

CRASH DATA RESEARCH CENTER

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Buffalo, NY 14225

**CALSPAN ON-SITE SIDE IMPACT INFLATABLE
OCCUPANT PROTECTION SYSTEM CRASH INVESTIGATION**

SCI CASE NO: CA09036

VEHICLE: 2009 NISSAN VERSA

LOCATION: NEW JERSEY

CRASH DATE: APRIL, 2009

Contract No. DTNH22-07-C-00043

Prepared for:

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National Highway Traffic Safety Administration
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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 investigation focused on the intersection crash of a 2009 Nissan Versa and a 2002 Chevrolet Impala. The Nissan was equipped with side impact Inflatable Curtain (IC) air bags, front seat-mounted side impact air bags, Certified Advanced 208-Compliant (CAC) frontal air bags and front safety belt pretensioners. The crash occurred when the eastbound Chevrolet traveled through a stop sign and impacted the forward aspect of the right side of the southbound Nissan that was traveling straight through the intersection. The direction of the impact force was in the 2 o'clock sector for the Nissan. The impact force deployed the right IC air bag and the CAC frontal air bags of the Nissan. The Nissan was driven by a 53-year-old unrestrained male and occupied by a 65-year-old unrestrained female in the front right passenger position. The driver and passenger had police reported complaints of chest and neck pain and were transported to a local hospital. The direction of the impact force was in the 11 o'clock sector for the Chevrolet. The Chevrolet's frontal air bags did not deploy. The Chevrolet was occupied by a 75-year-old restrained driver, an 80-year-old restrained female front right passenger and an 82-year-old restrained female in an unknown rear seat position. The driver of the Chevrolet had a reported knee contusion. The passengers in the Chevrolet sustained police reported complaints of pain. All the occupants of the Chevrolet were transported to a local hospital.			
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BACKGROUND

This investigation focused on the intersection crash of a 2009 Nissan Versa and a 2002 Chevrolet Impala. The Nissan was equipped with side impact Inflatable Curtain (IC) air bags, front seat-mounted side impact air bags, Certified Advanced 208-Compliant (CAC) frontal air bags and front safety belt pretensioners. The crash occurred when the eastbound Chevrolet traveled through a stop sign and impacted the forward aspect of the right side of the southbound Nissan that was traveling straight through the intersection.

Figure 1 depicts the Nissan's right side damage caused by the initial impact. The direction of the impact force was in the 2 o'clock sector for the Nissan. The impact force deployed the right IC air bag and the CAC frontal air bags of the Nissan. The Nissan was driven by a 53-year-old unrestrained male and occupied by a 65-year-old unrestrained female in the front right passenger position. The driver and passenger had police reported complaints of chest and neck pain and were transported to a local hospital. The direction of the impact force was in the 11 o'clock sector for the Chevrolet. The Chevrolet's frontal air bags did not deploy. The Chevrolet was occupied by a 75-year-old restrained driver, an 80-year-old restrained female front right passenger and an 82-year-old restrained female in an unknown rear seat position. The driver of the Chevrolet had a reported knee contusion. The passengers in the Chevrolet sustained police reported complaints of pain. All the occupants of the Chevrolet were transported to a local hospital.



Figure 1: Front right oblique view of the Nissan Versa.

This crash was identified through the weekly sampling of police reported crashes conducted by the General Estimates System (GES) of the National Automotive Sampling System (NASS). The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) forwarded the police report to the Calspan Special Crash Investigations (SCI) team on May 20, 2009. Calspan SCI initiated follow-up investigation and established cooperation with the insurance carrier of the vehicles. The Nissan and Chevrolet were both considered total losses and were available for inspection at a salvage yard. The SCI team also contacted Nissan North America and made arrangements to acquire the scan tool necessary to image the data stored within the Nissan's Event Data Recorder (EDR). The vehicle and scene inspections took place June 10, 2009. The EDR data within the Chevrolet was also imaged at that time.

VEHICLE DATA

2009 Nissan Versa

The 2009 Nissan Versa, four-door sedan was identified by the Vehicle Identification Number (VIN): 3N1BC11E49L (production sequence deleted). The date of manufacturer was July 2008. The odometer reading at the time of the SCI inspection was 20,034 km (12, 449 miles). The powertrain consisted of 1.8-liter, I4 engine linked to a five-speed automatic transmission with front-wheel drive. The service brakes were a front disc/rear drum system with ABS. The manual restraint system consisted of three-point lap and shoulder belts in all five seat positions. The front safety belts were equipped with retractor pretensioners. The Nissan was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags, front seat-mounted side impact air bags, and side impact Inflatable Curtains (IC) air bags. The vehicle manufacturer has certified that the frontal air bags in the Nissan were compliant with the advanced air bag requirements of the Federal Motor Vehicle Safety Standard No. 208. The Nissan was equipped with Continental Conti-Pro Contact P185/65R15 tires mounted on OEM alloy wheels. The vehicle manufacturer recommended front and rear cold tire pressure was 228 kPa (33 PSI). The specific tire data at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	234 kPa (34 PSI)	6 mm (8/32 in)	No	None
LR	234 kPa (34 PSI)	7 mm (9/32 in)	No	None
RF	241 kPa (35 PSI)	6 mm (8/32 in)	No	None
RR	234 kPa (34 PSI)	7 mm (9/32 in)	No	Axle bent, rim contact

2002 Chevrolet Impala

The 2002 Chevrolet Impala was identified by the VIN: 2G1WH55K229 (production sequence deleted). The vehicle was manufactured in December 2001. The digital odometer reading was unknown. This four-door, front-wheel drive sedan was powered by a 3.8-liter, V6 engine linked to a four-speed automatic transmission. The brakes were a four-wheel disc system with ABS. The manual restraint system consisted of three-point lap and shoulder belts in the five seat positions. The Chevrolet was equipped with redesigned frontal air bags for the driver and front right passenger in addition to a driver only, seatback mounted side impact air bag. It was not equipped with side impact air bags. The tires were Goodyear Eagle P225/60R16 mounted on OEM alloy wheels. The vehicle manufacturer recommended front and rear tire pressure was 207 kPa (30 PSI). The specific tire data at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	Tire flat	6 mm (8/32 in)	No	Sidewall tire, rim abraded
LR	145 kPa (21 PSI)	5 mm (6/32 in)	No	None
RF	214 kPa (31 PSI)	6 mm (7/32 in)	No	None
RR	152 kPa (22 PSI)	5 mm (6/32 in)	No	None

CRASH SITE

The crash occurred during the daytime hours in April 2009. At the time of the crash, the weather was clear and dry. The crash occurred within a four-leg intersection of a two-lane north/south road and a two-lane east/west road in a residential setting. The intersection was controlled by stops sign for east/west traffic. The north/south road measured 9.3 m (30.5 ft) in total width. The east/west road measured 12.2 m (40.0 ft) in total width. The travel lanes of each road were delineated by double-yellow centerlines. The intersection was bordered by 15 cm (6 in) concrete curbs and sidewalks. The posted speed limit was 40 km/h (25 mph).



Figure 2: South view of the intersection.

Figure 2 is a south view toward the intersection, the trajectory of the Nissan. A schematic of the crash is included at the end of this report as **Figure 11**.

CRASH SEQUENCE

Pre-Crash

The Nissan Versa was southbound driven by the 53-year-old unrestrained male. The imaged EDR data indicated the Nissan was traveling 43 km/h (26 mph) two seconds prior to the crash. The Chevrolet was eastbound driven by the 75-year-old restrained female. The EDR reported speed of the Impala was 48 km/h (30 mph) two seconds prior to the crash. The respective EDR data reported that neither driver applied brakes prior to the impact.

Crash

The crash occurred when the center and left aspects of the Chevrolet's front plane impacted the forward aspect of the Nissan's right plane (Event 1). The directions of the impact force were in the 2 o'clock sector for the Nissan and 11 o'clock sector for the Chevrolet. This impact resulted in the actuation of the safety belt pretensioners in the Nissan and the deployment of the vehicle's frontal air bags and right IC air bag. The frontal air bags in the Chevrolet did not deploy. The Damage Algorithm of the WinSMASH program was used to calculate the severity (delta V) of the crash. The total delta V of the Nissan was 28 km/h (17.3 mph). The longitudinal and lateral delta V components were -14 km/h (-8.7 mph) and -24 km/h (-14.9 mph), respectively. The Chevrolet's total delta V was 25 km/h (15.5 mph) with longitudinal and lateral components of -22 km/h (-13.7 mph) and 12 km/h (7.5 mph).

The force of the impact forward of the Nissan's center of gravity caused the vehicle to rotate counterclockwise approximately 45 degrees. The Chevrolet rotated clockwise 45 degrees. The right quarterpanel of the Nissan struck the left plane of the Chevrolet in a secondary side slap (Event 2). The vehicles then separated and slid to final rest. The Nissan came to rest on the west leg of the intersection, facing west, approximately 16 m (52 ft) from the initial impact. The Chevrolet came to rest facing southwest on the south leg of the intersection at the west curb line. The Chevrolet's final rest location was approximately 10 m (33 ft) from the initial impact point.

Post-crash

The police and ambulance personnel responded to the crash. The driver and front right occupant of the Nissan exited the vehicle unassisted. The driver complained of neck pain. The front right passenger had a complaint of chest pain. These individuals were transported by ground ambulance to a local hospital for evaluation. The three female occupants of the Chevrolet remained in their vehicle and were assisted by the first responders. The driver sustained a police reported knee contusion. The front right passenger reported chest pain and the rear seated passenger reported unspecified body pain. All three individuals were transported to a local hospital. The Nissan and the Chevrolet sustained disabling damage and were towed from the crash site. The vehicles were subsequently deemed total losses by their respective insurance companies.

2009 NISSAN VERSA

Exterior Damage

The Exterior of the Nissan sustained two areas of damage to the right side plane during the multiple event crash sequence. **Figure 3** is a view of the damage to the right fender (Event 1). The direct contact damage began at the trailing edge of the fender and extended 105 cm (41.3 in) forward to the right corner. The impact resulted in lateral deformation to the fender, the right side of the engine compartment and the front bumper reinforcement. Black vinyl transfer marks were noted to the right front wheel. There was no right front suspension damage or right wheelbase reduction. The crush profile was measured along the mid-door level and was as follows: C1 = 2 cm (0.8 in), C2 = 6 cm (2.4 in), C3 = 14 cm (5.5 in), C4 = 29 cm (11.4 in), C5 = 35 cm (13.8 in), C6 = 33 cm (13.0 in). The maximum crush was located at C5. The Collision Deformation Classification was 02RFEW3.

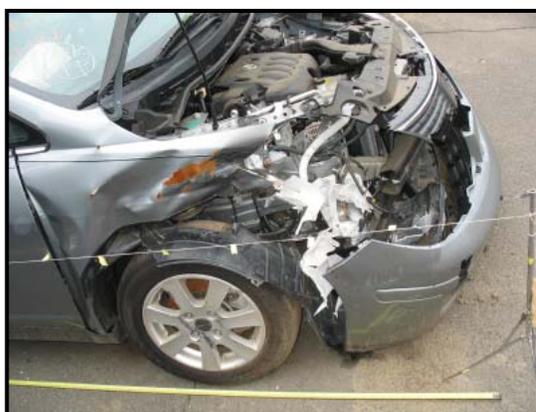


Figure 3: Right lateral view of the impact damage (Event 1).

The Nissan rotated counterclockwise as a result of the initial impact and the vehicles contacted in a secondary side slap (Event 2). **Figure 4** is a right rear oblique view of the side slap impact damage. The contact damage began 43 cm (17 in) forward of the right rear axle and extended 129 cm (50.8 in) rearward to the right rear corner. Direct contact was noted to the right rear wheel rim. The residual crush profile was as follows: C1 = 4 cm (1.6 in), C2 = 6 cm (2.4 in), C3 = 11 cm (4.3 in), C4 = 10 cm (3.9 in), C5 = 1 cm (0.8 in), C6 = 0. The CDC was 03RZEW2.



Figure 4: Right rear oblique view of the side slap damage (Event 2).

The windshield was not fractured and all the glazing was intact. The front right door was jammed closed and overlapped the right B-pillar 1 cm (0.4 in). The rear right door and the left doors remained closed during the crash sequence and were operational at the time of the SCI inspection.

Interior Damage

The interior damage to the Nissan was limited to the deployment of the vehicle's air bag systems and the minor interior occupant contact points. There was no intrusion into the vehicle's occupant space.

The driver seat was located in a rear-track position and measured 2 cm (0.8 in) forward of full-rear. The seat track travel measured 24 cm (9.4 in). The seat back was reclined 15 degrees aft of vertical. The horizontal distance from the seat back to the driver air bag module measured 64 cm (25.2 in). The three-spoke tilt steering wheel was in the full-up position. There was no deformation of the steering wheel rim and no displacement of the shear capsules. The driver's lower extremities contacted the knee bolster and the bottom aspect of the steering column evidenced by two scuff marks. A 3 cm (1.1 in) long scuff was located 4 cm (1.6 in) right of the steering column, 41 cm (16.1 in) above the floor. Another 3 cm (1.1 in) long scuff mark was located on the bottom of the steering column, 49 cm (19.3 in) above the floor.

The front right seat was located in a full-rear position at the time of the SCI inspection. The seat back was reclined 20 degrees aft of vertical. The horizontal distance from the seat back to the vertical face of the instrument panel measured 84 cm (33.1 in). The horizontal distance to the trailing edge of the front right passenger air bag module measured 110 cm (43.3 in). There were no identified contacts to the right aspect of the instrument panel.

Manual Restraint System

The driver's safety belt consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and an Emergency Locking Retractor (ELR). The retractor was equipped with a pretensioner. The D-ring was adjusted to the full-down position. The safety belt was stowed in the retractor at initial inspection. The webbing was locked and under tension in the stowed position by the fired pretensioner. Based upon the post-crash condition of the belt system, the driver was unrestrained at the time of the crash. The imaged EDR data from the Nissan supported that conclusion.

The front right passenger's safety belt consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring, and a switchable Automatic Locking Retractor/ELR. The retractor was also equipped with a pretensioner. The adjustable D-ring was in the full-down position. At the time of the SCI inspection, the webbing was stowed within the retractor and under tension by the actuated pretensioner. Based upon the post-crash condition of the safety belt, the front right passenger was unrestrained at the time of the crash. The imaged EDR data also supported that conclusion.

Frontal Air Bag System

The frontal air bag system in the Nissan Versa consisted of CAC air bags for the driver and front right passenger. The frontal air bags deployed as a result of the initial impact with the Chevrolet. The driver air bag module was located in the center hub of the steering wheel rim. The module cover flaps were an asymmetrical design consisting of five individual flaps. There was no noted contact to the cover flaps. The deployed driver air bag measured 55 cm (21.6 in) in its deflated state, **Figure 5**. It was tethered by two straps and vented by two 4 cm (1.5 in) diameter ports. Multiple scattered scuff marks were observed in the 1 to 3 o'clock sectors on the face of the bag. The contact area measured 15 cm x 18 cm (5.9 in x 7.1 in). The scuff marks were related to probable driver contact to the inflated air bag.

The front right passenger air bag, **Figure 6**, was a top-mount design located in right aspect of the instrument panel. The module cover flaps were symmetrical and constructed of vinyl. Each flap measured 5 cm x 22 cm (2.0 in x 8.7 in). The face of the passenger air bag measured 48 cm (18.9 in) in width at its top aspect and tapered to a 28 cm (11.0 in) width. The height of the air bag measured 48 cm (18.9 in). The bag was not tethered. The rearward excursion of the bag from the module measured 54 cm (21.7 in). The bag was vented from the side panels by two 6 cm (2.4 in) diameter ports. There was no contact evidence on the air bag.



Figure 5: Nissan driver air bag.



Figure 6: Front right passenger air bag.

Inflatable Curtain Air Bags

The Nissan Versa was equipped with IC air bags mounted to the roof side rails. The right curtain deployed as a result of the crash. The IC air bag measured 140 cm x 42 cm (55.1 in x 16.5 in) length x height in overall dimensions and provided coverage from the upper aspect of the A- to C-pillar area (**Figure 7**). A trapezoidal shaped void at the forward third of the front glazing was not protected by the deployed curtain. This area measured 40 cm x 35 cm (15.7 in x 13.8 in) length x height. A 35 cm (13.8 in) long tether extended from the A-pillar and was sewn to the forward aspect of the membrane. The vertical coverage of the curtain extended 2 cm (1 in) below the beltline in both the front and second row.

A scuff mark from probable front right passenger head contact was observed on the IC air bag **Figure 8**. The mark measured 2 cm (0.8 in) in length and was located 15 cm (5.9 in) below the roof rail and 26 cm (10.2 in) forward of the right B-pillar.



Figure 7: Nissan deployed right curtain.



Figure 8: View of the contact evidence to the right curtain.

Event Data Recorder

The air bag systems in the Nissan Versa were controlled by an Air bag Control Module (ACM) that was mounted under the center console aft of the transmission selector. The ACM had Event Data Recording (EDR) capabilities.

The proprietary scan tool obtained from Nissan North America was used to communicate with the EDR and image the stored data. The scan tool was connected to the Diagnostic Link Connector located under the left instrument panel. The software driven scan tool was powered via the Nissan's electrical system and communicated to the ACM directly across the vehicle's communication bus. The following data was imaged during the SCI inspection.

The crash occurred on Ignition Cycle 1664 and was imaged on Cycle 1693. The record indicated the EDR data was complete and had successfully recorded the crash data. The imaged data indicated that there were no historical Diagnostic Trouble Codes (DTC) present prior to the crash. This was an indicator that the *Air Bag* light in the instrument cluster was "Off" prior to the crash and the air bag system was operational.

The current diagnostic record indicated that the EDR recorded a frontal and side collision. This data field also reported the deployed state of the driver air bag module, front passenger air bag module, right curtain module and the actuation of both pretensioners.

The EDR recorded fourteen seconds (14 sec) of Speed, RPM, Throttle Position, Brake Switch data. Time "Zero" (0 sec) was assumed to indicate the impact event. The data imaged from the EDR is listed in the following table:

Time (sec)	Speed	Engine Speed (RPM)	Throttle Position (%)	Brake Switch Status
-7	46 km/h (29 mph)	1134	0	Off
-6	45 km/h (28 mph)	1153	0	Off
-5	45 km/h (28 mph)	1147	1	Off
-4	45 km/h (28 mph)	1181	0	Off
-3	44 km/h (27 mph)	1100	0	Off
-2	43 km/h (27 mph)	1100	0	Off
-1	43 km/h (27 mph)	1100	0	Off
0	16 km/h (10 mph)	FF	FF	Off
1	22 km/h (14 mph)	FF	FF	Off
2	14 km/h (9 mph)	FF	FF	Off
3	8 km/h (5 mph)	FF	FF	Off
4	1 km/h (1 mph)	FF	FF	Off
5	0	FF	FF	Off
6	0	FF	FF	Off

Note: FF denotes unwritten default data

The EDR also recorded the bi-directional longitudinal and lateral delta V of the Nissan. The delta V's are listed in the table below. The maximum longitudinal delta V was -15 km/h (-9 mph) at 80 milliseconds. The maximum lateral delta V was -8 km/h (5 mph) at 60 milliseconds. The EDR had memory capacity to record 300 milliseconds of delta V data. The maximum frontal acceleration was -12.7 g at 39.5 milliseconds. The maximum lateral acceleration was -35.7g at 25.5 milliseconds.

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

Time (milliseconds)	Frontal Delta V	Lateral Delta V
170	0	0
180	0	FF
190 to 300	FF	FF

Note: FF denotes unwritten default data

2002 CHEVROLET IMPALA

Exterior Damage

The Chevrolet Impala, **Figure 9**, sustained front and left plane damage as a result of the crash sequence. The Event 1 frontal damage consisted of deformation to the bumper fascia, bumper reinforcement beam, left head lamp assembly, hood and left fender. The direct contact damage began on the vehicle's centerline and extended 78 cm (30.7 in) to the left front corner. This contact pattern wrapped around the Chevrolet's left corner during the later stage of Event 1, as the Nissan rotated CCW due to the force of the impact. The direct contact damage extended from the left corner rearward on the left fender 73 cm (28.7 in). Contact abrasions were noted on the left front wheel rim. The crush profile measured along the bumper reinforcement was as follows: C1 = 21 cm (8.3 in), C2 = 20 cm (7.9 in), C3 = 19 cm (7.5 in), C4 = 14 cm (5.5 in), C5 = 15 cm (5.9 in), C6 = 9 cm (3.5 in). The CDC was 11FYEW1.



Figure 9: Front view of the Chevrolet.

The left plane of the Chevrolet sustained a combined length of direct contact and induced damage that measured 158 cm (62.2 in), **Figure 10** as a result of the secondary side slap (Event 2). The damaged region began on the mid-aspect of the left rear door and ended at the mid-aspect of the quarterpanel. The direct contact region measured 119 cm (46.9 in) in length. The maximum deformation was 6 cm (2.5 in). The CDC was 09LZEW1.



Figure 10: Side slap damage to the left plane of the Chevrolet.

All the doors remained closed during the impact and were operational at the time of the SCI inspection. The windshield was not fractured and all the window glazing was intact. There was no change in the wheelbase dimensions. The frontal air bags did not deploy as a result of the crash.

Event Data Recorder

The air bag system in the Chevrolet Impala consisted of redesigned driver and front right passenger air bags that were monitored and controlled by a Sensing Diagnostic control Module (SDM) located under the front right passenger seat. The SDM had Event Data Recording (EDR) capabilities. The EDR was imaged via the diagnostic link connector with software version 3.1 of the Bosch Crash Data Retrieval tool.

The Chevrolet’s EDR recorded a single Non-Deployment Event that was related to the frontal crash. The event recording was complete. The EDR recorded vehicle speed two seconds prior to Algorithm Enable (AE) was 48 km/h (30 mph). The crash data was recorded on ignition cycle 5217 and the data imaged on ignition cycle 5226. The Chevrolet EDR’s was designed to measure the crash severity in the longitudinal direction vehicle. The maximum EDR recorded longitudinal delta V was -21 km/h (-13.1 mph) at 232.5 milliseconds after Algorithm Enable (AE). The imaged data report is attached to the end of this report as *Attachment A*.

2009 NISSAN VERSA

Driver Demographics

Age/Sex:	53-year-old/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Rear track: 2 cm (0.8 in) forward of full rear
Safety Belt Usage:	None used
Usage Source:	SCI vehicle inspection
Egress from Vehicle:	Exited vehicle unassisted
Type of Medical Treatment:	Transported to a local hospital, treated and released

Driver Injuries

<i>Injury</i>	<i>Injury Severity (AIS 90/Update 98)</i>	<i>Injury Source</i>
Cervical sprain	Minor (640278.1,6)	Crash force
Left knee contusion	Minor (890402.1,2)	Knee bolster
Right lower extremity (shin) abrasion	Minor (890202.1,1)	Knee bolster

Source: Emergency room records

Driver Kinematics

The 53-year-old male driver of the Nissan was seated in a rear-track position and was unrestrained. At impact, the frontal air bags and the right IC air bag deployed. The driver responded to the 2 o’clock direction of the impact force by initiating a forward and right trajectory. This kinematic pattern was evidenced by lower extremity contact to the knee bolster

resulting in a left knee contusion. The driver’s right lower extremity was abraded by contact with the knee bolster. The driver contacted the upper right aspect of the expanded driver air bag with his chest and face and rode down the force of the crash. He rebounded back into his seat and came to rest.

Front Right Passenger Demographics

Age/Sex: 65-year-old/Female
 Height: Unknown
 Weight: 68 kg (150 lbs)
 Seat Track Position: Full-rear track
 Safety Belt Usage: None used
 Usage Source: SCI vehicle inspection
 Egress from Vehicle: Exited vehicle unassisted
 Type of Medical Treatment: Transported to a local hospital, treated and released

Front Right Passenger Injuries

<i>Injury</i>	<i>Injury Severity (AIS 90/Update 98)</i>	<i>Injury Source</i>
Left fifth digit sprain	Minor (750402.1,2)	Unknown interior contact
Anterior chest pain	Not able to code under AIS rules	Deployed front right passenger air bag
Right cervical pain	Not able to code under AIS rules	Crash force

Source: Emergency room records

Front Right Passenger Kinematics

The 65-year-old female was seated in a full-rear track position and was unrestrained. At impact, the frontal air bags and the right IC air bag deployed. The front right passenger initiated a forward and right trajectory in response to the 2 o’clock direction of the impact force. The passenger contacted the right curtain with her head evidenced by the identified scuff mark. This contact did not result in an injury. Her forward trajectory resulted in chest contact to the deployed front right passenger air bag. The passenger rode down the down the force of the crash through her contact with the deployed air bags and then rebounded back into her seat where she came to rest.

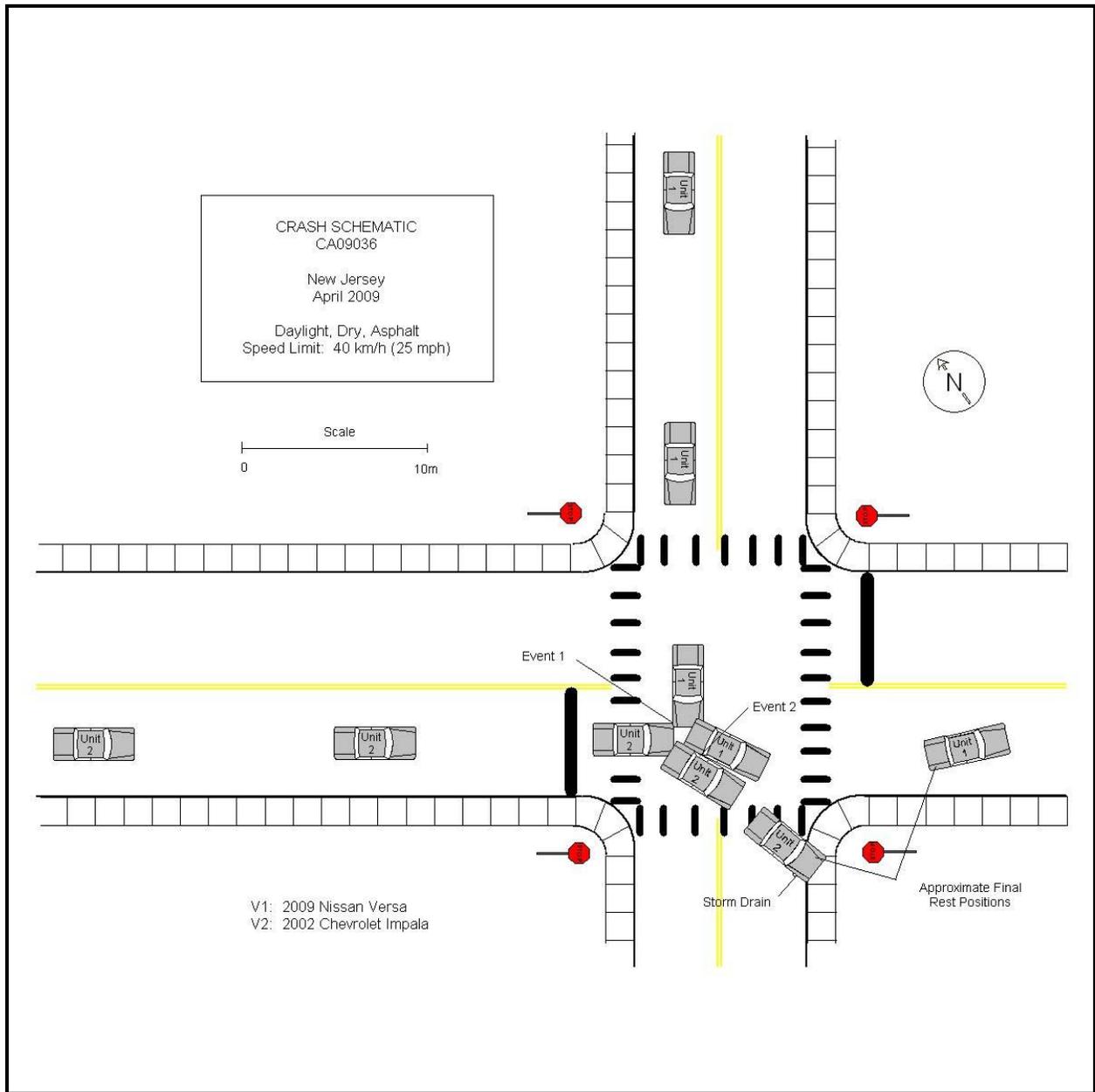


Figure 11: Crash schematic.

ATTACHEMENT A

2002 Chevrolet Impala EDR DATA

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	2G1WH55K229*****
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CA09036 IMPALA.CDR
Saved on	Wednesday, June 10 2009 at 02:22:24 PM
Collected with CDR version	Crash Data Retrieval Tool 3.1
Reported with CDR version	Crash Data Retrieval Tool 3.4
EDR Device Type	airbag control module
Event(s) recovered	Non-Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of Recorded Crash Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle longitudinal velocity change. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as a Deployment Level Event, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds before a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.

The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within five seconds of one another. If multiple Non-Deployment Events occur within five seconds prior to a Deployment Event, then the most severe Non-Deployment Event will be recorded and locked. If multiple Non-Deployment Events precede a Deployment Event, and occur within five seconds of each other (but not necessarily all within five seconds of the Deployment Event), then the most severe of the Non-Deployment Events (which may have occurred more than five seconds prior to the Deployment Event) will be recorded and locked. If a Deployment Level Event occurs within five seconds after the Deployment Event, the Deployment Level Event will overwrite any non-locked Non-Deployment Event. If multiple Non-Deployment Events occur within five seconds prior to a Deployment Event, and one or more of those events was a Pretensioner Deployment Event, then the most recent Pretensioner Deployment Event will be recorded and locked. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

Data:

-SDM Recorded Vehicle Longitudinal Velocity Change reflects the change in longitudinal velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Longitudinal Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment Events, the SDM will record 100 milliseconds of data after deployment criteria is met and up to 50 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 150 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.

-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

- significant changes in the tire's rolling radius
- final drive axle ratio changes
- wheel lockup and wheel slip

-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.

-Pre-Crash data is recorded asynchronously.

-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:

- the SDM receives a message with an "invalid" flag from the module sending the pre-crash data
- no data is received from the module sending the pre-crash data
- no module present to send the pre-crash data

-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Driver's Belt Switch Circuit may be reported other than the actual state.

-The Time Between Non-Deployment Event to Deployment Events is displayed in seconds. If the time between the two events is greater than 25.4 seconds, "N/A" is displayed in place of the time.

- If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
- Multiple Events will indicate whether one or more associated events preceded the recorded event.
- Multiple Events Not Recorded can be used in the following senieos:
 - If a single event is recorded, this parameter will indicate whether one or more associated events prior to the recorded event was not recorded due to insufficient record space (because there were more events than there were available event records).
 - If two associated events are recorded, this parameter for the first event will indicate whether one or more associated events prior to the first event was not recorded due to insufficient record space.
 - If two associated events are recorded, this parameter for the second event will indicate whether one or more associated events between the first and second events was not recorded due to insufficient record space.
- All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

Data Source:

All SDM recorded data is measured, calculated, and stored internally, except for the following:

- Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.
- Brake Switch Circuit Status data is transmitted by either the ABS module or the PCM, via the vehicle's communication network, to the SDM.
- The Belt Switch Circuit is wired directly to the SDM.

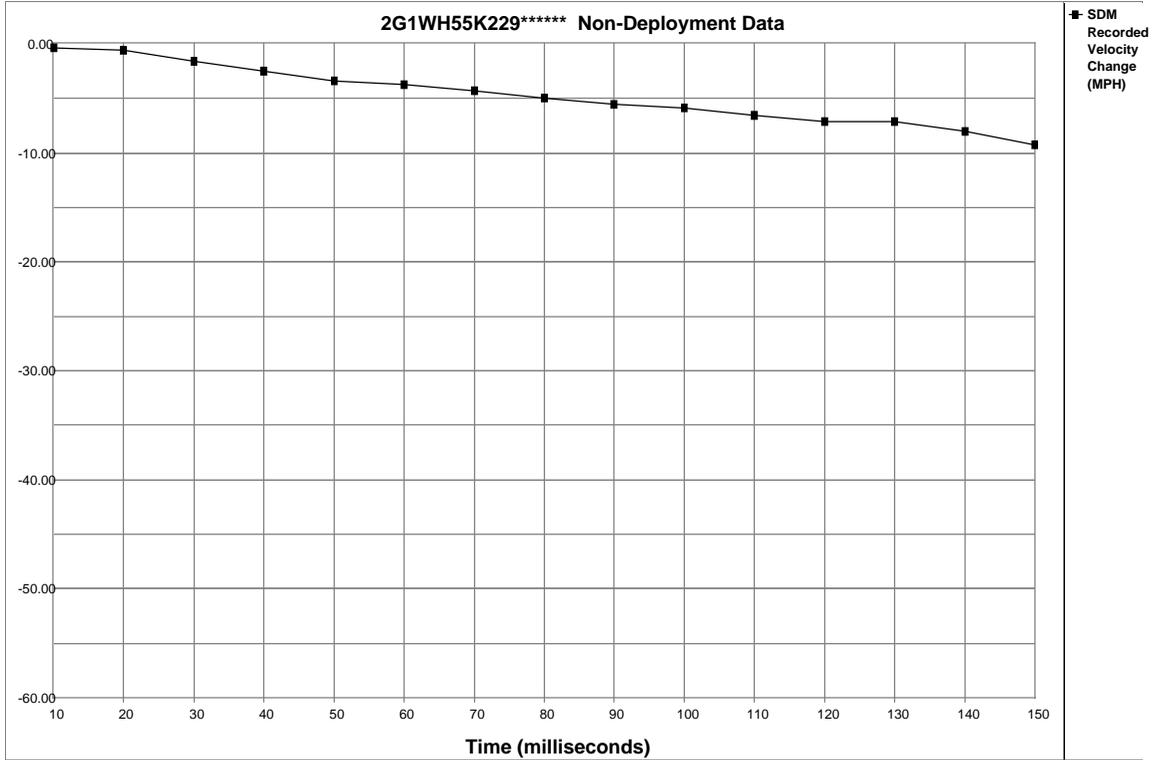
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System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Non-Deployment	5217
Ignition Cycles At Investigation	5226
Maximum SDM Recorded Velocity Change (MPH)	-13.11
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	232.5
Crash Record Locked	No
Event Recording Complete	Yes
Multiple Events Associated With This Record	Yes
One Or More Associated Events Not Recorded	Yes

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle
-5	27	1472	5
-4	28	1088	5
-3	29	1216	5
-2	30	1344	6
-1	19	1280	0

Seconds Before AE	Brake Switch Circuit Status
-8	OFF
-7	OFF
-6	OFF
-5	OFF
-4	OFF
-3	OFF
-2	OFF
-1	OFF



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.31	-0.62	-1.55	-2.48	-3.41	-3.72	-4.34	-4.96	-5.58	-5.89	-6.51	-7.13	-7.13	-8.06	-9.30

Hexadecimal Data

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR system.

```
$01 07 21 E6 D9 9F DC
$02 21 00 17 00 00
$03 41 53 31 33 31 39
$04 4B 35 58 36 38 31
$06 10 31 02 21
$10 FD 72 FC
$11 7C 7C 7D 7F 7E 7F
$12 96 00 00 00 00 00
$13 FF 02
$14 1D 00 05 00 00 00
$15 31 35 57 46 48 48
$16 48 31 35 57 46 48
$17 48 48
$18 1F 00 11 AB 01
$1F FF
$20 1E FD 00 00 FF FF
$21 FF FF FF FF FF FF
$22 FF FF FF FF FF FF
$23 FF FF FF FF FF FF
$24 00 02 A4 26 5D 4E
$25 46 00 00 01 FF FF
$26 01 02 05 08 0B 0C
$27 0E 10 12 13 15 17
$28 17 1A 1E 00 FD 73
$29 FE A5 FF FF FF FF
$2A FF FF FF FF FF FF
$2B FF FF FF FF FF FF
$2C FF FF FF FF FF FF
$2D FF FF
$30 FF FF FF FF FF FF
$31 FF FF FF FF FF FF
$32 FF FF FF FF FF FF
$33 FF FF FF FF FF FF
$34 FF FF FF FF FF FF
$35 FF FF FF FF FF FF
$36 FF FF FF FF FF FF
$37 FF FF FF FF FF FF
$38 FF FF FF FF FF FF
$39 FF FF FF FF FF FF
$3A FF FF FF FF FF FF
$3B FF FF FF FF FF FF
$3C FF FF FF FF FF FF
$3D FF FF
$40 02 1E 30 2F 2D 00
$41 00 00 00 00 10 0D
$42 0D 00 03 14 15 13
$43 11 00 7D 80
$44 1E 30 2F 2D 2B 00
$45 00 00 00 10 0D 0D
$46 0D 00 14 15 13 11
$47 17 00 7D 80
$48 FF FF FF FF FF FF
$49 FF FF FF FF FF FF
$4A FF FF FF FF FF FF
$4B FF FF FF FF
$4C FF FF FF FF FF FF
$4D FF FF FF FF FF FF
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\$4E FF FF FF FF FF FF
\$4F FF FF FF FF
\$50 FF FF FF FF FF FF
\$51 FF FF FF FF FF FF
\$52 FF FF FF FF FF FF
\$53 FF FF FF FF FF FF
\$54 FF FF FF FF FF FF

Disclaimer of Liability

The users of the CDR product and reviewers of the CDR reports and exported data shall ensure that data and information supplied is applicable to the vehicle, vehicle's system(s) and the vehicle ECU. Robert Bosch LLC and all its directors, officers, employees and members shall not be liable for damages arising out of or related to incorrect, incomplete or misinterpreted software and/or data. Robert Bosch LLC expressly excludes all liability for incidental, consequential, special or punitive damages arising from or related to the CDR data, CDR software or use thereof.