

REPORT NUMBER: TWG-TRC-13-01

NEW CAR ASSESSMENT PROGRAM (NCAP)
SIDE AIRBAG OUT-OF-POSITION INJURY TESTING

GENERAL MOTORS LLC
2013 BUICK VERANO 4-
DOOR SEDAN

NHTSA NUMBER: MD0105TWG2
TRC TEST NUMBER: S130212-1

PREPARED BY:
TRANSPORTATION RESEARCH CENTER INC.
10820 State Route 347
P.O. BOX B-67
East Liberty, OH 43319



Test Date: February 12, 2013

FINAL REPORT

Alpha Technology Associate, Inc.
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Fairfax, VA 22031

This Final Test Report was prepared for the U.S. Department of Transportation, National Highway Traffic Safety Administration, under Contract No. DTNH22-08-D-00088, Alpha Technology PO 4GT150. This document is disseminated under the sponsorship of the U.S. Department of Transportation in the interest of information exchange. The United States Government assumes no liability for its contents or use thereof.

Prepared By: ILO Projects Operations Group

Approved By: 
Margaret Susan, Project Manager

Approval Date: _____

FINAL REPORT ACCEPTANCE BY:

Accepted By: _____

Acceptance Date: _____

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				14. Sponsoring Agency Code NVS-111		
15. Supplementary Notes						
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 the T R C Test Facility in East Liberty, O h i o , on February 12, 2013.						
Injury Summary						
HIC15	Maximum Chest Displacement (mm)	Maximum Chest Displacement Rate (m/s)	NIJ(NTF)	NIJ(NTE)	NIJ(NCF)	NIJ(NCE)
65.610	N/A	N/A	0.1086	0.1717	1.0749	0.5795
17. Key Words New Car Assessment Program (NCAP) Side Airbag Out-Of-Position				18. Distribution Statement <u>Copies of this report are available from:</u> Alpha Technology Associate, Inc 2810 Old Lee Hwy, Suite 120 Fairfax,VA 22031 Phone: (703) 876-0010 Fax: (703) 876-0120 Attn: Mai Lan Aram		
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SECTION 1

TEST PURPOSE AND PROCEDURE

1.1 PURPOSE

The purpose of this test was to obtain data from a static out-of-position side impact using a vehicle that had undergone a New Car Assessment Program (NCAP) sponsored test requested by the National Highway Traffic Safety Administration (NHTSA). This test was performed following the technical requirements under NHTSA contract No. DTNH22-08-D-00088 and through Alpha Technology Associate, Inc.

1.2 SUMMARY

The effects of both a seat-mounted side airbag and a curtain airbag deployment in a 2013 Buick Verano 4 door sedan on an out-of-position SID-ILs Hybrid III 5th female anthropomorphic test device (ATD) were evaluated. The test was performed by TRC on February 12, 2013. Pre- and post-test photographs of the vehicle and ATD can be found in Appendix A.

Two (2) high-speed digital cameras were used to document the side airbag deployment event. Images were recorded at rates of 1000 frames per second. One camera was placed perpendicular to the right-front seat centerline to capture the deployment event from the side. The second camera was placed parallel to the right- front seat centerline to capture the deployment event from the front.

The SID-ILs 5th female anthropomorphic test device (ATD) was placed in the right front (passenger) seat situated perpendicular to the centerline of the seat, facing inboard. This was placed following the ATD 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 specific test was section 3.3.5.3.

The SID-ILs ATD was instrumented with head x, y and z accelerometers, six upper neck axial force and moment load cell transducers, and six lower neck axial force and moment load cell transducers.

Eighteen (18) channels of data were recorded using an on-board data acquisition system. Appendix A contains photographs. Appendix B contains ATD response data traces. Appendix C contains the Instrumentation Data Channel assignments.

The 5th female ATD was positioned in the seat dummy facing toward the center of the vehicle with its arm against the seatback. The arm was rotated horizontal in the forward direction with respect to the dummy. The seat track was positioned 102 mm rearward of full forward to minimize the vertical distance between the dummy's head and the roof-rail module and to maximize the cushion to head interaction. The head was in a neutral orientation and the pelvis was in contact with the door trim panel. The CG of the head was centered in the deployment trajectory of the airbag. A vertical plane through the centerline of the dummy's rib-stiffener and shoulder bolt was parallel to the centerline of the vehicle. This orientation complies with section 3.3.5.3 of the TWG Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags, First Revision dated July, 2003.

SECTION 2

DATA SHEET NO. 1 TEST SUMMARY

TEST CONFIGURATION INFORMATION:

Seating Position:	P2	Right Front Seating Position
Test:	3.3.5.3	Inboard Facing SID-IIs on Raised Seat (Driver and Passenger Positions with Roof-Rail-Mounted Airbags)
Airbag:	Seat	Seat mounted – outside seam
Airbag:	Side Rail	Side curtain airbag.
Booster Block:	N/A	N/A
ATD Type/Serial No.:	297	5 th Female SID-IIs

SEAT POSITION

Measurement	Value
Total Fore/Aft Travel (Detents)	50
Placed in Position #	21

Number of Data Channels:	18	
Number of Cameras:	0	Real Time
	2	High Speed Digital

VISIBLE DUMMY CONTACT POINTS

Head Contact:	Curtain Airbag, I/P
Upper Torso Contact:	Torso Airbag
Lower Torso Contact:	None
Left Knee Contact:	None
Right Knee Contact:	None

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

NHTSA No.	MD0105	Traction Control System (TCS)	Yes
Model Year	2013	Power Steering	Yes
Make	Buick	Power Window Auto-Reverse	Yes
Model	Verano	Driver Front Airbag	Yes
Body Style	4-Door Sedan	Driver Curtain Airbag	Yes
VIN	IG4PP5SK2D4100715	Driver Head/Torso Airbag	No
Body Color	Blue	Driver Torso Airbag	No
Odometer Reading (miles)	9	Driver Torso/Pelvis Airbag	Yes
Engine Displacement (L)	2.4	Driver Pelvis Airbag	No
Number of Cylinders	4	Driver Knee Airbag	Yes
Engine Placement	Transverse	Front Pass. Front Airbag	Yes
Transmission Type	Automatic	Front Pass. Curtain Airbag	Yes
Transmission Speeds	6	Front Pass. Head/Torso Airbag	No
Overdrive	No	Front Pass. Torso Airbag	No
Final Drive	Front	Front Pass. Torso/Pelvis Airbag	Yes
Roof Rack	No	Front Pass. Pelvis Airbag	No
Sunroof / T-Top	No	Front Pass. Knee Airbag	Yes
Running Boards	No	Driver Pretensioner	Yes
Tilt Steering Wheel	Yes	Driver Load Limiter	Yes
Power Seats	No	Front Pass. Pretensioner	No
Anti-Lock Brakes (ABS)	Yes	Front Pass. Load Limiter	No
Automatic Door Locks (ADL)	Yes	Other	No

Does owner's manual provide instructions to turn off automatic door locks?

No

DATA FROM CERTIFICATION LABEL

Manufactured by	General Motors LLC	GVWR (kg)	1978
Date of Manufacture	8/12	GAWR Front (kg)	1061
		GAWR Rear (kg)	917

VEHICLE SEATING AND WEIGHT CAPACITY

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				400
Cargo Wt. (RCLW) (kg)				59.80

DATA SHEET NO. 3

DUMMY POSITIONING IN VEHICLE

Measurement		Value
Total Seat Fore/Aft Travel		245
Test Distance Rearward of Full-Forward (mm)		102
Total Fore/Aft Travel (Detents)		50
Seat Vertical Position		Full Up
Placed in Position #		21
Seat Back Angle at Headrest Post	SA (°)	N/A
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	N/A
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	N/A
Head CG to Door Panel/Window	HD (mm)	132
Head to Seat Back Centerline	HSC (mm)	198
Head to B-Pillar (cg)	HB (mm)	150
Head to Roof, Z (top of the head)	HZ (mm)	10
Chest to Seat	CD (mm)	N/A
Chest to Seat Back	CS (mm)	N/A
Right Arm to Seat Back Centerline	RACL (mm)	N/A
Left Arm to Seat Back Centerline	LACL (mm)	N/A
Right Arm to Door Panel	RA (mm)	N/A
Left Arm to B-Post	LA (mm)	N/A
Knee to Knee	KK (mm)	145
Toe to Toe	TT (mm)	152
Right Knee to Seat Cushion Centerline	KSCR (mm)	165
Left Knee to Seat Cushion Centerline	KSCL (mm)	166
Right Toe to Seat Cushion Centerline	TSCR (mm)	590
Left Toe to Seat Cushion Centerline	TSCL (mm)	590
Nose to Seat	ND (mm)	N/A

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

Channel	Min	Time (ms)	Min	Time (ms)
Head Ax [g , CFC_1000]	33.852	7.28	-16.259	11.6
Head Ay [g , CFC_1000]	22.842	13.12	-38.136	6.32
Head Az [g , CFC_1000]	88.689	5.92	-21.246	14.56
Upper Neck Fx [N , CFC_1000]	223.794	8.96	-135.507	31.84
Upper Neck Fy [N , CFC_1000]	584.681	41.68	-126.712	157.92
Upper Neck Fz [N , CFC_1000]	217.156	120.00	-3,324.09	13.44
Upper Neck Mx [N-m , CFC_600]	19.08	72.00	-52.492	17.76
Upper Neck My [N-m , CFC_600]	51.483	18.96	-19.142	57.92
Upper Neck Mz [N-m , CFC_600]	13.423	25.52	-11.3	92.8
Lower Neck Fx [N , CFC_1000]	772.73	17.12	-313.12	49.28
Lower Neck Fy [N , CFC_1000]	321.63	19.84	-144.53	143.68
Lower Neck Fz [N , CFC_1000]	225.41	120.08	-3542.27	14.32
Lower Neck Mx [N-m , CFC_600]	52.43	20.56	-31.85	147.20
Lower Neck My [N-m , CFC_600]	138.86	13.44	-3.60	120.00
Lower Neck Mz [N-m , CFC_600]	27.95	21.04	-23.15	76.48
Airbag Event Passenger Side Curtain Voltage [V]	35.47	0.64		
Airbag Event Front Passenger Seat Voltage [V]	25.01	2.80		
Airbag Event Passenger Side Curtain Current [A]	3.17	7.52		
Airbag Event Front Passenger Seat Current [A]	3.38	0.48		

HEAD INJURY CRITERIA (HIC)

	HIC(15)	t ₁ (msec)	t ₂ (msec)	HIC(36)	t ₁ (msec)	t ₂ (msec)
Position #2 Right Front	65.61	5.52	19.44	65.61	5.52	19.44

Position 2 Neck Injury Summary (SID-IIs)

Nij V10	Nij	Time (ms)
Upper Neck NTF	0.109	128.64
Upper Neck NTE	0.172	89.84
Upper Neck NCF	1.075	13.60
Upper Neck NCE	0.580	35.760

Peak Tension (CFC1000) 217 N Peak Compression (CFC1000) -3324 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

Test Vehicle: 2013 Buick Verano
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: MD0105TWG2
Test Date: 2/12/13

APPENDIX A
PHOTOGRAPHS

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Figure A-1 Front ¾ View, as received

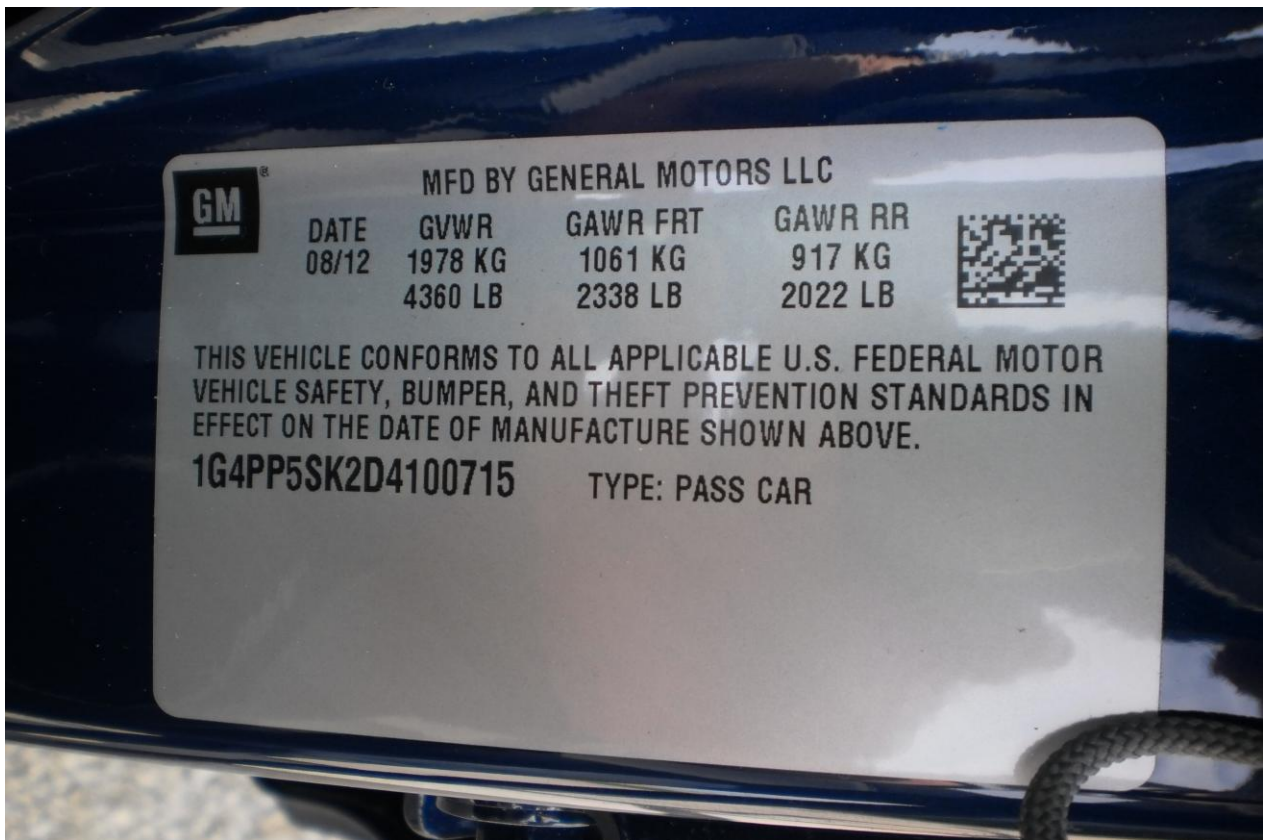


Figure A-2 Vehicle Certification label



Figure A-3 Pre-Crash Test Images from NCAP Vehicle



Figure A-4 Post-Crash Test images From NCAP Vehicle



Figure A-5 Pre-Test Front Right Dummy position – Side View



Figure A-6 Pre-Test Front Right Dummy position $\frac{3}{4}$ View



Figure A-7 Pre-Test Front Right Dummy position – Front View



Figure A-8 Pre-Test Front Right Dummy position – full Side View



Figure A-9 Post-Test Front Right Dummy position – Side View



Figure A-10 Post-Test Front Right Dummy position $\frac{3}{4}$ View



Figure A-11 Post-Test Front Right Dummy position – Front View



Figure A-12 Post-Test Front Passenger Airbags – Side View



Figure A-13 Pre-Test Overall Testing Area



Figure A-14 Post-Test Overall Testing Area



Figure A-15 Post-Test Front Passenger Door-window

Test Vehicle: 2013 Buick Verano
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: MD0105TWG2
Test Date: 2/12/13

APPENDIX B

SID-IIs RESPONSE DATA TRACES

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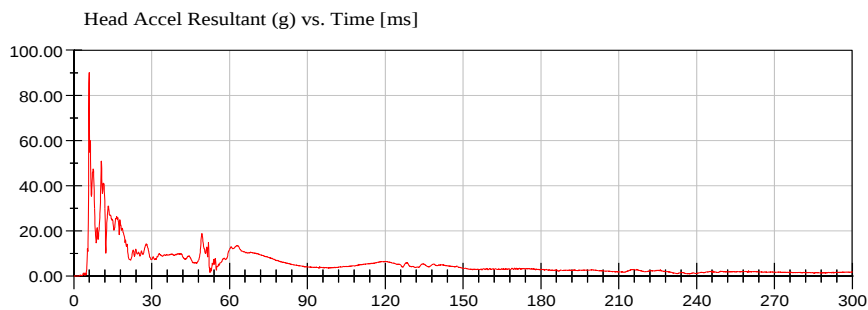
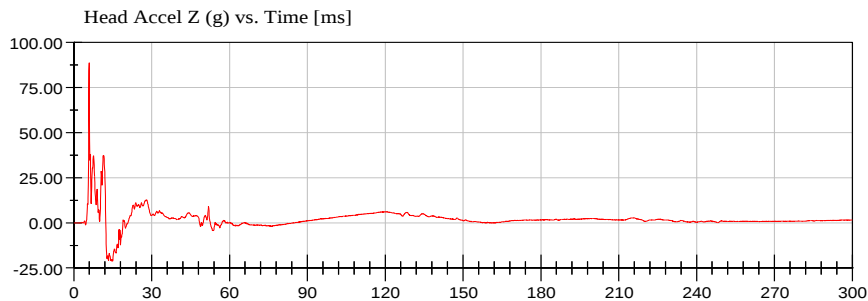
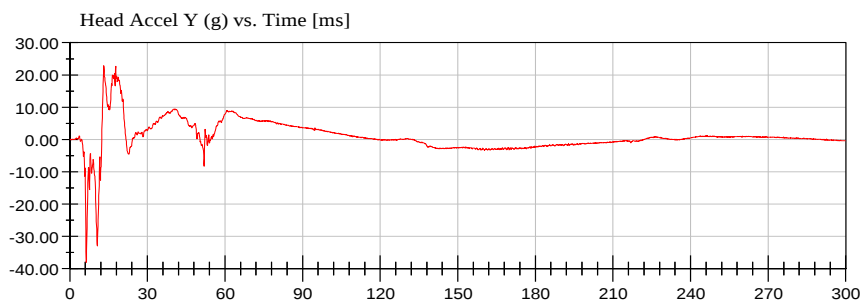
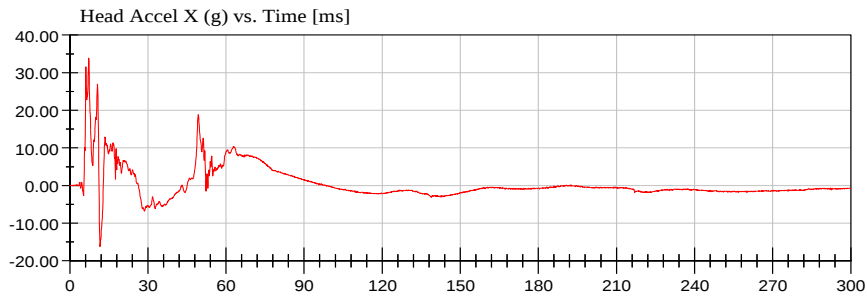
Alpha Technology

Position #2 SID IIs Dummy (297)

Test Date: 02/12/2013

Test Lab: SLED

Test Number: S130212-1 (MD0105TWG2)



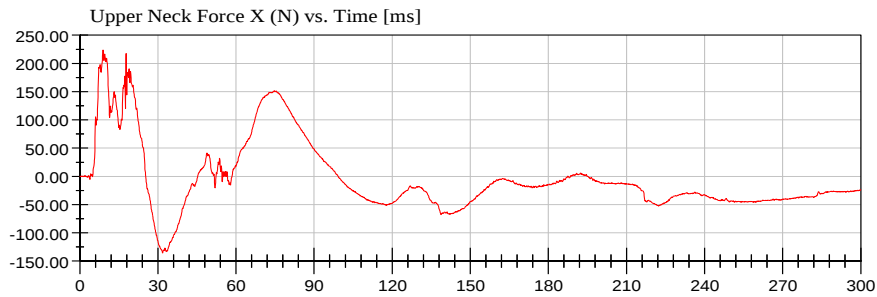
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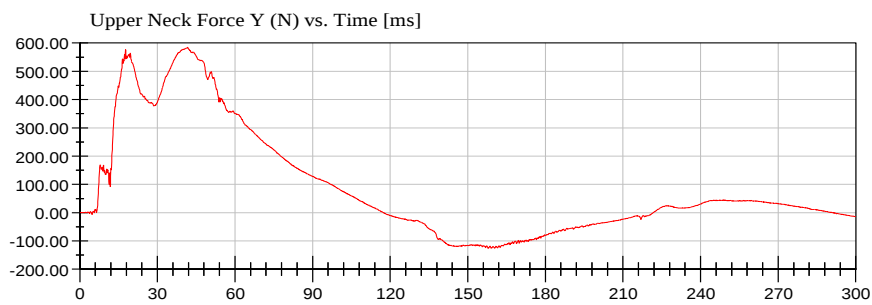


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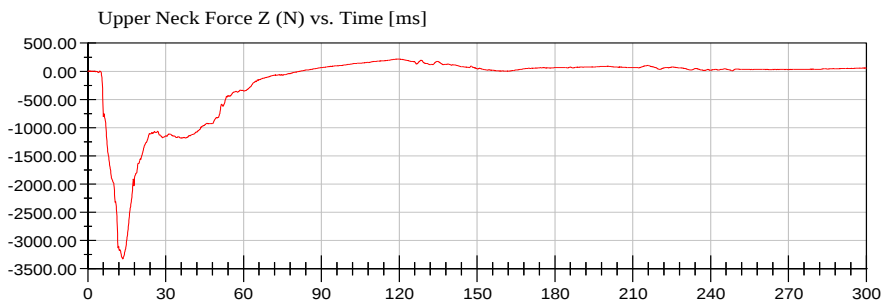


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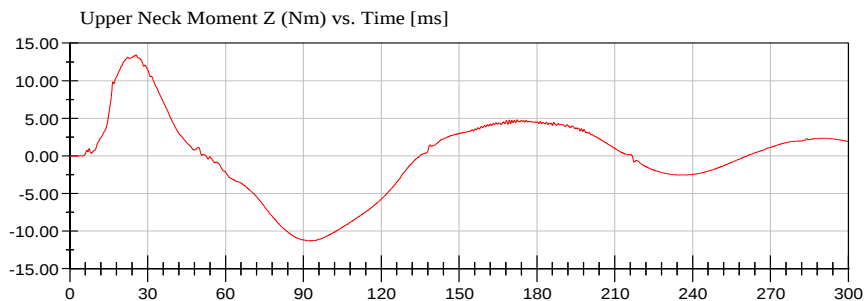
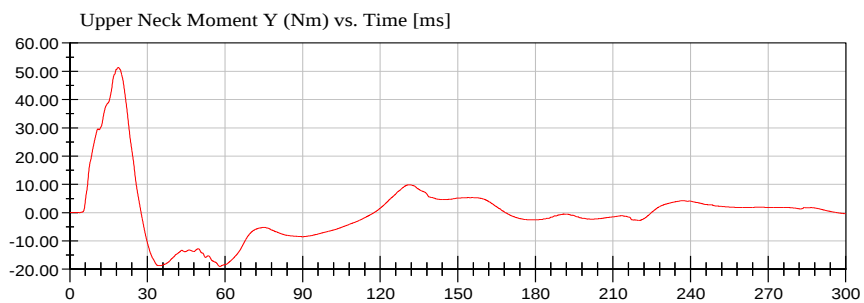
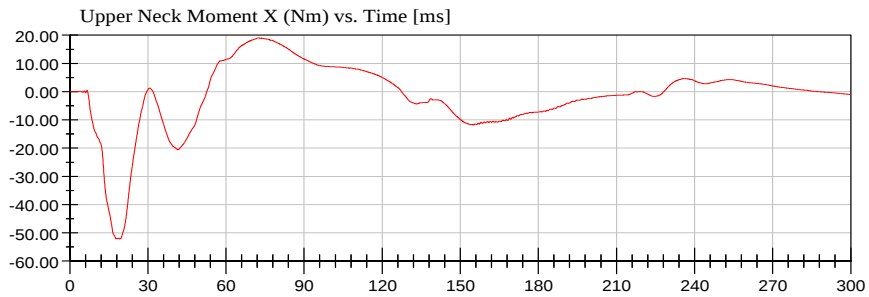
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Position #2 SID II's Dummy (297)

Test Date: 02/12/2013

Test Lab: SLED

Test Number: S130212-1 (MD0105TWG2)



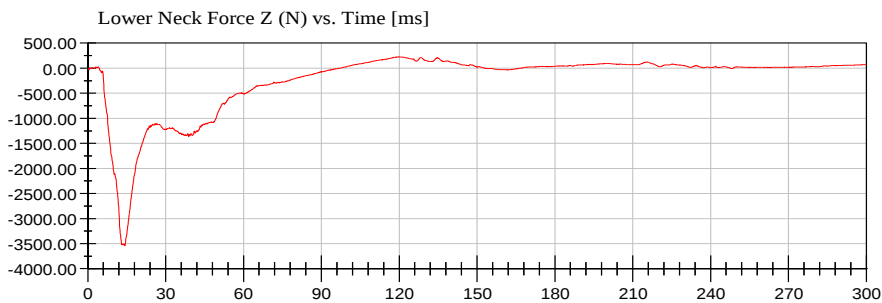
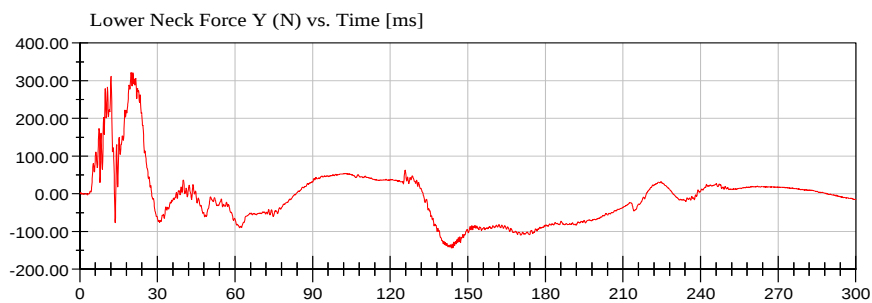
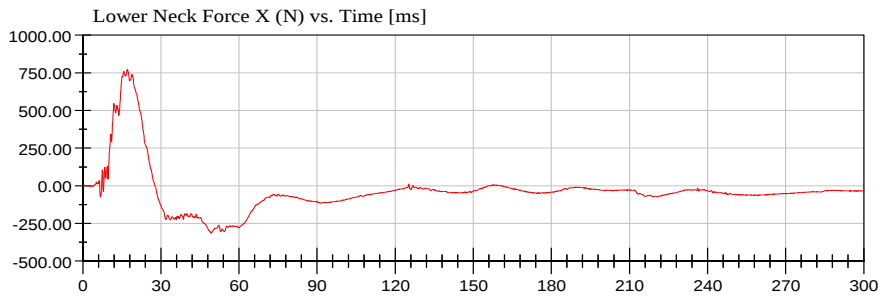
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Test Lab: SLED

Test Number: S130212-1 (MD0105TWG2)

Position #2 SID IIs Dummy (297)

Test Date: 02/12/2013



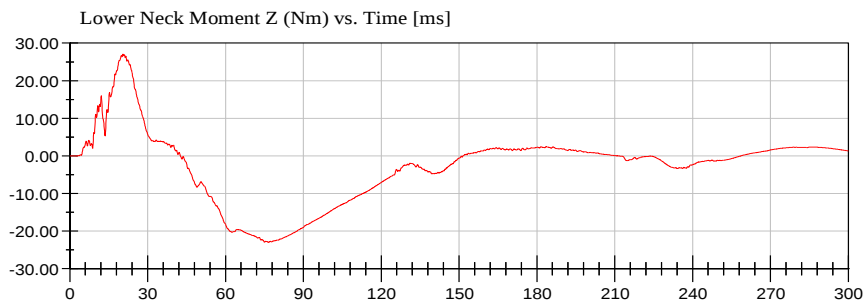
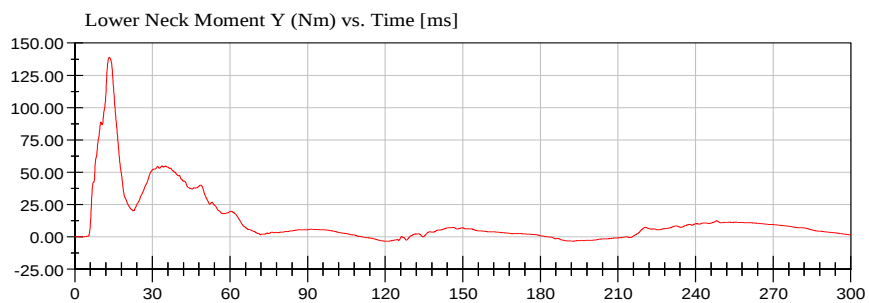
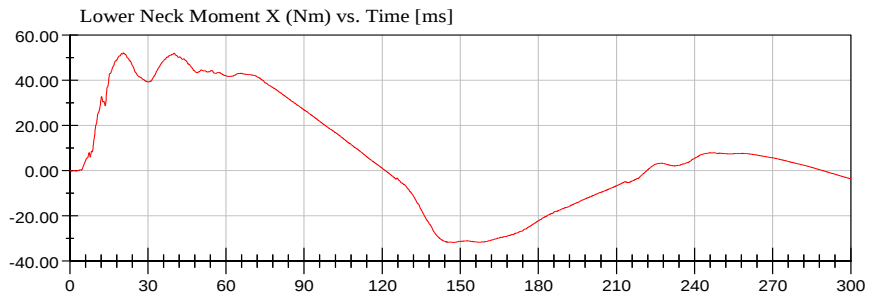
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Test Date: 02/12/2013



Alpha Technology

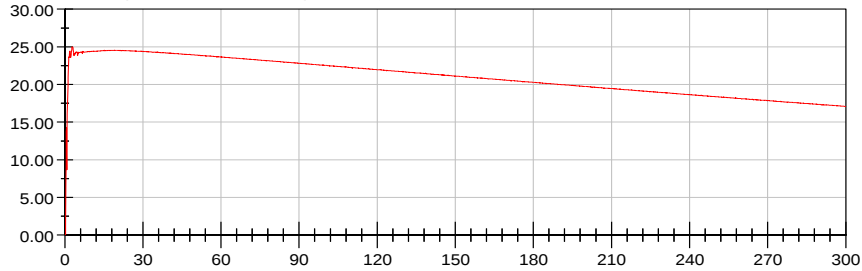
Position #2 SID IIs Dummy (297)

Test Date: 02/12/2013

Test Lab: SLED

Test Number: S130212-1 (MD0105TWG2)

Airbag Event Front Passenger Seat (V) vs. Time [ms]



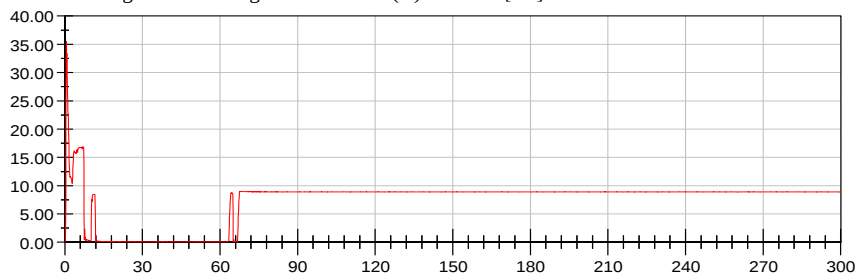
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0.00 V at 0.00 ms

Airbag Event Passenger Side Curtain (V) vs. Time [ms]



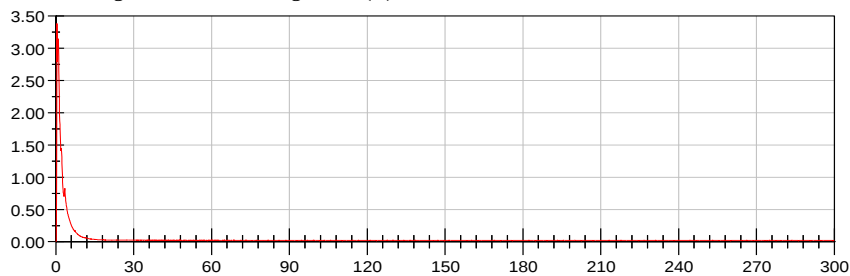
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Airbag Event Front Passenger Seat (A) vs. Time [ms]



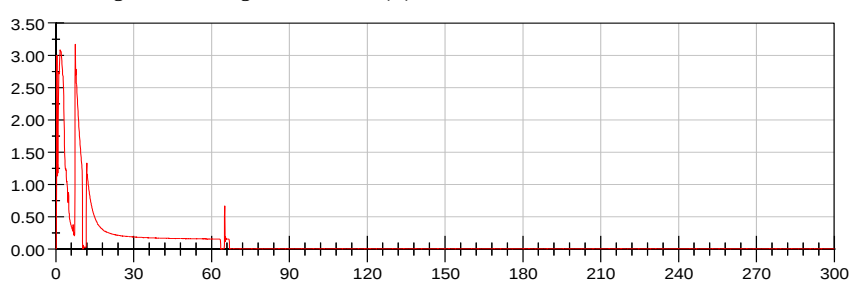
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0.00 A at 0.00 ms

Airbag Event Passenger Side Curtain (A) vs. Time [ms]



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<Min>

0.00 A at 0.00 ms



Test Vehicle: 2013 Buick Verano
Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: MD0105TWG2
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APPENDIX C

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

Test Vehicle: 2013 Buick Verano
 Test Program: Side Airbag O.O.P. Injury Testing

NHTSA No.: MD0105TWG2
 Test Date: 2/12/13

TEST EQUIPMENT LIST AND CALIBRATION INFORMATION

P572C INSTRUMENTATION

	POSITION #2 (RIGHT) SERIAL NO.: 297		
	SERIAL NUMBER	MANUFACTURER	CALIBRATION DATE
Head Accel X	P51292	Endevco	28-Jan-2013
Head Accel Y	P58999	Endevco	28-Jan-2013
Head Accel Z	P58797	Endevco	28-Jan-2013
Upper Neck Force X	1716A-1914-FX	Denton	28-Jan-2013
Upper Neck Force Y	1716A-1914-FY	Denton	28-Jan-2013
Upper Neck Force Z	1716A-1914-FZ	Denton	28-Jan-2013
Upper Neck Moment X	1716A-1914-MX	Denton	28-Jan-2013
Upper Neck Moment Y	1716A-1914-MY	Denton	28-Jan-2013
Upper Neck Moment Z	1716A-1914-MZ	Denton	28-Jan-2013
Lower Neck Force X	3166-143-FX	Denton	27-Jul-2012
Lower Neck Force Y	3166-143-FY	Denton	27-Jul-2012
Lower Neck Force Z	3166-143-FZ	Denton	27-Jul-2012
Lower Neck Moment X	3166-143-MX	Denton	27-Jul-2012
Lower Neck Moment Y	3166-143-MY	Denton	27-Jul-2012
Lower Neck Moment Z	3166-143-MZ	Denton	27-Jul-2012
Airbag Event Front Passenger Seat	K3789-166	KAYSER-THREDE	12-Feb-2013
Airbag Event Passenger Side Curtain	K3789-166	KAYSER-THREDE	12-Feb-2013
Airbag Event Front Passenger Seat	K3789-166	KAYSER-THREDE	12-Feb-2013
Airbag Event Passenger Side Curtain	K3789-166	KAYSER-THREDE	12-Feb-2013

Transportation Research Center Inc.

Left Lateral Head Drop
SID IIs Serial No. 297 Certification No. 2-1
Test Date: 2/6/2013

Test Parameter	Specification	Test Results	Pass
Temperature	18.9 - 25.6 °C	21.1 °C	Yes
Relative Humidity	10 - 70 %	34 %	Yes
Peak Head Resultant Acceleration	115 - 137 g	119.6 g	Yes
Peak Head Longitudinal Acceleration	(-15) - 15 g	3.4 g	Yes
Is Head Resultant Acceleration Curve Unimodal within 15% of Peak?	Yes	Yes	Yes

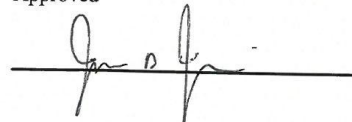
Test meets specifications.

Comments:

Technician



Approved



Specification Source: Procedures based on Final Rule effective 8/24/2009
Polarity in accordance with SAE J211.

02.06.2013 13:21:48 198

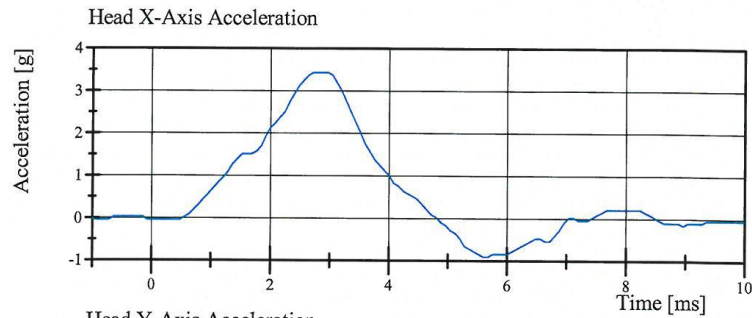


Transportation Research Center Inc.

Left Lateral Head Drop

SID IIs Serial No. 297 Certification No. 2-1

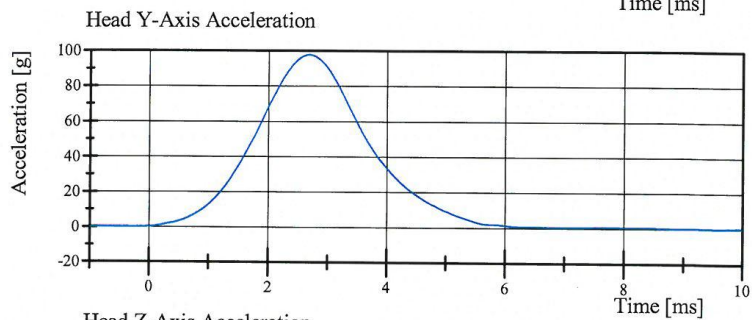
Test Date: 2/6/2013



Filter Class: CFC_1000

Max: 3.4 gn at 2.7 ms

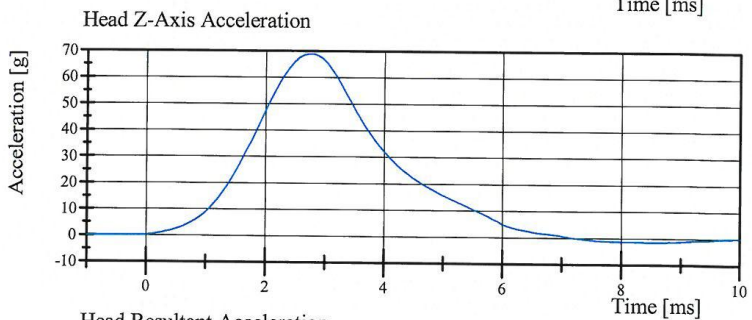
Min: -0.9 gn at 5.6 ms



Filter Class: CFC_1000

Max: 97.7 gn at 2.6 ms

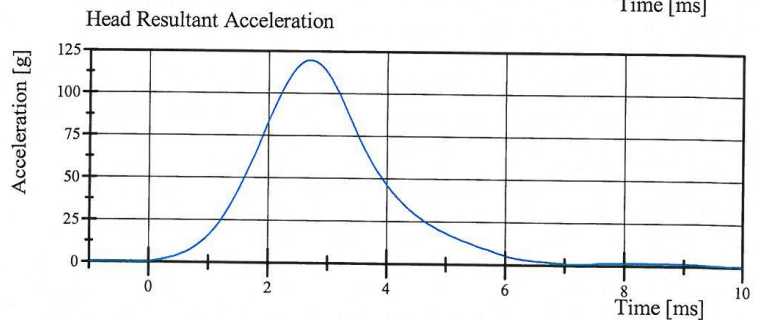
Min: -0.0 gn at -0.1 ms



Filter Class: CFC_1000

Max: 68.8 gn at 2.7 ms

Min: -1.5 gn at 8.5 ms



Filter Class: CFC_1000

Max: 119.6 gn at 2.7 ms

Min: 0.0 gn at -1.0 ms

Specification Source: Procedures based on Final Rule effective 8/24/2009
Polarity in accordance with SAE J211.

02.06.2013 13:22:06 198



Transportation Research Center Inc.

Left Lateral Neck

SID IIs Serial No. 297 Certification No. 2-5

Test Date: 2/7/2013

Test Parameter	Specification	Test Results	Pass
Temperature	20.6 - 22.2 °C	21.4 °C	Yes
Relative Humidity	10 - 70 %	29 %	Yes
Pendulum Velocity	(-5.51) - (-5.63) m/s	-5.599 m/s	Yes
Pendulum Integrated Velocity			
Change at 10 ms	2.20 - 2.80 m/s	2.709 m/s	Yes
Change at 15 ms	3.30 - 4.10 m/s	3.986 m/s	Yes
Change at 20 ms	4.40 - 5.40 m/s	5.360 m/s	Yes
Change at 25 ms	5.40 - 6.10 m/s	5.833 m/s	Yes
Change at 25 to 100 ms	5.50 - 6.20 m/s	5.835 m/s	Yes
Maximum Headform Flexion occurring between 50ms and 70ms.			
Peak	(-71) - (-81) deg	-74.1 deg	Yes
Time of Peak	50 - 70 ms	64.2 ms	Yes
Total Neck Occipital Condyles Moment	36 - 44 N·m	42.6 N·m	Yes
Total Neck Occipital Condyles Moment			
Decay Time to 0 N·m	102 - 126 ms	119.0 ms	Yes

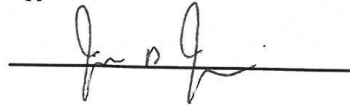
Test meets specifications.

Comments:

Technician



Approved



Specification Source: Procedures based on Final Rule effective 8/24/2009
Polarity in accordance with SAE J211.

02.07.2013 08:50:51 604

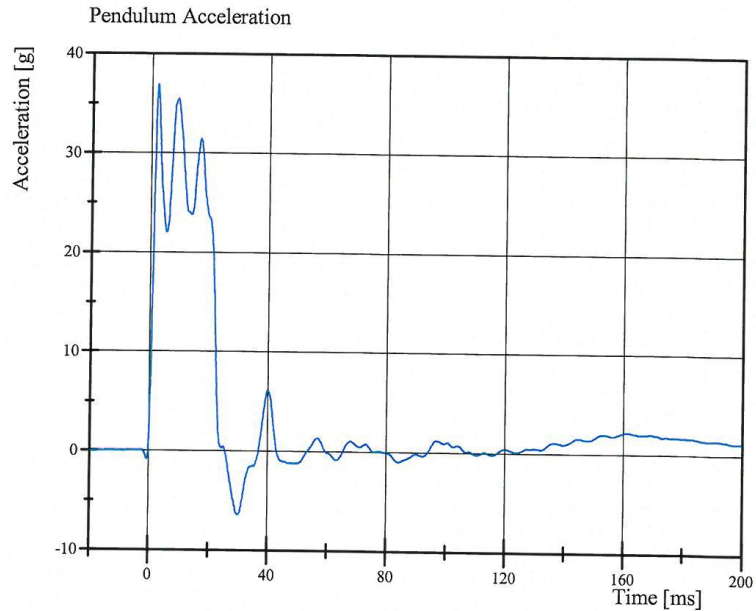


Transportation Research Center Inc.

Left Lateral Neck

SID IIs Serial No. 297 Certification No. 2-5

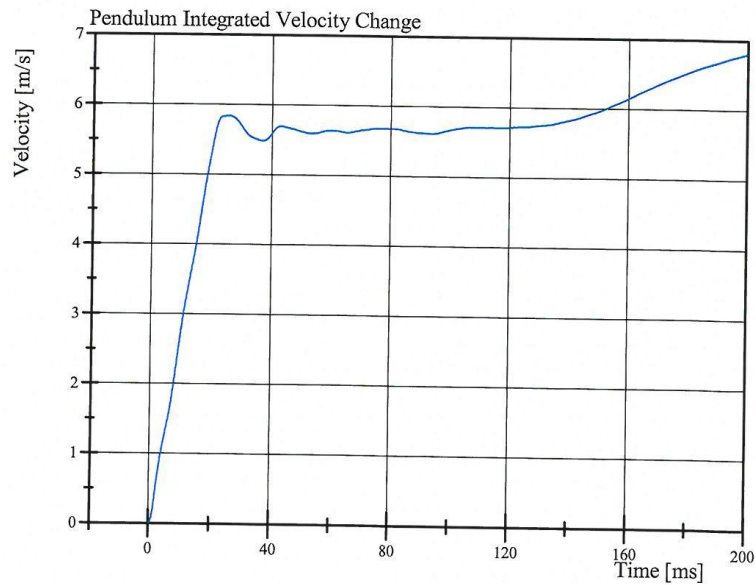
Test Date: 2/7/2013



Filter Class: CFC_180

Max: 36.8 gn at 2.2 ms

Min: -6.4 gn at 30.2 ms



Filter Class: CFC_180

Max: 6.8 m/s at 200.0 ms

Min: 0.0 m/s at 0.0 ms

Specification Source: Procedures based on Final Rule effective 8/24/2009
Polarity in accordance with SAE J211.

02.07.2013 08:50:58 604

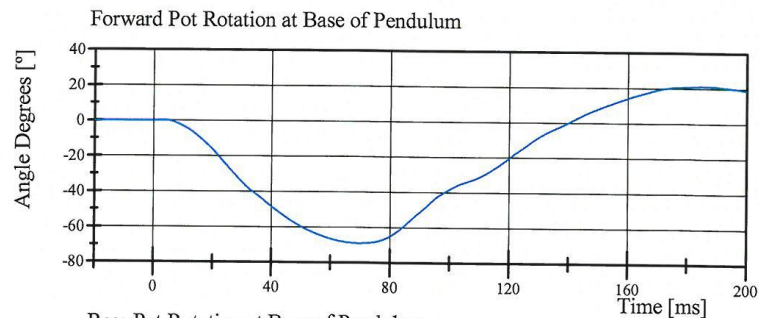


Transportation Research Center Inc.

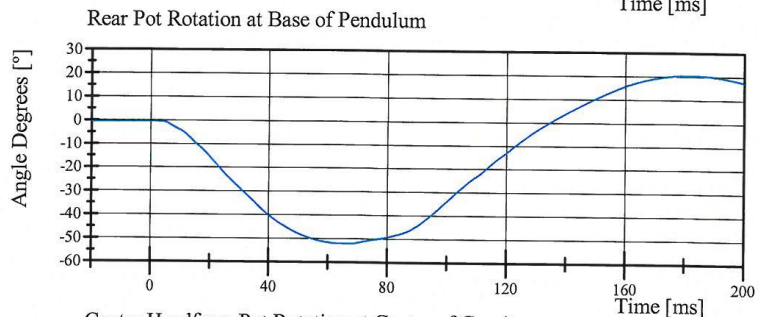
Left Lateral Neck

SID IIa Serial No. 297 Certification No. 2-5

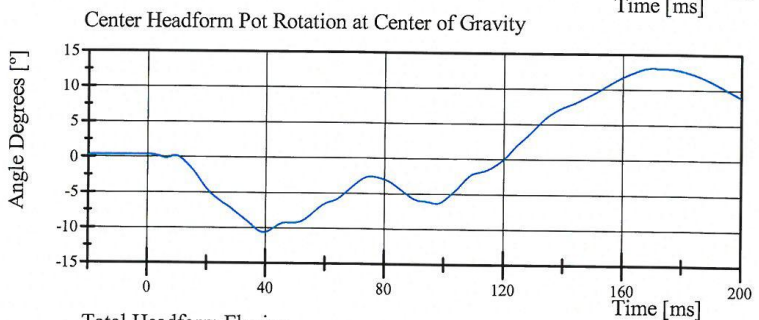
Test Date: 2/7/2013



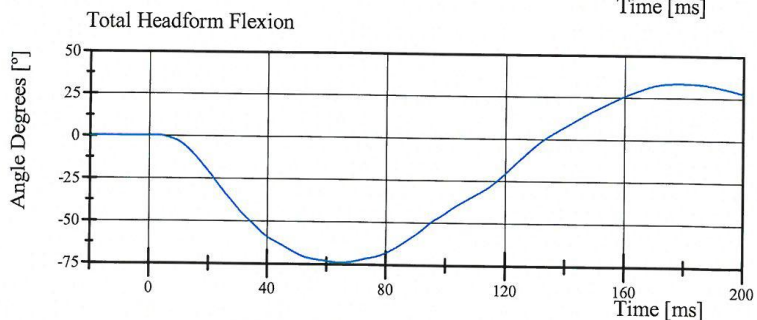
Filter Class: CFC_60
Max: 21.0 ° at 185.9 ms
Min: -69.1 ° at 69.8 ms



Filter Class: CFC_60
Max: 20.5 ° at 181.7 ms
Min: -52.2 ° at 67.0 ms



Filter Class: CFC_60
Max: 13.1 ° at 170.2 ms
Min: -10.7 ° at 39.4 ms



Filter Class: CFC_60
Max: 33.4 ° at 177.8 ms
Min: -74.1 ° at 64.2 ms

Specification Source: Procedures based on Final Rule effective 8/24/2009
Polarity in accordance with SAE J211.

02.07.2013 08:50:58 604

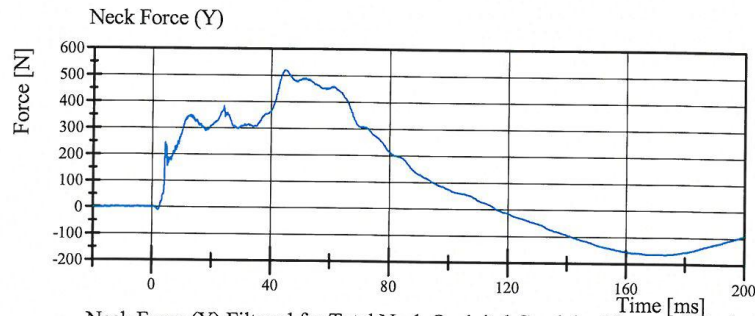


Transportation Research Center Inc.

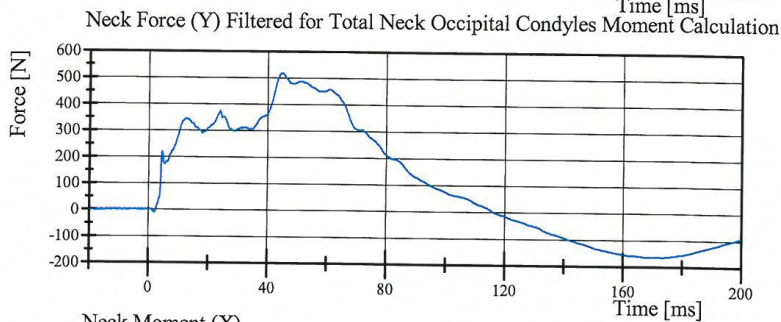
Left Lateral Neck

SID IIs Serial No. 297 Certification No. 2-5

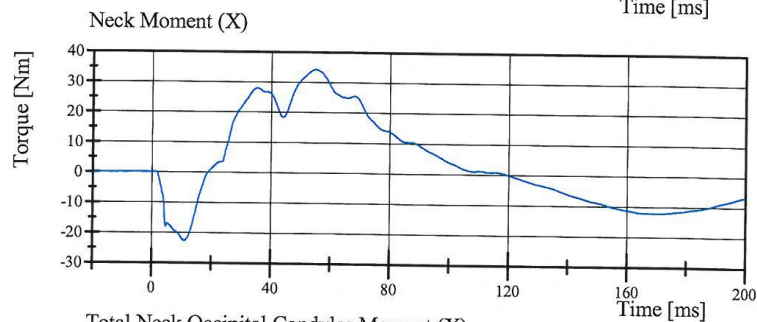
Test Date: 2/7/2013



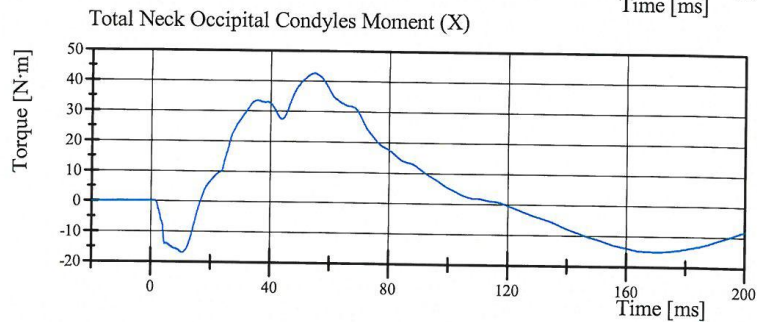
Filter Class: CFC_1000
Max: 518.4 N at 44.9 ms
Min: -165.2 N at 173.0 ms



Filter Class: CFC_600
Max: 517.9 N at 44.9 ms
Min: -164.9 N at 173.0 ms



Filter Class: CFC_600
Max: 34.3 Nm at 54.7 ms
Min: -22.7 Nm at 11.0 ms



Filter Class: Without_(Consta
Max: 42.6 N·m at 54.7 ms
Min: -17.0 N·m at 10.5 ms

Specification Source: Procedures based on Final Rule effective 8/24/2009
Polarity in accordance with SAE J211.

02.07.2013 08:50:59 604

