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SCI/NASS COMBINATION 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - NASS-2005-49-105C
LOCATION - Texas
VEHICLE - 2005 NISSAN ALTIMA
CRASH DATE - August 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.

Technical Report Documentation Page

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On-site investigation of an air bag deployment crash involving a 2005 Nissan Altima equipped with Certified Advanced 208-Compliant air bags, a 1991 Acura Legend and a 2002 Buick LeSabre

16. *Abstract*
This report covers a SCI/NASS combination investigation of an air bag deployment crash involving a 2005 Nissan Altima (case vehicle), a 1991 Acura Legend (first other vehicle) and a 2002 Buick LeSabre (second other vehicle). This crash is of special interest because the manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. In addition, the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including, retractor-type safety belt pretensioners and active head restraints. The case vehicle's restrained driver (55-year-old male) sustained minor injuries. There were no other occupants in the case vehicle. The case vehicle had been stopped, heading west in the westbound left turn lane, waiting to make a left turn. The Acura was traveling eastward, approaching the same intersection, intending to continue eastward. The Buick was stopped, heading north, in the center northbound through lane of the intersecting divided trafficway. The case vehicle accelerated, attempting to make the intended left turn. Neither the case vehicle's driver nor the Acura's driver attempted any avoidance maneuvers. The front of the case vehicle impacted the front of the Acura, causing the case vehicle's driver air bag (only) to deploy. The Acura's driver and front right passenger air bags both deployed. The case vehicle rotated counterclockwise approximately 160 degrees, traveled a short distance in a northeasterly direction and came to rest within the intersection, heading northeastward. The Acura was redirected to the south and its front impacted the front of the Buick. The Acura came to rest in the outside northbound lane of the intersecting roadway, heading slightly east of south. The Buick was pushed rearward and came to rest heading slightly east of north in the center northbound lane. The case vehicle and the Acura were towed due to disabling damage. The Buick was driven away from the scene. The case vehicle driver was transported via ambulance to a hospital where he was treated for minor injuries and released.

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BACKGROUND

NASS-2005-49-105C

This SCI/NASS combination investigation was brought to the NHTSA's attention in September 2005 by NASS-CDS sampling activities. This crash involved a 2005 Nissan Altima (case vehicle, NASS vehicle #2), a 1991 Acura Legend LS (first other vehicle, NASS vehicle #1), and a 2002 Buick LeSabre Limited (second other vehicle, NASS vehicle #3). The crash occurred in August 2005, at 4:55 a.m., in Texas, and was investigated by the applicable municipal police department. This crash is of special interest because the manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. In addition, the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including, retractor-type safety belt pretensioners and active head restraints. The case vehicle's restrained driver (55-year-old male, white, non-Hispanic) sustained minor injuries. There were no other occupants in the case vehicle. This report is based on the coded NASS case and this contractor's evaluation of the available evidence.

CRASH CIRCUMSTANCES

The case vehicle had been stopped, heading west in the westbound left turn lane of a four-lane roadway that was part of a divided trafficway (three through lanes plus a left turn lane in each direction, separated by a curbed, grass median), waiting to make a left turn to travel south (**Figure 1**). The Acura was traveling eastward in the center eastbound through lane of the same trafficway, approaching the same intersection, intending to continue eastward (**Figure 2**). The Buick was stopped, heading north, in the center northbound through lane of the intersecting divided trafficway. It was daylight, the weather was clear and the concrete road surface was dry and free of defects with a slight downhill grade for westbound traffic, and the speed limit was 64 km.p.h. [40 m.p.h.]. The case vehicle accelerated, attempting to make the intended left turn. Neither the case vehicle's driver nor the Acura's driver attempted any avoidance maneuvers prior to the crash. The crash occurred in the center through lane of the eastbound roadway, within the four-leg intersection of the two trafficways.

Figure 1: Case vehicle's westbound approach toward intended left turn at intersection

Figure 2: Acura's eastbound approach toward intersection, intending to go straight

The front of the case vehicle impacted the front of the Acura, causing the case vehicle's driver air bag (only) to deploy. The Acura's driver and front right passenger air bags both deployed. The case vehicle rotated counterclockwise

approximately 160 degrees, traveled a short distance in a northeasterly direction, and came to rest within the intersection, just west of the median, heading northeastward. The Acura was redirected to the south and its front impacted the front of the Buick. The Acura rotated a few degrees clockwise and came to rest in the outside northbound lane of the intersecting roadway, heading slightly east of south. The Buick was pushed rearward, rotated a few degrees clockwise, and came to rest heading slightly east of north in the center northbound lane. The Buick's air bags did not deploy. The case vehicle and the Acura were towed due to disabling damage. The Buick was driven away from the scene.

CASE VEHICLE: 2005 NISSAN ALTIMA

The case vehicle was a 2005 Nissan Altima SE front wheel drive, four-door, five-passenger sedan (VIN: 1N4BL11D35N------), equipped with a six-cylinder gasoline engine and an automatic transmission with a console-mounted selector lever. Four wheel anti-lock brakes were an option for this model, but it is not known if the case vehicle was so equipped. This was a Certified Advanced 208-Compliant (CAC) vehicle, equipped with dual stage driver and front right passenger air bag inflators and a front right passenger seat weight sensor. In addition, the case vehicle was equipped with safety belt retractor pretensioners and active head restraints for the two front seats. Front seat back-mounted side impact air bags and right and left side curtain air bags were optional for this model, but the case vehicle did not have these options. Its wheelbase was 280 centimeters [110.2 inches] and its odometer reading was 3,093 kilometers [1,922 miles]. The case vehicle was towed due to disabling engine and front suspension damage.

CASE VEHICLE 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 damage that began slightly inboard of the right headlamp/turn signal assembly and continued across the front for 82 centimeters [32.3 inches] (**Figures 3 - 5**). The bumper cover was torn off, and the right headlamp/turn signal and the grille were shattered and broken away. The steel bumper was crushed rearward against the bottom of the radiator and the radiator was crushed rearward. The left headlamp/turn signal assembly was displaced but intact. The engine hood was dented on the right portion of the leading edge. The

leading edge of the right fender was crushed rearward and the left fender sustained induced damage. Both front tires were restricted by deformed body panels in the wheel wells, and the wheelbase was shortened by 2 centimeters [0.8 inches] on the right and 1 centimeter [0.4 inches] on the left. None of the tires was deflated. The windshield was cracked along the lower edge and there was no other glazing damage.

Figure 5: Case vehicle's front bumper cover, which was torn off during the collision events

The crush measurements were taken along the steel bumper because the bumper cover was torn off. Maximum crush was documented as 32 centimeters [12.6 inches] at C5, slightly to the right of center. The CDC was determined to be **01-FZEW-2 (30 degrees)**. The WinSMASH reconstruction program, damage-only algorithm based on the measured crush profiles of the case vehicle and the Acura, was used on the case vehicle's single impact. The total, longitudinal and lateral delta-Vs for the case vehicle are, respectively: 22 km.p.h. [13.7 m.p.h.], -19 km.p.h. [-11.8 m.p.h.] and -11 km.p.h. [-6.8 m.p.h.]. This is a borderline reconstruction because the Acura sustained two impacts with some overlapping damage, but the results appear reasonable. This was a crash of low severity (14-23 km.p.h. [9-14 m.p.h.]) for the case vehicle.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with driver and front right passenger advanced air bags with dual-stage inflators, and with retractor pretensioners and active head restraints for the two front seats. In addition, the front right bucket seat was equipped with an occupant weight sensing system in the seat cushion. The driver was the only occupant in the case vehicle, and only the driver's air bag deployed.

Figure 6: Driver's air bag tucked away, showing cover flaps

Figure 7: Front of driver's air bag, top of air bag is oriented at the 7:00 sector

The driver's air bag was mounted in the steering wheel hub with the cover flaps in the H-configuration (**Figure 6**). The flaps measured 13 centimeters [5.1 inches] laterally, with the upper and lower flaps, respectively, 4 centimeters [1.6 inches] and 6 centimeters [2.4 inches] vertically. The cover flaps opened at the designated tear points and there was no evidence of damage to the cover flaps or the adjacent structures. The driver's air bag was round with a diameter of 62 centimeters [24.4 inches] (**Figure 7**). There were routine deployment smudges on the front of the air bag fabric, with no evidence of occupant contact or damage to the air bag.

The front right passenger's air bag was mounted in the top of the instrument panel on the right and did not deploy because the seat weight sensor correctly detected that there was no occupant in the front right seat. The case vehicle was equipped with an indicator light in the center instrument cluster (**Figure 8**) that displayed the front right air bag's automatically-determined status.

Figure 8: Passenger air bag status indicator, light on shows air bag automatically suppressed

The case vehicle was equipped with retractor-type safety belt pretensioners for the two front seats that actuated for both seats. The driver's safety belt, which was in use at the time of the crash, was locked with the webbing extended (**Figure 9**). There was no passenger in the front right seat position and the safety belt webbing was pulled taut against the right B-pillar (**Figure 10**).

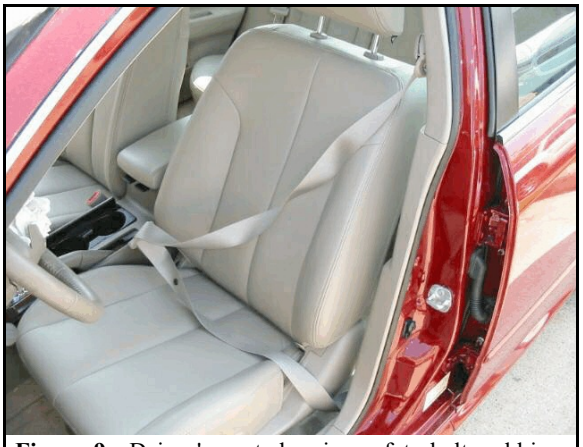


Figure 9: Driver's seat showing safety belt webbing extended because it was in use when it was locked by the actuated retractor pretensioner

Figure 10: Passenger's unused safety belt taut against right B-pillar; note, trim panel torn (arrow) by the force of the retractor pretensioner

The driver's active head restraint (**Figure 11**) did not show any evidence of its action because the system is entirely mechanical. The padded head restraint is connected to a pressure plate in the backrest of the seat. The system uses the force of the occupant's body against the seat back to move the head restraint forward, and when this force is relaxed the system returns. There was probably some slight movement of the driver's active head restraint when the driver rebounded into his seat as the case vehicle rotated counterclockwise to final rest.

Figure 11: Driver's active head restraint; the small black tag (arrow) reads " Active Head Restraint"

CASE VEHICLE DRIVER'S KINEMATICS

The case vehicle's driver (55-year-old male, white, non-Hispanic, 183 centimeters, 93 kilograms [72 inches, 205 pounds]) was restrained by his available, active, three-point, lap-and-shoulder safety belt system. He was seated in a normal driving posture, with his back against the seat back, his left foot on the floor, his right foot operating the accelerator pedal and both hands on the steering wheel. His bucket seat track was adjusted at the middle position and the seat back was slightly reclined.

The driver did not attempt any avoidance actions and his posture did not change, but he was probably leaning slightly to the right in response to the beginning of his intended left turn maneuver. The case vehicle's front was impacted by the Acura's front, causing the case vehicle's driver air bag to deploy and the driver's retractor pretensioner to actuate. The driver moved forward and rightward in response to the 1:00 o'clock impact force. He loaded against the safety belt webbing and sustained cervical and lumbar spine strains. He probably encountered the air bag with his face and chest, but there was no injury associated with this contact. His left leg flailed and his left knee impacted the knee bolster, causing an abrasion. He probably rebounded into his seat as the case vehicle rotated counterclockwise. The safety belt system held him in place as the case vehicle rotated to final rest. His position at final rest is not known, but he probably remained in his seat, in an upright posture.

CASE VEHICLE DRIVER'S INJURIES

The driver was transported via ambulance to a hospital, where he was treated and released.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Lumbar spine strain	minor 640678.1,8	Belt restraint webbing	certain	Emergency Room

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
2.	Cervical spine strain	minor 640278.1,6	Belt restraint webbing	certain	Emergency Room
3.	Left knee abrasion	minor 890202.1,2	Knee bolster	certain	Emergency Room

FIRST OTHER VEHICLE: 1991 ACURA LEGEND

The first other vehicle was a 1991 Acura Legend LX front wheel drive, four-door, five passenger sedan (VIN: JH4KA767XMC------). The Acura was equipped with four wheel, anti-lock brakes and driver and front right passenger air bags, which deployed during the crash. The Acura was towed due to disabling damage.

Figure 12: Acura's front and right side

Figure 13: Acura's front and left side

The Acura sustained direct contact damage across its entire front (**Figures 12** and **13**), with the heaviest damage at the front left corner. The left fender was crushed inward with substantial induced damage extending to the left A-pillar, the left side of the engine hood was crushed inward and bent downward, the left headlamp/turn signal assembly and grille were shattered and broken away, and the bumper cover was torn off. The steel bumper was crushed rearward against the bottom of the radiator and the radiator was crushed rearward against the engine. The right headlamp/turn signal assembly was shattered but did not break away and the leading edge of the right fender was crushed rearward. The wheelbase was shortened by 12 centimeters [4.7 inches] on the left and was unchanged on the right. The left front wheel/tire assembly was displaced rearward and was restricted against the trailing edge of the left wheel well. The right front wheel was restricted by deformed body panels in the right wheel well. The hood shifted rearward and impacted the windshield, causing extensive cracking, and there was no other glazing damage.

Because the bumper cover was torn off, the crush profile was measured along the steel bumper. Maximum crush was measured as 19 centimeters [7.5 inches] at the front left corner.

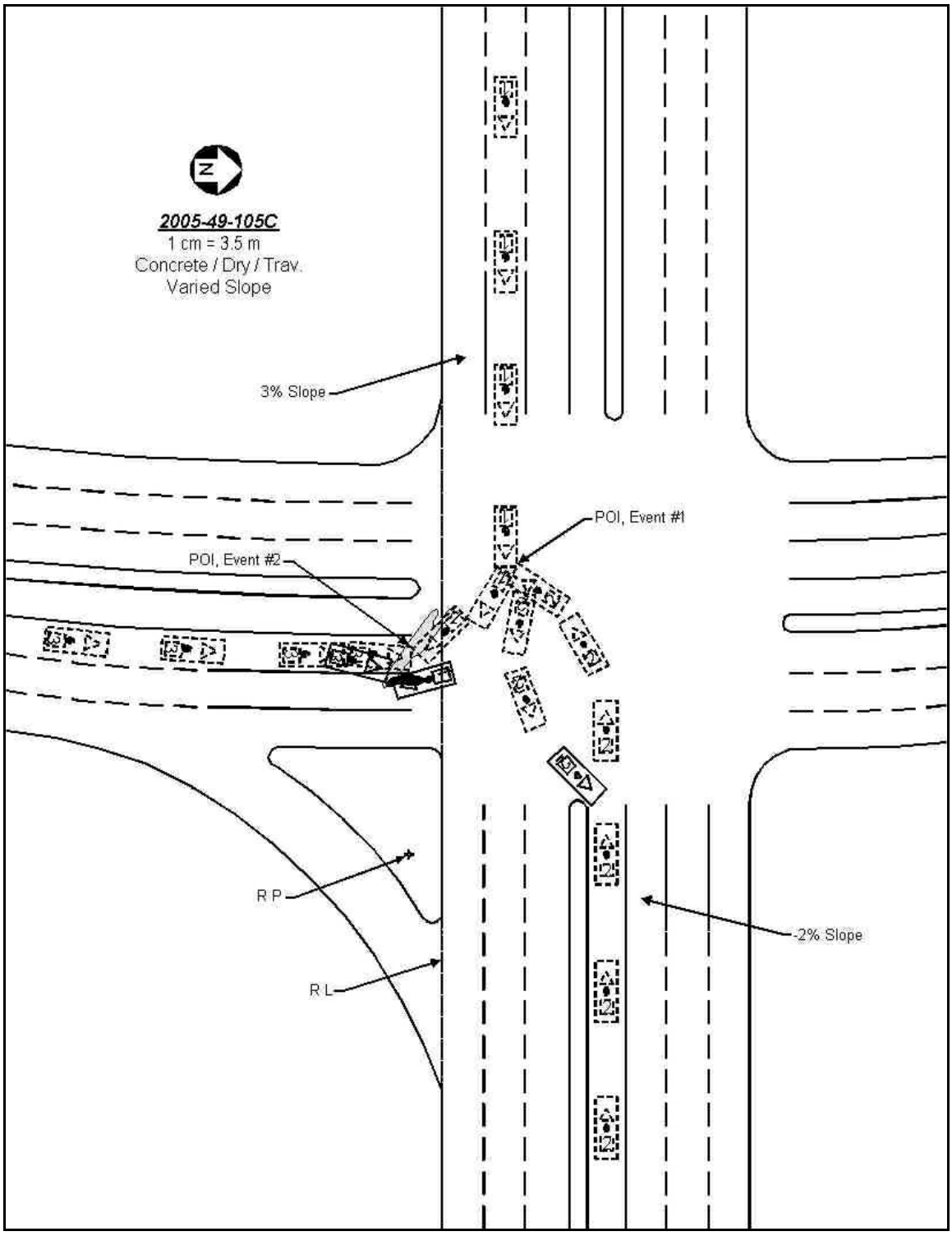
The CDC for the Acura's first impact, with the case vehicle, was determined to be **11-FYEW-1 (340 degrees)**. The WinSMASH reconstruction program, damage-only algorithm based on the measured crush profiles of the Acura and the case vehicle, was used on the Acura's most severe (first) impact. The total, longitudinal and lateral delta-Vs for the Acura are, respectively: 20 km.p.h. [12.4 m.p.h.], -19 km.p.h. [-11.8 m.p.h.] and + 7 km.p.h. [+ 4.3 m.p.h.]. This is a borderline reconstruction because the Acura sustained two impacts with some overlapping damage, but the results appear reasonable. This first impact was of low severity (14-23 km.p.h. [9-14 m.p.h.]) for the Acura.

The Acura also sustained a second impact with the Buick. The CDC for this second impact was determined to be **12-FREW-1 (0 degrees)**. Because this impact did not involve the case vehicle, it is not further discussed.

The Acura's driver (75-year-old male) and front right passenger (63-year-old female) were both restrained by their available, active, three-point, lap-and-shoulder safety belt systems. There were no other occupants in the Acura. Both were transported via ambulance to a hospital, where both were treated and released.

SECOND OTHER VEHICLE: 2002 BUICK LESABRE

The second other vehicle was a 2002 Buick LeSabre Limited front wheel drive, four-door, five-passenger sedan (VIN: 1G4HR54K22U------). Four wheel anti-lock brakes, dual frontal air bags and front seat back-mounted side impact air bags were standard equipment on this vehicle. None of the Buick's air bags deployed. The Buick was driven from the crash scene and its restrained driver (80-year-old female) was not injured. There were no other occupants in the Buick. The Buick did not contact the case vehicle and is not further discussed.



The case vehicle is vehicle #2 and the Acura is vehicle #1 in this diagram.