REPORT NUMBER TR-P31043-04-NC

SIDE AIRBAG OCCUPANT RISK PROGRAM
OCCUPANT OUT-OF-POSITION TESTS

NISSAN MOTOR CO., LTD.
2011 NISSAN SENTRA 2.0
4-DOOR SEDAN

NHTSA NUMBER: MB5214TWG2

PREPARED BY:
KARCO ENGINEERING, LLC
9270 HOLLY ROAD
ADELANTO, CALIFORNIA 92301

APRRIL 27, 2011

FINAL REPORT

PREPARED FOR:

ALPHA TECHNOLOGY ASSOCIATE, INC.
2810 OLD LEE HWY, SUITE 120
FAIRFAX, VA 22031

This final test report was prepared for the U.S. Department of Transportation, Alpha Technology Associate, Inc., in response to Contract Number DTNH22-06-D-00027.

Prepared By: 

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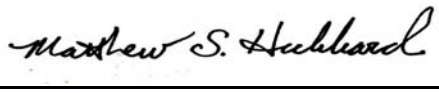
KARCO Engineering, LLC.

Reviewed By: 

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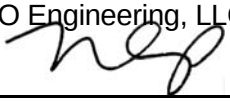

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Mr. Frank D. Richardson, Program Manager
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Approval Date: _____

FINAL REPORT ACCEPTED BY:

_____
Engineer, Alpha Technology Associate, Inc.

_____
Date of Acceptance

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SECTION 1

PURPOSE AND SUMMARY OF TEST MB5214TWG2

1.1 PURPOSE

This occupant out-of-position static side airbag deployment test is part of the Technical Working Group Occupant Injury Risk from Deploying Side Airbags Testing Program sponsored by Alpha Technology Associate, Inc. under Contract No. DTNH22-06-D-00027. The purpose of this test was to obtain occupant injury data for a side airbag deployment.

The occupant out-of-position side airbag test was conducted in accordance with the Technical Working Group Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

1.2 SUMMARY

The effects of a roof mounted curtain airbag and a torso airbag deployment in a 2011 Nissan Sentra 2.0 4-Door Sedan with an out-of-position Hybrid III 6 year old child dummy were evaluated. The test was performed at Karco Engineering, LLC on Aprril 27, 2011. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

Three high-speed digital cameras and one real time camera were used to document the airbag deployment. Camera locations and other pertinent camera information can be found on Data Sheet No.1 and Data Sheet No.6.

A Hybrid III 6 year old child anthropomorphic test device (ATD) was placed in the right front passenger seating position facing inboard according to the dummy placement instructions (3.3.5.1) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The Hybrid III 6 year old child ATD was instrumented with head tri-axial accelerometers, and upper and lower neck transducers.

Fifteen (15) channels of data were recorded using an on-board data acquisition system. Appendix A contains Photographs. Appendix B contains dummy response data traces. Appendix C contains the Instrumentation Data Channel assignments.

The front passenger side door remained closed during the deployment and was operable after the deployment.

The Hybrid III 6 year old child dummy's visible contact points were as follows: The curtain airbag contacted the ATD’s head and the torso airbag contacted the ATD’s back.

OUT OF POSITION OCCUPANT DATA SUMMARY

ATD Position	HIC_{15}
Passenger	7.1

Orientation of the Hybrid III 6 year old child dummy was in the inboard facing position leaning back against the front passenger door. The dummy's head centerline was aligned with the deploying trajectory of the curtain airbag. This orientation complies with section 3.3.5.1 of the Technical Working Group (TWG) recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

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SECTION 2

OCCUPANT AND VEHICLE INFORMATION/DATA SHEETS

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No.:MB5214TWG2
Test Program: TWG 3.3.5.1 Test Date: 04/27/11

CONVERSION FACTORS USED IN THIS REPORT*

Quantity	Typical Application	Std Units	Metric Unit	Multiply By
Mass	Vehicle Weight	lb	kg	0.4536
Linear Velocity	Impact Velocity	mile/h	km/h	1.609
Length or Distance	Measurements	in	mm	25.4
Volume	Fuel Systems	gal	liter	3.785
Volume	Small Fluids	oz	mL	29.573
Pressure	Tire Pressures	lbf/in^2	kPa	7.0
Volume	Liquid	gal	liter	3.785
Temperature	General Use	^oF	^oC	=(tf -32)/1.8
Force	Dynamic Forces	lbf	N	4.448
Moment	Torque	lbf/ft	Nm	1.355

* Based on the Recommended Practice in SAE J916, May 85

DATA SHEET NO. 1

TEST SUMMARY

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No.: MB5214TWG2

Test Program: TWG 3.3.5.1 Test Date: 04/27/11

TEST DUMMY INFORMATION

Description	Passenger Seat Inboard Facing
Dummy Type / Serial No.	Hybrid III 6-year-old / 186
Head Contact	Yes
Chest Contact	None
Abdomen Contact	Yes
Pelvis	None
Left Knee Contact	None
Right Knee Contact	None

MOVIE COVERAGE

High Speed Digital	3
Real Time	1
Total	4

DATA CHANNELS

SID IIs ATD Sensors	15
Belt Assessment Sensors	0
Vehicle Structure Accelerometers	0
Total	15

DATA SHEET NO. 2

GENERAL TEST AND VEHICLE PARAMETER DATA

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No.:MB5214TWG2

Test Program: TWG 3.3.5.1 Test Date: 04/27/11

TEST VEHICLE INFORMATION

Make	Nissan
Model	Sentra 2.0
Body Style	4-Door Sedan
NHTSA No.	MB5214TWG2
VIN	3N1AB6AP5BL606254
Color	Brilliant Silver
Delivery Date	September 28, 2010
Odometer Reading (mile)	89
Dealer	West Covina Nissan
Transmission	Automatic
Final Drive	Front
Type/Number Cylinders	Inline 4
Engine Displacement (L)	2.0
Engine Placement	Transverse

TEST VEHICLE OPTIONS

Driver Front Airbag	Yes
Driver Side Airbag	Yes
Driver Side Curtain Airbag	Yes
Pass. Front Airbag	Yes
Pass.Side Airbag	Yes
Pass. Curtain Airbag	Yes
Power Brakes	Yes
Power Steering	Yes
Disc Brakes, Front	Yes
Disc Brakes, Rear	Yes
Anti-lock Brakes	Yes
Tilt Steering Wheel	Yes
Power Windows	Yes
Power Seats	No

DATA FROM CERTIFICATION LABEL

Manufactured By	Nissan Motor Co., LTD
Date of Manufacture	August-10

GVWR (kg)	1792
GAWR Front (kg)	1010
GAWR Rear (kg)	821

DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	300	300
Cold Pressure (kPa)	230	230
Recommend Tire Size	P205/60R15	P205/60R15
Tire Size on Vehicle	P205/60R15	P205/60R15
Tire Manufacturer	Bridgestone	Bridgestone

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench	N/A	
Number of Occupants	2	3	N/A	5
Capacity Wt. (VCW) (kg)				385

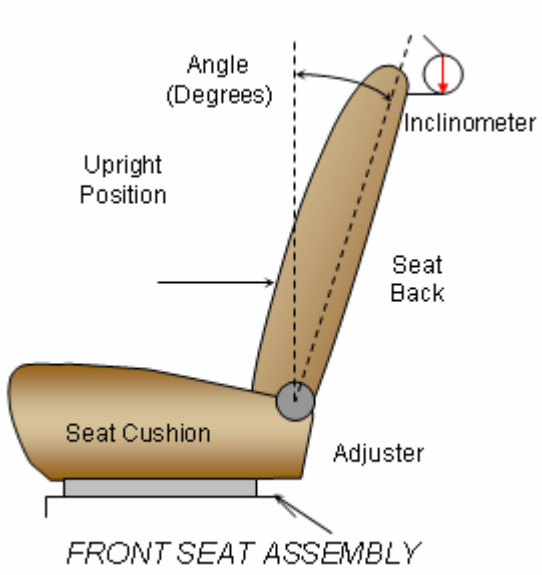
* Vehicle had undergone New Car Assessment Program Frontal Impact Testing on October 27, 2010

DATA SHEET NO. 3

TEST VEHICLE INFORMATION

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No.:MB5214TWG2

Test Program: TWG 3.3.5.1 Test Date: 04/27/11



NOMINAL DESIGN RIDING POSITION

The passenger seat back is positioned to section 3.3.5.1 of the Technical Working Group (TWG) recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SEAT BACK ANGLES

Position	Deg.
Passenger w/ Dummy	11.5

Seat upright is 0 degrees.
Taken at headrest post.

SEAT FORE/AFT POSITIONS

The first or forward most position is counted as number one (1). The fore/aft position is set aft of the middle position for the passenger seat.

SEAT FORE/AFT POSITIONING

	Total Fore/Aft Travel	Placed in Position #
Passenger Seat	25	4th

DATA SHEET NO. 4

DUMMY POSITIONING INFORMATION

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No. MB5214TWG2

Test Program: TWG 3.3.5.1 Test Date: 04/27/11

TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	6 Yr. Old	
		Length (mm)	Angle (°)
SA	Seat Back Angle		11.2
AMW	Side Airbag Module Width (Torso / Curtain)	28 / 35	
ABW	Side Airbag Width (Torso / Curtain)	235 / 500	
AML	Side Airbag Module Length (Torso / Curtain)	200 / 315	
ABL	Side Airbag Length (Torso / Curtain)	570 / 1565	
AN	Top of Airbag Module to Head/Neck Junction	385	
HD	Head CG to Door Panel/ Window	87	
HSC	Head to Seat Back Centerline	341	
HB	Head to B-Pillar (first contact)	410	
HZ	Head to Roof (Z)	95	
HHD	Head to Header	478	
ND	Nose to Dash	475	
NS	Nose to Seat Back	340	
NR	Nose to Header	282	
CD	Chest to Dash	438	
CS	Chest to Seat Back	331	
RACL	Right Arm to Dash	285	
LACL	Left Arm to Seat Back Centerline	224	
RA	Right Arm to Door Panel	100	
LA	Left Arm to Door Panel	145	
KK	Knee to Knee	93	
TT	Toe to Toe	85	
KSCR	Right Knee to Seat Cushion Centerline	68	
KSCL	Left Knee to Seat Cushion Centerline	72	
	Head Level (X Direction)		0.9
	Head Level (Y Direction)		0.2

DATA SHEET NO. 5
HYBRID III ATD INJURY CRITERIA AND SENSOR DATA

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No.: MB5214TWG2

Test Program: TWG 3.3.5.1 Test Date: 4/27/11

HEAD PEAK ACCELERATIONS

			6 Yr. Old			
Location	Axis	Units	Max	Time	Min	Time
Head CG	X	G's	12.4	18.2	-20.2	11.4
Head CG	Y	G's	12.7	28.6	-7.7	17.9
Head CG	Z	G's	50.0	11.4	-7.8	10.9
Head CG Resultant	N/A	G's	54.6	11.4		

UPPER NECK PEAK FORCES AND MOMENTS

			6 Yr. Old			
Location	Axis	Units	Max	Time	Min	Time
Neck Force	X	Newtons	249.6	16.9	-229.7	74.0
Neck Force	Y	Newtons	171.6	5.3	-87.4	6.1
Neck Force	Z	Newtons	72.0	9.1	-1042.3	35.0
Neck Force Resultant	N/A	Newtons	1060.2	35.0		
Neck Moment	X	Nm	13.0	94.6	-10.5	11.3
Neck Moment	Y	Nm	24.3	19.1	-2.9	8.5
Neck Moment	Z	Nm	6.6	38.9	-2.1	112.8
Neck Moment Resultant	N/A	Nm	25.9	19.2		

LOWER NECK PEAK FORCES AND MOMENTS

			6 Yr. Old			
Location	Axis	Units	Max	Time	Min	Time
Neck Force	X	Newtons	335.8	9.1	-115.6	8.1
Neck Force	Y	Newtons	254.2	10.5	-113.5	111.8
Neck Force	Z	Newtons	48.6	8.8	-1025.2	35.9
Neck Force Resultant	N/A	Newtons	1026.1	35.9		
Neck Moment	X	Nm	17.6	29.4	-9.9	212.9
Neck Moment	Y	Nm	48.6	36.1	-3.0	22.7
Neck Moment	Z	Nm	13.7	11.9	-3.2	75.3
Neck Moment Resultant	N/A	Nm	50.7	36.0		

HEAD INJURY CRITERIA (HIC 15)

	6 Yr. Old			
Location	HIC15	T^1	T^2	Avg G
Head CG	7.1	10.3	24.0	12.1

UPPER NECK NIJ VALUES

	6 Yr. Old			
Location	Ntf	Nte	Ncf	Nce
Upper Neck	0.00	0.06	0.45	0.10

CAMERA LOCATIONS

Test Vehicle: 2011 Nissan Sentra 2.0 4-Door Sedan NHTSA No.:MB5214TWG2

Test Program: TWG 3.3.5.1 Test Date: 04/27/11

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No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Real Time	0	-3100	-1075	0.0	N/A	30
2	High Speed Side View	0	-2710	-977	0.6	35	1000
3	High Speed 3/4 View	-1620	-1200	-1435	6.8	50	1000
4	High Speed Front View	-1600	-315	-1273	3.6	35	1000

* All measurements are taken relative to CG of dummy's head.

APPENDIX A

PHOTOGRAPHS

Figure A-1: Right Front ¾ View, As Received

Figure A-2: Vehicle Certification Label

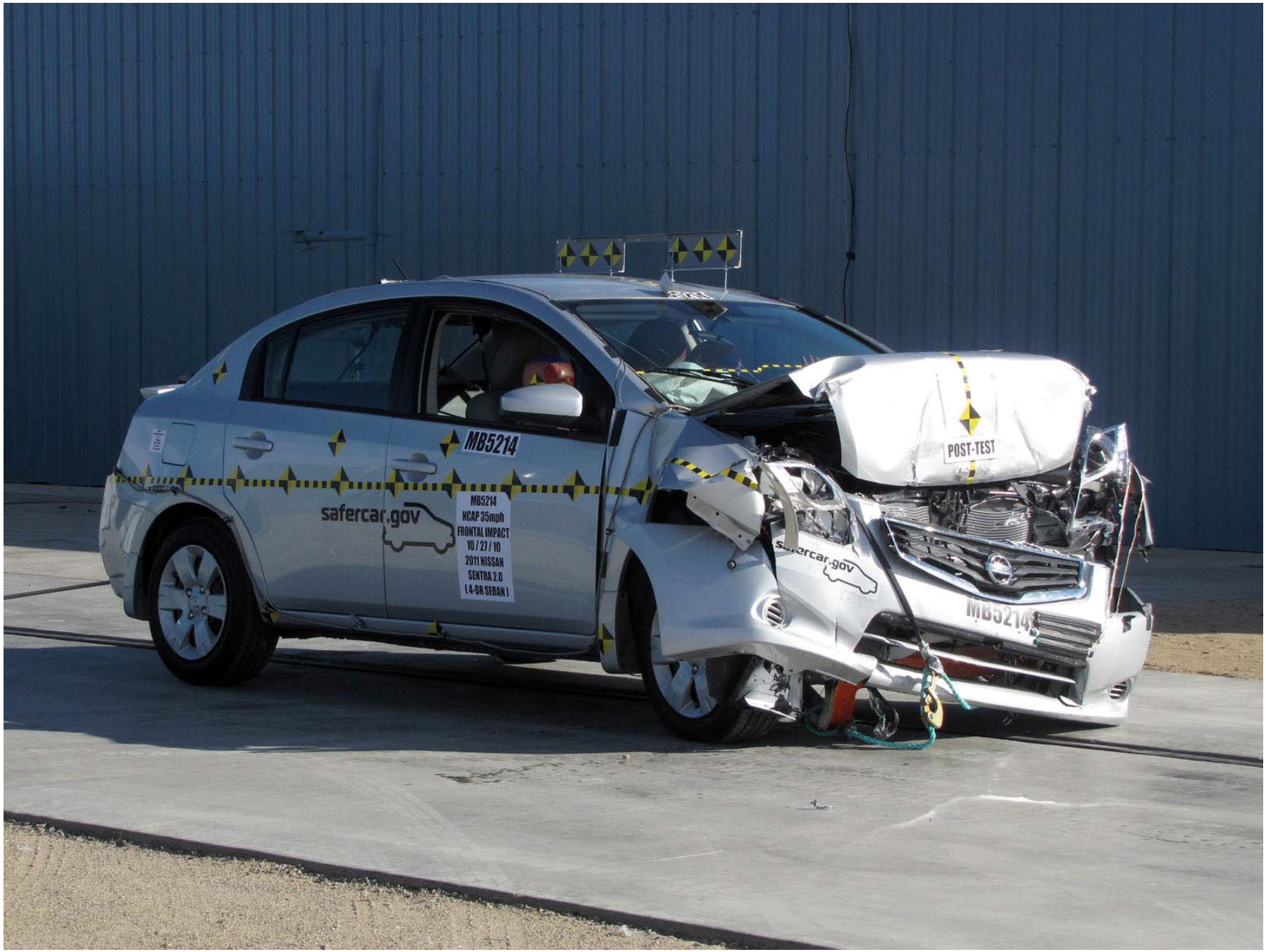


Figure A-3: Post-Test Right Front ¾ View of Frontal NCAP Test

Figure A-4: Post-Test Right Side View of Frontal NCAP Test

Figure A-5: Pre-Test Dummy Position, Left Side View

Figure A-6: Pre-Test Dummy Position, ¾ View

Figure A-7: Pre-Test Dummy Position, Front View

Figure A-8: Post-Test Dummy Position and Airbags, Left Side View

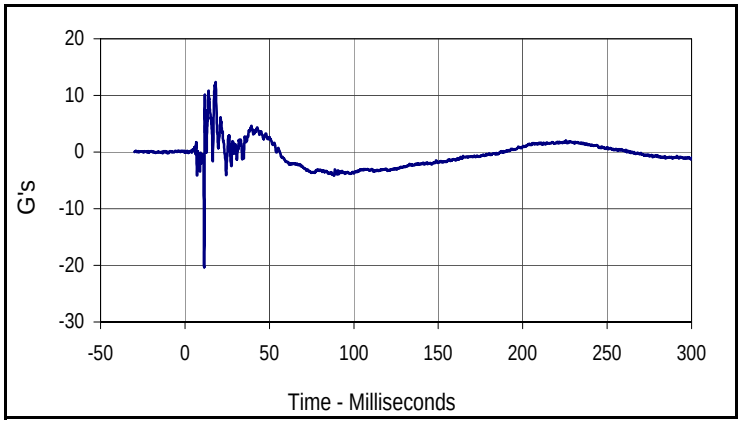
Figure A-9: Post-Test Airbags, Left Side View

Figure A-10: Post-Test Airbags, Left Front ¾ View

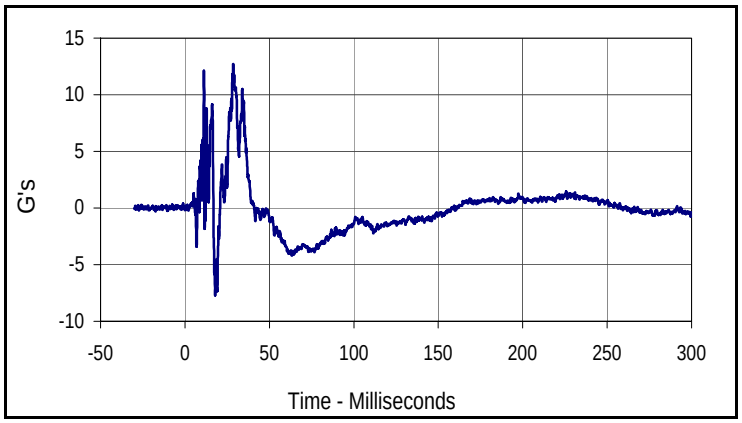
APPENDIX B

DATA PLOTS

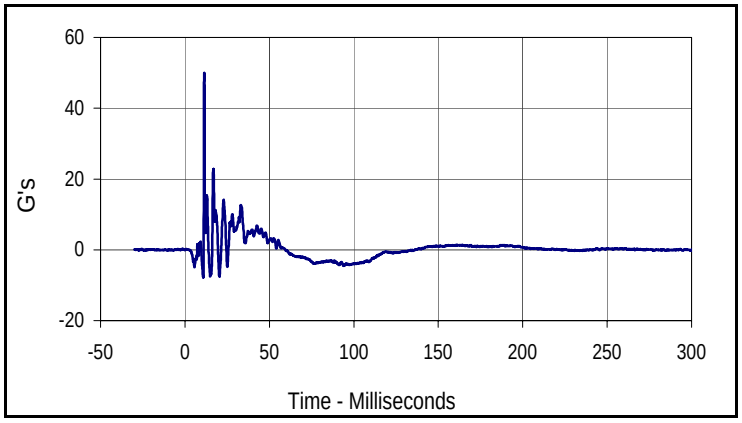
Test Vehicle:	2011 Nissan Sentra 2.0 4-Door Sedan	Test Date:	4/27/11
Test Program:	TWG 3.3.5.1	NHTSA No.:	MB5214TWG2



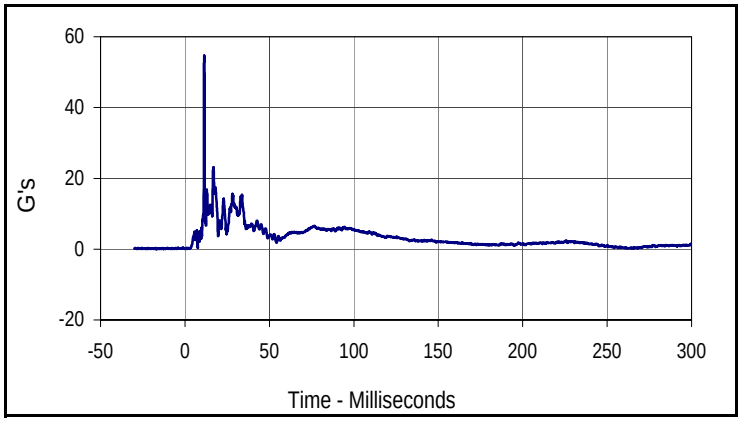
Curve Description			
6 Yr. Old Head X			
CURNO	Type	SAE Class	Units
001	FIL	1000	G's
Max	Time	Min	Time
12.4	18.2	-20.2	11.4



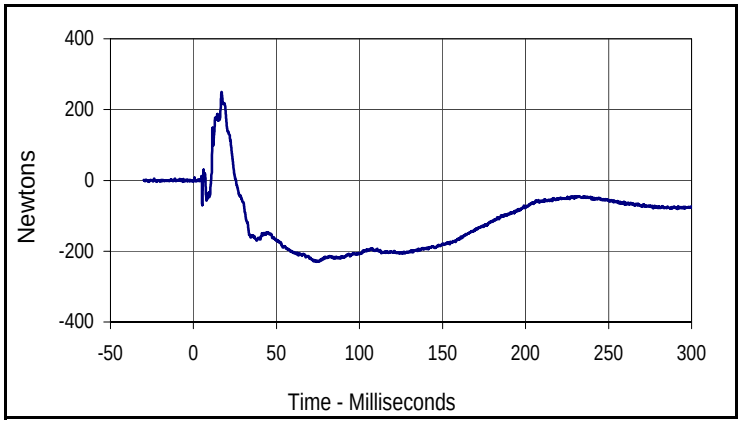
Curve Description			
6 Yr. Old Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	G's
Max	Time	Min	Time
12.7	28.6	-7.7	17.9



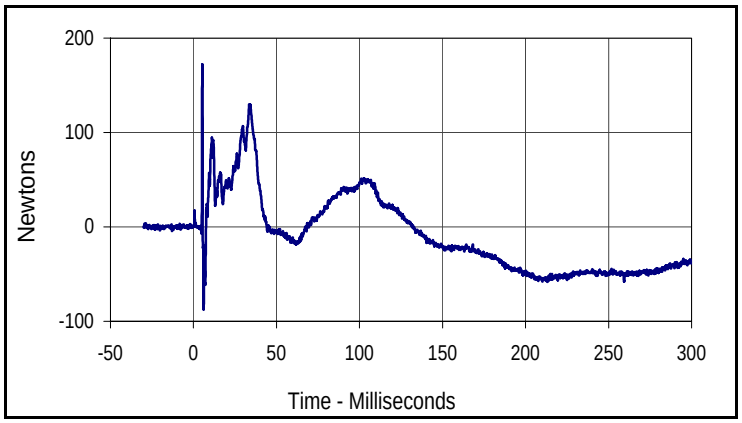
Curve Description			
6 Yr. Old Head Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	G's
Max	Time	Min	Time
50.0	11.4	-7.8	10.9



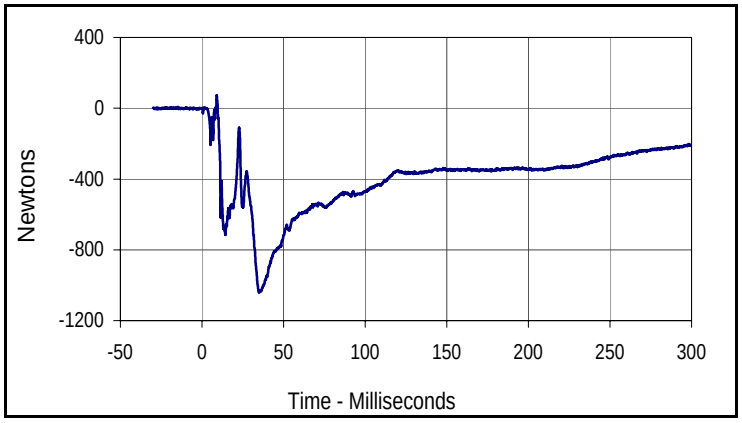
Curve Description			
6 Yr. Old Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	G's
Max	Time	Min	Time
54.6	11.4	0.0	441.6



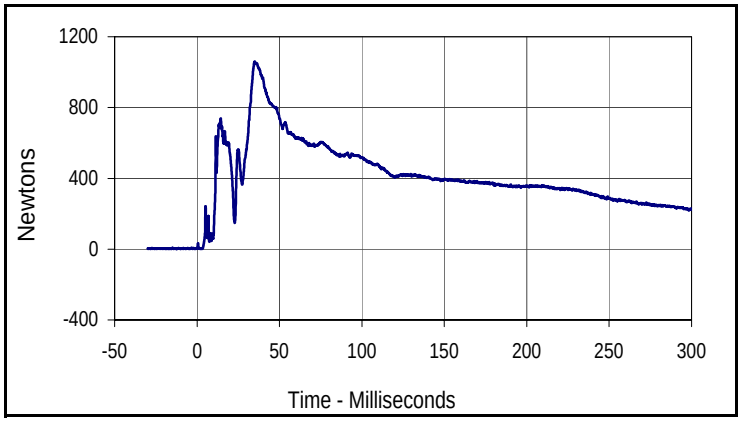
Curve Description			
6 Yr. Old Upper Neck Force X			
CURNO	Type	SAE Class	Units
004	FIL	1000	Newtons
Max	Time	Min	Time
249.6	16.9	-229.7	74.0



Curve Description			
6 Yr. Old Upper Neck Force Y			
CURNO	Type	SAE Class	Units
005	FIL	1000	Newtons
Max	Time	Min	Time
171.6	5.3	-87.4	6.1

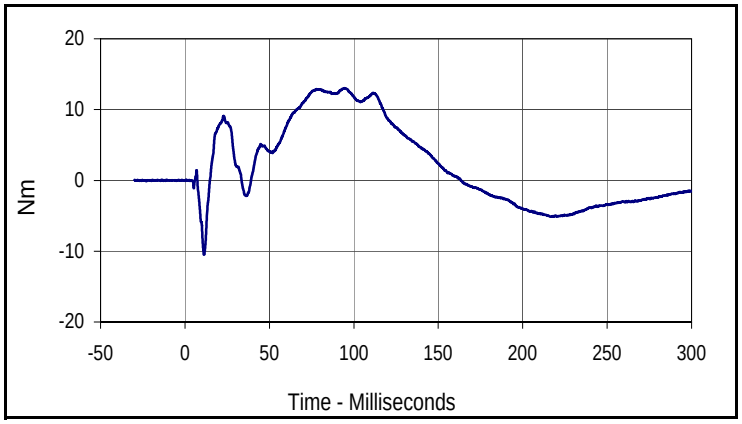


Curve Description			
6 Yr. Old Upper Neck Force Z			
CURNO	Type	SAE Class	Units
006	FIL	1000	Newtons
Max	Time	Min	Time
72.0	9.1	-1042.3	35.0



Curve Description			
6 Yr. Old Upper Neck Force Resultant			
CURNO	Type	SAE Class	Units
004	RES	1000	Newtons
Max	Time	Min	Time
1060.2	35.0	0.8	2.8

Test Vehicle:	2011 Nissan Sentra 2.0 4-Door Sedan	Test Date:	4/27/11
Test Program:	TWG 3.3.5.1	NHTSA No.:	MB5214TWG2



Curve Description			
6 Yr. Old Upper Neck Moment X			
CURNO	Type	SAE Class	Units
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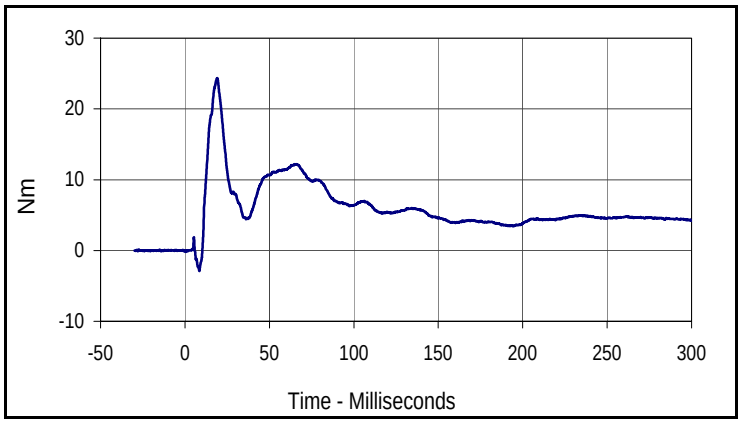
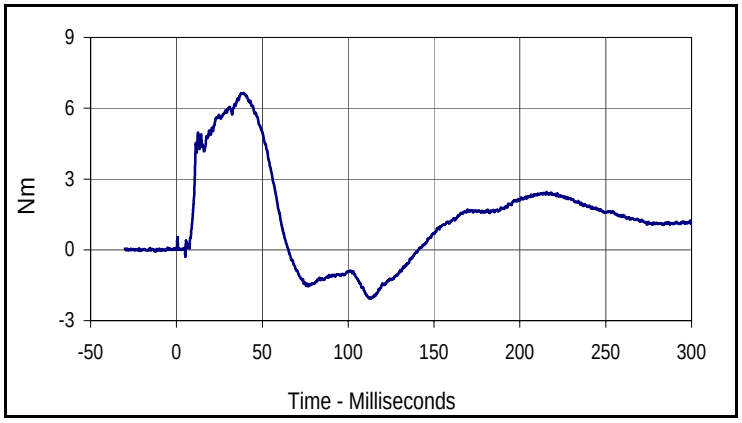
Max	Time	Min	Time
13.0	94.6	-10.5	11.3



Curve Description			
6 Yr. Old Upper Neck Moment Y			
CURNO	Type	SAE Class	Units
008	FIL	600	Nm
Max	Time	Min	Time
24.3	19.1	-2.9	8.5



Curve Description			
6 Yr. Old Upper Neck Moment Z			
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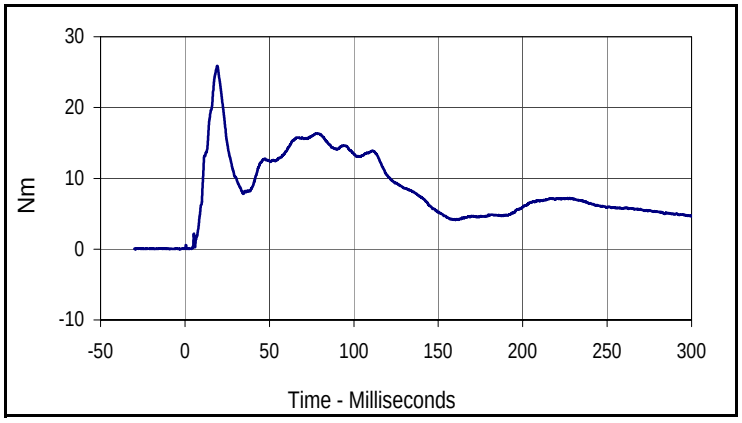
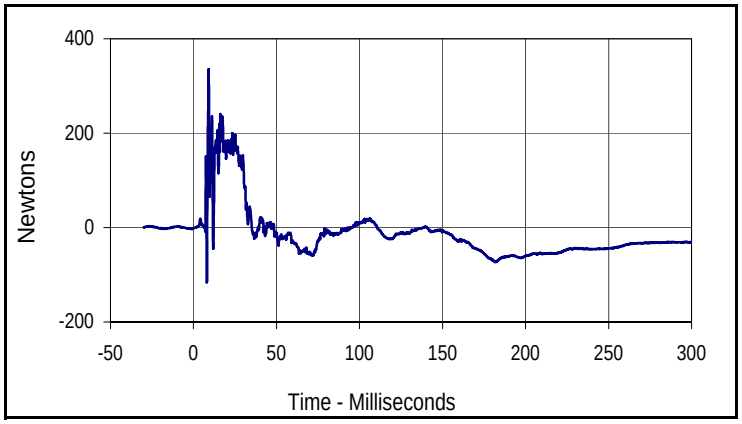
Max	Time	Min	Time
6.6	38.9	-2.1	112.8



Curve Description			
6 Yr. Old Upper Neck Moment Resultant			
CURNO	Type	SAE Class	Units
007	RES	600	Nm
Max	Time	Min	Time
25.9	19.2	0.0	1.2

Test Vehicle:	2011 Nissan Sentra 2.0 4-Door Sedan	Test Date:	4/27/11
Test Program:	TWG 3.3.5.1	NHTSA No.:	MB5214TWG2



Curve Description			
6 Yr. Old Lower Neck Force X			
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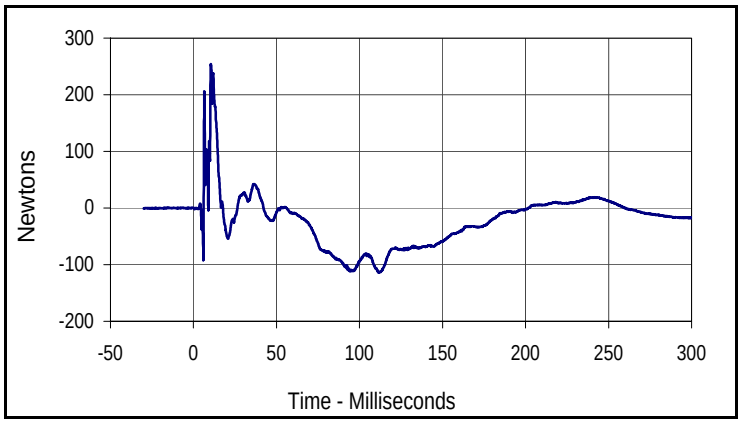
010	FIL	1000	Newtons
Max	Time	Min	Time
335.8	9.1	-115.6	8.1



Curve Description			
6 Yr. Old Lower Neck Force Y			
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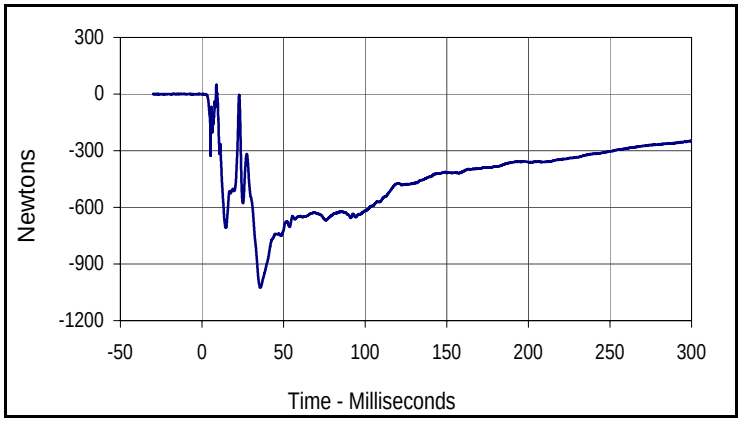
011	FIL	1000	Newtons
Max	Time	Min	Time
254.2	10.5	-113.5	111.8



Curve Description			
6 Yr. Old Lower Neck Force Z			
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012	FIL	1000	Newtons
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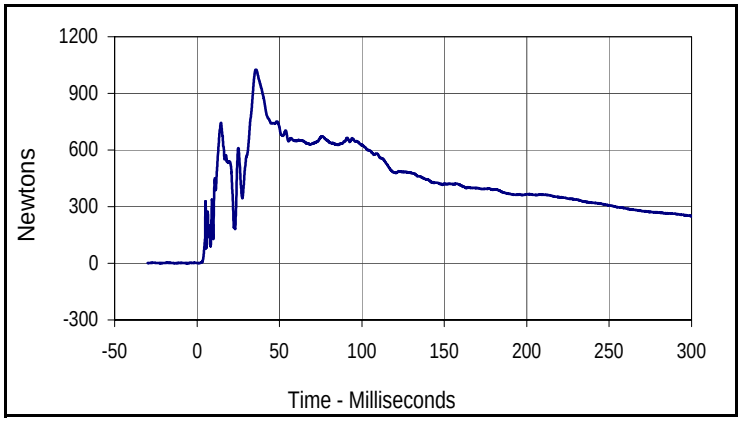

Curve Description			
6 Yr. Old Lower Neck Force Resultant			
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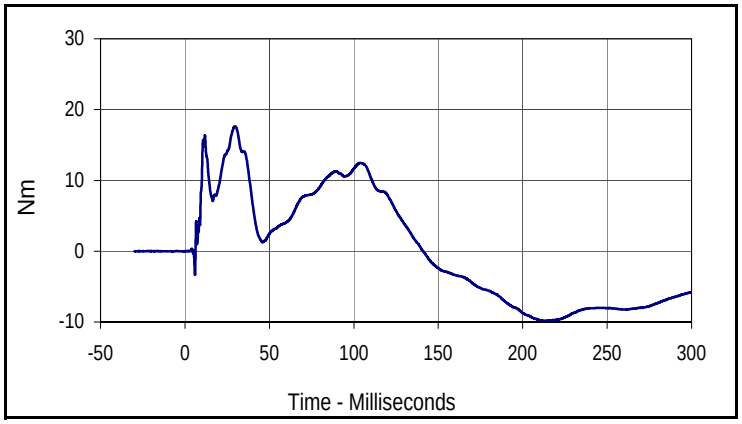
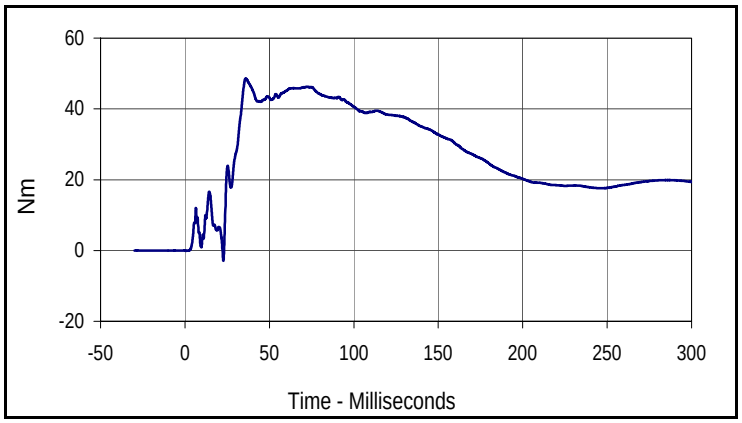
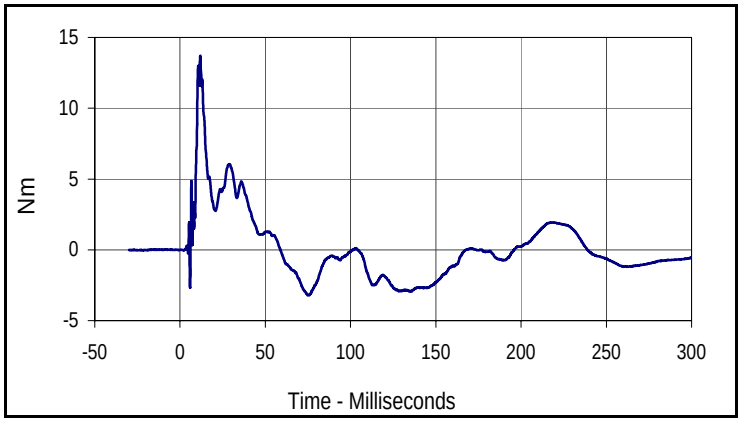


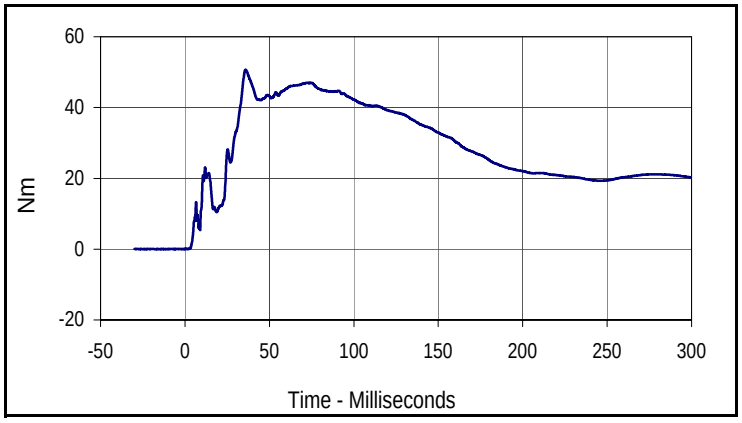
Curve Description			
6 Yr. Old Lower Neck Moment X			
CURNO	Type	SAE Class	Units
013	FIL	600	Nm
Max	Time	Min	Time
17.6	29.4	-9.9	212.9



Curve Description			
6 Yr. Old Lower Neck Moment Y			
CURNO	Type	SAE Class	Units
014	FIL	600	Nm
Max	Time	Min	Time
48.6	36.1	-3.0	22.7



Curve Description			
6 Yr. Old Lower Neck Moment Z			
CURNO	Type	SAE Class	Units
015	FIL	600	Nm
Max	Time	Min	Time
13.7	11.9	-3.2	75.3



Curve Description			
6 Yr. Old Lower Neck Moment Resultant			
CURNO	Type	SAE Class	Units
013	RES	600	Nm
Max	Time	Min	Time
50.7	36.0	0.0	1.5

APPENDIX C

INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

TWG 3.3.5.1
Instrumentation Data Channel Assignments
A.T.D. Serial Number 186
4/27/11
2011 Nissan Sentra 2.0 4-Door Sedan

CH.	LOCATION	AXIS	IDENT. NO.	DESCRIPTION	MFR	MODEL	UNITS
1	HEAD	X	J34330	Accel.,full bridge	ENDEVCO	7264-2000	G
2	HEAD	Y	P15334	Accel.,full bridge	ENDEVCO	7264C-2000	G
3	HEAD	Z	ACCW9	Accel.,full bridge	ENDEVCO	7264-2000	G
4	UPPER NECK FORCE	X	260	Load cell, six axis neck	R. A. Denton	IF-205	N
5	UPPER NECK FORCE	Y	260	Load cell, six axis neck	R. A. Denton	IF-205	N
6	UPPER NECK FORCE	Z	260	Load cell, six axis neck	R. A. Denton	IF-205	N
7	UPPER NECK MOMENT	X	260	Load cell, six axis neck	R. A. Denton	IF-205	Nm
8	UPPER NECK MOMENT	Y	260	Load cell, six axis neck	R. A. Denton	IF-205	Nm
9	UPPER NECK MOMENT	Z	260	Load cell, six axis neck	R. A. Denton	IF-205	Nm
10	LOWER NECK FORCE	X	93	Load cell, six axis neck	R. A. Denton	2430	N
11	LOWER NECK FORCE	Y	93	Load cell, six axis neck	R. A. Denton	2430	N
12	LOWER NECK FORCE	Z	93	Load cell, six axis neck	R. A. Denton	2430	N
13	LOWER NECK MOMENT	X	93	Load cell, six axis neck	R. A. Denton	2430	Nm
14	LOWER NECK MOMENT	Y	93	Load cell, six axis neck	R. A. Denton	2430	Nm
15	LOWER NECK MOMENT	Z	93	Load cell, six axis neck	R. A. Denton	2430	Nm