mga research corporation

REPORT NUMBER: TWG-MGA-2010-010

SIDE AIRBAG OUT-OF-POSITION INJURY TECHNICAL WORKING GROUP

FORD MOTOR COMPANY
2010 FORD FUSION S 4-DR SEDAN
NHTSA NUMBER: MA0211TWG2

TEST DATE: AUGUST 11, 2010

FINAL REPORT DATE: JANUARY 13, 2011

FINAL REPORT

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FINAL REPORT ACCEPTANCE BY:

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Date: _____

The results presented in this report relate only to the specified test items.

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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 air bag deployment. These data constitute part of the general consumer information collected by Alpha Technology Associate, Inc.

SUMMARY

The effects of both a curtain and torso airbag deployment in a 2010 Ford Fusion S 4-Dr Sedan with an out-of-position Hybrid III 6-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on August 11, 2010. Pre and post test photographs of the vehicle and dummy can be found in Appendix A.

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 ¾ View Through Windshield

One Hybrid III 6-Year-Old child dummy (Serial Number 144) was placed in the right front passenger seat situated in the front-facing position along the outboard edge of the seat per Section 3.3.3.5 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
- Chest Accelerations
- Upper Thorax @ Spine Acceleration
- Upper Spine Acceleration
- Upper Sternum Acceleration
- Lower Sternum Acceleration
- Lower Abdominal @ Spine Acceleration

The 23 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 6-Year-Old child dummy's visible contact points were as follows:

- Curtain airbag to top and right side of head
- Torso bag to right shoulder and right torso

The Hybrid III 6-Year-Old child dummy was placed in the right front passenger seat along the outboard edge of the foam block, aligning the upper spine with the deployment trajectory of the airbag. The dummy's head was placed in between the seat bolster and pillar/side trim. The head remained in its neutral orientation. The legs were aligned so that they cross the heel placement points that were previously marked on the seat cushion. The feet were held in place and the pelvis slid forward and parallel to the centerline of the vehicle until the dummy's head/neck junction was aligned vertically with the top edge of the airbag module. The legs were then repositioned so that they cross the heel placement points. With the vehicle door closed, the dummy's outboard arm was raised to clear the armrest and the pelvis and upper torso was slid outboard until the pelvis or torso contacted the door. The outboard arm was placed on the armrest. The inboard arm was flexed so that the upper arm contacted the seat back and the fingertips contacted the foam block.

The dummy's skullcap seam was taped with 4mm electrical tape to prevent the airbag from getting caught in the seam. The dummy's headskin was cleaned with alcohol and dusted with baby powder to achieve acceptable frictional characteristics.

This orientation complies with Section 3.3.3.5 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	3.3.3.5*	Forward-facing child dummy
Curtain Airbag	Roof-Rail Mounted	Side Airbag
Torso Airbag	Seat Mounted	Side Airbag
ATD Type/Serial No.	Hybrid III 6 Year Old / 144	Child Dummy

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

Number of Data Channels	23
Number of Airbag Channels	4
Number of High-Speed Video	3

Visible Dummy Contact Points	
Head Contact	Curtain airbag to top and right side of head
Right Shoulder Contact	Torso bag
Right Torso Contact	Torso bag
Right 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 June 25, 2009.

TEST VEHICLE INFORMATION

Manufacturer	Ford
Model	Fusion
Body Style	Sedan
NHTSA No.	MA0211TWG2
VIN	3FAHP0GA6AR117490
Color	Sangria Red Metallic
Delivery Date	6/01/2009
Odometer Reading (mile)	56
Dealer	Country Ford
Transmission	Manual
Final Drive	Front
Number of Cylinders	4
Engine Displacement (L)	2.5
Engine Placement	Lateral
Automatic Door Lock (ADL)	Yes
Owners Manual Details Instructions on Disabling ADLs	Yes
Bucket Seats	Yes

TEST VEHICLE OPTIONS

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

DATA FROM CERTIFICATION LABEL

Manufactured By	Ford Motor Company
Date of Manufacture	03/09

GVWR (kg)	1965
GAWR Front (kg)	1034
GAWR Rear (kg)	931

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bucket		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				385
Cargo Wt. (RCLW) (kg)				45

DATA SHEET NO. 3

DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		Between Mid & Rear
Seat Height Position		Non-Adjustable
Placed in Position No. 2		---
Seat Back Angle	SA (°)	10.8
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	282
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	145
Head CG to Door Panel/Window	HD (mm)	184
Head to Seat Back Centerline	HSC (mm)	207
Chest to Dash	CD (mm)	610
Chest to Seatback	CS (mm)	198
Right Arm to Seat Back Centerline	RACL (mm)	355
Left Arm to Seat Back Centerline	LACL (mm)	118
Right Arm to Door Panel	RA (mm)	Contact
Left Arm to B-Post	LA (mm)	196
Knee to Knee	KK (mm)	137
Toe to Toe	TT (mm)	160
Right Knee to Seat Cushion Centerline	KSCR (mm)	180
Left Knee to Seat Cushion Centerline	KSCL (mm)	41
Right Toe to Seat Cushion Centerline	TSCR (mm)	84
Left Toe to Seat Cushion Centerline	TSCL (mm)	68
Nose to Dash	ND (mm)	659
Nose to Seatback	NS (mm)	260
Top of Head to Headliner	HH (mm)	130

DATA SHEET NO. 4

DUMMY INJURY CRITERIA VALUES

NHTSA No. MA0211TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	32.0	10.4	-3.3	4.5
Head Y	g	1.6	10.9	-31.1	10.6
Head Z	g	53.1	10.5	-14.0	11.8
Head Resultant	g	60.3	10.5		
Upper Neck Fx	N	303.2	10.1	-65.3	122.6
Upper Neck Fy	N	46.3	118.9	-239.9	14.1
Upper Neck Fz	N	227.4	22.0	-716.5	10.6
Upper Neck F Resultant	N	751.1	10.6		
Upper Neck Mx	Nm	15.4	9.8	-23.2	21.6
Upper Neck My	Nm	28.4	10.1	-18.9	32.0
Upper Neck Mz	Nm	1.7	114.7	-5.0	14.7
Upper Neck M Resultant	Nm	32.4	10.1		
Lower Neck Fx	N	405.0	10.9	-82.1	36.3
Lower Neck Fy	N	113.9	5.5	-261.4	13.1
Lower Neck Fz	N	367.5	4.1	-463.2	4.5
Lower Neck F Resultant	N	547.0	4.5		
Lower Neck Mx	Nm	8.3	108.4	-43.7	14.6
Lower Neck My	Nm	14.1	126.6	-38.1	16.4
Lower Neck Mz	Nm	3.4	121.3	-28.9	8.9
Lower Neck M Resultant	Nm	62.1	14.5		
Chest X	G	46.8	3.9	-4.9	39.1
Chest Y	G	22.5	9.3	-13.6	5.5
Chest Z	G	10.5	8.6	-3.5	4.7
Chest Resultant	G	49.5	3.9		
Upper Spine X	G	23.1	8.7	-92.2	4.8
Upper Sternum X	G	308.7	5.2	-234.2	5.7
Lower Sternum X	G	154.7	5.5	-184.8	5.2
Upper Thorax @ Spine X	G	28.1	8.6	-7.3	39.4
Lower Abdominal @ Spine X	G	18.9	4.4	-1.7	41.6

DATA SHEET NO. 4 (continued)

DUMMY INJURY CRITERIA VALUES

NHTSA No. MA0211TWG2

	HEAD INJURY CRITERIA (HIC)					
	HIC15			HIC36		
ATD position	HIC	T^1 (msec)	T^2 (msec)	HIC	T^1 (msec)	T^2 (msec)
No. 2 Right Front	14.2	7.7	11.1	16.2	5.5	28.9

Position 2 Neck Injury Summary (6-Year-Old – Out-Of-Position)

	Nij	Time (msec)	Z Force (N) (CFC 600)	X Force (N) (CFC 600)	Y Moment (N-m) (CFC 600)
Ntf	0.13	15.4	9.33	280.88	17.02
Nte	0.52	30.5	1.04	48.08	-18.50
Ncf	0.44	10.5	-566.02	179.62	25.52
Nce	0.55	32.4	-33.23	55.16	-18.89
Peak Tension (CFC1000)		**227.4 N**	**Peak Compression (CFC 1000)**		**-716.5 N**

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	2800 N	Extension (mCVe)	37 N-m	Tension	1490 N
Compression (CVc)	2800 N	Flexion (mCVf)	93 N-m	Compression	1820 N
Condyle Offset	**0.01778 m**				

APPENDIX A

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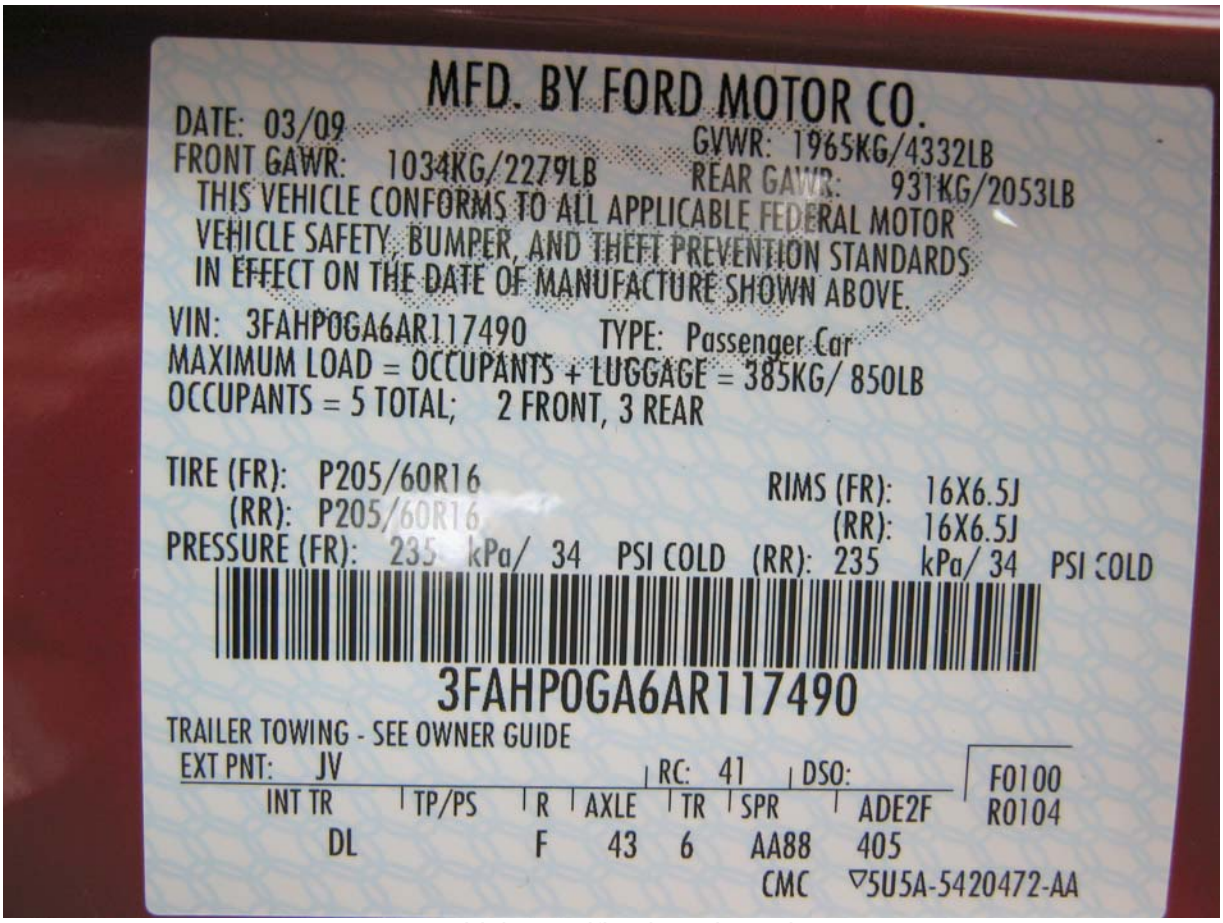
Right ¾ Front View of Vehicle, As Received



Vehicle Certification Placard

Pre-Test Vehicle Left Side View

Post-Test Vehicle Left Side View

Pre-Test 6-Year-Old Child Dummy Left Side View

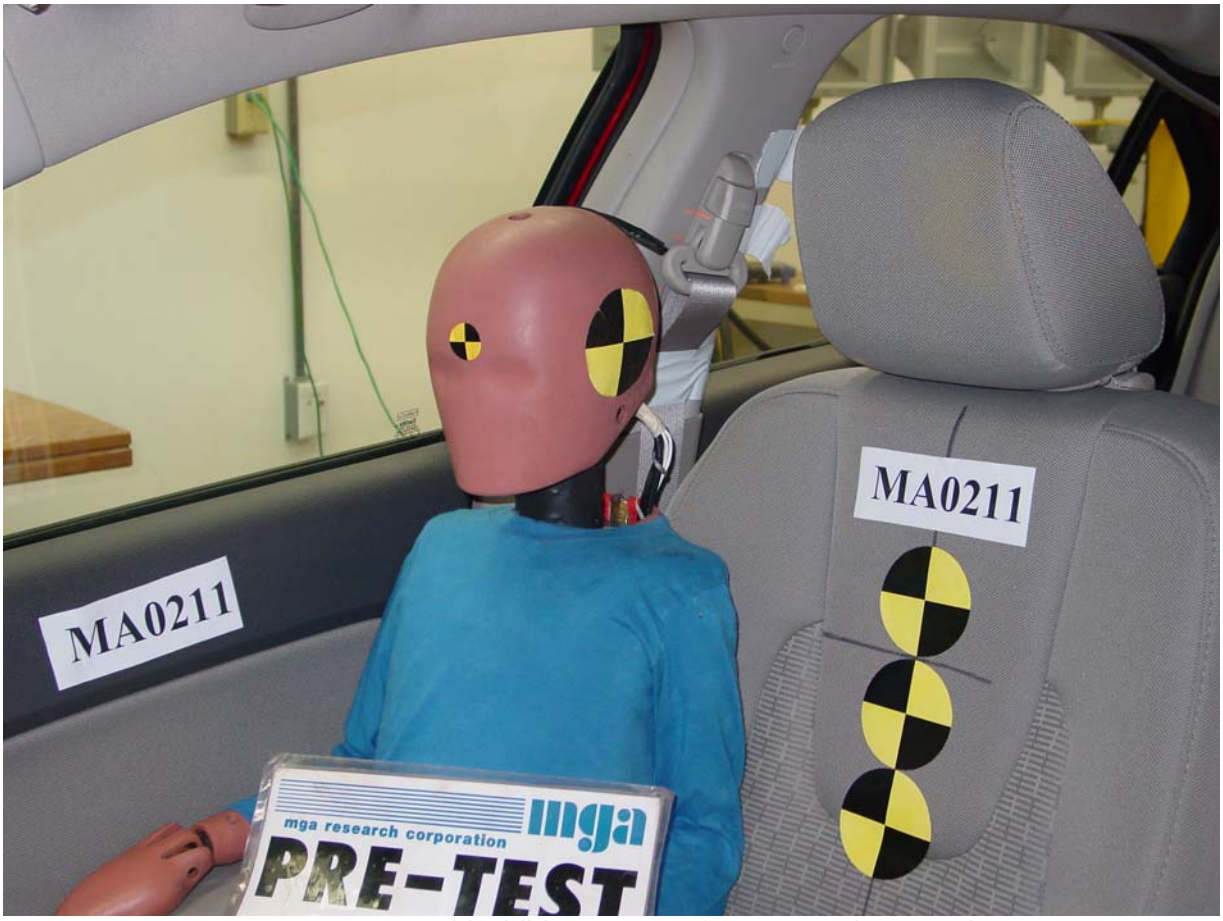
Post-Test 6-Year-Old Child Dummy Left Side View

Pre-Test 6-Year-Old Child Dummy Left Side Closeup View

Post-Test 6-Year-Old Child Dummy Left Side Closeup View

Pre-Test 6-Year-Old Child Dummy Left ¾ Front View

Post-Test 6-Year-Old Child Dummy Left ¾ Front View



Pre-Test 6-Year-Old Child Dummy Left ¾ Front Closeup View

Post-Test 6-Year-Old Child Dummy Left ¾ Front Closeup View

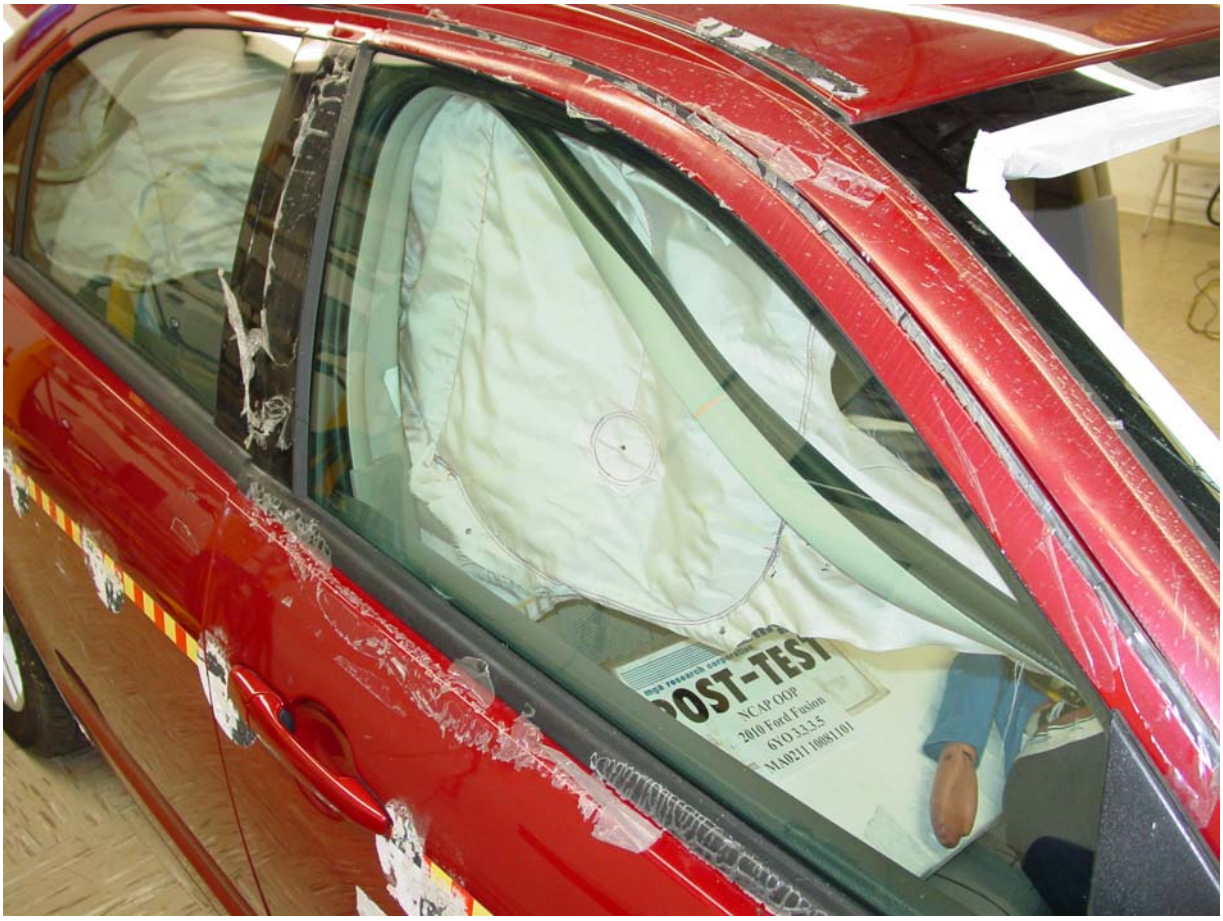
Pre-Test 6-Year-Old Child Dummy Front View

Post-Test 6-Year-Old Child Dummy Front View

Pre-Test 6-Year-Old Child Dummy Front Closeup View

Post-Test 6-Year-Old Child Dummy Front Closeup View

Pre-Test 6-Year-Old Child Dummy Right ¾ Front View



Post-Test 6-Year-Old Child Dummy Right ¾ Front View

Pre-Test 6-Year-Old Child Dummy Right Side View

Post-Test 6-Year-Old Child Dummy Right Side View

Post-Test Curtain and Torso Airbag Left View

Post-Test Curtain and Torso Airbag Left ¾ Front View

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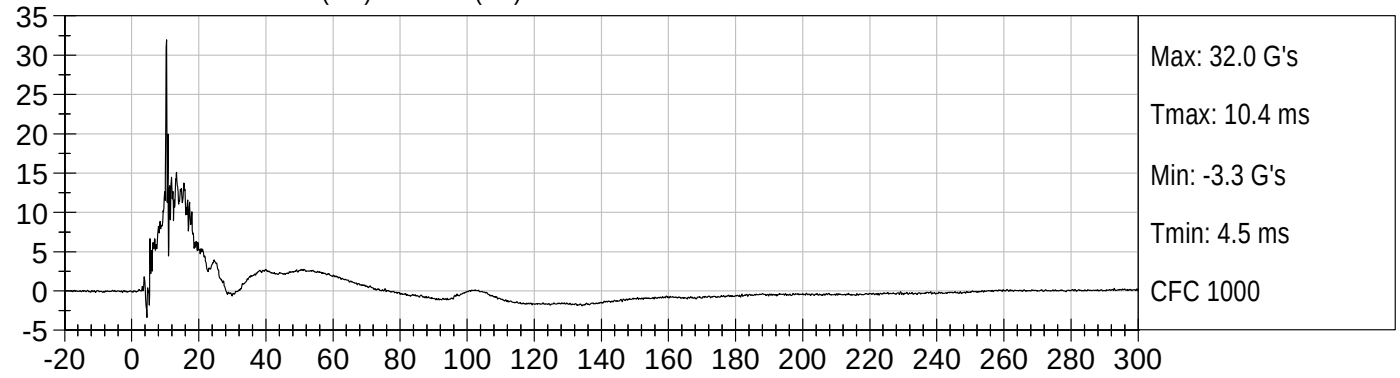
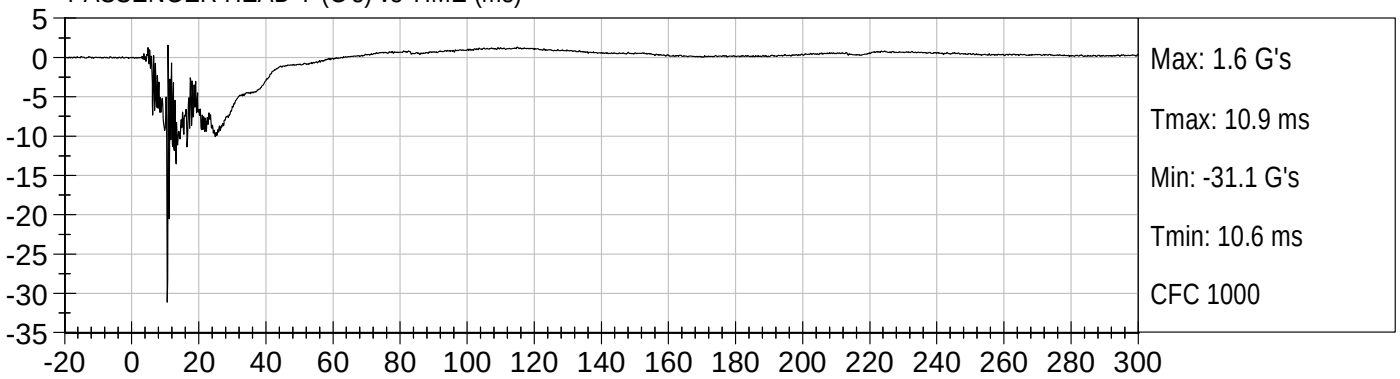
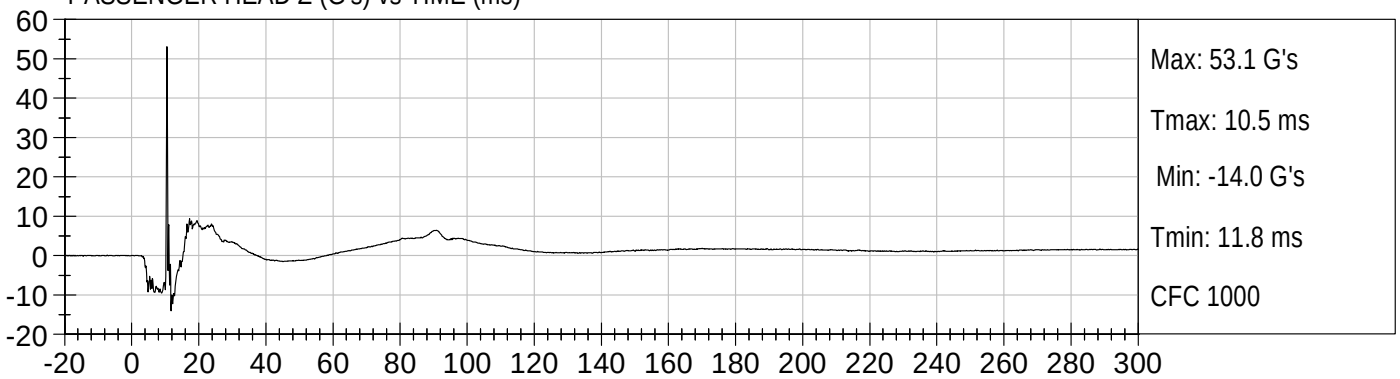
PASSENGER HEAD X (G's) vs TIME (ms)



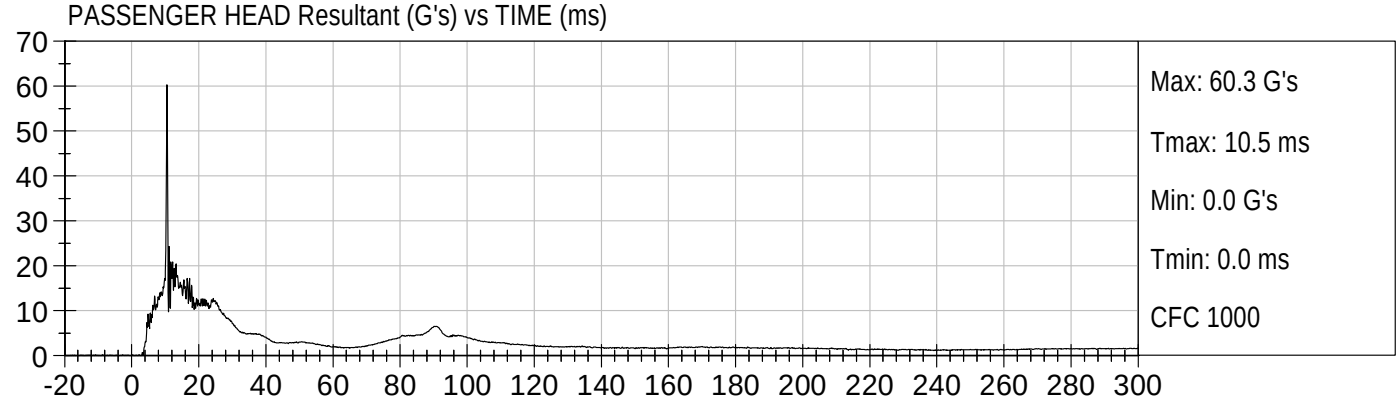
PASSENGER HEAD Y (G's) vs TIME (ms)



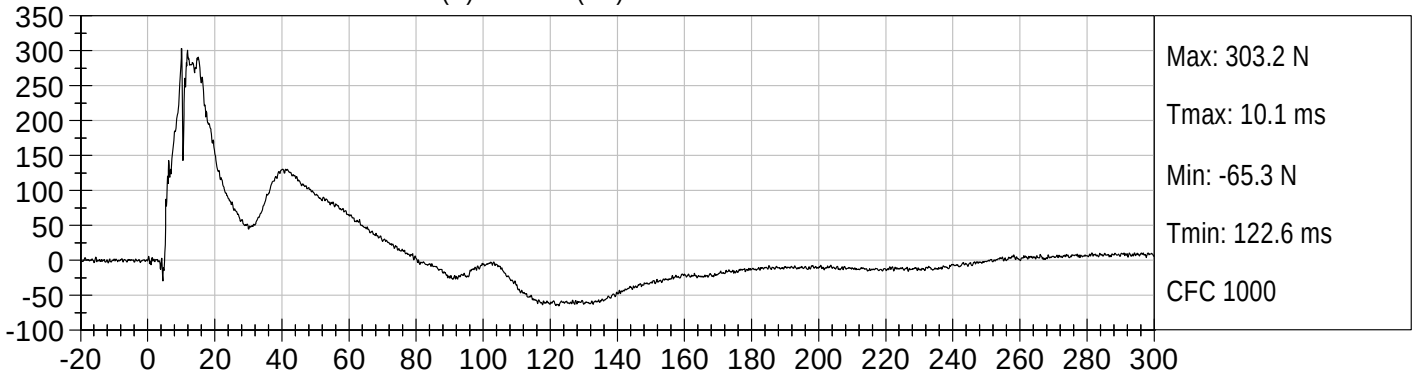
PASSENGER HEAD Z (G's) vs TIME (ms)



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



PASSENGER UPPER NECK FX (N) vs TIME (ms)



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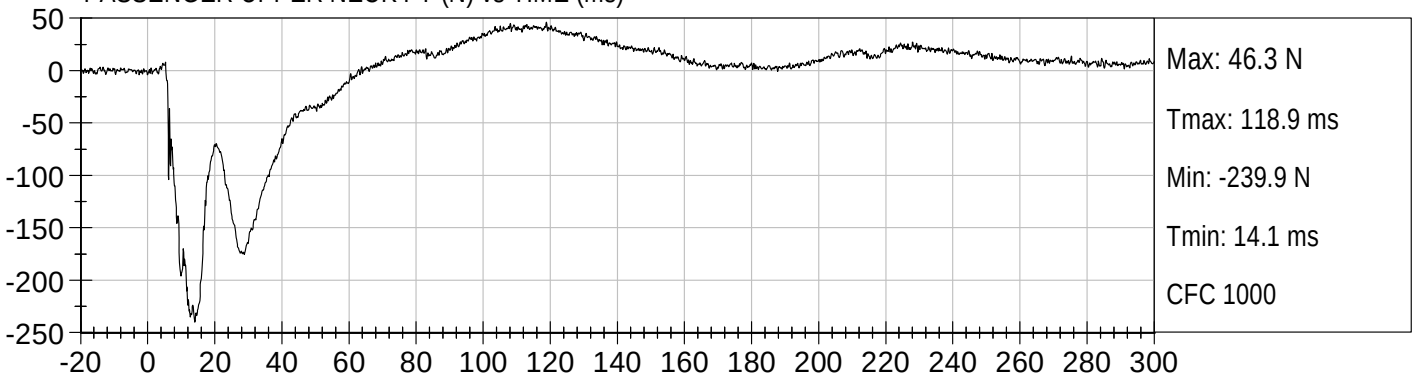

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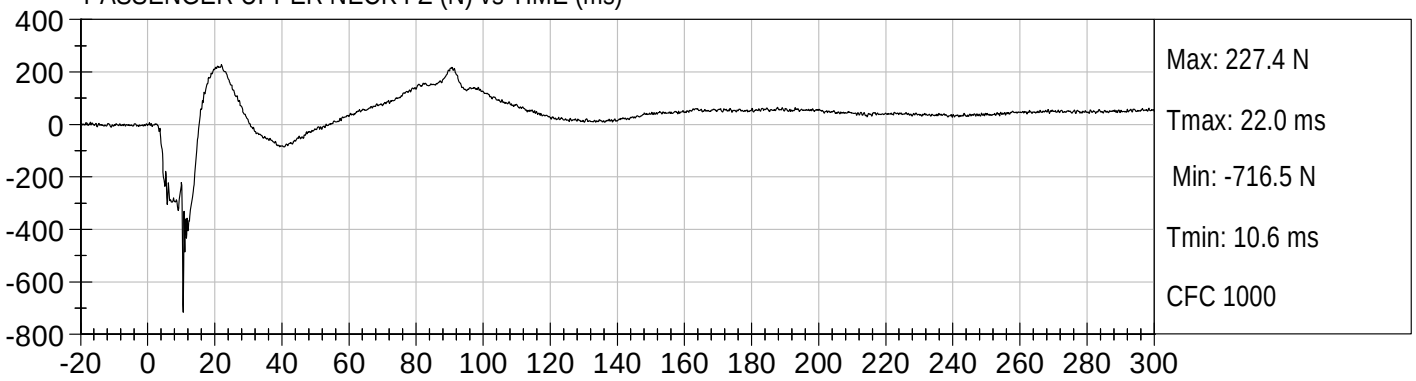
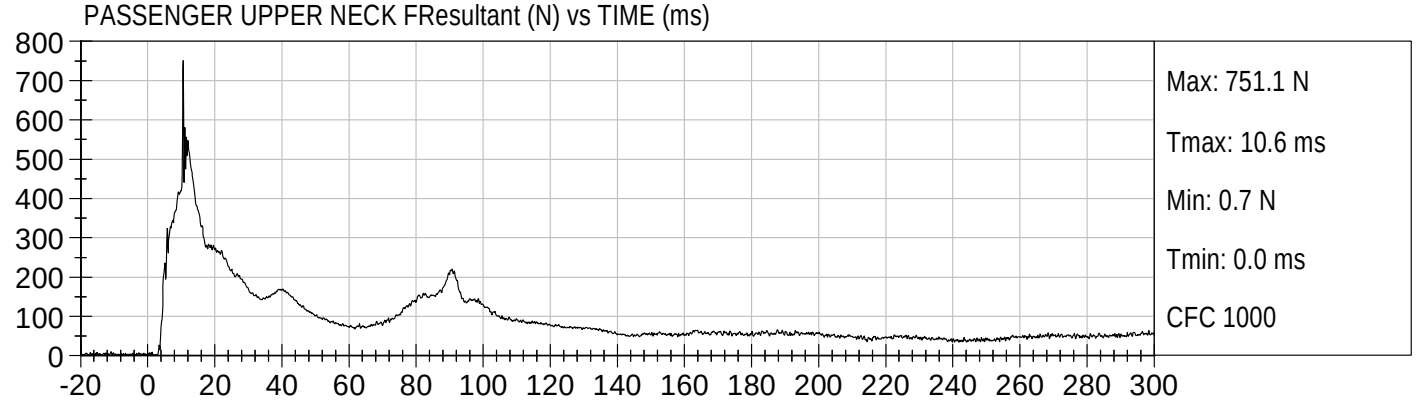
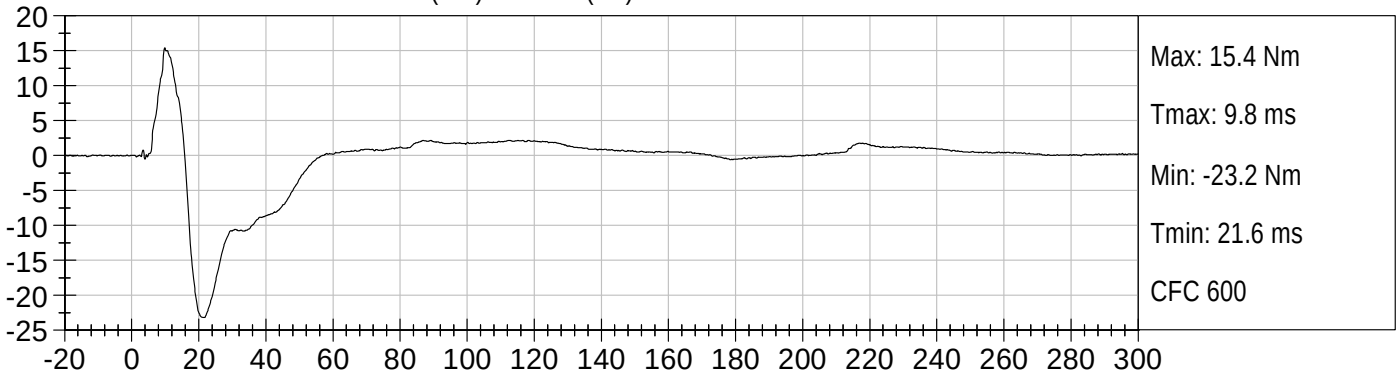


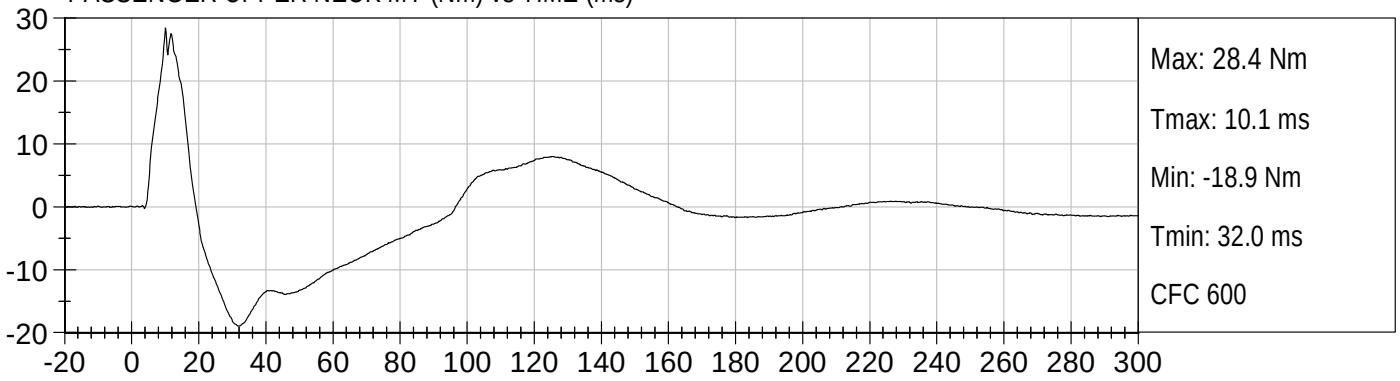
PASSENGER UPPER NECK FResultant (N) vs TIME (ms)



PASSENGER UPPER NECK MX (Nm) vs TIME (ms)



PASSENGER UPPER NECK MY (Nm) vs TIME (ms)



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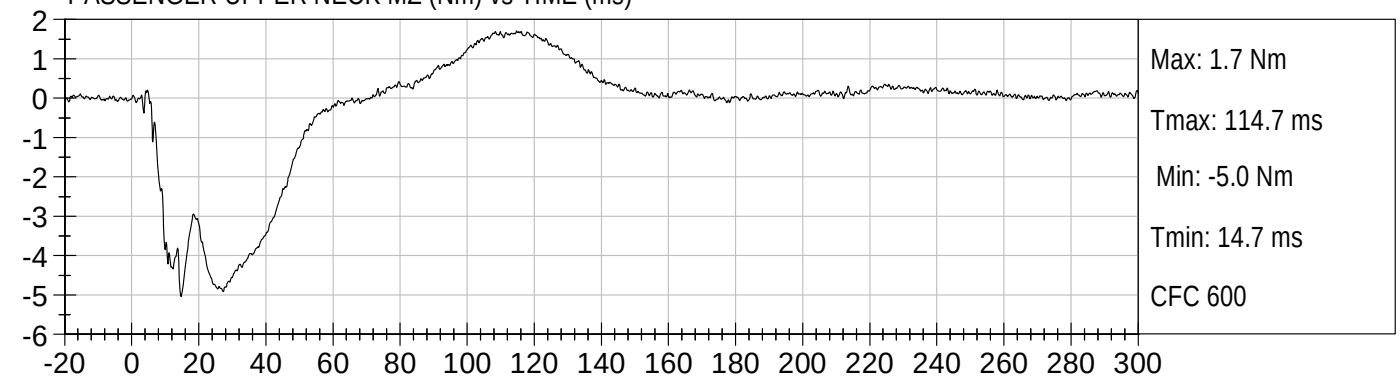
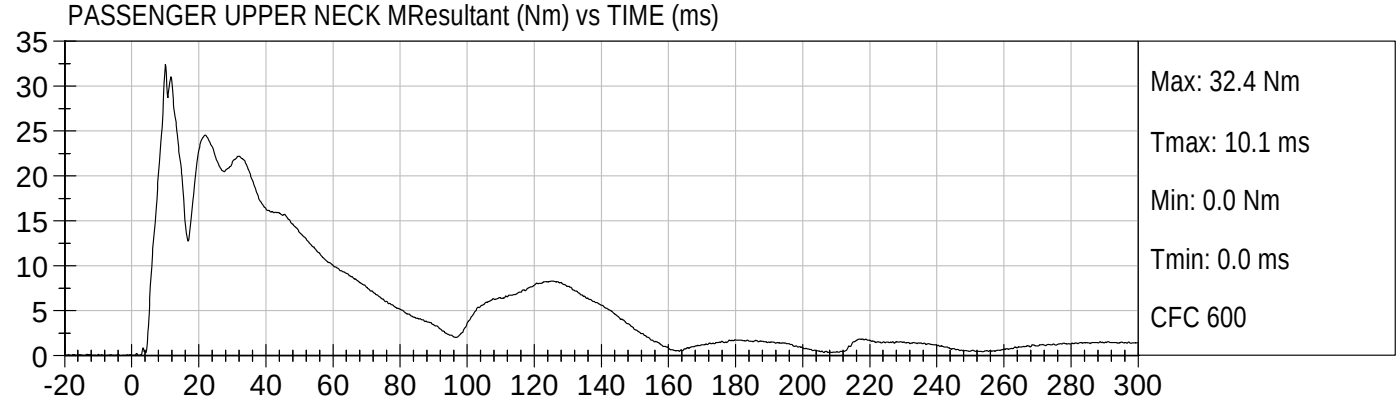
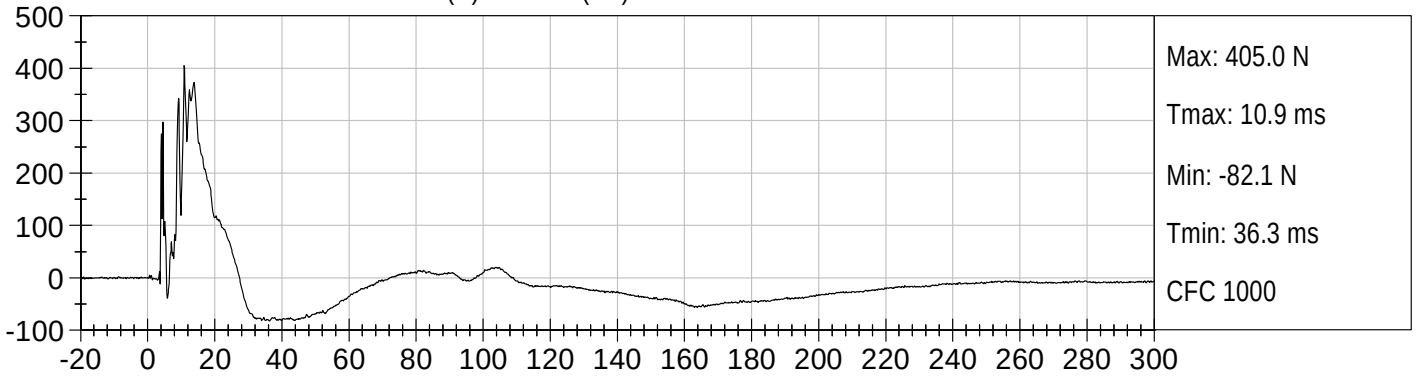


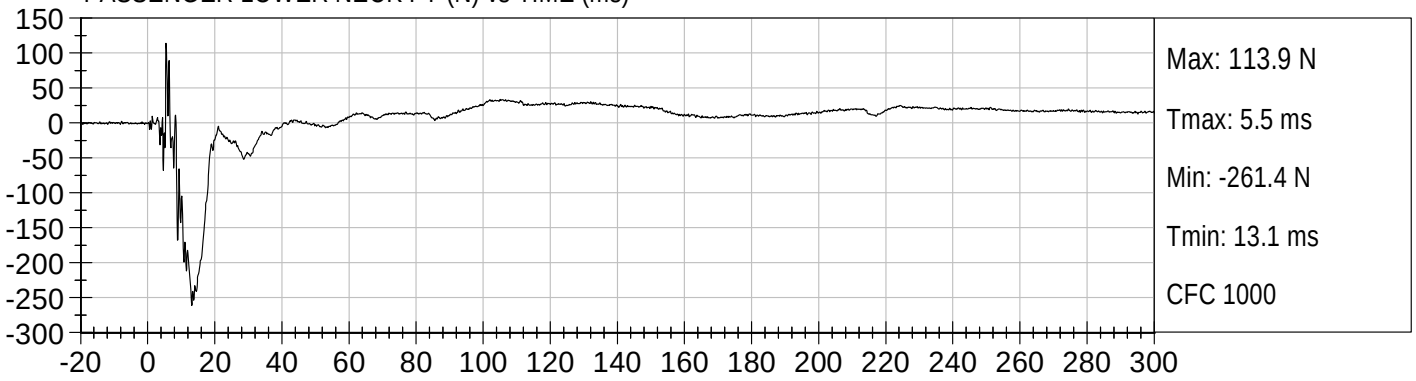
PASSENGER UPPER NECK MResultant (Nm) vs TIME (ms)



PASSENGER LOWER NECK FX (N) vs TIME (ms)



PASSENGER LOWER NECK FY (N) vs TIME (ms)



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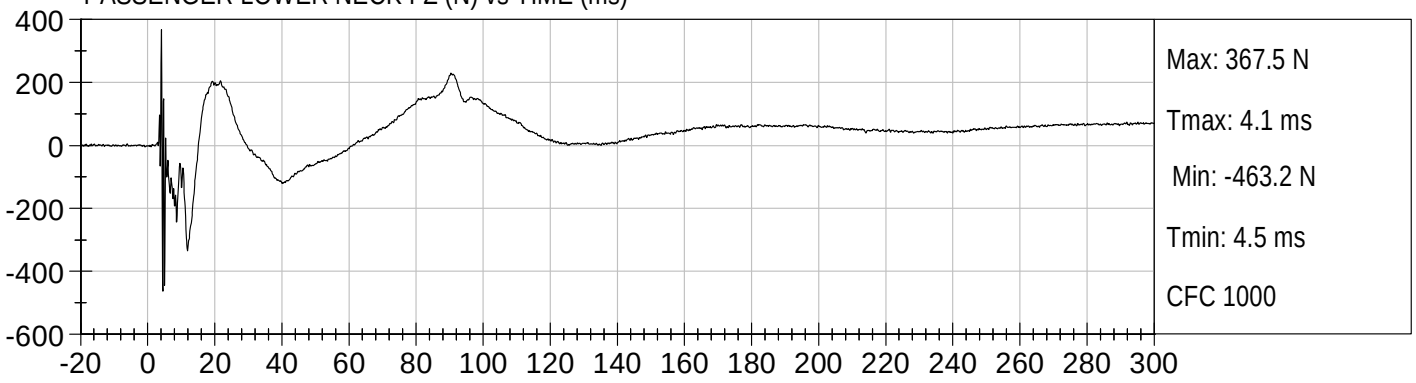
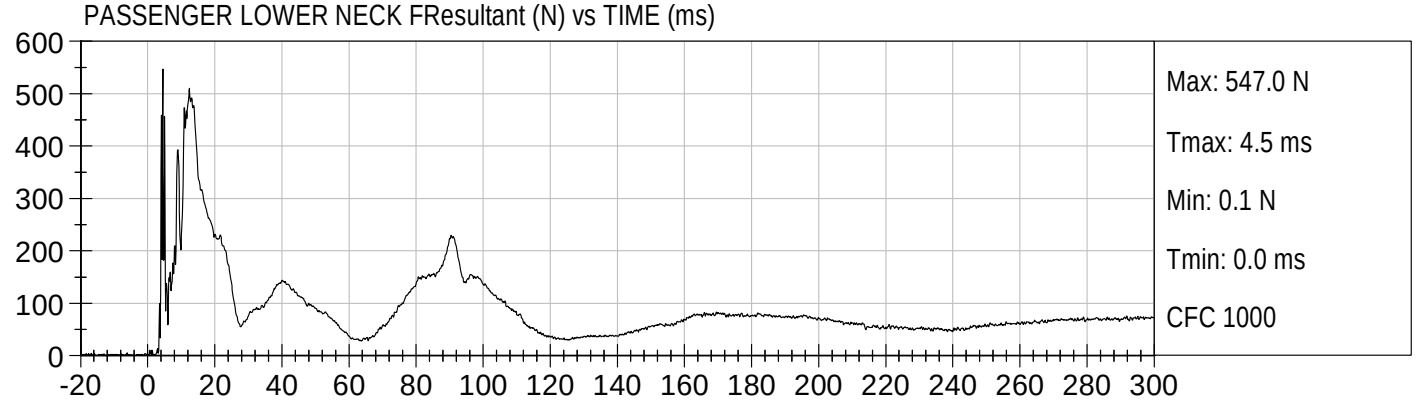
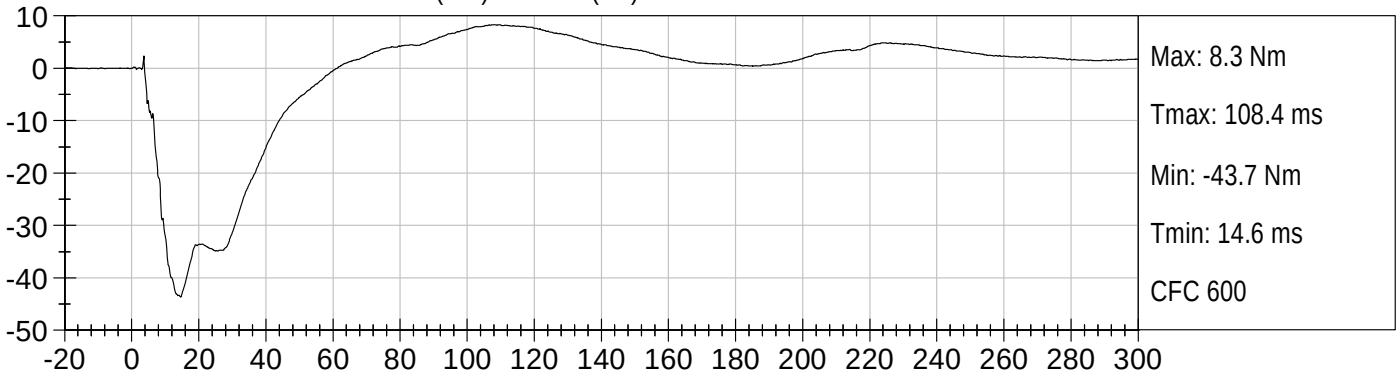


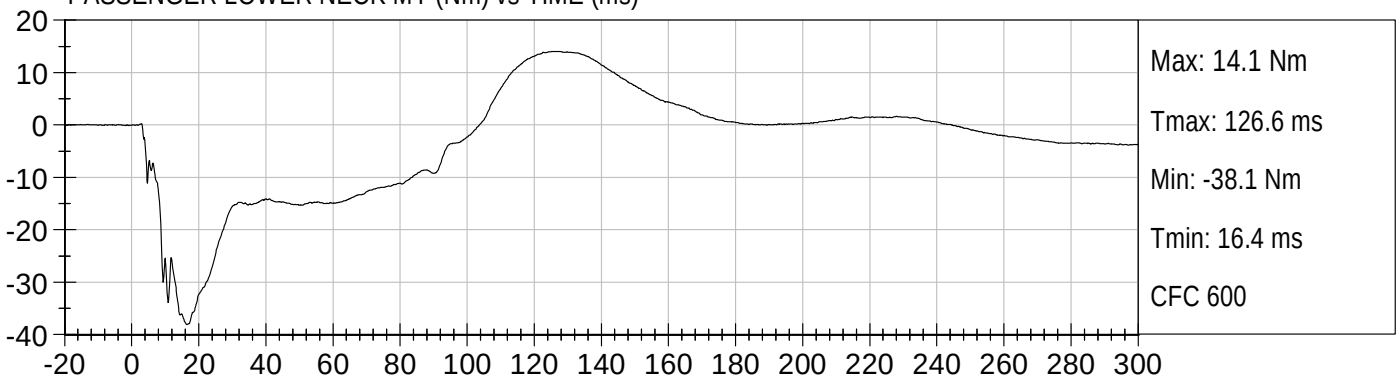
PASSENGER LOWER NECK FResultant (N) vs TIME (ms)



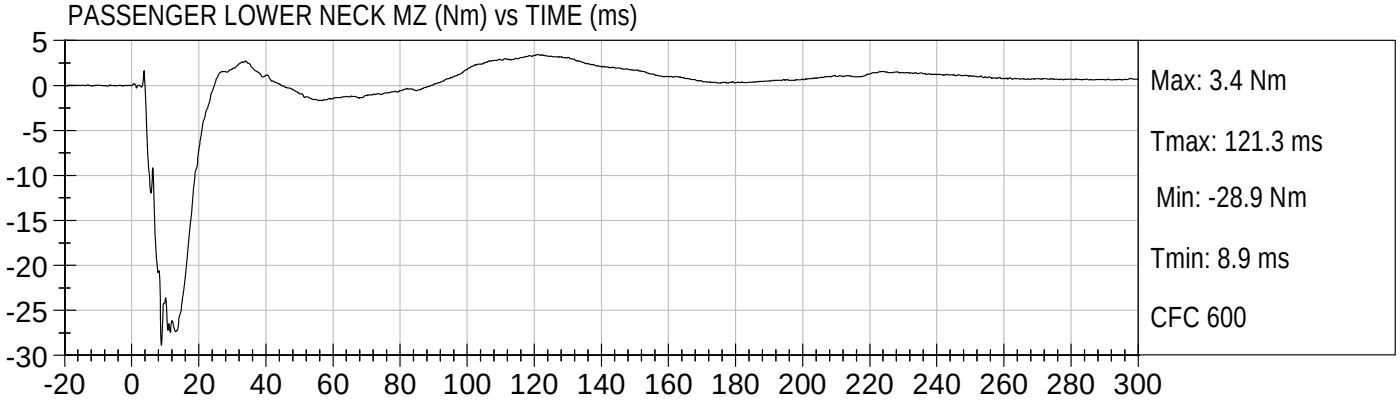
PASSENGER LOWER NECK MX (Nm) vs TIME (ms)



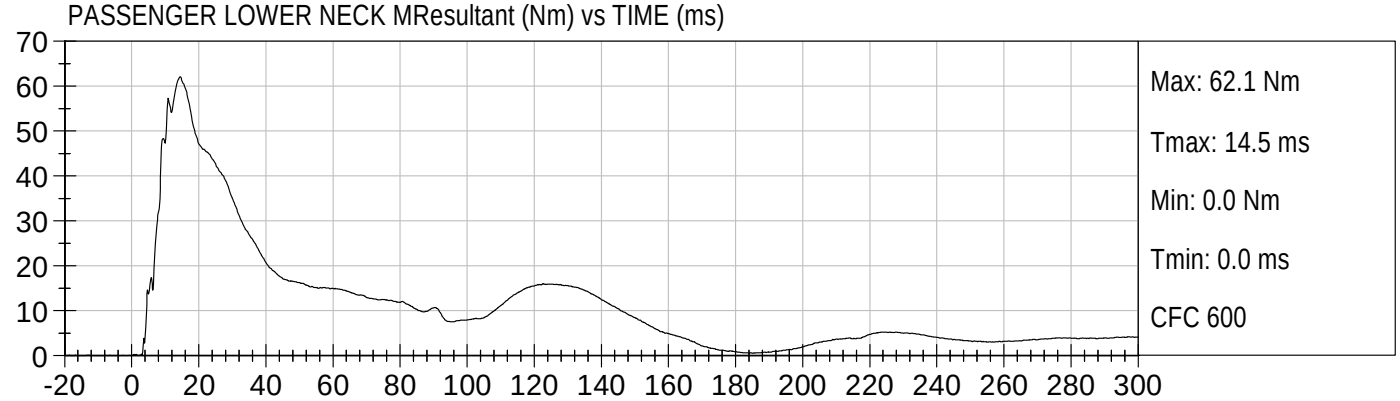
PASSENGER LOWER NECK MY (Nm) vs TIME (ms)



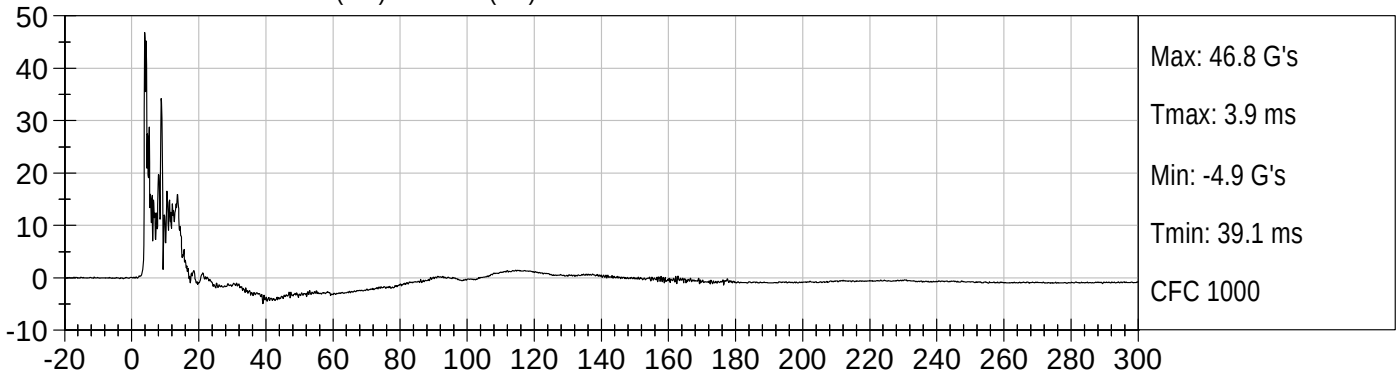
PASSENGER LOWER NECK MZ (Nm) vs TIME (ms)



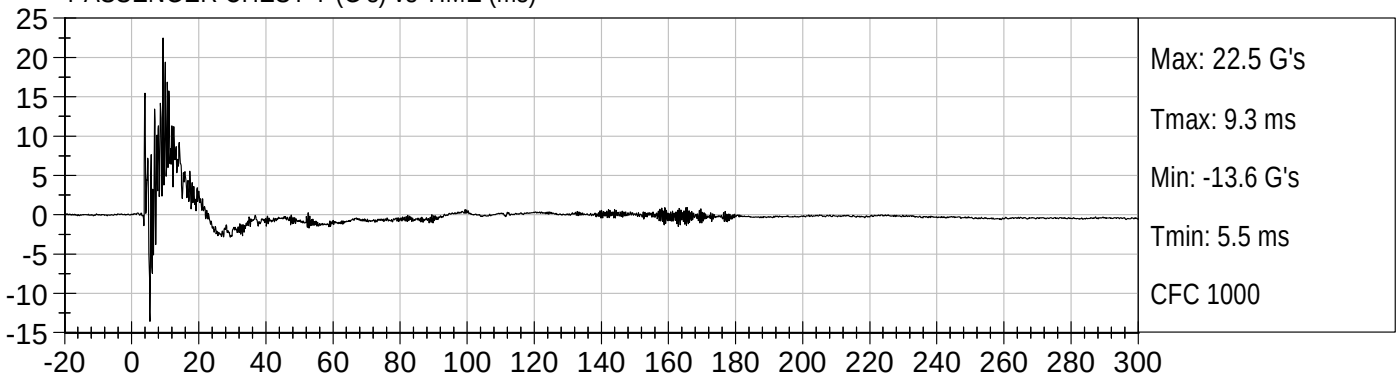
PASSENGER LOWER NECK MResultant (Nm) vs TIME (ms)



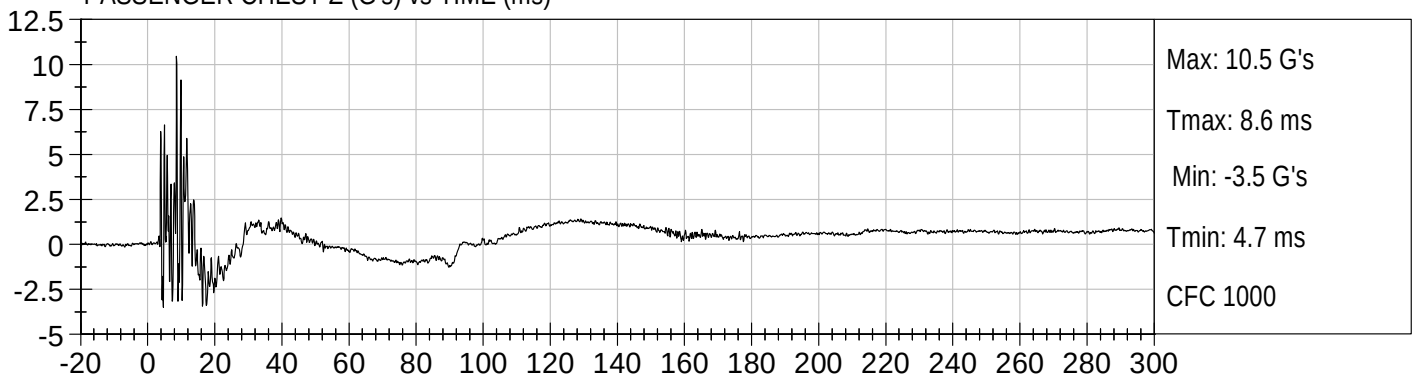
PASSENGER CHEST X (G's) vs TIME (ms)



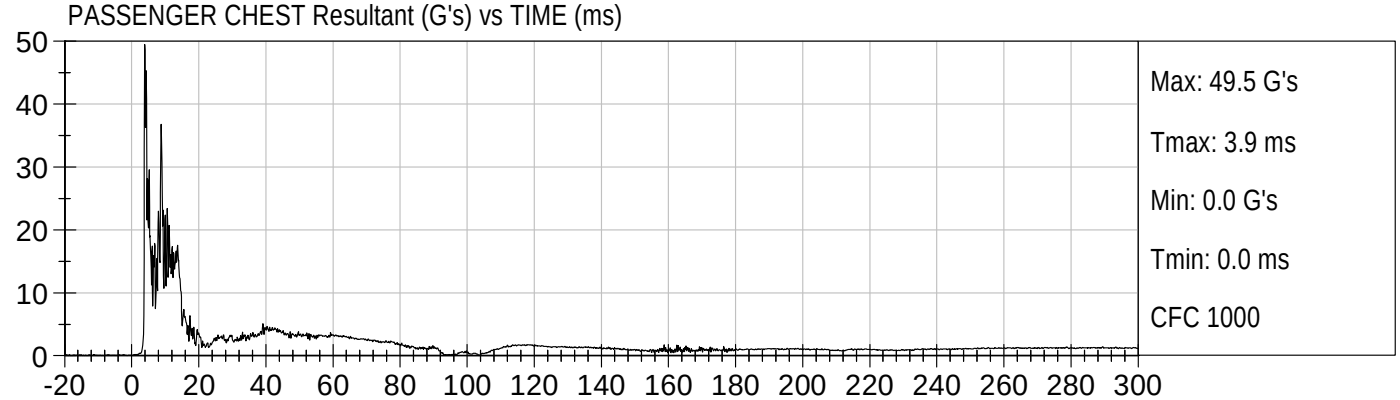
PASSENGER CHEST Y (G's) vs TIME (ms)



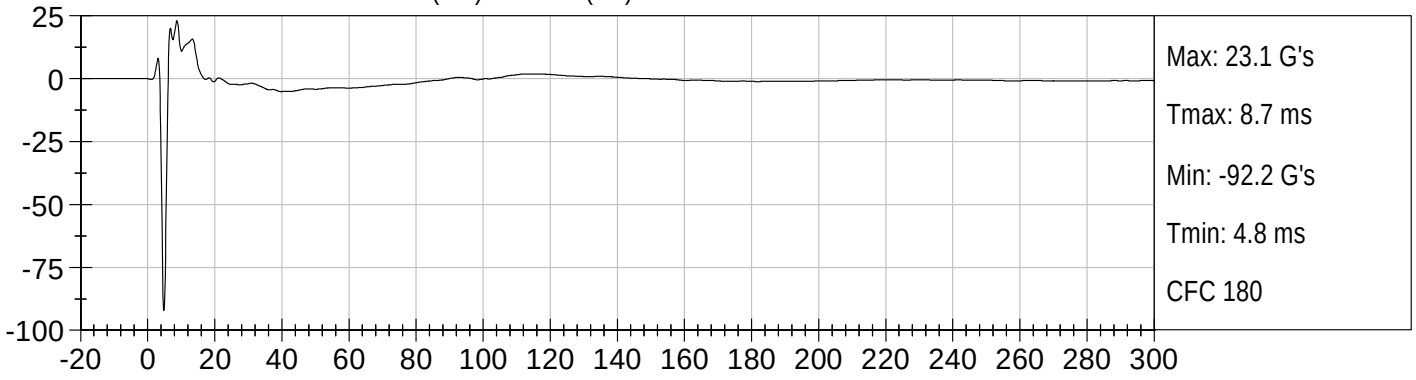
PASSENGER CHEST Z (G's) vs TIME (ms)



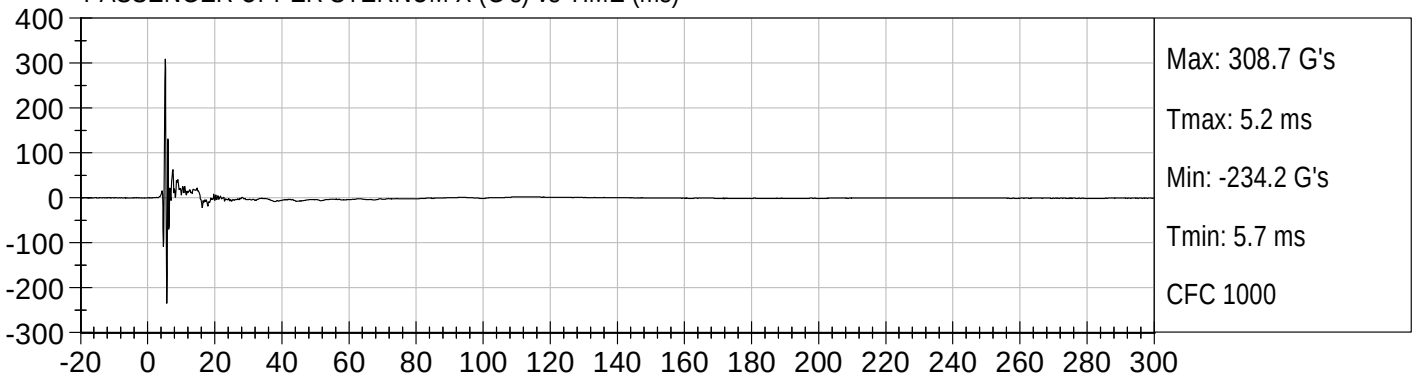
PASSENGER CHEST Resultant (G's) vs TIME (ms)



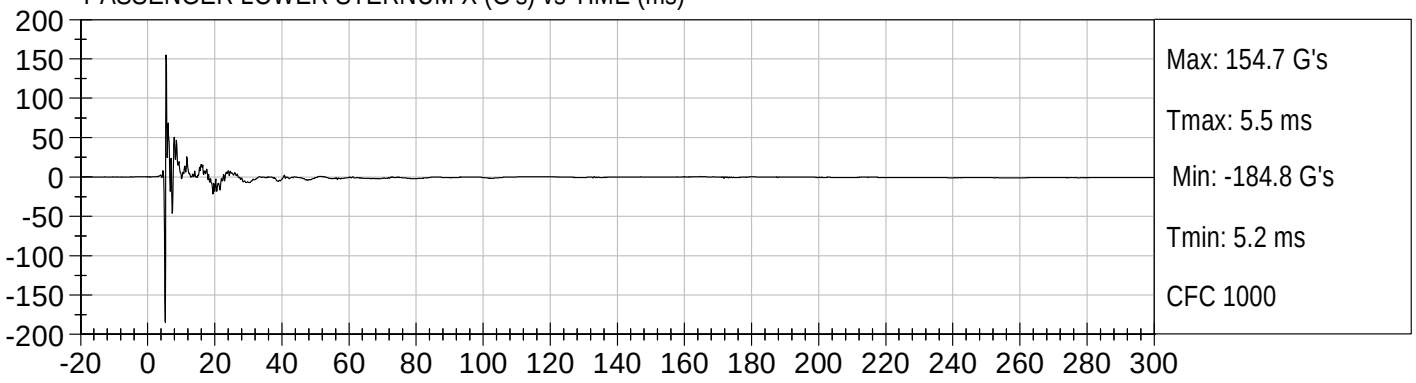
PASSENGER UPPER SPINE X (G's) vs TIME (ms)



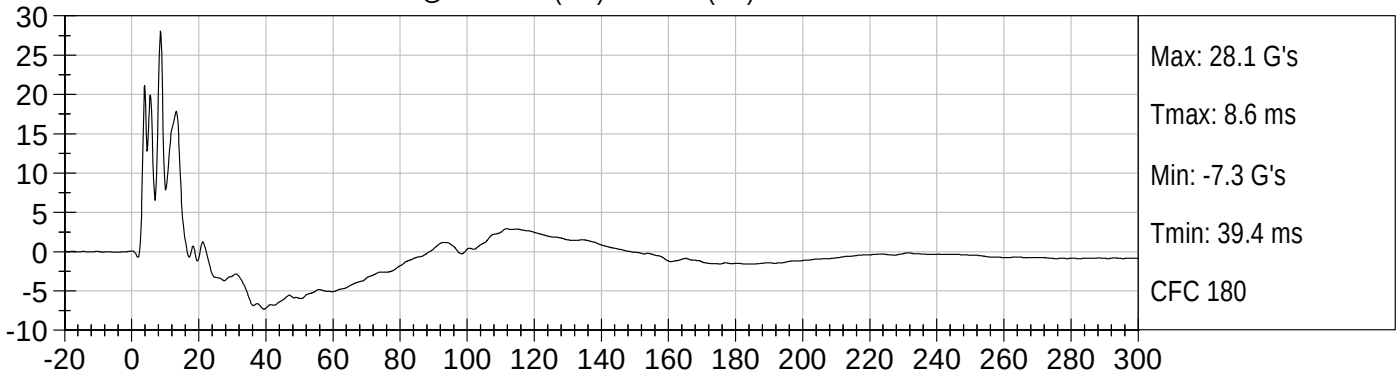
PASSENGER UPPER STERNUM X (G's) vs TIME (ms)



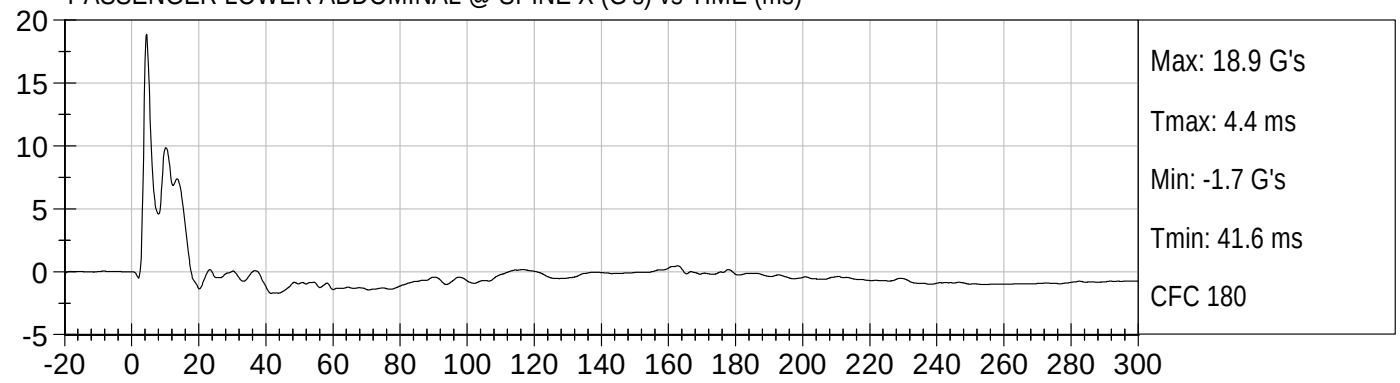
PASSENGER LOWER STERNUM X (G's) vs TIME (ms)



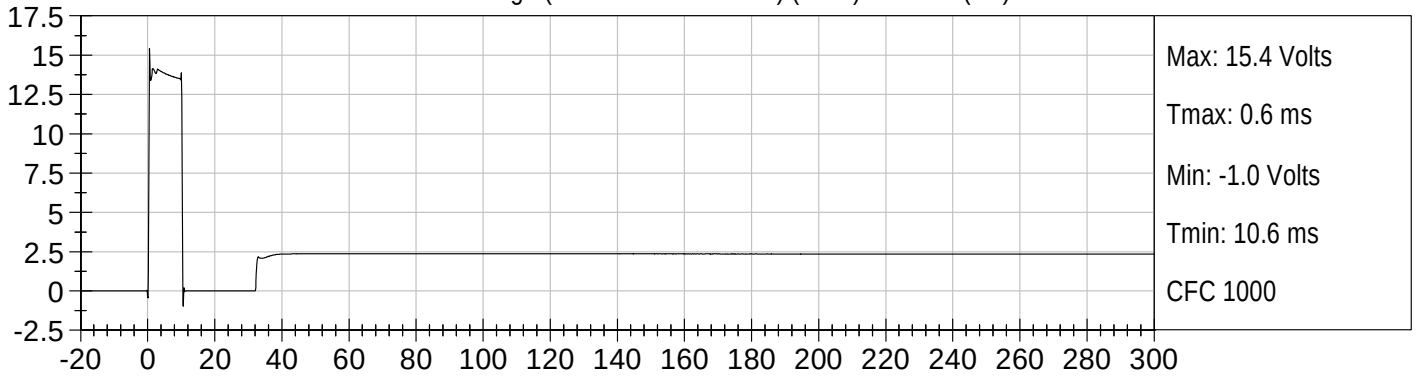
PASSENGER UPPER THORAX @ SPINE X (G's) vs TIME (ms)



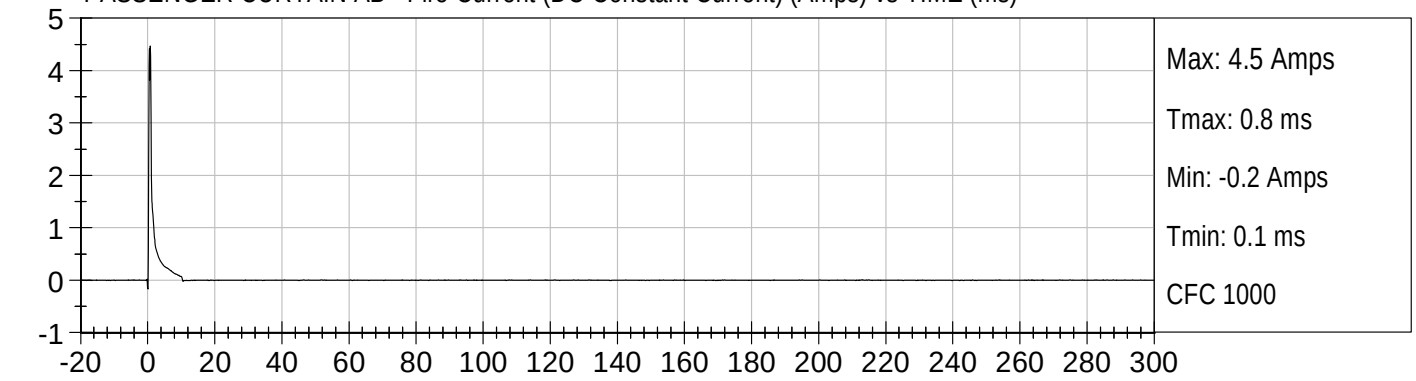
PASSENGER LOWER ABDOMINAL @ SPINE X (G's) vs TIME (ms)



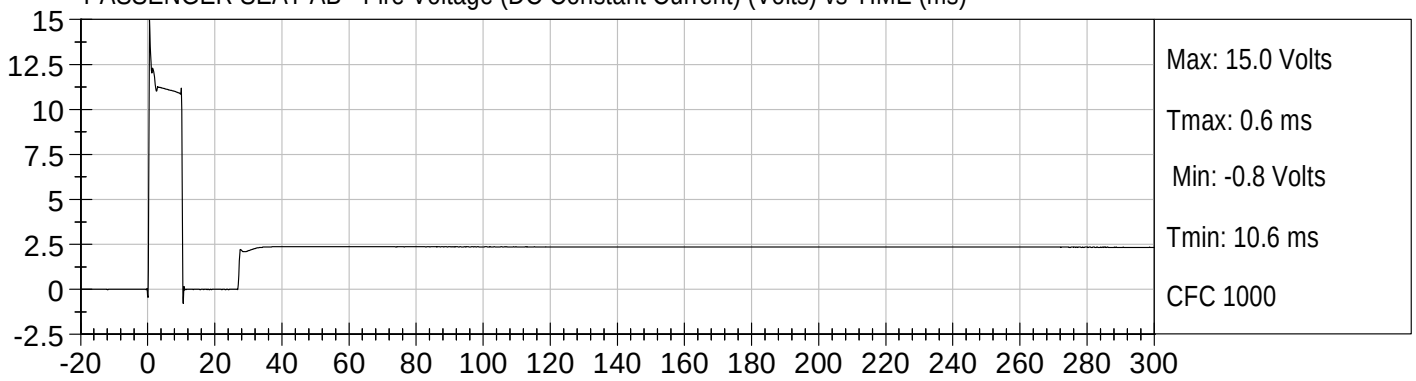
PASSENGER CURTAIN AB - Fire Voltage (DC Constant Current) (Volts) vs TIME (ms)



PASSENGER CURTAIN AB - Fire Current (DC Constant Current) (Amps) vs TIME (ms)



PASSENGER SEAT AB - Fire Voltage (DC Constant Current) (Volts) vs TIME (ms)



PASSENGER SEAT AB - Fire Current (DC Constant Current) (Amps) vs TIME (ms)