

REPORT NUMBER TR-P28059-01-NC

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

**TOYOTA MOTOR MANUFACTURING, CANADA, INC.
2008 LEXUS RX350
5-DOOR MPV**

NHTSA NUMBER: M85102TWG2

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



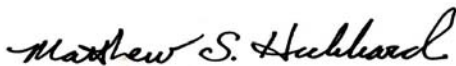
JUNE 18, 2008

FINAL REPORT

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Date: 06/18/08



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Date: 06/18/08

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Manager, New Car Assessment Program

Date of Acceptance

COTR, NCAP Frontal Impact Program

Date of Acceptance

Technical Report Documentation Page

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16. Abstract A static side airbag deployment was conducted on a 2008 Lexus RX350 5-Door MPV at KARCO Engineering, LLC on 6/18/2008. This test was conducted to obtain data indicant of TWG Side Airbag Out-of-Position Injury criteria.			
Measurement Description	Units	Threshold	Hybrid III 6 Year Old ATD
Head Injury Criteria (HIC ₁₅)		700	1.8
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SECTION 1

PURPOSE AND SUMMARY OF TEST M85102TWG2

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 the National Highway Traffic Safety Administration (NHTSA) under Contract No. DTNH22-03-D-32005. 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 deployment in a 2008 Lexus RX350 5-Door MPV with an out-of-position Hybrid III 6 Year-Old Child dummy were evaluated. The test was performed at Karco Engineering, LLC on June 18, 2008. Pre- and post-test photographs of the vehicle and dummy can be found in Appendix A.

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

One Part 572N, Hybrid III 6-Year old child anthropomorphic test device (ATD) was placed in the right front passenger seating position facing forward 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 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.

OUT OF POSITION OCCUPANT DATA SUMMARY

ATD Position	HIC ₁₅
Passenger	1.4

Orientation of the Hybrid III 6 Year-old Child Dummy was in the inboard facing position leaning against the front passenger door. The dummy's spine was aligned with the deploying trajectory of the curtain airbag. The lower legs were extended. Synthetic foam was used to raise the dummy. 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.

SECTION 2

OCCUPANT AND VEHICLE INFORMATION/DATA SHEETS

Test Vehicle: 2008 Lexus RX350 5-Door MPV NHTSA No.: M85102TWG2
Test Program: TWG 3.3.5.1. Test Date: 06/18/08

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: 2008 Lexus RX350 5-Door MPV NHTSA No.: M85102TWG2
Test Program: TWG 3.3.5.1. Test Date: 06/18/08

TEST DUMMY INFORMATION

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

MOVIE COVERAGE

High Speed Digital	2
Total	2

DATA CHANNELS

Child 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: 2008 Lexus RX350 5-Door MPV NHTSA No.: M85102TWG2
 Test Program: TWG 3.3.5.1. Test Date: 06/18/08

TEST VEHICLE INFORMATION

Make	Lexus
Model	RX350
Body Style	5-Door MPV
NHTSA No.	M85102TWG2
VIN	2T2HK31U58C056710
Color	Green
Delivery Date	May 21, 2008
Odometer Reading (mile)	67
Dealer	Lexus of Riverside
Transmission	Automatic
Final Drive	AWD
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 Manufacturing, Indiana, Inc.	GVWR (kg)	2390
Date of Manufacture	Mar. 07	GAWR Front (kg)	1300
		GAWR Rear (kg)	1300

DATA FROM TIRE PLACARD

Measured Parameter	Front	Rear
Maximum Tire Pressure (kPa)	308	308
Cold Pressure (kPa)	210	210
Recommend Tire Size	P235/55R18	P235/55R18
Tire Size on Vehicle	P235/55R18	P235/55R18
Tire Manufacturer	Michelin	Michelin

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				420

* Vehicle had undergone New Car Assessment Program Frontal Impact Testing on September 6, 2007

DATA SHEET NO. 3

TEST VEHICLE INFORMATION

Test Vehicle: 2008 Lexus RX350 5-Door MPV NHTSA No.: M85102TWG2
Test Program: TWG 3.3.5.1. Test Date: 06/18/08

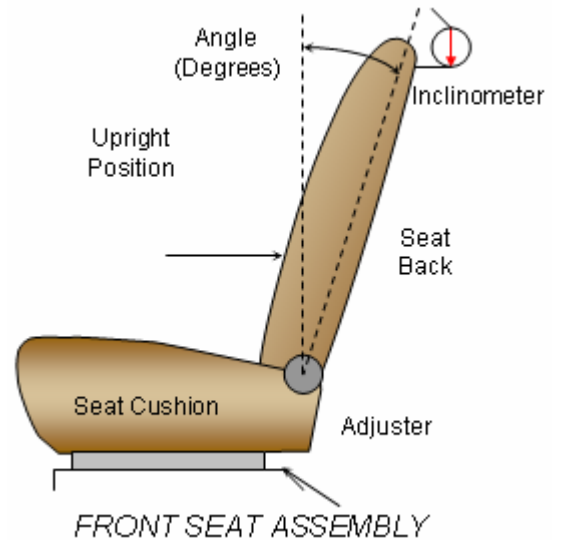
NOMINAL DESIGN RIDING POSITION

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	3

Seat upright is 0 degrees. Measurement is taken off of head rest support.



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	264mm	132mm

DATA SHEET NO. 4

DUMMY POSITIONING INFORMATION

Test Vehicle: 2008 Lexus RX350 5-Door MPV NHTSA No.: M85102TWG2
 Test Program: TWG 3.3.5.1. Test Date: 06/18/08

TEST DUMMY POSITION MEASUREMENTS

Code	Measurement Description	Hybrid III 6-Year-Old Child Dummy	
		Length (mm)	Angle (°)
SA	Seat Back Angle		3.0
AMW	Side Airbag Module Width	75	
ABW	Side Airbag Width	285	
AML	Side Airbag Module Length	300	
ABL	Side Airbag Length	1890	
AN	Top of Airbag Module to Head/Neck Junction	351	
HD	Head CG to Door Panel/ Window	183	
HSC	Head to Seat Back Centerline	315	
HB	Head to B-Pillar (first contact)	297	
HZ	Head to Roof (Z)	234	
HHD	Head to Header	385	
ND	Nose to Dash	467	
NS	Nose to Seat Back	315	
NR	Nose to Header	364	
CD	Chest to Dash	435	
CS	Chest to Seat Back	297	
RACL	Right Arm to Seat Back Centerline	420	
LACL	Left Arm to Seat Back Centerline	230	
RA	Right Arm to Door Panel	70	
LA	Left Arm to Door Panel	65	
KK	Knee to Knee	93	
TT	Toe to Toe	84	
KSCR	Right Knee to Seat Cushion Centerline	77	
KSCL	Left Knee to Seat Cushion Centerline	77	
TSCR	Right Toe to Seat Cushion Centerline	465	
TSCL	Left Toe to Seat Cushion Centerline	474	

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

Test Vehicle: 2008 Lexus RX350 5-Door MPV

NHTSA No.: M85102TWG2

Test Program: TWG 3.3.5.1

Test Date: 6/18/08

HEAD PEAK ACCELERATIONS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Head CG	X	G's	13.7	12.9	-4.5	83.6
Head CG	Y	G's	2.8	37.6	-5.1	17.8
Head CG	Z	G's	23.7	12.7	-8.6	13.8
Head CG Resultant	N/A	G's	24.5	12.7		

UPPER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Neck Force	X	Newtons	25.5	16.9	-129.6	76.8
Neck Force	Y	Newtons	134.5	37.8	-109.8	19.2
Neck Force	Z	Newtons	8.0	9.0	-527.0	29.2
Neck Force Resultant	N/A	Newtons	543.7	36.8		
Neck Moment	X	Nm	16.0	21.6	-6.1	55.0
Neck Moment	Y	Nm	14.6	56.6	-0.1	12.6
Neck Moment	Z	Nm	2.9	68.3	-1.2	19.5
Neck Moment Resultant	N/A	Nm	16.9	21.7		

LOWER NECK PEAK FORCES AND MOMENTS

Location	Axis	Units	Pass. (6 Yr.)			
			Max	Time	Min	Time
Neck Force	X	Newtons	101.9	57.8	-37.0	100.5
Neck Force	Y	Newtons	77.8	54.0	-125.7	20.5
Neck Force	Z	Newtons	3.1	9.8	-511.8	36.8
Neck Force Resultant	N/A	Newtons	515.1	36.8		
Neck Moment	X	Nm	19.6	37.3	-5.3	64.9
Neck Moment	Y	Nm	30.9	70.4	-0.4	0.6
Neck Moment	Z	Nm	3.3	54.1	-5.4	20.3
Neck Moment Resultant	N/A	Nm	31.8	38.2		

DATA SHEET NO. 5...(CONTINUED)Test Vehicle: 2008 Lexus RX350 5-Door MPVNHTSA No.: M85102TWG2Test Program: TWG 3.3.5.1Test Date: 6/18/08**HEAD INJURY CRITERIA (HIC 15)**

Location	Pass. (6 Yr.)			
	HIC15	T ¹	T ²	Avg G
Head CG	1.8	12.4	27.4	6.7

UPPER NECK NIJ VALUES

Location	Pass. (6 Yr.)			
	Ntf	Nte	Ncf	Nce
Upper Neck	0.00	0.00	0.33	0.00

DATA SHEET NO. 6**CAMERA LOCATIONS**Test Vehicle: 2008 Lexus RX350 5-Door MPV NHTSA No.: M85102TWG2Test Program: TWG 3.3.5.1. Test Date: 06/18/08

No.	Camera View	Location (mm)			Angle (Deg.)	Lens (mm)	Speed (fps)
		X	Y	Z			
1	High Speed Digital Side View	0	-3041	-1198	0.0	50	1000
2	High Speed Digital Front View	1917	0	-1625	-13.0	50	1000

* Cameras aligned to the CG of dummy's head as reference.

APPENDIX A

PHOTOGRAPHS



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

MFD. BY: TOYOTA MOTOR MANUFACTURING CANADA INC. 03
 GVWR: 2390KG (5265LB)
 GAWR: FRT. 1300KG (2865LB) WITH P235/55R18 TIRES,
 18X7JJ RIMS, AT 210KPA (30PSI) COLD
 RR. 1300KG (2865LB) WITH P235/55R18 TIRES,
 18X7JJ RIMS, AT 210KPA (30PSI) COLD
 THIS VEHICLE CONFORMS TO ALL APPLICABLE FEDERAL MOTOR
 VEHICLE SAFETY AND THEFT PREVENTION STANDARDS IN EFFECT ON
 THE DATE OF MANUFACTURE SHOWN ABOVE.
 2T2HK31U58C056710 MPV



C/IR: 6U3/LA00 GSU35L-CWAGKA
 A/TM: -02B/U151F MADE IN CANADA 341 A

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

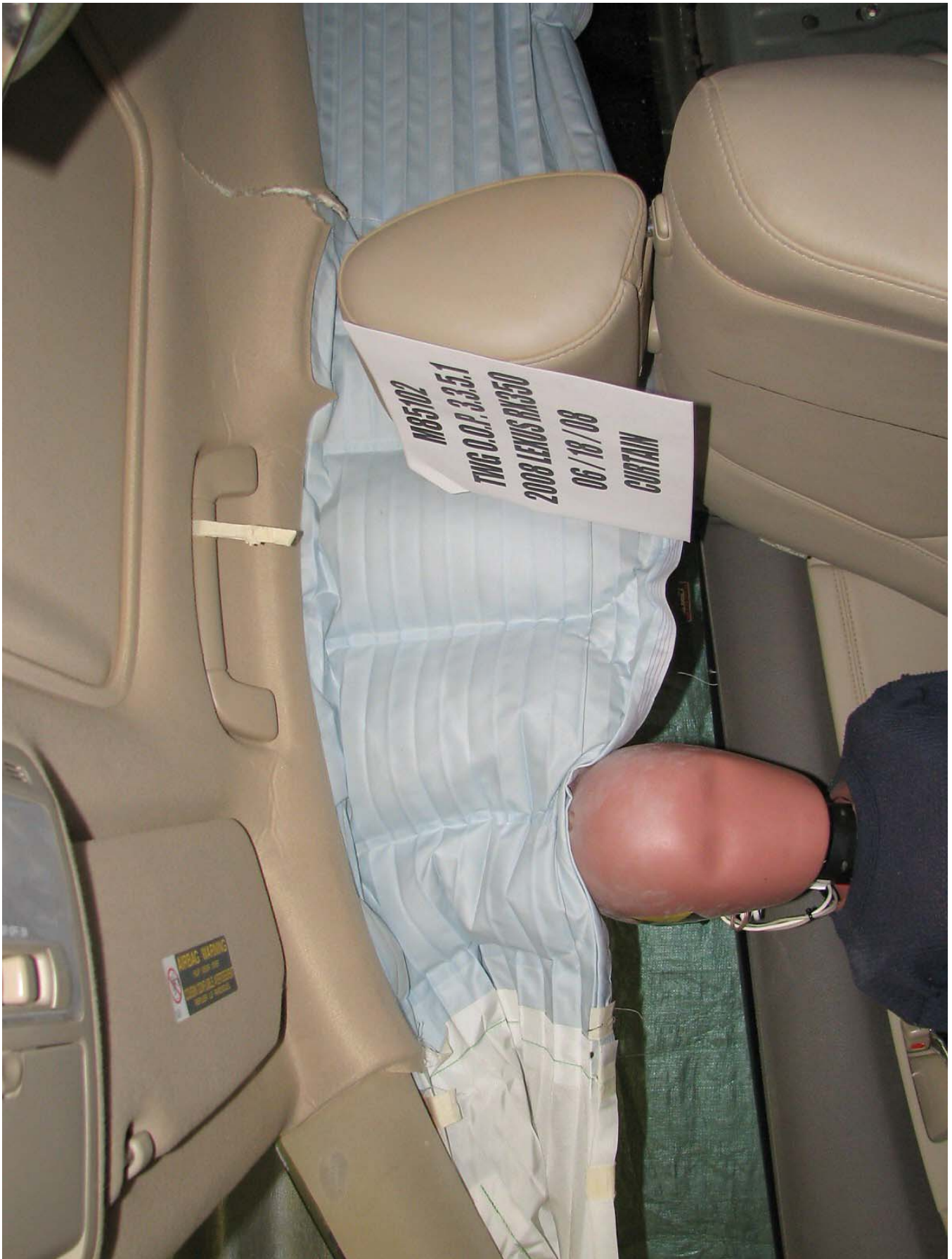


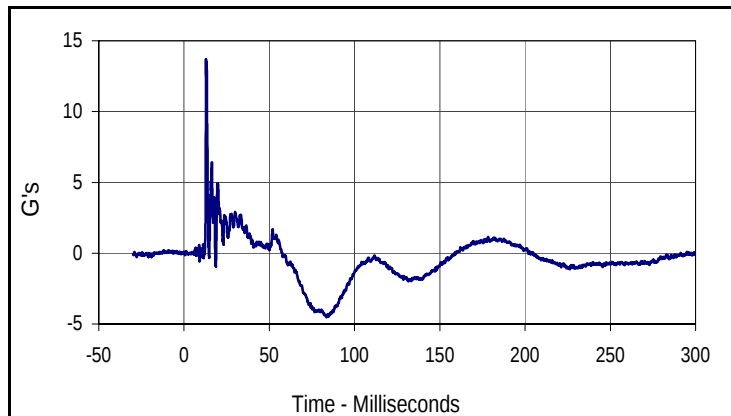
Figure A-10: Post-Test Airbags, Close-up View

APPENDIX B

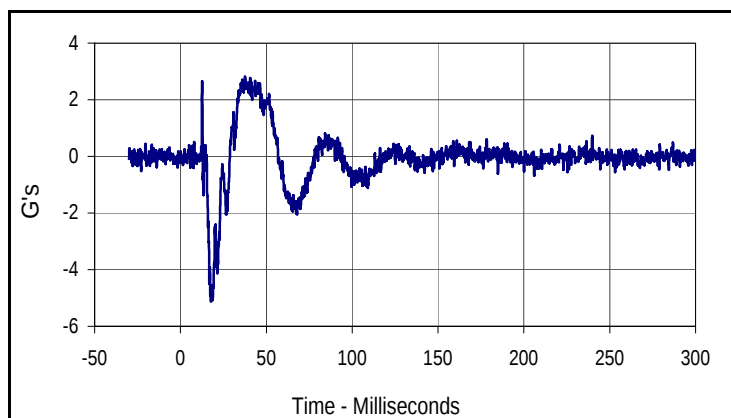
DATA PLOTS

Test Vehicle: 2008 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.1

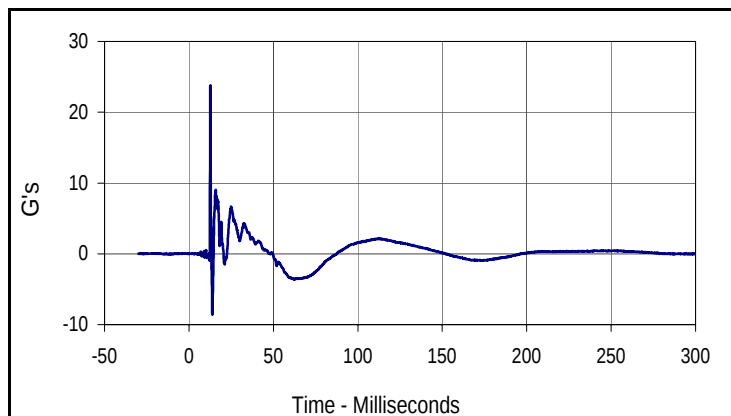
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 NHTSA No.: M85102TWG2



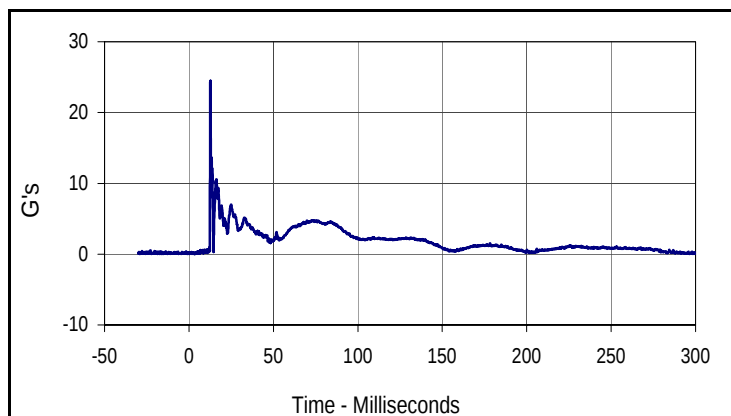
Curve Description			
Pass. (6 Yr.) Head X			
CURNO	Type	SAE Class	Units
001	FIL	1000	G's
Max	Time	Min	Time
13.7	12.9	-4.5	83.6



Curve Description			
Pass. (6 Yr.) Head Y			
CURNO	Type	SAE Class	Units
002	FIL	1000	G's
Max	Time	Min	Time
2.8	37.6	-5.1	17.8



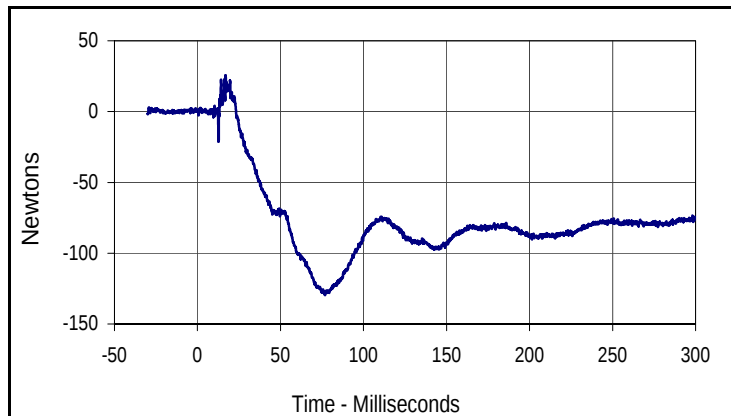
Curve Description			
Pass. (6 Yr.) Head Z			
CURNO	Type	SAE Class	Units
003	FIL	1000	G's
Max	Time	Min	Time
23.7	12.7	-8.6	13.8



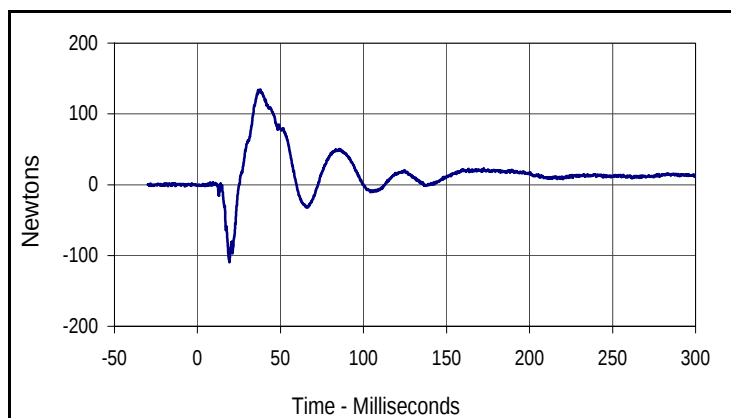
Curve Description			
Pass. (6 Yr.) Head Resultant			
CURNO	Type	SAE Class	Units
001	RES	1000	G's
Max	Time	Min	Time
24.5	12.7	0.0	3.4

Test Vehicle: 2008 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.1

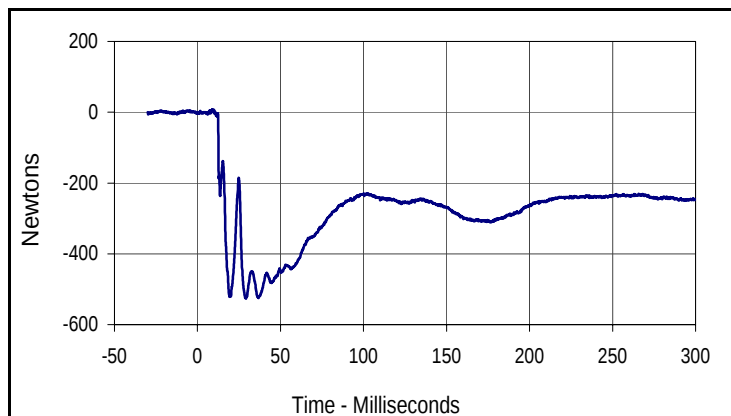
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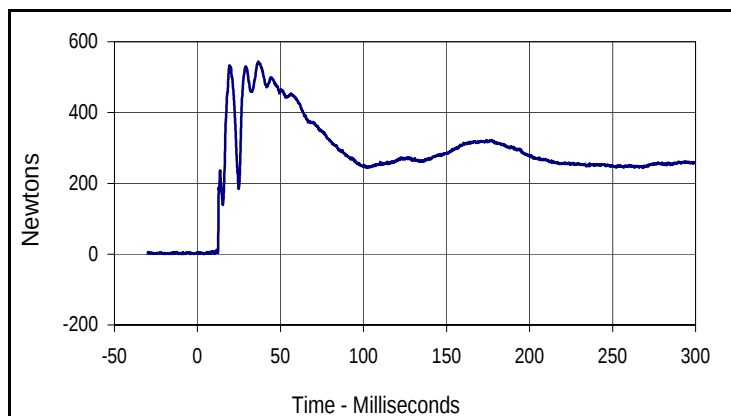
Curve Description			
Pass. (6 Yr.) Upper Neck Force X			
CURNO	Type	SAE Class	Units
004	FIL	1000	Newtons
Max	Time	Min	Time
25.5	16.9	-129.6	76.8



Curve Description			
Pass. (6 Yr.) Upper Neck Force Y			
CURNO	Type	SAE Class	Units
005	FIL	1000	Newtons
Max	Time	Min	Time
134.5	37.8	-109.8	19.2



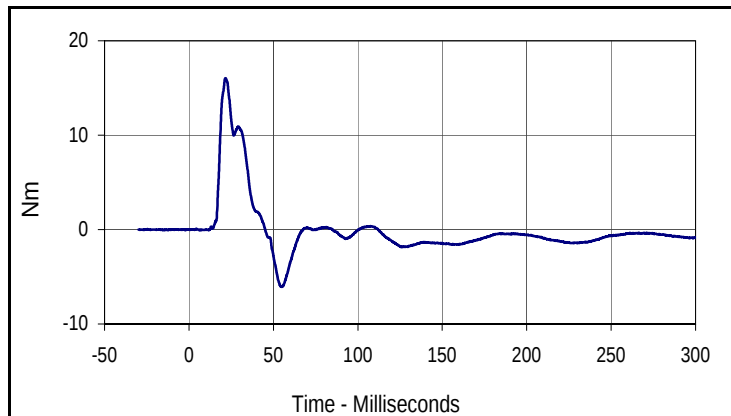
Curve Description			
Pass. (6 Yr.) Upper Neck Force Z			
CURNO	Type	SAE Class	Units
006	FIL	1000	Newtons
Max	Time	Min	Time
8.0	9.0	-527.0	29.2



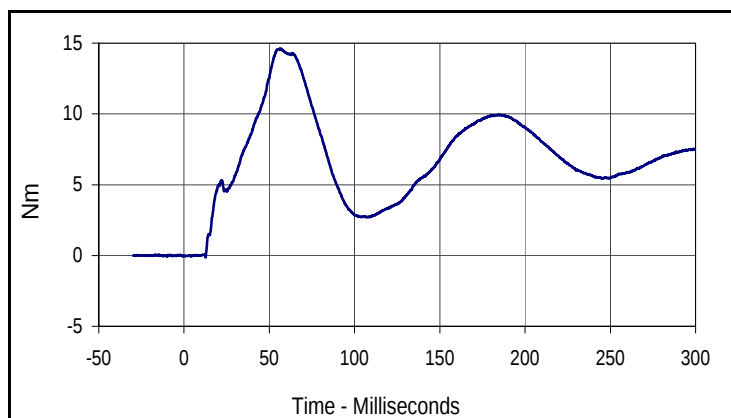
Curve Description			
Pass. (6 Yr.) Upper Neck Force Resultant			
CURNO	Type	SAE Class	Units
004	RES	1000	Newtons
Max	Time	Min	Time
543.7	36.8	0.6	3.6

Test Vehicle: 2008 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.1

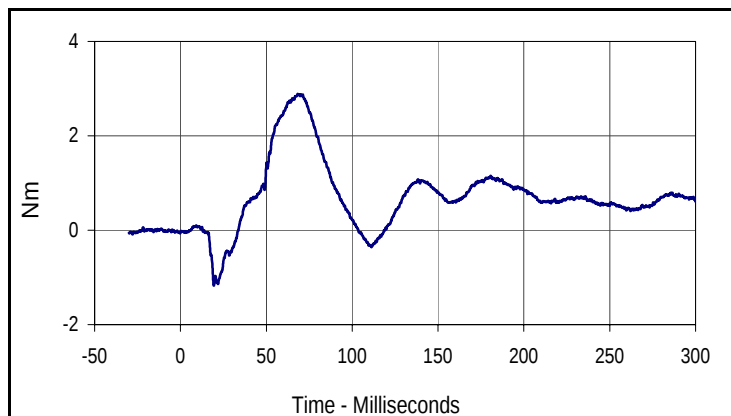
Test Date: 6/18/08
 NHTSA No.: M85102TWG2



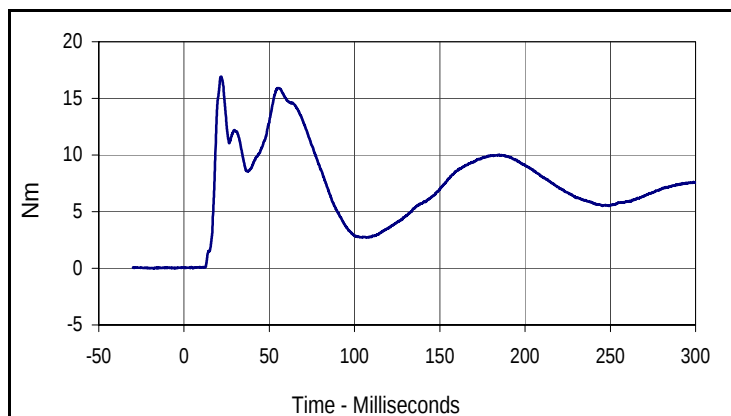
Curve Description			
Pass. (6 Yr.) Upper Neck Moment X			
CURNO	Type	SAE Class	Units
007	FIL	600	Nm
Max	Time	Min	Time
16.0	21.6	-6.1	55.0



Curve Description			
Pass. (6 Yr.) Upper Neck Moment Y			
CURNO	Type	SAE Class	Units
008	FIL	600	Nm
Max	Time	Min	Time
14.6	56.6	-0.1	12.6



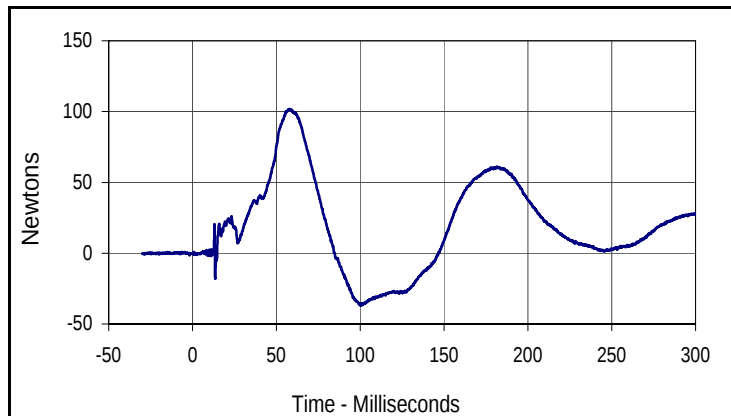
Curve Description			
Pass. (6 Yr.) Upper Neck Moment Z			
CURNO	Type	SAE Class	Units
009	FIL	600	Nm
Max	Time	Min	Time
2.9	68.3	-1.2	19.5



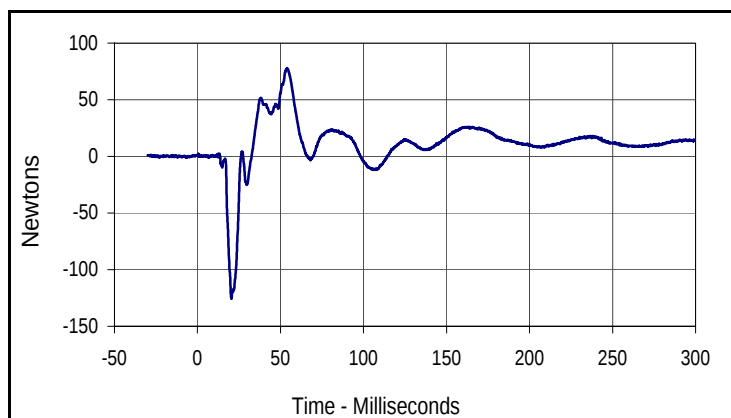
Curve Description			
Pass. (6 Yr.) Upper Neck Moment Resultant			
CURNO	Type	SAE Class	Units
007	RES	600	Nm
Max	Time	Min	Time
16.9	21.7	0.0	5.2

Test Vehicle: 2008 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.1

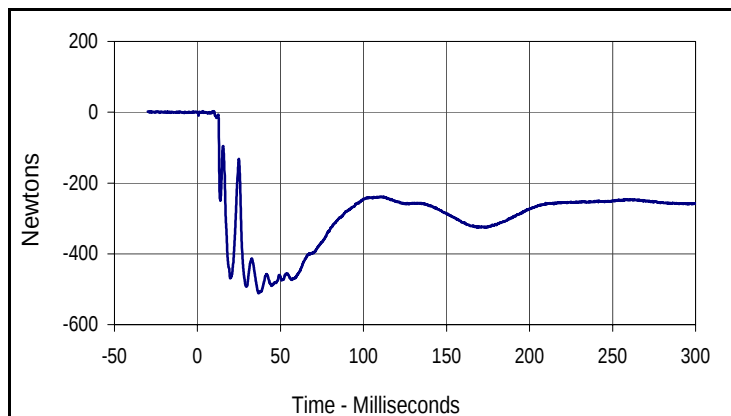
Test Date: 6/18/08
 NHTSA No.: M85102TWG2



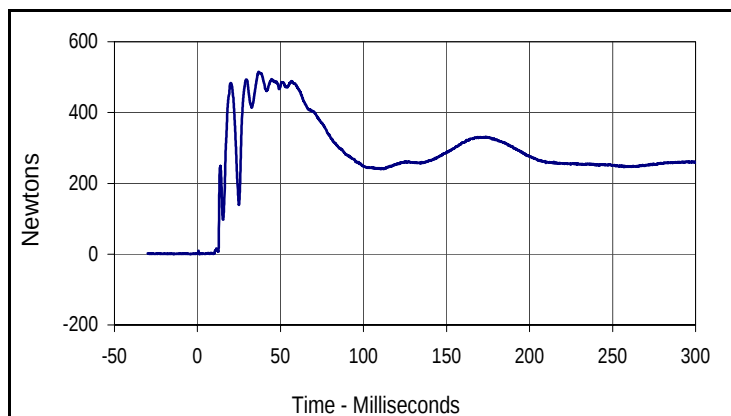
Curve Description			
Pass. (6 Yr.) Lower Neck Force X			
CURNO	Type	SAE Class	Units
010	FIL	1000	Newtons
Max	Time	Min	Time
101.9	57.8	-37.0	100.5



Curve Description			
Pass. (6 Yr.) Lower Neck Force Y			
CURNO	Type	SAE Class	Units
011	FIL	1000	Newtons
Max	Time	Min	Time
77.8	54.0	-125.7	20.5



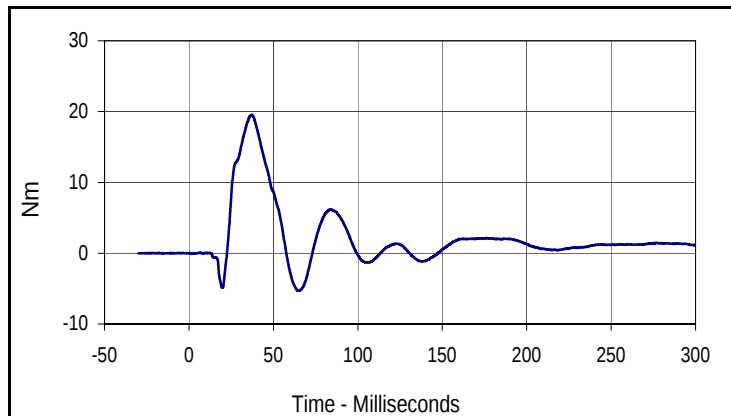
Curve Description			
Pass. (6 Yr.) Lower Neck Force Z			
CURNO	Type	SAE Class	Units
012	FIL	1000	Newtons
Max	Time	Min	Time
3.1	9.8	-511.8	36.8



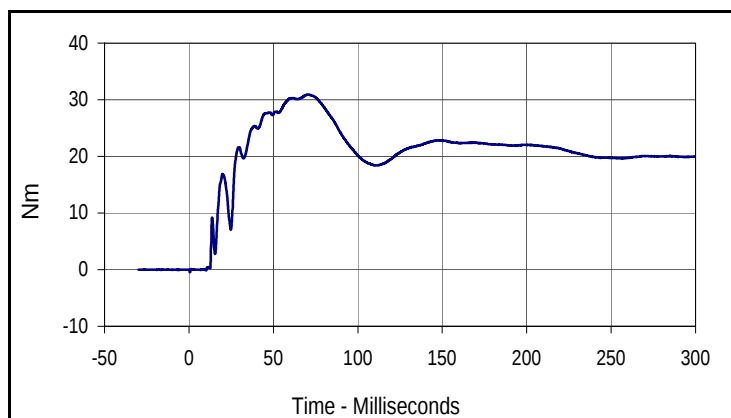
Curve Description			
Pass. (6 Yr.) Lower Neck Force Resultant			
CURNO	Type	SAE Class	Units
010	RES	1000	Newtons
Max	Time	Min	Time
515.1	36.8	0.2	1.2

Test Vehicle: 2008 Lexus RX350 5-Door MPV
 Test Program: TWG 3.3.5.1

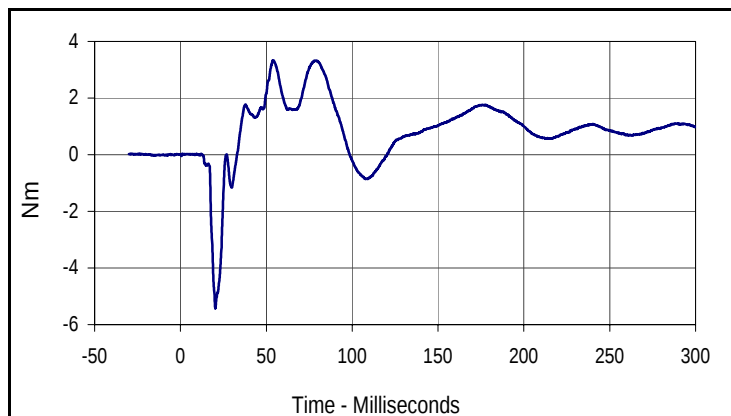
Test Date: 6/18/08
 NHTSA No.: M85102TWG2



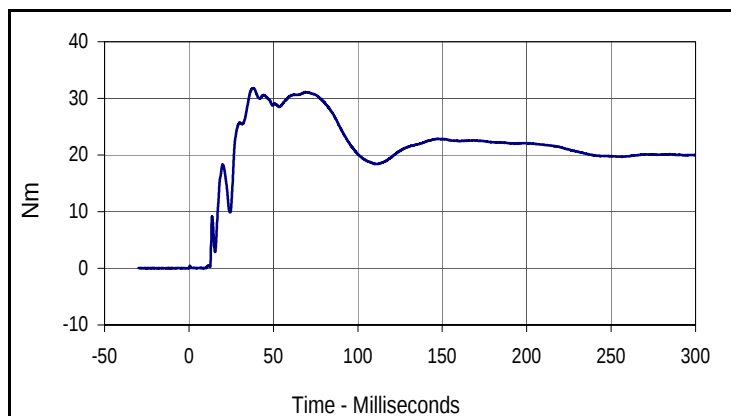
Curve Description			
Pass. (6 Yr.) Lower Neck Moment X			
CURNO	Type	SAE Class	Units
013	FIL	600	Nm
Max	Time	Min	Time
19.6	37.3	-5.3	64.9



Curve Description			
Pass. (6 Yr.) Lower Neck Moment Y			
CURNO	Type	SAE Class	Units
014	FIL	600	Nm
Max	Time	Min	Time
30.9	70.4	-0.4	0.6



Curve Description			
Pass. (6 Yr.) Lower Neck Moment Z			
CURNO	Type	SAE Class	Units
015	FIL	600	Nm
Max	Time	Min	Time
3.3	54.1	-5.4	20.3



Curve Description			
Pass. (6 Yr.) Lower Neck Moment Resultant			
CURNO	Type	SAE Class	Units
013	RES	600	Nm
Max	Time	Min	Time
31.8	38.2	0.0	0.1

APPENDIX C

INSTRUMENTATION DATA CHANNEL ASSIGNMENTS

TWG 3.3.5.1
Instrumentation Data Channel Assignments
A.T.D. Serial Number 144
6/18/08
2008 Lexus RX350 5-Door MPV

CH.	LOCATION	AXIS	IDENT. NO.	DESCRIPTION	MFR	MODEL	UNITS
1	HEAD	X	J23803	Accel.,full bridge	ENDEVCO	7264-2000	G
2	HEAD	Y	AAKA1	Accel.,full bridge	ENDEVCO	7264-2000	G
3	HEAD	Z	99H30-Z15	Accel.,full bridge	ENTRANS	7264-2000	G
4	UPPER NECK FORCE	X	157 FX	Load cell, six axis neck	R. A. Denton	IF-205	N
5	UPPER NECK FORCE	Y	157 FY	Load cell, six axis neck	R. A. Denton	IF-205	N
6	UPPER NECK FORCE	Z	157 FZ	Load cell, six axis neck	R. A. Denton	IF-205	N
7	UPPER NECK MOMENT	X	157 MX	Load cell, six axis neck	R. A. Denton	IF-205	Nm
8	UPPER NECK MOMENT	Y	157 MY	Load cell, six axis neck	R. A. Denton	IF-205	Nm
9	UPPER NECK MOMENT	Z	157 MZ	Load cell, six axis neck	R. A. Denton	IF-205	Nm
10	LOWER NECK FORCE	X	180 FX	Load cell, six axis neck	R. A. Denton	2430	N
11	LOWER NECK FORCE	Y	180 FY	Load cell, six axis neck	R. A. Denton	2430	N
12	LOWER NECK FORCE	Z	180 FZ	Load cell, six axis neck	R. A. Denton	2430	N
13	LOWER NECK MOMENT	X	180 MX	Load cell, six axis neck	R. A. Denton	2430	Nm
14	LOWER NECK MOMENT	Y	180 MY	Load cell, six axis neck	R. A. Denton	2430	Nm
15	LOWER NECK MOMENT	Z	180 MZ	Load cell, six axis neck	R. A. Denton	2430	Nm