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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 report documents the onsite investigation of the non-deployment of the driver frontal air bag in a 2013 Chevrolet Impala involved in a road departure/fixed object crash. The Chevrolet, which was driven by an unbelted 28-year-old male, struck a W-beam guardrail that bordered the southeast quadrant of a four-leg intersection with its front plane. The southbound Chevrolet exited an interstate, traveling along an exit ramp immediately prior to the crash. The vehicle then passed through a four-leg intersection (located at the end of the ramp) and struck the face of the guardrail bordering the opposite roadside. The unbelted driver sustained police-reported A-level (incapacitating) injuries and was transported to a regional trauma center, where he was admitted for 33 days.

After the reconstruction and analysis of this crash, it has been theorized that the most probable causative factor of air bag non-deployment was the rotation of the ignition switch to the accessory position, which removed 12-volt electrical power to the driver air bag module immediately prior to the impact. However, the Chevrolet's EDR did not have the capacity to record or report the position of the ignition switch. The longitudinal severity of the impact (delta V) recorded by the vehicle's Event Data Recorder (EDR) was -89 km/h (-55 mph).

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On-Site Driver's Frontal Air Bag Non-Deployment Investigation
Office of Defects Investigation
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Background

This report documents the onsite investigation of the non-deployment of the driver frontal air bag in a 2013 Chevrolet Impala (Figure 1) in a road departure/fixed object crash. The Chevrolet, which was driven by an unbelted 28-year-old male, struck a W-beam guardrail that bordered the southeast quadrant of a four-leg intersection with its front plane. The southbound Chevrolet exited an interstate, traveling along an exit ramp immediately prior to the crash. The vehicle then passed through a four-leg intersection (located at the end of the ramp) and struck the face of the guardrail bordering the opposite roadside. The unbelted driver sustained police-reported A-level (incapacitating) injuries and was transported to a regional trauma center, where he was admitted for 33 days.

Figure 1. On-scene police image of the Chevrolet at its final rest position

The crash was reported to the National Highway Traffic Safety Administration by the investigating police officer. The notification was forwarded to NHTSA's Crash Investigation Division (CID), and an on-site investigation was assigned to the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., in February 2017. The SCI team established cooperation with the police and conducted an on-site investigation in February 2017. The on-site activities included exterior and interior inspections of the Chevrolet to measure the deformation and intrusion, to document the evidence of interior occupant contact, and to examine the manual and supplemental restraint systems and the potential causes of the air bag non-deployment. Data were imaged from the Chevrolet's EDR using the Bosch Crash Data Retrieval software and tool during the SCI vehicle inspection process. The crash site was photographed and mapped using a total station for causative factors.

After the reconstruction and analysis of this crash, it has been theorized that the most probable causative factor of air bag non-deployment was the rotation of the ignition switch to the "Accessory" position, which removed 12-volt electrical power to the driver air bag module immediately prior to the impact. However, the Chevrolet's EDR did not have the capacity to record or report the position of the ignition switch. The longitudinal severity of the impact (delta V) recorded by the vehicle's EDR was -89 km/h (-55 mph).

Summary

Crash Site

This single-vehicle, multi-event crash occurred on the morning of January 2017 at a four-leg intersection formed by a one-way southbound interstate exit ramp and a three-lane east/west trafficway. The police-reported environmental conditions at the time of the crash were daylight, cloudy skies with snow, and wet roads. The National Weather Service reported a temperature of -1 ºC (30.2 ºF), a relative humidity of 80 percent, 20.4 km/h (12.7 mph) westerly winds, and mostly cloudy skies.

The physical environment of the crash site was documented during the SCI inspection using a Nikon Nivo 5.M+ total station. At the intersection, the southbound one-way exit ramp consisted of two 4.6 m (15.1 ft) wide lanes. The right lane was designated for straight and right-turning traffic, and the left lane was designated for left-turning traffic. There was a 2.3 percent positive grade at the stop bar. The advisory speed limit on the exit ramp was 64 km/h (40 mph). The west leg of the intersecting trafficway consisted of two eastbound lanes and one westbound lane. The total width of each eastbound lane measured 3.6 m (11.8 ft). The width of the westbound lane measured 3.6 m (11.8 ft). The opposing lanes were separated by a 4.3 m (14.1 ft) wide raised concrete median. The median was raised 15 cm (6.0 in) and had a tapered edge. A sign post and delineator located in the median were struck by the vehicle as it crossed the divider. The travel lanes were bordered by a 2.4 m (7.9 ft) wide shoulders. W-beam guardrails bordered the pavement edges at the northeast, southeast, and southwest intersection quadrants. The southwest guardrail was the point of impact. The traffic flow through the intersection was regulated by overhead traffic signals mounted on non-breakway poles. Figure 2 is a lookback to the north along the exit ramp. Figure 3 is a southbound trajectory view along the path of the Chevrolet.

Figure 2. Lookback view (north) along the Chevrolet's path 90 m (300 ft) from the guardrail impact

Figure 3. South trajectory view of the Chevrolet 90 m (300 ft) from the guardrail impact

Pre-Crash

The unbelted 28-year-old male driver of the Chevrolet was the sole occupant of the vehicle. The driver maneuvered the vehicle onto the exit ramp from the southbound lanes of the interstate highway and traveled south along the exit ramp.

The reconstructed trajectory of the vehicle determined that it was traveling in the right lane. The EDR-reported speed of the Chevrolet at 5 seconds prior to algorithm enable (AE) was 94 km/h (58 mph). As the vehicle ascended the exit ramp, the driver accelerated the Chevrolet to 102 km/h (63 mph) at 2.5 seconds prior to AE. The SCI crash reconstruction and a time/distance analysis determined that the vehicle was approximately 52 m (169 ft) from the guardrail impact at this time (Figure 4). The EDR recorded an intermittent application of the brake pedal over the next 2.0 seconds. It was probable that the driver attempted an avoidance maneuver as the vehicle reached and then entered the intersection. A crash diagram is included at the end of this report.

Figure 4. Southbound trajectory view of the Chevrolet approximately 60 m (200 ft) from the guardrail impact

Figure 5. Southwest-looking trajectory view of the Chevrolet at the median (Events 1 and 2). The location of the guardrail impact (Event 3) is in the background

Crash

The Chevrolet overran the end of the median that divided the traffic lanes of the intersecting road (Figure 5) at a reconstructed speed of approximately 85 km/h (53 mph). The front plane struck and fractured the sign post located at the center of the median (Event 1). As the vehicle continued forward, the left-exterior mirror struck and was abraded by the polymer delineator (Event 2). Yellow/orange paint transfer to the exterior surface of the mirror's body evidenced the contact. The crash reconstruction timeline determined that these impact events occurred less than one second prior to AE.

The Chevrolet crossed the eastbound traffic lanes and struck the W-beam guardrail protecting the apex of the southwest intersection quadrant (Event 3). The SCI-reconstructed speed of the Chevrolet at impact was approximately 80 km/h (50 mph). This impact speed was consistent with the -89 km/h (-55 mph) EDR-recorded delta V. The EDR-recorded speed of the vehicle 0.5 seconds prior to AE was 54 km/h (34 mph). Through the course of the SCI reconstruction, it was determined that, although this value was measured at the wheel sensor, the value under-reported the speed of the vehicle's center of mass. The discrepancy in the value was due to the fact the brakes were applied and may have been indicative of ABS wheel-lockup on the wet, snow-covered road surface.

The guardrail installation (Figure 6) consisted of the W-beam mounted to 10 x 16 cm (4.0 x 6.0 in) I-beam posts with 19 cm (7.5 in) composite block-outs. The I-beams were embedded in the ground on a 46 cm (18.0 in) nominal spacing. The height at the top of the W-beam measured 72 cm (28.5 in). The length of the direct contact to the guardrail measured 236 cm (93.0 in) as a result of the impact which was distributed across the entire width of the Chevrolet's front plane. The force of the impact deflected eight I-beams posts that supported the guardrail to the southwest. At the center of the deformed guardrail section, the residual deflection measured 39 cm (15.3 in). The I-beam post located at the maximum deflection point contacted the utility pole supporting the traffic lights during the impact. A 4 cm (1.5 in) wide area of the I-beam flange was deformed by this contact and is highlighted by the arrow in Figure 7. The damaged flange indicated that the maximum dynamic deformation of the guardrail was an estimated 56 cm (22.0 in). The driver air bag did not deploy as a result of the impact.

Figure 6. Southwest-facing trajectory view of the damaged guardrail

Figure 7. Close-up view of the deformed guardrail and the evidence of contact between the I-beam post and the pole (highlighted by the arrow)

Post-Crash

The Chevrolet rebounded from the impact and came to rest near the guardrail. A witness to the crash, who was stopped in a non-contact vehicle on the eastbound lane at the traffic light, exited her vehicle and approached the Chevrolet. She reported to the police that she initially thought that the vehicle was driverless as it crossed her path. This statement was indicative that prior to the impact, the driver may have been out of position. The witness opened the right-front door and found the driver pinned under the instrument panel. He was semi-conscious and incoherent. The witness then called the emergency response system as another passerby came to assist at the scene.

A small fire developed in the engine compartment of the Chevrolet (Event 4). Several additional people with fire extinguishers stopped to help and initially dampened the fire. Then, the police, fire personnel, and emergency medical services (EMS) arrived. In total, five fire extinguishers were used to suppress the fire.

The driver was removed from the vehicle by EMS and transported by ambulance to a regional trauma center. He was admitted into the intensive care unit for the treatment of police-reported

incapacitating (A-level) injuries, and he was hospitalized for 33 days. The Chevrolet was removed from the crash site by a local tow service, then stored at their premises pending the completion of the police and subsequent SCI investigations.

2013 Chevrolet Impala

Description

The 2013 Chevrolet Impala 4-door sedan (Figure 8), manufactured in August 2012, was identified by vehicle identification number 2G1WD5E38D1xxxxxx. The Chevrolet was equipped with the "police performance package." The powertrain consisted of a 3.6-liter, transverse-mounted, 6-cylinder, gasoline engine linked to a 6-speed automatic transmission with steering-column-mounted shifter. Standard equipment included 4-wheel power-assisted disc brakes with ABS and electronic brakeforce distribution, traction control, and power-assisted speed proportional rack-and-pinion steering. The gross vehicle weight rating for this vehicle was 2,123 kg (4,679 lb) with gross axle weight ratings of 1,157 kg (2,550 lb) front and 966 kg (2,129 lb) rear. At the time of the crash, the Chevrolet was configured with Avalanche X-treme P225/55R17 studded tires on the front axle and all-season radial tires on the rear axle. The vehicle manufacturer recommended size was P235/55R17. Specific tire data at the time of the SCI inspection were as follows:

Figure 8. Front view of the Chevrolet Impala

Position	Tire Identification Number	Measured Tread Depth	Restriction	Damage
LF	UR00 HWF XXXX	2 mm (3/32 in)	No	None, suspension fractured
LR	UR00 HWF XXXX	6 mm (8/32 in)	No	None
RR	UR00 HWF XXXX	6 mm (8/32 in)	No	None
RF	UR00 HWF XXXX	3 mm (4/32 in)	Yes	Rim deformed, tire debeaded

The interior of the Chevrolet was configured for seating five occupants with front-row bucket seats and a three-passenger rear bench seat. All seating surfaces were cloth. The head restraints in the front row were adjustable. The driver's head restraint was adjusted 3 cm (1.2 in) above the seat back. Manual restraint was provided by 3-point lap and shoulder safety belts for the five seat positions. Supplemental restraint consisted of certified advanced 208-compliant (CAC) dual-stage driver's and passenger's frontal air bags, front seat-mounted side impact air bags, and roof-side rail-mounted inflatable curtain air bags.

Vehicle History

A vehicle history report indicated that the Chevrolet operated as a police vehicle in Virginia from December 2012 to December 2015. It was sold at auction on December 2, 2015, with an odometer reading of 73,794 km (45,855 miles). The Chevrolet was then registered on January 11, 2016, by the driver. The last reported service for the vehicle was on November 2, 2016, which consisted of an oil and filter change with a reported odometer reading of 125,701 km (78,109 miles). Although there were no reported crashes or service to the air bags in the history report, the driver's wife told the police investigator that the vehicle was involved in a previous minor side-impact crash. However, no air bags were deployed in that crash, and there were no crash-related injuries.

NHTSA Recalls and Investigations

The Chevrolet Impala for model years 2006 to 2014 was subject to NHTSA Recall 14V355. This recall was issued on June 23, 2014, and addressed the potential safety issue where the ignition switch could potentially rotate under certain circumstances if the key ring carried excess weight, which would result in the non-deployment of the air bag systems in the event of a subsequent crash. A VIN-based search of the www.nhtsa.gov/recalls and manufacturer's database for this particular 2013 Chevrolet Impala did not identify any open recalls at the time of this report.

Exterior Damage

Any damage associated to the impact with the sign post (Event 1) was masked by the overlapping guardrail impact. The SCI reconstruction of the crash determined that the left aspect of the front plane struck the sign post. The collision deformation classification assigned to the Chevrolet for the impact to the sign post was 12FLLN1. The Event 2 damage consisted of an orange/yellow paint transfer on the forward surface of the body of the left-exterior mirror (Figure 9). The paint transfer measured approximately 10 cm x 7 cm (4.0 x 3.0 in) length by width. The mirror's height was (40.0 in) above ground level. This damage was consistent with swiping contact with the polymer delineator located in the median. The CDC associated to this damage was 12LPMS1. The guardrail impact (Event 3) damage and direct contact extended across the entire 152 cm (60.0) front plane end width. The bumper fascia fractured during the impact and exposed the reinforcement beam. The hood was removed post-crash and was missing. The extent of crush deformation was biased to the right due to the orientation of the vehicle relative to the curved profile of the guardrail at the point of impact.

Figure 9. Image depicting the swiping abrasion/paint transfer to the left mirror of the Chevrolet (Event 2)

A residual crush profile (Figure 10) was measured along the bumper reinforcement beam using a Field L of 119 cm (47.0 in). It produced the following resultant measurements: C1 = 30 cm (11.8 in), C2 = 38 cm (15.0 in), C3 = 49 cm (19.3 in), C4 = 56 cm (22.0 in), C5 = 59 cm (23.2 in), and C6 = 69 cm (27.1 in). The maximum crush was observed at the right-front corner. The front wheel assembly was displaced rearward into the lower A-pillar shortening the wheelbase 19 cm (7.3 in). The right-front wheel rim was deformed from contact with an I-beam supporting the guardrail. The lower control arm of the left-front suspension fractured at the frame, and the wheel assembly was only attached by its upper strut. The left drive shaft had separated from the transmission. The CDC assigned to the guardrail impact (Event 3) damage pattern was 12FDEW4. The WinSMASH program was used to produce a barrier equivalent speed (BES) calculation of the Event 3 impact. The calculated BES was 50 km/h (31 mph). Comparatively, the EDR recorded delta V components were -88 km/h (-55 mph) longitudinal and -12 km/h (-7 mph) lateral.

Figure 10. Overhead view of the Chevrolet's frontal deformation

The minor fire (Event 4) was confined to the engine compartment at the fire wall. The cause of the fire was most likely electrical due to the forward right location of the battery and presence of combustible materials/fuel as a result of the severe impact and deformation.

Event Data Recorder

The Chevrolet Impala was equipped with an air bag control module (ACM) that performed the diagnostic, sensing, and deployment command functions for the vehicle's supplemental restraint systems. This module had EDR capabilities and was fastened to the floor pan under the front-row right seat. The ACM had been removed from this location prior to the SCI inspection by a police investigator who had imaged the module during the course of his investigation. At the time of the SCI inspection, the ACM was lying loose in the center console. The EDR component was imaged with the Bosch CDR tool and software version 17.2 via a direct-to-module connection. Electrical power was supplied from a 120-volt source. The imaged data were later reported using version 19.6, and is included at the end of this report as Appendix A.

The data limitations reported that the EDR was capable of recording two event types, namely non-deployment events and deployment events. A non-deployment event recorded data, did not deploy air bags and required a minimum velocity change (delta V) of 8 km/h (5 mph) for qualification. Pretensioner-only actuation, battery cut-off, and head restraint actuation were considered non-deployment events. The oldest unlocked non-deployment event was overwritten once all three memory locations were full. Locked non-deployment events could not be overwritten.

A non-deployment event that occurred in five seconds of a deployment event became locked and could not be overwritten. Deployment events by definition deployed air bags. The recorded data from a deployment event became locked and could not be overwritten.

This EDR could store three events. A 5-second pre-crash buffer that described various vehicle performance parameters (including vehicle speed, accelerator pedal position, brake status, and engine performance) was recorded for each event record. These performance parameters were recorded asynchronously in 0.5-second intervals.

The imaged data indicated that the Chevrolet's EDR had recognized and recorded one non-deployment event and one deployment event. Event counter data fields in the recording indicated that these were the only recorded events, and the data were completely recorded to memory. The data were imaged on ignition cycle 19,756.

EDR Event Record 1

Event Record 1 was a non-deployment event that occurred on ignition cycle 18,444. Based on the disparity in the number of ignition cycles, this was a historical record not related to the crash under investigation.

EDR Event Record 2

Event Record 2 was a deployment event, recorded by the EDR on ignition cycle 19,756. This record was attributed to SCI Event 3 (guardrail impact). At the time of the event, the driver's safety belt was unbuckled. The front-row right seat was empty, and the passenger's frontal air bag was suppressed. The recorded pre-crash vehicle parameters were as follows on the next page.

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Time seconds	Speed km/h (mph)	Accelerator Pedal % Full	Engine Throttle % Full	Engine rpm	Brake Status
-5	94 (58)	51	75	2,752	Off
-4.5	95 (59)	59	78	3,008	Off
-4	97 (60)	59	79	3,008	Off
-3.5	99 (62)	60	79	3,072	Off
-3	101 (63)	49	76	3,072	Off
-2.5	102 (63)	0	28	2,816	Off
-2	101 (63)	0	21	2,624	On
-1.5	93 (58)	0	18	2,176	On
-1	63 (39) Value underreported	0	15	1,472	Off
-0.5	54 (34) Value underreported	0	16	1,216	On

The maximum recorded longitudinal delta V was -88 km/h (-55 mph) at 146 milliseconds. The maximum recorded lateral delta V was -12 km/h (-7 mph) at 64 milliseconds. Examination of the data trends revealed that the driver was applying the accelerator as the Chevrolet ascended the exit ramp to the intersection. The accelerator was recorded as released 2.5 seconds prior to AE, and then the brakes were intermittently applied over the 2.0 seconds prior to AE. Based on the SCI crash reconstruction, the reported vehicle speed values at the 1.0 and 0.5 second intervals prior to AE underreported the speed of the vehicle's center of mass. The underreporting of the speed values was attributed to probable ABS wheel lockup of the braking vehicle or wheel slip as reported in the Data Limitations. The calculated average deceleration values (speed change) between time steps -1.5, -1.0 and -0.5 were unrealistic for a sedan. The reconstructed impact speed was approximately 48 to 50 mph, particularly in consideration of the -88 km/h (-55 mph) longitudinal delta V.

The event severity status fields indicated that actuation/deployment of the front pretensioners, front air bag stage 1 and front air bag stage 2 were required (Yes). However, the event data page reported no actuation or deployments were commanded. Of significance, the SIR warning lamp was "On" at the time of AE (time zero). The logic of the data fields indicated that status of the lamp was "On" 0.5 seconds before time zero, the lamp was continuously "On" for less than one full second, and the status had changed from "Off" to "On" during the current ignition cycle (19,756). Three Diagnostic Trouble Codes (DTCs) were recorded: B0083-02, B0084-02, and B0052-00. Codes B0083 and B0084 correlated to the left- and right-front crash sensors. The B0052 code indicated that the air bag deployment command was given.

Interior Damage

All the Chevrolet's doors remained closed during the crash and were operational post-crash. The windshield was fractured from the exterior crash force. The glazing of all the side windows and the backlight was intact. The interior damage to the vehicle consisted of component intrusion and occupant contact. The intrusion was biased to the right aspect of the interior. The right aspect of the instrument panel intruded 5 cm (2.0 in). The right toe pan intruded 38 cm (15.0 in). The radio

located in the center aspect of the instrument panel was displaced from its mount and intruded 20 cm (7.9 in). The residue of fire retardant was observed throughout the surfaces of the interior.

The driver seat was located in a full-rear track position and was jammed in position by floor pan deformation. The floor pan deformation extended rearward into the second row. The driver seatback was reclined 30 degrees aft of vertical. The horizontal distance from the center hub of the steering wheel to the seatback measured 69 cm (27.2 in). This distance was measured 51 cm (20.1 in) above the seat bight. The right-half sector of the four-spoke steering wheel rim was deformed forward approximately 3 cm (1.2 in) due to contact and loading from the driver's torso. This loading also completely separated the steering column from the shear capsules. The displaced column had dropped down and was resting on the lower instrument panel.

Figure 11. Left-interior view of the Chevrolet

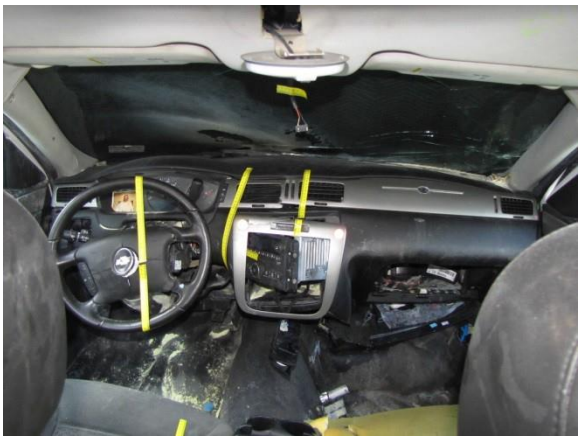


Figure 12. Image depicting the driver interior contact points in the Chevrolet

Figures 11 and 12 are interior views of the Chevrolet. The unbelted driver responded to the crash force with a forward displacement. A 6 cm (2.4 in) long friction abrasion attributed to the driver's buttock was observed on the forward-right aspect of the seat cushion. The abrasion was located 32 cm (12.6 in) forward of the seat bight and 15 cm (5.9 in) right of the centerline of the seat. The forward-right corner of the driver seat was compressed downward approximately 8 cm (3.1 in). The right aspect of the knee bolster was loaded by the driver's lower extremities. The metal backer panel behind the vinyl bolster trim was deformed forward. This contact began 4 cm (1.5 in) right of the bolster's centerline and extended 13 cm (5.1 in) to its right edge. The driver contacted the center aspect of the instrument panel (IP). This contact extended the full height of the IP. The trim and vent louvers were fractured over an 18 cm (7.1 in) wide area. The face plate of the displaced radio was fractured. The center mirror was displaced from its mount, and an isolated crack in the windshield laminate was indicative of a probable head contact.

The seatback of the second-row bench seat was displaced forward by the contents of the trunk. Two tires that were located in the trunk compartment responded to the crash force and loaded the aft aspect of the seatback from behind.

Manual Restraint Systems

The Chevrolet was equipped with manual 3-point lap and shoulder safety belts for the five designated seating positions. The driver's safety belt consisted of continuous loop webbing, a

light-weight locking latch plate, an adjustable D-ring, and an emergency locking retractor. The driver's D-ring was adjusted to the full-down position. The retractor was equipped with a pretensioner. The safety belt was stowed on the retractor at the time of the SCI inspection, and the webbing freely extended at examination. The pretensioner was not actuated. Inspection revealed evidence of historical use; however, this historical use was not attributed to only this driver because the vehicle was purchased used. No crash-related evidence of use was observed on the webbing or the latch plate. Based on these observations, the driver was unbelted at the time of the impact. This determination was in agreement with the EDR.

Supplemental Restraint Systems

The Chevrolet was equipped with six air bags to provide supplemental crash protection in front, side, and rollover crashes. The front air bag system consisted of CAC dual stage driver and passenger frontal air bags. The vehicle was further equipped with front-seat-mounted, side-impact air bags and roof-side rail-mounted, IC air bags. The driver's frontal air bag was housed in the center hub of the four-spoke steering wheel and did not deploy in the crash. Prior to the SCI inspection, the state police also inspected the vehicle. During this inspection, the cover flap was cut open by the investigator to ensure that indeed there was an air bag installed in the module (Figure 13).

Figure 13. Image depicting the presence of the undeployed air bag housed in the driver's frontal air bag module in the Chevrolet

Air Bag Non-Deployment Discussion

The front plane of the Chevrolet struck the W-beam guardrail in a perpendicular orientation. The direct contact damage was distributed across the entire end width of the vehicle and generated a crash force in the 12 o'clock direction. The maximum recorded longitudinal severity of the impact (delta V) was -88 km/h (-55 mph) at 146 milliseconds. The magnitude of this maximum value was in excess of the severity developed during the barrier testing in NHTSA's New Car Assessment Program. A deployment of the driver's frontal air bag (and actuation of the safety belt pretensioner, if in use) was to be expected in this crash.

The imaged-EDR data indicated that the status of the air bag warning lamp had changed from "Off" to "On," 0.5 seconds prior to AE. The time and distance analysis determined that the

Chevrolet encountered the median approximately 0.8 seconds prior to AE. The status change of the warning lamp was consistent with the Chevrolet traveling (vaulting) across the median at a high rate of speed and the subsequent sudden deceleration of the ground contact while crossing it. After the reconstruction and analysis of this crash, one possibly theory is that the most probable causative factor of air bag non-deployment was the rotation of the ignition switch.

The 2006–2014 Chevrolet Impala was subject to NHTSA Recall 14V355. This recall stated:

> If the key ring is carrying added weight and the vehicle goes off road or experiences some other jarring event, it may unintentionally move the key away from the "run" position. If this occurs, engine power, power steering and power braking will be affected, increasing the risk of a crash. If the ignition switch is not in the run position, the air bags may not deploy if the vehicle is involved in a crash, increasing the risk of injury or fatality.

The Technical Service Bulletin (TSB) No.14299C indicated that the corrective action for this recall was to place a filler-insert in the slotted key or place a key cover over the head of the key such that the key only had a single hole (Figure 14). Additionally, two 13 mm (0.5 in) key rings (chained together) were then added to the replacement hole with the remote keyless entry (RKE) transmitter attached to the second ring. Additionally, the TSB advised to only add items to the second ring and to limit the number to a few essential keys or small items no larger than the RKE transmitter. The TSB is included at the end of this report as Appendix B.

Figure 14. Image depicting the key cover and key ring corrective action of the recall, obtained from TSB No. 14299C

At the time of the SCI inspection, the Chevrolet's ignition key (and key ring) was found lying on the driver seat (Figure 15). The ignition key was broken with the end of the key remaining in the ignition switch. The police investigator reported that at some point in time during the post-crash movement of the vehicle, the key was broken. Examination of the vehicle's key revealed that the recall's corrective action had been performed by the placement of a single-hole key cover over the head of the key (Figure 16). A key ring that measured 32 mm (1.3 in) diameter was attached to the key cover. Five keys were attached to a 16 mm (0.6 in) ring and linked to the large diameter key ring, along with a bent fork. The items attached to the ignition key weighed 73.7 grams (2.6 oz.).

Figure 15. Left-interior view of the Chevrolet and the position of the keys on the driver seat at the time of the SCI inspection

Figure 16. Image depicting the Chevrolet's broken ignition key, 32 mm key ring, and additional attached items

The Chevrolet's ignition switch had three positions: Off, Accessory, and Run, with clockwise rotation. When fully rotated counterclockwise, the switch was in the "Off" position. Clockwise rotation, beyond the "Run" position, engaged the starter motor. The police investigator stated that the position of the ignition switch was not documented at the time of the crash.

However, while it could not be confirmed as a certainty, the police investigator did believe that the on-scene police images may have been taken prior to anyone manipulating the steering wheel, column, or ignition. Figure 17 is an on-scene image of the steering column and ignition switch, taken 53 minutes after the reported time of the crash. Based on the SCI inspections of the Chevrolet and an exemplar Chevrolet Impala, the ignition switch depicted in Figure 17 is in the "Accessory" position. The switch was in this same position at the time of the SCI vehicle inspection in February 2017.

Figure 17. On-scene police image of the steering wheel and column depicting the position of the ignition switch

During the SCI inspection, the broken key was inserted into the ignition switch. The switch rotated to all positions. It was then observed that the ignition switch could be rotated from "Run" to "Accessory" by applying a small force at the attached fork and key group (Figures 18 and 19). It was theorized that the sudden vehicle deceleration (jarring), as the Chevrolet encountered and crossed the median, may have set the items attached to the key in motion and caused the switch to rotate from the "Run" position to "Accessory." The ignition switch rotation removed 12-volt electrical power to the (driver) air bag module circuitry impeding the air bag deployment, despite the fact that the deployment command was sent by the control module (ACM). The ACM circuit remained powered regardless of the ignition switch position.

Figure 18. Image depicting the ignition switch of the Chevrolet in the "Run" position

Figure 19. Image depicting the ignition switch of the Chevrolet in the "Accessory" position with a force application applied at the attached items

2013 Chevrolet Impala Occupant

Driver Demographics

Age/sex:	28 years/male
Height:	185 cm (73 in)
Weight:	80 kg (176 lb)
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Full-rear
Manual restraint usage:	None
Usage source:	Vehicle inspection
Air bags:	Driver's frontal, seat-mounted and IC air bags available; none deployed
Alcohol/drug data:	BAC = 0; positive for marijuana
Egress from vehicle:	Removed by EMS
Transport from scene:	Ambulance to a Level 1 trauma center
Type of medical treatment:	Hospitalized for 33 days

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Bilateral anterior pelvic ring fractures; superior and inferior right rami fractures, minimally displaced; left-sided S1 joint ligamentous injury; comminuted closed fracture of right sacrum ala (complete Zone 2 fracture) with related pelvic soft tissue hematoma	856163.4	Left lower instrument panel (including knee bolster)	Certain
2	Closed comminuted displaced fracture of posterior wall of left acetabulum	856251.2	Left lower instrument panel (including knee bolster)	Certain
3	Left femoral head impaction fracture	853171.3	Left lower instrument panel (including knee bolster)	Certain
4	Closed Le Fort III fracture – right; Left Le Fort I fracture	250808.3	Center instrument panel	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
5	Closed fracture of right zygomatic tripod	251816.2	Center instrument panel	Certain
6	Right internal iliac artery laceration	520604.3	Left lower instrument panel (including knee bolster)	Certain
7	Left internal iliac artery laceration	520604.3	Left lower instrument panel (including knee bolster)	Certain
8	Right traumatic hemo-pnemothorax	442205.3	Center instrument panel	Certain
9	Contusion of the right lung	442202.2	Center instrument panel	Certain
10	Minimal left lung contusion	441407.2	Steering wheel rim - right aspect and Column	Certain
11	Thermal inhalation injury	419200.2	Post-crash fire	Certain
12	Closed fracture of sternum	450804.2	Steering wheel rim - right aspect and Column	Certain
13	Concussion with loss of consciousness of 30 minutes or less	161004.2	Center instrument panel	Certain
14	Right L5 transverse process fracture	650620.1	Left lower instrument panel (including knee bolster)	Possible
15	Two complex and two simple 1 cm lacerations to nasal bridge	210602.1	Center instrument panel	Certain
16	Ear laceration, NFS	210600.1	Unknown	Unknown
17	Right periorbital contusion	210402.1	Center instrument panel	Certain
18	Left periorbital contusion	210402.1	Center instrument panel	Certain
19	Scalp laceration, NFS	110600.1	Unknown	Unknown
20	Left extraconal hemorrhage/ extraconal air; left proptosis	240499.1	Center instrument panel	Probable
21	Soft tissue abrasion to right forehead	210202.1	Center instrument panel	Certain
22	Complex 6 cm laceration with exposed left patella	810802.1	Left instrument panel and knee bolster	Certain
23	Large ecchymosis to right anterior shoulder	710402.1	Center instrument panel	Certain
24	Mild ecchymosis to left shoulder	710402.1	Steering wheel rim	Certain
25	Contusion to lateral right thigh	810402.1	Center console	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
26	Mild soft tissue contusion overlying right hip at level of greater trochanter	810402.1	Center console	Probable
27	Small superficial abrasion to right anterior knee	810202.1	Left instrument panel and knee bolster	Certain

Source: hospital records.

Driver Kinematics

The unbelted 28-year old male driver of the Chevrolet was seated in the driver's seat of the Chevrolet, with the seat adjusted to a full-rear track position. He was out of position in a slumped posture to his right, based on witness statements to the investigating police officer that the vehicle appeared to be driverless. The driver was operating the vehicle along the exit ramp in the right lane at an EDR-reported speed of 94 km/h (58 mph) 5.0 seconds prior to AE and was applying the accelerator. As the vehicle approached the intersection, the driver began intermittently applying the brakes and apparently was only in partial control of the vehicle. For undetermined reasons, the vehicle entered the four-leg intersection on a straight trajectory without stopping and overran the end of the center median, less than 1.0 second prior to the guardrail impact. The SCI crash reconstruction determined that the speed of the Chevrolet was approximately 85 km/h (53 mph) when it encountered the median.

The tapered edge of the median curb acted as a ramp causing the vehicle to partially vault across the median surface. The Chevrolet struck the sign post with its front plane and struck the delineator with its left-exterior mirror as it crossed the median (Events 1 and 2). These minor severity impacts had no effect on the driver's kinematics. The vehicle contacted the road surface of the intersecting road, and the driver initiated a slight forward trajectory with vertical displacement as he loaded the seat cushion in response to the dynamic deceleration. A friction abrasion was observed at the forward-right corner of the seat cushion. This aspect of the seat was loaded and deformed downward.

The front plane of the Chevrolet then struck the guardrail (Event 3). The driver reacted to the 12 o'clock direction of the impact with a continued forward trajectory. His knees contacted the lower instrument panel/knee bolster. The right knee loading deformed the right half of the metal backer panel. He sustained a small superficial abrasion over the right knee, and a 6 cm (2.4 in) laceration of the left knee with exposure of the patella from direct contact with the lower instrument panel/knee bolster. The subsequent knee loading was transferred through the femurs, which resulted in bilateral pelvic ring fractures, a comminuted displaced fracture of the left acetabulum, a left femoral head fracture, and bilateral iliac artery lacerations. The driver's left chest loaded the right half of the steering wheel rim, deforming the wheel rim and the spokes. The loading force was transmitted into the energy-absorbing steering column which compressed and completely separated the shear capsules. The asymmetrical chest loading of the steering assembly resulted in mild ecchymosis of the left shoulder, a closed fracture of the sternum, and a left pulmonary contusion. The driver's right hip lateral thigh areas contacted the center console,

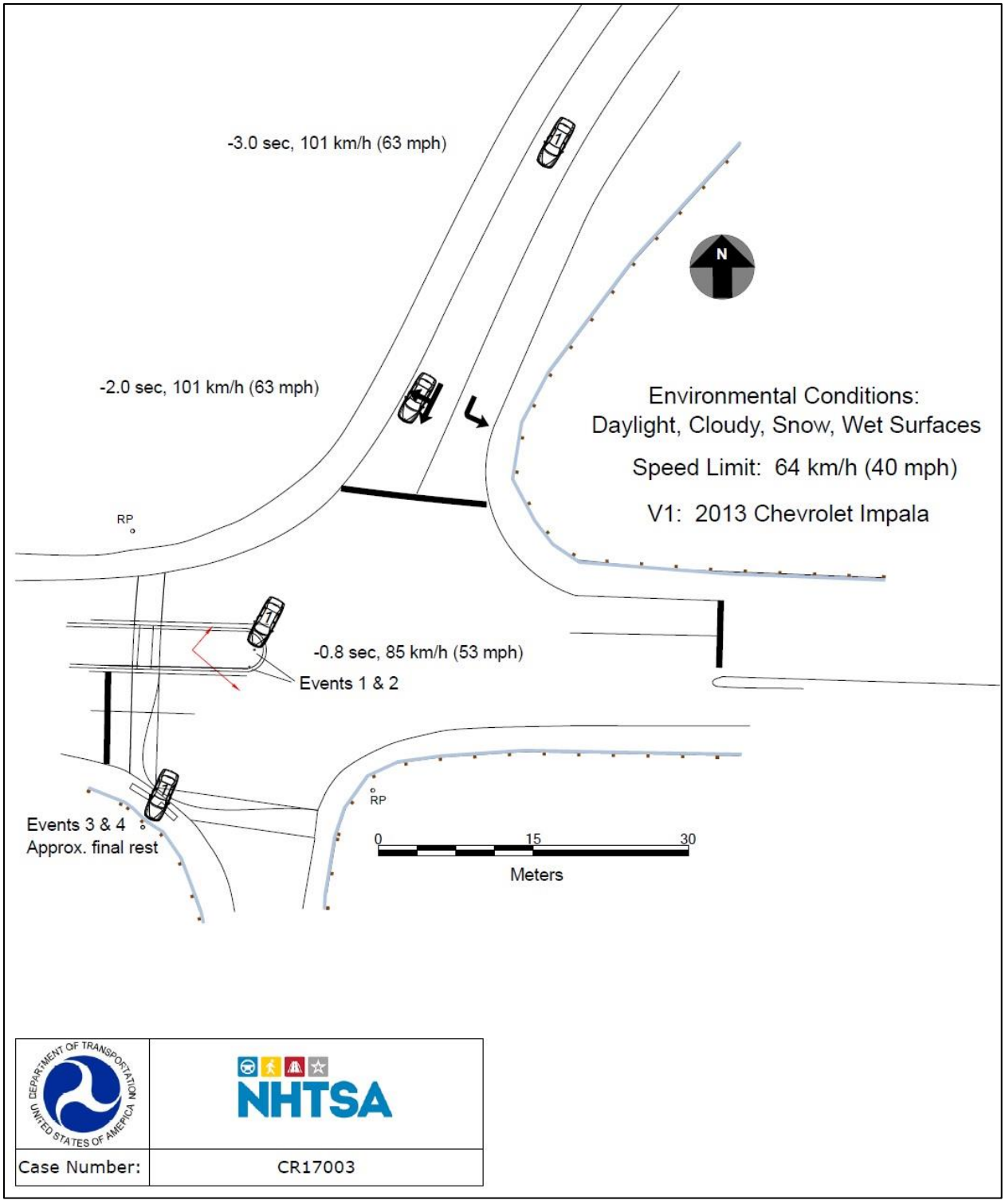
causing soft tissue contusions. The asymmetrical loading of the driver's torso against the steering wheel rim caused his torso to rotate CCW with respect to his abdomen and pelvis. He led with his right shoulder area as he continued forward and struck the center-mid aspect of the instrument panel. The driver sustained a large area of ecchymosis to the right shoulder area, a contusion of the right lung with pneumothorax and a traumatic right hemo-pnemothorax.

The driver's face and head struck the upper aspect of the center instrument panel, which resulted in lacerations to the bridge of the nose, an abrasion of the right forehead, bilateral periorbital contusions, bilateral LeFort fractures, and a right zygomatic tripod fracture. He also sustained a concussion with loss of consciousness (<30 minutes). The medical records listed a fracture of the right transverse process at the level of L5. This fracture was possibly related to the energy induced through the lower instrument panel/knee bolster. Additionally, the driver sustained unspecified lacerations of an ear and the scalp that resulted from unknown sources.

A minor severity post-crash fire (Event 4) initiated in the engine compartment and was extinguished prior to spreading to the occupant compartment. The driver did experience a thermal inhalation injury that was associated with this fire.

The driver was removed from the vehicle by EMS and transported by ambulance to a regional trauma center, where he was admitted to the intensive care unit for 33 days due to the extent and treatment of his injuries.

Crash Diagram



Appendix A: Event Data Recorder Report for 2013 Chevrolet Impala[1]

[1] The EDR report contained in this technical report was imaged using the version of the Bosch CDR software current 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 User	2G1WD5E38D1******
Case Number EDR Data Imaging Date	
Crash Date	
Filename Saved on	CR17003_V1_ACM.CDRX
Imaged with CDR version	Crash Data Retrieval Tool 17.2
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version Reported with Software Licensed to (Company Name)	Crash Data Retrieval Tool 19.6 NHTSA
EDR Device Type Event(s) recovered	Airbag Control Module Non-Deployment, Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events for Front, Side, and Rear (FSR) 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 [8 km/h]. A Non-Deployment Event contains Pre-Crash and Crash data. The oldest Non-Deployment event can be overwritten by a Deployment Event, if all three records are full and the Non-Deployment Event is not locked. A Non-Deployment Event can be overwritten by a more recent Non-Deployment Event if all three records are full and the Non-Deployment is older than approximately 250 ignition cycles. Also, a Non-Deployment event can be recorded if one of the following occurs without the Deployment of any of the frontal air bags, side air bags, or roll bars:

-Pretensioner(s) only Deployment
-Head Rest Deployment
-Battery Cut-Off Deployment

The second type of SDM recorded crash event for FSR Events is the Deployment Event. It also contains Pre-Crash and Crash data. Deployment Events cannot be overwritten or cleared by the SDM.
Rollover Events contains Pre-Crash and Crash data. Rollover event follow the same rules as FSR Deployment events. The SDM can store up to three Events.

Data:

For FSR Events, 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 and Non-Deployment Events, the SDM will record up to 300 milliseconds of data after time zero. The SDM will also record up to 300 milliseconds of Vehicle Acceleration data after time zero.
For Rollover Events, the SDM may record Lateral Acceleration, Vertical Acceleration, and Roll Rate data, if the SDM is rollover capable. This data reflects what the sensing system experienced during the recorded portion of the event. For Rollover Deployment Events, the SDM will record up to 700 milliseconds of data before the Deployment criteria is met and 290 milliseconds after the Deployment criteria is met.
-Deployment loops may be displayed as being deployed in a Non-Deployment event record, if a Deployment event is qualified during the Non-Deployment event. That is, if two or more events are occurring at the same time and one is a Non-Deployment event and one of the others is a Deployment event, and the Deployment event is qualified while the Non-Deployment is still active, the deployed loops may be recorded in the Non-Deployment event record.
-Time between events is recorded in 10 msec intervals and is displayed in seconds for a maximum time of 655.33 seconds.
-The Maximum SDM Recorded Vehicle Velocity Change may occur between the recorded 10 millisecond sample points of the SDM Recorded Vehicle Velocity Change.
-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 0.5 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 0.5 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
-Pre-Crash Electronic Data Validity Check Status indicates "Data Not Available" if:
-No data is received from the module sending the pre-crash data
-For diesel powered vehicles, the data displayed as Throttle Position (%) is actually the data for the Air Inlet Flap Position. This is not the same as the throttle position for a gasoline powered engines.
-Belt Switch Circuit Status indicates the status of the seat belt switch circuit.
-The ignition cycle counter will increment when the power mode cycles from OFF/Accessory to RUN. Applying and removing of battery power to the module will not increment the ignition cycle counter.
-Ignition Cycles Since DTCs Were Last Cleared can record a maximum value of 253 cycles and can only be reset by a scan tool.
-Dynamic Deployment Event Counter tracks the number of Deployment events that have occurred during the SDM's lifetime.
-Dynamic Event Counter tracks the number of qualified events (either Deployments, Non-deploy, or Rollover events) that have occurred during the SDM's lifetime.
-For Deployment Events, DTC B0052 (Deployment commanded) shall be recorded with the remainder of the data for this event even though it occurred after Event Enable.
-Once a firing loop has been commanded to be deployed, it will not be commanded to be deployed again during the same ignition cycle. Firing loop deployment times for subsequent deployment type events, during the same ignition cycle, will not be recorded. Also, forced timer loops, will not be shown as being commanded to deploy. Loops without their own independent deployment calibration are called "forced timer loops." Examples of a forced timer loops are Pretensioner Deployment Loop #2 and Knee Deployment Loop.
-Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously may be reported higher than Ignition Cycles At Event because the Ignition Cycles SIR Warning Lamp was ON/OFF counter is not cleared during the vehicle build process.
-Ignition Cycles At Event may be reported higher than Ignition Cycles At Investigation by one ignition cycle. This is due to the way Ignition Cycles At Investigation is written during a vehicle power loss situation.
-The GM parameter name is displayed in parentheses after the NHTSA Part 563 parameter name.
-The reported range of the longitudinal and lateral acceleration values is approximately 50 g.
-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 by the Body Control Module, 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 Acceleration	Forward
Longitudinal Velocity Change	Forward
Lateral Acceleration	Left to Right
Lateral Velocity Change	Left to Right
Vertical Acceleration	Downward
Roll Rate	Clockwise 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.

01053_SDM11e-autoliv_r013

System Status at Time of Retrieval

Dynamic Deployment Event Counter	1
Multi-Event, Number of Events (Dynamic Event Counter)	2
Dynamic OnStar Notification Event Counter	1
Vehicle Identification Number (VIN)	??????????******
Ignition Cycle, Download (Ignition Cycles at Investigation)	19756
End Model Part Number	A5000000
System Type	Autoliv
Software Module Identifier 1	015E79A6
Software Module Identifier 2	015E79A7
Software Module Identifier 3	015E79A5
Manufacturing Traceability Data, Component Identifier	AS
Manufacturing Traceability Data, Part Number/Broadcast Code	8741
Manufacturing Traceability Data, Supplier Code	E
Manufacturing Traceability Data, Traceability Number	050020043
ESS # 1 Traceability Data, Component Identifier	AU
ESS # 1 Traceability Data, Part Number/Broadcast Code	0000
ESS # 1 Traceability Data, Supplier Code	E
ESS # 1 Traceability Data, Traceability Number	000000000
ESS # 2 Traceability Data, Component Identifier	AT
ESS # 2 Traceability Data, Part Number/Broadcast Code	0000
ESS # 2 Traceability Data, Supplier Code	E
ESS # 2 Traceability Data, Traceability Number	000000000
ESS # 3 Traceability Data, Component Identifier	AH
ESS # 3 Traceability Data, Part Number/Broadcast Code	0000
ESS # 3 Traceability Data, Supplier Code	E
ESS # 3 Traceability Data, Traceability Number	000000000
ESS # 4 Traceability Data, Component Identifier	AJ
ESS # 4 Traceability Data, Part Number/Broadcast Code	0000
ESS # 4 Traceability Data, Supplier Code	E
ESS # 4 Traceability Data, Traceability Number	000000000
ESS # 5 Traceability Data, Component Identifier	00
ESS # 5 Traceability Data, Part Number/Broadcast Code	0000
ESS # 5 Traceability Data, Supplier Code	E
ESS # 5 Traceability Data, Traceability Number	000000000
ESS # 6 Traceability Data, Component Identifier	00
ESS # 6 Traceability Data, Part Number/Broadcast Code	0000
ESS # 6 Traceability Data, Supplier Code	E
ESS # 6 Traceability Data, Traceability Number	000000000
ESS # 7 Traceability Data, Component Identifier	00
ESS # 7 Traceability Data, Part Number/Broadcast Code	0000
ESS # 7 Traceability Data, Supplier Code	E
ESS # 7 Traceability Data, Traceability Number	000000000
ESS # 8 Traceability Data, Component Identifier	00
ESS # 8 Traceability Data, Part Number/Broadcast Code	0000
ESS # 8 Traceability Data, Supplier Code	E
ESS # 8 Traceability Data, Traceability Number	000000000

System Status at Event (Event Record 1)

Event Record Type	Non-Deployment
OnStar Deployment Status Data Sent	No
Complete file recorded (Event Recording Complete)	Yes
Crash Record Locked	No
OnStar SDM Recorded Vehicle Velocity Change Data Sent	No
Deployment Event Counter	0
Multi-Event, Number of Events (Event Counter)	1
OnStar Notification Event Counter	0
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	18444
Algorithm Active: Frontal	Yes
Algorithm Active: Side	No
Algorithm Active: Rollover	No
Algorithm Active: Rear	No
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	No
Event Severity Status: Frontal Stage 1	No
Event Severity Status: Frontal Stage 2	No
Event Severity Status: Left Side	No
Event Severity Status: Right Side	No
Event Severity Status: Rear	No
Event Severity Status: Rollover	No
Safety Belt Status, Driver (Driver Belt Switch Circuit Status)	Not Buckled
Safety Belt Status, Right Front Passenger (Passenger Belt Switch Circuit Status)	Buckled
Center Front Row Belt Switch Circuit Status (If Equipped)	Data Not Available
Left Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Center Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Right Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status	Occupied
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Small Adult)
Passenger Air Bag ON Indicator Status	On
Passenger Air Bag OFF Indicator Status	Off
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	653490
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	83
Ignition Cycles Since DTCs Were Last Cleared 0.5 Seconds Prior to Time Zero	253
Maximum Delta-V, Longitudinal (Maximum Longitudinal SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	-6 [-10]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	134
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	5 [8]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	144

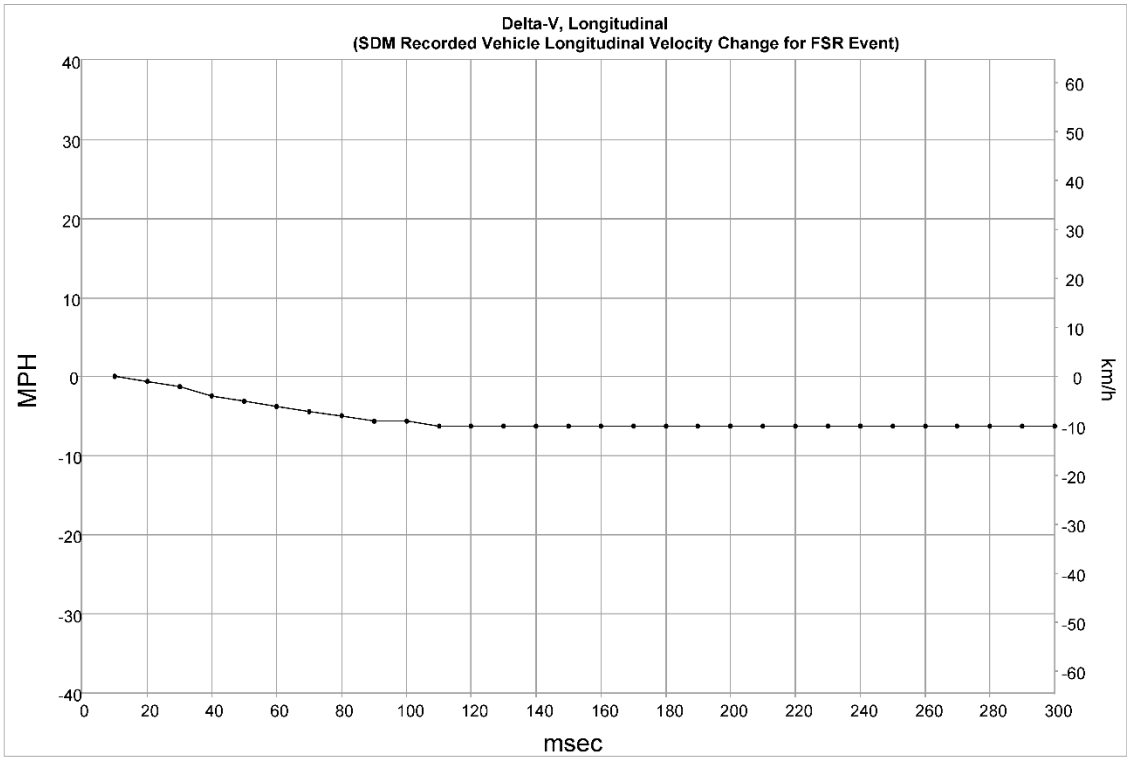
DTCs Present at Time of Event (Event Record 1)

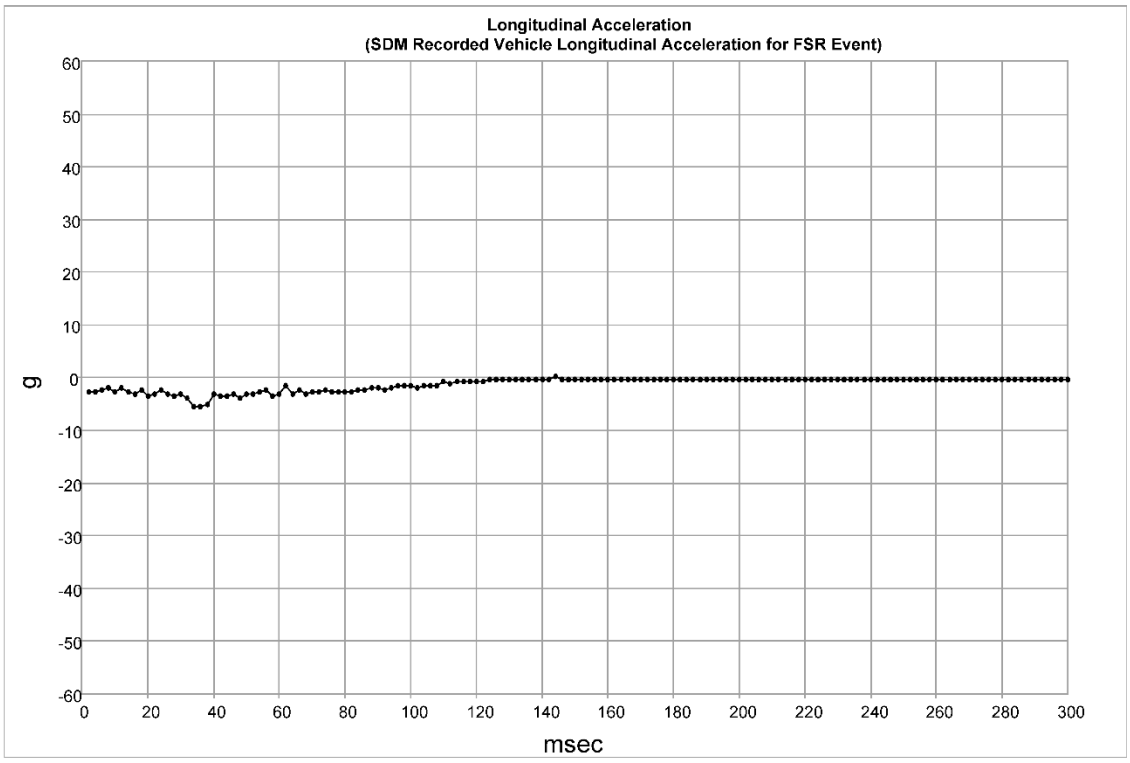
No Diagnostic Trouble Codes

Event Data (Event Record 1)

Driver 1st Stage Deployment Loop Commanded	No
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	No
Passenger Pretensioner Deployment Loop #1 Commanded	No
Driver Pretensioner Deployment Loop #2 Commanded	No
Passenger Pretensioner Deployment Loop #2 Commanded	No
Driver Thorax Loop Commanded	No
Passenger Thorax Loop Commanded	No
Left Row 1 Roof Rail/Head Curtain Loop Commanded	No
Right Row 1 Roof Rail/Head Curtain Loop Commanded	No
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Right Front Passenger (Passenger 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (Passenger 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, driver (Driver Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available

Longitudinal Crash Pulse (Event Record 1)





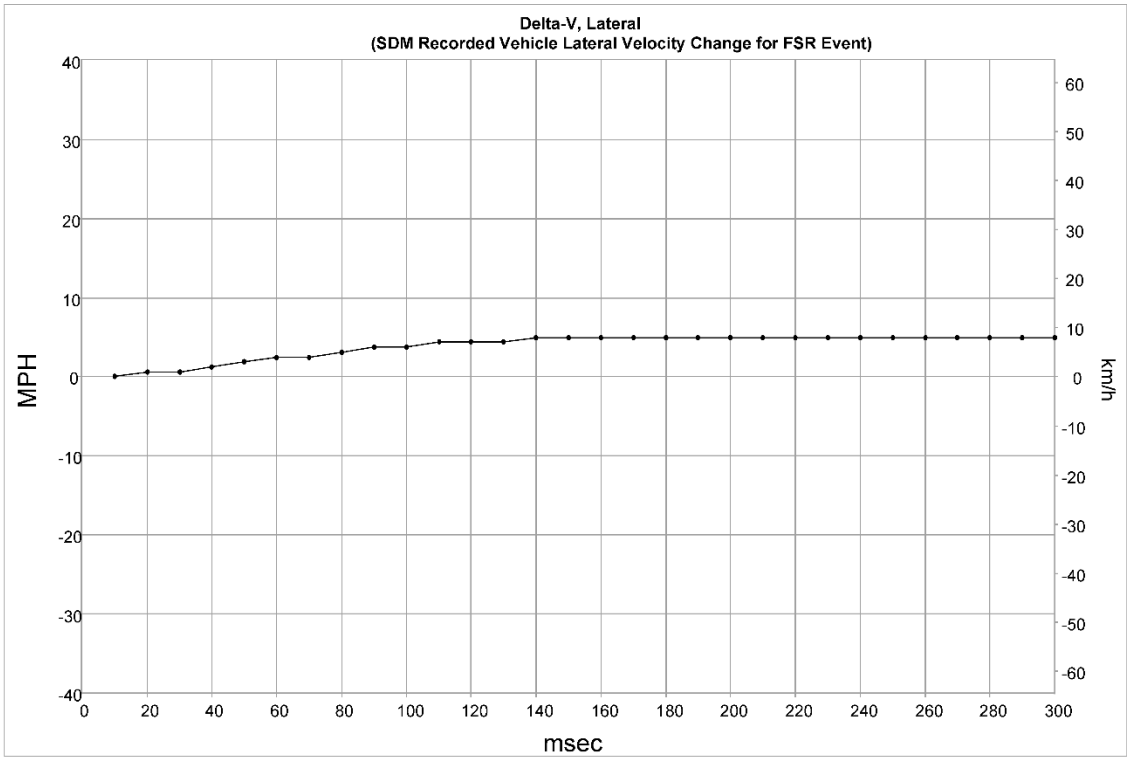
Longitudinal Crash Pulse (Event Record 1)

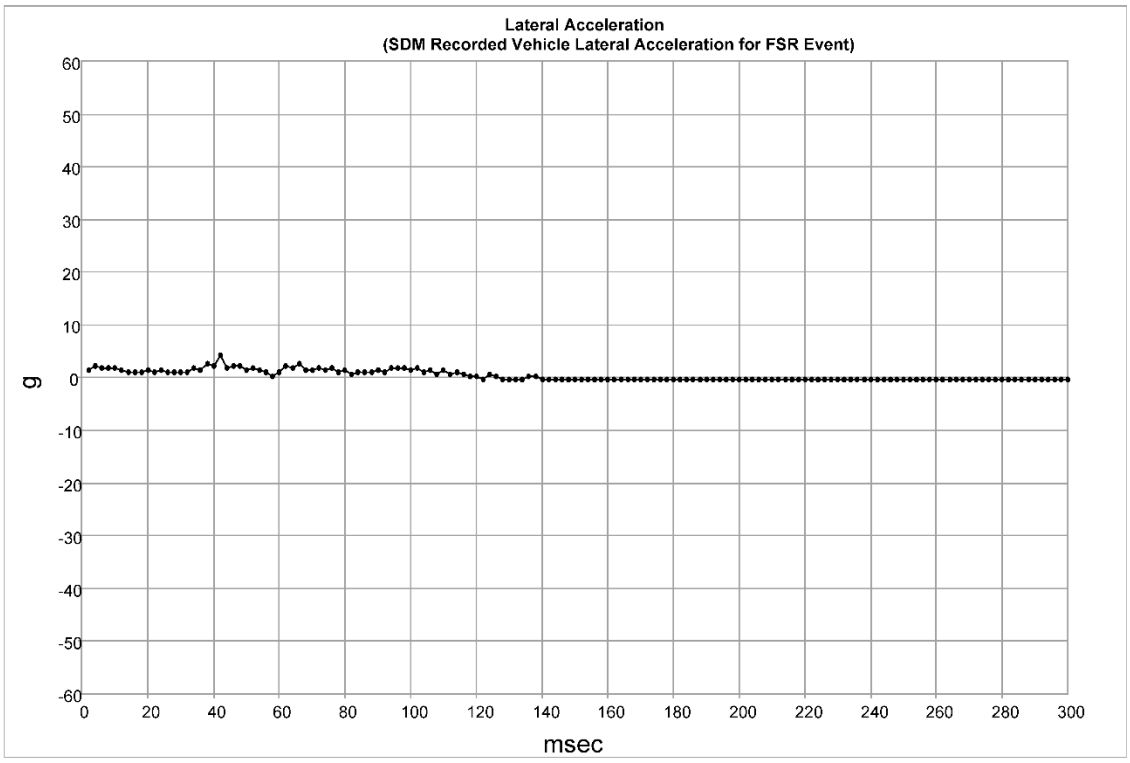
Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	0.0	0.0
20	-0.6	-1.0
30	-1.2	-2.0
40	-2.5	-4.0
50	-3.1	-5.0
60	-3.7	-6.0
70	-4.3	-7.0
80	-5.0	-8.0
90	-5.6	-9.0
100	-5.6	-9.0
110	-6.2	-10.0
120	-6.2	-10.0
130	-6.2	-10.0
140	-6.2	-10.0
150	-6.2	-10.0
160	-6.2	-10.0
170	-6.2	-10.0
180	-6.2	-10.0
190	-6.2	-10.0
200	-6.2	-10.0
210	-6.2	-10.0
220	-6.2	-10.0
230	-6.2	-10.0
240	-6.2	-10.0
250	-6.2	-10.0
260	-6.2	-10.0
270	-6.2	-10.0
280	-6.2	-10.0
290	-6.2	-10.0
300	-6.2	-10.0

Longitudinal Crash Pulse (Event Record 1)

Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
2	-2.6	102	-1.8	202	-0.2
4	-2.6	104	-1.4	204	-0.2
6	-2.2	106	-1.4	206	-0.2
8	-1.8	108	-1.4	208	-0.2
10	-2.6	110	-0.6	210	-0.2
12	-1.8	112	-1.0	212	-0.2
14	-2.6	114	-0.6	214	-0.2
16	-3.0	116	-0.6	216	-0.2
18	-2.2	118	-0.6	218	-0.2
20	-3.4	120	-0.6	220	-0.2
22	-3.0	122	-0.6	222	-0.2
24	-2.2	124	-0.2	224	-0.2
26	-3.0	126	-0.2	226	-0.2
28	-3.4	128	-0.2	228	-0.2
30	-3.0	130	-0.2	230	-0.2
32	-3.8	132	-0.2	232	-0.2
34	-5.4	134	-0.2	234	-0.2
36	-5.4	136	-0.2	236	-0.2
38	-5.0	138	-0.2	238	-0.2
40	-3.0	140	-0.2	240	-0.2
42	-3.4	142	-0.2	242	-0.2
44	-3.4	144	0.2	244	-0.2
46	-3.0	146	-0.2	246	-0.2
48	-3.8	148	-0.2	248	-0.2
50	-3.0	150	-0.2	250	-0.2
52	-3.0	152	-0.2	252	-0.2
54	-2.6	154	-0.2	254	-0.2
56	-2.2	156	-0.2	256	-0.2
58	-3.4	158	-0.2	258	-0.2
60	-3.0	160	-0.2	260	-0.2
62	-1.4	162	-0.2	262	-0.2
64	-3.0	164	-0.2	264	-0.2
66	-2.2	166	-0.2	266	-0.2
68	-3.0	168	-0.2	268	-0.2
70	-2.6	170	-0.2	270	-0.2
72	-2.6	172	-0.2	272	-0.2
74	-2.2	174	-0.2	274	-0.2
76	-2.6	176	-0.2	276	-0.2
78	-2.6	178	-0.2	278	-0.2
80	-2.6	180	-0.2	280	-0.2
82	-2.6	182	-0.2	282	-0.2
84	-2.2	184	-0.2	284	-0.2
86	-2.2	186	-0.2	286	-0.2
88	-1.8	188	-0.2	288	-0.2
90	-1.8	190	-0.2	290	-0.2
92	-2.2	192	-0.2	292	-0.2
94	-1.8	194	-0.2	294	-0.2
96	-1.4	196	-0.2	296	-0.2
98	-1.4	198	-0.2	298	-0.2
100	-1.4	200	-0.2	300	-0.2

Lateral Crash Pulse (Event Record 1)





Lateral Crash Pulse (Event Record 1)

Time (msec)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (MPH)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (km/h)
10	0.0	0.0
20	0.6	1.0
30	0.6	1.0
40	1.2	2.0
50	1.9	3.0
60	2.5	4.0
70	2.5	4.0
80	3.1	5.0
90	3.7	6.0
100	3.7	6.0
110	4.3	7.0
120	4.3	7.0
130	4.3	7.0
140	5.0	8.0
150	5.0	8.0
160	5.0	8.0
170	5.0	8.0
180	5.0	8.0
190	5.0	8.0
200	5.0	8.0
210	5.0	8.0
220	5.0	8.0
230	5.0	8.0
240	5.0	8.0
250	5.0	8.0
260	5.0	8.0
270	5.0	8.0
280	5.0	8.0
290	5.0	8.0
300	5.0	8.0

Lateral Crash Pulse (Event Record 1)

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	1.4	102	1.8	202	-0.2
4	2.2	104	1.0	204	-0.2
6	1.8	106	1.4	206	-0.2
8	1.8	108	0.6	208	-0.2
10	1.8	110	1.4	210	-0.2
12	1.4	112	0.6	212	-0.2
14	1.0	114	1.0	214	-0.2
16	1.0	116	0.6	216	-0.2
18	1.0	118	0.2	218	-0.2
20	1.4	120	0.2	220	-0.2
22	1.0	122	-0.2	222	-0.2
24	1.4	124	0.6	224	-0.2
26	1.0	126	0.2	226	-0.2
28	1.0	128	-0.2	228	-0.2
30	1.0	130	-0.2	230	-0.2
32	1.0	132	-0.2	232	-0.2
34	1.8	134	-0.2	234	-0.2
36	1.4	136	0.2	236	-0.2
38	2.6	138	0.2	238	-0.2
40	2.2	140	-0.2	240	-0.2
42	4.2	142	-0.2	242	-0.2
44	1.8	144	-0.2	244	-0.2
46	2.2	146	-0.2	246	-0.2
48	2.2	148	-0.2	248	-0.2
50	1.4	150	-0.2	250	-0.2
52	1.8	152	-0.2	252	-0.2
54	1.4	154	-0.2	254	-0.2
56	1.0	156	-0.2	256	-0.2
58	0.2	158	-0.2	258	-0.2
60	1.0	160	-0.2	260	-0.2
62	2.2	162	-0.2	262	-0.2
64	1.8	164	-0.2	264	-0.2
66	2.6	166	-0.2	266	-0.2
68	1.4	168	-0.2	268	-0.2
70	1.4	170	-0.2	270	-0.2
72	1.8	172	-0.2	272	-0.2
74	1.4	174	-0.2	274	-0.2
76	1.8	176	-0.2	276	-0.2
78	1.0	178	-0.2	278	-0.2
80	1.4	180	-0.2	280	-0.2
82	0.6	182	-0.2	282	-0.2
84	1.0	184	-0.2	284	-0.2
86	1.0	186	-0.2	286	-0.2
88	1.0	188	-0.2	288	-0.2
90	1.4	190	-0.2	290	-0.2
92	1.0	192	-0.2	292	-0.2
94	1.8	194	-0.2	294	-0.2
96	1.8	196	-0.2	296	-0.2
98	1.8	198	-0.2	298	-0.2
100	1.4	200	-0.2	300	-0.2

Rollover Crash Pulse (Event Record 1)
SDM Recorded Vehicle Roll Rate

Contains No Recorded Data

Rollover Crash Pulse (Event Record 1)
Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for Rollover Event)

Contains No Recorded Data

Vertical Crash Pulse (Event Record 1)
Normal Acceleration (SDM Recorded Vehicle Vertical Acceleration for Rollover Event)

Contains No Recorded Data

Pre-Crash Data -5.0 to -0.5 sec (Event Record 1)

Times (sec)	Accelerator Pedal, % Full (Accelerator Pedal Position)	Service Brake (Brake Switch Circuit State)	Engine RPM (Engine Speed)	Engine Throttle, % Full (Throttle Position)	Speed, Vehicle Indicated (Vehicle Speed) (MPH [km/h])
-5.0	0	On	1536	13	75 [121]
-4.5	0	On	1536	13	71 [114]
-4.0	0	On	1472	13	67 [108]
-3.5	0	On	1280	12	62 [100]
-3.0	0	On	1280	11	57 [92]
-2.5	0	On	1536	13	52 [83]
-2.0	0	On	1152	10	43 [69]
-1.5	0	On	960	12	36 [58]
-1.0	0	On	640	19	23 [37]
-0.5	0	On	768	20	21 [34]

Pre-Crash Data -2.0 to -0.5 sec (Event Record 1)

Times (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Engine Torque (lb-ft [N-m])	Reduced Engine Power Mode Indicator
-2.0	No	No	No	-13 [-18]	Off
-1.5	No	No	No	-6 [-8]	Off
-1.0	No	No	No	27 [37]	Off
-0.5	No	No	No	55 [74]	Off

System Status at Event (Event Record 2)

Event Record Type	Deployment
OnStar Deployment Status Data Sent	No
Complete file recorded (Event Recording Complete)	Yes
Crash Record Locked	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	No
Deployment Event Counter	1
Multi-Event, Number of Events (Event Counter)	2
OnStar Notification Event Counter	0
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	19756
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	No
Algorithm Active: Rear	Yes
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	Yes
Event Severity Status: Frontal Stage 1	Yes
Event Severity Status: Frontal Stage 2	Yes
Event Severity Status: Left Side	No
Event Severity Status: Right Side	No
Event Severity Status: Rear	No
Event Severity Status: Rollover	No
Safety Belt Status, Driver (Driver Belt Switch Circuit Status)	Not Buckled
Safety Belt Status, Right Front Passenger (Passenger Belt Switch Circuit Status)	Not Buckled
Center Front Row Belt Switch Circuit Status (If Equipped)	Data Not Available
Left Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Center Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Right Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status	Empty
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Not Applicable)
Passenger Air Bag ON Indicator Status	Off
Passenger Air Bag OFF Indicator Status	On
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	On
SIR Warning Lamp ON/OFF Time Continuously (seconds)	0
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	1
Ignition Cycles Since DTCs Were Last Cleared 0.5 Seconds Prior to Time Zero	253
Maximum Delta-V, Longitudinal (Maximum Longitudinal SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	-55 [-88]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	146
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	-7 [-12]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	64

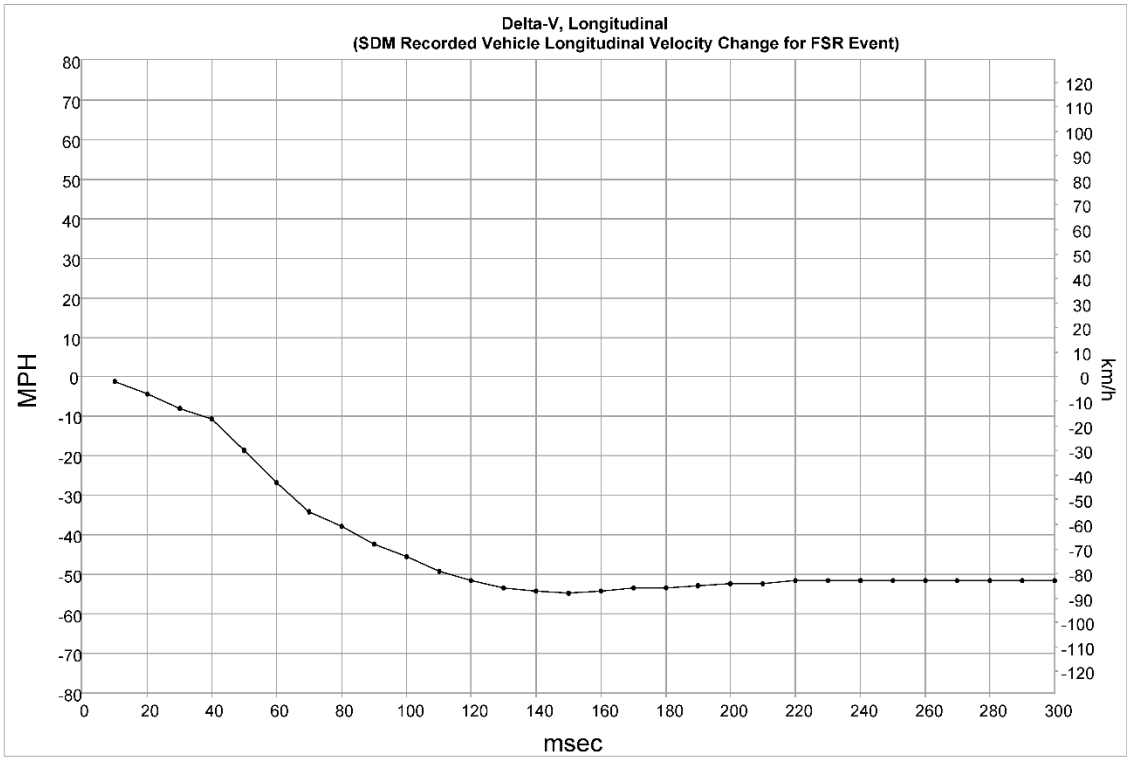
DTCs Present at Time of Event (Event Record 2)

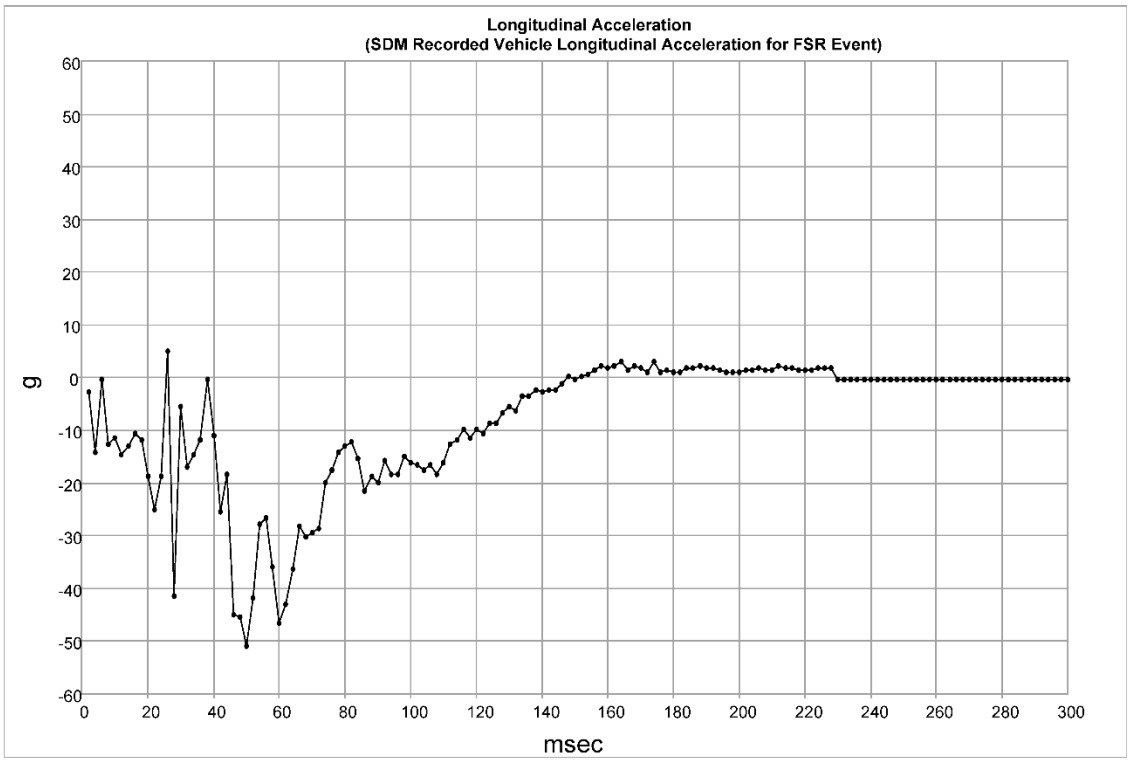
B0083-02
B0084-02
B0052-00

Event Data (Event Record 2)

Driver 1st Stage Deployment Loop Commanded	No
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	No
Passenger Pretensioner Deployment Loop #1 Commanded	No
Driver Pretensioner Deployment Loop #2 Commanded	No
Passenger Pretensioner Deployment Loop #2 Commanded	No
Driver Thorax Loop Commanded	No
Passenger Thorax Loop Commanded	No
Left Row 1 Roof Rail/Head Curtain Loop Commanded	No
Right Row 1 Roof Rail/Head Curtain Loop Commanded	No
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Right Front Passenger (Passenger 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (Passenger 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, driver (Driver Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available

Longitudinal Crash Pulse (Event Record 2)





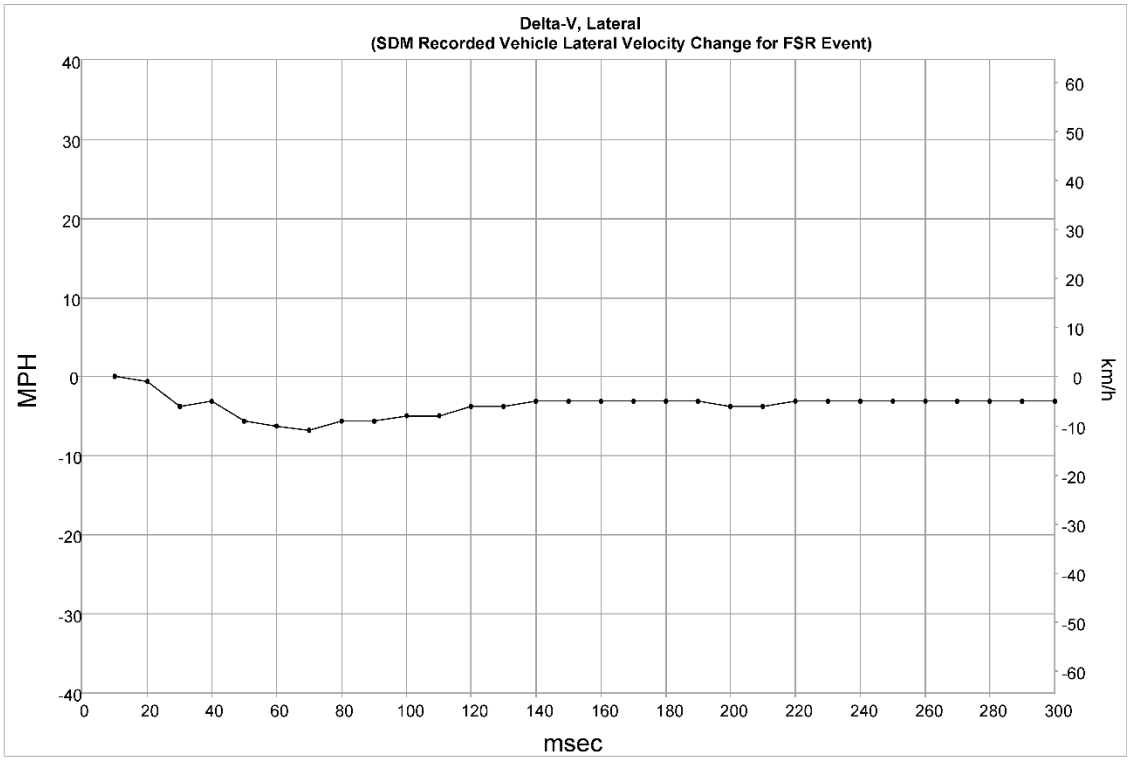
Longitudinal Crash Pulse (Event Record 2)

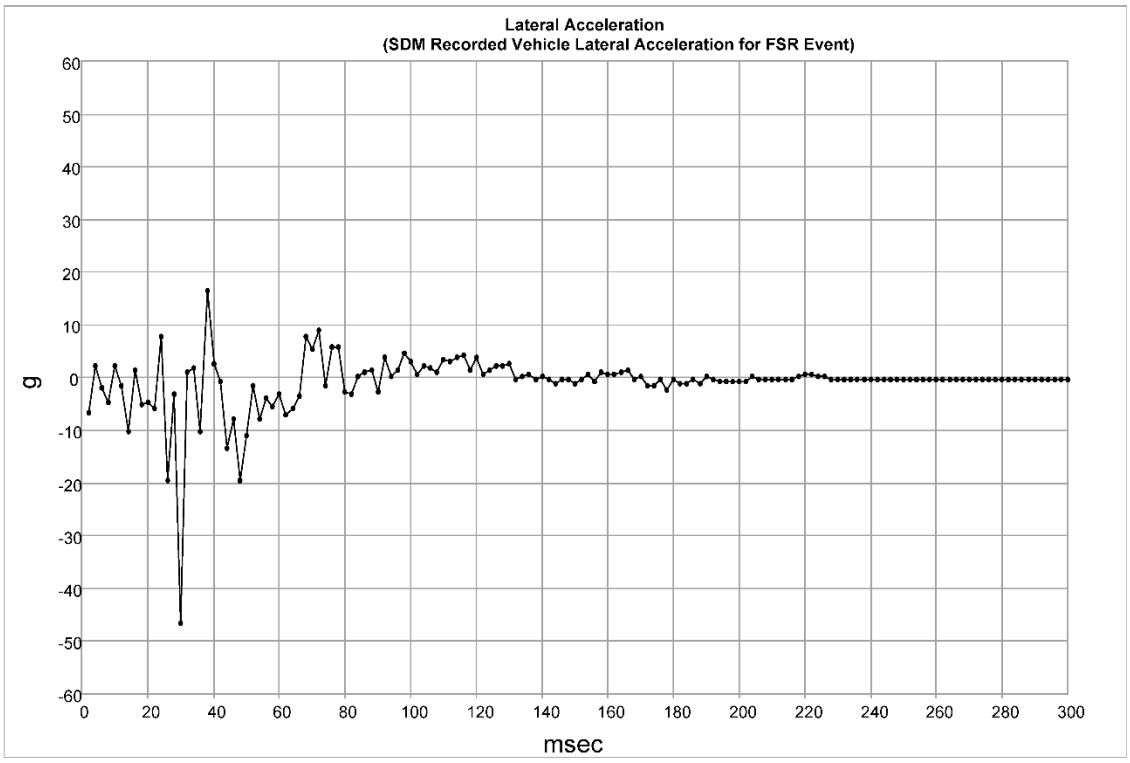
Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	-1.2	-2.0
20	-4.3	-7.0
30	-8.1	-13.0
40	-10.6	-17.0
50	-18.6	-30.0
60	-26.7	-43.0
70	-34.2	-55.0
80	-37.9	-61.0
90	-42.3	-68.0
100	-45.4	-73.0
110	-49.1	-79.0
120	-51.6	-83.0
130	-53.4	-86.0
140	-54.1	-87.0
150	-54.7	-88.0
160	-54.1	-87.0
170	-53.4	-86.0
180	-53.4	-86.0
190	-52.8	-85.0
200	-52.2	-84.0
210	-52.2	-84.0
220	-51.6	-83.0
230	-51.6	-83.0
240	-51.6	-83.0
250	-51.6	-83.0
260	-51.6	-83.0
270	-51.6	-83.0
280	-51.6	-83.0
290	-51.6	-83.0
300	-51.6	-83.0

Longitudinal Crash Pulse (Event Record 2)

Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
2	-2.6	102	-16.6	202	1.4
4	-14.2	104	-17.4	204	1.4
6	-0.2	106	-16.6	206	1.8
8	-12.6	108	-18.2	208	1.4
10	-11.4	110	-16.2	210	1.4
12	-14.6	112	-12.6	212	2.2
14	-13.0	114	-11.8	214	1.8
16	-10.6	116	-9.8	216	1.8
18	-11.8	118	-11.4	218	1.4
20	-18.6	120	-9.8	220	1.4
22	-25.0	122	-10.6	222	1.4
24	-18.6	124	-8.6	224	1.8
26	5.0	126	-8.6	226	1.8
28	-41.4	128	-6.6	228	1.8
30	-5.4	130	-5.4	230	-0.2
32	-17.0	132	-6.2	232	-0.2
34	-14.6	134	-3.4	234	-0.2
36	-11.8	136	-3.4	236	-0.2
38	-0.2	138	-2.2	238	-0.2
40	-11.0	140	-2.6	240	-0.2
42	-25.4	142	-2.2	242	-0.2
44	-18.2	144	-2.2	244	-0.2
46	-45.0	146	-1.0	246	-0.2
48	-45.4	148	0.2	248	-0.2
50	-51.0	150	-0.2	250	-0.2
52	-41.8	152	0.2	252	-0.2
54	-27.8	154	0.6	254	-0.2
56	-26.6	156	1.4	256	-0.2
58	-35.8	158	2.2	258	-0.2
60	-46.6	160	1.8	260	-0.2
62	-43.0	162	2.2	262	-0.2
64	-36.2	164	3.0	264	-0.2
66	-28.2	166	1.4	266	-0.2
68	-30.2	168	2.2	268	-0.2
70	-29.4	170	1.8	270	-0.2
72	-28.6	172	1.0	272	-0.2
74	-19.8	174	3.0	274	-0.2
76	-17.4	176	1.0	276	-0.2
78	-14.2	178	1.4	278	-0.2
80	-13.0	180	1.0	280	-0.2
82	-12.2	182	1.0	282	-0.2
84	-15.4	184	1.8	284	-0.2
86	-21.4	186	1.8	286	-0.2
88	-18.6	188	2.2	288	-0.2
90	-19.8	190	1.8	290	-0.2
92	-15.8	192	1.8	292	-0.2
94	-18.2	194	1.4	294	-0.2
96	-18.2	196	1.0	296	-0.2
98	-15.0	198	1.0	298	-0.2
100	-16.2	200	1.0	300	-0.2

Lateral Crash Pulse (Event Record 2)





Lateral Crash Pulse (Event Record 2)

Time (msec)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (MPH)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (km/h)
10	0.0	0.0
20	-0.6	-1.0
30	-3.7	-6.0
40	-3.1	-5.0
50	-5.6	-9.0
60	-6.2	-10.0
70	-6.8	-11.0
80	-5.6	-9.0
90	-5.6	-9.0
100	-5.0	-8.0
110	-5.0	-8.0
120	-3.7	-6.0
130	-3.7	-6.0
140	-3.1	-5.0
150	-3.1	-5.0
160	-3.1	-5.0
170	-3.1	-5.0
180	-3.1	-5.0
190	-3.1	-5.0
200	-3.7	-6.0
210	-3.7	-6.0
220	-3.1	-5.0
230	-3.1	-5.0
240	-3.1	-5.0
250	-3.1	-5.0
260	-3.1	-5.0
270	-3.1	-5.0
280	-3.1	-5.0
290	-3.1	-5.0
300	-3.1	-5.0

Lateral Crash Pulse (Event Record 2)

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	-6.6	102	0.6	202	-0.6
4	2.2	104	2.2	204	0.2
6	-1.8	106	1.8	206	-0.2
8	-4.6	108	1.0	208	-0.2
10	2.2	110	3.4	210	-0.2
12	-1.4	112	3.0	212	-0.2
14	-10.2	114	3.8	214	-0.2
16	1.4	116	4.2	216	-0.2
18	-5.0	118	1.4	218	0.2
20	-4.6	120	3.8	220	0.6
22	-5.8	122	0.6	222	0.6
24	7.8	124	1.4	224	0.2
26	-19.4	126	2.2	226	0.2
28	-3.0	128	2.2	228	-0.2
30	-46.6	130	2.6	230	-0.2
32	1.0	132	-0.2	232	-0.2
34	1.8	134	0.2	234	-0.2
36	-10.2	136	0.6	236	-0.2
38	16.6	138	-0.2	238	-0.2
40	2.6	140	0.2	240	-0.2
42	-0.6	142	-0.2	242	-0.2
44	-13.4	144	-1.0	244	-0.2
46	-7.8	146	-0.2	246	-0.2
48	-19.4	148	-0.2	248	-0.2
50	-11.0	150	-1.0	250	-0.2
52	-1.4	152	-0.2	252	-0.2
54	-7.8	154	0.6	254	-0.2
56	-3.8	156	-0.6	256	-0.2
58	-5.4	158	1.0	258	-0.2
60	-3.0	160	0.6	260	-0.2
62	-7.0	162	0.6	262	-0.2
64	-5.8	164	1.0	264	-0.2
66	-3.4	166	1.4	266	-0.2
68	7.8	168	-0.2	268	-0.2
70	5.4	170	0.2	270	-0.2
72	9.0	172	-1.4	272	-0.2
74	-1.4	174	-1.4	274	-0.2
76	5.8	176	-0.2	276	-0.2
78	5.8	178	-2.2	278	-0.2
80	-2.6	180	-0.2	280	-0.2
82	-3.0	182	-1.0	282	-0.2
84	0.2	184	-1.0	284	-0.2
86	1.0	186	-0.2	286	-0.2
88	1.4	188	-1.0	288	-0.2
90	-2.6	190	0.2	290	-0.2
92	3.8	192	-0.2	292	-0.2
94	0.2	194	-0.6	294	-0.2
96	1.4	196	-0.6	296	-0.2
98	4.6	198	-0.6	298	-0.2
100	3.0	200	-0.6	300	-0.2

Rollover Crash Pulse (Event Record 2)
SDM Recorded Vehicle Roll Rate

Contains No Recorded Data

Rollover Crash Pulse (Event Record 2)
Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for Rollover Event)

Contains No Recorded Data

Vertical Crash Pulse (Event Record 2)
Normal Acceleration (SDM Recorded Vehicle Vertical Acceleration for Rollover Event)

Contains No Recorded Data

Pre-Crash Data -5.0 to -0.5 sec (Event Record 2)

Times (sec)	Accelerator Pedal, % Full (Accelerator Pedal Position)	Service Brake (Brake Switch Circuit State)	Engine RPM (Engine Speed)	Engine Throttle, % Full (Throttle Position)	Speed, Vehicle Indicated (Vehicle Speed) (MPH [km/h])
-5.0	51	Off	2752	75	58 [94]
-4.5	59	Off	3008	78	59 [95]
-4.0	59	Off	3008	79	60 [97]
-3.5	60	Off	3072	79	62 [99]
-3.0	49	Off	3072	76	63 [101]
-2.5	0	Off	2816	28	63 [102]
-2.0	0	On	2624	21	63 [101]
-1.5	0	On	2176	18	58 [93]
-1.0	0	Off	1472	15	39 [63]
-0.5	0	On	1216	16	34 [54]

Pre-Crash Data -2.0 to -0.5 sec (Event Record 2)

Times (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Engine Torque (lb-ft [N-m])	Reduced Engine Power Mode Indicator
-2.0	No	No	No	-4 [-5]	Off
-1.5	No	No	No	-8 [-10]	Off
-1.0	No	No	No	-4 [-5]	Off
-0.5	No	No	No	1 [2]	Off

Hexadecimal Data

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DPID $11
FF F0 00 F0 C0 78 00

DPID $15
01 02 03 04 05 06 07

DPID $16
08 09 0A 0D 0E 00 00

DPID $17
00 00 00 00 00 00 00

DPID $32
00 FD 4D 2C 00 00 00

DPID $35
78 00 00 00 00 00 00

DID $01
41 55 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $03
41 54 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $05
41 48 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $07
41 4A 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $09
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $0B
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $0D
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $0F
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30 30

DID $30
01 00 02 01

DID $90
FF FF FF FF FF FF FF FF FF FF FF 2A 2A 2A 2A 2A 2A

DID $9A
04 01

DID $B4
41 53 38 37 34 31 45 30 35 30 30 32 30 30 34 33

DID $C1
01 5E 79 A6

DID $C2
01 5E 79 A7

DID $CB
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01 5E 79 A5

DID $31

0000	A5	00	00	00	01	00	01	48	0C	FF
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0030	00	00	00	00	00	00	00	00	55	55
0040	50	00	00	00	00	0C	0A	0F	12	18
0050	14	14	17	18	18	07	34	06	EA	06
0060	91	06	7D	14	13	0C	0A	0D	0B	0C
0070	0D	0D	0D	22	25	3A	45	53	5C	64
0080	6C	72	79	00	FF	45	00	53	FD	00
0090	00	00	00	00	00	00	00	00	00	00
0100	00	00	00	00	00	00	00	00	00	00
0110	00	00	00	00	00	00	75	43	87	48
0120	FF	FF	FF	FF	FF	FF	FF	FF	7F	7F
0130	7E	80	7D	80	7B	81	7A	82	79	83
0140	78	83	77	84	76	85	76	85	75	86
0150	75	86	75	86	75	87	75	87	75	87
0160	75	87	75	87	75	87	75	87	75	87
0170	75	87	75	87	75	87	75	87	75	87
0180	75	87	75	87	75	87	75	87	79	83
0190	79	85	7A	84	7B	84	79	84	7B	83
0200	79	82	78	82	7A	82	77	83	78	82
0210	7A	83	78	82	77	82	78	82	76	82
0220	72	84	72	83	73	86	78	85	77	8A
0230	77	84	78	85	76	85	78	83	78	84
0240	79	83	7A	82	77	80	78	82	7C	85
0250	78	84	7A	86	78	83	79	83	79	84
0260	7A	83	79	84	79	82	79	83	79	81
0270	7A	82	7A	82	7B	82	7B	83	7A	82
0280	7B	84	7C	84	7C	84	7C	83	7B	84
0290	7C	82	7C	83	7C	81	7E	83	7D	81
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0490	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0500	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0510	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0520	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0530	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
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0580	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0590	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
0600	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF

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 0800    00 00 00 00 00 00 00 00 00 00
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 0830    00 00 00 00 00 00 00 00 00 00
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 1160    FF FF FF FF FF FF FF FF FF FF
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DID $32

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 0010    FF 00 00 00 0E 00 00 00 00 00
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0040    00 00 00 00 00 13 17 22 29 2C
0050    30 30 2F 2F 2B 06 A4 06 96 06
0060    8B 06 96 10 0F 12 15 1C 4C 4F
0070    4F 4E 4B 36 3F 5D 65 66 65 63
0080    61 5F 5E 10 00 00 00 01 FD 80
0090    83 02 80 84 02 00 00 00 00 00
0100    00 00 00 00 00 00 00 00 00 00
0110    00 00 00 80 52 00 27 49 73 20
0120    FF FF FF FF FF FF FF FF 7D 7F
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0140    48 74 42 76 3B 76 36 77 30 77
0150    2C 79 29 79 28 7A 27 7A 28 7A
0160    29 7A 29 7A 2A 7A 2B 79 2B 79
0170    2C 7A 2C 7A 2C 7A 2C 7A 2C 7A
0180    2C 7A 2C 7A 2C 7A 2C 7A 79 6F
0190    5C 85 7F 7B 60 74 63 85 5B 7C
0200    5F 66 65 83 62 73 51 74 41 71
0210    51 93 8C 4F 18 78 72 0B 55 82
0220    5B 84 62 66 7F A9 64 86 40 7E
0230    52 5E 0F 6C 0E 4F 00 64 17 7C
0240    3A 6C 3D 76 26 72 0B 78 14 6E
0250    25 71 39 77 34 93 36 8D 38 96
0260    4E 7C 54 8E 5C 8E 5F 79 61 78
0270    59 80 4A 82 51 83 4E 79 58 89
0280    52 80 52 83 5A 8B 57 87 56 81
0290    54 85 56 84 52 82 57 88 60 87
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0310    6A 83 6A 85 6F 85 72 86 70 7F
0320    77 80 77 81 7A 7F 79 80 7A 7F
0330    7A 7D 7D 7F 80 7F 7F 7D 80 7F
0340    81 81 83 7E 85 82 84 81 85 81
0350    87 82 83 83 85 7F 84 80 82 7C
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 0820   18 00 00 41 31 00 00 00 31 00
 0830   00 70 14 00 14 00 00 00 18 00
 0840   00 41 41 00 00 00 31 00 00 70
 0850   14 00 14 00 00 00 18 00 00 41
 0860   00 00 41 00 02 00 00 00 00 00
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Disclaimer of Liability

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Appendix B: General Motors Technical Service Bulletin No. 14299

Bulletin No.: 14299
Date: August 2014

Recall Bulletin

PRODUCT SAFETY RECALL

SUBJECT: **Unintended Ignition Key Rotation**

MODELS:
2005-2009 Buick Allure (Canada)
2005-2009 Buick LaCrosse
2006-2011 Buick Lucerne
2000-2005 Cadillac DeVille
2006-2011 Cadillac DTS
2006-2007 Chevrolet Monte Carlo
2006-2013 Chevrolet Impala
2014 Chevrolet Impala Limited (U.S. Fleet Only)

It is a violation of Federal law for a dealer to deliver a new motor vehicle or any new or used item of motor vehicle equipment (including a tire) covered by this notification under a sale or lease until the defect or noncompliance is remedied.

Vehicles involved in this recall were placed on stop delivery June 20, 2014. Once the service procedure contained in this bulletin has been performed on the vehicle, the vehicle is released from stop delivery and the vehicle can be delivered to the customer.

All involved vehicles that are in dealer inventory must be held and not delivered to customers, dealer traded, or used for demonstration purposes until the repair contained in this bulletin has been performed on the vehicle.

CONDITION

General Motors has decided that a defect which relates to motor vehicle safety exists in all 2005-2009 model year (MY) Buick Allure (Canada), 2005-2009 MY Buick LaCrosse, 2006-2011 MY Buick Lucerne, 2000-2005 MY Cadillac DeVille, 2006-2011 MY Cadillac DTS, 2006-2007 MY Chevrolet Monte Carlo, 2006-2013 MY Chevrolet Impala and 2014 MY Chevrolet Impala Limited (U.S. Fleet Only) vehicles. If the key ring is carrying added weight and the vehicle goes off road or experiences some other jarring event, it may unintentionally move the key away from the "run" position. If this occurs, engine power, power steering and power braking will be affected, increasing the risk of a crash. If the ignition switch is not in the run position, the air bags may not deploy if the vehicle is involved in a crash, increasing the risk of injury or fatality.

CORRECTION

Dealers are to install two 16mm key rings and an insert in the key slot or a cover over the key head on all ignition keys.

VEHICLES INVOLVED

All involved vehicles are identified by Vehicle Identification Number on the Investigate Vehicle History screen in GM Global Warranty Management system. Dealership service personnel should always check this site to confirm vehicle involvement prior to beginning any required inspections and/or repairs. It is important to routinely use this tool to verify eligibility because not all similar vehicles may be involved regardless of description or option content.

For dealers with involved vehicles, a listing with involved vehicles containing the complete vehicle identification number, customer name, and address information has been prepared and will be provided to U.S. and Canadian dealers through the GM GlobalConnect Recall Reports, or sent directly to export dealers. Dealers will not have a report available if they have no involved vehicles currently assigned.

The listing may contain customer names and addresses obtained from Motor Vehicle Registration Records. The use of such motor vehicle registration data for any purpose other than follow-up necessary to complete this recall is a violation of law in several states/provinces/countries. Accordingly, you are urged to limit the use of this report to the follow-up necessary to complete this recall.

PART INFORMATION

Note: An initial supply of parts (including proper adhesives and application tools) required to complete this recall will be pre-shipped to involved dealers of record. This pre-shipment is scheduled to begin the week of Aug 25, 2014 to dealers with involved vehicles. Parts pre-shipped by GMCCA will be charged to dealer's open parts account. The Loctite adhesive and primer will be shipped direct from the supplier at no charge. The 3M adhesive, nozzle, applicator gun and plunger will also be shipped direct from the supplier at no charge.

Dealers will receive cancellations on any order placed for the related GM part number(s) listed below until further notice.

Note: Pre-shipments to involved export customers of record are estimated to begin the week of September 15th. Export customers will receive cancellations on any order placed for the related GM part number(s) listed below until further notice.

For Service Option #1 - Install Two 16mm Key Rings and an Insert in the Key Slot

Part Number	Description	Quantity/Vehicle
23279477	Key Insert (Pack of 4)	4
N/A	Loctite Adhesive 426	As Per Procedure
N/A	Loctite Primer 770	As Per Procedure
23247262 or 23232599	Key Ring (Pack of 4)	4 Rings (2 Per Key)

Note: Since only a small number of vehicles will require key replacement, dealers are encouraged not to order service keys for shelf stock. If a service key is required, dealers should refer to the GM Electronic Parts Catalog (EPC) for service key part number information and order accordingly from GMCCA.

For Service Option #2 – Install Two 16mm Key Rings and a Cover over the Key Head

Part Number	Description	Quantity/Vehicle
TBD	Key Cover Kit (Includes Two Front and Rear Covers)	1
N/A	3M Scotch–Weld Adhesive (Acrylic Low Odor Adhesive - DP8805NS Green)	As Per Procedure
N/A	Nozzle for 3M Scotch–Weld Adhesive (PN69043)	As Per Procedure
N/A	Applicator Gun for 3M Scotch–Weld Adhesive (PN08190)	As Per Procedure
N/A	10:1 Ratio Plunger for 3M Scotch–Weld Adhesive (PN69044)	As Per Procedure
23247262 or 23232599	Key Ring (Pack of 4)	4 Rings (2 Per Key)

Note: Since only a small number of vehicles will require key replacement, dealers are encouraged not to order service keys for shelf stock. If a service key is required, dealers should refer to the GM Electronic Parts Catalog (EPC) for service key part number information and order accordingly from GMCCA.

SERVICE PROCEDURE

Note: Carefully read and follow the instructions below.

- Use the key insert repair procedure to repair most customer-provided keys.
- Some keys will NOT be able to be repaired using the key insert repair. Use the two piece key cover kit to repair keys that cannot be repaired using the insert key repair.
- GM will release the two piece key cover kit in late September.
- In the rare instance that keys cannot be repaired, order new service keys for the customer-provided keys. Do NOT order new service keys unless BOTH repair methods have been attempted.
- The new service keys may have to be modified as instructed in this bulletin.
- If the new service key has a slot design for the key ring, it MUST be repaired using the key insert or two-piece key cover repair.
- If the new service key has a round hole or square design for the key ring, no key modification is required. Install two 16mm key rings as instructed in the service procedure.

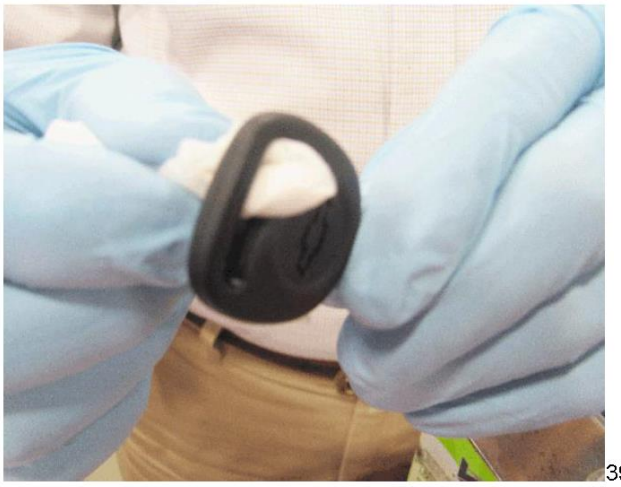
Key Insert Repair

3970365

Note: Locate the four key inserts and four 16 mm rings. Two key inserts are required to modify one key. Two 16mm key rings are required for each key repair.

Note: If the key slot is too small or large for the insert, use the two-piece key cover repair. If the head of the insert does not cover the entire slot, the key insert repair cannot be used.

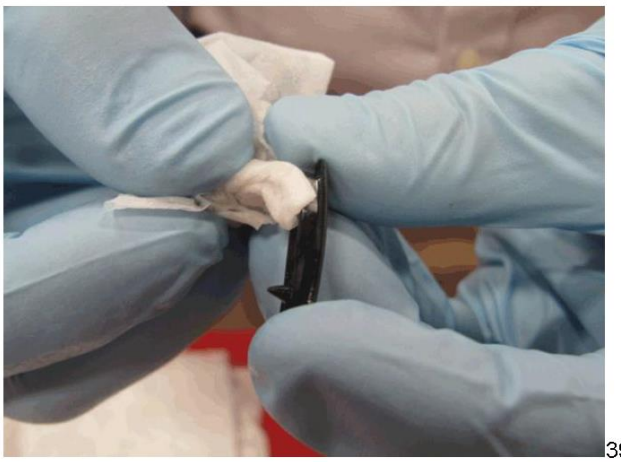
1. Test fit the customer-provided key. Insert a key insert into the front slot of the key and insert a second key insert into the back slot of the key. Ensure the key insert fits flush into the slot of both sides of the key.
2. Remove the inserts from the front and back key slots.



3970395

Caution: Do NOT use petroleum-based cleaning products to clean the key or key covers.

3. Clean the head and slot of the keys using a shop towel and isopropyl alcohol.

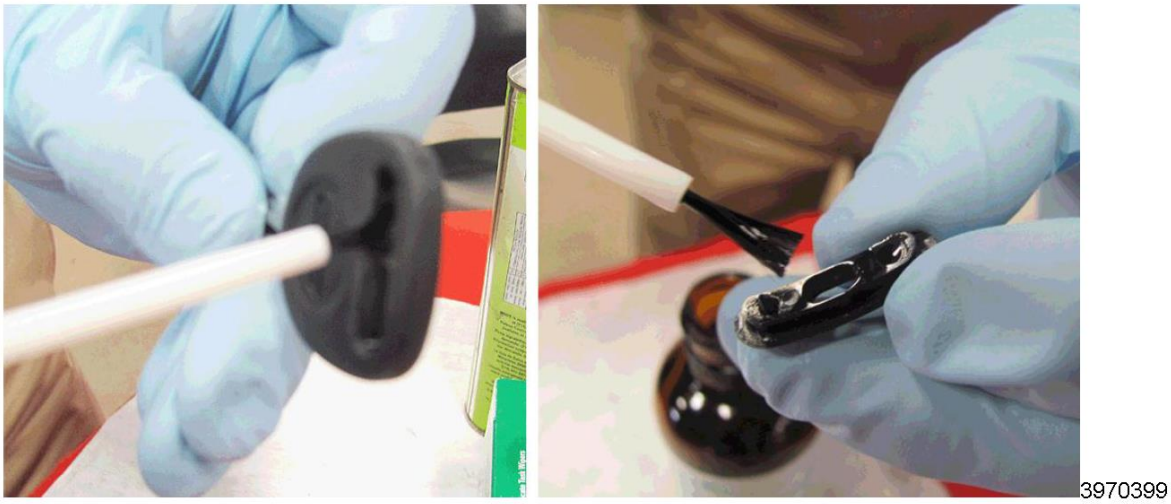

3970397

4. Clean the key inserts using a shop towel and isopropyl alcohol.

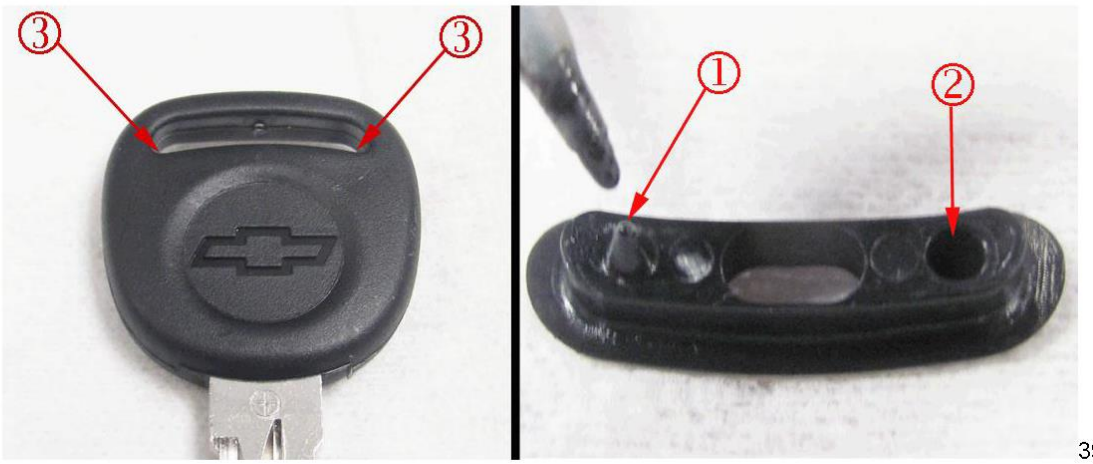
Caution: Allow the primer to dry for 5 minutes BEFORE proceeding to step 7 to ensure the adhesive will provide a strong bond between the key insert and the slot of the key.

Note: The adhesive for this repair begins to cure quickly. It is essential that both keys are repaired promptly. Ensure all of the required tools, parts and supplies are on your work bench BEFORE attempting to apply primer and adhesive to the key slots and key inserts. The following items should be on the work bench:

- Rubber gloves and shop towels
- Adhesive
- Key inserts
- Two rings for each key
- Spring clamp with rubber ends


3970399

5. Apply the primer to the front and back key slot of the two keys.
6. Apply the primer to the four inserts.



3970372

7. Apply adhesive to the corners (3) of the key slots.
8. Apply adhesive to the post (1) and hole (2) of each insert.


3970401

9. Insert a front and back insert to the key slot of each key.
10. Clean the body of the keys with a shop towel.
11. Clean the hole of each key with a shop towel and screwdriver.


3970376

12. Clamp the two key insert to the key slot using a spring clamp with rubber ends.

13. Remove the clamp from the key assembly after allowing the adhesive to dry for 5 minutes.

3970400

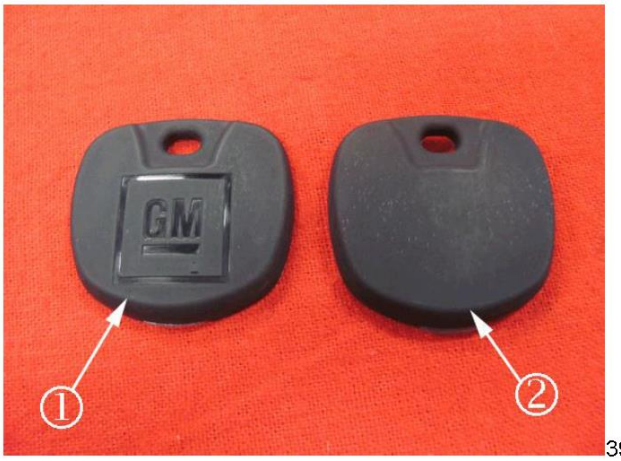
14. Install two 16 mm key rings to the key assembly. Attach the first 16 mm ring to the key hole. Attach the second 16 mm ring to the first 16 mm ring. Refer to photograph.

15. Make a copy to the owner manual supplement on the last page of this bulletin and insert it into the vehicle's owner manual.

Two-Piece Key Cover Repair

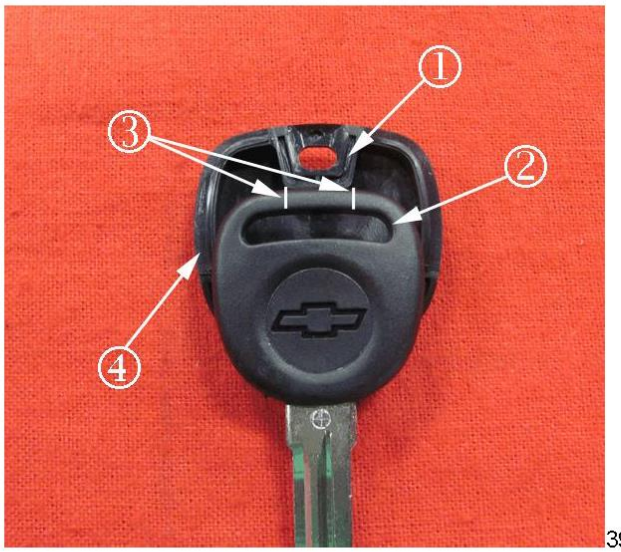
3971048

Note: Locate the four key covers and four 16 mm rings. A front and back cover are required to modify one key. Two 16mm key rings are required for each key repair.



3971010

Note: There is a front and back key cover. The front key cover has a GM logo on it (1). The back key cover is blank (2).



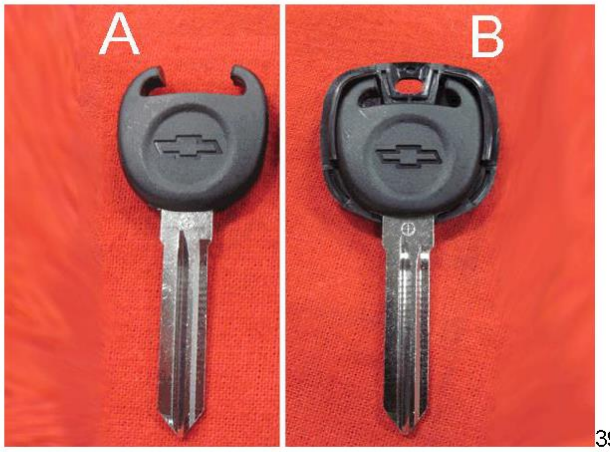
3971023

1. Test fit the customer-provided key into the back key cover.

   1.1 Ensure the body of the key fits into the back key cover. The body of the key may require some filing to fit into the cover. Use a file to remove the material from the body of the key.

   1.2 Align the back cover boss (1) with the slot (2) of the customer-provided key.

   1.3 Using a pen or knife mark the top portion of the slot (3) that must be cut in order for the customer-provided key to fit inside of the back cover.

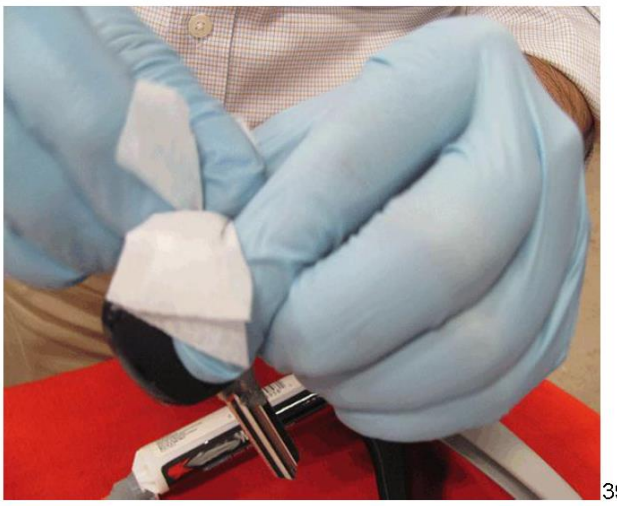


3971044

   1.4 Using a knife or box cutter, cut out a notch (A) in the slot of the key.

   1.5 The back cover boss must fit inside of the notched area of the key (B).

   1.6 Remove the key from the back cover.


3971005

Caution: Do NOT use petroleum-based cleaning products to clean the key or key covers.

2. Clean the head and slot of the keys using a shop towel and isopropyl alcohol.
3. Clean the front and back key covers using a shop towel and isopropyl alcohol.

Note: The adhesive for this repair begins to cure quickly. It is essential that both keys are repaired promptly. Ensure all of the required tools, parts and supplies are on your work bench BEFORE attempting to assemble the key covers over the key. The following items should be on the work bench:

- Adhesive
- A front and back key cover for each key
- File
- Shop towels and rubber gloves
- Two rings for each key
- Spring clamp with rubber ends

Note: Use a small flat bladed screwdriver to separate the two covers. Insert the screwdriver into the key blade opening of the cover. Turn the screw driver to separate the two covers.

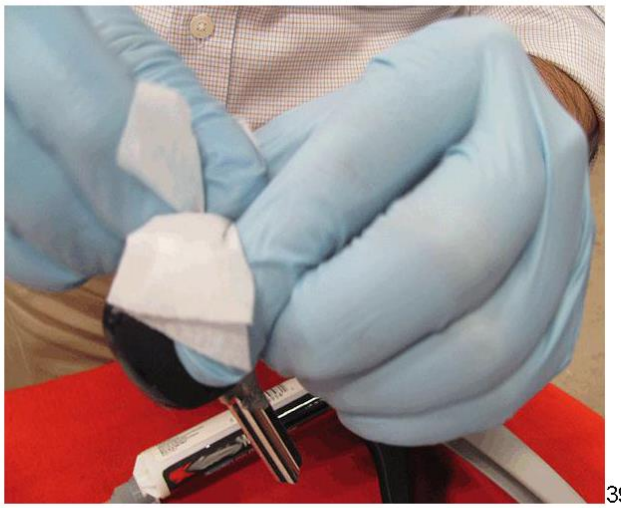
4. Assemble the front and back key cover over the key. Ensure the front and back cover fit over the key and that the two covers snap together.
    - If the key covers fit over the key and snap together correctly, proceed to step 5.
    - If the key covers do NOT fit over the key, file more material off the body of the key. Re-assemble the key covers over the key to ensure proper cover fit. Clean the key and covers BEFORE applying the adhesive.


3971030

5. Dispense a small amount of adhesive to ensure the mixed adhesive is blue or green (not white or brown) in color. Then apply a bead of adhesive to the inside of the front and back key cover. Ensure a bead of adhesive is applied to the whole perimeter of the cover.

3970991

6. Press the front and back key cover over the key.


3971005

7. Remove excess adhesive from the body of the key using a shop towel and isopropyl alcohol.
8. Remove excess adhesive from the hole of the front and back key cover using a shop towel and small screwdriver.


3970997

9. Clamp the two covers together using a spring clamp with rubber ends.
10. Allow the adhesive to dry for 30 minutes before removing the spring clamp from the key assembly.

3971045

11. Install two 16 mm key rings to the key assembly. Attach the first 16 mm ring to the key hole. Attach the second 16 mm ring to the first 16mm ring. Refer to photograph.

12. Make a copy to the owner manual supplement on the last page of this bulletin and insert it into the vehicle's owner manual.

Note: Do not re-attach the fob or any other keys to the second 16 mm ring. Instruct the customer not to attach the fob or any other keys to the second ring for approximately 24-hours to allow the adhesive to reach maximum holding strength. Customers are to refer to the owner manual supplement for proper attachment instructions.

FLOOR PLAN REIMBURSEMENT

Dealers in possession of vehicles included in the Stop Delivery are eligible for reimbursement of floor plan expense upon completion of this recall. This reimbursement is limited to the number of days from the Stop Delivery message to receipt of the recall parts and/or repair procedures. Floor plan reimbursement beyond these dates is not allowed. The amount of reimbursement should be charged as a net amount expense using the recall labor operation provided.

COURTESY TRANSPORTATION – For U.S. and Canada

The General Motors Courtesy Transportation program is intended to minimize customer inconvenience when a vehicle requires a repair that is covered by the New Vehicle Limited Warranties. The availability of courtesy transportation to customers whose vehicles are within the warranty coverage period and involved in a product program is very important in maintaining customer satisfaction. Dealers are to ensure that these customers understand that shuttle service or some other form of courtesy transportation is available and will be provided at no charge. Dealers should refer to the General Motors Service Policies and Procedures Manual for Courtesy Transportation guidelines.

WARRANTY TRANSACTION INFORMATION

Submit a transaction using the table below. All transactions should be submitted as a ZFAT transaction type, unless noted otherwise.

Note: To avoid having to "H" route the courtesy transportation and/or floor plan transaction for approval, it must be submitted prior to the repair transaction.

Labor Code	Description	Labor Time	Net Item
9100637	Install Key Insert and Key Rings (Two Keys)	0.4	N/A
9100872	Install Key Cover and Key Rings (Two Keys) Add: 0.1-0.3 to Modify Key to Fit Key Cover	0.4	N/A
9100873	**Insert Test Fit Unsuccessful – Repair Not Workable** Install Key Cover and Key Rings (Two Keys) Add: 0.1-0.3 to Modify Key to Fit Key Cover (If Required)	0.5	N/A
9100874	**Service Keys (Round Hole or Square Design)** Add: 0.1-0.3 to Modify Key to Fit Key Cover (If Required) Includes: Insert Test Fit, Key Cover Repair and Cutting Two Keys - **Service Key Modification Not Required**	0.8	N/A
9100875	**Service Keys (Slot Design)** Add: 0.1-0.3 to Modify Key to Fit Key Cover if required Includes: Insert Test Fit, Key Cover Repair and Cutting Two Keys - **Service Key Modification Required**	1.2	N/A
9100876	Floor Plan Reimbursement	N/A	*

Note: Most keys will NOT require much filing to fit into the key covers. The 0.4 base time includes time to perform minor filing for correct key-to-cover fit. **Only use the add time for repairs that require a substantial amount of filing time**.

* The amount identified in "Net Item" should represent the product of the vehicle's average daily interest rate (see table below) multiplied by the actual number of days the vehicle was in dealer inventory and not available for sale. This reimbursement is limited to the number of days from the date of the stop delivery message (June 20, 2014) to the date the repair is completed and the vehicle is ready for sale (not to exceed 70 days):

Vehicle	U.S. Reimbursement Amount	Canadian Reimbursement Amount
2013 Impala	$4.06	$ 4.80
2014 Impala Limited	$4.51	N/A

CUSTOMER NOTIFICATION – For U.S. and Canada

General Motors will notify customers of this recall on their vehicle.

CUSTOMER NOTIFICATION – For Export

Letters will be sent to known owners of record located within areas covered by the U.S. National Traffic and Motor Vehicle Safety Act.

DEALER RECALL RESPONSIBILITY – For U.S. and Export (U.S. States, Territories, and Possessions)

It is a violation of Federal law for a dealer to deliver a new motor vehicle or any new or used item of motor vehicle equipment (including a tire) covered by this notification under a sale or lease until the defect or noncompliance is remedied.

The U.S. National Traffic and Motor Vehicle Safety Act provides that each vehicle that is subject to a recall of this type must be adequately repaired within a reasonable time after the customer has tendered it for repair. A failure to repair within sixty days after tender of a vehicle is prima facie evidence of failure to repair within a reasonable time. If the condition is not adequately repaired within a reasonable time, the customer may be entitled to an identical or reasonably equivalent vehicle at no charge or to a refund of the purchase price less a reasonable allowance for depreciation. To avoid having to provide these burdensome remedies, every effort must be made to promptly schedule an appointment with each customer and to repair their vehicle as soon as possible. In the recall notification letters, customers are told how to contact the U.S. National Highway Traffic Safety Administration if the recall is not completed within a reasonable time.

DEALER RECALL RESPONSIBILITY – All

All unsold new vehicles in dealers' possession and subject to this recall must be held and inspected/repaired per the service procedure of this recall bulletin before customers take possession of these vehicles.

Dealers are to service all vehicles subject to this recall at no charge to customers, regardless of mileage, age of vehicle, or ownership, from this time forward.

Customers who have recently purchased vehicles sold from your vehicle inventory, and for which there is no customer information indicated on the dealer listing, are to be contacted by the dealer. Arrangements are to be made to make the required correction according to the instructions contained in this bulletin.

In summary, whenever a vehicle subject to this recall enters your vehicle inventory, or is in your dealership for service in the future, you must take the steps necessary to be sure the recall correction has been made before selling or releasing the vehicle.

REPRODUCE LOCALLY - INSERT IN VEHICLE'S OWNER MANUAL

Supplement to the Owner Manual

This information is in addition to and/or replaces information located under "Keys" found in Section 2 of your owner manual.

⚠ WARNING

If the key is unintentionally rotated while the vehicle is running, the ignition could be moved out of the RUN position. This could be caused by heavy items hanging from the key ring, or by large or long items attached to the key ring that could be contacted by the driver or steering wheel. If the ignition moves out of the RUN position,

(Continued)

WARNING (Continued)

the engine will shut off, braking and steering power assist may be impacted, and airbags may not deploy. To reduce the risk of unintentional rotation of the ignition key, do not change the way the ignition key and Remote Keyless Entry (RKE) transmitter, if equipped, are connected to the provided key rings.

The ignition key and key rings, and RKE transmitter, if equipped, are designed to work together as a system to reduce the risk of unintentionally moving the key out of the RUN position. The ignition key has a small hole to allow attachment of the provided key ring. It is important that any replacement ignition keys have a small hole. See your dealer if a replacement key is required.

The combination and size of the rings that came with your keys were specifically selected for your vehicle. The rings are connected to the key like two links of a chain to reduce the risk of unintentionally moving the key out of the RUN position. Do not add any additional items to the ring attached to the ignition key. Attach additional items only to the second ring, and limit added items to a few essential keys or small, light items no larger than an RKE transmitter.

Litho in U.S.A.
Part No. 23259399

DOT HS 813 155
December 2021

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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