

REPORT NUMBER: TWG-MGA-2008-005

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

**TOYOTA MOTOR CORPORATION
2008 TOYOTA 4RUNNER 4X4
NHTSA NUMBER: M85106TWG2**

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



Test Date: July 2, 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

Reviewed by: David Winkelbauer
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 2, 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;">40.9</td> <td style="text-align: center;">51.2</td> <td style="text-align: center;">0.31</td> <td style="text-align: center;">0.59</td> <td style="text-align: center;">0.47</td> <td style="text-align: center;">0.93</td> </tr> </table>				HIC 15	HIC 36	NIJ NTF	NIJ NTE	NIJ NCF	NIJ NCE	40.9	51.2	0.31	0.59	0.47	0.93
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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 curtain and torso airbag deployments in a 2008 Toyota 4Runner 4x4 with an out-of-position Hybrid III 6-Year-Old child dummy was evaluated. The test was performed by MGA Research Corporation on July 2, 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 Hybrid III 6-Year-Old child dummy (Serial Number 159) was placed in the right front passenger seat situated in the forward facing position 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 Spine Acceleration
- Upper Sternum Acceleration
- Lower Sternum Acceleration
- Chest Displacement
- Lower Abdominal @ Spine Acceleration
- Upper Thorax @ Spine Acceleration

The 24 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 Hybrid III 6-Year-Old child dummy's visible contact points were as follows: The torso airbag to the left shoulder and torso of the dummy.

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.

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 6-Year-Old
Curtain Airbag	Roof-Rail Mounted	Side Airbag
Torso Airbag	Seat Mounted	Side Airbag
ATD Type/Serial No.	Hybrid III 6-Year-Old / 159	Hybrid III Child Dummy

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

Number of Data Channels	24
Number of Real-Time Video	1
Number of High-Speed Video	3

Visible Dummy Contact Points	
Head Contact	Top of head to curtain airbag
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 Impact on September 20, 2007.

TEST VEHICLE INFORMATION

Manufacturer	Toyota
Model	4Runner
Body Style	MPV
NHTSA No.	M85106TWG2
VIN	JTEBU14R180128928
Color	Shadow Mica
Delivery Date	9/14/2007
Odometer Reading (mile)	34
Dealer	Wilde Toyota
Transmission	Automatic
Final Drive	4 Wheel
Number of Cylinders	6
Engine Displacement (L)	4.0
Engine Placement	Longitudinal
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	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
Anti-lock Brakes	Yes
Traction Control	Yes
All Wheel Drive	Yes
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation
Date of Manufacture	07/07

GVWR (kg)	2535
GAWR Front (kg)	1160
GAWR Rear (kg)	1390

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	Bench	
Number of Occupants	2	3	2	7
Capacity Wt. (VCW) (kg)				477
Cargo Wt. (RCLW) (kg)				0

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		6 Fwd from Rear
Seat Height Position		Lowest
Placed in Position No. 2		---
Seat Back Angle	SA (°)	24
Top of Airbag Module to Head/Neck Junction	AN (mm)	168
Head CG to Window	HD (mm)	160
Head to Seat Back Centerline	HSC (mm)	155
Chest to Dash	CD (mm)	573
Chest to Seatback	CS (mm)	181
Right Arm to Seat Back Centerline	RACL (mm)	292
Left Arm to Seat Back Centerline	LACL (mm)	55
Right Arm to Door Panel	RA (mm)	Contact
Left Arm to Door Panel	LA (mm)	323
Knee to Knee	KK (mm)	114
Toe to Toe	TT (mm)	139
Right Knee to Seat Cushion Centerline	KSCR (mm)	96
Left Knee to Seat Cushion Centerline	KSCL (mm)	28
Right Toe to Seat Cushion Centerline	TSCR (mm)	18
Left Toe to Seat Cushion Centerline	TSCL (mm)	135
Nose to Dash	ND (mm)	657
Nose to Headrest	NS (mm)	173
Top of Head to Headliner	HH (mm)	146

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No. M85106TWG2

		MAXIMUM VALUE			
		Position No. 2			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	15.6	14.9	-9.2	295.4
Head Y	g	6.1	284.3	-23.2	18.6
Head Z	g	32.4	21.0	-16.5	9.7
Head Resultant	g	37.5	18.5		
Upper Neck FX	N	416.6	14.8	-274.4	296.2
Upper Neck FY	N	181.2	23.1	-163.0	14.7
Upper Neck FZ	N	339.2	17.6	-867.8	289.9
Upper Neck Force Resultant	N	890.5	289.9		
Upper Neck MX	Nm	10.6	14.6	-17.4	25.1
Upper Neck MY	Nm	34.8	13.0	-31.6	297.9
Upper Neck MZ	Nm	3.8	299.9	-8.7	41.1
Upper Neck Moment Resultant	Nm	35.7	13.1		
Lower Neck FX	N	423.4	14.1	-346.2	298.3
Lower Neck FY	N	122.6	25.1	-192.7	13.7
Lower Neck FZ	N	267.8	17.9	-781.4	290.0
Lower Neck Force Resultant	N	789.6	290.1		
Lower Neck MX	Nm	15.2	86.2	-15.7	13.7
Lower Neck MY	Nm	42.8	292.8	-51.2	17.2
Lower Neck MZ	Nm	8.7	5.8	-18.5	13.5
Lower Neck Moment Resultant	Nm	55.2	14.4		

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

NHTSA No. M85106TWG2

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	40.9	17.7	32.7	51.2	6.5	40.8

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

	Nij	Time (msec)	Z Force (N) (CFC 600)	X Force (N) (CFC 600)	Y Moment (N-m) (CFC 600)
Ntf	0.31	14.9	126.05	414.49	31.57
Nte	0.59	50.2	136.62	114.97	-17.94
Ncf	0.47	9.9	-531.74	293.11	31.02
Nce	0.93	297.9	-555.87	-261.89	-31.55
Peak Tension (CFC1000)		339.2 N	Peak Compression (CFC 1000)		-867.8 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
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Pre-Test Vehicle Left Side View



Post-Test Vehicle Left Side View



Vehicle Certification Placard



Vehicle Tire Placard



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



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



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



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



Pre-Test 6-Year-Old Dummy Left $\frac{3}{4}$ Front View



Post-Test 6-Year-Old Dummy Left $\frac{3}{4}$ Front View



Pre-Test 6-Year-Old Dummy Front View



Post-Test 6-Year-Old Dummy Front View



Pre-Test 6-Year-Old Dummy Right $\frac{3}{4}$ Front View



Post-Test 6-Year-Old Dummy Right $\frac{3}{4}$ Front View



Pre-Test 6-Year-Old Dummy Feet Position View



Post-Test Right Front Passenger Compartment View

APPENDIX B
DUMMY RESPONSE DATA TRACES

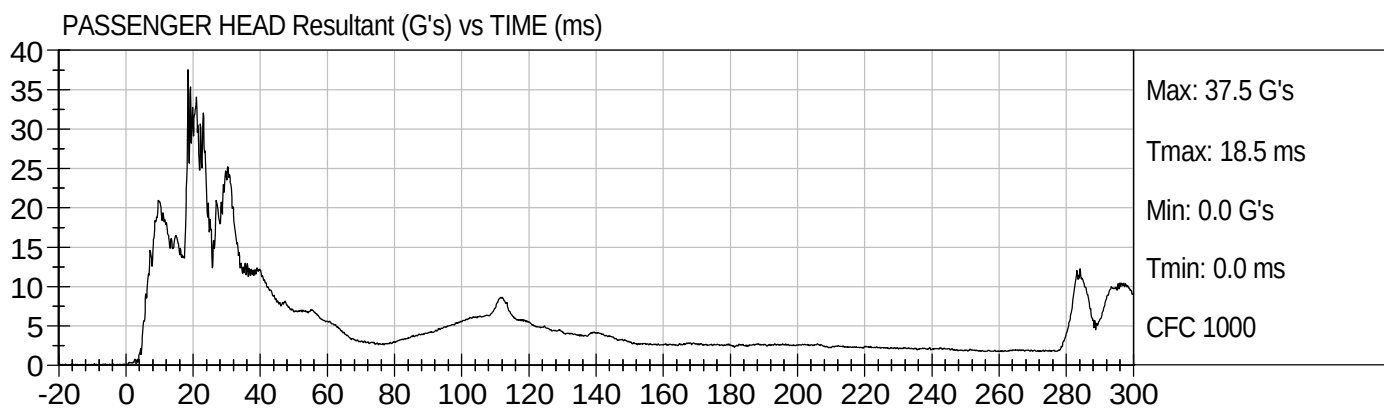
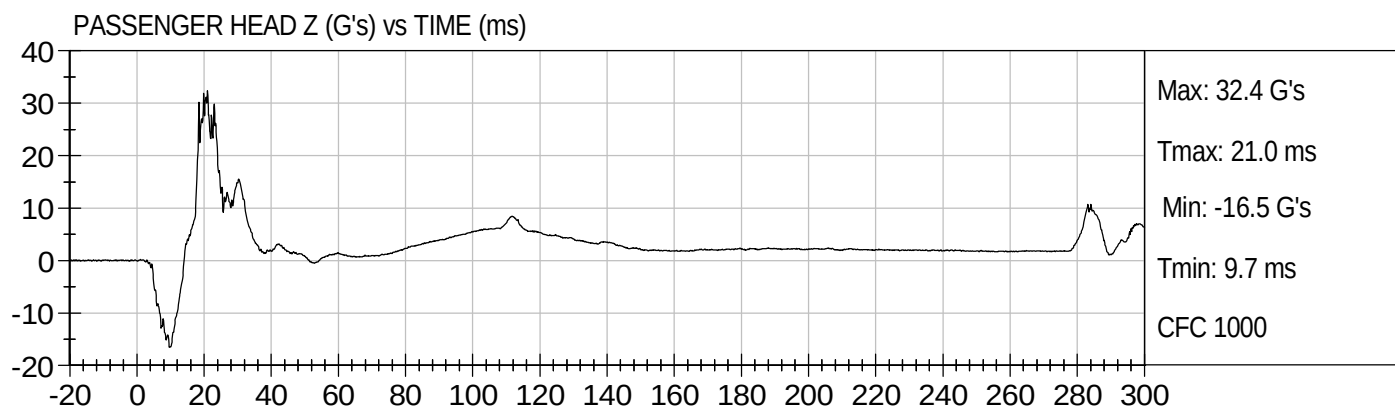
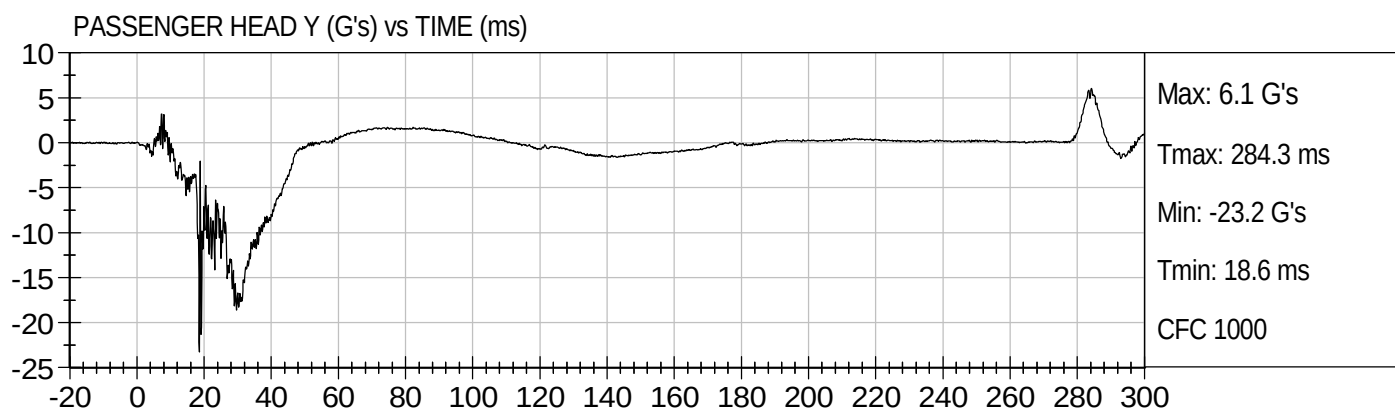
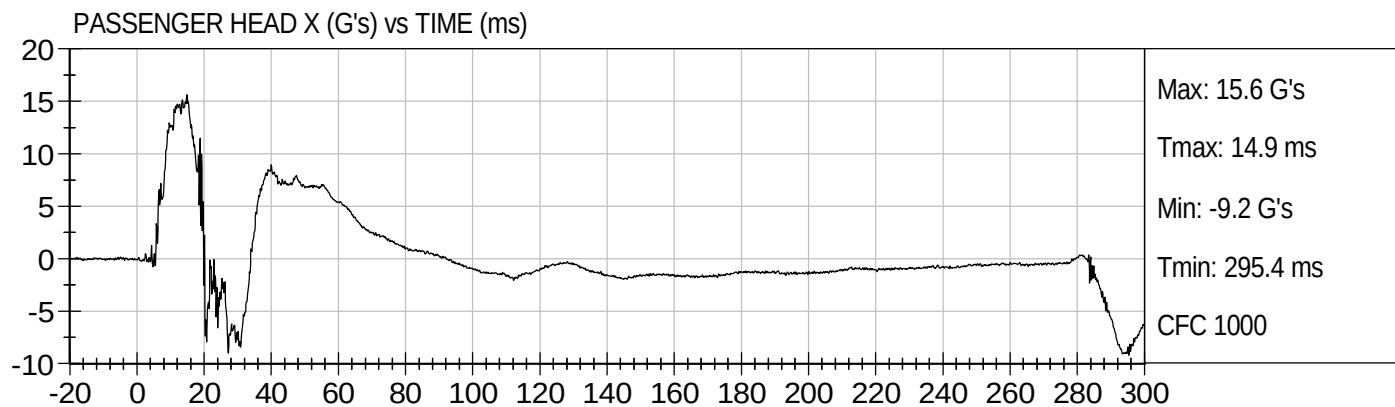
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NCAP SIDE OOP 6YO 3.3.3.5
2008 TOYOTA 4RUNNER M85106

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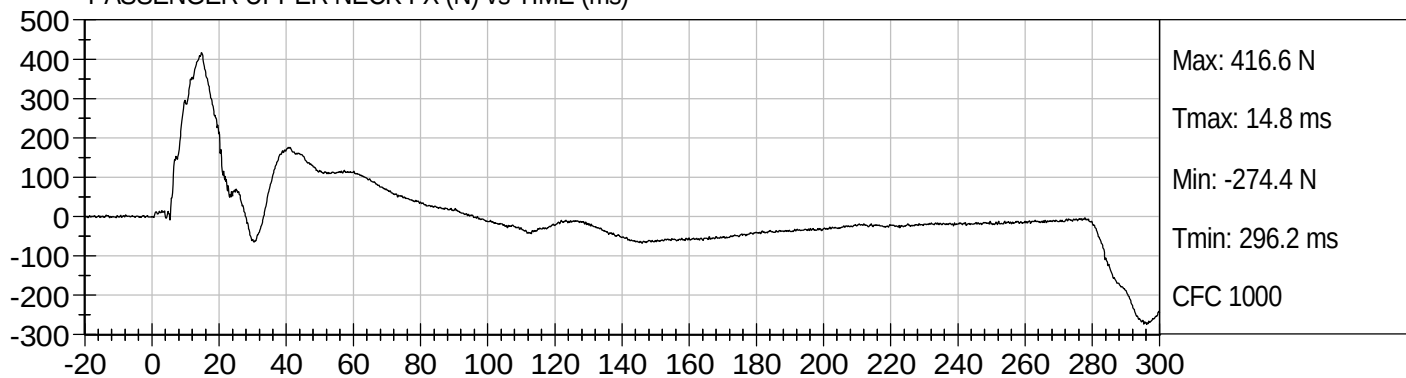




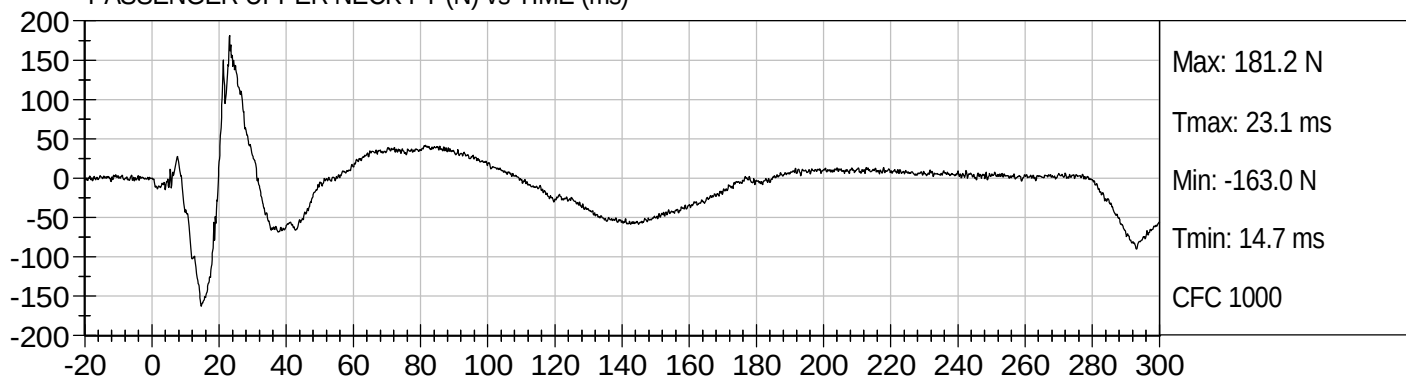
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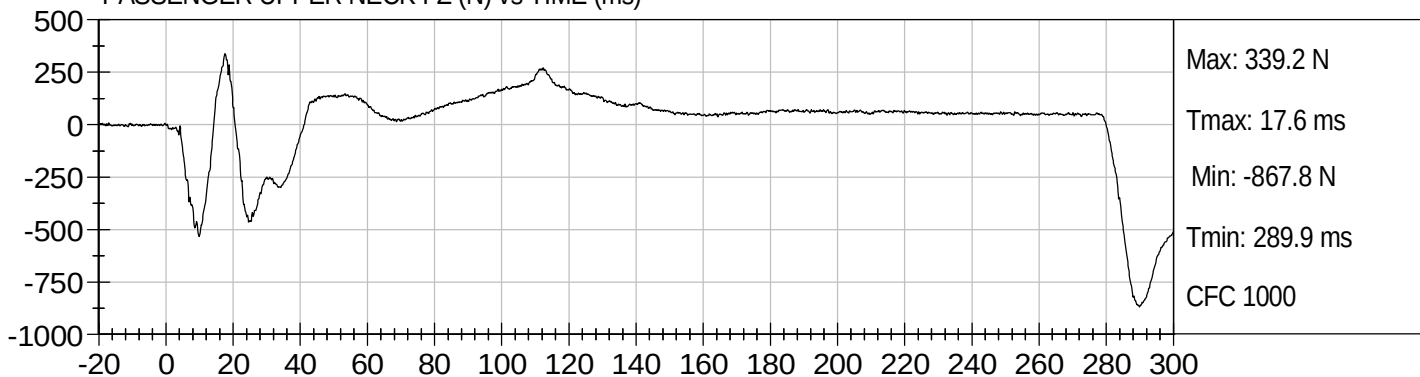
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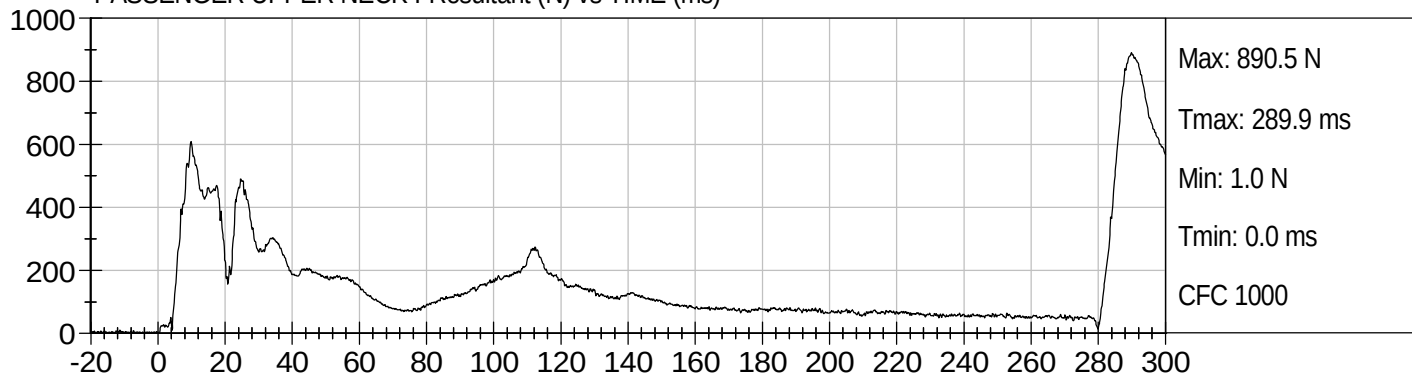
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PASSENGER UPPER NECK FZ (N) vs TIME (ms)



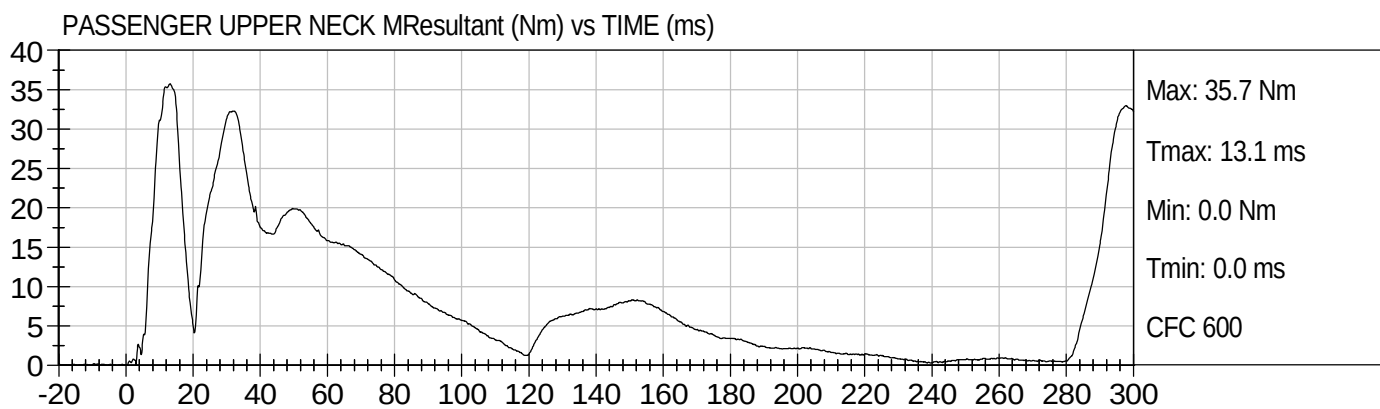
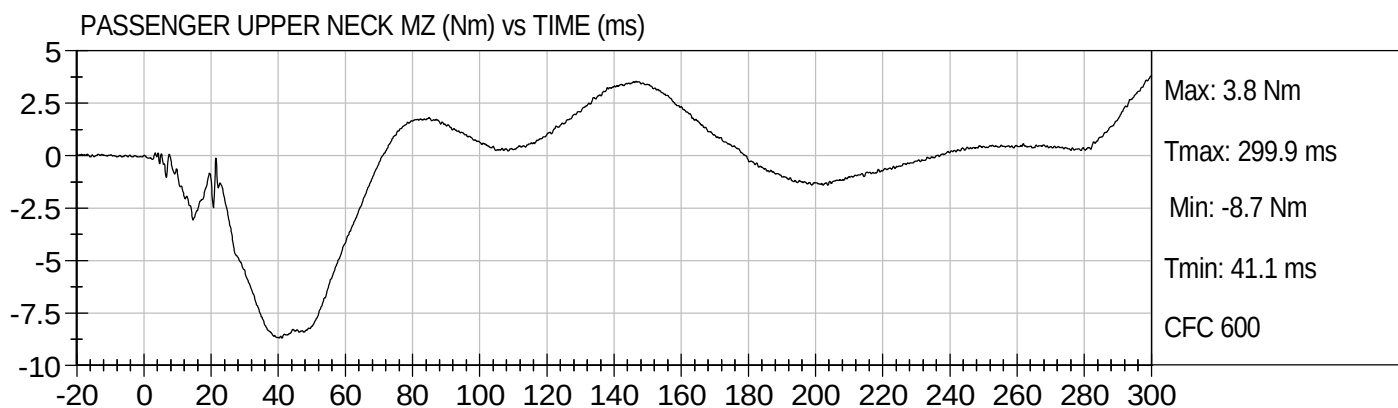
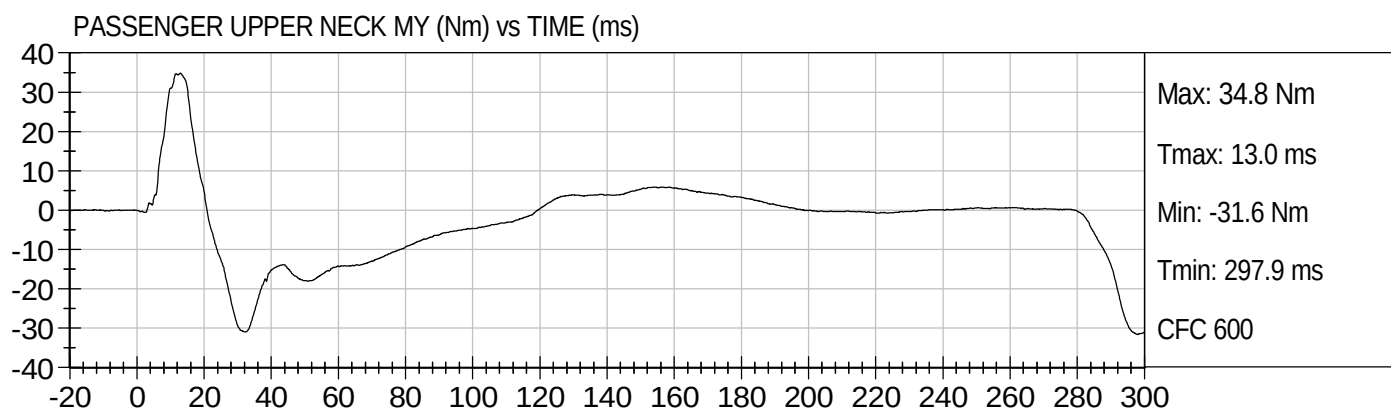
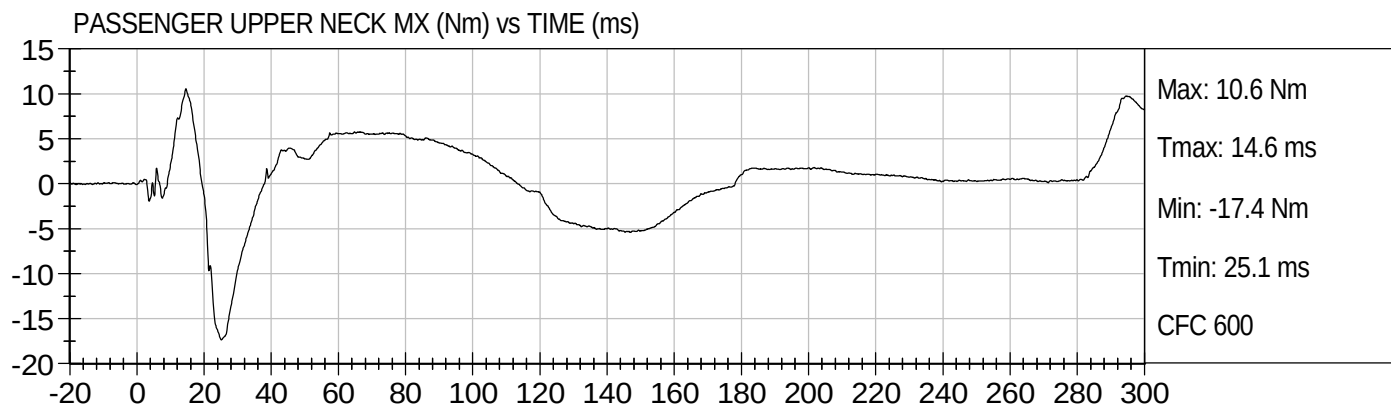
PASSENGER UPPER NECK FResultant (N) vs TIME (ms)





NCAP SIDE OOP 6YO 3.3.3.5
2008 TOYOTA 4RUNNER M85106

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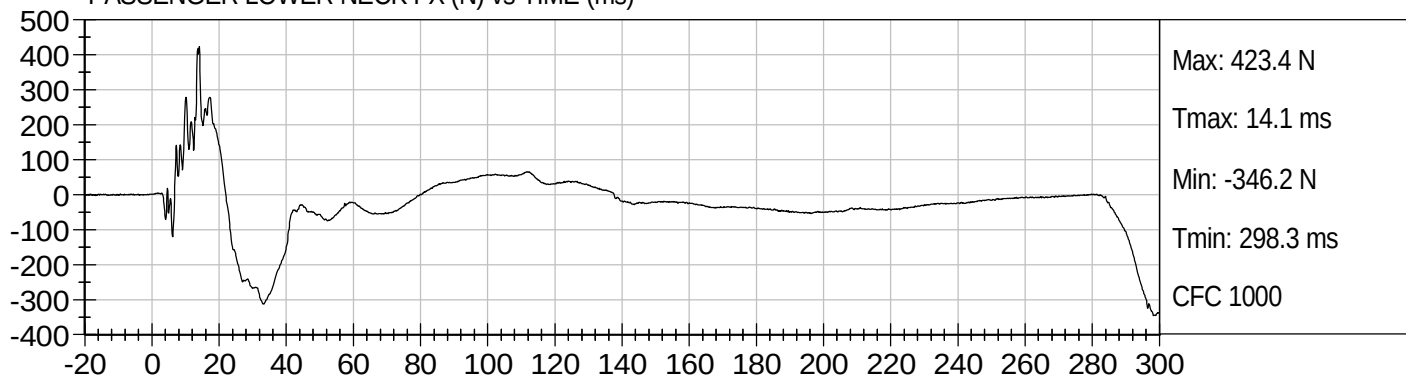




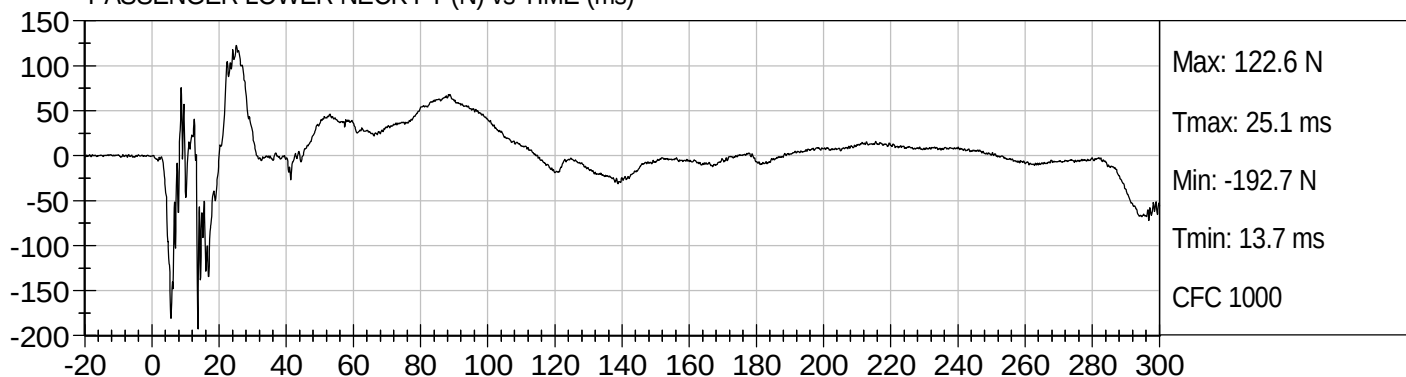
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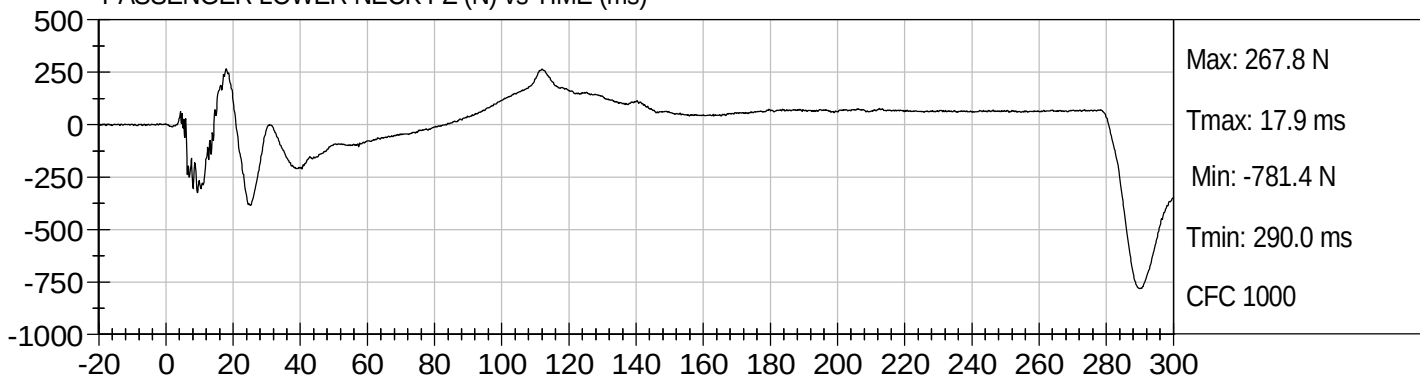
PASSENGER LOWER NECK FX (N) vs TIME (ms)



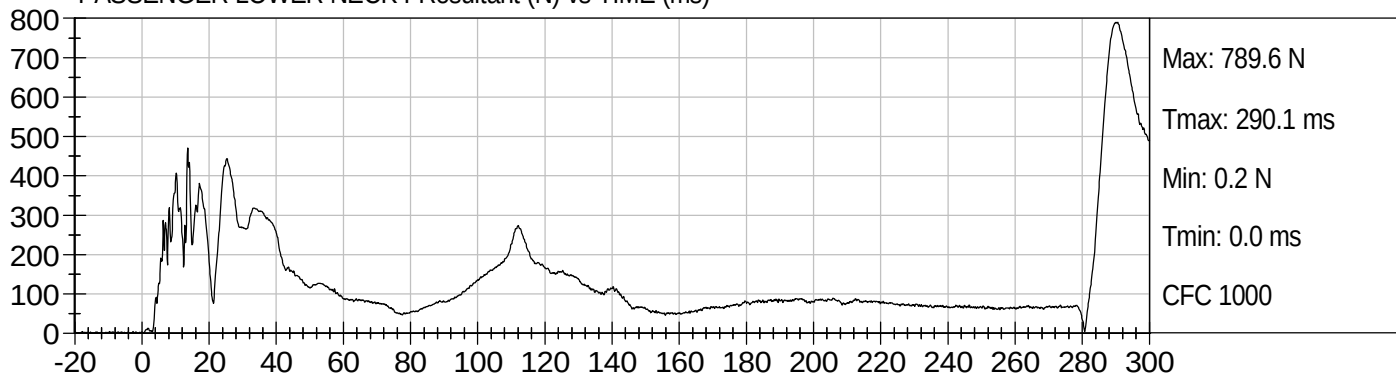
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PASSENGER LOWER NECK FZ (N) vs TIME (ms)



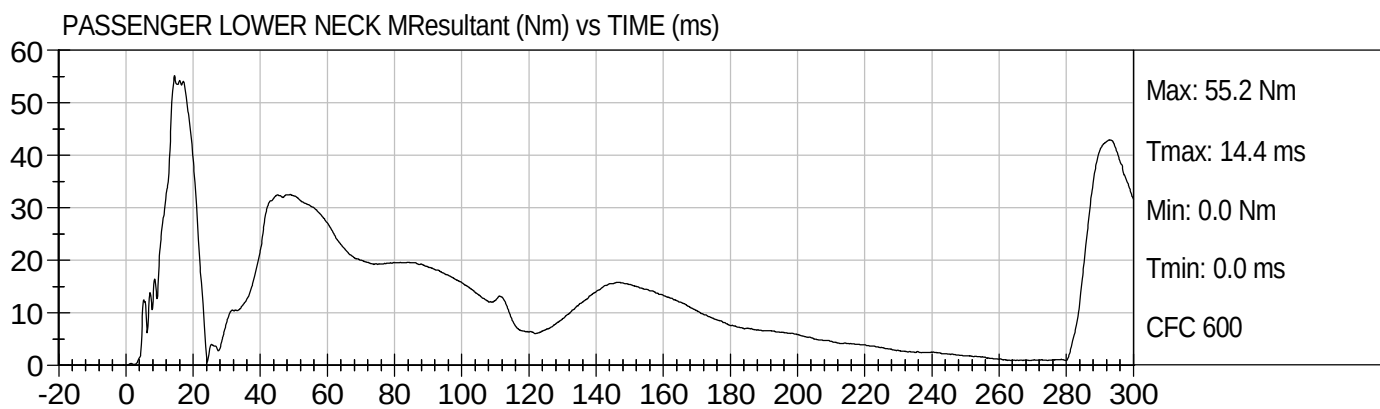
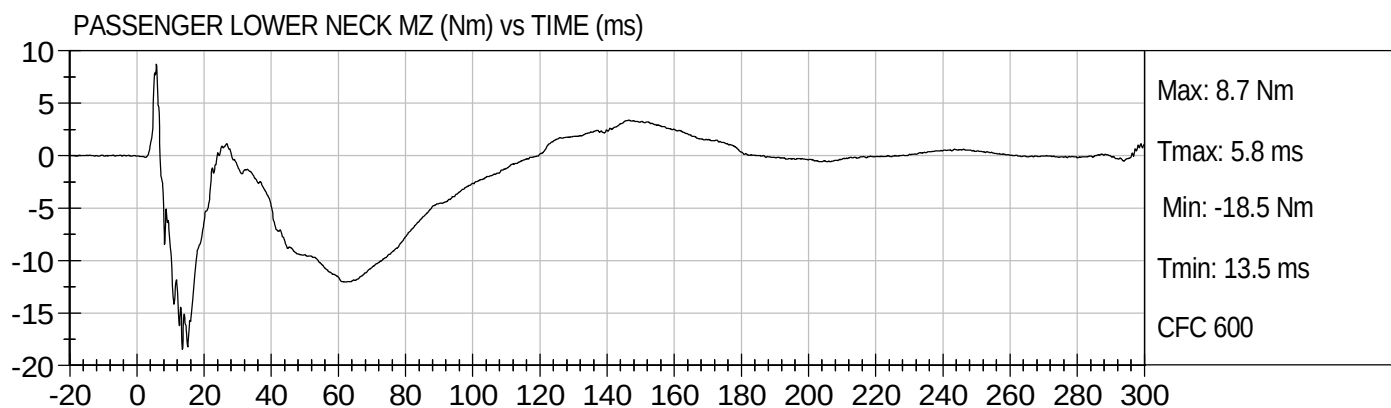
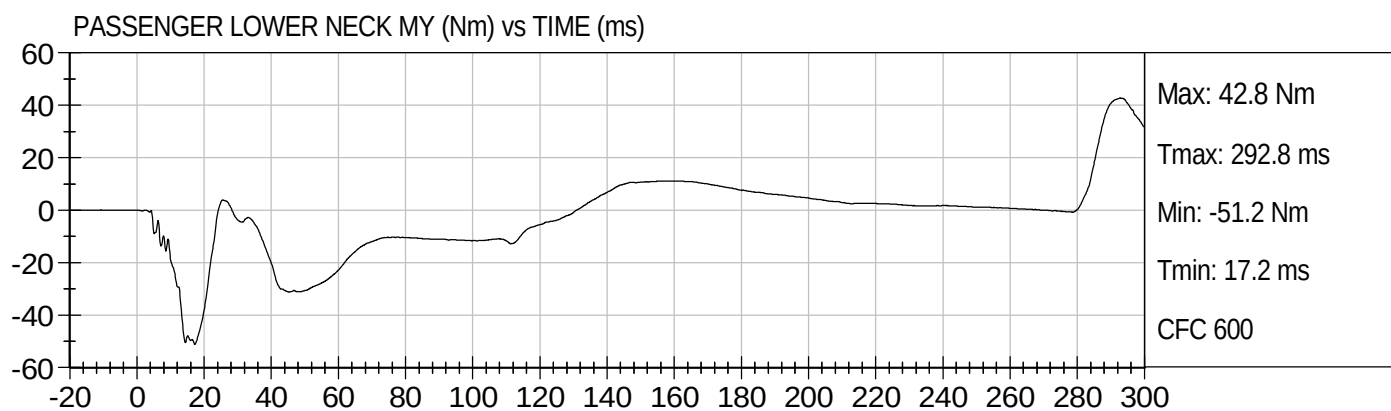
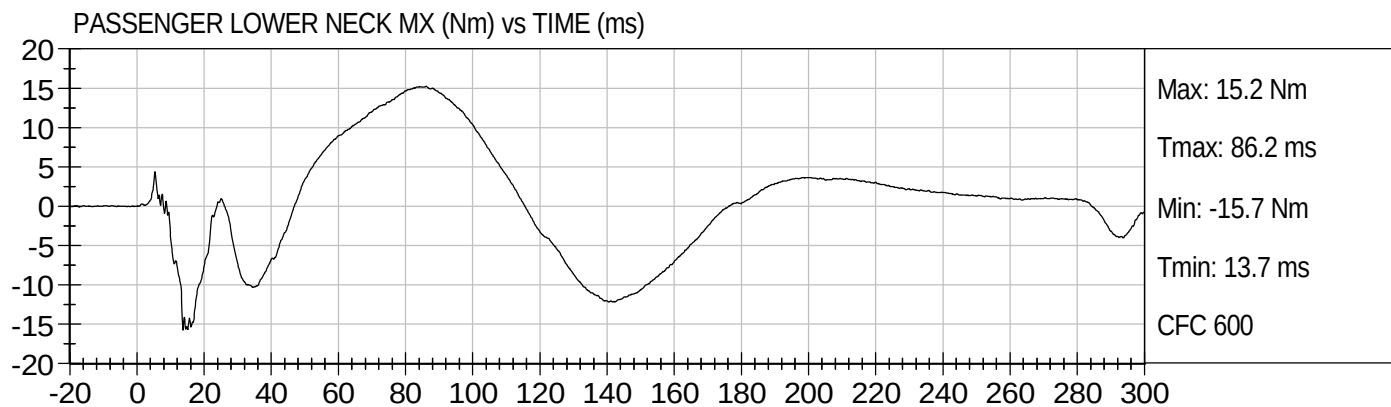
PASSENGER LOWER NECK FResultant (N) vs TIME (ms)





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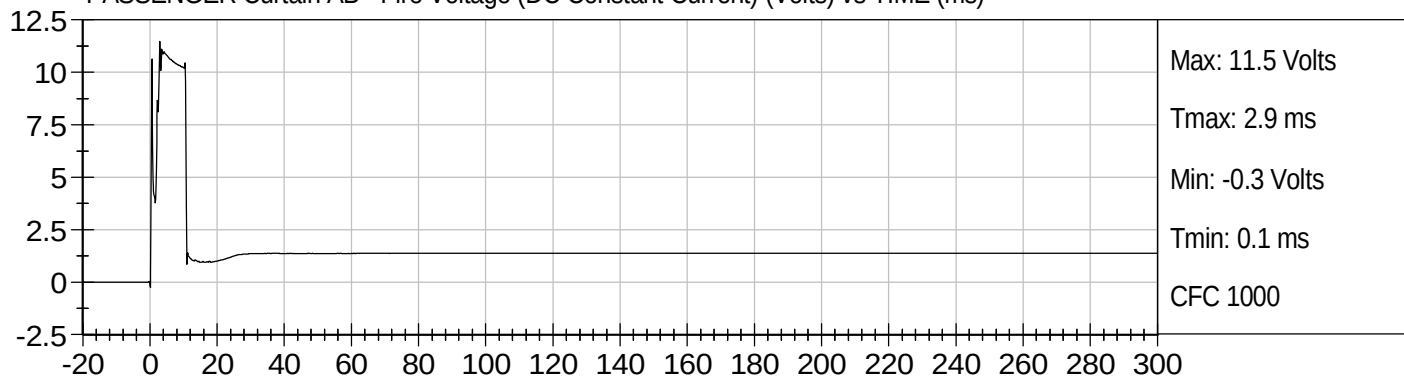




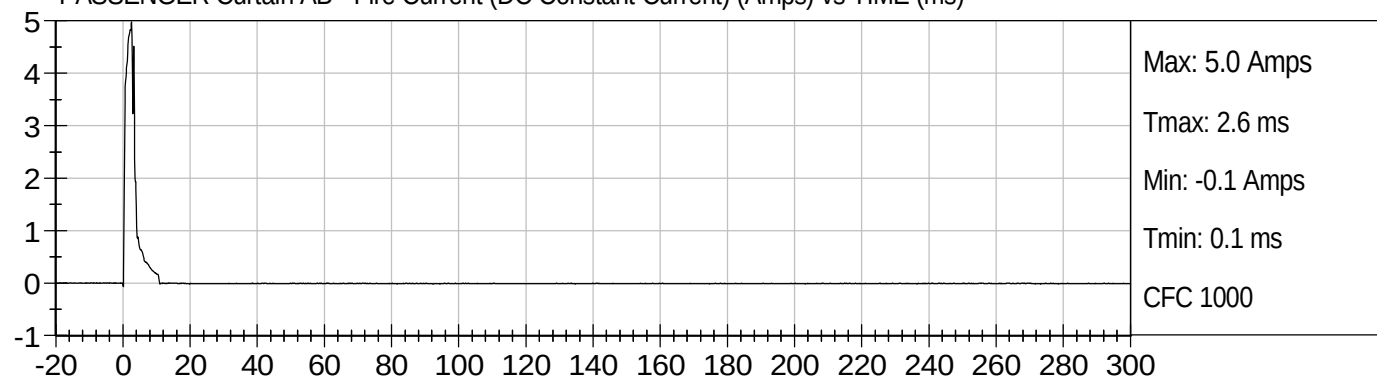
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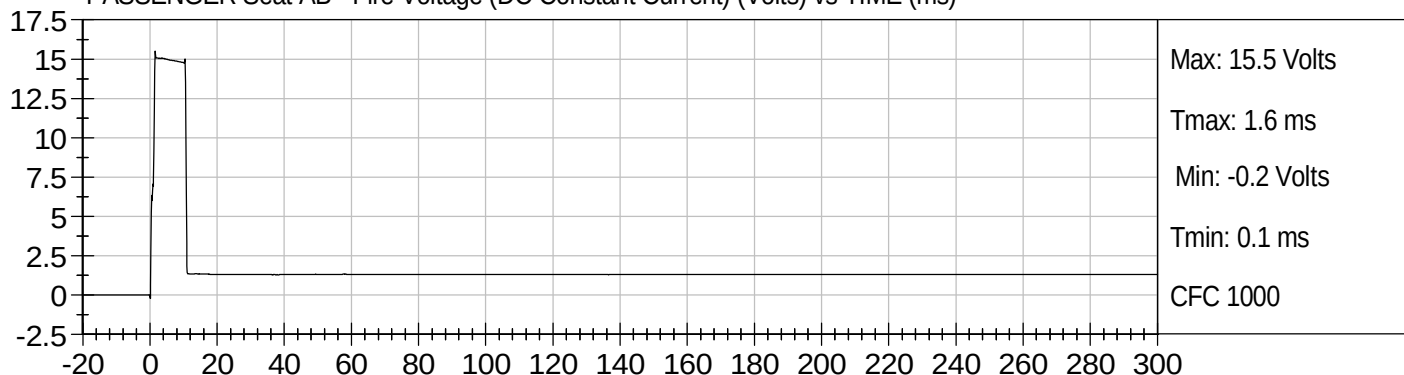
PASSENGER Curtain AB - Fire Voltage (DC Constant Current) (Volts) vs TIME (ms)



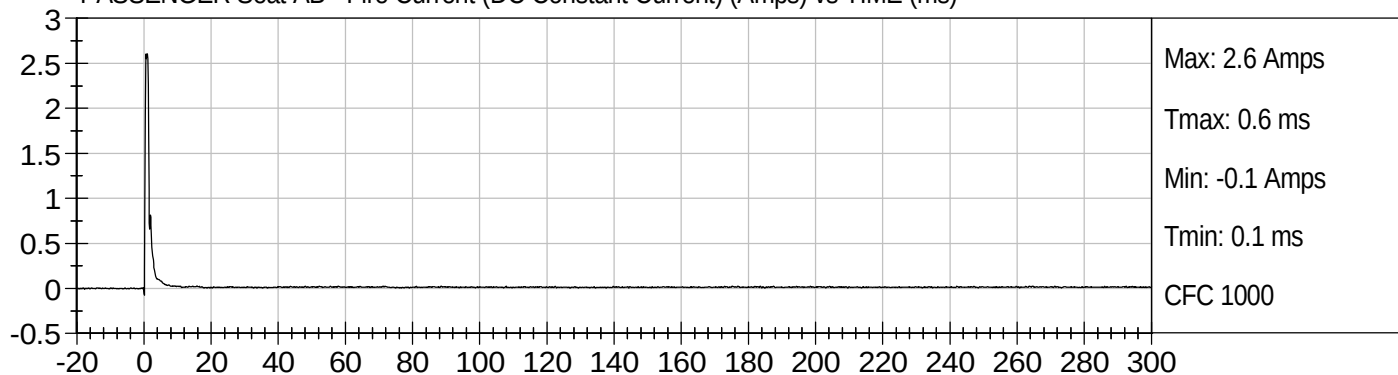
PASSENGER Curtain AB - Fire Current (DC Constant Current) (Amps) vs TIME (ms)



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



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



APPENDIX C

INSTRUMENTATION CALIBRATION DATA

Hybrid III 6-Year-Old – Serial Number 159

	SERIAL NO.	MANUFACTURER	CALIBRATION DATE
Head X	P47894	Endevco	4/11/2008
Head Y	P47895	Endevco	4/11/2008
Head Z	P47896	Endevco	4/11/2008
Upper Neck Load Cell	252	Denton	3/17/2008
Lower Neck Load Cell	LNG146	Denton	5/05/2008
Chest X	P52144	Endevco	4/15/2008
Chest Y	G22-D16	Entran	1/15/2008
Chest Z	G21-M14	Entran	1/15/2008
Chest Displacement	159	Servo	2/08/2008
Upper Spine X	P59321	Endevco	5/19/2008
Upper Sternum X	P47306	Endevco	4/21/2008
Lower Sternum X	P47307	Endevco	4/15/2008
Upper Thorax @ Spine X	P59319	Endevco	5/19/2008
Lower Abdominal @ Spine X	P59320	Endevco	5/19/2008