

REPORT NUMBER: 214P-MGA-2011-014

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

**GENERAL MOTORS LLC
2011 CHEVROLET VOLT 5-DR HATCHBACK
NHTSA NUMBER: CB0105**

**PREPARED BY:
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BURLINGTON, WI 53105**




Test Date: April 20, 2011


Report Date: June 6, 2011

FINAL REPORT

**PREPARED FOR:
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NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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16. Abstract 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 April 20, 2011. The impact velocity was 31.5 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 297 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 (HIC₃₆)</td> <td style="padding: 5px;">N/A</td> <td style="padding: 5px;">290</td> </tr> <tr> <td style="padding: 5px;">Max. Rib Deflection</td> <td style="padding: 5px;">mm</td> <td style="padding: 5px;">31</td> </tr> <tr> <td style="padding: 5px;">Sum of Abdomen Forces</td> <td style="padding: 5px;">N</td> <td style="padding: 5px;">1205</td> </tr> <tr> <td style="padding: 5px;">Pubic Symphysis Force</td> <td style="padding: 5px;">N</td> <td style="padding: 5px;">2340</td> </tr> </tbody> </table> 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.				Measurement Description	Units	Result	Head Injury Criteria (HIC ₃₆)	N/A	290	Max. Rib Deflection	mm	31	Sum of Abdomen Forces	N	1205	Pubic Symphysis Force	N	2340
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TABLE OF CONTENTS

<u>Section</u>		<u>Page No.</u>
1	Purpose and Summary of the Test	1
2	Occupant and Vehicle Information	3
<u>Data Sheet</u>		<u>Page No.</u>
1	Test Vehicle Information and Options	3
2	General Test and Vehicle Parameter Data	4
3	Vehicle Tire Information	5
4	Seat and Seat Belt Adjustment Data	6
5	Fuel Systems and Steering Wheel Position Data	7
6	Dummy Longitudinal Clearance Dimensions	8
7	Dummy Lateral Clearance Dimensions	9
8	High Speed Camera Locations and Data	10
9	Test Vehicle Accelerometer Locations	11
10	Test Vehicle Accelerometer Data Summary	12
11	Dummy Injury Response Data	13
12	Post Test Observations	14
13	Vehicle Pre Test and Post Test Measurements	15
14	Exterior Crush Measurements	16
15	Vehicle Exterior Crush Profiles	17
16	Summary of FMVSS 301 Fuel System Data	19
17	Temperature and Humidity Traces	20
<u>Appendix</u>		
A	Photographs	A-1
B	Dummy Response Data	B-1
C	Vehicle Accelerometer Response Data	C-1
D	Dummy Performance Calibration Test Data	D-1
E	Test Equipment and Instrumentation Calibration	E-1

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 31.5 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin, on April 20, 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 572U 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 ES-2re male dummy was instrumented with a triaxial accelerometer pack located in the head, 3 rib displacement transducers located in the chest, 3 load cells located in the abdomen and a load cell located in the pubic symphysis.

A summary of the test results follows:

DUMMY INJURY VALUES

Dummy	HIC (36ms)	Thorax Deflection (mm)		Abdomen Forces (N)		Pubic Symphysis (N)
ES-2re 50 th Percentile Male	290	Upper	30.9	Front	220.3	2339.7
		Middle	22.7	Mid	442.3	
		Lower	21.7	Rear	605.8	
		Max.	30.9	Sum	1205.5	

GENERAL COMMENTS

There was no valid data collected for:
 Left Floor Sill Y after 10 msec.
 B Pillar Sill Y after 55 msec.
 B Pillar Low Y after 35 msec.
 B Pillar Mid Y after 35 msec.
 Seat Y after 20 msec.
 Rear Deck X after 20 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. CB0105
Test Date: 4/20/2011

VEHICLE INFORMATION	
Make	Chevrolet
Model	Volt
Body Style	Sedan
VIN	1G1RC6E47BU101294
Body Color	Black
Engine Displacement (L)	1.4
# of Cylinders	4
Engine Placement	Lateral
Transmission Type	Automatic
Transmission Speeds	1
Overdrive	No
Final Drive	Front
Odometer Reading	8 miles

OPTIONS	
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 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)	2061
GAWR Front (kg)	1139
GAWR Rear (kg)	922

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. CB0105
 Test Program: FMVSS 214 Pole Test Date: 4/20/2011

TIRE PRESSURES

	Units	LF	RF	RR	LR
As Delivered	kPa	240	240	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	537.5	334.3		570.6	397.4		566.1	384.2	
Right	kg	502.6	336.1		506.7	381.0		529.3	368.8	
Ratio	%	60.8	39.2		58.0	42.0		59.3	40.7	
Totals	kg	1040.1	670.4	1710.5	1077.3	778.4	1855.7	1095.4	753.0	1848.4

TEST VEHICLE TARGET WEIGHT (TVTW) CALCULATION

Measured Parameter	Units	Value
As Delivered Weight	kg	1710.5
Weight of 1 P572U ATD (ES-2re) Dummy	kg	77.1
Rated Cargo/Luggage Weight (RCLW)	kg	68
Calculated Target Vehicle Test Weight (TVTW)	kg	1855.6

TEST VEHICLE ATTITUDES

	Units	LF	RF	RR	LR
Fully Loaded	mm	698	705	697	689
As Tested	mm	698	705	704	708
Difference	mm	0	0	-7	-19

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	1370

**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

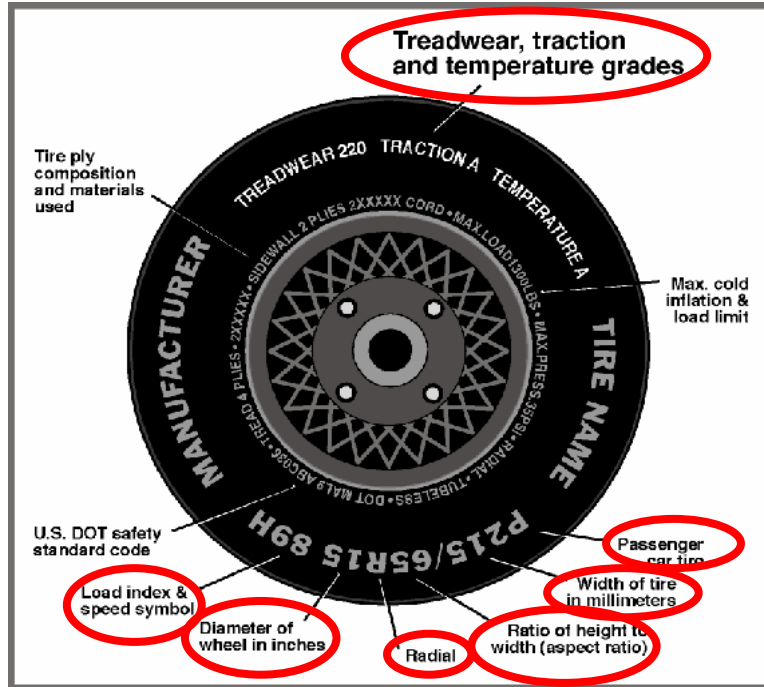
DATA SHEET NO. 3

VEHICLE TIRE INFORMATION

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

NHTSA No. CB0105
 Test Date: 4/20/2011

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

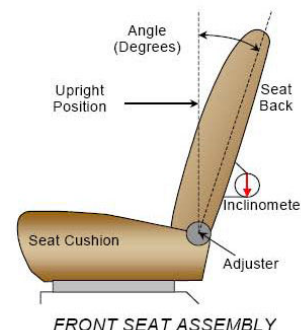
DATA SHEET NO. 4
SEAT AND SEAT BELT ADJUSTMENT DATA

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

NHTSA No. CB0105
 Test Date: 4/20/2011

NORMAL DESIGN RIDING POSITION

The driver seat back is positioned to the manufacturer's designated angle. The procedure is as follows: Set the seat back angle at -5 degrees. Seat back angle is referenced to "zero" on top of rocker (sill). Inclinator is placed on upper portion of headrest post.



SEAT BACK ANGLE

	Degrees	Detents
Driver with Seated Dummy	-5.4° at headrest post	19 th detent (forward-most as 0)

SEAT FORE/AFT POSITION

The method used for determining seat fore/aft position is as follows: For seat track adjustments, set in mid track position.

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Front Seat	54 detents	27 th detent (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 anchorage was non-adjustable.

SEAT BELT UPPER ANCHORAGE

	Total # of Positions	Placed in Position #
Driver Seat	Fixed	

HEADREST RESTRAINT

The headrest was placed in the uppermost 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

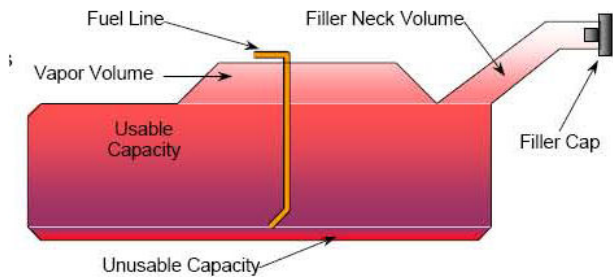
NHTSA No. CB0105
 Test Date: 4/20/2011

FUEL TANK CAPACITY

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

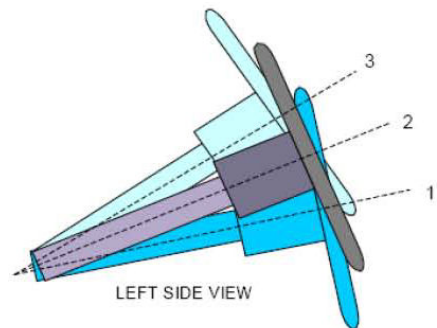
FUEL PUMP

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

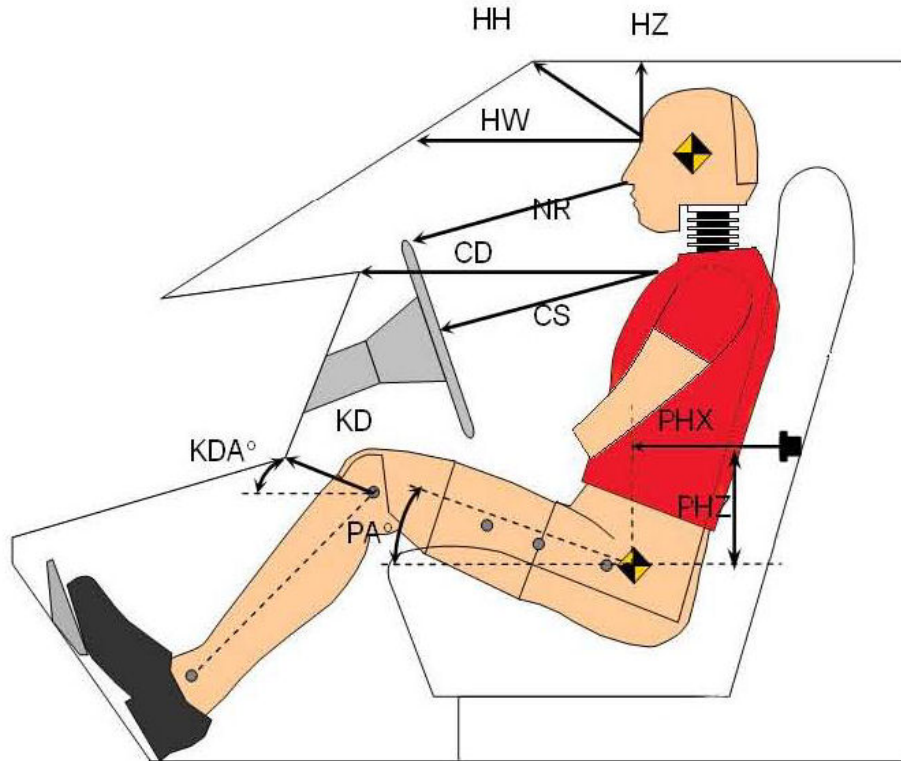
STEERING COLUMN POSITIONING

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1	70.4	218
Geometric Center – Position 2	68.2	190
Uppermost – Position 3	66.0	162
Telescoping Steering Wheel Travel		56
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. CB0105
 Test Date: 4/20/2011

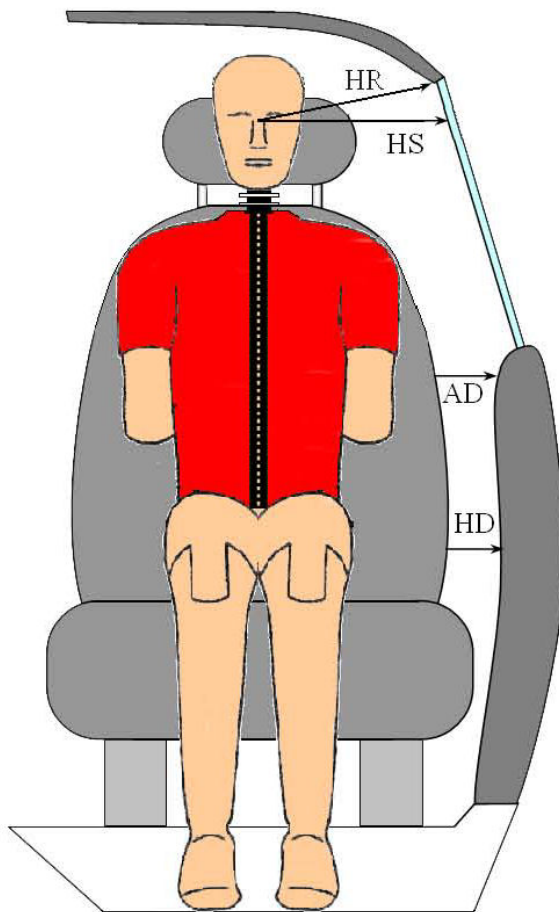


Driver Code	Measurement Description	Length (mm)	Angle (°)
HH	Head to Header	502	
HW	Head to Windshield	705	
HZ	Head to Roof	142	
NR	Nose to Rim	488	
CD	Chest to Dash	595	
CS	Chest to Steering Wheel	386	
KDL	Left Knee to Dash	214	32.3
KDR	Right Knee to Dash	193	30.2
PA	Pelvis Angle X		28.4
	Torso Angle Y		0.2
PHX	H-Point to Striker (X-Axis)	134	
PHZ	H-Point to Striker (Z-Axis)	145	

DATA SHEET NO. 7
DUMMY LATERAL CLEARANCE DIMENSIONS

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

NHTSA No. CB0105
 Test Date: 4/20/2011

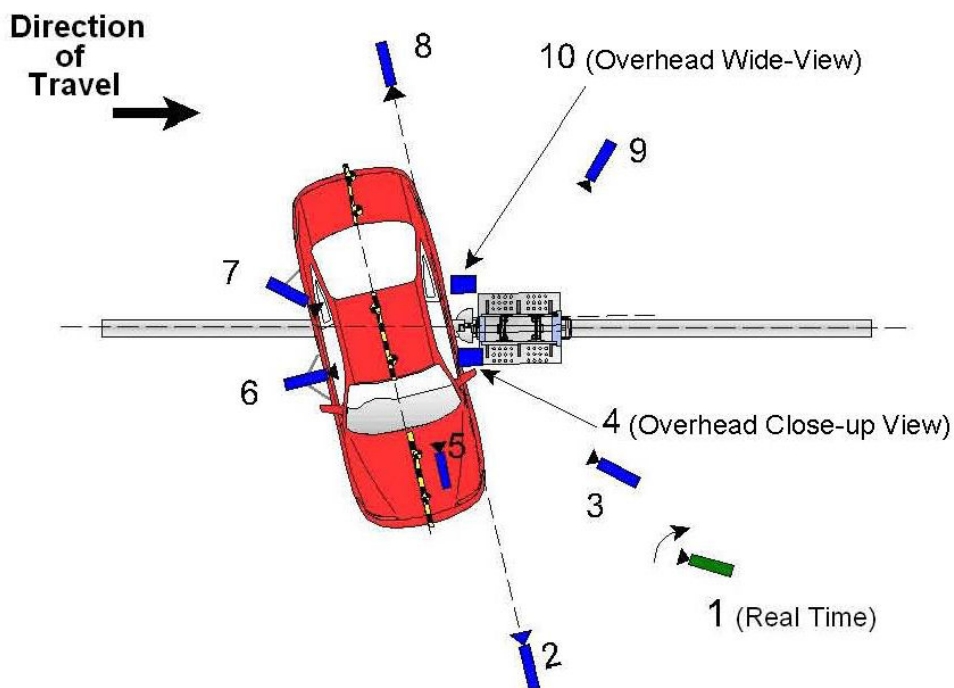


Code	Measurement Description	Units	Front Occupant
HR	Head to Side Header	mm	175
HS	Head to Side Window	mm	296
AD	Arm to Door	mm	100
HD	H-Point to Door	mm	134

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. CB0105
 Test Date: 4/20/2011



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

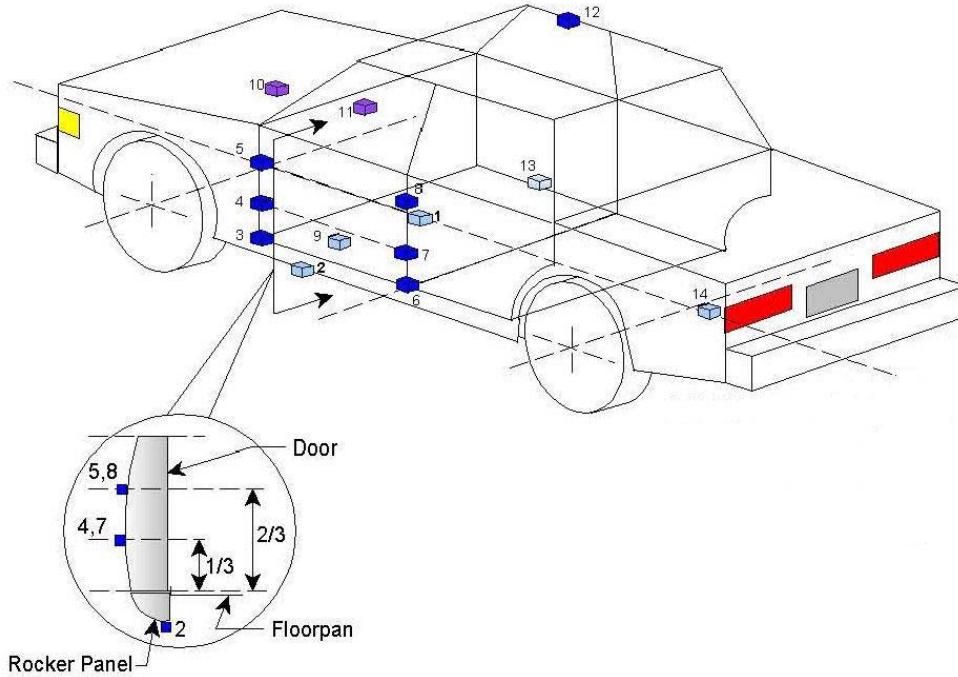
Camera No.	View	Coordinates (mm)			Lens (mm)	Film Speed (fps)
		X	Y	Z		
1	Real-Time					30
2	Front Ground Level	5780	30	1710	24	1000
3	Impact Side 45° Forward	4560	2200	1830	20	1000
4	Overhead Closeup	0	70	4520	50	1000
5	Onboard – Driver Front				16	1000
6	Onboard – Driver Side				8	1000
7	Onboard – Driver Rear				8	1000
8	Rear Ground Level	-5710	30	1680	24	1000
9	Impact Side 45° Rearward	-4020	3990	1840	20	1000
10	Overhead Wide	0	-330	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. CB0105
 Test Date: 4/20/2011



Loc. No.	Accelerometer Location			
	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2250	380	-170
2	Left Floor Sill	2560	-725	-200
3	A Pillar Sill	3010	-725	-200
4	A Pillar Low	2924	-675	-520
5	A Pillar Mid	2965	-775	-805
6	B Pillar Sill	1920	-725	-200
7	B Pillar Low	1865	-685	-555
8	B Pillar Mid	1865	-700	-760
9	Seat	1980	-510	-325
10	Engine	3655	0	-800
11	Firewall	3425	0	-900
12	Roof	1660	560	-1435
13	Floor Sill	1675	725	-200
14	Rear Deck	275	0	-375

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. CB0105
 Test Date: 4/20/2011

Loc. No.	Description	Peak Values (g's)			
		Max	Time (ms)	Min	Time (ms)
1	Vehicle CG (X)	4.1	63.9	-4.5	30.7
	Vehicle CG (Y)	17.4	41.2	-1.2	131.0
	Vehicle CG (Z)	18.1	62.7	-7.7	47.2
	Resultant	18.7	62.8		
2	Left Floor Sill (Y)	(1)	(1)	(1)	(1)
3	A Pillar Sill (Y)	20.5	48.8	-11.8	16.8
4	A Pillar Low (Y)	19.7	11.5	-18.4	16.3
5	A Pillar Mid (Y)	24.4	32.9	-4.7	16.7
6	B Pillar Sill (Y)	(2)	(2)	(2)	(2)
7	B Pillar Low (Y)	(3)	(3)	(3)	(3)
8	B Pillar Mid (Y)	(4)	(4)	(4)	(4)
9	Seat (Y)	(5)	(5)	(5)	(5)
10	Engine (X)	18.6	84.1	-11.4	37.2
	Engine (Y)	16.8	86.7	-2.6	173.5
11	Firewall (Y)	12.6	65.1	-2.3	19.3
12	Roof (Y)	19.3	42.9	-2.2	229.3
13	Floor Sill (Y)	19.9	42.8	-1.2	183.2
14	Rear Deck (X)	(6)	(6)	(6)	(6)
	Rear Deck (Y)	26.4	61.5	-7.0	137.4

- (1) No valid data collected for Left Floor Sill Y after 10 msec.
- (2) No valid data collected for B Pillar Sill Y after 55 msec.
- (3) No valid data collected for B Pillar Low Y after 35 msec.
- (4) No valid data collected for B Pillar Mid Y after 35 msec.
- (5) No valid data collected for Seat Y after 20 msec.
- (6) No valid data collected for Rear Deck X after 20 msec.

DATA SHEET NO. 12
POST TEST OBSERVATIONS

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

NHTSA No. CB0105
Test Date: 4/20/2011

TEST DUMMY INFORMATION AND CONTACT

Description	Front Occupant
Dummy Type / Serial No.	ES-2re / 016
Head Contact	Curtain Airbag, Headrest, Side Header
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 and Left Rear Window Broke
Other Notable Effects	None

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

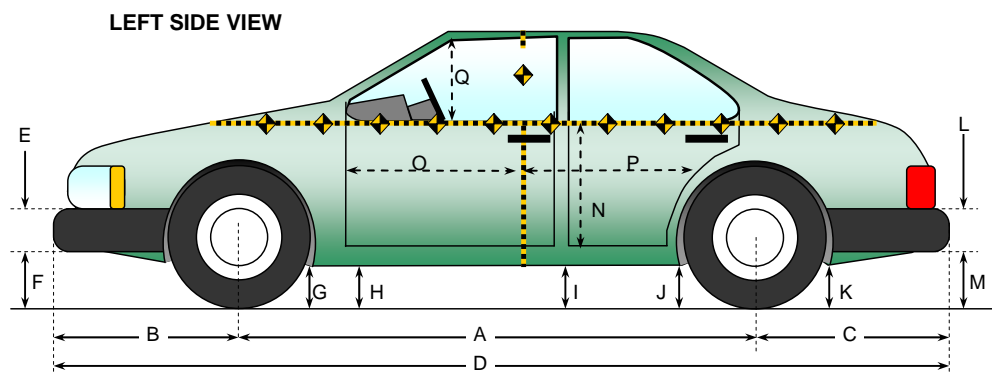
Restraint Type	Front Occupant	
	Installed	Operated
Frontal Airbag	Yes	No
Side Torso/Pelvis Airbag	Yes	Yes
Head Airbag	No	
Curtain Airbag	Yes	Yes
Knee Airbag	Yes	No
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	

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. CB0105
 Test Date: 4/20/2011

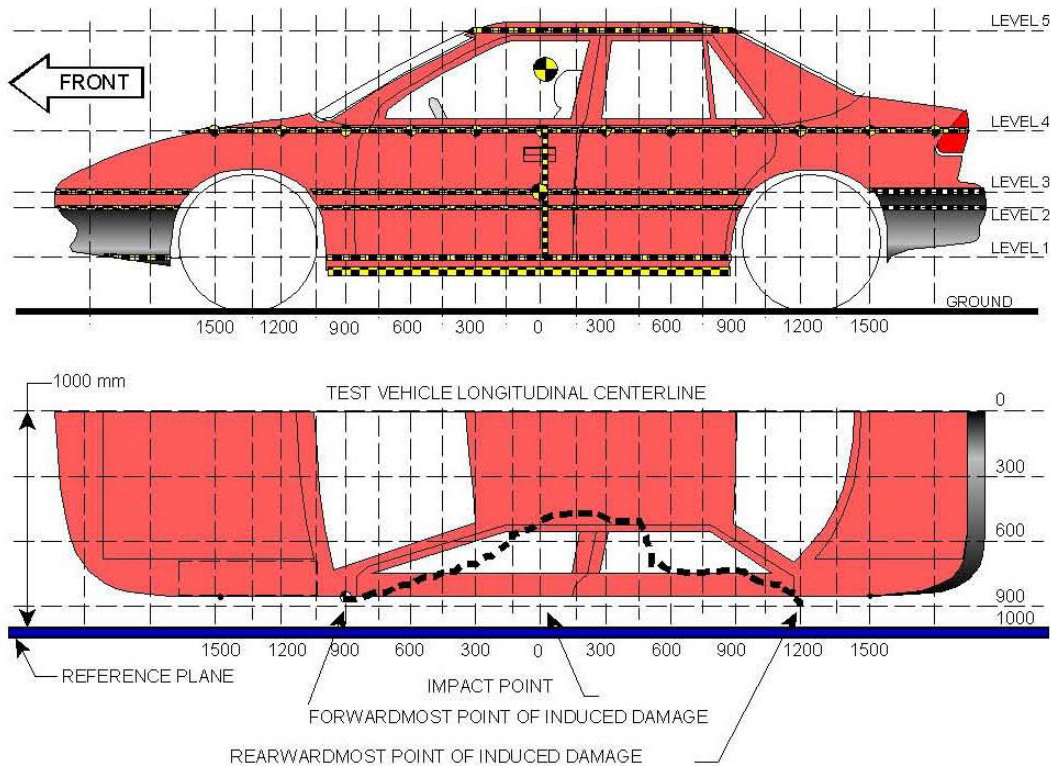


Code	Measurement Description	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	Wheelbase	2685	2625	60
B	Front Axle to FSOV	1010	1010	0
C	Rear Axle to RSOV	805	805	0
D	Total Vehicle Length at Centerline	4500	4440	60
E	Front Bumper Thickness	114	114	0
F	Front Bumper Bottom to Ground	102	87	15
G	Sill Height at Front Wheel Well	160	173	-13
H	Sill Height at Front Door Leading Edge	168	177	-9
I	Sill Height at B Pillar	183	131	52
J1	Sill Height at Rear Wheel Well	172	176	-4
J2	Pinch Weld Height at Rear Wheel Well	177	183	-6
K	Sill Height Aft of Rear Wheel Well	238	248	-10
L	Rear Bumper Thickness	110	110	0
M	Rear Bumper Bottom to Ground	248	251	-3
N	Sill Height to Window Bottom Sill	740	736	4
O	Front Door Leading Edge to Impact CL	923	921	2
P	Rear Door Trailing Edge to Impact CL	980	1010	-30
Q	Front Window Opening	405	378	27
R	Right Side Length	3070	3085	-15
S	Left Side Length	3070	3000	70
T	Vehicle Width at B Post	1785	1604	181

DATA SHEET NO. 14
EXTERIOR CRUSH MEASUREMENTS

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

NHTSA No. CB0105
 Test Date: 4/20/2011



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	255	0	235
2	Occupant H-Point	287	0	520
3	Mid-Door	297	0	631
4	Window Sill	249	0	964
5	Window Top	95	-75	1340

DATA SHEET NO. 15

VEHICLE EXTERIOR CRUSH PROFILES

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

NHTSA No. CB0105
 Test Date: 4/20/2011

	Level 1	Level 2	Level 3	Level 4	Level 5
Maximum Crush (mm)	255	287	297	249	95
Distance From Impact (mm)	0	0	0	0	-75

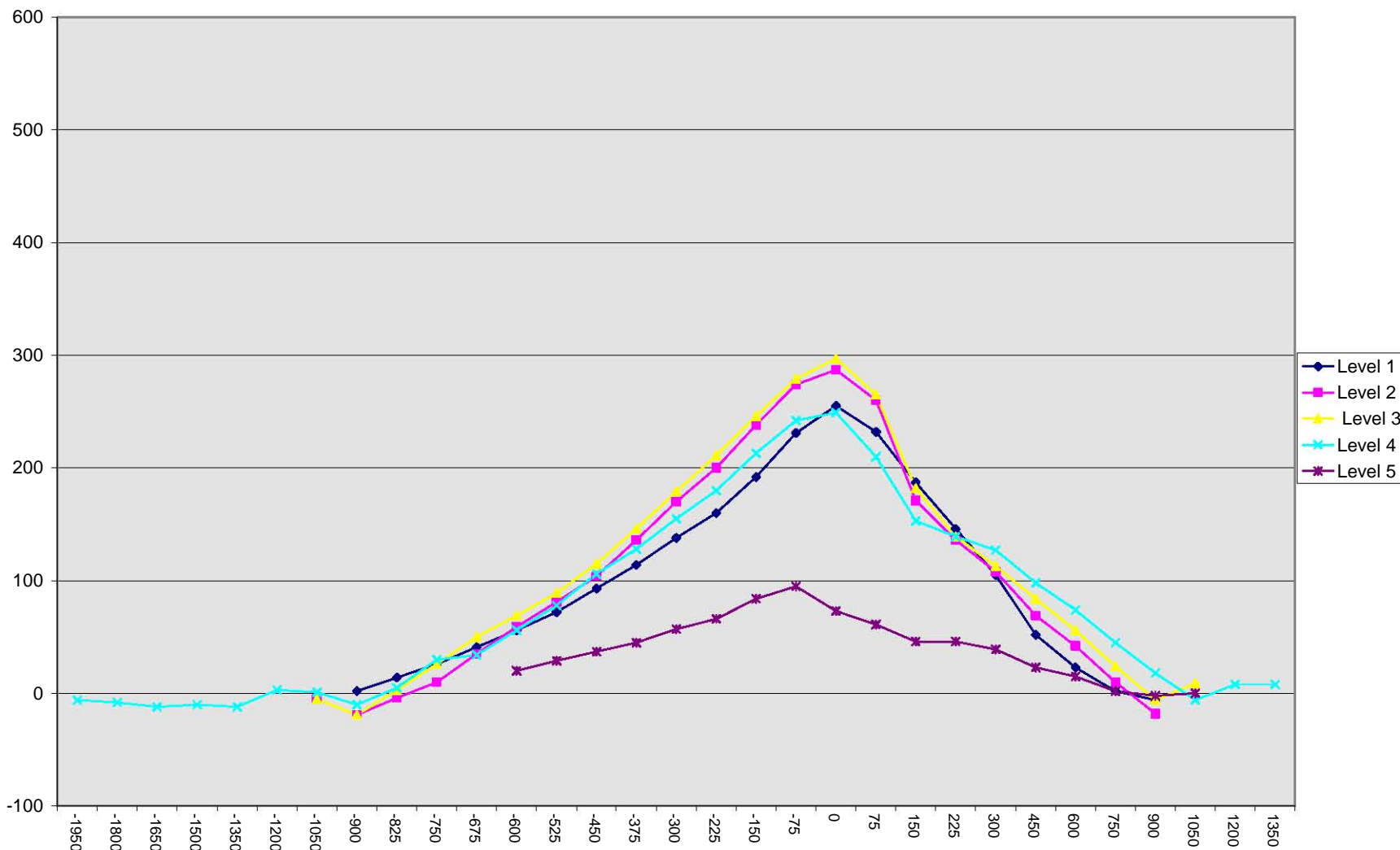
	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1950				435					429					-6	
-1800				381					373					-8	
-1650				350					338					-12	
-1500				326					316					-10	
-1350				310					298					-12	
-1200				300					303					3	
-1050		216	214	291			211	209	292			-5	-5	1	
-900	239	222	226	291		241	203	207	281		2	-19	-19	-10	
-825	239	229	227	295		253	225	230	300		14	-4	3	5	
-750	238	230	226	295		264	240	252	325		26	10	26	30	
-675	237	229	226	298		278	264	276	332		41	35	50	34	
-600	237	226	224	296	490	293	285	293	352	510	56	59	69	56	20
-525	238	225	222	293	482	310	306	311	371	511	72	81	89	78	29
-450	238	224	221	292	479	331	328	336	398	516	93	104	115	106	37
-375	237	222	220	290	476	351	358	366	418	521	114	136	146	128	45
-300	236	221	220	288	478	374	391	399	443	535	138	170	179	155	57
-225	236	221	219	288	480	396	421	430	468	546	160	200	211	180	66
-150	235	220	218	285	480	427	458	464	498	564	192	238	246	213	84
-75	236	219	218	283	482	467	493	497	525	577	231	274	279	242	95
0	235	219	217	282	485	490	506	514	531	558	255	287	297	249	73
75	235	219	216	283	485	467	479	481	493	546	232	260	265	210	61
150	235	219	217	284	486	422	390	399	437	532	187	171	182	153	46
225	235	219	217	282	489	381	355	356	421	535	146	136	139	139	46
300	235	218	217	281	490	340	326	330	408	529	105	108	113	127	39
450	235	216	216	282	496	287	285	300	380	519	52	69	84	98	23
600	235	216	217	282	500	258	258	273	356	515	23	42	56	74	15
750	235	216	218	284	506	237	226	242	329	508	2	10	24	45	2
900	232	215	216	286	515	226	197	210	304	513	-6	-18	-6	18	-2
1050			210	292	530			219	286	530			9	-6	0
1200				295					303					8	
1350				302					310					8	

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

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

NHTSA No. CB0105
 Test Date: 4/20/2011

18



DATA SHEET NO. 16

SUMMARY OF FMVSS 301 FUEL SYSTEM DATA

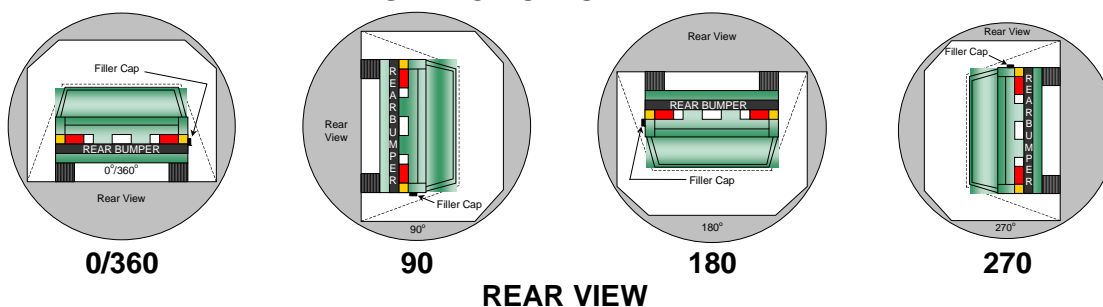
Test Vehicle: 2011 Chevrolet Volt 5-Dr Hatchback
 Test Program: FMVSS 214 Pole

NHTSA No. CB0105
 Test Date: 4/20/2011

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°	2	minutes	02	seconds	5	minutes	7	minutes	02	seconds	8	minutes
90° - 180°	1	minutes	55	seconds	5	minutes	6	minutes	55	seconds	7	minutes
180° - 270°	1	minutes	48	seconds	5	minutes	6	minutes	48	seconds	7	minutes
270° - 360°	1	minutes	59	seconds	5	minutes	6	minutes	59	seconds	7	minutes

Rollover Stage	Spillage (g)			
	First 5 min. from onset of rotation	6 th min.	7 th min.	8 th 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

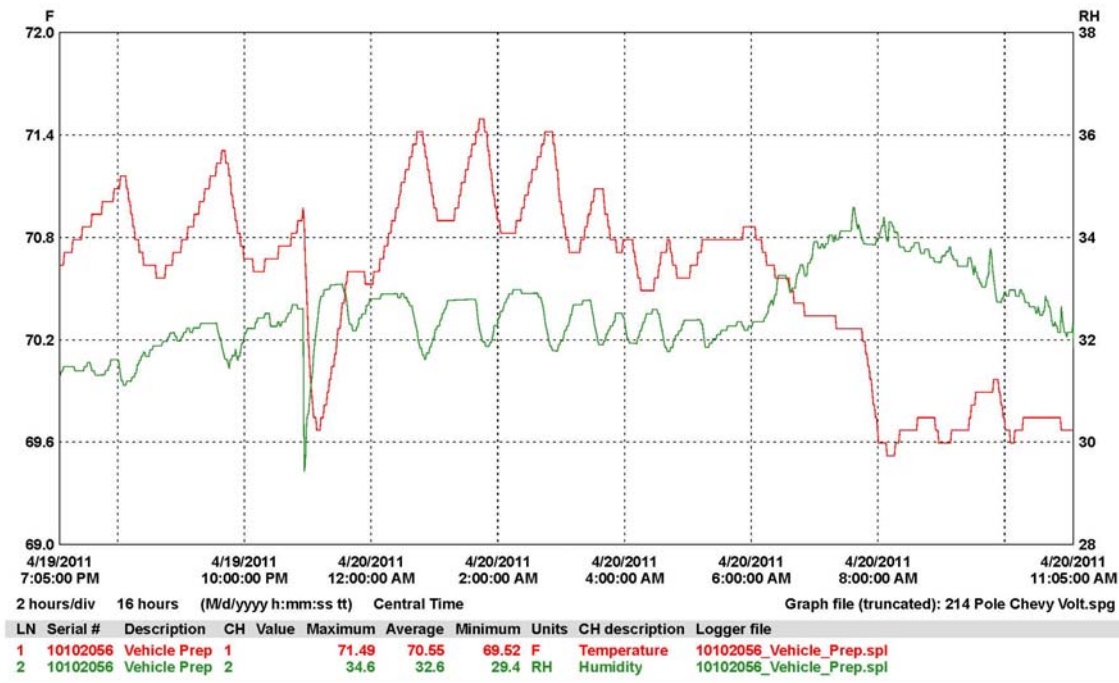
Rollover Stage	Spillage Location(s)
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

DATA SHEET NO. 17
TEMPERATURE AND HUMIDITY TRACES

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

NHTSA No. CB0105
 Test Date: 4/20/2011

Time of Impact: 11:04 am



APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

		<u>Page No.</u>
Photo No. 1.	Pre-Test Frontal View of Test Vehicle	A-1
Photo No. 2.	Post-Test Frontal View of Test Vehicle	A-1
Photo No. 3.	Pre-Test Rear View of Test Vehicle	A-2
Photo No. 4.	Post-Test Rear View of Test Vehicle	A-2
Photo No. 5.	Pre-Test Impacted Side View of Test Vehicle	A-3
Photo No. 6.	Post-Test Impacted Side View of Test Vehicle	A-3
Photo No. 7.	Pre-Test Left $\frac{3}{4}$ Front View of Vehicle and Pole	A-4
Photo No. 8.	Pre-Test Left $\frac{3}{4}$ Rear View of Vehicle and Pole	A-4
Photo No. 9.	Pre-Test Overhead View of Test Vehicle	A-5
Photo No. 10.	Post-Test Overhead View of Test Vehicle	A-5
Photo No. 11.	Pre-Test Dummy Through Opposite Window	A-6
Photo No. 12.	Post-Test Dummy Through Opposite Window	A-6
Photo No. 13.	Pre-Test Close-up of Dummy with Door Closed (Impact Side)	A-7
Photo No. 14.	Post-Test Dummy with Door Closed (Impact Side)	A-7
Photo No. 15.	Pre-Test Dummy Door Open	A-8
Photo No. 16.	Pre-Test Dummy Shoulder and Door Top View	A-9
Photo No. 17.	Post-Test Dummy Shoulder and Door Top View	A-9
Photo No. 18.	Pre-Test Interior of Front Door Closed	A-10
Photo No. 19.	Post-Test Interior of Front Door Showing Dummy Impact Locations	A-10
Photo No. 20.	Impact Event	A-11
Photo No. 21.	Post-Test Impact Zone Close-up View	A-11
Photo No. 22.	Post-Test $\frac{3}{4}$ Front View of Impact Zone	A-12
Photo No. 23.	Post-Test $\frac{3}{4}$ Rear View of Impact Zone	A-12
Photo No. 24.	Post-Test Close-up View of Impact Point Target	A-13
Photo No. 25.	Close-up View of Vehicle's Certification Label	A-14
Photo No. 26.	Close-up View of Vehicle's Tire Placard Label	A-14
Photo No. 27.	Post-Test Vehicle at 90 Degree Rollover	A-15
Photo No. 28.	Post-Test Vehicle at 180 Degree Rollover	A-15
Photo No. 29.	Post-Test Vehicle at 270 Degree Rollover	A-16
Photo No. 30.	Post-Test Vehicle at 360 Degree Rollover	A-16



Pre-Test Frontal View of Test Vehicle



Post-Test Frontal View of Test Vehicle



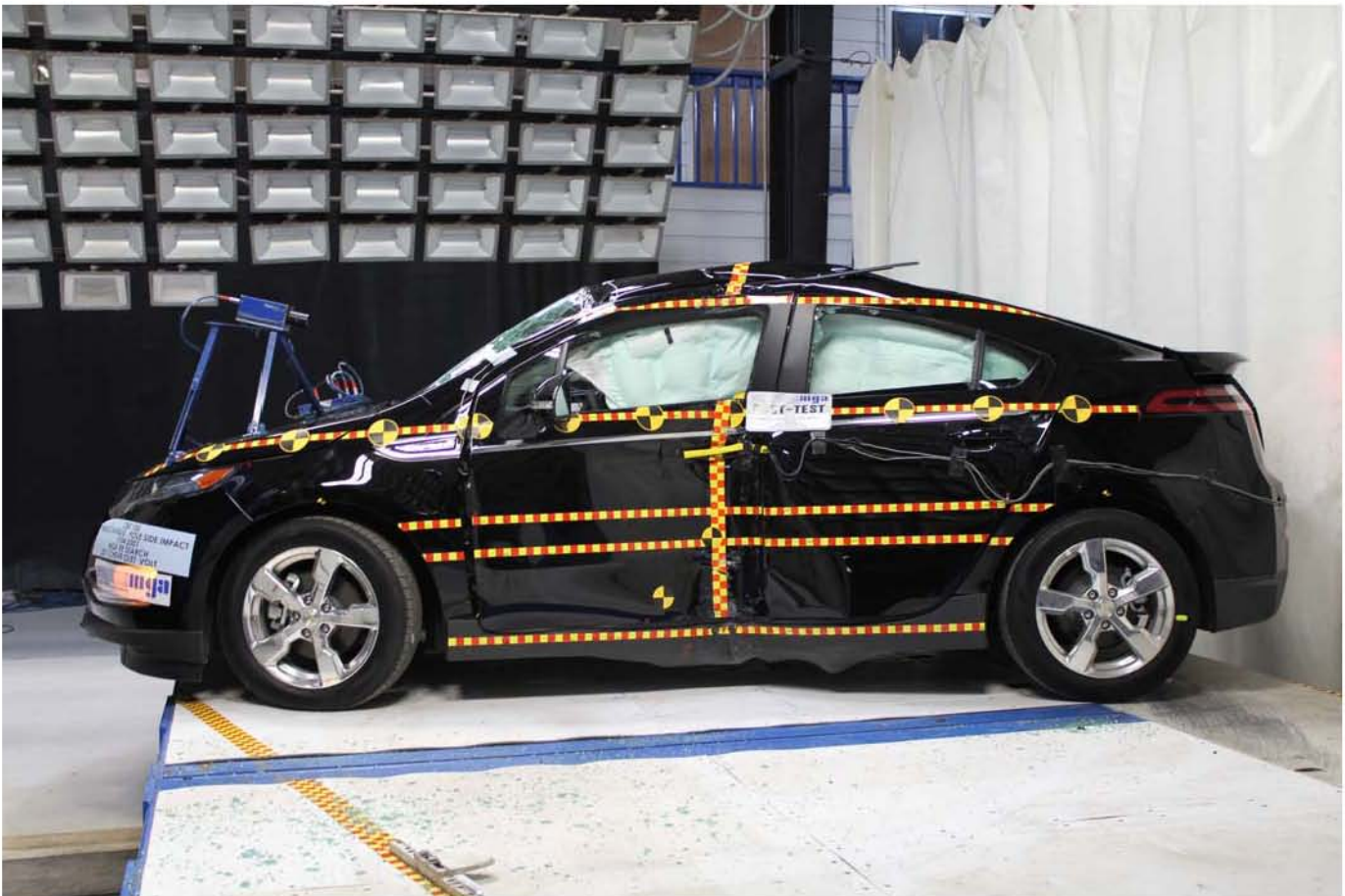
Pre-Test Rear View of Test Vehicle



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



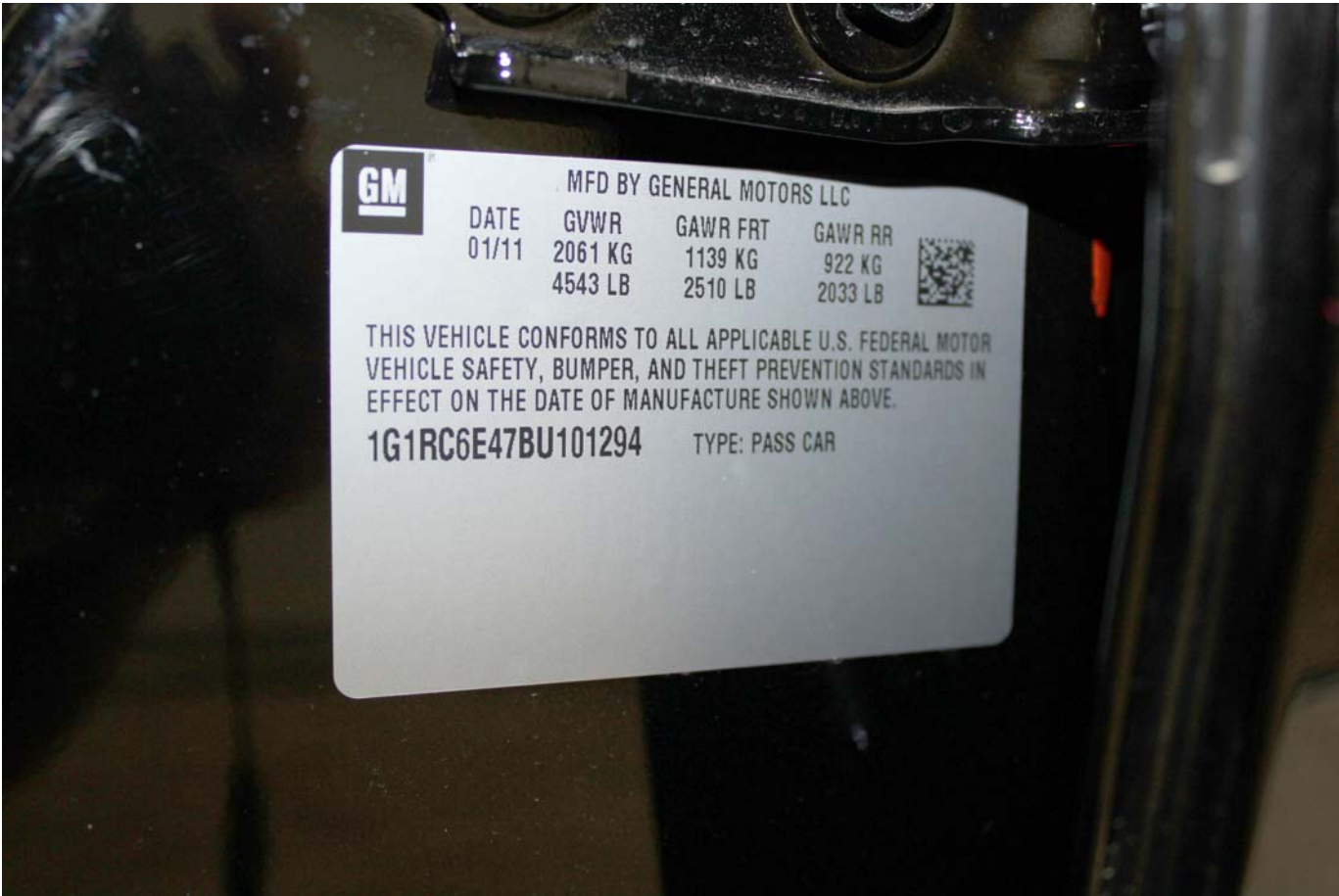
Post-Test $\frac{3}{4}$ Front View of Impact Zone



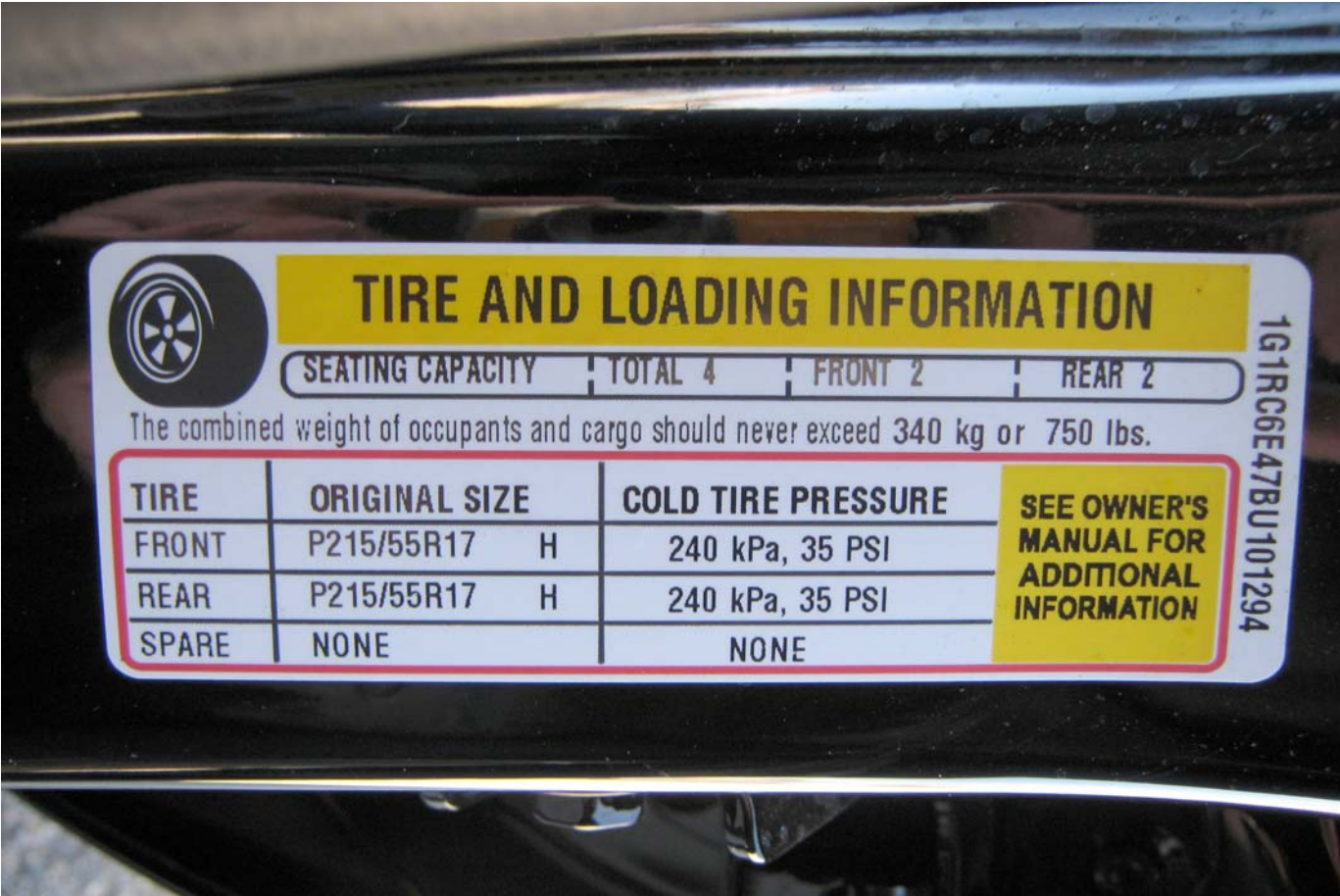
Post-Test $\frac{3}{4}$ Rear View of Impact Zone



Post-Test Close-up View of Impact Point Target



Close-up View of Vehicle's Certification Label



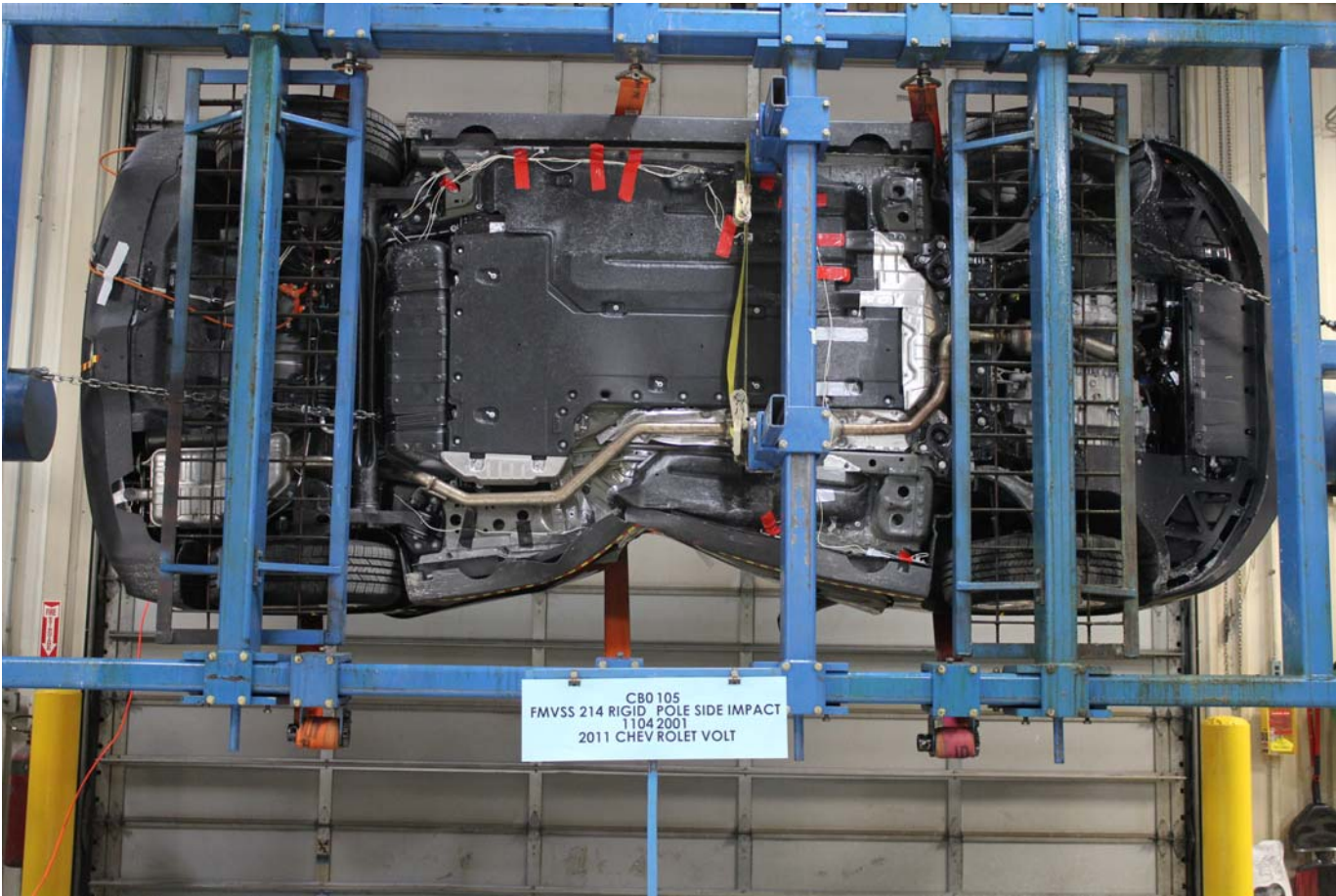
Close-up View of Vehicle's Tire Placard Label



Post-Test Vehicle at 90 Degree Rollover



Post-Test Vehicle at 180 Degree Rollover



Post-Test Vehicle at 270 Degree Rollover



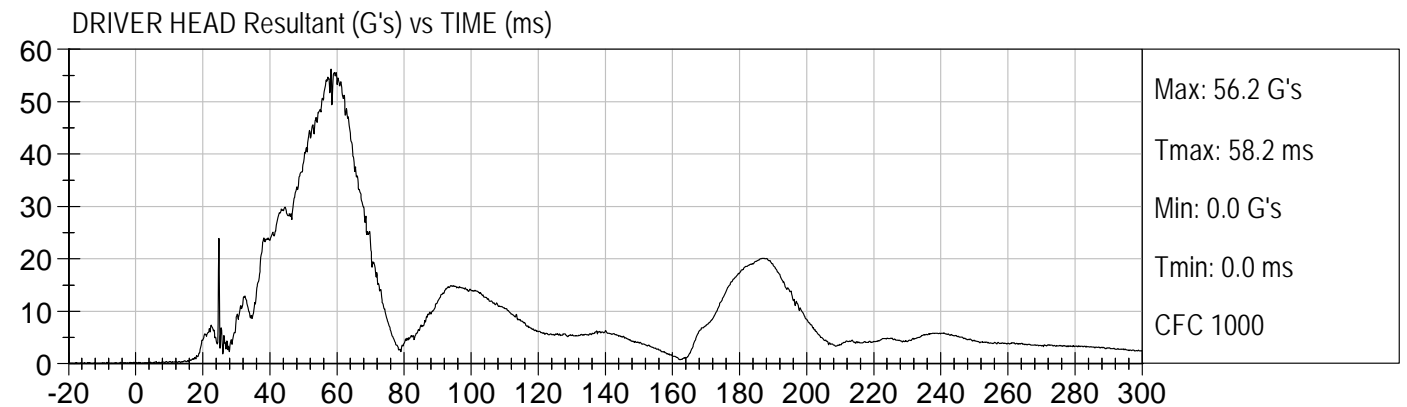
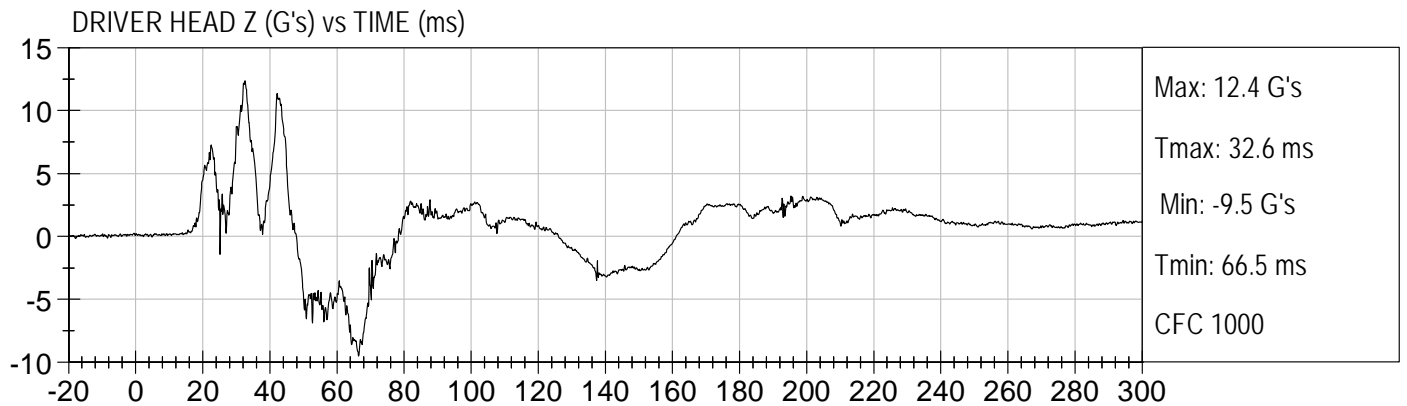
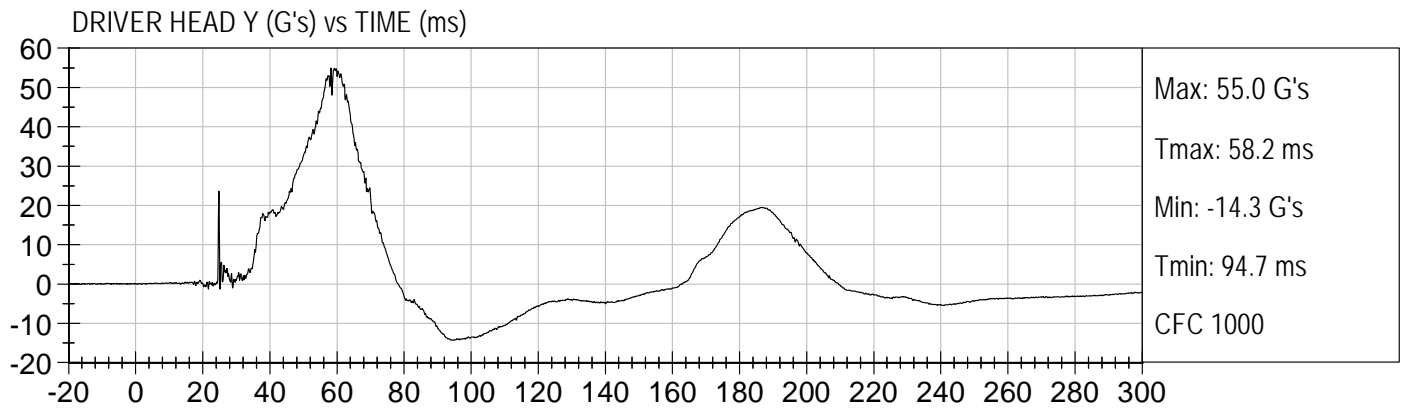
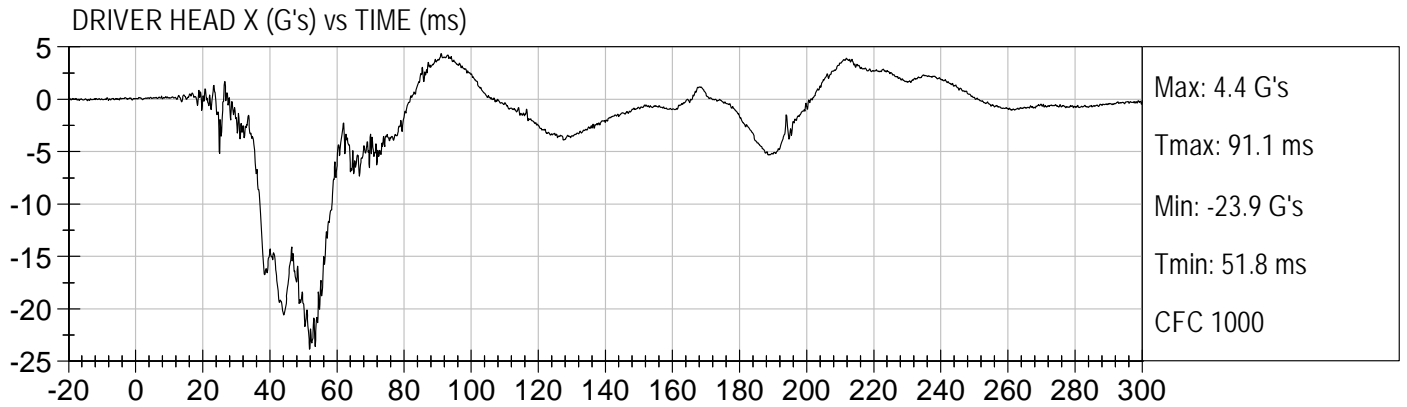
Post-Test Vehicle at 360 Degree Rollover

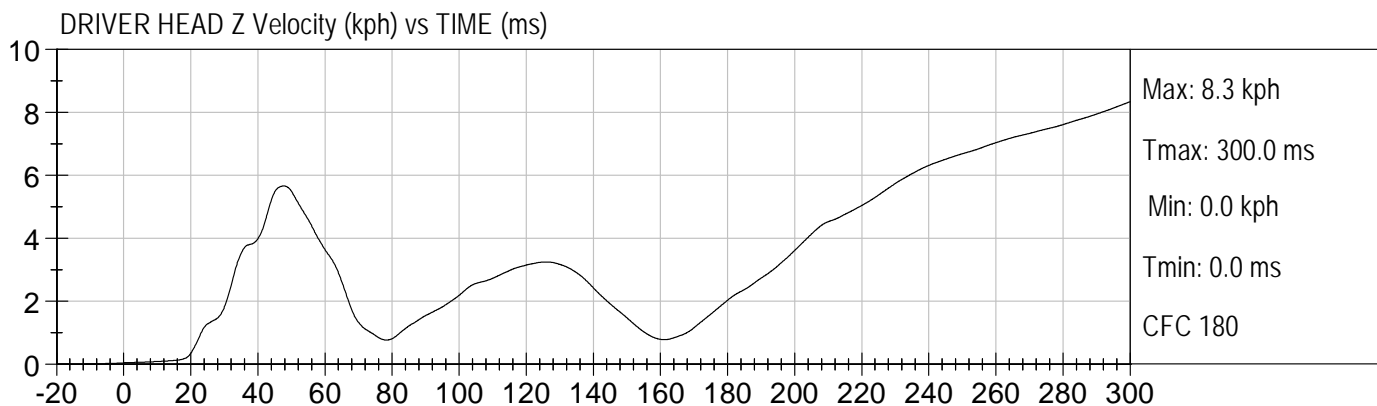
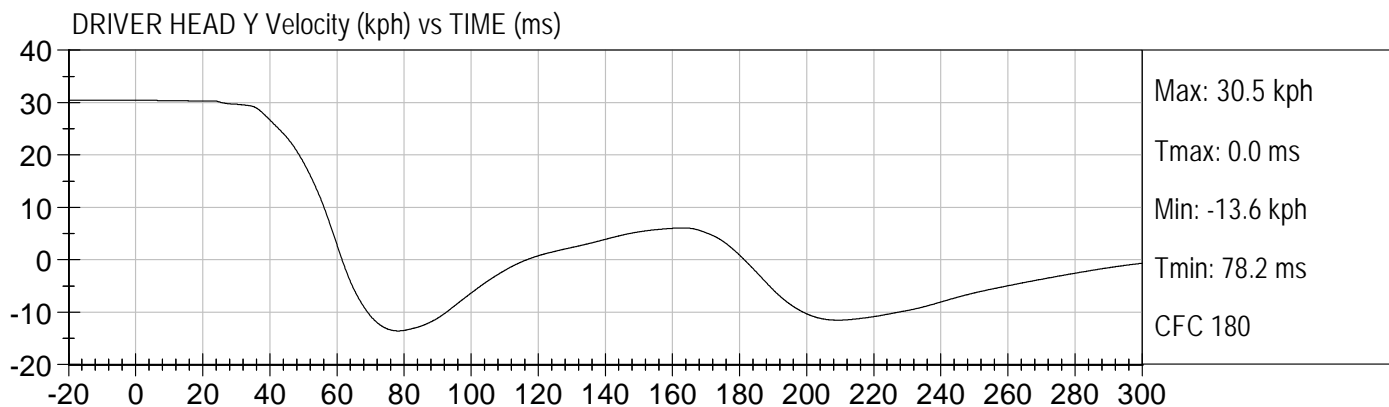
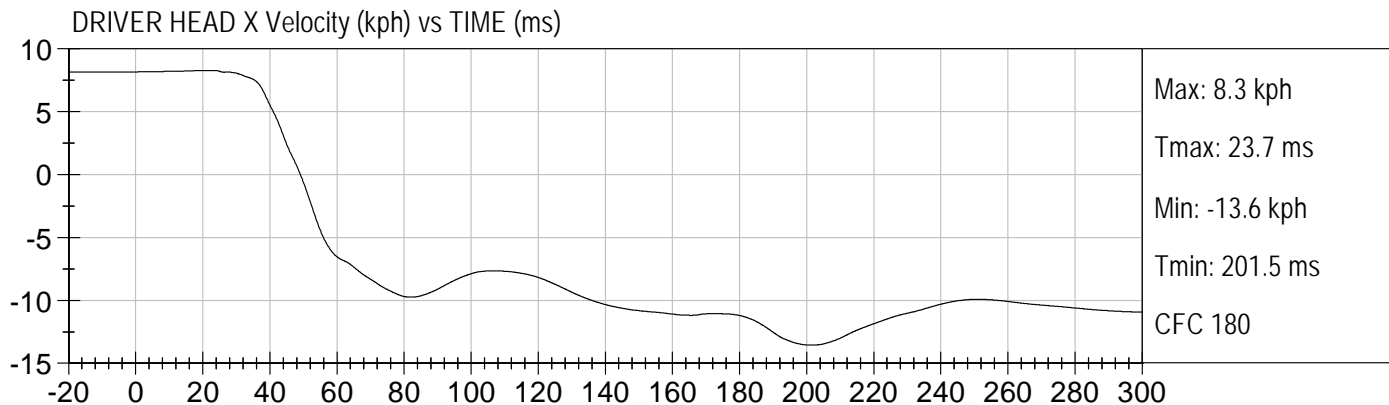
APPENDIX B
DUMMY RESPONSE DATA

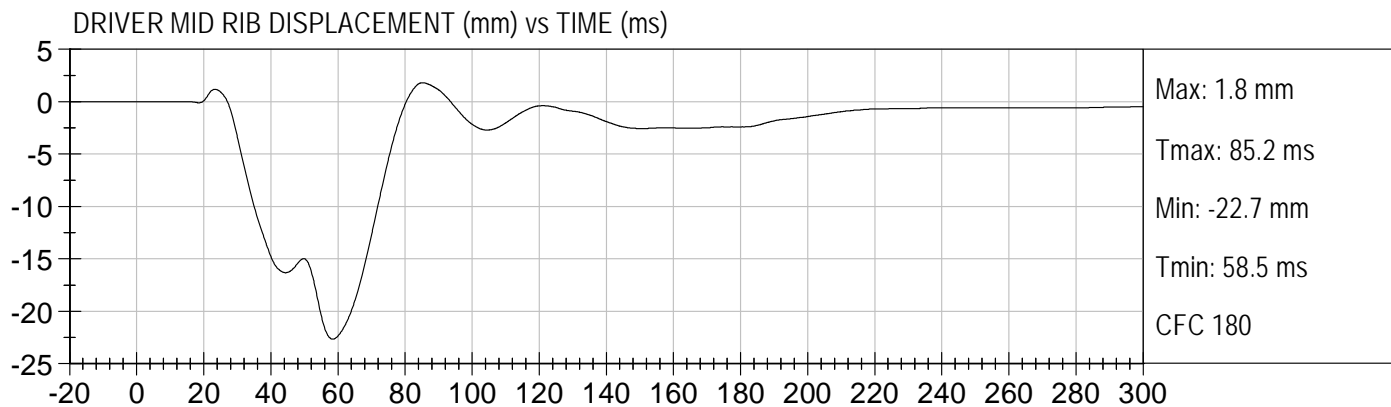
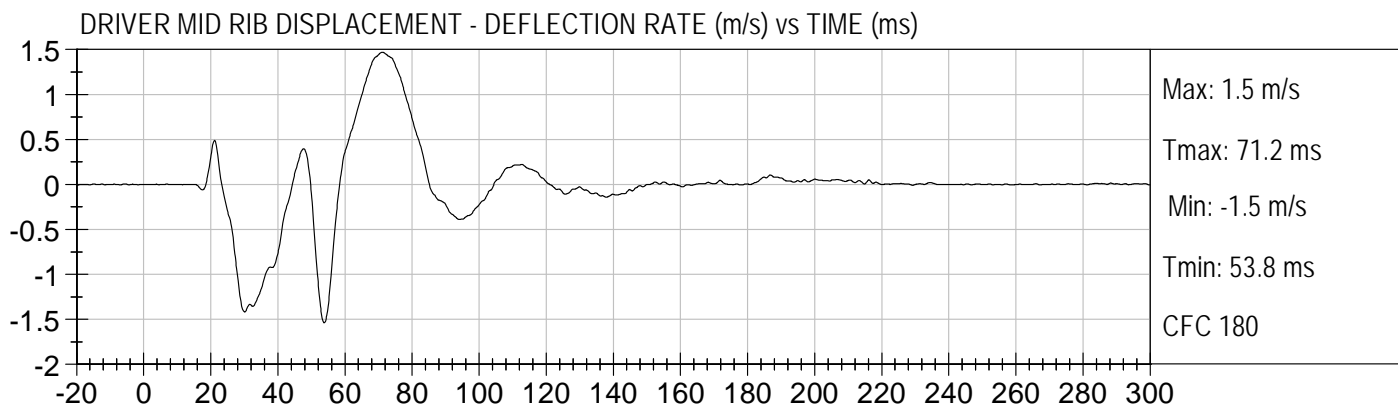
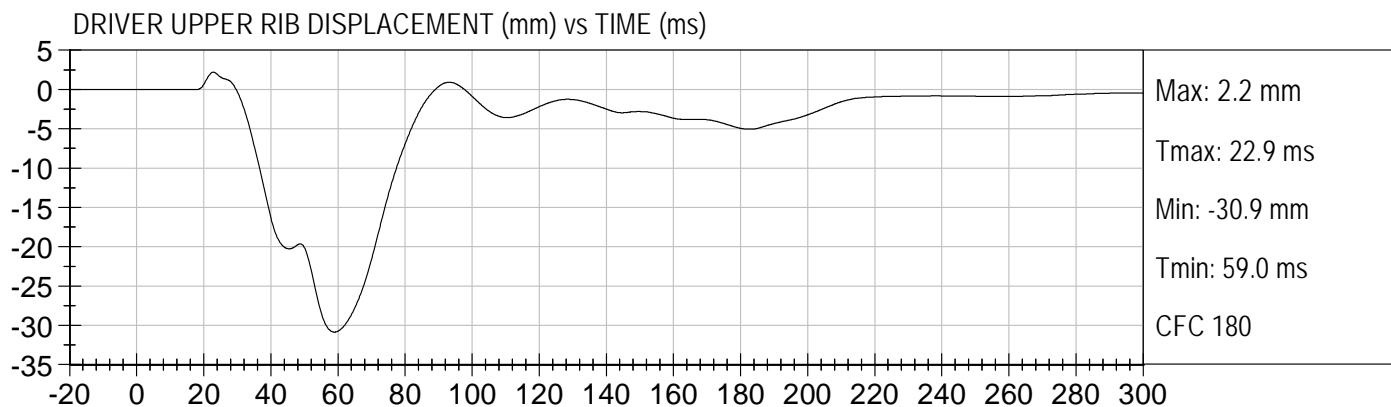
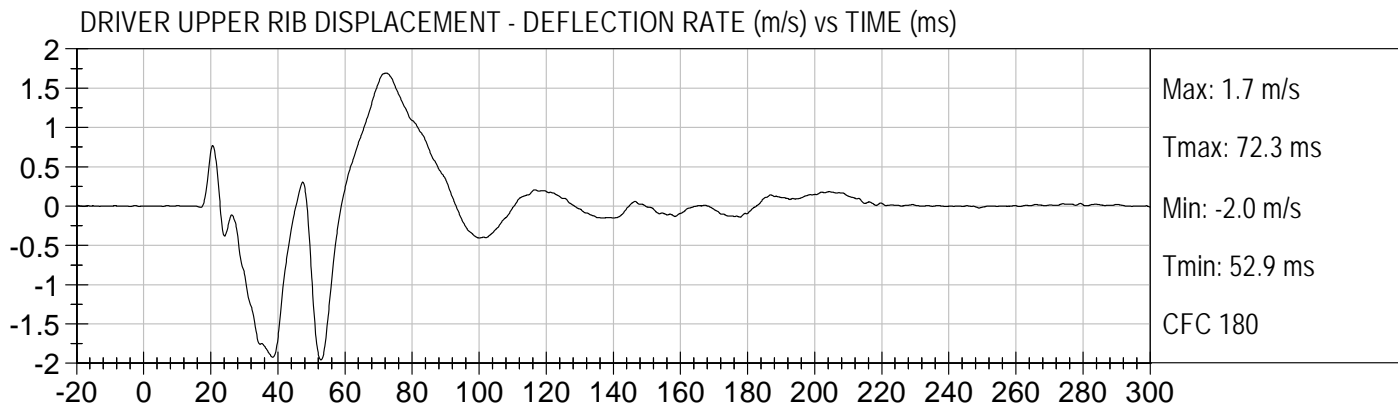
TABLE OF DATA PLOTS

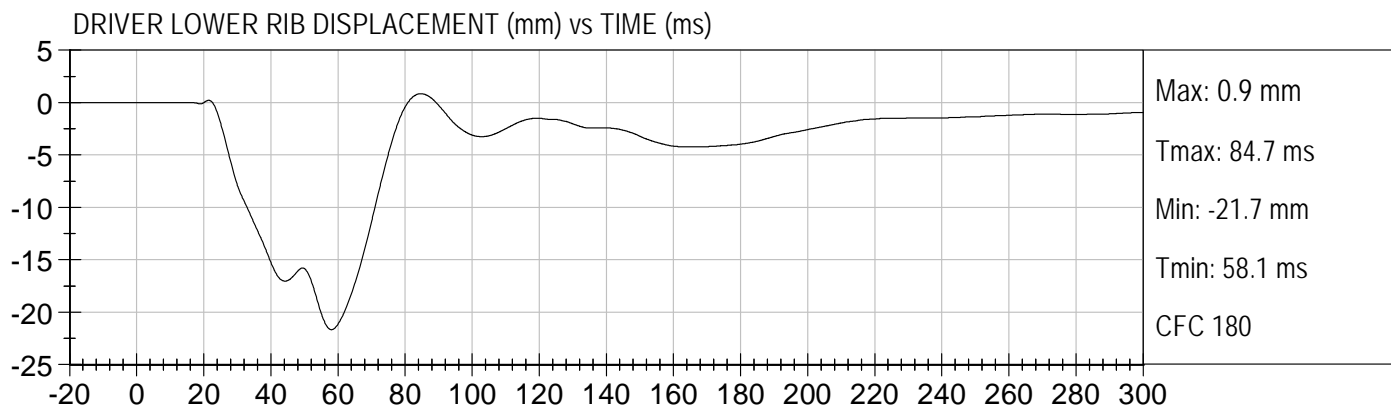
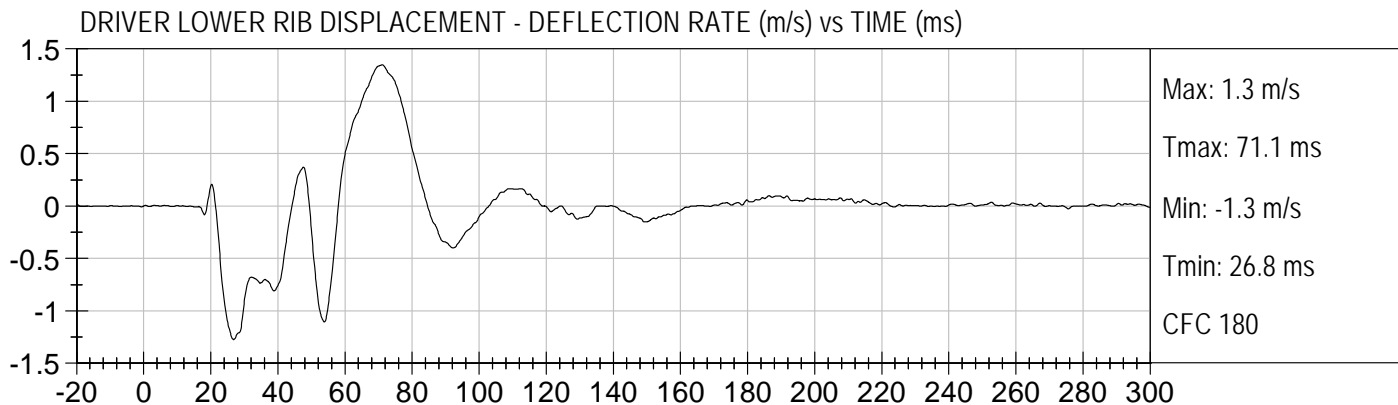
Dummy Instrumentation Plots FILTERED DATA

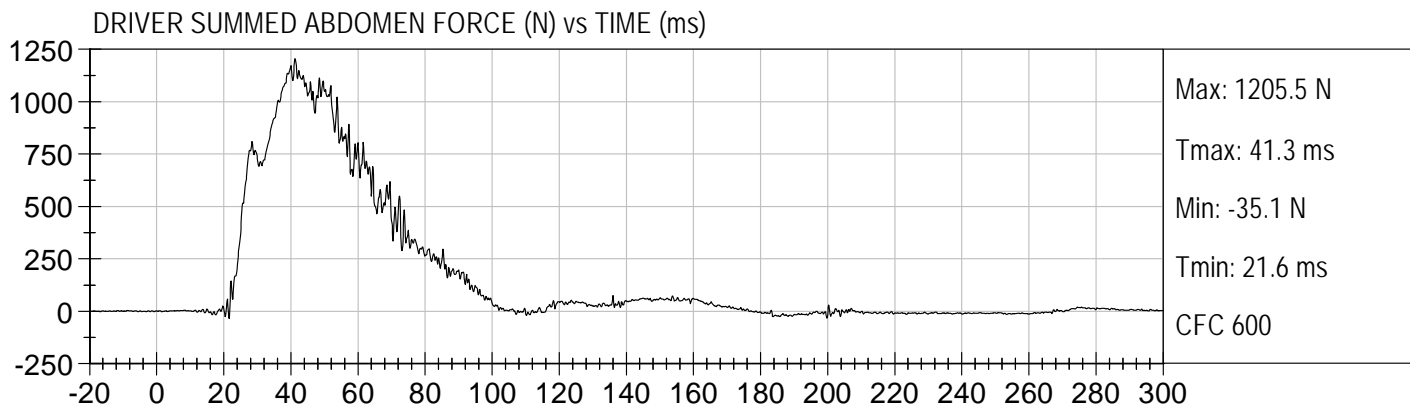
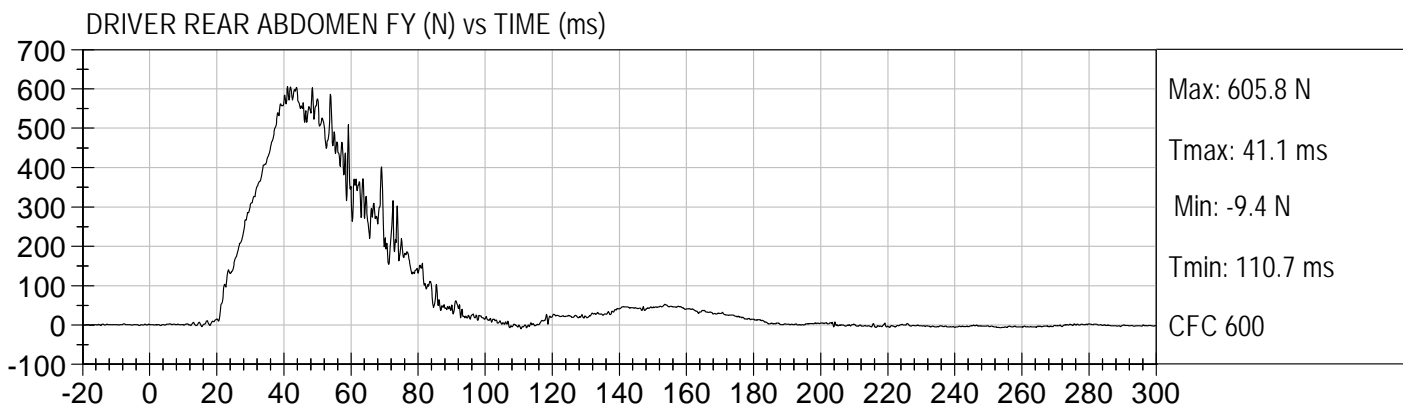
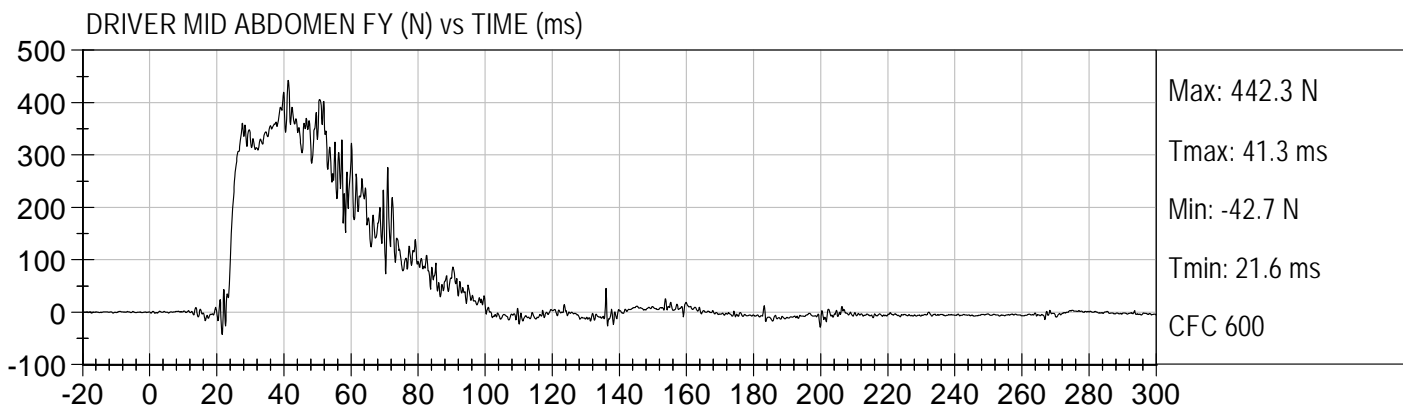
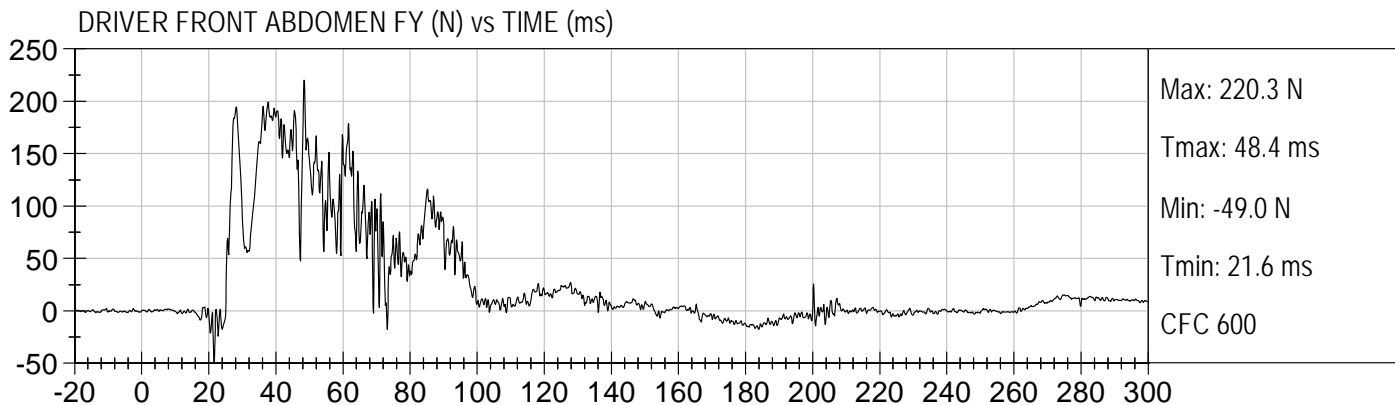
		<u>Page No.</u>
Figure No. 1.	ES-2re Head (X) Acceleration vs. Time	B-1
Figure No. 2.	ES-2re Head (Y) Acceleration vs. Time	B-1
Figure No. 3.	ES-2re Head (Z) Acceleration vs. Time	B-1
Figure No. 4.	ES-2re Head Resultant Acceleration vs. Time	B-1
Figure No. 5.	ES-2re Head (X) Velocity vs. Time	B-2
Figure No. 6.	ES-2re Head (Y) Velocity vs. Time	B-2
Figure No. 7.	ES-2re Head (Z) Velocity vs. Time	B-2
Figure No. 8.	ES-2re Upper Thorax Rib Deflection Rate vs. Time	B-3
Figure No. 9.	ES-2re Upper Thorax Rib Deflection (Y) vs. Time	B-3
Figure No. 10.	ES-2re Middle Thorax Rib Deflection Rate vs. Time	B-3
Figure No. 11.	ES-2re Middle Thorax Rib Deflection (Y) vs. Time	B-3
Figure No. 12.	ES-2re Lower Thorax Rib Deflection Rate vs. Time	B-4
Figure No. 13.	ES-2re Lower Thorax Rib Deflection (Y) vs. Time	B-4
Figure No. 14.	ES-2re Front Abdomen Force (Y) vs. Time	B-5
Figure No. 15.	ES-2re Middle Abdomen Force (Y) vs. Time	B-5
Figure No. 16.	ES-2re Rear Abdomen Force (Y) vs. Time	B-5
Figure No. 17.	ES-2re Sum of the Abdominal Forces vs. Time	B-5
Figure No. 18.	ES-2re Pubic Symphysis Force (Y) vs. Time	B-6

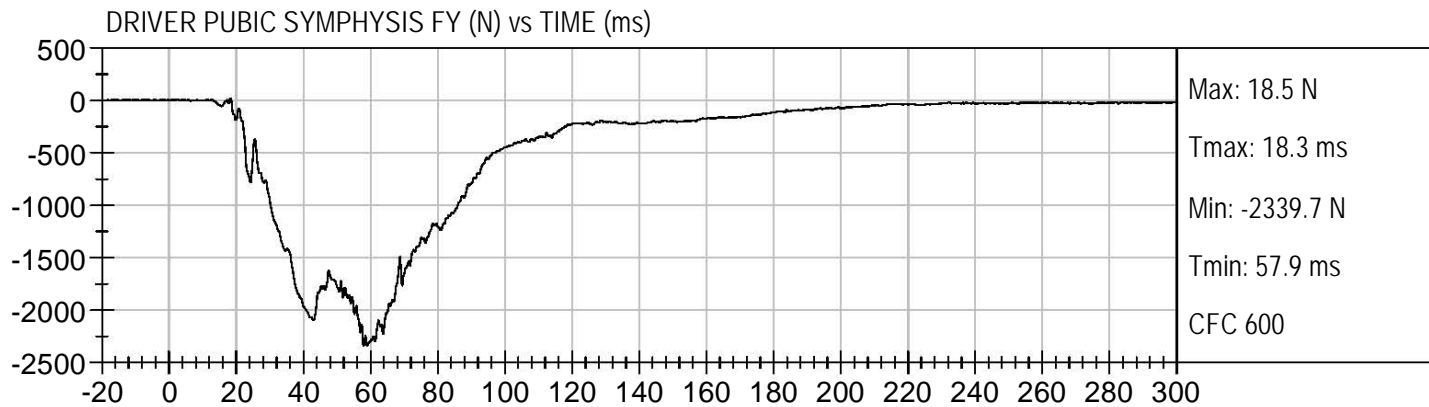












APPENDIX C

VEHICLE ACCELEROMETER RESPONSE DATA

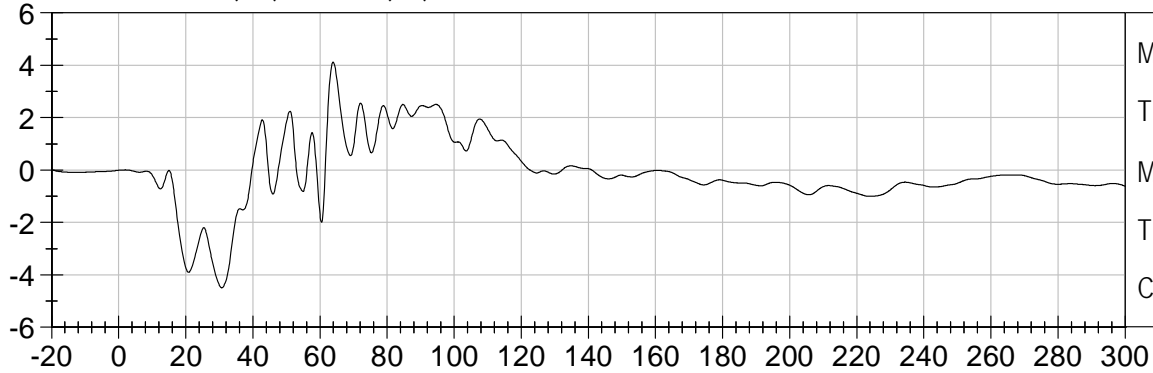
TABLE OF DATA PLOTS

		<u>Page No.</u>
Figure No. 1.	Vehicle Center of Gravity (X) Acceleration vs. Time	C-1
Figure No. 2.	Vehicle Center of Gravity (X) Velocity vs. Time	C-1
Figure No. 3.	Vehicle Center of Gravity (Y) Acceleration vs. Time	C-1
Figure No. 4.	Vehicle Center of Gravity (Y) Velocity vs. Time	C-1
Figure No. 5.	Vehicle Center of Gravity (Z) Acceleration vs. Time	C-2
Figure No. 6.	Vehicle Center of Gravity (Z) Velocity vs. Time	C-2
Figure No. 7.	Vehicle Center of Gravity Resultant Acceleration vs. Time	C-2
Figure No. 8.	Left Floor Sill (Y) Acceleration vs. Time	C-3
Figure No. 9.	Left Floor Sill (Y) Velocity vs. Time	C-3
Figure No. 10.	Left Floor Sill (Y) Displacement vs. Time	C-3
Figure No. 11.	Left A-Pillar Sill (Y) Acceleration vs. Time	C-4
Figure No. 12.	Left A-Pillar Sill (Y) Velocity vs. Time	C-4
Figure No. 13.	Left A-Pillar Sill (Y) Displacement vs. Time	C-4
Figure No. 14.	Left Lower A-Pillar (Y) Acceleration vs. Time	C-5
Figure No. 15.	Left Lower A-Pillar (Y) Velocity vs. Time	C-5
Figure No. 16.	Left Lower A-Pillar (Y) Displacement vs. Time	C-5
Figure No. 17.	Left Mid A-Pillar (Y) Acceleration vs. Time	C-6
Figure No. 18.	Left Mid A-Pillar (Y) Velocity vs. Time	C-6
Figure No. 19.	Left Mid A-Pillar (Y) Displacement vs. Time	C-6
Figure No. 20.	Left B-Pillar Sill (Y) Acceleration vs. Time	C-7
Figure No. 21.	Left B-Pillar Sill (Y) Velocity vs. Time	C-7
Figure No. 22.	Left B-Pillar Sill (Y) Displacement vs. Time	C-7
Figure No. 23.	Left Lower B-Pillar (Y) Acceleration vs. Time	C-8
Figure No. 24.	Left Lower B-Pillar (Y) Velocity vs. Time	C-8
Figure No. 25.	Left Lower B-Pillar (Y) Displacement vs. Time	C-8
Figure No. 26.	Left Mid B-Pillar (Y) Acceleration vs. Time	C-9
Figure No. 27.	Left Mid B-Pillar (Y) Velocity vs. Time	C-9
Figure No. 28.	Left Mid B-Pillar (Y) Displacement vs. Time	C-9

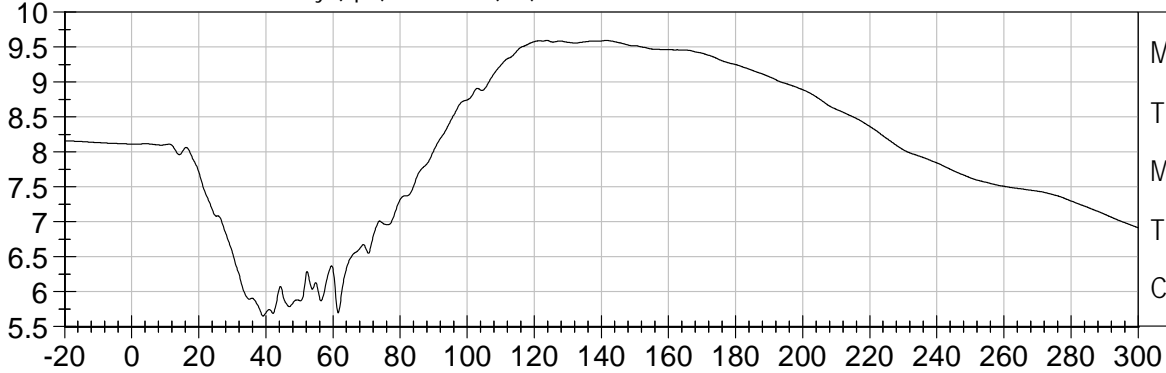
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Figure No. 29. Driver Seat Track (Y) Acceleration vs. Time	C-10
Figure No. 30. Driver Seat Track (Y) Velocity vs. Time	C-10
Figure No. 31. Driver Seat Track (Y) Displacement vs. Time	C-10
Figure No. 32. Engine Top (X) Acceleration vs. Time	C-11
Figure No. 33. Engine Top (X) Velocity vs. Time	C-11
Figure No. 34. Engine Top (Y) Acceleration vs. Time	C-11
Figure No. 35. Engine Top (Y) Velocity vs. Time	C-11
Figure No. 36. Firewall Center (Y) Acceleration vs. Time	C-12
Figure No. 37. Firewall Center (Y) Velocity vs. Time	C-12
Figure No. 38. Right Roof at Vertical Impact Reference Line (Y) Acceleration vs. Time	C-13
Figure No. 39. Right Roof at Vertical Impact Reference Line (Y) Velocity vs. Time	C-13
Figure No. 40. Right Floor Sill (Y) Acceleration vs. Time	C-13
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



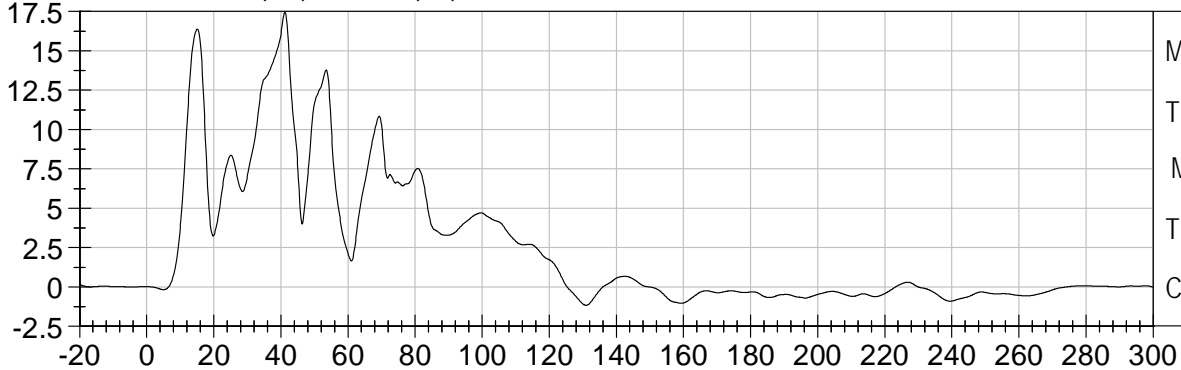
VEHICLE CG X (G's) vs TIME (ms)



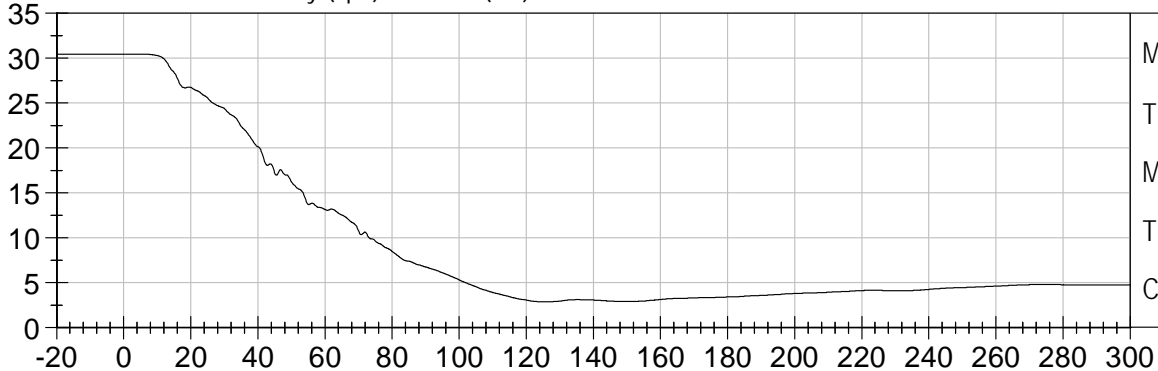
VEHICLE CG X Velocity (kph) vs TIME (ms)

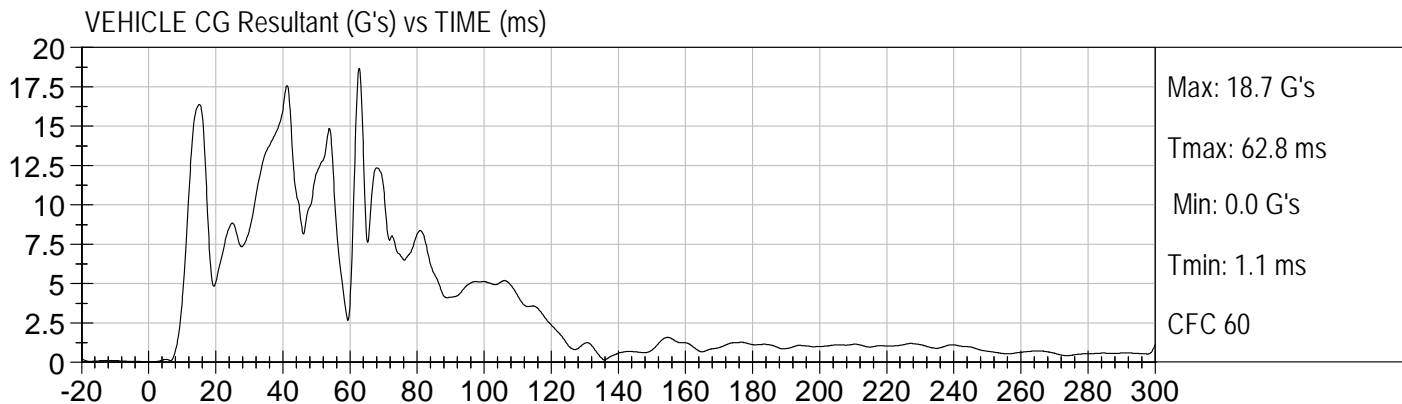
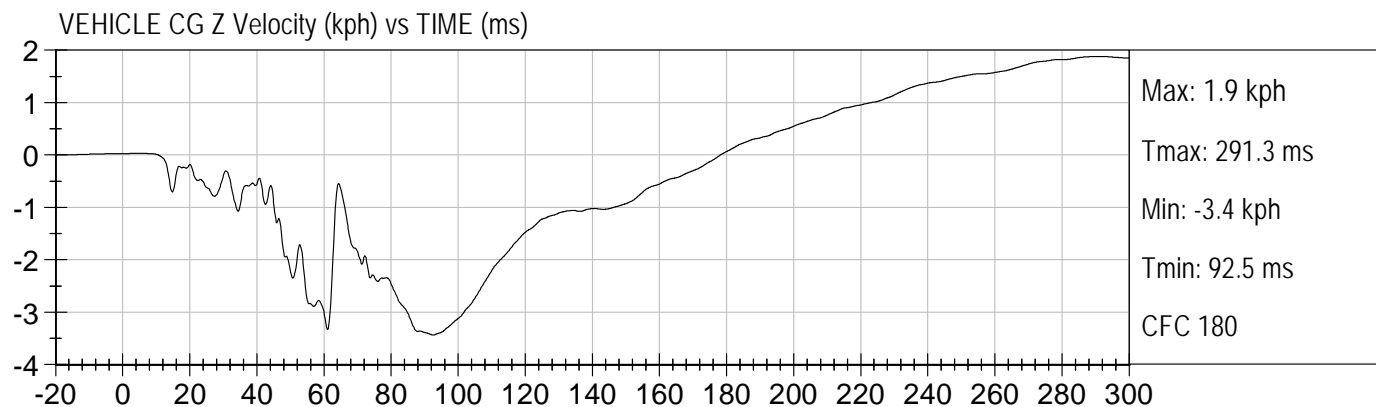
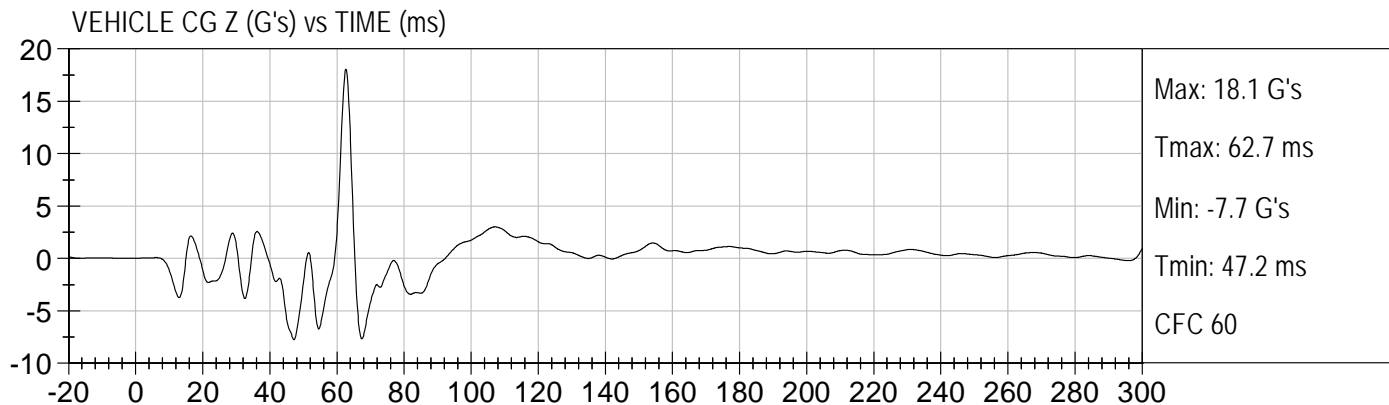


VEHICLE CG Y (G's) vs TIME (ms)



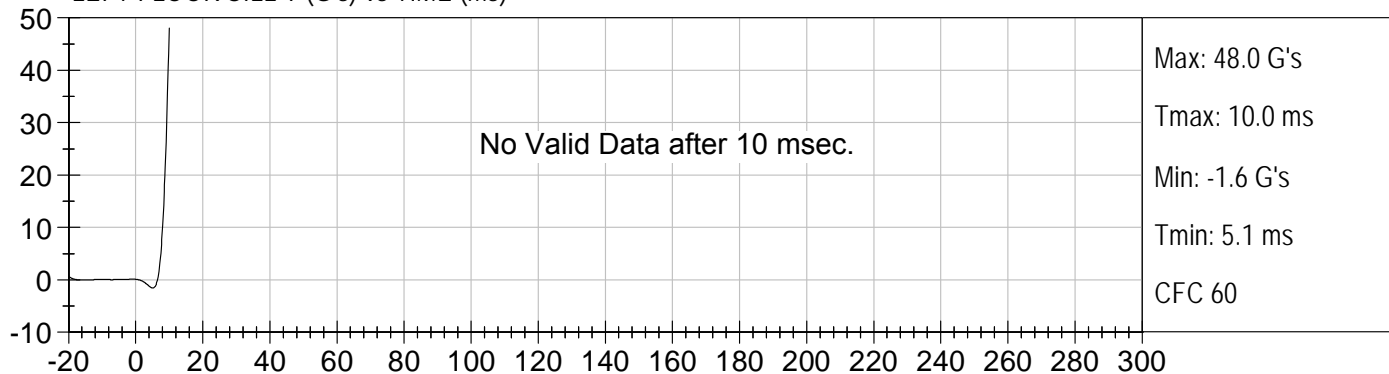
VEHICLE CG Y Velocity (kph) vs TIME (ms)



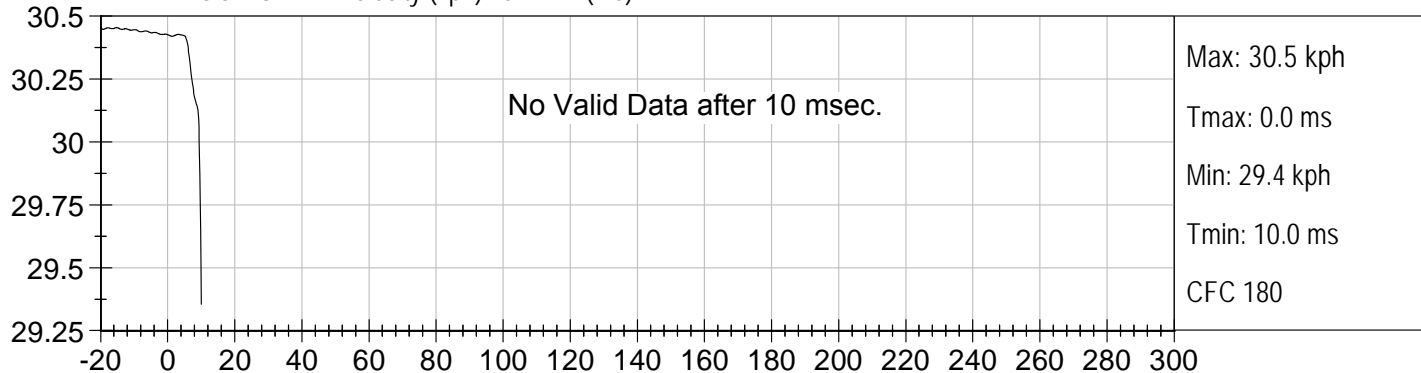




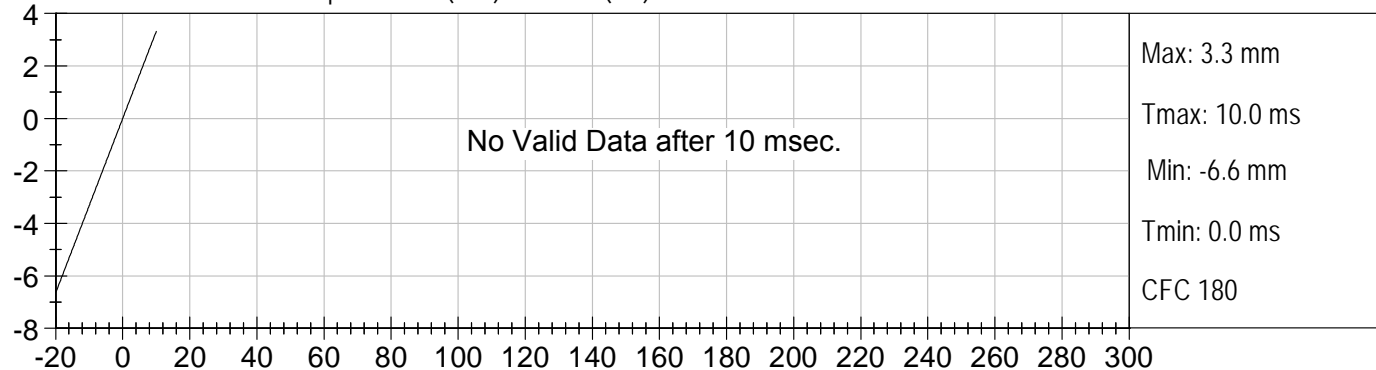
LEFT FLOOR SILL Y (G's) vs TIME (ms)

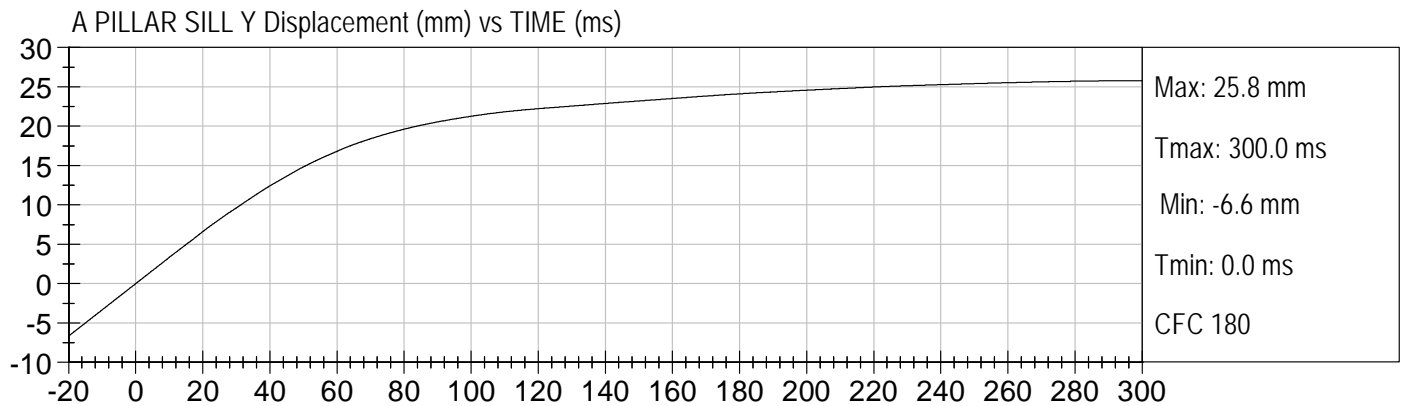
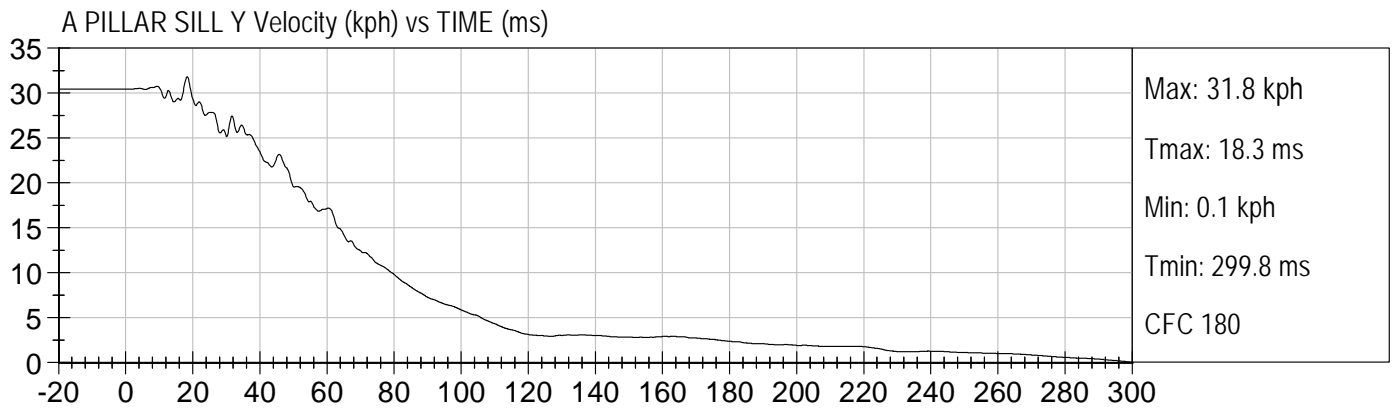
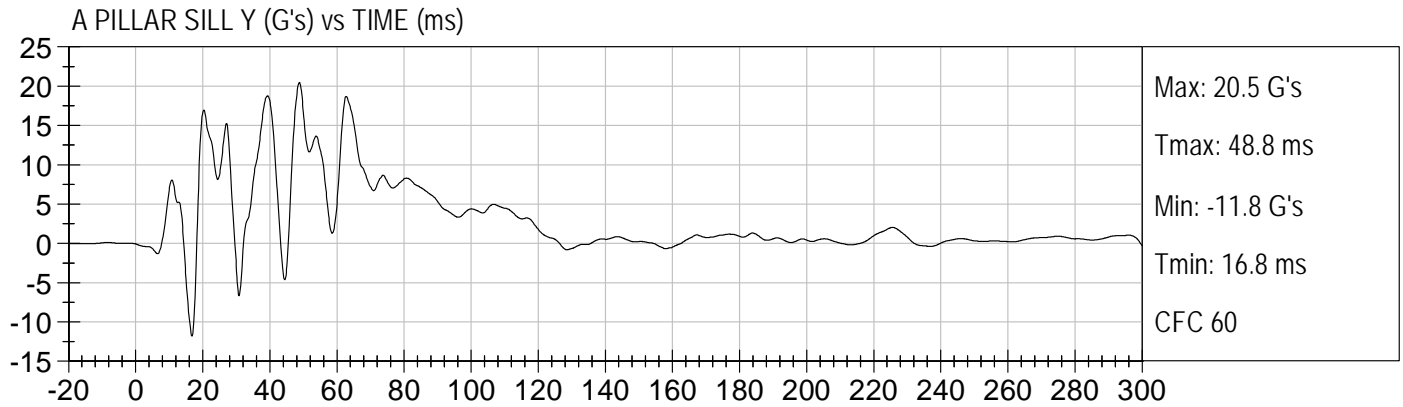


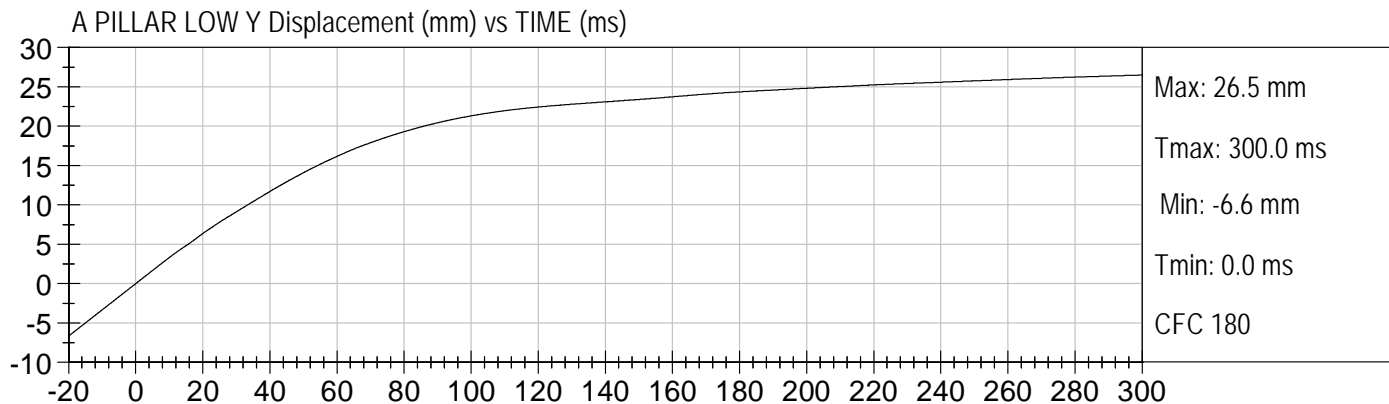
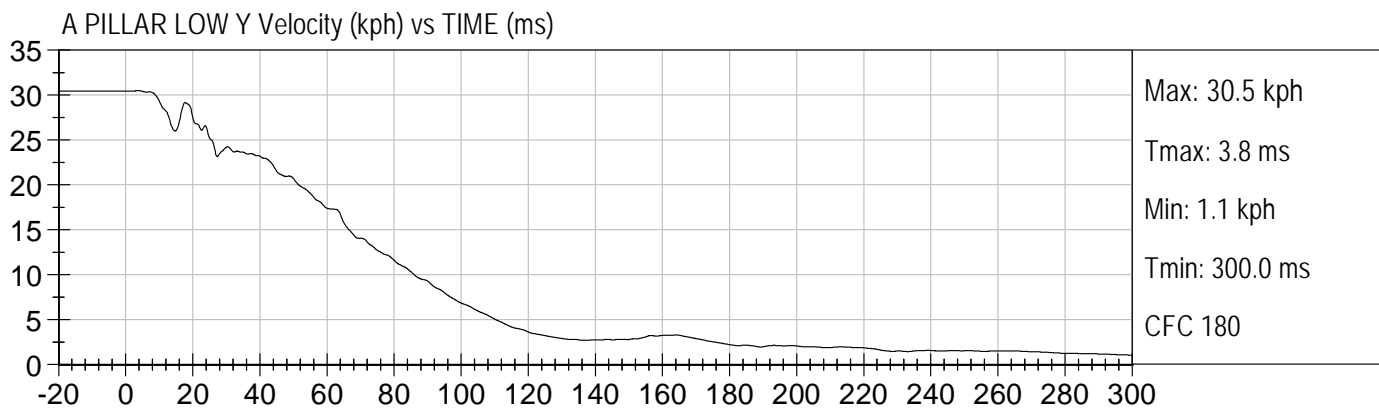
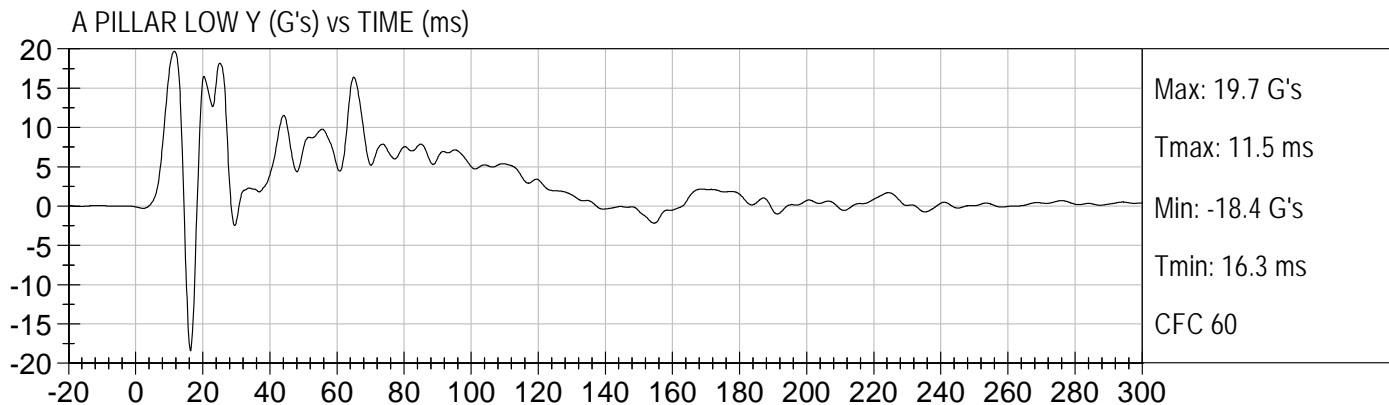
LEFT FLOOR SILL Y Velocity (kph) vs TIME (ms)

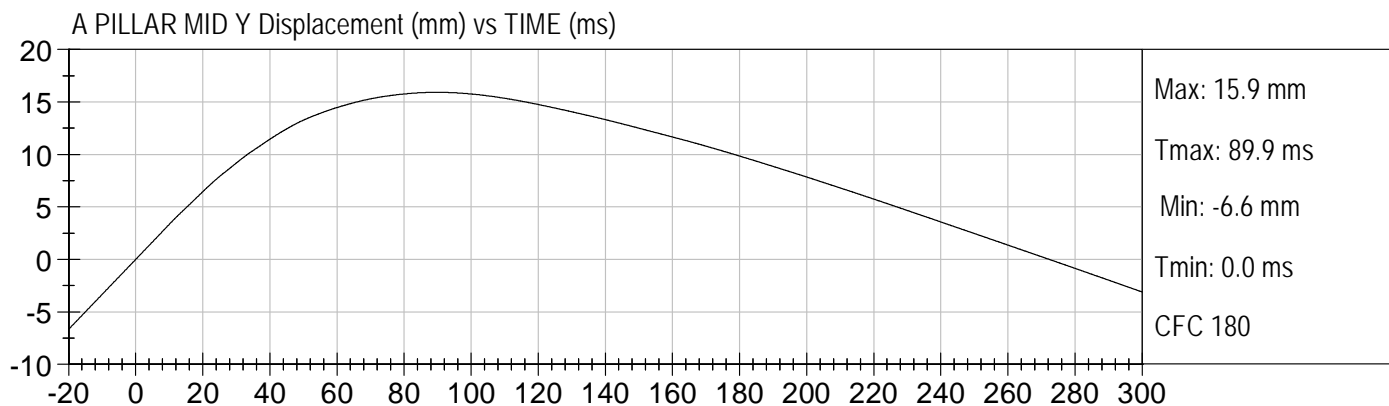
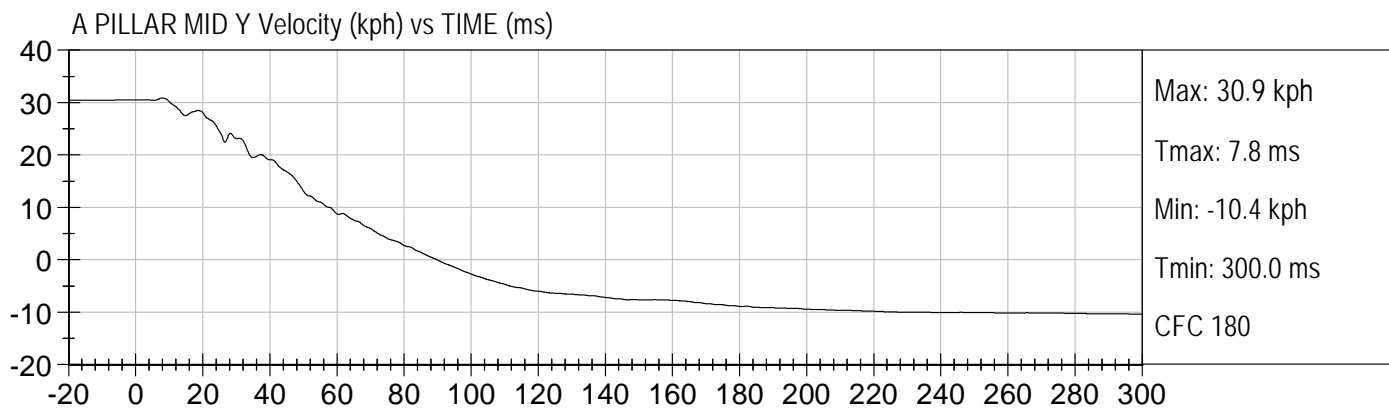


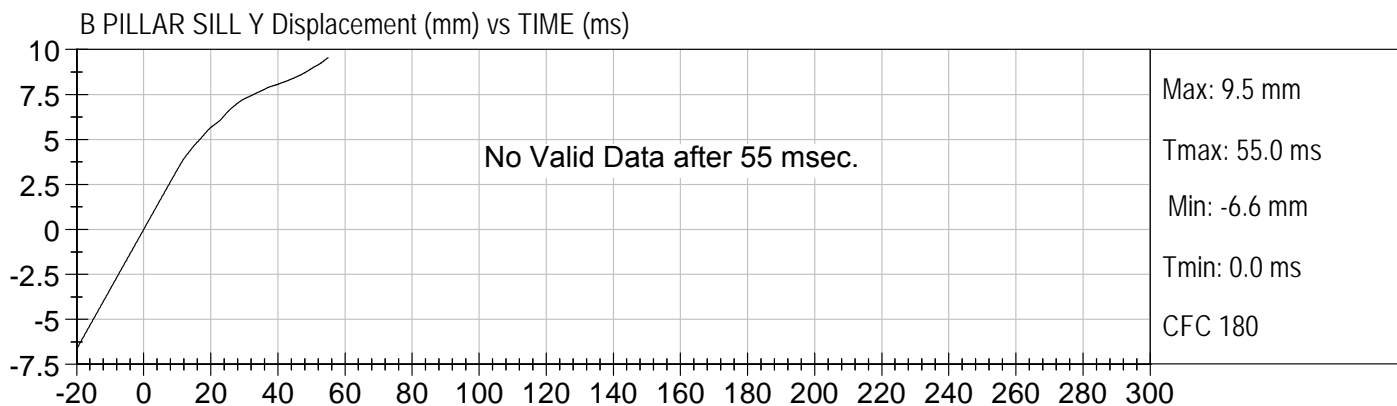
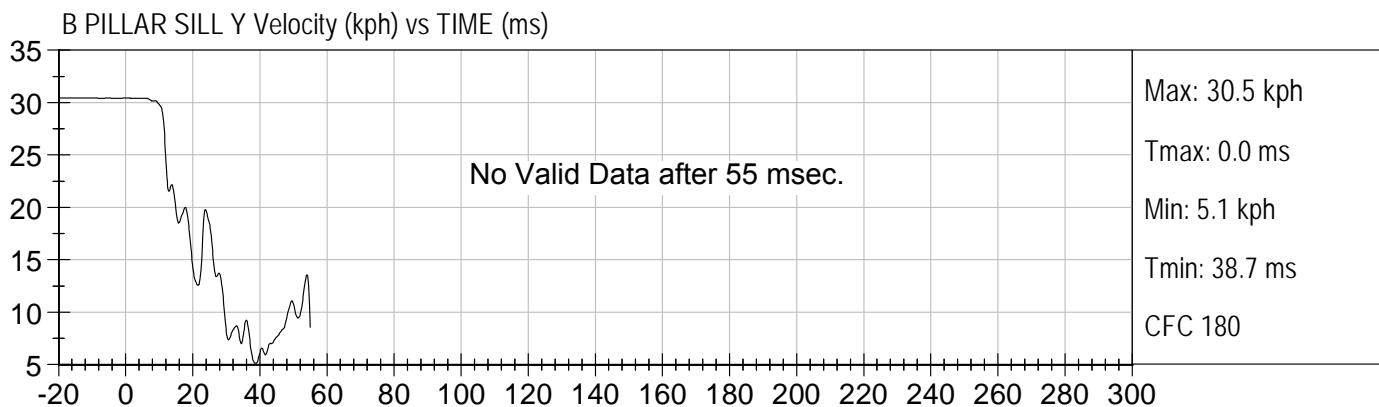
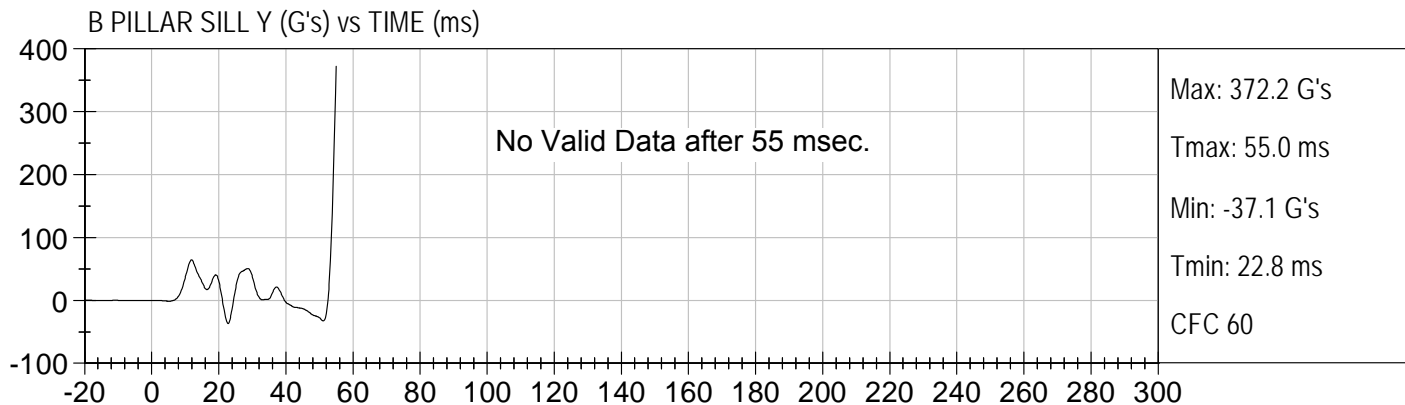
LEFT FLOOR SILL Y Displacement (mm) vs TIME (ms)

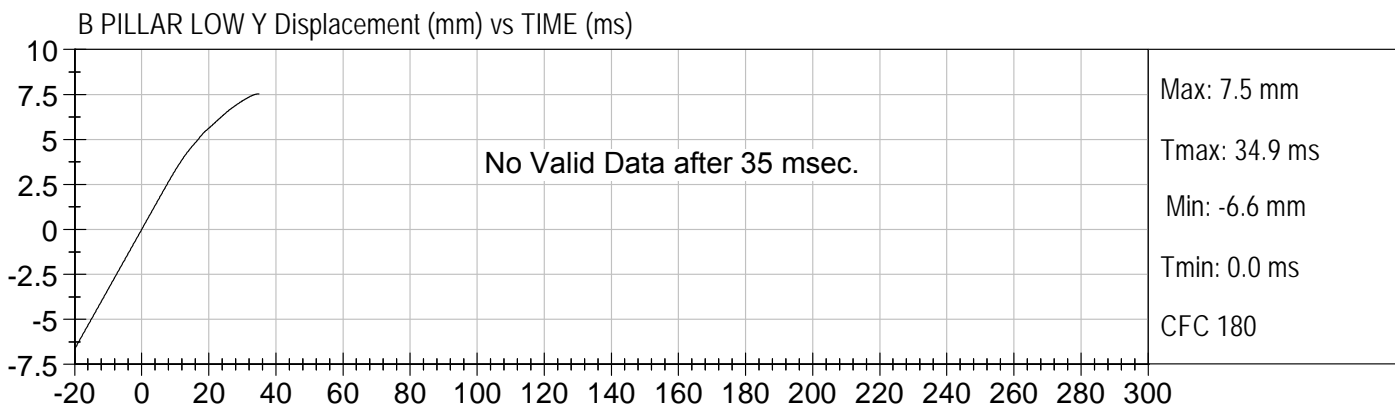
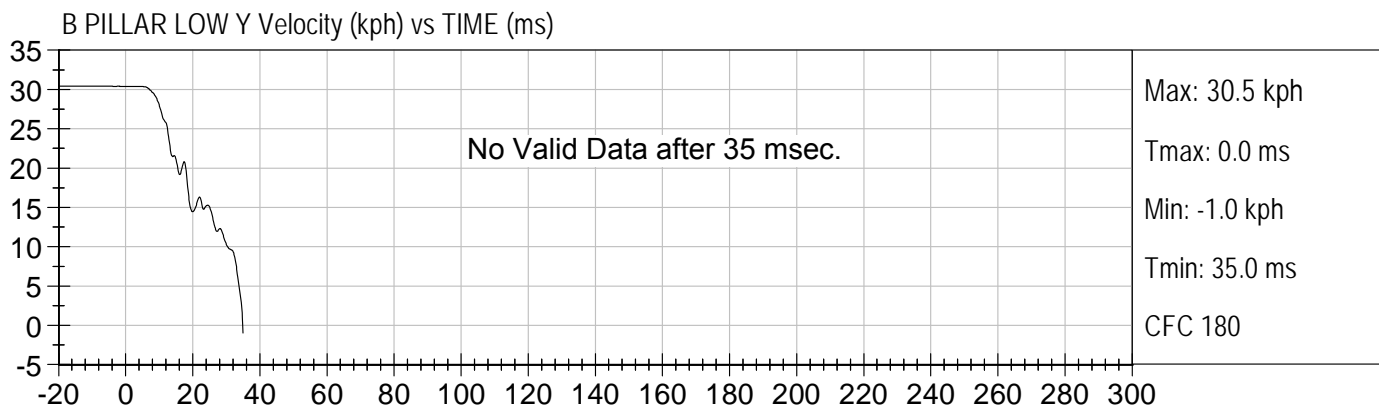
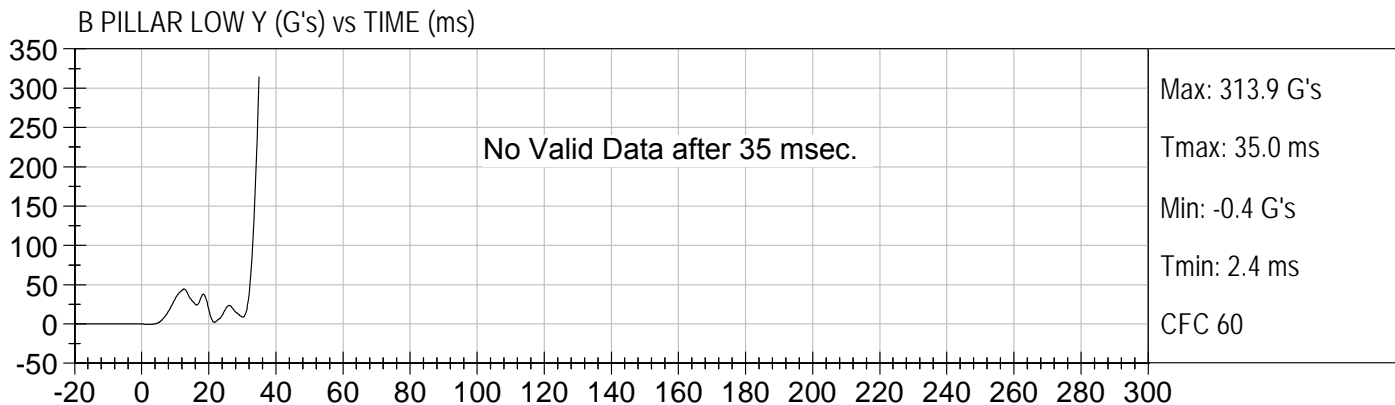






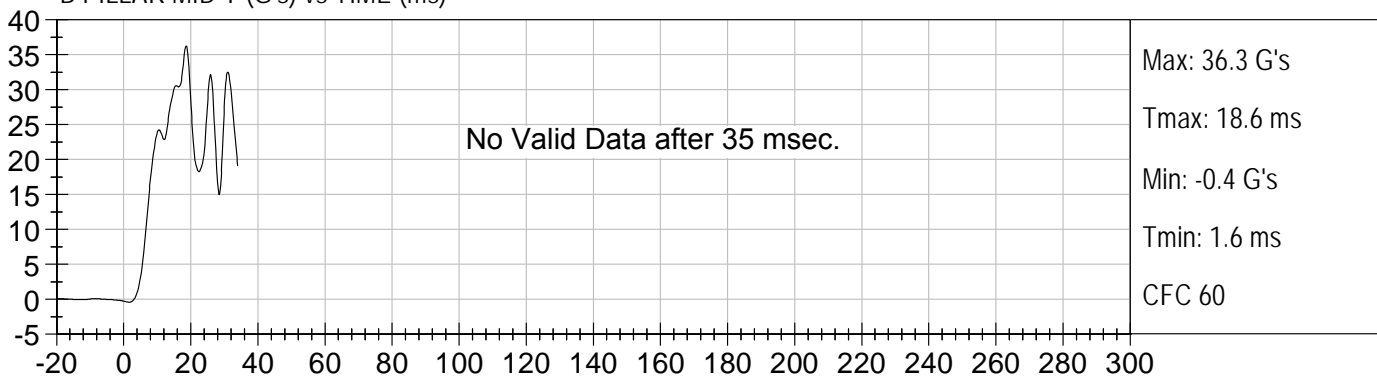




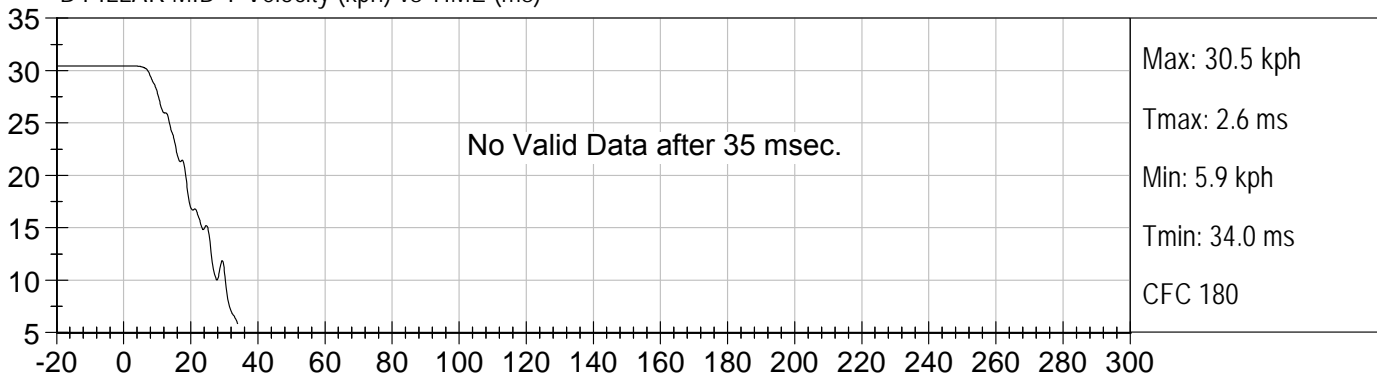




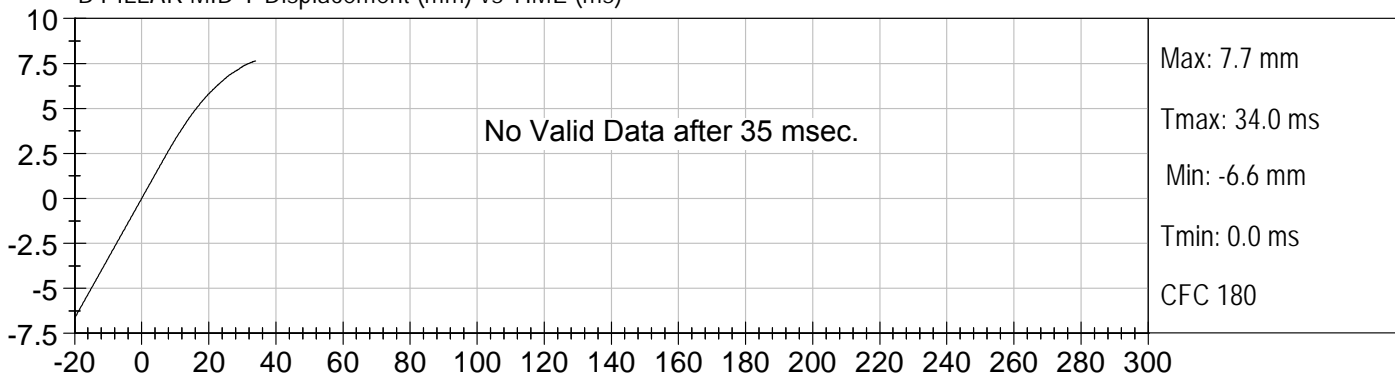
B PILLAR MID Y (G's) vs TIME (ms)

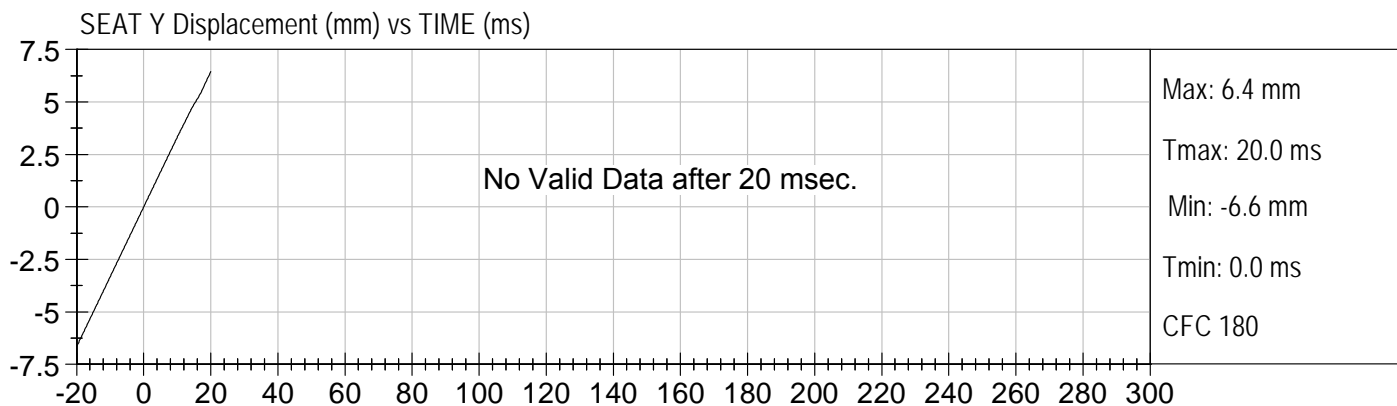
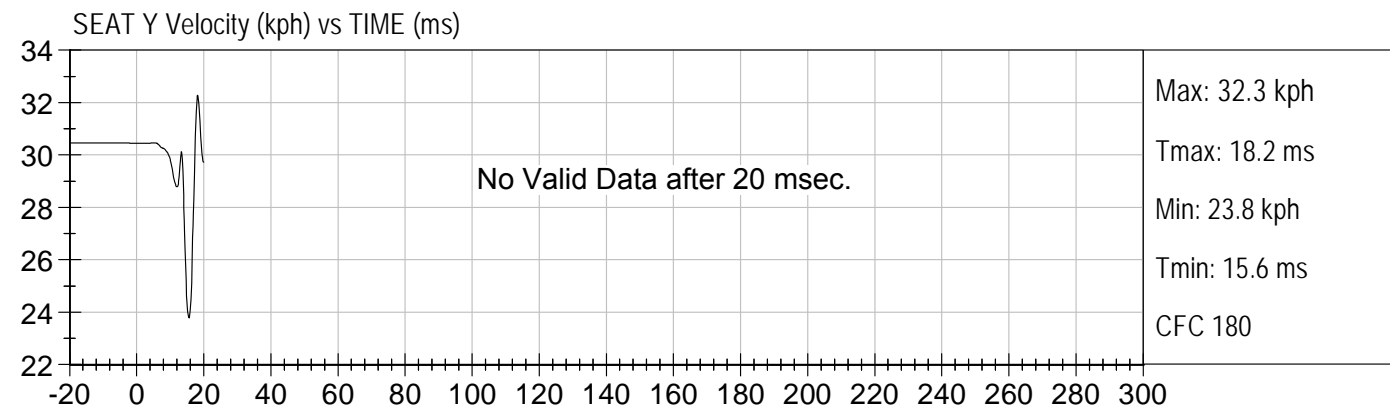
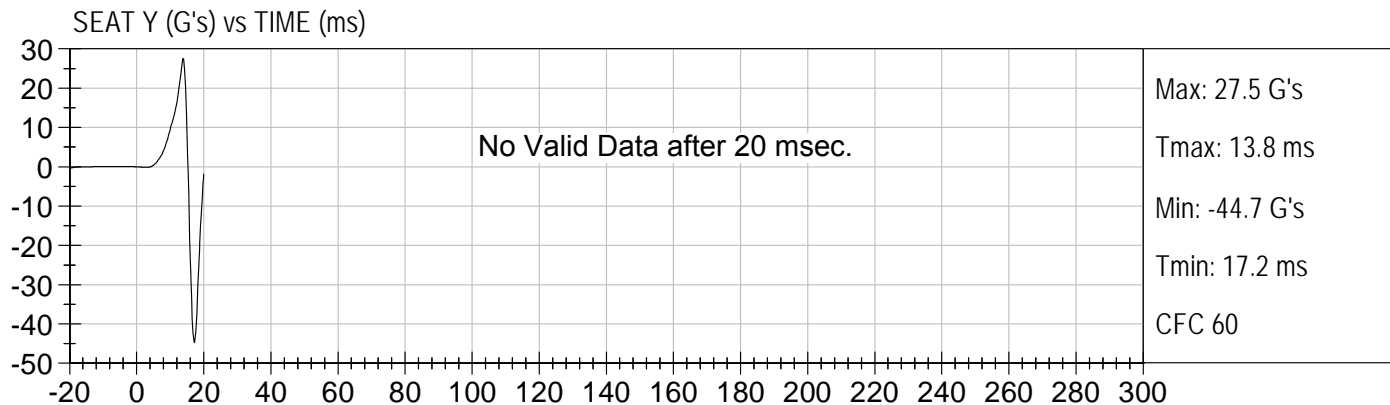


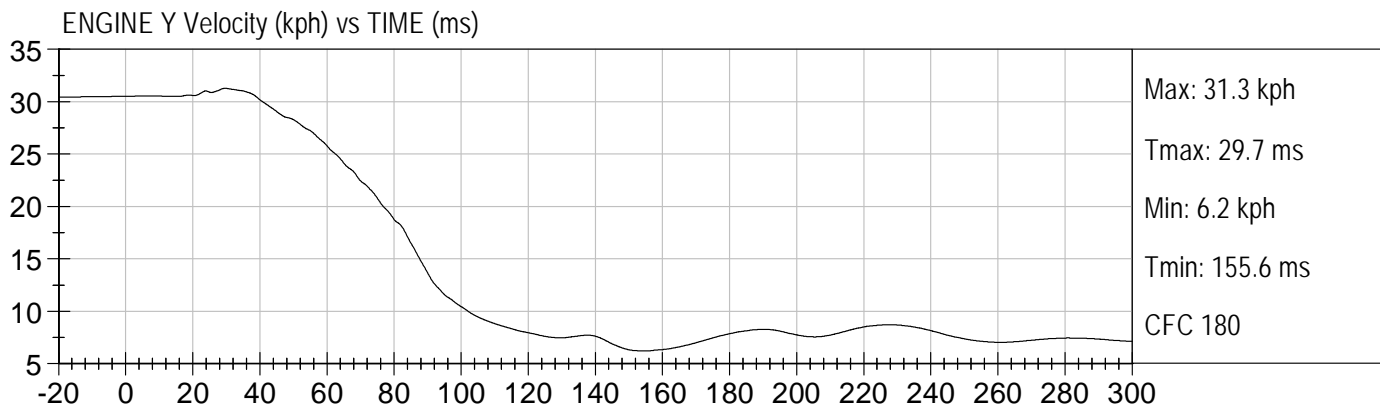
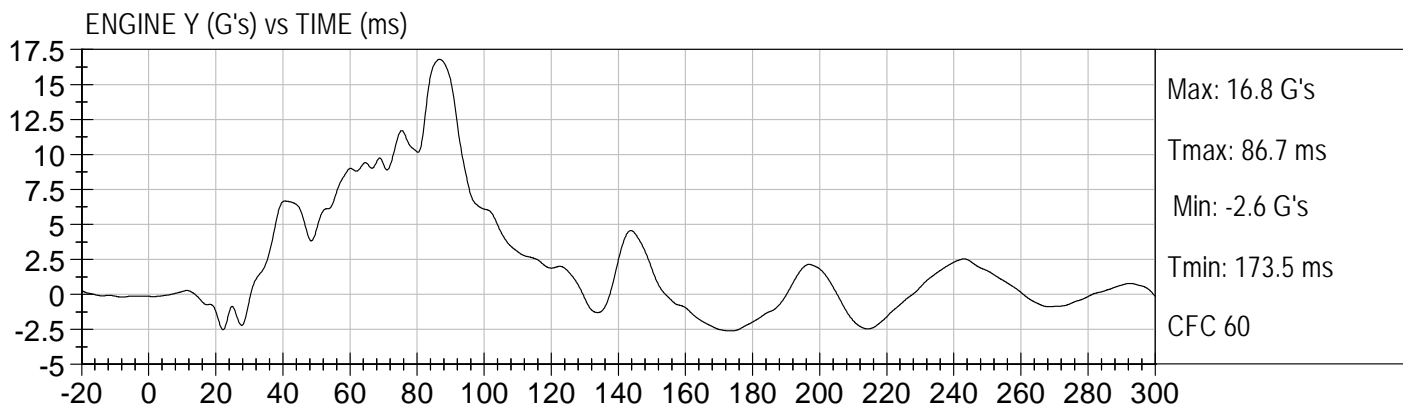
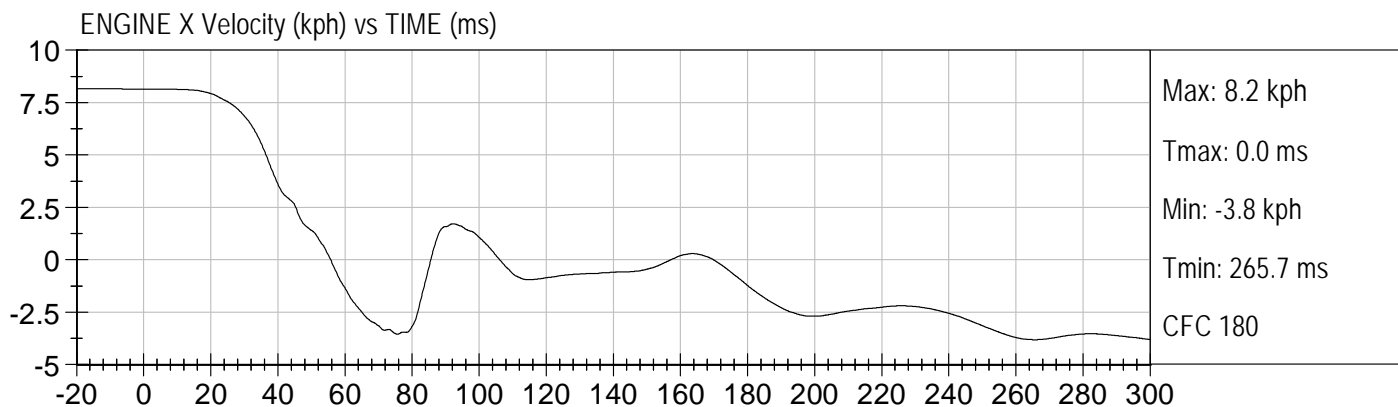
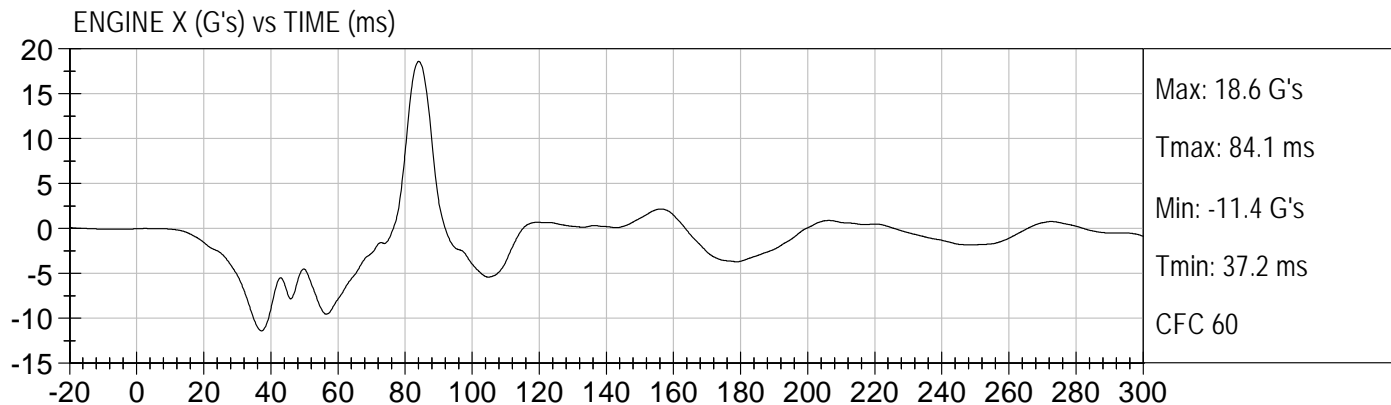
B PILLAR MID Y Velocity (kph) vs TIME (ms)

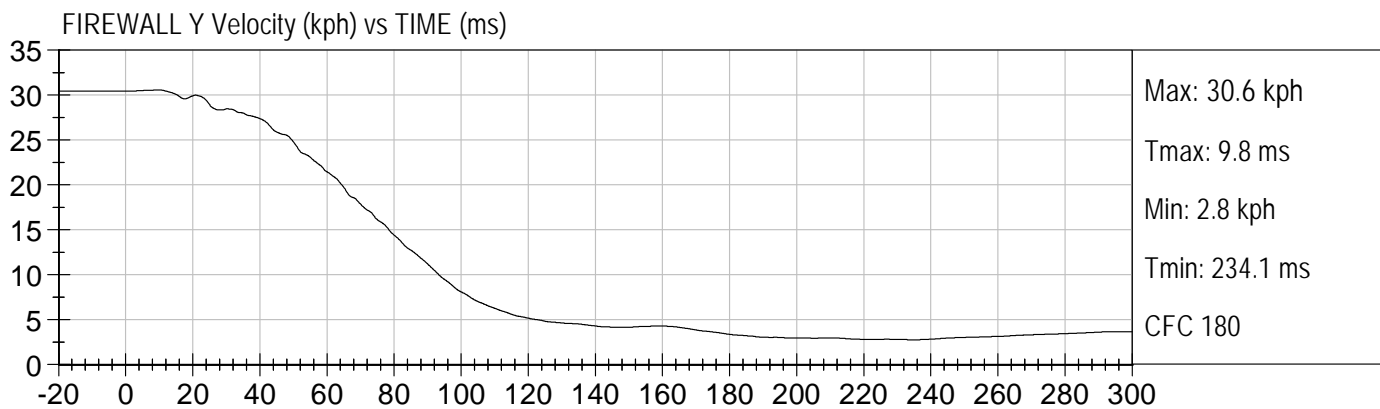
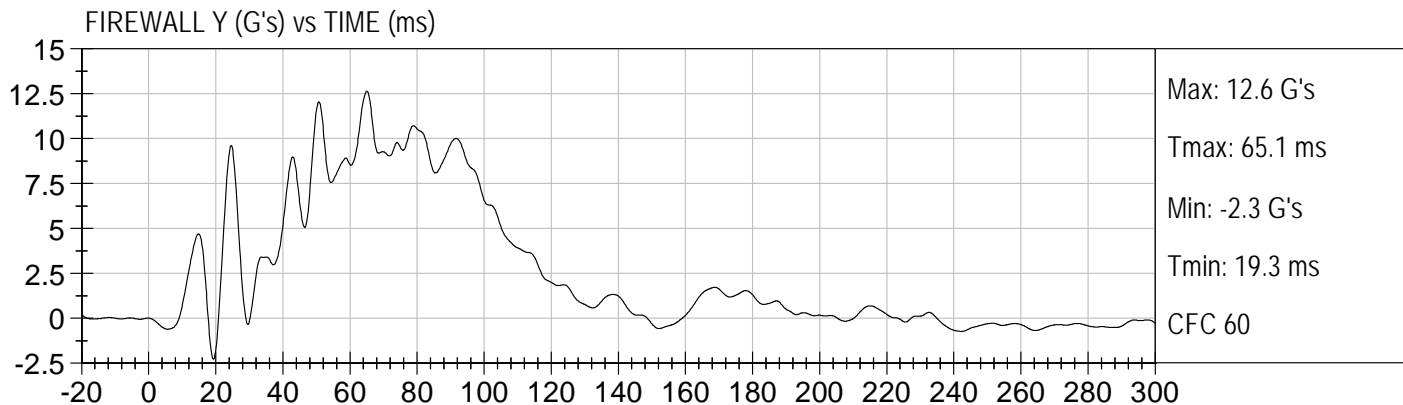


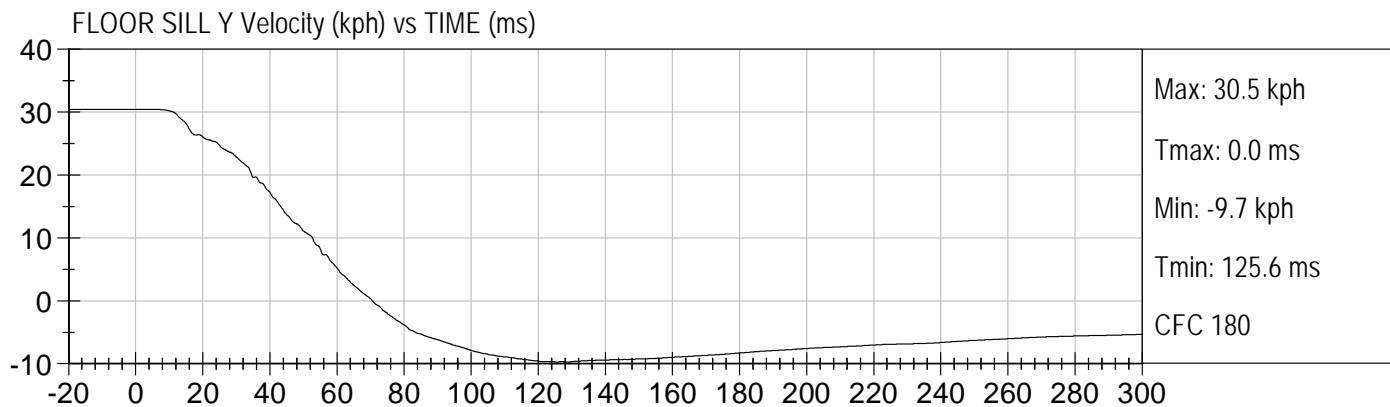
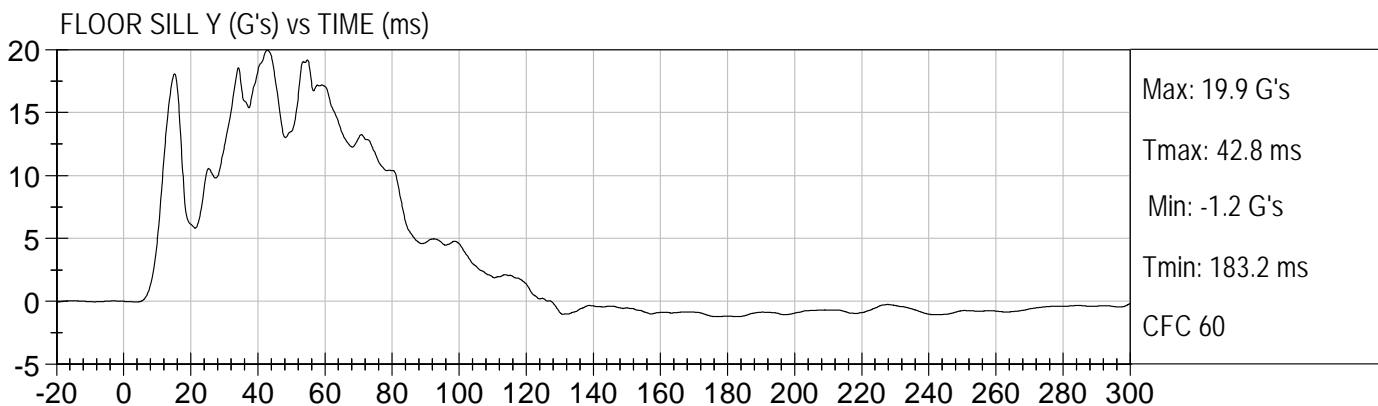
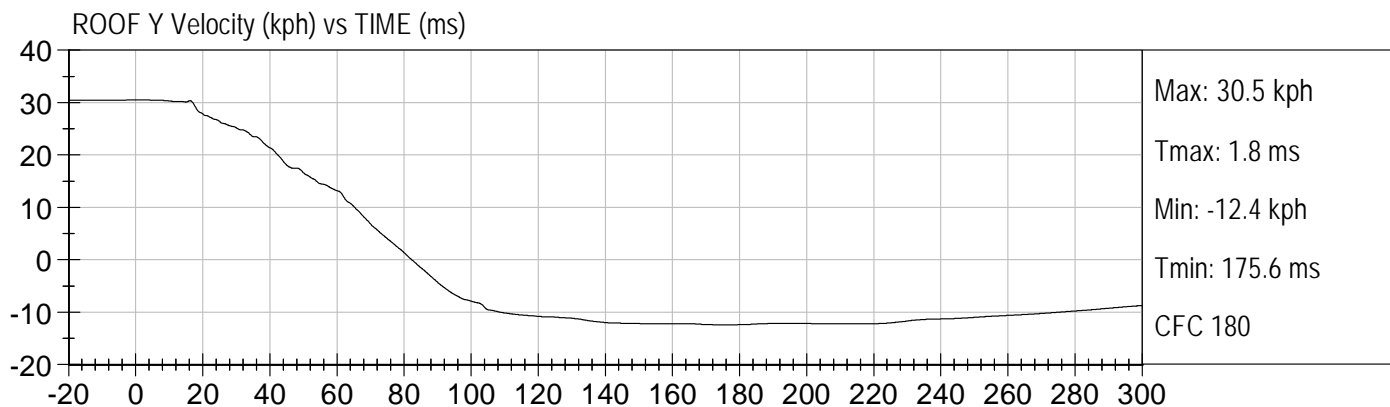
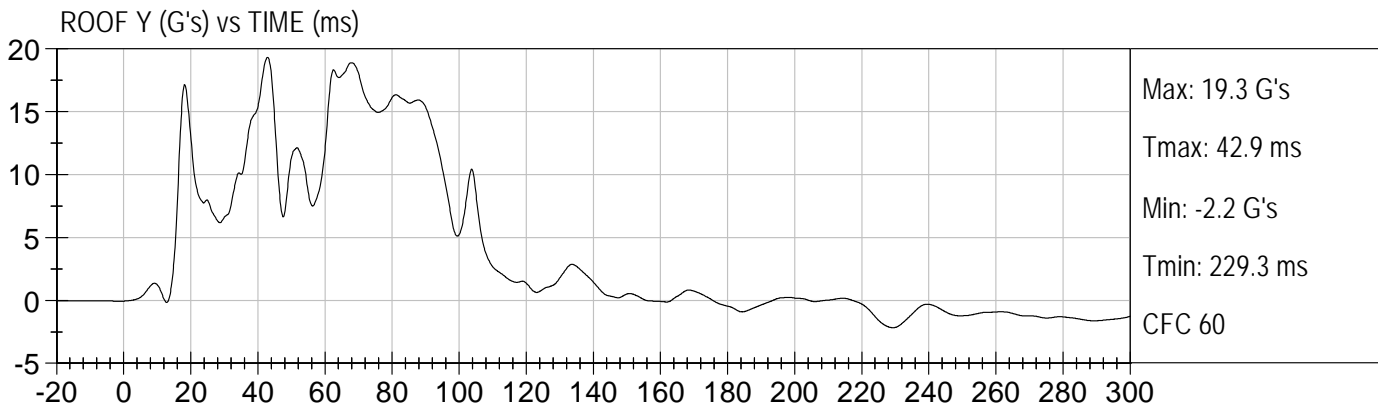
B PILLAR MID Y Displacement (mm) vs TIME (ms)

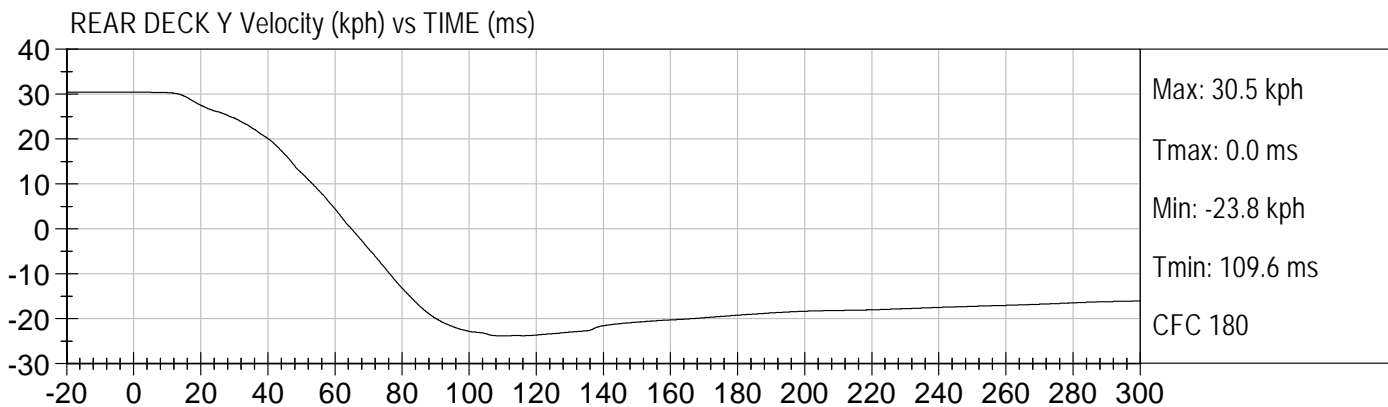
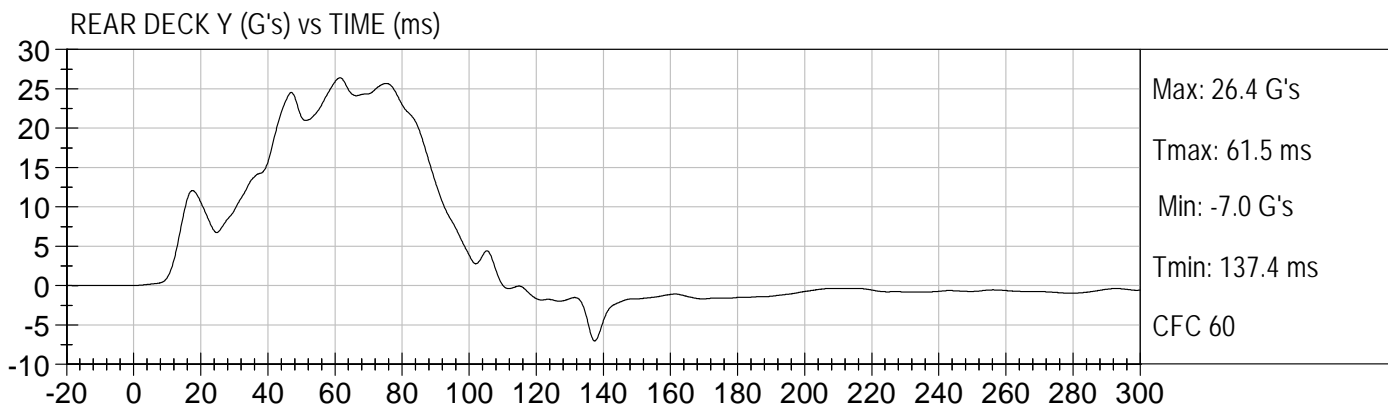
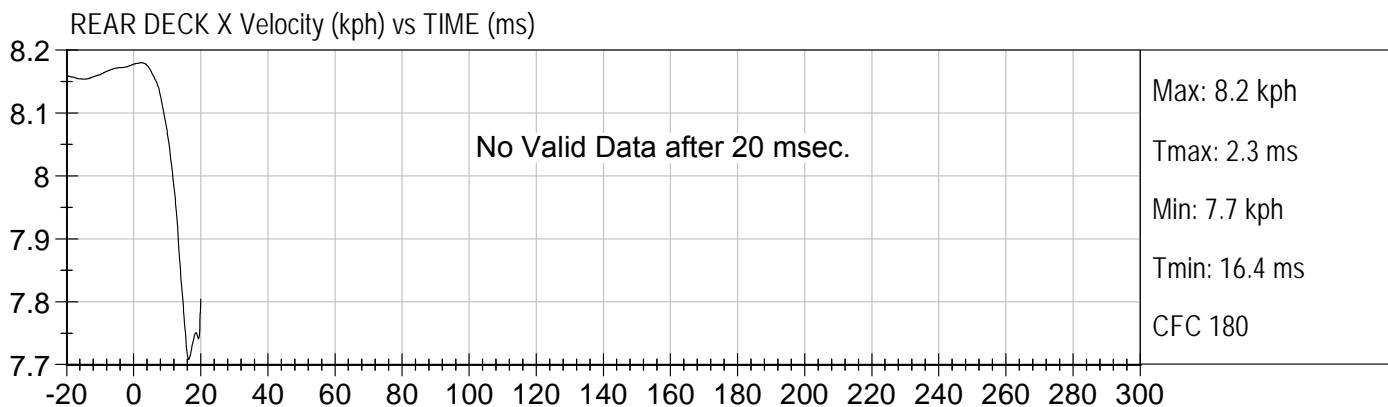
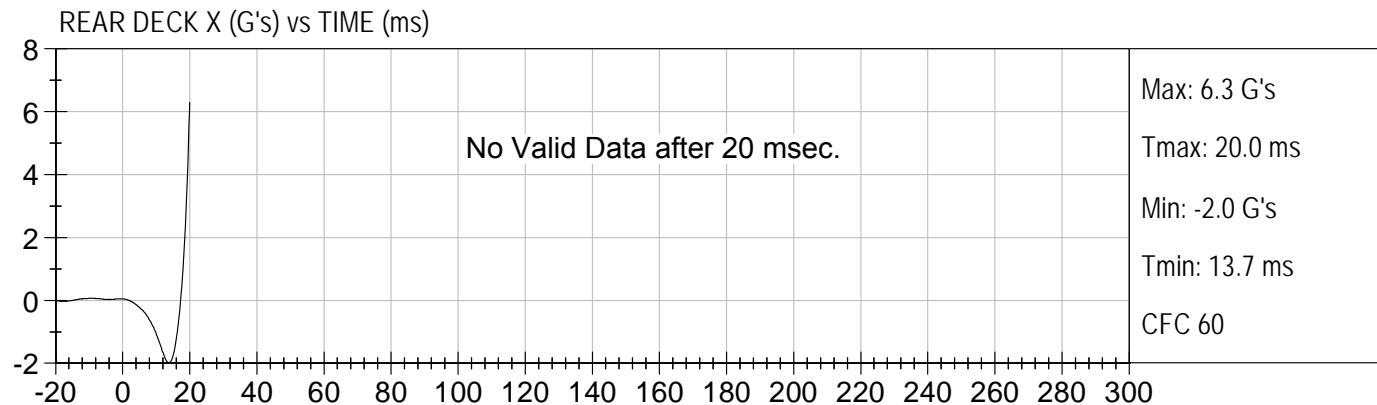












APPENDIX D

DUMMY PERFORMANCE CALIBRATION TEST DATA

MGA RESEARCH CORPORATION
HEAD DROP TEST
ES-2re DUMMY

ATD Serial No: 016

Test ID: D111411

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Peak Resultant Acceleration	G's	125 to 155	149	Pass
Peak Lateral Acceleration	G's	+/- 15	-11.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

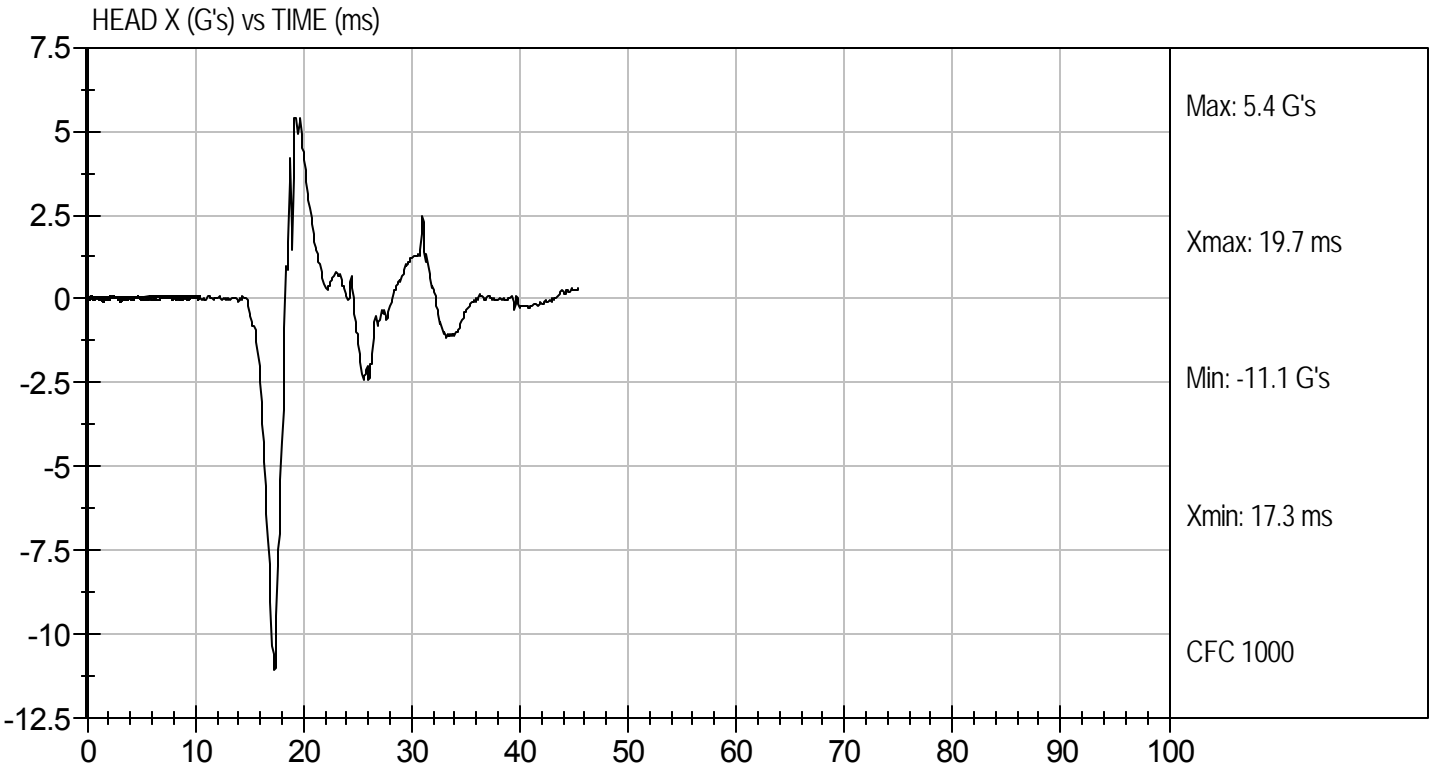
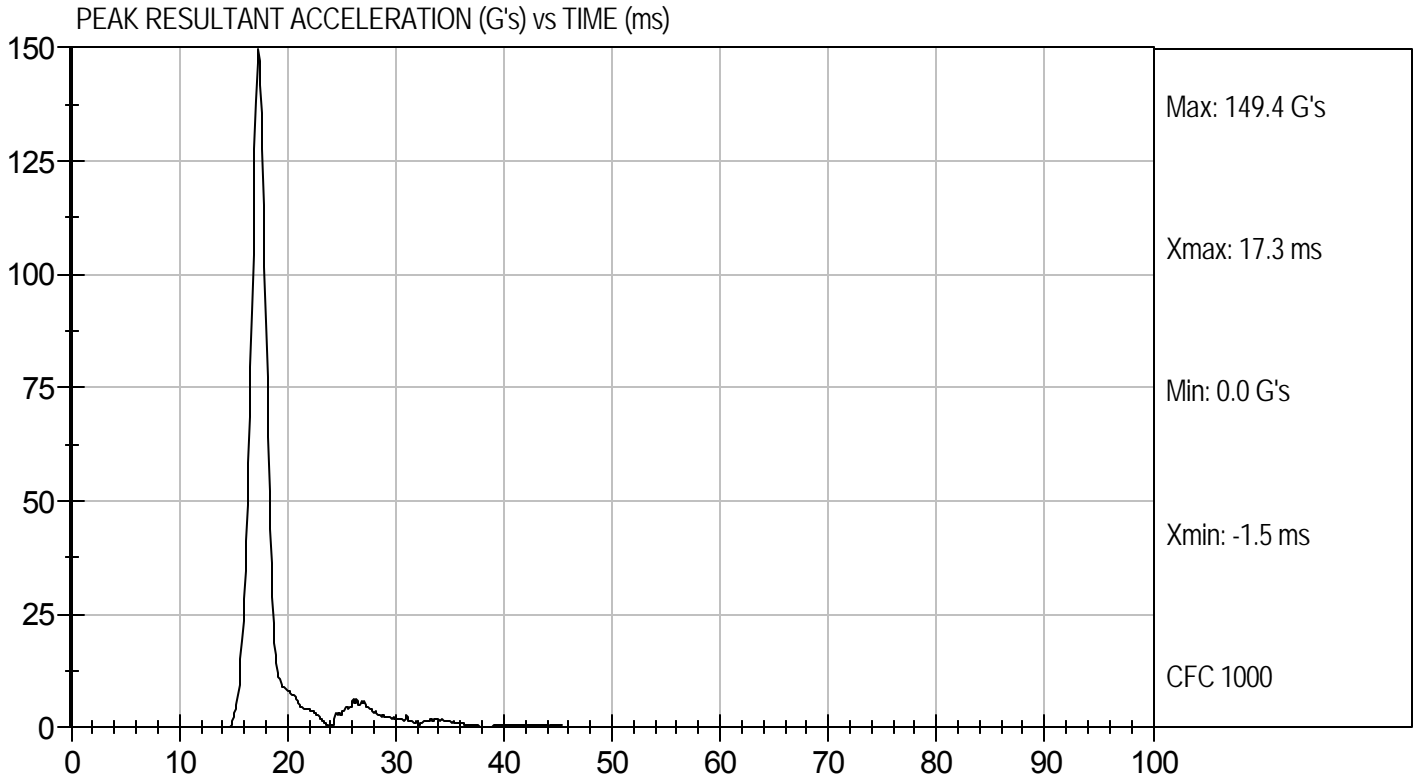
4/15/11
Test Date

David Winkelbauer
Approved By



Test Desc: Head Drop
Component ID: D111411

Test Date: 4/15/11
Velocity: 0 ft/s, 0 m/s



**MGA RESEARCH CORPORATION
NECK PENDULUM TEST
ES-2re DUMMY**

ATD Serial No: 016

Test I.D.: D111412

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	18.0 to 22.0	20.8	Pass
Laboratory Relative Humidity		%	10 to 70	25	Pass
Pendulum Speed		m/s	3.3 to 3.5	3.5	Pass
Pendulum Deceleration	1 ms	m/s	0.00 to -0.05	-0.02	Pass
	3 ms	m/s	-0.25 to -0.375	-0.31	Pass
	14 ms	m/s	-3.20 to -3.70	-3.34	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	51.7	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	58.8	Pass
Head Rotation Decay Time to 0 degree		ms	53.0 to 88.0	55.4	Pass
Overall Test Results					Pass

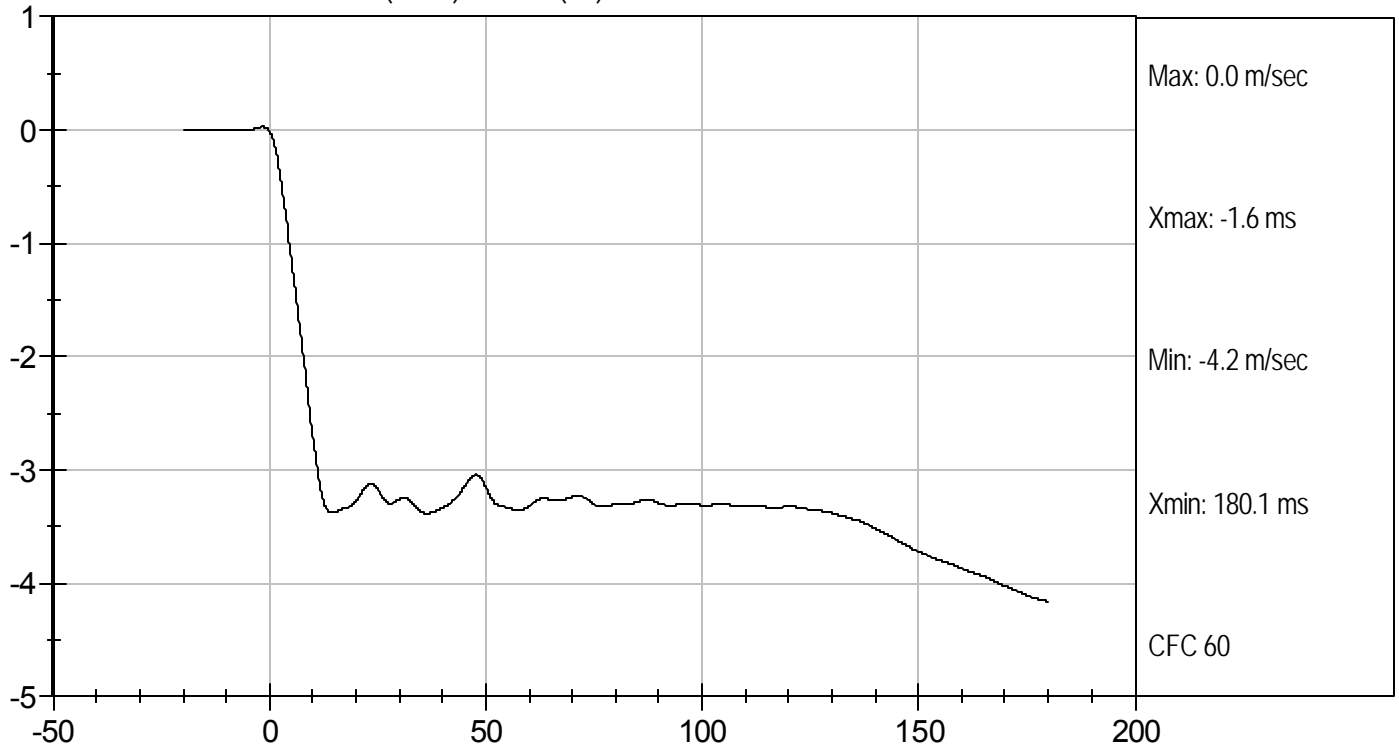
Jessica Hall
Laboratory Technician

4/15/11
Test Date

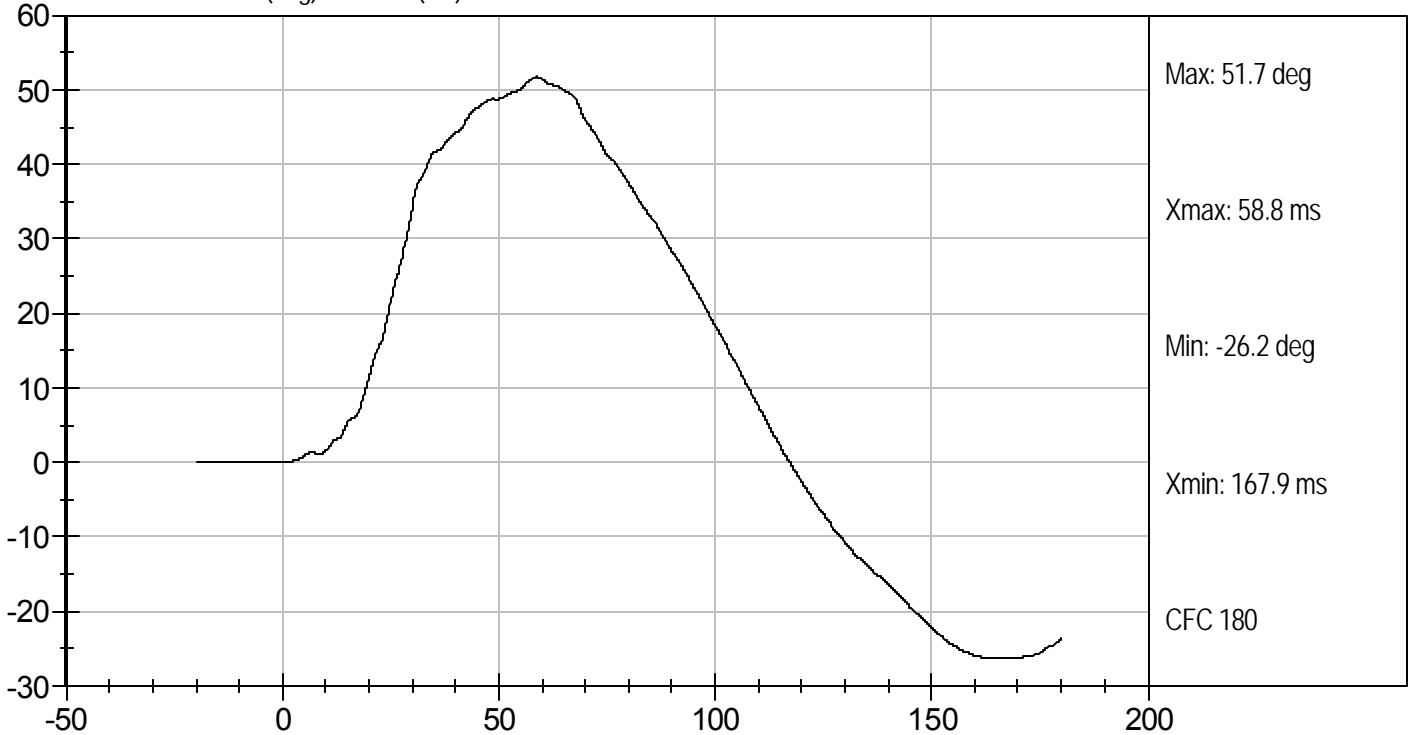
David Winkelbauer
Approved By



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



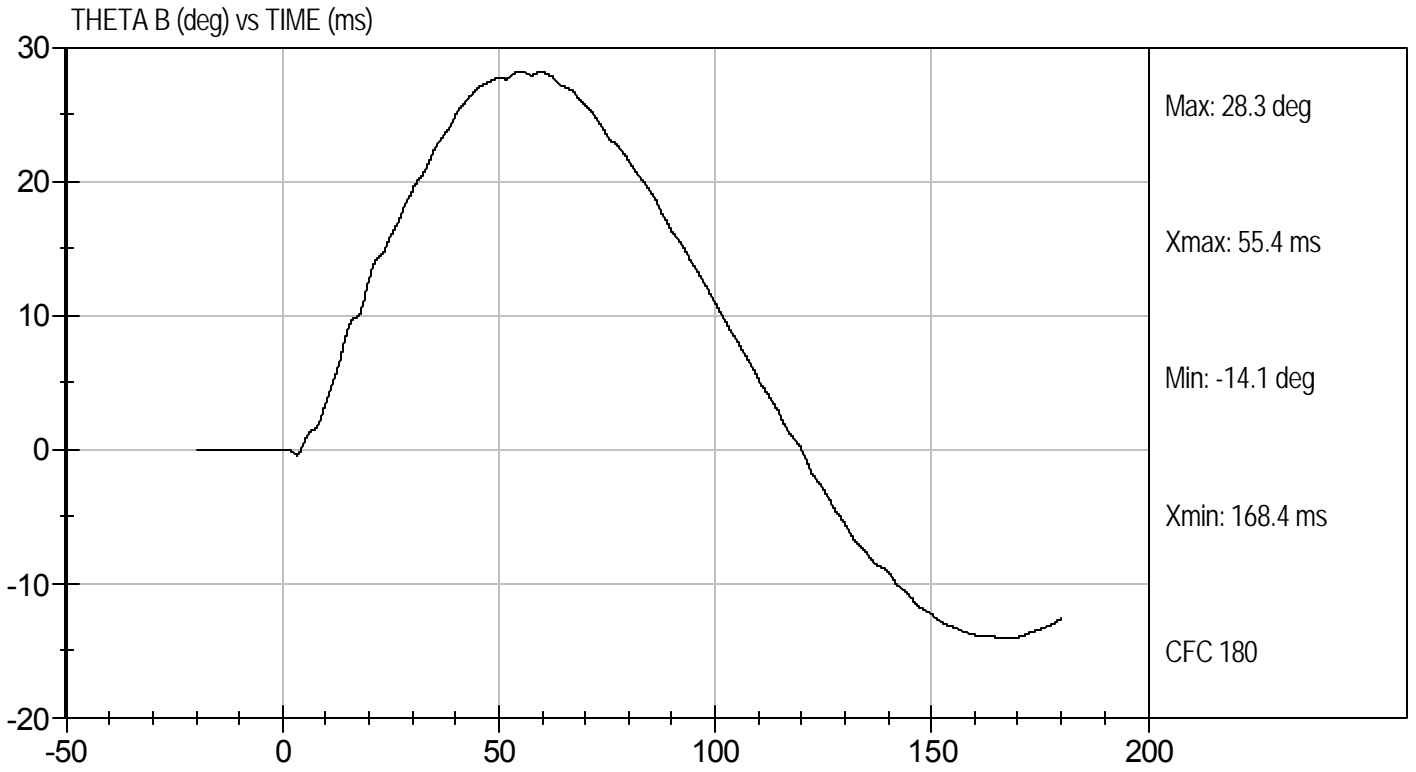
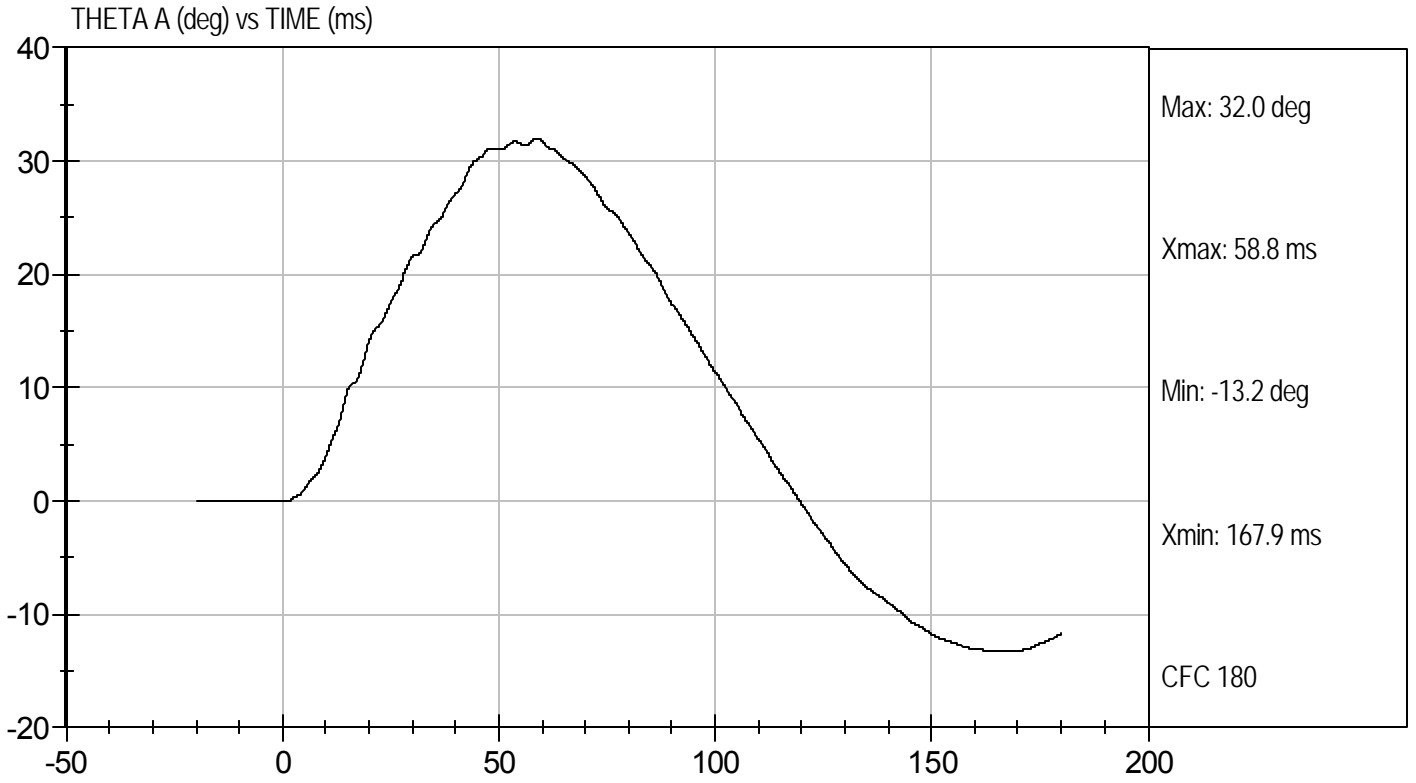
FLEXION ANGLE (deg) vs TIME (ms)





Test Desc: Neck Bending
Component ID: D111412

Test Date: 4/15/11
Velocity: 11.42 ft/s, 3.5 m/s



MGA RESEARCH CORPORATION
SHOULDER IMPACT TEST
ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111413

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Pendulum Speed	m/s	4.2 to 4.4	4.4	Pass
Peak Shoulder Acceleration	G's	7.5 to 10.5	9.2	Pass
Time of Peak Shoulder Acceleration	ms	NA	18.2	Pass
Overall Test Results				Pass

Jessica Gall
 Laboratory Technician

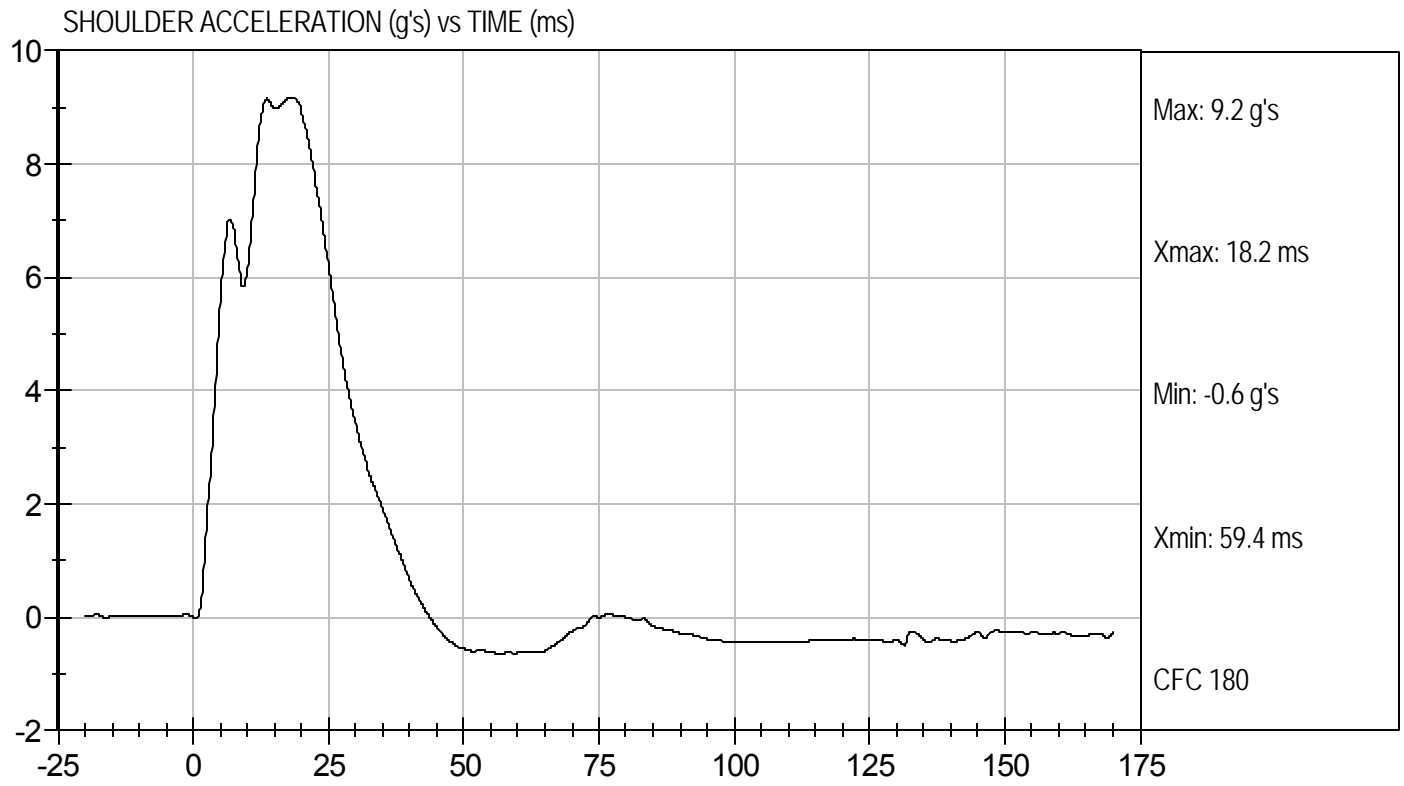
4/15/11
 Test Date

David Winkelbauer
 Approved By



Test Desc: Shoulder Impact
Component ID: D111413

Test Date: 4/15/11
Velocity: 14.37 ft/s, 4.4 m/s



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111414

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	39.2	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.1	Pass
Overall Test Results				Pass

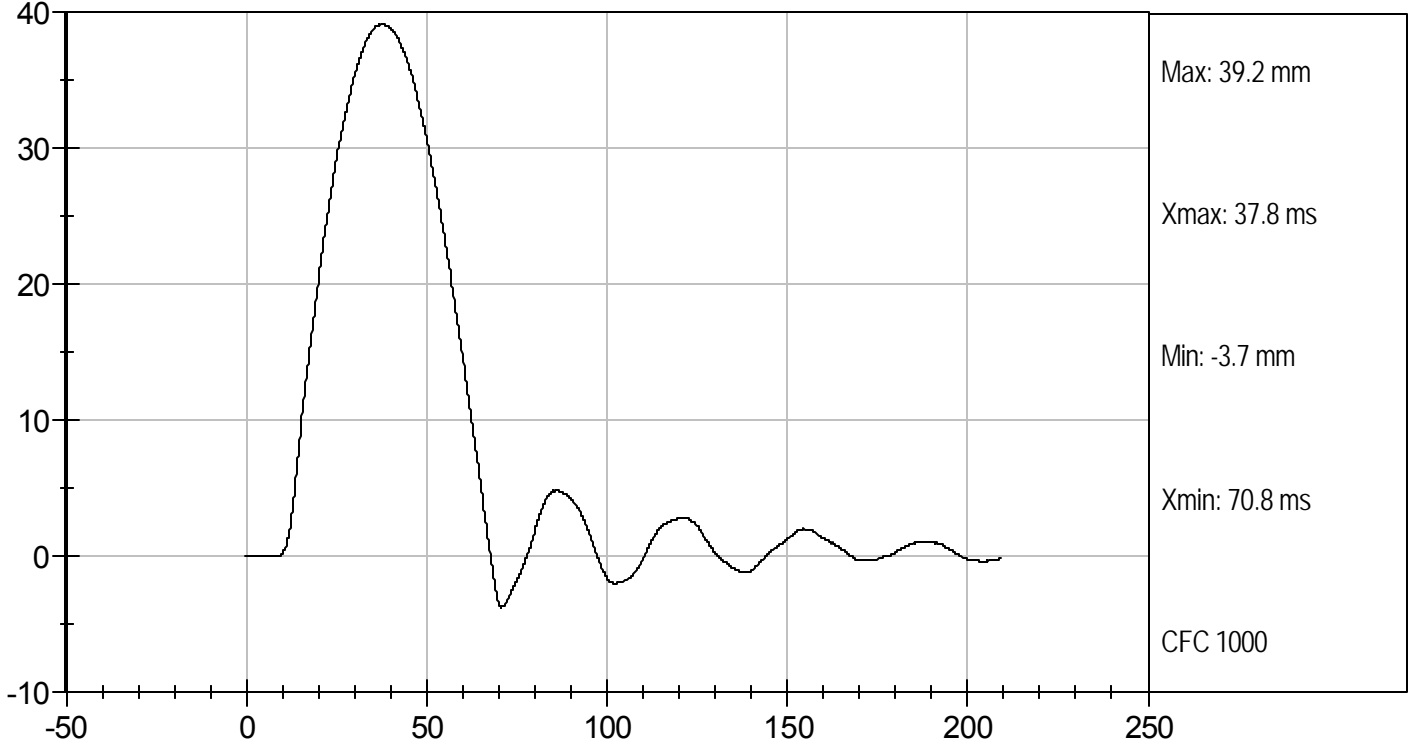
Jessica Hall
Laboratory Technician

4/15/11
Test Date

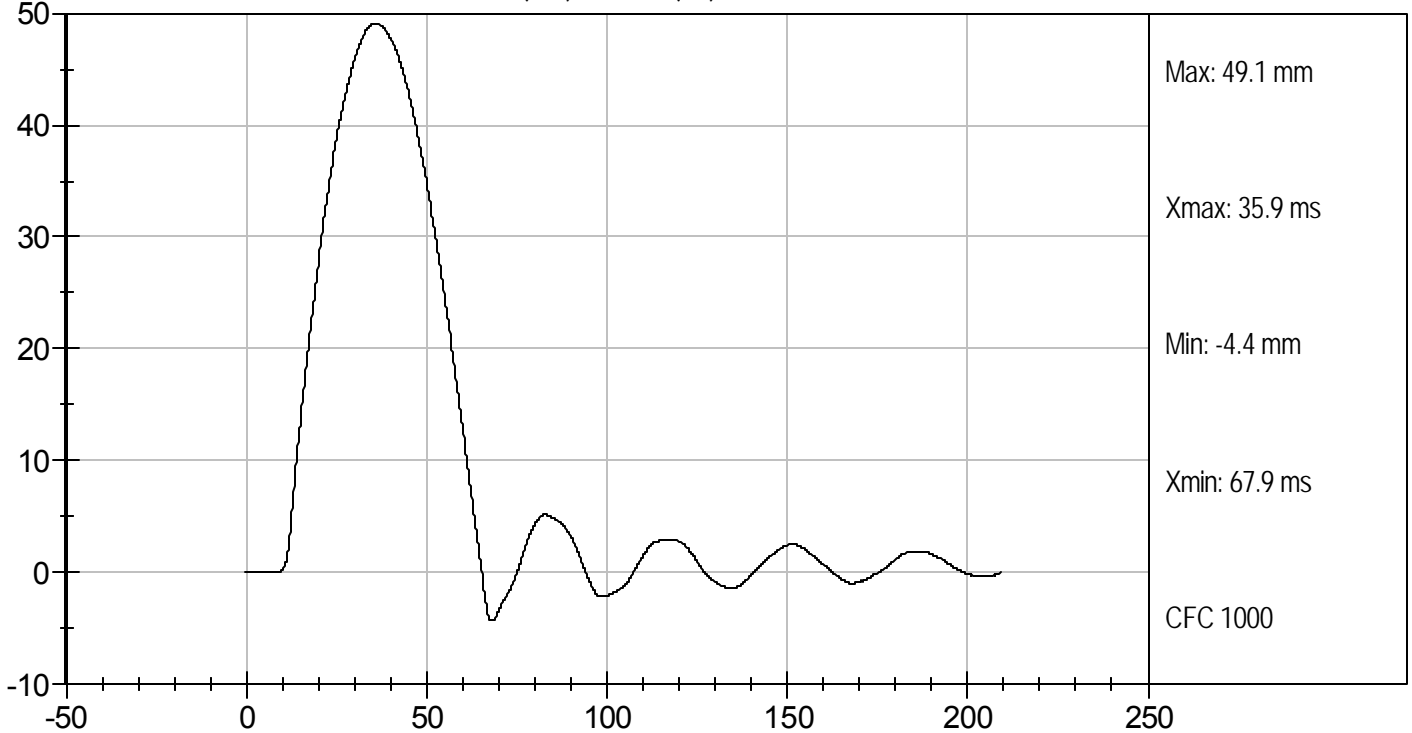
David Winkelbauer
Approved By



UPPER RIB DISPLACEMENT @ 3 M/SEC (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT @ 4 M/SEC (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

MID RIB TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111415

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.8	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.5	Pass
Overall Test Results				Pass

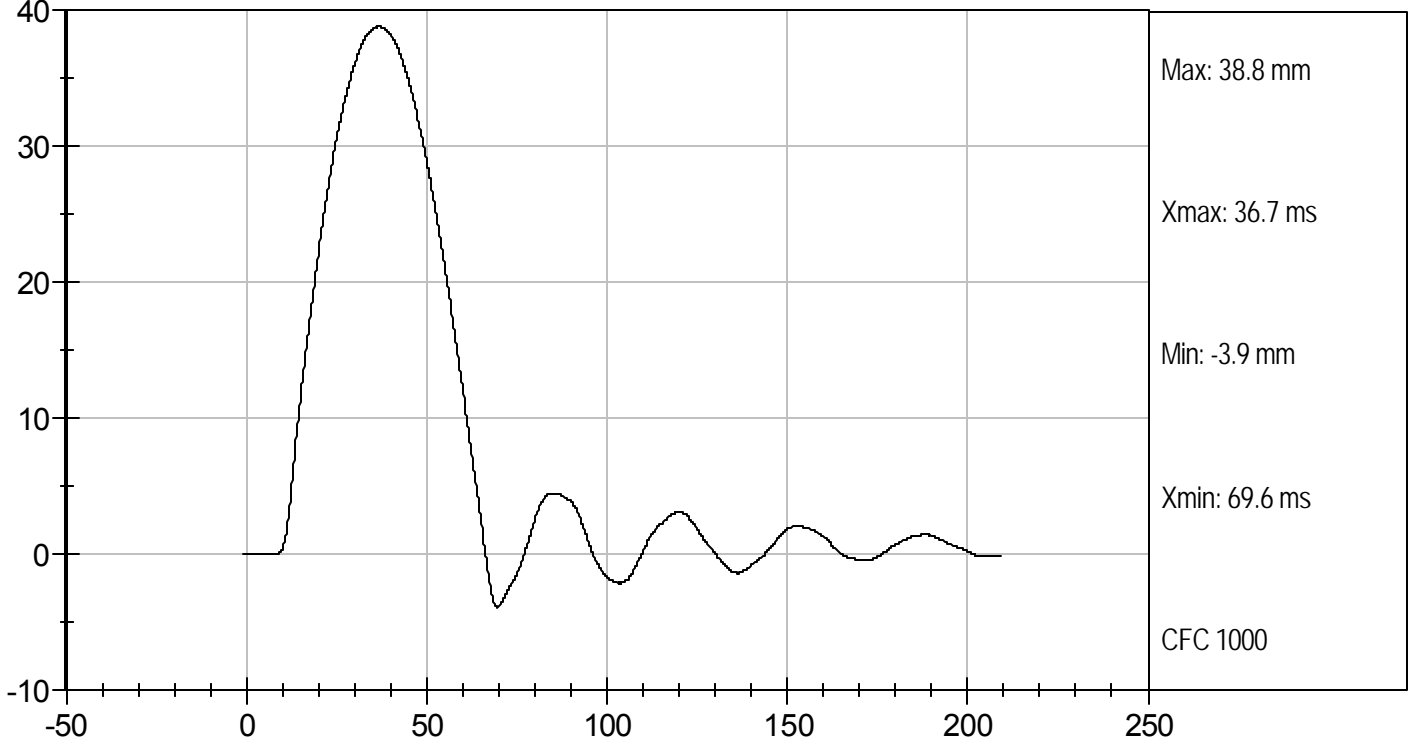
Jessica Hall
Laboratory Technician

4/15/11
Test Date

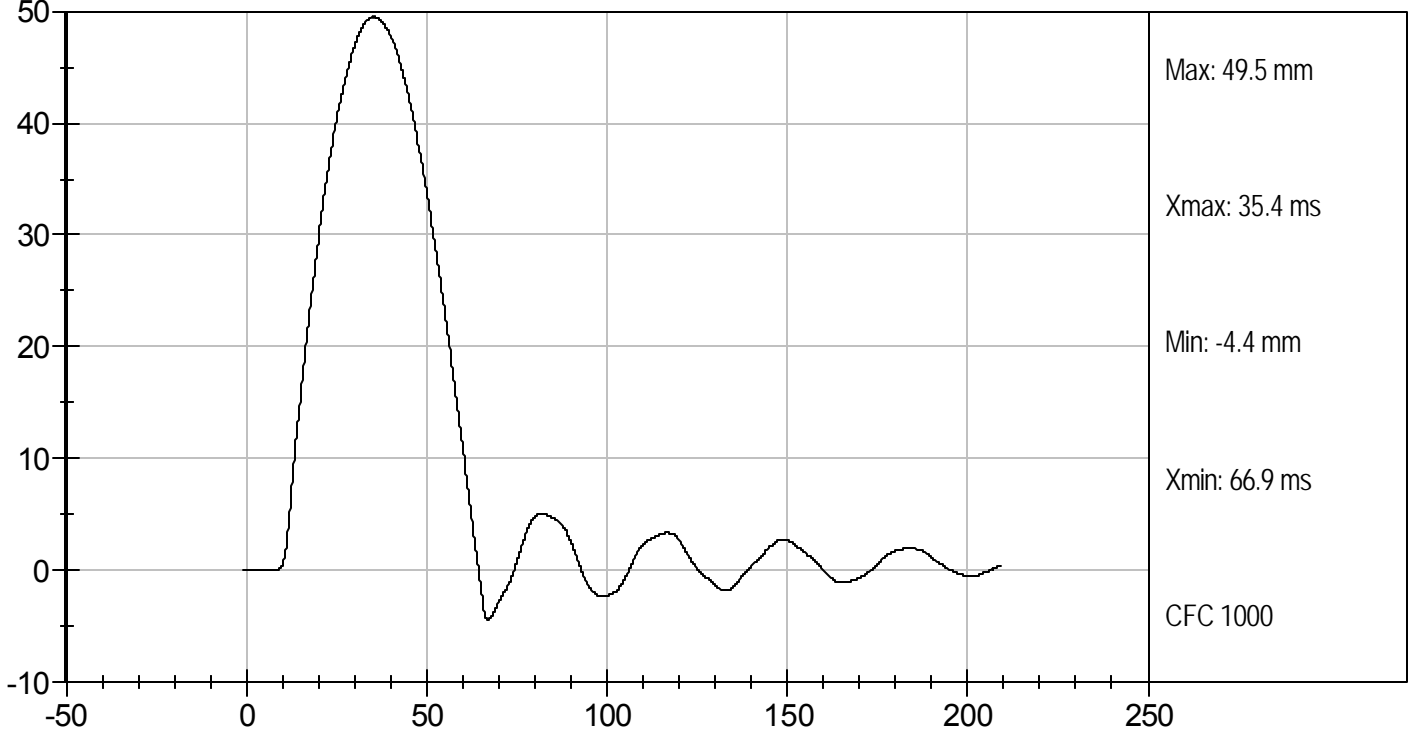
David Winkelbauer
Approved By



MID RIB DISPLACEMENT @ 3 M/SEC (mm) vs TIME (ms)



MID RIB DISPLACEMENT @ 4 M/SEC (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

LOWER RIB TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111416

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.9	Pass
Laboratory Relative Humidity	%	10 to 70	23	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.7	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.3	Pass
Overall Test Results				Pass

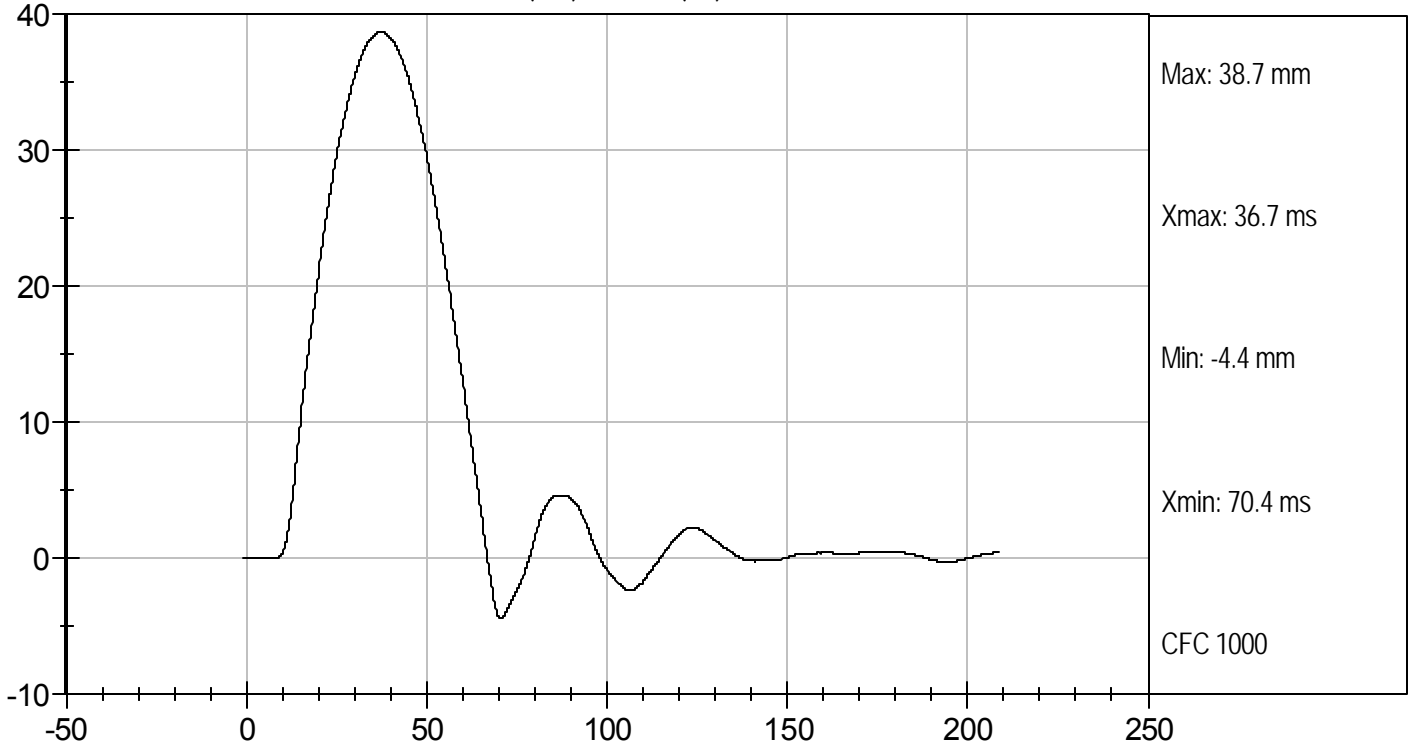
Jessica Gall
Laboratory Technician

4/15/11
Test Date

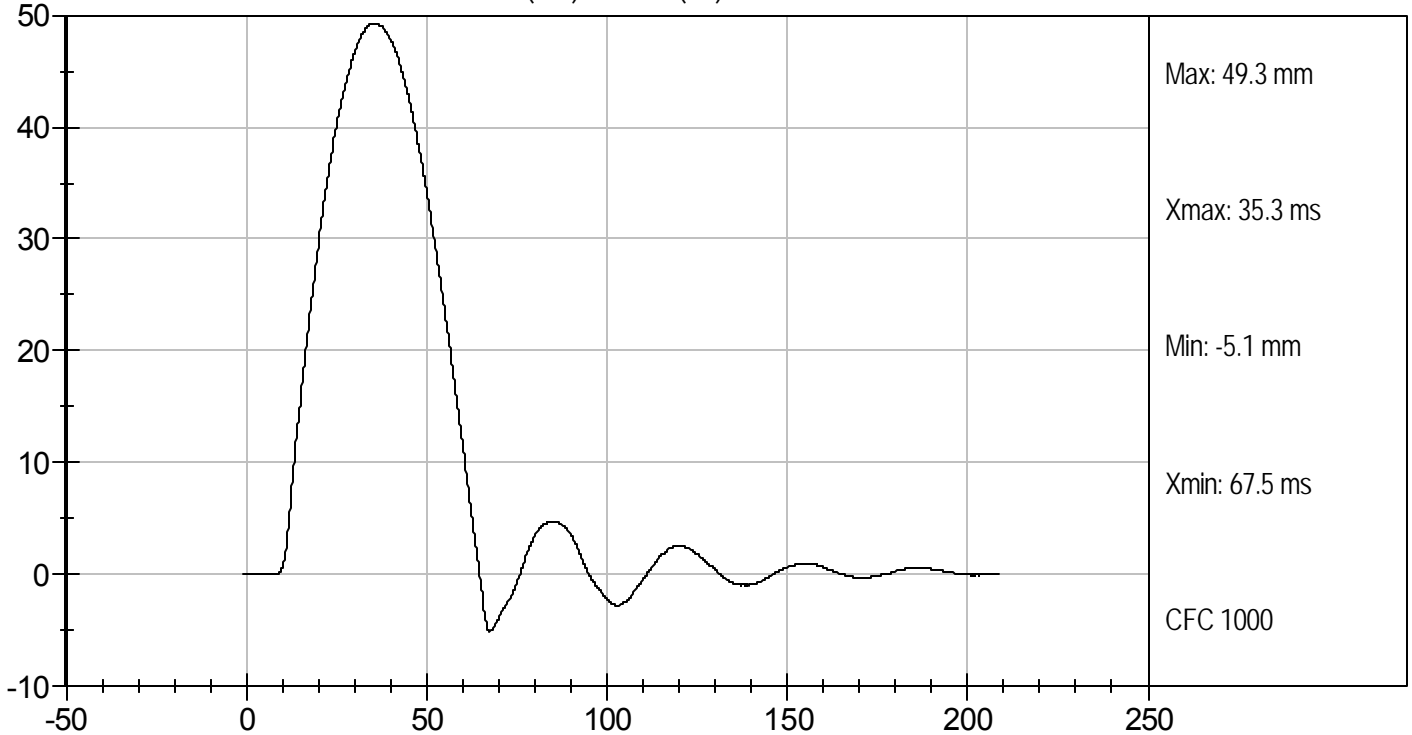
David Winkelbauer
Approved By



LOWER RIB DISPLACEMENT @ 3 M/SEC (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT @ 4 M/SEC (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMEN TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111417

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Speed	m/s	3.90 to 4.10	4.06	Pass
Maximum Impact Force	kN	4.00 to 4.80	4.33	Pass
Time of Maximum Impact Force	ms	10.60 to 13.00	11.20	Pass
Maximum Total Abdomen Force	kN	2.20 to 2.70	2.55	Pass
Time of Maximum Abdomen Force	ms	10.00 to 12.30	11.00	Pass
Overall Test Results				Pass


Laboratory Technician

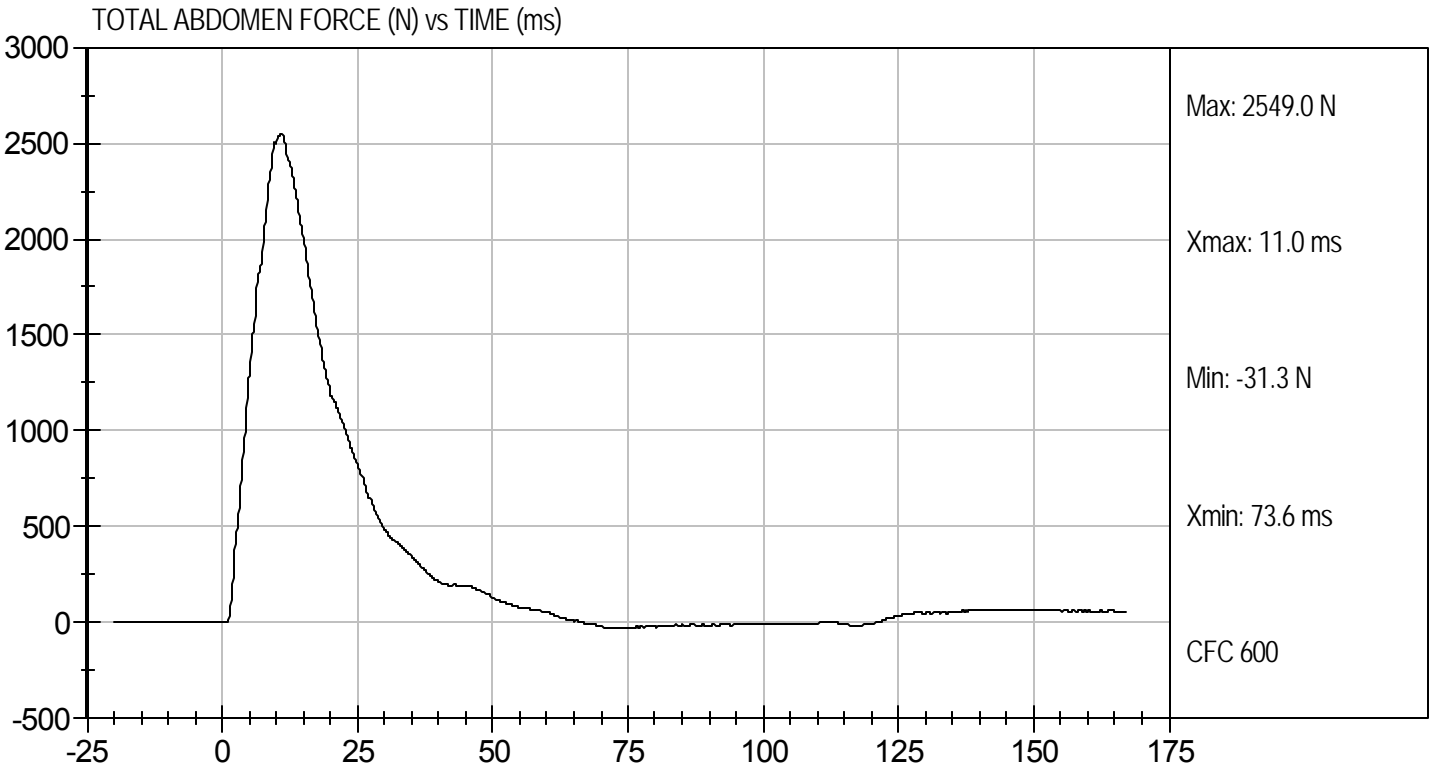
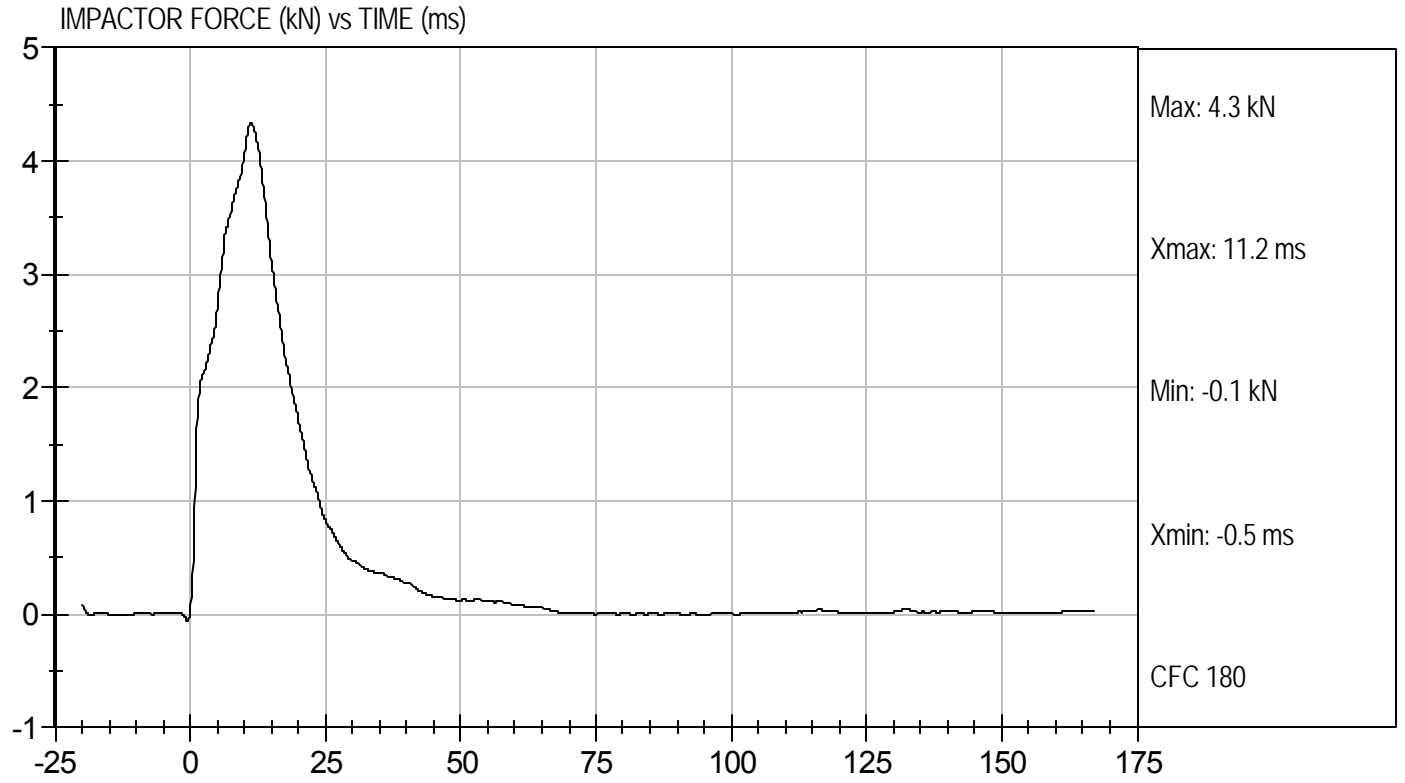
4/15/11
Test Date


Approved By



Test Desc: Abdomen Impact
Component ID: D111417

Test Date: 4/15/11
Velocity: 13.33 ft/s, 4.06 m/s



MGA RESEARCH CORPORATION
LUMBAR SPINE TEST
ES-2re DUMMY


ATD Serial No: 016

Test I.D.: D111418

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	30	Pass
Pendulum Speed		m/s	5.95 to 6.15	6.12	Pass
Pendulum Deceleration	1 ms	m/s	-0.05 to 0.00	-0.01	Pass
	3.7 ms	m/s	-0.425 to -0.24	-0.41	Pass
	27 ms	m/s	-6.50 to -5.80	-5.83	Pass
	30 ms	m/s	>= -6.5	-6.06	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	45.4	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	45.1	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	46	Pass
Overall Results					Pass

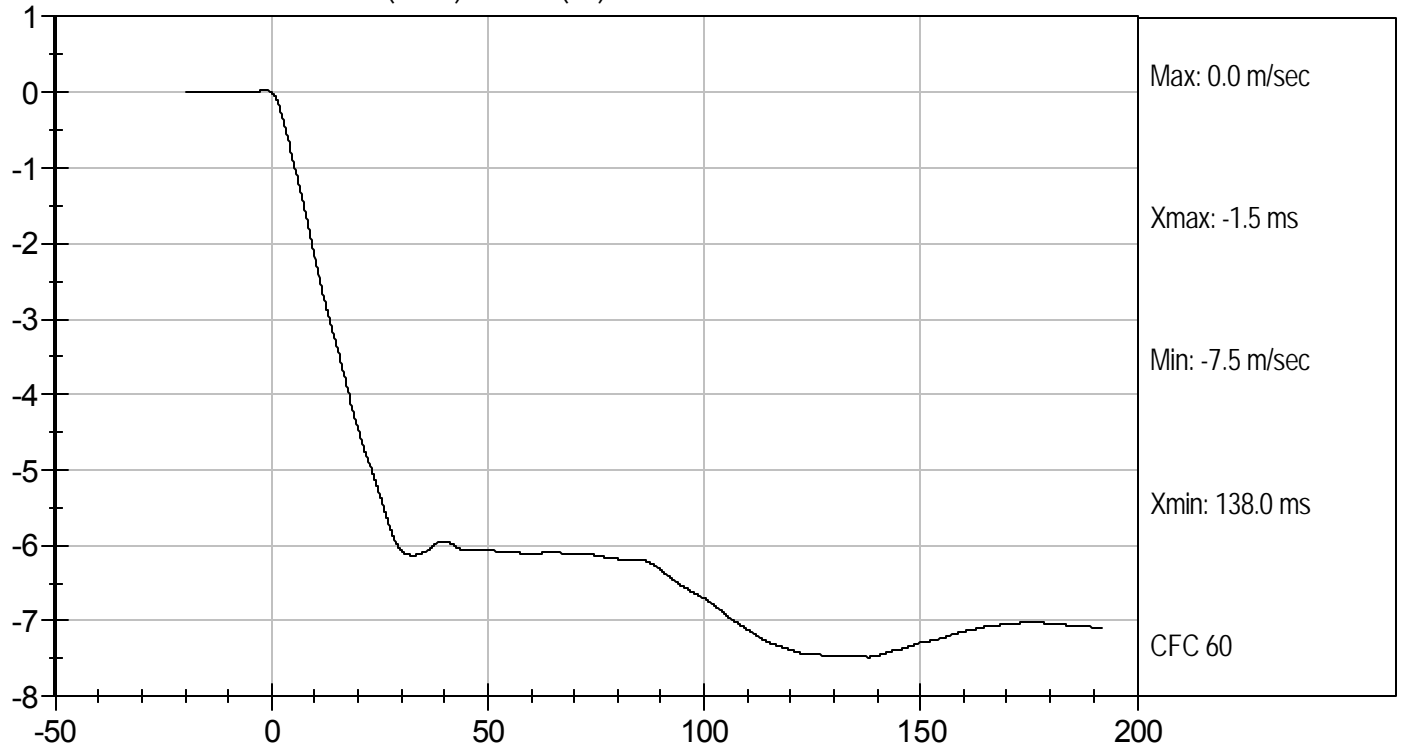

 Laboratory Technician

4/15/11
 Test Date

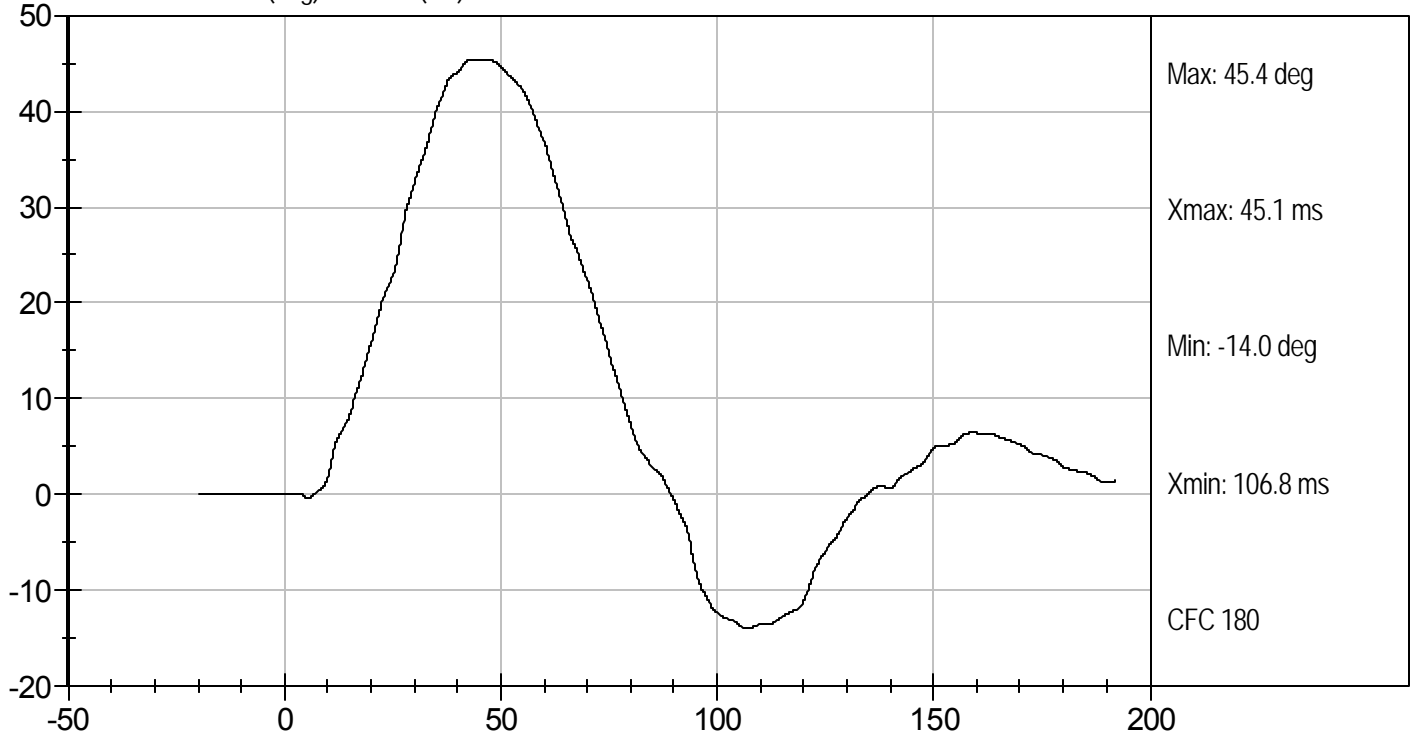

 Approved By

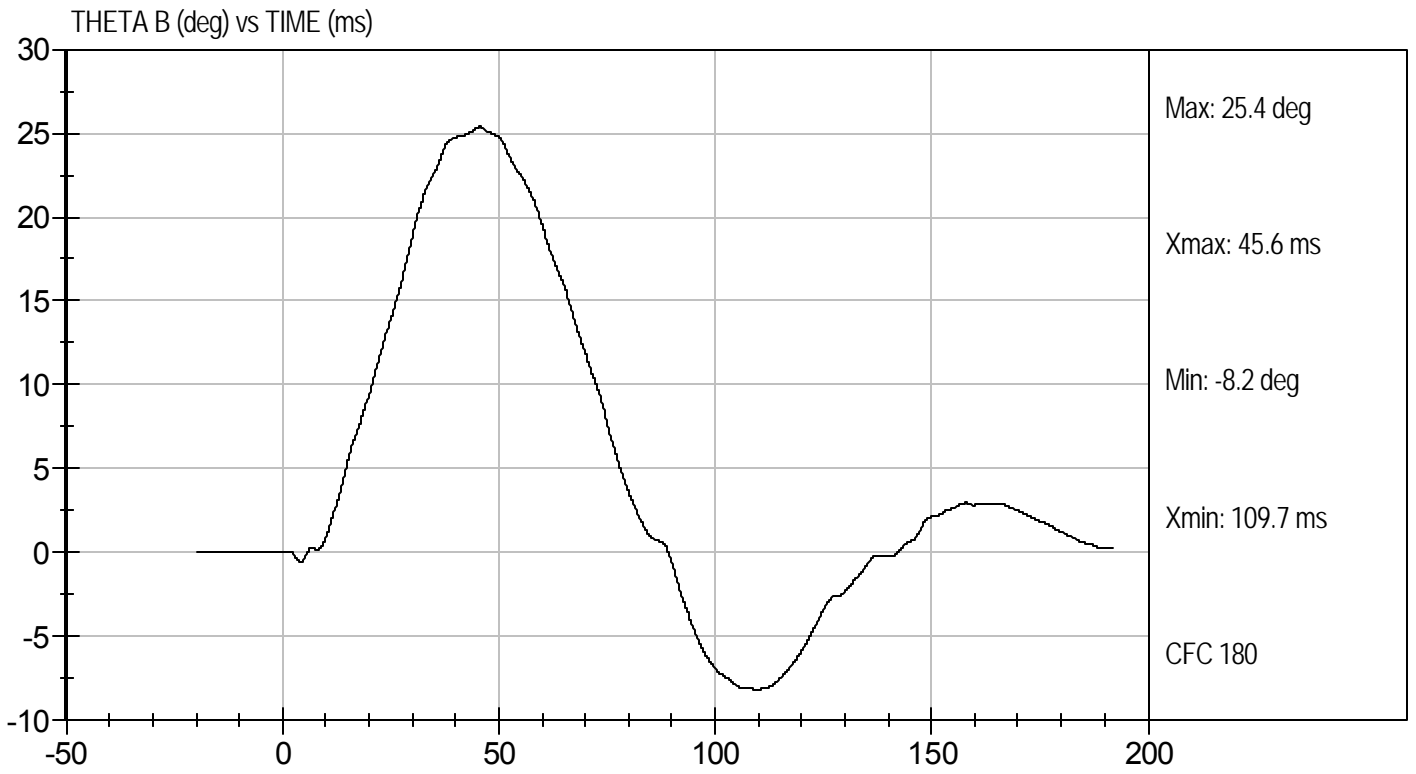
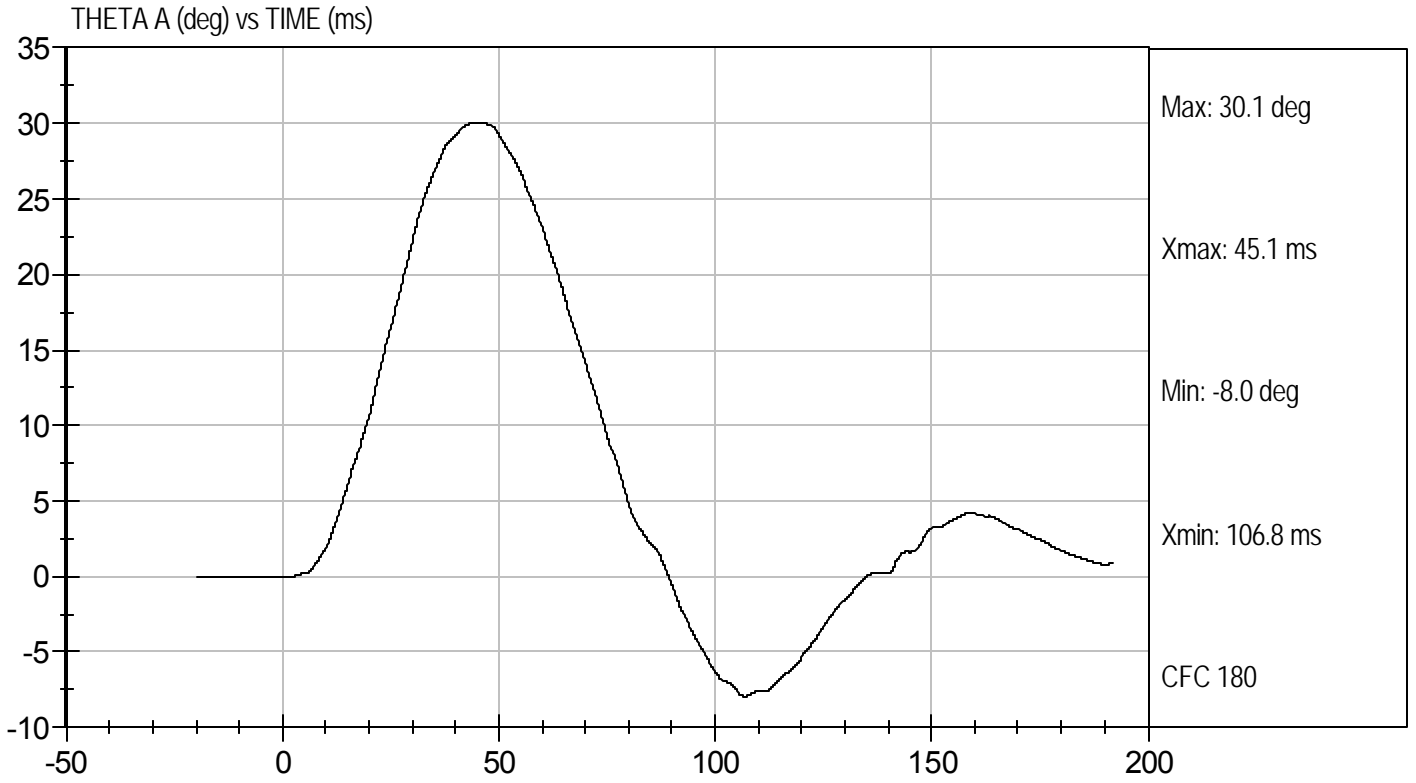


PENDULUM DECELERATION (m/sec) vs TIME (ms)



FLEXION ANGLE (deg) vs TIME (ms)





MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111419

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.1	Pass
Laboratory Relative Humidity	%	10 to 70	26	Pass
Probe Speed	m/s	4.20 to 4.40	4.34	Pass
Maximum Impactor Force	kN	4.70 to 5.40	4.76	Pass
Time of Maximum Impactor Force	ms	11.80 to 16.10	13.10	Pass
Maximum Pubic Force	kN	1.23 to 1.59	1.35	Pass
Time of Maximum Pubic Force	ms	12.20 to 17.00	14.20	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

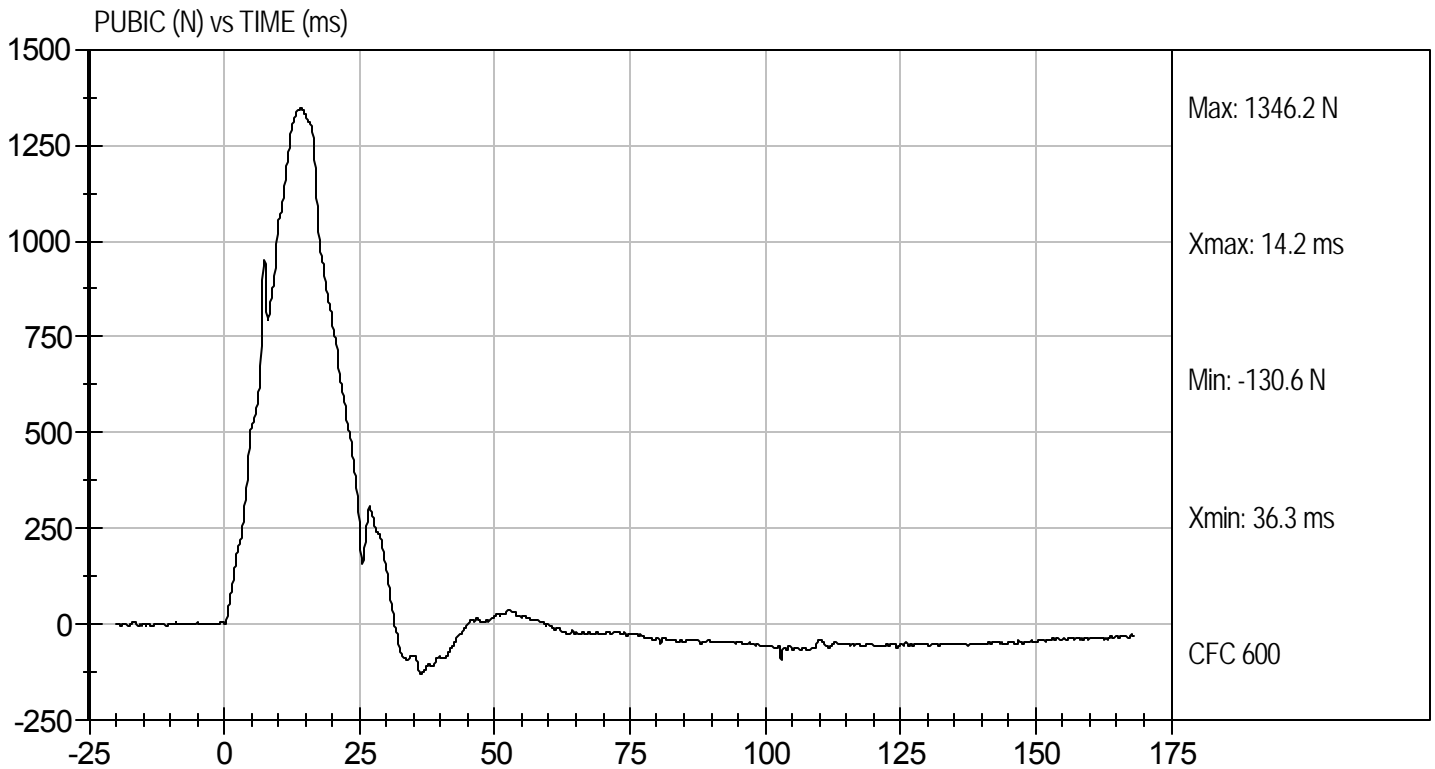
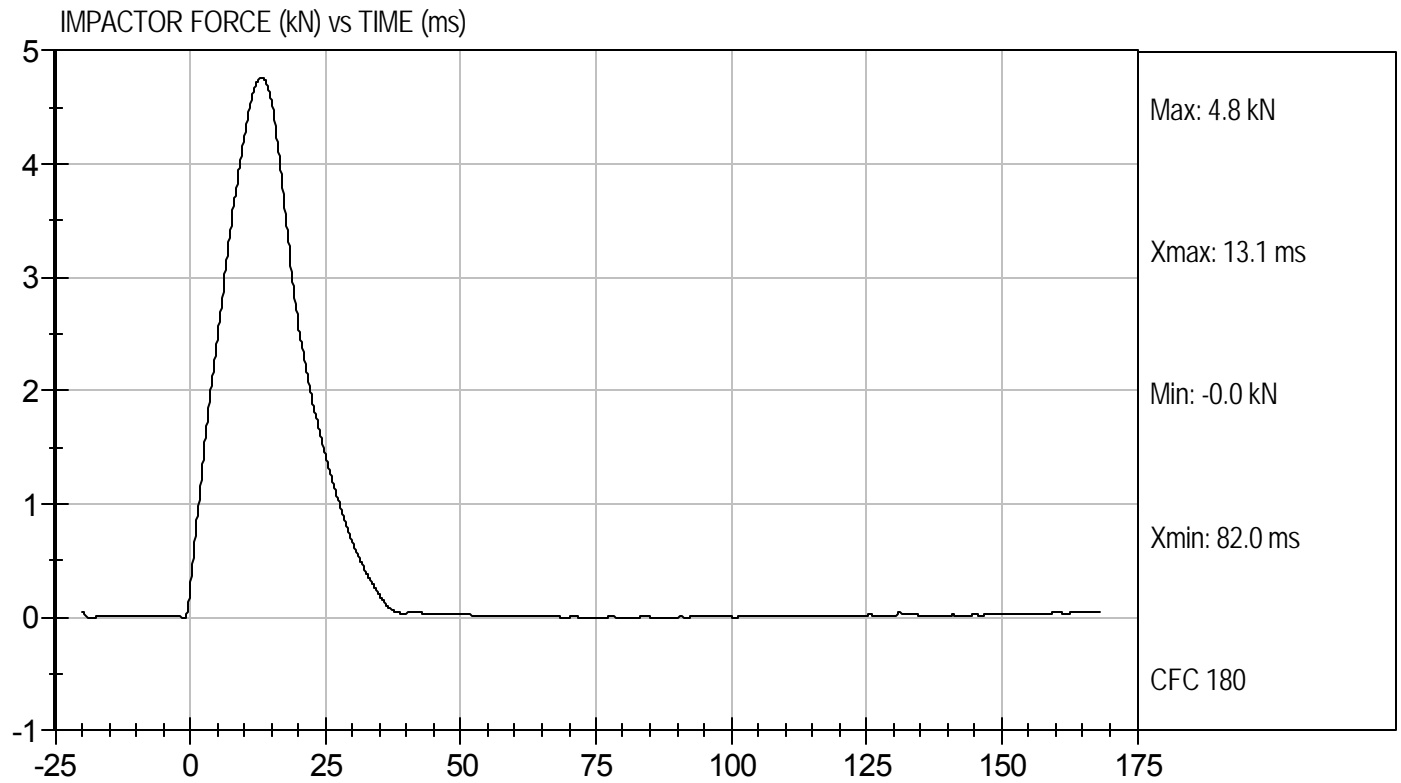
4/15/11
Test Date

David Winkelbauer
Approved By



Test Desc: Pelvis Impact
Component ID: D111419

Test Date: 4/15/11
Velocity: 14.25 ft/s, 4.34 m/s



MGA RESEARCH CORPORATION
FULL BODY THORAX IMPACT TEST
ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111410

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.1	Pass
Humidity	%	10 to 70	26	Pass
Probe Speed	m/s	5.40 to 5.60	5.58	Pass
Maximum Impactor Force (after 6 ms)	kN	5.10 to 6.20	5.16	Pass
Upper Rib Displacement	mm	34.0 to 41.0	38.1	Pass
Middle Rib Displacement	mm	37.0 to 45.0	40.8	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.1	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

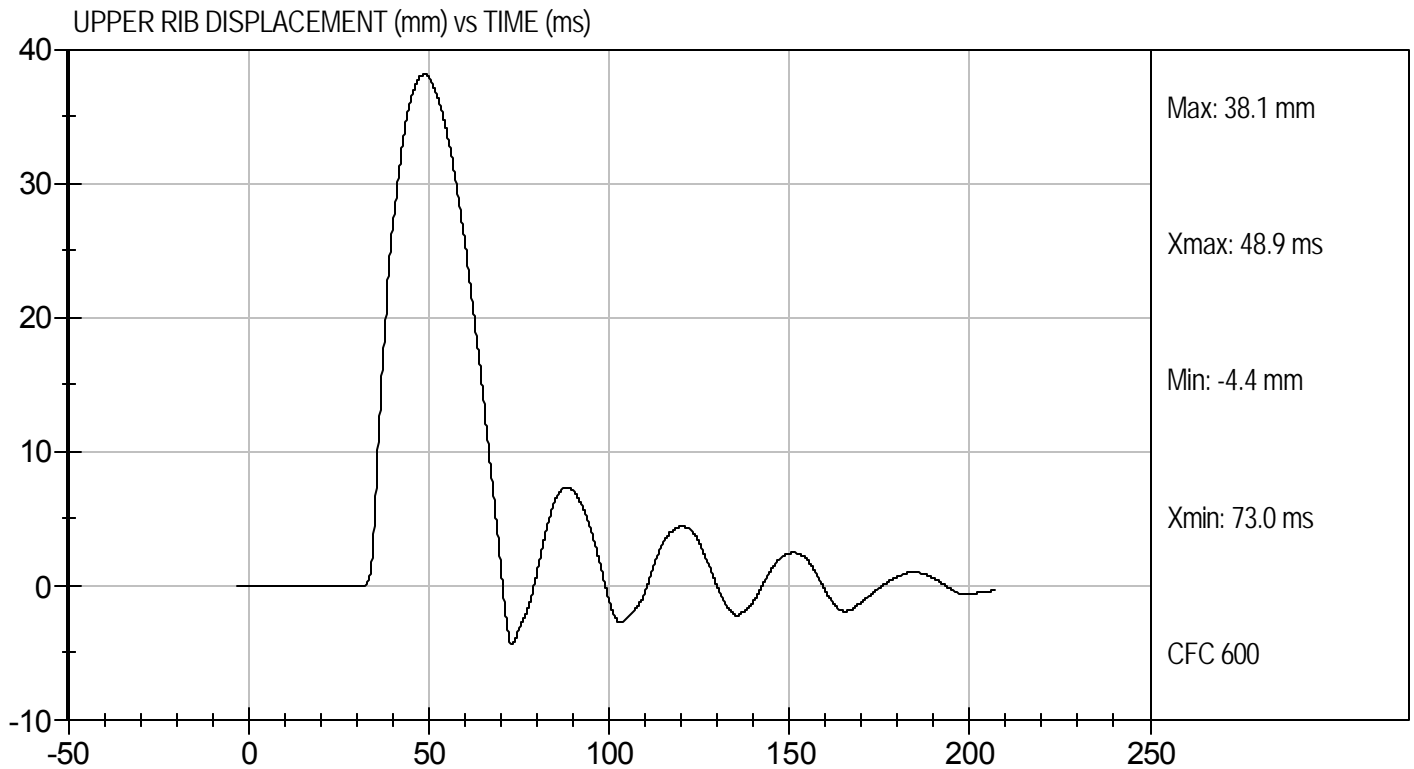
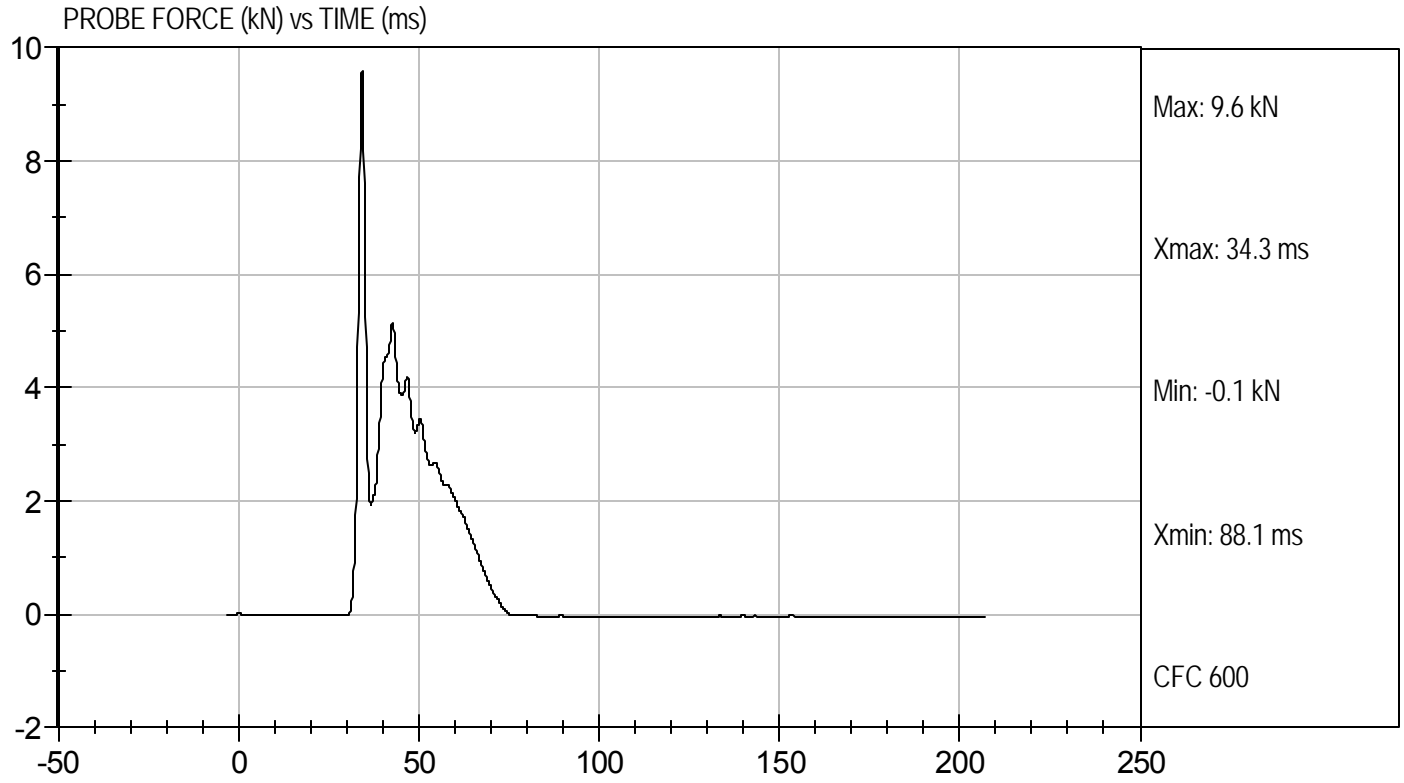
4/15/11
Test Date

David Winkelbauer
Approved By



Test Desc: Thorax Impact
Component ID: D111410

Test Date: 4/15/11
Velocity: 18.32 ft/s, 5.58 m/s

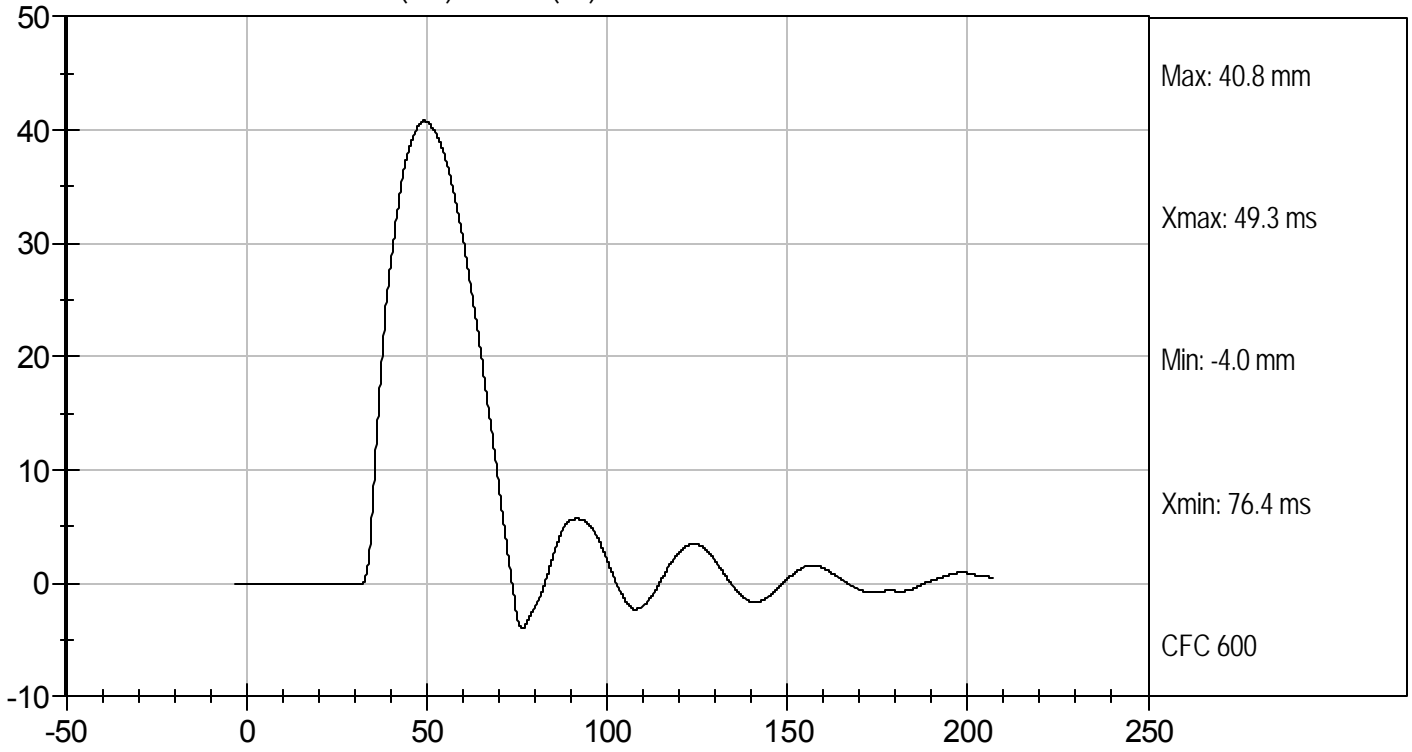




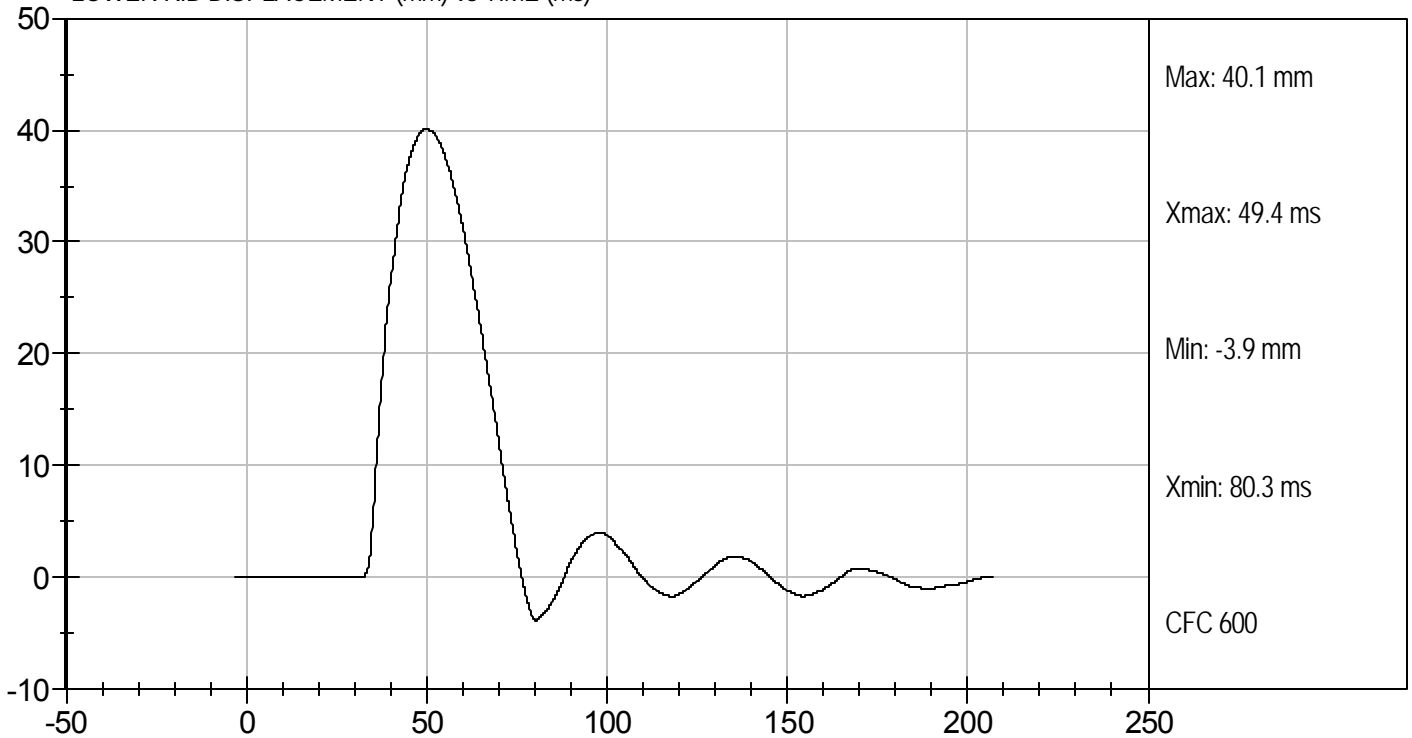
Test Desc: Thorax Impact
Component ID: D111410

Test Date: 4/15/11
Velocity: 18.32 ft/s, 5.58 m/s

MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



MGA RESEARCH CORPORATION
HEAD DROP TEST
ES-2re DUMMY

ATD Serial No: 016

Test ID: D111501

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.9	Pass
Laboratory Relative Humidity	%	10 to 70	29	Pass
Peak Resultant Acceleration	G's	125 to 155	142	Pass
Peak Lateral Acceleration	G's	+/- 15	-12.5	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
Overall Test Results				Pass

Jessica Hall
 Laboratory Technician

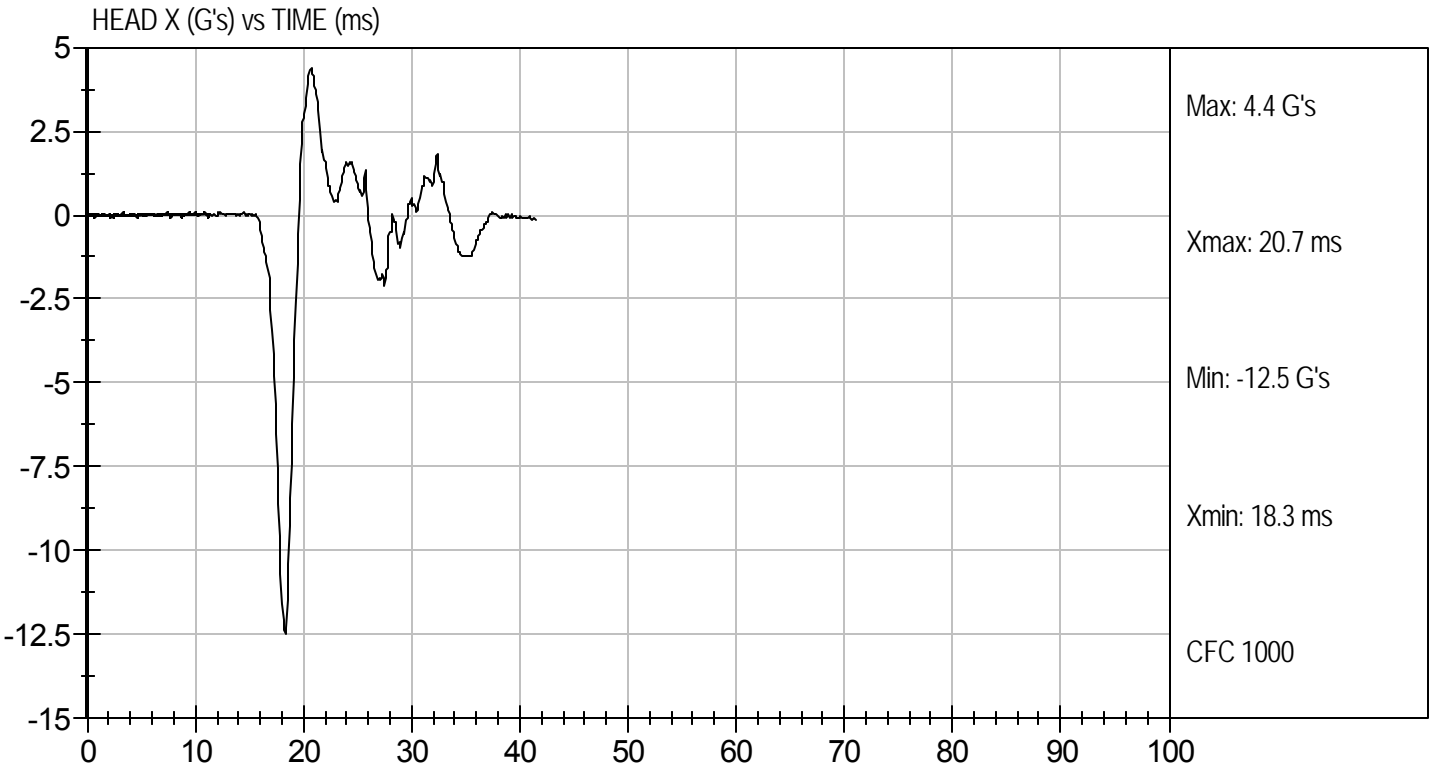
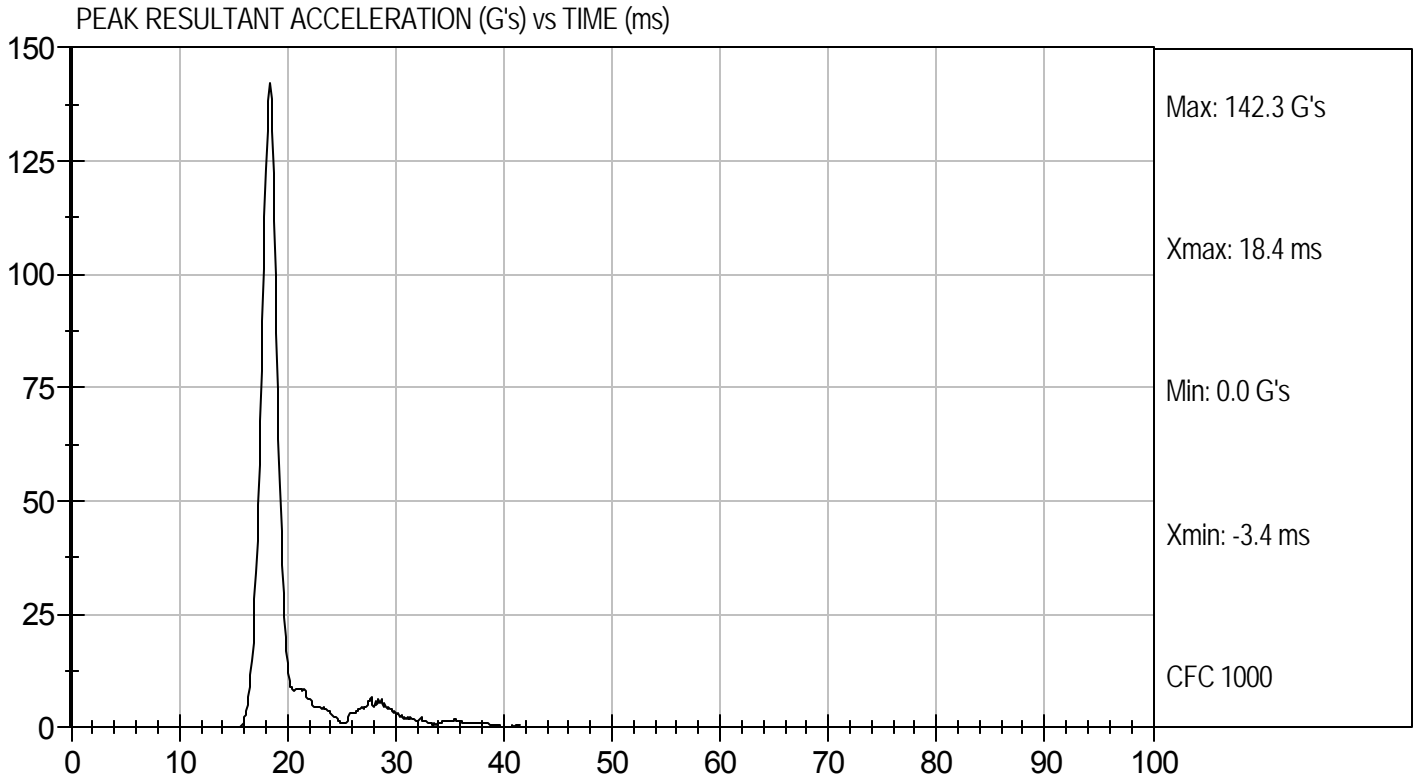
4/21/11
 Test Date

David Winkelbauer
 Approved By



Test Desc: Head Drop
Component ID: D111501

Test Date: 4/21/11
Velocity: 0 ft/s, 0 m/s



MGA RESEARCH CORPORATION
NECK PENDULUM TEST
ES-2re DUMMY

ATD Serial No: 016

Test I.D.: D111502

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	18.0 to 22.0	21.6	Pass
Laboratory Relative Humidity		%	10 to 70	26	Pass
Pendulum Speed		m/s	3.3 to 3.5	3.4	Pass
Pendulum Deceleration	1 ms	m/s	0.00 to -0.05	-0.02	Pass
	3 ms	m/s	-0.25 to -0.375	-0.32	Pass
	14 ms	m/s	-3.20 to -3.70	-3.37	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	50.0	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	58.8	Pass
Head Rotation Decay Time to 0 degree		ms	53.0 to 88.0	55.0	Pass
Overall Test Results					Pass

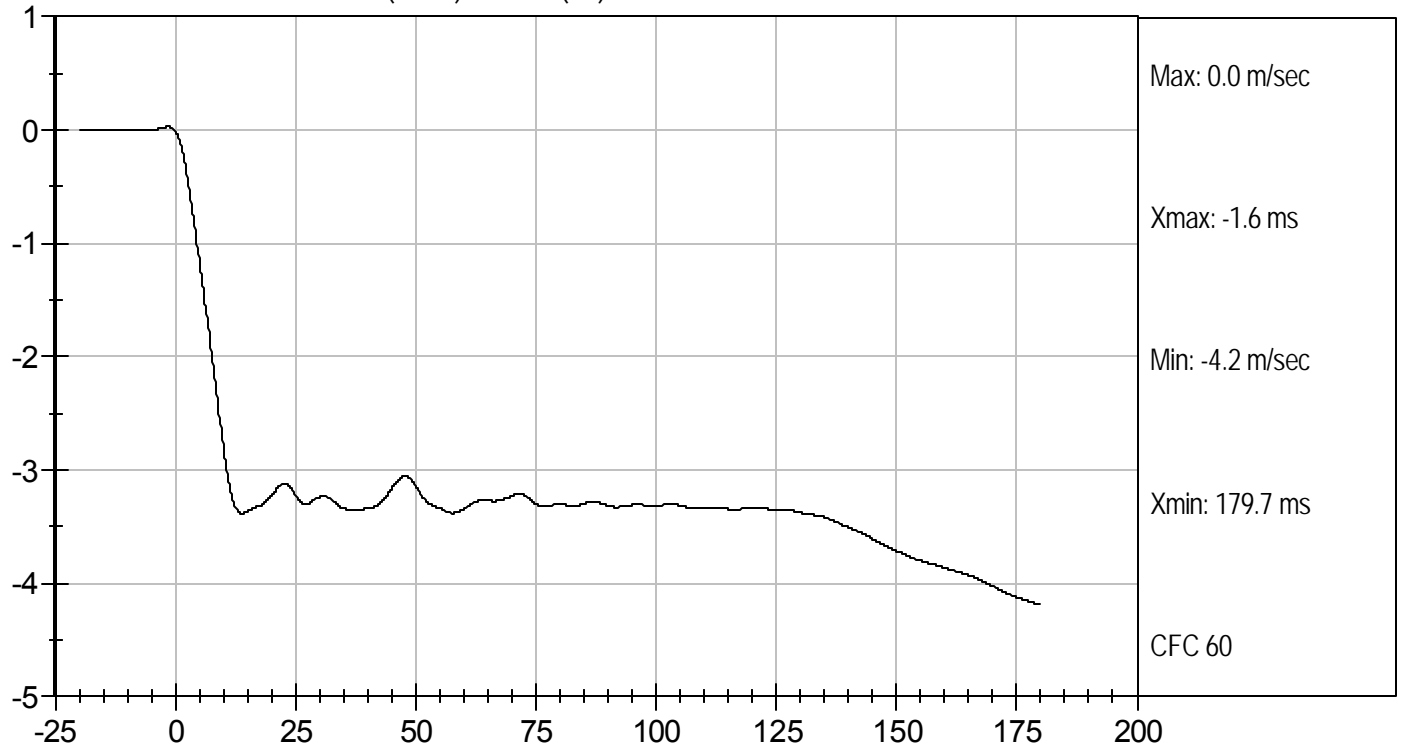
Jessica Hall
Laboratory Technician

4/21/11
Test Date

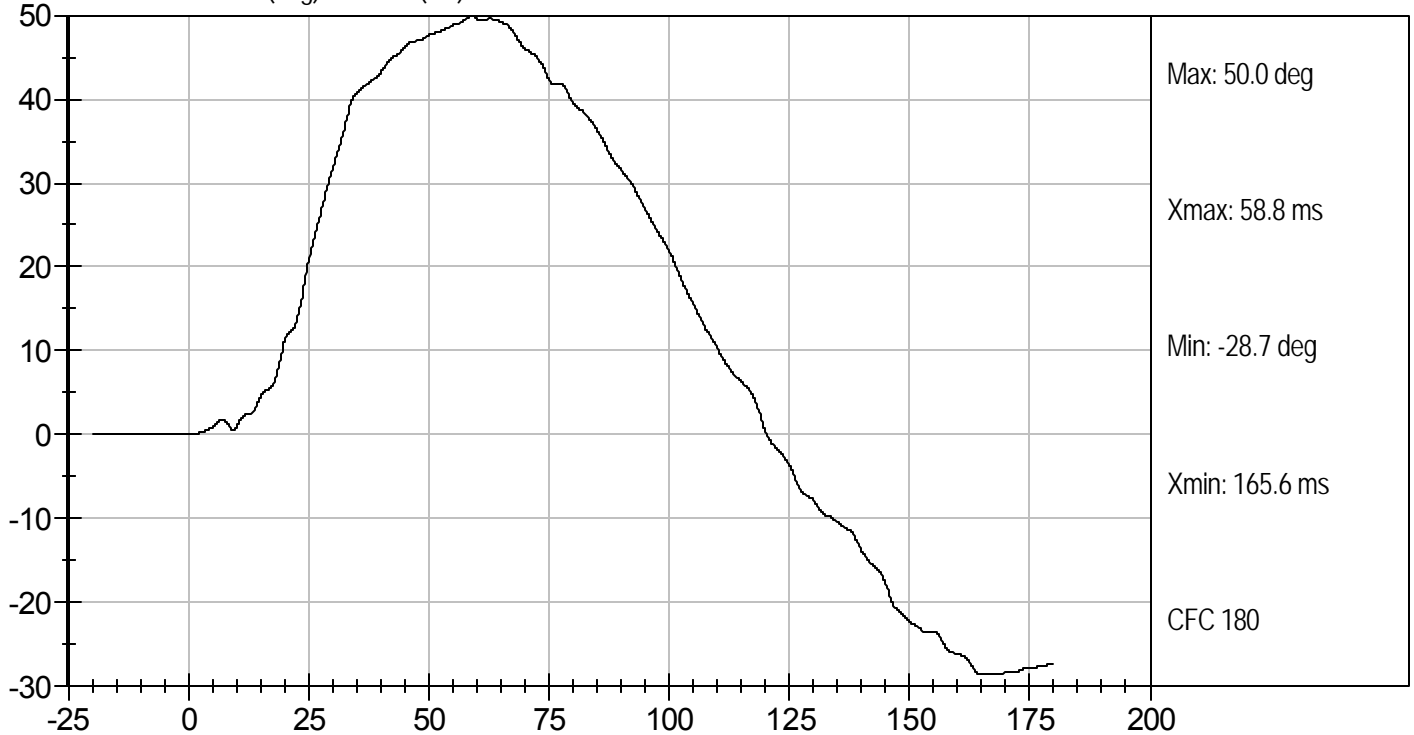
David Winkelbauer
Approved By



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



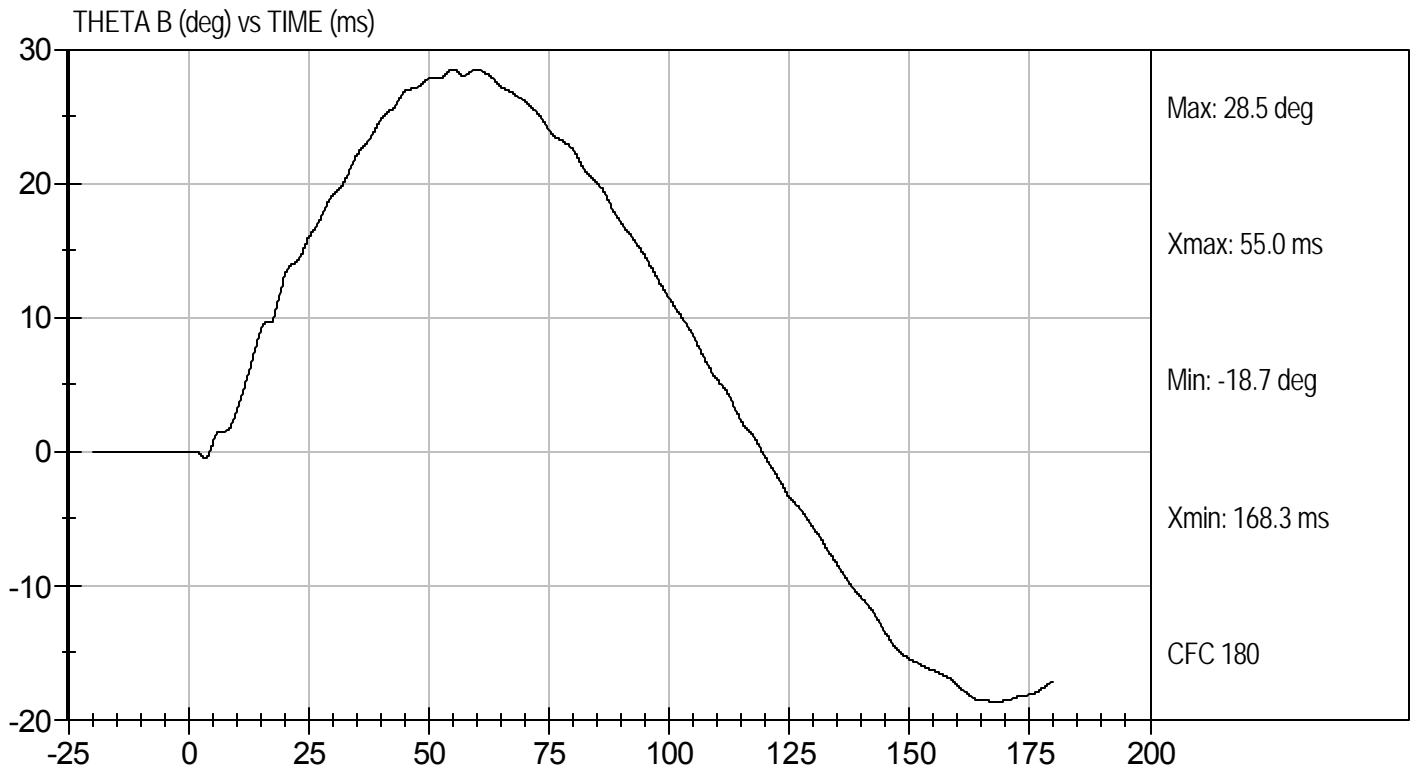
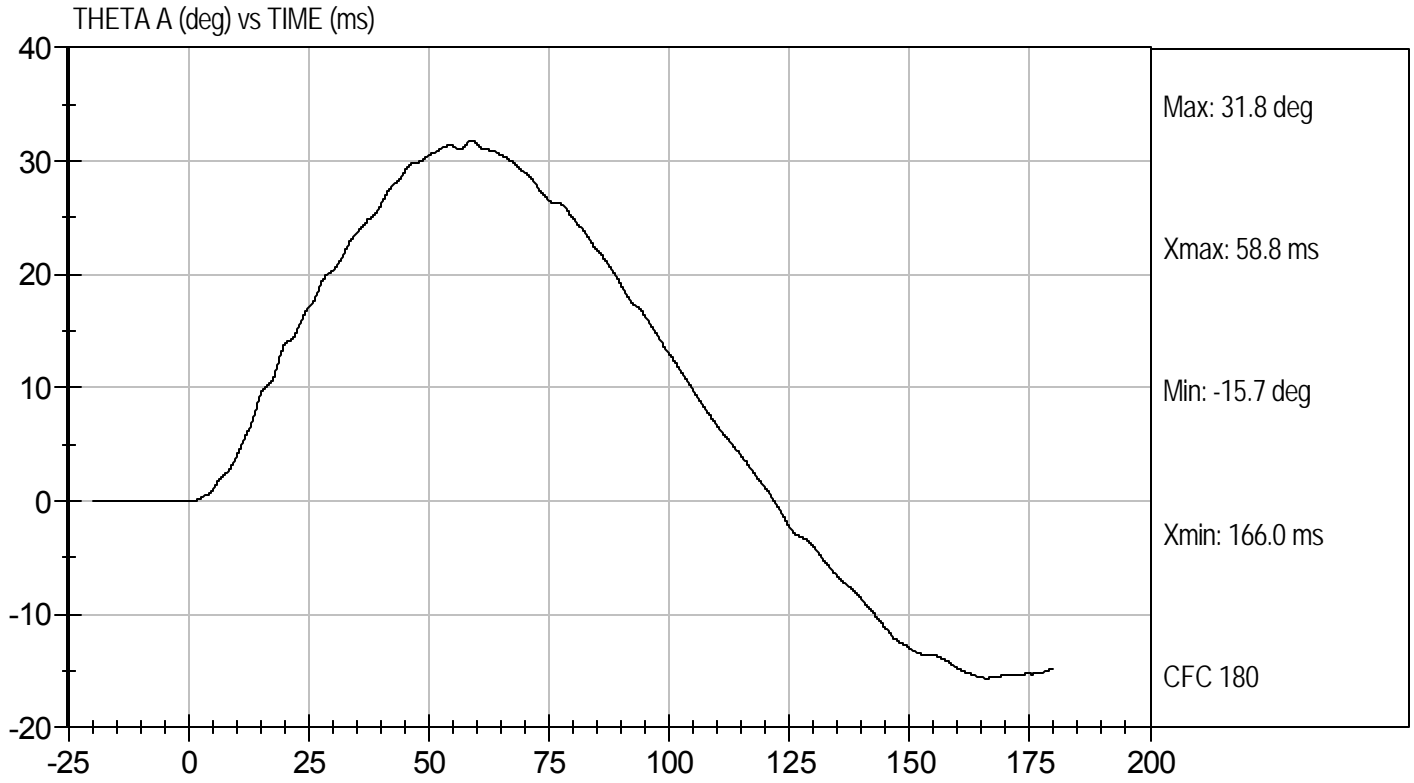
FLEXION ANGLE (deg) vs TIME (ms)





Test Desc: Neck Bending
Component ID: D111502

Test Date: 4/21/11
Velocity: 11.26 ft/s, 3.4 m/s



MGA RESEARCH CORPORATION
SHOULDER IMPACT TEST
ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111503

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Pendulum Speed	m/s	4.2 to 4.4	4.3	Pass
Peak Shoulder Acceleration	G's	7.5 to 10.5	9.0	Pass
Time of Peak Shoulder Acceleration	ms	NA	18.7	Pass
Overall Test Results				Pass

Jessica Gall
 Laboratory Technician

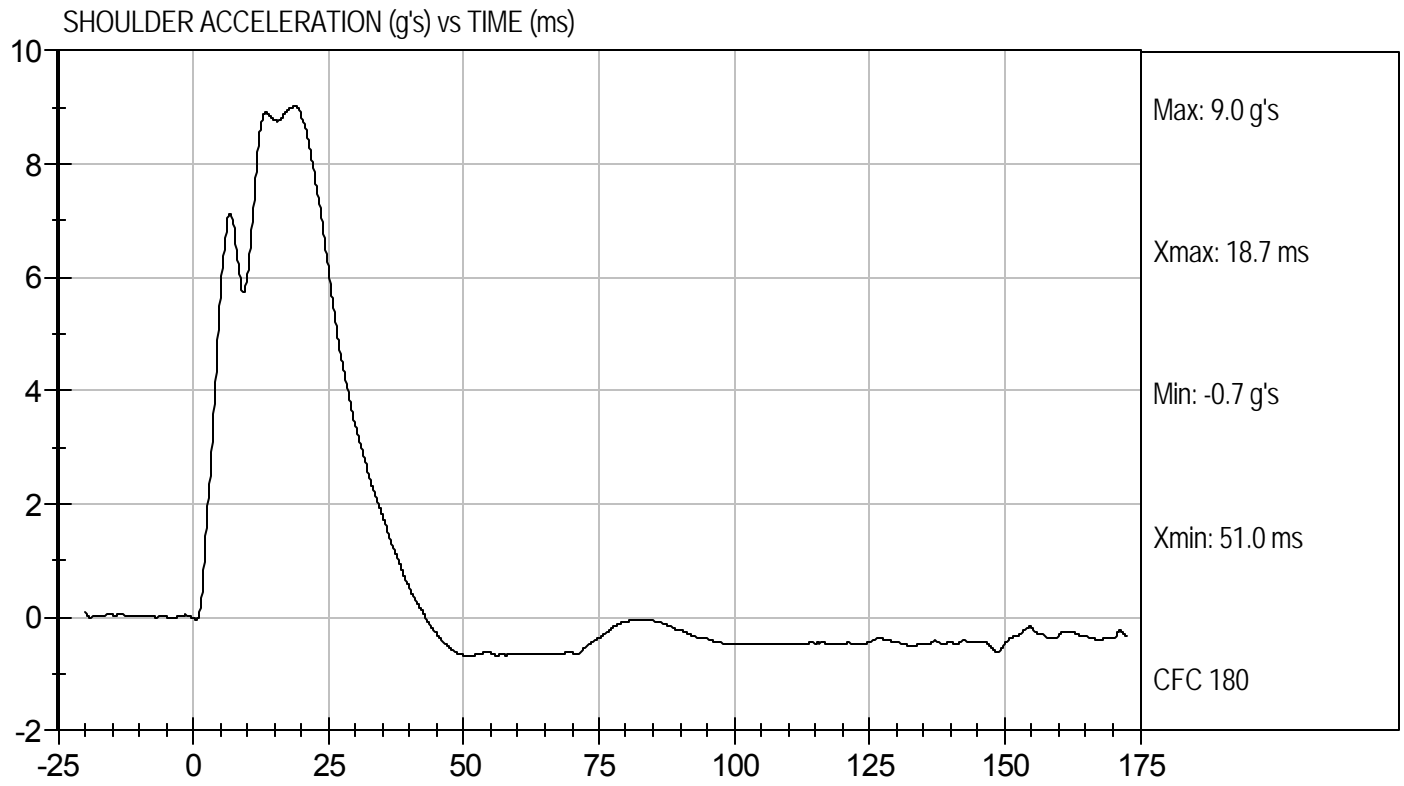
4/21/11
 Test Date

David Winkelbauer
 Approved By



Test Desc: Shoulder Impact
Component ID: D111503

Test Date: 4/21/11
Velocity: 14.24 ft/s, 4.3 m/s



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111504

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	27	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.7	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.3	Pass
Overall Test Results				Pass

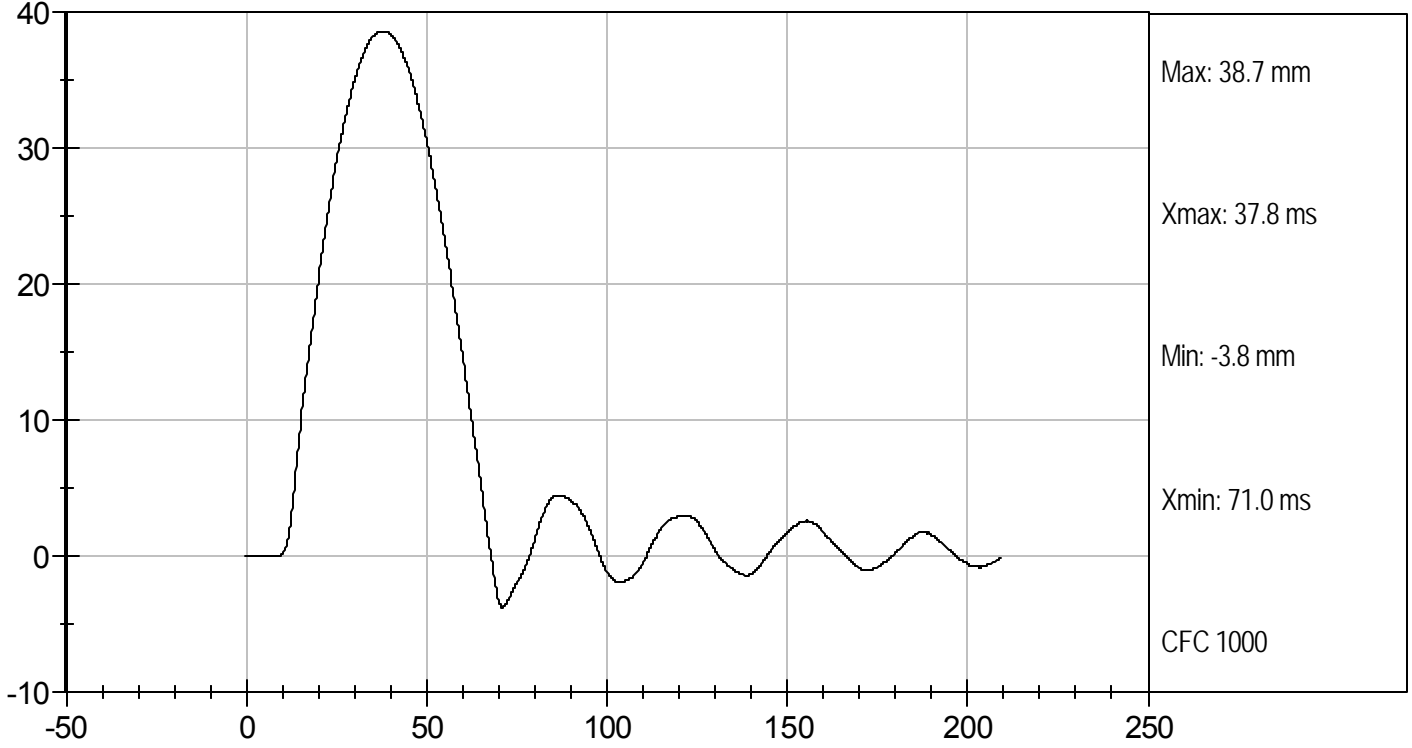
Jessica Hall
Laboratory Technician

4/21/11
Test Date

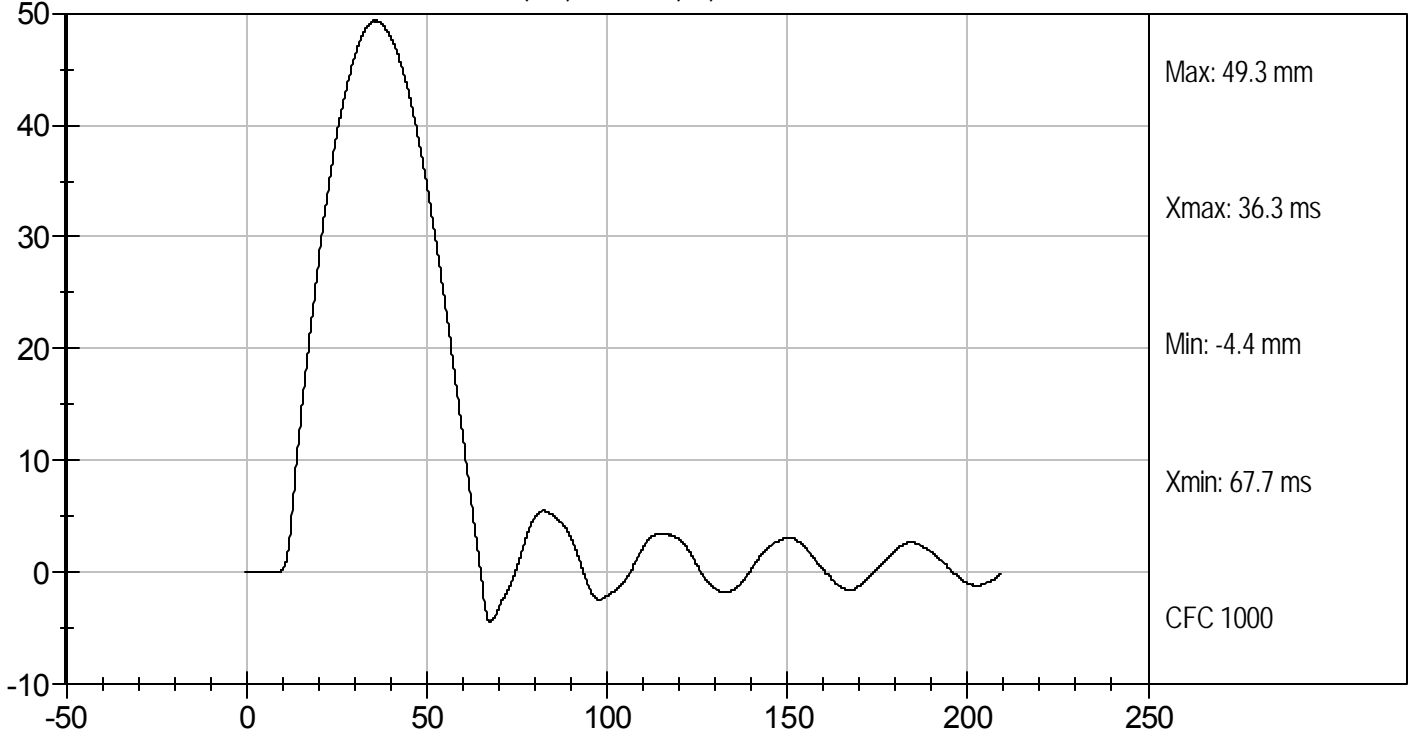
David Winkelbauer
Approved By



UPPER RIB DISPLACEMENT @ 3 M/SEC (mm) vs TIME (ms)



UPPER RIB DISPLACEMENT @ 4 M/SEC (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

MID RIB TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111505

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	27	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.6	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.2	Pass
Overall Test Results				Pass

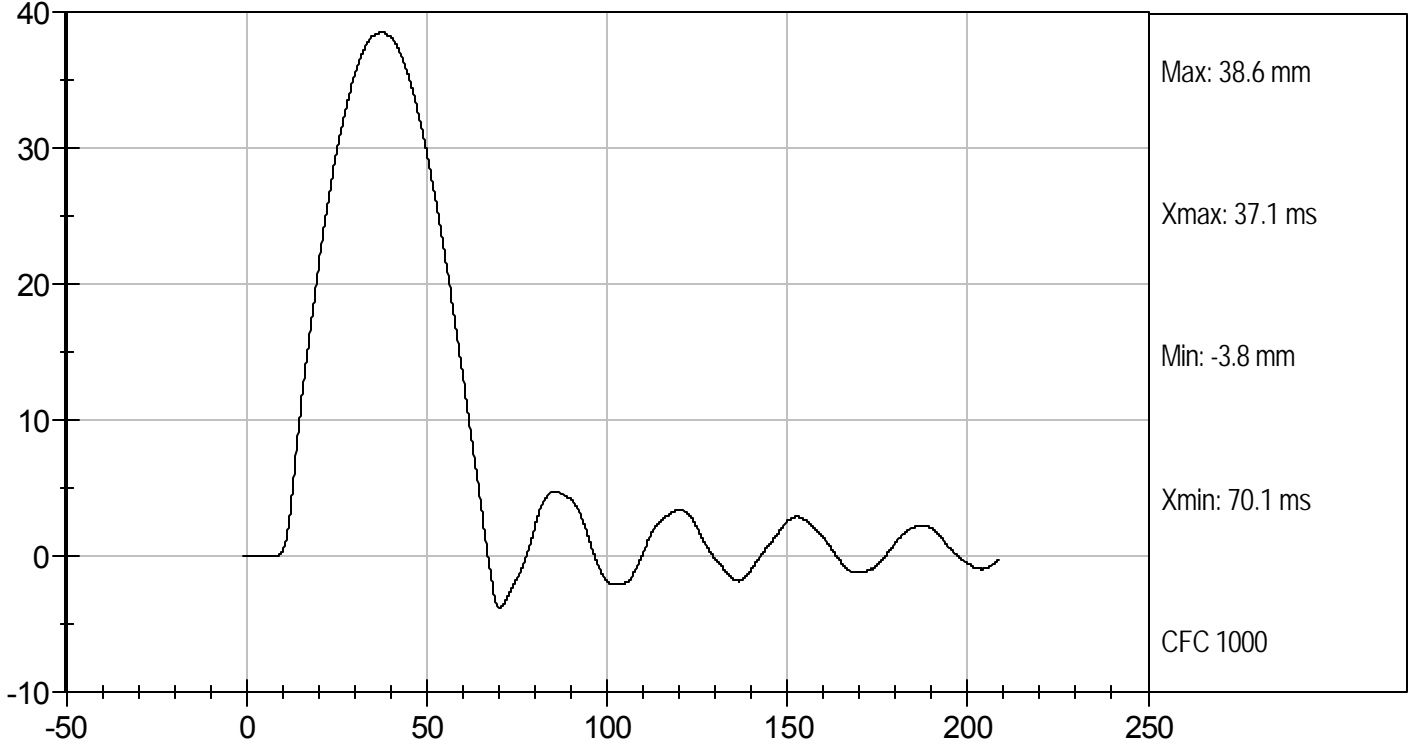
Jessica Hall
Laboratory Technician

4/21/11
Test Date

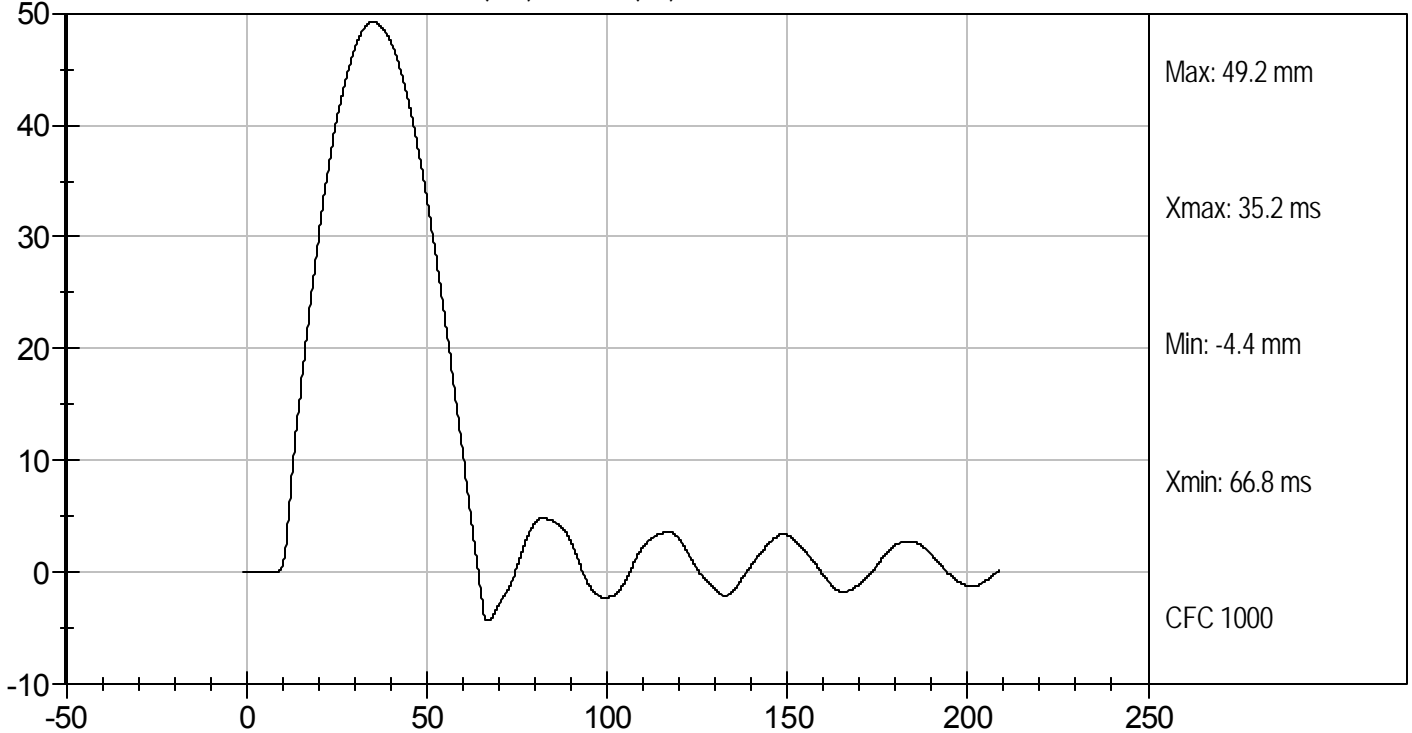
David Winkelbauer
Approved By



MID RIB DISPLACEMENT @ 3 M/SEC (mm) vs TIME (ms)



MID RIB DISPLACEMENT @ 4 M/SEC (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

LOWER RIB TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111506

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	27	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.9	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.8	Pass
Overall Test Results				Pass

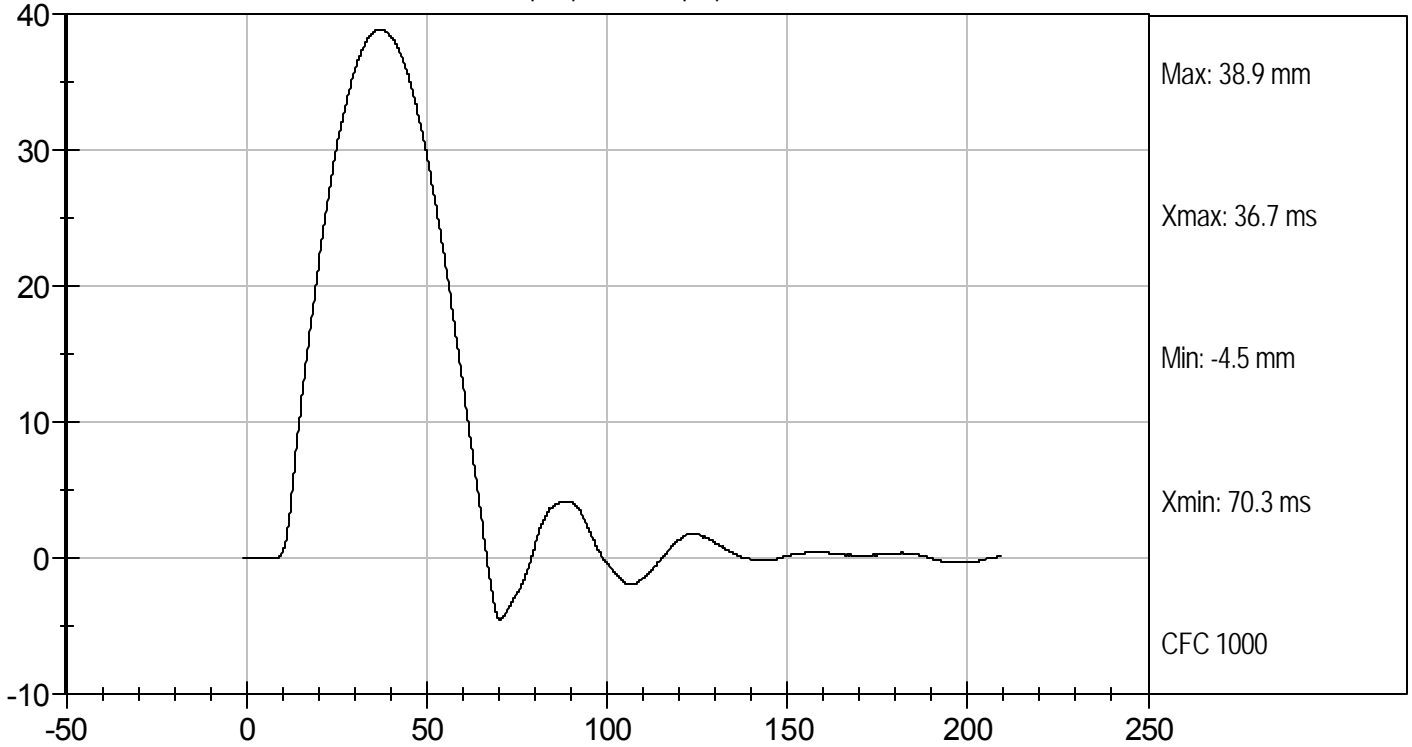
Jessica Hall
Laboratory Technician

4/21/11
Test Date

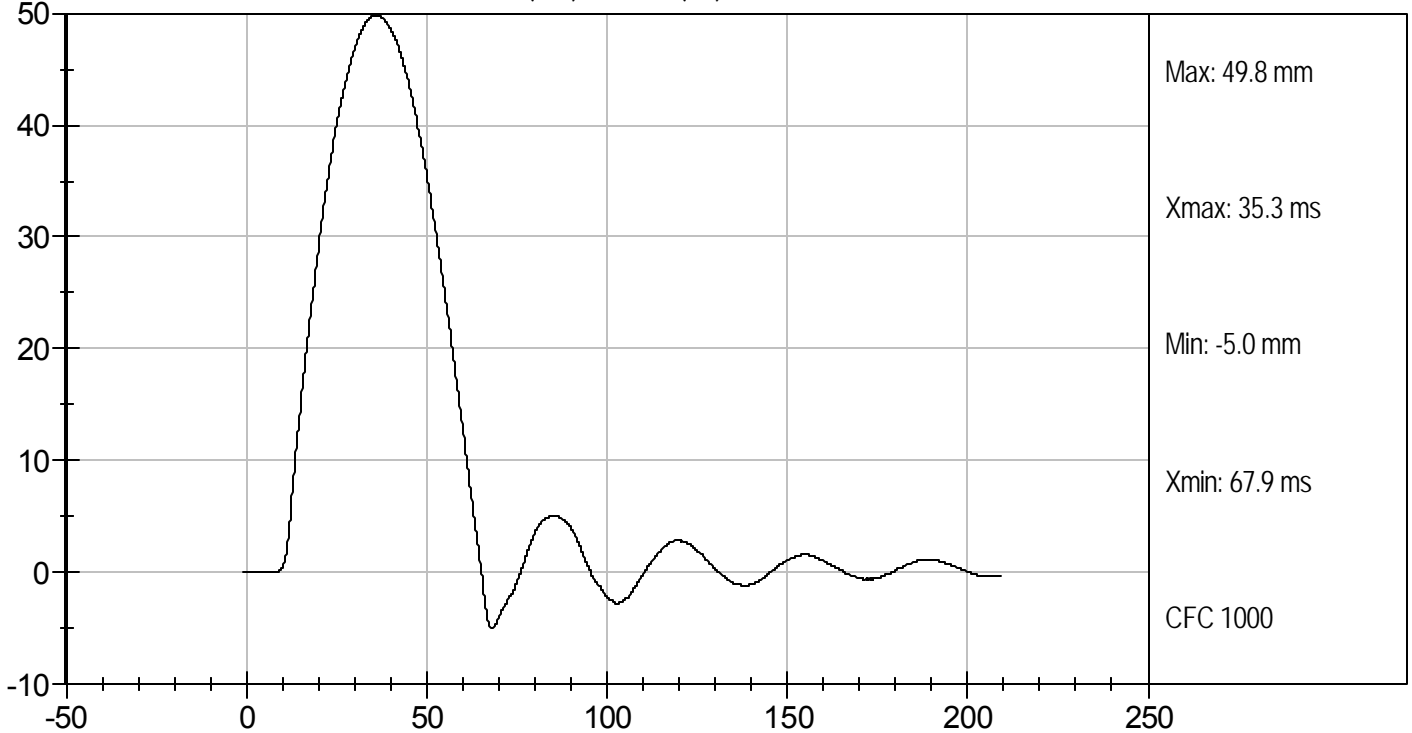
David Winkelbauer
Approved By



LOWER RIB DISPLACEMENT @ 3 M/SEC (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT @ 4 M/SEC (mm) vs TIME (ms)



MGA RESEARCH CORPORATION

ABDOMEN TEST

ES-2re DUMMY

ATD Serial No: 016

Test I.D: D111507

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Probe Speed	m/s	3.90 to 4.10	4.10	Pass
Maximum Impact Force	kN	4.00 to 4.80	4.37	Pass
Time of Maximum Impact Force	ms	10.60 to 13.00	11.30	Pass
Maximum Total Abdomen Force	kN	2.20 to 2.70	2.59	Pass
Time of Maximum Abdomen Force	ms	10.00 to 12.30	10.70	Pass
Overall Test Results				Pass

Jessica Hall
Laboratory Technician

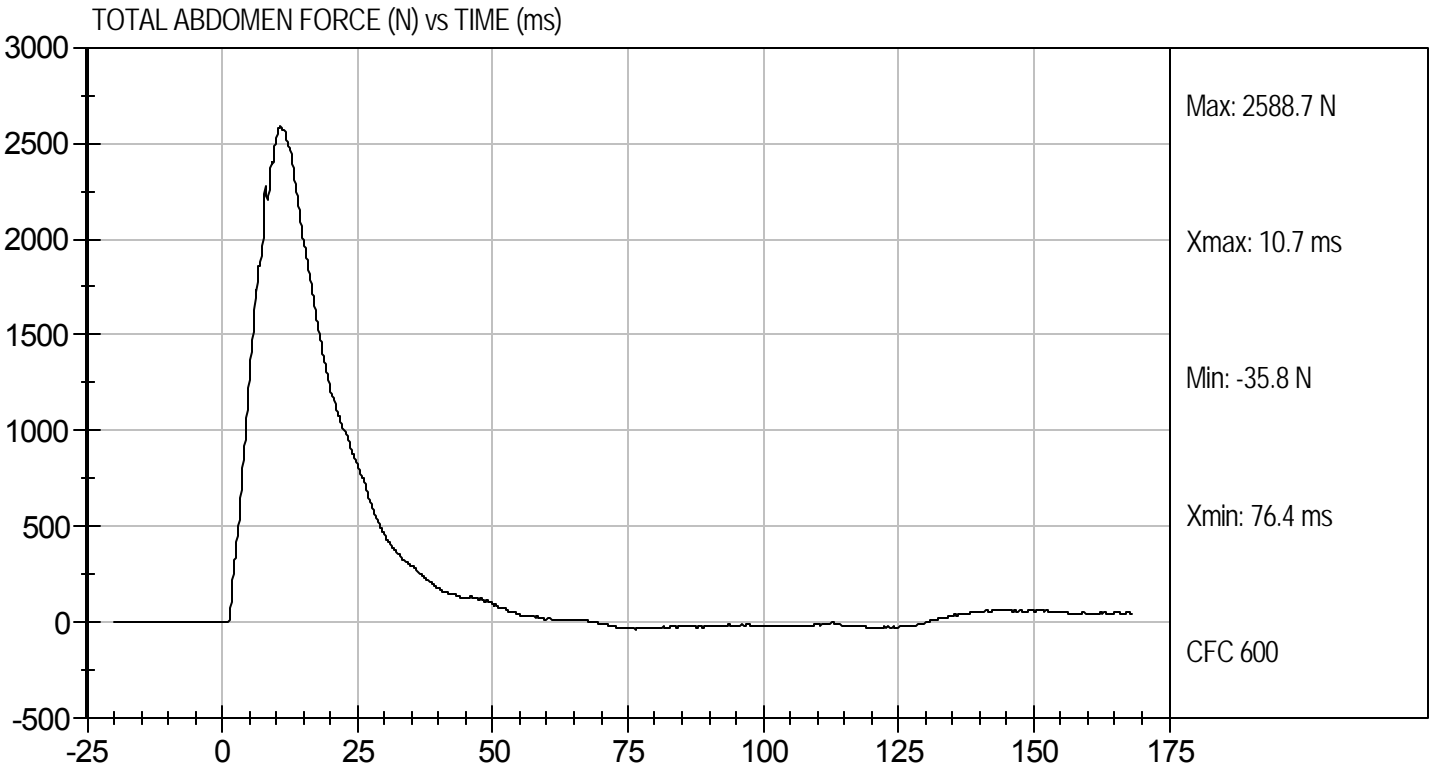
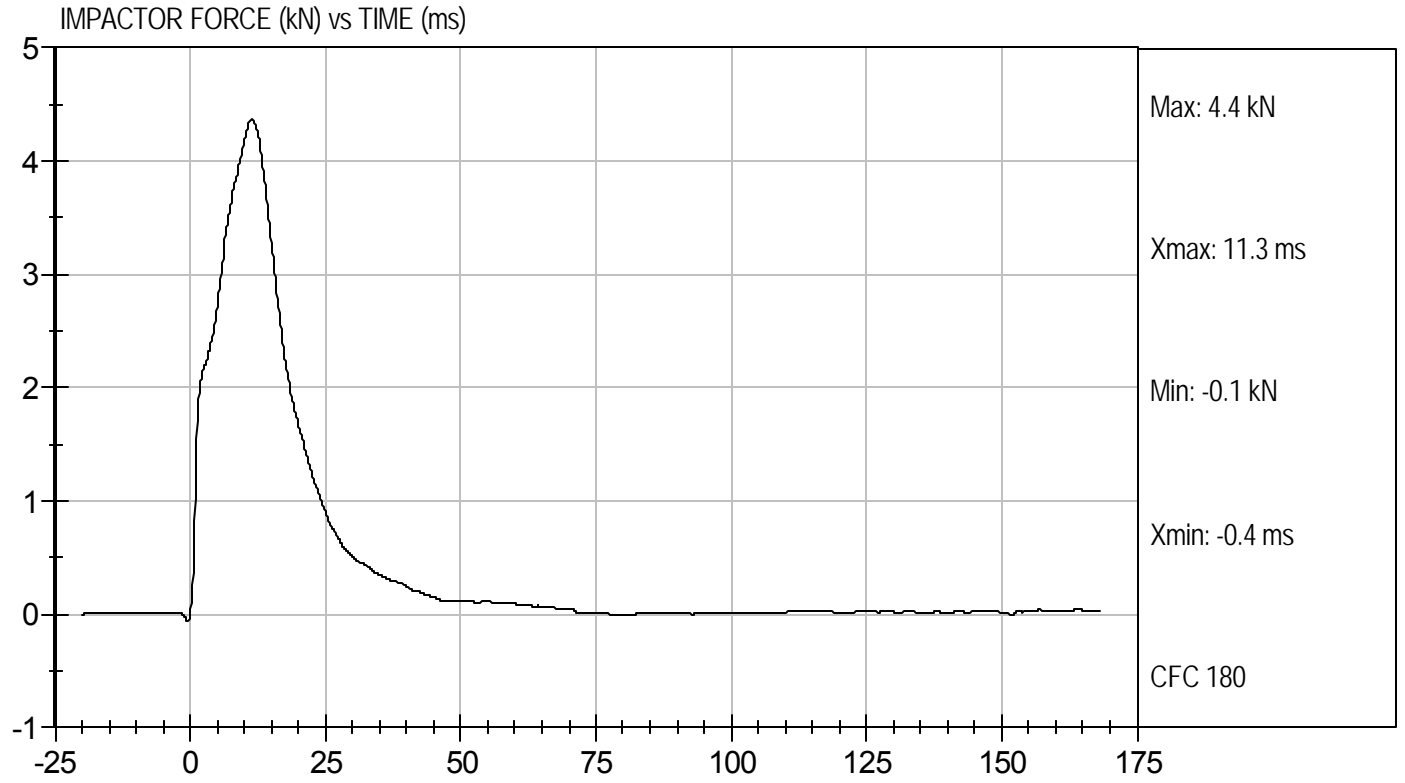
4/21/11
Test Date

David Winkelbauer
Approved By



Test Desc: Abdomen Impact
Component ID: D111507

Test Date: 4/21/11
Velocity: 13.44 ft/s, 4.1 m/s



MGA RESEARCH CORPORATION
LUMBAR SPINE TEST
ES-2re DUMMY

ATD Serial No: 016

Test I.D.: D111508

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	26	Pass
Pendulum Speed		m/s	5.95 to 6.15	6.12	Pass
Pendulum Deceleration	1 ms	m/s	-0.05 to 0.00	-0.02	Pass
	3.7 ms	m/s	-0.425 to -0.24	-0.41	Pass
	27 ms	m/s	-6.50 to -5.80	-5.81	Pass
	30 ms	m/s	>= -6.5	-6.24	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	45.1	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	44.2	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	45	Pass
Overall Results					Pass

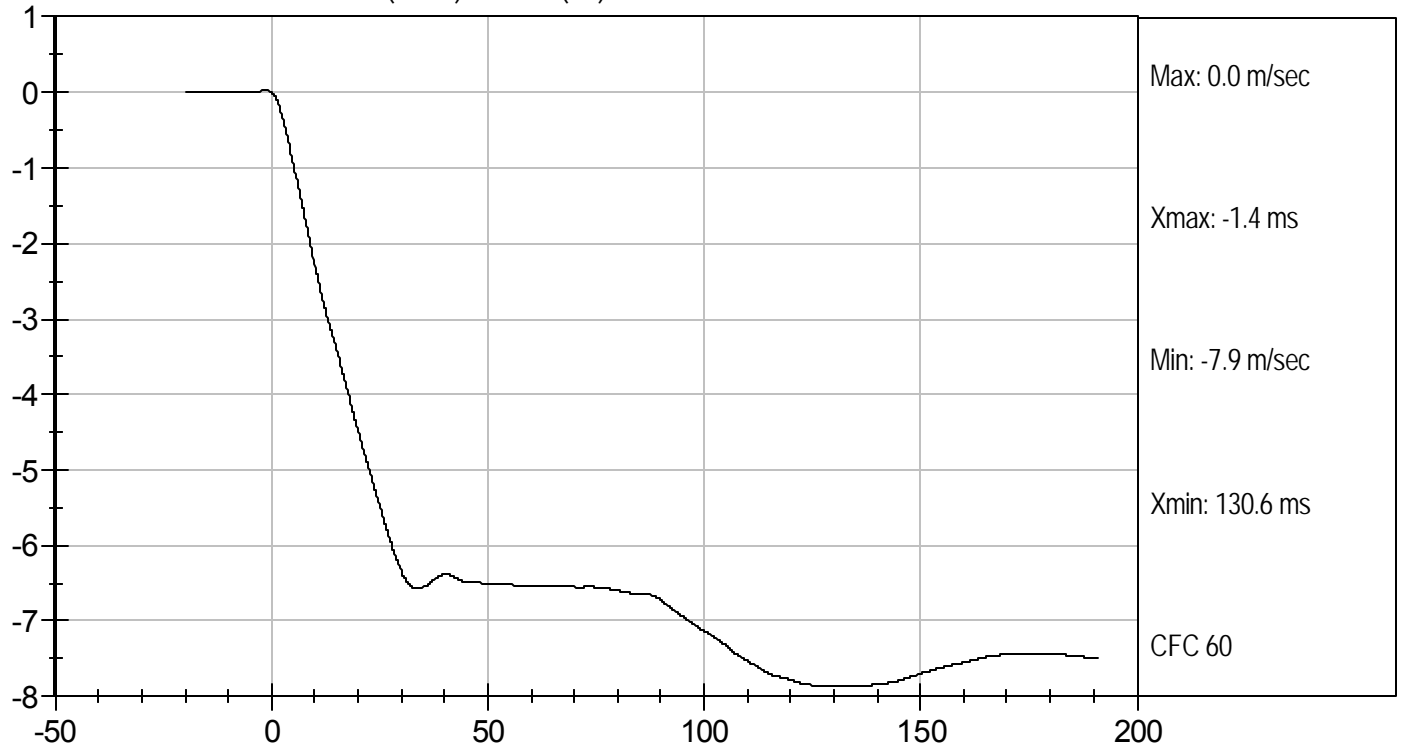
Jessica Gall
Laboratory Technician

4/21/11
Test Date

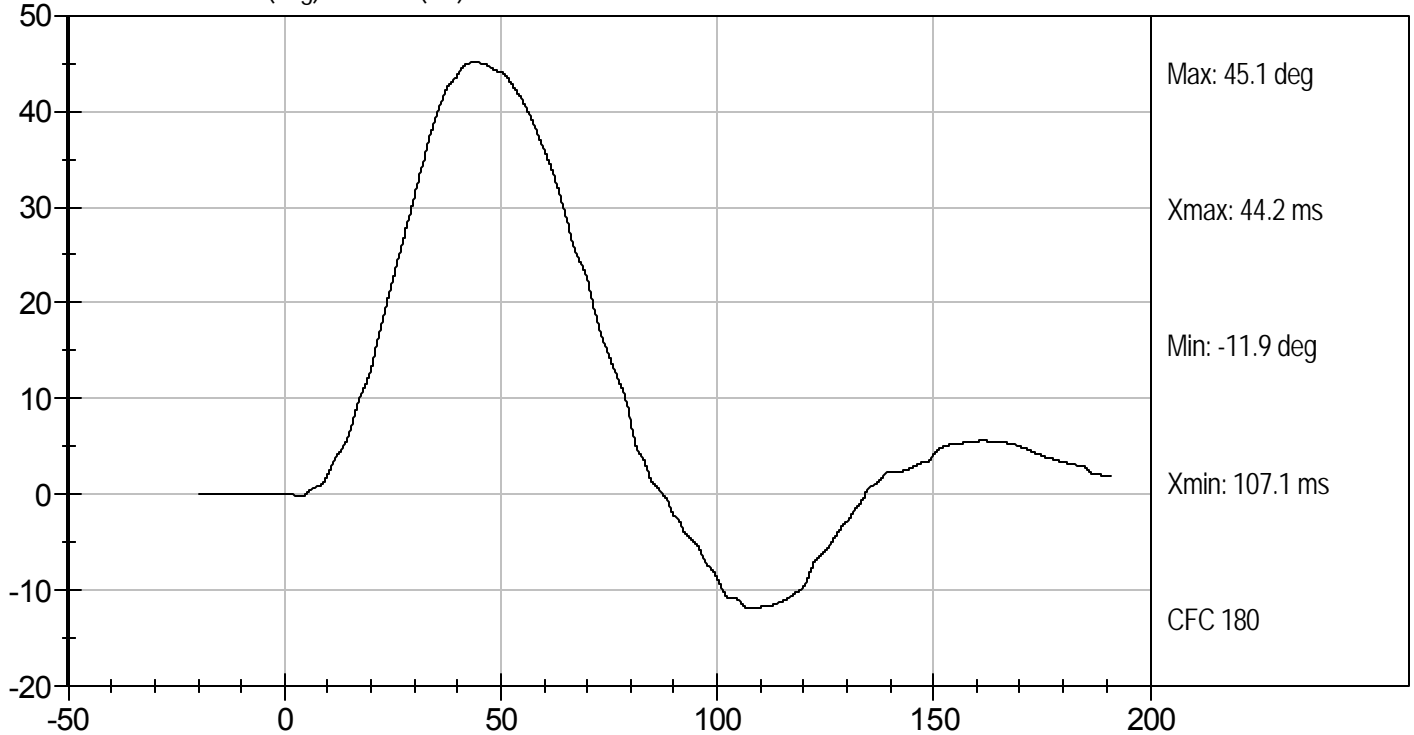
David Winkelbauer
Approved By

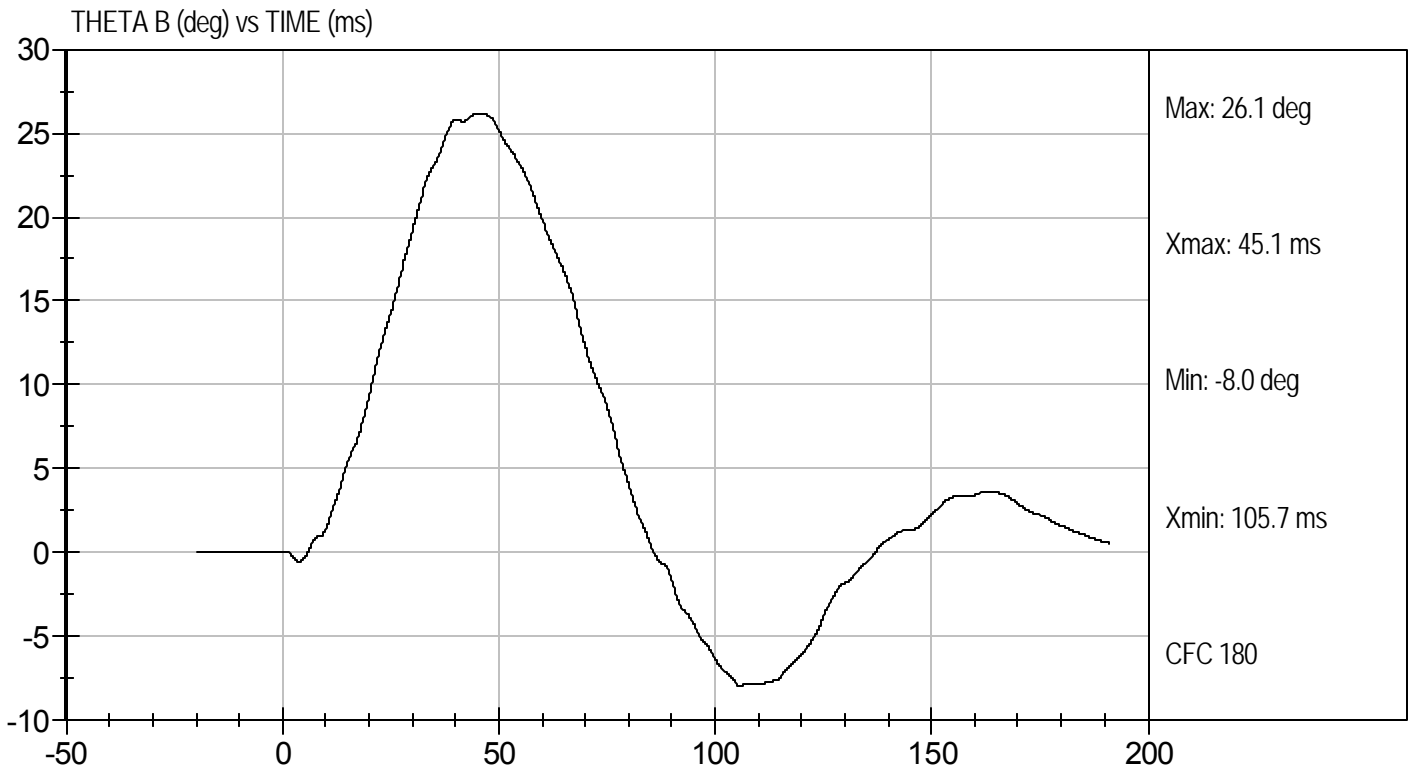
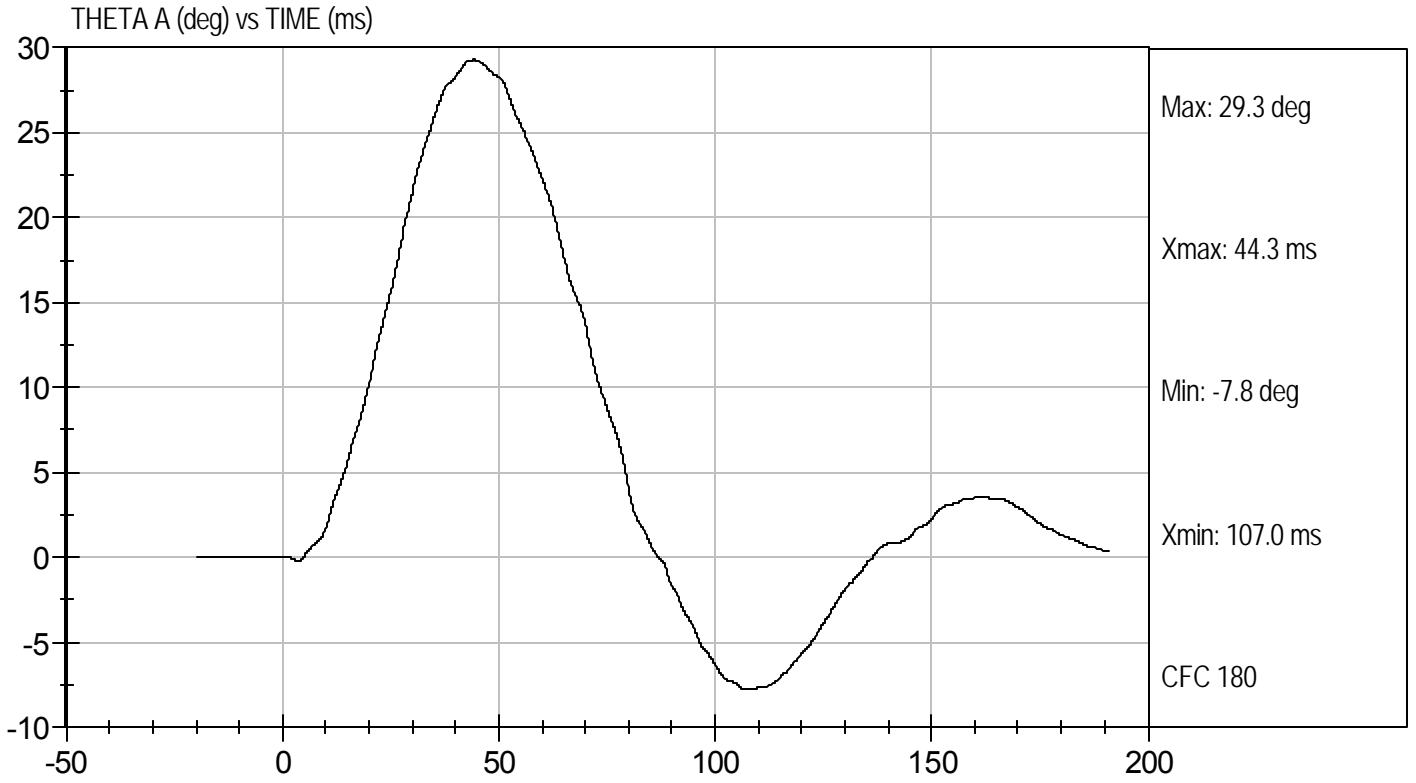


PENDULUM DECELERATION (m/sec) vs TIME (ms)



FLEXION ANGLE (deg) vs TIME (ms)





MGA RESEARCH CORPORATION

**PELVIS TEST
ES-2re DUMMY**

ATD Serial No: 016

Test I.D: D111509

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	20.7	Pass
Laboratory Relative Humidity	%	10 to 70	28	Pass
Probe Speed	m/s	4.20 to 4.40	4.34	Pass
Maximum Impactor Force	kN	4.70 to 5.40	4.79	Pass
Time of Maximum Impactor Force	ms	11.80 to 16.10	13.60	Pass
Maximum Pubic Force	kN	1.23 to 1.59	1.41	Pass
Time of Maximum Pubic Force	ms	12.20 to 17.00	15.80	Pass
Overall Test Results				Pass

Jessica Gall
Laboratory Technician

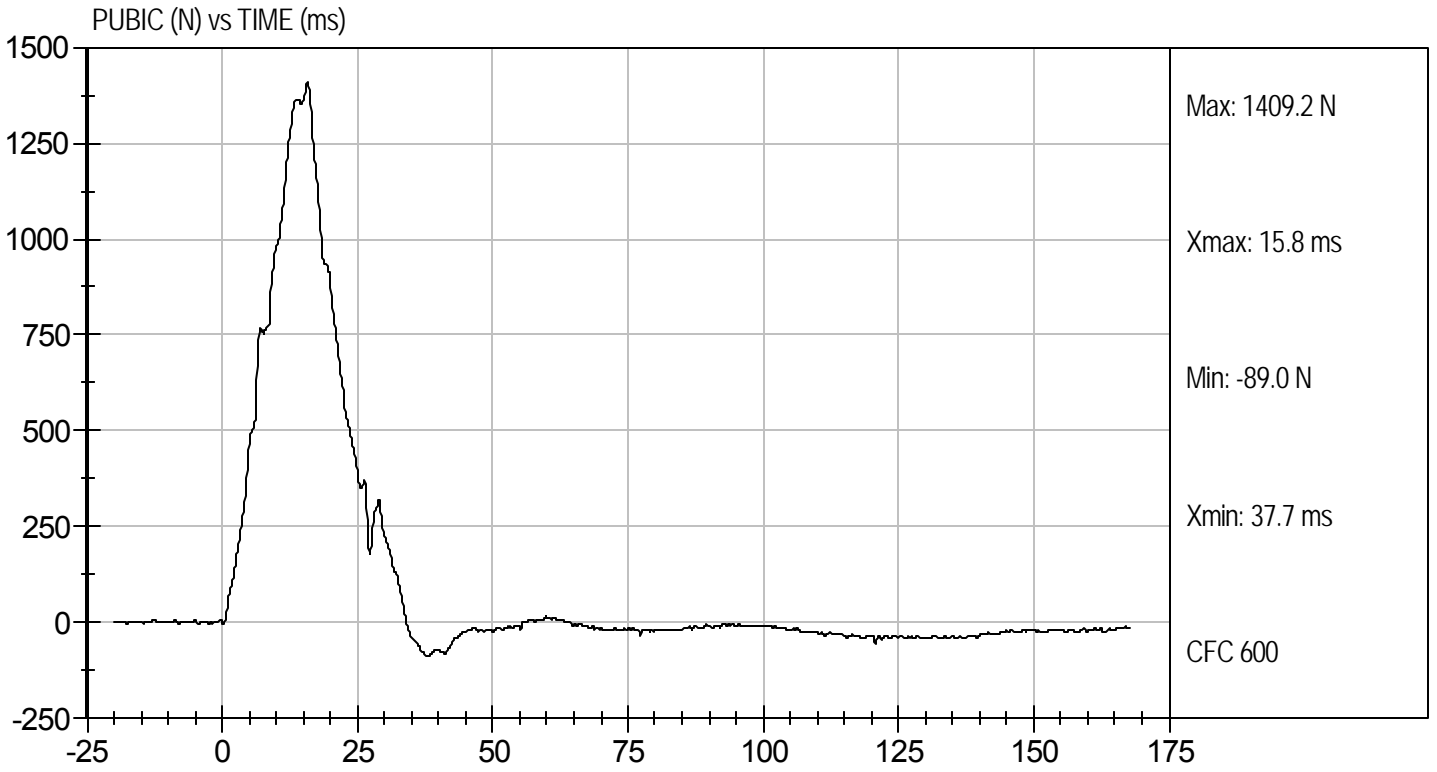
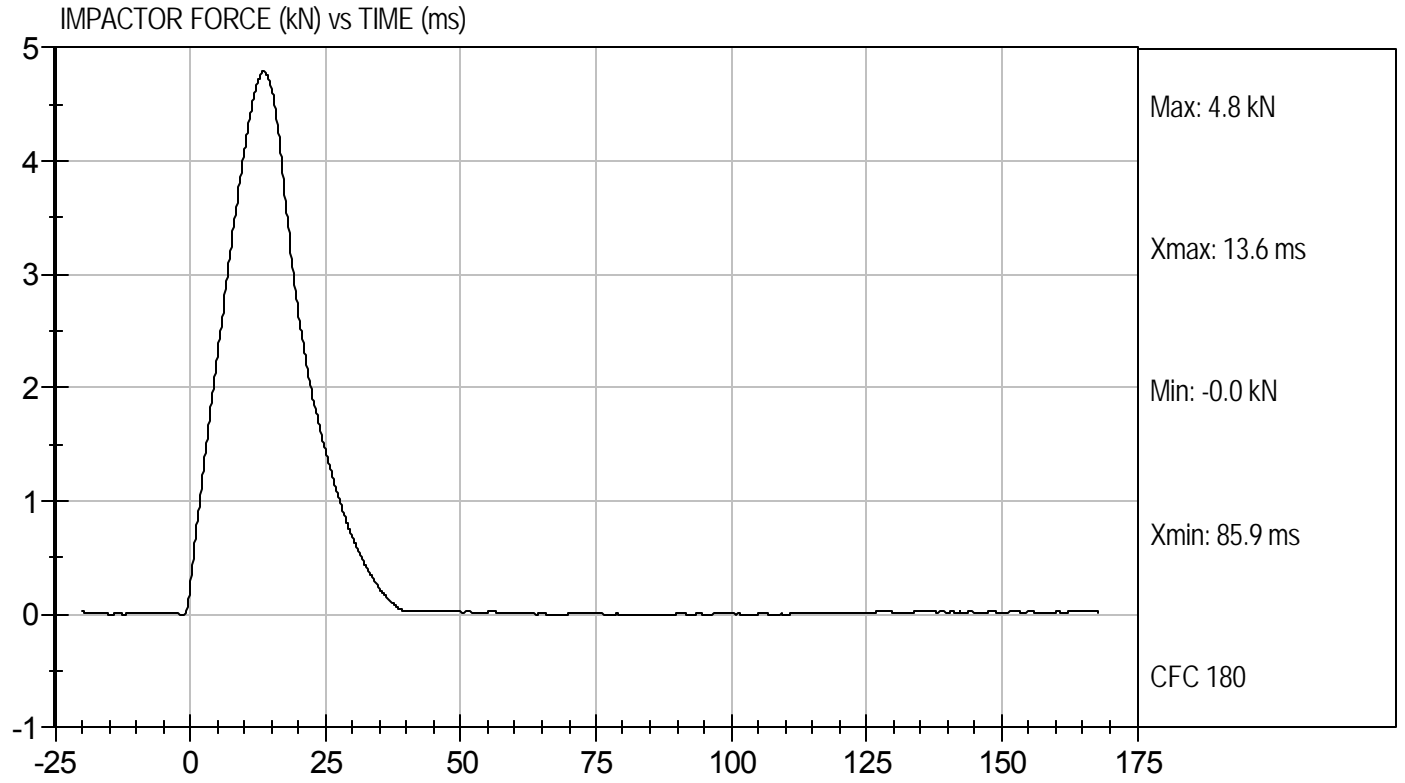
4/21/11
Test Date

David Winkelbauer
Approved By



Test Desc: Pelvis Impact
Component ID: D111509

Test Date: 4/21/11
Velocity: 14.24 ft/s, 4.34 m/s



MGA RESEARCH CORPORATION
FULL BODY THORAX IMPACT TEST
ES-2re DUMMY

ATD Serial No: 016

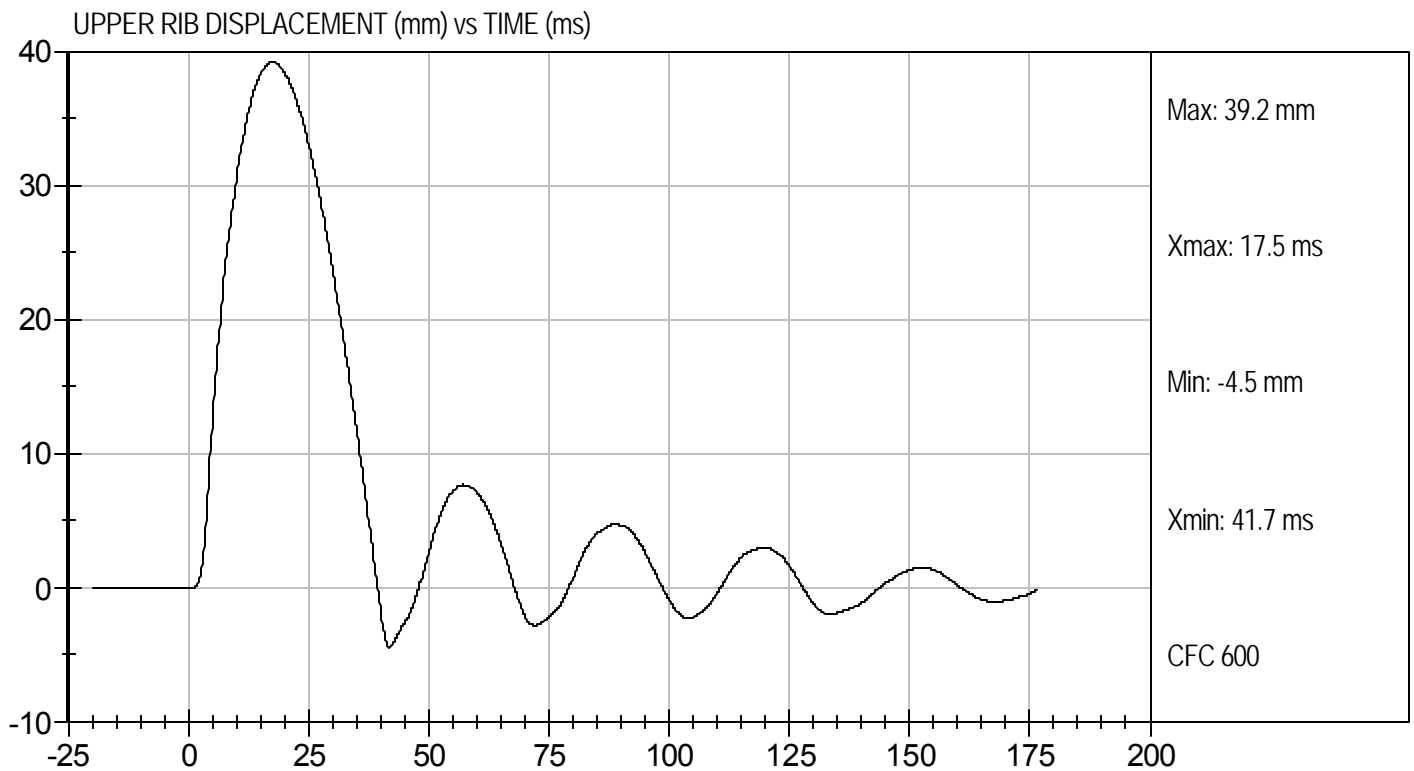
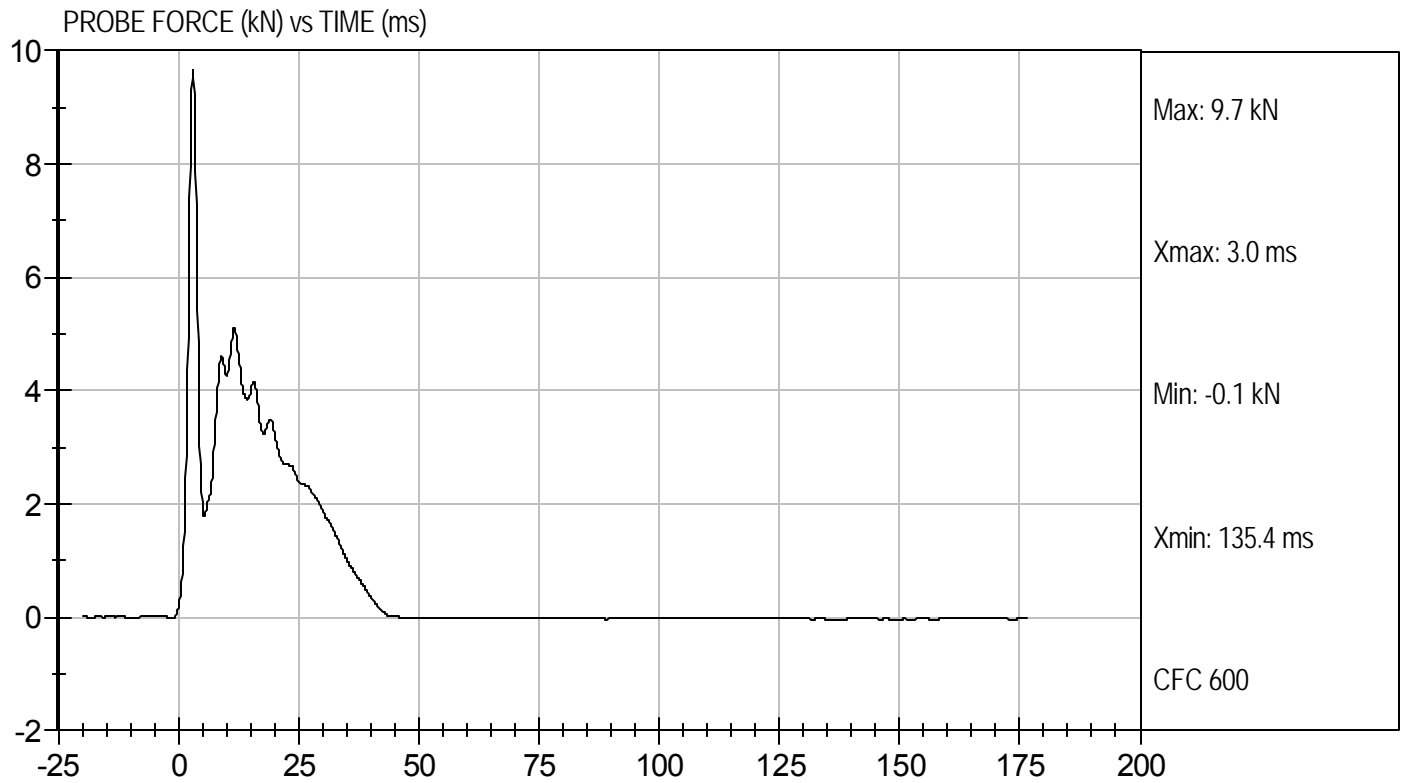
Test I.D: D111500

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	20.7	Pass
Humidity	%	10 to 70	28	Pass
Probe Speed	m/s	5.40 to 5.60	5.58	Pass
Maximum Impactor Force (after 6 ms)	kN	5.10 to 6.20	5.12	Pass
Upper Rib Displacement	mm	34.0 to 41.0	39.2	Pass
Middle Rib Displacement	mm	37.0 to 45.0	41.5	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.5	Pass
Overall Test Results				Pass

Jessica Hall
 Laboratory Technician

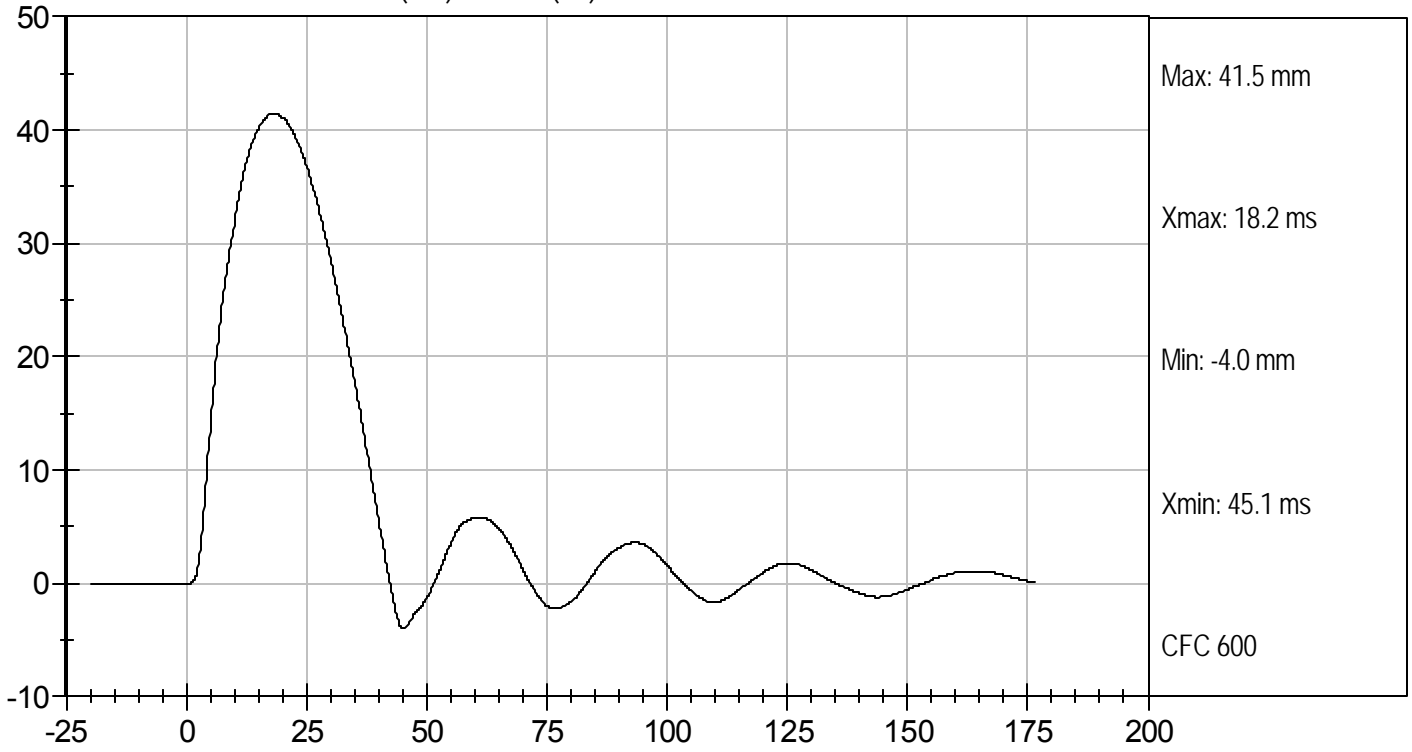
4/21/11
 Test Date

David Winkelbauer
 Approved By

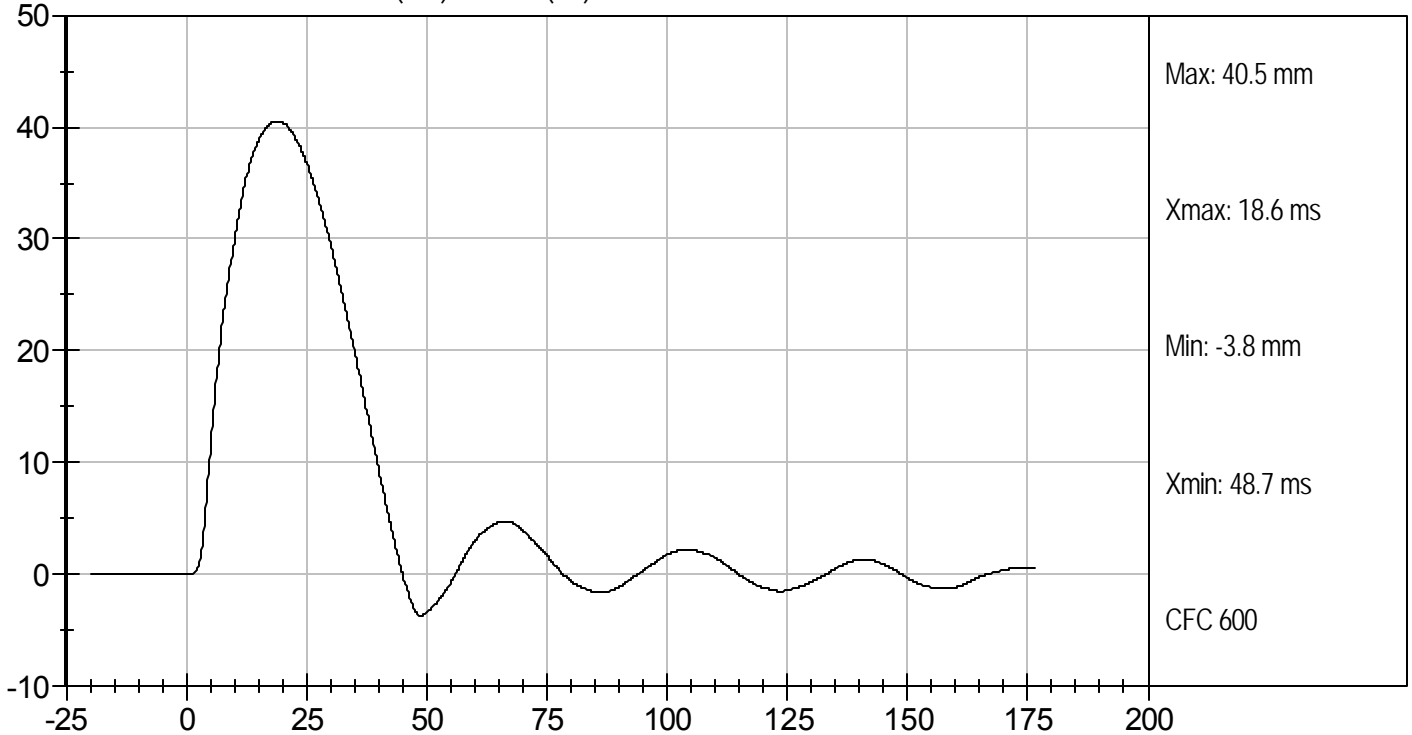




MIDDLE RIB DISPLACEMENT (mm) vs TIME (ms)



LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



APPENDIX E

TEST EQUIPMENT AND INSTRUMENTATION CALIBRATION

Table 1 – Dummy Instrumentation

		ES-2re S/N: 016		
		Serial Number	Manufacturer	Calibration Date
Head Accelerometers	X	P66854	Endevco	2/14/2011
	Y	P66855	Endevco	2/14/2011
	Z	P66856	Endevco	2/14/2011
Thorax Potentiometers	Upper Rib (Y)	G144	Honeywell	2/17/2011
	Middle Rib (Y)	G143	Honeywell	2/17/2011
	Lower Rib (Y)	G142	Honeywell	2/17/2011
Abdomen Load Cells	Forward (Y)	ABG119	FTSS	11/01/2010
	Middle (Y)	ABG120	FTSS	11/01/2010
	Rear (Y)	ABG121	FTSS	11/01/2010
Pubic Symphysis Load Cell (Y)		PG431	Denton	11/01/2010

Table 2 – Vehicle Instrumentation

	Serial Number	Manufacturer	Calibration Date
Vehicle CG (X)	P55706	Endevco	12/22/2010
Vehicle CG (Y)	P55705	Endevco	12/22/2010
Vehicle CG (Z)	P55704	Endevco	12/22/2010
Left Floor Sill (Y)	P49503	Endevco	1/13/2011
A Pillar Sill (Y)	P59350	Endevco	1/13/2011
A Pillar Low (Y)	P59287	Endevco	2/19/2011
A Pillar Mid (Y)	P49518	Endevco	12/22/2010
B Pillar Sill (Y)	P49497	Endevco	11/05/2010
B Pillar Low (Y)	P53288	Endevco	1/13/2011
B Pillar Mid (Y)	P59296	Endevco	11/05/2010
Seat (Y)	P49525	Endevco	1/13/2011
Engine (X)	P52186	Endevco	11/05/2010
Engine (Y)	P52187	Endevco	11/05/2010
Firewall (Y)	P59247	Endevco	11/05/2010
Roof (Y)	P47810	Endevco	2/19/2011
Floor Sill (Y)	P49447	Endevco	11/05/2010
Rear Deck (X)	P52281	Endevco	12/13/2010
Rear Deck (Y)	P52282	Endevco	12/13/2010