

REPORT NUMBER TR-P31043-08-NC

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

**TOYOTA MOTOR CORPORATION
2011 LEXUS RX350
5-DOOR MPV**

NHTSA NUMBER: MB5120TWG2

**PREPARED BY:
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JULY 18, 2011

FINAL REPORT

PREPARED FOR:

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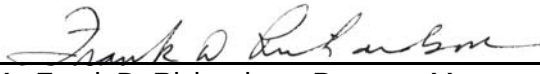
This final test report was prepared for the U.S. Department of Transportation, Alpha Technology Associate, Inc., in response to Contract Number DTNH22-06-D-00027.

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SECTION 1

PURPOSE AND SUMMARY OF TEST MB5120TWG2

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 Lexus RX350 5-Door MPV with an out-of-position SID IIs 5th percentile adult female dummy were evaluated. The test was performed at Karco Engineering, LLC on July 18, 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 SID IIs 5th percentile adult female anthropomorphic test device (ATD) was placed in the right front passenger seating position facing inboard according to the dummy placement instructions (3.3.5.3) in the July 2003 Revision of the Technical Working Group's 'Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags'.

The SID IIs 5th percentile adult female 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 SID IIs 5th percentile adult female 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	50.1

Orientation of the SID IIs 5th percentile adult female 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 3.3.5.3 of the Technical Working Group (TWG) recommendation in the Recommended Procedures for Evaluating Occupant Injury Risk from Deploying Side Airbags.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION/DATA SHEETS

Test Vehicle: 2011 Lexus RX350 5-Door MPV NHTSA No.: MB5120TWG2
Test Program: TWG 3.3.5.3 Test Date: 07/18/11

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	°F	°C	$=(tf - 32)/1.8$
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 Lexus RX350 5-Door MPV NHTSA No.: MB5120TWG2

Test Program: TWG 3.3.5.3 Test Date: 07/18/11

TEST DUMMY INFORMATION

Description	Passenger Seat Inboard Facing
Dummy Type / Serial No.	SID IIs / 307
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 Lexus RX350 5-Door MPV NHTSA No.: MB5120TWG2
 Test Program: TWG 3.3.5.3 Test Date: 07/18/11

TEST VEHICLE INFORMATION

Make	Lexus
Model	RX350
Body Style	5-Door MPV
NHTSA No.	MB5120TWG2
VIN	JTJBK1BA6B2433275
Color	Smokey Granite Mica
Delivery Date	October 28, 2010
Odometer Reading (mile)	143
Dealer	South Bay Lexus
Transmission	Automatic
Final Drive	4WD
Type/Number Cylinders	V6
Engine Displacement (L)	3.5
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	Yes

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Corporation	GVWR (kg)	2560
Date of Manufacture	September-11	GAWR Front (kg)	1360
		GAWR Rear (kg)	1385

DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	275	275
Cold Pressure (kPa)	220	220
Recommend Tire Size	P235/60R18	P235/60R18
Tire Size on Vehicle	P235/60R18	P235/60R18
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)				395

* Vehicle had undergone New Car Assessment Program Frontal Impact Testing on November 10, 2010

DATA SHEET NO. 3

TEST VEHICLE INFORMATION

Test Vehicle: 2011 Lexus RX350 5-Door MPV NHTSA No.: MB5120TWG2
Test Program: TWG 3.3.5.3 Test Date: 07/18/11

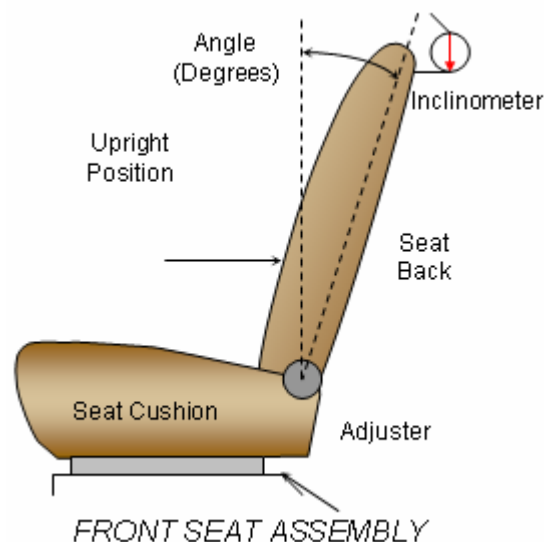
NOMINAL DESIGN RIDING POSITION

The passenger seat back is positioned to section 3.3.5.3 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	3

Seat upright is 0 degrees.
Taken at head rest 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	260	0

DATA SHEET NO. 4

DUMMY POSITIONING INFORMATION

Test Vehicle: 2011 Lexus RX350 5-Door MPV NHTSA No. MB5120TWG2
 Test Program: TWG 3.3.5.3 Test Date: 07/18/11

TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	SID IIs 5th percentile female	
		Length (mm)	Angle (°)
SA	Seat Back Angle		3
AMW	Side Airbag Module Width (Torso / Curtain)	40 / 35	
ABW	Side Airbag Width (Torso / Curtain)	350 / 560	
AML	Side Airbag Module Length (Torso / Curtain)	130 / 425	
ABL	Side Airbag Length (Torso / Curtain)	595 / 1680	
AN	Top of Airbag Module to Head/Neck Junction	384	
HD	Head CG to Door Panel/ Window	159	
HSC	Head to Seat Back Centerline	260	
HB	Head to B-Pillar (first contact)	254	
HZ	Head to Roof (Z)	27	
HHD	Head to Header	235	
ND	Nose to Dash	577	
NS	Nose to Seat Back	254	
NR	Nose to Header	321	
CD	Chest to Dash	497	
CS	Chest to Seat Back	312	
RACL	Right Arm to Seat Back Centerline	N/A	
LACL	Left Arm to Seat Back Centerline	225	
RA	Right Arm to Door Panel	N/A	
LA	Left Arm to Door Panel	153	
KK	Knee to Knee	95	
TT	Toe to Toe	90	
KSCR	Right Knee to Seat Cushion Centerline	210	
KSCL	Left Knee to Seat Cushion Centerline	215	
	Head Level (X Direction)		3.2
	Head Level (Y Direction)		10.5

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

Test Vehicle: 2011 Lexus RX350 5-Door MPV

NHTSA No.: MB5120TWG2

Test Program: TWG 3.3.5.3

Test Date: 7/18/11

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Pass. SID-IIs			
			Max	Time	Min	Time
Head CG	X	G's	36.1	7.8	-9.5	17.7
Head CG	Y	G's	12.1	14.8	-32.8	8.5
Head CG	Z	G's	44.1	6.5	-11.0	12.6
Head CG Resultant	N/A	G's	62.5	8.5		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Pass. SID-IIs			
			Max	Time	Min	Time
Neck Force	X	Newtons	132.2	7.9	-310.5	16.8
Neck Force	Y	Newtons	218.0	23.0	-192.7	2.5
Neck Force	Z	Newtons	71.4	117.4	-1847.2	2.6
Neck Force Resultant	N/A	Newtons	1859.7	2.6		
Neck Moment	X	Nm	16.0	10.2	-12.3	20.5
Neck Moment	Y	Nm	12.2	10.6	-15.7	17.3
Neck Moment	Z	Nm	5.2	35.7	-5.8	82.1
Neck Moment Resultant	N/A	Nm	20.0	10.2		

HEAD INJURY CRITERIA (HIC 15)

Location	Pass. SID-IIs			
	HIC15	T ¹	T ²	Avg G
Head CG	50.1	6.0	12.3	36.1

UPPER NECK NIJ VALUES

Location	Pass. SID-IIs			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.05	0.09	0.51	0.63

CAMERA LOCATIONS

Test Vehicle: 2011 Lexus RX350 5-Door MPV NHTSA No.: MB5120TWG2

Test Program: TWG 3.3.5.3 Test Date: 07/18/11

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	Real Time	0	3250	1300	0.0	N/A	30
2	High Speed Side View	0	3120	1140	0.4	35	1000
3	High Speed 3/4 View	1595	1475	1435	2.2	50	1000
4	High Speed Front View	1725	360	1435	3.5	35	1000

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

APPENDIX A

PHOTOGRAPHS



Figure A-1: Right Front $\frac{3}{4}$ View, As Received



Figure A-2: Vehicle Certification Label

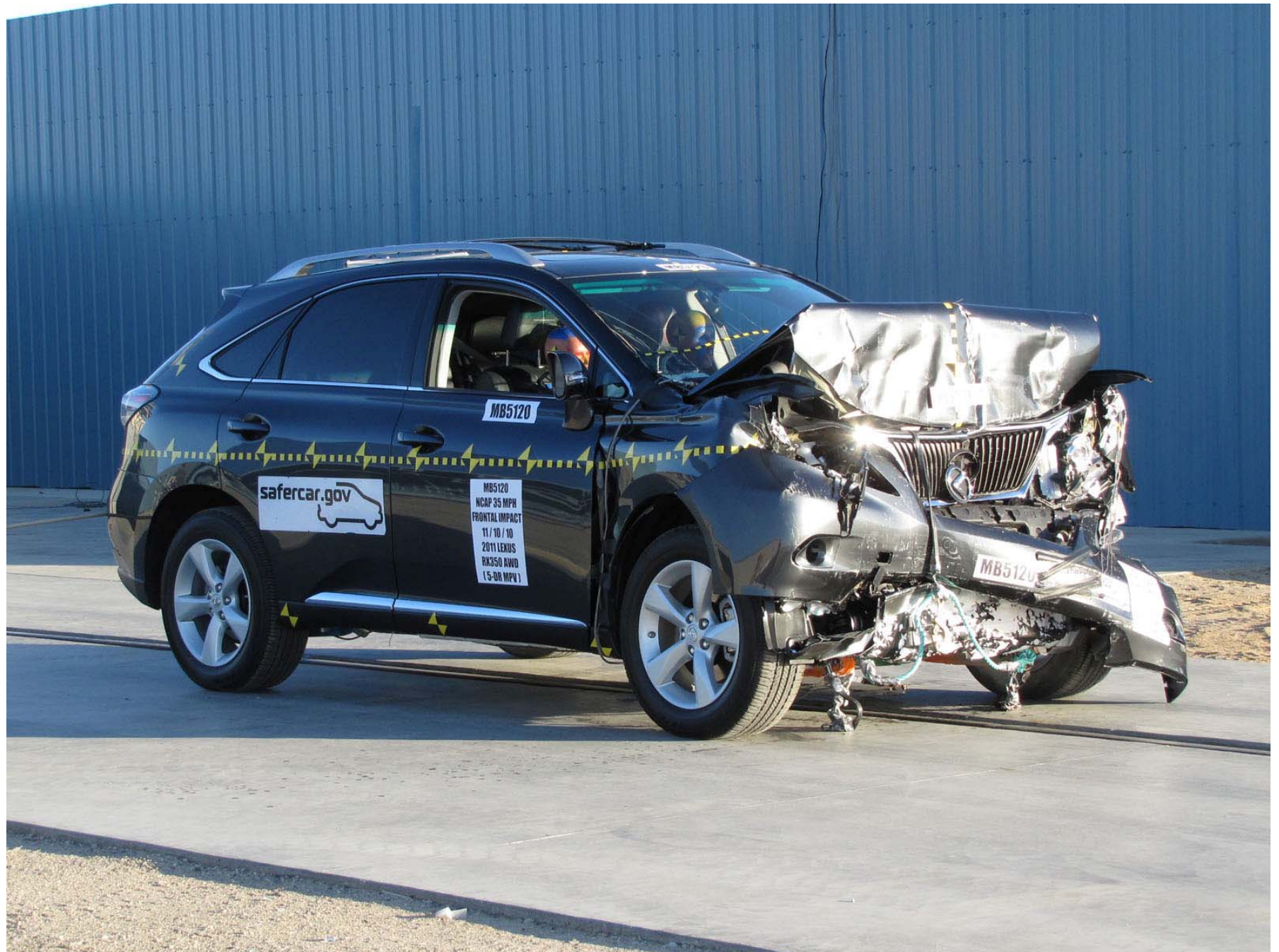


Figure A-3: Post-Test Right Front $\frac{3}{4}$ View of Frontal NCAP Test



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



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

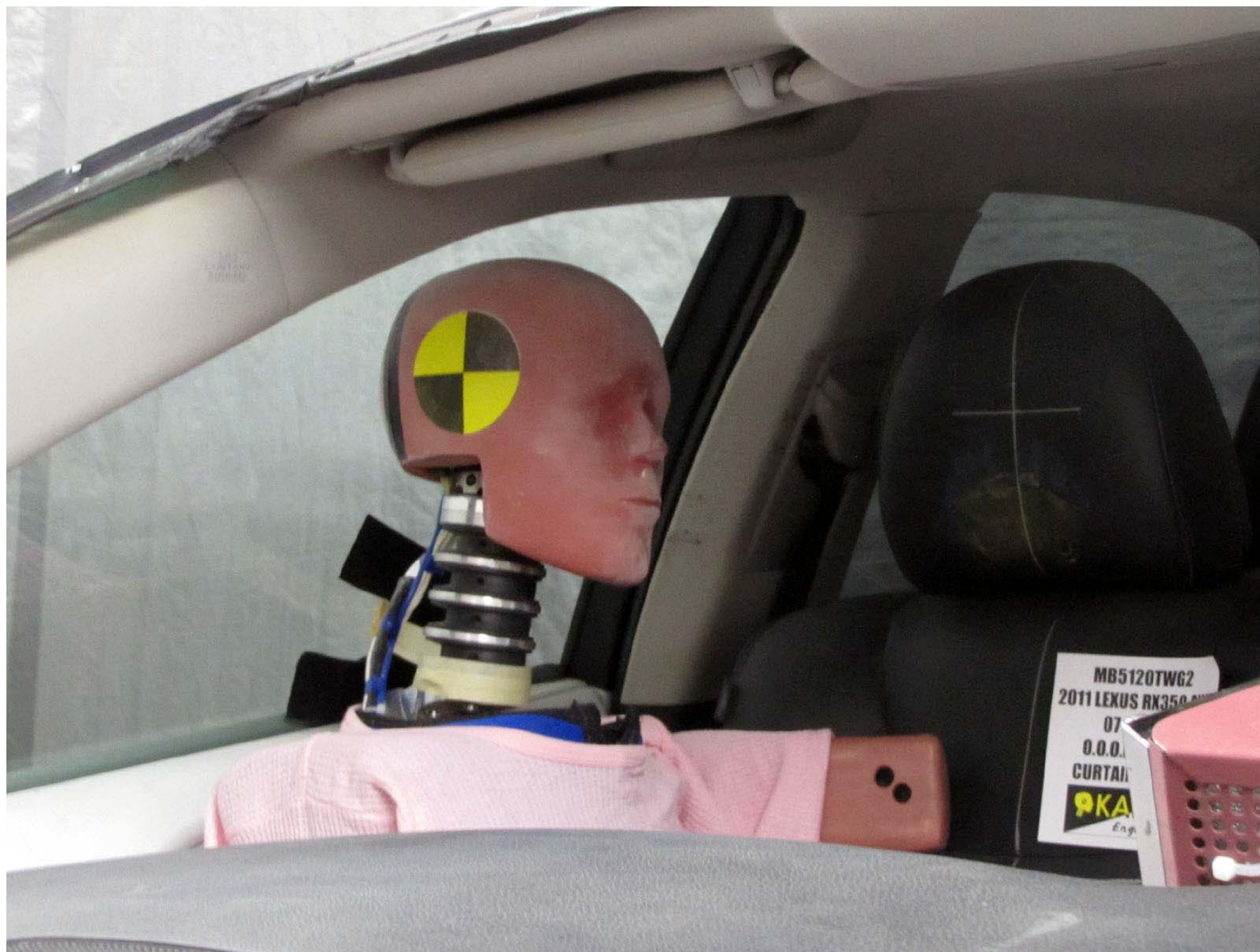


Figure A-6: Pre-Test Dummy Position, $\frac{3}{4}$ View



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



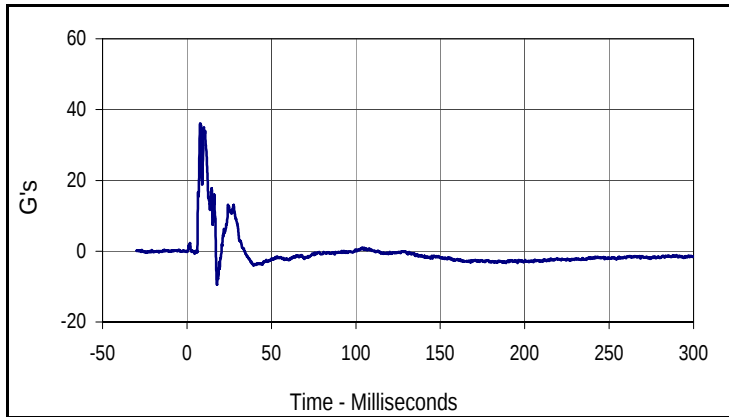
Figure A-10: Post-Test Airbags, Left Front ¾ View

APPENDIX B

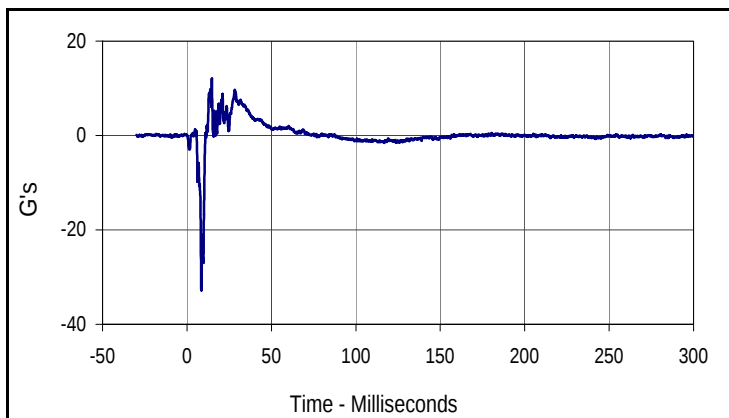
DATA PLOTS

Test Vehicle: 2011 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.3

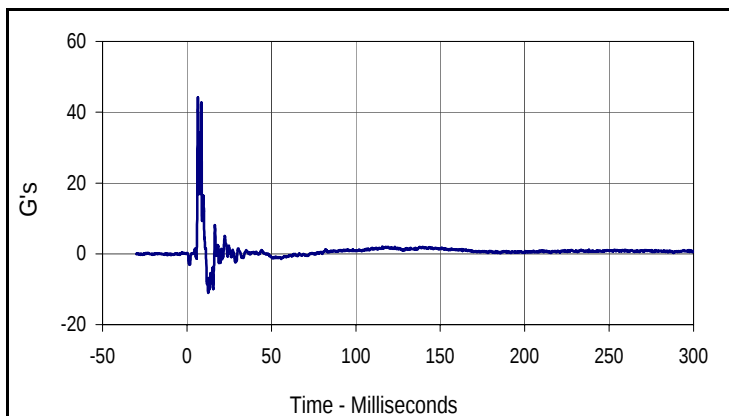
Test Date: 7/18/11
 NHTSA No.: MB5120TWG2



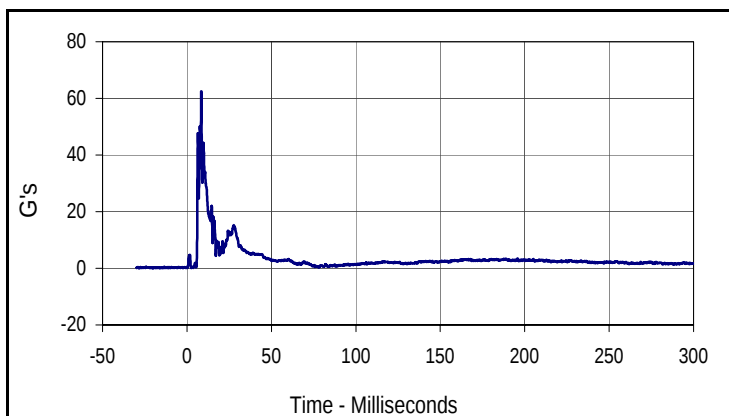
Curve Description			
Pass. SID-IIs Head X			
CURNO	Type	SAE Class	Units
001	FIL	1000	G's
Max	Time	Min	Time
36.1	7.8	-9.5	17.7



Curve Description			
Pass. SID-IIs Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	G's
Max	Time	Min	Time
12.1	14.8	-32.8	8.5



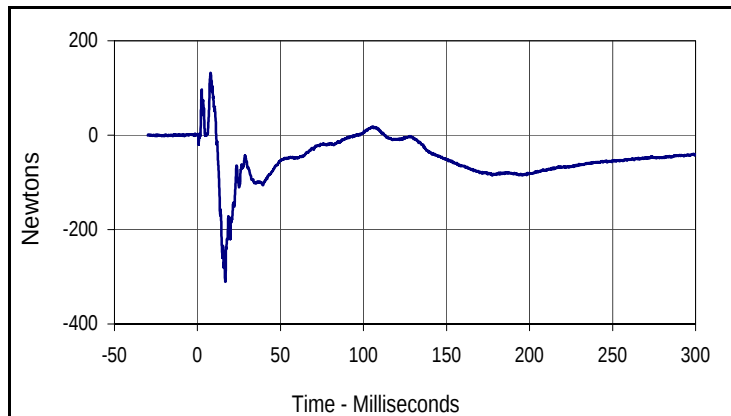
Curve Description			
Pass. SID-IIs Head Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	G's
Max	Time	Min	Time
44.1	6.5	-11.0	12.6



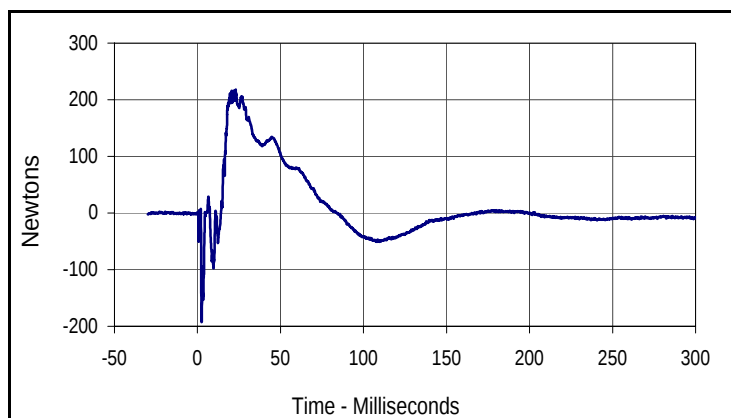
Curve Description			
Pass. SID-IIs Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	G's
Max	Time	Min	Time
62.5	8.5	0.1	3.7

Test Vehicle: 2011 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.3

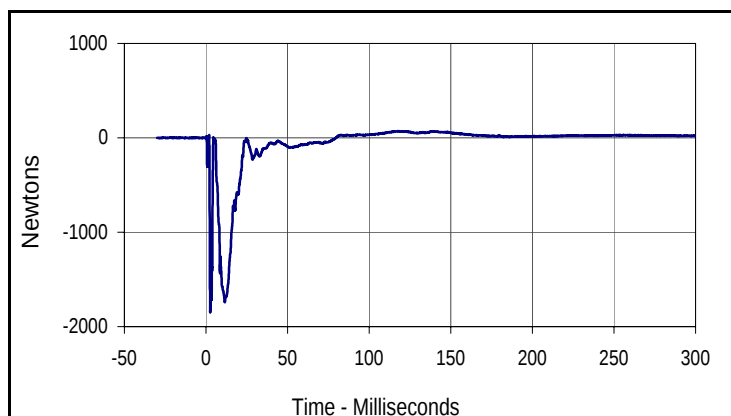
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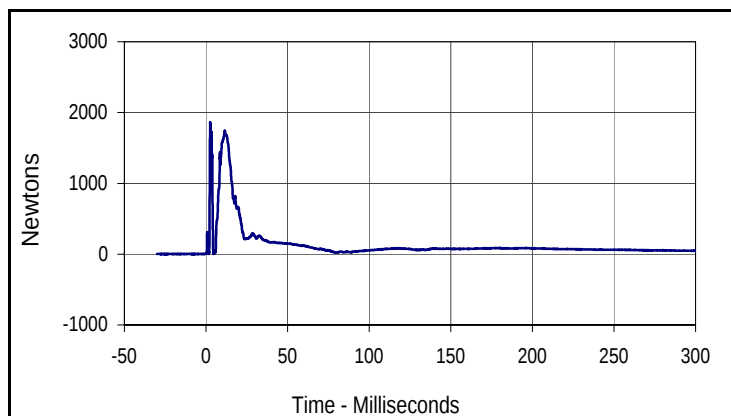
Curve Description			
Pass. SID-IIs Upper Neck Force X			
CURNO	Type	SAE Class	Units
004	FIL	1000	Newtons
Max	Time	Min	Time
132.2	7.9	-310.5	16.8



Curve Description			
Pass. SID-IIs Upper Neck Force Y			
CURNO	Type	SAE Class	Units
005	FIL	1000	Newtons
Max	Time	Min	Time
218.0	23.0	-192.7	2.5



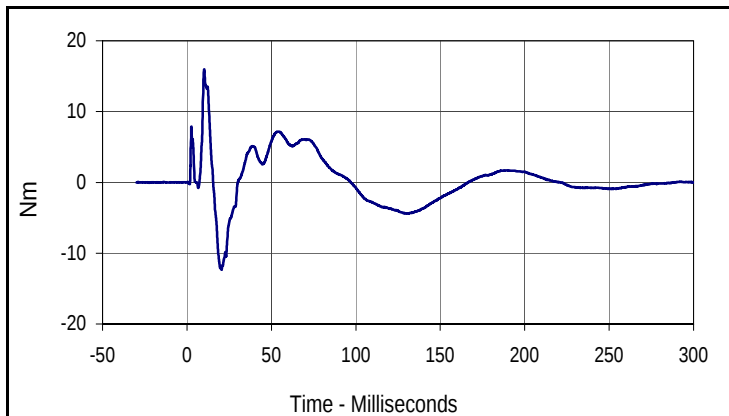
Curve Description			
Pass. SID-IIs Upper Neck Force Z			
CURNO	Type	SAE Class	Units
006	FIL	1000	Newtons
Max	Time	Min	Time
71.4	117.4	-1847.2	2.6



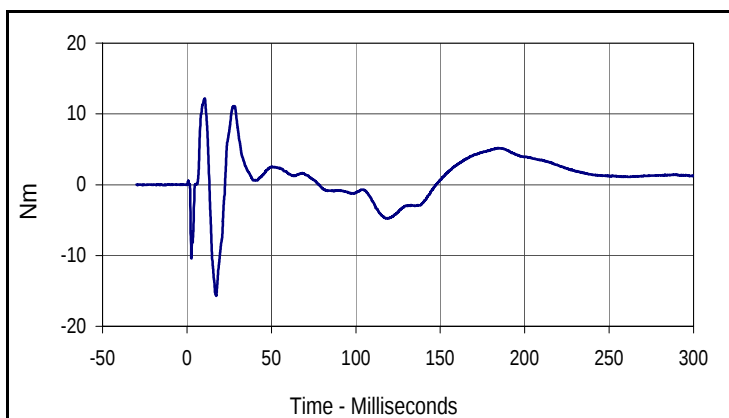
Curve Description			
Pass. SID-IIs Upper Neck Force Resultant			
CURNO	Type	SAE Class	Units
004	RES	1000	Newtons
Max	Time	Min	Time
1859.7	2.6	1.7	1.6

Test Vehicle: 2011 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.3

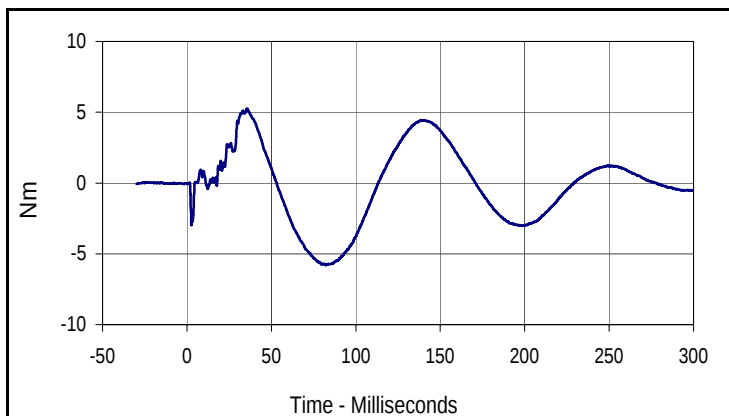
Test Date: 7/18/11
 NHTSA No.: MB5120TWG2



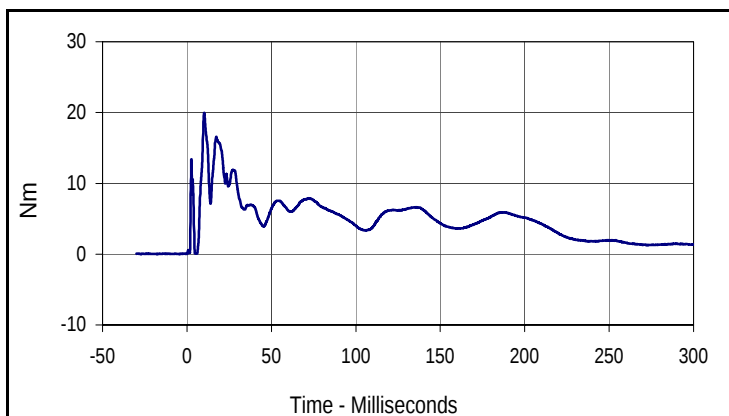
Curve Description			
Pass. SID-III Upper Neck Moment X			
CURNO	Type	SAE Class	Units
007	FIL	600	Nm
Max	Time	Min	Time
16.0	10.2	-12.3	20.5



Curve Description			
Pass. SID-III Upper Neck Moment Y			
CURNO	Type	SAE Class	Units
008	FIL	600	Nm
Max	Time	Min	Time
12.2	10.6	-15.7	17.3



Curve Description			
Pass. SID-III Upper Neck Moment Z			
CURNO	Type	SAE Class	Units
009	FIL	600	Nm
Max	Time	Min	Time
5.2	35.7	-5.8	82.1



Curve Description			
Pass. SID-III Upper Neck Moment Resultant			
CURNO	Type	SAE Class	Units
007	RES	600	Nm
Max	Time	Min	Time
20.0	10.2	0.0	0.0

APPENDIX C

INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

TWG 3.3.5.3
Instrumentation Data Channel Assignments
A.T.D. Serial Number 307
7/18/11
2011 Lexus RX350 5-Door MPV

CH.	LOCATION	AXIS	IDENT. NO.	DESCRIPTION	MFR	MODEL	UNITS
1	HEAD	X	P58900	Accel.,full bridge	Endevco	7264C-2K	G
2	HEAD	Y	P58902	Accel.,full bridge	Endevco	7264C-2K	G
3	HEAD	Z	P58983	Accel.,full bridge	Endevco	7264C-2K	G
4	UPPER NECK FORCE	X	287	Load cell, six axis neck	FTSS	IF-205	N
5	UPPER NECK FORCE	Y	287	Load cell, six axis neck	FTSS	IF-205	N
6	UPPER NECK FORCE	Z	287	Load cell, six axis neck	FTSS	IF-205	N
7	UPPER NECK MOMENT	X	287	Load cell, six axis neck	FTSS	IF-205	Nm
8	UPPER NECK MOMENT	Y	287	Load cell, six axis neck	FTSS	IF-205	Nm
9	UPPER NECK MOMENT	Z	287	Load cell, six axis neck	FTSS	IF-205	Nm

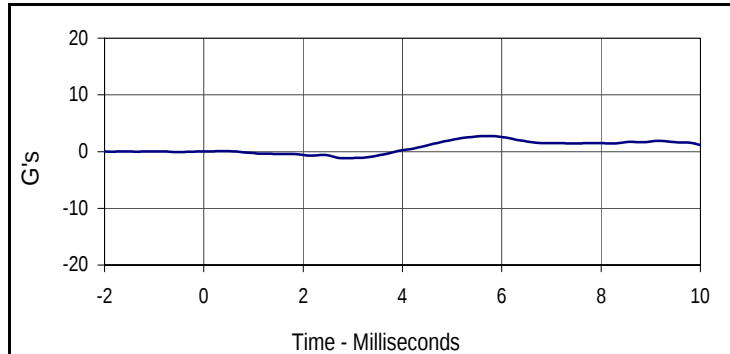
APPENDIX D
PRE-TEST / SID-IIs CONFIGURATION AND PERFORMANCE VERIFICATION DATA

Test Program: SID IIs Lateral Head Drop Calibration
 ATD Serial No.: 307

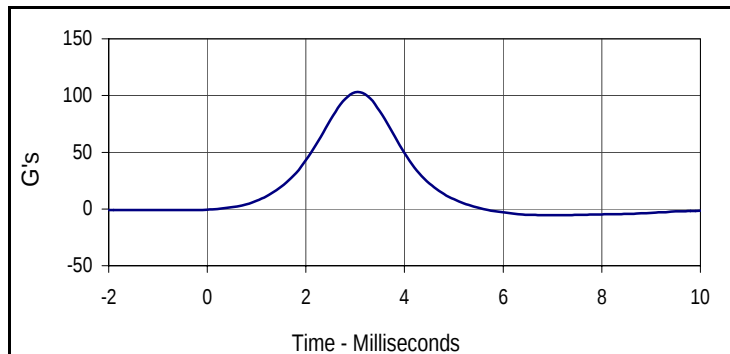
Test Date: 7/14/11
 Test I.D.: 307HD012



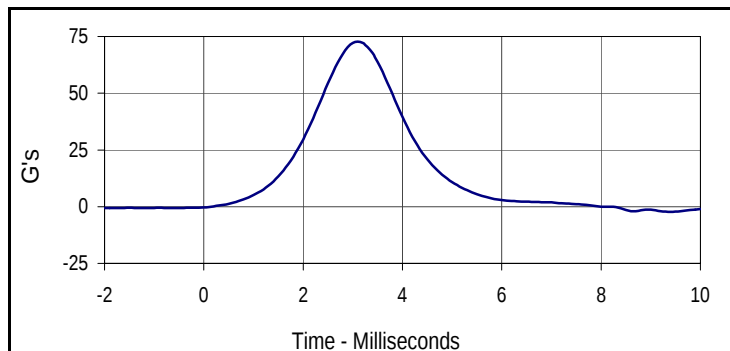
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	°C	20.6 to 22.2	21.34	Pass
Laboratory Relative Humidity	%	10 to 70	19.87	Pass
Peak Resultant Acceleration	G's	115 to 137	126.0	Pass
Peak Longitudinal Acceleration	G's	≤15	2.8	Pass
Is Acceleration Unimodal?	Yes/No	Yes	Yes	Pass
Oscillations After Main Pulse	%	<15	11.1	Pass
Overall Test Results			Pass	



Curve Description			
Head X			
CURNO	Type	SAE Class	Units
001	FIL	1000	G's
Max	Time	Min	Time
2.8	5.7	-1.2	2.9



Curve Description			
Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	G's
Max	Time	Min	Time
102.9	3.1	-5.5	6.9



Curve Description			
Head Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	G's
Max	Time	Min	Time
72.7	3.1	-2.2	9.4



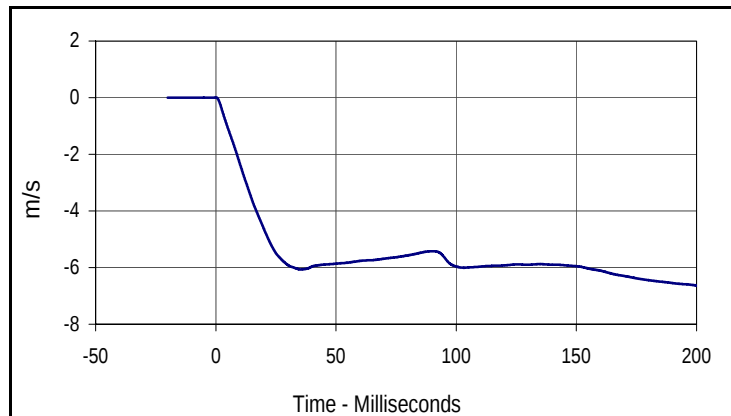
Curve Description			
Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	G's
Max	Time	Min	Time
126.0	3.1	0.1	0.2

Test Program: SID IIs Neck Calibration
 ATD Serial No.: 307

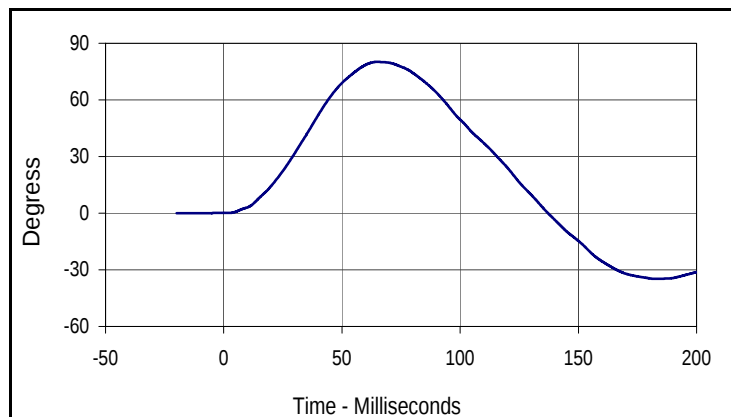
Test Date: 7/14/11
 Test I.D.: 307NB012



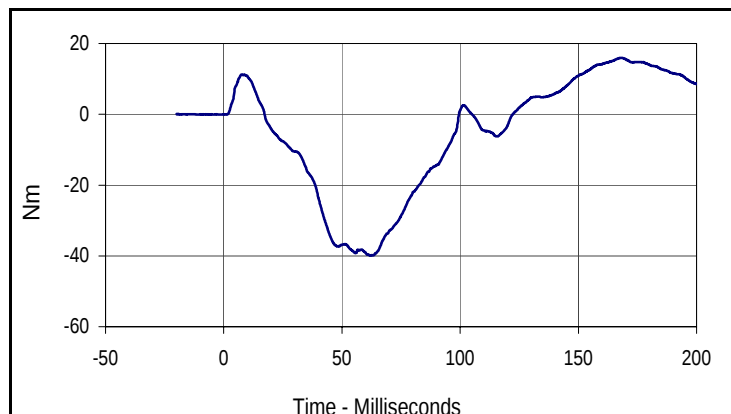
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		°C	20.6 to 22.2	21.53	Pass
Laboratory Relative Humidity		%	10 to 70	20.74	Pass
Pendulum Velocity		m/s	5.51 to 5.63	5.58	Pass
Pendulum Deceleration	10 msec	m/s	-2.20 to -2.80	-2.33	Pass
	15 msec	m/s	-3.30 to -4.10	-3.60	Pass
	20 msec	m/s	-4.40 to -5.40	-4.64	Pass
	25 msec	m/s	-5.40 to -6.10	-5.49	Pass
	25-100 msec	m/s	-5.50 to -6.20	-6.07	Pass
Translation-Rotation	Max	Degrees	71.0 to 81.0	80.2	Pass
	Time	msec	50.0 to 70.0	65.0	Pass
Peak Occipital Condyle Moment		Nm	-36.0 to -44.0	-40.0	Pass
Decaying Moment Time to Cross 0 Nm		msec	102.0 to 126.0	122.3	Pass
			Overall Test Results		Pass



Curve Description			
Pendulum Velocity			
CURNO	Type	SAE Class	Units
001	FIL	180	m/s
Max	Time	Min	Time
0.0	-0.2	-6.6	200.0



Curve Description			
Maximum Translation Rotation			
CURNO	Type	SAE Class	Units
002	FIL	60	Degress
Max	Time	Min	Time
80.2	65.0	-34.8	182.6



Curve Description			
Moment About Occipital Condyle			
CURNO	Type	SAE Class	Units
003	FIL	600	Nm
Max	Time	Min	Time
16.0	168.3	-40.0	61.9

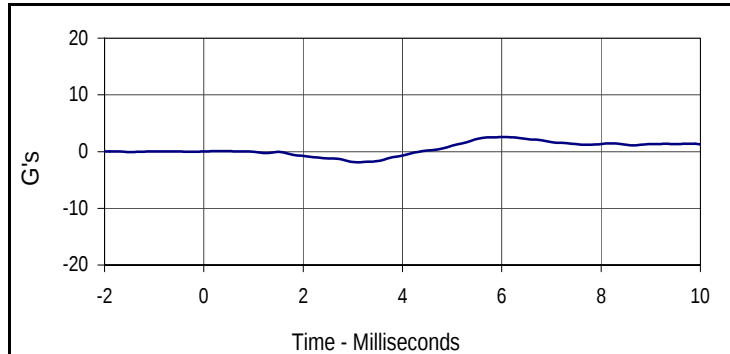
APPENDIX D
POST-TEST / SID-IIs CONFIGURATION AND PERFORMANCE VERIFICATION DATA

Test Program: SID IIs Lateral Head Drop Calibration
 ATD Serial No.: 307

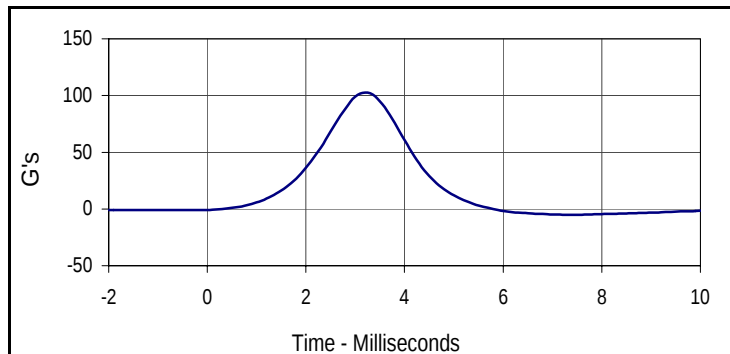
Test Date: 7/18/11
 Test I.D.: 307HD013



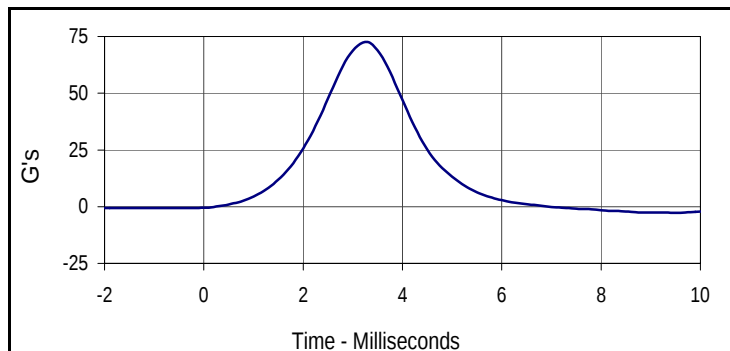
Tested Parameter	Units	Specification	Result	Pass/Fail
Laboratory Temperature	°C	20.6 to 22.2	21.42	Pass
Laboratory Relative Humidity	%	10 to 70	20.13	Pass
Peak Resultant Acceleration	G's	115 to 137	125.6	Pass
Peak Longitudinal Acceleration	G's	≤15	2.6	Pass
Is Acceleration Unimodal?	Yes/No	Yes	Yes	Pass
Oscillations After Main Pulse	%	<15	14.3	Pass
Overall Test Results			Pass	



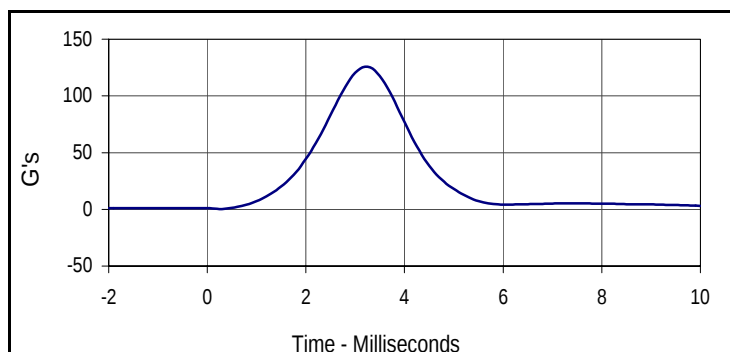
Curve Description			
Head X			
CURNO	Type	SAE Class	Units
001	FIL	1000	G's
Max	Time	Min	Time
2.6	6.1	-1.9	3.1



Curve Description			
Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	G's
Max	Time	Min	Time
102.7	3.2	-5.1	7.3



Curve Description			
Head Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	G's
Max	Time	Min	Time
72.5	3.3	-2.7	9.5



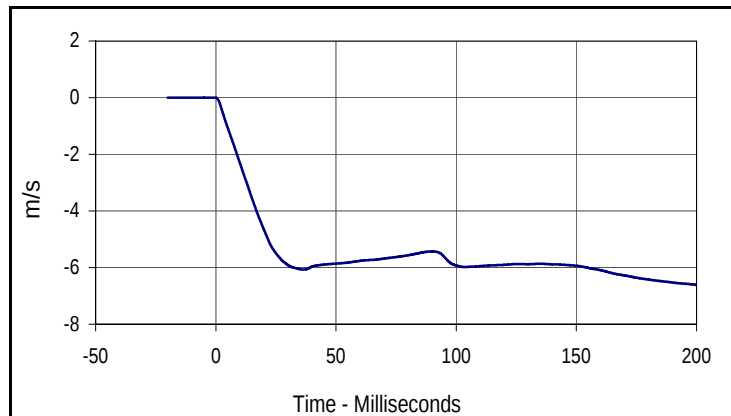
Curve Description			
Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	G's
Max	Time	Min	Time
125.6	3.2	0.2	0.3

Test Program: SID IIs Neck Calibration
 ATD Serial No.: 307

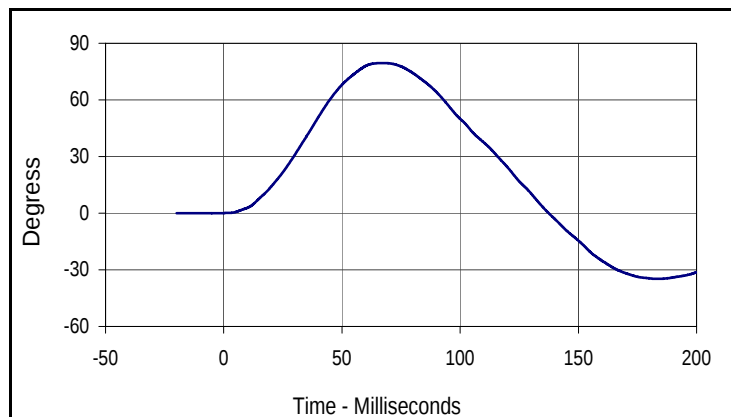
Test Date: 7/18/11
 Test I.D.: 307NB013



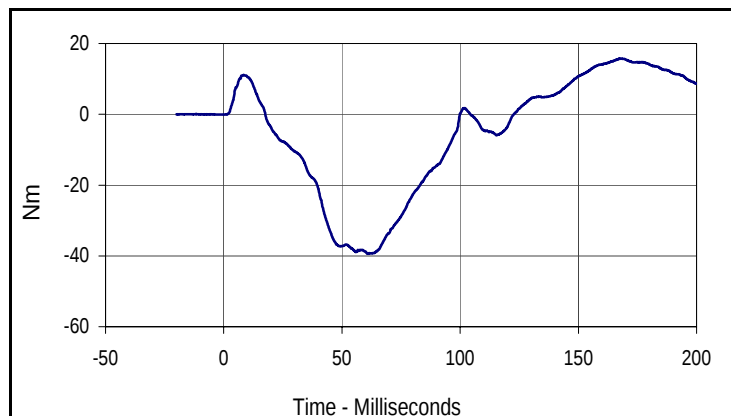
Tested Parameter		Units	Specification	Result	Pass/Fail
Laboratory Temperature		°C	20.6 to 22.2	21.34	Pass
Laboratory Relative Humidity		%	10 to 70	20.54	Pass
Pendulum Velocity		m/s	5.51 to 5.63	5.56	Pass
Pendulum Deceleration	10 msec	m/s	-2.20 to -2.80	-2.30	Pass
	15 msec	m/s	-3.30 to -4.10	-3.55	Pass
	20 msec	m/s	-4.40 to -5.40	-4.66	Pass
	25 msec	m/s	-5.40 to -6.10	-5.50	Pass
	25-100 msec	m/s	-5.50 to -6.20	-6.07	Pass
Translation-Rotation	Max	Degrees	71.0 to 81.0	79.5	Pass
	Time	msec	50.0 to 70.0	66.7	Pass
Peak Occipital Condyle Moment		Nm	-36.0 to -44.0	-39.4	Pass
Decaying Moment Time to Cross 0 Nm		msec	102.0 to 126.0	122.7	Pass
			Overall Test Results		Pass



Curve Description			
Pendulum Velocity			
CURNO	Type	SAE Class	Units
001	FIL	180	m/s
Max	Time	Min	Time
0.0	-0.5	-6.6	200.0



Curve Description			
Maximum Translation Rotation			
CURNO	Type	SAE Class	Units
002	FIL	60	Degress
Max	Time	Min	Time
79.5	66.7	-34.8	183.4



Curve Description			
Moment About Occipital Condyle			
CURNO	Type	SAE Class	Units
003	FIL	600	Nm
Max	Time	Min	Time
15.8	168.0	-39.4	61.1