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CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION SYSTEM CRASH INVESTIGATION
SCI CASE NO.: CA10036

VEHICLE: 2009 NISSAN VERSA

LOCATION: NORTH CAROLINA

CRASH DATE: SEPTEMBER 2010

Contract No. DTNH22-07-C-00043

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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 are 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 side impact inflatable occupant protection system of a 2009 Nissan Versa that was involved in a left side impact crash. The Nissan was involved in an intersection crash with a 2007 Honda Element and subsequently rolled over. The Nissan Versa was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, side impact Inflatable Curtain (IC) air bags, and side air bags located in the front seat backs. The CAC system included dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The vehicle was traveling on a two-lane roadway and entered a four-leg intersection. The left plane of the Nissan was impacted by the front of the Honda. The Nissan's driver frontal air bag, left IC and left side impact air bag deployed during the crash. The Nissan was deflected to its right and separated from the impact with a counterclockwise rotation. The Nissan subsequently tripped into a right side leading one-quarter turn rollover. The restrained 69-year-old male driver of the Nissan sustained minor severity injuries. He was transported to a local hospital where he was admitted and released the following day.			
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BACKGROUND

This on-site investigation focused on the side impact inflatable occupant protection system of a 2009 Nissan Versa **(Figure 1)** that was involved in a left side impact crash. The Nissan was involved in an intersection crash with a 2007 Honda Element and subsequently rolled over. The Nissan Versa was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, side impact Inflatable Curtain (IC) air bags, and side air bags located in the front seat backs. The CAC system included dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The vehicle was traveling on a two-lane roadway and entered a four-leg intersection. The left plane of the Nissan was impacted by the front of the Honda. The Nissan's driver frontal air bag, left IC and left side impact air bag deployed during the crash. The Nissan was deflected to its right and separated from the impact with a counterclockwise rotation. The Nissan subsequently tripped into a right side leading one-quarter turn rollover. The restrained 69-year-old male driver of the Nissan sustained minor severity injuries. He was transported to a local hospital where he was admitted and released the following day.

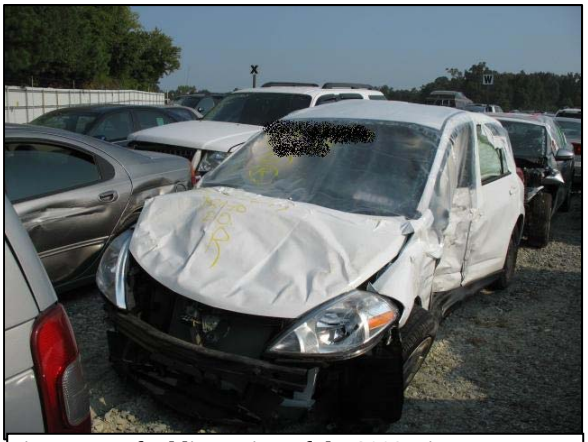

Figure 1: Left oblique view of the 2009 Nissan Versa.

The crash was identified through a visit to a regional vehicle salvage facility on September 23, 2010. Based on the impact configuration and severity of the damage, this case was assigned by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) for an on-site investigation on October 5, 2010. The on-site investigation was initiated on October 7, 2010. This investigation involved the inspection and documentation of the involved vehicles and the crash site, and a detailed interview with the driver of the Nissan. Additionally, the Event Data Recorder (EDR) of the Nissan Versa was imaged as a part of this investigation using a proprietary scan tool supplied by Nissan Motor Company.

SUMMARY

Vehicle Data

2009 Nissan Versa

The 2009 Nissan Versa four-door hatchback was manufactured in June, 2008 and was identified by the Vehicle Identification Number (VIN) 3N1BC13EX9L (production sequence deleted). The driver reported that the vehicle had been driven approximately 7,242 km (4,500 mi) at the time of the crash. The Nissan had been involved in a minor parking lot crash approximately 2 months prior to this crash. The damage was minor and was limited to cosmetic damage to the front bumper fascia. This previous damage was not repaired prior to this crash.

The front-wheel drive Nissan was powered by a 1.8-liter, inline four-cylinder engine linked to a Continuously Variable Transmission (CVT). The braking system consisted of front disc and rear drum brakes with four-wheel antilock and electronic brake force distribution. The Nissan was also equipped with a direct Tire Pressure Monitoring System (TPMS). The driver advised in the interview that the TPMS warning light was not illuminated prior to the crash. The Nissan was equipped with four Continental ContiPro Contact tires in size P185/65R15. This tire size matched the manufacturer's recommendation. The tires were mounted on OEM steel wheels with plastic covers. The vehicle manufacturer recommended cold tire pressure was 228 kPa (33 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	159 kPa (23 PSI)	6 mm (7/32 in)	None
Left Rear	165 kPa (24 PSI)	6 mm (8/32 in)	None
Right Rear	214 kPa (31 PSI)	6 mm (8/32 in)	None
Right Front	200 kPa (29 PSI)	6 mm (7/32 in)	None

The interior of the Nissan was equipped with cloth-surfaced five-passenger seating. The front bucket seats were separated by a center console and were equipped with height adjustable head restraints. At the time of the SCI inspection, both front head restraints were in the full-down position. The driver's seat track was jammed in place due to the lateral intrusion of the left front door and B-pillar and the seat itself. The seat track was adjusted 14 cm (5.5 in) forward of the full-rear position. The driver's seat back angle measured 24 degrees aft of vertical. The front right seat track was in the full-rear position, and the seat back measured 23 degrees aft of vertical. The rear seat consisted of a bench seat with split 60/40 folding backs and adjustable head restraints in the full-down position for the outboard seating positions.

The interior occupant safety systems consisted of 3-point lap and shoulder belts for the five designated seating positions, front seat safety belt retractor pretensioners, CAC dual-stage frontal

air bags, front seat-mounted side air bags and roof side rail-mounted side impact Inflatable Curtain (IC) air bags that provided protection for the four outboard seating positions.

2007 Honda Element

The 2007 Honda Element was manufactured in March, 2007 and was identified by the VIN 5J6YH28307L (production sequence deleted). The all-wheel drive Honda was powered by a 2.4-liter inline four cylinder engine linked to a four-speed automatic transmission. The braking system consisted of power-assisted front and rear disc brakes with four-wheel antilock. The Honda was also equipped with a direct TPMS. The Honda was equipped with four Goodyear Wrangler HP tires in size P215/70R16, which matched the manufacturer recommended tire size. The manufacturer recommended cold tire pressure was 228 kPa (33 PSI) for the front and 241 kPa (35 PSI) for the rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left Front	200 kPa (29 PSI)	3 mm (4/32 in)	None
Left Rear	207 kPa (30 PSI)	3 mm (4/32 in)	None
Right Rear	Flat	3 mm (4/32 in)	De-beaded
Right Front	200 kPa (20 PSI)	3 mm (4/32 in)	None

Crash Site

This crash occurred during daylight hours at the 4-leg intersection of a 2-lane north/south road and a 2-lane east/west road. The environmental conditions were clear and dry at the time of the crash. Both roadways were straight and the level in the area of the crash. The east and westbound approaches to the intersection were controlled by stop signs, each with a flashing red light positioned above the stop sign. Beyond the shoulder on the southeast corner of the intersection, the roadside had a negative one percent grade and consisted of grass over soft soil. There was a short drainage ditch measuring 5 m (16.4 ft) in length adjacent to the southeast corner. **Figure 2** depicts the eastbound approach used by the Nissan in this crash. The speed limit for both roadways was 56 km/h (35 mph). A Crash Schematic is included as **Figure 9** of this report.

Figure 2: Eastbound pre-crash trajectory view of the Nissan.

Crash Sequence

Pre-crash

The restrained 69-year-old male driver of the Nissan was operating his vehicle eastbound approaching the intersection. He was traveling home from a shopping trip and was approximately 11.2 km (7 mi) from his destination. As the vehicle approached the intersection, it was traveling at an EDR-reported speed of 47 km/h (29.2 mph). The Honda was traveling southbound on the intersecting roadway at a police-estimated speed of 56 km/h (35 mph).

The Nissan entered the intersection directly into the path the Honda. Based on the EDR data, the driver of the Nissan did not apply the brakes during the crash sequence. This supports his belief, stated in the interview, he "blacked out" for an unknown reason prior to the impact. There was no evidence present at the scene to support any pre-crash avoidance maneuver by either vehicle. Based on the residual damage to the vehicles, it is apparent that the driver of the Honda attempted to steer left to avoid the collision, changing the heading angle of the Honda five degrees Counterclockwise (CCW) just prior to the initial impact.

Crash

The front plane of the Honda impacted the left plane of the Nissan (Event 1). The direction of force was within the 10 o'clock sector for the Nissan and the 2 o'clock sector for the Honda. The force of the impact actuated both front pretensioners in the Nissan, deployed the driver's frontal air bag, the left side impact air bag and the left IC air bag. In the Honda, the pretensioners actuated and the driver's frontal air bag also deployed. The Damage Algorithm of the WinSMASH program was used to calculate the severity of the crash (delta-V). The total delta-V of the Nissan was 31 km/h (19.3 mph). The Nissan's longitudinal and lateral components were -20 (-12.4 mph) and 24 km/h (14.9 mph), respectively. The total delta-V of the Honda was 26 mph (16.2 mph) with longitudinal and lateral components of -17 km/h (-10.6 mph) and -20 km/h (-12.4 mph), respectively.

The impact deflected the Nissan to the right and caused the vehicle to initiate a CCW rotation. The Nissan followed an arcing trajectory, leading with its right side, for a distance of 11.3 m (37 ft). It traveled off the roadway at the southeast corner of the intersection. When the right wheels of the Nissan departed the roadway, they furrowed into the soft soil of the roadside. The Nissan tripped into a right side leading rollover (Event 2). It rolled one quarter turn onto its right plane and came to rest off the roadway in the southeast corner of the intersection. The distance from trip to final rest was approximately 3 m (9.8 ft).

The Honda separated from the intersection crash with a southeast trajectory and a CCW rotation. The Honda rotated 115 degrees CCW within the roadway and traveled 9.5 m (31.2 ft) toward the southeast corner of the intersection. The right rear tire de-beaded from the wheel and deposited a 5.5 m (18 ft) gouge mark in the asphalt. The Honda came to rest straddling the edge of the road

with its left and right wheels. As it approached final rest, the right side of the Honda contacted a metal sign located at the roadside. The lower left corner of the sign deformed resulting in surface abrasions to the right side of the Honda (Event 3).

Post-crash

Police, emergency medical and tow personnel responded to the crash site. The driver of the Nissan was entrapped in the Nissan by the final rest position of the vehicle on its right side, and the jammed left doors from the initial impact. The windshield of the Nissan was cut by EMS to remove the driver while he was unconscious. The driver of the Nissan was transported to a local hospital where he was admitted for one day for soft tissue injuries and checked for possible head injuries due to his loss of consciousness. The Nissan and the Honda were towed from the scene due to disabling damage. The vehicles were both transferred to a regional vehicle salvage facility for auction, where they were inspected.

2009 Nissan Versa

Exterior Damage

Figure 3: View of the damage to the Nissan's left plane.

The left plane of the Nissan sustained moderate damage in the initial impact (Event 1). The direct contact damage began 88 cm (34.7 in) forward of the left rear axle, and extended forward 168 cm (66.1 in) to the left front wheel area. The combined direct and induced damage began 16 cm (6.3 in) forward of the left rear axle and extended forward 255 cm (100.4 in). The maximum crush was located 151 cm (59.4 in) forward of the left rear axle and measured 41 cm (16.1 in). A residual crush profile was measured at the lower door level and was as follows: C1 = 0 cm, C2 = 9 cm (3.5 in), C3 = 26 cm (10.2 in), C4 = 33 cm (13 in), C5 = 9 cm (3.5 in), C6 = 0 cm. The Door Sill Differential was 18 cm (7.1 in) with a max crush height of 41 cm (16.1 in). **Figure 3** depicts the initial impact damage to the Nissan. The left doors were both jammed closed as a result of the left side deformation. The Collision Deformation Classification (CDC) assigned for this impact was 10LYEW3.

Subsequent to the initial impact, the Nissan was involved in a one-quarter turn rollover onto its right side (Event 2). The direct contact damage began at the forward edge of the right front fender and extended rearward 352 cm (138.6 in) to the right rear tail light area. Vertically, the direct damage extended the full height of the right side, 135 cm (53.2 in) from the door sill to the roof side rail. The maximum vertical and lateral deformation **(Figure 4)** were located on the right roof side rail 9 cm (3.5 in) rear of the junction between the closed right front and rear doors

The residual vertical deformation was 2 cm (0.8 in). The residual lateral deformation was 4 cm (1.6 in). The CDC of the rollover was 00RDAO2.

Figure 4: Rollover damage to the Nissan's right roof side rail.

The right doors remained closed throughout the crash sequence and were operational post-crash. The AS-1 windshield was completely fractured by the impact forces but was held in place by the laminate. The windshield was cut by EMS to remove the driver. The AS-2 tempered front right and left windows disintegrated due to impact forces. The AS-2 tempered rear side windows and backlight were not damaged in this crash.

Interior Damage

The Nissan sustained moderate-severity damage that was attributed to passenger compartment intrusion, occupant contact and air bag deployment. There was an area of smeared blood on the front left door panel located 33-36 cm (13-14.2 in) forward of the rear edge of the door and 4-9 cm (1.6-3.5 in) below the window sill. This blood was attributed to the driver's head laceration. There was a scuff mark on the left door panel slightly above the left armrest. This scuff mark was attributed to the driver's left elbow and lower arm and was located 21-45 cm (8.3-17.7 in) forward of the rear edge of the door and 12-23 cm (4.7-9.1 in) below the window sill. The occupant compartment intrusion is listed on the following table:

Position	Component	Direction	Magnitude
Row 1 Left	Side panel forward of the A-pillar	Lateral	3 cm (1.2 in)
Row 1 Left	A-pillar	Lateral	5 cm (2 in)
Row 1 Left	Left door Forward Lower Quadrant	Lateral	10 cm (3.9 in)
Row 1 Left	Left door Rearward Lower Quadrant	Lateral	13 cm (5.1 in)
Row 1 Left	Left door sill	Lateral	9 cm (3.5 in)
Row 1 Left	B-pillar	Lateral	9 cm (3.5 in)
Row 1 Center	Driver's seat (into center console)	Lateral	3 cm (1.2 in)
Row 2 Left	Left door Forward Lower Quadrant	Lateral	5 cm (2 in)

Manual Restraint Systems

The Nissan was equipped with 3-point lap and shoulder belts for the five designated seating positions. All belt systems utilized a continuous loop of webbing and sliding latch plates. The upper D-rings for the front seats were height adjustable. The left D-ring was in the full-down position and the right was in the full-up position. The driver's belt retracted onto and Emergency Locking Retractor (ELR). All other belts retracted onto switchable ELR/Automatic Locking Retractors (ALR). Both front safety belts utilized retractor pretensioners which actuated during this crash sequence. The driver's safety belt was in use at the time of the crash and contained one area of crash related evidence. A frictional abrasion attributed to the latch plate was located 50-53 cm (19.7-20.9 in) above the lower floor anchor. The driver's belt webbing was extended and locked by the actuation of the retractor pretensioner. The length of the webbing measured 181 cm (71.3 in). The front right belt was stowed and pulled taut against the B-pillar by the actuation of the retractor pretensioner.

Frontal Air Bag System

The Nissan was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger air bags, seat track positioning sensors, front seat retractor pretensioners, safety belt buckle switches and a front occupant detector sensor. The manufacturer of the Nissan certified that the vehicle was compliant with the advanced air bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The driver's frontal air bag deployed during this crash sequence.

The driver's air bag was concealed within the center hub of the three-spoke steering wheel by five asymmetrical triangular cover flaps. The upper right flap was 11 cm (4.3 in) wide and 10 cm (3.9 in) in height. The lower right flap measured 8 cm (3.1 in) in width and 4 cm (1.6 in) in height. The lower center flap was 3 cm (1.2 in) in width at the upper tear seam, 7 cm (2.8 in) in width at the lower aspect of the flap, and 5 cm (2 in) in height. The lower left flap was 6 cm (2.4 in) in height and 4 cm (1.6 in) in width. The upper left flap measured 8 cm (3.1 in) in width and 6 cm (2.4 in) in height. The flaps opened as designed.

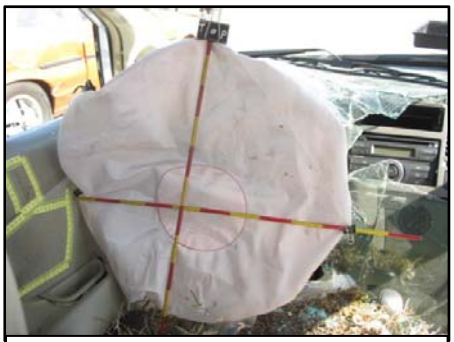

Figure 5: View of the Nissan's driver air bag.

The driver's frontal air bag **(Figure 5)** measured 52 cm (20.5 in) in diameter in its deflated state. It was tethered by two straps at the 12 and 6 o'clock positions of a circular tether sewn to the face of the air bag that measured 16 cm (6.3 in) in diameter. The driver's frontal air bag was vented by two vent ports on the upper rear of the air bag at the 10 and 2 o'clock positions. There were multiple droplets of blood measuring less than 1 cm (0.4 in) in diameter dispersed on the right hemisphere of the face of the air bag. The driver's frontal air bag was not damaged.

The passenger side frontal air bag was concealed within the upper aspect of the right instrument panel. The front right seat was not occupied during this crash; therefore this air bag was suppressed at the time of the crash, as designed.

Event Data Recorder

The Nissan Versa's safety systems were controlled by an Air bag Control Module (ACM) that was located under the center console. The ACM had Event Data Recording (EDR) capabilities and was imaged at the time of the SCI inspection using the Consult-II scan tool supplied by Nissan Motor Company. The scan tool was connected to the vehicle's Diagnostic Link Connector located under the left instrument panel. External 12-volt electrical power was supplied to the vehicle to facilitate the imaging. The imaged data is summarized as follows:

The Ignition Cycle count at the time of the crash was 3840 and 3849 at the time of the data imaging. There were no historical diagnostic trouble codes present prior to the crash. The EDR data was completely written. The ACM detected both a frontal and a side collision and SCI analysis of the data has determined that the detected collisions were related to the intersection crash event. The rollover event was not reported. The imaged data reported the actuated state of both front safety belt pretensioners, and the deployed state of the driver frontal air bag, the driver side impact air bag and the left IC air bag. The respective actuation/deployment times were not reported.

The EDR recorded fourteen seconds (14 sec) of Speed, RPM, Throttle Position, Brake Switch data. Time "-1 sec" corresponded to the last data sample prior to the crash event. Time "0 sec" was assumed to indicate the impact event and/or safety system deployment. The pre-crash data imaged from the EDR is listed in the following table:

Time (sec)	**Speed**	**Engine Speed (RPM)**	**Throttle Position (%)**	**Brake Switch Status**
-7	47 km/h (29 mph)	1363	5	Off
-6	47 km/h (29 mph)	1356	6	Off
-5	47 km/h (29 mph)	1244	1	Off
-4	46 km/h (29 mph)	1175	1	Off
-3	46 km/h (29 mph)	1178	1	Off
-2	45 km/h (28 mph)	1163	0	Off
-1	44 km/h (27 mph)	1153	1	Off
0	23 km/h (15 mph)	1488	0	Off
1	19 km/h (12 mph)	FF	FF	FF
2	10 km/h (6 mph)	372	0	Off
3	0	219	0	Off
4	0	FF	0	Off
5	0	FF	0	Off
6	0	FF	0	Off

Note: FF denotes unwritten default data

The EDR reported 400 milliseconds of bi-directional longitudinal and lateral delta V data for the Nissan. The delta V's are listed in the table below. The maximum longitudinal delta V was -12 km/h (-7 mph) at 60 milliseconds. The maximum lateral delta V was 24 km/h (15 mph) at 40 milliseconds. The EDR also reported 400 milliseconds of acceleration data. The maximum frontal acceleration was -15.6 g at 52.5 milliseconds. The maximum lateral acceleration was 33.1g at 31.0 milliseconds.

Time (milliseconds)	Frontal Delta V	Lateral Delta V
-100 to 0	FF	FF
0	FF	1 km/h (1 mph)
10	0	5 km/h (3 mph)
20	-2 km/h (1 mph)	11 km/h (7 mph)
30	-3 km/h (2 mph)	20 km/h (12 mph)
40	-7 km/h (4 mph)	24 km/h (15mph)
50	-10 km/h (6 mph)	23 km/h (14 mph)
60	-12 km/h (7 mph)	20 km/h (12 mph)
70	-12 km/h (7 mph)	20 km/h (12 mph)
80	0	20 km/h (12 mph)
90	0	20 km/h (12 mph)
100	0	19 km/h (12 mph)
110	0	16 km/h (10 mph)
120	0	15 km/h (9 mph)
130	0	13 km/h (8 mph)
140	0	12 km/h (7 mph)
150	0	FF
160	0	FF
170	0	FF
180 to 300	FF	FF

Note: FF denotes unwritten default data

Side Impact Air Bag System

The Nissan was equipped with side impact air bags mounted in the outboard aspects of the front seat backs and roof side rail-mounted side impact IC air bags. The left side air bag and left IC deployed during this crash.

The deployed side impact air bag **(Figure 6)** measured 38 cm (15 in) in height. The kidney-shaped bag measured 14 cm (5.5 in) and 16 cm (6.3 in) in width at the upper and lower aspects, respectively, and 11 cm (4.3 in) in width at the center. The left side air bag deployed from a 32 cm (12.6 in) tear seam in seat back. There was no damage or occupant contact evidence present on this air bag.

Figure 6: Left side air bag in the Nissan.

The deployed left IC measured 150 cm (59 in) in length. **Figure 7** depicts the inboard side of the left IC. It measured 40 cm (15.7 in) in height at the front and rear seating positions and was tethered to the left A-pillar by a webbing strap 40 cm (15.7 in) in length. Vertically, the IC air bag extended below the belt line at the front and rear outboard seating positions. The left IC provided head protection from the left C-pillar forward to a location 38 cm (15 in) aft of the left A-pillar. The IC was labeled with the identification "6105534C SI/PA 6.6". There was a scuff mark attributed to the driver's head on the inboard side of the left IC. This scuff mark was located 26-35 cm (10.2-13.8 in) rear of the front edge of the IC and 12-22 cm (4.7-8.7 in) above the lower edge of the IC.

Figure 7: View of the inboard side of the Nissan's left IC.

Driver Demographics/Data

Driver Age/Sex:	69-year-old/Male
Height:	163 cm (64 in)
Weight:	57 kg (125 lb)
Eyewear:	Prescription glasses
Seat Track Position:	Mid-track, 14 cm (5.5 in) forward of full-rear
Manual Safety Belt Use:	Lap and shoulder
Usage Source:	SCI vehicle inspection
Egress from Vehicle:	Removed from vehicle while unconscious
Mode of Transport from Scene:	Ground ambulance
Type of Medical Treatment:	Hospitalized for one day at a local hospital.

Driver Injuries

Injury	Injury Severity (AIS 2005/08)	Injury Source
3 cm (1 in) laceration of the left superior aspect of the scalp	Minor (110600.1,2)	Disintegrated side glass
Muscle strain in lower back	Minor (640678.1,8)	Impact forces
Contusion to dorsal side of left arm from shoulder to top of hand	Minor (710402.1,2)	Left door rear upper quadrant

Source = driver interview

Driver Kinematics

The 69-year-old make driver of the Nissan was seated in a mid-track position; the seat was adjusted 14 cm (5.5 in) forward of full-rear. He was restrained by the manual 3-point lap and shoulder belt system. The driver reported in the interview that he had finished shopping and was on his way home, a trip which should have taken him 15 minutes. The driver believes that he "blacked out" for an unknown reason prior to the crash and does not remember details of this crash. He regularly drove other older residents of his apartment complex to complete their errands, and was concerned about another "black out" occurring with passengers in the vehicle. Since this crash, he has turned in his license to the state DMV and no longer operates a motor vehicle.

As a result of the left side impact, the driver's retractor pretensioner actuated and the driver's frontal air bag and left side and IC air bags deployed. The driver initiated a left trajectory within the front left seating position in response to the 310 degree Principal Direction of Force (PDOF). He loaded the left door panel with his left upper and lower arm and hand, resulting in the contusion extending from his shoulder to his left hand. The driver then initiated a rebound trajectory to the right within the front left seating position. He loaded the safety belt and was held in place as the Nissan was deflected to the right. When the Nissan initiated the rollover event to the right and came to rest, the driver's lower body was held in place by the safety belt, and his upper body extended right over the center console, resulting in the lower back strain. He sustained a 3 cm (1 in) laceration of the left superior scalp from possible contact with disintegrated side glass during the rollover event.

The driver was trapped in the vehicle as the operational right doors were positioned against the ground by the Nissan's final rest position, and the left doors were jammed shut as a result of the initial impact damage. EMS workers cut the windshield partially out of the vehicle and removed the driver while unconscious. He was transported by ground ambulance to a local hospital where he was admitted and treated for soft tissue injuries. He was monitored for a possible head injury and released the following day.

2007 Honda Element

Exterior Damage

The front plane of the Honda sustained moderate severity damage as a result of the Event 1 impact with the Nissan **(Figure 8)**. The direct contact damage extended across the entire 168 cm (66.1 in) end-width of the front bumper. The maximum crush was located at C2, 49 cm (19.3 in) left of the vehicle centerline. A residual crush profile was measured at the bumper level and was as follows: C1 = 23 cm (9.1 in), C2 = 25 cm (9.8 in), C3 = 11 cm (4.3 in), C4 = 10 cm (3.9 in), C5 = 15 cm (5.9 in), C6 = 8 cm (3.1 in). The front bumper height was 37 cm (14.6 in). The right and left wheelbases were shortened by 9 cm (3.5 in) and 5 cm (2 in), respectively. The forward aspects of the frame rails were shifted to the left by the lateral forces exerted during the

initial impact. The right frame rail shifted left 15 cm (5.9 in) and the left frame rail shifted left 22 cm (8.7 in). The left aspect of the windshield was fractured at the left A-pillar; the fracture extended laterally across to the midpoint of the windshield. All other windows were undamaged post-crash. All doors remained closed during the crash and were operational post-crash. The CDC assigned for this impact was 82FDEW2.

Figure 8: View of the frontal damage to the Honda.

There was a small area of abrasions from the contact of the Honda's right plane to the metal road sign at final rest. This contact was 10 cm (3.9 in) aft of the right B-pillar and extended from the belt line to the window sill. There was no crush to the body panel and the damaged area was 8 cm (3.1 in) in width. The CDC assigned for this impact was 09RPGN2.

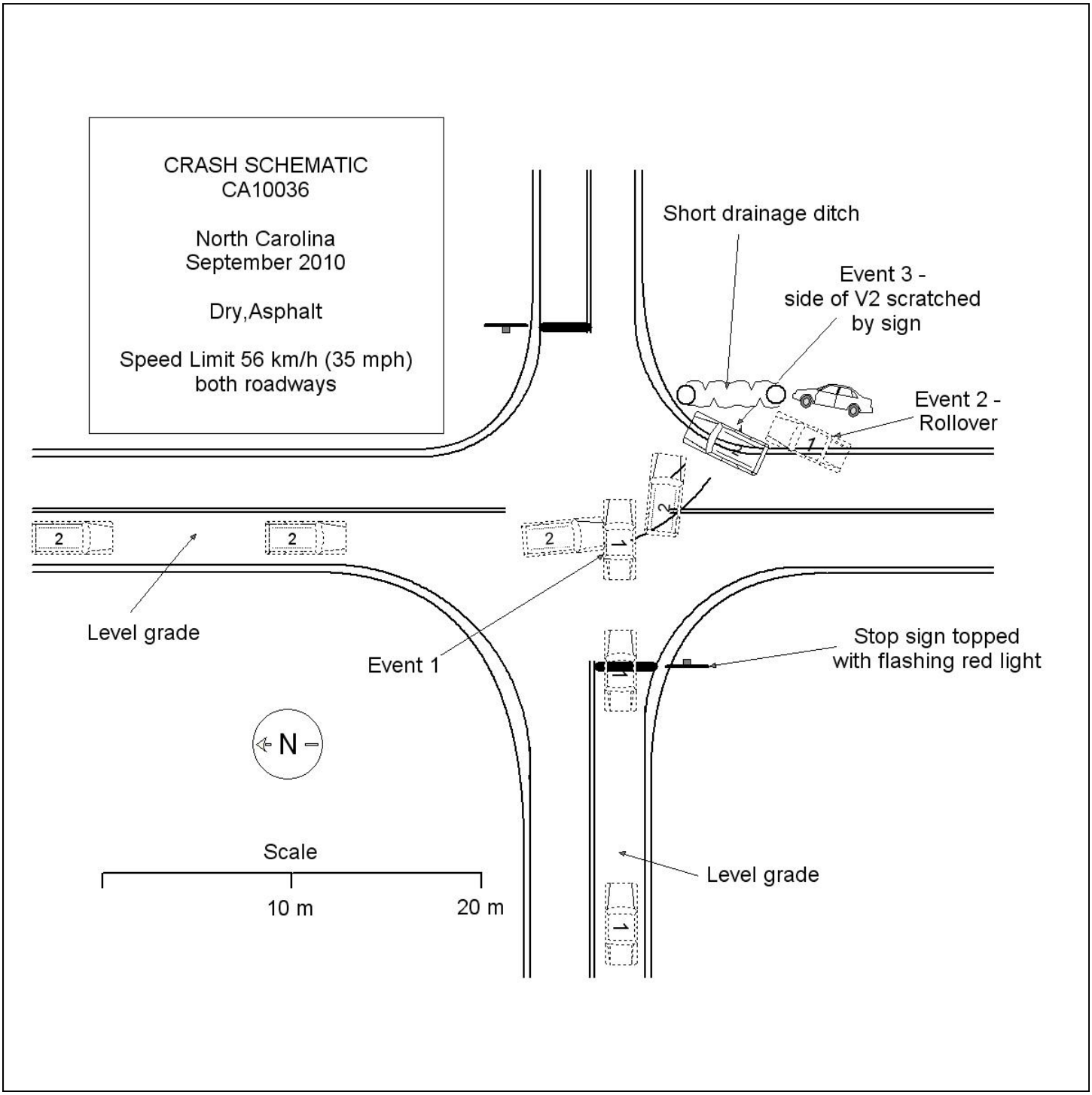

Figure 9: Crash Schematic