mga research corporation

REPORT NUMBER: TWG-MGA-2011-015

SIDE AIRBAG OUT-OF-POSITION INJURY TECHNICAL WORKING GROUP

DAIMLER AG STUTTGART
2011 MERCEDES-BENZ C300 4-DR SEDAN
NHTSA NO.: MB0501TWG2

TEST DATE: SEPTEMBER 6, 2011

FINAL REPORT DATE: SEPTEMBER 16, 2011

FINAL REPORT

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FINAL REPORT ACCEPTANCE BY:

_____

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 2011 Mercedes-Benz C300 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 September 6, 2011. 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 inboard-facing position along the outboard edge of the seat per Section 3.3.5.1 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 front of head
- Torso bag to left shoulder and left 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, facing inboard with its legs extended and arms hanging at its sides. The seat track was positioned forward to minimize the cushion to head interaction. The dummy's pelvis was slid outboard until the dummy's back contacted the door trim panel or armrest and the center of gravity of the head was centered in the deployment trajectory of the airbag. The head remained in its neutral orientation. A vertical plane through the centerline of the dummy's shoulder bolts was parallel to the vehicle centerline. The dummy's arms were bent at the elbow until 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 3.3.5.1 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	3.3.5.1*	Inboard-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 Dummy Data Channels	23
Number of Airbag Channels	4
Number of High-Speed Videos	3

Visible Dummy Contact Points	
Head Contact	Curtain airbag to top and front of head
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 Side MDB Impact on September 8, 2010.

TEST VEHICLE INFORMATION

Manufacturer	Mercedes-Benz
Model	C300
Body Style	Sedan
NHTSA No.	MB0501TWG2
VIN	WDDGF5EB1BA416677
Color	Steel Grey
Delivery Date	9/02/2010
Odometer Reading (mile)	134
Dealer	Concours Motors
Transmission	Automatic
Final Drive	Rear
Number of Cylinders	6
Engine Displacement (L)	3.0
Engine Placement	Longitudinal
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	No
Tilt Wheel	Yes
Air Conditioning	Yes
Anti-lock Brakes	Yes
Traction Control	Yes
All Wheel Drive	No
Power Seats	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Daimler AG Stuttgart
Date of Manufacture	6/2010

GVWR (kg)	2,060
GAWR Front (kg)	1,010
GAWR Rear (kg)	1,090

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				380
Cargo Wt. (RCLW) (kg)				40

DATA SHEET NO. 3

DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		Rearmost
Seat Height Position		Highest
Placed in Position No. 2		---
Seat Back Angle (at headrest post)	SA (°)	21
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	215
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	226
Head CG to Window	HD (mm)	118
Head to Seat Back Centerline	HSC (mm)	229
Chest to Dash	CD (mm)	565
Chest to Seatback	CS (mm)	280
Right Arm to Seat Back Centerline	RACL (mm)	242
Left Arm to Seat Back Centerline	LACL (mm)	236
Right Arm to Door Panel	RA (mm)	88
Left Arm to B-Post	LA (mm)	40
Knee to Knee	KK (mm)	107
Toe to Toe	TT (mm)	80
Right Knee to Seat Cushion Centerline	KSCR (mm)	44
Left Knee to Seat Cushion Centerline	KSCL (mm)	41
Right Toe to Seat Cushion Centerline	TSCR (mm)	370
Left Toe to Seat Cushion Centerline	TSCL (mm)	364
Nose to Dash	ND (mm)	615
Nose to Headrest	NS (mm)	296
Top of Head to Headliner	HH (mm)	67

DATA SHEET NO. 4

DUMMY INJURY CRITERIA VALUES

NHTSA No. MB0501TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	20.5	56.9	-19.3	11.7
Head Y	g	11.5	15.8	-3.9	12.1
Head Z	g	31.0	11.7	-4.9	16.7
Head Resultant	g	37.2	11.7		
Upper Neck Fx	N	210.0	19.7	-28.2	9.6
Upper Neck Fy	N	177.2	16.3	-23.0	137.8
Upper Neck Fz	N	15.9	1.1	-505.8	15.8
Upper Neck F Resultant	N	553.8	15.8		
Upper Neck Mx	Nm	14.8	35.6	-8.2	11.8
Upper Neck My	Nm	20.6	18.1	-0.6	11.0
Upper Neck Mz	Nm	7.9	51.5	-0.2	1.1
Upper Neck M Resultant	Nm	22.0	21.5		
Lower Neck Fx	N	72.0	72.3	-362.0	14.5
Lower Neck Fy	N	308.5	13.2	-74.4	134.2
Lower Neck Fz	N	15.7	1.0	-425.2	15.4
Lower Neck F Resultant	N	546.4	15.4		
Lower Neck Mx	Nm	20.9	13.3	-1.4	300.0
Lower Neck My	Nm	8.8	12.1	-11.8	19.2
Lower Neck Mz	Nm	14.5	13.2	-0.1	0.0
Lower Neck M Resultant	Nm	25.6	13.2		
Chest X	G	29.9	13.3	-14.8	13.8
Chest Y	G	15.8	13.0	-9.9	12.7
Chest Z	G	8.8	12.3	-3.4	17.7
Chest Resultant	G	30.5	13.3		
Upper Spine X	G	9.4	12.9	-6.4	17.5
Upper Sternum X	G	17.7	13.6	-11.1	18.1
Lower Sternum X	G	20.1	11.2	-22.0	21.7
Upper Thorax @ Spine X	G	16.8	12.8	-12.0	17.3
Lower Abdominal @ Spine X	G	5.4	9.1	-3.5	24.1

DATA SHEET NO. 4 (continued)

DUMMY INJURY CRITERIA VALUES

NHTSA No. MB0501TWG2

	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	5.3	55.1	62.1	5.3	55.1	62.1

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	0.00	5.8	6.96	-1.63	-0.02
Nte	0.01	10.6	0.88	3.67	-0.22
Ncf	0.32	16.7	-444.54	199.32	18.61
Nce	0.09	11.7	-236.38	28.66	0.47
Peak Tension (CFC1000)		**15.9 N**	**Peak Compression (CFC 1000)**		**-505.8 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

PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

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

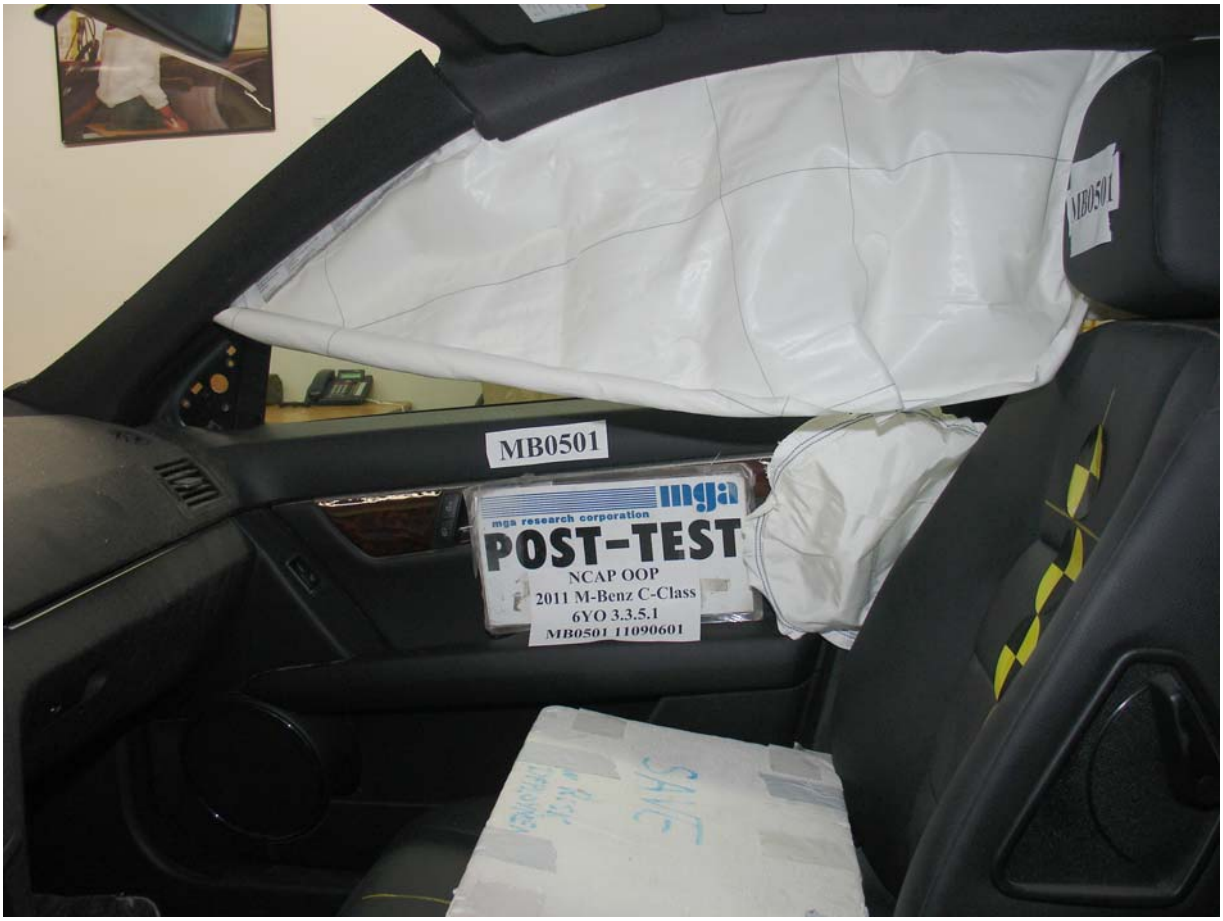
Pre-Test 6-Year-Old Child Dummy Right ¾ Front View

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 6-Year-Old Child Dummy Right Side View (Door Open)



Post-Test Curtain Airbag Left Side View

Post-Test Curtain Airbag Left ¾ Front View

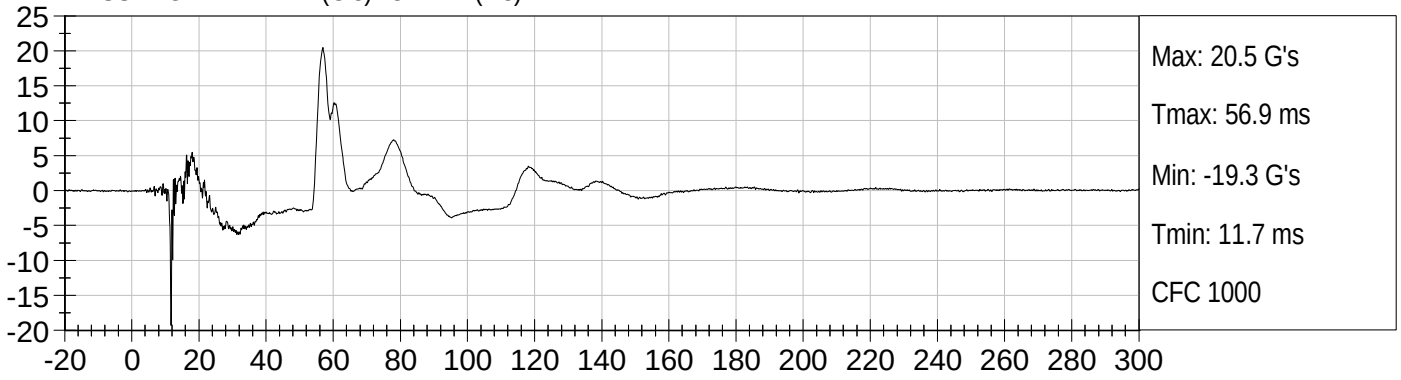
Post-Test Curtain Airbag Front View

APPENDIX B

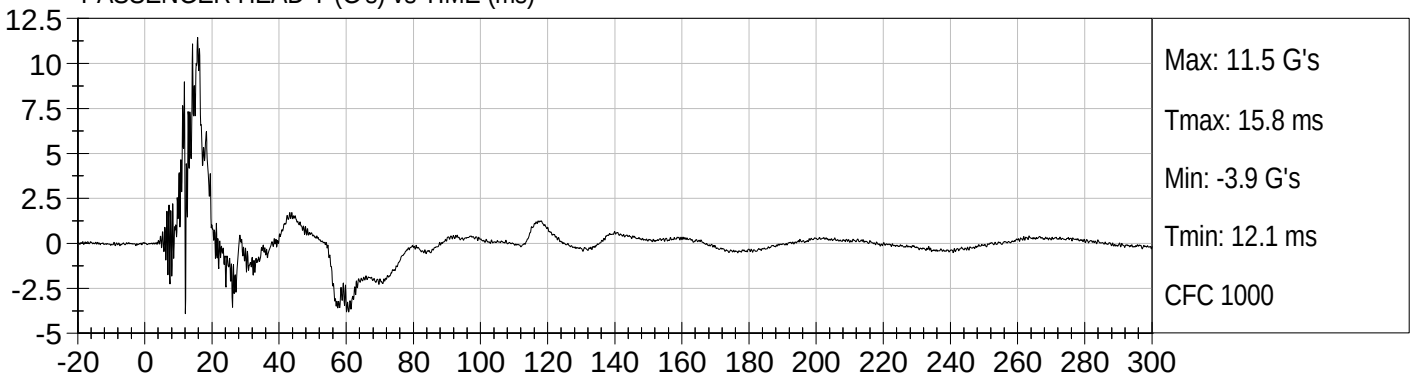
DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

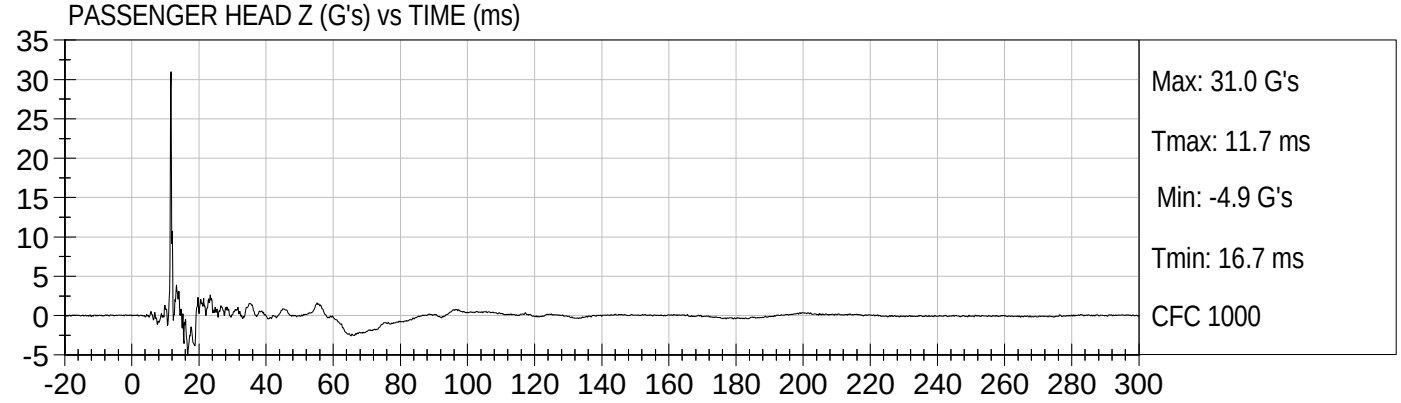
PASSENGER HEAD X (G's) vs TIME (ms)



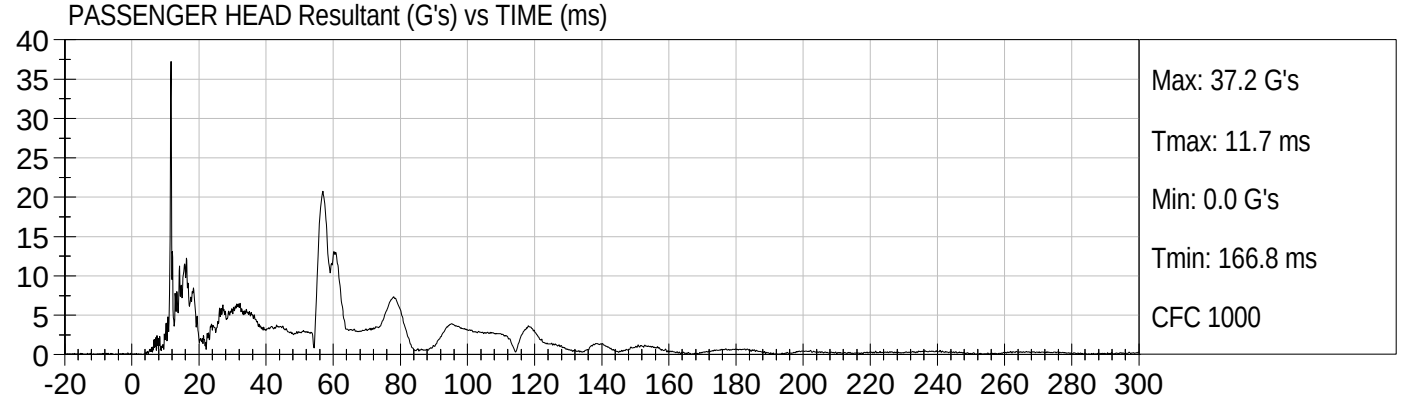
PASSENGER HEAD Y (G's) vs TIME (ms)



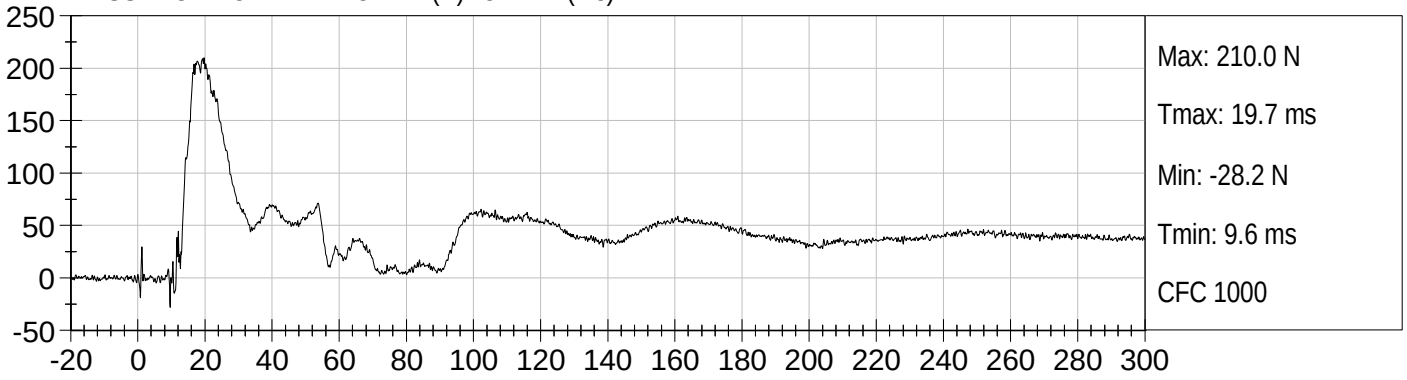
PASSENGER HEAD Z (G's) vs TIME (ms)



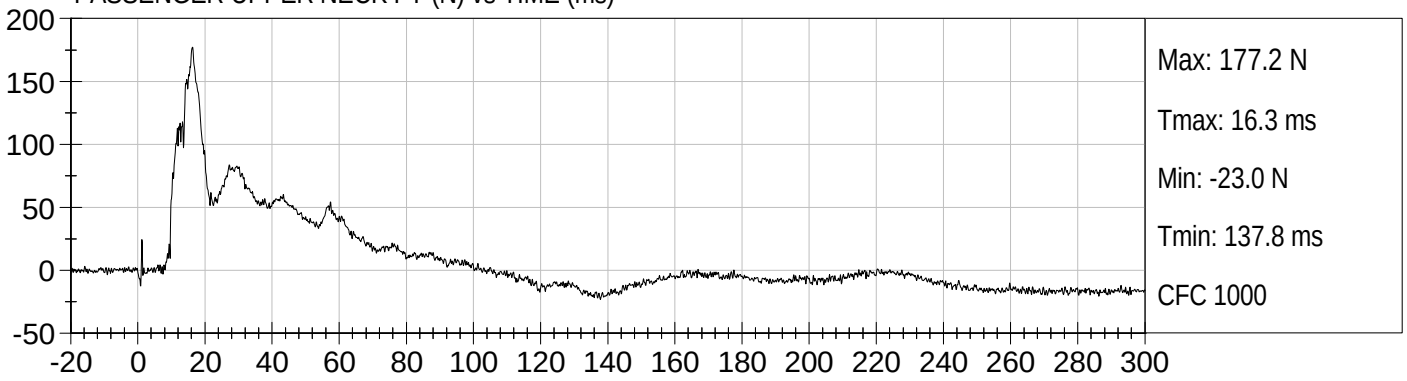
PASSENGER HEAD Resultant (G's) vs TIME (ms)



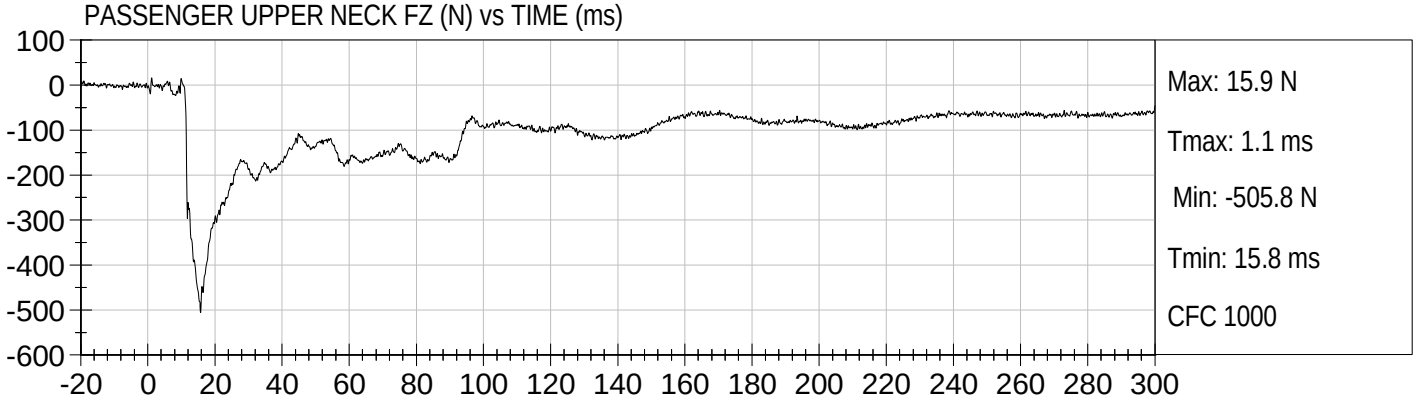
PASSENGER UPPER NECK FX (N) vs TIME (ms)



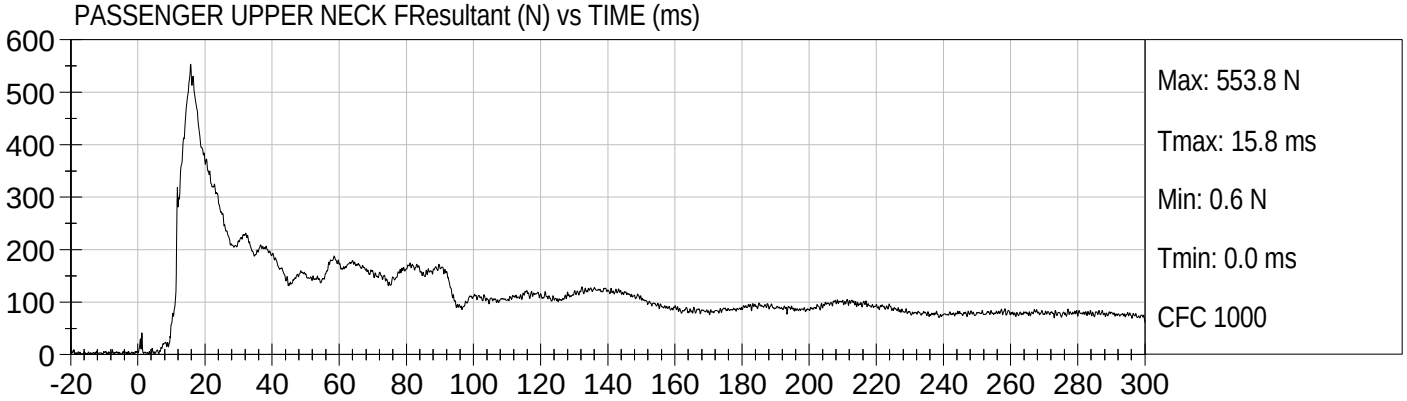
PASSENGER UPPER NECK FY (N) vs TIME (ms)



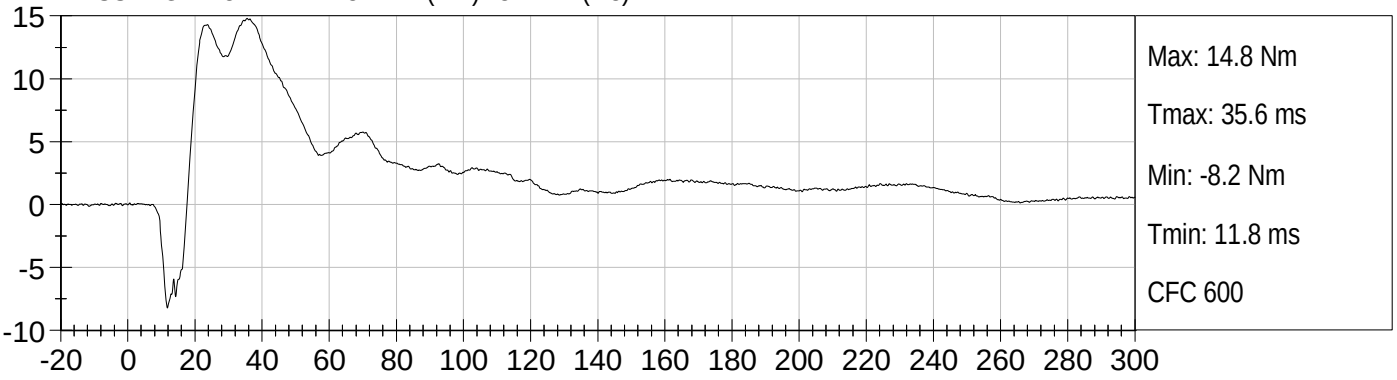
PASSENGER UPPER NECK FZ (N) vs TIME (ms)



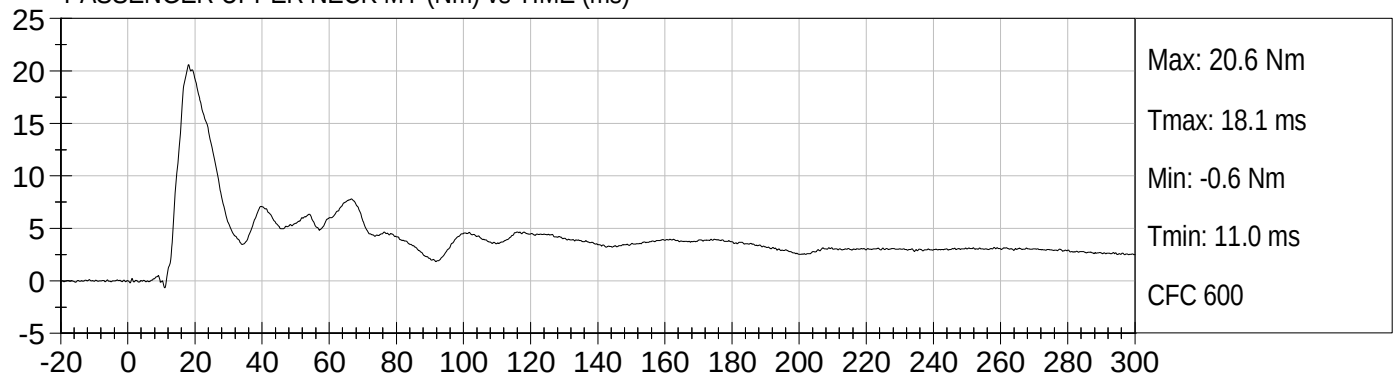
PASSENGER UPPER NECK FResultant (N) vs TIME (ms)



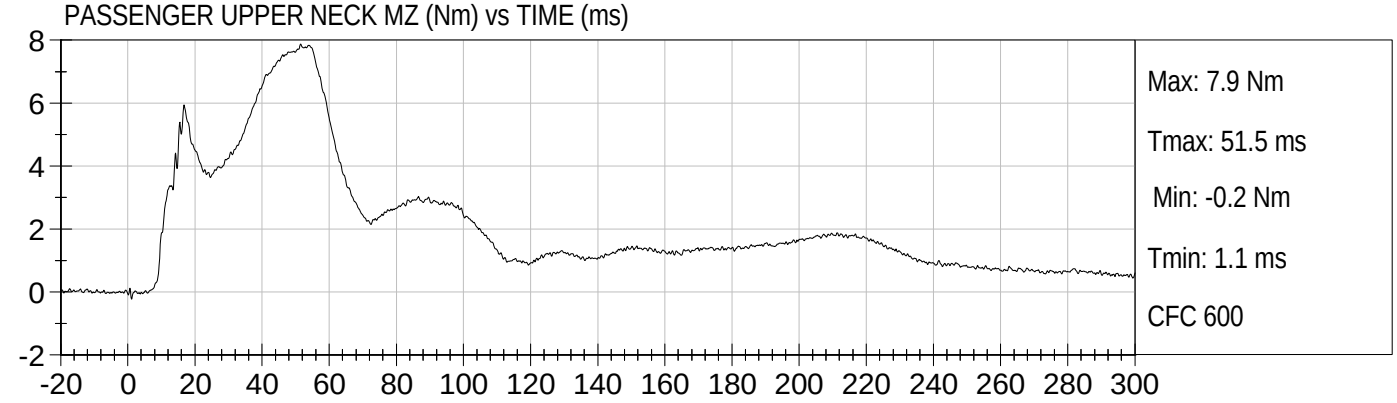
PASSENGER UPPER NECK MX (Nm) vs TIME (ms)



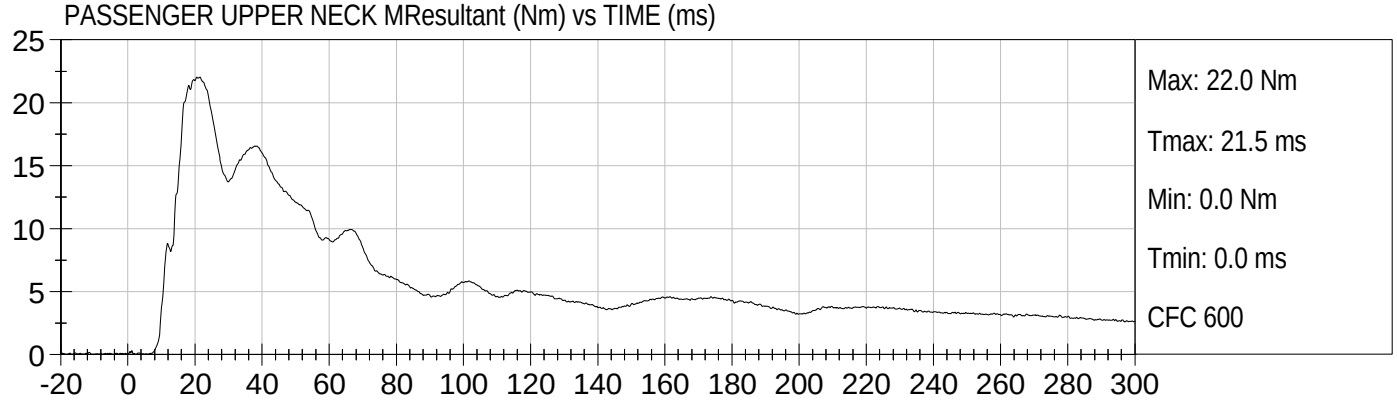
PASSENGER UPPER NECK MY (Nm) vs TIME (ms)



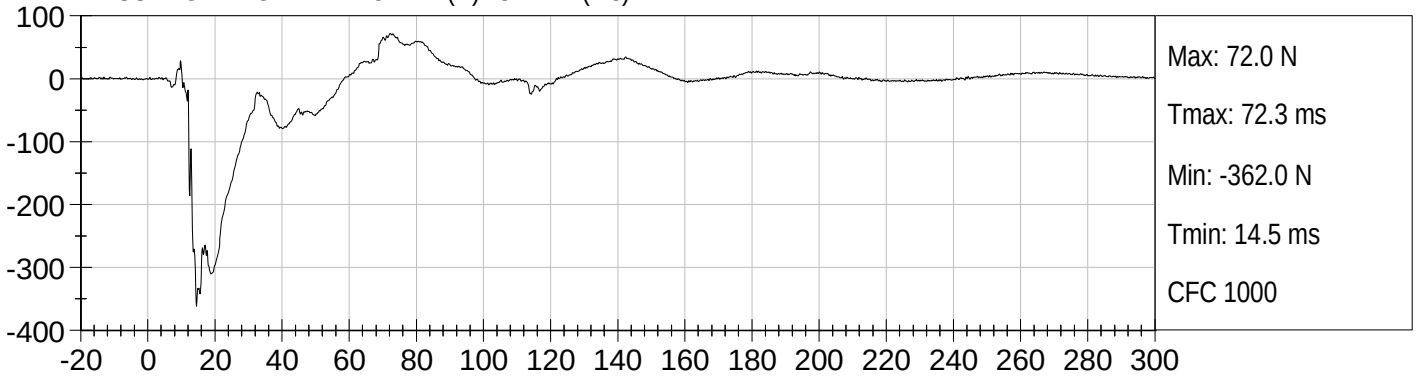
PASSENGER UPPER NECK MZ (Nm) vs TIME (ms)



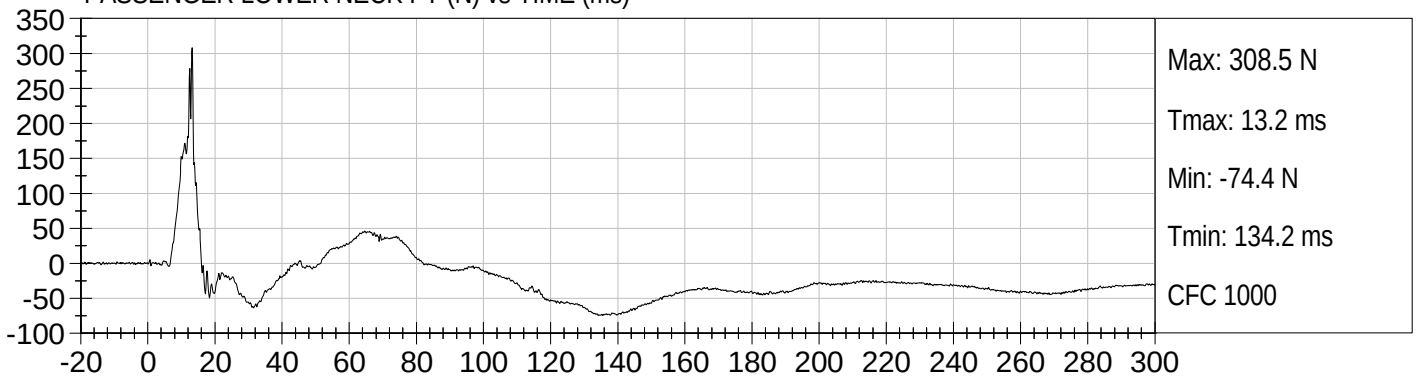
PASSENGER UPPER NECK MResultant (Nm) vs TIME (ms)



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



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



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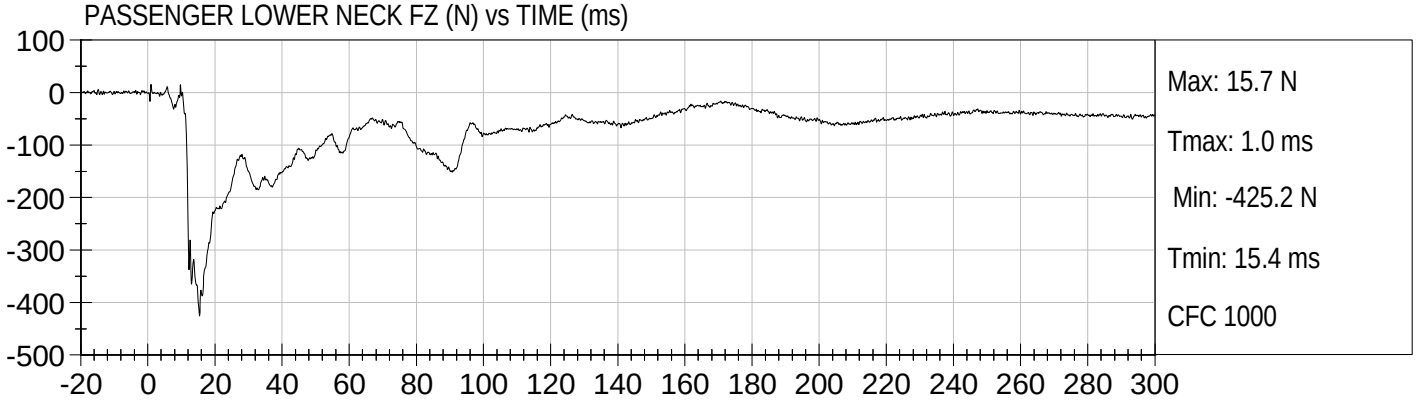
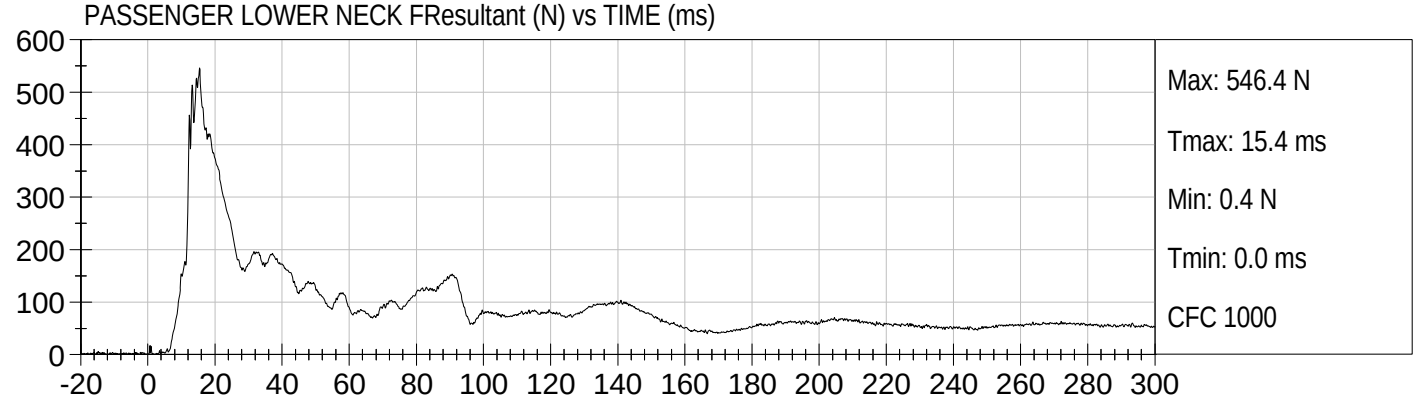
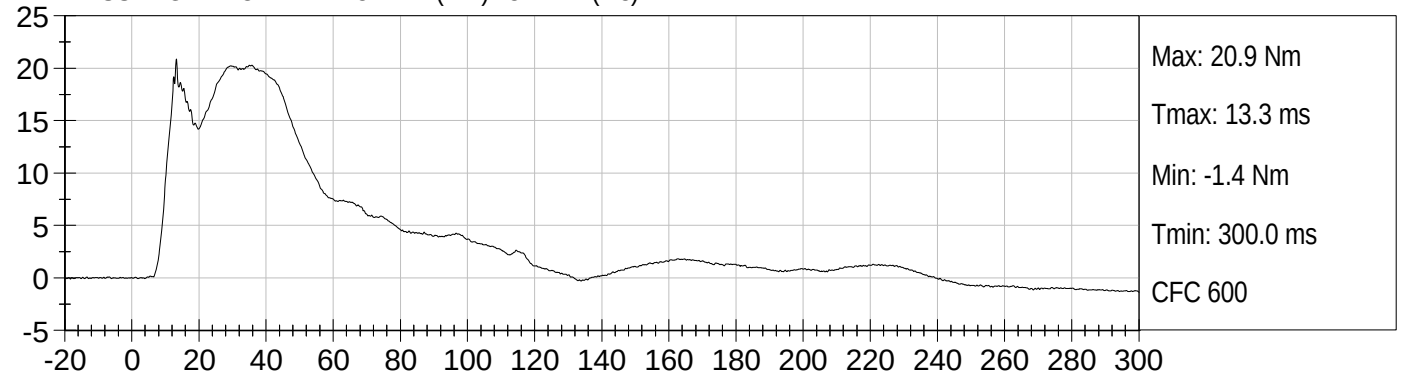


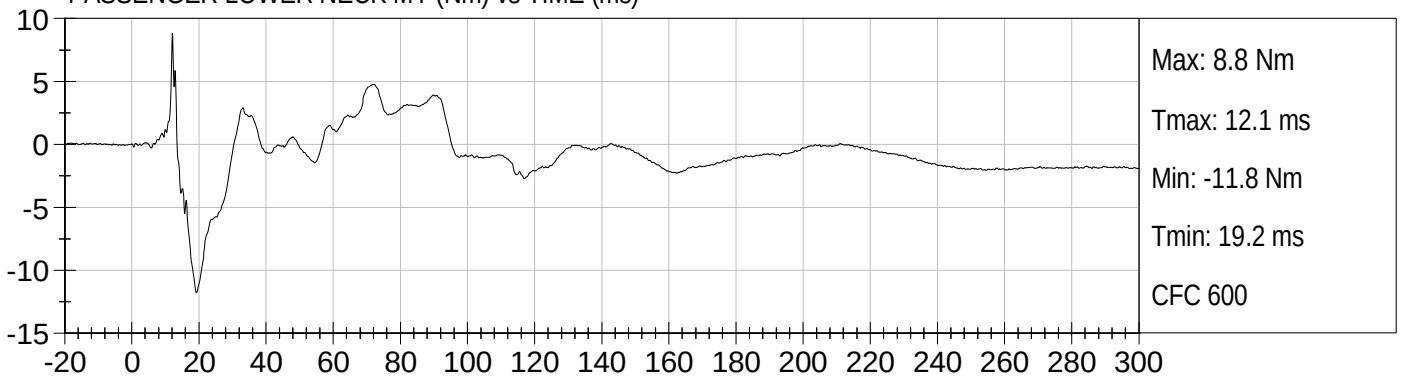
PASSENGER LOWER NECK FResultant (N) vs TIME (ms)



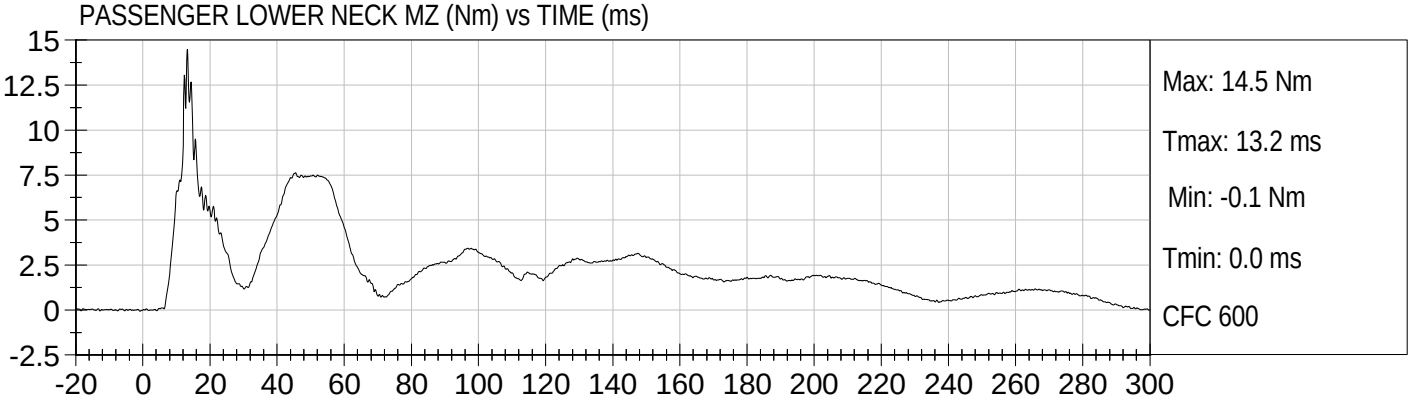
PASSENGER LOWER NECK MX (Nm) vs TIME (ms)



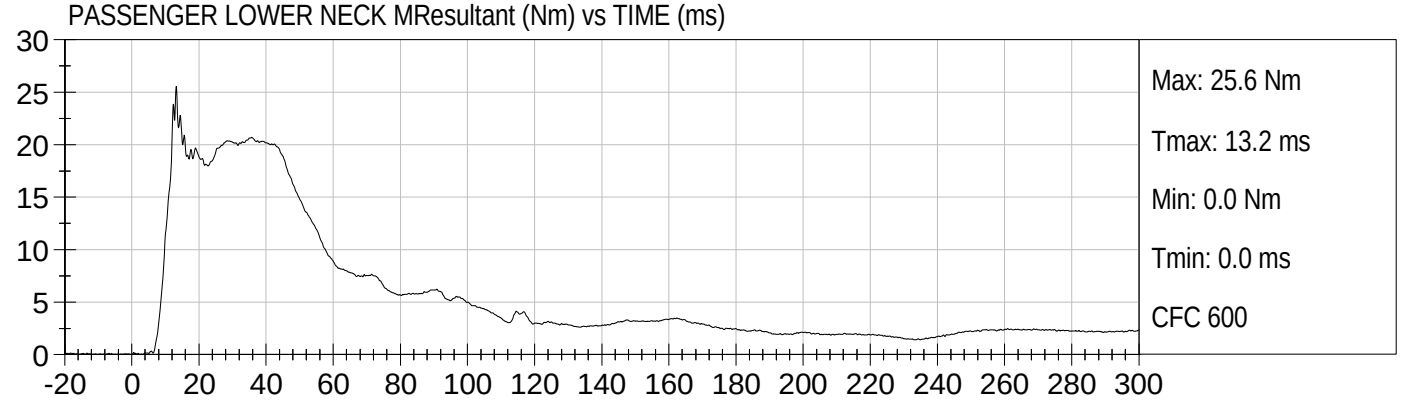
PASSENGER LOWER NECK MY (Nm) vs TIME (ms)



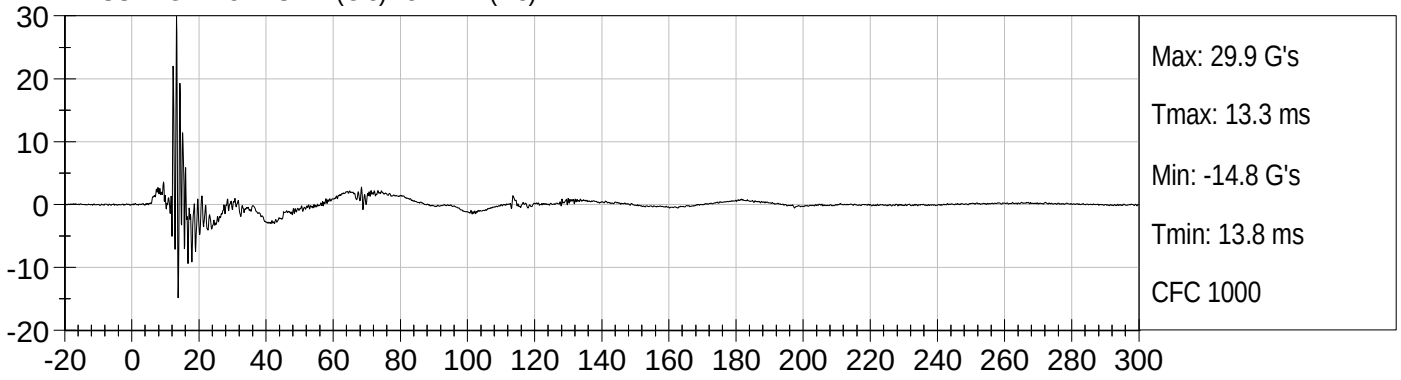
PASSENGER LOWER NECK MZ (Nm) vs TIME (ms)



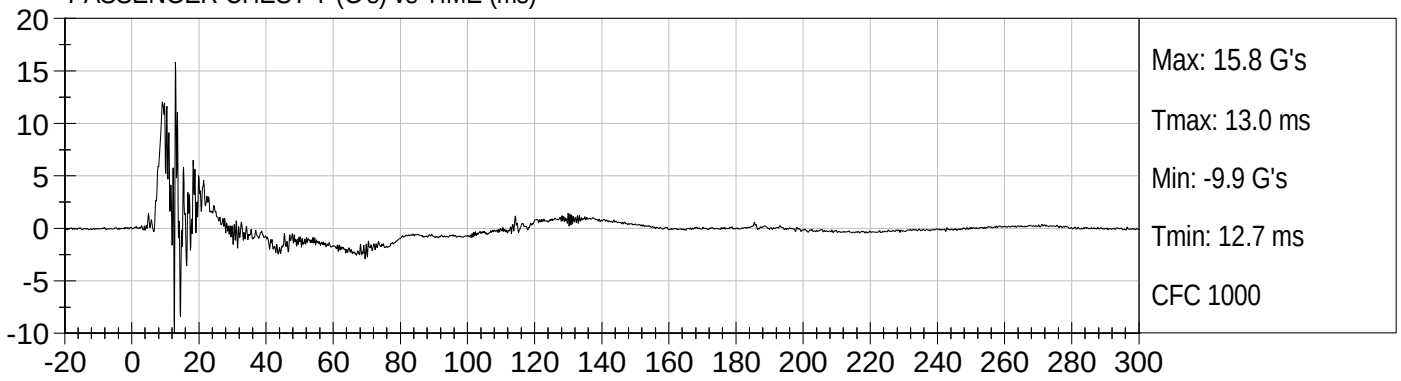
PASSENGER LOWER NECK MResultant (Nm) vs TIME (ms)



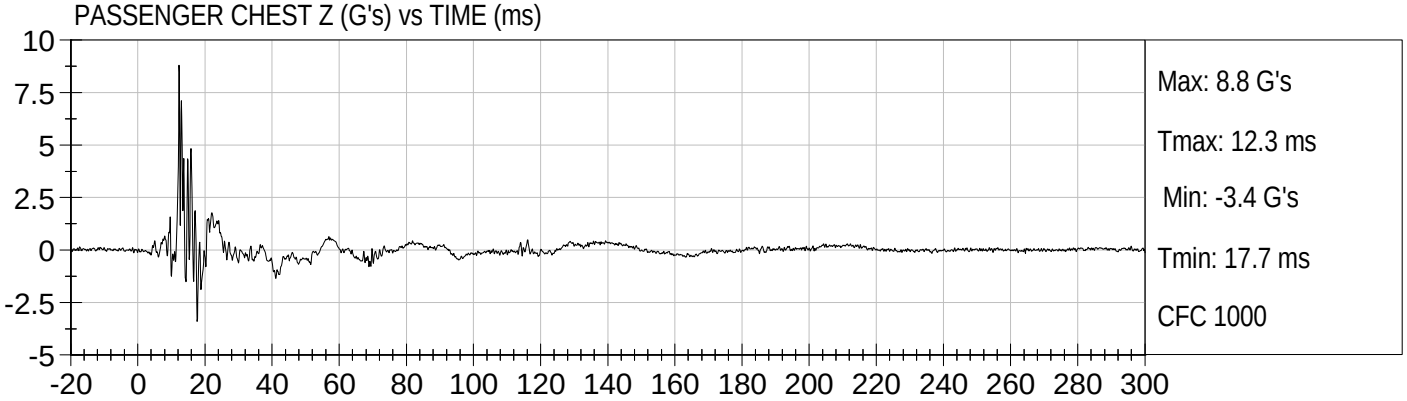
PASSENGER CHEST X (G's) vs TIME (ms)



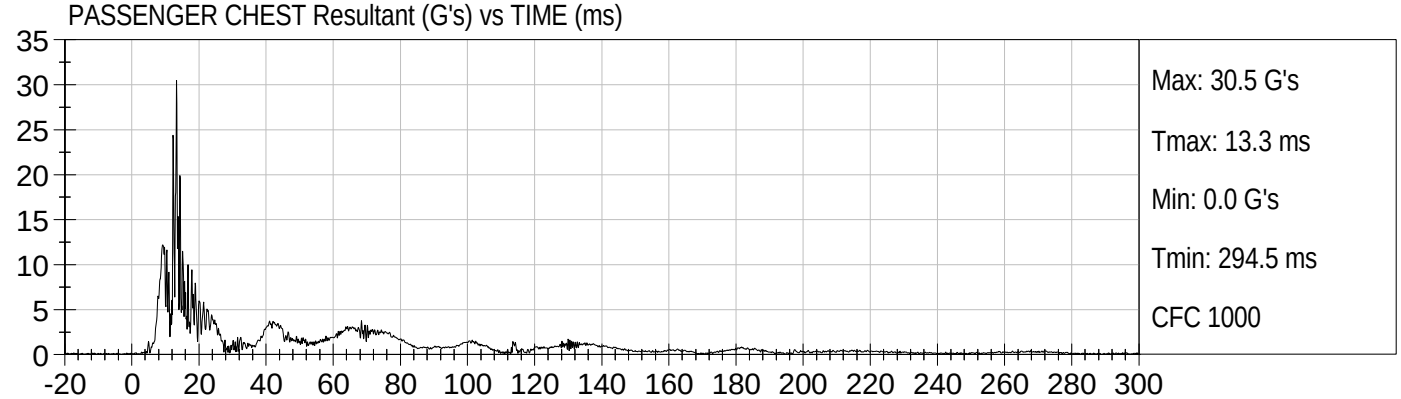
PASSENGER CHEST Y (G's) vs TIME (ms)



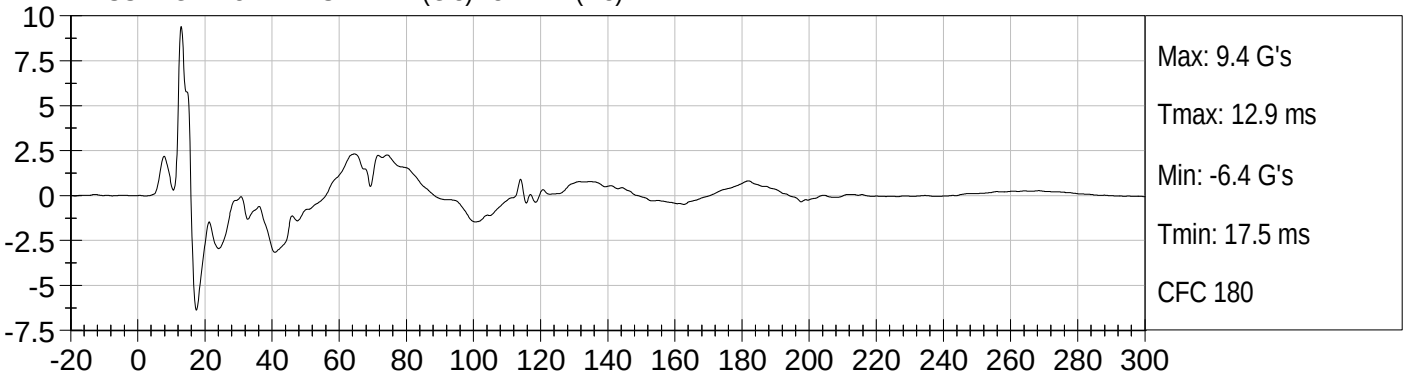
PASSENGER CHEST Z (G's) vs TIME (ms)



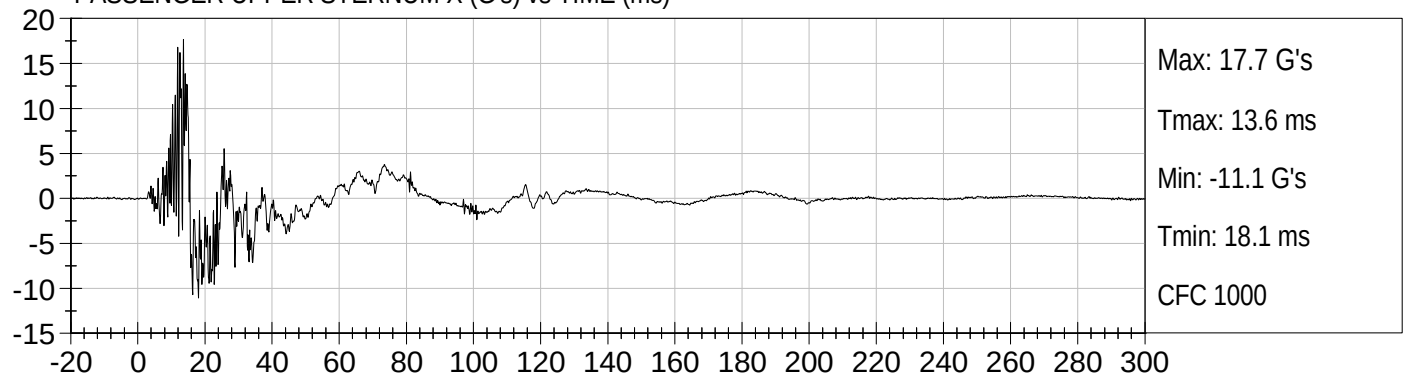
PASSENGER CHEST Resultant (G's) vs TIME (ms)



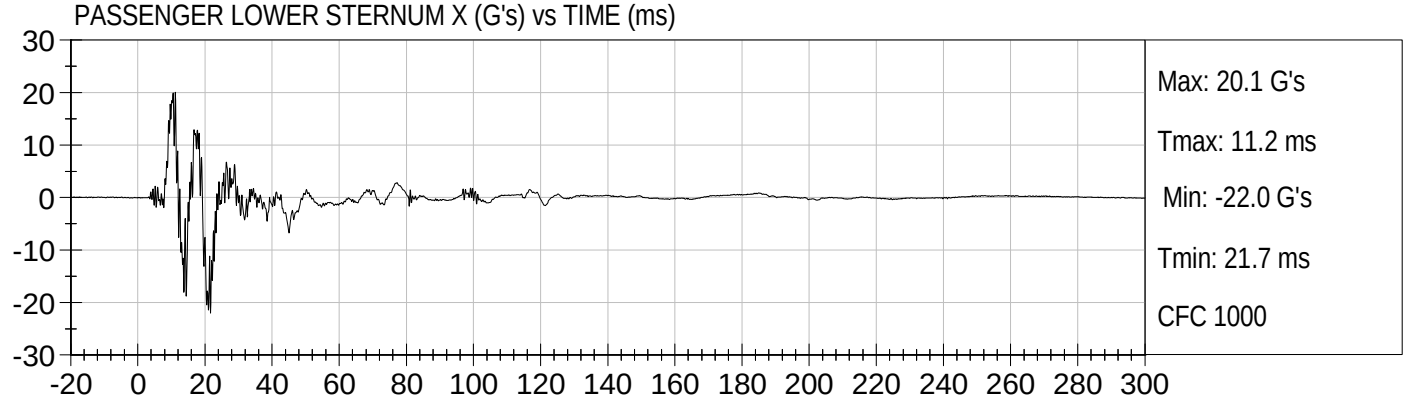
PASSENGER UPPER SPINE X (G's) vs TIME (ms)



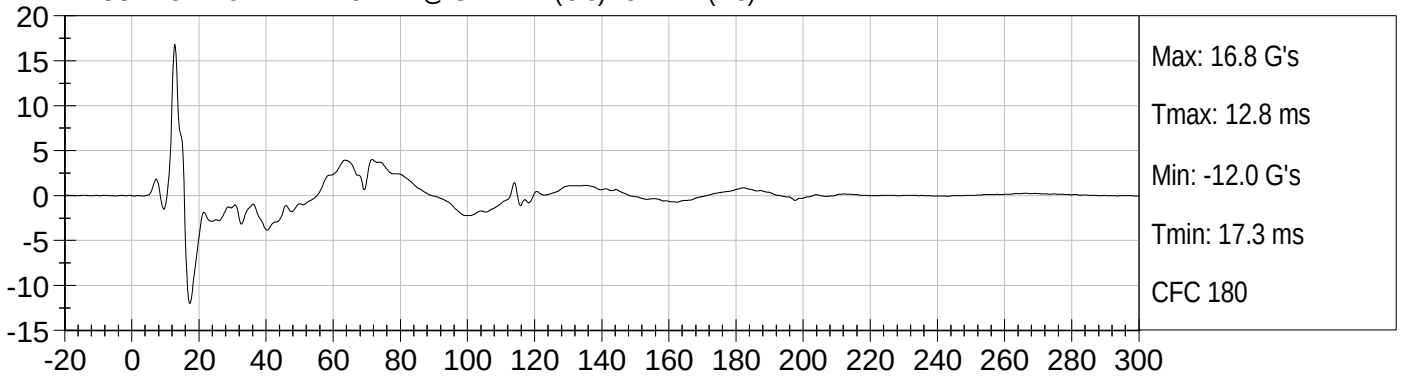
PASSENGER UPPER STERNUM X (G's) vs TIME (ms)



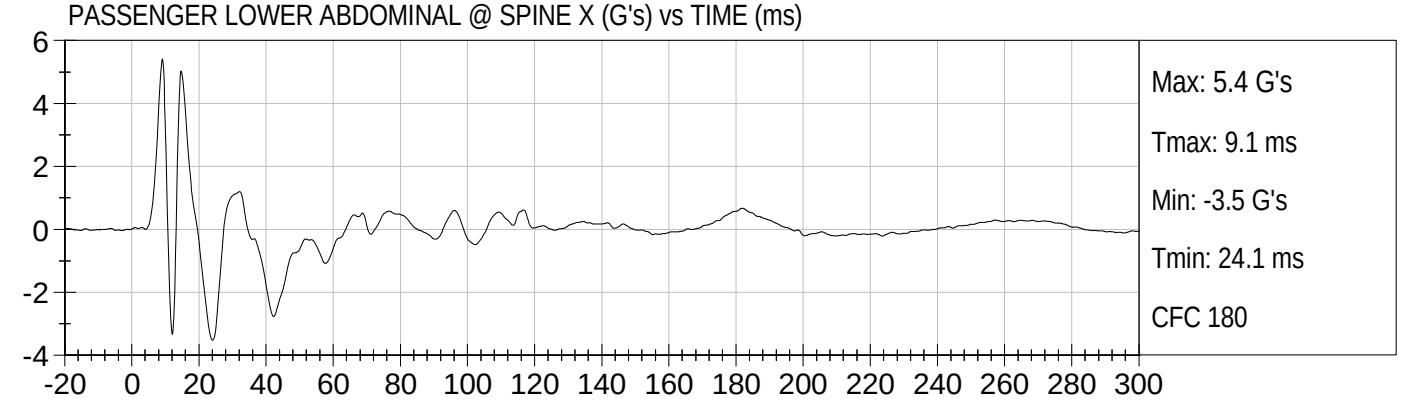
PASSENGER LOWER STERNUM X (G's) vs TIME (ms)



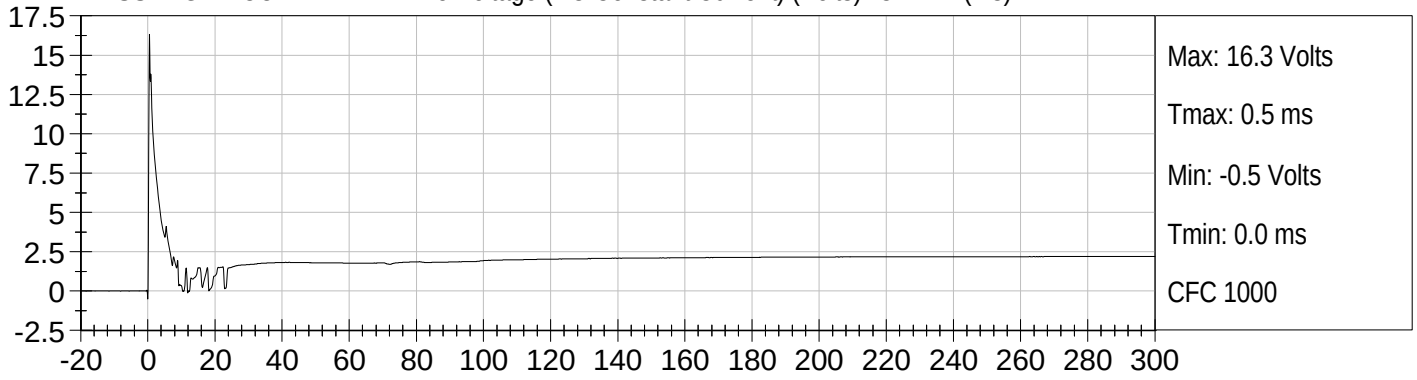
PASSENGER UPPER THORAX @ SPINE X (G's) vs TIME (ms)



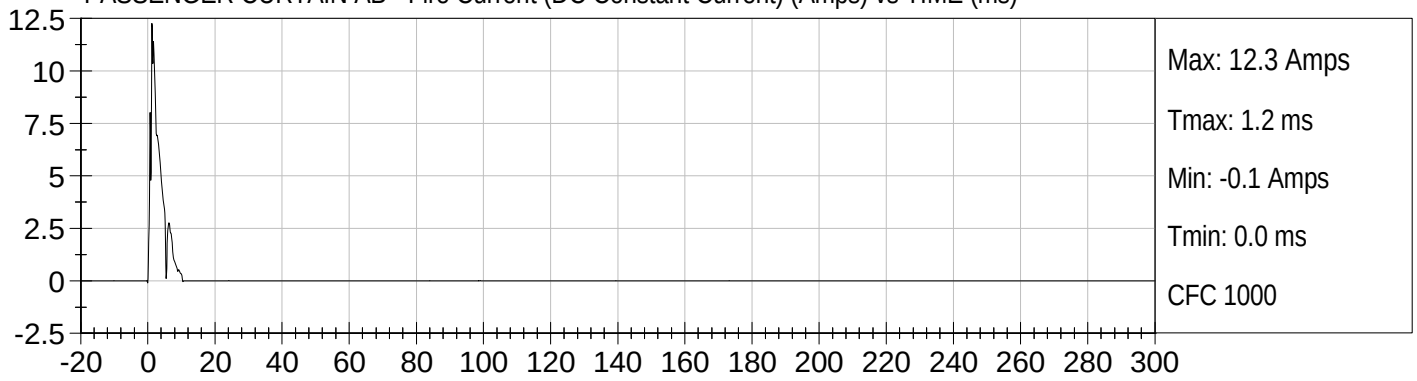
PASSENGER LOWER ABDOMINAL @ SPINE X (G's) vs TIME (ms)



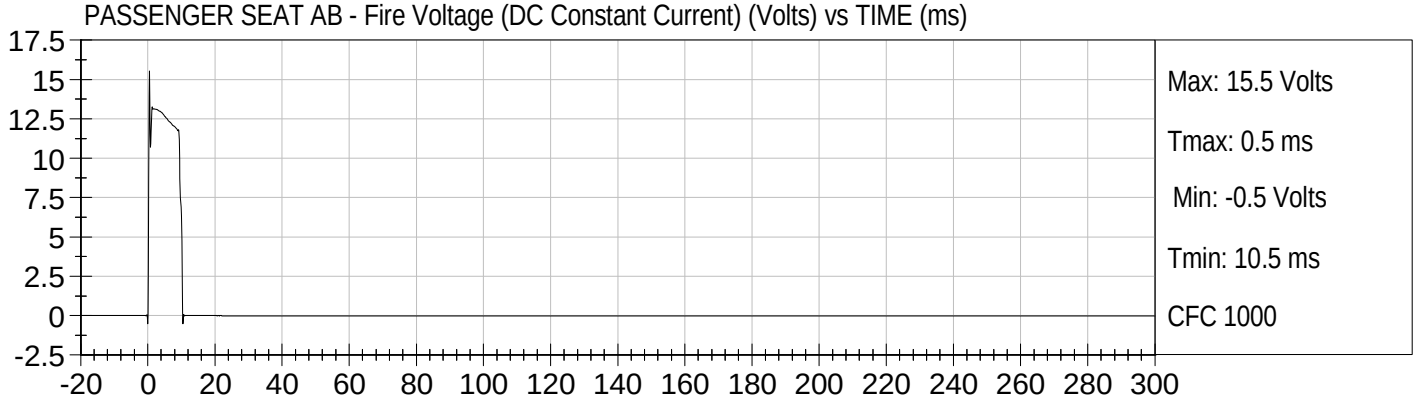
PASSENGER CURTAIN AB - Fire Voltage (DC Constant Current) (Volts) vs TIME (ms)



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)