REPORT NUMBER: SPNCAP-MGA-2011-003

NEW CAR ASSESSMENT PROGRAM (NCAP)
Side Impact Pole Test

HYUNDAI MOTOR MANUFACTURING ALABAMA, LLC
2011 Hyundai Sonata GLS 4-Dr Sedan
NHTSA No.: MB5002

MGA RESEARCH CORPORATION
5000 Warren Road
Burlington, WI 53105

Test Date: June 14, 2010

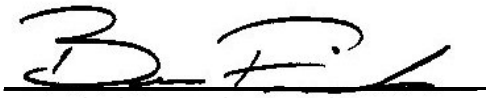
Final Report Date: July 8, 2010

FINAL REPORT

U.S. DEPARTMENT OF TRANSPORTATION
National Highway Traffic Safety Administration
Office of Crashworthiness Standards
1200 New Jersey Ave, SE
Mail Code: NVS 111, Room W43-410
Washington, DC 20590

This final test report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, in response to Contract Number DTNH22-09-D-00124.

Prepared by: 
Donna Janovicz, Project Manager

Approved by: 
Ben Fischer, Project Engineer

Approval Date: July 8, 2010

FINAL REPORT ACCEPTANCE BY OCWS:

_____
Division Chief, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

_____
COTR, New Car Assessment Program
NHTSA, Office of Crashworthiness Standards

Date: _____

Technical Report Documentation Page

1. Report No. SPNCAP-MGA-2011-003	*2. Government Accession No.*	*3. Recipient's Catalog No.*
4. Title and Subtitle Final Report of New Car Assessment Program Side Impact Pole Testing of 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No.: MB5002		*5. Report Date* July 8, 2010 *6. Performing Organization Code* MGA
7. Author(s) Donna Janovicz, Project Manager Ben Fischer, Project Engineer		*8. Performing Organization Report No.* SPNCAP-MGA-2011-003
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		*10. Work Unit No.* *11. Contract or Grant No.* DTNH22-09-D-00124
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Crashworthiness Standards 1200 New Jersey Ave, SE, Room W43-410 Washington, DC 20590		*13. Type of Report and Period Covered:* Final Test Report June 14, 2010 to July 8, 2010 *14. Sponsoring Agency Code* NVS-111
15. Supplementary Notes		

16. Abstract

A 32.2 km/h (20 mph), 75° oblique impact NCAP Side Pole Test was conducted on the subject 2011 Hyundai Sonata GLS 4-Dr Sedan in accordance with the specifications of the Office of Crashworthiness Standards NCAP Side Pole Laboratory Test Procedure for the generation of consumer information on vehicle side pole crash protection. The test was conducted at MGA Research Corporation, in Burlington, Wisconsin, on June 14, 2010.

The impact velocity was 32.5 km/h, and the ambient temperature at the struck (driver's) side of the target vehicle at the time of impact was 21°C. The test vehicle post-test maximum crush was 377 mm at level 3. The test vehicle's performance was as follows:

	Driver ATD (SID-IIs)		
Measurement Description	**Units**	**Threshold**	**Result**
Head Injury Criteria (HIC_{36})	N/A	1000	236
Resultant Lower Spine Acceleration	Gs	82	40
Combined Acetabular and Iliac Pelvic Force	N	5525	4235

The two doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite doors did not open during the side impact event.

17. Key Words New Car Assessment Program (NCAP) Side Impact Pole Part 572V SID-IIs		*18. Distribution Statement* Copies of this report are available from: National Highway Traffic Safety Adm. Technical Reference Division 1200 New Jersey Ave, SE Washington, D.C. 20590	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 126	22. Price

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SECTION 1
TEST PURPOSE AND PROCEDURE

This side impact test is part of the FY 2011 New Car Assessment Program Side Impact Test Program, sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-09-D-00124. The purpose of this test is to generate comparative side impact performance in a 2011 Hyundai Sonata GLS 4-Dr Sedan. The side impact test was conducted in accordance with the Office of Crashworthiness Standard's Side NCAP Pole Laboratory Test Procedure, dated January 2010.

SECTION 2

SUMMARY OF TEST RESULTS

A rigid pole side impact test was conducted on a 2011 Hyundai Sonata GLS 4-Dr Sedan. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 32.5 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin, on June 14, 2010. Pre-test and post-test photographs of the test vehicle and side impact dummy (SID-IIs) are included in Appendix A of this report.

One Part 572V (SID-IIs) dummy was placed in the driver designated seating position according to instructions specified in the OCWS NCAP Side Pole Laboratory Test Procedure dated January 2010. Camera locations and other pertinent camera information are included in this report.

The Part 572V (SID-IIs) dummy was instrumented accordingly:

Head Accelerometers
Thorax Upper, Middle, and Lower Rib Potentiometers
Abdomen Upper and Lower Rib Potentiometers
Lower Spine Accelerometers
Iliac Load Cell
Acetabulum Load Cell

Appendix B contains the vehicle and dummy response data. Dummy configuration and performance verification data can be found in Appendix C of this report.

The following table summarizes the results of the test:

DUMMY INJURY VALUES

Dummy	HIC (36ms)	Resultant Lower Spine Acceleration	Pelvic Force (N)	
SID-IIs 5th Percentile Female	236	40	Iliac Wing	1357
			Acetabular	2918
			Sum	4235

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Left Front (Driver) P1		Left Rear (Passenger) P4	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No	No	
Knee Airbag	No		No	
Side Curtain Airbag	Yes	Yes	Yes	Yes
Side Torso/Pelvis Airbag	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	No	
Seat Belt Load Limiter	Yes		No	

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

GENERAL COMMENTS

There was no valid data collected for:

Left Floor Sill Y after 10 msec.
Left A-Post @ Sill Y after 70 msec.
Left Mid B-Post Y after 10 msec.
Driver Seat Track Y after 10 msec.

SECTION 3

OCCUPANT AND VEHICLE INFORMATION

DATA SHEET NO. 1

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

TEST VEHICLE INFORMATION AND OPTIONS

NHTSA No.	MB5002	Anti-Lock Brakes	Yes
Model Year	2011	All Wheel Drive	No
Make	Hyundai	Power Steering	Yes
Model	Sonata	Driver Front Airbag	Yes
Body Style	Sedan	Driver Curtain Airbag	Yes
VIN	5NPEB4AC6BH021683	Driver Head/Torso Airbag	No
Body Color	Venetian Red	Driver Torso Airbag	No
Delivery Date	5/17/2010	Driver Torso/Pelvis Airbag	Yes
Odometer (mi)	182	Driver Pelvis Airbag	No
Odometer (km)	293	Driver Knee Airbag	No
Dealer	Boucher Fleet Group	Rear Pass. Front Airbag	No
Transmission	Automatic	Rear Pass. Curtain Airbag	Yes
Final Drive	Front	Rear Pass. Head/Torso Airbag	No
Type/No. Cylinders	4	Rear Pass. Torso Airbag	No
Engine Displacement (L)	2.4	Rear Pass. Torso/Pelvis Airbag	No
Engine Placement	Lateral	Rear Pass. Pelvis Airbag	No
Roof Rack	No	Rear Pass. Knee Airbag	No
Sunroof/T-Top	No	Pretensioners	Yes
Tinted Glass	No	Load Limiters	Yes
Traction Control	Yes	Automatic Door Locks	Yes
Power Brakes	Yes	Bucket Seats	Yes
Front Disc	Yes	Tilt Steering	Yes
Rear Disc	Yes	Power Seats	No
Does owner's manual provide instruction to turn off automatic door locks?			No

DATA FROM CERTIFICATION LABEL

Manufactured By	Hyundai Motor Manufacturing Alabama, LLC
Date of Manufacture	Feb/20/10

GVWR (kg)	1950
GAWR Front (kg)	1100
GAWR Rear (kg)	960

VEHICLE SEATING AND WEIGHT CAPACITY DATA

Measured Parameter	Front	Rear	Third	Total	
Designated Seating Capacity (DSC)	2	3		5	
Capacity Weight (VCW) (kg)				410	(A)
DSC x 68.04 kg				340	(B)
Cargo Weight (RCLW) (kg)				70	(A-B)

VEHICLE SEAT TYPE

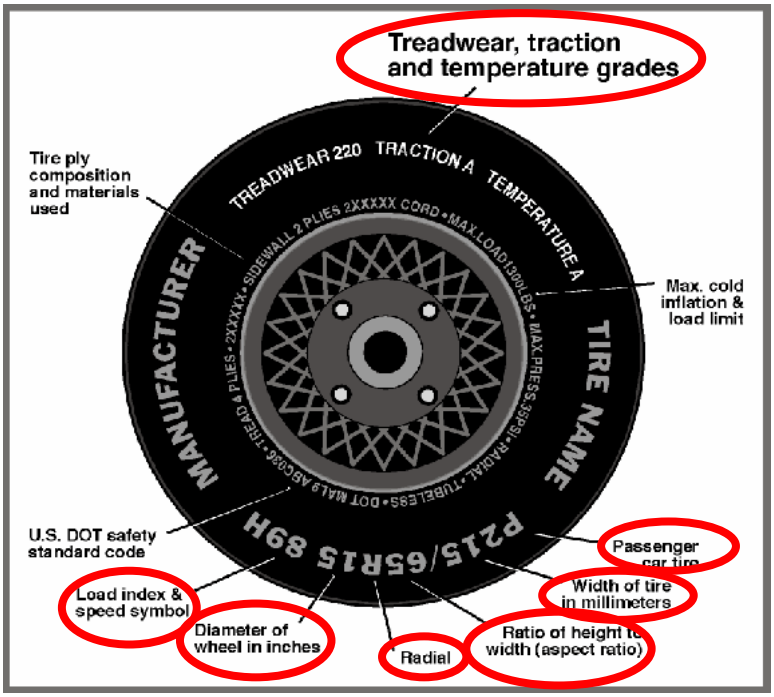
Seating Location	Type of Seat Pan				Type of Seat Back		
	Bucket	Bench	60/40 Split Folding	Contoured	Fixed	Adjustable	
						Manual	Power
Front Seat	X					w/Lever	
Rear or Second Row			X		X		
Third Row Seat							

DATA SHEET NO. 1 (continued)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	225	225
Recommended Tire Size	P205/65R16	P205/65R16
Tire Size on Vehicle	P205/65R16	P205/65R16
Tire Model	Kumho	Kumho
Tire Manufacturer	Solus KH25	Solus KH25
Treadwear	480	480
Traction	A	A
Temperature Grades	A	A
Tire Plies Sidewall	1 poly	1 poly
Tire Plies Body	2 steel / 1 poly / 1 nylon	2 steel / 1 poly / 1 nylon
Load Index & Speed Symbol	94H	94H
Tire Material	Rubber	Rubber
DOT Safety Code Right	DOT Y0L4 YPL8	DOT Y0L4 YPL8
DOT Safety Code Left	DOT Y0L4 YPL8	DOT Y0L4 YPL8

DATA SHEET NO. 1 (continued)

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

TEST VEHICLE WEIGHTS

	Units	As Delivered (UVW)			As Tested (ATW)			Fully Loaded		
		Front	Rear	Total	Front	Rear	Total	Front	Rear	Total
Left	kg	435.0	307.5		464.9	338.4		451.8	364.7	
Right	kg	456.3	269.0		456.4	323.4		455.4	318.0	
Ratio	%	60.7	39.3		58.2	41.8		57.1	42.9	
Totals	kg	891.3	576.5	1467.8	921.3	661.8	1583.1	907.2	682.7	1589.9

TARGET TEST WEIGHT CALCULATION

Measured Parameter	Units	Value	
Total Delivered Weight (UVW)	kg	1467.8	(A)
Actual Weight of 1 P572V ATD (SID-IIs) ATD Used	kg	52.2	(B)
Rated Cargo/Luggage Weight (RCLW)	kg	70	(C)
Calculated Target Vehicle Test Weight (TVTW)	kg	1590.0	(A+B+C)

TEST VEHICLE ATTITUDES AND CG

	Units	As Delivered	As Tested	Fully Loaded
Driver Door Sill Angle (front-to-rear)*	deg	-0.3	-0.3	0.0
Front Passenger Sill Angle (front-to-rear)*	deg	-0.6	-0.6	-0.2
Front Bumper Angle (left-to-right)**	deg	-0.4	-0.3	-0.3
Rear Bumper Angle (left-to-right)**	deg	0.0	0.0	0.0
Vehicle CG (Aft of Front Axle)	mm	1098	1169	1201
Vehicle CG (Left (+) / Right (-) from Longitudinal Centerline)	mm	9	12	22

*Front up is positive ** Left up is positive

GENERAL VEHICLE TEST DATA

Measurement Description	Units	Value
Weight of Ballast in Cargo Area	kg	11.3
Weight of Vehicle Components Removed	kg	19.5

Vehicle components removed to meet target vehicle test weight: Right rear tail light, spare tire, jack & tools, trunk liners, right front mirror, rear floor mats.

TEST VEHICLE IMPACT POINT DATA

Measurement Parameter	Units	Value
Vertical Impact Reference Line (Aft of Front Axle)	mm	1182
Actual Impact Point (Aft of Front Axle)	mm	1192
Impact Point Difference (- forward / + rearward)	mm	10

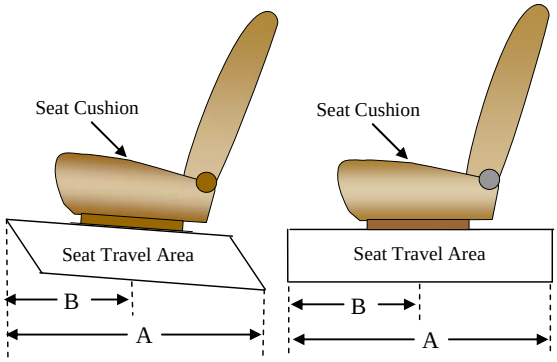
DATA SHEET NO. 2

SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

SEAT FORE/AFT POSITIONS

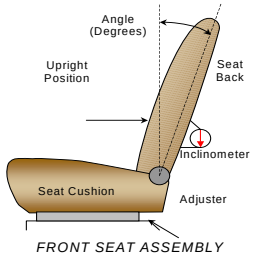
The driver seat was a manual fore/aft adjustable seat with a manual angle adjustment. The seat travel was set as specified in Appendix B of the TP dated January 2010. The right front passenger manual seat was set to match the driver seat. The rear passenger seats' were non-adjustable.



SEAT FORE/AFT POSITIONING	Total Fore/Aft Travel (mm)	Placed in Detent # or Position (mm)
Driver Seat	24 detents	0 detent (full forward)
Front Passenger Seat	24 detents	0 detent (full forward)
Rear Seat – Struck Side	Fixed	
Rear Seat – Non-Struck Side	Fixed	

SEAT BACK ANGLE POSITION

The seat back was set as specified in Appendix B of the TP dated January 2010. The seat back angle measurement was made relative to the rocker sill at the headrest post.



SEAT BACK ANGLE	Degrees	Detents
Driver Seat Back Angle with Seated Dummy	-3.0	
Front Passenger Seat Back Angle	-3.0	
Struck Side Rear Seat Back Angle	Fixed	
Non-Struck Side Rear Passenger Seat Back Angle	Fixed	

SEAT BELT UPPER ANCHORAGE

The driver and passenger seat belt upper anchorages were set at the manufacturer's specified placement in Form 1.

SEAT BELT UPPER ANCHORAGES	Total # of Positions	Placed in Position #
Driver Seat	3 detents	1 (uppermost as 0)
Front Passenger Seat	3 detents	1 (uppermost as 0)

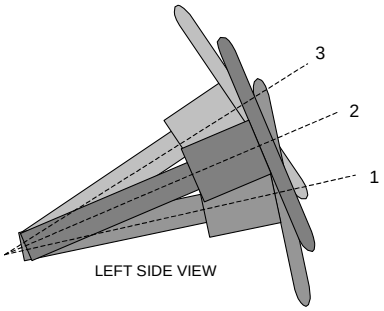
DATA SHEET NO. 2 (CONTINUED)

SEAT, SEAT BELT, STEERING WHEEL ADJUSTMENT, AND FUEL SYSTEM DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

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.

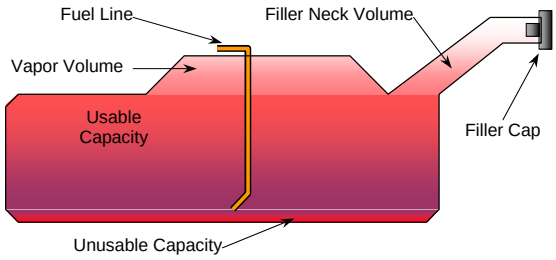


STEERING COLUMN ASSEMBLY

STEERING COLUMN POSITIONING

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1	63.5	182 mm
Geometric Center – Position 2	65.5	202 mm
Uppermost – Position 3	67.5	222 mm
Telescoping Steering Wheel Travel	4.0	40 mm
Test Position	65.5	202 mm

Describe the fuel pump type, its behavior, and the location of the fuel filler pipe. The test vehicle is equipped with an electric fuel pump. Fuel pump will operate when engine system is normally operating. The fuel pipe is on the left side.



VEHICLE FUEL TANK ASSEMBLY

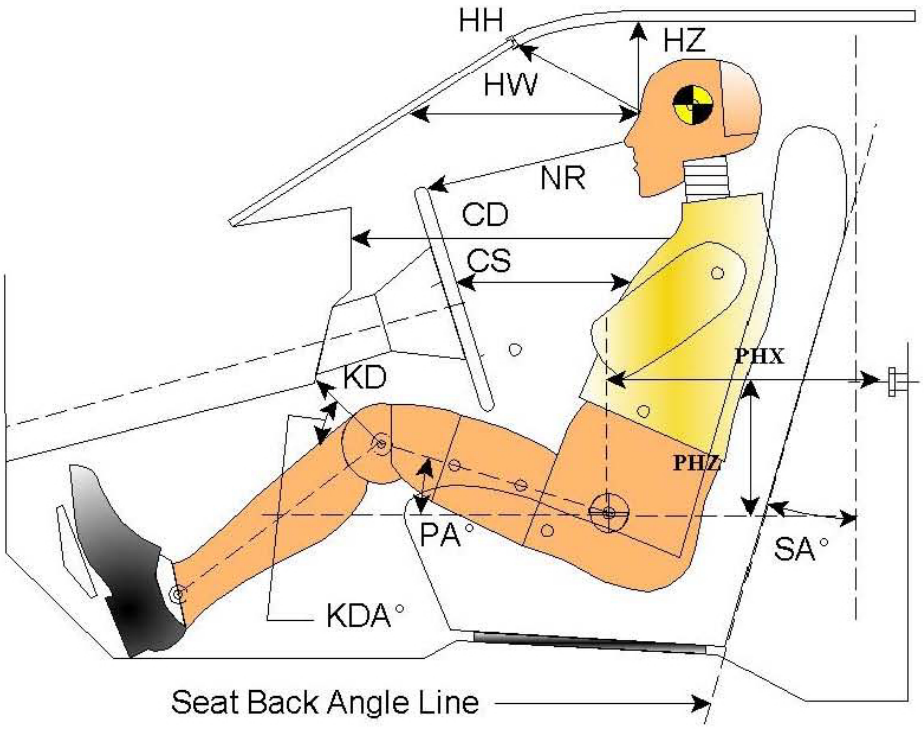
FUEL TANK CAPACITY DATA

	Liters
Usable Capacity of “Standard” Tank	70.0
Usable Capacity of “Optional” Tank	
Usable Capacity of Standard Tank as Specified in Owner’s Manual	70.0
Usable Capacity of Optional Tank as Specified in Owner’s Manual	
92-94% of Usable Capacity	64.4 to 65.8
Actual Amount of Solvent Used	65.1
1/3 of Usable Capacity	23.3

.DATA SHEET NO. 3

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

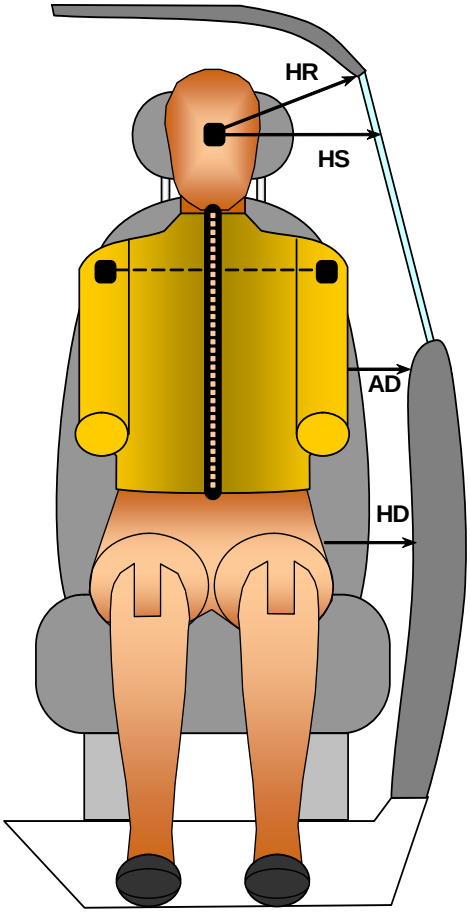


Code	Measurement Description	Driver S/N 296	
		Length (mm)	Angle (°)
HH	Head to Header	250	
HW	Head to Windshield	645	
HZ	Head to Roof	183	
NR	Nose to Rim	275	
CD	Chest to Dash	446	
CS	Chest to Steering Wheel	224	
KDL/KDAL	Left Knee to Dash	170	32.8
KDR/KDAR	Right Knee to Dash	149	35.0
PA	Pelvic Angle		18.7
PHX	H-Point to Striker (X-Axis)	331	
PHZ	H-Point to Striker (Z-Axis)	268	
SA	Seat Back Angle		3.0

DATA SHEET NO. 4

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010



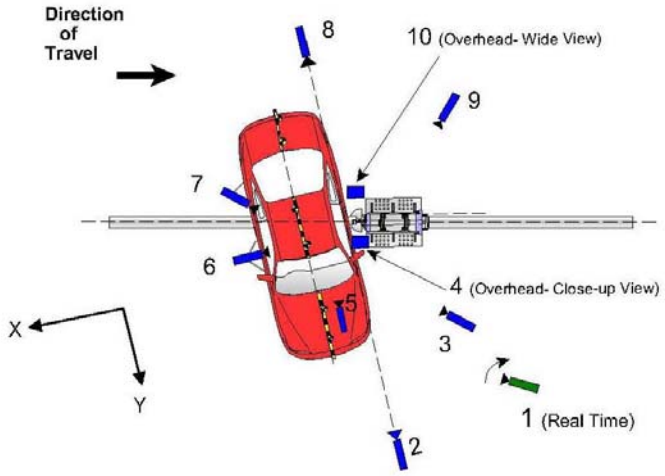
FRONT VIEW OF DUMMY

Code	Measurement Description	Driver S/N 296 Length (mm)
HR	Head to Side Header	240
HS	Head to Side Window	373
AD	Arm to Door	94
HD	H-Point to Door	181

DATA SHEET NO. 5

CAMERA LOCATIONS AND DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010



Reference: From Point of Impact for X and Y; from Ground for Z):
+X = Forward of Impact, + Y = Right of Impact, +Z = Down

Camera No.	View	Coordinates (mm)			Lens (mm)	Film Speed (fps)
		X*	Y*	Z*		
1	Real-Time Pan View					30
2	Front Ground Level	0	5610	-1570	24	1000
3	Impact Side 45° Forward	-1760	4270	-1630	20	1000
4	Overhead Closeup	40	0	-4520	50	1000
5	Onboard – Driver Front				12.5	1000
6	Onboard – Driver Side				8	1000
7	Onboard – Driver Rear				8	1000
8	Rear Ground Level	0	-6460	-1590	24	1000
9	Impact Side 45° Rearward	-3620	-3130	-1620	20	1000
10	Overhead Wide View	80	0	-4520	14	1000
11	Real-Time Dummy Front View					30

* All measurements accurate to ± 6 mm

Note: Vehicle was at a 15° angle to the rigid pole.

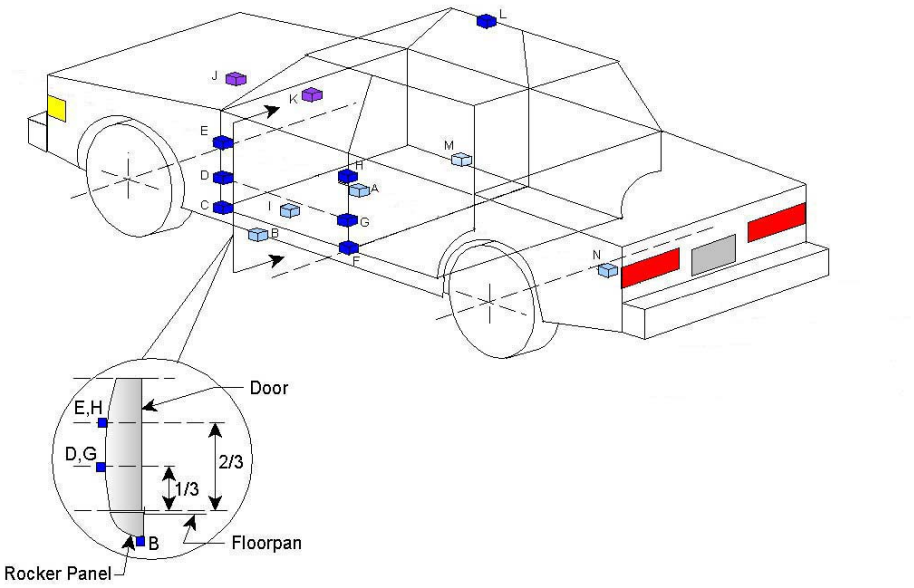
INSTRUMENTATION

	Number of Channels
Driver Dummy	16
Vehicle Structure	21
Pole Load Cells – Not used	8
Contact Switches	3
Airbag Timing	2
Total No. of Data Channels	50

DATA SHEET NO. 6

VEHICLE ACCELEROMETER DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010



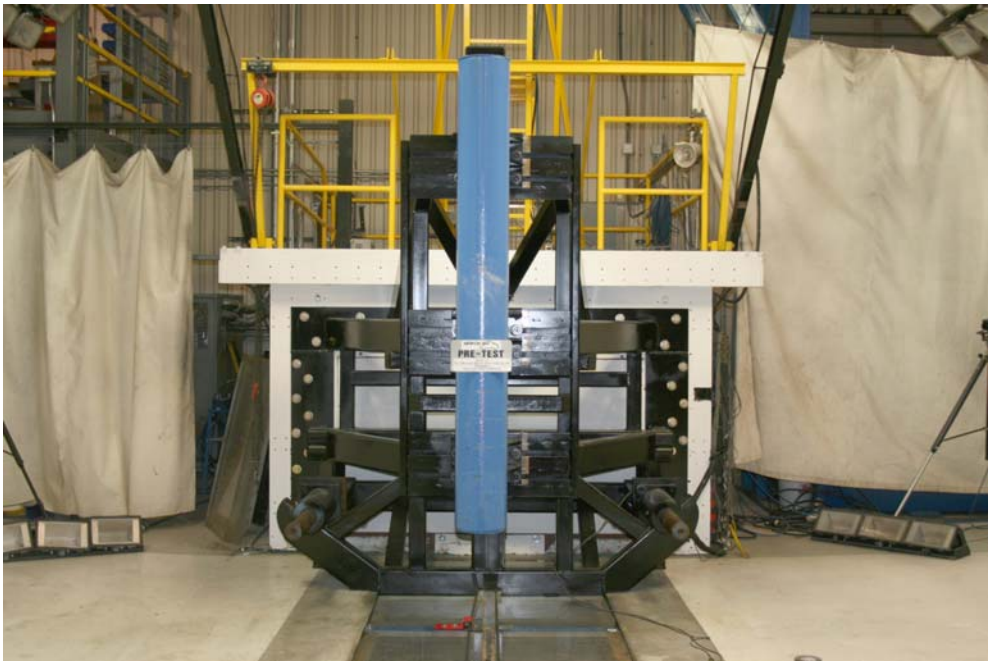
	Accelerometer Location			
	ID	Coordinates (mm)		
		X	Y	Z
A	Vehicle CG	2630	165	-160
	Vehicle CG Sensor	2675	165	-160
B	Left Floor Sill	3065	-720	-185
C	A Pillar Sill	3190	-720	-180
D	A Pillar Low	3228	-705	-507
E	A Pillar Mid	3305	-815	-755
F	B Pillar Sill	2130	-720	-190
G	B Pillar Low	2145	-730	-503
H	B Pillar Mid	2145	-730	-690
I	Driver Seat	2380	-600	-338
L	Engine Top	4055	0	-810
J	Firewall	3735	0	-855
K	Right Roof	2540	607	-1415
M	Right Floor Sill	2572	700	-190
N	Rear Floorpan	995	0	-493

Reference: From Point of Impact for X and Y; from Ground for Z):
+X = Forward of Vehicle, + Y = Right of Vehicle, +Z = Down

DATA SHEET NO. 7

RIGID POLE LOAD CELL DATA

Test Vehicle:	2011 Hyundai Sonata GLS 4-Dr Sedan	NHTSA No.	MB5002
Test Program:	NCAP Side Pole Impact Test	Test Date:	6/14/2010



254 mm Diameter Rigid Pole

The pole was not instrumented.

Load Cell Locations	
ID	Height From Ground (m)
1	
2	
3	
4	
5	
6	
7	
8	

DATA SHEET NO. 8

POST-TEST OBSERVATIONS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

TEST DUMMY INFORMATION AND CONTACT

Description	Driver
Dummy Type / Serial No.	SID-IIs / 296
Head Contact	Curtain Airbag, Headrest
Upper Torso Contact	Side Airbag
Lower Torso Contact	Side Airbag
Left Knee Contact	Door Panel
Right Knee Contact	Left Knee

POST TEST DOOR OPENING AND SEAT TRACK INFORMATION

Description	Front	Rear
Left Side Doors	Remained closed and jammed shut	Remained closed and jammed shut
Right Side Doors	Remained closed and operational	Remained closed and operational
Hatch and Other Doors	Remained closed and operational	Remained closed and operational
Seat Movement	0	0
Seat Back Failure	None	None

POST-TEST STRUCTURAL OBSERVATIONS

Critical Areas of Performance	Observations and Conclusions
Pillar Performance	No Separation
Sill Separation	None
Windshield Damage	Cracked
Window Damage	Left Front Window Broke
Other Notable Effects	None

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

Restraint Type	Left Front (Driver) P1		Left Rear (Passenger) P4	
	Mounted	Deployed	Mounted	Deployed
Frontal Airbag	Yes	No	No	
Knee Airbag	No		No	
Side Curtain Airbag	Yes	Yes	Yes	Yes
Side Torso/Pelvis Airbag	Yes	Yes	No	
Seat Belt Pretensioner	Yes	Yes	No	
Seat Belt Load Limiter	Yes		No	

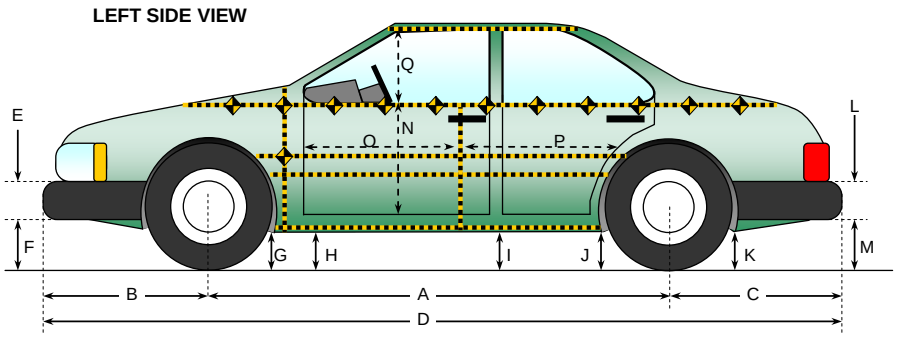
VEHICLE SPEED AND IMPACT DATA

Measured Parameter	Units	Requirement	Value
Horizontal Offset from Vertical Impact Reference Line	mm	+/- 38	+10
Trap No. 1 Velocity (Primary)	km/h	31.4 to 33.0	32.5
Trap No. 2 Velocity (Redundant)	km/h	31.4 to 33.0	32.7

DATA SHEET NO. 9

VEHICLE PROFILE MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010



All measurements in (mm) with tolerance of ± 3 mm

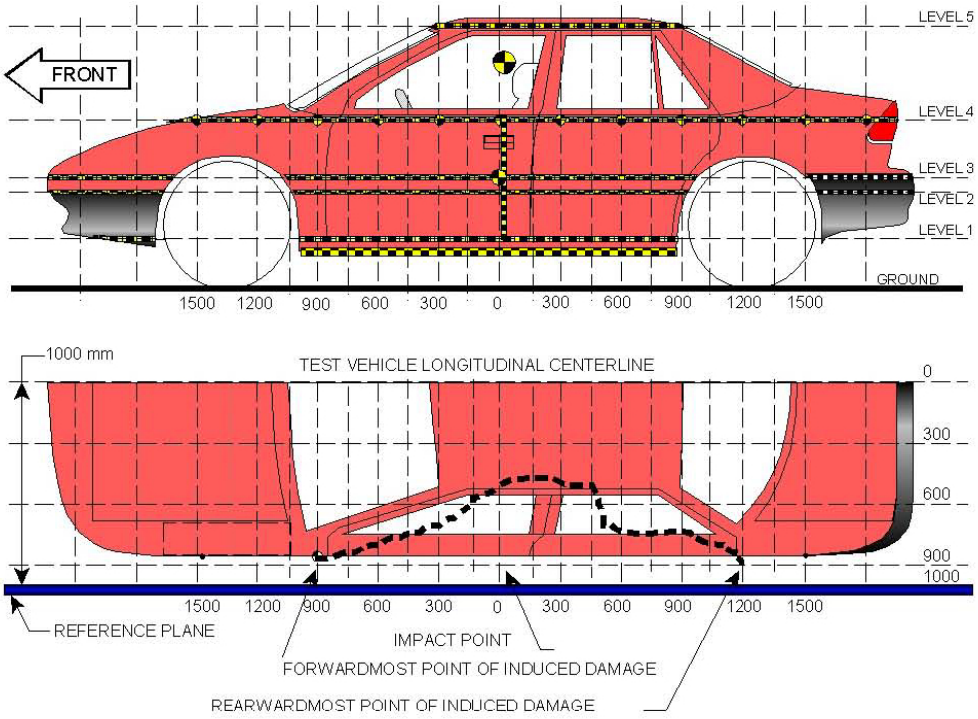
VEHICLE PRE- AND POST-TEST MEASUREMENT INFORMATION

Code	Measurement Description	Pre-Test	Post-Test	Difference
A	Wheelbase	2796	2704	92
B	Front Axle to FSOV	949	1012	-63
C	Rear Axle to RSOV	1075	1091	-16
D1	Total Vehicle Length at Left Side	4620	4626	-6
D2	Total Vehicle Length at Centerline	4820	4807	13
D3	Total Vehicle Length at Right Side	4620	4505	115
E	Front Bumper Thickness	160	160	0
F	Front Bumper Bottom to Ground	168	210	-42
G	Sill Height at Front Wheel Well	157	153	4
H	Sill Height at Front Door Leading Edge	160	150	10
I	Sill Height at B Pillar	168	183	-15
J1	Sill Height at Rear Wheel Well	174	201	-27
J2	Pinch Weld Height at Rear Wheel Well	174	192	-18
K	Sill Height Aft of Rear Wheel Well	217	235	-18
L	Rear Bumper Thickness	170	170	0
M	Rear Bumper Bottom to Ground	351	345	6
N	Sill Height to Window Bottom Sill	748	751	-3
O	Front Door Leading Edge to Impact CL	771	756	15
P	Rear Door Trailing Edge to Impact CL	1250	1276	-26
Q	Front Window Opening	402	360	42
R	Right Side Length	4015	4021	-6
S	Left Side Length	4015	3900	115
T	Vehicle Width at B Post	1821	1707	114

DATA SHEET NO. 10

VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010



NOTE: The measurements are taken along the vertical impact reference line. Vehicle measurements forward of the vertical impact reference line are negative.

Level	Measurement Description	Height Above Ground (mm)
1	Sill Top	240
2	Occupant H-Point	561
3	Mid-Door	640
4	Window Sill	964
5	Window Top	1368

DATA SHEET NO. 10 (CONTINUED)

VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1200				314					320					6	
-1050				301					312					11	
-900			188	290				224	306				36	16	
-825		193	196	281			223	222	299			30	26	18	
-750	216	197	196	277		270	222	219	298		54	25	23	21	
-675	224	199	195	273		283	217	205	276		59	18	10	3	
-600	226	200	194	272		302	250	238	271		76	50	44	-1	
-525	228	200	194	271		319	288	273	311		91	88	79	40	
-450	229	200	193	262		339	326	308	337		110	126	115	75	
-375	229	200	192	264		364	353	341	372		135	153	149	108	
-300	229	199	191	261		387	378	374	404		158	179	183	143	
-225	229	199	191	260		422	422	424	452		193	223	233	192	
-150	229	199	191	258		465	472	476	498		236	273	285	240	
-75	229	198	191	257	481	523	526	525	539	615	294	328	334	282	134
0	229	198	189	258	477	555	559	566	575	631	326	361	377	317	154
75	229	198	189	258	480	534	559	566	572	619	305	361	377	314	139
150	227	197	188	258	483	476	510	485	534	612	249	313	297	276	129
225	227	197	188	259	485	425	451	452	479	601	198	254	264	220	116
300	226	197	188	260	486	384	404	407	430	588	158	207	219	170	102
375	226	197	188	261	488	350	357	353	394	578	124	160	165	133	90
450	227	199	190	262	488	325	311	304	380	573	98	112	114	118	85
525	227	197	191	263	489	292	296	289	366	555	65	99	98	103	66
600	228	197	192	265	491	265	285	280	355	544	37	88	88	90	53
675	229	198	194	265	491	242	274	266	344	535	13	76	72	79	44
750	228	199	195	267	492	220	264	256	337	525	-8	65	61	70	33
825	228	200	196	268	493	197	249	244	325	516	-31	49	48	57	23
900	228	201	197	269	494	179	239	234	320	508	-49	38	37	51	14
1050	228	201	199	270	496	161	226	222	308	500	-67	25	23	38	4
1200	225	198	199	276	497	144	197	199	294	510	-81	-1	0	18	13
1350		190	191	280	505		169	168	273	513		-21	-23	-7	8
1500			186	285	521			175	261	519			-11	-24	-2
1650				295					290					-5	
1800				305					304					-1	
1950				314					316					2	
2100				329					329					0	

NOTE: The measurements are taken along the vertical impact reference line.
Vehicle measurements forward of the vertical impact reference line are negative.

DATA SHEET NO. 10 (CONTINUED)

VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

MAXIMUM CRUSH DATA

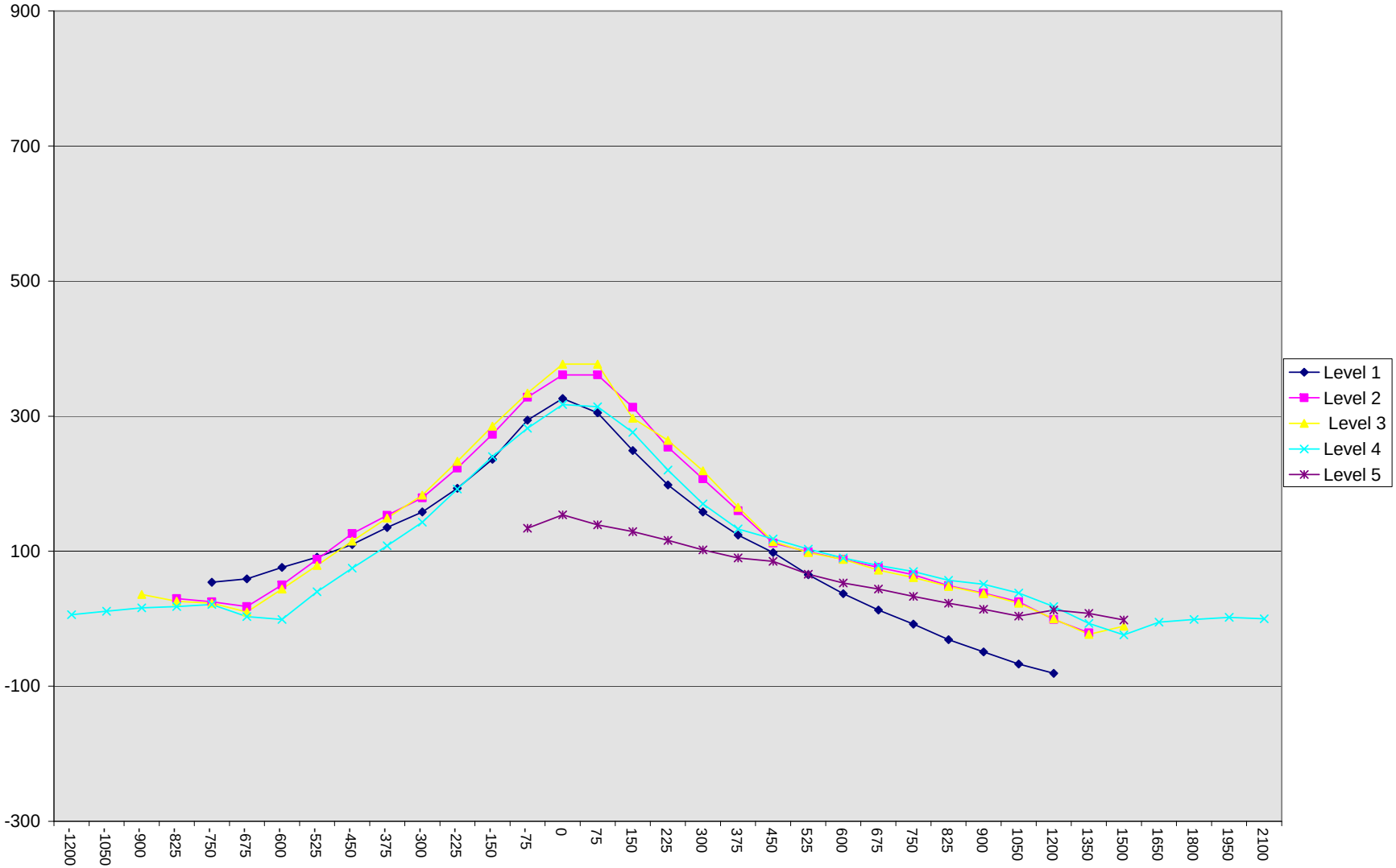
	Level 1	Level 2	Level 3	Level 4	Level 5
Maximum Crush (mm)	326	361	377	317	154
Distance From Impact (mm)	0	0	0	0	0

Note: Pre-test measurements are taken when the vehicle is in the “As Tested” weight condition. Vehicle measurements forward of the vertical impact reference line are negative. The crush profile grid is established prior to test based on an estimated impact point. The final distance to impact is determined after the final dummy positioning and the pole is aligned with the center of gravity of the dummy’s head.

DATA SHEET NO. 10 (CONTINUED)

VEHICLE EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010



DATA SHEET NO. 11

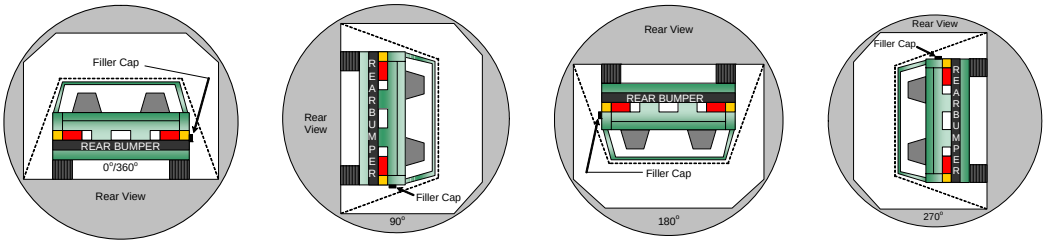
FMVSS 301 FUEL SYSTEM INTEGRITY POST-IMPACT DATA

Test Vehicle: 2011 Hyundai Sonata GLS 4-Dr Sedan NHTSA No. MB5002
Test Program: NCAP Side Pole Impact Test Test Date: 6/14/2010

Test Time: 11:22 am Temperature: 21° C

A. From impact until vehicle motion ceases: 0 oz.
(Maximum Allowable = 1 ounce)
B. For the 5 minute period after motion ceases: None
(Maximum allowable = 5 ounces)
C. For the following 25 minutes: None
(Maximum allowable = 1 oz./minute)
D. Spillage Details: None

FMVSS 301 STATIC ROLLOVER DATA



0°/360° 90° 180° 270°

ROLLOVER SOLVENT COLLECTION TIME TABLE IN SECONDS

Test Phase	Rotation Time	Hold Time	Total Time
0° to 90°	120	300	420
90° to 180°	113	300	413
180° to 270°	109	300	409
270° to 360°	112	300	412

FMVSS 301 ROLLOVER SPILLAGE TABLE (units in ounces)

Test Phase	First 5 Minutes	Sixth Minute	Seventh Minute	Eight Minute
0° to 90°	0	0	0	0
90° to 180°	0	0	0	0
180° to 270°	0	0	0	0
270° to 360°	0	0	0	0

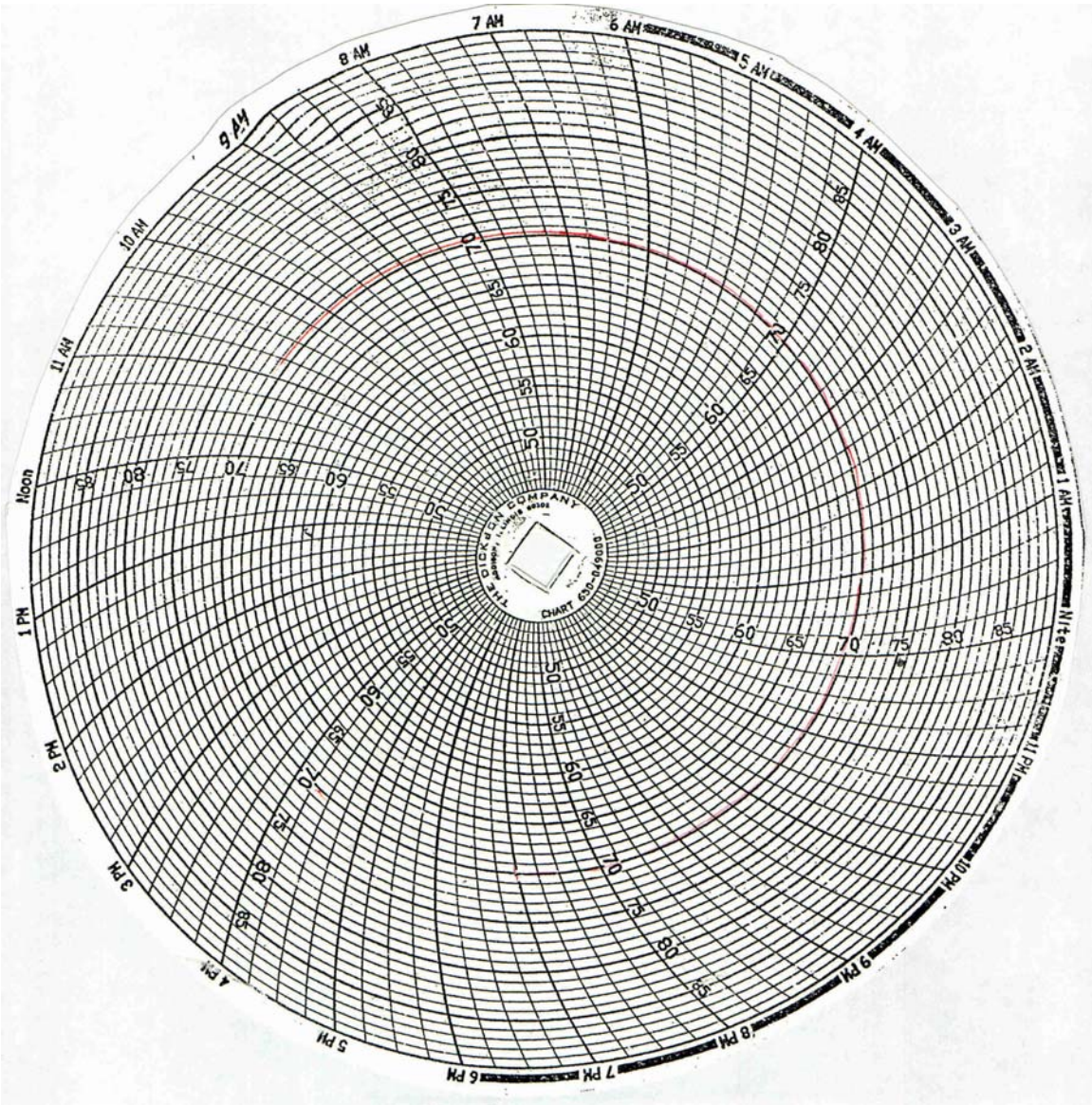
ROLLOVER SOLVENT SPILLAGE LOCATION TABLE

Test Phase	Spillage Location
0° to 90°	
90° to 180°	
180° to 270°	
270° to 360°	

DATA SHEET NO. 12

DUMMY/VEHICLE TEMPERATURE STABILIZATION DATA

Test Vehicle:	2011 Hyundai Sonata GLS 4-Dr Sedan	NHTSA No.	MB5002
Test Program:	NCAP Side Pole Impact Test	Test Date:	6/14/2010



APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

As Delivered Right Front ¾ View of Test Vehicle

As Delivered Left Rear ¾ View of Test Vehicle

Pre-Test Frontal View of Test Vehicle

Post-Test Frontal View of Test Vehicle

Pre-Test Left Front ¾ View of Test Vehicle

Post-Test Left Front ¾ View of Test Vehicle

Pre-Test Left Side View of Test Vehicle

Post-Test Left Side View of Test Vehicle

Pre-Test Left Rear ¾ View of Test Vehicle

Post-Test Left Rear ¾ View of Test Vehicle

Pre-Test Rear View of Test Vehicle

Post-Test Rear View of Test Vehicle

Pre-Test Right Side View of Test Vehicle

Post-Test Right Side View of Test Vehicle

Pre-Test Overhead View of Test Vehicle and Pole

Post-Test Overhead View of Test Vehicle and Pole

Pre-Test Left Side View of Pole Positioned Against Side of Vehicle at Ideal Impact Point

Pre-Test Right Side View of Pole Positioned Against Side of Vehicle at Ideal Impact Point

Pre-Test Close-Up View of Impact Point Target

Post-Test Close-Up View of Impact Point Target Showing Impact Location

Pre-Test Front Close-Up View of Dummy (through front window)

Post-Test Front Close-Up View of Dummy (through front window)

Pre-Test Left Side View of Dummy Showing Belts, Chalking, and Contact Switches (Door Open)

Pre-Test Left Side View of Dummy Shoulder and Door Top View

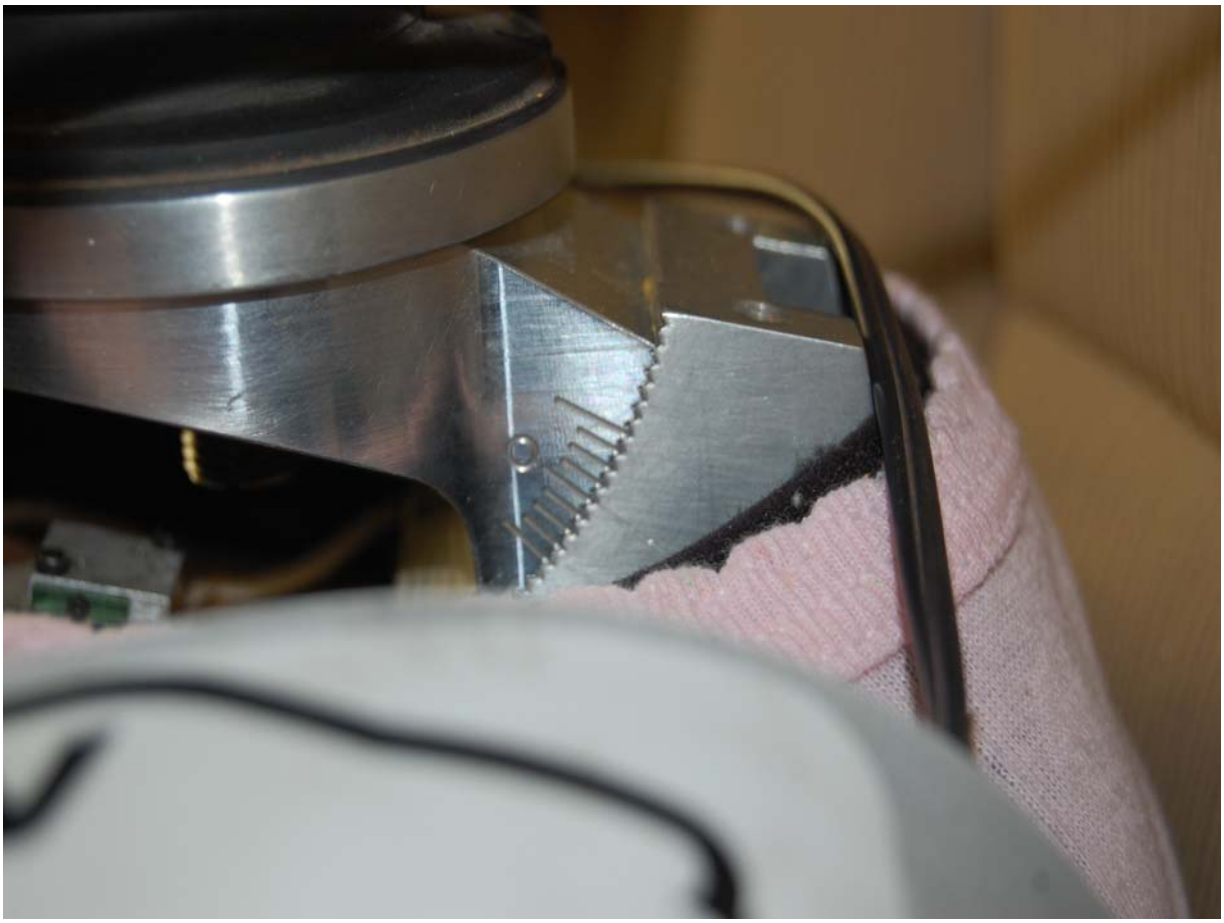
Post-Test Left Side View of Dummy Shoulder and Door Top View

Pre-Test Frontal View of Seat Back Prior to Dummy Positioning

Pre-Test Frontal View of Dummy Head and Shoulders in Relation to Head Restraint

Pre-Test Frontal View of Seat Pan Prior to Dummy Positioning

Pre-Test Overhead View of Dummy Thighs on Seat Pan



Pre-Test View of Dummy's Neck Showing Position of Adjustable Neck Bracket

Pre-Test View of Dummy's Head Showing Dummy's Head is Level

Pre-Test Placement of Dummy's Feet


Pre-Test View of Belt Anchorage for Dummy to Show Position

Pre-Test Left Side View of Steering Wheel to Show Position

Pre-Test View of Parking Brake

Pre-Test Close-Up Left Side View of Driver Seat Track Showing Test Position

Pre-Test Close-Up Left Side View of Driver Seat Back Showing Test Position

Pre-Test Close-Up View of Driver Seat Back or Head Restraint Showing Seat Back Test Position

Pre-Test Dummy and Door Clearance View

Post-Test Dummy and Door Clearance View

Pre-Test Right Side View of Dummy and Front Seat Occupant Compartment

Post-Test Right Side View of Dummy and Front Seat Occupant Compartment

Pre-Test Inner Door Panel View

Post-Test Inner Door Panel View Showing Dummy Contact Location

Post-Test Dummy Close-Up Head Contact with Vehicle View

Post-Test Dummy Close-Up Head Contact with Side Airbag View

Post-Test Dummy Close-Up Torso Contact with Vehicle Interior View

Post-Test Dummy Close-Up Torso Contact with Side Airbag View

Post-Test Dummy Close-Up Pelvis Contact View

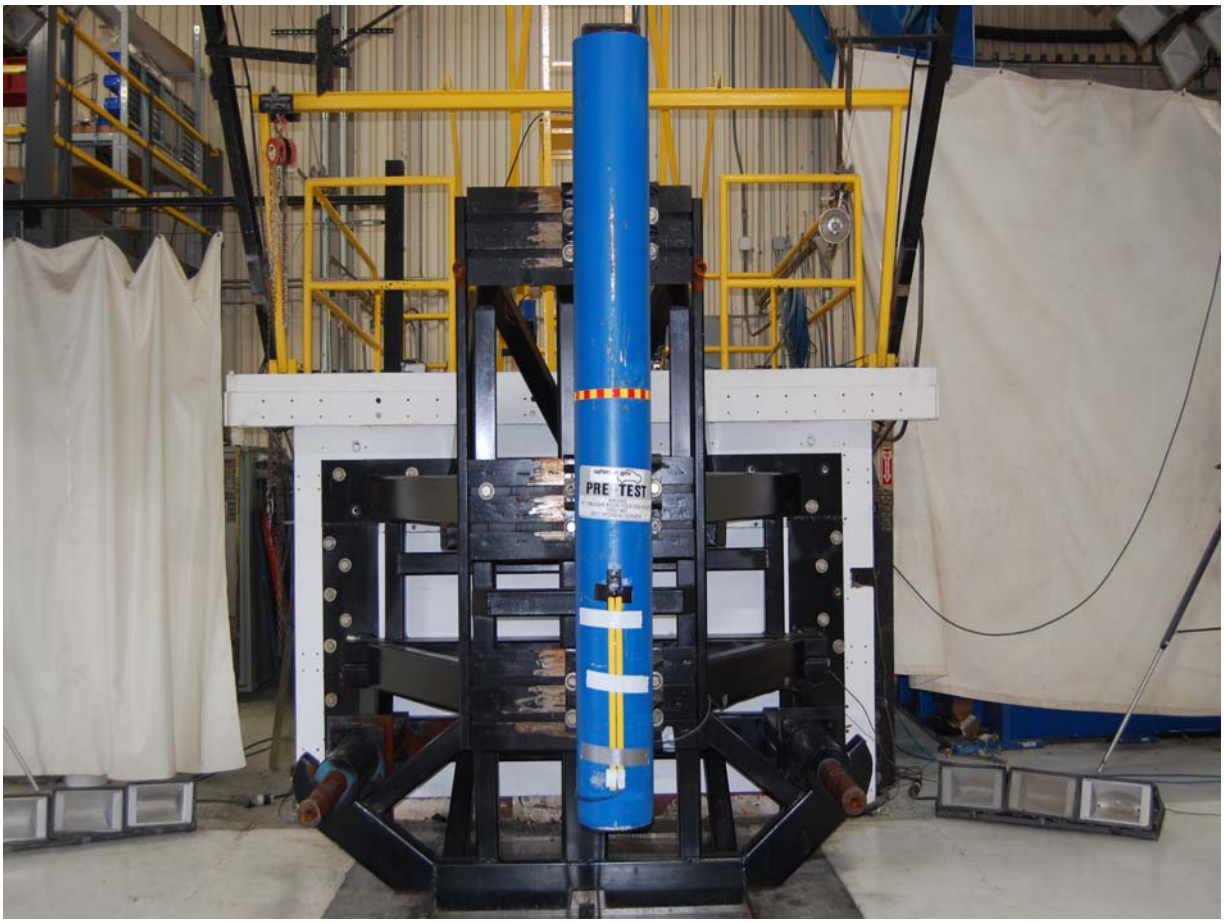
Post-Test Dummy Close-Up Pelvis Contact with Side Airbag View

Pre-Test View of Fuel Filler Cap or Fuel Filler Neck

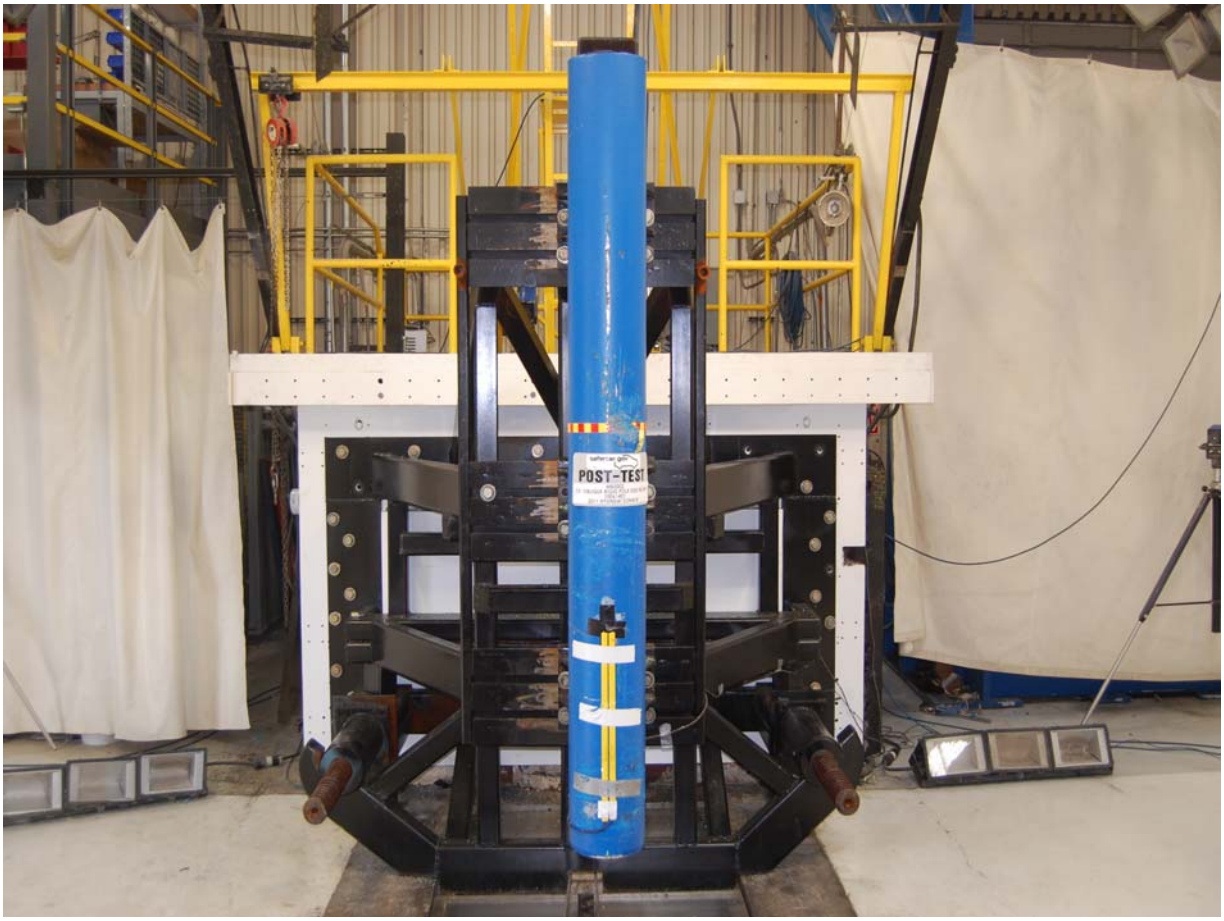
Post-Test View of Fuel Filler Cap or Fuel Filler Neck

Close-Up View of Vehicle's Certification Label

Close-Up View of Vehicle's Tire Information Placard of Label



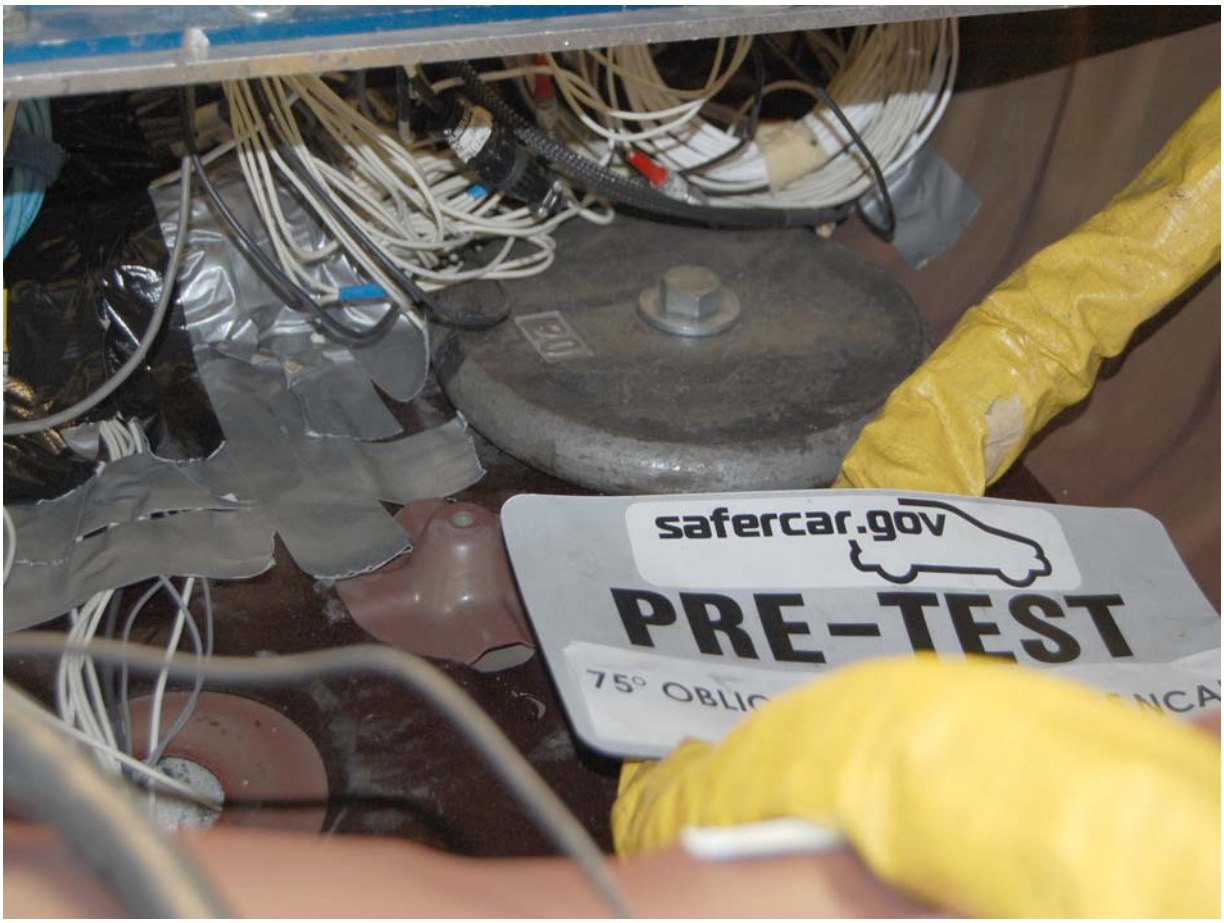
Pre-Test Pole Barrier Front View



Post-Test Pole Barrier Front View

Pre-Test Pole Barrier Side View

Post-Test Pole Barrier Side View



Pre-Test Ballast View

Post-Test Primary and Redundant Speed Trap Read-Out

FMVSS No. 301/305 Rollover 0 Degrees

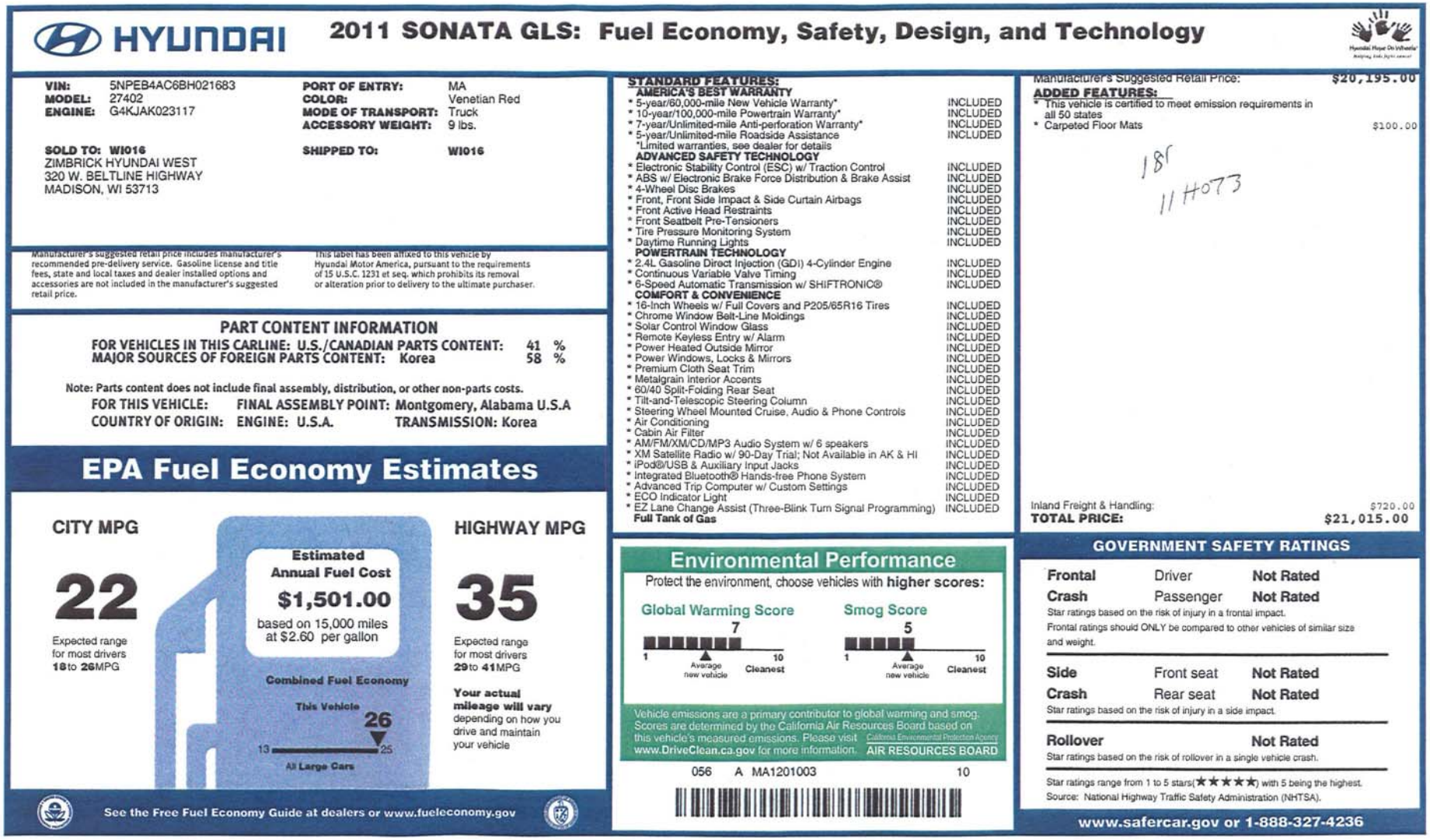
FMVSS No. 301/305 Rollover 90 Degrees

FMVSS No. 301/305 Rollover 180 Degrees

FMVSS No. 301/305 Rollover 270 Degrees

FMVSS No. 301/305 Rollover 360 Degrees

Impact Event (Impact Side)



2011 SONATA GLS: Fuel Economy, Safety, Design, and Technology

HYUNDAI

Hyundai Hope On Wheels

VIN: 5NPEB4AC6BH021683
MODEL: 27402
ENGINE: G4KJAK023117

PORT OF ENTRY: MA
COLOR: Venetian Red
MODE OF TRANSPORT: Truck
ACCESSORY WEIGHT: 9 lbs.

SOLD TO: WI016
ZIMBRICK HYUNDAI WEST
320 W. BELTLINE HIGHWAY
MADISON, WI 53713

SHIPPED TO: WI016

Manufacturer's suggested retail price includes manufacturer's recommended pre-delivery service. Gasoline license and title fees, state and local taxes and dealer installed options and accessories are not included in the manufacturer's suggested retail price.

This label has been affixed to this vehicle by Hyundai Motor America, pursuant to the requirements of 15 U.S.C. 1231 et seq. which prohibits its removal or alteration prior to delivery to the ultimate purchaser.

PART CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE: U.S./CANADIAN PARTS CONTENT: 41 %
MAJOR SOURCES OF FOREIGN PARTS CONTENT: Korea 58 %

Note: Parts content does not include final assembly, distribution, or other non-parts costs.

FOR THIS VEHICLE: FINAL ASSEMBLY POINT: Montgomery, Alabama U.S.A
COUNTRY OF ORIGIN: ENGINE: U.S.A. TRANSMISSION: Korea

EPA Fuel Economy Estimates

CITY MPG

22

Expected range for most drivers **18** to **26** MPG

Estimated Annual Fuel Cost

$1,501.00

based on 15,000 miles at $2.60 per gallon

Combined Fuel Economy

This Vehicle **26**

13 — 25

All Large Cars

HIGHWAY MPG

35

Expected range for most drivers **29** to **41** MPG

Your actual mileage will vary depending on how you drive and maintain your vehicle

See the Free Fuel Economy Guide at dealers or www.fueleconomy.gov

STANDARD FEATURES:

AMERICA'S BEST WARRANTY	
* 5-year/60,000-mile New Vehicle Warranty*	INCLUDED
* 10-year/100,000-mile Powertrain Warranty*	INCLUDED
* 7-year/Unlimited-mile Anti-perforation Warranty*	INCLUDED
* 5-year/Unlimited-mile Roadside Assistance	INCLUDED
*Limited warranties, see dealer for details	
ADVANCED SAFETY TECHNOLOGY	
* Electronic Stability Control (ESC) w/ Traction Control	INCLUDED
* ABS w/ Electronic Brake Force Distribution & Brake Assist	INCLUDED
* 4-Wheel Disc Brakes	INCLUDED
* Front, Front Side Impact & Side Curtain Airbags	INCLUDED
* Front Active Head Restraints	INCLUDED
* Front Seatbelt Pre-Tensioners	INCLUDED
* Tire Pressure Monitoring System	INCLUDED
* Daytime Running Lights	INCLUDED
POWERTRAIN TECHNOLOGY	
* 2.4L Gasoline Direct Injection (GDI) 4-Cylinder Engine	INCLUDED
* Continuous Variable Valve Timing	INCLUDED
* 6-Speed Automatic Transmission w/ SHIFTRONIC®	INCLUDED
COMFORT & CONVENIENCE	
* 16-Inch Wheels w/ Full Covers and P205/65R16 Tires	INCLUDED
* Chrome Window Belt-Line Moldings	INCLUDED
* Solar Control Window Glass	INCLUDED
* Remote Keyless Entry w/ Alarm	INCLUDED
* Power Heated Outside Mirror	INCLUDED
* Power Windows, Locks & Mirrors	INCLUDED
* Premium Cloth Seat Trim	INCLUDED
* Metalgrain Interior Accents	INCLUDED
* 60/40 Split-Folding Rear Seat	INCLUDED
* Tilt-and-Telescopic Steering Column	INCLUDED
* Steering Wheel Mounted Cruise, Audio & Phone Controls	INCLUDED
* Air Conditioning	INCLUDED
* Cabin Air Filter	INCLUDED
* AM/FM/XM/CD/MP3 Audio System w/ 6 speakers	INCLUDED
* XM Satellite Radio w/ 90-Day Trial; Not Available in AK & HI	INCLUDED
* iPod®/USB & Auxiliary Input Jacks	INCLUDED
* Integrated Bluetooth® Hands-free Phone System	INCLUDED
* Advanced Trip Computer w/ Custom Settings	INCLUDED
* ECO Indicator Light	INCLUDED
* EZ Lane Change Assist (Three-Blink Turn Signal Programming)	INCLUDED
Full Tank of Gas	

Manufacturer's Suggested Retail Price: **$20,195.00**

ADDED FEATURES:

* This vehicle is certified to meet emission requirements in all 50 states	
* Carpeted Floor Mats	$100.00

18r
11H073

Inland Freight & Handling: $720.00
TOTAL PRICE: **$21,015.00**

Environmental Performance

Protect the environment, choose vehicles with **higher scores:**

Global Warming Score

7

1 — 10

Average new vehicle — Cleanest

Smog Score

5

1 — 10

Average new vehicle — Cleanest

Vehicle emissions are a primary contributor to global warming and smog. Scores are determined by the California Air Resources Board based on this vehicle's measured emissions. Please visit www.DriveClean.ca.gov for more information.

California Environmental Protection Agency AIR RESOURCES BOARD

056 A MA1201003 10

GOVERNMENT SAFETY RATINGS

Frontal Crash	Driver	**Not Rated**
	Passenger	**Not Rated**

Star ratings based on the risk of injury in a frontal impact.
Frontal ratings should ONLY be compared to other vehicles of similar size and weight.

Side Crash	Front seat	**Not Rated**
	Rear seat	**Not Rated**

Star ratings based on the risk of injury in a side impact.

Rollover **Not Rated**

Star ratings based on the risk of rollover in a single vehicle crash.

Star ratings range from 1 to 5 stars(★★★★★) with 5 being the highest.
Source: National Highway Traffic Safety Administration (NHTSA).

www.safercar.gov or 1-888-327-4236

Monroney Label

OMG038400

Headrest

The driver's and front passenger's seats are equipped with a headrest for the occupant's safety and comfort.

The headrest not only provides comfort for the driver and front passenger, but also helps to protect the head and neck in the event of a collision.

⚠ WARNING

- **For maximum effectiveness in case of an accident, the headrest should be adjusted so the middle of the headrest is at the same height of the center of gravity of an occupant's head. Generally, the center of gravity of most people's head is similar with the height of the top of their eyes. Also, adjust the headrest as close to your head as possible. For this reason, the use of a cushion that holds the body away from the seatback is not recommended.**
- **Do not operate the vehicle with the headrests removed as severe injury to the occupants may occur in the event of an accident. Headrests may provide protection against neck injuries when properly adjusted.**
- **Do not adjust the headrest position of the driver's seat while the vehicle is in motion.**

OYF039010

Adjusting the height up and down

To raise the headrest, pull it up to the desired position (1). To lower the headrest, push and hold the release button (2) on the headrest support and lower the headrest to the desired position (3).

OYF039012

Removal

To remove the headrest, raise it as far as it can go then press the release button (1) while pulling upward (2).

To reinstall the headrest, put the headrest poles (3) into the holes while pressing the release button (1). Then adjust it to the appropriate height.

⚠ WARNING

Make sure the headrest locks in position after adjusting it to properly protect the occupants.

HNF2041-1

Active headrest (if equipped)

The active headrest is designed to move forward and upward during a rear impact. This helps to prevent the driver's and front passenger's head from moving rearward and thus helps prevent neck injuries.

Head Restraint Use and Adjustment Information from Vehicle Owner's Manual

APPENDIX B

DUMMY RESPONSE DATA

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 Acceleration (X) Redundant

Driver Head Acceleration (Y) Redundant

Driver Head Acceleration (Z) Redundant

Driver Upper Thorax Rib Deflection (Y)

Driver Middle Thorax Rib Deflection (Y)

Driver Lower Thorax Rib Deflection (Y)

Driver Upper Abdomen Rib Deflection (Y)

Driver Lower Abdomen Rib Deflection (Y)

Driver Shoulder Contact Switch

Driver Torso Contact Switch

Driver Pelvis Contact Switch

Vehicle CG Acceleration (X)

Vehicle CG Acceleration (Y)

Vehicle CG Acceleration (Z)

Vehicle CG Angular Rate About X (Roll)

Vehicle CG Angular Rate About Y (Pitch)

Vehicle CG Angular Rate About Z (Yaw)

Left Floor Sill Acceleration (Y)

Left A-Pillar Sill Acceleration (Y)

Left Lower A-Pillar Acceleration (Y)

Left Mid A-Pillar Acceleration (Y)

Left B-Pillar Sill Acceleration (Y)

Left Lower B-Pillar Acceleration (Y)

Left Mid B-Pillar Acceleration (Y)

Driver Seat Track at Dummy H-Point Acceleration (Y)

Engine Top Acceleration (X)

Engine Top Acceleration (Y)

Firewall Center Acceleration (Y)

Right Roof at Vertical Impact Reference Line Acceleration (Y)

Right Sill at Vertical Impact Reference Line Acceleration (Y)

Rear Floorpan Behind Rear Axle at Centerline Acceleration (X)

Rear Floorpan Behind Rear Axle at Centerline Acceleration (Y)

Driver Side Airbag Timing

Driver Side Curtain Airbag Timing

Load Cell Pole Barrier #1 Force (Y) – Not used

Load Cell Pole Barrier #2 Force (Y) – Not used

Load Cell Pole Barrier #3 Force (Y) – Not used

Load Cell Pole Barrier #4 Force (Y) – Not used

Load Cell Pole Barrier #5 Force (Y) – Not used

Load Cell Pole Barrier #6 Force (Y) – Not used

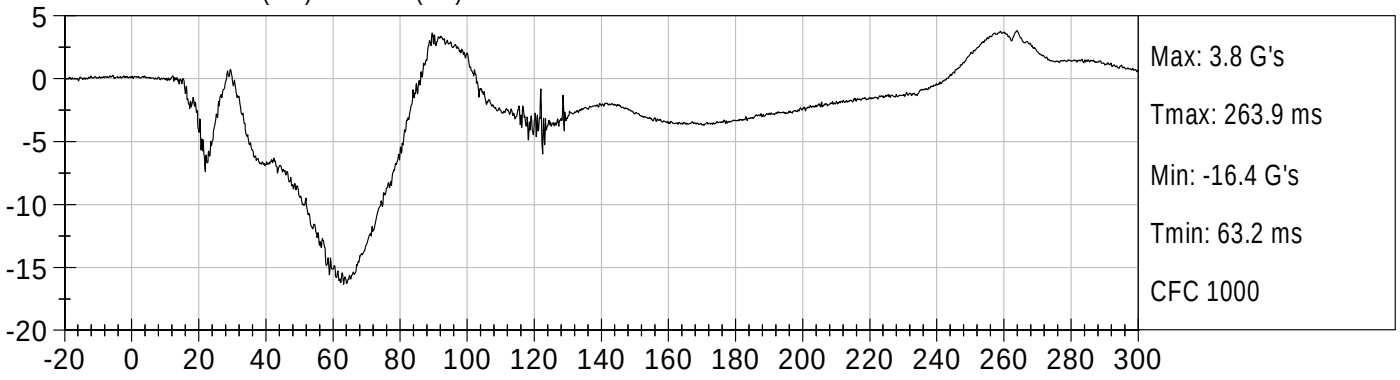
Load Cell Pole Barrier #7 Force (Y) – Not used

Load Cell Pole Barrier #8 Force (Y) – Not used

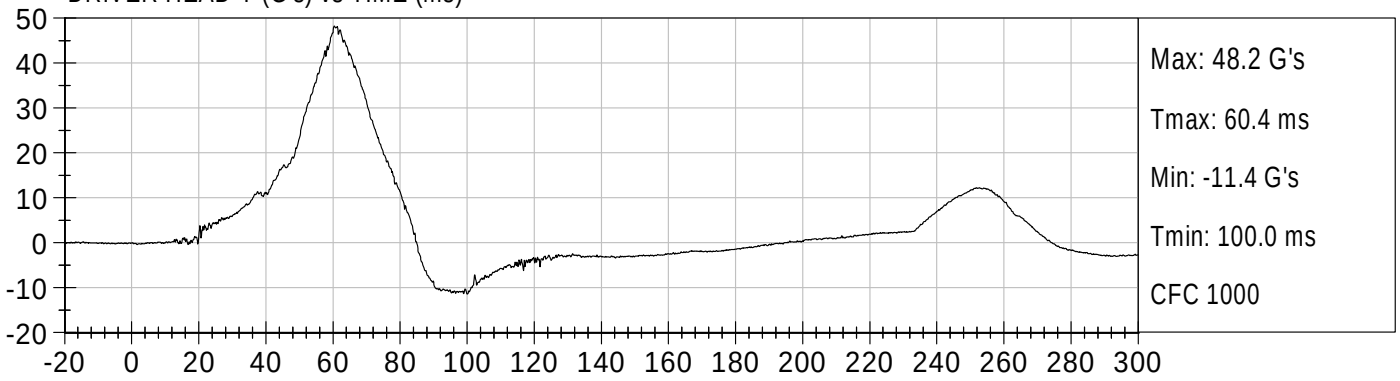
75° Oblique Rigid Pole Side NCAP
2011 Hyundai Sonata - MB5002

Test Date: 06/14/2010
Speed: 20.2 mph (32.5 km/h)

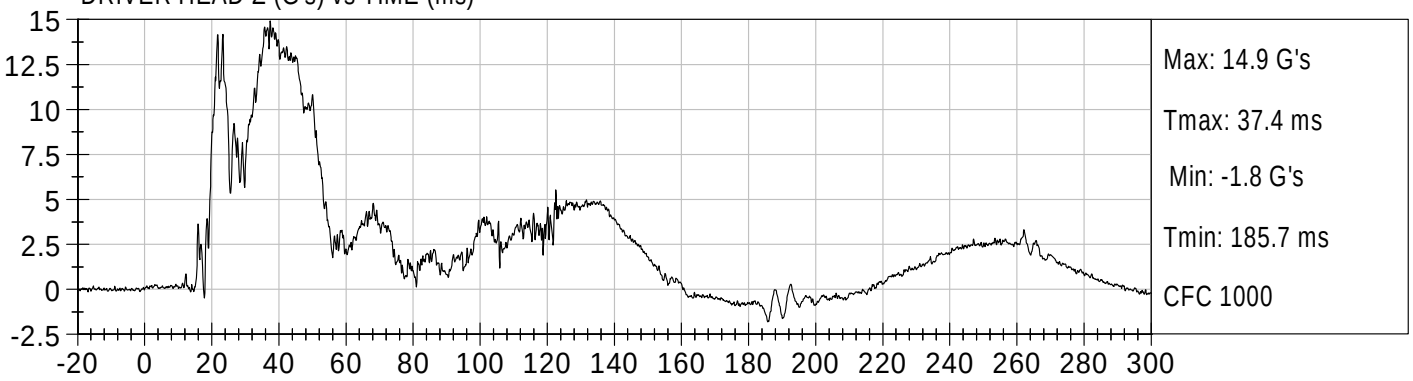
DRIVER HEAD X (G's) vs TIME (ms)



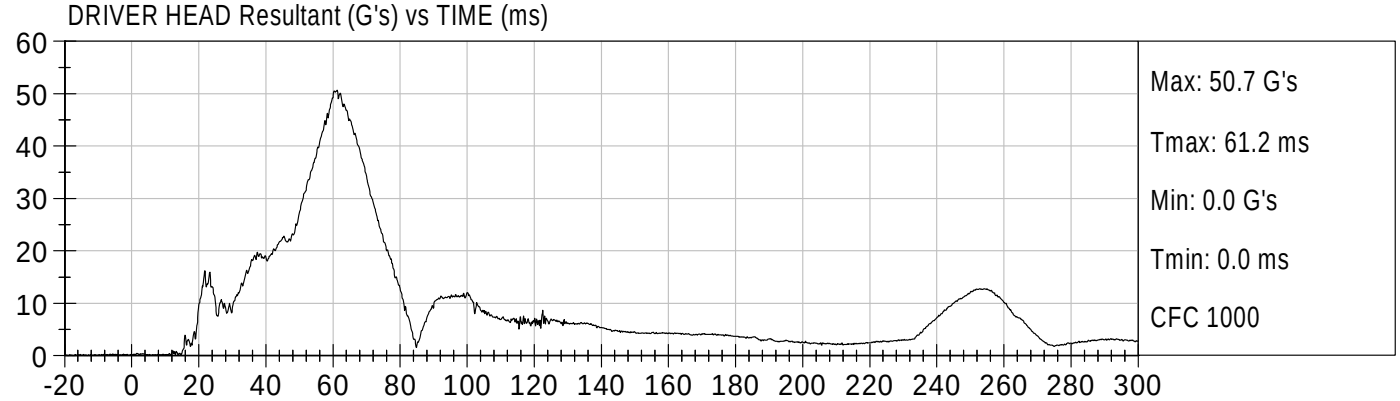
DRIVER HEAD Y (G's) vs TIME (ms)



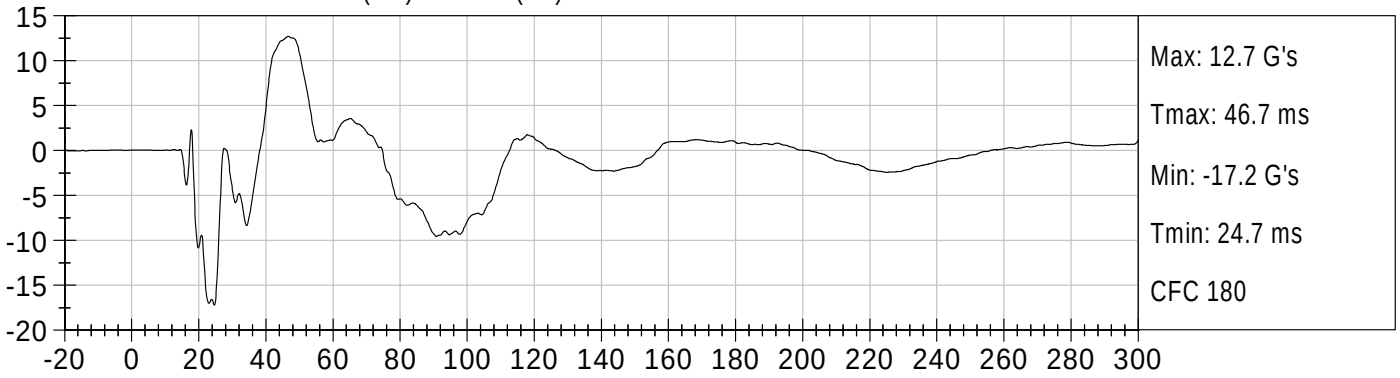
DRIVER HEAD Z (G's) vs TIME (ms)



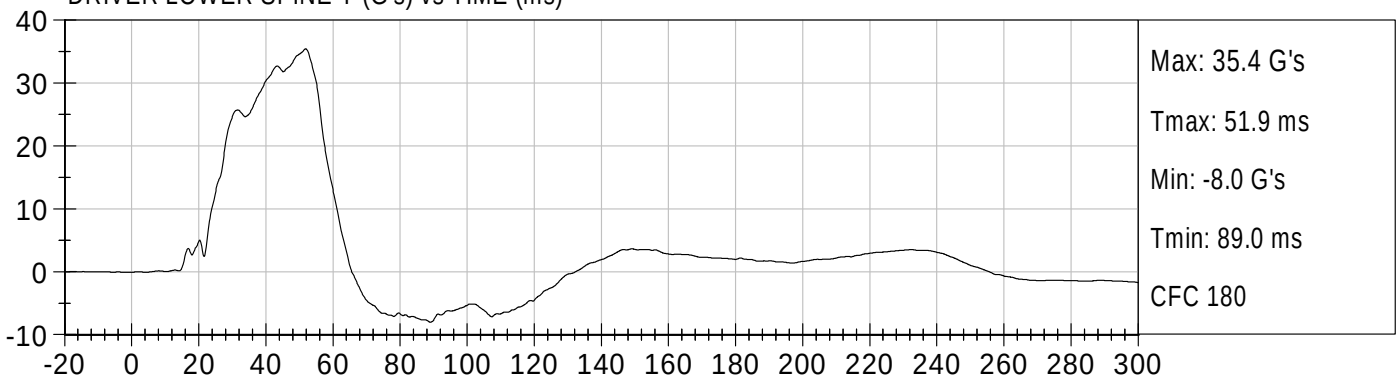
DRIVER HEAD Resultant (G's) vs TIME (ms)



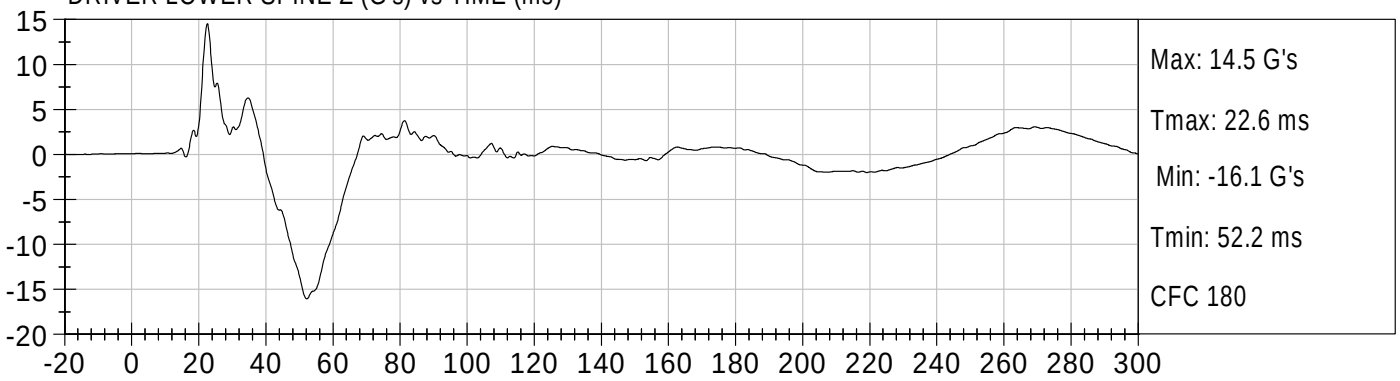
DRIVER LOWER SPINE X (G's) vs TIME (ms)



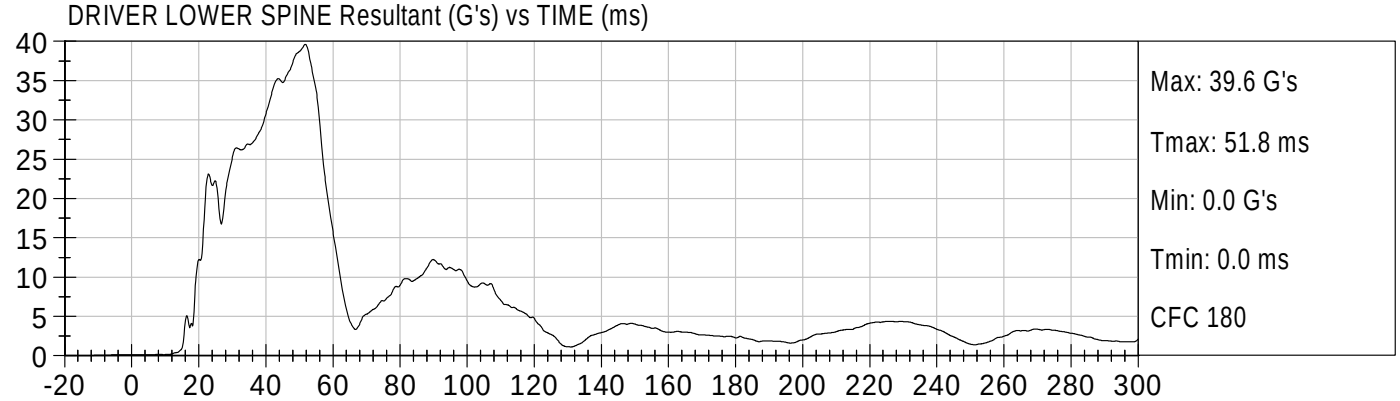
DRIVER LOWER SPINE Y (G's) vs TIME (ms)



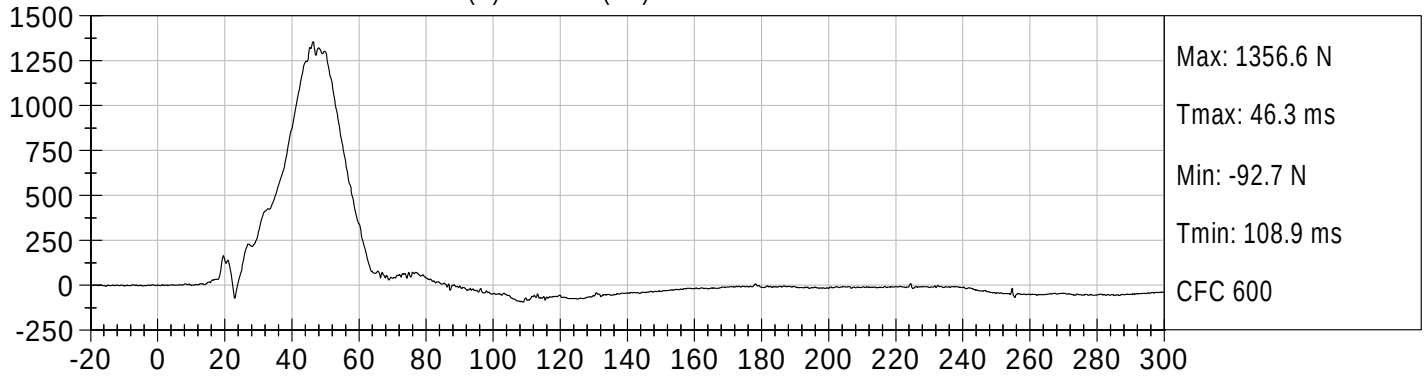
DRIVER LOWER SPINE Z (G's) vs TIME (ms)



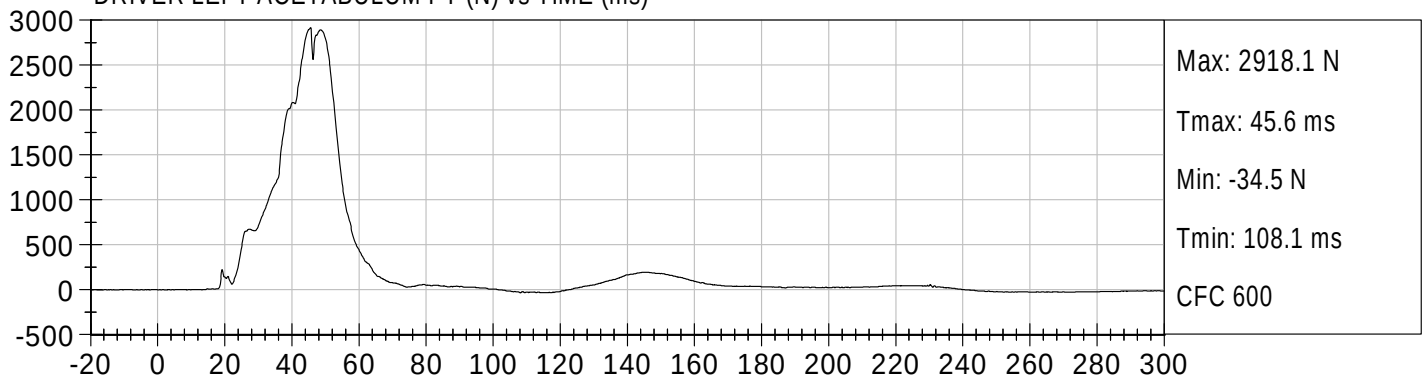
DRIVER LOWER SPINE Resultant (G's) vs TIME (ms)



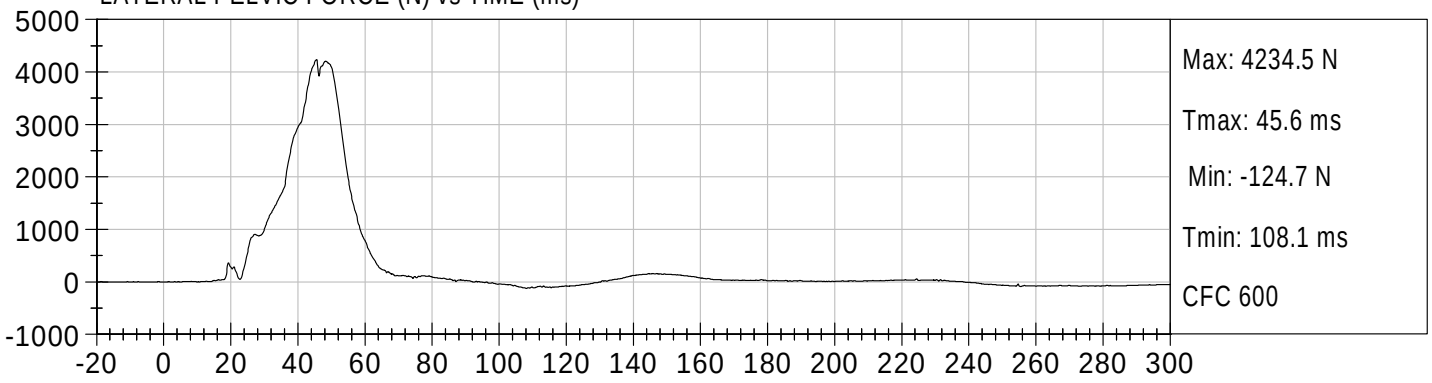
DRIVER LEFT ILLIUM CREST FY (N) vs TIME (ms)



DRIVER LEFT ACETABULUM FY (N) vs TIME (ms)



LATERAL PELVIC FORCE (N) vs TIME (ms)



APPENDIX C

DUMMY CALIBRATION AND PERFORMANCE VERIFICATION DATA

MGA RESEARCH CORPORATION

HEAD DROP TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D101781

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	50	Pass
Peak Resultant Acceleration	G's	115 to 137	120	Pass
Peak Lateral Acceleration	G's	+/- 15	-5.6	Pass
Unimodal	N/A	<15%	Yes	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

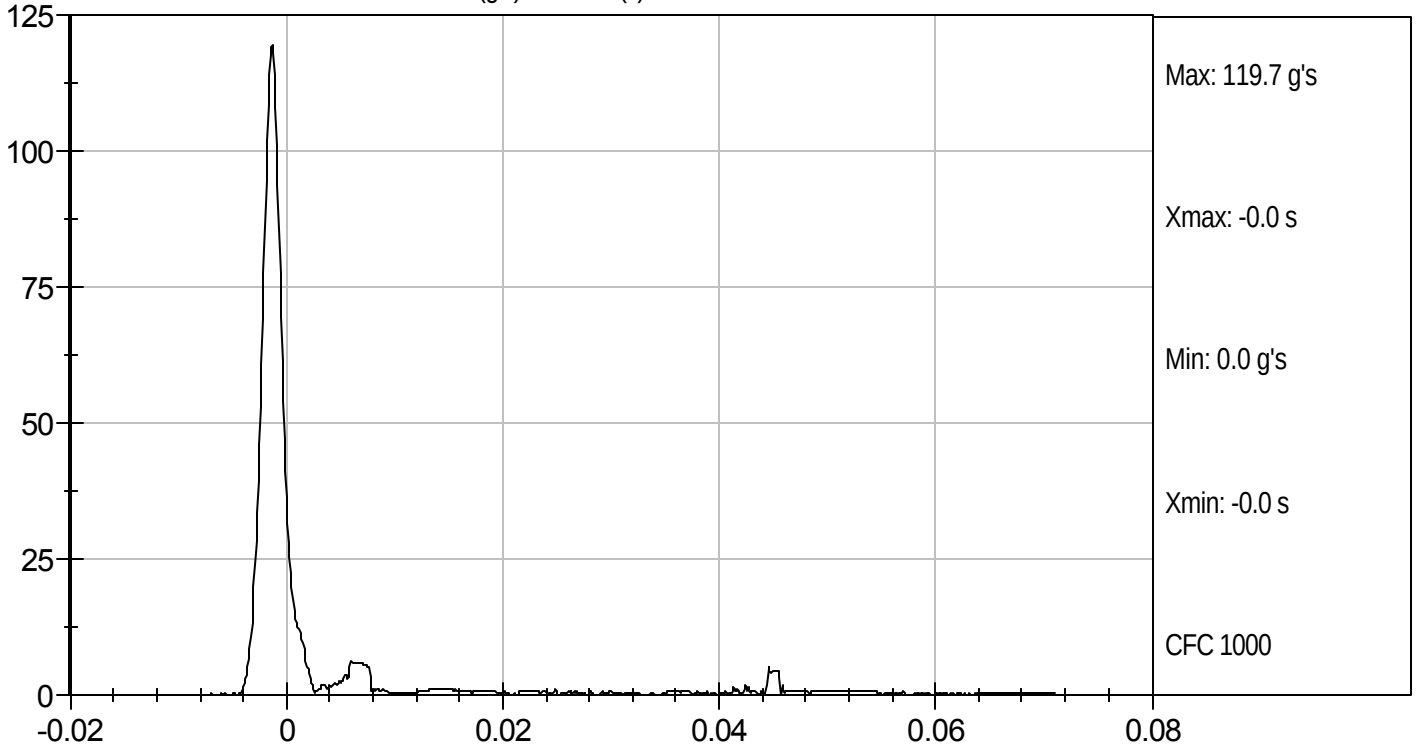
6/9/10
Test Date

David Winkelbauer
Approved By

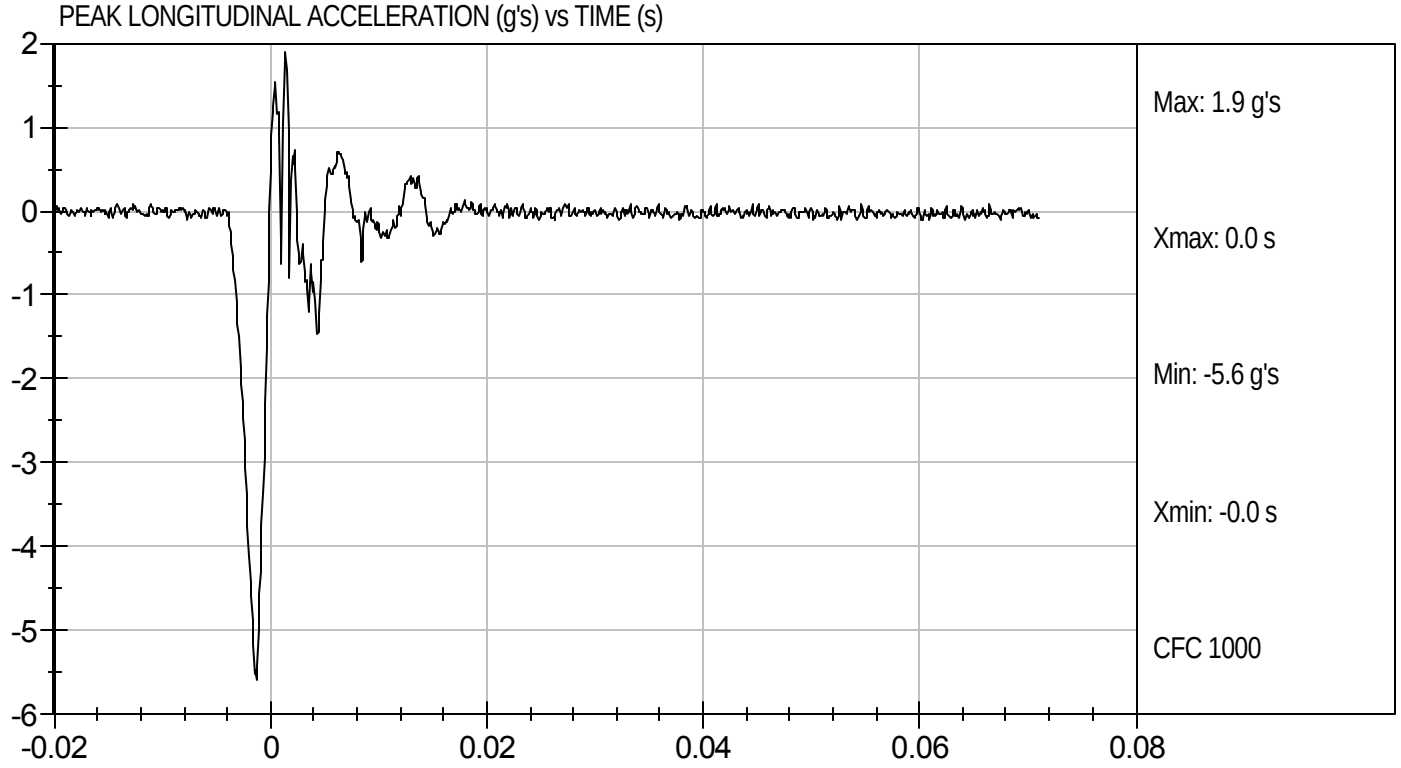
Test Desc: Head Drop
Component ID: D101781

Test Date: 6/9/10
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (g's) vs TIME (s)



PEAK LONGITUDINAL ACCELERATION (g's) vs TIME (s)



MGA RESEARCH CORPORATION

LATERAL NECK PENDULUM TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101782

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	22.0	Pass
Humidity		%	10 to 70	57	Pass
Impact Velocity		m/s	5.51 to 5.63	5.61	Pass
Delta Velocity	10 ms	m/s	2.20 to 2.80	2.75	Pass
	15 ms	m/s	3.30 to 4.10	3.93	Pass
	20 ms	m/s	4.40 to 5.40	5.20	Pass
	25 ms	m/s	5.40 to 6.10	5.49	Pass
	25-100 ms	m/s	5.50 to 6.20	5.51	Pass
Maximum D-Plane Rotation		deg	71 to 81	72	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	58	Pass
Maximum Occipital Condyle Moment during Rotation Interval		Nm	-44 to -36	-43	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	114	Pass
			Overall Test Results		Pass

Jessica Gall
Laboratory Technician

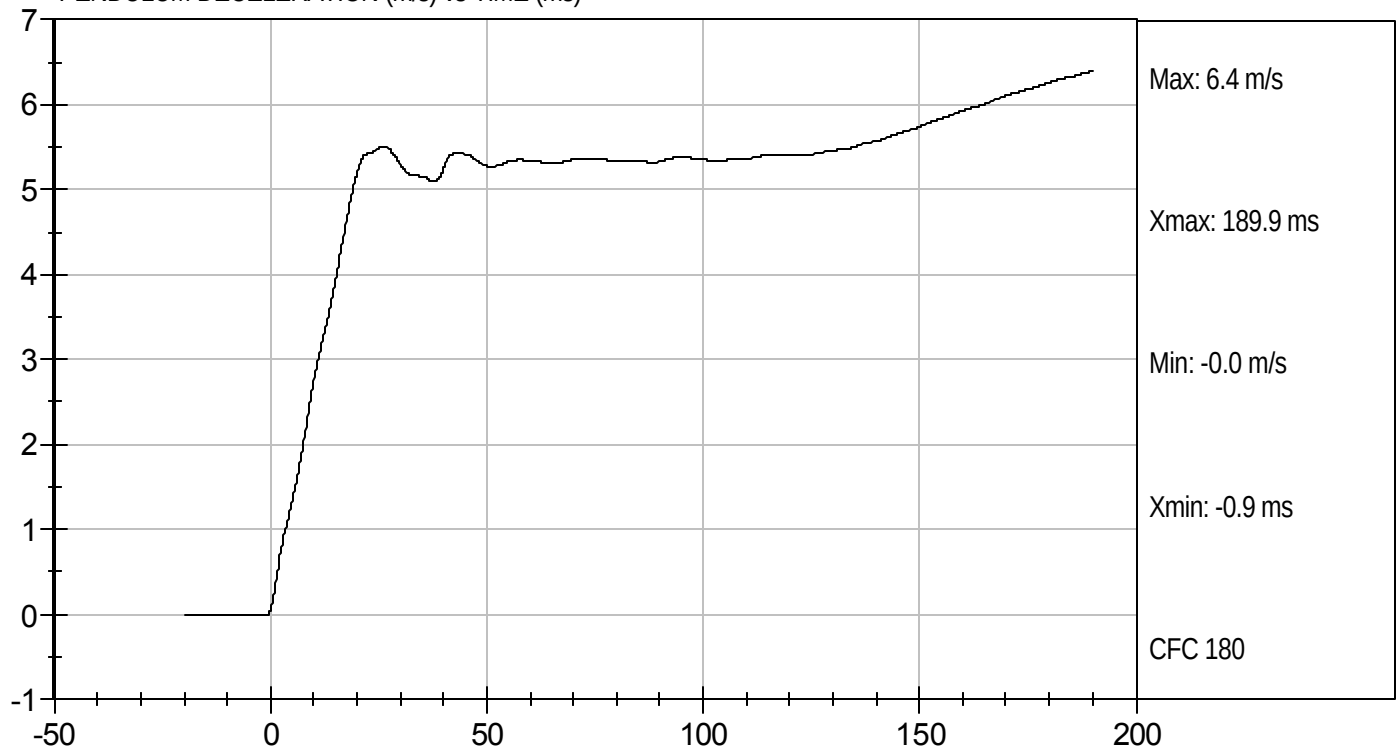
6/9/10
Test Date

David Winkelbauer
Approved By

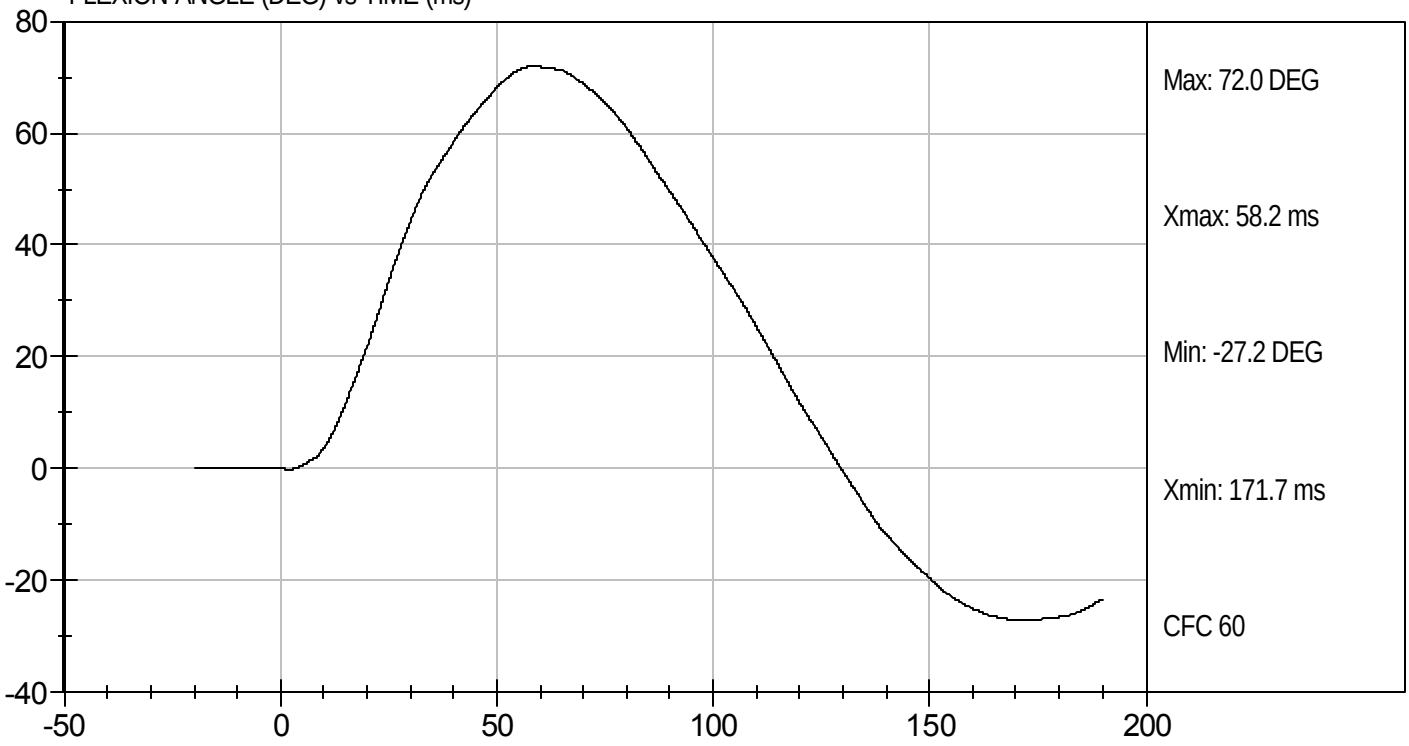
Test Desc: Neck Bending
Component ID: D101782

Test Date: 6/9/10
Velocity: 18.42 ft/s, 5.61 m/s

PENDULUM DECELERATION (m/s) vs TIME (ms)

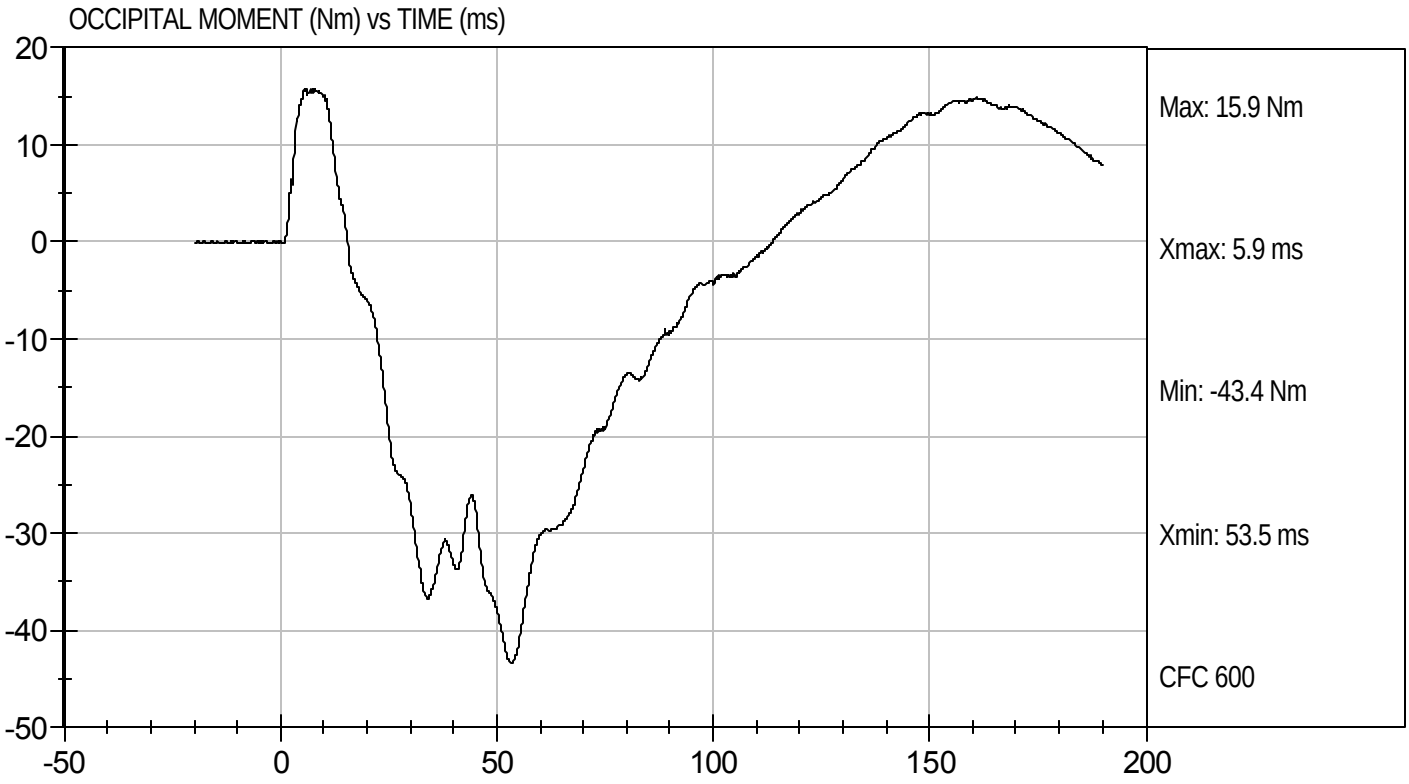


FLEXION ANGLE (DEG) vs TIME (ms)



Test Desc: Neck Bending
Component ID: D101782

Test Date: 6/9/10
Velocity: 18.42 ft/s, 5.61 m/s



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D101783

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	49	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Maximum Probe Acceleration	G's	13 to 18	15	Pass
Shoulder Displacement	mm	28 to 37	31	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	18	Pass
		Overall Test Results		Pass

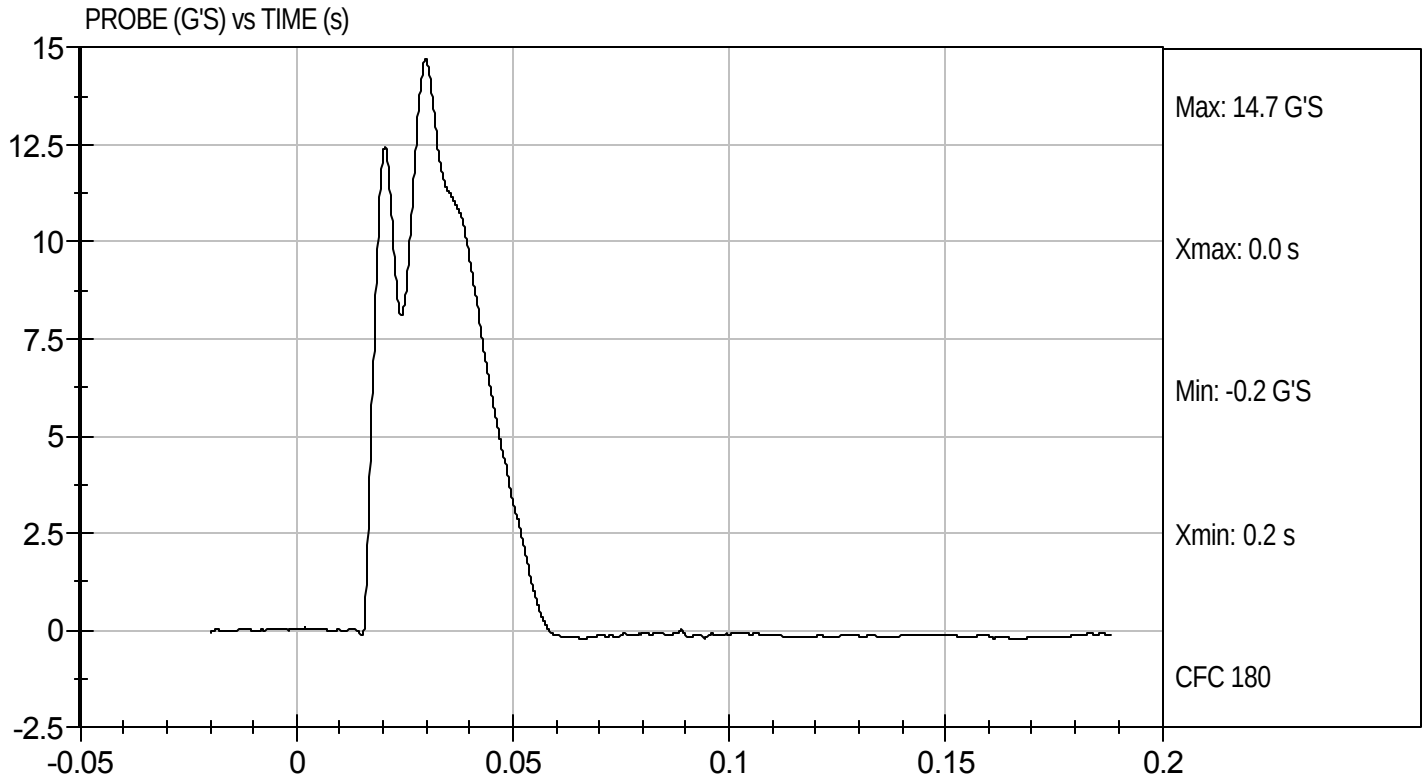
Jessica Hall
Laboratory Technician

6/10/10
Test Date

David Winkelbauer
Approved By

Test Desc: Shoulder Impact
Component ID: D101783

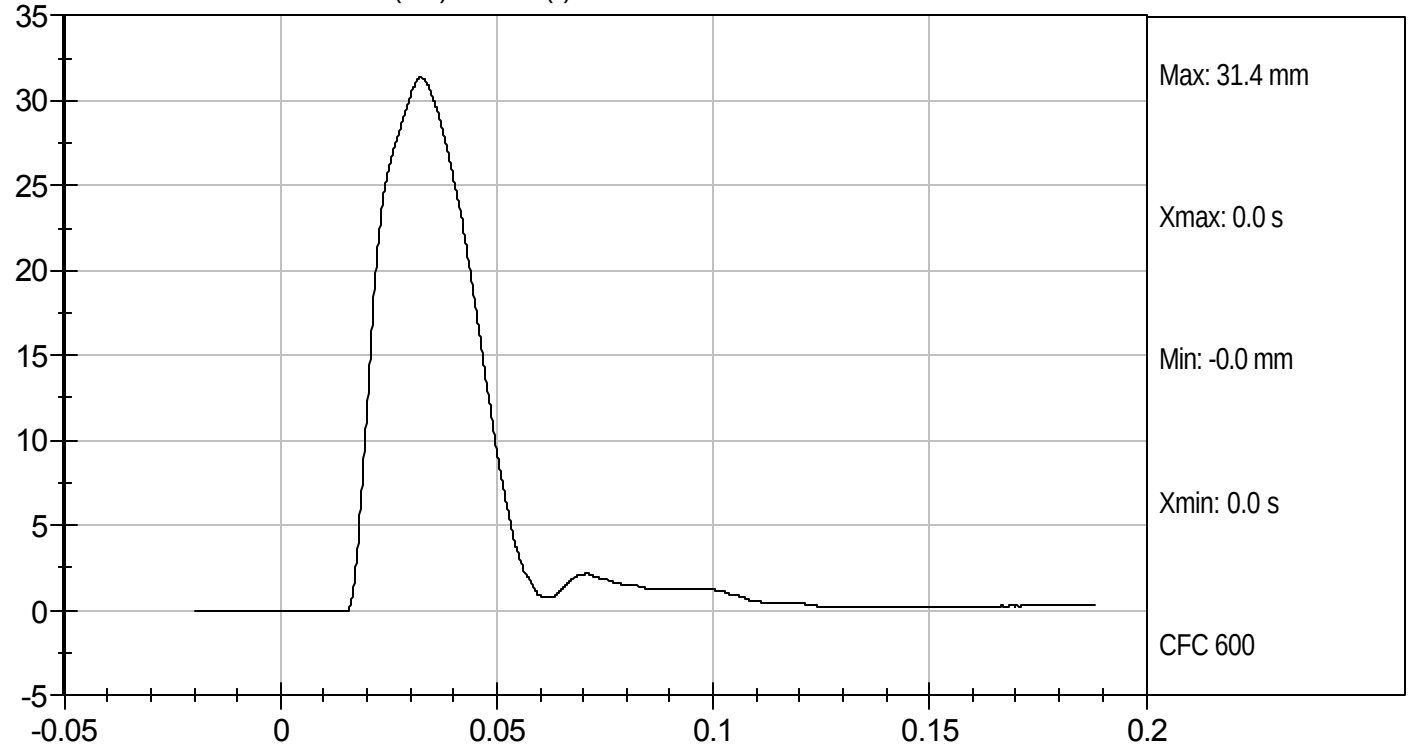
Test Date: 6/10/10
Velocity: 14.37 ft/s, 4.38 m/s



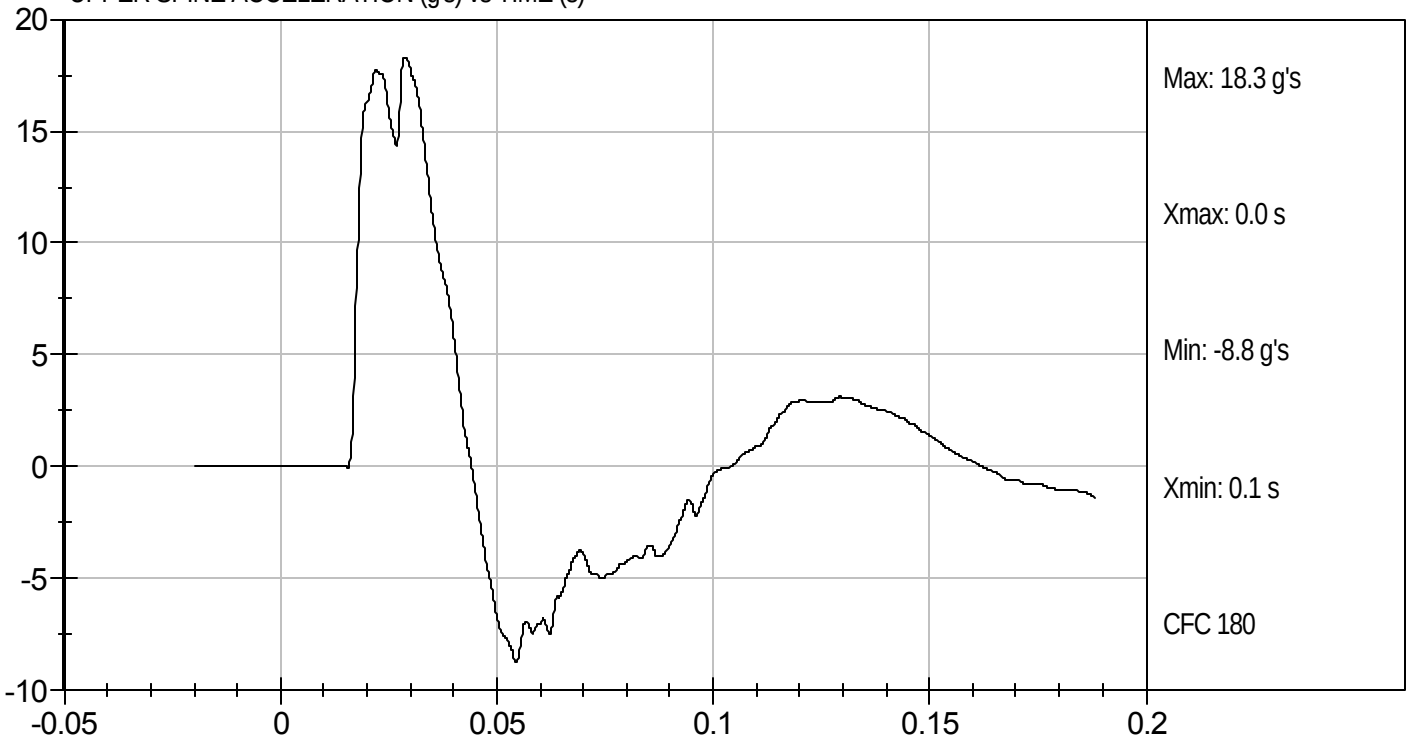
Test Desc: Shoulder Impact
Component ID: D101783

Test Date: 6/10/10
Velocity: 14.37 ft/s, 4.38 m/s

SHOULDER DISPLACEMENT (mm) vs TIME (s)



UPPER SPINE ACCELERATION (g's) vs TIME (s)



MGA RESEARCH CORPORATION

THORAX (WITH ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101784

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	48	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Peak Impactor Acceleration	G's	30 to 36	31	Pass
Shoulder Displacement	mm	31 to 40	36	Pass
Upper Rib Displacement	mm	25 to 32	27	Pass
Middle Rib Displacement	mm	30 to 36	31	Pass
Lower Rib Displacement	mm	32 to 38	33	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	38	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	32	Pass
		Overall Test Results		Pass

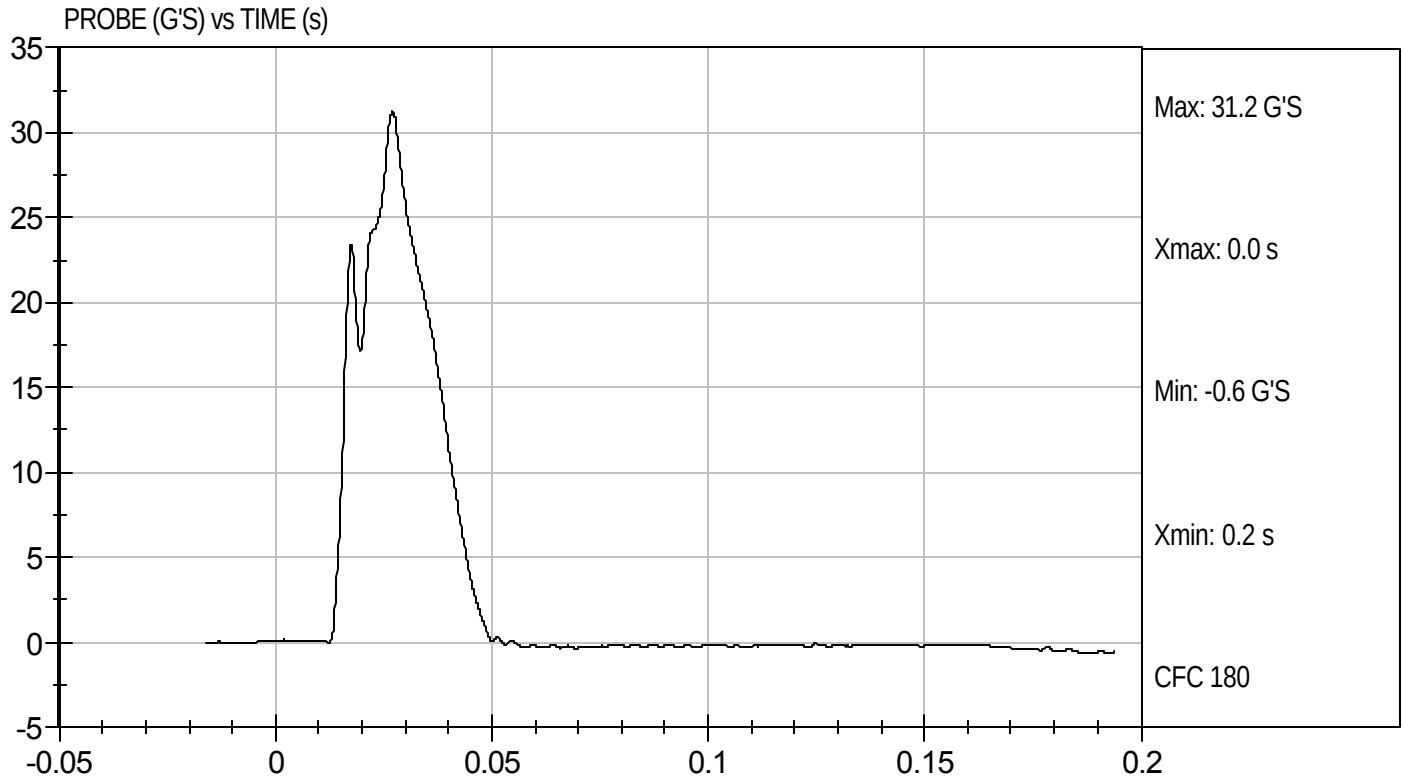
Jessica Hall
Laboratory Technician

6/10/10
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax With Arm
Component ID: D101784

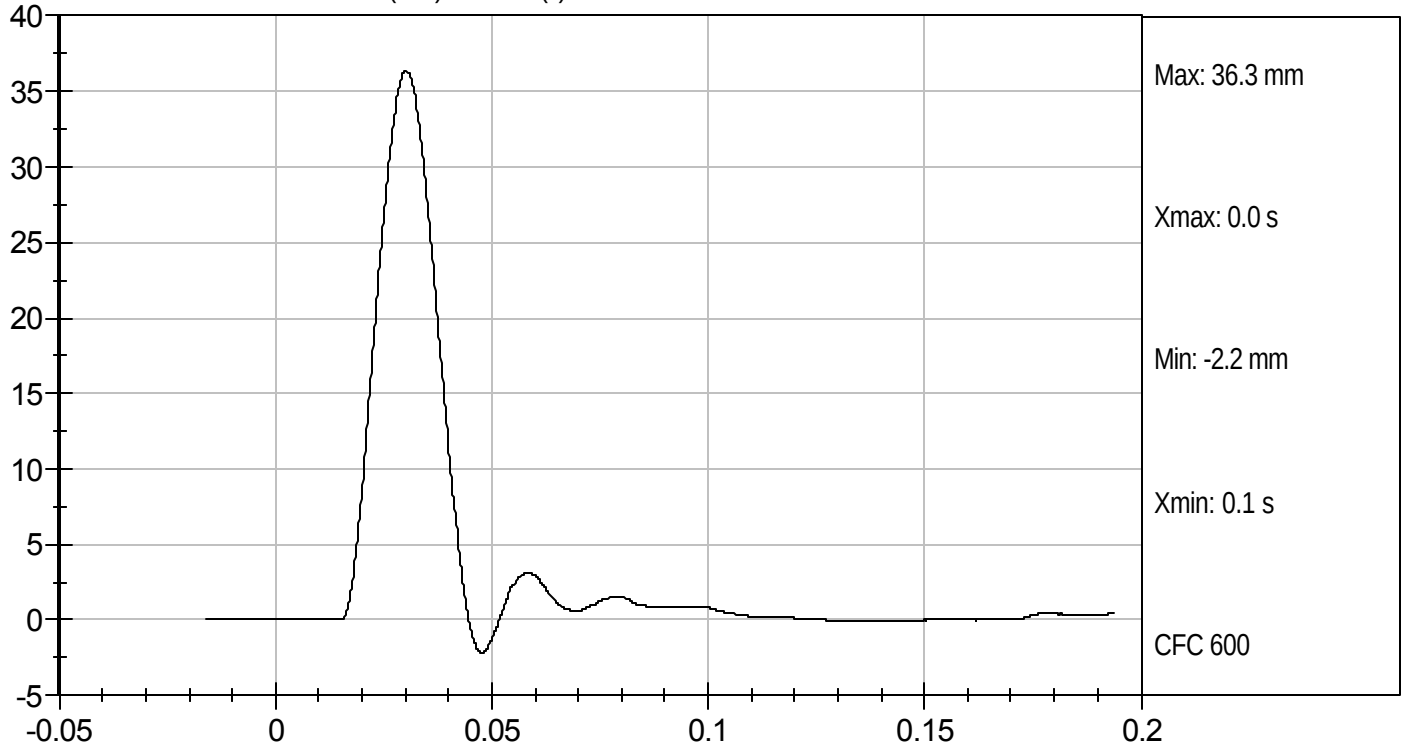
Test Date: 6/10/10
Velocity: 22.22 ft/s, 6.77 m/s



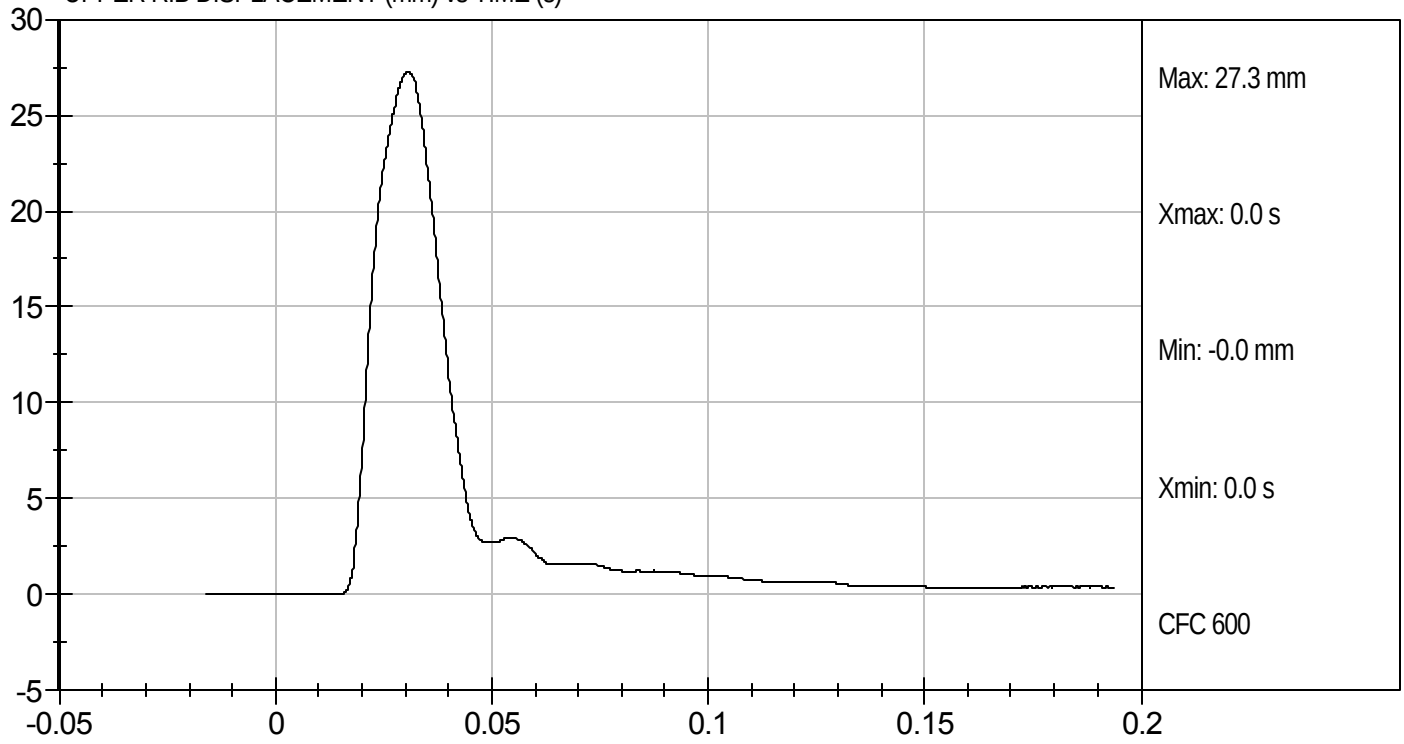
Test Desc: Thorax With Arm
Component ID: D101784

Test Date: 6/10/10
Velocity: 22.22 ft/s, 6.77 m/s

SHOULDER DISPLACEMENT (mm) vs TIME (s)



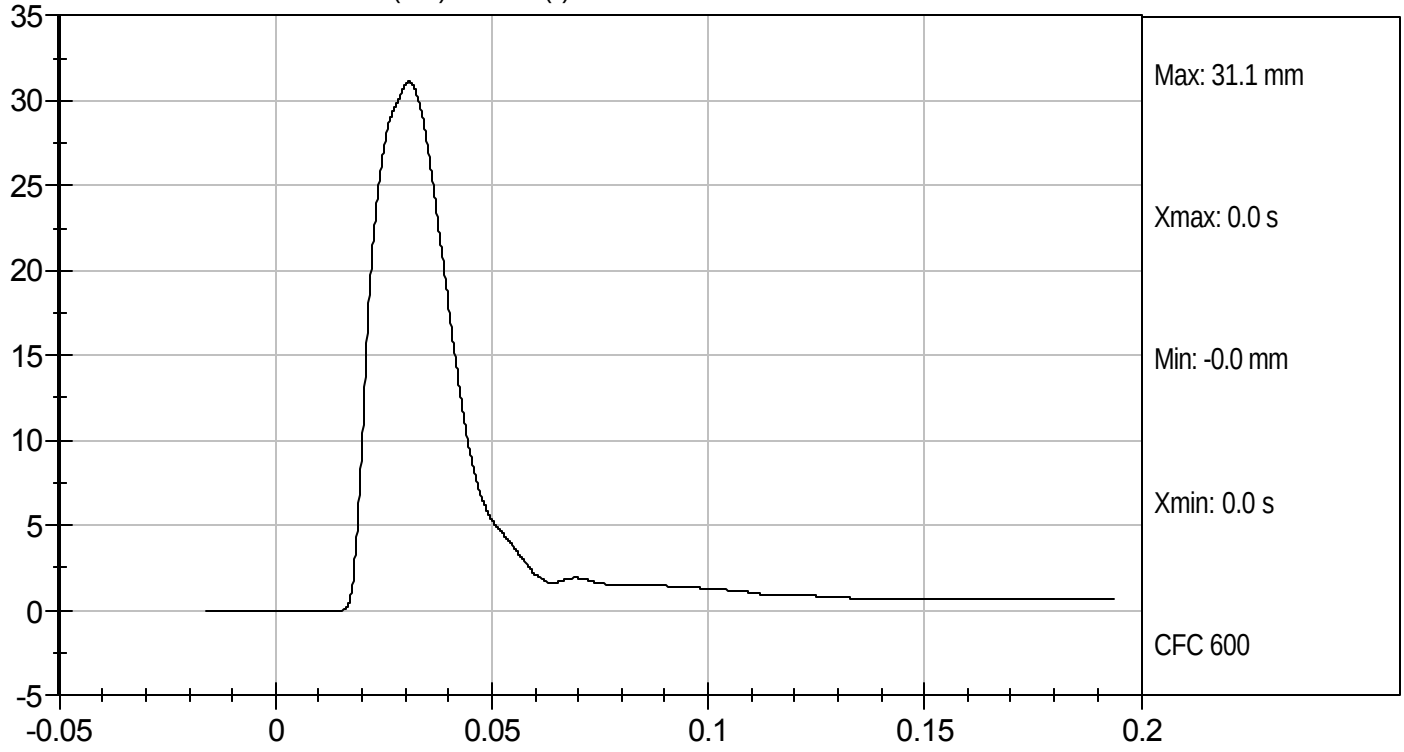
UPPER RIB DISPLACEMENT (mm) vs TIME (s)



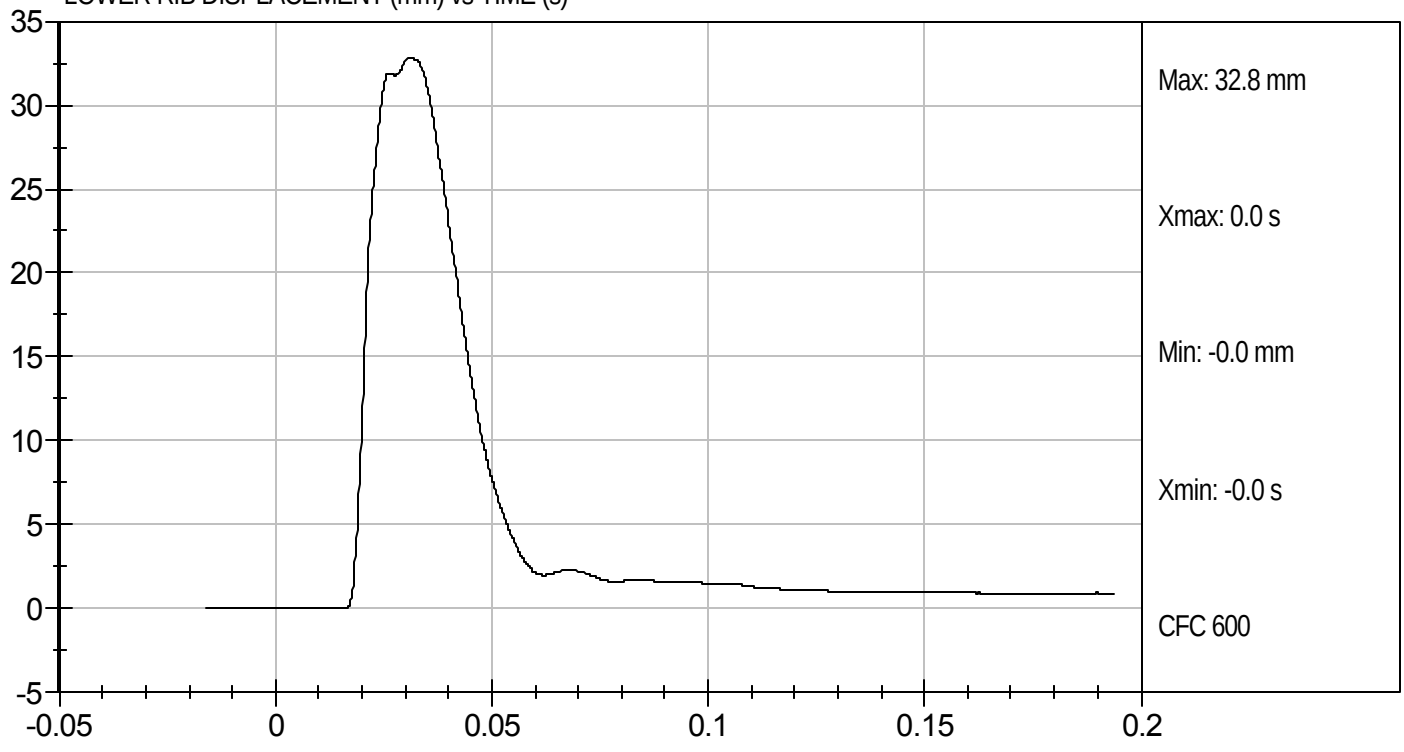
Test Desc: Thorax With Arm
Component ID: D101784

Test Date: 6/10/10
Velocity: 22.22 ft/s, 6.77 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (s)



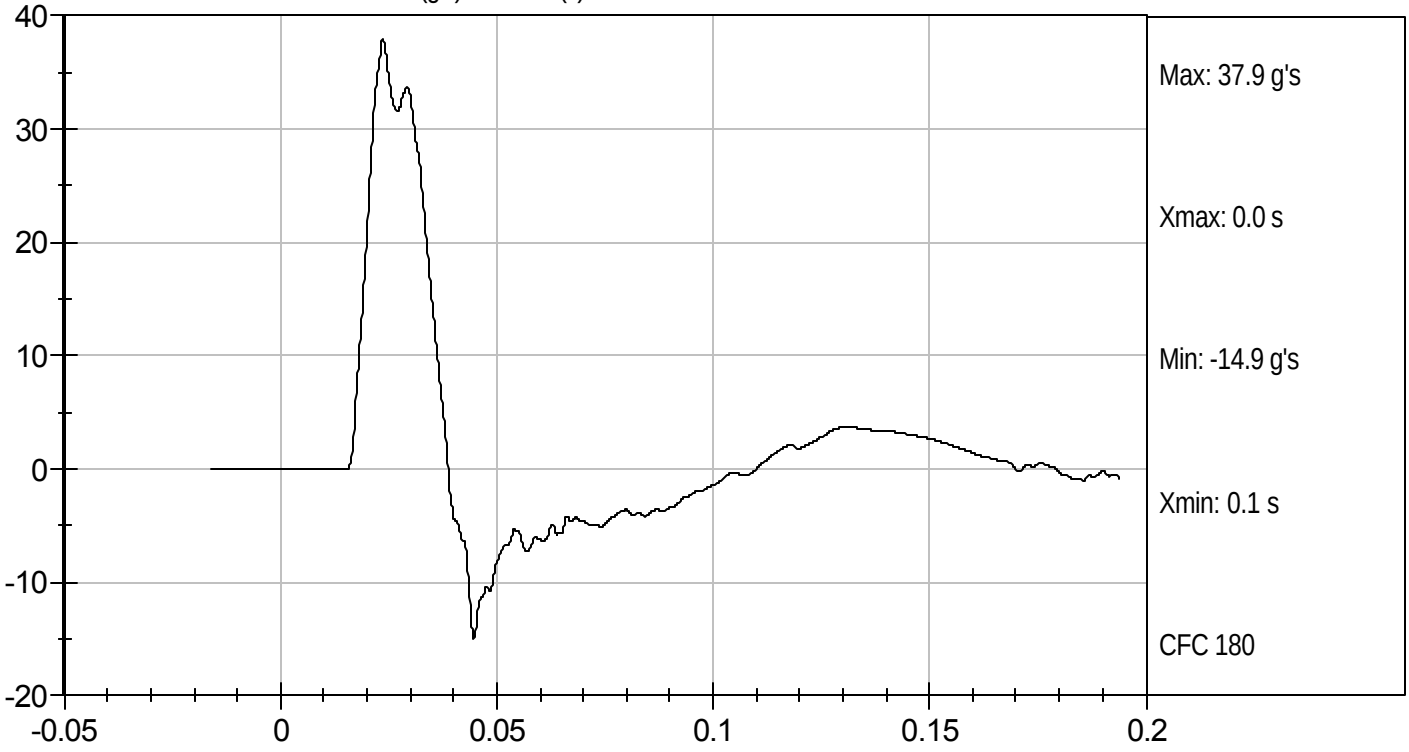
LOWER RIB DISPLACEMENT (mm) vs TIME (s)



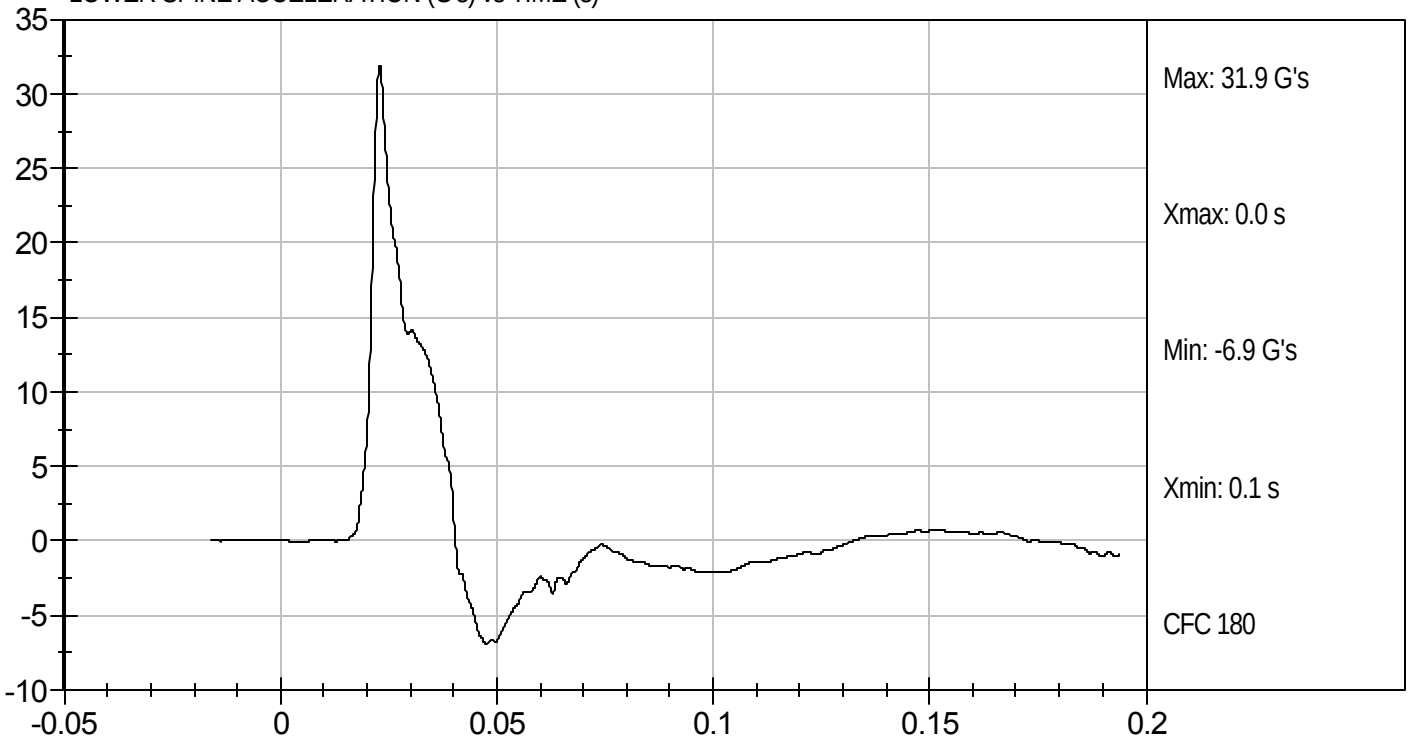
Test Desc: Thorax With Arm
Component ID: D101784

Test Date: 6/10/10
Velocity: 22.22 ft/s, 6.77 m/s

UPPER SPINE ACCELERATION (g's) vs TIME (s)



LOWER SPINE ACCELERATION (G's) vs TIME (s)



MGA RESEARCH CORPORATION

THORAX (WITHOUT ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101785

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	48	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Peak Impactor Force	G's	14 to 18	14	Pass
Upper Rib Displacement	mm	32 to 40	35	Pass
Middle Rib Displacement	mm	39 to 45	41	Pass
Lower Rib Displacement	mm	35 to 43	39	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	14	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	8	Pass
		Overall Test Results		Pass

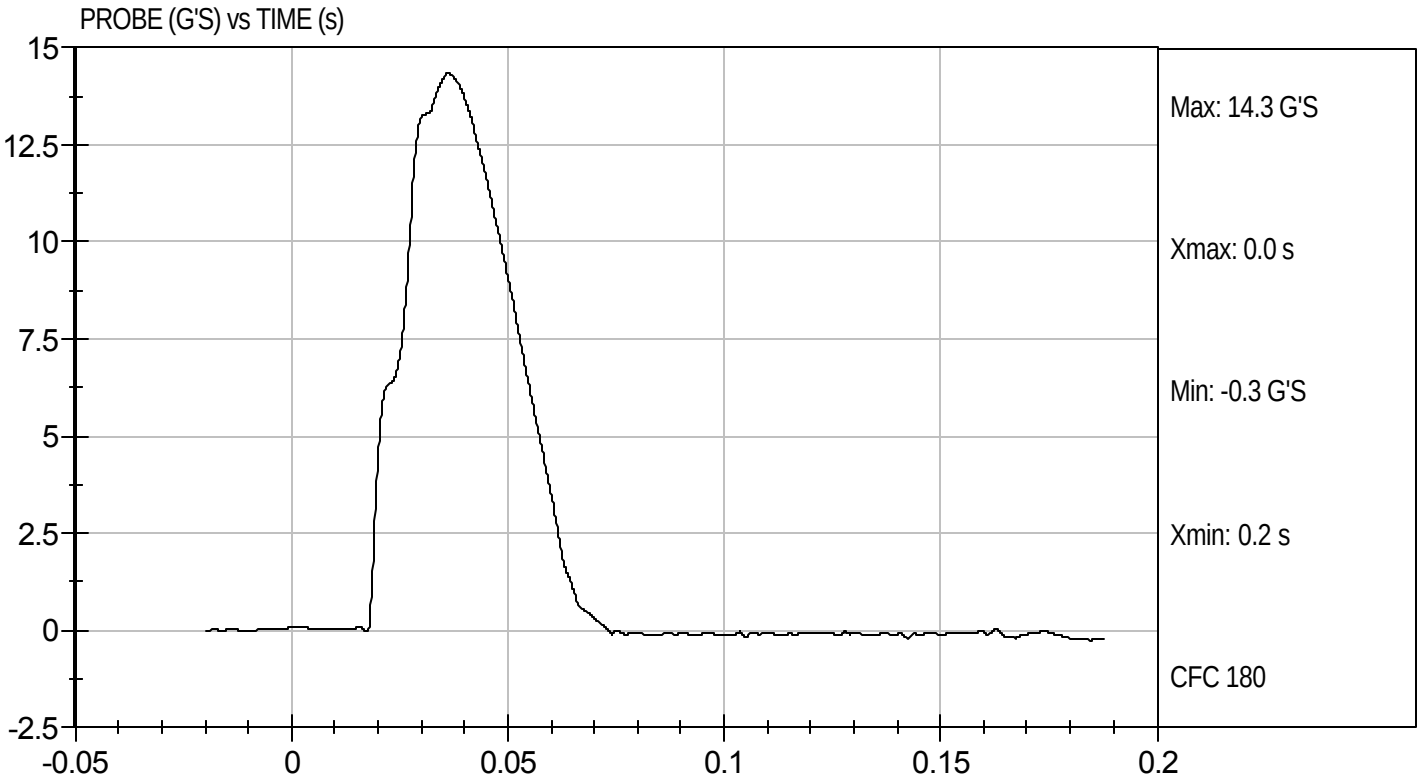
Jessica Hall
Laboratory Technician

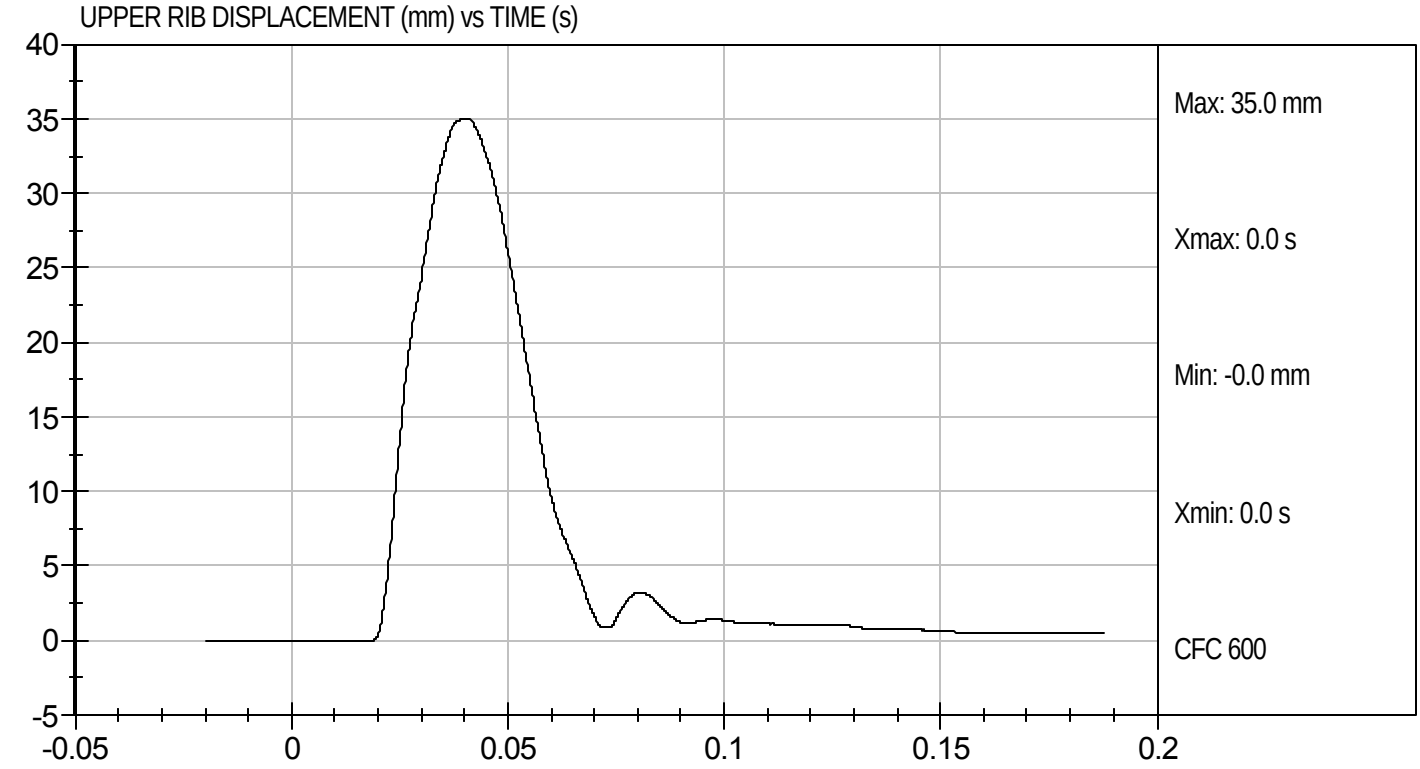
6/10/10
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Without Arm
Component ID: D101785

Test Date: 6/10/10
Velocity: 14.12 ft/s, 4.30 m/s

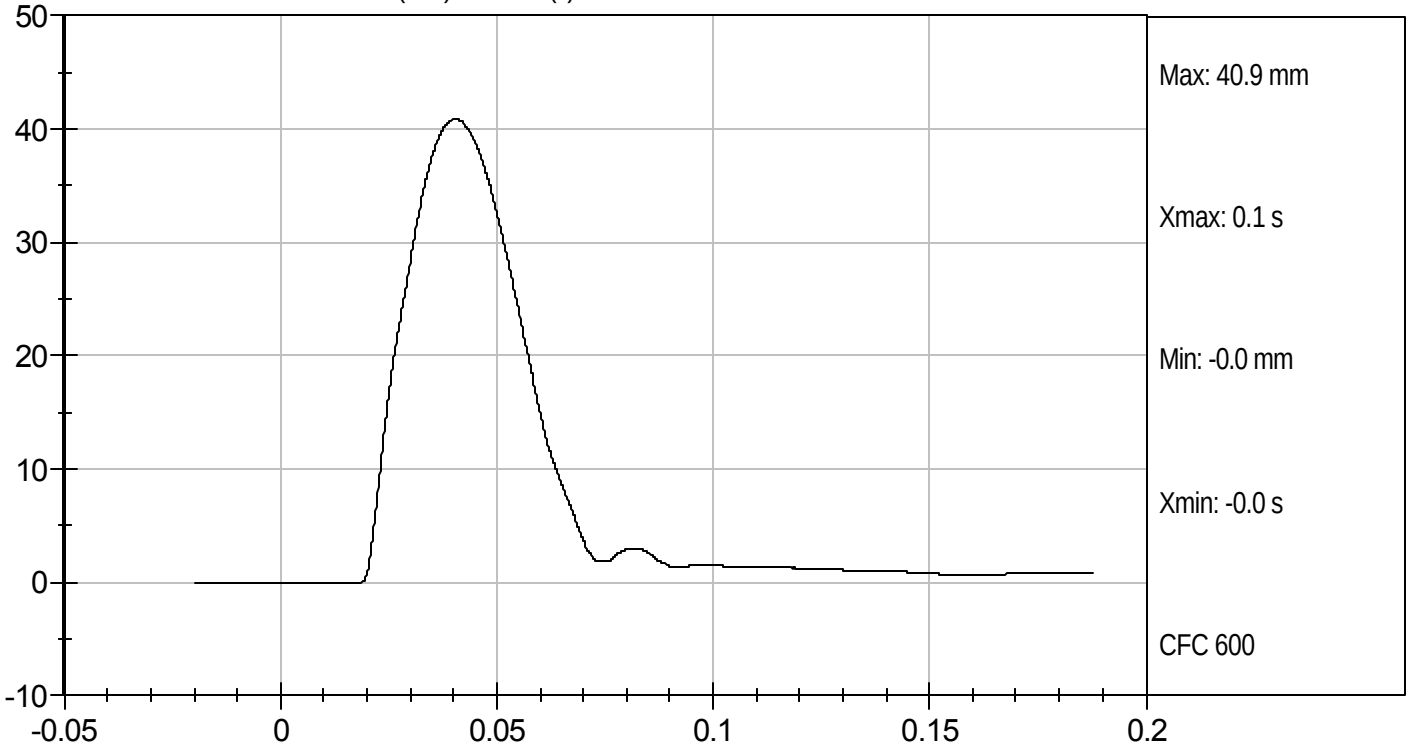




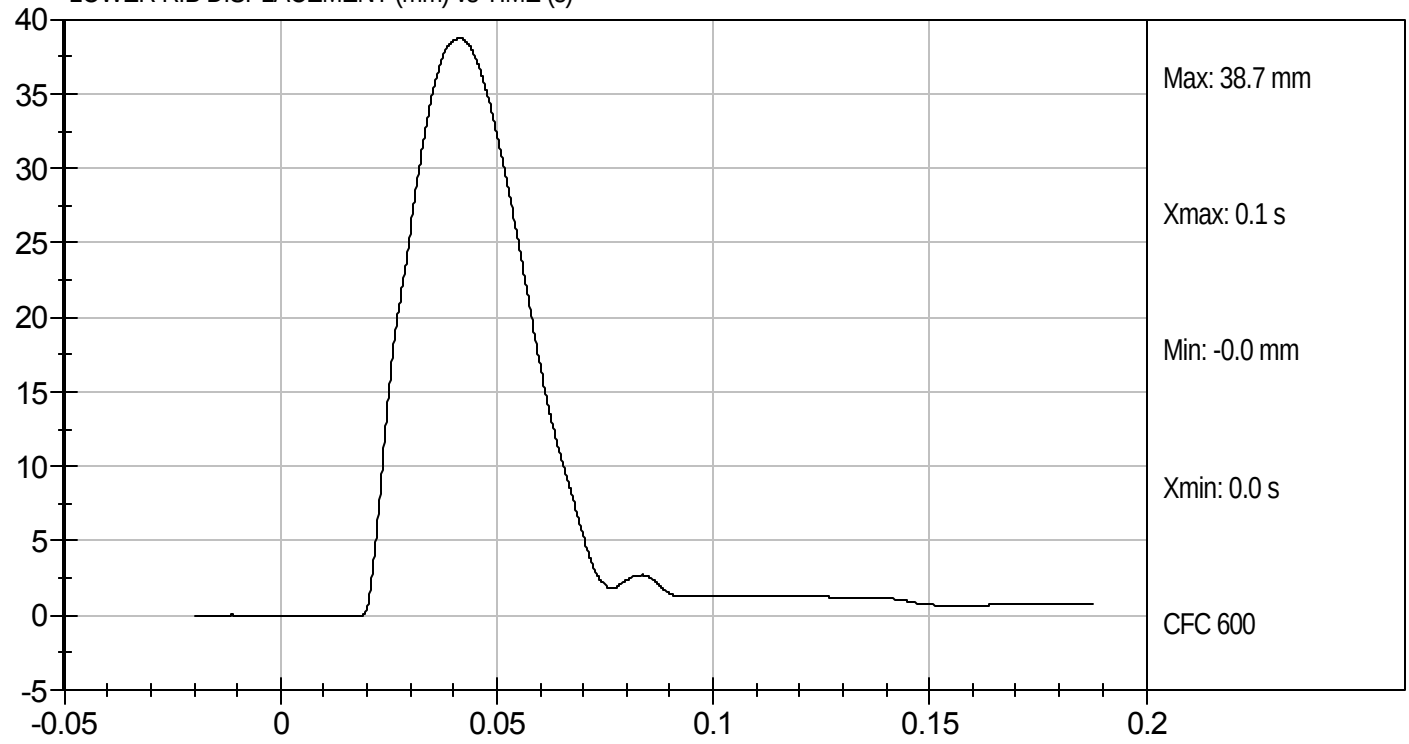
Test Desc: Thorax Without Arm
Component ID: D101785

Test Date: 6/10/10
Velocity: 14.12 ft/s, 4.30 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (s)



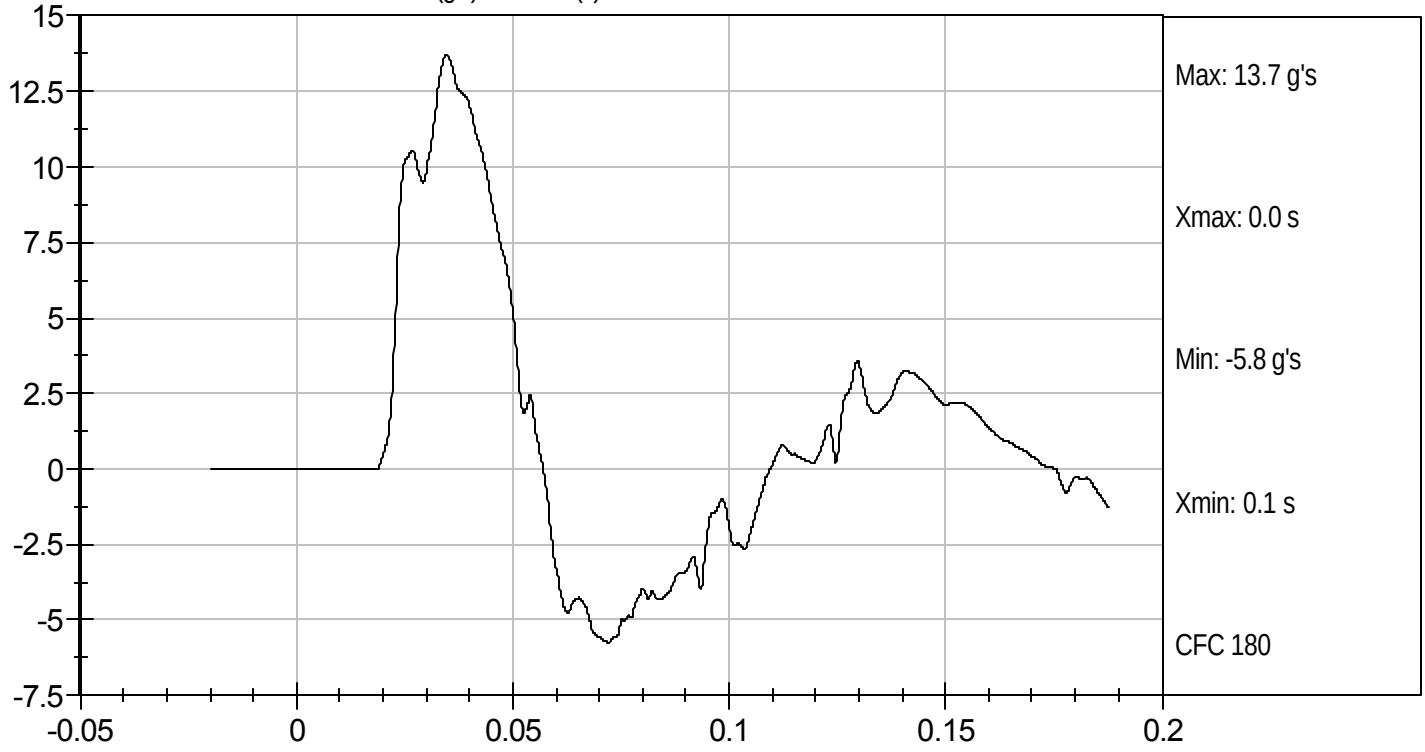
LOWER RIB DISPLACEMENT (mm) vs TIME (s)



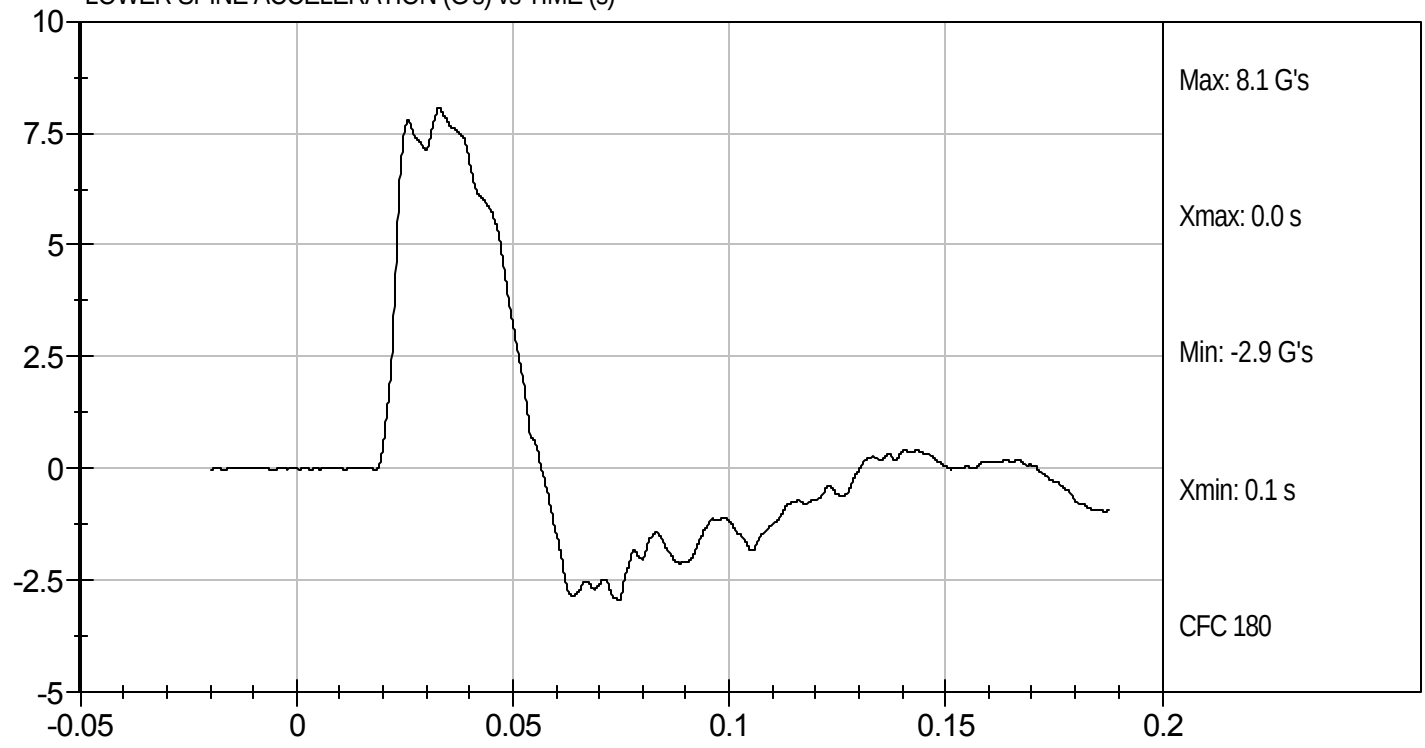
Test Desc: Thorax Without Arm
Component ID: D101785

Test Date: 6/10/10
Velocity: 14.12 ft/s, 4.30 m/s

UPPER SPINE ACCELERATION (g's) vs TIME (s)



LOWER SPINE ACCELERATION (G's) vs TIME (s)



MGA RESEARCH CORPORATION

ABDOMINAL IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101786

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	48	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Peak Impactor Acceleration	G's	12 to 16	14	Pass
Upper Rib Displacement	mm	36 to 47	40	Pass
Lower Rib Displacement	mm	33 to 44	38	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

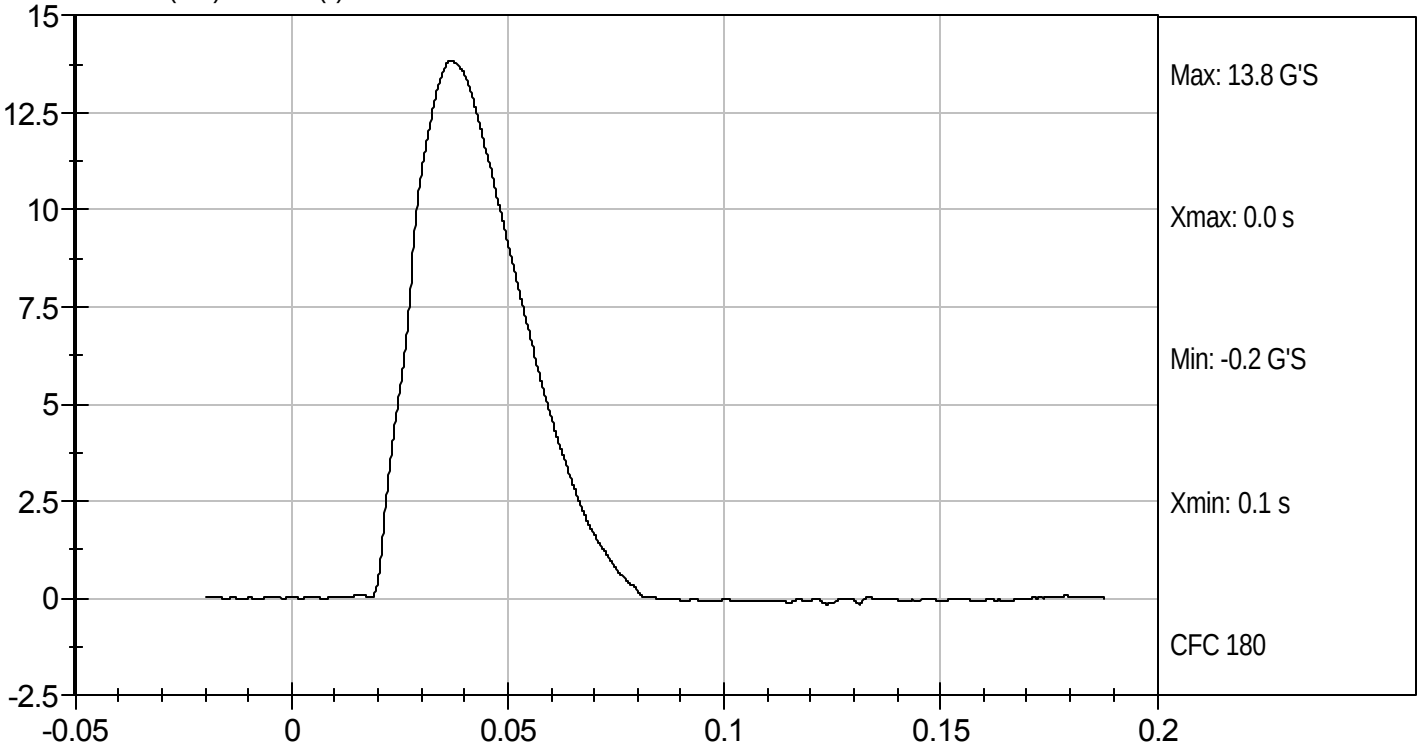
6/10/10
Test Date

David Winkelbauer
Approved By

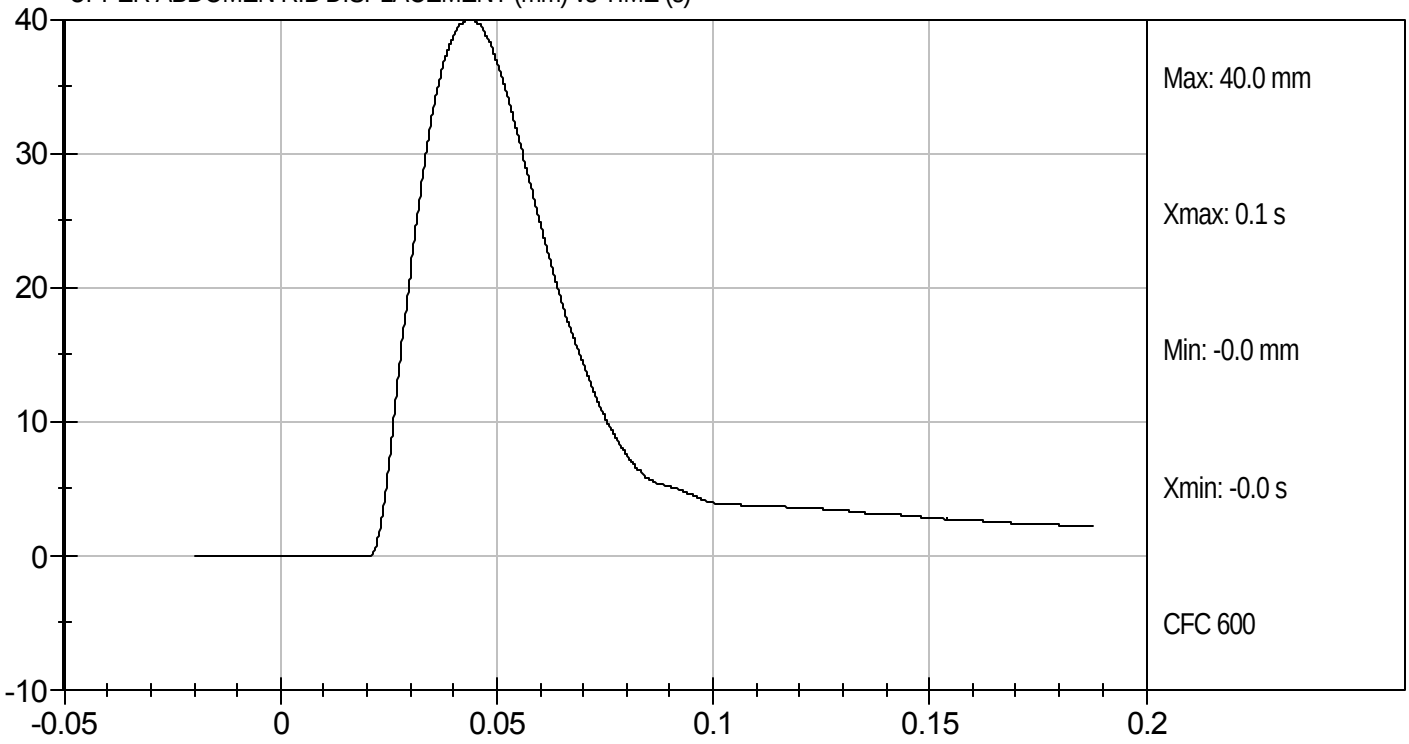
Test Desc: Abdomen Impact
Component ID: D101786

Test Date: 6/10/10
Velocity: 14.12 ft/s, 4.30 m/s

PROBE (G'S) vs TIME (s)



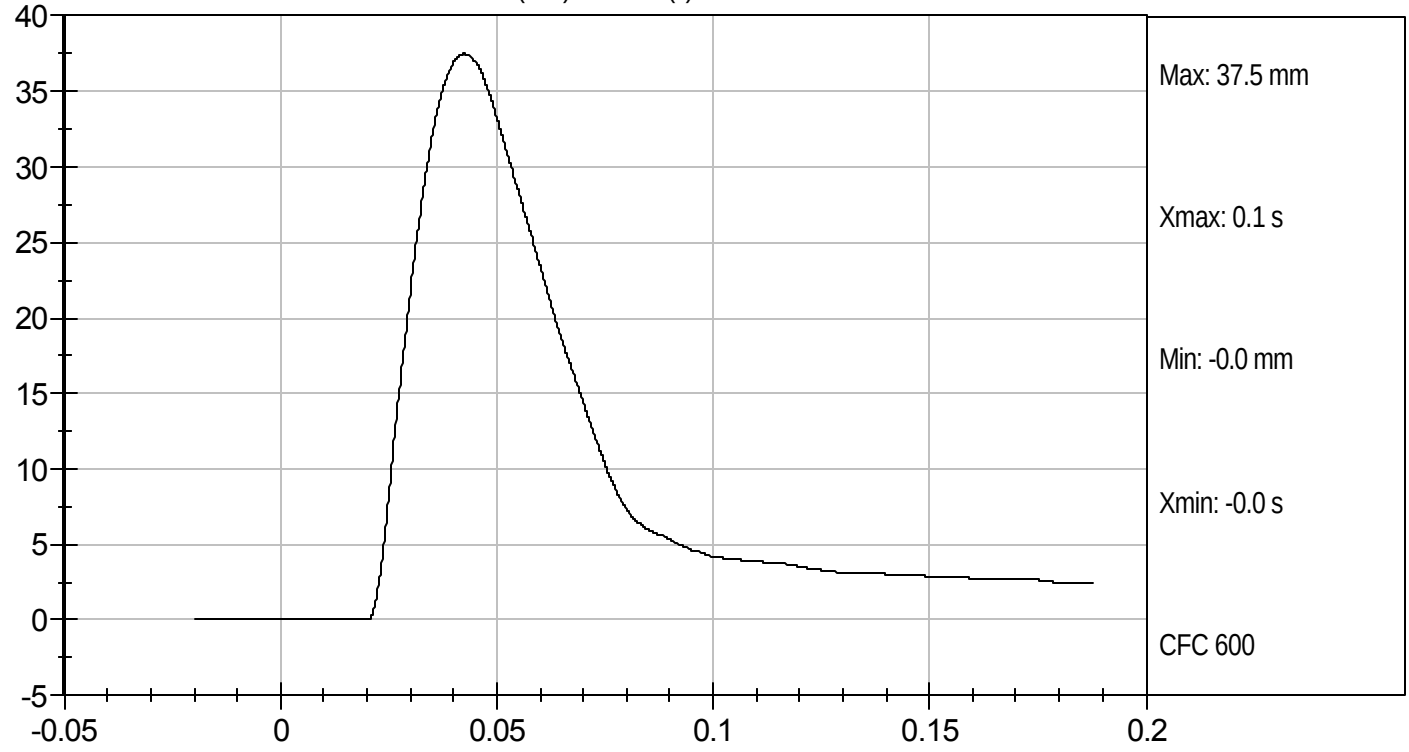
UPPER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (s)



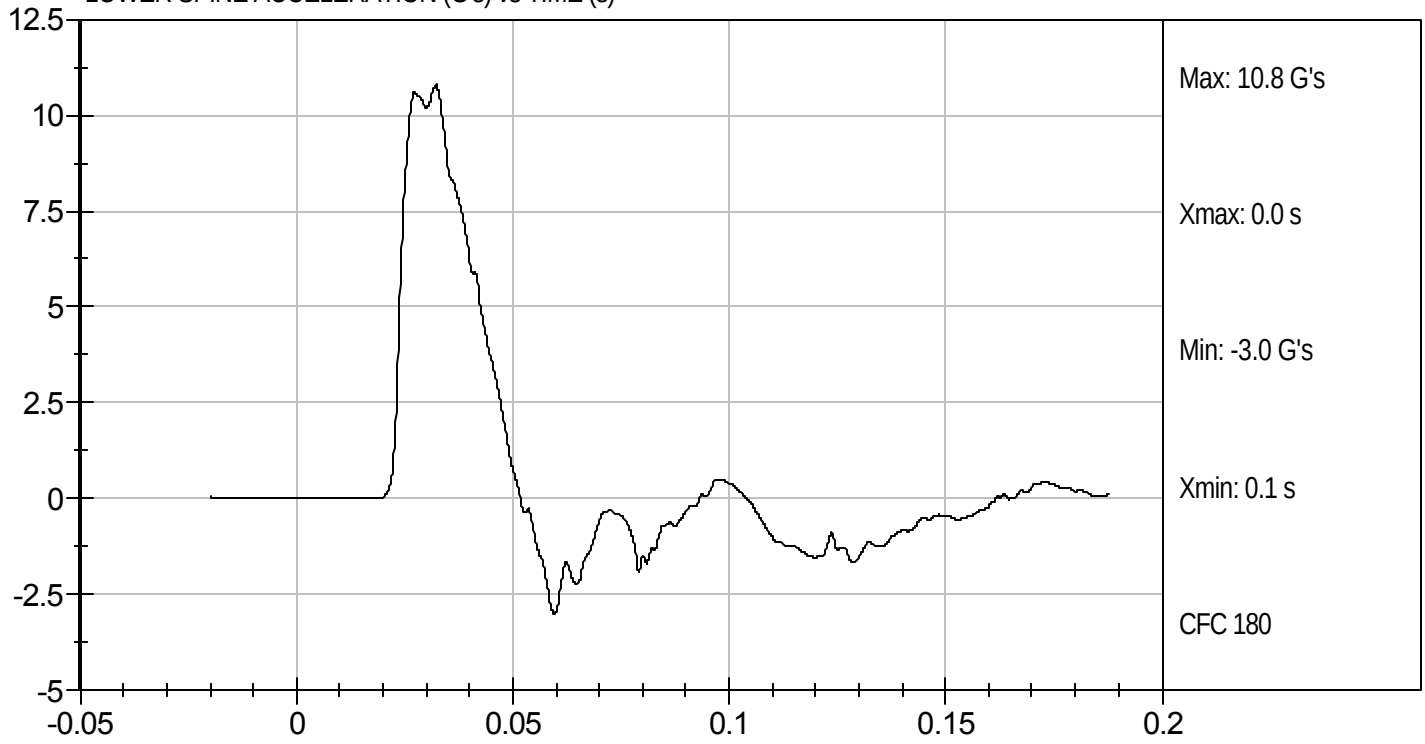
Test Desc: Abdomen Impact
Component ID: D101786

Test Date: 6/10/10
Velocity: 14.12 ft/s, 4.30 m/s

LOWER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (s)



LOWER SPINE ACCELERATION (G's) vs TIME (s)



MGA RESEARCH CORPORATION

PELVIS IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101787

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22.0	Pass
Humidity	%	10 to 70	49	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Peak Impactor Acceleration	G's	38 to 47	42	Pass
Pelvis Y Acceleration after 6 ms	G's	34 to 42	40	Pass
Peak Acetabulum Force	N	3600 to 4300	3890	Pass
		Overall Test Results		Pass

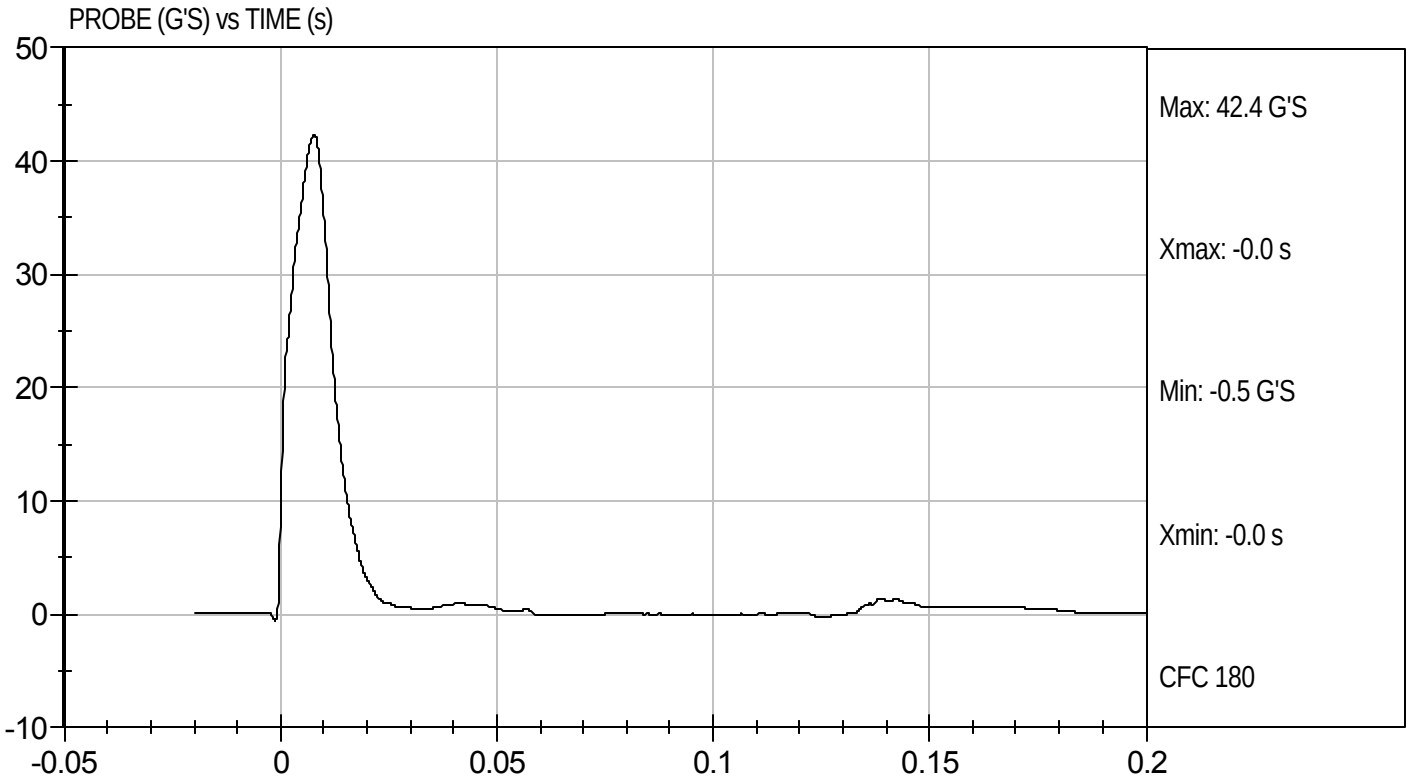
Jessica Hall
Laboratory Technician

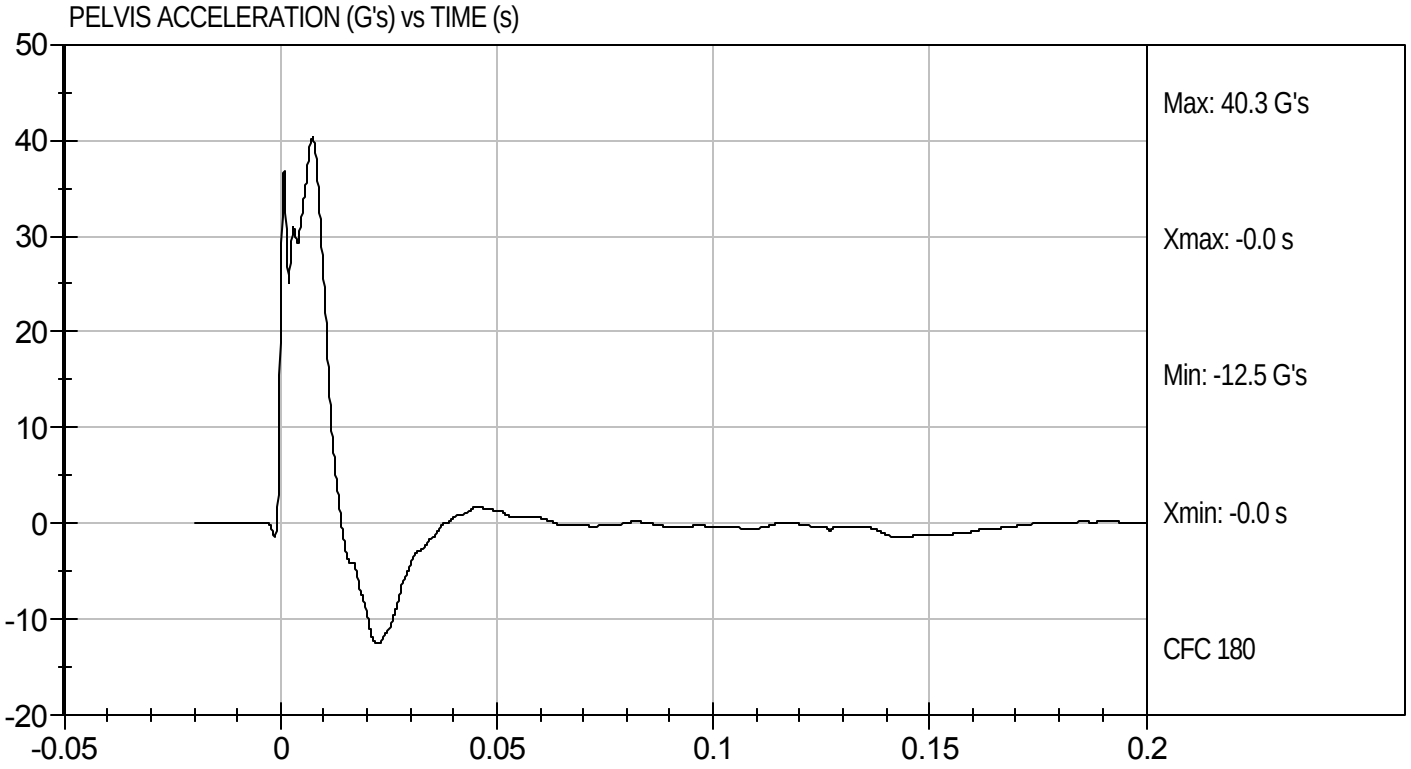
6/10/10
Test Date

David Winkelbauer
Approved By

Test Desc: Pelvis Impact
Component ID: D101787

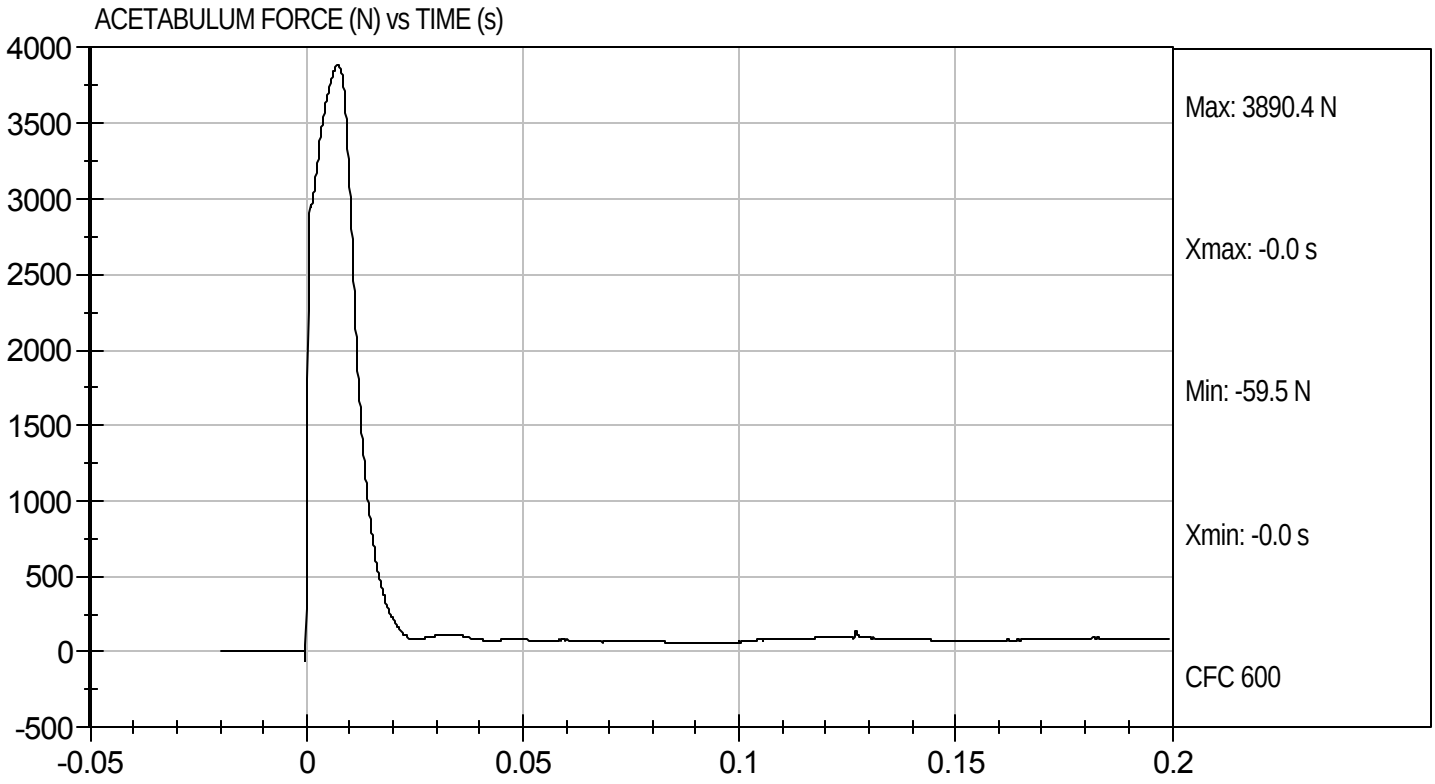
Test Date: 6/10/10
Velocity: 22.22 ft/s, 6.77 m/s





Test Desc: Pelvis Impact
Component ID: D101787

Test Date: 6/10/10
Velocity: 22.22 ft/s, 6.77 m/s



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101788

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.0	Pass
Humidity	%	10 to 70	49	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Peak Impactor Acceleration	G's	36 to 45	37	Pass
Pelvis Y Acceleration	G's	28 to 39	33	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4699	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

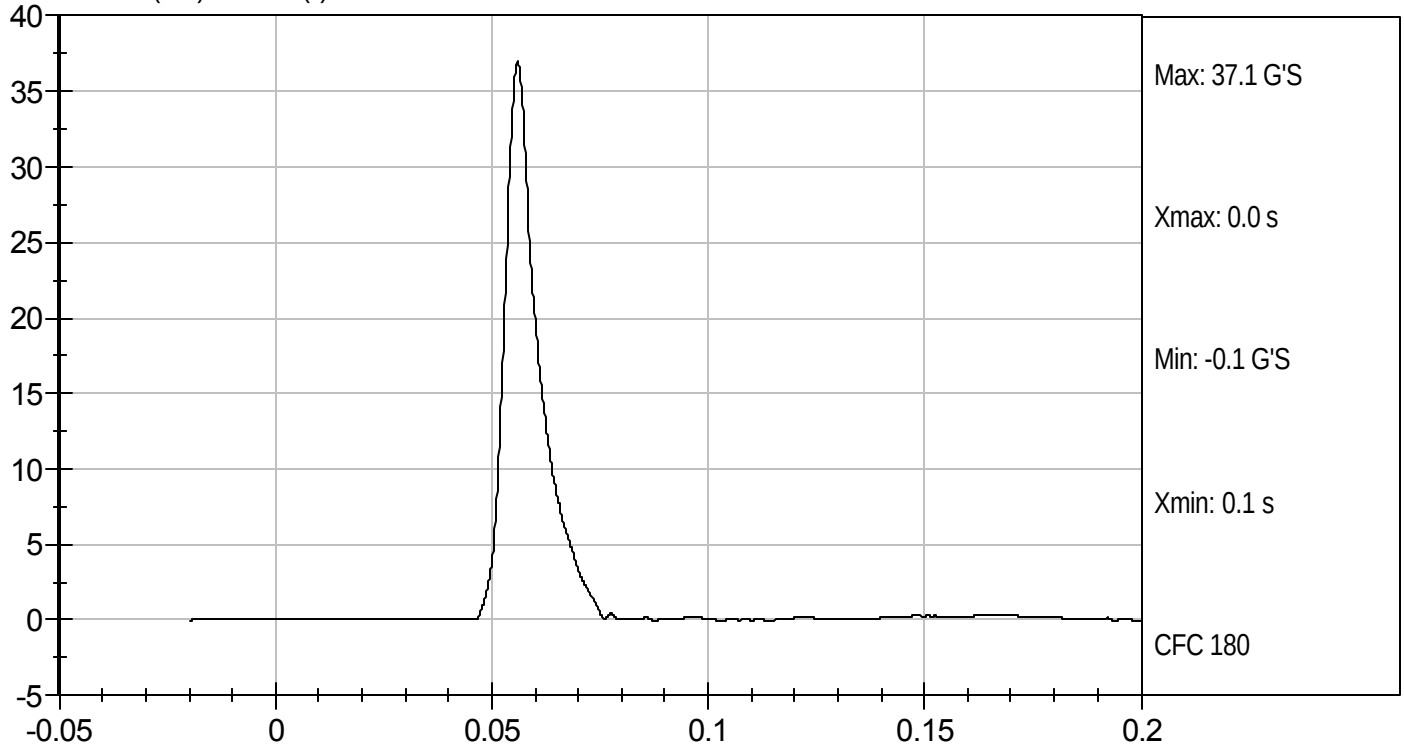
6/9/10
Test Date

David Winkelbauer
Approved By

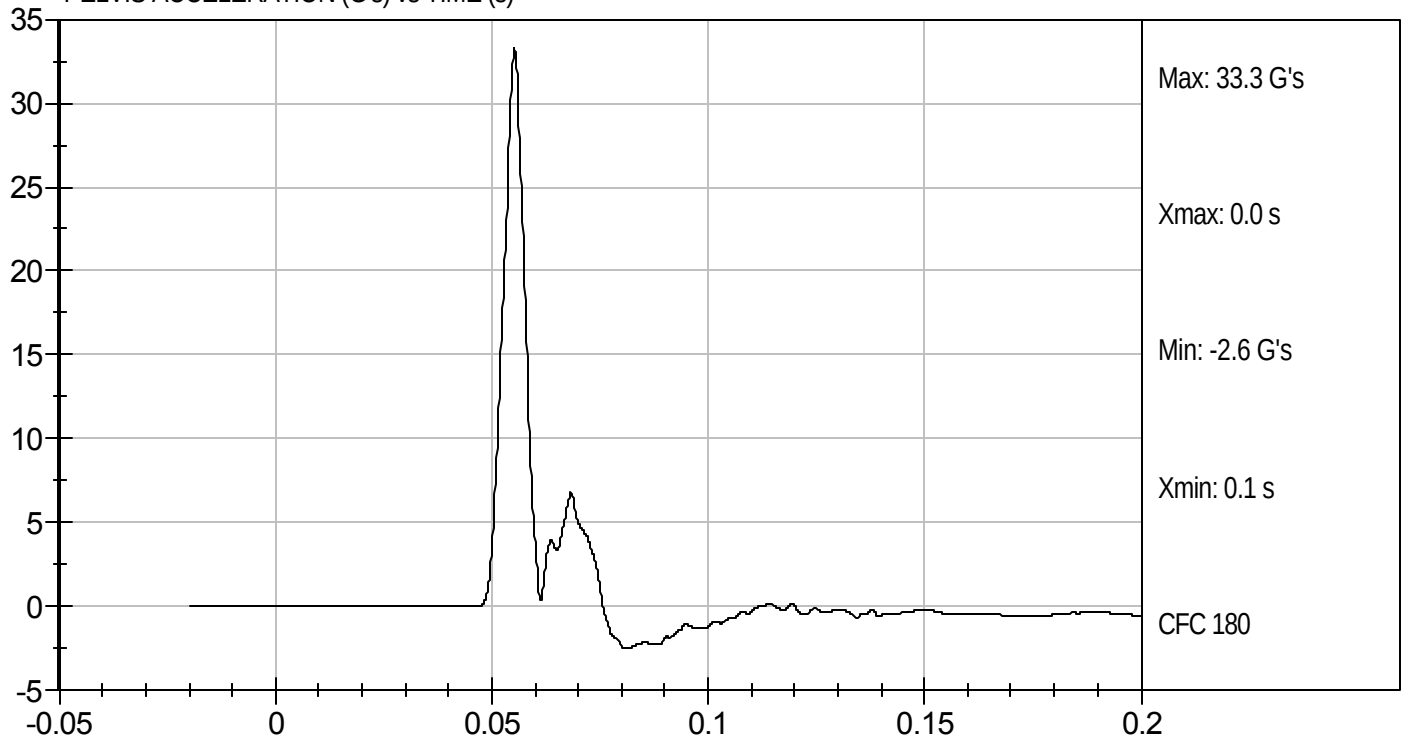
Test Desc: Iliac Impact
Component ID: D101788

Test Date: 6/9/10
Velocity: 14.12 ft/s, 4.30 m/s

PROBE (G'S) vs TIME (s)

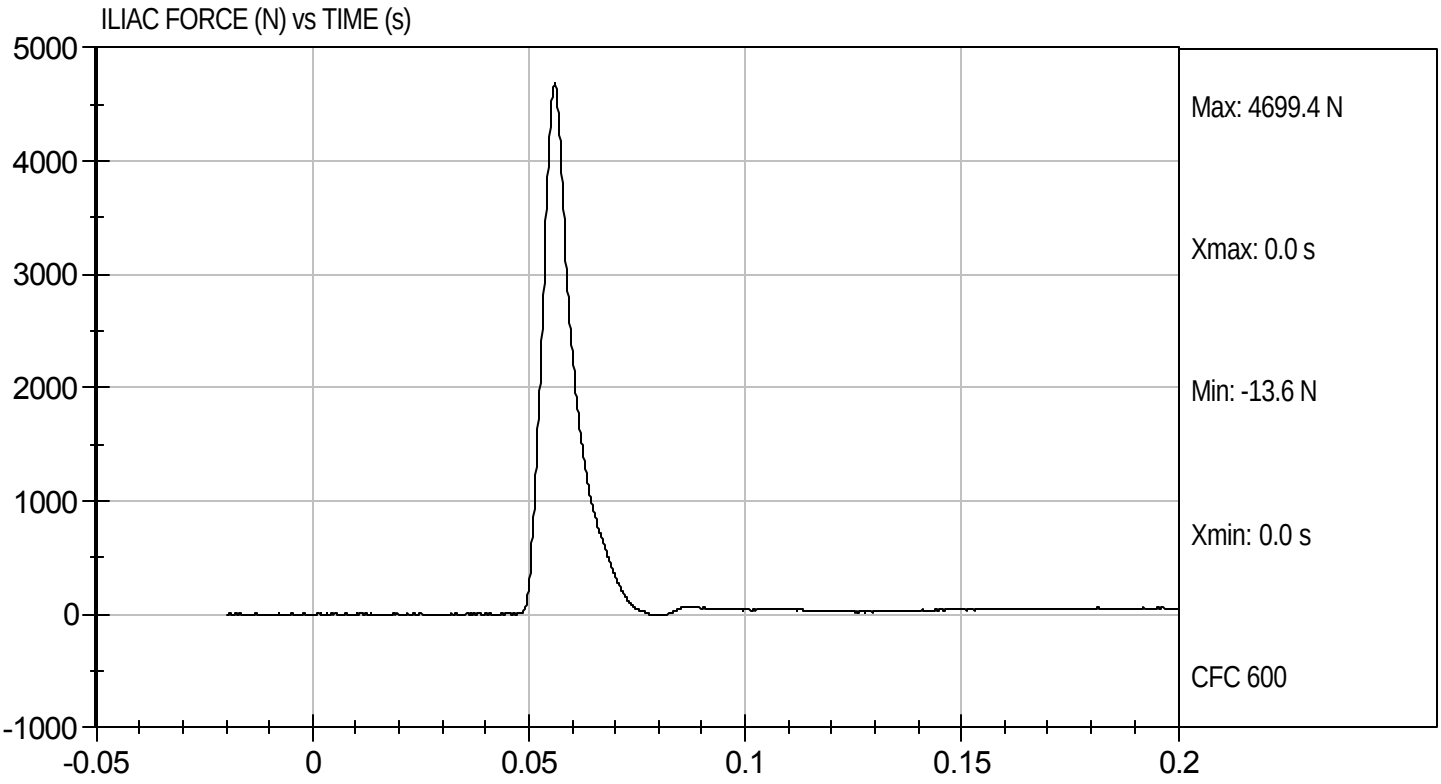


PELVIS ACCELERATION (G's) vs TIME (s)



Test Desc: Iliac Impact
Component ID: D101788

Test Date: 6/9/10
Velocity: 14.12 ft/s, 4.30 m/s



MGA RESEARCH CORPORATION

HEAD DROP TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D101821

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	54	Pass
Peak Resultant Acceleration	G's	115 to 137	128	Pass
Peak Lateral Acceleration	G's	+/- 15	5.1	Pass
Unimodal	N/A	<15%	Yes	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

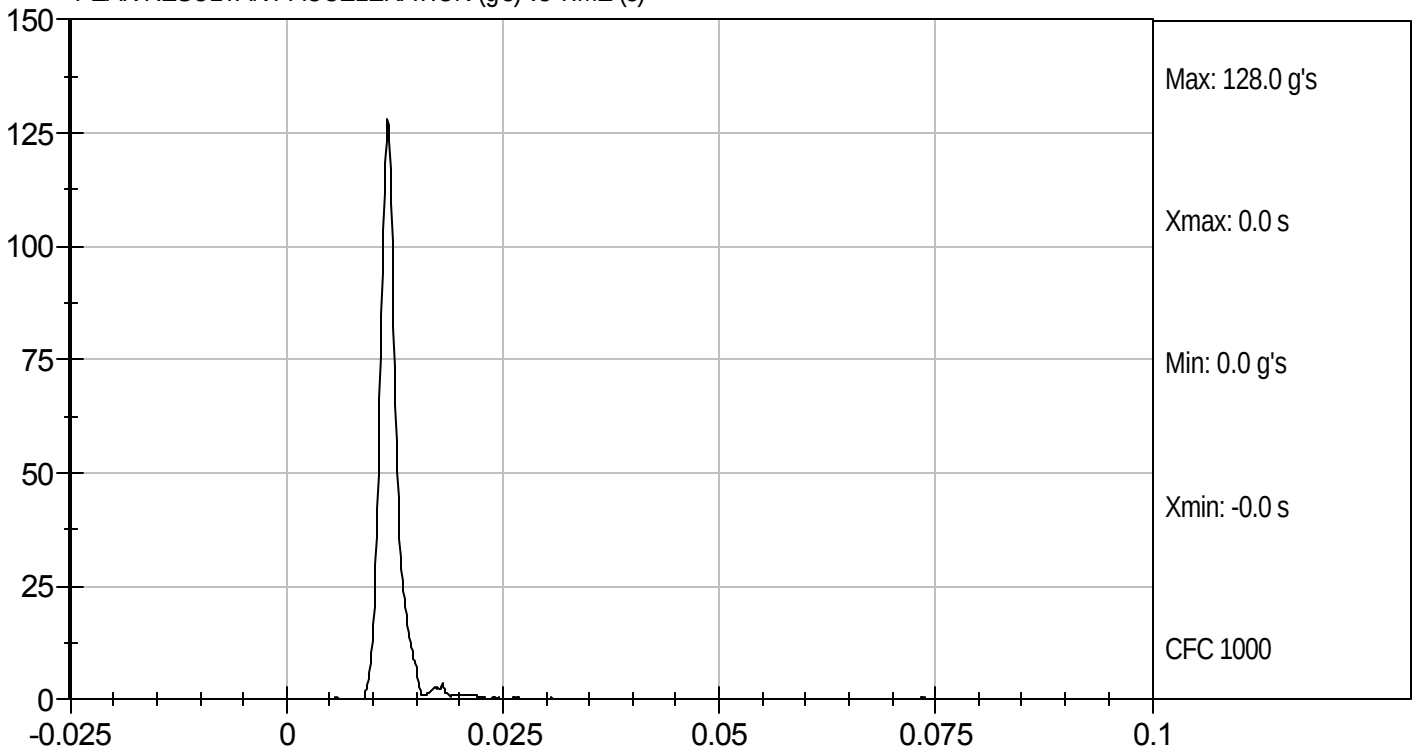
6/15/10
Test Date

David Winkelbauer
Approved By

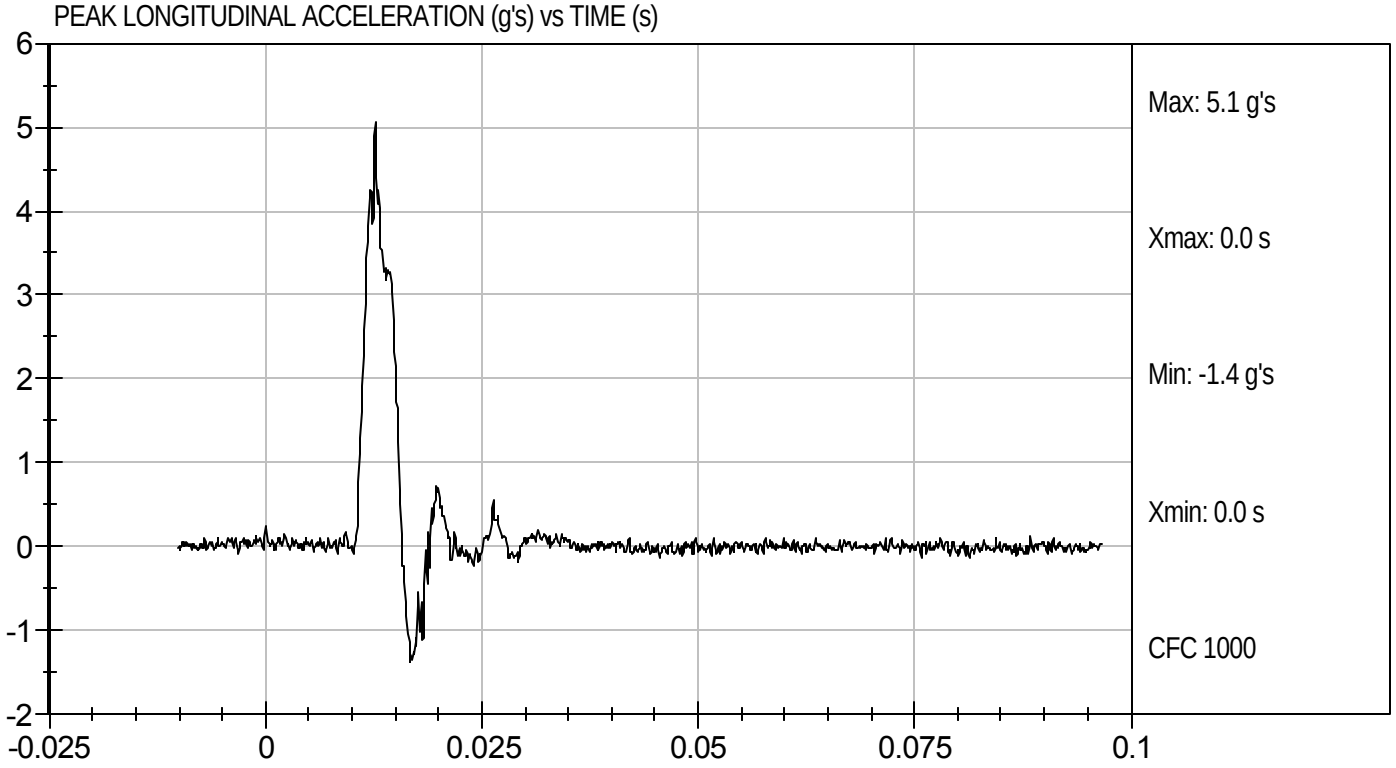
Test Desc: Head Drop
Component ID: D101821

Test Date: 6/15/10
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (g's) vs TIME (s)



PEAK LONGITUDINAL ACCELERATION (g's) vs TIME (s)



MGA RESEARCH CORPORATION

LATERAL NECK PENDULUM TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101822

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	22.0	Pass
Humidity		%	10 to 70	54	Pass
Impact Velocity		m/s	5.51 to 5.63	5.58	Pass
Delta Velocity	10 ms	m/s	2.20 to 2.80	2.72	Pass
	15 ms	m/s	3.30 to 4.10	3.93	Pass
	20 ms	m/s	4.40 to 5.40	5.22	Pass
	25 ms	m/s	5.40 to 6.10	5.46	Pass
	25-100 ms	m/s	5.50 to 6.20	5.50	Pass
Maximum D-Plane Rotation		deg	71 to 81	75	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	66	Pass
Maximum Occipital Condyle Moment during Rotation Interval		Nm	-44 to -36	-40	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	116	Pass
			Overall Test Results		Pass

Jessica Gall
Laboratory Technician

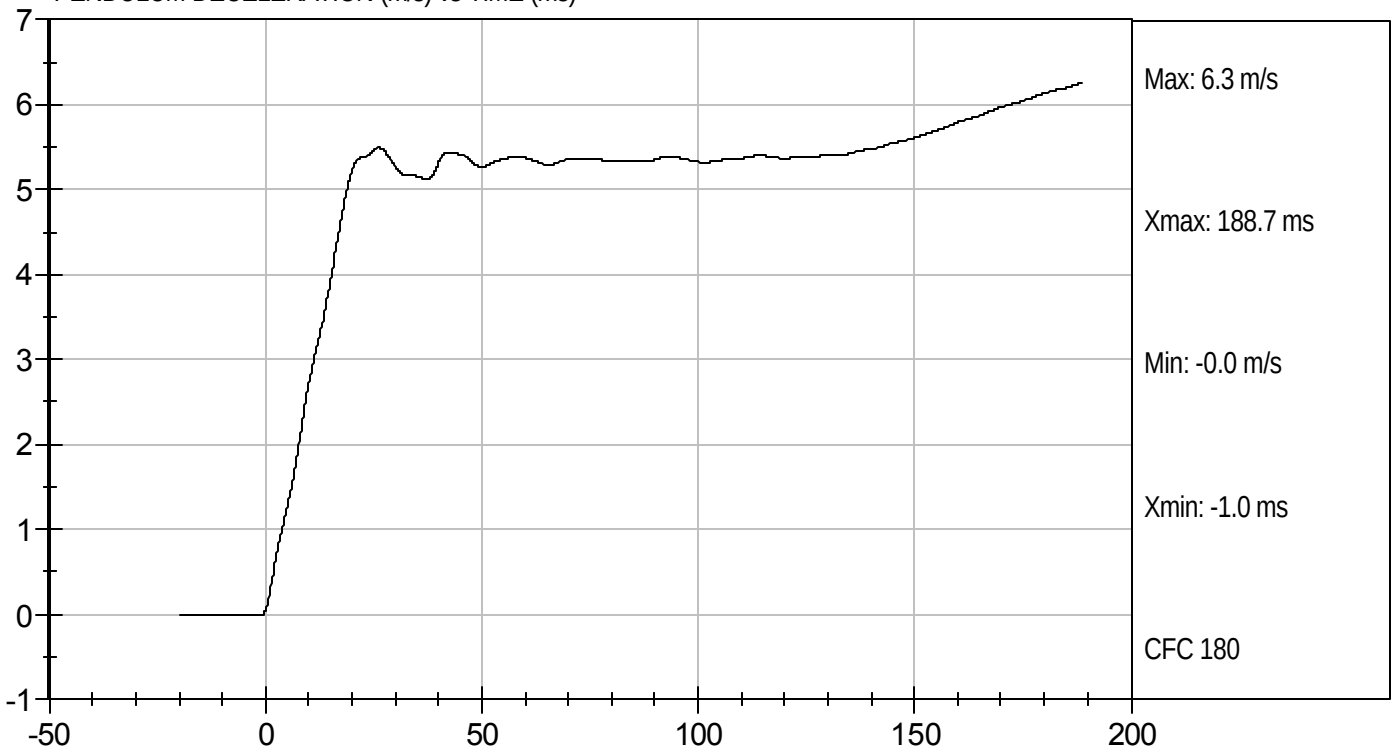
6/15/10
Test Date

David Winkelbauer
Approved By

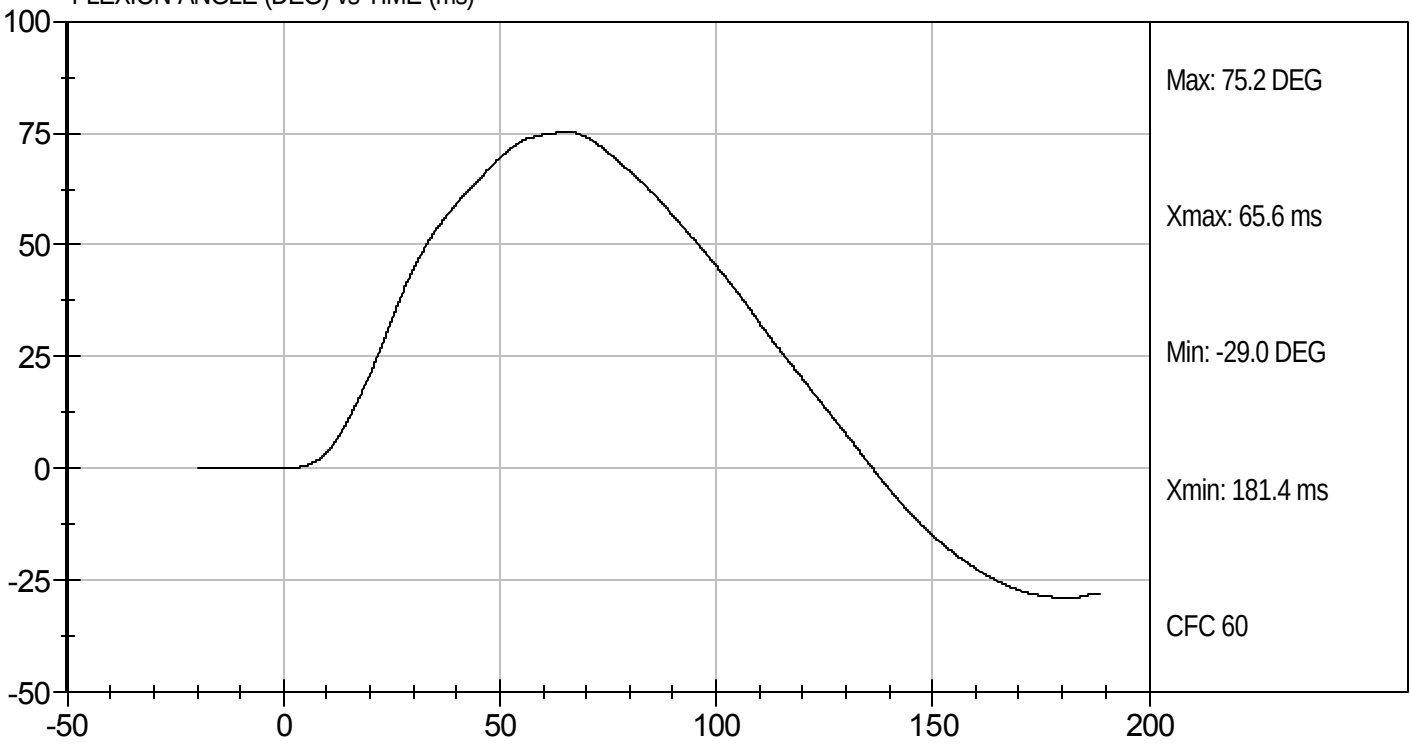
Test Desc: Neck Bending
Component ID: D101822

Test Date: 6/15/10
Velocity: 18.32 ft/s, 5.58 m/s

PENDULUM DECELERATION (m/s) vs TIME (ms)

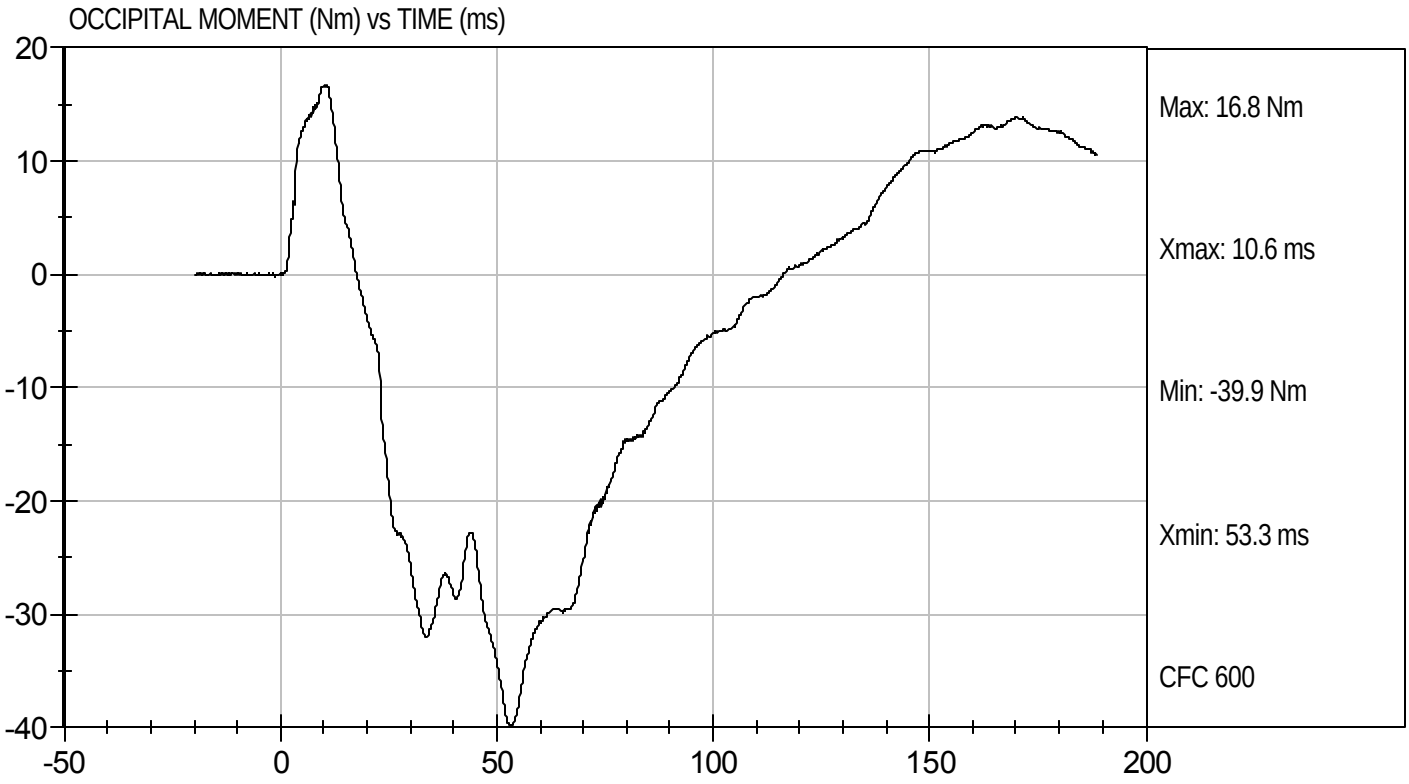


FLEXION ANGLE (DEG) vs TIME (ms)



Test Desc: Neck Bending
Component ID: D101822

Test Date: 6/15/10
Velocity: 18.32 ft/s, 5.58 m/s



MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test ID:** D101823

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.0	Pass
Laboratory Relative Humidity	%	10 to 70	59	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Maximum Probe Acceleration	G's	13 to 18	14	Pass
Shoulder Displacement	mm	28 to 37	31	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	18	Pass
		Overall Test Results		Pass

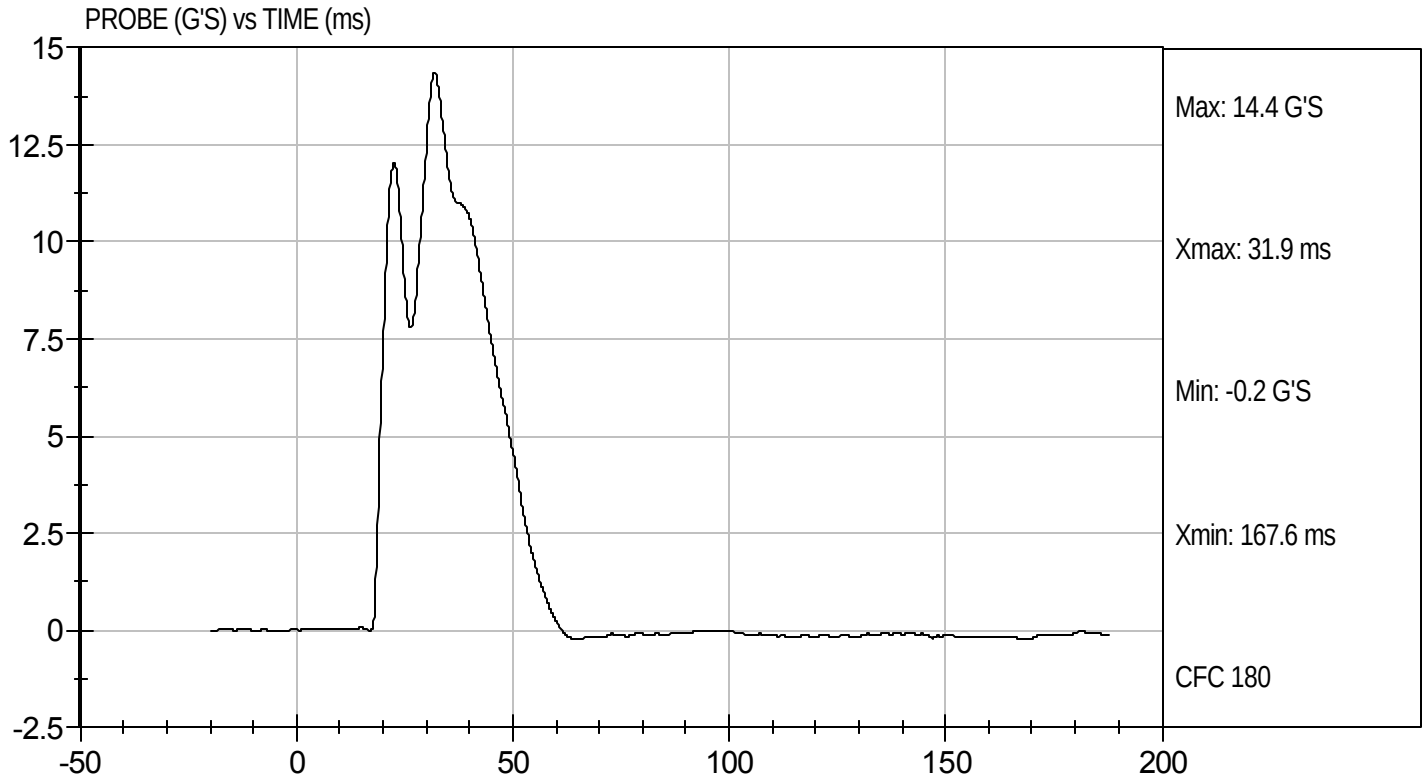
Jessica Hall
Laboratory Technician

6/14/10
Test Date

David Winkelbauer
Approved By

Test Desc: Shoulder Impact
Component ID: D101823

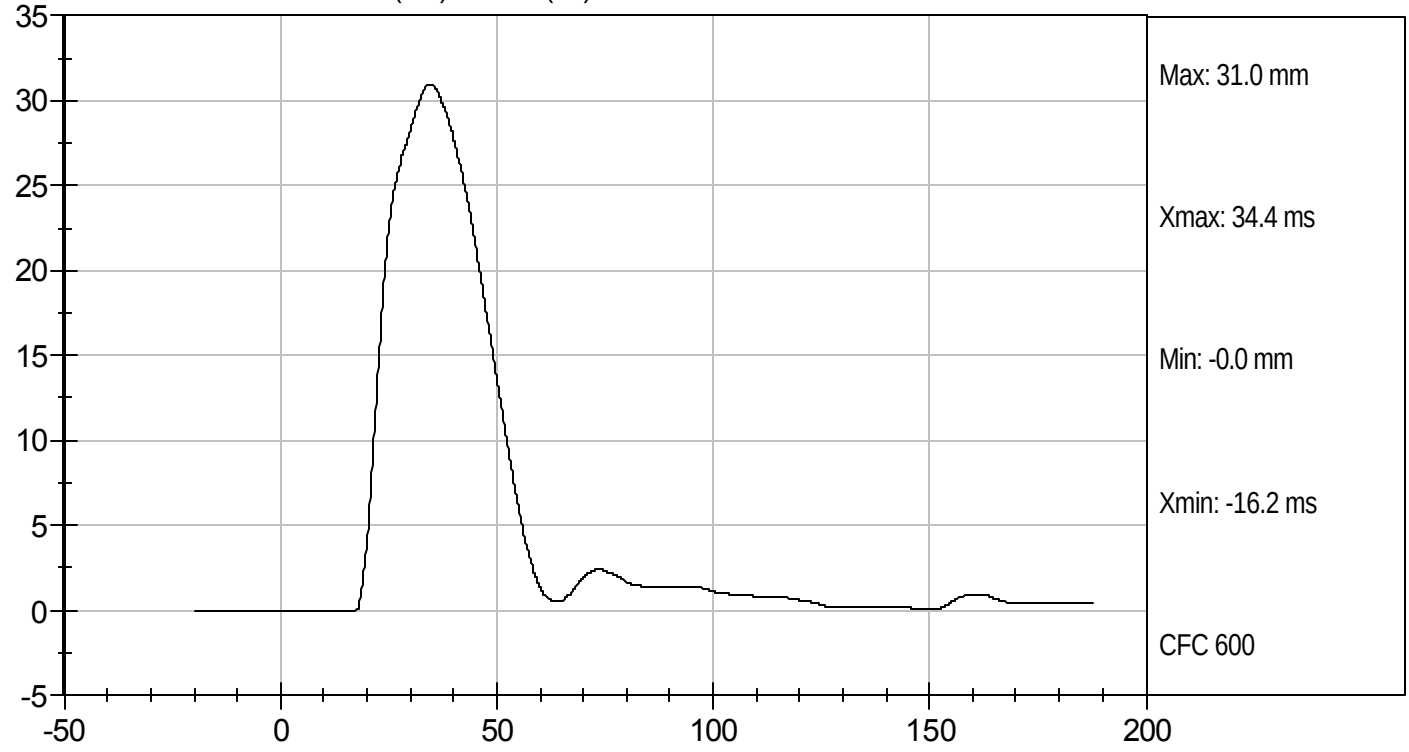
Test Date: 6/14/10
Velocity: 14.25 ft/s, 4.34 m/s



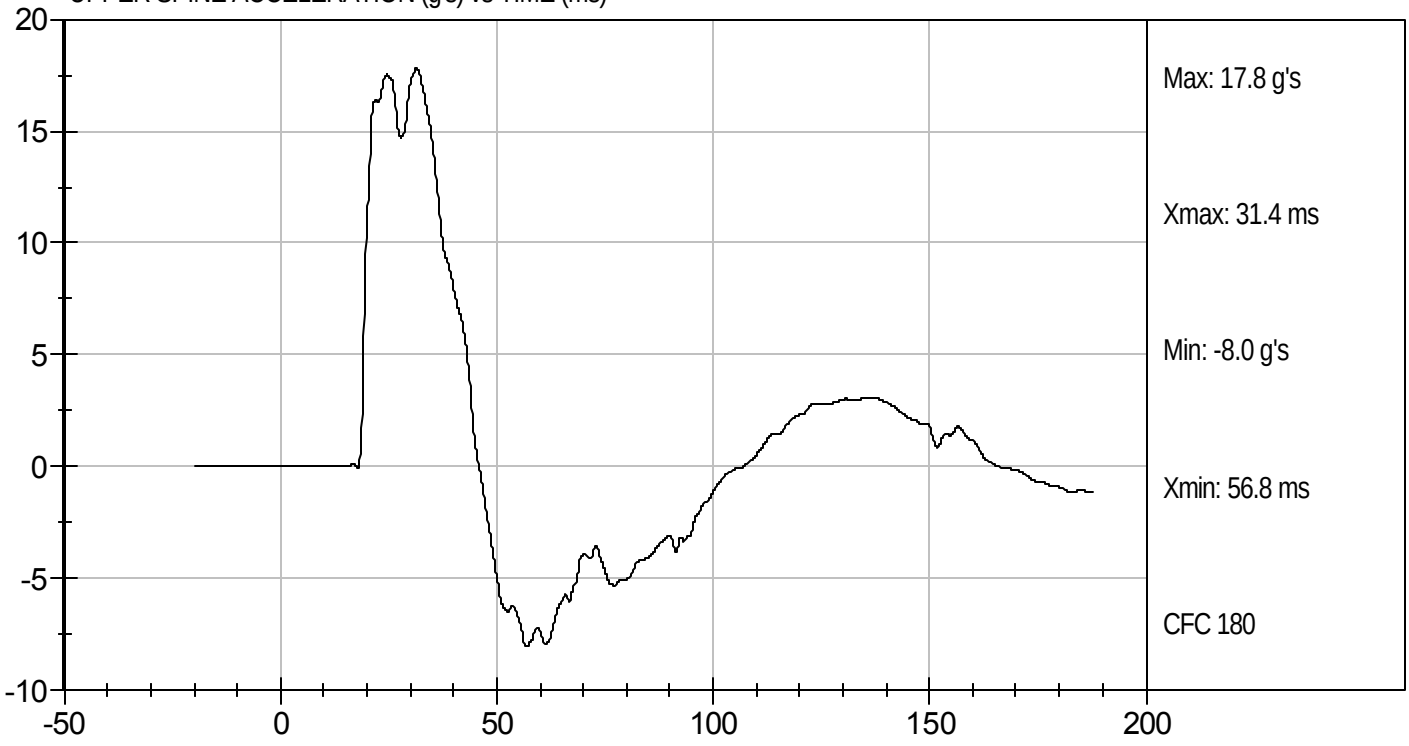
Test Desc: Shoulder Impact
Component ID: D101823

Test Date: 6/14/10
Velocity: 14.25 ft/s, 4.34 m/s

SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER SPINE ACCELERATION (g's) vs TIME (ms)



MGA RESEARCH CORPORATION

THORAX (WITH ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101824

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22.0	Pass
Humidity	%	10 to 70	59	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Peak Impactor Acceleration	G's	30 to 36	31	Pass
Shoulder Displacement	mm	31 to 40	37	Pass
Upper Rib Displacement	mm	25 to 32	27	Pass
Middle Rib Displacement	mm	30 to 36	31	Pass
Lower Rib Displacement	mm	32 to 38	33	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	37	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	34	Pass
		Overall Test Results		Pass

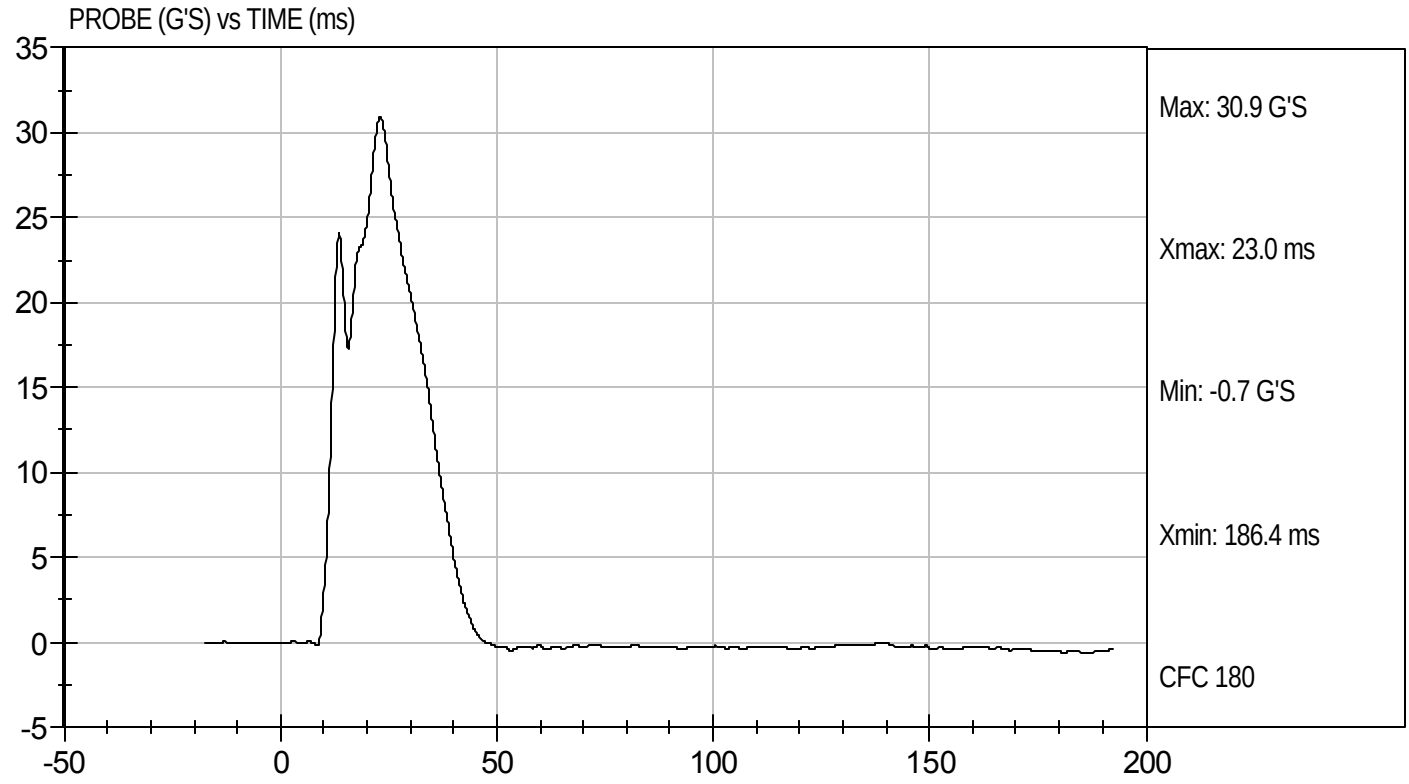
Jessica Gall
Laboratory Technician

6/14/10
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax With Arm
Component ID: D101824

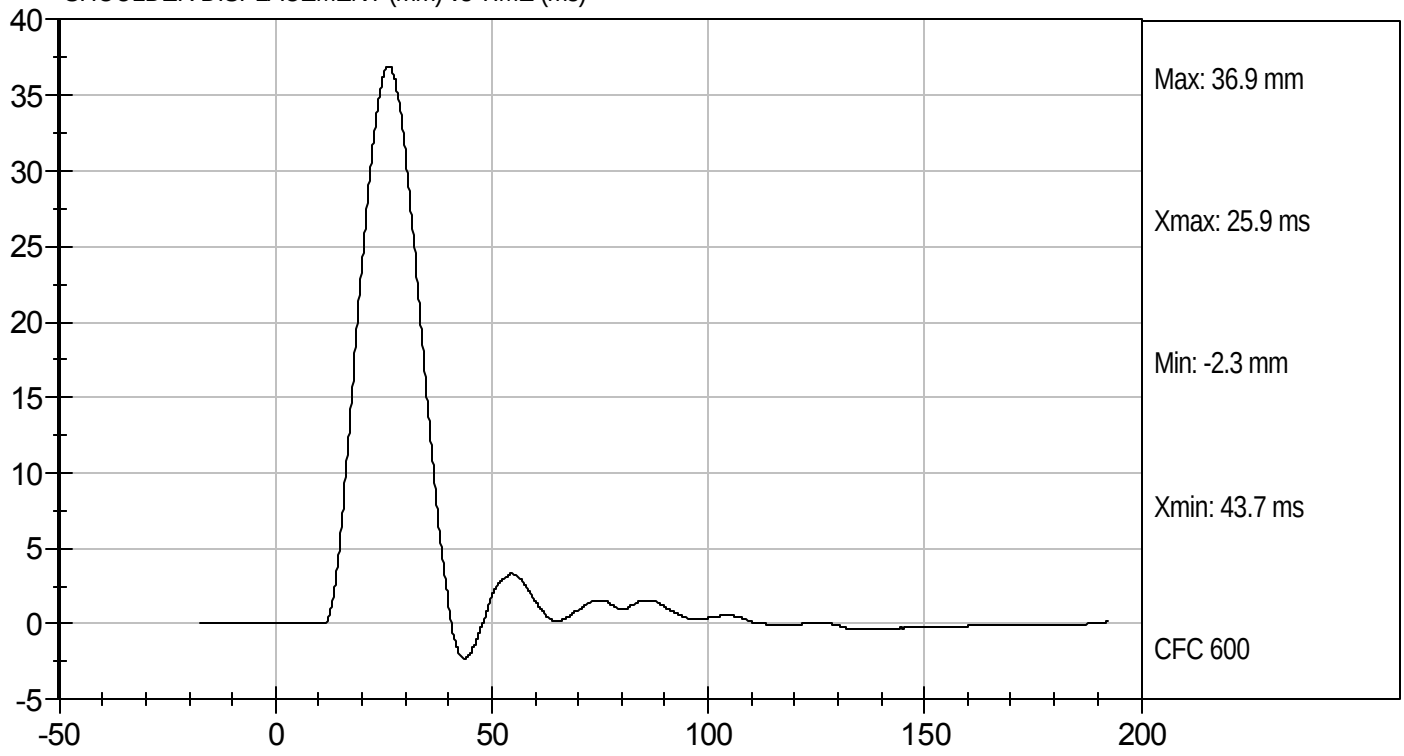
Test Date: 6/14/10
Velocity: 22.22 ft/s, 6.77 m/s



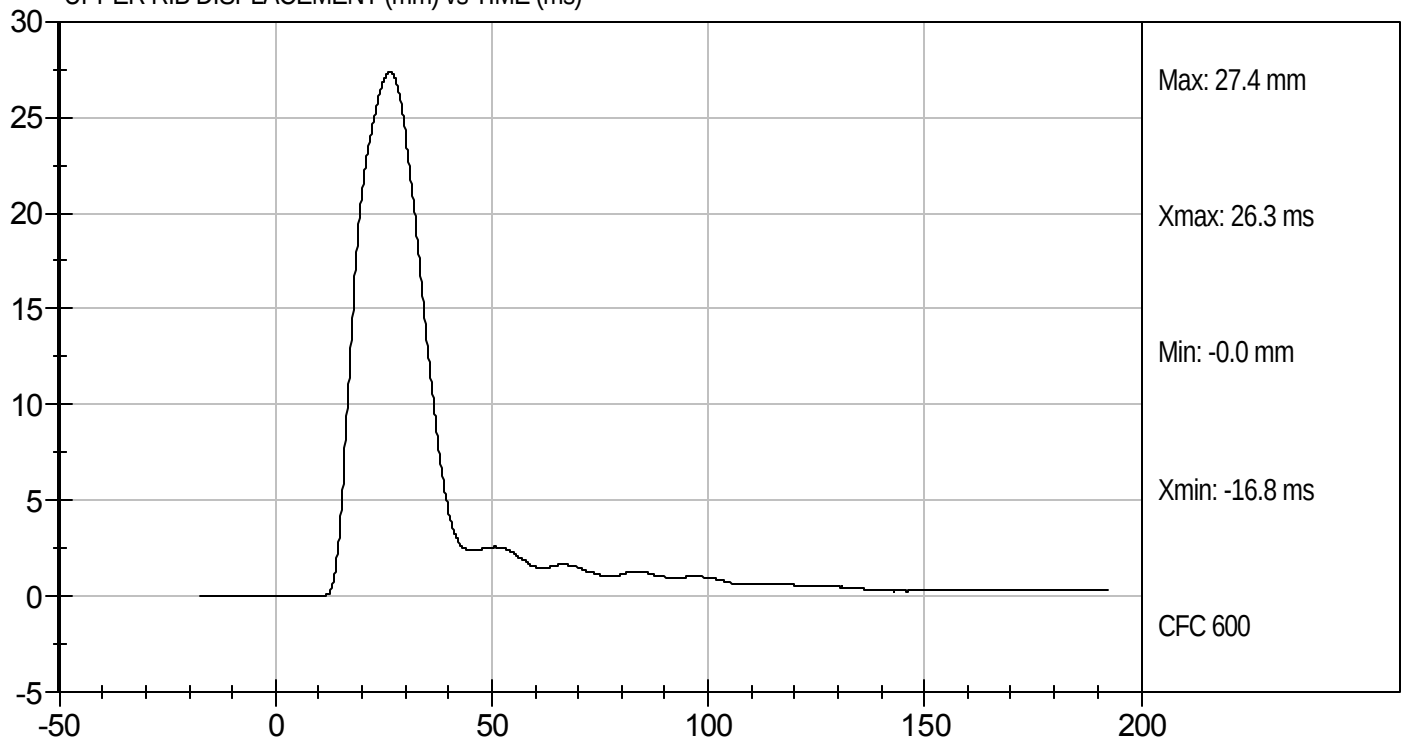
Test Desc: Thorax With Arm
Component ID: D101824

Test Date: 6/14/10
Velocity: 22.22 ft/s, 6.77 m/s

SHOULDER DISPLACEMENT (mm) vs TIME (ms)



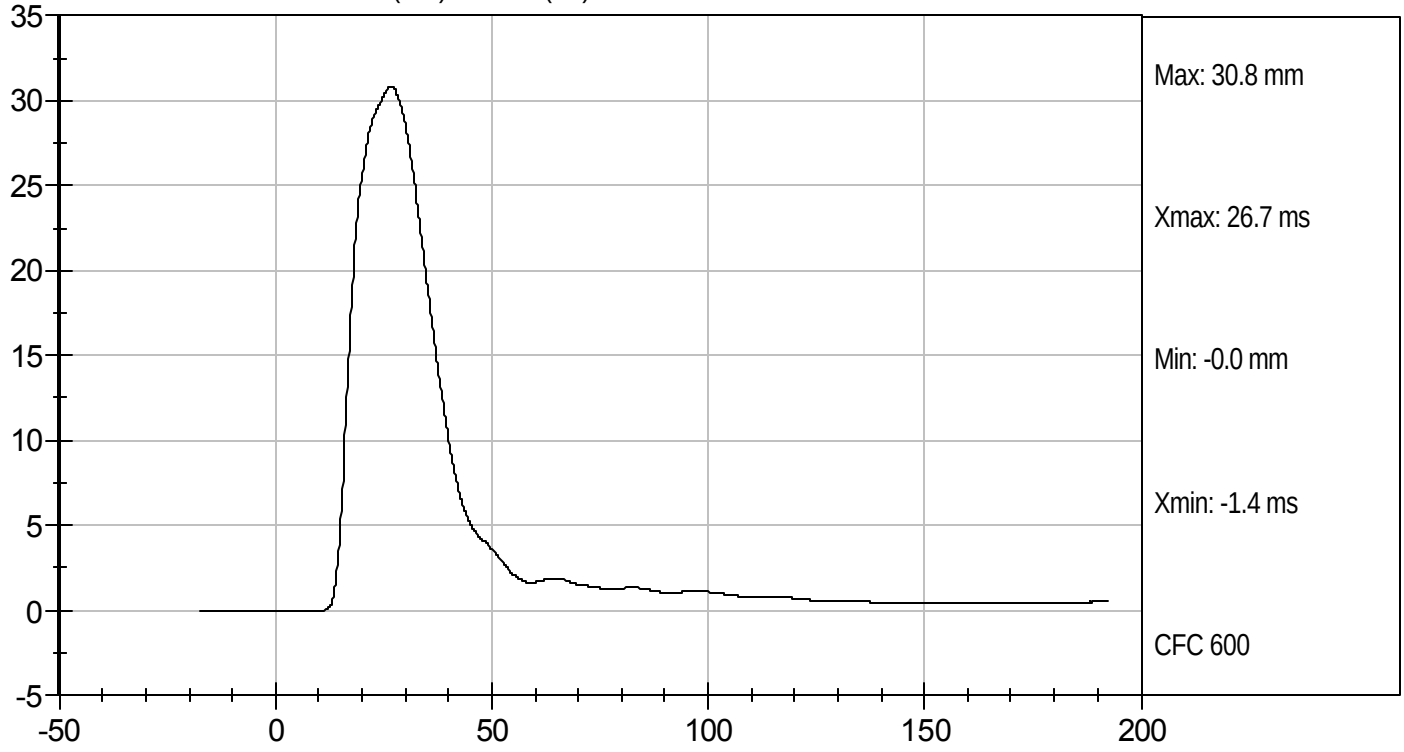
UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



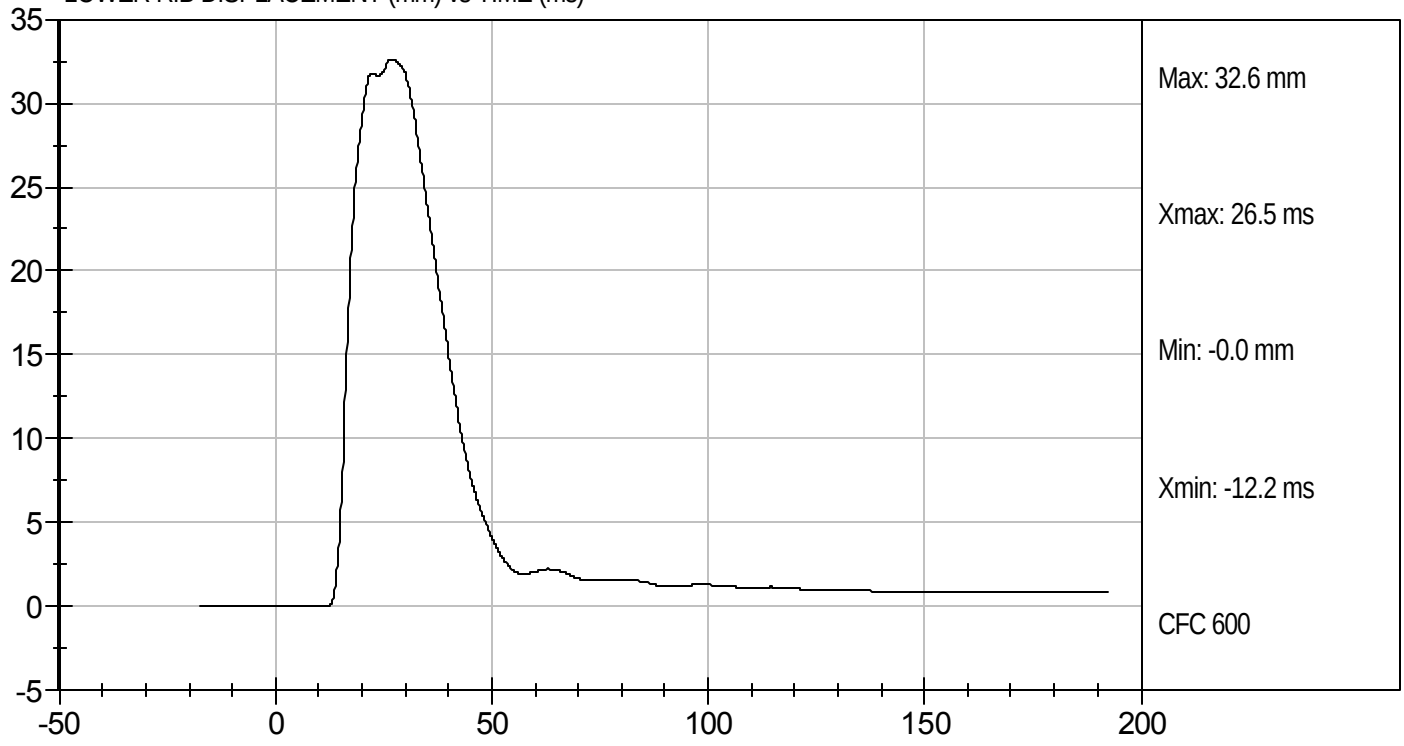
Test Desc: Thorax With Arm
Component ID: D101824

Test Date: 6/14/10
Velocity: 22.22 ft/s, 6.77 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



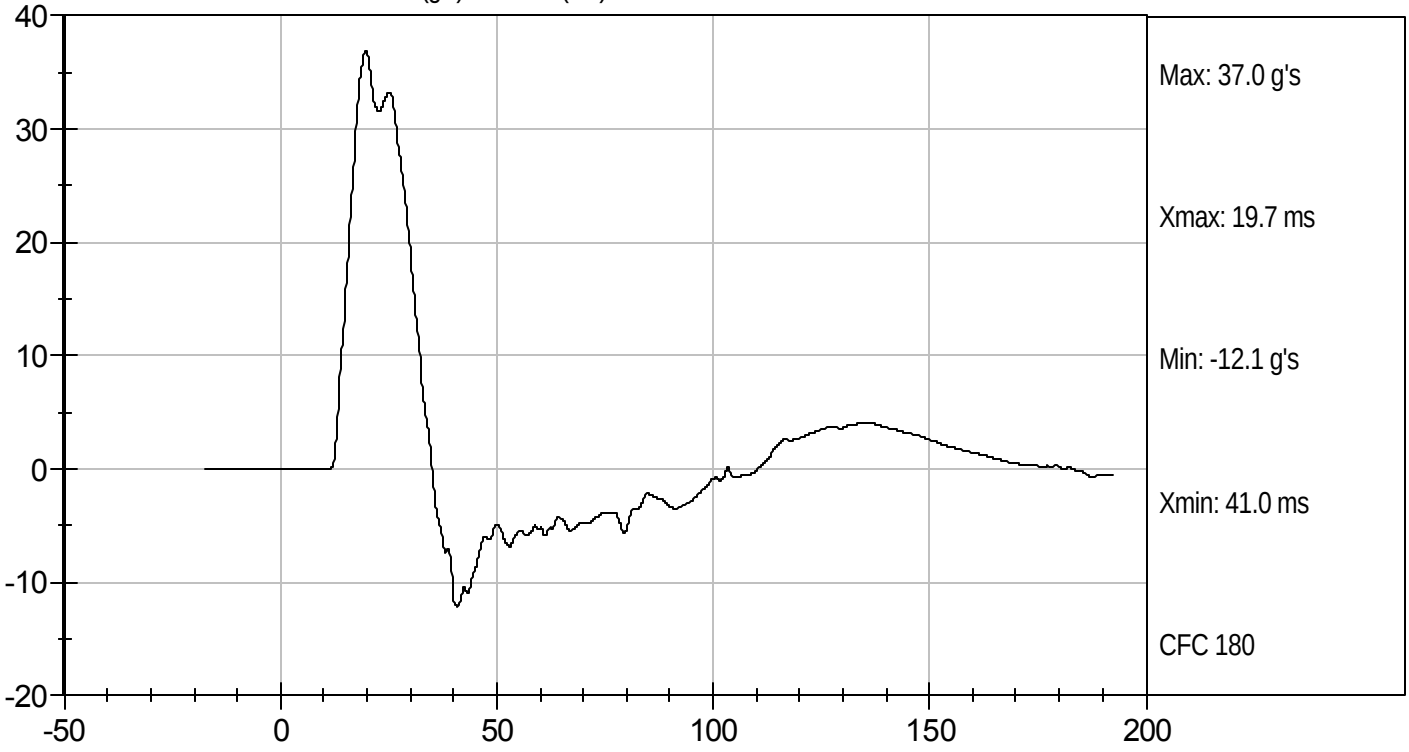
LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



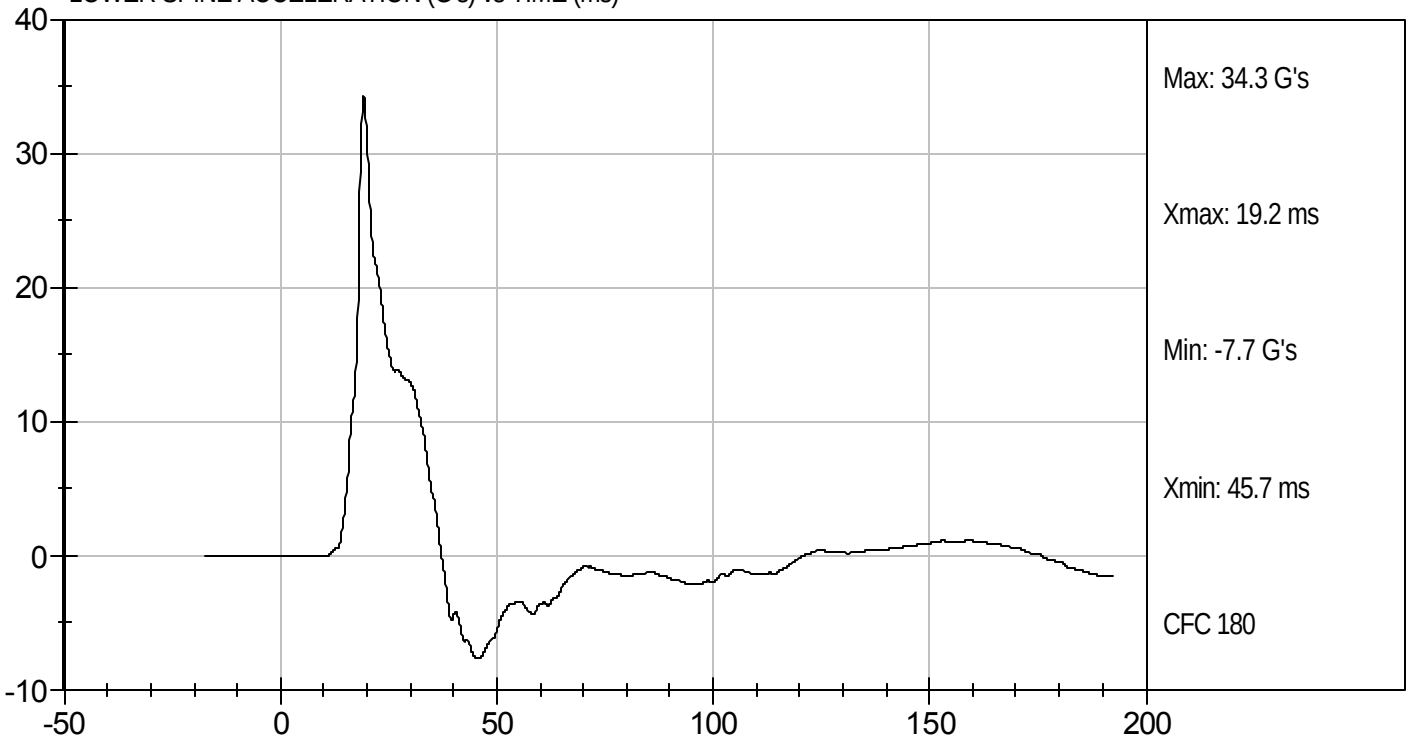
Test Desc: Thorax With Arm
Component ID: D101824

Test Date: 6/14/10
Velocity: 22.22 ft/s, 6.77 m/s

UPPER SPINE ACCELERATION (g's) vs TIME (ms)



LOWER SPINE ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

THORAX (WITHOUT ARM) IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101825

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	56	Pass
Impact Velocity	m/s	4.20 to 4.40	4.23	Pass
Peak Impactor Force	G's	14 to 18	14	Pass
Upper Rib Displacement	mm	32 to 40	35	Pass
Middle Rib Displacement	mm	39 to 45	40	Pass
Lower Rib Displacement	mm	35 to 43	38	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	13	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	9	Pass
		Overall Test Results		Pass

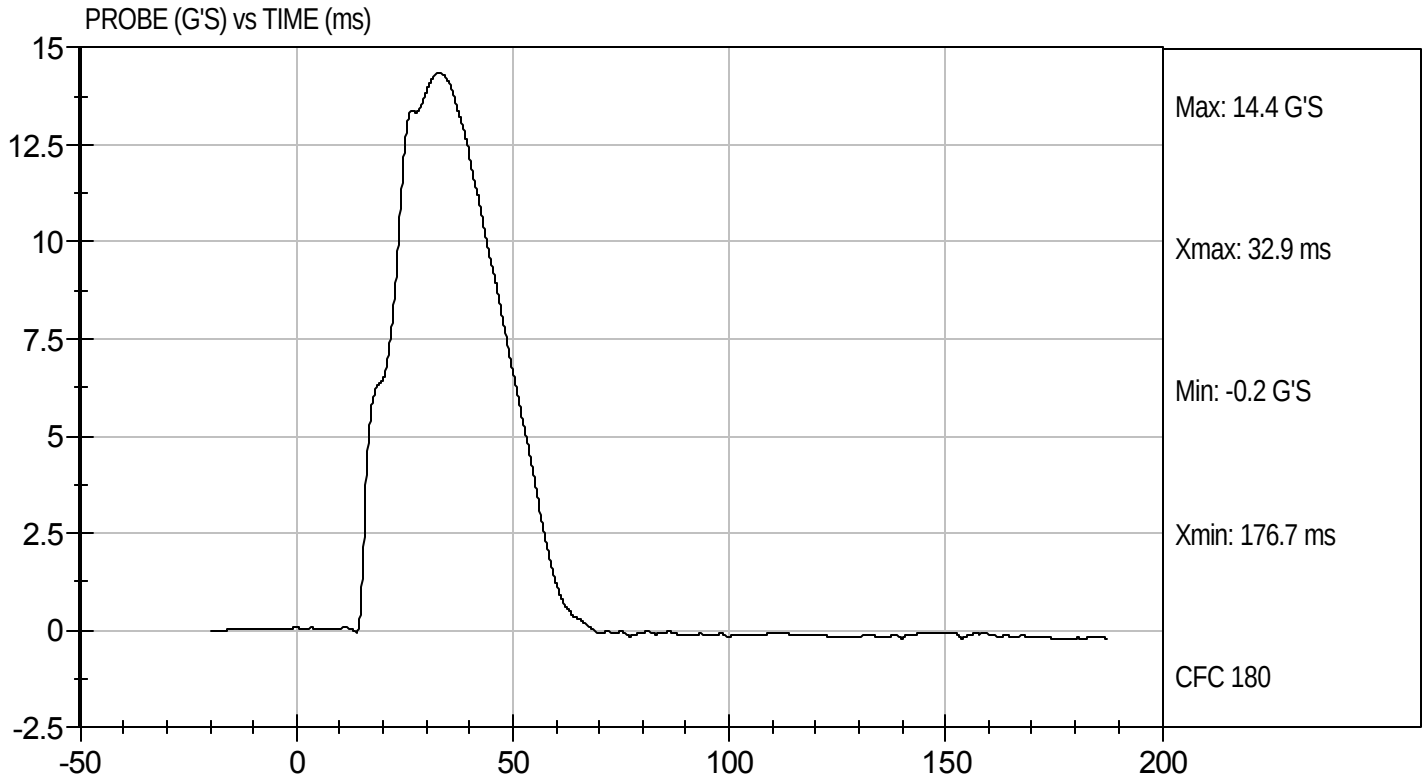
Jessica Hall
Laboratory Technician

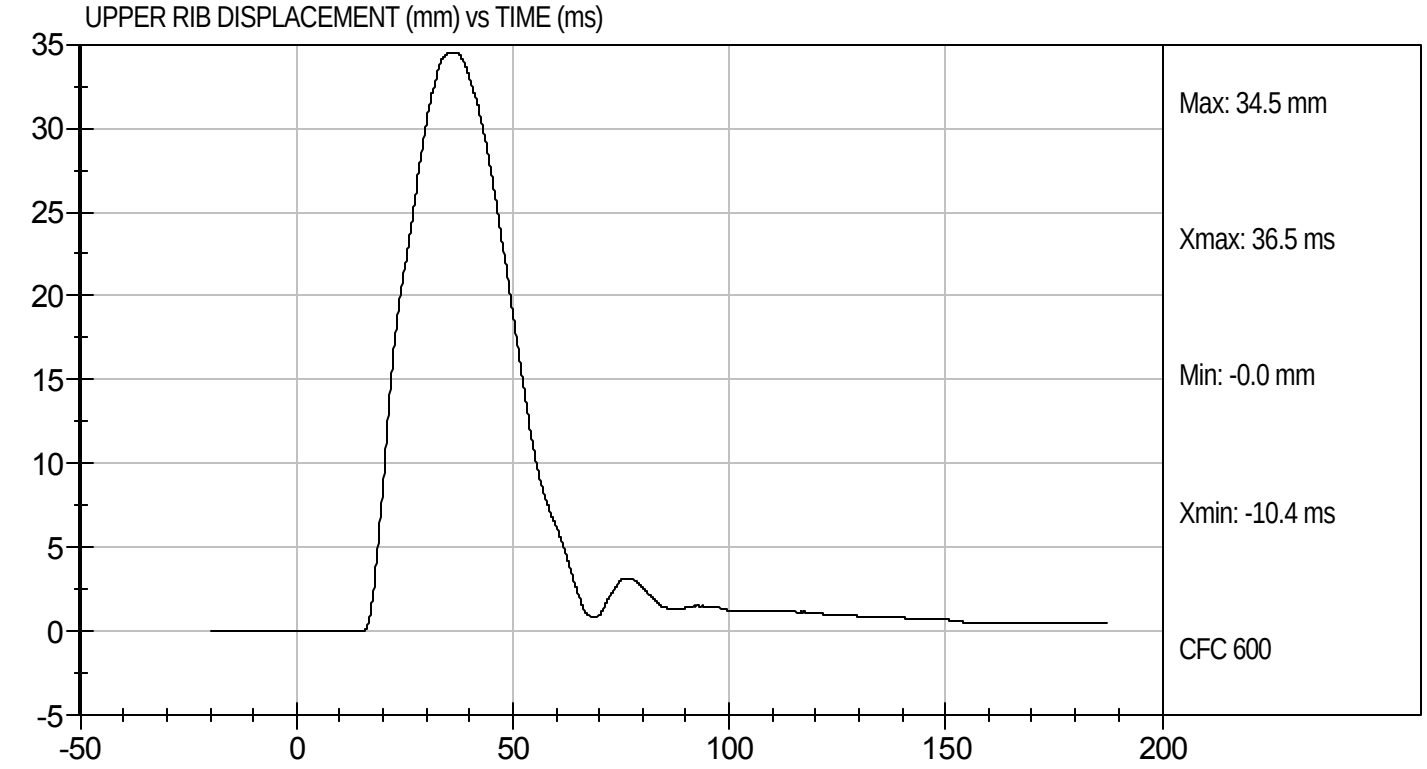
6/14/10
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Without Arm
Component ID: D101825

Test Date: 6/14/10
Velocity: 13.89 ft/s, 4.23 m/s

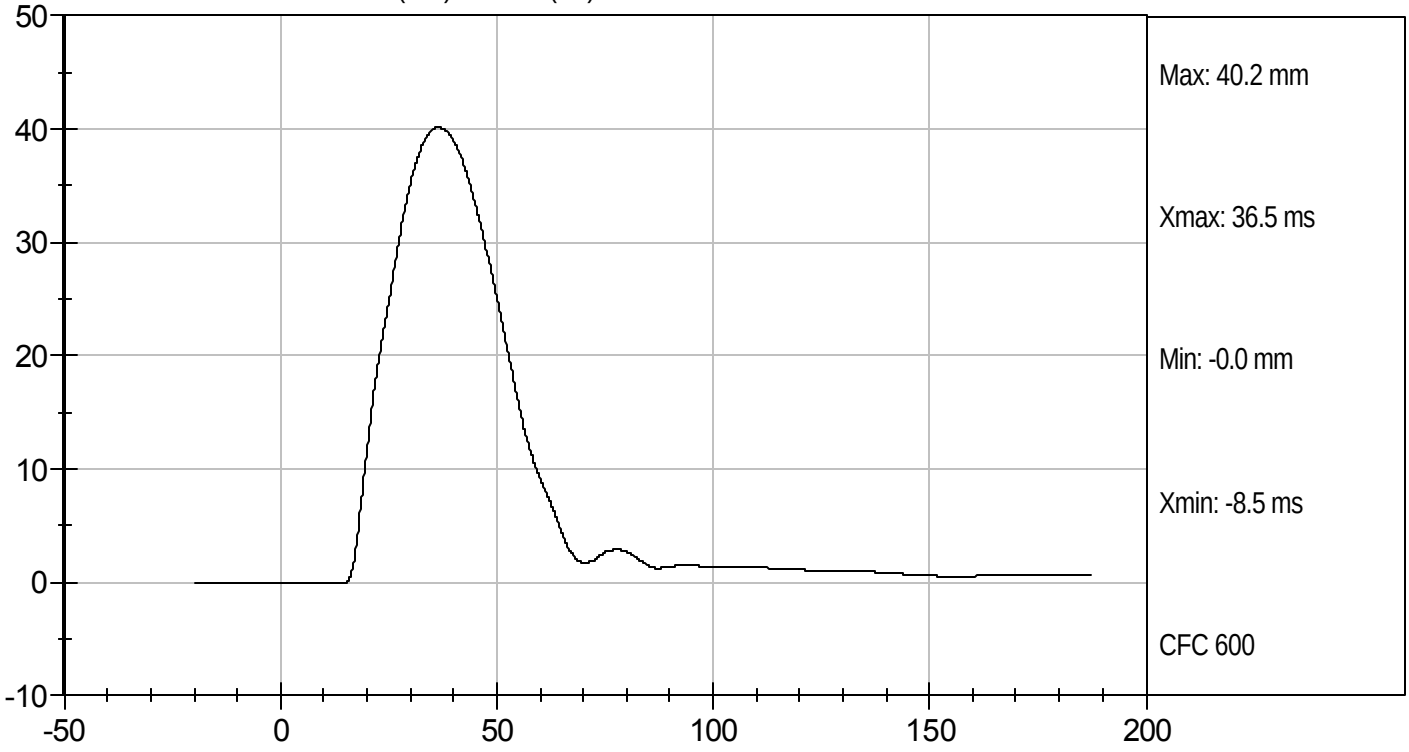




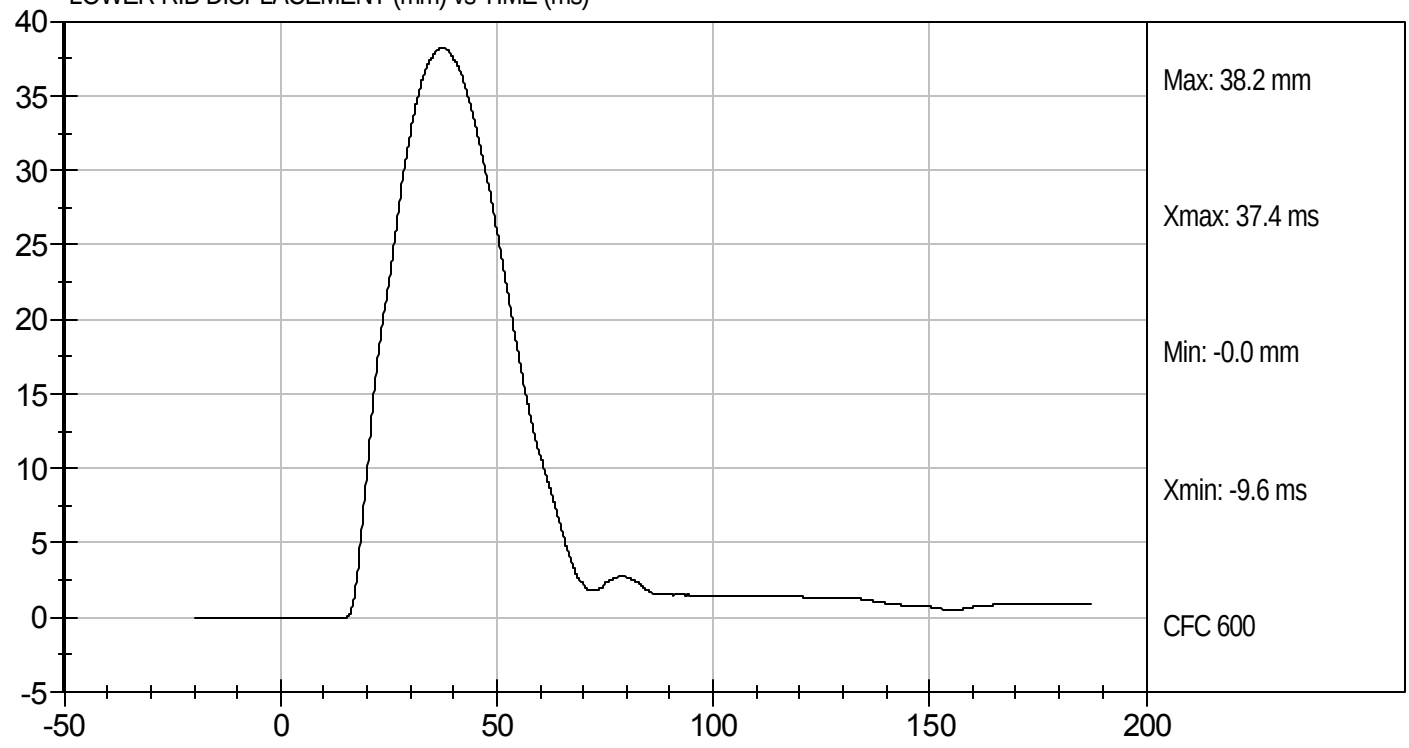
Test Desc: Thorax Without Arm
Component ID: D101825

Test Date: 6/14/10
Velocity: 13.89 ft/s, 4.23 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



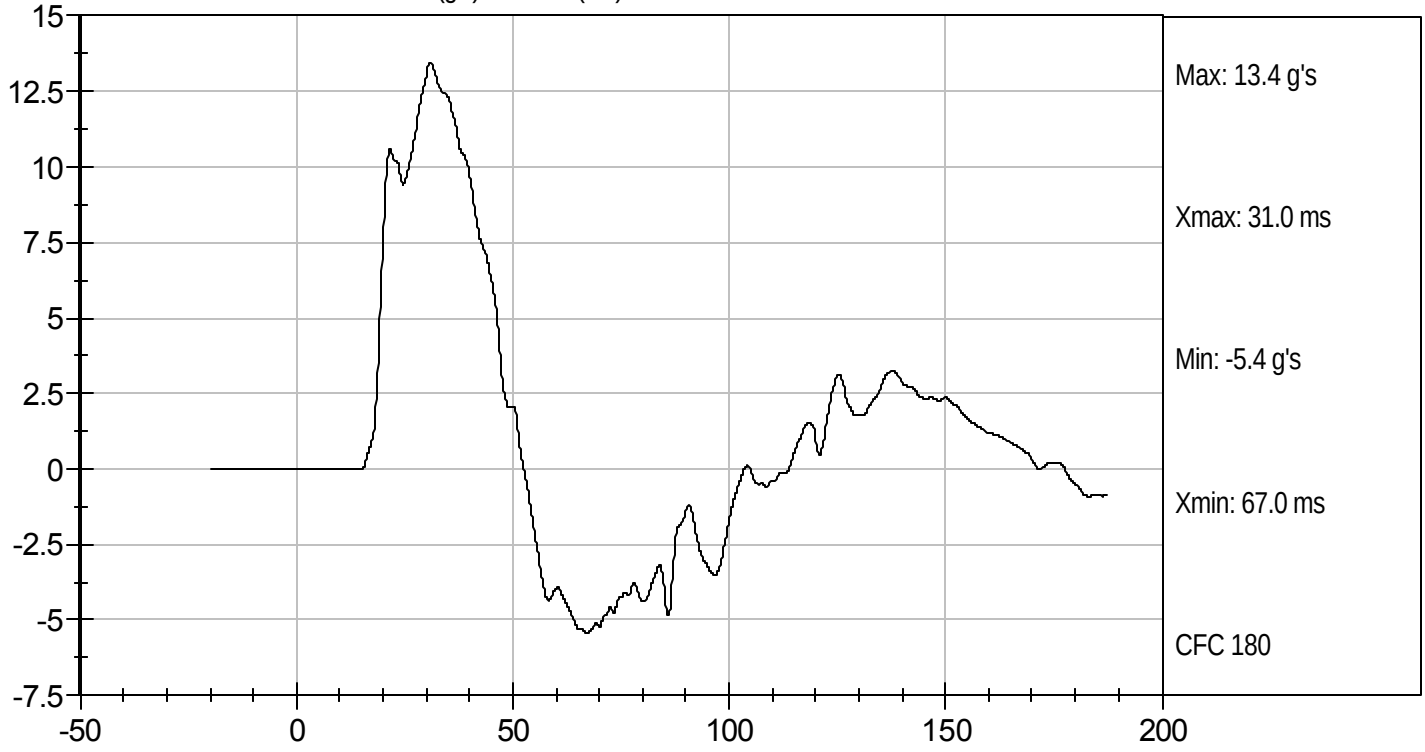
LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



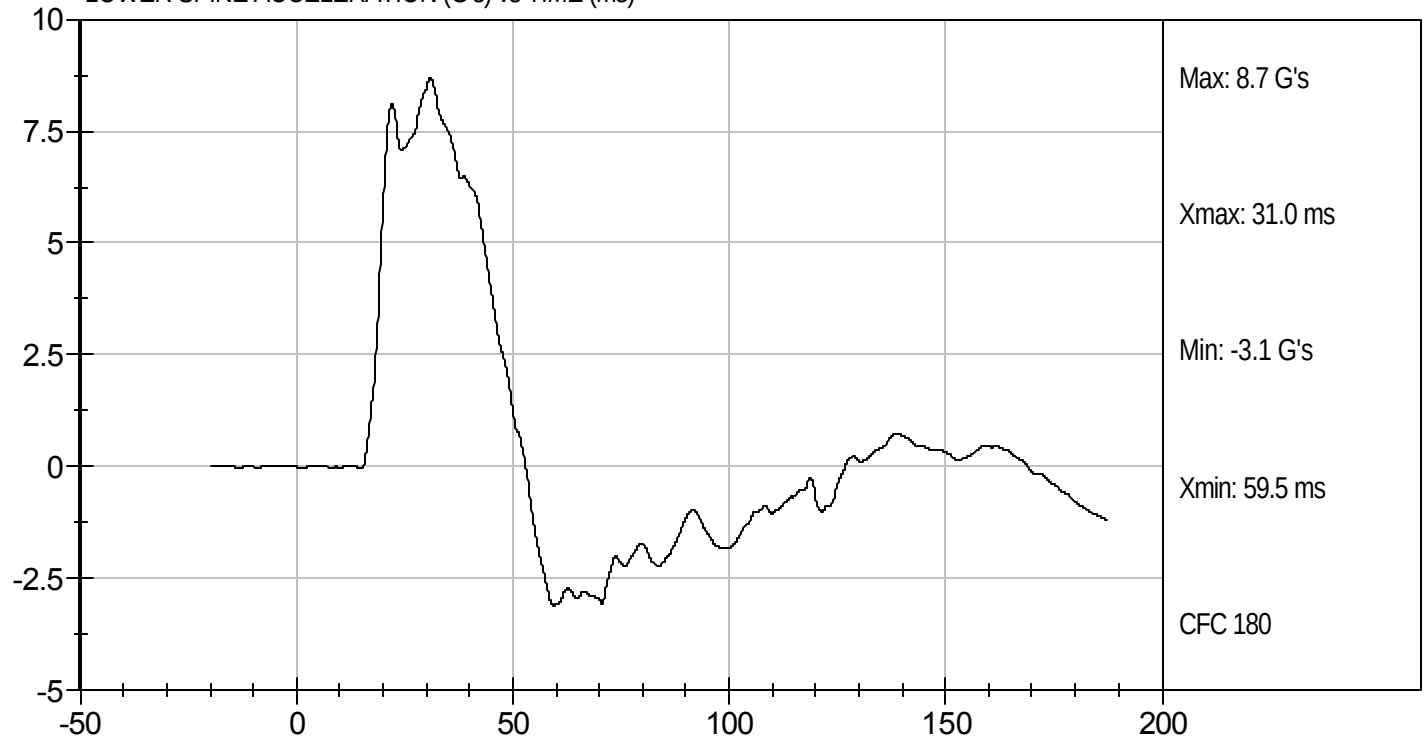
Test Desc: Thorax Without Arm
Component ID: D101825

Test Date: 6/14/10
Velocity: 13.89 ft/s, 4.23 m/s

UPPER SPINE ACCELERATION (g's) vs TIME (ms)



LOWER SPINE ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMINAL IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101826

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	56	Pass
Impact Velocity	m/s	4.20 to 4.40	4.23	Pass
Peak Impactor Acceleration	G's	12 to 16	14	Pass
Upper Rib Displacement	mm	36 to 47	37	Pass
Lower Rib Displacement	mm	33 to 44	38	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	11	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

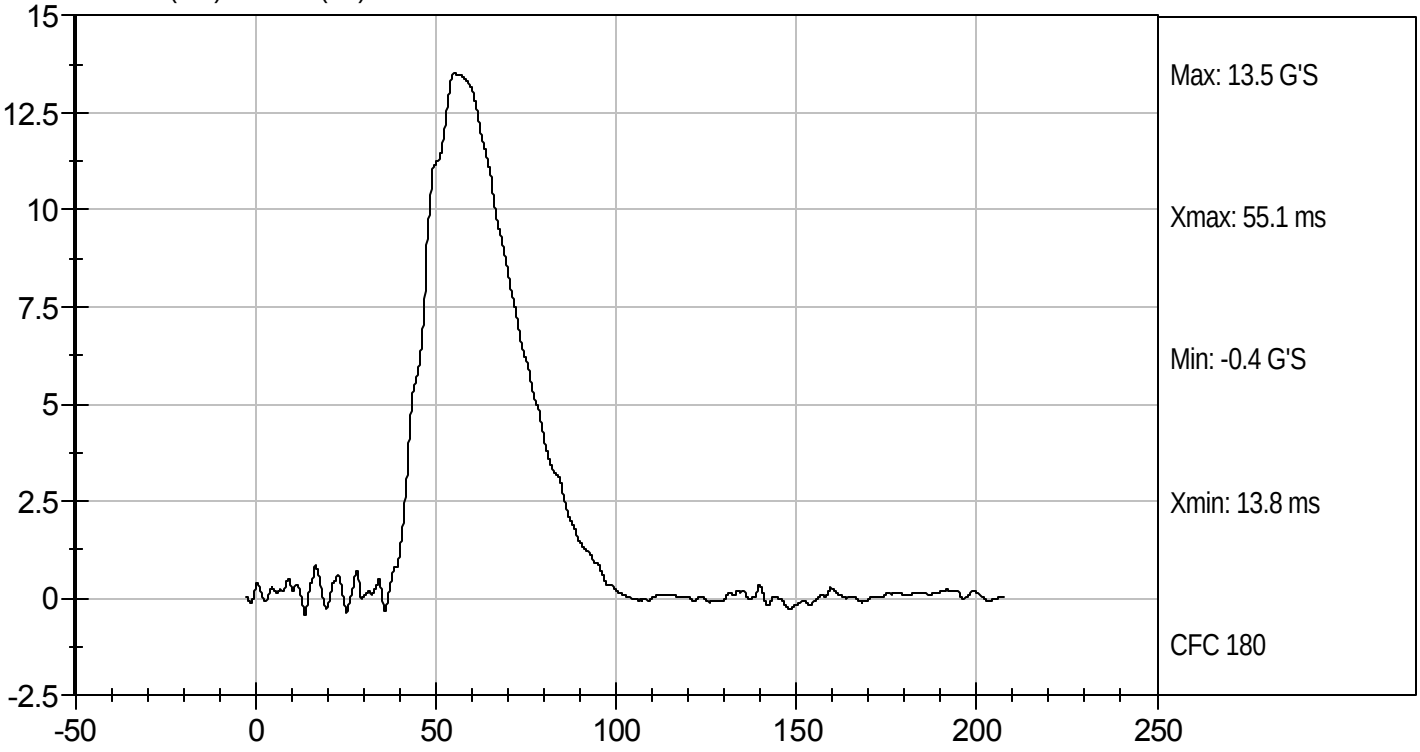
6/14/10
Test Date

David Winkelbauer
Approved By

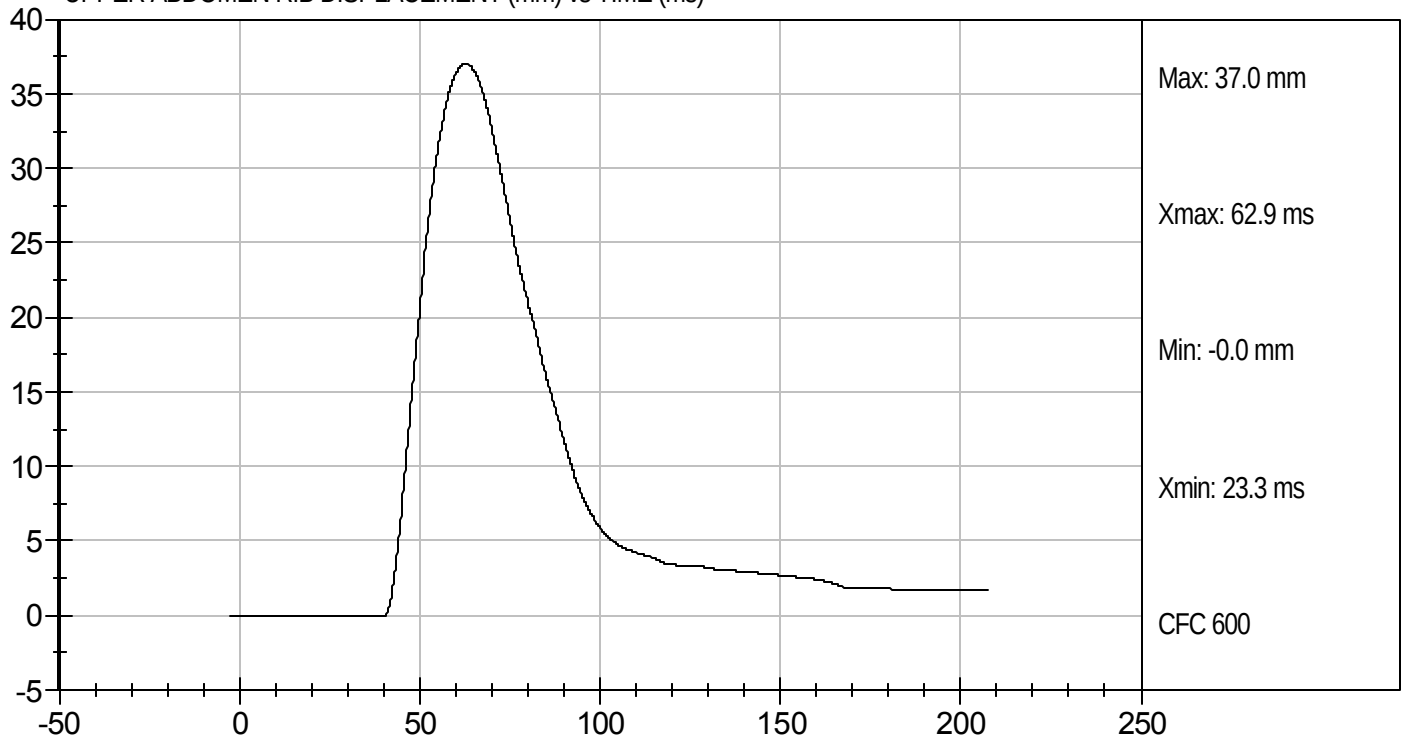
Test Desc: Abdomen Impact
Component ID: D101826

Test Date: 6/14/10
Velocity: 13.89 ft/s, 4.23 m/s

PROBE (G'S) vs TIME (ms)



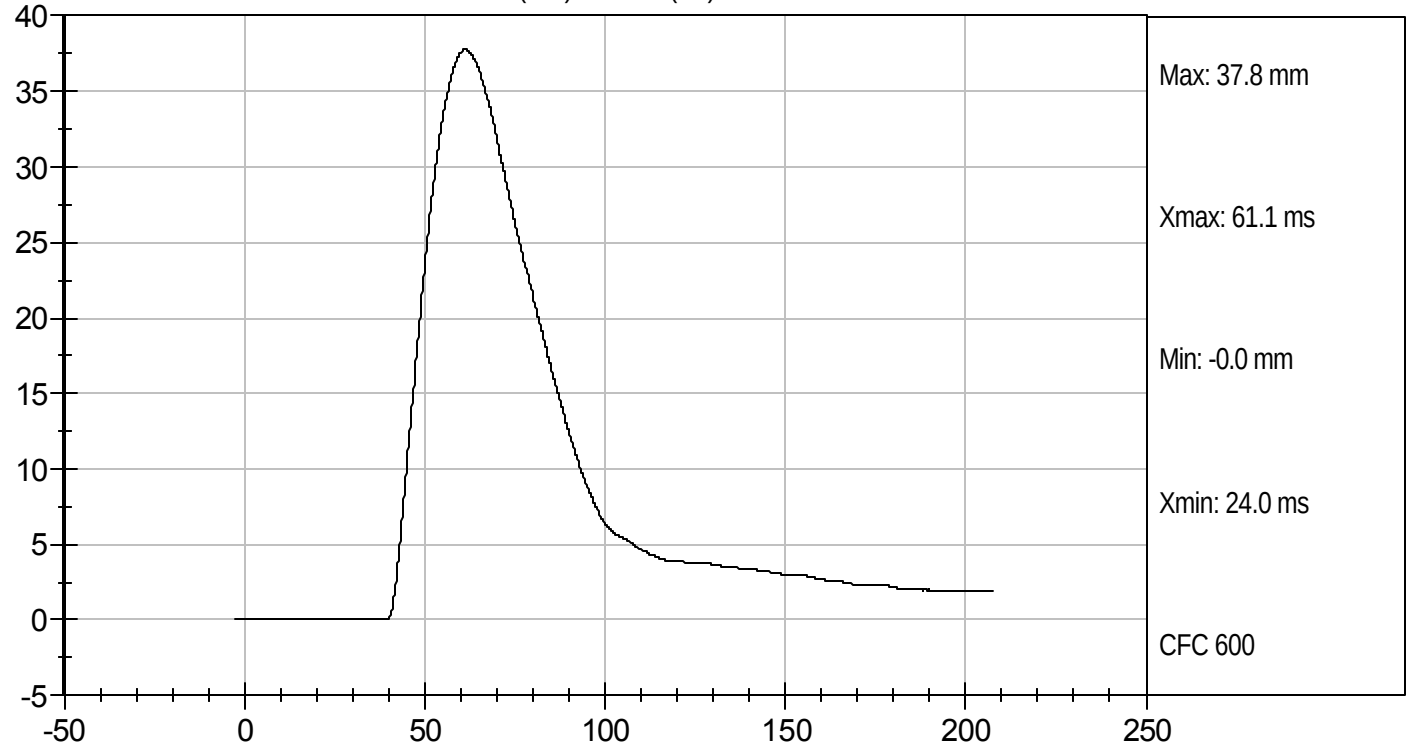
UPPER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



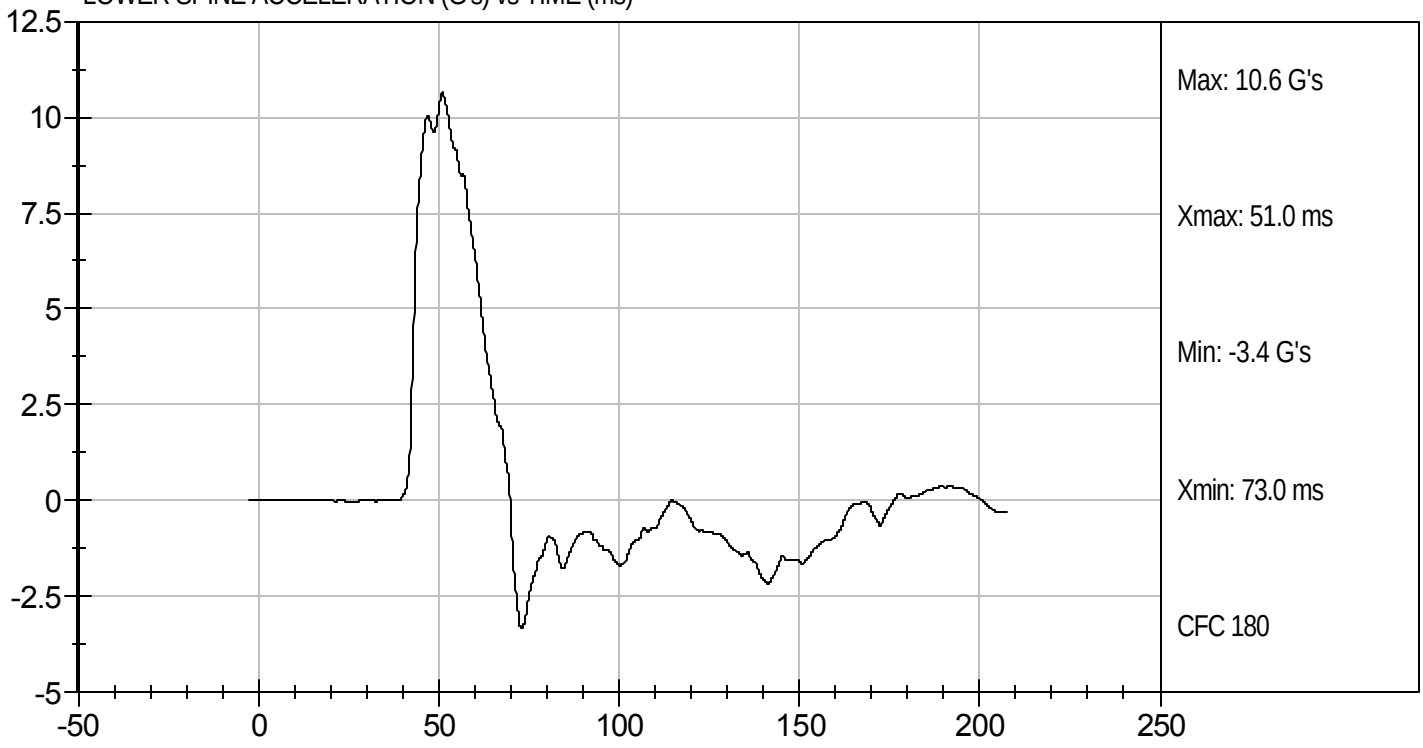
Test Desc: Abdomen Impact
Component ID: D101826

Test Date: 6/14/10
Velocity: 13.89 ft/s, 4.23 m/s

LOWER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER SPINE ACCELERATION (G's) vs TIME (ms)



MGA RESEARCH CORPORATION

PELVIS IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101827

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.9	Pass
Humidity	%	10 to 70	55	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Peak Impactor Acceleration	G's	38 to 47	42	Pass
Pelvis Y Acceleration after 6 ms	G's	34 to 42	38	Pass
Peak Acetabulum Force	N	3600 to 4300	3998	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

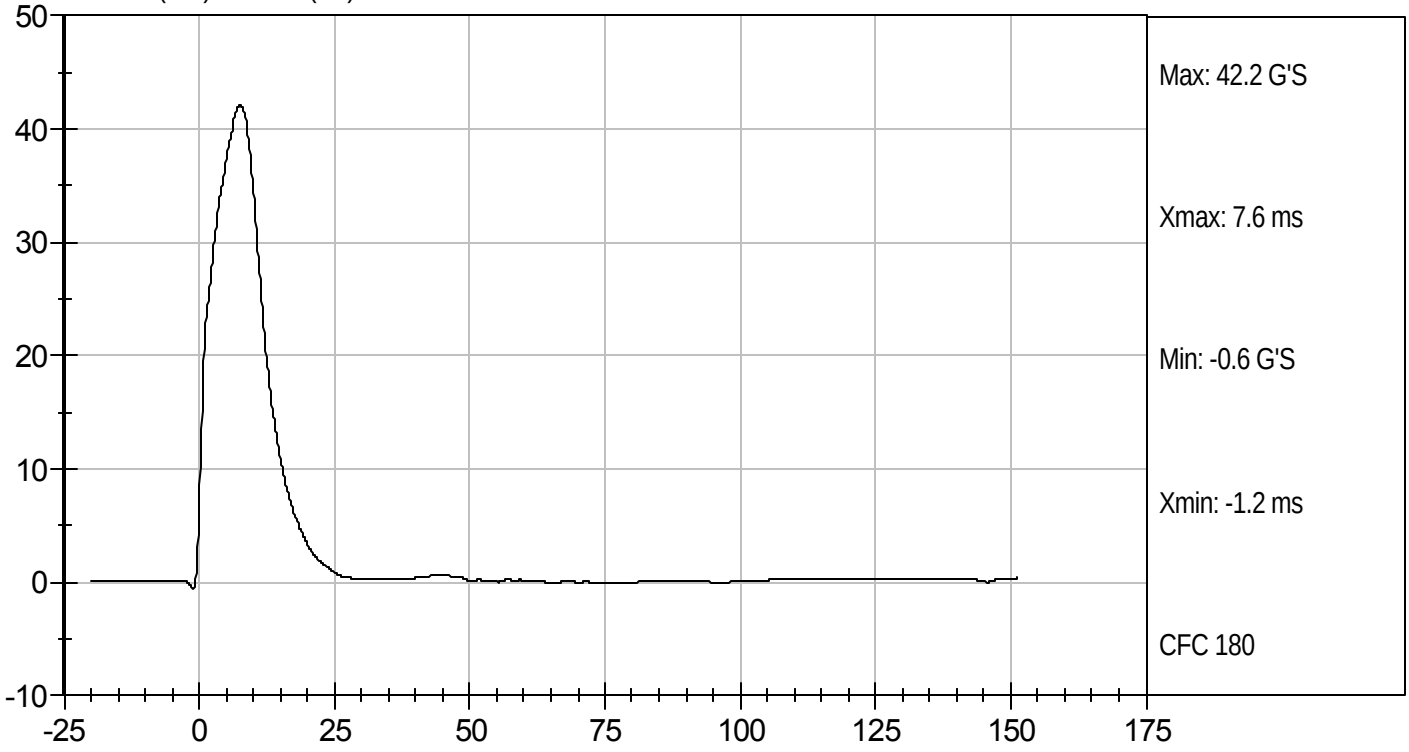
6/14/10
Test Date

David Winkelbauer
Approved By

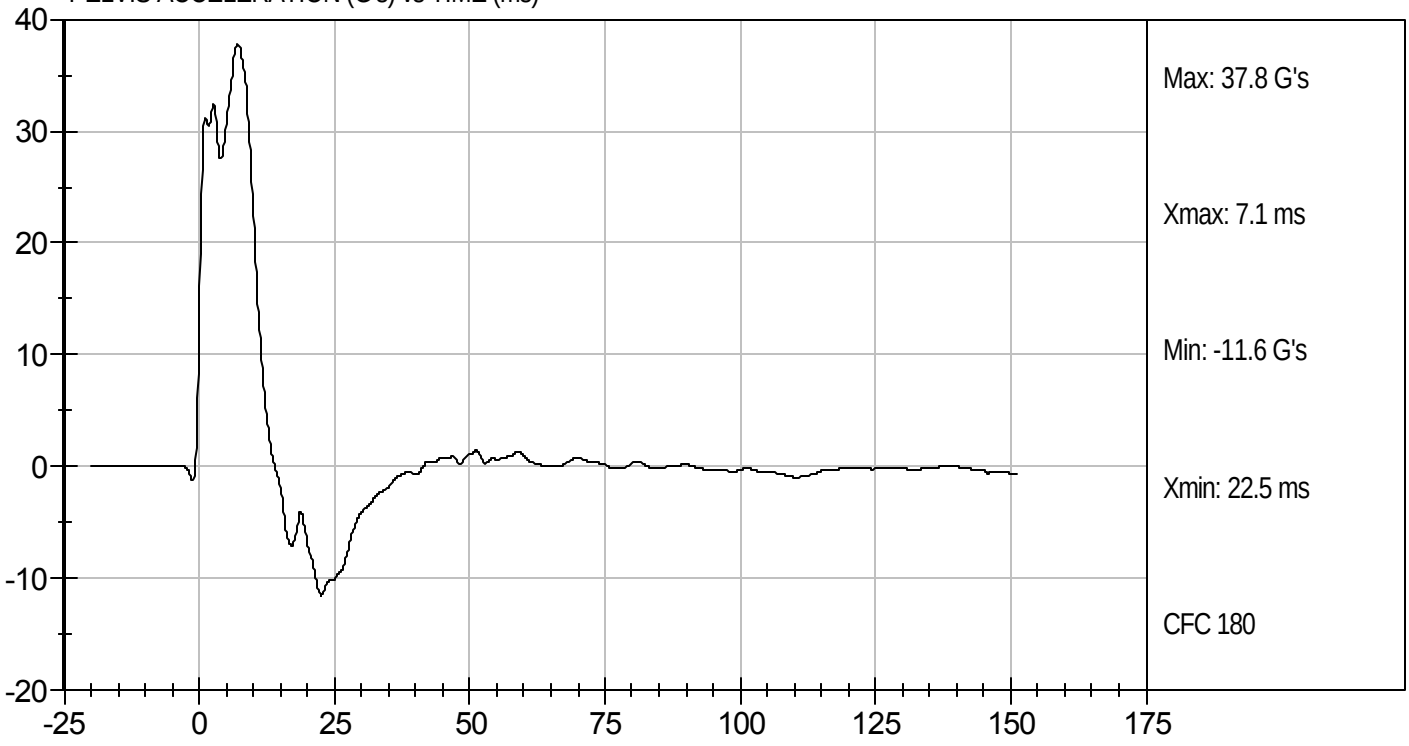
Test Desc: Pelvis Impact
Component ID: D101827

Test Date: 6/14/10
Velocity: 22.22 ft/s, 6.77 m/s

PROBE (G'S) vs TIME (ms)

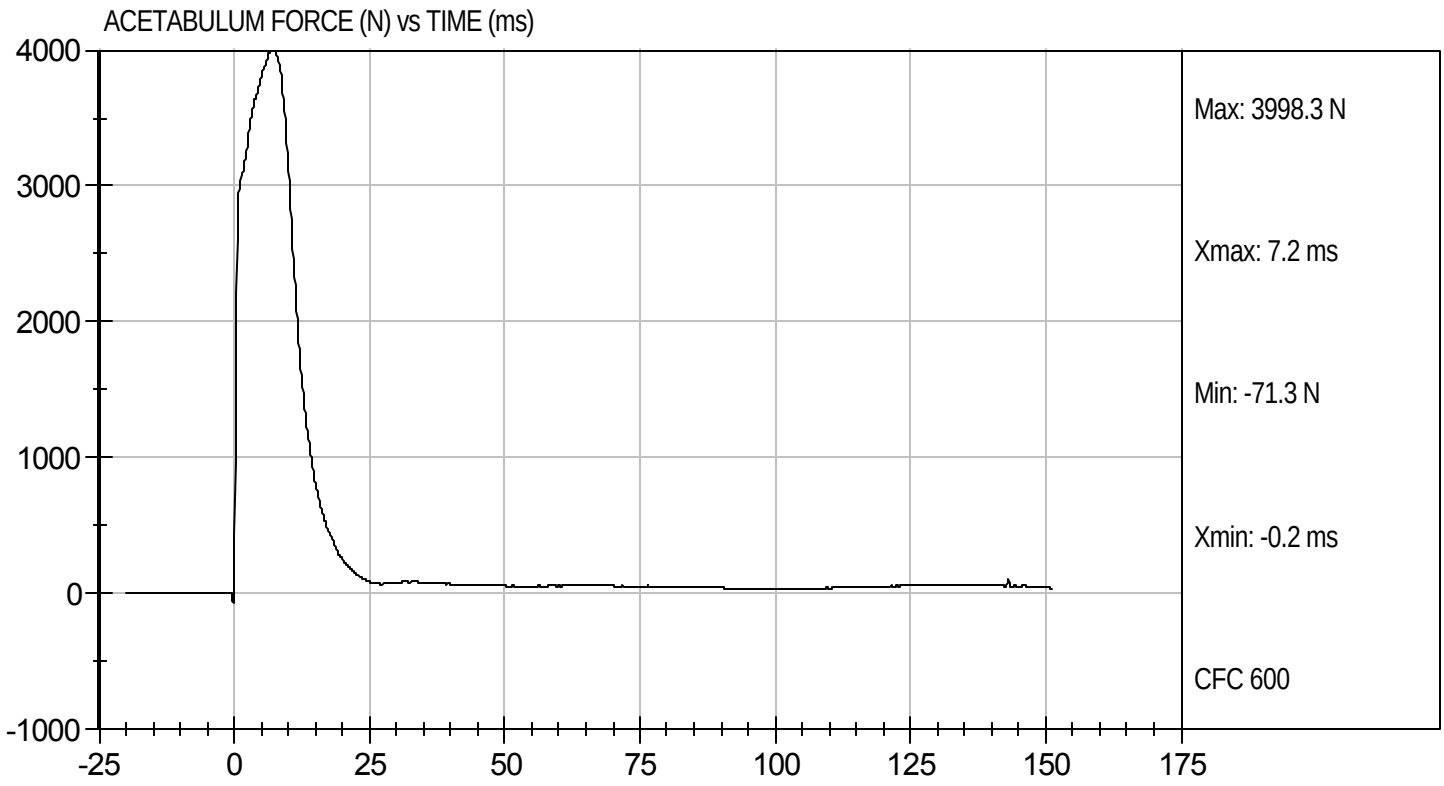


PELVIS ACCELERATION (G's) vs TIME (ms)



Test Desc: Pelvis Impact
Component ID: D101827

Test Date: 6/14/10
Velocity: 22.22 ft/s, 6.77 m/s



MGA RESEARCH CORPORATION

ILIAC IMPACT TEST

SID-IIs BUILD LEVEL D DUMMY

ATD Serial No: 296 **Test I.D:** D101828

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.9	Pass
Humidity	%	10 to 70	55	Pass
Impact Velocity	m/s	4.20 to 4.40	4.30	Pass
Peak Impactor Acceleration	G's	36 to 45	37	Pass
Pelvis Y Acceleration	G's	28 to 39	35	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4592	Pass
		Overall Test Results		Pass

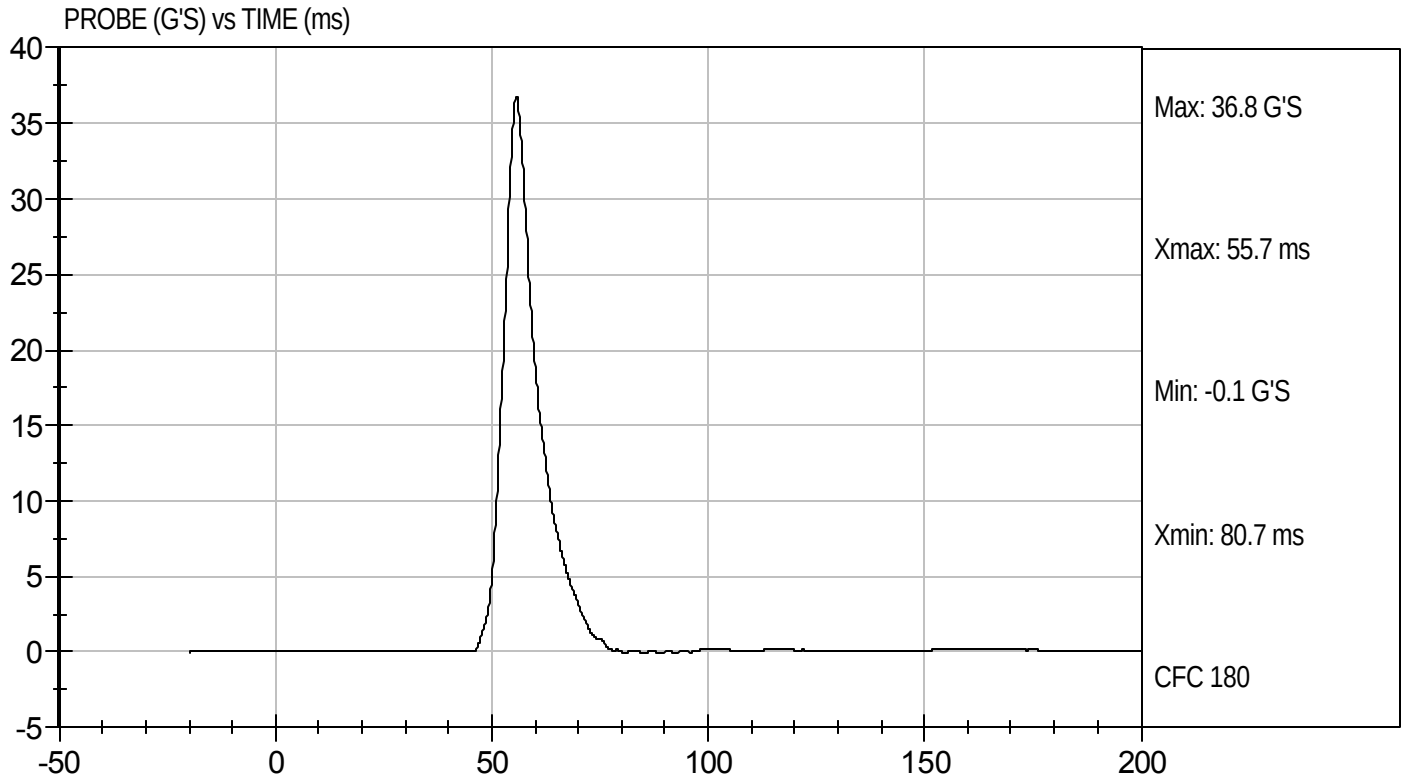
Jessica Hall
Laboratory Technician

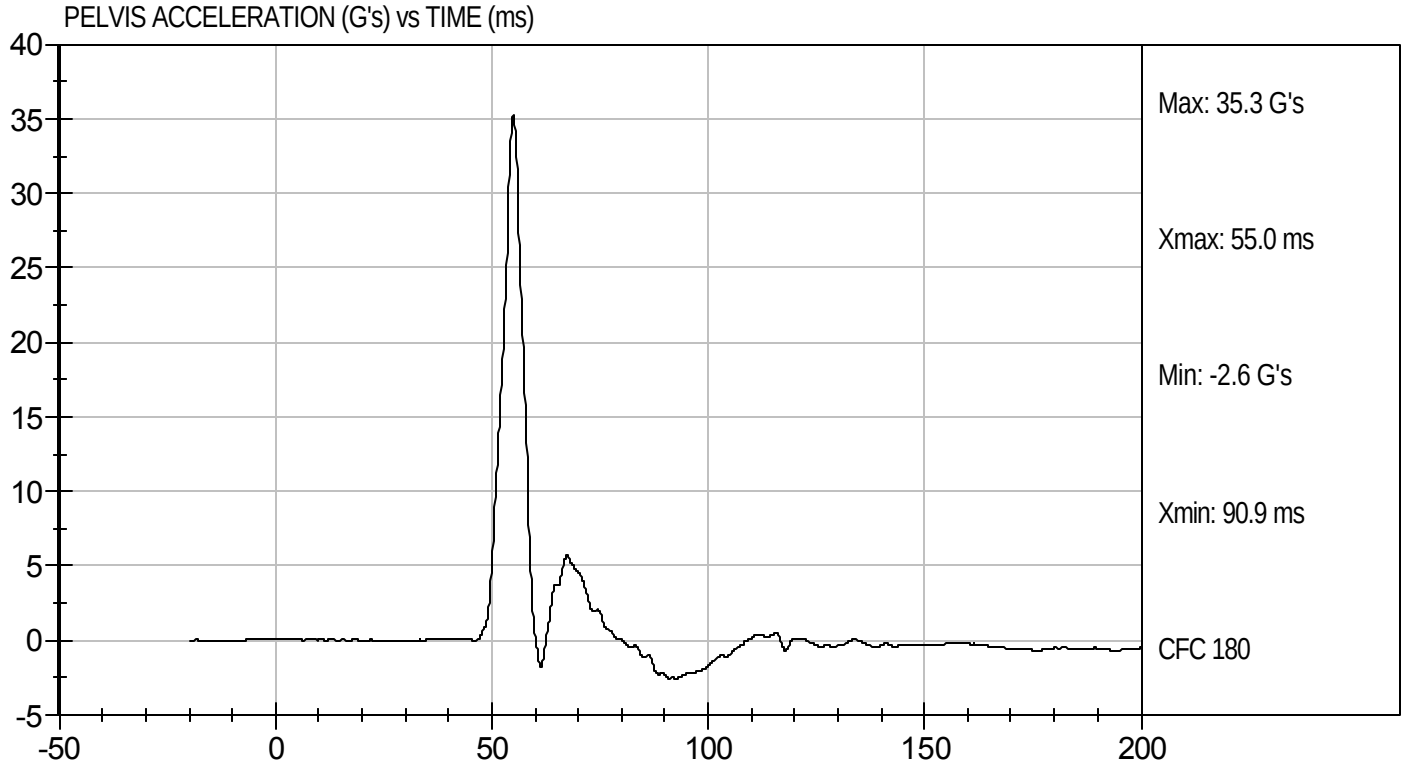
6/14/10
Test Date

David Winkelbauer
Approved By

Test Desc: Iliac Impact
Component ID: D101828

Test Date: 6/14/10
Velocity: 14.12 ft/s, 4.30 m/s





Test Desc: Iliac Impact
Component ID: D101828

Test Date: 6/14/10
Velocity: 14.12 ft/s, 4.30 m/s