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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 submitted.

16. Abstract

This report documents the on-site investigation of the non-deployment of the side air bag systems in a 2008 Pontiac G6 involved in a fixed-object crash. The Pontiac had front seat belt pretensioners, driver and passenger frontal air bags, front-seat-mounted outboard side impact air bags and side-impact sensing inflatable curtain air bags. The Pontiac was driven by an unbelted 28-year-old male, with an unbelted 18-year-old female right front passenger, and a 3-month-old infant in the second-row left seat in a rear-facing child restraint system that was not secured by the harness straps. As the Pontiac was traveling west on a two-lane roadway, the driver lost control and the Pontiac began to rotate clockwise. The Pontiac departed the right side of the road in a clockwise yaw, traveled down an embankment and through an open field into a treed area. The left plane/rear door area of the Pontiac struck a large diameter tree. None of the Pontiac's air bags deployed. According to the police report, the driver and front passenger sustained incapacitating (A-level) injuries and were transported to a trauma center. The infant was ejected through the backlight opening of the vehicle and was fatally injured.

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On-Site Air Bag Non-Deployment Crash Investigation
Office of Defects Investigation
Case Number: CR20034
Vehicle: 2008 Pontiac G6
Location: Ohio
Crash Date: July 2020

Background

This report documents the on-site investigation of the non-deployment of the side air bag systems in a 2008 Pontiac G6 (Figure 1) involved in a fixed-object crash. The Pontiac had front seat belt pretensioners, driver and passenger frontal air bags, front-seat-mounted outboard side impact, and side-impact sensing inflatable curtain (IC) air bags. The Pontiac was driven by an unbelted 28-year-old male, with an unbelted 18-year-old female right front passenger and a 3-month-old infant in a second row left rear-facing child restraint system (CRS) that was not secured by the harness straps. As the Pontiac was traveling west on a two-lane roadway, the driver lost control and the Pontiac began to rotate clockwise. The Pontiac departed the right side of the road in a clockwise yaw, traveled down an embankment, and through an open field into a treed area. The Pontiac's left plane/rear door area struck a large diameter tree. None of the Pontiac's air bags deployed.

According to the police report, the driver and front passenger sustained incapacitating (A-level) injuries and were transported to a trauma center. The infant was ejected through the Pontiac's backlight opening and fatally injured.

Figure 1. Left side view of the Pontiac

The Ohio State Highway Patrol notified NHTSA's Vehicle Research Test Center of the crash in November 2020. The notification was forwarded to the Crash Investigation Division and assigned to the Special Crash Investigations (SCI) team at Crash Research and Analysis, Inc. During the time between the crash date and notification, the Pontiac was sold by the tow company to a vehicle salvage company in a nearby city. SCI contacted the salvage company and established cooperation to inspect the vehicle in November 2020. The investigation included an inspection of the Pontiac to measure exterior deformation, interior damage and intrusion, documentation of any evidence of interior occupant contact, identification of the ejection portal,

examination of the manual and supplemental restraint systems, and an inspection of the ignition system. The crash site was documented by photographs and a total station mapping system.

The Pontiac's event data recorder (EDR) was imaged during the police investigation; however, no crash event was recorded. The EDR was also imaged at the time of the SCI inspection, confirming that no crash-related data were recorded. The EDR was removed from the vehicle and forwarded to NHTSA for further analysis. Through the course of the SCI investigation, the root cause of the non-deployment of the Pontiac's air bag systems could not be determined.

Summary

Crash Site

This single-vehicle, road-departure/fixed-object crash occurred at night in July 2020. At the time of the crash, the police reported environmental conditions were clear, dry, and dark without artificial lighting. The weather conditions reported by the National Weather Service were a temperature of 18.9 °C (66 °F), 87 percent relative humidity, calm winds, and fair skies.

The crash occurred on a two-lane east/west roadway in a rural setting (Figure 2). The bituminous roadway was straight, measured 6.1 m (20.0 ft) in total width, and had no painted markings. The posted speed limit was 89 km/h (55 mph). An open cultivated field was located on the south roadside. The north roadside consisted of grass with a cluster of deciduous trees located farther to the west. Three trees in the cluster were struck by the Pontiac. A crash diagram is included at the end of this report.

Figure 2. West-looking trajectory view of the Pontiac

Figure 3. Northwest trajectory view of the Pontiac approaching the point of impact with the trees

Pre-Crash

The Pontiac was traveling west and was driven by an unbelted 28-year-old male, with an unbelted 18-year-old female right front passenger and a 3-month old male seated in a rear-facing CRS. The CRS was secured to the second-row left position by the Pontiac's seat belt; however, the infant was not secured by its harness straps. The driver stated to the police investigator that the front passenger grabbed the steering wheel during an argument, which caused the vehicle to

depart the road. The loss of control developed into a clockwise yaw, as the Pontiac traveled through the grass field approximately 46 m (150 ft) in a northwesterly direction toward the trees (Figure 3).

Crash

The Pontiac entered the cluster of trees and struck a tree 36 cm (14.2 in) in diameter (Event 1) with its left plane, denoted by the white arrow in Figure 4. This impact had a 10 o'clock direction of force with the maximum deformation centered on the left rear door of the vehicle. The force of the impact aft of the Pontiac's center of mass imparted a counterclockwise rotation to the Pontiac. During the rotation, the right rear corner of the Pontiac struck a tree 21 cm (8.3 in) in diameter (Event 2), denoted by the yellow arrow in Figure 4. The Pontiac's trunk space crushed and deformed laterally to the left.

Figure 4. Northwest-facing view of the tree impacted during Events 1 (white arrow) and 2 (yellow arrow)

The deformed Pontiac separated from the second tree impact and continued to rotate counterclockwise into the tree cluster. A tree 9 cm (3.5 in) in diameter was struck by the front right corner of the vehicle (Event 3) and fractured. During its rotation to final rest, the undercarriage of the Pontiac rode over the trunk of a previously downed tree (Event 4). This undercarriage impact separated the exhaust system from the vehicle. This latter damage was observed in the on-scene police images (Figures 5 and 6).

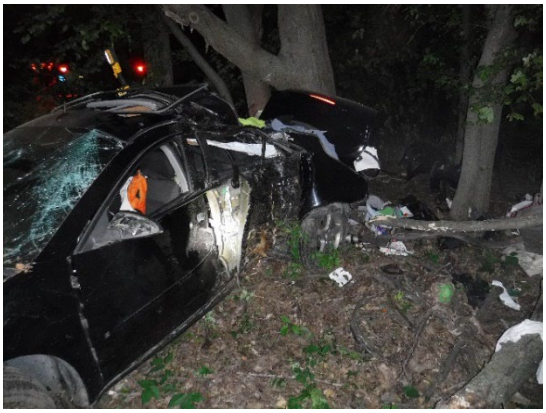


Figure 5. On-scene police image of the Pontiac at final rest and the yielding tree impacts

Figure 6. On-scene police image of the Pontiac at final rest and the displaced exhaust system

The forces of the Events 1 and 2, coupled with the centripetal force of the rotation, resulted in the ejection of the infant through the disintegrated backlight. Items of clothing and miscellanea from the trunk were also dispersed throughout the final rest area. The Pontiac came to rest facing east approximately 8.5 m (28 ft) from the initial tree impact. None of the air bags in the vehicle deployed.

Post-Crash

Police and emergency services were alerted and responded to the scene. The driver and front passenger exited the Pontiac through the right front door. The driver was found on the ground by the first responders and had sustained police-reported incapacitating (A-level) injuries. He was transported by helicopter to a trauma center. The front passenger also sustained A-level injuries and was transported by helicopter to the trauma center. The 3-month-old infant was ejected through the backlight opening during the counterclockwise rotation of the vehicle. His ejected location was not documented by the police. The infant was transported by helicopter to the trauma center in critical condition and pronounced deceased 80 minutes after arrival.

2008 Pontiac G6

Description

The 2008 Pontiac G6 was a 4-door sedan (Figure 7) identified by VIN 1G2ZG57NX84xxxxxx. It had the SE-level trim package. The date of manufacture was unknown. The jammed status of the left front door prevented access to the certification label. The battery was discharged; the odometer reading was unknown. The last known odometer reading was 312,344 km (194,087 miles) in May 2020 according to a vehicle history report. The Pontiac was configured on a 285 cm (112.2 in) wheelbase with an overall length of 480 cm (189.0 in). The powertrain consisted of a 3.5-liter, 6-cylinder gasoline engine linked to an automatic transmission. Standard equipment included power-assisted front disc/rear drum brakes with ABS, traction control, and power steering. The curb weight was 1,507 kg (3,322 lb). At the time of the crash, the Pontiac had four Mastercraft MC-440 tires of the vehicle manufacturer recommended size 225/50R17. All tires had greater than 3 mm (4/32 in) of tread and were not damaged in the crash.

Figure 7. Left front oblique view of the Pontiac

The Pontiac had seating for five occupants with front-row bucket seats and a three-passenger rear bench seat with a folding back. The driver seat was adjusted in a mid-track position. Its adjustable head restraint was fully down. The front-row right seat was adjusted fully rearward with the head restraints adjusted 5 cm (2.0 in) above the seatback. Manual restraint was provided by 3-point lap and shoulder seat belts for the five seat positions. The front seat belts were equipped with retractor pretensioners. Supplemental restraint was provided by frontal air bags, front-seat back-mounted outboard side impact air bags, and side impact-sensing IC air bags.

Vehicle History

A vehicle history report obtained for this investigation indicated that the Pontiac had four different owners over the course of its lifetime. The first ownership period lasted 2 years and 11 months (March 2008 – February 2011). There were no reported crashes and the Pontiac's odometer reading at the time of sale was 96,173 km (59,761 miles).

The second ownership extended 9 years and 1 month (March 2011 – April 2020). There were four reported crashes during the period.

- December 2012 – Minor frontal crash with an animal. No air bag deployment.
- January 2013 – Utility pole crash, right front and right plane damage. Vehicle was towed. No air bag deployment.
- February 2013 – Left side damage in vehicle-to-vehicle crash. No air bag deployment.
- November 2015 – Minor frontal damage without air bag deployment.

A vehicle service conducted by a Chevrolet dealership in December 2013 reported a complete maintenance inspection including an oil/filter change, fuel system check, and air bag system check.

A used car dealer took ownership of the Pontiac in May 2020 with a reported mileage of 312,207 km (194,002 miles). In the later part of May 2020, the driver purchased the Pontiac with a reported odometer reading of 312,344 km (194,087 miles).

NHTSA Recalls and Investigations

At the time of the November 2020 inspection and at the time of this September 2022 report, a query of the NHTSA recall database https://www.nhtsa.gov/recalls indicated that there were no unrepaired recalls for the 2008 Pontiac G6 involved in this investigation; there were no open investigations.

Exterior Damage

The Pontiac sustained direct contact damage to the left, right, front, and undercarriage planes during the multiple event crash sequence. The highest severity impact was the Event 1 left plane impact to the 36 cm (14.2 in) tree (Figure 8). The direct contact damage began on the mid-aspect of the left front door and extended rearward 108 cm (42.5 in). The combined width of the direct and induced damage measured 310 cm (122.0 in). This field L began 49 cm (19.3 in) aft of the left front axle and extended rearward. The maximum crush was 29 cm (11.4 in) located at the mid-aspect of the left rear door, 233 cm (91.7 in) aft of the left front axle. The residual crush profile was as follows: C1 = 13 cm (5.1 in), C2 = 26 cm (10.2 in), C3 = 29 cm (11.4 in), C4 = 12 cm (4.7 in), C5 = 3 cm (1.2 in), C6 = 0. Both left doors were jammed shut in the impact. The left front, left rear and backlight glazing disintegrated during this event. The collision deformation classification (CDC) assigned to the damage pattern was 10LZAW3, with a PDOF of 310 degrees.

Figure 8. Overhead view of the Pontiac's left plane deformation

The damage algorithm of the WinSMASH program was used to calculate the severity of the impact. The calculated total delta V was 33 km/h (21 mph). The longitudinal and lateral components were -21 km/h (-13 mph) and 25 (16 mph), respectively. Analysis of the crash fit the parameters of the WinSMASH program; however, based on SCI field experience the results were considered low, underestimating the severity of the impact.

The Pontiac rotated counterclockwise and the aft-aspect of the right plane struck the 21 cm (8.3 in) diameter tree (Event 2, Figures 9 and 10). The direction of force was in the 3 o'clock sector. The direct contact damage began 38 cm (15.0 in) aft of the rear axle and extended 21 cm (8.3 in) to the right rear bumper corner. The combined width of the direct and induced damage (field L) measured 64 cm (25.2 in). The force of the impact collapsed the trunk space and deformed the end structure to the left. The residual crush profile was as follows: C1 = 44 cm (17.3 in), C2 = 36 cm (14.2 in), C3 = 24 cm (9.4 in), C4 = 16 cm (6.3 in), C5 = 12 cm (4.7 in), C6 = 8 cm (3.1 in). The maximum crush was located at the right rear corner and measured 44 cm (17.3 in). The CDC assigned to the damage pattern was 03RBEN4. The calculated WinSMASH total delta V for this impact was 14 km/h (9 mph) with longitudinal and lateral components of 0 km/h and -14 km/h (-9 mph), respectively. These results were considered low, underestimating the severity of the impact.

Figure 9. Overhead view of the Pontiac's right plane deformation

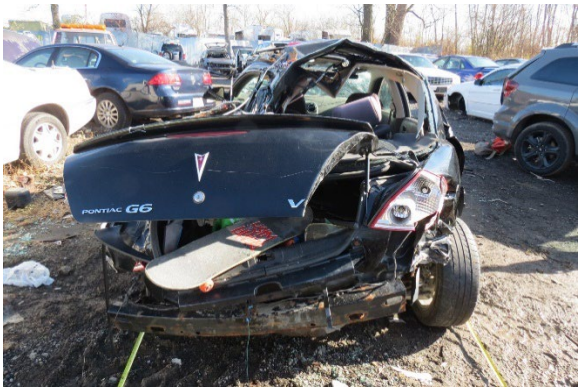


Figure 10. Back plane view of the Pontiac's deformation

The front plane and undercarriage sustained minor severity damage from yielding object impacts with trees (Events 3 and 4) as it rotated to final rest. The front bumper cover separated in the front plane impact. The maximum crush of 6 cm (2.4 in) was measured at the right front bumper corner. There was no deformation of the right frame rail; the direct contact was located at the right front bumper corner. The CDC was 12FREE1. The exhaust system separated and was displaced from the undercarriage as the vehicle overrode a previously downed tree. This damage was observed in the on-scene police photographs. The assigned CDC was 00U99999 (where 9 represents unknown values). Analysis of these two yielding object impacts was beyond the scope of the WinSMASH program.

Event Data Recorder

The Pontiac G6 had a sensing diagnostic control module (SDM) that provided the sensing, diagnostic and control of the Pontiac's supplemental restraint systems. The SDM also had event data recording capabilities. The module was located under the center console and had been removed by the police investigation. The EDR was imaged during the SCI vehicle inspection with version 19.5.3 of the Bosch Crash Data Retrieval software via a direct-to-module connection to the SDM with external 12-volt power. The EDR file reported that no events were recorded. The imaged data file is attached at the end of this report as an appendix and is reported with version 21.5.1 of the CDR software.

Post-inspection, the module was forwarded to NHTSA's Vehicle Research and Test Center (VRTC) for further examination. VRTC examined the EDR and forwarded this reply: "We took possession of the module only to preserve it in case there was any future need. We already knew it was able to be downloaded, ruling out electrical overstress (EOS). We checked it again for good measure and it still shows as operable with no stored files."

Interior Damage

Interior damage to the Pontiac consisted of the intrusion of multiple components to the left occupant compartment and were attributed to the Event 1 tree impact. Refer to the table below. The most severe intrusions were located at the second-row left position. The intruding left rear door contacted and deformed the rear-facing CRS (Figure 11). The CRS compressed into the seat cushion and the door deformed around the left aspect of the CRS. There was no actuation or deployment of any supplemental safety systems.

Row	Intruded Component	Intrusion	Crush Direction
Front-row left	A (A1/A2)-pillar	4 cm (1.6 in)	Lateral
Front-row left	B-pillar	26 cm (10.2 in)	Lateral
Front-row left	Door/rear upper quadrant	20 cm (7.9 in)	Lateral
Front-row left	Front seatback	10 cm (3.8 in)	Lateral
Front-row left	Window frame	10 cm (3.8 in)	Vertical
Second-row left	C-pillar	19 cm (7.5 in)	Lateral
Second-row left	Door/rear upper quadrant	47 cm (18.5 in)	Lateral
Second-row left	Roof side rail	25 cm (9.8 in)	Vertical
Second-row left	Window frame	26 cm (10.2 in)	Vertical
Second-row left	Backlight header	13 cm (5.1 in)	Vertical

Several areas of occupant contact were noted in the front interior and were attributed to the unbelted driver and unbelted front passenger. The driver loaded the steering assembly and displaced the column from the shear capsules. The steering column had dropped down and was resting on the left lower knee bolster (Figure 12). A scuff was noted on the headliner covering the left roof side rail attributed to the driver's face. The right aspect of the windshield was fractured in a star pattern directly forward of the unbelted front passenger. The fracture was attributed to head contact.

Figure 11. Lateral view across the second row of the Pontiac and the CRS in the left position

Figure 12. View of the driver's contact to the steering wheel and left roof side rail

Manual Restraint Systems

The Pontiac had manual 3-point lap and shoulder seat belt systems for the five designated seat positions. The front-row seat belts consisted of continuous loop webbing, sliding latch plate and adjustable D-rings. Both D-rings were adjusted to the full-down positions. The driver seat belt system retracted onto an emergency locking retractor (ELR) while the front right position utilized a switchable ELR/automatic locking retractor (ALR). The front retractors were equipped with pretensioners. At inspection, both seat front seat belts were stowed on their respective retractors and the seat belt retractors were locked. The seat belt webbings would not extend or retract. However, although locked in the stowed position, it was observed that neither webbing was under tension, which is typically found when the retractor pretensioner actuates with stowed webbing. Based on the damaged condition of the vehicle and its pillars, it was likely that the emergency mode of the retractor was activated locking the retractors. The pretensioners likely

were not actuated. Based on the observations of the SCI vehicle inspection, it was determined that neither front seat belt was in use at the time of the crash.

The three seat belts in the second row consisted of continuous loop webbing with sliding latch plates and switchable ALR/ELR retractors. The second-row left seat belt was used to secure the rear-facing CRS, which was still with the vehicle at the time of the SCI inspection (Figure 13). The webbing was routed through the rear-facing belt path of the base. Due to the crash damage and intrusion, the seat belt webbing was not accessible until the seat belt buckle was unlatched and the CRS removed (Figure 14). At inspection, the second-row left retractor was not accessible due to deformation and the webbing could not extend or retract. It was not possible to determine the mode of the switchable retractor. Alternatively, it was possible that the second-row left retractor was locked in emergency mode due to deformation of the left C-pillar.

Figure 13. View of the CRS and intruded left rear door

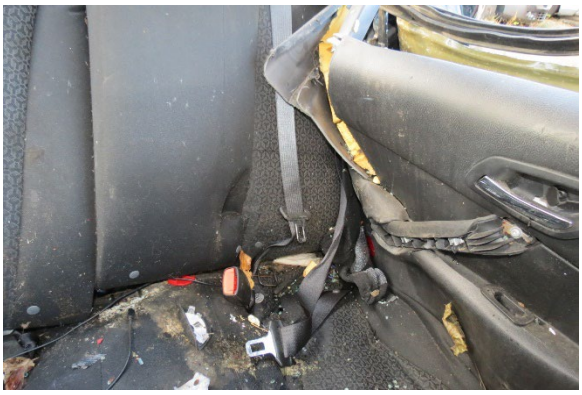


Figure 14. View of the (extended) second-row left seat belt used to secure the CRS. Note that the left position was nearly eliminated by the intruded door.

Supplemental Restraint Systems

The Pontiac had driver and passenger frontal air bags, front-seat-mounted outboard side impact air bags, and side-impact sensing IC air bags. None of air bags deployed in the crash. During the vehicle inspection, the presence of the undeployed left IC was confirmed. The IC air bag was observed at its attachment to the deformed left roof side rail.

Air Bag Non-Deployment Discussion

None of the Pontiac's supplemental restraint systems deployed in the angled side impact crash. From a visual perspective, the barrier equivalent damage to the Pontiac's left plane from the tree impact was moderately severe, suggesting the severity of the crash may have been sufficient to require deployment of the left IC air bag. The Pontiac's IC air bags were designed to deploy independently, deploying during a lateral impact on the struck side of the vehicle. Additionally, the magnitude of the longitudinal component of the 10 o'clock impact may have been sufficient to warrant the deployment of the front air bags.

For comparison, NHTSA Test G50194 was a side impact NCAP test of a 2005 Pontiac G6 (Figure 15). The test vehicle was struck by a crabbed (27 degree) moving deformable barrier at 61.9 km/h (38.5 mph). The maximum lateral crush was 24 cm (9.4 in). The measured maximum longitudinal and lateral delta Vs of the test vehicle were -2.8 km/h (-1.2 mph) and 21.5 km/h (13.3 mph), respectively. In the test, the left front-seat-mounted side impact air bag and the left IC air bag deployed. Subjectively, the test vehicle involved in a lesser severity impact deployed the side impact air bags, yet the Pontiac under investigation involved in what appeared to be a greater severity crash (as compared by WinSMASH) did not deploy air bags.

Figure 15. Post-test image depicting the left side deformation of the 2005 Pontiac G6

Of particular note is the lack of EDR data related to the crash sequence. The EDR did not record any of the events in this crash. A possible power loss to the SDM was investigated. The SDM fuse in the interior fuse block was checked during the SCI inspection and the 10 amp fuse was observed to be intact. The ignition switch of the Pontiac G6 was designed into the face of the instrument panel, right of the steering column (Figure 16) and the switch was in the off-position. The key was missing and not available for the inspection, therefore the fob and any additional weight hanging on the key was not known. The key slot was aligned in the longitudinal direction relative to the vehicle and in this orientation rotation of the key due to the longitudinal deceleration experienced by the vehicle would not be expected. Pre-crash rotation of the key by one of the Pontiac's occupants could not be ruled out as a possibility. The driver stated to the police investigator that the front passenger grabbed the steering wheel during an argument, which caused the vehicle to depart the road.

Although the vehicle had a prior crash history, none of the crashes reportedly involved air bag deployment and a complete air bag system service check was conducted in 2013. The purchase

of the Pontiac two months prior to the crash under SCI investigation suggested that the air bag system was likely operational at the time of its sale. The root cause of the air bag non-deployment was unknown.

Figure 16. Image depicting the ignition switch of the Pontiac

Child Restraint System

The CRS installed in the second-row left position of the Pontiac was an Evenflo Urbini Sonti rear-facing infant seat (model number: 25HB4Y-TLKU, Figure 17) that was manufactured in November 2016. Its construction consisted of a molded polymer shell, a rigid Styrofoam liner and a fabric cover. The CRS was designed for use with or without its detachable base. The base unit was designed with LATCH; however, it was not used. An adjustable carrying handle was mounted to the midpoint of the lateral aspects of the CRS. The CRS handle could be in any position when the vehicle was in motion. Manufacturer specifications listed occupant size was 1.8-15.8 kg (4-35 lb) in weight and less than 81 cm (32 in) in height. The demographics of the 3-month old male occupant were within the recommended weight and height limits of the CRS.

Figure 17. Image of Evenflo CRS

The CRS was designed with an internal 5-point harness system that was adjustable in the shell. According to the police report, the harness was not used to secure the child. At SCI inspection, it was observed that there were four vertical adjustment slots for the shoulder straps. The harness straps were adjusted to the third highest slots. At inspection and initial observation, the chest clip of the harness was adjusted to the top of the straps in a position that rendered it most likely unusable. The right side of the shell intruded/deformed laterally 8 cm (3.1 in) due to contact with

the left rear door of the Pontiac. The styrofoam liner in the shell was completely fractured (Figure 18).

Figure 18. View of the fractured liner in the CRS

2008 Pontiac G6 Occupants

Driver Demographics

Age/sex:	28 years/male
Height:	168 cm (66 in), source - medical record
Weight:	64 kg (141 lb), source - medical record
Eyewear:	None
Seat type:	Forward-facing bucket seat
Seat track position:	Mid-track
Manual restraint usage:	None
Usage source:	SCI vehicle inspection
Air bags:	Frontal, seat-mounted outboard side impact, and IC air bags; none deployed
Alcohol/drug involvement:	Ethanol <0.010 g/dL, positive for cocaine (no level given) (Source: medical records)
Egress from vehicle:	Exited under own power through the right front door
Transport from scene:	Helicopter
Type of medical treatment:	Level 1 trauma center; hospitalized seven days

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Large liver laceration, Grade IV, 7 x 2 cm with 1.3 L of blood in abdomen; large irregular liver hematoma, 9.4 x 8.0 x 8.8 cm	541826.4	Isolated IPC Front - Steering wheel (combination of rim and hub/spoke)	Certain
2	Left 12th rib fracture	450201.1	Isolated Left Door Panel – Left hardware/armrest rear lower quadrant	Possible
3	Periocular ecchymosis	210402.1	Isolated Roof – Roof left side rail	Possible
4	Minor facial abrasions, NFS	210202.1	Isolated Roof – Roof left side rail	Possible
5	Right chest abrasions	410202.1	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
6	Scattered abrasions to right upper extremity	710202.1	Unknown	Unknown
7	Right knee ecchymosis	810402.1	Isolated Front - Left lower instrument panel (includes knee bolster)	Certain

Source: hospital records

Driver Kinematics

The unbelted driver was seated in an upright posture with the driver seat adjusted to a mid-track position. The driver stated to the police investigator that the front passenger grabbed the steering wheel during an argument, which caused the vehicle to depart the road. At impact, the driver responded to the 10'clock direction of the impact force with a forward and left trajectory. The driver's lower extremities contacted the lower left instrument panel (knee bolster) and his abdomen and chest contacted the steering wheel rim. The driver loaded the steering wheel rim, displacing the column from the shear capsules. This loading resulted in the Grade IV liver laceration. The driver's left flank contacted the left door/arm rest resulting a fracture of the left 12th rib. His face scuffed the headliner at the left roof side rail, resulting in the identified soft tissue injuries.

The driver rebounded back into his seat as the vehicle came to final rest. He was able to exit the vehicle through the right front door. He was found on the ground by the first responders and transported to a trauma center by helicopter where he was hospitalized for 7 days.

Front-Row Right Passenger

Age/sex:	18 years/female
Height:	157 cm (62 in), source - interview
Weight:	54 kg (120 lb), source - interview
Eyewear:	None
Seat type:	Forward-facing bucket seat
Seat track position:	Full rear
Manual restraint usage:	None
Usage source:	SCI vehicle inspection
Air bags:	Frontal, seat-mounted outboard side impact, and IC air bags; none deployed
Egress from vehicle:	Exited under own power through the right front door
Transport from scene:	Helicopter
Type of medical treatment:	Level 1 trauma center; hospitalized 1 day

Front-Row Right Passenger Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Minimally displaced, comminuted tuft fracture of left 4th finger	752653.1	Isolated Front - Right instrument panel	Possible
2	Closed fractures of front incisors, right and left, upper and lower	251404.1	Isolated Front - Windshield	Certain
3	Abrasions to forehead, NFS	210202.1	Isolated Front - Windshield	Certain
4	Abrasions to cheek, NFS	210202.1	Isolated Front - Windshield	Certain
5	Contusion to left chest	410402.1	Isolated Front - Right instrument panel	Probable
6	Contusion to abdomen, NFS	510402.1	Isolated Front - Right instrument panel	Probable
7	Abrasions to abdomen, NFS	510202.1	Isolated Front - Right instrument panel	Probable
8	Laceration to left 4th finger	710602.1	Isolated Front - Right instrument panel	Possible
9	Abrasions to left hand	710202.1	Isolated Front - Right instrument panel	Possible
10	Right elbow contusion	710402.1	Isolated Right Door Panel – Right door panel unknown/multiple quadrant	Probable
11	Left elbow contusion	710402.1	Unknown	Unknown
12	Right elbow abrasion	710202.1	Isolated Right Door Panel – Right door panel unknown/multiple quadrant	Probable
13	Left elbow abrasion	710202.1	Unknown	Unknown
14	Left knee contusion	810402.1	Isolated Front - Right lower instrument panel	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
	Left knee contusion (cont.)		(includes knee bolster)	
15	Left knee abrasion	810202.1	Isolated Front - Right lower instrument panel (includes knee bolster)	Probable
16	Bruising over right tibia	810402.1	Isolated Front - Right lower instrument panel (includes knee bolster)	Certain

Source: hospital records

Front-Row Right Passenger Kinematics

The unbelted female right passenger was seated in an unknown posture with her seat adjusted to the full-rear position. The driver stated to the police investigator that the front passenger grabbed the steering wheel during an argument, which caused the vehicle to depart the road. At impact, she initiated a forward and left trajectory in response to the 10 o'clock direction of the impact force. She slid forward on her seat and contacted the right instrument panel with her torso and lower extremities, sustaining soft tissue injuries. Her face/head struck the windshield resulting in a tooth fracture and forehead abrasion.

She rebounded back into her seat when the vehicle came to rest and exited through the right front door. She was transported to a trauma center by helicopter and was treated. She discharged herself against medical advice 11 hours after the crash.

Second-Row Left Passenger

Age/sex:	3 months/male
Height:	54 cm (21 in), source – coroner report
Weight:	5 kg (11 lb), source – coroner report
Eyewear:	None
Seat type:	Rear-facing CRS secured to a bench seat
Seat track position:	Not adjustable
Manual restraint usage:	Lap and shoulder belt used to secure the CRS
Usage source:	SCI vehicle inspection
Air bags:	IC air bag; not deployed
Egress from vehicle:	Fully ejected
Transport from scene:	Helicopter
Type of medical treatment:	None, fatally injured

Second-Row Left Passenger Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Partial transection of brainstem and the pons-midbrain junction	140218.6	Isolated IPC Other Vehicle or Object - Ground	Probable
2	Uncal herniation	140202.5	Isolated IPC Other Vehicle or Object - Ground	Probable
3	Extensive subdural hematoma overlying convexities	140656.5	Isolated IPC Other Vehicle or Object - Ground	Probable
4	Diffuse subarachnoid hemorrhage	140693.2	Isolated IPC Other Vehicle or Object - Ground	Probable
5	Intraventricular hemorrhage layering within lateral ventricles, filling the third ventricles and perimesencephalic cistern, and within the fourth ventricle	140678.2	Isolated IPC Other Vehicle or Object - Ground	Probable
6	Global cerebral edema with complete loss of gray-white differentiation and global effacement of the sulci	140668.3	Isolated IPC Other Vehicle or Object - Ground	Probable
7	Left temporal parenchymal hemorrhagic contusion	140602.3	Isolated IPC Other Vehicle or Object - Ground	Probable
8	Large diastatic left and right parietal skull fracture; mildly comminuted left; comminuted complex right	150404.3	Isolated IPC Other Vehicle or Object - Ground	Probable
9	Left temporal skull fracture	150402.2	Isolated IPC Other Vehicle or Object - Ground	Probable
10	Right temporal skull fracture	150402.2	Isolated IPC Other Vehicle or Object - Ground	Probable
11	Diffuse subgaleal hemorrhage, left (greater than right side)	110403.2	Isolated Other Vehicle or Object - Ground	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
12	Diffuse subgaleal hemorrhage, right	110403.2	Isolated Other Vehicle or Object - Ground	Probable
13	Left mid/distal clavicular shaft fracture	750621.2	Isolated Other Vehicle or Object - Ground	Probable
14	Comminuted right mid tibial diaphyseal fracture with approximately 14 degrees apex dorsal/posterior angulation	854271.2	Isolated IPC Other Vehicle or Object - Ground	Probable
15	Non-displaced right distal fibular shaft fracture	854471.2	Isolated Other Vehicle or Object - Ground	Probable
16	Multiple abrasions, 1/8 – 7/8 in left parietal and temporal scalp	110202.1	Isolated Other Vehicle or Object - Ground	Probable
17	Right scalp abrasions	110202.1	Isolated Other Vehicle or Object - Ground	Probable
18	Linear abrasion, 7/8 in to right forehead	210202.1	Isolated Other Vehicle or Object - Ground	Probable
19	Scattered abrasions over neck	310202.1	Isolated Other Vehicle or Object - Ground	Probable
20	Ecchymosis over entire left back	410402.1	Isolated Other Vehicle or Object - Ground	Probable
21	Multiple abrasions involving lower back, 1/8 – ¾ in	410202.1	Isolated Other Vehicle or Object - Ground	Probable
22	Abrasions to penis	543099.1	Isolated Other Vehicle or Object - Ground	Probable
23	Left shoulder contusion	710402.1	Isolated Other Vehicle or Object - Ground	Probable
24	Left elbow (5/8 in) and antecubital abrasions (1/2 in)	710202.1	Isolated Other Vehicle or Object - Ground	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
25	Ecchymosis over left buttock	810402.1	Isolated Other Vehicle or Object - Ground	Probable
26	Contusion over right tibia and fibula	810402.1	Isolated Other Vehicle or Object - Ground	Probable
27	Abrasions to posterior right thigh	810202.1	Isolated Other Vehicle or Object - Ground	Probable
28	Abrasions to right lower leg	810202.1	Isolated Other Vehicle or Object - Ground	Probable
29	Abrasions to lateral left knee	810202.1	Isolated Other Vehicle or Object - Ground	Probable

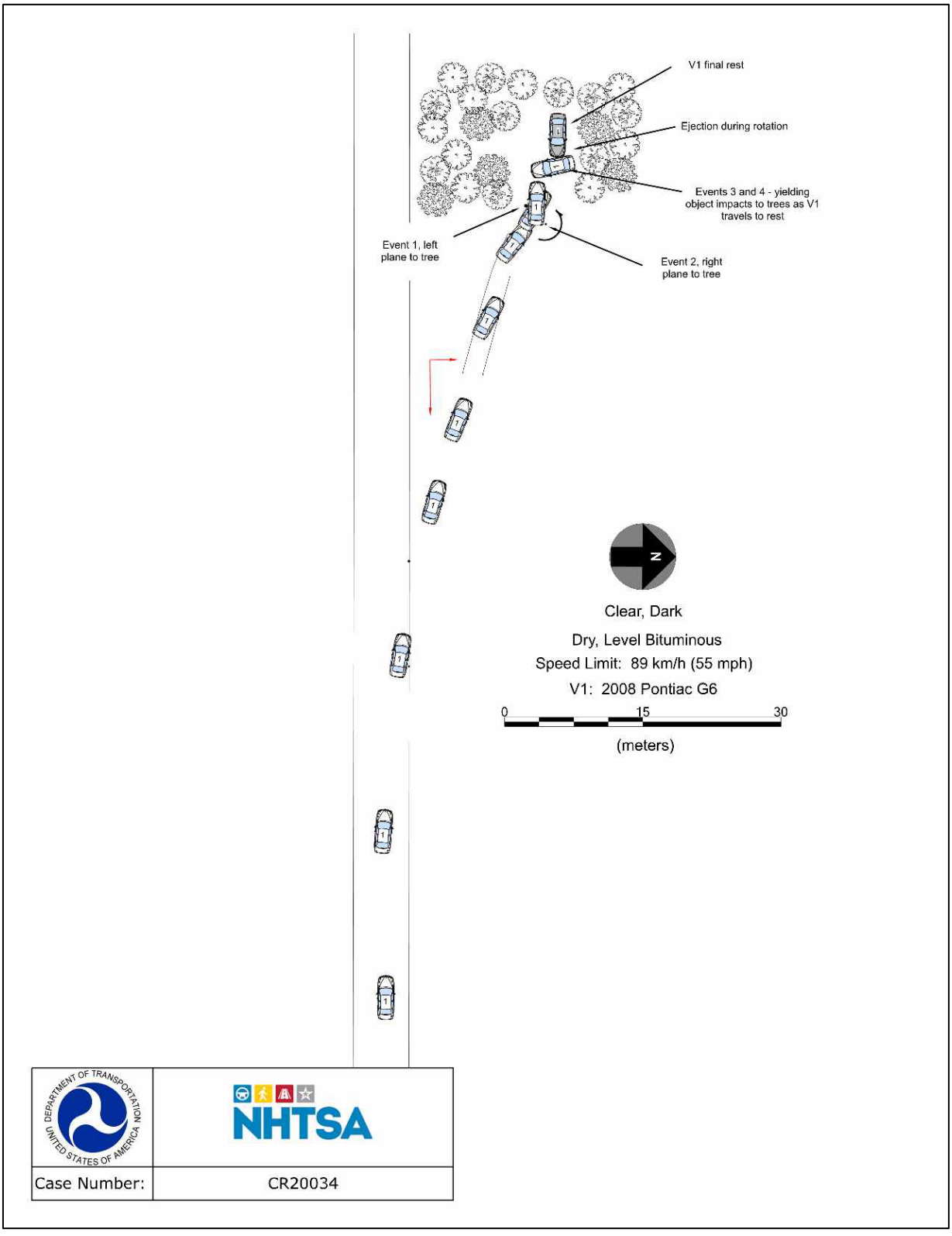
Source: hospital records and coroner's report (internal)

Second-Row Left Passenger Kinematics

The 3-month-old male infant was seated in a rear-facing manner in the CRS. According to the police report, he was not secured in the carrier shell; the harness was not used. The infant likely was displaced forward and left (with respect to the vehicle) during the Event 1 tree impact loading the back and right surfaces of the CRS shell. The right side of the rear-facing shell compressed laterally due to contact from the intruding left rear door. It is possible the infant was injured during this event; however, these injuries would likely be masked by the injuries sustained during the ejection due to its severity.

As the Pontiac rotated counterclockwise about the first tree impact, its right rear corner struck the second tree and deformed. The infant responded to the 3 o'clock direction of force and the centripetal force of the rotation with a rightward and upward trajectory. He was ejected through the backlight opening and the infant struck the ground likely sustaining the identified injuries. His ejected location was not documented by the police. The infant was transported by helicopter to a regional trauma center and was pronounced deceased.

Crash Diagram



Appendix A: 2009 Pontiac G6 Event Data Recorder Report[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	1G2ZG57NX84******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR20034_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 19.5.3
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 21.5.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	None

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

Hexadecimal Data

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$DB  00 00
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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.

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January 2023

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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