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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-06-005

LOCATION - TEXAS

VEHICLE - 2005 NISSAN ALTIMA

CRASH DATE - December 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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15. <i>Supplementary Notes</i> On-site certified advanced 208-compliant vehicle investigation involving a 2005 Nissan Altima equipped with manual safety belts and manufacturer certified advanced 208-compliant front air bag system.					
16. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash involving a 2006 Nissan Altima (case vehicle) and a 1991 Honda Accord (other vehicle), which were involved in an offset frontal crash on a seven-lane, divided city street. This crash is of special interest because the supplemental restraint (air bag) system in the Nissan Altima is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208, and the case vehicle's driver [60-year-old, White (non-Hispanic) male] sustained a police reported "A" (incapacitating) injury as a result of the crash. The case vehicle was traveling west in an unknown westbound lane approaching a four leg intersection. The Honda was traveling east in the eastbound center through lane also approaching the intersection. The case vehicle's driver experienced a seizure and the case vehicle drifted in a southwest direction, through the intersection and into the eastbound lanes of traffic. The front of the case vehicle impacted the front of the eastbound Honda, causing the case vehicle's driver air bag to deploy. The case vehicle rotated clockwise and continued southwest and came to rest in a driveway to a local business heading northeast. The Honda was moved westward and rotated clockwise approximately 170 degrees and came to a final rest in the center lane heading west. The case vehicle's driver was restrained by his manual, three-point, lap-and-shoulder belt. He was transported to a hospital and admitted for treatment of his injuries.					
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This investigation was brought to NHTSA's attention on or before February 17, 2006 by NASS CDS/GES sampling activities. This crash involved a 2005 Nissan Altima S (case vehicle) and a 1991 Honda Accord LX (other vehicle), which were involved in an offset frontal crash. The crash occurred in December, 2005, at 6:25 a.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the supplemental restraint (air bag) system in the Nissan Altima is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208, and the case vehicle's driver [60-year-old, White (non-Hispanic) male] sustained a police reported "A" (incapacitating) injury as a result of the crash. This contractor inspected the crash scene and case vehicle on February 24, 2006. The case vehicle driver could not be located for an interview, and the Honda was sold at auction prior to this contractor's investigation. This report is based on the police crash report, scene and vehicle inspections, case vehicle driver medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling west in an unknown westbound lane of a seven-lane, divided city street approaching a four leg intersection. The Honda was traveling east in the eastbound center through lane also approaching the intersection. The police crash report indicated that as the case vehicle approached the intersection, the driver experienced a seizure and lost control of his vehicle. It drifted in a southwest direction, through the intersection and into the eastbound lanes of traffic. The front of the case vehicle then impacted the front of the eastbound Honda, causing the case vehicle's driver air bag to deploy. As a result of the impact, the case vehicle rotated clockwise and continued southwest and came to rest in a driveway to a local business heading northeast. The Honda was moved westward and rotated clockwise approximately 170 degrees and came to a final rest in the center lane heading west.

The CDC for the case vehicle was determined to be: **12-FDEW-4 (10 degrees)**. The case vehicle sustained residual maximum crush of 85 centimeters (33.5 inches) occurring at C₆. The WinSMASH reconstruction program, missing vehicle algorithm calculated the case vehicle's Total, Longitudinal, and Lateral Delta Vs respectively as: 61.0 km.p.h. (37.9 m.p.h.), -60.1 km.p.h. (-38.5 m.p.h.), and -10.6 km.p.h. (6.6 m.p.h.). The case vehicle was towed due to damage.

The Honda was not inspected, so neither a CDC could be assigned nor crush profile determined. The WinSMASH reconstruction program, missing vehicle algorithm, calculated the Honda's Total, Longitudinal, and Lateral Delta Vs respectively as: 70.0 km.p.h. (43.5 m.p.h.), -68.9 km.p.h. (-42.8 m.p.h.), 12.2 km.p.h. (7.6 m.p.h.) The Honda was towed due to damage.

The case vehicle's driver was restrained by his manual, three-point, lap-and-shoulder safety belt. He sustained a nonanatomic brain injury due to contact with the air bag. He also sustained a fractured nose, fractured sternum, two fractured ribs and a thoracic cavity injury due to riding down the air bag and loading the steering wheel. He was hospitalized for two days. The driver's

use of his safety belt system and the deployment of his air bag prevented him from sustaining more severe injuries.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which both vehicles were traveling was a seven-lane, divided, city street, traversing in a generally east-west direction and was curved to the north. Both the eastern and western legs of the intersection had three through lanes in each direction and one left turn lane. Each through lane was approximately 3.3 meters (10.8 feet) in width with the exception of the westbound inside through lane, which was approximately 3.6 meters (11.8 feet) in width. Each left turn lane was approximately 3.6 meters (11.8 feet) in width and the raised concrete median was approximately 1 meter (3.3 feet) in width. The north and south legs of the intersection each had two through lanes. The northbound lane was approximately 7 meters (23 feet) in width near the intersection. The southbound lane was approximately 6.8 meters (22.3 feet) near the intersection. Each leg of the intersection was bordered by concrete barrier curbs. Pavement markings consisted of broken white lane lines, solid white edge lines, solid white turn lane lines, solid white stop bars and cross walks and solid yellow median lines. The intersection was controlled by three-phase traffic signals. The speed limit for both vehicles was 72 km.p.h. (45 m.p.h.). At the time of the crash the light condition was dark, but illuminated by overhead street lamps at the area of impact, the atmospheric condition was cloudy, and the roadway pavement was dry concrete. The roadway grade for the approach to impact was 3.1% positive for the case vehicle and 3.1% negative for the Honda. Traffic density was not determined, and the site of the crash was commercial. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling west in an undetermined lane of the westbound roadway (**Figure 1**). It is not known if the driver was intending to continue through the right curve and the intersection, or if he was going to turn at the intersection. The Honda was traveling east in the center through lane (**Figure 2** below). The Honda's driver was intending to continue through the left curve to the intersection. The police crash report indicated that as the case vehicle approached the intersection, the driver experienced a seizure and lost control of his vehicle. It drifted in a southwest direction, through the intersection and into the eastbound lanes of traffic. Due to the seizure, the driver most likely took no actions to avoid the cash. The crash occurred in the center eastbound through lane of the roadway (**Figure 3** below).



Figure 1: Approach of case vehicle westbound to impact (arrow), number shows meters to impact

Crash: The front of the case vehicle (**Figure 4** below) impacted the front of the Honda, causing the case vehicle's driver air bag to deploy. The front right air bag did not deploy because there was no front right passenger in the vehicle.



Figure 2: Approach of Honda eastbound to impact (arrow)



Figure 3: View southwest from case vehicle's approach to impact area (red arrow), green arrow shows area of final rest of case vehicle, blue arrow shows area of final rest of Honda



Figure 4: Front right view of damage to front of case vehicle from impact with the Honda, each increment on vertical scale is tenth of meter, each increment on rods in 5cm (2 in)



Figure 5: View southwest to area of case vehicle's final rest (arrow)

Post-Crash: As a result of the impact, the case vehicle rotated clockwise and continued southwest and came to rest in a driveway to a local business (**Figures 3 and 5**) heading northeast. The Honda, most likely braking at the time of the crash, was moved westward and rotated clockwise approximately 170 degrees and came to a final rest in the center lane heading west (**Figure 3**).

CASE VEHICLE

The 2005 Nissan Altima was a front wheel drive, four-door sedan (VIN: 1N4AL11D15N-----) equipped with a 2.5 liter, I-4 engine and a three-speed automatic transmission with overdrive. Anti lock brakes were optional for this vehicle but it is unknown if it was so equipped. The front seating row was equipped with driver and front right passenger dual-stage air bags, a front right occupant classification system and driver and front right passenger manual, three-point, lap-and-shoulder safety belt systems with belt usage sensors, pretensioners and load limiters. Seat back-mounted side impact air bags and side curtain air bags were optional, but the case vehicle was not so equipped. The back seat was also equipped with

a LATCH system for securing child safety seats. In addition, 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 case vehicle’s wheelbase was 280 centimeters (110.2 inches). The case vehicle’s odometer reading at the time of the inspection could not be determined because the vehicle was equipped with an electronic odometer.

The various sensors in the case vehicle’s advanced occupant restraint system analyze a combination of factors including the predicted crash severity and safety belt usage to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat position, an occupant classification sensor determines if the seat is empty or occupied by a young child or child safety seat and suppresses deployment of the front right air bag.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle’s impact with the Honda involved the frontal plane. The front bumper, bumper fascia, grille, radiator, right fender, right headlamp/turn signal assembly and right front wheel were directly damaged and crushed rearward. Direct damage was difficult to determine because the bumper fascia was no longer attached to the vehicle. However, based on the damage to the bumper bar and the undeformed end width of the case vehicle, the direct damage was estimated to be approximately 113 centimeters (44.5 inches) in length. The front crush profile was taken at the bumper bar. The residual maximum crush was measured as 85 centimeters (33.5 inches) occurring at C₆ (Figure 6). The table below shows the case vehicle’s front crush profile.

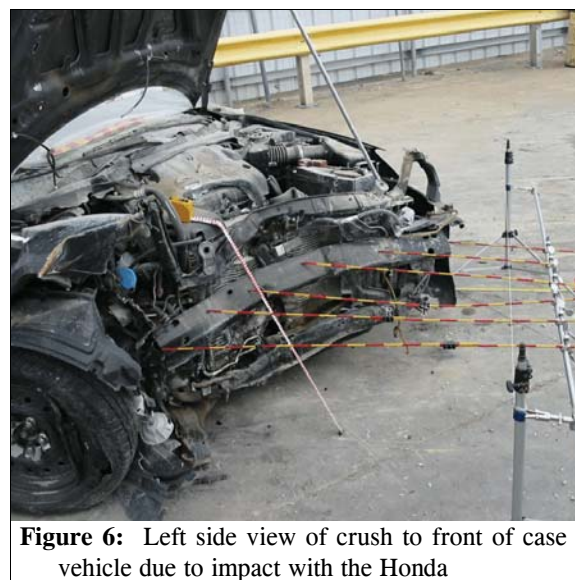


Figure 6: Left side view of crush to front of case vehicle due to impact with the Honda

Units	Event	Direct Damage		Field L	C ₁	C ₂	C ₃	C ₄	C ₅	C ₆	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	113	85	78	6	38	64	79	82	85	18	0
in		44.5	33.5	30.7	2.4	15.0	25.2	31.1	32.3	33.5	7.1	0.0

The case vehicle’s left side wheelbase was extended 8 centimeters (3.1 inches) while the right side wheelbase was shortened 48 centimeters (18.9 inches). There was induced damage to the windshield, right fender, right front wheel, right A-pillar, right front and rear doors, right sill, and the roof. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle’s exterior.

The case vehicle manufacturer's recommended tire size was: P215/60R16, and the vehicle was equipped with tires of this size. The case vehicle's tire data are shown in the table below.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	221	32	200	29	7	9	None	No	No
RF	Flat	Flat	200	29	7	9	Cut/torn sidewall	Yes	No
LR	Flat	Flat	200	29	9	11	Bead separated, rim abraded	No	Yes
RR	193	28	200	29	9	11	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior (**Figures 7 and 8**) revealed evidence of occupant contact to the driver's air bag and safety belt. There was no deformation of the steering wheel but the steering column appeared to be slightly compressed. There were numerous intrusions to the passenger compartment. The most severe intrusions involved 31 centimeters (12.2 inches) of longitudinal intrusion to the side panel forward of the right "A"-pillar and 21 centimeters (8.3 inches) of longitudinal intrusion of the right toe pan.



Figure 7: Overview of case vehicle's steering wheel, instrument panel and windshield



Figure 8: Overview of case vehicle's steering wheel and instrument panel

Damage Classification: Based on the vehicle inspection, the CDC for the case was determined to be: **12-FDEW-4 (10 degrees)**. The WinSMASH reconstruction program, missing vehicle algorithm, was used to reconstruct the case vehicle's Delta Vs. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 61 km.p.h. (37.9 m.p.h.), -60.1 km.p.h. (-37.3 m.p.h.), and -10.6 km.p.h. (6.6 m.p.h.). This was a borderline reconstruction and the results appear reasonable. The case vehicle was towed due to damage.

The case vehicle was equipped with manufacturer certified advanced 208-compliant, dual stage driver and front right passenger air bags. The driver's air bag deployed in this crash as a result of the case vehicle's front impact with the Honda.

The case vehicle's driver air bag was located in the steering wheel hub. The air bag module cover consisted of three asymmetrical flaps made of pliable vinyl. Each of the two top flaps had overall dimensions of 8 centimeters (3.1 inches) in width and 3.5 centimeters (1.4 inches) in height at its outside edge. There was a semicircular cut-out at the bottom of the two flaps to accommodate the manufacturer's logo located on the top of the bottom flap. The bottom flap was trapezoidal in shape and had overall dimensions of 13.5 centimeters (5.3 inches) in width at the top, 10 centimeters (3.9 inches) in width at the bottom and 6.5 centimeters (2.6 inches) in height along each of the two outer edges. The manufacturer's logo was located at the top center of the flap and formed a semicircular tab that mated to the semicircular cut-out at the bottom of the top two flaps. An inspection of the air bag module's cover flaps (**Figure 9**) and the air bag's fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed without tethers and had two vent ports, each approximately 2.5 centimeters (1 inch) in diameter, located at the 10 and 2 o'clock positions. The deployed driver's air bag (**Figure 10**) was round with a diameter of approximately 65 centimeters (25.6 inches). The distance between the mid-center of the driver's seat back, as positioned at the time of the vehicle inspection (i.e., seat track at approximate middle position, seat back upright) and the front surface of the air bag's fabric at approximate full



Figure 9: Case vehicle's driver air bag module cover flaps



Figure 10: Case vehicle's driver air bag, yellow tape shows blood stains on air bag



Figure 11: Overview of right instrument panel, front passenger air bag located in top of instrument panel

excursion was 25 centimeters (9.8 inches). An inspection of the driver's air bag fabric revealed blood stains on the front of the air bag and a water stain or some other type of stain on the back of the air bag.

The front right passenger's air bag was located in the top of the instrument panel (**Figure 11** above). This air bag did not deploy as a result of the crash. With no occupant in the right front seat, the case vehicle's advanced occupant protection system suppressed the deployment of the air bag.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [60-year-old, White (non-Hispanic) male, unknown height, 73 kilograms (160 pounds)] was seated in an unknown position. Based on the police crash report and medical records, the driver had experienced a seizure just prior to the crash. His injuries indicated he was nominally upright behind the steering wheel, but his head could have been slumped forward. His feet were on the floor, but in an unknown location, and the position of his hands is not known. The driver's seat track was located in its approximate middle position, the seat back was upright, and the tilt steering column was located in the approximate center position. It is unknown if the driver was wearing glasses or contact lenses at the time of the crash.

Based on the vehicle inspection, the case vehicle's driver was restrained by his manual, three-point, lap-and-shoulder safety belt system. Inspection of the driver's safety belt assembly revealed load abrasions on the D-ring and shoulder belt (**Figure 12**). In addition, the pretensioner had actuated and the retractor was jammed with a length of belt extended out of the retractor.



Figure 12: Arrows show load abrasions on case vehicle driver's D-ring and shoulder belt

The case vehicle's impact with the Honda caused the case vehicle driver's safety belt pretensioner to actuate and the driver's air bag to deploy. The driver continued forward and slightly rightward along a path opposite the case vehicle's 10 degree direction of principal force as the case vehicle decelerated. The driver's face and chest impacted the deployed air bag and his knees most likely impacted the knee bolster. He sustained a nonanatomic brain injury due to the air bag impact. Due to the severity of the crash, he rode down the air bag and his chest loaded the steering wheel causing a comminuted fracture of his sternum, fractures of the right 5th and 6th ribs, a thoracic cavity injury with small hemomediastinum and a nose fracture. Following impact, as the case vehicle rotated clockwise, the driver most likely moved to his left and most likely contacted the left front door with the left side of his torso. He remained restrained in his seat as the case vehicle rotated clockwise to final

rest. The driver was removed from the vehicle by rescue personnel. The driver's use of his safety belt system and the deployment of his air bag prevented him from sustaining more severe injuries.

CASE VEHICLE DRIVER INJURIES

The driver sustained police reported "A" (incapacitating) injuries and was transported by ambulance to the hospital. The driver was admitted to the hospital for two days for treatment of his injuries. The table below shows the case vehicle driver's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury ¹ , unknown if loss of consciousness but amnesia to events prior to emergency room; awake, alert, confused on arrival, GCS = 14	moderate 160602.2,0	Air bag, driver's	Probable	Hospitalization records
2	Fracture, comminuted, minimally displaced, mid-sternum, not further specified	moderate 450804.2,4	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
3	Fracture anterior right 5 th and 6 th ribs, not further specified	moderate 450220.2,1	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
4	Injury to thoracic cavity with small hemomediastinum, retro-sternal	severe 442206.4,9 ²	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
5	Fracture nose, not further specified	minor 251000.1,4	Steering wheel rim	Probable	Hospitalization records
6 7	Contusion {black eyes} bilateral eyes, not further specified	minor 297402.1,1 297402.1,2	Steering wheel rim	Probable	Hospitalization records
8	Abrasion tip of nose	minor 290202.1,4	Air bag, driver's	Probable	Emergency room records
9	Abrasion anterior chest wall, not further specified	minor 490202.1,4	Torso portion of safety belt system	Certain	Emergency room records
10	Contusion left upper chest, not further specified	minor 490402.1,2	Torso portion of safety belt system	Certain	Emergency room records

¹ The driver had a seizure which precipitated the crash. He also had a seizure in the emergency department. He sustained a known head injury during the crash.

² Because the NASS CDS Injury Coding protocol does not allow the use of the most appropriate Aspect code (i.e., "Central"), the Aspect "Unknown" is used here.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
11	Contusion {ecchymosis} upper sternal area	minor 490402.1,4	Steering wheel hub and/or spokes and rim	Certain	Hospitalization records
12	Abrasions abdomen, not further specified	minor 590202.1,8	Lap portion of safety belt system	Probable	EMS treatment record
13	Contusion left lower abdomen, not further specified	minor 590402.1,2	Lap portion of safety belt system	Probable	Emergency room records
14	Contusion right forearm, not further specified	minor 790402.1,1	Air bag, driver's	Probable	Emergency room records
15	Abrasion left knee, not further specified	minor 890202.1,2	Knee bolster, driver's, left of steering column	Probable	Emergency room records
16	Abrasion right knee, not further specified	minor 890202.1,1	Knee bolster, driver's, right of steering column	Probable	Emergency room records
17	Contusion right knee, not further specified	minor 890402.1,1	Knee bolster, driver's, right of steering column	Probable	Emergency room records
18	Abrasion right lower leg and/or right shin	minor 890202.1,1	Left instrument panel and below	Probable	Emergency room records
19	Contusion right lower leg, not further specified	minor 890402.1,1	Left instrument panel and below	Probable	Emergency room records

OTHER VEHICLE

The 1991 Honda Accord LX was a front wheel drive, two-door coupe (VIN: 1HGCB7156MA-----). The Honda was not equipped with driver or front right passenger air bags.

Damage Classification: With no inspection and no available vehicle photographs, the CDC for the Honda could not be estimated. The WinSMASH reconstruction program, missing vehicle algorithm, was used to reconstruct the Honda's Delta Vs for the impact with the case vehicle. The Total, Longitudinal, and Lateral Delta Vs are respectively: 70.0 km.p.h. (43.5 m.p.h.), -68.9 km.p.h. (-42.8 m.p.h.), 12.2 km.p.h. (7.6 m.p.h.). This was a borderline reconstruction, and the results appear reasonable. The Honda was towed due to damage.

Honda's Occupants: According to the police crash report, the Honda's driver [51-year-old, Black (unknown if Hispanic) male] was restrained by his manual, three-point, lap-and-shoulder safety belt system. The driver sustained police reported "A" injuries and was transported by ambulance to the hospital and admitted for treatment. The police crash report indicated the driver sustained a lacerated liver.

