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SCI/NASS COMBINATION 208-COMPLIANT INVESTIGATION

CASE NUMBER - NASS-2004-49-132G

LOCATION - Texas

VEHICLE - 2004 LEXUS RX330

CRASH DATE - April 2004

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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.

Technical Report Documentation Page

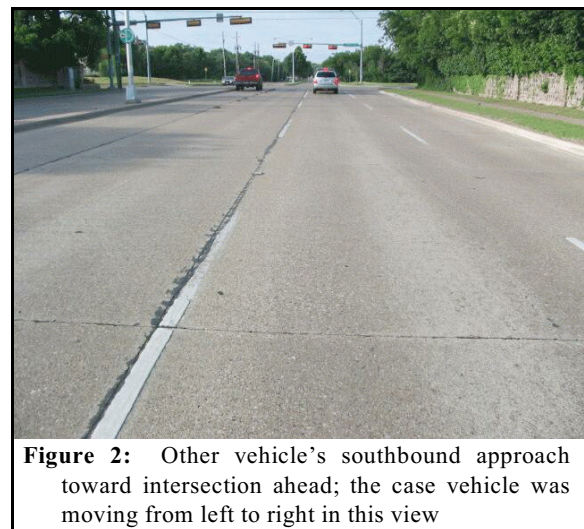
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15. <i>Supplementary Notes</i> SCI/NASS combination investigation of an air bag deployment crash involving a 2004 Lexus RX330, equipped with a certified advanced 208-compliant air bag system, and a 1998 Toyota 4-Runner					
16. <i>Abstract</i> This report covers a SCI/NASS combination investigation of an air bag deployment crash involving a 2004 Lexus RX330 (case vehicle) and a 1998 Toyota 4-Runner (other vehicle). This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection system (AOPS) features and an event data recorder (EDR). The manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The restrained case vehicle driver (85-year-old male, white, non-Hispanic) did not sustain any injuries in the crash. There was no other occupant in the case vehicle. The EDR was harvested from the case vehicle and forwarded to the manufacturer to be downloaded. The case vehicle was traveling westward in the center westbound through lane of a four-lane roadway that was part of a divided local trafficway (three through lanes in each direction separated by a curbed grass median, with a left turn lane for westbound traffic), approaching a four-leg intersection and intending to continue westward. The other vehicle was traveling southward in the center southbound through lane of the intersecting divided local trafficway. The two vehicles entered the intersection simultaneously and the case vehicle driver braked at the last second. The crash occurred within the intersection. The case vehicle's front impacted the other vehicle's left side, causing the case vehicle driver's steering-wheel mounted and knee bolster-mounted air bags to deploy. The other vehicle's dual frontal air bags also deployed. The case vehicle rotated counterclockwise approximately 270 degrees while sliding southward and came to rest straddling the north/south trafficway's concrete divider on the south leg of the intersection, heading north. The other vehicle rotated counterclockwise approximately 150 degrees while sliding to the southwest, departed the roadway at the southwest corner where it was redirected by the curb, and came to rest in the grass on the roadside heading east. Both vehicles were towed due to disabling damage. The case vehicle driver did not sustain any injuries and did not seek medical attention. The other vehicle's driver (44-year-old female, lone occupant) sustained minor injuries, was treated at the scene and did not seek further medical attention.					
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This NASS/SCI combination investigation was brought to the NHTSA's attention in early May 2004 by NASS-CDS sampling activities and was designated for SCI in late May. This crash involved a 2004 Lexus RX330 SUV (case vehicle) and a 1998 Toyota 4-Runner Limited SUV (other vehicle). The crash occurred in April 2004, at 9:40 p.m., in Texas, and was investigated by the applicable municipal police department. This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection system (AOPS) features and an event data recorder (EDR). The manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The restrained case vehicle driver (85-year-old male, white, non-Hispanic) did not sustain any injuries in the crash. There was no other occupant in the case vehicle. The EDR was harvested from the case vehicle and forwarded to the manufacturer to be downloaded. This report is based on the coded NASS case, the EDR data provided by the manufacturer and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling westward in the center westbound through lane of a four-lane roadway that was part of a divided local trafficway (three through lanes in each direction separated by a curbed grass median, with a left turn lane for westbound traffic), approaching a four-leg intersection and intending to continue westward (**Figure 1**). The other vehicle was traveling southward in the center southbound through lane of a four-lane roadway that was part of the intersecting divided local trafficway (three through lanes in each direction separated by a raised concrete median strip, with a left turn lane for southbound traffic), approaching the same intersection and intending to continue southward (**Figure 2**). The weather was clear and it was dark but lighted by street lamps. Both roadways were concrete, dry, straight, level and without defects, and the speed limit for both roadways was 56 km.p.h. [35 m.p.h.]. The intersection was controlled by automatic traffic signals. The two vehicles entered the intersection simultaneously and the case vehicle driver braked at the last second. The crash occurred within the intersection.



The case vehicle's front impacted the other vehicle's left side, causing the case vehicle driver's steering-wheel mounted and knee bolster-mounted air bags to deploy. The other vehicle's dual

frontal air bags also deployed. The case vehicle rotated counterclockwise approximately 270 degrees while sliding southward and came to rest straddling the north/south trafficway's concrete divider on the south leg of the intersection, heading north. The other vehicle rotated counterclockwise approximately 150 degrees while sliding to the southwest, departed the roadway at the southwest corner where it was redirected by the curb, and came to rest in the grass on the roadside heading east.

CASE VEHICLE

The case vehicle was a 2004 Lexus RX330 all wheel drive, four-door, five-passenger SUV (VIN: JTJHA31U240-----), equipped with a 3.3 liter V6 gasoline engine and an automatic transmission with a console-mounted selector lever. Four wheel anti-lock brakes were standard for this model. The Lexus was a certified advanced 208-compliant (CAC) vehicle, fitted with driver and front right passenger multi-stage air bags, a driver's seat track sensor, a front right occupant detection sensor, a knee bolster-mounted air bag for the driver, seat back-mounted side impact air bags for the two front seat positions, and left and right roof rail-mounted curtain wall air bags that provided inflatable protection for the first and second row outboard seat positions. The two front seat safety belt systems were equipped with retractor pretensioners and load limiters. The odometer reading is not known due to the non-functioning electronic instrument cluster, but the driver estimated 8,047 kilometers [5,000 miles]. Its wheelbase was 272 centimeters [106.9 inches]. The Lexus was towed due to disabling front end and engine damage.



Figure 3: Case vehicle's front and right side



Figure 4: Case vehicle's front and left side

The case vehicle sustained direct contact across the entire front, with its front right corner area snagging against the other vehicle's left rear area such that there was substantial right-to-left lateral movement of the case vehicle's front end components. The front bumper cover was torn off and not available for inspection. The grille was shattered and broken away and the front of the engine hood was crushed rearward and distorted, with the hood's right hinge broken and the hood displaced upward and leftward. Both headlamp/turn signal assemblies were shattered and broken away and the leading edges of both fenders were crushed rearward. Maximum crush was recorded as 9 centimeters [2.4 inches] near the center of the front bumper. The case vehicle's front right corner area snagged against the other vehicle and all of the components in the case vehicle's front overhang were displaced to the left. The right fender was crushed inward from the snagging as well as

rearward from the initial engagement (**Figure 3**). The left fender sustained induced damage and was displaced outward well as being crushed rearward from the initial engagement (**Figure 4**). The wheelbase was lengthened 13 centimeters [5.1 inches] on the right and 6 centimeters [2.4 inches] on the left. None of the tires were deflated or restricted. There was a crack in the windshield on the right side and no other glazing damage. Inspection of the case vehicle's interior revealed that the left side of the instrument panel intruded slightly, measured as 3 centimeters [1.2 inches]. The steering wheel was not deformed. There were no other intrusions and there was no evidence of occupant contact on any of the interior components.

The CDC for the case vehicle's single impact was determined to be **02-FDEW-1 (50)**. The other vehicle was equipped with aftermarket running boards and much of the direct damage on the Toyota was to this add-on component, which renders this impact out of scope for the WinSMASH reconstruction program. (This is discussed further under **OTHER VEHICLE**, following the discussion of the case vehicle and its occupant.) The NASS investigator estimated that the single impact was of moderate severity (24-40 km.p.h. [15-25 m.p.h.]) for the case vehicle.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with driver and front right passenger advanced (multi-stage) air bags, a knee bolster-mounted air bag for the driver, seat back-mounted side impact air bags for the two front seat positions, and left and right roof rail-mounted curtain wall air bags that provide inflatable protection for both the front and back outboard seat positions, for a total of seven air bags. The driver's steering wheel and knee bolster air bags deployed.

The driver's frontal air bag was located in the steering wheel hub. The module cover flaps were arranged in a "Y" configuration, aligned with the steering wheel spokes (see **Figure 7**). The flaps opened at the designated tear points and there was no evidence of damage to the cover flap or the adjacent structures. The driver's air bag was round with a diameter of 55 centimeters [21.7 inches] (**Figure 5**). There was no evidence of contact on the air bag fabric. The driver's air bag had two vent ports configured as slits on the back of the air bag at the 10:00 and 2:00 o'clock positions. Each slit was approximately 5 centimeters [2.0 inches] long (**Figure 6**).



Figure 5: Front of driver's air bag

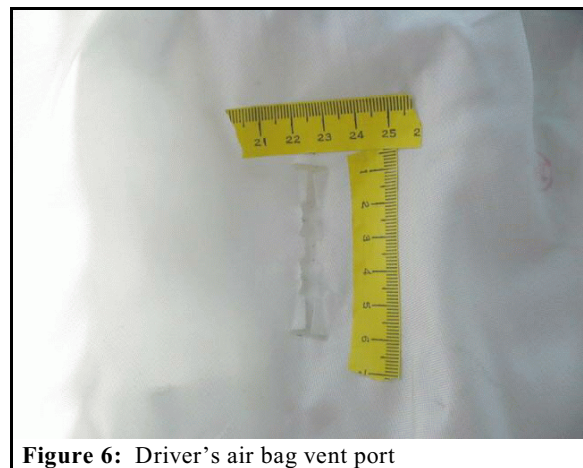


Figure 6: Driver's air bag vent port

The driver's knee bolster air bag was mounted in the lower edge of the instrument panel, directly beneath the steering column (**Figure 7**). The module had two rectangular cover flaps, each measuring 25 centimeters [9.8 inches] horizontally. The forward flap measured 5 centimeters [2 inches] vertically and the rearward flap (i.e., closest to the driver) measured 4 centimeters [1.6 inches] vertically (**Figure 8**). The flaps opened at the tear points, with no evidence of damage to the flaps or the adjacent structures. The deployment caused the knee bolster panel to become slightly displaced on the right side of the steering column, near the center console (**Figure 9**). The deployed air bag was approximately rectangular, measuring 60 centimeters [23.6 inches] horizontally and 30 centimeters [11.8 inches] vertically (**Figure 10**). There was no evidence of damage or contact on the air bag fabric.



Figure 7: Driver's seating area, showing knee bolster air bag directly beneath steering column



Figure 8: Driver's knee bolster air bag, with deployed bag stuffed into module, showing cover flaps



Figure 9: Driver's knee bolster panel displaced on the right side of the steering column

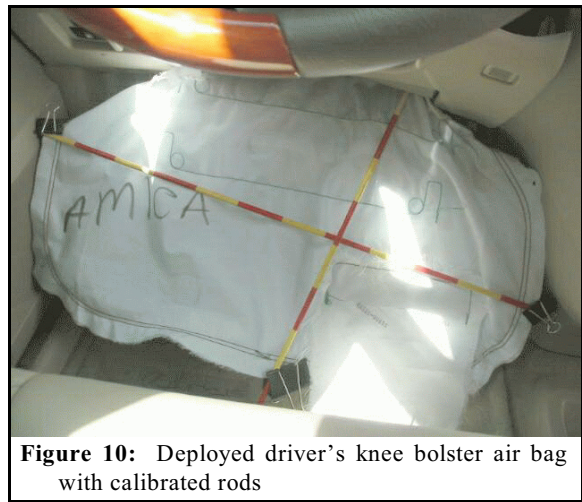


Figure 10: Deployed driver's knee bolster air bag with calibrated rods

EVENT DATA RECORDER

The case vehicle's event data recorder (EDR) was removed from the vehicle and forwarded to the manufacturer to be downloaded and decoded. The manufacturer provided a printed download report and a discussion concerning how to interpret the data. The data show that the system status

warning lamp (on the instrument panel) was off, indicating there were no problems detected in the air bag system. The EDR had recorded one prior non-deployment event, but the prior event was not related to this current crash sequence. There was no passenger detected in the front right seat position, the front right safety belt was not buckled and the case vehicle was not equipped with a manual cut-off switch for the front right air bag. The driver's seat track adjustment was recorded as being in the full rear position and the driver's safety belt was buckled.

The EDR's pre-crash data included six pre-crash readings, beginning at five seconds prior to algorithm enable. These data indicate that the case vehicle was traveling 66 km.p.h. [41.0 m.p.h.] with zero throttle and engine speed 1,200 r.p.m. at five seconds prior to algorithm enable, and these readings remained constant for three seconds. The travel speed increased to 68 km.p.h. [42.2 m.p.h.] at approximately two seconds prior to algorithm enable, with no throttle input and engine r.p.m. constant, and the driver braked at approximately one second prior to the impact. The last pre-crash reading was recorded at 0.9 seconds prior to algorithm enable and shows travel speed as 68 km.p.h. [42.2 m.p.h.], engine r.p.m. 800, accelerator off and brakes on.

The driver's air bag was commanded to deploy 10 milliseconds [0.01 seconds] after algorithm enable and the two stages in this two-stage air bag fired simultaneously. This manufacturer's EDR report includes information indicating that the command to deploy was issued 100 milliseconds [0.1 seconds] after the last pre-crash data was recorded. The report also indicates that the passenger's air bag was not commanded to deploy.

The EDR recorded post-crash longitudinal velocity change in 10 millisecond increments, from 10 milliseconds [0.01 seconds] to 150 milliseconds [0.15 seconds] after algorithm enable. The recorded numeric data and the plotted graph show a smooth, steep curve from -0.8 km.p.h. [-0.5 m.p.h.] at 10 milliseconds to -22.2 km.p.h. [-13.8 m.p.h.] at 100 milliseconds. After 100 milliseconds, the curve flattens and the data indicate a maximum of -25.3 km.p.h. [-15.7 m.p.h.] at 150 milliseconds, and the recording stops.

The EDR does not contain any information about the driver's knee bolster air bag, which did deploy. The EDR does not contain any information about the seat back-mounted side impact air bags or the roof rail-mounted curtain wall air bags, none of which deployed. The EDR also does not contain any information about the safety belt retractor pretensioners. According to the NASS researcher's findings, the driver's pretensioner did actuate while the front right passenger's did not.

CASE VEHICLE DRIVER'S KINEMATICS

The case vehicle driver (85-year-old male, white, non-Hispanic, 170 centimeters, 77 kilograms [67 inches, 170 pounds]), was restrained by the available, manual, three-point, lap-and-shoulder safety belt system. He was seated in a normal driving posture, with the seat track adjusted to the full rear position, the seat back slightly reclined, his back against the seat back, his left foot on the floor, his right foot operating the foot controls and both hands on the steering wheel. According to the EDR data, the driver braked approximately one second prior to impact. He probably moved slightly forward in response to the braking deceleration, but the safety belt retractor locked and he was held in position by the safety belt.

The front of the case vehicle impacted the left side of the other vehicle and the case vehicle driver moved slightly forward and rightward, toward the 2:00 o'clock direction of force. The steering wheel and knee bolster air bags deployed, the pretensioner actuated, and the driver was held in place by the safety belt system. The driver probably contacted the steering wheel air bag with his face and chest, and probably contacted the knee bolster air bag with his knees and/or lower legs. The case vehicle rotated counterclockwise approximately 270 degrees as it slid to rest and the driver probably moved slightly to the right but was held in place by the safety belt system. The driver exited the vehicle without assistance. He was not injured and did not receive any medical treatment.

OTHER VEHICLE

The other vehicle was a 1998 Toyota 4-Runner four wheel drive, four-door, five passenger SUV (VIN: JT3HN87R9W9-----), equipped with a 3.4 liter V6 gasoline engine and an automatic transmission with a console-mounted selector lever. Rear wheel anti-lock brakes were standard on this model. Four wheel anti-lock brakes were available as an option, but it is not known if this vehicle was so equipped. Its odometer reading is not known due to the non-functioning electronic instrument cluster, but the driver estimated 148,056 - 154,493 kilometers [92,000 - 96,000 miles]. Its wheelbase was 268 centimeters [105.3 inches]. The 4-Runner was towed due to damage to its rear axle.

The 4-Runner sustained direct contact damage on its left side, from slightly forward of the B-pillar on the front door extending rearward to the left rear wheel well and wheel/tire assembly. The 4-Runner was fitted with after market running boards along the door sills and much of the visible damage consisted of crushing and bending of the left running board. There are no measurement protocols for such after market components and the NASS researcher did not attempt to obtain a crush profile. The left rear wheel was visibly displaced rearward with the leading edge bent outward and the left rear tire was deflated. The displacement/bending of the wheel and axle was the most severe damage on the 4-Runner. The 4-Runner's left rear wheel well and wheel/tire damage reflects the snagging of the case vehicle's front right corner structures.

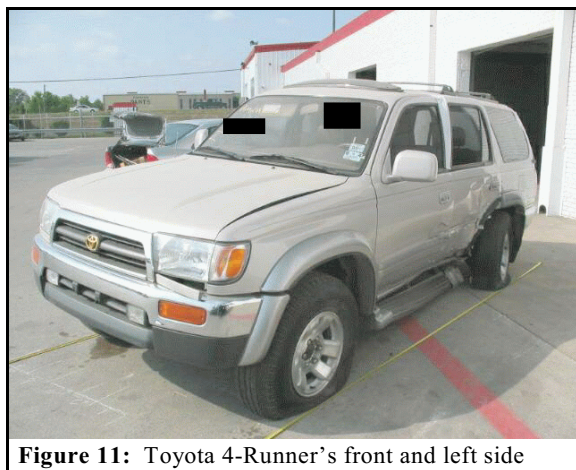


Figure 11: Toyota 4-Runner's front and left side



Figure 12: Toyota 4-Runner's left side

The CDC for the 4-Runner was determined to be **11-LZEW-3 (320)**. This impact is out of scope for the WinSMASH reconstruction program because the damage included the after market running board and because the case vehicle's right front corner snagged against the 4-Runner's left rear wheel and wheel well area. The NASS investigator estimated that this was a crash of moderate severity (24-40 km.p.h. [15-25 m.p.h.]) for the 4-Runner.

The 4-Runner's driver (44-year-old female) sustained minor contusions and abrasions. She was treated at the scene by emergency medical technicians and did not seek further medical attention. There was no other occupant in the 4-Runner.

