



REPORT NUMBER: TWG-MGA-2016-006

**SIDE AIRBAG OUT-OF-POSITION INJURY
TECHNICAL WORKING GROUP**

**TOYOTA MOTOR MANUFACTURING CANADA, INC.
2016 Lexus RX 350 5-Door SUV
NHTSA No.: M20165105TWG3**

TEST DATE: MAY 19, 2016

FINAL REPORT DATE: JUNE 3, 2016

FINAL REPORT

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The results presented in this report relate only to the specified test items.

TABLE OF CONTENTS

<u>Section</u>		<u>Page No</u>
1	Purpose and Summary of Test	1
2	Occupant and Vehicle Information / Data Sheets	3
<u>Data Sheet No.</u>		<u>Page No.</u>
1	Test Summary	3
2	Test Vehicle Information	4
3	Dummy Positioning in Vehicle	5
4	Dummy Injury Criteria Values	6
<u>Appendix</u>		
A	Photographs	8
B	Dummy Response Data Traces	22

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 Alpha Technology Associate, Inc.

SUMMARY

The effects of both a curtain and torso airbag deployment in a 2016 Lexus RX 350 5-Door SUV with an out-of-position Hybrid III 3-Year-Old child dummy were evaluated. The curtain and seat airbags were fired remotely. The test was performed by MGA Research Corporation on May 19, 2016. Pre-test and post-test photographs of the vehicle and dummy can be found in Appendix A.

Two high-speed cameras (1000 fps) were used to document the side airbag deployment event. The following camera locations were used:

- Left Side Through Removed Left Passenger Door
- Left Side $\frac{3}{4}$ View Through Windshield

One Hybrid III 3-Year-Old child dummy (Serial Number 082) was placed in the right rear passenger seat situated in the rear-facing position along the outboard edge of the seat per Section 3.3.3.2 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 Accelerations
- Lower Spine Accelerations
- Upper Sternum Acceleration
- Lower Sternum Acceleration
- Chest Potentiometer

The 27 channels of data were recorded on an on-board data acquisition system. Appendix B contains the dummy data traces.

The Hybrid III 3-Year-Old child dummy's visible contact points were as follows:

- Curtain bag to back of head and back of dummy
- Torso bag to left side of head, left shoulder, left torso, and left pelvis

The Hybrid III 3-Year-Old child dummy was placed in the right rear passenger seat along the outboard edge of the seat cushion, kneeling and facing rearward. The vertical centerline of the dummy's sternum was aligned as close as possible with the leading edge of the seatback bolster. The sternum contacted with seat. The dummy's head was placed in between the seat bolster and pillar/side trim to maximize contact between the sternum and seatback. The head remained in its neutral orientation. The outboard leg was positioned at the outboard edge of the seat cushion and parallel to the seat centerline and remained on the cushion. The outboard knee and lower leg was slid toward the seatback/seat cushion junction until the top edge of the upper rib was aligned horizontally with the top edge of the airbag module. The inboard leg was aligned parallel to the centerline of the seat cushion. The inboard knee and lower leg was slid toward the seat bight until a line drawn through both shoulder bolts was perpendicular to the vehicle centerline. The inboard arm was rotated towards the seatback until the thumb contacts the seatback. The outboard arm and hand was rotated to hang down as close to vertical as possible.

The dummy's skullcap seam was taped with 4mm electrical tape to prevent the airbag from getting caught in the seam. The dummy's headskin was cleaned with alcohol and dusted with baby powder to achieve acceptable frictional characteristics.

This orientation complies with Section 3.3.3.2 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	P3	Right Rear Seating Position
Test	3.3.3.2*	Rear-facing child dummy
Curtain Airbag	Roof-Rail Mounted	Side Airbag
Torso Airbag	Seat Mounted	Side Airbag
ATD Type/Serial No.	Hybrid III 3 Year Old / 082	Child Dummy

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

Number of Dummy Data Channels	27
Number of Airbag Channels	4
Number of High-Speed Videos	2

Visible Dummy Contact Points	
Head Contact	Curtain bag
Left Shoulder Contact	Curtain & Seat Torso/Pelvis bag
Left Torso Contact	Seat Torso/Pelvis bag
Left Pelvis Contact	Seat Torso/Pelvis bag

DATA SHEET NO. 2

TEST VEHICLE INFORMATION

Please note that this vehicle had previously been tested in an
NCAP MDB Side Impact on March 2, 2016.

TEST VEHICLE INFORMATION

TEST VEHICLE OPTIONS

Manufacturer	Lexus	Driver Front Airbag	Yes
Model	RX 350	Driver Side Curtain Airbag	Yes
Body Style	5 Door SUV	Driver Side Torso/Pelvis Airbag	Yes
NHTSA No.	M20165105	Rear Passenger Side Curtain Airbag	Yes
VIN	2T2ZZMCA2GC004359	Rear Passenger Side Torso/Pelvis Airbag	Yes
Color	Nebula Gray Pearl	Force Limiter	Yes
Delivery Date	2/22/2016	Pretensioner	Yes
Odometer Reading (mile)	157	Power Steering	Yes
Dealer	Lexus North Shore	Power Door Locks	Yes
Transmission	Automatic	Tilt Wheel	Yes
Final Drive	FWD	Air Conditioning	Yes
Number of Cylinders	6	Anti-lock Brakes	Yes
Engine Displacement (L)	3.5	Traction Control	Yes
Engine Placement	Lateral	All-Wheel Drive	No
Automatic Door Lock (ADL)	Yes	Power Seats	Yes
Owner's Manual Details Instructions on Disabling ADLs	Yes		
Bucket Seats	Yes		

DATA FROM CERTIFICATION LABEL

Manufactured By	Toyota Motor Manufacturing Canada, Inc.	GVWR (kg)	2570
Date of Manufacture	11/15	GAWR Front (kg)	1360
		GAWR Rear (kg)	1410

Measured Parameter	Front	Rear	Third	Total
Type of Seats	Bucket	Split Bench		
Number of Occupants	2	3		5
Capacity Wt. (VCW) (kg)				420
Cargo Wt. (RCLW) (kg)				64

DATA SHEET NO. 3
DUMMY POSITIONING IN VEHICLE

Measurement		Value
Seat Position		Non-Adjustable
Seat Height Position		Non-Adjustable
Placed in Position No. 3		---
Seat Back Angle (at headrest post)	SA (°)	Non-Adjustable
Top of Curtain Airbag Module to Head/Neck Junction	AN (mm)	245
Top of Seat Airbag Module to Head/Neck Junction	AN (mm)	72
Head CG to Window	HD (mm)	182
Head to Seat Back Centerline	HSC (mm)	204
ATD Back to Seatback	CD (mm)	644
Chest to Seatback	CS (mm)	16
Right Arm to Seat Back Centerline	RACL (mm)	80
Left Arm to Seat Back Centerline	LACL (mm)	288
Right Arm to Door Panel	RA (mm)	305
Left Arm to Door Panel	LA (mm)	61
Knee to Knee	KK (mm)	145
Toe to Toe	TT (mm)	159
Right Knee to Seat Cushion Centerline	KSCR (mm)	115
Left Knee to Seat Cushion Centerline	KSCL (mm)	246
Right Toe to Seat Cushion Centerline	TSCR (mm)	75
Left Toe to Seat Cushion Centerline	TSCL (mm)	220
Nose to Dash	ND (mm)	N/A
Nose to Seatback	NS (mm)	Contact
Top of Head to Headliner	HH (mm)	127

DATA SHEET NO. 4
DUMMY INJURY CRITERIA VALUES

NHTSA No.: M20165105TWG3

		MAXIMUM VALUE			
		Position No. 3			
DESCRIPTION	UNIT	MAXIMUM	TIME (ms)	MINIMUM	TIME (ms)
Head X	g	41.7	22.3	-8.6	17.4
Head Y	g	8.5	9.3	-18.2	21.9
Head Z	g	17.2	23.1	-24.2	22.0
Head Resultant	g	42.9	22.3		
Upper Neck Fx	N	431.4	22.2	-122.7	21.2
Upper Neck Fy	N	67.7	110.8	-254.7	11.1
Upper Neck Fz	N	636.1	23.2	-69.5	267.9
Upper Neck F Resultant	N	643.5	23.2		
Upper Neck Mx	Nm	9.9	11.3	-6.7	23.0
Upper Neck My	Nm	4.1	64.7	-7.3	21.5
Upper Neck Mz	Nm	4.4	59.5	-8.9	26.1
Upper Neck M Resultant	Nm	11.4	11.4		
Lower Neck Fx	N	68.8	8.6	-191.2	22.8
Lower Neck Fy	N	54.1	99.1	-243.4	11.5
Lower Neck Fz	N	707.8	22.8	-63.2	270.6
Lower Neck F Resultant	N	741.2	22.8		
Lower Neck Mx	Nm	10.4	39.3	-16.8	20.5
Lower Neck My	Nm	11.1	53.4	-4.0	8.8
Lower Neck Mz	Nm	5.1	62.3	-11.6	22.5
Lower Neck M Resultant	Nm	20.1	20.5		
Chest X	G	9.3	22.8	-25.6	8.8
Chest Y	G	14.8	8.9	-1.8	17.5
Chest Z	G	5.2	14.2	-12.0	22.5
Chest Resultant	G	29.7	8.9		
Upper Spine X	G	7.8	33.3	-10.7	9.3
Upper Spine Y	G	16.9	7.7	-6.8	10.8
Upper Spine Z	G	8.6	16.0	-16.3	22.6
Upper Spine Resultant	G	19.3	7.7		
Lower Spine X	G	10.1	13.8	-40.5	7.6
Lower Spine Y	G	25.6	8.7	-3.0	12.4
Lower Spine Z	G	12.9	8.8	-15.7	22.6
Lower Spine Resultant	G	48.0	8.5		
Upper Sternum X	G	311.7	9.2	-448.9	6.2
Lower Sternum X	G	211.6	11.6	-637.1	7.0
Chest Displacement	mm			-16.7	11.0

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

NHTSA No.: M20165105TWG3

ATD position	HEAD INJURY CRITERIA (HIC)					
	HIC15			HIC36		
	HIC	T ¹ (msec)	T ² (msec)	HIC	T ¹ (msec)	T ² (msec)
No. 3 Right Rear	9.55	21.1	22.5	9.55	21.1	22.5

Position 3 Neck Injury Summary (3-Year-Old – Out-Of-Position)

	Nij	Time (msec)	Z Force (N) (CFC 600)	X Force (N) (CFC 600)	Y Moment (N-m) (CFC 600)
Ntf	0.20	9.6	421.41	32.47	0.09
Nte	0.40	23.3	597.82	-76.59	-3.08
Ncf	0.08	267.9	-66.93	9.76	3.25
Nce	0.00	-17.7	-5.16	-0.60	-0.02
Peak Tension (CFC1000)		636.1 N	Peak Compression (CFC 1000)		-69.5 N

Critical Values

Nij Intercepts				Peak Limits	
Tension (CVt)	2120 N	Extension (mCVe)	27 N-m	Tension	1130 N
Compression (CVc)	2120 N	Flexion (mCVf)	68 N-m	Compression	1380 N

APPENDIX A
PHOTOGRAPHS

TABLE OF PHOTOGRAPHS

	<u>Page No.</u>
Photo No. 1. Right ¾ Front View of Vehicle, As Received	9
Photo No. 2. Vehicle Certification Placard	9
Photo No. 3. Pre-Test Vehicle Left Side View	10
Photo No. 4. Post-Test Vehicle Left Side View	10
Photo No. 5. Pre-Test 3-Year-Old Child Dummy Left Side View	11
Photo No. 6. Post-Test 3-Year-Old Child Dummy Left Side View	11
Photo No. 7. Pre-Test 3-Year-Old Child Dummy Left Side Closeup View	12
Photo No. 8. Post-Test 3-Year-Old Child Dummy Left Side Closeup View	12
Photo No. 9. Pre-Test 3-Year-Old Child Dummy Left ¾ Front View	13
Photo No. 10. Post-Test 3-Year-Old Child Dummy Left ¾ Front View	13
Photo No. 11. Pre-Test 3-Year-Old Child Dummy Left ¾ Front Closeup View	14
Photo No. 12. Post-Test 3-Year-Old Child Dummy Left ¾ Front Closeup View	14
Photo No. 13. Pre-Test 3-Year-Old Child Dummy Front View	15
Photo No. 14. Post-Test 3-Year-Old Child Dummy Front View	15
Photo No. 15. Pre-Test 3-Year-Old Child Dummy Front Closeup View	16
Photo No. 16. Post-Test 3-Year-Old Child Dummy Front Closeup View	16
Photo No. 17. Pre-Test 3-Year-Old Child Dummy Right ¾ Front View	17
Photo No. 18. Post-Test 3-Year-Old Child Dummy Right ¾ Front View	17
Photo No. 19. Pre-Test 3-Year-Old Child Dummy Right Side View	18
Photo No. 20. Post-Test 3-Year-Old Child Dummy Right Side View	18
Photo No. 21. Post-Test 3-Year-Old Child Dummy Right Side View (Door Open)	19
Photo No. 22. Post-Test Curtain Airbag Left Side View	19
Photo No. 23. Post-Test Curtain Airbag Left ¾ Front View	20
Photo No. 24. Post-Test Curtain Airbag Front View	20
Photo No. 25. Post-Test Curtain Airbag Right Side View (Door Open)	21



Photo No. 1. Right ¾ Front View of Vehicle, As Received



Photo No. 2. Vehicle Certification Placard



Photo No. 3. Pre-Test Vehicle Left Side View



Photo No. 4. Post-Test Vehicle Left Side View



Photo No. 5. Pre-Test 3-Year-Old Child Dummy Left Side View



Photo No. 6. Post-Test 3-Year-Old Child Dummy Left Side View



Photo No. 7. Pre-Test 3-Year-Old Child Dummy Left Side Closeup View



Photo No. 8. Post-Test 3-Year-Old Child Dummy Left Side Closeup View



Photo No. 9. Pre-Test 3-Year-Old Child Dummy Left ¾ Front View



Photo No. 10. Post-Test 3-Year-Old Child Dummy Left ¾ Front View



Photo No. 11. Pre-Test 3-Year-Old Child Dummy Left $\frac{3}{4}$ Front Closeup View



Photo No. 12. Post-Test 3-Year-Old Child Dummy Left $\frac{3}{4}$ Front Closeup View



Photo No. 13. Pre-Test 3-Year-Old Child Dummy Front View



Photo No. 14. Post-Test 3-Year-Old Child Dummy Front View



Photo No. 15. Pre-Test 3-Year-Old Child Dummy Front Closeup View



Photo No. 16. Post-Test 3-Year-Old Child Dummy Front Closeup View



Photo No. 17. Pre-Test 3-Year-Old Child Dummy Right ¾ Front View



Photo No. 18. Post-Test 3-Year-Old Child Dummy Right ¾ Front View



Photo No. 19. Pre-Test 3-Year-Old Child Dummy Right Side View



Photo No. 20. Post-Test 3-Year-Old Child Dummy Right Side View



Photo No. 21. Post-Test 3-Year-Old Child Dummy Right Side View (Door Open)



Photo No. 22. Post-Test Curtain Airbag Left Side View



Photo No. 23. Post-Test Curtain Airbag Left $\frac{3}{4}$ Front View



Photo No. 24. Post-Test Curtain Airbag Front View



Photo No. 25. Post-Test Curtain Airbag Right Side View (Door Open)

APPENDIX B

DUMMY RESPONSE DATA TRACES

TABLE OF DATA PLOTS

	<u>Page No.</u>
Figure No. 1. RRP Head X Acceleration vs. Time	24
Figure No. 2. RRP Head Y Acceleration vs. Time	24
Figure No. 3. RRP Head Z Acceleration vs. Time	24
Figure No. 4. RRP Head Resultant Acceleration vs. Time	24
Figure No. 5. RRP Upper Neck X Force vs. Time	25
Figure No. 6. RRP Upper Neck Y Force vs. Time	25
Figure No. 7. RRP Upper Neck Z Force vs. Time	25
Figure No. 8. RRP Upper Neck Resultant Force vs. Time	25
Figure No. 9. RRP Upper Neck X Moment vs. Time	26
Figure No. 10. RRP Upper Neck Y Moment vs. Time	26
Figure No. 11. RRP Upper Neck Z Moment vs. Time	26
Figure No. 12. RRP Upper Neck Resultant Moment vs. Time	26
Figure No. 13. RRP Lower Neck X Force vs. Time	27
Figure No. 14. RRP Lower Neck Y Force vs. Time	27
Figure No. 15. RRP Lower Neck Z Force vs. Time	27
Figure No. 16. RRP Lower Neck Resultant Force vs. Time	27
Figure No. 17. RRP Lower Neck X Moment vs. Time	28
Figure No. 18. RRP Lower Neck Y Moment vs. Time	28
Figure No. 19. RRP Lower Neck Z Moment vs. Time	28
Figure No. 20. RRP Lower Neck Resultant Moment vs. Time	28
Figure No. 21. RRP Chest X Acceleration vs. Time	29
Figure No. 22. RRP Chest Y Acceleration vs. Time	29
Figure No. 23. RRP Chest Z Acceleration vs. Time	29
Figure No. 24. RRP Chest Resultant Acceleration vs. Time	29

	<u>Page No.</u>
Figure No. 25. RRP Upper Spine X Acceleration vs. Time	30
Figure No. 26. RRP Upper Spine Y Acceleration vs. Time	30
Figure No. 27. RRP Upper Spine Z Acceleration vs. Time	30
Figure No. 28. RRP Upper Spine Resultant Acceleration vs. Time	30
Figure No. 29. RRP Lower Spine X Acceleration vs. Time	31
Figure No. 30. RRP Lower Spine Y Acceleration vs. Time	31
Figure No. 31. RRP Lower Spine Z Acceleration vs. Time	31
Figure No. 32. RRP Lower Spine Resultant Acceleration vs. Time	31
Figure No. 33. RRP Upper Sternum X Acceleration vs. Time	32
Figure No. 34. RRP Lower Sternum X Acceleration vs. Time	32
Figure No. 35. RRP Chest Displacement vs. Time	32
Figure No. 36. Passenger Curtain Airbag – Fire Voltage vs. Time	33
Figure No. 37. Passenger Curtain Airbag – Fire Current vs. Time	33
Figure No. 38. RRP Seat Airbag – Fire Voltage vs. Time	33
Figure No. 39. RRP Seat Airbag – Fire Current vs. Time	33



















