U.S. Department
of Transportation
National Highway
Traffic Safety
Administration

NHTSA

DOT HS 813 300

May 2022

Special Crash Investigations: On-Site Air Bag Non-Deployment Crash Investigation; Vehicle: 2008 Chevrolet Malibu; Location: New York; Crash Date: September 2017

DISCLAIMER

Suggested APA Format Citation:

Crash Research & Analysis, Inc. (2022, May). *Special Crash Investigations: On-site air bag non-deployment crash investigation; Vehicle: 2008 Chevrolet Malibu; Location: New York; Crash Date: September 2017* (Report No. DOT HS 813 300). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 813 300		

4. Title and Subtitle	5. Report Date
Special Crash Investigations: On-Site Air Bag Non-Deployment Crash Investigation; Vehicle: 2008 Chevrolet Malibu; Location: New York; Crash Date: September 2017	May 2022
	6. Performing Organization Code

7. Author	8. Performing Organization Report No.
Crash Research & Analysis, Inc.	CR18019

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Crash Research & Analysis, Inc. P.O. Box 302 Elma, NY 14059	**11. Contract or Grant No.** 693JJ919C000004

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Technical Report
	14. Sponsoring Agency Code

15. Supplementary Notes

Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

16. Abstract

This on-site investigation documents the non-deployment of the air bag systems in a 2008 Chevrolet Malibu involved in a fatal road departure/fixed object crash. The Chevrolet had a certified advanced 208-compliant frontal air bag system and inflatable curtain air bags. Driven by an unbelted 36-year-old female, the Chevrolet traveled on a straight trajectory through a slight right curve. The vehicle departed the left road edge, struck a small bush, gouged the ground with its undercarriage, and then struck a large-diameter tree. The Chevrolet sustained significant front plane damage, but none of the air bags in the Chevrolet deployed. The driver was transported by ambulance to a Level II trauma center and died 35 hours post-crash.

No specific conclusions concerning the lack of supplemental restraint deployment/actuation could be determined. The Chevrolet's air bag sensing and diagnostic control module (SDM) recognized and recorded a crash event that produced a maximum velocity change of 89.59 km/h (55.67 mph). The recorded crash event occurred in close proximity to impacts that were not recorded by the Chevrolet's SDM; however, a lack of EDR data concerning those impacts prevented the investigation team from drawing conclusions as to whether the unrecorded impacts had any effect on the recorded crash event. Based on SCI expertise, crash events similar in magnitude to that of the Chevrolet's impact with the large-diameter tree would be expected to result in seat belt pretensioner actuation and frontal air bag deployment.

17. Key Words	18. Distribution Statement
non-deployment, fatality, air bag	This document is available to the public from the DOT, BTS, National Transportation Library, Repository & Open Science Access Portal, rosap.ntl.bts.gov.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	37	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

Table of Contents

Special Crash Investigations
On-Site Air Bag Non-Deployment Crash Investigation
Office of Defects Investigation
Case Number: CR18019
Vehicle: 2008 Chevrolet Malibu
Location: New York
Crash Date: September 2017

Background

This on-site investigation documents the non-deployment of the air bag systems in a 2008 Chevrolet Malibu (Figure 1) that was involved in a road departure/fixed object crash. The Chevrolet had a certified advanced 208-compliant (CAC) frontal air bag system, inflatable curtain (IC) air bags, and front-seat belt retractor pretensioners. Driven by an unbelted 36-year-old female, the Chevrolet traveled on a straight trajectory through a slight right curve. The vehicle departed the left road edge, struck a small bush (Event 1), gouged the ground with its undercarriage (Event 2), and then struck a large-diameter tree (Event 3). The Chevrolet sustained significant front plane damage, but no air bags deployed. The driver was transported by ambulance to a Level II trauma center and died 35 hours post-crash.

Figure 1. Left-front oblique view of the 2008 Chevrolet Malibu at the time of the SCI inspection

Notification of the crash was provided to the National Highway Traffic Safety Administration in July 2018 by the investigating law enforcement officer. Further research was requested, and the notification was forwarded to the Crash Investigation Division and assigned to the Special Crash Investigations (SCI) team for an on-site investigation. The SCI team contacted and established cooperation with the law enforcement officer to inspect the vehicle. NHTSA notified the manufacturer, Chevrolet, and several technical and legal representatives participated in the inspection of the vehicle. The on-site portion, which took place in July 2018, included exterior and interior inspections of the Chevrolet to measure deformation and intrusion, to document evidence of occupant contact, and to examine the manual and supplemental restraint systems. The Chevrolet had an air bag sensing and diagnostic control module (SDM) that had Event Data Recorder (EDR) capabilities supported by the Bosch Crash Data Retrieval (CDR) tool. The

recorded data were imaged during the SCI vehicle inspection process. Additionally, the SCI investigator documented the crash site using photographs and a total station mapping system.

No specific conclusions concerning the lack of supplemental restraint deployment/actuation could be determined. The Chevrolet's SDM recognized and recorded a crash event that produced a maximum velocity change of 89.59 km/h (55.67 mph). The recorded crash event occurred in close proximity to impacts that were not recorded by the Chevrolet's SDM; however, a lack of EDR data concerning those impacts prevented the investigation team from drawing conclusions as to whether the unrecorded impacts had any effect on the recorded crash event. Based on SCI expertise, crash events similar in magnitude to that of the Chevrolet's impact with the large-diameter tree would be expected to result in seat belt pretensioner actuation and frontal air bag deployment.

Crash Site

This crash occurred on a two-lane roadway at night. Lighting conditions were dark, as the roadway and surrounding area were not artificially lit. Reported weather conditions in the locale from the national weather service included overcast skies with light rain, a temperature of 12 ºC (54 ºF), a 94-percent relative humidity, and calm winds (0 km/h). Law enforcement documentation described the roadway as wet asphalt.

The physical environment of the roadway and intersection was documented during the SCI crash site inspection using photographs and a Nikon Nivo 5.M+ total station mapping system. The roadway consisted of one lane each in the north and southbound travel directions, separated by a double-solid yellow centerline and bordered by painted white edge (fog) lines. The travel lane widths were 3.2 m (10.5 ft) for the northbound lane and 3.4 m (11.2 ft) for the southbound lane. Narrow 1.4 m (4.6 ft) west and 1.0 m (3.3 ft) east shoulders bordered the travel lanes.

In the vicinity of the crash site, the travel lanes curved to the right in the southbound direction with a measured radius of curvature of 209 m (686 ft) at the point of the Chevrolet's road departure. The vertical profile of the roadway was level. Figure 2 shows the roadway for the Chevrolet's pre-crash travel trajectory. Speed was controlled by a posted limit of 72 km/h (45 mph).

Figure 2. Southbound view of the Chevrolet's pre-crash approach to the crash site

Figure 3. Southerly view of the intersecting roadway and large-diameter coniferous tree

A private driveway and a local roadway intersected the two-lane roadway from the east. The private drive measured 4.0 m (13.1 ft) wide, and the local roadway measured 7.0 m (23.0 ft) wide. A stop bar and stop sign controlled westbound traffic approaching the north/south two-lane roadway. Located 8.5 m (27.9 ft) east of the east road edge and 6.5 m (21.3 ft) south of the intersecting roadway edge was a 102 cm (40.0 in) diameter coniferous tree. A crash diagram is included at the end of this report.

Pre-Crash

The 36-year-old female driver of the Chevrolet was driving to her residence after work in a southerly direction on the two-lane roadway and negotiated a left curve that transitioned into a straight section of roadway on approach to the right curve. According to the data imaged from the Chevrolet's SDM, she drove the vehicle at a recorded speed of 98 km/h (61 mph) at 5 seconds prior to algorithm enable (AE).

The Chevrolet continued from the straight section of the roadway and entered the right curve, but it kept going straight (Figure 4). This suggests the driver was possibly distracted or fell asleep (specifics unknown). The vehicle crossed the double-solid yellow centerline, crossed the northbound travel lane and east shoulder, then departed the east road edge and entered the grass roadside.

This errant trajectory alerted the driver, who made a right steering input in an attempt to regain the roadway. At the 3-second interval prior to AE, the EDR-recorded speed of the Chevrolet was 97 km/h (60 mph). Recorded steering wheel angle data indicated a right steering input by the driver at this time interval. Due to the wet conditions, the Chevrolet initiated a slight clockwise yaw (approximately 5 degrees) as it continued southbound. On-scene images obtained from the investigating law enforcement agency showed these dynamics, as four distinct tire marks were visible in the grass roadside (Figure 5).

Data imaged from the Chevrolet's EDR suggested that the driver recognized the yawing errant trajectory of the vehicle and actively attempted to regain control of the vehicle. She braked, which engaged the vehicle's antilock system. Steering angle data indicated that after initially steering right, the driver steered left and then again to the right. As the vehicle maintained its

southbound trajectory, the tires slid on the wet grass. This reduced wheel speed rotation resulted in an under-reporting of the vehicle's speeds as recorded by the EDR. The Chevrolet crossed over the driveway of the private residence and continued southbound.

Figure 4. Southbound view of the Chevrolet's roadside departure trajectory at the time of the SCI inspection

Figure 5. Northbound lookback view of the Chevrolet's trajectory (on-scene law enforcement image)

Crash

The first impact (Event 1) occurred as the Chevrolet's front plane, right aspect struck a small shrub in the lawn of the residence, north of the intersecting local roadway. The front-right tire/wheel overrode the shrubbery, which damaged the vegetation (Figure 4). It is likely this impact did not produce discernable damage to the vehicle, as it was insufficient in severity to affect or otherwise alter the Chevrolet's trajectory. As the Chevrolet continued south, it traveled 6.0 m (19.7 ft) through the wet grass and approached the intersecting local roadway. There the front undercarriage struck and gouged (Event 2) the grass/soil surface at the north edge of the intersecting local roadway (Figure 4). This non-horizontal impact also did not alter the trajectory of the Chevrolet.

Compression of the Chevrolet's suspension occurred relative to the uneven roadside/grass surface and varying elevation with respect to the surface of the intersecting local roadway. This caused the vehicle to bound across the intersecting local roadway and through the grass as it approached the large-diameter tree. The distance between the gouge marks and the tree measured 13.5 m (44.3 ft). At the EDR-reported pre-crash speed of 97 km/h (60 mph), the vehicle would have traveled this short distance in approximately 0.5 seconds. The front plane, center aspect of the Chevrolet then struck the large-diameter tree (Event 3). As the front structure began to crush, the left and right aspects of the front plane engaged the tree, resulting in a direct contact width of 90 cm (35.4 in) across the front plane that had a concave profile that matched the circumferential dimension of the 102 cm (40.0 in) overall diameter tree. Directions of force were within the 12 o'clock sector for the Chevrolet. The vehicle rotated 10 degrees counterclockwise during the engagement before it came to final rest with its front plane engaged against the trunk of the tree (Figure 6).

Figure 6. South-facing view of the Chevrolet's trajectory and the three impact events (on-scene law enforcement image)

Post-Crash

The emergency response system was alerted, and the law enforcement, fire department, and emergency medical services (EMS) personnel responded to the crash scene. The first arriving law enforcement units observed the driver unresponsive and slumped over, lying supine on the front-row right seat cushion.

According to the first arriving law enforcement officer, he shattered the left-front door glazing to gain access to the vehicle and assess the condition of the driver. He then removed the driver from the vehicle, and, recognizing a lack of vital life signs, initiated cardiopulmonary resuscitation. An automated external defibrillator was applied, and it advised "no shock." Resuscitation efforts continued until EMS personnel arrived at the crash scene, at which point the driver was intubated, placed on a long spine board, and transported by ambulance to a Level II trauma center. She was admitted for treatment, but she succumbed to her injuries 35 hours after the crash. Following the on-scene law enforcement investigation, the Chevrolet was towed from the crash site to a private tow yard, where it was secured in impound until this SCI investigation.

2008 Chevrolet Malibu

Description

The 2008 Chevrolet Malibu (Figure 7) had the LT trim level. It was manufactured in July 2007 and was identified by the Vehicle Identification Number 1G1ZT58N18Fxxxxxx. At the time of the crash, the vehicle's odometer reading was 156,030 km (96,955 mi). The Chevrolet was a front-wheel-drive platform, powered by a 3.5-liter, V-6, gasoline engine and linked to a 6-speed automatic transmission. Its service brakes were power-assisted 4-wheel disc with antilock, while the steering was hydraulic power-assisted rack-and-pinion. Additional features included traction control, electronic stability control, and a tire pressure monitoring system.

Figure 7. Right-front oblique view of the 2008 Chevrolet Malibu at the time of the SCI inspection

The gross vehicle weight rating was 1,948 kg (4,295 lb), with gross axle weight ratings of 1,009 kg (2,225 lb) front and 939 kg (2070 lb) rear. The vehicle manufacturer's recommended tire size was P215/60R16, with recommended cold tire pressures of 210 kPa (30 psi) for all four axle positions. At the time of the SCI inspection, the Chevrolet had Cooper CS4 Touring all-season radial tires of the recommended size, mounted on 5-spoke OEM steel wheels with plastic hubcaps. The tires had matching tire identification numbers of U95M CL1. Both rear tires were undamaged, while both front tires were flat. The right-front tire was restricted due to damage.

The Chevrolet had seating for five occupants (2/3), with front-row bucket seats and a second-row bench seat that featured split forward-folding seat backs. All seating surfaces were cloth, and the four outboard seat positions had adjustable head restraints. At the time of the SCI vehicle inspection, the driver's seat was adjusted to a position between middle and rear, with the seatback slightly reclined and the adjustable head restraint 8 cm (3 in) above the seatback. Manual restraint systems in the Chevrolet included 3-point lap and shoulder seat belts for all five seat positions. Supplemental restraint systems included the CAC frontal air bag system, IC air bags, and front-seat belt retractor pretensioners. None of the supplemental restraint systems were actuated or deployed as a result of the crash.

Vehicle History

A commercially obtainable vehicle history for this specific 2008 Chevrolet Malibu indicated that the vehicle had three separate owners over its lifespan. There was no reported service or replacement of the vehicle's supplemental restraint systems over its lifespan. There also were no crashes reported other than the crash under investigation.

The first owner was a rental vehicle facility that operated the Chevrolet for 13 months. There were no service records or issues reported during this period. The Chevrolet was then sold in late 2008 to its second owner, whose ownership period lasted 8 years and 6 months. During that time, State-sanctioned safety inspections were performed regularly, and a wiring issue was repaired in September 2014. The Chevrolet was then offered for sale in mid-2017, when the third owner purchased it. Routine service was performed at the odometer reading 153,585 km (95,433 mi), the only reported activity under the third ownership period leading up to the crash in September 2017.

Exterior Damage

This crash involved the Chevrolet's front plane and the undercarriage. Event 1 involved the front plane, right aspect as the Chevrolet overrode and damaged the small shrub. This impact did not produce residual damage to the Chevrolet. A collision deformation classification (CDC) of 12FREU1 (U representing no residual damage) was assigned for this event. As the Chevrolet continued forward, the front undercarriage gouged the earth at the north edge of the intersecting roadway (Event 2). There was no structural damage, but grass and dirt were embedded into the undercarriage. The non-horizontal forces produced in a CDC of 00UFDW1.

The front plane of the Chevrolet struck the 102 cm (40.0 in) diameter tree (Event 3). The initial contact involved the center aspect; however, as the frontal structure began to crush, the left and right aspects also became involved due to the wide diameter of the tree trunk. Direct contact damage measured 90 cm (35.4 in) wide and spanned the three zones of the end plane. Involved components included the bumper fascia and bumper beam, both front frame rails, the hood, the upper radiator support, the air conditioner condenser and radiator, the engine, and both headlight assemblies.

Figure 8. Front-plane damage profile to the Chevrolet

Induced damage involved both front fenders and their support structures, as well as the windshield glazing. The combined direct and induced damage length spanned the entire front-end width of the Chevrolet. Figures 8 and 9 depict the front plane damage to the Chevrolet.

Figure 9. Overhead perspective of the damage profile

A residual crush profile was documented to the bumper beam of the Chevrolet using a Field-L width of 100 cm (39.4 in). Maximum crush was observed at the vehicle's centerline and measured 77 cm (30.3 in) in magnitude. The resultant crush profile produced the following measurements: C1 = 23 cm (9.1 in), C2 = 62 cm (24.4 in), C3 = 74 cm (29.1 in), C4 = 77 cm (30.3 in), C5 = 71 cm (28.0 in), and C6 = 49 cm (19.3 in). The CDC for this damage was 12FDEW4. The damage algorithm of the WinSMASH model was used to calculate the severity of the crash. The total vehicle velocity change (delta V) was 62 km/h (38.5 mph), with specific longitudinal and lateral components of -62 km/h (-38.5 mph) and zero, respectively. Based on SCI expertise and observed vehicle damage, these results were substantially underestimated. The frontal damage shortened the left wheelbase by 4 cm (1.6 in) and elongated the right wheelbase by 5 cm (2.0 in). All four doors remained closed during the crash and were operational at the time of the SCI inspection.

Event Data Recorder

The 2008 Chevrolet Malibu had an SDM mounted to the center tunnel, between the front seats. The SDM had EDR capabilities to record crash data. Prior to the SCI inspection, the SDM was removed from its mounted location in the vehicle by the investigating law enforcement agency as part of their investigation. The SDM was available to the SCI investigator, who imaged the EDR using the Bosch CDR tool with software version 17.7.2 via a direct connection to the SDM while using an external electrical power source. The imaged data, later read using software version 21.4.1, are included at the end of this technical report as Appendix A.

The SDM monitored and measured vehicle acceleration in both the longitudinal and lateral directions. The EDR could record two different event types, termed "Non-Deployment" or "Deployment," and store a combination of up to two different events. Non-deployment events could be overwritten after approximately 250 ignition cycles, whereas deployment events became locked and could not be overwritten. The minimum recorded Vehicle Velocity Change needed to record a non-deployment event was 8 km/h (5 mph). At AE and recognition of a

longitudinal or lateral event, the EDR had the capacity to record longitudinal and lateral delta V data in 10 millisecond intervals. Up to 300 milliseconds were recorded for a non-deployment event, while up to 70 milliseconds before the criteria were met and up to 220 milliseconds after the criteria were met were recorded for deployment event types.

Associated with each event was a 5-second pre-crash buffer that recorded vehicle speed (mph), engine speed (rpm), throttle (%), brake switch circuit state data, accelerator pedal position (%), antilock brake status, lateral acceleration, yaw rate, steering wheel angle, and vehicle dynamics control status. For the 2- and 1-second pre-crash intervals, the EDR also recorded cruise control usage and reduced engine power mode data.

The imaged data contained one non-deployment event, which occurred on ignition cycle 9,778. Event recording was reported complete for the recovered event, and there were no other events associated with the recorded data. That is, no deployment or non-deployment events were recorded prior to or following the reported event.

The supplemental inflatable restraints (SIR) warning lamp was indicated as "off" for at least 655,200 seconds, and it had been 254 ignition cycles since any diagnostic trouble codes (DTCs) had been cleared. Both the driver's and front-right passenger's belt switch circuit status were reported as "unbuckled," and it was indicated that the passenger's automatic suppression system had suppressed deployment of the passenger's air bag systems. The tire pressure warning lamp and brake system warning lamp were both "off" at the time of AE. At one-second prior to AE, the Chevrolet's transmission was indicated to be in the fourth gear and with the selector in the drive position. The traction control was inactive, the service engine/vehicle lamps were off, and the vehicle's doors were closed. Additional valid pre-crash data associated with the recorded event are outlined in the following table:

Time (seconds)	**-5**	**-4**	**-3**	**-2**	**-1**
Vehicle Speed	98 km/h (61 mph)	98 km/h (61 mph)	97 km/h (60 mph)	76 km/h (47 mph)	47 km/h (29 mph)
Engine Speed (rpm)	1,984	1,792	1,600	1,216	704
Throttle (%)	29	27	16	16	16
Brake Switch	OFF	OFF	OFF	ON	ON
Anti-lock System Active	No	No	No	Yes	Yes
Cruise Control Active	-	-	-	No	No
Red. Engine Power	-	-	-	OFF	OFF
Steering Wheel Angle	0	0	-16	32	-16

No deployment commands were produced in conjunction with the recorded event. The maximum recorded vehicle velocity change was 89.59 km/h (55.57 mph) at 170 ms after AE. The maximum recorded longitudinal velocity change was -89.59 km/h (-55.57 mph) at 170 ms after AE, while the maximum recorded lateral velocity change was -6.55 km/h (-4.07 mph) at 200 ms after AE.

The reported pre-crash data stated that the antilock brake system was active during the final two data sample intervals. Therefore, the reader is cautioned that the reported vehicle speed data may not be accurate. This is because the reported vehicle speed variable is based on a calculation that uses the rotational speed of the vehicle's wheels and transmission shaft. Application of the

Chevrolet's brakes by the driver as the vehicle traversed across the wet grass surface on approach to the large-diameter tree impact resulted in wheel lock-up and slippage, as indicated by the ABS activation. Further, a review of the reported vehicle speed data reveals an unlikely reduction in vehicle speed, based on consideration of the wet grass surface and corresponding low coefficient of friction. Therefore, the reported vehicle speeds for the final two pre-crash sample intervals are likely inaccurate and under-representative of the vehicle's actual velocity.

Interior Damage

The interior of the Chevrolet sustained damage from exterior deformation and driver contact as a result of the crash. The frontal crush had displaced the drivetrain rearward, which produced the longitudinal intrusion of frontal components into the occupant compartment. The SCI investigator documented 18 cm (7.1 in) intrusion of the left (driver's) toe pan and 12 cm (4.7 in) intrusion of the front-right (passenger's) toe pan. In addition, the center aspect and right aspect of the instrument panel were displaced 5 cm (2.0 in) and 3 cm (1.2 in). The combination of these intrusions separated and displaced the forward aspect of the vehicle's center console.

The driver initiated a forward trajectory in response to the crash forces. She was subjected to unrestricted movement about the vehicle's interior during the crash due to her unbelted status. She therefore was displaced from the driver's seat into the frontal components. Her left knee contacted and loaded the lower left instrument panel, which deformed the polymer component as evidenced by tensile stress discoloration. Her abdomen and torso struck the steering wheel rim and the non-deployed air bag module, which bent the wheel rim forward at the four spoke locations and deformed the lower aspect of the wheel rim (Figure 10). The estimated wheel rim deformation was 4 cm (1.6 in).

Figure 10. Driver trajectory and loading damage to the steering assembly and the lower instrument panel

The associated loading force was transmitted into the energy-absorbing steering column, which compressed the column and separated the shear capsules. Corresponding forward displacement of the steering assembly fractured the surrounding instrument panel/cowl and displaced the trim panel at the base of the instrument cluster. The column-mounted windshield wiper stalk was fractured, most likely from contact by the driver's right hand during her displacement. Despite the contacts, the windshield remained in place post-crash and following the removal of the driver

from the vehicle. However, at the time of the SCI inspection, the left two-thirds of the windshield's laminate was torn, and the windshield had sagged into contact with the upper instrument panel.

Driver contact to the windshield glazing was evident in several law enforcement images. Contortion of the driver's body over the compressed steering wheel/column during the crash allowed her head to strike the windshield immediately above and to the right of the steering assembly. The driver's head fractured the laminated glazing and embedded strands of the driver's hair into the fracture site (Figure 11, an on-scene law enforcement image categorized in the on-scene images of the Crash Viewer application). A second windshield fracture site was located adjacent to the left upper A-pillar, attributed to contact from the driver's left hand/forearm. Induced deformation fractures to the glazing were apparent around the windshield's outer edges. The tempered left-front door glazing was shattered by the first arriving law enforcement officer. All other door glazing (closed) and the backlight glazing remained intact and were not damaged or contacted relative to the crash or occupant.

Figure 11. Law enforcement image of the vehicle's windshield and driver contact damage

Manual Restraint Systems

The Chevrolet had 3-point continuous loop lap and shoulder seat belt systems for all five seat positions. They all used sliding latch plates, and the driver's and front-row passenger systems had adjustable D-rings. The driver's seat belt retracted onto an emergency locking retractor (ELR), while the four other systems used switchable ELR/automatic locking retractors (ALR). Both front-seat belt systems had retractor pretensioners.

At the time of the SCI vehicle inspection, the driver's D-ring was adjusted to the full-down position. The seat belt was stowed against the B-pillar, and the webbing spooled freely from/retracted to the ELR retractor. There was no occupant loading evidence and/or damage discernable on the driver's seat belt system, and the retractor pretensioner was not actuated.

Figure 12 shows the driver's seat belt system at the time of the SCI vehicle inspection. Based on the post-crash condition of the system and the contact evidence in the vehicle as observed by the SCI investigator during the inspection, and in conjunction with the data imaged from the Chevrolet's EDR, it was apparent that the driver was not belted at the time of the crash.

Figure 12. View of the driver's seat belt system at the time of the SCI vehicle inspection

Supplemental Restraint Systems

The Chevrolet had a CAC frontal air bag system and roof side rail-mounted IC air bags that provided side impact protection to both seat rows. The CAC system consisted of dual-stage driver's and passenger's frontal air bags, seat track position sensors, seat belt buckle switches, retractor pretensioners, and a front-right occupant classification sensor. The driver's frontal air bag was conventionally mounted in the hub of the four-spoke steering wheel, while the passenger's frontal air bag was a mid-mount design in the right instrument panel. The IC air bags were mounted to the roof side rails and concealed by the vehicle's head liner. Labeling molded into the polymer surfaces of the pillar trim panels identified the presence of the IC air bags. The supplemental restraints (air bags and pretensioners) were controlled and monitored by the center tunnel-mounted SDM. None of the Chevrolet's air bags deployed, and neither of the seat belt pretensioners actuated as a result of the crash.

NHTSA Recalls and Investigations

A VIN-based query of NHTSA's www.nhtsa.gov/recalls database for the 2008 Chevrolet Malibu as of the date of submission of this report indicated one open recall issued in April 2014 and that the vehicle was identified by NHTSA Recall No. 14V224 and the manufacturer Recall Number N140152. The recall pertained to a potential fracture of the transmission shift cable. There were no open investigations concerning this specific vehicle.

Air Bag Non-Deployment Discussion

None of the Chevrolet's supplemental restraint systems actuated or deployed during the crash. With regard to the SCI reconstruction of the crash, there were three separate and distinct crash events. These included the impact of the front plane, right aspect with the small shrub (Event 1), the impact and engagement of the undercarriage with the ground (Event 2), and the impact of the

front plane, center aspect with the large-diameter tree (Event 3). Based on SCI expertise, supplemental restraint deployment and/or actuation would not be expected in relation to either of the first two SCI reconstruction events. However, both pretensioner actuation and frontal air bag deployment would be expected in relation to an event of similar magnitude to that of the Chevrolet's impact with the large-diameter tree.

The EDR data imaged from the Chevrolet's SDM reported only one recorded crash event: the impact with the large-diameter tree. No other events — historical, preceding, or otherwise — were reported. The lack of event data in the EDR report indicated that the prior SCI reconstructed impacts (Event 1 and Event 2) did not meet the threshold to be recorded as an event by the SDM. The recorded data including the measured delta V data and associated crash pulse were consistent only with the tree impact (Event 3). The time of the maximum-recorded longitudinal delta V in relation to AE (170 ms) was consistent only with the tree impact. Based on the speed of the vehicle and distance between impacts as documented by this investigation, it was clear that the recorded data were related specifically to the tree impact. While possible, there are no means by which to determine if either of the other impacts (Events 1 and 2) enabled the SDM's algorithm, as this is not a variable captured or reported by the software. It is plausible that one or possibly both of the impacts (Events 1 and 2) triggered an AE in the SDM, but the SDM did not measure corresponding associated forces of sufficient magnitude to precipitate event recording. Additionally, the EDR having enabled by these events did not adequately reset prior to the occurrence of Event 3.

The recorded data and observations of both the law enforcement and this SCI investigation corroborated to confirm that the Chevrolet's key was in the ignition, the ignition was rotated to the "run" position, and the vehicle's transmission was in "drive" at the time of the crash. The EDR data also indicated that the air bag warning lamp was not illuminated, and there were no active DTCs prior to the crash. This indicated that the Chevrolet's supplemental restraint systems and devices were operational and functioning correctly. During the SCI vehicle inspection, the SDM was reconnected (it had previously been removed from the vehicle by the investigating law enforcement agency), and the Chevrolet was powered up using an external 12-volt power supply. The ignition switch was cycled through the "run" position to energize the vehicle's systems and instrument panel, which illuminated all indicator lamps as the vehicle performed the routine self-diagnostic checks associated with each ignition cycle. The air bag indicator lamp illuminated during the self-diagnostic check function and then cycled off, indicative that the system was operational. The check engine light, the brake warning light, and the seat belt warning light remained lit. All other warning lamps cycled to off.

Two remote satellite sensors for the frontal air bag system were mounted to the aft side of the upper radiator support (identified by the arrows in Figure 13). The satellite sensors were identified by the following nomenclature: Left – AD1097R00TBA, 5WK4384901, and 15821097; Right – AD1097R00NHS, 5WK438901, and 15821097. The upper radiator support was deformed by the exterior crush, and, although the sensors were rotated from their original mounted positions, they were not physically damaged.

Figure 13. Satellite crash sensors mounted to the radiator support

Through the course of this investigation, no root cause to explain the non-deployment of the Chevrolet's air bag system could be determined. Based on SCI expertise, crash events similar in magnitude to that of the Chevrolet's impact with the large-diameter tree would be expected to result in pretensioner actuation and air bag deployment.

2008 Chevrolet Malibu Occupant

Driver Demographics

Age/sex:	36 years/female
Height:	180 cm (71 in)
Weight:	136 kg (299 lb)
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Mid-to-rear track position
Manual restraint usage:	3-point lap and shoulder seat belt available; not used
Usage source:	Vehicle inspection
Air bags:	Frontal and inflatable curtain air bags available; none deployed
Alcohol/drug data:	BAC = 0; positive for buprenorphine (pain medication) and levetiracetam (antiepileptic) according to internal autopsy report
Egress from vehicle:	Removed by emergency personnel while unconscious
Transport from scene:	Ambulance to a Level II trauma center
Type of medical treatment:	Hospitalized; declared deceased after 1 day

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Right temporal uncal and bilateral cerebellar tonsillar herniations	140202.5	Isolated IPC Front - Windshield	Probable
2	Medulla oblongata shows focal acute hemorrhage near inferior olivary nucleus; SAH over the brainstem	140210.5	Isolated IPC Front - Windshield	Probable
3	Diffuse loss of gray-white differentiation and diffuse sulcal effacement as well as mass effect and compression of the ventricular system and basilar cisterns (swelling)	140666.5	Isolated IPC Front - Windshield	Probable
4	Hemorrhage within the left lateral ventricle	140677.4	Isolated IPC Front - Windshield	Probable
5	Hemorrhage within the right lateral ventricle	140677.4	Isolated IPC Front - Windshield	Probable
6	Subarachnoid hemorrhage over the brain convexities	140693.2	Isolated IPC Front - Windshield	Probable
7	Inferior herniation of the cerebellum at foramen magnum	140450.3	Isolated IPC Front - Windshield	Probable
8	Spleen is completely shattered; Grade 5 injury	544228.5	Isolated IPC Front - Steering wheel rim	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
9	Non-displaced fracture of right superior pubic ramus with separation of sacroiliac joints; Non-displaced bilateral sacral bone fractures	856171.4	Isolated IPC Front - Left lower instrument panel (includes knee bolster)	Certain
10	Fractures of left 3rd-8th ribs anteriorly; Fractures of left 4th-9th ribs posteriorly	450212.3	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Certain
11	Fractures of right 1st-6th ribs anteriorly; 6th is mildly displaced	450203.3	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Certain
12	Large left hemothorax	442200.3	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Certain
13	Small right hemopneumothorax	442205.3	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Certain
14	Superior dislocation of right femoral head which is also fractured with a fracture fragment remaining in acetabular cap	853171.3	Isolated IPC Front - Left lower instrument panel (includes knee bolster)	Certain
15	Closed fracture of proximal right fibula	854471.2	Isolated Front - Left lower instrument panel (includes knee bolster)	Certain
16	Fracture of right distal tibia	854331.2	Isolated IPC Floor - Floor (including toe pan)	Certain
17	Fracture of right distal fibula	854441.2	Isolated Floor - Floor (including toe pan)	Certain
18	Abnormal separation of left C1 into C2 lateral masses; Subluxation of C1 on C2	650206.3	Isolated IPC Front - Windshield	Probable
19	Fracture dislocation at T1-T2 with mild offset; ¾ in-wide separation of T1 on T2 with exposed spinal canal	610400.3	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Probable
20	Non-displaced fracture of bilateral transverse processes at L5	650620.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
21	Right T1 transverse process fracture, non-displaced	650420.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Probable
22	Left T2 transverse process fracture, non-displaced	650420.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Probable
23	Left T3 transverse process fracture, non-displaced	650420.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Probable
24	Right sternoclavicular dislocation	770530.2	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Probable
25	Contusion to superior front parietal area extending to left temporal area 6 x 5 inches	110402.1	Isolated Front - Windshield	Certain
26	Contusions of mucosa of lower lip, chin, left lower eyelid, right cheek	210402.1	Isolated Front - Windshield	Certain
27	Abrasion to forehead	210202.1	Isolated Front - Windshield	Certain
28	Abrasion to nose	210202.1	Isolated Front - Windshield	Certain
29	Abrasion below lip	210202.1	Isolated Front - Windshield	Certain
30	Contusion to lower left breast 1 ½ x 1 ½ inch	410402.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain
31	Contusion to right side of chest 4 x 1 inch	410402.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain
32	Contusion to dorsum of left arm 3 x 2 inches	710402.1	Isolated Front - Windshield	Probable
33	Contusions to right upper arm up to 2 x 1 ½ inches	710402.1	Isolated Front - Center instrument panel	Probable
34	Contusions to right thigh ranging from ¼ to 6 x 6 inches	810402.1	Isolated Front - Steering wheel rim	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
35	Contusion to left thigh ranging from ¼ to 6 x 6 inches	810402.1	Isolated Front - Steering wheel rim	Certain

Source: hospital records and Autopsy report (internal).

Driver Kinematics

The 36-year-old female driver was seated in the driver's seat of the Chevrolet. She had adjusted the seat to a mid-to-rear track position, with the seat track slightly reclined. The driver did not use the available 3-point lap and shoulder seat belt system for manual restraint. Her lack of seat belt use was determined by the post-crash SCI inspection of the manual restraint system, in conjunction with the data imaged from the Chevrolet's EDR and the driver's resulting injury profile.

The Event 1 impact (small shrubbery) did not displace the driver or induce injury. It was of insufficient magnitude to elicit a kinematic response. Similarly, the Event 2 impact (undercarriage) was also of insufficient magnitude to induce injury, although it likely vertically compressed the driver into the seat cushion.

At impact with the large-diameter tree (Event 3), the unbelted driver initiated a forward trajectory in response to the 12 o'clock impact force. Her knees and lower extremities contacted and engaged the lower left instrument panel. Her left knee loading stressed and disengaged the polymer panel from its mounts, and the driver sustained direct contact fractures of the right proximal fibula and distal tibia and fibula. Energy from this loading was transmitted through the femur, which resulted in a fracture of the right femoral head and acetabular cap and a non-displaced fracture of the right superior ramus with separation of the sacroiliac joints.

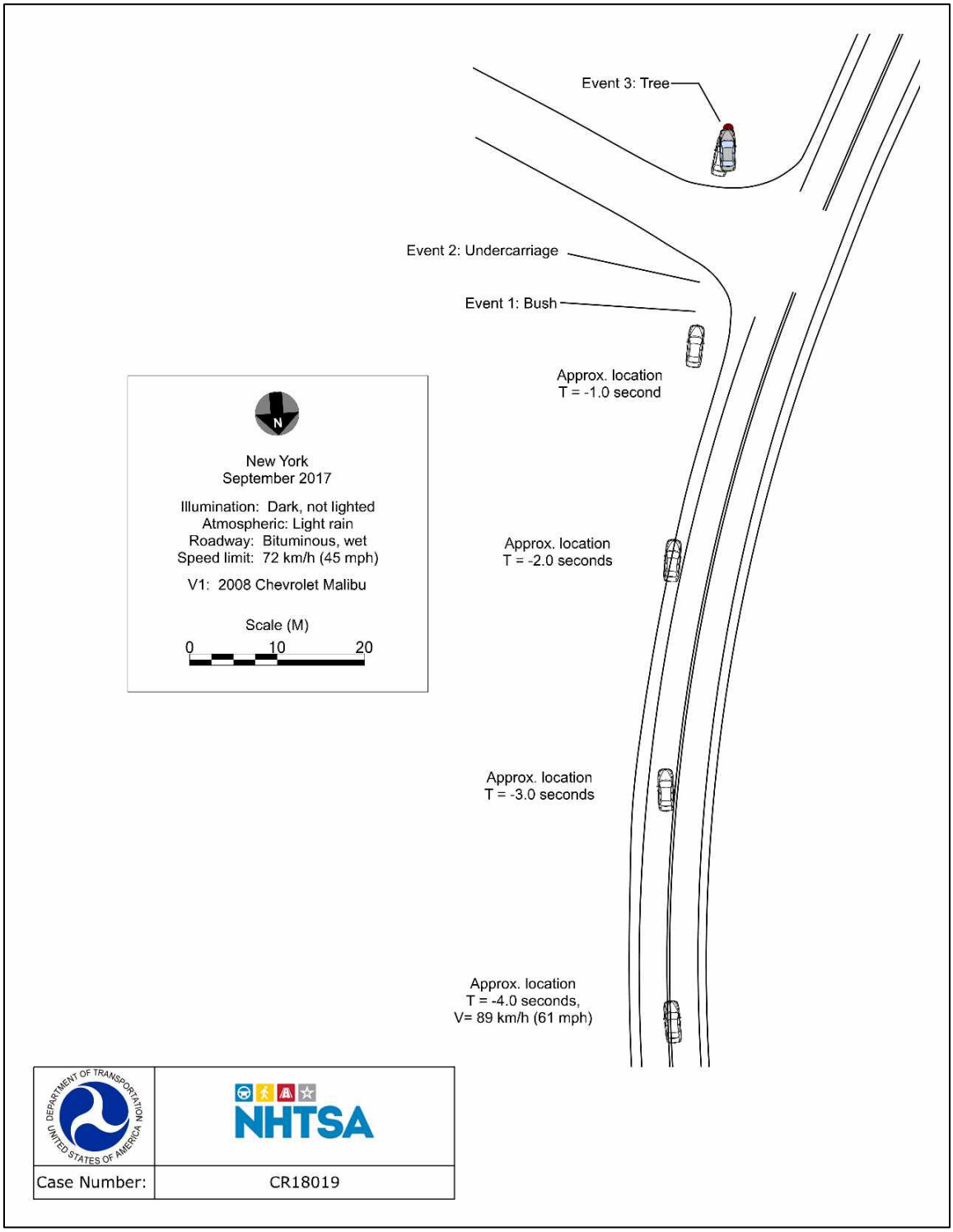
The driver's torso contacted the steering assembly, which deformed the steering wheel rim and compressed the energy absorbing column. Direct contact with the steering assembly resulted in a contusion of the left breast and right chest, a Grade 5 injury of the spleen, fractures of left ribs 3-8 anteriorly and 4-9 posteriorly, fractures of right ribs 1 to 6 anteriorly, an underlying left hemothorax, and a small right hemopneumothorax. Her right shoulder rotated forward outside the confines of the steering wheel rim, which resulted in a sternoclavicular dislocation. The flexation of her torso as it engaged and deformed the steering wheel assembly caused fractures of the transverse processes at T1-T3 and at L5. Additionally, the driver sustained a fracture dislocation at T1-T2 with exposed spinal canal.

The driver's face and head contacted the middle aspect of the windshield, forward and to the right of the steering assembly, above the center instrument panel area. This contact fractured the laminated glazing, evidenced by hair and tissue embedded into the fracture pattern. She sustained a right temporal uncal and bilateral cerebellar tonsillar herniations with diffuse loss of gray-white differentiation and diffuse sulcal effacement, compression of the ventricular system and basilar cisterns, and herniation of the cerebellum at the foramen magnum. The windshield contact pocketed the head as the body continued to load forward, causing hyperflexion-type separation of C1 on C2 and subluxation of C1 on C2. Numerous soft tissue injuries of the face and scalp

were also sustained by the driver from the windshield contact. These included a contusion to the superior front parietal area, extending to the left temporal area, and contusions of the chin, left lower eyelid, and right cheek. Abrasions were present to the forehead, nose, and below the lip. The driver's thighs sustained contusions from contact with the lower aspect of the steering wheel rim. Her left arm separated from the steering wheel and contacted the windshield to the left of the steering assembly, adjacent to the left upper A-pillar. This contact fractured the laminated glazing and contused the dorsum of the left forearm. The driver's right upper arm sustained contusions from possible (no associated contact evidence) contact with the center instrument panel.

According to the first arriving law enforcement officer, he removed the driver from the vehicle while she was unconscious and unresponsive. A lack of vital life signs was detected, an automated external defibrillator was applied, "no shock" was advised, and cardiopulmonary resuscitation was initiated. Following the arrival of EMS personnel, the driver was placed on a long spine board, intubated, and then transported by ambulance to a Level II trauma center. The driver expired 35 hours after the crash.

Crash Diagram



Appendix A: Event Data Recorder Report for 2008 Chevrolet Malibu[1]

[1] The EDR report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the vehicle inspection. The CDR report contained in the associated Crash Viewer application may differ relative to this report.

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	1G1ZT58N18F******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR18019_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.7.2
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 21.4.1
Reported with Software Licensed to (Company Name)	NHTSA
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 can record up to 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. If a CDR Printout user were to calculate resultant velocity change using X and Y axis time history data, the calculated value may be different than the Maximum SDM Recorded Velocity Change parameter value displayed in the CDR report. This is due to the rounding that occurs within the SDM while calculating the Maximum SDM Recorded Velocity Change value.
-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. The 1.0 second Pre-crash data value (most recent recorded data point) is the data point last sampled before AE. That is to say, the last data point may have been captured just before AE but no more than 1.0 second before AE. All subsequent Pre-crash data values are referenced from this data point.
-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
-Vehicle speed, Transmission Gear Select, and Transmission Actual Gear will be marked as invalid for manual transmission vehicles
-Pre-crash data associated with this event will always be for the first event even if it is not recorded.
-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 Passenger Belt Switch Circuit Status for 2010 Chevrolet Cobalt and 2010 Pontiac G5 vehicles, with RPO Z49, will report a default value of "Buckled". The Passenger Belt Switch Circuit Status for 2010 and 2011 Chevrolet HHR, with the LS or LT trim package and RPO Z49, will report a default value of "Buckled".
-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. Time Between events is measured from end of one event to the beginning of a next event. An event may occur within 5 seconds of another event, known as an extended event. This occurs when three or more sequential events are separated by more than 5 seconds but each event in the sequence is no more than 5 seconds apart from a subsequent event. Pre-crash data is locked to the first event in an extended event.
-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 reported in 16 degree increments. 2005 through 2010 Chevrolet Cobalt, 2005 and 2006 Pontiac Pursuit, 2007 through 2010 Pontiac G5, and 2006 through 2011 Chevrolet HHR, do not record Steering Wheel Angle data and should not be relied upon.
-If more than one event is recorded, use the follow to determine which event the Multiple Event Data is associated with:
-If a Deployment event and not locked Non-Deployment event are recorded, the Multiple Event Data is associated with the Deployment event.
-If a Deployment event and a locked Non-Deployment event are recorded, then the Multiple Event Data is associated with both events.
-If a Deployment event and Deployment event #2 are recorded, then the Multiple Event Data is associated with both events.
-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.

Data Element Sign Convention:
The following table provides an explanation of the sign notation for data elements that may be included in this CDR report. Directional references to sign notation are all from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

Data Element Name	Positive Sign Notation Indicates
Longitudinal Velocity Change	Forward
Lateral Velocity Change	Left to Right
Lateral Acceleration	Left to Right
Yaw Rate	Clockwise *
Steering Wheel Angle	Clockwise *

*For Cadillac STS model vehicles with StabiliTrak 3.0 systems (RPO JL7), the positive sign notation Indicates a counterclockwise rotation.

Hexadecimal Data:
Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR

report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR tool.

01016_SDMEps_r011

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	**1ZT58N*8*******
Low Tire Pressure Warning Lamp (If Equipped)	OFF
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)	Fourth Gear
Transmission Selector Position (If Equipped)	Drive
Traction Control System Active (If Equipped)	No
Service Engine Soon (Non-Emission Related) Lamp	OFF
Service Vehicle Soon Lamp	OFF
Outside Air Temperature (degrees F) (If Equipped)	54
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)	No	No
Cruise Control Resume Switch Active (If Equipped)	No	No
Cruise Control Set Switch Active (If Equipped)	No	No

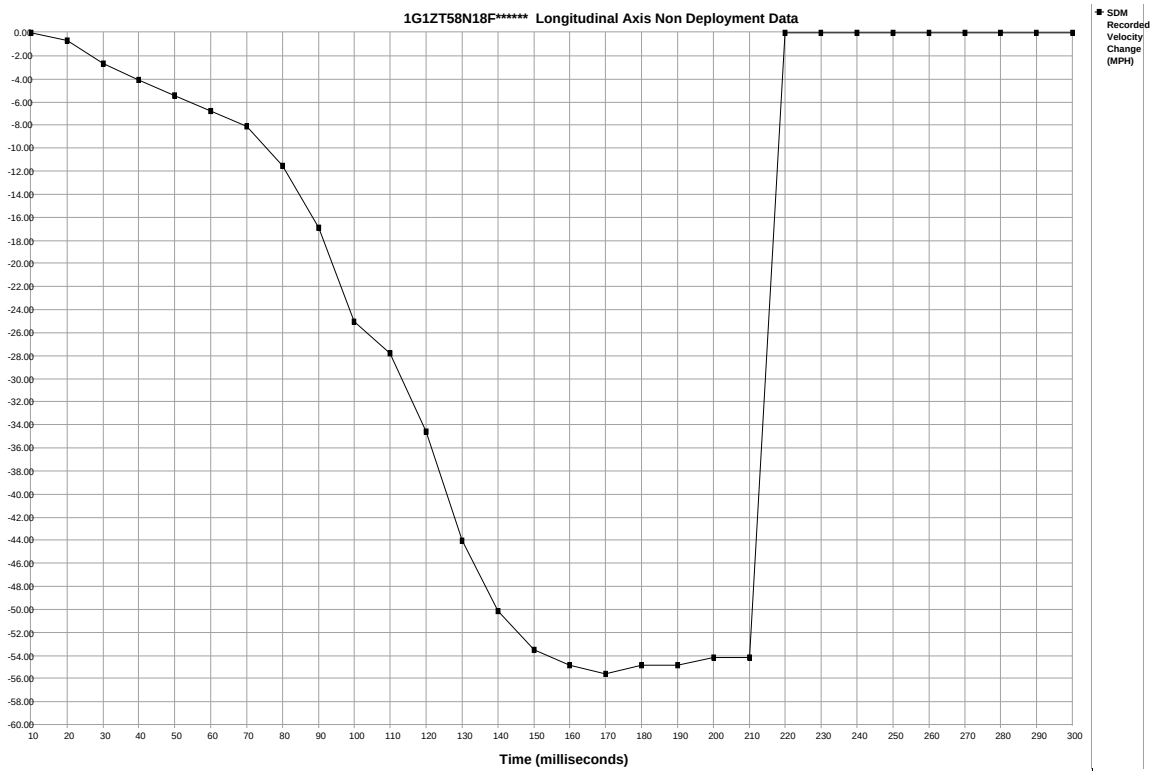
Pre-Crash Data

Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Vehicle Speed (MPH)	61	61	60	47	29
Engine Speed (RPM)	1984	1792	1600	1216	704
Percent Throttle	29	27	16	16	16
Brake Switch Circuit State	OFF	OFF	OFF	ON	ON
Accelerator Pedal Position (percent)	Invalid	Invalid	Invalid	Invalid	Invalid
Antilock Brake System Active (If Equipped)	No	No	No	Yes	Yes
Lateral Acceleration (feet/s²)(If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

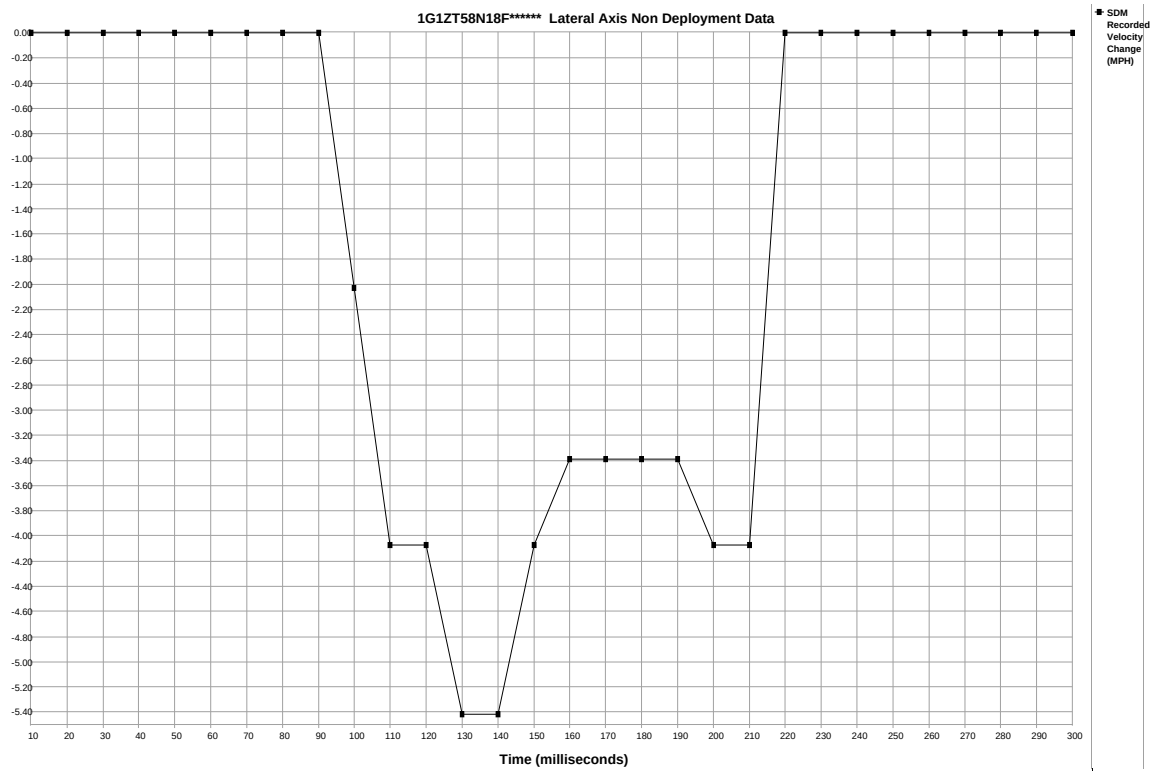
Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Yaw Rate (degrees per second) (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Steering Wheel Angle (degrees) (If Equipped)	0	0	-16	32	-16
Vehicle Dynamics Control Active (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

System Status At Non-Deployment

Ignition Cycles At Investigation	9778
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time (seconds)	655200
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	9777
Ignition Cycles At Event	9778
Ignition Cycles Since DTCs Were Last Cleared	254
Driver's Belt Switch Circuit Status	UNBUCKLED
Passenger Belt Switch Circuit Status (If Equipped)	UNBUCKLED
Automatic Passenger SIR Suppression System Validity Status at AE	Valid
Automatic Passenger SIR Suppression System Status at AE	Air Bag Suppressed
Diagnostic Trouble Code at Event Enable, fault number: 1	N/A
Diagnostic Trouble Code at Event Enable, fault number: 2	N/A
Diagnostic Trouble Code at Event Enable, fault number: 3	N/A
Diagnostic Trouble Code at Event Enable, fault number: 4	N/A
Diagnostic Trouble Code at Event Enable, fault number: 5	N/A
Diagnostic Trouble Code at Event Enable, fault number: 6	N/A
Maximum Resultant SDM Recorded Vehicle Velocity Change (MPH)	55.67
Time From Algorithm Enable to Maximum Resultant SDM Recorded Vehicle Velocity Change (msec)	170
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
Second Row Left Pretensioner Deployment Loop Commanded	No
Third Row Left Roof Rail/Head Curtain Loop Commanded	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)	0.00	-0.68	-2.71	-4.07	-5.42	-6.78	-8.13	-11.52	-16.94	-25.07	-27.79	-34.56	-44.05	-50.15	-53.54
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-54.89	-55.57	-54.89	-54.89	-54.22	-54.22	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	-2.03	-4.07	-4.07	-5.42	-5.42	-4.07
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
SDM Lateral Axis Recorded Velocity Change (MPH)	-3.39	-3.39	-3.39	-3.39	-4.07	-4.07	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Hexadecimal Data

```
$01  08 00 00 00 00 00 00
$02  30 00 00 00 00 00 00
$03  00 00 00 00 00 00 00
$04  00 00 00 00 00 00 00
$05  80 00 00 00 00 00 00
$06  00 0A 00 03 0A 00 00
$07  00 20 00 00 00 00 00
$08  16 0D 00 00 00 00 00
$09  03 FF 7E 00 00 00 00
$0A  00 00 00 00 00 00 00
$0B  00 00 05 0F 00 00 00
$0C  00 00 00 00 00 00 00
$0D  00 00 40 00 00 00 00
$0E  40 00 00 00 00 00 00
$0F  00 00 00 00 00 00 00
$10  00 00 00 00 00 00 00
$11  00 00 00 00 00 00 00
$12  00 00 00 00 00 00 00
$13  00 00 00 00 00 00 00
$14  00 00 00 00 00 00 00
$15  00 00 00 00 00 00 00
$16  03 06 0C 16 34 00 00
$17  00 00 00 00 00 00 00
$18  00 00 00 00 00 00 00
$19  00 00 00 00 00 00 00
$1B  3F 30 00 66 00 1A 00
$1C  3F 30 00 66 00 1A 00
$1D  00 00 00 00 00 00 00
$1E  00 00 00 00 00 00 00
$1F  28 00 00 00 00 00 00
$20  40 00 00 00 00 00 00
$21  00 00 00 00 F0 00 00
$22  00 94 00 00 00 00 00
$24  00 00 00 00 00 00 00
$25  00 00 00 00 00 00 00
$26  00 00 00 00 00 00 00
$27  FF 00 FF 00 00 00 00
$2A  00 00 00 00 00 00 00
$2B  00 00 00 00 00 00 00
$2D  00 00 00 00 00 00 00
$2E  00 00 2A 00 01 00 00
$2F  00 FE 26 32 00 00 00
$30  9D 00 00 00 00 00 00
$31  00 00 00 00 00 80 00
$32  C0 00 00 00 00 00 00
$33  28 2A 2A 44 4B 00 00
$34  0B 13 19 1C 1F 00 00
$35  2E 4B 61 62 62 00 00
$36  FF 02 FF 00 00 00 00
$37  C0 00 00 04 0B 00 20
$38  68 00 40 00 03 C0 00
$39  00 00 00 00 00 80 00
$3A  00 00 00 00 00 80 00
$3B  03 06 0C 00 00 00 00
$3C  00 00 00 00 00 00 C0
$3D  31 5A 54 35 38 4E 00
$3E  38 FF FF FF 00 00 00
$3F  00 00 90 00 00 00 00
$40  20 A5 00 00 00 00 00
$41  00 00 00 00 00 00 00
```

```
$42  00 FF F0 26 31 00 00
$43  FE 26 32 00 00 00 00
$44  00 00 00 00 00 00 00
$45  00 00 00 00 00 00 00
$46  00 00 00 00 00 00 00
$47  00 00 00 FF 00 FC 00
$48  00 FA 00 F8 00 F6 00
$49  00 F4 00 EF 00 E7 00
$4A  FD DB FA D7 FA CD 00
$4B  F8 BF F8 B6 FA B1 00
$4C  FB AF FB AE FB AF 00
$4D  FB AF FA B0 FA B0 00
$4E  00 00 00 00 00 00 00
$4F  00 00 00 00 00 00 00
$50  00 00 00 00 00 00 00
$51  50 00 00 00 00 00 00
$52  00 00 00 00 00 00 00
$53  11 1A 5D 00 00 00 00
$54  00 00 00 00 00 00 00
$55  00 00 00 00 00 00 00
$67  00 00 00 00 00 00 00
$68  F8 F8 90 C0 00 00 00
$69  80 FF FF FF FF 00 00
$6A  FF FF FF 00 00 00 00
$6B  FF FF FF FF FF FF 00
$6C  FF FF FF FF FF FF 00
$6D  FF FF FF FF FF FF 00
$6E  FF FF FF FF FF FF 00
$6F  FF FF FF FF FF FF 00
$70  FF FF FF FF FF FF 00
$71  FF FF FF FF FF FF 00
$72  FF FF FF FF FF FF 00
$73  FF FF FF FF FF FF 00
$74  FF FF FF FF FF FF 00
$75  FF FF FF FF FF FF 00
$76  FF FF FF FF FF FF 00
$77  FF FF FF FF FF FF 00
$78  F0 00 00 F0 00 00 00
$79  81 FF FF FF 00 00 00
$7A  82 FF FF 00 00 00 00
$7B  FF FF FF FF FF FF 00

$01  41 55 31 30 39 38 52 30 30 36 31 37 37 42 38 44
$02  3F 0A 00 00
$03  41 54 31 30 39 38 52 30 30 31 46 34 46 35 30 44
$04  3F 0A 00 00
$05  42 55 00 00 00 00 52 FF FF FF FF FF FF FF FF FF
$06  FF FF 00 00
$07  42 54 00 00 00 00 52 FF FF FF FF FF FF FF FF FF
$08  FF FF 00 00
$0D  41 48 31 30 39 37 52 30 30 30 36 38 37 41 38 44
$0E  3F 0A 00 00
$0F  41 4A 31 30 39 37 52 30 30 39 46 31 46 41 30 44
$10  3F 0A 00 00
$13  42 52 38 36 39 36 44 31 37 31 39 39 34 41 52 33
$14  16 45 45 46
$17  42 54 FF FF FF FF FF FF FF FF FF FF FF FF FF FF
$18  FF FF FF FF
$21  27 35 B4 97 3F AA 0C BD
$22  51 80
$23  31 5A FA FA FA FA FA
$24  31 5A FA FA FA FA FA
$25  31 5A FA FA FA FA FA
$26  31 5A FA FA FA FA FA
$40  00 00
```

```
$41  3F 30 00 66 00 1A
$42  D0 E4
$43  00 00 8E 80
$44  C6 00 00 FC 80 C0
$45  07 01 07 01 05 01
$46  00 0F 0F 64 64
$47  0A 64 02 04 04 05 0A 06 04 0A 00 00 FA 00 00 FF 04 64
$48  18 08 08
$B0  58
$B1  FD FE 00
$B2  FF FF FF FF FF
$B4  41 53 35 31 38 30 32 31 30 35 57 51 20 20 20 20
$B7  50 AA 01 02 07
$B8  44 45 84 01 30
$C1  30 32 30 37
$CA  30 32 30 37
$CB  00 F1 A0 2C
$CC  00 F1 A0 2C
$D1  00 00
$DB  00 00
$DC  00 00
```

Disclaimer of Liability

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

DOT HS 813 300
May 2022

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

15596-050422-v2