

REPORT NUMBER: TWG-MGA-2007-009

**NEW CAR ASSESSMENT PROGRAM
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING**

**GM DAEWOO AUTO & TECHNOLOGY COMPANY
2007 CHEVROLET AVEO LS
NHTSA NUMBER: M70103TWG2**

**PREPARED BY:
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BURLINGTON, WI 53105**



Test Date: May 3, 2007

Final Report Date: May 30, 2007

FINAL REPORT

**PREPARED FOR:
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16. Abstract This side impact out-of-position test was performed in conjunction with a New Car Assessment Program (NCAP). This test was conducted at MGA Research Corporation in Burlington, Wisconsin, on May 3, 2007. <table style="margin-left: auto; margin-right: auto; border: none;"> <tr> <td style="text-align: center;">HIC 15</td> <td style="text-align: center;">HIC 36</td> <td style="text-align: center;">NIJ NTF</td> <td style="text-align: center;">NIJ NTE</td> <td style="text-align: center;">NIJ NCF</td> <td style="text-align: center;">NIJ NCE</td> </tr> <tr> <td style="text-align: center;">6.2</td> <td style="text-align: center;">6.6</td> <td style="text-align: center;">0.28</td> <td style="text-align: center;">0.39</td> <td style="text-align: center;">0.20</td> <td style="text-align: center;">0.30</td> </tr> </table>				HIC 15	HIC 36	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE	6.2	6.6	0.28	0.39	0.20	0.30
HIC 15	HIC 36	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE										
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SECTION 1

PURPOSE AND SUMMARY OF TEST

PURPOSE

The purpose of this test was to obtain data in a static out-of-position side airbag deployment. These data constitute part of the general consumer information collected by the New Car Assessment Program (NCAP) sponsored by the National Highway Traffic Safety Administration (NHTSA) under contract number DTNH22-03-D-12005.

SUMMARY

The effects of a torso airbag deployment in a 2007 Chevrolet Aveo with an out-of-position SID-IIs Build Level D were evaluated. The test was performed by MGA Research Corporation on May 3, 2007. Pre and post test photographs of the vehicle and dummy can be found in Appendix A.

One real-time camera (24 fps) and three high-speed cameras (1000 fps) were used to document the side airbag deployment event. The following camera locations were used:

- Left Side Through Removed Driver Door
- Front Through Windshield
- Left Side $\frac{3}{4}$ View Through Windshield

One SID-IIs Build Level D dummy (Serial Number 032) was placed in the right front passenger seat situated in the inboard-facing position per Section 3.3.3.6 according to dummy placement instructions specified in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as prepared by the Side Airbag Out-of-Position Injury Technical Working Group (TWG).

The dummy was instrumented with the following instrumentation:

- Head Accelerations
- Upper Neck Load Cell
- Lower Neck Load Cell
- Upper Spine Accelerations
- Lower Spine Accelerations
- Rib Displacements
- Rib Accelerations
- Spine Box Accelerations
- Pelvic Accelerations

The 43 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy data traces. Appendix C contains the instrumentation calibration data.

The SID-IIs dummy's visible contact points were as follows: The torso bag to the left shoulder and torso of the dummy.

The SID-IIs dummy was placed in the right front passenger seat facing toward the center of the vehicle with its arm against the seatback. The dummy's pelvis was adjusted until the dummy contacted the door trim panel. The arm was rotated to a horizontal orientation. The dummy's pelvis was then adjusted forward/rearward, with respect to the vehicle, to lean the dummy rearward to align the center of the first thoracic rib with the top edge of the airbag module. The dummy's spine was aligned such that a vertical plane through the centerline of the dummy's shoulder rib stiffener and shoulder bolt was parallel to the longitudinal plane of the vehicle. Masking tape was wrapped around the dummy's neck bracket to hold the dummy in place, if necessary.

This orientation complies with Section 3.3.3.6 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags as defined by Lund, et al and the Technical Working Group First Revision dated July, 2003.

SECTION 2
OCCUPANT AND VEHICLE INFORMATION / DATA SHEETS

DATA SHEET NO. 1
TEST SUMMARY

	Test Data	Description
Seating Position	P2	Right Front Seating Position
Test	3.3.3.6*	Side-facing SID-IIs dummy
Curtain Airbag		
Torso Airbag	Seat Mounted	Side airbag
ATD Type/Serial No.	SID-IIs Build Level D / 032	5 th Percentile Adult Female

* Procedure as defined by Lund, et al and the Technical Working Group dated July, 2003

Number of Data Channels	43
Number of Real-Time Video	1
Number of High-Speed Video	3

Visible Dummy Contact Points	
Head Contact	None
Left Shoulder Contact	Torso bag
Left Torso Contact	Torso bag
Left Pelvis Contact	None

DATA SHEET NO. 2**TEST VEHICLE INFORMATION**

Please note that this vehicle had previously been tested in an
NCAP Frontal Impact on September 7, 2006.

TEST VEHICLE INFORMATION

Manufacturer	Chevrolet
Model	Aveo LS
Body Style	Sedan
NHTSA No.	M70103TWG2
VIN	KL1TD56687B050273
Color	Summit White
Delivery Date	8/25/06
Odometer Reading (mile)	50
Dealer	Frank Boucher
Transmission	Automatic
Final Drive	Front
Number of Cylinders	4
Engine Displacement (L)	1.6
Engine Placement	Lateral
Automatic Door Lock (ADL)	No
Owners Manual Details Instructions on Disabling ADLs	N/A
Bucket Seats	Yes

TEST VEHICLE OPTIONS

Front Airbag	Yes
Driver Side Curtain Airbag	No
Driver Side Torso Airbag	Yes
Rear Passenger Side Curtain Airbag	No
Rear Passenger Side Torso Airbag	No
Force Limiter	Yes
Pretensioner	Yes
Power Steering	Yes
Power Door Locks	No
Tilt Wheel	Yes
Air Conditioning	Yes
Anti-lock Brakes	No
Traction Control	No
All Wheel Drive	No
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	GM Daewoo
Date of Manufacture	06/06

GVWR (kg)	1573
GAWR Front (kg)	838
GAWR Rear (kg)	802

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

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		Rearmost
Seat Height Position		Non-adjustable
Placed in Position No. 2		---
Seat Back Angle	SA (°)	25
Top of Airbag Module to Head/Neck Junction	AN (mm)	178
Head CG to Door Panel/Window	HD (mm)	169
Head to Seat Back Centerline	HSC (mm)	114
Chest to Dash	CD (mm)	---
Chest to Seatback	CS (mm)	---
Right Arm to Seat Back Centerline	RACL (mm)	---
Left Arm to Seat Back Centerline	LACL (mm)	---
Right Arm to Door Panel	RA (mm)	154
Left Arm to Door Panel	LA (mm)	93
Knee to Knee	KK (mm)	143
Toe to Toe	TT (mm)	86
Right Knee to Seat Cushion Centerline	KSCR (mm)	---
Left Knee to Seat Cushion Centerline	KSCL (mm)	---
Right Toe to Seat Cushion Centerline	TSCR (mm)	---
Left Toe to Seat Cushion Centerline	TSCL (mm)	---
Nose to Dash	ND (mm)	---
Nose to Seatback	NS (mm)	---
Top of Head to Headliner	HH (mm)	---

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. M70103TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	13.0	20.2	-3.7	34.2
Head Y	g	9.2	14.5	-2.4	205.7
Head Z	g	12.4	27.4	-8.2	22.9
Head Resultant	g	16.0	19.9		
Head X Redundant	g	12.9	19.9	-3.9	34.2
Head Y Redundant	g	9.0	14.3	-2.6	200.6
Head Z Redundant	g	12.7	27.3	-8.1	14.7
Head Resultant Redundant	g	15.7	19.7		
Upper Neck Fx	N	420.2	20.1	-114.9	34.7
Upper Neck Fy	N	244.5	14.6	-88.5	206.3
Upper Neck Fz	N	460.5	27.5	-303.8	22.8
Upper Neck F Resultant	N	527.7	20.0		
Upper Neck Mx	N-m	15.0	23.1	-21.8	13.8
Upper Neck My	N-m	40.9	19.8	-24.9	34.8
Upper Neck Mz	N-m	11.0	26.4	-8.4	95.8
Upper Neck M Resultant	N-m	42.5	20.3		
Lower Neck Fx	N	782.3	15.2	-148.6	31.7
Lower Neck Fy	N	567.8	12.4	-117.1	22.4
Lower Neck Fz	N	401.9	27.3	-457.7	15.2
Lower Neck F Resultant	N	951.6	15.2		
Lower Neck Mx	N-m	44.4	13.6	-19.3	203.8
Lower Neck My	N-m	20.6	153.2	-61.4	19.6
Lower Neck Mz	N-m	26.4	12.6	-8.0	119.3
Lower Neck M Resultant	N-m	66.9	19.5		
Upper Spine X	g	65.0	15.1	-26.2	20.5
Upper Spine Y	g	27.5	11.0	-13.5	30.3
Upper Spine Z	g	13.3	15.4	-6.7	20.4
Upper Spine Resultant	g	66.8	15.1		

DATA SHEET NO. 4 (continued)
DUMMY INJURY CRITERIA VALUES

NHTSA No. M70103TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Lower Spine X	g	15.8	20.9	-52.8	15.2
Lower Spine Y	g	18.5	11.2	-13.2	21.8
Lower Spine Z	g	9.6	23.2	-12.1	18.9
Lower Spine Resultant	g	54.1	15.3		
Upper Thorax Spine Y	g	23.4	11.1	-12.9	30.2
Middle Thorax Spine Y	g	21.9	11.2	-10.9	30.1
Lower Thorax Spine Y	g	20.1	11.3	-9.4	21.4
Upper Abdomen Spine Y	g	18.5	11.2	-13.2	21.8
Lower Abdomen Spine Y	g	22.2	16.0	-18.3	21.9
Shoulder Rib DY	mm	3.4	34.2	-19.3	13.4
Upper Thorax Rib DY	mm	2.6	25.3	-16.7	13.0
Mid Thorax Rib DY	mm	2.8	25.4	-16.6	14.4
Lower Thorax Rib DY	mm	3.7	25.0	-13.7	11.7
Upper Abdominal Rib DY	mm	0.3	21.1	-2.8	25.3
Lower Abdominal Rib DY	mm	1.3	34.0	-0.9	43.4
Upper Thorax Rib Y	g	358.5	7.6	-291.0	13.1
Mid Thorax Rib Y	g	277.4	11.8	-219.3	14.1
Lower Thorax Rib Y	g	218.2	12.4	-158.3	14.5
Upper Abdominal Rib Y	g	60.0	9.6	-33.3	15.4
Lower Abdominal Rib Y	g	41.3	19.1	-39.9	25.1
Pelvis X	g	3.7	30.8	-1.6	69.3
Pelvis Y	g	2.6	29.3	-2.7	69.0
Pelvis Z	g	4.6	15.2	-4.3	29.8
Pelvis Resultant	g	5.3	15.2		

DATA SHEET NO. 4 (continued)
DUMMY INJURY CRITERIA VALUES

NHTSA No. M70103TWG2

ATD position	HEAD INJURY CRITERIA (HIC)					
	HIC15			HIC36		
	HIC	T ¹ (msec)	T ² (msec)	HIC	T ¹ (msec)	T ² (msec)
No. 2 Right Front	6.2	13.8	28.8	6.6	10.8	29.3

Position 2 Neck Injury Summary (SID-IIs Build Level D – Out-Of-Position)

	Nij	Time (msec)	Z Force (N) (CFC 600)	X Force (N) (CFC 600)	Y Moment (N-m) (CFC 600)
Ntf	0.28	19.90	295.70	416.49	40.84
Nte	0.39	34.80	215.90	-114.63	-24.92
Ncf	0.20	22.10	-205.82	360.35	29.11
Nce	0.30	37.70	-18.33	4.48	-19.54
Peak Tension (CFC1000)		460.5 N	Peak Compression (CFC 1000)		-303.8 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	3880 N	Extension (mCVe)	61 N-m	Tension	2070 N
Compression (CVc)	3880 N	Flexion (mCVf)	155 N-m	Compression	2520 N
Condyle Offset	0.01778 m				

APPENDIX A
PHOTOGRAPHS

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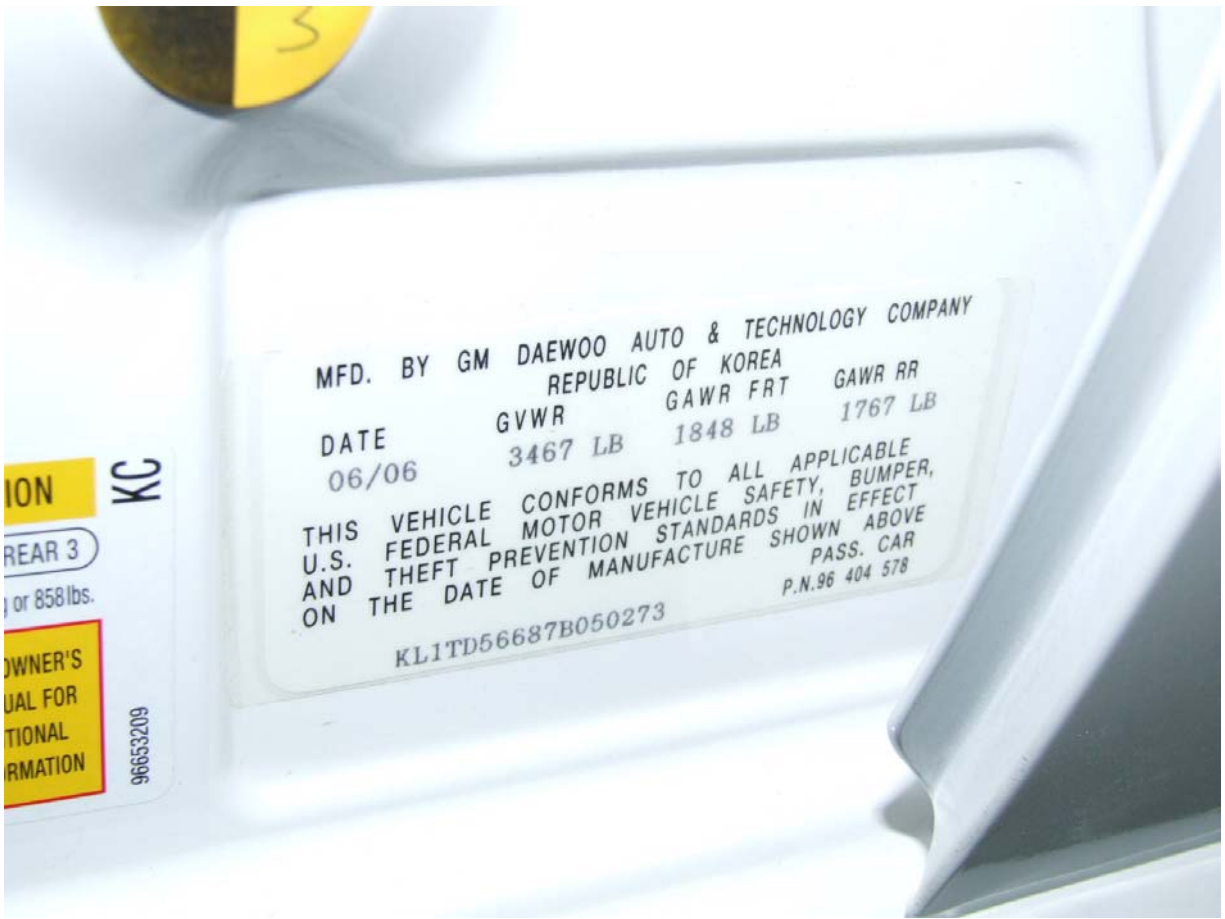
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Pre-Test Vehicle Left Side View



Post-Test Vehicle Left Side View



Vehicle Certification Placard



TIRE AND LOADING INFORMATION

SEATING CAPACITY : TOTAL 5 : FRONT 2 : REAR 3

The combined weight of occupants and cargo should never exceed 390 kg or 858 lbs.

TIRE	SIZE	COLD TIRE PRESSURE
FRONT	P185/60R14	210 KPA , 30 PSI
REAR	P185/60R14	210 KPA , 30 PSI
SPARE	T105/70D14	420 KPA , 60 PSI

SEE OWNER'S
MANUAL FOR
ADDITIONAL
INFORMATION

96653209

KC

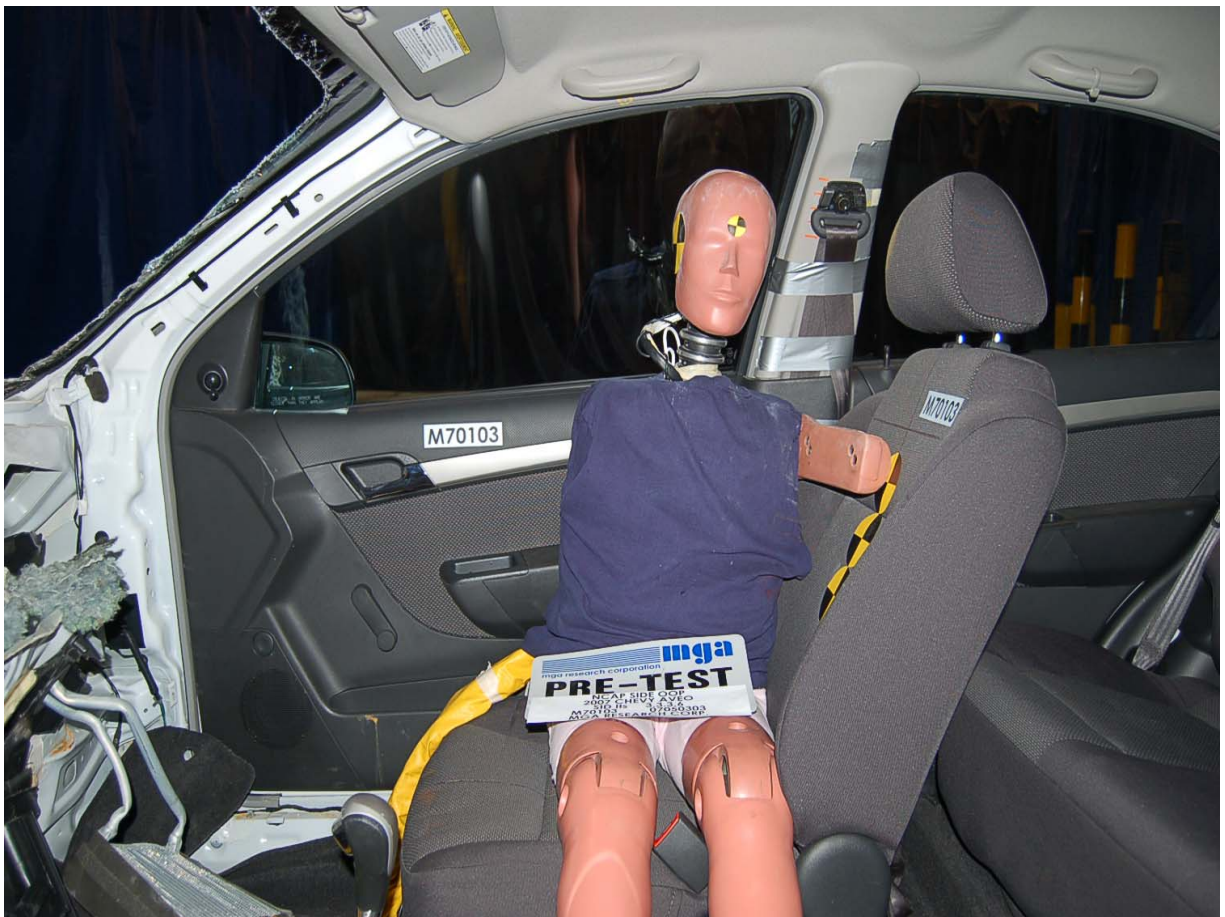
Vehicle Tire Placard



Pre-Test SID-III Dummy Frontal View



Post-Test SID-III Dummy Frontal View



Pre-Test SID-IIs Dummy Frontal Closeup View



Post-Test SID-IIs Dummy Frontal Closeup View



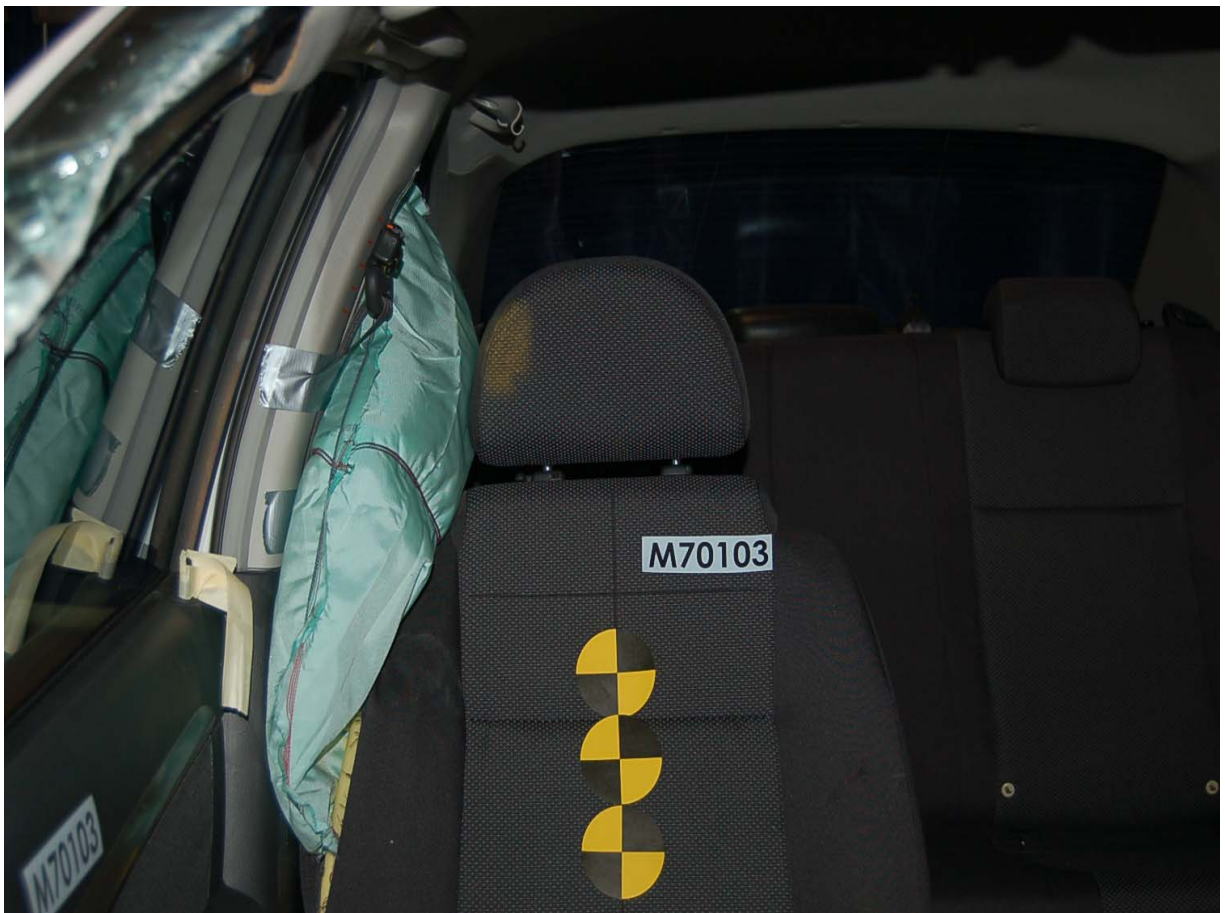
Pre-Test SID-11s Dummy Right 3/4 Front View



Post-Test SID-11s Dummy Right 3/4 Front View



Pre-Test SID-IIs Dummy Right Side Head View



Post-Test SID-IIs Dummy Right Side Head View



Post-Test Right Front Passenger Compartment View



Post-Test Torso Airbag View

APPENDIX B

DUMMY RESPONSE DATA TRACES

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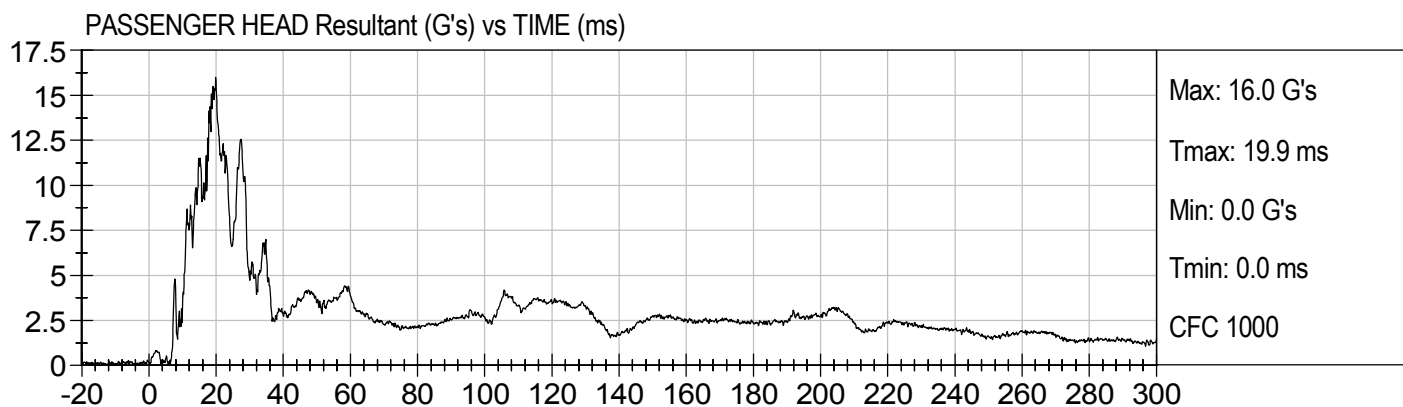
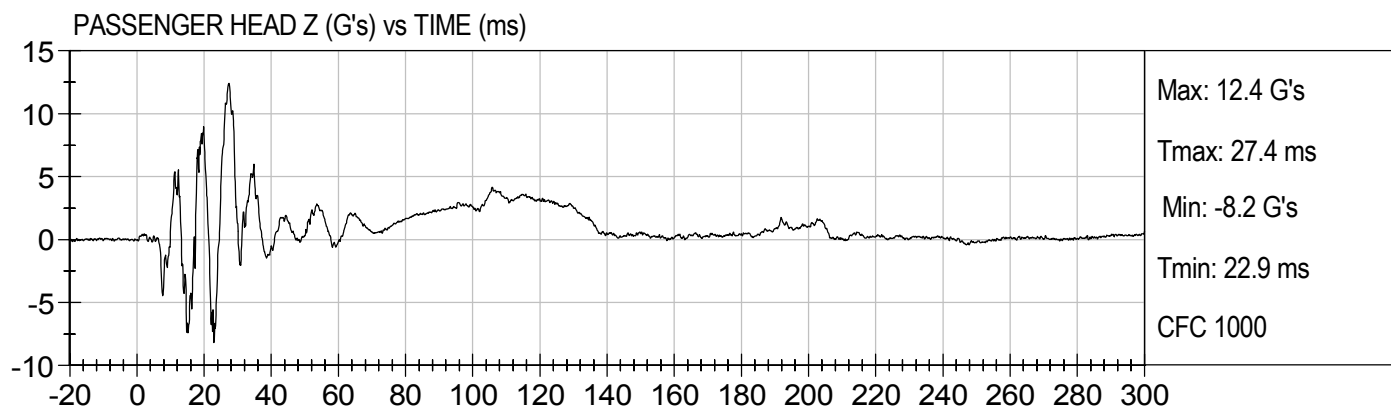
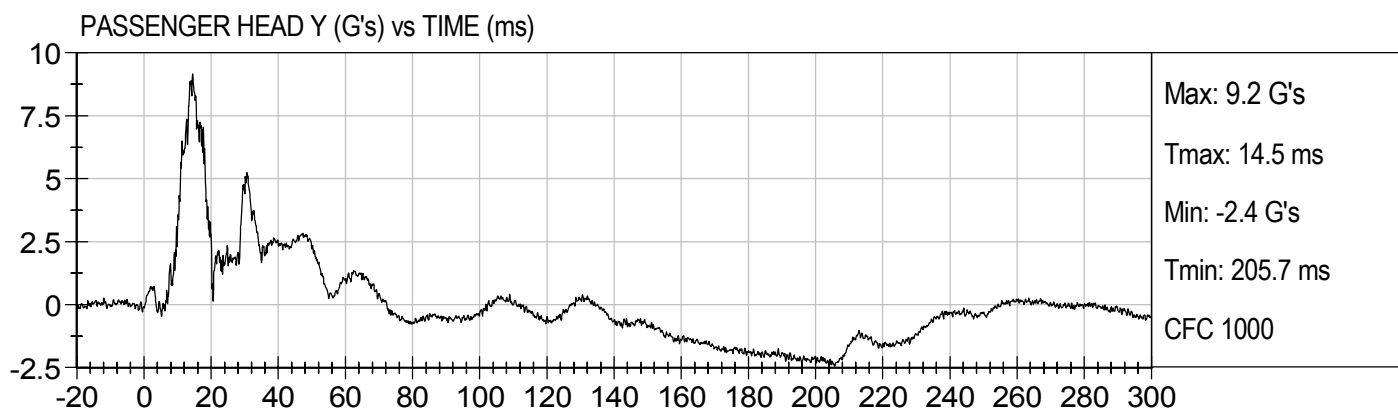
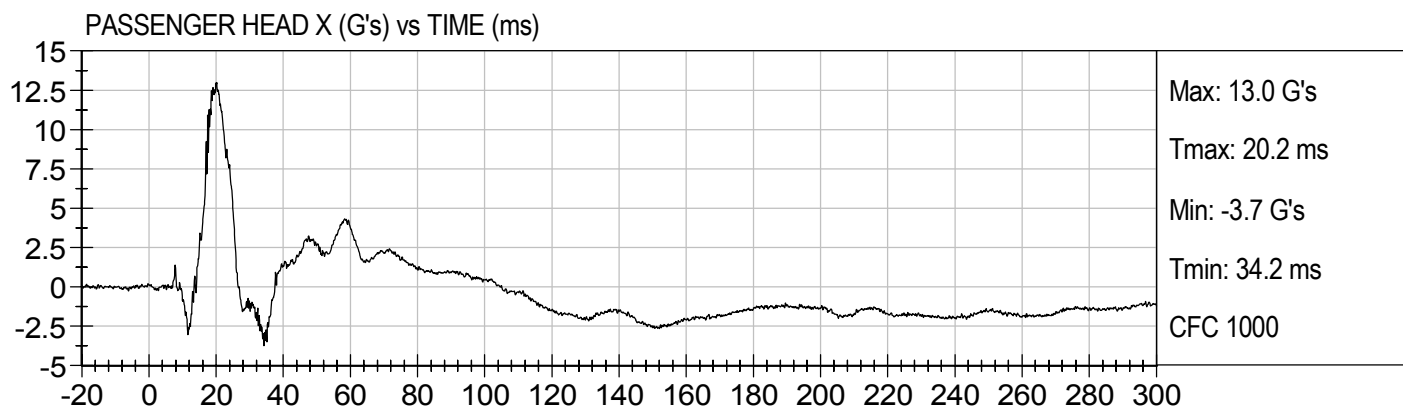
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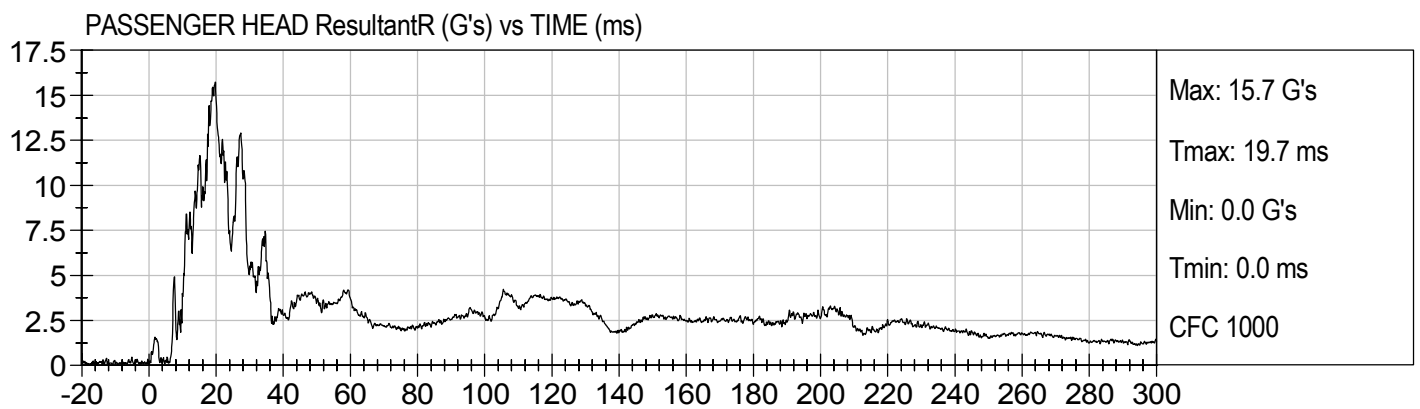
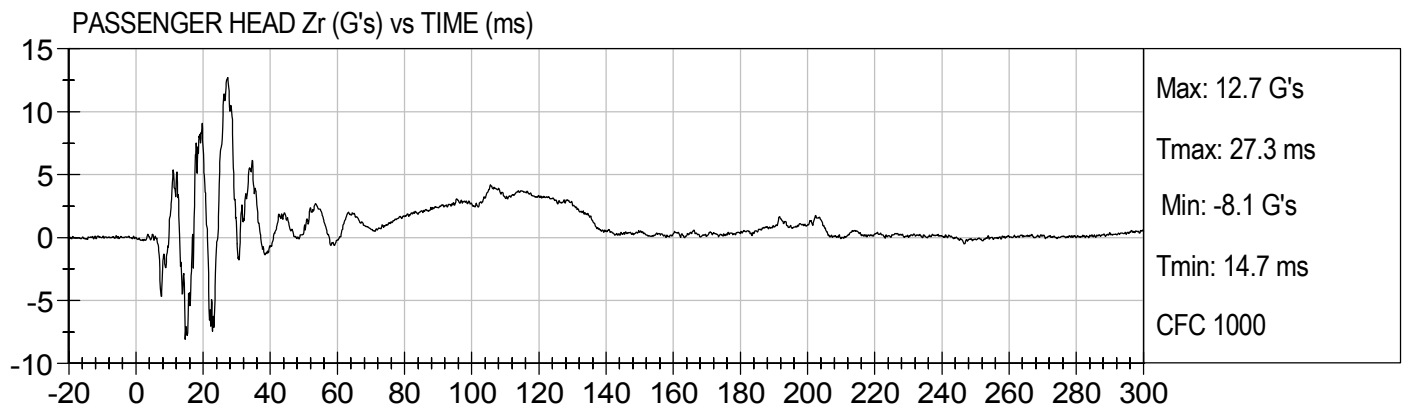
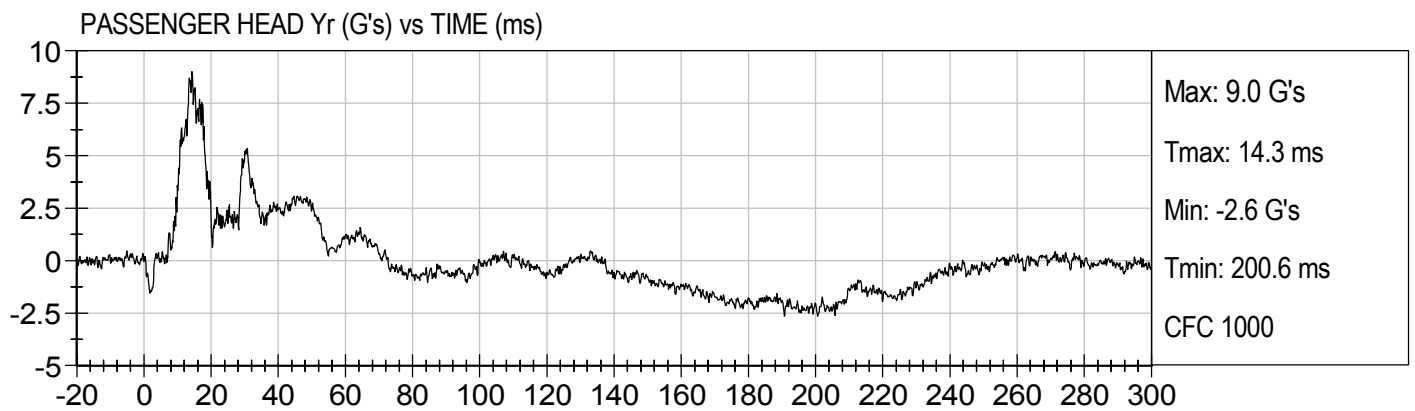
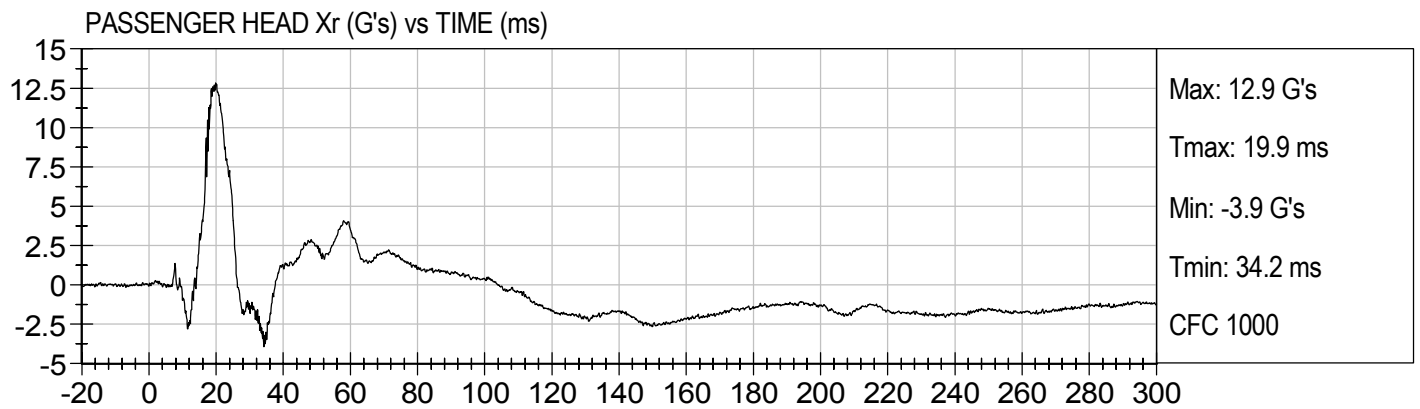
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Figure No. 58.	Passenger Pelvis Resultant Acceleration vs. Time	B-18

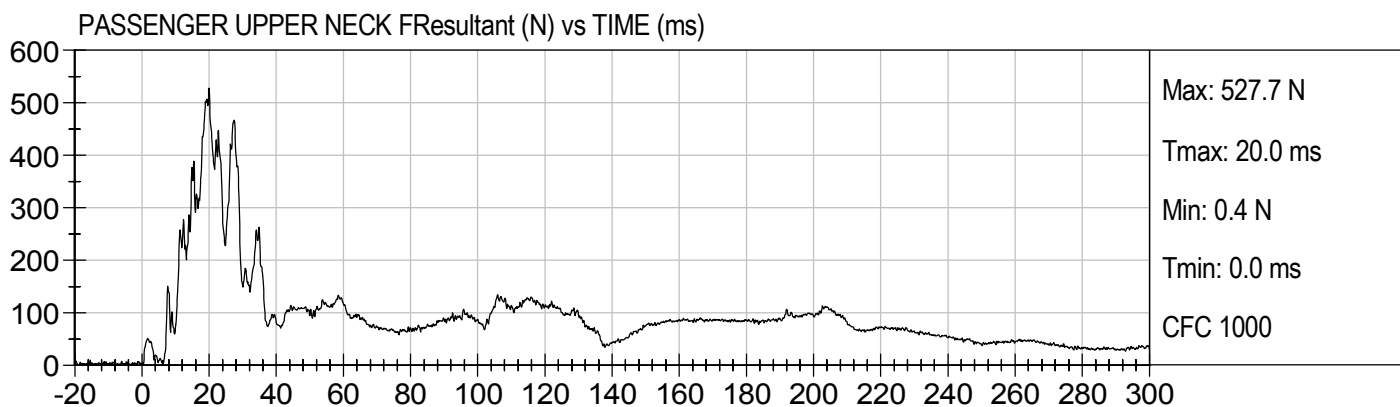
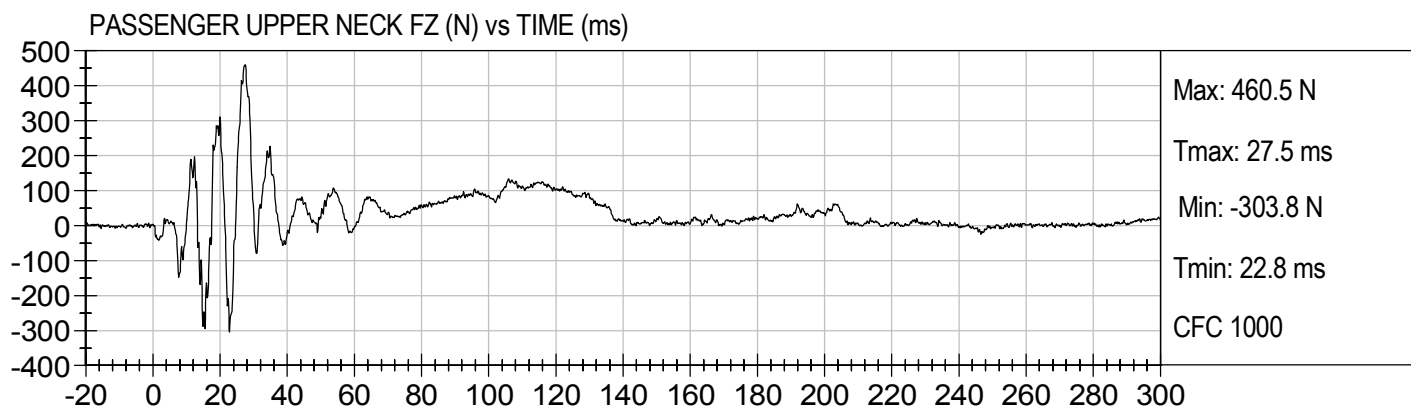
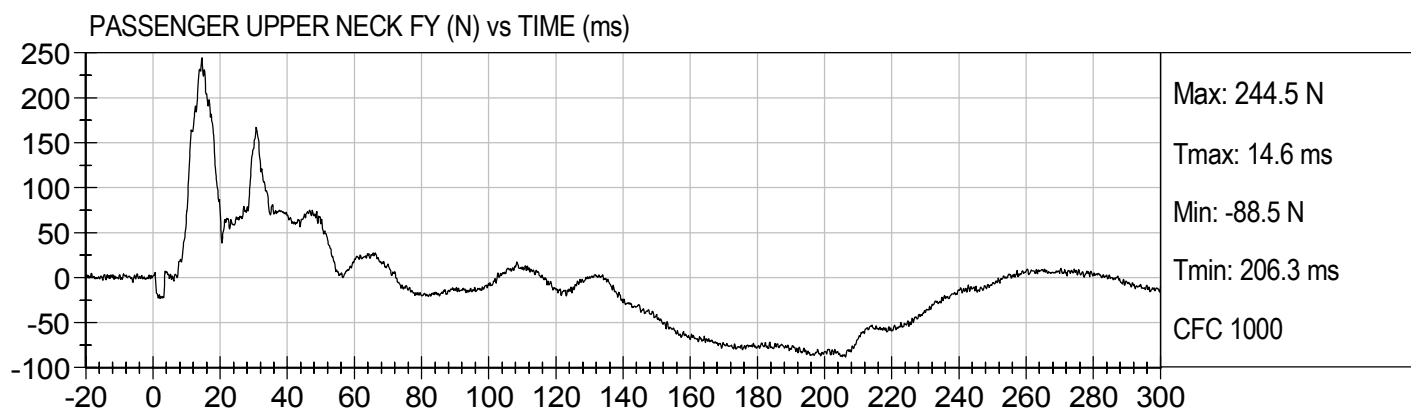
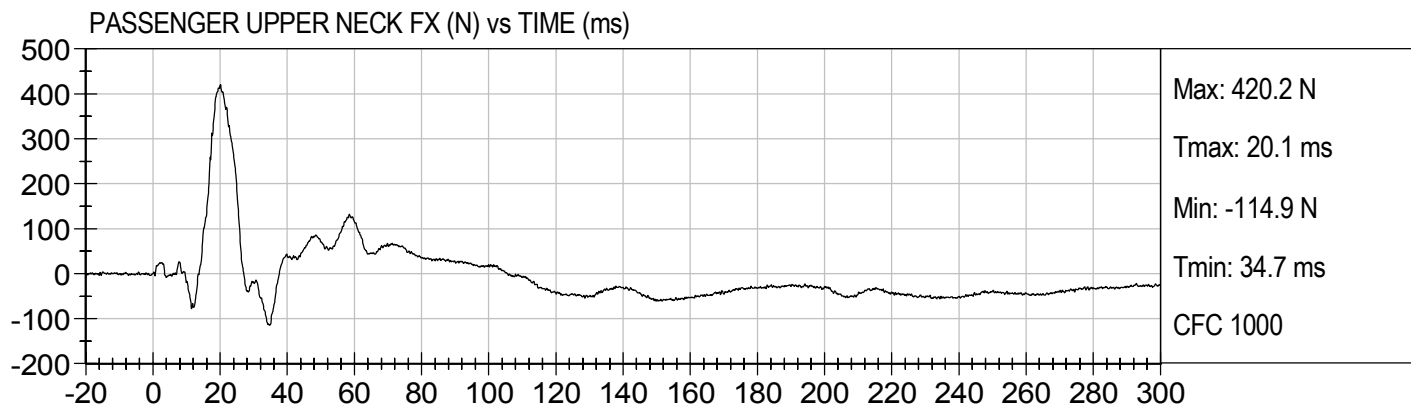


NCAP SIDE OOP SID-IIsD POSITION 3.3.3.6
2007 CHEVY AVEO M70103

Test Date: 05/03/2007
Speed: 0.0 mph (0.0 km/h)



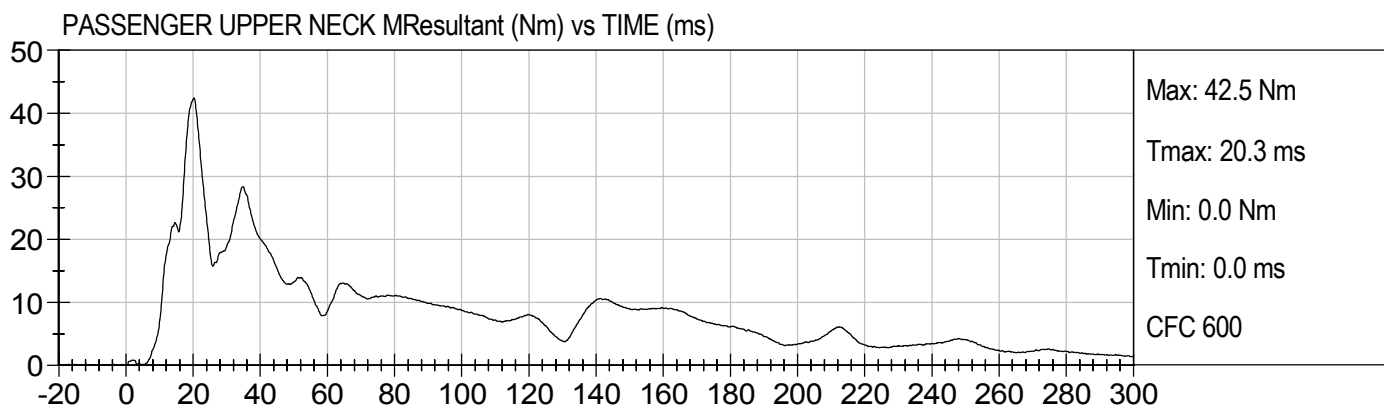
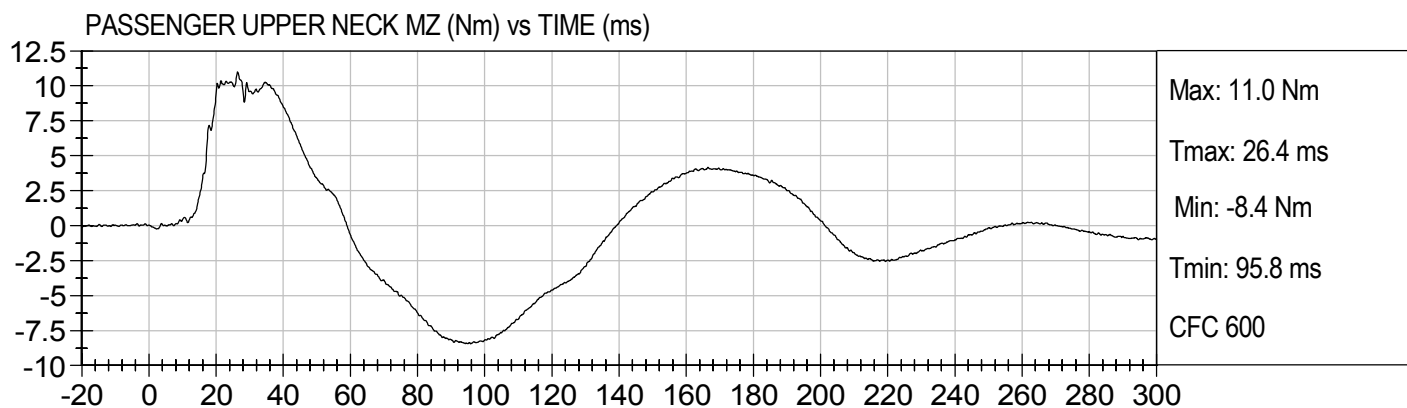
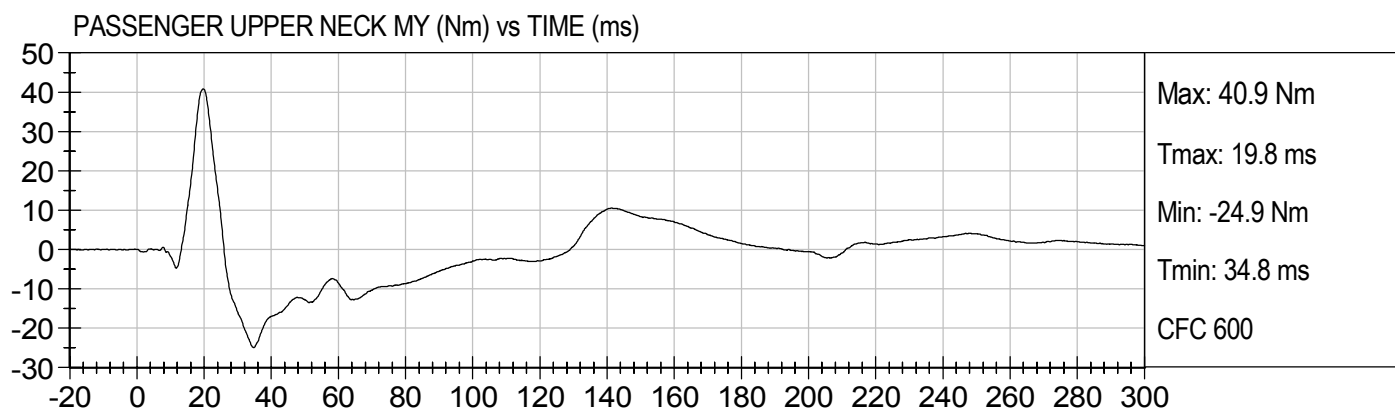
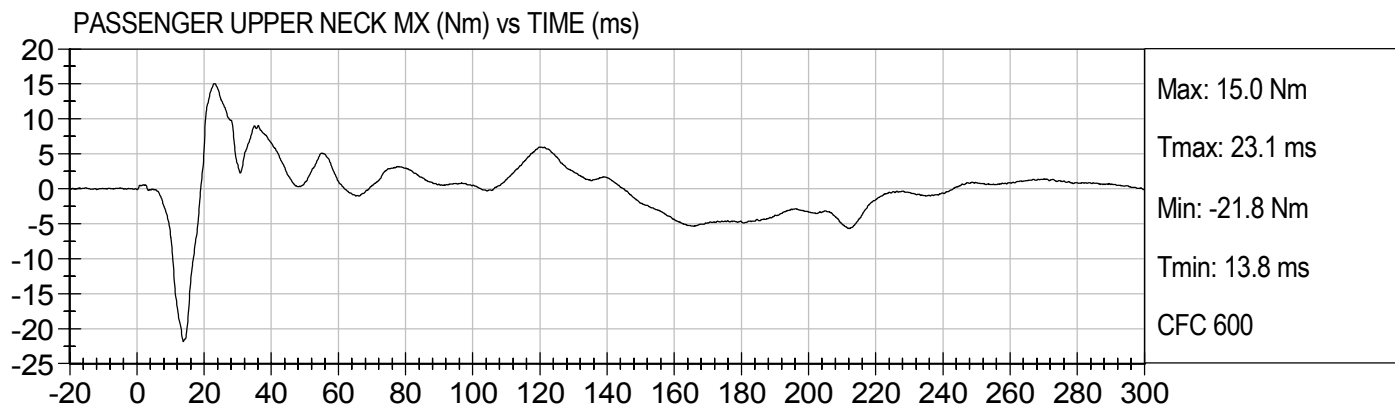


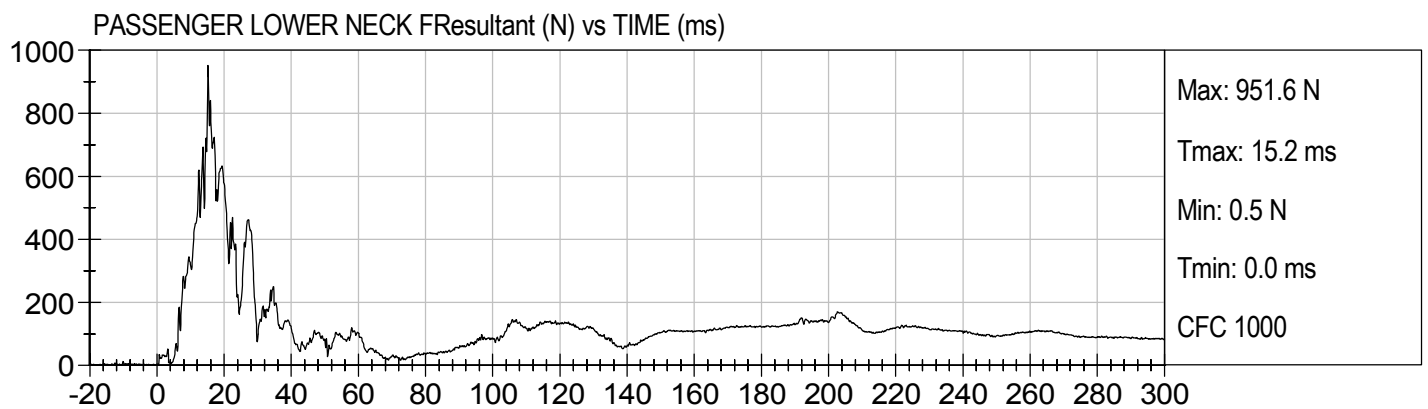
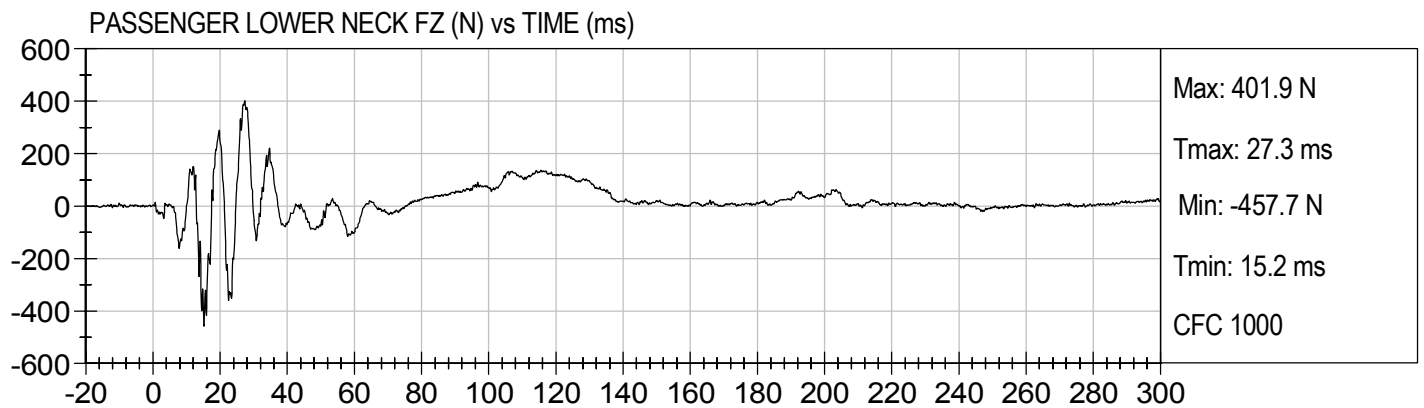
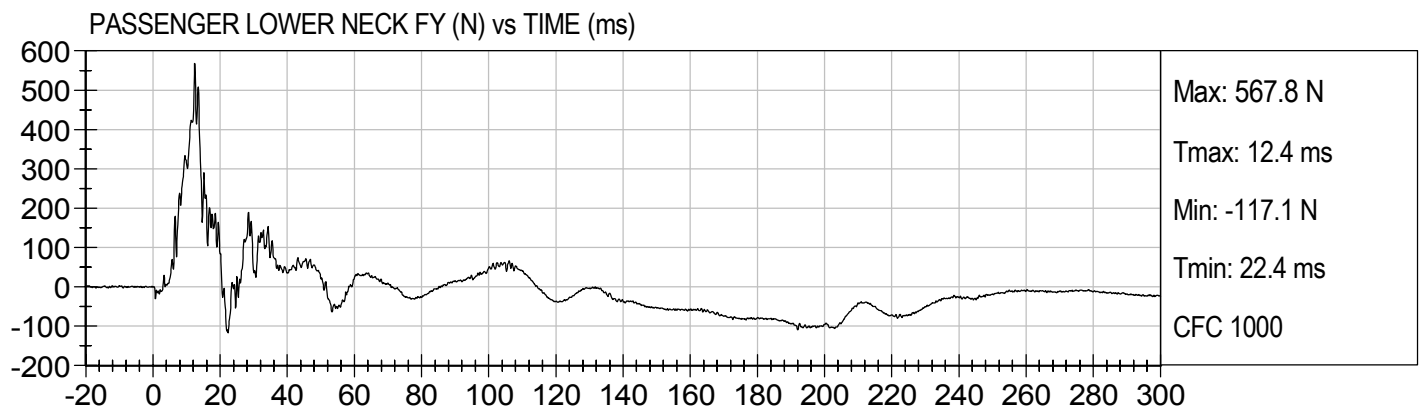
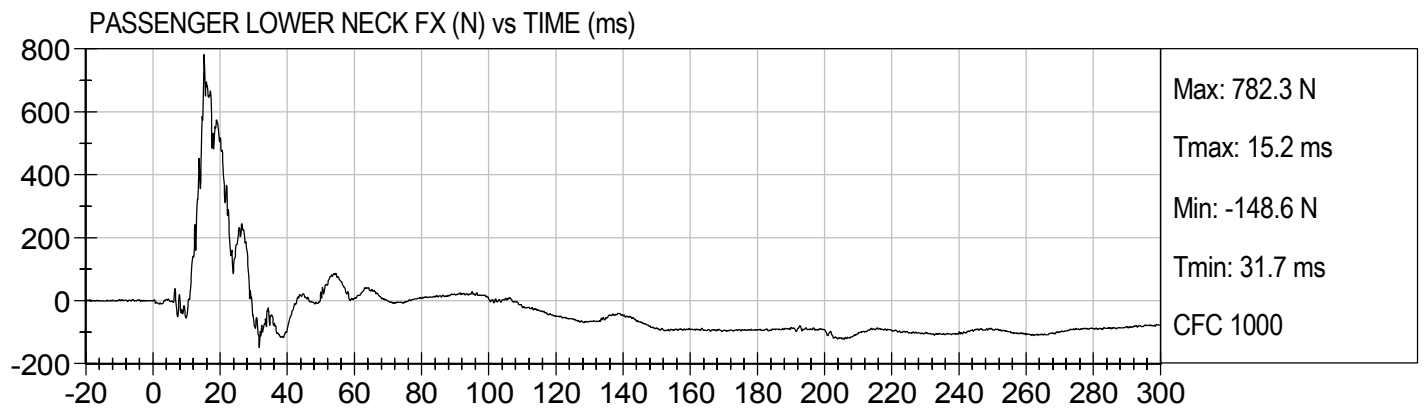


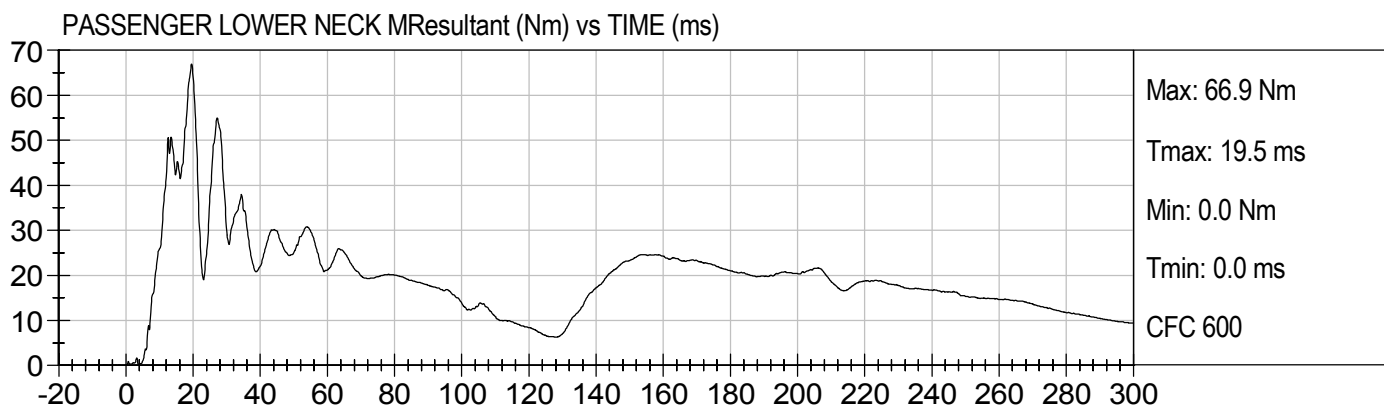
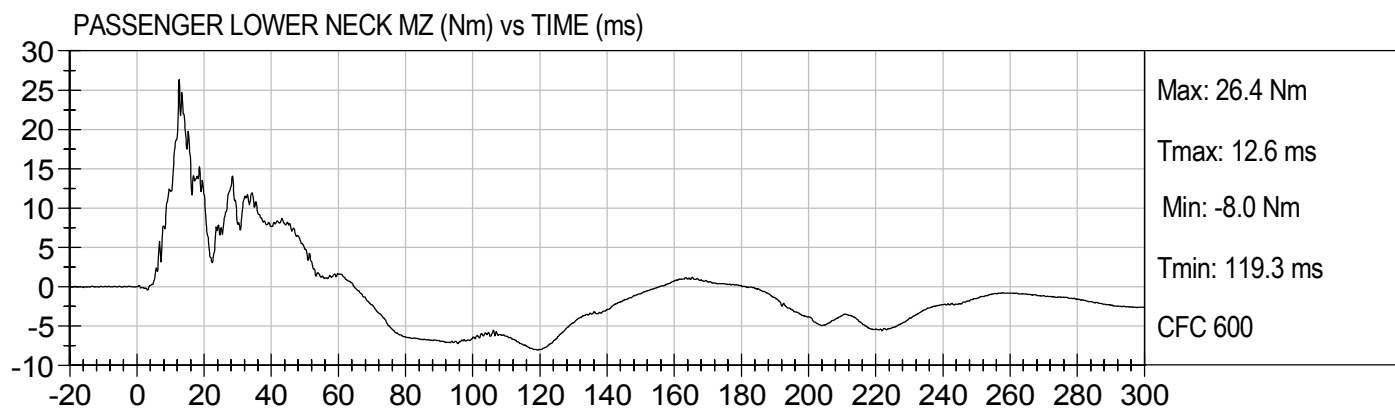
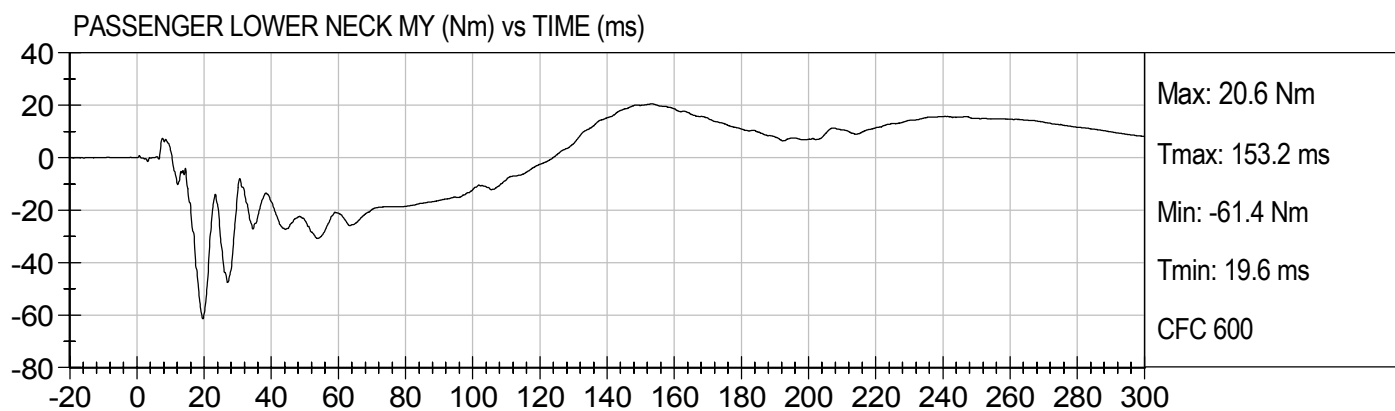
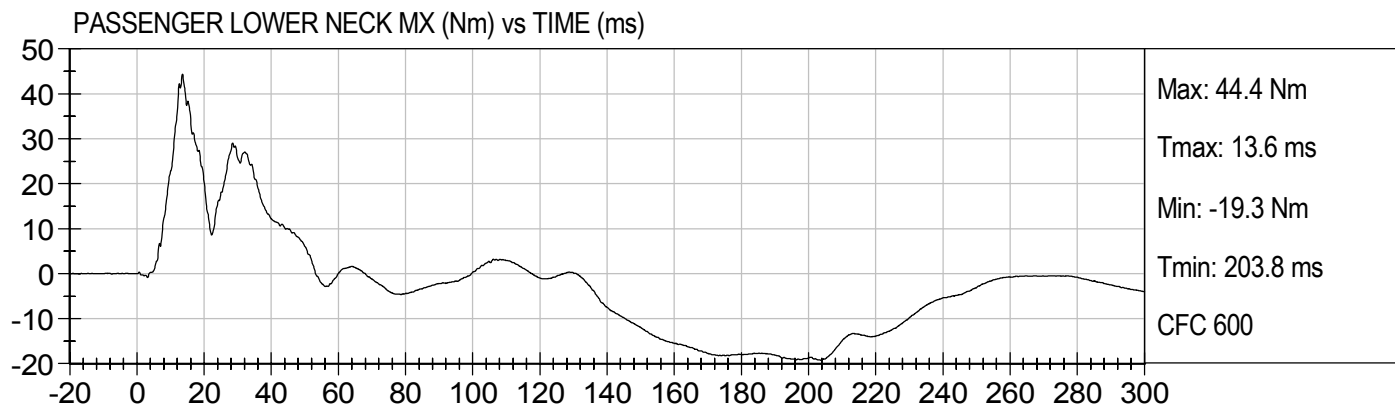


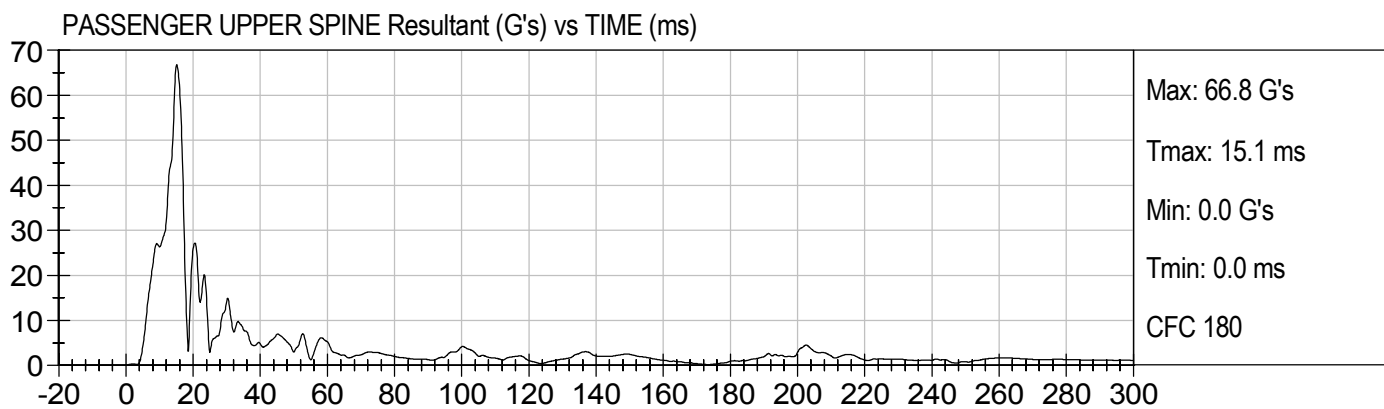
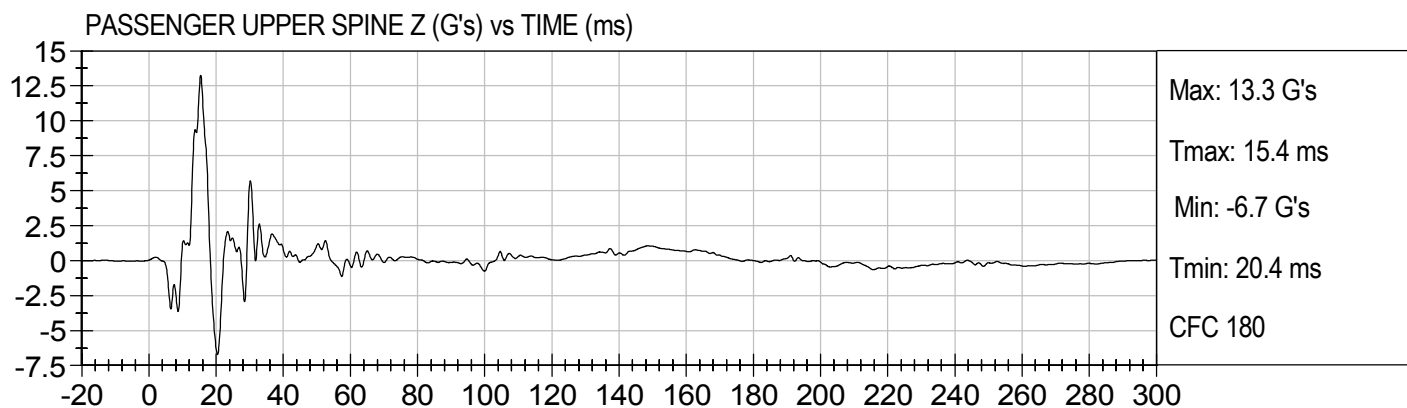
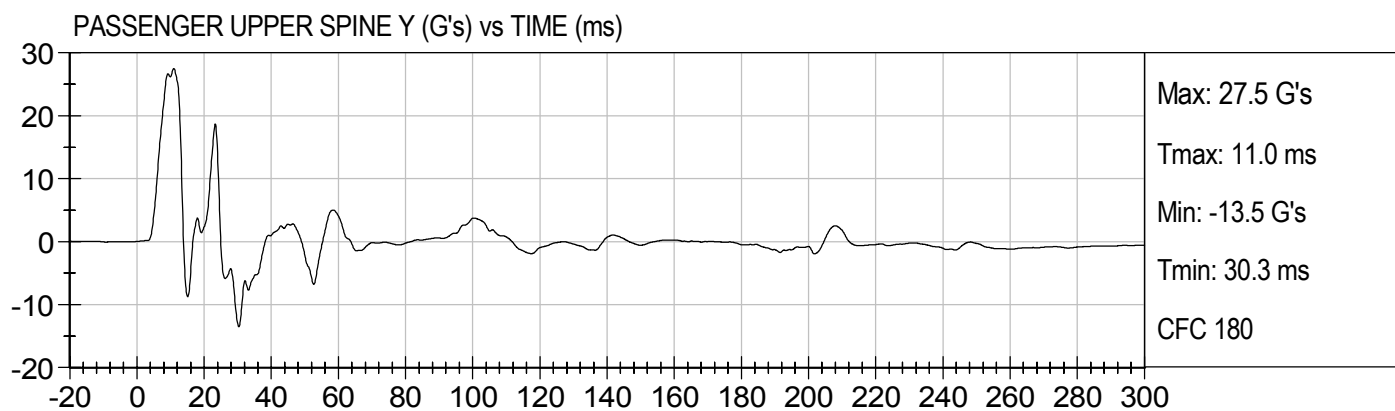
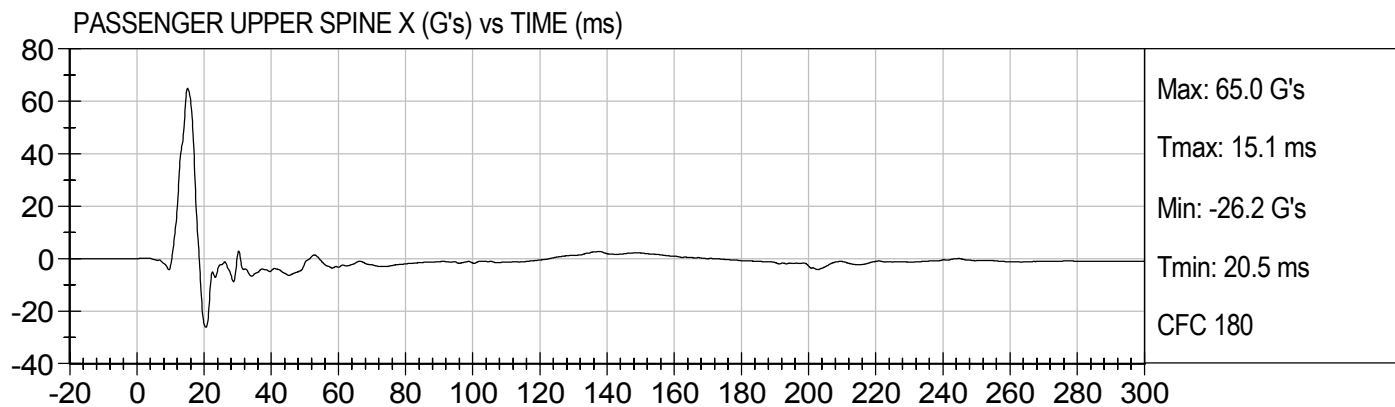
NCAP SIDE OOP SID-IIsD POSITION 3.3.3.6
2007 CHEVY AVEO M70103

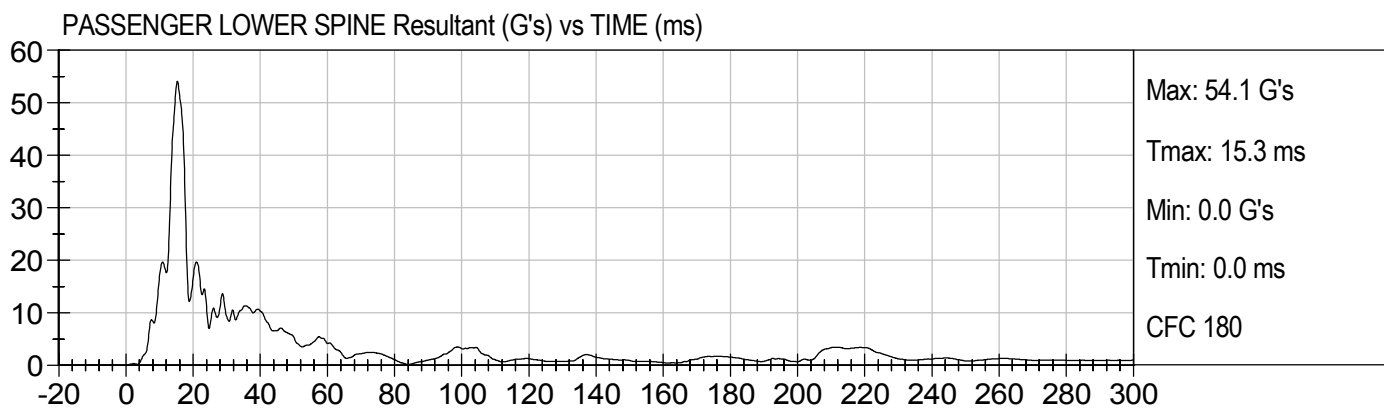
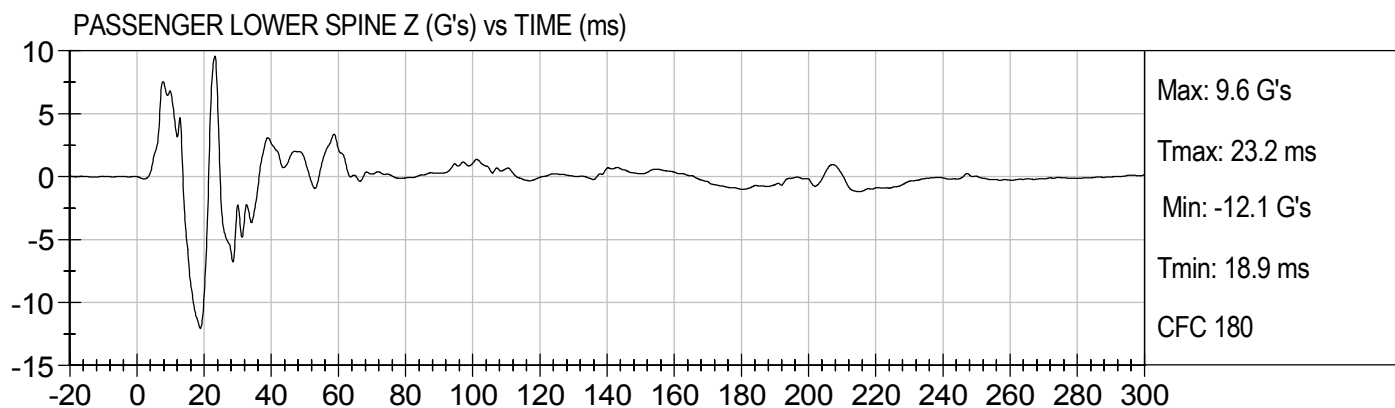
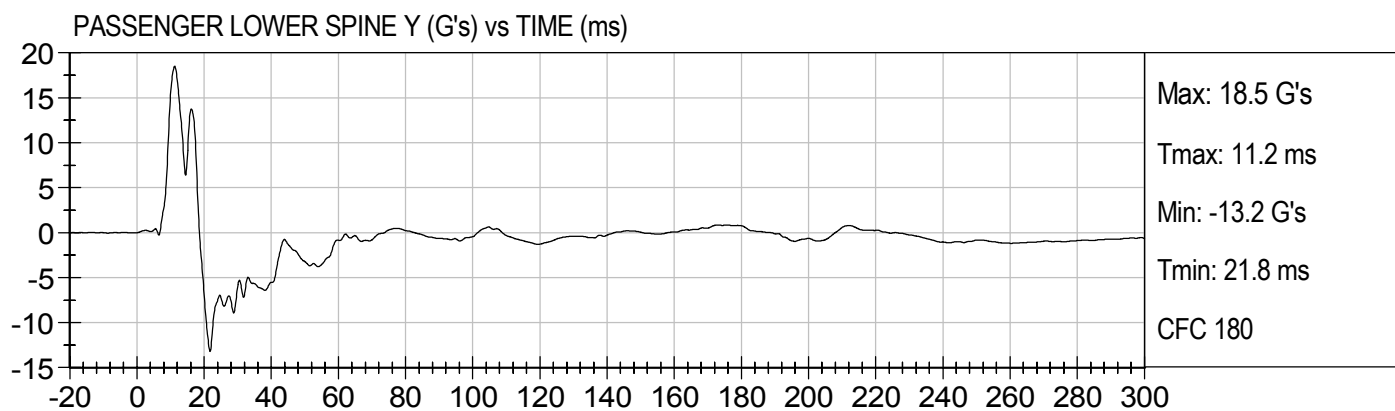
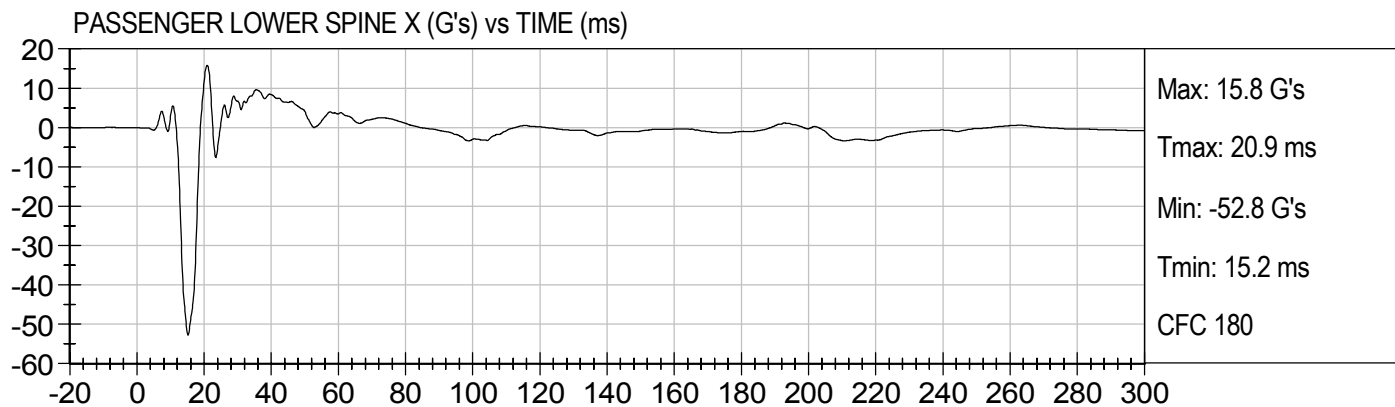
Test Date: 05/03/2007
Speed: 0.0 mph (0.0 km/h)

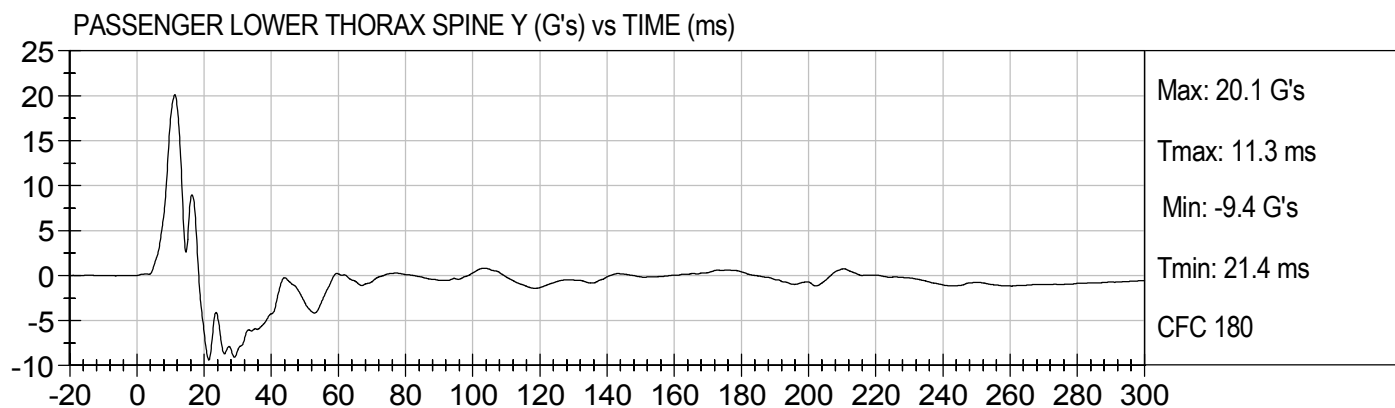
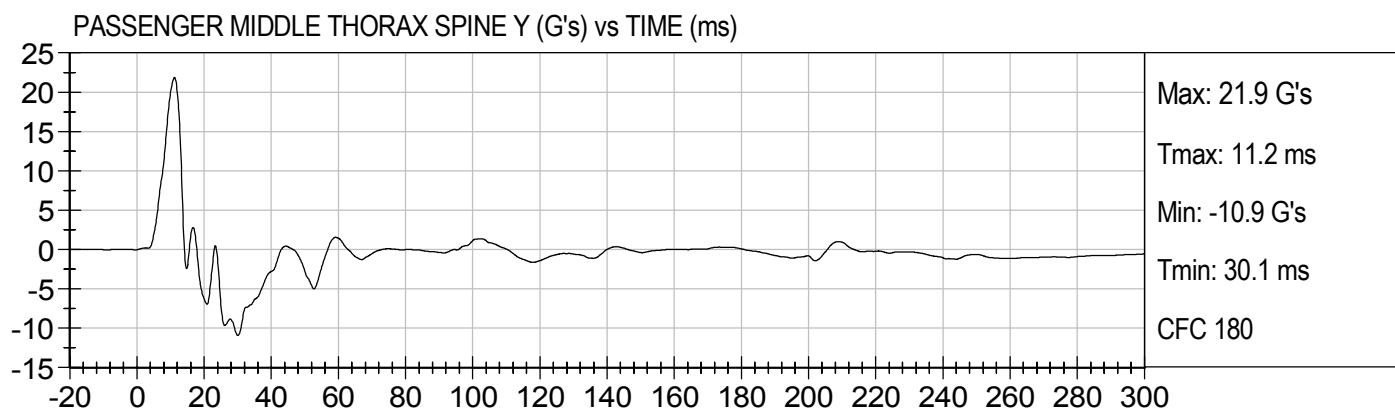
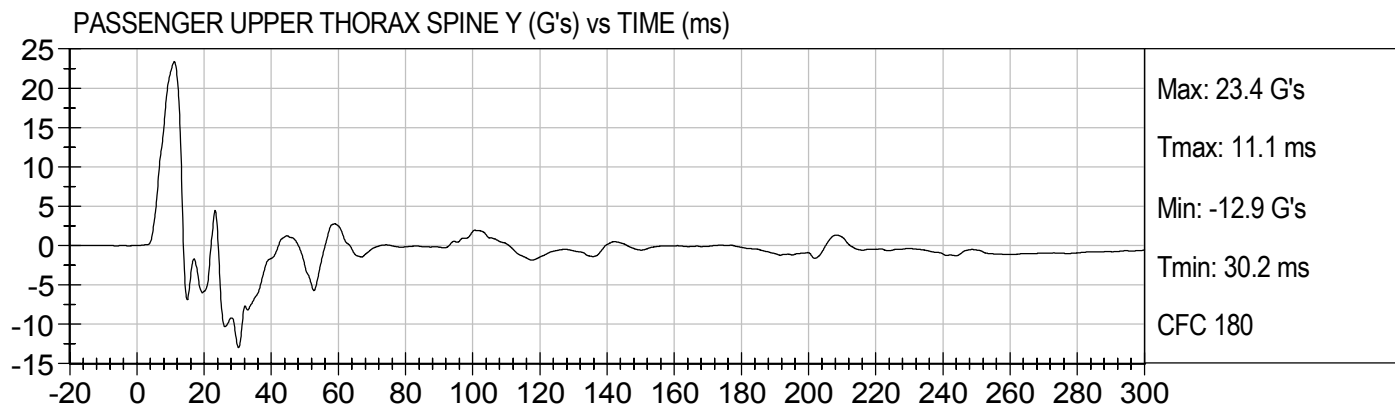


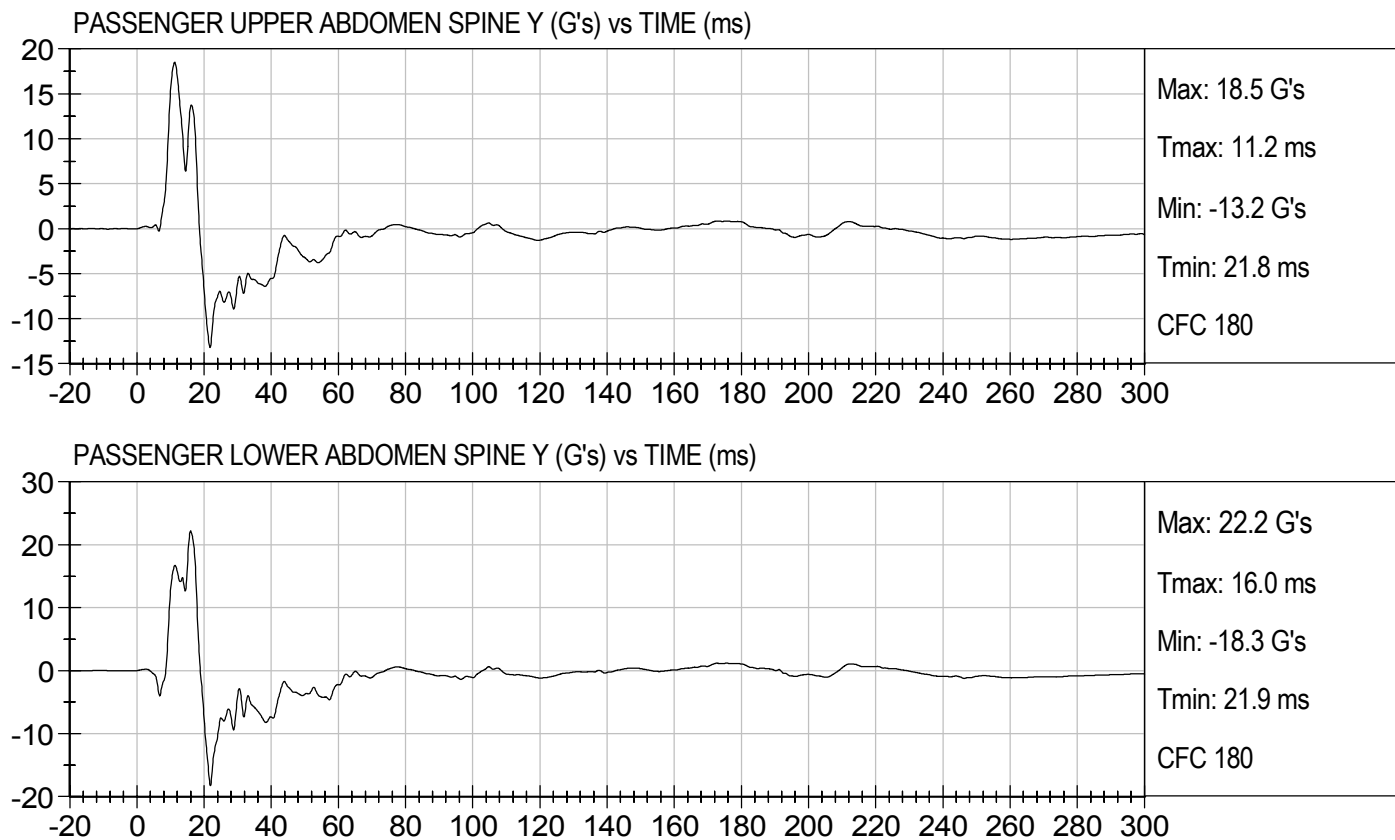


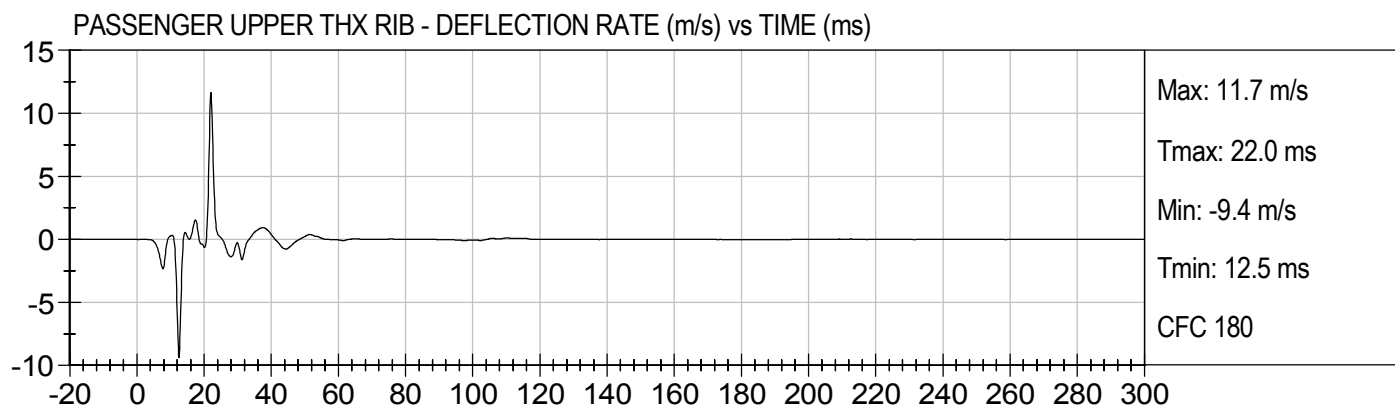
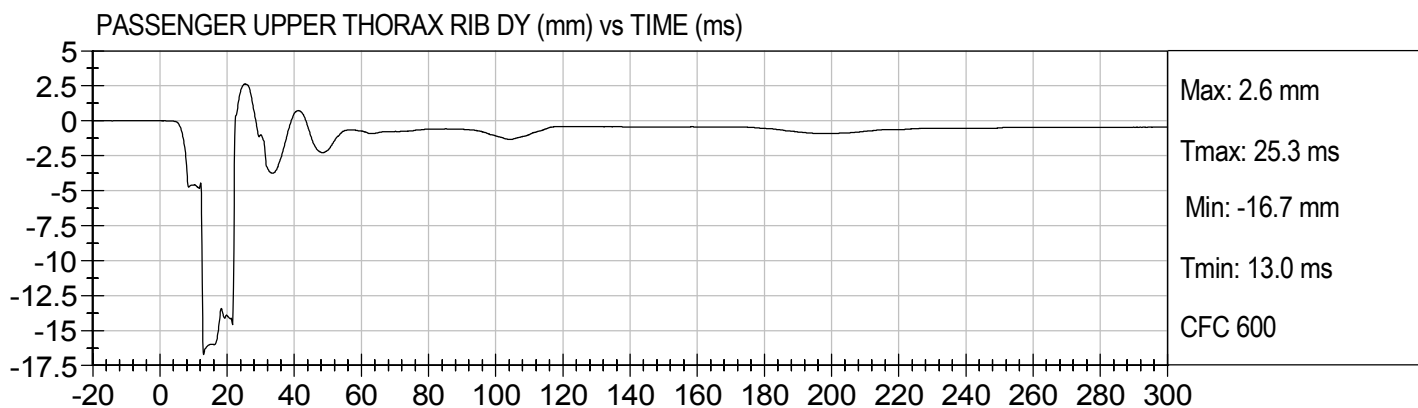
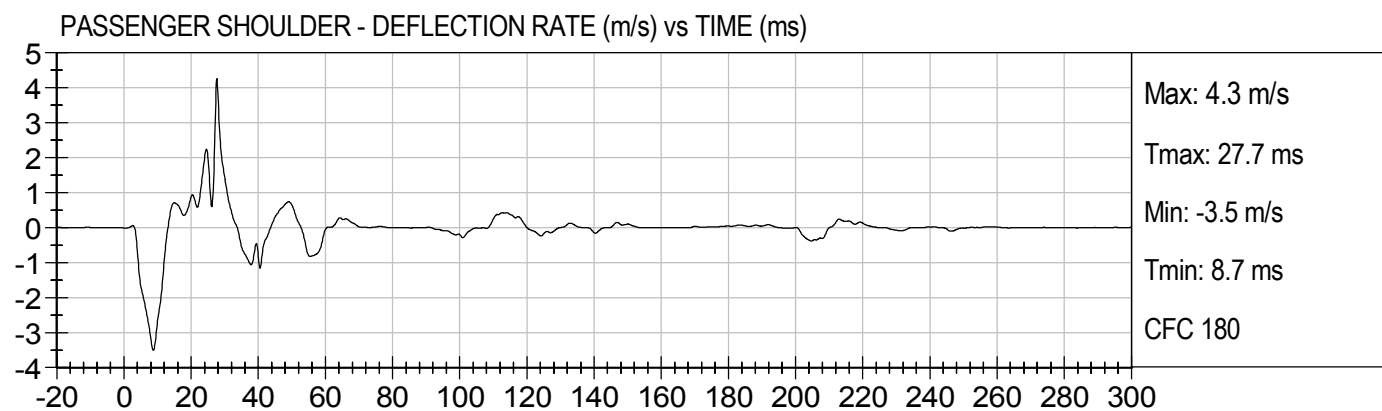
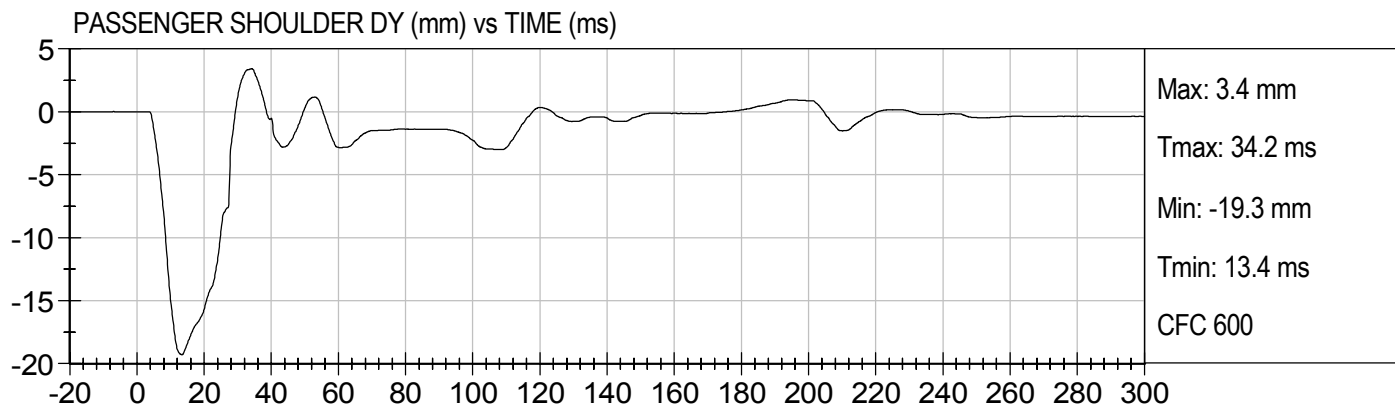


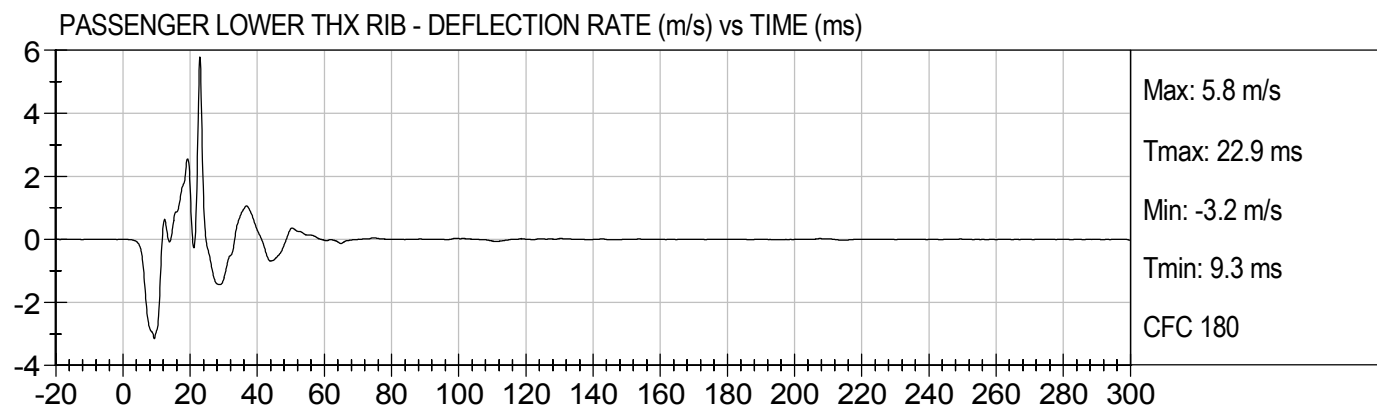
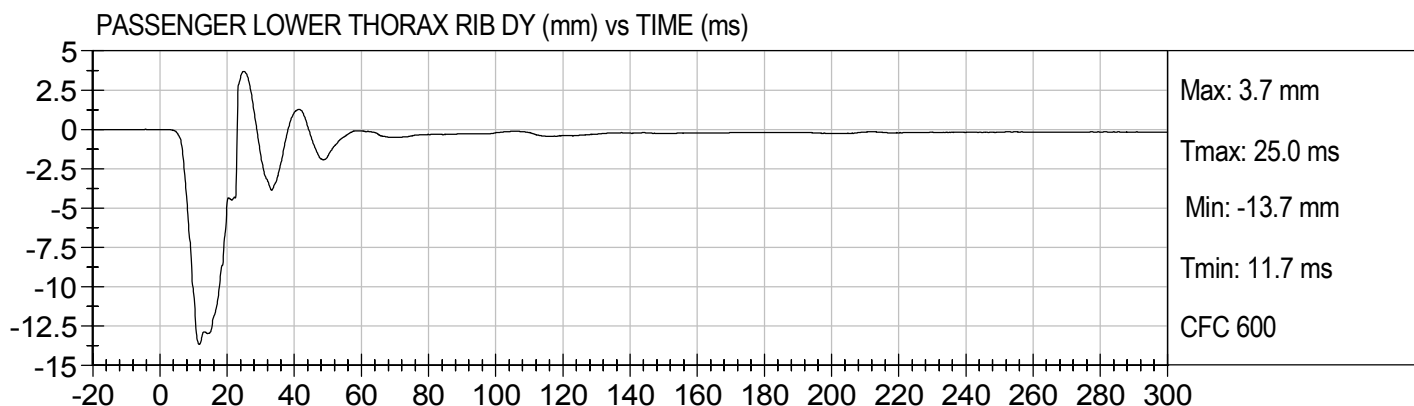
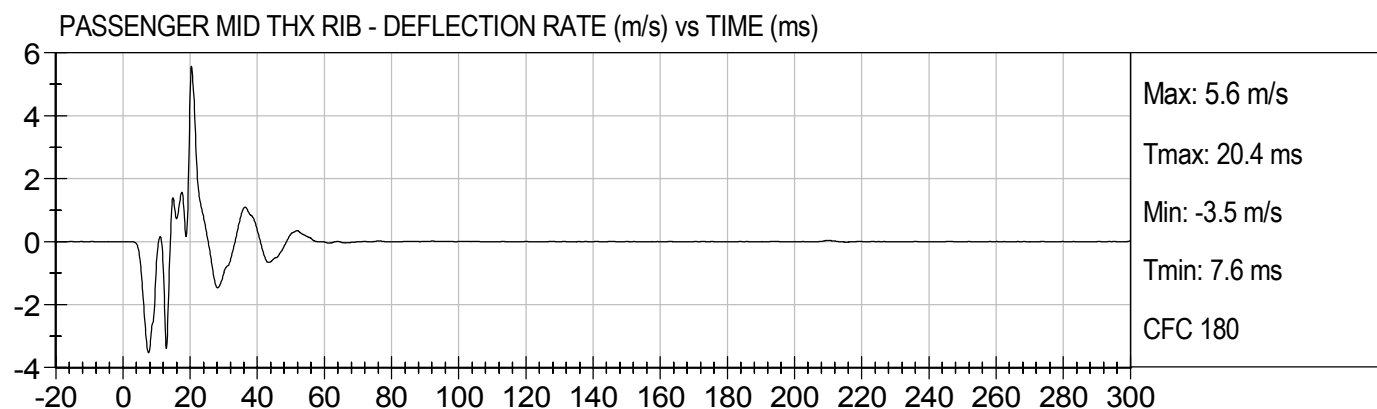
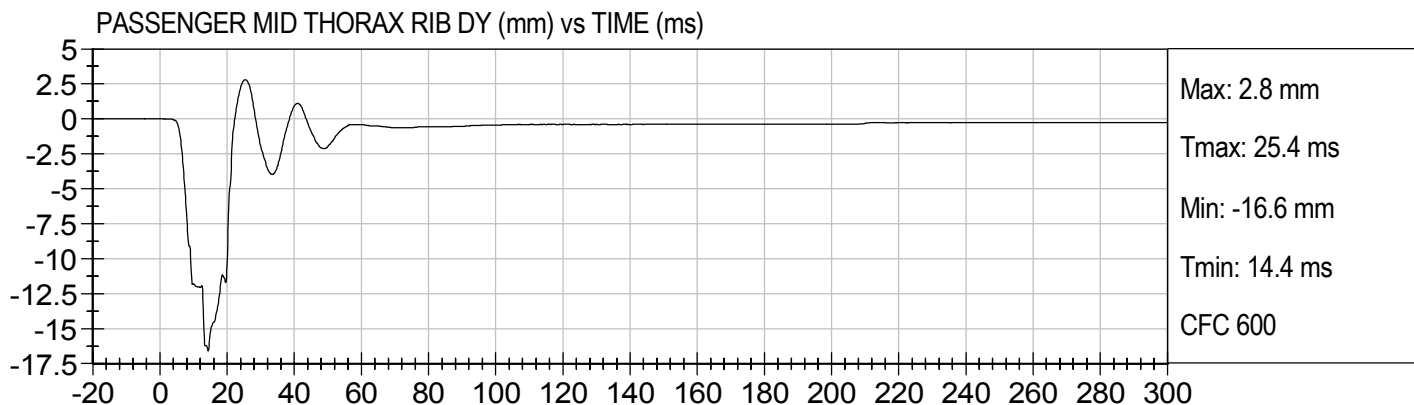


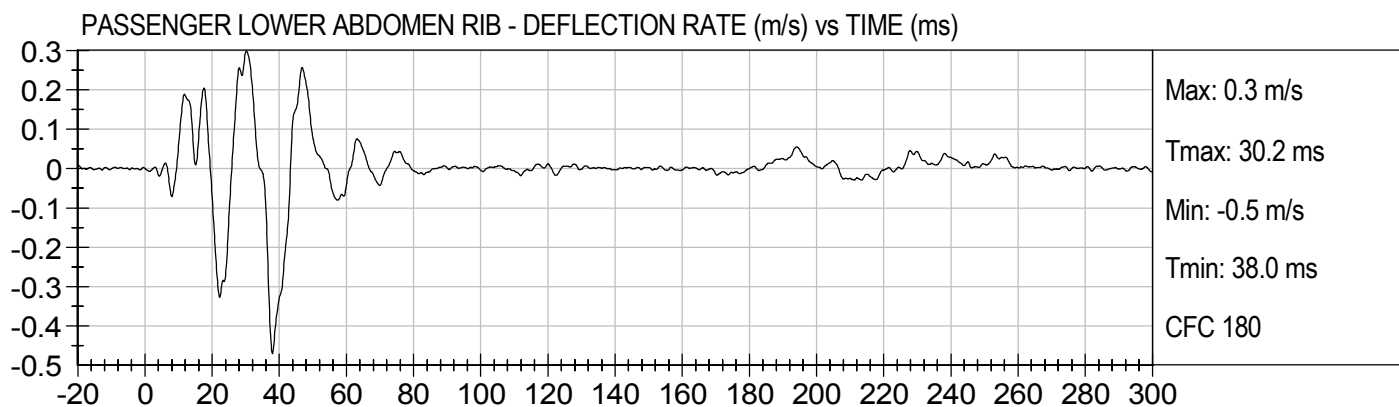
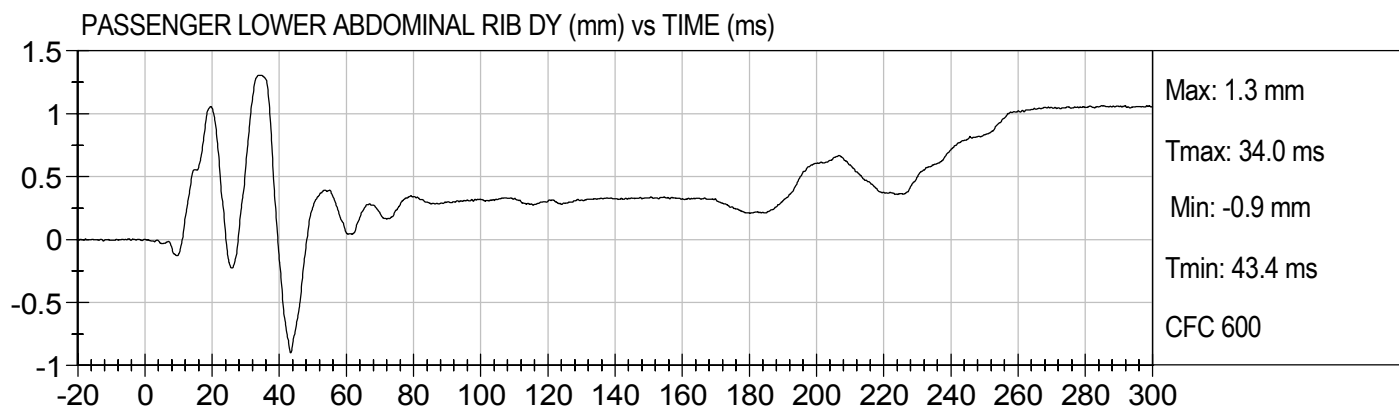
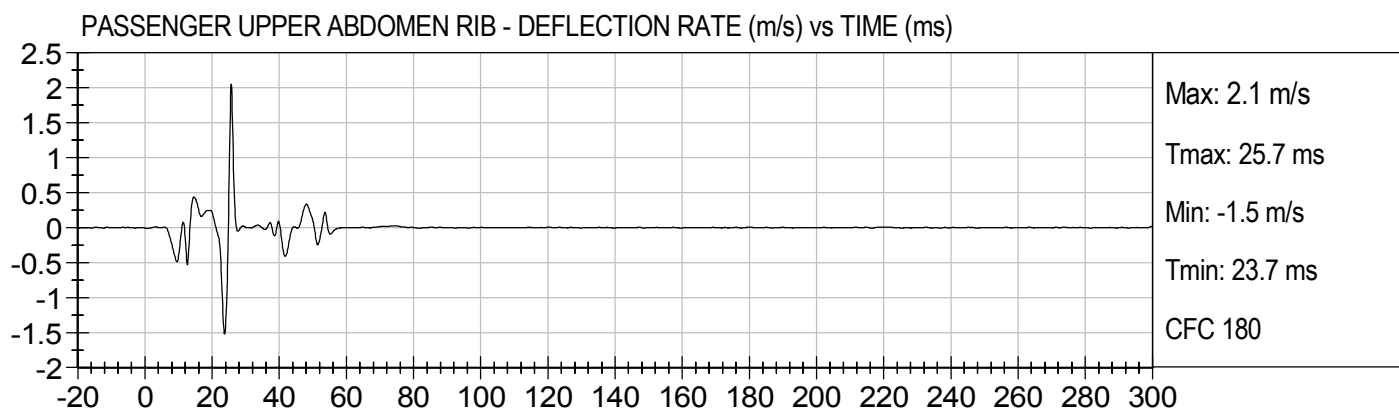
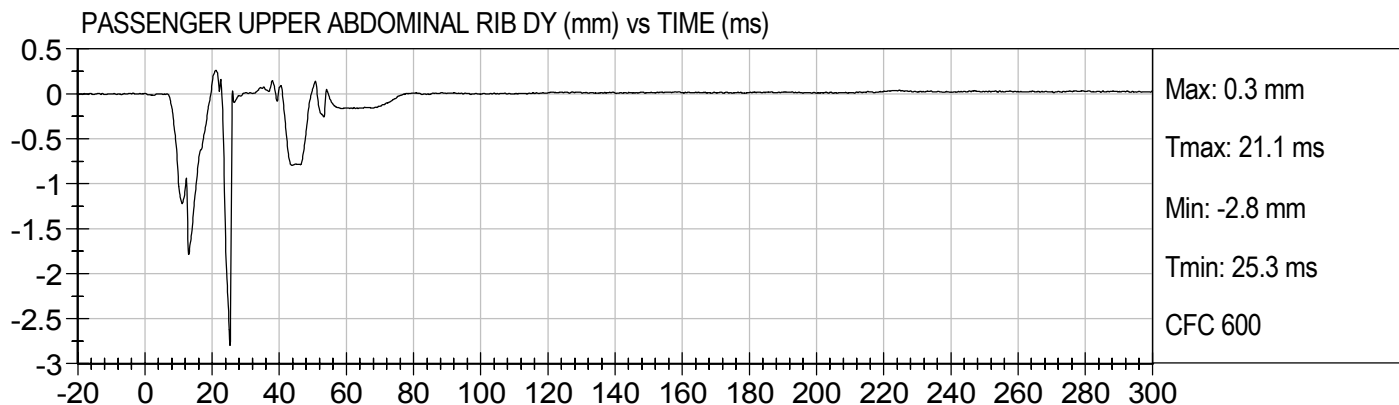


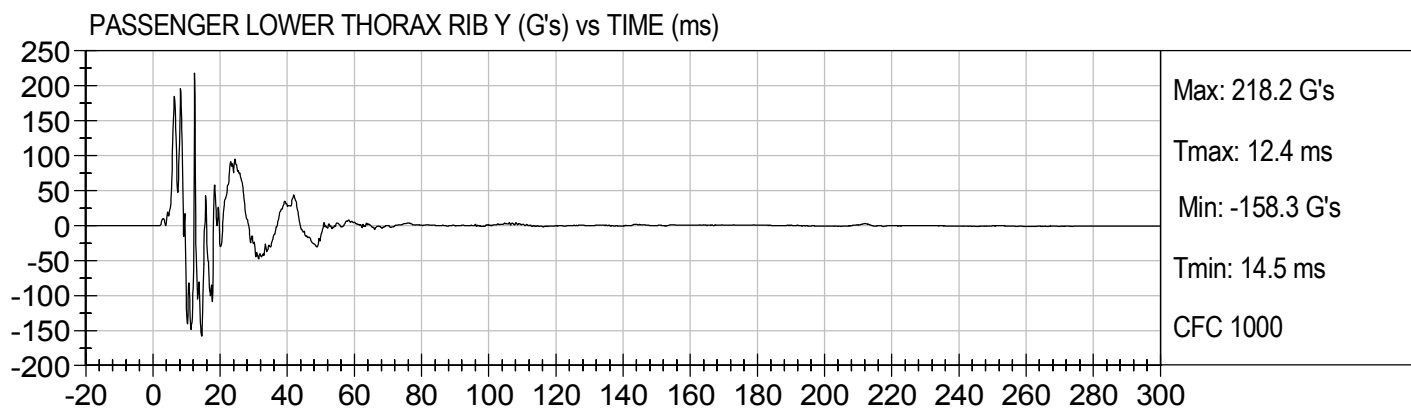
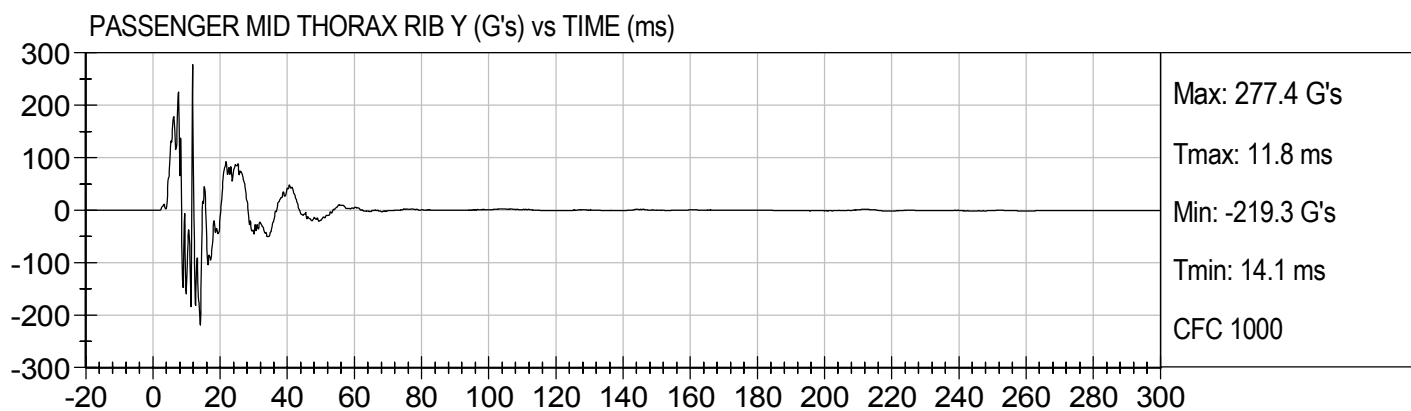
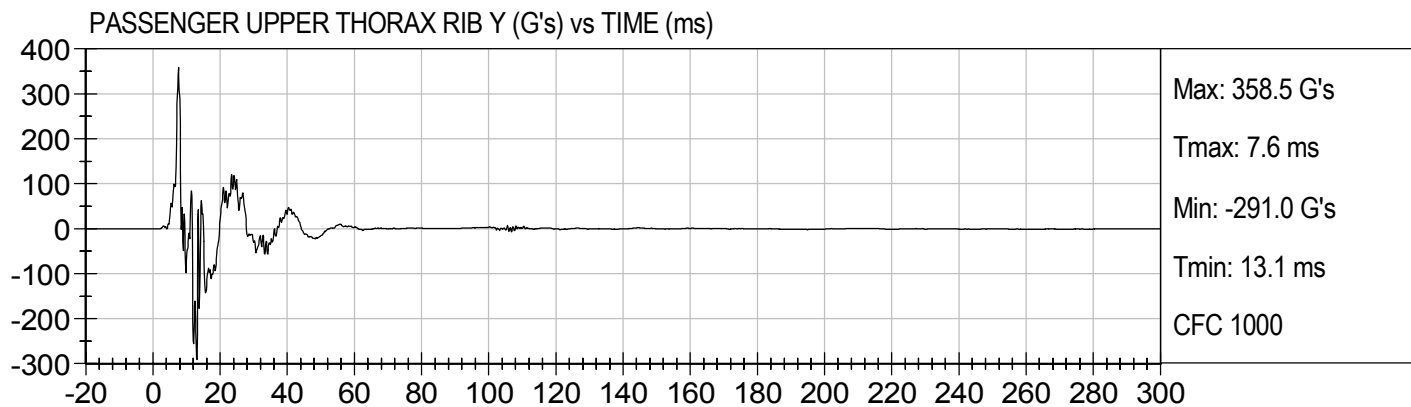


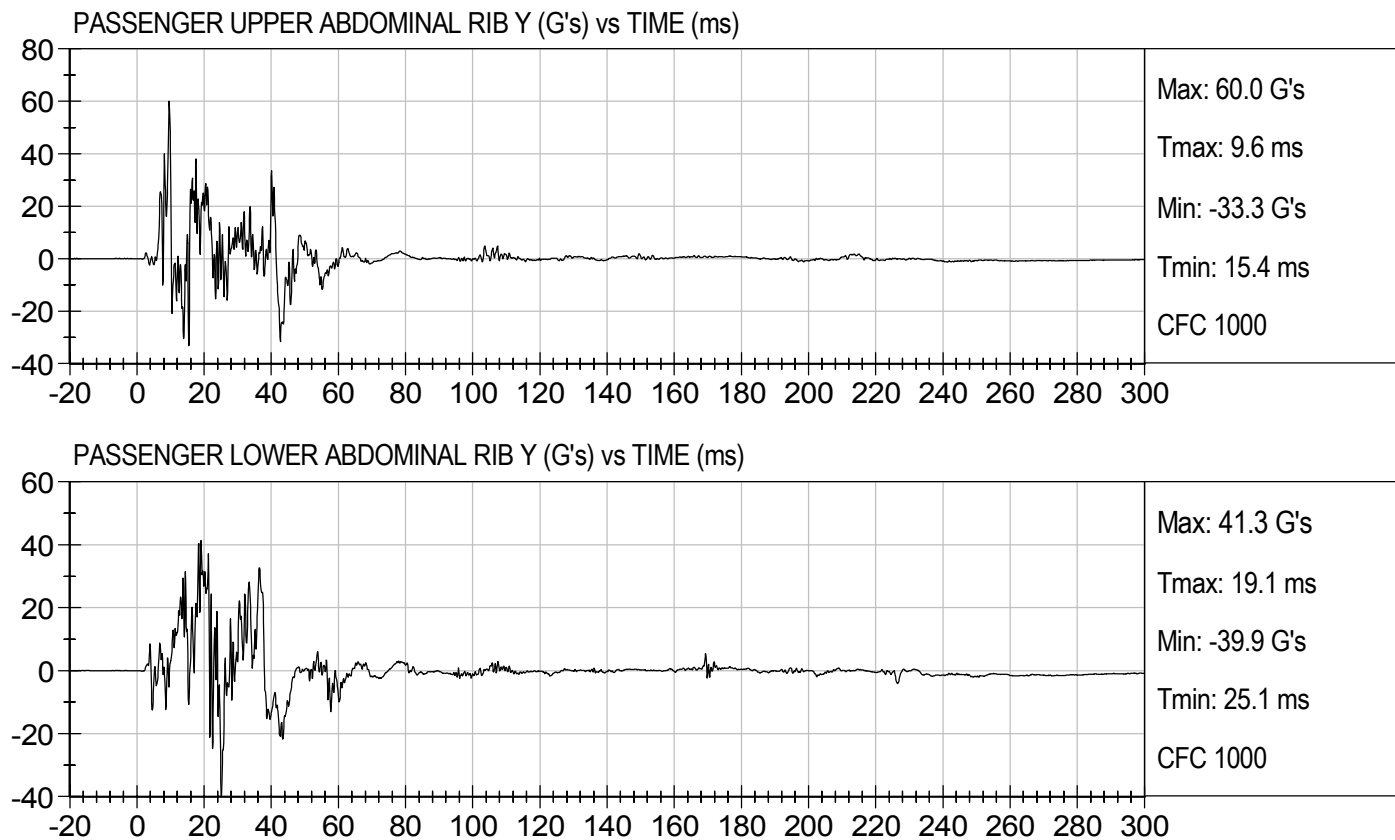


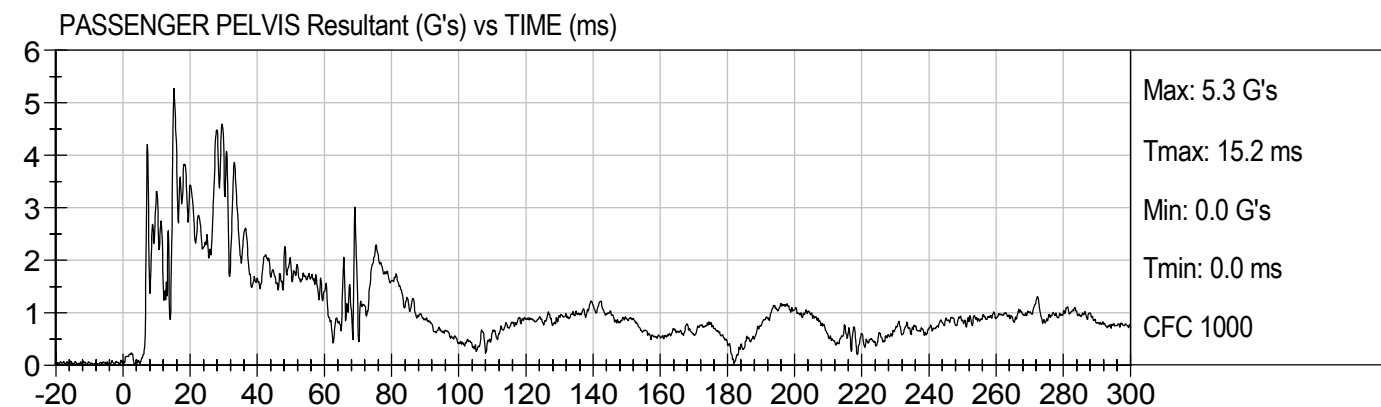
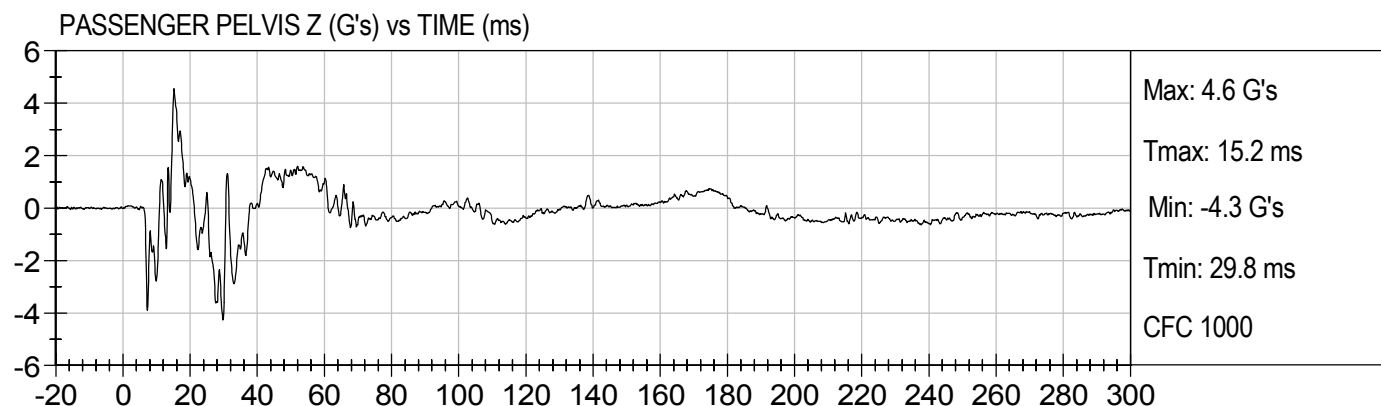
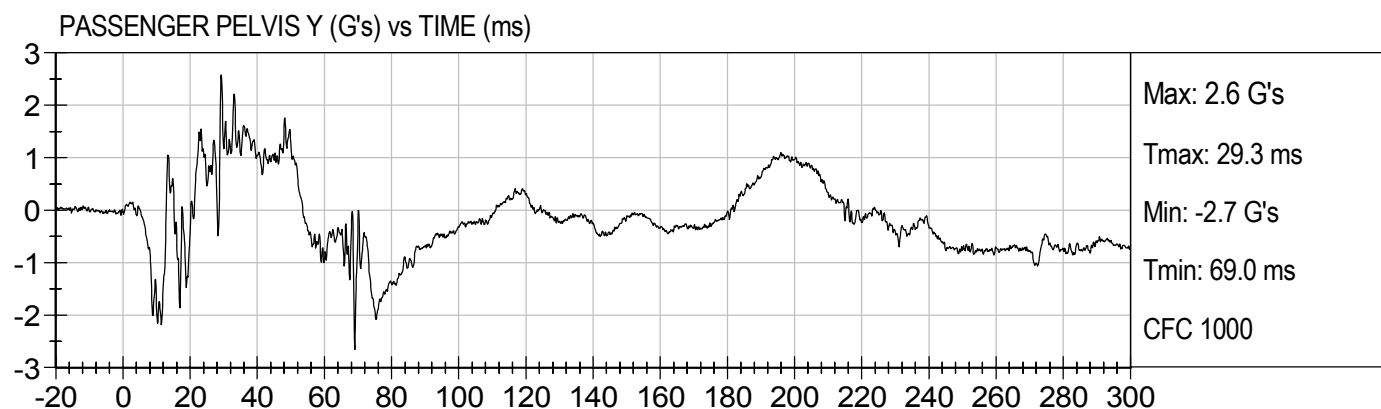
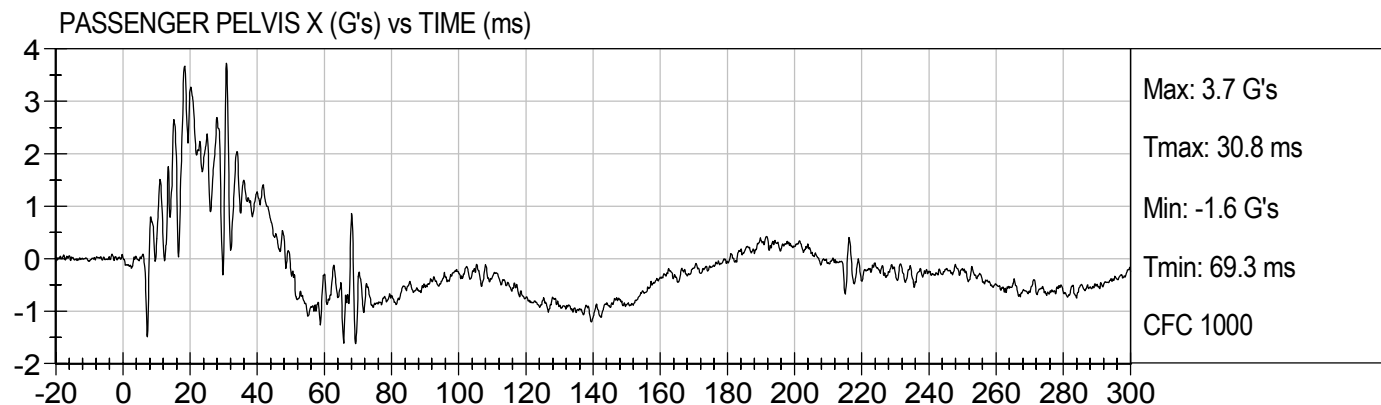












APPENDIX C**INSTRUMENTATION CALIBRATION DATA****SID-IIs Build Level D – Serial Number 032**

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	P47837	Endevco	4/19/2007
Head Y	P47845	Endevco	4/19/2007
Head Z	P47835	Endevco	4/19/2007
Upper Neck Load Cell	NG180	FTSS	3/13/2007
Lower Neck Load Cell	LNG101	FTSS	3/19/2007
Upper Spine X	A12-A11	Entran	3/30/2007
Upper Spine Y	A05-A23	Entran	3/30/2007
Upper Spine Z	A27-Z07	Entran	3/30/2007
Lower Spine X	P52174	Endevco	1/19/2007
Lower Spine Y	P52172	Endevco	1/19/2007
Lower Spine Z	P52173	Endevco	1/19/2007
Shoulder Displacement	032SHLD	Servo	4/25/2007
Upper Thorax Rib Displacement	032RIB1	Servo	4/25/2007
Mid Thorax Rib Displacement	032RIB2	Servo	4/25/2007
Lower Thorax Rib Displacement	032RIB3	Servo	4/25/2007
Upper Abdominal Rib Displacement	032RIB4	Servo	4/25/2007
Lower Abdominal Rib Displacement	032RIB5	Servo	4/25/2007
Upper Thorax Rib Y	L17-Z13	Entran	4/03/2007
Mid Thorax Rib Y	C15-Z01	Entran	4/19/2007
Lower Thorax Rib Y	ET21191	Entran	4/03/2007
Upper Abdominal Rib Y	ET21248	Entran	3/30/2007
Lower Abdominal Rib Y	ET21158	Entran	3/30/2007
Upper Thorax Spine Y	P47109	Endevco	3/30/2007
Middle Thorax Spine Y	P47108	Endevco	3/30/2007
Lower Thorax Spine Y	P47110	Endevco	3/30/2007
Upper Abdomen Spine Y	P52172	Endevco	1/19/2007
Lower Abdomen Spine Y	L20-B17	Entran	4/02/2007
Pelvis X	P52171	Endevco	1/19/2007
Pelvis Y	P52169	Endevco	1/19/2007
Pelvis Z	P52170	Endevco	1/19/2007
Head X Redundant	P47846	Endevco	4/19/2007
Head Y Redundant	P47844	Endevco	4/19/2007
Head Z Redundant	P47838	Endevco	4/19/2007