TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH INVESTIGATION

CALSPAN CASE NO: CA05-002

VEHICLE: 2004 CHEVROLET SILVERADO

LOCATION: MICHIGAN

CRASH DATE: DECEMBER 2004

Contract No. DTNH22-01-C-17002

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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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.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. CA05-002	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Calspan On-Site Certified Advanced 208-Compliant Vehicle Crash Investigation Vehicle: 2004 Chevrolet Silverado Location: State of Michigan		*5. Report Date*: March 2005 *6. Performing Organization Code*	
7. Author(s) Crash Data Research Center		*8. Performing Organization Report No.*	
9. Performing Organization Name and Address Transportation Sciences Crash Data Research Center Calspan Corporation P.O. Box 400 Buffalo, New York 14225		*10. Work Unit No.* C00410.0000.0258 *11. Contract or Grant No.* DTNH22-01-C-17002	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		*13. Type of Report and Period Covered* Technical Report Crash Date: December 2004 *14. Sponsoring Agency Code*	
15. Supplementary Note On-site investigation focused on the performance of the Certified Advanced 208-Compliant safety system in a 2004 Chevrolet Silverado.			
16. Abstract This on-site investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2004 Chevrolet Silverado pickup truck. The manufacturer of this vehicle has certified that this 2004 Chevrolet Silverado meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS 208) No. 208. The system consisted of dual stage frontal air bags, seat track positioning sensors for the front seats, an occupant presence sensor for the front right seat, and safety belt buckle switch sensors to monitor belt usage. In addition, the Chevrolet was equipped an Event Data Recorder (EDR) that was downloaded (Deployment and Non-Deployment) during the on-site investigative effort. The EDR printout is included as **Attachment A** of this report. The Chevrolet was occupied by a restrained 38-year-old male driver. The Silverado was involved in an intersection crash with a 2002 Chevrolet Express cargo van. The Chevrolet Express was occupied by a 41-year-old male driver. During the crash events, an unidentified vehicle struck the rear left area of the Chevrolet Express van. The Chevrolet Express was also equipped with an EDR that was downloaded during this on-site investigative effort. The Chevrolet Express EDR printout is included as **Attachment B** of this report. As a result of the crash, the driver's frontal air bag deployed in the Chevrolet Silverado. The driver of the Silverado sustained a right knee contusion, a left leg abrasion, and a right shoulder strain and was transported to a hospital where he was treated and released. Both vehicles sustained severe frontal damage and were towed from the crash site.			
17. Key Words Driver's Frontal Air Bag Deployment Certified Advanced 208-Compliant Safety System		*18. Distribution Statement* General Public	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 25	*22. Price*

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LOCATION - STATE OF MICHIGAN
CRASH DATE – DECEMBER 2004

BACKGROUND

This on-site investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2004 Chevrolet Silverado pickup truck **(Figure 1)**. The manufacturer of this vehicle has certified that this 2004 Chevrolet Silverado meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system consisted of dual stage frontal air bags, seat track positioning sensors for the front seats, an occupant presence sensor for the front right seat, and safety belt buckle switch sensors to monitor belt usage. In addition, the Chevrolet was equipped an Event Data Recorder (EDR) that was downloaded (Deployment and Non-Deployment) during the on-site investigative effort. The EDR printout is included as **Attachment A** of this report. The Chevrolet was occupied by a restrained 38-year-old male driver. The Silverado was involved in an intersection crash with a 2002 Chevrolet Express cargo van. The Chevrolet Express was occupied by a 41-year-old male driver. During the crash events, an unidentified vehicle struck the rear left area of the Chevrolet Express van. The Chevrolet Express was also equipped with an EDR that was downloaded during this on-site investigative effort. The Chevrolet Express EDR printout is included as **Attachment B** of this report. As a result of the crash the driver's frontal air bag deployed in the Chevrolet Silverado. The driver of the Silverado sustained a right knee contusion, a left leg abrasion, and a right shoulder strain and was transported to a hospital where he was treated and released. Both vehicles sustained severe frontal damage and were towed from the crash site.

Figure 1. Subject vehicle 2004 Chevrolet Silverado.

This crash was identified by the NASS PSU-12 during the weekly review of the Police Accident Reports (PAR's). The NASS PSU forwarded the PAR to the National Highway Traffic Safety Administration (NHTSA) due to the presence of the Certified Advanced 208-Compliant frontal air bag system in the 2004 Chevrolet Silverado. NHTSA forwarded the PAR to the Calspan Special Crash Investigations (SCI) team for follow-up investigation. The Chevrolet Silverado was located and cooperation was established with the tow yard. The case was assigned to the Calspan SCI team on January 10, 2005 as an on-site investigative effort. The vehicles and the crash site were inspected on January 11-12, 2005.

SUMMARY

Crash Site

This intersection crash occurred during the daylight hours of December 2004. At the time of the crash, the weather was cloudy and the roadway was wet from prior precipitation. The crash occurred at a signalized intersection of two local roadways. Both roadways were one-way and were configured with two travel lanes and were bordered by concrete barrier curbs. The northbound lanes had a slight uphill grade prior to the intersection. The westbound roadway had a slight left curve prior to the intersection. Traffic flow through the intersection was controlled by a three-phase traffic signal. The posted speed limit for both roadways was 80 km/h (50 mph). The scene schematic is included as **Figure 15** of this report.

Vehicle Data – 2004 Chevrolet Silverado

The 2004 Chevrolet Silverado was identified by the Vehicle Identification Number (VIN): 1GCEC19X64 (production sequence omitted). The odometer reading at the time of the inspection was unknown due to lack of power to the vehicle. The vehicle was a four-door extended cab pickup truck that was equipped with a 4.3-liter, V6 engine, 4-speed automatic transmission, rear-wheel drive, power-front and rear disc brakes with anti-lock, power steering, and a tilt steering wheel. The Chevrolet was configured with Goodyear Wrangler ST P235/75R16 tires. The vehicle manufacturer recommended tire pressure was unknown. The vehicle placard was not obtainable due to the restricted (jammed closed) left front door. The specific tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	0 kPa	6 mm (8/32)	Yes	Cut sidewall
LR	179 kPa (26.0 PSI)	6 mm (8/32)	No	Rim deformed and abraded
RF	214 kPa (31 PSI)	5.5 mm (7/32)	No	None
RR	214 kPa (31 PSI)	5.5 mm (7/32)	No	None

The seating positions in the Chevrolet were configured with a cloth upholstered three-passenger front split-bench seat with height adjustable head restraints for the outboard seats. The front seat head restraints were both adjusted to the full-down positions at the time of the vehicle inspection. The second row was configured with a three-passenger bench seat and height adjustable head restraints for the outboard seating positions. The left head restraint was adjusted to the full-down position. The right head restraint was adjusted 3.5 cm (1.4”) above the full-down position.

2002 Chevrolet Express

The 2002 Chevrolet Express was identified by the VIN: 1GCFG15W32 (production sequence omitted). The odometer reading at the time of the inspection was unknown due to lack of power to the vehicle. The vehicle was a large cargo van that was equipped with a 4.3-liter, V6 engine, 4-speed automatic transmission, rear-wheel drive, anti-lock braking system (ABS), OEM steel wheels, and power steering. The Chevrolet was

configured with a Michelin tire on the front left and Cooper Discoverer HT tires on the left rear and right side; all were size, P235/75R15. The specific tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	228 kPa (33 PSI)	5 mm (6/32)	No	None
LR	214 kPa (31 PSI)	8 mm (10/32)	No	None
RF	0 kPa	5 mm (6/32)	Yes	Unknown
RR	0 kPa	8 mm (10/32)	No	De-beaded

Crash Sequence

Pre-Crash

The restrained 38-year-old male driver of the 2004 Chevrolet Silverado was operating the vehicle northbound **(Figure 2)** on the two-lane roadway approaching the intersection. Based on the EDR Deployment data, the vehicle speed was 62.8 km/h (39.0 mph) five-seconds prior to Algorithm Enable (AE). The EDR indicated that the driver of the Silverado applied a level of braking at three seconds and one second prior to AE which reduced the Silverado's speed to 54.7 km/h (34.0 mph) one second prior to AE. The 41-year-old male driver of the 2002 Chevrolet Express was operating the vehicle eastbound **(Figure 3)** on the intersecting roadway. The EDR from the Express did not included pre-crash data for this vehicle. It was police reported that the driver of the Silverado entered the intersection on a red traffic signal phase. The driver of the Silverado stated to the SCI investigator that traffic signal was in the green phase as he approached the intersection. He further stated that the Chevrolet Express did not appear to be slowing, therefore he applied the brakes and steered left towards the Express.

Figure 3. Silverado's northbound approach to the intersection.

Figure 2. Express's eastbound approach to the intersection.

Crash

The front aspect of the Silverado impacted the frontal aspect of the Express in the intersection **(Figure 4)**. The resultant directions of force were 11 o'clock for the Silverado and 1 o'clock for the Express. The WINSMASH damage algorithm was used to calculate a delta V for this impact. The total calculated delta V for the Silverado was 26.0 km/h (16.2 mph). The longitudinal and lateral components were -19.9 km/h (-12.4 mph) and 16.7 km/h (10.4 mph), respectively. The total calculated delta V for the Express was 27.0 km/h (16.8 mph). The longitudinal and lateral components were -25.4 km/h (-15.8 mph) and -9.2 km/h (-5.7 mph), respectively. This impact resulted in the EDR recorded Deployment event which indicated that the maximum-recorded delta V was -41.4 km/h (-25.7 mph) for the Silverado. The EDR Deployment event for the Express shows that the maximum-recorded delta V for the Express was -53.4 km/h (-33.2 mph).

Figure 4. Northbound view of initial area of impact.

As a result of the initial impact, the Silverado and the Express began to travel in a northeast direction. The left rear aspect of the Express was impacted by unknown vehicle that was traveling adjacent to the Express in the left eastbound through lane.

The Silverado initiated a counterclockwise rotation and the Express rotated clockwise as they continued in an eastbound direction. The left rear aspect of the Silverado impacted the right rear aspect of the Express **(Figure 5)**. The resultant directions of force for this impact were 9 o'clock for the Silverado and 3 o'clock for the Express. The WINSMASH damage algorithm was used to calculate a delta V for the impact. The total calculated delta V for the Silverado was 10.0 km/h (6.2 mph). The longitudinal and lateral components were 0.0 km/h and 10.0 km/h (6.2 mph), respectively. The total calculated delta V for the Express was 10.0 km/h (6.2 mph). The longitudinal and lateral components were 0.0 km/h and -10.0 km/h (-6.2 mph), respectively.

Figure 5. Eastbound view of the secondary area of impact.

The Silverado and the Express came to rest in the left eastbound through lane east of the intersection. There was no physical evidence at the crash site to support impact and final rest positions.

Post-Crash

Police and EMS personnel responded to the crash site. The driver of the Silverado stated to the SCI investigator that he climbed out of the left front window to exit the vehicle. He sustained a right knee contusion, a left leg abrasion, and a right shoulder strain and was transported to a hospital where he was treated and released. Both vehicles sustained moderate damage and were towed from the crash site.

Vehicle Damage

Exterior Damage – 2004 Chevrolet Silverado

The 2004 Chevrolet Silverado sustained severe frontal damage as a result of the initial impact with the Chevrolet Express cargo van **(Figure 6)**. The damage consisted of longitudinal and lateral displacement of the frontal components. The lateral displacement resulted from the 11 o'clock direction force. The direct contact damage measured 132.0 cm (52.0") and began at the front left bumper corner and extended right. The maximum crush measured 57.0 cm (22.4") and was located at the front left bumper corner. The SCI investigator utilized six equidistant crush measurements to document the crush along the front bumper using a combined direct and induced damage width of 155.0 cm (61.0") and were as follows: C1 = 57.0 cm (22.4"), C2 = 43.0 cm (16.9"), C3 = 42.0 cm (16.5"), C4 = 24.0 cm (9.4"), C5 = 3.0 cm (1.2"), C6 = 0.0 cm. The Collision Deformation Classification (CDC) for this impact was 11-FDEW-3.

Figure 6. 2004 Chevrolet Silverado frontal damage.

The Silverado sustained moderate severity left side damage as a result of the sideslap impact **(Figure 7)**. The damage consisted of lateral deformation to the left rear aspect of the bed, longitudinal abrasions to the bed and rear of the cab area, and abrasions and minor deformation to the left rear wheel rim. The direct contact damage measured 155.0 cm (61.0"), which began 35.6 cm (14.0") rear of the left rear axle and extended forward. The maximum crush measured 39.0 cm (15.4") and was located 34.3 cm (13.5") forward of the left rear axle. Six crush measurements was used to document the damage from this impact using a combined direct and induced damage width of 212.1 cm (83.5") and were as follows: C1 = 14.0 cm (5.5"), C2 = 17.0 cm (6.7"), C3 = 35.0 cm (13.8"), C4 = 39.0 cm (15.4"), C5 = 23.0 cm (9.1"), C6 = 3.0 cm (1.2"). The CDC for this impact was 09-LBEW-3.

Figure 7. Left side damage from secondary impact with the Chevrolet Express.

The Silverado's windshield was fractured from contact with the hood edge, and the front left glazing was disintegrated during the initial impact. The backlight was disintegrated as a result of the secondary impact. The remainder of the glazing was intact post-crash. The left side doors were restricted in the closed position from the longitudinal displacement of the frontal components. The right side doors were closed and operational post-crash.

Interior Damage – 2004 Chevrolet Silverado

The 2004 Chevrolet Silverado sustained minor interior damage as a result of occupant contacts. **Figure 8** is an overall view of the passenger compartment. At impact with the Chevrolet Express, the driver's frontal air bag deployed. The driver initiated a forward and left trajectory in response to the 11 o'clock direction of force. The driver's abdomen loaded the safety belt, which was evidenced by loading and a light colored clothing transfer on the lap portion of the safety belt. The driver's left thigh contacted and scuffed the left door panel mounted armrest and his left knee contacted the manual widow lever, which was fractured from the contact. Also present was a scuffmark to the left side of the knee bolster from possible contact with the driver's left knee. Body fluid was noted on the top center aspect of the steering wheel from possible contact from the driver. Passenger compartment intrusion was limited to 5.0 cm (1.9") longitudinal reduction of the left toe pan.

Figure 8. Overall view of the passenger compartment.

Exterior – 2002 Chevrolet Express

The 2002 Chevrolet Express sustained severe frontal damage as result of the frontal impact with the Silverado **(Figure 9)**. The direct damage consisted of longitudinal deformation of the frontal structure and minor lateral left displacement. The direct contact damage measured 142.0 cm (56.0"), which began at the front right bumper corner and extended left. The maximum crush measured 33.0 cm (12.9") and was located at the front right bumper corner. Six crush measurements were utilized to document the crush along the front bumper using a combined direct and induced damage width of 160.0 cm (63.0") and were as follows: C1 = 0.0 cm, C2 = 11.0 cm (4.3"), C3 = 16.0 cm (6.3"), C4 = 29.0 cm (11.4"), C5 = 32.0 cm (12.6"), C6 = 33.0 cm (13.0"). The CDC for this impact was 01-FDEW-3.

Figure 9. 2002 Chevrolet Express frontal damage.

The Express sustained moderate severity damage to the left rear aspect from a subsequent impact with an unidentified vehicle **(Figure 10)**. The damage consisted of longitudinal and lateral displacement of the left rear sheet metal. The direct damage from this impact measured 170.2 cm (67.0") and was approximately 25.4 cm (10.0") in depth. The CDC for this impact was 09-LBEW-2.

The Express sustained minor severity damage to the right rear corner as a result of the secondary impact with the Silverado **(Figure 11)**. The damage consisted of lateral deformation to the right rear aspect. The direct damage measured 71.1 cm (28.0") which began at the right rear corner and extended forward. The maximum crush measured 23.0 cm (9.1") and was located at the right rear corner. Six equidistant crush measurements were utilized to document the damage from this impact using a combined direct and induced damage width of 73.6 cm (29.0") and were as follows: C1 = 23.0 cm (9.1"), C2 = 11.0 cm (4.3"), C3 = 6.0 cm (2.4"), C4 = 3.0 cm (1.2"), C5 = 0.0 cm, C6 = 1.0 cm (0.4"). The CDC for this impact was 03-RBEW-2.

Figure 10. Damage from the impact with the unknown vehicle.

Figure 11. Damage from the secondary impact with the Silverado.

Certified Advanced 208-Compliant Safety System – 2004 Chevrolet Silverado

The 2004 Chevrolet Silverado was equipped with a Certified Advanced 208-Compliant (CAC) frontal safety system. The manufacturer of this vehicle has certified that this 2004 Chevrolet Silverado meets the advanced air bag requirements of the Federal Motor Vehicle Safety Standard (FMVSS 208) No. 208. The system consisted of dual stage frontal air bags, seat track positioning sensors for the front seats, an occupant presence sensor for the front right seat, and safety belt buckle switch sensors to monitor belt usage. A Sensing and Diagnostic Module (SDM) controlled the system. The SDM measures and predicts crash severity and monitors seat track position, belt status, and occupant presence to deploy the appropriate safety system. In the subject crash, the SDM commanded a Stage One deployment of the driver air bag at 5.0 milliseconds after AE.

The driver's air bag was conventionally located in the center of the steering wheel hub **(Figure 12).** Two symmetrical I-configuration cover flaps concealed the air bag. Both cover flaps measured 12.0 cm (4.7") in height at the center tear seam and 8.0 cm (3.1") in width. The air bag membrane was 60.0 cm (23.6") in diameter in its deflated state and was vented by two vent ports that were located on the rear aspect of the air bag at the 11 and 1 o'clock positions. The driver's air bag was tethered by two wide band tethers at the 9 and 3 o'clock positions. There were no occupant contact points present on the air bag membrane; however, dirt transfers were present on the air bag face at the 1 o'clock position from post-crash handling of the air bag.

Figure 12. Deployed driver's frontal air bag.

The front right passenger air bag was a mid-mount design in the right instrument panel. The front right seat was not occupied during the crash; therefore the front right air bag did not deploy.

Manual Air Bag Cut-Off Switch – 2004 Chevrolet Silverado

In addition to the CAC system, the Silverado was equipped with a center instrument panel-mounted cut-off switch for the front right air bag **(Figure 13)**. The cut-off switch was manually operated by the driver using the vehicle ignition key. The cut-off switch could be utilized in either of two settings "Off" and "Auto". At the time of the crash, the switch was in the "Off" position. This was supported by the EDR summary data that reported the "Automatic Passenger SIR Suppression System Status" as "Air Bag Suppressed". Furthermore, the driver stated to the SCI investigator that the switch was in the "Off" position at the time of the crash.

Figure 13. Manual cut-off switch.

Event Data Recorder – 2004 Chevrolet Silverado

The 2004 Chevrolet Silverado was equipped with an Event Data Recorder (EDR). The EDR was downloaded during the SCI inspection and the printout is included as **Attachment A** of this report. The EDR was downloaded through the SDM that was located under the driver's seat using the Vetronix Crash Data Retrieval tool. The battery was damaged during the crash; therefore the SCI investigator applied power to the SDM using a portable battery.

The downloaded data consisted of two events, a Deployment and Non-Deployment events. The Deployment event indicated that the driver's safety belt was buckled at the time of the crash. The maximum-recorded delta V was -41.4 km/h (-25.7 mph) at 97.5 milliseconds after AE. The SDM commanded a Stage One deployment of the driver's air bag at 5.0 milliseconds after AE. The pre-crash data summary shows that the vehicle was traveling at 62.7 km/h (39.0 mph) five seconds prior to AE and had slowed to 54.7 km/h (34.0 mph) one second prior to AE. The brake switch circuit status was in the off-position five, four, and one second prior to AE.

Based on the dynamics of the crash and the SCI reconstruction, the EDR Non-Deployment data was related to the secondary side slap. Examination of the data indicated that some of the pre-crash values were invalid. Invalid data is generally associated with a lack of battery power. This was consistent with the frontal crash damage that involved the front left area where the battery was located.

Event Data Recorder – 2002 Chevrolet Express

The 2002 Chevrolet Express was equipped with an EDR. The SCI investigator downloaded the EDR during this on-site investigative effort. The EDR printout is included as **Attachment B** of this report. The EDR was downloaded through the SDM that was located under the driver's seat using the Vetronix Crash Data Retrieval tool. The battery was separated from the vehicle during the crash; therefore the SCI investigator applied power to the SDM using a portable battery. The EDR recorded a Deployment and a Non-Deployment event. The Deployment data indicated that the driver's safety was buckled at the time of AE. The maximum-recorded delta V was -52.1 km/h (-33.2 mph) at 107.5 milliseconds.

The Non-Deployment event that was recorded 81 ignition cycles prior to the deployment event, therefore it was not related to this crash.

Manual Restraint Systems – 2004 Chevrolet Silverado

The 2004 Chevrolet Silverado was equipped with integrated manual 3-point lap and shoulder safety belts for front outboard seating positions. The rear outboard positions were equipped with manual 3-point lap and shoulder safety belts. The front and rear center safety belts were configured with 2-point manual lap belts. The driver's safety belt was configured with a sliding latch plate, and an Emergency Locking Retractor (ELR). The driver utilized his safety belt in the crash which was evidenced by the loading and a light colored clothing transfer on the safety belt. Furthermore, the retractor was found restricted in the used position at the time of the SCI inspection and the EDR indicated the safety belt was buckled at the time of AE. A cut was noted to the driver's safety belt

Figure 14. Damage to the driver's safety belt buckle sleeve.

buckle sleeve **(Figure 14)**, which resulted from the driver loading the sleeve against the seatback bracket. Although the sleeve was cut, no failures were noted to the safety belt buckle assembly. The front right safety belt was configured with a sliding latch plate and a switchable ELR/Automatic Locking Retractor (ALR). The rear outboard safety belts were configured with sliding latch plates and switchable ELR/ALR. The front and rear center safety belts were configured with locking latch plates and no retractors.

Occupant Demographics – 2004 Chevrolet Silverado

Driver

Age/Sex:	38-year-old/male
Height:	180.3 cm (71.0")
Weight:	74.8 kg (165.0 lbs)
Seat Track Position:	Full rear
Manual Restraint Use:	Integrated 3-point manual lap and shoulder safety belt
Usage Source:	Vehicle inspection
Eyewear:	Eyeglasses
Type of Medical Treatment:	Transported to a local hospital, treated and released.

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Mechanism
Right knee contusion	Minor (890402.1,1)	Knee bolster
Left tibia abrasion	Minor (890202.1,2)	Knee bolster
Right shoulder strain (muscle)	Minor (740402.1,1)	Impact forces

Source: Emergency room records

Driver Kinematics

The 38-year-old male driver of the 2004 Chevrolet Silverado was seated in an upright posture with the seat track adjusted to a rear track position. The driver utilized the manual 3-point lap and shoulder safety belt in the crash, which was evidenced by the loading, and transfer mark on the safety belt. Furthermore, the retractor was found restricted in the used position at the time of the SCI inspection and the EDR indicated the safety belt was buckled at the time of AE. At impact with the Chevrolet Express, the driver's frontal air bag deployed. The driver initiated a forward and left trajectory in response to the 11 o'clock direction of force. The left side of the driver's torso loaded the shoulder belt which resulted in rotation of the right shoulder causing the right shoulder strain. His right knee contacted the knee bolster, which resulted in the right knee contusion. The driver's lower left leg contacted the knee bolster which resulted in the abrasion over the left tibia. The driver exited the vehicle though the left front window due to the restricted left front door. He was transported to a local hospital where he was treated and released for the minor injuries. The combination of belt usage and frontal air bag deployment prevented the driver from sustaining further possible injuries.

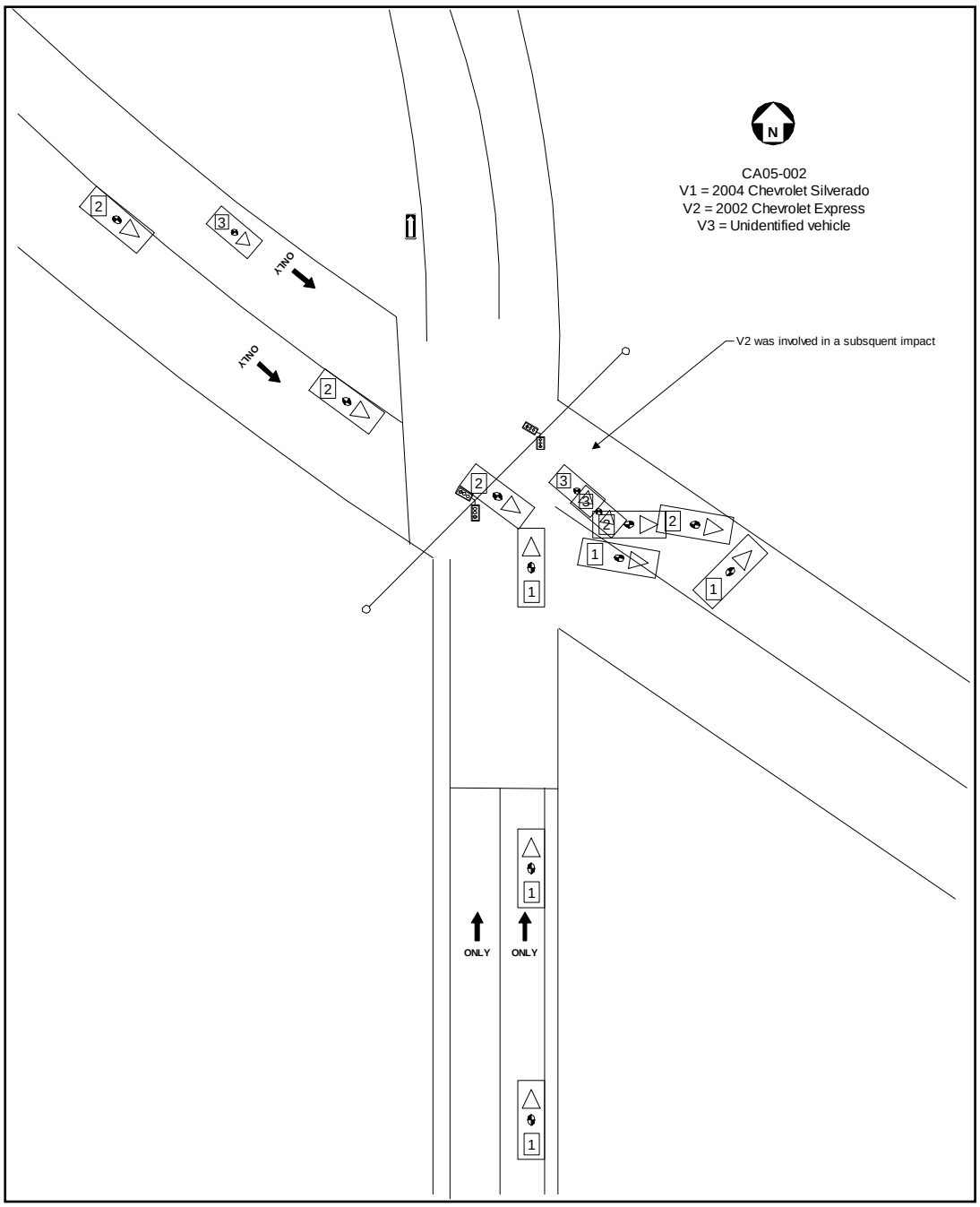


Figure 15. Scene Schematic

Attachment A: Chevrolet Silverado EDR Report

Attachment B: Chevrolet Express EDR Report

CDR File Information

Vehicle Identification Number	1GCEC19X64Zxxxxxx
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	WITHOUTVIN.CDR
Saved on	Monday, January 10 2005 at 03:55:38 PM
Data check information	4ED86F3B
Collected with CDR version	Crash Data Retrieval Tool 2.40
Collecting program verification number	32B7A917
Reported with CDR version	Crash Data Retrieval Tool 2.40
Reporting program verification number	32B7A917
Interface used to collected data	Block number: 00 Interface version: 3D Date: 06-18-04 Checksum: 5C00
Event(s) recovered	Deployment Non-Deployment

SDM Data Limitations

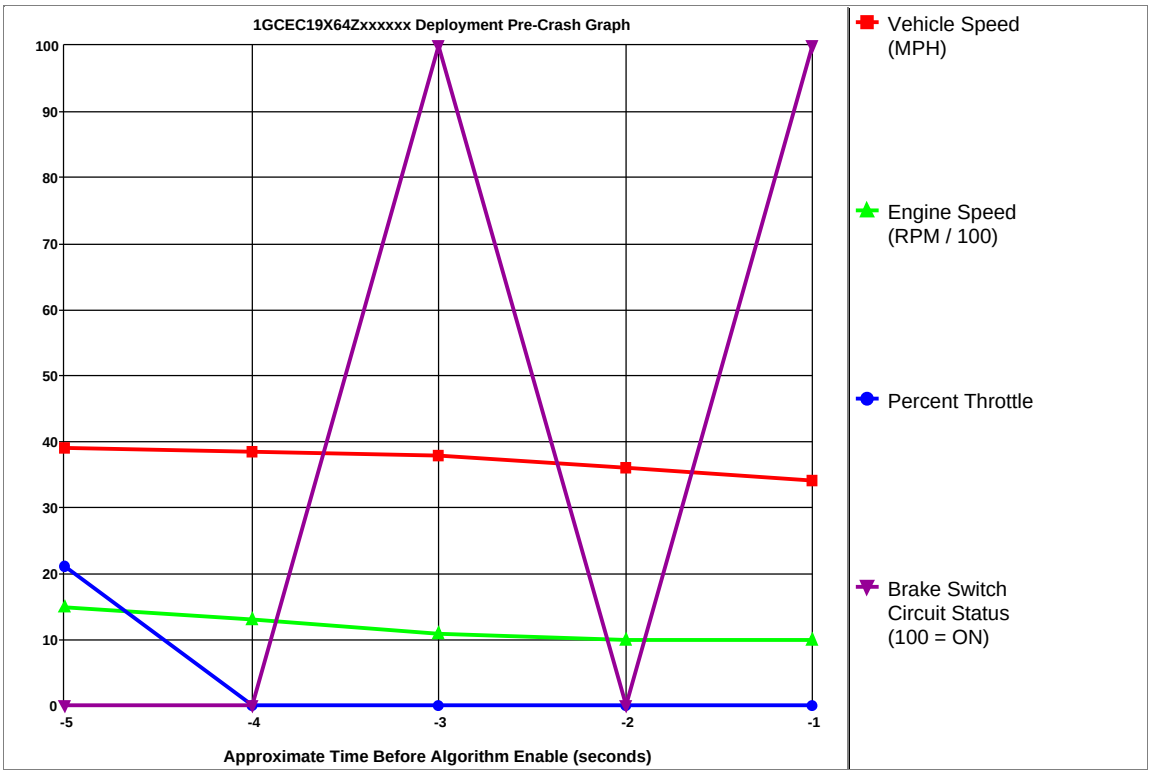
SDM Recorded Crash Events:
There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.
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. Deployment events can not be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.
The data in the non-deployment file will be locked after a deployment, if the non-deployment occurred within 5 seconds before the deployment or a deployment level event occurs within 5 seconds after the deployment.

SDM Data Limitations:
-SDM Recorded Vehicle Forward Velocity Change is one of the measures used to make air bag deployment decisions. SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward 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. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For deployments and deployment level 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-deployments, the SDM will record the first 150 milliseconds of data after algorithm enable.
-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 if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.
-Brake Switch Circuit Status indicates the status of the brake switch circuit.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM does not receive a valid message.
-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit
-The Time Between Non-Deployment and 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.

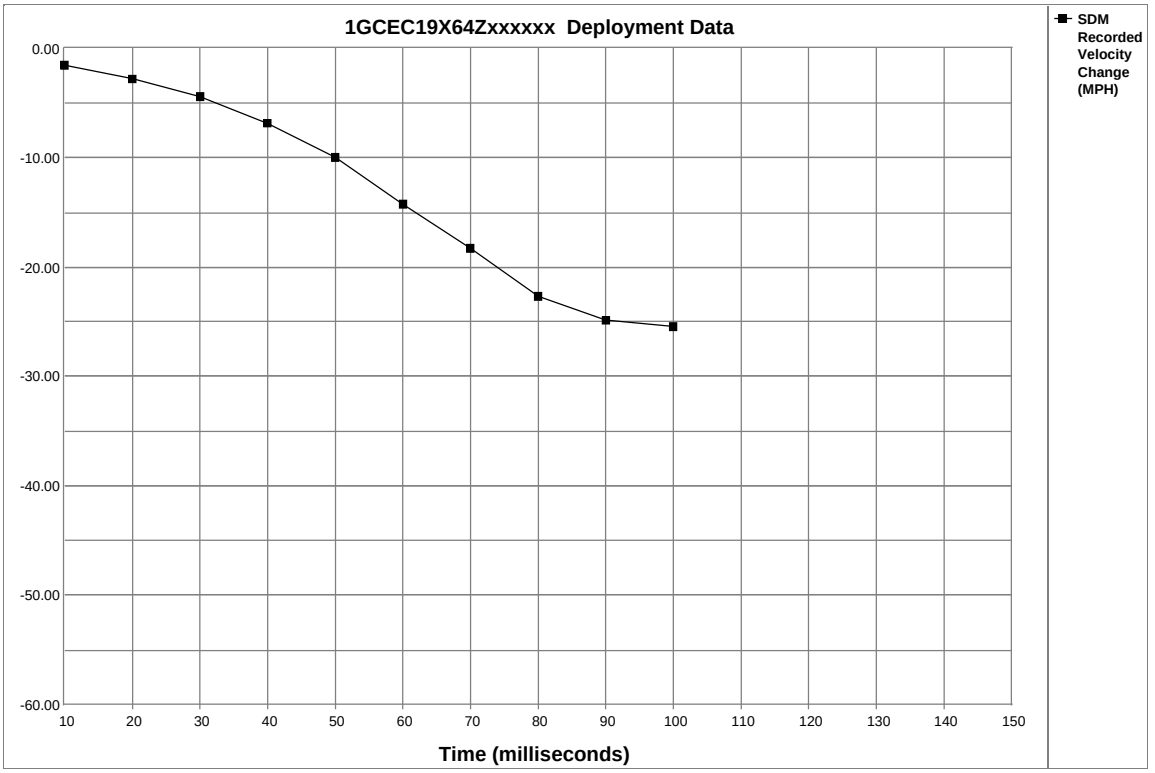
SDM Data Source:
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted once a second by the Powertrain Control Module (PCM), via the Class 2 data link, to the SDM.
-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the Class 2 data link, to the SDM.
-In most vehicles, the Driver's Belt Switch Circuit is wired directly to the SDM. In some vehicles, the Driver's Belt Switch Circuit Status data is transmitted from the Body Control Module (BCM), via the Class 2 data link, to the SDM.

System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Deployment	2953
Ignition Cycles At Investigation	2954
Maximum SDM Recorded Velocity Change (MPH)	-25.69
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	97.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	5
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	Suppressed
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Time Between Non-Deployment And Deployment Events (sec)	N/A
Frontal Deployment Level Event Counter	1
Automatic Passenger SIR Suppression System Status	Air Bag Suppressed
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No



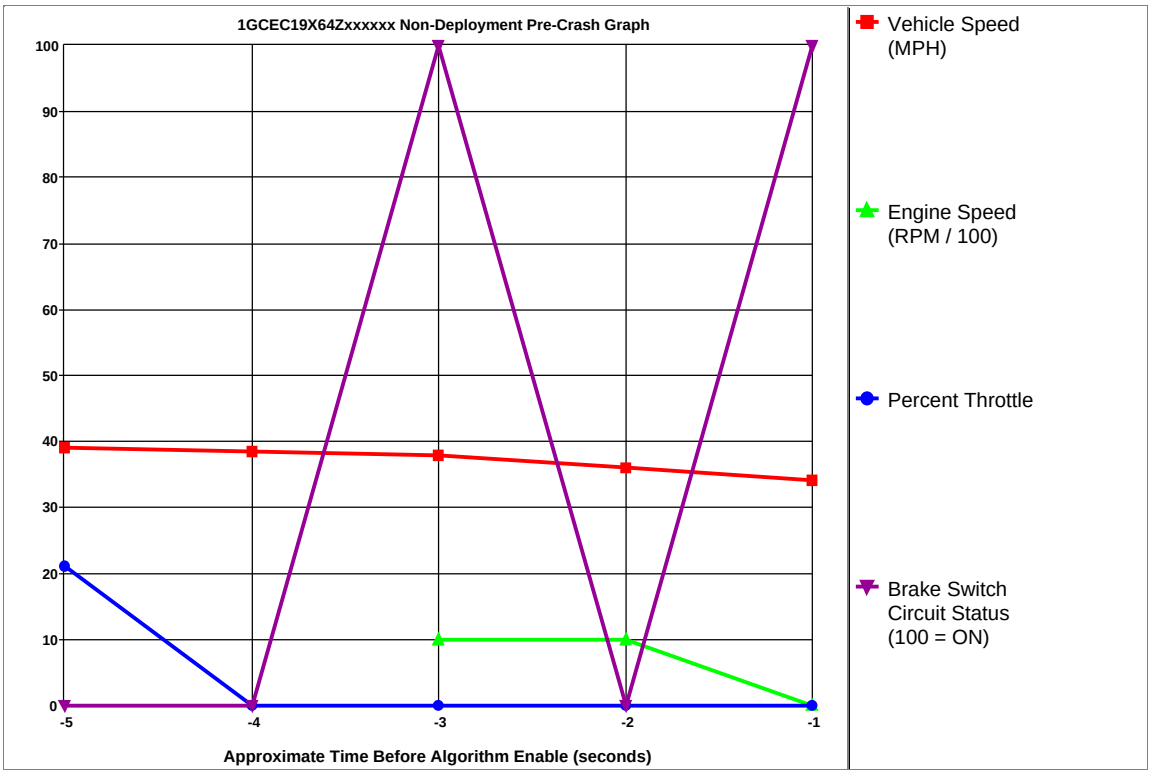
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	39	1536	21	OFF
-4	39	1344	0	OFF
-3	38	1088	0	ON
-2	36	1024	0	OFF
-1	34	960	0	ON



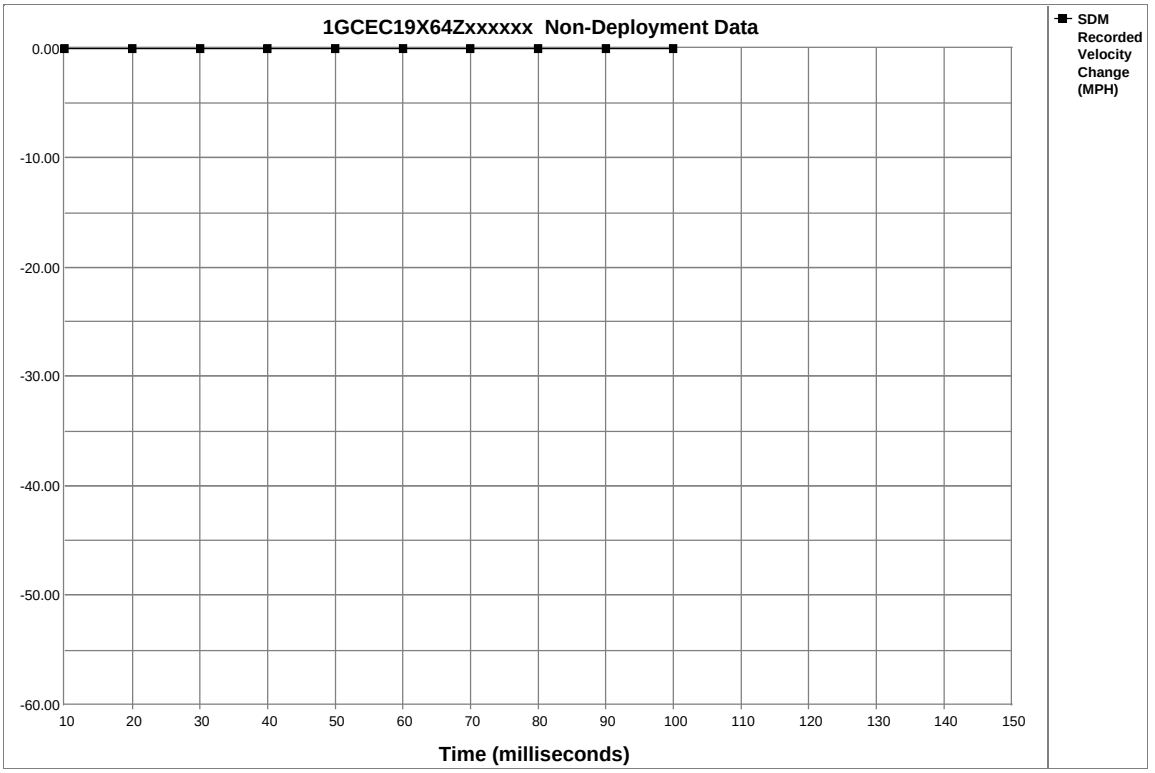
Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-1.55	-2.79	-4.34	-6.82	-9.92	-14.26	-18.29	-22.63	-24.80	-25.42	N/A	N/A	N/A	N/A	N/A

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Non-Deployment	2953
Ignition Cycles At Investigation	2954
Maximum SDM Recorded Velocity Change (MPH)	-0.16
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	80
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No



Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	39	Invalid	21	OFF
-4	39	Invalid	0	OFF
-3	38	1024	0	ON
-2	36	960	0	OFF
-1	34	0	0	ON



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	N/A	N/A	N/A	N/A	N/A

Hexadecimal Data

This page displays all the data retrieved from the air bag module.
It contains data that is not converted by this program.

```
$01  F0 39 33 A9 AE C6
$02  F1 F1 00 00 B8 00
$03  41 53 34 30 36 34
$04  4B 57 5A 39 39 32
$05  00 00 00 00 00 00
$06  15 13 06 08 00 00
$07  00 00 00 00 00 00
$08  00 00 00 00 00 00
$09  00 00 00 00 00 00
$0A  00 00 00 00 00 00
$0B  00 00 00 00 00 00
$0C  00 00 00 00 00 00
$0D  00 00 00 00 00 00
$0E  00 00 00 00 00 00
$0F  00 00 00 00 00 00
$10  FE 8E FC 00 00 00
$11  7F 7F 7F 7F 7F 7F
$12  8A 79 79 23 23 11
$13  FF 02 00 00 00 00
$14  03 03 00 00 6C 00
$15  FA FA FA FA FA FA
$16  FA FA FA FA FA FA
$17  FA FA 00 00 00 00
$18  00 0F 05 EC F5 00
$19  09 00 0A 00 00 64
$1A  00 00 00 00 00 00
$1B  00 00 00 00 00 00
$1C  00 0C 00 00 00 00
$1D  00 00 00 00 00 00
$1F  FE 00 00 00 00 00
$20  52 FB 00 00 FF FF
$21  FF F7 FF FF FF FF
$22  FF FF FF FF FF FF
$23  FF FF FF FF FF F7
$24  00 00 08 00 20 49
$25  27 00 00 03 FF FF
$26  00 00 00 00 00 00
$27  00 00 00 00 00 00
$28  00 00 00 0A FE 8E
$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 00 00 00 00
$30  B2 FE 00 00 FF FF
$31  FF FF FF FF FF FF
$32  FF FF FF FF FF FF
$33  FF FF FF FF FF FF
$34  00 00 33 04 02 03
$35  00 00 00 00 00 00
$36  00 00 00 00 00 00
$37  00 00 00 05 2C 49
$38  27 03 4A 26 00 00
$39  01 00 00 03 FF FF
$3A  05 09 0E 16 20 2E
$3B  3B 49 50 52 00 00
$3C  00 00 00 0A FE 8E
$3D  FE A5 00 00 00 00
$40  37 3A 3D 3E 3F 00
$41  A0 00 00 00 00 00
$42  36 00 0F 10 11 15
$43  18 00 48 FE 00 00
```

$44	00	00	00	00	00	00
$45	00	00	00	00	00	00
$46	00	00	0E	0E	0E	0E
$47	0E	00	34	FE	00	00
$48	37	3A	3D	3E	3F	00
$49	A0	00	00	00	00	00
$4A	36	00	0F	10	11	15
$4B	18	00	48	FE	00	00
$4C	FF	FF	FF	FF	FF	FF
$4D	FF	FF	FF	FF	FF	FF
$4E	FF	FF	FF	FF	FF	FF
$4F	FF	FF	FF	FF	00	00
$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

CDR File Information

Vehicle Identification Number	1GCFG15W321xxxxxx
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	WITHOUTVIN V2.CDR
Saved on	Tuesday, January 11 2005 at 02:34:31 PM
Data check information	893FE710
Collected with CDR version	Crash Data Retrieval Tool 2.40
Collecting program verification number	32B7A917
Reported with CDR version	Crash Data Retrieval Tool 2.40
Reporting program verification number	32B7A917
Interface used to collected data	Block number: 00 Interface version: 3D Date: 06-18-04 Checksum: 5C00
Event(s) recovered	Deployment Non-Deployment

SDM Data Limitations

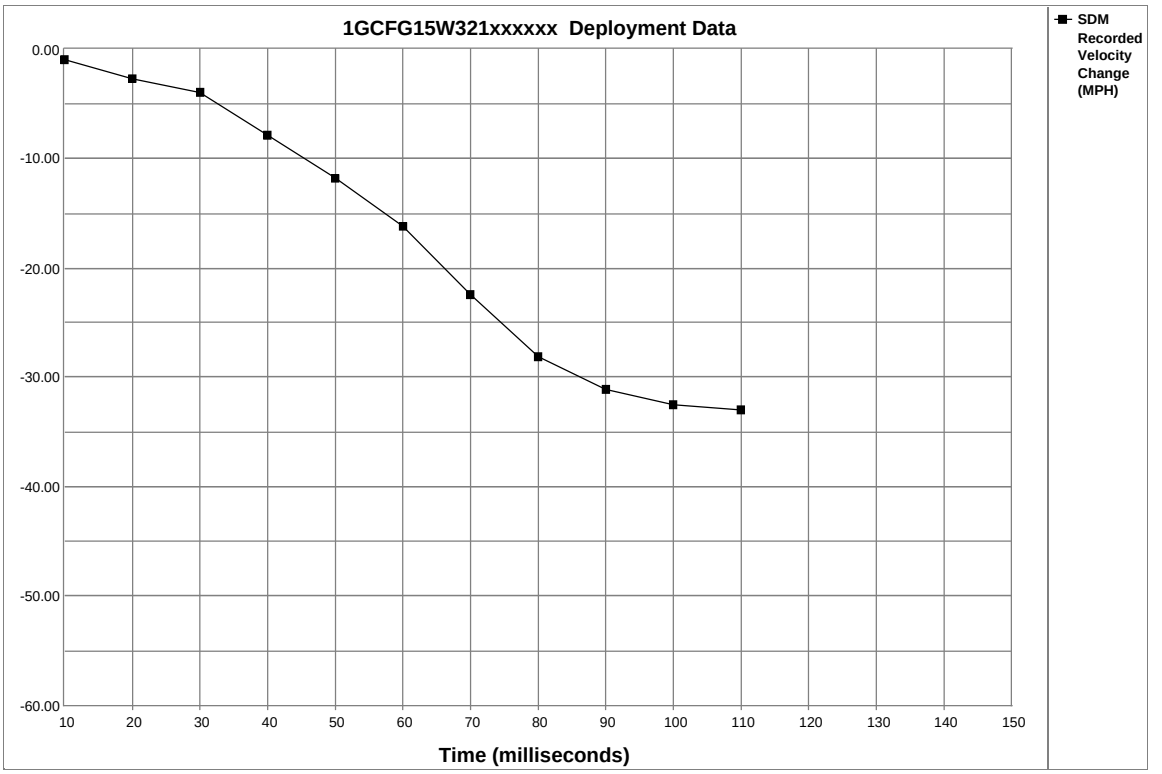
SDM Recorded Crash Events:
There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.
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. Deployment events can not be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.
The data in the non-deployment file will be locked after a deployment, if the non-deployment occurred within 5 seconds before the deployment or a deployment level event occurs within 5 seconds after the deployment.

SDM Data Limitations:
-SDM Recorded Vehicle Forward Velocity Change is one of the measures used to make air bag deployment decisions. SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward 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. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For deployments, 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-deployments and deployment level events, the SDM will record the first 150 milliseconds of data after algorithm enable.
-SDM Recorded Vehicle Speed accuracy can be affected if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.
-Brake Switch Circuit Status indicates the status of the brake switch circuit.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM does not receive a valid message.
-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit
-Passenger Front Air Bag Suppression Switch Circuit Status indicates the status of the suppression switch circuit.
-The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than five 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.

SDM 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 once a second by the Powertrain Control Module (PCM), via the Class 2 data link, to the SDM.
-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the Class 2 data link, to the SDM. Depending on vehicle option content, the Brake Switch Circuit Status data may not be available.
-If the vehicle is a 2000 - 2002 Chevrolet Cavalier Z24 or a Pontiac Sunfire GT, with a manual transmission (RPO MM5) and a 2.4L engine (RPO LD9), the Brake Switch Circuit Status data will be reported in the opposite state than what actually occurred, e.g. an actual brake switch status of "ON" will be reported as "OFF".
-In most vehicles, the Driver's Belt Switch Circuit is wired directly to the SDM. In some vehicles, the Driver's Belt Switch Circuit Status data is transmitted from the Body Control Module (BCM), via the Class 2 data link, to the SDM.
-The Passenger Front Air Bag Suppression Switch Circuit is wired directly to the SDM.

System Status At Deployment

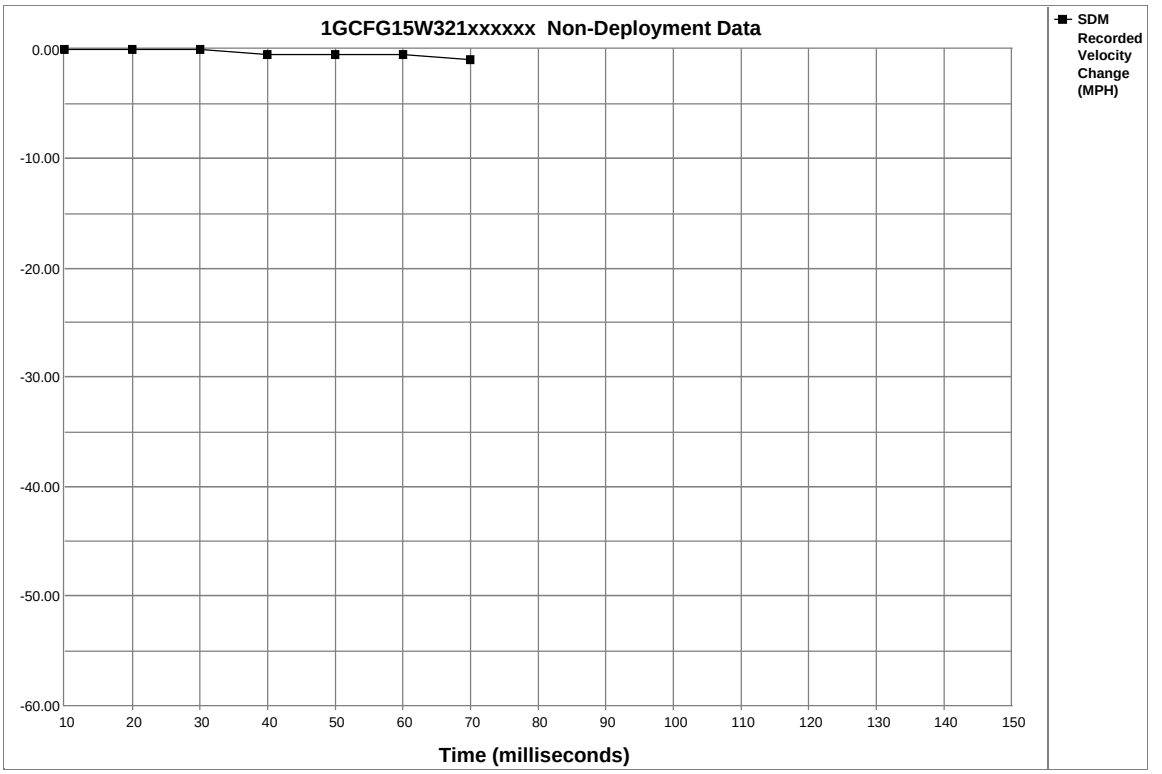
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed
Ignition Cycles At Deployment	8494
Ignition Cycles At Investigation	8495
Maximum SDM Recorded Velocity Change (MPH)	-33.24
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	107.5
Time Between Non-Deployment And Deployment Events (sec)	N/A
Time From Algorithm Enable to Deployment Command Criteria Met (msec)	12.5



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
SDM Recorded Velocity Change	-0.88	-2.63	-3.95	-7.90	-11.85	-16.24	-22.38	-28.08	-31.15	-32.47	-32.91	N/A	N/A	N/A	N/A

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed
Ignition Cycles At Non-Deployment	8413
Ignition Cycles At Investigation	8495
Maximum SDM Recorded Velocity Change (MPH)	-0.99
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	70



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
SDM Recorded Velocity Change	0.00	0.00	0.00	-0.44	-0.44	-0.44	-0.88	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Hexadecimal Data

This page displays all the data retrieved from the air bag module.
It contains data that is not converted by this program.

```
$01  08 23 00 00
$02  9B 4A
$03  41 53 31 31 37 37
$04  4B 33 37 47 5A 32
$05  00
$06  15 07 14 21
$10  FB DA 80
$11  7C 7F 7E F9 84 03
$14  03 82 80 80
$18  84 83 84 B8 FF 00
$1C  FA FA FA FA FA FA
$1D  FA FA FA FA FA FA
$1E  FA FA
$1F  FF 02 00 00 00
$20  A0 00 00 FF 22 FC
$21  FF FF FF FF FF FF
$22  FF FF FF FF FF FF
$23  FF 00 00 48 03 00
$24  00 00 01 01 01 02
$25  FF FF FF FF FF FF
$26  FF FF 07 00 00 00
$27  00 00 00 00 00 00
$28  00 00 00 00 00 00
$29  00 00 00 00 00 FB
$2A  E4 E0 FF FF FF FF
$2B  FF FF FF 00 00 00
$2C  00 00 00 00
$2D  1C 0B 0E 00
$30  A0 00 00 FF 2C F8
$31  FF BF FF FF FF FF
$32  FF FF FF FF FF FF
$33  FC 0B 03 03 02 06
$34  09 12 1B 25 33 40
$35  47 4A 4B FF FF FF
$36  FF 0B 56 09 7A 00
$37  00 00 00 00 00 00
$38  00 00 00 00 00 00
$39  00 00 00 00 00 00
$3A  00 FB DA C0 00 00
$3B  00 04 00
$3C  05 2B 56 2B
$40  FF FF FF FF FF FF
$41  FF FF FF FF FF FF
$42  FF FF FF FF FF FF
$43  FF
```