



REPORT NUMBER: TWG-MGA-2010-002

**SIDE AIRBAG OUT-OF-POSITION INJURY
TECHNICAL WORKING GROUP**

**FUJI HEAVY INDUSTRIES LTD.
2010 SUBARU OUTBACK MPV
NHTSA NUMBER: MA5502TWG2**

TEST DATE: AUGUST 3, 2010

FINAL REPORT DATE: JANUARY 13, 2011

FINAL REPORT

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Date: 1/13/2011

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Secretary: Donna Janovicz

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 2010 Subaru Outback MPV with an out-of-position Hybrid III 3-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on August 3, 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 $\frac{3}{4}$ View Through Windshield

One Hybrid III 3-Year-Old child dummy (Serial Number 082) was placed in the right front passenger seat situated in the front-facing position along the outboard edge of the seat per Section 3.3.3.1 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
- Upper Spine Acceleration
- Mid Spine Acceleration
- Lower Spine Acceleration
- Upper Sternum Acceleration
- Lower Sternum Acceleration
- Lower Rib @ Spine Acceleration

The 27 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 3-Year-Old child dummy's visible contact points were as follows:

- Curtain bag to top and right side of head
- Torso bag to back of head
- Torso bag to right shoulder, right torso, and right pelvis

The Hybrid III 3-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 the heels were placed on the 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 heels were then repositioned and placed at 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 3.3.3.1 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	3.3.3.1*	Forward-facing child dummy
Curtain Airbag	Roof-Rail Mounted	Side Airbag
Torso Airbag	Seat Mounted	Side Airbag
ATD Type/Serial No.	Hybrid III 3 Year Old / 082	Child Dummy

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

Number of Data Channels	27
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; Torso bag to back of head
Right Shoulder Contact	Torso bag
Right Torso Contact	Torso bag
Right Pelvis Contact	Torso bag

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

Please note that this vehicle had previously been tested in an
NCAP Frontal Impact on October 12, 2009.

TEST VEHICLE INFORMATION

Manufacturer	Subaru
Model	Outback
Body Style	MPV
NHTSA No.	MA5502TWG2
VIN	4S4BRCAC2A3323552
Color	Satin White Pearl
Delivery Date	9/24/2009
Odometer Reading (mile)	70
Dealer	Wilde Subaru
Transmission	Automatic
Final Drive	AWD
Number of Cylinders	4
Engine Displacement (L)	2.5
Engine Placement	Longitudinal
Automatic Door Lock (ADL)	No
Owners Manual Details Instructions on Disabling ADLs	N/A
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	Yes
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Fuji Heavy Industries Ltd.
Date of Manufacture	08/09

GVWR (kg)	2080
GAWR Front (kg)	1070
GAWR Rear (kg)	1060

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bucket		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				408
Cargo Wt. (RCLW) (kg)				68

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 (°)	18
Top of Airbag Module to Head/Neck Junction	AN (mm)	15
Head CG to Door Panel/Window	HD (mm)	241
Head to Seat Back Centerline	HSC (mm)	161
Chest to Dash	CD (mm)	744
Chest to Seatback	CS (mm)	158
Right Arm to Seat Back Centerline	RACL (mm)	295
Left Arm to Seat Back Centerline	LACL (mm)	106
Right Arm to Door Panel	RA (mm)	Contact
Left Arm to B-Post	LA (mm)	253
Knee to Knee	KK (mm)	140
Toe to Toe	TT (mm)	128
Right Knee to Seat Cushion Centerline	KSCR (mm)	93
Left Knee to Seat Cushion Centerline	KSCL (mm)	5
Right Toe to Seat Cushion Centerline	TSCR (mm)	39
Left Toe to Seat Cushion Centerline	TSCL (mm)	97
Nose to Dash	ND (mm)	798
Nose to Seatback	NS (mm)	225
Top of Head to Headliner	HH (mm)	318

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. MA5502TWG2

DESCRIPTION	UNIT	MAXIMUM VALUE			
		Position No. 2			
		MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	G	38.4	8.3	-3.7	29.3
Head Y	G	5.5	62.2	-27.9	14.3
Head Z	G	18.4	14.6	-14.5	7.0
Head Resultant	G	42.1	8.3		
Upper Neck Fx	N	370.2	10.1	-91.6	26.4
Upper Neck Fy	N	265.3	12.0	-249.5	26.1
Upper Neck Fz	N	650.1	17.2	-555.6	4.3
Upper Neck F Resultant	N	719.7	13.6		
Upper Neck Mx	Nm	13.0	55.3	-26.7	17.2
Upper Neck My	Nm	19.5	8.4	-9.6	54.1
Upper Neck Mz	Nm	4.0	100.1	-30.3	32.0
Upper Neck M Resultant	Nm	31.1	30.1		
Lower Neck Fx	N	630.1	7.6	-46.3	63.0
Lower Neck Fy	N	130.6	10.8	-168.0	24.7
Lower Neck Fz	N	671.9	14.1	-383.1	5.5
Lower Neck F Resultant	N	853.1	14.0		
Lower Neck Mx	Nm	24.3	62.1	-42.8	24.7
Lower Neck My	Nm	4.9	58.3	-28.9	9.1
Lower Neck Mz	Nm	5.3	6.8	-24.4	36.7
Lower Neck M Resultant	Nm	48.4	24.7		
Upper Spine X	G	57.4	3.7	-9.3	33.4
Upper Spine Y	G	14.5	25.4	-45.4	8.3
Upper Spine Z	G	15.1	5.0	-21.1	3.4
Upper Spine Resultant	G	62.0	3.6		
Mid Spine X	G	42.3	4.0	-6.1	32.9
Mid Spine Y	G	6.5	2.9	-28.5	11.3
Mid Spine Z	G	15.7	4.8	-2.1	7.5
Mid Spine Resultant	G	44.8	5.6		
Lower Spine X	G	46.7	5.7	-5.9	23.5
Lower Spine Y	G	4.1	30.4	-23.2	10.3
Lower Spine Z	G	3.6	15.0	-12.0	7.3
Lower Spine Resultant	G	48.5	5.9		
Upper Sternum X	G	88.1	4.1	-53.2	4.7
Lower Sternum X	G	94.8	4.5	-69.4	3.9
Lower Rib @ Spine X	G	37.3	5.4	-4.9	27.1

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

NHTSA No. MA5502TWG2

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	81.3	5.9	20.9	85.7	5.0	24.3

Position 2 Neck Injury Summary (3-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	0.46	13.7	616.56	308.06	11.55
Nte	0.44	53.1	167.23	7.98	-9.64
Ncf	0.36	4.4	-443.18	122.99	9.97
Nce	0.00	1.0	-0.13	-0.76	-0.12
Peak Tension (CFC1000)	650.1 N		Peak Compression (CFC 1000)		-555.6 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	2120 N	Extension (mCVe)	27 N-m	Tension	1130 N
Compression (CVc)	2120 N	Flexion (mCVf)	68 N-m	Compression	1380 N

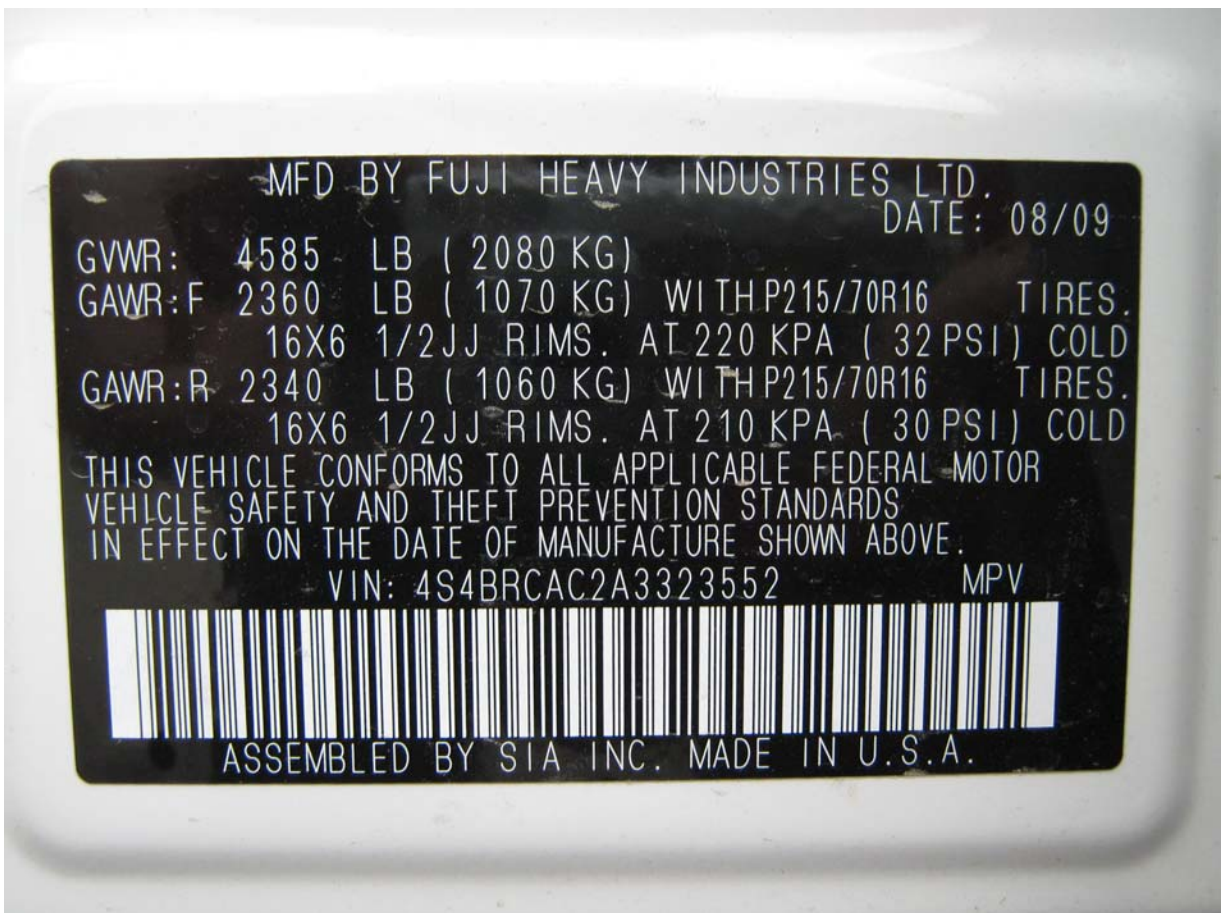
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Right ¾ Front View of Vehicle, As Received



Vehicle Certification Placard



Pre-Test Vehicle Left Side View



Post-Test Vehicle Left Side View



Pre-Test 3-Year-Old Child Dummy Left Side View



Post-Test 3-Year-Old Child Dummy Left Side View



Pre-Test 3-Year-Old Child Dummy Left Side Closeup View



Post-Test 3-Year-Old Child Dummy Left Side Closeup View



Pre-Test 3-Year-Old Child Dummy Left ¾ Front View



Post-Test 3-Year-Old Child Dummy Left ¾ Front View



Pre-Test 3-Year-Old Child Dummy Left 3/4 Front Closeup View



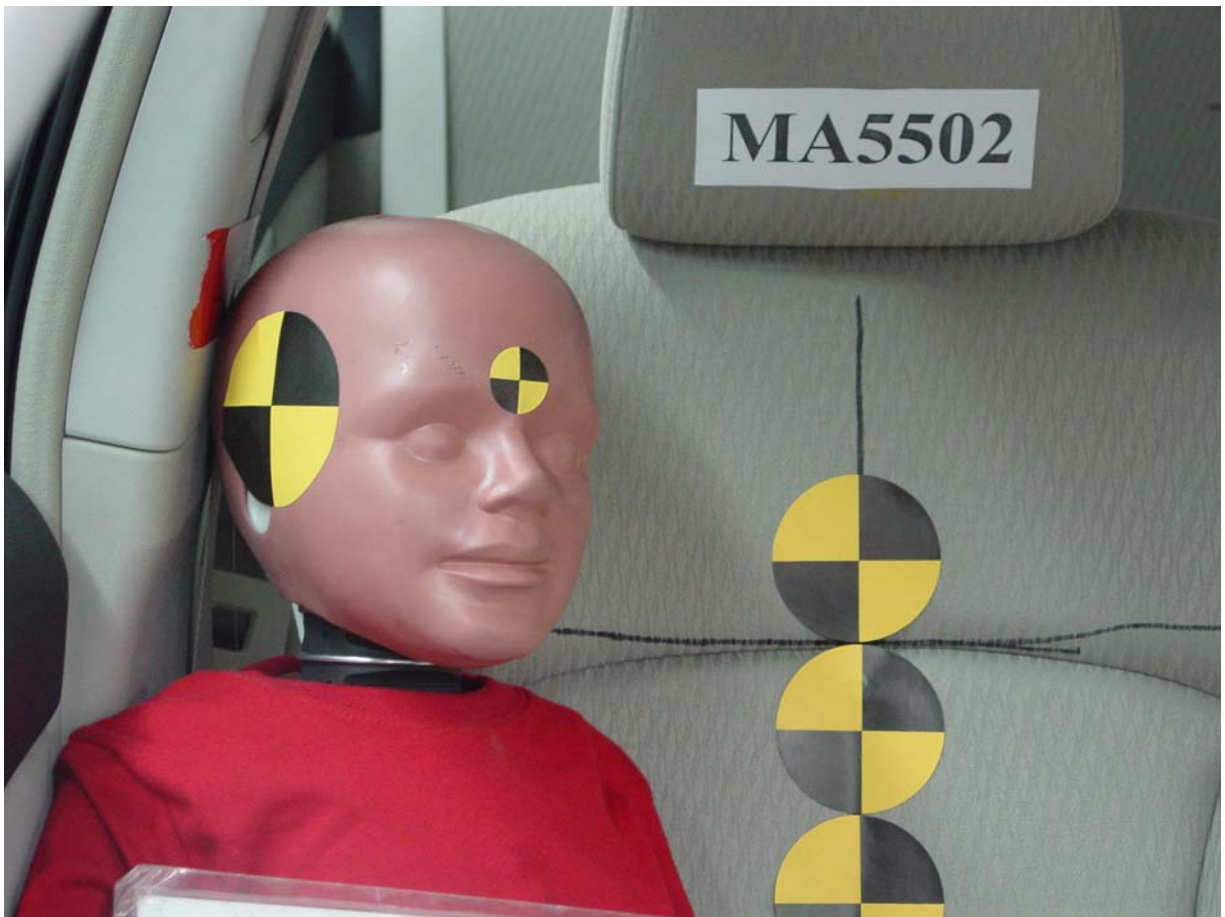
Post-Test 3-Year-Old Child Dummy Left 3/4 Front Closeup View



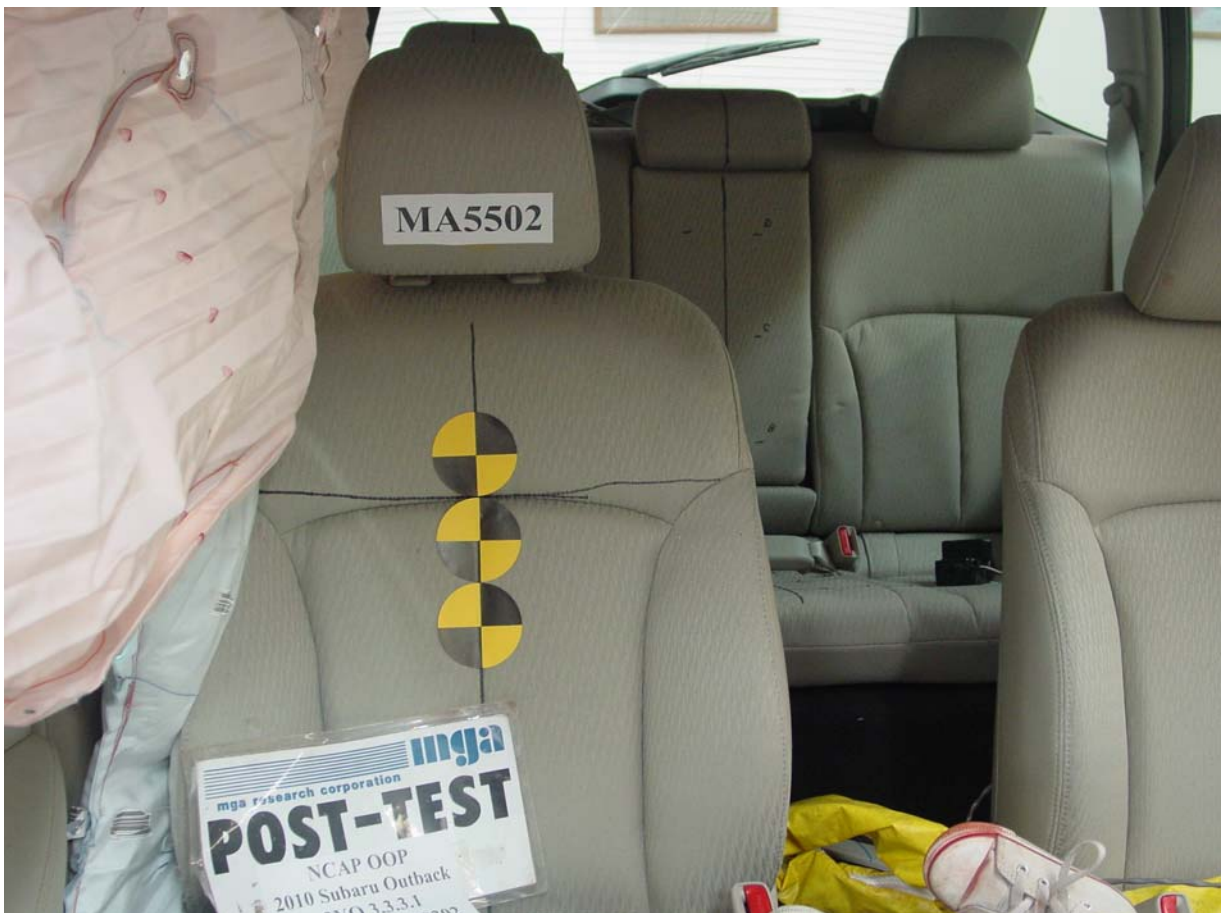
Pre-Test 3-Year-Old Child Dummy Front View



Post-Test 3-Year-Old Child Dummy Front View



Pre-Test 3-Year-Old Child Dummy Front Closeup View



Post-Test 3-Year-Old Child Dummy Front Closeup View



Pre-Test 3-Year-Old Child Dummy Right $\frac{3}{4}$ Front View



Post-Test 3-Year-Old Child Dummy Right $\frac{3}{4}$ Front View



Pre-Test 3-Year-Old Child Dummy Right Side View



Post-Test 3-Year-Old Child Dummy Right Side View



Post-Test Curtain and Torso/Pelvis Airbag Left View



Post-Test Curtain and Torso/Pelvis Airbag Left Closeup View

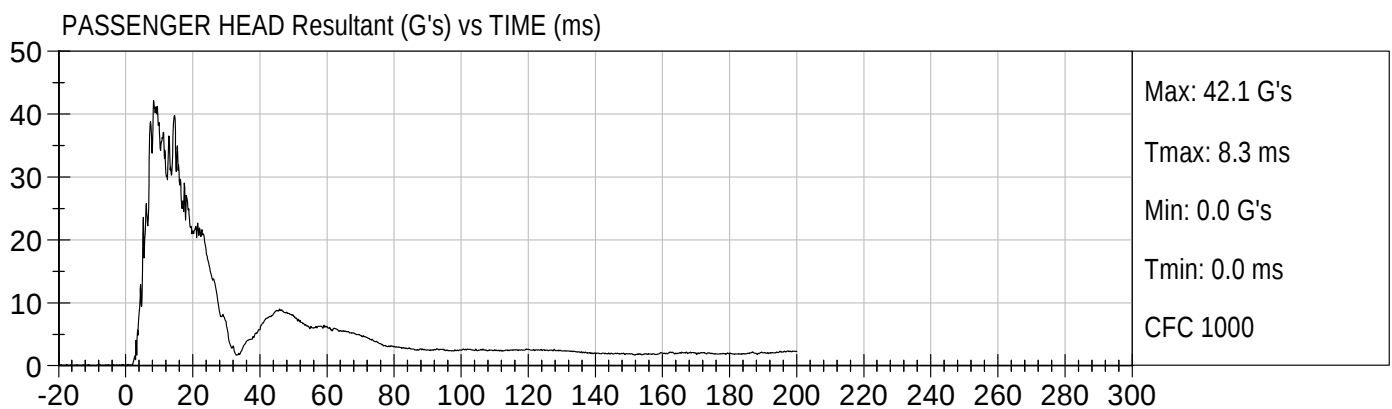
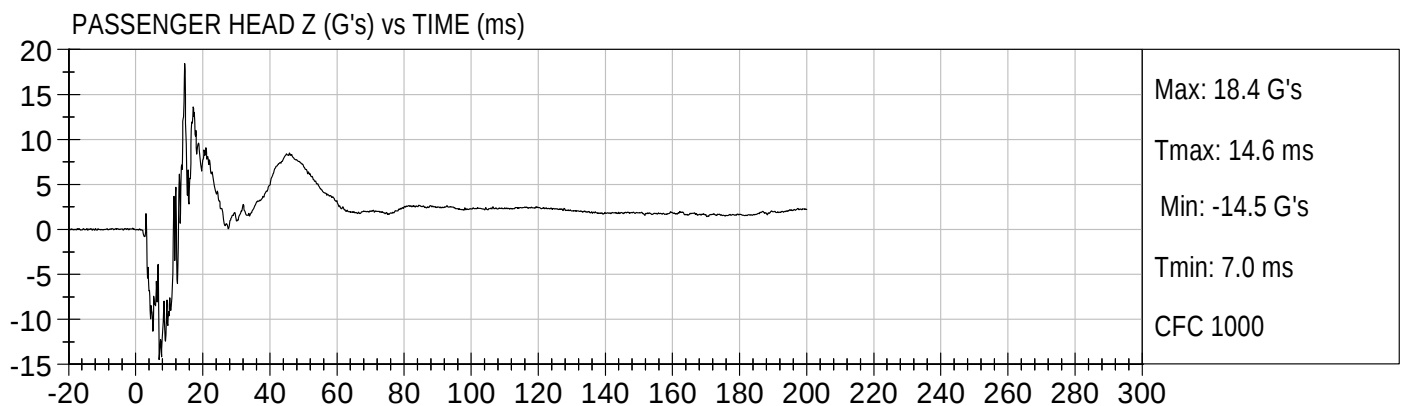
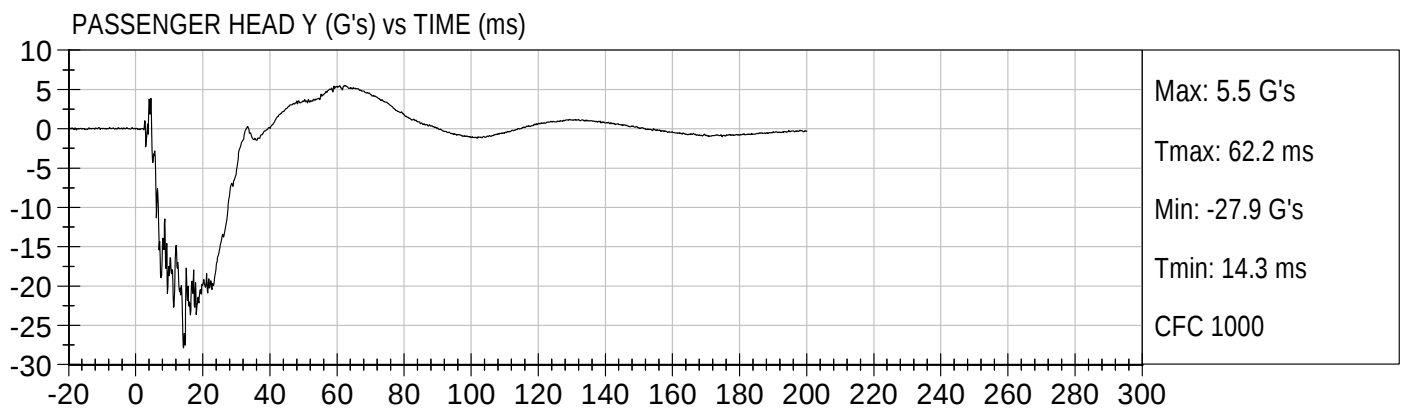
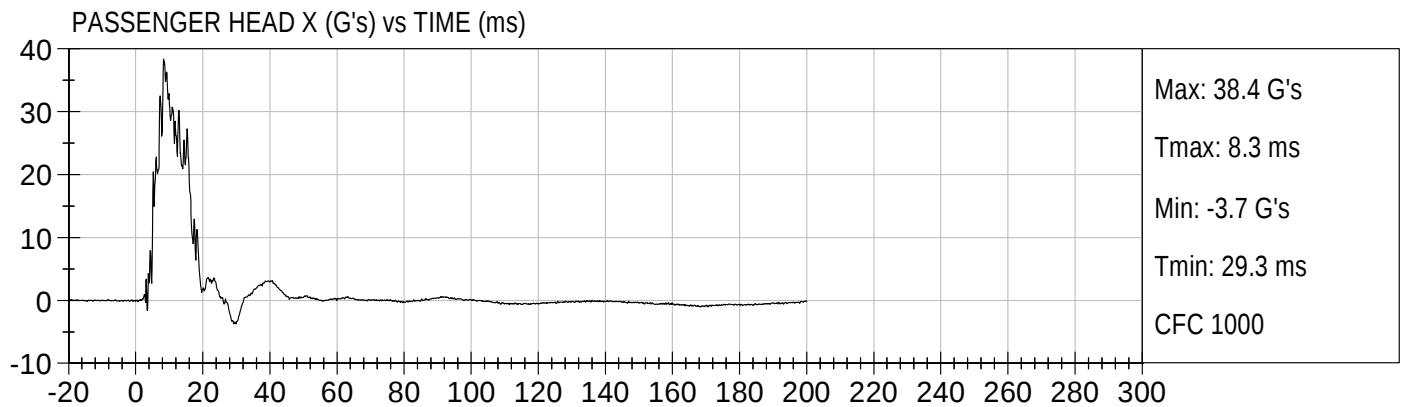
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DUMMY RESPONSE DATA TRACES

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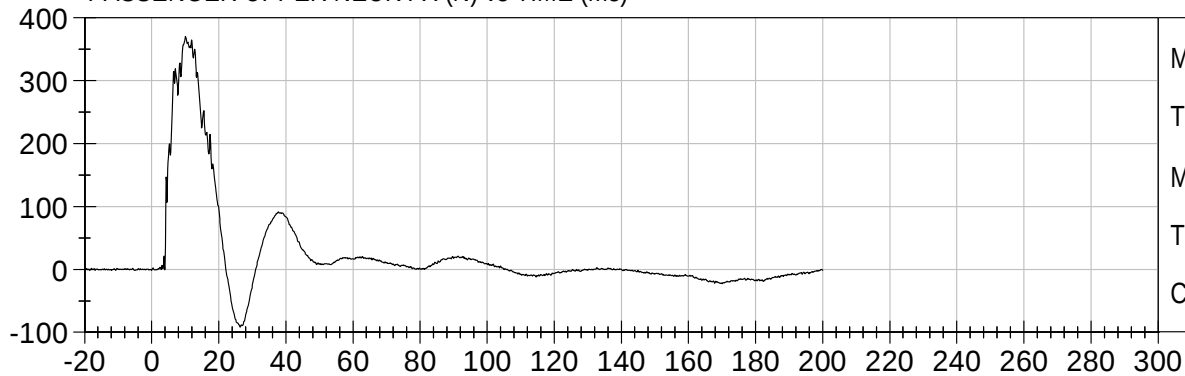
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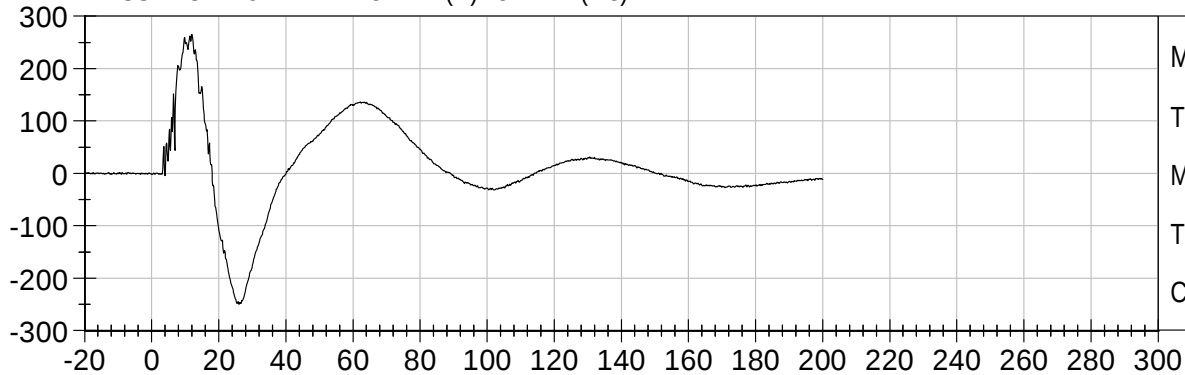


PASSENGER UPPER NECK FX (N) vs TIME (ms)



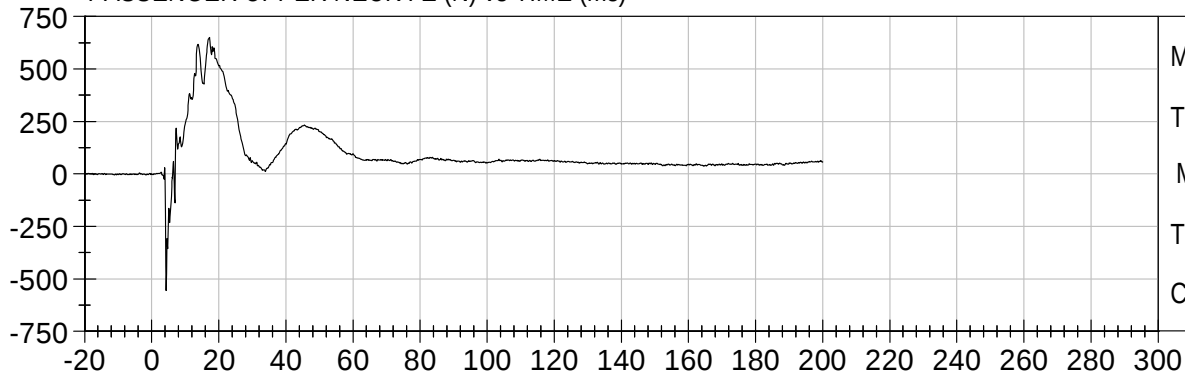
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Min: -91.6 N
Tmin: 26.4 ms
CFC 1000

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



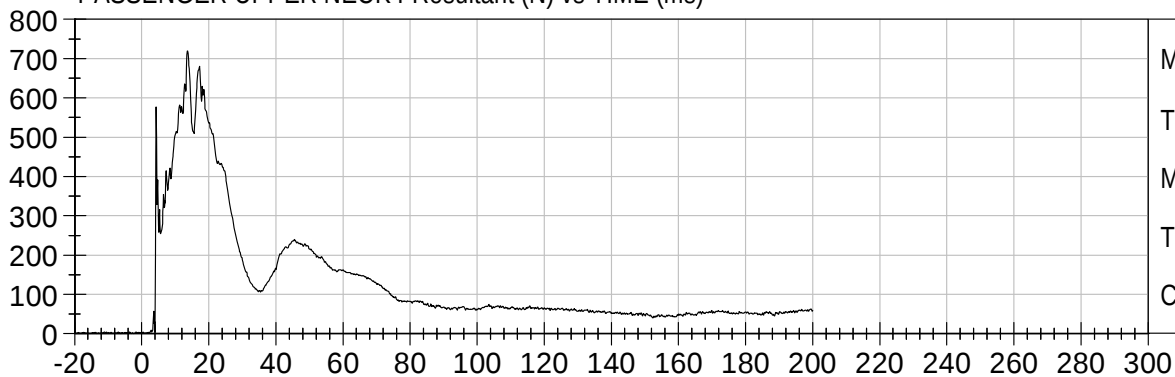
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PASSENGER UPPER NECK FZ (N) vs TIME (ms)



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CFC 1000

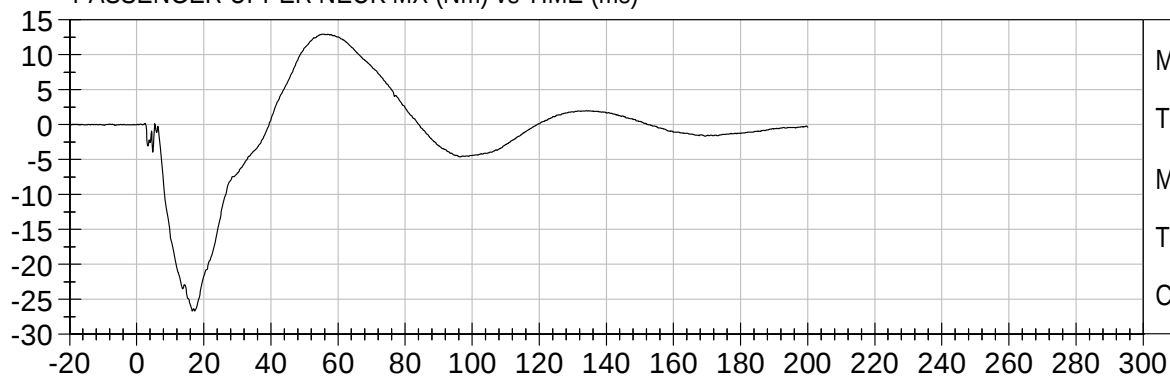
PASSENGER UPPER NECK FResultant (N) vs TIME (ms)



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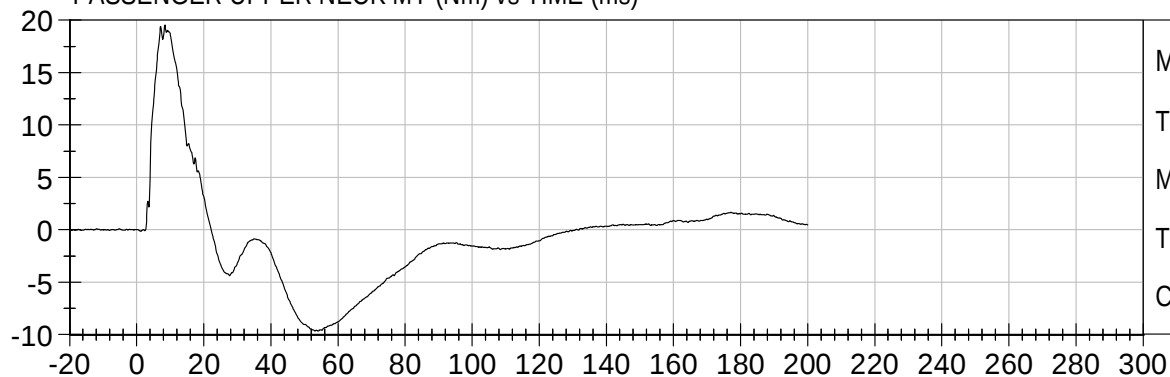


PASSENGER UPPER NECK MX (Nm) vs TIME (ms)



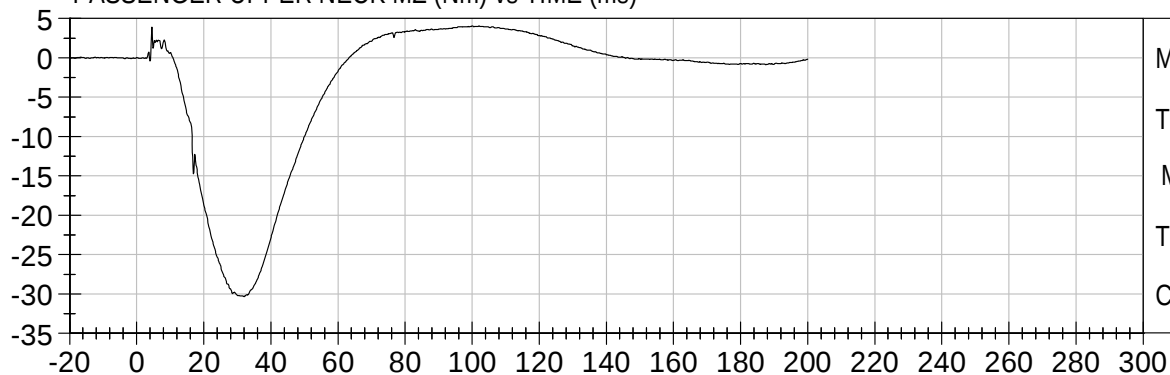
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Tmin: 17.3 ms
CFC 600

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



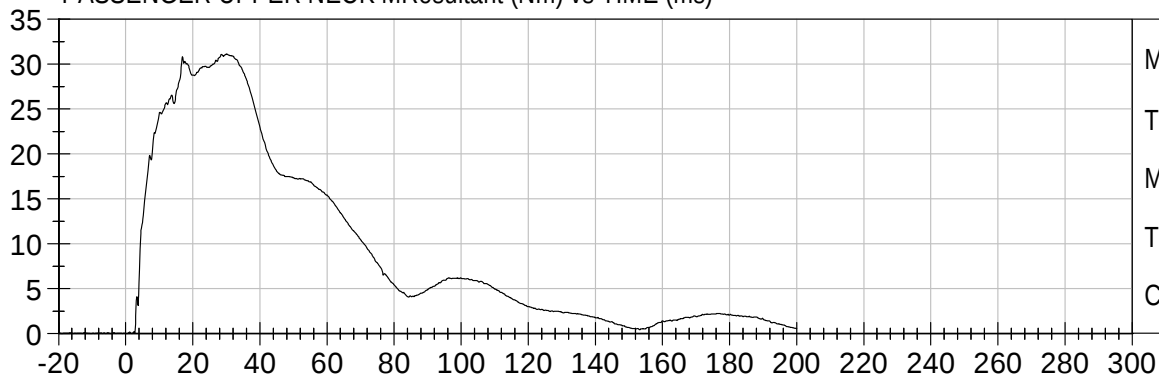
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Min: -9.6 Nm
Tmin: 54.1 ms
CFC 600

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



Max: 4.0 Nm
Tmax: 100.1 ms
Min: -30.3 Nm
Tmin: 32.0 ms
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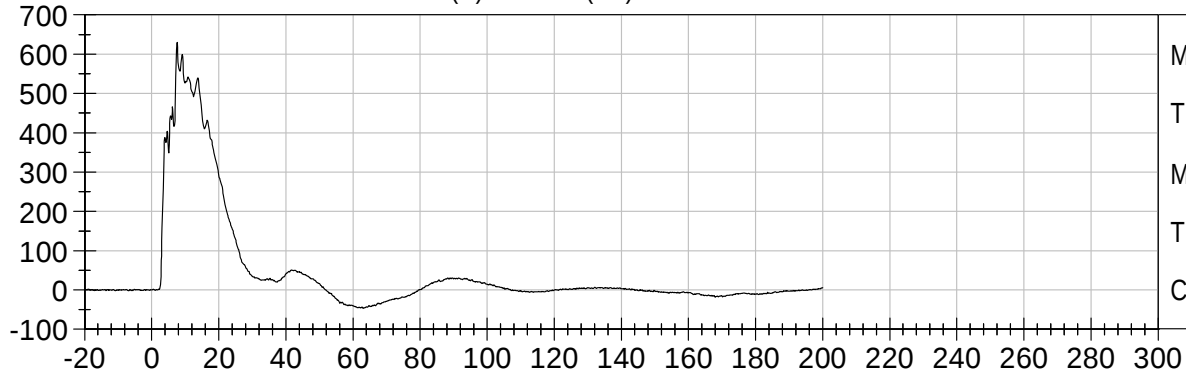
PASSENGER UPPER NECK MResultant (Nm) vs TIME (ms)



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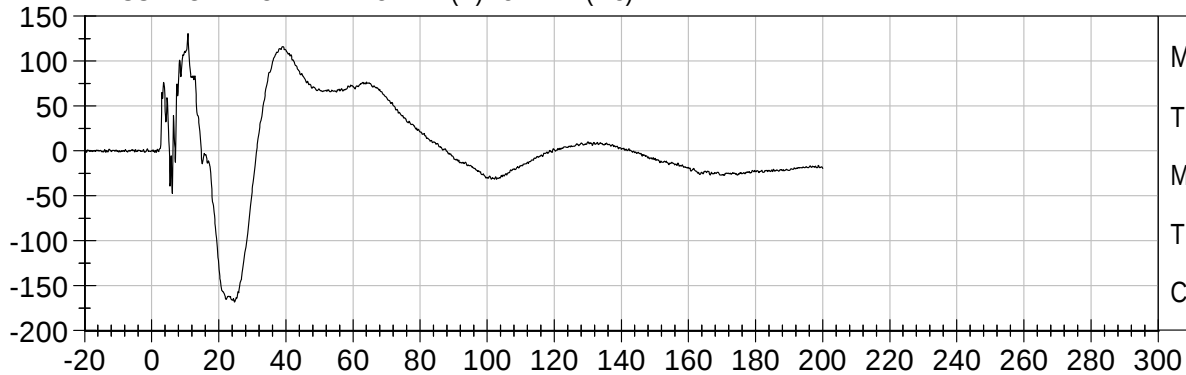


PASSENGER LOWER NECK FX (N) vs TIME (ms)



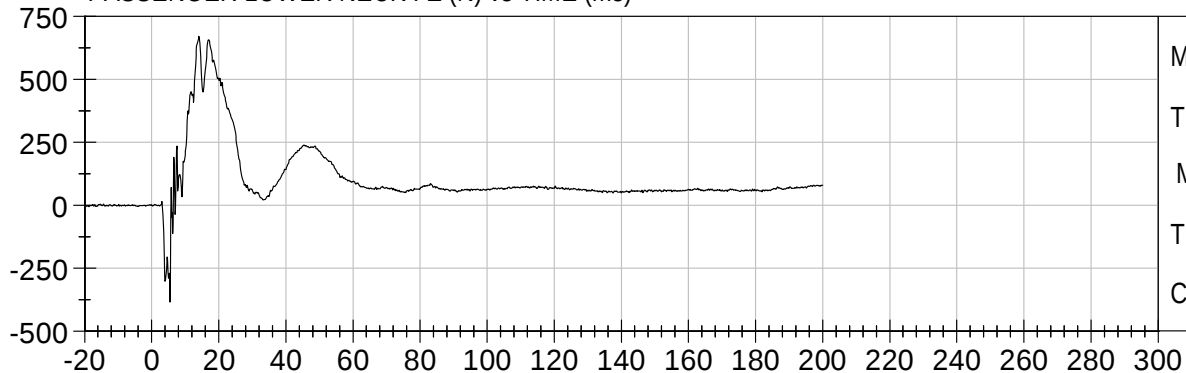
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PASSENGER LOWER NECK FY (N) vs TIME (ms)



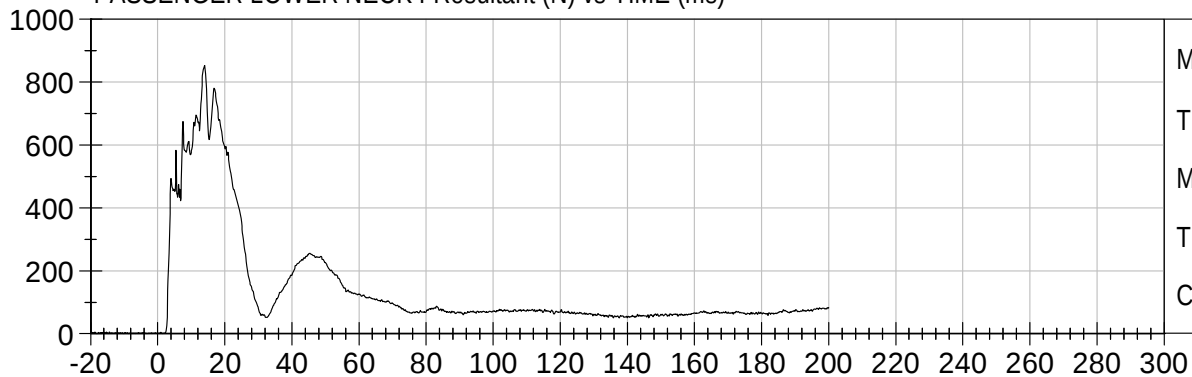
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PASSENGER LOWER NECK FZ (N) vs TIME (ms)

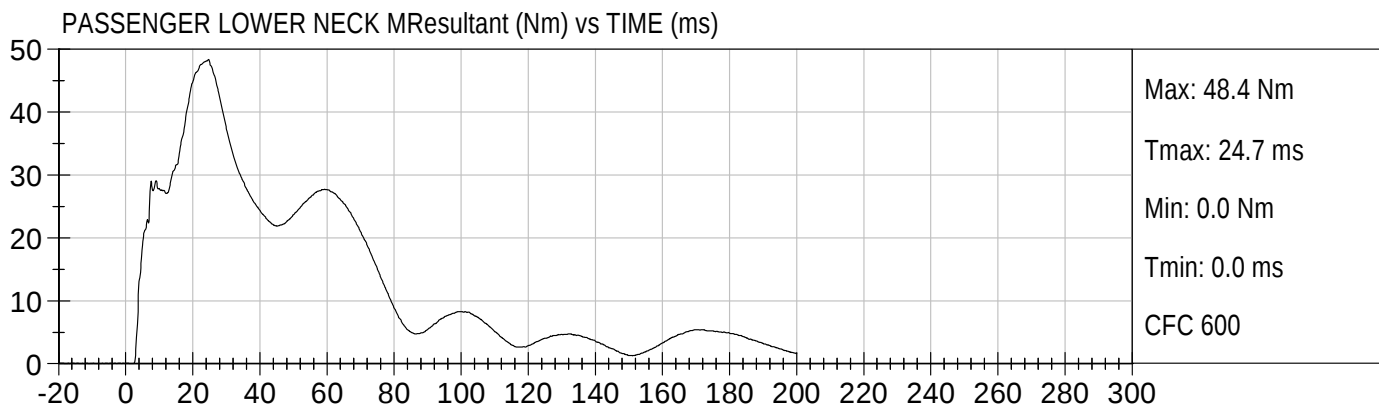
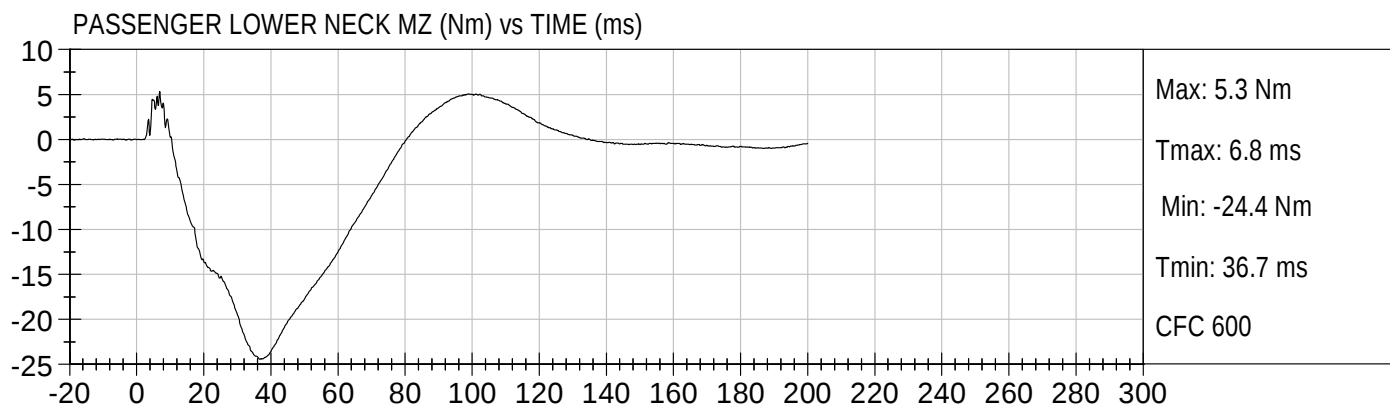
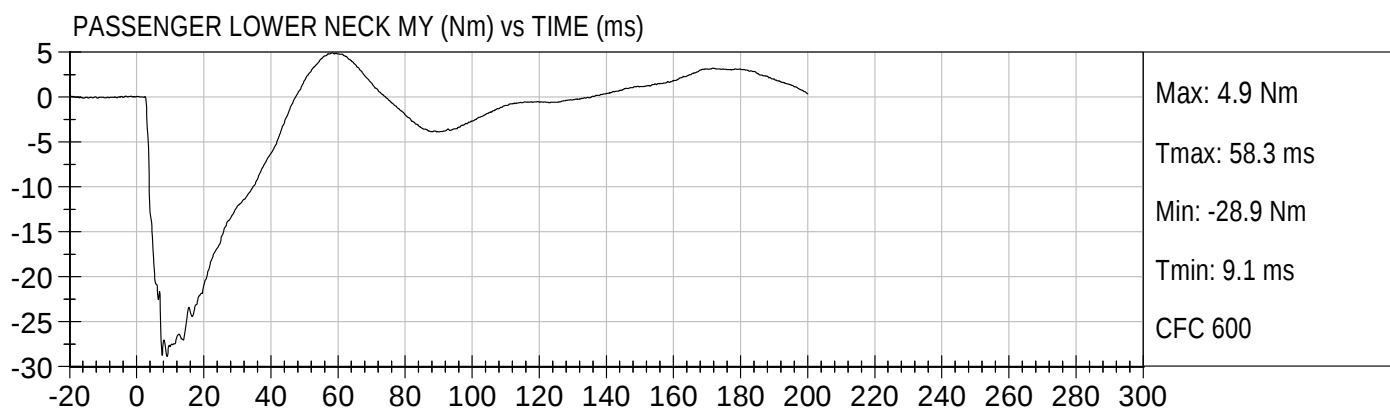
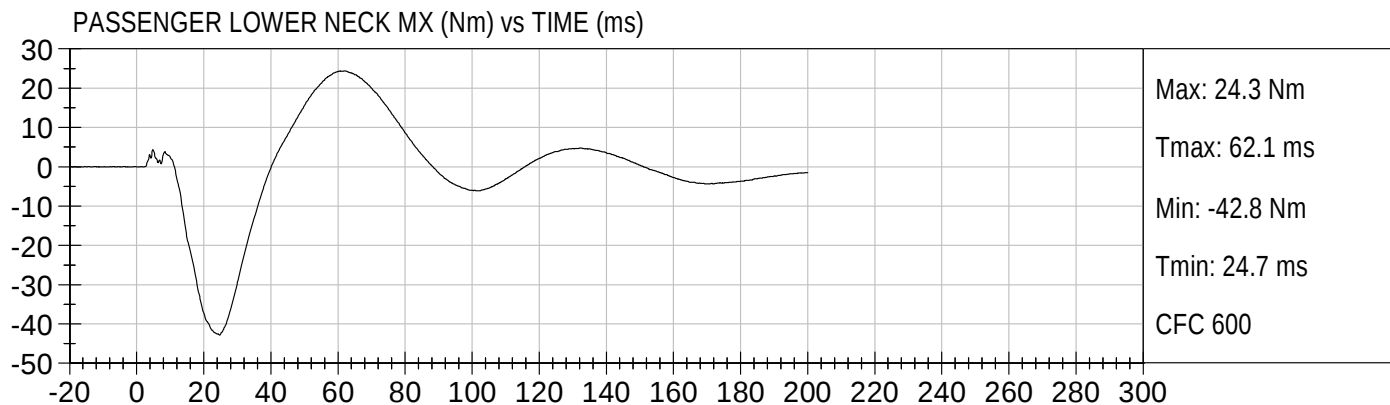


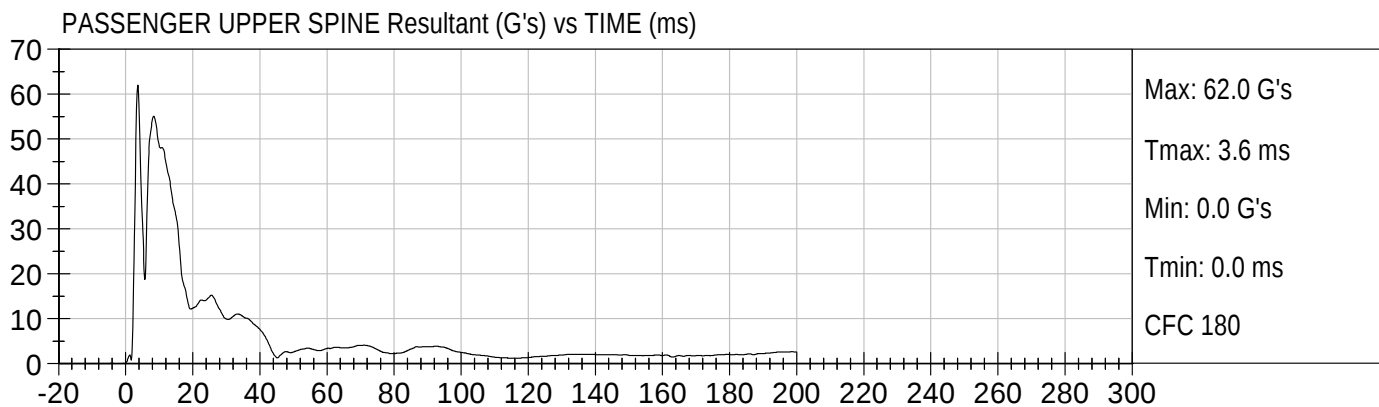
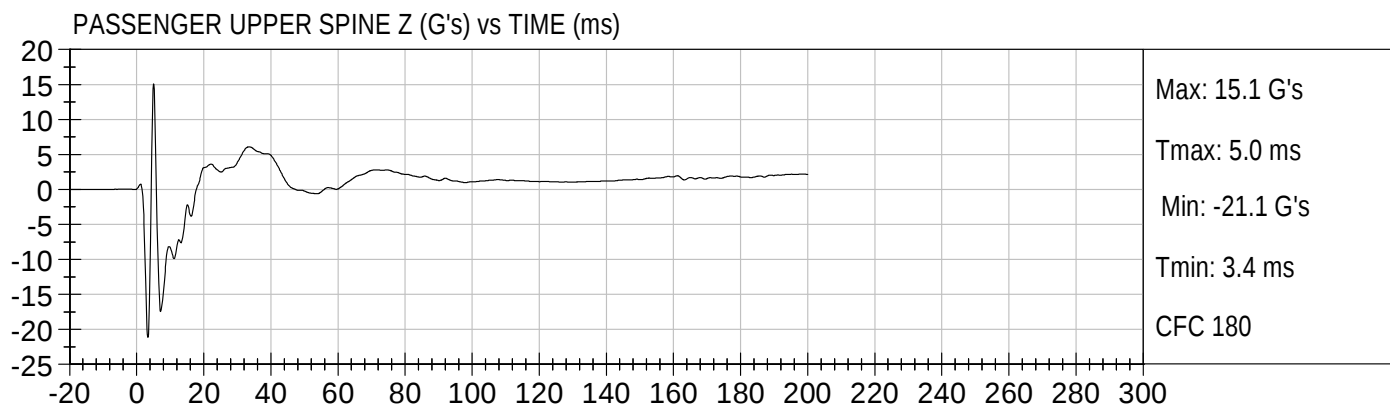
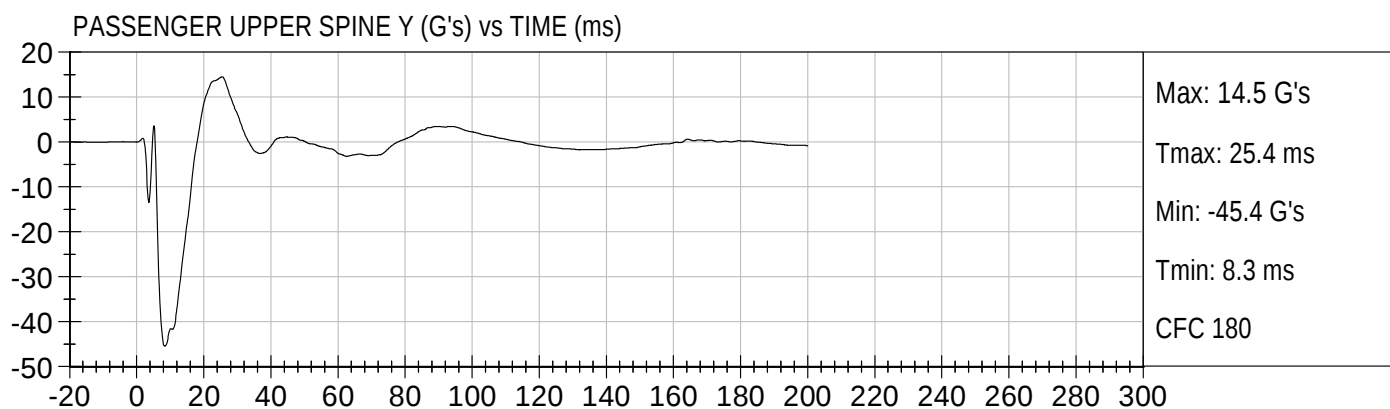
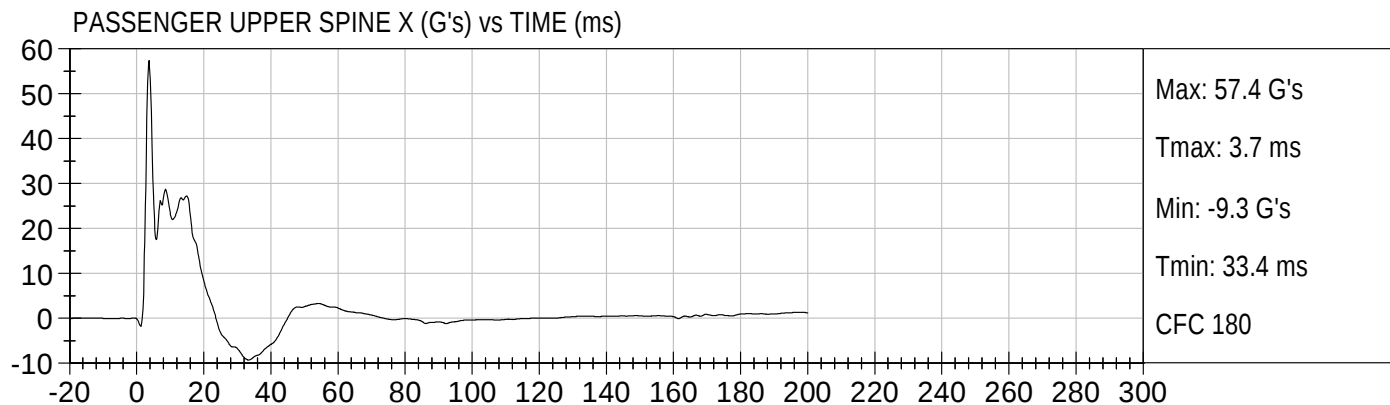
Max: 671.9 N
Tmax: 14.1 ms
Min: -383.1 N
Tmin: 5.5 ms
CFC 1000

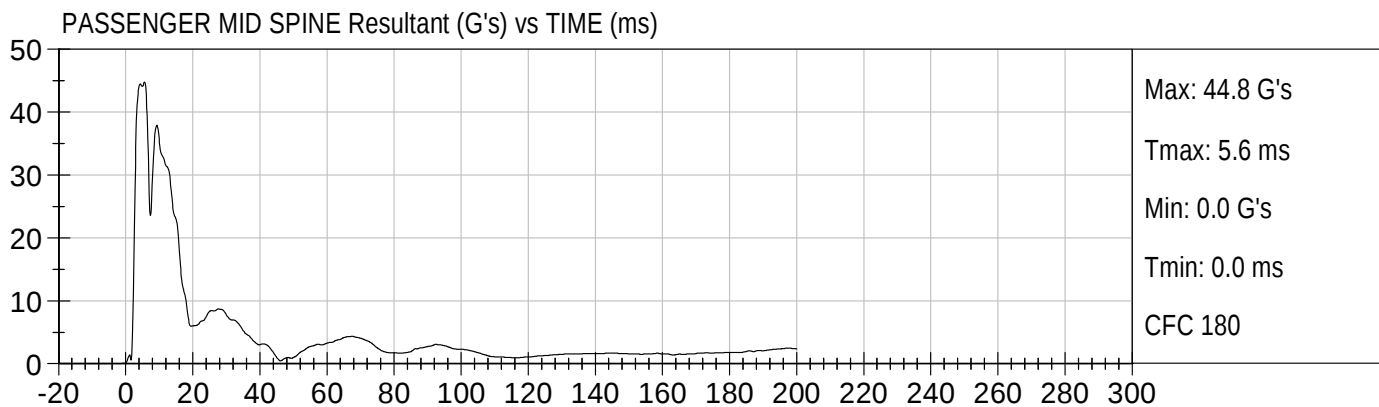
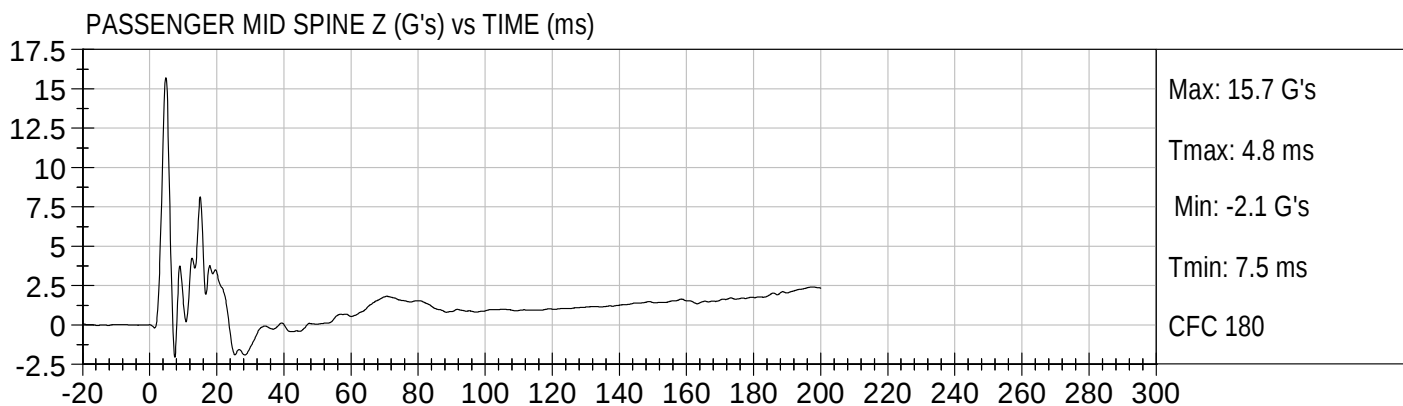
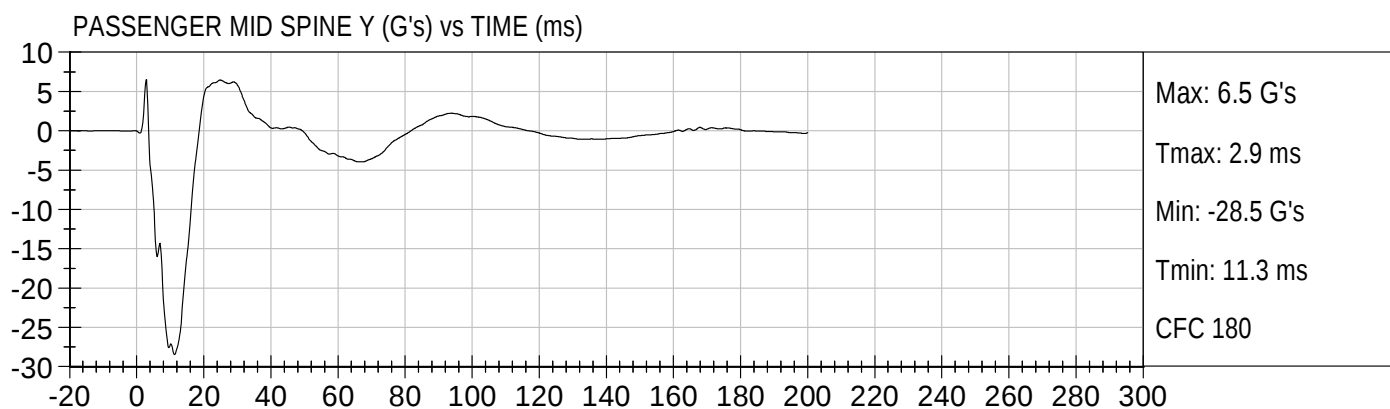
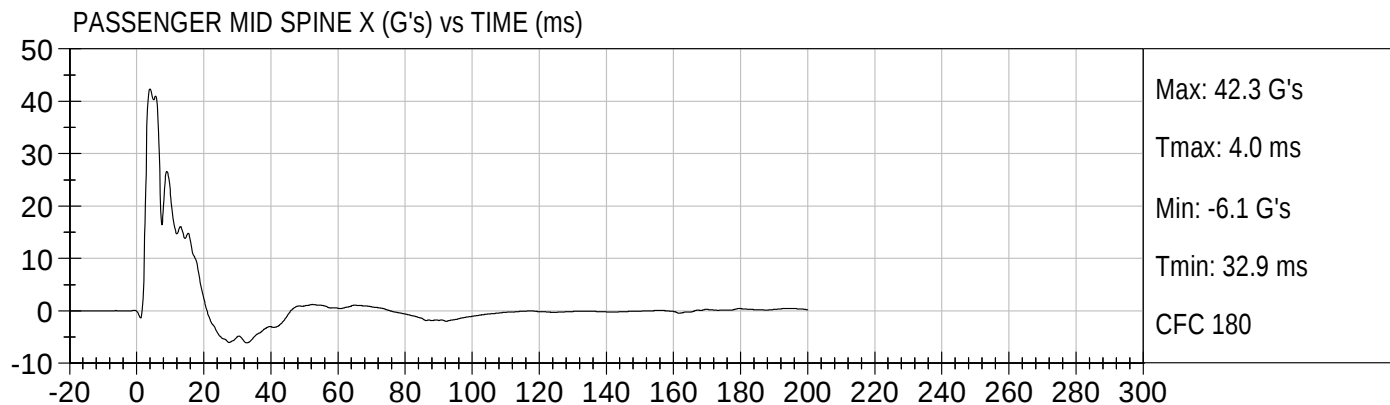
PASSENGER LOWER NECK FResultant (N) vs TIME (ms)



Max: 853.1 N
Tmax: 14.0 ms
Min: 0.3 N
Tmin: 0.0 ms
CFC 1000

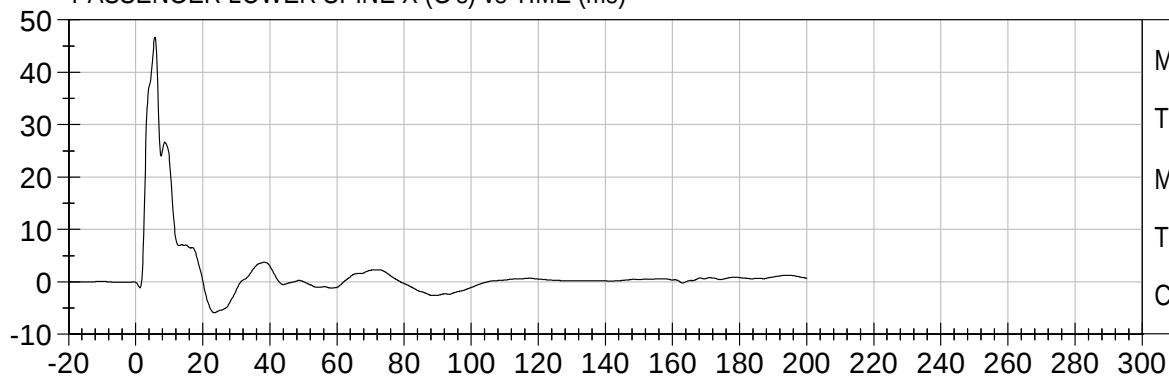






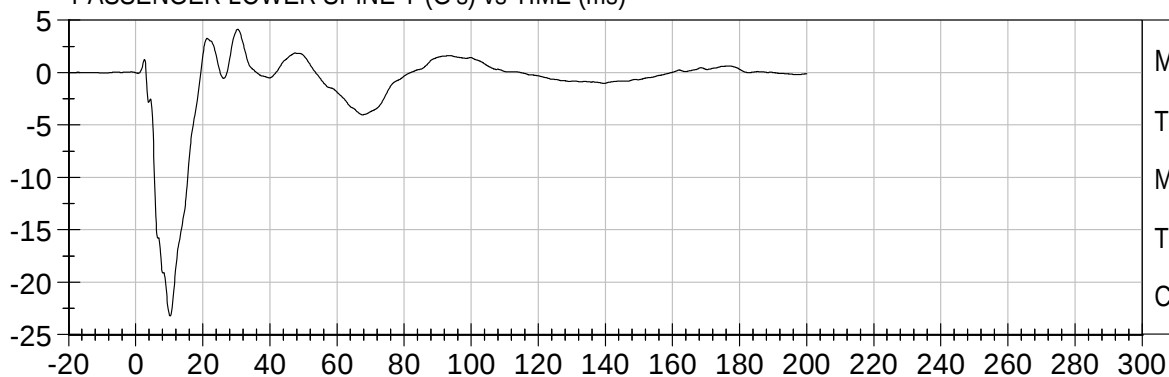


PASSENGER LOWER SPINE X (G's) vs TIME (ms)



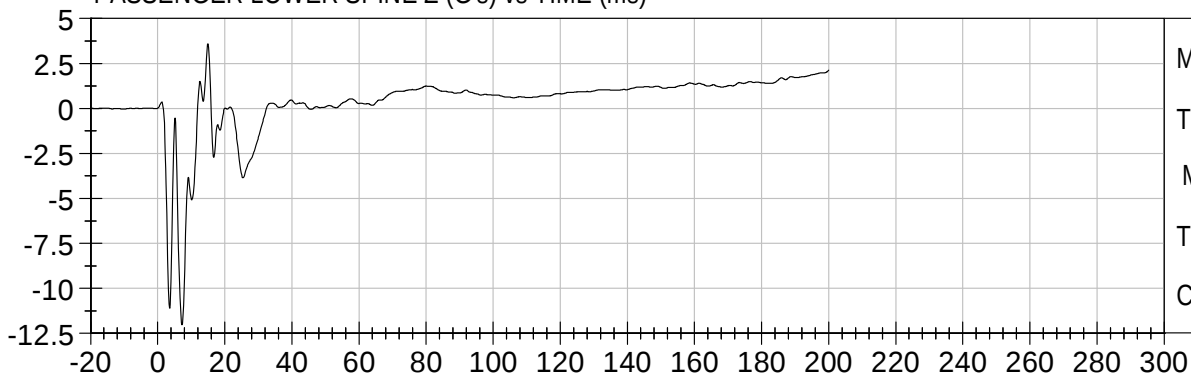
Max: 46.7 G's
Tmax: 5.7 ms
Min: -5.9 G's
Tmin: 23.5 ms
CFC 180

PASSENGER LOWER SPINE Y (G's) vs TIME (ms)



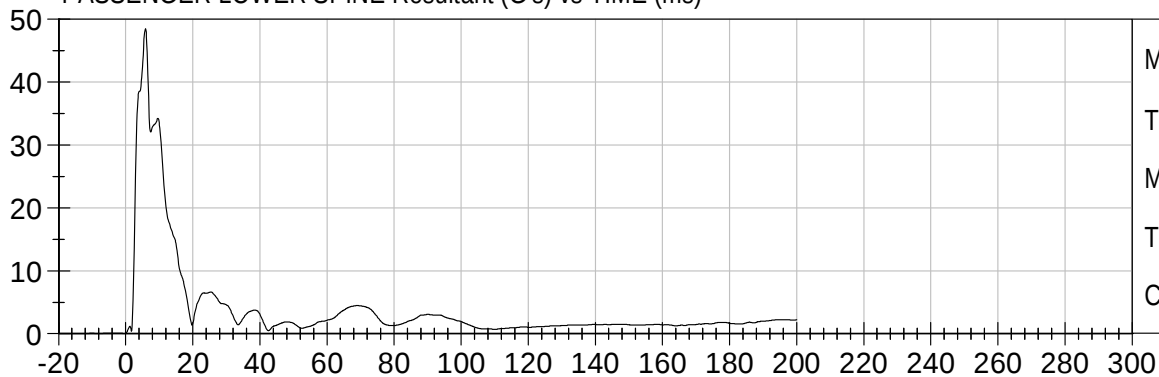
Max: 4.1 G's
Tmax: 30.4 ms
Min: -23.2 G's
Tmin: 10.3 ms
CFC 180

PASSENGER LOWER SPINE Z (G's) vs TIME (ms)



Max: 3.6 G's
Tmax: 15.0 ms
Min: -12.0 G's
Tmin: 7.3 ms
CFC 180

PASSENGER LOWER SPINE Resultant (G's) vs TIME (ms)



Max: 48.5 G's
Tmax: 5.9 ms
Min: 0.0 G's
Tmin: 0.0 ms
CFC 180

