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Special Crash Investigations On-Site Child Restraint System Crash Investigation Vehicle: 2009 Pontiac G6 Location: California Crash Date: September 2016

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15. Supplementary Notes

On-site Child Restraint System investigation involving a 2009 Pontiac G6.

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.

16. Abstract

This report documents the investigation of a child restraint system (CRS) used by a 2-year-old male occupant of a 2009 Pontiac G6 involved in a rollover crash. The crash occurred at 1330 hours in September 2016 on a curved, two-lane, State highway in rural California. The Pontiac was being driven westbound by an unbelted 54-year-old female. The second row was occupied by a 2-year-old male seated in a forward-facing CRS. The vehicle was traveling at an EDR-reported speed of 129 km/h (80 mph) when the driver lost control, struck an embankment, and overturned. As the Pontiac struck the embankment, it began a sharp clockwise rotation, tripped, and then began a left-side-leading rollover. The vehicle rolled six quarter-turns before coming to rest on its roof on the roadway. The driver was partially ejected and fatally injured. The 2-year-old remainedrestrained in the CRS and sustained minor injuries. The Pontiac was towed due to damage.

17. Key Words	18. Distribution Statement
child restraint system, rollover, fatality	Document is available to the public from the National Technical Information Service, www.ntis.gov.

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On-Site Child Restraint System Investigation
Case Number DS16019
Vehicle: 2009 Pontiac G6
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BACKGROUND

This report documents the investigation of a child restraint system (CRS) used by a 2-year-old male occupant of a 2009 Pontiac G6 involved in a rollover crash (**Figure 1**). This crash was identified by a Dynamic Science, Inc., investigator from an online news article. The article was forwarded to the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration in September 2016 and permission was given to pursue the investigation. SCI obtained permission to inspect the Pontiac and CRS and the case was assigned in September 2016. The Pontiac and CRS inspections were completed in October 2016. The Pontiac was supported by the Bosch Crash Data Retrieval system and the vehicle's event data recorder (EDR) was imaged during the inspection.

Figure 1. 2009 Pontiac G6

The crash occurred at 1330 hours in September 2016 on a curved, two-lane, State highway in rural California. The Pontiac was being driven westbound by an unbelted 54-year-old female. The second row was occupied by a 2-year-old male seated in a forward-facing CRS. The vehicle was traveling at an EDR-reported speed of 129 km/h (80 mph) when the driver lost control, struck an embankment, and overturned. The driver was partially ejected and fatally injured. The 2-year-old remained restrained in the CRS and sustained minor injuries. The Pontiac was towed due to damage.

SUMMARY

Crash Site

The crash site was an east/west, two-lane, undivided State roadway (**Figure 2**). The asphalt roadway was initially straight before transitioning to a right curve with a radius of 574 m (1,886 ft). The travel lanes were separated by solid/dashed yellow lines in the straight portion and double yellow lines in the curved portion. The roadway was bordered by white fog lines on either side and steep rising embankments. The roadway was dry at the time of the crash. The posted speed limit was 105

km/h (55 mph) in both directions. The weather at the nearest reporting station was 25.5 degrees C (78 degrees F), 25 percent humidity, 16 km (10 miles) visibility, and the winds were out of the northwest at 26 km/h (16 mph). A crash diagram is attached at the end of this technical report.

Pre-Crash

The Pontiac was traveling westbound at an EDR-reported speed of 129 km/h (80 mph) at -5 seconds prior to algorithm enable (AE) as the vehicle approached a right curve. Witnesses reported that the driver was driving aggressively and had passed these witnesses at a high speed. The vehicle was being driven by an unbelted 54-year-old female. The second row right seat was occupied by a 2-year-old male seated in a forward-facing CRS. From -5.0 to -2.0 seconds prior to AE, the driver was traveling along a straight roadway at 129 km/h (80 mph). As the vehicle entered the curve the driver over-steered to the right, with the left front tire depositing a critical curve yaw mark. The yaw mark measured 31.9 m (104.6 ft) in length with a middle ordinate of 0.8 m (2.6 ft). The calculated speed was 120.2 km/h (74.7 mph) using a friction coefficient of 0.7. The EDR-reported speed at -1 second before impact was 120.7 km/h (74.9 mph). At this time, the vehicle was approximately 33 m (110 ft) from the impact area. The driver did not apply the brakes in an attempt to avoid the crash as indicated by the pre-crash data, which reported the service brake as "Off" during the 5.0 seconds of pre-crash recording. The Pontiac's EDR-reported pre-crash data are presented in the following table.

Figure 2. Westbound travel path

Pontiac's Pre-Crash EDR Data

Time (sec)	Speed km/h (mph)	Engine RPM	Percent Throttle	Brake Switch Circuit State	Accelerator Pedal Position %
-5	128 (80)	2368	40	Off	37
-4	128 (80)	2368	40	Off	37
-3	128 (80)	2368	40	Off	37
-2	128 (80)	2368	39	Off	34
-1	120 (75)	3008	60	Off	71

Crash

As the vehicle departed the roadway on the right, the front plane struck the dirt embankment (**Figure 3**). The EDR reported a maximum longitudinal delta-V of -38.1 km/h (-23.7 mph) at 170 ms and a maximum lateral delta-V of 21.7 km/h (13.5 mph) at 170 ms. The WinSMASH barrier option calculated a total delta-V of 12.0 km/h (7.4 mph). The longitudinal and lateral values were -10.0 km/h (6.2 mph) and 6.0 km/h (3.7 mph), respectively. The WinSMASH results were considered low. The vehicle sustained damage below the bumper that could not be included in the measured crush profile.

Figure 3. Area of embankment impact

The driver's air bag deployed and the seat belt pretensioners actuated during the embankment impact. The Pontiac began a sharp clockwise rotation, tripped, and began a left-side-leading rollover. The vehicle rolled six quarter-turns before coming to rest on its roof on the north roadside facing east (**Figure 4**). The distance from trip to final rest was approximately 55 m (180 ft).

Figure 4. 2009 Pontiac G6, final rest (police photo)

Post-Crash

The driver was partially ejected through the left front driver side window and was fatally injured. Witnesses traveling behind the Pontiac stopped moments after the crash. They checked on the driver of the Pontiac and determined that she was deceased. The witnesses broke the left rear window, unbuckled the CRS harness, and removed the child. Emergency responders arrived on scene shortly after the crash. The driver was declared deceased at 1416 hours by a responding paramedic. The 2-year-old remained restrained in the CRS and sustained police reported "C" (other visible) injuries that included abrasions to the chin and neck. He was transported by a relative to a local hospital where he was treated and released after 3 hours. The Pontiac was towed due to damage.

2009 PONTIAC G6 GT

Description

The 2009 Pontiac G6 was a 4-door sedan identified by the Vehicle Identification Number 1G2ZH57N094xxxxxx. The vehicle was configured with a 3.5-liter, 6-cylinder, gasoline engine, a 4-speed automatic transmission, front-wheel drive, 4-wheel ABS, and power steering. The vehicle manufacturer's recommended tire size was P215/55R17 with a cold pressure of 207 kPa (30 psi). The vehicle was equipped with Fuzion UHP Sport AS P235/45R17 tires for the left rear, right rear, and right front positions, and an Achilles ATR Sport P235/45ZR17 for the left front position. The right front tire was a directional type and had been mounted backwards. If a directional tire is rotating the wrong direction it should only cause a problem with wet (or snow) traction. It should not affect wear, pull, dry traction, ride or any other characteristics. The specific tire information was as follows.

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Tire Flat	3 mm (4/32 in)	No	Debeaded
LR	Tire Flat	3 mm (4/32 in)	No	Debeaded
RR	269 kPa (39 psi)	3 mm (4/32 in)	No	None
RF	Tire Flat	2 mm (3/32 in)	Yes	Debeaded

The Pontiac was configured with seating for five occupants. The front row was equipped with cloth-covered bucket seats with adjustable head restraints. Both front seats were adjusted to the middle track position. The second row was equipped with a bench seat with folding backs with adjustable head restraints at the outboard positions.

Exterior Damage

The Pontiac sustained moderate front plane damage from the impact to the dirt embankment during Event 1 (**Figure 5**). The direct damage began at the right bumper corner and extended 40.0 cm (15.7 in) to the left. The direct damage was also located along the width of the undercarriage and lower radiator. The Field L extended from bumper corner to bumper corner. Twelve measurements were taken at bumper backing bar level by the Nikon Total Station and the Faro Blitz program computed crush measurement in six increments as follows: C_1 = 1.0 cm (0.4 in), C_2 = 0 cm, C_3 = 0 cm, C_4 = 0 cm, C_5 = 1 cm (0.4 in), C_6 = 1 cm (0.4 in). The calculated principal direction of

Figure 5. Frontal damage, 2009 Pontiac G6

force was 330 degrees. The Collision Deformation Classification was 11FDEW1. During the rollover (Event 2), the Pontiac sustained direct damage to the top plane. The damage to the top plane included the hood and roof (**Figure 6**) and extended from roof side rail to roof side rail. The maximum vertical crush was located 23.0 cm (9.0) left of the roof side rail at the mid windshield header and measured 35.0 cm (13.7 in). The CDC was 00TDDO3. The trunk lid was damaged and appeared to have been pried open to access the trunk contents.

Figure 6. Rollover damage, 2009 Pontiac G6

Event Data Recorder (EDR)

The Pontiac was equipped with an air bag supplemental restraint system that had EDR capability to store deployment and non-deployment events. Both types of events can contain pre-crash and crash data. For the pre-crash data there is a 5-second buffer that records vehicle speed, engine speed, percent throttle, brake switch circuit state, accelerator pedal position, and antilock brake system active.

The data from the Pontiac's EDR was imaged using the Bosch Crash Data Retrieval Tool version 17.0 via the Diagnostic Link Connector using vehicle power and reported using version 17.10. A single deployment event was recovered from ignition cycle 12,409.

The first event resulted from the impact with the embankment and the crash record was locked. The maximum longitudinal Delta-V was -38.1 km/h (-23.7 mph). The maximum lateral delta-V was 21.7 km/h (13.5 mph). The Bosch CDR report is included at the end of this report and the EDR-reported data not discussed elsewhere in this report was summarized as follows:

The pre-crash data at -1 seconds from algorithm enable (AE) was as follows:

Vehicle Speed:	120 km/h (75 mph)
Engine Speed (rpm):	3,008
Percent Throttle:	60
Brake Switch Circuit State:	Off
Accelerator Pedal Position (percent):	71
Antilock Brake System Active (if equipped):	Yes

Interior Damage

The Pontiac sustained minor interior damage as a result of intrusions, occupant contacts, and integrity loss. The vehicle sustained vertical intrusions to the front row at the roof, roof side rail, windshield header, and A-pillars; and to the second row at the roof, backlight header, roof, and C-pillar. The left front and second row left doors were jammed shut. The laminated windshield was

holed and the left front, left rear, right, and backlight glazing was disintegrated. Both front seat belts were locked in place by pretensioner actuation. There were scuffs located on the left side glass frame and along the driver's seat back.

Manual Restraint Systems

The front row was equipped with driver and front right passenger lap and shoulder seat belts. The driver's belt was equipped with continuous loop belt webbing, a sliding latch plate, an emergency locking retractor (ELR), and an adjustable upper anchor that was adjusted to the full down position. The front right passenger's seat belt was equipped the same as the driver's, but had a switchable ELR/automatic locking retractor (ALR). The adjustable upper anchor was adjusted to the full down position. The front seat positions were equipped with retractor- mounted seat belt pretensioners which actuated during the crash. Both seat belts were locked in the stored position. The EDR reported that the driver's seat belt was "Buckled." However, based on the vehicle inspection, the police report and witness statements it was determined that the driver's seat belt was not used. The reason for the false reading is not known. The second row was equipped with lap and shoulder seat belts for the three second row seat positions. The outboard seat belts had indications of historical usage. The second row right seat belt was used to secure the CRS. It is not known if the retractor had been switched from ELR to ALR.

Figure 7. Driver's air bag, 2009 Pontiac G6

Supplemental Restraint Systems

The Pontiac's Supplemental Restraint Systems included a sensing diagnostic module, driver's and front passenger's frontal air bags, front row seat back mounted side air bags, and front and second row side impact inflatable curtain (IC) air bags.

Both stages of the driver's frontal air bag deployed from the steering wheel hub during the impact with the dirt embankment (**Figure 7**). The air bag measured 48.0 cm (18.8 in) in width, and was configured with two vent ports and a single tether. There was no damage or contacts to the air bag. The passenger's frontal air bag and both left and right IC air bags did not deploy.

Child Restraint System (CRS)
Safety 1st Alpha Omega Elite Convertible CRS

The Safety 1st Alpha Omega Convertible CRS was a 3-in-1 safety seat being used in a forward- facing orientation (**Figure 8**). It was installed in the second row right position using the vehicle's lap and shoulder belt. The seat had been removed from the vehicle prior to the SCI vehicle inspection.

Figure 8. Safety 1st Alpha Omega Convertible CRS (police photo)

The model number was WCE2B830507 and the date of manufacture was 7/9/2015. The Safety 1st was configured with a 5-point harness system with buckle and retainer clip and two level harness slots (**Figure 9**). The seat was designed to be used with or without the internal harness. The occupant parameters for using the seat forward-facing with the harness are as follows.

- Weight: 22 - 50 lbs (10 - 23 kg)
- Height: 29 - 45 in (74 - 114 cm)
- At least one (1) year old

The child met the age (2 years), weight (13 kg/29 lbs), and height (88 cm/35 in) requirements.

The CRS was installed using the vehicle's lap and shoulder belt routed through the forward- facing belt path. The right arm was locked in the up position and could not be moved. There was no other damage to the CRS.

Figure 9. Safety 1st Alpha Omega Elite CRS

The Pontiac was configured with Lower Anchors and Tethers for CHildren (LATCH) in the second row. All three second row seat positions were equipped with lower anchors and upper tether anchors. LATCH was not used in this crash.

Rollover Mitigation
The NHTSA has given this vehicle model a four start rating on a five star scale with a risk of rollover of 18.5 percent for the front-wheel drive model. The Pontiac's mitigation features consisted

of ABS and traction control. According to the EDR report, the antilock brake system was inactive between -5.0 to -2.0 seconds and went active at -1.0 seconds. The control loss was the result of impact forces associated with the impact to an embankment. As the Pontiac struck the embankment, it began a sharp clockwise rotation, tripped, and then began a left side leading rollover. The vehicle rolled six quarter-turns before coming to rest on its roof on the roadway. The distance from trip to final rest was approximately 55 m (180 ft). The speed range of the vehicle at trip point was calculated to be 71 km/h (44 mph) - 92 km/h (57 mph) based on the distance traveled during the rollover and a deceleration value range of 0.36 - 0.61 g.[1] The calculated elapsed time during the rollover was 4.2 - 5.5 seconds.

NHTSA Recalls and Investigations

The vehicle was subject to NHTSA recall 14V252. GM has determined that over time an increased resistance can develop in the body control module (BCM) connection system and result in voltage fluctuations or intermittency in the brake apply sensor (BAS) circuit that can cause service brake lamp malfunction. As a result, the service brake lamps may illuminate when the service brakes are not being applied, or may not illuminate when the service brakes are being applied. Additionally, cruise control may not engage. It is not known if any notifications were received by the current or previous vehicle owners.

2009 PONTIAC G6 OCCUPANTS

Driver Demographics

Age/Sex:	54 years/female
Height:	170 cm (67 in)
Weight:	63 kg (139 lbs)
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Middle track
Manual restraint usage:	Lap and shoulder seat belt not used
Usage source:	Vehicle inspection, police statement
Air bags:	Driver frontal air bag deployed. Seat-mounted side air bag and IC air bag did not deploy.
Alcohol/drug data:	No alcohol, positive for butalbital and cannabinoids
Egress from vehicle:	Partial ejection
Transport from scene:	None
Type of medical treatment:	None, fatal at scene

[1] Orlowksi, K. R., Moffat, E. A., Bundorf, R. T., & M. P. Holcolm, M. P. (1989). Reconstruction of rollover collisions (SAE Paper No. 890857). Warrendale, PA: Society of Automotive Engineers.

Driver Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Slight subdural and subarchnoid hemorrhage, right frontoparietal region	140693.2	Ground	Probable
2 3	Fracture, atlanto-occipital joint with slight subdural and subarachnoid hemorrhage over base of brain	650216.2 140693.2	Ground	Probable
4	Subgaleal hemorrhage, left parieto-occipital region	110402.1	Ground	Probable
5	Hemorrhage, strap muscle, right neck	310402.1	Unknown	Unknown
6	Contusion, right front chest, 12.7 cm (5.0 in) x 10.1 cm (4.0 in)	410402.1	Unknown	Unknown
7	Abrasions, right side back, 5.0 cm (2.0 in) x 10.1 cm (4.0 in)	410202.1	Seat back	Possible
8	Abrasion, left gluteal region near hip, 15.2 cm (6.0 in) x 7.6 cm (3.0 in)	810202.1	Door panel	Possible
9	Abrasions, left arm (9 x 3 in)	710202.1	Ground	Certain
10	Abrasions, right forearm (11 x 3.5 in)	710202.1	Ground	Certain
11	Abrasion, right hand (3 x 2 in)	710202.1	Ground	Certain
12	Avulsion, left elbow, 12.7 cm (5.0 in) x 10.1 cm (4.0 in)	710800.1	Ground	Certain
13	Abrasion, right face, 15.2 cm (6.0 in) x 12.7 cm (5.0 in)	210202.1	Ground	Probable

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
14	Laceration, right face, 3.8 cm (1.5 in) x 1.2 cm (0.5 in)	210600.1	Flying glass	Possible
15	Abrasion, right neck	310202.1	Unknown	Unknown
16	Abrasion, linear, front of chest near neck extending from right clavicle to the left clavicle	410202.1	Driver air bag	Possible
17	Laceration, right ear	210600.1	Flying glass	Possible
18	Abrasion, left knee	810202.1	Left instrument panel	Possible

Source: Autopsy report

Driver Kinematics

The 54-year-old female driver was unbelted and seated in an unknown posture. As the vehicle entered the curve, the driver over-steered to the right. The vehicle began a slight clockwise yaw. At impact with the embankment, the driver was displaced forward and to the left and possibly contacted the deployed air bag with her left chest and the instrument panel with her left knee. As the vehicle tripped, the driver was displaced to the left. During the rollover sequence, the driver was displaced in multiple directions and contacted the seat back and door panel. Flying glass fragments caused lacerations to her face and ear. Her left arm and head were partially ejected through the left front driver window and contacted the ground. She came to rest in the driver seat area. The first passerby arrived on scene moments after the crash and noted that she did not have a pulse at that time.

Second Row Right Occupant Demographics

Age/Sex:	2 years/male
Height:	89 cm (35 in)
Weight:	13 kg (29 lbs)
Eyewear:	None
Seat type:	Bench
Seat track position:	NA
Manual restraint usage:	Lap and shoulder seat belt used to secure
CRS Usage source:	Vehicle inspection
Air bags:	IC air bag did not deploy
Alcohol/Drug Data:	NA
Egress from vehicle:	Removed by witnesses through left rear window
Transport from scene:	Relative
Type of medical treatment:	Transported, treated and released

Second Row Right Occupant Injuries

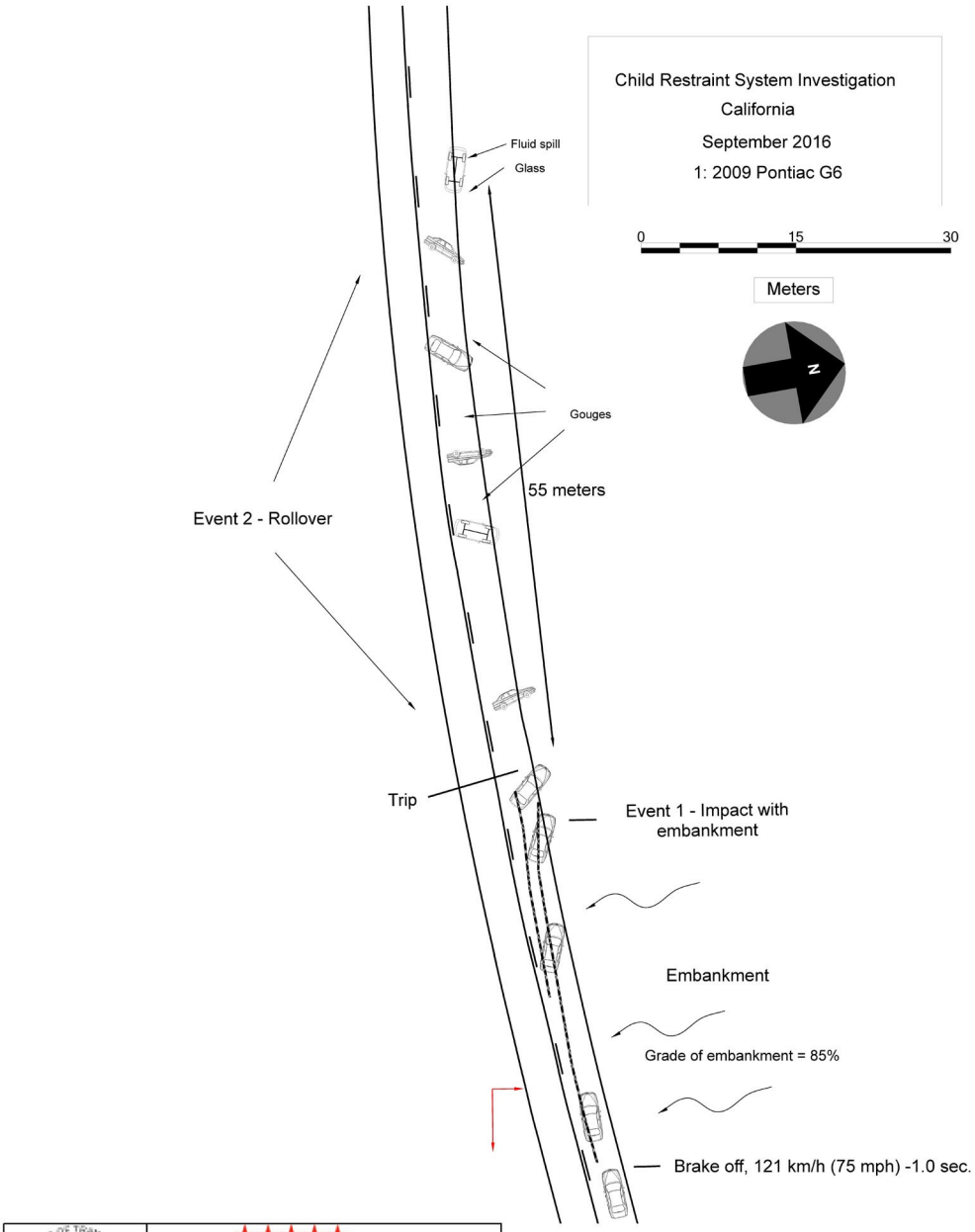
Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Abrasions, chin	210202.1	CRS harness	Probable
2	Abrasions, right upper chest	410202.1	CRS harness	Certain

Source: Emergency room records, radiology reports

Second Row Right Occupant Kinematics

The 2-year-old male second row right occupant was seated forward-facing in a Safety 1st Alpha Omega Elite Convertible CRS and was using the 5-point internal harness. The CRS was secured to the vehicle using the vehicle's lap and shoulder seat belt. At impact with the embankment, the child was displaced slightly forward and to the left but remained restrained by the internal harness. As the vehicle began a clockwise rotation, he was displaced to the left and then was displaced in multiple directions during the left side leading rollover. He remained restrained throughout the crash sequence. Witnesses broke out the left rear window with a rock. They unbuckled the CRS harness and removed the child. He was then transported to a local hospital by a relative.

CRASH DIAGRAM



	NHTSA www.nhtsa.gov
Case Number:	DS16019

APPENDIX A:
EVENT DATA RECORDER REPORT 2009 PONTIAC G6[2]

[2] 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	1G2ZH57N094******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	16019_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.0
Imaged with Software Licensed to (Company Name)	Company Name information was removed when this file was saved without VIN sequence number
Reported with CDR version	Crash Data Retrieval Tool 17.10
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event may contain Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event 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.

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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	**2ZH57N*9*******
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)	Fourth Gear
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)	77
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

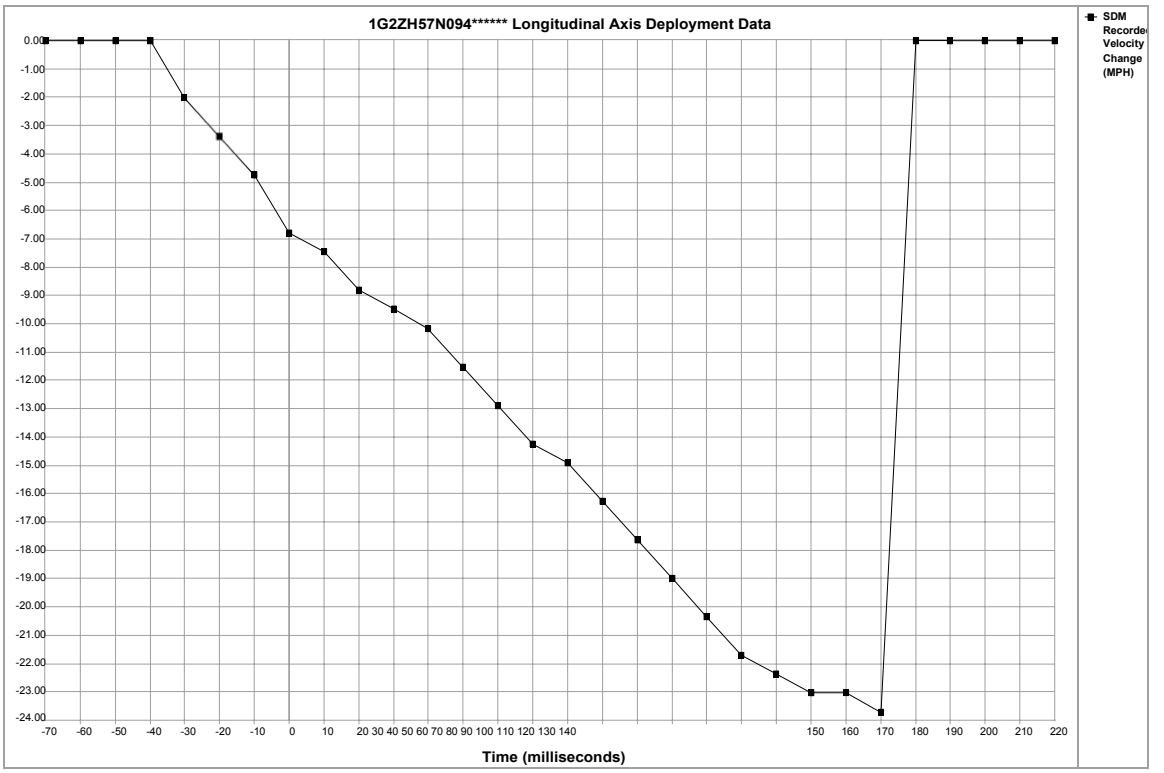
Pre-Crash Data

Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Vehicle Speed (MPH)	80	80	80	80	75
Engine Speed (RPM)	2368	2368	2368	2368	3008
Percent Throttle	40	40	40	39	60
Brake Switch Circuit State	OFF	OFF	OFF	OFF	OFF
Accelerator Pedal Position (percent)	37	37	37	34	71
Antilock Brake System Active (If Equipped)	No	No	No	No	Yes
Lateral Acceleration (feet/s²)(If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Yaw Rate (degrees per second) (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

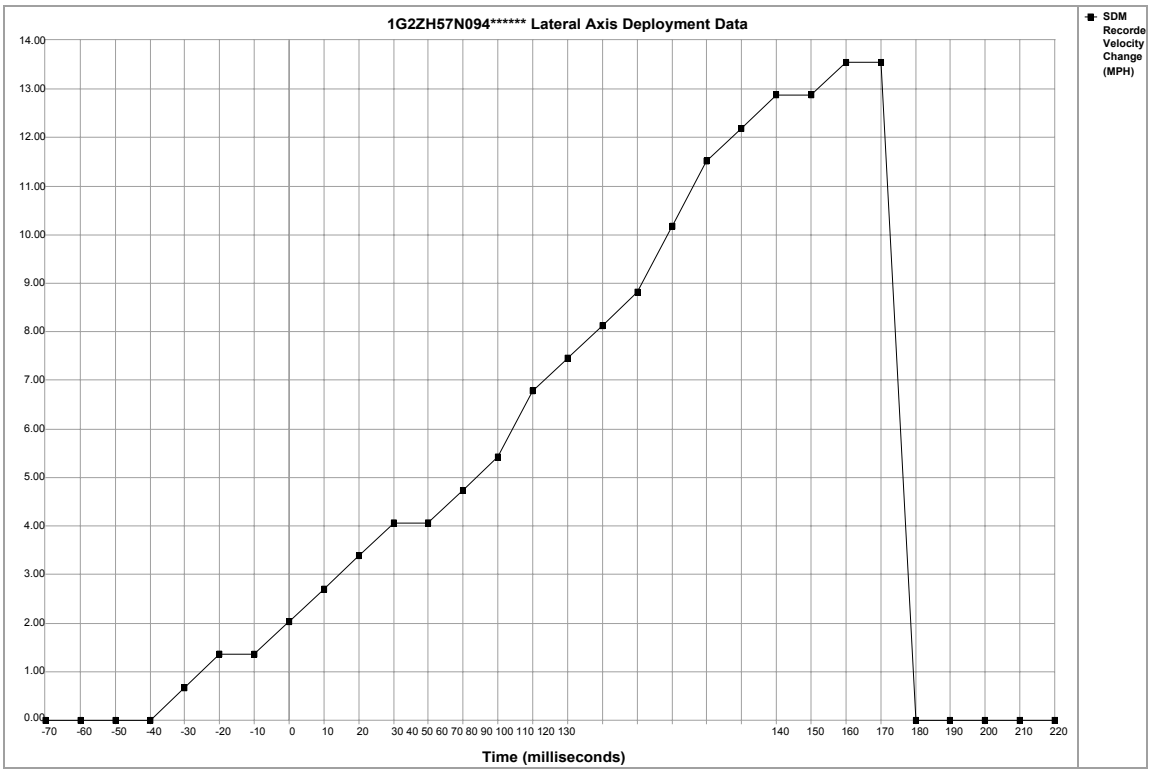
Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Steering Wheel Angle (degrees) (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Vehicle Dynamics Control Active (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

System Status At Deployment

Ignition Cycles At Investigation	12409
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time (seconds)	655200
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	3450
Ignition Cycles At Event	12409
Ignition Cycles Since DTCs Were Last Cleared	254
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Belt Switch Circuit Status (If Equipped)	UNBUCKLED
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
Automatic Passenger SIR Suppression System Validity Status at AE	Valid
Automatic Passenger SIR Suppression System Status at AE	Air Bag Suppressed
Automatic Passenger SIR Suppression System Validity Status at First Deployment Command	Valid
Automatic Passenger SIR Suppression System Status at First Deployment Command	Air Bag Suppressed
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	46
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	146
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Driver Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Time Between Events (sec)	N/A
Driver First Stage Deployment Loop Commanded	Yes
Driver Second Stage Deployment Loop Commanded	Yes
Driver Side Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop Commanded	Yes
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Driver Knee Deployment Loop Commanded	No
Passenger First Stage Deployment Loop Commanded	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Passenger Pretensioner Deployment Loop Commanded	Yes
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded	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
Driver 2nd Stage Deployment Loop Commanded for Disposal	Yes
Passenger 2nd Stage Deployment Loop Commanded for Disposal	No
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Event Recording Complete	Yes



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	-2.03	-3.39	-4.74	-6.78	-7.45	-8.81	-9.49	-10.17	-11.52	-12.88	-14.23
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-14.91	-16.26	-17.62	-18.98	-20.33	-21.69	-22.36	-23.04	-23.04	-23.72	0.00	0.00	0.00	0.00	0.00



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.68	1.36	1.36	2.03	2.71	3.39	4.07	4.07	4.74	5.42	6.78
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Lateral Axis Recorded Velocity Change (MPH)	7.45	8.13	8.81	10.17	11.52	12.20	12.88	12.88	13.55	13.55	0.00	0.00	0.00	0.00	0.00

Hexadecimal Data

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$05	00	00	00	00	00	00	00
$06	00	09	00	00	09	92	21
$07	00	29	00	00	00	00	00
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$0B	00	00	04	0F	00	00	00
$0C	80	00	80	00	00	00	00
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$11	30	39	34	31	36	31	34
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$2B	00	00	00	00	00	00	00
$2D	00	00	00	00	00	00	00
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$3E	39	FF	FF	FF	00	00	00
$3F	00	00	90	00	00	00	00
$40	00	00	00	00	00	00	00
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$42	80	FF	FF	FF	FF	00	00
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$45   FF FF FF FF FF FF 00
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$0D   41 48 31 30 39 37 52 30 30 45 43 38 37 43 31 36
$0E   3F 0A 00 00
$0F   41 4A 31 30 39 37 52 30 30 31 43 33 33 43 39 36
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$13   42 52 39 32 30 37 4A 31 38 32 30 30 34 30 31 47
$14   16 46 3D 35
$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 2D E9 0C E4
$22   92 21
$23   32 5A FA FA FA FA FA
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$25   32 5A FA FA FA FA FA
$26   32 5A FA FA FA FA FA
$40   00 00
$41   FF 30 00 66 00 1A
$42   D0 E4
$43   00 00 8E 80
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$46   00 0F 0F 64 64
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$48   18 08 08
$B0   58
$B1   FD FE 00
$B2   FF FF FF FF FF
$B4   41 53 39 32 32 31 32 31 35 31 57 31 20 20 20 20
$B7   50 AA 01 02 07
$B8   44 45 84 01 11
$C1   30 32 30 37
$CA   30 32 30 37
$CB   00 E8 D6 55
$CC   00 E8 D6 55
$D1   00 00
$DB   00 00
$DC   00 00
```

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**National Highway
Traffic Safety
Administration**

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