TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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GENERAL DYNAMICS REMOTE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION
SCI TECHNICAL SUMMARY REPORT

NASS/SCI COMBO CASE NO. 02-45-137E

VEHICLE – 2002 LEXUS SC430
LOCATION - STATE OF TENNESSEE

CRASH DATE – AUGUST 2002

Contract No. DTNH22-01-C-17002

Prepared for:

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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 are 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 remote investigation focused on the performance of the Advanced Occupant Protection System (AOPS) in a 2002 Lexus SC430. The AOPS features included dual stage frontal air bags and retractor mounted front safety belt pretensioners. The Lexus was also equipped with seat back mounted side impact air bags. The Lexus was also equipped with an Electronic Data Recorder (EDR) that was downloaded by Toyota. The output data is included in this summary report. The Lexus was occupied by an unrestrained 40-year-old male driver. The Lexus was involved in a moderate severity front-to-rear crash with the rear of a 2002 Dodge Ram pickup truck. The impact was sufficient to deploy the Lexus's frontal air bags and front safety belt pretensioners. The driver sustained a facial abrasion, neck abrasion and contusion, and a back contusion. He was transported by ambulance to a local hospital where he was treated and released. The driver of the Dodge was police reported as not injured. The front right passenger of the Dodge was police reported as sustaining "B" type injuries, however, he was not transported.			
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TABLE OF CONTENTS

GENERAL DYNAMICS REMOTE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION
SCI SUMMARY TECHNICAL REPORT
NASS/SCI COMBO CASE NO. 02-45-137E
SUBJECT VEHICLE – 2002 LEXUS SC430
LOCATION - STATE OF TENNESSEE
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BACKGROUND

This remote investigation focused on the performance of the Advanced Occupant Protection System (AOPS) in a 2002 Lexus SC430. The AOPS features included dual stage frontal air bags and retractor mounted front safety belt pretensioners. The Lexus was also equipped with seat back mounted side impact air bags. The Lexus was also equipped with an Electronic Data Recorder (EDR) that was downloaded by Toyota. The output data is included in this summary report as **Attachment A**. The Lexus was occupied by an unrestrained 40-year-old male driver. The Lexus **(Figure 1)** was involved in a moderate severity front-to-rear crash with the rear of a 2002 Dodge Ram pickup truck. The impact was sufficient to deploy the Lexus's frontal air bags and front safety belt pretensioners. The driver sustained a facial abrasion, neck abrasion and contusion, and a back contusion. He was transported by ambulance to a local hospital where he was treated and released. The driver of the Dodge was police reported as not injured. The front right passenger of the Dodge was police reported as sustaining "B" type injuries, however, he was not transported.

Figure 1. Lexus SC430

This crash was identified by the National Automotive Sampling System (NASS) PSU 45 during the weekly sampling of Police Accident Reports (PARs). This crash was selected as CDS Case No. 02-45-137E. The NASS PSU performed the vehicle inspections and scene inspection. Due to the presence of the Advanced Occupant Protection System, NHTSA assigned the tasks of case review and report preparation to the Veridian SCI team.

SUMMARY

Crash Site

This two-vehicle crash occurred during the daylight hours of August 2002 in the state of Tennessee. At the time of the crash, there were no adverse weather conditions and the asphalt roadway surface was dry. The crash occurred at an intersection of an eastbound interstate off-ramp and a north/south roadway. The eastbound interstate off-ramp was configured with three travel lanes for eastbound travel. The roadway was bordered with a yellow fog line on the north edge and a white fog line on the south edge. The

eastbound roadway curves left approaching the intersection and has a downhill grade. Traffic flow through the intersection was controlled by a three-phase traffic light. The posted speed limit for the eastbound roadway was 89 km/h (55 mph).

Crash Sequence

Pre-Crash

The 40-year-old male driver of the 2002 Lexus SC430 was operating the vehicle eastbound on the off-ramp approaching the intersection **(Figure 2)**. The driver of the 2002 Dodge Ram was stopped at the intersection. Although the driver of the Lexus braked prior to impact, there was no pre-impact physical evidence was noted at the crash site. The EDR pre-crash data indicated that the Lexus was traveling at 126.0 km/h (78.3 mph) five seconds prior to Algorithm Enable (AE) and the Lexus had slowed to 85.9 km/h (53.4 mph) 0.9 seconds prior to AE. The NASS scene schematic is included as **Figure 11** of this report.

Figure 2. Eastbound approach to intersection.

Crash

The front left area of the Lexus impacted the rear right area of the stopped Dodge **(Figure 3**). The resultant directions of force were within 12 o'clock for the Lexus and 6 o'clock for the struck Dodge. The Lexus subsequently under-rode the rear of the Dodge resulting in contact to the A-pillar of the Lexus. The impact resulted in moderate frontal damage to the Lexus and was sufficient to deploy the frontal air bags and safety belt pretensioners. The EDR data indicated that the front safety belts were in use at the time of impact. The EDR recorded a maximum velocity change of 19.5 km/h (12.1 mph) Due to both vehicles being under repair at the time of the NASS inspection no crush measurements were obtained by the NASS researcher.

Figure 3. Area of impact.

Post-Crash

The Lexus traveled across the intersection and came to rest off-road of the northeast corner of the intersection. The Dodge was displaced forward and to the left where it came to rest east of the impact area. Both vehicles were towed due to disabling damage. The driver of the Lexus was removed from the vehicle due to perceived serious injury. He was transported by ambulance to a local hospital where he was treated for his injuries and released. The driver and front right passenger of the Dodge exited the vehicle under

their own power. The driver was police reported as not injured. The front right passenger was police reported as sustaining "B" type injuries, however, he was not transported.

Vehicle Data – 2002 Lexus SC430

The 2002 Lexus SC430 was identified by the Vehicle Identification Number (VIN): JTHFN48Y02 (production sequence omitted). The odometer reading was unknown due to lack of power to the vehicle at the time of the inspection. The vehicle was a two-door convertible that was equipped with a 4.3-liter, 8-cylinder engine, with rear wheel drive and a 5-speed automatic transmission. The Lexus was also equipped 4-wheel disc brakes with ABS and Electronic Brake force distribution, Vehicle Stability Control, Traction Control, Run-flat tires and a Tire Pressure Monitoring System. The tires on the Lexus were Bridgestone Potenza RE040 radials, size P245/40R18. The 2002 Lexus was configured with front bucket seats and second row bench seat. The driver's seat was equipped with power adjustments for seat track and recline adjustments.

2002 Dodge Ram Pickup

The 2002 Dodge Ram was identified by the Vehicle Identification Number (VIN): 3D7HU18N82 (production sequence omitted). The odometer reading was 172 km (107 miles) at the time of the inspection. The vehicle was a four-door pickup truck that was equipped with a 4.7-liter, 8-cylinder engine, four-wheel drive and a 5-speed automatic transmission. The tires on the Dodge were Goodyear WRANGLER radials, size P265/70R17. The 2002 Dodge was configured with a split front bench seat with a center seat that folded to an armrest and a second row folding bench seat.

Vehicle Damage

Exterior Damage – 2002 Lexus SC430

The 2002 Lexus SC430 sustained moderate frontal damage as a result of the impact with the 2002 Dodge Ram **(Figure 4)**. The damage to the Lexus had been altered by the repairs prior to the NASS inspection, therefore no damage measurements were obtained. The front left bumper fascia, frame rail, hood, and fender engaged the rear of the Dodge; however, these components were removed and were not inspected. The front of the Lexus underrode the rear of the Dodge resulting in damage to the left A-pillar. The underride damaged consisted of crushing at the base of the A-pillar extending upward approximately half the length of the A-pillar. The windshield exhibited damage from underride contacted with the Dodge and the displaced A-pillar. The damage to the windshield consisted of several cracks beginning at the base of the windshield at the A-pillar extending to the top. The right side of the windshield was damaged from the deployment of the front right air bag. The remainder of the vehicle glazing was not damaged. The Collision Deformation Classification for the frontal impact to the Lexus was 12-FLAA6.

Figure 4. Damage altered by repairs.

2002 Dodge Ram Pickup

The 2002 Dodge Ram was under repair at the time of the inspection **(Figure 5)**. The cargo bed and other rear components had been removed from the frame for repairs **(Figure 6)**. No crush measurements were obtained by the NASS researcher. The vehicle did exhibit longitudinal displacement of the bed and rear axle. As a result of the longitudinal displacement, the front of the bed contacted the rear right of the cab. The bed appeared to have underride damage from the impact with the Lexus. The Collision Deformation Classification for this impact was 06-BREE5.

Figure 5. Rear of Dodge under repair.

Figure 6. Damaged bed.

Interior Damage – 2002 Lexus SC430

The 2002 Lexus SC430 sustained minor interior damage as a result of the crash. The damage consisted of occupant contacts to the interior. At impact, the driver initiated a forward trajectory. His knees contacted the knee bolster evidenced by two scuffs **(Figure 7)**. There was no intrusion of the interior components.

Figure 7. Occupant contacts to the lower left instrument panel.

Manual Restraints System – 2002 Lexus SC430

The 2002 Lexus SC430 was equipped with manual 3-point lap and shoulder belts for all four seating positions. The front safety belts were equipped with retractor-mounted pretensioners, which fired as a result of the crash **(Figure 8)**. The driver's safety belt was configured with a sliding latch plate and a belt-sensitive Emergency Locking Retractor (ELR). The EDR indicated that both front safety belts were buckled. However, no occupant was present in the front right seat. The lack of occupant loading and the deployment of the safety belt pretensioners in the stowed position

Figure 8. Fired front left safety belt pretensioner.

indicates no usage for the driver. The remaining safety belts were configured with sliding latch plates and belt-sensitive switchable ELR/Automatic Locking Retractors (ALR).

Advanced Occupant Protection System-2002 Lexus SC430

The 2002 Lexus SC430 was equipped with an AOPS that consisted of dual-stage frontal air bags for the driver and front right passenger positions. The EDR data did not indicated if the deployment was a single or dual stage deployment. The repair facility had cut the front left air bag out of the module **(Figure 9)** and the NASS researcher inspected the air bag in this condition. The front left air bag deployed from the center of the steering wheel hub and measured 65.0 cm (25.6") in diameter. The front left air bag module had a triangular cover flap configuration with a horizontal tear seam that was measured by the NASS researcher as 14.6 cm (5.7") in width. The air bag was configured with two tethers and two vent ports that vented the air bag at the 11 and 1o'clock positions.

Figure 9. Driver's air bag cut out of module.

The front right air bag deployed from the top of the right instrument panel and was measured by the NASS researcher as 45.0 cm (17.7") in width and 60.0 cm (23.6"). The air bag was configured with a single cover flap that measured 27.0 cm (10.6") in width and 11.0 cm (4.3") in height. The front right air bag contained no tethers and was vented internally.

Electronic Data Recorder-2002 Lexus SC430

The 2002 Lexus was equipped with an Electronic Data Recorder (EDR). The EDR was removed by the NASS researcher and was forwarded to NHTSA and Toyota for download. The EDR data was electronically forwarded to NHTSA, then to the SCI team where it was evaluated and compiled into this summary report. The EDR recorded 5.0 seconds of pre-crash data that included vehicle speed, engine RPM, accelerator pedal status, and brake pedal status. In addition, the EDR recorded belt switch status for both front seat positions, the deployment time of the frontal air bag system following the algorithm wake-up, and diagnostic faults. The EDR pre-crash data indicated the vehicle was traveling at a velocity of 126.0 km/h (78.3 mph) at 5.0 seconds prior to AE. The EDR output noted that the brake status was in the "On" position from 5.0 to 4.0 seconds prior to AE and in the "Off" position from 3.0 to 0.9 seconds prior to AE. During this time frame, the Lexus SC430 decelerated to 85.9 km/h (53.4 mph). The vehicle engine RPM's dropped during this 5.0 seconds interval, indicative of no throttle input. No faults were detected in the AOPS. The EDR recorded a longitudinal velocity change of 19.5 km/h (12.1 mph) at 160 ms into the crash event. The deployment time of the frontal air bag system was 60 ms into the event with a recorded velocity change of 5.5 km/h (3.4 mph).

Side Impact Air Bag System 2002 Lexus SC430

The 2002 Lexus SC430 was equipped with side impact air bags that were located in the front outboard seat backs **(Figure 10)**. The side impact air bag crash sensors were located in the lower B- pillars and the center of the lower doors. The side impact air bags did not deploy in this crash.

Figure 10. Location of side impact air bag.

Occupant Demographics – 2002 Lexus SC430

Driver

Age/Sex:	40-year-old male
Height:	170 cm (67”)
Weight:	79 kg (174 lb)
Seat Track Position:	Mid-to-rear
Manual Restraint Use:	None Used
Usage Source:	Vehicle inspection
Eyewear:	Unknown
Type of Medical Treatment:	Transported by ambulance to a local hospital

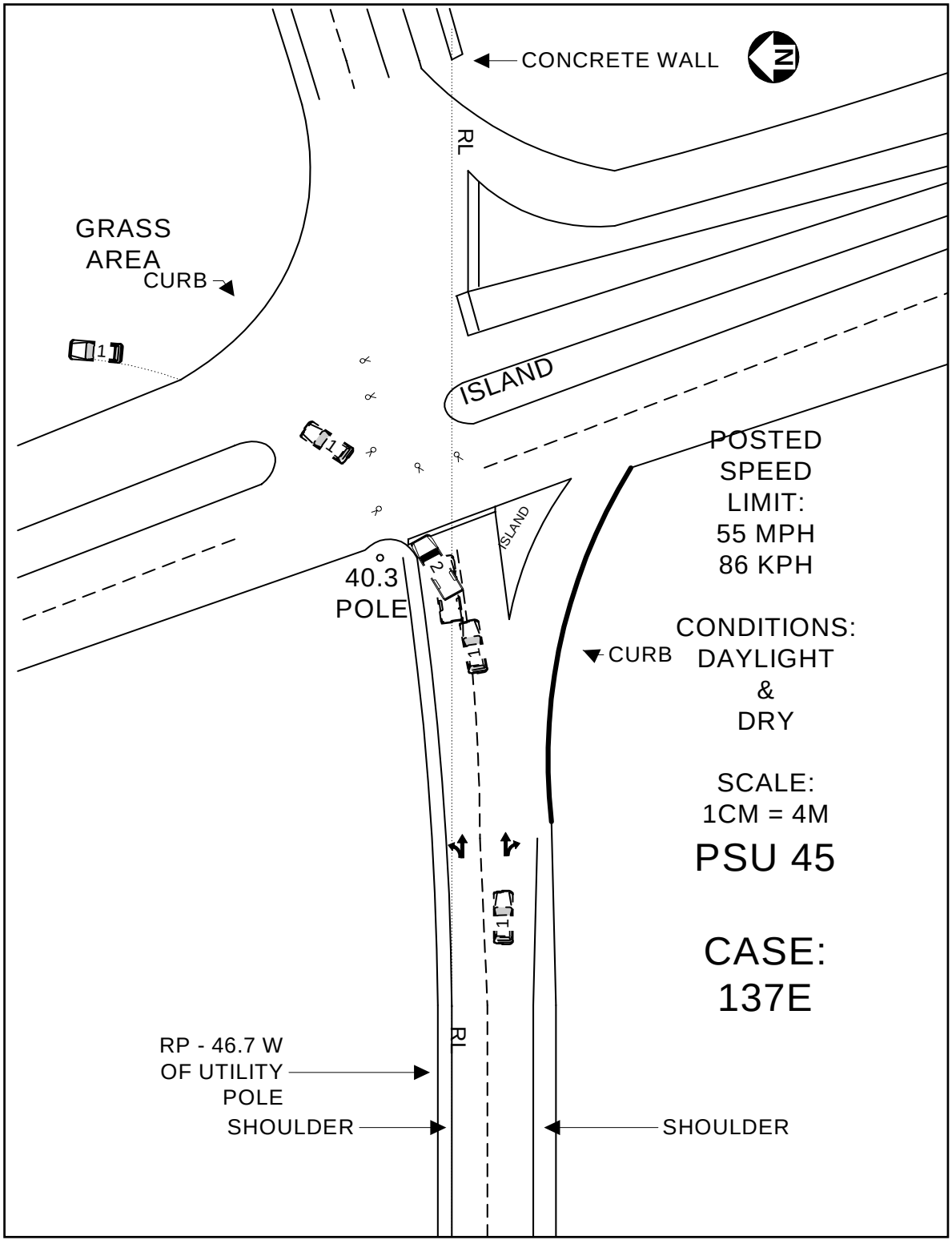
Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Multiple facial abrasion, NFS	Minor (290202.1,9)	Front left air bag
Multiple neck/throat abrasion, NFS	Minor (390202.1,9)	Front left air bag
Multiple neck/throat contusion, NFS	Minor (390402.1,9)	Front left air bag
Multiple back Contusion, NFS	Minor (690402.1,9)	Front left seat back

Injury source: Driver and Emergency Records

Driver Kinematics

The 40-year-old male driver of the 2002 Lexus SC430 was seated in a presumed upright posture and was unrestrained. He was probably slightly out of position forward at impact due to pre-crash braking and elongated crash pulse prior to air bag deployment. The seat track was adjusted to a mid-to-rear position. At impact, the front left air bag deployed and the driver’s safety belt pretensioner actuated. The unrestrained driver initiated a forward trajectory and was contacted by the expanding air bag that resulted in the facial abrasions, neck abrasions, and neck contusion. The driver rebounded into the seat back, which resulted in a back contusion. The frontal air bag deployment prevented the driver from possible contact with the steering assembly and windshield. The driver was transported by ambulance to a hospital where he was treated and released.



NASS Scene Schematic: Figure 11