

**REPORT NUMBER: 214P-MGA-2011-020**

**SAFETY COMPLIANCE TESTING FOR FMVSS 214  
DYNAMIC SIDE IMPACT PROTECTION  
RIGID POLE**

**GENERAL MOTORS LLC  
2011 CHEVROLET VOLT 5-DR HATCHBACK  
NHTSA NUMBER: CB0102**

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




**Test Date: September 21, 2011**


**Report Date: October 20, 2011**

**FINAL REPORT**

**PREPARED FOR:  
U.S. DEPARTMENT OF TRANSPORTATION  
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION  
ENFORCEMENT  
OFFICE OF VEHICLE SAFETY COMPLIANCE  
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Accepted by: \_\_\_\_\_

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### Technical Report Documentation Page

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<b>4. Title and Subtitle</b> Final Report of FMVSS 214P Compliance Test Side Impact Protection Testing of 2011 Chevrolet Volt 5-Dr Hatchback; NHTSA No.: CB0102		<b>5. Report Date</b> October 20, 2011													
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<b>9. Performing Organization Name and Address</b> MGA Research Corporation 5000 Warren Road Burlington, WI 53105		<b>10. Work Unit No.</b>													
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<b>12. Sponsoring Agency Name and Address</b> U.S. Department of Transportation National Highway Traffic Safety Administration Office of Vehicle Safety Compliance (NVS-220) 1200 New Jersey Ave, SE Washington, DC 20590		<b>13. Type of Report and Period Covered:</b> Final Test Report September 21, 2011 to October 20, 2011													
		<b>14. Sponsoring Agency Code</b> NVS-220													
<b>15. Supplementary Notes</b>															
<b>16. Abstract</b> A 32 km/h (20 mph), 75° oblique impact compliance test was conducted on the subject 2011 Chevrolet Volt 5-Dr Hatchback in accordance with the specifications of the Office of Vehicle Safety Compliance TP-214P-01 for the determination of FMVSS No. 214 Side Impact Protection compliance. The test was conducted at MGA Research Corporation, in Burlington, Wisconsin, on September 21, 2011.  The impact velocity was 32.0 km/h, and the ambient temperature at the struck (driver's) side of the test vehicle at the time of impact was 21°C. The test vehicle post-test maximum crush was 357 mm at level 3. The test vehicle's performance follows: <table border="1" style="margin: 10px auto; border-collapse: collapse; text-align: center;"> <thead> <tr> <th style="padding: 5px;">Measurement Description</th> <th style="padding: 5px;">Units</th> <th style="padding: 5px;">Result</th> </tr> </thead> <tbody> <tr> <td style="padding: 5px;">Head Injury Criteria (HIC<sub>36</sub>)</td> <td style="padding: 5px;">N/A</td> <td style="padding: 5px;">198</td> </tr> <tr> <td style="padding: 5px;">Resultant Lower Spine Acceleration</td> <td style="padding: 5px;">G</td> <td style="padding: 5px;">40</td> </tr> <tr> <td style="padding: 5px;">Combined Acetabular and Iliac Pelvic Force</td> <td style="padding: 5px;">N</td> <td style="padding: 5px;">2976</td> </tr> </tbody> </table>				Measurement Description	Units	Result	Head Injury Criteria (HIC <sub>36</sub> )	N/A	198	Resultant Lower Spine Acceleration	G	40	Combined Acetabular and Iliac Pelvic Force	N	2976
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Head Injury Criteria (HIC <sub>36</sub> )	N/A	198													
Resultant Lower Spine Acceleration	G	40													
Combined Acetabular and Iliac Pelvic Force	N	2976													
The doors on the struck side of the vehicle did not separate from the body at the hinges or latches and the opposite side doors did not open during the side impact event.															
<b>17. Key Words</b> Compliance Testing Side Impact Protection Pole Test ES-2re SID-IIs		<b>18. Distribution Statement</b> Copies of this report are available from: National Highway Traffic Safety Administration Technical Information Services (TIS) Room E12-100 East Building 1200 New Jersey Ave. Washington, D.C. 20590 Telephone No. (202) 366-2588													
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## **SECTION 1**

### **PURPOSE AND SUMMARY OF TEST**

#### PURPOSE

This side impact test is part of the FY 2011 FMVSS 214 Side Impact Protection Compliance Test Program sponsored by the National Highway Traffic Safety Administration (NHTSA), under Contract No. DTNH22-07-D-00062. The purpose of this test was to evaluate side impact protection in a 2011 Chevrolet Volt 5-Dr Hatchback. The side impact test was conducted in accordance with the Office of Vehicle Safety Compliance's Laboratory Test Procedure (TP-214P-01, dated January 2010).

#### SUMMARY

A rigid pole side impact test was conducted on a 2011 Chevrolet Volt 5-Dr Hatchback. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 32.0 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin, on September 21, 2011. Pre-test and post-test photographs of the test vehicle and side impact dummy are included in Appendix A of this report.

One Part 572V dummy was placed in the left front outboard designated seating position according to instructions specified in TP-214P-01, dated January 2010. The side impact event was documented by ten (10) cameras.

The SID-II's female dummy was instrumented with a triaxial accelerometer pack located in the head, 5 rib displacement transducers located in the thorax and abdomen, triaxial accelerometer pack located in the lower spine, a Iliac load cell, and an acetabulum load cell.

A summary of the test results follows:

**DUMMY INJURY VALUES**

Dummy	HIC (36ms)	Resultant Lower Spine Acceleration (G)	Pelvic Force (N)	
SID-IIs 5 <sup>th</sup> Percentile Feale	198	40	Iliac Wing	1152
			Acetabular	1914
			Sum	2976

**GENERAL COMMENTS**

There was no valid data collected for:  
Driver Seat Track Y after 5 msec.

MGA does not endorse or certify products. The manufacturer's name appears solely for identification purposes.

**SECTION 2**  
**OCCUPANT AND VEHICLE INFORMATION**

**DATA SHEET NO. 1**

**TEST VEHICLE INFORMATION AND OPTIONS**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
Test Date: 9/21/2011

<b>VEHICLE INFORMATION</b>	
Make	Chevrolet
Model	Volt
Body Style	5-Dr Hatchback
VIN	1G1RC6E48BU101109
Body Color	Silver
Engine Displacement (L)	1.4
# of Cylinders	4
Engine Placement	Lateral
Transmission Type	Automatic
Transmission Speeds	1
Overdrive	No
Final Drive	Front
Odometer Reading	31 miles

<b>OPTIONS</b>	
ESC	Yes
All Wheel Drive	No
Power Steering	Yes
Tilt Steering Wheel	Yes
Driver Side Curtain Airbag	Yes
Driver Side Torso/Pelvis Airbag	Yes
Driver Knee Bag	Yes
Driver Seat Belt Pretensioners	Yes
Driver Seat Belt Load Limiters	Yes
Driver Power Seat	No
Rear Pass. Curtain Airbag	Yes
Rear Pass. Side Torso/Pelvis Airbag	No
Rear Pass. Seat Belt Pretensioners	No
Rear Pass. Seat Belt Load Limiters	No
Rear Pass. Power Seats	No
Power Windows	Yes
Air Conditioning	Yes
AM/FM CD	Yes
Automatic Door Locks (ADL)	Yes
Does owner's manual provide instructions to disable ADL's?	No
Anti-Lock Brakes	Yes

**DATA FROM CERTIFICATION LABEL**

Manufactured By	General Motors LLC
Date of Manufacture	01/11

GVWR (kg)	2062
GAWR Front (kg)	1139
GAWR Rear (kg)	923

**VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION**

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bucket		
Number of Occupants	2	2		4
Capacity Weight (VCW) (kg)				340
Cargo Weight (RCLW) (kg)				68

**DATA SHEET NO. 2**

**GENERAL TEST AND VEHICLE PARAMETER DATA**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback      NHTSA No. CB0102  
 Test Program: FMVSS 214 Pole      Test Date: 9/21/2011

**TIRE PRESSURES**

	Units	LF	RF	RR	LR
As Delivered	kPa	240	2240	240	240
As Tested	kPa	240	240	240	240

**TEST VEHICLE WEIGHTS**

	Units	As Delivered			Fully Loaded			As Tested		
		Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total	Front Axle	Rear Axle	Total
Left	kg	527.1	339.3		546.1	393.7		547.0	381.9	
Right	kg	511.7	324.3		514.4	368.3		524.8	363.4	
Ratio	%	61.0	39.0		58.2	41.8		59.0	41.0	
Totals	kg	1038.8	663.6	1702.4	1060.5	762.0	1822.5	1071.8	745.3	1817.1

**TEST VEHICLE TARGET WEIGHT (TVTW) CALCULATION**

Measured Parameter	Units	Value
As Delivered Weight	kg	1702.4
Weight of 1 P572V ATD (SID-IIs) Dummy	kg	52.2
Rated Cargo/Luggage Weight (RCLW)	kg	68
Calculated Target Vehicle Test Weight (TVTW)	kg	1822.6

**TEST VEHICLE ATTITUDES**

	Units	LF	RF	RR	LR
Fully Loaded	mm	704	705	693	692
As Tested	mm	704	704	707	708
Difference	mm	0	1	-14	-16

**CALCULATION OF THE VERTICAL IMPACT REFERENCE LINE**

Measurement Parameter	Units	Value
Test Vehicle Wheel Base	mm	2685
Vertical Impact Reference Line (Aft of Front Axle)	mm	1124

**WEIGHT of BALLAST and VEHICLE COMPONENTS  
REMOVED TO MEET VEHICLE TEST WEIGHT**

Description of Component	Weight (kg)
Ballast	0
No vehicle components removed to meet VTW	0



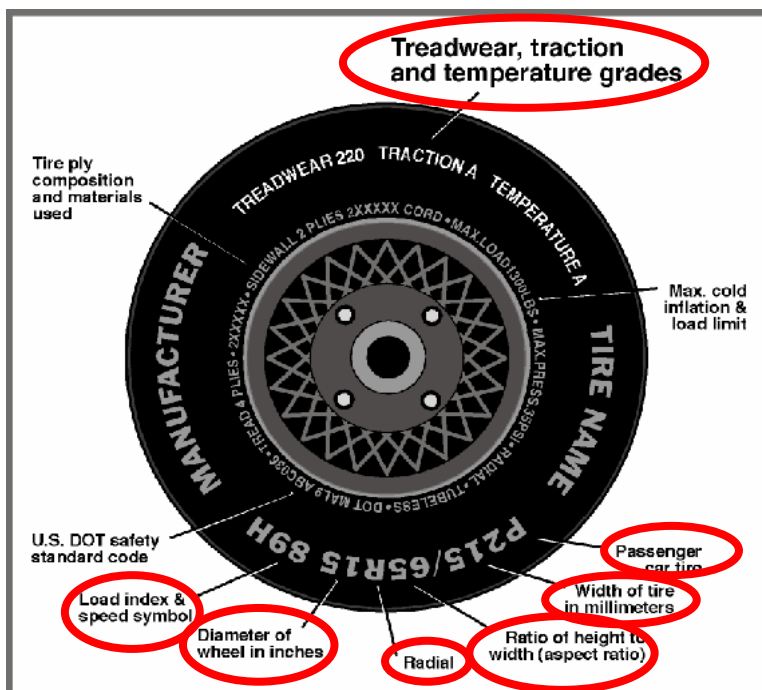
### DATA SHEET NO. 3

#### VEHICLE TIRE INFORMATION

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

#### VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	240	240
Recommended Tire Size	P215/55R17	P215/55R17
Tire Size on Vehicle	P215/55R17	P215/55R17
Tire Manufacturer	Goodyear	Goodyear
Tire Name	Assurance	Assurance
Tire Type	Passenger	Passenger
Tire Width	215	215
Aspect Ratio	55	55
Radial	Yes	Yes
Wheel Diameter	17	17
Load Index/Speed Symbol	93H	93H
Treadwear	580	580
Traction Grade	A	A
Temperature Grade	A	A

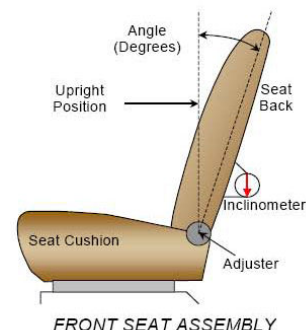
**DATA SHEET NO. 4**  
**SEAT AND SEAT BELT ADJUSTMENT DATA**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

**NORMAL DESIGN RIDING POSITION**

The driver seat was a manual adjustable seat with manual height adjustment. The seat travel was set as specified in Appendix A of the TP dated January 2010. The right front passenger seat was set to match the driver seat. The rear passenger seats were fixed.



**SEAT BACK ANGLE**

	Degrees	Detents
Driver with Seated Dummy	-12.5° at headrest post	

**SEAT FORE/AFT POSITION**

The seat back was set as specified in Appendix A of the TP dated January 2010. For the front seats, the seat back angle measurement was made relative to the door sill on the headrest post.

**SEAT FORE/AFT POSITIONING**

	Total Fore/Aft Travel	Placed in Position #
Front Seat	244 mm	0 mm (forward-most as 0)

**SEAT BELT UPPER ANCHORAGE**

The method of positioning the seat belt upper anchorage is as follows: Detents to the nominal design position are measured with respect to the uppermost detent. The seat belt upper anchorages were non-adjustable.

**SEAT BELT UPPER ANCHORAGE**

	Total # of Positions	Placed in Position #
Driver Seat	Fixed	Fixed

**HEADREST RESTRAINT**

The headrest was placed in the full down position.

## DATA SHEET NO. 5

### FUEL SYSTEMS AND STEERING WHEEL POSITION DATA

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

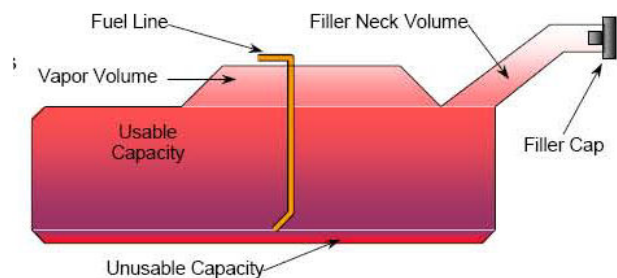
NHTSA No. CB0102  
 Test Date: 9/21/2011

#### FUEL TANK CAPACITY

	Liters
Usable Capacity (Form 1)	35.2
Useable Capacity (Owner's Manual)	35.2
92-94% of Usable Capacity	32.4 to 33.1
Actual Amount of Solvent Used	32.6

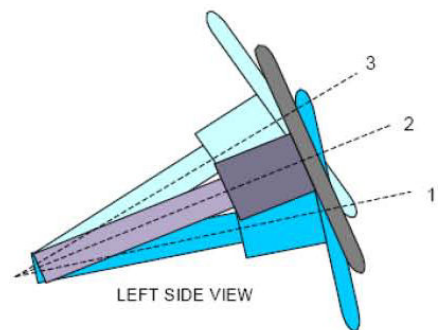
#### FUEL PUMP

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 run when the gasoline generator is commanded to start. The fuel pipe is on the right side.



#### STEERING COLUMN ADJUSTMENT

Steering wheel and column adjustments are made so that the steering wheel hub is at the center of its geometric locus it describes when it moves 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

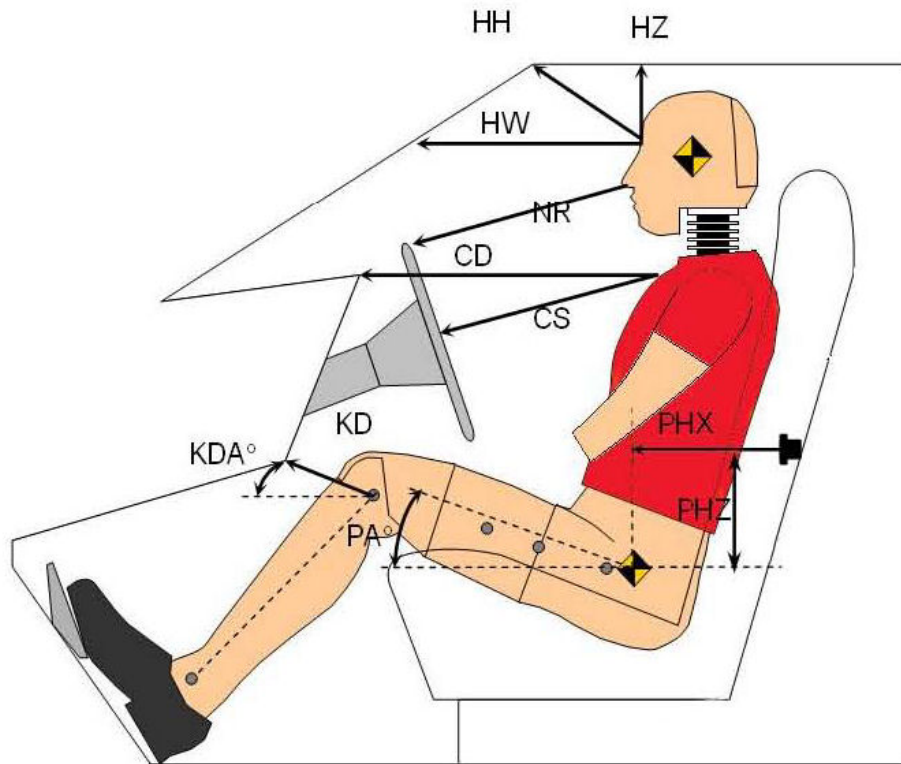
#### STEERING COLUMN POSITIONING

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1	70.4	218
Geometric Center – Position 2	68.2	190
Uppermost – Position 3	66.0	163
Telescoping Steering Wheel Travel		55
Test Position	68.2	190

**.DATA SHEET NO. 6**  
**DUMMY LONGITUDINAL CLEARANCE DIMENSIONS**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

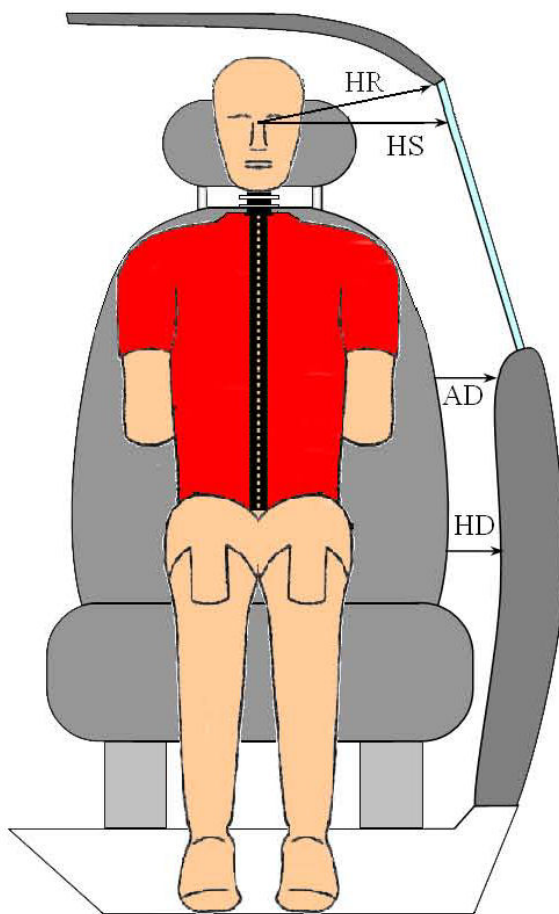


Driver Code	Measurement Description	Length (mm)	Angle (°)
HH	Head to Header	322	
HW	Head to Windshield	711	
HZ	Head to Roof	214	
NR	Nose to Rim	248	
CD	Chest to Dash	430	
CS	Chest to Steering Wheel	205	
KDL	Left Knee to Dash	163	29.0
KDR	Right Knee to Dash	159	32.9
PA	Pelvis Angle X		22.5
	Torso Angle Y		1.1
PHX	H-Point to Striker (X-Axis)	285	
PHZ	H-Point to Striker (Z-Axis)	141	

**DATA SHEET NO. 7**  
**DUMMY LATERAL CLEARANCE DIMENSIONS**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

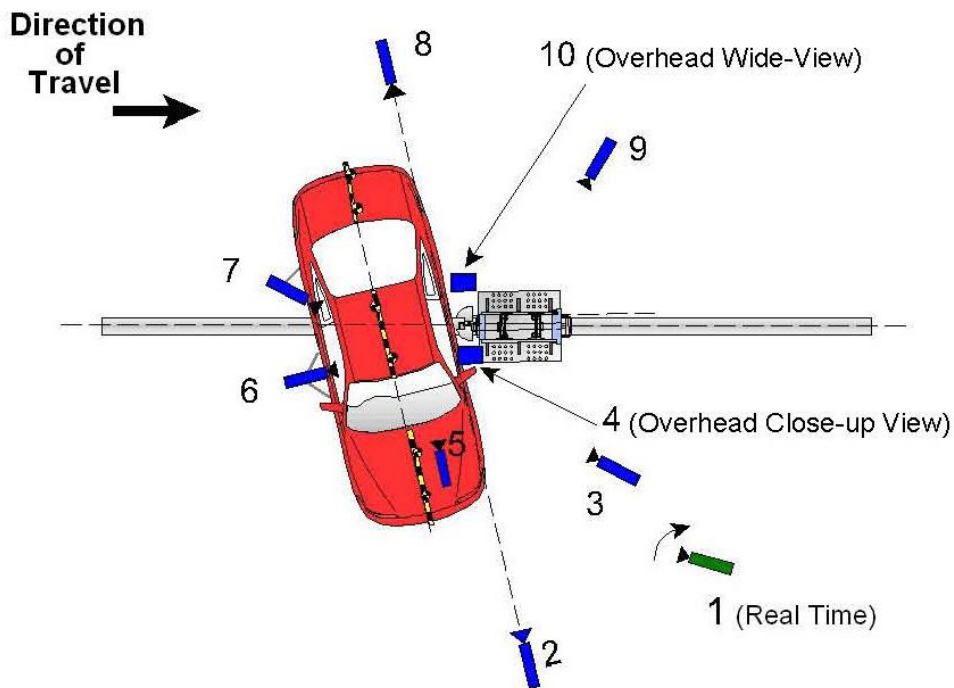


Code	Measurement Description	Units	Front Occupant
HR	Head to Side Header	mm	223
HS	Head to Side Window	mm	352
AD	Arm to Door	mm	159
HD	H-Point to Door	mm	154

**DATA SHEET NO. 8**  
**HIGH SPEED CAMERA LOCATIONS AND DATA**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011



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

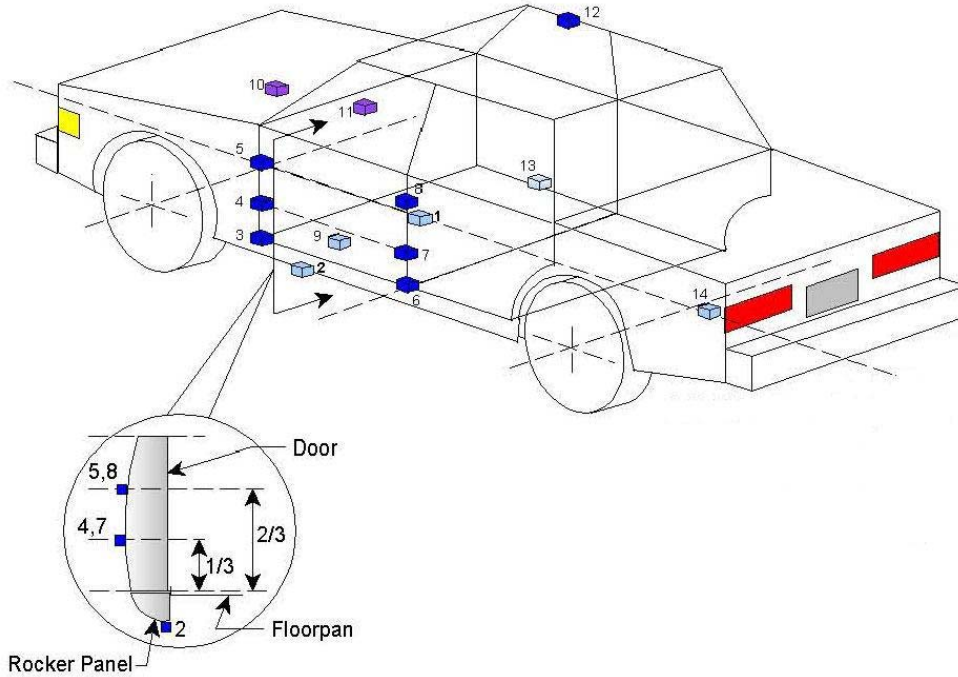
Camera No.	View	Coordinates (mm)			Lens (mm)	Film Speed (fps)
		X	Y	Z		
1	Real-Time					30
2	Front Ground Level	5640	20	1690	24	1000
3	Impact Side 45° Forward	4380	2240	1860	20	1000
4	Overhead Closeup	0	-60	4520	50	1000
5	Onboard – Driver Front				16	1000
6	Onboard – Driver Side				8	1000
7	Onboard – Driver Rear				8	1000
8	Rear Ground Level	-5600	30	1670	24	1000
9	Impact Side 45° Rearward	-4130	3510	1850	20	1000
10	Overhead Wide	0	-290	4610	14	1000

## DATA SHEET NO. 9

### TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011



Loc. No.	Accelerometer Location			
	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2415	420	-165
2	Left Floor Sill	2550	-725	-190
3	A Pillar Sill	2998	-725	-178
4	A Pillar Low	2926	-685	-496
5	A Pillar Mid	2975	-805	-754
6	B Pillar Sill	1930	-725	-185
7	B Pillar Low	1865	-699	-520
8	B Pillar Mid	1852	-710	-760
9	Seat	1921	-550	-280
10	Engine	3669	70	-782
11	Firewall	3423	0	-881
12	Roof	2116	580	-1415
13	Floor Sill	2129	725	-190
14	Rear Deck	290	0	-365

Reference: X – Test Vehicle Rear Bumper (+ forward)  
 Y – Test Vehicle Centerline (+ to right)  
 Z – Ground Plane (+ down)

**DATA SHEET NO. 10**

**TEST VEHICLE ACCELEROMETER DATA SUMMARY**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

Loc. No.	Description	Peak Values (g's)			
		Max	Time (ms)	Min	Time (ms)
1	Vehicle CG (X)	2.8	100.0	-6.0	37.6
	Vehicle CG (Y)	17.2	32.7	-0.9	171.8
	Vehicle CG (Z)	4.7	37.2	-4.7	31.3
	Resultant	18.2	32.7		
2	Left Floor Sill (Y)	73.6	17.4	-57.0	34.4
3	A Pillar Sill (Y)	25.9	30.0	-4.1	35.3
4	A Pillar Low (Y)	38.8	13.5	-7.4	26.8
5	A Pillar Mid (Y)	30.2	41.9	-8.2	34.9
6	B Pillar Sill (Y)	59.3	24.8	-25.5	15.7
7	B Pillar Low (Y)	26.8	43.3	-18.7	16.3
8	B Pillar Mid (Y)	88.0	15.3	-5.0	60.7
9	Seat (Y)	(1)	(1)	(1)	(1)
10	Engine (X)	9.6	92.7	-11.4	46.0
	Engine (Y)	14.0	58.8	-6.3	27.9
11	Firewall (Y)	14.0	40.5	-1.7	28.1
12	Roof (Y)	17.9	55.9	-1.3	282.5
13	Floor Sill (Y)	17.9	39.6	-1.0	163.4
14	Rear Deck (X)	4.0	122.6	-7.4	67.1
	Rear Deck (Y)	21.1	41.0	-1.8	146.9

<sup>(1)</sup> No valid data collected for Driver Seat Back Y after 5 msec.



**DATA SHEET NO. 11**  
**DUMMY INJURY RESPONSE DATA**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
Test Date: 9/21/2011

Dummy S/N 262	Positive		Negative	
	MAX	TIME (ms)	MAX	TIME (ms)
<b>HEAD ACCELERATION (G)</b>				
Longitudinal (X)	7.9	118.8	16.4	56.5
Lateral (Y)	37.4	58.3	10.2	116.5
Vertical (Z)	17.1	36.5	3.4	87.3
Resultant (R)	40.9	57.3		
HIC36 (t1, t2)	198		t1 = 39.8	t2 = 73.6
<b>THORAX DEFLECTION (mm)</b>				
Upper Rib			19.6	39.1
Middle Rib			14.8	39.9
Lower Rib			15.6	37.3
<b>ABDOMINAL DEFLECTION (mm)</b>				
Upper Rib			16.4	48.9
Lower Rib			27.1	48.8
<b>LOWER SPINE RESULTANT (mm)</b>				
Longitudinal (X)	8.8	50.4	11.2	30.6
Lateral (Y)	39.7	36.5	10.0	77.6
Vertical (Z)	10.8	24.0	12.3	47.5
Resultant (R)	40.3	36.4		
<b>PELVIS FORCE (N)</b>				
Iliac	1152.1	37.4		
Acetabulum	1913.7	46.4		
Sum	2975.5	46.4		

Reference: Positive Direction -Longitudinal (X) = forward  
-Lateral (Y) = to right  
-Vertical (Z) = down

**DATA SHEET NO. 12**  
**POST TEST OBSERVATIONS**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
Test Date: 9/21/2011

**TEST DUMMY INFORMATION AND CONTACT**

Description	Front Occupant
Dummy Type / Serial No.	SID-IIs / 262
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
Right Side Doors	Remained closed and operational	Remained closed and operational
Hatch and Other Doors		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 Cracked
Other Notable Effects	None

**SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION**

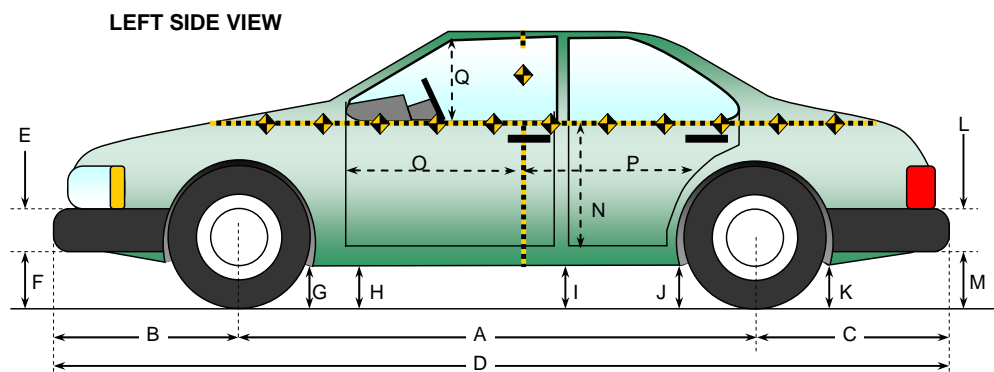
Restraint Type	Front Occupant	
	Installed	Operated
Frontal Airbag	Yes	No
Side Torso/Abdoment/Pelvis Airbag	Yes	Yes
Head Airbag	No	
Curtain Airbag	Yes	Yes
Knee Airbag	Yes	No
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	

## DATA SHEET NO. 13

### VEHICLE PRE TEST AND POST TEST MEASUREMENTS

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

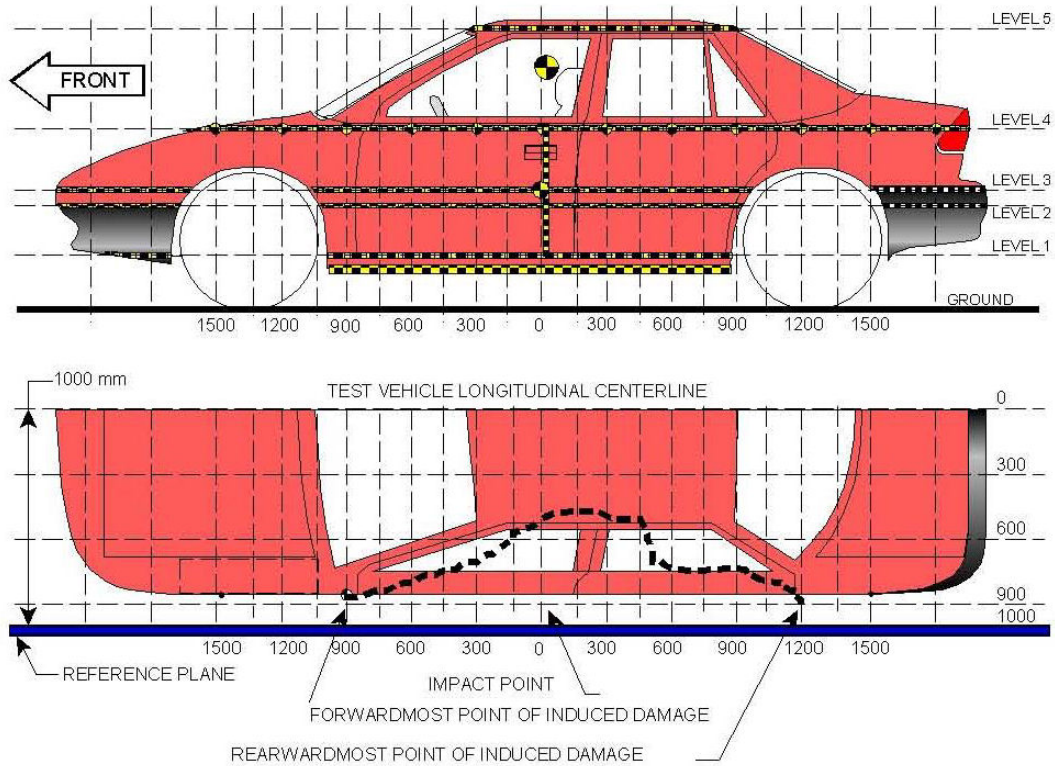


Code	Measurement Description	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	Wheelbase	2685	2618	67
B	Front Axle to FSOV	1012	1012	0
C	Rear Axle to RSOV	828	827	1
D	Total Vehicle Length at Centerline	4525	4457	68
E	Front Bumper Thickness	190	190	0
F	Front Bumper Bottom to Ground	207	235	-28
G	Sill Height at Front Wheel Well	168	174	-6
H	Sill Height at Front Door Leading Edge	170	183	-13
I	Sill Height at B Pillar	176	192	-16
J1	Sill Height at Rear Wheel Well	176	186	-10
J2	Pinch Weld Height at Rear Wheel Well	173	187	-14
K	Sill Height Aft of Rear Wheel Well	226	220	6
L	Rear Bumper Thickness	100	100	0
M	Rear Bumper Bottom to Ground	247	242	5
N	Sill Height to Window Bottom Sill	748	775	-27
O	Front Door Leading Edge to Impact CL	664	660	4
P	Rear Door Trailing Edge to Impact CL	1236	1276	-40
Q	Front Window Opening	370	329	41
R	Right Side Length	3447	3454	-7
S	Left Side Length	3447	3361	86
T	Vehicle Width at B Post	1785	1705	80

**DATA SHEET NO. 14**  
**EXTERIOR CRUSH MEASUREMENTS**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011



NOTE: All measurements are in millimeters (mm)

**Maximum Exterior Crush Measurements**

Level	Measurement Description	Maximum Exterior Static Crush	Distance from Impact	Height Above Ground (mm)
1	Sill Top	317	0	226
2	Occupant H-Point	354	0	531
3	Mid-Door	357	0	624
4	Window Sill	344	0	862
5	Window Top	126	0	1353

## DATA SHEET NO. 15

### VEHICLE EXTERIOR CRUSH PROFILES

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

	Level 1	Level 2	Level 3	Level 4	Level 5
Maximum Crush (mm)	317	354	357	344	126
Distance From Impact (mm)	0	0	0	0	0

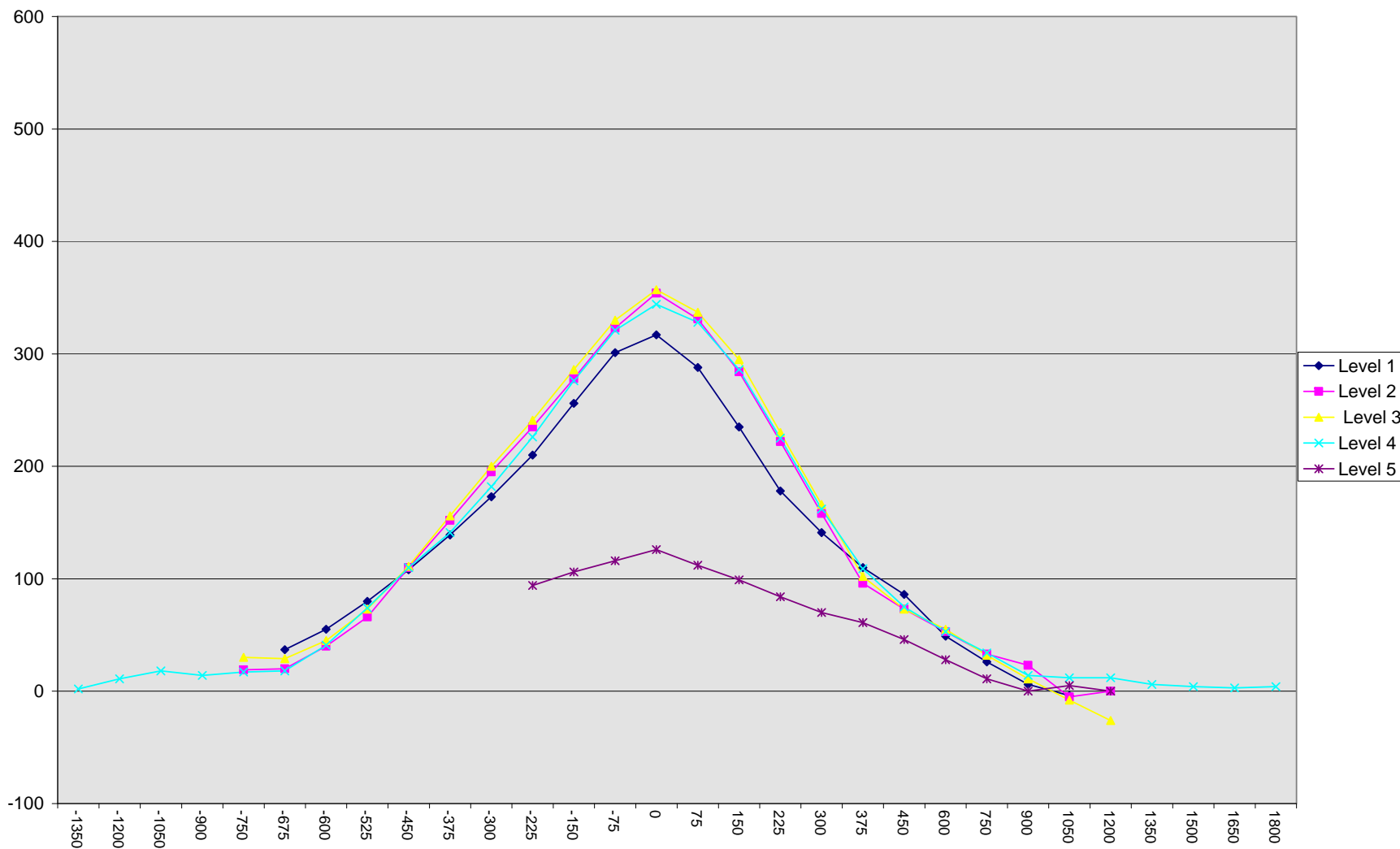
	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1350				263					265					2	
-1200				245					256					11	
-1050				240					258					18	
-900				244					258					14	
-750		212	212	241			231	242	258			19	30	17	
-675	238	214	220	239		275	234	249	257		37	20	29	18	
-600	237	223	222	236		292	263	267	277		55	40	45	41	
-525	237	227	223	236		317	293	296	310		80	66	73	74	
-450	236	226	221	234		344	336	332	344		108	110	111	110	
-375	236	224	220	235		375	376	376	376		139	152	156	141	
-300	236	223	218	234		409	418	418	416		173	195	200	182	
-225	236	222	217	233	506	446	457	458	459	600	210	235	241	226	94
-150	236	220	216	233	504	492	498	502	509	610	256	278	286	276	106
-75	236	219	215	233	503	537	542	545	554	619	301	323	330	321	116
0	235	218	215	234	503	552	572	572	578	629	317	354	357	344	126
75	235	217	214	234	502	523	548	551	562	614	288	331	337	328	112
150	235	217	214	234	504	470	501	509	520	603	235	284	295	286	99
225	234	216	213	235	504	412	438	443	460	588	178	222	230	225	84
300	234	216	213	235	507	375	374	379	397	577	141	158	166	162	70
375	234	216	213	237	507	344	312	315	346	568	110	96	102	109	61
450	234	215	213	238	509	320	288	286	313	555	86	73	73	75	46
600	234	214	212	241	511	283	267	267	294	539	49	53	55	53	28
750	233	213	213	245	512	259	246	245	279	523	26	33	32	34	11
900	233	212	214	249	516	239	235	225	263	516	6	23	11	14	0
1050	233	212	214	253	522	229	207	206	265	527	-4	-5	-8	12	5
1200		211	210	259	530		211	184	271	530		0	-26	12	0
1350				265					271					6	
1500				273					277					4	
1650				281					284					3	
1800				290					294					4	

**DATA SHEET NO. 15 (CONTINUED)**  
**VEHICLE EXTERIOR CRUSH PROFILES**

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
Test Date: 9/21/2011

18



## DATA SHEET NO. 16

### SUMMARY OF FMVSS 301 FUEL SYSTEM DATA

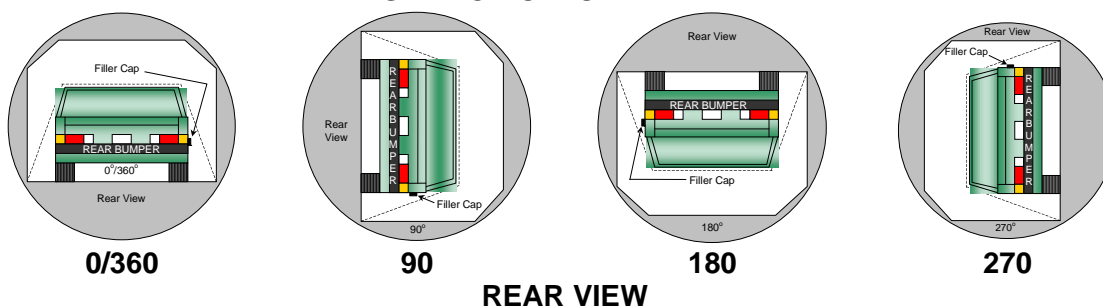
Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

#### FUEL SYSTEM INTEGRITY POST IMPACT DATA

Time Interval	FMVSS 301 Maximum Allowable Spillage	Spillage (g)
Impact Until Motion Ceases	28 g	0
First Five Minutes Following Impact	142 g	0
Next 25 Minutes	28 g / 1 minute	0

#### STATIC ROLLOVER DATA



**REAR VIEW**

Rollover Stage	Rotation Time (spec. 1-3 min)				FMVSS 301 Hold Time		Total Time				Next Whole Minute Interval	
0° - 90°	1	minutes	59	seconds	5	minutes	6	minutes	59	seconds	7	minutes
90° - 180°	1	minutes	53	seconds	5	minutes	6	minutes	53	seconds	7	minutes
180° - 270°	1	minutes	49	seconds	5	minutes	6	minutes	49	seconds	7	minutes
270° - 360°	1	minutes	58	seconds	5	minutes	6	minutes	58	seconds	7	minutes

Rollover Stage	Spillage (g)			
	First 5 min. from onset of rotation	6 <sup>th</sup> min.	7 <sup>th</sup> min.	8 <sup>th</sup> min. (if required)
0° - 90°	0	0	0	
90° - 180°	0	0	0	
180° - 270°	0	0	0	
270° - 360°	0	0	0	
FMVSS 301 Maximum Allowable (for each 90° stage)	142	28	28	28

Rollover Stage	Spillage Location(s)
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

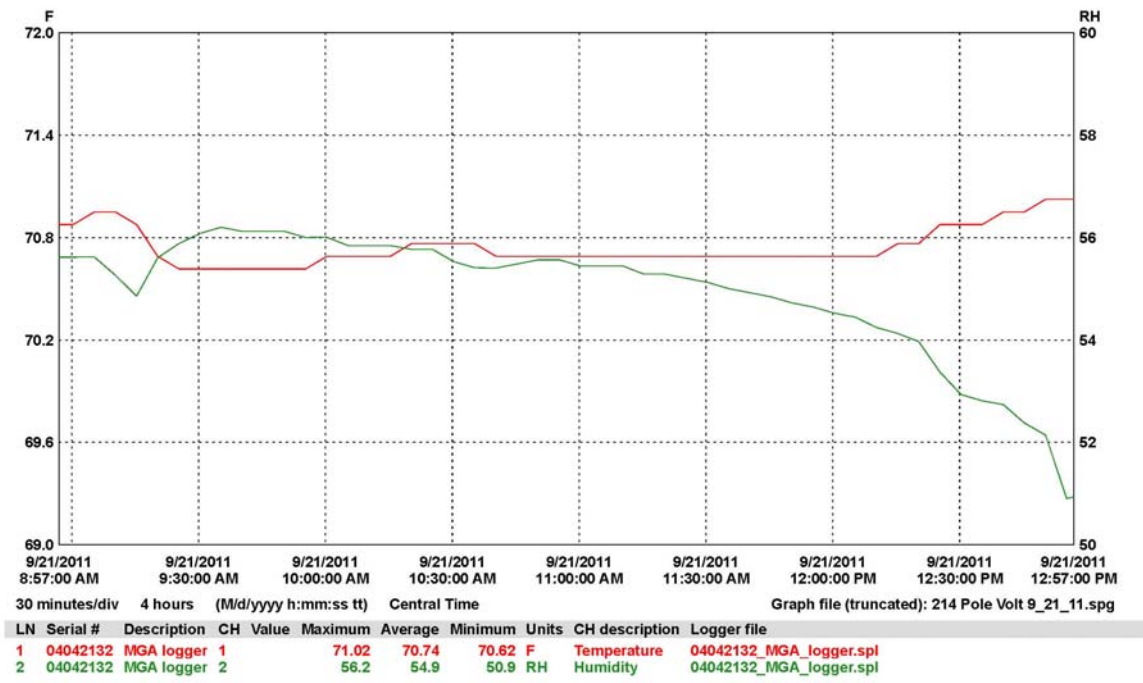
## DATA SHEET NO. 17

### TEMPERATURE AND HUMIDITY TRACES

Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback  
 Test Program: FMVSS 214 Pole

NHTSA No. CB0102  
 Test Date: 9/21/2011

Time of Impact: 12:57 pm





**APPENDIX A**  
**PHOTOGRAPHS**

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Pre-Test Frontal View of Test Vehicle



Post-Test Frontal View of Test Vehicle





Pre-Test Rear View of Test Vehicle



Post-Test Rear View of Test Vehicle



Pre-Test Impacted Side View of Test Vehicle



Post-Test Impacted Side View of Test Vehicle





Pre-Test Left  $\frac{3}{4}$  Front View of Vehicle and Pole



Pre-Test Left  $\frac{3}{4}$  Rear View of Vehicle and Pole





Pre-Test Overhead View of Test Vehicle



Post-Test Overhead View of Test Vehicle





Pre-Test Dummy Through Opposite Window



Post-Test Dummy Through Opposite Window





Pre-Test Close-up of Dummy with Door Closed (Impact Side)



Post-Test Dummy with Door Closed (Impact Side)



Pre-Test Dummy Door Open





Pre-Test Dummy Shoulder and Door Top View



Post-Test Dummy Shoulder and Door Top View



Pre-Test Interior of Front Door Closed



Post-Test Interior of Front Door Showing Dummy Impact Locations





Impact Event



Post-Test Impact Zone Close-up View





Post-Test  $\frac{3}{4}$  Front View of Impact Zone

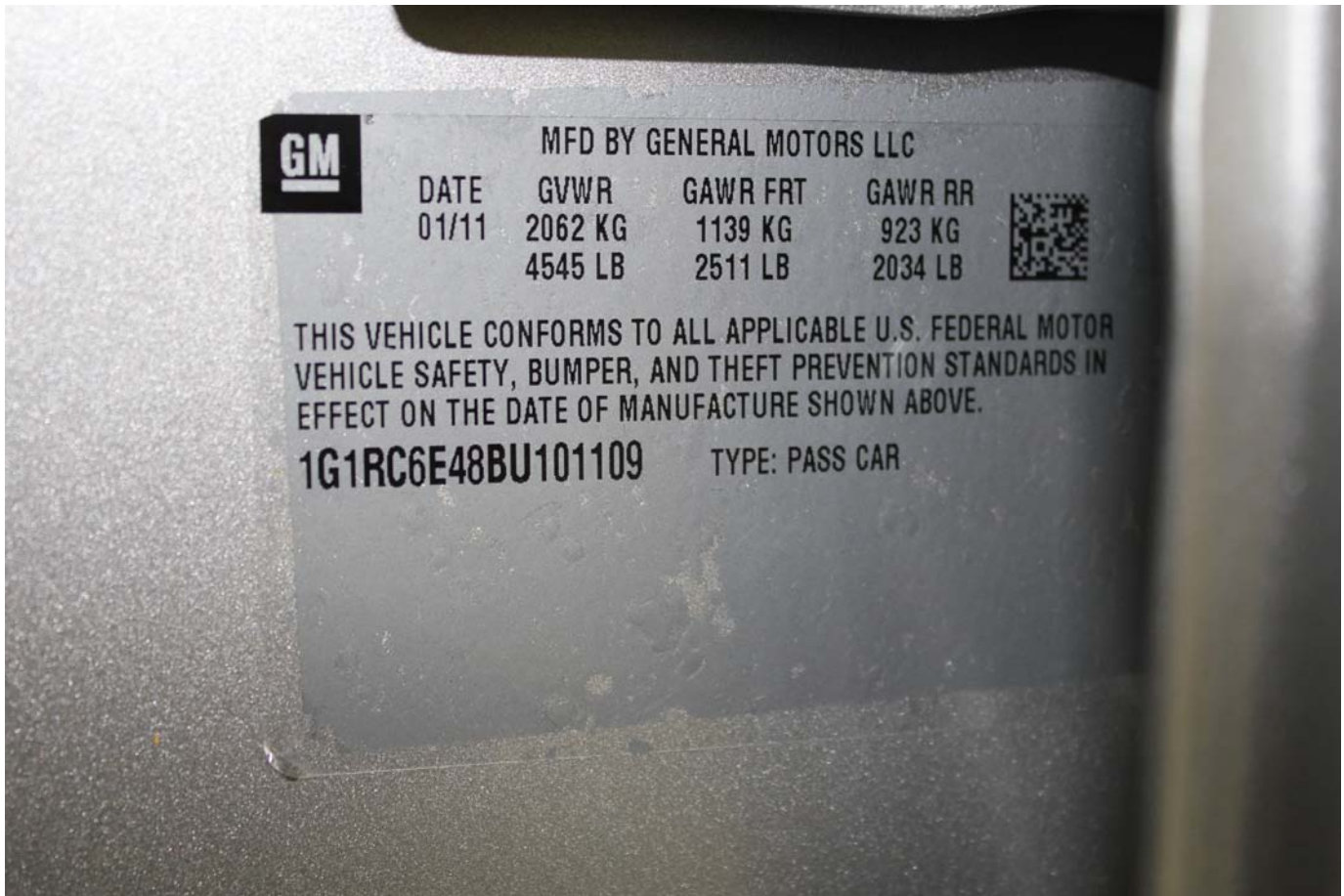


Post-Test  $\frac{3}{4}$  Rear View of Impact Zone



Post-Test Close-up View of Impact Point Target





Close-up View of Vehicle's Certification Label



Close-up View of Vehicle's Tire Placard Label



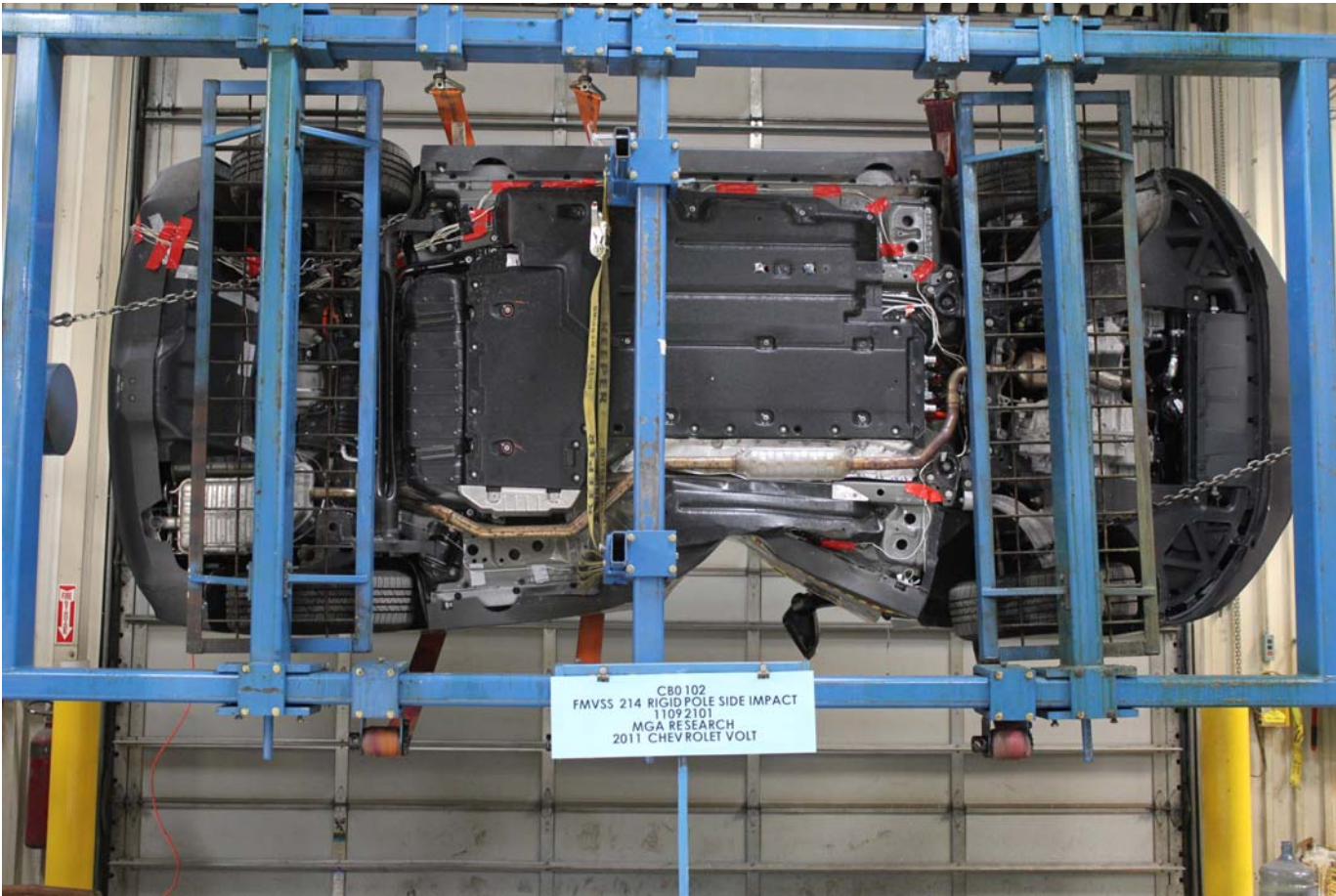


Post-Test Vehicle at 90 Degree Rollover



Post-Test Vehicle at 180 Degree Rollover





Post-Test Vehicle at 270 Degree Rollover



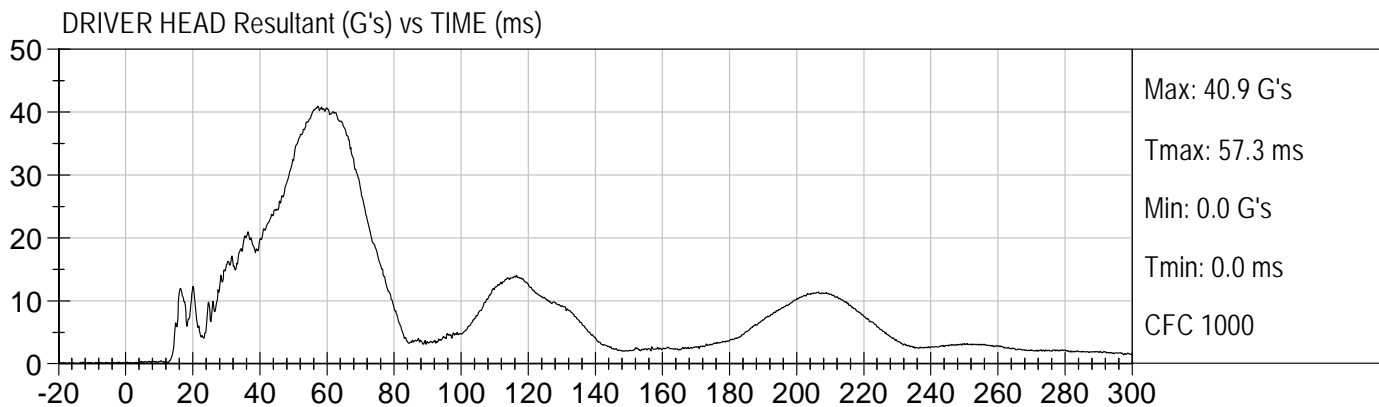
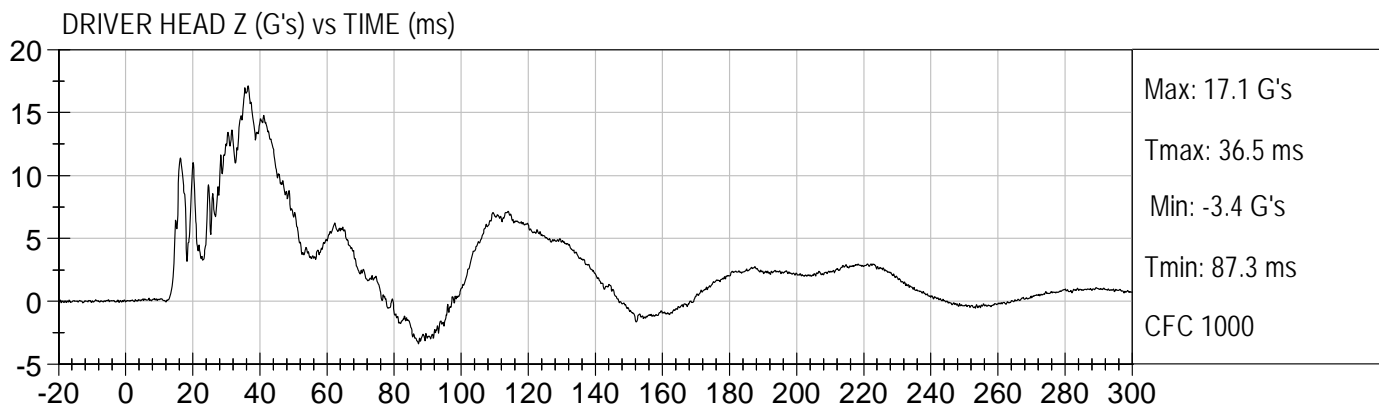
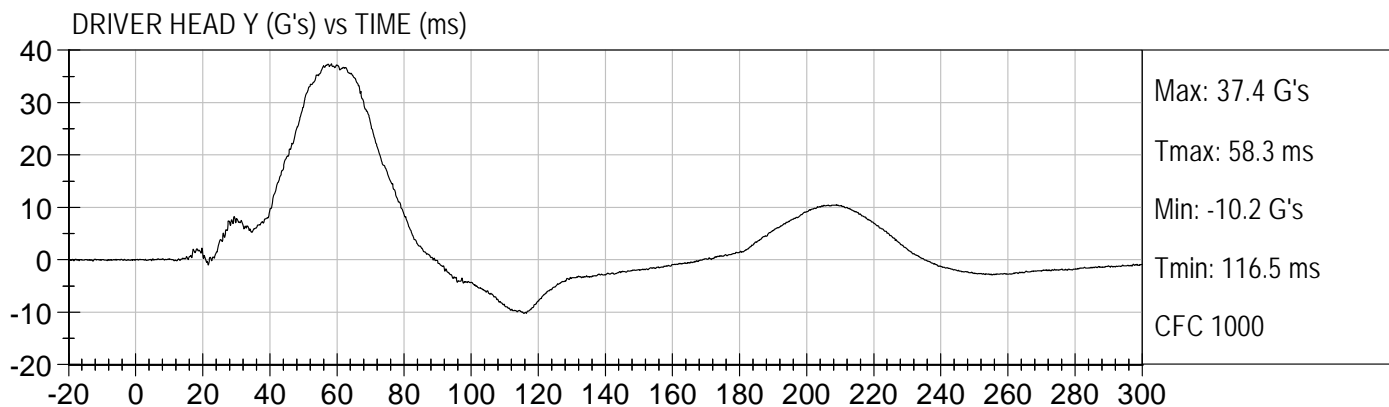
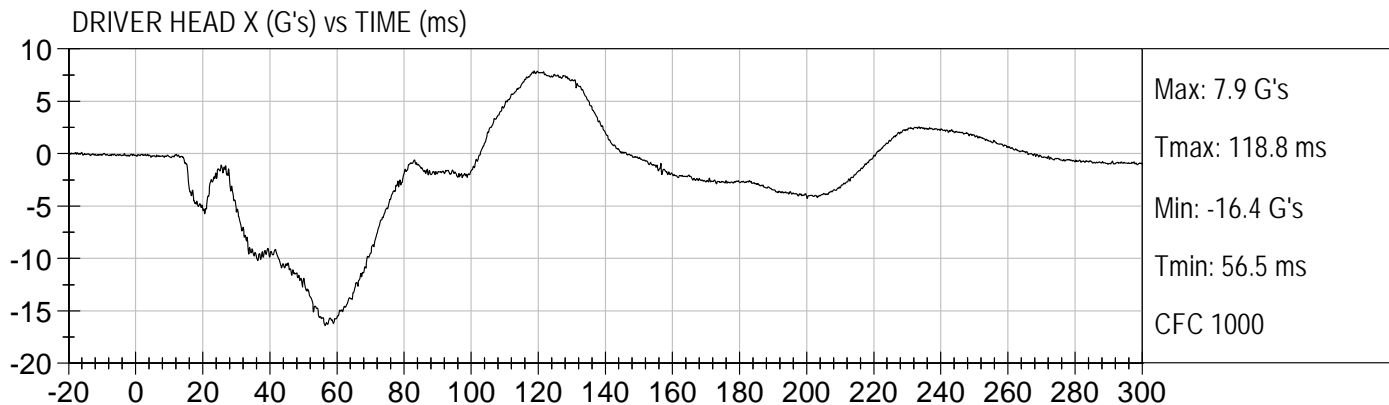
Post-Test Vehicle at 360 Degree Rollover

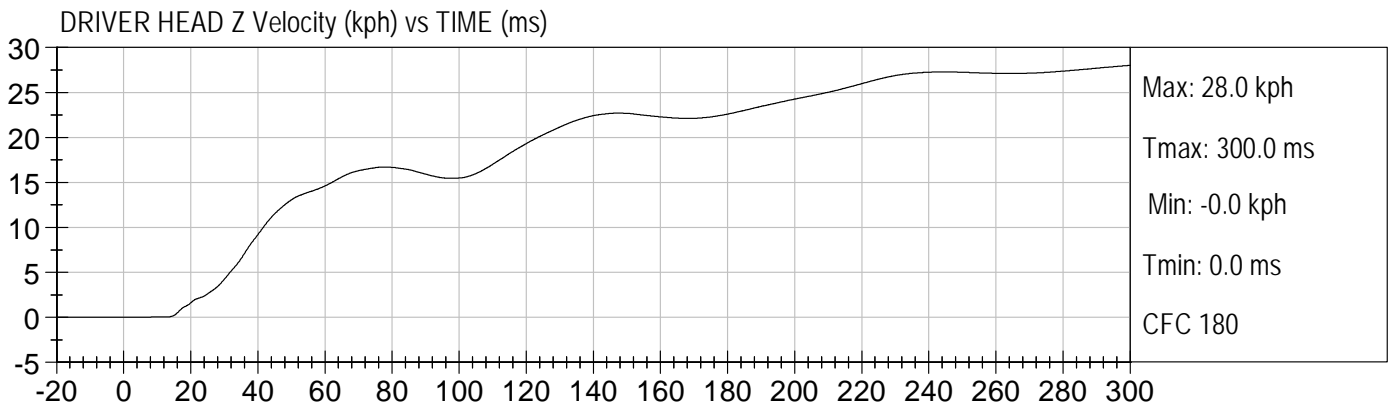
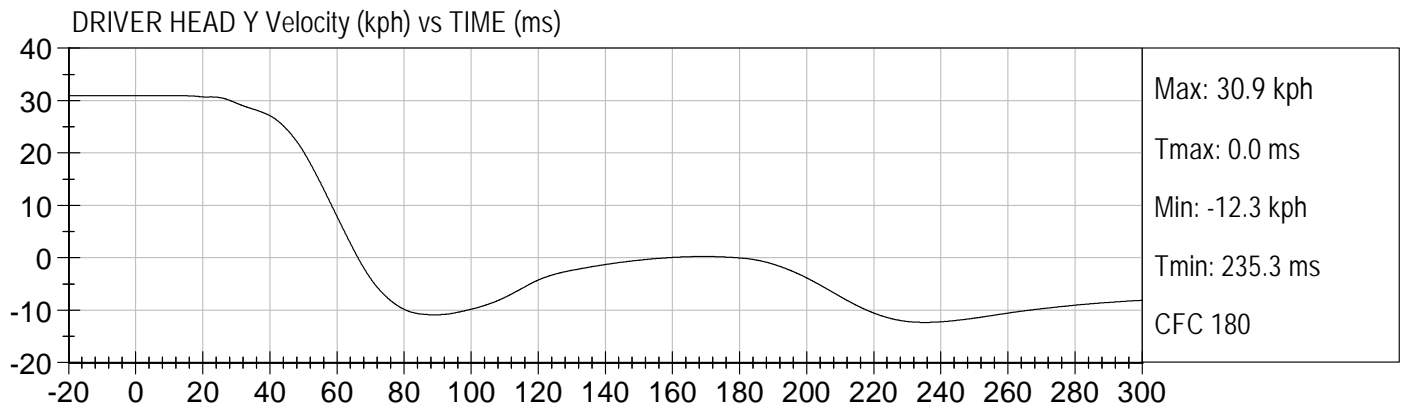
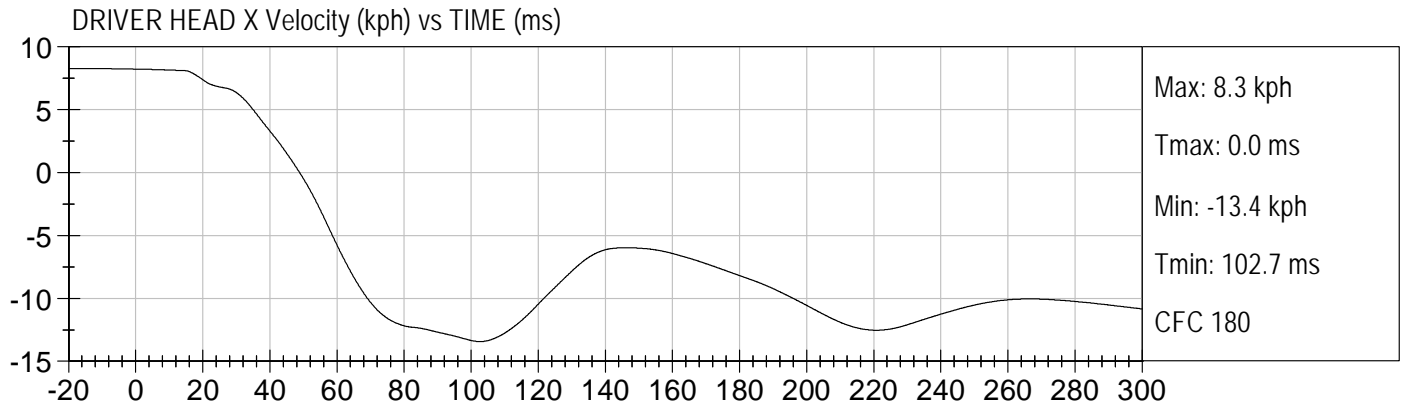
**APPENDIX B**  
**DUMMY RESPONSE DATA**

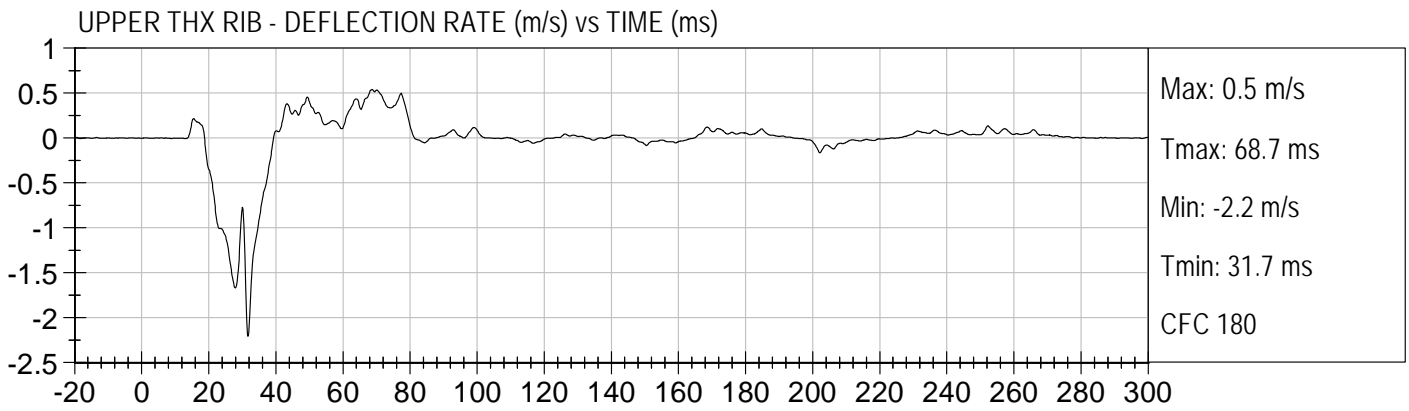
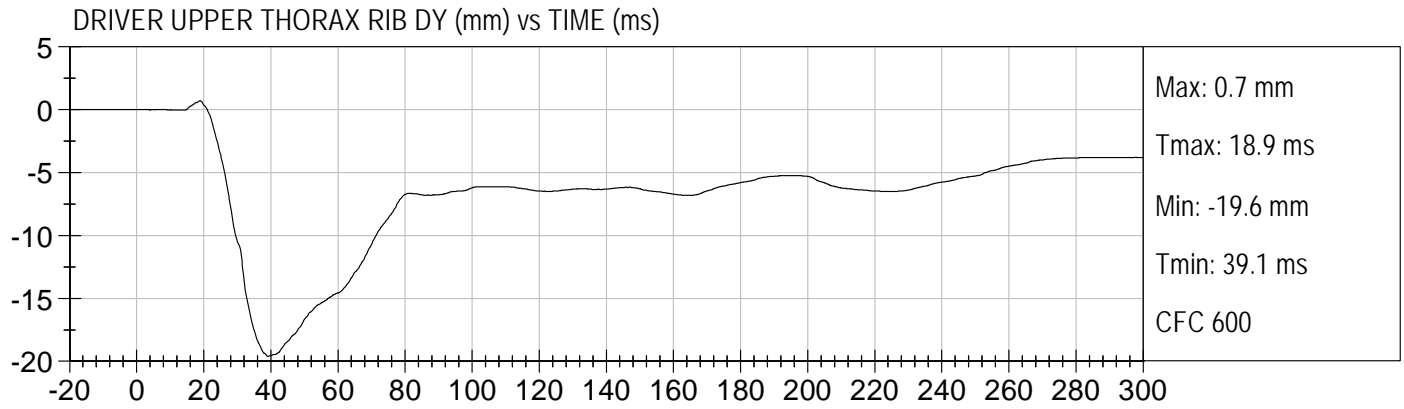
## TABLE OF DATA PLOTS

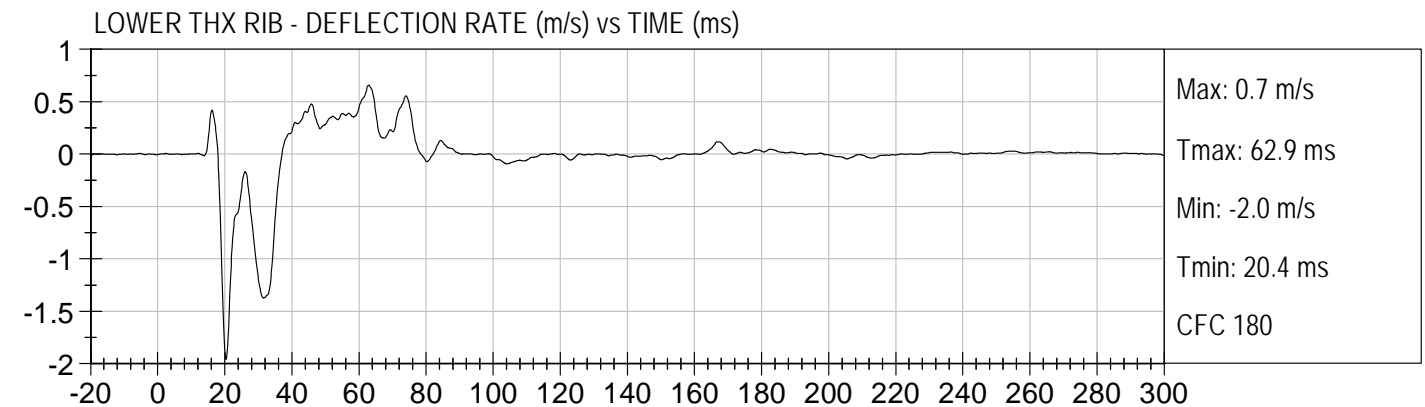
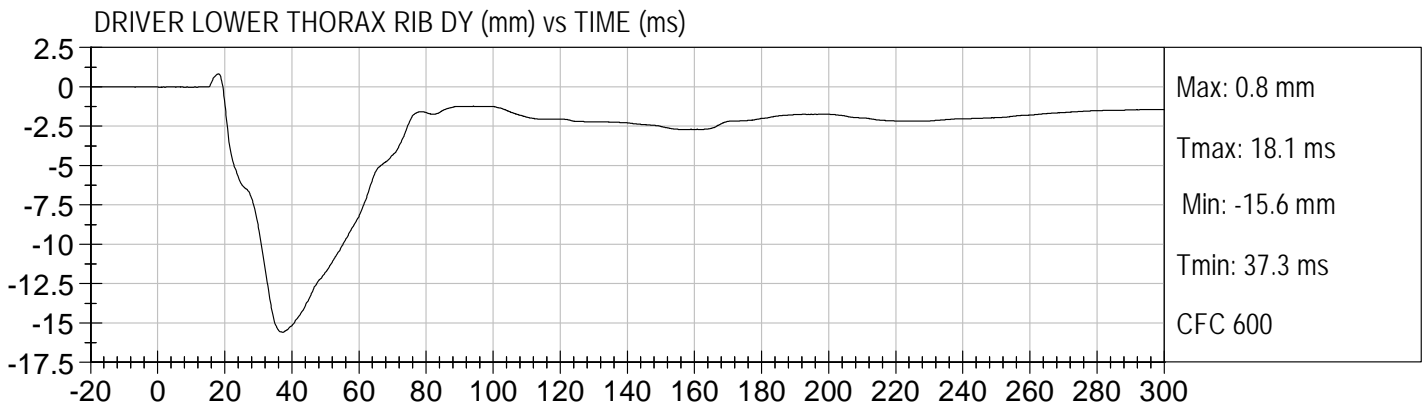
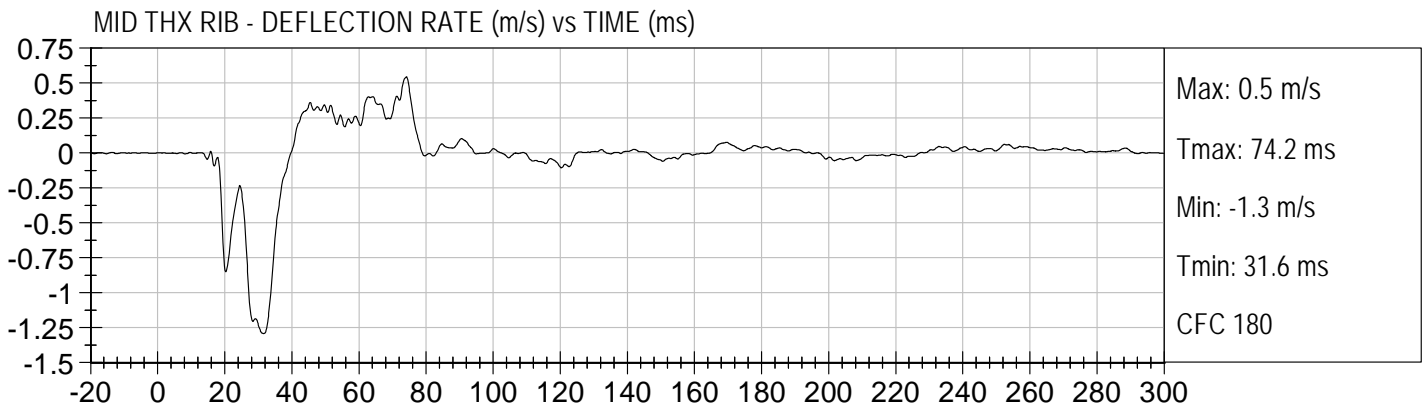
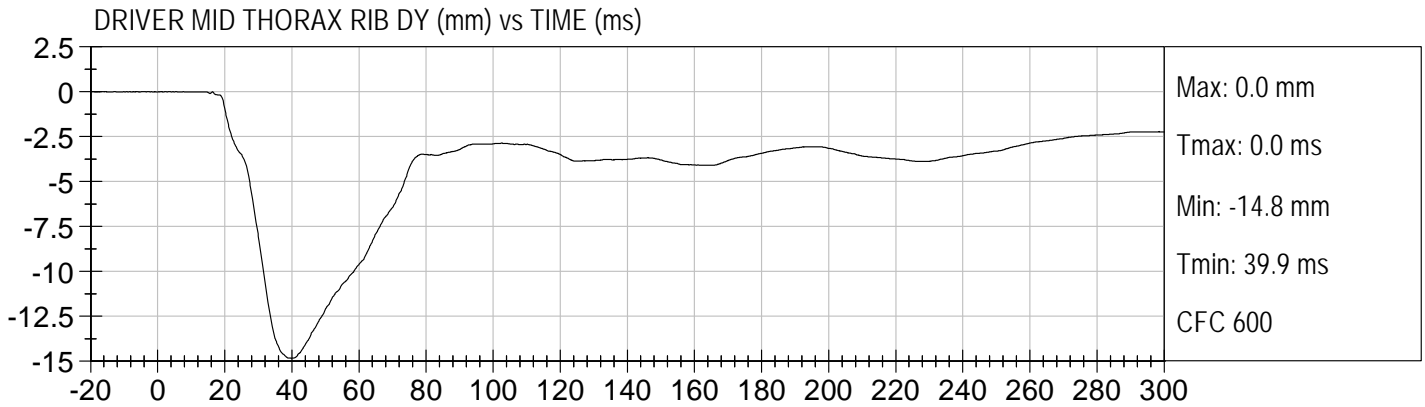
### Dummy Instrumentation Plots FILTERED DATA

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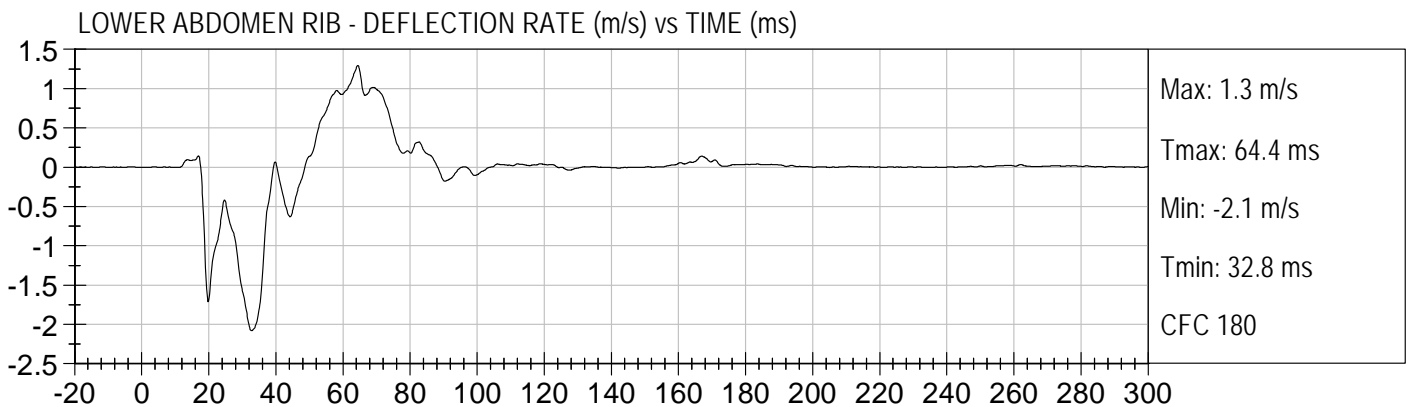
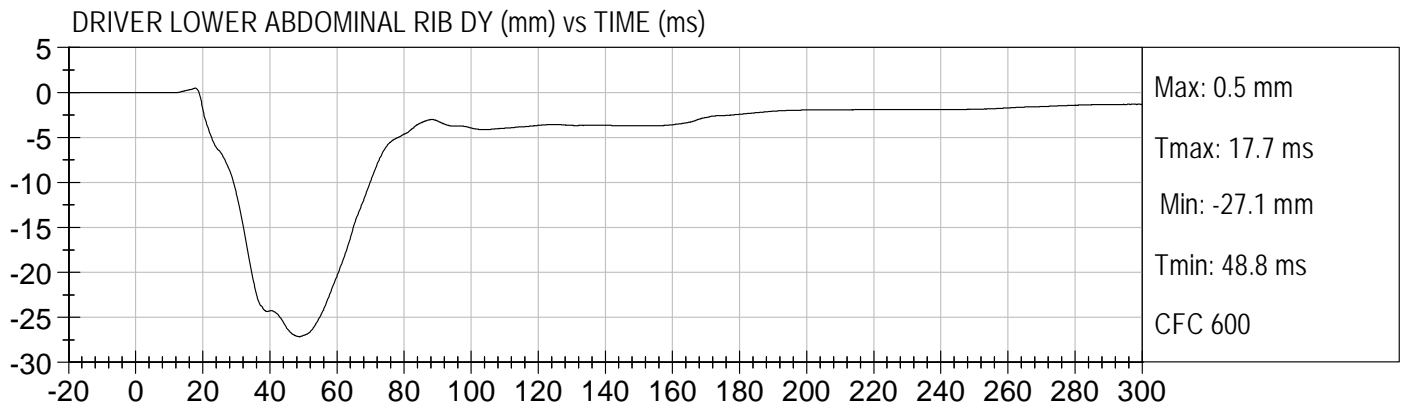
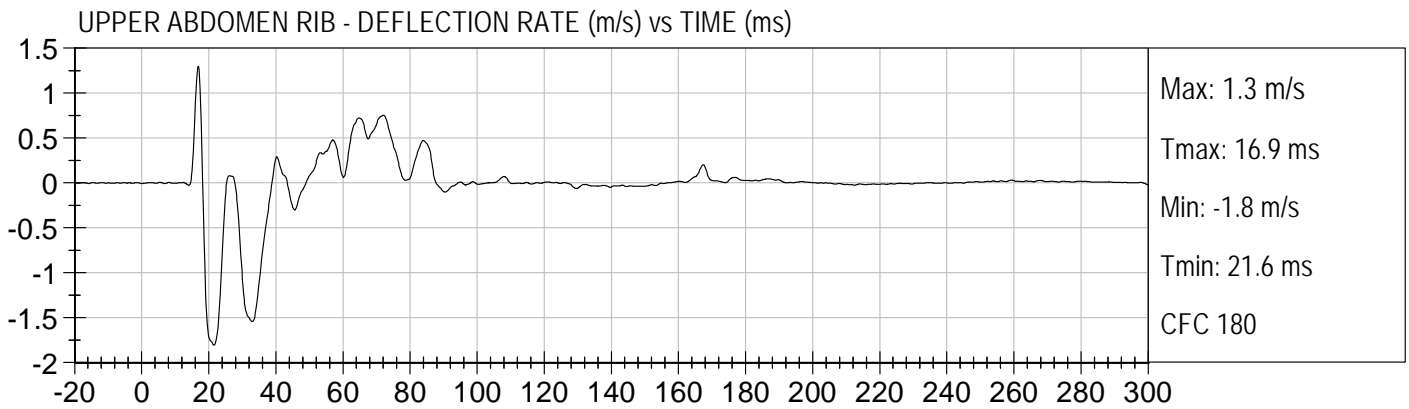
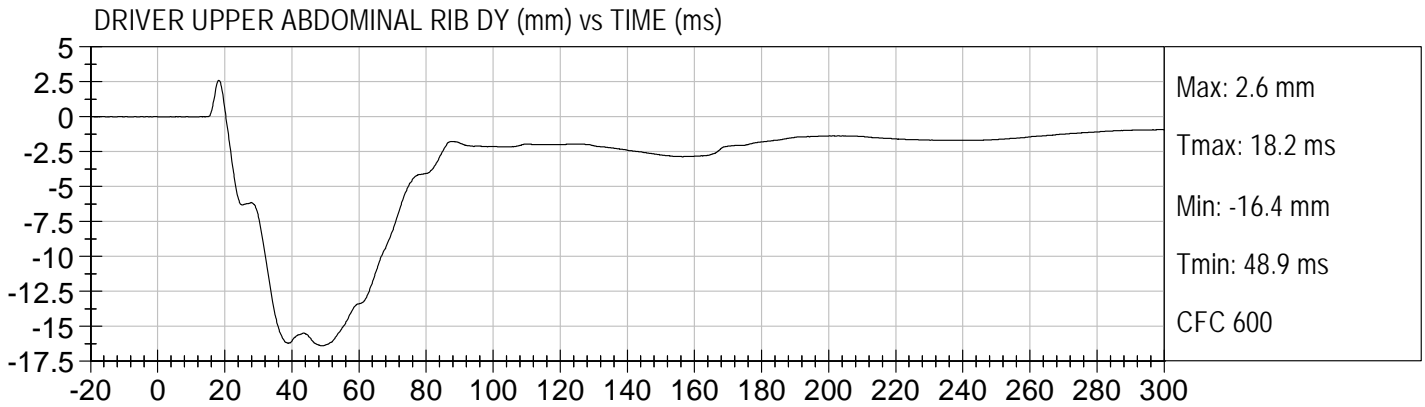


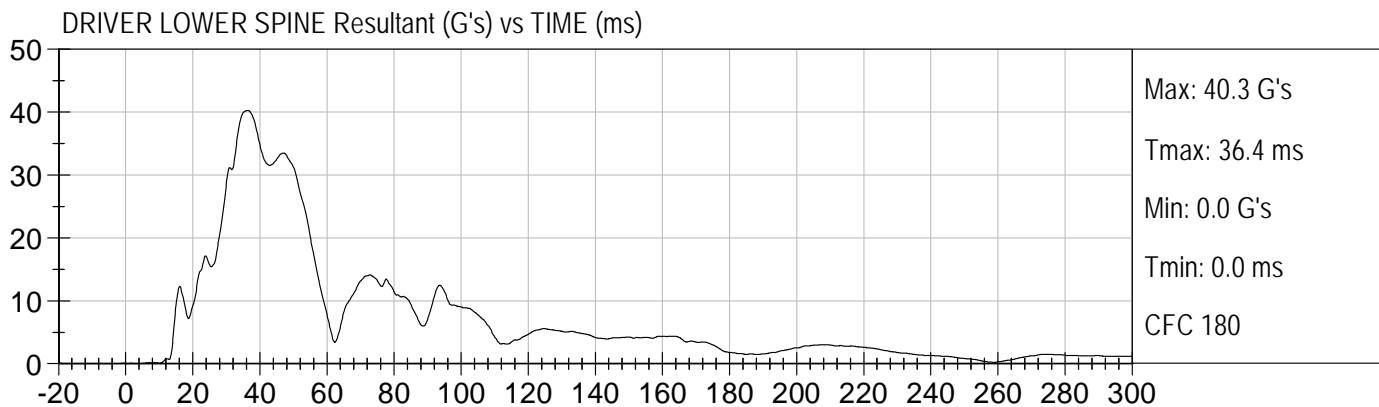
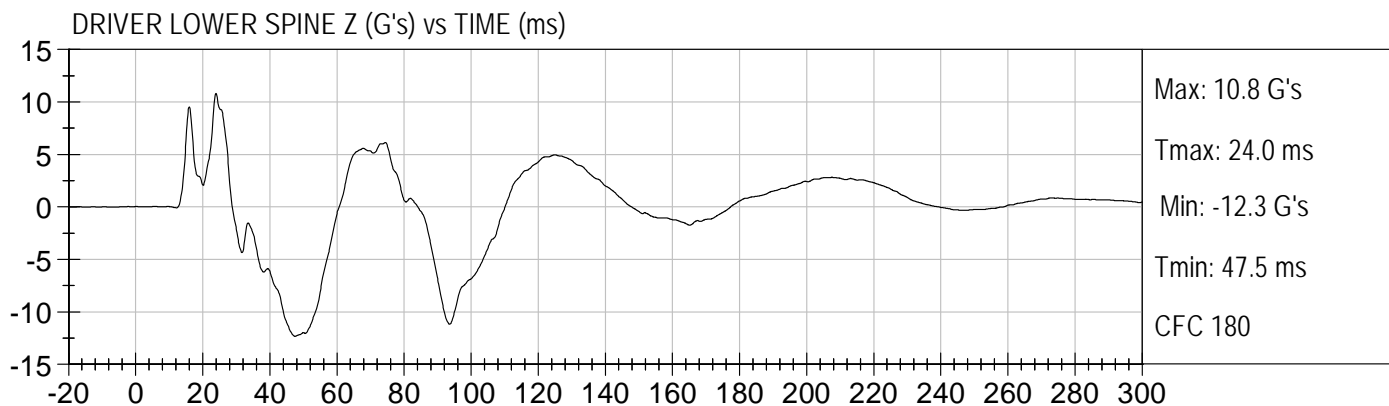
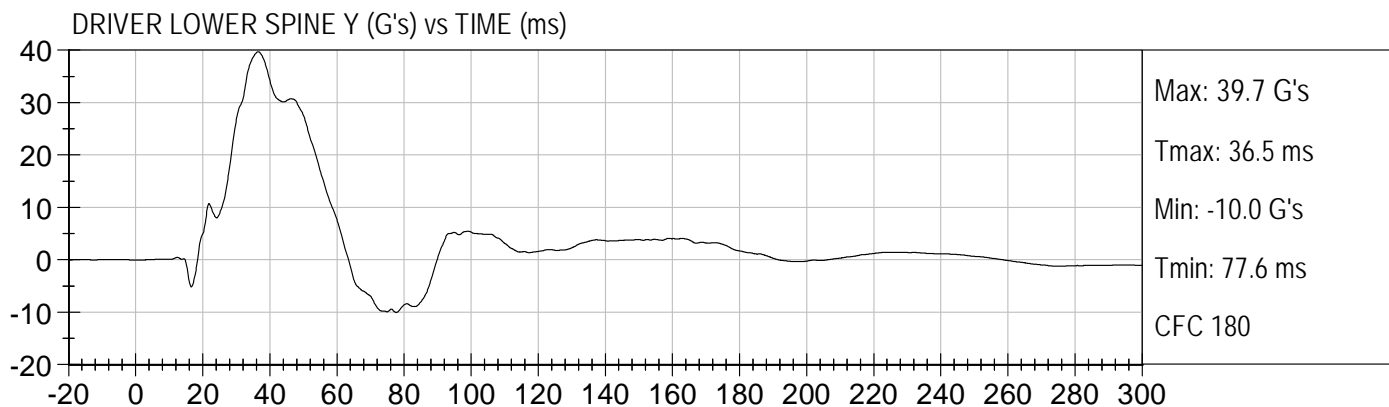
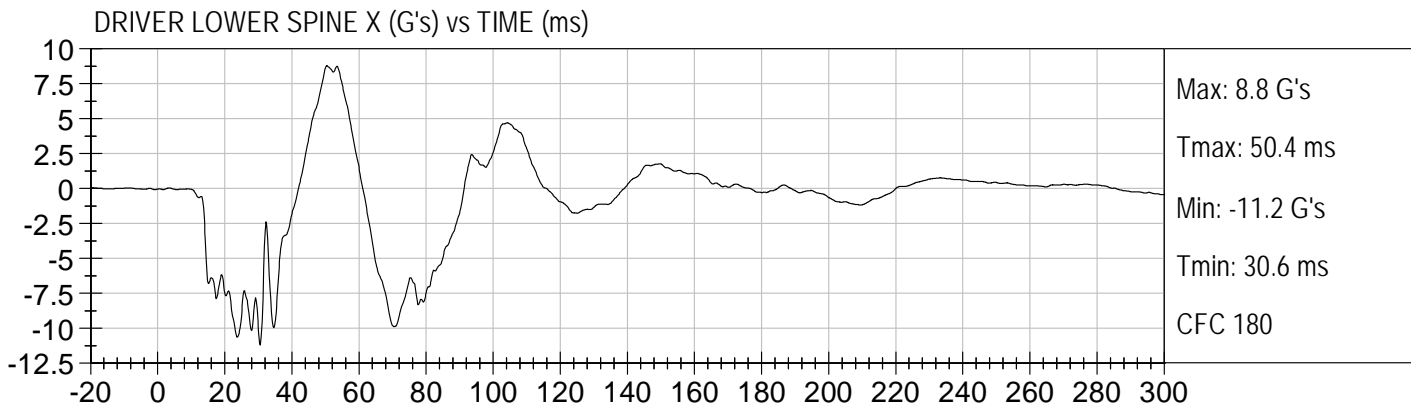


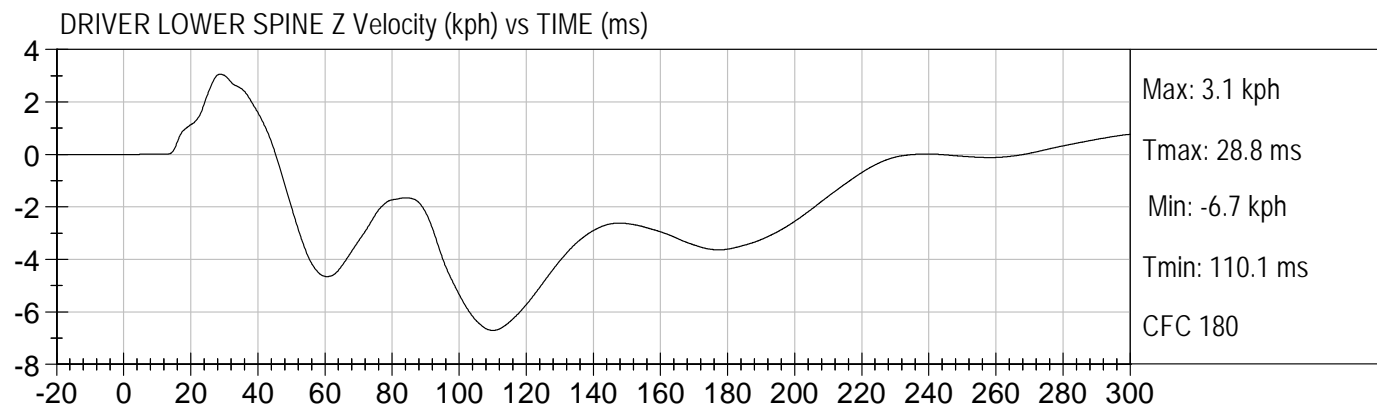
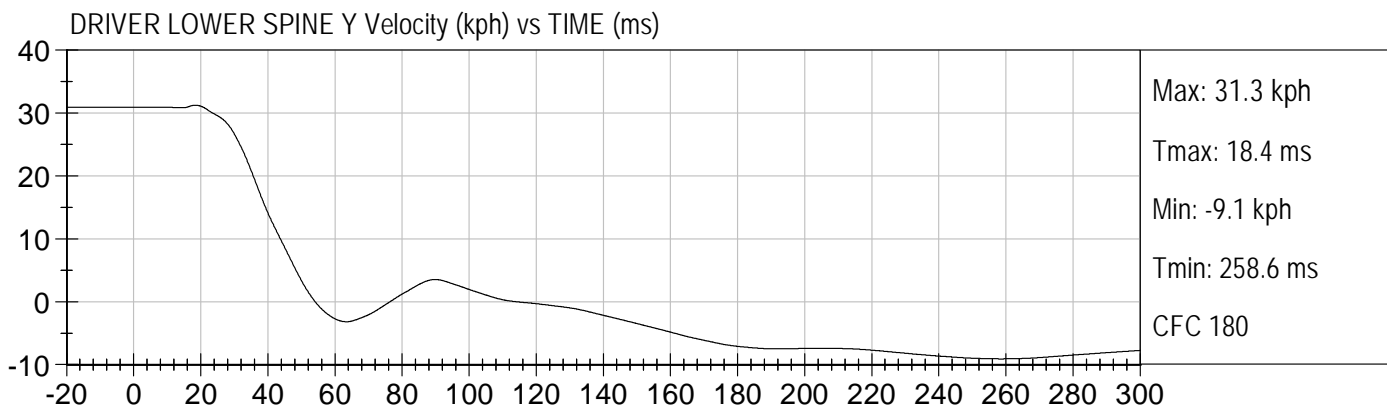
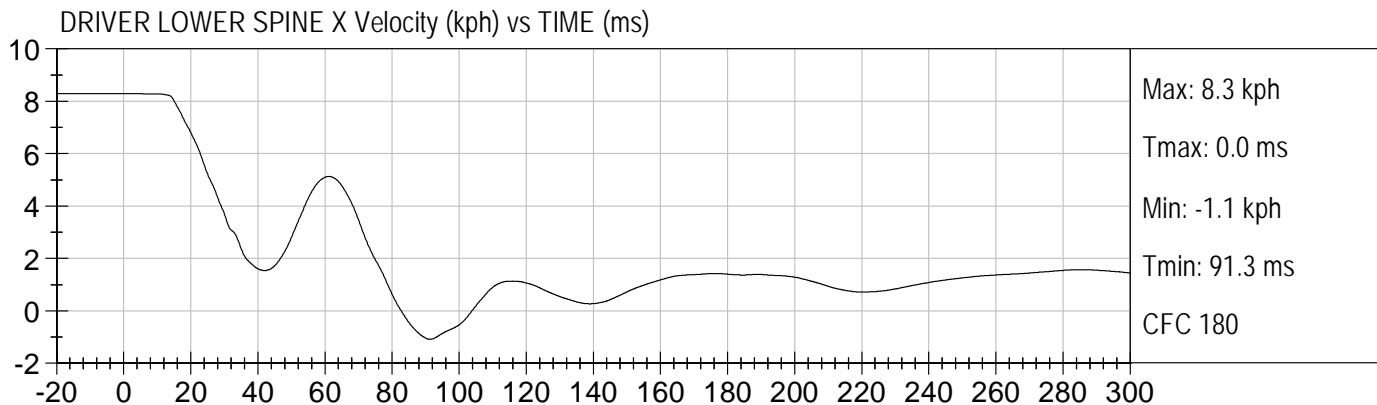


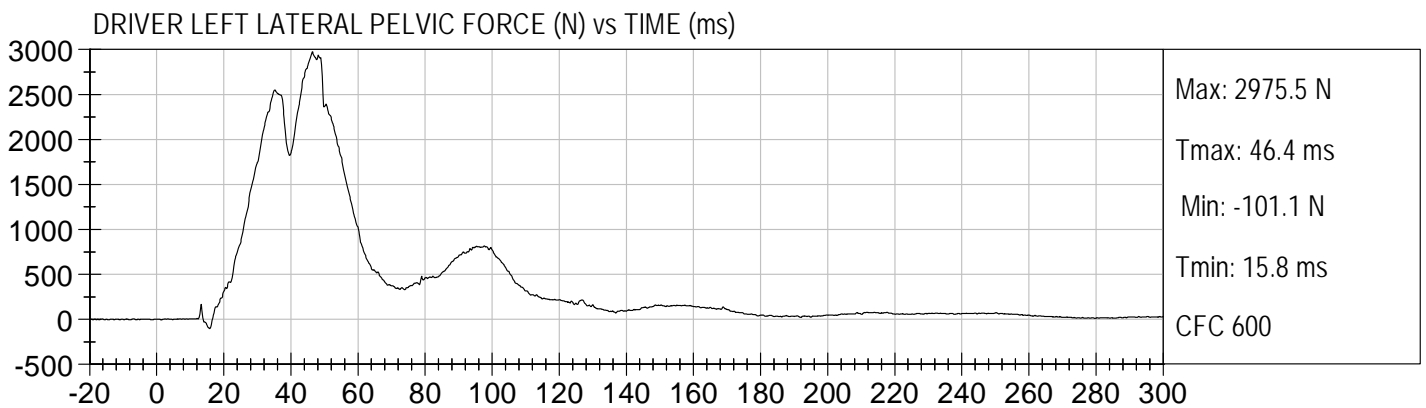
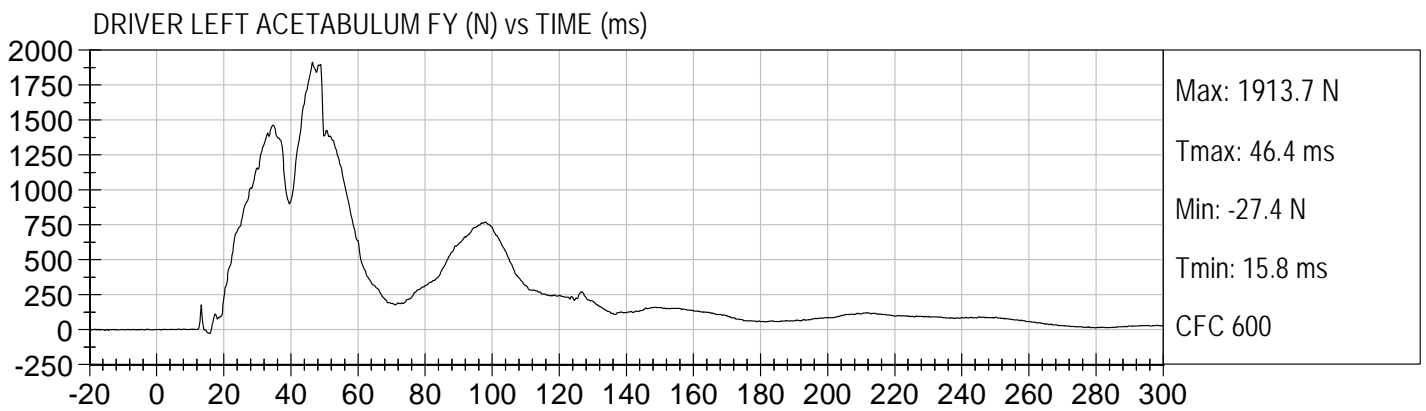
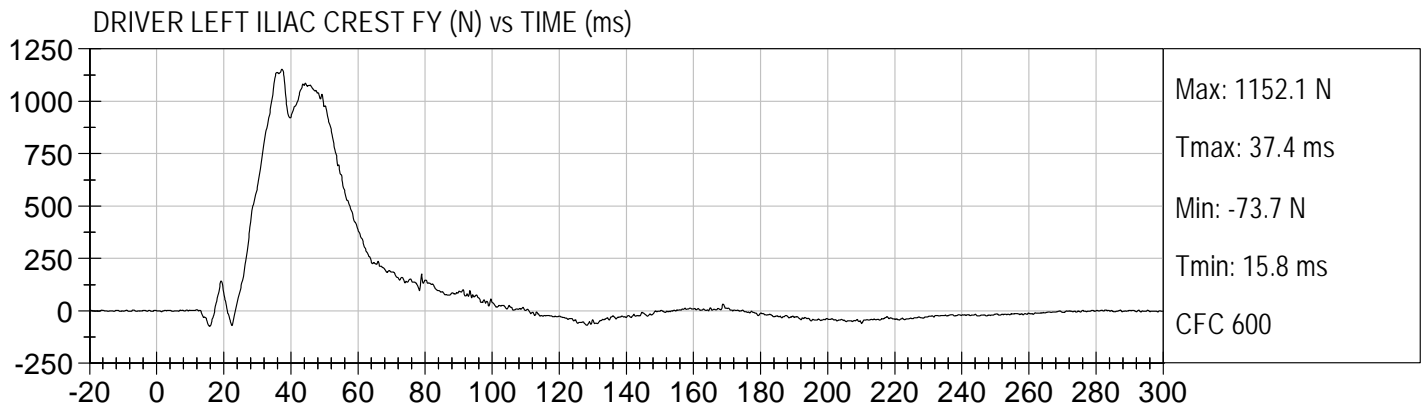












**APPENDIX C**

**VEHICLE ACCELEROMETER RESPONSE DATA**

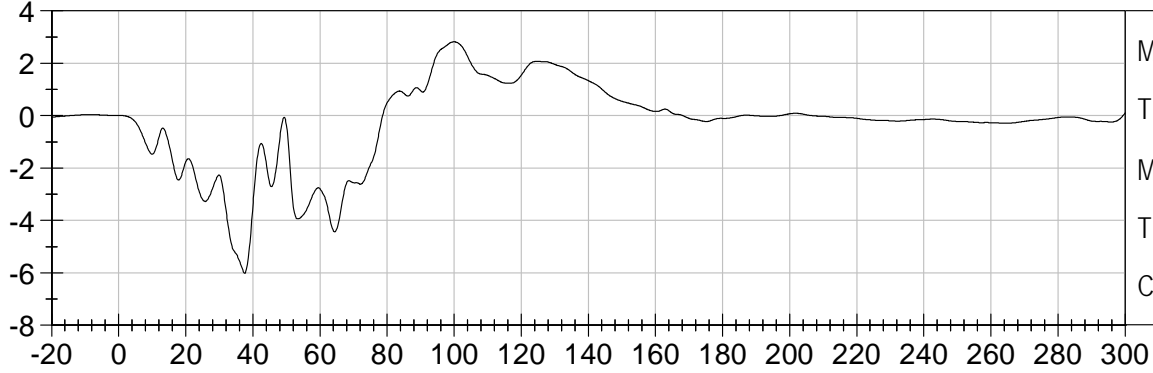
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Figure No. 41. Right Floor Sill (Y) Velocity vs. Time	C-13
Figure No. 42. Rear Deck (X) Acceleration vs. Time	C-14
Figure No. 43. Rear Deck (X) Velocity vs. Time	C-14
Figure No. 44. Rear Deck (Y) Acceleration vs. Time	C-14
Figure No. 45. Rear Deck (Y) Velocity vs. Time	C-14

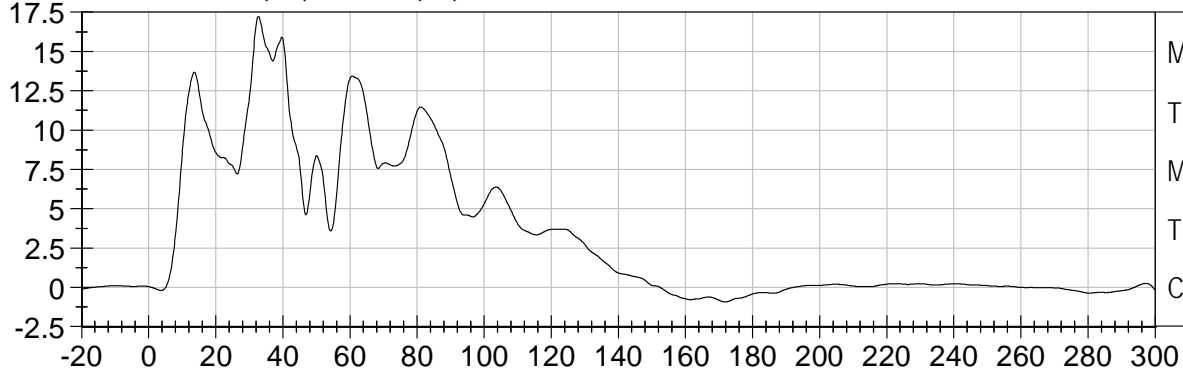


VEHICLE CG X (G's) vs TIME (ms)



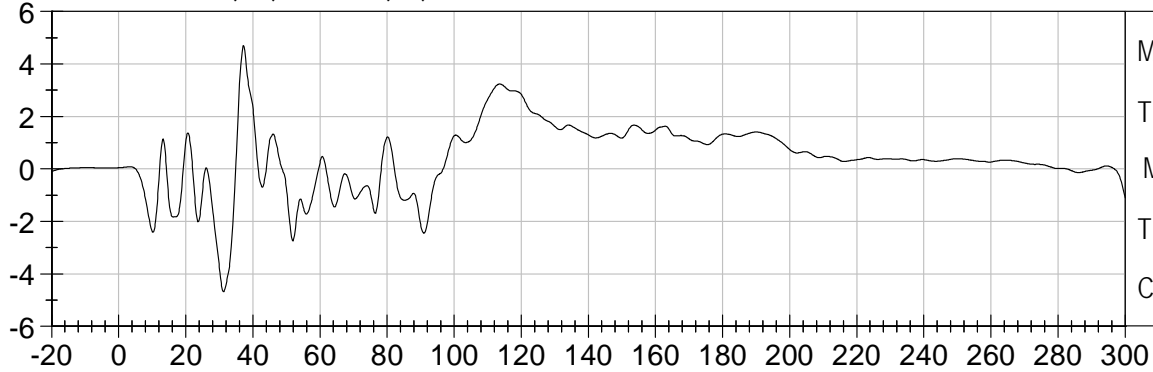
Max: 2.8 G's  
Tmax: 100.0 ms  
Min: -6.0 G's  
Tmin: 37.6 ms  
CFC 60

VEHICLE CG Y (G's) vs TIME (ms)



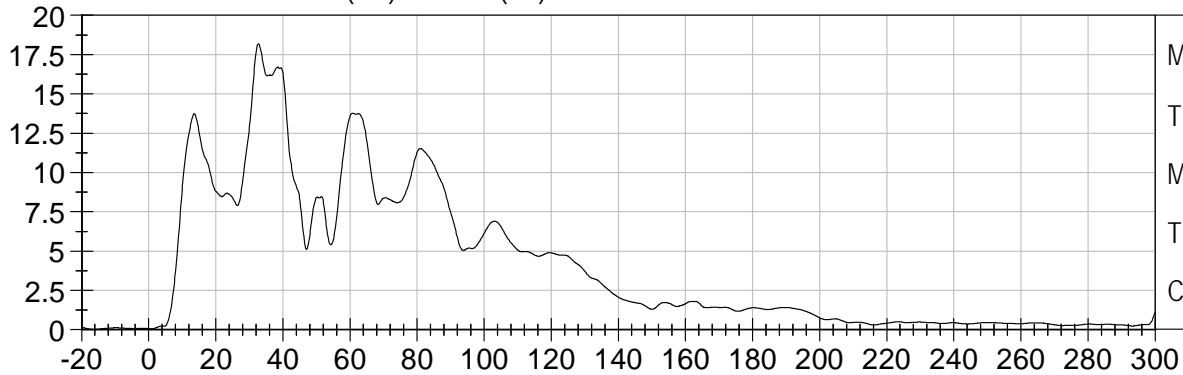
Max: 17.2 G's  
Tmax: 32.7 ms  
Min: -0.9 G's  
Tmin: 171.8 ms  
CFC 60

VEHICLE CG Z (G's) vs TIME (ms)



Max: 4.7 G's  
Tmax: 37.2 ms  
Min: -4.7 G's  
Tmin: 31.3 ms  
CFC 60

VEHICLE CG Resultant (G's) vs TIME (ms)

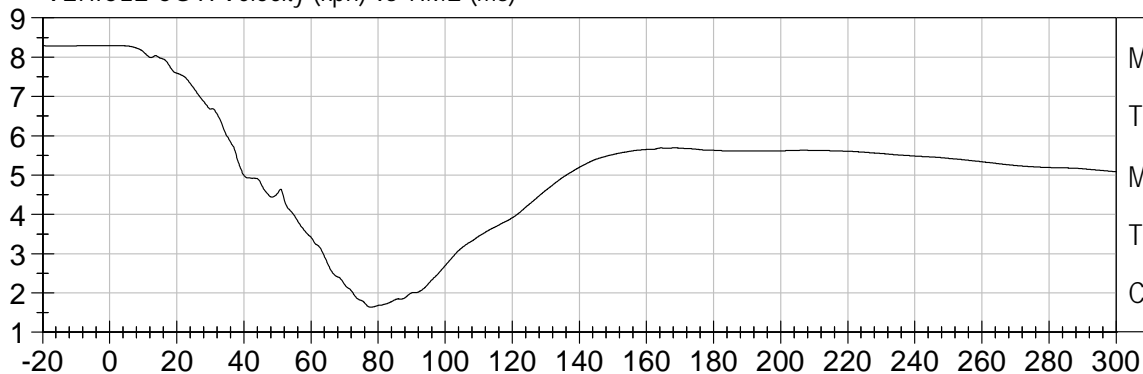


Max: 18.2 G's  
Tmax: 32.7 ms  
Min: 0.0 G's  
Tmin: 0.0 ms  
CFC 60

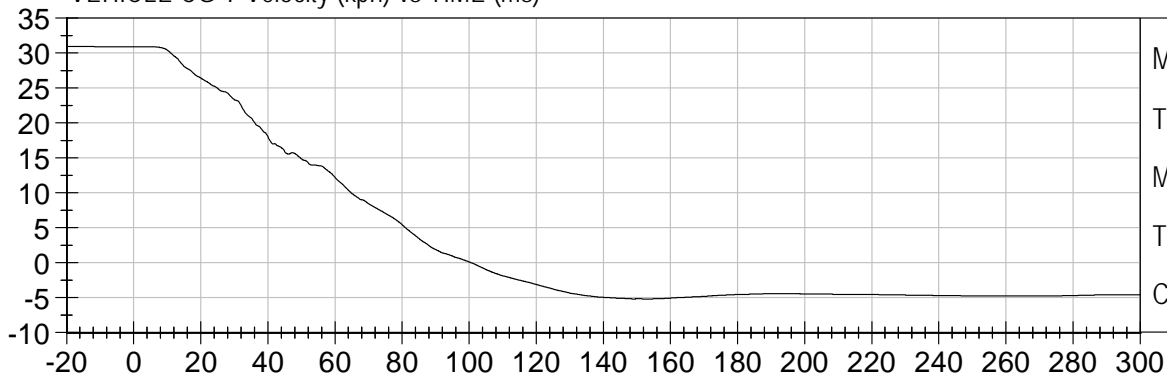




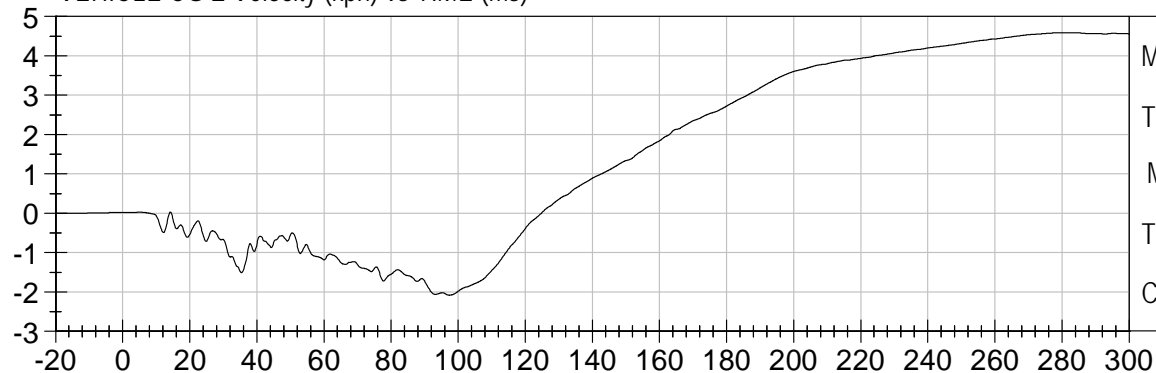
VEHICLE CG X Velocity (kph) vs TIME (ms)

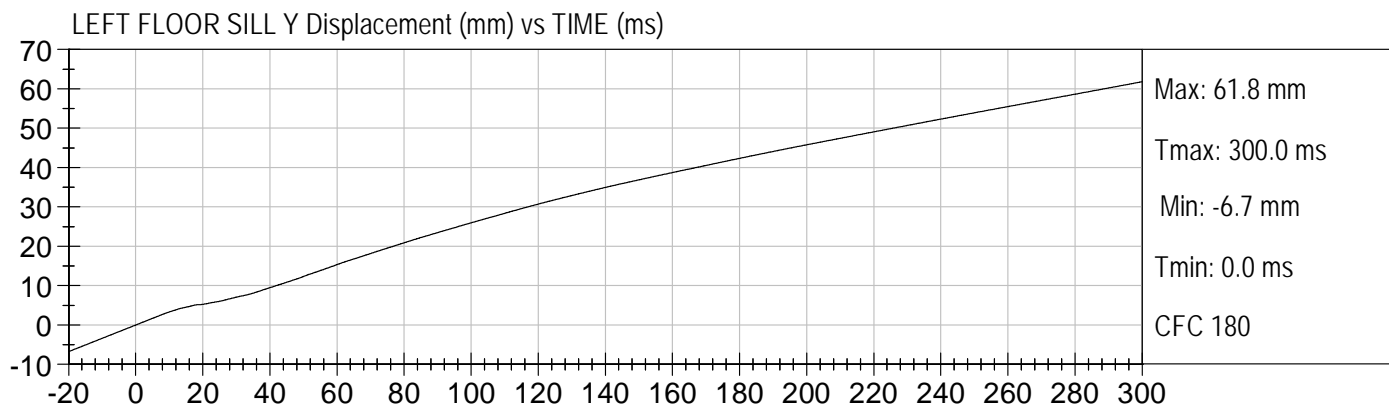
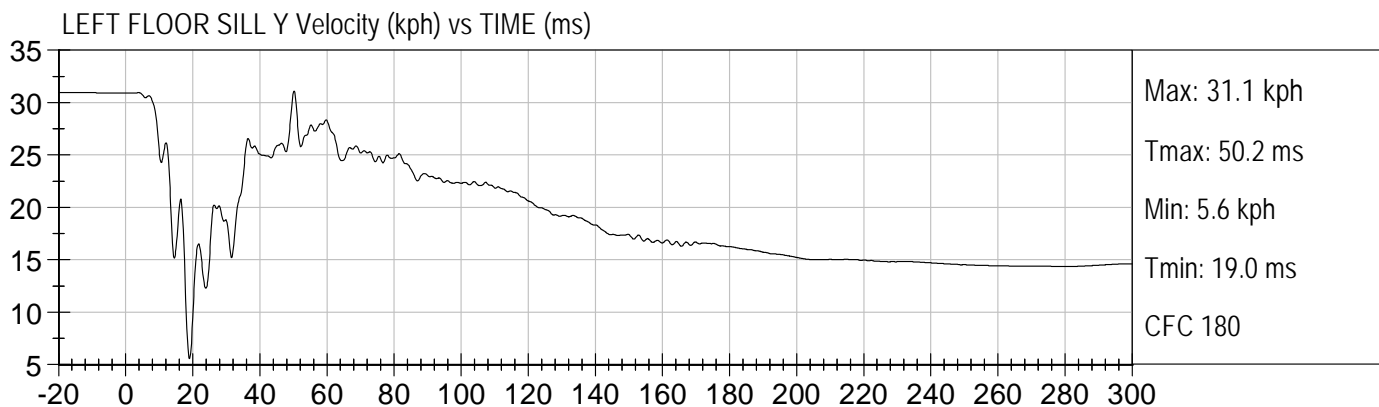
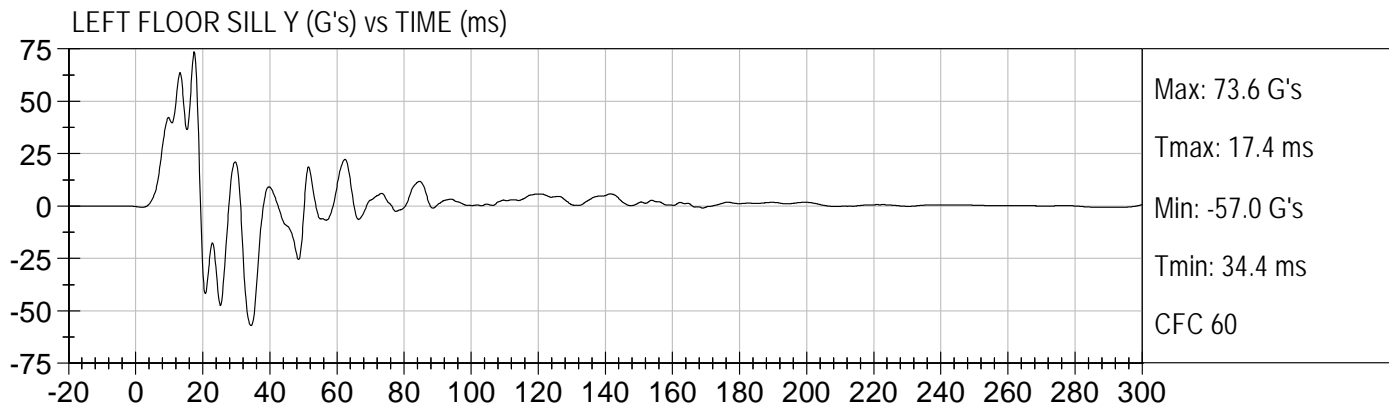


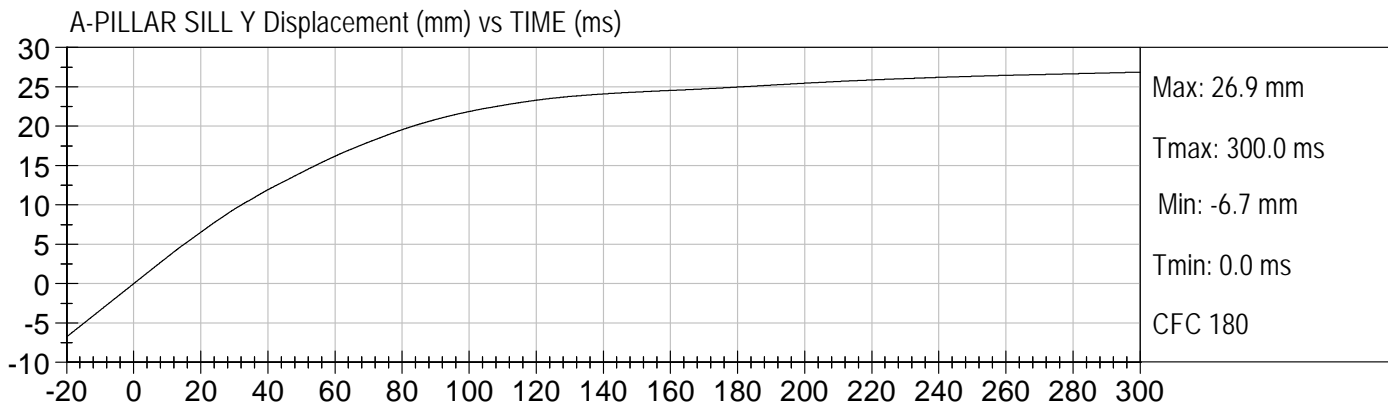
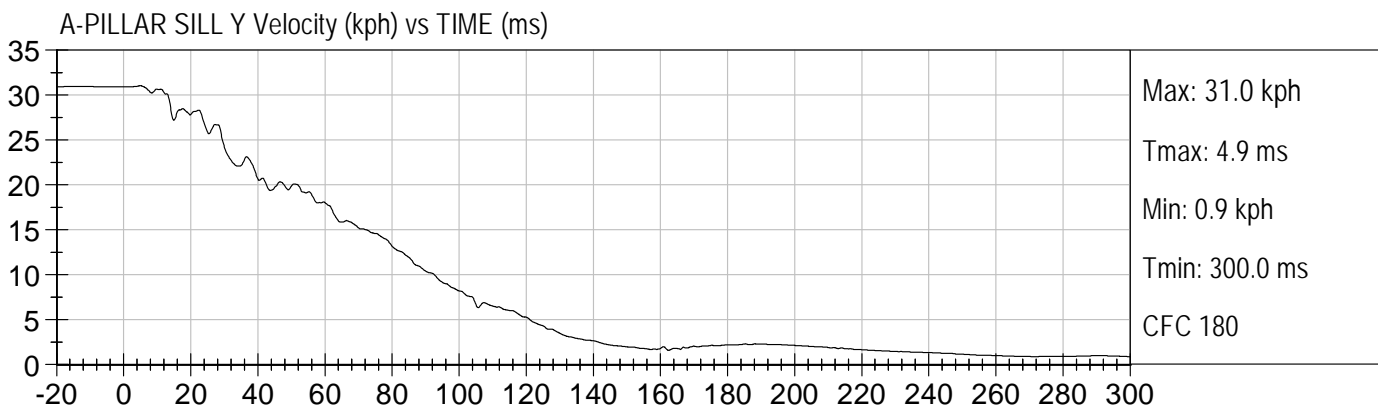
VEHICLE CG Y Velocity (kph) vs TIME (ms)

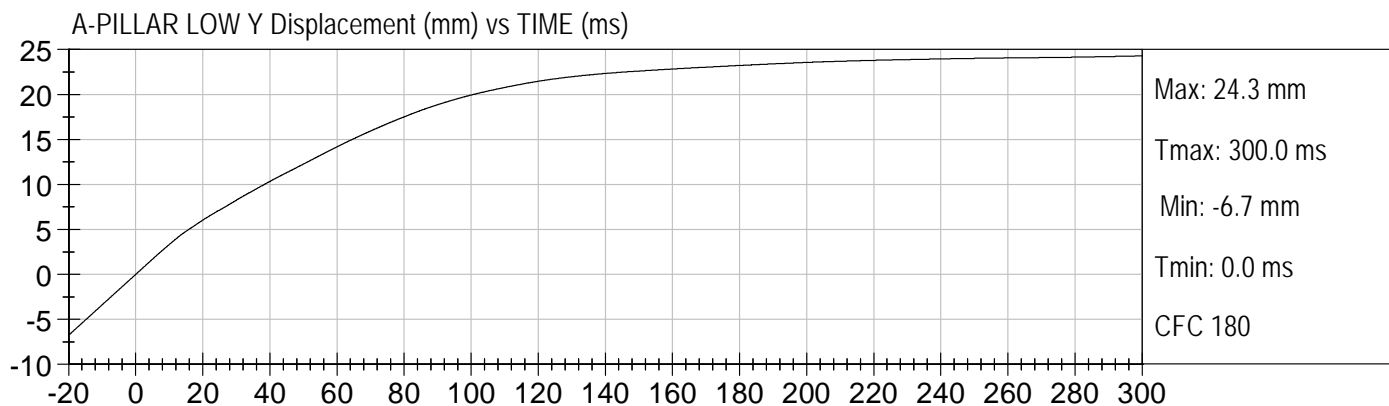
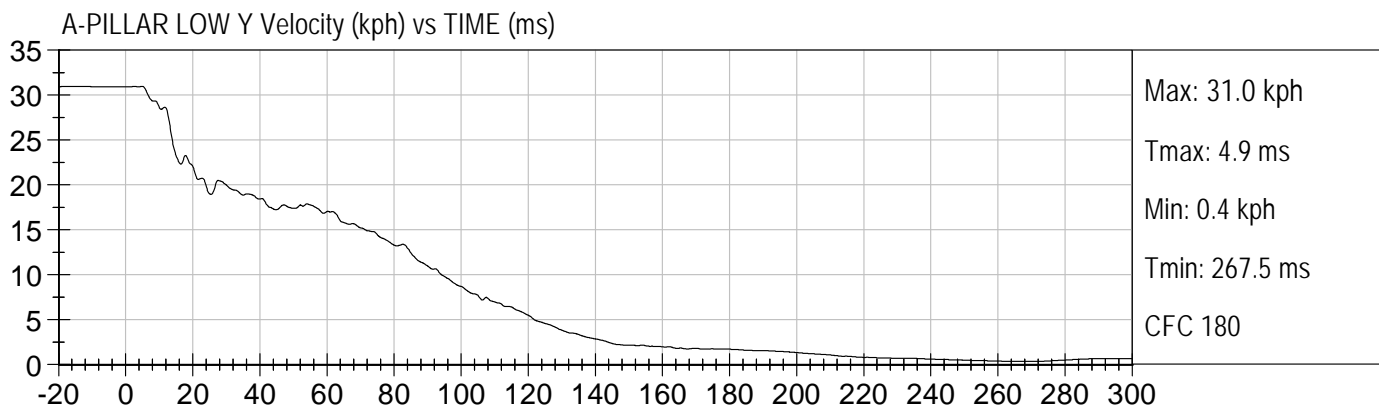
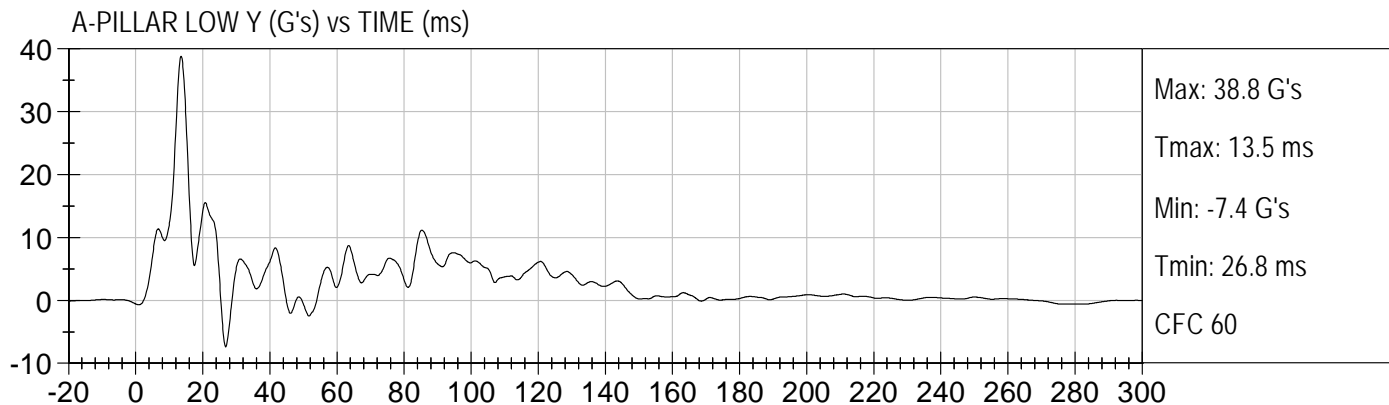


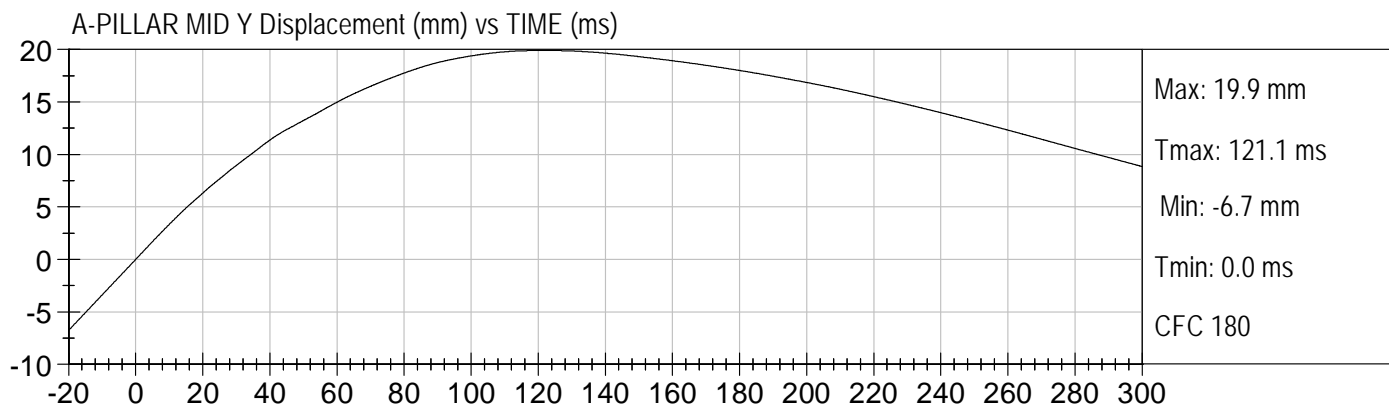
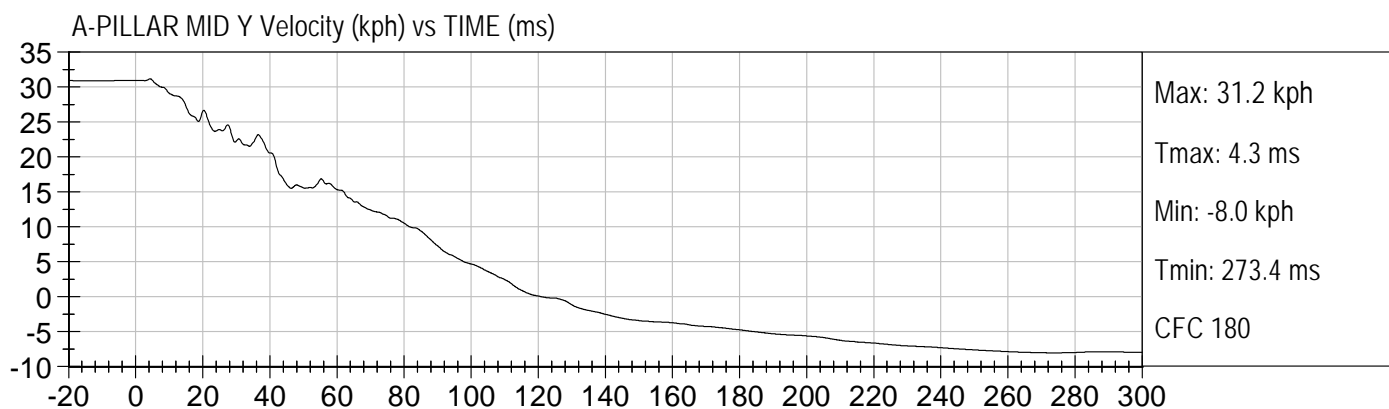
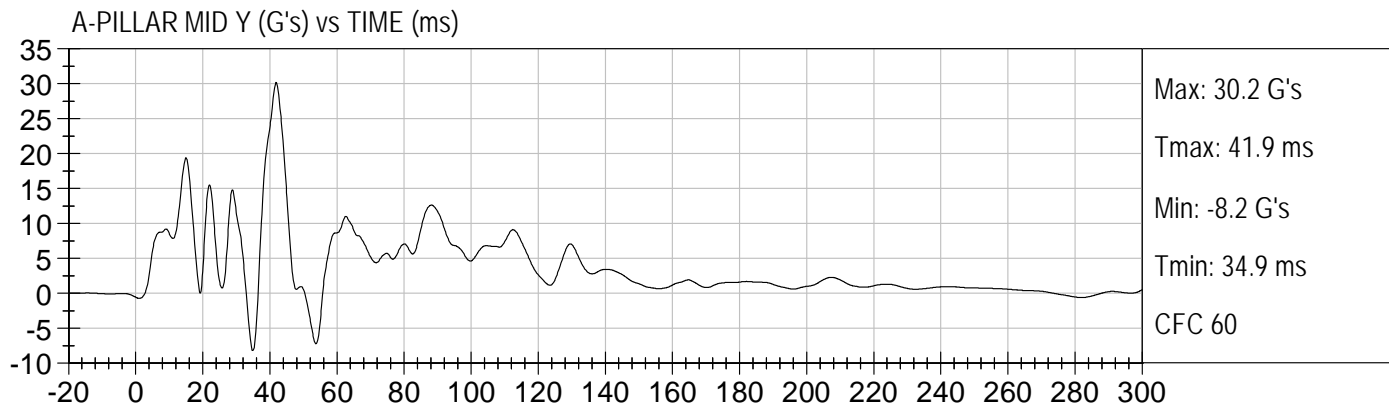
VEHICLE CG Z Velocity (kph) vs TIME (ms)

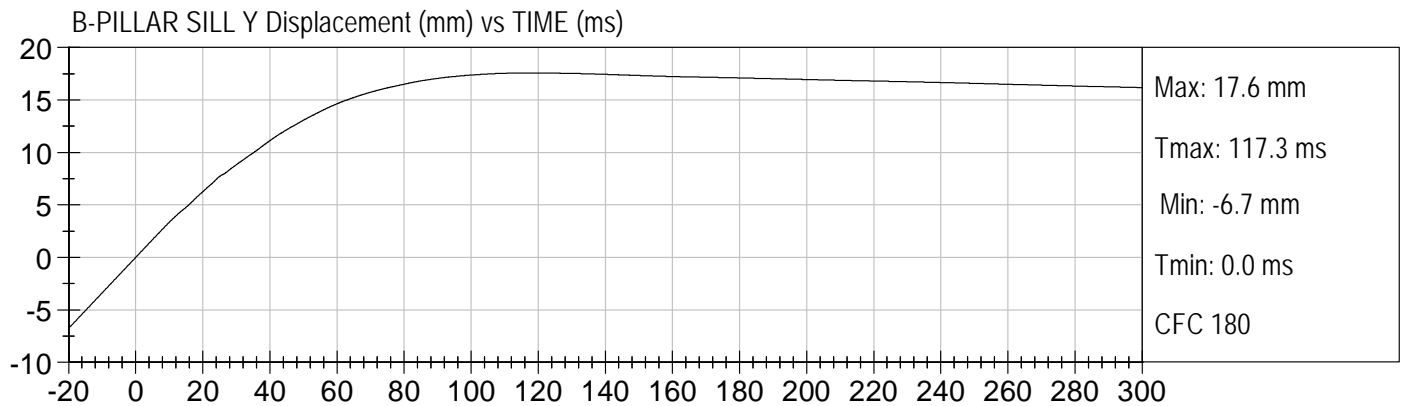
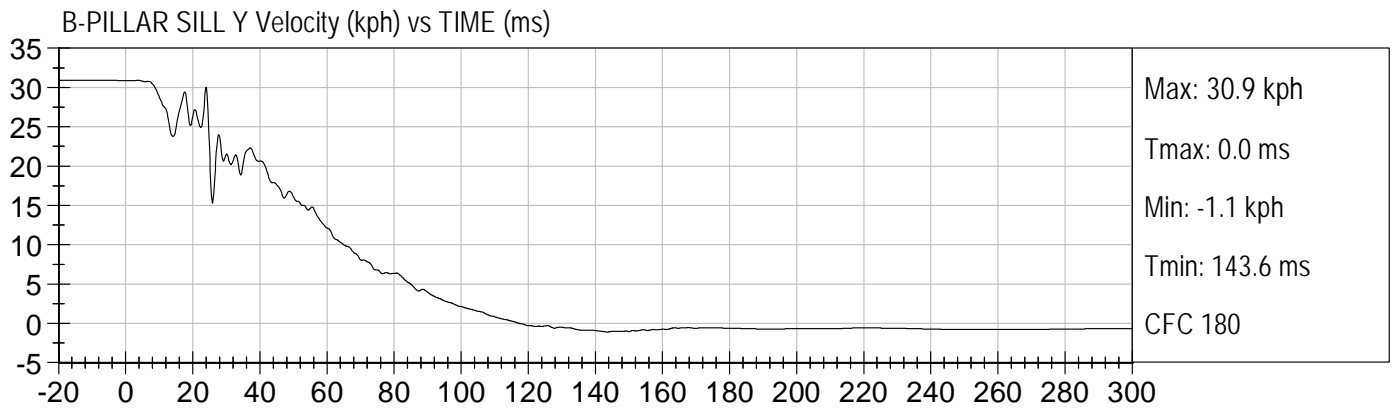
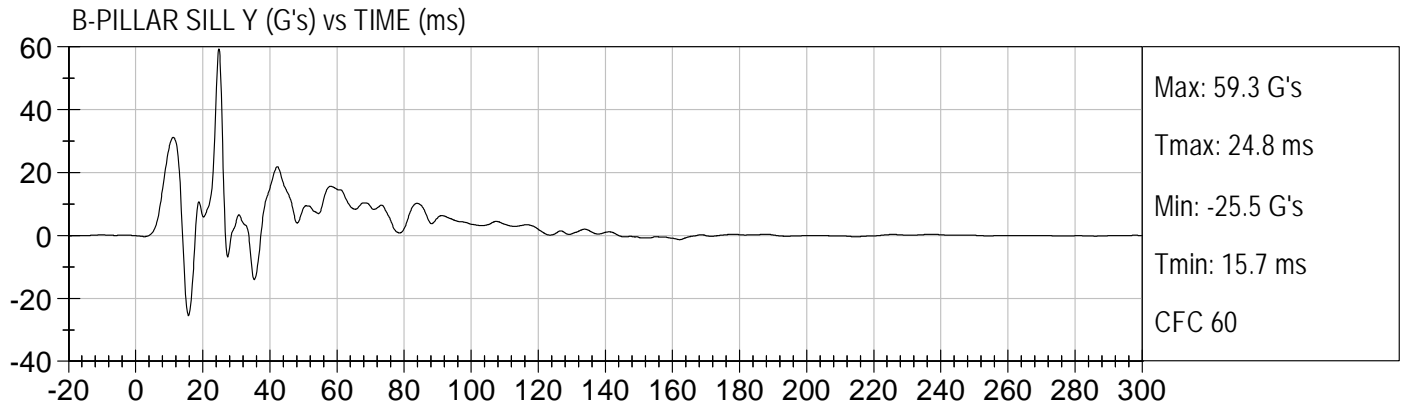




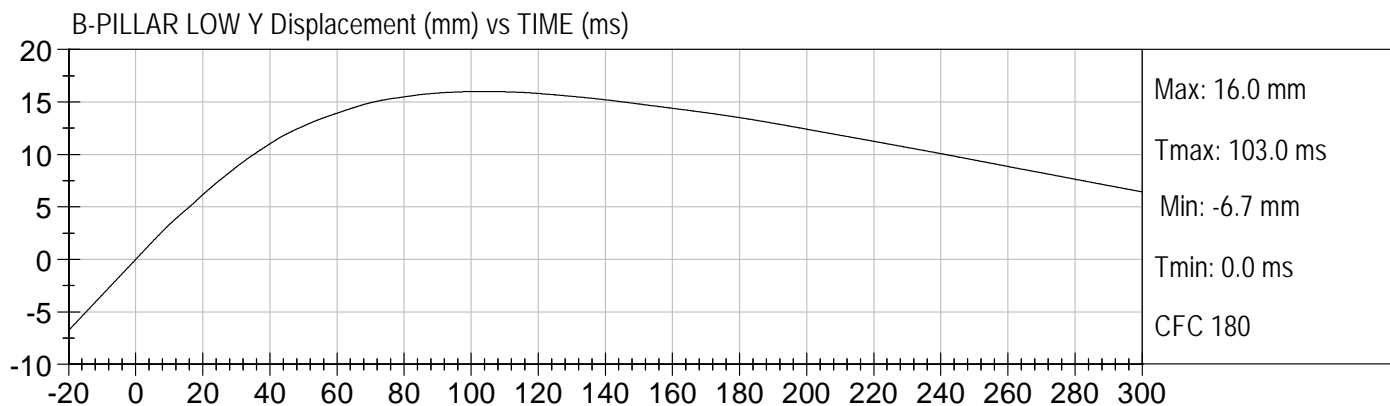
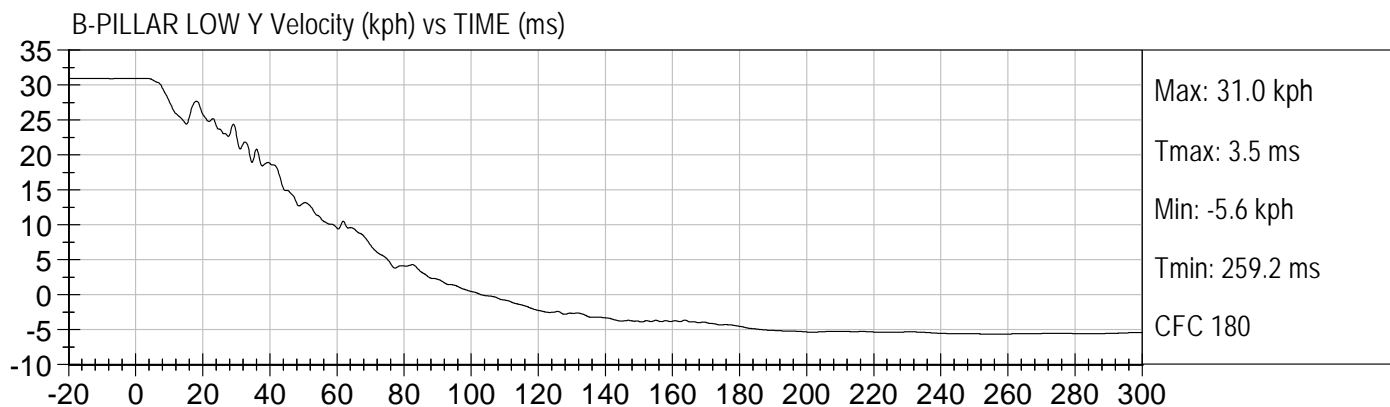
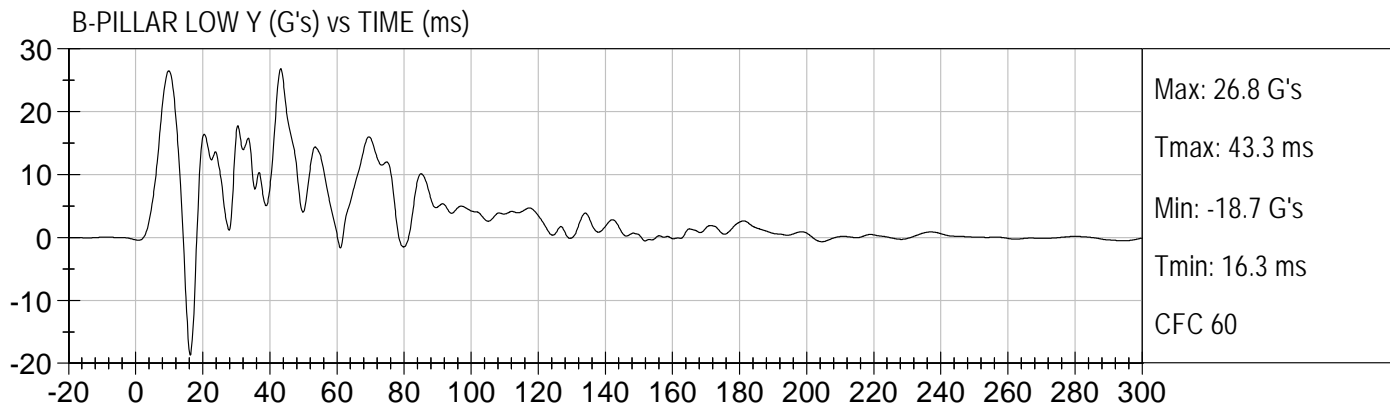


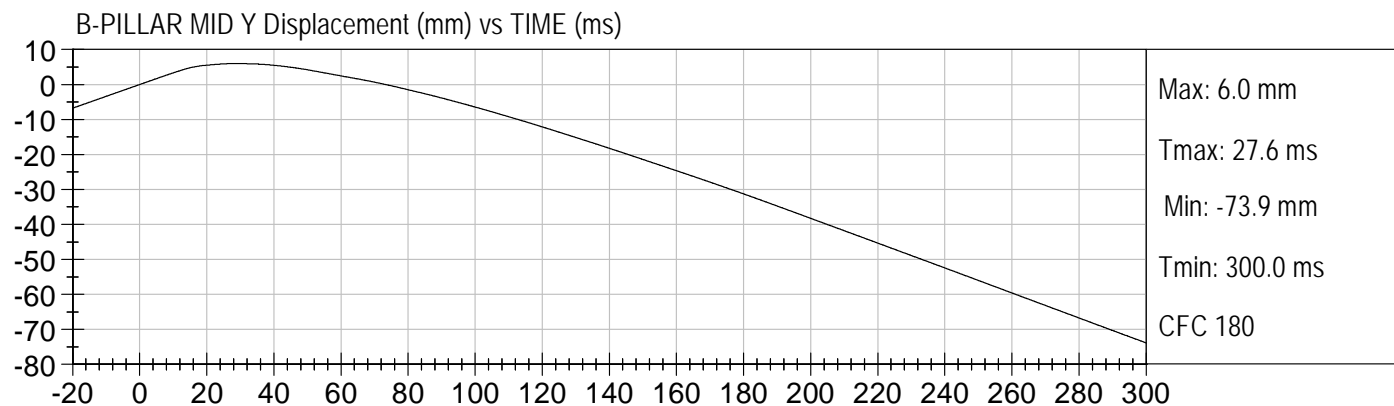
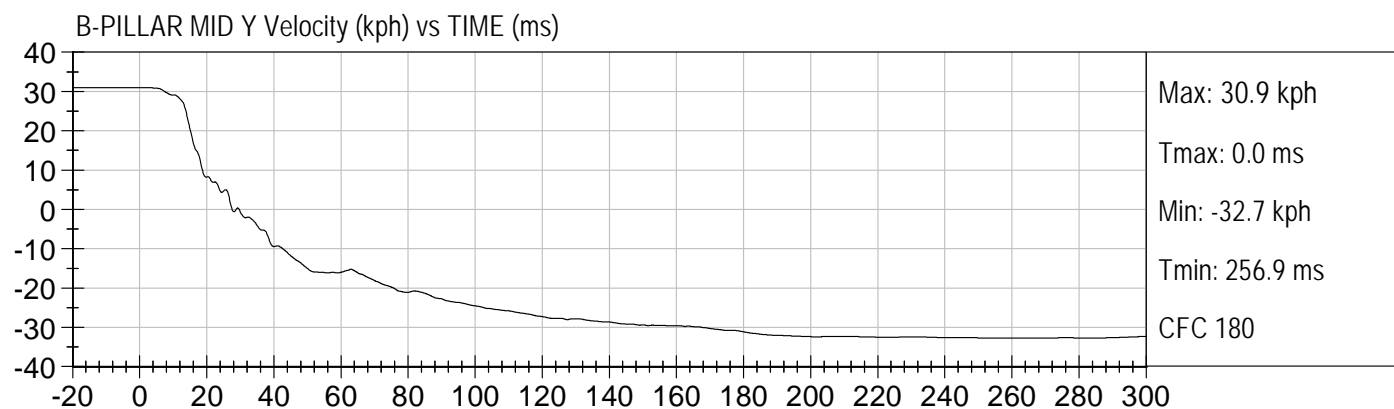
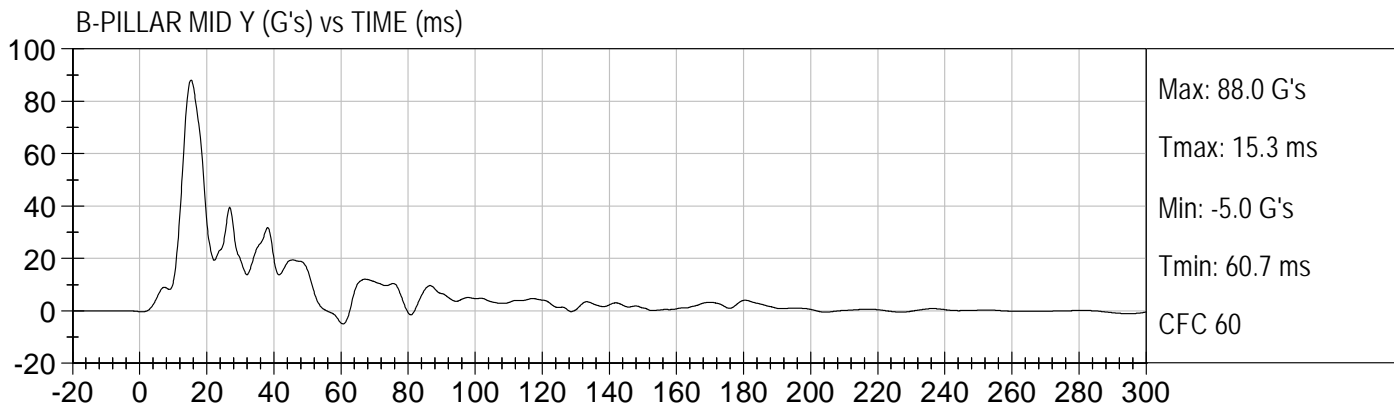


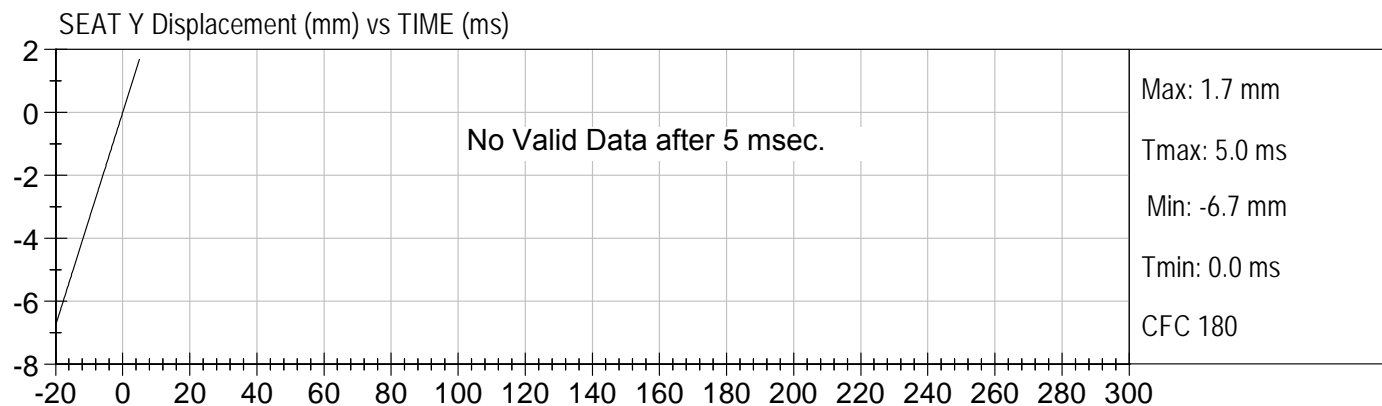
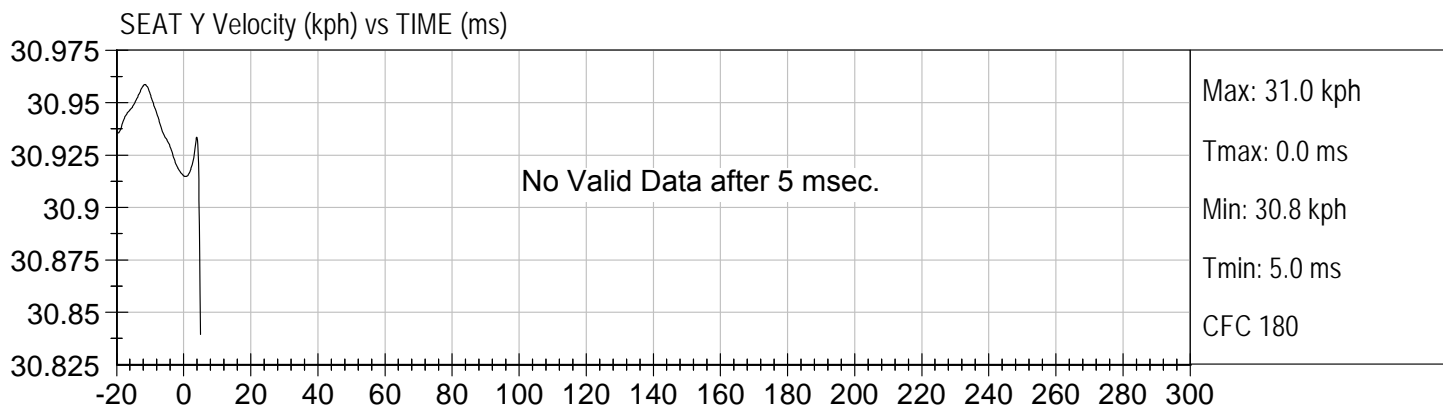
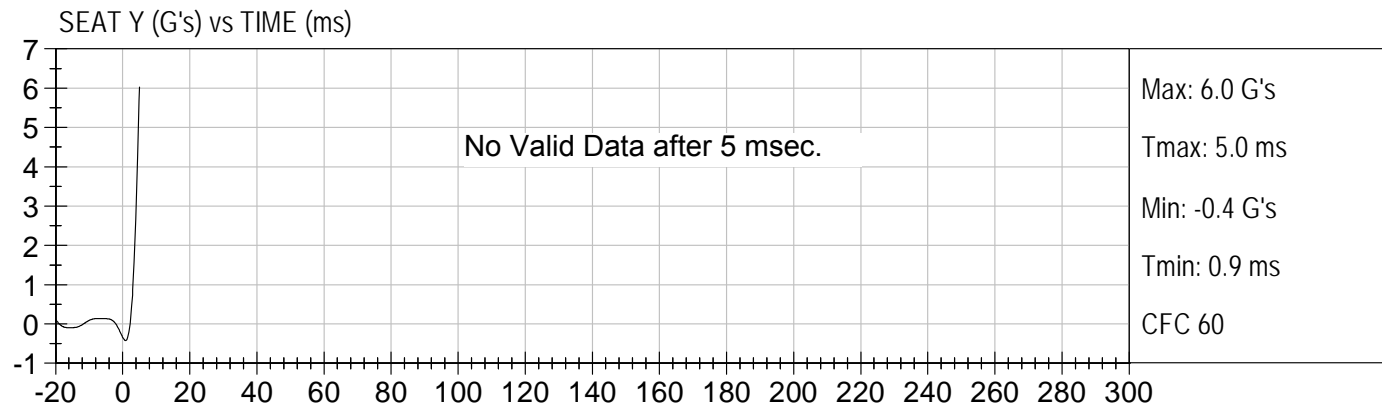


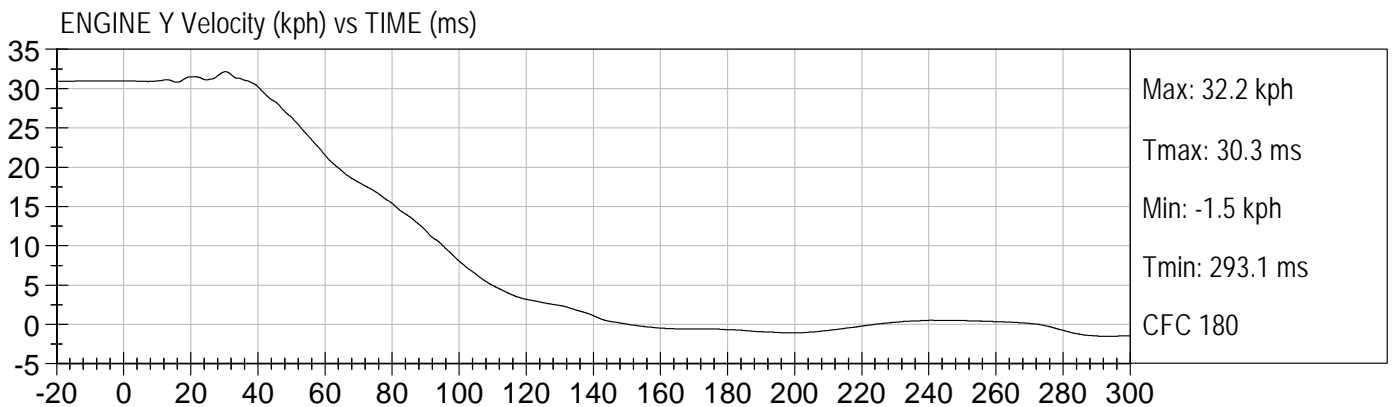
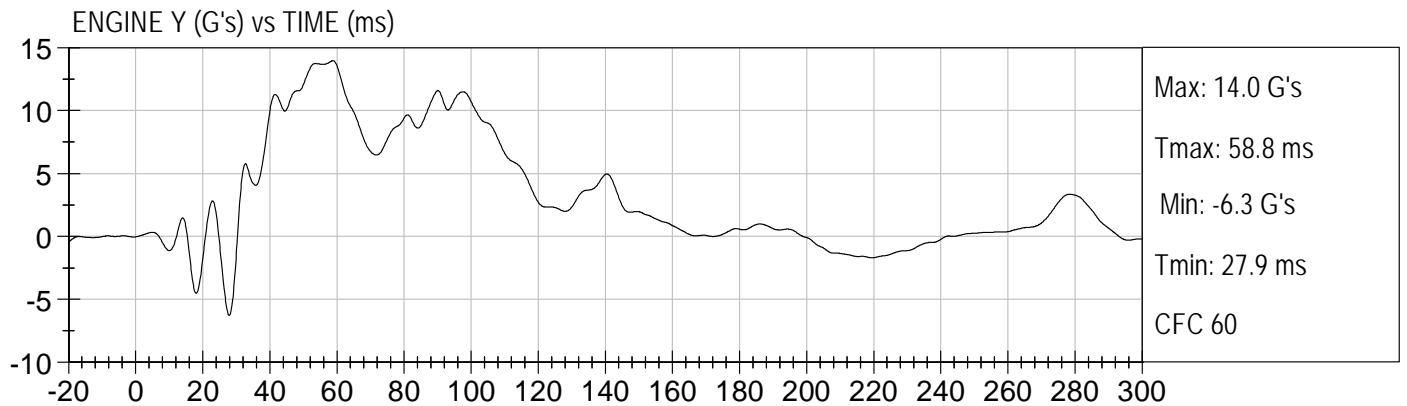
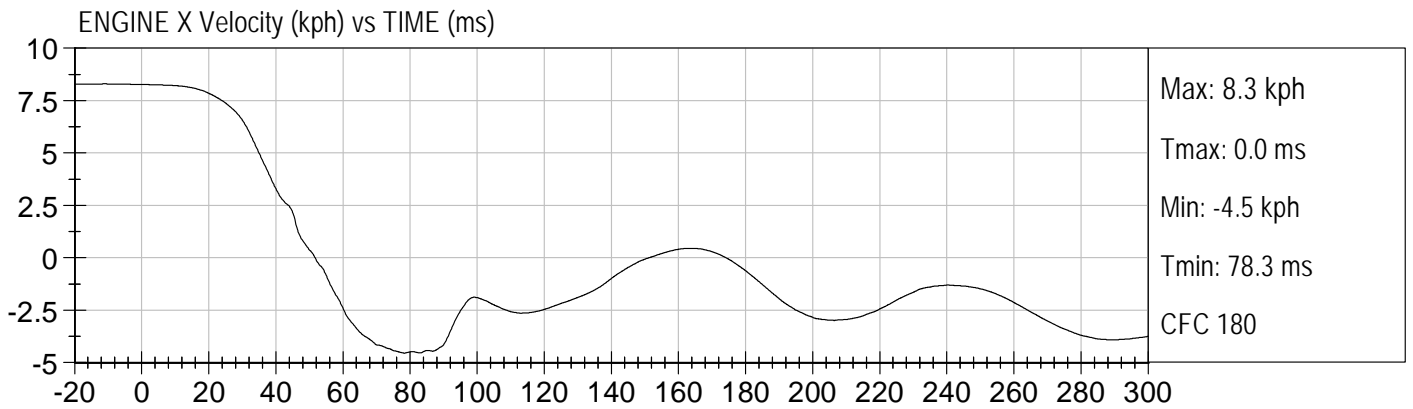
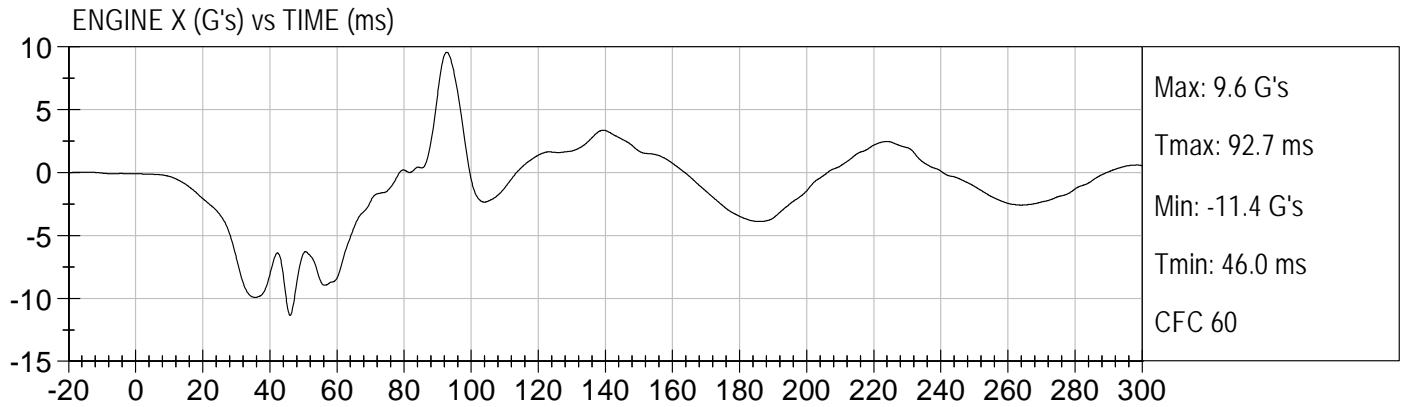


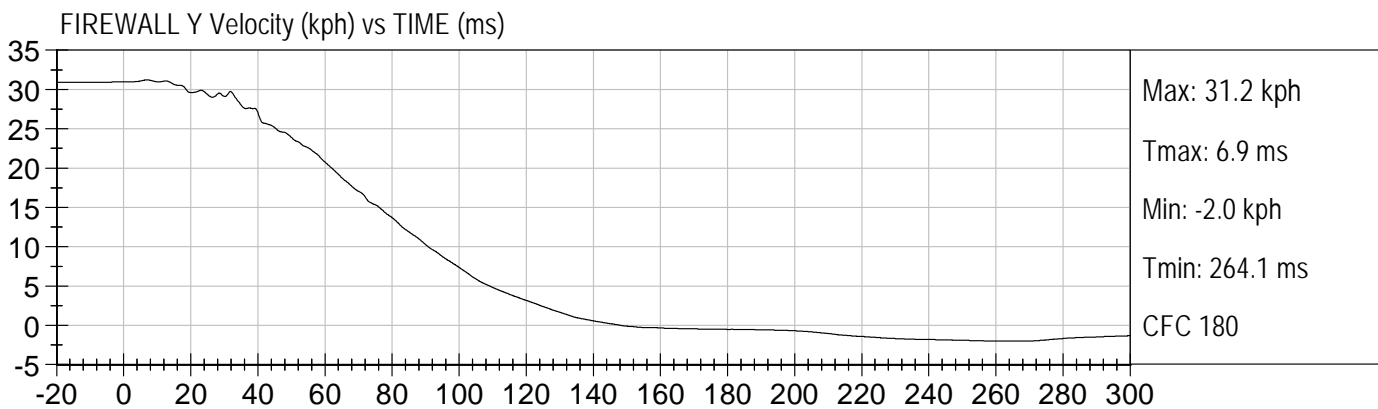
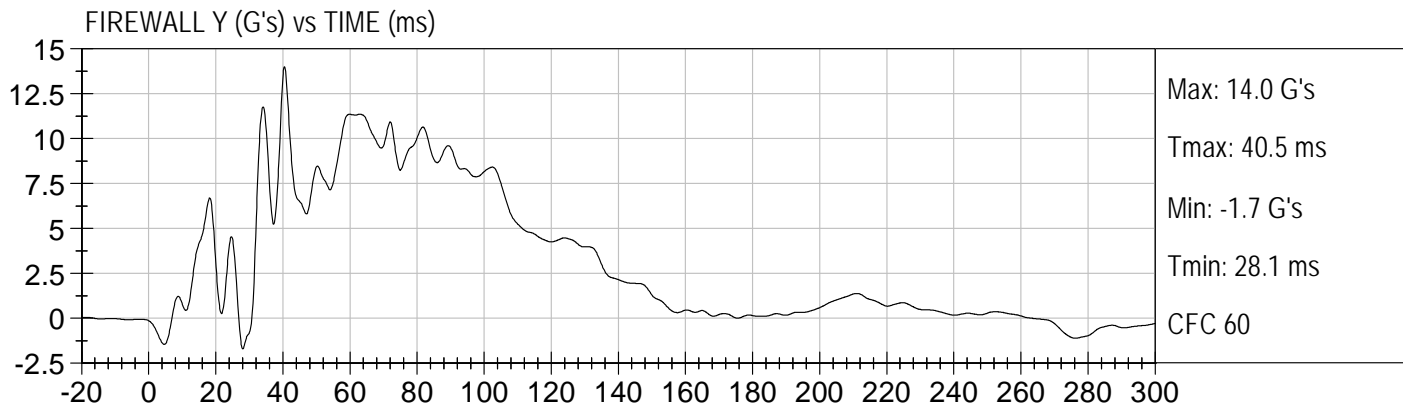


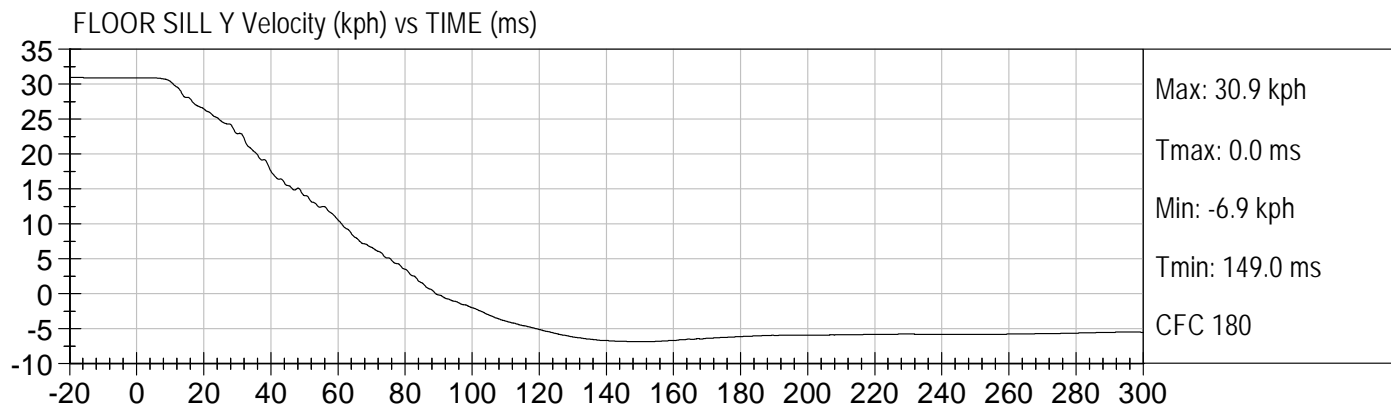
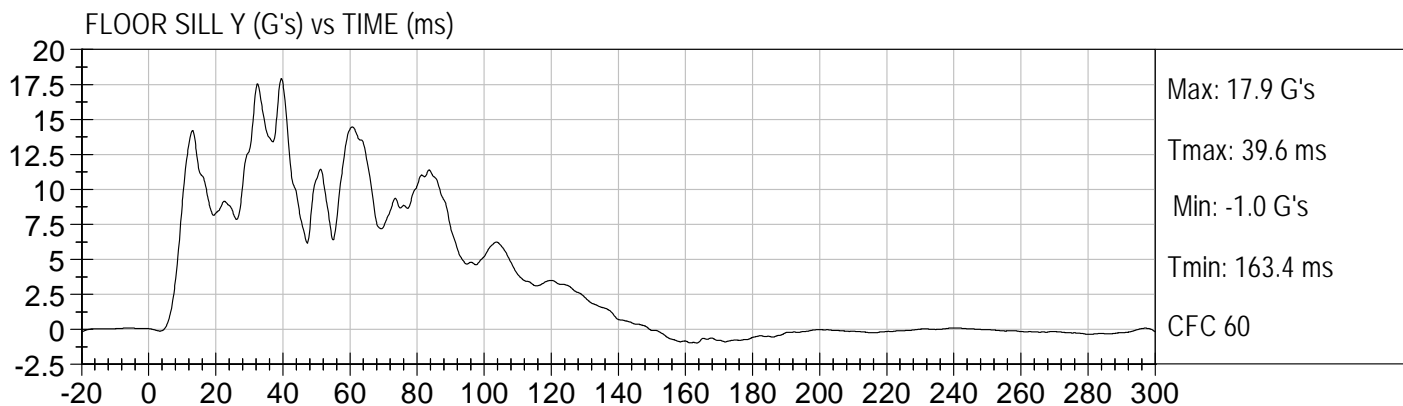
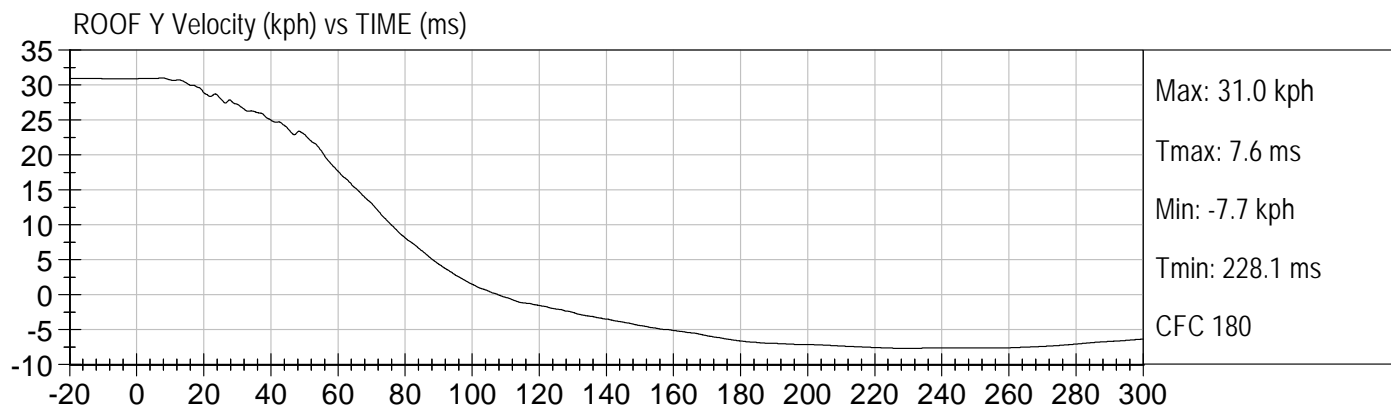
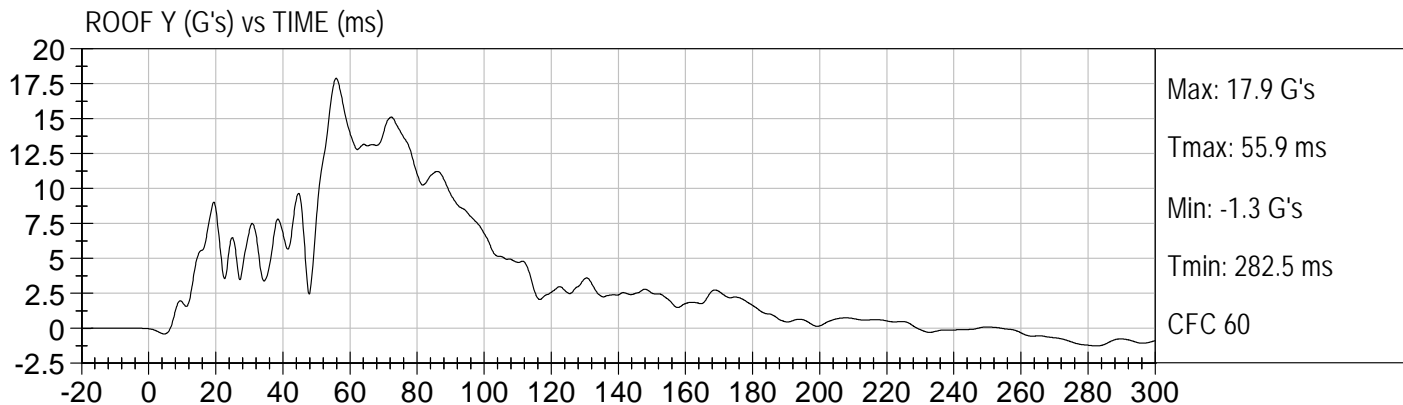




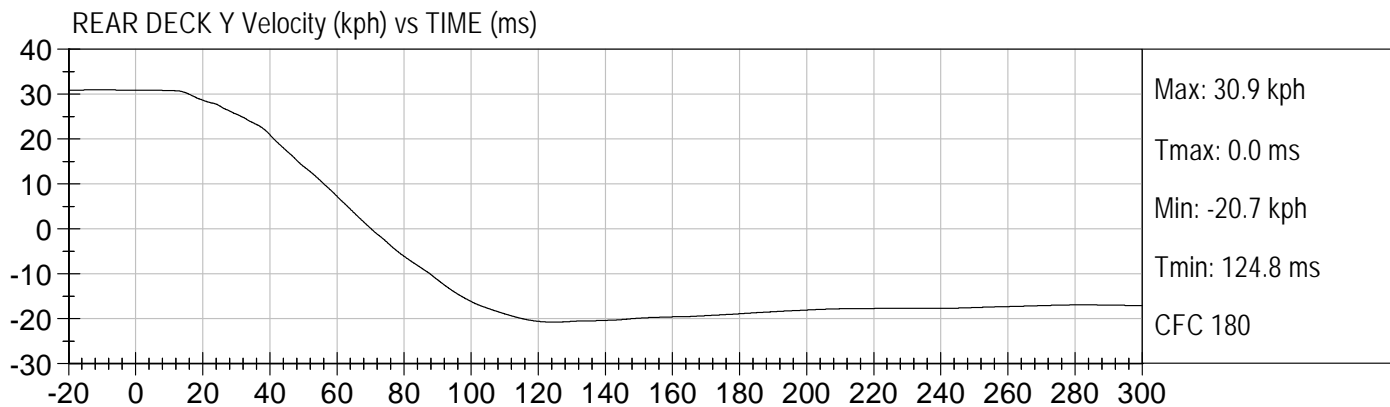
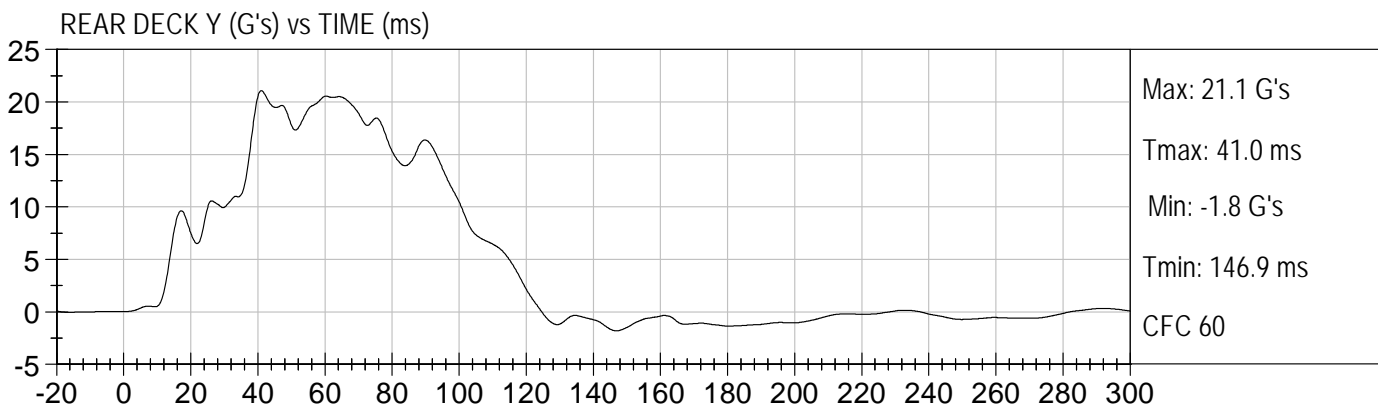
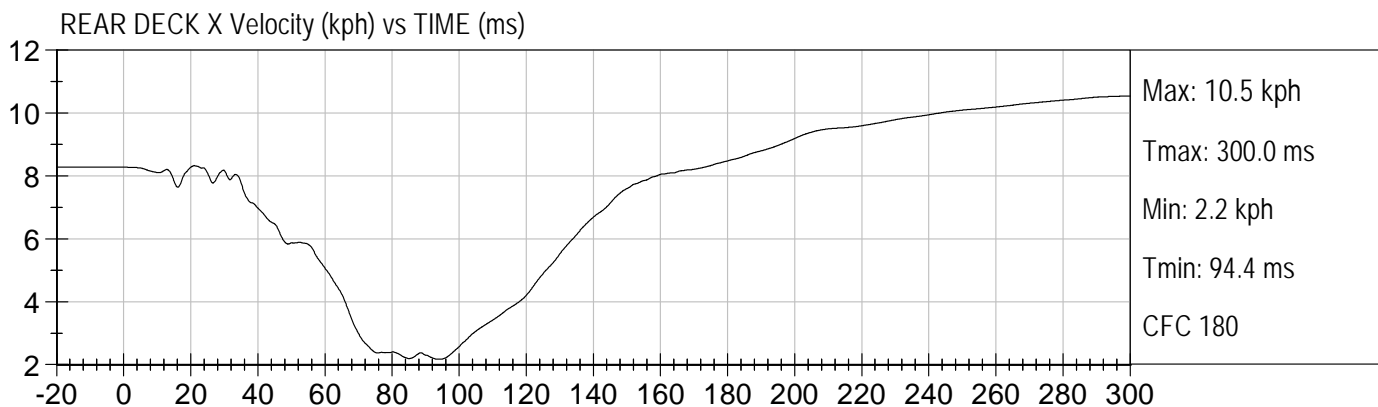
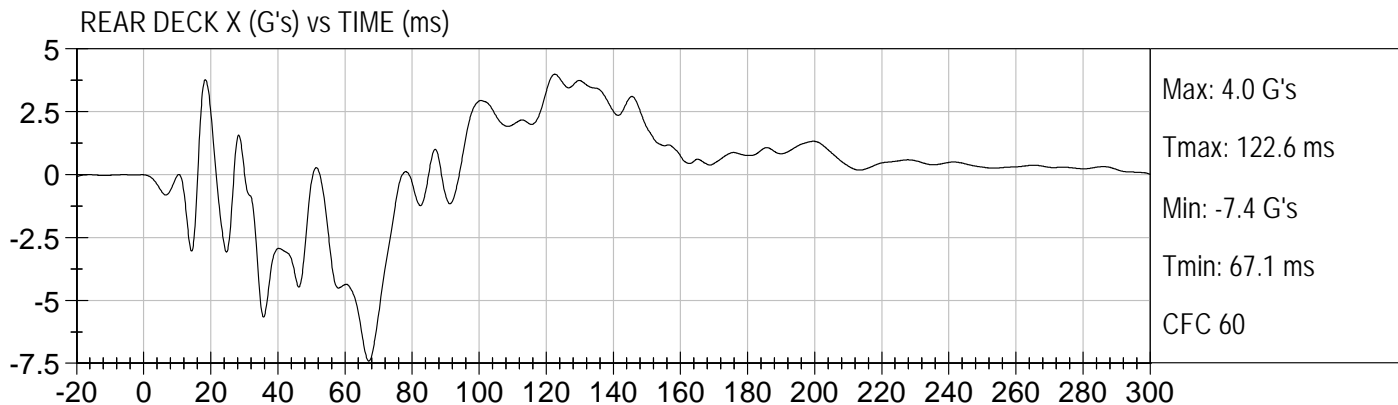












**APPENDIX D**

**DUMMY PERFORMANCE CALIBRATION TEST DATA**

**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

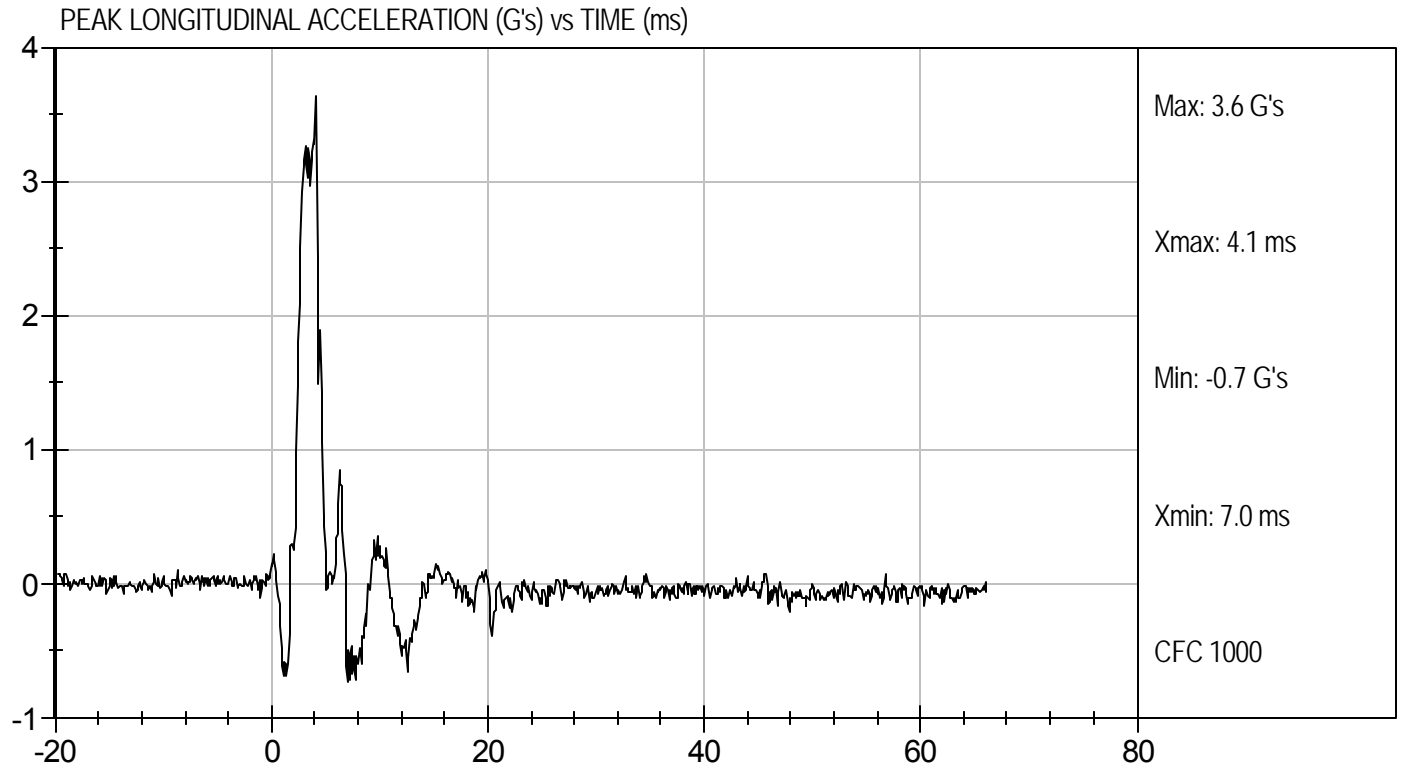
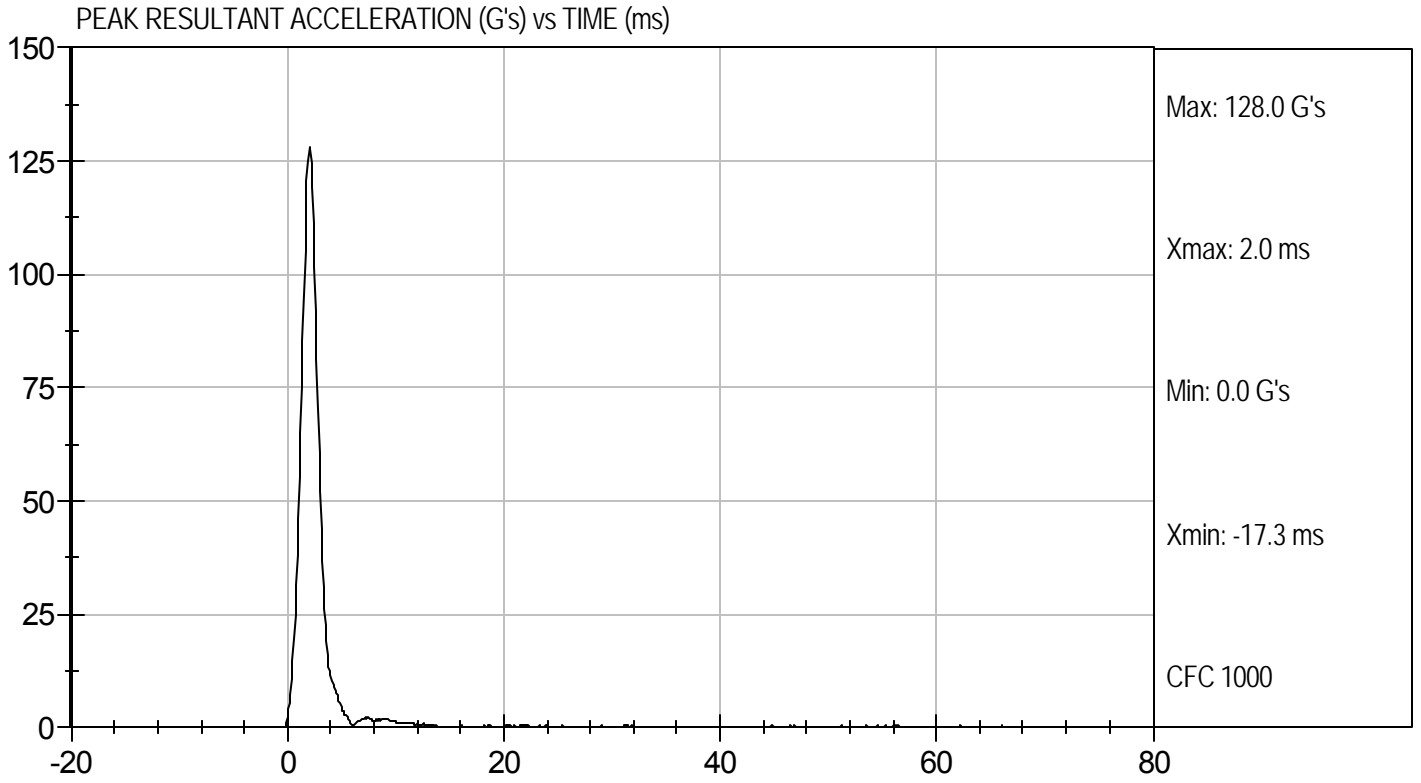
Test ID: D112991

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	43	Pass
Peak Resultant Acceleration	G's	115 to 137	128	Pass
Peak Lateral Acceleration	G's	+/- 15	3.6	Pass
Unimodal	N/A	<15%	Yes	Pass
Overall Test Results				Pass

*Jessica Hall*  
 Laboratory Technician

9/13/11  
 Test Date

*David Winkelbauer*  
 Approved By





**MGA RESEARCH CORPORATION  
LATERAL NECK PENDULUM TEST  
SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D.: D112992

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.1	Pass
Humidity		%	10 to 70	46	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	3.84	Pass
	20 ms	m/s	4.40 to 5.40	5.15	Pass
	25 ms	m/s	5.40 to 6.10	5.60	Pass
	25-100 ms	m/s	5.50 to 6.20	5.62	Pass
Maximum D-Plane Rotation		deg	71 to 81	77	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	57	Pass
Maximum Occipital Condyle Moment during Rotation Interval Nm			-44 to -36	-41	Pass
Time of Moment Decay to 0 Nm		ms	102 to 126	116	Pass
Overall Test Results					Pass

Jessica Gall  
Laboratory Technician

9/12/11  
Test Date

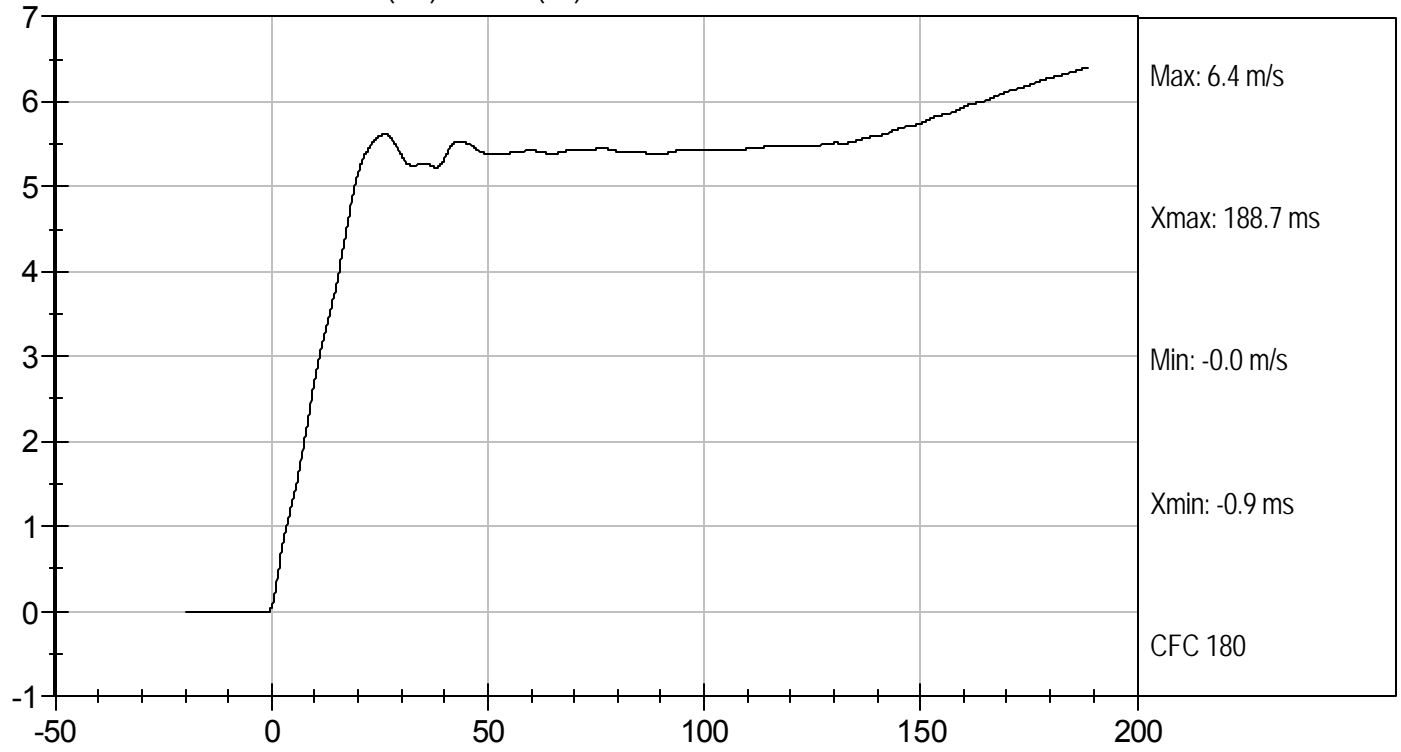
David Winkelbauer  
Approved By



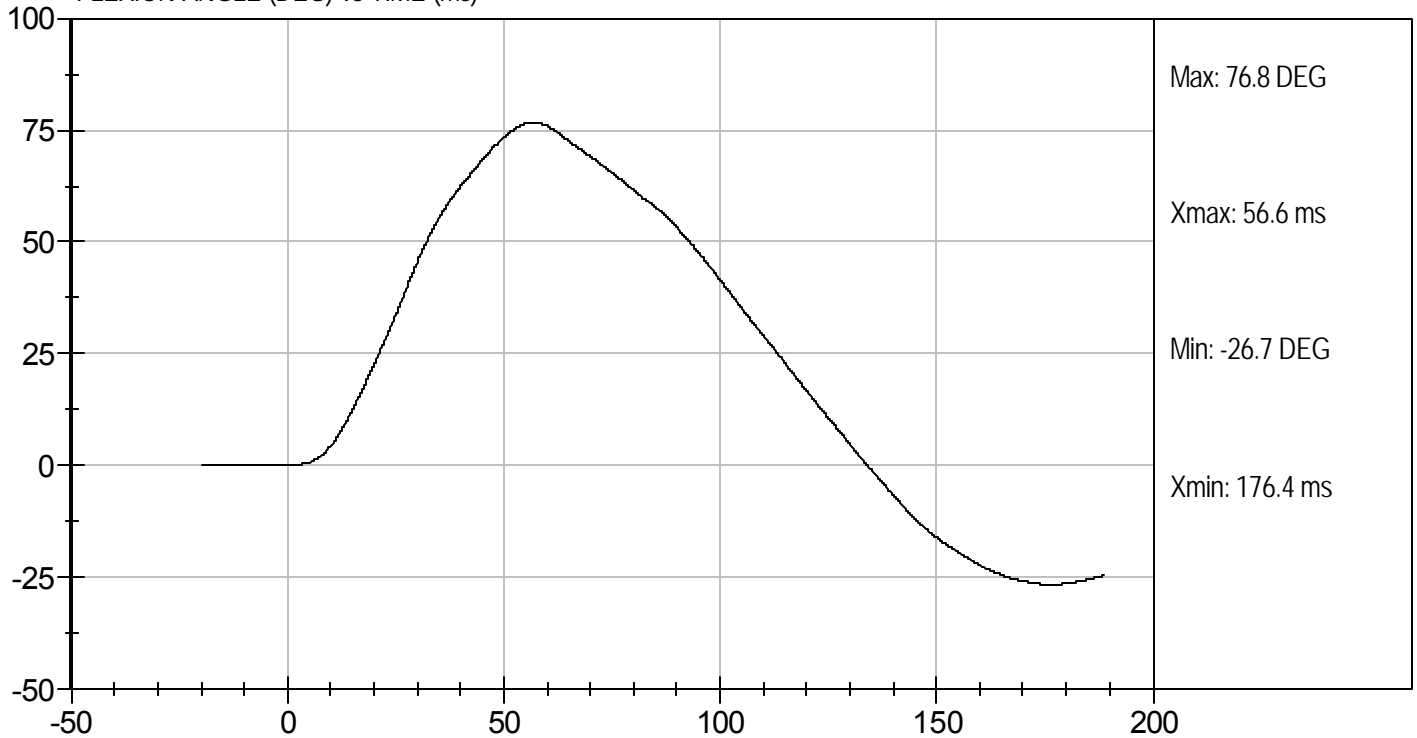
Test Desc: Neck Bending  
Component ID: D112992

Test Date: 9/12/11  
Velocity: 18.32 ft/s, 5.58 m/s

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



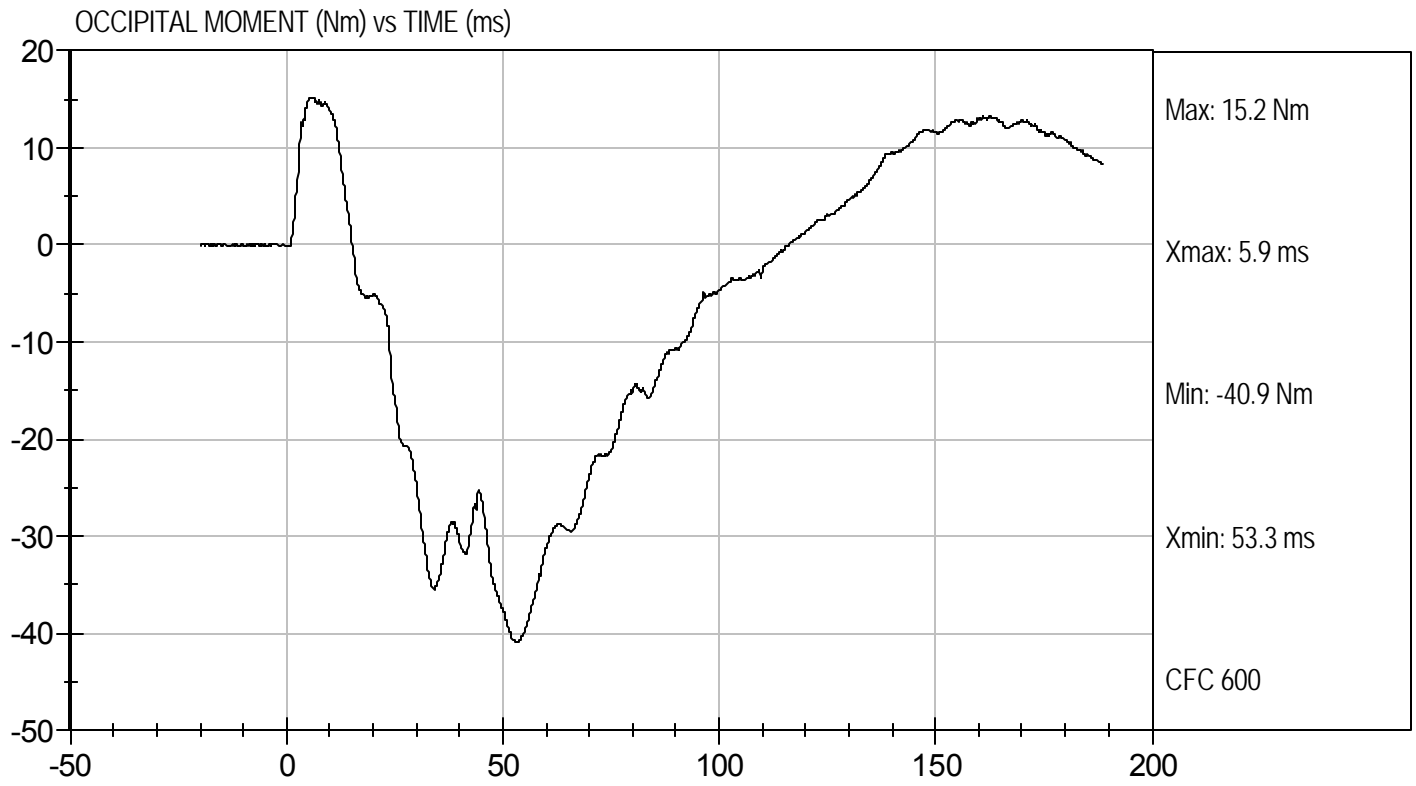
FLEXION ANGLE (DEG) vs TIME (ms)





Test Desc: Neck Bending  
Component ID: D112992

Test Date: 9/12/11  
Velocity: 18.32 ft/s, 5.58 m/s



**MGA RESEARCH CORPORATION  
SHOULDER IMPACT TEST  
SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test ID: D112993

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
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	19	Pass
Overall Test Results				Pass

Jessica Hall  
Laboratory Technician

9/13/11  
Test Date

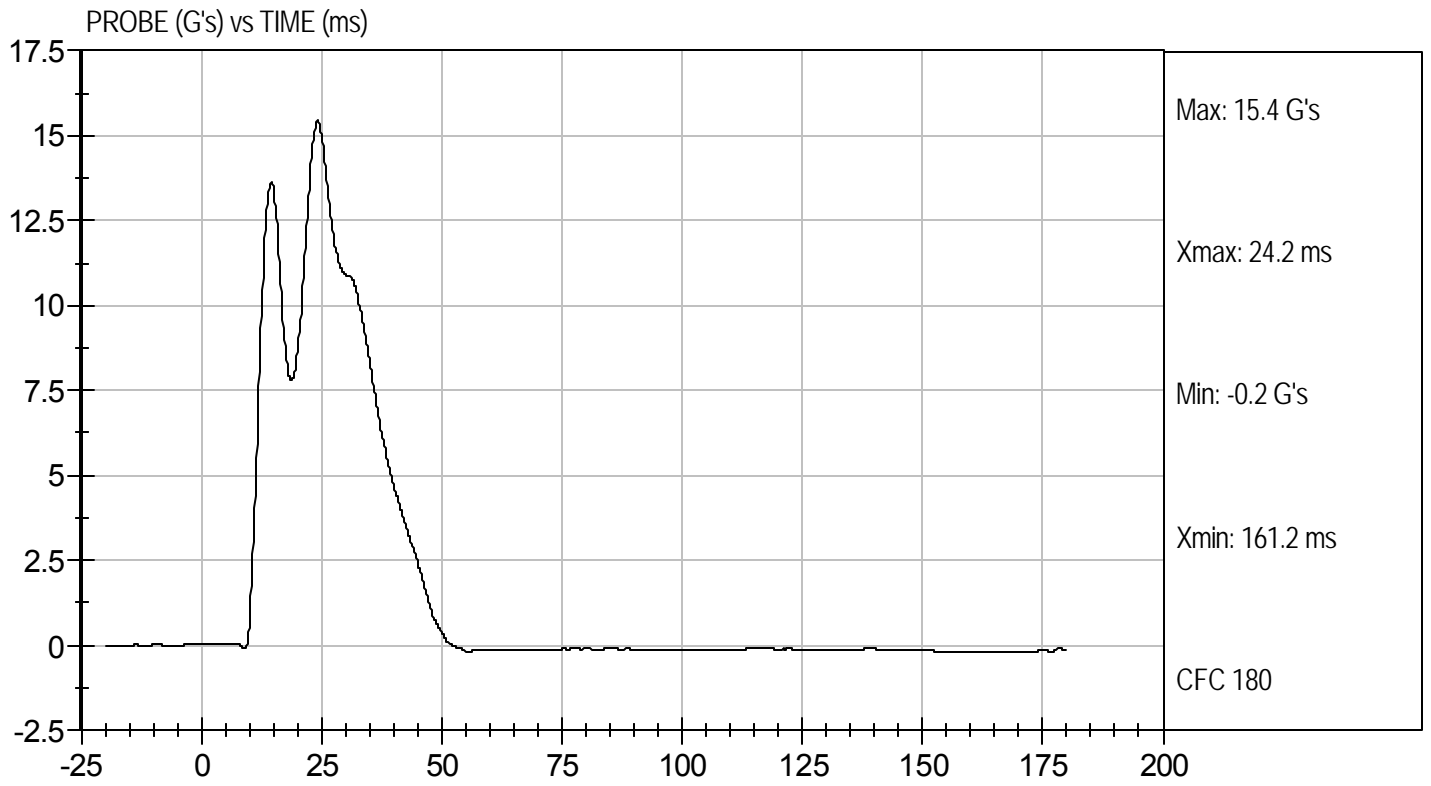
David Winkelbauer  
Approved By

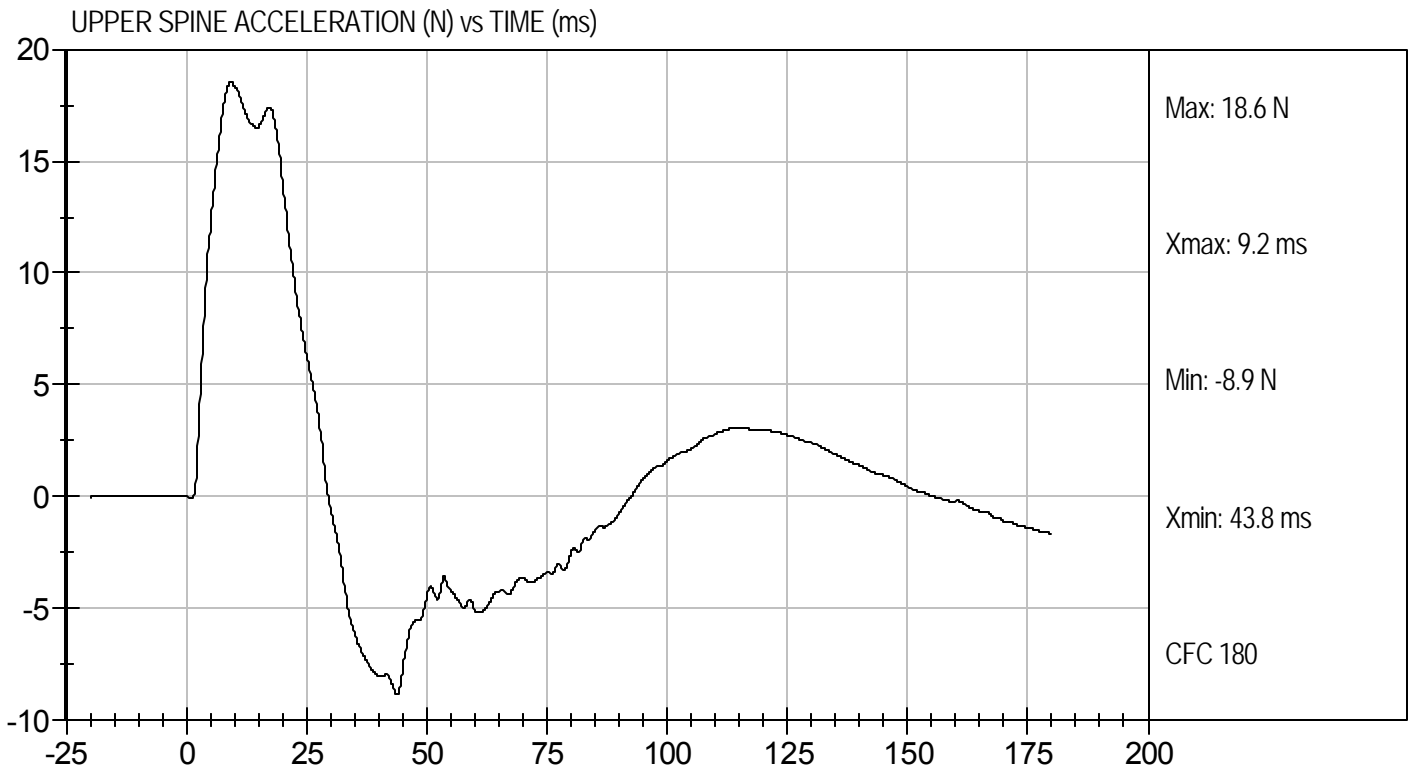
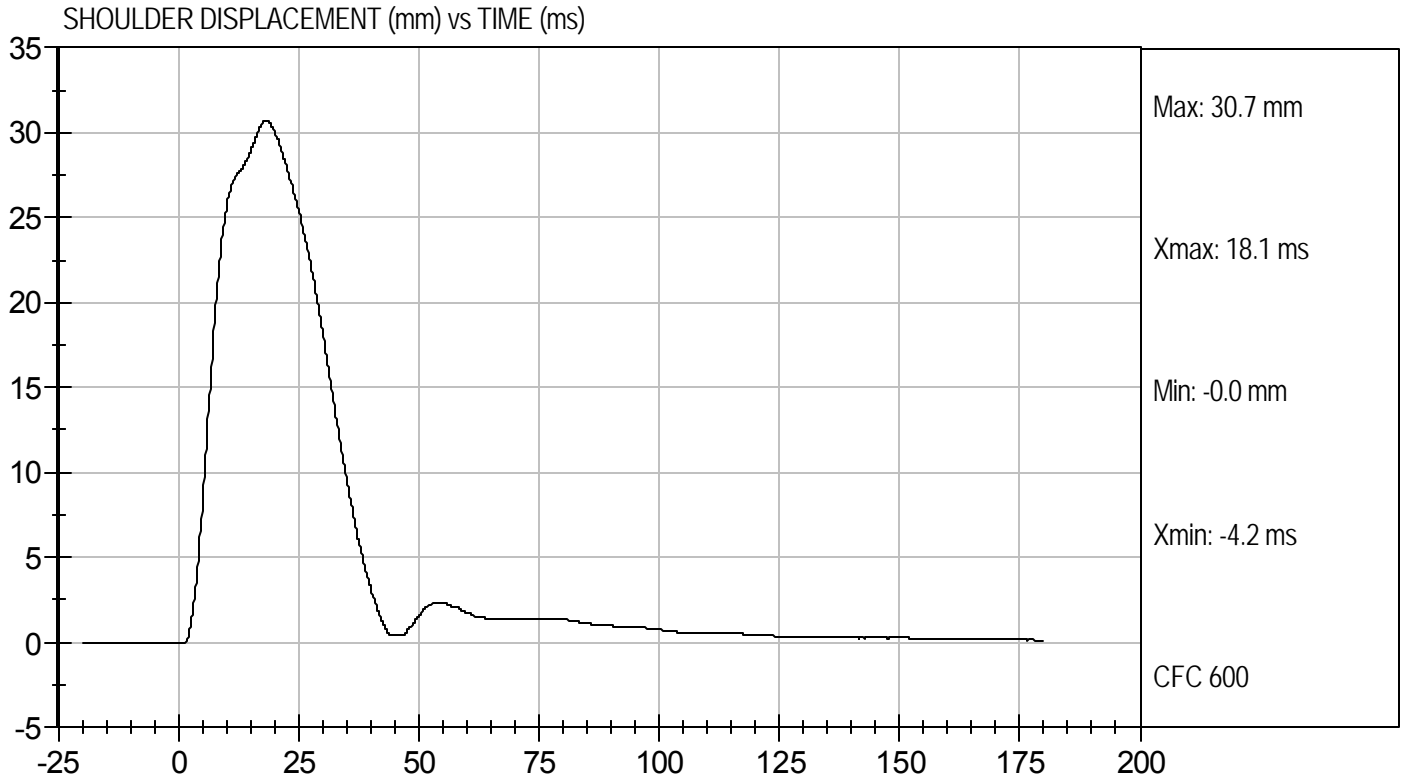




Test Desc: Shoulder Impact  
Component ID: D112993

Test Date: 9/13/11  
Velocity: 14.36 ft/s, 4.38 m/s





**MGA RESEARCH CORPORATION  
THORAX (WITH ARM) IMPACT TEST  
SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D112994

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.7	Pass
Humidity	%	10 to 70	45	Pass
Impact Velocity	m/s	6.60 to 6.80	6.77	Pass
Peak Impactor Acceleration	G's	30 to 36	32	Pass
Shoulder Displacement	mm	31 to 40	37	Pass
Upper Rib Displacement	mm	25 to 32	29	Pass
Middle Rib Displacement	mm	30 to 36	32	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	32	Pass
Overall Test Results				Pass

*Jessica Gall*  
\_\_\_\_\_  
Laboratory Technician

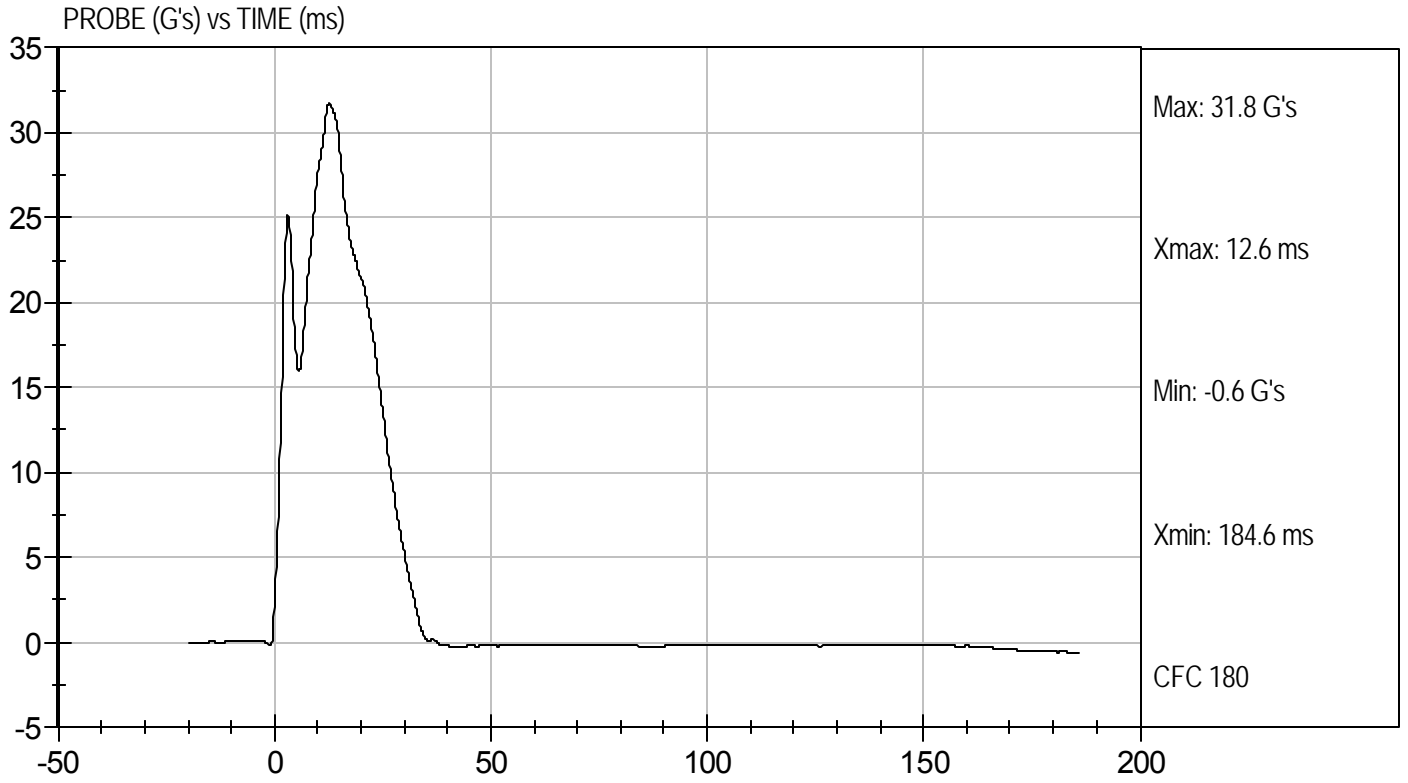
9/13/11  
\_\_\_\_\_  
Test Date

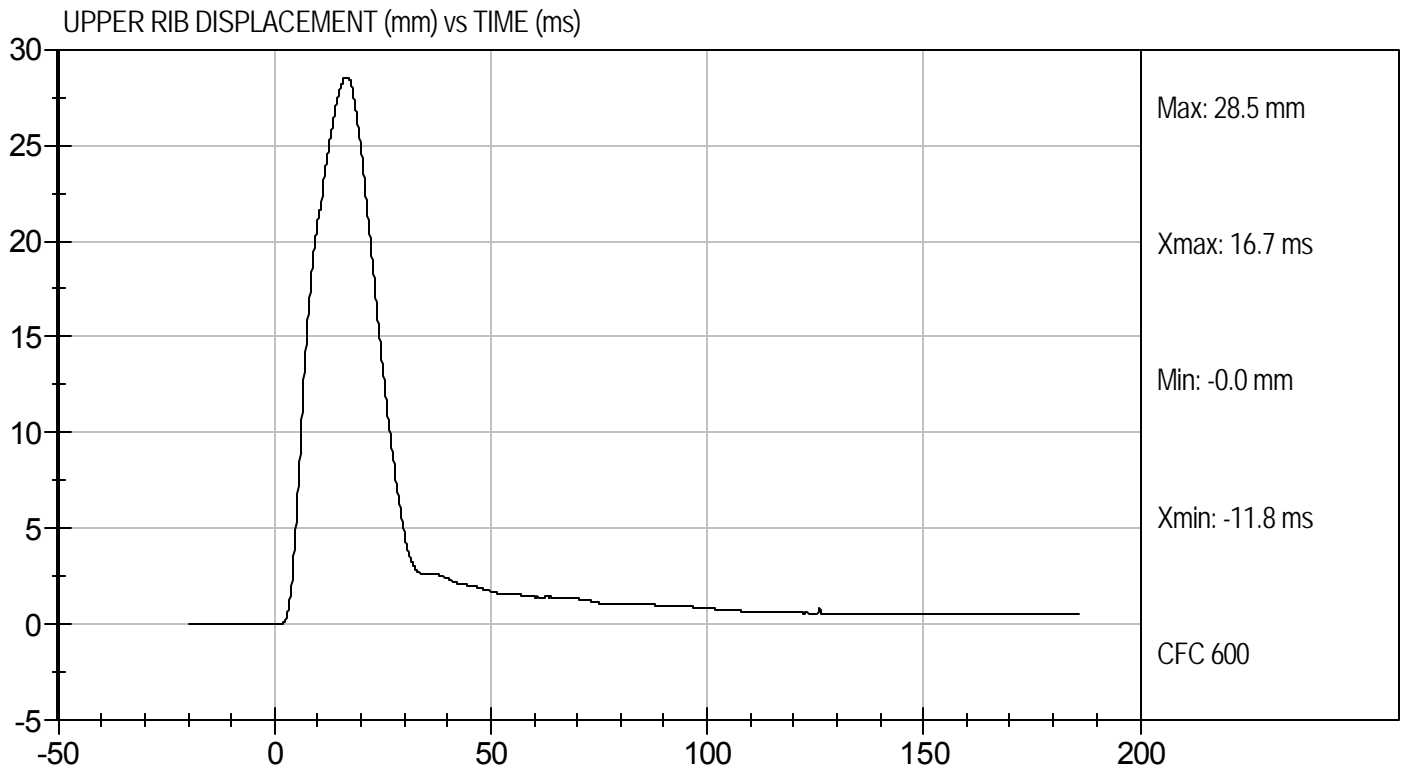
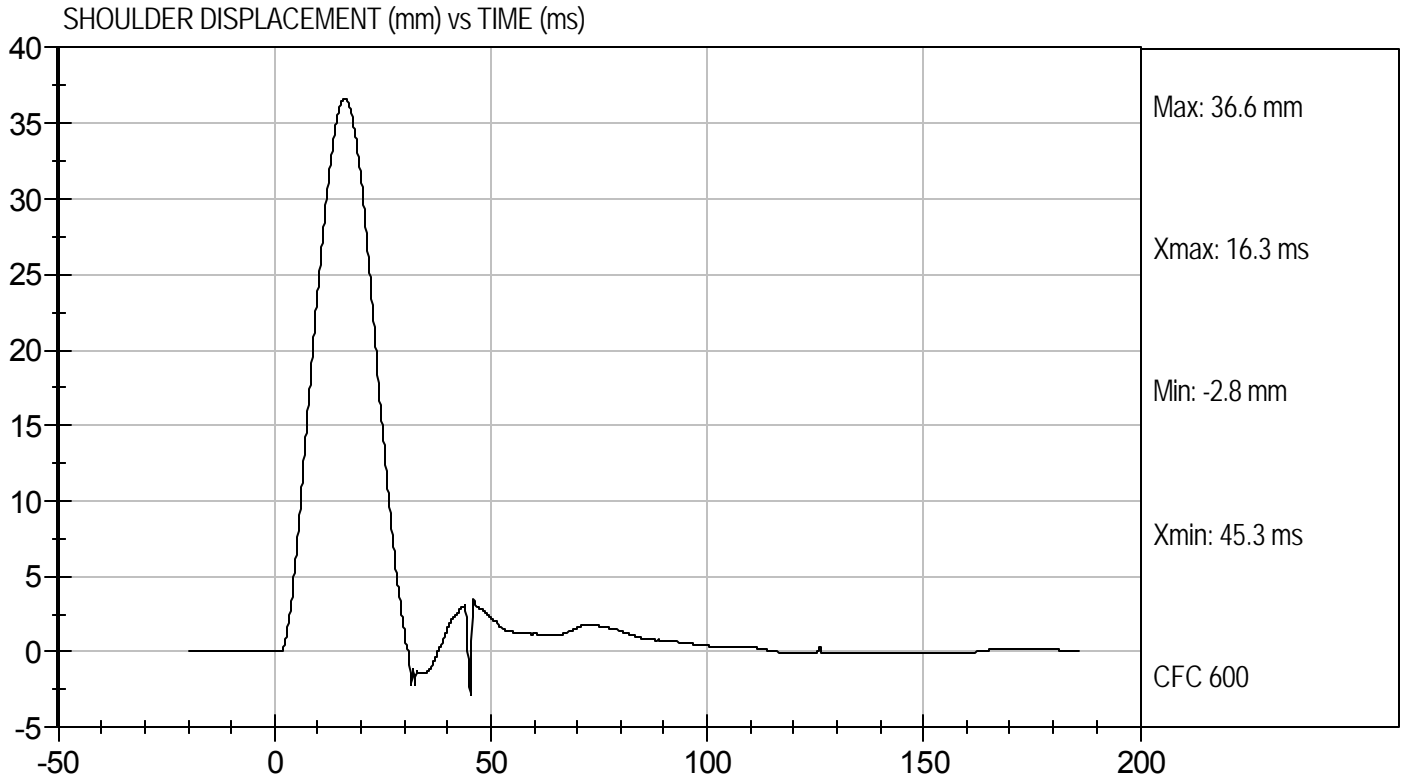
*David Winkelbauer*  
\_\_\_\_\_  
Approved By



Test Desc: Thorax With Arm  
Component ID: D112994

Test Date: 9/13/11  
Velocity: 22.22 ft/s, 6.77 m/s

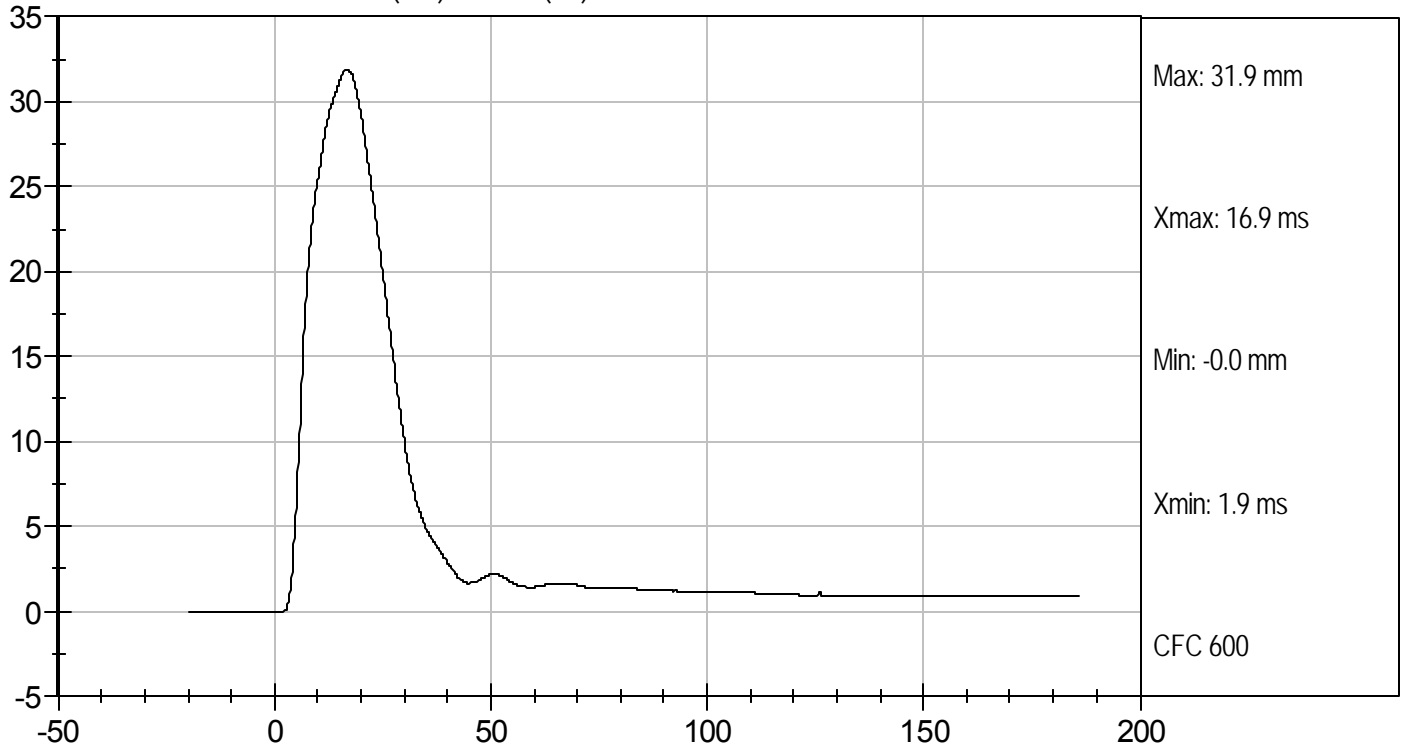




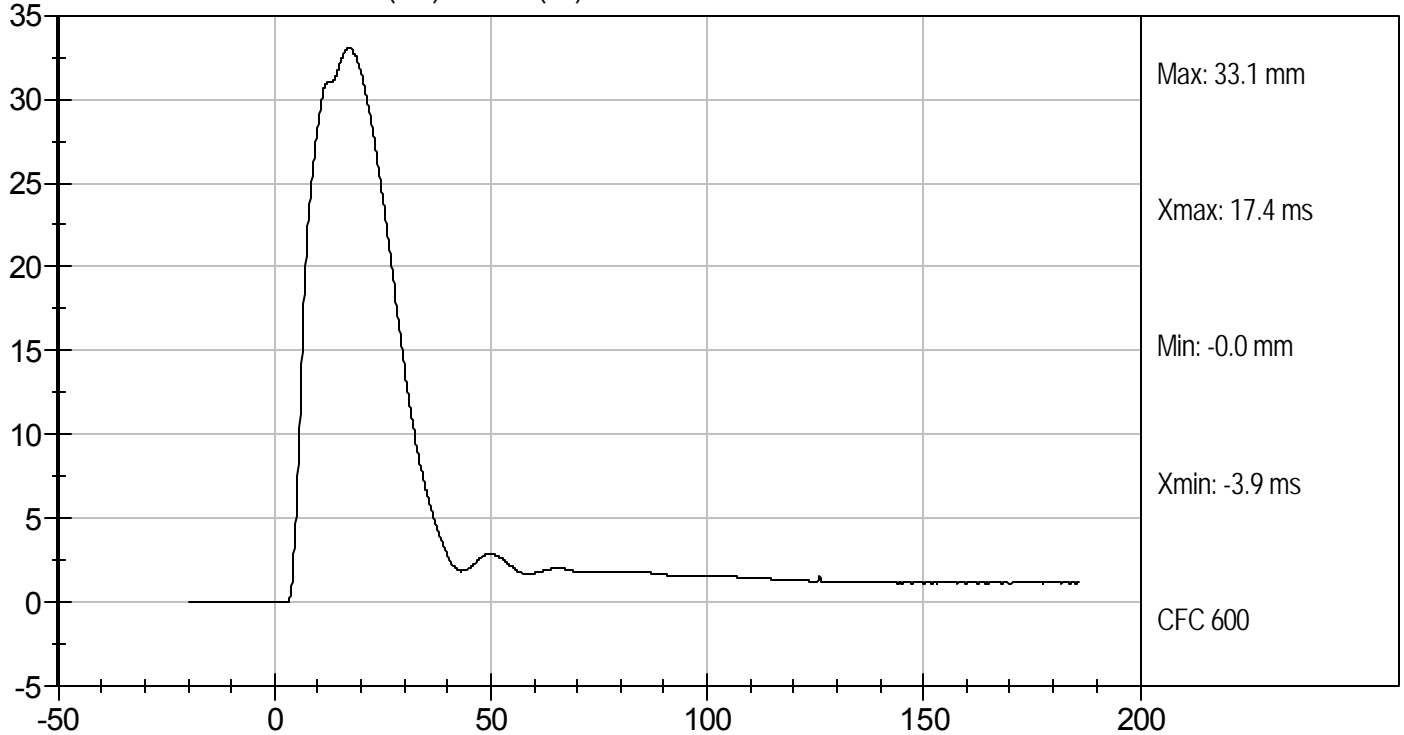




MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)

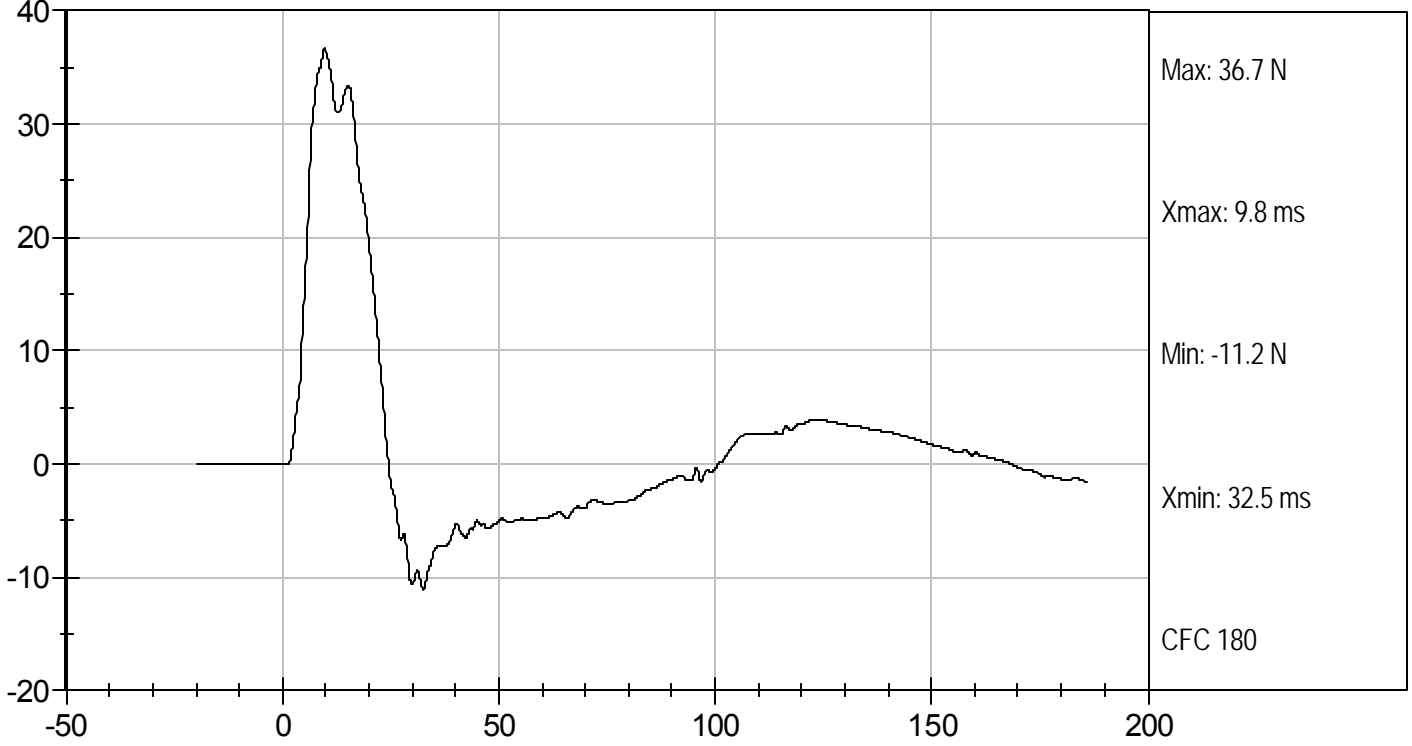


LOWER RIB DISPLACEMENT (mm) vs TIME (ms)

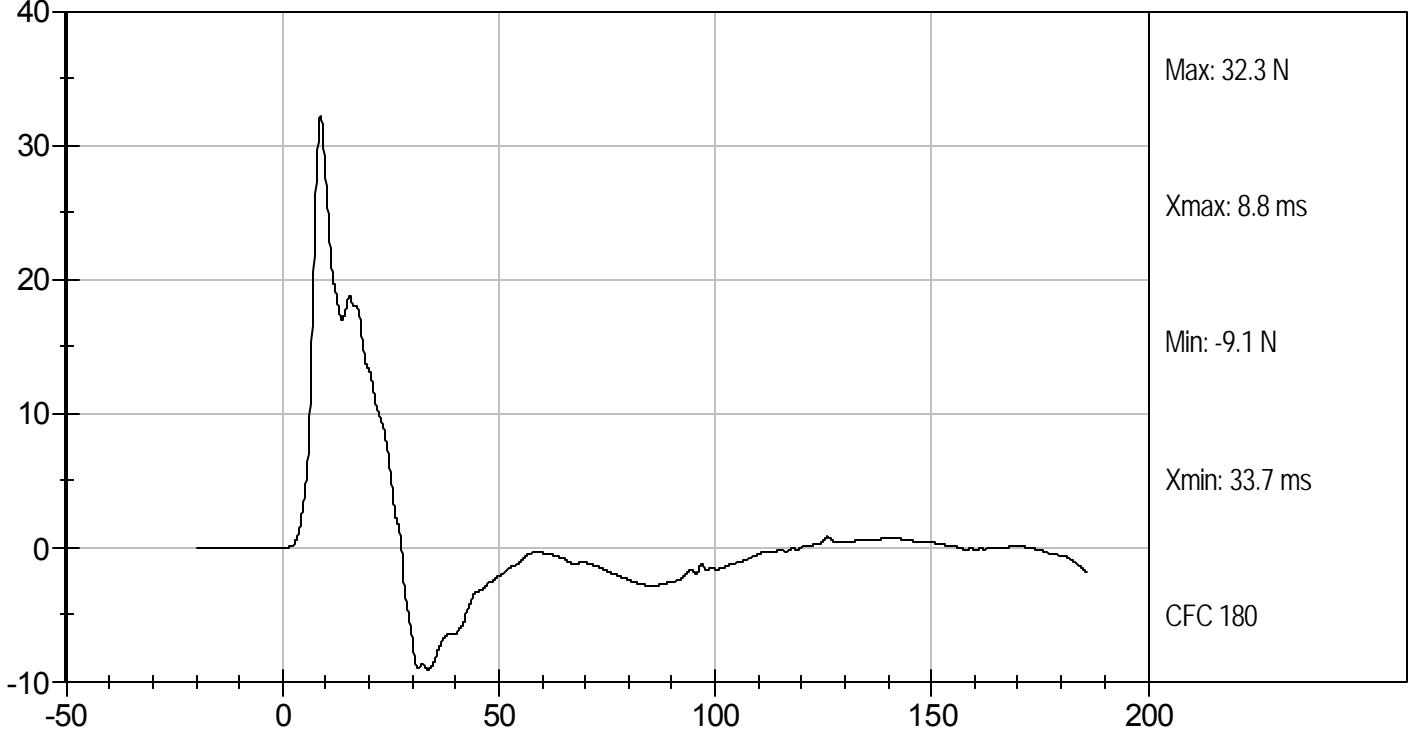




UPPER SPINE ACCELERATION (N) vs TIME (ms)



LOWER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION**  
**THORAX (WITHOUT ARM) IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D112995

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.8	Pass
Humidity	%	10 to 70	44	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Peak Impactor Force	G's	14 to 18	16	Pass
Upper Rib Displacement	mm	32 to 40	34	Pass
Middle Rib Displacement	mm	39 to 45	39	Pass
Lower Rib Displacement	mm	35 to 43	36	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	16	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	10	Pass
Overall Test Results				Pass

Jessica Hall  
Laboratory Technician

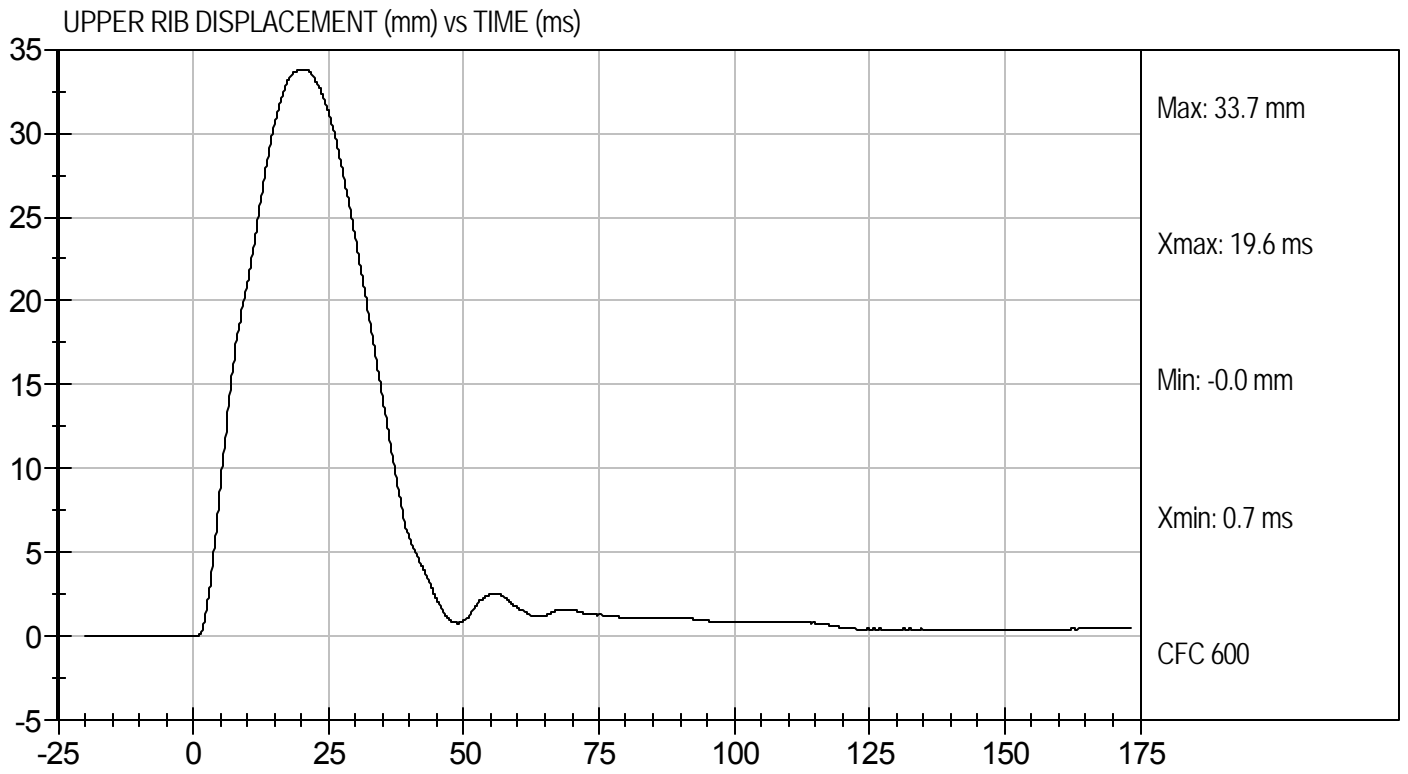
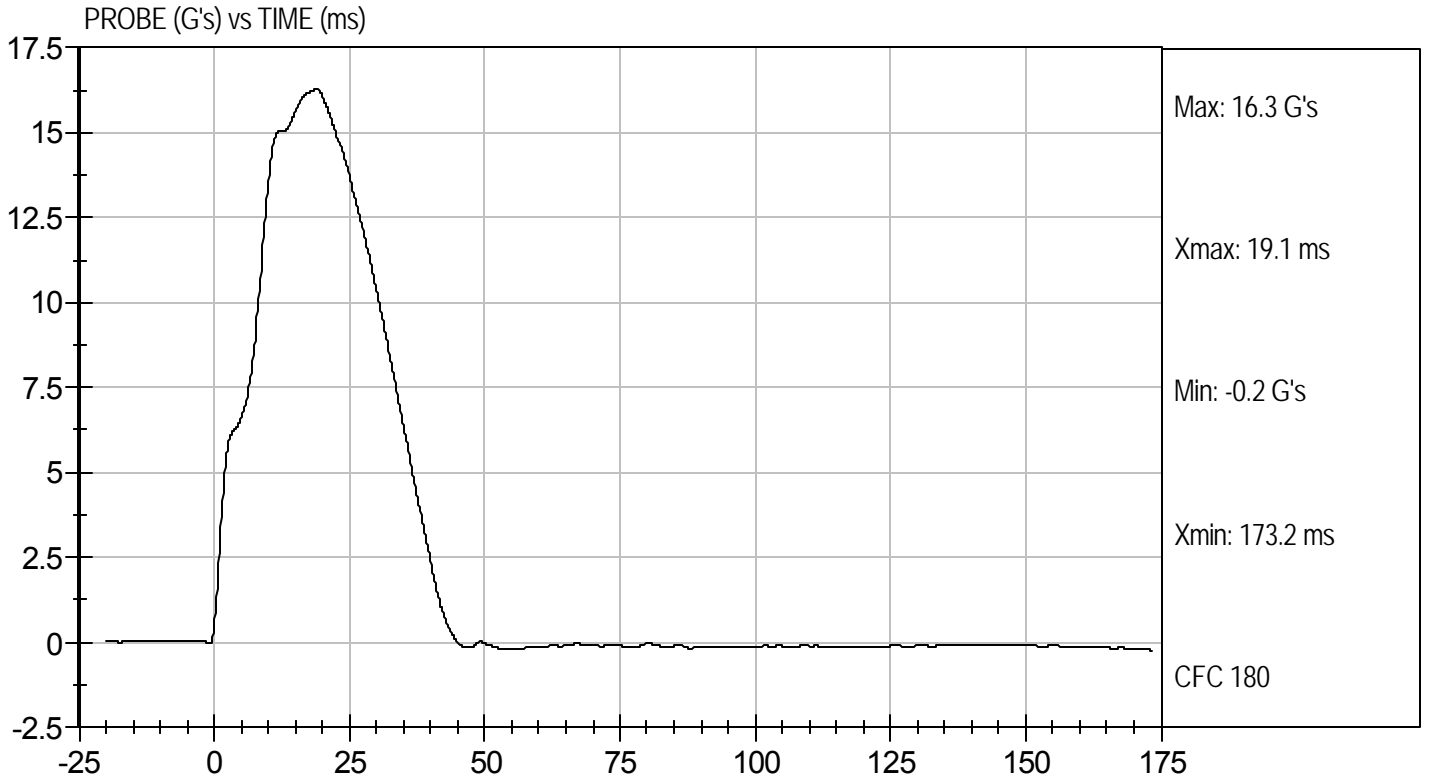
9/13/11  
Test Date

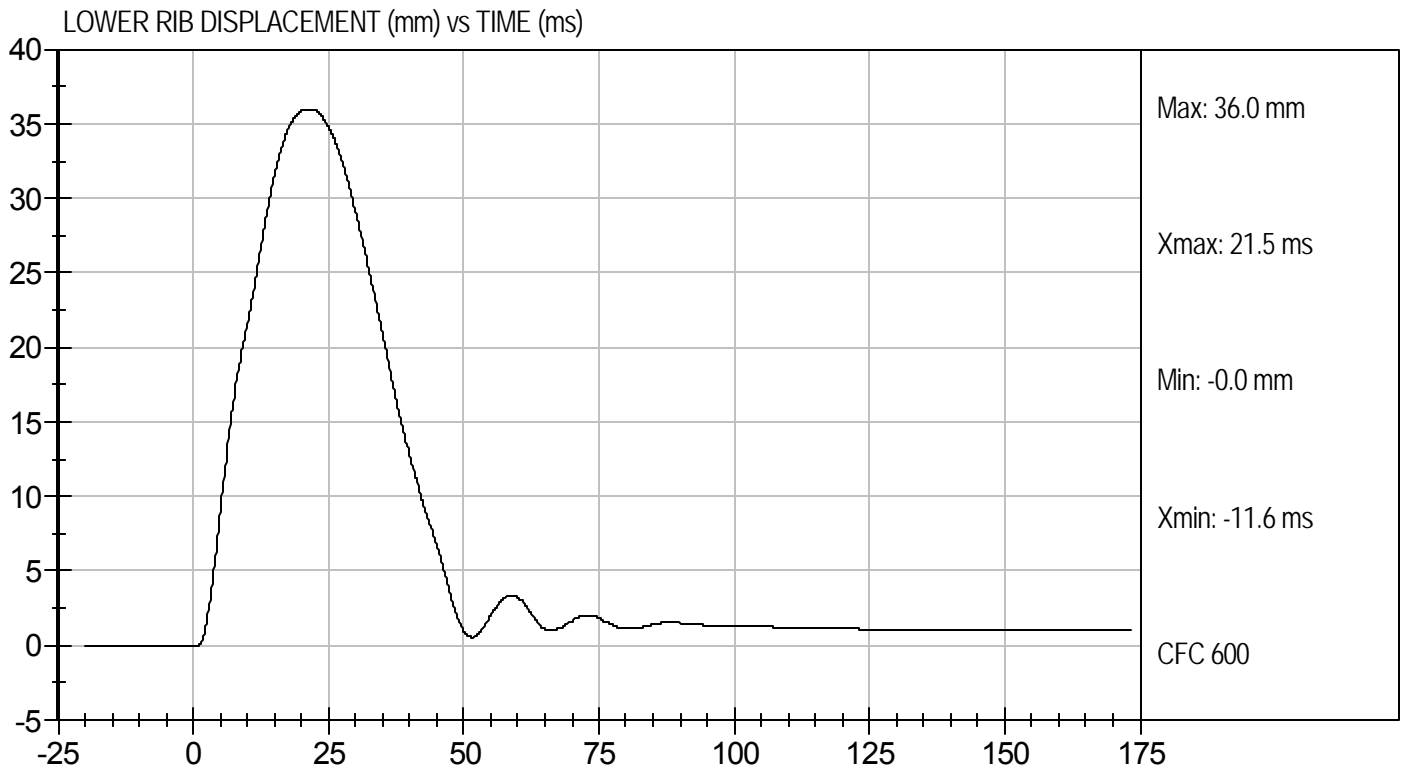
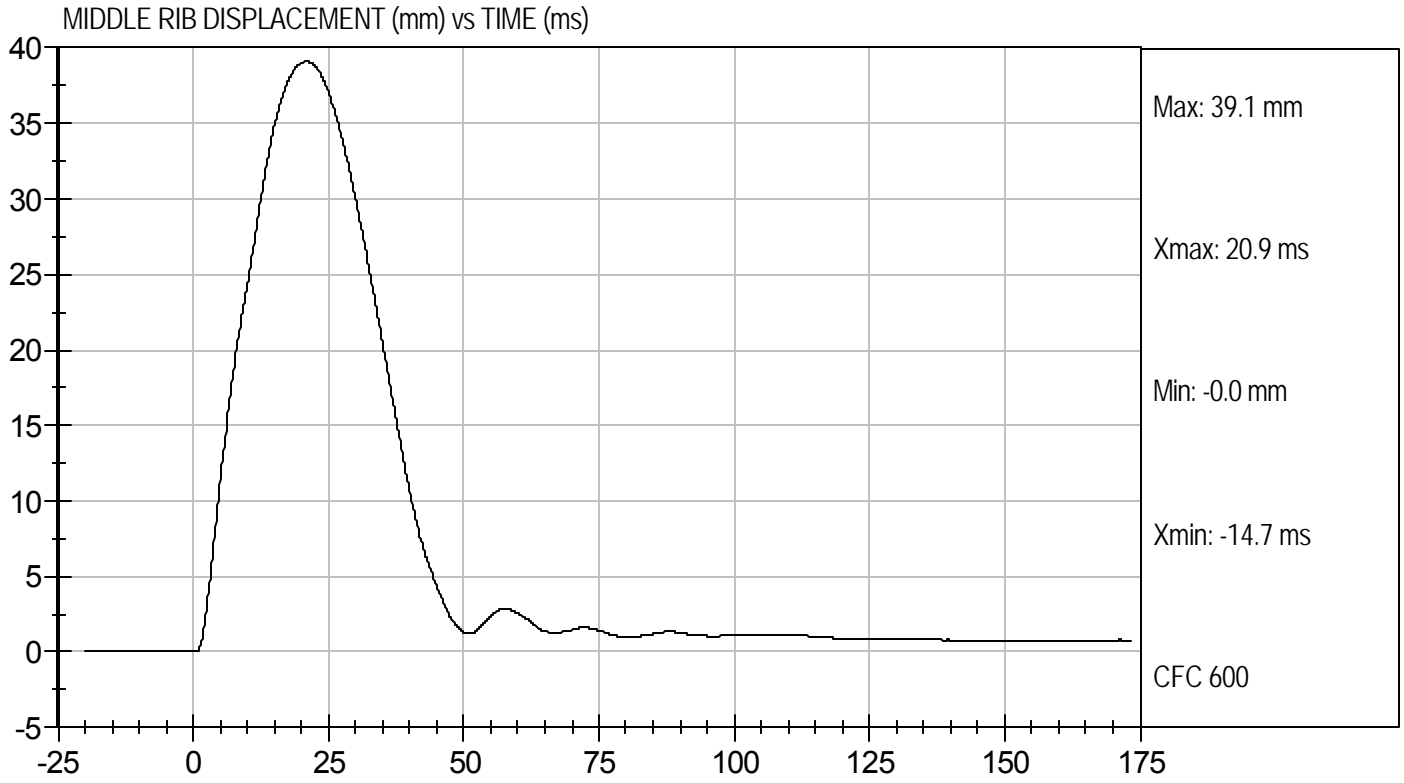
David Winkelbauer  
Approved By



Test Desc: Thorax Without Arm  
Component ID: D112995

Test Date: 9/13/11  
Velocity: 14.36 ft/s, 4.38 m/s

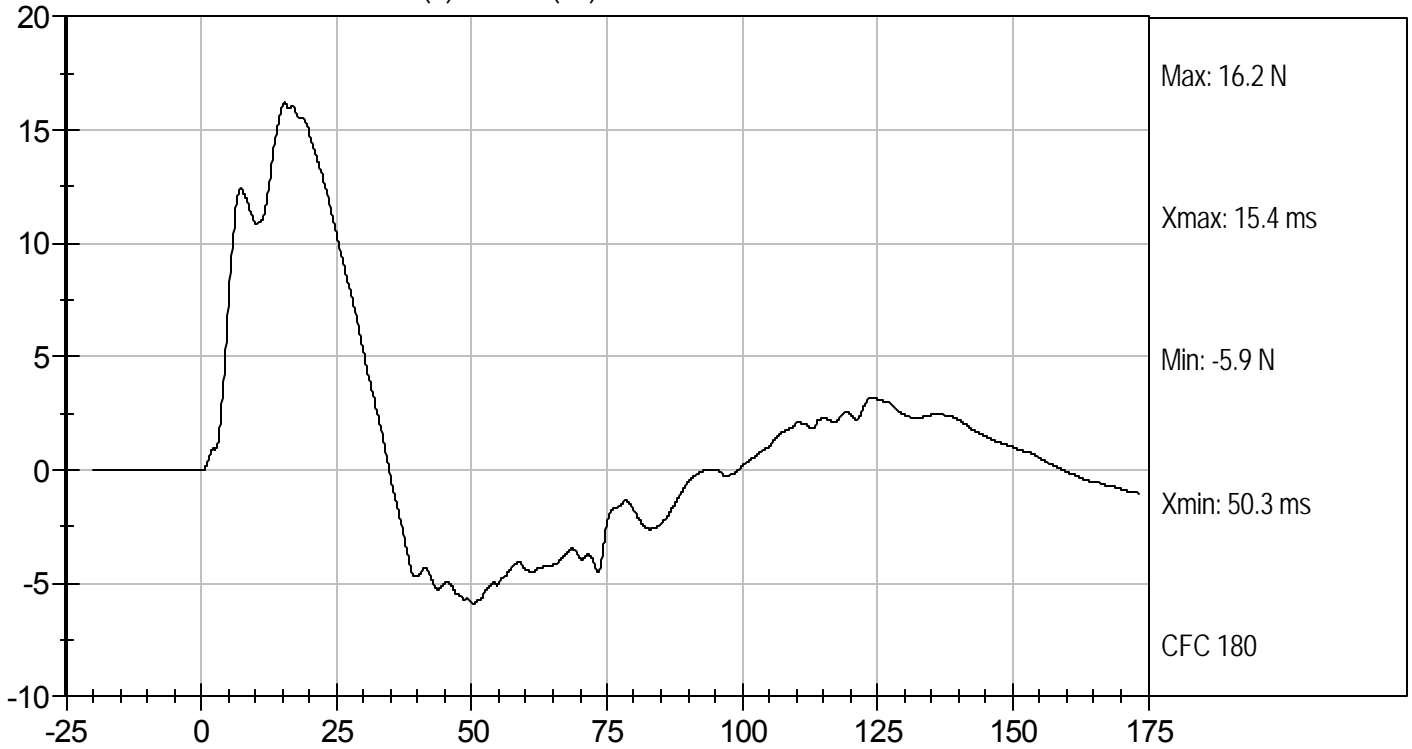




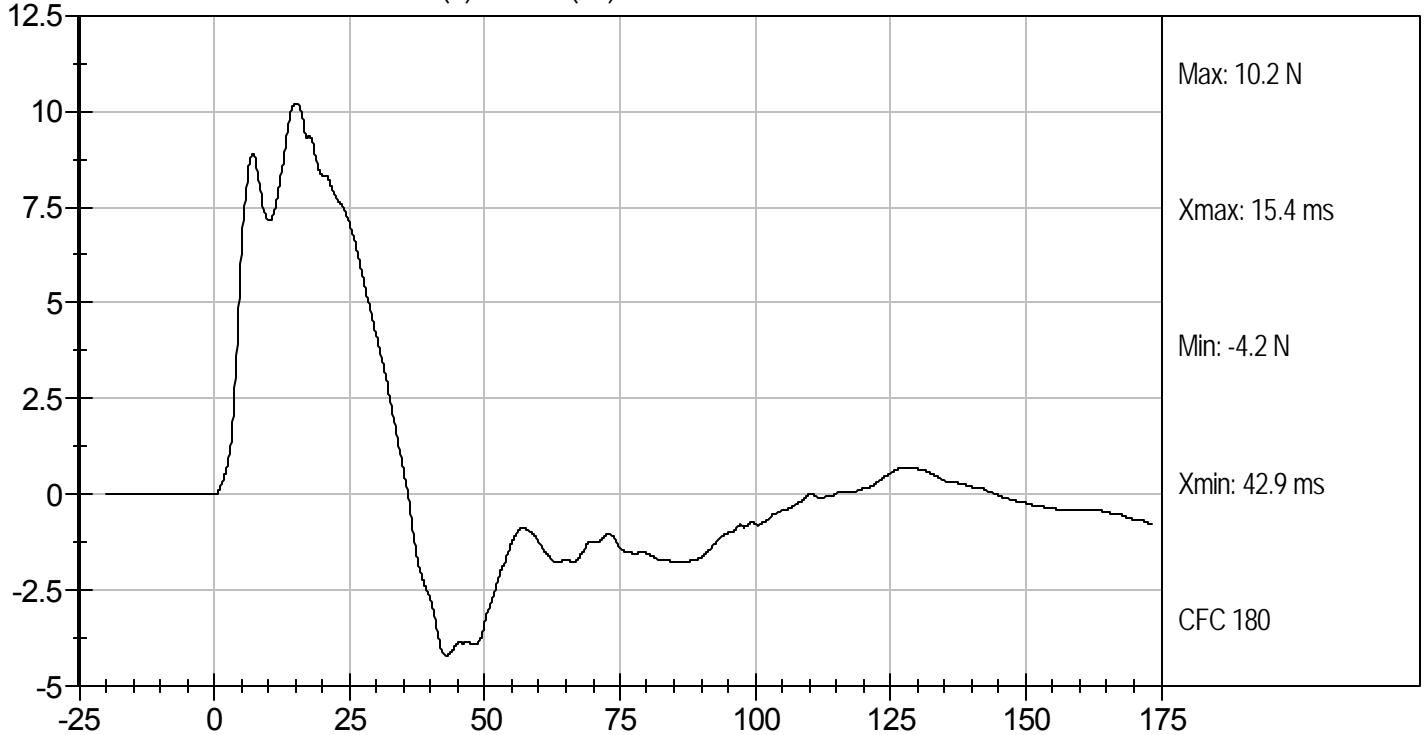




UPPER SPINE ACCELERATION (N) vs TIME (ms)



LOWER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION**  
**ABDOMINAL IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D112996

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.7	Pass
Humidity	%	10 to 70	44	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Peak Impactor Acceleration	G's	12 to 16	13	Pass
Upper Rib Displacement	mm	36 to 47	41	Pass
Lower Rib Displacement	mm	33 to 44	34	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	10	Pass
Overall Test Results				Pass

*Jessica Hall*  
 \_\_\_\_\_  
 Laboratory Technician

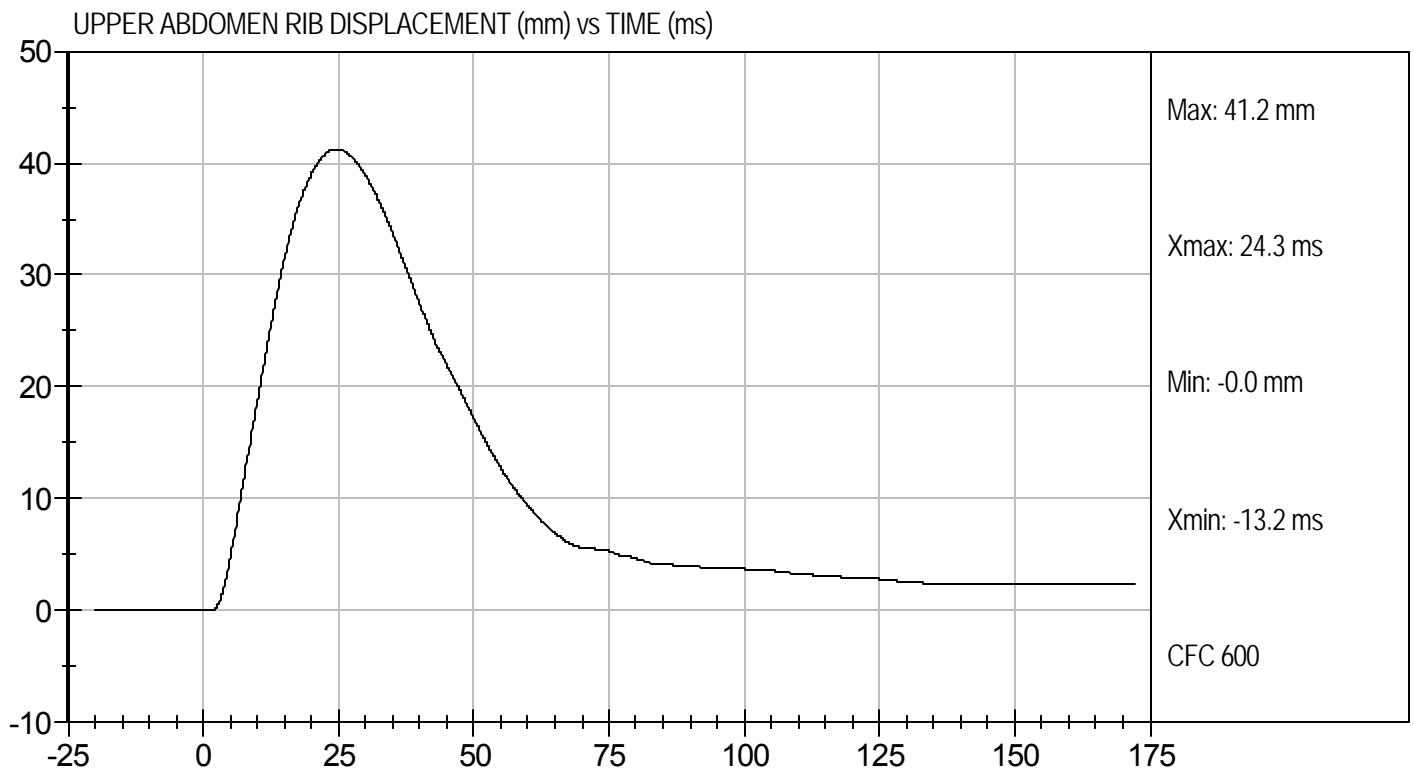
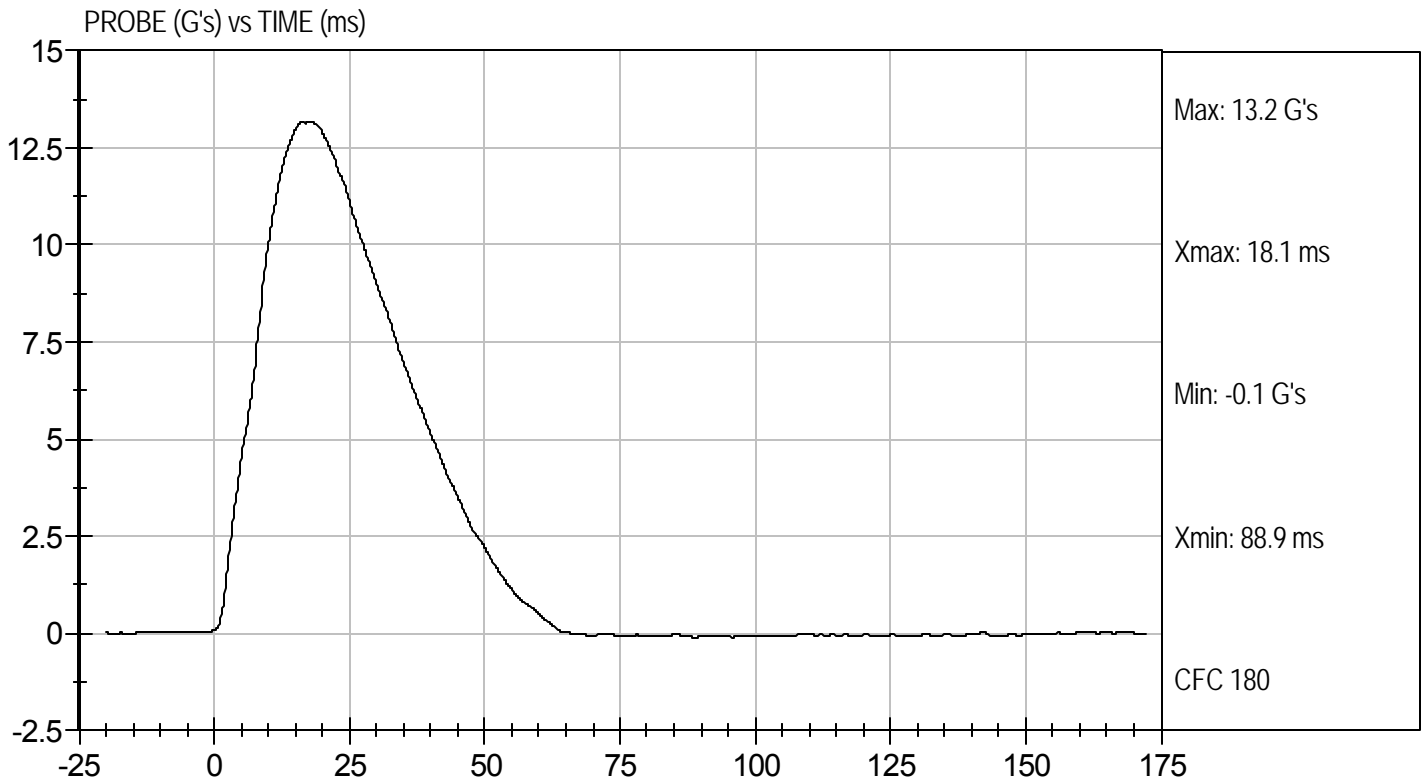
9/13/11  
 \_\_\_\_\_  
 Test Date

*David Winkelbauer*  
 \_\_\_\_\_  
 Approved By



Test Desc: Abdomen Impact  
Component ID: D112996

Test Date: 9/13/11  
Velocity: 14.25 ft/s, 4.34 m/s

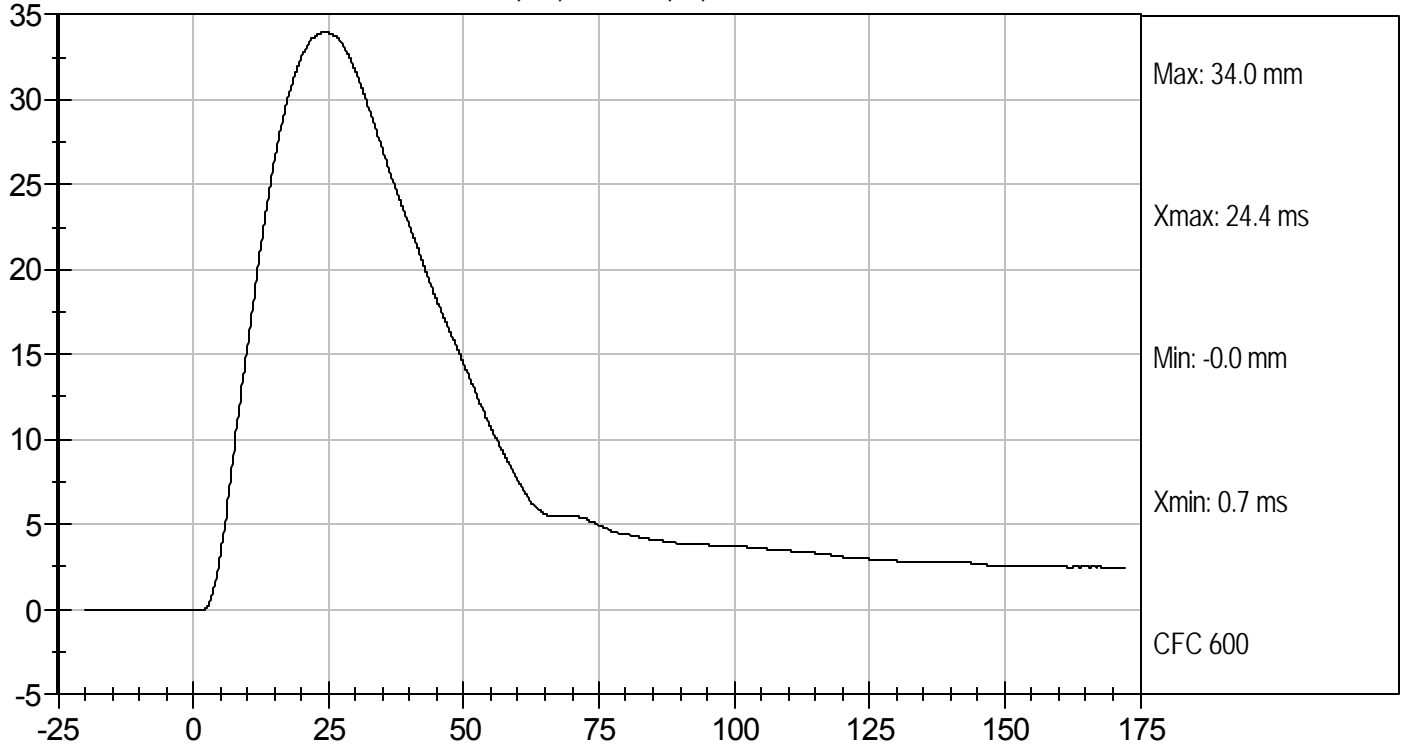




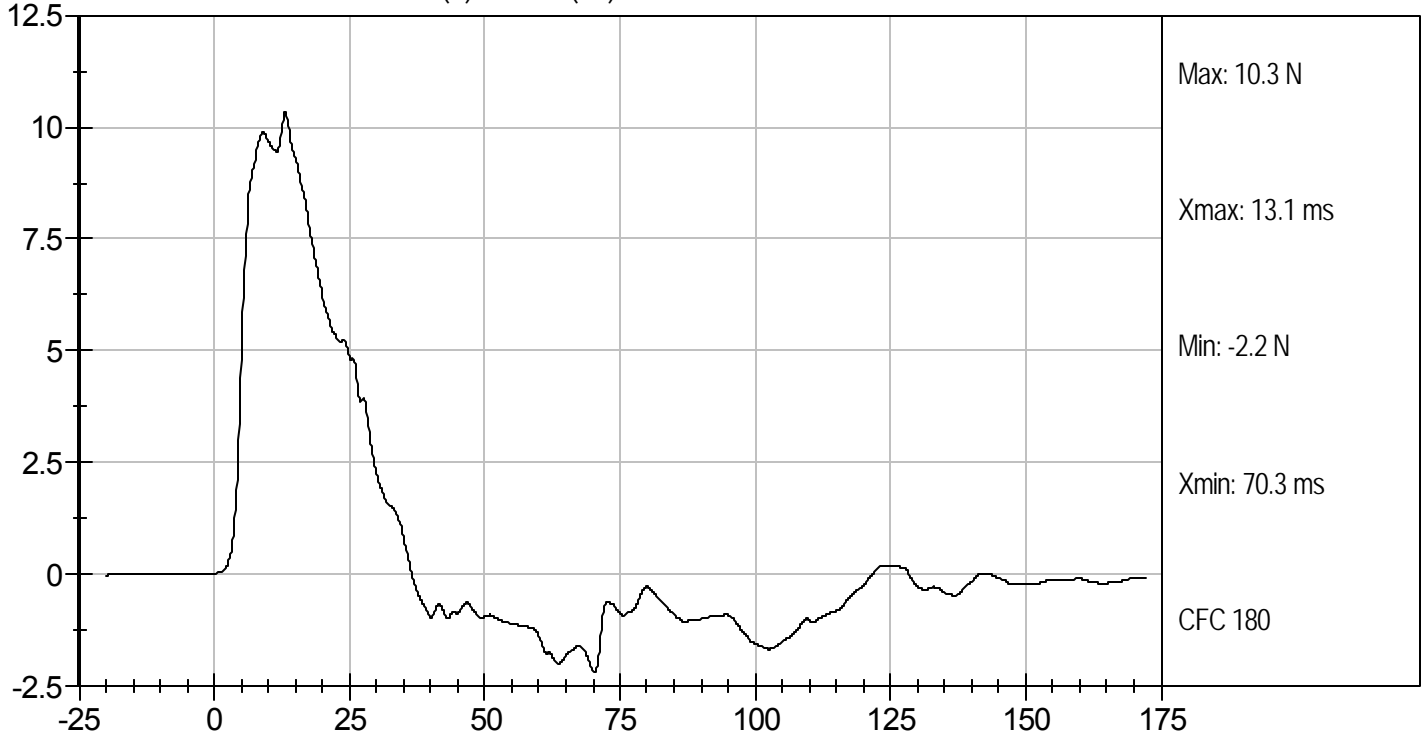
Test Desc: Abdomen Impact  
Component ID: D112996

Test Date: 9/13/11  
Velocity: 14.25 ft/s, 4.34 m/s

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



LOWER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION**  
**PELVIS IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D112997

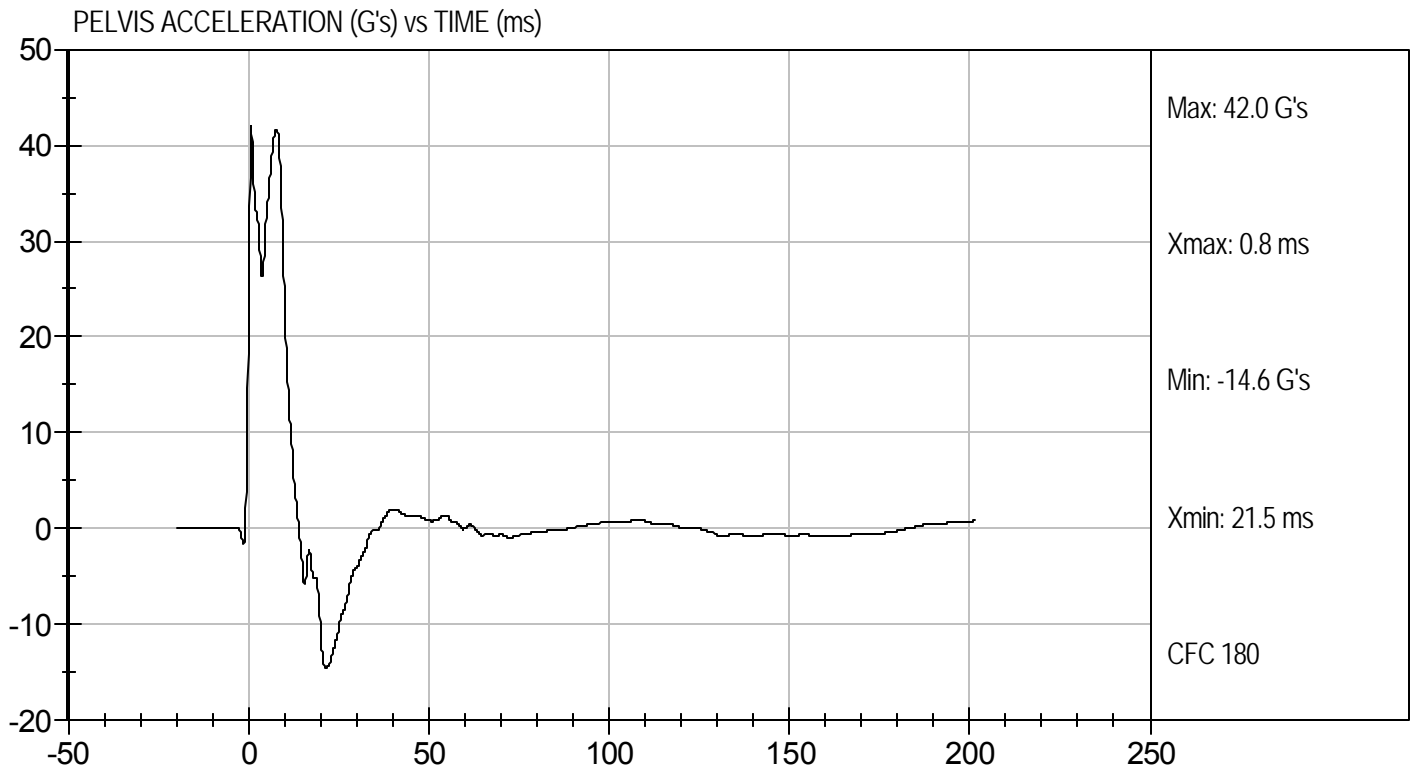
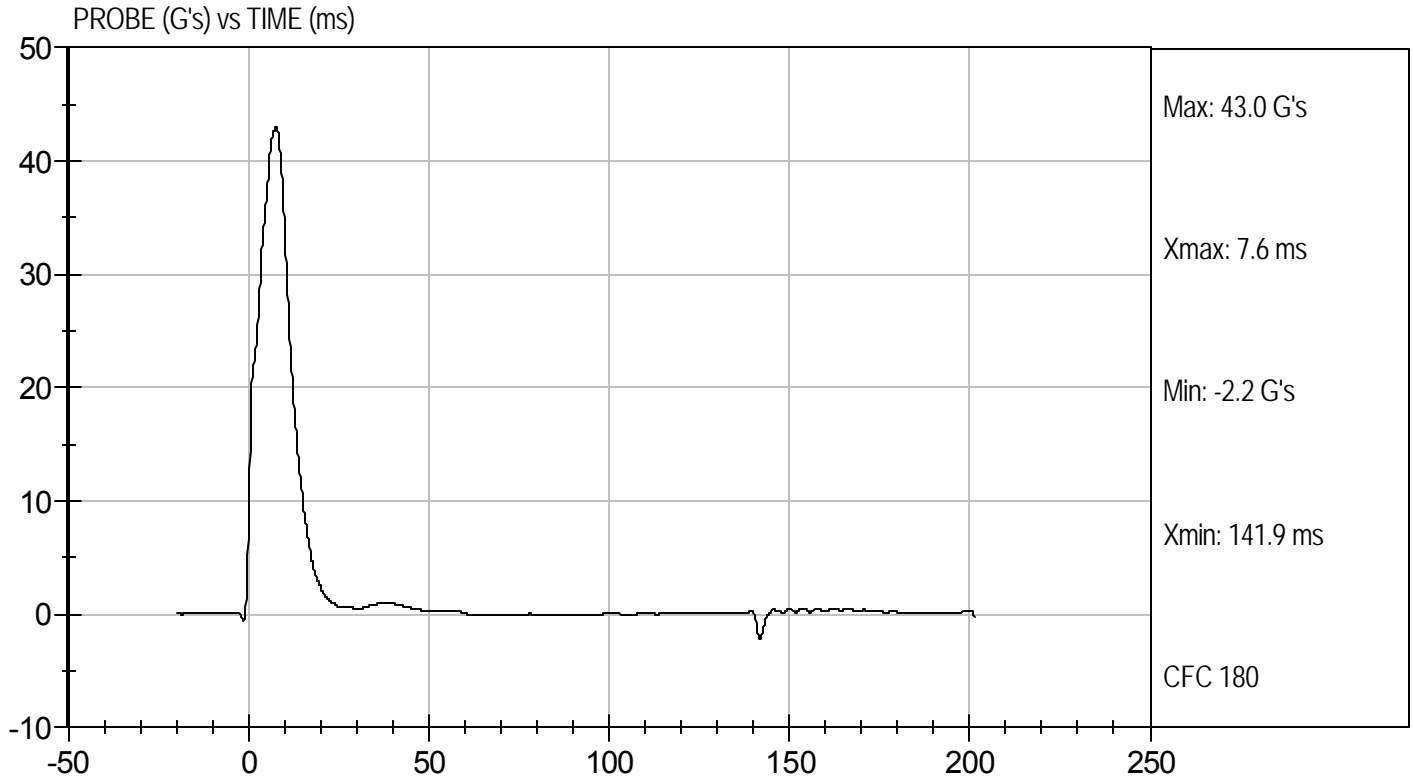
Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.3	Pass
Humidity	%	10 to 70	42	Pass
Impact Velocity	m/s	6.60 to 6.80	6.71	Pass
Peak Impactor Acceleration	G's	38 to 47	43	Pass
Pelvis Y Acceleration after 6 ms	G's	34 to 42	42	Pass
Peak Acetabulum Force	N	3600 to 4300	3742	Pass
Overall Test Results				Pass

*Jessica Hall*  
 \_\_\_\_\_  
 Laboratory Technician

9/13/11  
 \_\_\_\_\_  
 Test Date

*David Winkelbauer*  
 \_\_\_\_\_  
 Approved By

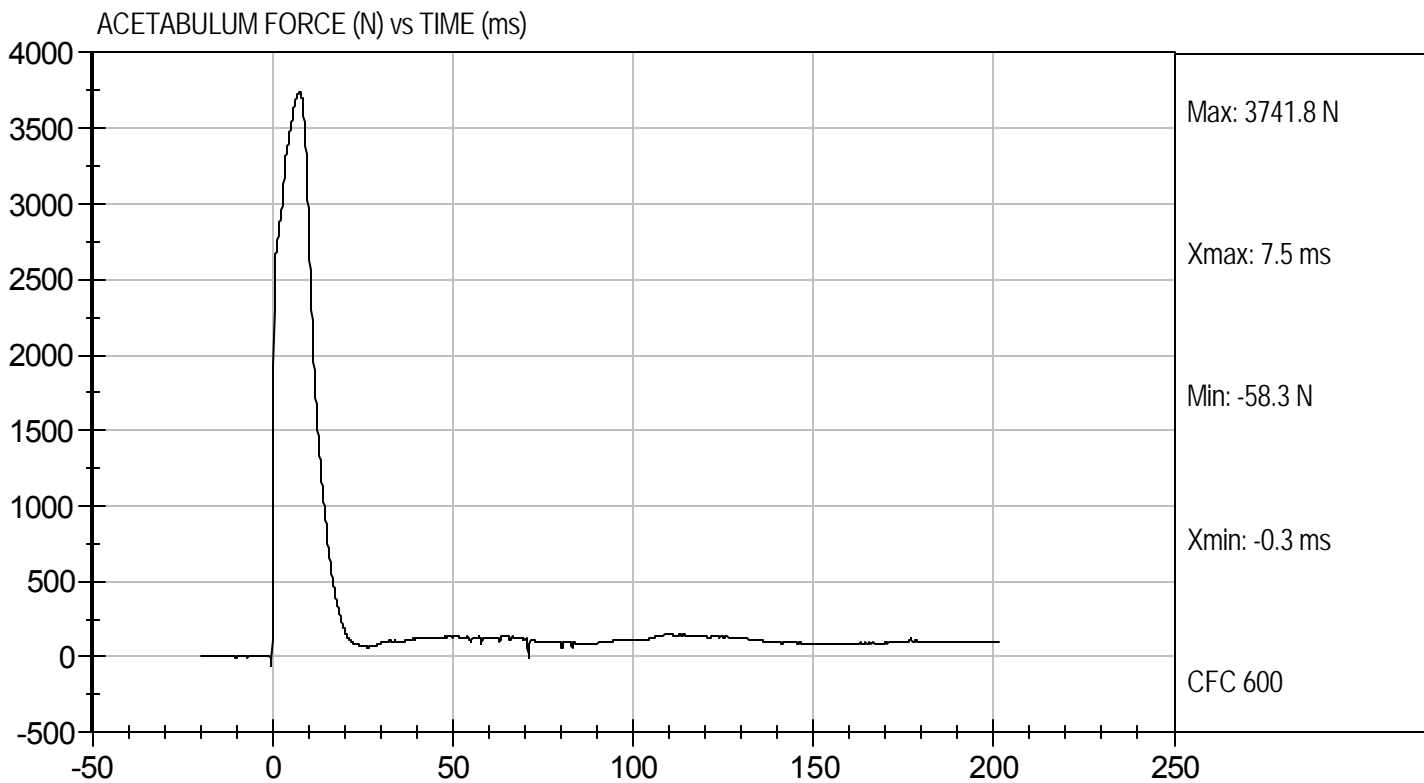






Test Desc: Pelvis Impact  
Component ID: D112997

Test Date: 9/13/11  
Velocity: 22.00 ft/s, 6.71 m/s



**MGA RESEARCH CORPORATION**  
**ILIAC IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D112998

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	45	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Peak Impactor Acceleration	G's	36 to 45	37	Pass
Pelvis Y Acceleration	G's	28 to 39	31	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4117	Pass
Overall Test Results				Pass

*Jessica Hall*  
 \_\_\_\_\_  
 Laboratory Technician

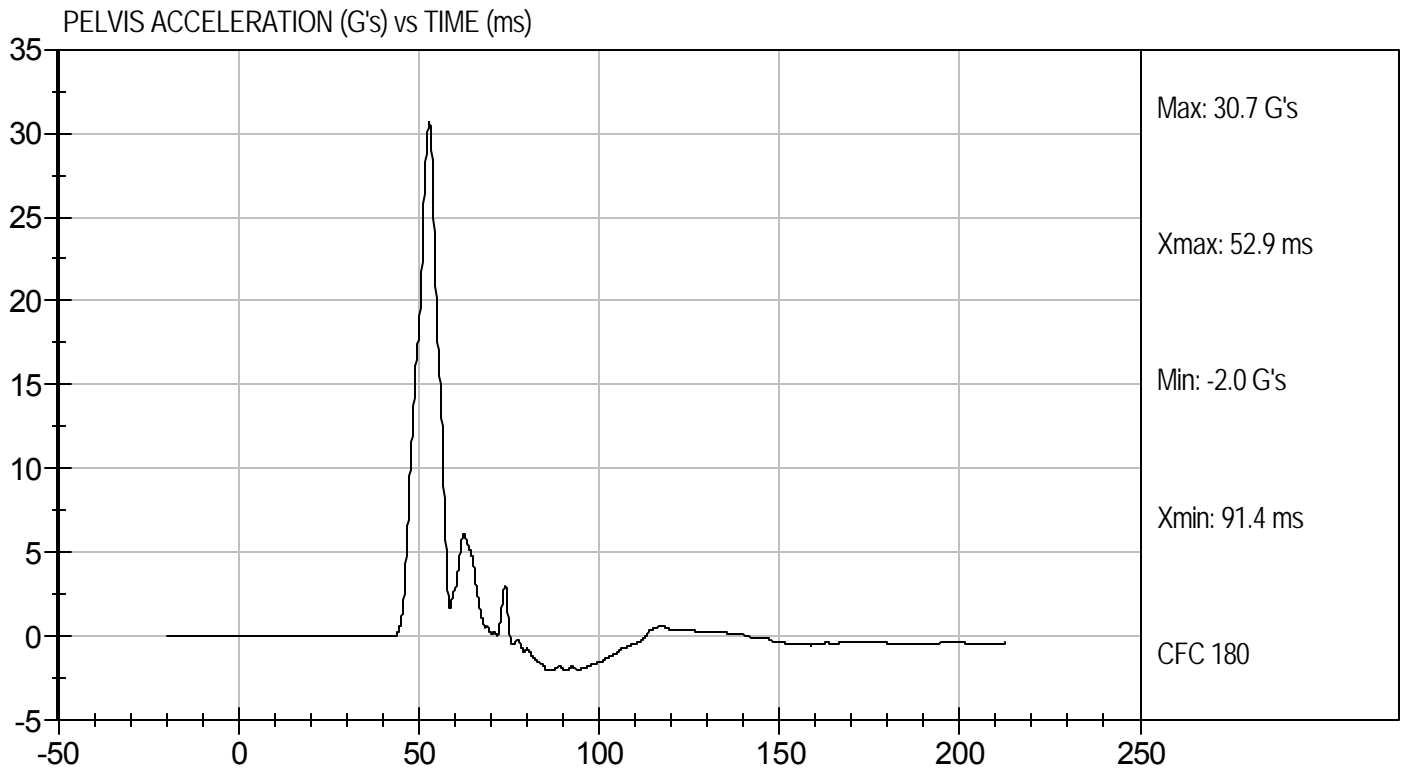
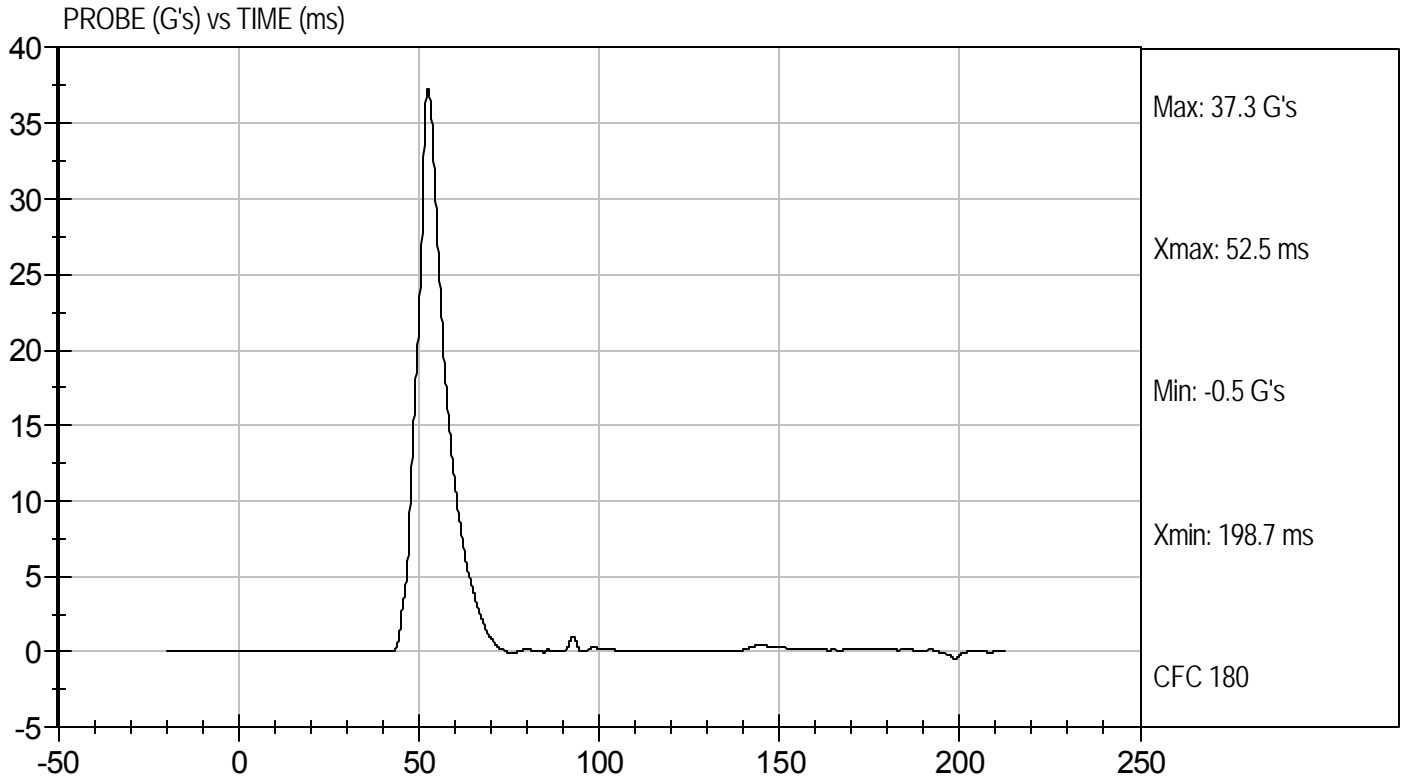
9/13/11  
 \_\_\_\_\_  
 Test Date

*David Winkelbauer*  
 \_\_\_\_\_  
 Approved By



Test Desc: Iliac Impact  
Component ID: D112998

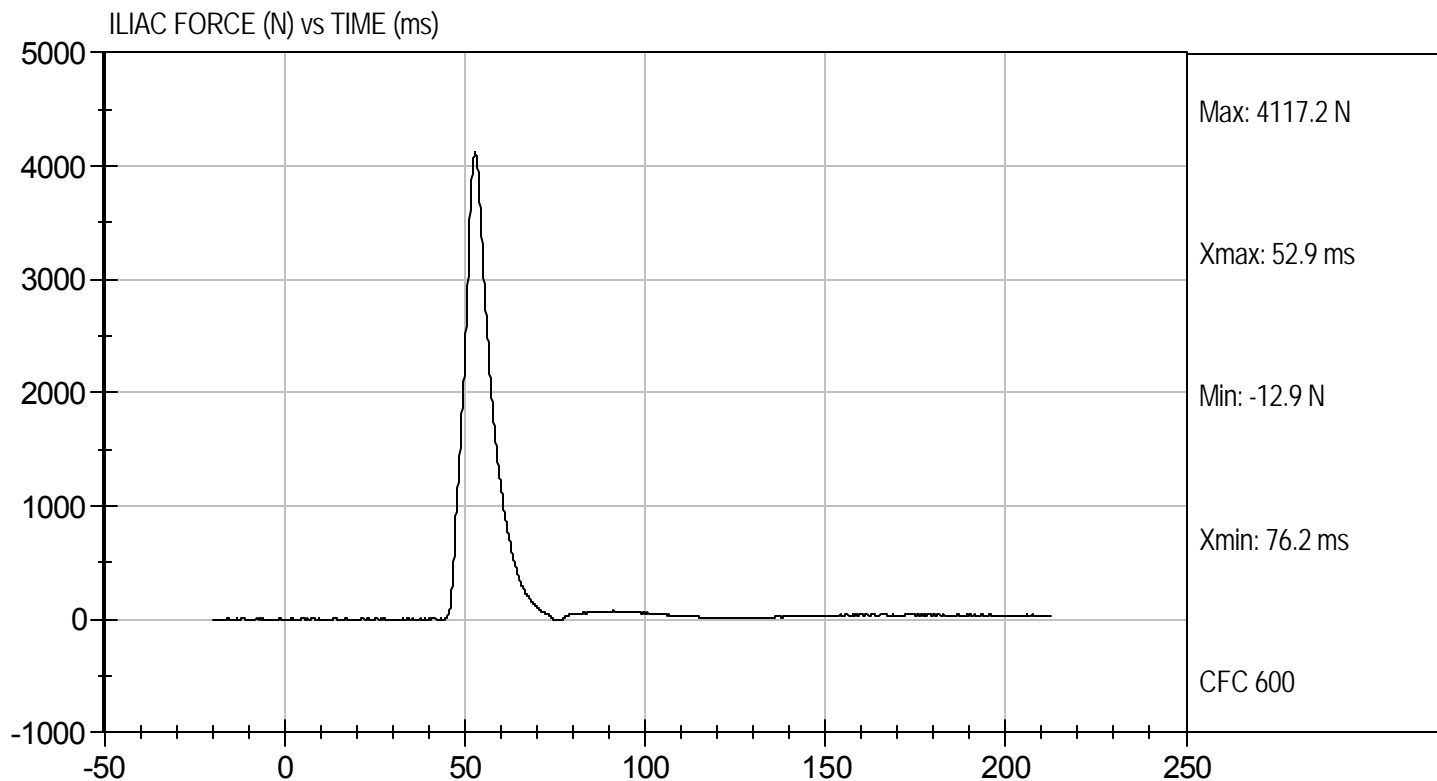
Test Date: 9/13/11  
Velocity: 14.36 ft/s, 4.38 m/s





Test Desc: Iliac Impact  
Component ID: D112998

Test Date: 9/13/11  
Velocity: 14.36 ft/s, 4.38 m/s



**MGA RESEARCH CORPORATION**  
**HEAD DROP TEST**  
**SID-Its BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test ID: D113121

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	42	Pass
Peak Resultant Acceleration	G's	115 to 137	136	Pass
Peak Lateral Acceleration	G's	+/- 15	-3.4	Pass
Unimodal	N/A	<15%	Yes	Pass
Overall Test Results				Pass

*Jessica Hall*  
 Laboratory Technician

9/21/11  
 Test Date

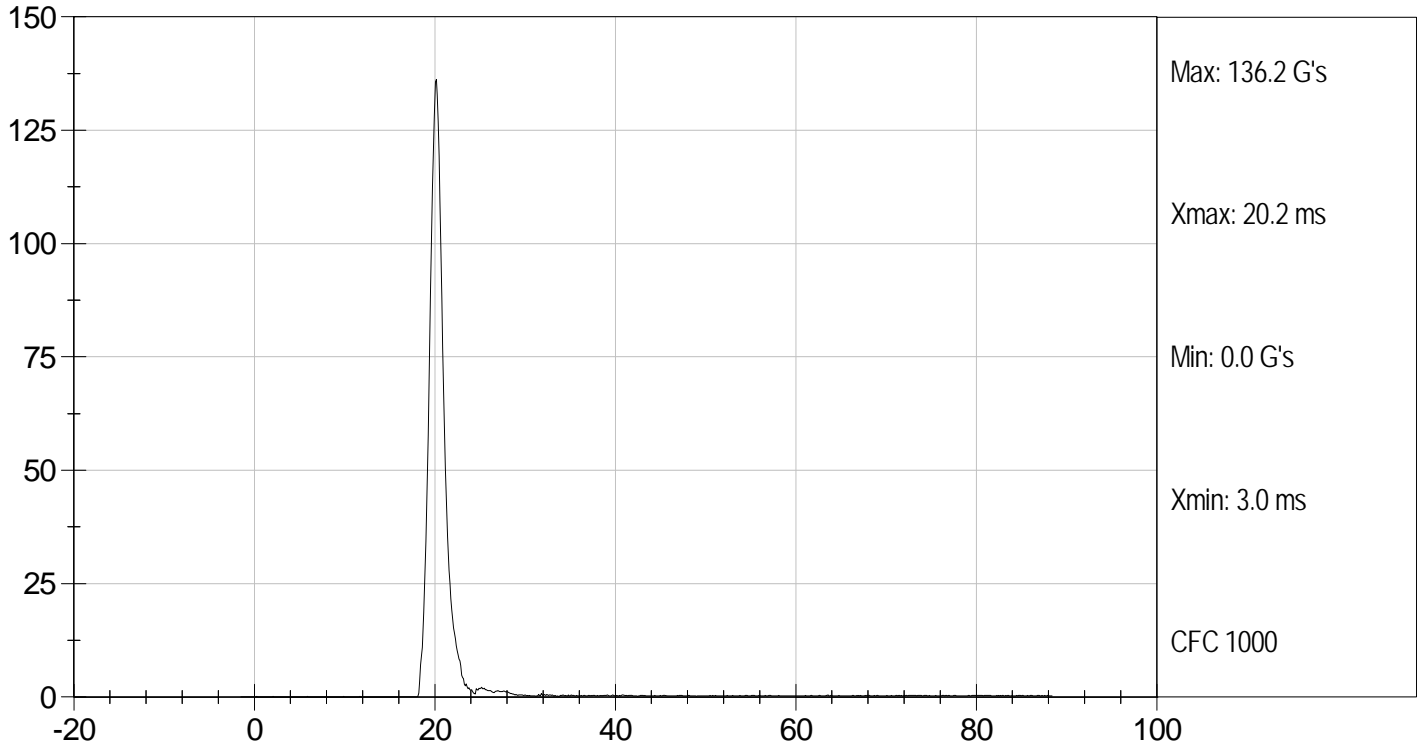
*David Winkelbauer*  
 Approved By



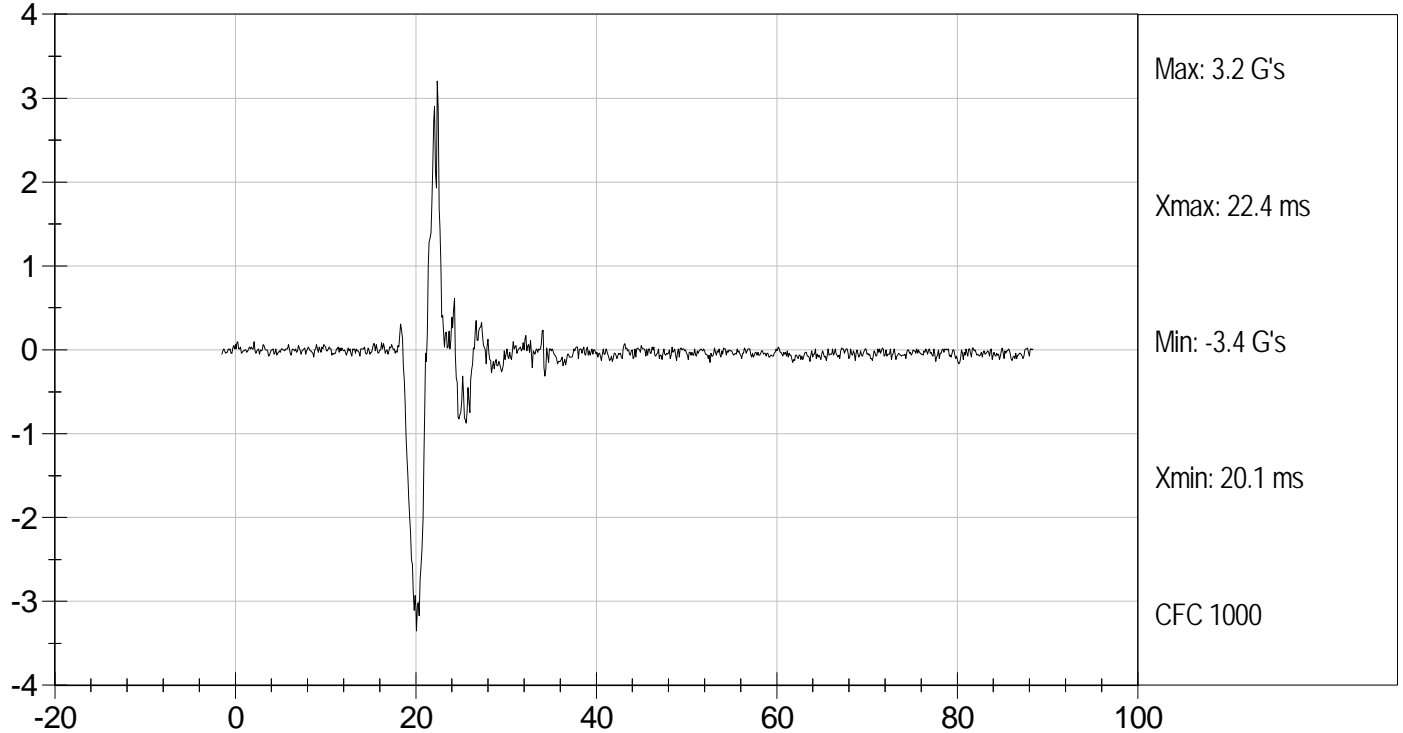
Test Desc: Head Drop  
Component ID: D113121

Test Date: 9/21/11  
Velocity: 0 ft/s, 0 m/s

PEAK RESULTANT ACCELERATION (G's) vs TIME (ms)



PEAK LONGITUDINAL ACCELERATION (G's) vs TIME (ms)





**MGA RESEARCH CORPORATION  
LATERAL NECK PENDULUM TEST  
SID-IIs BUILD LEVEL D DUMMY**


ATD Serial No: 262

Test I.D: D113122

Tested Parameter		Units	Specification	Result	Pass/Fail
Temperature		deg C	20.6 to 22.2	21.5	Pass
Humidity		%	10 to 70	43	Pass
Impact Velocity		m/s	5.51 to 5.63	5.58	Pass
Delta Velocity	10 ms	m/s	2.20 to 2.80	2.68	Pass
	15 ms	m/s	3.30 to 4.10	3.78	Pass
	20 ms	m/s	4.40 to 5.40	4.94	Pass
	25 ms	m/s	5.40 to 6.10	5.52	Pass
	25-100 ms	m/s	5.50 to 6.20	5.54	Pass
Maximum D-Plane Rotation		deg	71 to 81	75	Pass
Time of Maximum D-Plane Rotation		ms	50 to 70	60	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	118	Pass
Overall Test Results					Pass

  
Laboratory Technician

9/21/11  
Test Date

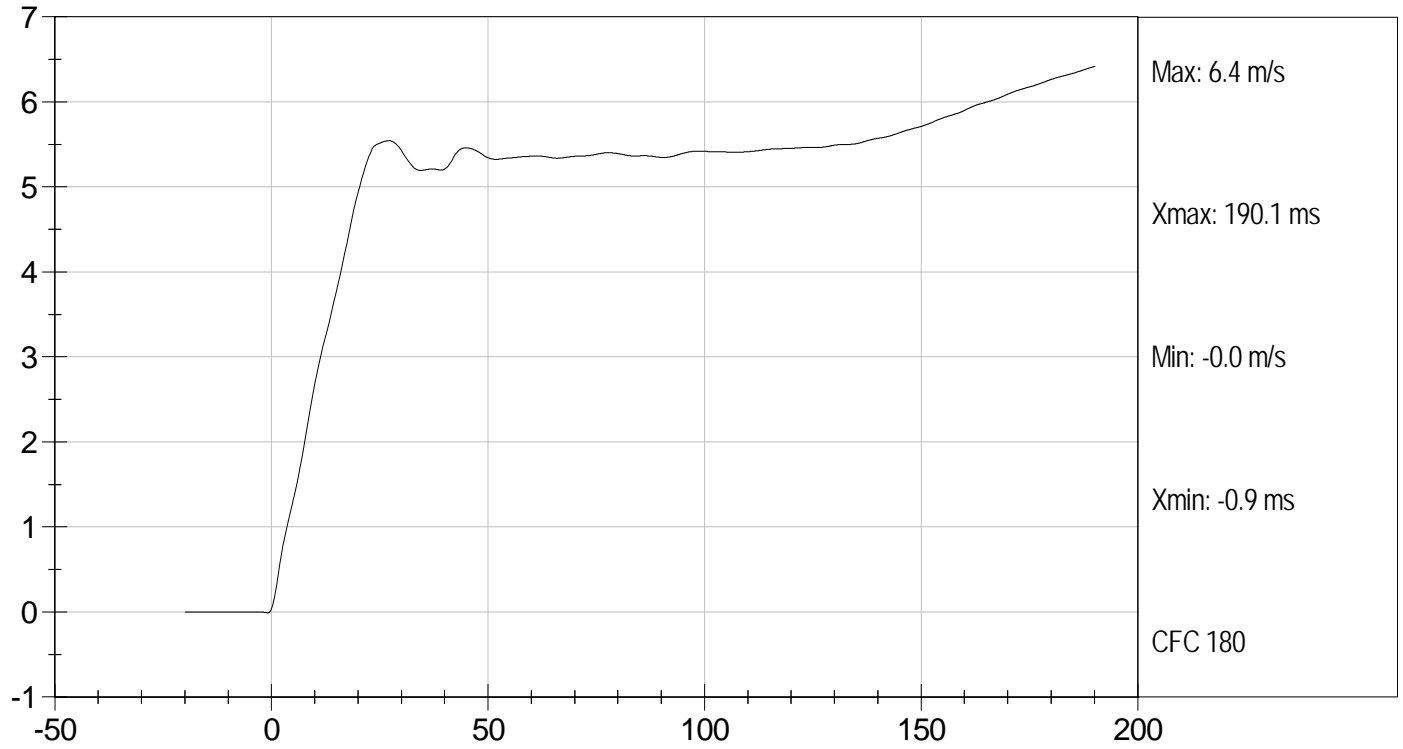
  
Approved By



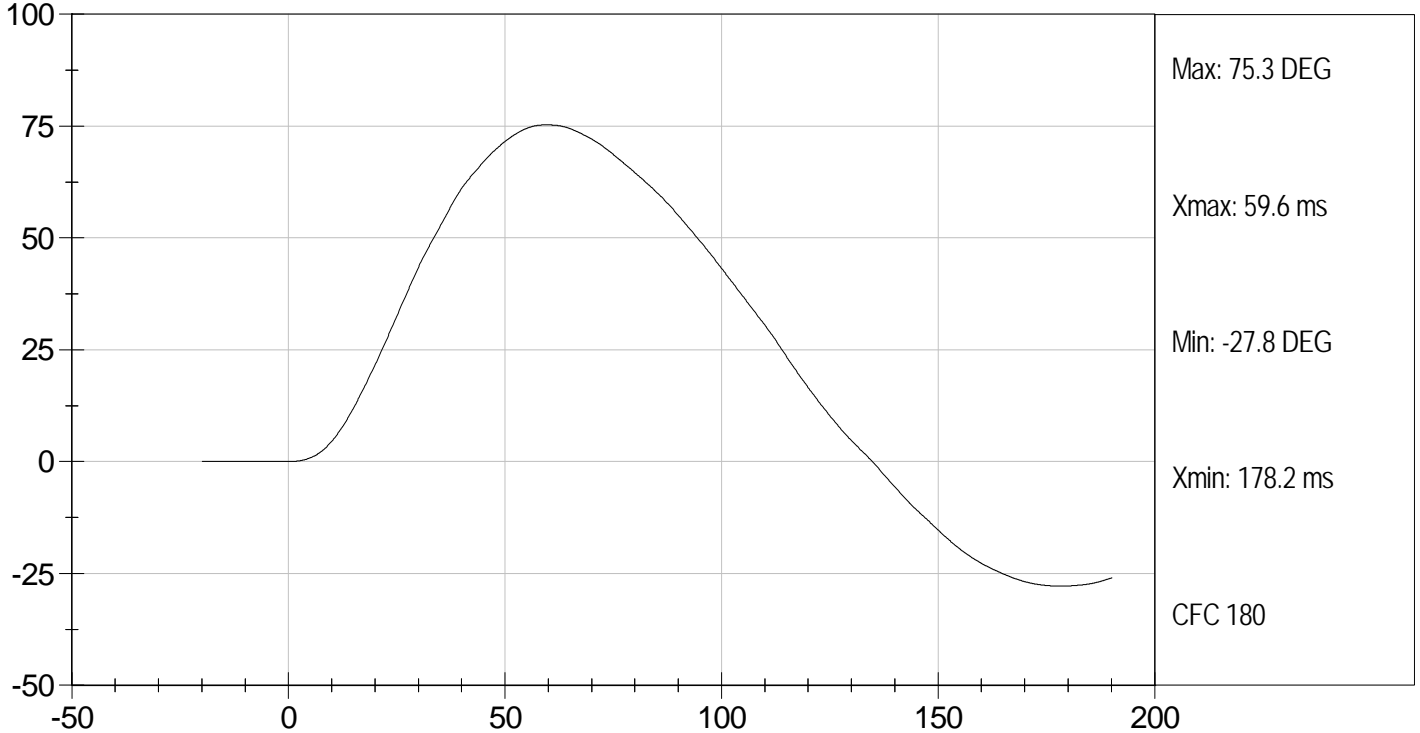
Test Desc: Neck Bending  
Component ID: D113122

Test Date: 9/21/11  
Velocity: 18.32 ft/s, 5.58 m/s

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



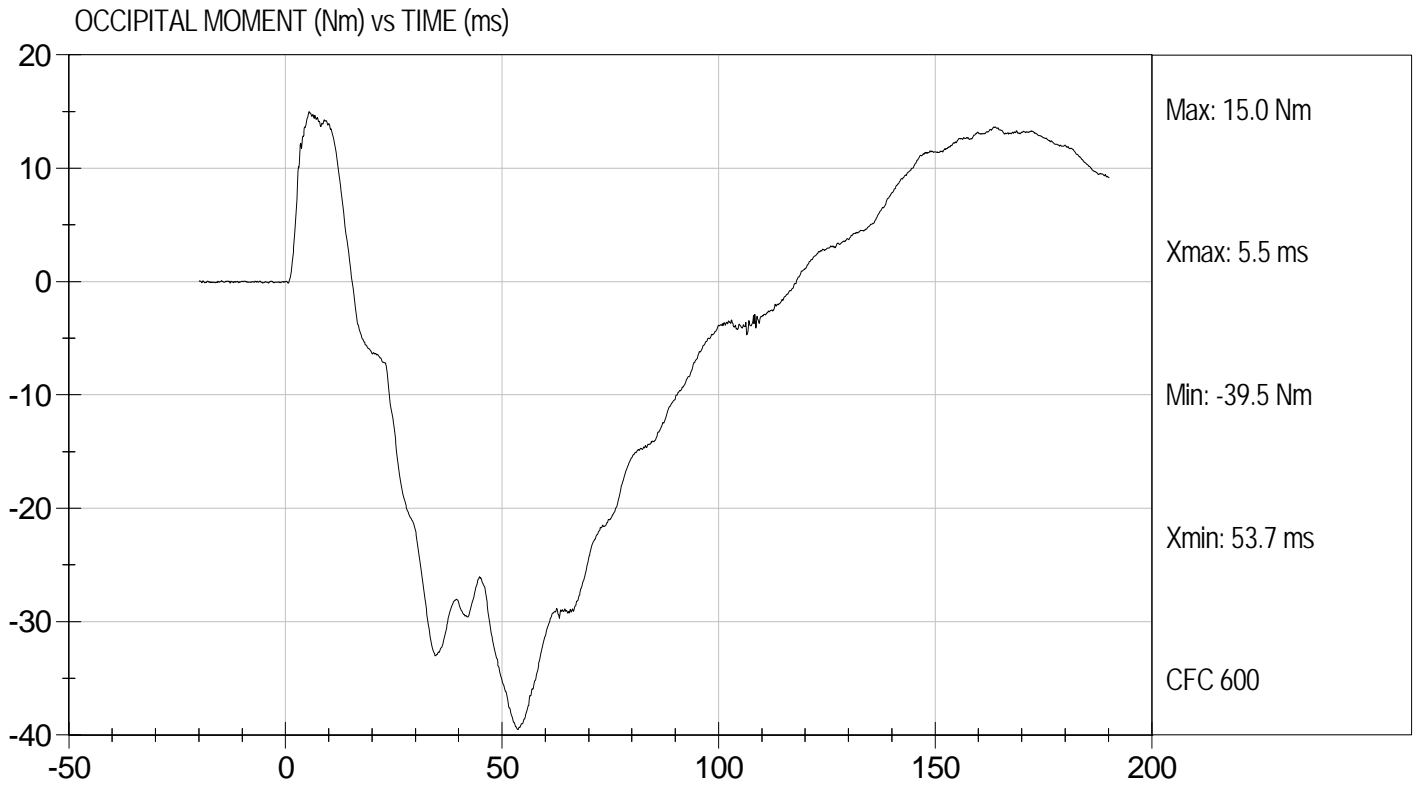
FLEXION ANGLE (DEG) vs TIME (ms)





Test Desc: Neck Bending  
Component ID: D113122

Test Date: 9/21/11  
Velocity: 18.32 ft/s, 5.58 m/s



**MGA RESEARCH CORPORATION  
SHOULDER IMPACT TEST  
SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test ID: D113123

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	43	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	32	Pass
Upper Spine (T1) Y Acceleration	G's	17 to 22	18	Pass
Overall Test Results				Pass

Jessica Hall  
Laboratory Technician

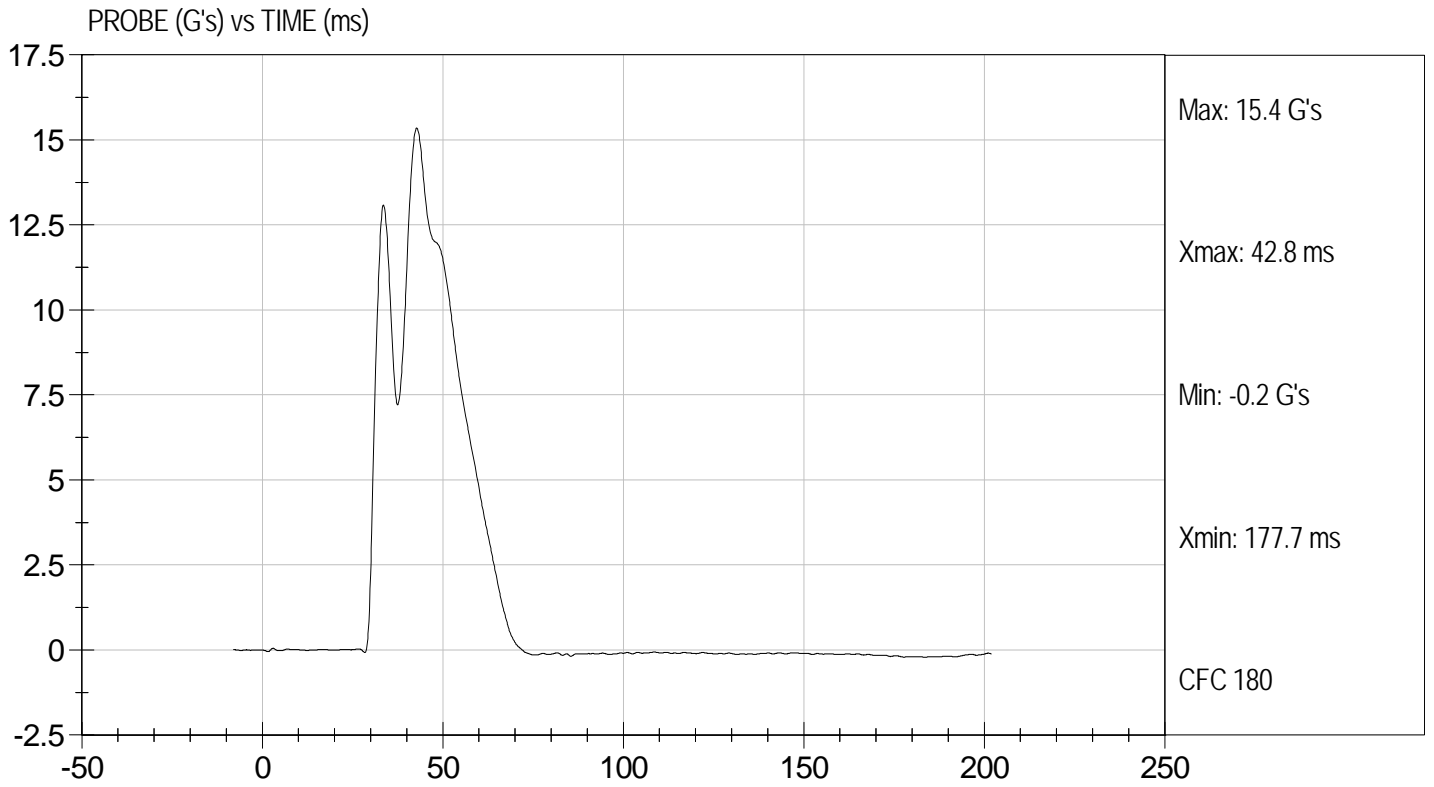
9/22/11  
Test Date

David Winkelbauer  
Approved By



Test Desc: Shoulder Impact  
Component ID: D113123

Test Date: 9/22/11  
Velocity: 14.36 ft/s, 4.38 m/s

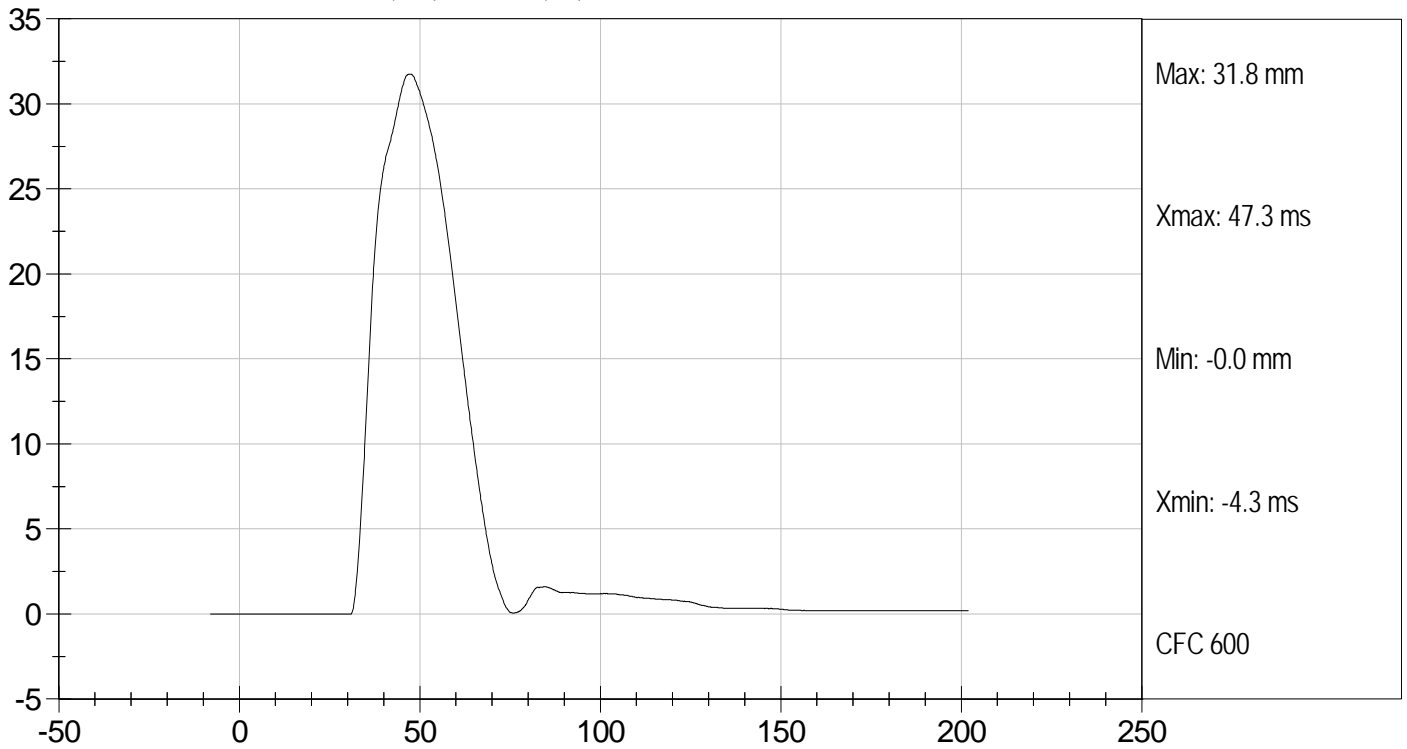




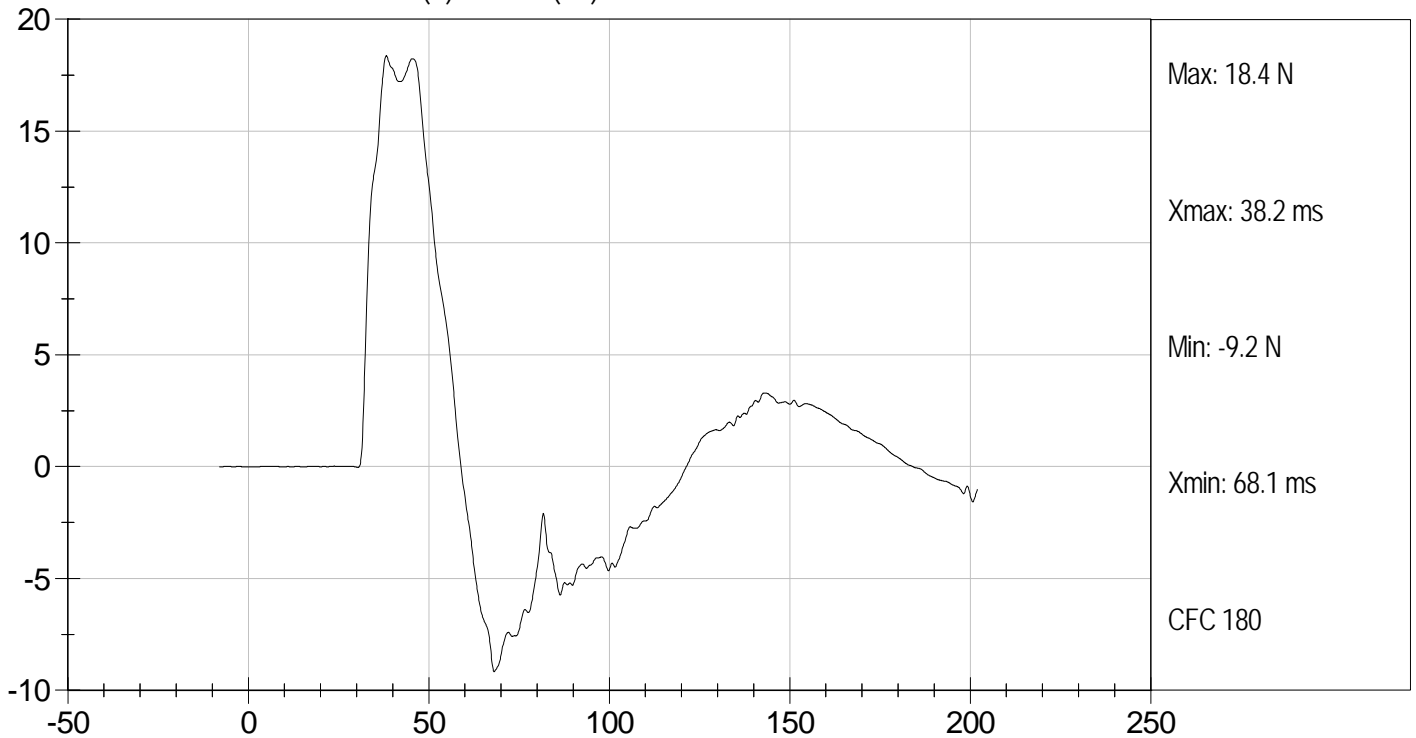
Test Desc: Shoulder Impact  
Component ID: D113123

Test Date: 9/22/11  
Velocity: 14.36 ft/s, 4.38 m/s

SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION  
THORAX (WITH ARM) IMPACT TEST  
SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D113124

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	43	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	33	Pass
Upper Rib Displacement	mm	25 to 32	27	Pass
Middle Rib Displacement	mm	30 to 36	32	Pass
Lower Rib Displacement	mm	32 to 38	34	Pass
Upper Spine (T1) Y Acceleration	G's	34 to 43	37	Pass
Lower Spine (T12) Y Acceleration	G's	29 to 37	30	Pass
Overall Test Results				Pass

*Jessica Hall*  
Laboratory Technician

9/22/11  
Test Date

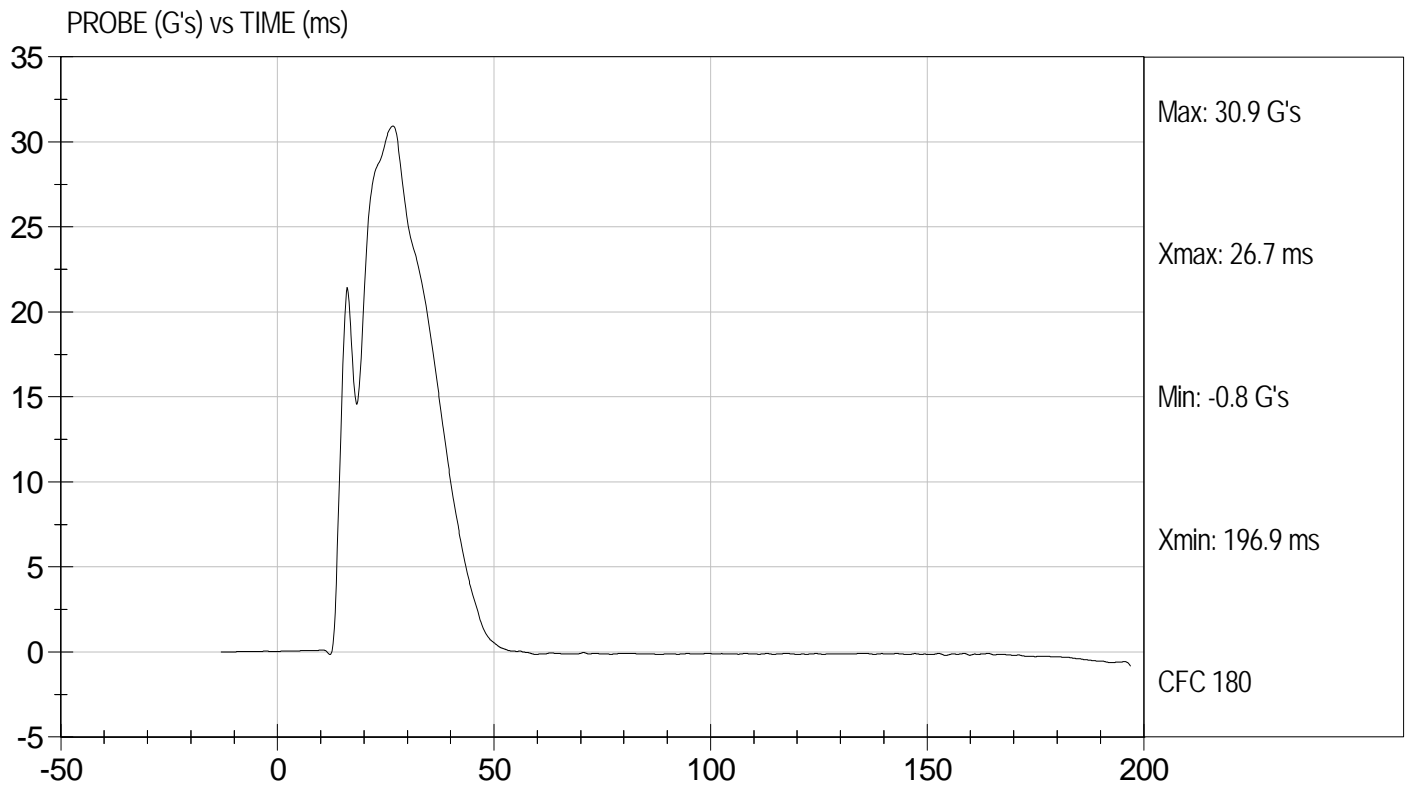
*David Winkelbauer*  
Approved By





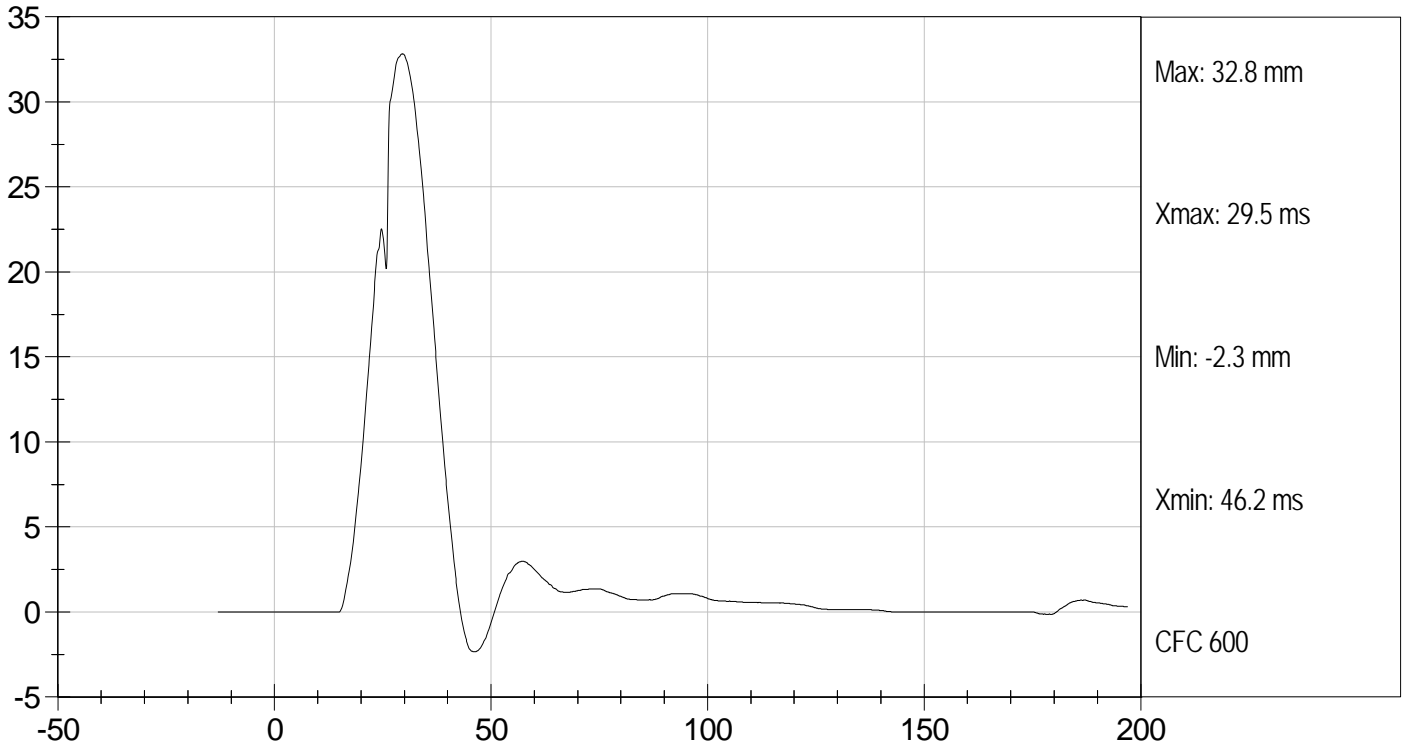
Test Desc: Thorax With Arm  
Component ID: D113124

Test Date: 9/22/11  
Velocity: 22.22 ft/s, 6.77 m/s

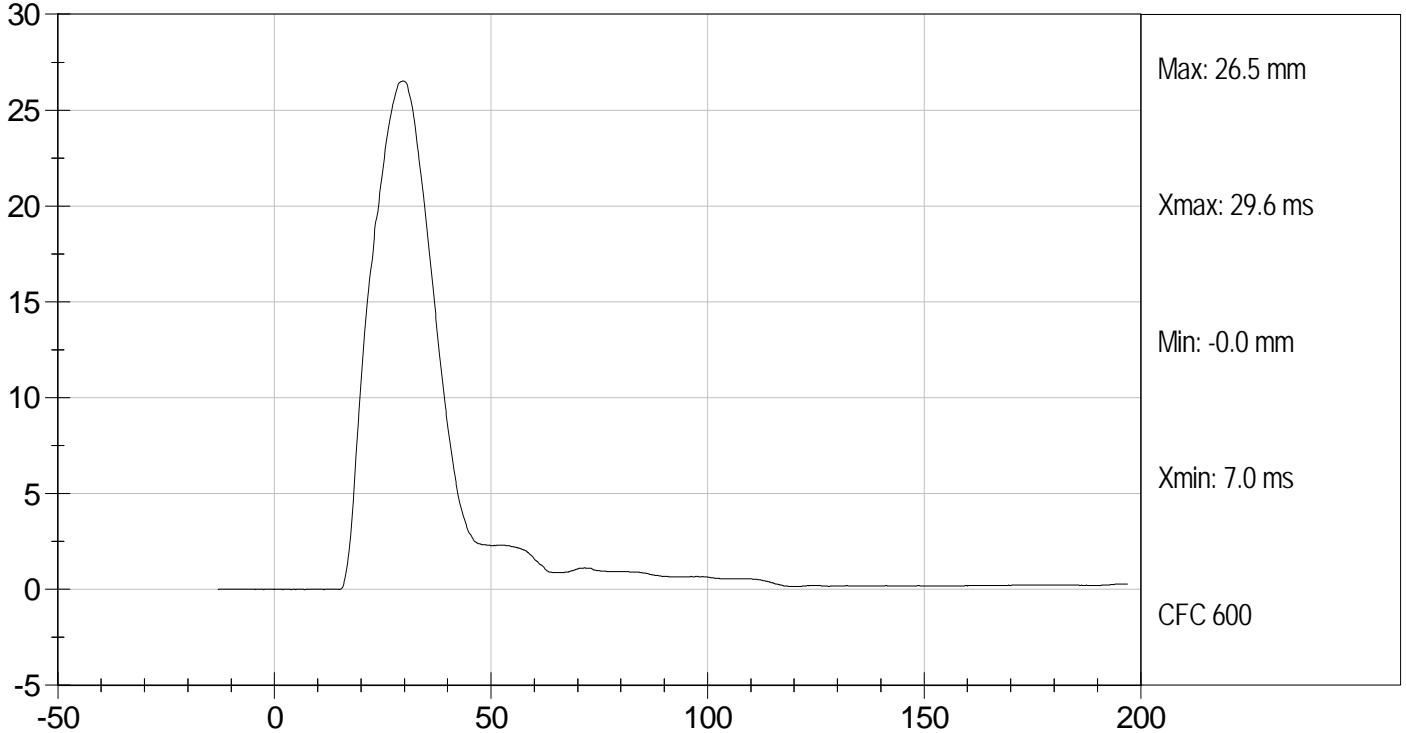




SHOULDER DISPLACEMENT (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT (mm) vs TIME (ms)

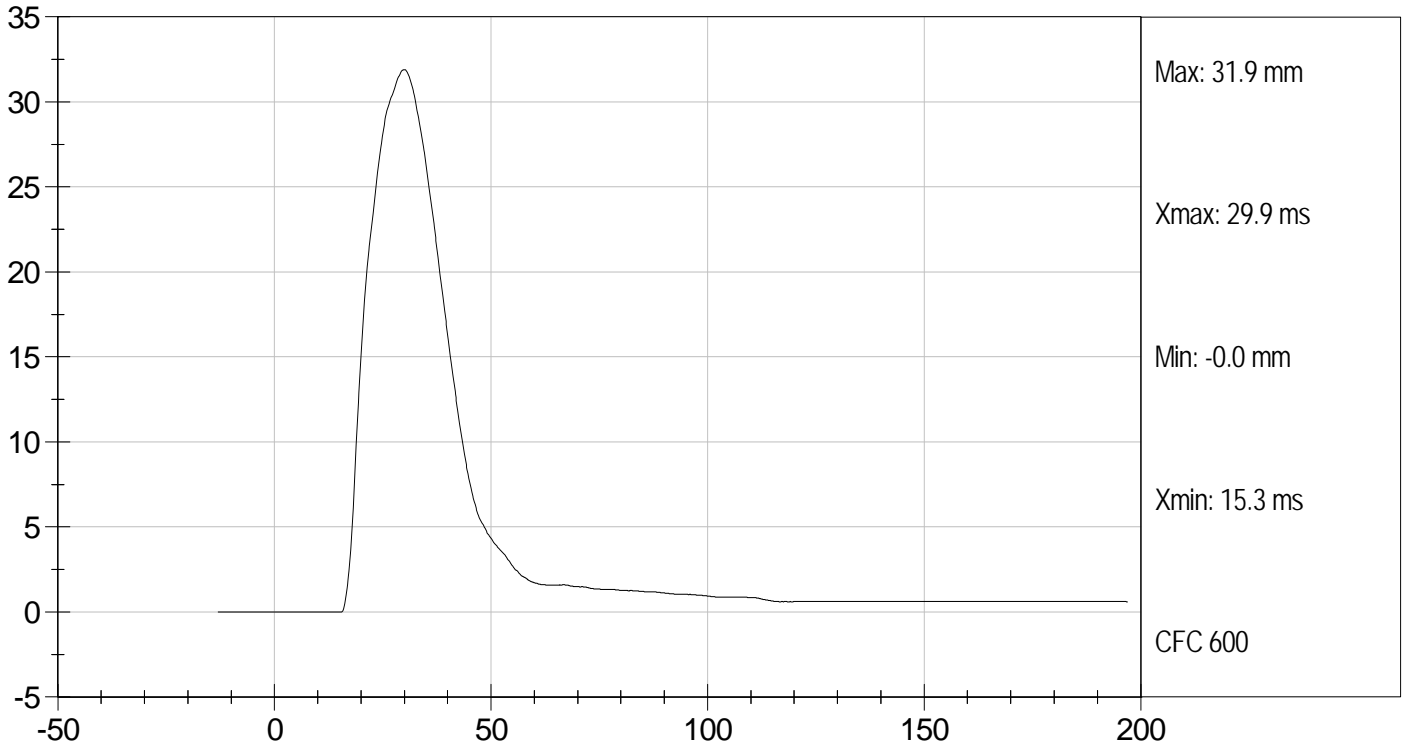




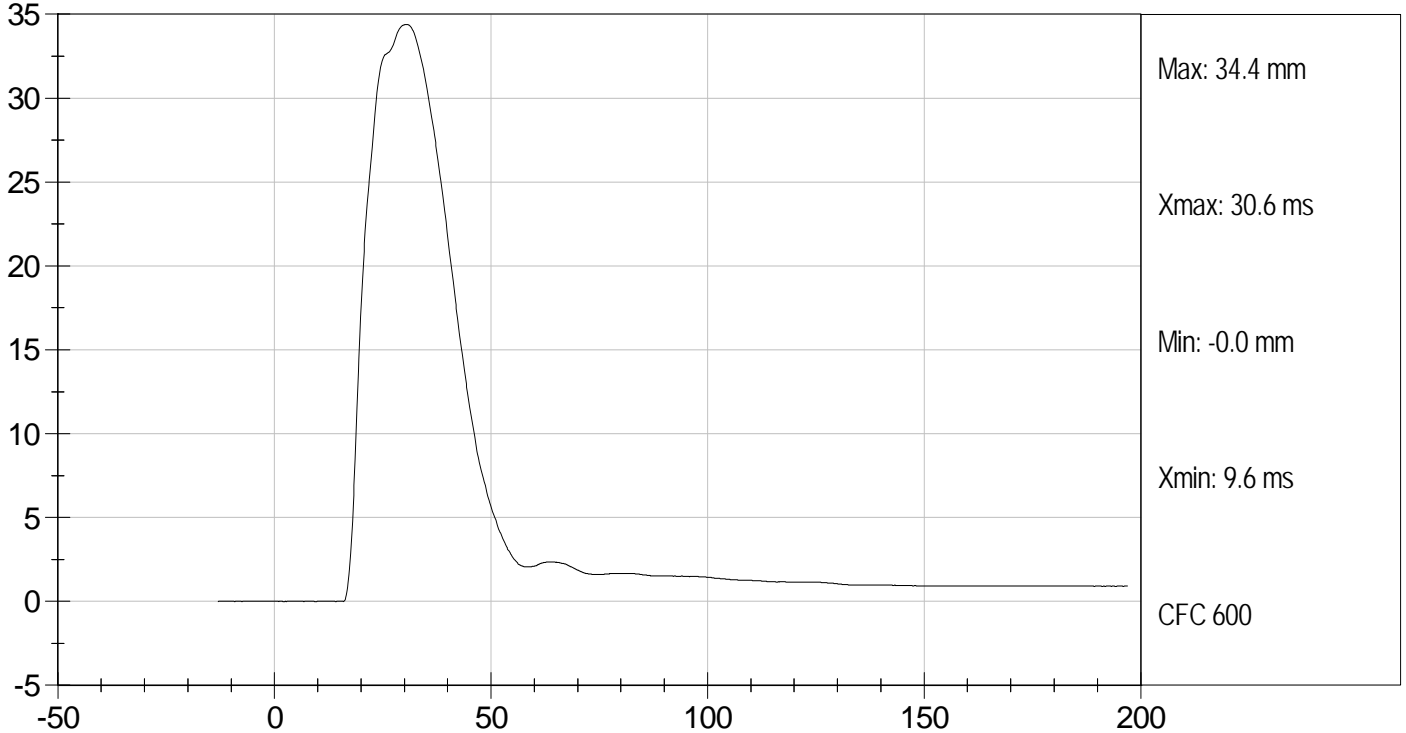
Test Desc: Thorax With Arm  
Component ID: D113124

Test Date: 9/22/11  
Velocity: 22.22 ft/s, 6.77 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT (mm) vs TIME (ms)

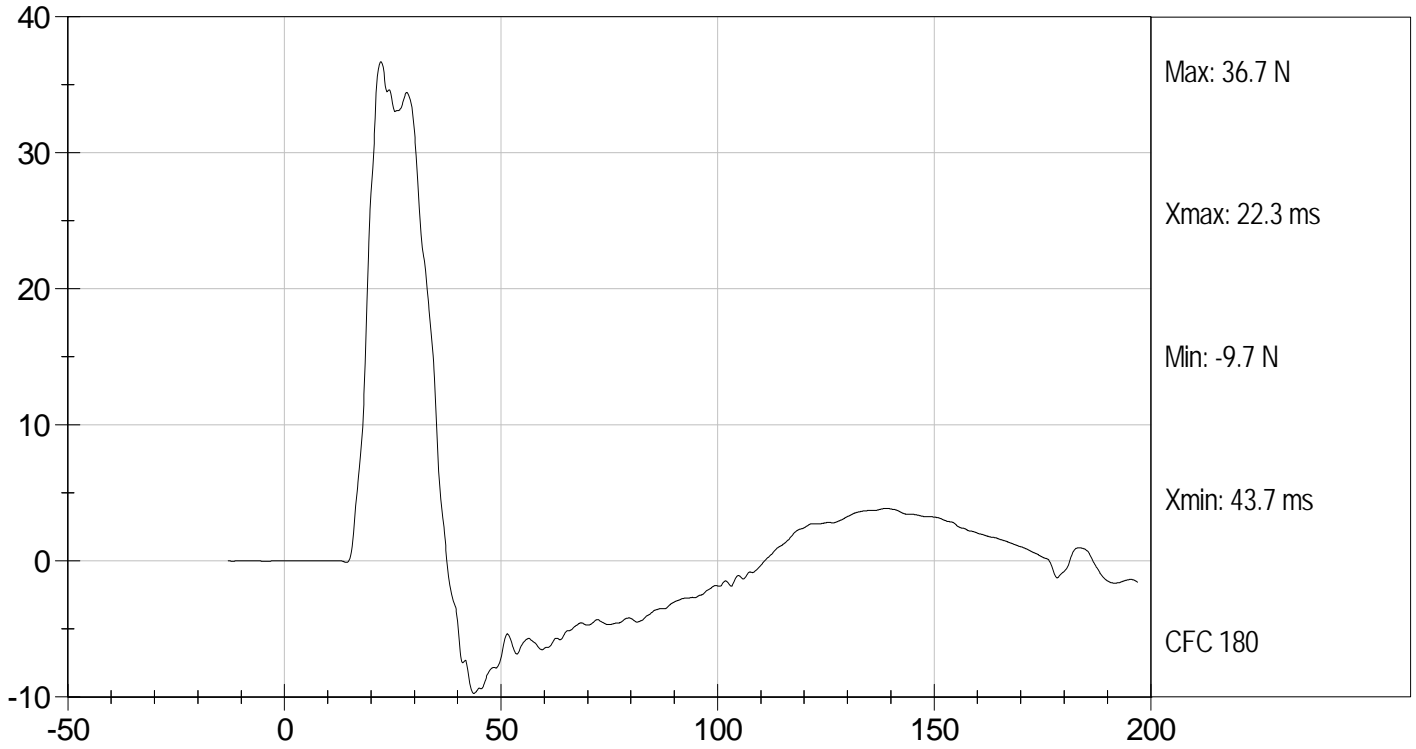




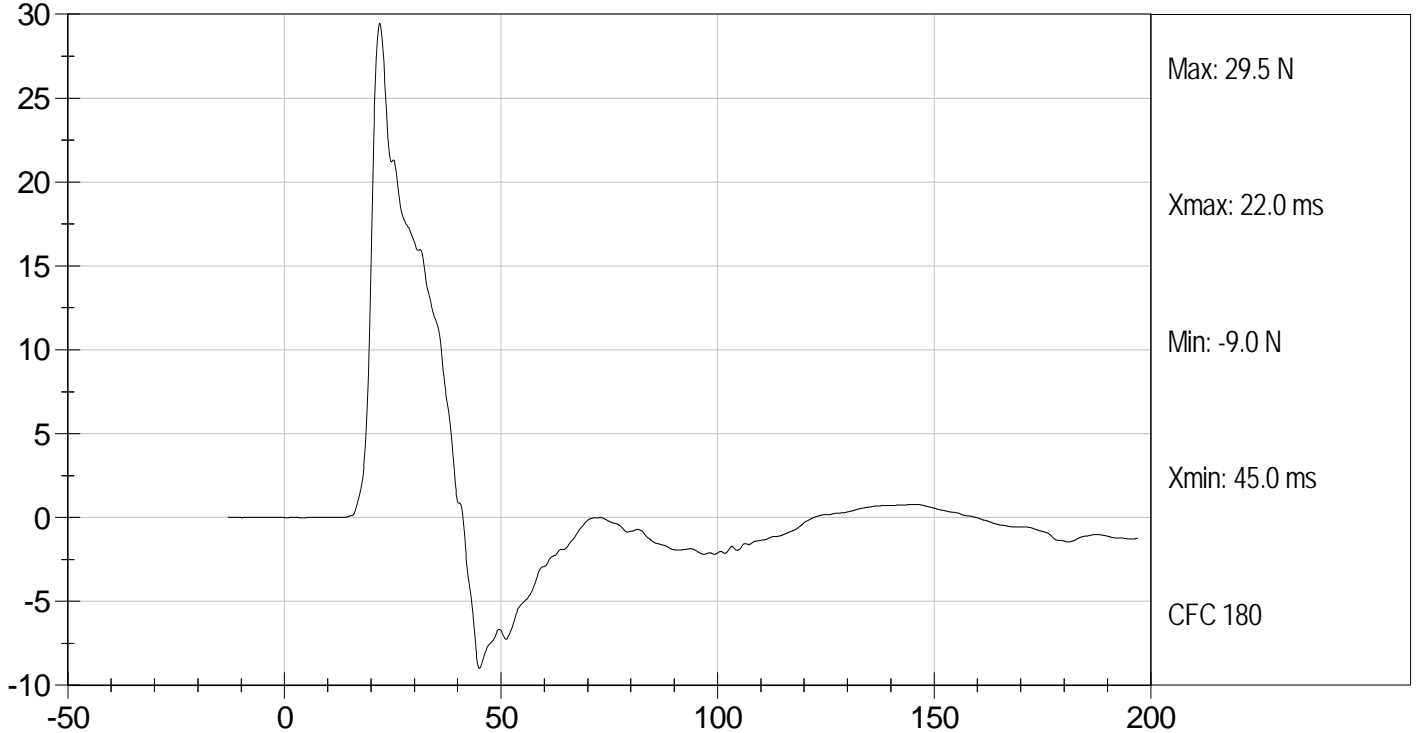
Test Desc: Thorax With Arm  
Component ID: D113124

Test Date: 9/22/11  
Velocity: 22.22 ft/s, 6.77 m/s

UPPER SPINE ACCELERATION (N) vs TIME (ms)



LOWER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION  
 THORAX (WITHOUT ARM) IMPACT TEST  
 SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D113125

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	42	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Peak Impactor Force	G's	14 to 18	17	Pass
Upper Rib Displacement	mm	32 to 40	34	Pass
Middle Rib Displacement	mm	39 to 45	39	Pass
Lower Rib Displacement	mm	35 to 43	36	Pass
Upper Spine (T1) Y Acceleration	G's	13 to 17	17	Pass
Lower Spine (T12) Y Acceleration	G's	7 to 11	10	Pass
Overall Test Results				Pass

Jessica Hall  
 Laboratory Technician

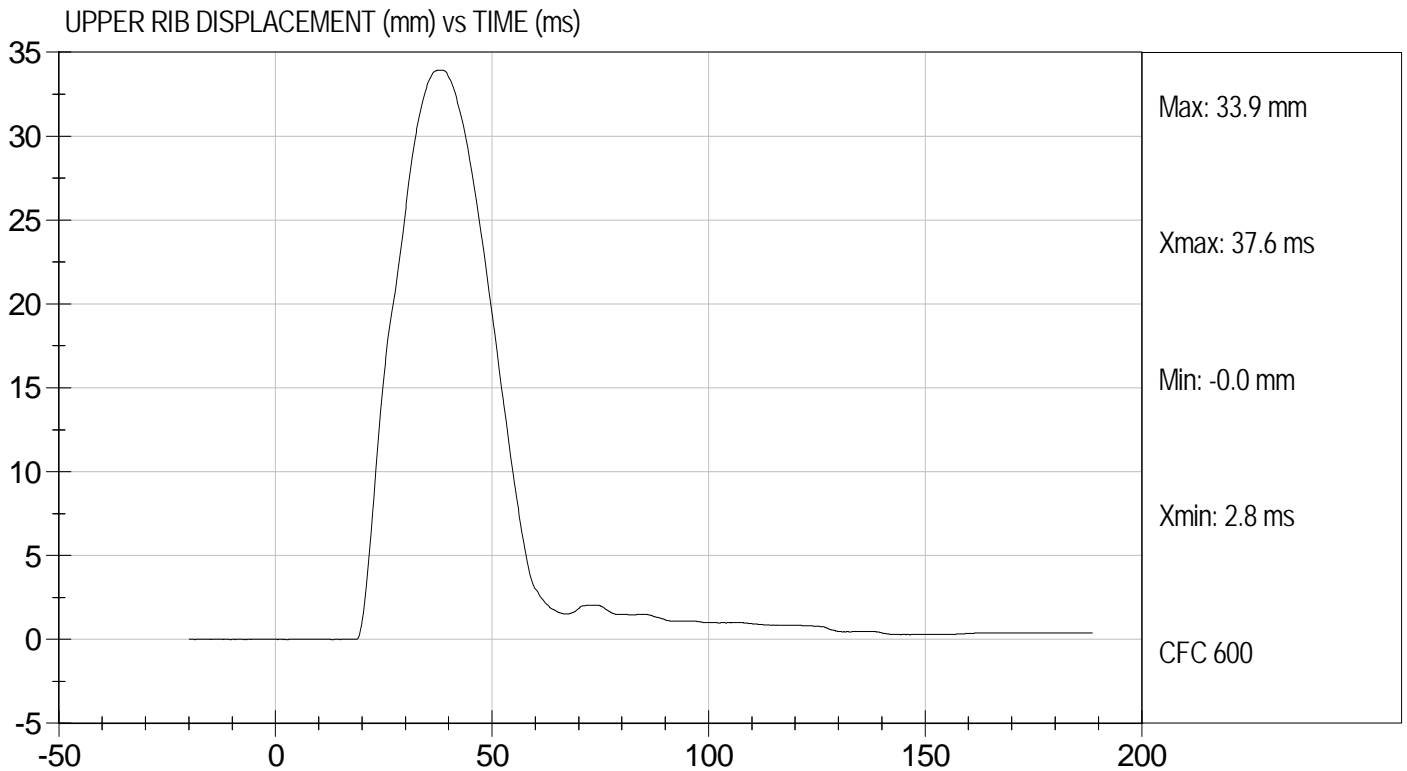
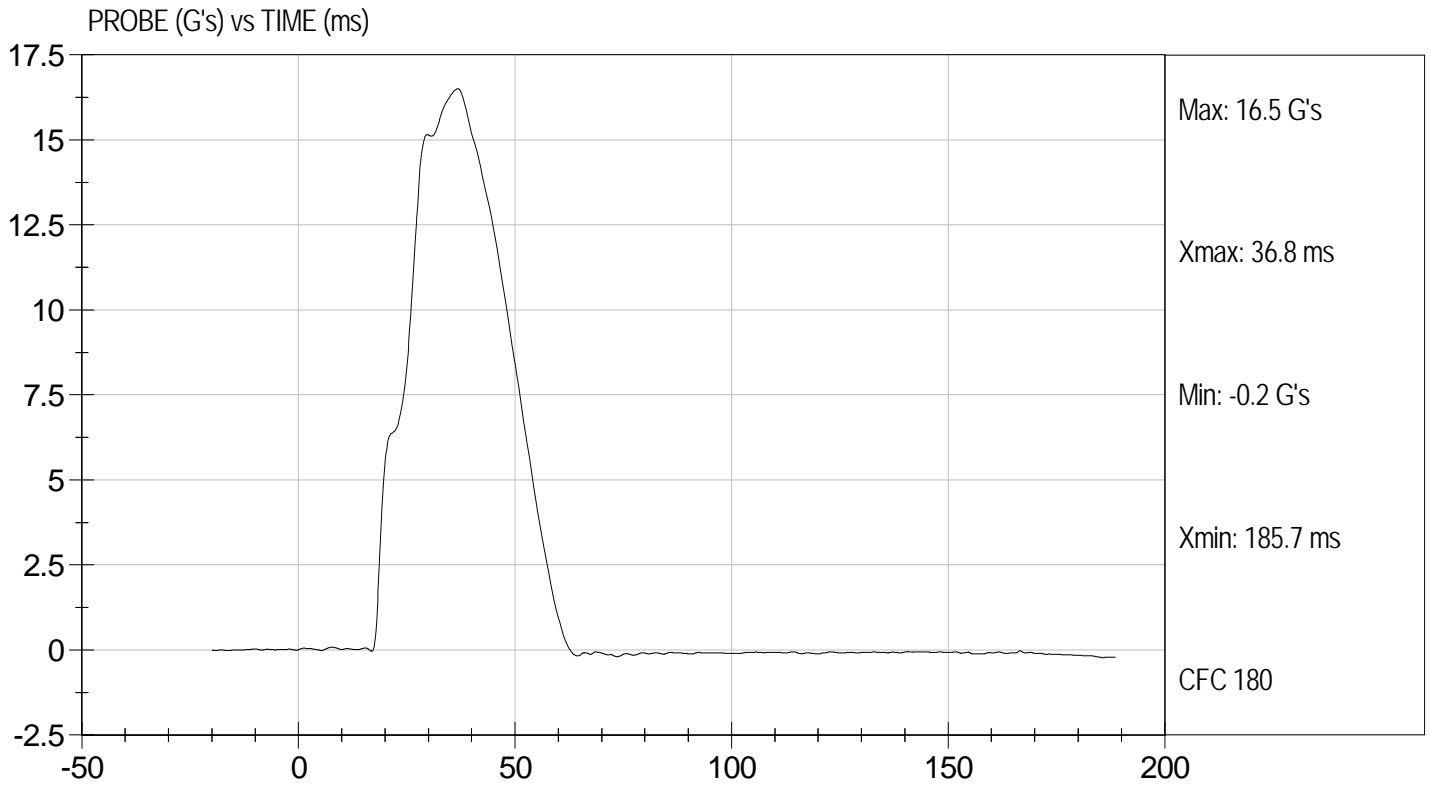
9/22/11  
 Test Date

David Winkelbauer  
 Approved By



Test Desc: Thorax Without Arm  
Component ID: D113125

Test Date: 9/22/11  
Velocity: 14.36 ft/s, 4.38 m/s

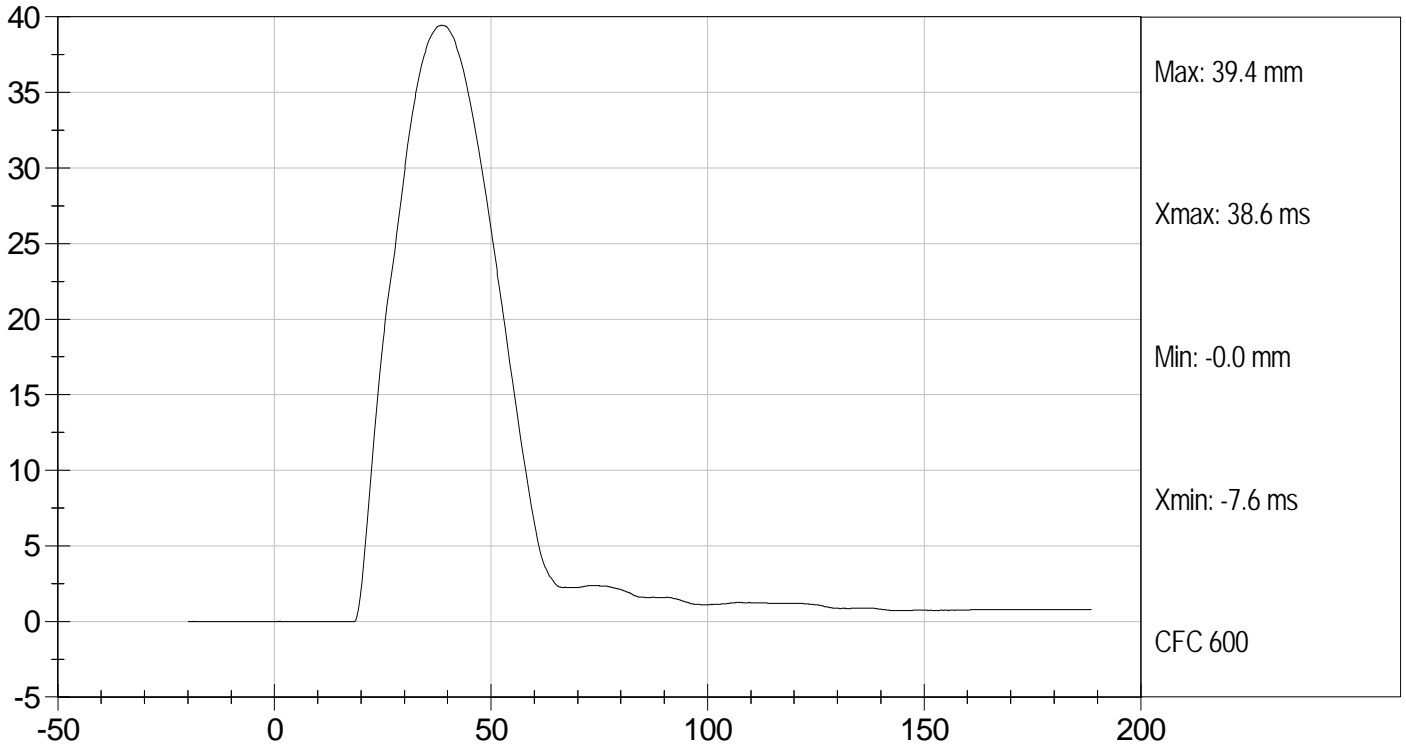




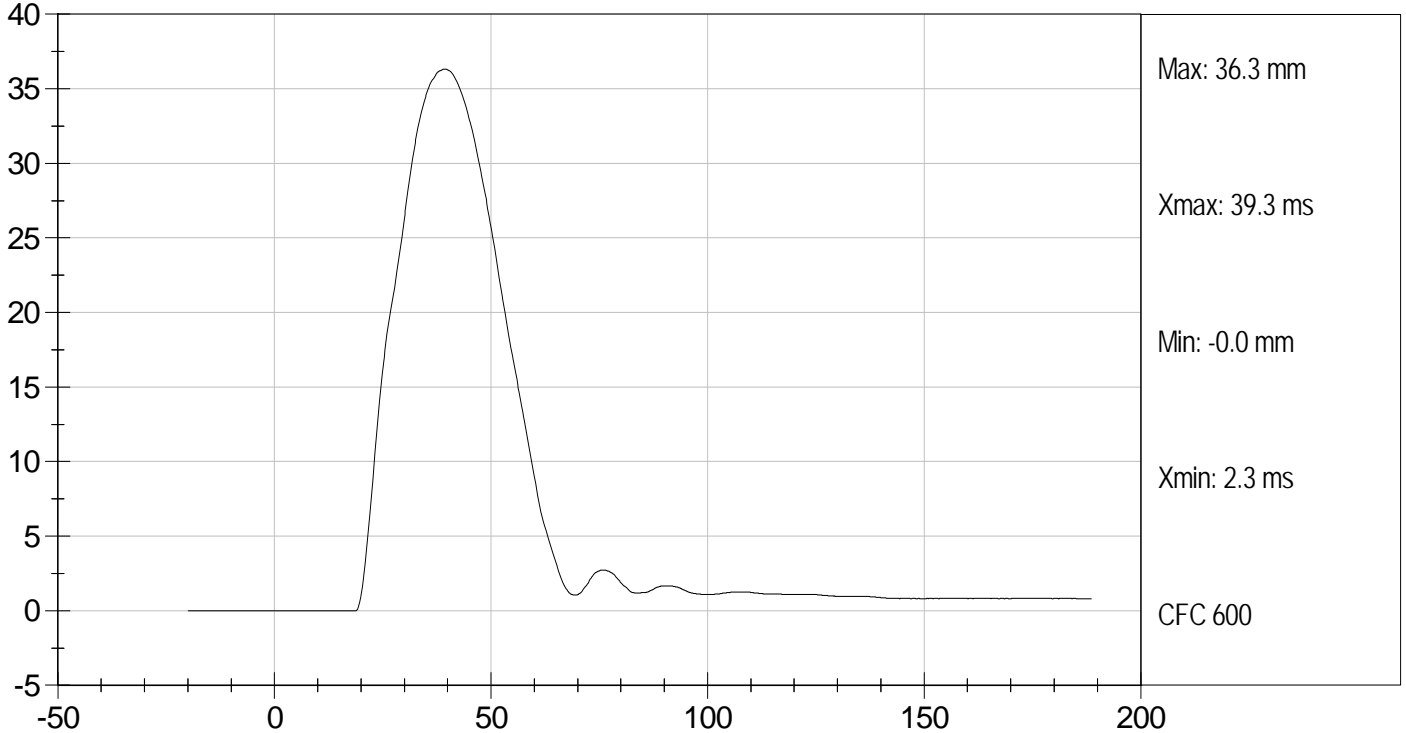
Test Desc: Thorax Without Arm  
Component ID: D113125

Test Date: 9/22/11  
Velocity: 14.36 ft/s, 4.38 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



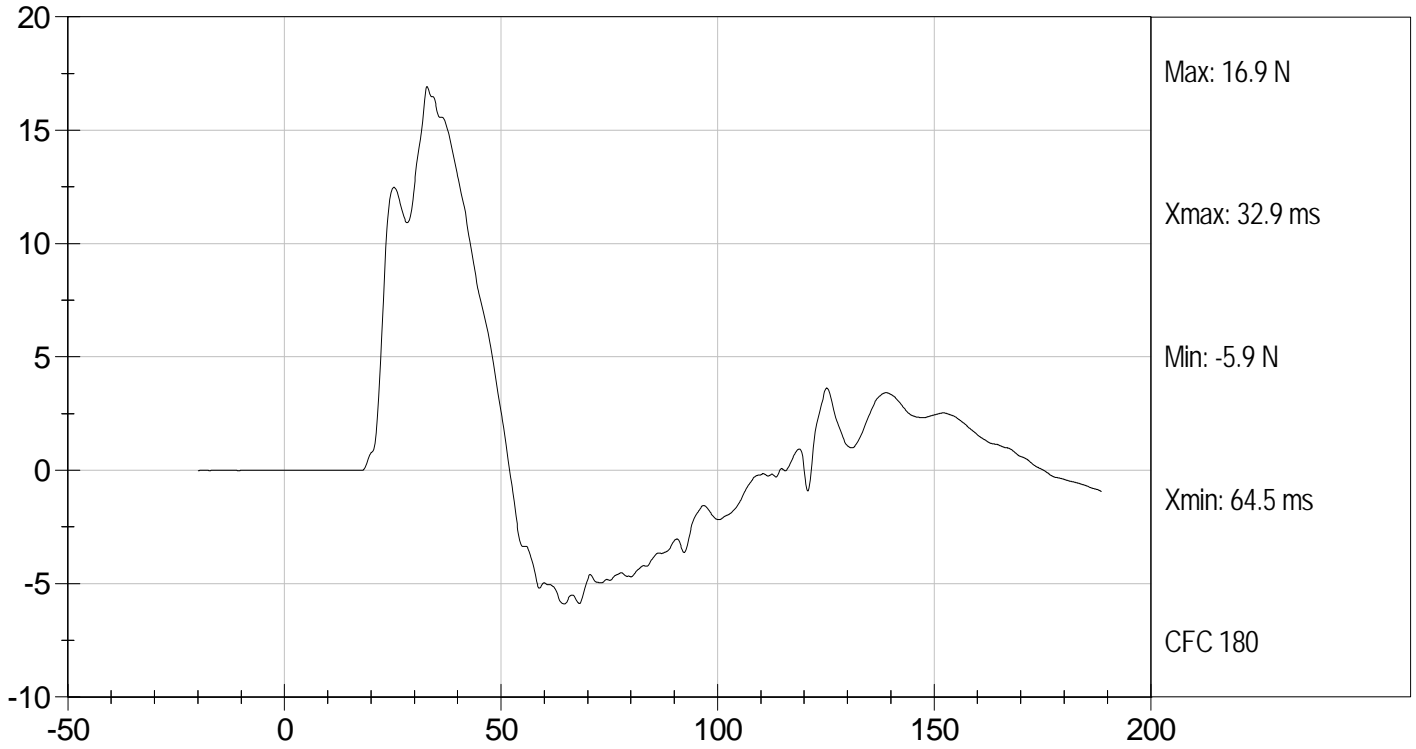




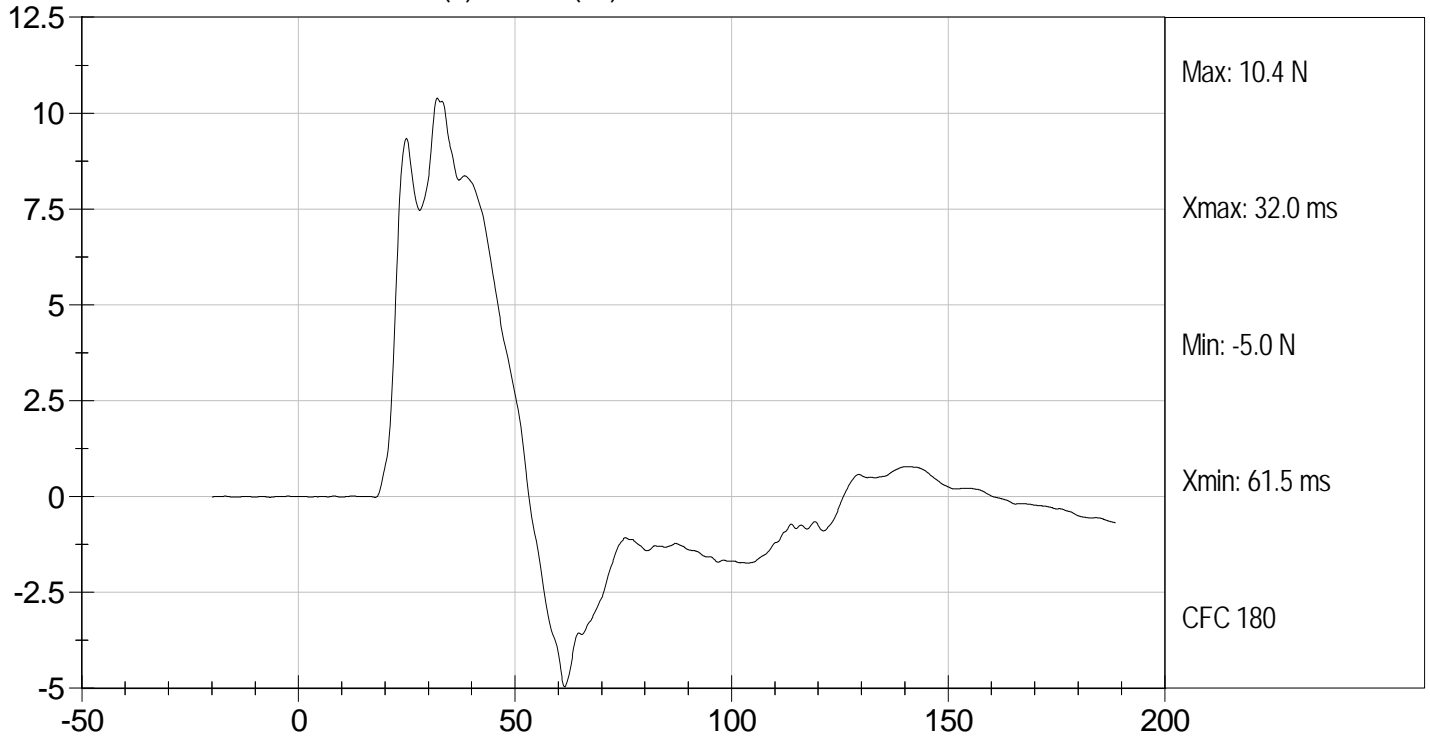
Test Desc: Thorax Without Arm  
Component ID: D113125

Test Date: 9/22/11  
Velocity: 14.36 ft/s, 4.38 m/s

UPPER SPINE ACCELERATION (N) vs TIME (ms)



LOWER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION**  
**ABDOMINAL IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D113126

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	4.20 to 4.40	4.38	Pass
Peak Impactor Acceleration	G's	12 to 16	13	Pass
Upper Rib Displacement	mm	36 to 47	44	Pass
Lower Rib Displacement	mm	33 to 44	40	Pass
Lower Spine (T12) Y Acceleration	G's	9 to 14	10	Pass
Overall Test Results				Pass

*Jessica Hall*  
 Laboratory Technician

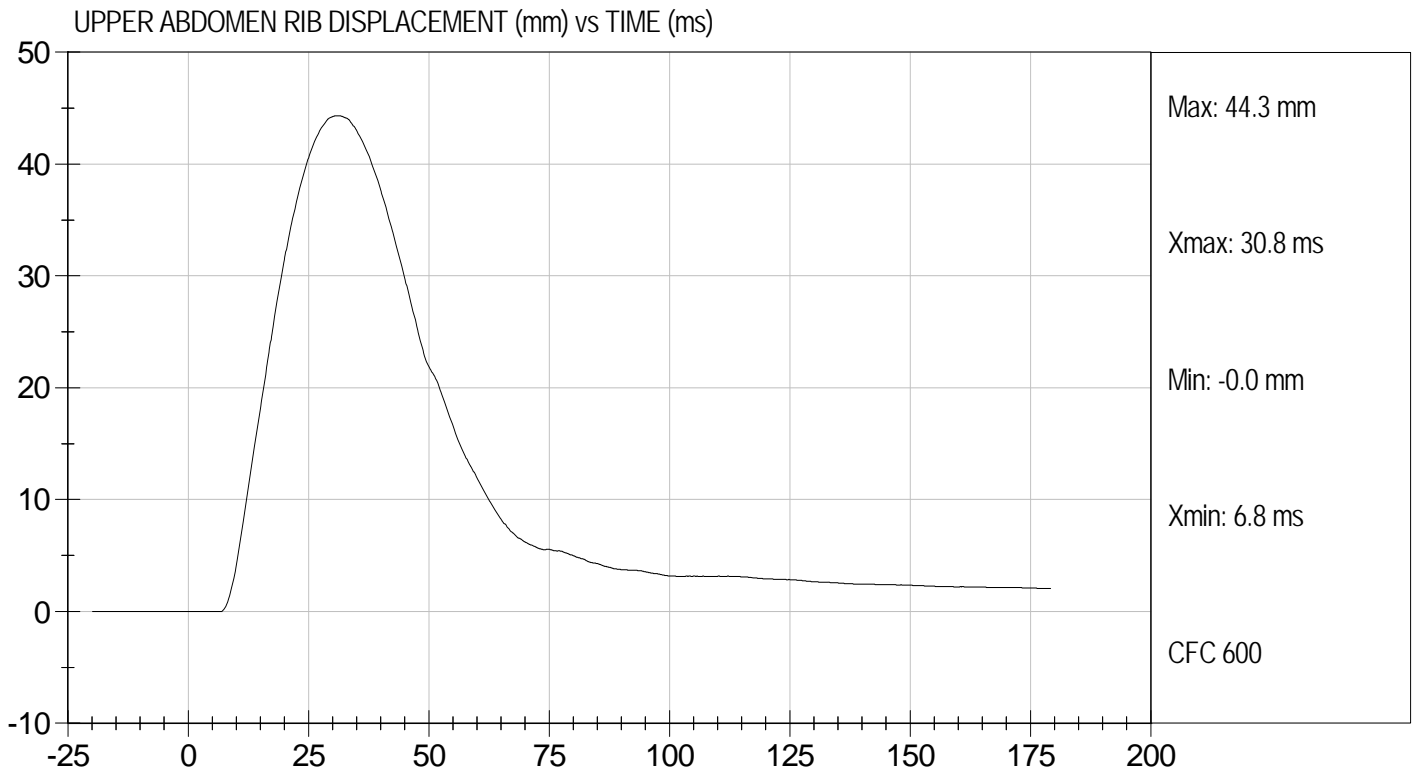
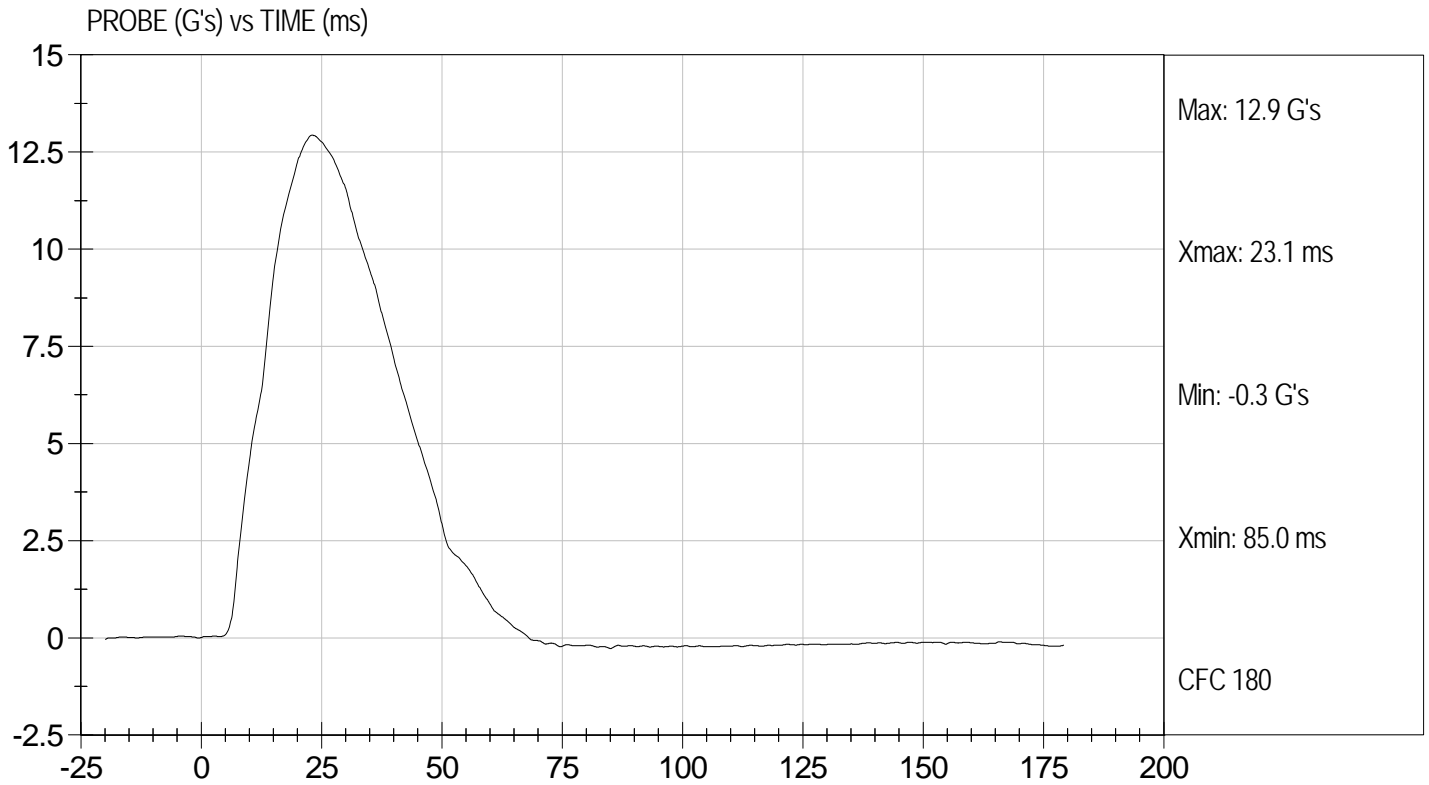
9/22/11  
 Test Date

*David Winkelbauer*  
 Approved By



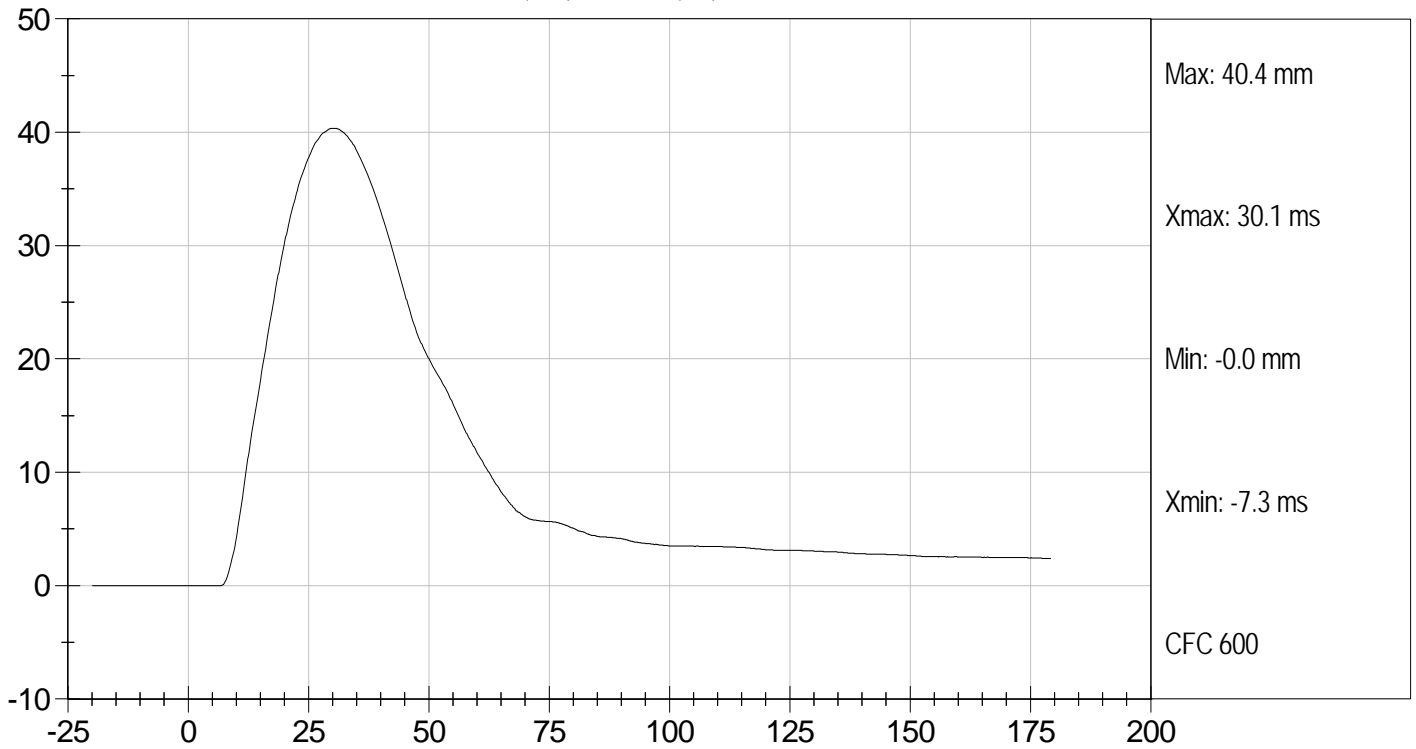
Test Desc: Abdomen Impact  
Component ID: D113126

Test Date: 9/22/11  
Velocity: 14.36 ft/s, 4.38 m/s

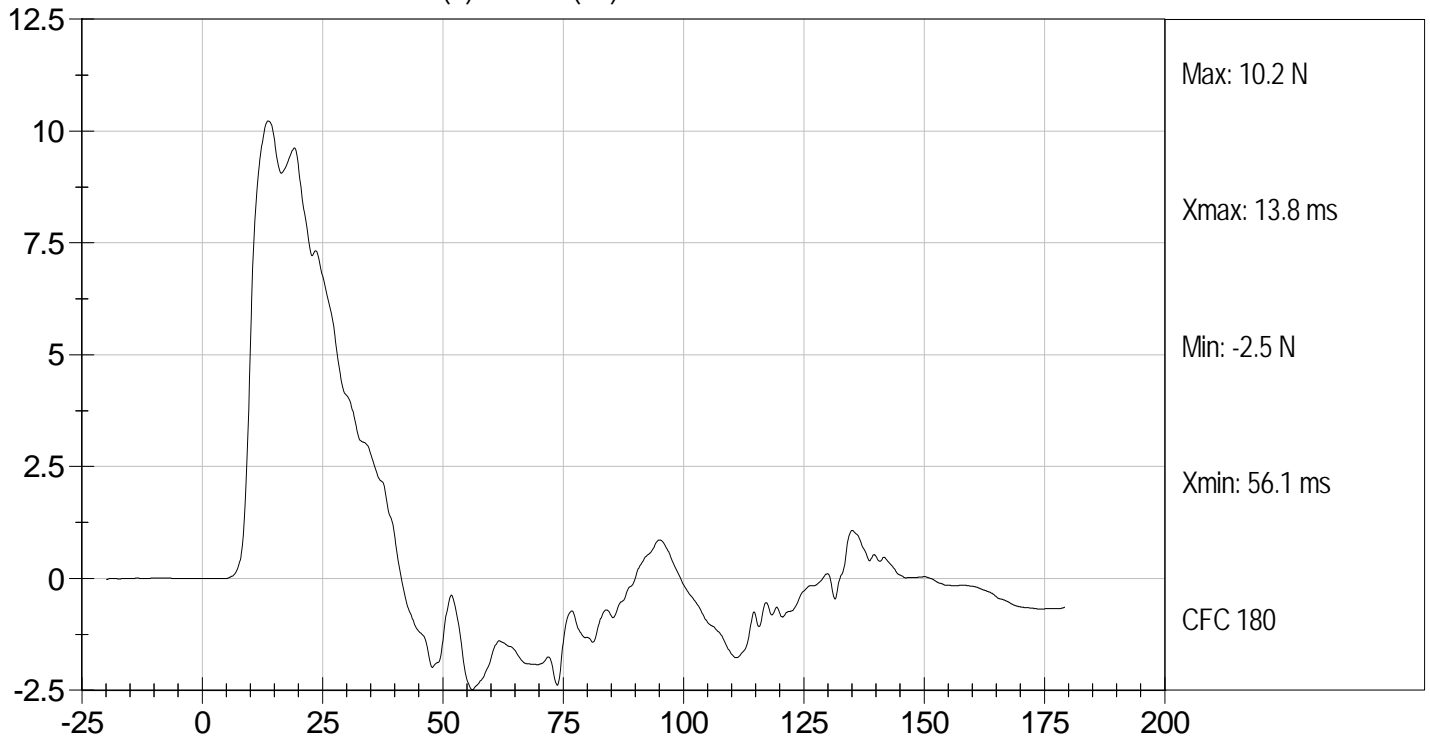




LOWER ABDOMEN RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER SPINE ACCELERATION (N) vs TIME (ms)



**MGA RESEARCH CORPORATION**  
**PELVIS IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D113127

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	6.60 to 6.80	6.70	Pass
Peak Impactor Acceleration	G's	38 to 47	44	Pass
Pelvis Y Acceleration after 6 ms	G's	34 to 42	39	Pass
Peak Acetabulum Force	N	3600 to 4300	3874	Pass
			Overall Test Results	Pass

Jessica Hall  
Laboratory Technician

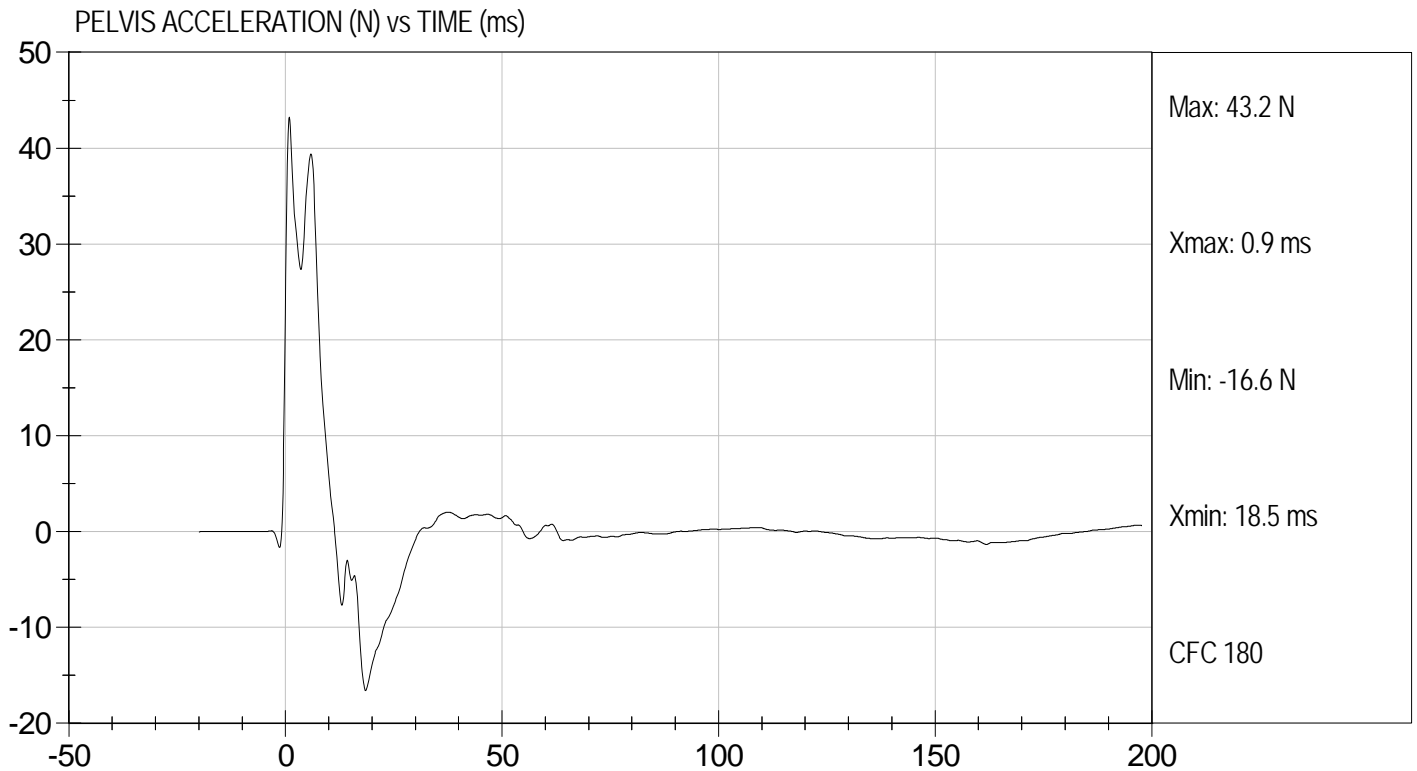
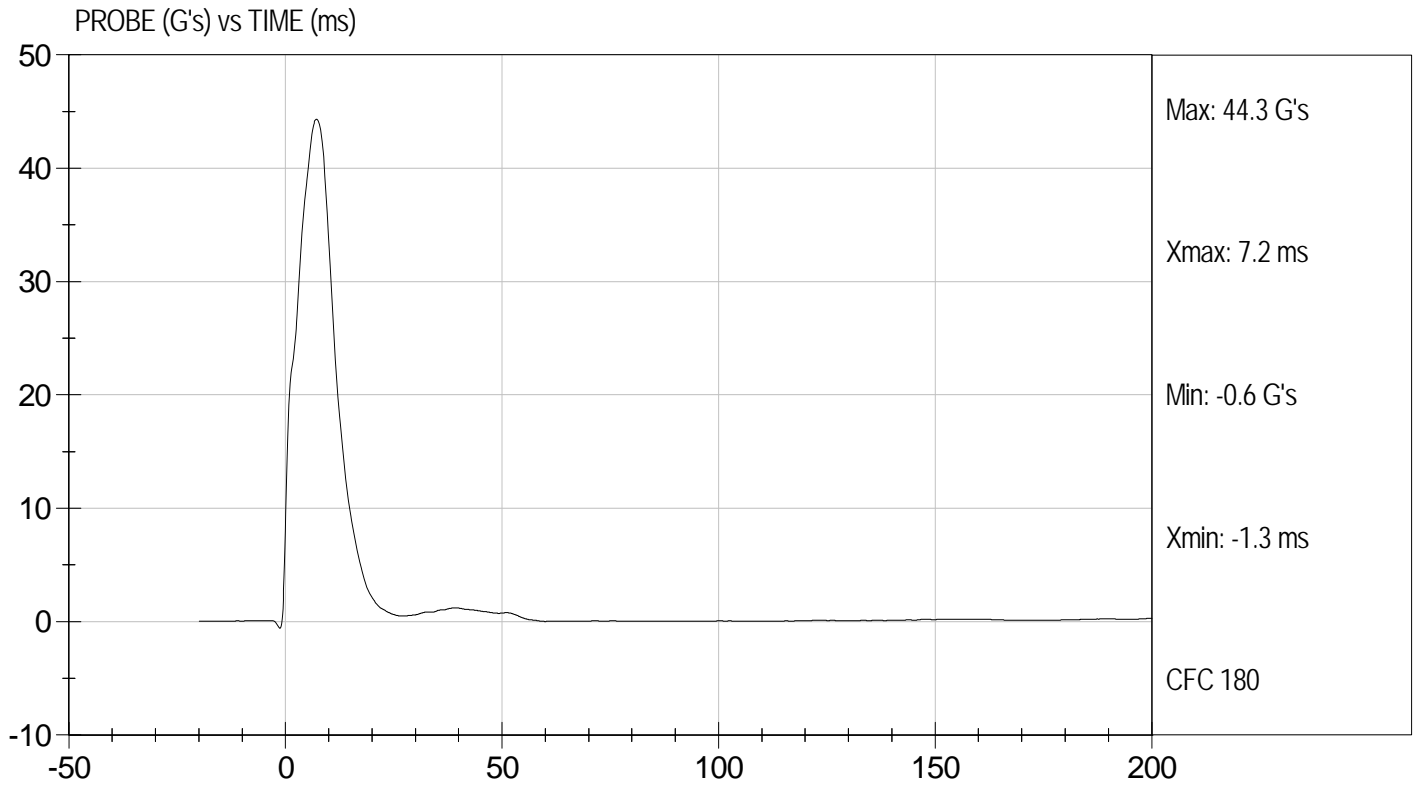
9/22/11  
Test Date

David Winkelbauer  
Approved By



Test Desc: Pelvis Impact  
Component ID: D113127

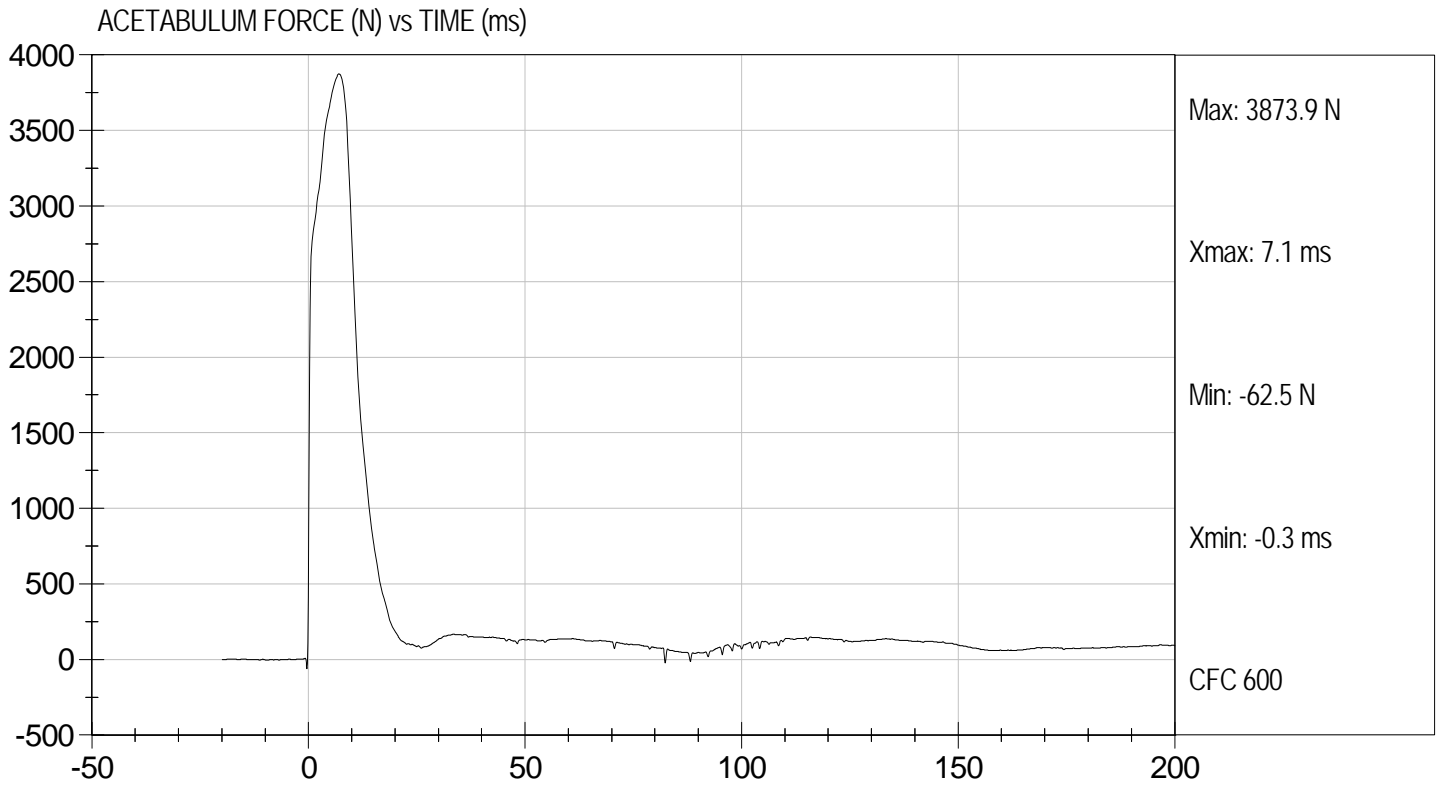
Test Date: 9/22/11  
Velocity: 21.99 ft/s, 6.70 m/s





Test Desc: Pelvis Impact  
Component ID: D113127

Test Date: 9/22/11  
Velocity: 21.99 ft/s, 6.70 m/s



**MGA RESEARCH CORPORATION**  
**ILIAC IMPACT TEST**  
**SID-IIs BUILD LEVEL D DUMMY**

ATD Serial No: 262

Test I.D: D113128

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.5	Pass
Humidity	%	10 to 70	43	Pass
Impact Velocity	m/s	4.20 to 4.40	4.34	Pass
Peak Impactor Acceleration	G's	36 to 45	40	Pass
Pelvis Y Acceleration	G's	28 to 39	36	Pass
Peak Pelvis Iliac Force	N	4100 to 5100	4700	Pass
			Overall Test Results	Pass

Jessica Hall  
Laboratory Technician

9/22/11  
Test Date

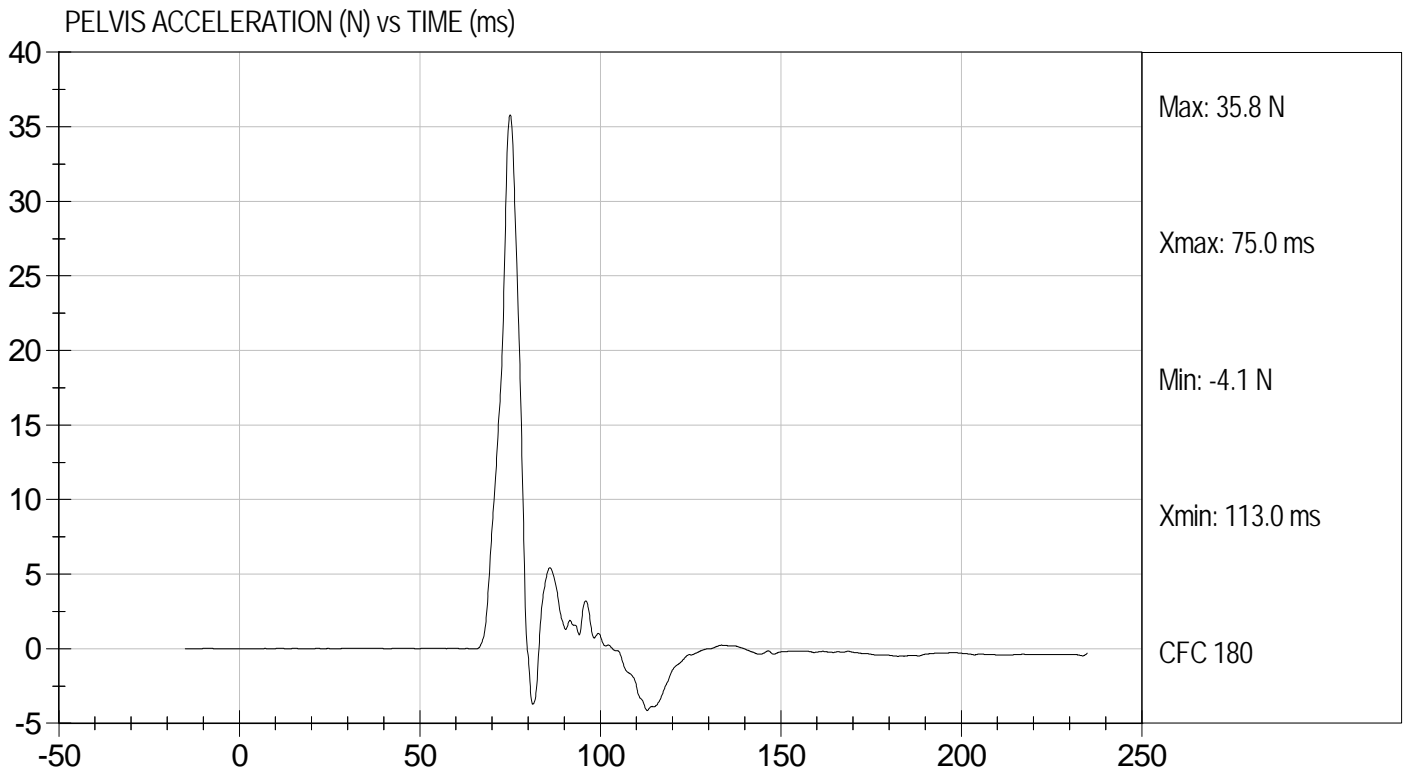
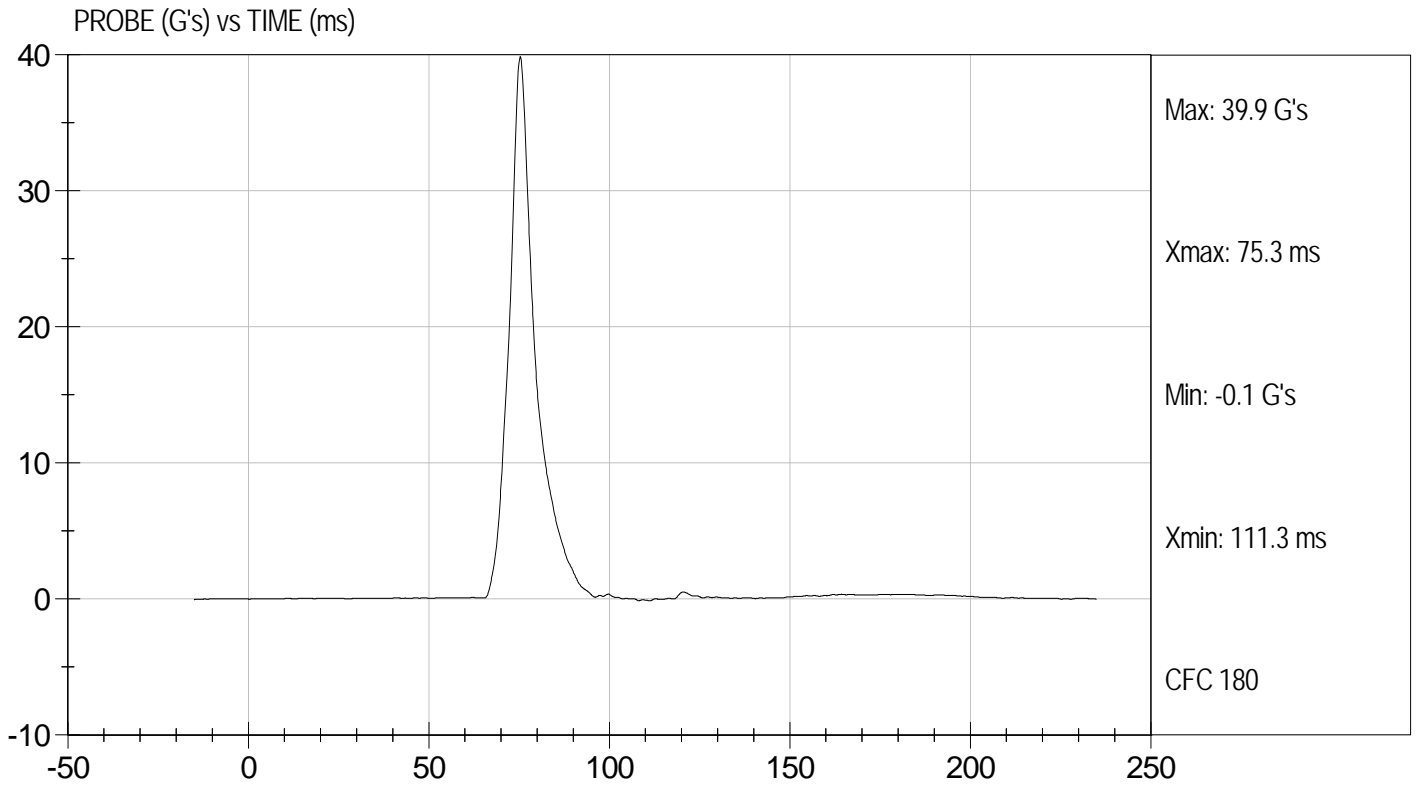
David Winkelbauer  
Approved By





Test Desc: Iliac Impact  
Component ID: D113128

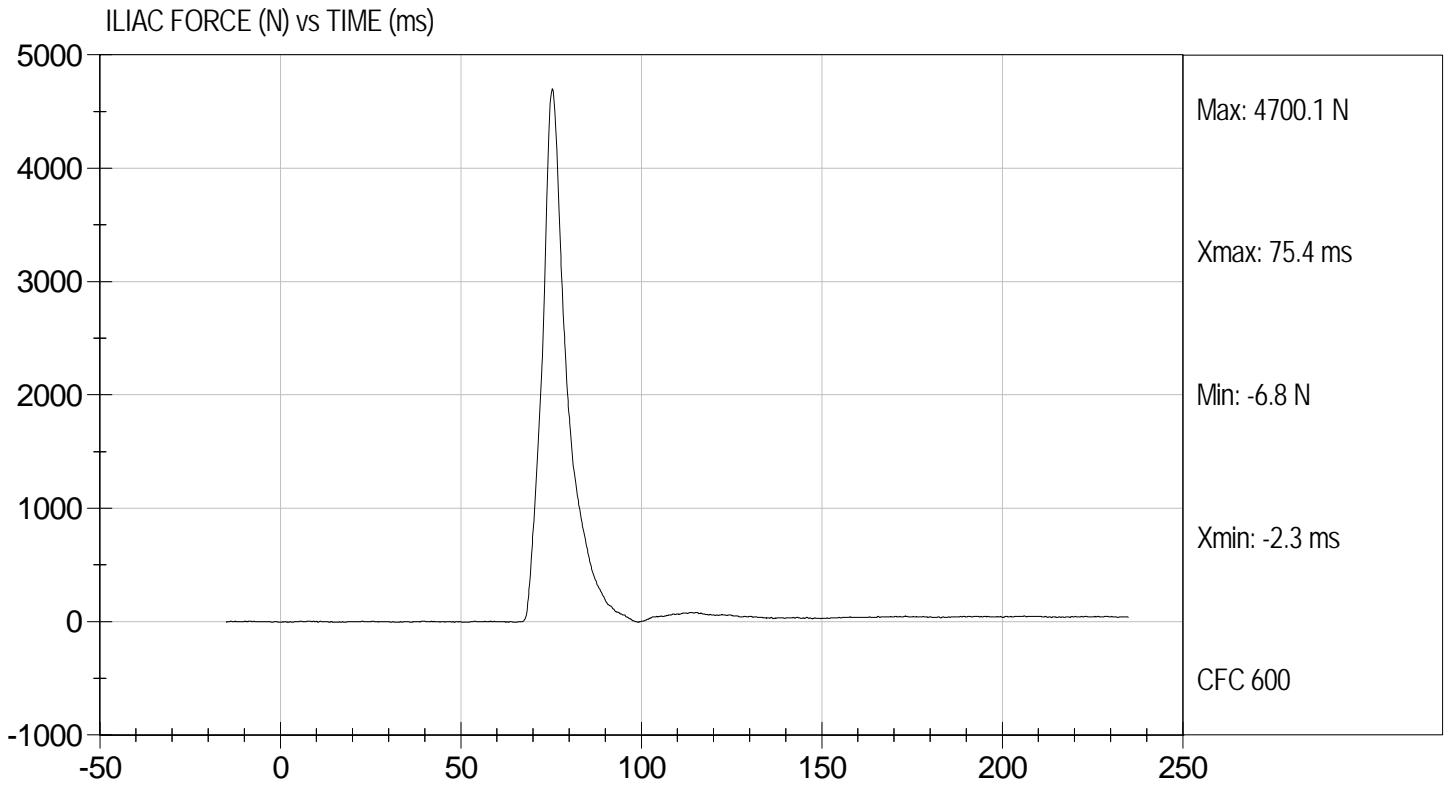
Test Date: 9/22/11  
Velocity: 14.24 ft/s, 4.34 m/s





Test Desc: Iliac Impact  
Component ID: D113128

Test Date: 9/22/11  
Velocity: 14.24 ft/s, 4.34 m/s



## **APPENDIX E**

### **TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION**

**Table 1 – Dummy Instrumentation**

		SID-IIs S/N: 262			
		Serial Number	Manufacturer	Calibration Date	
Head Accelerometers		X	P73732	Endevco	09/09/11
		Y	P73733	Endevco	09/09/11
		Z	P73734	Endevco	09/09/11
Rib Displacement Transducers	Thorax	Upper	G488	FTSS	09/12/11
		Middle	G503	FTSS	09/12/11
		Lower	G509	FTSS	09/12/11
	Abdominal	Upper	G545	FTSS	09/12/11
		Lower	G573	FTSS	09/12/11
Lower Spine Accelerometers (T12)		X	P73723	Endevco	09/09/11
		Y	P73724	Endevco	09/09/11
		Z	P73725	Endevco	09/09/11
Acetabulum Load Cell		Y	ACG271	Denton	11/01/10
Illiatic Wing Load Cell		Y	IWG194	Denton	11/01/10

**Table 2 – Vehicle Instrumentation**

	Serial Number	Manufacturer	Calibration Date
Vehicle CG (X)	P52257	Endevco	07/01/11
Vehicle CG (Y)	P52259	Endevco	07/01/11
Vehicle CG (Z)	P52258	Endevco	07/01/11
Rotation About X Axis	ARS2478	DTS	07/13/11
Rotation About Y Axis	ARS2602	DTS	07/13/11
Rotation About Z Axis	ARS2601	DTS	07/13/11
Left Floor Sill (Y)	P59634	Endevco	05/20/11
A Pillar Sill (Y)	P63548	Endevco	07/14/11
A Pillar Low (Y)	P47889	Endevco	05/20/11
A Pillar Mid (Y)	P59376	Endevco	04/27/11
B Pillar Sill (Y)	P59360	Endevco	08/22/11
B Pillar Low (Y)	P59247	Endevco	05/20/11
B Pillar Mid (Y)	P59386	Endevco	05/20/11
Seat (Y)	P59251	Endevco	06/10/11
Engine (X)	P63255	Endevco	09/13/11
Engine (Y)	P63254	Endevco	09/13/11
Firewall (Y)	P59277	Endevco	04/28/11
Roof (Y)	P66605	Endevco	09/12/11
Floor Sill (Y)	P59407	Endevco	07/01/11
Rear Deck (X)	P59407	Endevco	07/01/11
Rear Deck (Y)	P63387	Endevco	09/13/11
Left Front Seat Crossmember (X)	P63534	Endevco	08/01/11
Left Front Seat Crossmember (Y)	P63535	Endevco	08/01/11
Left Front Seat Crossmember (Z)	P63536	Endevco	08/01/11
Vehicle Battery Bottom (X)	P59300	Endevco	05/20/11
Vehicle Battery Bottom (Y)	P59298	Endevco	05/20/11
Vehicle Battery Bottom (Z)	P59299	Endevco	05/20/11