CRASH DATA RESEARCH CENTER
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CALSPAN ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION SYSTEM CRASH INVESTIGAITON SCI CASE NO: CA09003

VEHICLE: 2008 CHEVROLET IMPALA

LOCATION: NEW YORK

CRASH DATE: JANUARY 2009

Contract No. DTNH22-07-C-00043

Prepared for:

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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 inflatable side impact protection system in a 2008 Chevrolet Impala. The Chevrolet was involved in an intersection-type crash with a 2005 GMC Envoy. As a result of the impact forces, both frontal air bags and the left and right curtain air bags deployed in the Chevrolet. The crash occurred when the eastbound Chevrolet Impala turned left in front of the westbound GMC Envoy. As a result of the impact forces, both the frontal air bags and the left and right inflatable curtain air bags deployed. The Chevrolet was driven by a 75-year-old restrained male and occupied by a 70-year-old restrained female in the right front passenger position. The driver and passenger both had police reported complaints of pain in their hip/upper leg areas and were transported by ground ambulance to a local hospital. The GMC's frontal air bags did not deploy. The GMC was driven by a 39-year-old restrained female who had police deported complaints of pain in her knee/lower leg area and was transported by ground ambulance to a local hospital. Both vehicles were towed from the crash scene due to disabling damage.			
17. Key Words Side Impact IC air bags Intrusion Restrained Driver Front right passenger Soft tissue injuries EDR		*18. Distribution Statement* General Public	
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BACKGROUND

This on-site investigation focused on the inflatable side impact protection system in a 2008 Chevrolet Impala (**Figure 1**). The Chevrolet was involved in an intersection-type crash with a 2005 GMC Envoy. As a result of the impact forces, both frontal air bags and the left and right curtain air bags deployed in the Chevrolet. The crash occurred when the eastbound Chevrolet Impala turned left in front of the westbound GMC Envoy. The Chevrolet Impala was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system and an inflatable side impact protection system. The CAC system in the Chevrolet was comprised of dual stage frontal air bags with a front right occupant presence sensor and front row retractor type pretensioners. The inflatable side impact protection system consisted of roof-rail mounted inflatable curtain (IC) air bags. As a result of the impact forces, both the frontal air bags and the left and right inflatable curtain air bags deployed. The Chevrolet was driven by a 75-year-old restrained male and occupied by a 70-year-old restrained female in the right front passenger position. The driver and passenger both had police reported complaints of pain in their hip/upper leg areas and were transported by ground ambulance to a local hospital. The GMC's frontal air bags did not deploy. The GMC was driven by a 39-year-old restrained female who had police deported complaints of pain in her knee/lower leg area and was transported by ground ambulance to a local hospital. Both vehicles were towed from the crash scene due to disabling damage.

Figure 1: Right front oblique view of the 2008 Chevrolet Impala. Image supplied by the police investigator.

Notification of this crash was provided to the Calspan Special Crash Investigations (SCI) team by the investigating police agency on February 2, 2009. The Calspan SCI team forwarded the crash specifics to the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA). Due to the crash dynamics and the deployment of IC air bags into an occupied seat position, an on-site investigation was assigned to the Calspan SCI team the same day. The on-site investigation which included the inspection of the Chevrolet, GMC, and the

crash site were conducted on February 4, 2009. The EDR data within both vehicles were also imaged at that time.

VEHICLE DATA

2008 Chevrolet Impala

The 2008 Chevrolet Impala was manufactured in 10/07 and was identified by the Vehicle Identification Number (VIN) 2G1WT58N089 (production sequence deleted). The odometer reading at the time of the SCI inspection was 8,884 miles (14,297 km). The powertrain consisted of 3.5-liter, V6 engine linked to a 4-speed automatic transmission with front wheel drive. The Chevrolet was equipped with 4-wheel disk brakes. The manual restraint system consisted of 3-point lap and shoulder safety belts in all five seating positions. The front safety belts were equipped with retractor pretensioners and load-force limiters. The Chevrolet was equipped with Certified Advanced 208-Compliant (CAC) frontal air bags and side impact Inflatable Curtains (IC) air bags. The vehicle manufacturer has certified that the frontal air bags in this Chevrolet were compliant with the advanced air bag requirements of the Federal Motor Vehicle Safety Standard No. 208. The Chevrolet was equipped with Goodyear Integrity P225/60R16 tires mounted on OEM, 5-spoke, alloy wheels. The vehicle manufacturer recommended front and rear cold tire pressure was 207 kPa (30 PSI). This vehicle was also equipped with an indirect tire pressure monitoring system. The specific tire data at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	165 kPa (24 PSI)	6 mm (8/32 in)	No	None
LR	179 kPa (26 PSI)	7 mm (9/32 in)	No	None
RR	179 kPa (26 PSI)	8 mm (10/32 in)	No	None
RF	179 kPa (26 PSI)	6 mm (8/32 in)	No	None

2005 GMC Envoy

The 2005 GMC Envoy was identified by the VIN: 1GKDT13S652 (production sequence deleted). The vehicle was manufactured in February 2005. The digital odometer reading was unknown. This 4-door, 4-wheel drive sport utility vehicle was powered by a 4.2-liter, V6 engine linked to a 4-speed automatic transmission. The brakes were a 4-wheel disc system with ABS. The manual restraint system consisted of 3-point lap and shoulder safety belts for all five seating positions. The front safety belts were equipped with retractor pretensioners. The GMC was also equipped with Certified Advanced 208-Compliant (CAC) frontal air bags for the driver and front right passenger positions and side impact Inflatable Curtains (IC) air bags for the four outboard seating positions. The GMC was equipped with Bridgestone Dueller HT P245/65R17 tires mounted on OEM, 6-spoke, alloy wheels. The vehicle manufacturer recommended front and rear

tire pressures were 207 kPa (30 PSI) and 241 kPa (35 PSI), respectively. The specific tire data at the time of the SCI inspection was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	159 kPa (23 PSI)	8 mm (10/32 in)	No	None
LR	159 kPa (23 PSI)	8 mm (10/32 in)	No	None
RR	172 kPa (25 PSI)	8 mm (10/32 in)	No	None
RF	172 kPa (25 PSI)	8 mm (10/32 in)	No	None

CRASH SITE

This crash occurred during the daylight morning hours of January 2009, on a two-lane, two-way portion of an east/west undivided roadway and its intersection with a business driveway. At the time of the crash, the area was experiencing snow showers and the level, bituminous road surface was snow covered. The roadway alignment was straight and configured with one travel lane in each direction. The eastbound and westbound travel lanes measured 4.2 m (13.8 ft) and 4.3 m (14.1 ft) wide. Bituminous shoulders bordered both lanes. The west side shoulder measured 0.8 m (2.6 ft) wide while the east side shoulder was 1.2 m (3.9 ft) wide. The westbound travel lane was marked as a passing zone. The posted speed limit was 64 km/h (40 mph). A private driveway intersected the westbound lane from the north. This driveway was oriented in a north/south direction and measured 7 m (23 ft) wide. The approximate point of impact was identified by the intersecting paths of travel between the Chevrolet Impala and the GMC Envoy. The point of impact was not documented by the investigating police. **Figure 2** is an eastbound view of the Chevrolet Impala's pre-crash path of travel. A Scene Diagram is included at the end of this report.

Figure 2: Eastbound view of the Chevrolet's pre-crash path of travel.

CRASH SEQUENCE

Pre-Crash

The Chevrolet Impala was traveling east driven by a 75-year-old restrained male. The GMC Envoy was traveling west driven by a 39-year-old restrained female. The GMC was traveling at a constant pre-crash speed of 85 km/h (53 mph) as reported by the imaged EDR. The Chevrolet had an EDR reported speed of (23 mph) 0.5 seconds prior to Algorithm Enable (AE). The Chevrolet initiated a left turn maneuver across the projected path of the GMC.

Crash

The crash occurred when the GMC's front plane impacted the Chevrolet's right plane (Event 1). The directions of the impact force were in the 12 o'clock sector for the GMC and 2 o'clock sector for the Chevrolet. The point of impact was located within the westbound travel lane. This impact resulted in the actuation of Chevrolet's safety belt pretensioners and the deployment of the vehicle's frontal air bags and both IC air bags. The frontal air bags in the GMC did not deploy in this crash. The Damage Algorithm of the WinSMASH program was used to calculate the severity (delta-V) of the crash. The total delta-V of the Chevrolet was 57 km/h (35.4 mph). The longitudinal and lateral delta-V components were -29 km/h (-18 mph) and -49 km/h (30.4 mph), respectively. The GMC's total delta-V was 47 km/h (29.2 mph) with longitudinal and lateral components of -46 km/h (-28.6 mph) and 8 km/h (5 mph), respectively.

Figure 3: On-scene final rest positions of the Chevrolet and GMC. Image supplied by the police investigator.

The force of the impact, forward of the Chevrolet's center of gravity, caused this vehicle to rotate counterclockwise approximately 55 degrees before coming to final rest (**Figure 3**). The GMC's forward momentum was altered laterally from impact forces which produced a clockwise rotation of approximately 55 degrees before arriving at final rest. The Chevrolet came to final rest on the north side of the roadway approximately 8 m (26.2 ft) west of the west side of the driveway. The GMC came to final rest adjacent to and immediately east of the Chevrolet.

Post-crash

Local police, fire and ambulance personnel responded to the crash. The driver of the Chevrolet complained of pain in his hip/upper leg area and was transported by ground ambulance to a local hospital where he was treated and released. The front right passenger of the Chevrolet complained of pain in her hip/upper leg area and was transported by ground ambulance to a local hospital where she was hospitalized. The driver of the GMC complained of pain in her knee/lower leg area and was transported by ground ambulance to a local hospital where she was treated and released. The Chevrolet and the GMC sustained disabling damage and were towed from the crash site. Both vehicles were subsequently deemed total losses by their respective insurance companies.

2008 CHEVROLET IMPALA

Exterior Damage

The exterior of the Chevrolet sustained right side-plane damage as a result of the crash sequence. The direct contact damage measured 149 cm (58.7 in). This direct damage extended from the right/front fender to the B-pillar area and included the right/front wheel. The vertical aspect of the direct damage ranged from the sill to the beltline area. The impact forces resulted in lateral and longitudinal deformation of the left/front door and front fender components but did not produce any vehicle shifting. The right wheelbase was measured to be 5 cm (2 in) shorter and the left wheelbase was measured to be 2 cm (0.8 in) longer than the manufacturer's original specification. The damage profile (**Figure 4**) measured 290 cm (114.2 in) between deflection points. The residual crush profile was measured at the mid-door level and its results are as follows: C1 = 2 cm (0.8 in), C2 = 16 cm (6.3 in), C3 = 46 cm (18.1 in), C4 = 55 cm (21.7 in), C5 = 24 cm (9.4 in), C6 = 7 cm (2.8 in). The maximum crush was located at C4. The Door Sill Differential (DSD) measured 25 cm (10 in) on the mid-aspect of the right front door. Refer to **Figure 5**. The left/front door remained closed and operational, however, all other doors were found to be jammed shut at the time of the SCI inspection. The roof support pillars were cut and the roof was removed during the extrication of the occupants. The Collision Deformation Classification assigned to this damage pattern was 02RYEW3.

Figure 4: The right side crush profile of the Chevrolet.

Figure 5: The right side crush profile of the Chevrolet.

Interior Damage

The interior damage to the Chevrolet consisted of the deployment of the vehicle's air bag systems, three occupant contacts, lateral intrusions of the first and second row right side interior components and longitudinal intrusions of the vehicle's instrument panel. Descriptions of the Chevrolet's intrusions are listed in the following table:

Position	Component	Intrusion	Direction
Row 1 Right	Side Panel, Forward of the A-Pillar	39 cm (15.4 in)	Lateral
	Door Panel	29 cm (11.4 in)	Lateral
	Floor Pan	29 cm (11.4 in)	Lateral
	Instrument Panel	8 cm (3.1 in)	Longitudinal
	Roof Side Rail	6 cm (2.4 in)	Lateral
	R.F. seat cushion	3 cm (1.2 in)	Lateral
Row 1 Center	Instrument Panel	12 cm (4.7 in)	Longitudinal
Row 2 Right	B-Pillar	16 cm (6.3 in)	Lateral
	Door Panel	8 cm (3.1 in)	Lateral
	Roof Side Rail	6 cm (2.4 in)	Lateral

The driver seat was located in the rear-most track position and the seat back was reclined 10 degrees aft of vertical with the head restraint 1 cm (0.4 in) above its full-down position. The 4-spoke tilt steering wheel was located in a center position. There was no deformation of the steering wheel rim and no displacement of the shear capsules. The first row right seat was located in a mid to rear track position, 8 cm (3.1 in) forward of the full-rear location and the seat back was reclined 10 degrees aft of vertical with the head restraint 3 cm (1.2 in) above its full-down position. The front row right passenger's lower extremities contacted the right/front door panel and armrest as evidenced by fracturing and deformation of these components.

Manual Restraint System

The driver's manual restraint was a 3-point lap and shoulder safety belt that consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and an Emergency Locking Retractor (ELR). The D-ring was adjusted to the full-down position. The retractor was equipped with a pretensioner that actuated as a result of the crash. The retractor was locked with belt webbing extended and gathered in the D-ring. The latch plate revealed historical evidence of use and the friction surface exhibited abrading to its full-width as a result of occupant loading. A 3 cm (1.2 in) crease in the webbing in the area of the buckled latch plate was also observed. The total length of the exposed belt webbing measured 188 cm (74 in).

The front right manual restraint was a 3-point lap and shoulder safety belt that consisted of continuous loop webbing, a sliding latch plate, an adjustable D-ring and a switchable Emergency Locking Retractor/Automatic Locking Retractor (ELR/ALR). The D-ring was adjusted to the full-down position. The retractor was equipped with a pretensioner that actuated as a result of the

crash. The retractor was locked and the webbing was extended in the used/worn position. The shoulder portion of the webbing was cut 61 cm (24 in) below the D-ring by the first responders. The lap portion of the webbing measured 80 cm (31.5) was creased from occupant loading. The crease was located 30 cm (11.8 in) to 43 cm (17 in) from the lower anchor. The latch plate was still in the buckle. It revealed historical evidence of use and the friction surface was abraded its full width as a result of occupant loading. The total length of the exposed belt webbing measured 141 cm (55.5 in).

Frontal Air Bag System

The driver frontal air bag deployed as a result of impact forces from a tri-flap configuration module located in the center of the steering wheel rim. The deployed air bag measured 62 cm (24.4 in) in diameter. The bag contained two tethers located in the 12/6 o'clock sectors and two vent ports located in the 11/1 o'clock sectors. The air bag's excursion from the module measured 27 cm (10.6 in). The front right passenger air bag deployed as a result of impact forces from a separation of the top and mid-instrument panels. The deployed air bag measured 62 cm (24.4 in) vertically and 40 cm (15.7 in) laterally. The bag contained two vent ports located in the side panel areas. The air bag's excursion from the module measured 47 cm (18.5 in). No discernable contact evidence was identified on any of the deployed air bags.

Inflatable Curtain Air Bags

The Chevrolet was equipped with side impact IC air bags mounted to the roof side rails. Both ICs deployed as a result of the impact. The IC air bags (**Figure 6**) measured 175 cm x 41 cm (68.9 in x 16.1 in) length x height in overall dimensions and provided coverage from the upper aspect of the A- to C-pillar area. A 26 cm (10.2 in) long tether extended from the A-pillar and was sewn to the forward aspect of the bag. The vertical coverage of the curtain extended 12 cm (4.7 in) below the beltline in both the front and second rows.

Figure 6: Left side IC airbag in Chevrolet.

Event Data Recorder

The air bag systems in the Chevrolet were controlled by an Air bag Control Module (ACM) that was located in the first row under the right seat. The ACM module was equipped with Event Data Recording (EDR) capabilities and controlled the diagnostic, sensing and deployment command functions of the air bag systems. The EDR was imaged through the diagnostic link connector with software version 3.0 of the Bosch Crash Data Retrieval tool and was reported with software version 3.4. The crash data was recorded and imaged on ignition cycle 1517 and the event recording was complete. The Chevrolet's EDR recorded a single Deployment Event

that was related to the right side impact. The imaged data indicated that both the driver and right front passenger safety belts were buckled at the time of the recorded event. The time between the ACM's algorithm enable to the deployment command was 24 milliseconds. The Chevrolet's EDR was designed to measure the changes of vehicle velocity (expressed in the form of delta-V) along both the longitudinal and lateral axis. The maximum EDR recorded longitudinal delta-V was -10.33 km/h (-6.42 mph) at 170 milliseconds. The maximum EDR recorded lateral delta-V was -34.42 km/h (-21.39 mph) at 180 milliseconds. The EDR recorded 2.5 seconds of Pre-Crash data for the multiple vehicle parameters which are listed in the following table. The imaged data report is attached to the end of this report as *Attachment A.*

Parameter	**-2.5 Seconds**	**-2.0 Seconds**	**-1.5 Seconds**	**-1.0 Seconds**	**-0.5 Seconds**
Vehicle Speed (MPH)	6	11	9	14	23
Engine Speed (RPM)	1280	1536	2112	2304	2688
Percent Throttle	27	10	77	44	35
Brake Switch Circuit Status	Off	On	Off	Off	Off

2005 GMC ENVOY

Exterior Damage

The exterior of the GMC sustained distributed front end-plane damage as a result of the crash sequence. The direct contact damage measured 164 cm (64.6 in) and included the bumper fascia, radiator/grill, both head-light assemblies and frontal aspects of both the hood and front fenders. The impact forces resulted in longitudinal deformation to the front bumper reinforcement, radiator, engine compartment and hood. The left wheelbase was reduced 3 cm (1.2 in). The combined crush profile (**Figure 7**) was measured along the bumper reinforcement bar and its results are as follows: C1 = 6 cm (2.4 in), C2 = 3 cm (1.2 in), C3 = 10 cm (4 in), C4 = 11 cm (4.3 in), C5 = 6 cm (2.4 in), C6 = 2 cm (0.8 in). The maximum crush was located at C4. The Collision Deformation Classification assigned to this damage pattern was 12FDEW1. All glazing within the GMC was intact and all doors were closed and operational at the time of the SCI inspection.

Figure 7: The front crush profile of the GMC.

Event Data Recorder

The air bag systems in the GMC were controlled by an ACM that was located in the center tunnel. The ACM module was equipped with Event Data Recording (EDR) capabilities and controlled the diagnostic, sensing and deployment command functions of the air bag systems. The EDR was imaged through the diagnostic link connector with software version 2.8 of the Bosch Crash Data Retrieval tool and has been reported with version 3.4. The crash data was recorded on ignition cycle 10336 and imaged on ignition cycle 10341. The GMC's EDR recorded a single Non-Deployment Event that was related to the frontal impact. The event recording was complete. The image indicated that the driver safety belt was buckled and the front right passenger safety belt was unbuckled at the time of the recorded event. The GMC's EDR was designed to measure the changes of vehicle velocity (expressed in the form of delta-V) along both the longitudinal and lateral axis. The maximum EDR recorded longitudinal delta-V was -31.77 km/h (-19.74 mph) at 110 milliseconds. The maximum EDR recorded lateral delta-V was +2.04 km/h (+1.27 mph) at 140 milliseconds. The EDR recorded 5 seconds of Pre-Crash data for the multiple vehicle parameters which are listed in the following table. The imaged data report is attached to the end of this report as *Attachment B.*

Parameter	**-5 Seconds**	**-4 Seconds**	**-3 Seconds**	**-2Seconds**	**-1 Seconds**
Vehicle Speed	85 km/h (53 mph)	85 km/h (53 mph)	85 km/h (53 mph)	85 km/h (53 mph)	69 km/h (43 mph)
Engine Speed (RPM)	1728	1536	1536	1536	1408
Percent Throttle	12	12	12	12	0
Brake Switch Circuit Status	Off	Off	Off	Off	On

2008 CHEVROLET IMPALA

Driver Demographics

Age/Sex:	75-year-old/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Full-rear track position.
Safety Belt Usage:	3-point safety belt
Usage Source:	SCI vehicle inspection, EDR
Egress from Vehicle:	Exited vehicle with EMS assistance
Type of Medical Treatment:	Transported to hospital; treated and released

Driver Injury

Injury	Injury Severity (AIS-2005)	Injury Source
No Injury	N/A	N/A

Source: Police Report.

Driver Kinematics

The 75-year-old male driver of the Chevrolet was seated in the full-rear track position and was restrained with the available 3-point safety belt system. At impact, the safety belt retractor locked and the pretensioner actuated. Both frontal and IC air bags deployed as a result of impact forces. The actuated pretensioner removed slack from the belt system and tightened the webbing around the driver. The driver responded to the 2 o'clock direction of impact forces by initiating a forward and right collinear trajectory as he loaded the belt restraint system with his left shoulder, chest and pelvis. This was evidenced by latch plate friction marks and corresponding abrasions to the underside of the webbing. After maximum engagement, the driver rebounded back into his seat where he came to final rest. No discernable contact evidence was documented to the deployed air bags or interior surfaces of this vehicle as a result of the driver's kinematics.

Front Right Passenger Demographics

Age/Sex:	70-year-old/Female
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Mid-to-rear; 8 cm (3.1 in) forward of full-rear position.
Safety Belt Usage:	3-point safety belt.
Usage Source:	SCI vehicle inspection, EDR
Egress from Vehicle:	Exited vehicle with EMS assistance.
Type of Medical Treatment:	Transported to hospital; admitted for treatment.

Front Right Passenger Injury

Injury	Injury Severity (AIS-2005)	Injury Source
Injured, details unknown	Unknown	Unknown

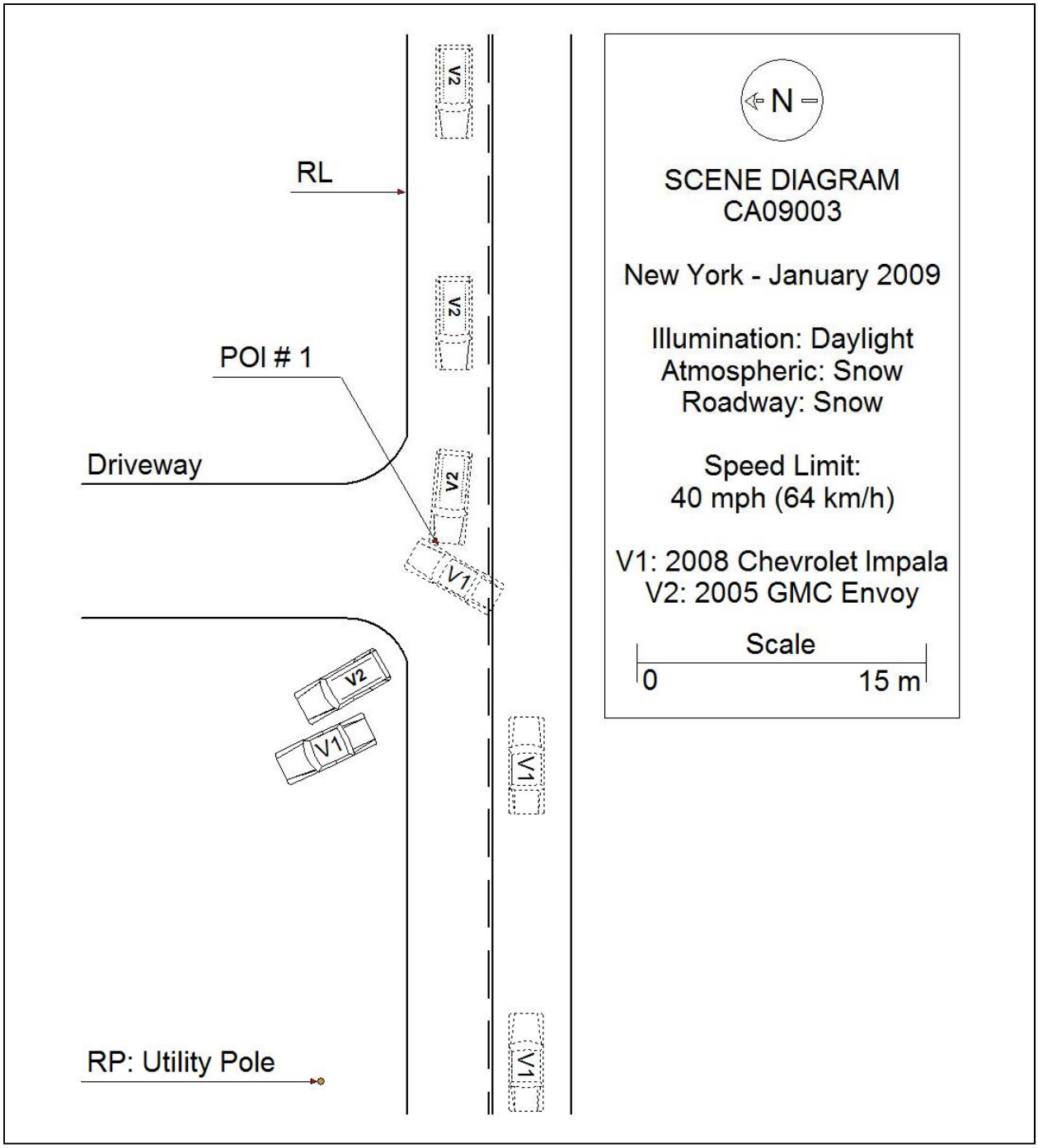
Source: Police Report. Medical records were not available.

Front Right Passenger Kinematics

The 70-year-old female was seated 8 cm (3.1 in) forward of the full-rear track position and was restrained with the available 3-point safety belt system. At impact, the safety belt retractor locked and the pretensioner actuated. Both frontal and IC air bags deployed as a result of impact forces. The actuated pretensioner removed slack from the belt system and tightened the webbing around this occupant. This passenger responded to the 2 o'clock direction of impact forces by initiating a forward and right collinear trajectory as she loaded the belt restraint system with her right shoulder, chest and pelvis. This was evidenced by latch plate friction marks and corresponding

abrasions to the underside of the webbing. The passenger contacted the lower rear quadrant of the right/front door panel (**Figure 8**) with the right aspect of her hip area as evidenced by the identified fracture of this component. The passenger also contacted the right/front door armrest with her lower right arm area as evidenced by the identified deformation of this component. A deformation of the right/front seat cushion was also identified as a possible contact point. The forward aspect of her trajectory resulted in chest contact to the deployed front right passenger air bag. The lateral aspect of her trajectory resulted in head contact to the deployed IC passenger air bag. The passenger rode 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 final rest. No discernable contact evidence was documented to the deployed air bags as a result of this occupant's kinematics.

Figure 8: Contact point evidence on the Chevrolet's right/front door panel



SCENE DIAGRAM

ATTACHMENT A

2008 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	2G1WT58N089******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	Friday, January 30 2009
Filename	CA09003 V1.CDR
Saved on	Friday, February 6 2009 at 11:58:45 AM
Collected with CDR version	Crash Data Retrieval Tool 3.00
Reported with CDR version	Crash Data Retrieval Tool 3.4
EDR Device Type	airbag control module
Event(s) recovered	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). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event may contain Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. 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 Deployment Event #2, if the Non-Deployment Event is not locked. A locked Non Deployment Event cannot be overwritten by the SDM.

The second type of SDM recorded crash event is the Deployment Event. It also may contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events. If a second Deployment Event occurs any time after the Deployment Event, the Deployment Event #2 will overwrite any non-locked Non-Deployment Event. 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 Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle 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 can record 220 milliseconds of data after deployment criteria is met and up to 70 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 300 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-The CDR tool displays time from Algorithm Enable (AE) to time of deployment command in a deployment event and AE to time of maximum SDM recorded vehicle velocity change in a non-deployment event. Time from AE begins when the first air bag system enable threshold is met and ends when deployment command criteria is met or at maximum SDM recorded vehicle velocity change. Air bag systems such as frontal, side, or rollover, may be a source of an enable. The time represented in a CDR report can be that of the enable of one air bag system to the deployment time of another air bag system.

-Maximum Recorded Vehicle Velocity Change is the maximum square root value of the sum of the squares for the vehicle's combined "X" and "Y" axis change in velocity.

-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 status 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 and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit.

-The Time Between Non-Deployment to 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 the value is negative, then the Deployment Event occurred first. If the value is positive, then the Non-Deployment Event occurred first.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-The ignition cycle counter relies upon the transitions through OFF->RUN->CRANK power-moding messages, on the GMLAN communication bus, to increment the counter. Applying and removing of battery power to the module will not increment the ignition cycle counter.
-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 Status Data (Pre-Crash) is transmitted to the SDM, by various vehicle control modules, via the vehicle’s communication network.
-The Belt Switch Circuit is wired directly to the SDM.

01004_SDMC-autoliv_r001

Multiple Event Data

Associated Events Not Recorded	0
An Event(s) Preceded the Recorded Event(s)	No
An Event(s) was in Between the Recorded Event(s)	No
An Event(s) Followed the Recorded Event(s)	No
The Event(s) Not Recorded was a Deployment Event(s)	No
The Event(s) Not Recorded was a Non-Deployment Event(s)	No

System Status At AE

Low Tire Pressure Warning Lamp (If Equipped)	Invalid
Vehicle Power Mode Status	Run
Remote Start Status (If Equipped)	Inactive
Run/Crank Ignition Switch Logic Level	Active

Pre-crash data

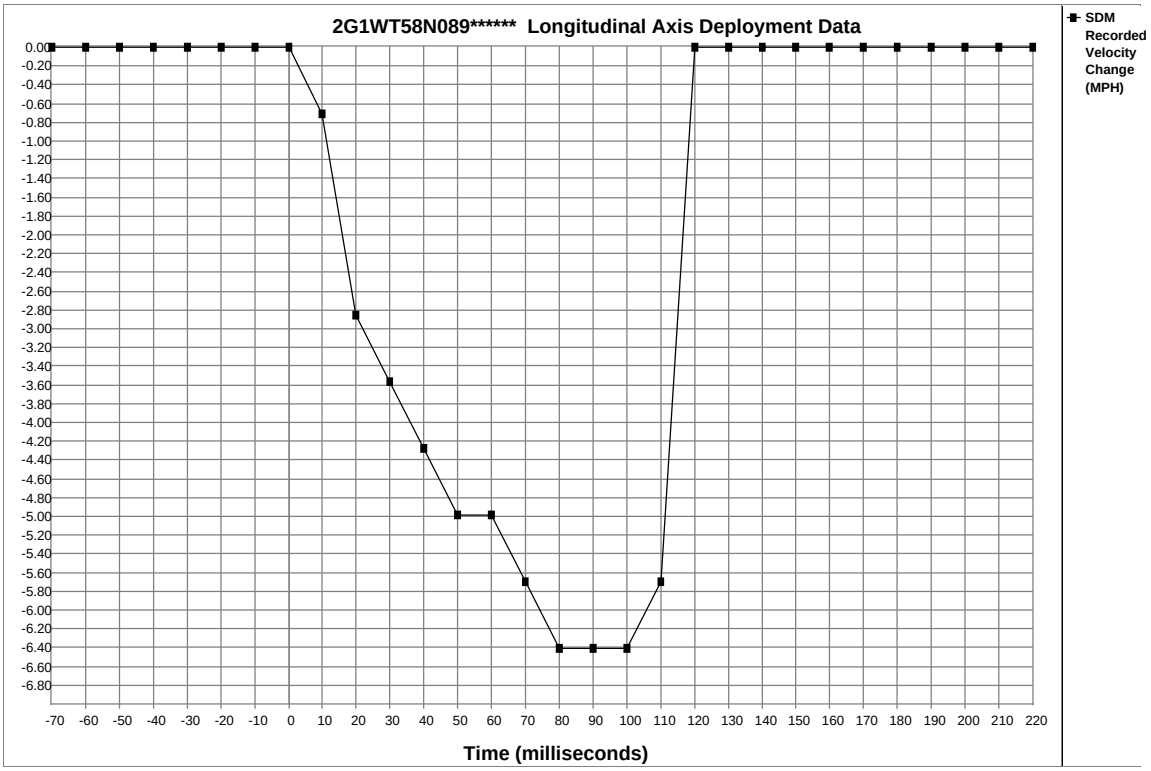
Parameter	-1.0 sec	-0.5 sec
Reduced Engine Power Mode	OFF	OFF
Cruise Control Active (If Equipped)	No	No
Cruise Control Resume Switch Active (If Equipped)	No	No
Cruise Control Set Switch Active (If Equipped)	No	No
Engine Torque (foot pounds)	140.88	59.75

Pre-Crash Data

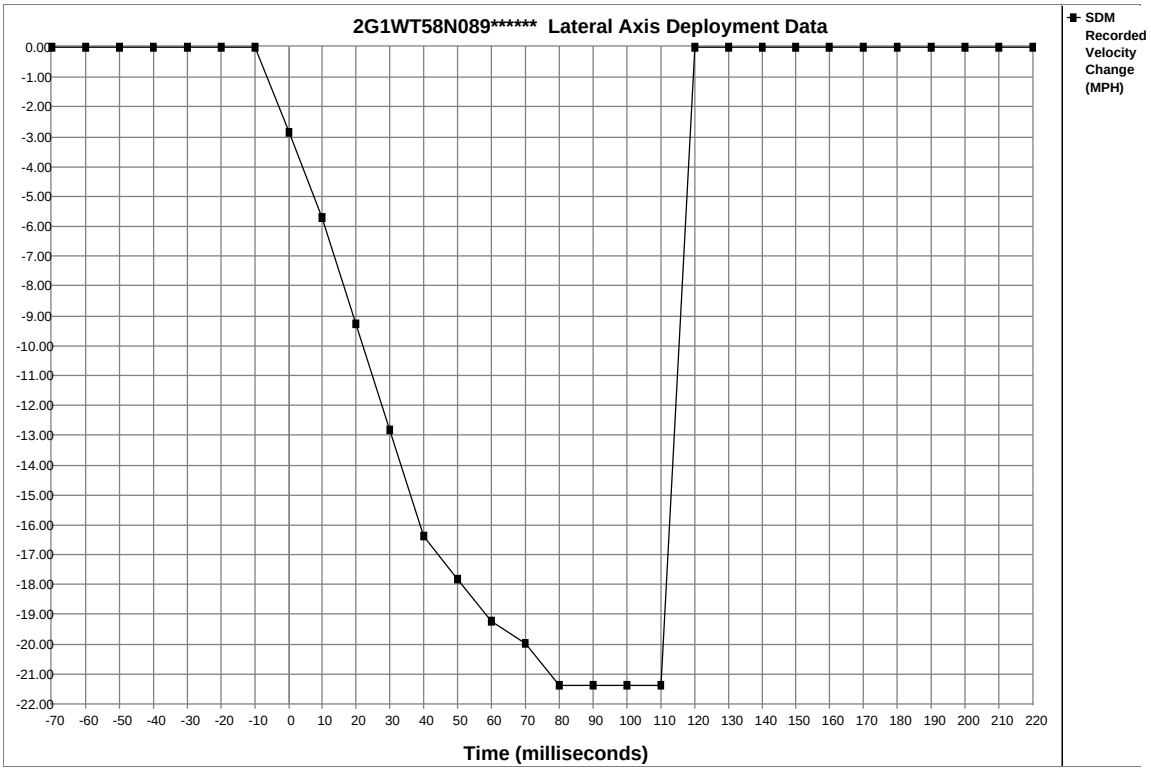
Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Accelerator Pedal Position (percent)	18	0	84	99	89
Vehicle Speed (MPH)	6	11	9	14	23
Engine Speed (RPM)	1280	1536	2112	2304	2688
Percent Throttle	27	10	77	44	35
Brake Switch Circuit Status	OFF	ON	OFF	OFF	OFF

System Status At Deployment

Ignition Cycles At Investigation	1517
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON Time Continuously (seconds)	0
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	38
Ignition Cycles At Event	1517
Ignition Cycles Since DTCs Were Last Cleared	255
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	BUCKLED
Passenger Classification Status at Event Enable	Large Occupant Classification Type #1
Current Passenger Position Status at Event Enable	Position Not Applicable
Previous Passenger Position Status at Event Enable	Unknown
Passenger Air Bag Indicator Status at Event Enable	ON
Diagnostic Trouble Codes at Event, fault number: 1	N/A
Diagnostic Trouble Codes at Event, fault number: 2	N/A
Diagnostic Trouble Codes at Event, fault number: 3	N/A
Diagnostic Trouble Codes at Event, fault number: 4	N/A
Diagnostic Trouble Codes at Event, fault number: 5	N/A
Diagnostic Trouble Codes at Event, fault number: 6	N/A
Diagnostic Trouble Codes at Event, fault number: 7	N/A
Diagnostic Trouble Codes at Event, fault number: 8	N/A
Diagnostic Trouble Codes at Event, fault number: 9	N/A
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	24
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Disposal
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	24
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Disposal
Driver Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	2
Passenger Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	2
Time Between Events (sec)	0
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
SDM Synchronization Counter	1516
Event Recording Complete	Yes
Driver First Stage Deployment Loop Commanded	Yes
Passenger First Stage Deployment Loop Commanded	Yes
Driver Second Stage Deployment Loop Commanded	Yes
Driver 2nd Stage Deployment Loop Commanded for Disposal	Yes
Passenger Second Stage Deployment Loop Commanded	Yes
Passenger 2nd Stage Deployment Loop Commanded for Disposal	Yes
Driver Pretensioner Deployment Loop Commanded	Yes
Passenger Pretensioner Deployment Loop Commanded	Yes
Driver Side Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Second Row Left Side Deployment Loop Commanded	No
Second Row Right Side Deployment Loop Commanded	No
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded	Yes
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded	Yes
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 3) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 3) Roof Rail/Head Curtain Loop Commanded	No
Driver Knee Deployment Loop Commanded	No
Passenger Knee Deployment Loop Commanded	No
Second Row Left Pretensioner Deployment Loop Commanded	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Second Row Center Pretensioner Deployment Loop Commanded	No



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.71	-2.85	-3.56	-4.28	-4.99	-4.99	-5.70
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-6.41	-6.41	-6.41	-5.70	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-2.85	-5.70	-9.27	-12.83	-16.39	-17.82	-19.24	-19.96
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Lateral Axis Recorded Velocity Change (MPH)	-21.38	-21.38	-21.38	-21.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ATTACHMENT B

2005 GMC Envoy 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	1GKDT13S652******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	Friday, January 30 2009
Filename	CA09003 V2.CDR
Saved on	Friday, February 6 2009 at 11:11:49 AM
Collected with CDR version	Crash Data Retrieval Tool 2.800
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). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event may contain 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 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 Deployment Event #2, 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 of 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 may contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events. If a second Deployment Event occurs any time after the Deployment Event, the Deployment Event #2 will overwrite any non-locked Non-Deployment Event. 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 Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle 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 230 milliseconds of data after deployment criteria is met and up to 70 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 300 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-The CDR tool displays time from Algorithm Enable (AE) to time of deployment command in a deployment event and AE to time of maximum SDM recorded vehicle velocity change in a non-deployment event. Time from AE begins when the first air bag system enable threshold is met and ends when deployment command criteria is met or at maximum SDM recorded vehicle velocity change. Air bag systems such as frontal, side, or rollover, may be a source of an enable. The time represented in a CDR report can be that of the enable of one air bag system to the deployment time of another air bag system.

-Maximum Recorded Vehicle Velocity Change is the maximum square root value of the sum of the squares for the vehicle's combined "X" and "Y" axis change in velocity.

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

-Driver's and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit.

-The Time Between Non-Deployment to 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 the value is negative, then the Deployment Event occurred first. If the value is positive, then the Non-Deployment Event occurred first.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-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 Status Data (Pre-Crash) is transmitted to the SDM, by various vehicle control modules, via the vehicle’s communication network.
-The Belt Switch Circuit is wired directly to the SDM.

01013_SDMDS_r001

Multiple Event Data

Associated Events Not Recorded	0
An Event(s) Preceded the Recorded Event(s)	No
An Event(s) was in Between the Recorded Event(s)	No
An Event(s) Followed the Recorded Event(s)	No
The Event(s) Not Recorded was a Deployment Event(s)	No
The Event(s) Not Recorded was a Non-Deployment Event(s)	No

System Status At 1 second

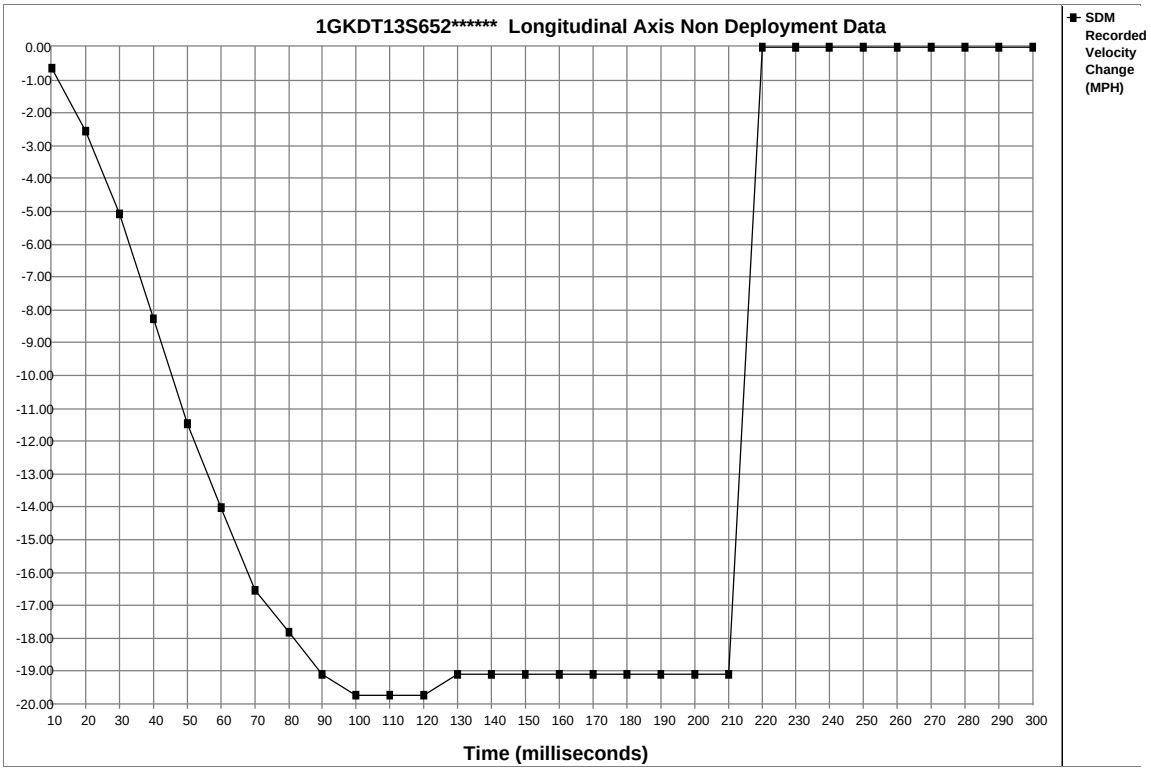
Left Front Door Ajar	No
Right Front Door Ajar	No
Left Rear Door Ajar	No
Right Rear Door Ajar	No

Pre-Crash Data

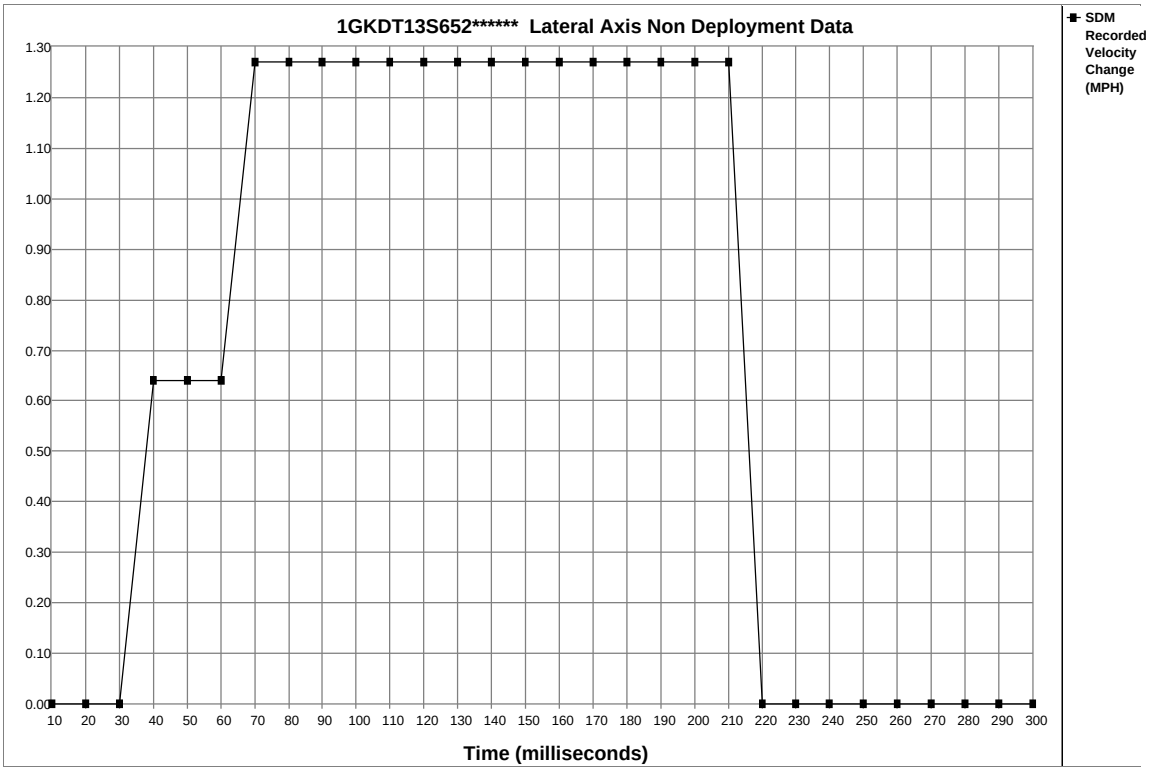
Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Vehicle Speed (MPH)	53	53	53	53	43
Engine Speed (RPM)	1728	1536	1536	1536	1408
Percent Throttle	12	12	12	12	0
Brake Switch Circuit Status	OFF	OFF	OFF	OFF	ON

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655350
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	1431
Ignition Cycles At Investigation	10341
Ignition Cycles At Event	10336
Ignition Cycles Since DTCs Were Last Cleared	255
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Driver Seat Position Switch Circuit Status	Rearward
Passenger Seat Position Switch Circuit Status	Rearward
Automatic Passenger SIR Suppression System Status at AE	Air Bag Suppressed
Driver 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Driver Side Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop Commanded	No
Driver Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Supplemental Deployment Loop #1 Commanded (If Equipped)	No
Passenger 1st Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Passenger Pretensioner Deployment Loop Commanded	No
Passenger Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Supplemental Deployment Loop #2 Commanded (If Equipped)	No
Second Row Left Side Deployment Loop Commanded	No
Second Row Left Pretensioner Deployment Loop Commanded (If Equipped)	No
Supplemental Deployment Loop #3 Commanded (If Equipped)	No
Second Row Right Side Deployment Loop Commanded (If Equipped)	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Supplemental Deployment Loop #4 Commanded (If Equipped)	No
Second Row Center Pretensioner Deployment Loop Commanded	No
Diagnostic Trouble Codes at Event, fault number: 1	N/A
Diagnostic Trouble Codes at Event, fault number: 2	N/A
Diagnostic Trouble Codes at Event, fault number: 3	N/A
Diagnostic Trouble Codes at Event, fault number: 4	N/A
Diagnostic Trouble Codes at Event, fault number: 5	N/A
Diagnostic Trouble Codes at Event, fault number: 6	N/A
Diagnostic Trouble Codes at Event, fault number: 7	N/A
Diagnostic Trouble Codes at Event, fault number: 8	N/A
Diagnostic Trouble Codes at Event, fault number: 9	N/A
Maximum SDM Recorded Velocity Change (MPH)	19.78
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	100
Crash Record Locked	No
Deployment Event Recorded in the Non-Deployment Record	No
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Event Recording Complete	Yes



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-0.64	-2.55	-5.09	-8.28	-11.46	-14.01	-16.55	-17.82	-19.10	-19.73	-19.73	-19.73	-19.10	-19.10	-19.10
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-19.10	-19.10	-19.10	-19.10	-19.10	-19.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.64	0.64	0.64	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27	1.27
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
SDM Lateral Axis Recorded Velocity Change (MPH)	1.27	1.27	1.27	1.27	1.27	1.27	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00