

Side Curtain Air Bag Investigation/Vehicle to Vehicle
Dynamic Science, Inc./Case Number: DS05023
2005 Lexus RX330
Utah
October 2005

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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.

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16. Abstract This on-site investigation focused on the deployment of the side curtain air bag system in a 2005 Lexus RX330. This two vehicle crash occurred in October 2005 at 0723 hours in an urban area of Utah. The crash occurred within the confines of a four-leg intersection. The case vehicle is a 2005 Lexus RX330 being driven by a restrained 58-year-old female. There were no other passengers in the vehicle. The other vehicle was a 1995 Volkswagen Jetta III four-door sedan being driven by a 19-year-old female. The Lexus was traveling south on a four lane, two-way roadway and was approaching an intersection controlled by traffic signals. The Volkswagen Jetta was traveling east on a four lane, two-way intersecting street. The driver of the Lexus had a red light but did not stop, traveled into the intersection and the front of the Jetta struck the right side of the case vehicle. The front left of the Jetta snagged on the right rear tire on the Lexus and combined with the force of the impact, caused the Lexus to rotate clockwise as it traveled towards the southeast corner of the intersection. The Lexus then rolled over one-quarter turn to the left, resulting in the deployment of the left and right side curtains. The case vehicle came to final rest still on the roadway, on its left side, facing southwest. The Jetta came to final rest still in the intersection, near the point of impact, facing southeast. The investigating officer did not indicate on the police report whether or not the driver of the Lexus was injured in the crash, but did report that the driver of the Jetta was not injured. According to the police report, paramedics responded to the scene and administered first aid but no one was transported for additional medical treatment.					
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Dynamic Science, Inc.
Crash Investigation
Case Number: DS05023

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BACKGROUND:

Description

This on-site investigation focused on the deployment of the side curtain air bag system in a 2005 Lexus RX330. This two vehicle crash occurred in October 2005 at 0723 hours in an urban area of Utah. The crash occurred within the confines of a four-leg intersection. The case vehicle is a 2005 Lexus RX330 being driven by a restrained 58-year-old female. There were no other passengers in the vehicle. The other vehicle was a 1995 Volkswagen Jetta III four-door sedan being driven by a 19-year-old female. The Lexus was traveling south on a four lane, two-way roadway and was approaching an intersection controlled by traffic signals. The Volkswagen Jetta was traveling east on a four lane, two-way intersecting street. The driver of the Lexus had a red light but did not stop, traveled into the intersection and the front of the Jetta struck the right side of the case vehicle. The front left of the Jetta snagged on the right rear tire on the Lexus and combined with the force of the impact, caused the Lexus to rotate clockwise as it traveled towards the southeast corner of the intersection. The Lexus then rolled over one-quarter turn to the left, resulting in the deployment of the left and right side curtains. The case vehicle came to final rest still on the roadway, on its left side, facing southwest. The Jetta came to final rest still in the intersection, near the point of impact, facing southeast. The investigating officer did not indicate on the police report whether or not the driver of the Lexus was injured in the crash, but did report that the driver of the Jetta was not injured. According to the police report, paramedics responded to the scene and administered first aid but no one was transported for additional medical treatment.

This crash was identified within a group of potential cases provided by NHTSA. DSI received the potential cases on October 24, 2005. DSI located and obtained permission to inspect the case vehicle on October 28, 2005 and was assigned the case on October 31, 2005. A police report was obtained on November 7, 2005 and field work was completed on November 8, 2005.



Figure 1. Right side impact damage - 2005 Lexus RX330



Figure 2. Left side rollover damage - 2005 Lexus RX330

SUMMARY

Crash Site

This two vehicle crash occurred in October 2005 at 0723 hours in an urban area of Utah. The crash occurred within the confines of a four-leg intersection controlled by traffic signals. The Lexus was traveling south on a roadway consisting of four undivided travel lanes. There are two northbound lanes separated from the two southbound lanes by painted, no passing double lane lines. At the intersection where the crash occurred there are two additional, dedicated left-turn only lanes.

The Volkswagen Jetta was traveling east in lane two on an intersecting roadway consisting of four undivided travel lanes. The outside lanes of this roadway can also be used for parking, but at the intersection, lane one is designated to be used by vehicles intending to turn right. On the opposite side of the intersection, the roadway narrows and there is only one eastbound travel lane available. This intersection is controlled by tri-color traffic signals that were functioning properly at the time of the crash.

The posted speed limit on both roadways was 40 km/h (25 mph). At the time of the crash, it was dawn, the pavement was dry and there were no adverse weather conditions present.

Pre-Crash

The case vehicle is a 2005 Lexus RX330 being driven by a restrained 58-year-old female. There were no passengers in the vehicle. The Lexus was traveling south in lane two of the four lane, two-way roadway. According to the police report, the driver of the case vehicle was on her way to a doctors appointment and was over an hour late.

The other vehicle was a 1995 Volkswagen Jetta III being driven by a 19-year-old female. There were no other occupants in the vehicle. The Jetta was traveling east in lane two on the four lane, two-way intersecting street.

The Lexus entered the intersection, crossing in front of the Volkswagen Jetta.



Figure 3. Approach of case vehicle to intersection-south



Figure 4. Approach of other vehicle to intersection-east

Crash

The driver of the Lexus RX330 entered the intersection in front of the Volkswagen Jetta and the front of the Jetta struck the right side of the case vehicle (02RPEW2). The missing vehicle routine of the WinSmash program computed a total delta V of 11.0 km/h (6.8 mph). The longitudinal and lateral components were -3.8 km/h (-2.4 mph) and -10.3 km/h (-6.4 mph), respectively.

The impact severity was moderate, but the front left of the Jetta snagged on the right rear tire on the Lexus. The snagging and the force of the impact caused the Lexus to rotate clockwise as it traveled laterally towards the southeast corner of the intersection. The Lexus rolled over one-quarter turn to its left (00LDAO2) which resulted in the deployment of both the right and left side curtain air bags.

The case vehicle came to final rest still on the roadway, on its left side, facing southwest. The Jetta came to final rest still in the intersection, facing southeast.

Post-Crash

According to the police report, the driver of the Jetta was not injured. There was no report of injury to the driver of the Lexus. According to the police report, paramedics responded to the scene and administered first aid but no one was transported for additional treatment.

Both vehicles were towed from the scene. The Lexus RX330 was later declared a total loss.



Figure 5. General rollover location - 2005 Lexus RX330 (southeast)

Vehicle Data - 2005 Lexus RX330

The 2005 Lexus RX330 was identified by the Vehicle Identification Number (VIN): JTJHA314350xxxxxx. The Lexus RX330 is a four-door, all wheel drive, multi-purpose vehicle with seating for five. It was equipped with a 3.3 liter 6-cylinder engine, 5 speed automatic transmission, anti-lock brakes, front and rear disc brakes, a low tire pressure indicator, stability control, electronic traction control via ABS and engine management, and a tilt and telescoping steering wheel. The vehicle mileage could not be obtained from the digital odometer because the vehicle had no power. According to information from the salvage yard that was storing the vehicle at the time of the inspection, the mileage was 13,098 km (8,139 miles).

The RX330 was equipped with advanced occupant protection systems including driver and front right passenger air bags with occupants sensors, driver and front passenger side impact air bags, a driver knee air bag, and front to rear side curtain air bags. The vehicle was also equipped with front row driver and passenger B pillar seat belt pretensioners.

The 2005 Lexus RX330 was equipped with Michelin Energy P235/55R18 tires. The recommended cold tire pressure was 207 kPa (30 psi) for both the front and rear. The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	214 kPa (31 psi)	6 mm (8/32 in)	No	Rim scuffed
LR	207 kPa (30 psi)	6 mm (8/32 in)	Yes	Partially separated from the axle
RR	200 kPa (29 psi)	7 mm (9/32 in)	No	None
RF	200 kPa (29 psi)	6 mm (8/32 in)	No	None

The front row seating in the 2005 Lexus RX330 was configured with dual leather bucket seats. The seats were equipped with adjustable head restraints that were not damaged. The second row was configured as a leather 40/20/40 split bench seat with folding backs. All three second row seating positions were equipped with adjustable head restraints that were not damaged. The second row outboard seating positions were equipped with the lower anchor points that are part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system. All three second row seating positions were equipped with child safety top tether strap anchor points, located on the back of the second row seat backs.

VEHICLE DAMAGE

Exterior Damage - 2005 Lexus RX330

The 2005 Lexus RX330 sustained moderate right side damage as a result of the impact with the Volkswagen Jetta. The Lexus sustained 178.0 cm (70.1 in) of direct damage along the right side of the vehicle, beginning 21.0 cm (8.3 in) forward of the right rear axle, extending forward. The combined direct and induced damage measured 202.0 cm (79.5 in) in length and also began 21.0 cm (8.3 in) forward of the right rear axle, extending forward. Six crush measurements were documented along the damaged lower right side as follows: C1=1.0 cm (0.4 in), C2=13.0 cm (5.1 in), C3=11.0 cm (4.3 in), C4=11.0 cm (4.3 in), C5=11.0 cm (4.3 in), C6=5.0 cm (2.0 in). C1 had to be projected past the right rear tire due to the height of the impact. C6 had to be projected beyond the contour gauge because the gauge itself was not long enough to capture the entire length of the direct and induced damage.

The case vehicle sustained moderate left side damage as a result of the rollover event. There was 3.0 cm (1.2 in) of lateral crush at the max crush location, 47.0 cm (18.5 in) aft of the left front axle. There was no vertical crush from the rollover event. The left rear tire was partially separated from the axle. It is possible that this damage occurred as result of the snag between the front end of the Jetta and the case vehicle's right rear tire. The snag may have caused the Lexus to tip to its left, shifting the vehicle's weight to the left tires. The partial separation of the tire from the axle likely occurred as the vehicle tipped, further evidenced in the damage found to the fuel tank and tank shield.

The non-metallic fuel tank, mounted on the left side, forward of the rear axle, was abraded but there was no leakage. The shield was crumpled and abraded. This damage likely occurred as the left rear tire partially broke away from the axle and the undercarriage contacted the ground just prior to the rollover event.

CDC	(Impact 1):	02RPEW2	
	(Impact 2):	00LDAO2	
Delta V (Impact 1):	Total		11.0 km/h (6.8 mph)
	Longitudinal		-3.8 km/h (-2.4 mph)
	Latitudinal		-10.3 km/h (-6.4 mph)
	Energy		19,296 joules (14,232 ft lbs)



Figure 6. Case vehicle's right rear tire - Location of possible snag



Figure 7. Damaged left rear axle - 2005 Lexus RX330



Figure 8. Damage to case vehicle's fuel tank and shield

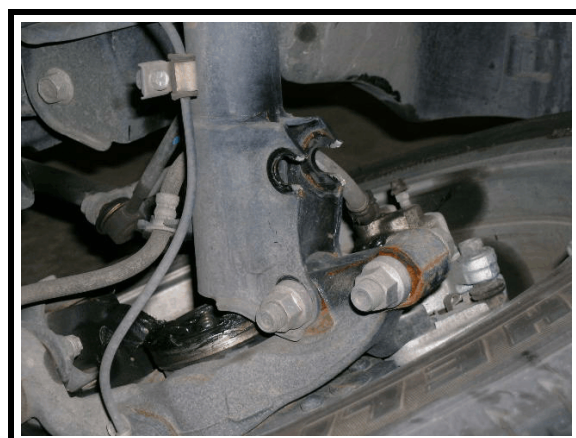


Figure 9. Close-up damage to the case vehicle's left rear tire/axle attachment point

Interior Damage - 2005 Lexus RX330

The 2005 Lexus RX330 sustained minor interior damage due to occupant contacts and normal air bag deployment related damage.

There were scuffs to the left kick panel, possibly from the driver's left ankle and/or foot. In the front row, there was a slight black transfer and brown discoloration on the inside portion of the left side curtain air bag.

The driver's seat belt B pillar pretensioner actuated during the collision and was still locked in place post-crash. In order to remove the driver, fire/rescue personnel cut the driver's seat belt. There was no integrity loss. The only intrusion was to the sill in the second row right seating area. The four doors and rear hatch all remained closed and operational. There was no glazing damage.

The specific passenger compartment intrusion was documented as follows:

Position	Intruded Component	Magnitude of Intrusion	Direction
RR	Sill	5.0 cm (2.0 in)	Lateral



Figure 10. Second row, right sill intrusion

Manual Restraint System - 2005 Lexus RX330

The 2005 Lexus RX330 was configured with manual 3-point lap and shoulder belts for each of the five seating positions. Both front seat belts were equipped with B pillar pretensioners and seat belt height adjusters. The driver's pretensioner actuated during the crash and was cut by fire/rescue personnel. The right front pretensioner did not actuate, but there was no occupant in that seating position and the belt was not in use during the collision. Both the driver and front right seat belt height adjusters were in the full up position. The driver's safety belt was configured with a sliding latch plate and an emergency locking retractor (ELR). The right front safety belt had a sliding latch plate and a switchable

ELR/Automatic Locking Retractor. All three second row seat belts had sliding latch plates and switchable retractors. The second row center safety belt is integrated into the seat back.



Figure 11. Driver's seat belt, cut by fire/rescue personnel.

Supplemental Restraint System - 2005 Lexus RX330

The case vehicle was equipped with advanced occupant protection systems. The systems consist of Certified Advanced 208 compliant driver and front right passenger front air bags with intelligent occupant sensors, a driver knee air bag, driver and front right passenger seat back mounted side air bags and right and left side curtains.

In this crash, none of the front, knee or seat back mounted side air bags deployed. Both the left and right side curtains deployed as a result of the rollover event.

The driver and front right passenger positions are also equipped with B-pillar seat belt pretensioners. The driver's seat belt pretensioner actuated during the crash; the front right seat belt pretensioner did not.

The deployed side curtains extended from the A pillars to just behind the second row seat backs. The left side curtain was rectangular in shape and in its deflated state, measured 195.0 cm (76.8 in) in length. The front section of the curtain measured 32.0 cm (12.6 in) in height and the back section measured 40.0 cm (15.7 in) in height. The air bag had one external tether, located at the front of the bag at the A pillar.

The right side curtain was also rectangular in shape and in its deflated state, measured the same as the left side curtain. The air bag also had one external tether, located at the front of the bag at the A pillar. The side curtains deployed from the roof side rail areas.

There was a faint black transfer and a brown discoloration found on the inner left side curtain in the driver's area. This was likely due to occupant contact with the bag. There was slight cosmetic damage on the outer portion of the second row, right side curtain which consisted of black transfers. The transfers were attributed to the right rear door trim, which was found hanging and in contact with the side curtain material.



Figure 12. Left side curtain air bag, front row



Figure 13. Right side curtain air bag, front row

Vehicle Data - 1995 Volkswagen Jetta III

Description:	1995 Volkswagen Jetta III	
VIN:	3VWRC81H8SMxxxxxxx	
Odometer:	Unknown	
Engine:	2.0L, 4 cylinder	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Front end damage; vehicle totaled per the police report	
CDC:	Unknown	
Delta V:	Total	15.0 km/h (9.3 mph)
	Longitudinal	-13.0 km/h (-8.1 mph)
	Latitudinal	7.5 km/h (4.7 mph)
	Energy	9,907 joules (7,307 ft lbs)

Occupant Demographics - 2005 Lexus RX330

	Driver
Age/Sex:	58/Female
Seated Position:	Between middle and forward most track position
Seat Type:	Leather covered bucket seat
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	42 years per police report
Body Posture:	Presumed to be upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Manual lap and shoulder belt available - used
Air bag:	Front air bag - non-deployed. Knee air bag - non-deployed. Seat back mounted side air bag - non-deployed. Left side curtain - deployed.

Occupant Demographics - 1995 Volkswagen Jetta III

	Driver
Age/Sex:	19/Female
Seated Position:	Front left
Seat Type:	Bucket
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	3 years per police report
Body Posture:	Presumed to be upright
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used per police report

Occupant Injuries - 2005 Lexus RX330

Driver: Unknown if the driver was injured. According to the police report, paramedics administered first aid at the scene and no one was transported.

Occupant Injuries - 1995 Volkswagen Jetta III

Driver: Not injured per the police report.

Occupant Kinematics - 2005 Lexus RX330

Driver Kinematics

The 58-year-old female driver of the case vehicle appears to have been seated in an upright posture in the leather covered bucket seat and was restrained by the 3-point manual lap and shoulder belt. The shoulder belt anchorage adjustment was in the full up position. The seat was adjusted to between the middle and forward most track position. The seat back was reclined at an 80 degree angle and the seat bottom had a 15 degree angle. At impact, the driver's safety belt pretensioner actuated as the driver began a lateral and slightly forward trajectory. The front left of the Jetta snagged on the case vehicle's right rear tire, causing the Lexus to initiate a clockwise rotation as the vehicle began to tip to its left. The driver pitched to her left but likely remained in position due to the activated seat belt pretensioner. The case vehicle's left rear tire partially separated from the axle, causing part of the undercarriage to contact the asphalt roadway, and resulting in damage to the fuel tank and fuel tank shield. The Lexus continued to rotate clockwise and rolled one quarter turn to the left, resulting in the deployment of both side curtains. During the rollover event, the driver likely engaged the deployed left side curtain with her head and left shoulder. The Lexus came to final rest still in the intersection, laying on its left side, facing southwest. The driver's seat belt was cut by fire/rescue personnel, and it is likely that this driver needed additional assistance in order to exit the vehicle.



Figure 14. Possible occupant contact, Left side curtain air bag

The police report did not indicate whether or not the driver of the Lexus was injured in the crash, but did report that the driver of the Jetta was not injured. Per the police report, paramedics administered first aid at the scene and neither driver was transported for medical treatment.

Attachment 1. Scene Diagram

