

Non Deployed Side Air Bag Investigation  
Dynamic Science, Inc. (DSI), Case Number DS07041  
2000 Lexus RX300  
Colorado  
September 2007

---

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

---

1. Report No. DS07041	2. Government Accession No.	3. Recipient Catalog No.	
4. Title and Subtitle Non Deployed Side Air Bag Investigation		5. Report Date November 5, 2008	
		6. Performing Organization Report No.	
7. Author(s) Dynamic Science, Inc.		8. Performing Organization Report No.	
9. Performing Organization name and Address Dynamic Science, Inc. 299 West Cerritos Avenue Anaheim, CA 92805		10. Work Unit No. (TRAVIS)	
		11. Contract or Grant no. DTNH22-07-00045	
12. Sponsoring Agency Name and Address U.S. Dept. of Transportation (NRD-111) National Highway Traffic Safety Administration 1200 New Jersey Ave, SE Washington, DC 20590		13. Type of report and period Covered [Report Month, Year]	
		14. Sponsoring Agency Code	
15. Supplemental Notes			
16. Abstract <p>This on-site Non Deployed Side Air Bag Investigation focused on the non-deployment of the side air bags in a 2000 Lexus RX300 sport utility vehicle. The Lexus RX300 was being driven by a restrained 19-year-old female. The front right seat was occupied by a restrained 18-year-old female. The Lexus was traveling westbound in the inboard lane. The driver became distracted and the Lexus left the road on the left side. The driver steered back to the right and traveled back onto the road. The driver then over-corrected to the left. The Lexus began a counterclockwise skid and departed the roadway on the left side. The Lexus traveled over a paved shoulder and then a dirt shoulder. The Lexus tripped and began a right side rollover down the embankment. The Lexus rolled 12 quarter turns before striking a tree with its right side. The Lexus came to rest against the tree, facing east. The driver of the Lexus sustained moderate injuries. The front right passenger was fatally injured. She was found partially ejected from the right door and was positioned between the tree and the frame of the door. The Lexus RX300 was towed from the scene due to damage and was placed on a police hold.</p>			
17. Key Words Non-deployment, rollover, ejection, fatality		18. Distribution Statement	
19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

**Dynamic Science, Inc.**  
**Crash Investigation**  
**Case Number: DS07041**

**TABLE OF CONTENTS**

Background .....	1
Summary .....	1
Crash Site .....	1
Pre Crash .....	2
Crash .....	2
Post Crash .....	3
Vehicle Data - 2000 Lexus RX300 .....	3
Vehicle Damage .....	4
Exterior Damage .....	4
Interior Damage .....	5
Manual Restraints .....	6
Supplemental Restraint Systems .....	8
Rollover Dynamics .....	8
Occupant Demographics .....	9
Occupant Kinematics .....	10
Occupant Injuries .....	12
Attachment 1. Scene Diagram .....	13

## Background

This on-site Non Deployed Side Air Bag Investigation focused on the non-deployment of the side air bags in a 2000 Lexus RX300 sport utility vehicle (**Figure 1**). The Lexus RX300 was being driven by a restrained 19-year-old female. The front right seat was occupied by a restrained 18-year-old female. The Lexus was traveling westbound in the inboard lane. The driver became distracted and the Lexus left the road on the left side. The driver steered back to the right and traveled back onto the road. The driver then over-corrected to the left. The Lexus began a counterclockwise skid and departed the roadway on the left side. The Lexus traveled over a paved shoulder and then a dirt shoulder. The Lexus tripped and began a right side rollover down the embankment. The Lexus rolled 12 quarter turns before striking a tree with its right side. The Lexus came to rest against the tree, facing east. The driver of the Lexus sustained moderate injuries. The front right passenger was fatally injured. She was found partially ejected from the right door and was positioned between the tree and the frame of the door. There were contradicting reports as to whether she was next to the tree or actually pinned between the tree and the vehicle. The Lexus RX300 was towed from the scene due to damage and was placed on a police hold.



**Figure 1.** Subject vehicle, 2000 Lexus RX300

This case was identified by a police officer in Colorado. The police officer contacted the local National Automotive Sampling System (NASS) team. The NASS team contacted the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA). DSI was emailed a request on November 14, 2007 to contact the investigating officer to let him know that a follow-on investigation was going to be conducted. DSI contacted the officer on November 14, 2007. DSI was assigned the case on November 15, 2007. Field work was completed on November 16, 2007. The investigating police officer and an engineer in the employ of the lawyer representing the parents of the front right seat passenger were present during the scene and vehicle inspections.

## Summary

### Crash Site

This single vehicle crash occurred in September 2007 at 1432 hours. The crash occurred on a two-lane state highway (**Figure 2**). The highway traveled in a western direction and there was a right hand curve at this location. The roadway was configured with two lanes that were separated by dashed white lines. There was a positive 6%



**Figure 2.** Path of travel (west)

grade. The left road edge was marked by a solid yellow line. There was an asphalt shoulder with a grooved rumble strip. The asphalt shoulder was bordered by a gravel shoulder, followed by a steep descending embankment, which had a 45 degree negative slope. The weather was clear and the asphalt roadway was dry at the time of the crash. The speed limit at this location was 105 km/h (65 mph).

### Pre Crash

The Lexus RX300 was being driven by a restrained 19-year-old female. The front right seat was occupied by a restrained 18-year-old female. The Lexus was traveling westbound in the inboard lane at a police reported speed of 105 km/h (65 mph). The driver had asked the front right passenger if she had any lip balm. The front right passenger began looking through her purse. The driver saw the lip balm in the purse and apparently reached over to get it with her right hand. As she did so, the Lexus drifted off the roadway to the left. As the Lexus engaged the rumble strip, driver steered back to the right and traveled back onto the road. The driver then over-corrected to the left. The Lexus began a counterclockwise skid and departed the roadway on the left side. The Lexus traveled over a paved shoulder and then a gravel shoulder.

### Crash

The Lexus tripped as the right tires dug in and the vehicle began a right side rollover down the steep embankment. The Lexus rolled 12 quarter turns before striking a tree with its right side. The right side glass disintegrated during the first quarter turn. The front right passenger door came open during the first roll and was deformed upward during the second roll. The Lexus continued the roll before coming to rest against the tree, facing east (**Figures 3 and 4**). The rollover distance from the roadway shoulder to the tree was 53.6 m (176 ft). There were 3 complete rolls during the rollover sequence.



**Figure 3.** Overview of rollover area and final rest



**Figure 4.** Lexus RX300 at final rest



**Figure 5.** Right side of Lexus RX300 at tree contact

## Post Crash

The driver of the Lexus sustained moderate injuries, including abrasions to the left shoulder and the right hip, and a cervical strain. It is not known if she was assisted from the vehicle or was able to exit under her own power. She was transported to a local hospital where she was treated and released. The front right passenger was fatally injured. She was found partially ejected from the right door and was possibly pinned between the tree and the frame of the door (**Figure 5**). She was found with the lap belt still around her and displaced to the right. She was extricated from the vehicle and transported to a local trauma center where she was pronounced deceased at 1743 hours, 1-hour/11-minutes post-crash. The cause of death was chest trauma with cardiac arrest.

The Lexus RX300 was towed from the scene due to damage. It was then placed on a police hold.

## Vehicle Data - 2000 Lexus RX300

The 2000 Lexus RX300 LE was identified by the Vehicle Identification Number (VIN): JT6HF10U4Y01xxxxxx. The vehicle's date of manufacture was 01/2000. The vehicle's odometer could not be read due to the absence of power to the instrument panel. The RX300 was a four-door, five-passenger sport utility vehicle that was equipped with a 3.0 liter, 6 cylinder engine, an automatic four-speed transmission, four wheel drive, front/rear disc brakes with ABS, and power steering. The RX300 was configured with Firestone Destination LE P225/70R16 tires. The vehicle manufacturer's recommended cold tire pressure was 207 kPa (30 psi). The tire manufacturer's recommended maximum tire pressure was 303 kPa (44 psi). The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire Flat	8 mm (10/32 in)	No	Tire debanded
LR	193 kPa (28 psi)	9 mm (11/32 in)	No	None
RR	Tire Flat	6 mm (8/32 in)	No	Tire debanded
RF	Tire Flat	6 mm (8/32 in)	No	Tire debanded

The seating in the Lexus was configured with front bucket seats with adjustable head restraints and a rear bench seat with adjustable head restraints. The driver's seat was located in the full forward track position. The front right seat track position was not known; the seat had been moved by rescue personnel. The driver's seat back was at 23 degree angle from the vertical and the seat cushion was at a 7 degree angle from the horizontal. The front right seat back was at a 27 degree angle from the vertical and the seat cushion was at a 7 degree angle from horizontal.

There were a total of three previous owners of the Lexus. The current owner bought this vehicle in August 2006. The Lexus was involved in some type of crash in September 2006. The damage is reported to have involved the right rear of the vehicle.



## Vehicle Damage

### Exterior Damage -2000 Lexus RX300

The 2000 Lexus RX300 sustained moderate damage to the top, left side and right side as a result of the rollover sequence. There was contact damage on the roof, primarily along the right roof rail. There was also contact damage to the left and right surfaces (**Figures 6-7**). The maximum crush was located at the right A-pillar and measured 36 cm (14.1 in) laterally and 27 cm (10.6 in) vertically.

The rollover sequence was a right side leading event. During the first roll, the Lexus engaged the right roof area and the right door with the ground and the right front door came open. There was no latch or striker damage. It appears that rods connecting the door handle to the latch may have come apart and released the door. As the vehicle continued to roll down the steep embankment, the speed began to increase. During the second roll, the front right door was pushed vertically to a position 90 degrees from its original position.

The Collision Deformation Classification (CDC) for the rollover was 00TDDO3.

Near conclusion of the third roll, the Lexus contacted the tree with the right side sill and door areas. There were two tree contact areas (**Figure 8**). The first contact was to the sill area (**Figure 9**). The direct contact damage began 62 cm (24.4 in) aft of the frontal axle and extended rearward 26 cm (10.2 in).



**Figure 6.** Left side damage, Lexus RX300



**Figure 7.** Right side damage, Lexus RX300



**Figure 8.** Right side tree damage



Six crush measurements were documented at the sill level as follows: C1 = 0 cm, C2 = 4 cm (1.6 in), C3 = 8 cm (3.1 in), C4 = 13 cm (5.1 in), C5 = 5 cm (1.9 in), C6 = 0 cm. This was an interrupted roll, and the force direction for this impact was non-horizontal. The CDC for the sill impact was 00RPLN2.

The second tree impact was to the rotated door panel. The direct contact damage began 37 cm (14.6 in) aft of the front axle, ended 52 cm (20.5 in) aft of the front axle, and measured 15 cm (5.9 in) along the side plane. The CDC for the door panel impact was 00RYMN1.

The front left, front right and right rear tires were debanded and flattened. The left front axle assembly was broken away from the wheel.

#### Interior Damage -2000 Lexus RX300

The 2000 Lexus RX300 sustained moderate interior damage as a result of passenger compartment intrusion (**Figures 10-11**). The right roof rail, right roof, right A-pillar, and right B-pillar sustained vertical and lateral intrusion. The left roof rail sustained vertical intrusion. The right front door opened during the rollover sequence and was deformed to a 90 degree angle. The driver's door and the two rear doors were jammed shut. The left side doors were able to be pulled open. The right rear door remained jammed. The inside door panel had separated from the vehicle. It was examined and there was damage due to occupant contact. The forward aspect of the armrest was cracked and scuffed. The damage was 17 cm (6.7 in) wide; the forward most crack measured 8 cm (3.1 in) vertically and the rear most crack measured 5 cm (1.9 in) vertically. The lower window frame area was deformed outward.



**Figure 9.** Close up of right sill damage



**Figure 10.** Right roof rail and A pillar intrusion

The specific passenger compartment intrusions were documented as follows:

Position	Intruded Compartment	Magnitude of Intrusion	Direction
Front row right	A-pillar	31 cm (12.2in)	Lateral
Front row right	Roof	31 cm (12.2in)	Lateral
Front row right	B-pillar	26 cm (10.2 in)	Lateral
Second row right	Roof side rail	22 cm (8.7 in)	Lateral
Front row right	Roof side rail	16 cm (6.3 in)	Vertical
Front row right	Roof	16 cm (6.3 in)	Vertical
Second row left	Roof rail	13 cm (5.1 in)	Vertical
Front row right	Sill	6 cm (2.3 in)	Lateral
Front row right	Windshield header	$\geq 15$ cm (5.9 in) to $< 30$ cm (11.8 in)	Vertical

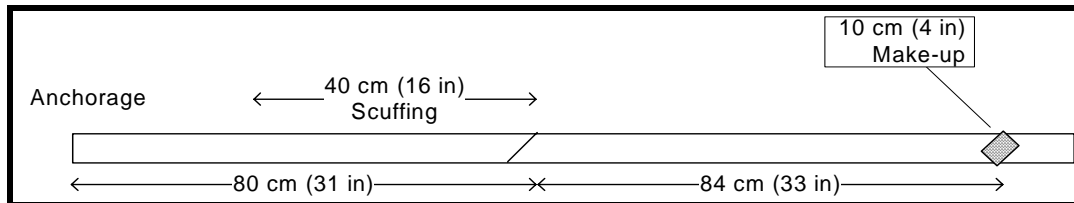
### Manual Restraints -2000 Lexus RX300

The 2000 Lexus RX300 was configured with 3-point manual lap and shoulder belts for each of the outboard seating positions. Both front seat safety belts were equipped with retractor pretensioners and adjustable D-rings. The pretensioners did not actuate. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). The adjustable D-ring was in the full up position for the driver's belt and near the full up position for the front right passenger's belt. The remaining outboard safety belts were configured with sliding latch plates and switchable ELR/Automatic Locking Retractors (ALR). The second row middle seat was equipped with a manual lap belt.



**Figure 11.** Overview of right side intrusion

Rescue personnel had cut the webbing on the front right passenger belt. The cut section measured 80 cm (31 in) from the lower anchor (**Figure 12**). There was 40 cm (16 in) of scuffing along the webbing before the cut mark (**Figure 13**). There was a 10 cm (4 in) make-up transfer that was found 164 cm (64 in) from the lower anchor. The make-up transfer was found on the inward facing portion of the webbing (**Figure 14**). The plastic stop button was missing from the belt (**Figure 15**).



**Figure 12.** Front right passenger seat belt webbing



**Figure 13.** Loading to front right passenger seat belt webbing



**Figure 14.** Make-up transfer



**Figure 15.** Missing stop button on front right passenger seat belt



**Figure 16.** Front right seat belt D ring position



## Supplemental Restraint Systems -2000 Lexus RX300

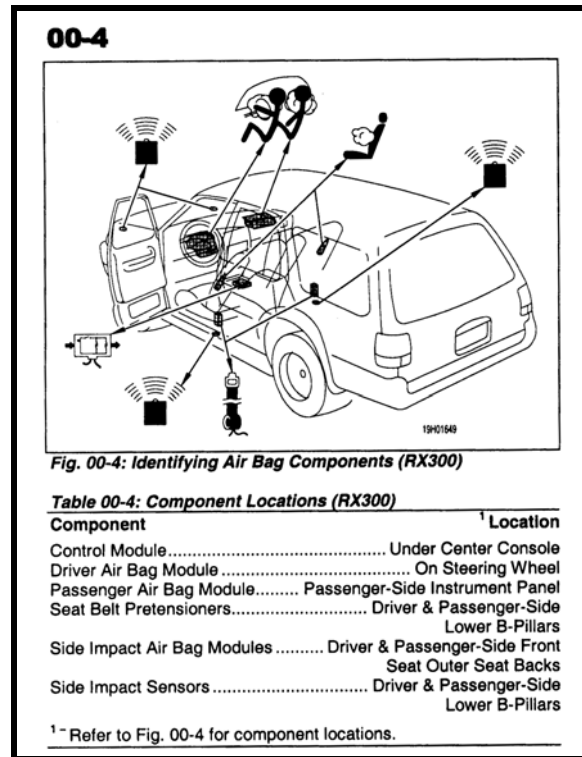
The 2000 Lexus RX300 was equipped with dual-stage frontal air bags, seat mounted side air bags and safety belt retractor pretensioners for the driver and front right passenger positions (**Figure 17**). The side impact sensors were located in the lower B pillars.

There were no air bag deployments or pretensioner actuations.

Based on the non-horizontal type of impact to the to the right side of the vehicle, it does not appear that the threshold was met for the side air bag deployment. The Lexus struck the tree while in mid-roll and the damage had a large vertical component.

### Rollover Dynamics

The Lexus RX300 was equipped with an automatic transmission, 4-wheel drive, front/rear disc brakes with ABS, and power steering. The vehicle was not equipped with stability control. The rollover rating for this vehicle was not available; the vehicle had not been tested. The driver lost control of the Lexus after a steering maneuver. The Lexus began a counterclockwise skid and departed the left side of the roadway. The Lexus traveled over a paved shoulder and then a gravel shoulder. The Lexus tripped as the right side tires dug in and began a right side leading rollover down the embankment. During the first roll, the Lexus engaged the right roof area and the right door with the ground and the right front door came open. The Lexus rolled a total of 12 quarter turns before striking a tree with its right side. The right side glass disintegrated during the first quarter turn. The front right passenger door came open during the first roll and was deformed upward during the second roll. The Lexus continued the rollover before coming to rest against the tree, facing east.



**Figure 17.** Overview of Supplemental Restraint System



**Figure 18.** Right side impact damage

**OCCUPANT DEMOGRAPHICS -2000 Lexus RX300**

	<b>Driver</b>	<b>Front Right Passenger</b>
Age/Sex:	19/Female	18/Female
Seated Position:	Front left	Front right
Seat Type:	Bucket	Bucket
Height:	168 cm (66in)	173 cm (68 in)
Weight:	58 kg (128 lbs)	52 kg (115 lbs)
Alcohol/Drug Involvement:	None	N/A
Body Posture:	Upright	Upright
Hand Position:	Left hand on steering wheel, right reaching into purse of front right passenger	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used	Lap and shoulder belt used
Air bag:	Steering wheel mounted frontal air bag, did not deploy. Seat mounted side air bag, did not deploy.	Instrument panel mounted frontal air bag, did not deploy. Seat mounted side air bag, did not deploy.



## OCCUPANT KINEMATICS -2000 Lexus RX300

### Driver Kinematics

The 19-year-old female driver was seated in an unknown posture and was restrained by the 3-point manual lap and shoulder belt. The seat track was positioned at the rear most position. Just prior to the crash, the driver had asked the front right passenger if she had any lip balm. The front right passenger began looking through her purse. The driver saw the lip balm in the purse and apparently reached over to get it with her right hand. As she did so, the Lexus drifted off the roadway to the left. As the Lexus engaged the rumble strip, the driver steered back to the right and traveled back onto the road. The driver then over-corrected to the left. The Lexus began a counterclockwise skid and departed the roadway on the left side. The driver was displaced to the right. The Lexus tripped and began a right side rollover down the embankment. The driver was displaced side to side in response to the rollover, but remained in her seated position. The Lexus rolled 12 quarter turns before striking a tree with its right side. The driver was probably displaced sharply to the right at impact with the tree. The driver of the Lexus sustained moderate injuries, including abrasions to the left shoulder and the right hip, and a cervical strain. It is not known if she was assisted from the vehicle or was able to exit under her own power. She was transported to a local hospital where she arrived with a Glasgow Coma Score (GCS) of 15. She was treated at the hospital and released.

### Right Front Occupant Kinematics

The 18-year-old female front right occupant was seated in an unknown posture and was restrained by the 3-point manual lap and shoulder belt. Just prior to the crash, the driver had asked the front right passenger if she had any lip balm. The front right occupant was began looking through her purse. The driver saw the lip balm in the purse and apparently reached over to get it with her right hand. As she did so, the Lexus drifted off the roadway to the left. As the Lexus engaged the rumble strip, driver steered back to the right and traveled back onto the road. The driver then over-corrected to the left. The Lexus began a counterclockwise skid and left the left side of the roadway. The front right occupant was displaced to the right. The Lexus tripped and began a right side rollover down the embankment. During the first roll, the front right occupant contacted the right door and armrest with her right hip and right upper leg (**Figure 19**). The door came open during this initial roll. The front right occupant was displaced side to side in response to the rollover. At some point, she came out of the shoulder harness. A make-up transfer was located on the inward facing portion of the shoulder harness indicating her probable movement. The Lexus rolled 12 quarter turns before striking a tree with its right side. The front right occupant was probably displaced sharply to the right during the tree impact , was partially ejected (**Figure 20**), and struck the tree. She was found hanging from right door with the lap belt still on her. She was



**Figure 19.** Contact to interior door panel/armrest

alive and able to speak to rescue personnel during the efforts to move the Lexus enough to free her from the vehicle. The seat belt was cut off of her and as the vehicle was moved, her condition deteriorated rapidly. She was removed from the vehicle and transported to a local trauma center where she expired at 1743 hours, 3 hours post-crash. The cause of death was blunt chest trauma with cardiac arrest.



**Figure 20.** Overview showing front right seat relative to struck tree

**OCCUPANT INJURIES -2000 Lexus RX300**

Driver: Injuries obtained from ER Report.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Abrasion, left shoulder	790202.1,2	Safety belt webbing	Certain
Abrasion, right hip	890202.1,1	Safety belt webbing, buckle	Certain
Cervical strain	640278.1,6	Impact forces	Probable

Front Right Occupant: Injuries obtained from Coroner's Investigative Report.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Blunt chest trauma with cardiac arrest	415099.7,0	Tree	Probable
Abrasions, face, right side	290202.1,1	Tree	Probable
Contusion, right eye	297402.1,1	Tree	Probable
Laceration NFS, knees, bilateral	890600.1,3	Tree	Possible
Abrasions, chest	490202.1,0	Seat belt webbing	Certain
Pelvis fracture (open book) <sup>1</sup>	852600.2,9	Tree	Probable
Fracture NFS, femur, right	851800.3,1	Tree	Probable
Fracture NFS, femur, left	851800.3,2	Tree	Probable

---

<sup>1</sup>The left and right halves of the pelvis are separated at the front and rear, the front opening more than the rear, i.e. like opening a book.

**Attachment 1. Scene Diagram**

