

Electronic Stability Control System Investigation/Vehicle to Vehicle
Dynamic Science, Inc./Case Number: DS06003
2005 Infiniti FX35
Washington
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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16. Abstract This on-site investigation focused on the Electronic Stability Control system in a 2005 Infiniti FX35. This three vehicle crash occurred in December 2005 at 1113 hours in an urban area of Washington. The crash occurred within the confines of an intersection. The case vehicle was a 2005 Infiniti FX35 being driven by a restrained 38-year-old male. The first other vehicle was a 1998 Dodge Dakota pickup. The third vehicle was a 2005 Ford Explorer. The Infiniti was traveling west in lane four, a left-turn only lane, on a four-lane, one way street. The Ford Explorer was traveling in lane three of the same four-lane roadway and was also in a left-turn only lane. The Dodge Dakota was traveling north in lane one on a six lane, two-way intersecting street. The driver of the Dakota pickup had a red light but did not stop, traveled into the intersection and the front of the Dakota struck the left side of the case vehicle, as it was beginning its left turn. After striking the case vehicle, the Dodge Dakota continued in a northerly direction and the front of the Dakota impacted the left front of the Ford Explorer. The driver of the case vehicle was slightly injured and was treated by paramedics at the scene. He sustained a bruise to the outer area of his left hand and complained of general soreness that was more pronounced on his left side.			
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Dynamic Science, Inc.
Crash Investigation
Case Number: DS06003

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Background:

Description

This on-site investigation focused on the Electronic Stability Control system in a 2005 Infiniti FX35. This three vehicle crash occurred in December 2005 at 1113 hours in an urban area of Washington. The crash occurred within the confines of a three-legged, T-intersection. The case vehicle was a 2005 Infiniti FX35 being driven by a restrained 38-year-old male. There no other passengers on-board. The other vehicle was a 1998 Dodge Dakota pickup being driven by a restrained 18-year-old male, the sole occupant. The third vehicle was a 2005 Ford Explorer being driven by a restrained 69-year-old male. There was a 62-year-old restrained female passenger seated in the Explorer's front right seat.

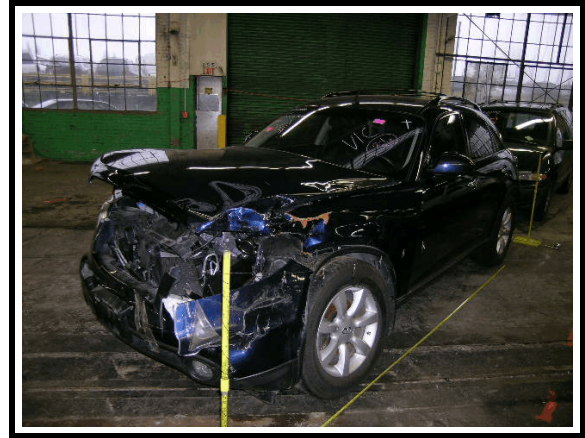


Figure 1. Left front of 2005 Infiniti FX35

The Infiniti was traveling west in lane four, a left-turn only lane, on a four-lane, one way street. The Ford Explorer was traveling in lane three of the same four-lane roadway and was also in a left-turn only lane. The Dodge Dakota was traveling north in lane one on a six lane, two-way intersecting street. This intersection is controlled by traffic signals. The driver of the Dakota pickup had a red light but did not stop, traveled into the intersection and the front of the Dakota struck the left side of the case vehicle as it was beginning its left turn. At impact, the case vehicle's seat back mounted left side air bag and left side curtain deployed. After striking the case vehicle, the Dodge Dakota continued in a northerly direction and the front of the Dakota impacted the left front of the Ford Explorer. The case vehicle and Ford Explorer both came to final rest partially in the intersection, facing northwest. The Dakota came to final rest in the intersection, facing north.

According to the police report, the driver of the Dakota sustained "possible" injuries and local fire department paramedics responded to the scene. According to the driver of the case vehicle, the driver of the Dodge Dakota had a bloody nose and was treated at the scene by paramedics. The driver of the case vehicle was slightly injured and was also treated by paramedics at the scene. He reported that he sought additional medical treatment at a walk-in clinic three days after the crash. He sustained a bruise to the outer area of his left hand and complained of general soreness that was more pronounced on his left side. The driver of the case vehicle also reported that the two occupants in the Ford Explorer were treated at the scene by paramedics, but did not appear to be injured, just shook up. No one was transported by paramedics for additional medical treatment.

This crash was identified within a group of potential cases DSI personnel provided to NHTSA. DSI located and obtained permission to inspect the case vehicle on January 17, 2006. NHTSA assigned the case on January 20, 2006. The vehicle inspection was completed on January 31, 2006. The time delay between the case assignment and the vehicle inspection was due to the

pending shipment of an Infiniti diagnostic scan tool that was obtained from a third party. A police report was obtained on February 8, 2006 and the scene inspection was completed on February 9, 2006. The scan tool was returned to the third party along with the downloaded information. Data from the module was downloaded using a Nissan diagnostics tool as hexadecimal and shipped to Nissan for interpretation. The only information provided by Nissan was that the driver was the case vehicle's only occupant and that the air bag deployed normally.

Summary

Crash Site

This three vehicle crash occurred in December 2005 at 1113 hours in an urban area of Washington. The crash occurred within the confines of a three-legged T-intersection, controlled by traffic signals. The Infiniti FX35 was traveling west in lane four on a one-way roadway consisting of four undivided asphalt travel lanes. At the intersection where the crash occurred, the westbound lanes are comprised of two dedicated right-turn only lanes and two dedicated left-turn only lanes. All four lanes have a 5% uphill grade. The Dodge Dakota was traveling north in lane one on an intersecting two-way roadway consisting of six undivided asphalt travel lanes. The three northbound lanes are separated from the three southbound lanes by painted, no passing double lane lines. The northbound lanes have a 4% uphill grade. The third vehicle was a 2005 Ford Explorer being driven by a restrained 69-year-old male. There was a 62-year-old restrained female passenger seated in the Explorer's front right seat.

The posted speed limit for westbound traffic was 40 km/h (25 mph). The speed limit for north/south traffic was 56 km/h (35 mph). At the time of the crash it was daylight, and although it was not raining, the pavement was still damp due to heavy rains from the previous evening. There were no visual obstructions present that would have played a factor in this collision.

Pre-Crash

The case vehicle was a 2005 Infiniti FX35 being driven by a restrained 38-year-old male (178 cm/70 in, 102 kg/225 lbs). There were no other occupants in the vehicle. The Infiniti had been traveling west in lane four of the four lane, one-way roadway and was stopped at the intersection, waiting to turn left.

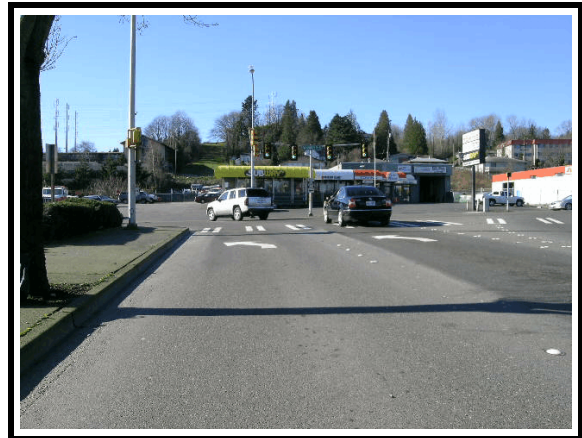


Figure 2. Approach of case vehicle to intersection - west

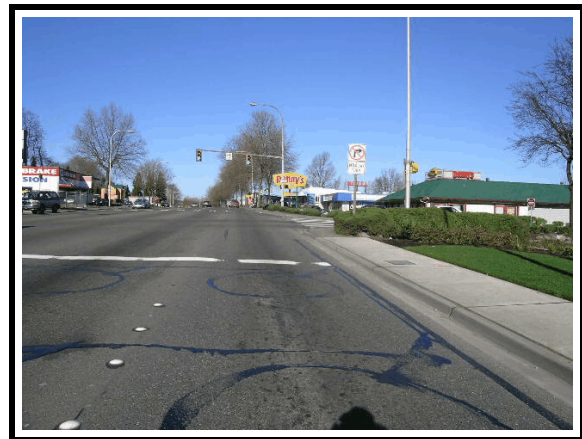


Figure 3. Approach of Dodge Dakota to intersection - north

The other vehicle was a 1998 Dodge Dakota pickup being driven by a restrained 18-year-old male. The pickup was traveling north in lane one of the six lane, two-way intersecting street.

The third vehicle was a 2005 Ford Explorer being driven by a restrained 69-year-old male. There was a 62-year-old restrained female passenger in the Explorer's front right seat. The Explorer had been traveling west in lane three of the four-lane, one way roadway and just prior to the crash, was stopped at the intersection, next to the case vehicle, also waiting to turn left. The pickup entered the intersection just as the case vehicle and the Ford Explorer were beginning their left turns.

Crash

The front of the Dodge Dakota struck the left side of the case vehicle. The impact severity was moderate and resulted in the deployment of the Infiniti's left seat back mounted side air bag and left side curtain. The missing vehicle routine of the WinSmash program computed a total delta V of 10.0 km/h (6.2 mph). The longitudinal and lateral components were -3.4 km/h (-2.1 mph) and 9.4 km/h (5.8 mph), respectively.

After the initial impact, the Dodge Dakota continued north and the front of the Dakota impacted the left side of the Ford Explorer. The Dakota came to final rest in the intersection, facing north. The case vehicle and Ford Explorer came to final rest in the intersection, facing northwest.

According to the driver of the case vehicle, after being struck by the Dodge Dakota, the front end of the Infiniti rotated clockwise and struck the left front of the Explorer. There was no damage found anywhere on the right side of the Infiniti and the police report did not indicate that the Infiniti and Explorer came in contact during the crash.

Post-Crash

Fire department paramedics responded to the scene and treated the driver of the Dakota for a bloody nose. Paramedics also checked the driver of the case vehicle, as well as the driver and front right passenger in the Ford Explorer. According to the driver of the case vehicle, the occupants of the Explorer did not appear to be injured, but were visibly shook up by the crash.



Figure 4. Approach of Ford Explorer to intersection (west)



Figure 5. Point of impact between the case vehicle and the Dodge Dakota (view looking southwest). Case vehicle turning left.

The driver of the Infiniti sustained a bruise to his outer left hand and complained of general body soreness that was more prominent on his left side. He reported that he went to a walk-in clinic three days after the crash, but no injuries were diagnosed. His official medical records were requested, but the clinic did not show any record of treatment for this driver.

The police report indicated that none of the vehicles involved were towed due to damage, but according to the driver of the case vehicle, all three vehicles were towed from the scene. The Infiniti FX35 was later declared a total loss.

Vehicle Data - 2005 Infiniti FX35

The 2005 Infiniti FX35 was identified by the Vehicle Identification Number (VIN): JNRAS08W65XXXXXX. The mileage at the time of the inspection was 41,824 km (25,988 miles). The case vehicle is a four-door hatchback, four wheel drive, multi-purpose utility vehicle with seating for five. It was equipped with a 3.5 liter 6-cylinder engine, 5 speed automatic transmission, front and rear disc anti-lock brakes, electronic traction control via the anti-lock brake system and engine management, electronic stability control, and a tilt and telescoping steering wheel. The vehicle was not equipped with the optional Lane Departure Warning System feature. It is not known if the case vehicle was equipped with the Intelligent Cruise Control System, which is an optional feature that helps the vehicle maintain a set distance from the vehicle traveling directly ahead of it.

This vehicle's electronic stability control system consists of a Vehicle Dynamic Control (VDC) feature and a Snow Mode switch. The VDC is intended to be used during most driving conditions, but can be shut off to assist drivers when they encounter certain situations. If the vehicle becomes stuck in snow and/or mud, the VDC system will, when activated, reduce the engine output in order to reduce wheel spin. In certain situations when the vehicle is stuck, it may be necessary to have full engine power. In this type of situation, the VDC system can be turned off by pushing the "VDC Off" button, located on the lower left instrument panel. When pushed, a "VDC OFF" indicator light will illuminate. To reactivate the VDC system, either the engine must be restarted or the "VDC OFF" button must be manually activated. The Snow Mode switch is intended to be used while driving or starting the vehicle on snowy and/or slippery surfaces. In order to be activated, the "SNOW" mode switch, located to the left of the VDC button, must be switched on. When the Snow Mode is in use, the



Figure 6. Location of VDC and Snow Mode switches



Figure 7. VDC and Snow Mode switches

vehicle's engine output is controlled in order to avoid wheel spin. At the time of the crash, the VDC feature was on but it did not play a factor in the pre-crash or collision events. The Snow Mode feature was not active at the time of the crash.

The Infiniti was equipped with advanced occupant protection systems, dual stage driver and front right passenger air bags, front row seat belt buckle sensors and dual front seat belt pretensioners. The vehicle was also equipped with front row driver and passenger seat back mounted side air bags and side-impact/rollover curtains that extend from the front row to the second row seat back. The case vehicle also comes equipped with front row active head restraints that are designed to activate in certain rear-end collisions.

The 2005 Infiniti FX35 was equipped with Bridgestone Potenza RE92A P265/60R18 tires. The recommended cold tire pressure was 221 kPa (32 psi) for the front and rear. This vehicle is equipped with a low tire pressure warning system that monitors all four tires. A sensor in each wheel sends a signal with information on the individual tire pressure. If the vehicle is being driven with any tire inflated to a pressure lower than 180 kPa (26 psi), a warning light will illuminate and a chime will sound for approximately 10 seconds. A driver may also get the tire pressure of all four tires by viewing this information on the navigation system screen. The specific tire information is as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	193 kPa (28 psi)	6 mm (8/32 in)	No	Rim scuffed
LR	186 kPa (27 psi)	6 mm (7/32 in)	No	None
RR	193 kPa (28 psi)	6 mm (7/32 in)	No	None
RF	186 kPa (27 psi)	6 mm (8/32 in)	No	None

The front row seating in the 2005 Infiniti FX35 was configured with dual leather bucket seats. The seats were equipped with adjustable, active head restraints that were not damaged. The active head restraints did not actuate during the collision as they are only intended to activate during certain types of rear-end crashes. The second row was configured as a leather 60/40 bench seat with folding backs. All three second row seating positions were equipped with adjustable head restraints that were not damaged.

Vehicle Damage

Exterior Damage - 2005 Infiniti FX35

The 2005 Infiniti FX35 sustained moderate left front damage as a result of the impact with the Dodge Dakota pickup. The Infiniti sustained 67.0 cm (26.4 in) of direct damage beginning 288.0 cm (113.4 in) forward of the left rear axle, extending forward along the left side. Six crush measurements were documented beginning 228.0 cm (89.8 in) forward of the left rear axle, extending forward 123.0 cm (48.4 in). The crush measurements were as follows: C1=0.0 cm (0.0 in), C2=2.0 cm (0.8 in), C3=11.0 cm (4.3 in), C4=23.0 cm (9.1 in), C5=20.0 cm (7.9 in), C6=2.0 cm (0.8 in).

The driver of the case vehicle reported that the right side of the Infiniti impacted the left side of the Ford Explorer. There was no visible damage anywhere on the right side of the Infiniti. It is possible that the Infiniti's right front tire may have contacted the Explorer, but no visible tire damage was found.

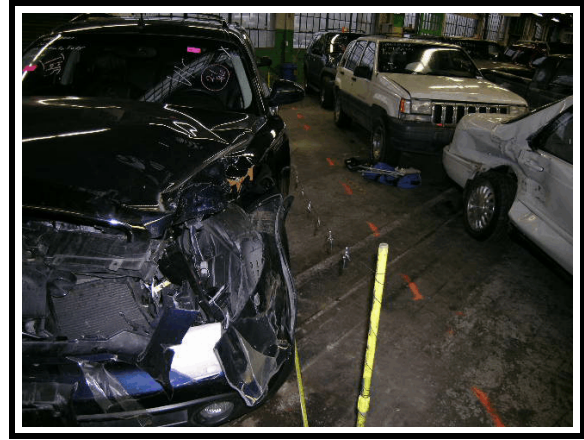


Figure 8. Left front damage - 2005 Infiniti FX35



Figure 9. Direct damage - 2005 Infiniti FX35

CDC:	10LFEW2	
Delta V:	Total	10.0 km/h (6.2 mph)
	Longitudinal	-3.4 km/h (-2.1 mph)
	Latitudinal	9.4 km/h (5.8 mph)
	Energy	15,033 joules (ft lbs)

Interior Damage - 2005 Infiniti FX35

The 2005 Infiniti FX35 sustained minor interior damage due to occupant contact and normal air bag deployment related damage.

The driver's B-pillar pretensioner actuated during the crash and was locked in place post-impact. There were black hairs found on the left roof side rail. There was no intrusion and no integrity loss. The side doors and hatch all remained closed and operational. There was no glazing damage.

Manual Restraint Systems - 2005 Infiniti FX35

The 2005 Infiniti FX35 was configured with manual 3-point lap and shoulder belts for each of the five seating positions. Both front seat belts were equipped with B-pillar pretensioners and seat belt height adjusters. The driver's B-pillar pretensioner actuated during the crash. The passenger side pretensioner did not actuate, but there was no occupant in this seating position. The driver's seat belt height adjuster was in the full down position; the right front adjuster was full up. The driver's safety belt was configured with a sliding latch plate and an emergency locking retractor (ELR). At the time of the inspection, the driver's seat belt and seat back cushion were covered with mold. The right front seat belt had a sliding latch plate and a switchable ELR/automatic locking retractor (ALR). The outboard second row seating positions were equipped with seat belt anchorage adjustments that were in the full up position. All three second row safety belts had sliding latch plates and switchable ELR/ALR belt retractors. The center seat belt can be stored in the ceiling of the vehicle when not in use. This belt can be connected to a buckle located to the left of the center seat in order to form a 3-point lap and shoulder belt.



Figure 10. Driver's seat belt - cinched in D ring. B-pillar pretensioner actuated.

The second row outboard seating positions were equipped with the lower anchor points that are part of this vehicle's Lower Anchors and Tethers for Children (LATCH) system. All three seating positions were also equipped with child safety seat top tether anchor points, located in the ceiling behind the second row seat backs.

Active restraints - 2005 Infiniti FX35

The front bucket seats in this vehicle come equipped with active head restraints. They are designed to activate only in certain rear-end crashes and will return to their original positions post-crash. The active head restraints did not activate during this collision, as there was no rear-end impact to the case vehicle.

Supplemental Restraint Systems - 2005 Infiniti FX35

The case vehicle was equipped with advanced occupant protection systems. The systems consists of dual stage driver and front right passenger air bags, a front right Passenger Sensing System, and driver and front passenger seat belt buckle usage sensors. This air bag system will monitor the severity of a collision and will then inflate the air bags based on whether or not the seat belts are in use. Air bag data was downloaded from the case vehicle by using a Nissan diagnostics scan tool. The download was successful and the information was shipped to Nissan for analysis. At this time, the only information provided by Nissan was that the driver was case vehicle's only occupant and that the air bag deployed normally. It is not known if additional information exists or will be provided.

The side curtains are designed to deploy during certain side impacts and rollover or near rollover events. In the event of a side impact, only the side curtain air bag on the side of the vehicle that was hit will deploy. According to the manufacturer, during a rollover event, both curtains will deploy and "remain inflated for a short period of time".

The driver and front right passenger positions are also equipped with seat back mounted side air bags and B-pillar seat belt pretensioners. During the impact with the Dodge Dakota, the case vehicle's driver's side air bag and side curtain deployed and the seat belt pretensioner actuated which is consistent with a side impact deployment.

The driver's side air bag was mounted in the driver's seat back. The air bag was semi-circular in shape with a height of 36.0 cm (14.2 in) and an excursion of 30.0 cm (11.8 in) in its deflated state and at its widest points. The air bag had no internal tethers. There was one circular vent port on the back of the bag located at approximately the 7 o'clock position, as viewed from the left side of the vehicle. There were no visible signs of occupant contact and no damage to the bag or module area.



Figure 11. Driver's seat back mounted side air bag

The deployed left side curtain air bag extended from the A pillar to the C pillar. There was a coverage gap present at the A-pillar. The gap consisted of a triangular shaped area measuring 31.0 cm (12.2 in) in height at the forward aspect of the bag, 32.0 cm (12.6 in) in width along the belt line and 34.0 cm (13.4 in) in length along the A-pillar. The curtain was rectangular in shape and in its deflated state, measured 143.0 cm (56.3 in) in length. The height of the front section of the curtain measured 42.0 cm (16.5 in) and the back section measured 38.0 cm (15.0 in). The air bag had one external tether, located at the front of the curtain at the A pillar. There were no vent ports. The side curtain deployed from the left roof side rail. There was no damage to the curtain. There were no indications of contact to the curtain itself, but several black hairs were found on the left roof side rail.



Figure 12. Left side curtain air bag



Figure 13. Left side curtain gap distance at the left A pillar.

Vehicle Data - 1998 Dodge Dakota

Description:	1998 Dodge Dakota 2-door Club Cab pickup	
VIN:	1B7GG22X5WSxxxxxx	
Odometer:	Unknown	
Engine:	3.9L, 6 cylinder	
Reported Defects:	None	
Cargo:	Unknown	
Damage Description:	Front end damage	
CDC:	Unknown	
Delta V:	Total	10.0 km/h (6.2 mph)
	Longitudinal	-10.0 km/h (-6.2 mph)
	Latitudinal	0.0 km/h (0.0 mph)
	Energy	5,850 joules (4,315 ft lbs)

Vehicle Data - 2005 Ford Explorer

Description:	2005 Ford Explorer XLT 4x4 4-door SUV	
VIN:	1FMZU73K05Zxxxxxx	
Odometer:	Unknown	
Engine:	4.0L, 6 cylinder	
Reported Defects:	None	
Cargo:	Unknown	
Damage Description:	Left/Front end damage	
CDC:	Unknown	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

Occupant Demographics - 2005 Infiniti FX35

	Driver
Age/Sex:	38/Male
Seated Position:	Front Left
Seat Type:	Leather covered bucket seat
Height:	178 cm (70 in)
Weight:	102 kg (225 lb)
Occupation:	Unknown
Pre-existing Medical Condition:	None
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Sitting upright, forward facing
Hand Position:	Left hand on steering wheel at the 9 o'clock position. Right hand on wheel at the 1 o'clock position.
Foot Position:	Left foot on floorboard foot-rest. Right foot on accelerator.
Restraint Usage:	Manual lap and shoulder belt available - used.
Glasses/Contacts:	None
Air bag:	Front air bag available - non-deployed. Seat back mounted side air bag available - deployed. Side curtain available - deployed.

Occupant Demographics - 1998 Dodge Dakota

	Driver
Age/Sex:	18/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	Presumed to be < 5 years
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt used per the police report

Occupant Demographics - 2005 Ford Explorer

	Driver	Occupant 2
Age/Sex:	69/Male	62/Female
Seated Position:	Front left	Front right
Seat Type:	Unknown	Unknown
Height:	Unknown	Unknown
Weight:	Unknown	Unknown
Occupation:	Presumed to be retired	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	Unknown
Driving Experience:	Presumed to be > 20 years	Not applicable
Body Posture:	Unknown	Unknown
Hand Position:	Unknown	Unknown
Foot Position:	Unknown	Unknown
Restraint Usage:	Lap and shoulder belt used per the police report	Lap and shoulder belt used per the police report

Occupant Injuries - 2005 Infiniti FX35

Driver: Injuries obtained from the driver interview. Official medical records were requested, but the clinic had no record of treatment for this driver.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Upper extremity skin contusion	790402.1,2	Door panel	Probable

Occupant Injuries - 1998 Dodge Dakota

Driver: Police report indicated a “possible” injury to this driver. Treated at the scene by paramedics for a bloody nose.

Occupant Injuries - 2005 Ford Explorer

Driver: Not injured per the police report.

Front Right Occupant: Not injured per the police report.

Occupant Kinematics - 2005 Infiniti FX35

Driver Kinematics

The 38-year-old male driver of the case vehicle was seated in an upright posture in the leather covered bucket seat and was restrained by the 3-point manual lap and shoulder belt. The shoulder belt anchorage was in the full down position. The seat was adjusted to between the middle and rearward most track position. The seat back was reclined at a 71 degree angle and the seat bottom had a 15 degree angle. This driver reported that as he began his left-turn, he saw the Dodge Dakota out of the corner of his eye, and sensing the impending crash, his body tensed up just prior to impact. At impact, the driver's B pillar safety belt pretensioner actuated and the left side air bag and side curtain deployed. The male driver initiated a lateral and slightly forward trajectory towards the 10 o'clock direction of force. He loaded the safety belt and likely engaged the deployed side air bag with the left side of his torso, and the side curtain air bag with the left side of his face and head. There were no direct indications of contact to either air bag, but several black hairs were found on the left roof side rail. This driver did not report any kind of head injury or soreness. The driver was treated at the scene by paramedics and three days after the crash, he went to a walk-in clinic for additional medical attention. His official medical records were requested, but the clinic had no record of treatment for this driver. He reported that he sustained a bruise to the outside of his left hand, most likely from contacting the left front door panel. This driver also complained of general body soreness that was more prominent on his left side.



Figure 14. Occupant contact/hair transfer to left roof side rail

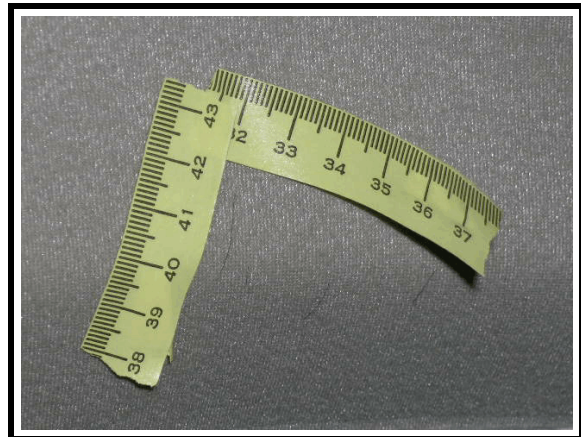


Figure 15. Close-up, hair found on left roof side rail.

Attachment 1. Scene Diagram