

On Site Side Air Curtain Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS02018
2002 Lexus GS300
California
June, 2002

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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 crash-worthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract The crash occurred in California in June, 2002 at 0800 hours. This was a two vehicle angle broadside type crash which occurred at a four leg intersection. The intersection is controlled by standard tri-colored traffic signals. The case vehicle, a 2002 Lexus GS300 4-door, was driven by a restrained 31-year-old male. The other vehicle, a 2000 Chevrolet Suburban, was driven by a 28-year-old female. There was a second male occupant in the other vehicle. There is no information available with regards to seated location, height or weight. The case vehicle was traveling eastbound in the middle lane of the one way street approaching the intersection with a green signal. The other vehicle was traveling southbound approaching the intersection with a red traffic signal. The driver of the other vehicle drove through the red traffic signal and the front of the other vehicle struck the left side of the case vehicle. The driver's side air curtain and side air bag deployed at this point. After impact, the case vehicle rotated counterclockwise and traveled in a counterclockwise yaw towards the south-east corner of the intersection. The right rear tire struck the concrete curb and damaged the right rear axle. The driver of the Lexus sustained a contusion to the left side of his head and muscle strains to his neck and lower back. His left shoulder was also sore.					
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Dynamic Science, Inc.
Crash Investigation
Case Number: DS02018

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BACKGROUND:

Description: This seat mounted side airbag and side curtain airbag case was identified by DSI through existing insurance contacts. The case was reported to the NHTSA on August 15, 2002. The case was assigned to DSI on August 20, 2002. An on-site investigation was conducted and all field work was completed on August 22, 2002.

Investigation Type: On Site Side Air Curtain
Crash Location: California
Crash Date: June, 2002
Notification Date: August 20, 2002
Field Work Completed: August 22, 2002

SUMMARY

Crash Site

The crash occurred in California in June, 2002 at 0800 hours. This was a two vehicle angle broadside type crash which occurred at a four leg intersection. The east roadway is a one-way street with three traffic lanes. It has an asphalt surface with a -1.4% grade. The speed limit is 48 km/h (30 mph). The north-south roadway consist of one traffic lane for each direction of travel. The north leg of the roadway has an asphalt surface with a +1.5% grade. The weather was clear and the road was dry. The speed limit is 40 km/h (25 mph). The intersection is controlled by standard tri-colored traffic signals.



Figure 1. Case vehicle direction of travel towards impact—east.

Pre-Crash

The case vehicle, a 2002 Lexus GS300 4-door, was driven by a restrained 31-year-old male (173 cm/68 in, 70 kg/155 lbs). The other vehicle, a 2000 Chevrolet Suburban, was driven by a 28-year-old female. There was a second male occupant in the other vehicle. There is no information available with regards to seated location, height or weight.

The case vehicle was traveling eastbound in the middle lane of the one way street approaching the intersection with a green signal. The other vehicle was traveling southbound approaching the intersection with a red traffic signal.

Crash

The driver of the other vehicle drove through the red traffic signal and the front of the other vehicle struck the left side (10LPEW3) of the case vehicle. On impact, the case vehicle sustained a total delta v of 20.0 km/h (12.4 mph)¹, a longitudinal delta v -12.9 km/h (-8.0 mph) and a latitudinal delta v of 15.3 km/h (9.5 mph). The driver's seat mounted side air bag and the driver's side curtain air bag deployed. The driver's seat belt pretensioner also deployed.

After impact, the case vehicle rotated counterclockwise and traveled in a counterclockwise yaw towards the south-east corner of the intersection. The right rear tire struck (03RBWN1) the concrete curb and damaged the right rear axle.

Post-Crash

The driver of the Lexus sustained a contusion to the left side of his head and muscle strains to his neck and lower back. His left shoulder was also sore. He was able to exit the vehicle on his own through the right front door. He lost two or three days of work. He went to his private doctor two days after the crash for an examination.

The police report does not indicate if the case vehicle was towed from the scene.



Figure 2. Case vehicle impact with S/E curb and final rest.



Figure 3. Case vehicle left side damage.

¹ Calculated using the missing vehicle option of WinSmash 2.12.

VEHICLE DATA -2002 Lexus GS300 four-door sedan

The 2002 Lexus four-door sedan was equipped with a five-speed automatic transmission, four wheel power assisted disc brakes, and anti-lock braking. Additional features include: ten-way power driver and passenger seats with memory feature for the driver side, automatic climate control with air filter and deodorizer, power windows, power door locks, outside temperature gauge, cruise control, a programmable garage door opener, and a compass in the rearview mirror.

VIN:	JT8BD69S220xxxxxx
Odometer:	3,011 km (1,871 miles)
Engine:	3.L I6
Reported Defects:	None noted
Cargo:	None

The 2002 Lexus GS300 was equipped with Dunlop SP Sport D8Z 225/55R16 tires. The specific tire data is as follows:

Tire	Tread	Pressure	Manufacturer Recommended Pressure
LF	8 mm (10/32 in)	193 kPa (28 psi)	221 kPa (32 psi)
LR	8 mm (10/32 in)	200 kPa (29 psi)	221 kPa (32 psi)
RF	8 mm (10/32 in)	207 kPa (30 psi)	221 kPa (32 psi)
RR	8 mm (10/32 in)	Unknown	221 kPa (32 psi)

The front seating positions in the 2002 Lexus GS300 were configured with bucket seats adjustable head restraints. The rear seating positions were configured with a bench seat with adjustable head restraints for the outboard positions.

VEHICLE DAMAGE

Exterior Damage - 2002 Lexus GS300

Damage Description:	The case vehicle sustained moderate damage to the left side and the right rear axle was damaged. Both left side doors were jammed shut.	
CDC:	Impact 1: 10LPEW2 (vehicle) Impact 2: 03RBWN1 (curb)	
Delta V (impact 1):	Total	20.0 km/h (12.4 mph)
	Longitudinal	-12.9 km/h (-8.0 mph)
	Latitudinal	15.3 km/h (9.5 mph)
	Energy	36,595 joules (26,991 ft lbs)

The Lexus GS300 sustained moderate left side damage as a result of the impact with the 2000 Chevrolet Suburban. The direct contact began 54.0 cm (21.2 in) forward of the rear axle and extended 113.0 (65.7 in) cm forward along the left side plane. Both left side doors were involved. Six crush measurements were taken along the mid-door line and were as follows: C1=0 cm (0 in), C2=23.0 cm (9.0 in), C3=28.0 cm (11.0 in), C4=21.0 cm (8.3 in), C5=12.0 cm (4.7 in), C6=0 cm (0 in).

The Lexus GS300 also sustained damage to the right rear tire as a result of the impact with the curb. The wheel and hub were broken away from the axle.

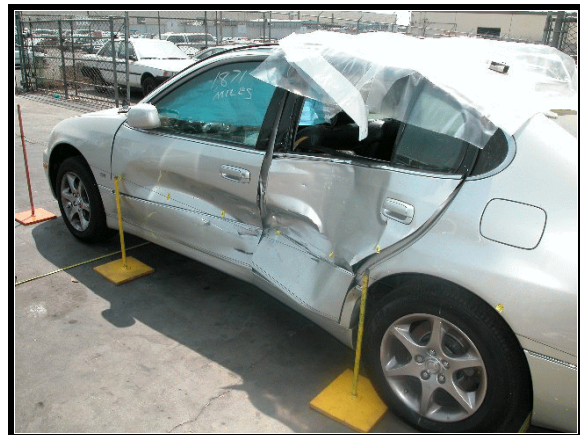


Figure 4. Left side of case vehicle, initial impact



Figure 5. Right rear tire damage from curb impact

Interior Damage - 2002 Lexus GS300

Interior damage to the Lexus GS300 was moderate and attributed to occupant contact and passenger compartment intrusion. A light strand of hair was found on the deployed left side air curtain. There was lateral intrusion of the driver's door panel and the B pillar into the driver's compartment. There was lateral intrusion of the left rear door panel and the window frame into the 2nd left seat area. The left rear window glazing disintegrated.



Figure 6. Left side intrusion

MANUAL RESTRAINT SYSTEMS - 2002 Lexus GS300

The case vehicle was equipped with three-point safety belts at all five seating positions with switchable retractors (ELR/ALR) at all but the driver's position (ELR only). The retractors for the front safety belts are equipped with pretensioners and force limiters. The driver's pretensioner actuated. The seat belt height adjuster was in the full down position.



Figure 7. Driver's seat belt (pretensioner actuated).

AIR BAG SYSTEM - 2002 Lexus GS300

The case vehicle is equipped with six air bags². A driver's steering wheel mounted airbag, a front right passenger's airbag that is top-mounted in the instrument panel. The vehicle is equipped with a driver's and front right seat mounted side airbags, and side curtain airbags mounted above the side windows. The side curtain airbags are located on the right and left sides of the vehicle above the doors and behind the headliner (they extend from the A-pillar rearward to about the middle of the rear windows on both sides.) The side curtain airbag will expand to cover the side windows. The driver's and front right passenger's frontal airbags did not deploy. The driver's seat mounted side airbag did deploy. It measured approximately 24.0 cm (9.4 in.) by 29.0 cm (11.4 in.). It was housed within a plastic module. The side airbag was not tethered or vented. There was no evidence of occupant contact. The driver's side curtain airbag did deploy. It was vaguely rectangular in shape and measured approximately 32.0 cm (12.6 in.) by 142.0 cm (55.9 in.). It contained six individual "pockets" that inflate. The side curtain airbag was not vented. There was no obvious driver contact but a hair strand was found on one of the eight "tabs" that were attached about the side curtain.

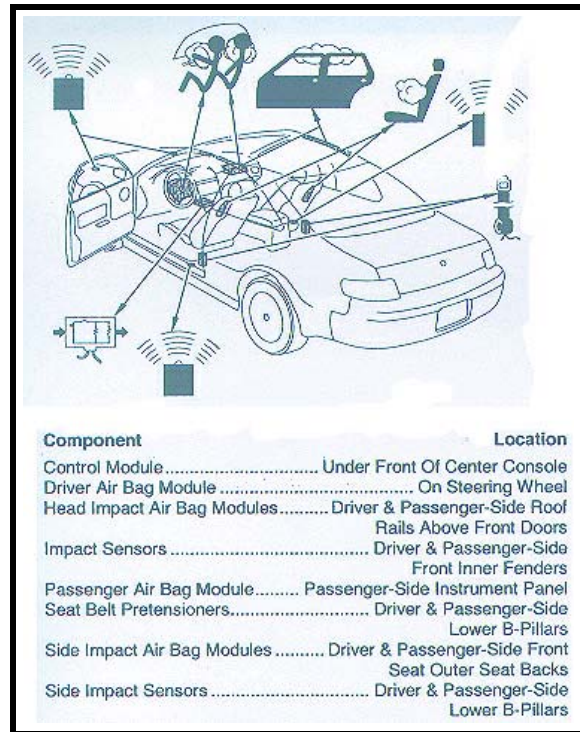


Figure 8. Case vehicle airbag system.



Figure 9. Side air curtain

² Data about the airbag system was obtained from Toyota's web page and *The Rescuer's Guide to Vehicle Safety Systems*.



Figure 10. Seat back mounted side air bag

VEHICLE DATA - 2000 Chevrolet Suburban

Description:	2000 Chevrolet Suburban	
VIN:	Unknown	
Odometer:	Unknown	
Engine:	Unknown	
Reported Defects:	None noted	
Cargo:	Unknown	
Damage Description:	Damage across entire front, per police report	
CDC:	Unknown	
Delta V:	Total	10.0 km/h (6.2 mph)
	Longitudinal	-8.7 km/h (-5.4 mph)
	Latitudinal	-5.0 km/h (-3.1 mph)
	Energy	15,394 joules (11,354 ft lbs)

OCCUPANT DEMOGRAPHICS - 2002 Lexus GS300

	Driver
Age/Sex:	31/Male
Seated Position:	Front left
Seat Type:	Leather covered bucket seat. Seat adjusted to approximately the middle track position. Seat back slightly reclined from vertical.
Height:	173 cm (68 in)
Weight:	70 kg (155 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Presumed to be greater than 10 years
Body Posture:	Normal, upright
Hand Position:	Both hands on steering wheel.
Foot Position:	Left foot on floor, right on accelerator.
Restraint Usage:	Lap and shoulder belt available, used. Shoulder belt upper anchorage adjusted to full down position.
Air bag:	Frontal air bag available, did not deploy. Left side air cushion available, deployed. Left side air bag available, deployed.

OCCUPANT DEMOGRAPHICS - other vehicle

	Driver	Occupant 2
Age/Sex:	28/Female	Unknown age/Male
Seated Position:	Front left	Unknown
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	Unknown	Unknown
Alcohol/Drug Involvement:	None	NA
Driving Experience:	Unknown	NA
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Unknown

OCCUPANT INJURIES -2002 Lexus GS300

	<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Driver:	Contusion, left side of head	190402.1,2	Side air curtain	Probable
	Neck strain	640278.1,6	Side air curtain, indirect	Probable
:	Lower back strain	640678.1,7	Side air bag, indirect	Probable

OCCUPANT INJURIES - 2000 Chevrolet Suburban

	<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Driver:	Not injured			
Occupant 2:	Not injured			

OCCUPANT KINEMATICS - 2002 Lexus GS300

The 31-year-old male driver (173 cm/68 in, 70 kg/155 lbs) of the Lexus GS300 was seated in a normal, upright position on a leather covered bucket seat. The seat was adjusted to approximately the middle track position and the seat back was slightly reclined from vertical. He was wearing the available 3-point lap and shoulder belt in the proper manner. The driver had both hands on the steering wheel. His left foot was on the floorboard; the right was on the accelerator. He was looking straight ahead and was not distracted. He was wearing sunglasses at the time of the crash. He did not see the other vehicle in time to take an evasive actions. At impact, he responded to the 10 o'clock direction of force by moving to the left and slightly forward. The left side air curtain and left side air bag both deployed. The left side of the driver's head contacted the deployed side air curtain. This contact caused a contusion and left a red mark on the left side of the driver's head. The driver's torso likely engaged the seat back mounted side air bag, but there were no indications of contact. The driver sustained a neck and lower back strain. The neck strain was likely related to the head contact to the side air curtain. The lower back strain was likely related to the contact to the left side air bag. He also complained of a sore left shoulder, but there was no associated injury.

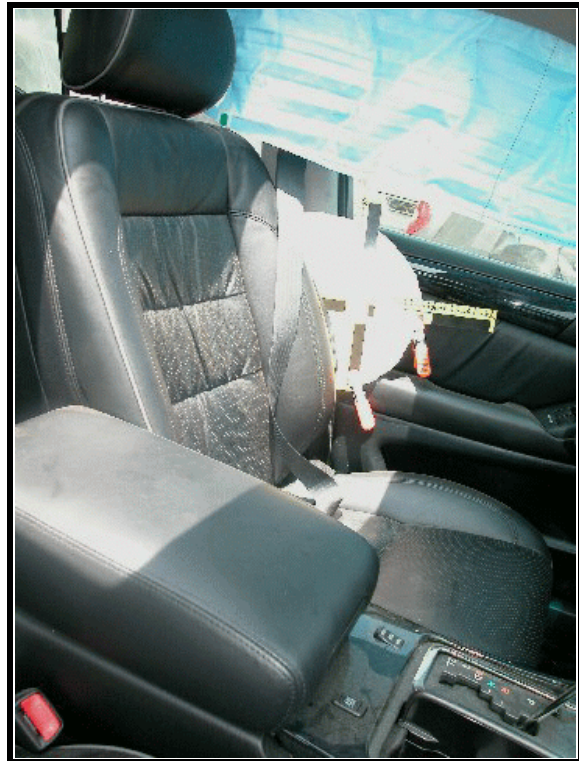


Figure 11. Driver's seated position with deployed side curtain and side air bag

ATTACHMENT 1 - SCENE DIAGRAM

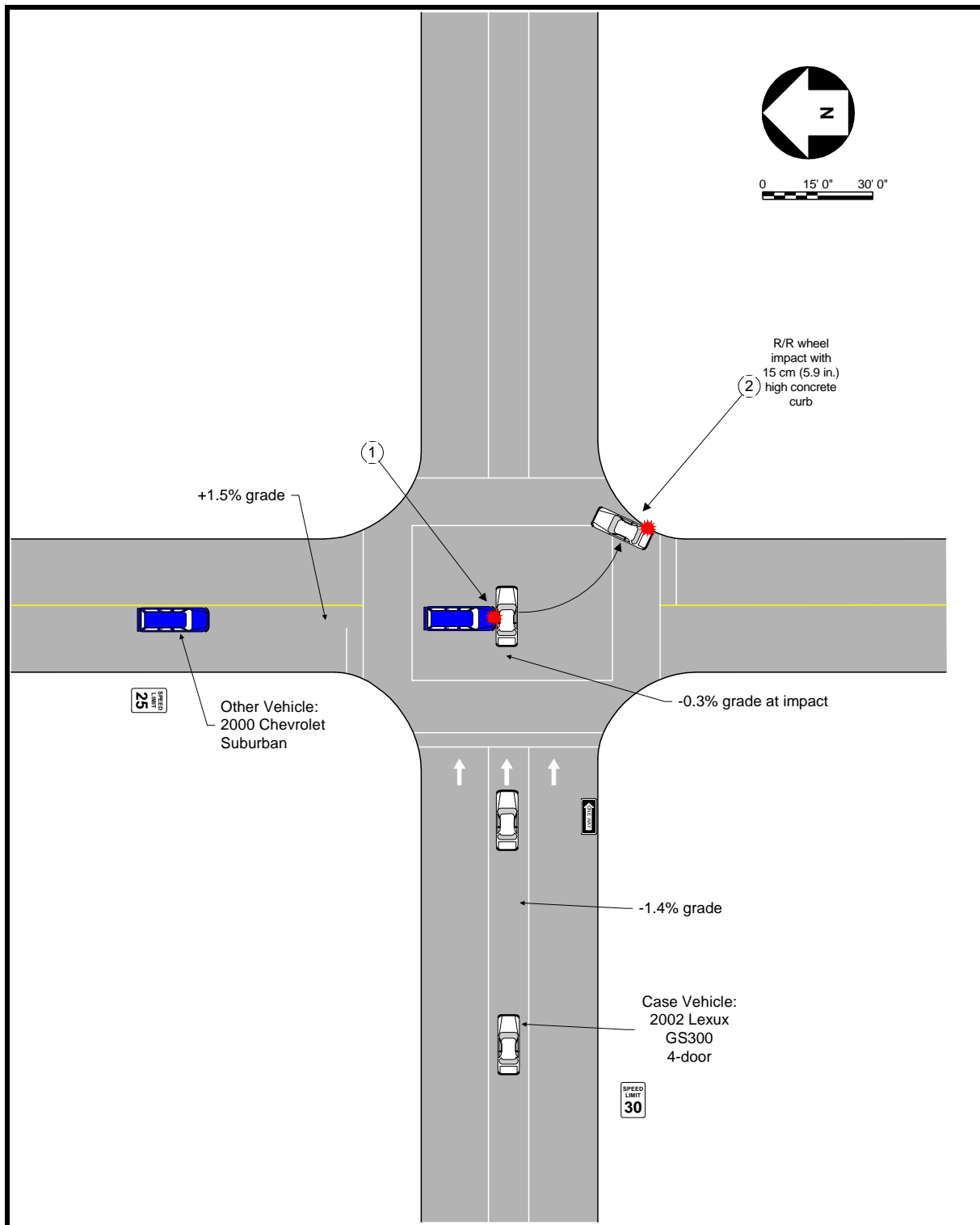


Figure 12. Scene Diagram