

REPORT NUMBER: TWG-MGA-2008-001

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

**BAYERISCHE MOTORENWERKE
2008 BMW X5
NHTSA NUMBER: M80504TWG2**

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



Test Date: July 1, 2008

Final Report Date: July 16, 2008

FINAL REPORT

**PREPARED FOR:
U.S. DEPARTMENT OF TRANSPORTATION
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION
RULEMAKING
OFFICE OF CRASHWORTHINESS STANDARDS
400 SEVENTH STREET, SW, ROOM 5311
WASHINGTON, D.C. 20590**

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Jessica Gall, Project Engineer

Date: 7/16/2008

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David Winkelbauer, Facility Director

Date: 7/16/2008

Technical Report Documentation Page

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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 July 1, 2008. <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;">5.7</td> <td style="text-align: center;">8.6</td> <td style="text-align: center;">0.05</td> <td style="text-align: center;">0.15</td> <td style="text-align: center;">0.19</td> <td style="text-align: center;">0.17</td> </tr> </table>				HIC 15	HIC 36	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE	5.7	8.6	0.05	0.15	0.19	0.17
HIC 15	HIC 36	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE										
5.7	8.6	0.05	0.15	0.19	0.17										
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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 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 both a curtain and torso airbag deployment in a 2008 BMW X5 with an out-of-position SID-IIs Build Level D were evaluated. The test was performed by MGA Research Corporation on July 1, 2008. 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 3.3.5.3 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 | • Rib Accelerations |
| • Upper Neck Load Cell | • Lumbar Load Cell |
| • Lower Neck Load Cell | • Left Ilium Crest Load Cell |
| • Shoulder Load Cell | • Left Acetabulum Load Cell |
| • Upper Spine Accelerations | • Spine Box Accelerations |
| • Lower Spine Accelerations | • Pelvic Accelerations |
| • Rib Displacements | |

The 50 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 curtain airbag to the top and back of the head. 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 arm was rotated horizontally in the forward direction with respect to the dummy. The seat track was adjusted forward. The dummy's pelvis was slid outboard until the dummy's back contacted the door trim panel or armrest and the CG of the head was centered in the deployment trajectory of the airbag. The vertical plane through the centerline of the dummy's rib-stiffener and shoulder bolt was parallel to the centerline of the vehicle. Masking tape was wrapped around the dummy's neck bracket to hold the dummy in place.

This orientation complies with Section 3.3.5.3 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	3.3.5.3*	Side-facing SID-IIs dummy
Curtain Airbag	Roof-Rail Mounted	Side 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	50
Number of Real-Time Video	1
Number of High-Speed Video	3

Visible Dummy Contact Points	
Head Contact	Curtain airbag to top and back 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 Frontal Impact on December 19, 2007.

TEST VEHICLE INFORMATION

Manufacturer	BMW
Model	X5
Body Style	SUV
NHTSA No.	M80504TWG2
VIN	5UXFE43568L002144
Color	Black Sapphire Metallic
Delivery Date	12/06/2007
Odometer Reading (mile)	73
Dealer	BMW of Riverside
Transmission	Automatic
Final Drive	AWD
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

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	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Bayerische Motorenwerke
Date of Manufacture	10/07

GVWR (kg)	2725
GAWR Front (kg)	1260
GAWR Rear (kg)	1560

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				524
Cargo Wt. (RCLW) (kg)				136

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		Rearmost
Seat Height Position		Lowest
Placed in Position No. 2		---
Seat Back Angle	SA (°)	13
Top of Airbag Module to Head/Neck Junction	AN (mm)	297
Head CG to Door Panel/Window	HD (mm)	201
Head to Seat Back Centerline	HSC (mm)	142
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)	139
Left Arm to B-Post	LA (mm)	100
Knee to Knee	KK (mm)	127
Toe to Toe	TT (mm)	94
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)	64

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. M80504TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	12.3	16.4	-3.7	220.3
Head Y	g	6.8	19.4	-13.5	12.3
Head Z	g	16.3	11.5	-14.0	13.8
Head Resultant	g	19.1	11.5		
Upper Neck Fx	N	87.9	19.8	-107.7	217.6
Upper Neck Fy	N	114.3	40.5	-41.5	116.6
Upper Neck Fz	N	137.7	28.3	-656.9	13.6
Upper Neck F Resultant	N	657.4	13.6		
Upper Neck Mx	Nm	5.0	66.1	-3.1	125.5
Upper Neck My	Nm	9.6	17.3	-9.7	52.4
Upper Neck Mz	Nm	7.1	35.5	-6.6	96.2
Upper Neck M Resultant	Nm	11.2	47.8		
Lower Neck Fx	N	286.9	15.5	-160.3	209.7
Lower Neck Fy	N	159.4	18.4	-52.4	138.7
Lower Neck Fz	N	143.0	28.0	-757.0	14.0
Lower Neck F Resultant	N	770.4	14.0		
Lower Neck Mx	Nm	19.7	36.6	-8.9	116.3
Lower Neck My	Nm	32.1	13.4	-20.2	35.6
Lower Neck Mz	Nm	12.6	18.2	-8.3	95.6
Lower Neck M Resultant	Nm	32.2	13.4		

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

NHTSA No. M80504TWG2

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	5.7	11.3	26.3	8.6	11.2	46.4

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	0.05	229.6	26.29	-103.59	5.33
Nte	0.15	53.9	28.74	1.06	-9.59
Ncf	0.19	15.8	-576.99	43.87	7.15
Nce	0.17	12.4	-565.24	-44.05	-2.64
Peak Tension (CFC1000)		137.7 N	Peak Compression (CFC 1000)		-656.9 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				

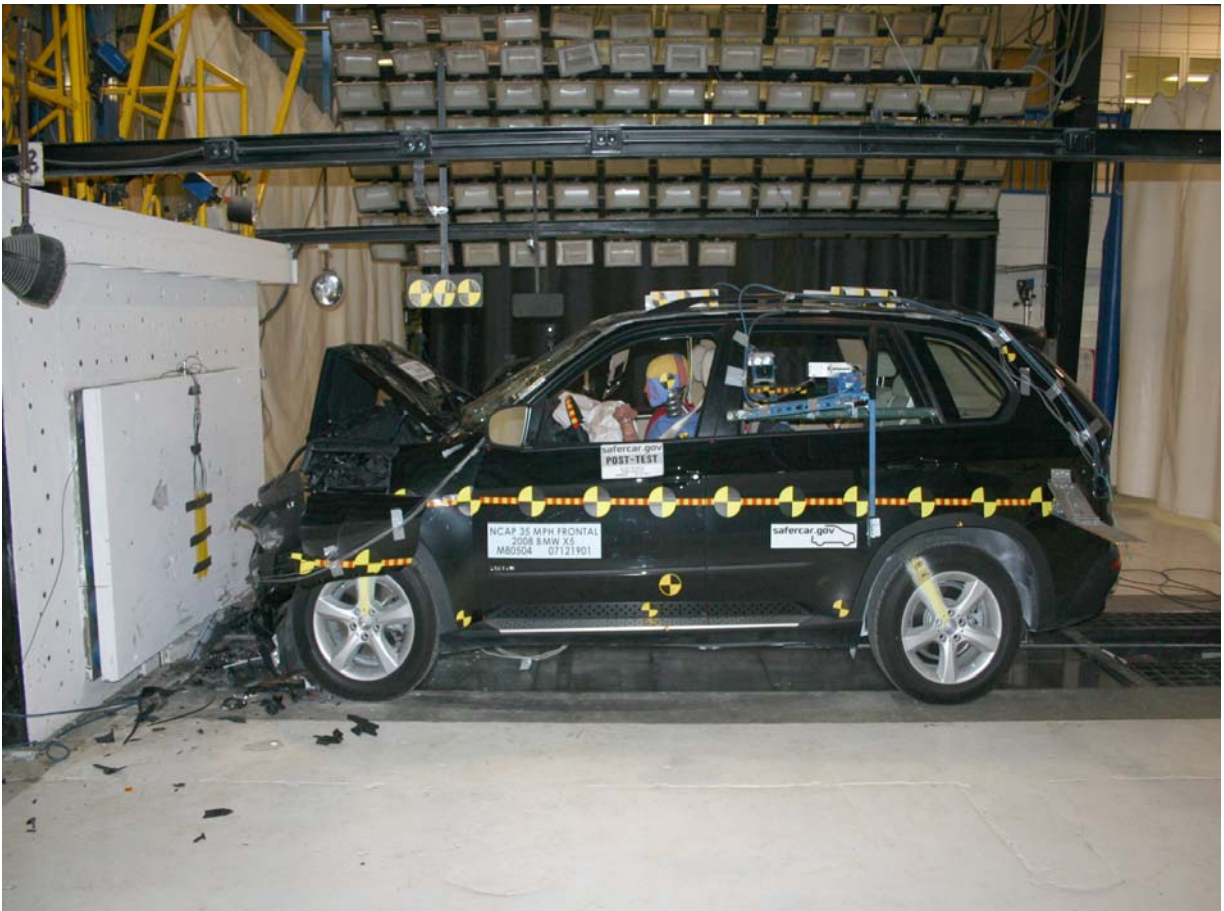
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Pre-Test Vehicle Left Side View



Post-Test Vehicle Left Side View



Vehicle Certification Placard



Vehicle Tire Placard



Pre-Test SID-IIs Dummy Left Side View



Post-Test SID-IIs Dummy Left Side View



Pre-Test SID-II's Dummy Left Side Closeup View



Post-Test SID-II's Dummy Left Side Closeup View



Pre-Test SID-IIs Dummy Left $\frac{3}{4}$ Front View



Post-Test SID-IIs Dummy Left $\frac{3}{4}$ Front View



Pre-Test SID-IIs Dummy Left $\frac{3}{4}$ Front Closeup View



Post-Test SID-IIs Dummy Left $\frac{3}{4}$ Front Closeup View



Pre-Test SID-IIs Dummy Front Closeup View



Post-Test SID-IIs Dummy Front Closeup View



Pre-Test SID-11s Dummy Right $\frac{3}{4}$ Front View



Post-Test SID-11s Dummy Right $\frac{3}{4}$ Front View



Post-Test Right Front Passenger Compartment View



Post-Test Curtain and Torso Airbag View

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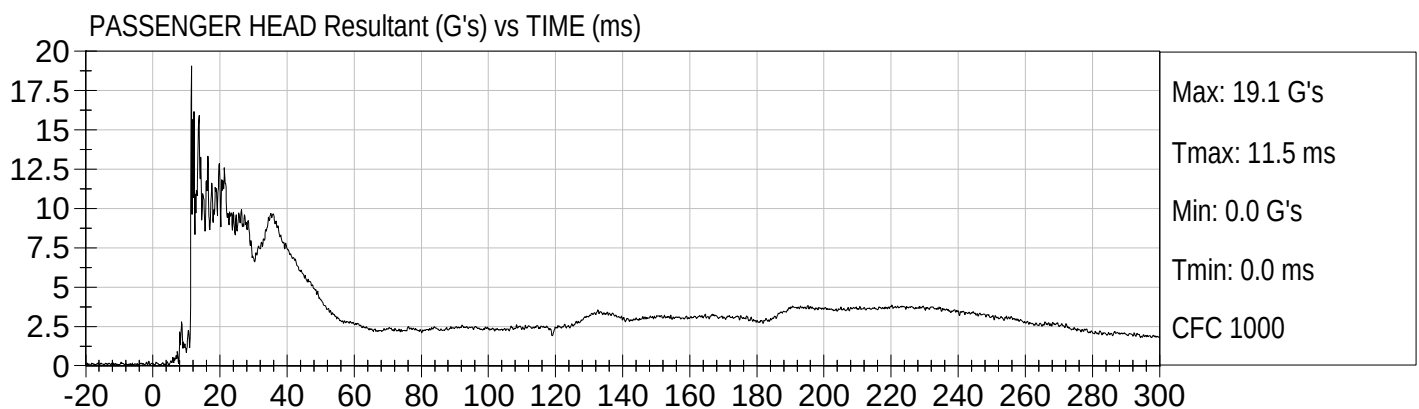
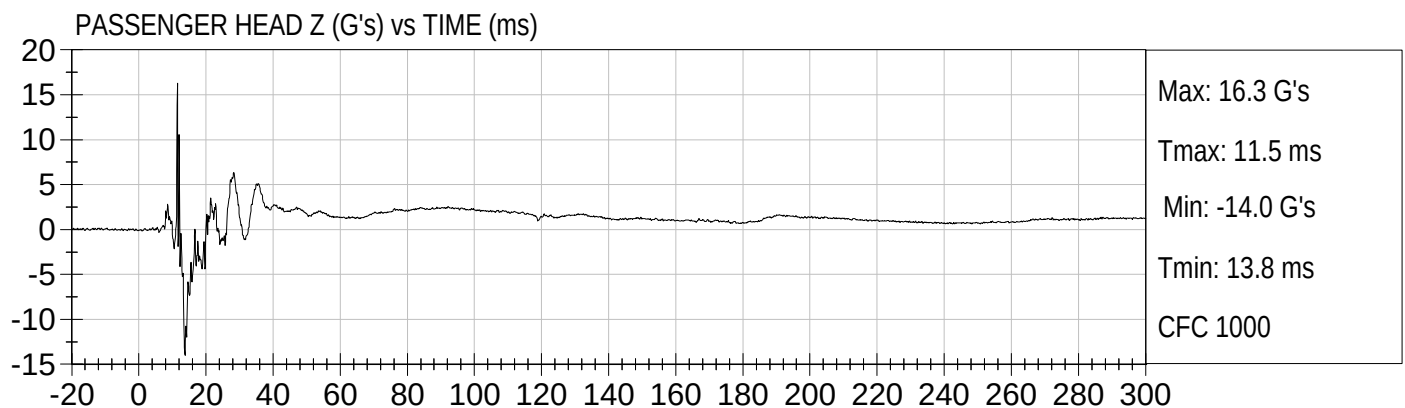
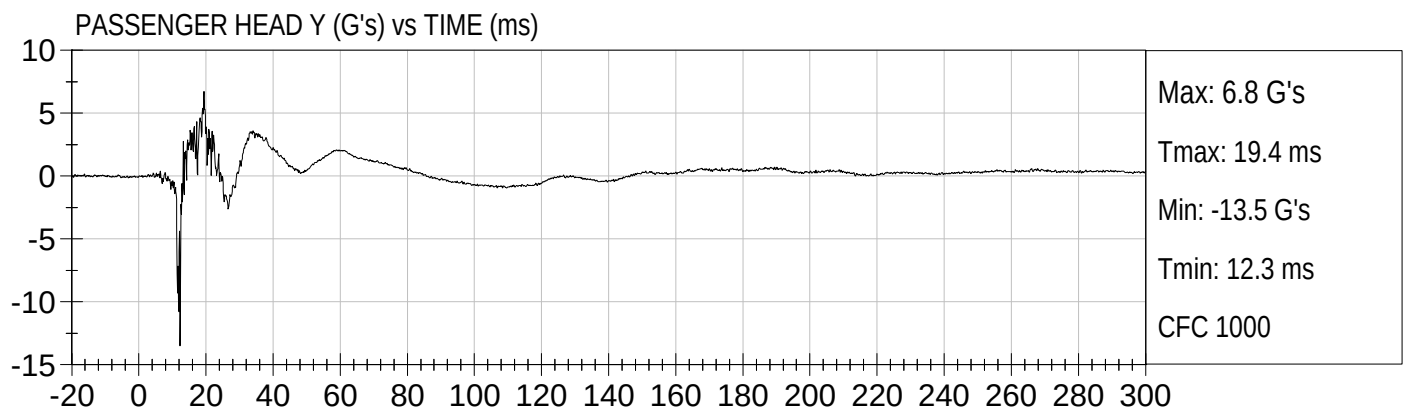
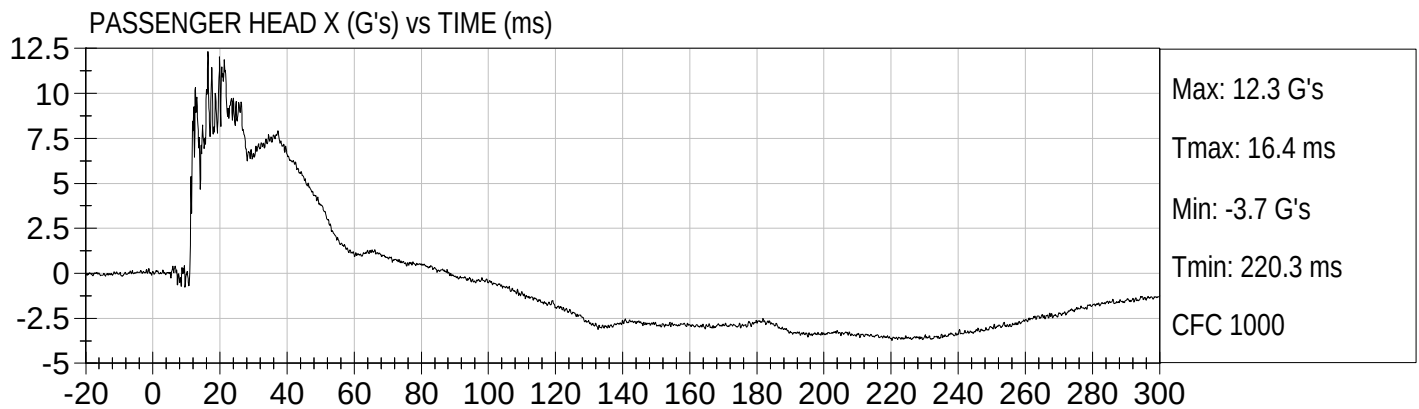


NCAP SIDE OOP
2008 BMW X5

SID-IIs
M80504

3.3.5.3

Test Date: 07/01/2008
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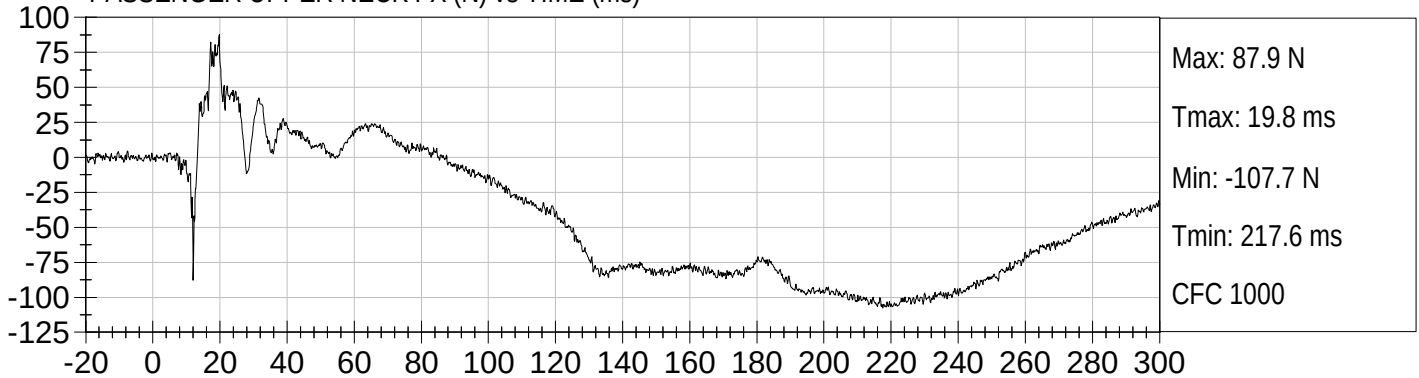
NCAP SIDE OOP
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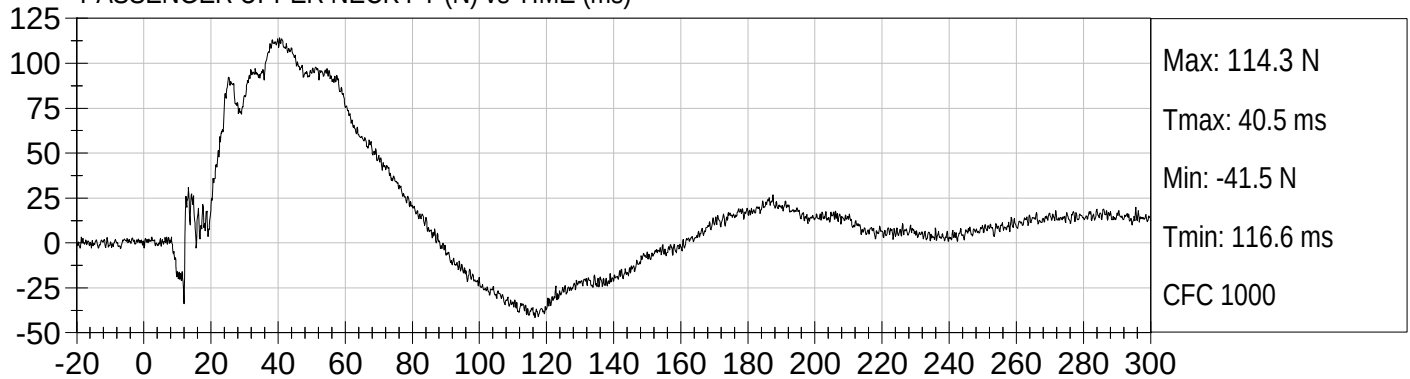
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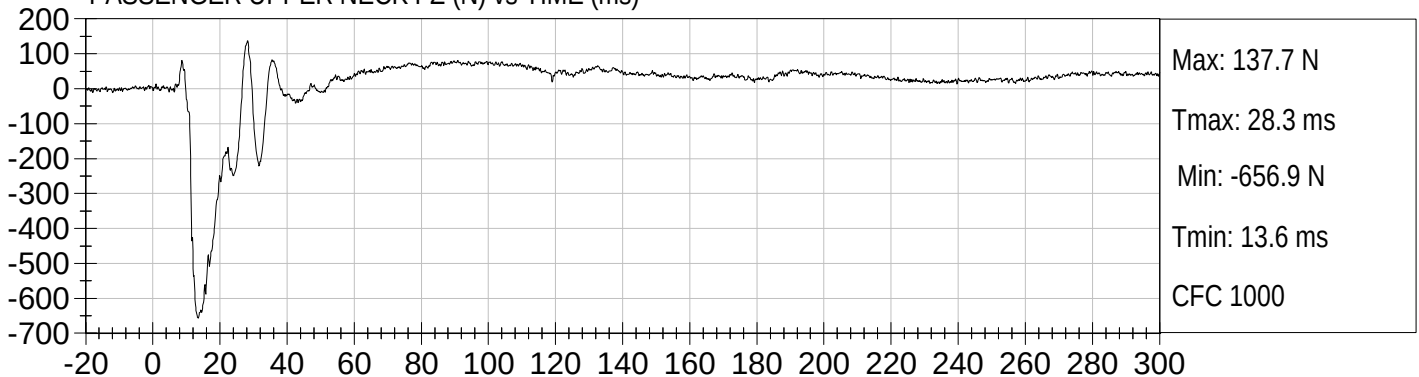
PASSENGER UPPER NECK FX (N) vs TIME (ms)



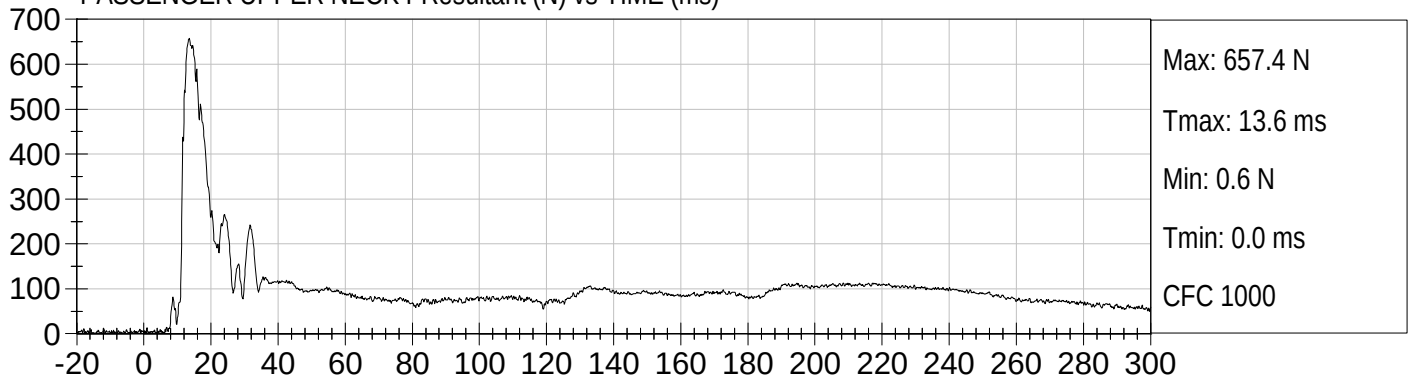
PASSENGER UPPER NECK FY (N) vs TIME (ms)



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



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





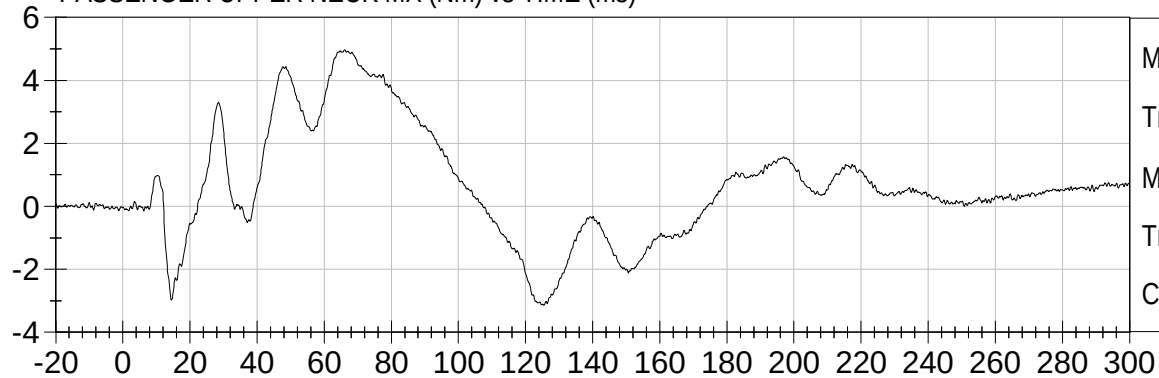
NCAP SIDE OOP
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3.3.5.3

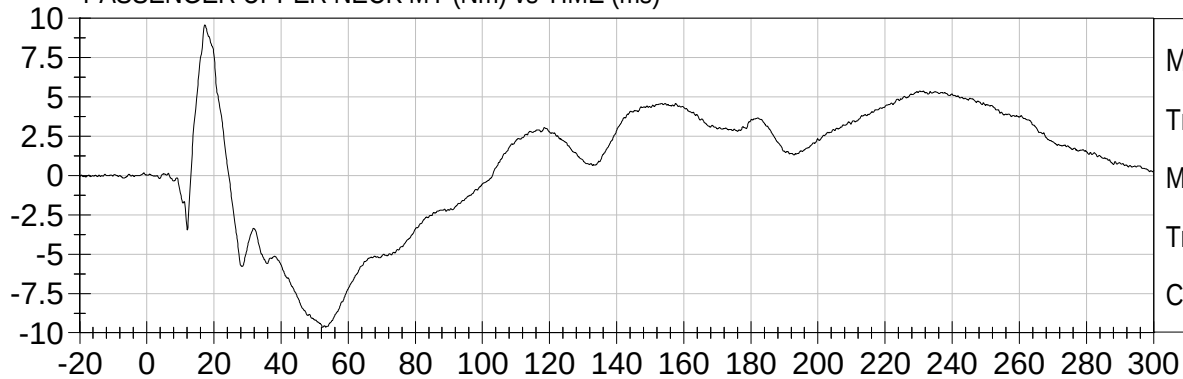
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PASSENGER UPPER NECK MX (Nm) vs TIME (ms)



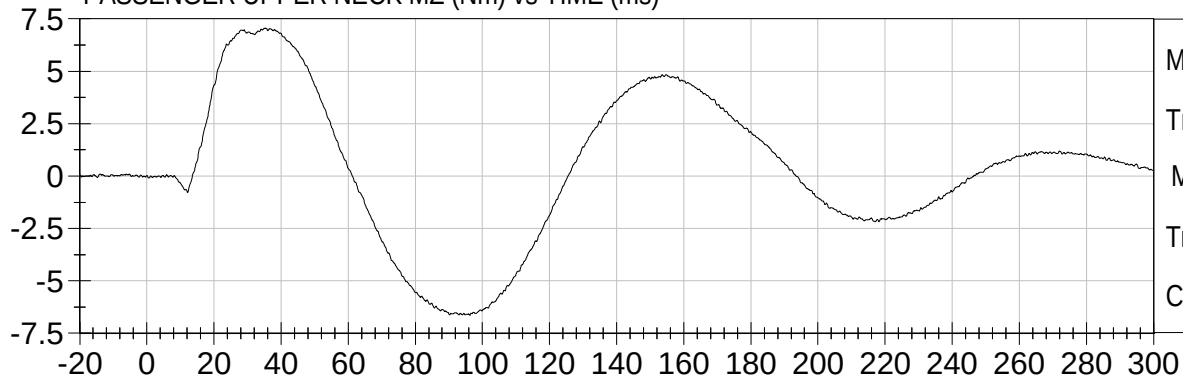
Max: 5.0 Nm
Tmax: 66.1 ms
Min: -3.1 Nm
Tmin: 125.5 ms
CFC 600

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



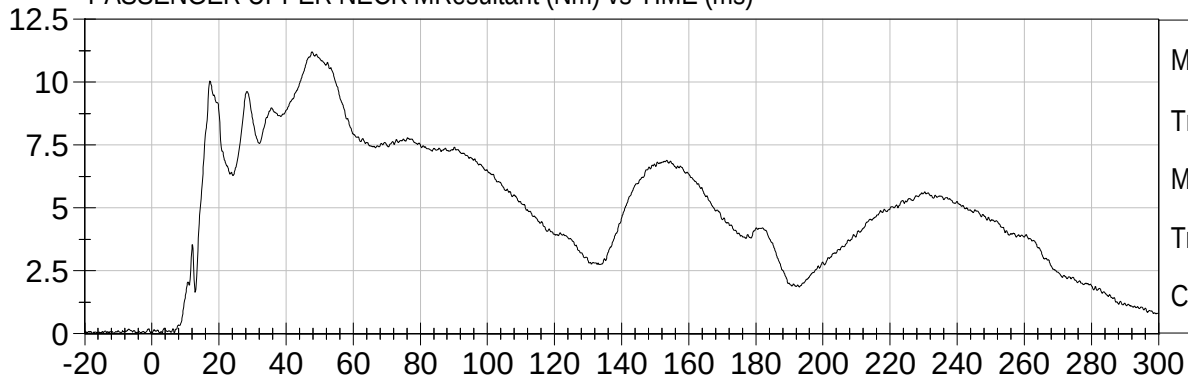
Max: 9.6 Nm
Tmax: 17.3 ms
Min: -9.7 Nm
Tmin: 52.4 ms
CFC 600

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



Max: 7.1 Nm
Tmax: 35.5 ms
Min: -6.6 Nm
Tmin: 96.2 ms
CFC 600

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



Max: 11.2 Nm
Tmax: 47.8 ms
Min: 0.0 Nm
Tmin: 0.0 ms
CFC 600

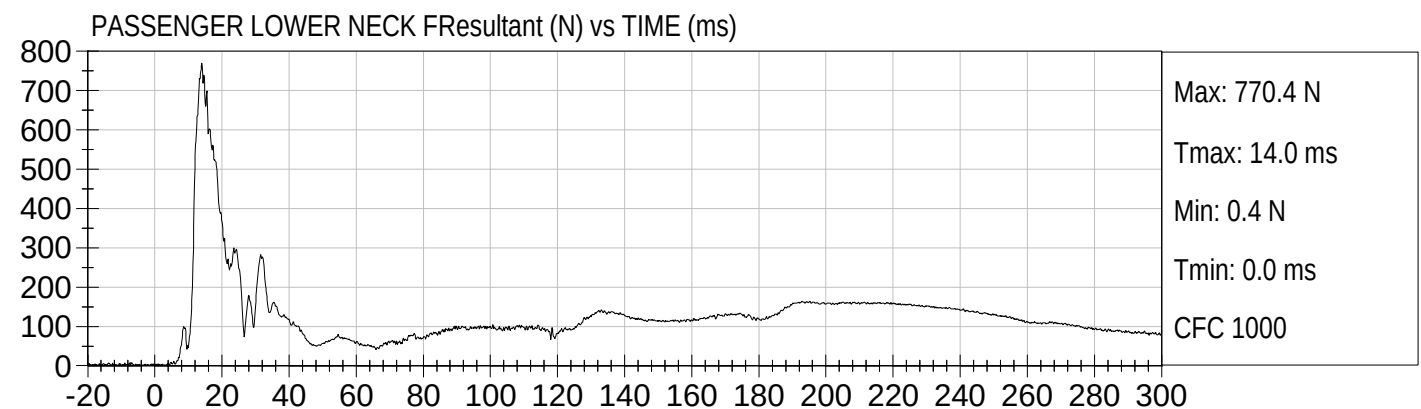
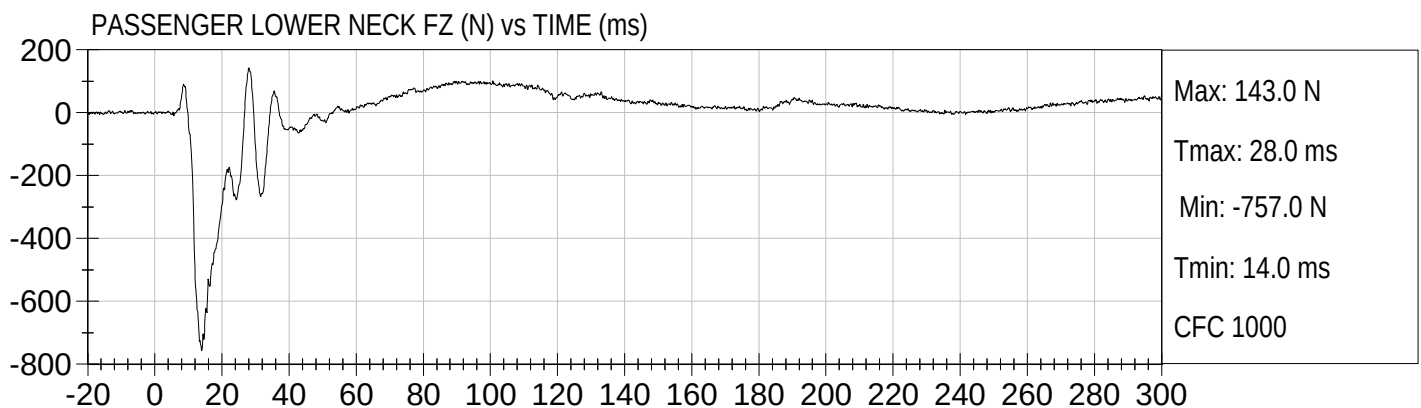
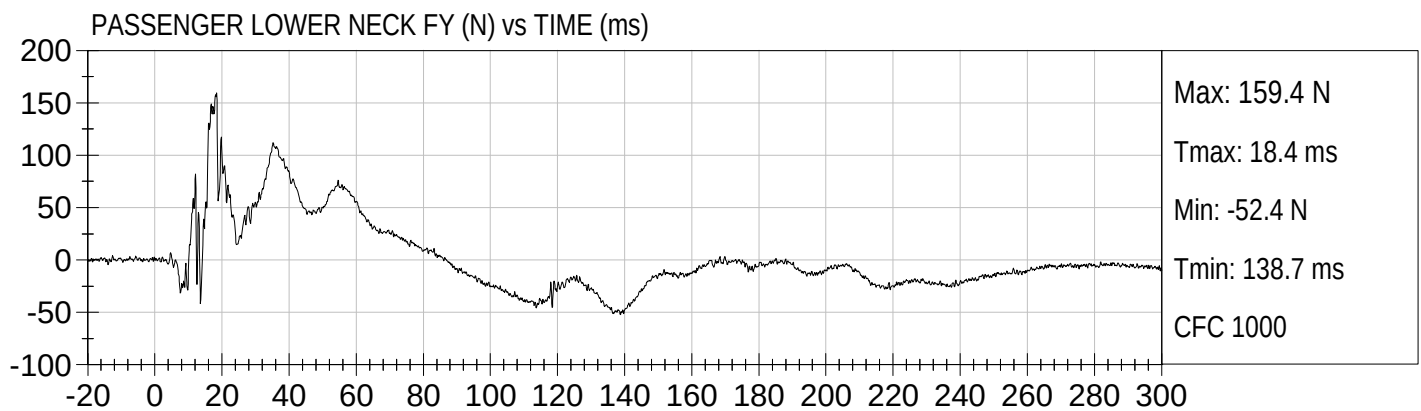
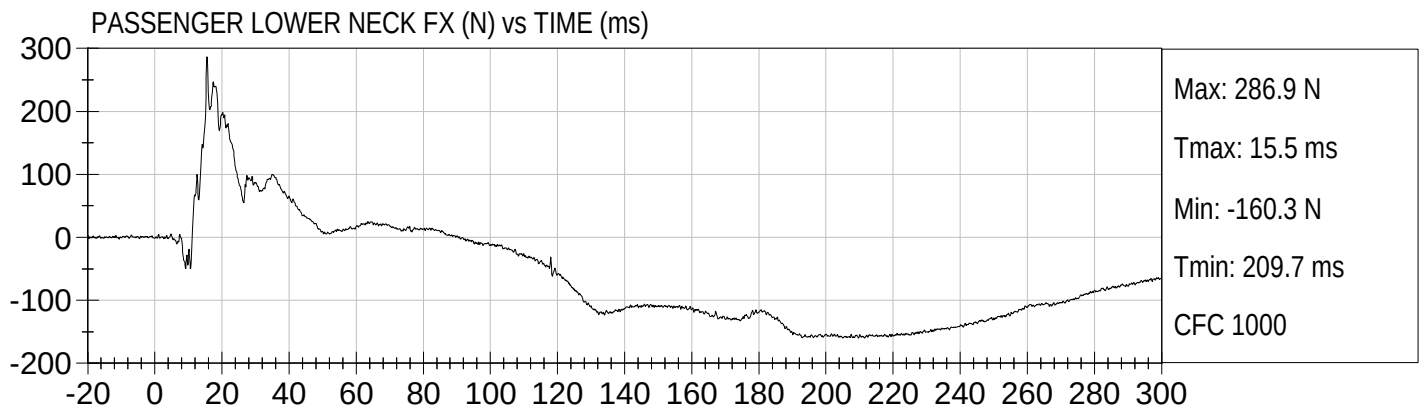


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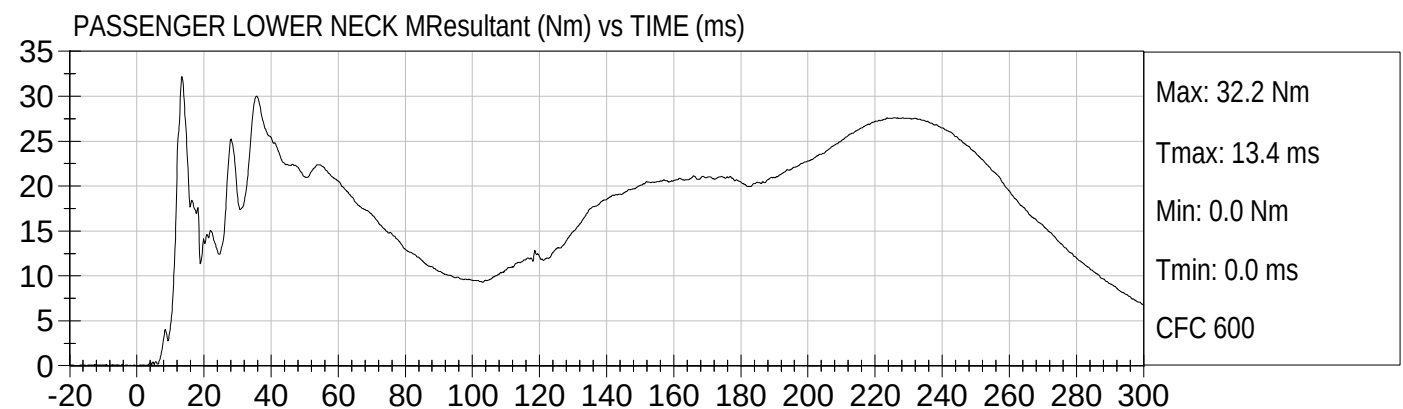
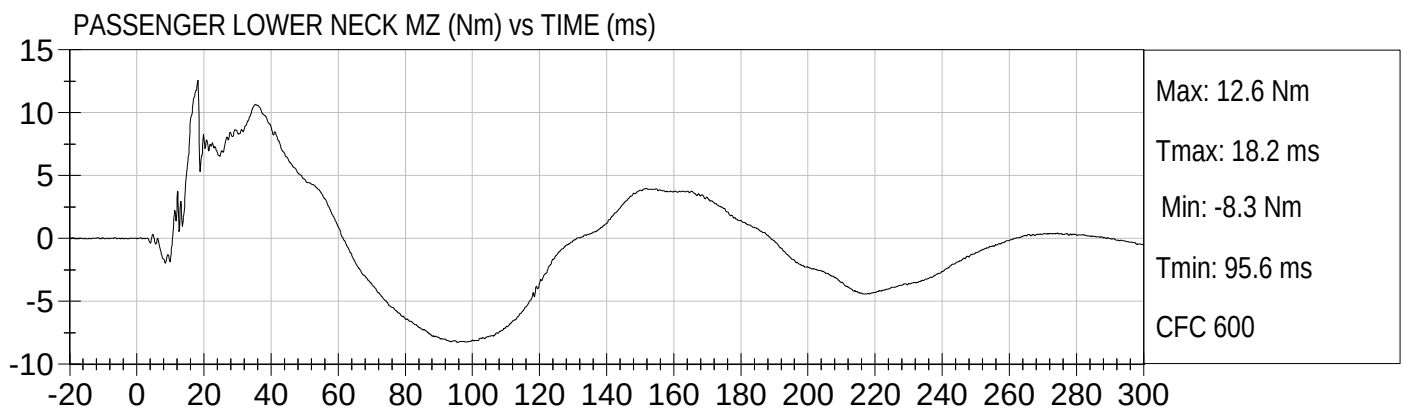
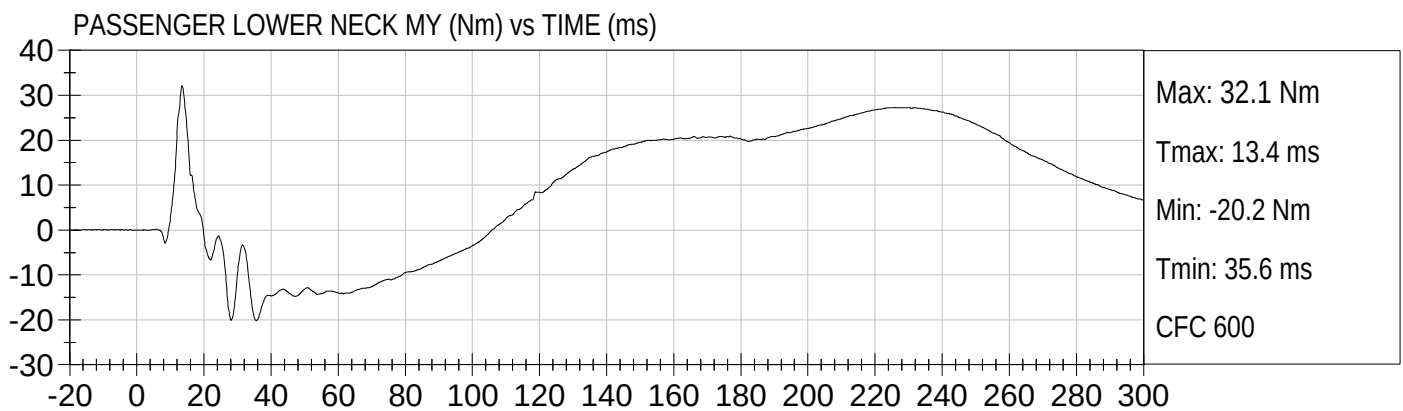
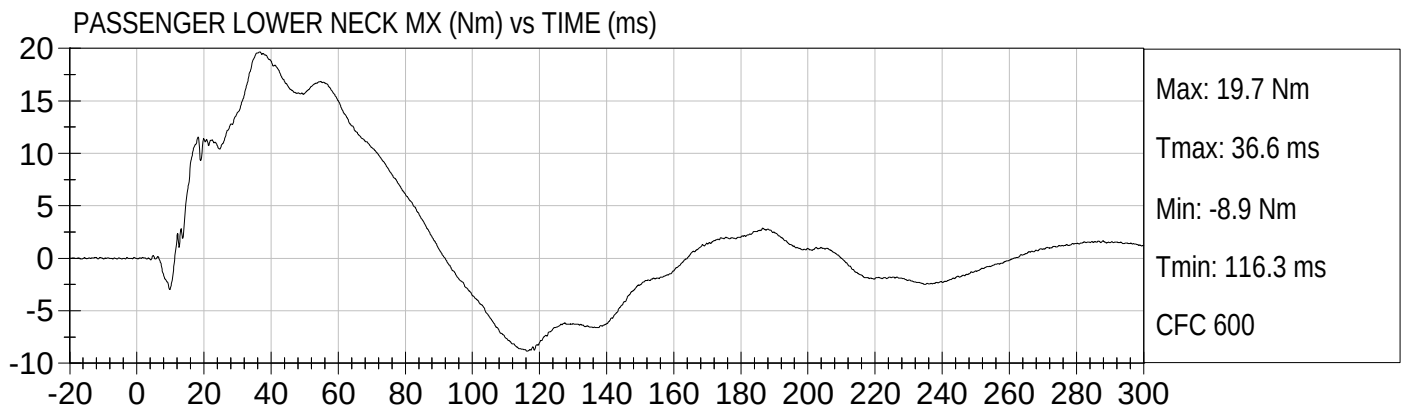


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Test Date: 07/01/2008
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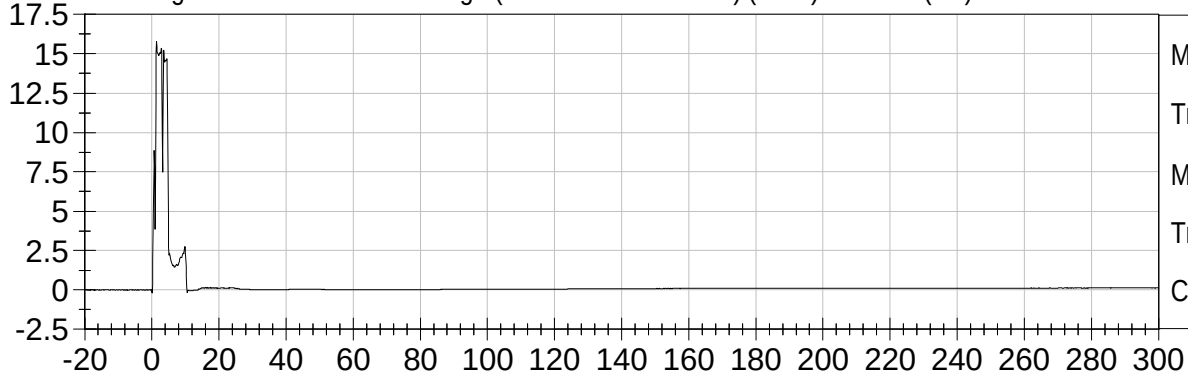
NCAP SIDE OOP
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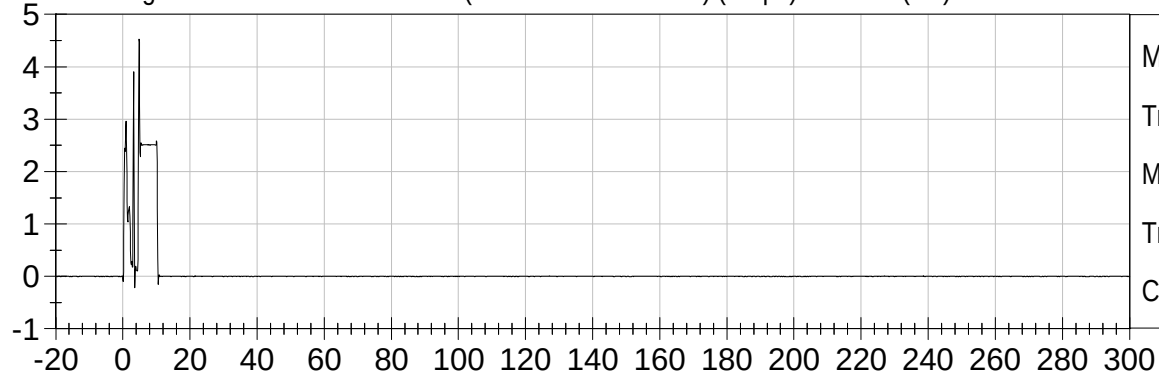
Test Date: 07/01/2008
Speed: 0.0 mph (0.0 km/h)

Passenger Curtain AB - Fire Voltage (DC Constant Current) (Volts) vs TIME (ms)



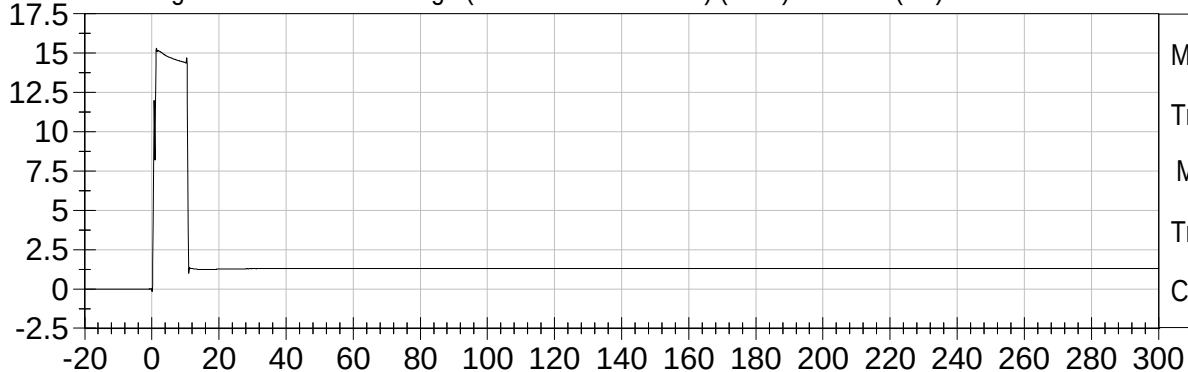
Max: 15.8 Volts
Tmax: 1.4 ms
Min: -0.2 Volts
Tmin: 0.1 ms
CFC 1000

Passenger Curtain AB - Fire Current (DC Constant Current) (Amps) vs TIME (ms)



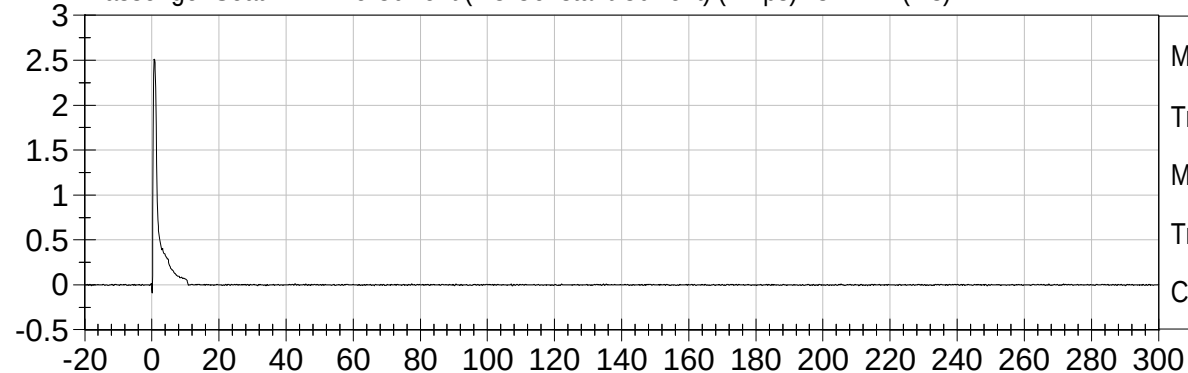
Max: 4.5 Amps
Tmax: 4.8 ms
Min: -0.2 Amps
Tmin: 3.6 ms
CFC 1000

Passenger Seat AB - Fire Voltage (DC Constant Current) (Volts) vs TIME (ms)



Max: 15.3 Volts
Tmax: 1.4 ms
Min: -0.2 Volts
Tmin: 0.1 ms
CFC 1000

Passenger Seat AB - Fire Current (DC Constant Current) (Amps) vs TIME (ms)



Max: 2.5 Amps
Tmax: 0.6 ms
Min: -0.1 Amps
Tmin: 0.1 ms
CFC 1000

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

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	A12-Z15	Entran	6/19/2008
Head Y	A07-J06	Entran	6/19/2008
Head Z	J23-M06	Entran	6/19/2008
Upper Neck Load Cell	NG180	FTSS	4/17/2008
Lower Neck Load Cell	LNG101	FTSS	5/20/2008
Shoulder Load Cell	SG101	FTSS	4/17/2008
Upper Spine X	P52134	Endevco	6/18/2008
Upper Spine Y	P52145	Endevco	6/18/2008
Upper Spine Z	P49481	Endevco	6/18/2008
Lower Spine X	P52173	Endevco	6/18/2008
Lower Spine Y	P52172	Endevco	6/18/2008
Lower Spine Z	P52174	Endevco	6/18/2008
Shoulder Displacement	032SHLD	Servo	6/24/2008
Upper Thorax Rib Displacement	032RIB1	Servo	6/19/2008
Mid Thorax Rib Displacement	032RIB2	Servo	6/19/2008
Lower Thorax Rib Displacement	032RIB3	Servo	6/19/2008
Upper Abdominal Rib Displacement	032RIB4	Servo	6/19/2008
Lower Abdominal Rib Displacement	032RIB5	Servo	6/19/2008
Left Upper Thorax Rib Y	P52261	Endevco	3/13/2008
Left Mid Thorax Rib Y	P52266	Endevco	3/13/2008
Left Lower Thorax Rib Y	P52270	Endevco	3/13/2008
Right Upper Thorax Rib Y	P45253	Endevco	6/18/2008
Right Mid Thorax Rib Y	P47079	Endevco	6/18/2008
Right Lower Thorax Rib Y	P44584	Endevco	6/18/2008
Left Upper Abdominal Rib Y	J14-J19	Entran	1/25/2008
Left Lower Abdominal Rib Y	J23-M11	Entran	1/25/2008
Right Lower Abdominal Rib Y	G04-Z45	Entran	6/19/2008
Lumbar Load Cell	LG104	FTSS	5/08/2008
Left Ilium Crest Load Cell	IWG272	Denton	4/17/2008
Left Acetabulum Load Cell	ACG259	Denton	4/17/2008
Pelvis X	P59397	Endevco	6/19/2008
Pelvis Y	P59398	Endevco	6/19/2008
Pelvis Z	P59399	Endevco	6/19/2008