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ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION INVESTIGATION

CASE NUMBER - IN-05-024
LOCATION - TEXAS
VEHICLE - 2005 NISSAN ALTIMA
CRASH DATE - July 2005

Submitted:

April 25, 2006
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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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16. *Abstract* This report covers an on-site investigation of an air bag deployment crash that involved a 2005 Nissan Altima (case vehicle) and a 2002 Honda Accord EX (other vehicle), which were involved in a rear-end collision on a city street. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including manufacturer certified advanced 208-compliant air bags, and the case vehicles' driver (48 year-old, male) sustained a police reported "B" (non-incapacitating) injury and the front right passenger (38-year-old, female) sustained a police reported "C" (possible) injury as a result of the crash. The case vehicle was traveling west in the center through lane of a multi-lane, divided city street approaching the Honda, which was also westbound and slowing for a red light at an intersection. The case vehicle's driver stated to police that he took his eyes off the road to answer his cellular telephone. The evidence indicated that the case vehicle's driver most likely steered left and braked in an attempt to avoid the crash. The front of the case vehicle then impacted the back of the Honda causing the case vehicle's driver and front right passenger air bags to deploy. The impact was low severity, so it is likely that only the first stage of the case vehicle's dual stage air bags deployed. As a result of the impact, the Honda was pushed forward an unknown distance and the case vehicle also continued forward to final rest. The case vehicle and the Honda came to final rest facing west near the mouth of the intersection with the front of the case vehicle in contact with the back of the Honda. The case vehicle's driver was unrestrained, and the front right passenger was restrained. The impact caused both the driver and front right passenger to continue forward opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The driver's face and chest impacted his deployed air bag. The front right passenger loaded her safety belt and her face and chest impacted her deployed air bag. The driver and front right passenger both refused transport to a medical facility.			
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IN-05-024

This investigation was brought to NHTSA's attention on July 26, 2005 by NASS CDS/GES sampling activities. This crash involved a 2005 Nissan Altima (case vehicle) and a 2002 Honda Accord EX (other vehicle), which were involved in a rear-end collision on a city street. The crash occurred in July, 2005 at 7:59 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including manufacturer certified advanced 208-compliant air bags, and the case vehicle's driver [48-year-old, White (non Hispanic) male] sustained a police reported "B" (non-incapacitating-evident) injury and the front right passenger [38-year-old, White (unknown if Hispanic) female] sustained a police reported "C" (possible) injury as a result of the crash. This contractor inspected the scene and case vehicle on August 11, 2005. The Honda had been repaired and was not inspected. The case vehicle driver refused to be interviewed. This report is based on the police crash report, scene and vehicle inspections, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling west in the center through lane of a multi-lane, divided city street approaching the Honda, which was also westbound and slowing for a red light at an intersection. The case vehicle's driver stated to police that he took his eyes off the road to answer his cellular telephone. The evidence indicated that the case vehicle's driver most likely steered left and braked in an attempt to avoid a crash. The front of the case vehicle then impacted the back of the Honda causing the case vehicle's driver and front right passenger air bags to deploy. The impact was low severity, so it is likely that only the first stage of the case vehicle's dual stage air bags deployed. As a result of the impact, the Honda was pushed forward an unknown distance and the case vehicle also continued forward to final rest. The case vehicle and the Honda came to final rest facing west near the mouth of the intersection with the front of the case vehicle in contact with the back of the Honda. At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, travel polished concrete.

The case vehicle's CDC was determined to be **12-FZEW-1** (**0** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, calculated the case vehicle's Total, Longitudinal, and Lateral Delta Vs respectively as: 14.0 km.p.h. (8.7 m.p.h.), -14.0 km.p.h. (-8.7 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The collision fit the WinSMASH reconstruction model, but the results appeared to be low. The case vehicle was towed due to damage.

The Honda was not inspected and there were no damage photographs available, so no CDC could be estimated. The WinSMASH reconstruction program, missing vehicle algorithm, calculated the Honda's Total, Longitudinal, and Lateral Delta Vs respectively as: 13.0 km.p.h. (8.1 m.p.h.), -13.0 km.p.h. (-8.1 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The collision fit the WinSMASH reconstruction model, but the results appeared to be low. The case vehicle was towed due to damage.

Immediately prior to the crash, the case vehicle's driver (48-year-old, male) was most likely seated in a nominal upright driving position; however, the position of his feet and hands is not

known. The driver's seat track was found adjusted to its rear-most position during the vehicle inspection, his seat back was found slightly reclined and the tilt steering column was found adjusted to its full down position. It is not known if the driver was wearing glasses at the time of the crash. The driver was not restrained by his manul, three-point, lap-and-shoulder safety belt system.

The case vehicle's impact with the back of the Honda caused the case vehicle's driver to continue forward opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated, and the driver's face and chest impacted his deployed air bag. Following the impact, the driver most likely rebounded back into his seat. The driver was most likely able to exit the case vehicle under his own power following the crash. The deployment of the case vehicle driver's air bag mitigated his interaction with the case vehicle's frontal interior components.

The police crash report indicated the driver sustained a "B" (non-incapacitating-evident) injury. He refused transport to a medical facility. The driver's injuries were most likely minor. However, it is not known what injuries the driver sustained in this crash.

Immediately prior to the crash, the case vehicle's front right passenger (38-year-old, female) was most likely seated in a nominal upright position; however the position of her feet and hands is not known. The passenger's seat track was found adjusted to its rear-most position during the vehicle inspection, and her seat back was found slightly reclined. It is not known if the passenger was wearing glasses at the time of the crash. The front right passenger was restrained by her three-point, lap-and-shoulder safety belt system.

The case vehicle's impact with the back of the Honda caused the front right passenger's safety belt retractor to lock and the pretensioner to activate tightening the safety belt against the passenger. The passenger continued forward opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated, and she loaded the safety belt and her face and chest contacted her deployed air bag. Following the impact, the passenger most likely rebounded back into her seat. The front right passenger was most likely able to exit the case vehicle under her own power following the crash. The front right passenger's use of her three-point, lap-and-shoulder safety belt and the deployment of her air bag mitigated her interaction with the case vehicle's frontal interior components.

The police crash report indicated the front right passenger sustained a "C" (possible) injury and refused transport to a medical facility. It is not known if the front right passenger was in fact injured in this crash.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle and the Honda were traveling was a seven-lane, divided, city street, traversing in an east and west direction. This trafficway formed a four-leg intersection with a five-lane, divided trafficway that traversed in a north and south direction. The north leg of the intersection had two southbound through lanes with one left turn lane and two northbound through lanes. The south leg of the intersection had two southbound

through lanes and two northbound through lanes with one left turn lane. The west leg of the intersection had three westbound through lanes and three southbound through lanes with one left turn lane. The east leg of the intersection had three westbound through lanes with one left turn lane and three eastbound through lanes. The average lane width was approximately 3.4 meters (11.2 feet). Both trafficways were divided by curbed medians, each approximately 1.3 meters (4.3 feet) in width. The intersection was controlled by three-phase traffic signals. Pavement markings consisted of "Bots Dots" to designate lane lines on the case vehicle's and Honda's roadway. The speed limit for the case vehicle's and Honda's roadway was 64 km.p.h. (40 m.p.h.). At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, travel polished concrete. The roadway grade on the case vehicle's and Honda's roadway was 2.2% negative. Traffic density was unknown. The site of the crash was urban residential. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling west in the center through lane approaching the Honda, which was also westbound and slowing for the red light at the intersection (**Figure 1**). The case vehicle's driver stated to police that he took his eyes off the road to answer his cellular telephone. There was no indication on the police crash report that the driver made any pre-crash avoidance maneuver. However, the damage to the front of the case vehicle was offset to the right indicating the driver likely steered left just prior to the impact. The underride damage to the case vehicle indicated the driver was most likely applying the brakes at impact. The crash occurred in the center through lane just prior to the four-leg intersection (**Figure 2**).

Figure 1: Approach of case vehicle and Honda westbound in center through lane

Figure 2: Area of impact and final rest in center westbound through lane just prior to the intersection

Crash: The front of the case vehicle (**Figure 3** below) impacted the back of the Honda causing the case vehicle's driver and front right passenger air bags to deploy. The impact was low severity, so it is likely that only the first stage of the case vehicle's dual stage air bags deployed. The damage to the case vehicle's hood indicates the case vehicle underrode the back bumper of the Honda.

Post-Crash: As a result of the impact, the Honda was pushed forward an unknown distance and the case vehicle also continued forward to final rest. Based on the police crash schematic, both

the case vehicle and the Honda came to final rest facing west near the mouth of the intersection with the front of the case vehicle in contact with the back of the Honda.

CASE VEHICLE

The 2005 Nissan Altama was a front wheel drive, four-door sedan (VIN: 1N4AL11D25C------) equipped with a 2.5 L, I4 engine; four-speed automatic transmission and power assisted, four wheel disc brakes. The front seating row was equipped with a tilt steering column, driver and front right passenger bucket seats with adjustable head restraints; driver and front right passenger manual, three-point, lap-and-shoulder safety belt systems with usage sensors and retractor-mounted pretensioners; dual-stage driver air bag and a dual-stage front right passenger air bag with an occupant classification system. The back bench seat was equipped with manual, three-point, lap-and-shoulder safety belt systems in all three seat positions, head restraints and a LATCH system for securing child safety seats. Front seat back-mounted side impact air bags, and front and rear side curtain air bags were an option, but the case vehicle was not so equipped. The case vehicle's wheelbase was 280 centimeters (110.2 inches). The odometer reading at the time of the inspection is not known because the case 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.

Figure 3: Overview of front damage to case vehicle due to impact with the back of the Honda, numbers on vertical scale are tenths of meter

Figure 4: Front left view of damage to case vehicle due to impact with the back of the Honda

Figure 5: Front right view of damage to case vehicle

Exterior Damage: The case vehicle's impact with the Honda involved the front bumper, grille hood and right headlamp/turn signal assembly (**Figures 4** and **5** above). The bumper, hood, grille and right headlamp/turn signal assembly were directly damaged and crushed rearward. The direct damage began at the front right bumper corner and extended 74 centimeters (49.1 inches) across the front end. The residual maximum crush to the bumper bar was measured as 5 centimeters (2 inches) occurring at C_6. The following table shows the case vehicle's crush profile.

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	74	5	160	0	0	0	1	2	5	43	0
in		29.1	2.0	63.0	0.0	0.0	0.0	0.4	0.8	2.0	16.9	0.0

The case vehicle's wheelbase was unaltered by the impact. Induced damage also involved the front bumper, hood and grille, as well as the right fender. Both headlamp/turn signal assemblies and the right fender had been removed and were not available for inspection.

The case vehicle'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	32nd of an inch			
LF	207	30	200	29	1	1	None	No	No
RF	214	31	200	29	2	2	None	No	No
LR	214	31	200	29	6	8	None	No	No
RR	200	29	200	29	7	9	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior (**Figure 6** below) revealed a possible makeup transfer on the top central portion of the front right air bag. In addition, the front right air bag contacted and fractured the windshield during its deployment (**Figure 7** below). No other occupant contact evidence was found, and no intrusion of the passenger compartment was observed. . Finally, there was no evidence of compression of the energy absorbing steering column (**Figure 8** below).

Damage Classification: Based on the vehicle inspection, the CDC was determined to be **12-FZEW-1** (**0** degrees). The WinSMASH reconstruction program, missing vehicle algorithm was used to reconstruct the case vehicle's Delta V. The Total, Longitudinal, and Lateral Delta Vs are,

respectively: 14.0 km.p.h. (8.7 m.p.h.), -14.0 km.p.h. (-8.7 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The collision fit the WinSMASH reconstruction model, but the results appeared to be low. The case vehicle was towed due to damage.

Figure 6: Overview of instrument panel, windshield and steering wheel

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

Figure 8: Left side view of case vehicle's steering wheel and column showing no deformation

Figure 9: Case vehicle driver's air bag module cover flaps, each increment on rod is 5 cm (2 in)

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with manufacturer certified advanced 208-compliant air bags at the driver and front right passenger positions. Both the driver's and front right passenger air bags deployed as a result of the case vehicle's impact with the Honda. This was a low severity crash, so it is likely that only the first stage of the case vehicle's dual stage air bags deployed.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points (**Figure 9**). There was no evidence of damage during the deployment to the air bag or the air bag module cover flaps. The air bag module cover consisted of three cover flaps, two at the top and one at the bottom. The cover flaps were constructed of pliable vinyl approximately 3 millimeters (0.1 inch) thick. The top flaps were 7.5 centimeters in length and 4

centimeters in height and had a rounded cut-out in the bottom center to accommodate the Nissan emblem located on the bottom flap. The bottom flap was 13.5 centimeters (5.3 inches) in length at the top and 9 centimeters (3.5 inches) in length at the bottom, and was approximately 6 centimeters (2.4 inches) in height. It was constructed with a rounded contour at the top center of the flap that formed the top portion of the Nissan emblem, which mated to the rounded cut-outs at the bottom center of the two top flaps. The deployed driver's air bag (**Figure10**) was round with a diameter of approximately 63 centimeters (24.8 inches). The air bag was designed without tethers and had two vent ports (**Figure 11**), each approximately 2.5 centimeters (1.0 inch) in diameter at the center portion of the air bag. Inspection of the air bag revealed no evidence of occupant contact.

Figure 10: Case vehicle driver's air bag

Figure 11: Arrows show case vehicle driver's air bag vent ports

The front right passenger's air bag was located on the top of the instrument panel (**Figure 7** above). An inspection of the air bag module cover flaps and the air bag 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 module cover flaps or the air bag. The air bag module cover consisted of two rectangular-shaped cover flaps (**Figure 12**). They were constructed of thin vinyl covering a 1 centimeter thick (0.4 inch) foam padding. The foam padding was attached to a metal backing plate. Both air bag module cover flaps were 28 centimeters (11 inches) in width and 5.5 centimeters in height (2.2 inches). The distance between the lower edge of the air bag module and the front edge of the instrument panel was 12 centimeters (4.7 inches). The deployed front right passenger's air bag (**Figure 13** below) was rectangular in shape with a height of approximately 53 centimeters (20.9 inches) and a width of approximately 37 centimeters (14.6 inches). The air bag was designed without tethers and had two vent ports, each approximately 3.5 centimeters (1.4 inches) in diameter, located on each side of the air bag at the 9:00 and 3:00 o'clock positions. The distance between the mid-center of the front right passenger's seat back, as positioned at the time of the vehicle inspection

Figure 12: Case vehicle's front right passenger air bag module flaps, windshield is fractured due to contact by deploying front right passenger air bag

(i.e, seat track in full rear position, seat back slightly reclined) and the front surface of the air bag at approximate full excursion was 26 centimeters (10.2 inches). The front right air bag contacted and fractured the windshield during its deployment; however, no damage to the air bag was observed due to this contact. A possible makeup transfer was found on the top right portion of the air bag (**Figure 14**). No other evidence of occupant contact to the air bag was observed.

Figure 13: Overview of front right passenger's air bag

Figure 14: Overview of location of possible makeup scuff (arrow) at top central portion of front right air bag

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [48-year-old, White (non-Hispanic) male; unknown height and weight] was most likely seated in a nominal upright driving position; however the position of his feet and hands is not known. The driver's seat track was found adjusted to its rear-most position during the vehicle inspection, his seat back was found slightly reclined and the tilt steering column was found adjusted to its full down position. It is not known if the driver was wearing glasses at the time of the crash.

The case vehicle's driver was not restrained by his manual, three-point, lap-and-shoulder, safety belt system. There was no evidence of load marks on the "D"-ring, shoulder belt or sliding latch plate. In addition, the retractor-mounted pretensioner had activated, and the belt was jammed in the retracted position.

The case vehicle's impact with the back of the Honda caused the driver to continue forward opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated, and the driver's face and chest impacted his deployed air bag. Following the impact, the driver most likely rebounded back into his seat. The driver was most likely able to exit the case vehicle under his own power following the crash. The deployment of the case vehicle driver's air bag mitigated the driver's interaction with the case vehicle's frontal interior components.

The police crash report indicated the driver sustained a "B" (non-incapacitating-evident) injury and refused transport to a medical facility. The driver's injuries were most likely minor. However, it is not known what injuries the driver sustained in this crash. It is also not known if the driver subsequently sought medical attention or lost any work days as a result of the crash.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's front right passenger [38-year-old, White (unknown if Hispanic) female; unknown height and weight] was most likely seated in a normal upright position; however the position of her feet and hands is not known. The passenger's seat track was found adjusted to its rear-most position during the vehicle inspection, and her seat back was found slightly reclined. It is not known if the passenger was wearing glasses at the time of the crash.

The front right passenger was restrained by her manual, three-point, lap-and-shoulder safety belt system. A load abrasion was found on the shoulder belt in a position on the belt consistent with usage in the crash, and a corresponding load abrasion was found on the "D"-ring (**Figure 15**). In addition, the retractor-mounted pretensioner had activated, and the retractor was jammed with a length of safety belt extended out of the retractor (**Figure 16**).

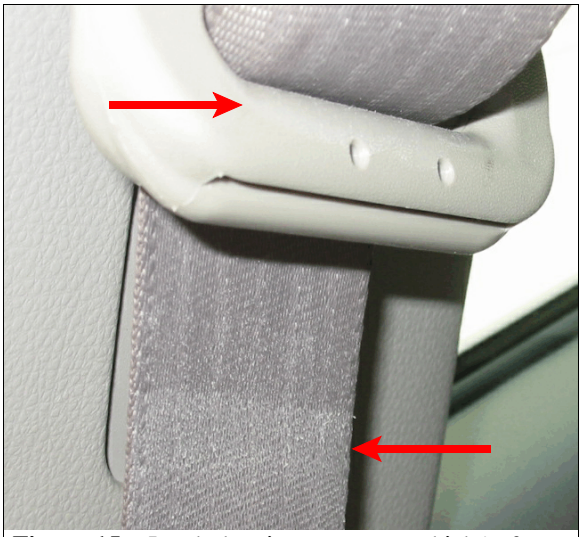


Figure 15: Load abrasions on case vehicle's front right passenger "D" ring and shoulder belt (arrows)

Figure 16: Front right passenger safety belt, retractor jammed with belt extended out of retractor, indicating activation of pretensioner while belt was in use

The case vehicle's impact with the back of the Honda caused the front right passenger's safety belt retractor to lock and the pretensioner to activate tightening the safety belt against the passenger. The passenger moved forward opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated.

The passenger loaded the safety belt and her face and chest contacted the deployed front right passenger air bag. Her contact with the air bag left a possible makeup scuff on the top central portion of the air bag. Following the impact, the passenger most likely rebounded back into her seat. The front right passenger was most likely able to exit the case vehicle under her own power following the crash. The front right passenger's use of her three-point, lap-and-shoulder safety belt and the deployment of her air bag mitigated her interaction with the case vehicle's frontal interior components.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The police crash report indicated the front right passenger sustained a "C" (possible) injury and refused transport to a medical facility. It is not known if the front right passenger was in fact injured in this crash, or lost any work days as a result of the crash.

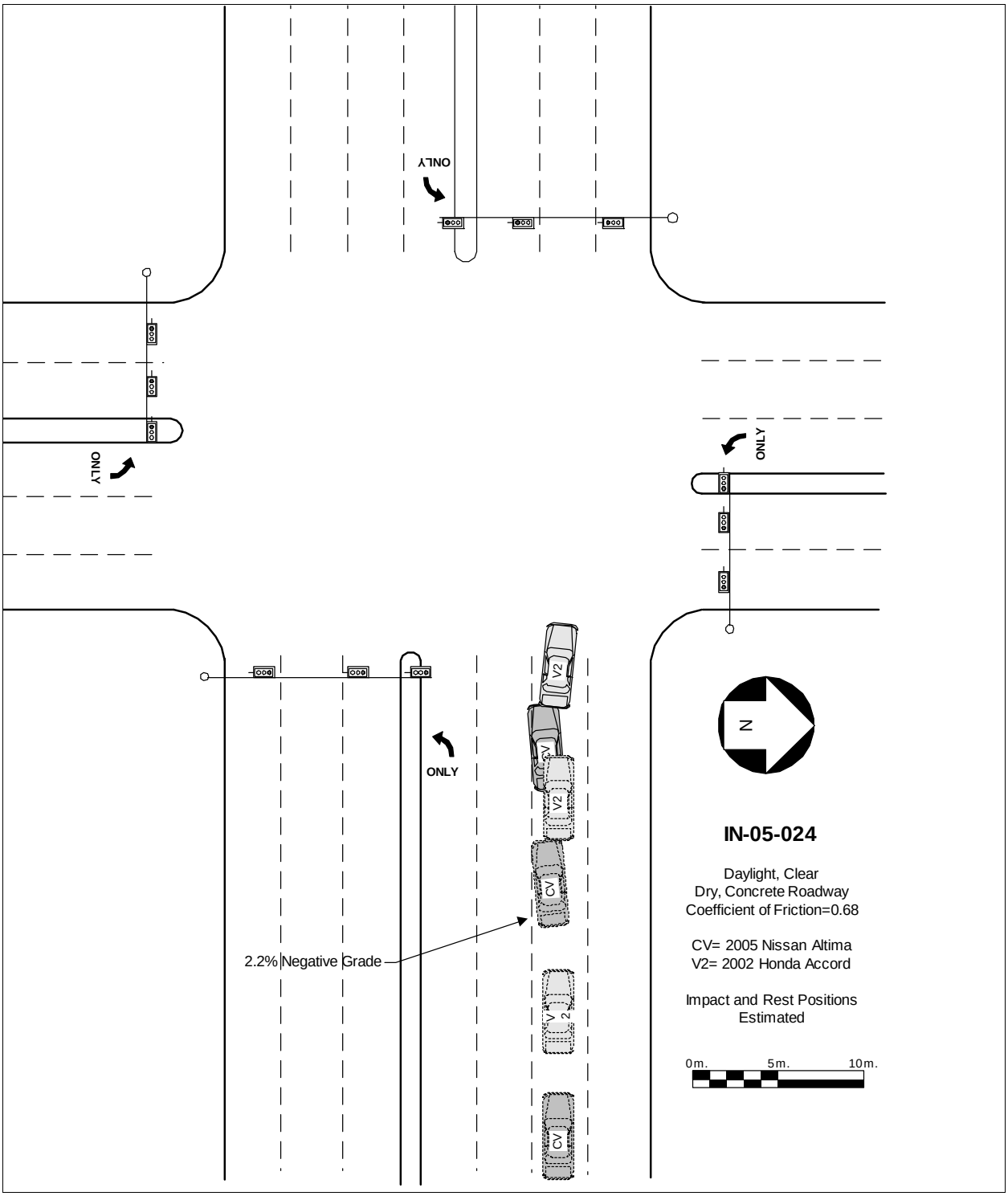
OTHER VEHICLE

The 2002 Honda Accord was a front wheel drive, four-door sedan (VIN: 1HGCG22592A------) equipped with a dual stage advanced frontal air bag system. The Honda was also equipped with seat back mounted side impact air bags and safety belt pretensioners for the driver and front right passenger.

Exterior Damage: The Honda was not inspected and there were no damage photographs available, so a CDC for the Honda could not be estimated. The WinSMASH reconstruction program, missing vehicle algorithm, was used to reconstruct the Honda's Delta V. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 13.0 km.p.h. (8.1 m.p.h.), -13.0 km.p.h. (-8.1 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The collision fit the WinSMASH reconstruction model, but the results appeared to be low. The case vehicle was towed due to damage.

Honda's Occupants: According to the police crash report, the driver of the Honda [39-year-old, White (unknown if Hispanic) female] was restrained by her manual, three-point, lap-and-shoulder, safety belt system. The police crash report indicated the driver sustained a "C" (possible) injury and refused transport to a medical facility.

According to the police crash report, the front right passenger of the Honda [43-year-old, White (unknown if Hispanic) male] was restrained by her manual, three-point, lap-and-shoulder, safety belt system. The police crash report indicated the front right passenger sustained a "C" (possible) injury and refused transport to a medical facility.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Coefficient of Friction=0.68
CV= 2005 Nissan Altima
V2= 2002 Honda Accord
Impact and Rest Positions
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