CRASH DATA RESEARCH CENTER

Calspan Corporation
Buffalo, NY 14225

CALSPAN ON-SITE INFLATABLE OCCUPANT PROTECTION SYSTEM CRASH INVESTIGATION

SCI CASE NO.: CA09016

VEHICLE: 2008 CHEVROLET COBALT LS SEDAN

LOCATION: NORTH CAROLINA

CRASH DATE: JANUARY 2009

Contract No. DTNH22-07-C-00043

Prepared for:

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

DISCLAIMER

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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. CA09016	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Calspan On-Site Inflatable Occupant Protection System Crash Investigation Vehicle: 2008 Chevrolet Cobalt Location: State of North Carolina		*5. Report Date*: December 2009 *6. Performing Organization Code*	
7. Author(s) Crash Data Research Center		*8. Performing Organization Report No.*	
9. Performing Organization Name and Address Crash Data Research Center Calspan Corporation P.O. Box 400 Buffalo, New York 14225		*10. Work Unit No.* *11. Contract or Grant No.* DTNH22-07-C-00043	
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: January 2009 *14. Sponsoring Agency Code*	
15. Supplementary Note This on-site investigation focused on the deployment of the side air bag system of a 2008 Chevrolet Cobalt LS sedan.			
16. Abstract This on-site investigation focused on the deployment of the side air bag system of a 2008 Chevrolet Cobalt LS sedan. The vehicle was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, and Inflatable Curtain (IC) air bags. The manufacturer of the Chevrolet has certified that the vehicle is compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system includes dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The Chevrolet was occupied by an 18-year-old female driver and 17-year-old female front right passenger. The vehicle was turning left at a signal-controlled intersection when impacted on the right side by a 2001 Ford Explorer. The right side IC air bag deployed in the Chevrolet. Both occupants were transported to a local hospital where they were treated in the emergency department and released.			
17. Key Words Inflatable Curtain (IC) air bags 2008 Chevrolet Cobalt Minor severity injuries		*18. Distribution Statement* General Public	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 13	*22. Price*

TABLE OF CONTENTS

CALSPAN ON-SITE INFLATABLE OCCUPANT PROTECTION SYSTEM CRASH INVESTIGATION
SCI CASE NO.: CA09016
VEHICLE: 2008 CHEVROLET COBALT LS
LOCATION: NORTH CAROLINA
CRASH DATE: JANUARY 2009

BACKGROUND

Figure 1. 2008 Chevrolet Cobalt case vehicle

This on-site investigation focused on the deployment of the side air bag system of a 2008 Chevrolet Cobalt LS sedan **(Figure 1)**. The vehicle was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system, and Inflatable Curtain (IC) air bags. The manufacturer of the Chevrolet has certified that the vehicle is compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The CAC system includes dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The Chevrolet was occupied by an 18-year-old female driver and 17-year-old female front right passenger. The vehicle was turning left at a signal-controlled intersection when impacted on the right side by a 2001 Ford Explorer. The right side IC air bag in the Chevrolet deployed. Both occupants were transported to a local hospital where they were treated in the emergency department and released.

The crash was identified through a visit to a regional vehicle salvage facility on March 12, 2009. Based on the side impact and the IC air bag deployment, this case was assigned as an on-site investigation on March 13, 2009. The on-site investigation was conducted on March 16-18, 2009 and involved the inspection and documentation of the involved vehicles, the crash site, and an interview with the driver of the Chevrolet. The Chevrolet's Event Data Recorder (EDR) was imaged during the investigation and the output is included as **Attachment A** of this report.

SUMMARY

Crash Site

This crash occurred during the evening hours of January 2009 in the northwest quadrant of a 3-leg intersection. At the time of the crash, the conditions were clear and the asphalt surfaced roadway was dry. Traveling north, the roadway curved to the left with a radius of curvature of 931 m (3054 ft). The northbound direction of travel contained three travel lanes that were 3.6 m (11.8 ft) in width. The northbound lanes were bordered on both sides by asphalt shoulders 1.5 m (4.9 ft) in width on the east side and 1 m (3.3 ft) on the west. The north and southbound lanes were divided by an unprotected grass median that was 9 m (29.5 ft) in width. South of the intersection were two southbound lanes that were 3.5 m (11.5 ft) in width. The southbound lanes were bordered by asphalt shoulders that were 1 m (3.3 ft) in width on the east and 0.9 m (3 ft) on the west. The southbound

direction of travel consisted of four travel lanes that were 3.7 m (12.1 ft) in width. The southbound lanes were bordered on both sides by asphalt shoulders, 1.2 m (3.9 ft) in width on the west side and 0.5 m (1.6 ft) on the east. On the west side of the intersection was a two-lane roadway that increased to three lanes divided by a concrete median and a painted island near the intersection. The intersection was controlled by overhead three-phase traffic signals. The crash schematic is included as **Figures 9 and 10** at the end of this report.

Vehicle Data

2008 Chevrolet Cobalt

The case vehicle was a 2008 Chevrolet Cobalt four-door sedan. The Chevrolet was manufactured in 12/07 and was identified by the Vehicle Identification Number (VIN): 1G1AK58F487 (production number deleted). The front-wheel drive Chevrolet was powered by a 2.2-liter, inline 4-cylinder engine linked to a 4-speed automatic transmission. The service brakes consisted of power-assisted front disc and rear drum brakes. The Chevrolet was not equipped with the optional four-wheel antilock brakes or traction control. The manufacturer recommended tire size was P195/65R15. The Chevrolet was equipped with Continental Touring Contact AS tires, size was P195/60R15 with Tire Identification Numbers (TIN): CPV9 BLC 3407. The tires were mounted on OEM steel wheels with five-spoke plastic wheel covers. The manufacturer recommended cold tire pressure was 207 kPa (30 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Tire/Wheel Damage
Left front	186 kPa (26 PSI)	6 mm (8/32 in)	None
Left Rear	179 kPa (26 PSI)	6 mm (8/32 in)	None
Right Front	165 kPa (24 PSI)	6 mm (8/32 in)	None
Right Rear	179 kPa (26 PSI)	6 mm (8/32 in)	None

The interior of the Chevrolet was configured with cloth surfaced five-passenger seating. The front bucket seats were separated by a center console and equipped with height-adjustable head restraints. The left head restraint was adjusted 4 cm (1.6 in) above the full-down position and the right head restraint was adjusted 6 cm (2.4 in) above the full-down position. The driver's seat at the time of the SCI inspection was adjusted to the full-rear position and the seat back was at an angle of 27 degrees aft of vertical. The driver stated her seat was adjusted to a middle track position at the time of the crash. This was supported by the reported height of the driver at 157 cm (62 in). The front right passenger seat was adjusted 7 cm (2.8 in) forward of the full-rear position and the seat back was reclined to angle of 29 degrees aft of vertical. The second row seat consisted of a spilt-bench with forward folding backs and integrated head restraints in the outboard positions.

The interior occupant safety systems consisted of 3-point lap and shoulder belts for all five seating positions, front safety belt retractor pretensioners, CAC frontal air bags, and IC air bags.

2001 Ford Explorer

The other vehicle in this case was a 2001 Ford Explorer XLT. The four-door Ford was manufactured in 10/00 and was identified by the VIN: 1FMZU63EX1Z (production sequence deleted). The four-wheel drive Ford was powered by a 4.0-liter, V-6 engine linked to a 5-speed automatic transmission. The braking system consisted of power-assisted front and rear disc with four-wheel antilock. The Explorer was equipped with four Michelin LTX M/S tires, size P235/75R15 mounted on OEM five-spoke alloy wheels. The manufacturer recommended tire size was P235/75R15 with a cold tire pressure of 207 kPa (30 PSI), front and rear. The specific tire data at the time of the SCI inspection was as follows:

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	214 kPa (31 PSI)	6 mm (8/32 in)	None
Left Rear	193 kPa (28 PSI)	6 mm (7/32 in)	None
Right Front	186 kPa (27 PSI)	6 mm (7/32 in)	None
Right Rear	200 kPa (29 PSI)	6 mm (7/32 in)	None

Crash Sequence

Pre-Crash

The Chevrolet was occupied by a restrained 18-year-old female driver and a restrained 17-year-old female front right passenger. The driver of the Chevrolet was operating the vehicle northbound towards the intersection in lane three of a three-lane divided roadway, negotiating a curve to the left (**Figure 2**). The driver was slowing on her initial approach to the intersection and traveling at an EDR recorded speed of 11 km/h (7 mph) at 5 seconds prior to Algorithm Enable (AE). The Ford was traveling southbound toward the intersection in lane three of the four-lane divided roadway, negotiating a curve to the right. As the Chevrolet approached the intersection, the overhead signal was in a green phase, and the driver accelerated. The driver of the Chevrolet stated that she did not see oncoming traffic and initiated a left turn across the intersection. This was confirmed by the EDR output which recorded the pre-crash speed of 27 km/h (17 mph). The driver of the Chevrolet did not initiate avoidance action.

Figure 3. Chevrolet's pre-crash trajectory

Crash

The full frontal area of the Ford impacted the right front and passenger side area of the Chevrolet in the intersection (Event 1). The directions of force for the initial impact were within the 2 o'clock sector for the Chevrolet and the 11 o'clock sector for the Ford. The damage

Figure 2. Area of initial impact from the travel direction of the Chevrolet.

algorithm of the WinSMASH program was used to calculate the severity (delta-V) of the crash. The total delta-V for the Chevrolet was 35 km/h (21.7 mph). The Ford's total delta-V was 22 km/h (13.7 mph). The longitudinal and lateral delta-V components for the Chevrolet were -22 km/h (-13.7 mph) and -27 km/h (-16.8 mph), respectively. The Ford's longitudinal and lateral delta-V components were -21 km/h (-13.0 mph), and 8 km/h (5.0 mph). **Figure 3** is an overall view of the area of impact at the crash site. The side impact crash event actuated the pretensioners and deployed the right IC air bag in the Chevrolet at 1.25 ms of AE. The frontal air bags in the Chevrolet did not deploy.

The impact to the right side induced a counterclockwise (CCW) rotation to the Chevrolet and a clockwise (CW) rotation to the Ford within the intersection. The Chevrolet rotated approximately 50 degrees CCW and the Ford rotated approximately 15 degrees CW within the intersection. The right rear aspect of the Chevrolet impacted the left front corner of the Ford in a sideslap configuration. The directions of force for the secondary impact were within the 3 o'clock sector to the Chevrolet and within the 9 o'clock sector for the Ford. The missing vehicle algorithm of the WinSMASH program was used to calculate a total delta-V of 4 km/h (2.5 mph) for the Chevrolet and 2 km/h (1.2 mph) for the Ford. The longitudinal and lateral delta-V components for the Chevrolet were 0 km/h and -4 km/h (-2.5 mph), respectively. The Ford's longitudinal and lateral delta-V components were -0.7 km/h (-0.4 mph) and 1.9 km/h (1.2 mph).

The Chevrolet continued on a southwest trajectory, curving to the right before coming to rest in the westbound travel lane, facing west/northwest. The Ford was deflected to its right, traveling southwest before coming to rest at the south road edge of the eastbound travel lane.

Post-Crash

The driver of the Chevrolet used her cellular telephone to alert the police and emergency personnel of the crash. Police, tow personnel, and a local EMS department responded to the crash site. The driver of the Chevrolet was transported by ambulance to a local hospital where she was treated for cervical strain and a soft tissue injury and released. The front right passenger of the Chevrolet was transported by a private vehicle to a local hospital where she was treated and released. The hospital did not have a record of treatment for this passenger.

Exterior Damage

2008 Chevrolet Cobalt

The exterior of the Chevrolet sustained moderate severity damage to the right side as a result of the multiple impact crash. The initial impact (Event 1) occurred to the front aspect of the right side. The direct contact damage began 120 cm (47.2 in) forward of the right rear axle and extended 145 cm (57.1 in) forward. The combined direct and induced damage (Field L) began 95 cm (37.4 in) forward of the right rear axle and extended 227 cm (89.4 in) forward. The maximum crush measured 26 cm (10.2 in) and was located 165 cm (64.9 in) forward of the right rear axle. The crush profile was as follows: C1 = 0 cm, C2 = 18 cm (7.1 in), C3 = 23 cm (9.1 in), C4 = 22 cm (8.7 in), C5 = 8 cm (3.1 in), C6 = 0 cm. The height of the maximum crush was 54 cm (21.3 in), consistent with the 56

cm (22 in) front bumper height of the Ford. The Door Sill Differential (DSD) of the maximum crush to the Chevrolet was 21 cm (8.3 in). The Collision Deformation Classification (CDC) assigned for this impact was 02-RYEW-2.

The sideslap impact involved the right rear aspect (Event 2) of the Chevrolet. The direct contact damage began 28 cm (11 in) rearward of the right rear axle and extended rearward 54 cm (21.3 in). The Field L was the same as the direct damage location. The maximum crush measured 3 cm (1.2 in) and was located at C4, 49 cm (19.3 in) rear of the right rear axle. The crush profile was as follows: C1 = 0 cm, C2 = 0 cm, C3 = 1 cm (0.4 in), C4 = 3 cm (1.2 in), C5 = 2 cm (0.8 in), C6 = 0 cm. The maximum crush height for Event 2 was 90 cm (35.4 in), consistent with the height of the left front corner of the Ford. The CDC assigned for this impact was 03-RBEW-1. **Figures 4 and 5** depict the right side damage sustained by the Chevrolet in Events 1 and 2.

Figure 4. Initial impact damage to the Chevrolet.

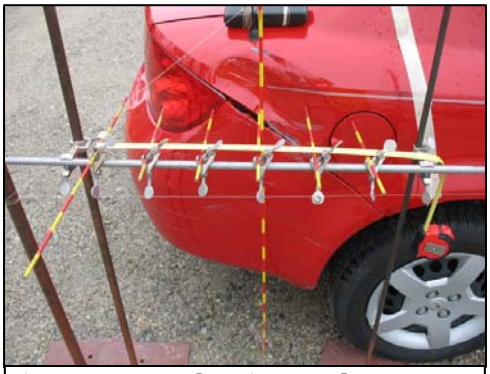


Figure 5. Secondary impact damage (Event 2) to the Chevrolet.

There was minor scratching to the rear bumper fascia of the Chevrolet extending from the left rear bumper corner to the right rear bumper corner (**Figure 6**). This damage occurred in a previous crash and was unrelated to the side impact crash. The imaged EDR data also showed a non-deployment event stored from thirteen ignition cycles prior to the deployment event.

Figure 6. Previous minor rear-end damage to the Chevrolet.

2001 Ford Explorer

The full frontal area of the Ford sustained moderate severity damage as a result of the initial impact with the Chevrolet **(Figure 7)**. The direct contact damage measured 152 cm (59.8 in) and extended the full width of the bumper. The maximum crush measured 21 cm (8.3 in) and was located at C6 at the front right bumper corner. The crush profile at bumper level was as follows: C1 = 18 cm (7.1 in), C2 = 19 cm (7.5 in), C3 = 16 cm (6.3 in), C4 = 16 cm (6.3 in), C5 = 16 cm (6.3 in), C6 = 21 cm (8.3 in). The right lateral displacement of the frame rails measured 19 cm (7.5 in). The CDC assigned for this event was 71-FDEW-1. The 11 o'clock impact force was incremented by 60 to accommodate the lateral displacement

Figure 7. Frontal damage to the Ford.

The damage for the side slap (Event 2) was located at the left front corner of the Ford and overlapped the initial impact damage. Due to the overlapping damage, a crush profile was not obtained. The partial CDC was 09LF99-99. (The 9 values represented unknowns. The 99 value was an unknown extent.)

2008 Chevrolet Cobalt

Interior Damage

The Chevrolet Cobalt sustained minor severity interior damage that was attributed to passenger compartment intrusion and occupant contact points. The front right passenger compartment was reduced in size by numerous intrusions. The maximum intrusion involved 24 cm (9.4 in) of lateral displacement of the side panel forward of the right A-pillar. A complete listing of the intrusions is provided in the table on page 7.

The occupant contact points consisted of a scuff to the left aspect of the roof located 5-11 cm (2-4.3 in) forward of the B-pillar and 8-16 cm (3.1–6.3 in) right of the left roof side rail. The scuff was a result of contact with the driver's head. The center instrument panel was scuffed 42-50 cm (16.5–19.7 in) above the floor and starting at the left corner of the center console and moving forward 8 cm (3.1 in) as a result of contact with the driver's right knee. The left side of the steering column was scuffed by the driver's left knee at the lower left corner of the column 7-12 cm (2.8–4.7 in) rear of the attachment point of the steering wheel rim. The front right door was abraded and scuffed 55-65 cm (21.7 – 25.6 in) forward of the aft edge of the front right door and 13–21 cm (5.1–8.3 in) below the window sill. This contact was attributed to the front right passenger's right knee. The front right door was scuffed 6 cm (2.4 in) forward of the aft edge 22 cm (8.7 in) below the window sill.

The passenger compartment intrusions are listed in the following table:

Position	Component	Direction	Magnitude
Row 1 Right	Side panel forward of the A-pillar	Lateral	24 cm (9.4 in)
Row 1 Right	A-pillar (lower)	Lateral	14 cm (5.5 in)
Row 1 Right	Front right door Forward Lower Quadrant (FLQ)	Lateral	22 cm (8.7 in)
Row 1 Right	Front right door Forward Upper Quadrant (FUQ)	Lateral	11 cm (4.3 in)
Row 1 Right	B-pillar (lower)	Lateral	10 cm (3.9 in)
Row 1 Right	Roof side rail	Lateral	4 cm (1.6 in)
Row 1 Right	Door sill	Lateral	8 cm (3.1 in)
Row 2 Right	Door sill	Lateral	3 cm (1.2 in)
Row 2 Right	Roof side rail	Lateral	3 cm (1.2 in)
Row 2 Right	Rear right door FLQ	Lateral	7 cm (2.8 in)
Row 2 Right	Rear right door FUQ	Lateral	3 cm (1.2 in)

Manual Restraint Systems

The manual restraint systems in the Chevrolet Cobalt consisted of 3-point lap and shoulder belts in the five seat positions. All belt systems utilized continuous loop webbing with sliding latch plates. The driver's belt retracted onto an Emergency Locking Retractor (ELR) with a retractor pretensioner. The upper D-ring was height adjustable and was found in the full-up position. The driver was using her safety belt at the time of the crash, which was supported by loading evidence on the belt webbing. The evidence consisted of two frictional abrasions, one near the latch plate and one near the D-ring. Specifically, the latch plate abrasion was located 77–80 cm (30.3–31.5 in) above the floor anchor, and the D-ring abrasion was located 144-150 cm (56.7–59.1 in) above the floor anchor. Additionally, the actuated retractor pretensioner locked the safety belt in the used position. The total length of locked webbing extending from the retractor measured 215 cm (84.6 in).

The front right passenger's belt retracted onto a switchable ELR/Automatic Locking Retractor (ALR) with a retractor pretensioner. The upper D-ring was height adjustable and was found in the full-up position. The front right passenger was using her safety belt at the time of the crash, which was supported by loading evidence on the belt webbing. The evidence consisted of frictional abrasions at the latch plate and the D-ring. The latch plate abrasion was located 70-72 cm (27.6-28.3 in) above the floor anchor, and the D-ring abrasion was located 139–144 cm (54.7–56.7 in) above the floor anchor. The actuation of the retractor pretensioner locked the safety belt in the used position. The total length of locked webbing extending from the retractor measured 209 cm (82.3 in).

The second row safety belt systems utilized switchable ALR/ELR retractors, continuous loop webbing and sliding latch plates. These positions were unoccupied at the time of the crash.

Frontal Air Bag System

The Chevrolet was equipped with a CAC frontal air bag system. The manufacturer of the vehicle has certified that the Chevrolet is compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The system included dual-stage frontal air bags for the driver and right front passenger positions, seat track positioning sensors, retractor pretensioners, and a front right occupant presence sensor. The driver's air bag was concealed within the center hub of the three-spoke steering wheel. The front right passenger's air bag was concealed within the top aspect of the right instrument panel. The frontal air bags did not deploy in this crash.

Side Impact Air Bag System

The Chevrolet was equipped with roof side rail-mounted IC air bags. The left side IC did not deploy. The right side IC deployed during the right side impact.

The right side IC air bag deployed from the roof side rail **(Figure 8)**. The air bag measured 152 cm (59.8 in) in length and 39 cm (15.4 in) in height.

Figure 8. Right IC air bag

The air bag was tethered to the A-pillar. A triangular-shaped gap of 17 cm (6.7 in) in height was located at the front of the IC. Vertically, the air bag extended below the belt line at both right outboard positions. The air bag provided head protection from aft of the A-pillar to the C-pillar of the vehicle. There was a vertical scuff mark on the inboard side of the air bag at the forward aspect of the B-pillar from contact with the headliner during deployment. This scuff mark began at the top of the IC and extended downward 21 cm (8.3 in). There was a scuff mark attributed to contact with the right side of the front right passenger's head. This scuff mark was located 53–64 cm (20.9–25.2 in) aft of the front edge of the IC and 8–21 cm (3.1–8.3 in) above the bottom edge.

Event Data Recorder

The EDR from the Chevrolet was imaged at the time of the inspection by applying power to the air bag system and imaging the data through the Diagnostic Link Connector (DLC) port under the left instrument panel. The data displayed a deployment and a non-deployment event stored in the module. The non-deployment event had occurred 13 ignition cycles prior to the deployment event and was not considered to be related to this crash. This was supported by the interview, in which the driver stated she had been involved in a minor rear-end crash in a parking lot three days prior to this crash.

At deployment, the number of ignition cycles was 723 (728 at investigation). Both the driver and front right passenger's belts were recorded as buckled. The imaged data indicated the passenger air bag was not suppressed. There were no diagnostic trouble codes stored at the time of the deployment. The imaged EDR data is included at the end of this report as **Attachment A.**

2008 Chevrolet Cobalt

Driver Demographics/Data

Age/Sex:	18-year-old/Female
Height:	157 cm (62 in)
Weight:	42 kg (92 lb)
Eyewear:	None
Seat Track Position:	Middle
Manual Safety Belt Use:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Egress From Vehicle:	Exited without assistance
Mode of Transport From Scene:	Ambulance
Type of Medical Treatment:	Treated in ER and released

Driver Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Right hip contusion	Minor (890402.1,1)	Center console
Cervical strain	Minor (640278.1,6)	Impact forces

Source = Driver interview and medical records

Driver Kinematics

The 18-year-old female driver was seated in a middle track position and was restrained by the manual 3-point lap and shoulder belt system. The side impact with the Ford actuated the driver's safety belt pretensioner and deployed the right side IC air bag. As a result of the right side impact, the driver initiated a trajectory to the right and loaded the safety belt system. Her right hip loaded the center console resulting in the contusion. As she loaded the belt and the center console, her head continued to the right resulting in cervical strain. The driver was transported by ambulance to a local hospital where she was treated in the emergency department and released.

Front Right Passenger Demographics/Data

Age/Sex:	17-year-old/Female
Height:	163 cm (64 in)
Weight:	48 kg (105 lb)
Eyewear:	None
Seat Track Position:	Middle
Manual Safety Belt Use:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Egress From Vehicle:	Exited without assistance
Mode of Transport From Scene:	Private vehicle
Type of Medical Treatment:	Treated in ER and released

Front Right Passenger Injuries

Injury	Injury Severity (AIS 90/Update 98)	Injury Source
Contusion of the right shoulder and upper arm	Minor (790402.1,1)	Right front door – forward lower quadrant
Right lower arm contusion	Minor (790402.1,1)	Right front door – forward lower quadrant
Cervical strain	Minor (640278.1,6)	Impact forces
Lumbar strain	Minor (640678.1,8)	Impact forces

Source = Driver interview

Front Right Passenger Kinematics

The 17-year-old female front right passenger was seated in a middle track position and was restrained by the manual 3-point lap and shoulder belt system. The side impact to the Chevrolet actuated the front right passenger's safety belt pretensioner and deployed the right side IC air bag. The front right passenger initiated a right trajectory within the front right seating position and loaded the intruding door panel resulting in contusions to the right arm and shoulder. Her head contacted the deployed the right IC air bag. Her lateral motion resulted in cervical and lumbar strains. The passenger was transported by a family member in a private vehicle to a local hospital where she was treated in the emergency department and released. The hospital did not have a record of treatment for this passenger.

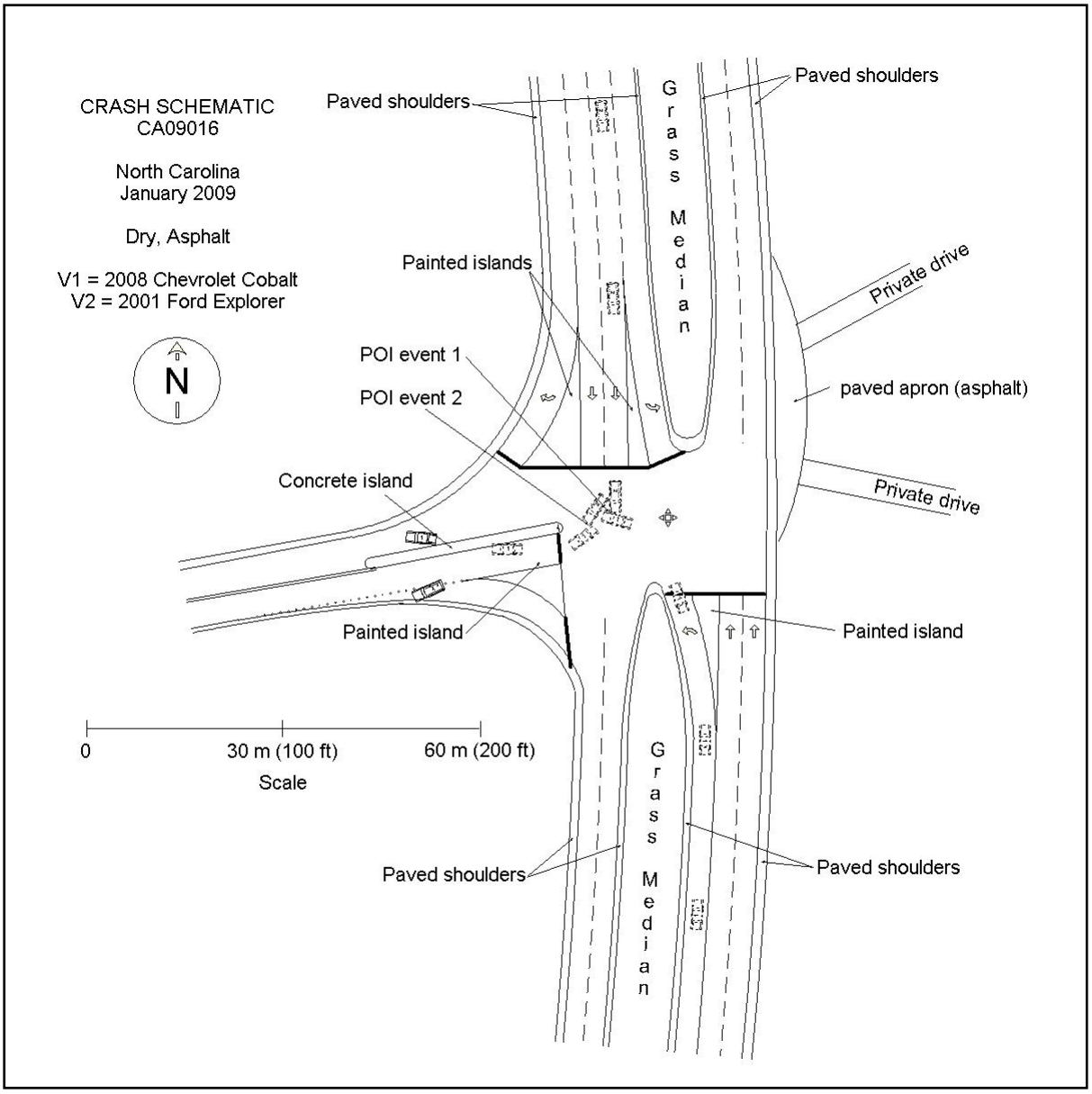


Figure 9. Crash Schematic

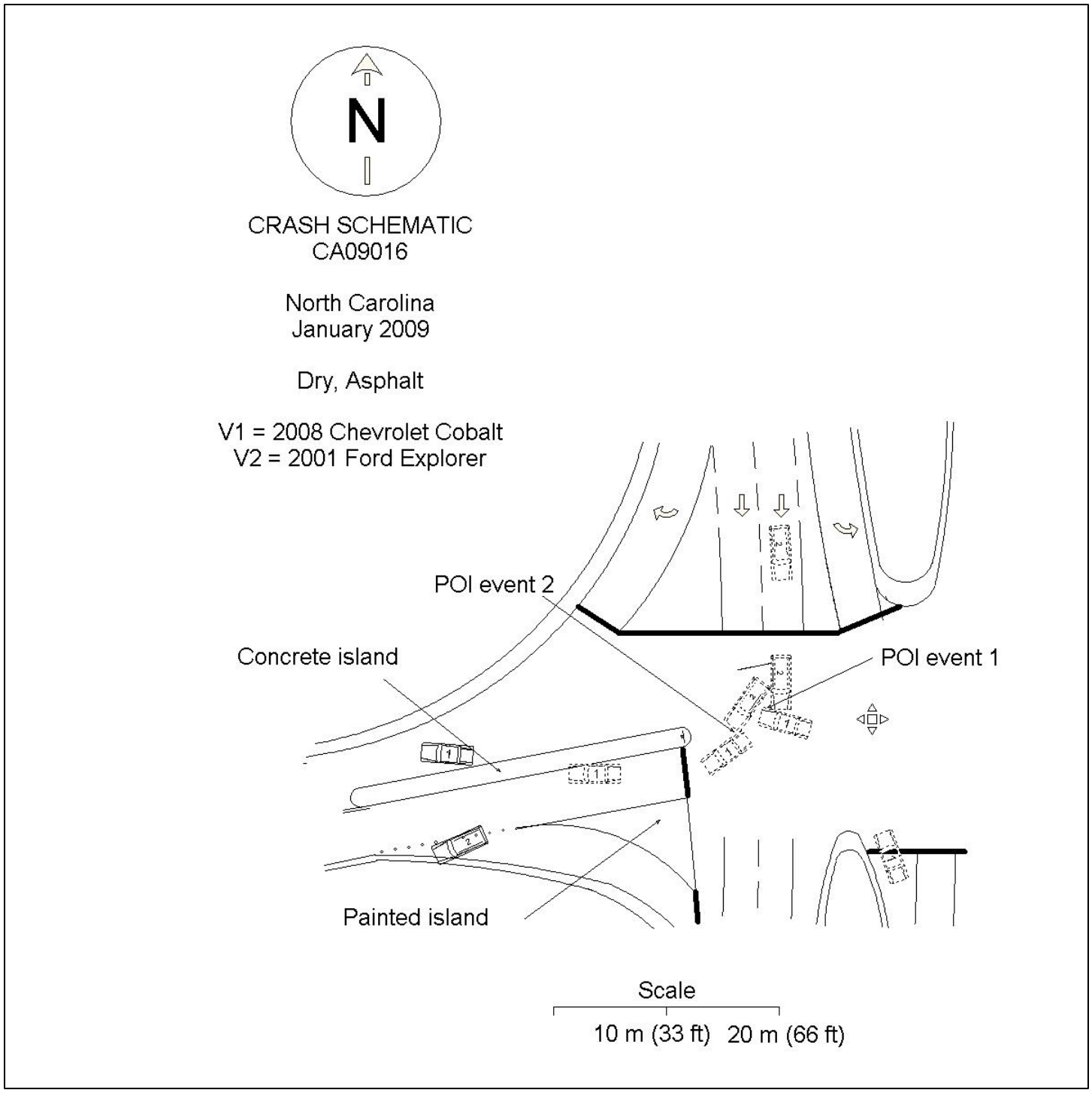


Figure 10. Enhanced view of the Crash Schematic

Attachment A: Imaged EDR Data from the Chevrolet

CDR File Information

User Entered VIN	1G1AK58F487******
User	
Case Number	CA09016
EDR Data Imaging Date	Monday, March 16 2009
Crash Date	Thursday, January 1 2009
Filename	WITHOUTVIN.CDR
Saved on	Monday, March 16 2009 at 04:33:51 PM
Collected with CDR version	Crash Data Retrieval Tool 3.00
Reported with CDR version	Crash Data Retrieval Tool 3.3
EDR Device Type	airbag control module
Event(s) recovered	Deployment Non-Deployment

IMPORTANT NOTICE: Robert Bosch LLC recommends that the latest production release of Crash Data Retrieval software be utilized when viewing, printing or exporting any retrieved data from within the CDR program. This ensures that the retrieved data has been translated using the most recent information including but not limited to that which was provided by the manufacturers of the vehicles supported in this product.

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 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 open/closed state of the brake switch circuit.

-Pre-Crash data is recorded asynchronously.

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

- -the SDM receives a message with an "invalid" flag from the module sending the pre-crash data
- -no data is received from the module sending the pre-crash data
- -no module is 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, except: The Passenger Belt Switch Circuit Status for 2005 vehicles is available only on the Cadillac STS. The Passenger Belt Switch Circuit Status for 2006 Chevrolet Cobalt Sport Coupe (AP) model vehicles, with the option package that includes Recaro brand seats (RPO ALV), always reports a default value of "Buckled," because there is no passenger belt switch with the Recaro seat option.
-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 counter.
-Steering Wheel Angle data is displayed as a positive value when the steering wheel is turned to the right and a negative value when the steering wheel is turned to the left, except for Cadillac STS model vehicles with StabiliTrak 3.0 systems (RPO JL7). For Cadillac STS model vehicles with StabiliTrak 3.0 systems (RPO JL7), when the steering wheel is turned to the right, a negative value will be displayed and when the steering wheel is turned to the left, a positive value will be displayed. The Steering Wheel Angle data is reported in 16 degree increments.

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.

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

Vehicle Identification Number	**1AK58F*8*******
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
Brake System Warning Lamp (If Equipped)	OFF

System Status At 1 second

Transmission Range (If Equipped)	Second Gear
Transmission Selector Position (If Equipped)	Fourth Gear
Traction Control System Active (If Equipped)	Invalid
Service Engine Soon (Non-Emission Related) Lamp	OFF
Service Vehicle Soon Lamp	OFF
Outside Air Temperature (degrees F) (If Equipped)	36
Left Front Door Status (If Equipped)	Closed
Right Front Door Status (If Equipped)	Closed
Left Rear Door Status (If Equipped)	Unused
Right Rear Door Status (If Equipped)	Unused
Rear Door(s) Status (If Equipped)	Closed

Pre-crash data

Parameter	-2 sec	-1 sec
Reduced Engine Power Mode	OFF	OFF
Cruise Control Active (If Equipped)	Invalid	Invalid
Cruise Control Resume Switch Active (If Equipped)	Invalid	Invalid
Cruise Control Set Switch Active (If Equipped)	Invalid	Invalid

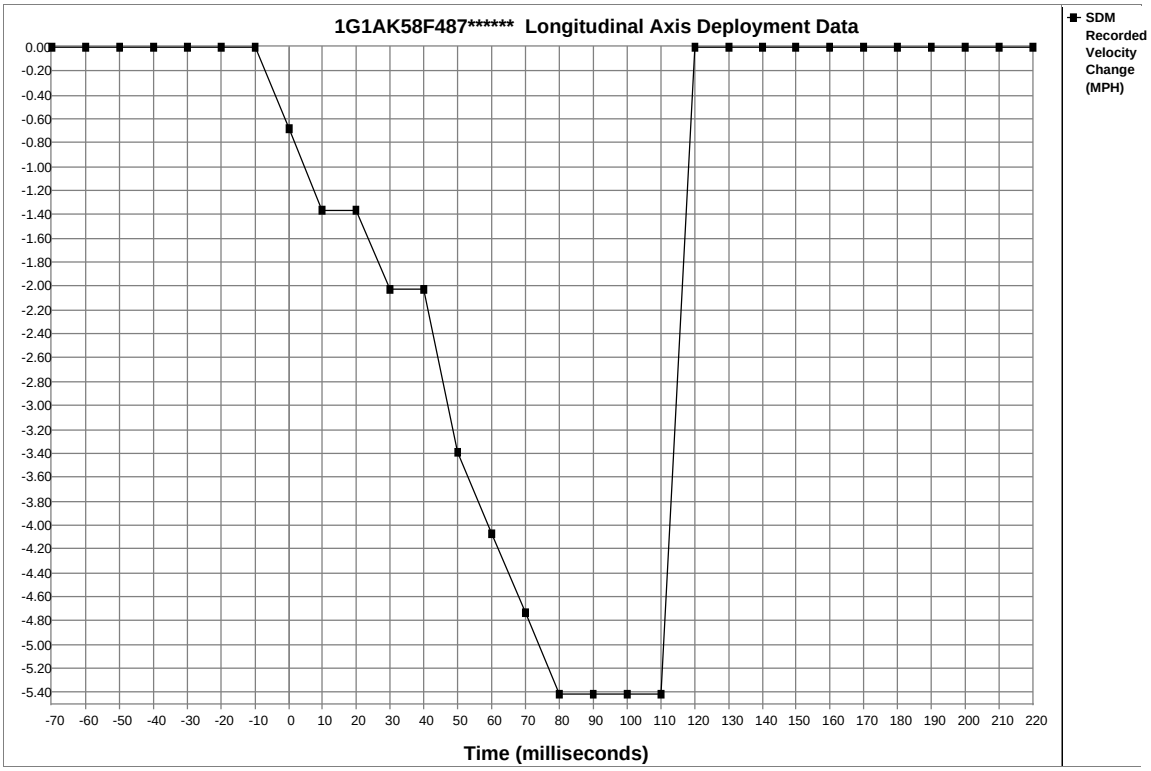
Pre-Crash Data

Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Vehicle Speed (MPH)	7	7	12	15	17
Engine Speed (RPM)	768	1856	2368	2304	2304
Percent Throttle	16	30	35	35	35
Brake Switch Circuit Status	OFF	OFF	OFF	OFF	OFF
Accelerator Pedal Position (percent)	10	19	24	24	24
Antilock Brake System Active (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Lateral Acceleration (feet/s^2)(If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Yaw Rate (degrees per second) (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

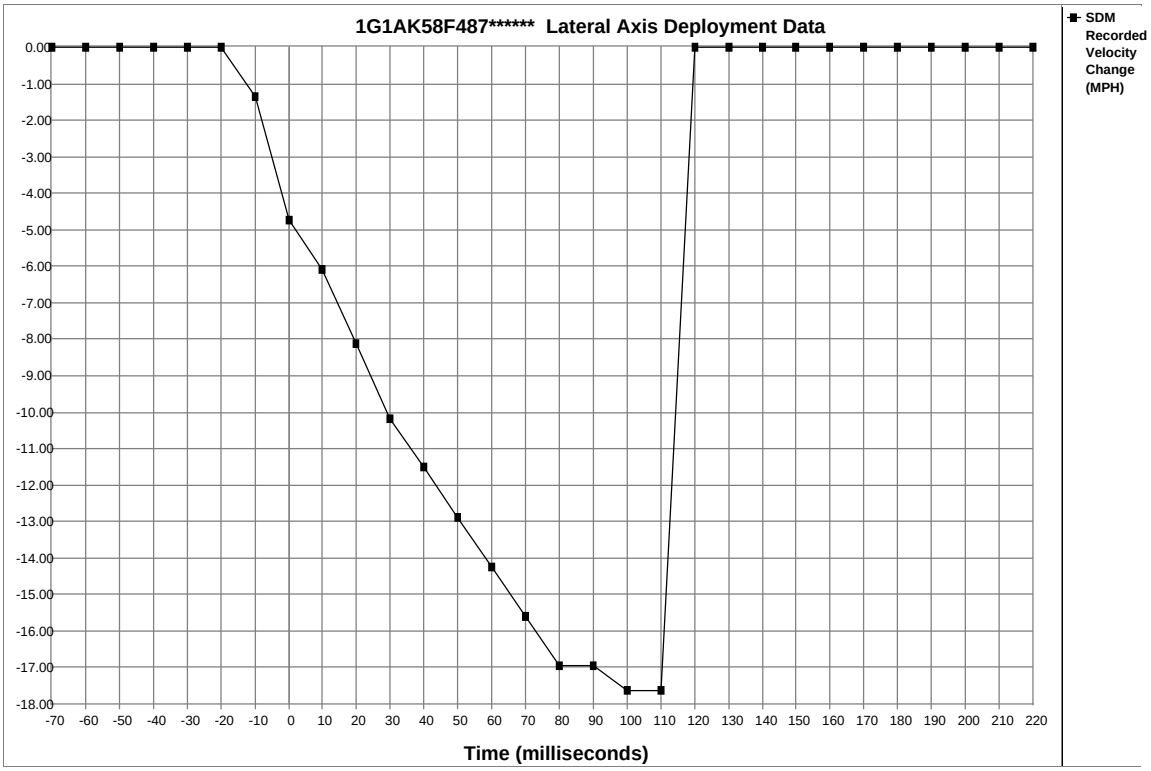
Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Steering Wheel Angle (degrees) (If Equipped)	0	0	0	0	0
Vehicle Dynamics Control Active (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

System Status At Deployment

Ignition Cycles At Investigation	728
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time (seconds)	655200
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	722
Ignition Cycles At Event	723
Ignition Cycles Since DTCs Were Last Cleared	254
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	BUCKLED
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
Automatic Passenger SIR Suppression System Validity Status at AE	Valid
Automatic Passenger SIR Suppression System Status at AE	Air Bag Not Suppressed
Automatic Passenger SIR Suppression System Validity Status at First Deployment Command	Valid
Automatic Passenger SIR Suppression System Status at First Deployment Command	Air Bag Not Suppressed
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Driver Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	1.25
Time Between Events (sec)	0
Driver First Stage Deployment Loop Commanded	No
Driver Second Stage Deployment Loop Commanded	No
Driver Side Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop Commanded	Yes
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Driver Knee Deployment Loop Commanded	No
Passenger First Stage Deployment Loop Commanded	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Passenger Pretensioner Deployment Loop Commanded	Yes
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded	Yes
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Passenger Knee Deployment Loop Commanded	No
Driver Anchor Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Left Pretensioner Deployment Loop Commanded	No
Third Row Left Roof Rail/Head Curtain Loop Commanded	No
Passenger Anchor Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Third Row Right Roof Rail/Head Curtain Loop Commanded	No
Second Row Center Pretensioner Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded for Disposal	No
Passenger 2nd Stage Deployment Loop Commanded for Disposal	No
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Deployment Event Recorded in the Non-Deployment Record	No
Event Recording Complete	Yes



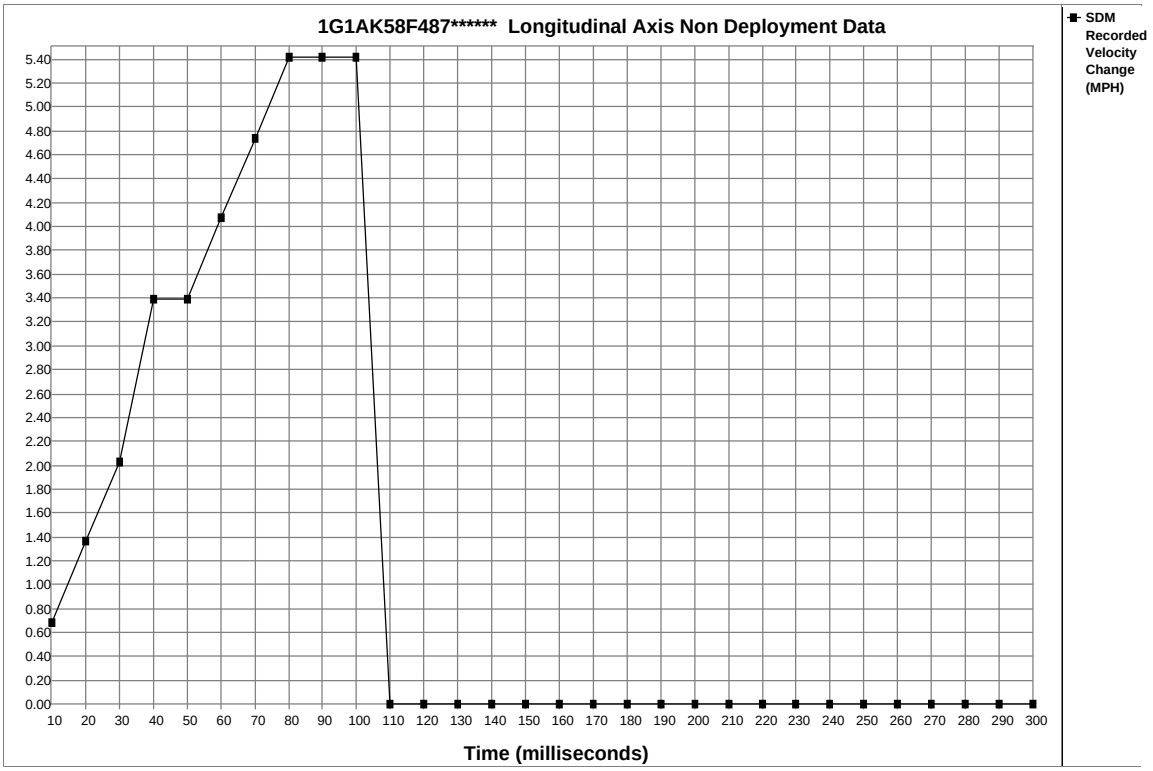
Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.68	-1.36	-1.36	-2.03	-2.03	-3.39	-4.07	-4.74
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-5.42	-5.42	-5.42	-5.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00



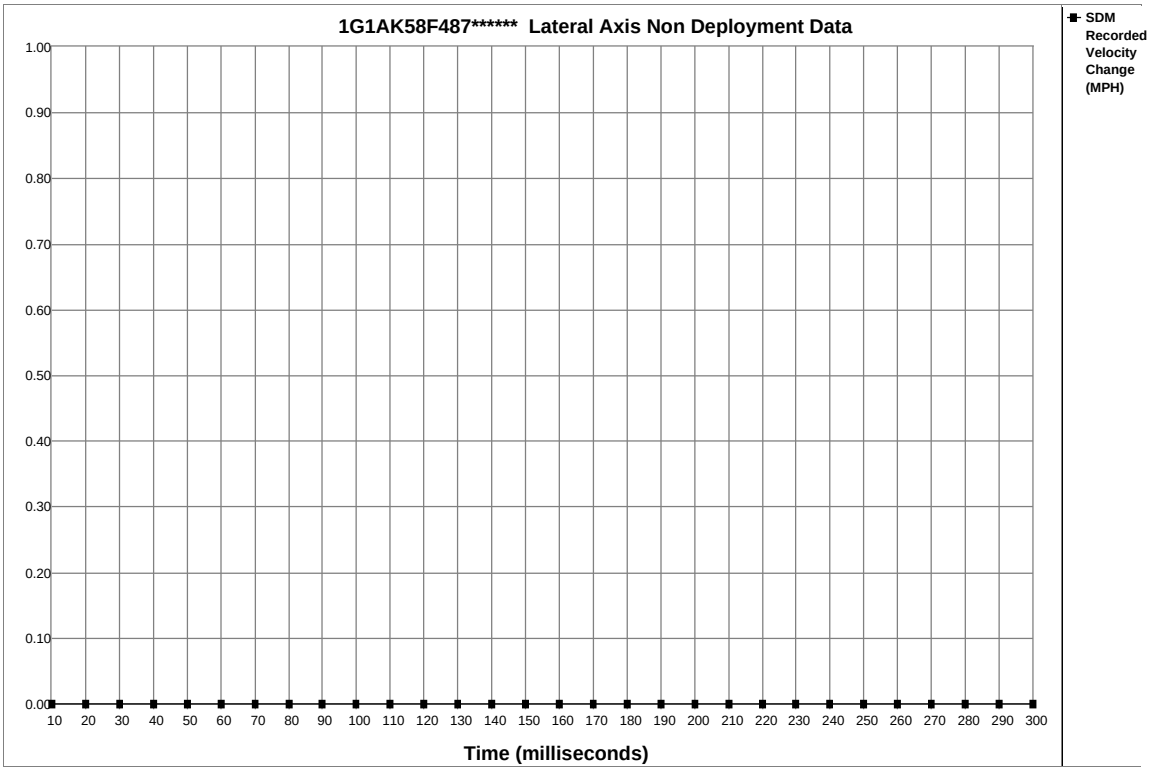
Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	-1.36	-4.74	-6.10	-8.13	-10.17	-11.52	-12.88	-14.23	-15.59
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Lateral Axis Recorded Velocity Change (MPH)	-16.95	-16.95	-17.62	-17.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

System Status At Non-Deployment

Ignition Cycles At Investigation	728
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time (seconds)	655200
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	709
Ignition Cycles At Event	710
Ignition Cycles Since DTCs Were Last Cleared	254
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Automatic Passenger SIR Suppression System Validity Status at AE	Valid
Automatic Passenger SIR Suppression System Status at AE	Air Bag Suppressed
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
Maximum SDM Recorded Velocity Change (MPH)	6.10
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	110
Driver First Stage Deployment Loop Commanded	No
Driver Second Stage Deployment Loop Commanded	No
Driver Side Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop Commanded	No
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Driver Knee Deployment Loop Commanded	No
Passenger First Stage Deployment Loop Commanded	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Passenger Pretensioner Deployment Loop Commanded	No
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Passenger Knee Deployment Loop Commanded	No
Driver Anchor Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Left Pretensioner Deployment Loop Commanded	No
Third Row Left Roof Rail/Head Curtain Loop Commanded	No
Passenger Anchor Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Third Row Right Roof Rail/Head Curtain Loop Commanded	No
Second Row Center Pretensioner Deployment Loop Commanded	No
Crash Record Locked	No
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Deployment Event Recorded in the Non-Deployment Record	No
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)	0.68	1.36	2.03	3.39	3.39	4.07	4.74	5.42	5.42	5.42	0.00	0.00	0.00	0.00	0.00
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	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	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00