REPORT NUMBER: 214P-MGA-2011-009

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

TOYOTA MOTOR CORPORATION
2011 SCION TC 3-DR LIFTBACK
NHTSA NUMBER: CB5107

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

Test Date: March 30, 2011

Report Date: June 28, 2011

FINAL REPORT

PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
ENFORCEMENT
OFFICE OF VEHICLE SAFETY COMPLIANCE
1200 NEW JERSEY AVENUE, SE
WEST BUILDING (NVS-220)
WASHINGTON, DC 20590

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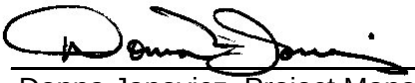
Prepared by: 
Donna Janovicz, Project Manager

Approved by: 
Joe Fleck, Project Engineer

Approval Date: June 28, 2011

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) Donna Janovicz, Project Manager Joe Fleck, Project Engineer		*8. Performing Organization Report No.* 214P-MGA-2011-009
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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 2011 Scion tC 3-Dr Liftback 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 March 30, 2011.

The impact velocity was 31.7 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 318 mm at level 3. The test vehicle's performance follows:

Measurement Description	Units	Result
Head Injury Criteria (HIC_{36})	N/A	353
Max. Rib Deflection	mm	14
Sum of Abdomen Forces	N	968
Pubic Symphysis Force	N	2172

The door on the struck side of the vehicle did not separate from the body at the hinges or latch and the opposite side door 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 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 Scion tC 3-Dr Liftback. 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 Scion tC 3-Dr Liftback. The subject vehicle was towed into the rigid pole at an angle of 75° and a velocity of 31.7 km/h. The test was conducted by MGA Research Corporation in Burlington, Wisconsin, on March 30, 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 50th Percentile Male	353	Upper	14.4	Front	268.3	2171.5
		Middle	11.3	Mid	296.5	
		Lower	8.8	Rear	420.9	
		Max.	14.4	Sum	968.2	

GENERAL COMMENTS

There was no valid data collected for:

A Pillar Low Y after 10 msec.
A Pillar Mid Y after 20 msec.
Seat Y after 15 msec.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION

DATA SHEET NO. 1

TEST VEHICLE INFORMATION AND OPTIONS

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

VEHICLE INFORMATION	
Make	Scion
Model	tC
Body Style	3-Dr Hatchback
VIN	JTKJF5C73B3009424
Body Color	Classic Silver Met
Engine Displacement (L)	2.5
# of Cylinders	4
Engine Placement	Lateral
Transmission Type	Manual
Transmission Speeds	6
Overdrive	Yes
Final Drive	Front
Odometer Reading	90 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 Pretentioners	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 Pretentioners	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?	Yes
Anti-Lock Brakes	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation
Date of Manufacture	10/10

GVWR (kg)	1882
GAWR Front (kg)	1150
GAWR Rear (kg)	950

VEHICLE SEATING AND CAPACITY WEIGHT INFORMATION

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Weight (VCW) (kg)				390
Cargo Weight (RCLW) (kg)				50

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

TIRE PRESSURES

	Units	LF	RF	RR	LR
As Delivered	kPa	230	230	210	210
As Tested	kPa	230	230	210	210

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	446.8	264.0		478.1	313.4		471.7	316.2	
Right	kg	429.1	264.4		440.9	298.5		440.0	297.1	
Ratio	%	62.4	37.6		60.0	40.0		59.8	40.2	
Totals	kg	875.9	528.4	1404.3	919.0	611.9	1530.9	911.7	613.3	1525.0

TEST VEHICLE TARGET WEIGHT (TVTW) CALCULATION

Measured Parameter	Units	Value
As Delivered Weight	kg	1404.3
Weight of 1 P572U ATD (ES-2re) Dummy	kg	77.1
Rated Cargo/Luggage Weight (RCLW)	kg	50
Calculated Target Vehicle Test Weight (TVTW)	kg	1531.4

TEST VEHICLE ATTITUDES

	Units	LF	RF	RR	LR
Fully Loaded	mm	688	693	698	690
As Tested	mm	694	693	702	707
Difference	mm	-6	0	-4	-17

CALCULATION OF THE VERTICAL IMPACT REFERENCE LINE

Measurement Parameter	Units	Value
Test Vehicle Wheel Base	mm	2705
Vertical Impact Reference Line (Aft of Front Axle)	mm	1251

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

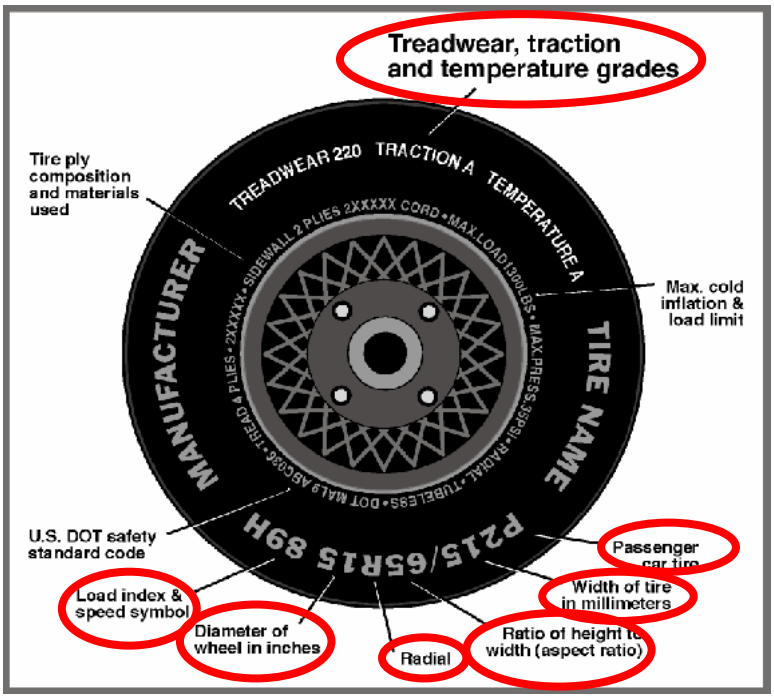
Description of Component	Weight (kg)
Ballast	0
Right Front Headrest and all Rear Headrests	1.8
Both Tail Lights, Trunk Plastics	3.6

DATA SHEET NO. 3

VEHICLE TIRE INFORMATION

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

VEHICLE TIRE INFORMATION

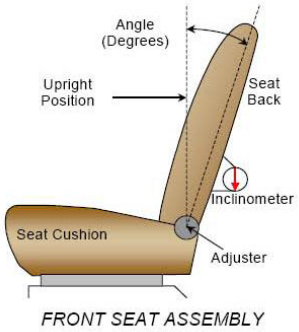


Measured Parameter	Front	Rear
Max. Tire Pressure (kPa)	350	350
Cold Pressure (kPa)	230	210
Recommended Tire Size	P225/45R18	P225/45R18
Tire Size on Vehicle	P225/45R18	P225/45R18
Tire Manufacturer	Yokohama	Yokohama
Tire Name	AVD S34	AVD S34
Tire Type	Passenger	Passenger
Tire Width	225	225
Aspect Ratio	45	45
Radial	Yes	Yes
Wheel Diameter	18	18
Load Index/Speed Symbol	91W	91W
Treadwear	360	360
Traction Grade	A	A
Temperature Grade	A	A

DATA SHEET NO. 4

SEAT AND SEAT BELT ADJUSTMENT DATA

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011



NORMAL DESIGN RIDING POSITION

The driver seat back is positioned to the manufacturer's designated angle. The procedure is as follows: Seat back angle is measured at the headrest post with the inclinometer zeroed at the door sill. Set seat back at 3 degrees.

SEAT BACK ANGLE

	Degrees	Detents
Driver without Seated Dummy	4.4° at headrest post	5th detent (1st 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	24 detents	12th 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

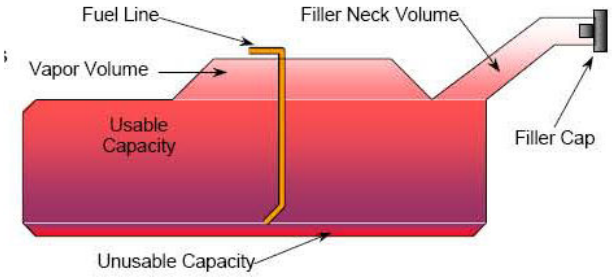
Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

FUEL TANK CAPACITY

	Liters
Usable Capacity (Form 1)	54.9
Usable Capacity (Owner's Manual)	55.0
92-94% of Usable Capacity	50.5 to 51.6
Actual Amount of Solvent Used	50.9

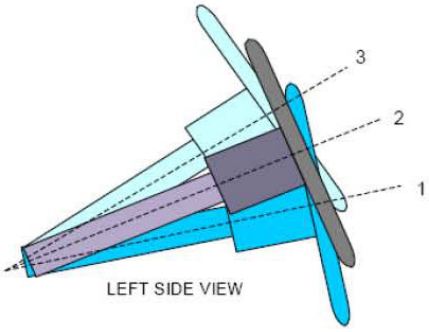
FUEL PUMP

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. The fuel pump is activated when the ignition is turned on. The fuel pipe is on the left 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

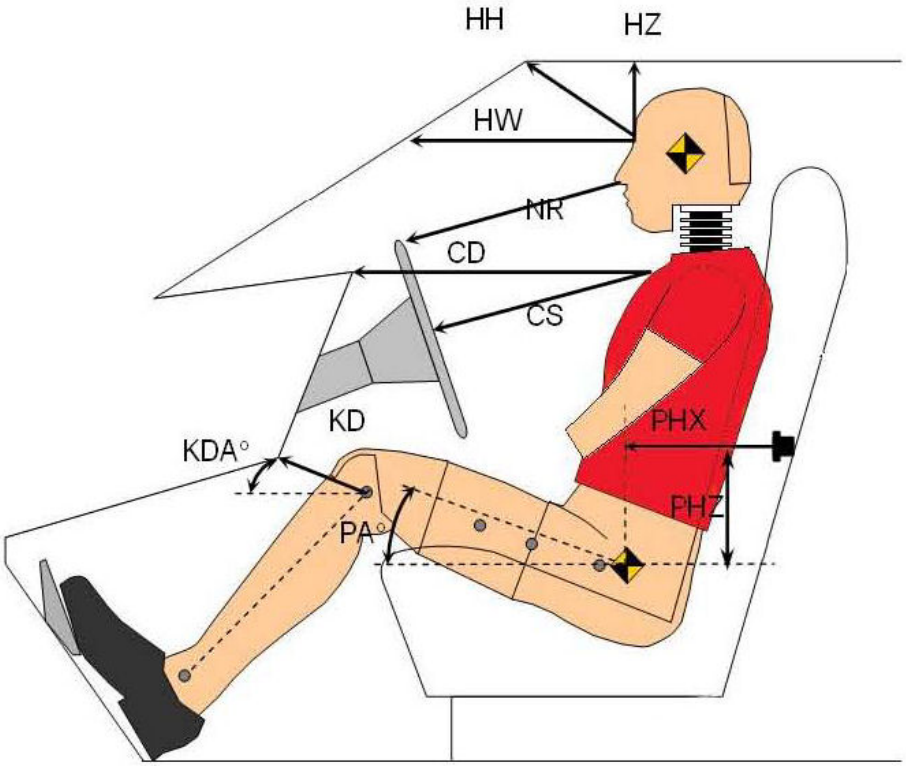
STEERING COLUMN POSITIONING

	Degrees	Fore/Aft Position (mm)
Lowermost - Position 1	71.8	130
Geometric Center – Position 2	70.3	110
Uppermost – Position 3	68.8	90
Telescoping Steering Wheel Travel		40
Test Position	70.3	110

.DATA SHEET NO. 6

DUMMY LONGITUDINAL CLEARANCE DIMENSIONS

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011



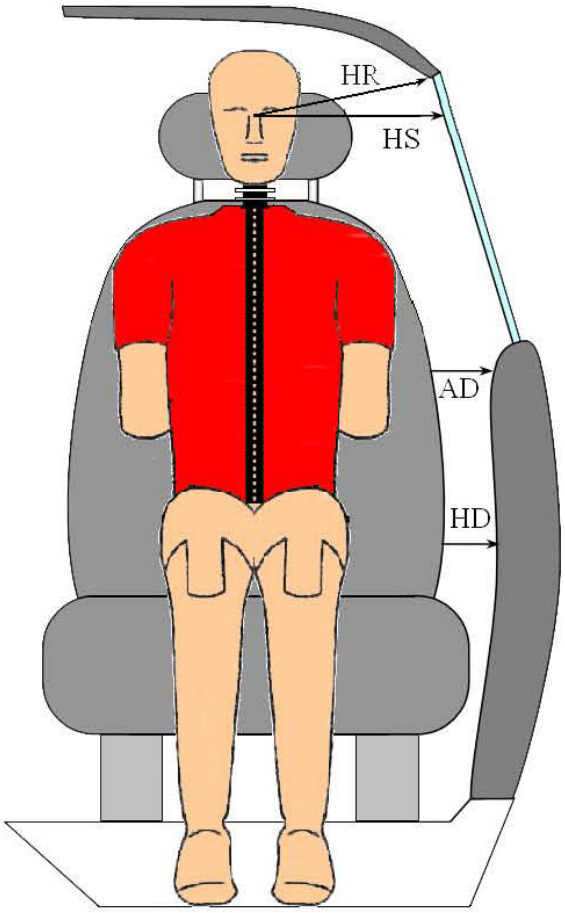
Driver Code	Measurement Description	Length (mm)	Angle (°)
HH	Head to Header	405	
HW	Head to Windshield	600	
HZ	Head to Roof	120	
NR	Nose to Rim	408	
CD	Chest to Dash	512	
CS	Chest to Steering Wheel	338	
KDL	Left Knee to Dash	196	33.1
KDR	Right Knee to Dash	174	30.9
	Torso Angle		19.6
PHX	H-Point to Striker (X-Axis)	454	
PHZ	H-Point to Striker (Z-Axis)	225	

DATA SHEET NO. 7

DUMMY LATERAL CLEARANCE DIMENSIONS

Test Vehicle: 2011 Scion tC 3-Dr Liftback
Test Program: FMVSS 214 Pole

NHTSA No. CB5107
Test Date: 3/30/2011

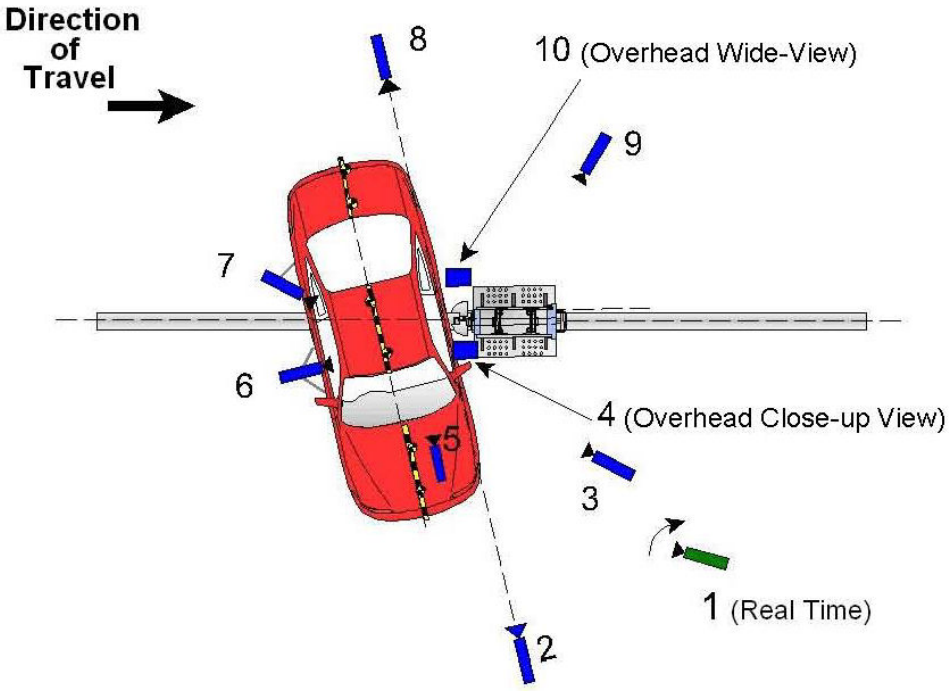


Code	Measurement Description	Units	Front Occupant
HR	Head to Side Header	mm	207
HS	Head to Side Window	mm	322
AD	Arm to Door	mm	103
HD	H-Point to Door	mm	146

DATA SHEET NO. 8

HIGH SPEED CAMERA LOCATIONS AND DATA

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011



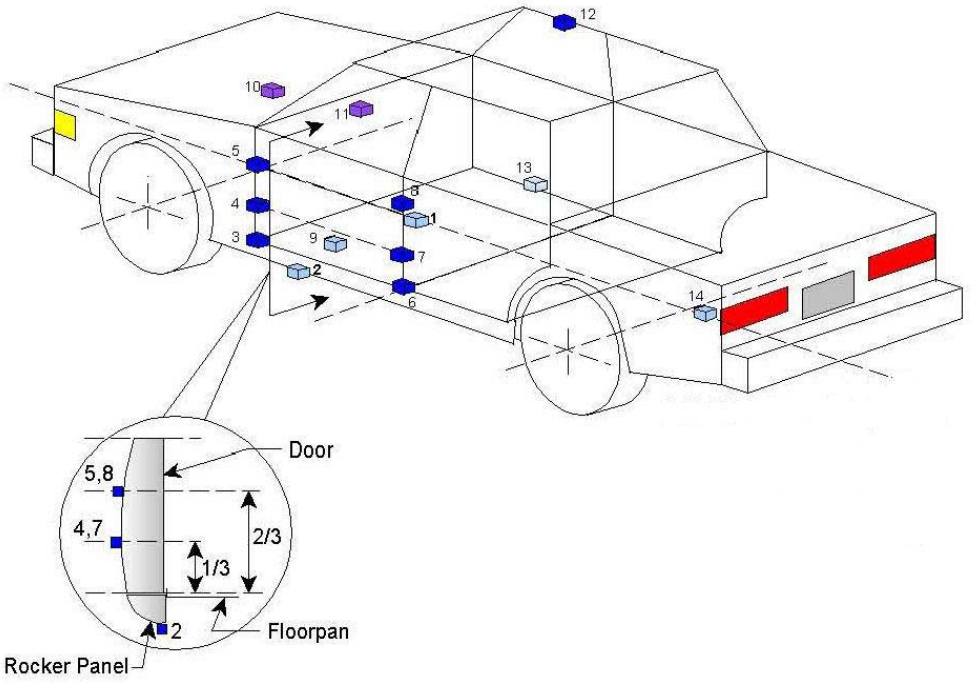
Reference: From Point of Impact for X and Y; from Ground for Z):
+X = Right of Impact, + Y = Forward of Impact, +Z = Up

Camera No.	View	Coordinates (mm)			Lens (mm)	Film Speed (fps)
		X	Y	Z		
1	Real-Time					30
2	Front Ground Level	5850	40	1730	24	1000
3	Impact Side 45° Forward	4530	2240	1850	20	1000
4	Overhead Closeup	0	80	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	-5790	40	1710	24	1000
9	Impact Side 45° Rearward	-3950	3900	1870	20	1000
10	Overhead Wide	0	-340	4610	14	1000

DATA SHEET NO. 9

TEST VEHICLE ACCELEROMETER LOCATIONS

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011



Loc. No.	Accelerometer Location			
	ID	Coordinates (mm)		
		X	Y	Z
1	Vehicle CG	2355	-225	-210
2	Left Floor Sill	2500	-705	-210
3	A Pillar Sill	3030	-705	-205
4	A Pillar Low	2995	-630	-515
5	A Pillar Mid	2980	-785	-745
6	B Pillar Sill	1800	-705	-220
7	B Pillar Low	1810	-710	-505
8	B Pillar Mid	1790	-702	-740
9	Seat	2150	-50	-340
10	Engine	3745	0	-840
11	Firewall	3465	0	-900
12	Roof	1810	580	-1410
13	Floor Sill	1745	705	-215
14	Rear Deck	370	0	-485

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 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

Loc. No.	Description	Peak Values (g's)			
		Max	Time (ms)	Min	Time (ms)
1	Vehicle CG (X)	15.5	64.3	-16.7	24.1
	Vehicle CG (Y)	33.7	11.7	-7.1	36.2
	Vehicle CG (Z)	38.1	57.0	-22.7	36.4
	Resultant	39.6	57.0		
2	Left Floor Sill (Y)	37.7	19.1	-30.8	27.9
3	A Pillar Sill (Y)	19.6	19.1	-6.4	29.3
4	A Pillar Low (Y)	(1)	(1)	(1)	(1)
5	A Pillar Mid (Y)	19.6	14.4	-8.6	28.7
6	B Pillar Sill (Y)	28.5	31.3	-8.2	17.3
7	B Pillar Low (Y)	(2)	(2)	(2)	(2)
8	B Pillar Mid (Y)	47.2	35.2	-22.9	23.6
9	Seat (Y)	(3)	(3)	(3)	(3)
10	Engine (X)	10.9	95.5	-19.2	34.0
	Engine (Y)	12.5	60.7	-1.9	145.6
11	Firewall (Y)	13.8	27.4	-0.8	3.4
12	Roof (Y)	36.5	45.8	-3.0	50.6
13	Floor Sill (Y)	25.2	27.2	-1.1	186.3
14	Rear Deck (X)	3.5	134.2	-5.8	56.5
	Rear Deck (Y)	19.4	54.6	-1.9	142.8

(1) No valid data collected for A Pillar Low Y after 10 msec.
(2) No valid data collected for B Pillar Low Y after 20 msec.
(3) No valid data collected for Seat Y after 15 msec.

DATA SHEET NO. 11

DUMMY INJURY RESPONSE DATA

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

Dummy S/N	Positive		Negative	
	MAX	TIME (ms)	MAX	TIME (ms)
HEAD ACCELERATION (G)				
Longitudinal (X)	16.8	117.4	29.7	49.9
Lateral (Y)	44.5	58.8	23.2	111.4
Vertical (Z)	19.6	43.8	1.3	61.9
Resultant (R)	52.4	51.3		
HIC36 (t1, t2)	353		t1 = 41.6	t2 = 71.3
THORAX DEFLECTION (mm)				
Upper Rib			14.4	54.5
Middle Rib			11.3	55.0
Lower Rib			8.8	55.2
ABDOMINAL FORCES (N)				
Front	268.3	46.9		
Middle	296.5	44.4		
Rear	420.9	46.5		
Sum	968.2	46.1		
PELVIS FORCE (N)				
Pubic Symphysis			2171.5	51.9

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

DATA SHEET NO. 12

POST TEST OBSERVATIONS

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

TEST DUMMY INFORMATION AND CONTACT

Description	Front Occupant
Dummy Type / Serial No.	ES-2re / 016
Head Contact	Curtain Airbag, Headrest
Upper Torso Contact	Side Airbag
Lower Torso Contact	Side Airbag
Left Knee Contact	Door Panel
Right Knee Contact	Left Knee

POST TEST DOOR OPENING AND SEAT TRACK INFORMATION

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

POST-TEST STRUCTURAL OBSERVATIONS

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

SUPPLEMENTAL RESTRAINT SYSTEM INFORMATION

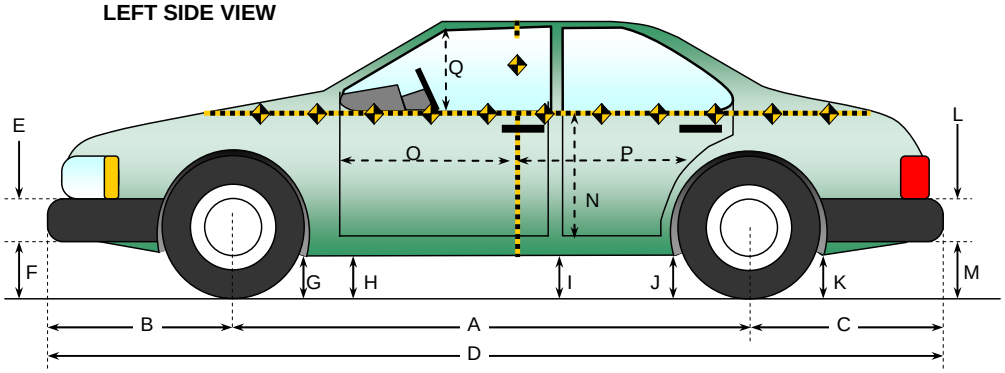
Restraint Type	Front Occupant	
	Installed	Operated
Frontal Airbag	Yes	No
Side Torso/Pelvis Airbag	Yes	Yes
Head Airbag	No	
Curtain Airbag	Yes	Yes
Knee Airbag	Yes	No
Seat Belt Pretensioner	Yes	Yes
Seat Belt Load Limiter	Yes	

DATA SHEET NO. 13

VEHICLE PRE TEST AND POST TEST MEASUREMENTS

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

LEFT SIDE VIEW

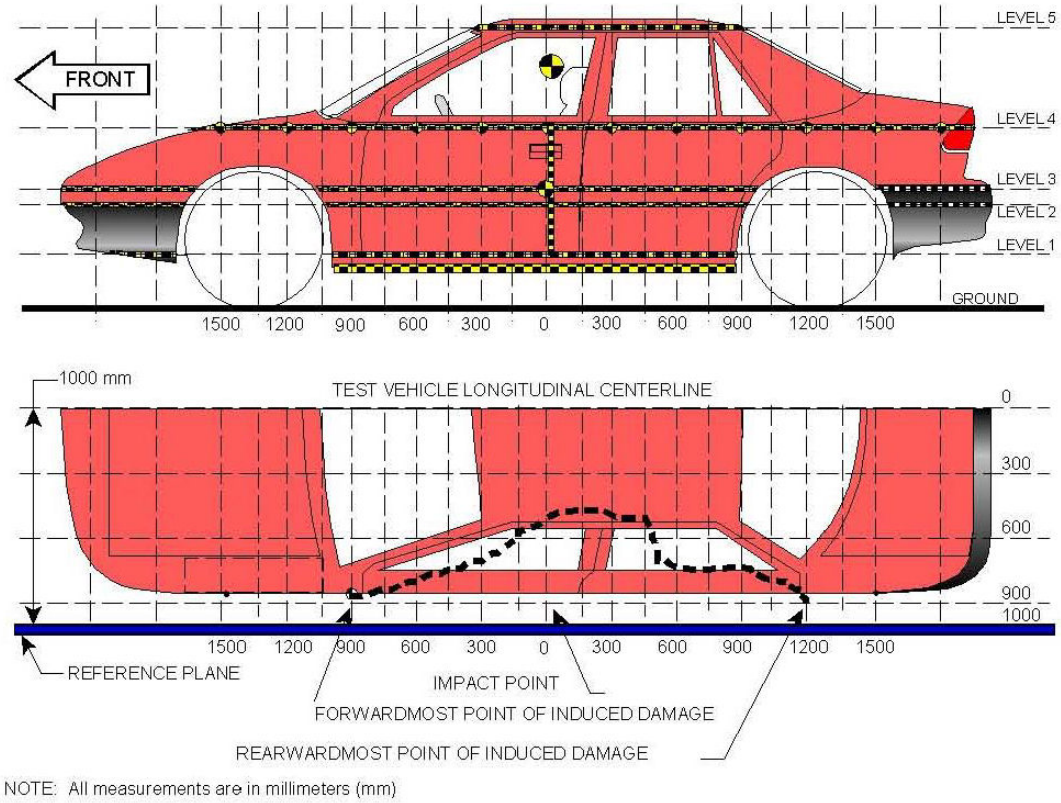


Code	Measurement Description	Pre-Test (mm)	Post-Test (mm)	Difference (mm)
A	Wheelbase	2705	2608	97
B	Front Axle to FSOV	900	900	0
C	Rear Axle to RSOV	815	815	0
D	Total Vehicle Length at Centerline	4420	4323	97
E	Front Bumper Thickness	105	105	0
F	Front Bumper Bottom to Ground	223	240	-17
G	Sill Height at Front Wheel Well	175	187	-12
H	Sill Height at Front Door Leading Edge	176	187	-11
I	Sill Height at B Pillar	190	225	-35
J1	Sill Height at Rear Wheel Well	178	194	-16
J2	Pinch Weld Height at Rear Wheel Well	197	193	4
K	Sill Height Aft of Rear Wheel Well	252	230	22
L	Rear Bumper Thickness	120	120	0
M	Rear Bumper Bottom to Ground	322	318	4
N	Sill Height to Window Bottom Sill	700	698	2
O	Front Door Leading Edge to Impact CL	793	800	-7
P	Rear Door Trailing Edge to Impact CL	544	528	16
Q	Front Window Opening	400	348	52
R	Right Side Length	3525	3532	-7
S	Left Side Length	3525	3398	127
T	Vehicle Width at B Post	1735	1695	40

DATA SHEET NO. 14

EXTERIOR CRUSH MEASUREMENTS

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011



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	297	0	260
2	Occupant H-Point	306	0	512
3	Mid-Door	318	0	642
4	Window Sill	274	0	953
5	Window Top	122	-75	1345

DATA SHEET NO. 15

VEHICLE EXTERIOR CRUSH PROFILES

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

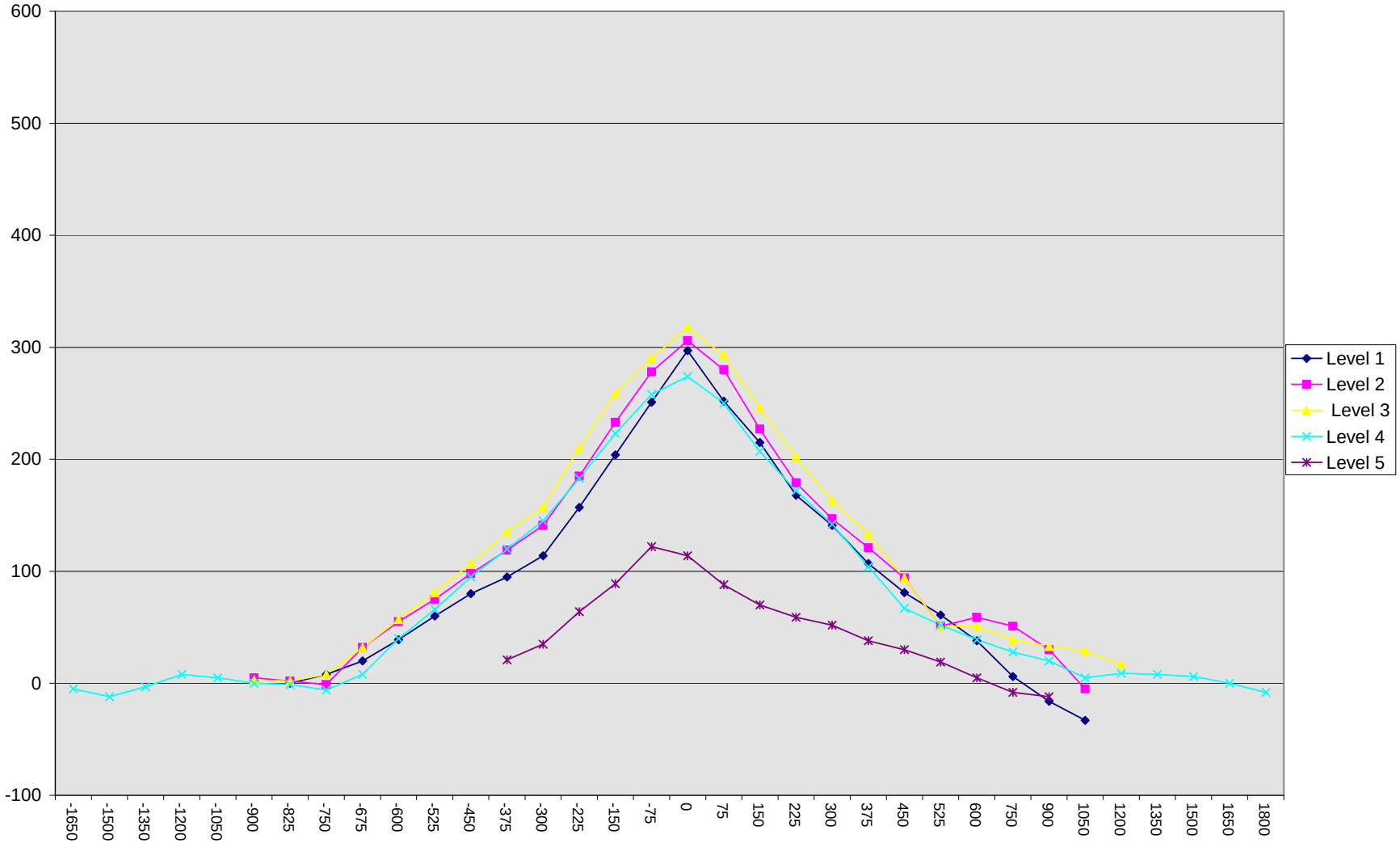
	Level 1	Level 2	Level 3	Level 4	Level 5
Maximum Crush (mm)	297	306	318	274	122
Distance From Impact (mm)	0	0	0	0	-75

	Pre-Test					Post-Test					Difference				
	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
-1650				389					384					-5	
-1500				367					355					-12	
-1350				345					342					-3	
-1200				330					338					8	
-1050				315					320					5	
-900		211	214	302			216	217	302			5	3	0	
-825	240	220	221	299		240	222	223	298		0	2	2	-1	
-750	239	230	225	296		247	229	233	290		8	-1	8	-6	
-675	239	233	226	294		259	265	258	302		20	32	32	8	
-600	239	234	226	291		278	289	283	331		39	55	57	40	
-525	239	234	226	290		299	309	307	356		60	75	81	66	
-450	239	234	226	289		319	332	333	384		80	98	107	95	
-375	239	234	226	288	498	334	353	361	408	519	95	119	135	120	21
-300	239	235	226	288	491	353	376	383	433	526	114	141	157	145	35
-225	239	235	226	287	486	396	420	436	470	550	157	185	210	183	64
-150	239	235	226	284	486	443	468	485	507	575	204	233	259	223	89
-75	240	235	227	283	483	491	513	517	541	605	251	278	290	258	122
0	240	235	227	283	482	537	541	545	557	596	297	306	318	274	114
75	241	235	228	283	482	493	515	521	533	570	252	280	293	250	88
150	243	236	228	282	482	458	463	474	489	553	215	227	246	207	70
225	243	236	229	282	482	411	415	431	454	541	168	179	202	172	59
300	244	236	230	283	483	385	383	393	425	535	141	147	163	142	52
375	244	237	230	282	483	351	358	363	386	521	107	121	133	104	38
450	245	237	231	282	485	326	331	325	349	513	81	94	94	67	30
525	245	238	232	282	486	306	289	283	334	505	61	51	51	52	19
600	245	239	234	283	489	283	298	285	322	494	38	59	51	39	5
750	244	241	236	285	496	250	292	275	313	488	6	51	39	28	-8
900	244	235	235	286	508	228	265	268	306	496	-16	30	33	20	-12
1050	239	214	222	293		206	209	251	298		-33	-5	29	5	
1200			203	294				220	303				17	9	
1350				294					302					8	
1500				297					303					6	
1650				305					305					0	
1800				323					315					-8	

DATA SHEET NO. 15 (CONTINUED)

VEHICLE EXTERIOR CRUSH PROFILES

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011



DATA SHEET NO. 16

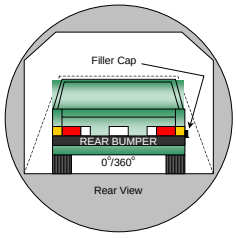
SUMMARY OF FMVSS 301 FUEL SYSTEM DATA

Test Vehicle: 2011 Scion tC 3-Dr Liftback
Test Program: FMVSS 214 Pole
NHTSA No. CB5107
Test Date: 3/30/2011

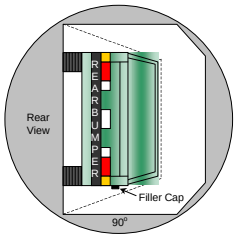
FUEL SYSTEM INTEGRITY POST IMPACT DATA

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

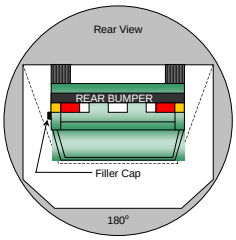
STATIC ROLLOVER DATA



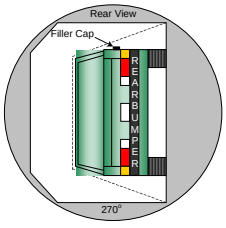
0/360



90



180



270

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	57	seconds	5	minutes	6	minutes	57	seconds	7	minutes
180° - 270°	1	minutes	49	seconds	5	minutes	6	minutes	49	seconds	7	minutes
270° - 360°	1	minutes	56	seconds	5	minutes	6	minutes	56	seconds	7	minutes

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

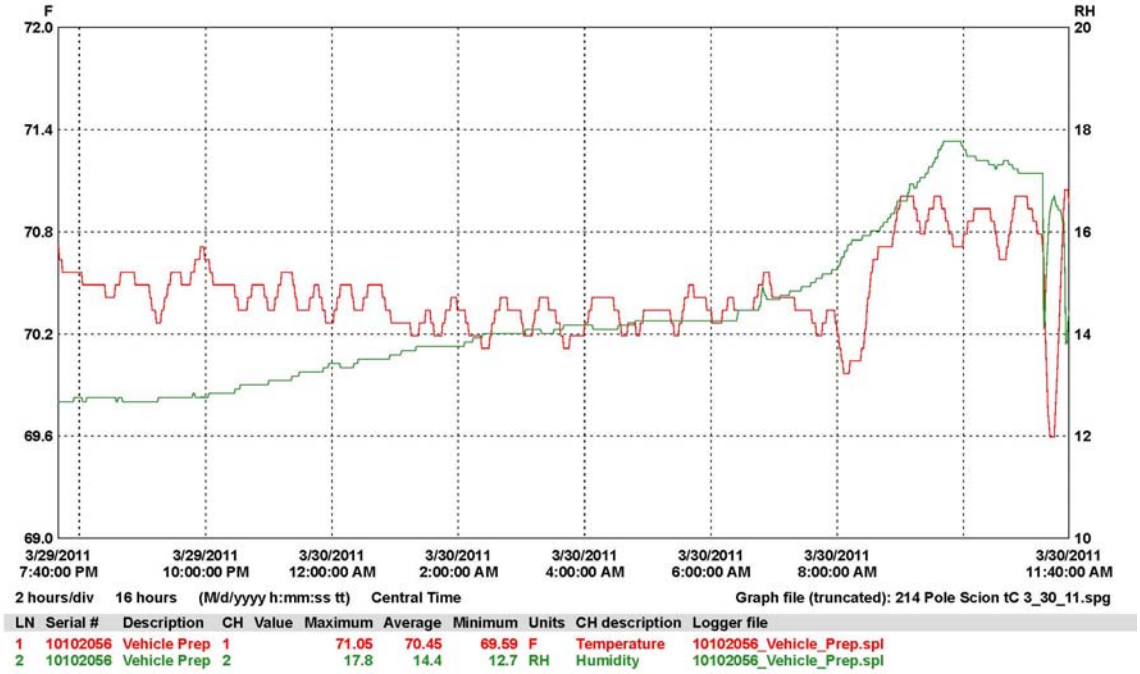
Rollover Stage	Spillage Location(s)
0° to 90°	None
90° to 180°	None
180° to 270°	None
270° to 360°	None

DATA SHEET NO. 17

TEMPERATURE AND HUMIDITY TRACES

Test Vehicle: 2011 Scion tC 3-Dr Liftback NHTSA No. CB5107
Test Program: FMVSS 214 Pole Test Date: 3/30/2011

Time of Impact: 11:36 am



LN	Serial #	Description	CH	Value	Maximum	Average	Minimum	Units	CH description	Logger file
1	10102056	Vehicle Prep	1		71.05	70.45	69.59	F	Temperature	10102056_Vehicle_Prep.spl
2	10102056	Vehicle Prep	2		17.8	14.4	12.7	RH	Humidity	10102056_Vehicle_Prep.spl

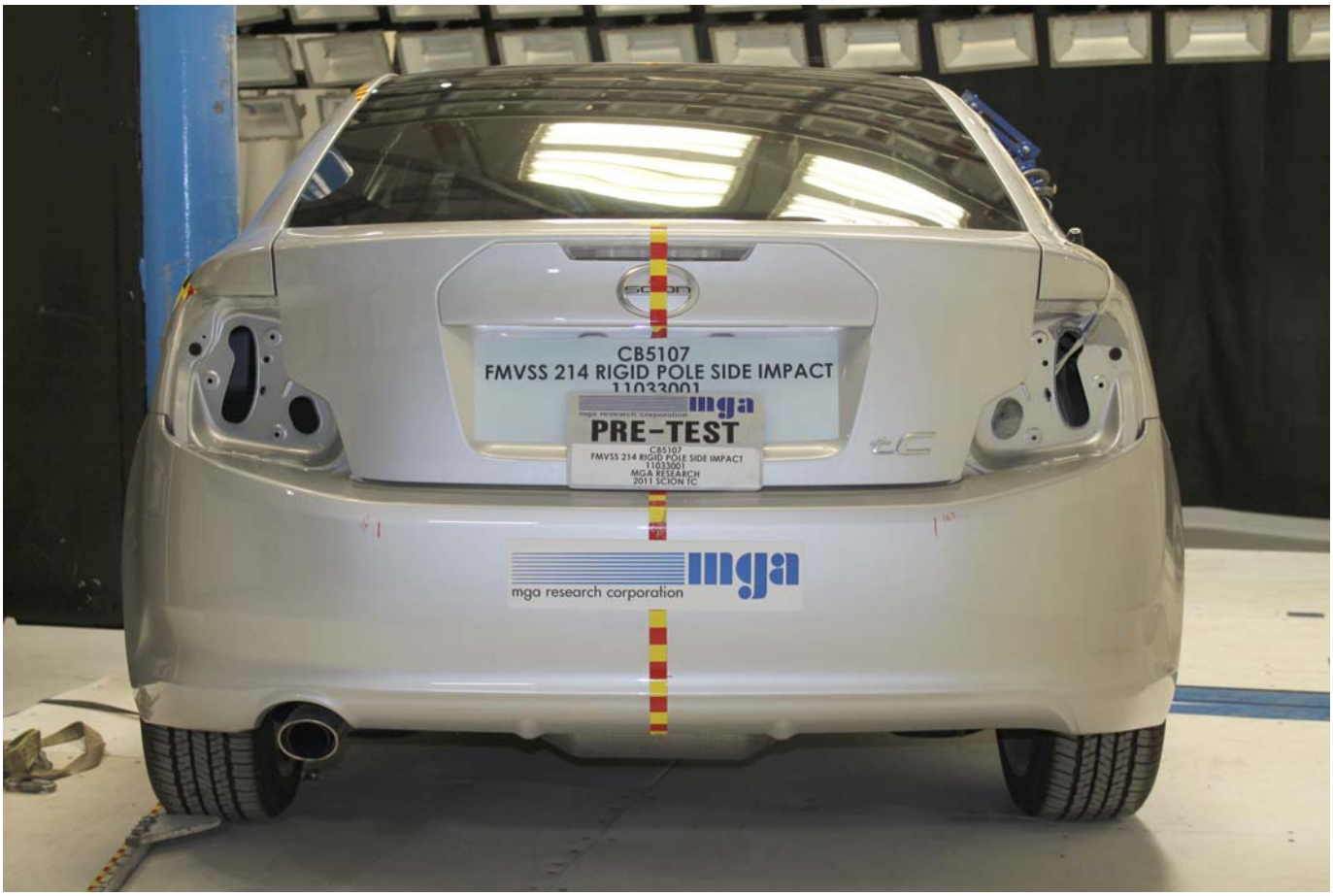
APPENDIX A

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

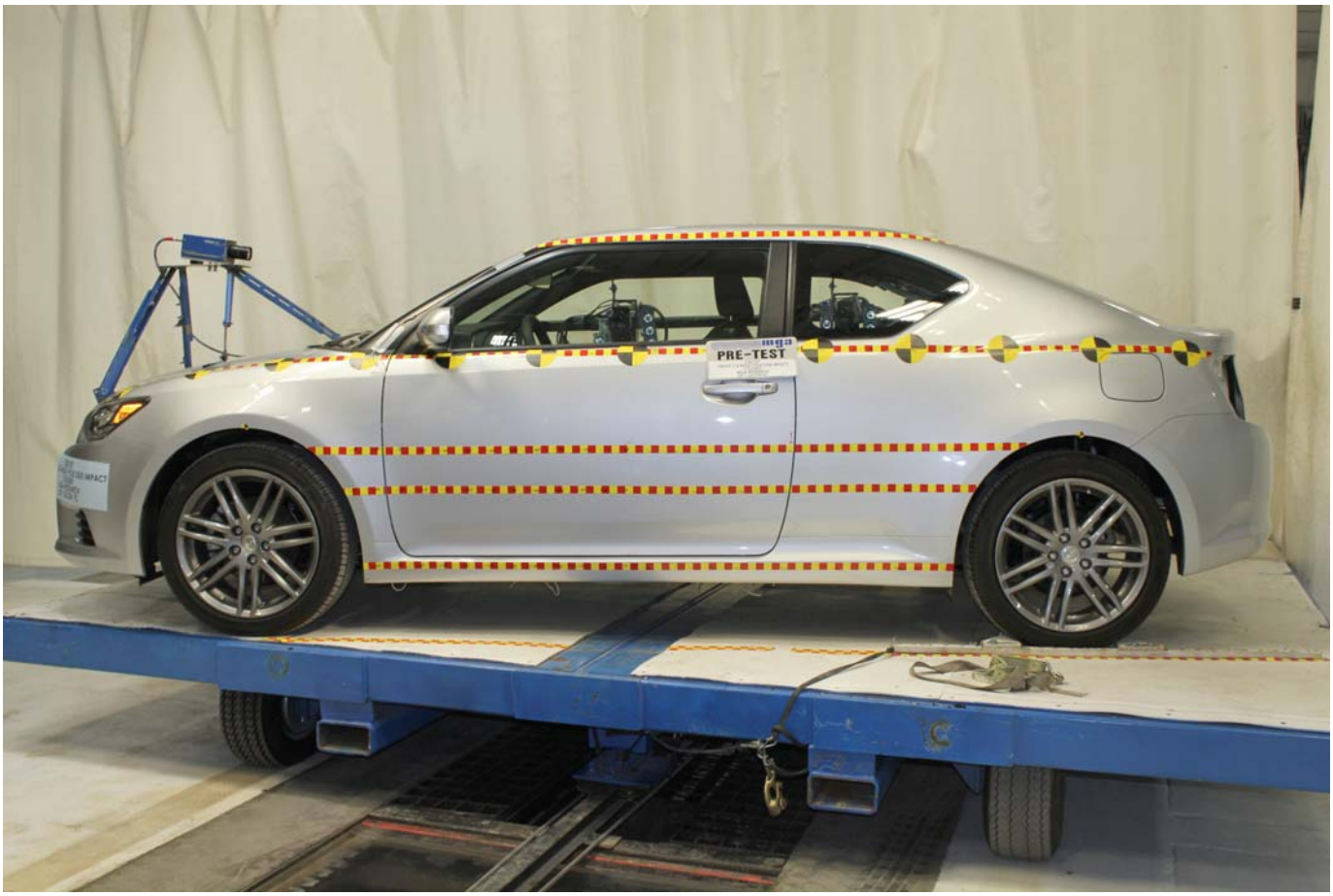
Pre-Test Frontal View of Test Vehicle

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

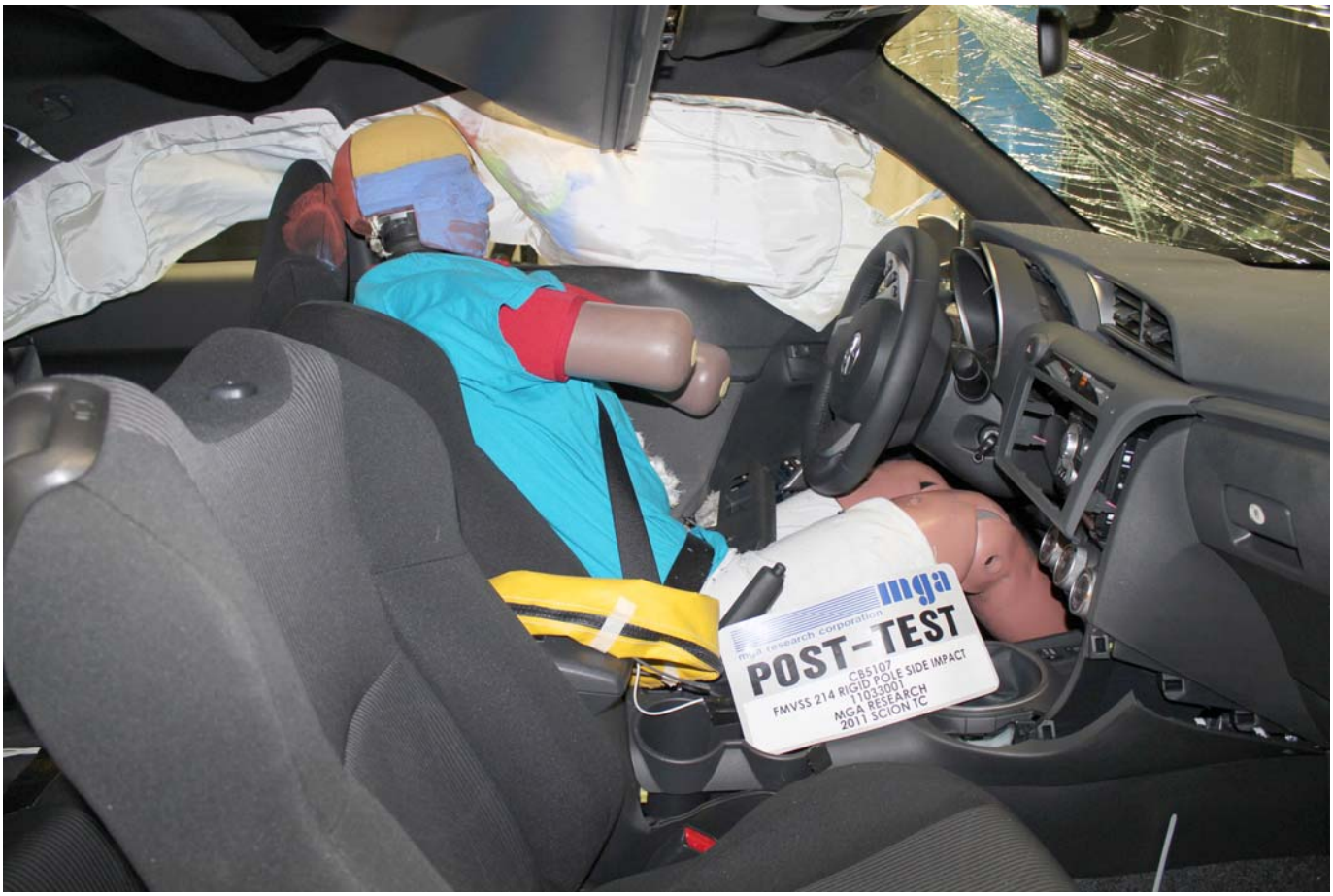
Pre-Test Left ¾ Front View of Vehicle and Pole

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

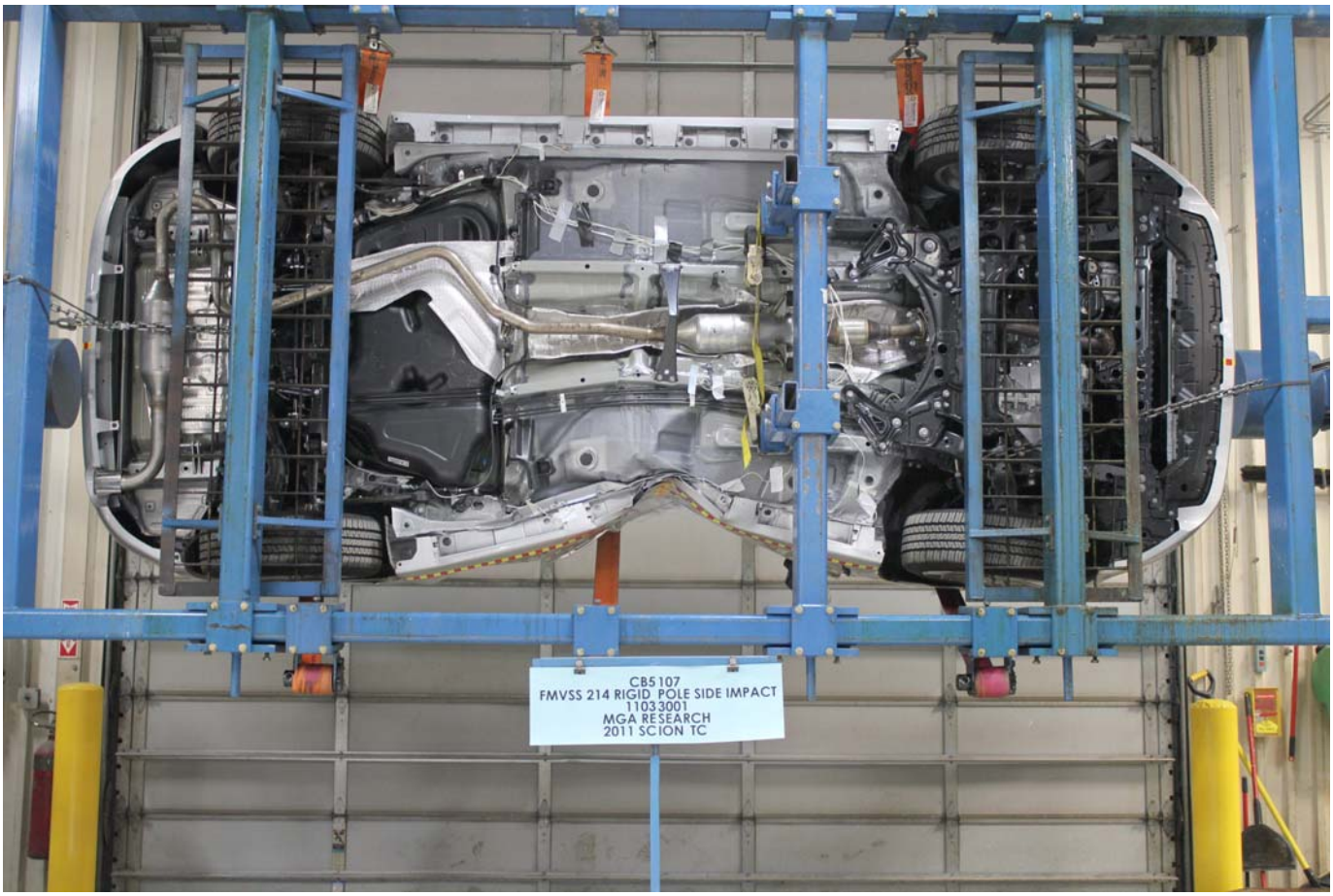
Post-Test ¾ Front View of Impact Zone

Post-Test ¾ Rear View of Impact Zone

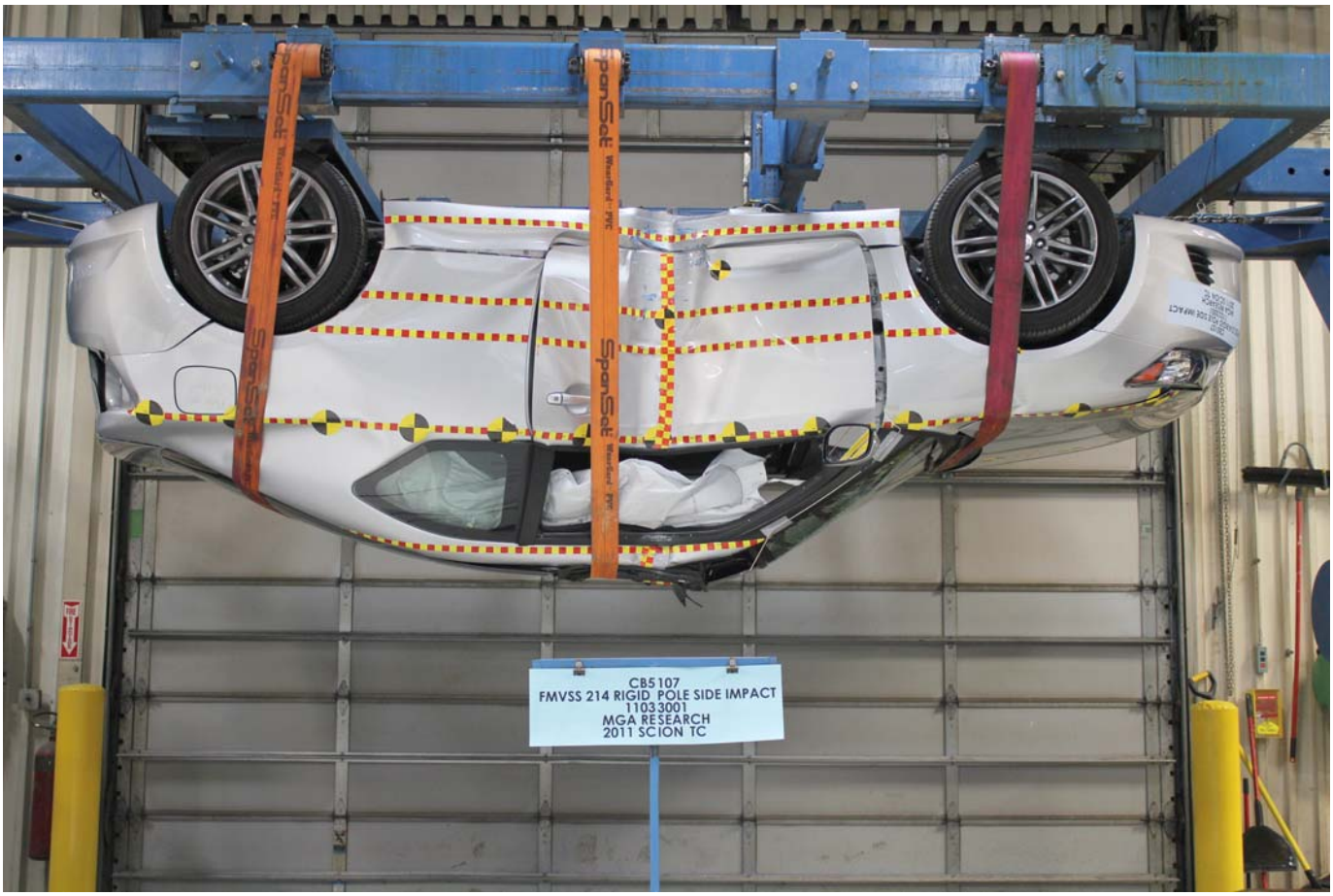
Post-Test Close-up View of Impact Point Target

Close-up View of Vehicle's Certification Label

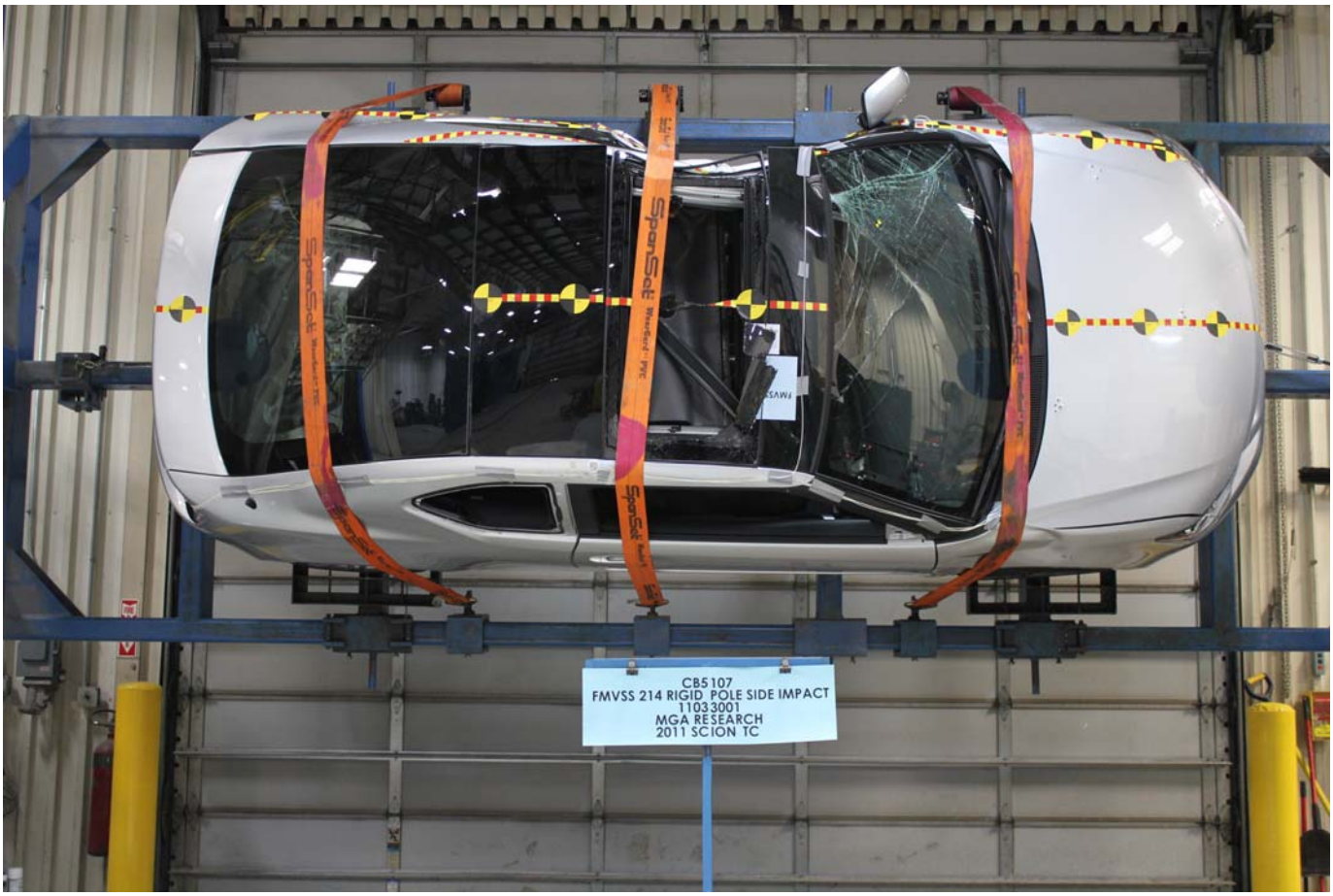
Close-up View of Vehicle's Tire Placard Label



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

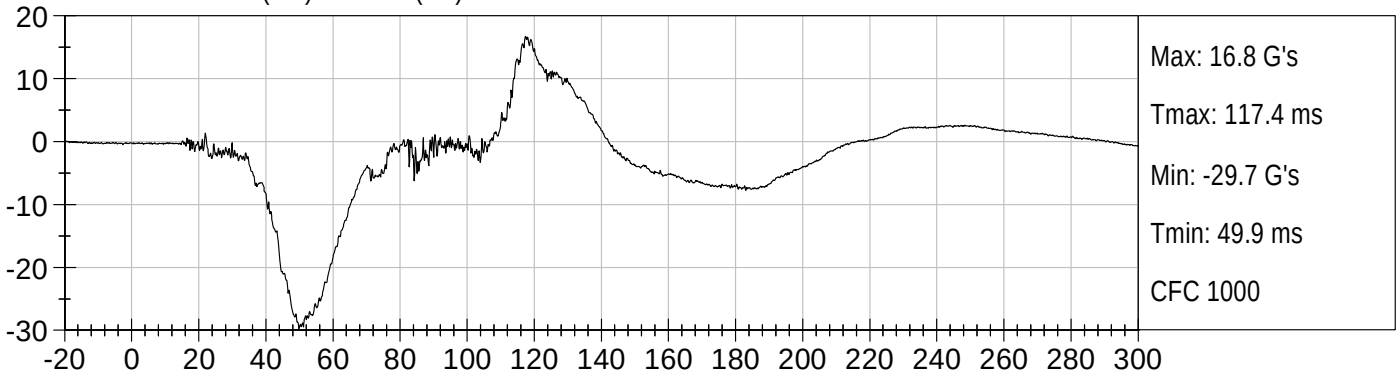
TABLE OF DATA PLOTS

Dummy Instrumentation Plots
FILTERED DATA

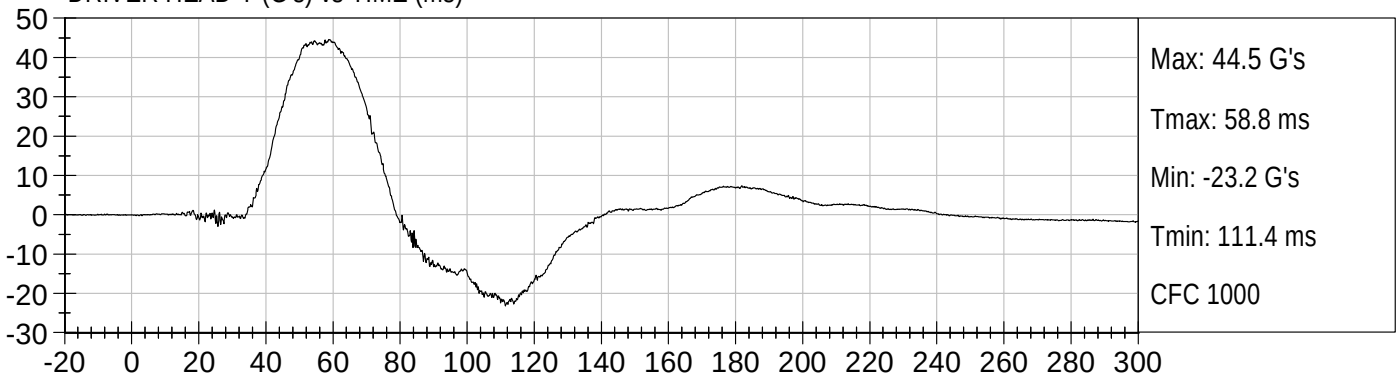
FMVSS 214 Rigid Pole Side Impact
2011 Scion tC - CB5107

Test Date: 03/30/2011
Speed: 19.7 mph (31.7 km/h)

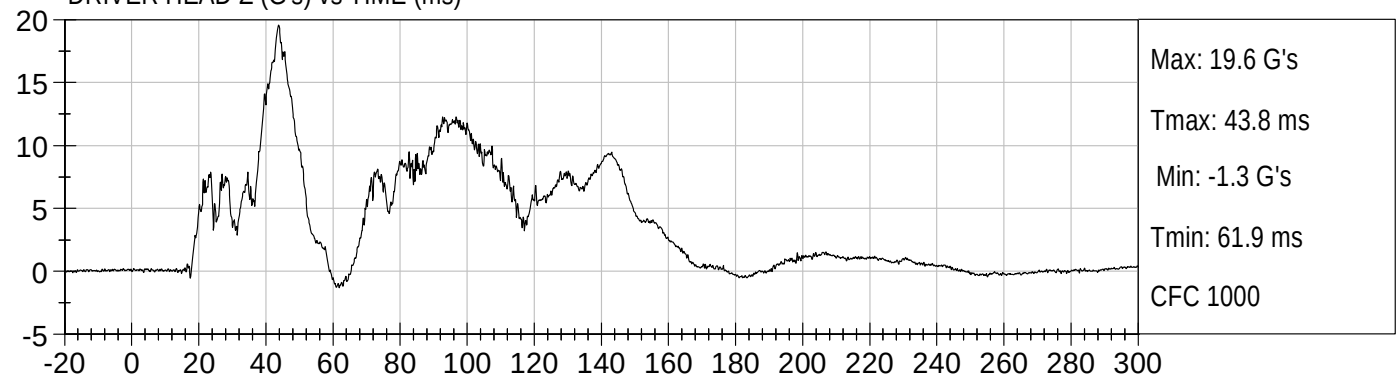
DRIVER HEAD X (G's) vs TIME (ms)



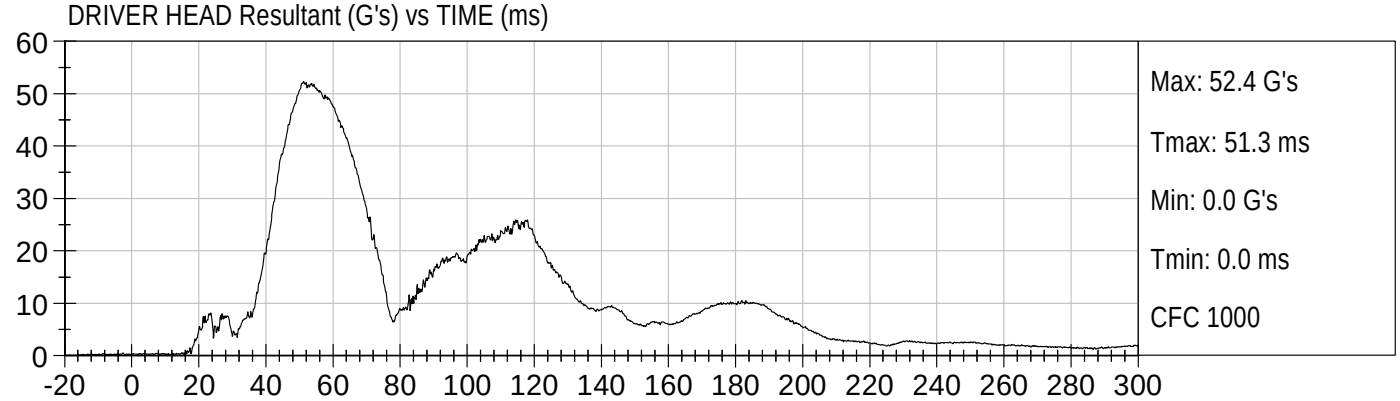
DRIVER HEAD Y (G's) vs TIME (ms)



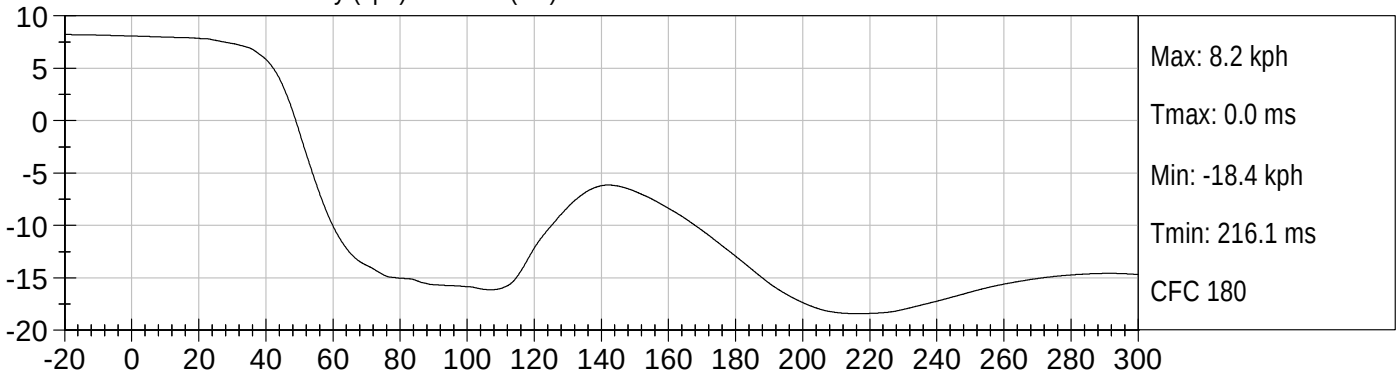
DRIVER HEAD Z (G's) vs TIME (ms)



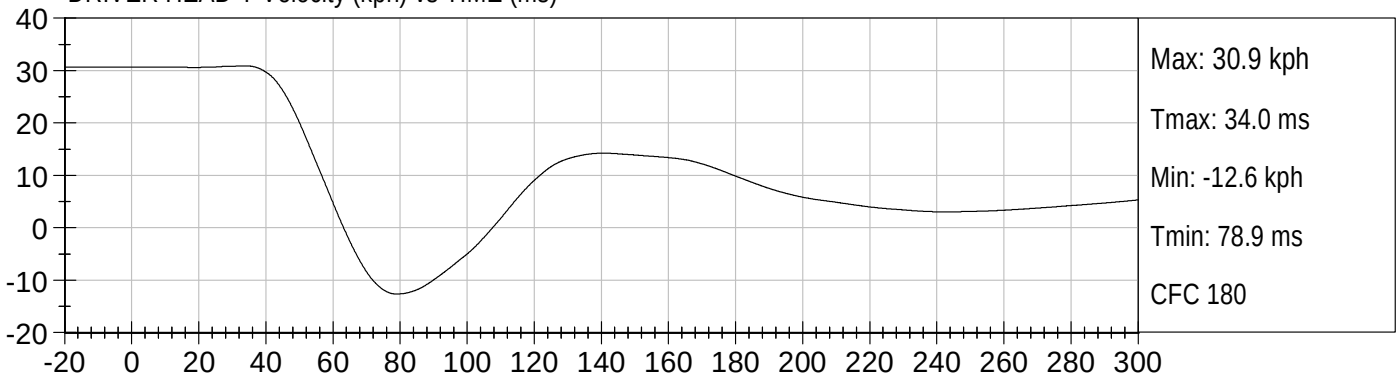
DRIVER HEAD Resultant (G's) vs TIME (ms)



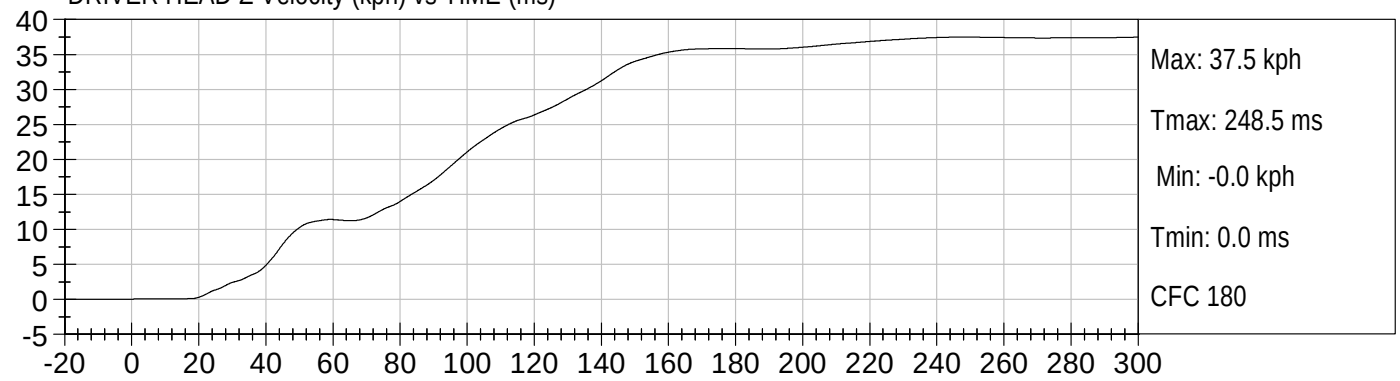
DRIVER HEAD X Velocity (kph) vs TIME (ms)



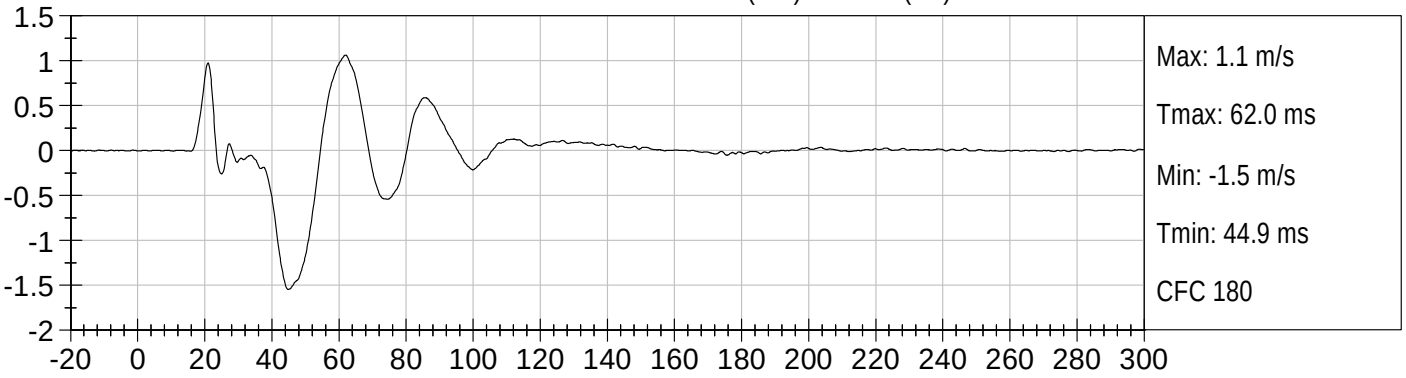
DRIVER HEAD Y Velocity (kph) vs TIME (ms)



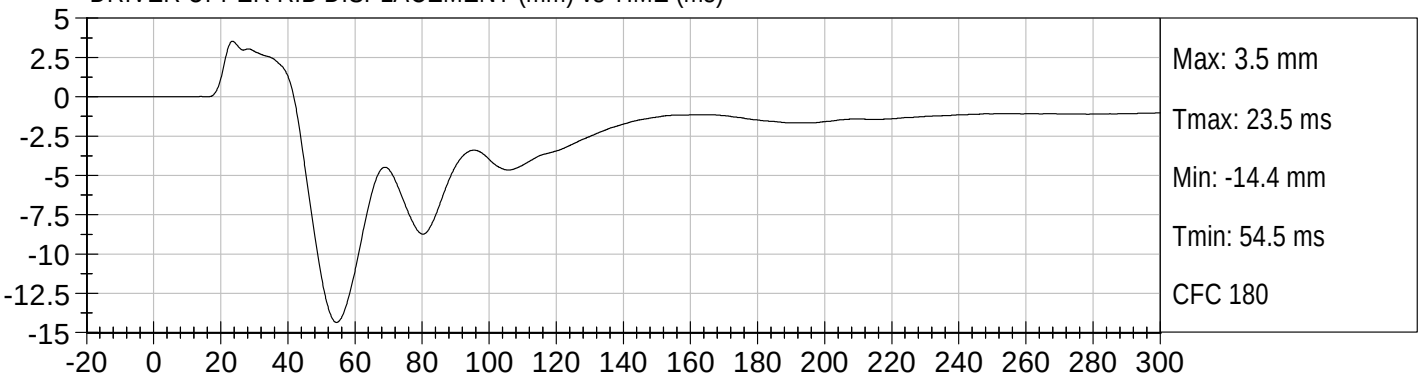
DRIVER HEAD Z Velocity (kph) vs TIME (ms)



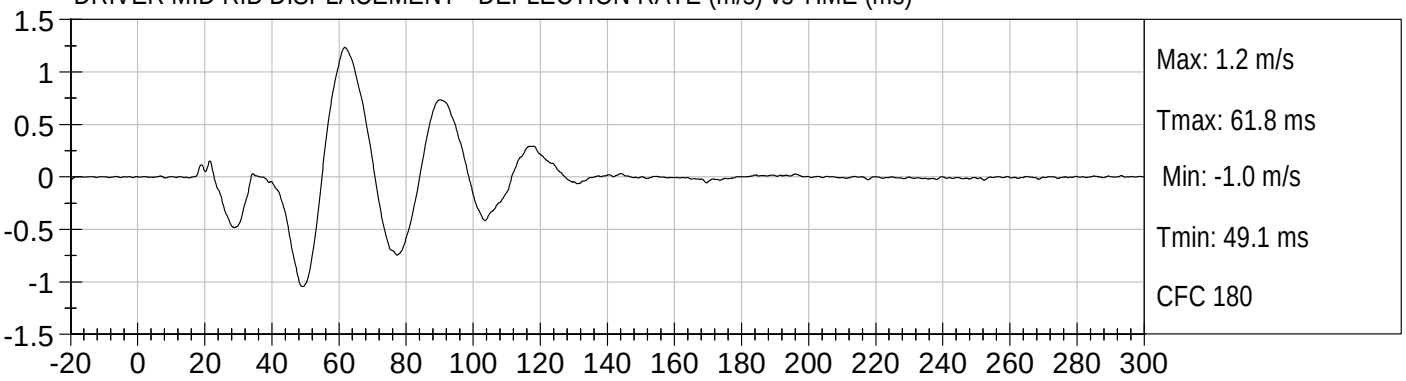
DRIVER UPPER RIB DISPLACEMENT - DEFLECTION RATE (m/s) vs TIME (ms)



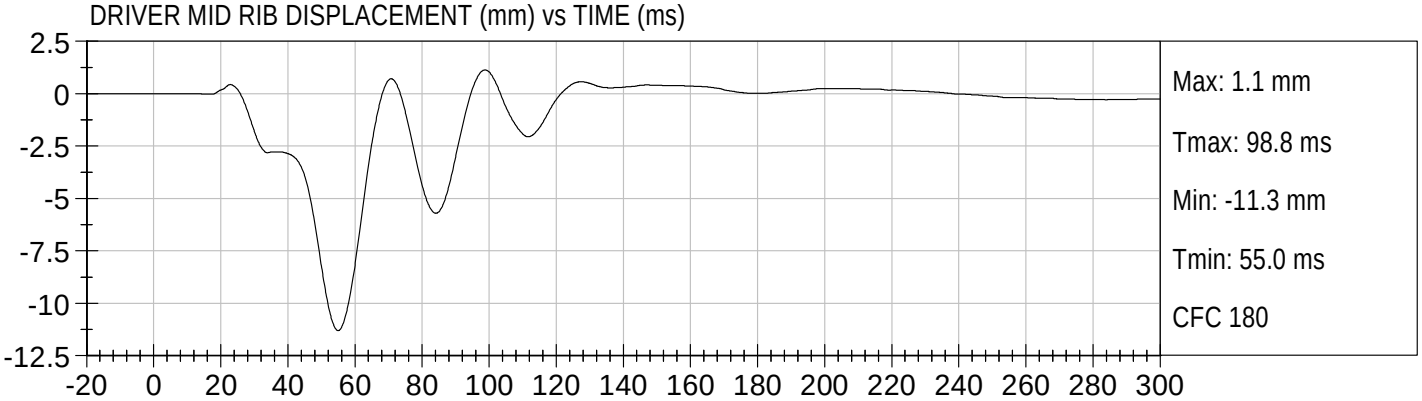
DRIVER UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



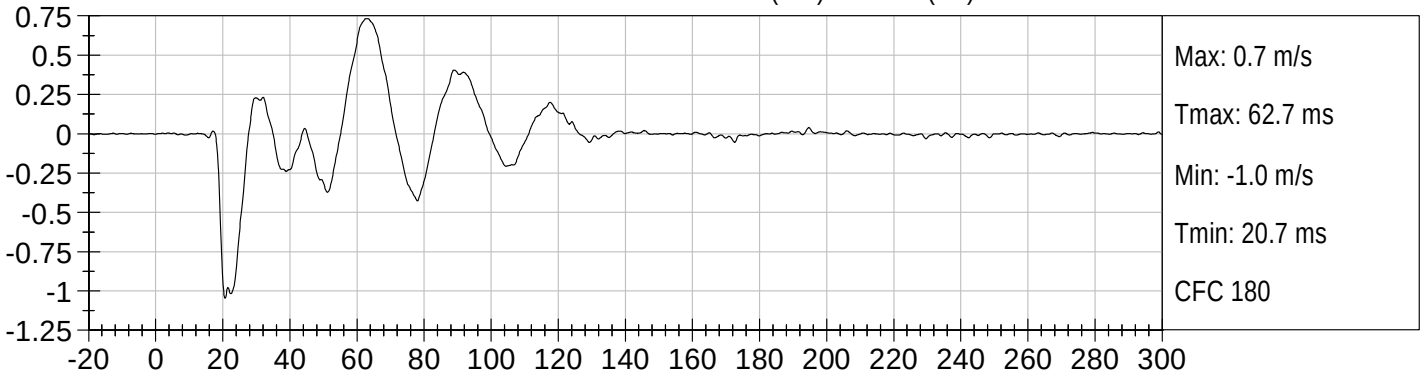
DRIVER MID RIB DISPLACEMENT - DEFLECTION RATE (m/s) vs TIME (ms)



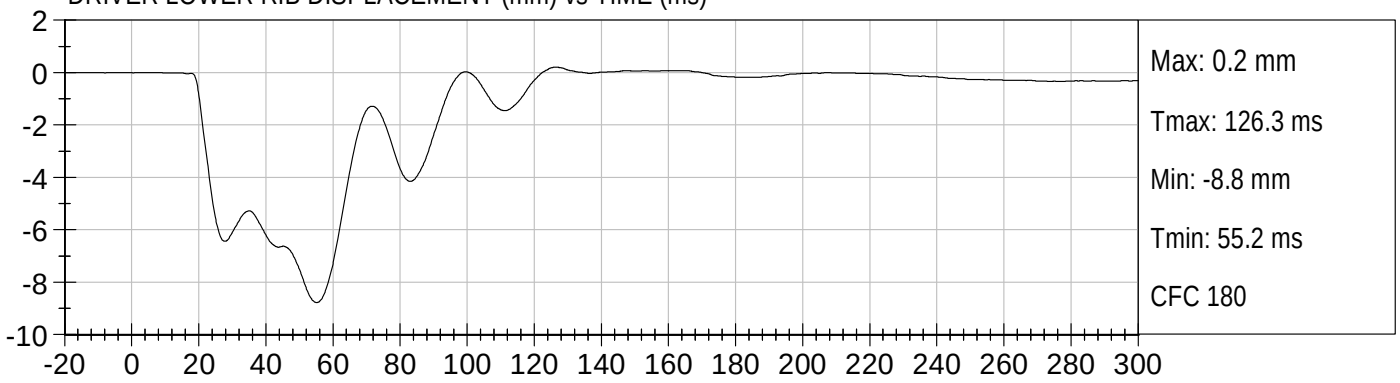
DRIVER MID RIB DISPLACEMENT (mm) vs TIME (ms)



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



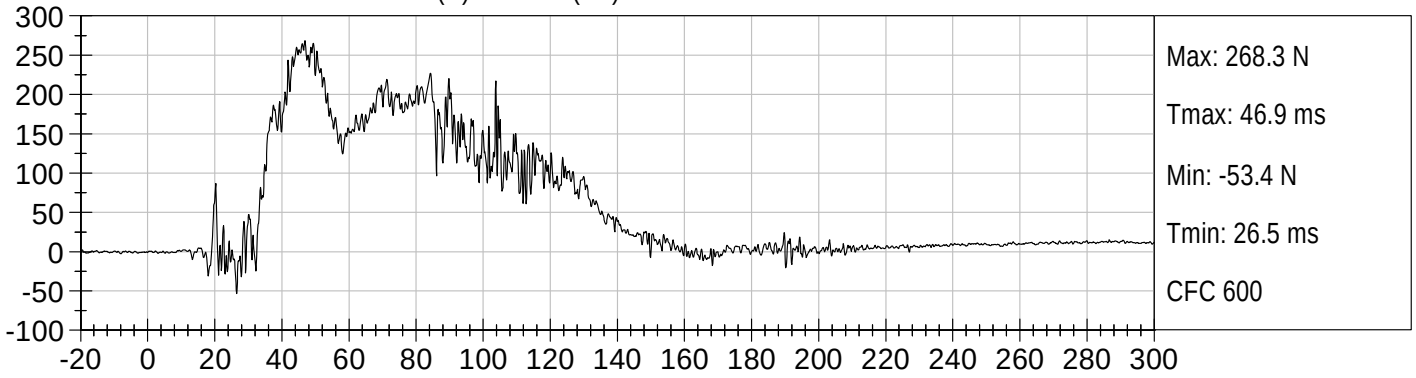
DRIVER LOWER RIB DISPLACEMENT (mm) vs TIME (ms)



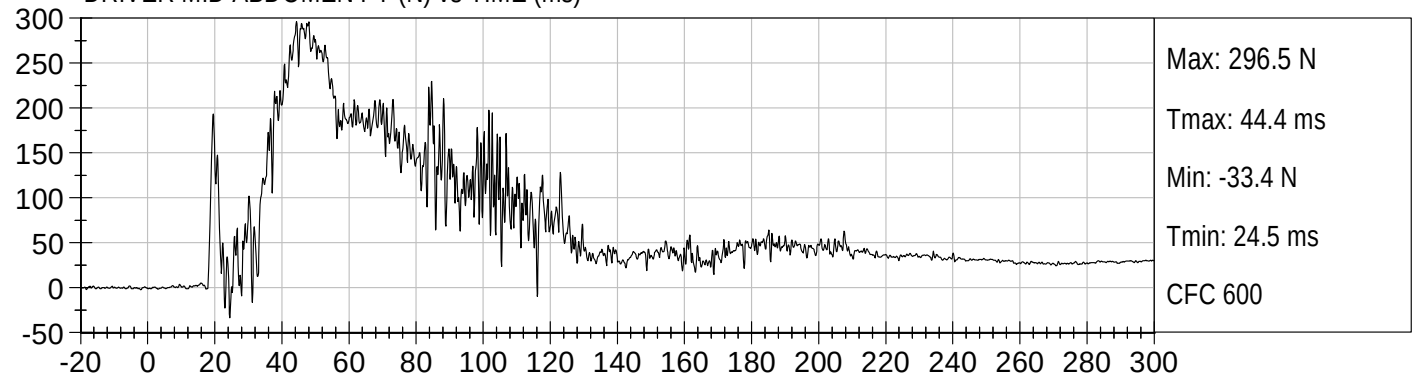
FMVSS 214 Rigid Pole Side Impact
2011 Scion tC - CB5107

Test Date: 03/30/2011
Speed: 19.7 mph (31.7 km/h)

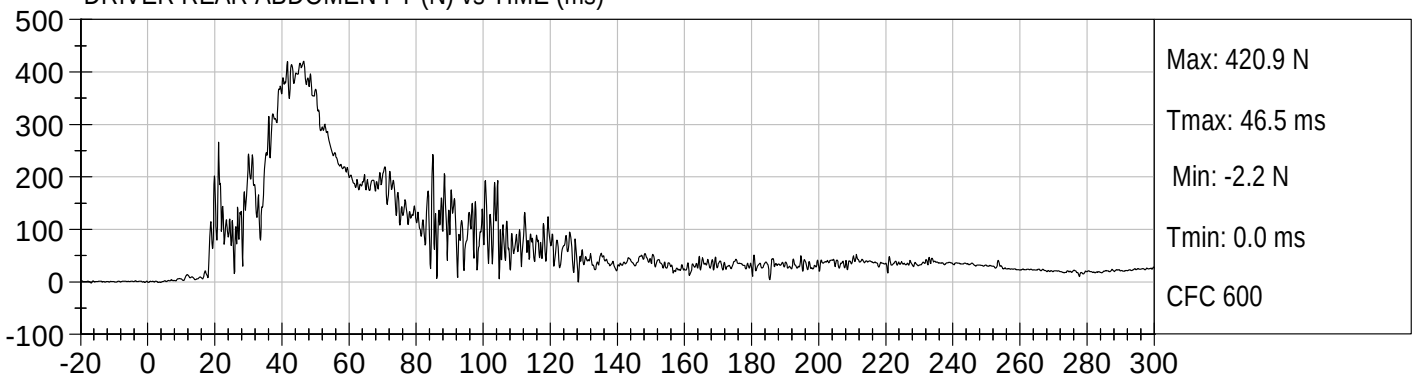
DRIVER FRONT ABDOMEN FY (N) vs TIME (ms)



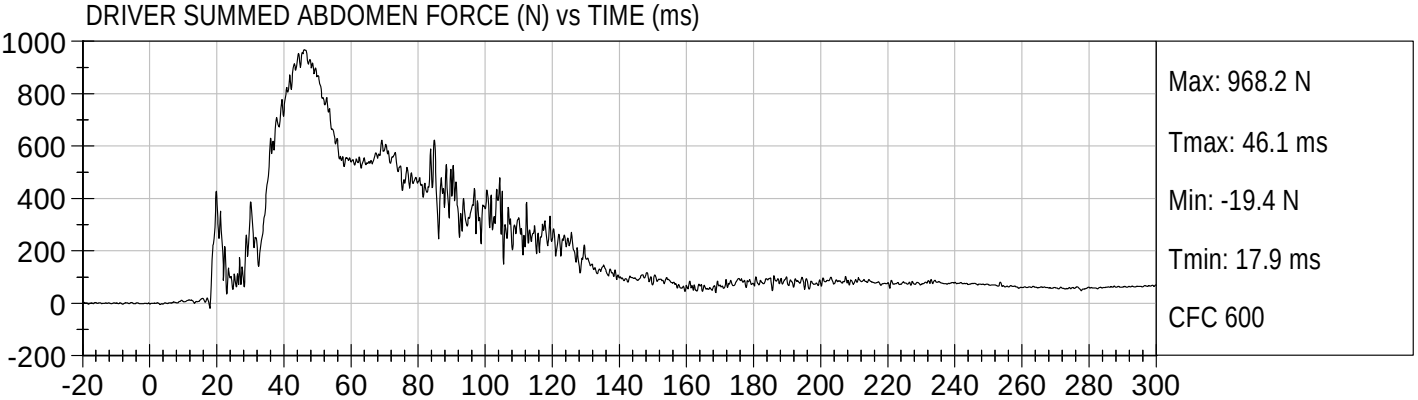
DRIVER MID ABDOMEN FY (N) vs TIME (ms)



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

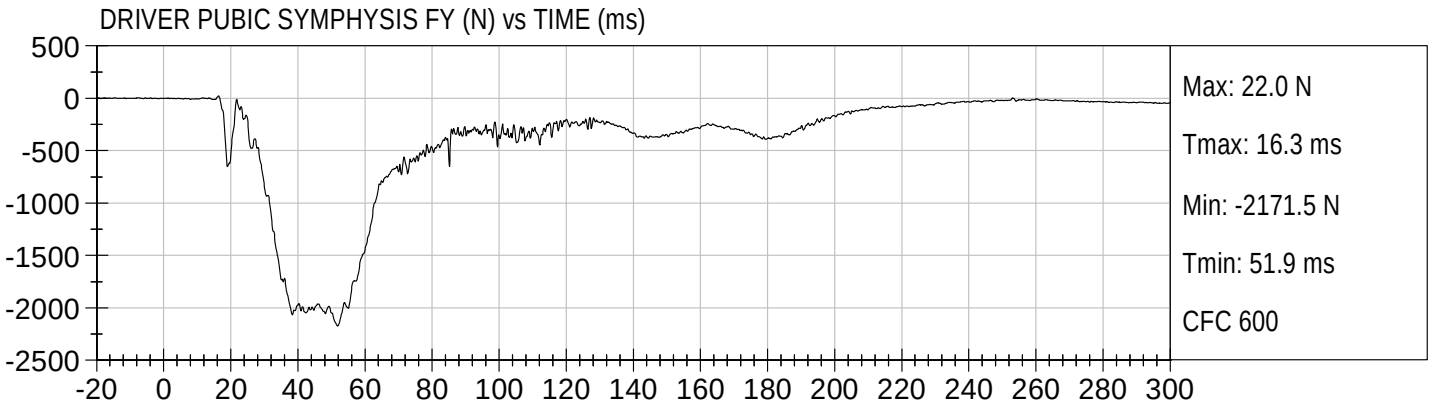


DRIVER SUMMED ABDOMEN FORCE (N) vs TIME (ms)



FMVSS 214 Rigid Pole Side Impact
2011 Scion tC - CB5107

Test Date: 03/30/2011
Speed: 19.7 mph (31.7 km/h)



APPENDIX C

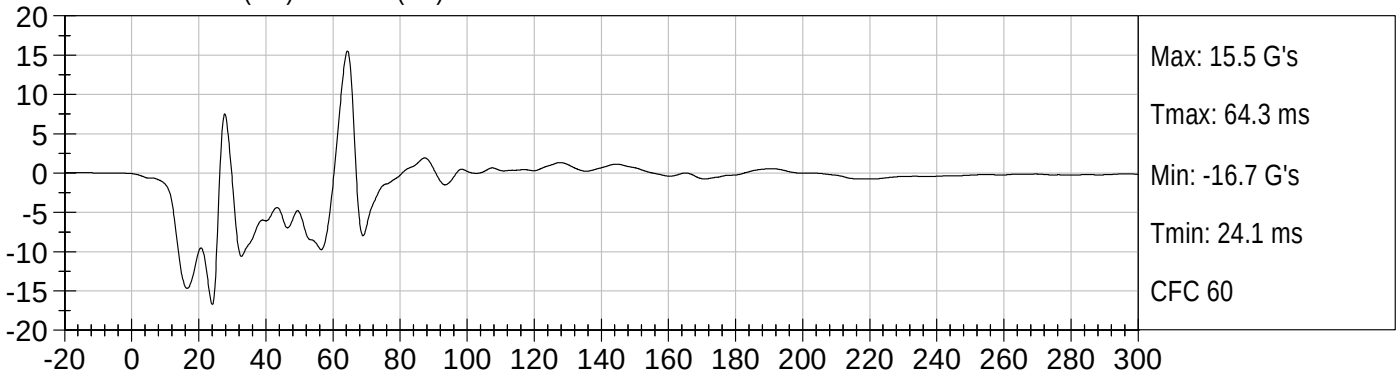
VEHICLE ACCELEROMETER RESPONSE DATA

TABLE OF DATA PLOTS

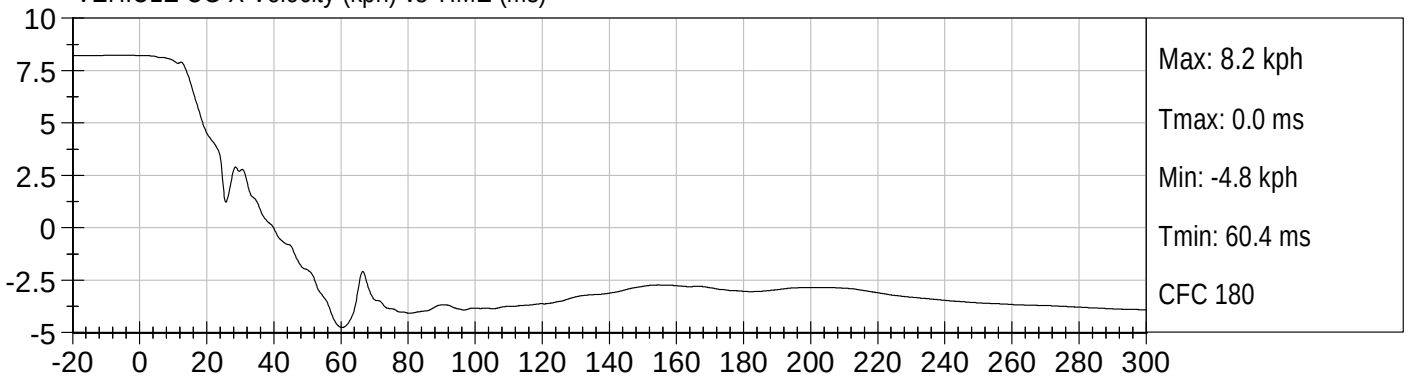
FMVSS 214 Rigid Pole Side Impact
2011 Scion tC - CB5107

Test Date: 03/30/2011
Speed: 19.7 mph (31.7 km/h)

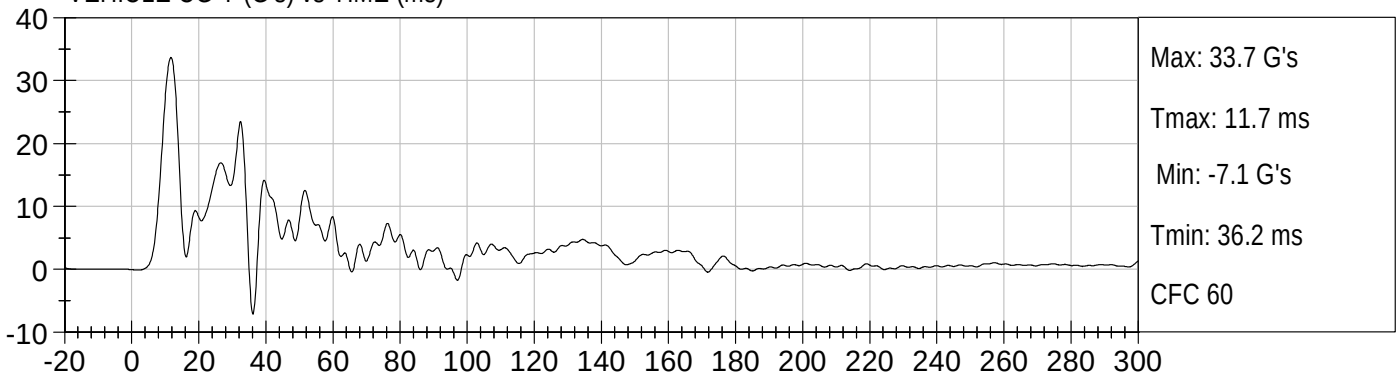
VEHICLE CG X (G's) vs TIME (ms)



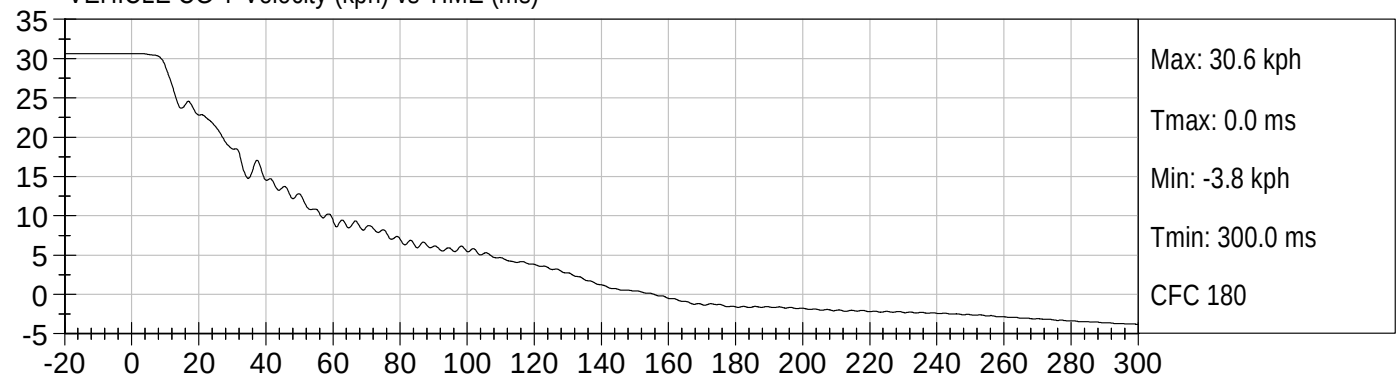
VEHICLE CG X Velocity (kph) vs TIME (ms)



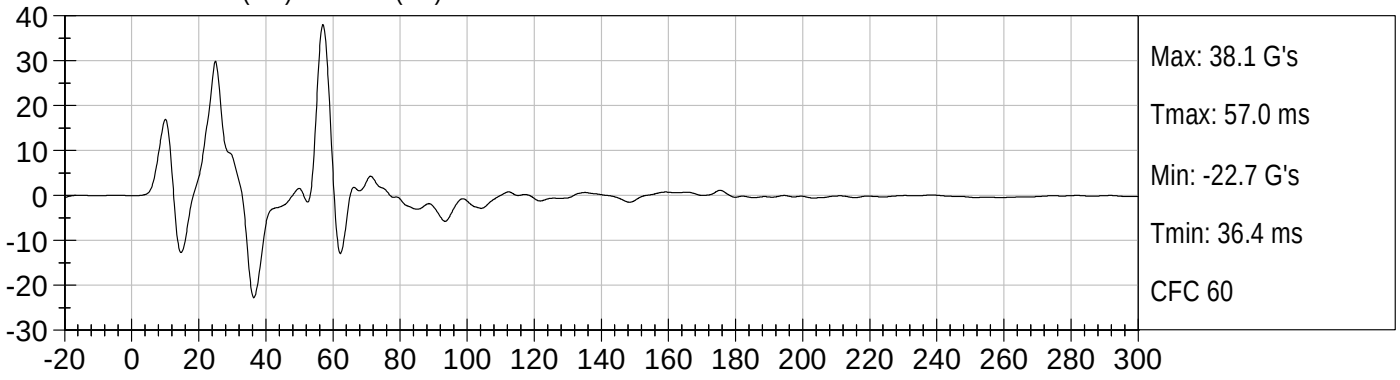
VEHICLE CG Y (G's) vs TIME (ms)



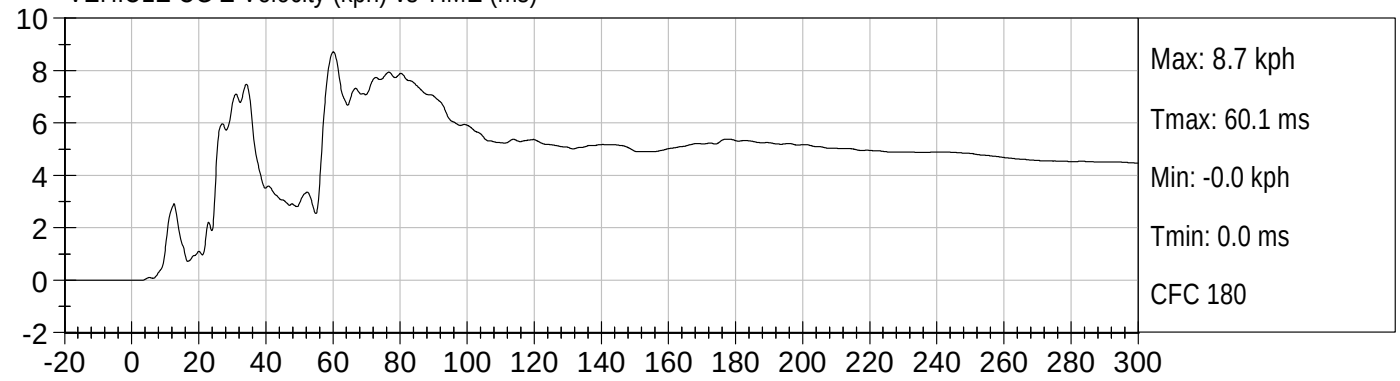
VEHICLE CG Y Velocity (kph) vs TIME (ms)



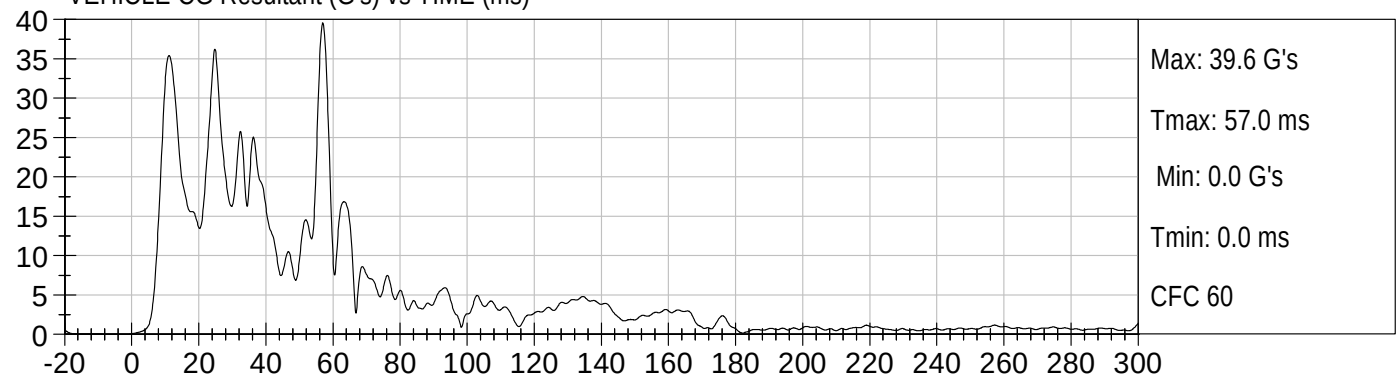
VEHICLE CG Z (G's) vs TIME (ms)



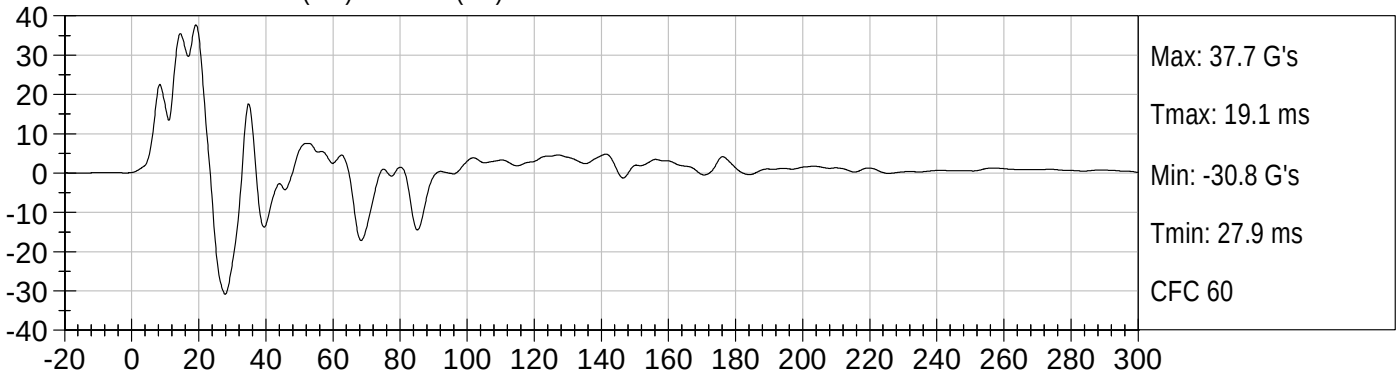
VEHICLE CG Z Velocity (kph) vs TIME (ms)



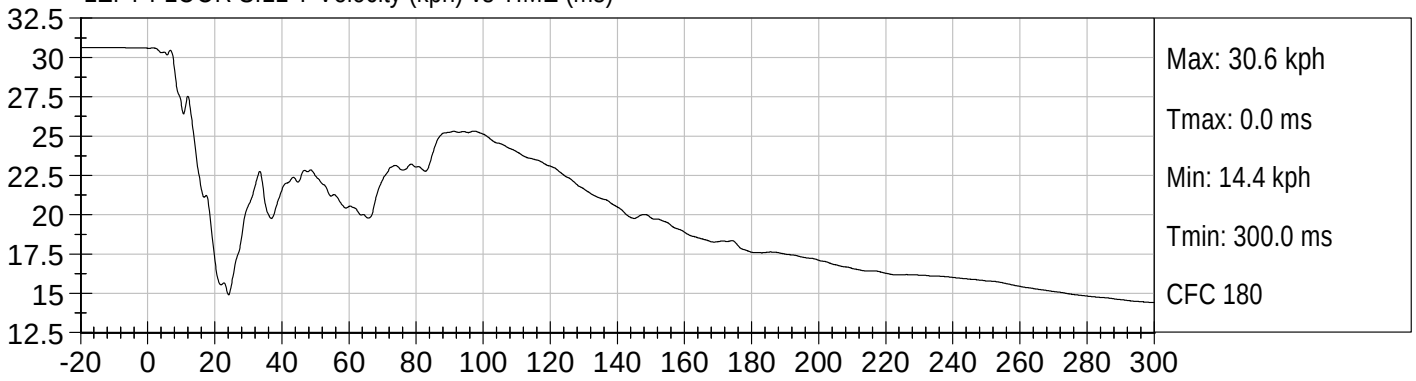
VEHICLE CG Resultant (G's) vs TIME (ms)



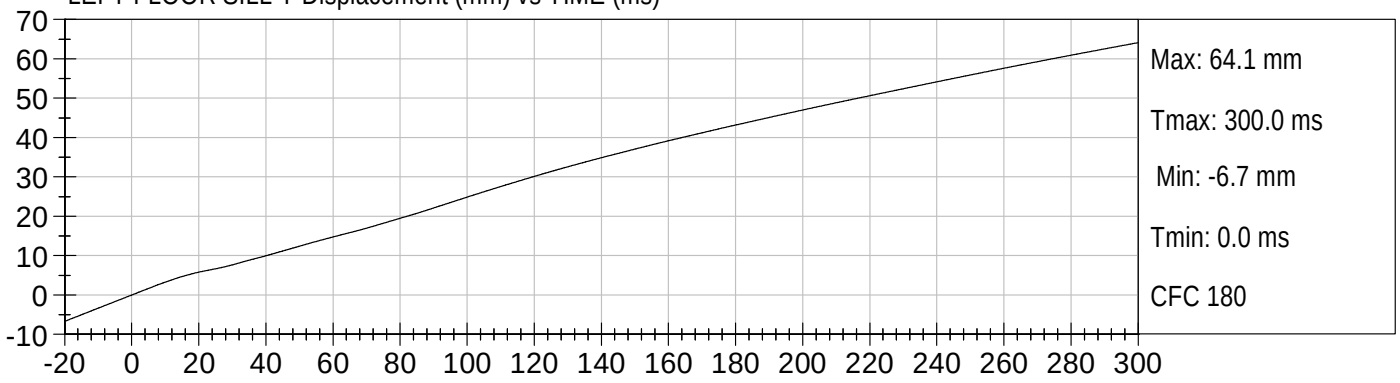
LEFT FLOOR SILL Y (G's) vs TIME (ms)



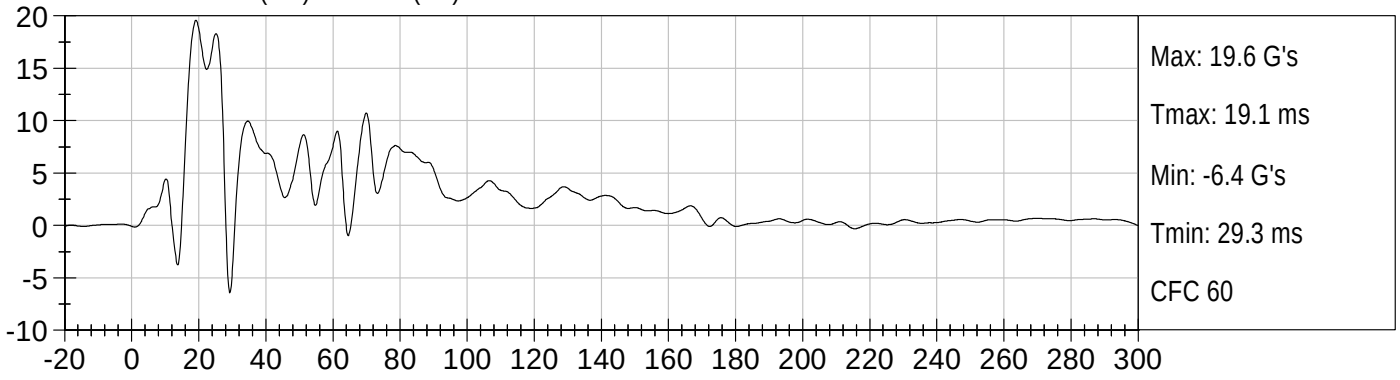
LEFT FLOOR SILL Y Velocity (kph) vs TIME (ms)



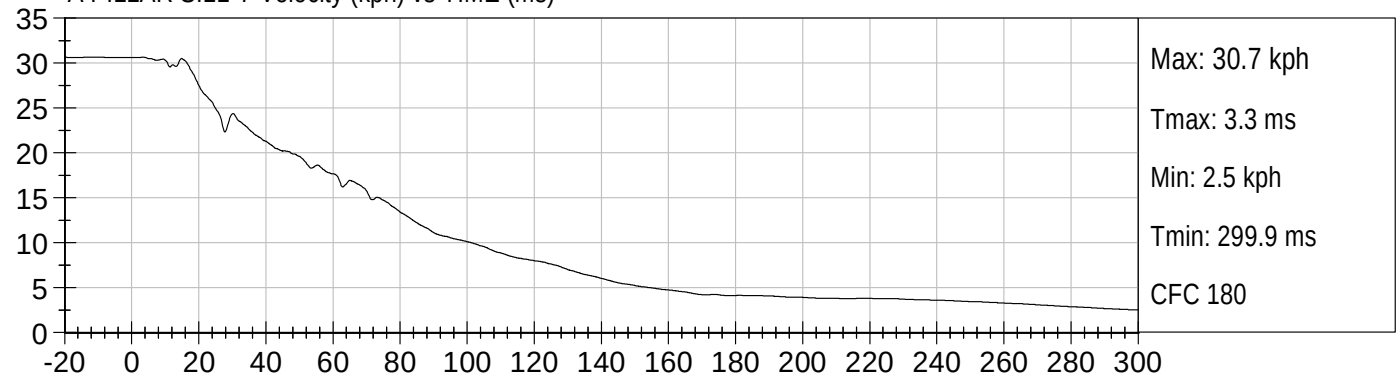
LEFT FLOOR SILL Y Displacement (mm) vs TIME (ms)



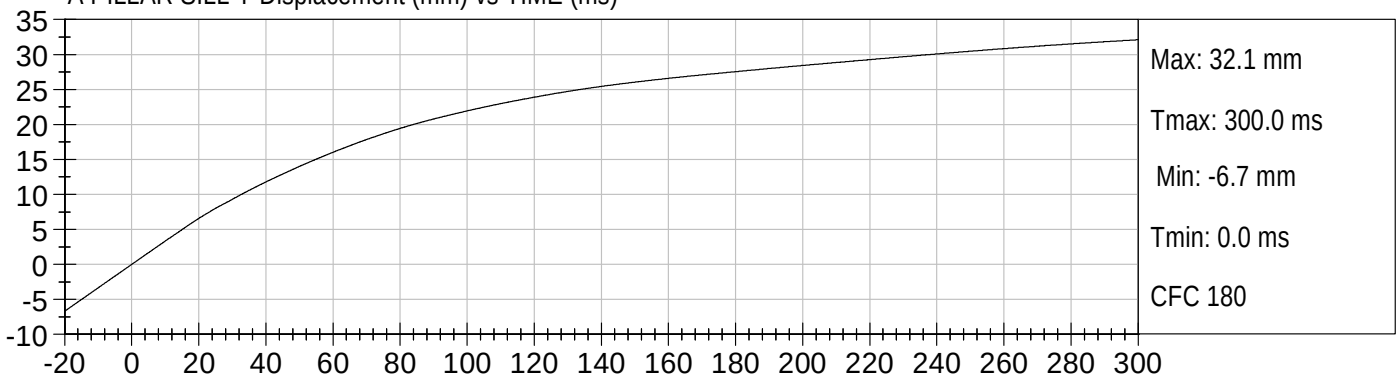
A PILLAR SILL Y (G's) vs TIME (ms)



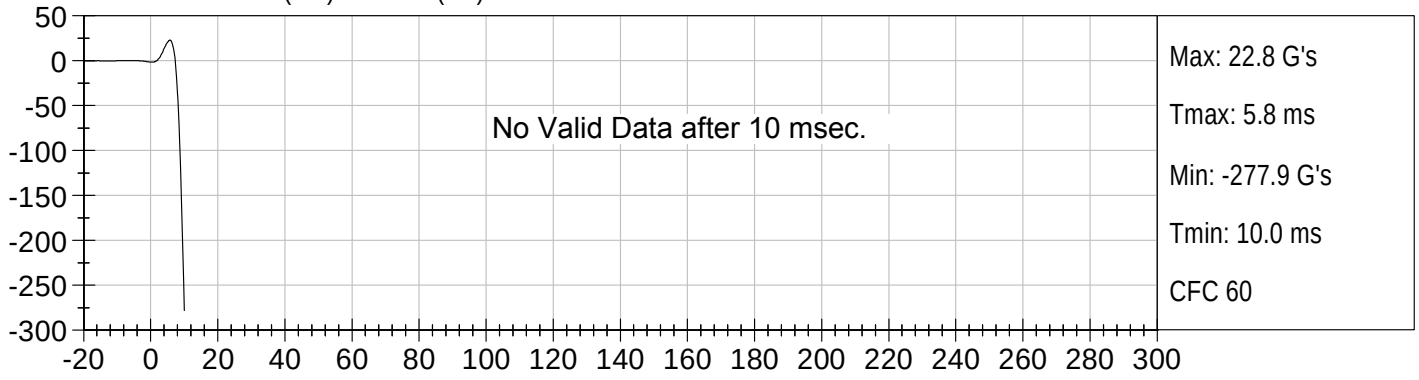
A PILLAR SILL Y Velocity (kph) vs TIME (ms)



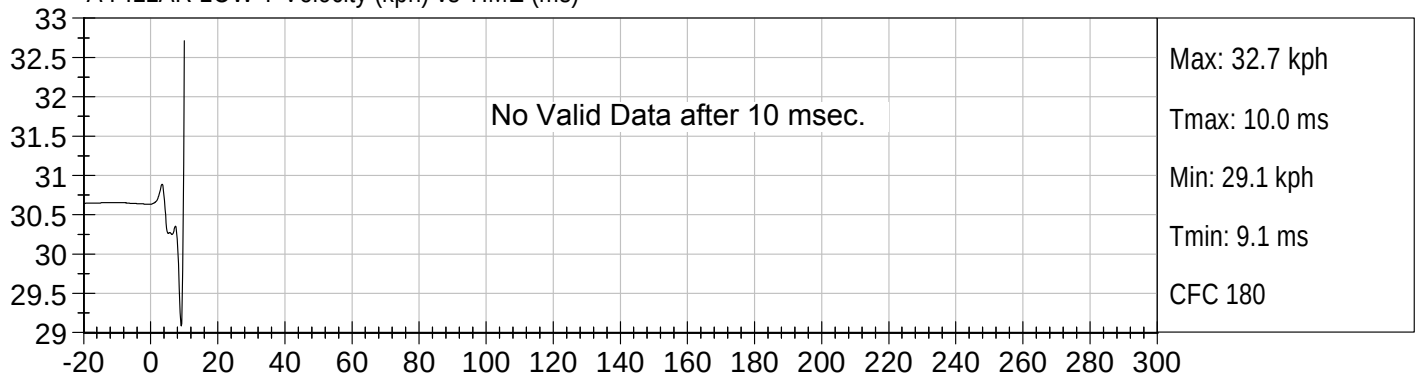
A PILLAR SILL Y Displacement (mm) vs TIME (ms)



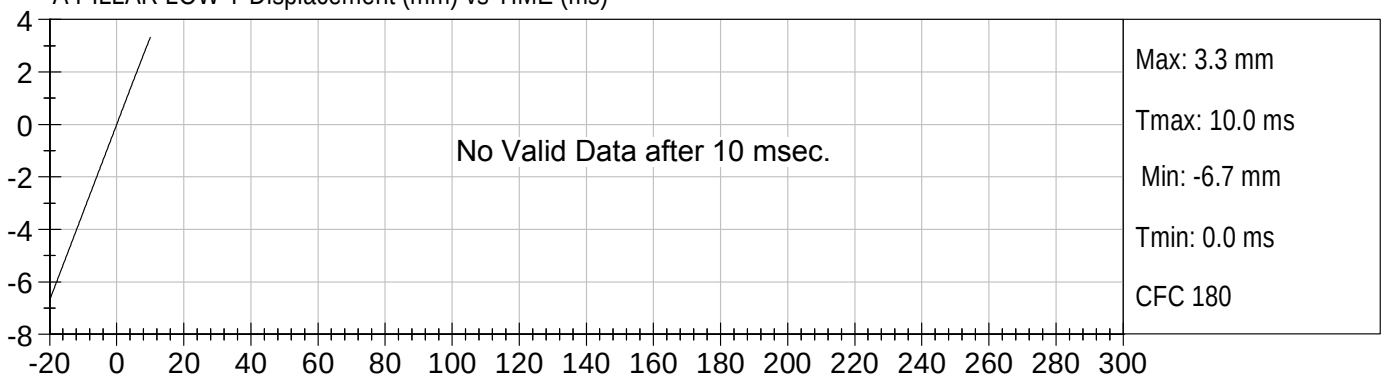
A PILLAR LOW Y (G's) vs TIME (ms)



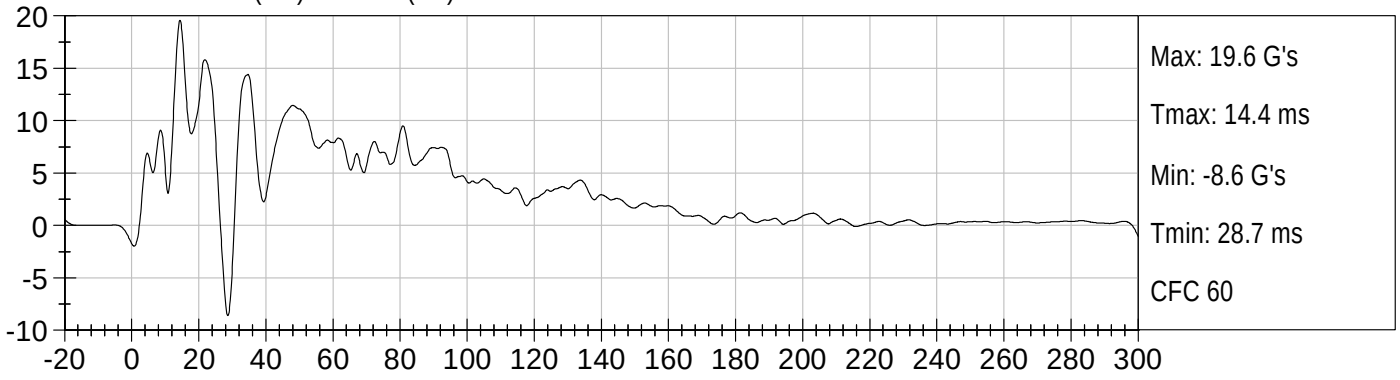
A PILLAR LOW Y Velocity (kph) vs TIME (ms)



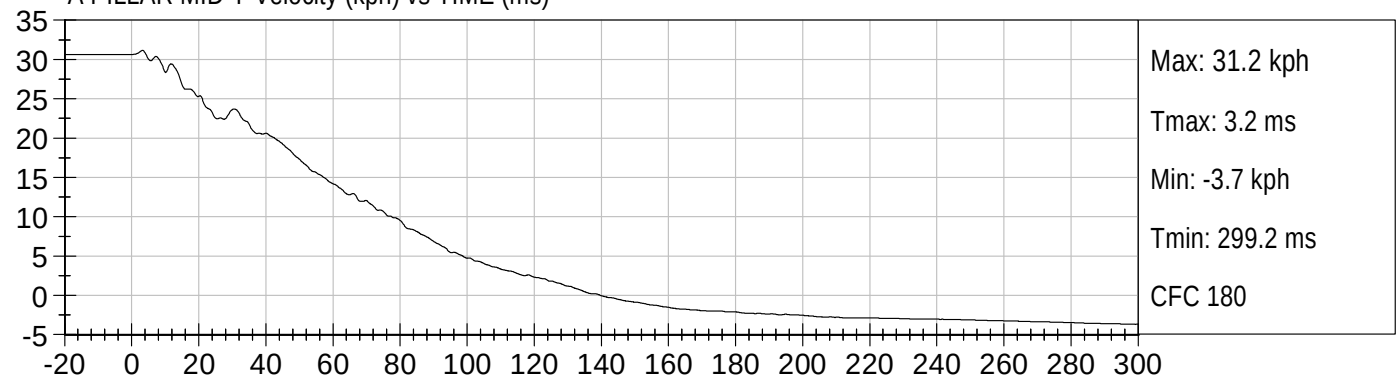
A PILLAR LOW Y Displacement (mm) vs TIME (ms)



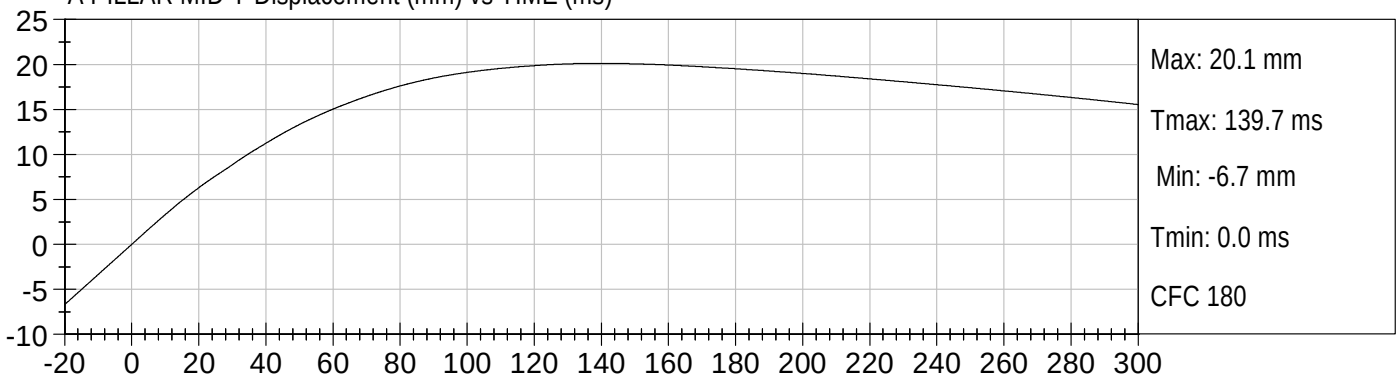
A PILLAR MID Y (G's) vs TIME (ms)



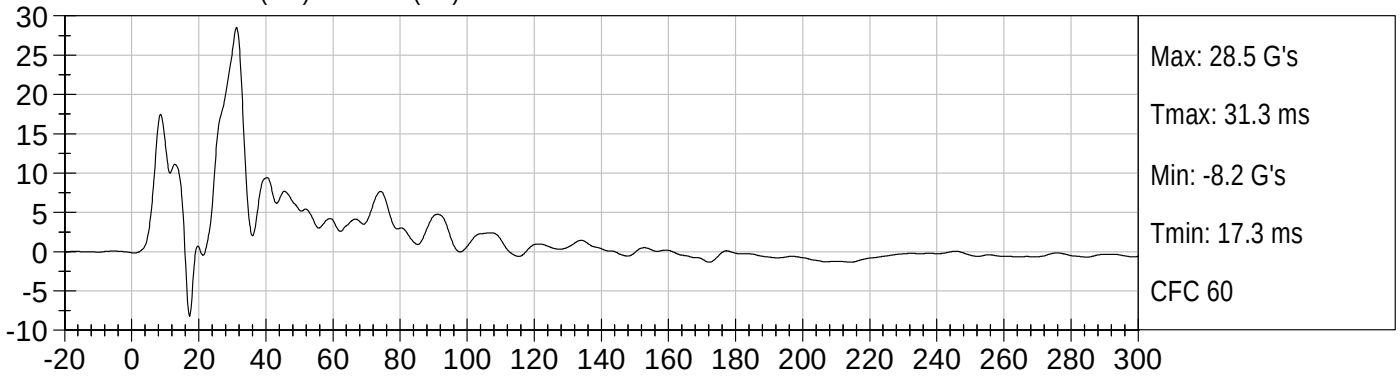
A PILLAR MID Y Velocity (kph) vs TIME (ms)



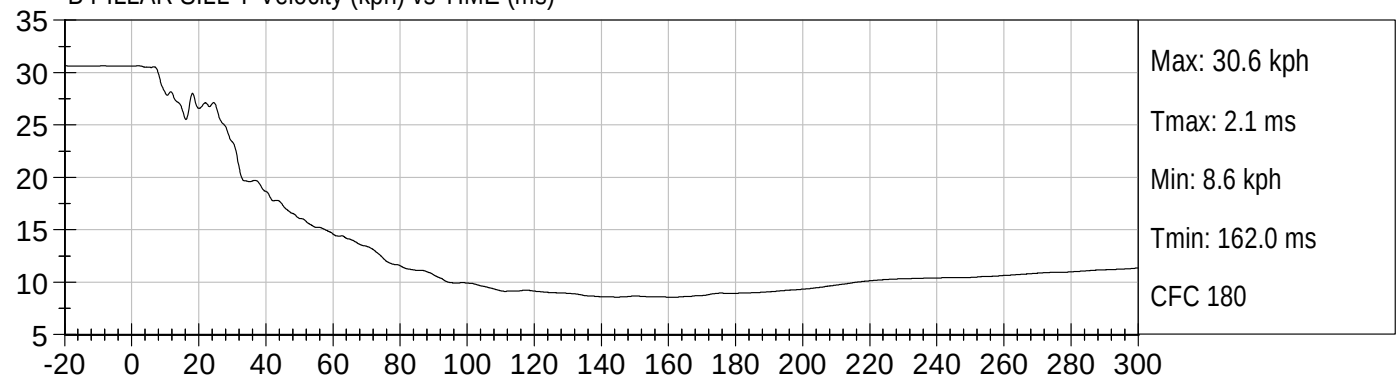
A PILLAR MID Y Displacement (mm) vs TIME (ms)



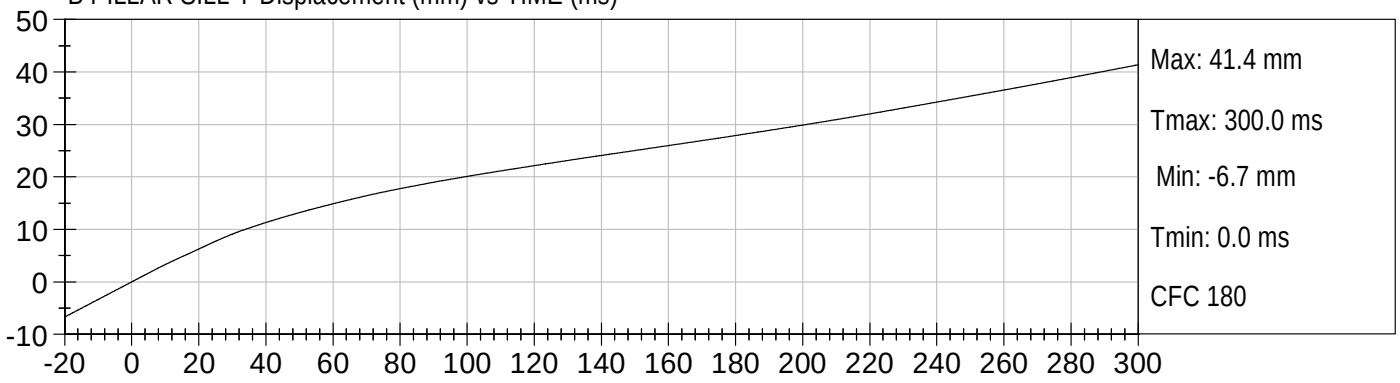
B PILLAR SILL Y (G's) vs TIME (ms)



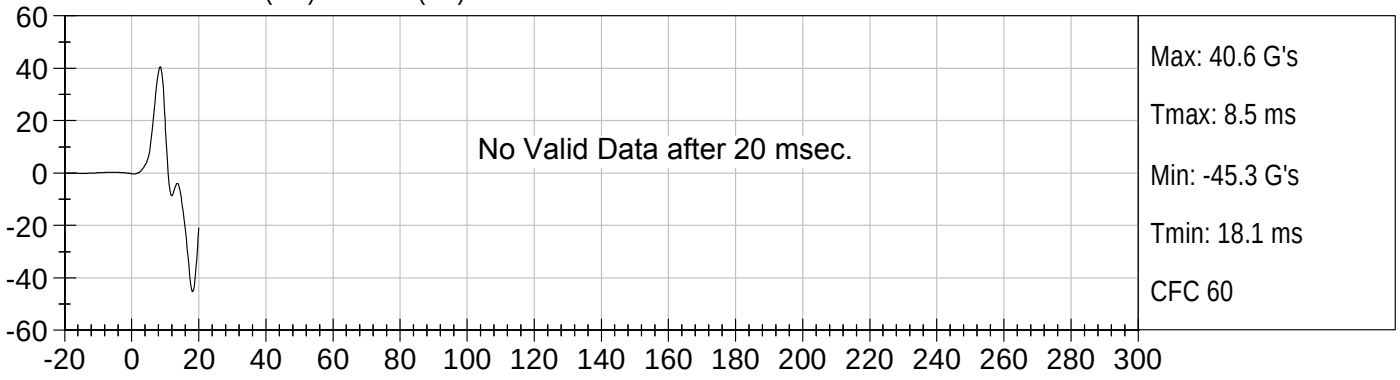
B PILLAR SILL Y Velocity (kph) vs TIME (ms)



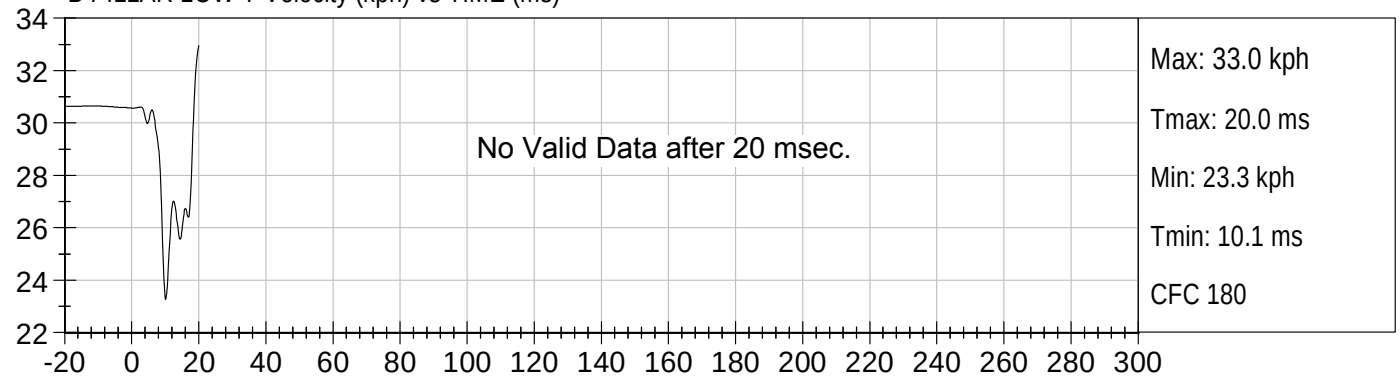
B PILLAR SILL Y Displacement (mm) vs TIME (ms)



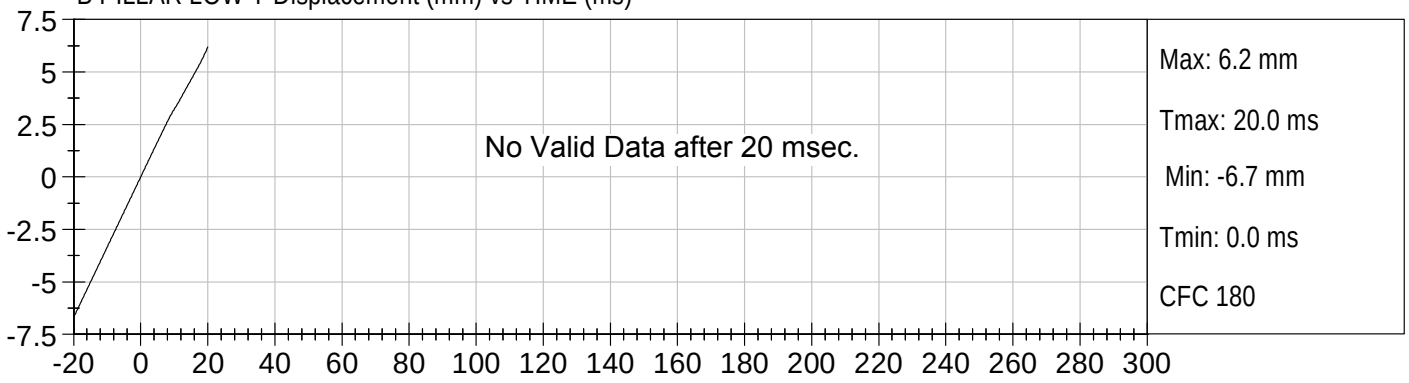
B PILLAR LOW Y (G's) vs TIME (ms)



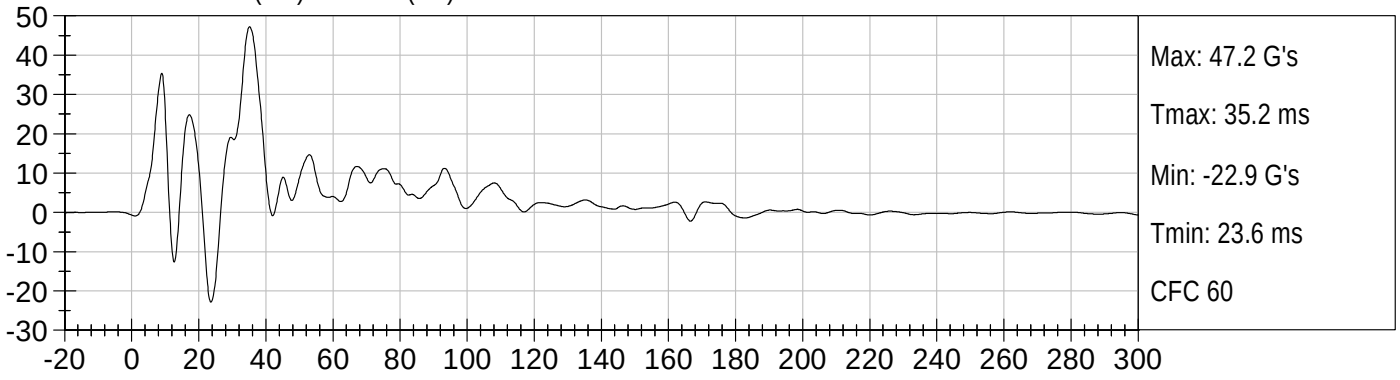
B PILLAR LOW Y Velocity (kph) vs TIME (ms)



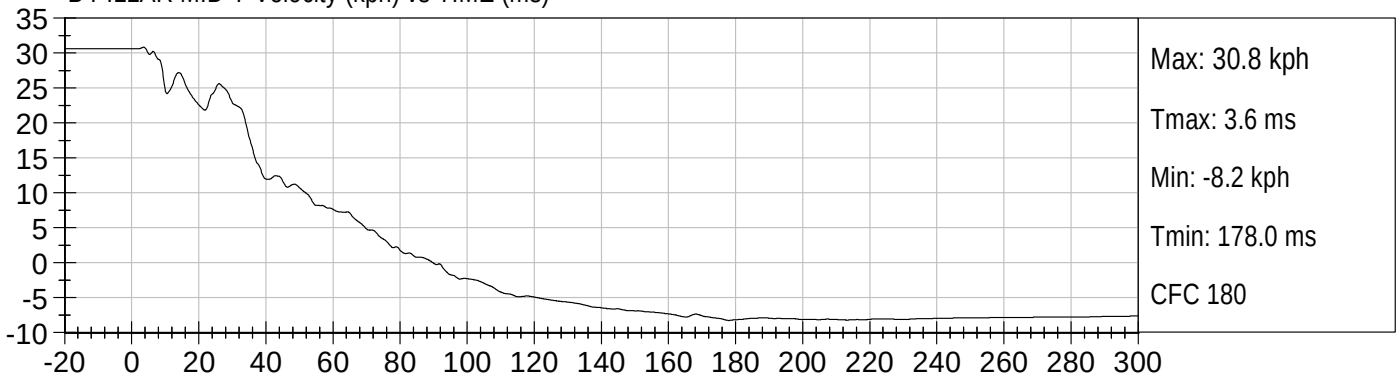
B PILLAR LOW Y Displacement (mm) vs TIME (ms)



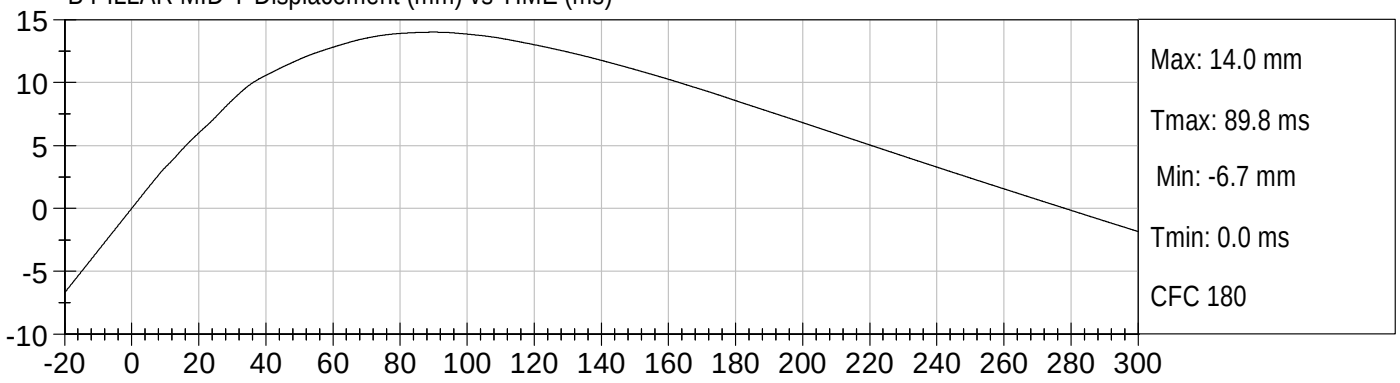
B PILLAR MID Y (G's) vs TIME (ms)



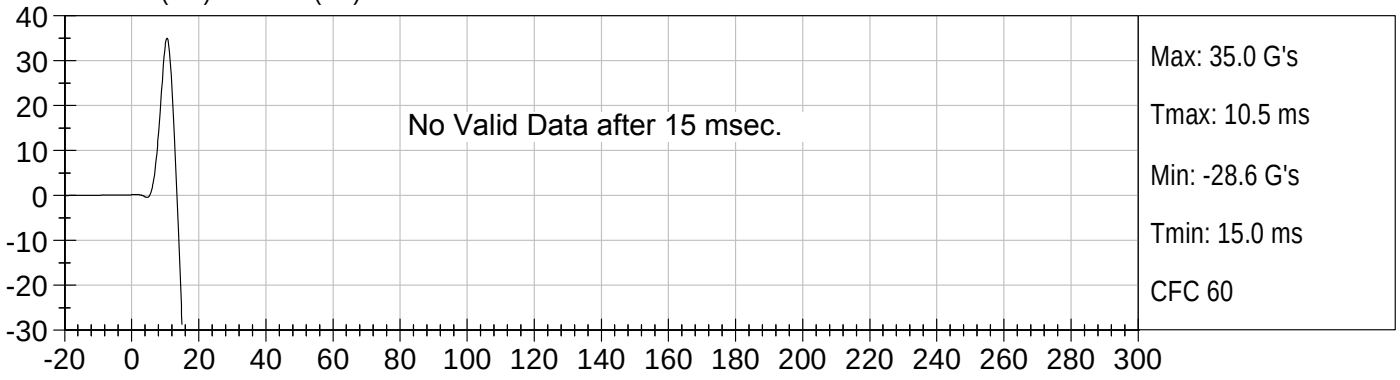
B PILLAR MID Y Velocity (kph) vs TIME (ms)



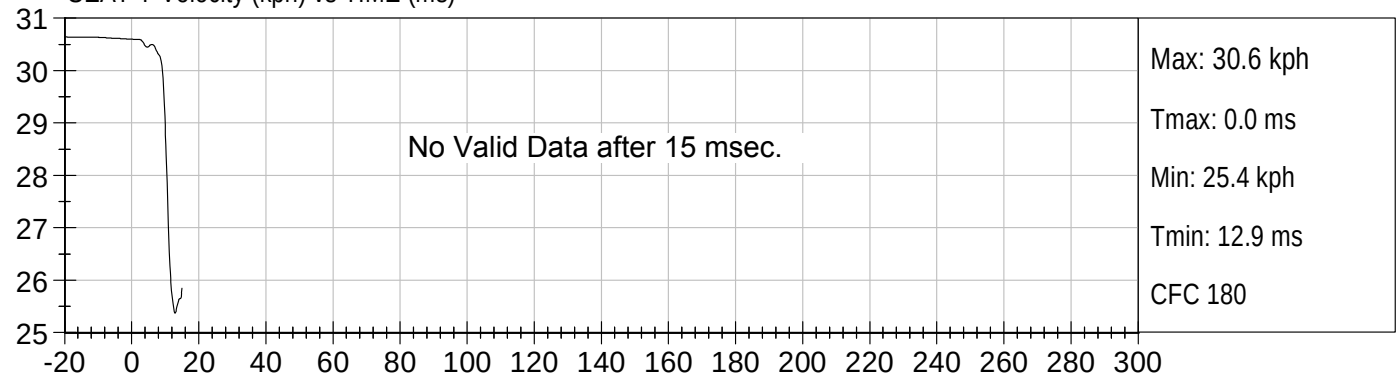
B PILLAR MID Y Displacement (mm) vs TIME (ms)



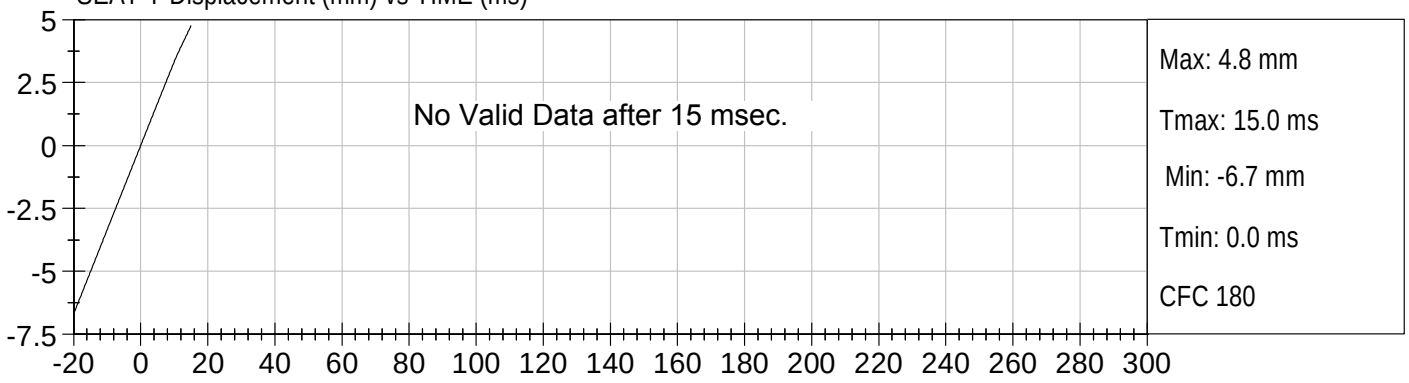
SEAT Y (G's) vs TIME (ms)



SEAT Y Velocity (kph) vs TIME (ms)



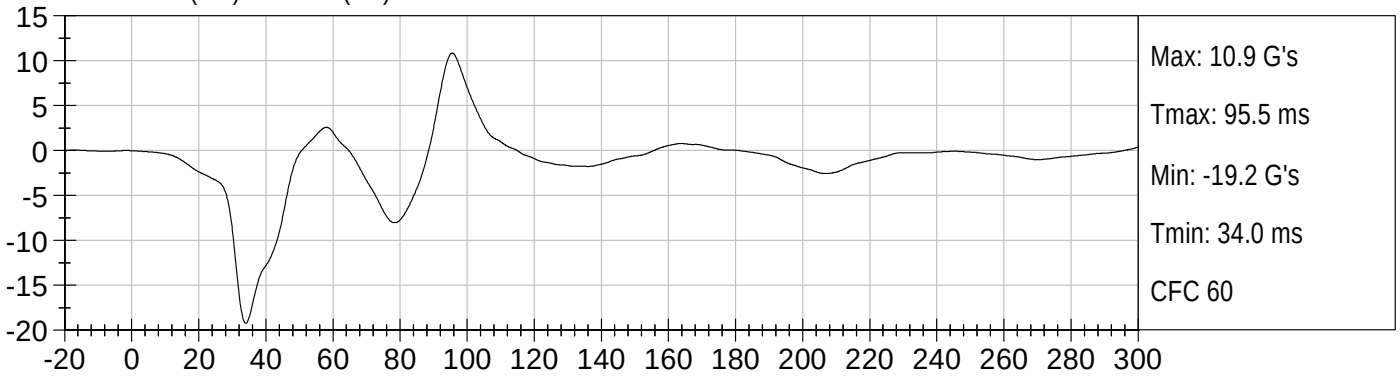
SEAT Y Displacement (mm) vs TIME (ms)



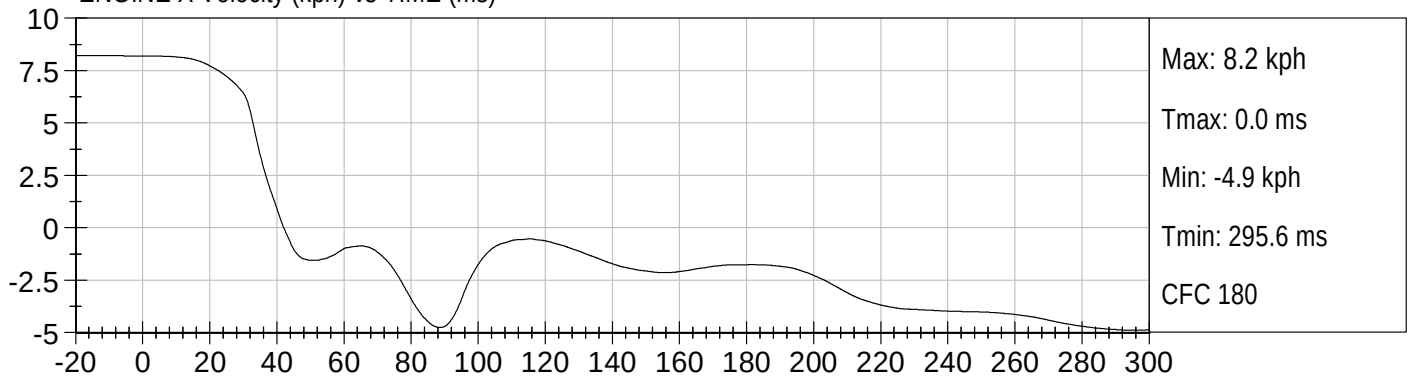
FMVSS 214 Rigid Pole Side Impact
2011 Scion tC - CB5107

Test Date: 03/30/2011
Speed: 19.7 mph (31.7 km/h)

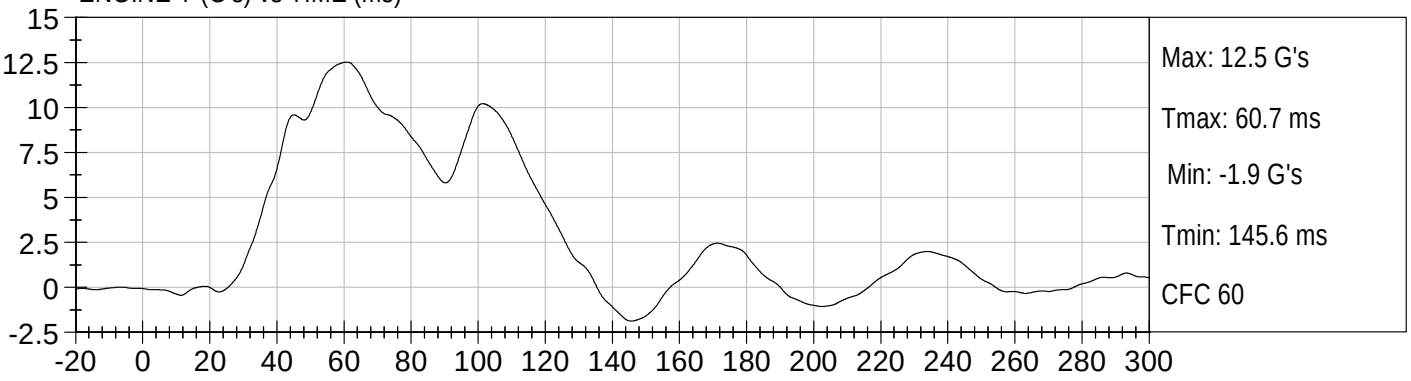
ENGINE X (G's) vs TIME (ms)



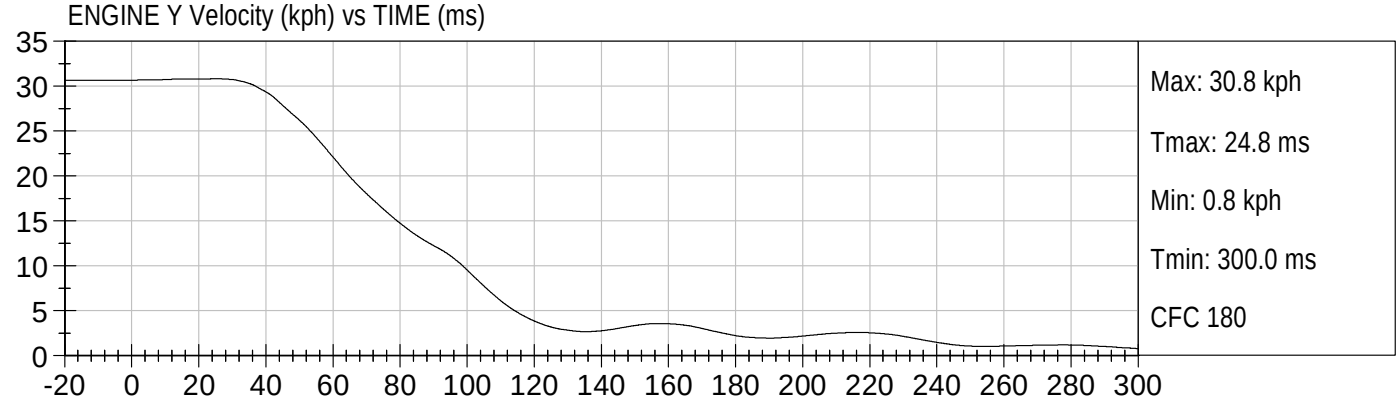
ENGINE X Velocity (kph) vs TIME (ms)



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

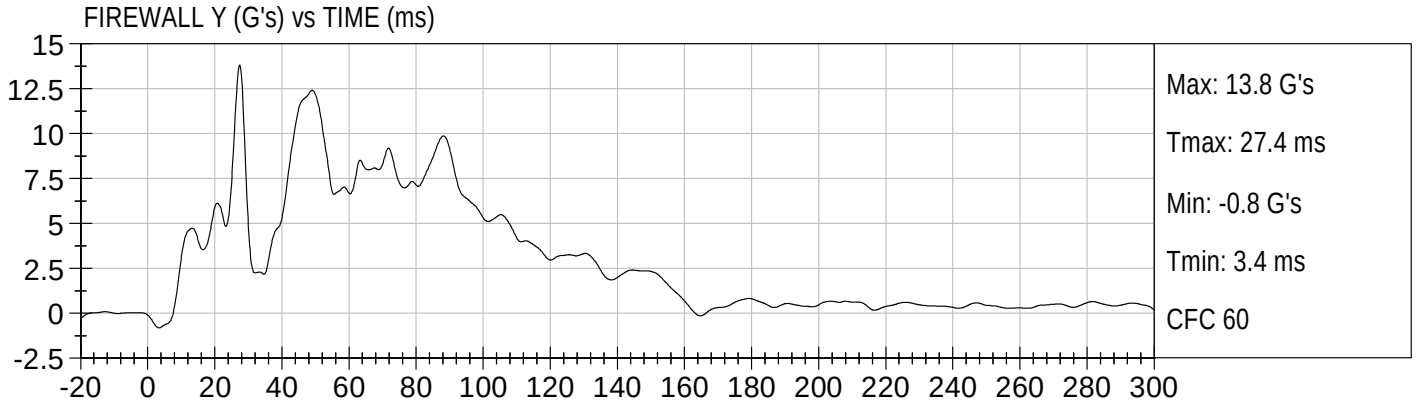


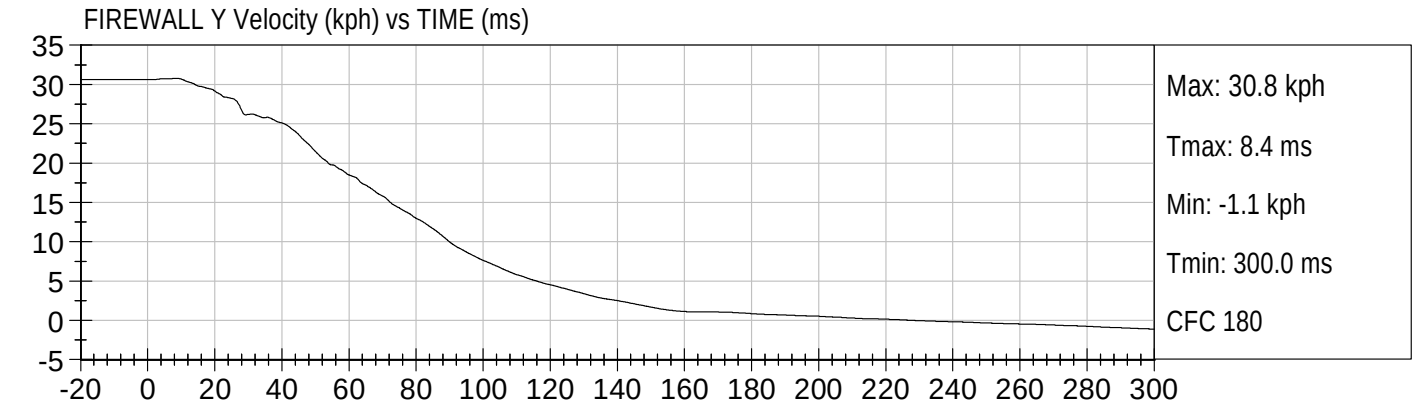
ENGINE Y Velocity (kph) vs TIME (ms)



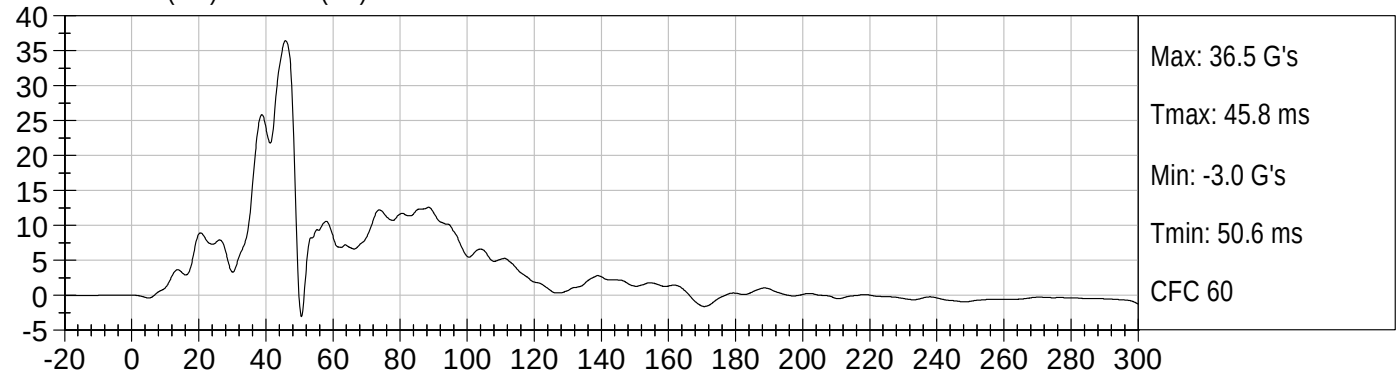
FMVSS 214 Rigid Pole Side Impact
2011 Scion tC - CB5107

Test Date: 03/30/2011
Speed: 19.7 mph (31.7 km/h)

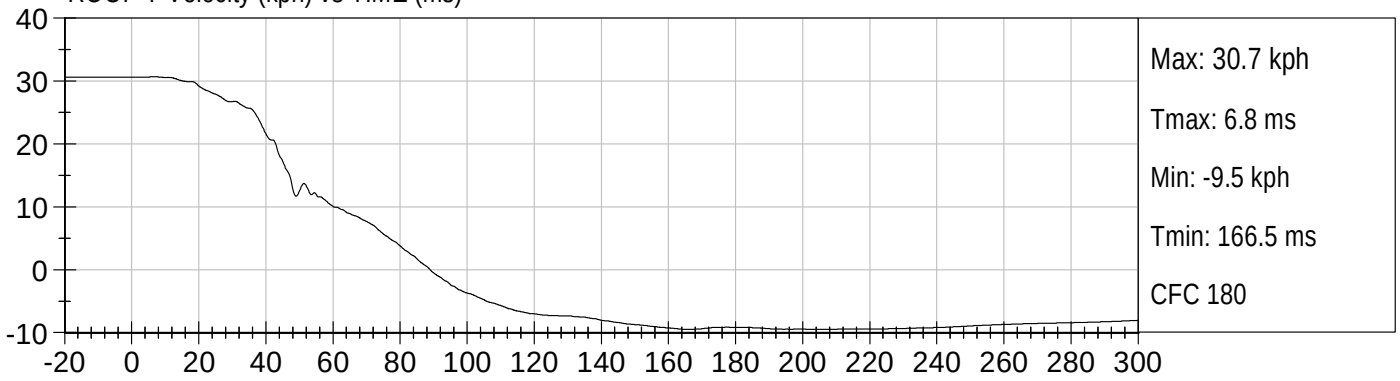




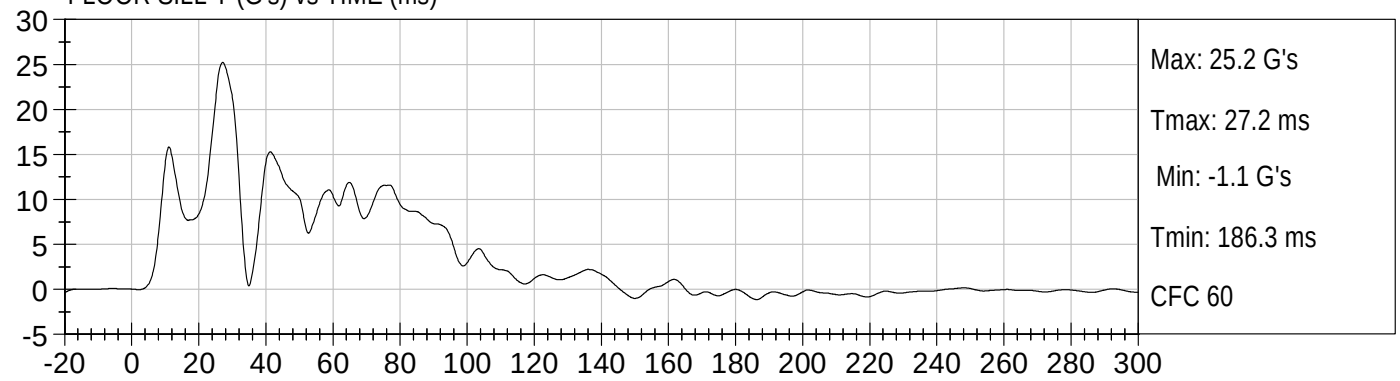
ROOF Y (G's) vs TIME (ms)



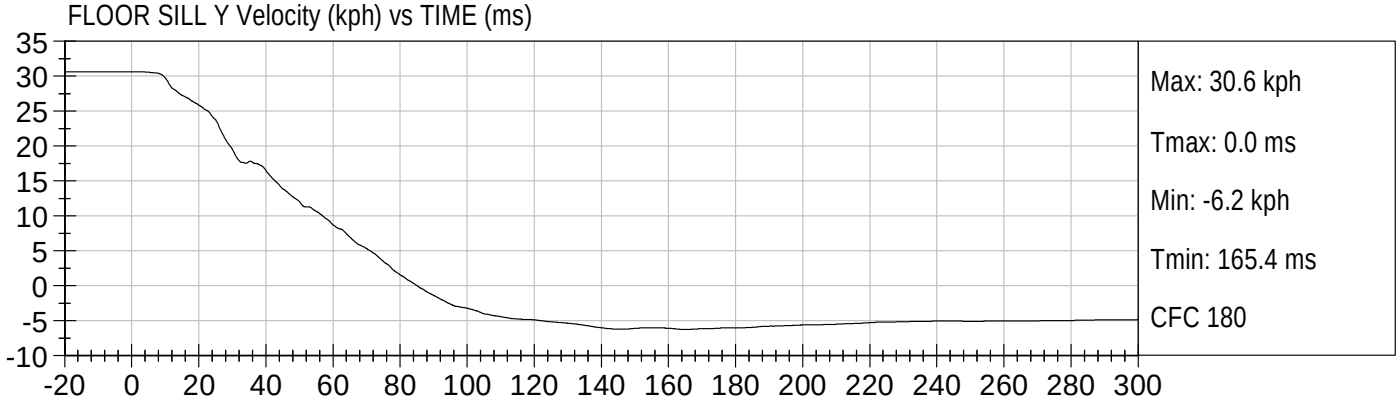
ROOF Y Velocity (kph) vs TIME (ms)



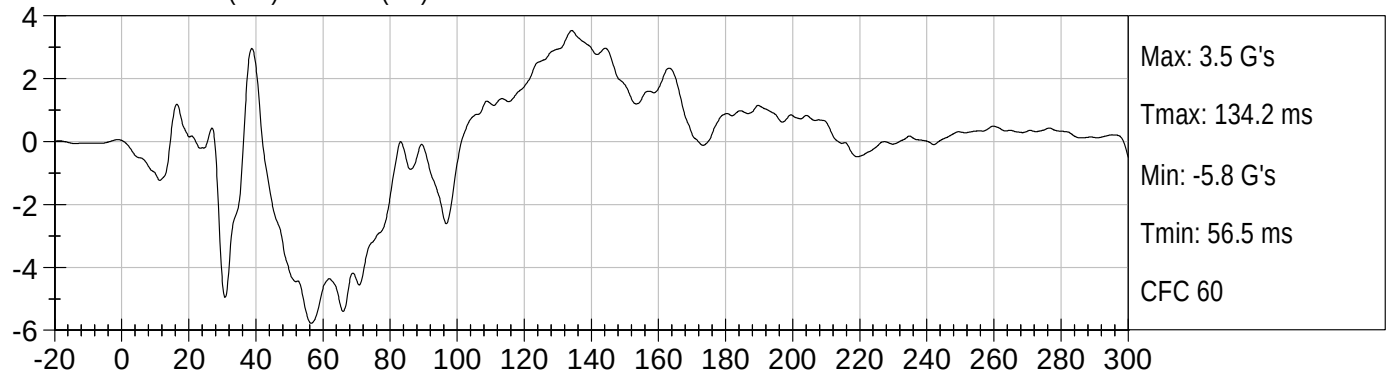
FLOOR SILL Y (G's) vs TIME (ms)



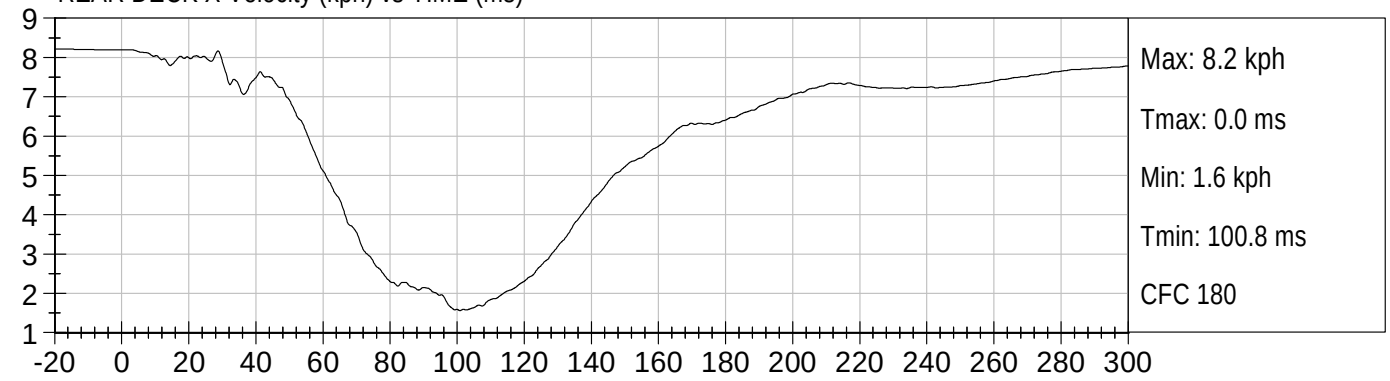
FLOOR SILL Y Velocity (kph) vs TIME (ms)



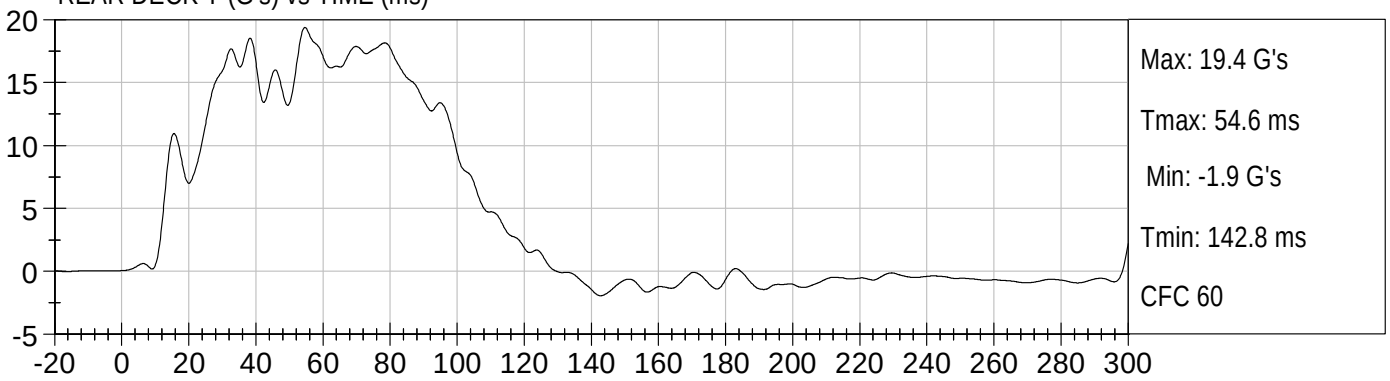
REAR DECK X (G's) vs TIME (ms)



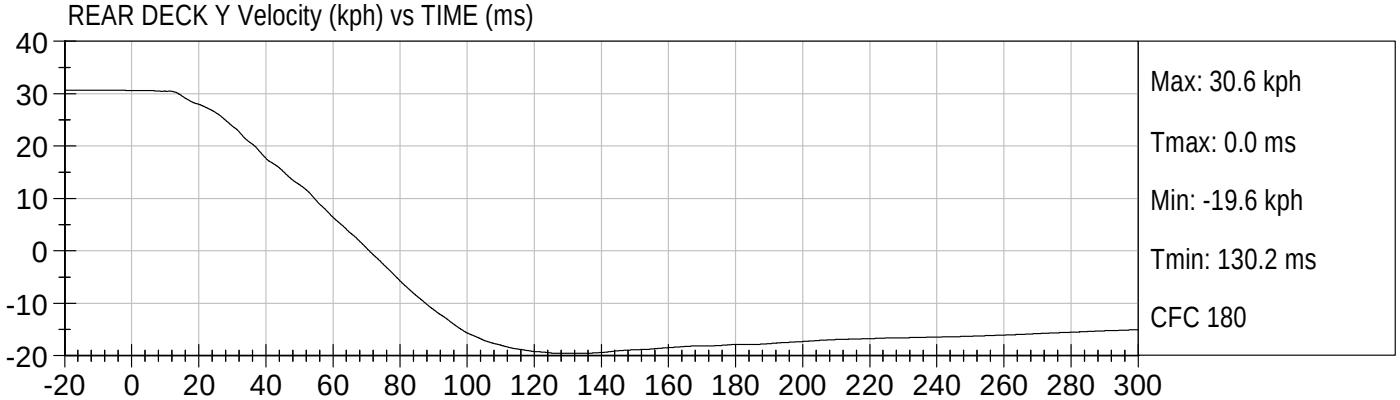
REAR DECK X Velocity (kph) vs TIME (ms)



REAR DECK Y (G's) vs TIME (ms)



REAR DECK 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:** D111141

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.4	Pass
Laboratory Relative Humidity	%	10 to 70	19	Pass
Peak Resultant Acceleration	G's	125 to 155	150	Pass
Peak Lateral Acceleration	G's	+/- 15	-7.1	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

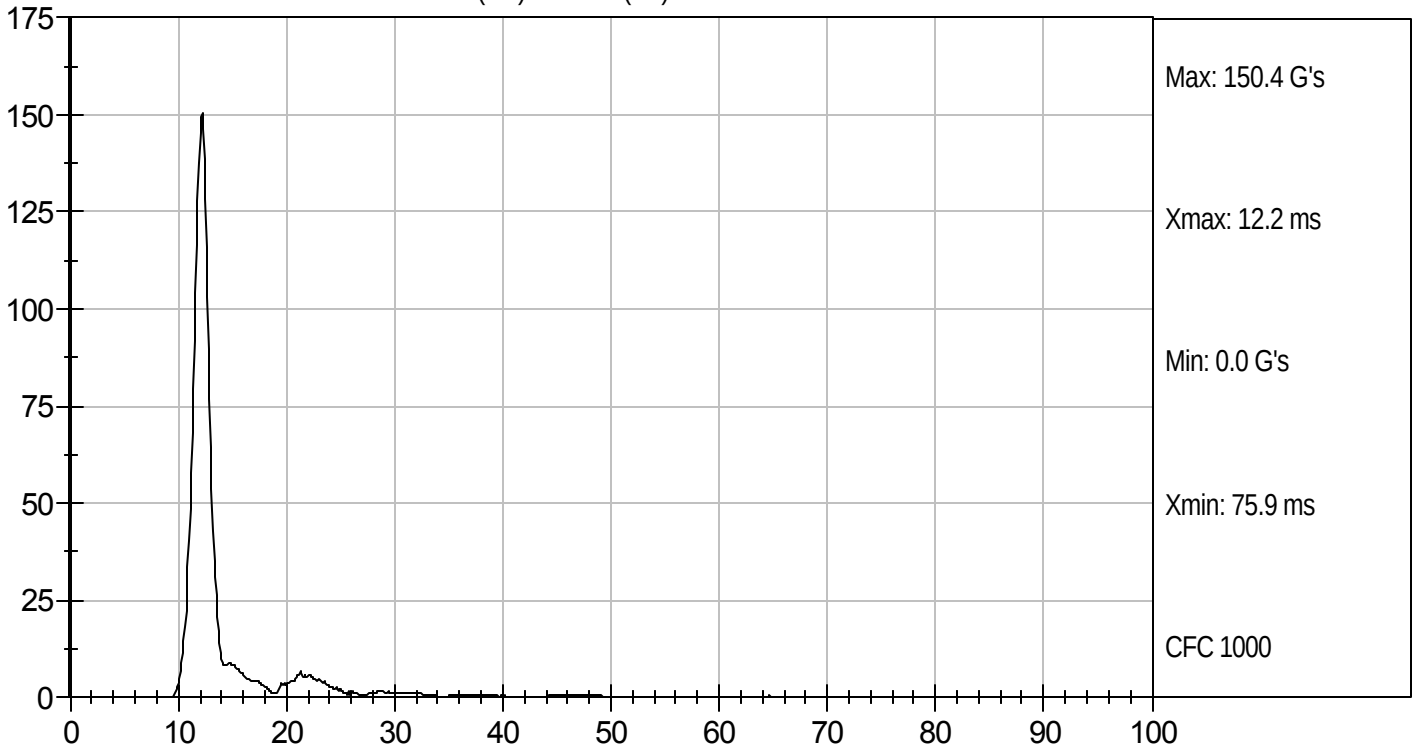
3/25/11
Test Date

David Winkelbauer
Approved By

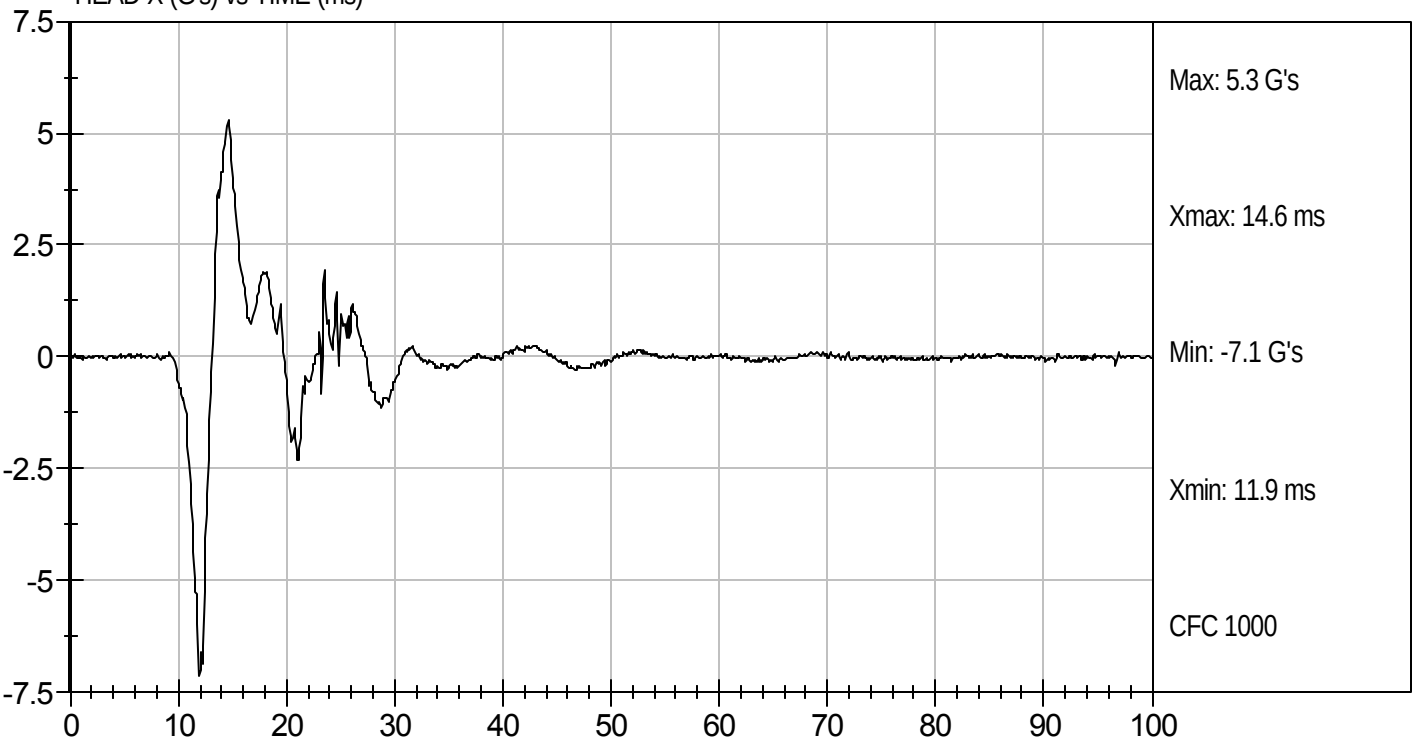
Test Desc: Head Drop
Component ID: D111141

Test Date: 3/25/11
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:** D111142

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	20	Pass
Pendulum Speed		m/s	3.3 to 3.5	3.5	Pass
Pendulum Deceleration	1 ms	m/s	0.00 to -0.05	-0.01	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	52.5	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	60.7	Pass
Head Rotation Decay Time to 0 degree		ms	53.0 to 88.0	54.5	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

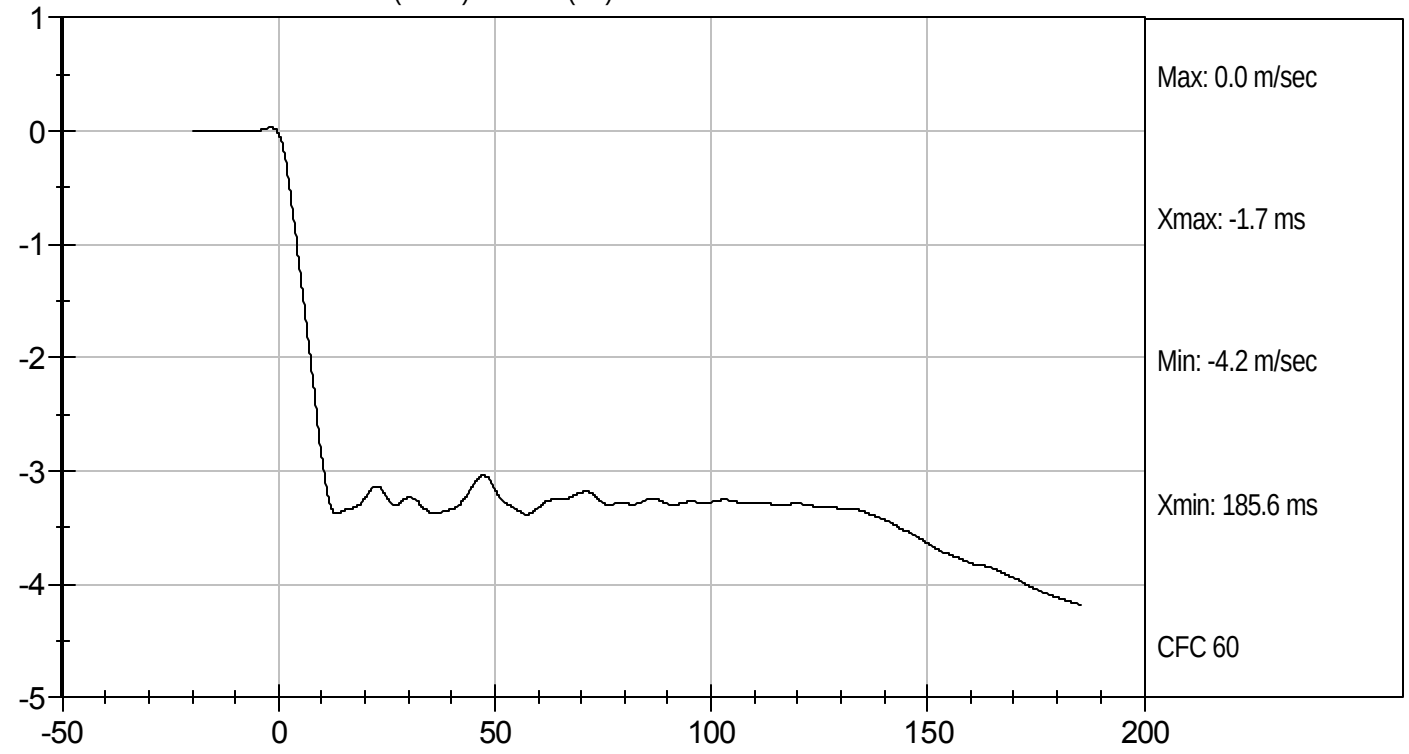
3/25/11
Test Date

David Winkelbauer
Approved By

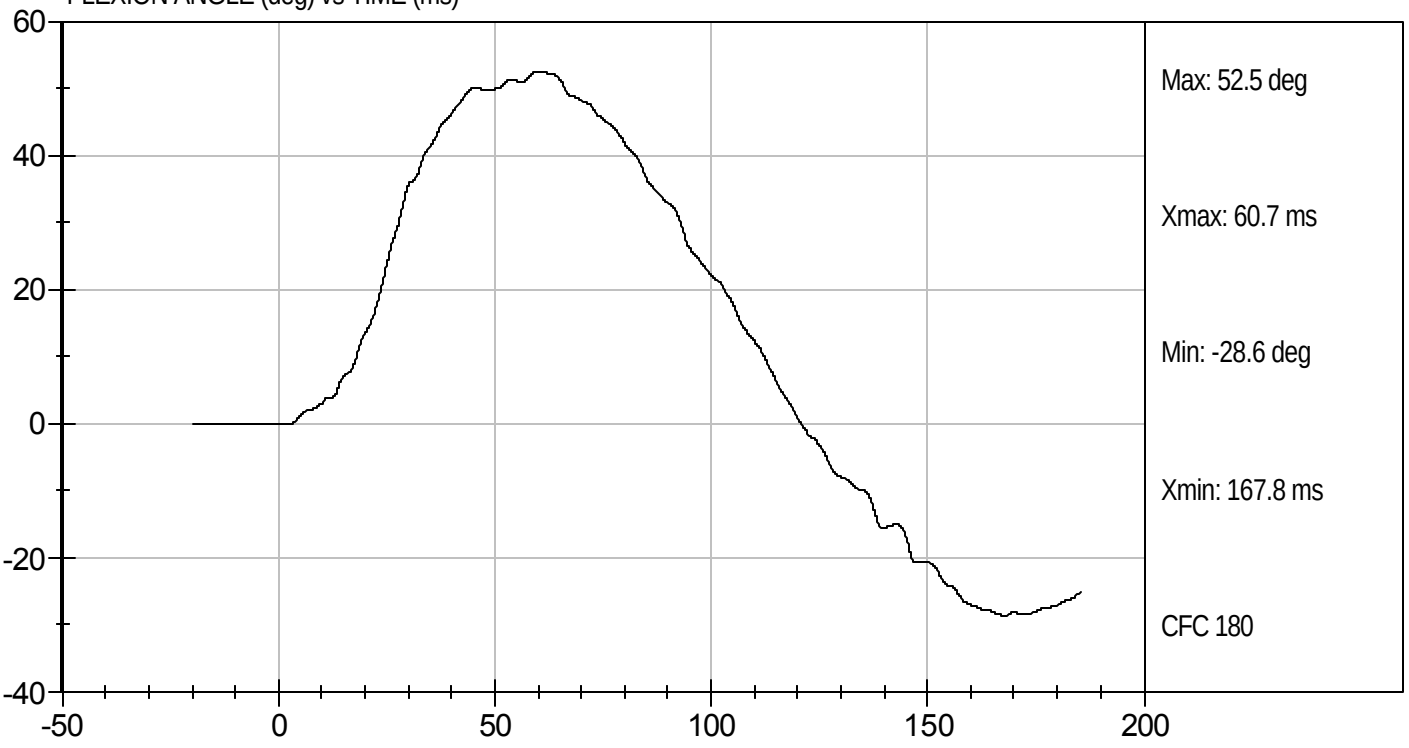
Test Desc: Neck Bending
Component ID: D111142

Test Date: 3/25/11
Velocity: 11.42 ft/s, 3.5 m/s

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

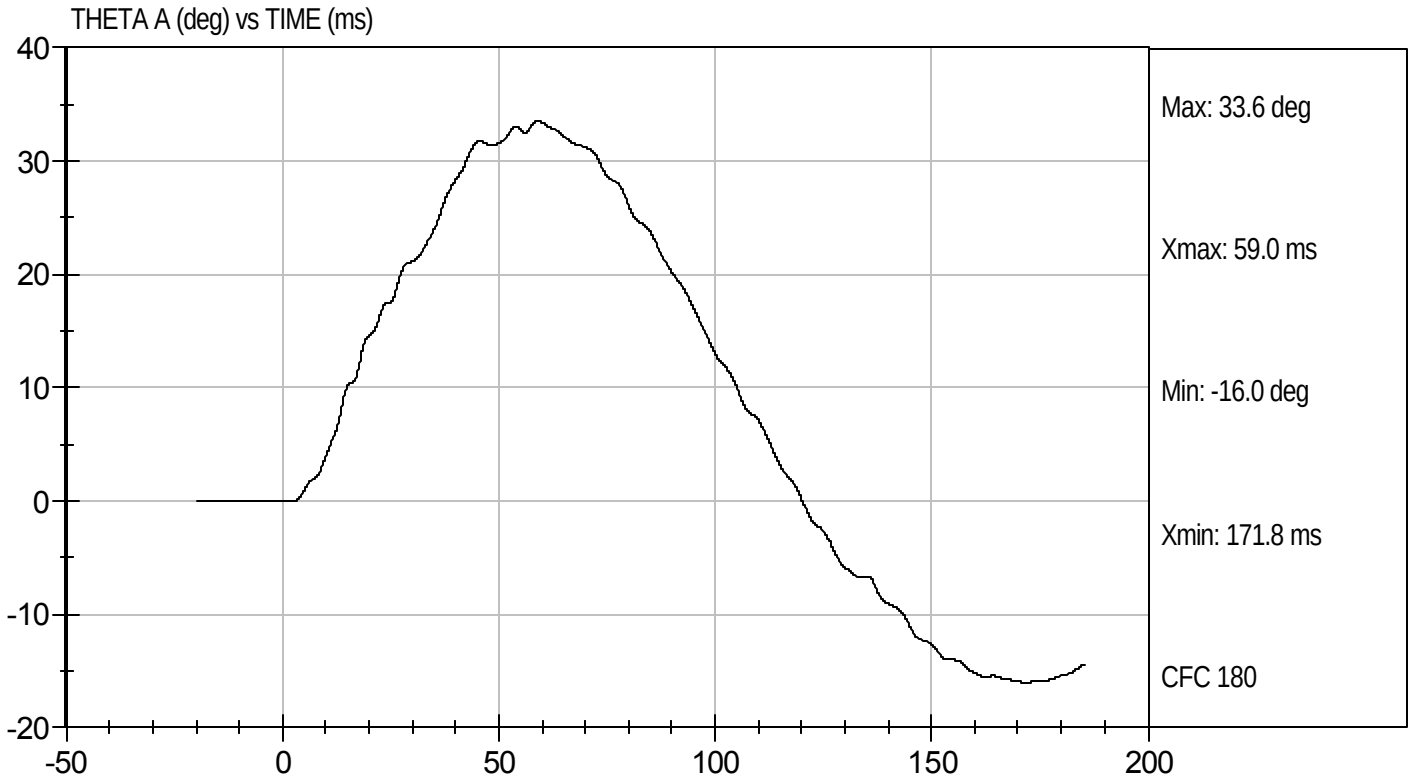


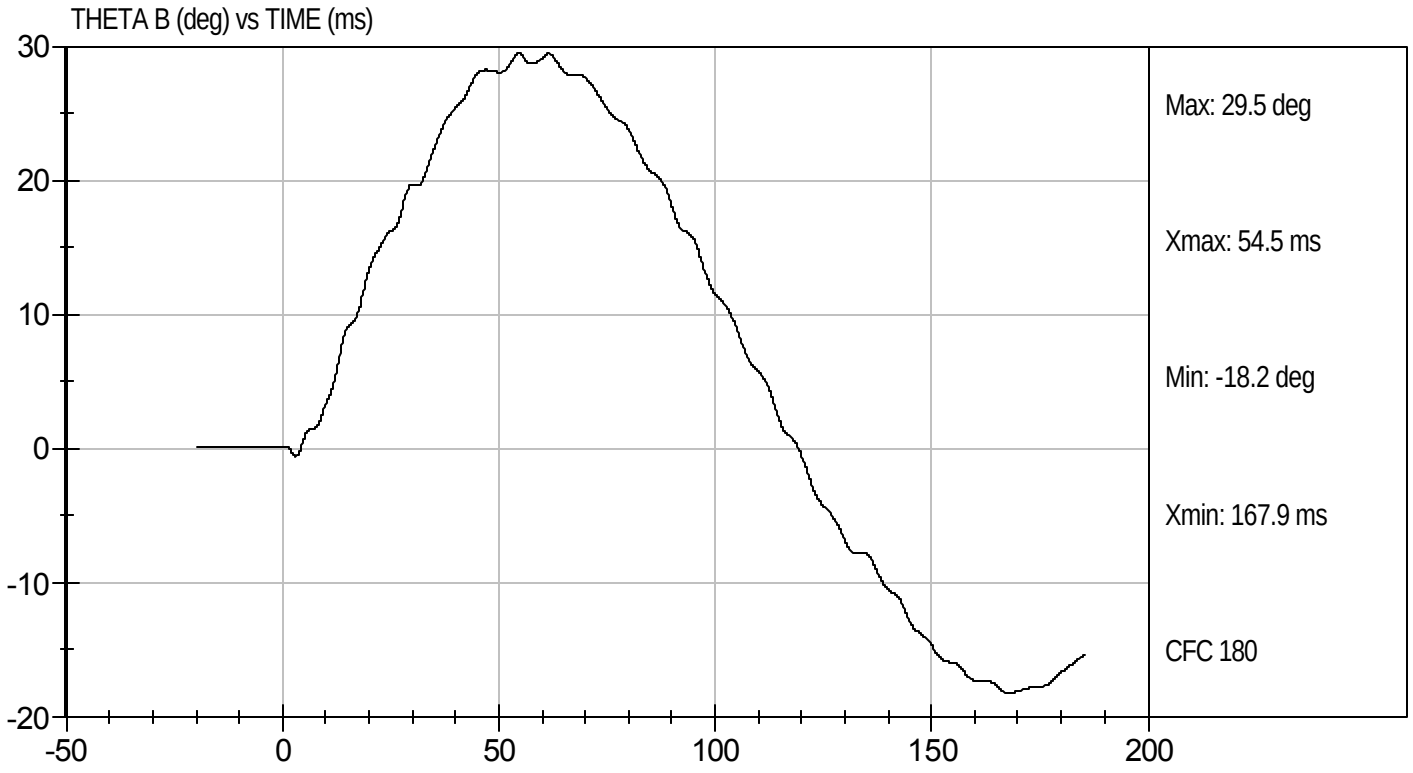
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Neck Bending
Component ID: D111142

Test Date: 3/25/11
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:** D111143

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	15	Pass
Pendulum Speed	m/s	4.2 to 4.4	4.4	Pass
Peak Shoulder Acceleration	G's	7.5 to 10.5	9.6	Pass
Time of Peak Shoulder Acceleration	ms	NA	18.0	Pass
		Overall Test Results		Pass

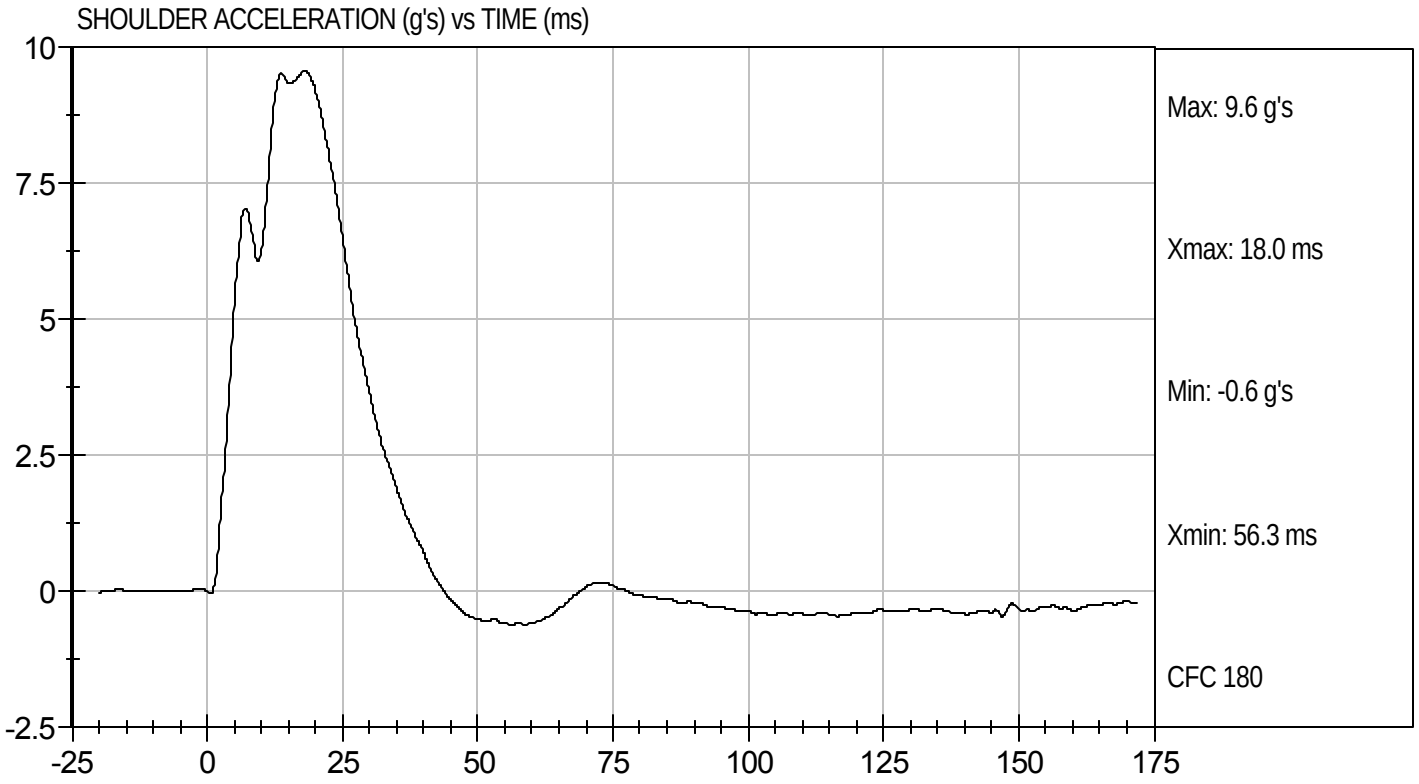
Jessica Hall
Laboratory Technician

3/28/11
Test Date

David Winkelbauer
Approved By

Test Desc: Shoulder Impact
Component ID: D111143

Test Date: 3/28/11
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:** D111144

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	19	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	48.3	Pass
		Overall Test Results		Pass

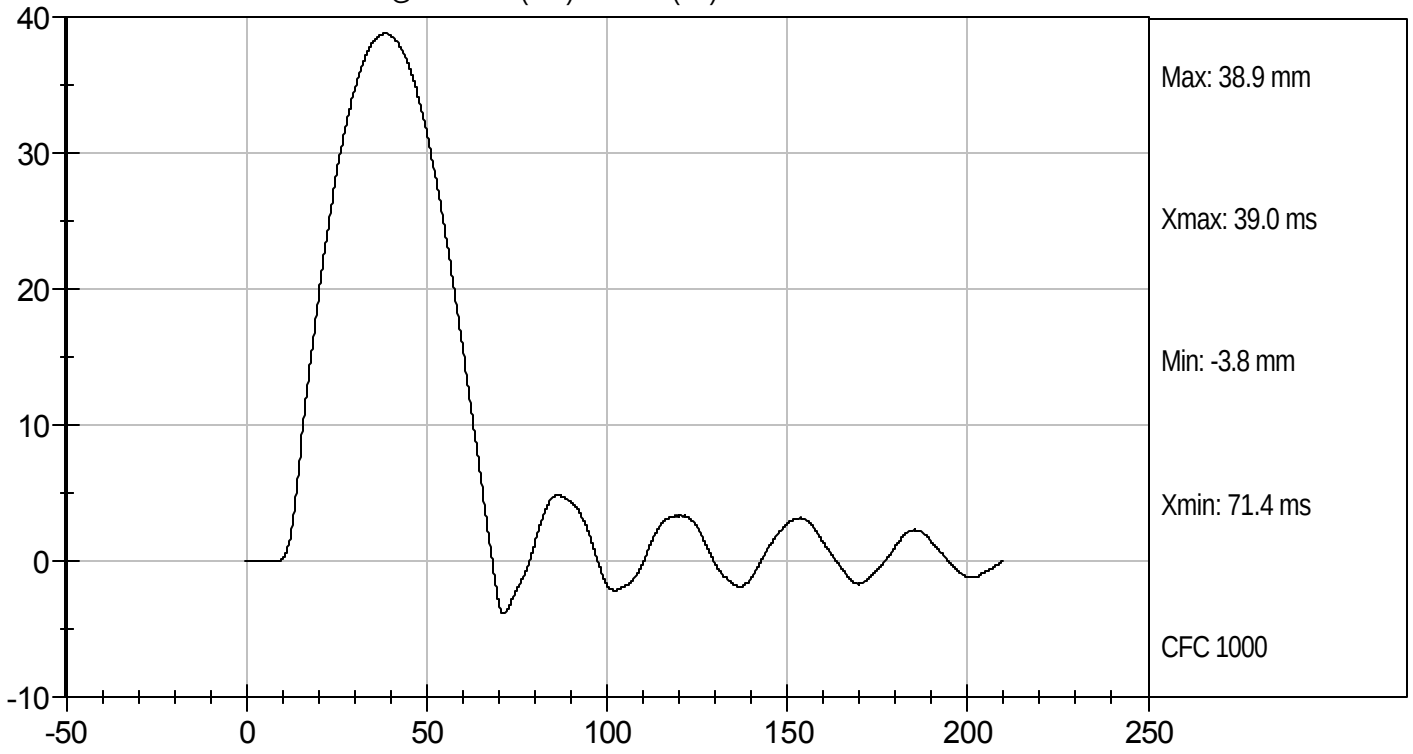
Jessica Gall
Laboratory Technician

3/25/11
Test Date

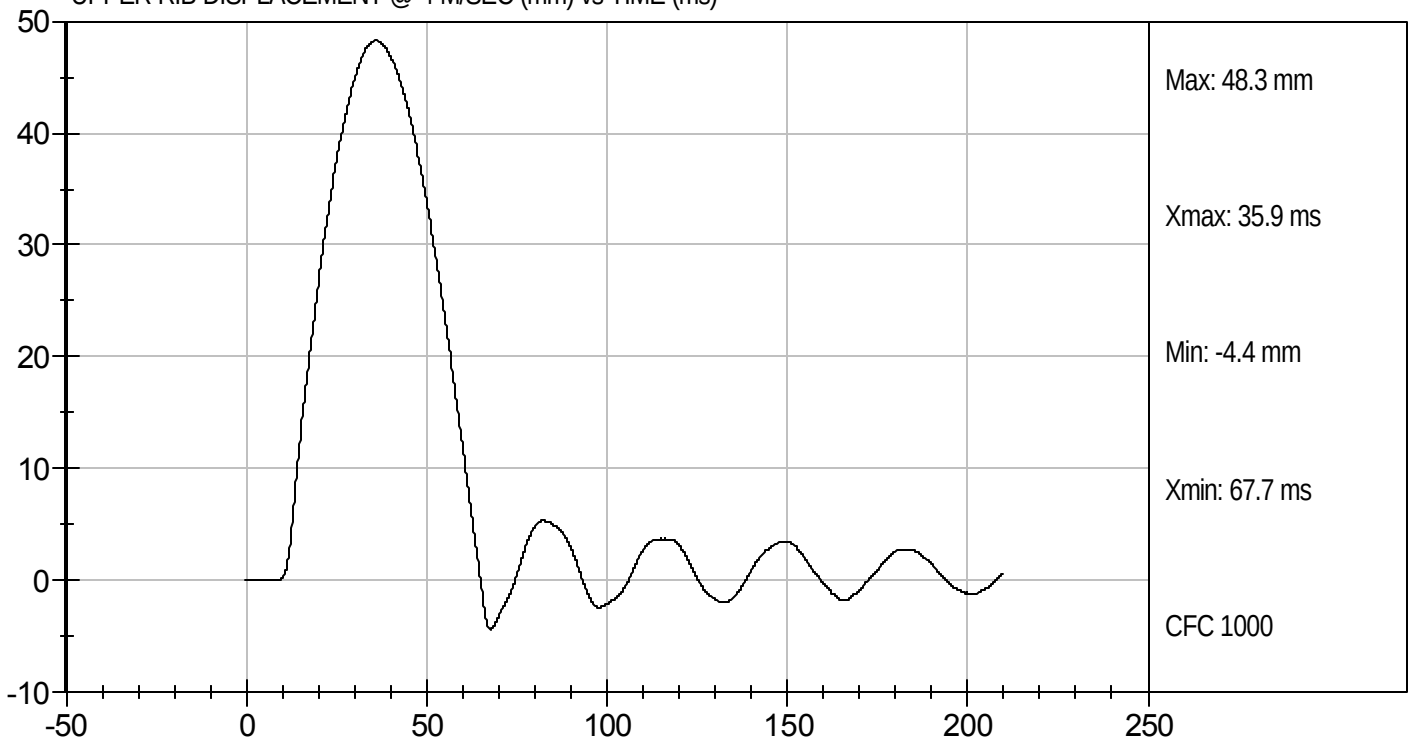
David Winkelbauer
Approved By

Test Desc: Rib Impact - Upper
Component ID: D111144
Test Date: 3/25/11

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:** D111145

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	19	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	48.8	Pass
		Overall Test Results		Pass

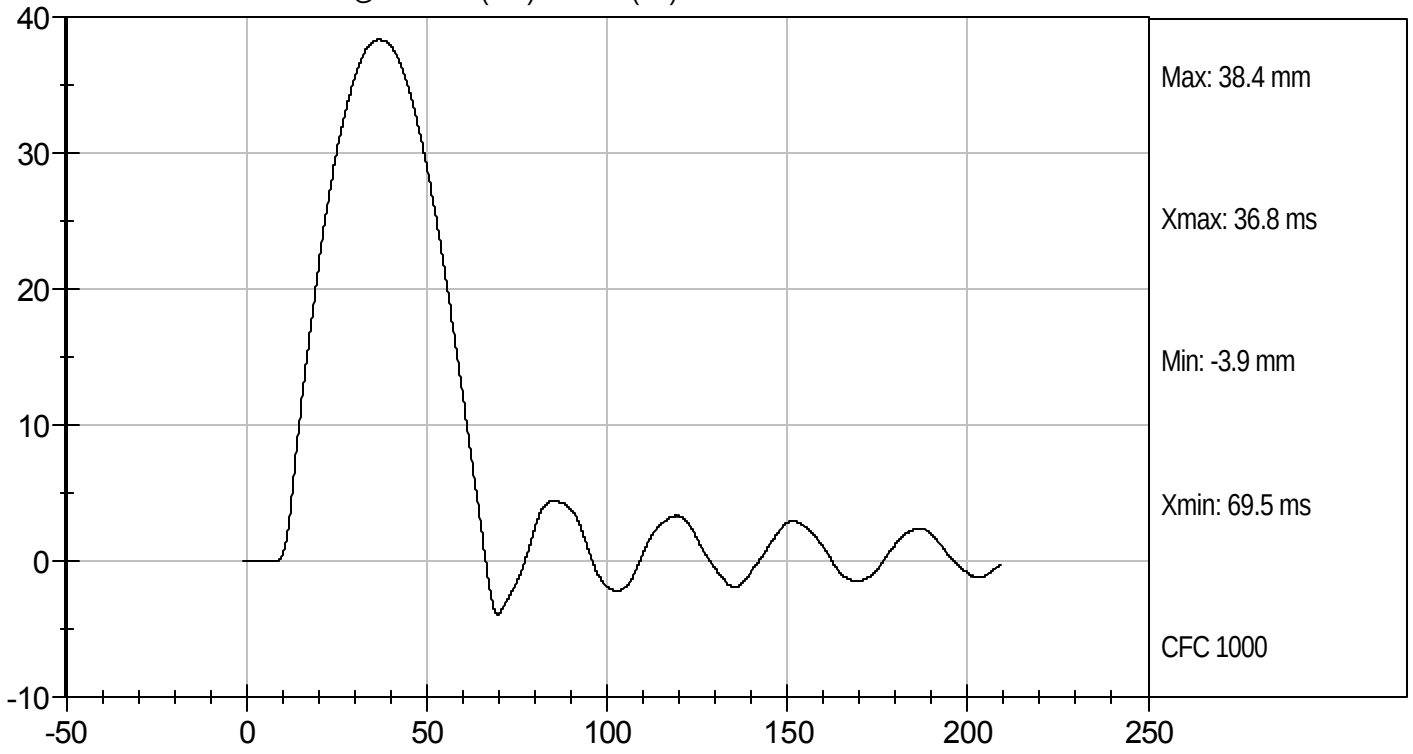
Jessica Hall
Laboratory Technician

3/25/11
Test Date

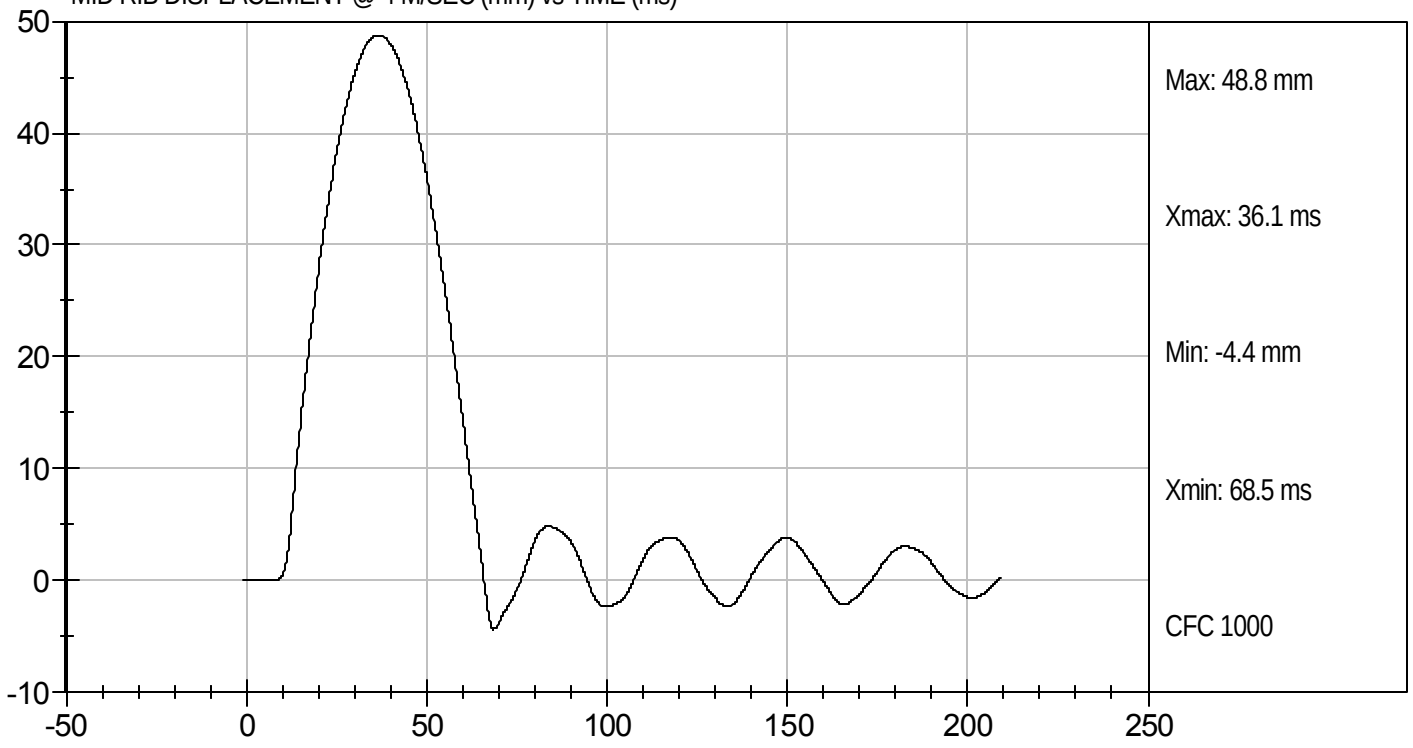
David Winkelbauer
Approved By

Test Desc: Rib Impact - Mid
Component ID: D111145
Test Date: 3/25/11

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:** D111146

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	19	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

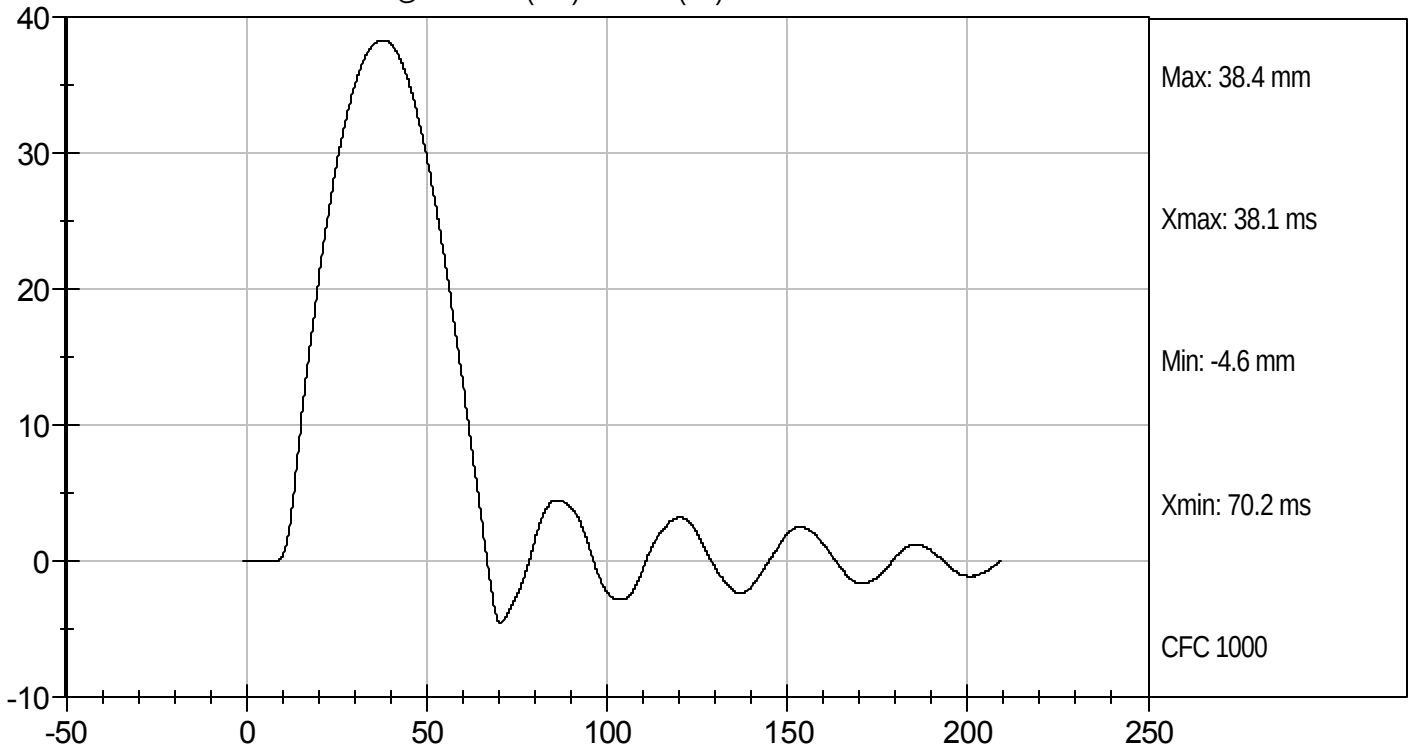
Jessica Gall
Laboratory Technician

3/25/11
Test Date

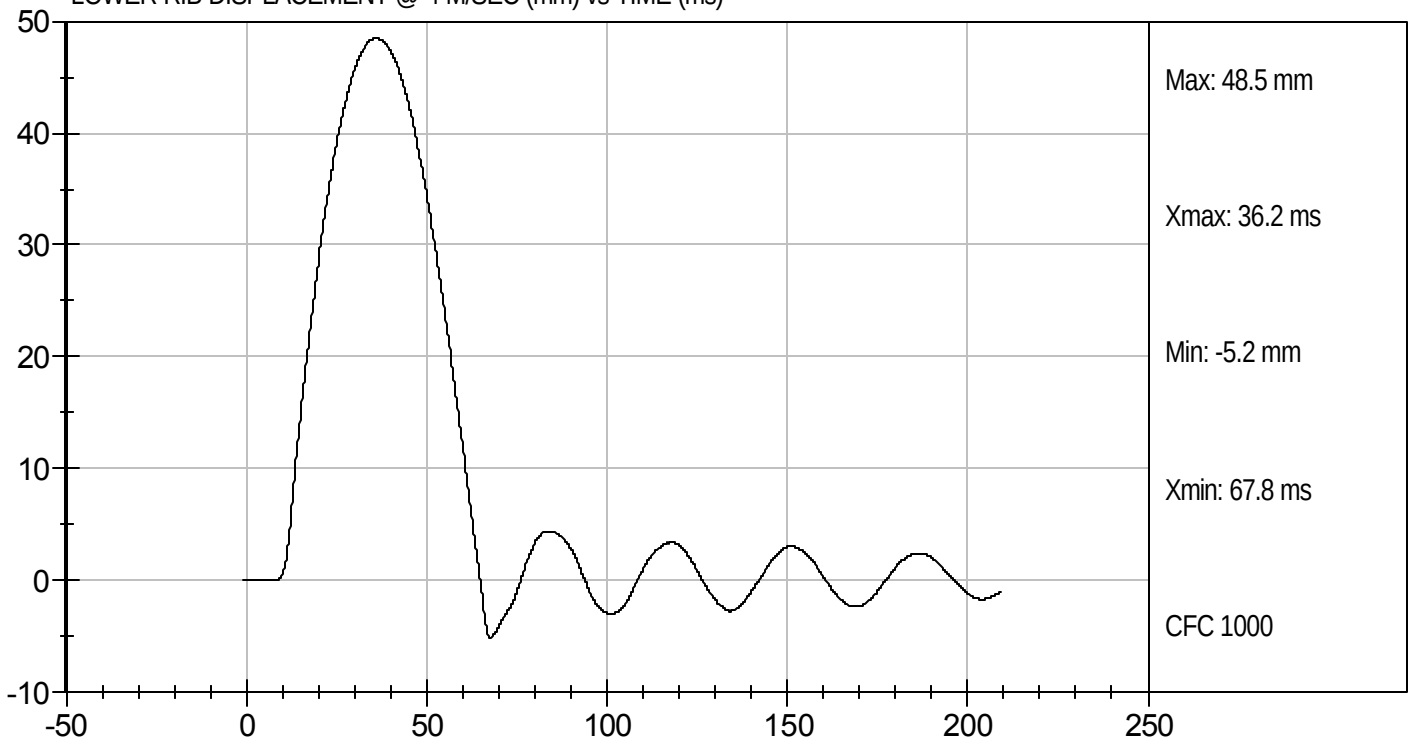
David Winkelbauer
Approved By

Test Desc: Rib Impact - Lower
Component ID: D111146
Test Date: 3/25/11

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:** D111147

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	15	Pass
Probe Speed	m/s	3.90 to 4.10	4.06	Pass
Maximum Impact Force	kN	4.00 to 4.80	4.14	Pass
Time of Maximum Impactor Force	ms	10.60 to 13.00	10.70	Pass
Maximum Total Abdomen Force	kN	2.20 to 2.70	2.50	Pass
Time of Maximum Abdomen Force	ms	10.00 to 12.30	10.20	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

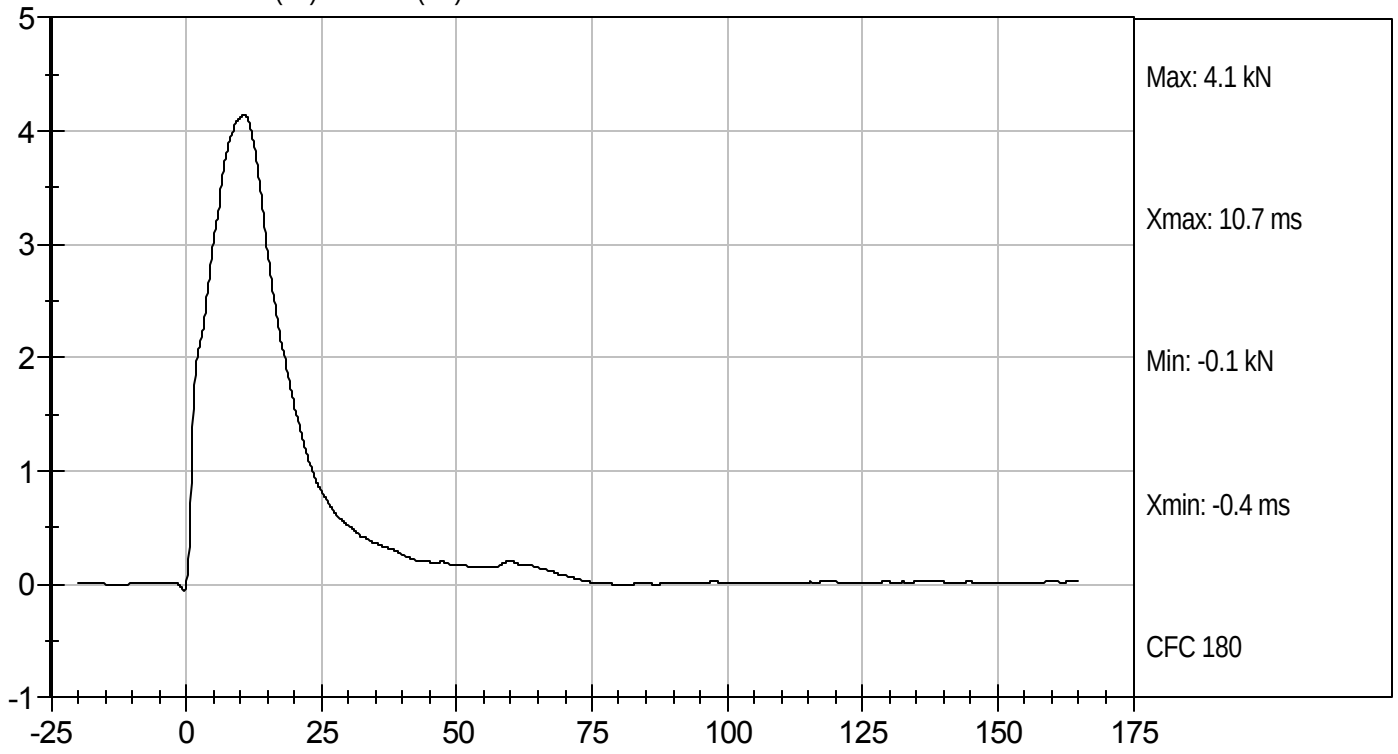
3/28/11
Test Date

David Winkelbauer
Approved By

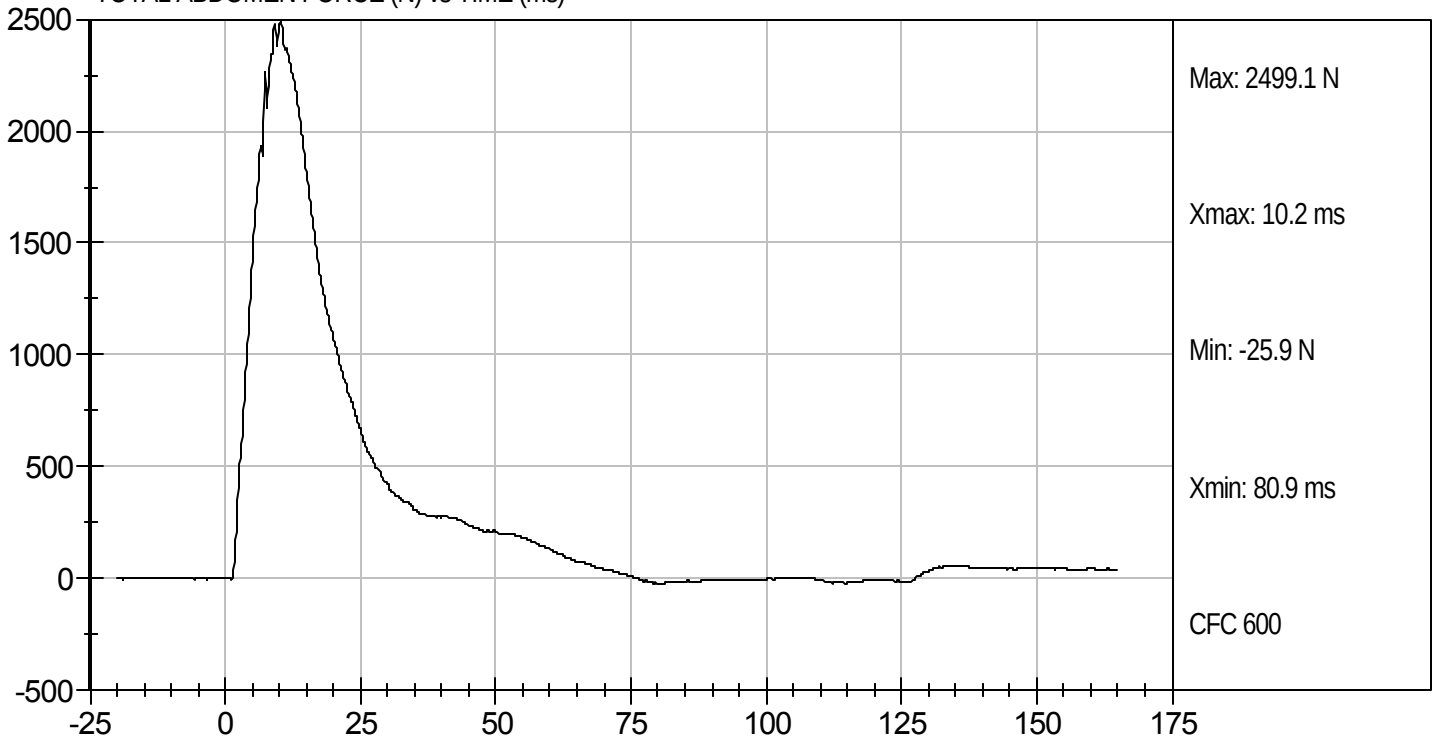
Test Desc: Abdomen Impact
Component ID: D111147

Test Date: 3/28/11
Velocity: 13.33 ft/s, 4.06 m/s

IMPACTOR FORCE (kN) vs TIME (ms)



TOTAL ABDOMEN FORCE (N) vs TIME (ms)



MGA RESEARCH CORPORATION

LUMBAR SPINE TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D111148

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	20	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	-0.42	Pass
	27 ms	m/s	-6.50 to -5.80	-5.99	Pass
	30 ms	m/s	>= -6.5	-6.12	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	45.0	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	44	Pass
			Overall Results		Pass

Jessica Hall
Laboratory Technician

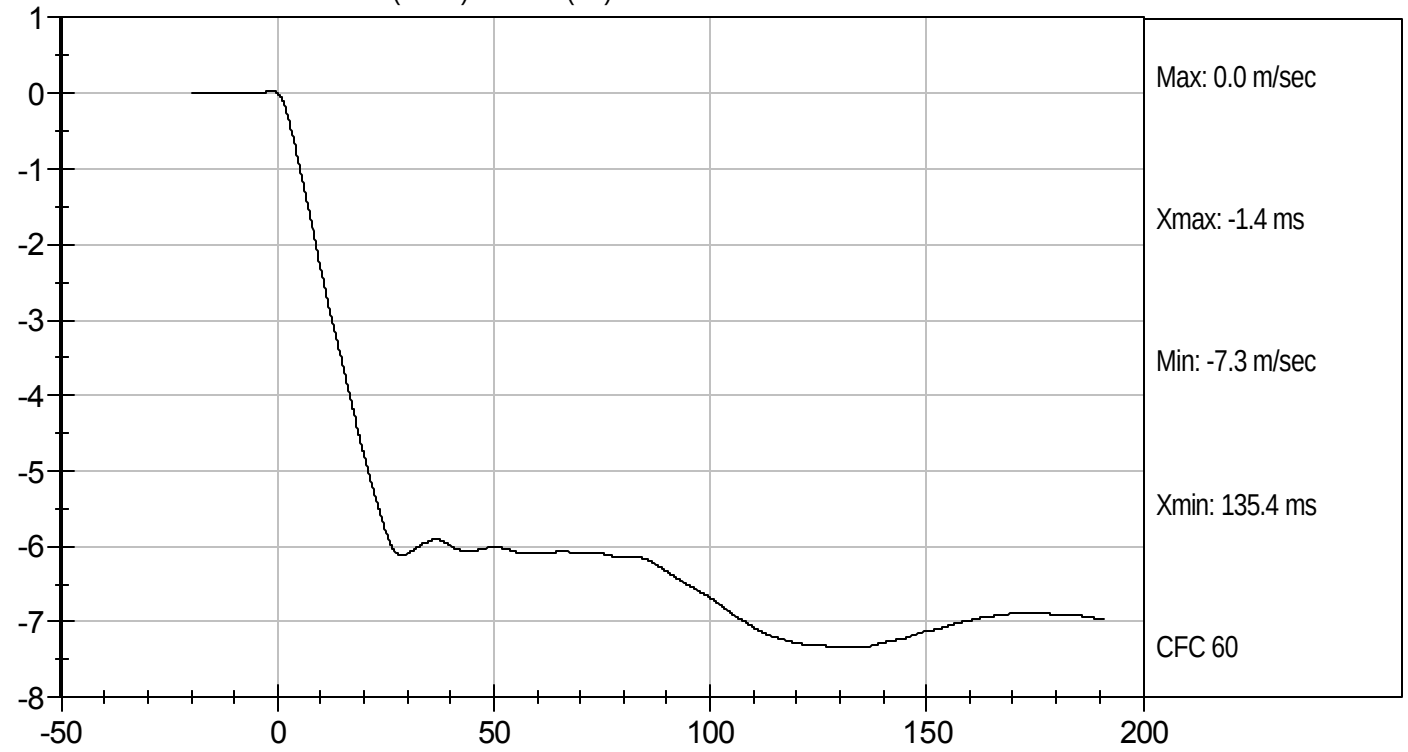
3/26/11
Test Date

David Winkelbauer
Approved By

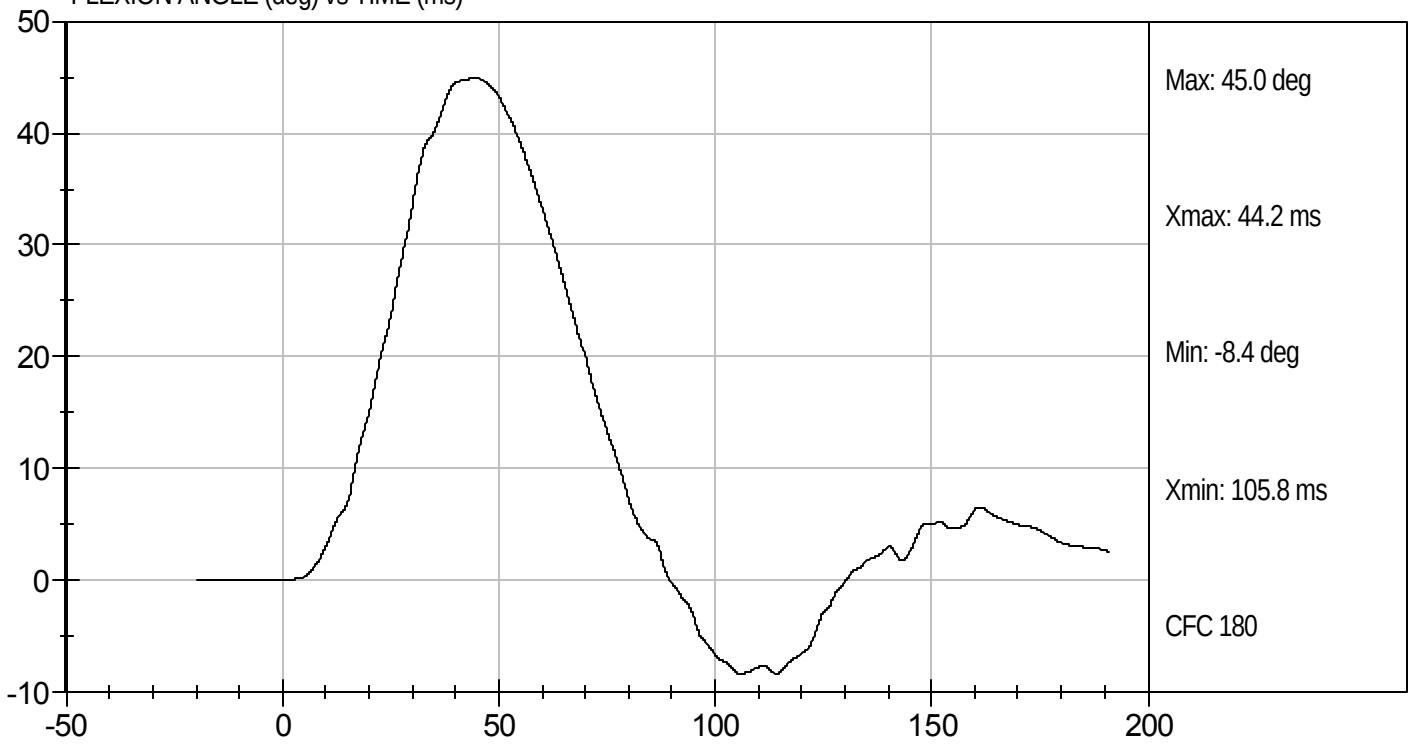
Test Desc: Lumbar Bending
Component ID: D111148

Test Date: 3/26/11
Velocity: 20.08 ft/s, 6.12 m/s

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

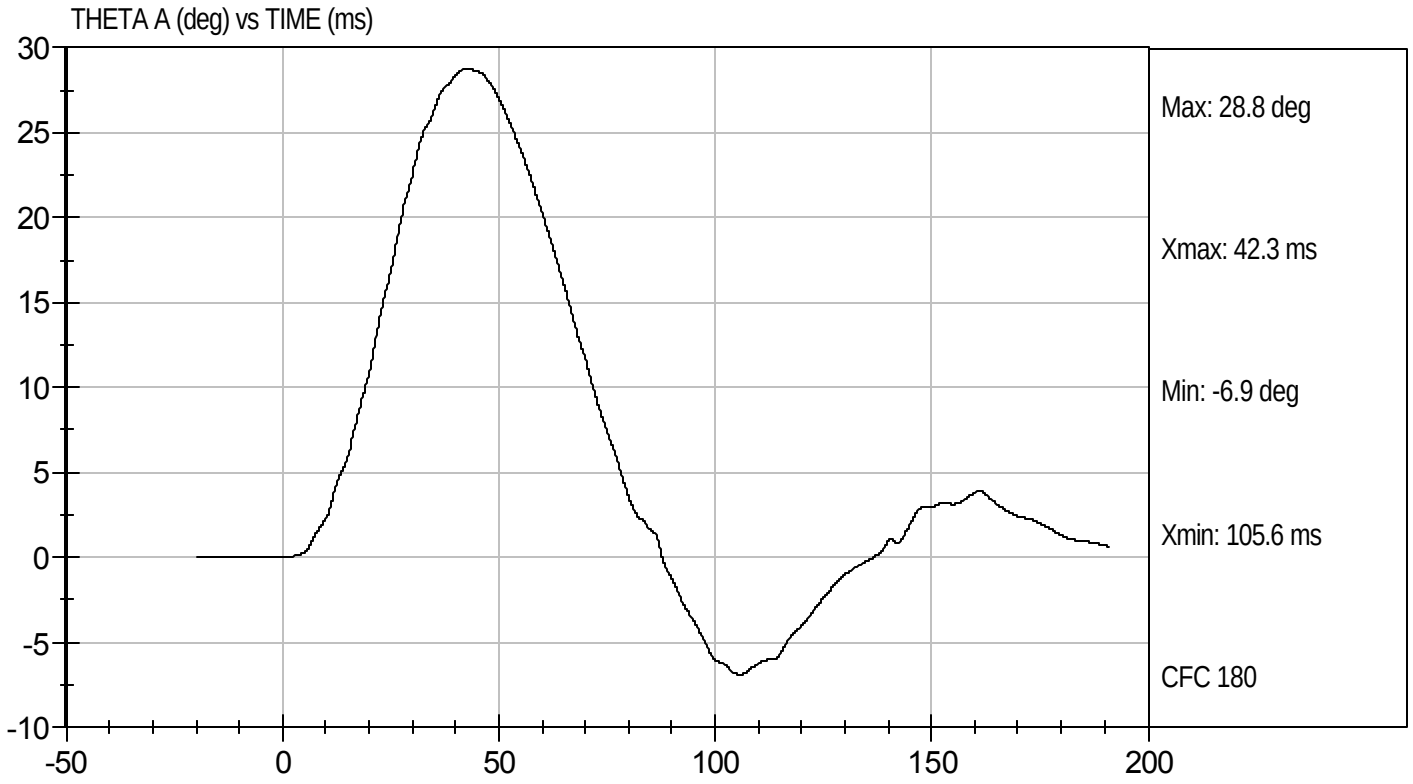


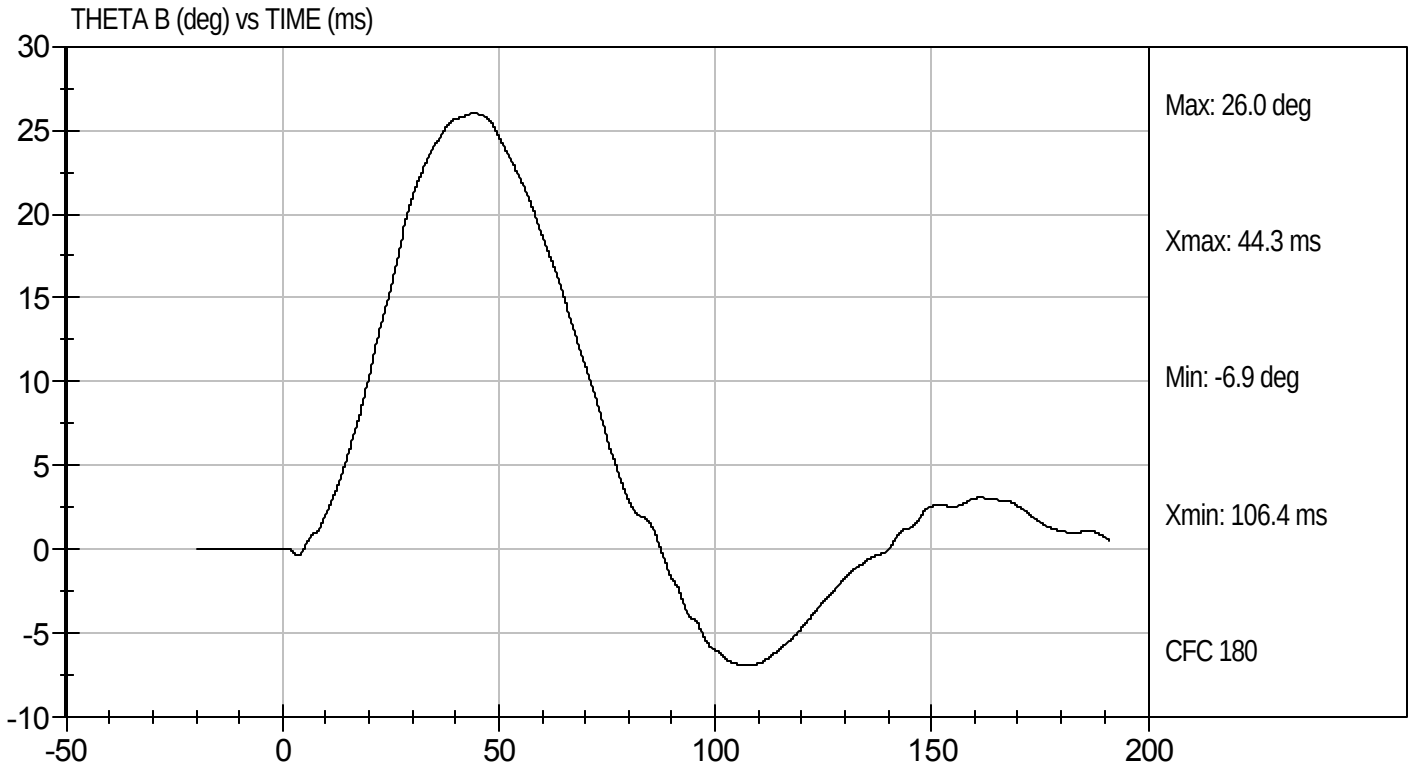
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Lumbar Bending
Component ID: D111148

Test Date: 3/26/11
Velocity: 20.08 ft/s, 6.12 m/s





MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D111149

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	16	Pass
Probe Speed	m/s	4.20 to 4.40	4.34	Pass
Maximum Impactor Force	kN	4.70 to 5.40	4.94	Pass
Time of Maximum Impactor Force	ms	11.80 to 16.10	13.30	Pass
Maximum Pubic Force	kN	1.23 to 1.59	1.49	Pass
Time of Maximum Pubic Force	ms	12.20 to 17.00	14.60	Pass
		Overall Test Results		Pass

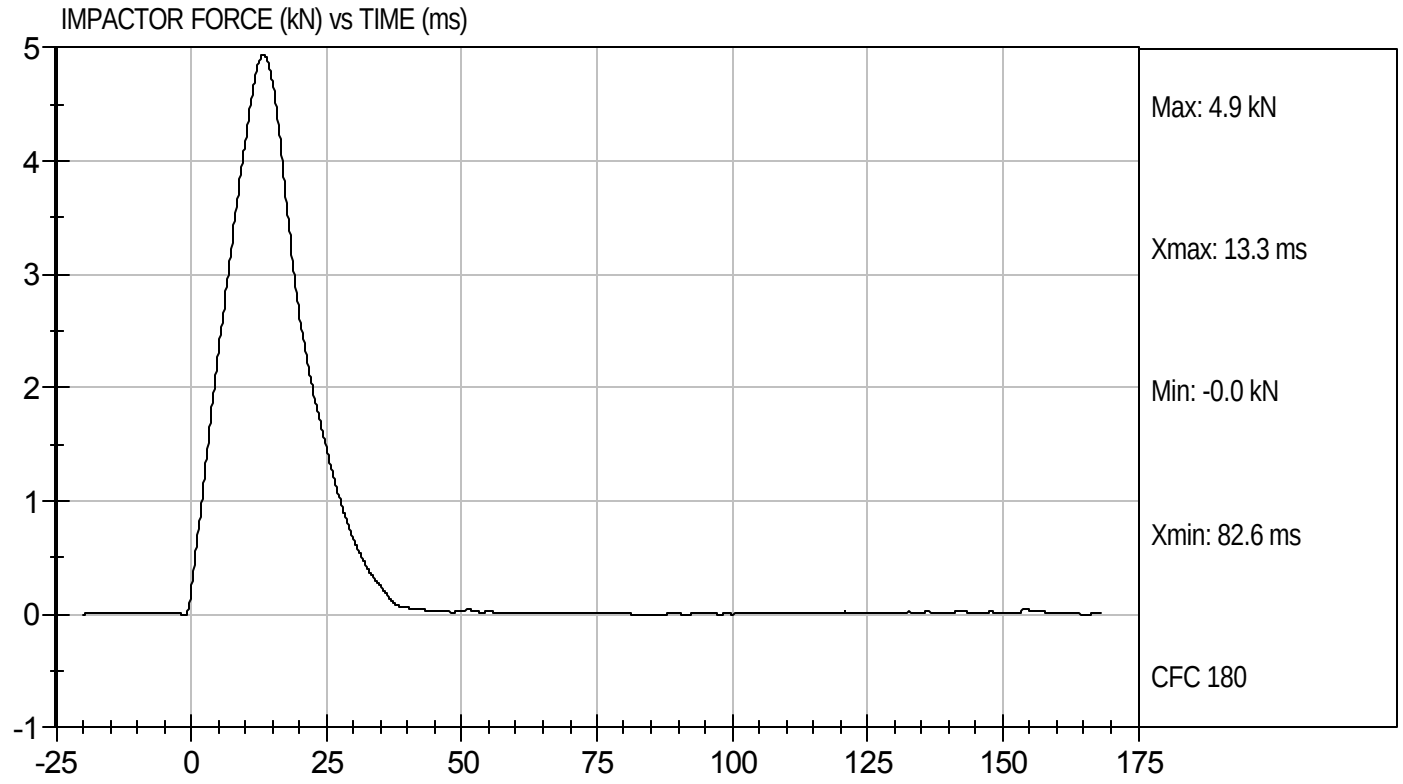
Jessica Hall
Laboratory Technician

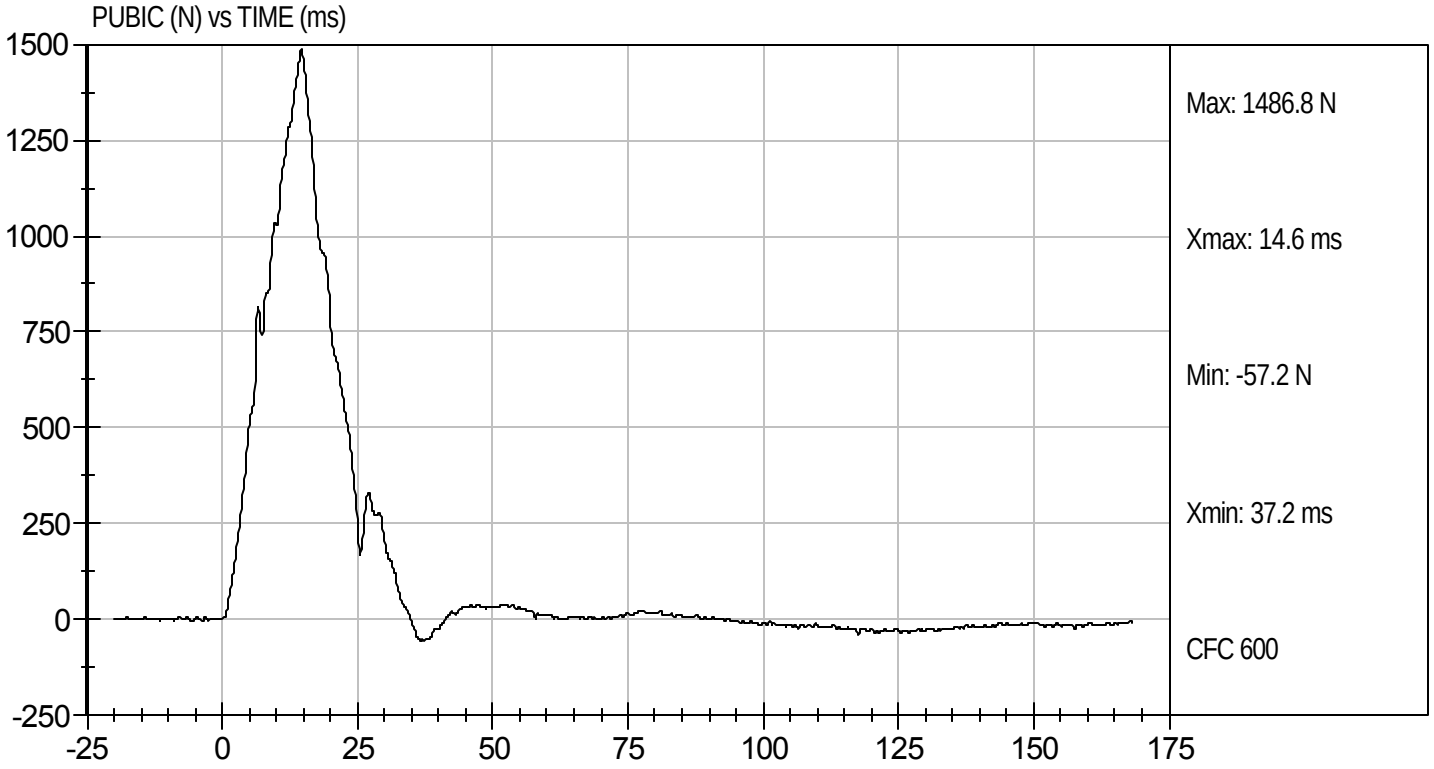
3/28/11
Test Date

David Winkelbauer
Approved By

Test Desc: Pelvis Impact
Component ID: D111149

Test Date: 3/28/11
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:** D111140

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	21.6	Pass
Humidity	%	10 to 70	17	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	5.10	Pass
Upper Rib Displacement	mm	34.0 to 41.0	38.4	Pass
Middle Rib Displacement	mm	37.0 to 45.0	41.1	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.2	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

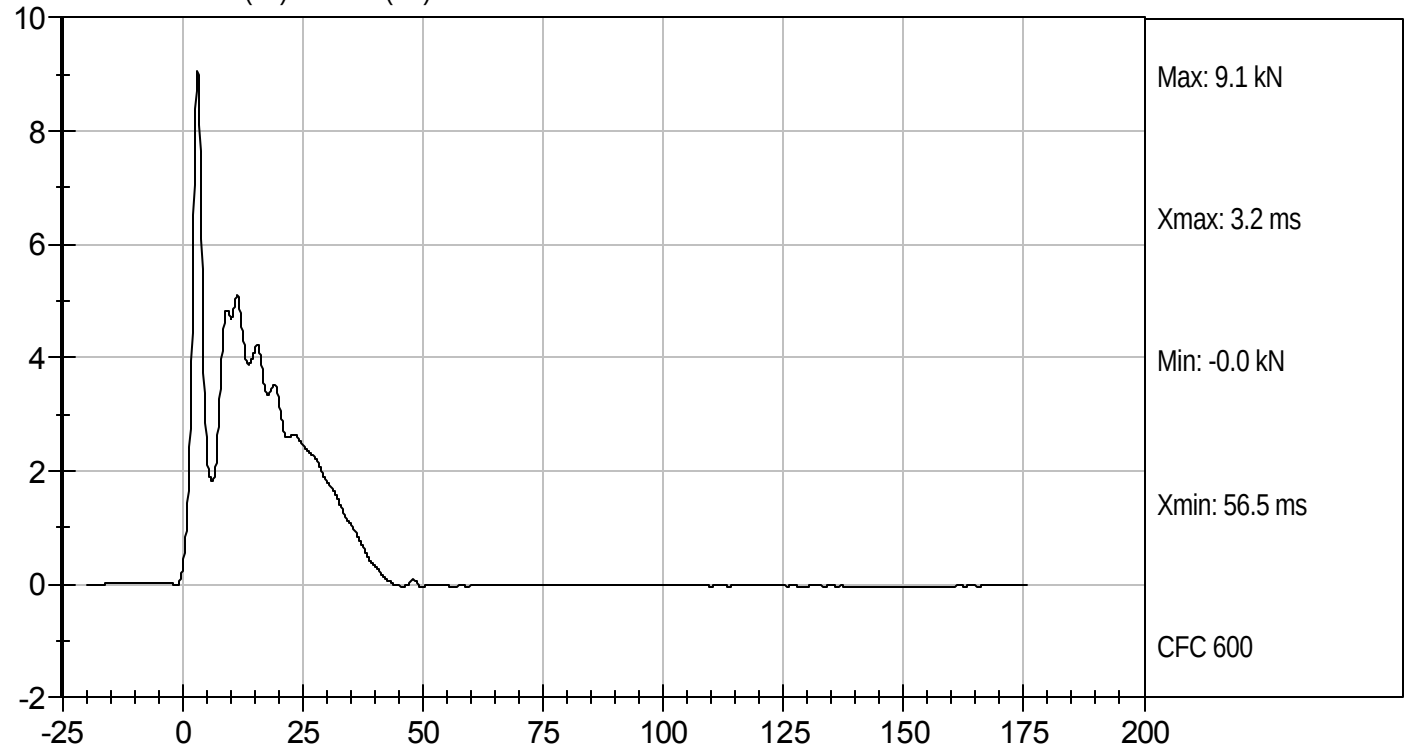
3/28/11
Test Date

David Winkelbauer
Approved By

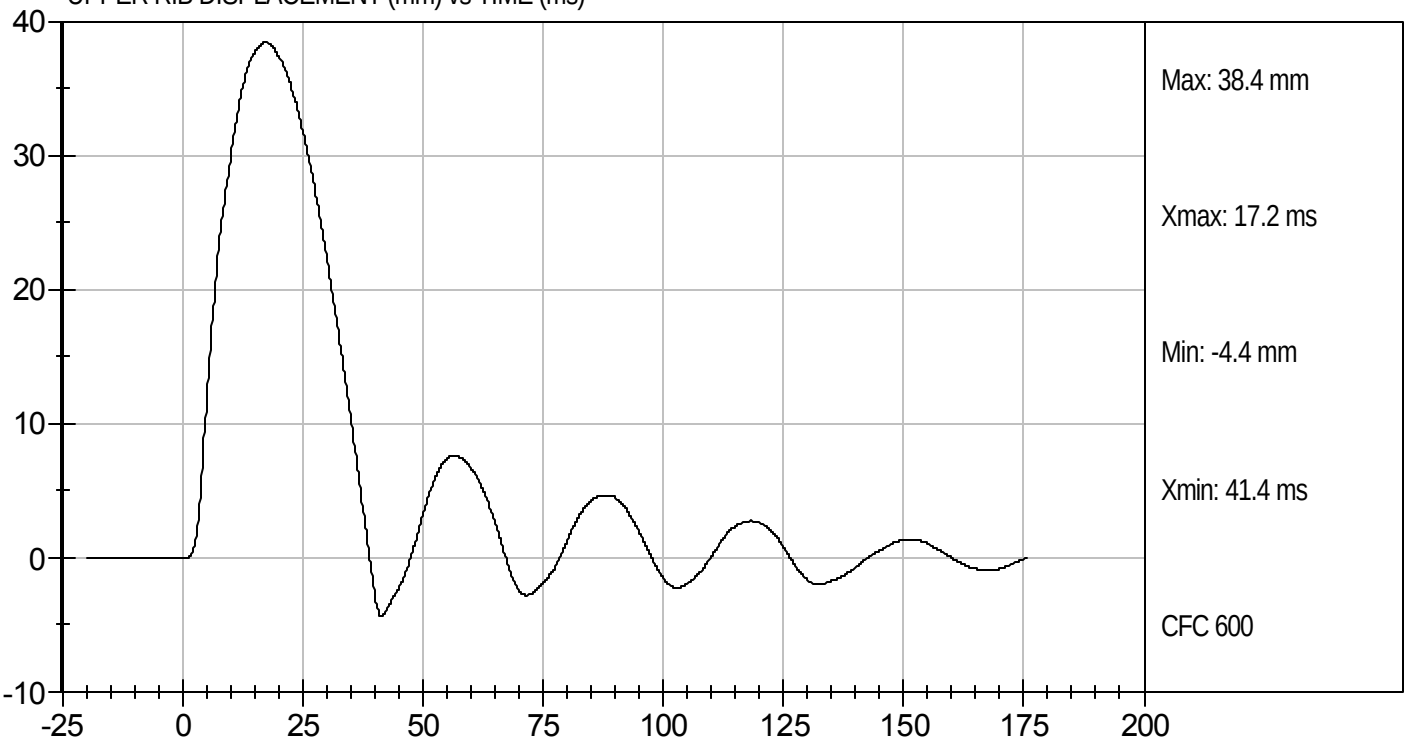
Test Desc: Thorax Impact
Component ID: D111140

Test Date: 3/28/11
Velocity: 18.32 ft/s, 5.58 m/s

PROBE FORCE (kN) vs TIME (ms)



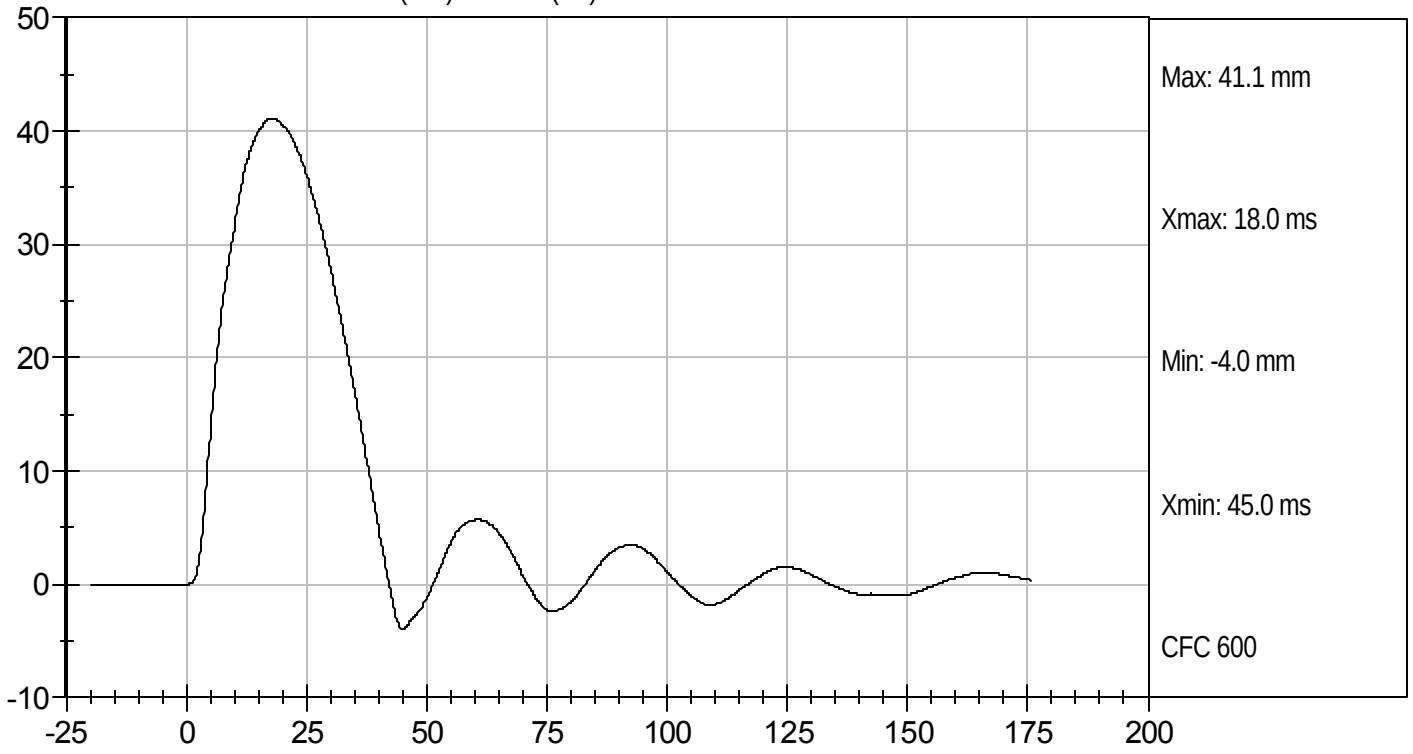
UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



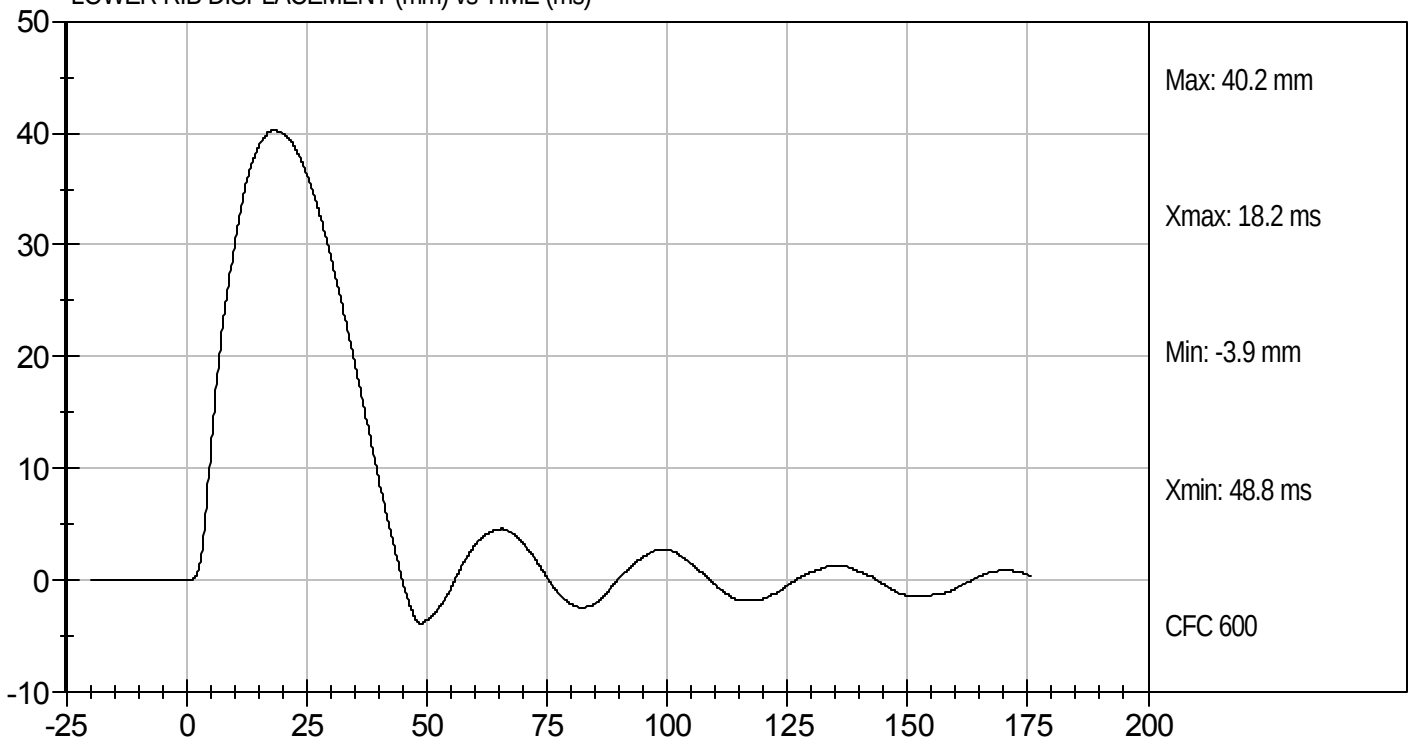
Test Desc: Thorax Impact
Component ID: D111140

Test Date: 3/28/11
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:** D111231

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	18.9 to 25.6	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Peak Resultant Acceleration	G's	125 to 155	139	Pass
Peak Lateral Acceleration	G's	+/- 15	6.5	Pass
Unimodal	N/A	Yes	Yes	Pass
Oscillations	N/A	within 15% of peak	Yes	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

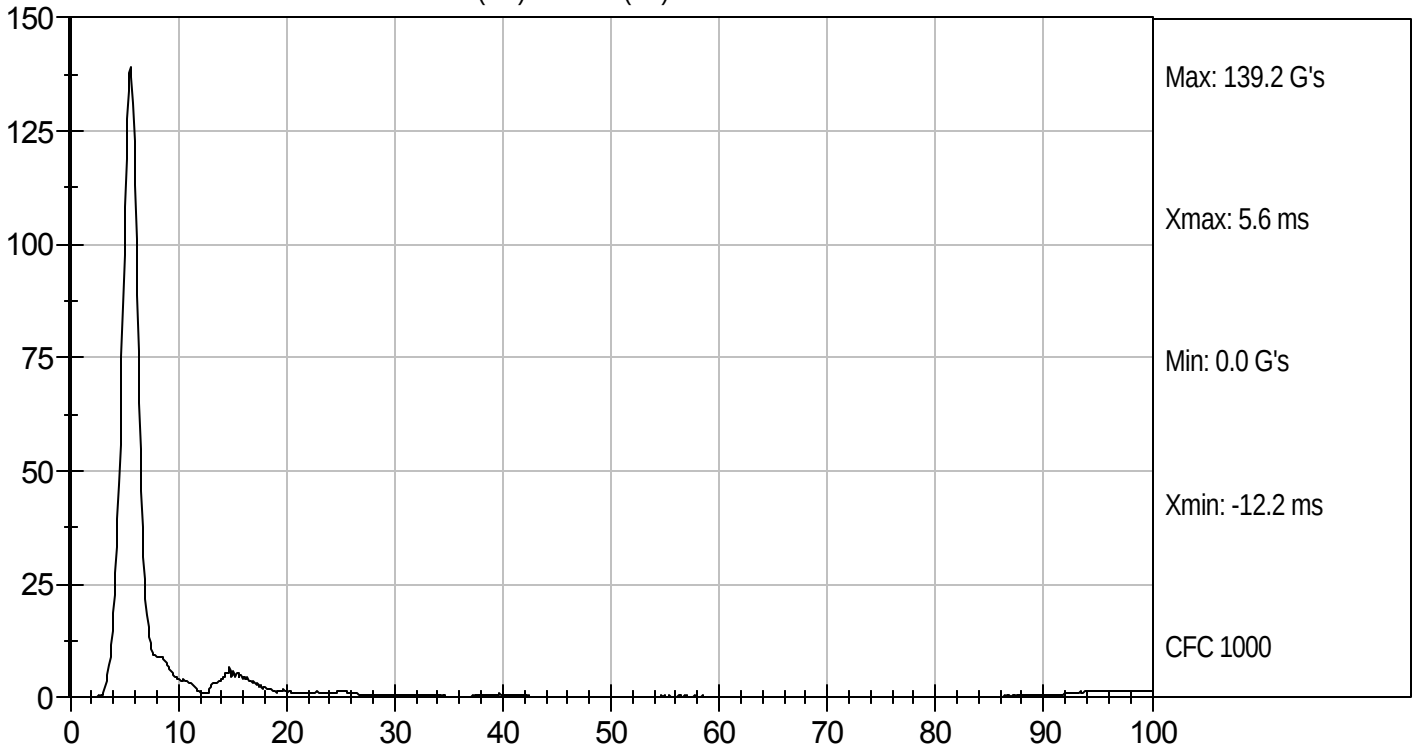
3/31/11
Test Date

David Winkelbauer
Approved By

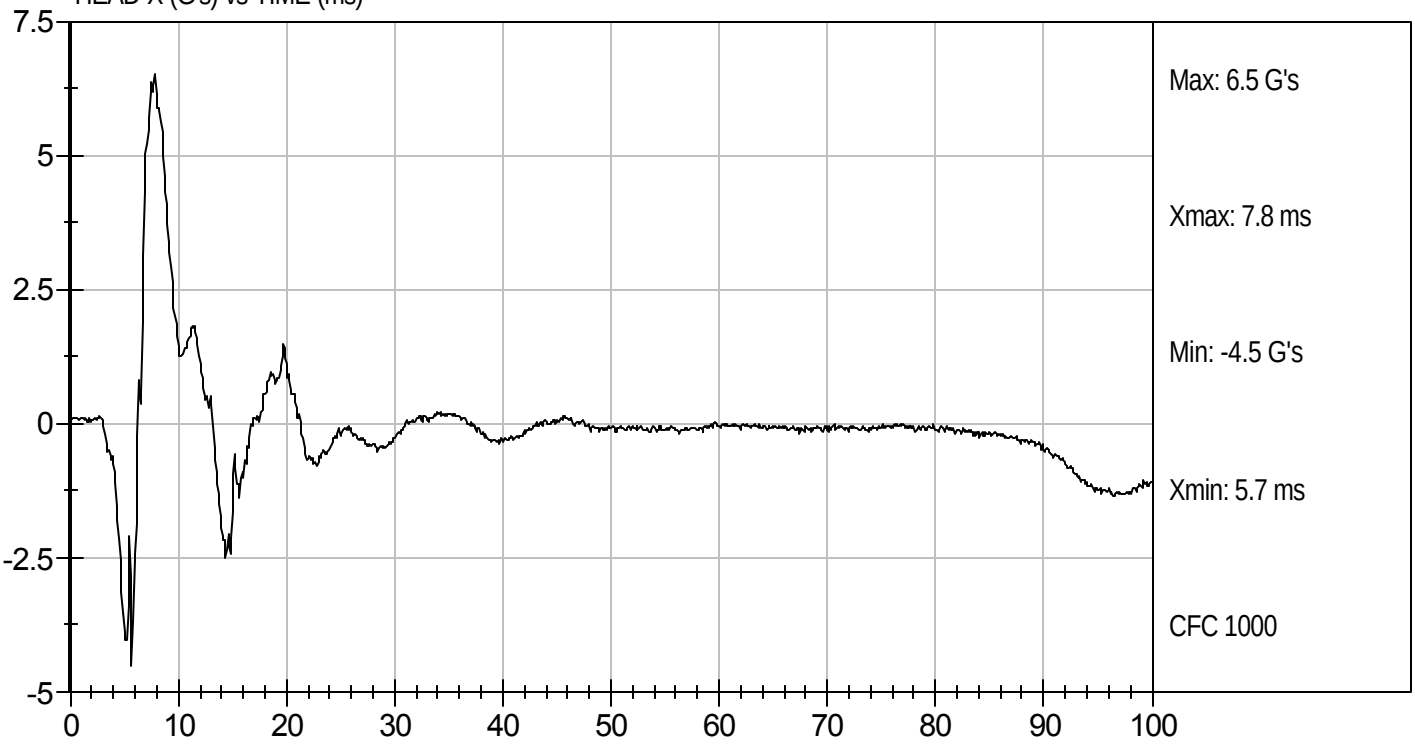
Test Desc: Head Drop
Component ID: D111231

Test Date: 3/31/11
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:** D111232

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	18.0 to 22.0	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	17	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	-3.38	Pass
Maximum Flexion Angle		deg	49.0 to 59.0	50.0	Pass
Time of Maximum Flexion Angle		ms	54.0 to 66.0	59.5	Pass
Head Rotation Decay Time to 0 degree		ms	53.0 to 88.0	61.7	Pass
			Overall Test Results		Pass

Jessica Hall
Laboratory Technician

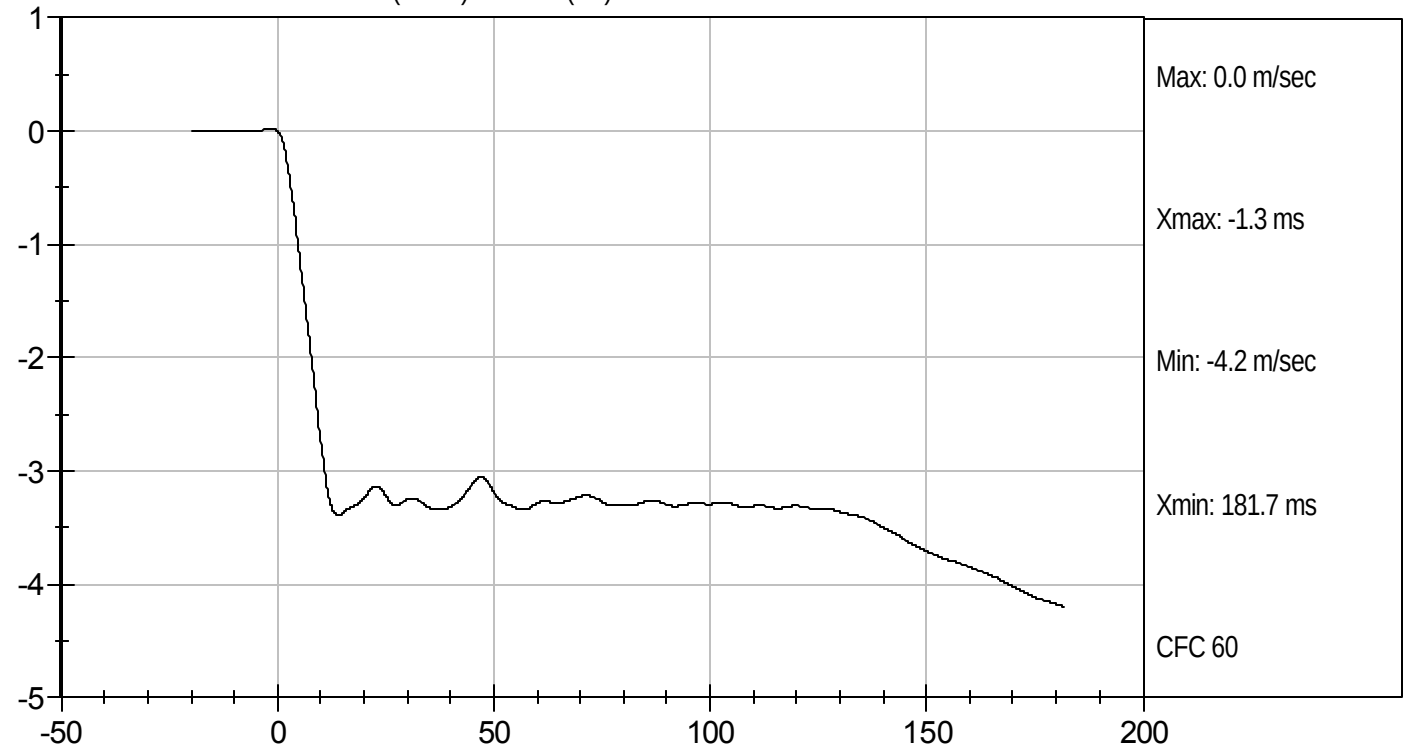
3/31/11
Test Date

David Winkelbauer
Approved By

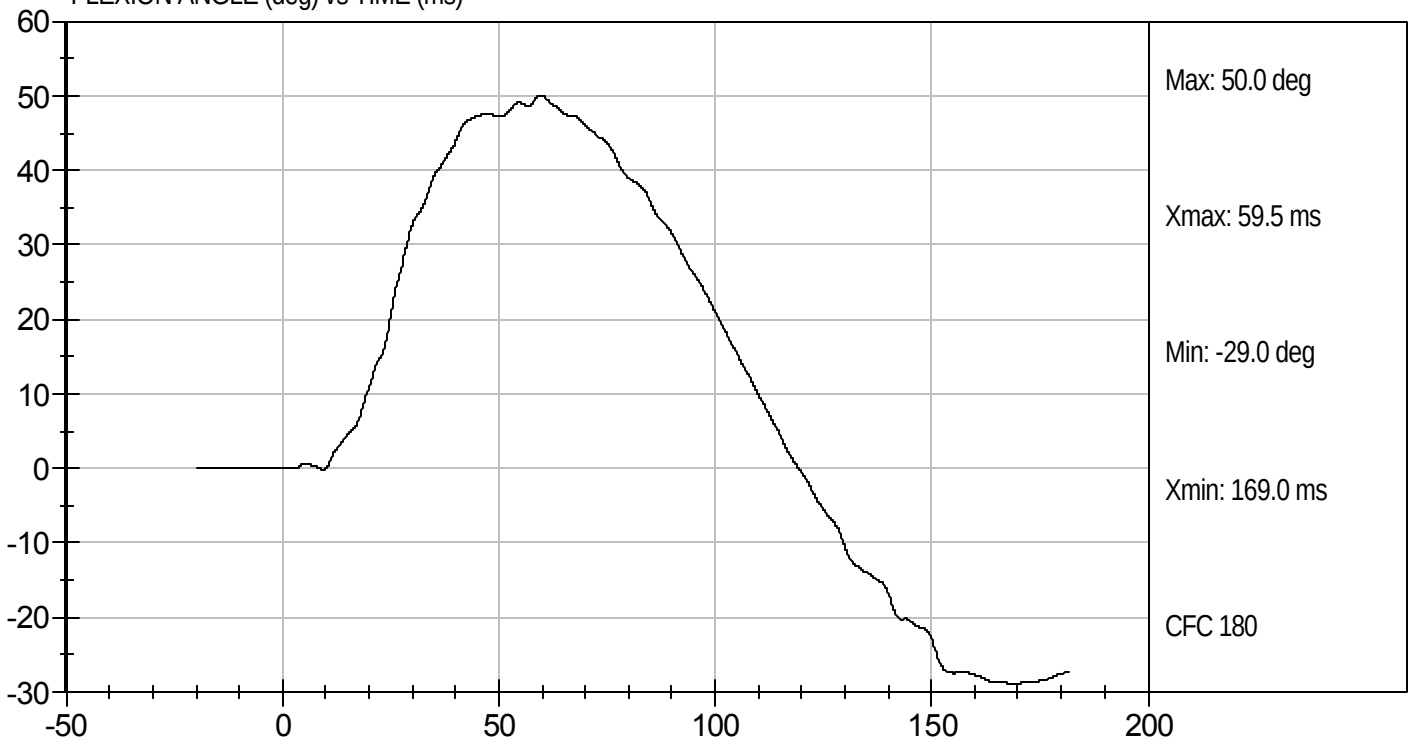
Test Desc: Neck Bending
Component ID: D111232

Test Date: 3/31/11
Velocity: 11.42 ft/s, 3.5 m/s

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

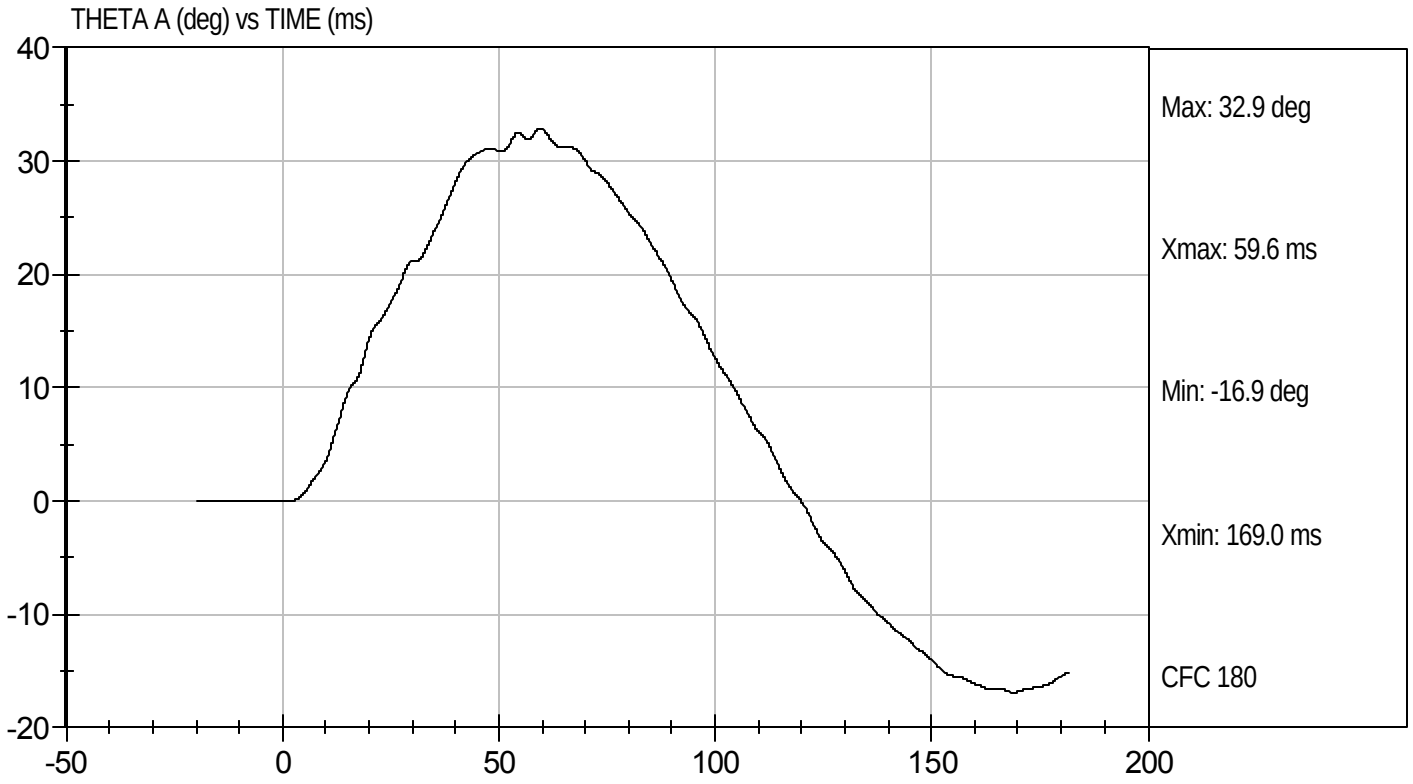


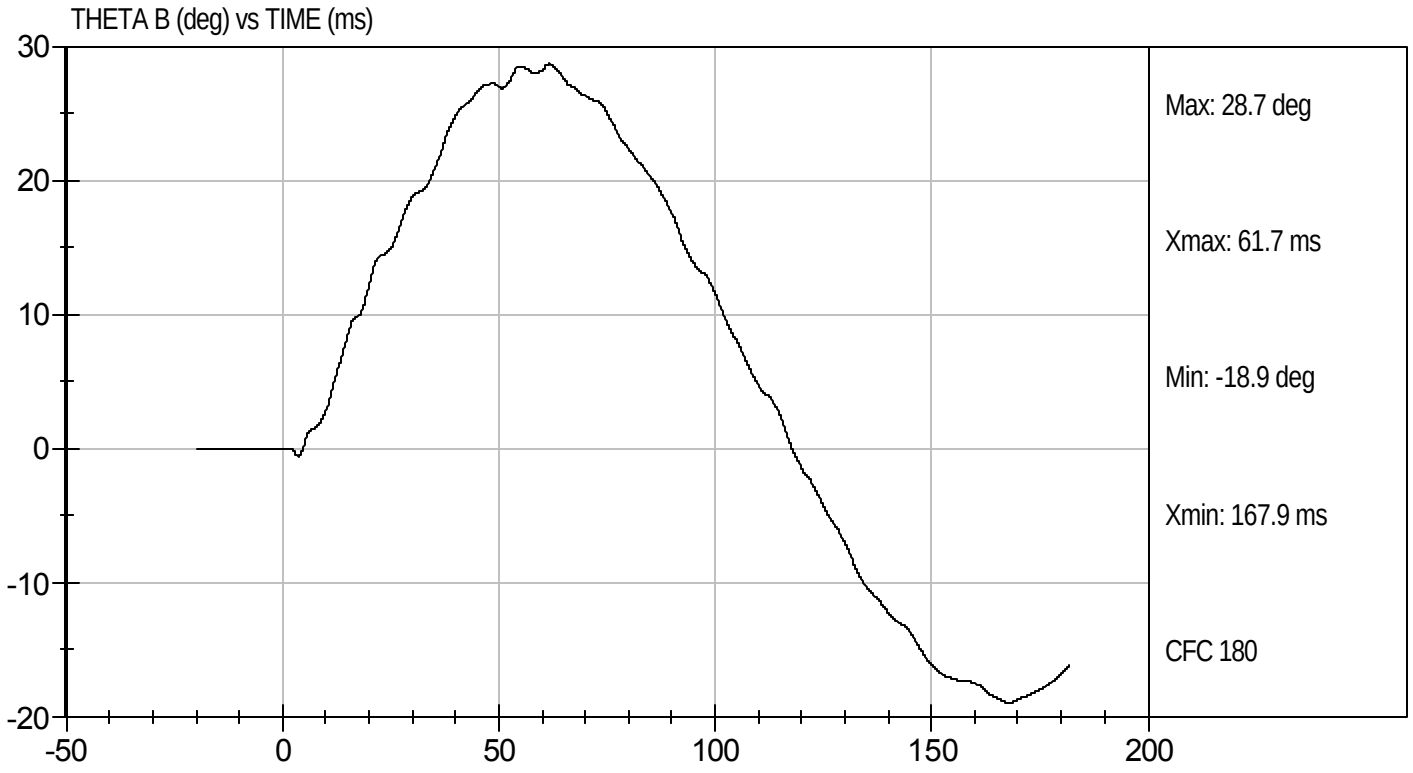
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Neck Bending
Component ID: D111232

Test Date: 3/31/11
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:** D111233

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Pendulum Speed	m/s	4.2 to 4.4	4.3	Pass
Peak Shoulder Acceleration	G's	7.5 to 10.5	9.2	Pass
Time of Peak Shoulder Acceleration	ms	NA	18.0	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

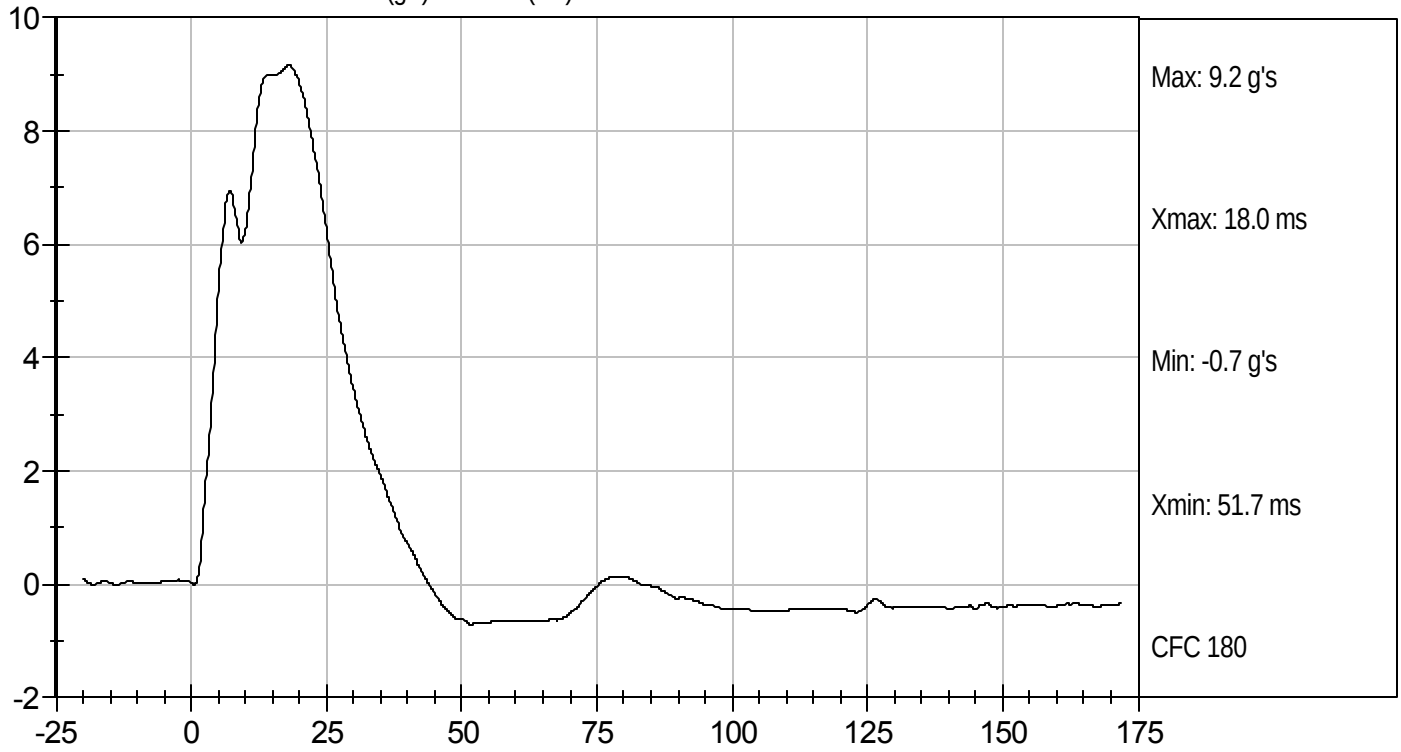
3/31/11
Test Date

David Winkelbauer
Approved By

Test Desc: Shoulder Impact
Component ID: D111233

Test Date: 3/31/11
Velocity: 14.12 ft/s, 4.3 m/s

SHOULDER ACCELERATION (g's) vs TIME (ms)



MGA RESEARCH CORPORATION

UPPER RIB TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D111234

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	17	Pass
Displacement at 3 m/s	mm	36.0 to 40.0	38.5	Pass
Displacement at 4 m/s	mm	46.0 to 51.0	48.5	Pass
		Overall Test Results		Pass

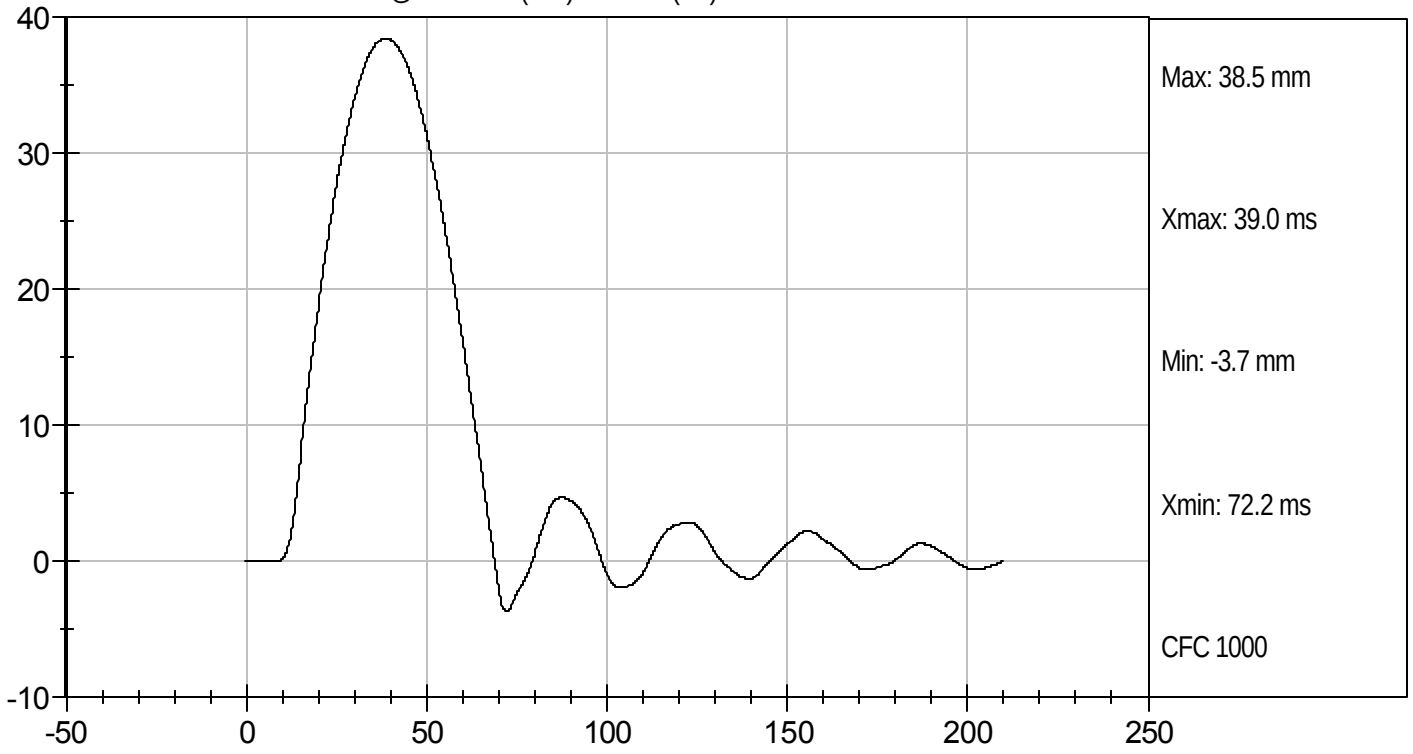
Jessica Gall
Laboratory Technician

3/31/11
Test Date

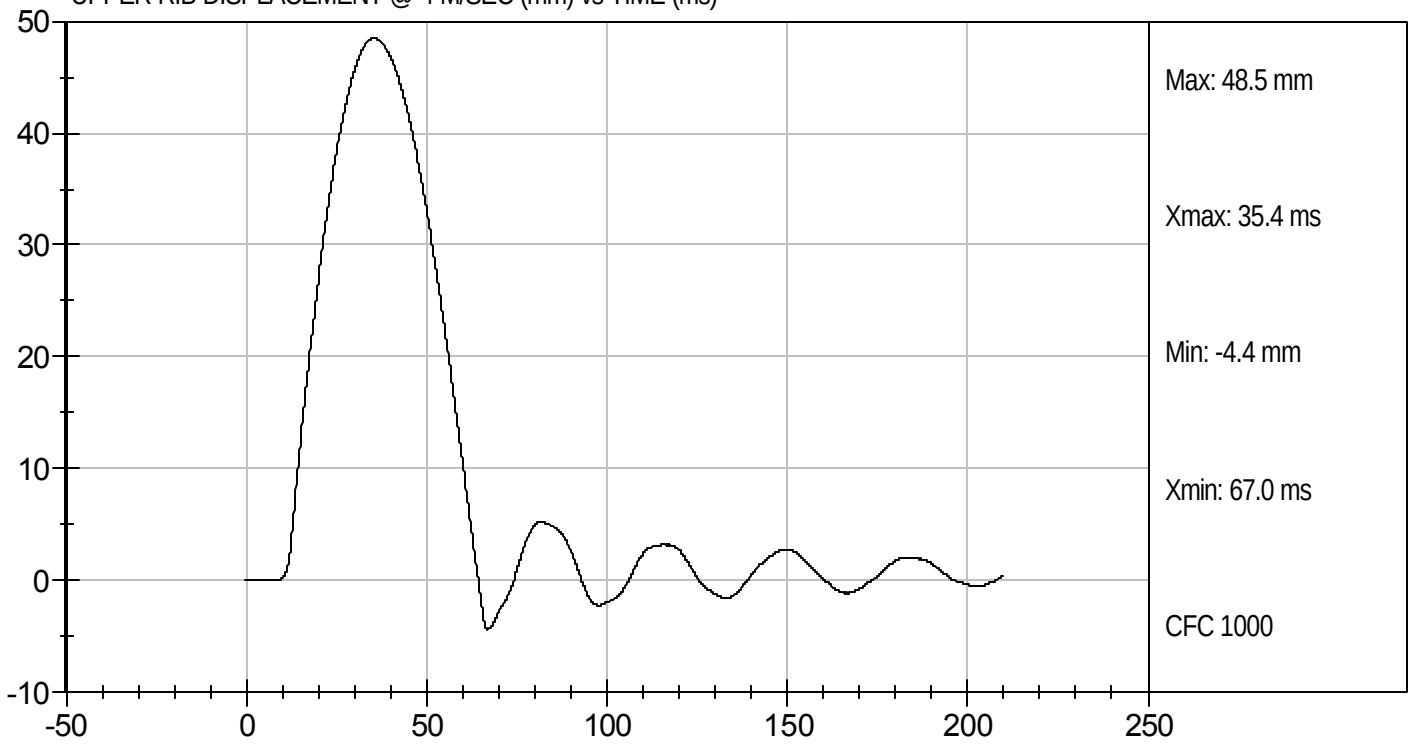
David Winkelbauer
Approved By

Test Desc: Rib Impact - Upper
Component ID: D111234
Test Date: 3/31/11

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:** D111235

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	17	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	49.5	Pass
		Overall Test Results		Pass

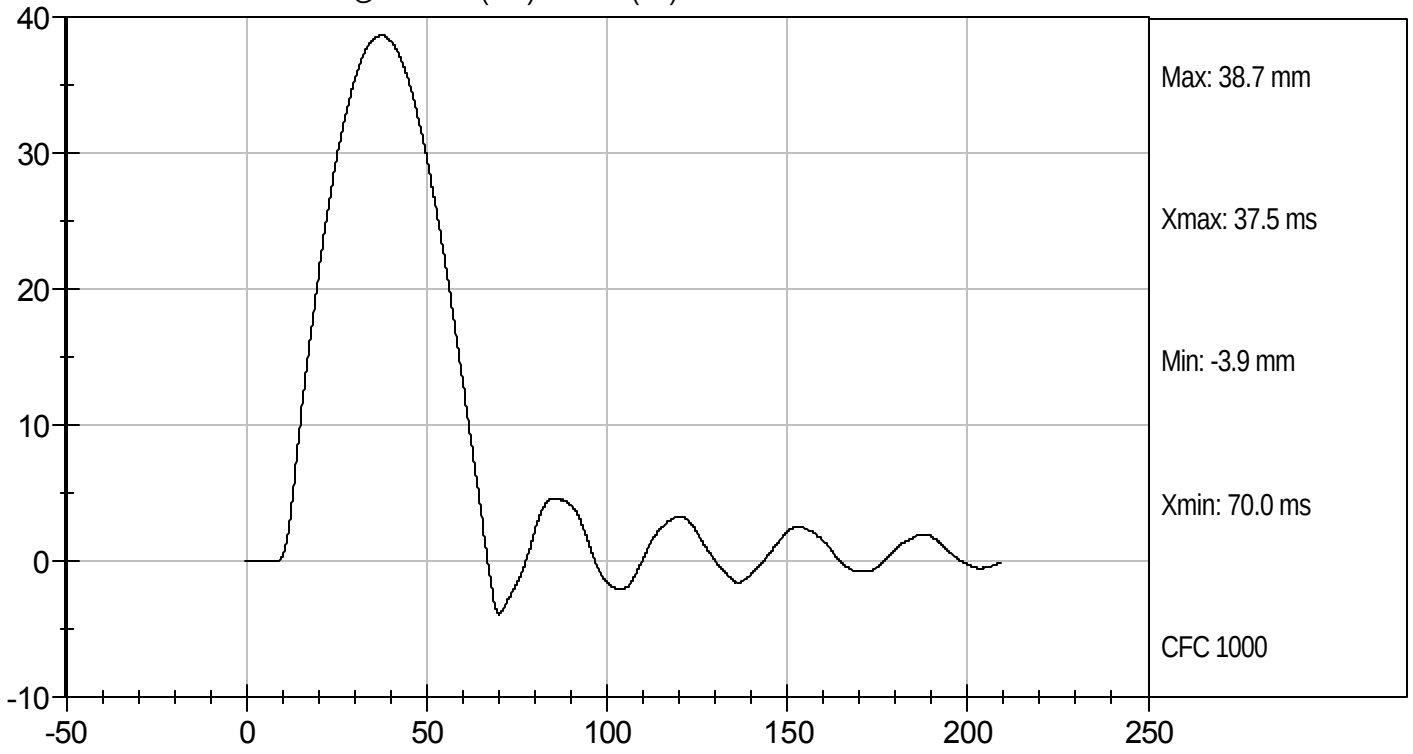
Jessica Hall
Laboratory Technician

3/31/11
Test Date

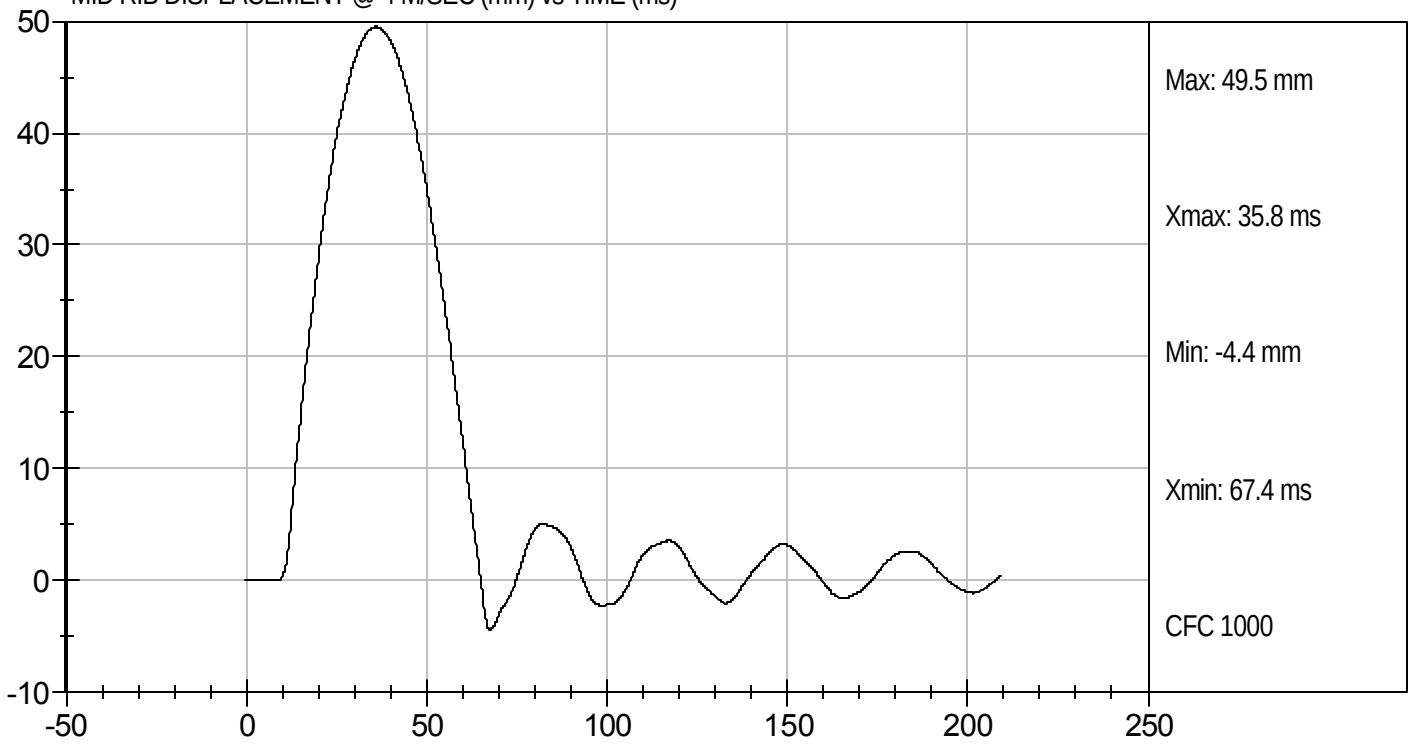
David Winkelbauer
Approved By

Test Desc: Rib Impact - Mid
Component ID: D111235
Test Date: 3/31/11

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:** D111236

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity	%	10 to 70	17	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	49.0	Pass
		Overall Test Results		Pass

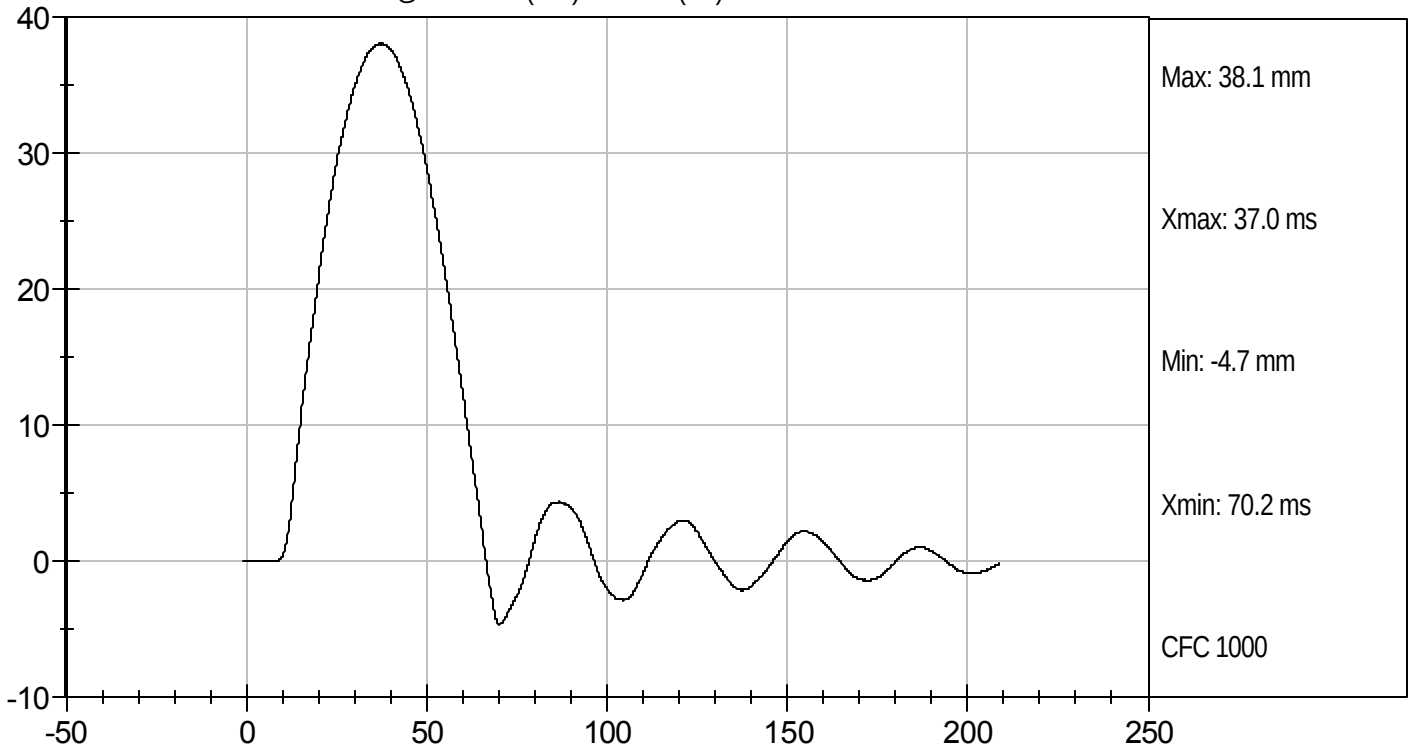
Jessica Gall
Laboratory Technician

3/31/11
Test Date

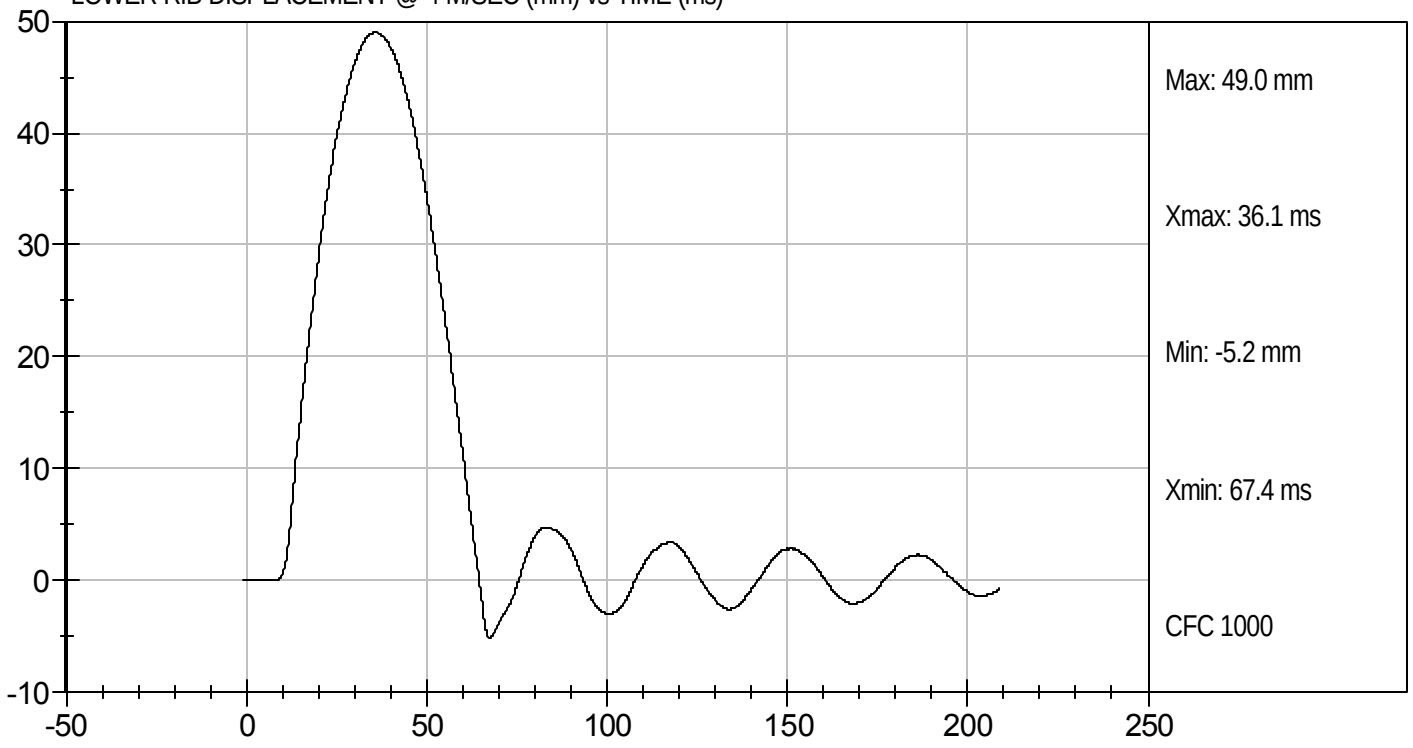
David Winkelbauer
Approved By

Test Desc: Rib Impact - Lower
Component ID: D111236
Test Date: 3/31/11

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:** D111237

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	17	Pass
Probe Speed	m/s	3.90 to 4.10	4.06	Pass
Maximum Impact Force	kN	4.00 to 4.80	4.42	Pass
Time of Maximum Impactor Force	ms	10.60 to 13.00	10.80	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	10.40	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

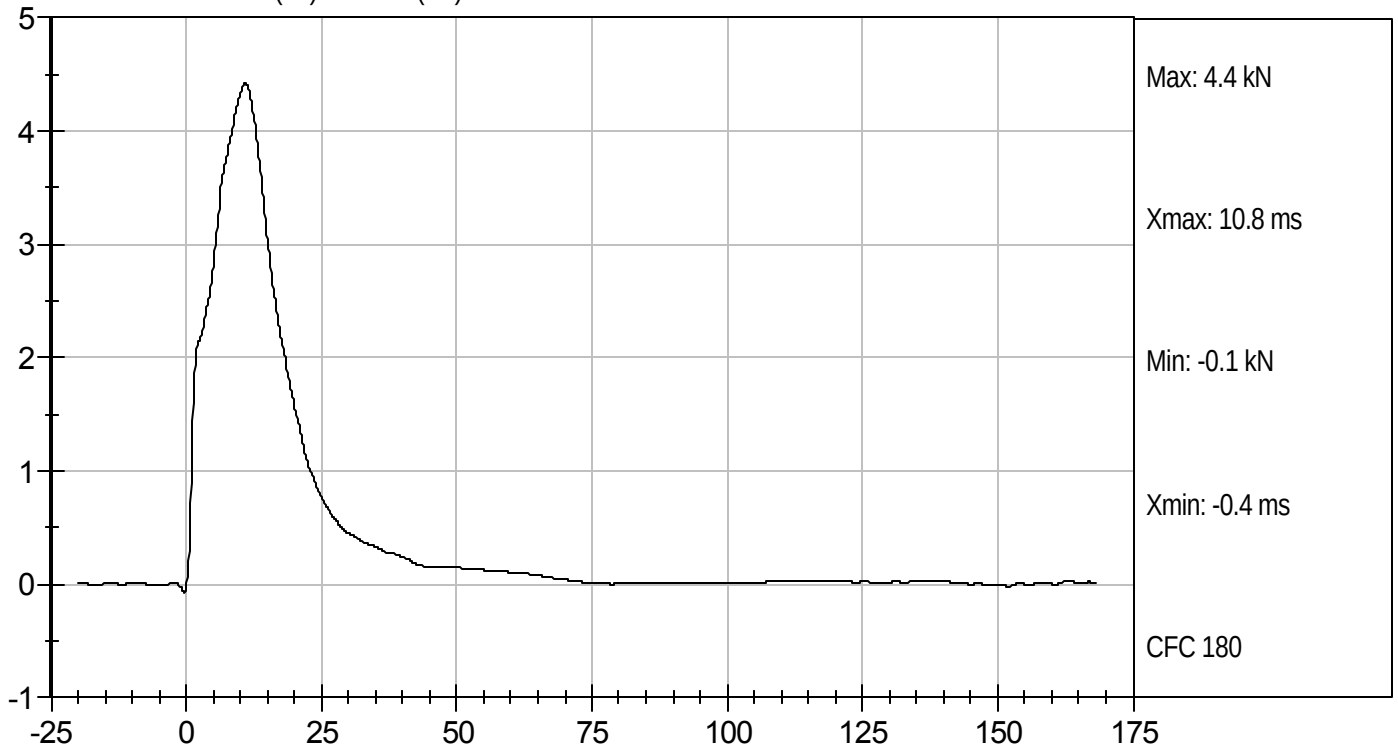
3/31/11
Test Date

David Winkelbauer
Approved By

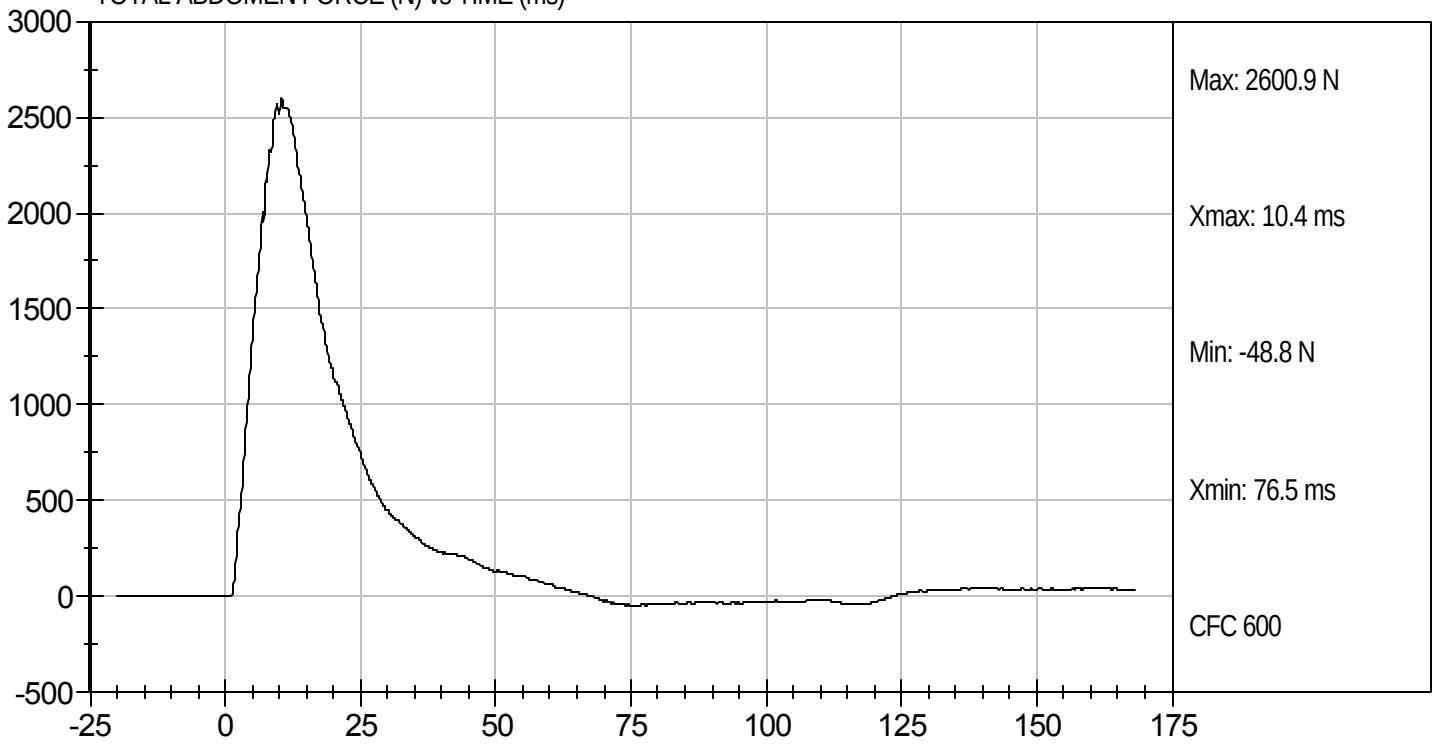
Test Desc: Abdomen Impact
Component ID: D111237

Test Date: 3/31/11
Velocity: 13.33 ft/s, 4.06 m/s

IMPACTOR FORCE (kN) vs TIME (ms)



TOTAL ABDOMEN FORCE (N) vs TIME (ms)



MGA RESEARCH CORPORATION

LUMBAR SPINE TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D111238

Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		deg C	20.6 to 22.2	21.8	Pass
Laboratory Relative Humidity		%	10 to 70	17	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	-5.84	Pass
	30 ms	m/s	>= -6.5	-6.05	Pass
Maximum Flexion Angle		deg	45.0 to 55.0	46.2	Pass
Time of Maximum Flexion Angle		ms	39.0 to 53.0	45.8	Pass
Headform Rotation Decay to Initial Position		ms	37 to 57	45	Pass
			Overall Results		Pass

Jessica Hall
Laboratory Technician

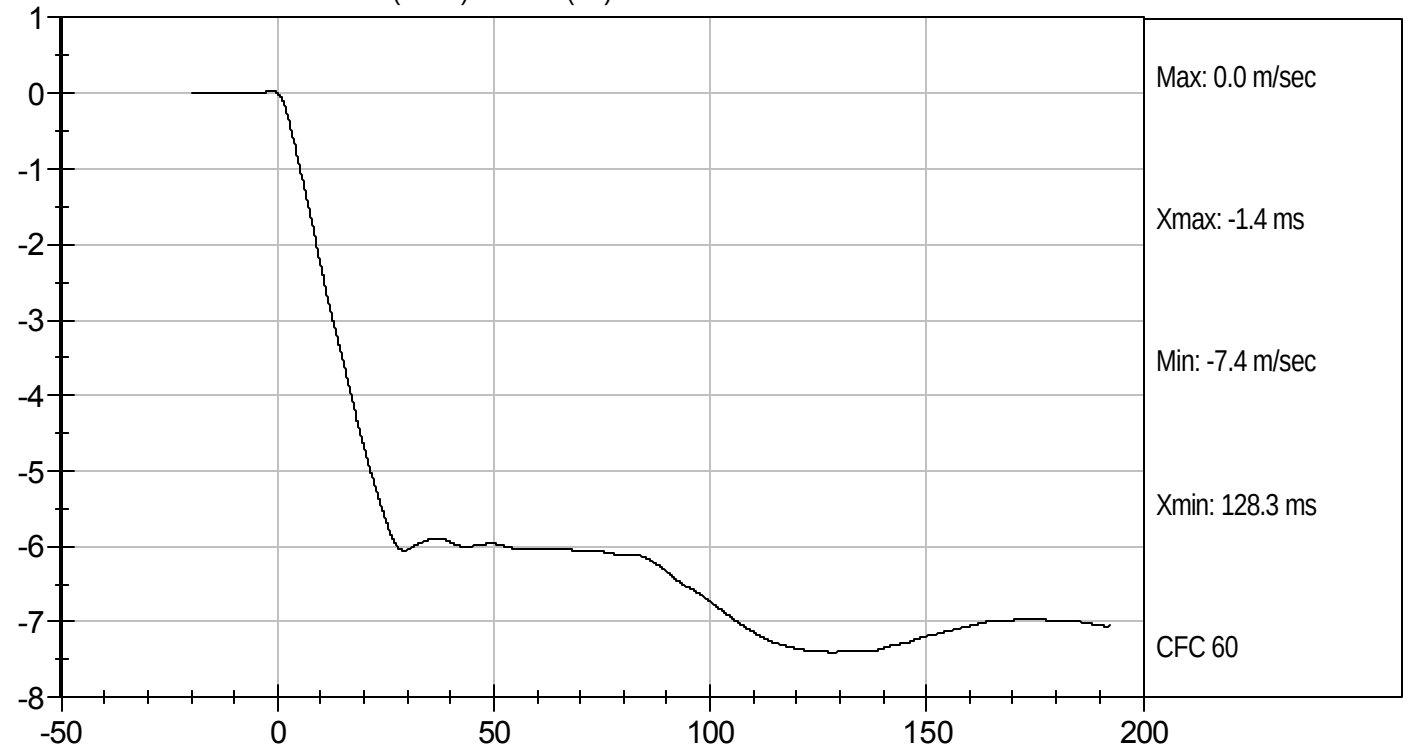
3/31/11
Test Date

David Winkelbauer
Approved By

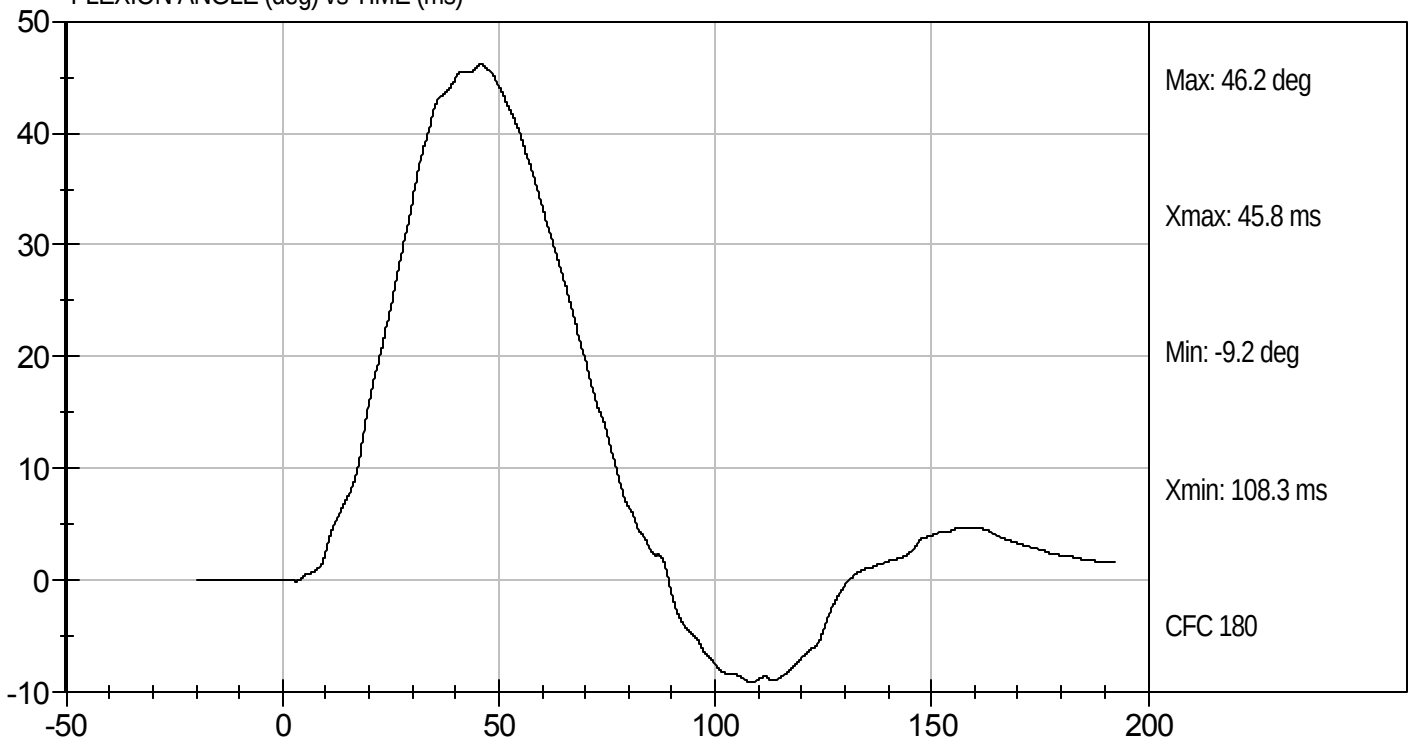
Test Desc: Lumbar Bending
Component ID: D111238

Test Date: 3/31/11
Velocity: 20.08 ft/s, 6.12 m/s

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

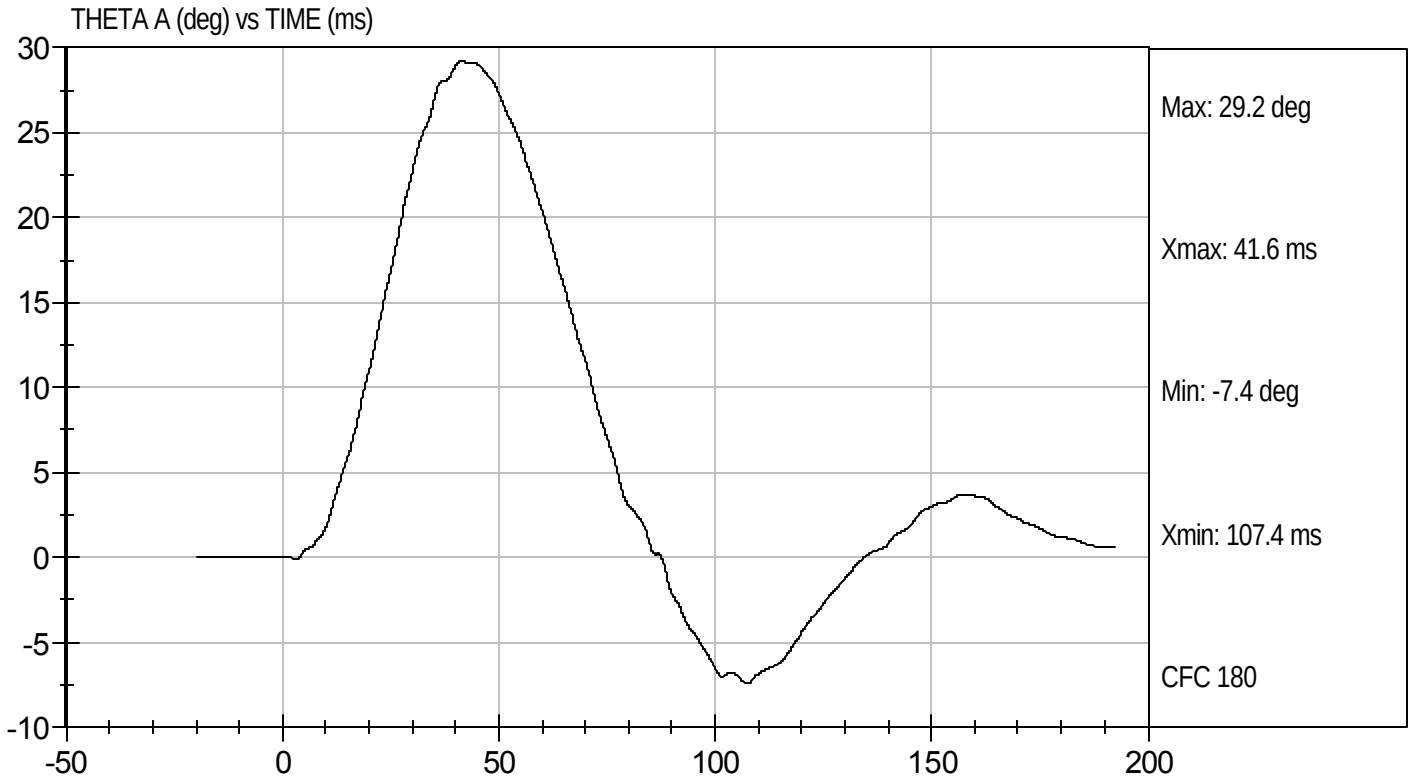


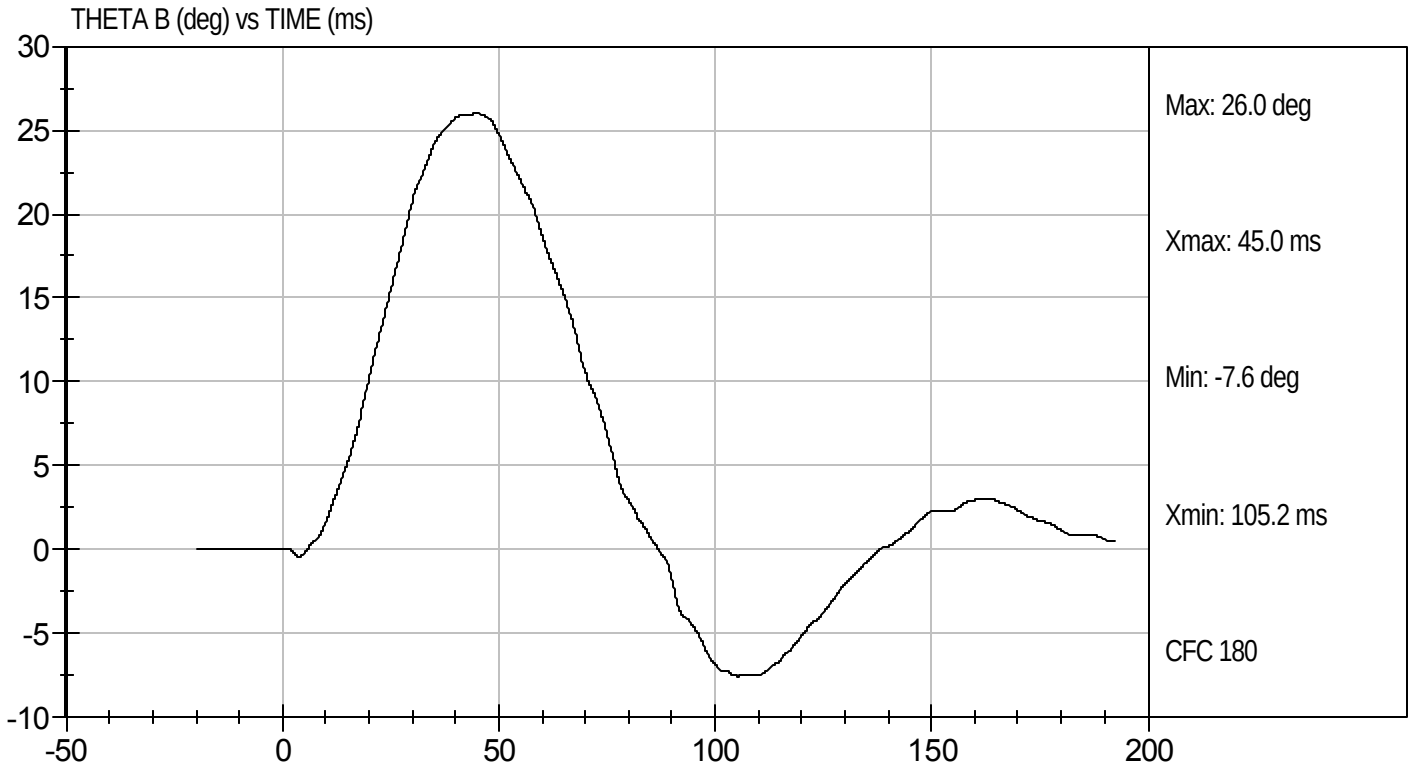
FLEXION ANGLE (deg) vs TIME (ms)



Test Desc: Lumbar Bending
Component ID: D111238

Test Date: 3/31/11
Velocity: 20.08 ft/s, 6.12 m/s





MGA RESEARCH CORPORATION

PELVIS TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D111239

Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	deg C	20.6 to 22.2	22.1	Pass
Laboratory Relative Humidity	%	10 to 70	18	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	13.20	Pass
Maximum Pubic Force	kN	1.23 to 1.59	1.42	Pass
Time of Maximum Pubic Force	ms	12.20 to 17.00	15.20	Pass
		Overall Test Results		Pass

Jessica Hall
Laboratory Technician

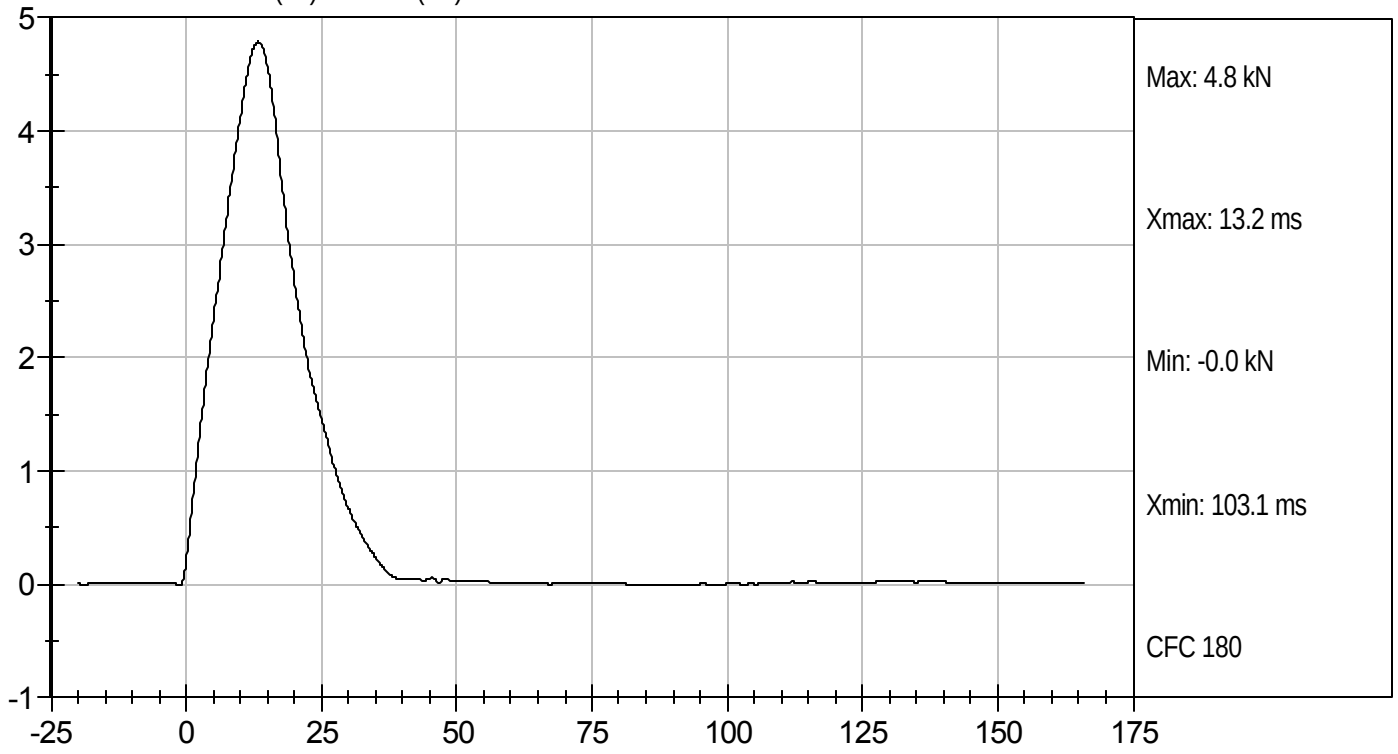
3/31/11
Test Date

David Winkelbauer
Approved By

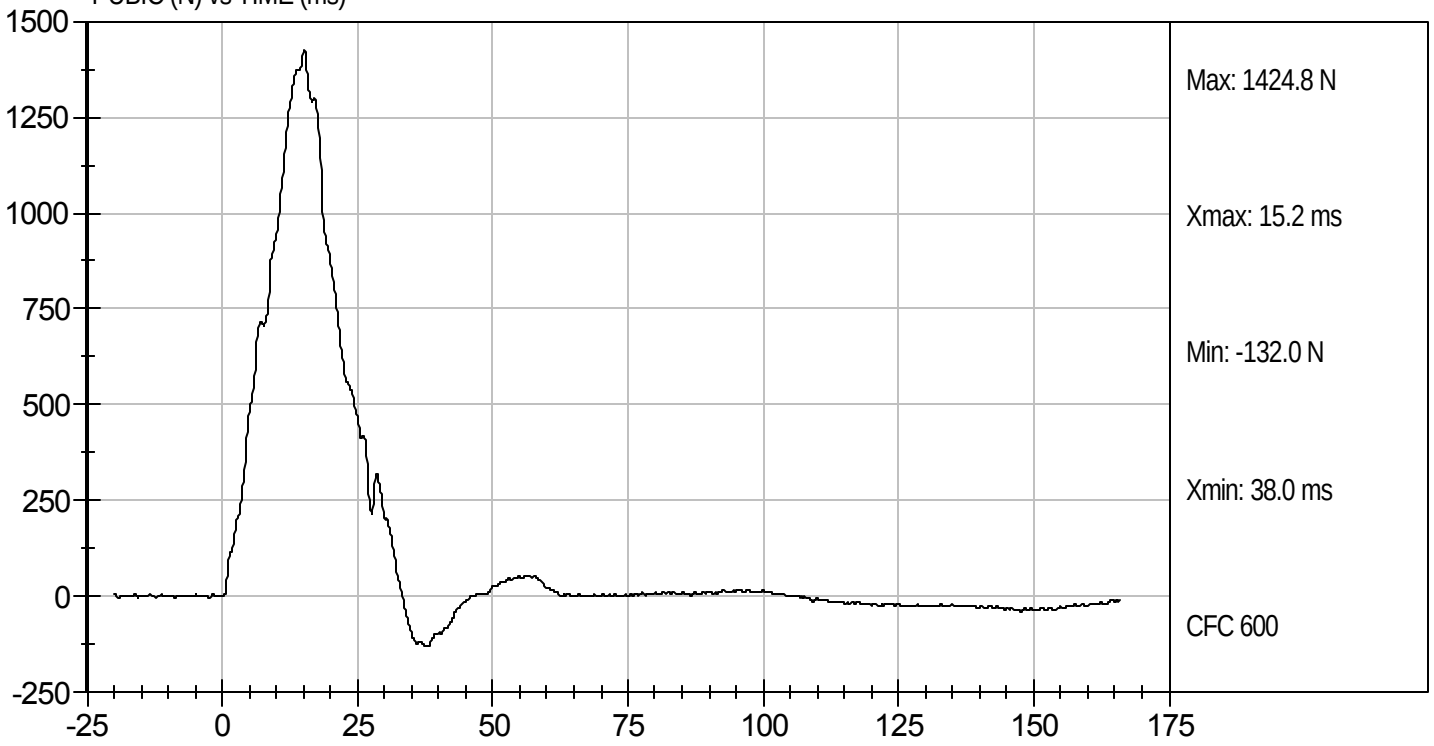
Test Desc: Pelvis Impact
Component ID: D111239

Test Date: 3/31/11
Velocity: 14.25 ft/s, 4.34 m/s

IMPACTOR FORCE (kN) vs TIME (ms)



PUBIC (N) vs TIME (ms)



MGA RESEARCH CORPORATION

FULL BODY THORAX IMPACT TEST

ES-2re DUMMY

ATD Serial No: 016 **Test I.D:** D111230

Tested Parameter	Units	Specification	Result	Pass/Fail
Temperature	deg C	20.6 to 22.2	22.0	Pass
Humidity	%	10 to 70	18	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	5.11	Pass
Upper Rib Displacement	mm	34.0 to 41.0	38.4	Pass
Middle Rib Displacement	mm	37.0 to 45.0	41.1	Pass
Lower Rib Displacement	mm	37.0 to 44.0	40.7	Pass
		Overall Test Results		Pass

Jessica Gall
Laboratory Technician

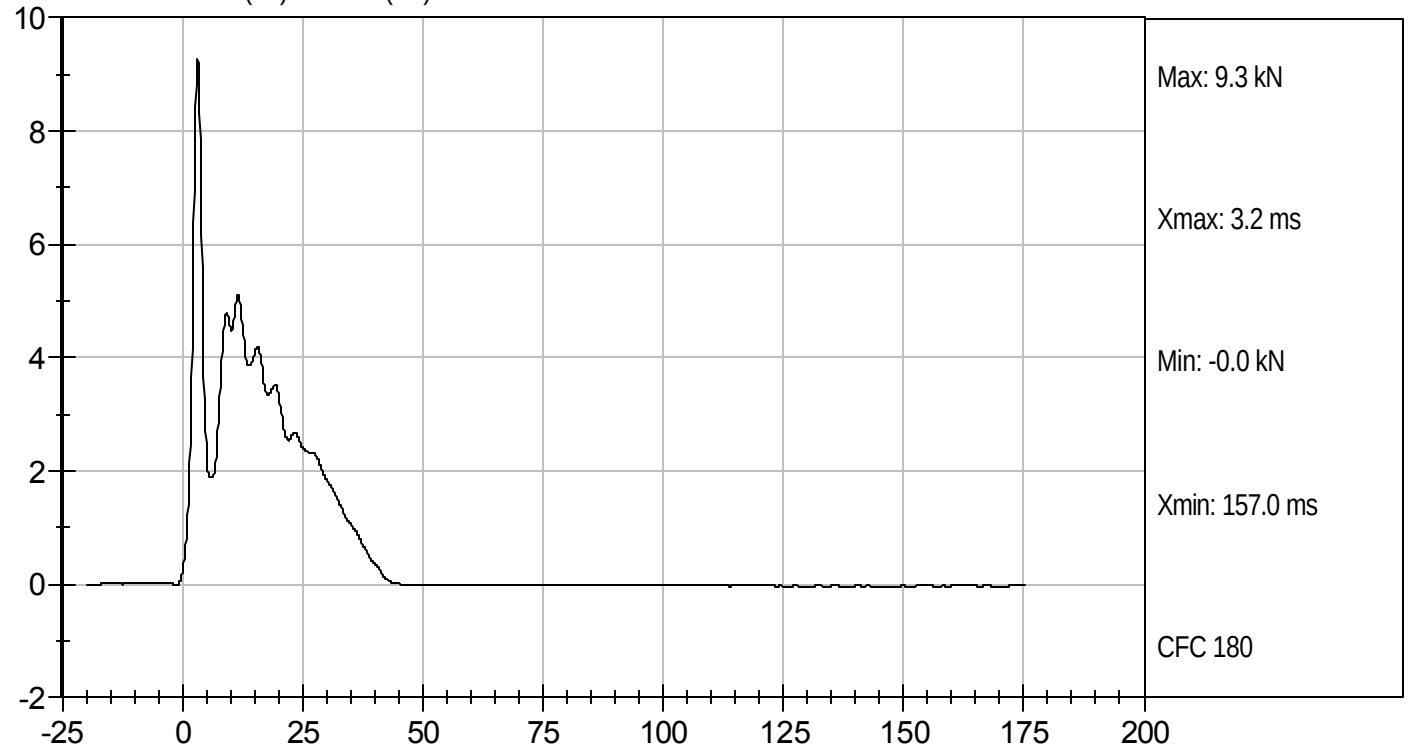
3/31/11
Test Date

David Winkelbauer
Approved By

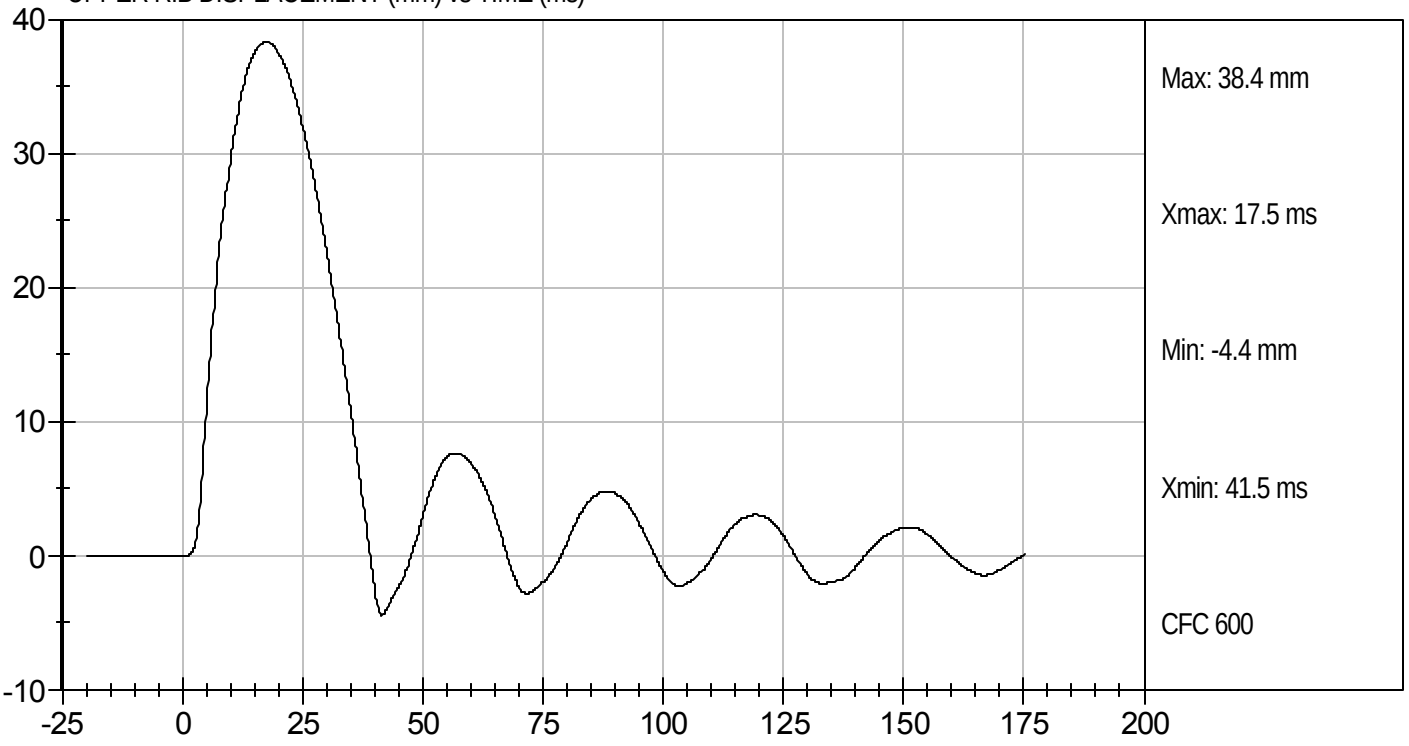
Test Desc: Thorax Impact
Component ID: D111230

Test Date: 3/31/11
Velocity: 18.32 ft/s, 5.58 m/s

PROBE FORCE (kN) vs TIME (ms)



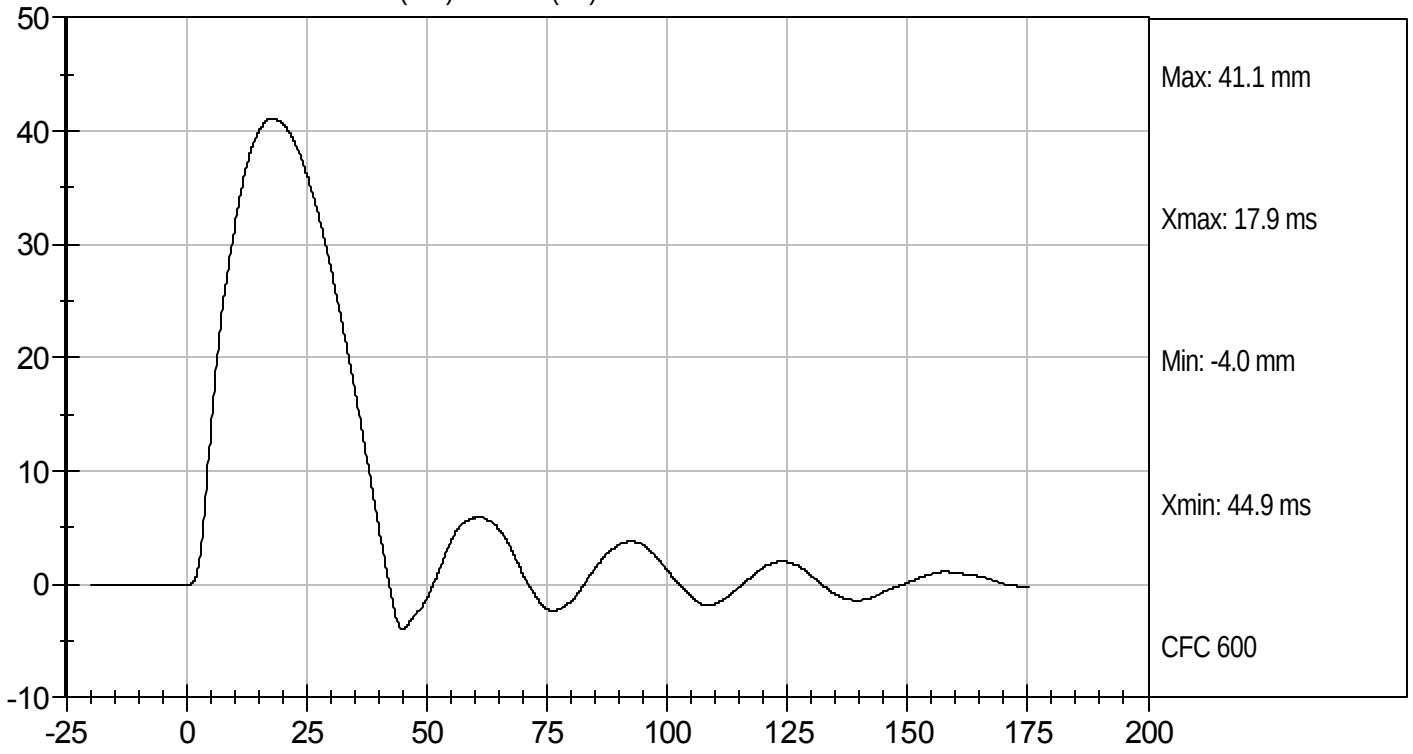
UPPER RIB DISPLACEMENT (mm) vs TIME (ms)



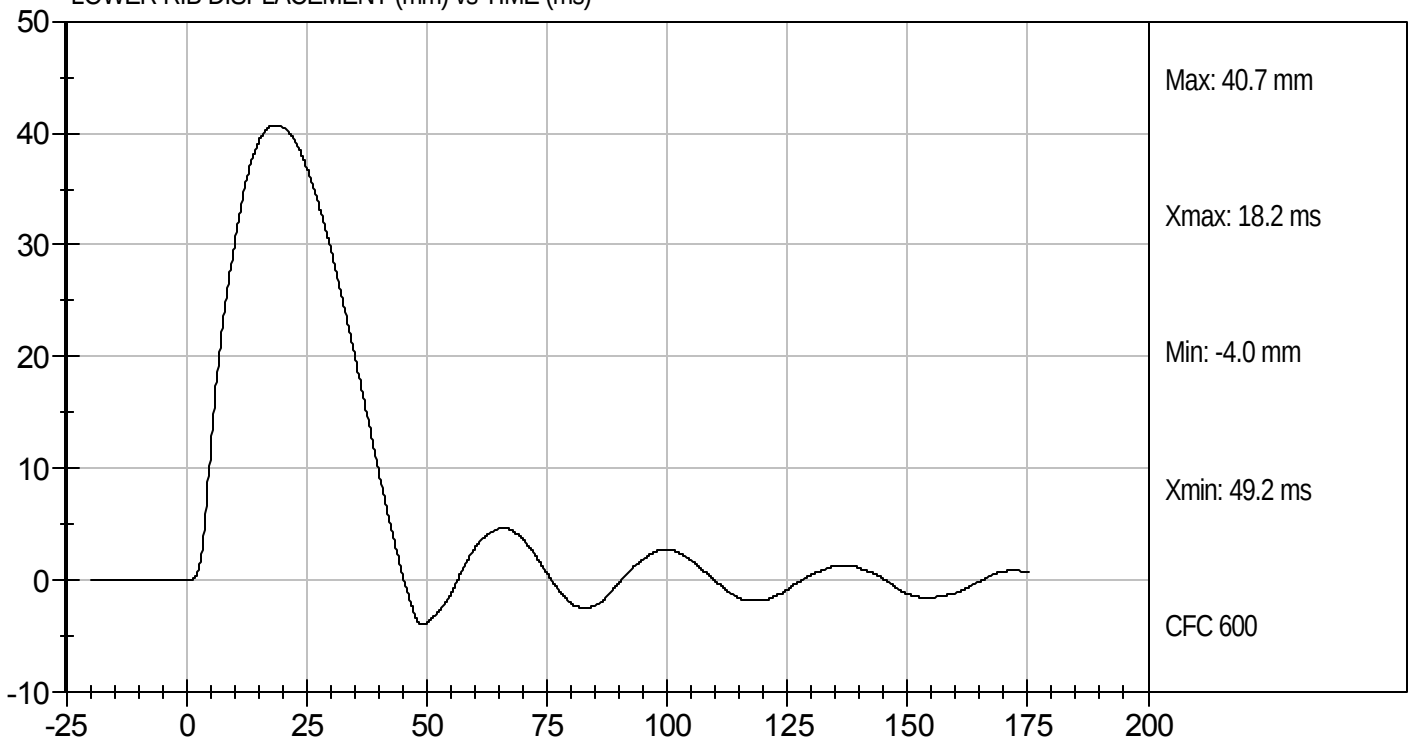
Test Desc: Thorax Impact
Component ID: D111230

Test Date: 3/31/11
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	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)	P49457	Endevco	12/03/2010
Vehicle CG (Y)	P49456	Endevco	12/03/2010
Vehicle CG (Z)	P49455	Endevco	12/03/2010
Left Floor Sill (Y)	P59626	Endevco	2/19/2011
A Pillar Sill (Y)	P49447	Endevco	11/05/2010
A Pillar Low (Y)	P52177	Endevco	12/22/2010
A Pillar Mid (Y)	P49443	Endevco	11/05/2010
B Pillar Sill (Y)	P49497	Endevco	11/05/2010
B Pillar Low (Y)	P59287	Endevco	2/19/2011
B Pillar Mid (Y)	P53288	Endevco	1/13/2011
Seat (Y)	P59251	Endevco	12/13/2010
Engine (X)	P52277	Endevco	12/03/2010
Engine (Y)	P52278	Endevco	12/03/2010
Firewall (Y)	P49469	Endevco	12/13/2010
Roof (Y)	P52226	Endevco	11/05/2010
Floor Sill (Y)	P59352	Endevco	1/13/2011
Rear Deck (X)	P59398	Endevco	2/19/2011
Rear Deck (Y)	P59399	Endevco	2/19/2011