REPORT NUMBER: 214P-MGA-2012-005

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

MITSUBISHI MOTORS CORPORATION, JAPAN
2012 MITSUBISHI I-MIEV ES 5-DR HATCHBACK
NHTSA NUMBER: CC5602

PREPARED BY:
MGA RESEARCH CORPORATION
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BURLINGTON, WI 53105

Test Date: May 23, 2012

Report Date: July 11, 2012

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
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FINAL REPORT ACCEPTANCE BY OVSC:

Accepted by: James A. Jones

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Technical Report Documentation Page

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7. Author(s) Joe Fleck, Project Engineer David Winkelbauer, Project Manager		*8. Performing Organization Report No.* 214P-MGA-2012-005
9. Performing Organization Name and Address MGA Research Corporation 5000 Warren Road Burlington, WI 53105		*10. Work Unit No.* *11. Contract or Grant No.* DTNH22-07-D-00062
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15. Supplementary Notes		

16. Abstract

A 32 km/h (20 mph), 75° oblique impact compliance test was conducted on the subject 2012 Mitsubishi i-MiEV ES 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 May 23, 2012.

The impact velocity was 31.2 km/h, and the ambient temperature at the struck (driver's) side of the test vehicle at the time of impact was 21.3°C. The test vehicle post-test maximum crush was 314 mm at level 4. The test vehicle's performance follows:

Measurement Description	Units	Result
Head Injury Criteria (HIC_{36})	N/A	220
Max. Rib Deflection	mm	40
Sum of Abdomen Forces	N	1898
Pubic Symphysis Force	N	2041

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.

17. Key Words Compliance Testing Side Impact Protection Pole Test ES-2re SID-IIs		*18. Distribution Statement* 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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Form DOT F1700.7 (8-72)

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PURPOSE AND SUMMARY OF TEST

PURPOSE

This side impact test is part of the MY 2012 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 2012 Mitsubishi i-MiEV ES 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 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 31.2 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin, on May 23, 2012. 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 eleven (11) 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)		Public Symphysis (N)
ES-2re 50th Percentile Male	220	Upper	40.3	Front	497.7	2041.1
		Middle	39.3	Mid	695.2	
		Lower	34.1	Rear	769.7	
		Max.	40.3	Sum	1897.7	

GENERAL COMMENTS

There was no valid data collected for:

Left Floor Sill Y after 3ms
Left Lower A-Post Y after 17ms
Left Lower B-Post Y after 94ms

Left Mid A-Post Y is questionable from 49-53ms
Left Mid B-Post Y is questionable from 5-25ms

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: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

VEHICLE INFORMATION	
Make	Mitsubishi
Model	i-MiEV
Body Style	5-Dr Hatchback
VIN	JA3215H12CU012517
Body Color	Raspberry Metallic
Displacement/Output	49 kW
# of Cylinders	Not Applicable
Engine Placement	Lateral
Transmission Type	Single Fixed Reduction
Transmission Speeds	1
Overdrive	Not Applicable
Final Drive	Rear
Odometer Reading	117 miles

OPTIONS	
ESC	Yes
All Wheel Drive	No
Power Steering	Yes
Tilt Steering Wheel	No
Driver Side Curtain Airbag	Yes
Driver Side Torso/Pelvis Airbag	Yes
Driver Knee Bag	No
Driver Seat Belt Pretentioners	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 Pretentioners	No
Rear Pass. Seat Belt Load Limiters	No
Rear Pass. Power Seats	No
Power Windows	Yes
Air Conditioning	Yes
AM/FM/CD/MP3	Yes
Automatic Door Locks (ADL)	No
Does owner's manual provide instructions to disable ADL's?	N/A
Anti-Lock Brakes	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Mitsubishi Motors Corporation, Japan
Date of Manufacture	NOV 2011

GVWR (kg)	1510
GAWR Front (kg)	675
GAWR Rear (kg)	890

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	2		4
Capacity Weight (VCW) (kg)				300
Cargo Weight (RCLW) (kg)				28

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

TIRE PRESSURES

	Units	LF	RF	RR	LR
As Delivered	kPa	250	250	250	250
As Tested	kPa	250	250	250	250

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	273.1	319.8		308.9	355.2		301.2	344.3	
Right	kg	265.3	317.5		276.2	340.2		283.5	345.2	
Ratio	%	45.8	54.2		45.2	54.3		45.9	54.1	
Totals	kg	538.4	637.3	1175.7	585.1	695.4	1280.5	584.7	689.5	1274.2

TEST VEHICLE TARGET WEIGHT (TVTW) CALCULATION

Measured Parameter	Units	Value
As Delivered Weight	kg	1175.7
Weight of 1 P572U ATD (ES-2re) Dummy	kg	77.1
Rated Cargo/Luggage Weight (RCLW)	kg	28
Calculated Target Vehicle Test Weight (TVTW)	kg	1280.8

TEST VEHICLE ATTITUDES

	Units	LF	RF	RR	LR
Fully Loaded	mm	612	625	641	647
As Tested	mm	625	625	646	650
Difference	mm	-13	0	-5	-3

CALCULATION OF THE VERTICAL IMPACT REFERENCE LINE

Measurement Parameter	Units	Value
Test Vehicle Wheel Base	mm	2552
Vertical Impact Reference Line (Aft of Front Axle)	mm	1160

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

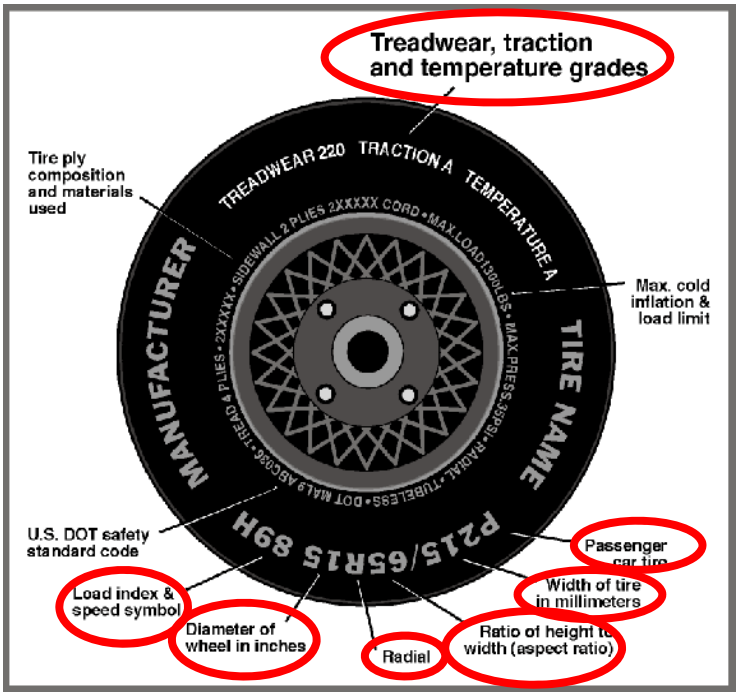
Description of Component	Weight (kg)
Ballast	0
Right/left tail lights, front/rear bumper covers, both rear windows/motors/door trim, both headlights, hood, rear bumper foam, right side mirror, both rear and left front headrests, rear windshield wiper and motor, front windshield wipers, rear seat bench cushion.	44.5

DATA SHEET NO. 3

VEHICLE TIRE INFORMATION

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

VEHICLE TIRE INFORMATION



Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	250	250
Recommended Tire Size	P145/65R15	P175/60R15
Tire Size on Vehicle	P145/65R15	P175/60R15
Tire Manufacturer	Dunlop	Dunlop
Tire Name	ENASAVE	ENASAVE
Tire Type	Passenger	Passenger
Tire Width	145	175
Aspect Ratio	65	60
Radial	Yes	Yes
Wheel Diameter	15	15
Load Index/Speed Symbol	72H	81H
Treadwear	340	340
Traction Grade	A	A
Temperature Grade	A	A

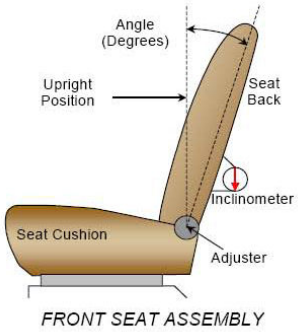
DATA SHEET NO. 4

SEAT AND SEAT BELT ADJUSTMENT DATA

Test Vehicle:	2012 Mitsubishi i-MiEV ES 5-Dr Hatchback	NHTSA No.	CC5602
Test Program:	FMVSS 214 Pole	Test Date:	5/23/2012

NORMAL DESIGN RIDING POSITION

The driver seat was manually adjustable fore and aft, with a manual angle adjustment. The seat 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.



FRONT SEAT ASSEMBLY

SEAT BACK ANGLE

	Degrees	Detents
Driver with Seated Dummy	7.6° at headrest post	5th detent (1st as 0)

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	22 detents (1st as 0)	11th 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. Set in 1st step (uppermost as 0).

SEAT BELT UPPER ANCHORAGE

	Total # of Positions	Placed in Position #
Driver Seat	4 total (1st as 1)	1st detent (1st as 0)

HEADREST RESTRAINT

The headrest was placed in the full up position.

DATA SHEET NO. 5

FUEL SYSTEMS AND STEERING WHEEL POSITION DATA

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

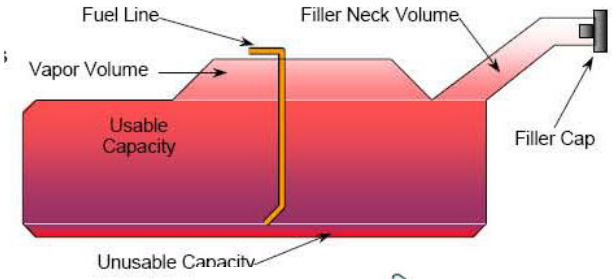
FUEL TANK CAPACITY

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

FUEL PUMP

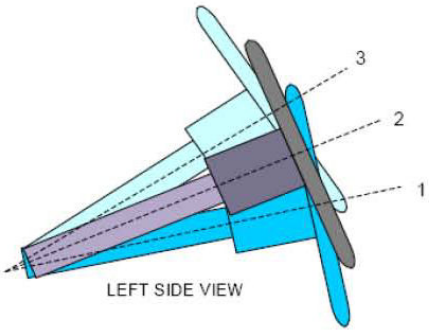
Describe the fuel pump type, its behavior, and the location of the fuel filler pipe.

Not Applicable



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

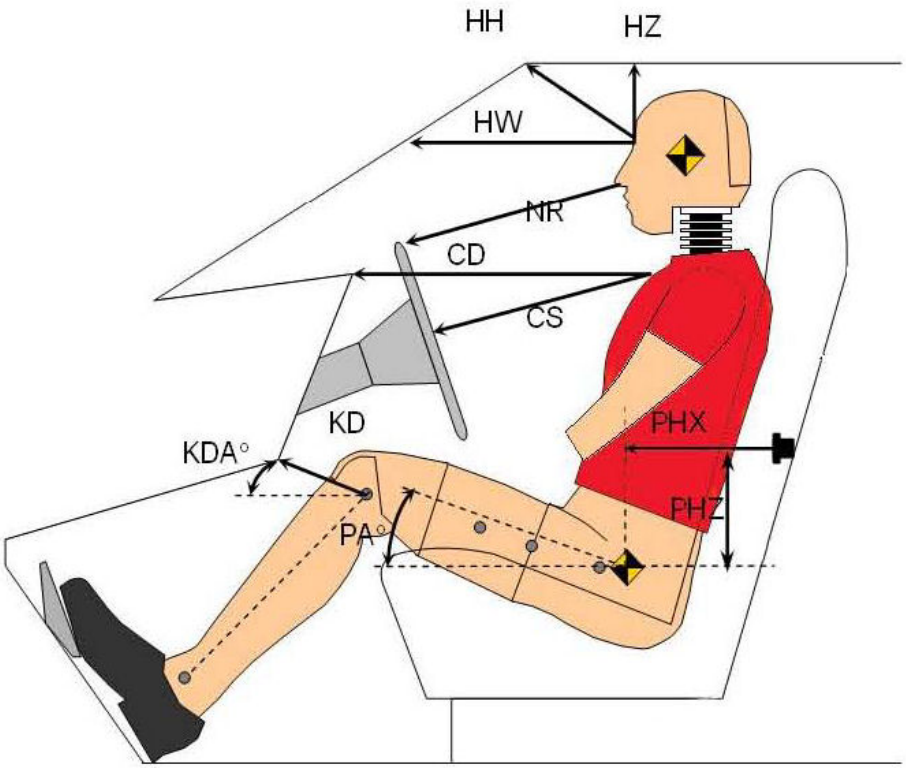
STEERING COLUMN POSITIONING

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1		
Geometric Center – Position 2		
Uppermost – Position 3		
Telescoping Steering Wheel Travel		
Test Position		

.**DATA SHEET NO. 6**

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

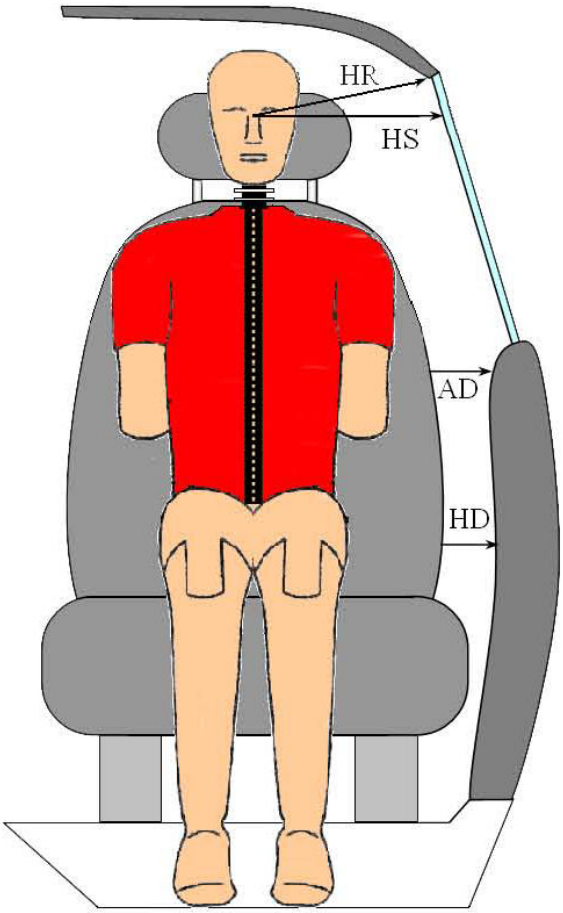


Driver Code	Measurement Description	Length (mm)	Angle (°)
HH	Head to Header	357	
HW	Head to Windshield	591	
HZ	Head to Roof	150	
NR	Nose to Rim	418	
CD	Chest to Dash	540	
CS	Chest to Steering Wheel	306	
KDL	Left Knee to Dash	115	23.8
KDR	Right Knee to Dash	96	20.6
PA	Pelvis Angle X		23.7
	Torso Angle Y		-0.3
PHX	H-Point to Striker (X-Axis)	230	
PHZ	H-Point to Striker (Z-Axis)	85	

DATA SHEET NO. 7

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

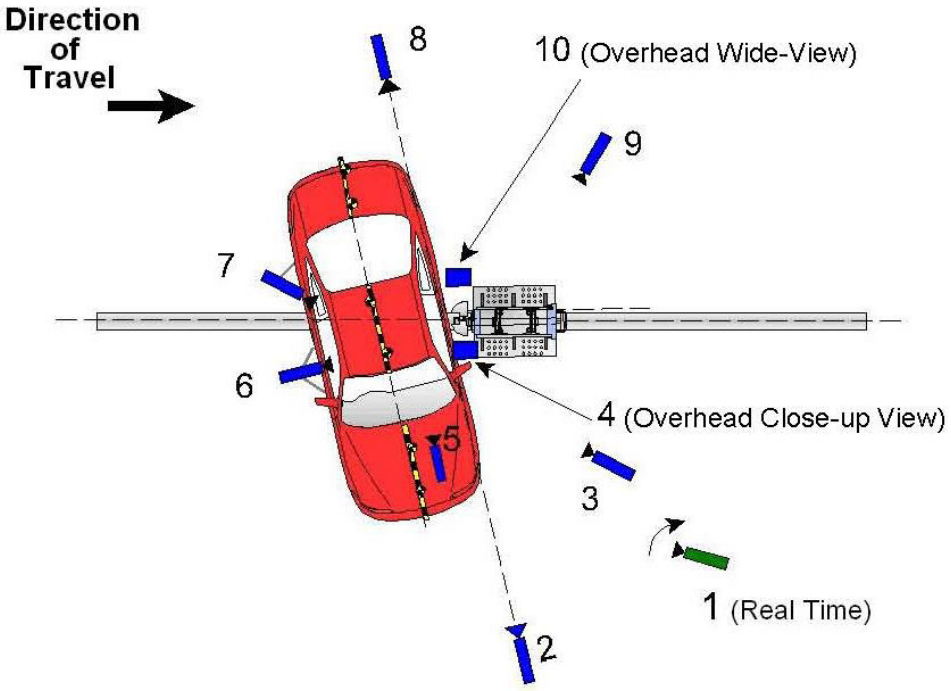


Code	Measurement Description	Units	Front Occupant
HR	Head to Side Header	mm	261
HS	Head to Side Window	mm	374
AD	Arm to Door	mm	120
HD	H-Point to Door	mm	154

DATA SHEET NO. 8

HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012



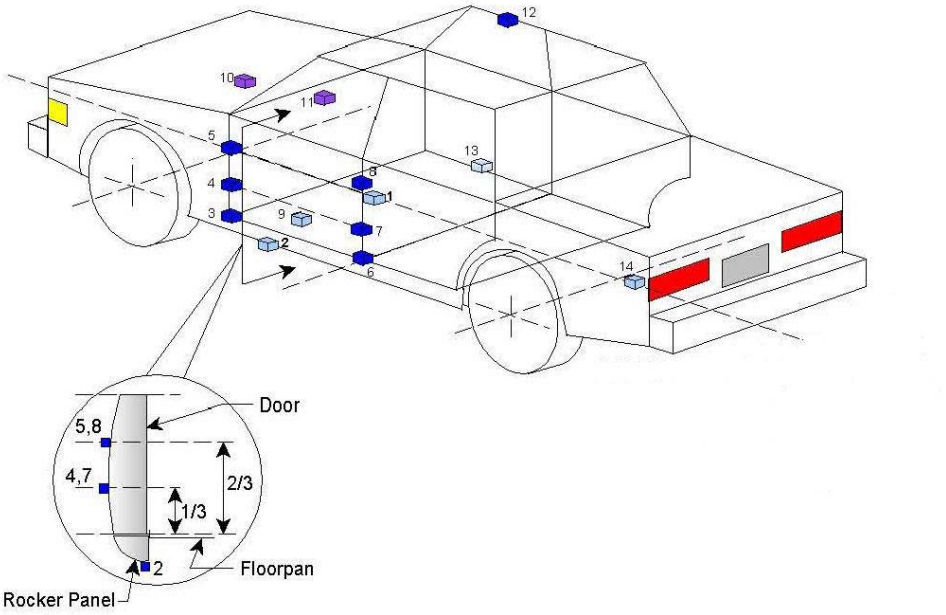
Reference: From Point of Impact for X and Y; from Ground for Z):
+X = Right of Impact, + Y = Forward of Impact, +Z = Up

Camera No.	View	Coordinates (mm)			Lens (mm)	Film Speed (fps)
		X	Y	Z		
1	Real-Time					30
2	Front Ground Level	5660	90	1830	24	1000
3	Impact Side 45° Forward	4920	2410	1930	20	1000
4	Overhead Closeup	0	-150	4420	50	1000
5	Onboard – Driver Front				16	1000
6	Onboard – Driver Side				8	1000
7	Onboard – Driver Rear				8	1000
8	Rear Ground Level	-5740	110	1820	24	1000
9	Impact Side 45° Rearward	-4040	3980	1940	20	1000
10	Overhead Wide	290	-310	4610	14	1000

DATA SHEET NO. 9

TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012



Loc. No.	Accelerometer Location			
	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	1473	0	-485
2	Left Floor Sill	1939	-659	-235
3	A Pillar Sill	2481	-656	-232
4	A Pillar Low	2583	-731	-540
5	A Pillar Mid	2576	-731	-784
6	B Pillar Sill	1573	-659	-240
7	B Pillar Low	1519	-660	-570
8	B Pillar Mid	1552	-636	-855
9	Driver Seat Track	1818	-470	-453
10	Top of Engine	571	138	-484
11	Firewall	3170	-30	-901
12	Right Roof	1497	615	-1567
13	Right Sill	1854	659	-242
14	Floorpan @ Rear Axle	167	0	-721

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: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

Loc. No.	Description	Peak Values (g's)			
		Max	Time (ms)	Min	Time (ms)
1	Vehicle CG (X)	7.6	19.2	-19.2	48.6
	Vehicle CG (Y)	28.1	51.0	-1.6	154.3
	Vehicle CG (Z)	14.5	30.4	-37.9	51.4
	Resultant	49.1	51.3		
2	Left Floor Sill (Y)	(1)	(1)	(1)	(1)
3	A Pillar Sill (Y)	17.3	51.4	-0.9	163.3
4	A Pillar Low (Y)	(2)	(2)	(2)	(2)
5	A Pillar Mid (Y)	(3)	(3)	(3)	(3)
6	B Pillar Sill (Y)	44.0	20.8	-11.8	25.1
7	B Pillar Low (Y)	(4)	(4)	(4)	(4)
8	B Pillar Mid (Y)	(5)	(5)	(5)	(5)
9	Driver Seat Track (Y)	52.6	34.1	-12.9	41.0
10	Top of Engine (X)	4.5	30.9	-10.1	68.7
	Top of Engine (Y)	16.7	75.8	-4.2	120.9
11	Firewall (Y)	20.6	78.1	-0.8	4.6
12	Right Roof (Y)	20.7	21.3	-10.1	59.5
13	Right Sill (Y)	21.3	57.1	-1.0	180.5
14	Floorpan @ Rear Axle (X)	2.4	25.1	-7.5	59.0
	Floorpan @ Rear Axle (Y)	15.1	60.4	-1.3	171.7

(1) No valid data collected after 3ms
(2) No valid data collected after 17ms
(3) Questionable data from 49-53ms
(4) No valid data collected after 94ms
(5) Questionable data from 5-25ms

DATA SHEET NO. 11

DUMMY INJURY RESPONSE DATA

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

Dummy S/N 016	Positive		Negative	
	MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (G)				
Longitudinal (X)	7.4	87.1	14.2	53.6
Lateral (Y)	42.9	44.6	14.8	86.2
Vertical (Z)	9.0	37.0	4.2	102.7
Resultant (R)	44.3	44.5		
HIC36 (t1, t2)	220		t1 = 36.8	t2 = 66.1
THORAX DEFLECTION (mm)				
Upper Rib			40.3	55.8
Middle Rib			39.3	53.8
Lower Rib			34.1	54.4
ABDOMINAL FORCES (N)				
Upper	497.7	47.0		
Middle	695.2	51.5		
Rear	769.7	47.8		
Sum	1897.7	47.1		
PELVIS FORCE (N)				
Pubic Symphysis			2041.1	61.5

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

DATA SHEET NO. 12

POST TEST OBSERVATIONS

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

TEST DUMMY INFORMATION AND CONTACT

Description	Front Occupant
Dummy Type / Serial No.	ES-2re / 016
Head Contact	Curtain Airbag, Headrest, Headliner
Upper Torso Contact	Side Airbag
Lower Torso Contact	Side Airbag
Left Knee Contact	Door Panel
Right Knee Contact	None

POST TEST DOOR OPENING AND SEAT TRACK INFORMATION

Description	Front	Rear
Left Side Doors	Remained closed and jammed shut	Remained closed and operational
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 Broke
Other Notable Effects	None

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

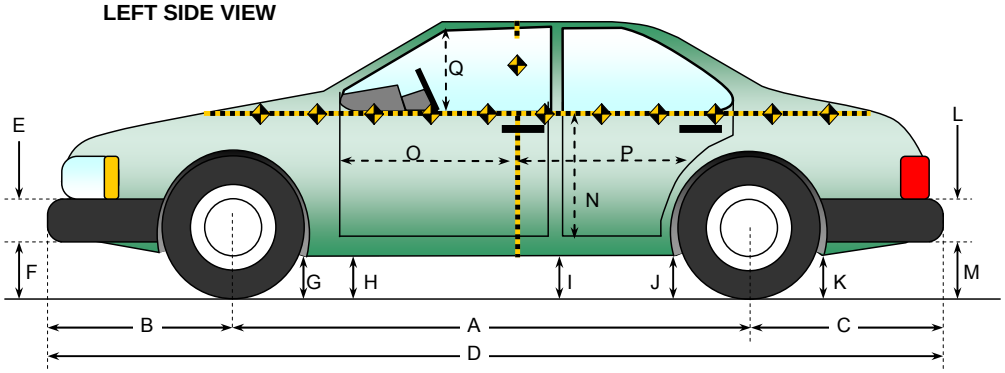
Restraint Type	Front Occupant	
	Installed	Operated
Frontal Airbag	Yes	No
Side Torso/Abdomen/Pelvis Airbag	Yes	Yes
Head Airbag	No	
Curtain Airbag	Yes	Yes
Knee Airbag	No	
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	

DATA SHEET NO. 13

VEHICLE PRE TEST AND POST TEST MEASUREMENTS

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

LEFT SIDE VIEW

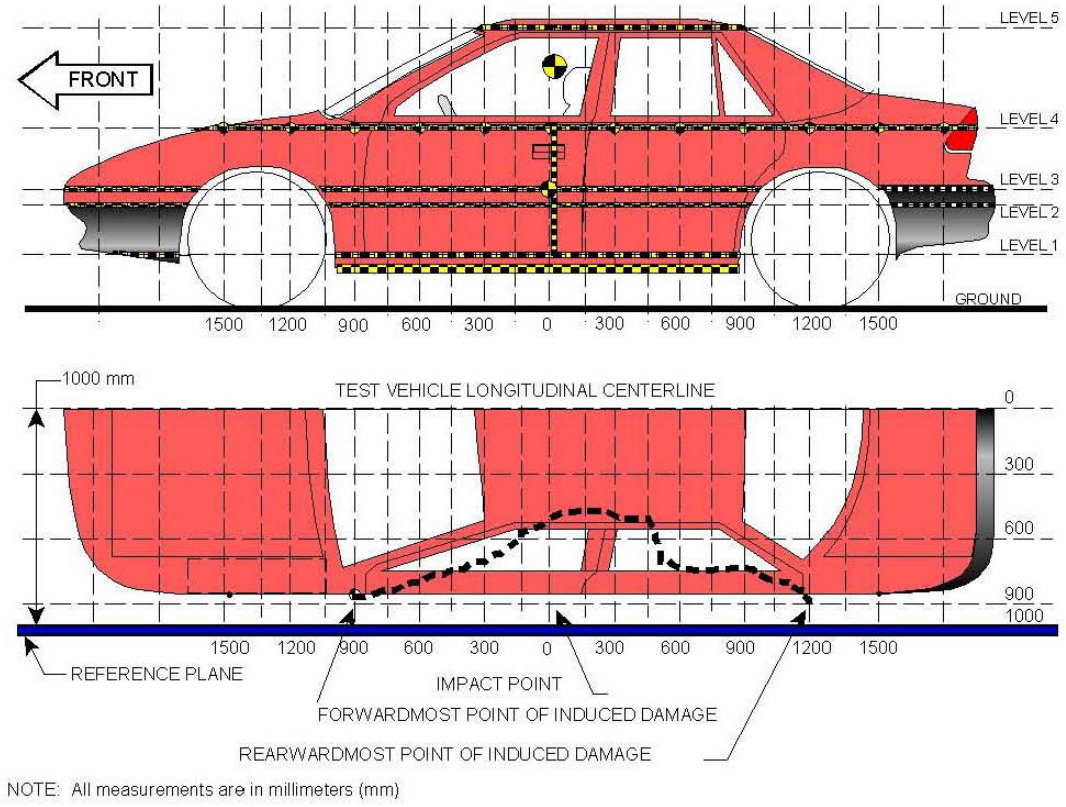


Code	Measurement Description	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	Wheelbase	2552	2520	32
B	Front Axle to FSOV	545	545	0
C	Rear Axle to RSOV	552	552	0
D	Total Vehicle Length at Centerline	3649	3617	32
E	Front Bumper Thickness	180	180	0
F	Front Bumper Bottom to Ground	373	404	-31
G	Sill Height at Front Wheel Well	215	216	-1
H	Sill Height at Front Door Leading Edge	221	221	0
I	Sill Height at B Pillar	227	220	7
J1	Sill Height at Rear Wheel Well	232	235	-3
J2	Pinch Weld Height at Rear Wheel Well	237	235	2
K	Sill Height Aft of Rear Wheel Well	326	377	-51
L	Rear Bumper Thickness	160	160	0
M	Rear Bumper Bottom to Ground	330	341	-11
N	Sill Height to Window Bottom Sill	697	703	-6
O	Front Door Leading Edge to Impact CL	767	766	1
P	Rear Door Trailing Edge to Impact CL	1097	1090	7
Q	Front Window Opening	437	430	7
R	Right Side Length	3060	3088	-28
S	Left Side Length	3060	2955	105
T	Vehicle Width at B Post	1585	1451	134

DATA SHEET NO. 14

EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012



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	236	75	275
2	Mid-Door	299	75	642
3	Occupant H-Point	303	75	666
4	Window Sill	314	75	835
5	Window Top	201	0	1505

DATA SHEET NO. 15

VEHICLE EXTERIOR CRUSH PROFILES

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

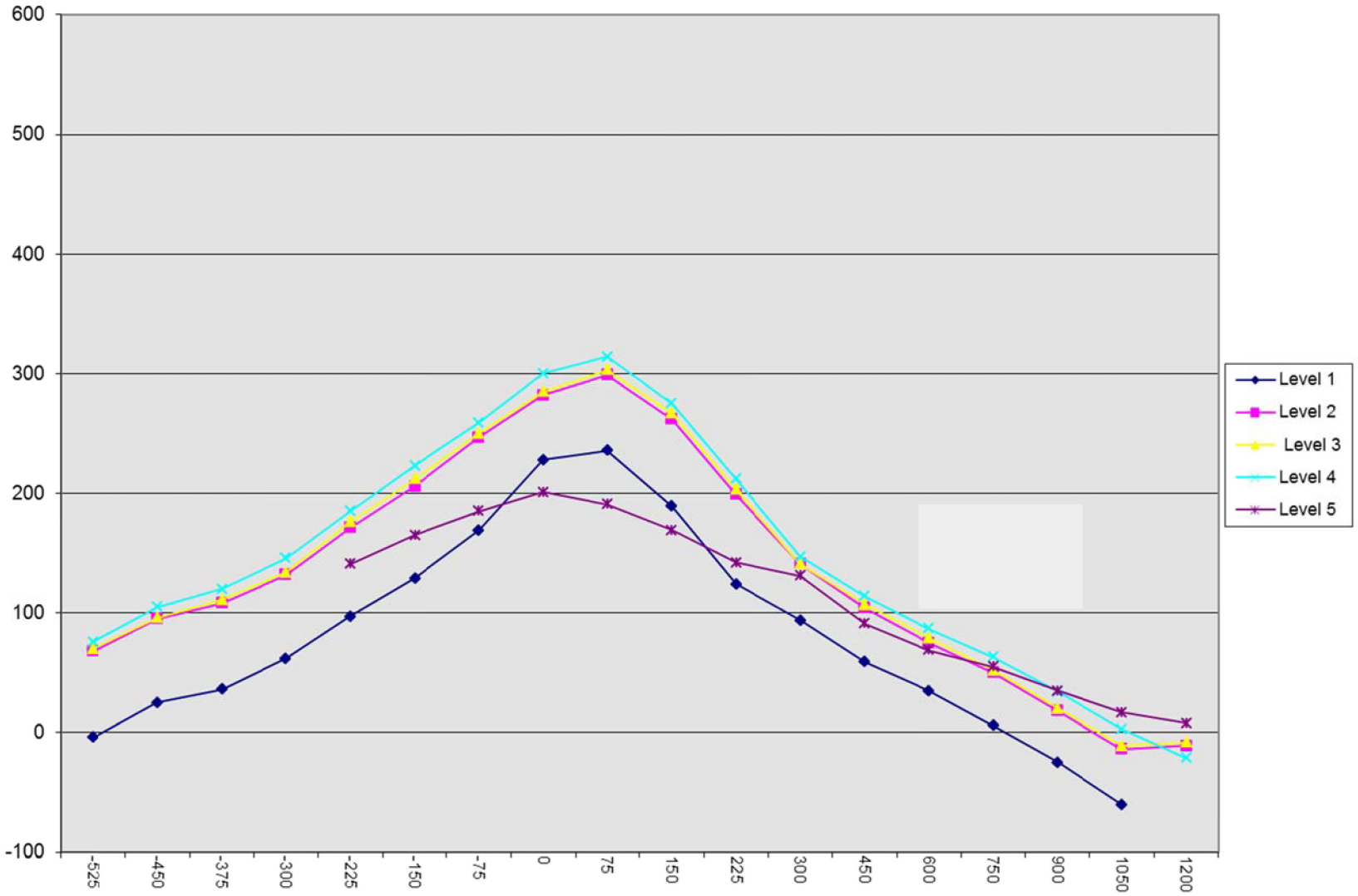
	Level 1	Level 2	Level 3	Level 4	Level 5
Maximum Crush (mm)	236	299	303	314	201
Distance From Impact (mm)	75	75	75	75	0

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-525	360	321	320	326		356	389	390	402		-4	68	70	76	
-450	355	319	318	323		380	414	414	428		25	95	96	105	
-375	349	317	317	318		385	425	428	438		36	108	111	120	
-300	342	316	315	315		404	448	449	461		62	132	134	146	
-225	339	315	313	313	501	436	486	489	498	642	97	171	176	185	141
-150	333	314	312	312	491	462	520	524	535	656	129	206	212	223	165
-75	329	314	312	311	478	498	561	562	570	663	169	247	250	259	185
0	323	313	311	310	468	551	595	596	610	669	228	282	285	300	201
75	322	313	311	310	461	558	612	614	624	652	236	299	303	314	191
150	324	314	311	310	455	513	576	578	585	624	189	262	267	275	169
225	323	314	312	309	453	447	513	515	521	595	124	199	203	212	142
300	324	316	314	310	446	418	457	455	457	577	94	141	141	147	131
450	325	320	316	312	444	384	424	423	426	535	59	104	107	114	91
600	326	325	321	315	445	361	400	400	402	514	35	75	79	87	69
750	331	331	328	320	451	337	381	380	383	506	6	50	52	63	55
900	335	340	336	325	459	310	358	356	359	494	-25	18	20	34	35
1050	338	350	346	335	471	278	336	335	338	488	-60	-14	-11	3	17
1200		316	319	345	491		305	311	324	499		-11	-8	-21	8

DATA SHEET NO. 15 (CONTINUED)

VEHICLE EXTERIOR CRUSH PROFILES

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

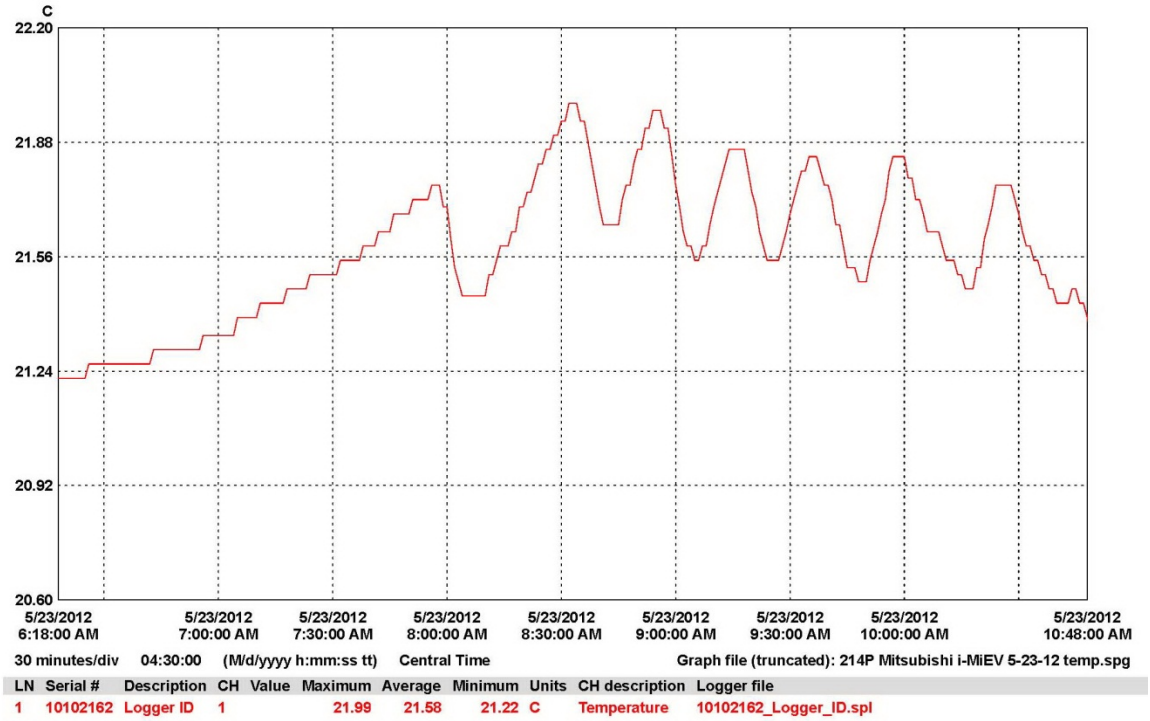


DATA SHEET NO. 16

TEMPERATURE AND HUMIDITY TRACES

Test Vehicle: 2012 Mitsubishi i-MiEV ES 5-Dr Hatchback NHTSA No. CC5602
Test Program: FMVSS 214 Pole Test Date: 5/23/2012

Time of Impact: 10:48 am

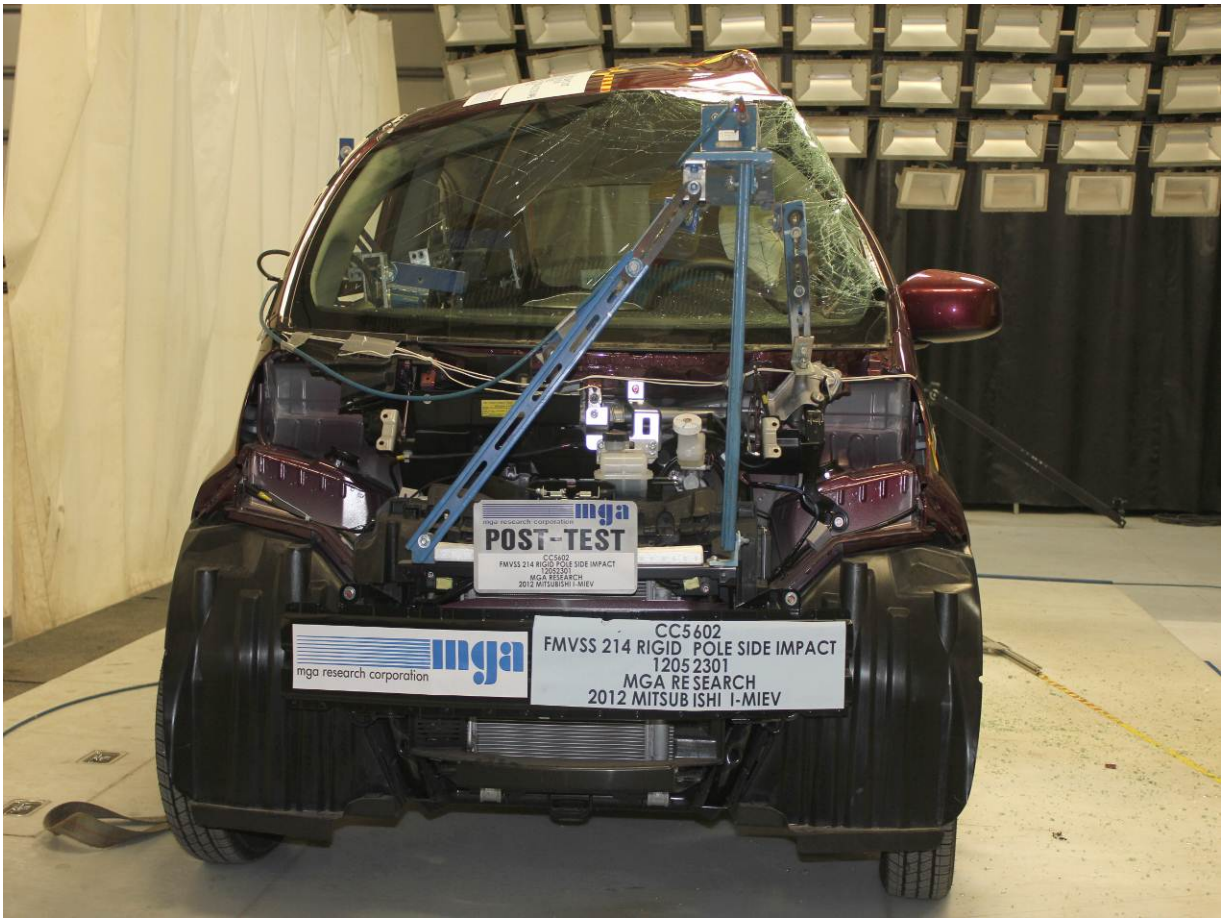


APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

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

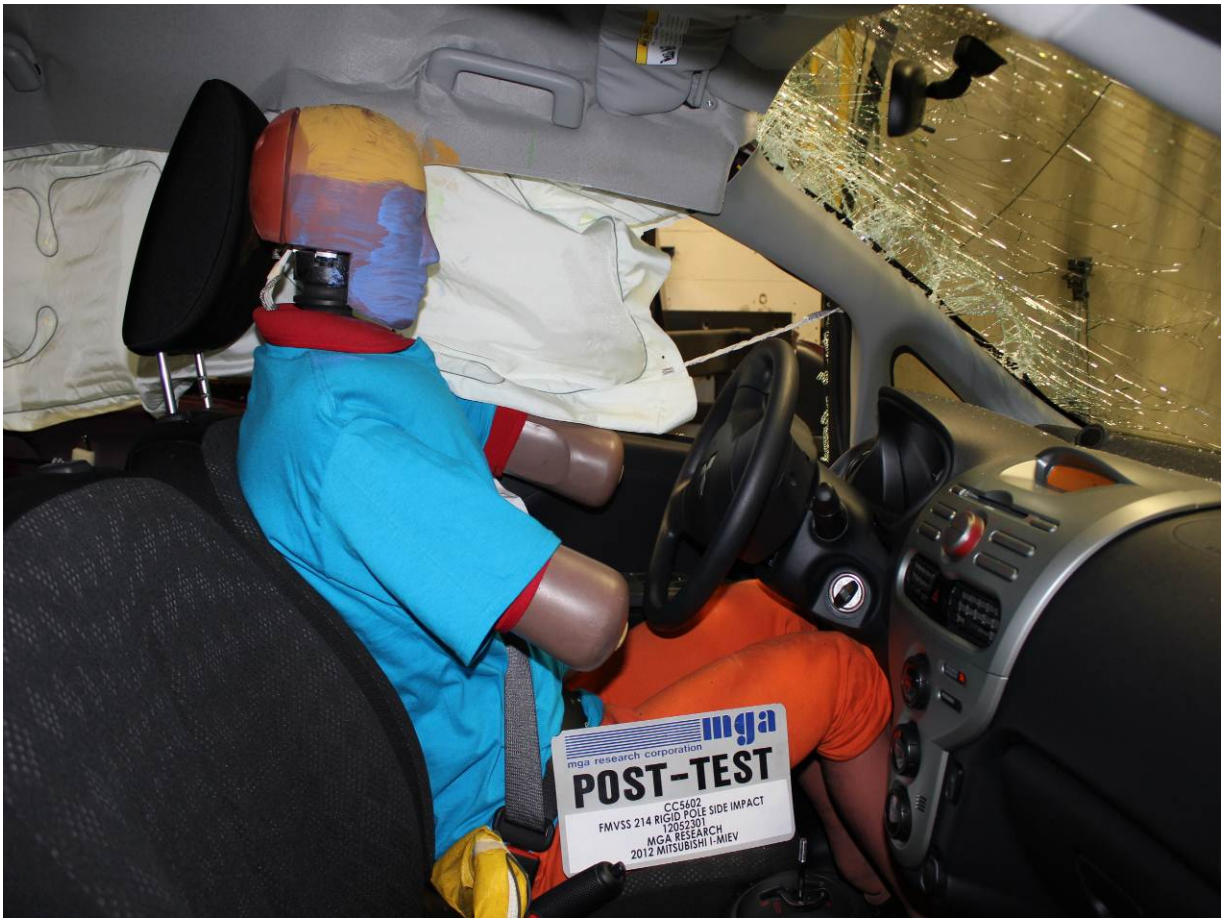
Pre-Test Left ¾ Front View of Vehicle and Pole

Pre-Test Left ¾ 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

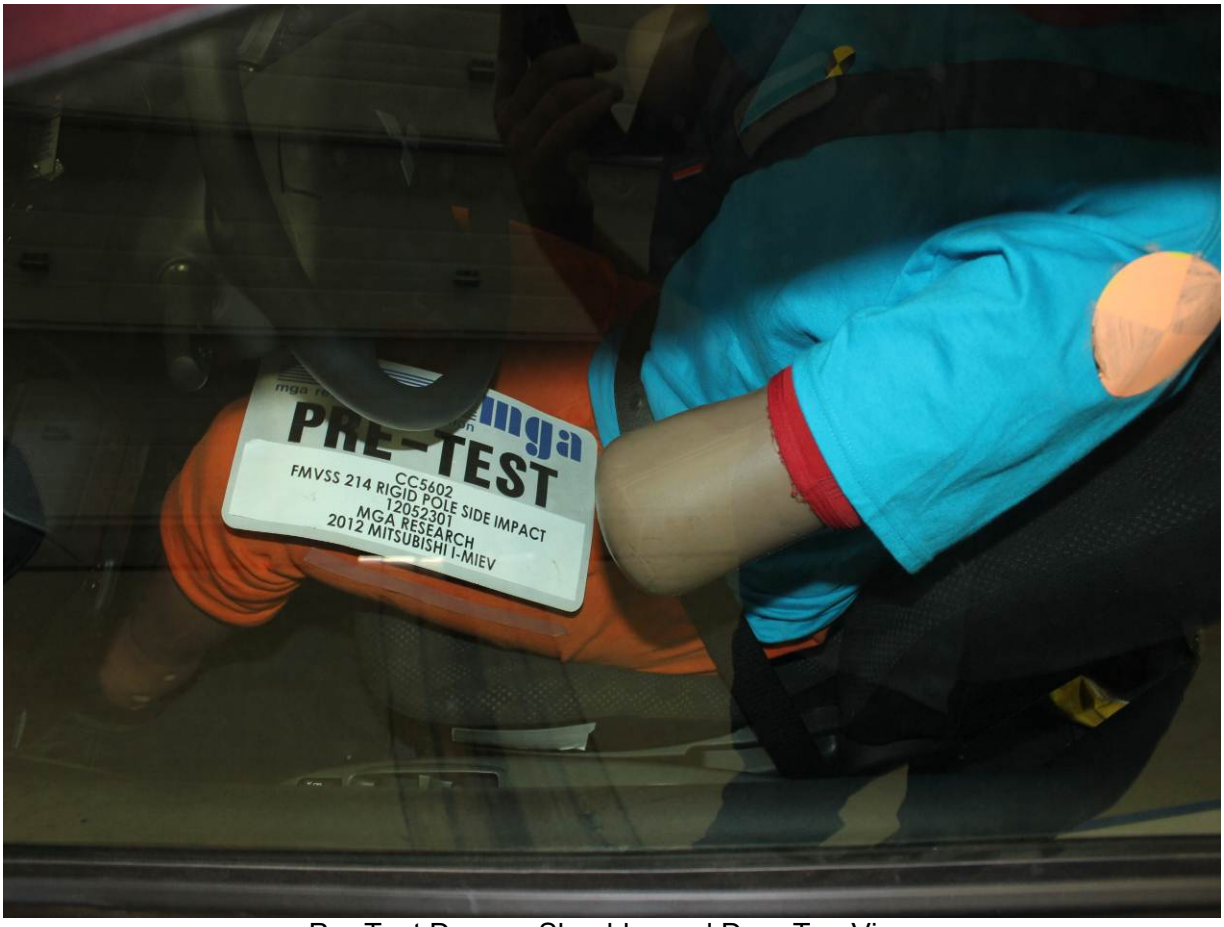


Post-Test Dummy Through Opposite Window

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

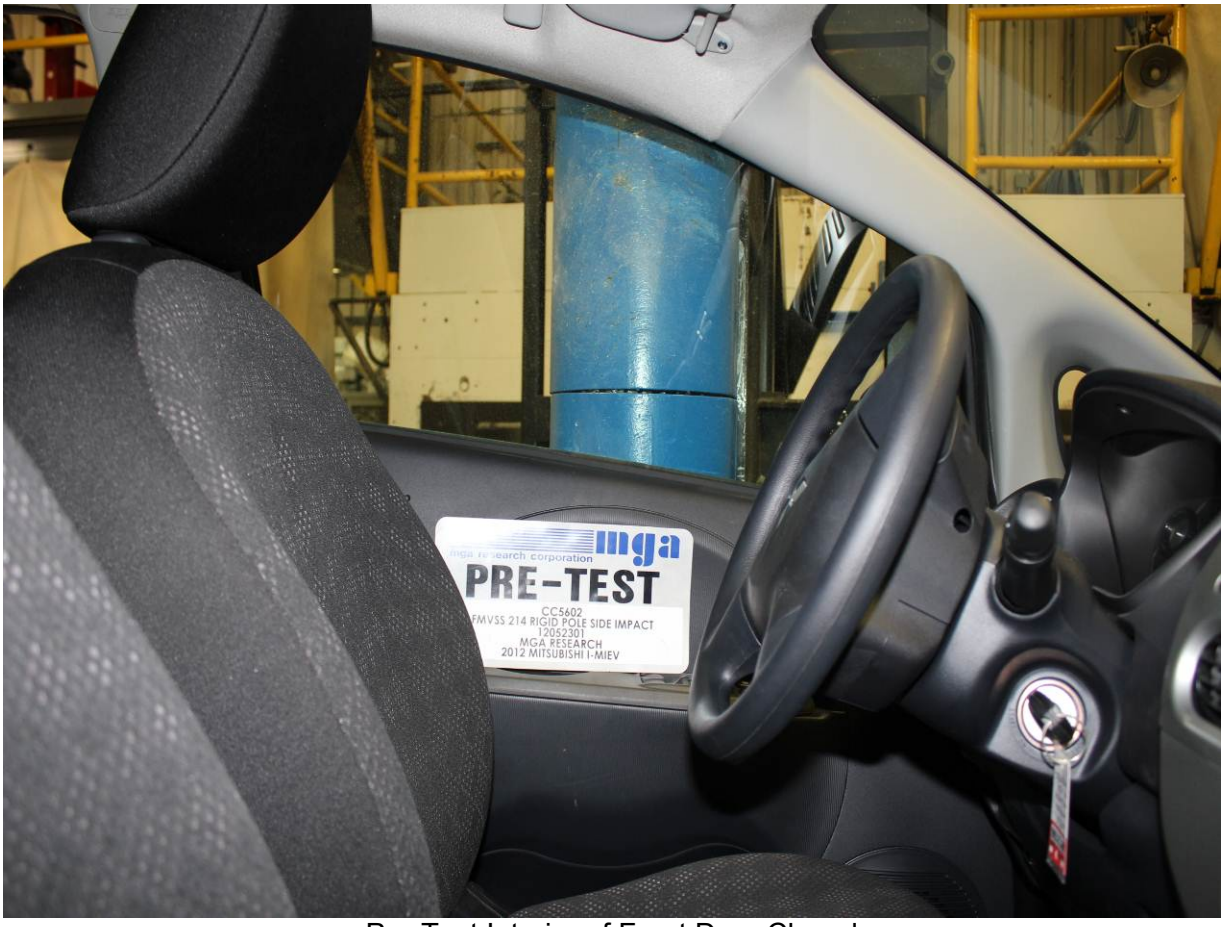
Post-Test Dummy with Door Closed (Impact Side)

Pre-Test Dummy Door Open

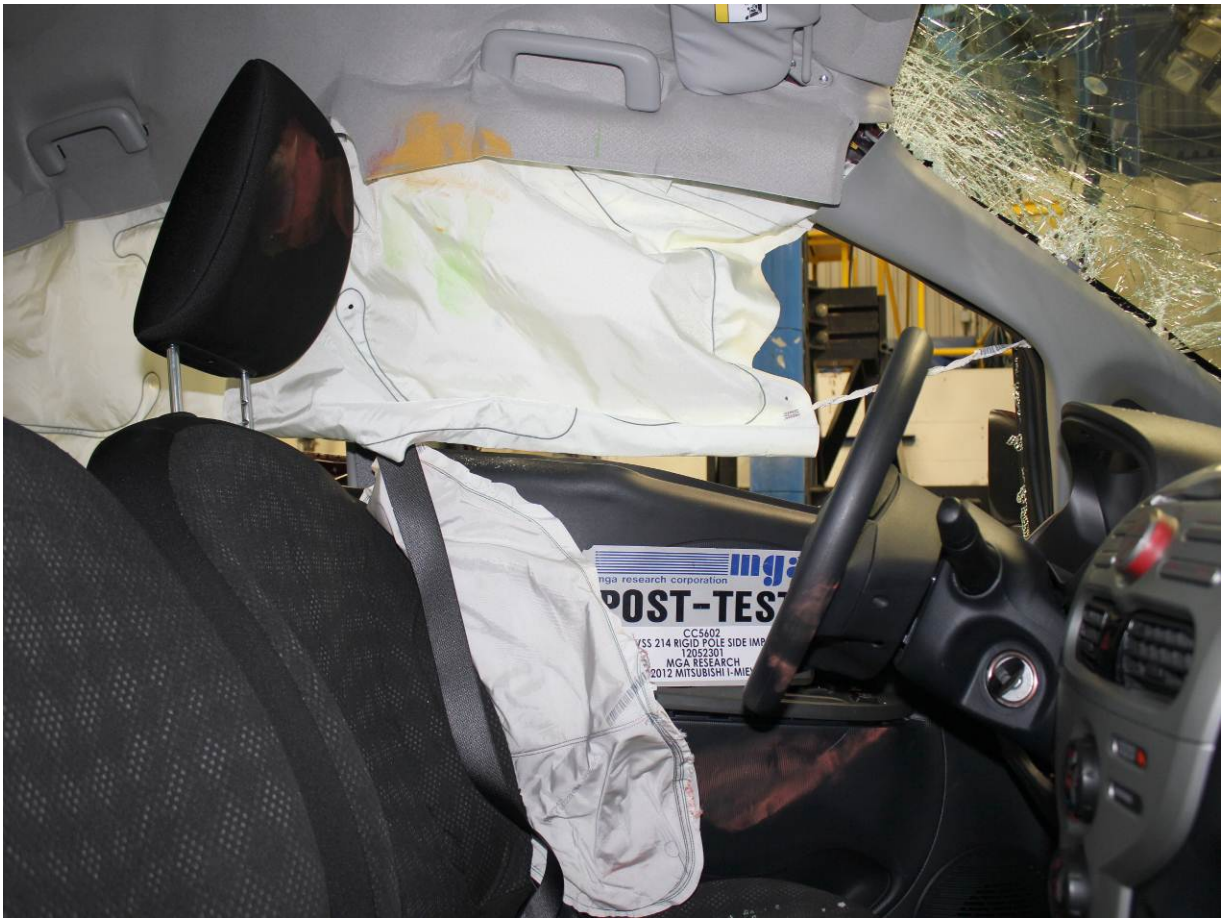


Pre-Test Dummy Shoulder and Door Top View

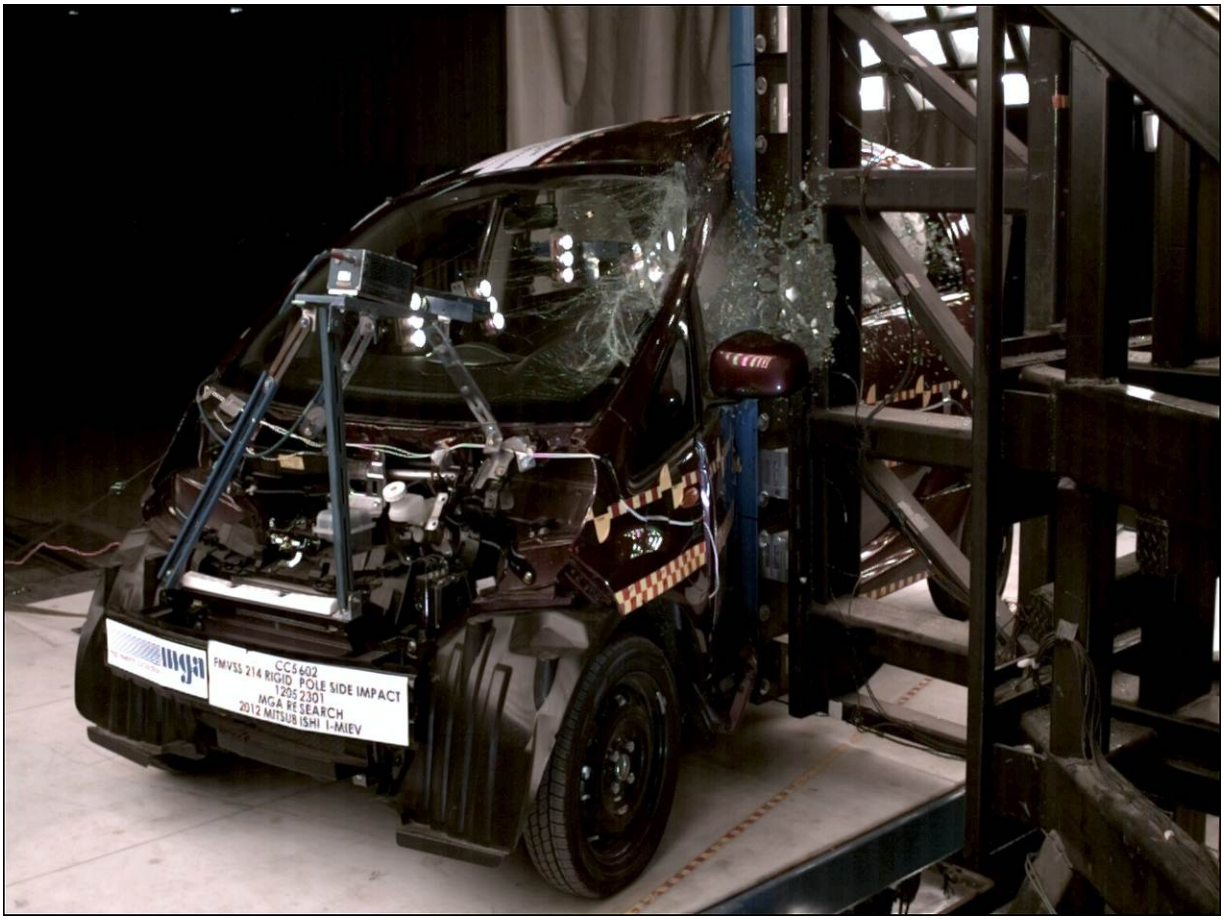
Post-Test Dummy Shoulder and Door Top View



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 ¾ Front View of Impact Zone

Post-Test ¾ 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

APPENDIX B

DUMMY RESPONSE DATA

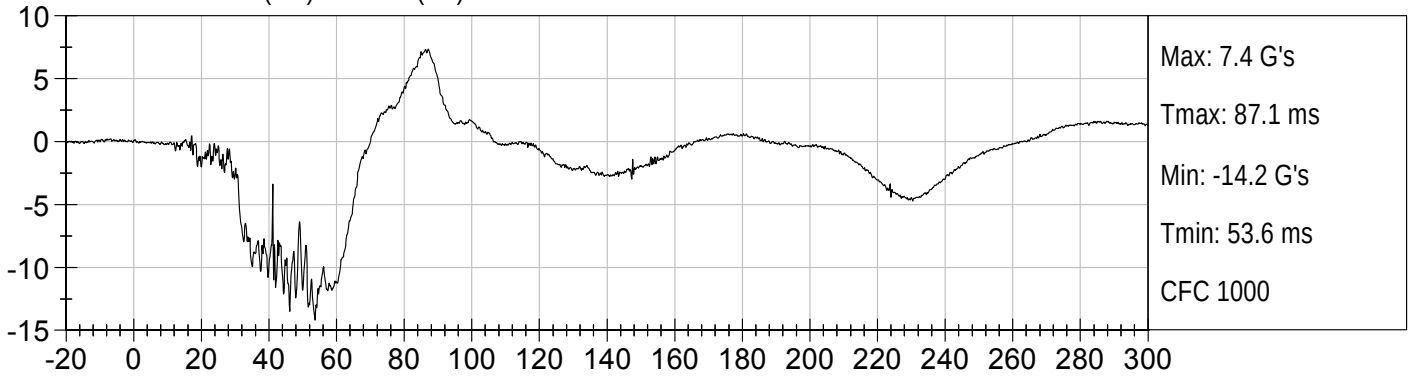
TABLE OF DATA PLOTS

Dummy Instrumentation Plots
FILTERED DATA

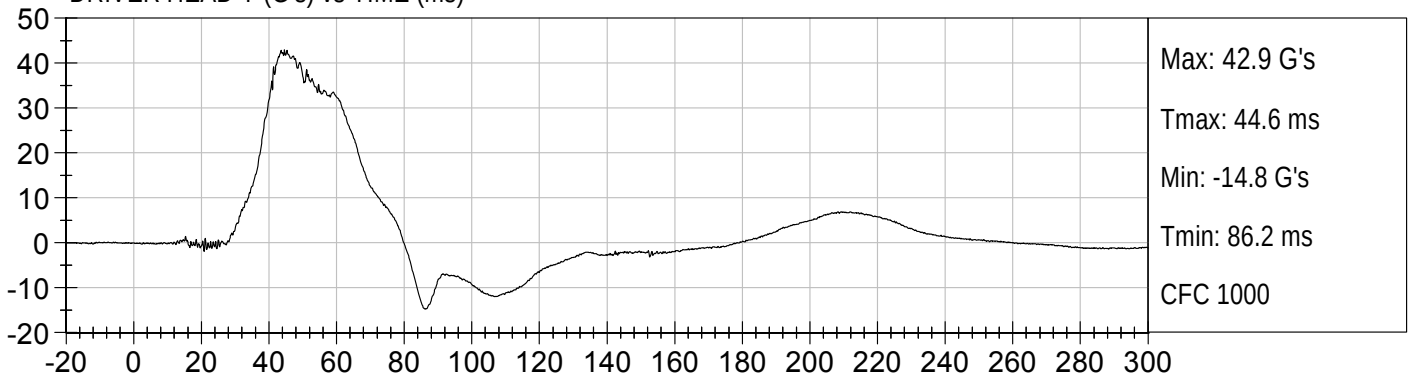
FMVSS 214 Rigid Pole Side Impact
2012 Mitsubishi i-MiEV - CC5602

Test Date: 05/23/2012
Speed: 19.4 mph (31.2 km/h)

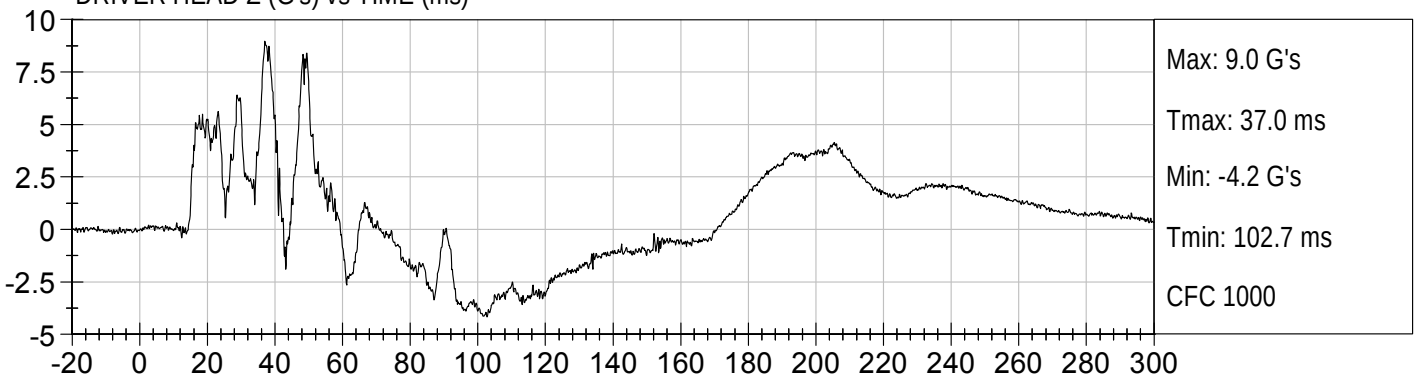
DRIVER HEAD X (G's) vs TIME (ms)



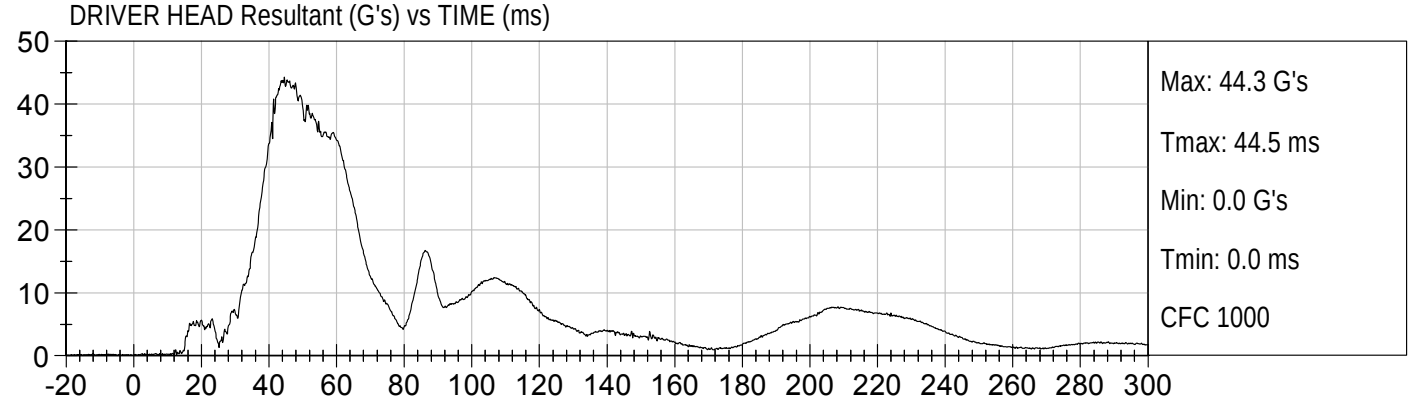
DRIVER HEAD Y (G's) vs TIME (ms)



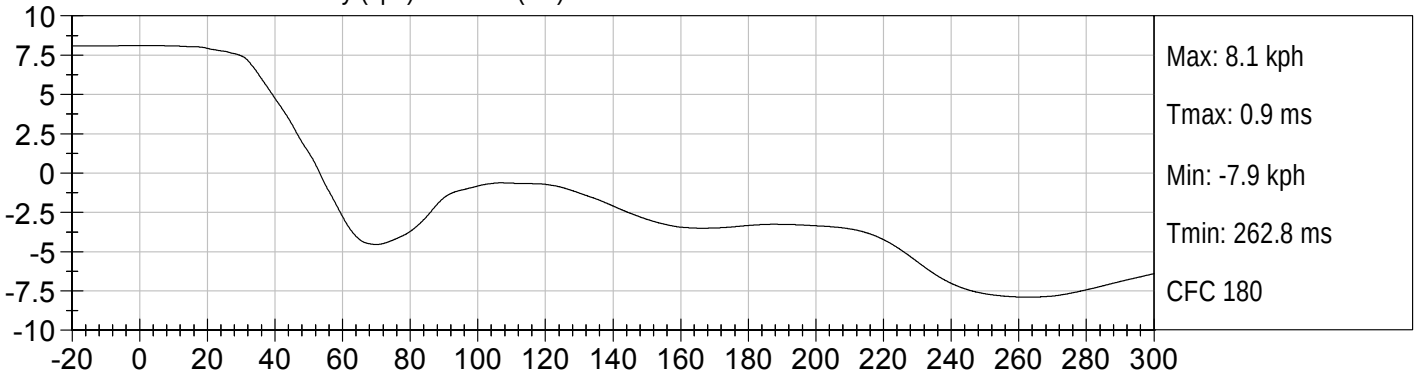
DRIVER HEAD Z (G's) vs TIME (ms)



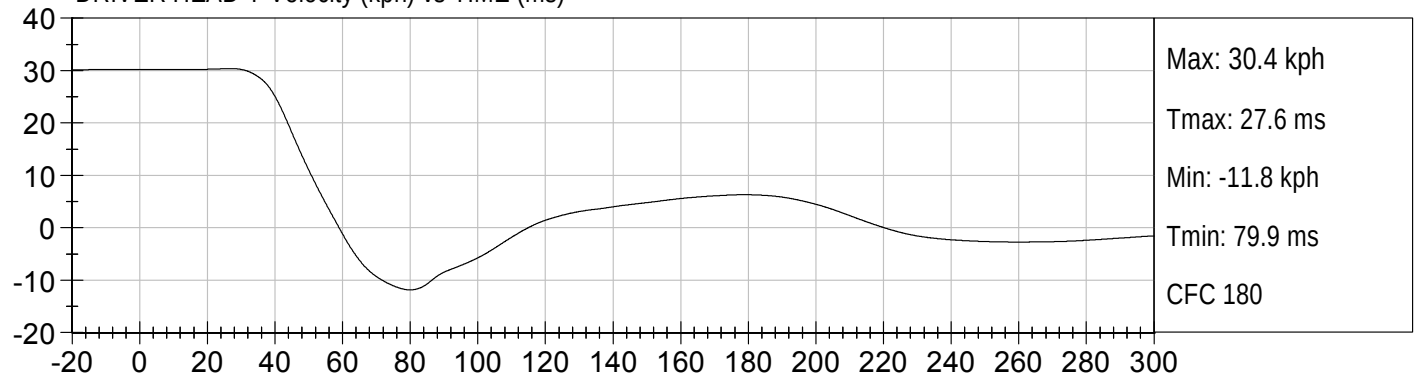
DRIVER HEAD Resultant (G's) vs TIME (ms)



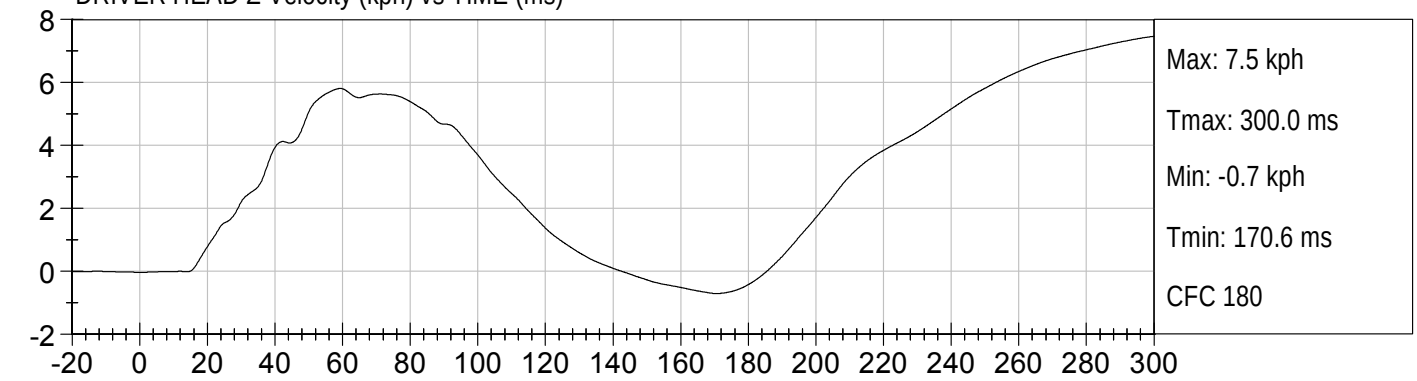
DRIVER HEAD X Velocity (kph) vs TIME (ms)



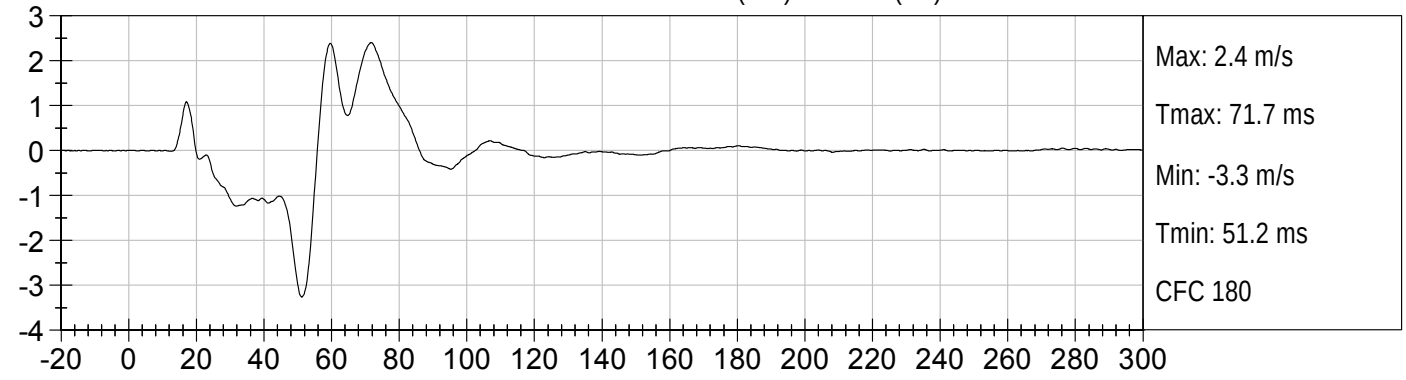
DRIVER HEAD Y Velocity (kph) vs TIME (ms)



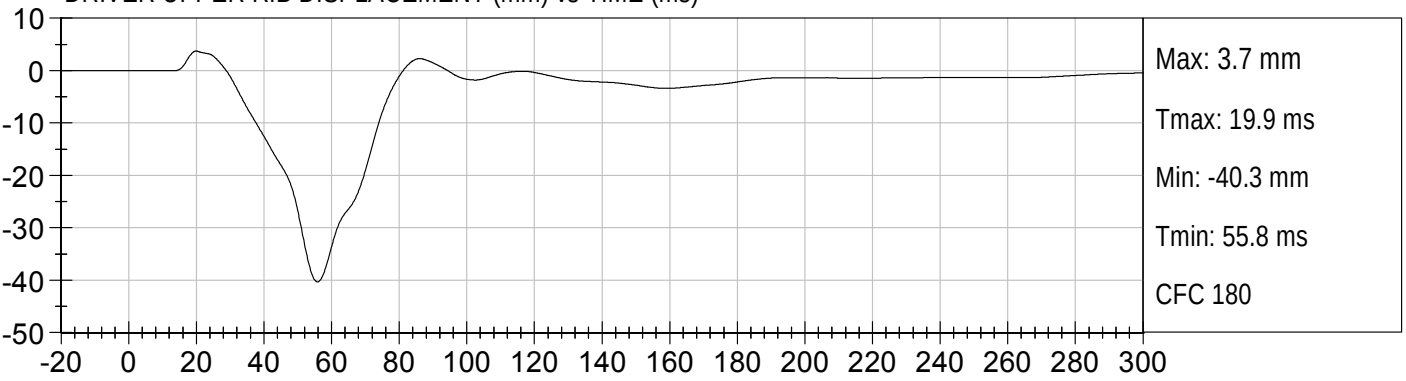
DRIVER HEAD Z Velocity (kph) vs TIME (ms)



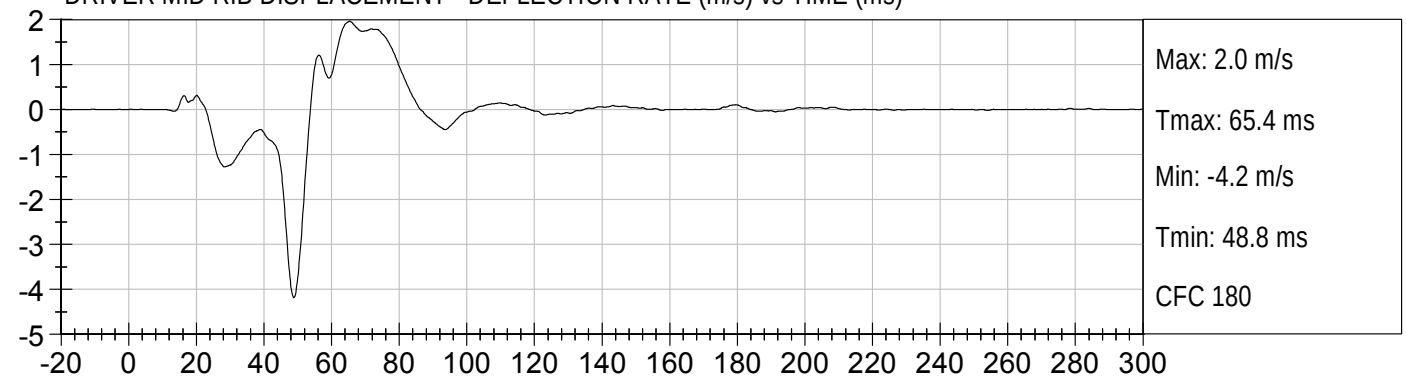
DRIVER UPPER RIB DISPLACEMENT - DEFLECTION RATE (m/s) vs TIME (ms)



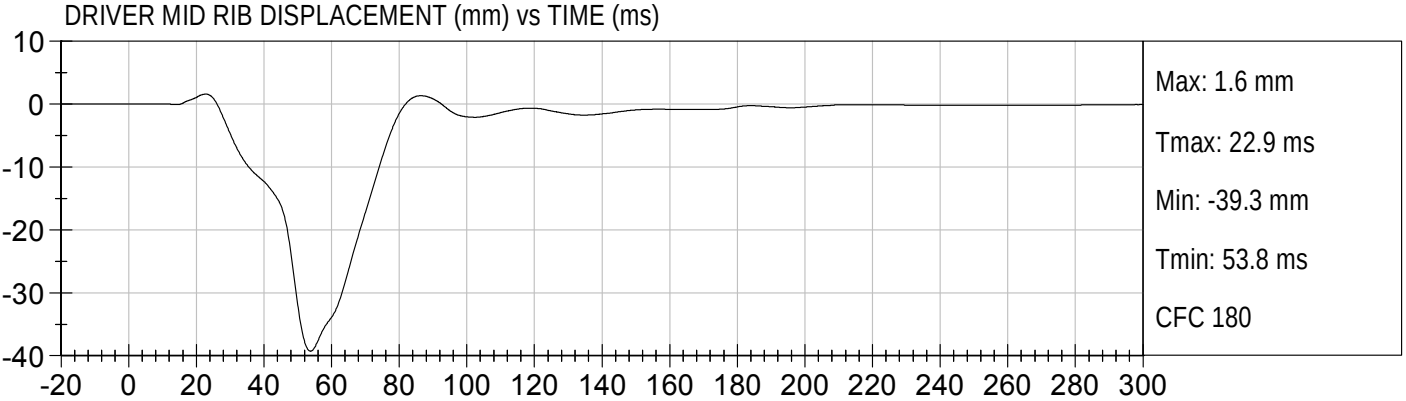
DRIVER UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



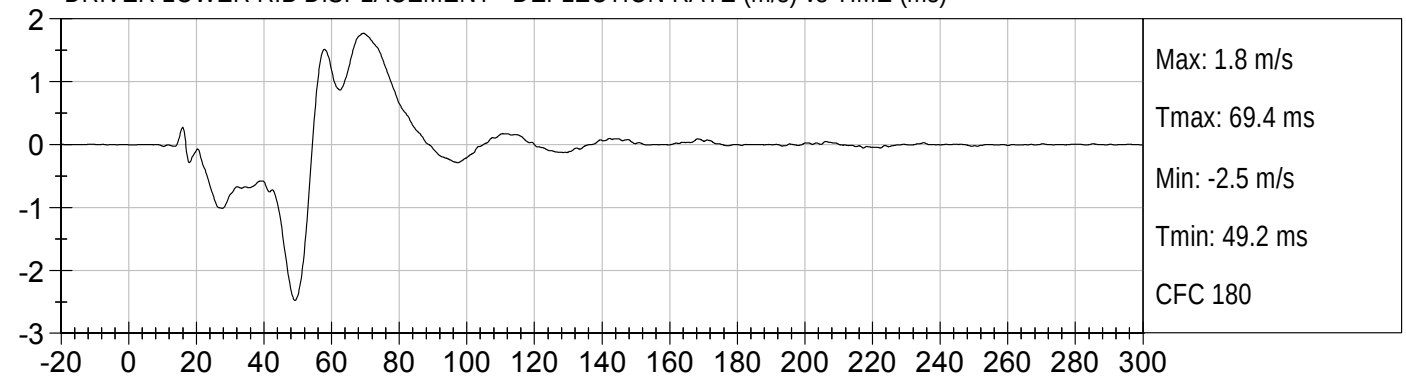
DRIVER MID RIB DISPLACEMENT - DEFLECTION RATE (m/s) vs TIME (ms)



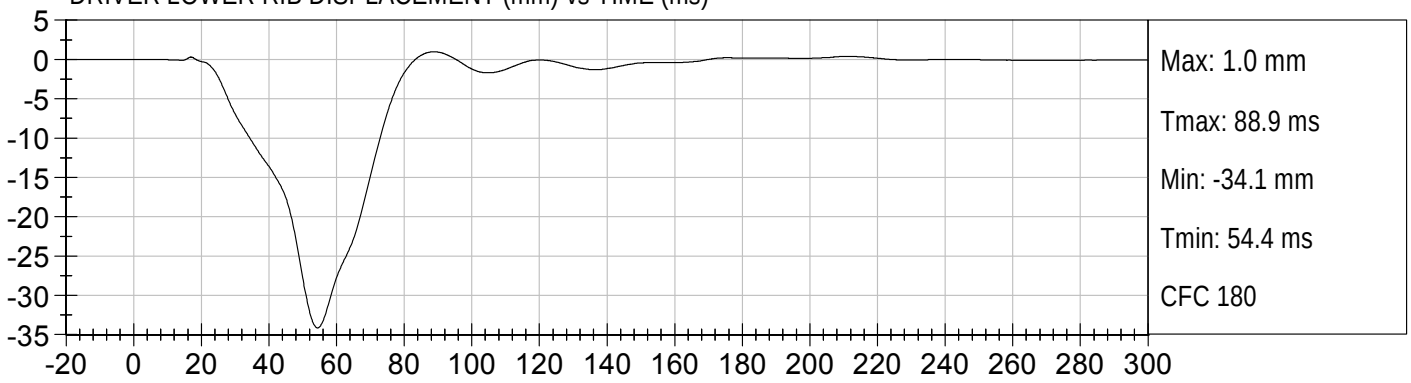
DRIVER MID RIB DISPLACEMENT (mm) vs TIME (ms)



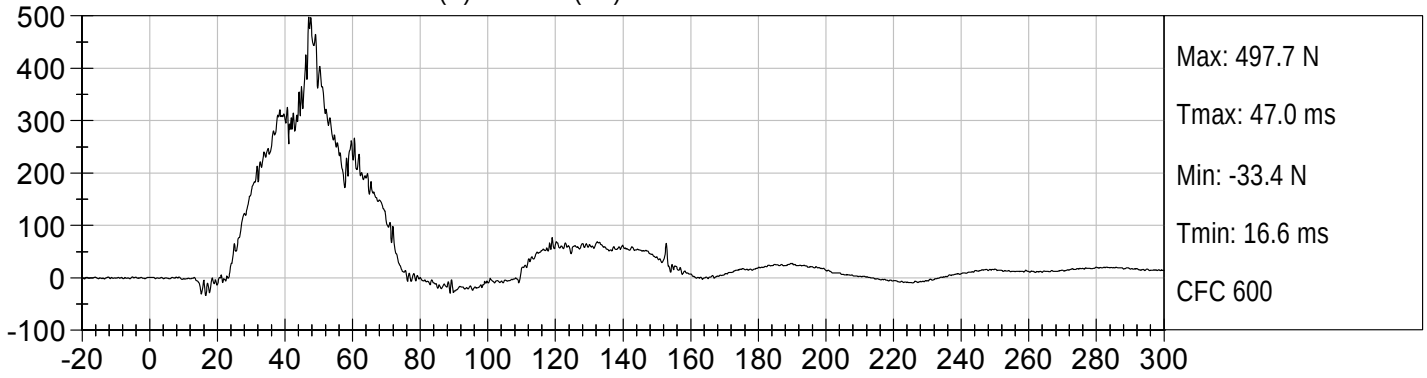
DRIVER LOWER RIB DISPLACEMENT - DEFLECTION RATE (m/s) vs TIME (ms)



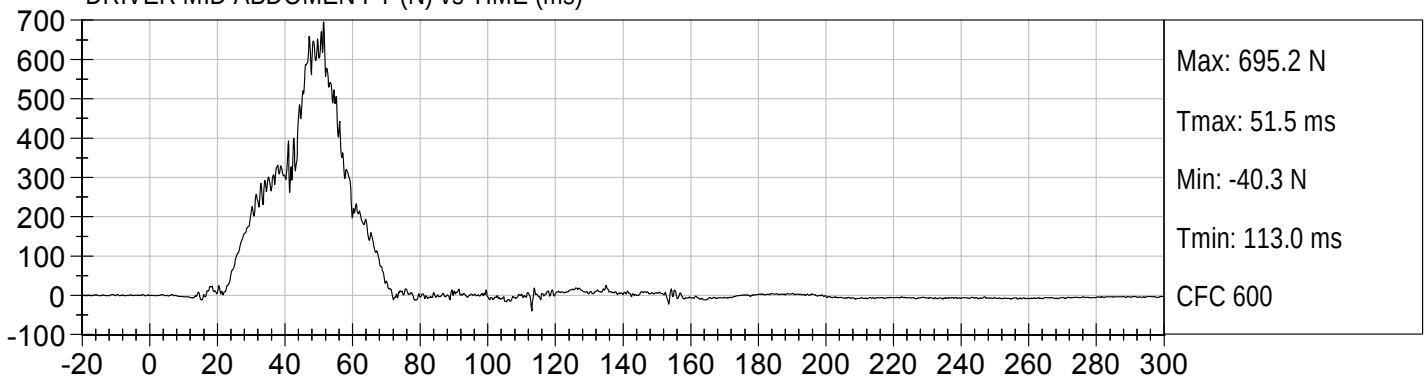
DRIVER LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



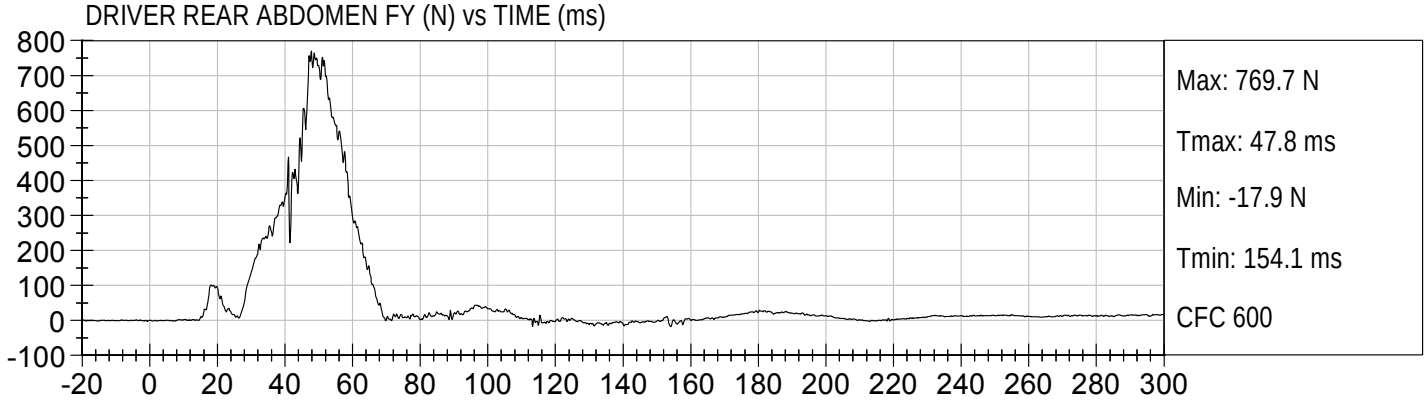
DRIVER FRONT ABDOMEN FY (N) vs TIME (ms)



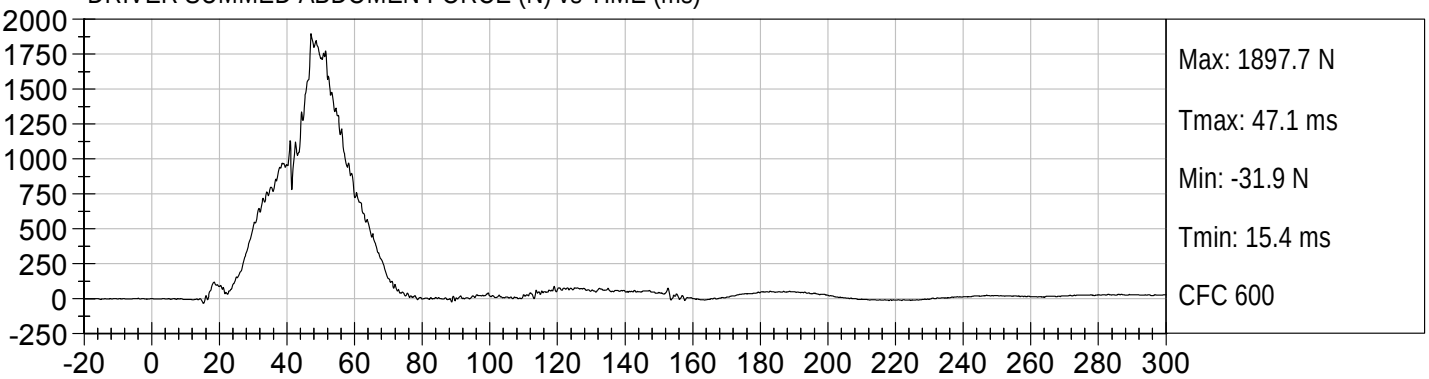
DRIVER MID ABDOMEN FY (N) vs TIME (ms)

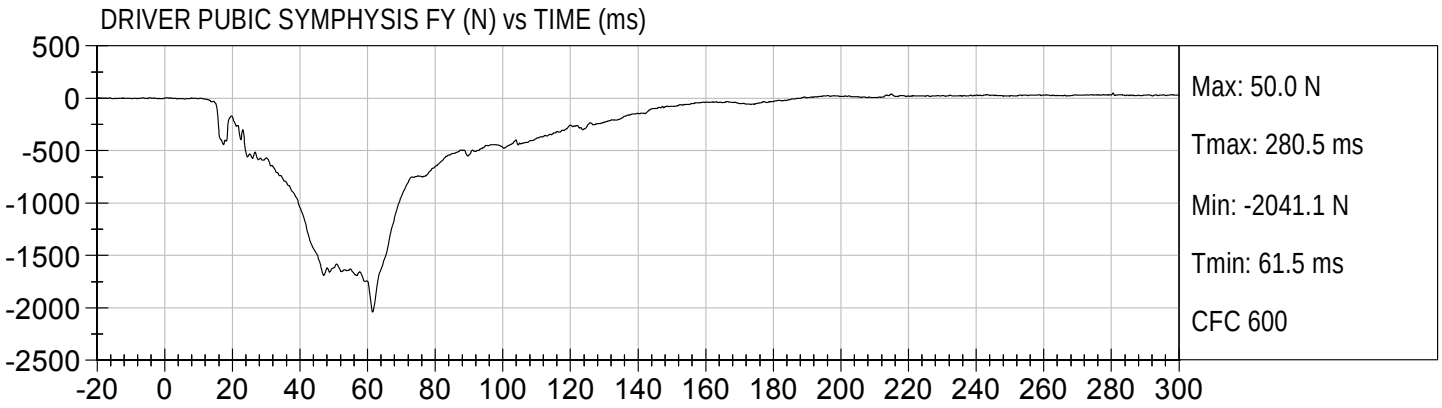


DRIVER REAR ABDOMEN FY (N) vs TIME (ms)



DRIVER SUMMED ABDOMEN FORCE (N) vs TIME (ms)




DRIVER PUBIC SYMPHYSIS FY (N) vs TIME (ms)
500
0
-500
-1000
-1500
-2000
-2500
-20 0 20 40 60 80 100 120 140 160 180 200 220 240 260 280 300
Max: 50.0 N
Tmax: 280.5 ms
Min: -2041.1 N
Tmin: 61.5 ms
CFC 600

APPENDIX C

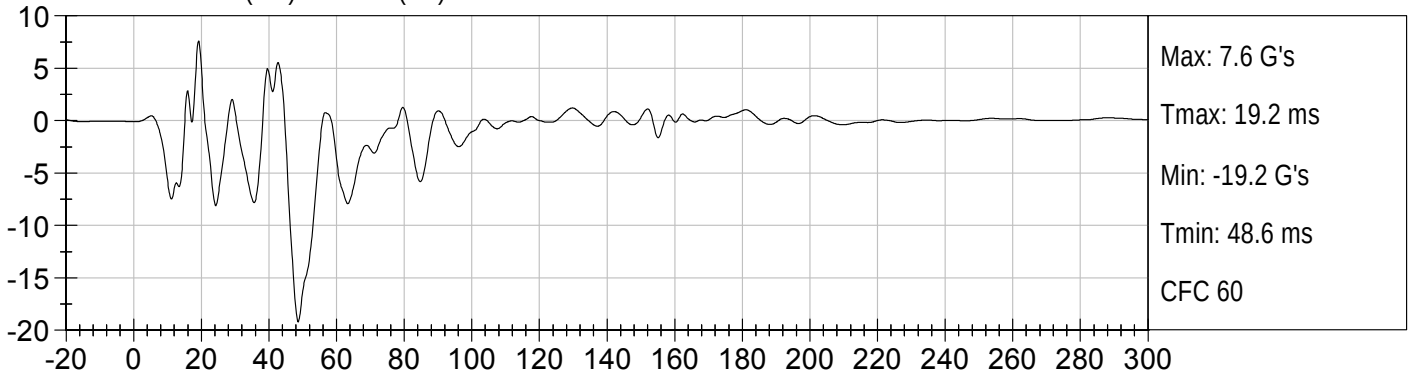
VEHICLE ACCELEROMETER RESPONSE DATA

TABLE OF DATA PLOTS

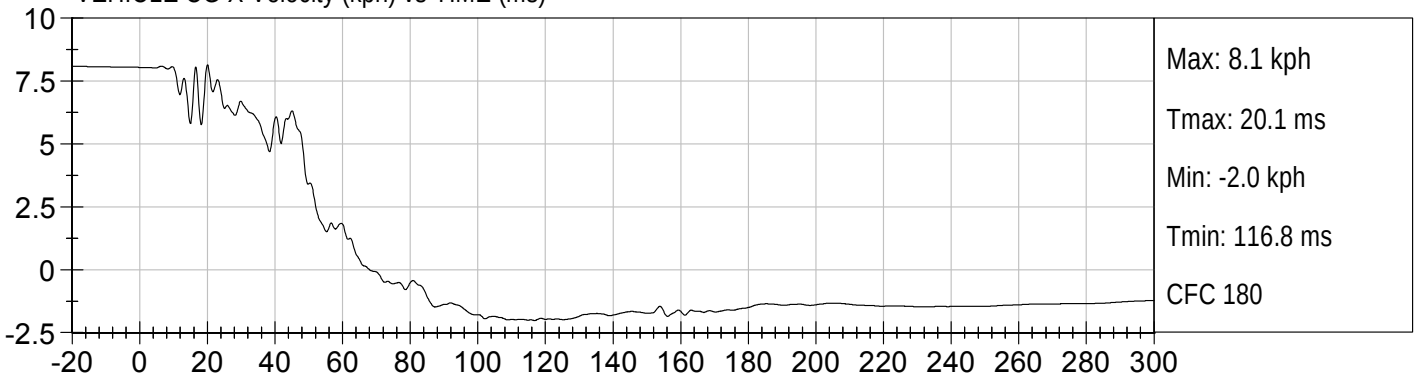
FMVSS 214 Rigid Pole Side Impact
2012 Mitsubishi i-MiEV - CC5602

Test Date: 05/23/2012
Speed: 19.4 mph (31.2 km/h)

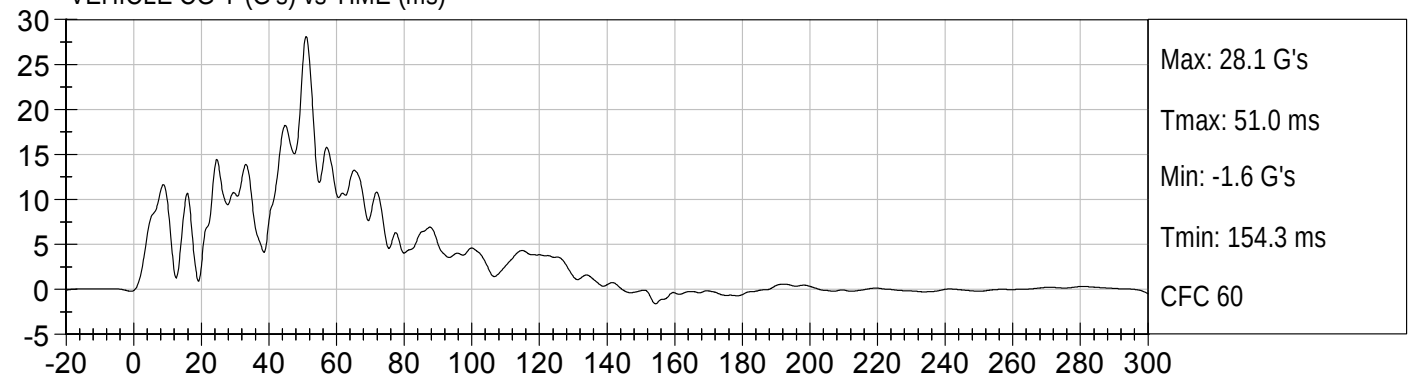
VEHICLE CG X (G's) vs TIME (ms)



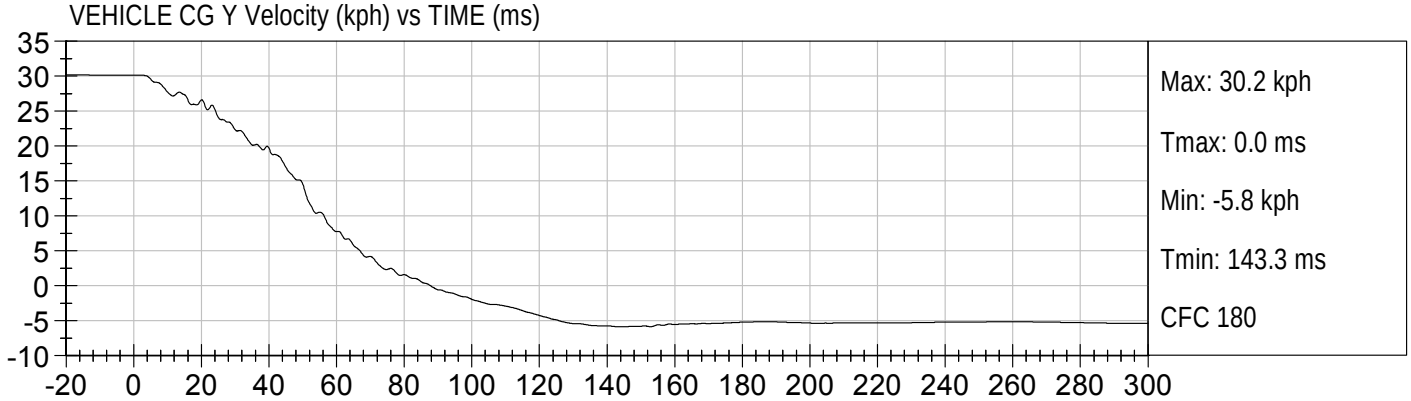
VEHICLE CG X Velocity (kph) vs TIME (ms)



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



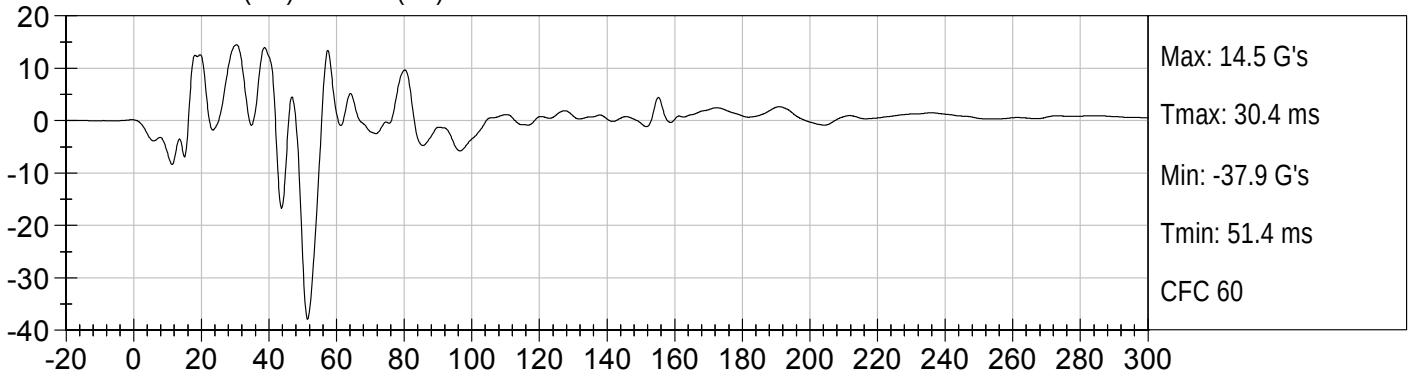
VEHICLE CG Y Velocity (kph) vs TIME (ms)



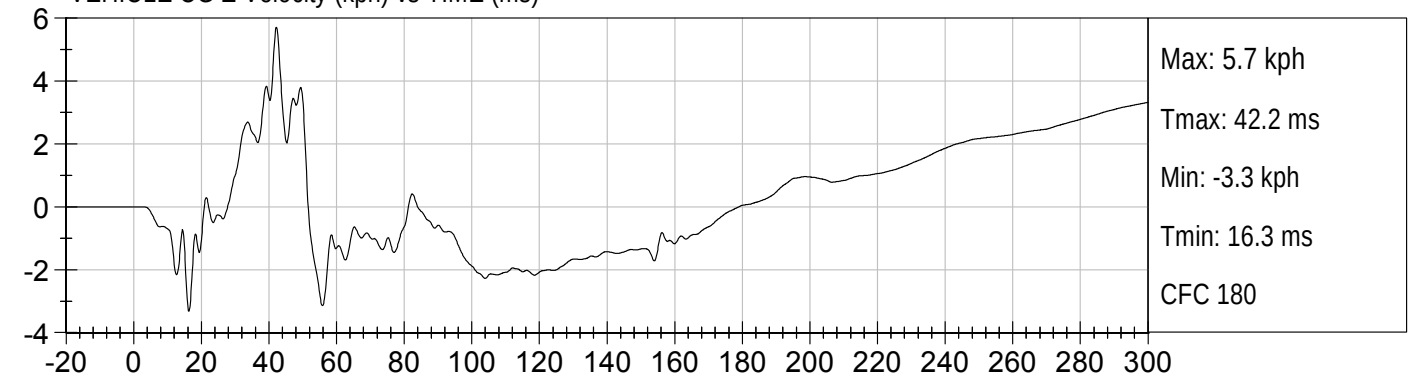
FMVSS 214 Rigid Pole Side Impact
2012 Mitsubishi i-MiEV - CC5602

Test Date: 05/23/2012
Speed: 19.4 mph (31.2 km/h)

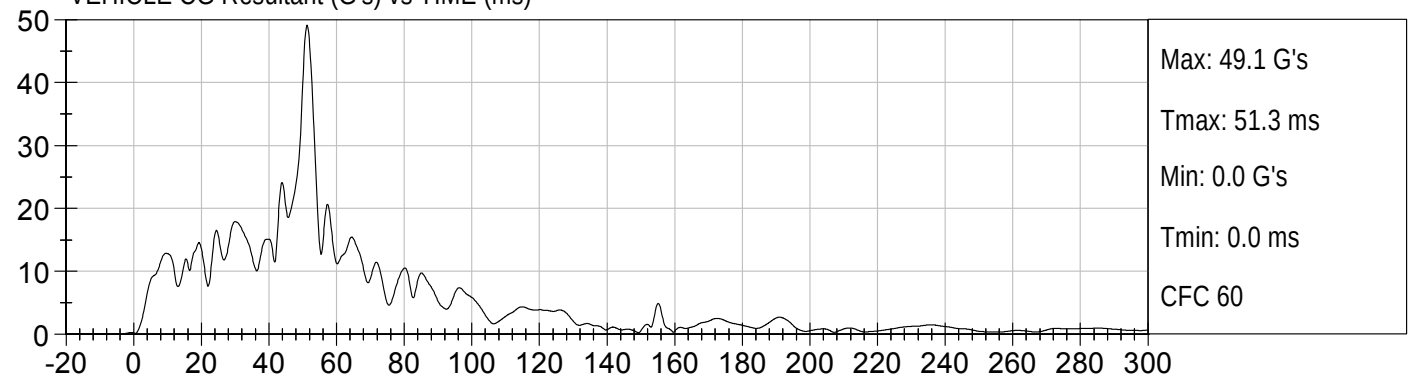
VEHICLE CG Z (G's) vs TIME (ms)



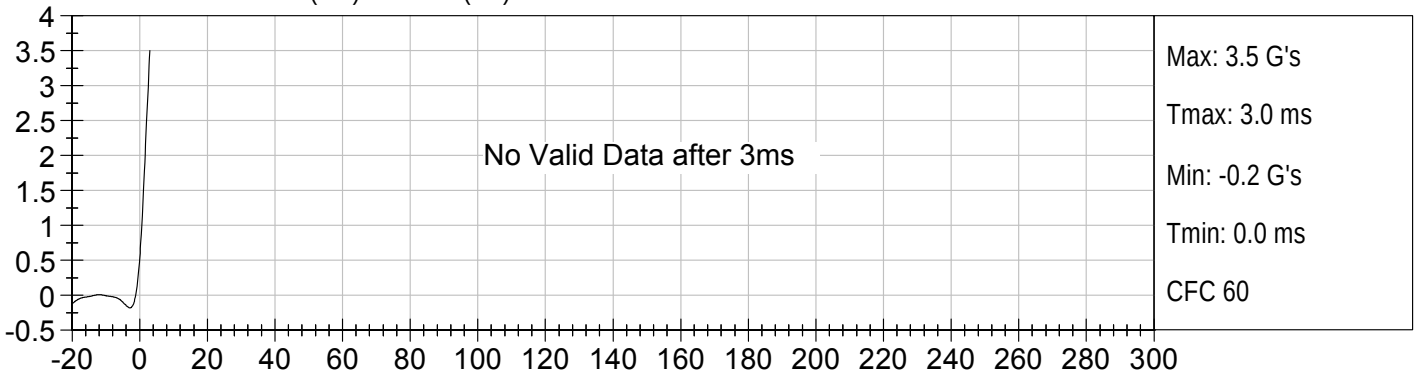
VEHICLE CG Z Velocity (kph) vs TIME (ms)



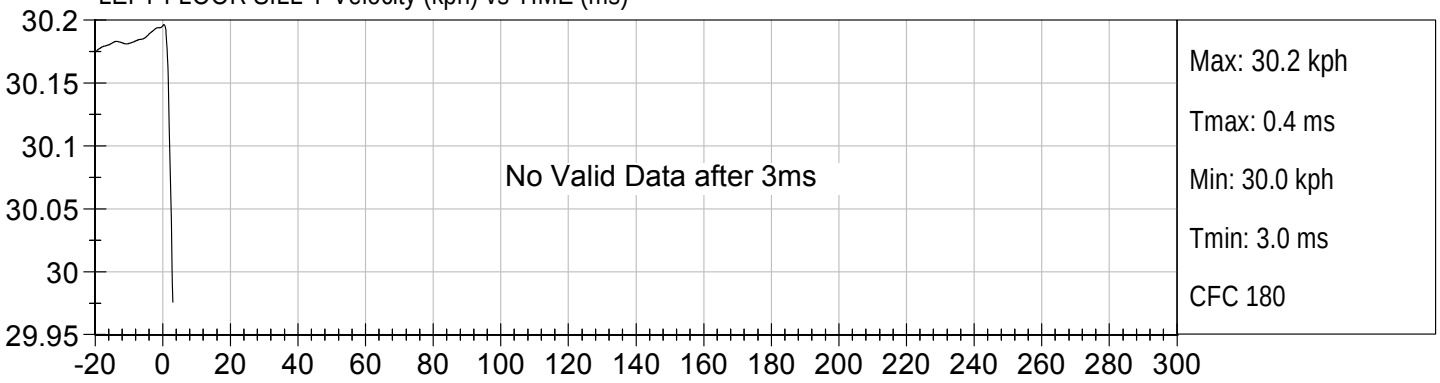
VEHICLE CG Resultant (G's) vs TIME (ms)



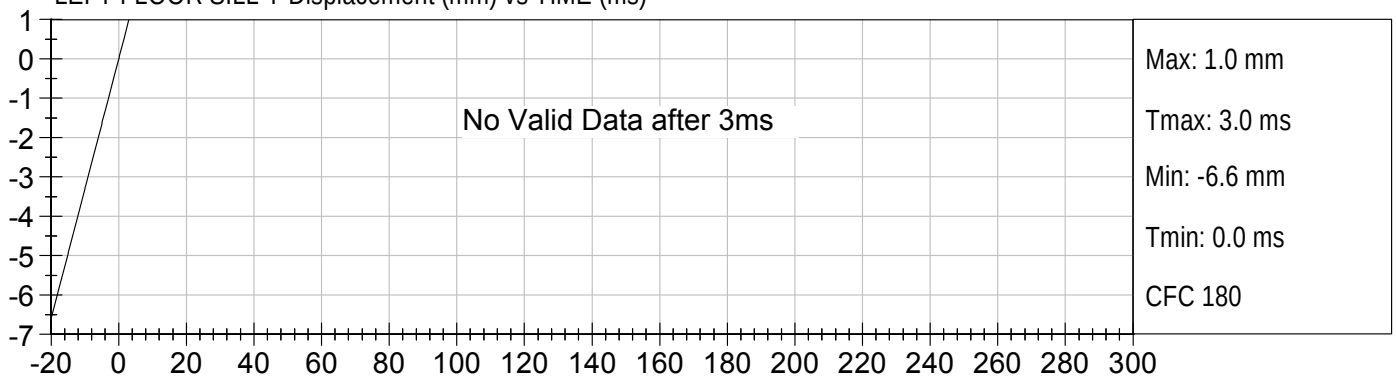
LEFT FLOOR SILL Y (G's) vs TIME (ms)



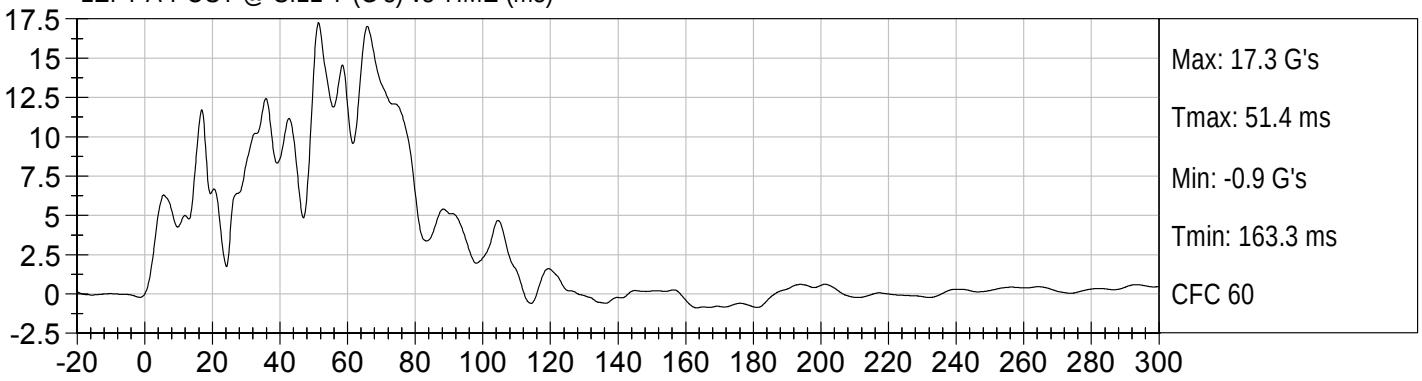
LEFT FLOOR SILL Y Velocity (kph) vs TIME (ms)



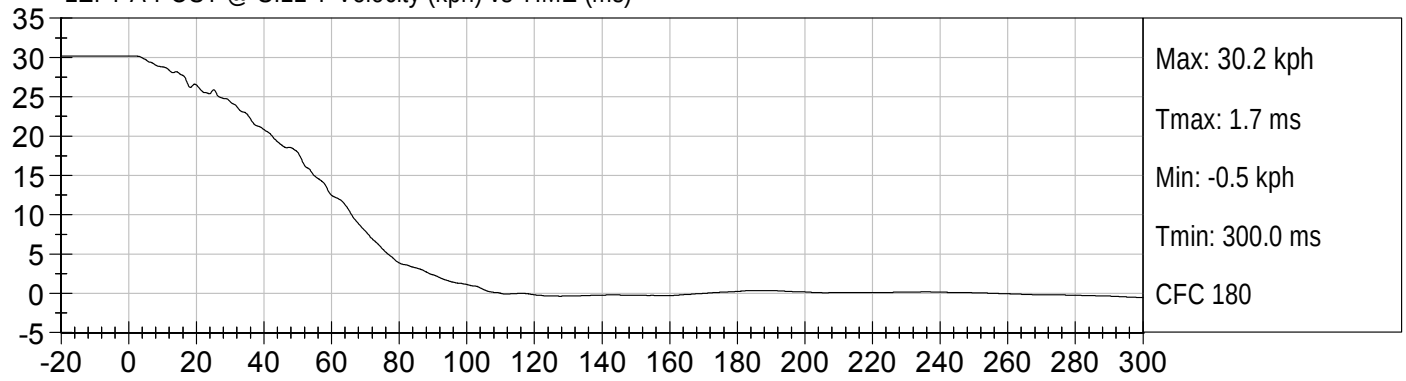
LEFT FLOOR SILL Y Displacement (mm) vs TIME (ms)



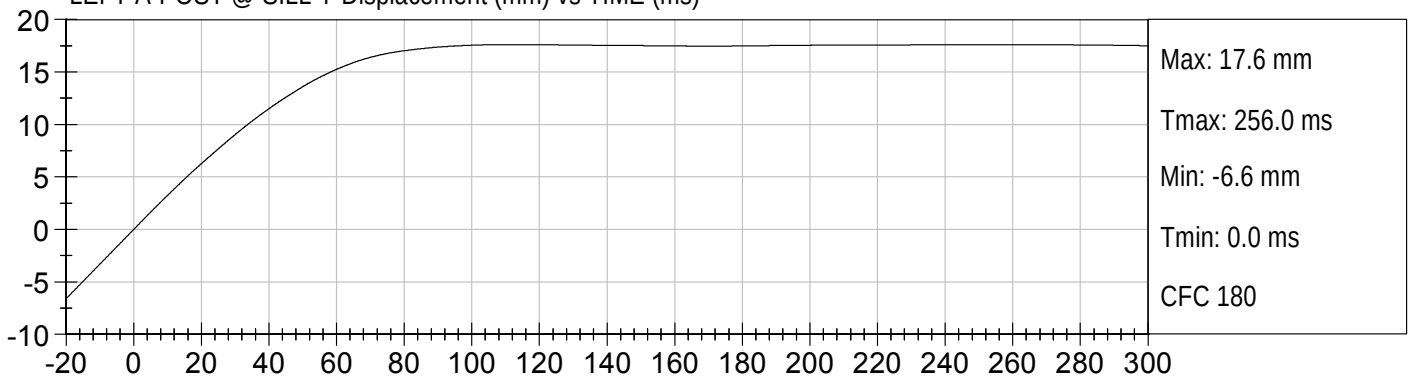
LEFT A-POST @ SILL Y (G's) vs TIME (ms)



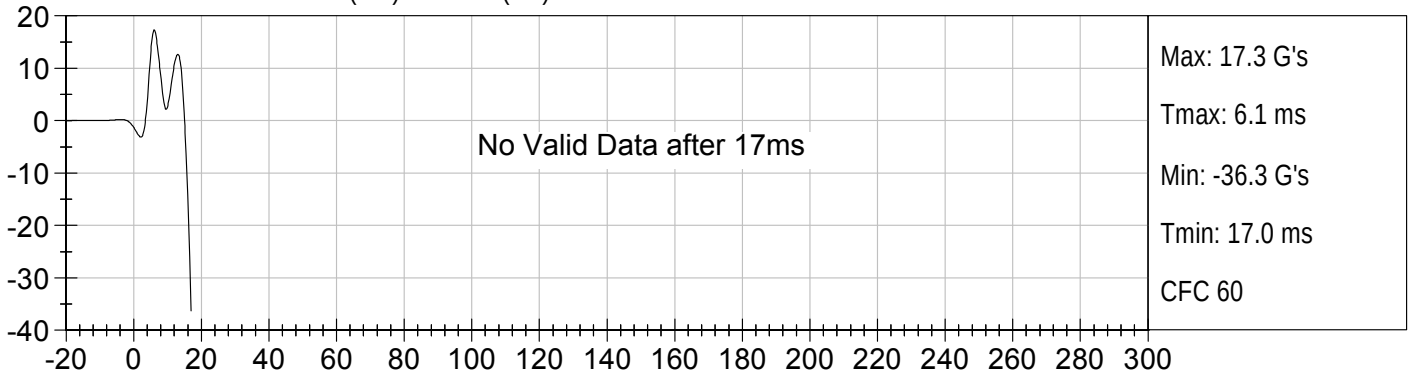
LEFT A-POST @ SILL Y Velocity (kph) vs TIME (ms)



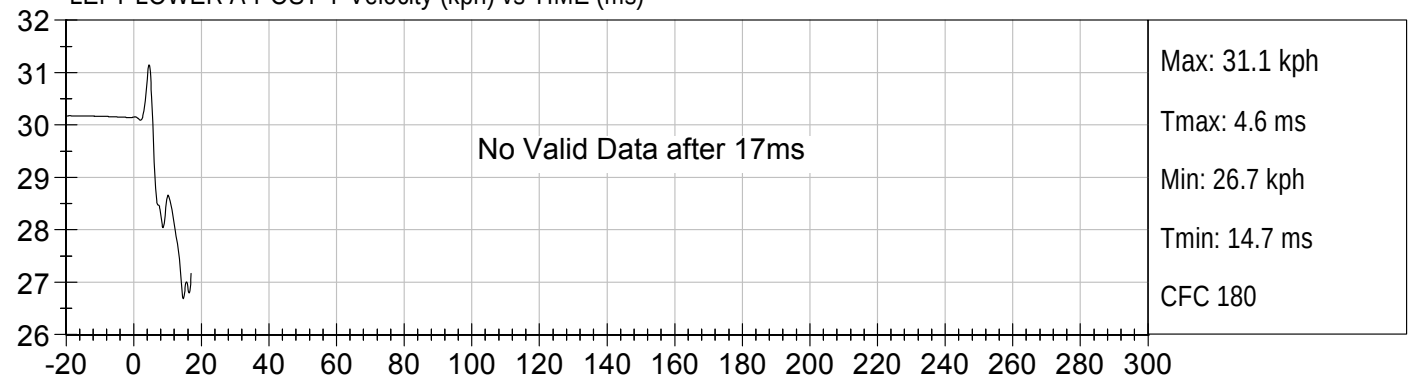
LEFT A-POST @ SILL Y Displacement (mm) vs TIME (ms)



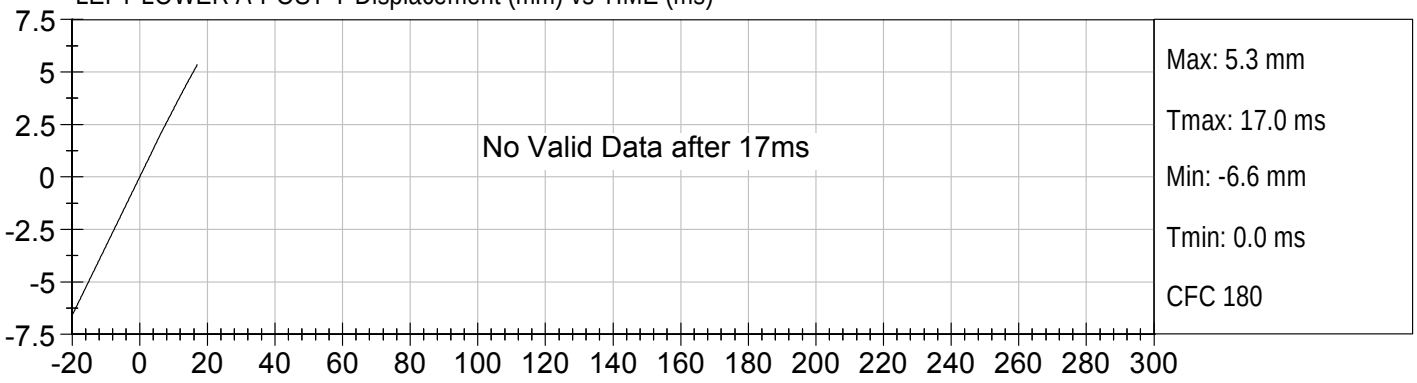
LEFT LOWER A-POST Y (G's) vs TIME (ms)



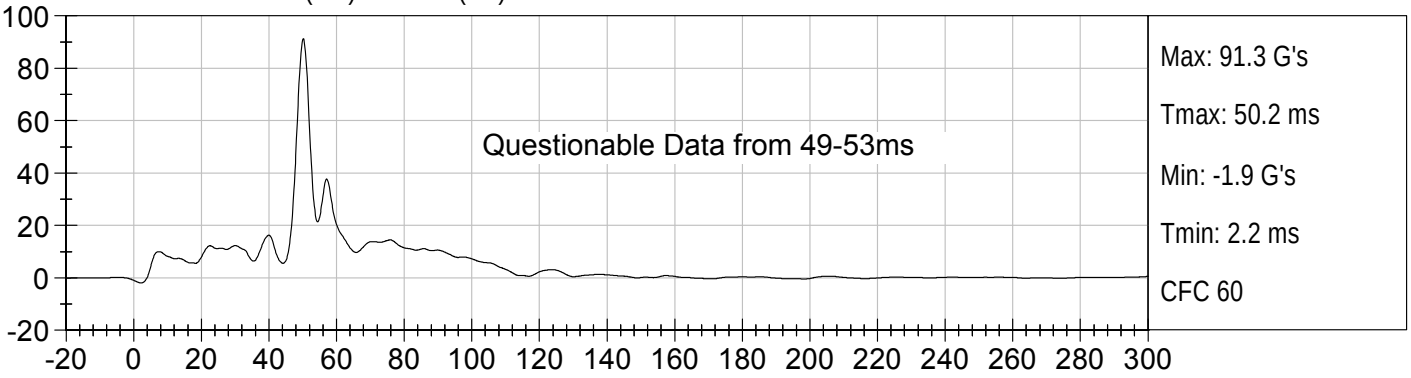
LEFT LOWER A-POST Y Velocity (kph) vs TIME (ms)



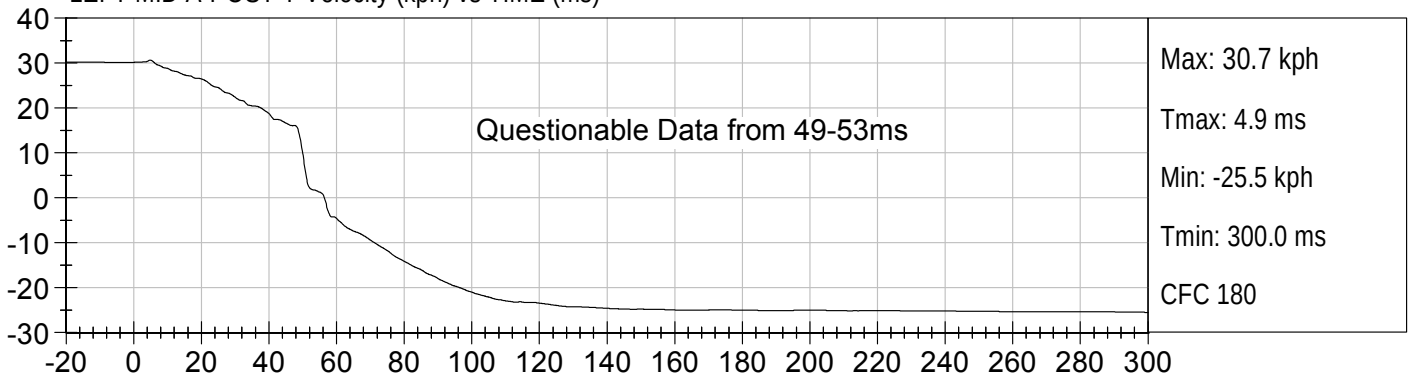
LEFT LOWER A-POST Y Displacement (mm) vs TIME (ms)



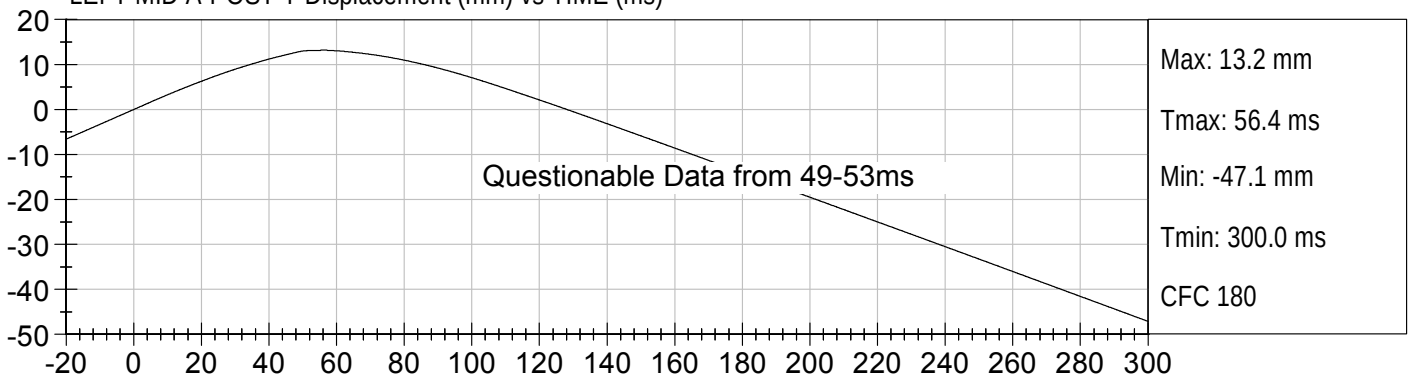
LEFT MID A-POST Y (G's) vs TIME (ms)



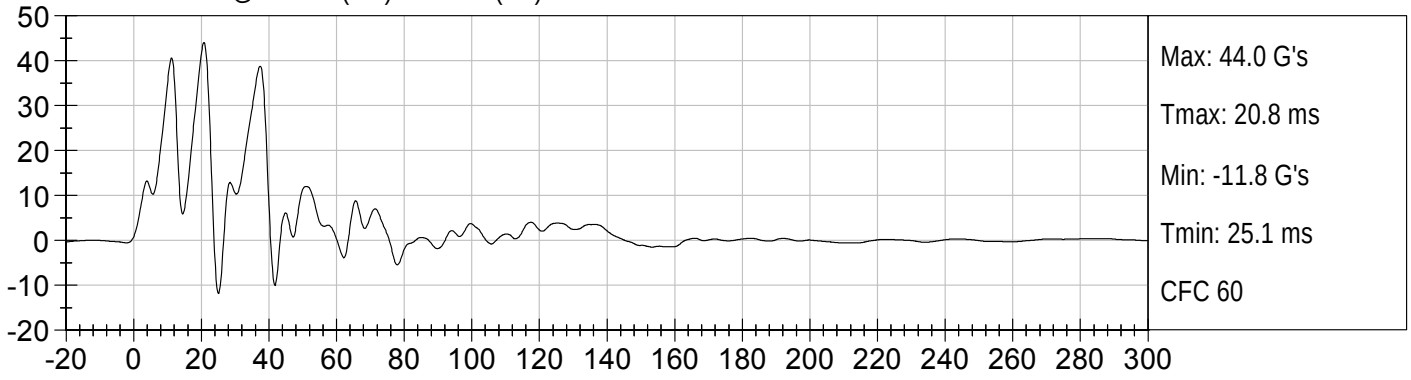
LEFT MID A-POST Y Velocity (kph) vs TIME (ms)



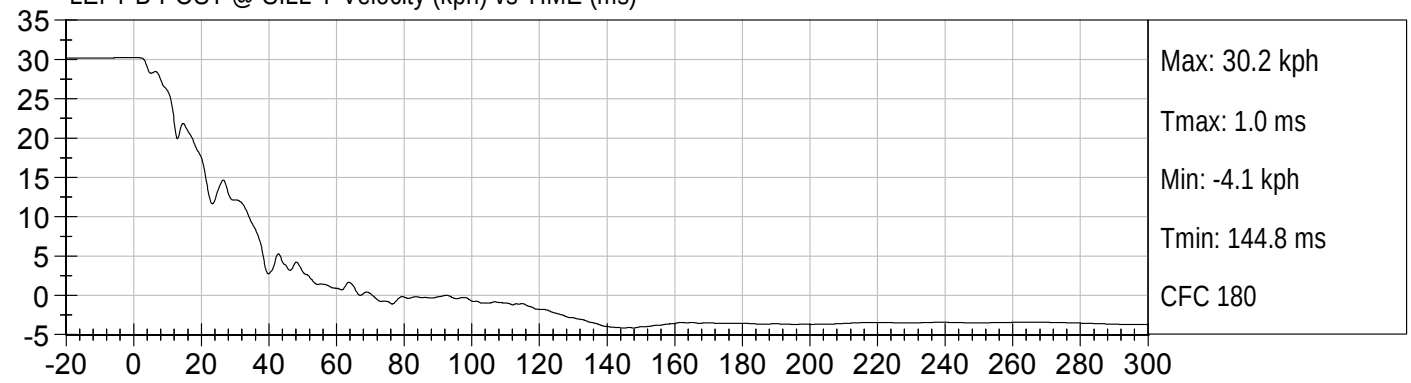
LEFT MID A-POST Y Displacement (mm) vs TIME (ms)



LEFT B-POST @ SILL Y (G's) vs TIME (ms)

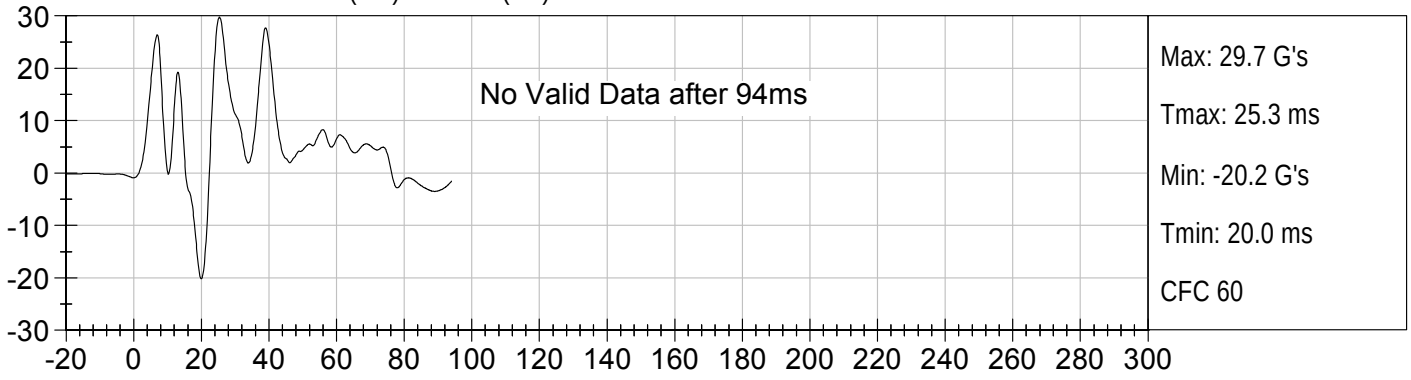


LEFT B-POST @ SILL Y Velocity (kph) vs TIME (ms)

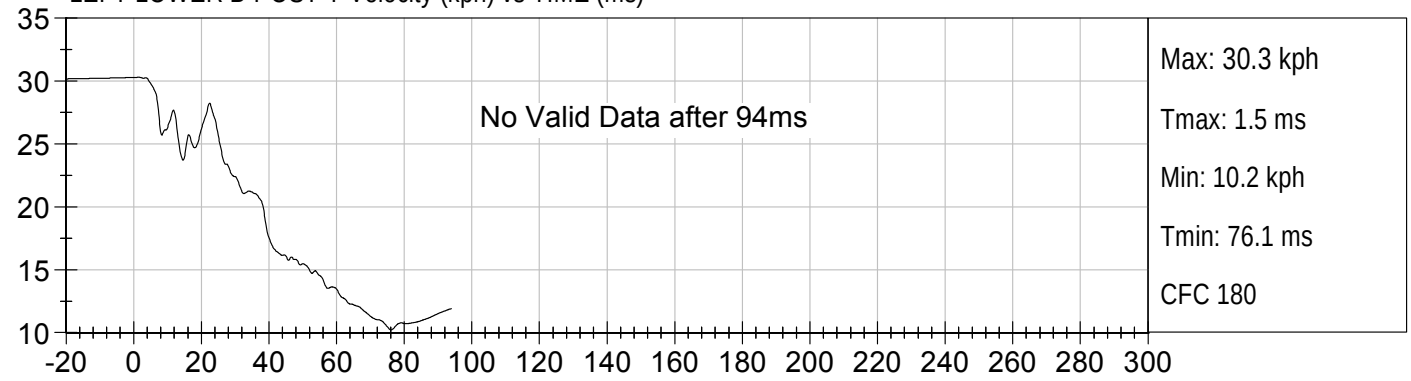


LEFT B-POST @ SILL Y Displacement (mm) vs TIME (ms)

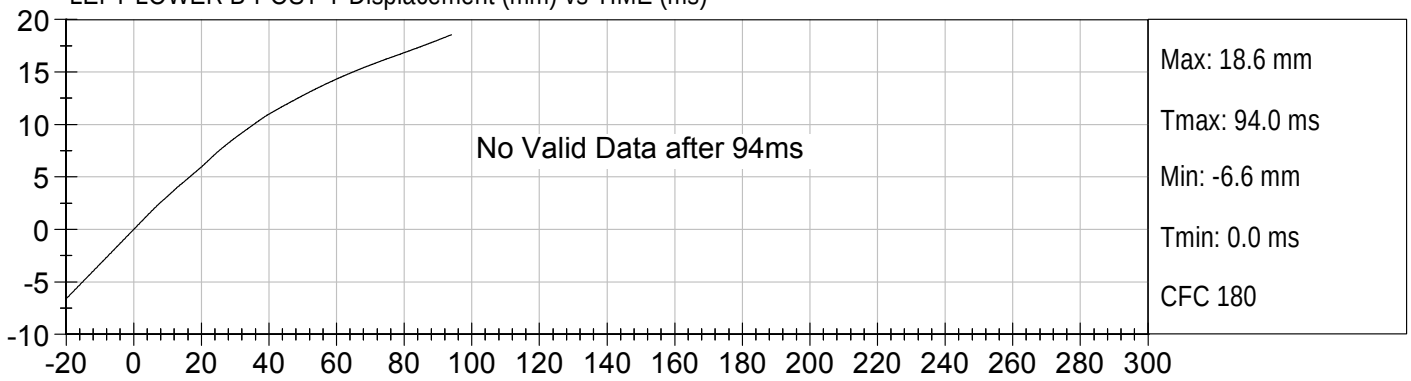
LEFT LOWER B-POST Y (G's) vs TIME (ms)



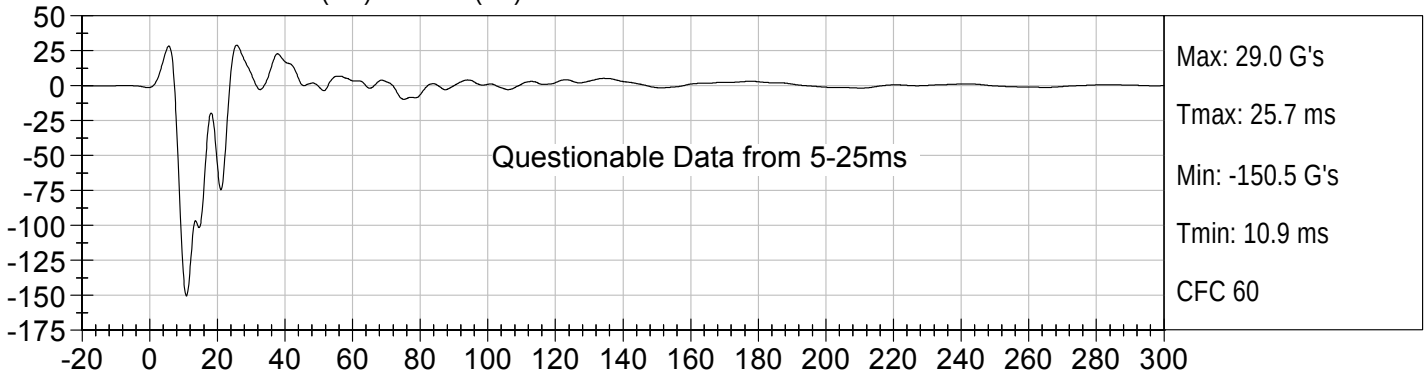
LEFT LOWER B-POST Y Velocity (kph) vs TIME (ms)



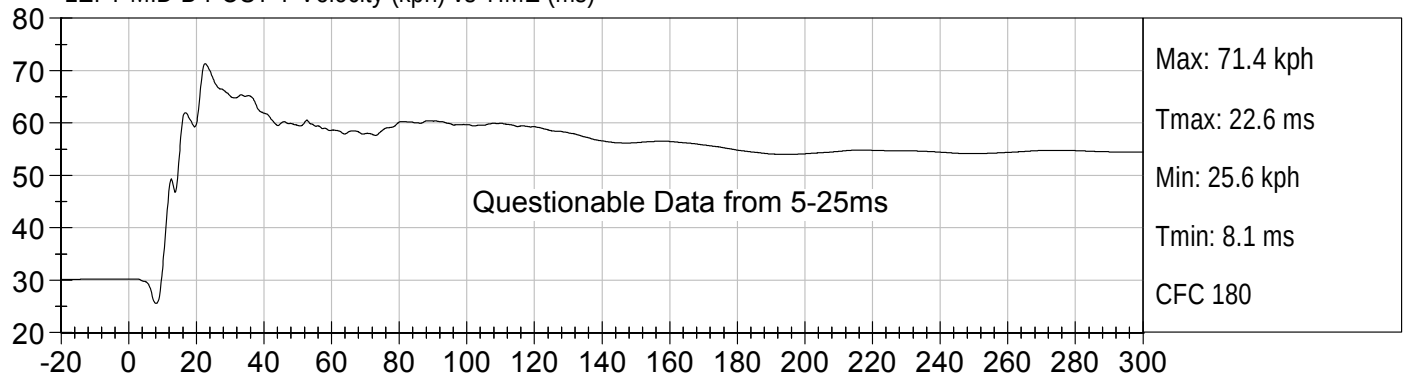
LEFT LOWER B-POST Y Displacement (mm) vs TIME (ms)



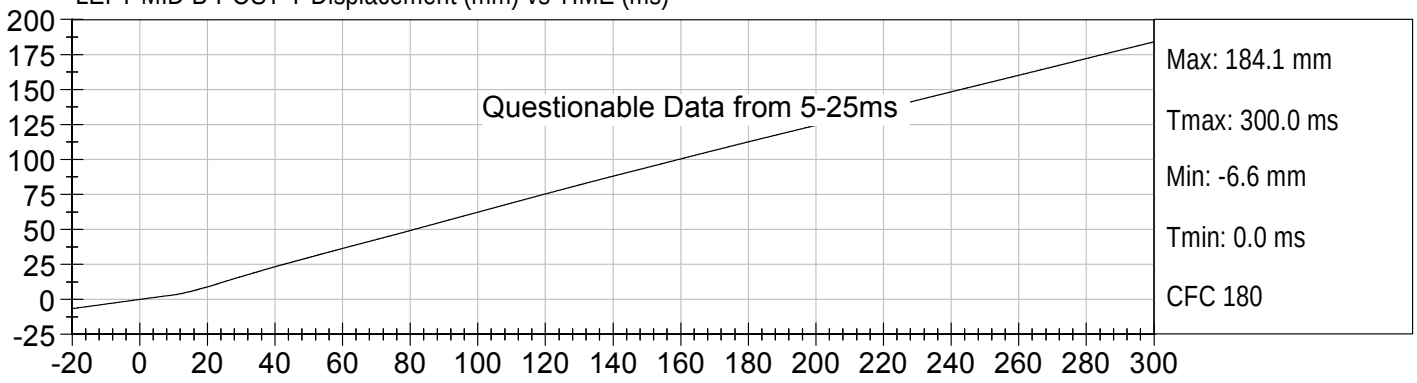
LEFT MID B-POST Y (G's) vs TIME (ms)



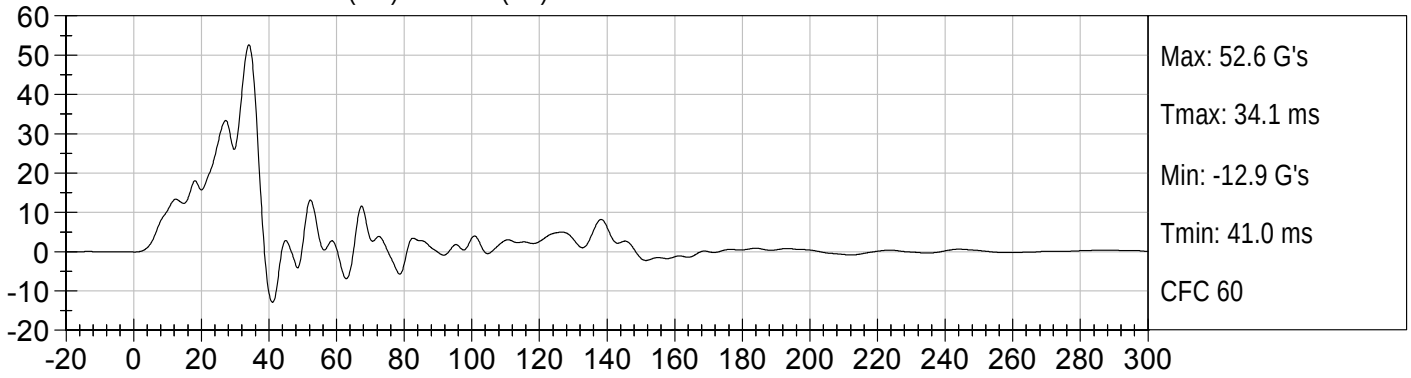
LEFT MID B-POST Y Velocity (kph) vs TIME (ms)



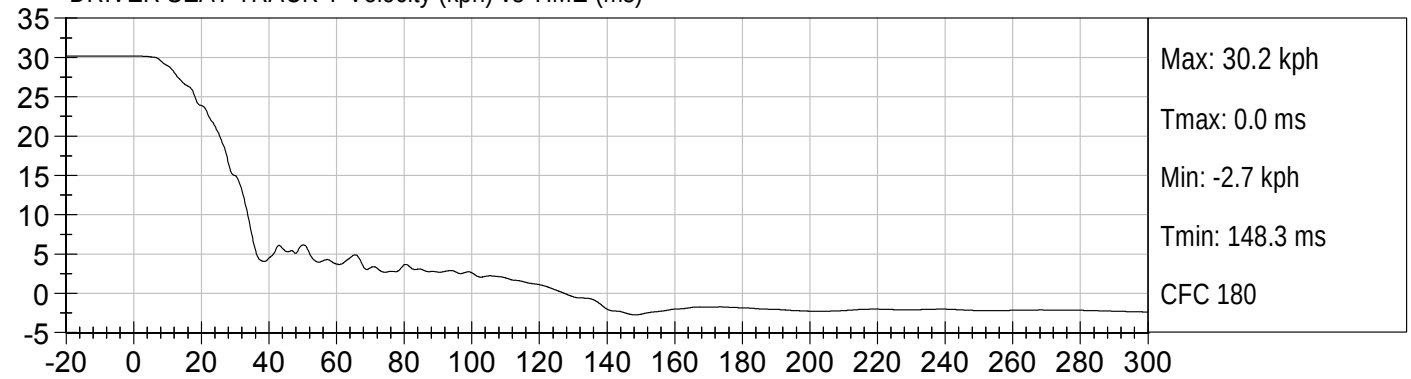
LEFT MID B-POST Y Displacement (mm) vs TIME (ms)



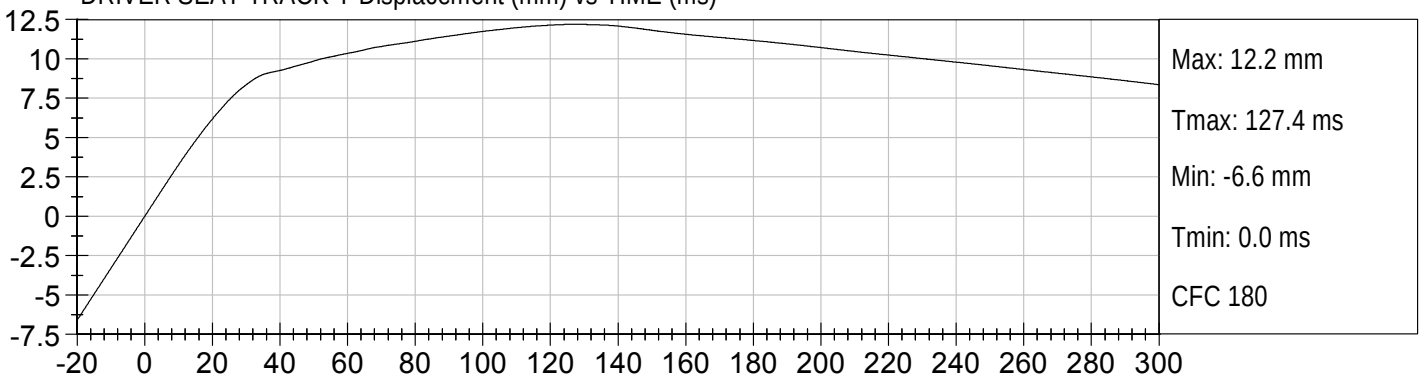
DRIVER SEAT TRACK Y (G's) vs TIME (ms)



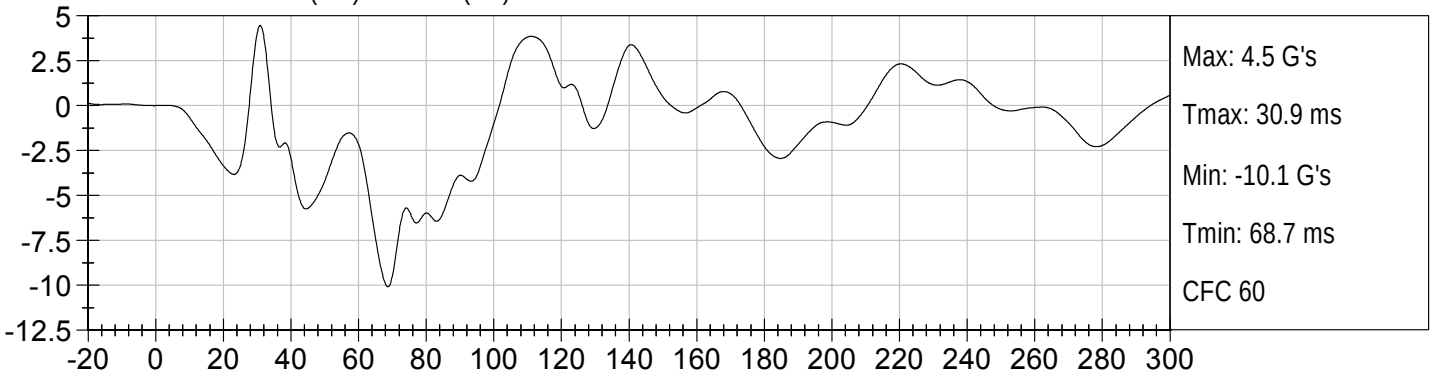
DRIVER SEAT TRACK Y Velocity (kph) vs TIME (ms)



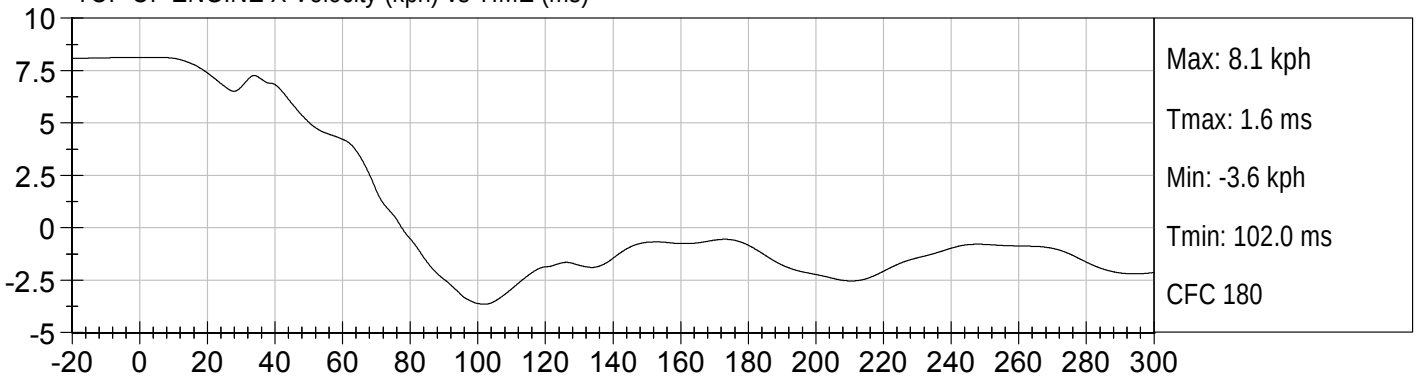
DRIVER SEAT TRACK Y Displacement (mm) vs TIME (ms)



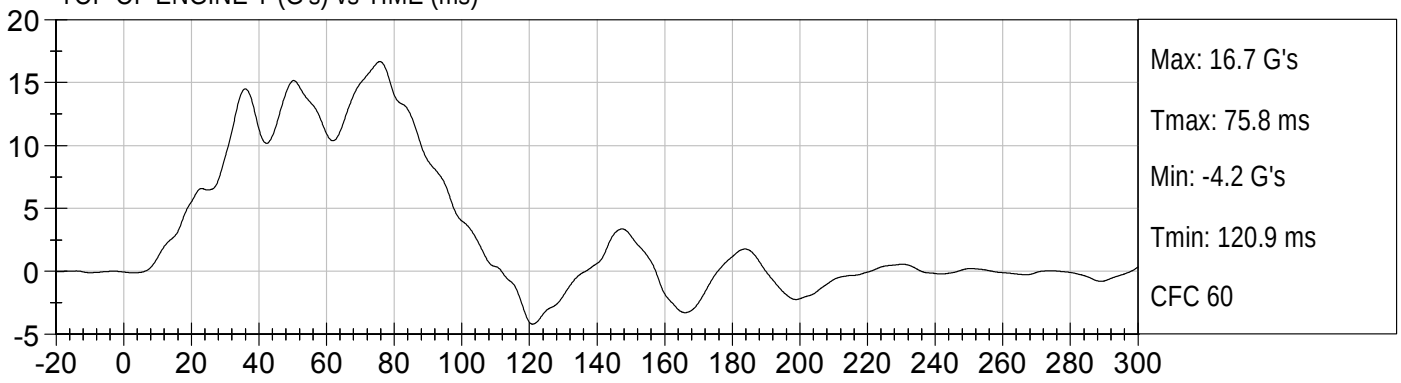
TOP OF ENGINE X (G's) vs TIME (ms)



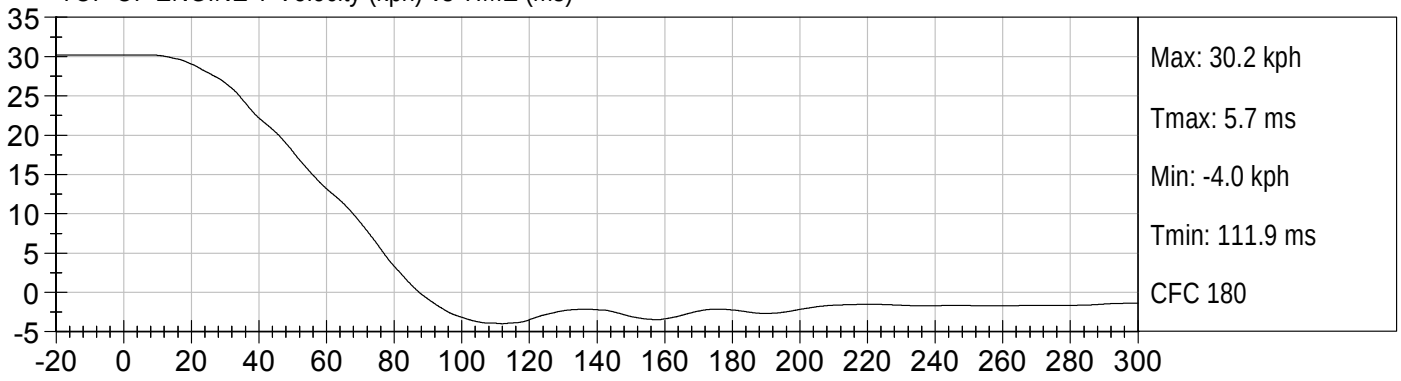
TOP OF ENGINE X Velocity (kph) vs TIME (ms)



TOP OF ENGINE Y (G's) vs TIME (ms)



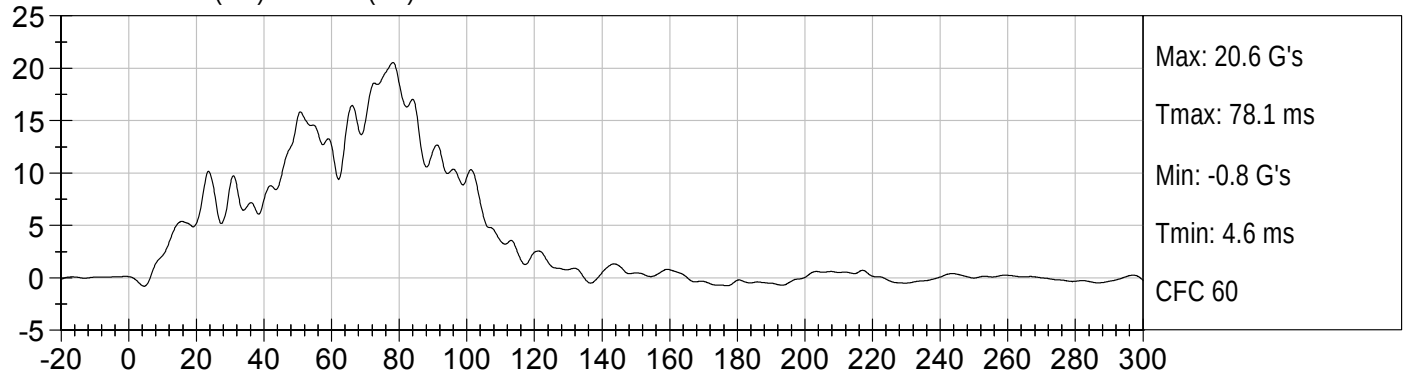
TOP OF ENGINE Y Velocity (kph) vs TIME (ms)



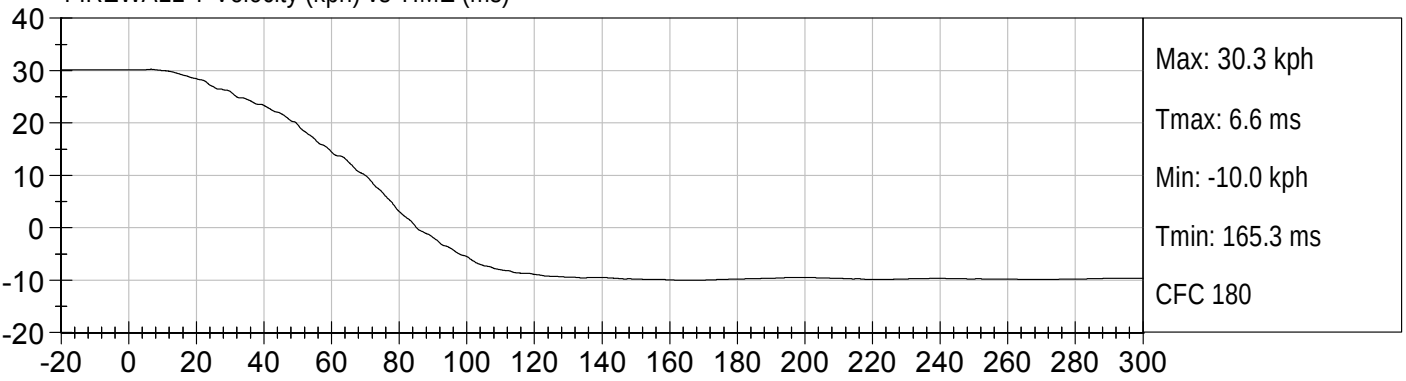
FMVSS 214 Rigid Pole Side Impact
2012 Mitsubishi i-MiEV - CC5602

Test Date: 05/23/2012
Speed: 19.4 mph (31.2 km/h)

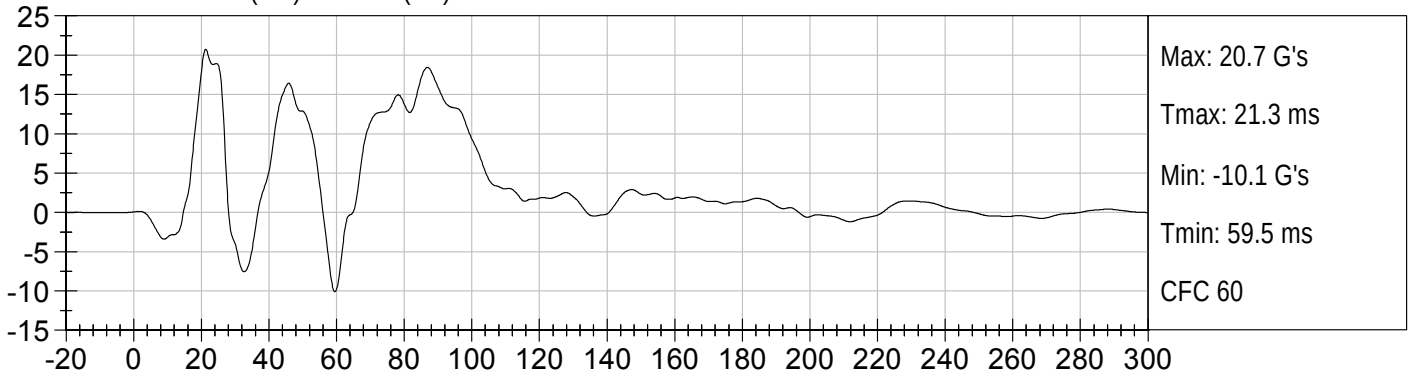
FIREWALL Y (G's) vs TIME (ms)



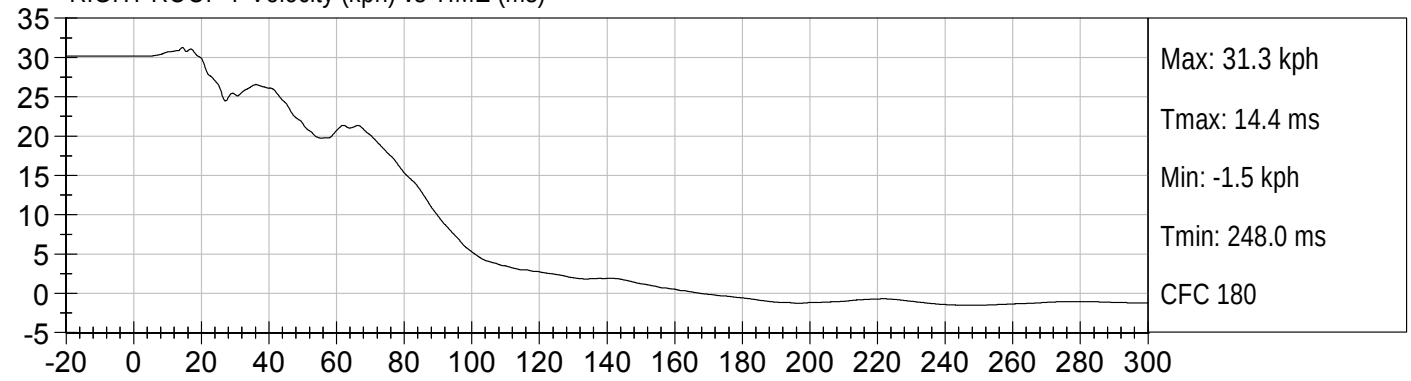
FIREWALL Y Velocity (kph) vs TIME (ms)



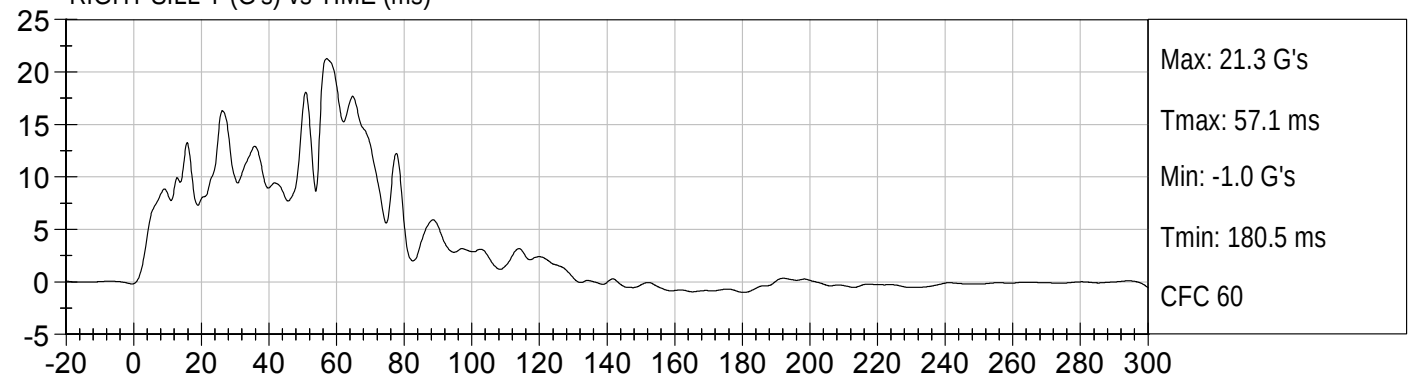
RIGHT ROOF Y (G's) vs TIME (ms)



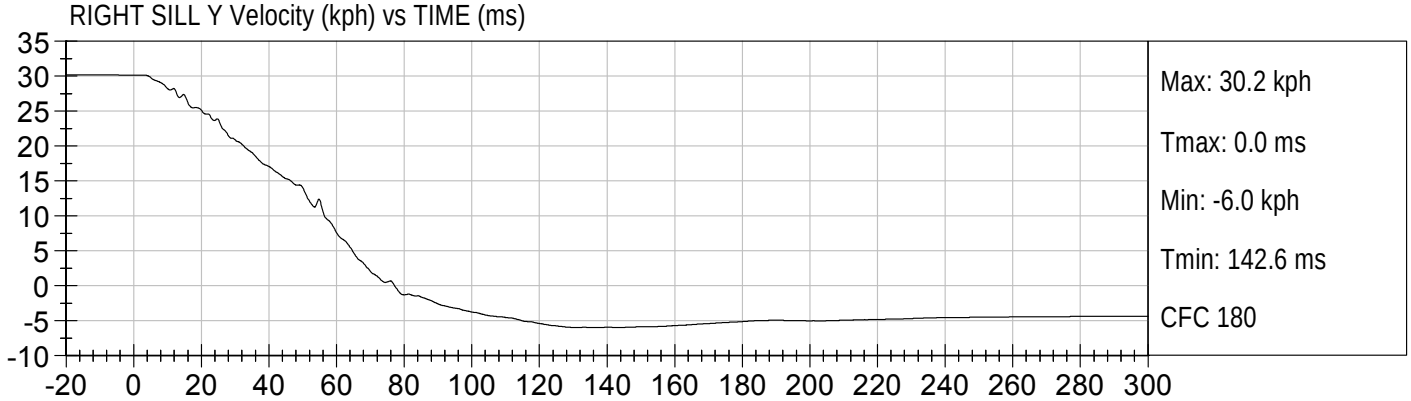
RIGHT ROOF Y Velocity (kph) vs TIME (ms)



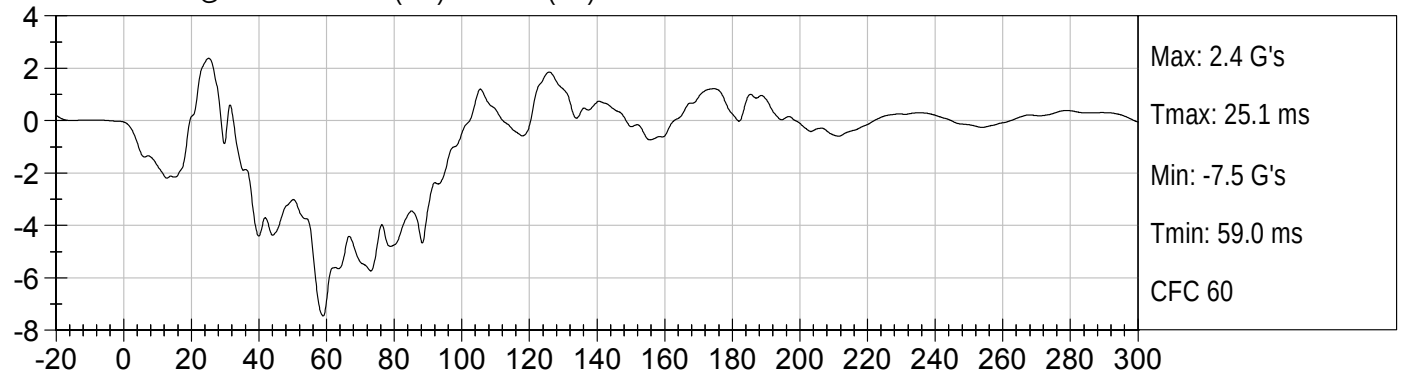
RIGHT SILL Y (G's) vs TIME (ms)



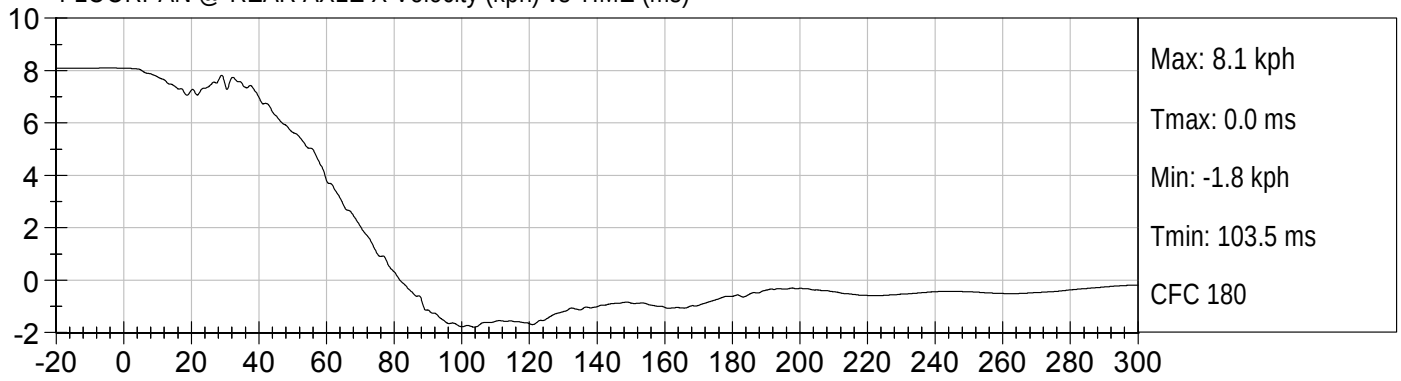
RIGHT SILL Y Velocity (kph) vs TIME (ms)



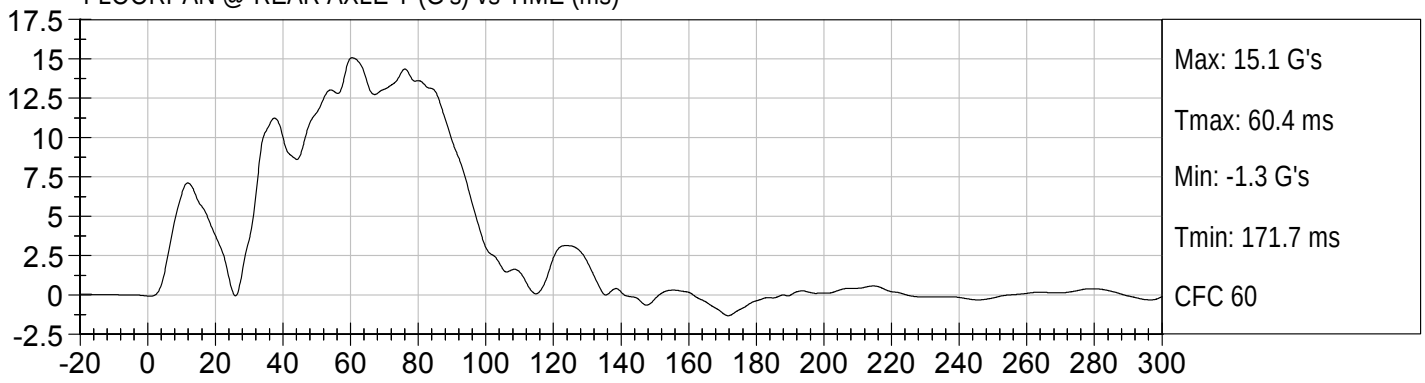
FLOORPAN @ REAR AXLE X (G's) vs TIME (ms)



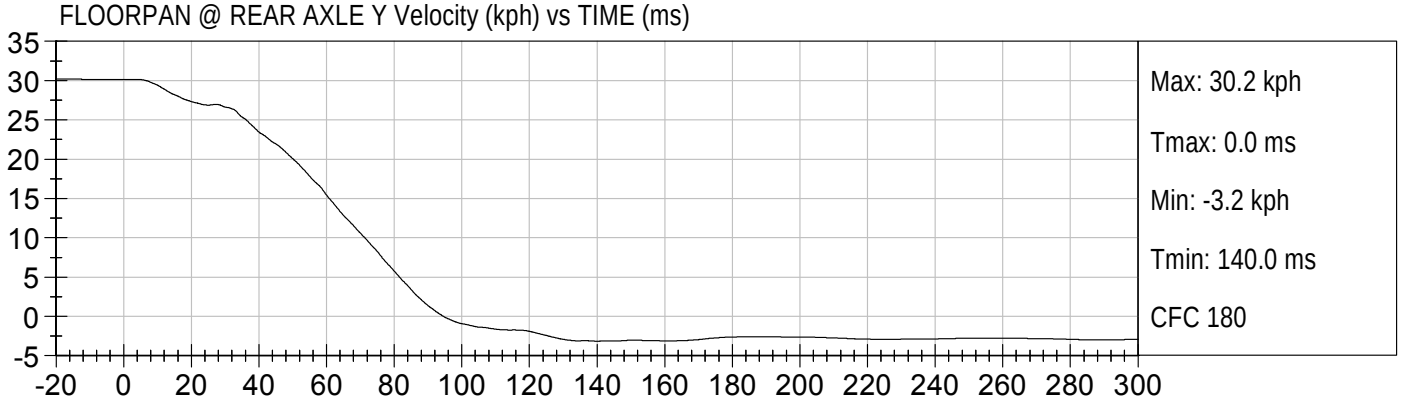
FLOORPAN @ REAR AXLE X Velocity (kph) vs TIME (ms)



FLOORPAN @ REAR AXLE Y (G's) vs TIME (ms)



FLOORPAN @ REAR AXLE Y Velocity (kph) 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:** D121701

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.0	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Peak Resultant Acceleration	G's	125 to 155	138	Pass
Peak Longitudinal Acceleration	G's	+/- 15	-8.8	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

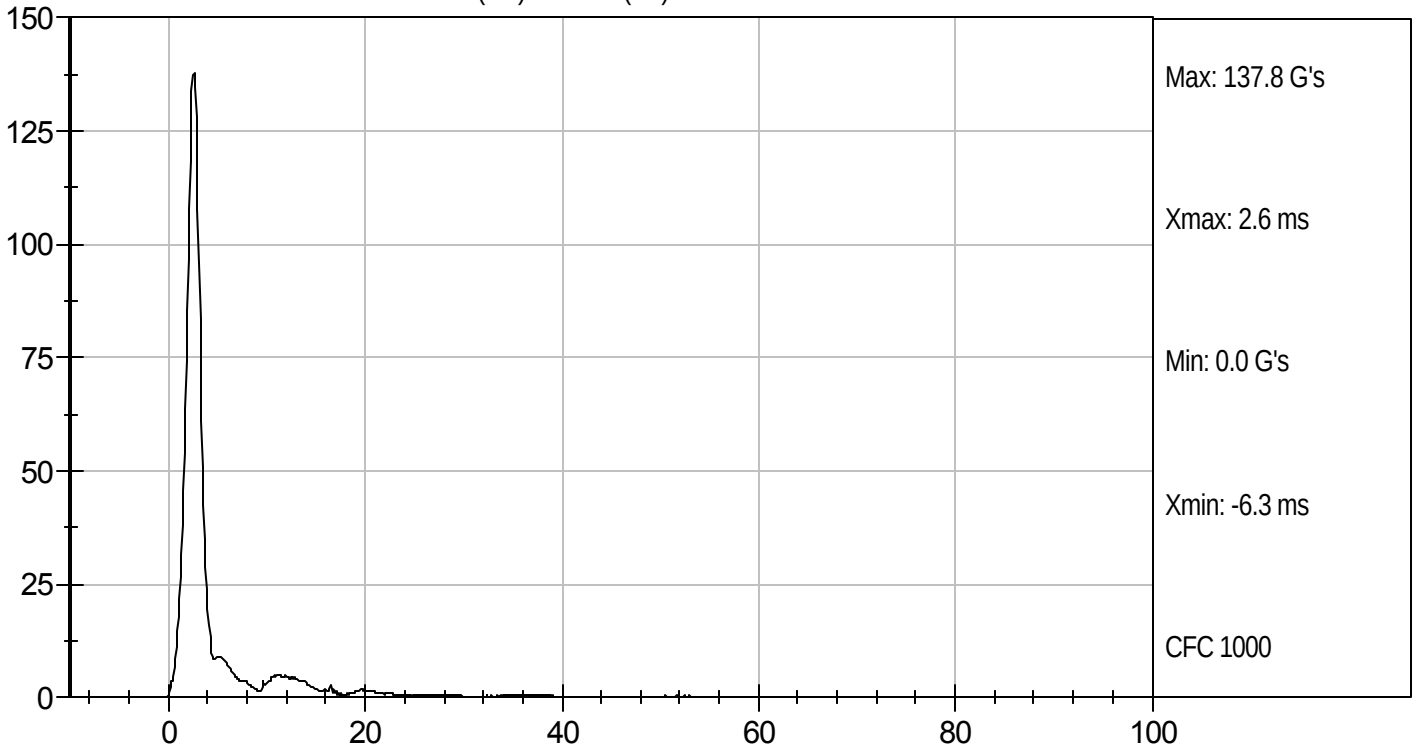
5/11/12
Test Date

David Winkelbauer
Approved By

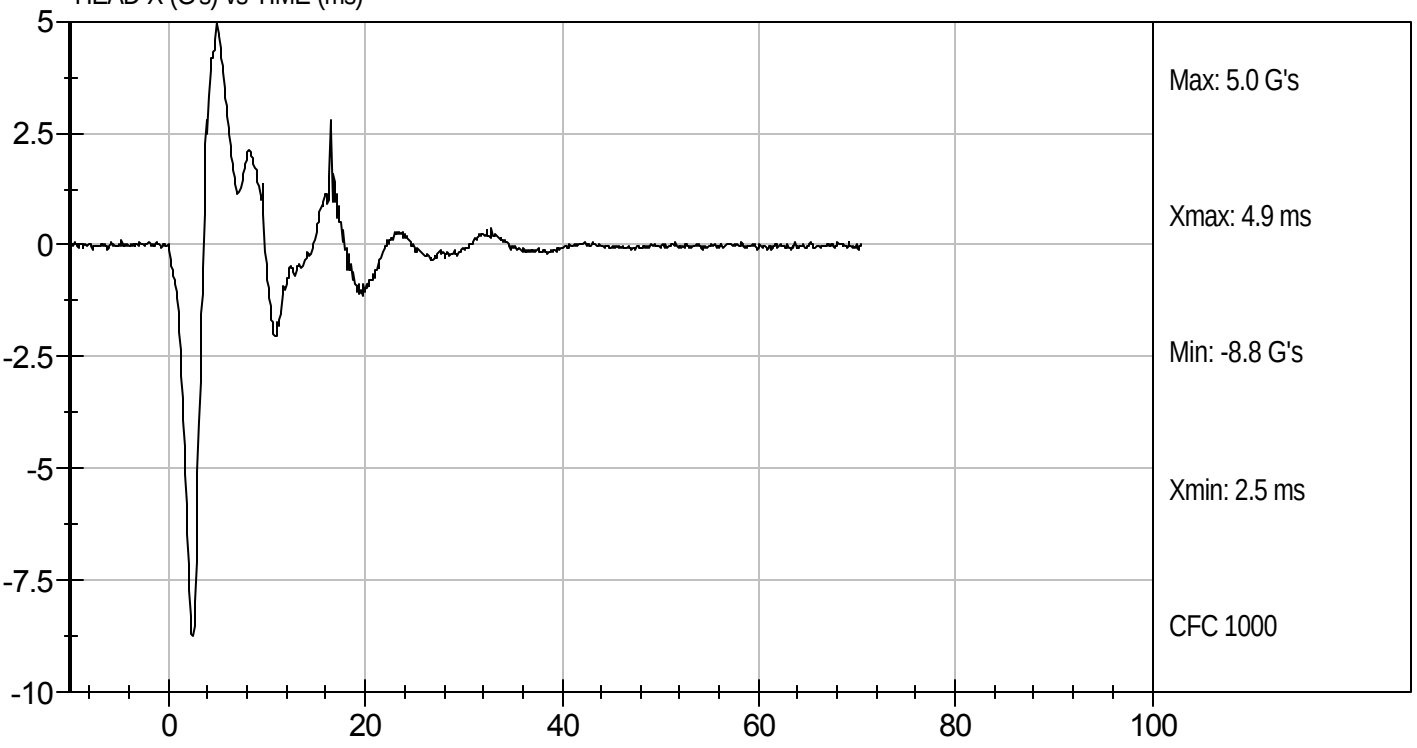
Test Desc: Head Drop
Component ID: D121701

Test Date: 5/11/12
Velocity: 0 ft/s, 0 m/s

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



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



MGA RESEARCH CORPORATION

NECK PENDULUM TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121702

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	18.0 to 22.0	21.4	Pass
Laboratory Relative Humidity		%	10 to 70	33	Pass
Pendulum Speed		m/s	3.3 to 3.5	3.3	Pass
Pendulum Deceleration	1 ms	m/s	0.00 to -0.05	-0.02	Pass
	3 ms	m/s	-0.25 to -0.375	-0.34	Pass
	14 ms	m/s	-3.20 to -3.70	-3.28	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	49.1	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	55.5	Pass
Head Rotation Decay Time to 0 degree		ms	53.0 to 88.0	60.4	Pass
			Overall Test Results		Pass

Jessica Gall
Laboratory Technician

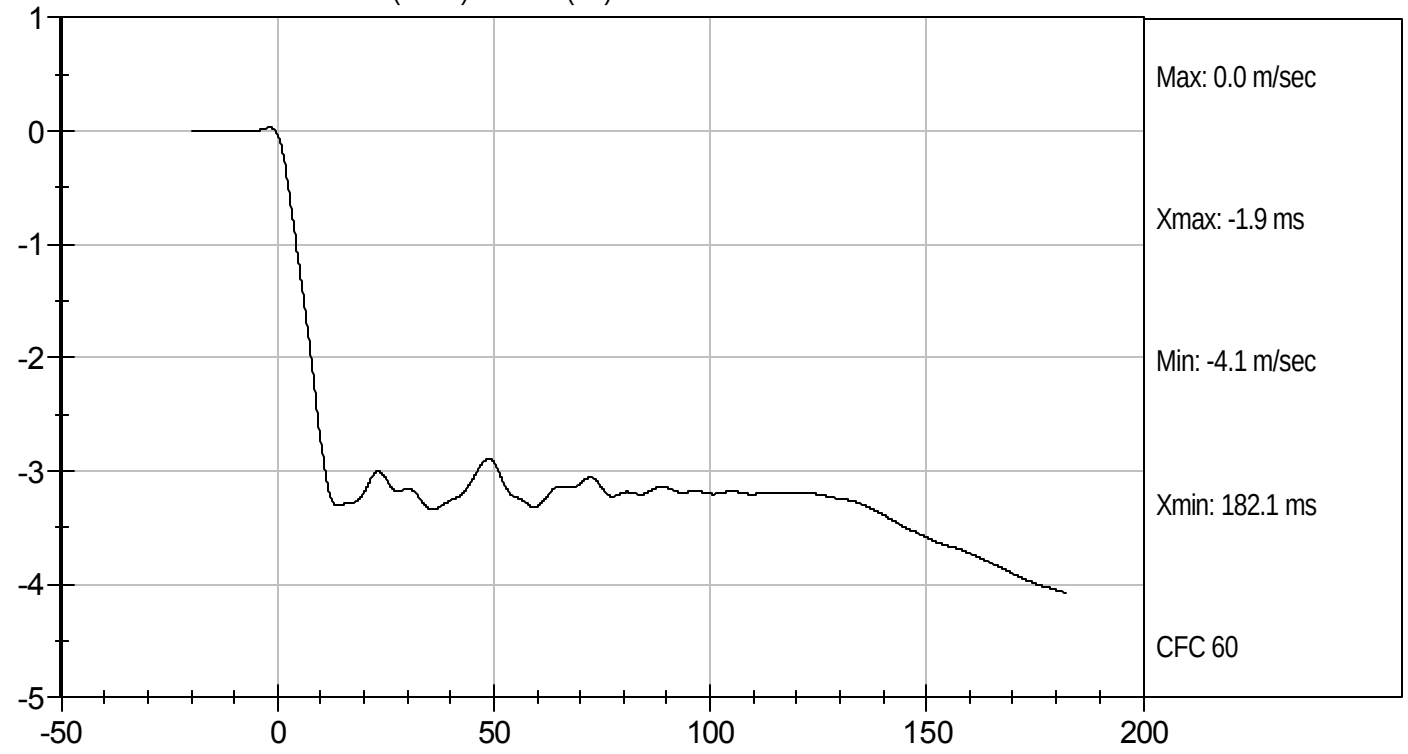
5/11/12
Test Date

David Winkelbauer
Approved By

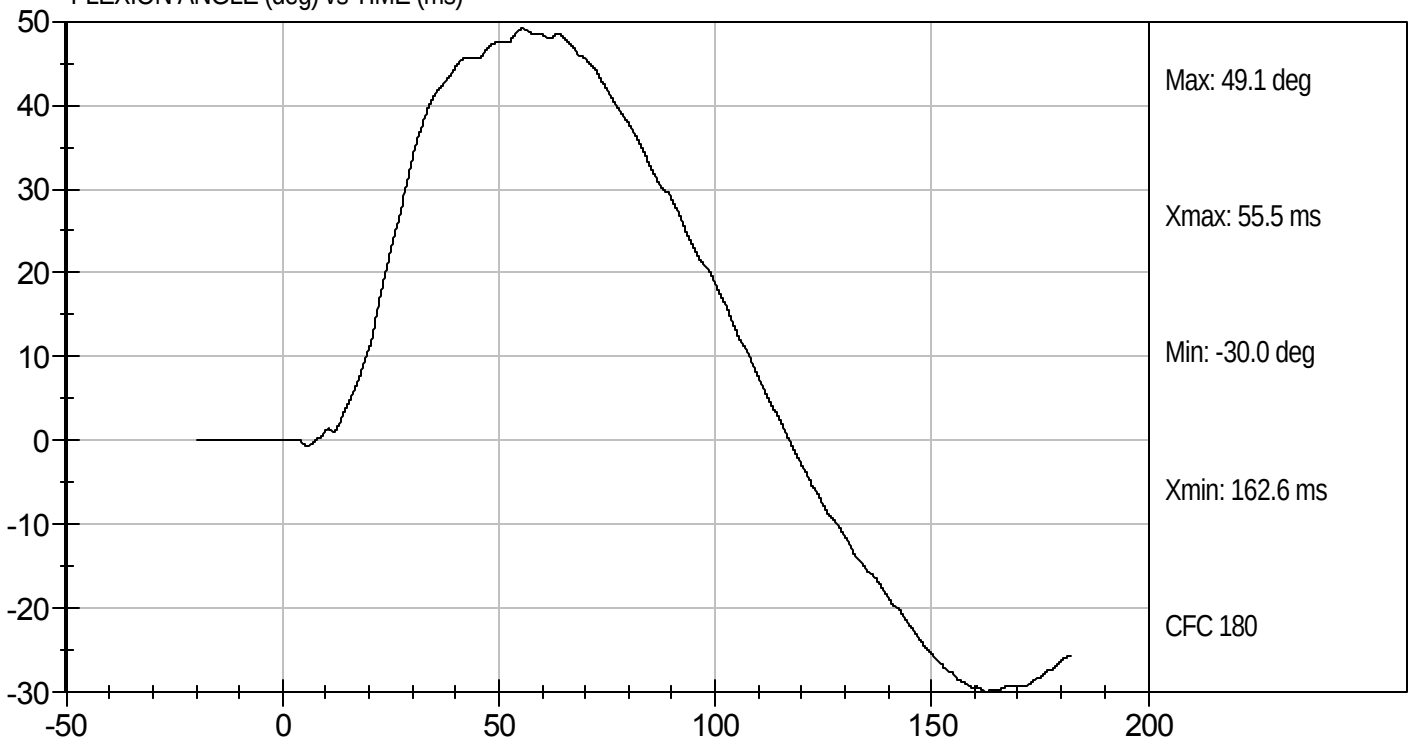
Test Desc: Neck Bending
Component ID: D121702

Test Date: 5/11/12
Velocity: 10.96 ft/s, 3.3 m/s

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

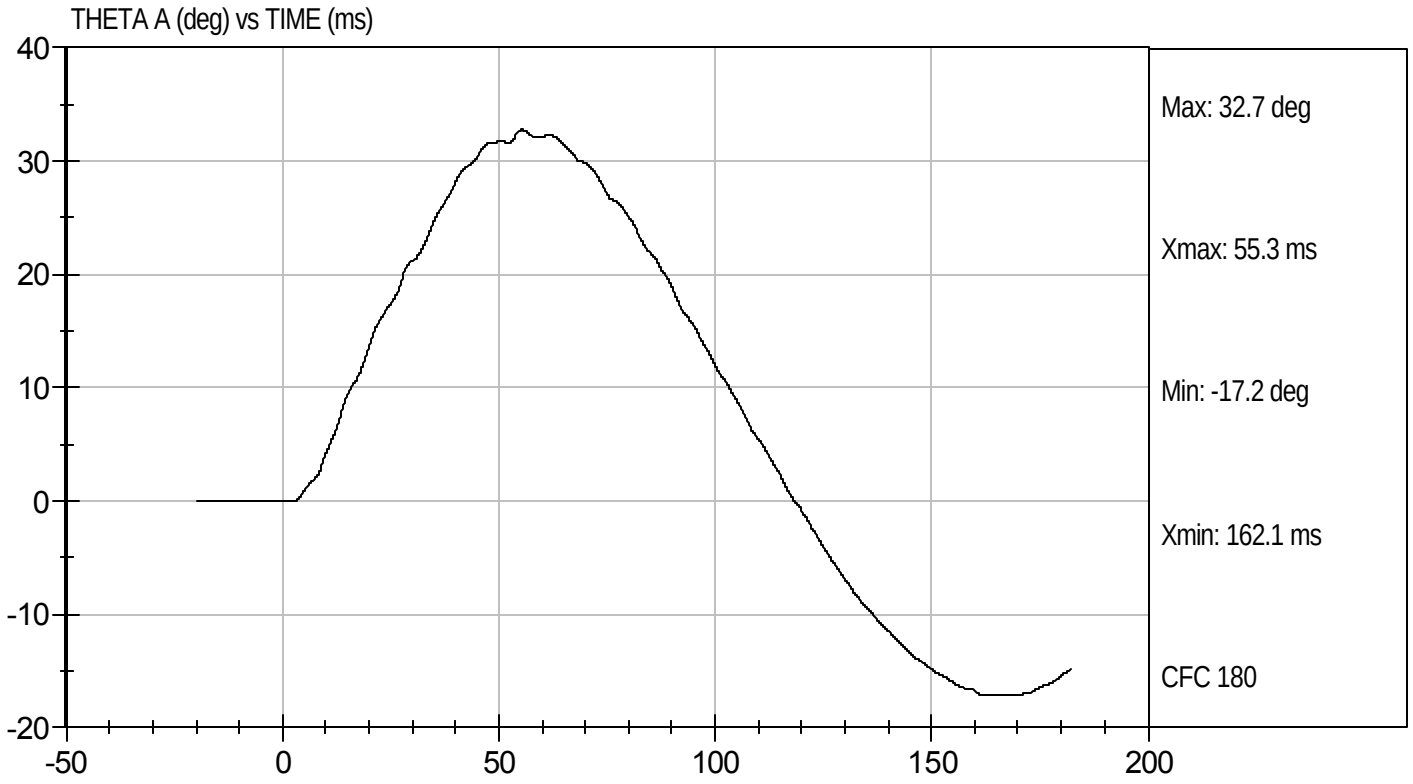


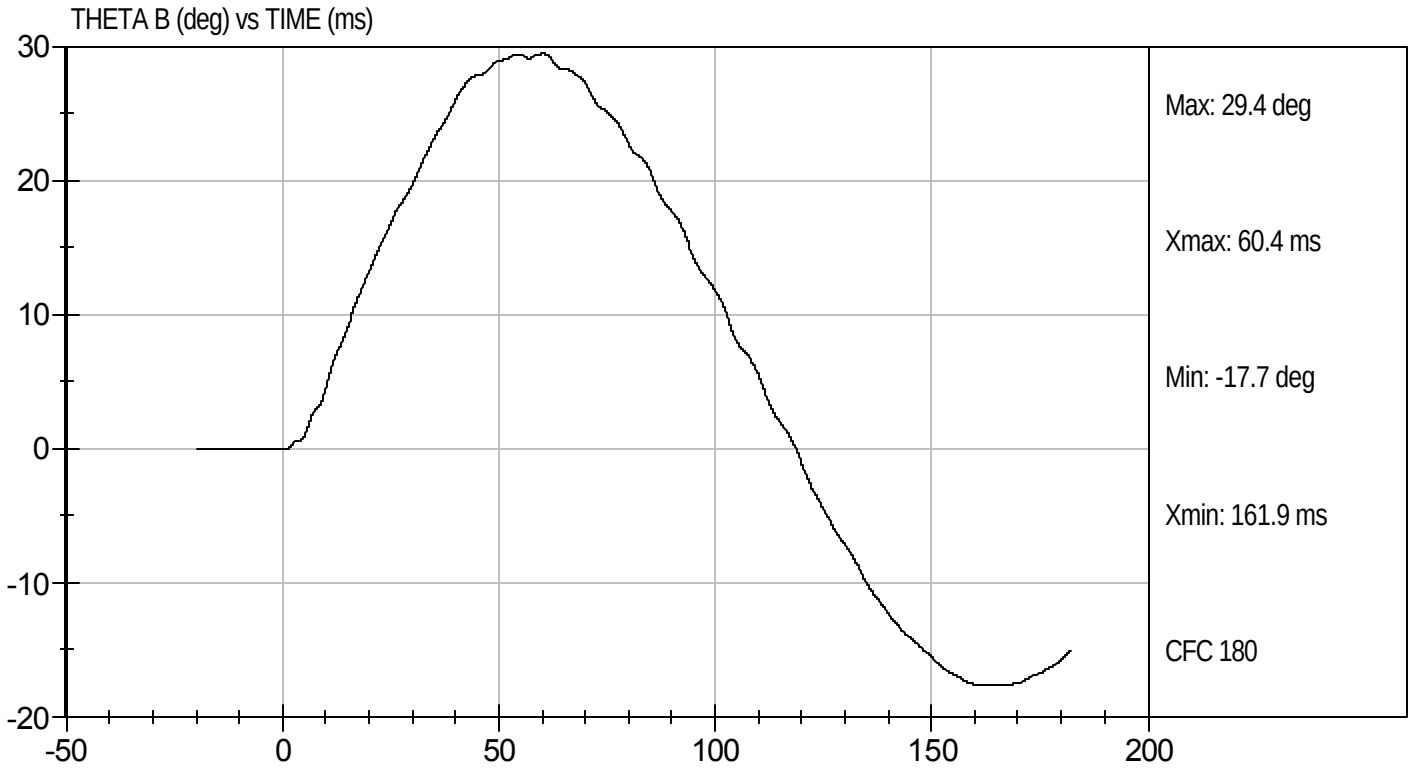
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Neck Bending
Component ID: D121702

Test Date: 5/11/12
Velocity: 10.96 ft/s, 3.3 m/s





MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121703

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	35	Pass
Pendulum Speed	m/s	4.2 to 4.4	4.3	Pass
Peak Shoulder Acceleration	G's	7.5 to 10.5	9.4	Pass
Time of Peak Shoulder Acceleration	ms	NA	18.4	Pass
		Overall Test Results		Pass

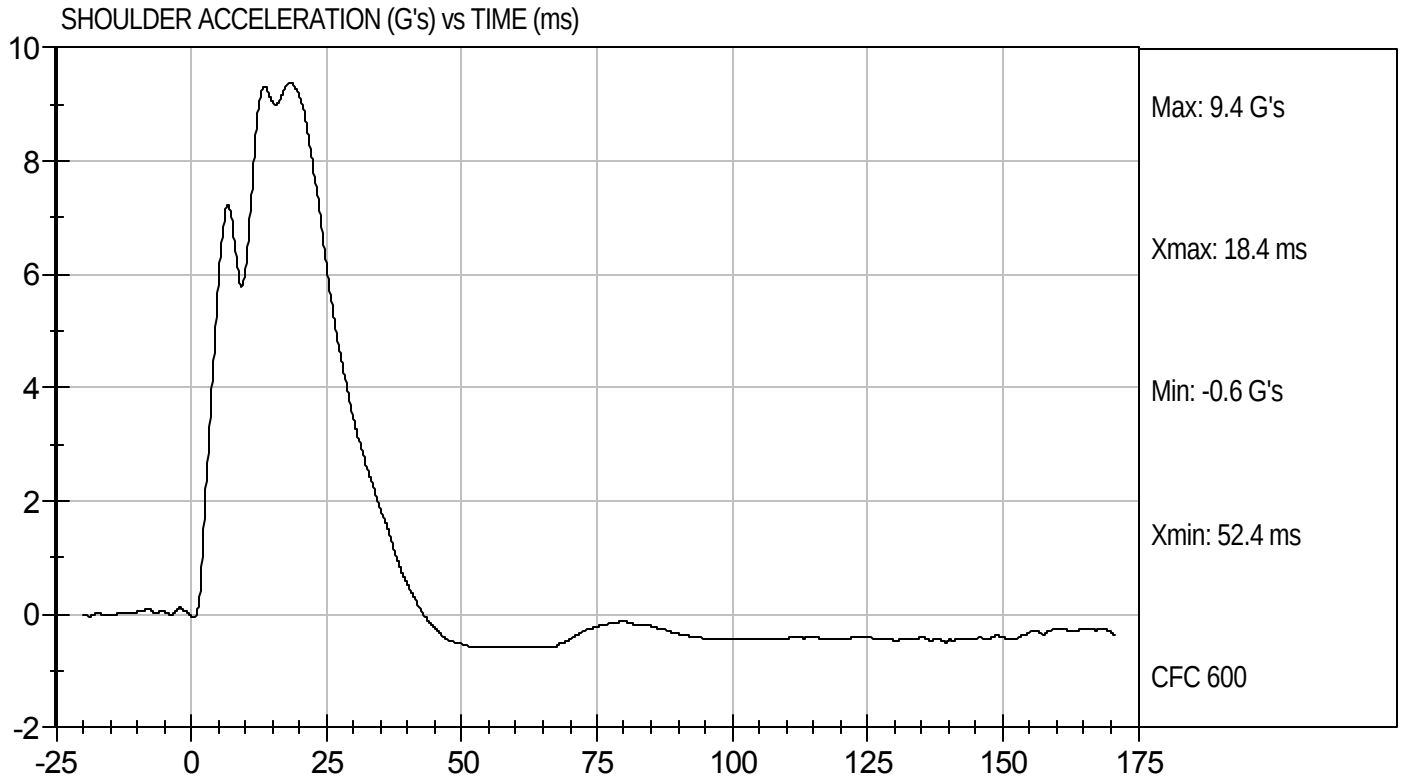
Jessica Hall
Laboratory Technician

5/11/12
Test Date

David Winkelbauer
Approved By

Test Desc: Shoulder Impact
Component ID: D121703

Test Date: 5/11/12
Velocity: 14.25 ft/s, 4.3 m/s



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121704

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	37	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	37.8	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	48.4	Pass
		Overall Test Results		Pass

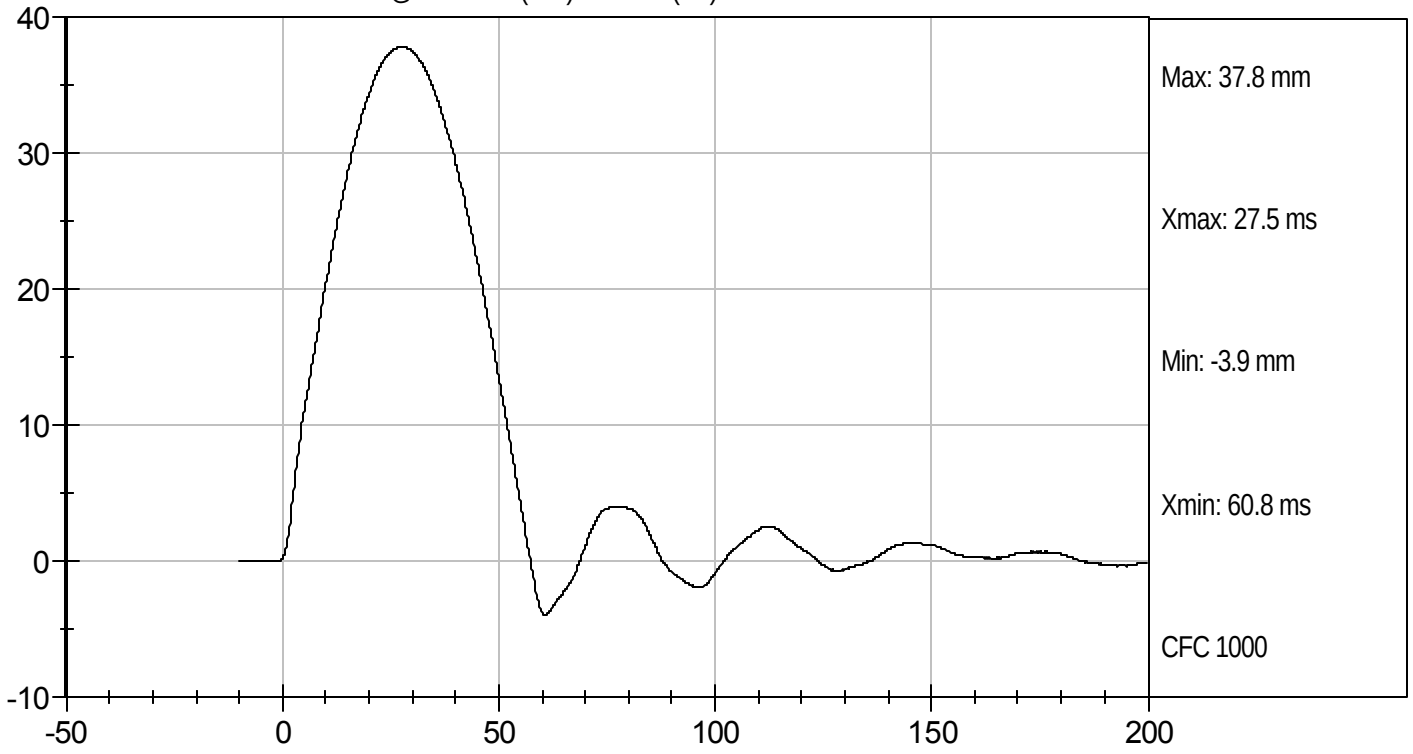
Jessica Hall
Laboratory Technician

5/11/12
Test Date

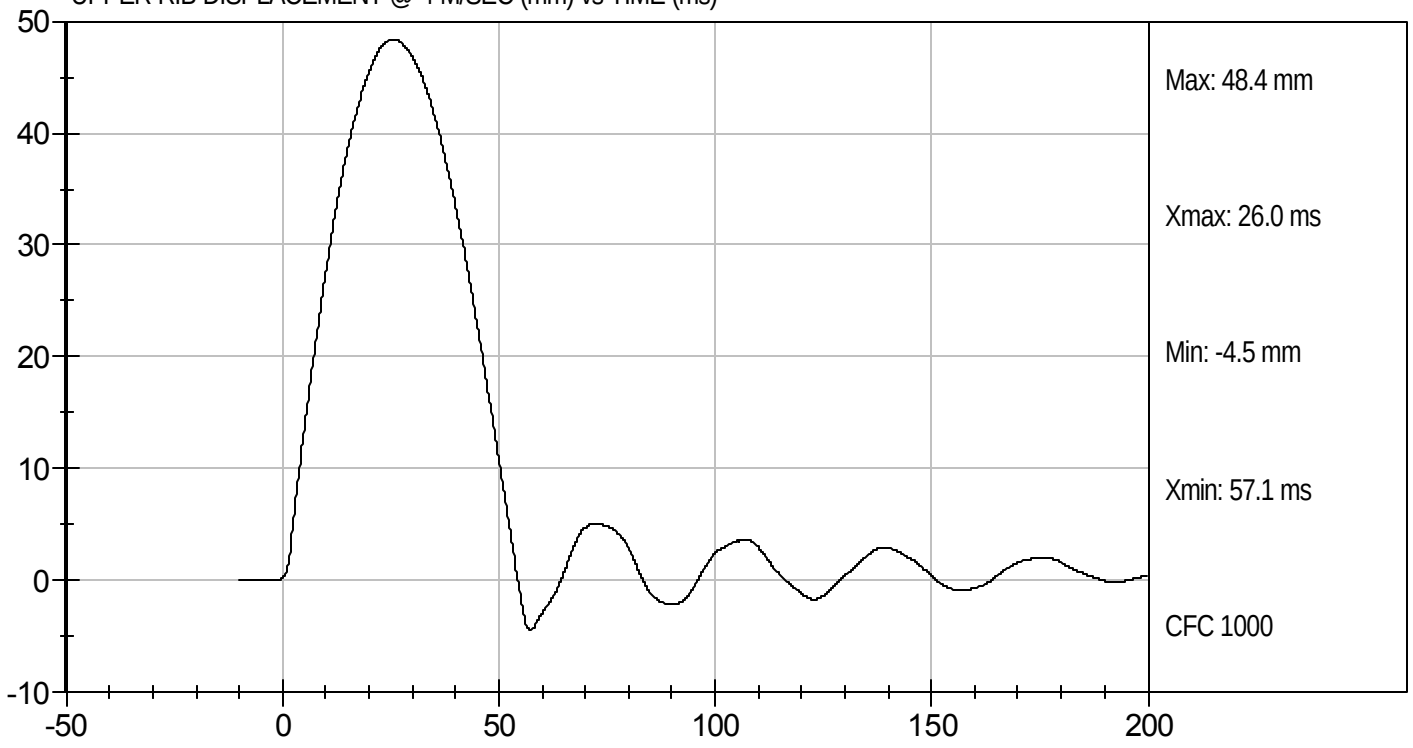
David Winkelbauer
Approved By

Test Desc: Rib Impact - Upper
Component ID: D121704
Test Date: 5/11/12

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:** D121705

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	37	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.0	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	48.2	Pass
		Overall Test Results		Pass

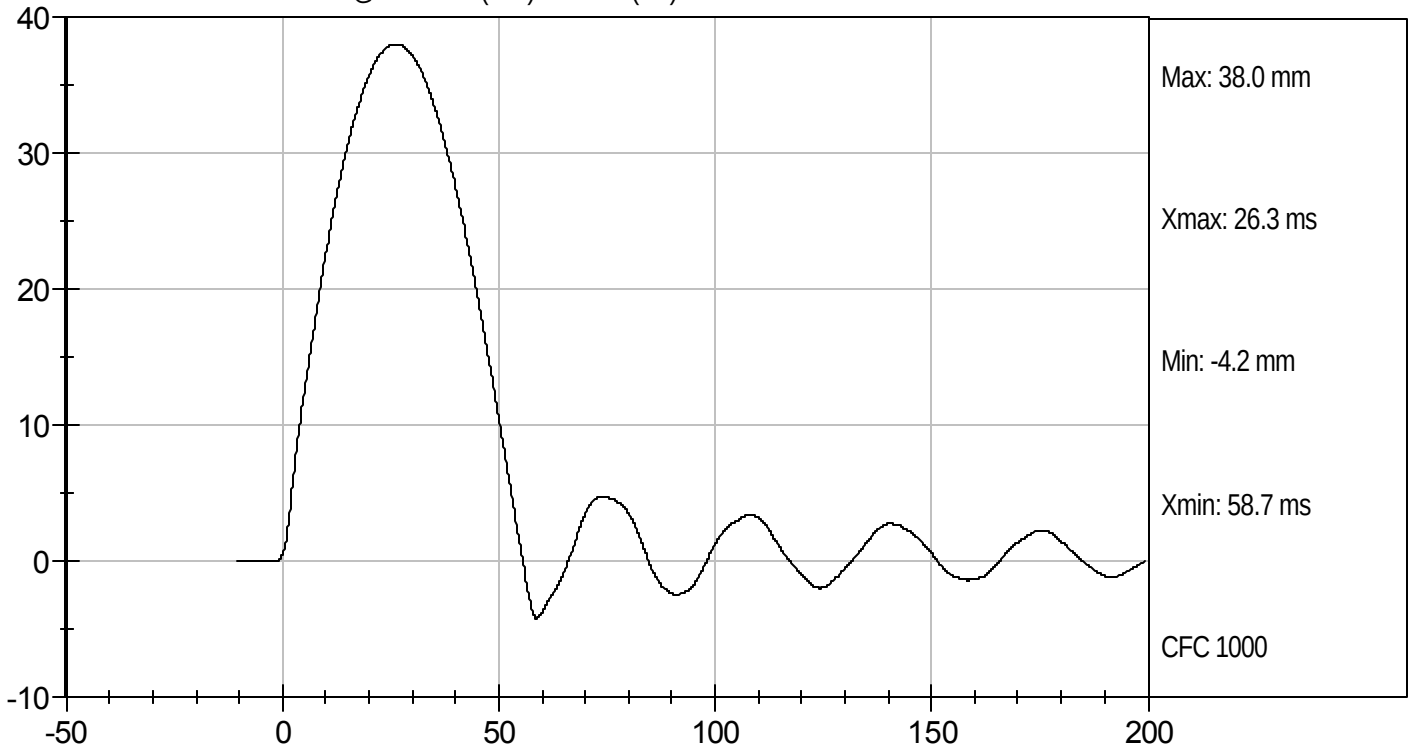
Jessica Hall
Laboratory Technician

5/11/12
Test Date

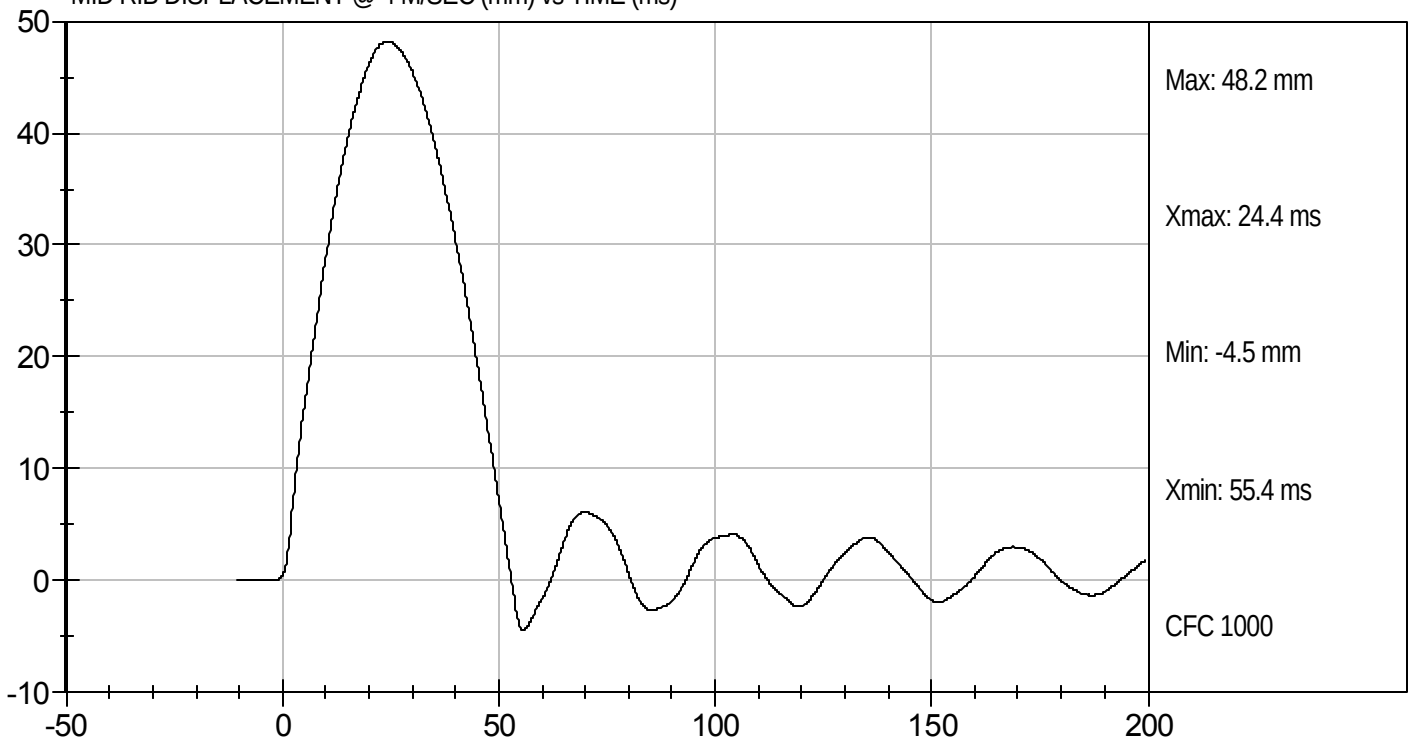
David Winkelbauer
Approved By

Test Desc: Rib Impact - Mid
Component ID: D121705
Test Date: 5/11/12

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:** D121706

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	37	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.2	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.1	Pass
		Overall Test Results		Pass

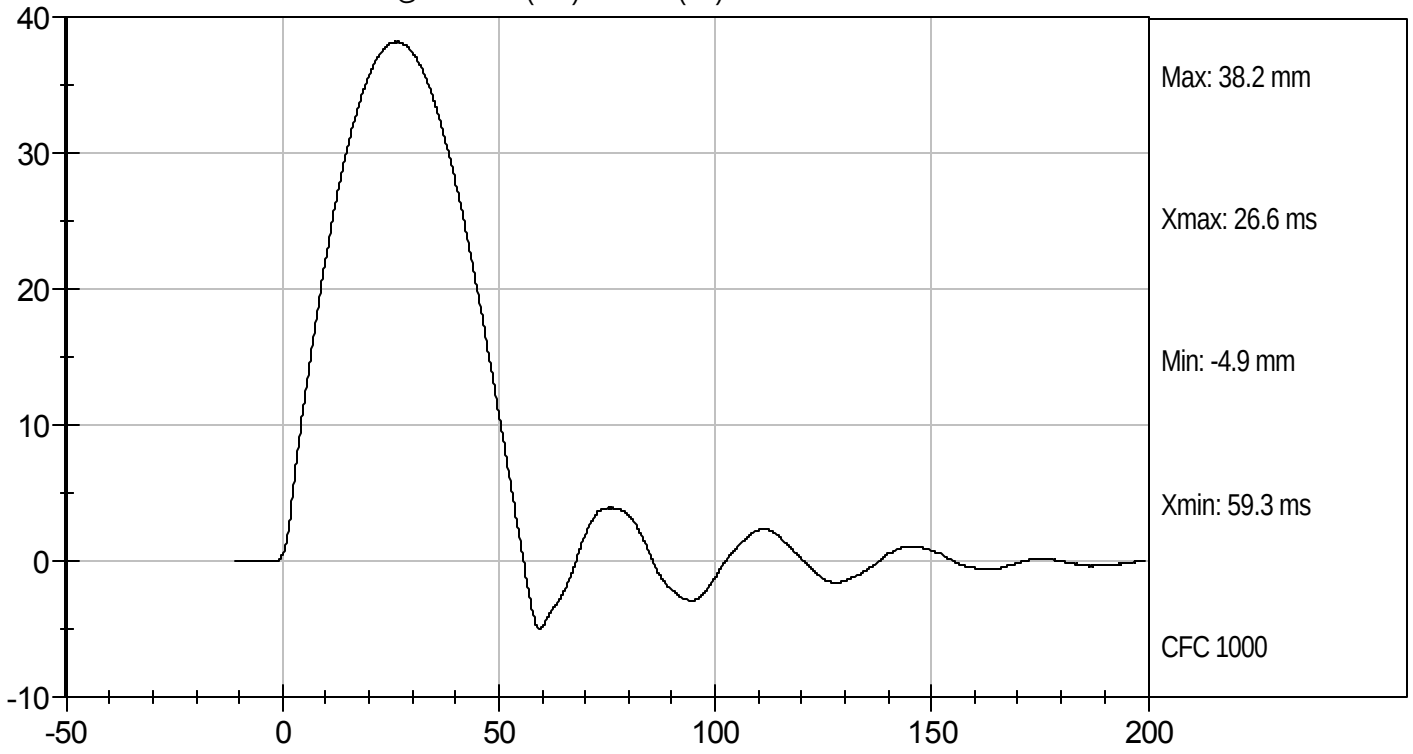
Jessica Gall
Laboratory Technician

5/11/12
Test Date

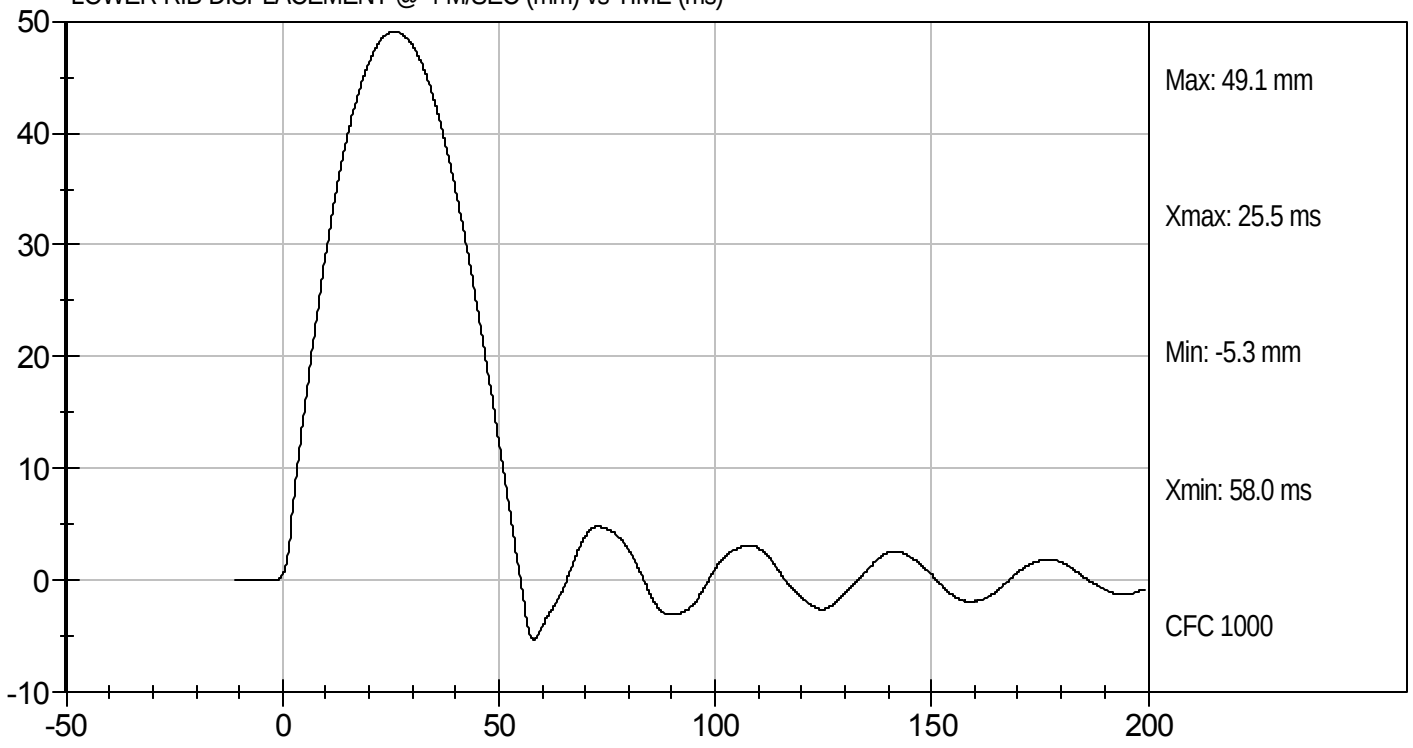
David Winkelbauer
Approved By

Test Desc: Rib Impact - Lower
Component ID: D121706
Test Date: 5/11/12

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:** D121707

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.2	Pass
Laboratory Relative Humidity	%	10 to 70	35	Pass
Probe Speed	m/s	3.90 to 4.10	4.10	Pass
Maximum Impact Force	kN	4.00 to 4.80	4.40	Pass
Time of Maximum Impactor Force	ms	10.60 to 13.00	11.60	Pass
Maximum Total Abdomen Force	kN	2.20 to 2.70	2.60	Pass
Time of Maximum Abdomen Force	ms	10.00 to 12.30	11.00	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

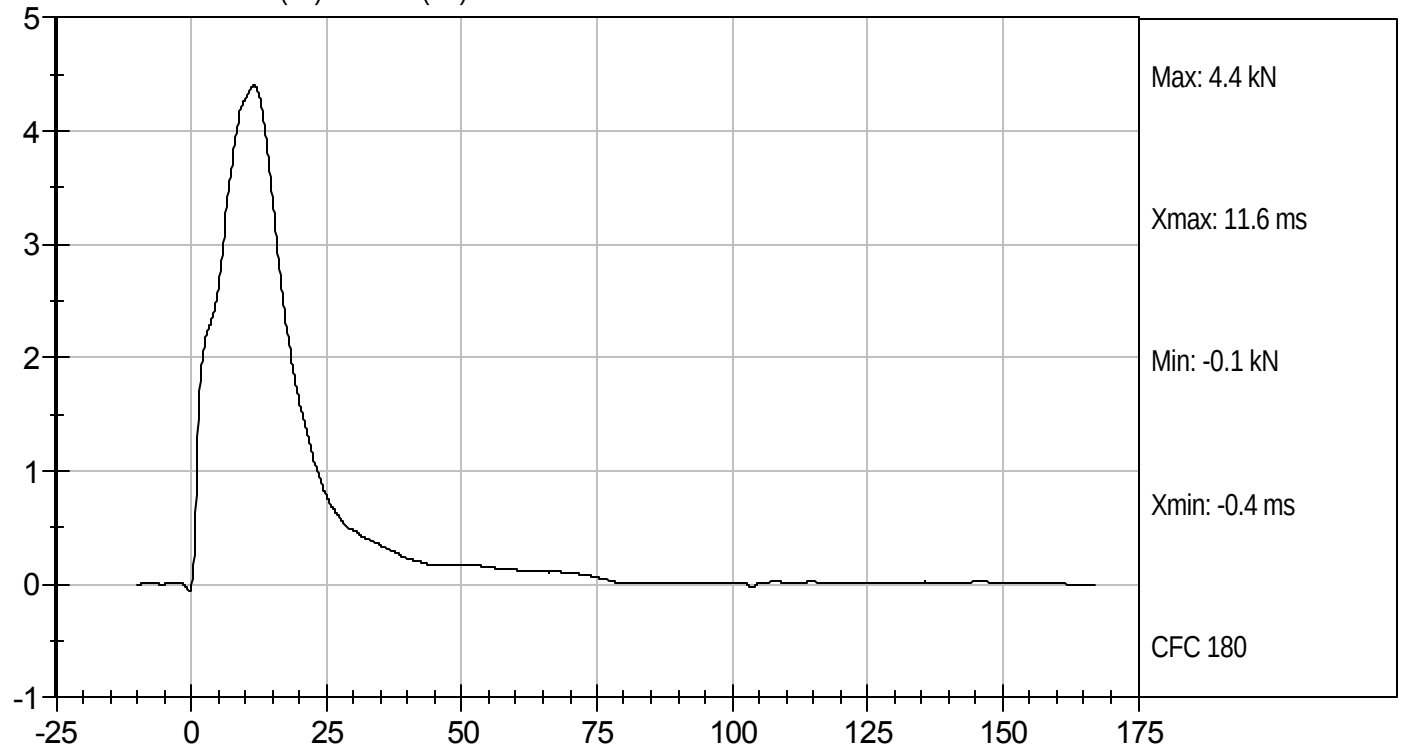
5/11/12
Test Date

David Winkelbauer
Approved By

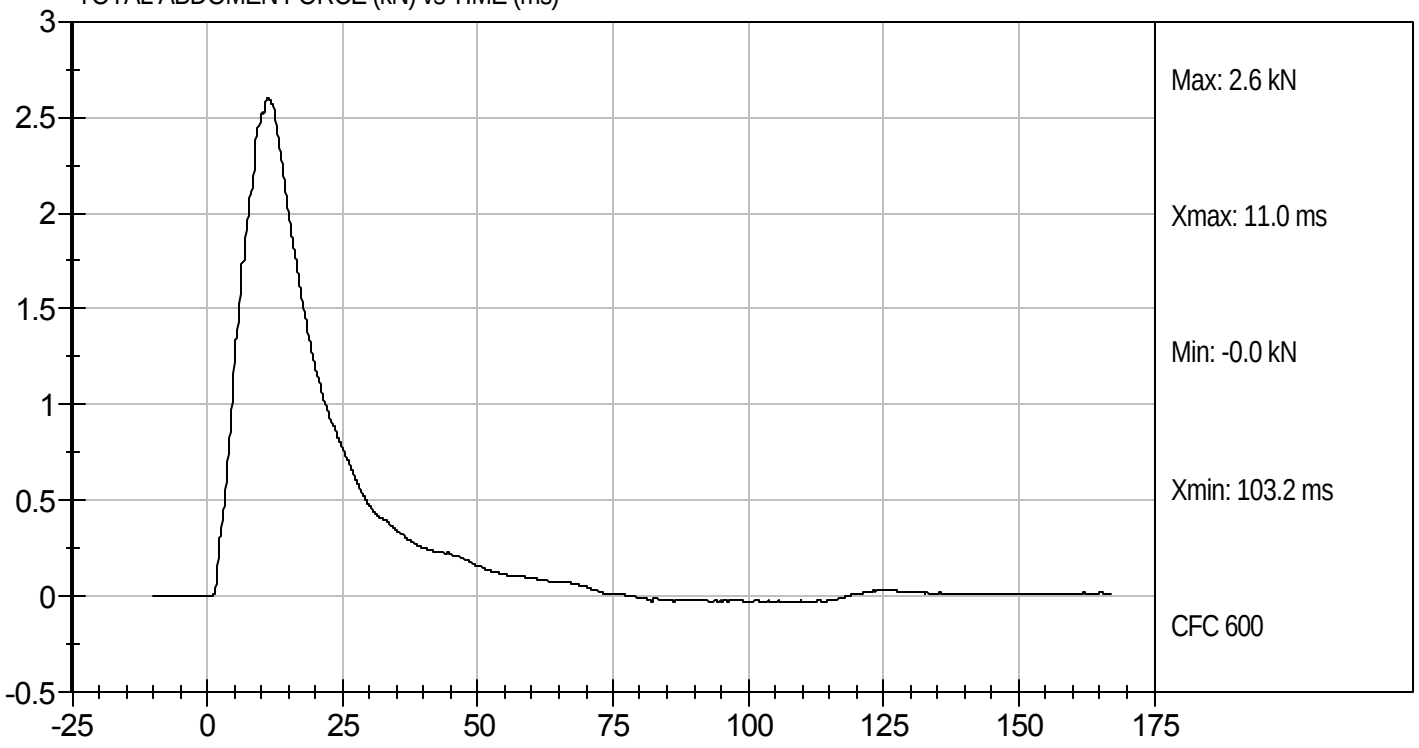
Test Desc: Abdomen Impact
Component ID: D121707

Test Date: 5/11/12
Velocity: 13.44 ft/s, 4.1 m/s

IMPACTOR FORCE (kN) vs TIME (ms)

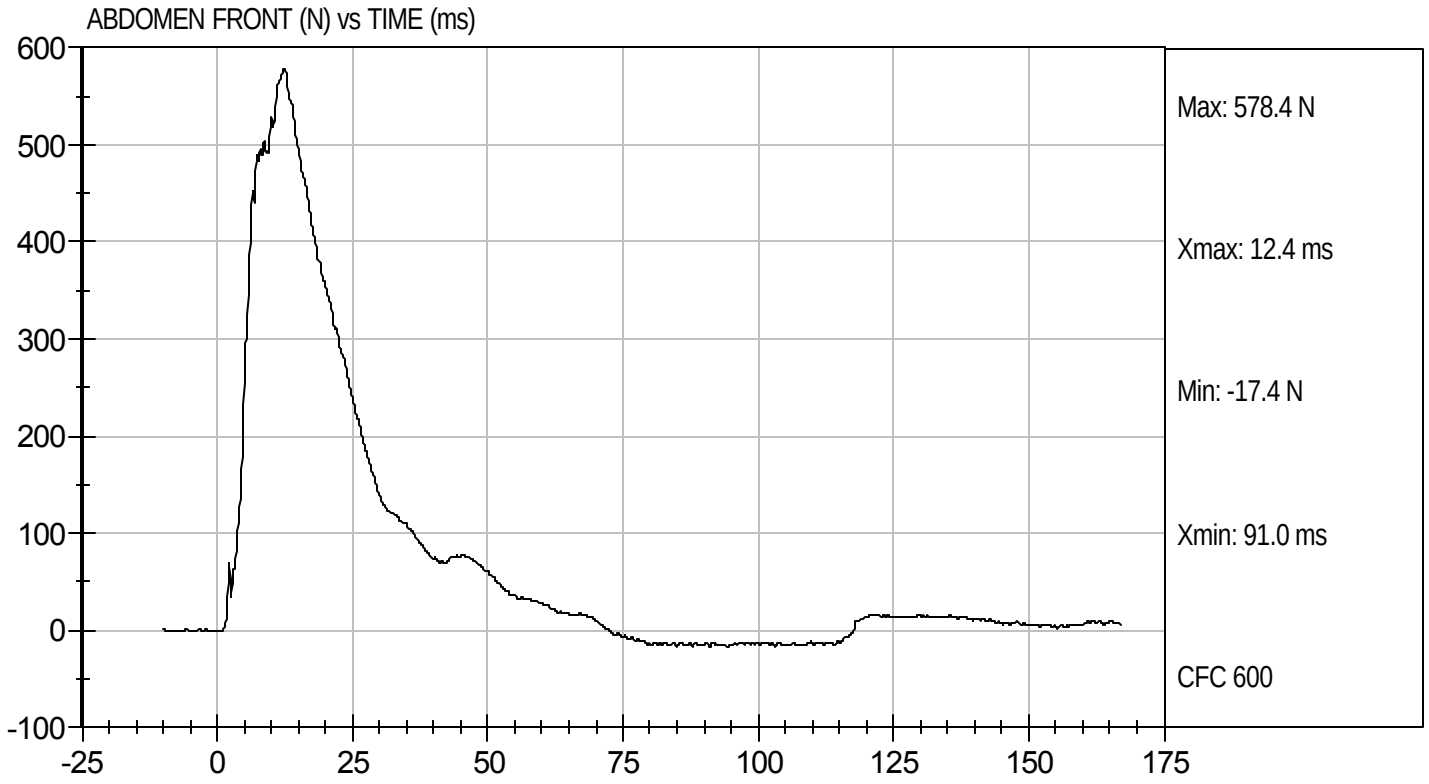


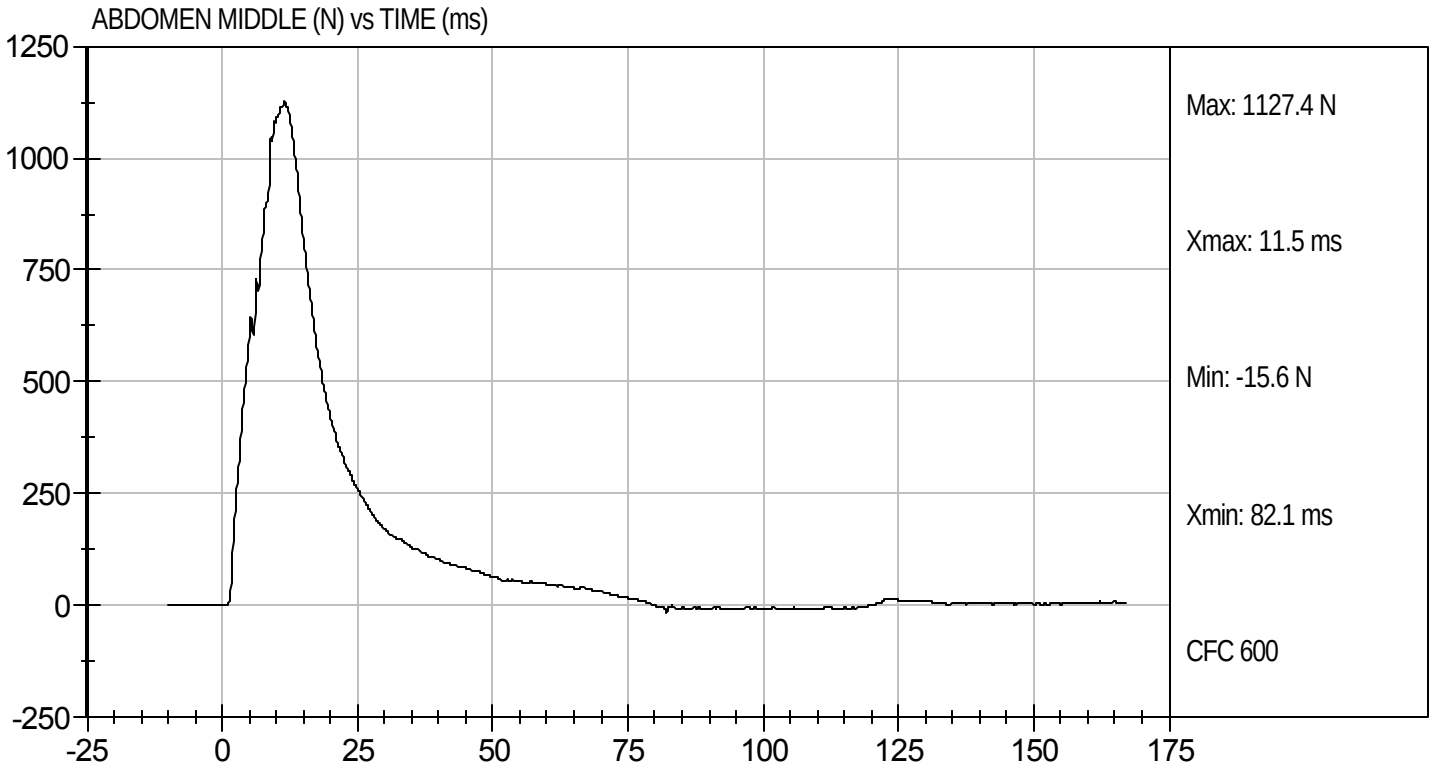
TOTAL ABDOMEN FORCE (kN) vs TIME (ms)



Test Desc: Abdomen Impact
Component ID: D121707

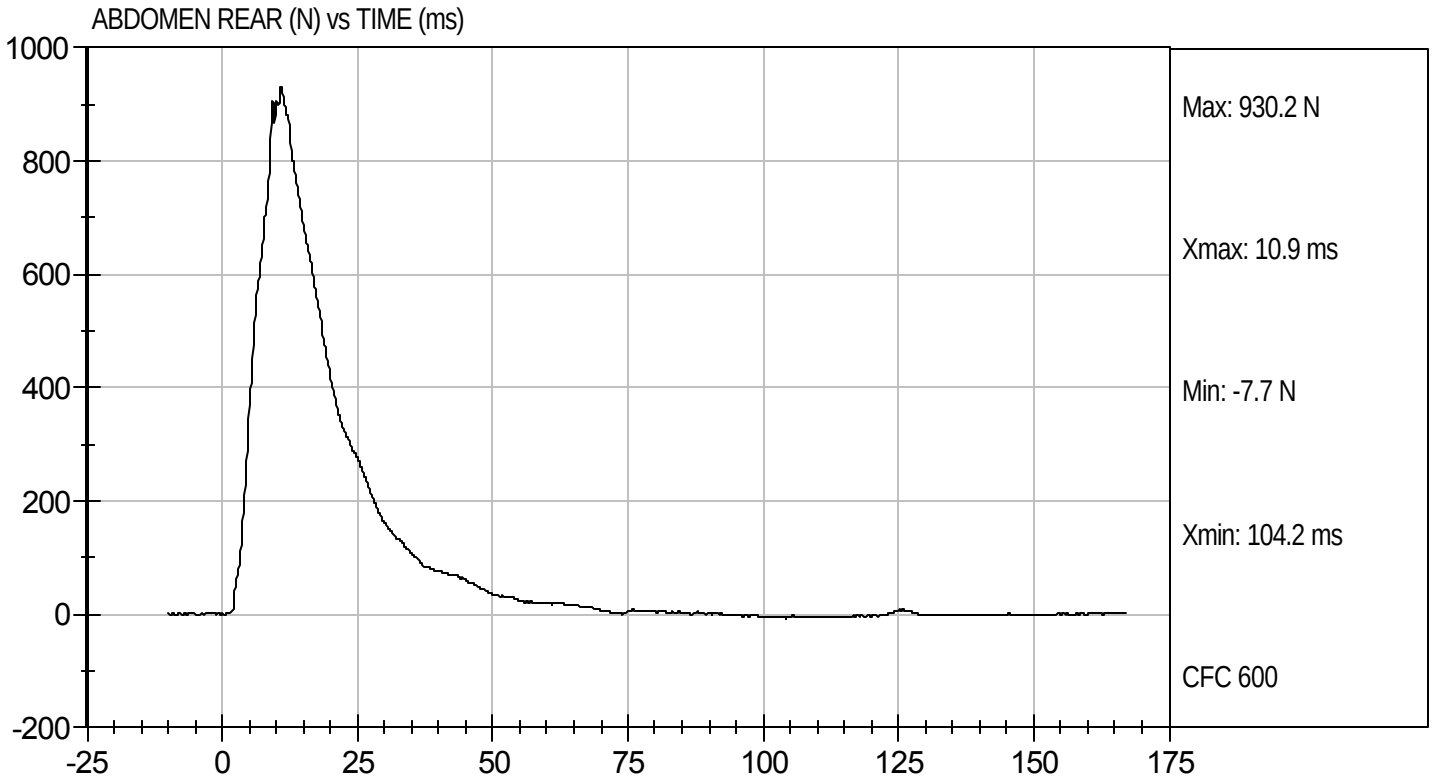
Test Date: 5/11/12
Velocity: 13.44 ft/s, 4.1 m/s





Test Desc: Abdomen Impact
Component ID: D121707

Test Date: 5/11/12
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:** D121708

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	33	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	-0.42	Pass
	27 ms	m/s	-6.50 to -5.80	-5.80	Pass
	30 ms	m/s	>= -6.5	-5.98	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	46.1	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	46.1	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	44	Pass
			Overall Results		Pass

Jessica Hall
Laboratory Technician

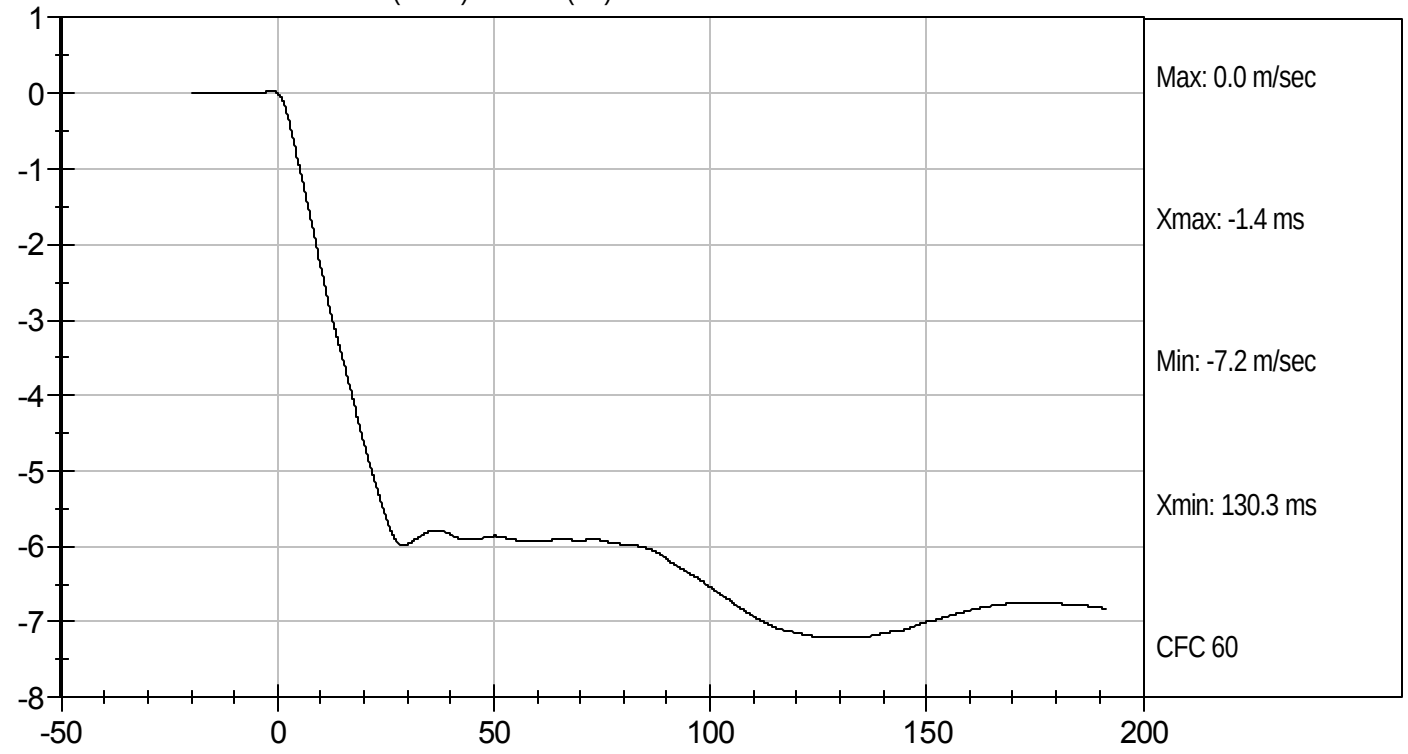
5/11/12
Test Date

David Winkelbauer
Approved By

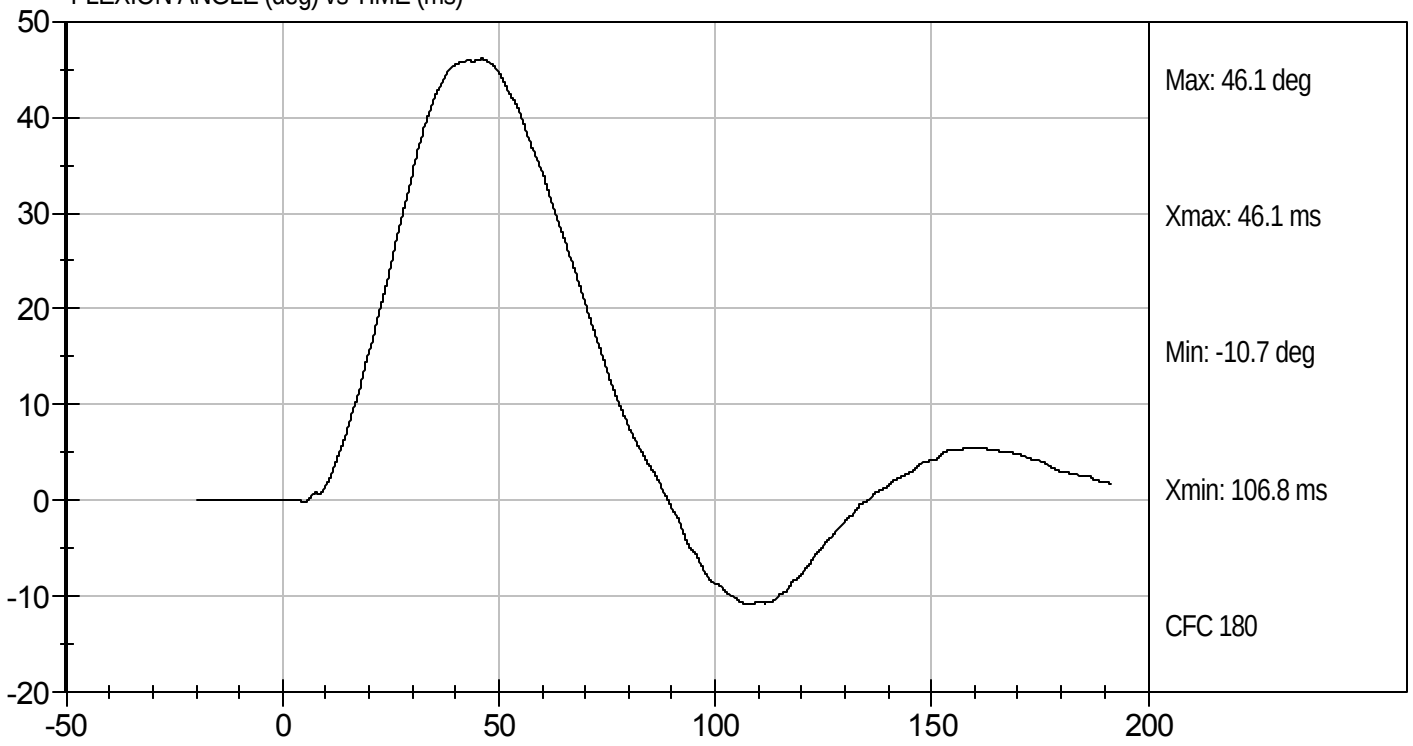
Test Desc: Lumbar Bending
Component ID: D121708

Test Date: 5/11/12
Velocity: 20.08 ft/s, 6.12 m/s

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

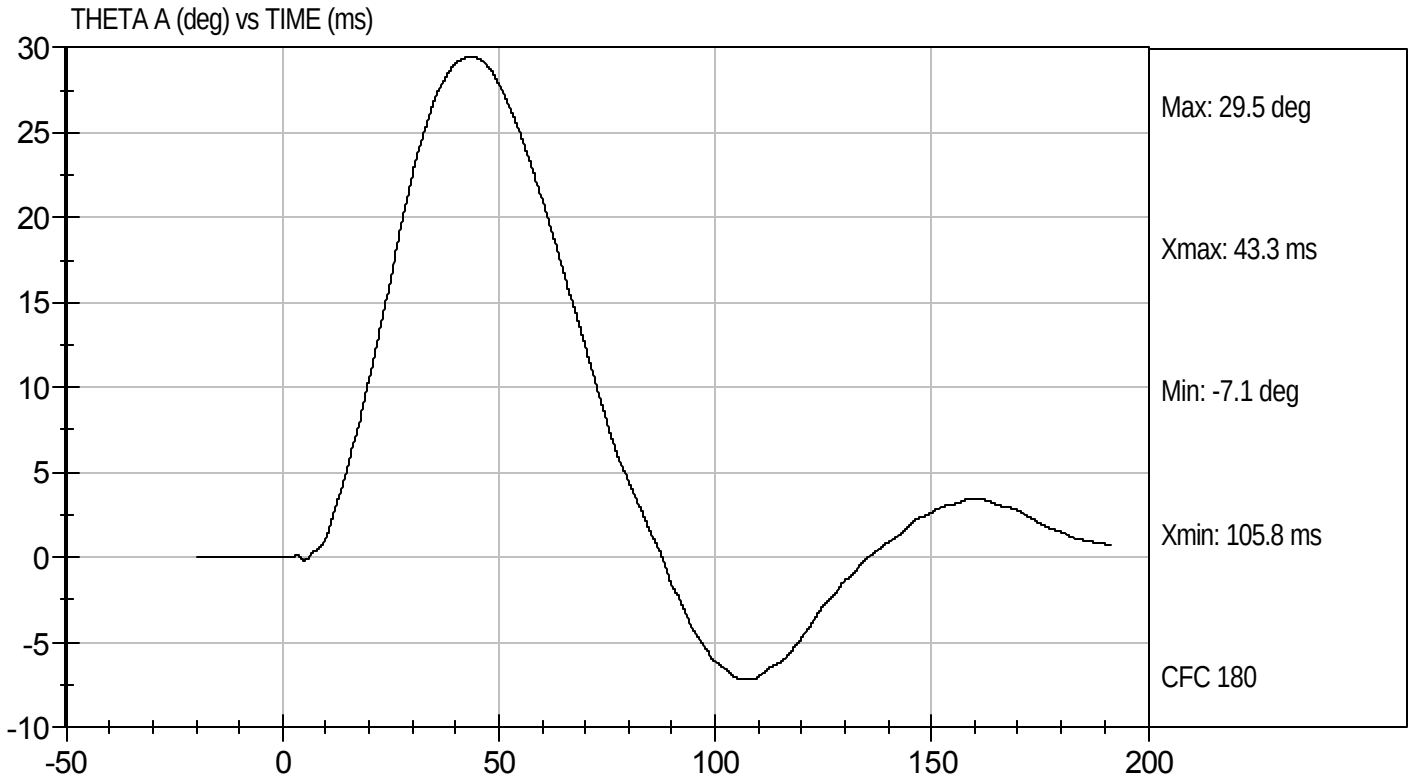


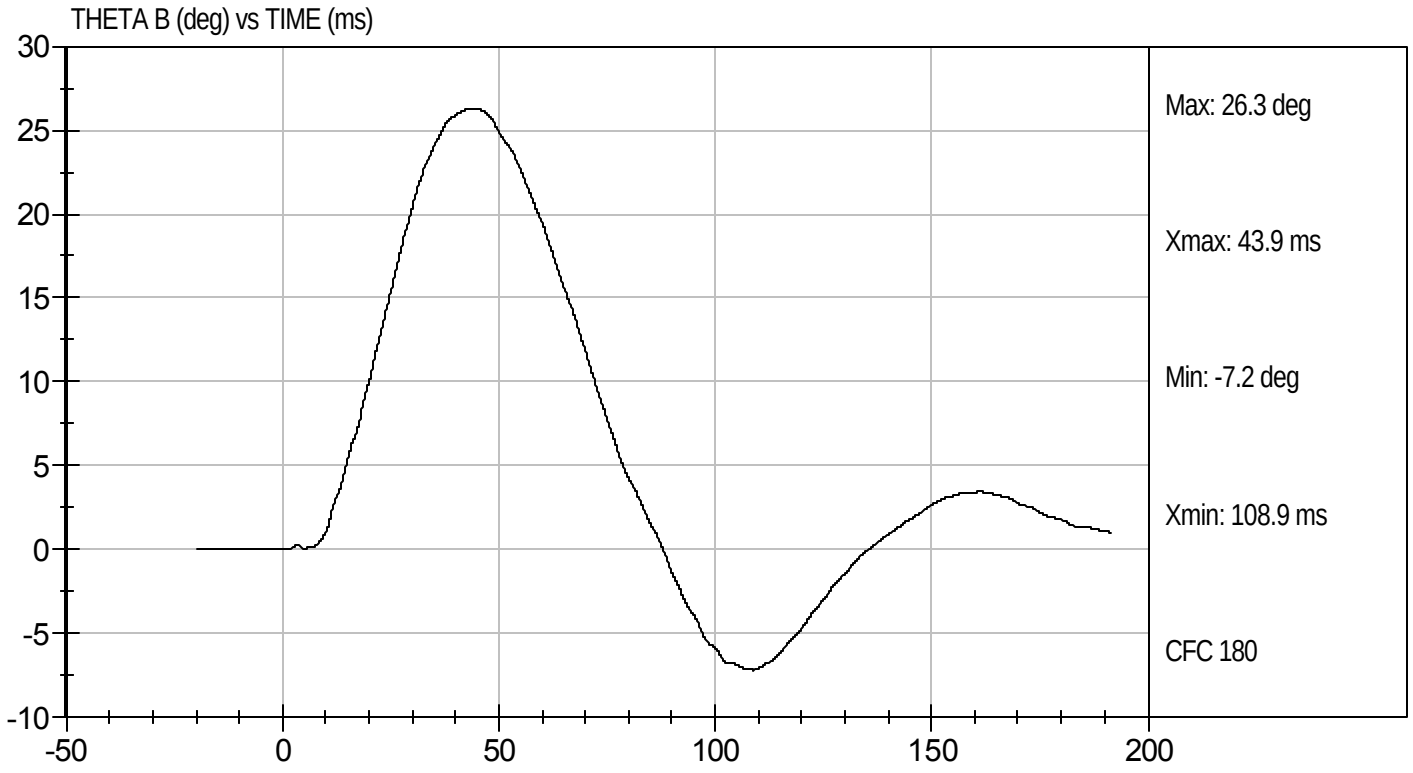
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Lumbar Bending
Component ID: D121708

Test Date: 5/11/12
Velocity: 20.08 ft/s, 6.12 m/s





MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121709

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	35	Pass
Probe Speed	m/s	4.20 to 4.40	4.27	Pass
Maximum Impactor Force	kN	4.70 to 5.40	4.91	Pass
Time of Maximum Impactor Force	ms	11.80 to 16.10	13.30	Pass
Maximum Pubic Force	kN	1.23 to 1.59	1.43	Pass
Time of Maximum Pubic Force	ms	12.20 to 17.00	14.00	Pass
		Overall Test Results		Pass

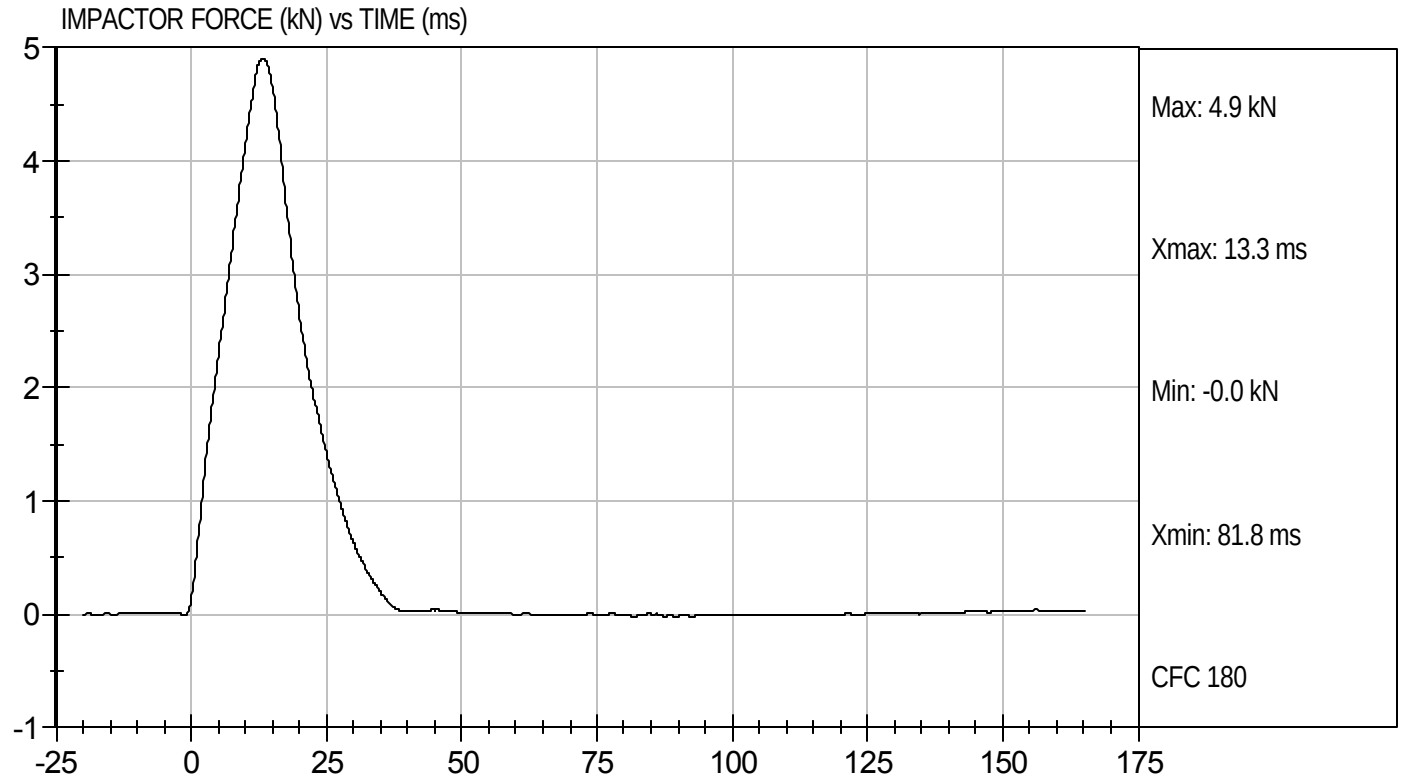
Jessica Hall
Laboratory Technician

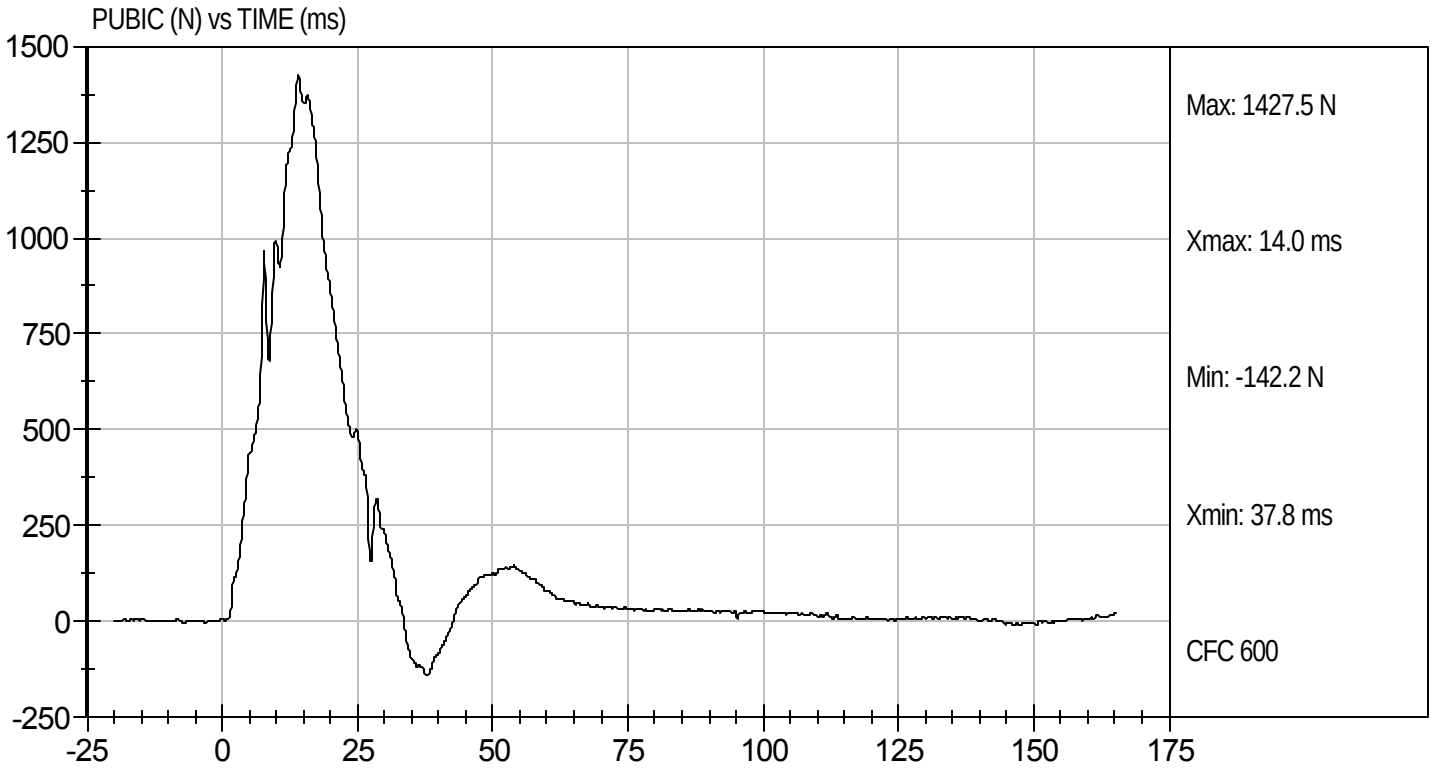
5/11/12
Test Date

David Winkelbauer
Approved By

Test Desc: Pelvis Impact
Component ID: D121709

Test Date: 5/11/12
Velocity: 14.01 ft/s, 4.27 m/s





MGA RESEARCH CORPORATION

FULL BODY THORAX IMPACT TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121700

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	35	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	5.34	Pass
Upper Rib Displacement	mm	34.0 to 41.0	39.9	Pass
Middle Rib Displacement	mm	37.0 to 45.0	42.2	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.2	Pass
		Overall Test Results		Pass

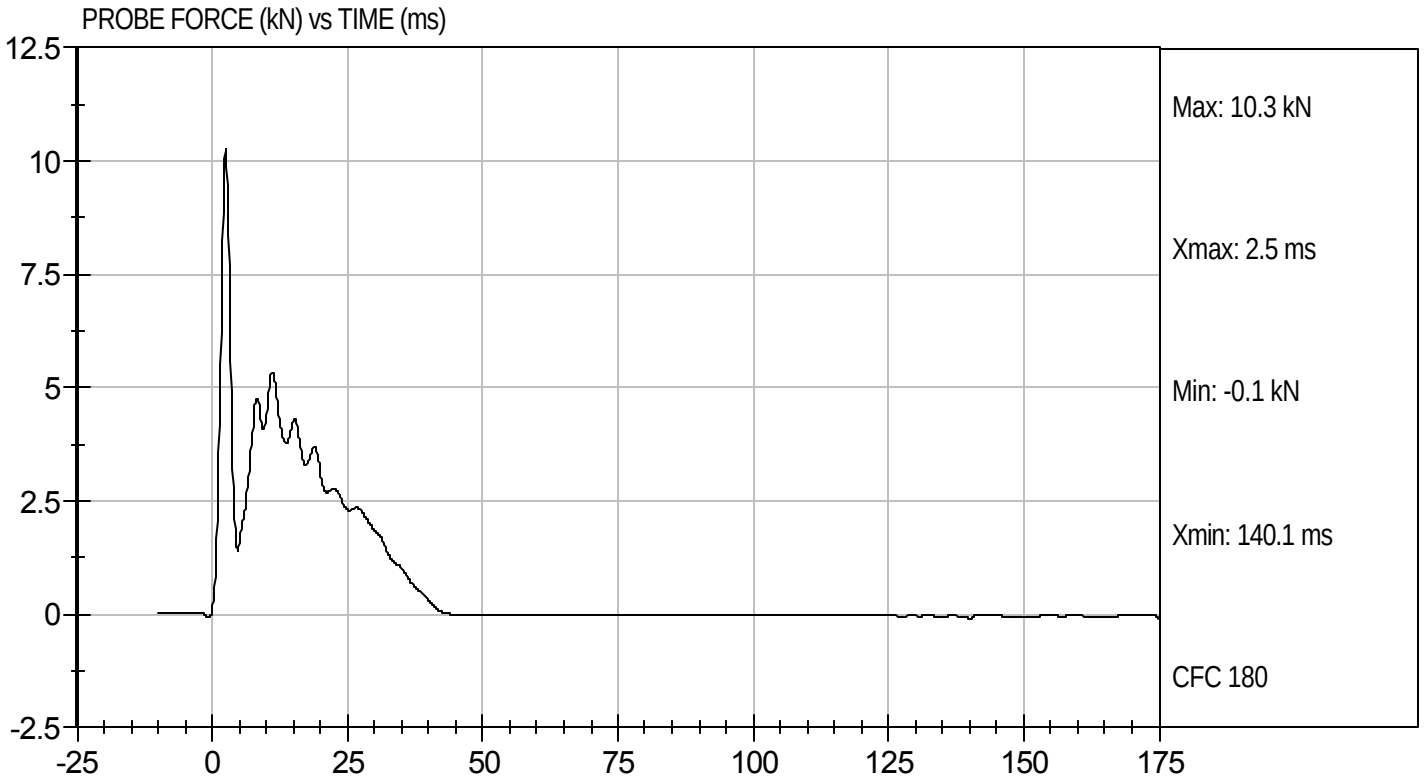
Jessica Hall
Laboratory Technician

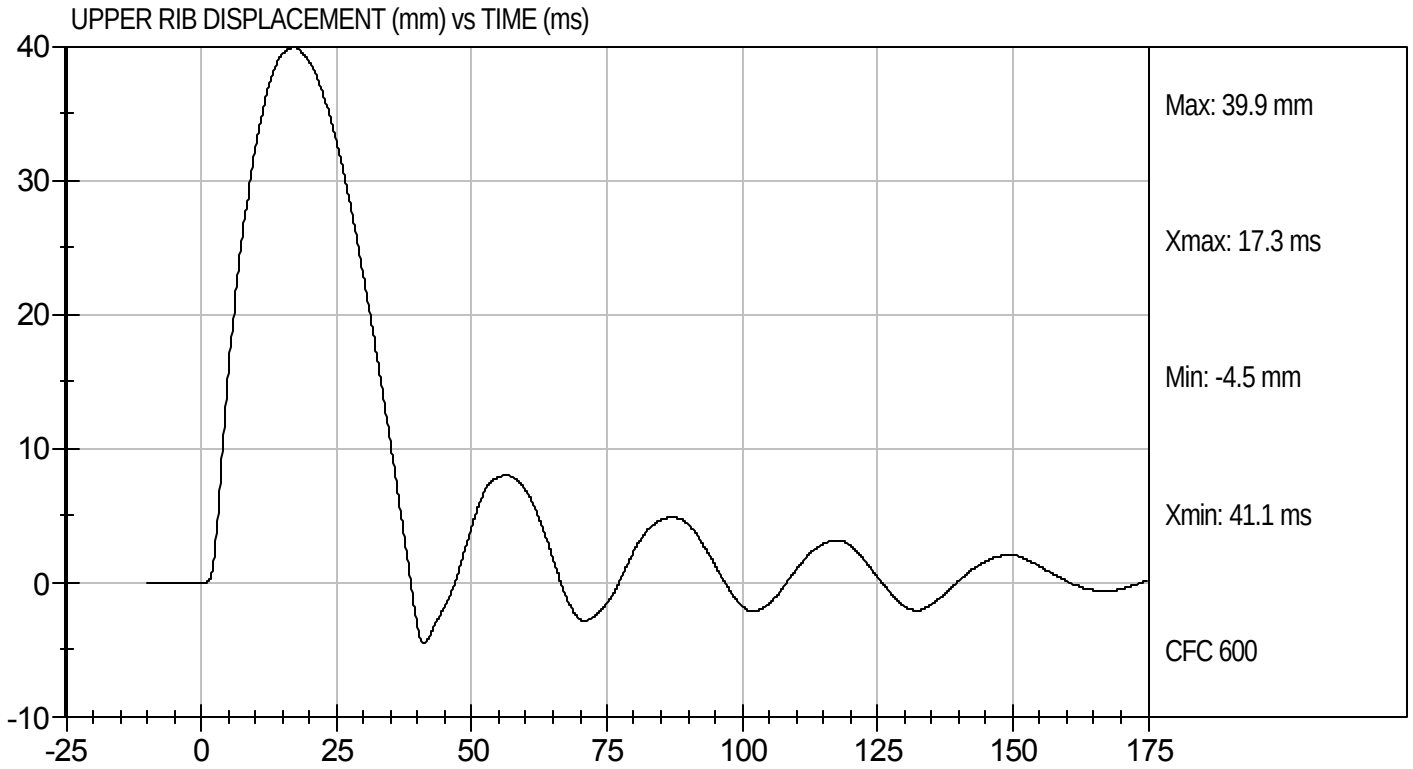
5/11/12
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Component ID: D121700

Test Date: 5/11/12
Velocity: 18.32 ft/s, 5.58 m/s

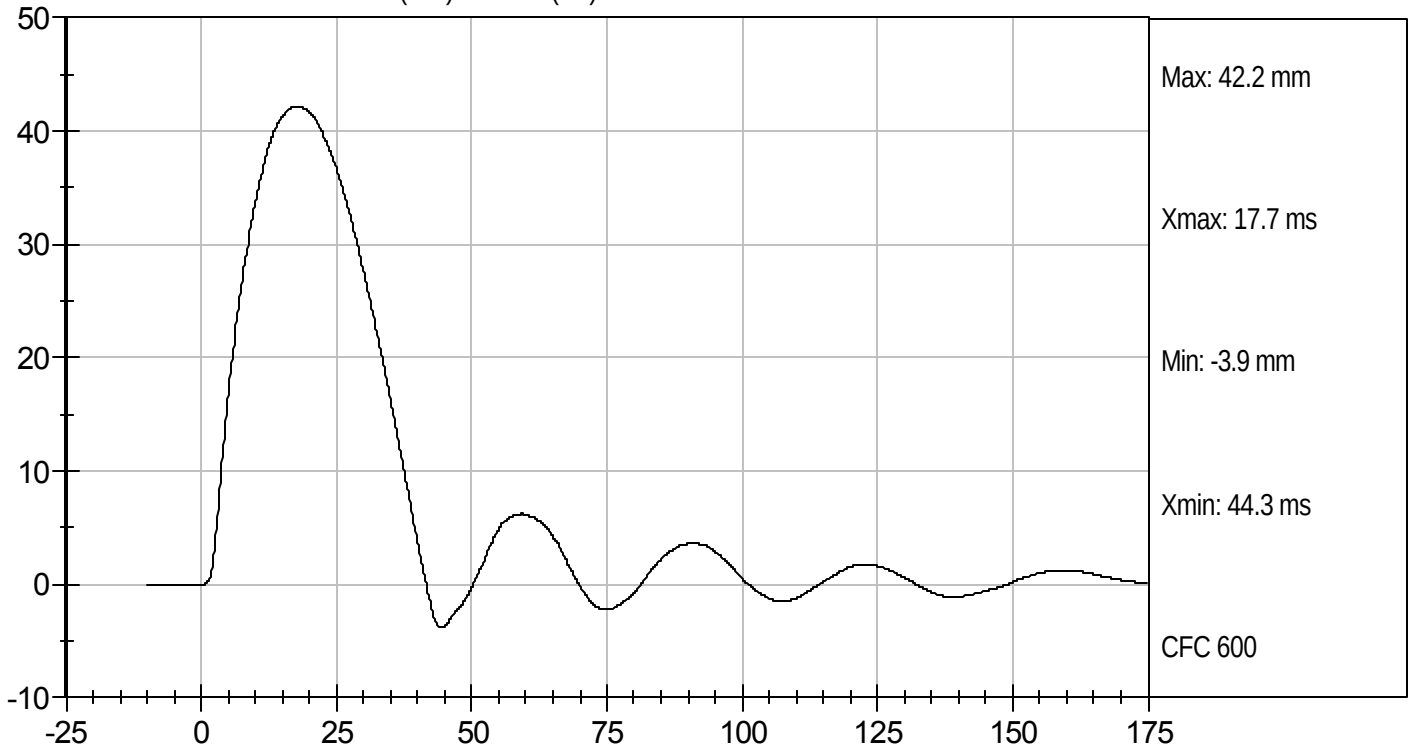




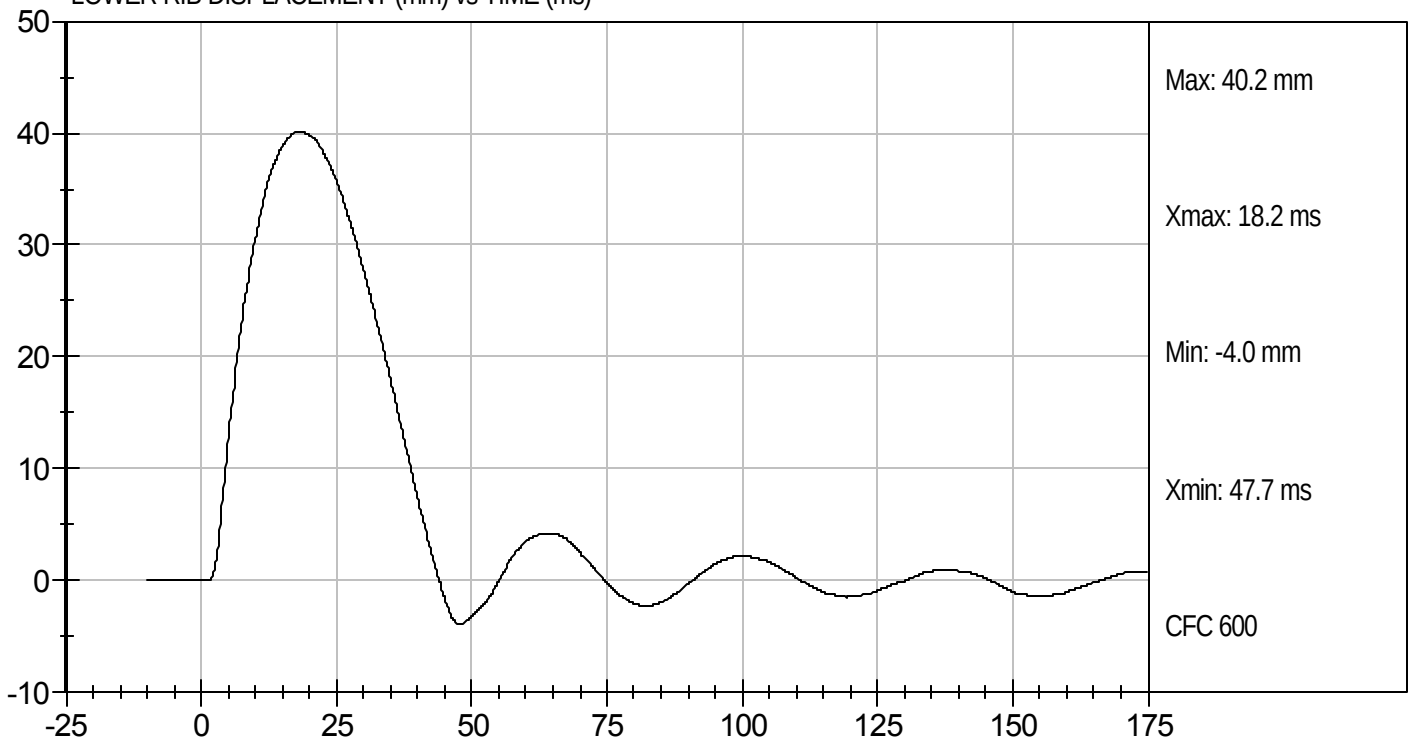
Test Desc: Thorax Impact
Component ID: D121700

Test Date: 5/11/12
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:** D121931

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Peak Resultant Acceleration	G's	125 to 155	142	Pass
Peak Longitudinal 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 Gall
Laboratory Technician

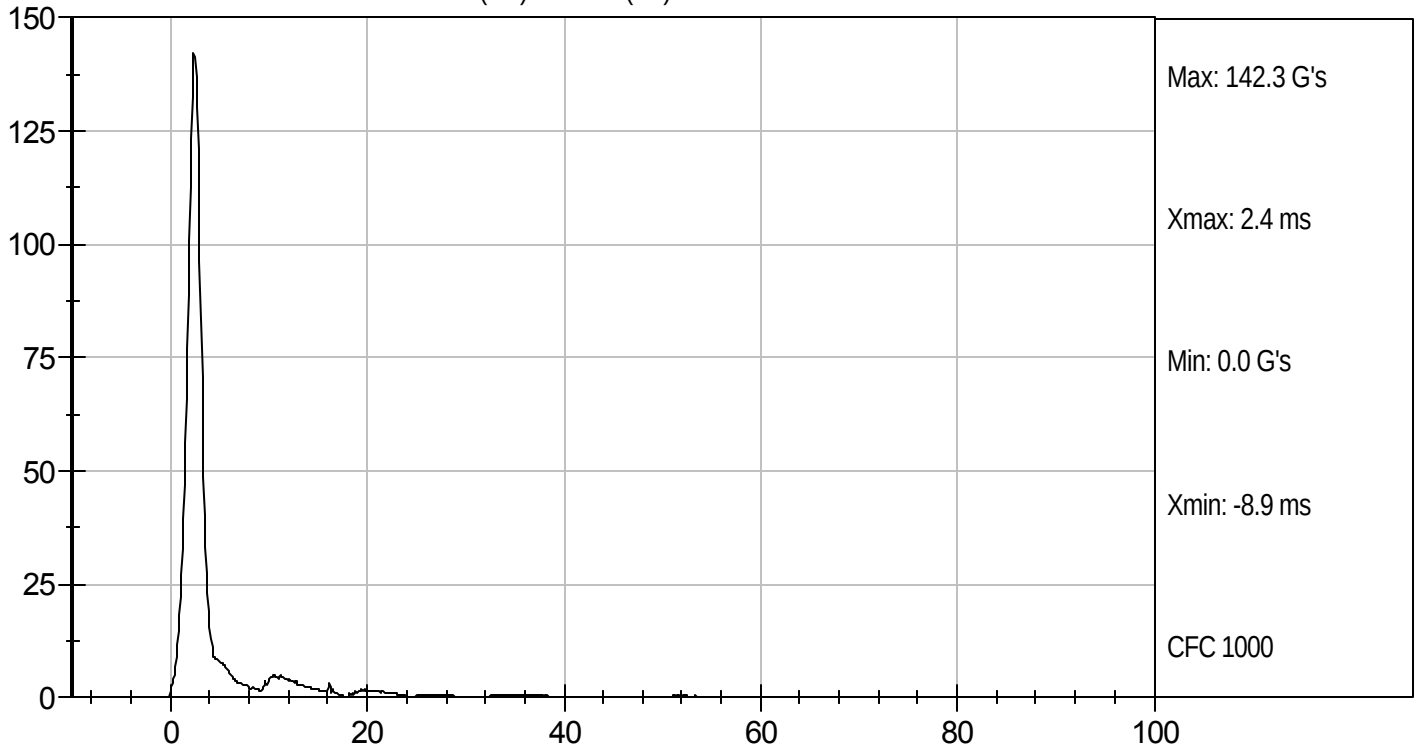
5/23/12
Test Date

David Winkelbauer
Approved By

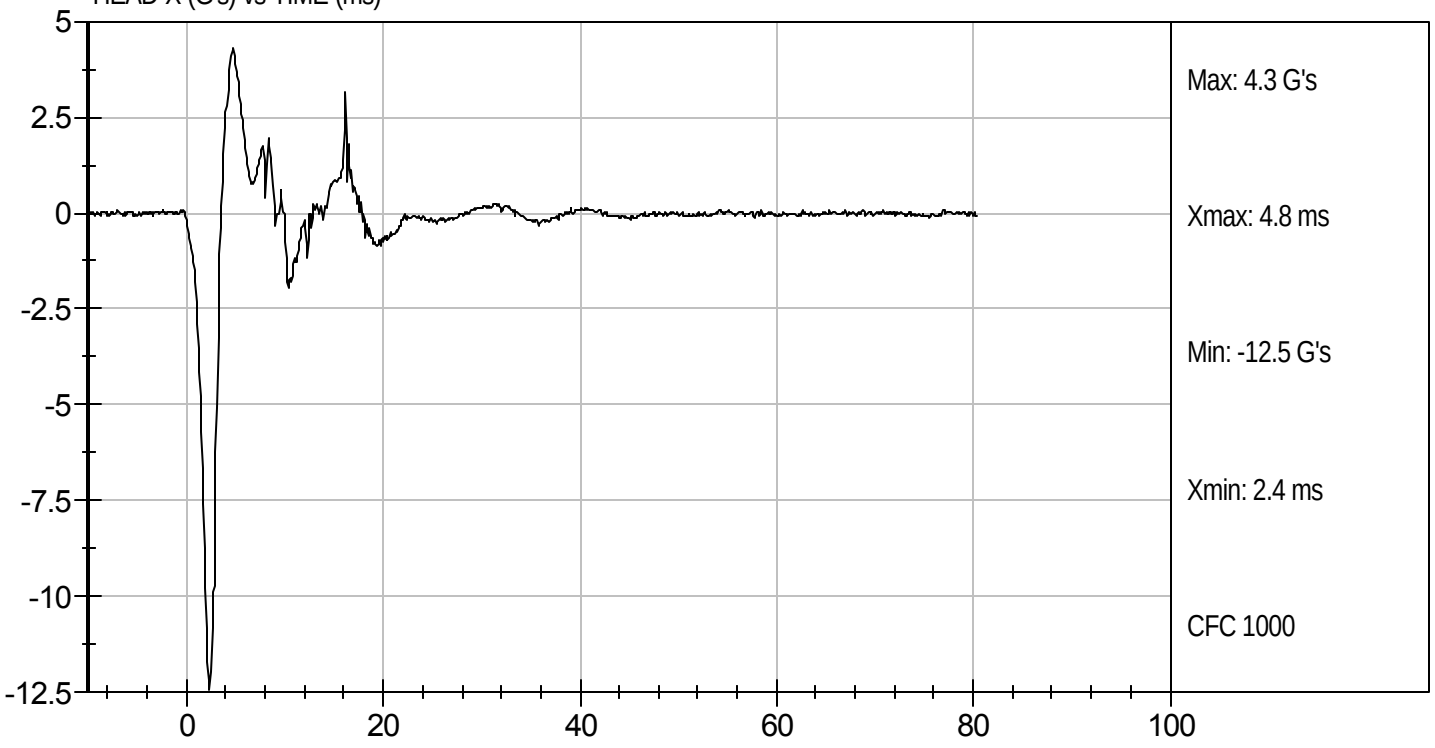
Test Desc: Head Drop
Component ID: D121931

Test Date: 5/23/12
Velocity: 0 ft/s, 0 m/s

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



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



MGA RESEARCH CORPORATION

NECK PENDULUM TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121932

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	18.0 to 22.0	21.5	Pass
Laboratory Relative Humidity		%	10 to 70	44	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	-3.28	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	51.9	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	59.4	Pass
Head Rotation Decay Time to 0 degree		ms	53.0 to 88.0	59.3	Pass
			Overall Test Results		Pass

Jessica Gall
Laboratory Technician

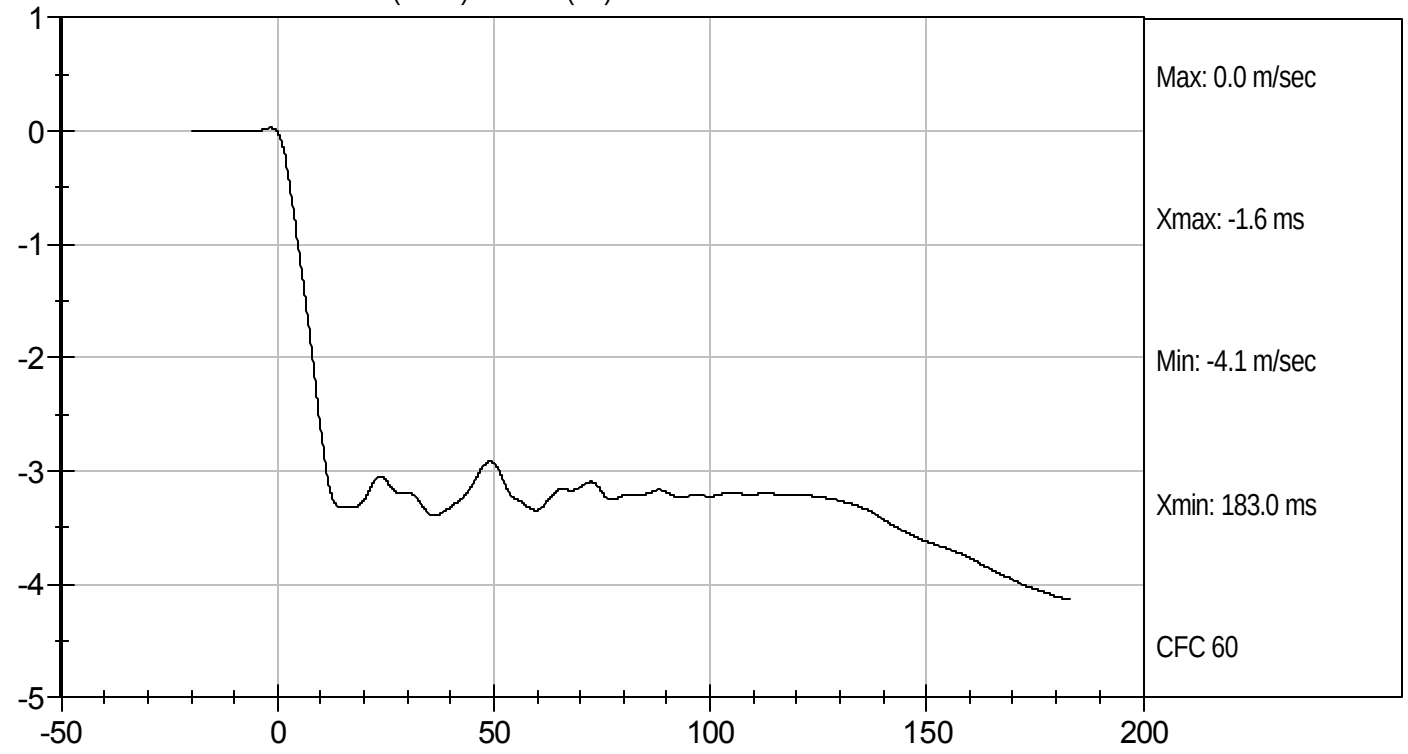
5/24/12
Test Date

David Winkelbauer
Approved By

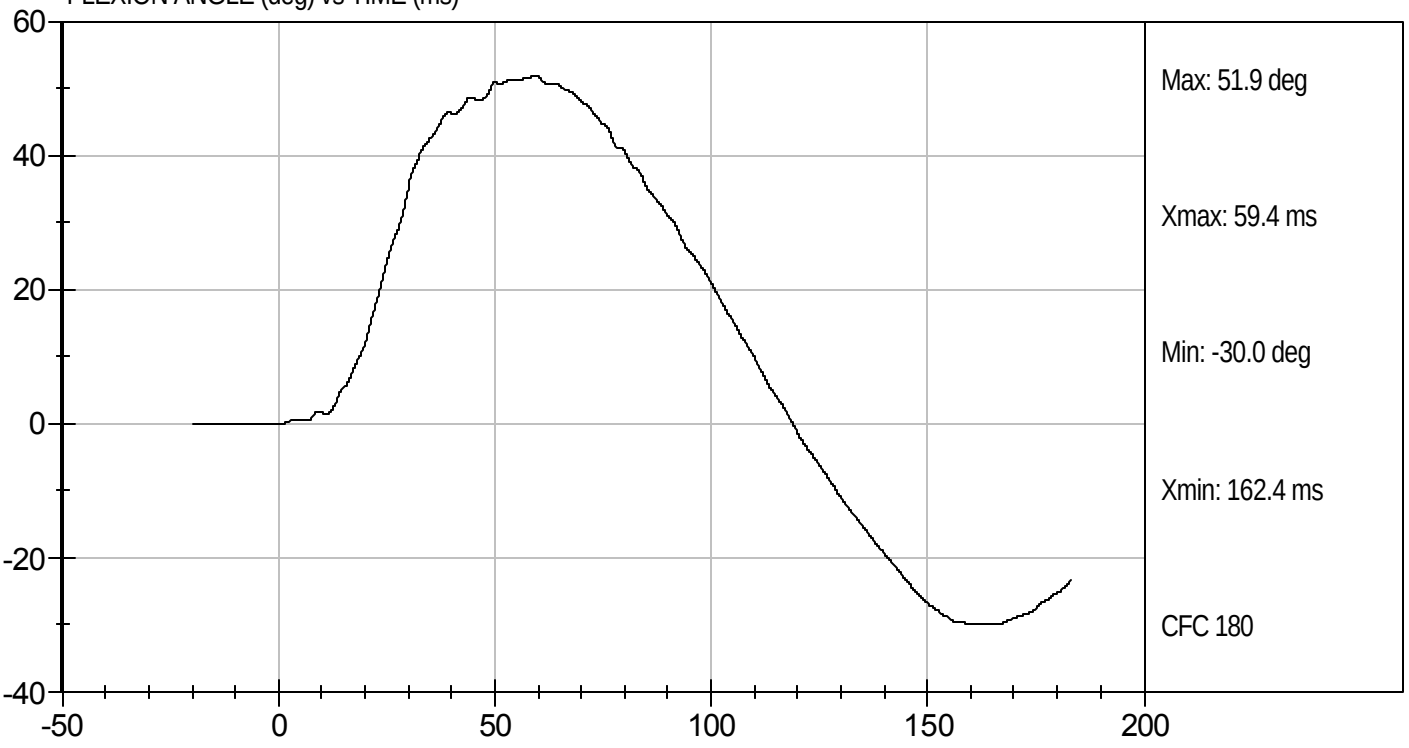
Test Desc: Neck Bending
Component ID: D121932

Test Date: 5/24/12
Velocity: 11.19 ft/s, 3.4 m/s

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

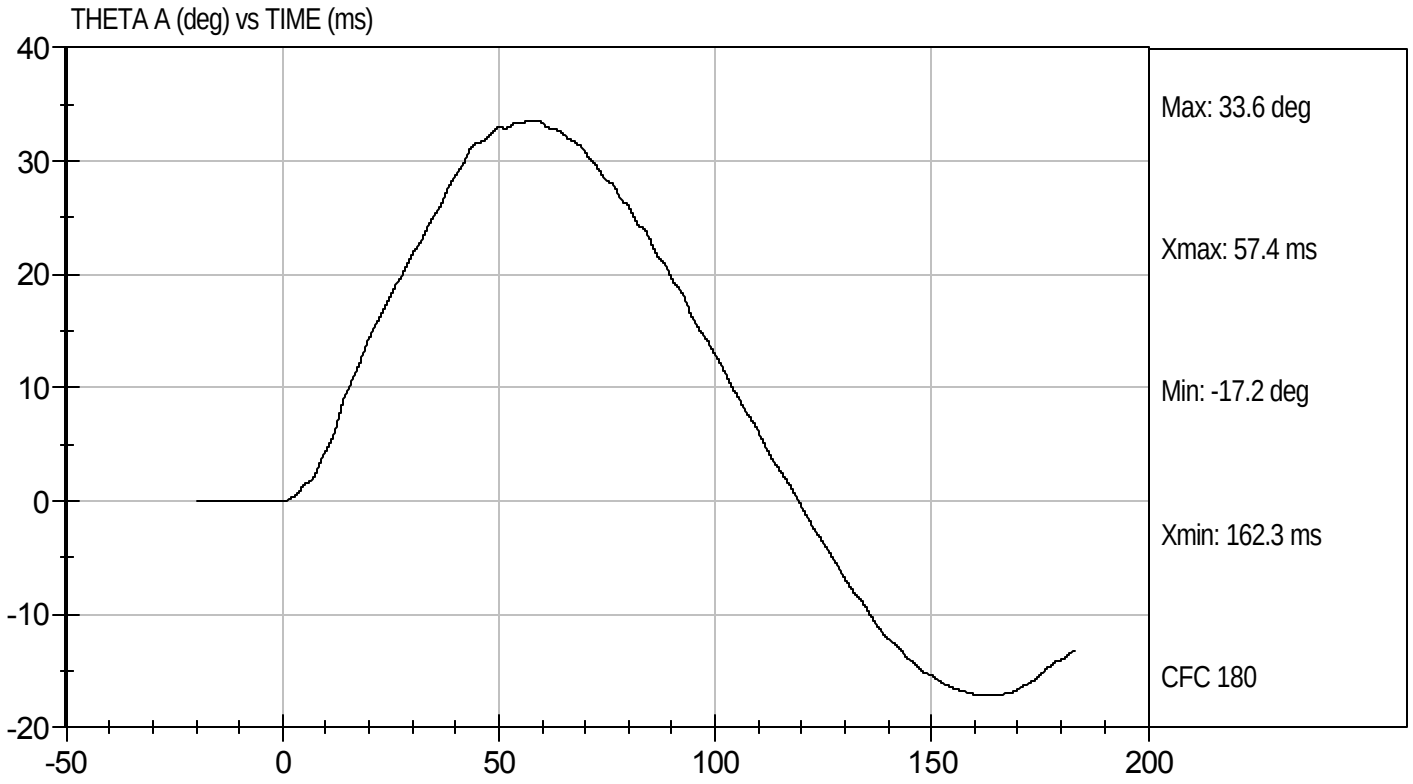


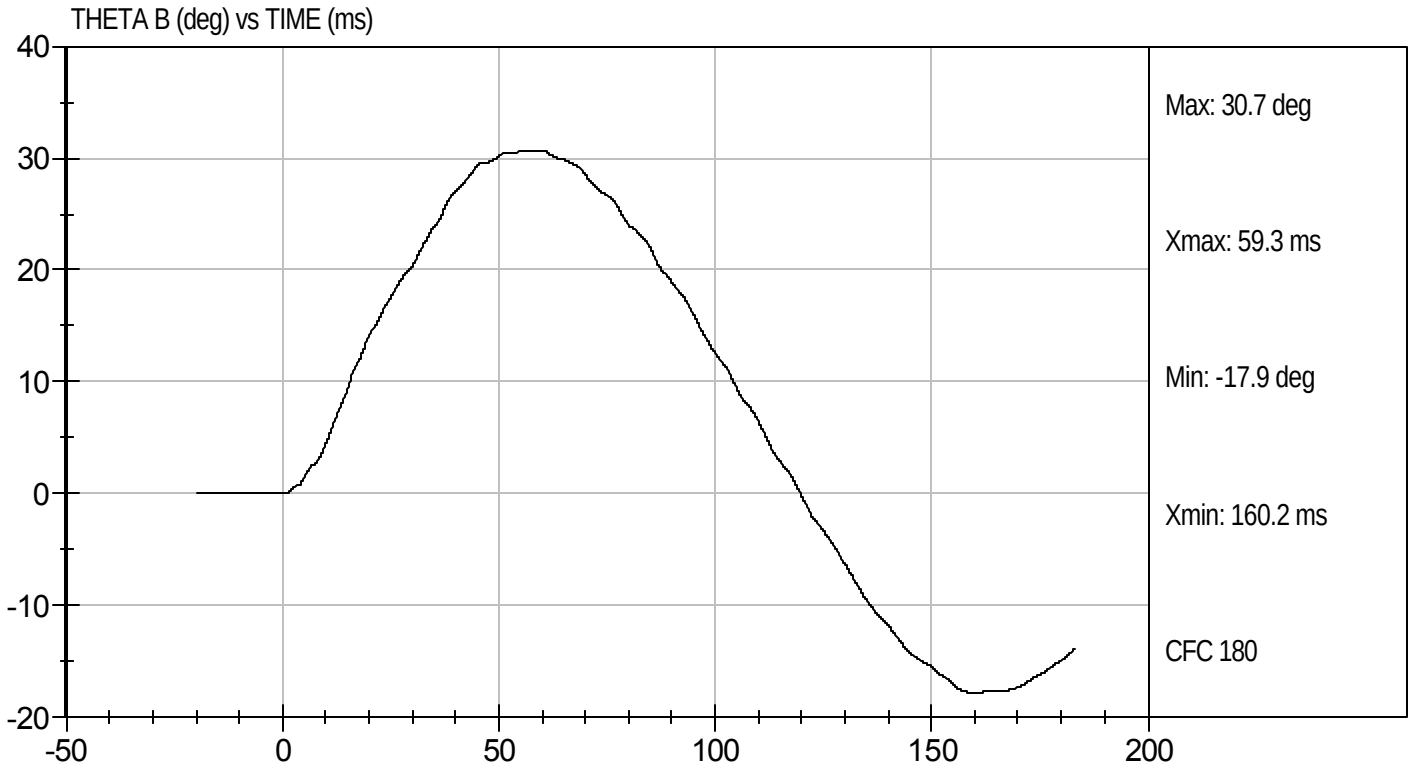
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Neck Bending
Component ID: D121932

Test Date: 5/24/12
Velocity: 11.19 ft/s, 3.4 m/s





MGA RESEARCH CORPORATION

SHOULDER IMPACT TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121933

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	37	Pass
Pendulum Speed	m/s	4.2 to 4.4	4.3	Pass
Peak Shoulder Acceleration	G's	7.5 to 10.5	8.7	Pass
Time of Peak Shoulder Acceleration	ms	NA	19.0	Pass
		Overall Test Results		Pass

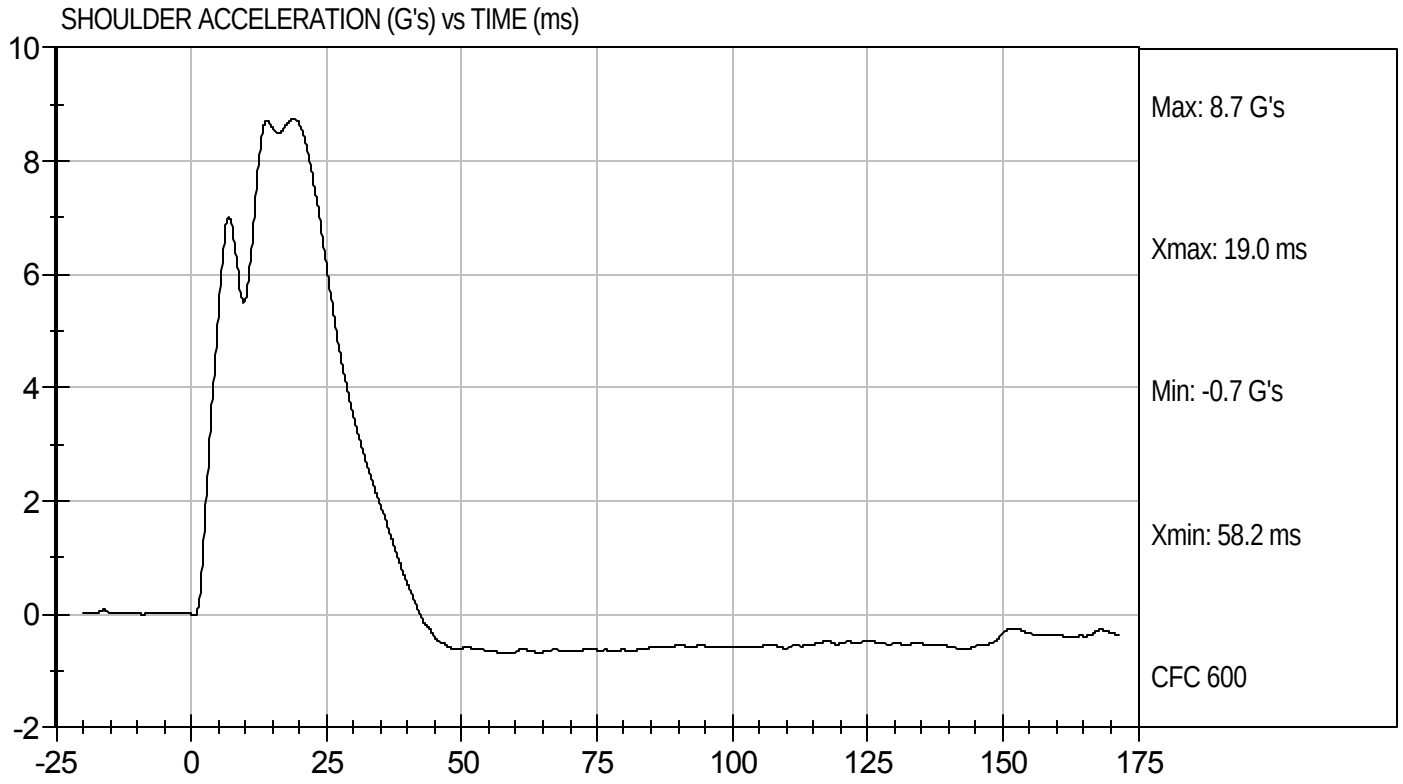
Jessica Hall
Laboratory Technician

5/23/12
Test Date

David Winkelbauer
Approved By

Test Desc: Shoulder Impact
Component ID: D121933

Test Date: 5/23/12
Velocity: 14.12 ft/s, 4.3 m/s



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121934

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.3	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	48.8	Pass
		Overall Test Results		Pass

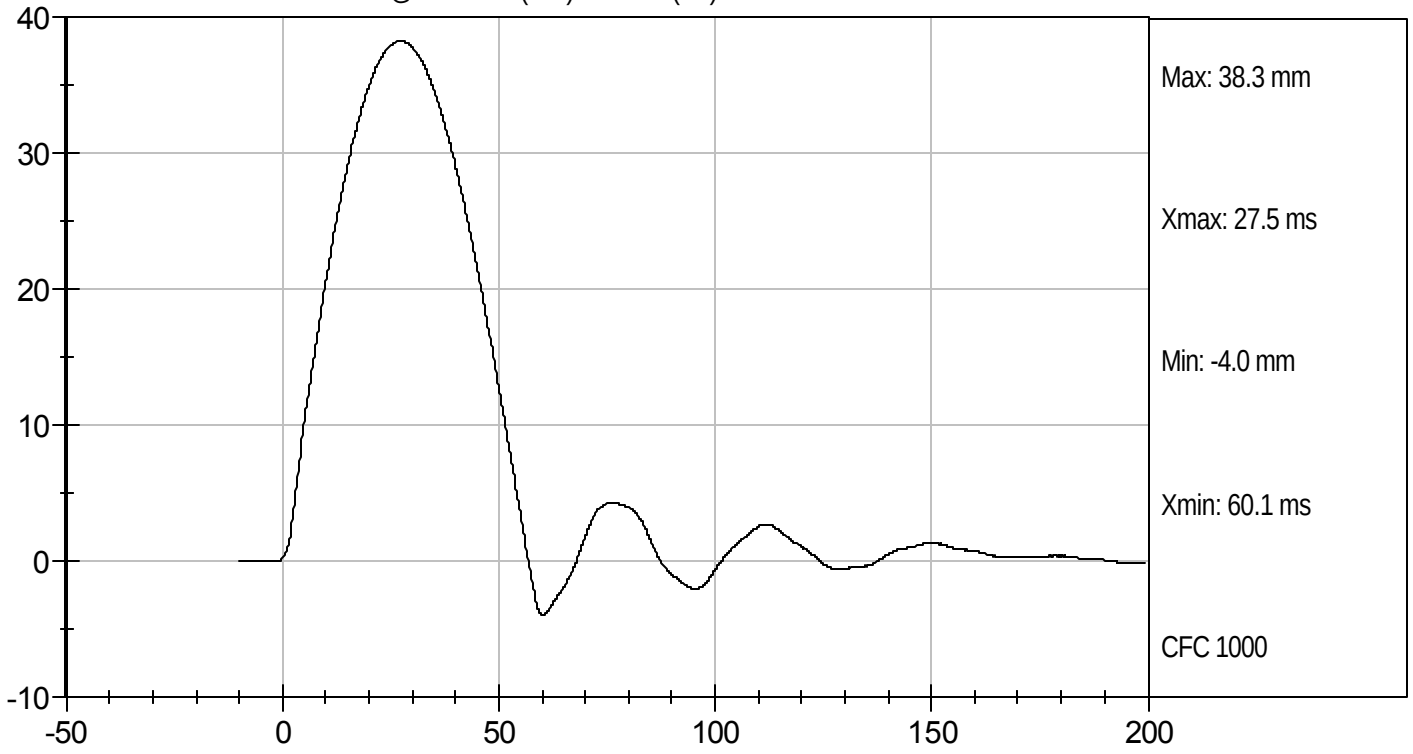
Jessica Hall
Laboratory Technician

5/24/12
Test Date

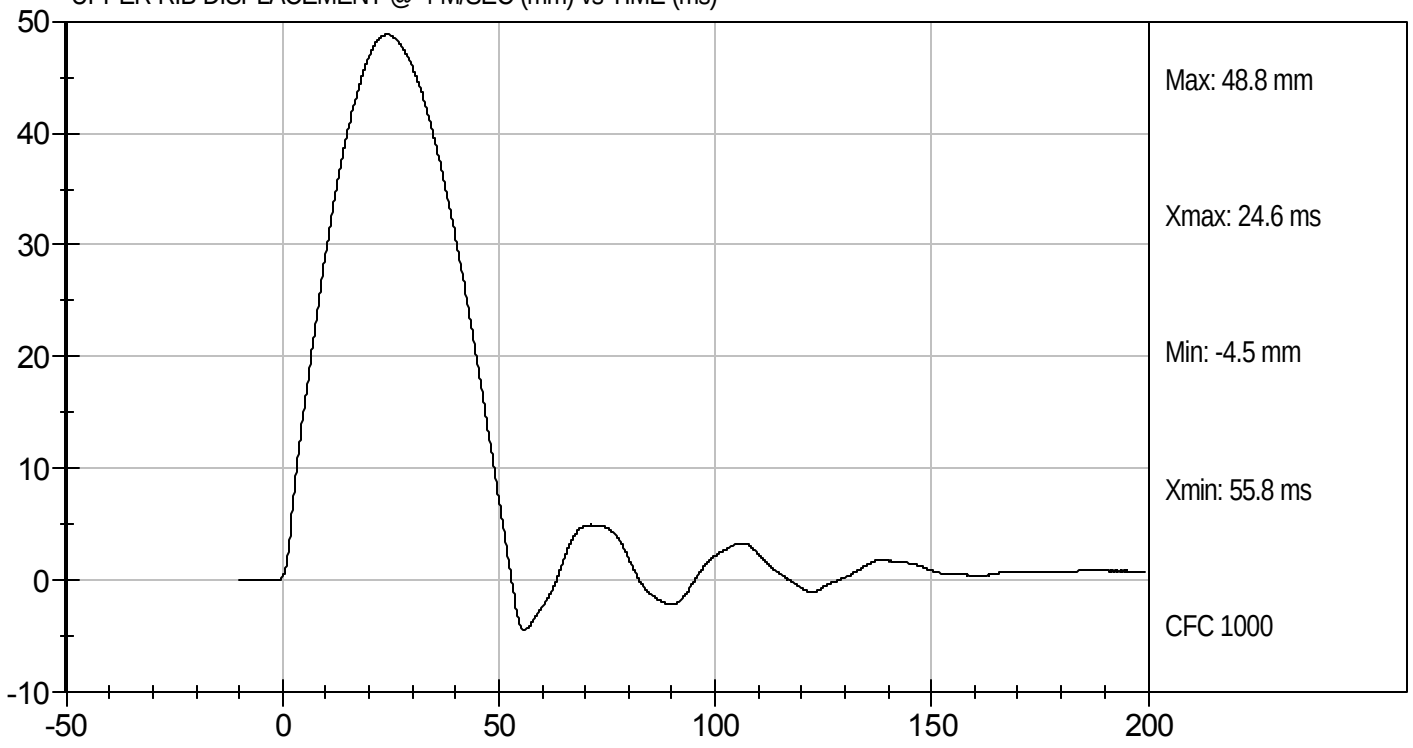
David Winkelbauer
Approved By

Test Desc: Rib Impact - Upper
Component ID: D121934
Test Date: 5/24/12

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:** D121935

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.4	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	48.5	Pass
		Overall Test Results		Pass

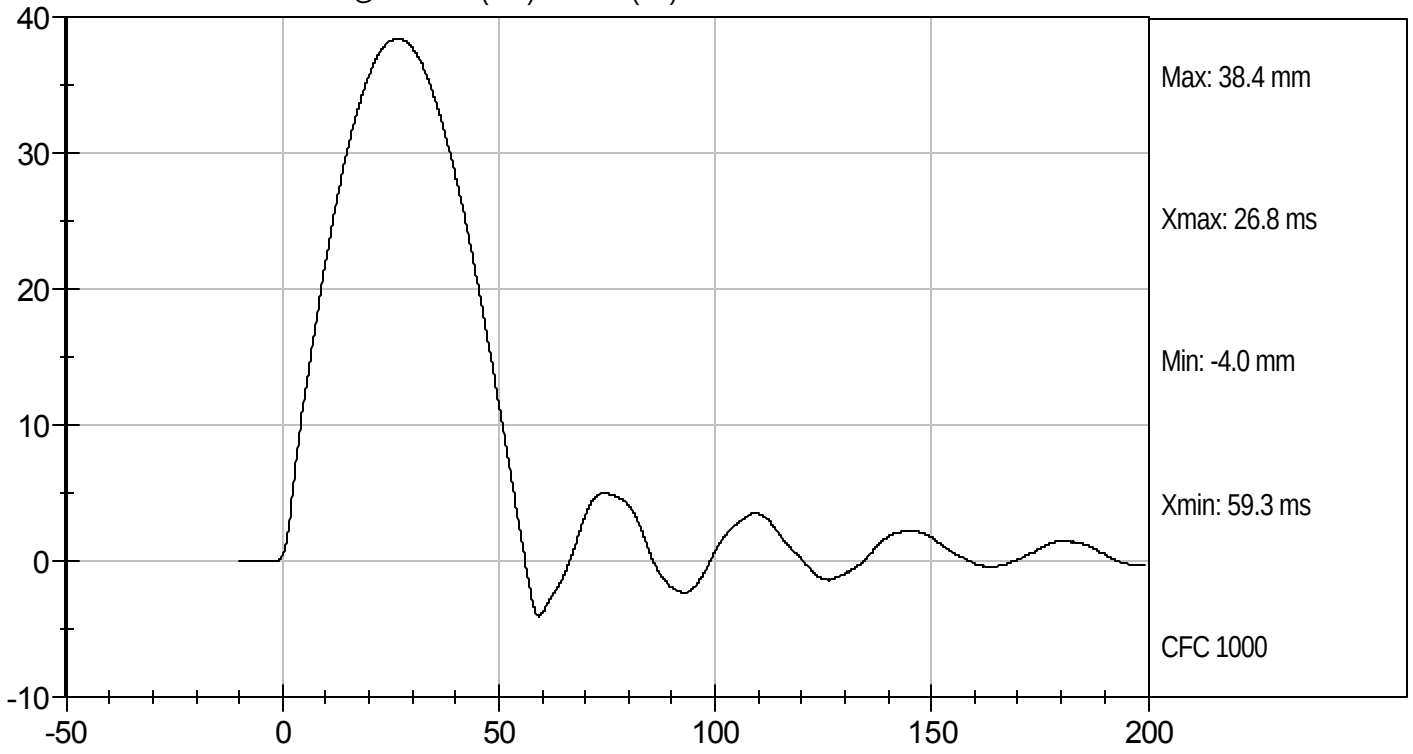
Jessica Gall
Laboratory Technician

5/24/12
Test Date

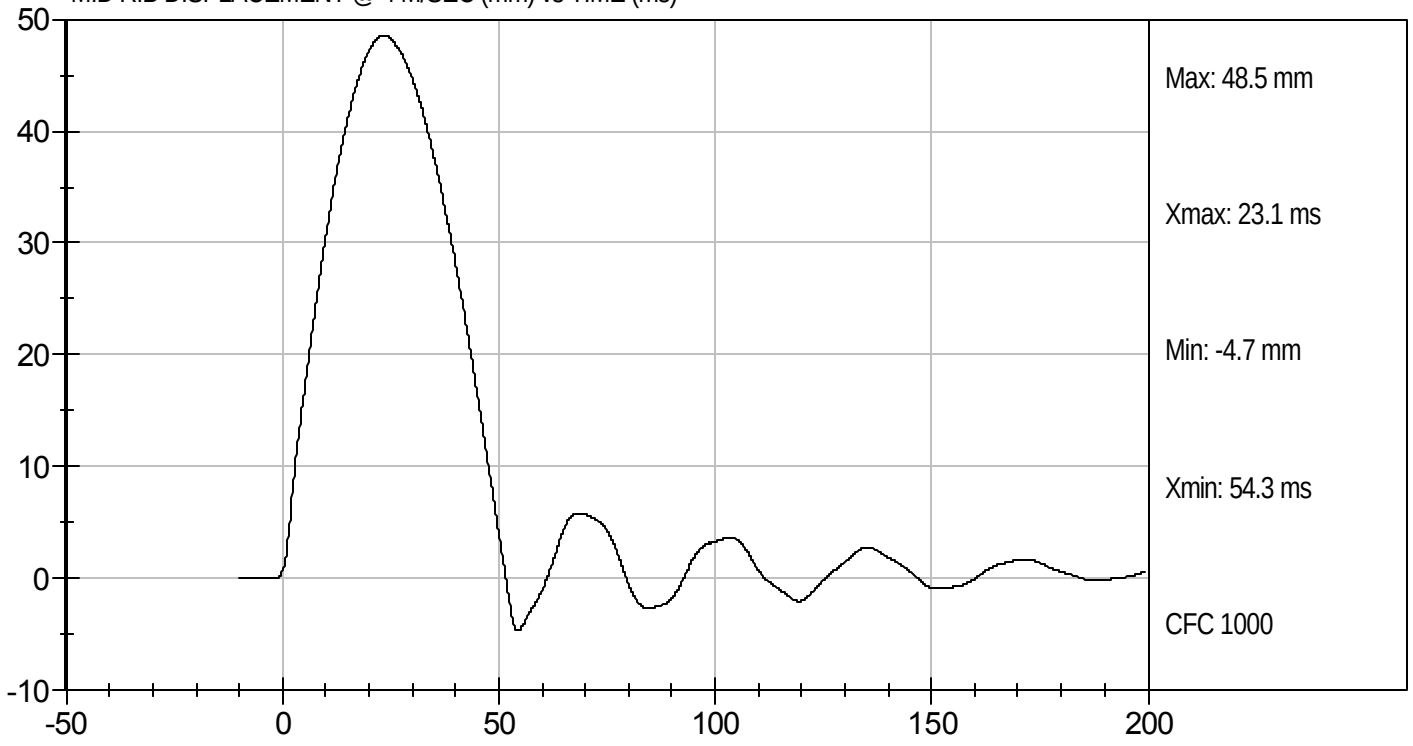
David Winkelbauer
Approved By

Test Desc: Rib Impact - Mid
Component ID: D121935
Test Date: 5/24/12

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:** D121936

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.7	Pass
Laboratory Relative Humidity	%	10 to 70	45	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.1	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	49.2	Pass
		Overall Test Results		Pass

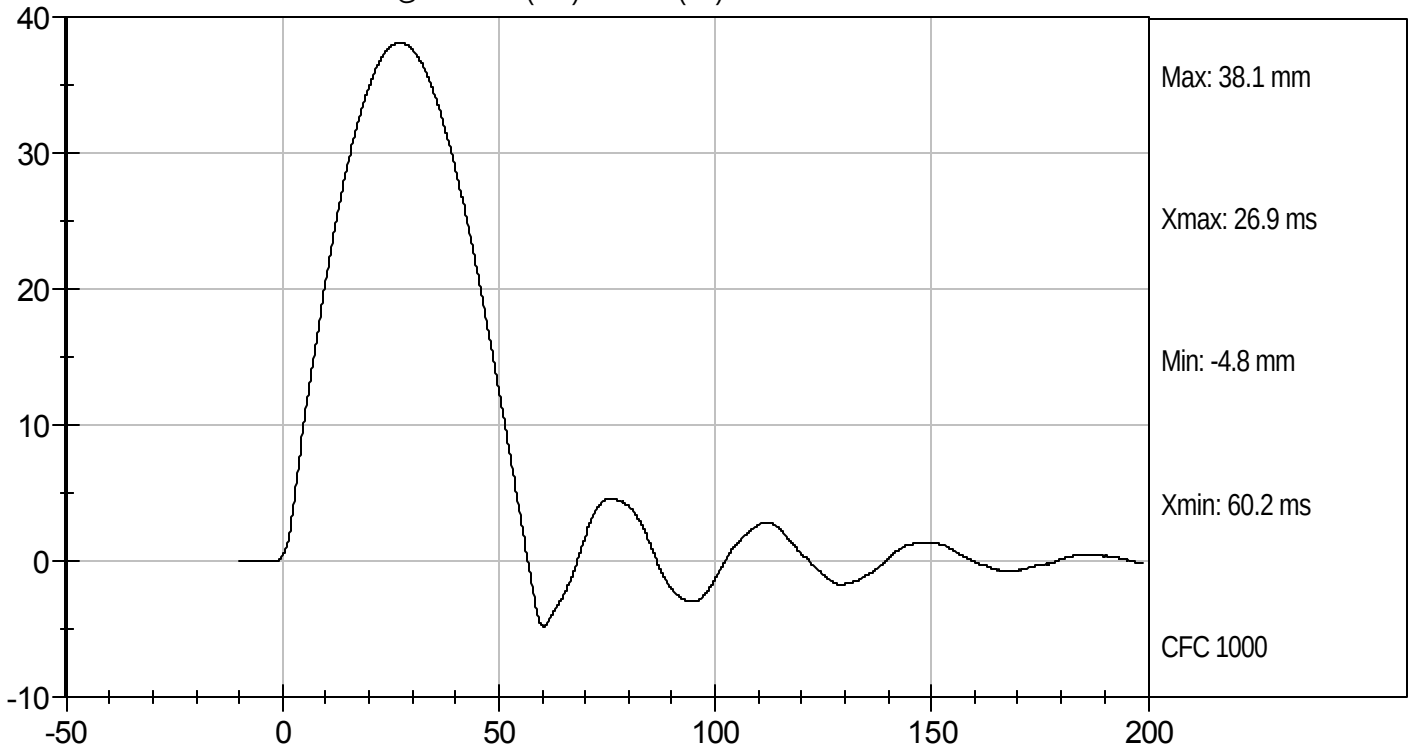
Jessica Gall
Laboratory Technician

5/24/12
Test Date

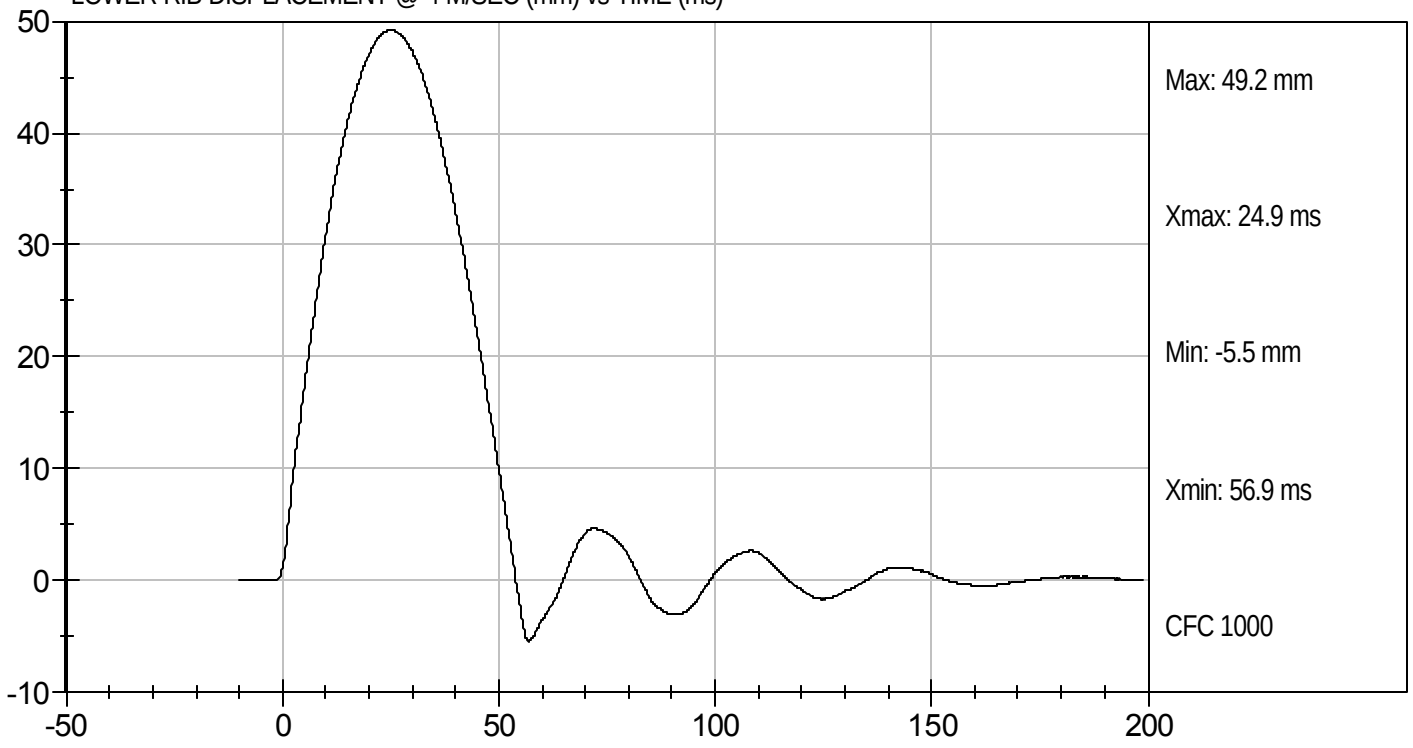
David Winkelbauer
Approved By

Test Desc: Rib Impact - Lower
Component ID: D121936
Test Date: 5/24/12

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:** D121937

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.3	Pass
Laboratory Relative Humidity	%	10 to 70	37	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 Impactor Force	ms	10.60 to 13.00	11.70	Pass
Maximum Total Abdomen Force	kN	2.20 to 2.70	2.63	Pass
Time of Maximum Abdomen Force	ms	10.00 to 12.30	11.20	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

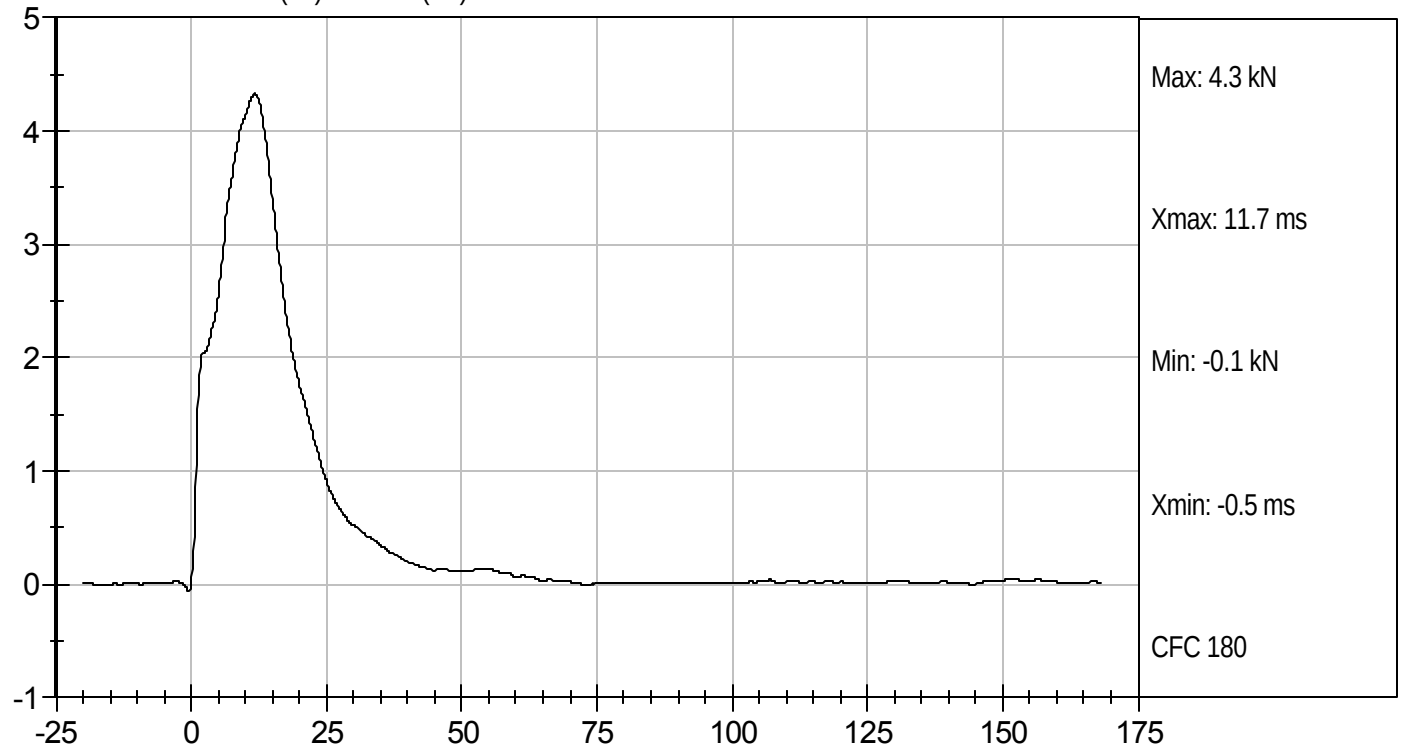
5/23/12
Test Date

David Winkelbauer
Approved By

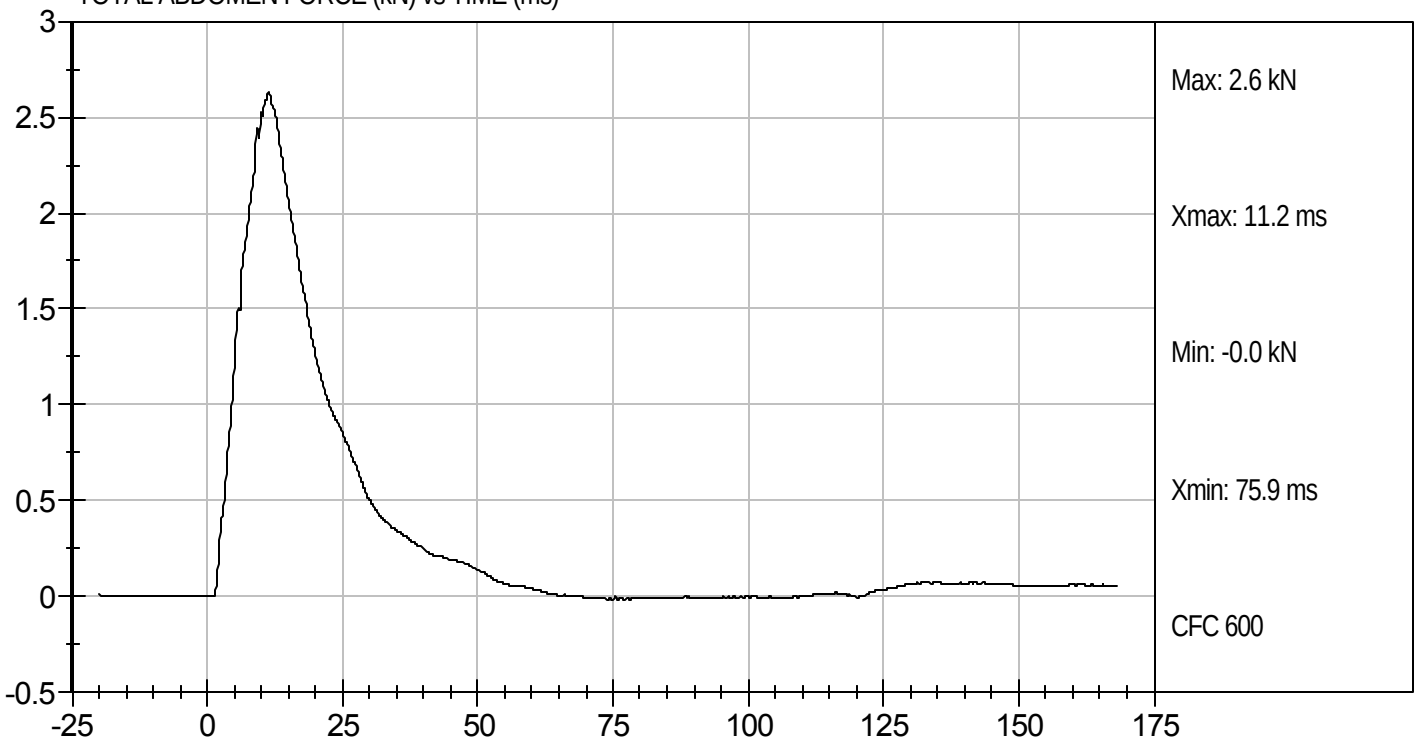
Test Desc: Abdomen Impact
Component ID: D121937

Test Date: 5/23/12
Velocity: 13.33 ft/s, 4.06 m/s

IMPACTOR FORCE (kN) vs TIME (ms)



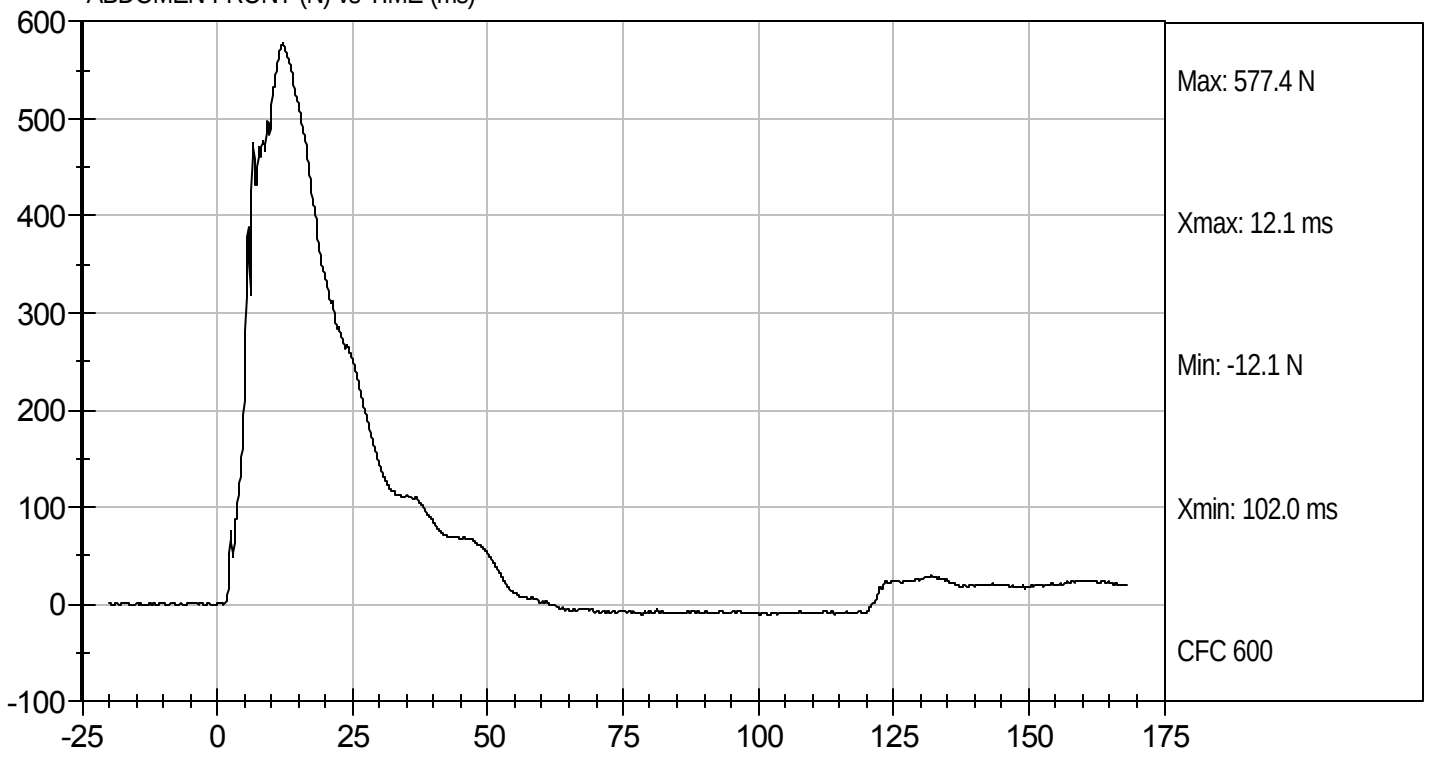
TOTAL ABDOMEN FORCE (kN) vs TIME (ms)



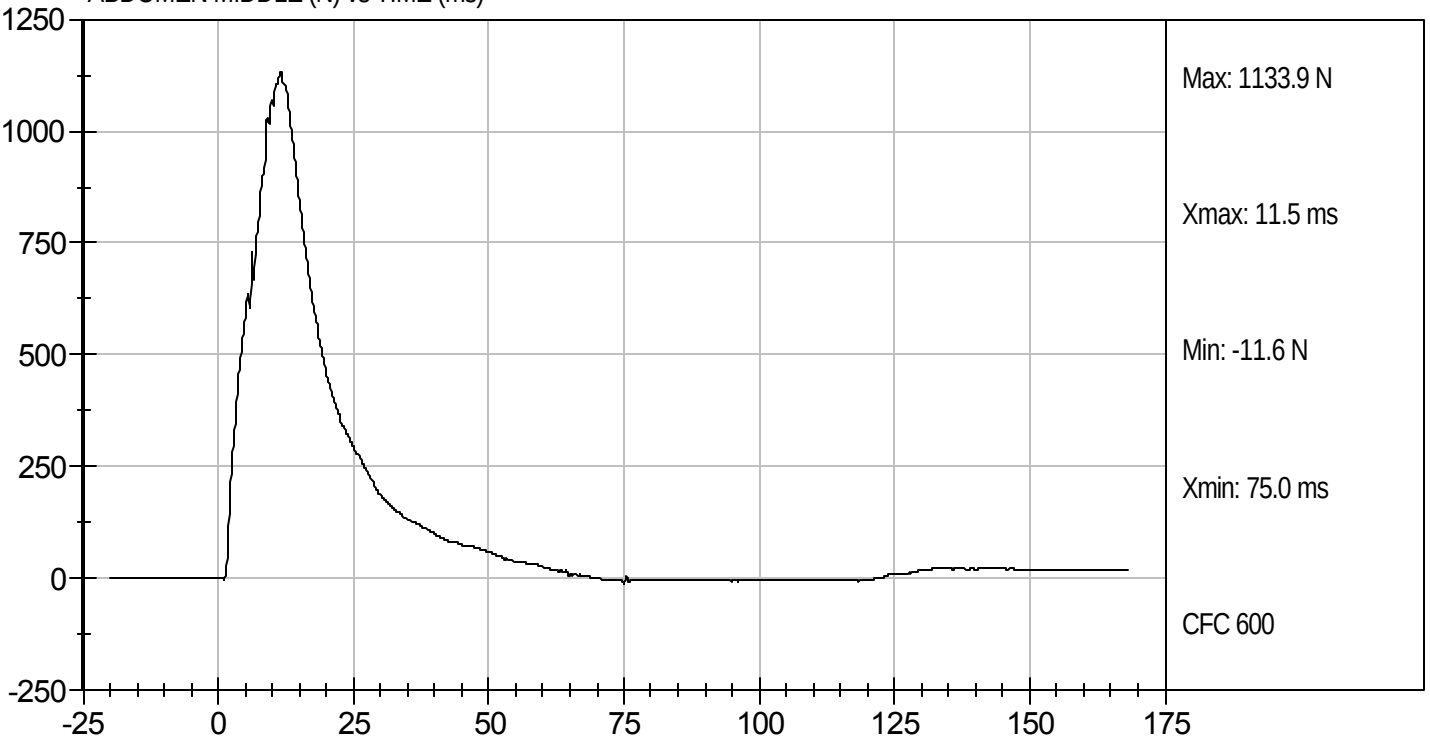
Test Desc: Abdomen Impact
Component ID: D121937

Test Date: 5/23/12
Velocity: 13.33 ft/s, 4.06 m/s

ABDOMEN FRONT (N) vs TIME (ms)

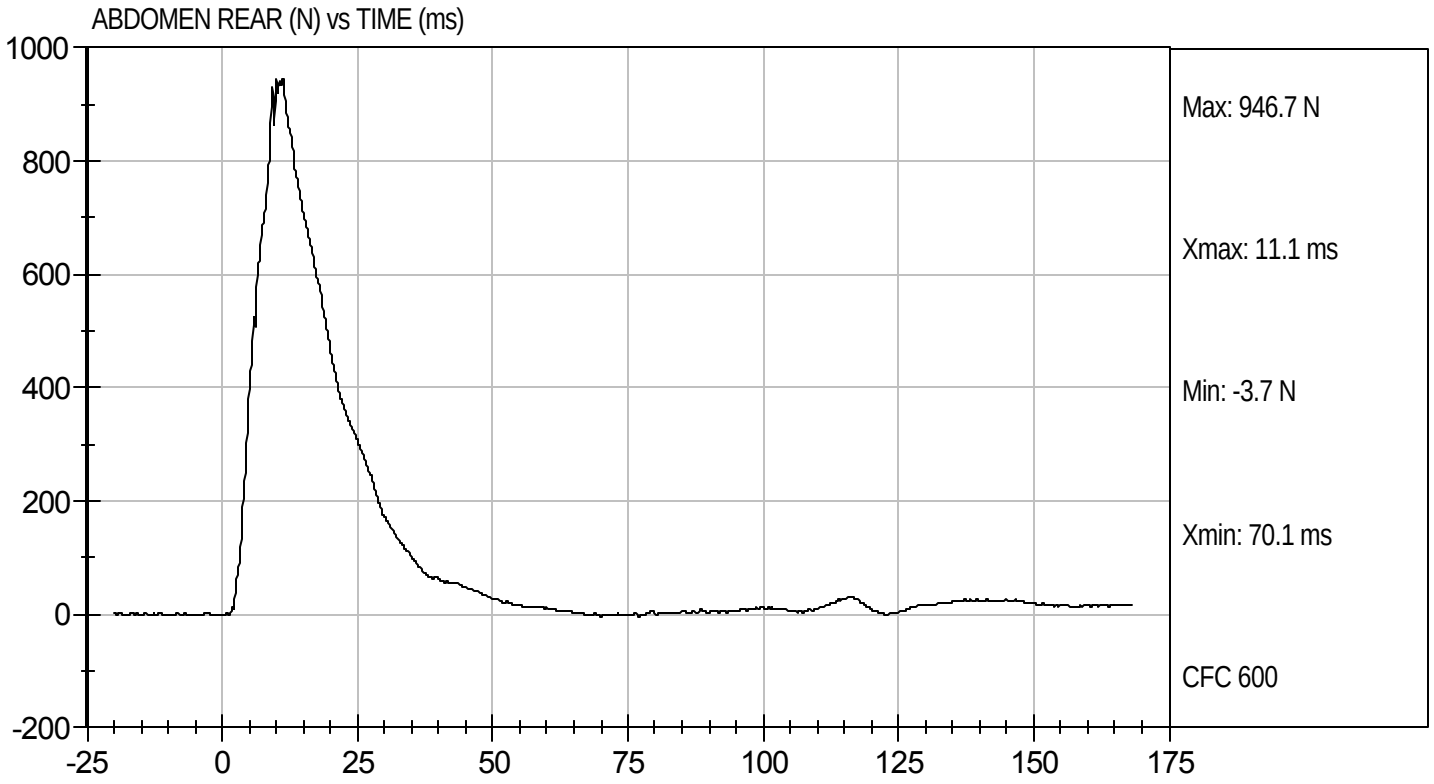


ABDOMEN MIDDLE (N) vs TIME (ms)



Test Desc: Abdomen Impact
Component ID: D121937

Test Date: 5/23/12
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:** D121938

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	44	Pass
Pendulum Speed		m/s	5.95 to 6.15	6.13	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	-0.42	Pass
	27 ms	m/s	-6.50 to -5.80	-5.97	Pass
	30 ms	m/s	>= -6.5	-5.91	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	45.7	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	46.9	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	45	Pass
			Overall Results		Pass

Jessica Hall
Laboratory Technician

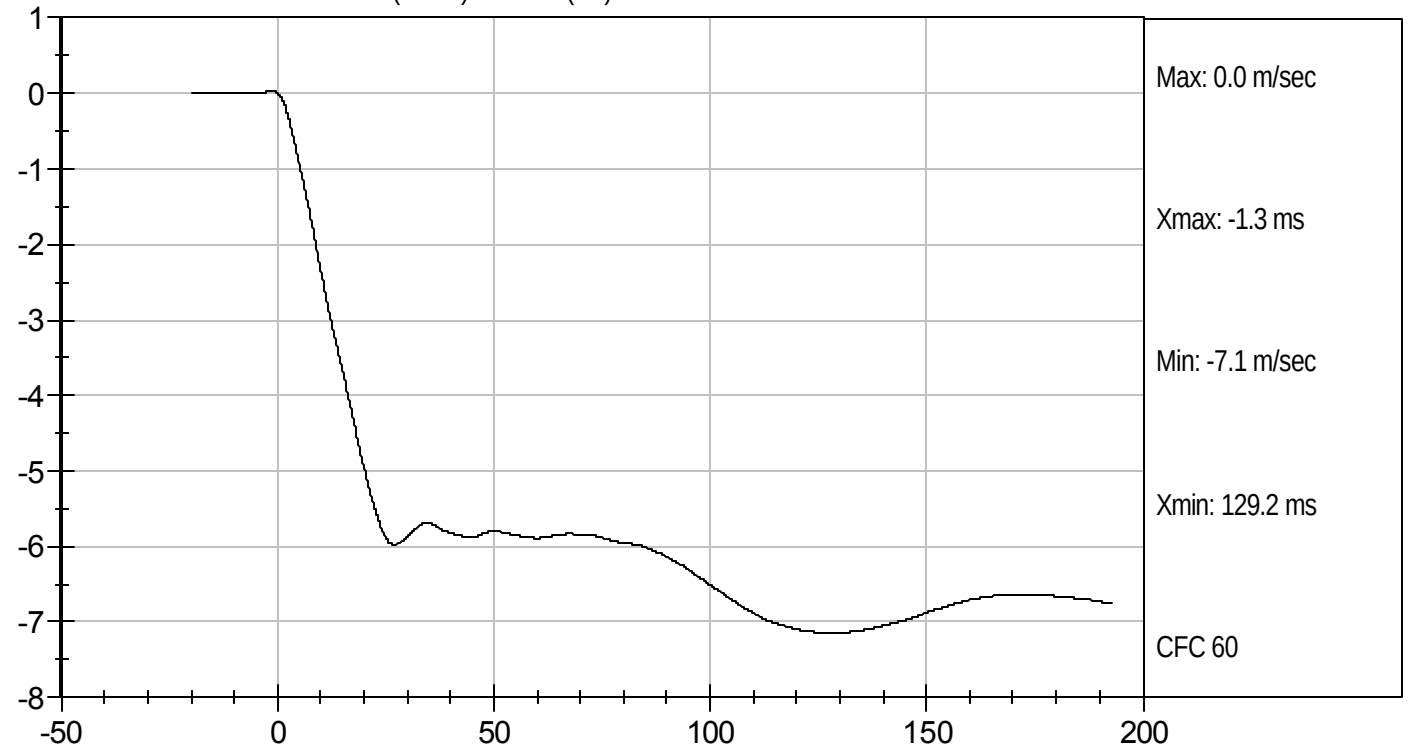
5/24/12
Test Date

David Winkelbauer
Approved By

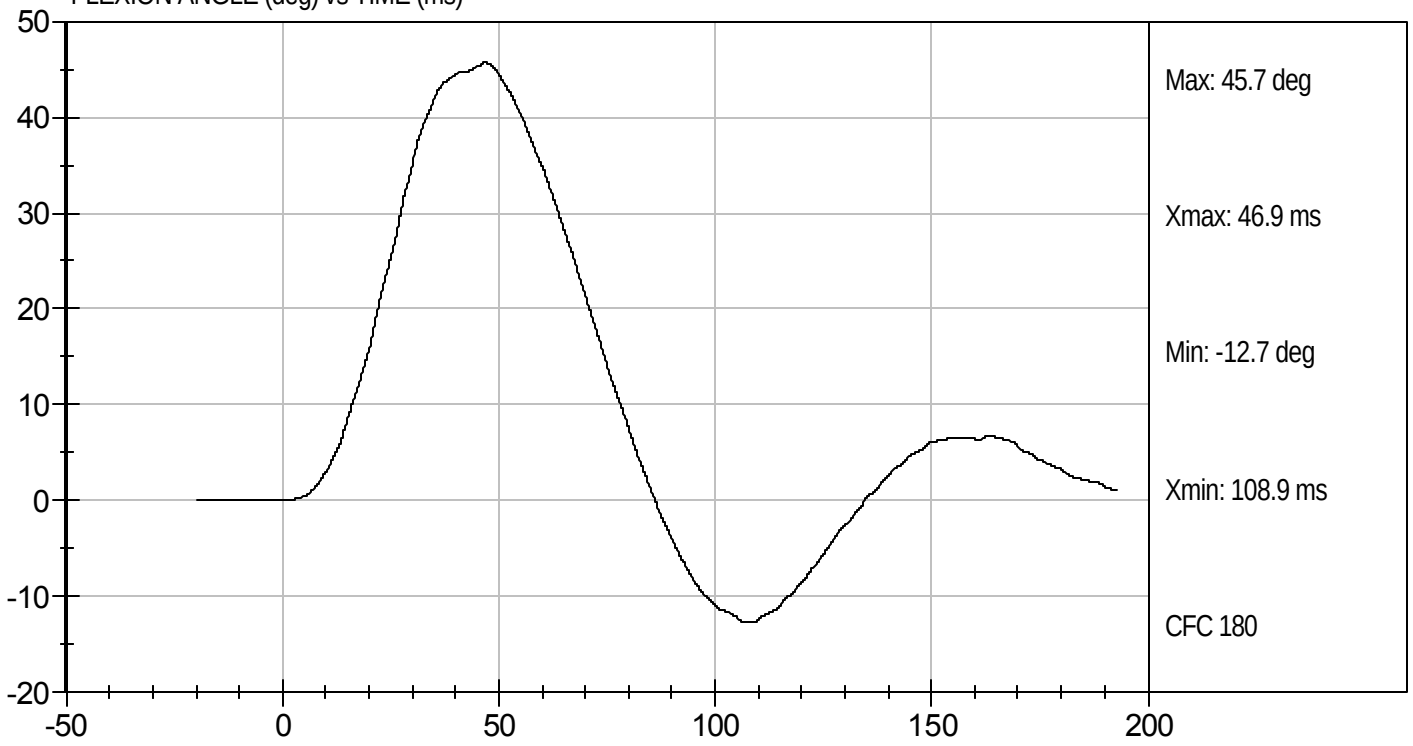
Test Desc: Lumbar Bending
Component ID: D121938

Test Date: 5/24/12
Velocity: 20.1 ft/s, 6.13 m/s

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

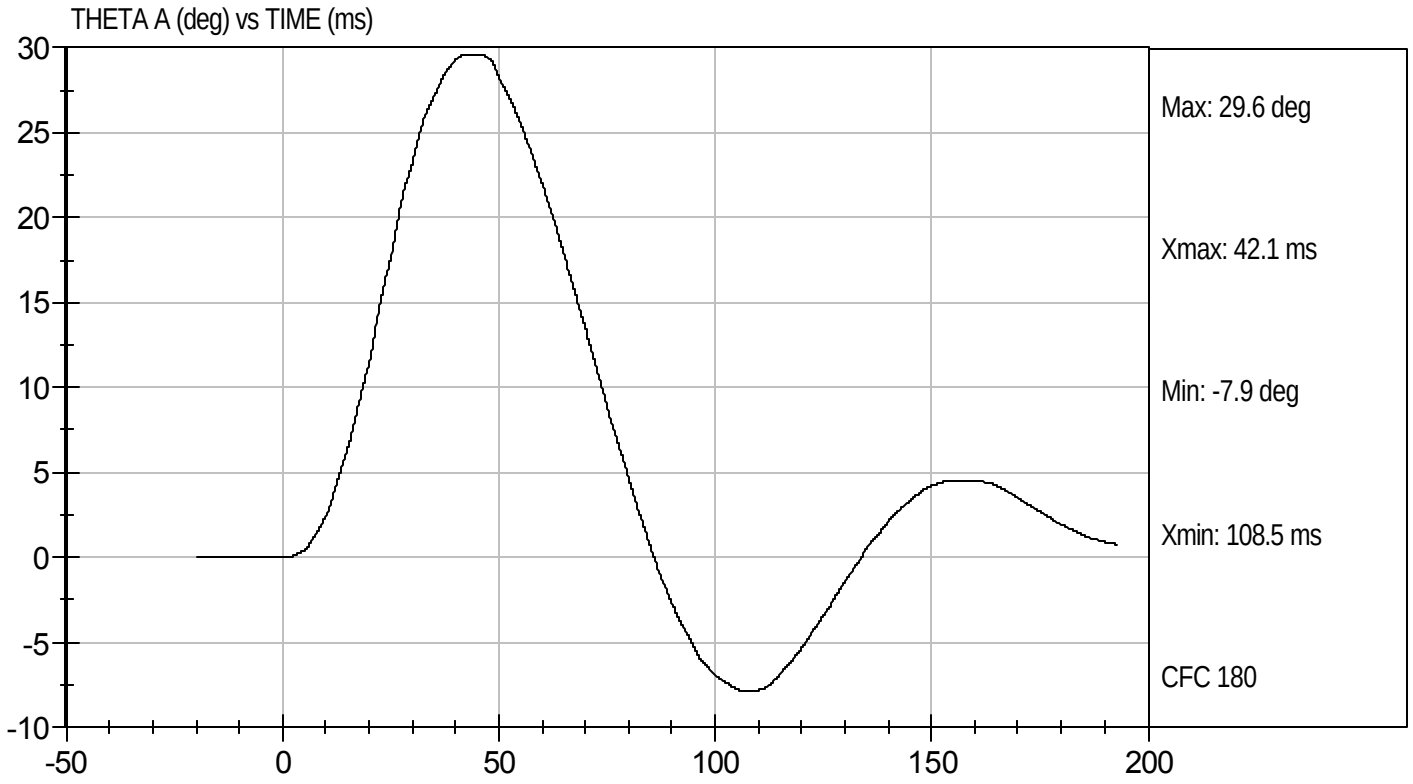


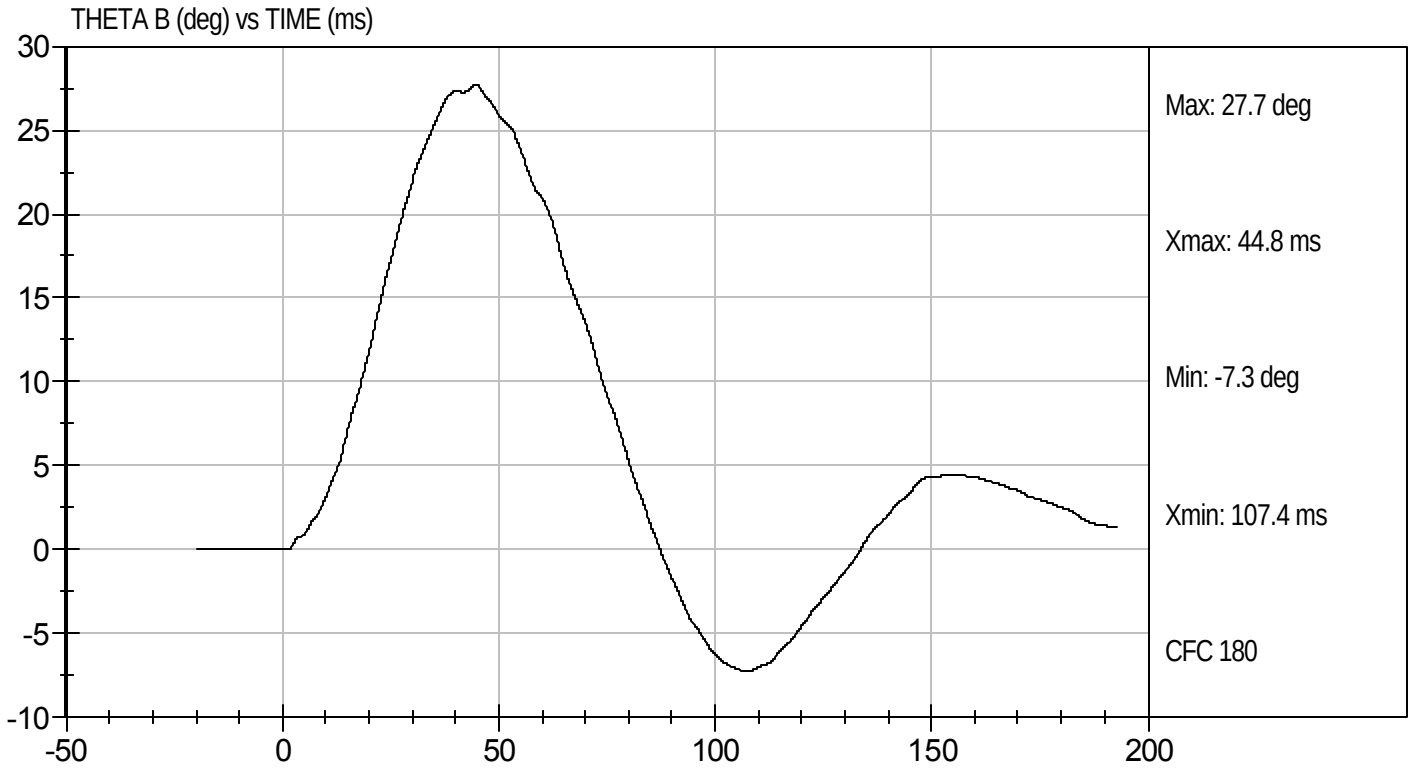
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Lumbar Bending
Component ID: D121938

Test Date: 5/24/12
Velocity: 20.1 ft/s, 6.13 m/s





MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121939

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	37	Pass
Probe Speed	m/s	4.20 to 4.40	4.30	Pass
Maximum Impactor Force	kN	4.70 to 5.40	4.91	Pass
Time of Maximum Impactor Force	ms	11.80 to 16.10	13.80	Pass
Maximum Pubic Force	kN	1.23 to 1.59	1.43	Pass
Time of Maximum Pubic Force	ms	12.20 to 17.00	15.10	Pass
		Overall Test Results		Pass

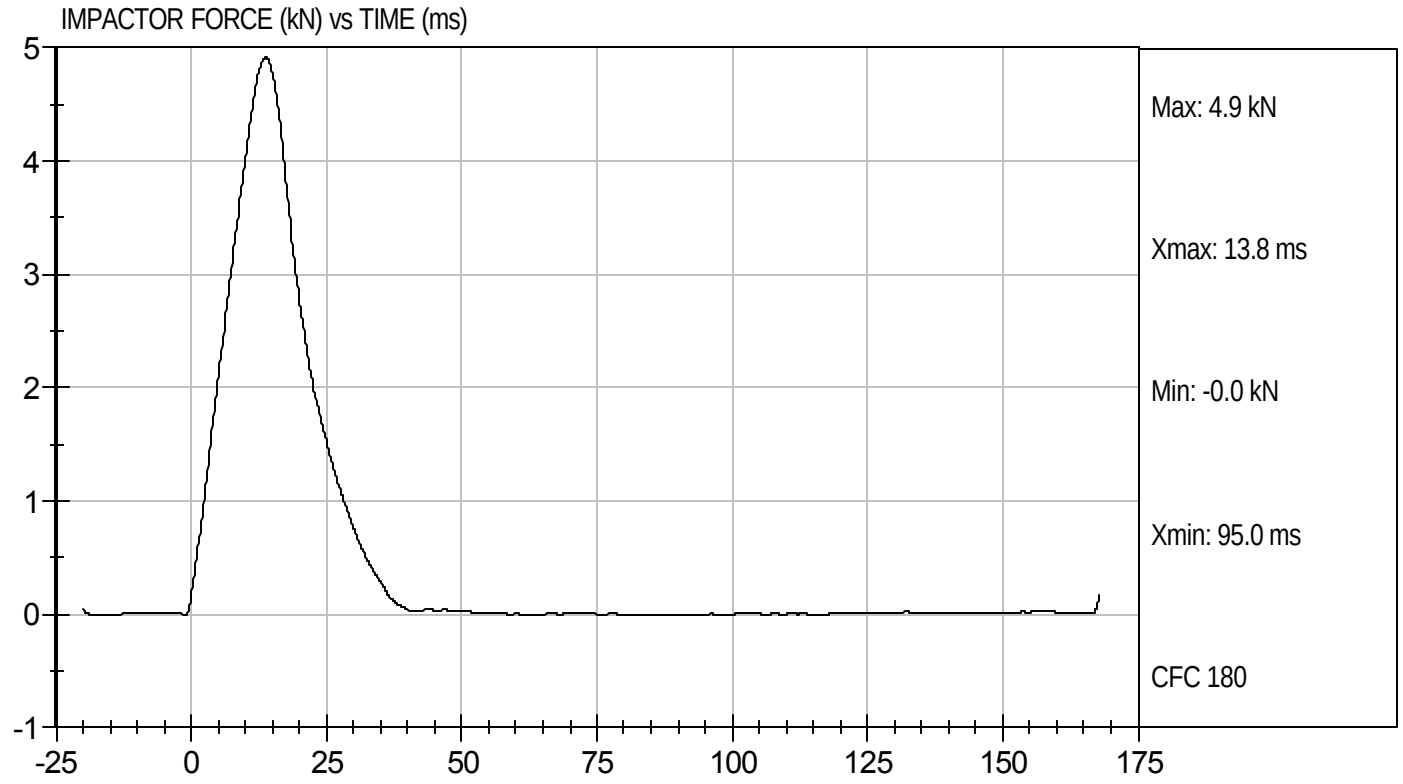
Jessica Hall
Laboratory Technician

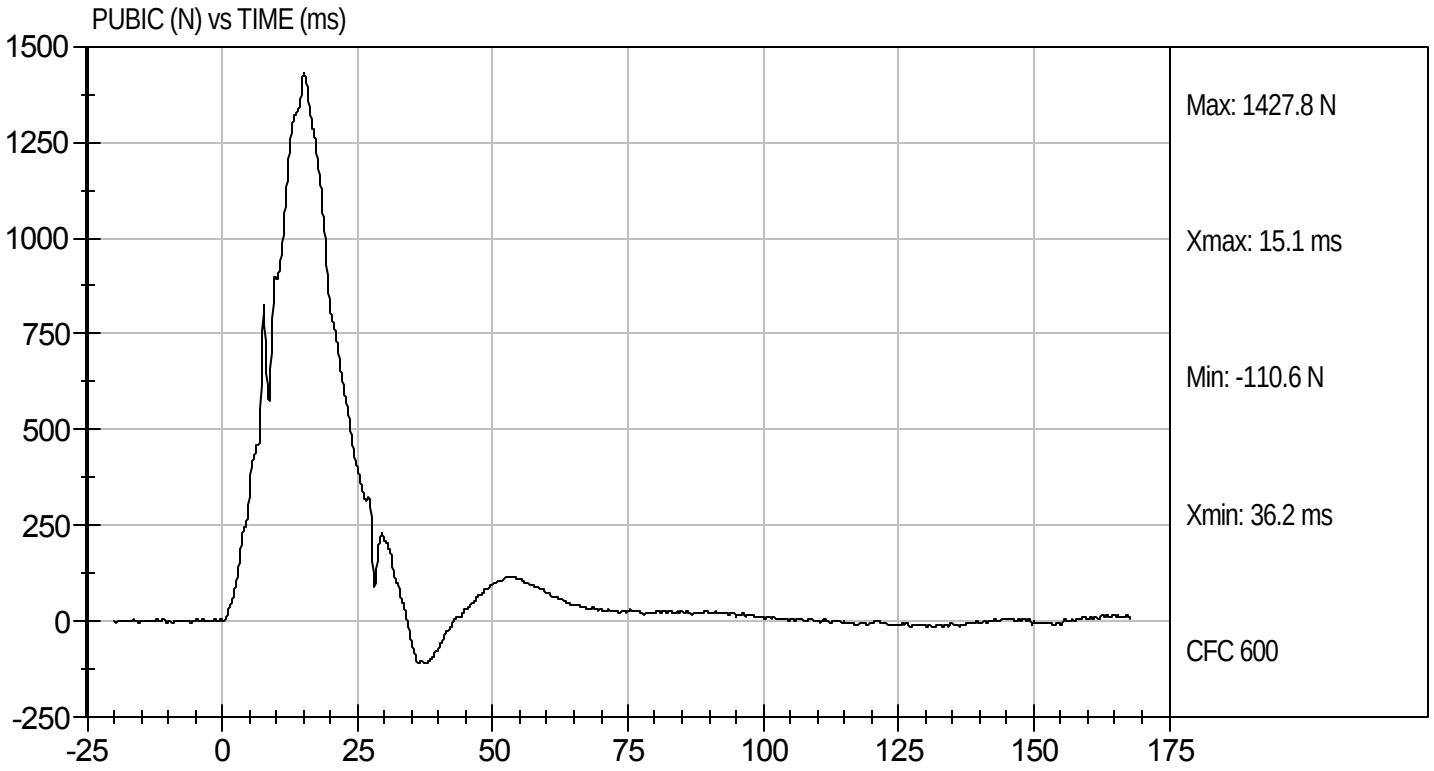
5/23/12
Test Date

David Winkelbauer
Approved By

Test Desc: Pelvis Impact
Component ID: D121939

Test Date: 5/23/12
Velocity: 14.12 ft/s, 4.30 m/s





MGA RESEARCH CORPORATION

FULL BODY THORAX IMPACT TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D121930

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.4	Pass
Humidity	%	10 to 70	37	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	5.21	Pass
Upper Rib Displacement	mm	34.0 to 41.0	37.9	Pass
Middle Rib Displacement	mm	37.0 to 45.0	41.3	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.3	Pass
		Overall Test Results		Pass

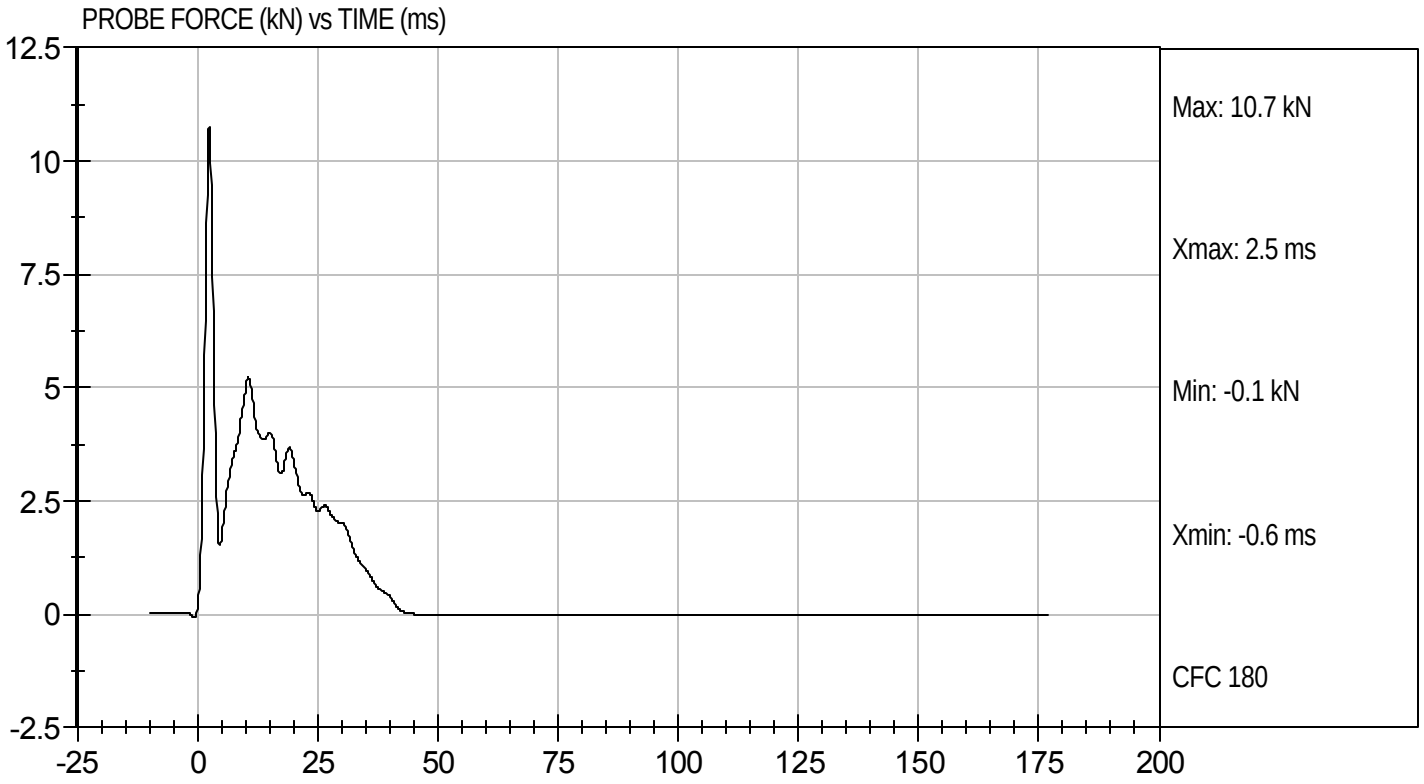
Jessica Hall
Laboratory Technician

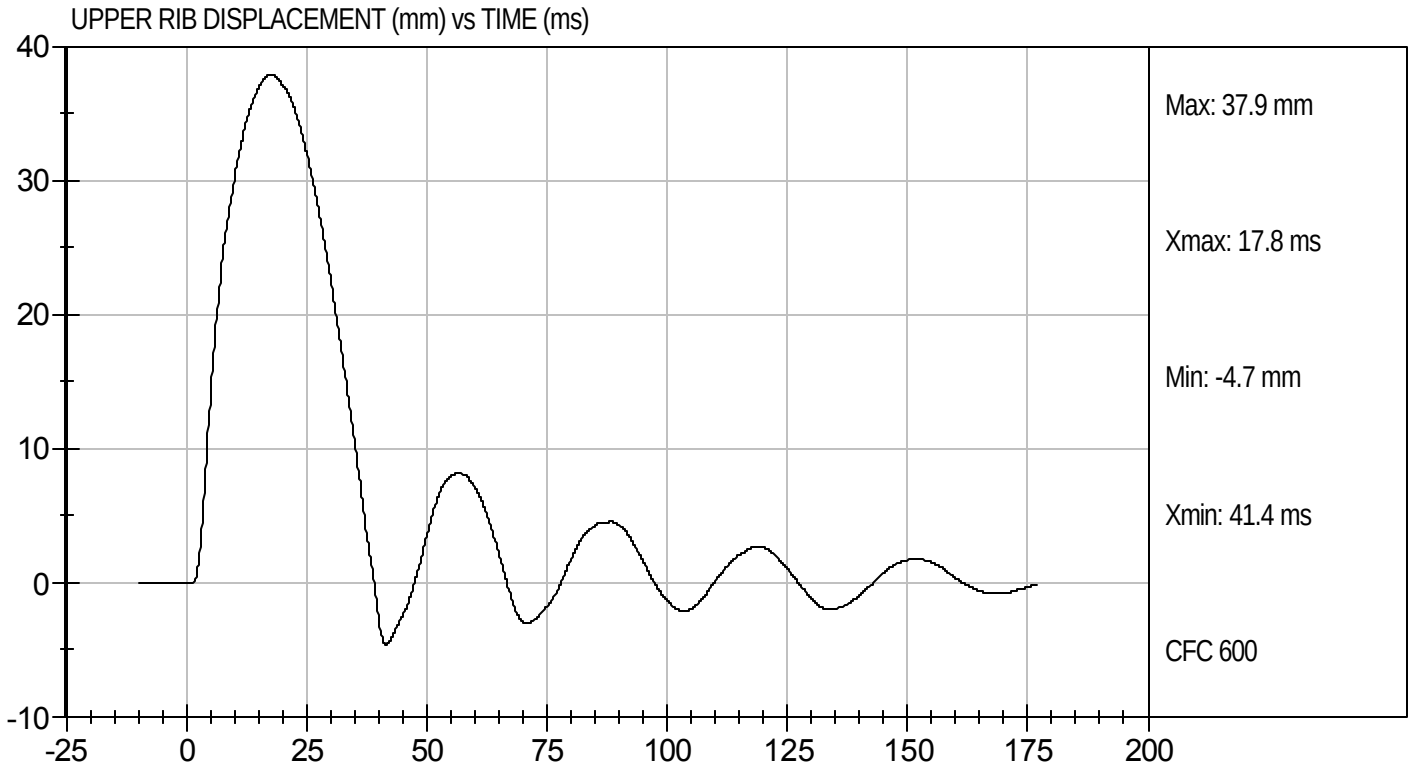
5/23/12
Test Date

David Winkelbauer
Approved By

Test Desc: Thorax Impact
Component ID: D121930

Test Date: 5/23/12
Velocity: 18.32 ft/s, 5.58 m/s

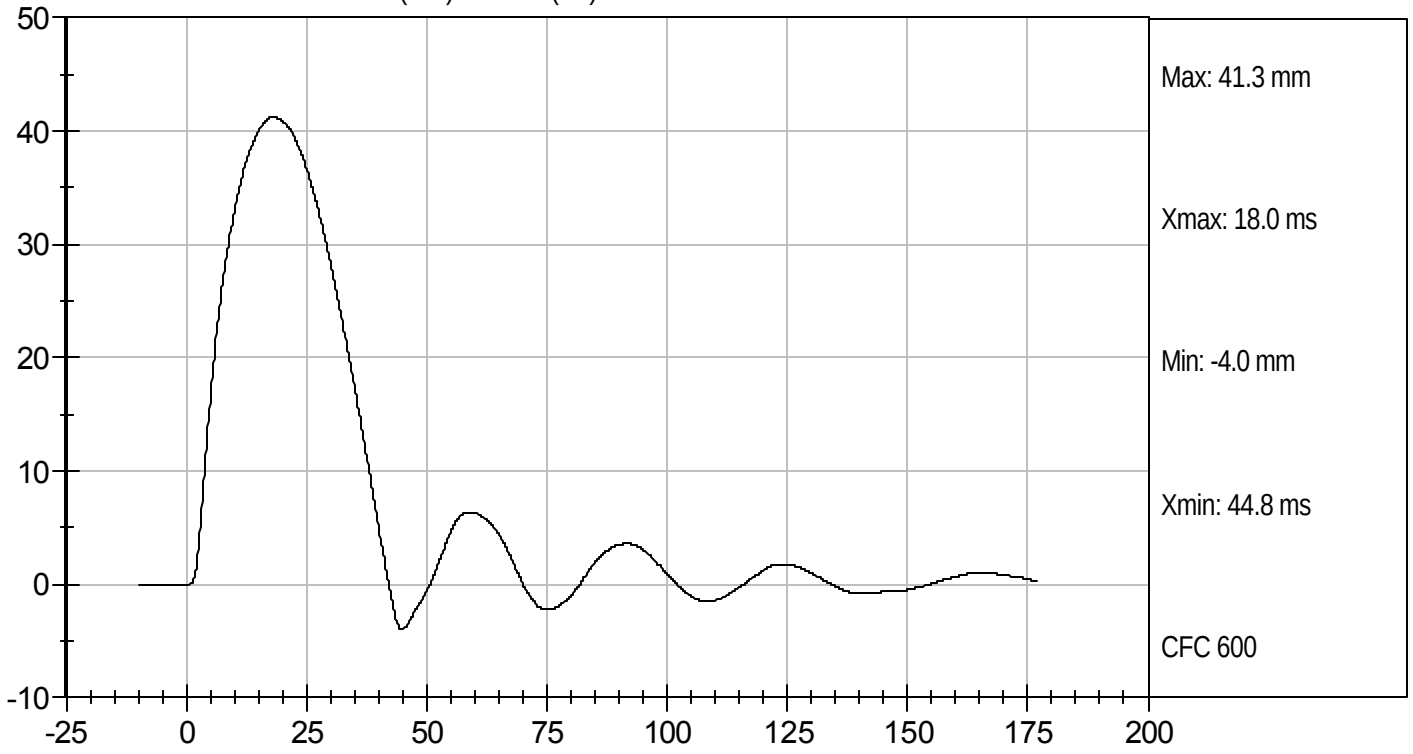




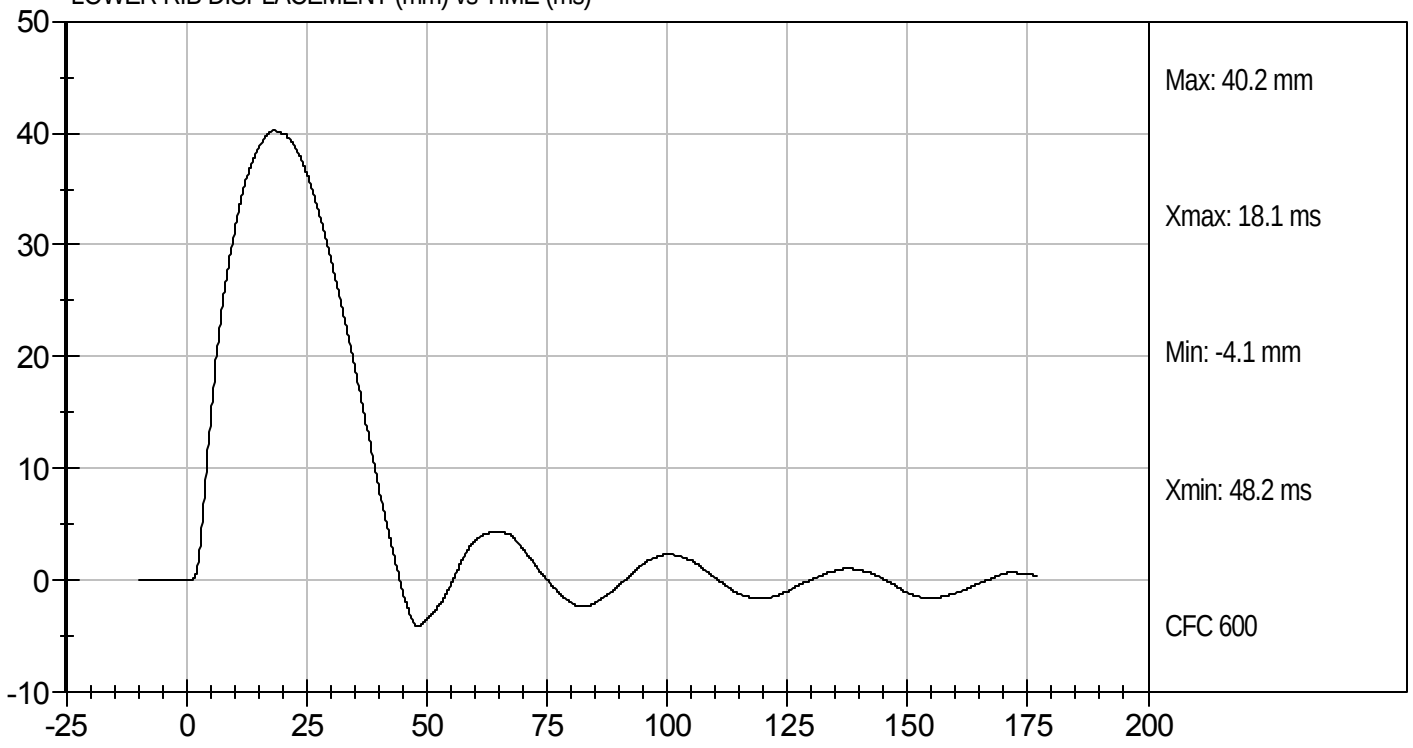
Test Desc: Thorax Impact
Component ID: D121930

Test Date: 5/23/12
Velocity: 18.32 ft/s, 5.58 m/s

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	P73999	Endevco	02/29/12
	Y	P74001	Endevco	02/29/12
	Z	P74002	Endevco	02/29/12
Thorax Potentiometers	Upper Rib (Y)	G144	Honeywell	03/01/12
	Middle Rib (Y)	G143	Honeywell	03/01/12
	Lower Rib (Y)	G142	Honeywell	03/01/12
Abdomen Load Cells	Forward (Y)	ABG119	FTSS	02/08/12
	Middle (Y)	ABG120	FTSS	02/08/12
	Rear (Y)	ABG121	FTSS	02/08/12
Pubic Symphysis Load Cell (Y)		PG223	FTSS	02/08/12

Table 2 – Vehicle Instrumentation

	Serial Number	Manufacturer	Calibration Date
Vehicle CG (X)	P63222	Endevco	02/10/12
Vehicle CG (Y)	P63221	Endevco	02/10/12
Vehicle CG (Z)	P63220	Endevco	02/10/12
Left Floor Sill (Y)	P59325	Endevco	12/14/11
A Pillar Sill (Y)	P63219	Endevco	05/02/12
A Pillar Low (Y)	P63530	Endevco	02/10/12
A Pillar Mid (Y)	P63293	Endevco	01/13/12
B Pillar Sill (Y)	P52191	Endevco	02/10/12
B Pillar Low (Y)	P59275	Endevco	05/02/12
B Pillar Mid (Y)	P59405	Endevco	01/12/12
Driver Seat Track (Y)	P63274	Endevco	02/10/12
Top of Engine (X)	P63494	Endevco	01/13/12
Top of Engine (Y)	P63495	Endevco	01/13/12
Firewall (Y)	P63538	Endevco	12/13/11
Right Roof (Y)	P49520	Endevco	03/13/12
Right Sill (Y)	P63893	Endevco	04/10/12
Floorpan @ Rear Axle (X)	P63881	Endevco	02/10/12
Floorpan @ Rear Axle (Y)	P63882	Endevco	02/10/12