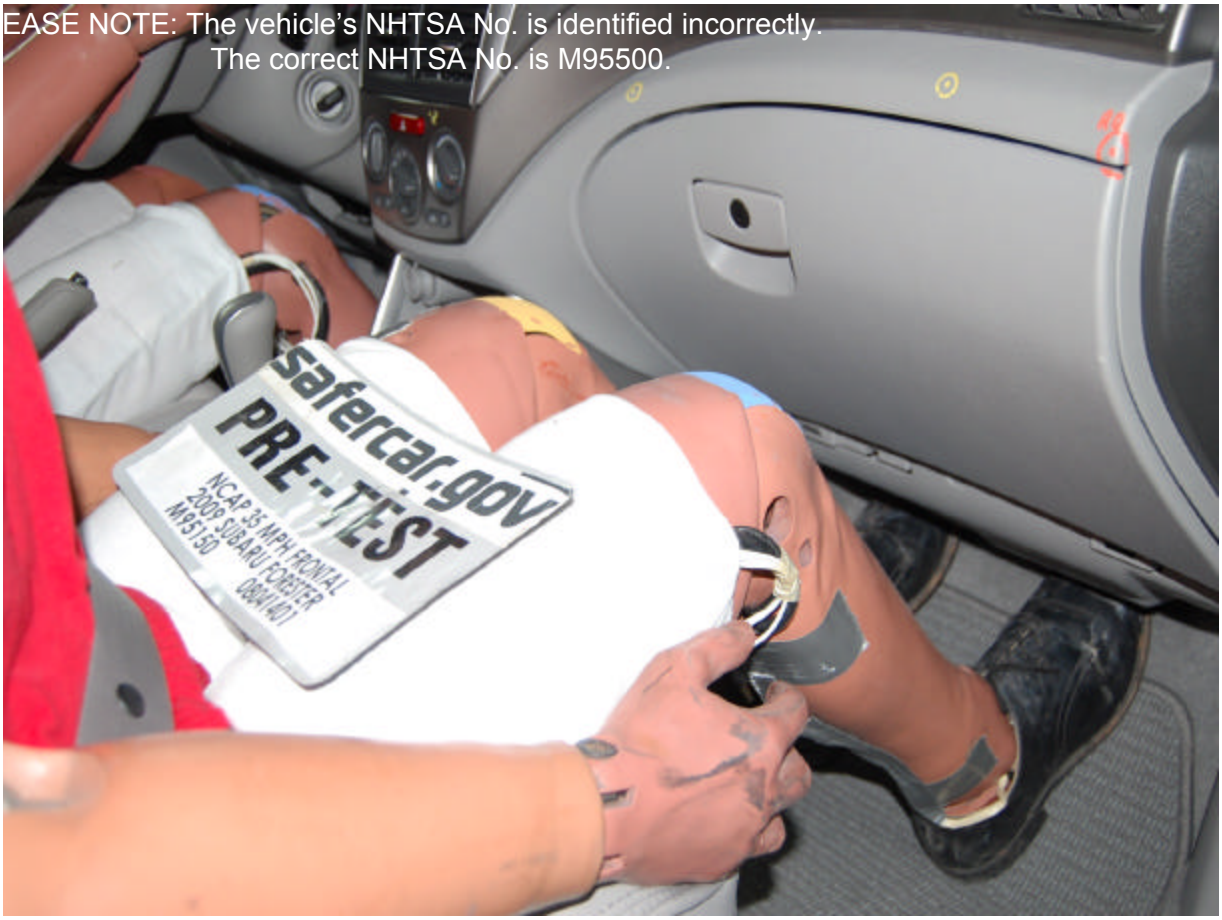
Post-Test Passenger Dummy (Through Window)

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

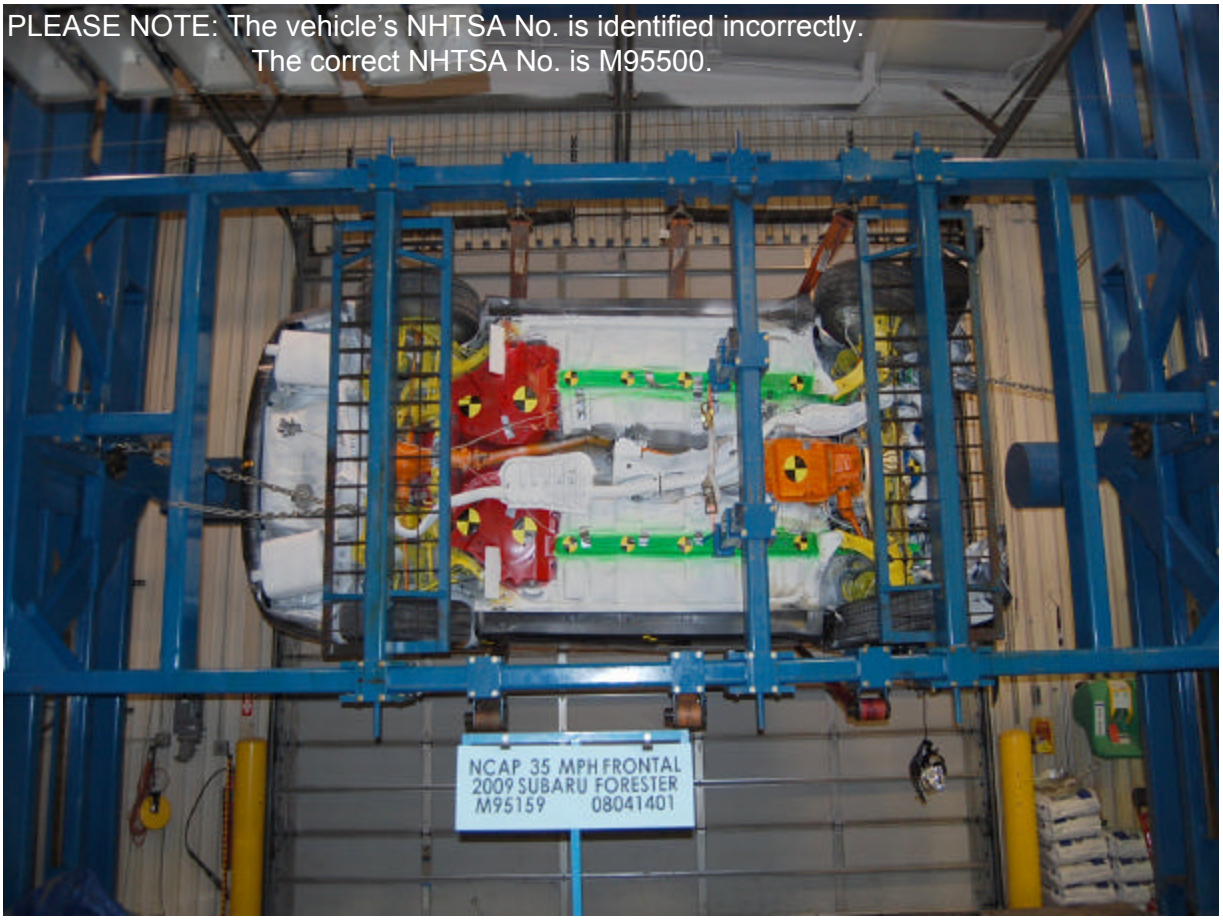
Post-Test Passenger Dummy Head Contact (Headrest)

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

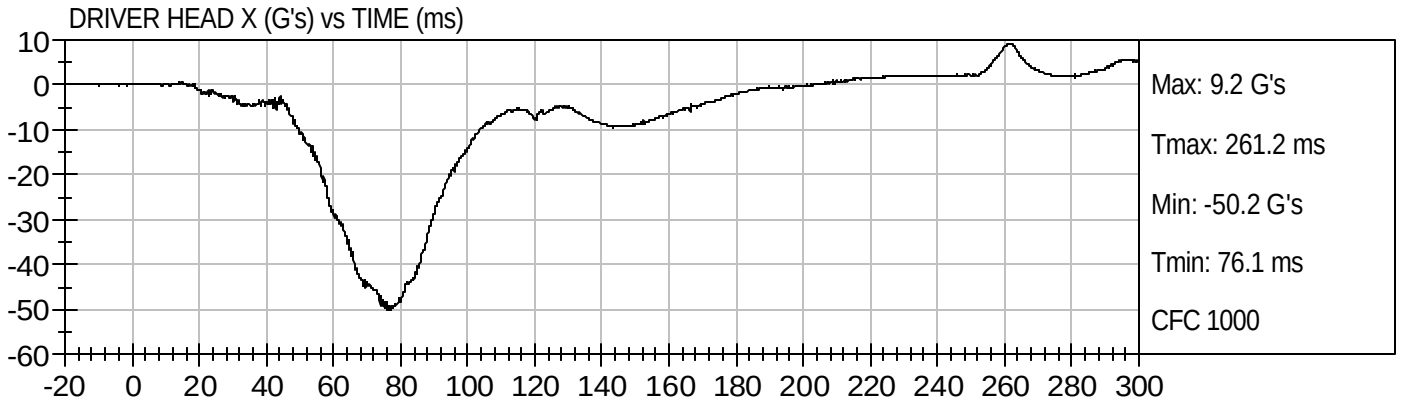
Barrier Force – Lower Left

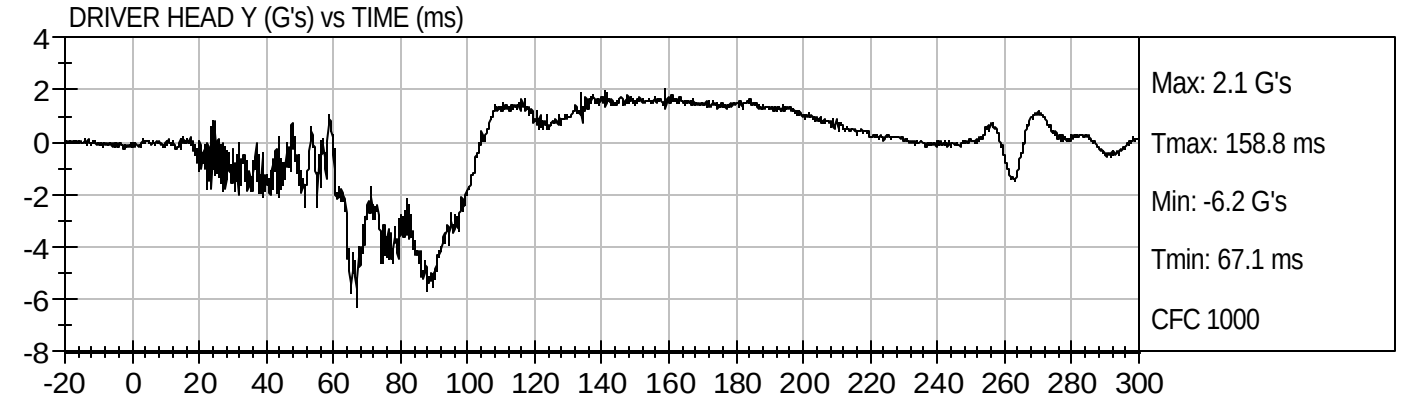
Barrier Force – Lower Center

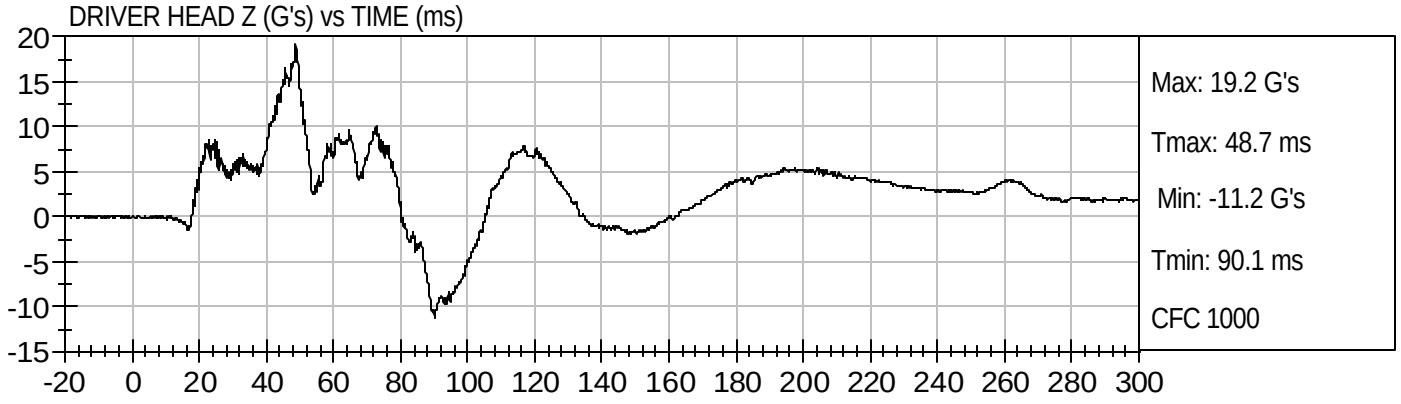
Barrier Force – Lower Right

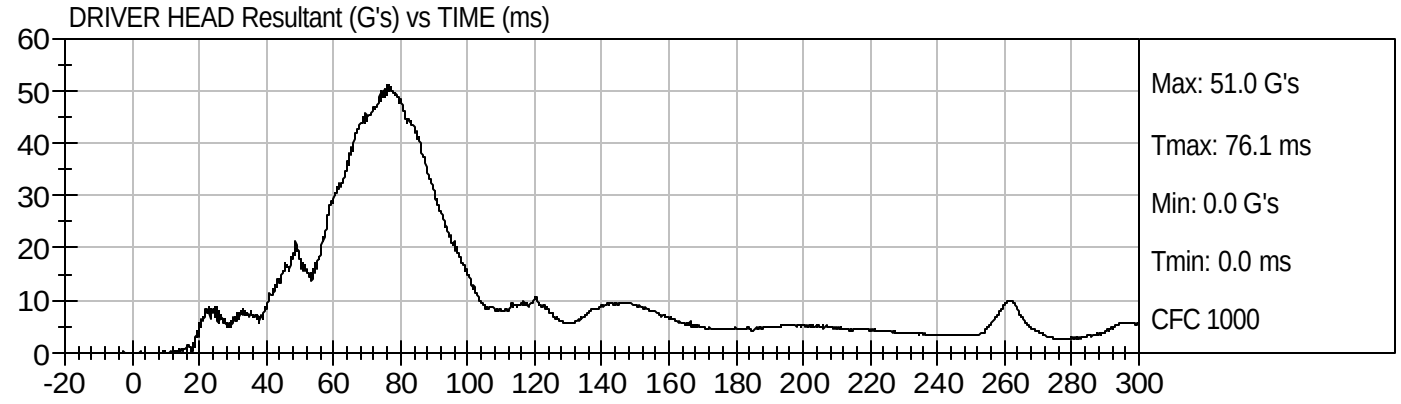
NCAP FRONTAL
2009 SUBARU FORESTER M95500

Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

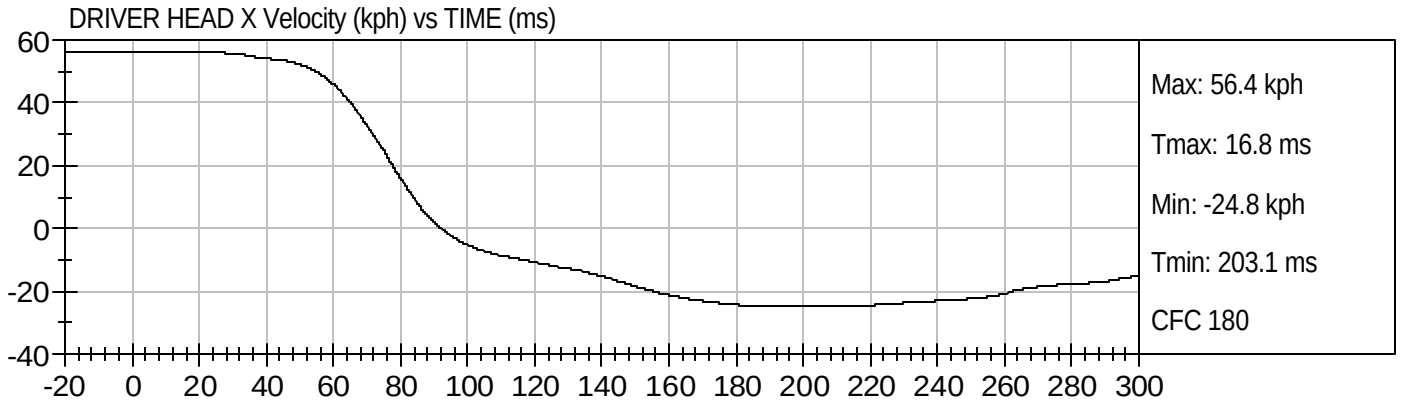


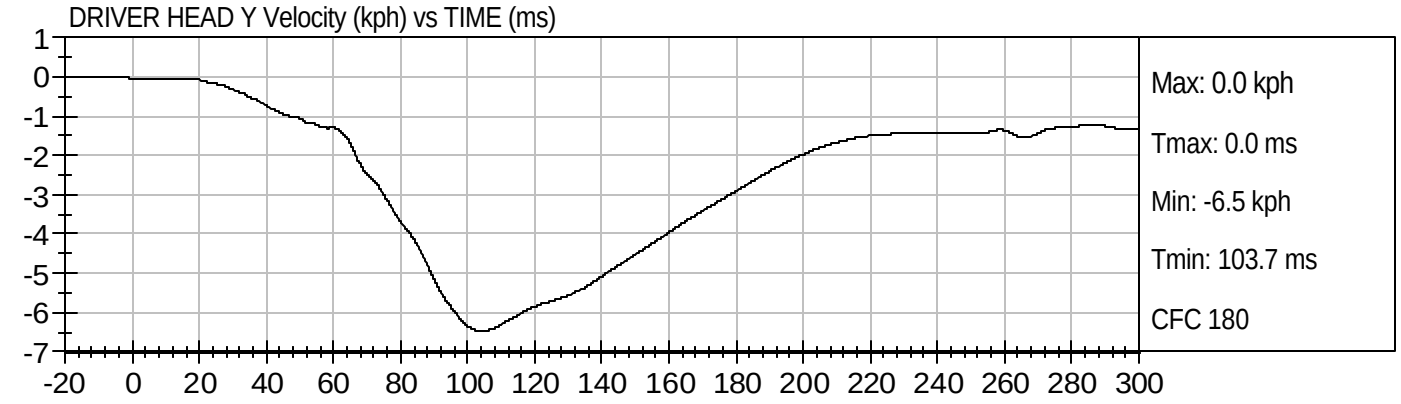


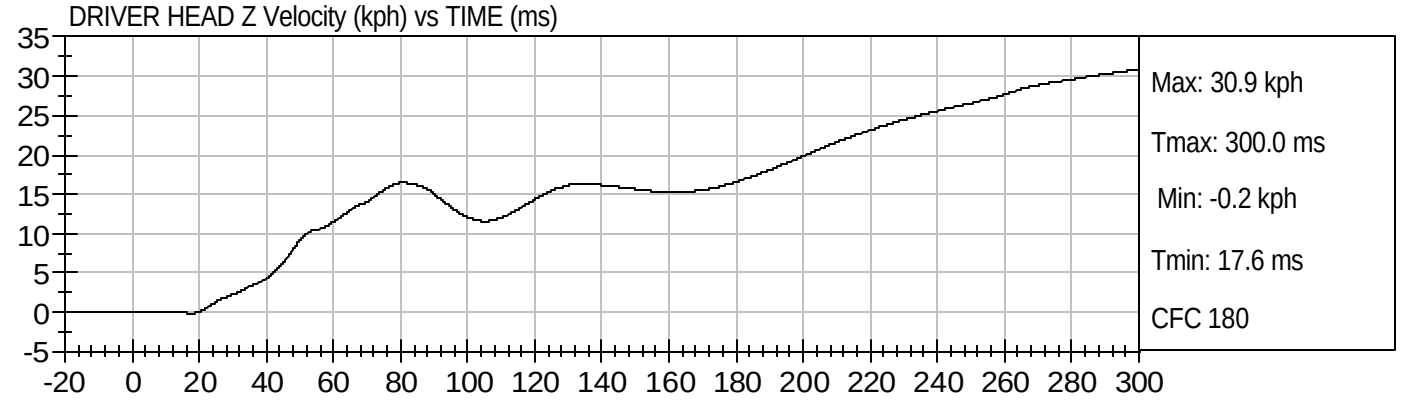




NCAP FRONTAL
2009 SUBARU FORESTER M95500
Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

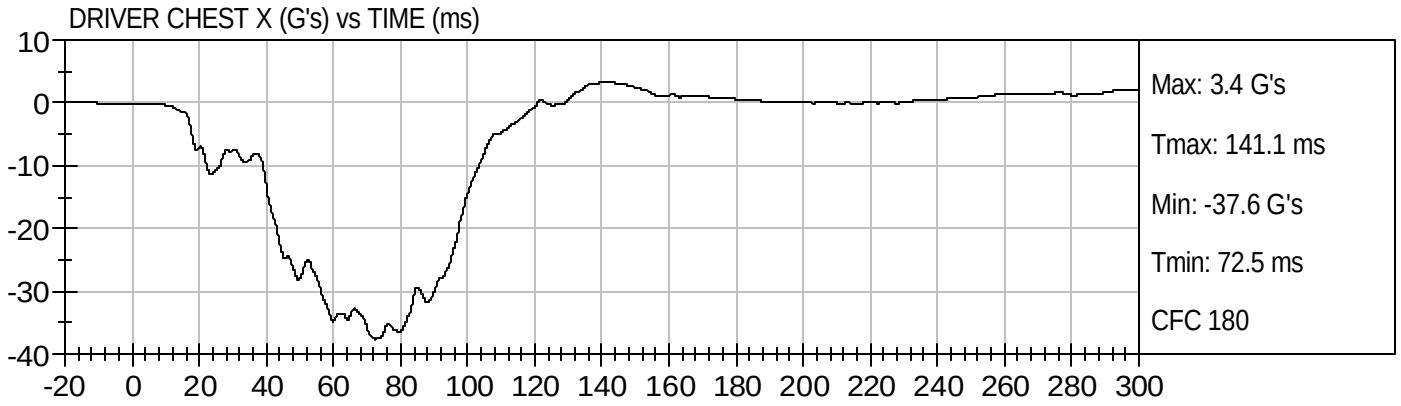


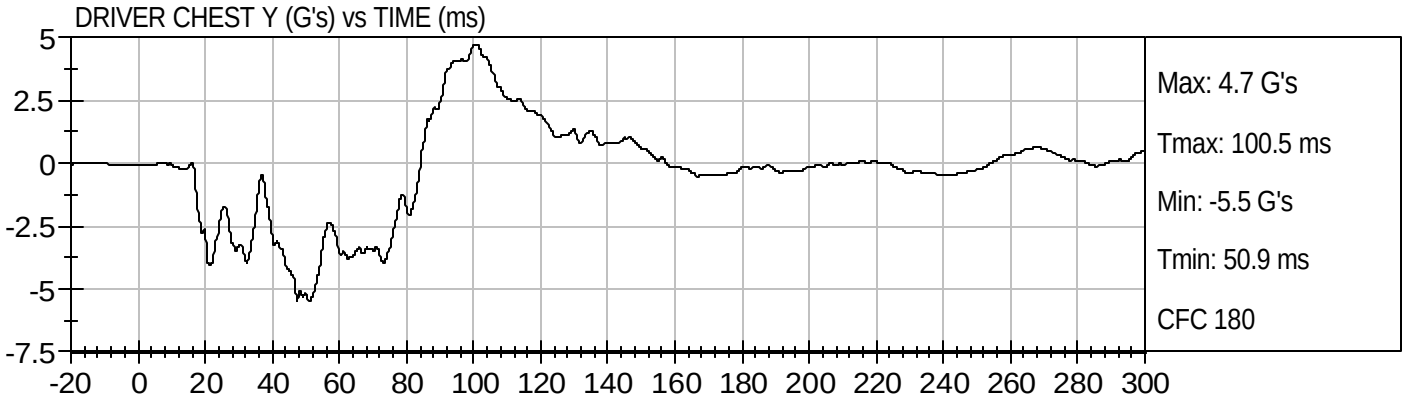


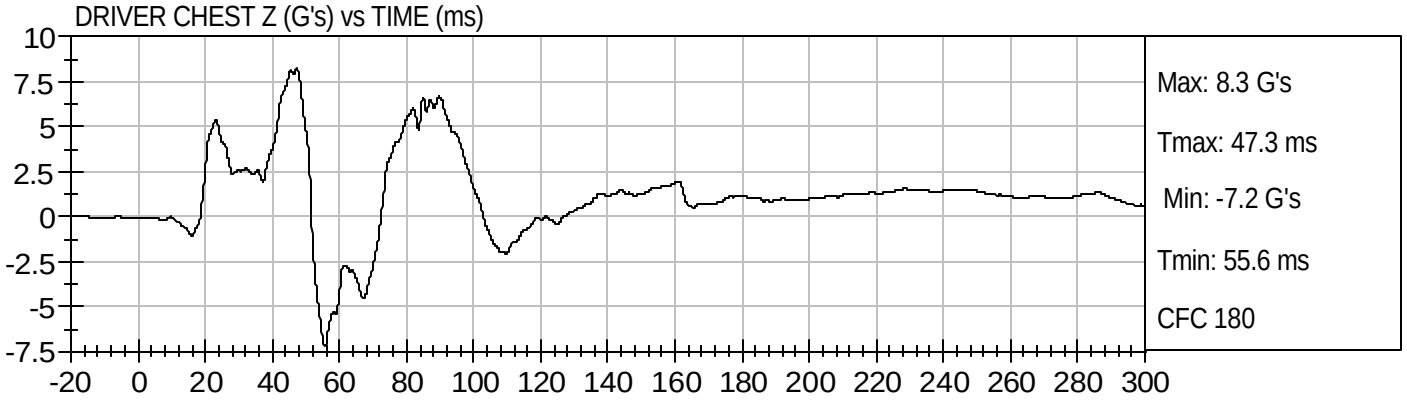


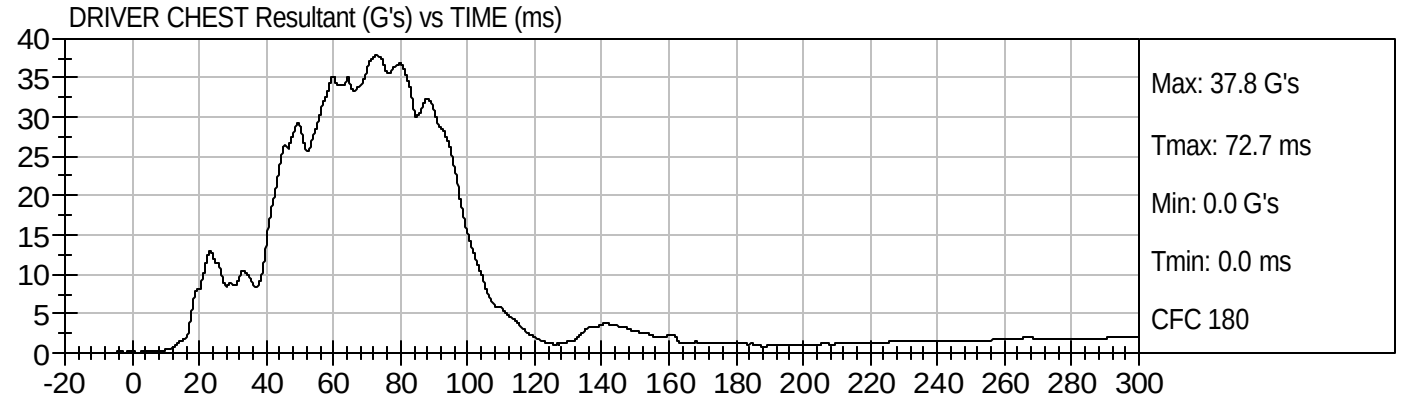
NCAP FRONTAL
2009 SUBARU FORESTER M95500

Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

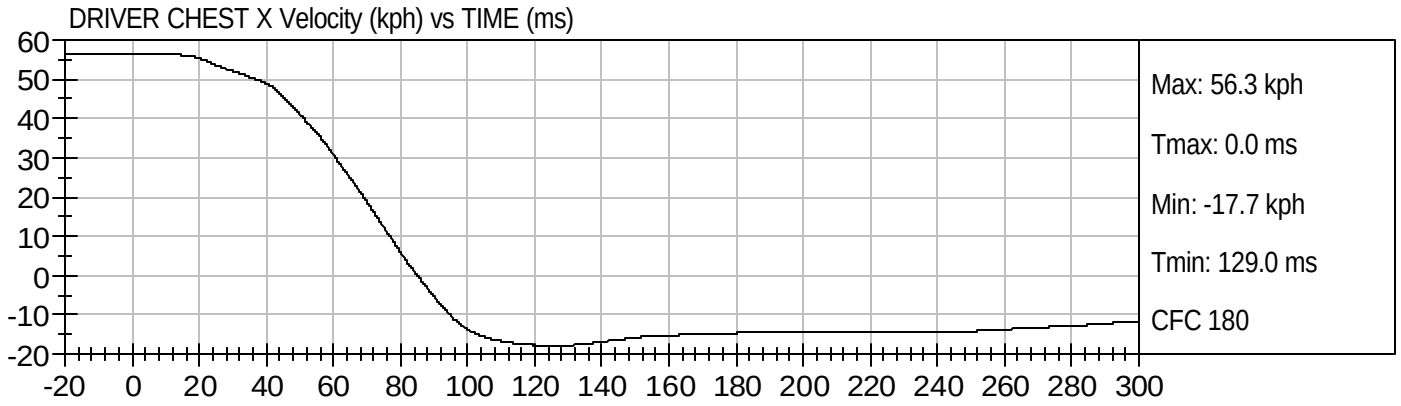


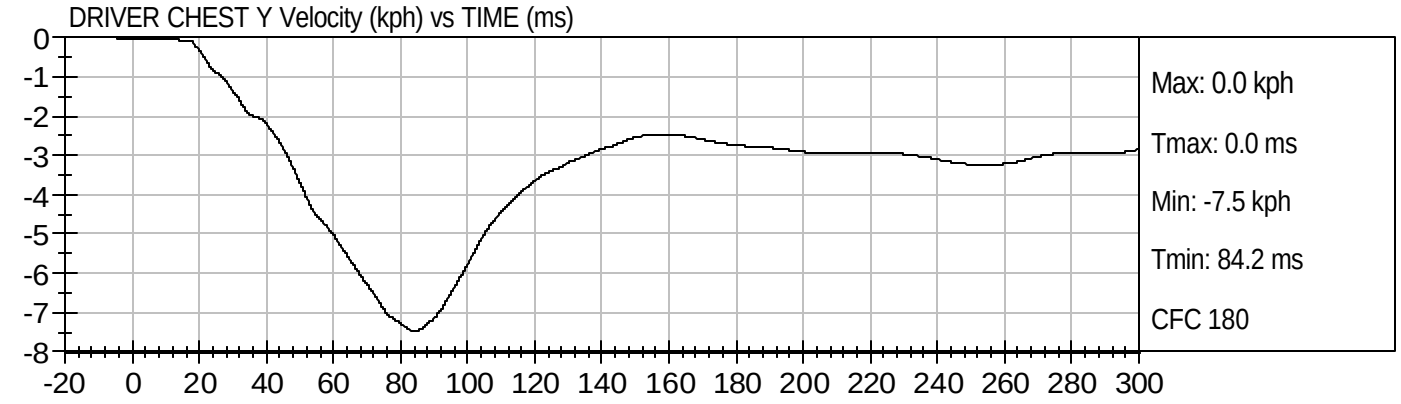


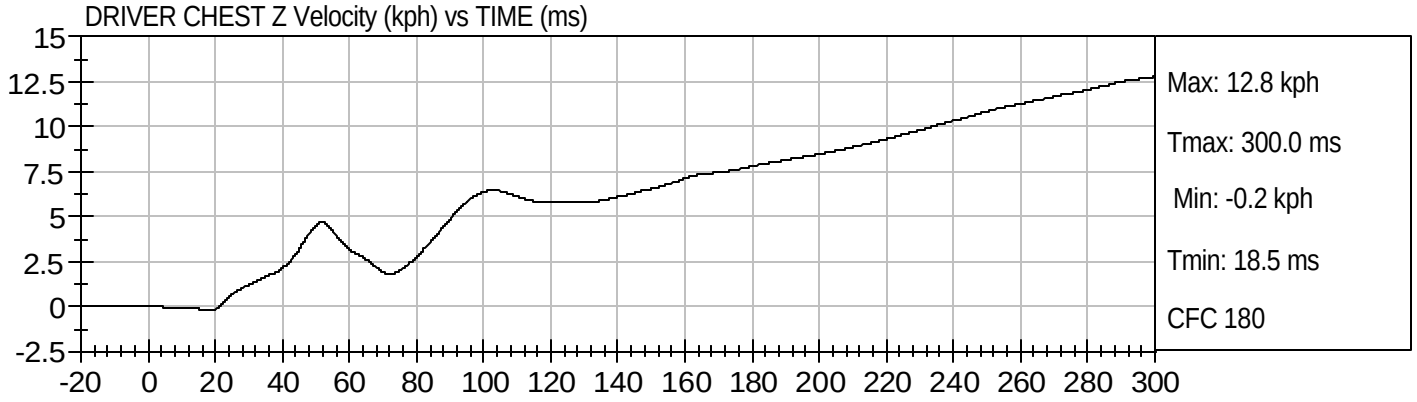




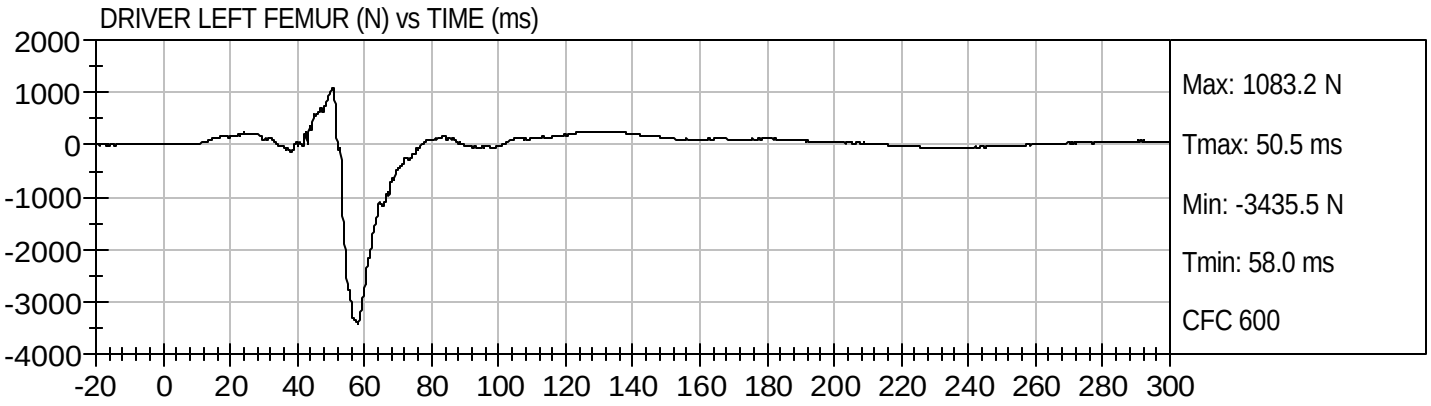
NCAP FRONTAL
2009 SUBARU FORESTER M95500
Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

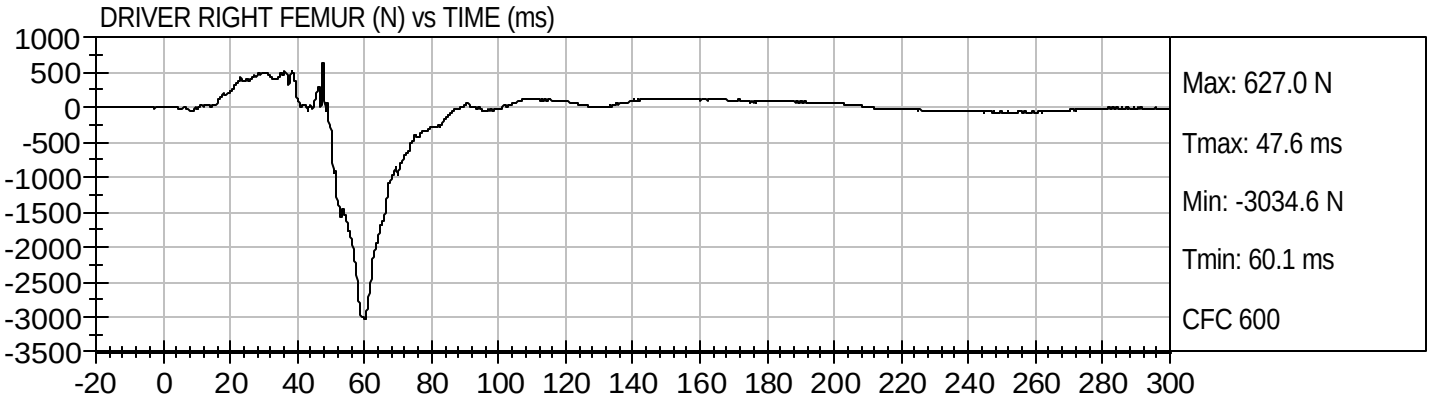






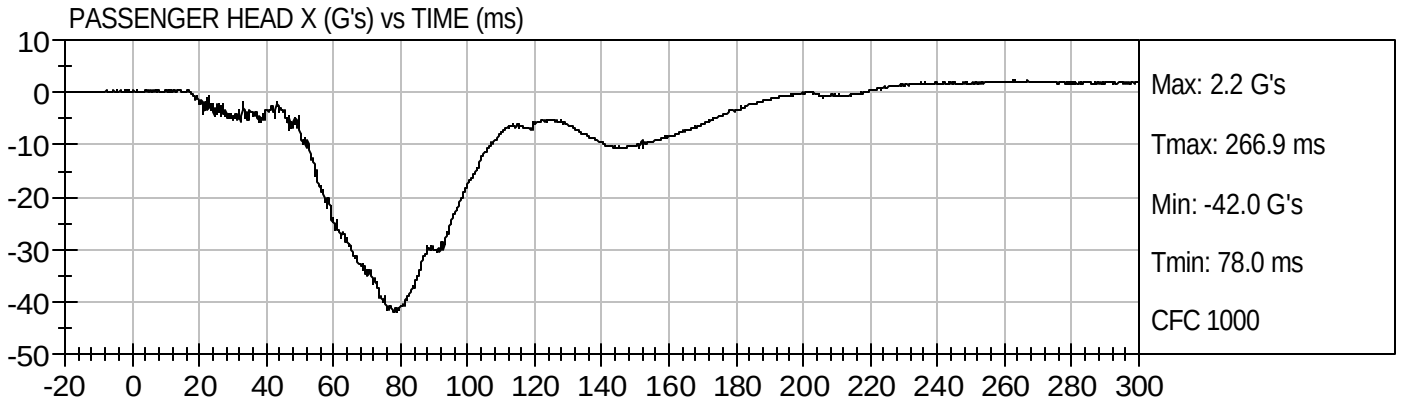
NCAP FRONTAL
2009 SUBARU FORESTER M95500
Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

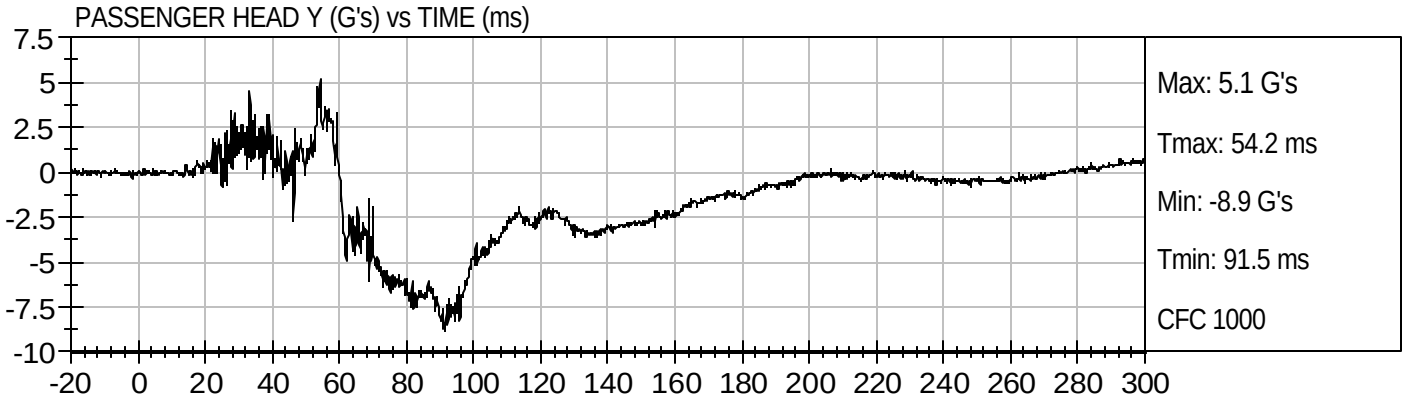


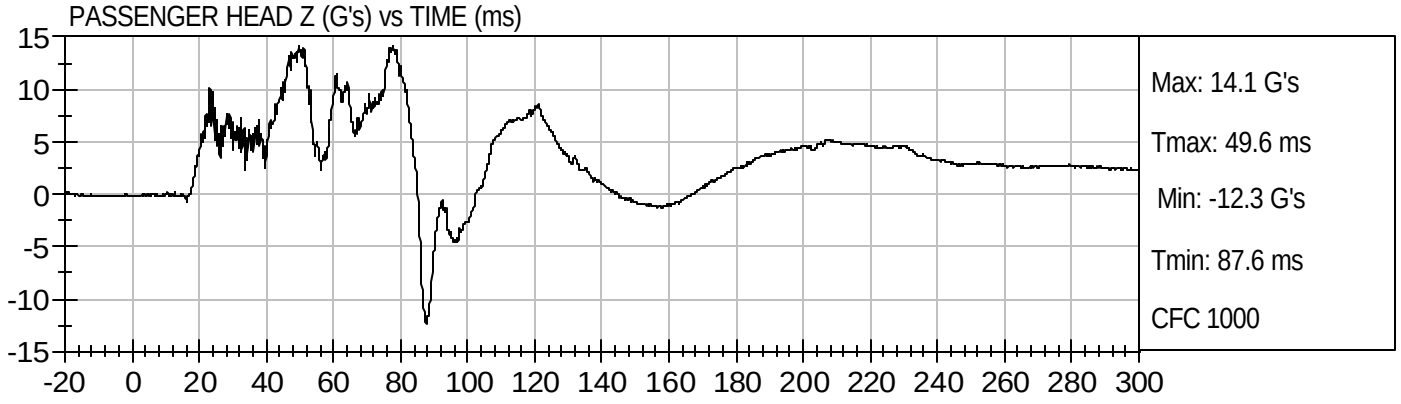


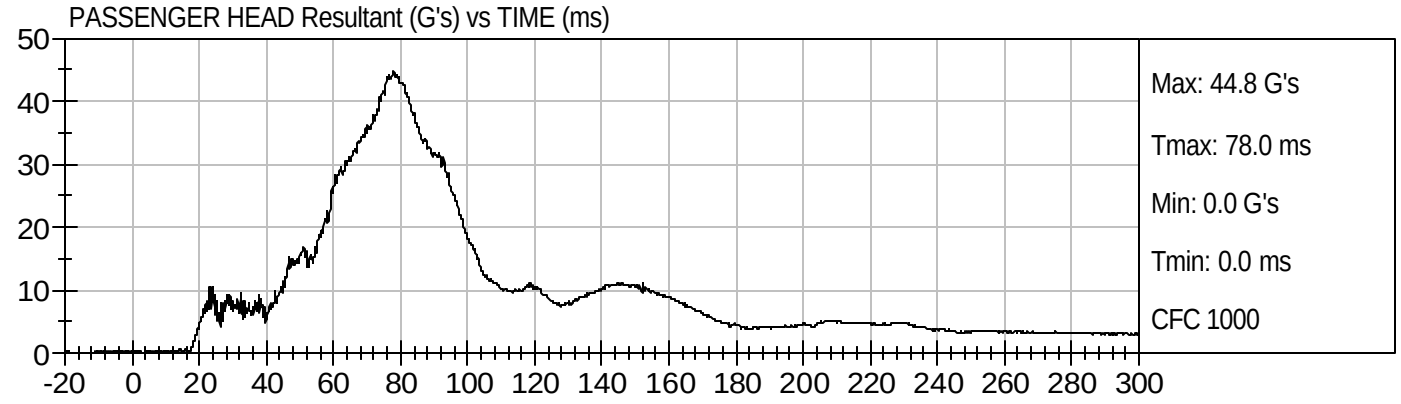
NCAP FRONTAL
2009 SUBARU FORESTER M95500

Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

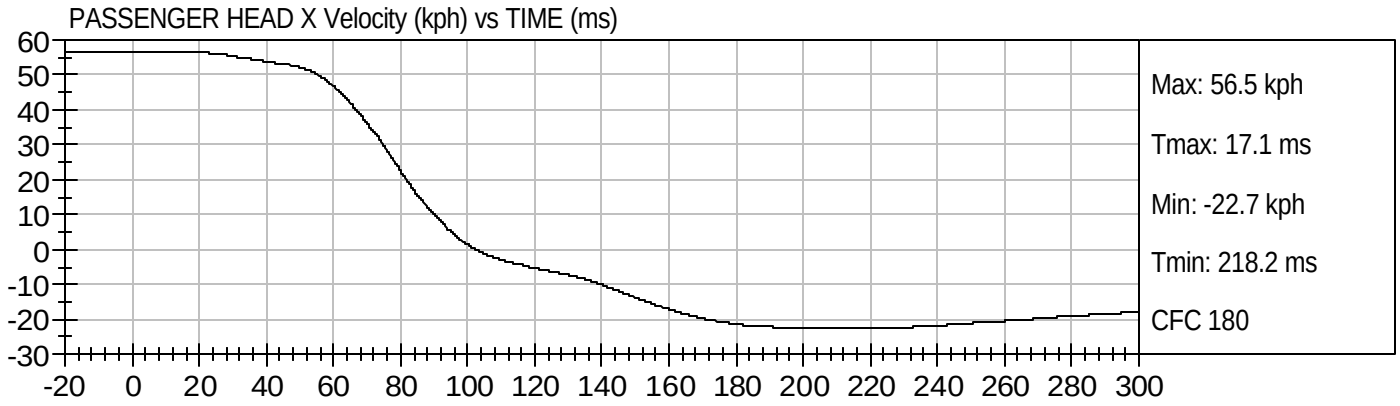


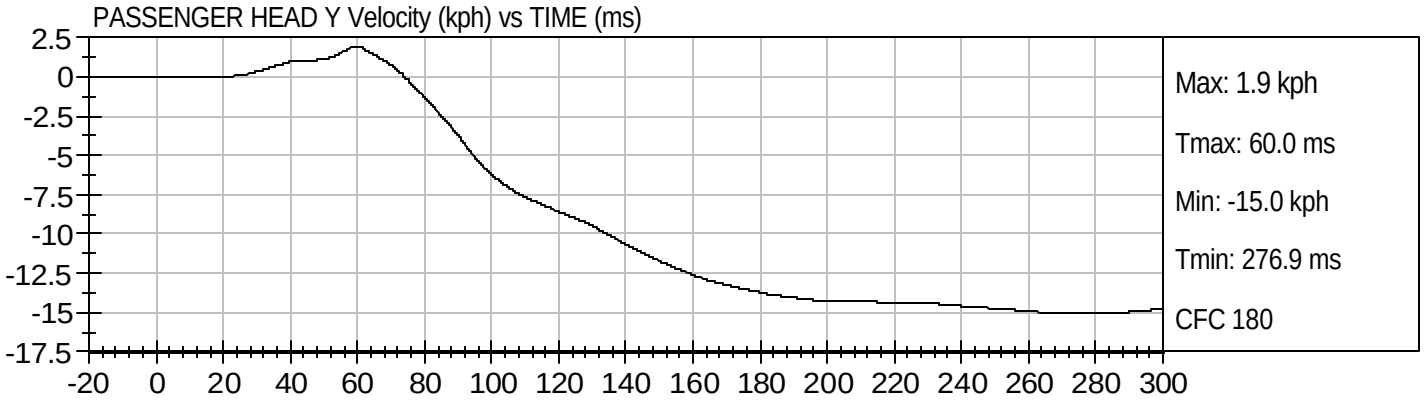


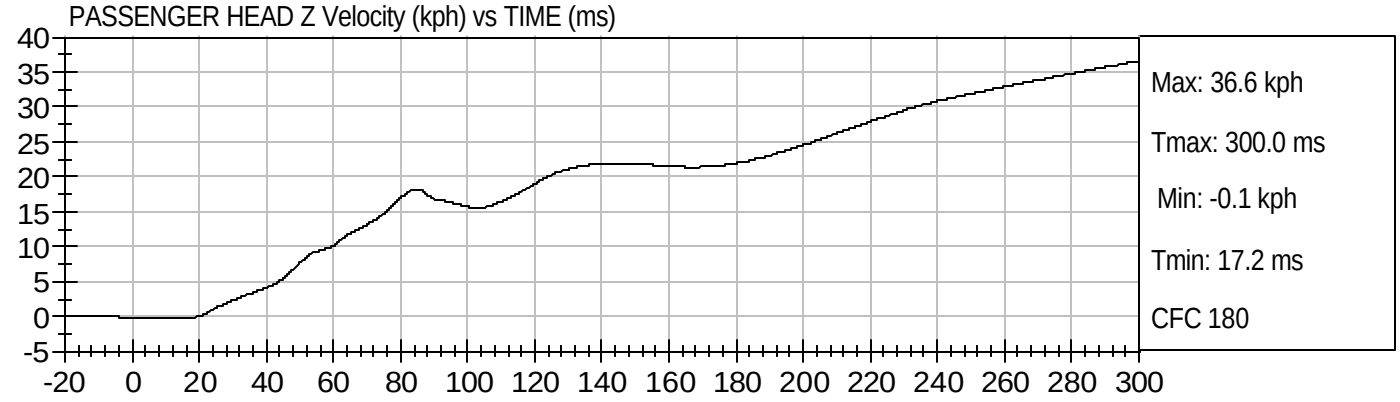




NCAP FRONTAL
2009 SUBARU FORESTER M95500
Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

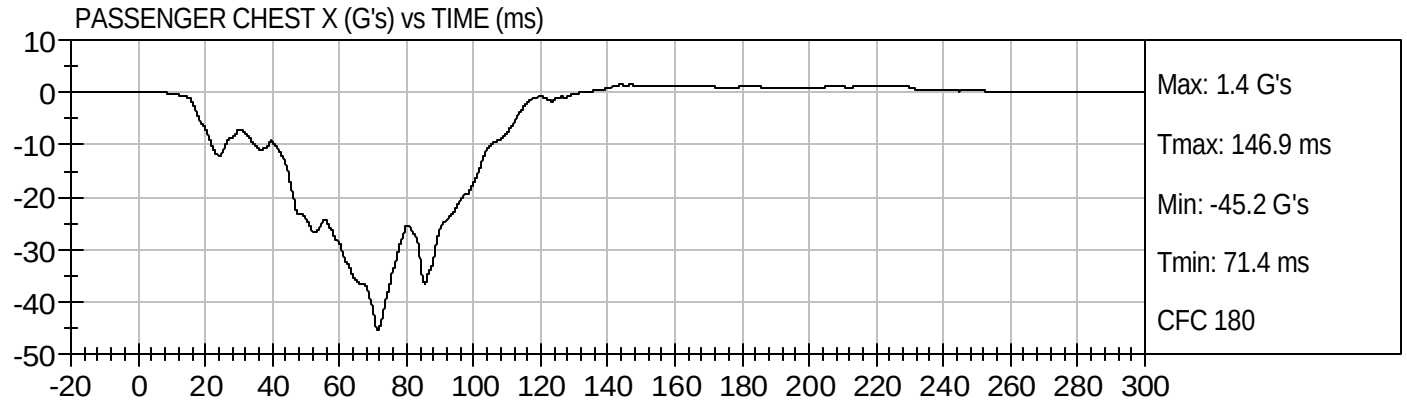


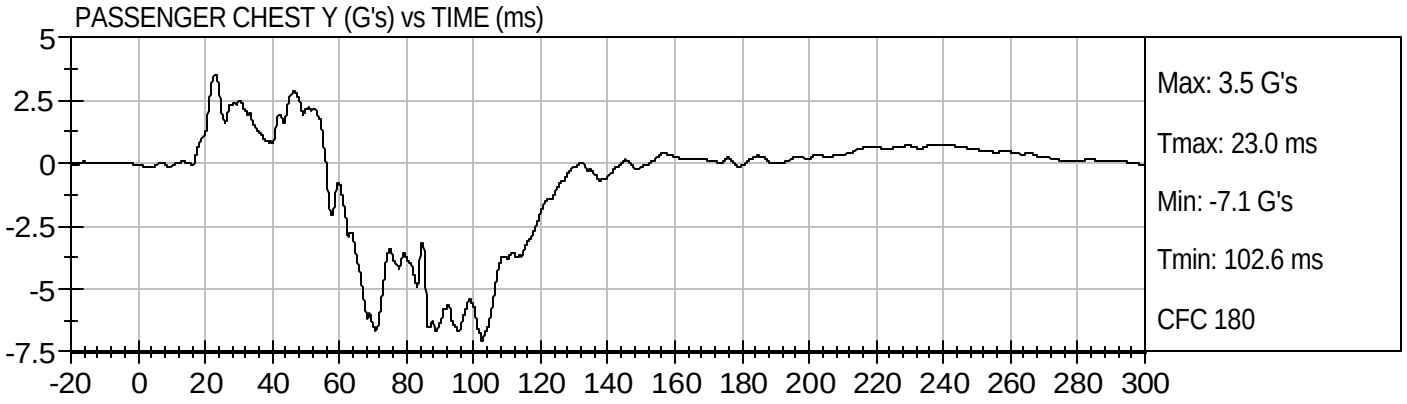


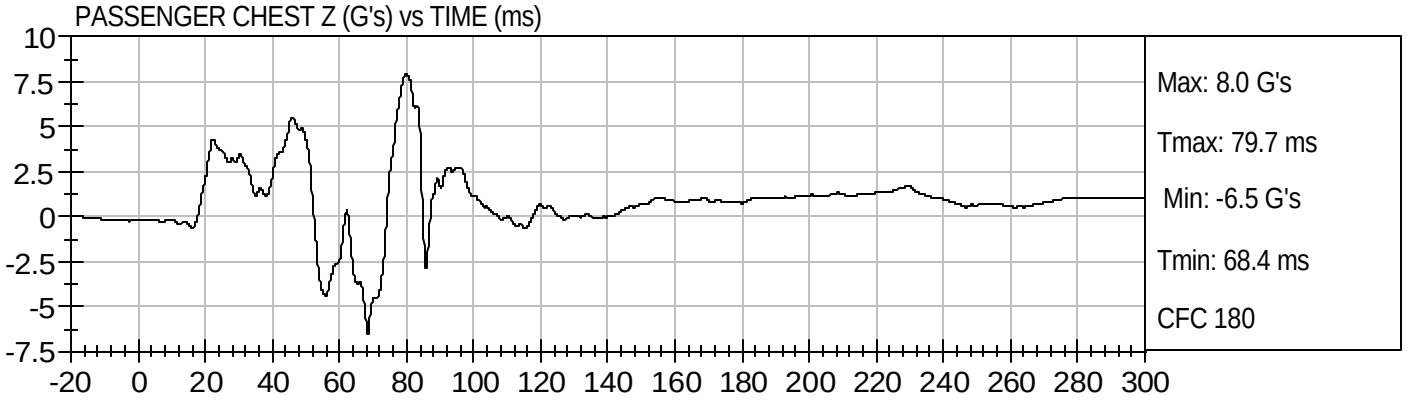


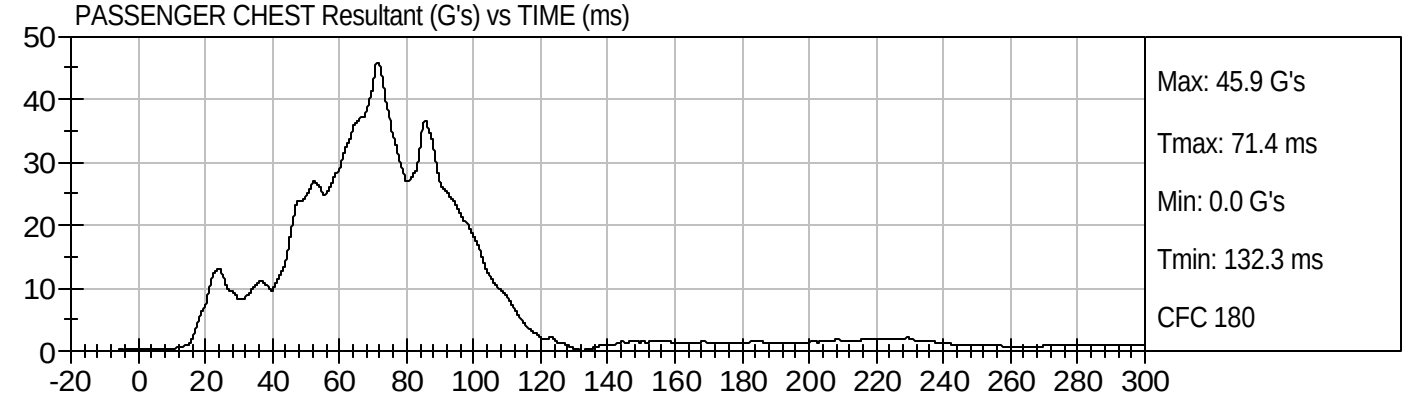
NCAP FRONTAL
2009 SUBARU FORESTER M95500

Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

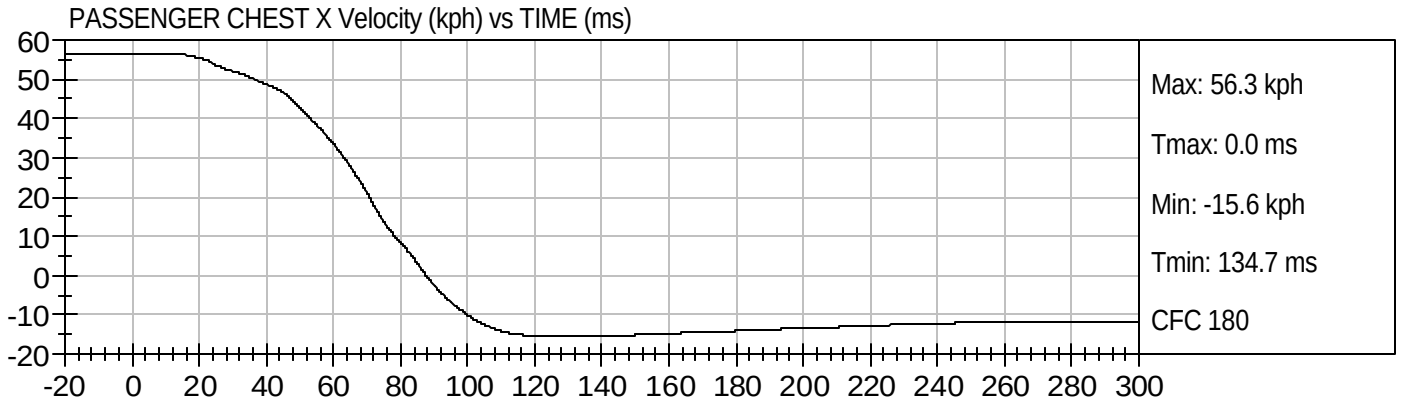


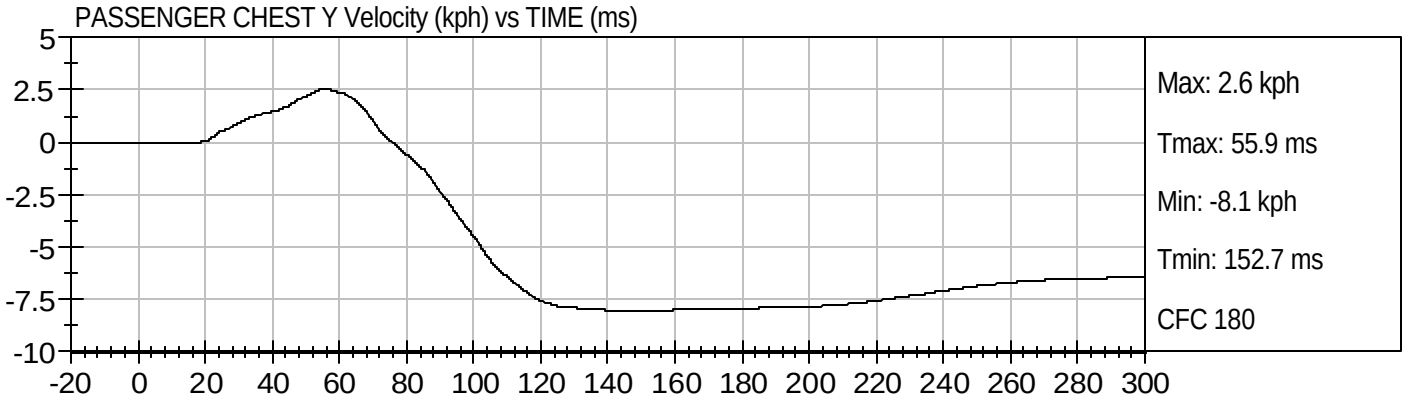


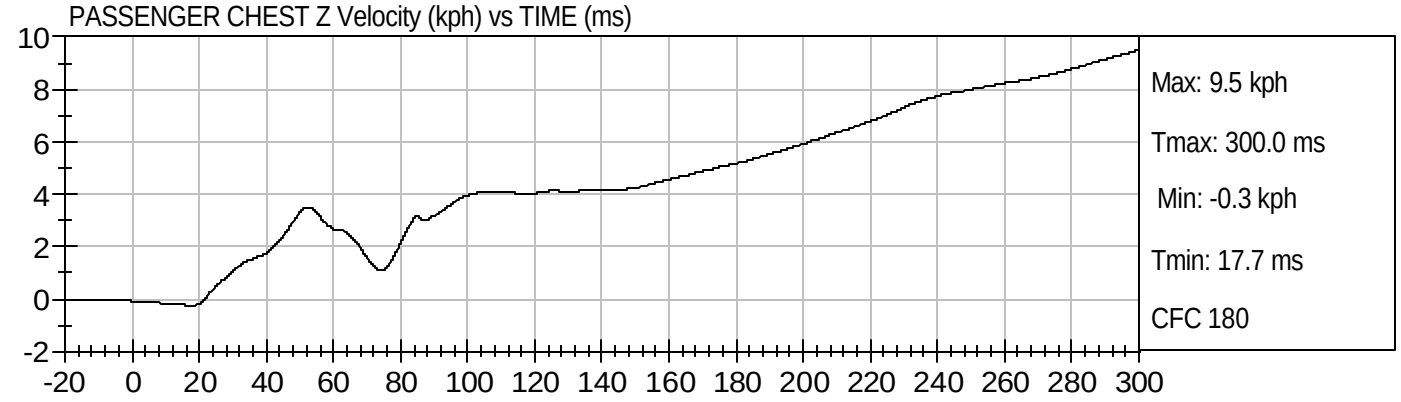




NCAP FRONTAL
2009 SUBARU FORESTER M95500
Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

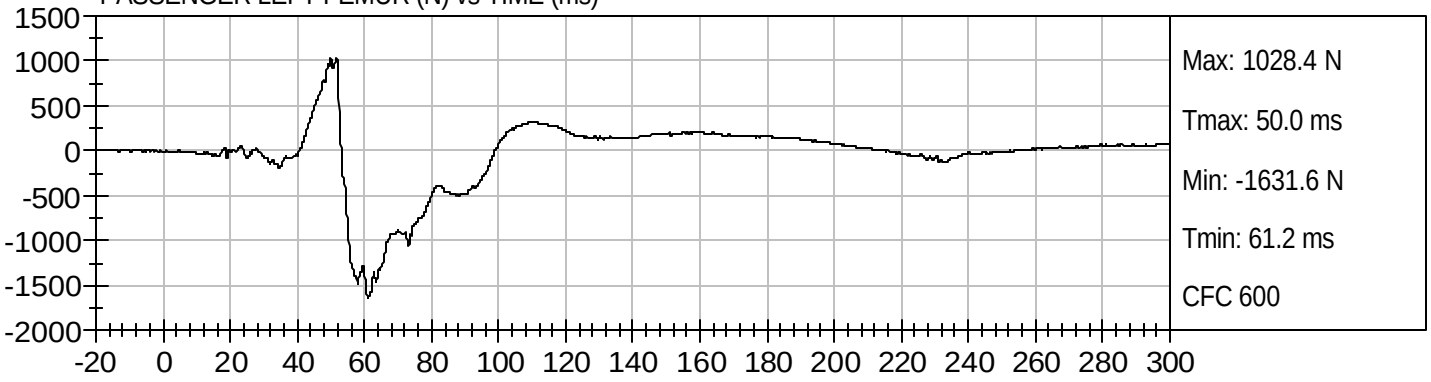




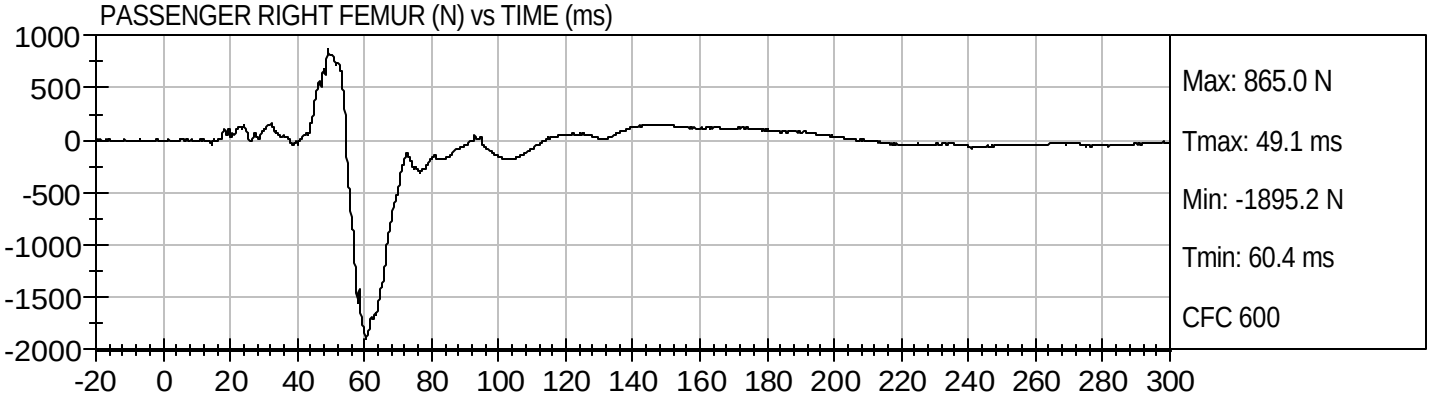


NCAP FRONTAL
2009 SUBARU FORESTER M95500
Test Date: 04/14/2008
Speed: 35.0 mph (56.3 km/h)

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: 066 **Test ID:** D073671

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Peak Resultant Acceleration	G's	225 - 275	266	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-6.3	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Laboratory Technician

12/26/07

Test Date

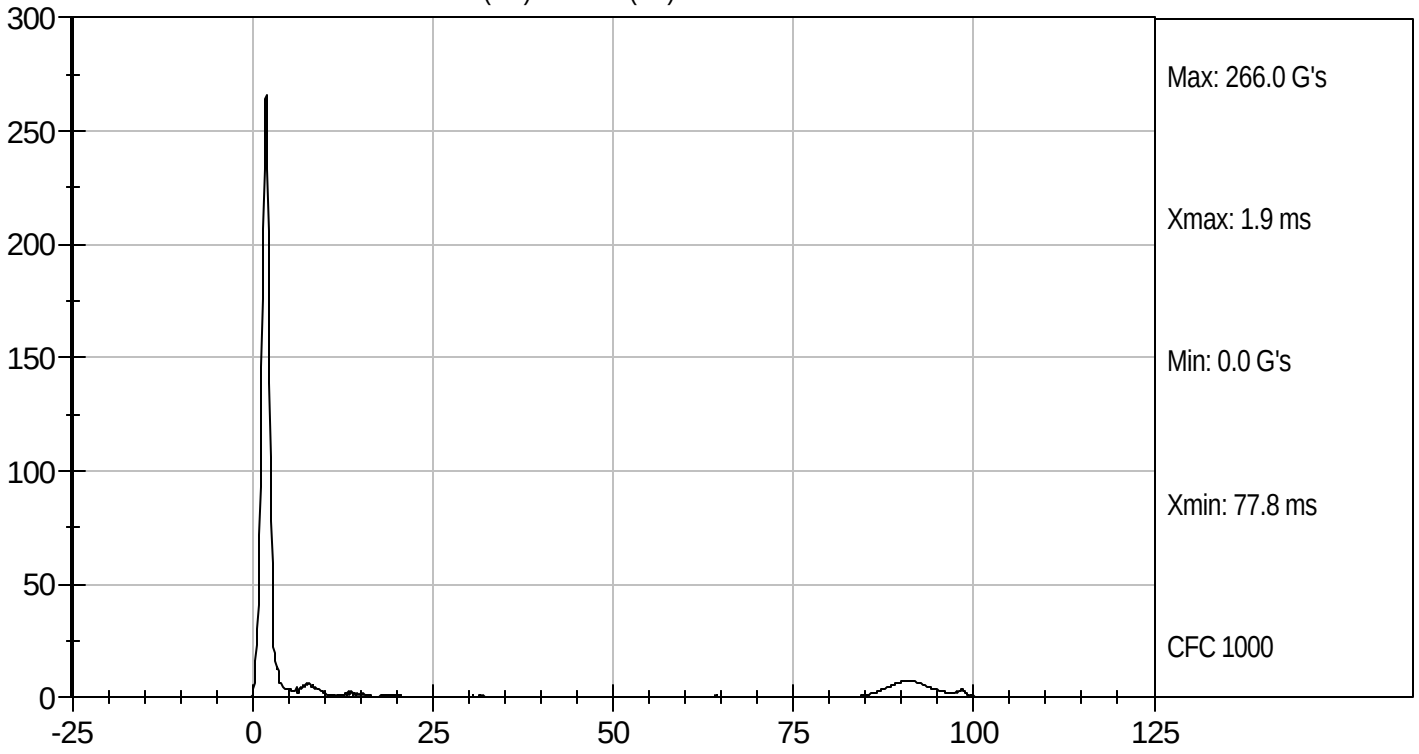
David Winkelbauer

Approved By

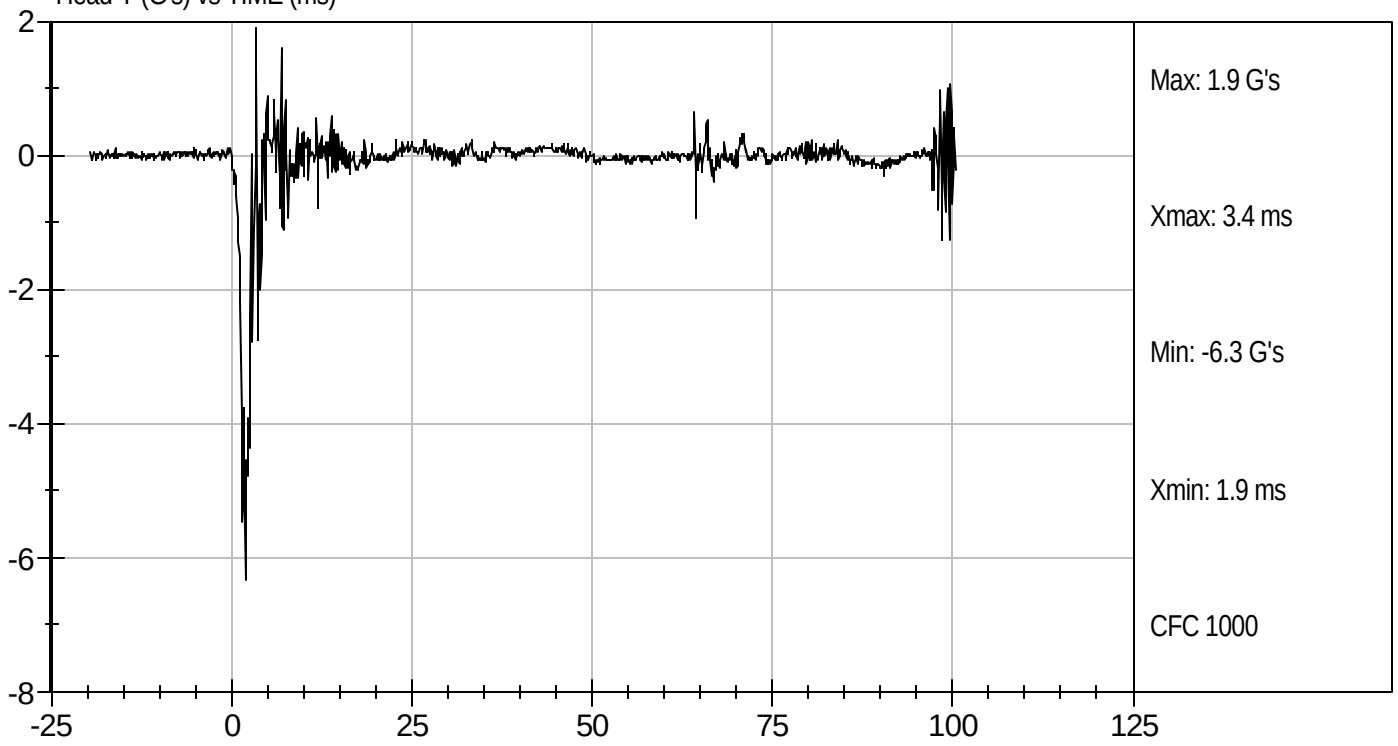
Test Desc: Head Drop
Component ID: D073671

Test Date: 12/26/07
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:** D073672

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	25.14	Pass
	20 msec	G's	17.60 to 22.60	21.44	Pass
	30 msec	G's	12.50 to 18.50	17.49	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	17.38	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	71.9	Pass
	Time	msec	57.0 to 64.0	59.4	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	113.8	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	102.0	Pass
	Time	msec	47.0 to 58.0	47.9	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	103.3	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

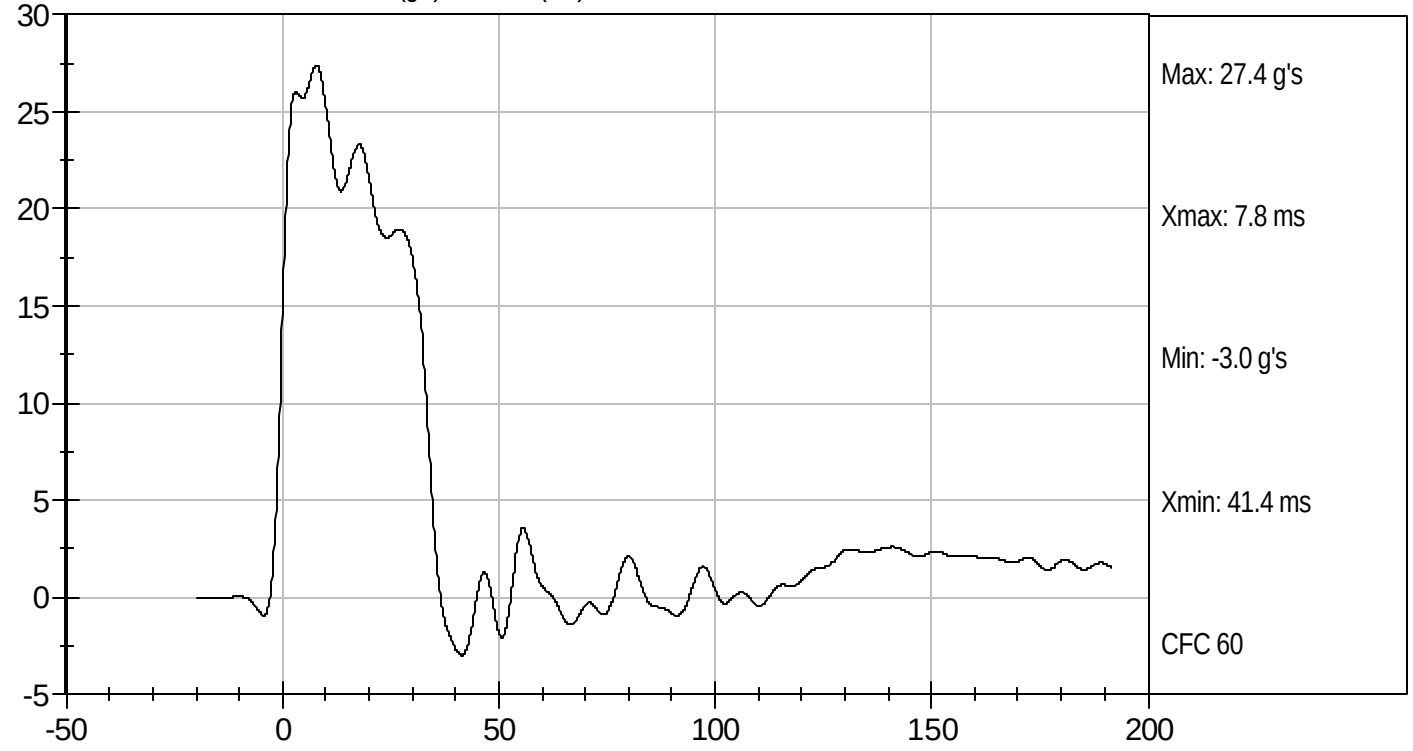
12/26/07
Test Date

David Winkelbauer
Approved By

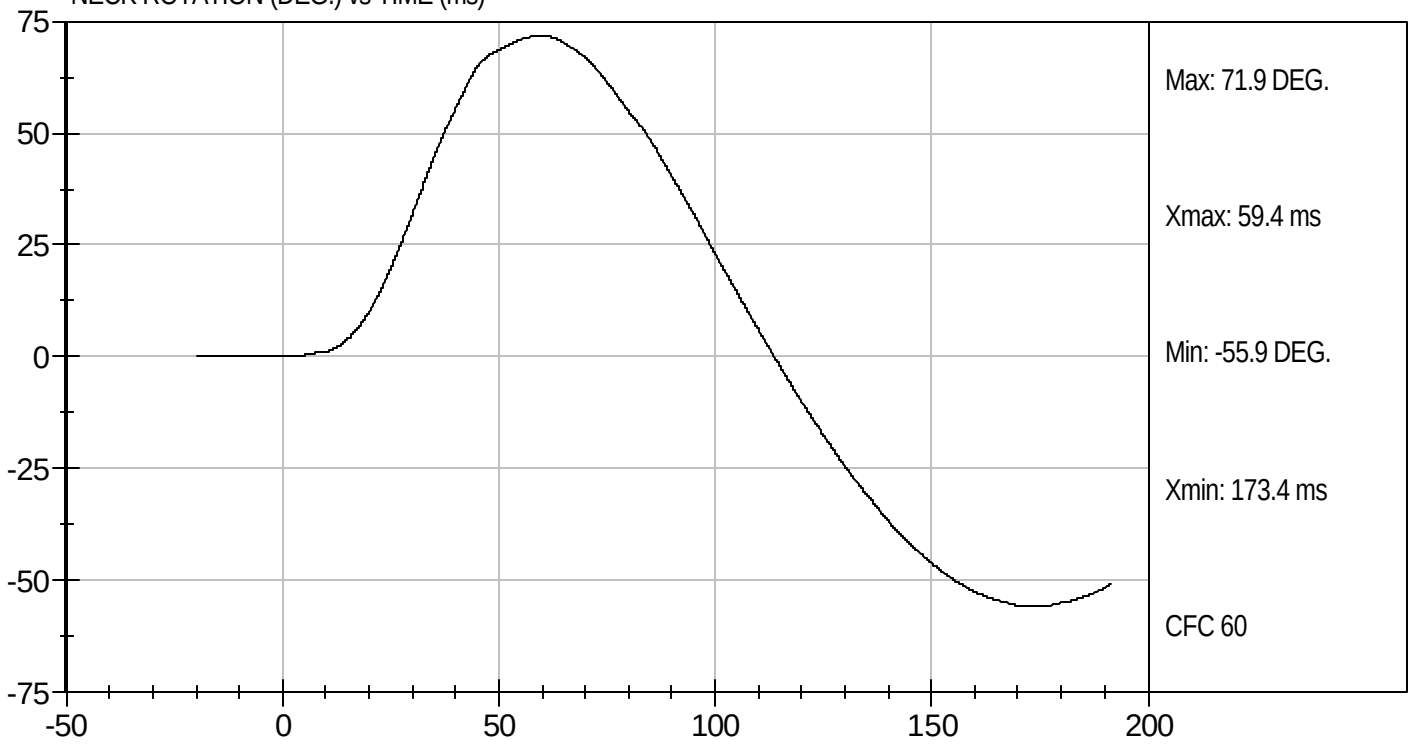
Test Desc: Neck Flexion
Component ID: D073672

Test Date: 12/26/07
Velocity: 23.15 ft/s, 7.06 m/s

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

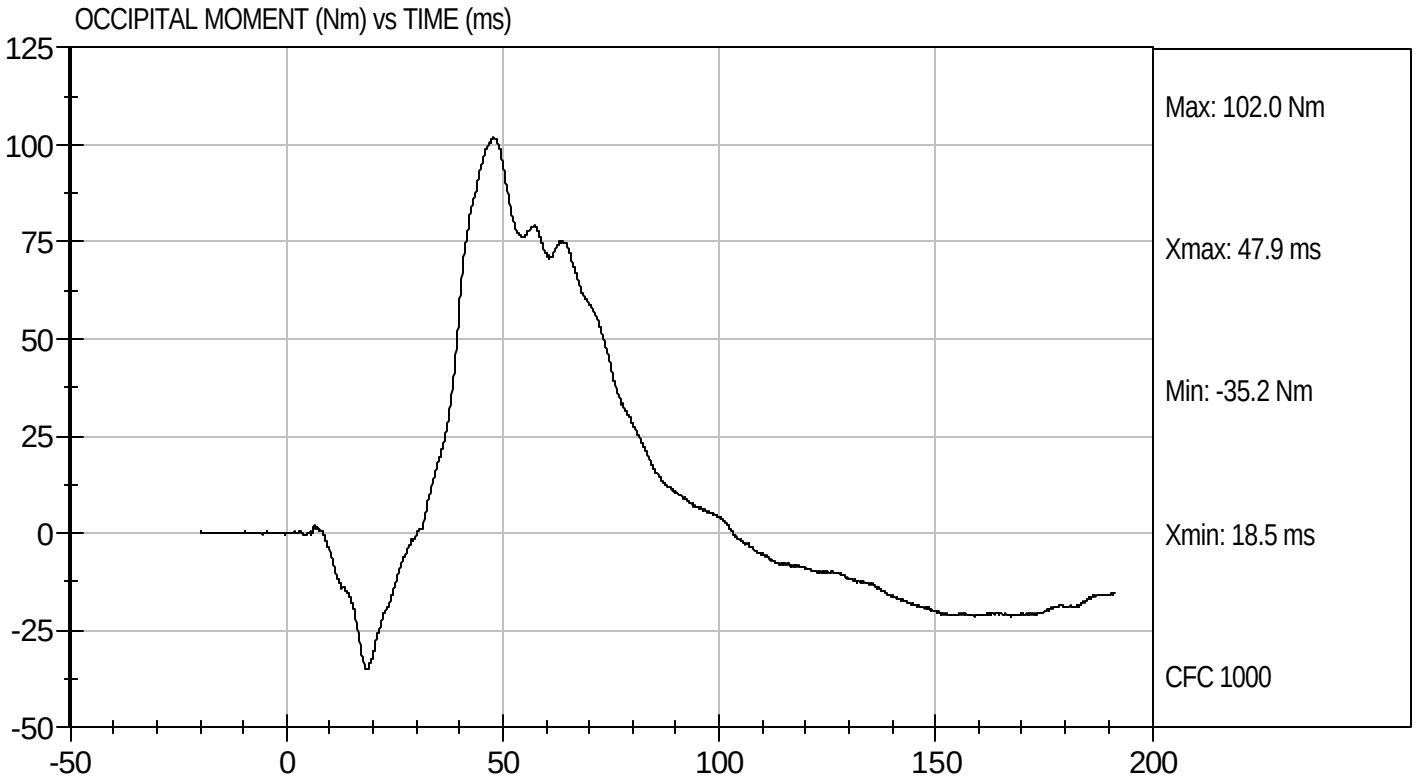


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D073672

Test Date: 12/26/07
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:** D073673

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	24	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.08	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	20.20	Pass
	20 msec	G's	14.00 to 19.00	17.76	Pass
	30 msec	G's	11.00 to 16.00	14.37	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	14.28	Pass
Deceleration Decay Time to Cross 5 G's		msec	38.0 to 46.0	38.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	81.0 to 106.0	98.1	Pass
	Time	msec	72.0 to 82.0	76.3	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	154.1	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-63.6	Pass
	Time	msec	65.0 to 79.0	69.1	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	143.8	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

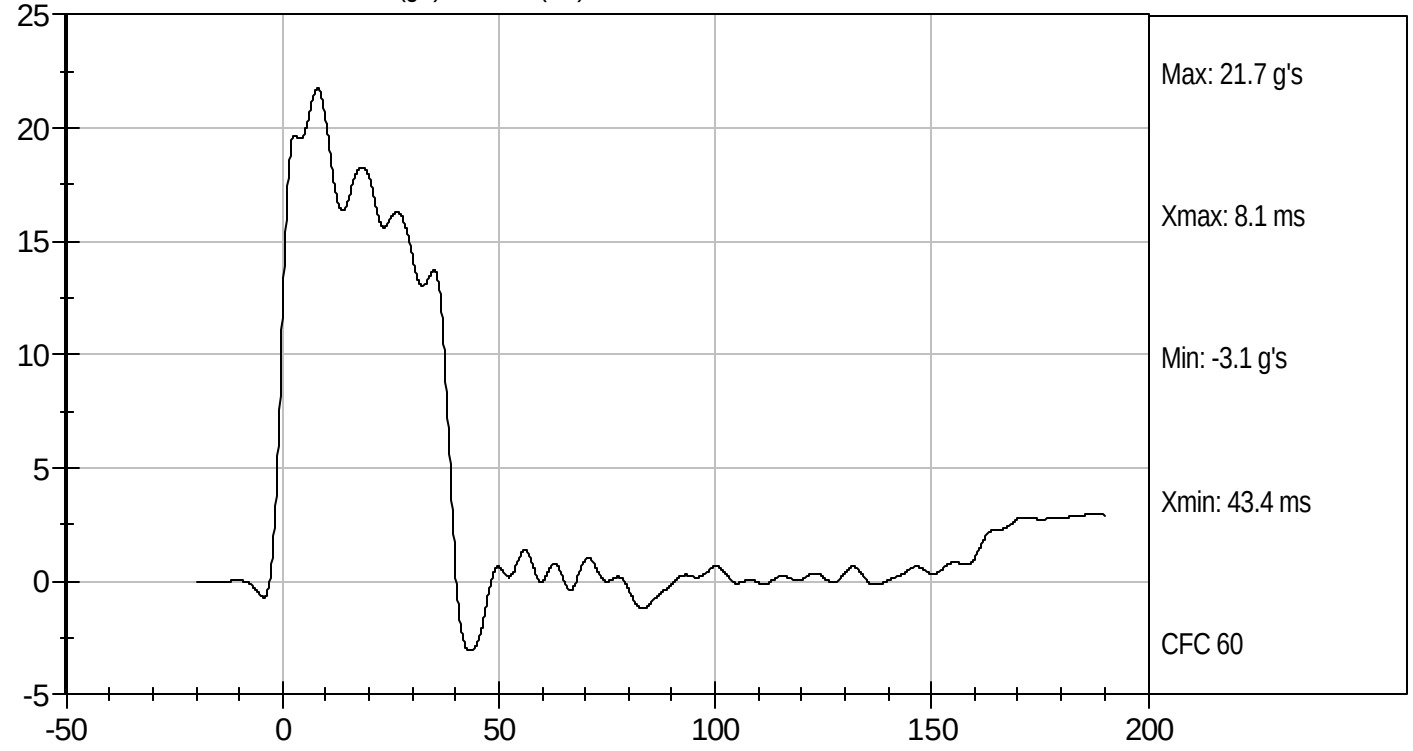
12/26/07
Test Date

David Winkelbauer
Approved By

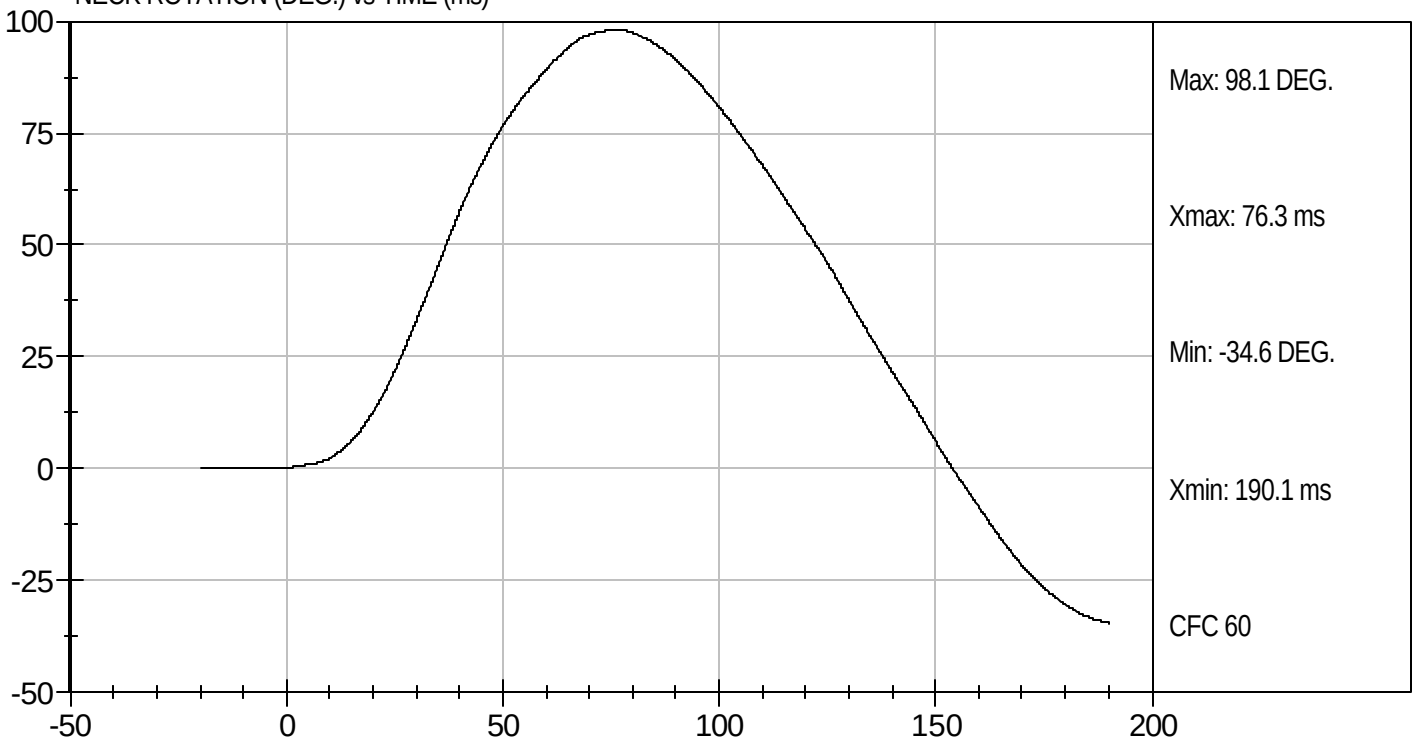
Test Desc: Neck Extension
Component ID: D073673

Test Date: 12/26/07
Velocity: 19.96 ft/s, 6.08 m/s

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

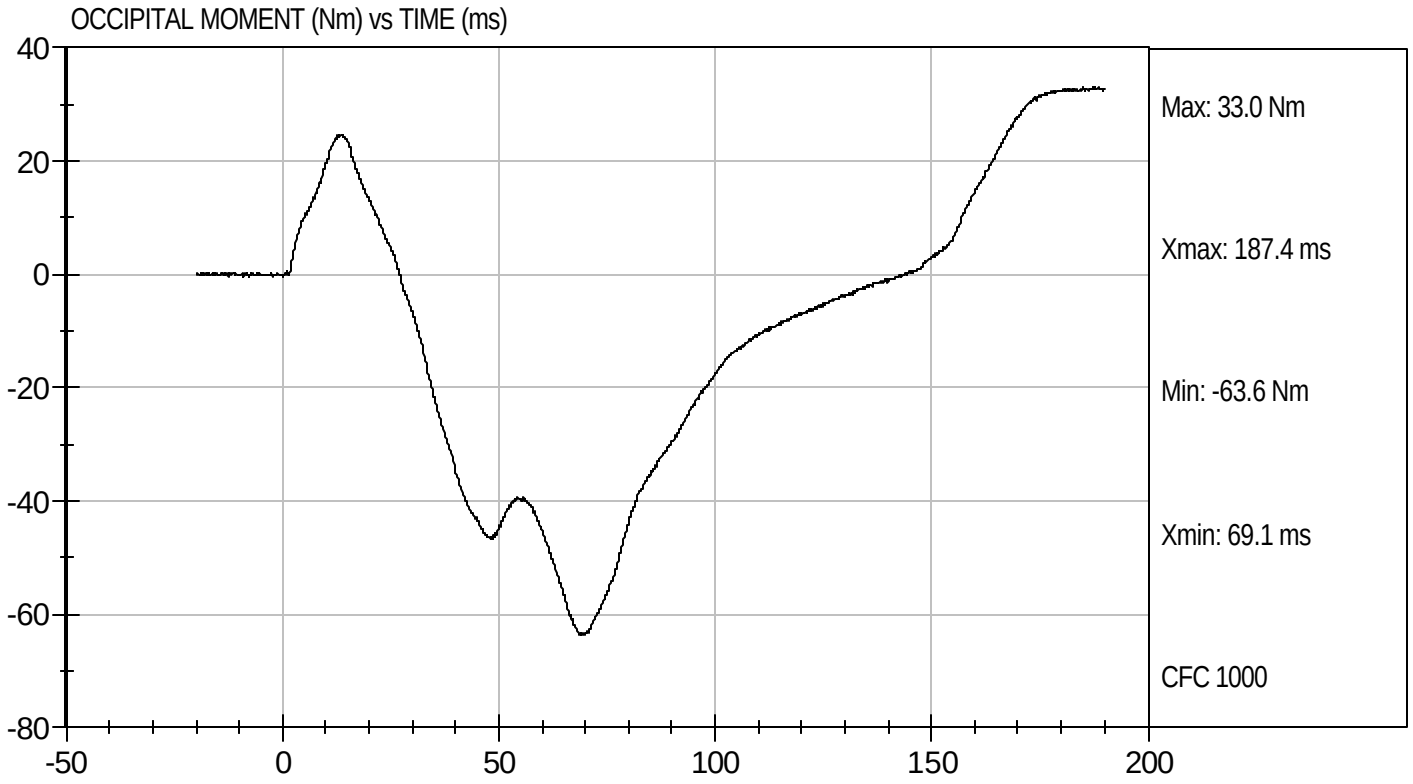


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D073673

Test Date: 12/26/07
Velocity: 19.96 ft/s, 6.08 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D073674

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	31	Pass
Probe Velocity	m/s	6.58 to 6.82	6.68	Pass
Peak Probe Force	N	5159 to 5893	5,286	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.64	Pass
Internal Hysteresis	%	69 to 85	73	Pass
		Overall Test Results		Pass

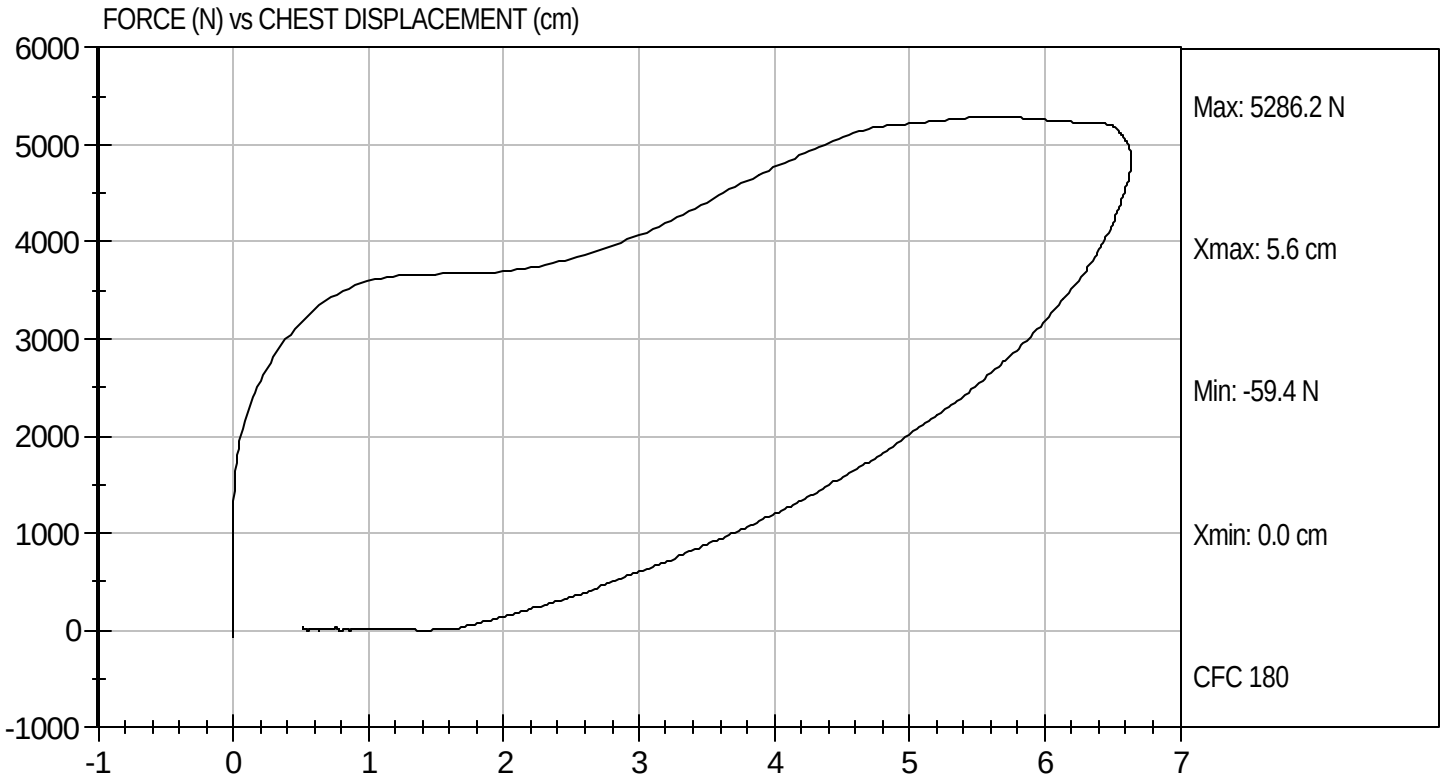
Laboratory Technician

1/11/08
Test Date

Approved By

Test Desc: Thorax Impact
Component ID: D073674

Test Date: 1/11/08
Velocity: 21.92 ft/s, 6.68 m/s



MGA RESEARCH CORPORATION

RIGHT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D073675

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.08	Pass
Peak Probe Force	Newtons	4715 to 5782	5,176	Pass
		Overall Test Results		Pass

Laboratory Technician

12/26/07

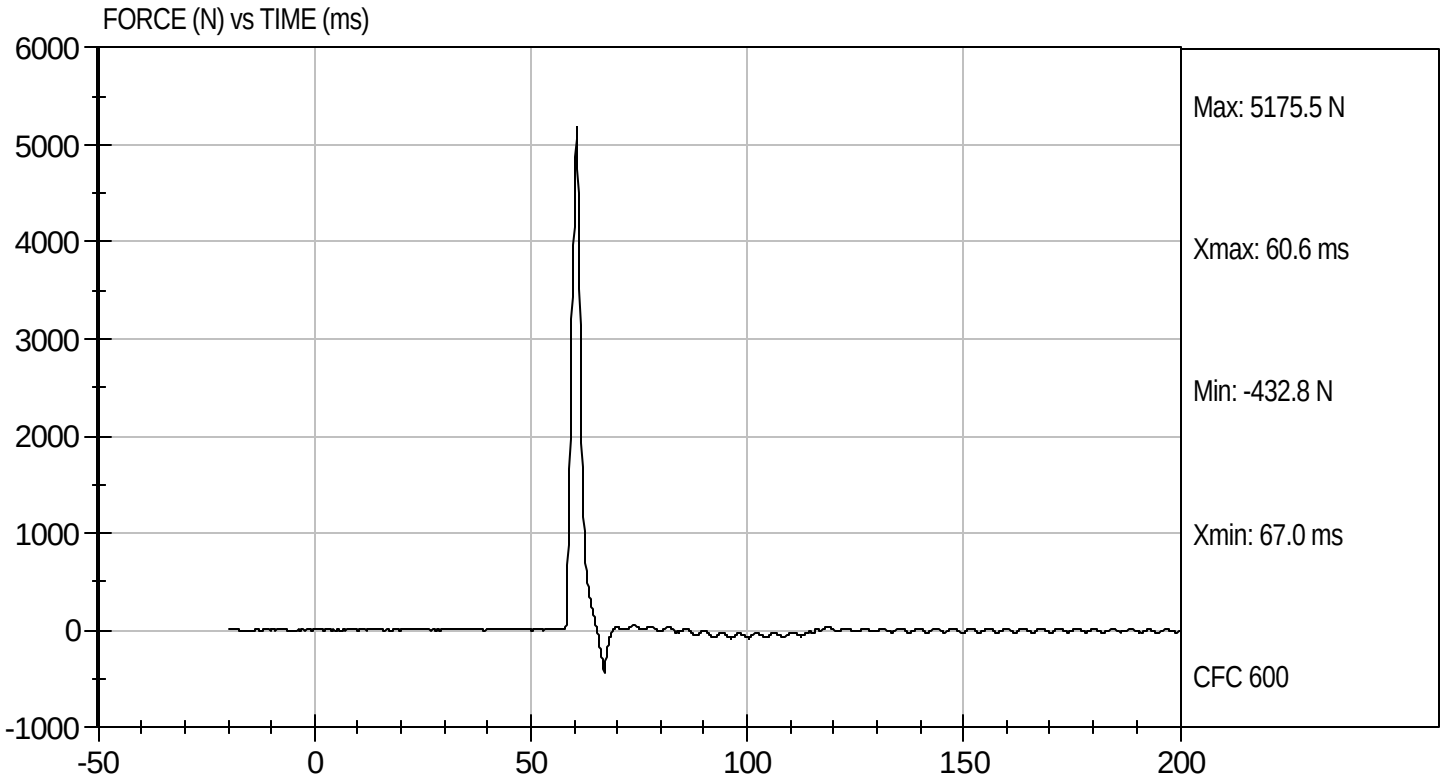
Test Date

David Winkelbauer

Approved By

Test Desc: Right Knee
Component ID: D073675

Test Date: 12/26/07
Velocity: 6.83 ft/s, 2.08 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D073676

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	24	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.07	Pass
Peak Probe Force	Newtons	4715 to 5782	4,979	Pass
		Overall Test Results		Pass

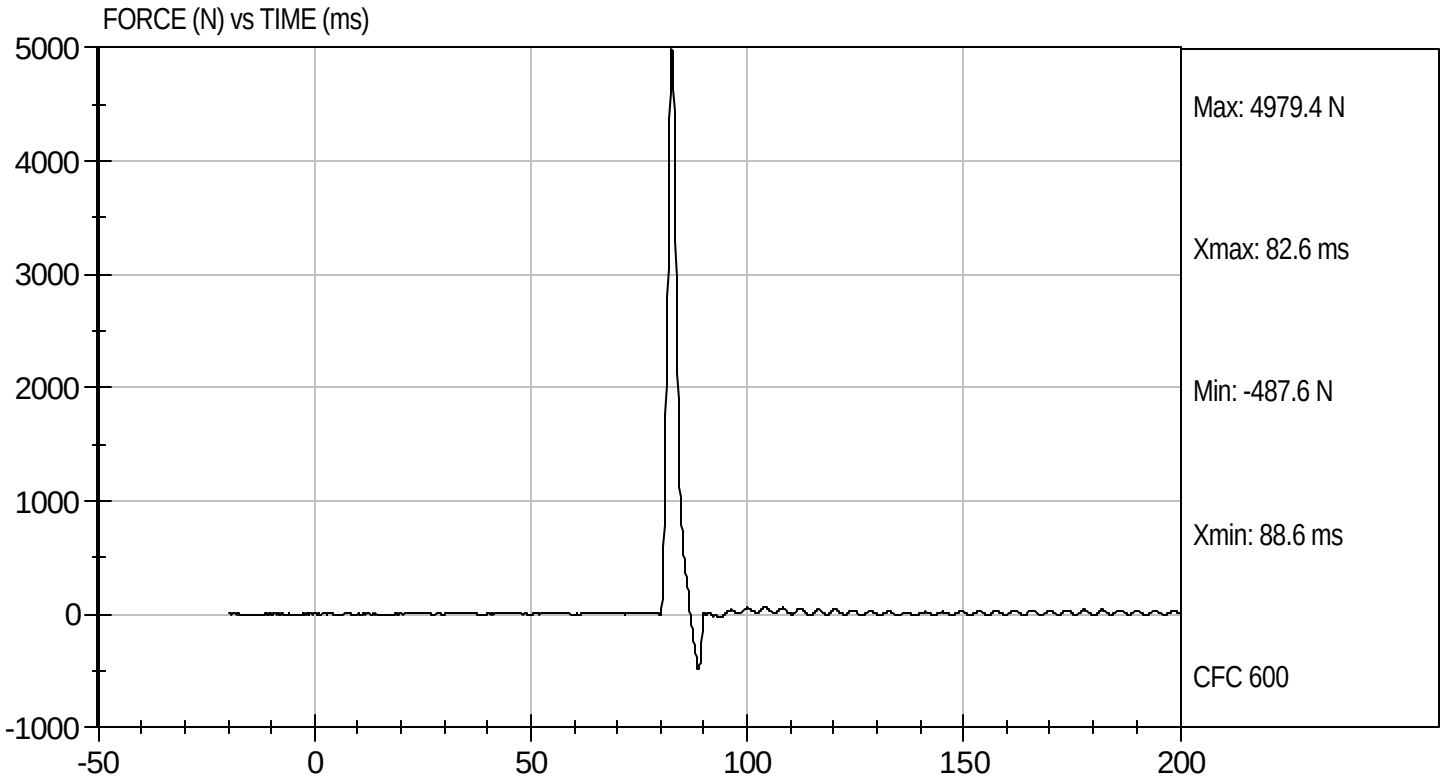
Laboratory Technician

12/26/07
Test Date

David Winkelbauer
Approved By

Test Desc: Left Knee
Component ID: D073676

Test Date: 12/26/07
Velocity: 6.80 ft/s, 2.07 m/s



MGA RESEARCH CORPORATION

HIP-FEMUR FLEXION TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 066 **Test I.D:** D073670

Tested Parameter	Units	Specification	Result		Pass/Fail
			Right	Left	
Laboratory Temperature	deg C	18.9 to 25.6	21.5	21.5	Pass
Laboratory Relative Humidity	%	10 to 70	24	24	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	69.4	61.9	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	40	40	Pass
		Overall Test Results			Pass

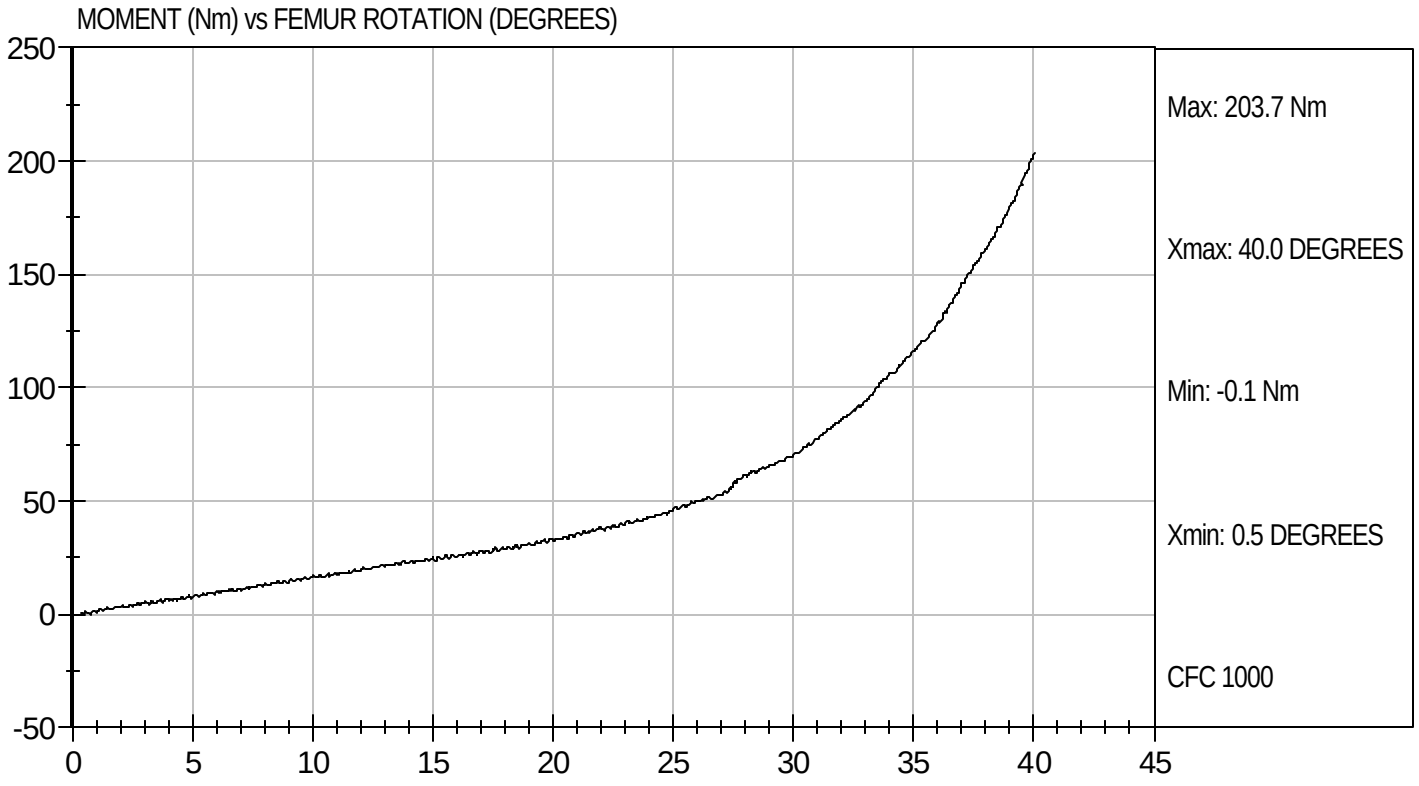
Laboratory Technician

12/26/07
Test Date

David Winkelbauer
Approved By

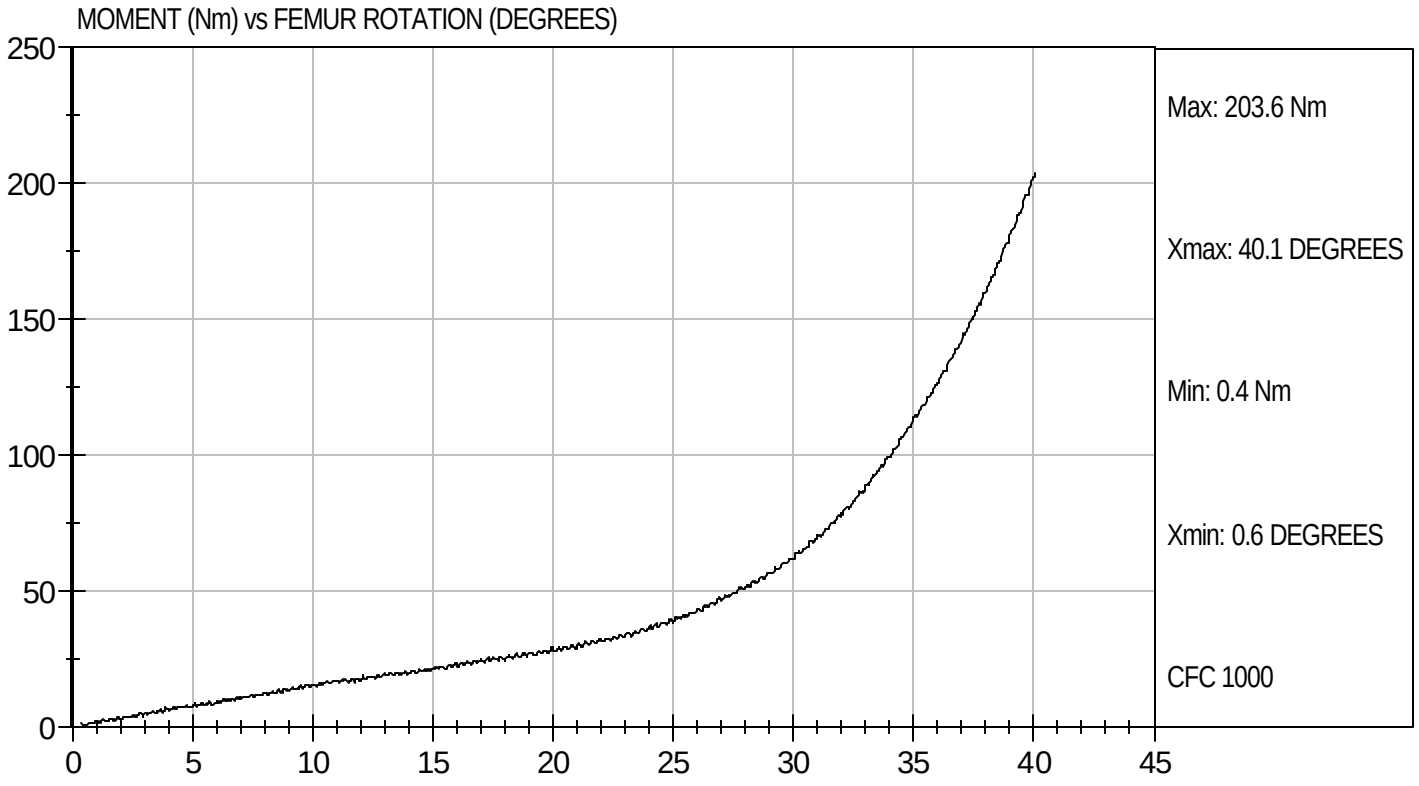
Test Desc: Hip Femur Flexion
Component ID: D073679

Test Date: 12/26/07
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D073670

Test Date: 12/26/07
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:** D08111

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 - 25.6	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	32	Pass
Peak Resultant Acceleration	G's	225 - 275	231	Pass
Peak Lateral Acceleration	G's	<= +/- 15.0	-2.6	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 10% of peak	Yes	Pass
		Overall Test Results		Pass

Laboratory Technician

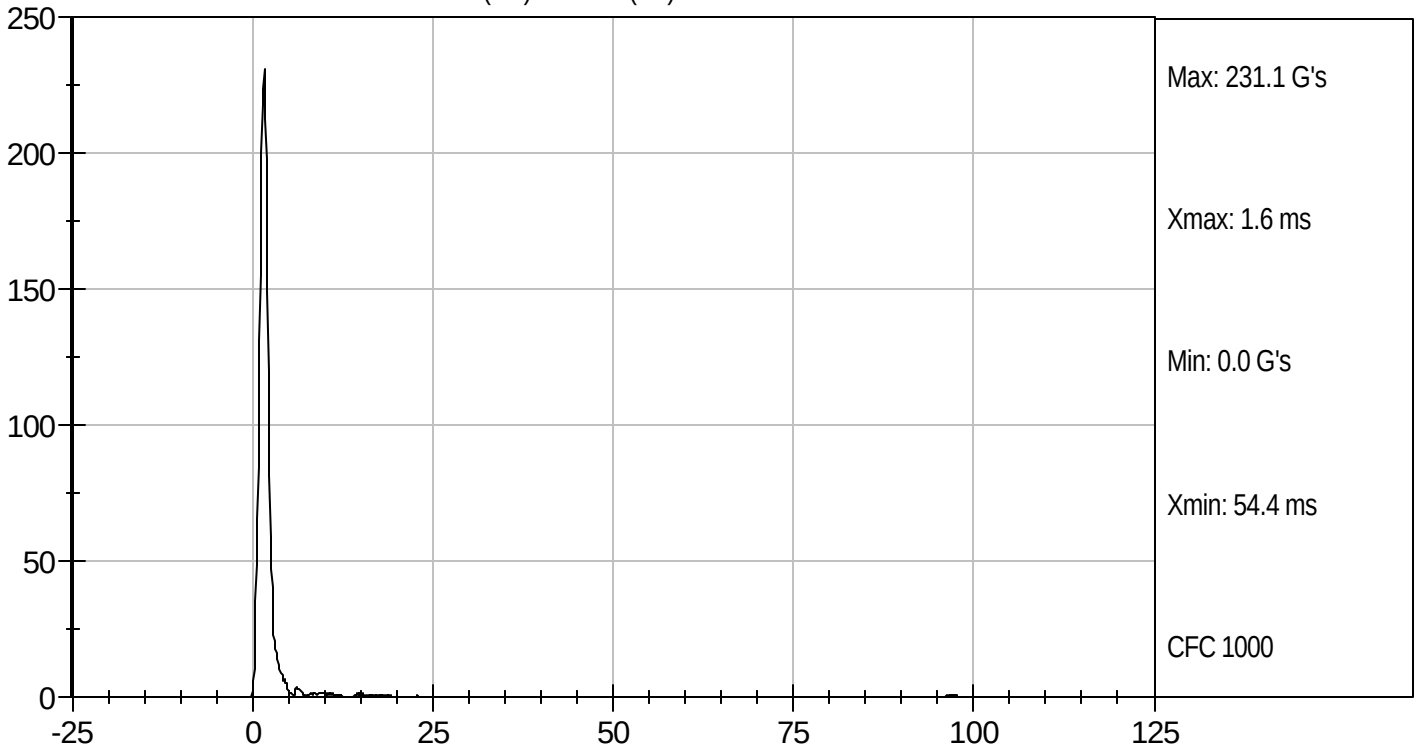
1/29/08
Test Date

David Winkelbauer
Approved By

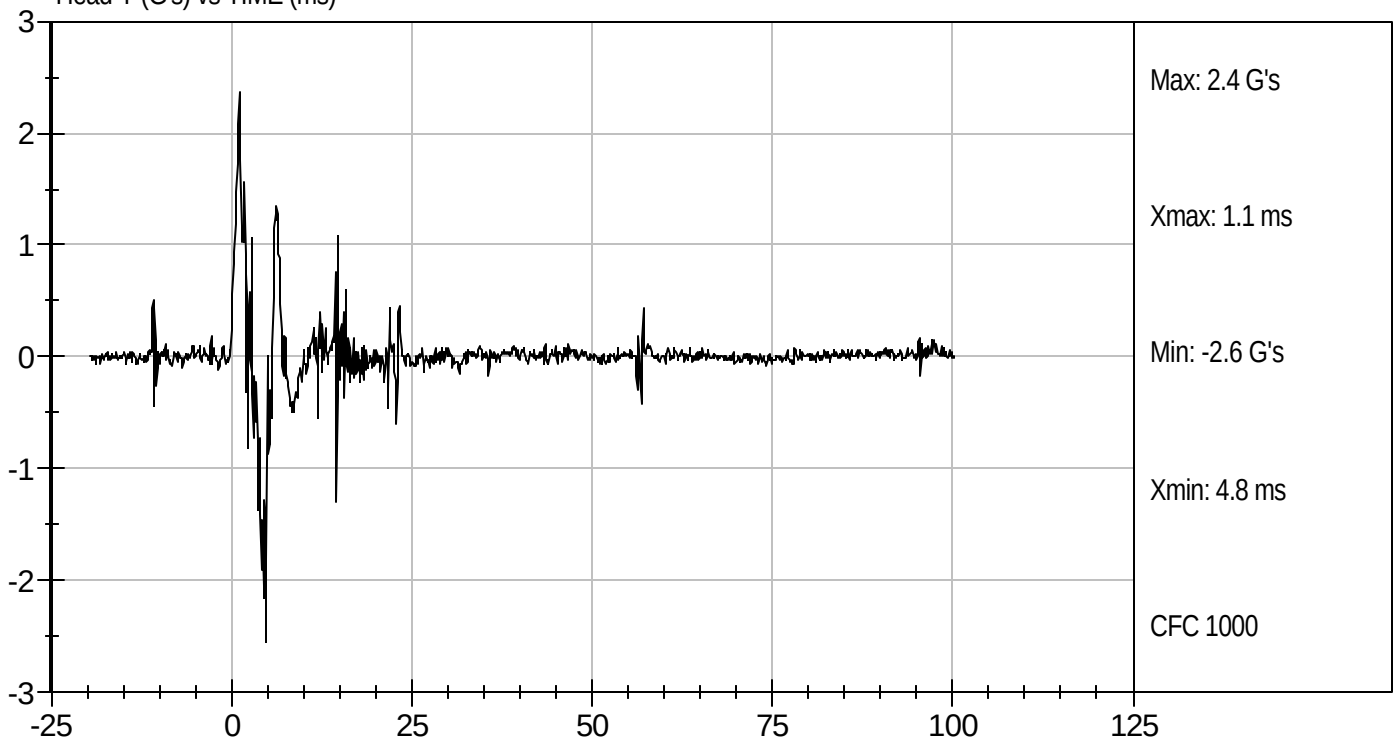
Test Desc: Head Drop
Component ID: D08111

Test Date: 1/29/08
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:** D08112

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	33	Pass
Pendulum Velocity		m/s	6.89 to 7.13	7.06	Pass
Pendulum Deceleration	10 msec	G's	22.50 to 27.50	24.69	Pass
	20 msec	G's	17.60 to 22.60	19.36	Pass
	30 msec	G's	12.50 to 18.50	16.10	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 29.0	15.98	Pass
Deceleration Decay Time to Cross 5 G's		msec	34.0 to 42.0	35.8	Pass
Maximum "D" Plane Rotation	Maximum	Degrees	64.0 to 78.0	71.9	Pass
	Time	msec	57.0 to 64.0	59.6	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	113.0 to 128.0	113.6	Pass
Moment About Occipital Condyle	Maximum	N m	88.1 to 108.5	99.3	Pass
	Time	msec	47.0 to 58.0	47.0	Pass
Positive Moment Decay Time To Zero Crossing		msec	97.0 to 107.0	103.9	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

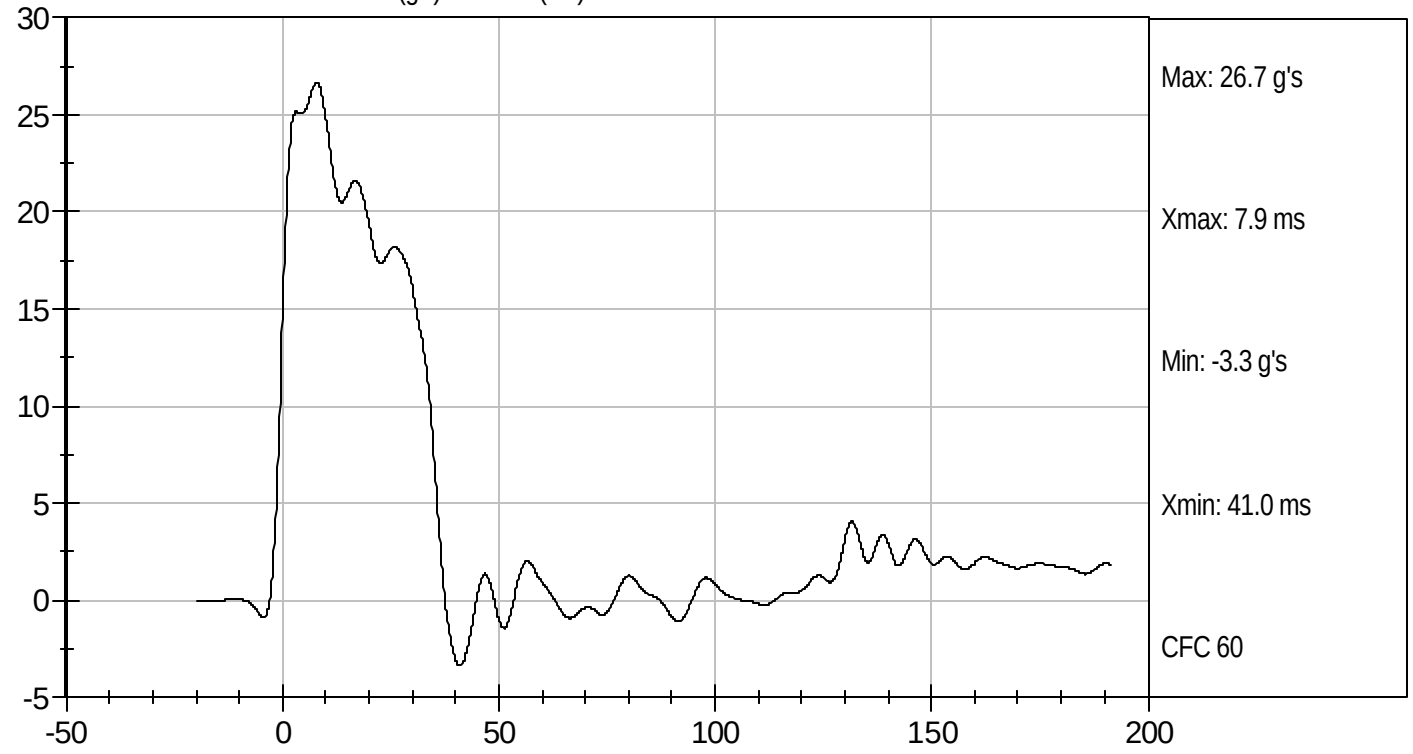
1/29/08
Test Date

David Winkelbauer
Approved By

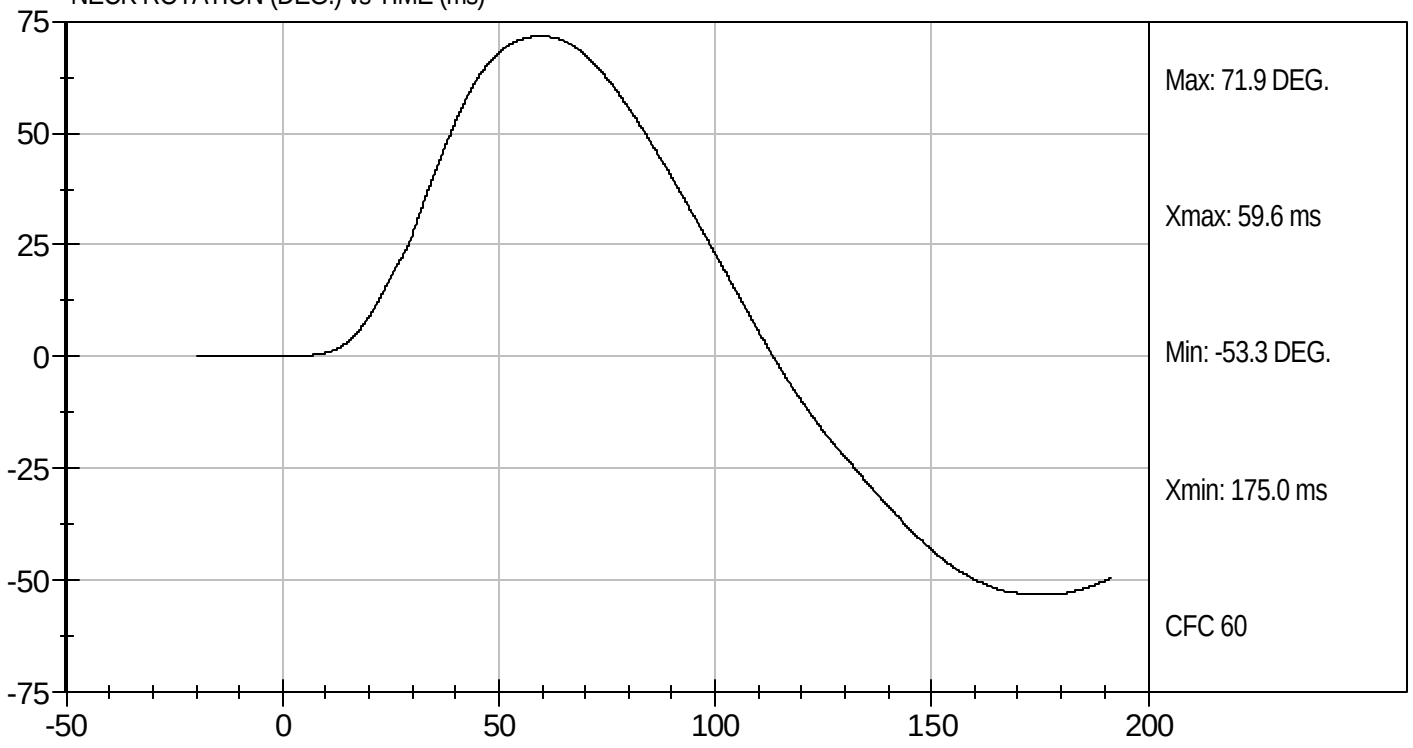
Test Desc: Neck Flexion
Component ID: D08112

Test Date: 1/29/08
Velocity: 23.15 ft/s, 7.06 m/s

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

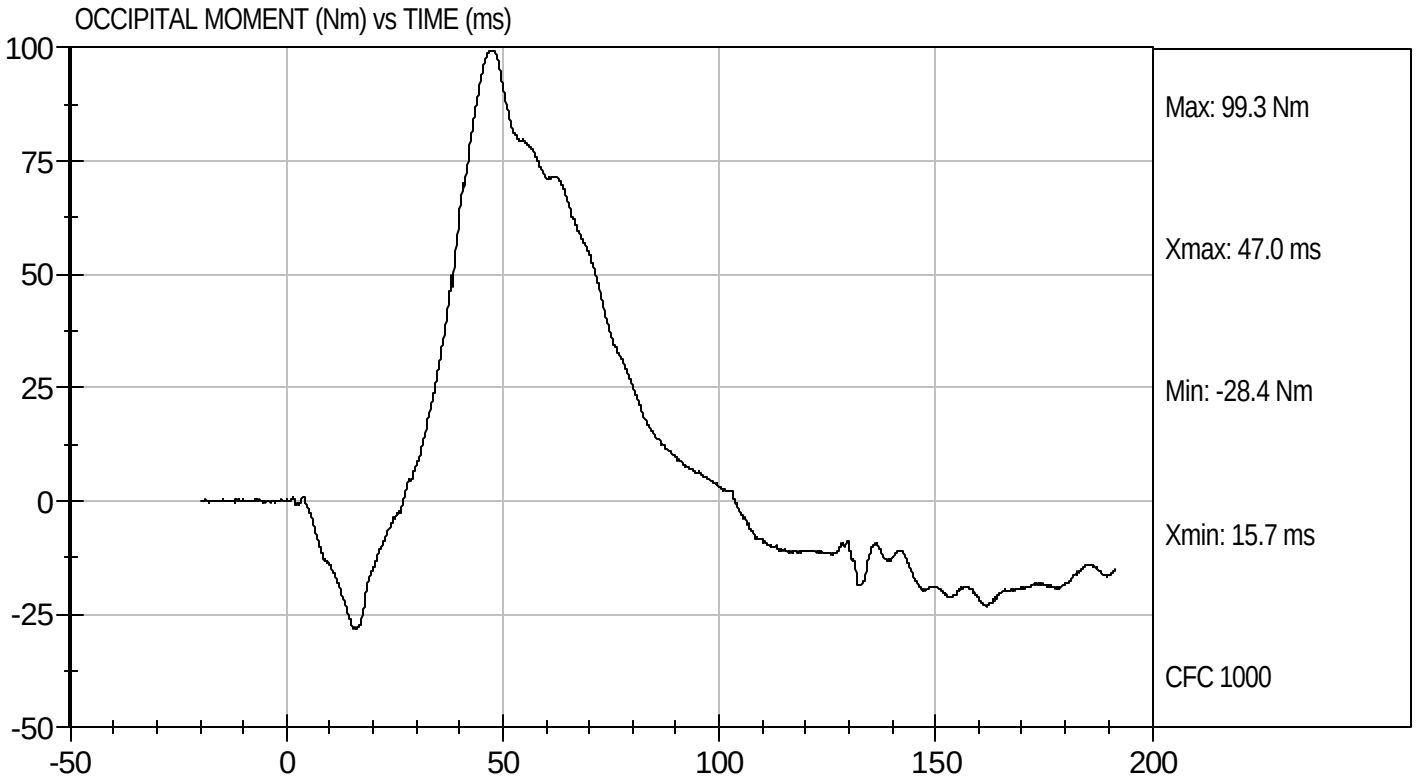


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Flexion
Component ID: D08112

Test Date: 1/29/08
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:** D08113

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	31	Pass
Pendulum Velocity		m/s	5.95 to 6.19	6.12	Pass
Pendulum Deceleration	10 msec	G's	17.20 to 21.20	18.58	Pass
	20 msec	G's	14.00 to 19.00	14.36	Pass
	30 msec	G's	11.00 to 16.00	13.56	Pass
Peak Pendulum Deceleration After 30 msec		G's	<= 22.0	13.81	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	77.1	Pass
"D" Plane Rotation Decay Time To Zero Crossing		msec	147.0 to 174.0	154.2	Pass
Moment About Occipital Condyle	Maximum	N m	-52.9 to -79.9	-68.5	Pass
	Time	msec	65.0 to 79.0	70.7	Pass
Negative Moment Decay Time To Zero Crossing		msec	120.0 to 148.0	143.3	Pass
			Overall Test Results		Pass

Laboratory Technician

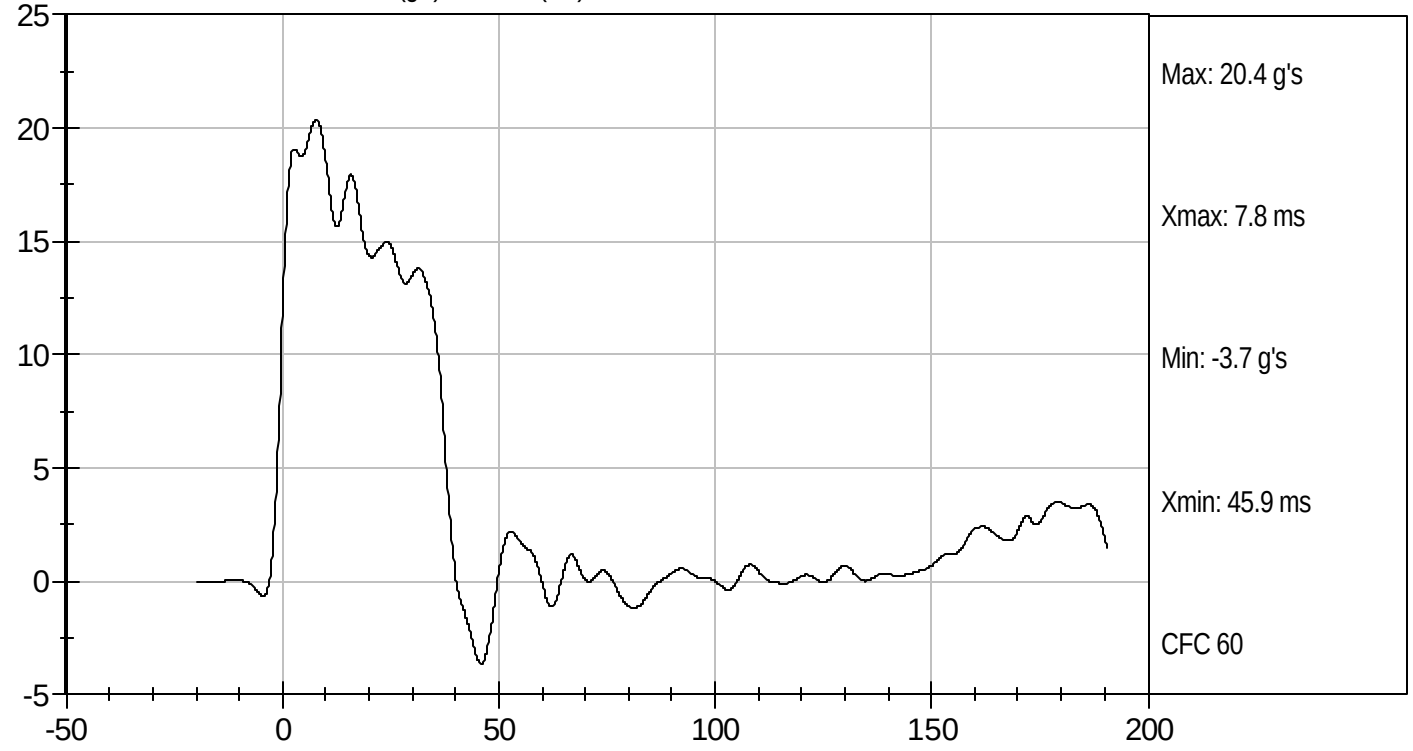
1/29/08
Test Date

Approved By

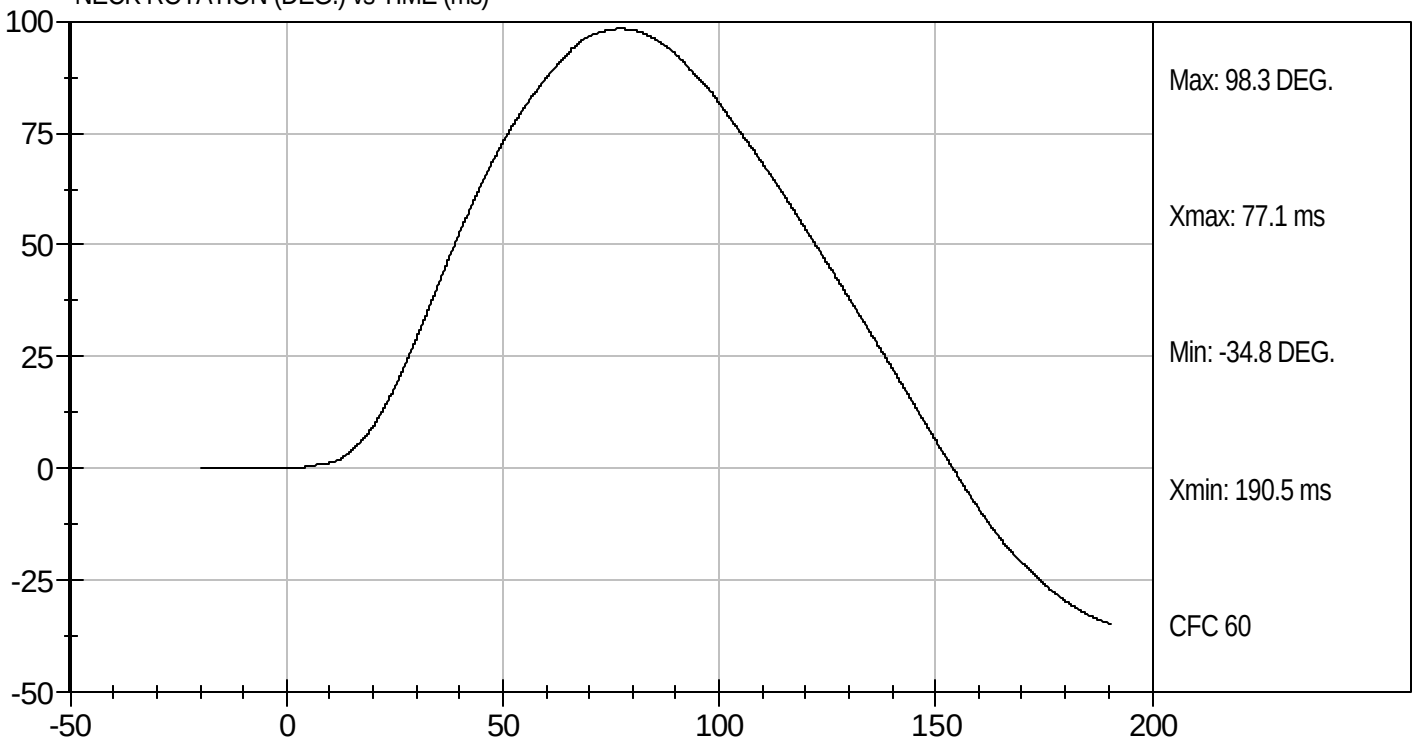
Test Desc: Neck Extension
Component ID: D08113

Test Date: 1/29/08
Velocity: 20.08 ft/s, 6.12 m/s

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

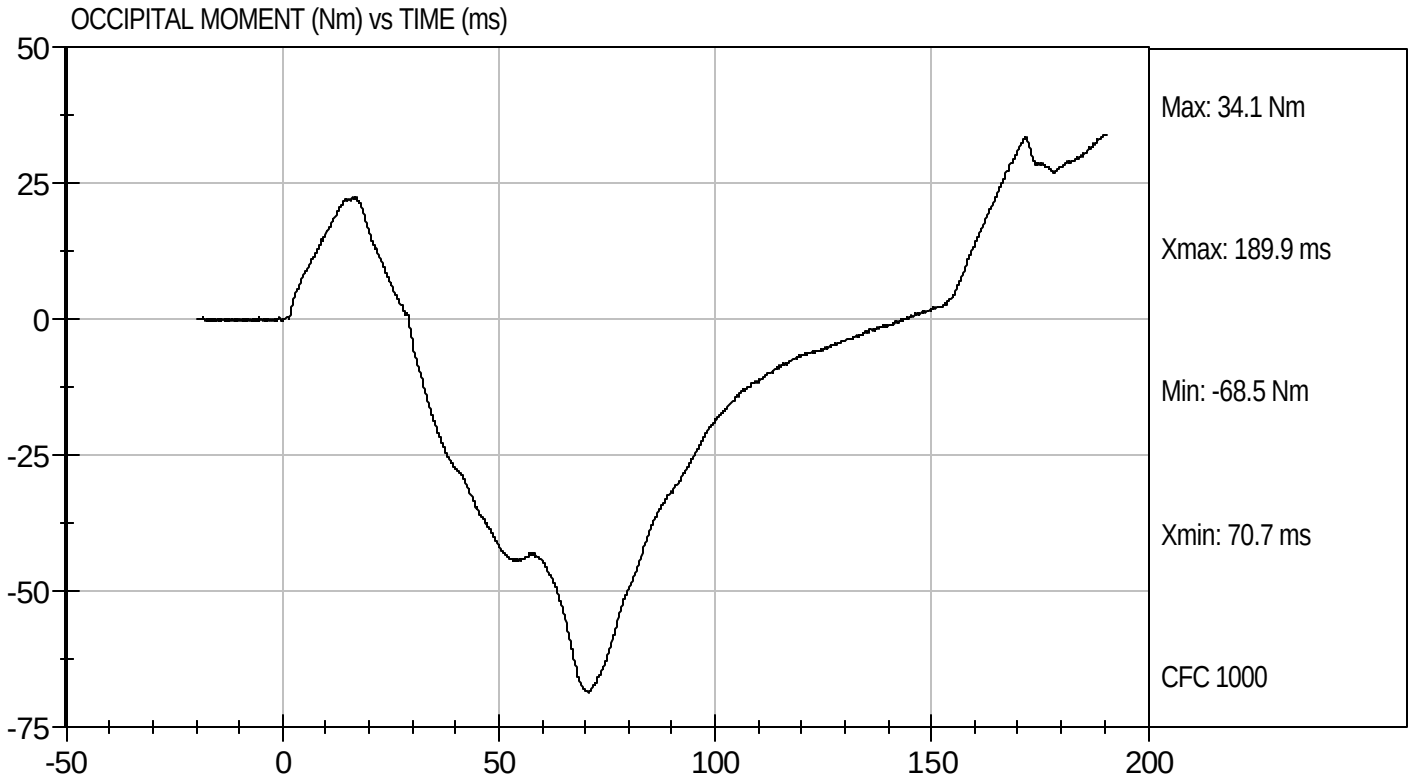


NECK ROTATION (DEG.) vs TIME (ms)



Test Desc: Neck Extension
Component ID: D08113

Test Date: 1/29/08
Velocity: 20.08 ft/s, 6.12 m/s



MGA RESEARCH CORPORATION

THORAX IMPACT

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D08114

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	31	Pass
Probe Velocity	m/s	6.58 to 6.82	6.77	Pass
Peak Probe Force	N	5159 to 5893	5,319	Pass
Peak Sternum Displacement	cm	6.35 to 7.26	6.37	Pass
Internal Hysteresis	%	69 to 85	71	Pass
		Overall Test Results		Pass

Laboratory Technician

1/29/08
Test Date

Approved By

Test Desc: Thorax Impact
Component ID: D08114

Test Date: 1/29/08
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:** D08115

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.09	Pass
Peak Probe Force	Newtons	4715 to 5782	5,560	Pass
		Overall Test Results		Pass

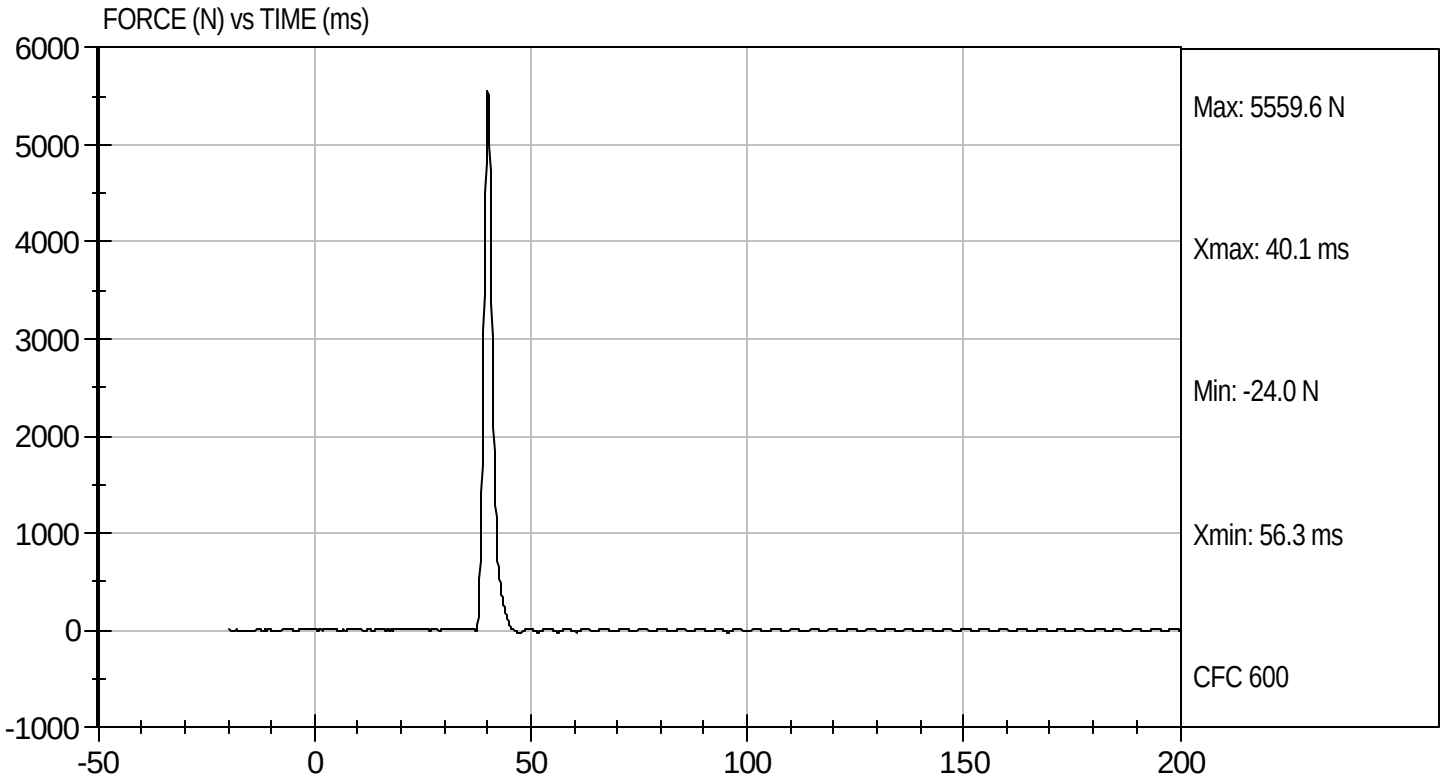
Jessica Gall
Laboratory Technician

1/29/08
Test Date

David Winkelbauer
Approved By

Test Desc: Right Knee
Component ID: D08115

Test Date: 1/29/08
Velocity: 6.86 ft/s, 2.09 m/s



MGA RESEARCH CORPORATION

LEFT KNEE IMPACT TEST

HYBRID III 50TH PERCENTILE MALE

ATD Serial No: 065 **Test I.D:** D08116

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.5	21.6	Pass
Laboratory Relative Humidity	%	10 to 70	33	Pass
Probe Velocity	m/sec	2.07 to 2.13	2.12	Pass
Peak Probe Force	Newtons	4715 to 5782	4,991	Pass
		Overall Test Results		Pass

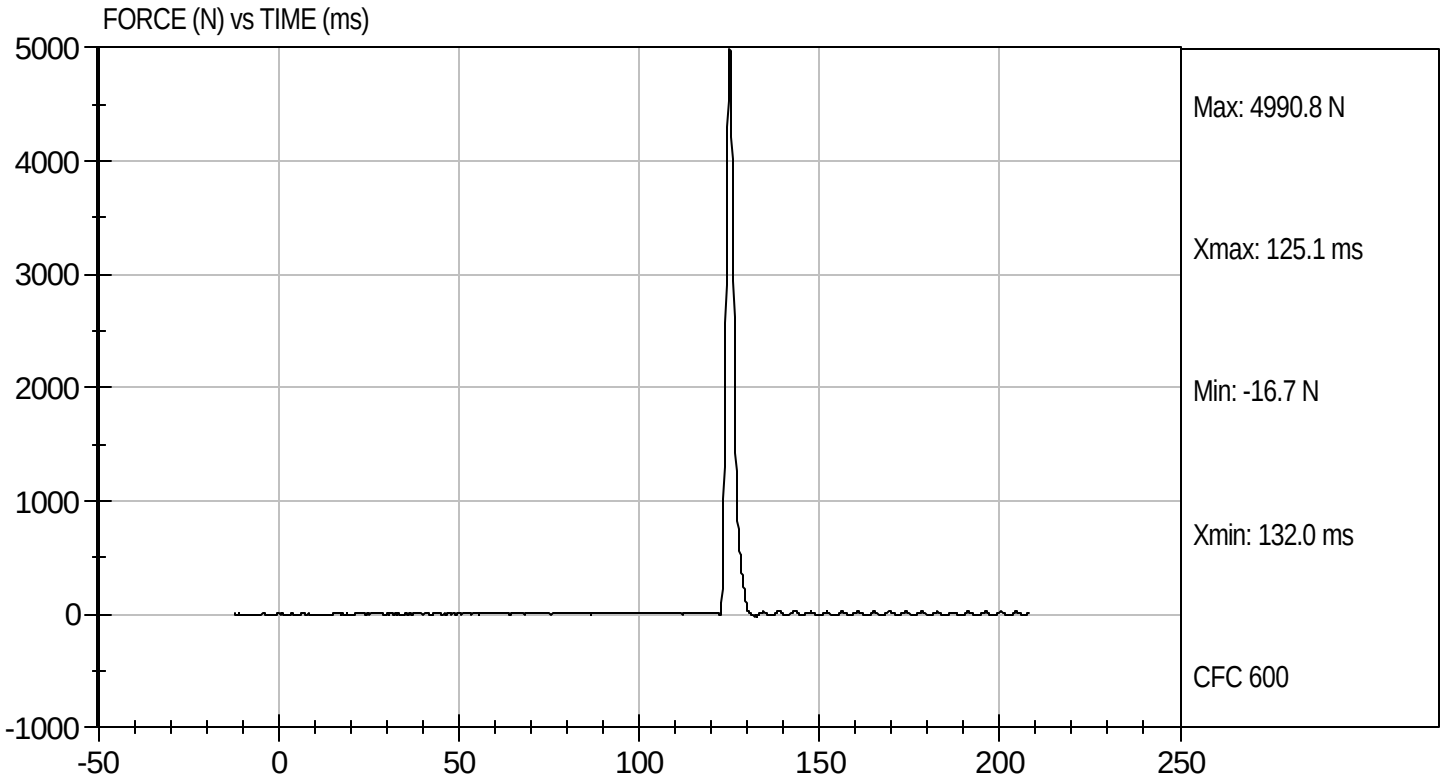
Jessica Gall
Laboratory Technician

1/29/08
Test Date

David Winkelbauer
Approved By

Test Desc: Left Knee
Component ID: D08116

Test Date: 1/29/08
Velocity: 6.97 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:** D08119

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	32	32	Pass
Rotation Rate	deg/sec	5 -10	8	8	Pass
30 Degrees	Nm	94.9 Nm Max	72.2	60.2	Pass
150 ft-lbf / 203.4 Nm	Deg	40- 50 Degree Max Rotation	42	42	Pass
		Overall Test Results			Pass

Laboratory Technician

1/29/08

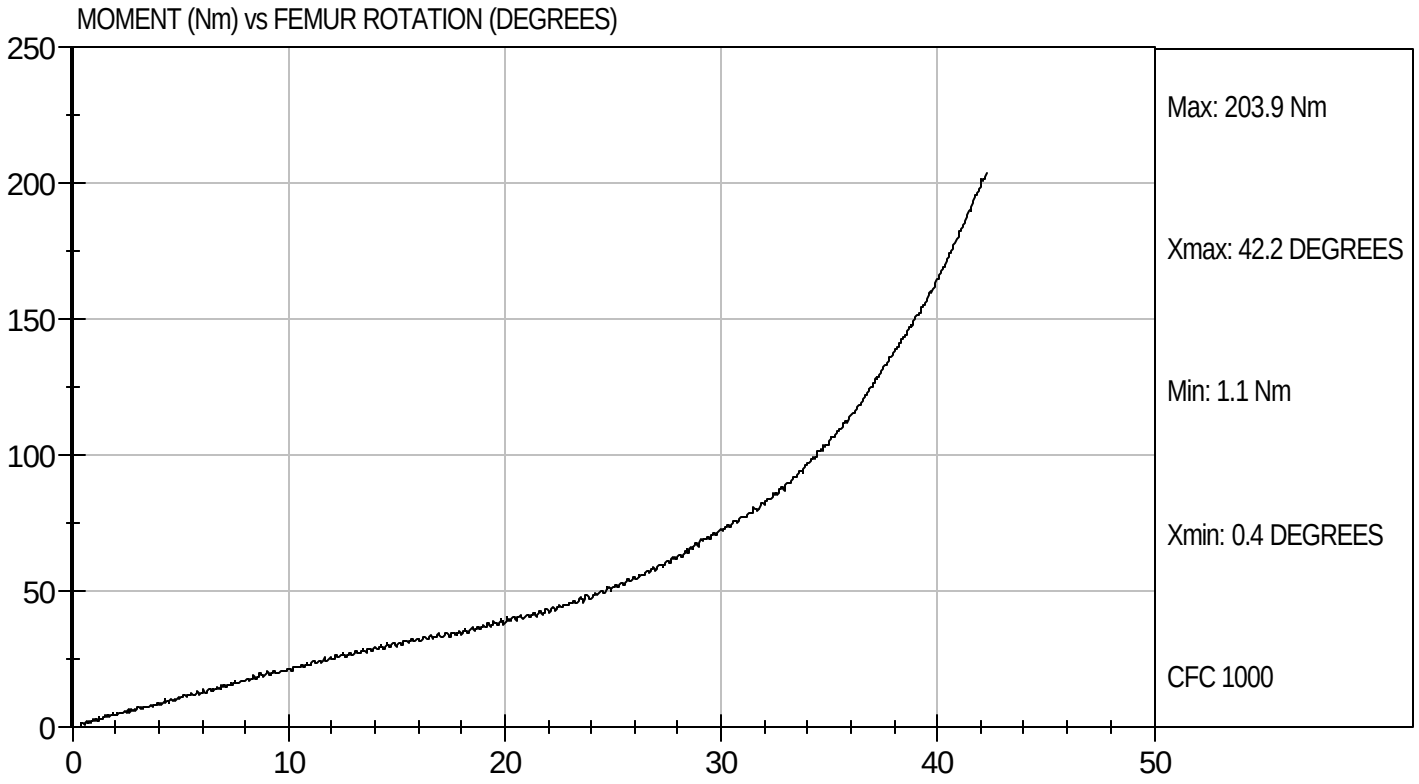
Test Date

David Winkelbauer

Approved By

Test Desc: Hip Femur Flexion
Component ID: D08119

Test Date: 1/29/08
Velocity: 0 ft/s, 0.00 m/s



Test Desc: Hip Femur Flexion
Component ID: D08110

Test Date: 1/29/08
Velocity: 0 ft/s, 0.00 m/s