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15. Supplementary Notes

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

16. Abstract

This on-site investigation documents the head-on crash of a 2014 Chevrolet Silverado with a 2003 Mitsubishi Galant that resulted in the fatality of the Chevrolet's belted 63-year-old female driver. The crash occurred on an east/west two-lane roadway when the Mitsubishi crossed over the centerline directly into the path of the Chevrolet. In addition to the fatality of the Chevrolet driver, the Mitsubishi's 18-year-old female driver sustained fatal injuries and the 19-year-old male front right passenger sustained incapacitating (A-level) injuries. A family member of the Chevrolet driver notified NHTSA of the crash in November 2019. The family member had received a recall notice from the vehicle manufacturer (identified as NHTSA Recall #19V645) regarding the Chevrolet's braking system and expressed concern that it could potentially be related to the crash. A query of NHTSA's recall database identified two additional open recalls: NHTSA Recall #16V209 regarding the Chevrolet driver's seat belt pretensioner, and NHTSA Recall #17V414 regarding the steering system. Through the course of this investigation the SCI team determined that the high delta V of the Chevrolet front plane impact was the sole contributor to the fatal outcome of the driver. There was no evidence to support the claim that any of the Chevrolet's open recalls played a role in the fatal outcome of the Chevrolet driver. With regard to the seat belt system recall, the SCI inspection observed that the driver seat belt system and pretensioner remained intact. The circumstances of the crash were outside the circumstances affecting the steering system recall. With regard to the braking system recall, SCI inspection of the vehicle found crash-related damage to the vehicle that prevented mechanical functionality testing of the system. However, data imaged from the vehicle EDR showed the driver applied the brakes in the last second of the pre-crash data interval, accompanied by a reduction in vehicle speed.

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On-Site Reported Brake System Malfunction Crash Investigation
Office of Defects Investigation
Case Number: CR19035
Vehicle: 2014 Chevrolet Silverado 1500
Location: North Carolina
Crash Date: June 2019

Background

This on-site investigation documents the head-on (offset frontal) crash of a 2014 Chevrolet Silverado (Figure 1) with a 2003 Mitsubishi Galant that resulted in the fatality of the Chevrolet's belted 63-year-old female driver. The crash occurred on an east/west, two-lane roadway when the Mitsubishi crossed over the centerline directly into the path of the Chevrolet. In addition to the Chevrolet driver fatality, the Mitsubishi's 18-year-old female driver sustained fatal injuries and the 19-year-old male front right passenger sustained incapacitating (A-level) injuries. A family member of the Chevrolet driver notified the National Highway Traffic Safety Administration of the crash in November 2019. The family member had received a recall notice from the vehicle manufacturer (identified by NHTSA Recall #19V645) regarding the Chevrolet's braking system and expressed concern that it could potentially be related to the crash. A query of NHTSA's recall database identified two additional open recalls, NHTSA Recall #16V209 regarding the Chevrolet driver's seat belt pretensioner, and NHTSA Recall #17V414 regarding the steering system.

Figure 1. Left front oblique view of the Chevrolet

The reported contributory role of the recalls in the crash and its fatal outcome necessitated further research, and the notification was forwarded to the Special Crash Investigations team at Crash Research & Analysis in November 2019 and assigned for on-site investigation. The SCI team located the Chevrolet at an insurance vehicle salvage facility and established cooperation for inspection. The Mitsubishi could not be located. On-site activities for this investigation took place in December 2019, and included the detailed exterior and interior inspection of the Chevrolet to measure the exterior and interior deformation and intrusion, document interior occupant contact evidence, examine the manual restraint systems, assess the supplemental

restraint systems, and inspect the braking system. During the SCI vehicle inspection, data were imaged from the Chevrolet's event data recorder (EDR) using the current version of the Bosch Crash Data Retrieval (CDR) tool/software. In addition, the crash site was photographed and documented using a total station mapping system.

Through the course of this investigation, the SCI team determined that the high delta V of the Chevrolet front plane impact was the sole contributor to the fatal outcome of the driver. There was no evidence to support the claim that any of the Chevrolet's open recalls played a role in the fatal outcome of the Chevrolet driver. With regard to the seat belt system recall, the SCI inspection observed that the driver seat belt system and pretensioner remained intact. The circumstances of the crash were outside of the circumstances affecting the steering system recall. With regard to the braking system recall, SCI inspection of the vehicle found crash-related damage to the vehicle that prevented mechanical functionality testing of the system. However, data imaged from the vehicle EDR indicated that the driver applied the brakes in the last second of the pre-crash data interval, accompanied by a reduction in vehicle speed.

Summary

Crash Site

This crash occurred on a two-lane roadway in a rural setting in the morning. Reported weather conditions in the locale included clear skies, a temperature of 28 ºC (83 ºF), 56-percent relative humidity, and 27 km/h (17 mph) westerly winds. In the eastbound travel direction, the roadway was straight and level for an extended continuous distance. For westbound traffic, the straight roadway crested a slightly blind hill and then entered the extended level portion. Both travel lanes were 3.1 m (10.2 ft) wide and supported by a 0.6 m (2.0 ft) roadway edge. In the vicinity of the crash, travel lanes were delineated by solid white fog lines and a yellow centerline that permitted passing for westbound traffic. The north and south roadsides consisted of grassy swales that transitioned to drainage ditches along expansive swampy and forested wilderness. Speed was regulated by a posted limit of 89 km/h (55 mph). Figure 2 shows the roadway for the Chevrolet's pre-crash travel trajectory, while Figure 3 shows the roadway for the Mitsubishi's approach. A crash diagram is included at the end of this report.

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

Figure 3. Westbound view of the Mitsubishi's pre-crash approach to the crash site

Pre-Crash

The Chevrolet traveled east on the two-lane roadway, driven by a belted 63-year-old female. She drove with both front door windows fully open. Specifics concerning her pre-crash activities and route of travel remain unknown. However, in the vicinity of the crash site the driver had continued along a straight and level section of the roadway and intended to maintain her westbound operation of the Chevrolet. Data imaged from the EDR indicated that the Chevrolet traveled at a constant speed of 89 km/h (55 mph) from -5 seconds to -1 second prior to algorithm enable (AE).

The Mitsubishi traveled west on the same two-lane roadway, driven by a belted 18-year-old female with a belted 19-year-old male front row right passenger. Specifics concerning their pre-crash activities and route of travel remain unknown. The Mitsubishi crested the slight hill and entered the extended straight and level portion of the roadway. As it continued west, the Mitsubishi drifted to the left from its travel lane over the yellow centerline and into the path of the oncoming Chevrolet.

The Chevrolet driver apparently saw the Mitsubishi's errant trajectory and encroachment into her travel path. The Chevrolet EDR data reported her braking input during the last second of the recorded pre-crash data interval, with a corresponding 11 km/h (7 mph) reduction in speed to 78 km/h (48 mph) at the -0.5 second pre-crash interval. There was no evidence documented by the law enforcement investigation or visible at the crash site at the time of the SCI inspection to support avoidance action by the Mitsubishi driver prior to the crash.

Crash

The Mitsubishi's front plane struck the front plane, left aspect of the Chevrolet in an off-set, head-on configuration. Directions of force were within the 12 o'clock sector (350 degrees) for both vehicles and the off-set alignment induced a counterclockwise rotation to each.

The Chevrolet rotated 70 degrees counterclockwise and slid 8.3 m (27.2 ft) eastward, where it departed the right roadway edge, finally resting in the south roadside facing north. The Mitsubishi rotated 125 degrees counterclockwise and slid 3.7 m (12.1 ft) westward, where it came to final rest straddling the roadway centerline and facing east.

Post-Crash

The local emergency response system received several calls reporting the crash. Law enforcement, fire department, and EMS personnel responded, using hydraulic rescue tools to force the Chevrolet driver's door open. They removed her and transported her via ambulance to a local hospital for treatment of incapacitating injuries. She was admitted for treatment but expired 3 days after the crash.

The Mitsubishi driver had no vital life signs and was pronounced deceased at the scene. The front passenger was transported by an ambulance to a local hospital and admitted for treatment of incapacitating (A-level) injuries.

Following the on-scene law enforcement investigation of the crash, a local service recovered the Chevrolet and Mitsubishi and towed them to a local yard. The Chevrolet was later transferred to

a regional insurance vehicle salvage facility, where it was located for this SCI investigation. The outcome of the Mitsubishi remains unknown; it could not be located for inspection.

2014 Chevrolet Silverado 1500

Description

The 2014 Chevrolet Silverado 1500 pickup (Figure 4) was manufactured in July 2014 and identified by the VIN 1GCRCPEH0EZxxxxxx. The electrical system was inoperable at the time of the SCI inspection and the odometer reading could not be obtained. The Chevrolet was a rear-wheel-drive platform, powered by a 4.3-liter, V-6 gasoline engine linked to an automatic transmission. Its service brakes were power-assisted 4-wheel disc with antilock, while the steering was hydraulic-power-assisted rack-and-pinion. Additional features included traction control, stability control, and tire pressure monitoring. The gross vehicle weight rating was 3,130 kg (6,900 lb), with gross axle weight ratings of 1,633 kg (3,600 lb) front and 1,792 kg (3,950 lb) rear. The manufacturer's recommended tire size was P255/70R17, with recommended cold tire pressures of 240 kPa (35 PSI) for all four axle positions. At the time of the SCI inspection, the Chevrolet had Bridgestone Dueller H/L tires of size P265/70R17 at all four axle positions. All four tires had at least 2 mm (3/32 in) of tread. Only the left front tire was damaged in the crash; it was deflated and restricted/captured in the damaged components.

Figure 4. Right plane view of the 2014 Chevrolet Silverado 1500 during the SCI vehicle inspection

The Chevrolet had seating for up to five occupants (2/3), with front-row bucket seats and a second-row bench seat with spilt forward-folding seat backs. The front-row seats and the second-row outboard positions had adjustable head restraints. All seating surfaces were cloth, with aftermarket polyester seat covers installed by the Chevrolet owner. Manual restraint systems consisted of 3-point lap and shoulder seat belts for all five seat positions. Supplemental restraint systems included front seat belt retractor and lower anchor pretensioners, with six inflatable supplemental restraints. In this crash the front seat belt pretensioners actuated and the driver's frontal air bag, driver's seat-mounted air bag, and both inflatable curtain (IC) air bags deployed.

Vehicle History

A commercially obtainable vehicle history for this specific 2014 Chevrolet Silverado 1500 stated the vehicle had only one owner over its lifetime. It was registered and titled in North Carolina to a resident. There were routine maintenance reports but no reported service to or replacement of the vehicle safety systems. The last reported odometer reading was 83,276 km (51,745 mi) in October 2016. Three manufacturer safety recalls were identified by the vehicle history report,

with no indication that the vehicle had received service remedies for any of them. For further description and information, see the NHTSA Recalls and Investigations section of this report.

Exterior Damage

This crash involved the Chevrolet's front plane and the damage pattern resembled an off-set profile heavily biased to the front left aspect. There was significant deformation/crush to the front plane, distributed across the Chevrolet's width. In the damage pattern was deformation and rearward displacement/compression of the engine and surrounding components. The left front axle position was deformed and displaced rearward, shortening the left wheelbase (Figure 4) by 62 cm (24.4 in). Direct contact on the hood began directly on the centerline and extended 82 cm (32.3 in) to the left front corner. Significant deformation was observed to the bumper beam, with direct contact from the engagement and rotation of the vehicles following initial contact extending 40 cm (15.7 in) right of center.

Figure 5. Front plane damage and left wheelbase reduction to the Chevrolet

Figure 6. Front plane damage profile and bumper beam deformation to the Chevrolet

A residual crush profile was documented to the deformed front bumper structure of the Chevrolet (Figure 6) using a Field-L width of 164 cm (64.6 in). Accounting for free-space, the resultant crush profile measurements included: C1 = 122 cm (48.0 in), C2 = 98 cm (38.6 in), C3 = 76 cm

(29.9 in), C4 = 85 cm (33.5 in), C5 = 16 cm (6.3 in), and C6 = 0 cm (0 in). Maximum crush was observed at the left front bumper corner. A corresponding collision deformation classification (CDC) of 12FYEW5 was assigned to the Chevrolet's front plane damage profile.

The WinSMASH model's "missing vehicle" algorithm was used to calculate the severity of the crash. The total calculated vehicle velocity change (delta V) was 66 km/h (41.0 mph), with specific longitudinal and lateral components of -65 km/h (-40 mph) and 11 km/h (7 mph), respectively. Based on SCI expertise and observed vehicle damage, the collision fits the model and the results appeared reasonable. Of note, the WinSMASH results were nearly identical to the EDR-reported delta V data (see Event Data Recorder section below).

Event Data Recorder

The 2014 Chevrolet Silverado 1500 had an air bag sensing and diagnostic control module (SDM) mounted to the center tunnel beneath the center console. The SDM monitored three-dimensional acceleration and commanded the actuation or deployment of pretensioners and inflatable supplemental restraint systems. The SDM also had EDR capabilities. During the SCI vehicle inspection the Chevrolet EDR data was imaged using the Bosch CDR tool and software version 19.1.1, via a direct to module connection and using an external power supply. The data was later read using software version 21.5, included as an appendix to this report.

The EDR could store up to three crash event records termed "deployment" or "non-deployment" event types. By definition, a deployment event was any recognized event in which the SDM deployed of an air bag. A non-deployment event did not deploy air bags, but could include pretensioner actuation-only commanded events. Non-deployment events were subject to overwrite by subsequent events of greater severity, whereas deployment events became locked to memory and could not be overwritten. A minimum SDM recorded vehicle velocity change of 8 km/h (5 mph) was needed to record a non-deployment event.

The EDR could record several events concurrently, and the recording to memory of those events would occur in the order they became qualified. That is, if two events began (enabled) consecutively, but the second event was qualified before the first event, then the second event was recorded before the first event despite the consecutive timing of those events.

If power to the SDM was lost following a crash , all or part of the data may not have been recorded to the EDR's memory. The EDR had the capacity to record 300 milliseconds of data once the minimum threshold was achieved. For rollover events, a total of 1,000 milliseconds of data could be recorded: 700 milliseconds leading up to deployment, and 300 milliseconds after deployment.

An asynchronous 5-second pre-crash buffer that recorded pre-crash data points in 0.5-second intervals was tied to the recording of each event. Data recorded included accelerator pedal (% full), service brake (on/off) status, engine speed (rpm), engine throttle (% full), and vehicle speed (mph) data. System status data including reported diagnostic trouble codes (DTCs), seat belt usage of front-row occupants, and vehicle ignition cycle at the time of the event were also recorded.

The imaged data contained one recorded event, a deployment event type, recorded as Event Record 1. The data were imaged on ignition cycle counter 13,550, which was the same ignition cycle reported when the event occurred. Therefore, the recovered data were related to the crash under investigation. The seat belt status of the driver (sole occupant) and right-front occupant positions were reported "Buckled" and "Not buckled," and the passenger classification status of the front right occupant position was reported "Empty." The driver seat track position was reported as "rearward." There were no DTCs active when the crash occurred, and no supplemental restraint system warning lights were illuminated. A complete file was recorded in association to the deployment event. The following recorded pre-crash buffer data was reported with Event Record 1.

Time (sec)	Accel. Pedal (%)	Service Brake	Engine rpm	Speed (km/h [mph])
-5.0	20	OFF	1,344	89 [55]
-4.5	20	OFF	1,344	89 [55]
-4.0	20	OFF	1,344	89 [55]
-3.5	20	OFF	1,344	89 [55]
-3.0	20	OFF	1,344	89 [55]
-2.5	20	OFF	1,344	89 [55]
-2.0	19	OFF	1,344	89 [55]
-1.5	0	OFF	1,344	89 [55]
-1.0	0	ON	1,216	81 [50]
-0.5	0	ON	1,152	78 [48]

The maximum longitudinal delta V reported was -65 km/h (-40 mph) at 158 milliseconds after time zero. The maximum lateral delta V was 14 km/h (9 mph), which occurred at 56 milliseconds. The following supplemental restraint system deployment/actuation commands were associated with the frontal event.

Frontal Impact With Mitsubishi (Event Record 1)	
Device	**Time after AE (milliseconds)**
Pretensioners, driver	8
Pretensioners, right front passenger	8
Frontal air bag, first Stage, driver	9
Frontal air bag, second stage, driver	12
Side air bag (seat-mounted), driver	15
Inflatable curtain, left	15
Inflatable curtain, right	15

Interior Damage

Although both front windows of the Chevrolet were fully open at the time of the crash, there was no loss of integrity to the interior compartment. Both left-side doors were jammed shut by damage/deformation, but the right-side doors remained closed and operational. The windshield was fractured across its entire width by the crash forces. The rest of the Chevrolet glazing remained intact and was not damaged during the crash.

Interior inspection of the Chevrolet revealed significant intrusion into the occupant compartment, with several areas of identifiable occupant contact. The significant crush to the left front aspect of the Chevrolet and corresponding reduction in the left wheelbase resulted in intrusion of the left toe pan, foot pedals, floor, left lower A-pillar, left instrument panel, left sill, and left B-pillar. Induced deformation buckled the Chevrolet's floor and deformed the driver seat. There was also induced deformation to the floor in the second row, as well as along the center tunnel of the vehicle. Figure 7 shows the driver's position and the surrounding intrusions/deformed components. Note that the floor/toe pan intrusions deformed and displaced the foot controls, such that the floor was engaged against the foot controls. This prevented the SCI investigator from depressing the brake pedal to verify functionality of the system during the SCI vehicle inspection process.

Figure 7. View of the intruded components surrounding the driver's position of the Chevrolet

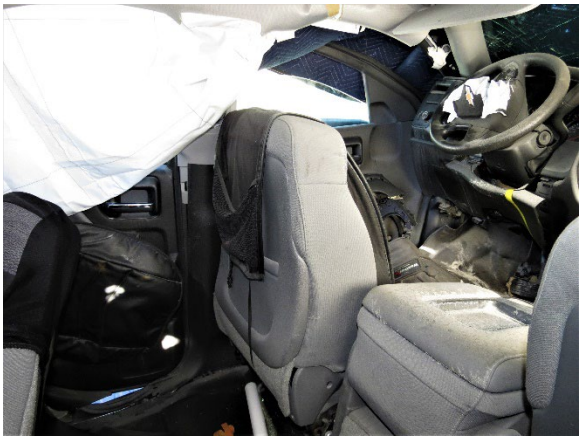


Figure 8. Left-facing view of the Chevrolet's deformed driver's seat and buckled left floor/sill

Figure 8 shows the buckled floor, sill, left B-pillar, and deformed driver's seat from a second row vantage point. Intrusions documented by the SCI inspection included:

Row	Position	Component	Intrusion Magnitude	Direction
Front Row	Left	Instrument panel left	5 cm (2.0 in)	Longitudinal
Front Row	Left	A (A1/A2)-pillar	13 cm (5.1 in)	Longitudinal
Front Row	Left	B-pillar	11 cm (4.3 in)	Lateral
Front Row	Left	Foot controls	16 cm (6.3 in)	Longitudinal
Front Row	Left	Toe pan	20 cm (7.9 in)	Vertical
Front Row	Left	Floor pan (includes sill)	19 cm (7.5 in)	Vertical
Second Row	Left	Floor pan (includes sill)	13 cm (5.1 in)	Lateral

The Chevrolet's interior surfaces were covered in a thick layer of dust, dirt, and grime accumulated from the date of the crash until the SCI vehicle inspection more than 5 months later. This layer of dirt masked evidence of occupant contact, if any. However, the SCI investigator observed deformation to the left lower instrument panel, consistent with loading by the driver's left and right knees (highlighted by yellow masking tape in Figure 9). The driver's contact to the left lower instrument panel resulted from the combination of her forward kinematic response, in conjunction with the rearward longitudinal intrusion of the instrument panel/surrounding frontal components.

Figure 9. Occupant contact to the Chevrolet's left lower instrument panel from the driver's knees

Figure 10. Chevrolet driver's seat belt system at the time of the SCI vehicle inspection

Manual Restraint Systems

The Chevrolet had 3-point continuous-loop lap and shoulder seat belts for all five seats. They all used lightweight cinching latch plates, and the driver and front-row right systems had adjustable D-rings. The driver seat belt retracted onto an emergency locking retractor (ELR), while the four other systems used switchable ELR/automatic locking retractors. Both front seat belt systems had retractor and lower anchor pretensioners. Data imaged from the Chevrolet EDR showed that all pretensioner systems were commanded to actuate from the front plane crash with the Mitsubishi.

At the time of the inspection, the SCI investigator found the driver seat belt system tied around the upper frame of the driver's door in an apparent attempt by a prior unknown person to hold the door closed. This had exposed the webbing and latch plate to the environment over time prior to the SCI inspection. Despite its exposure to the elements, a 20 cm (7.9 in) long area of stretching from the D-ring remained visible on the webbing. The webbing was extended (Figure 10) from the retractor, which was locked in position. The length of exposed webbing measured 195 cm (76.8 in) from the lower anchor to the D-ring. This represented an excess of 130 cm (51.2 in) webbing, as the length of exposed webbing if the belt were in a stowed position would be only 65 cm (25.6 in). There was also a portion of the webbing loosely gathered in the forward aspect of the D-ring.

The locked status of the retractor was presumably related to the actuation of the retractor pretensioner and engagement of the ELR. The SCI investigator observed that the lower anchor pretensioner was noticeably actuated, as the lower anchor was drawn most of the way down into the polymer cover on the outboard side of the driver seat (Figure 11). Intrusions and deformation to the Chevrolet prevented direct inspection of the pretensioners by the SCI investigator, as the B-pillar and left sill were rigidly engaged against the left side of the driver seat (Figure 12).

Figure 11. View of the Chevrolet driver's lower anchor visibly drawn into the fascia by pretensioner actuation

Figure 12. Deformed driver's seat engaged against the intruded left sill and B-pillar of the Chevrolet

Based on the observations of the SCI investigator, it was apparent that the driver was belted at the time of the crash. Even though the vehicle had not been serviced for the recall concerning the driver pretensioner, there was no evidence of pretensioner cable fracture. Therefore, the vehicle evidence suggested that the seat belt operated as designed during this crash and that the defect condition specified by Recall #16V209 was not present.

Supplemental Restraint Systems

The Chevrolet had several devices to provide for the supplemental restraint of its occupants. This included a certified advanced 208-compliant (CAC) frontal air bag system, front seat-mounted side impact air bags, and dual-sensing (side impact and rollover) IC air bags. The CAC system consisted of dual-stage driver and passenger frontal air bags, front seat track position sensors, front seat belt buckle sensors, front lower anchor and retractor pretensioners, and a front right occupant classification sensor. The driver frontal air bag was mounted in the hub of the four-spoke steering wheel, while the passenger frontal air bag was a top-mount design in the right instrument panel. The front seat-mounted side impact air bags were mounted in the outboard aspect of each front seat adjacent to the respective B-pillars, and provided supplemental protection for lateral (side) crash forces.

The IC air bags were mounted to the roof side rails and concealed by the vehicle head liner, designed to provide outboard protection for both seating rows. Labeling molded into the polymer surfaces of the pillar trim panels identified the presence of the IC air bags. The supplemental restraints (air bags and pretensioners) were controlled and monitored by the center tunnel-mounted air bag SDM. The lower anchor and retractor pretensioners actuated and deployed the driver frontal air bag, driver seat-mounted air bag, and both IC air bags.

The driver frontal air bag deployed from the steering wheel hub-mounted module and through the cover flaps without damage. In its deflated state, it measured approximately 60 cm (24 in) in overall diameter. It had a 16 cm (6.3 in) wide by 9 cm (3.5 in) tall oval center stitch pattern, to which internal tethers were affixed. The air bag was vented on its rear aspect by a pair of 4 cm (1.6 in) diameter vent ports, located at the 11 o'clock and 1 o'clock positions. The SCI investigator observed that there was some discoloration to the lower aspect/bottom of the air bag

fabric, presumably remnants of blood/body fluid from the driver. Figure 13 shows the deployed driver frontal air bag at the time of the SCI inspection.

The driver seat-mounted side impact air bag deployed from the outboard aspect of the seat back through the fabric/stitching of the seat. In its deflated state, it measured 62 cm (24.4 in) tall and 25 cm (9.8 in) wide. There was an 8 cm (3.1 in) vent in the stitching on the forward aspect. Some minor discoloration (source unknown) was visible on the upper aspect of the air bag. Figure 14 shows the driver seat-mounted side impact air bag.

Figure 13. View of the deployed driver's frontal air bag in the Chevrolet at the time of the SCI inspection

Figure 14. Chevrolet driver's deployed seat-mounted side impact air bag

The Chevrolet's IC air bags deployed downward from their roof side rail mounting locations through the edges of the headliner. They measured approximately 172 cm (68 in) in overall length, and provided 60 cm (23.6 in) of vertical coverage for the front- and second-row outboard positions that extended below the beltline. A fabric tether attached the forward aspect of each IC air bag to its upper A-pillar.

At the time of the SCI vehicle inspection, the left IC air bag had been cut post-crash, presumably by on-scene EMS personnel to gain unobstructed access to the interior. There was no discernable occupant contact to either of the IC air bags. Figure 15 shows the deployed left IC air bag, while Figure 16 shows the deployed right IC air bag.

Figure 15. View of the Chevrolet's left IC (cut forward aspect), left seat-mounted, and driver's frontal air bags

Figure 16. View of the Chevrolet's deployed right IC air bag, forward aspect, at the time of the SCI inspection

NHTSA Recalls and Investigations

Both prior to the on-site vehicle inspection and as of the July 2022 date this report was submitted, a VIN-based query of the NHTSA's recall database (www.nhtsa.gov/recalls) for the 2014 Chevrolet Silverado 1500 indicated three open recalls and no open investigations pertaining to this specific vehicle.

RECALL	DESCRIPTION	RISK
April 11, 2016 Manufacturer #N150822 NHTSA #16V209	The flexible steel cable that connects the driver's seat belt to the outboard side of the seat (the "tensioner cable") can fatigue and separate over time as a result of occupant movement into the driver's seat.	In a crash, a fatigued cable could break, reducing the effectiveness of the vehicle's seat belt.
June 29, 2017 Manufacturer #N172085440 NHTSA #17V414	A temporary loss of electric power steering (EPS) assist followed by a sudden return of the EPS assist, particularly during low-speed turning maneuvers. The loss and sudden return typically happens within a 1-second period and is caused by an electrical/software issue.	If EPS assist is lost and suddenly returned, the driver could lose temporary control of the steering wheel, increasing the risk of a crash.
September 6, 2019* Manufacturer #N192268490 NHTSA #19V645	The engine-mounted mechanical vacuum pump output may decrease over time, decreasing the amount of vacuum/power brake assist.	Increased brake pedal effort by the driver to achieve desired braking power.

* This recall was issued after the date of the crash under investigation.

According to the NHTSA recall query and the vehicle's history report, the Chevrolet had not received service remedy for any of the recalls. However, there was no evidence to suggest that the lack of remedy played any role in this crash.

The driver's seat belt system remained intact, securely affixed to the outboard side of the driver's seat. The lower anchor pretensioner had actuated during the crash, and had taken slack out of the system as a result. The Chevrolet did not appear to be affected by the conditions associated with Recall #16V209.

This crash occurred on an extended straight section of roadway and at travel speed. The Chevrolet maintained its travel trajectory and did not suffer a loss of directional control prior to the crash. Although there was no steering angle data reported by the imaged EDR data, there was no evidence to suggest that the EPS assist was involved in the crash. The circumstances of the crash were outside of the scope of the conditions for the recall. The Chevrolet did not appear to be affected by the conditions associated with Recall #17V414.

Data imaged from the Chevrolet EDR showed the driver had applied the brakes during the last second of the pre-crash data recording interval prior to impact, resulting in a minor reduction in speed. Given the late braking response and high delta V event, combined with SCI expertise, it was unlikely that there was any performance anomaly of the braking system in this crash. However, intrusion surrounding the braking system's foot control and associated vehicle damage prevented an SCI mechanical test of the braking system. Therefore, although unlikely, conclusive statements cannot be made regarding the applicability of Recall #19V645.

2014 Chevrolet Silverado 1500 Occupant Data

Driver Demographics

Age/sex:	63 years/female
Height:	170 cm (66.9 in)
Weight:	82 kg (181 lb)
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Middle to rear
Manual restraint usage:	3-point lap and shoulder seat belt with retractor and lower anchor pretensioners (both actuated)
Usage source:	Vehicle inspection, EDR data
Air bags:	Frontal, seat-mounted side impact, and IC air bags available; all deployed
Alcohol/drug involvement:	None (No test given)
Egress from vehicle:	Removed from vehicle while incapacitated
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Admitted for treatment, but expired 3 days after the crash

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Large left 15 cm diaphragmatic laceration with herniation of stomach, colon, omentum, and spleen into left thoracic cavity with lung compression	440610.4	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left air bag – steering wheel hub Tertiary: Front – steering wheel hub/spoke	Certain Certain Probable
2	Left hemopneumothorax, no further specificity	442205.3	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left air bag – steering wheel hub Tertiary: Front – steering wheel hub/spoke	Certain Certain Probable
3	Rib Cage fractures without flail, any location unilateral or bilateral-> >=3 ribs (OIS II), left posterior rib 5, left lateral rib 8, left anterior rib 9, left lateral rib 10, left posterior rib 11, left lateral rib 12	450203.3	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left air bag – steering wheel hub Tertiary: Front – steering wheel hub/spoke	Certain Certain Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
4	Lung contusion-> unilateral NFS, left lung lobe 2	441406.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left air bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	Certain Certain Probable
5	Fracture through right side of manubrium near first rib	450804.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left air bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	Certain Certain Probable
6	Extensive anterior pneumomediastinum, no further specificity	442209.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left air bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	Certain Certain Probable
7	Laceration of left inferior and superior gluteal arteries	520604.3	Caused by other injury – pelvic ring fracture: Critical IPC 2-point Critical #1: Interior – This occupant's seat cushion Critical #2: Interior – Lap portion of belt restraint	Certain Probable
8	Multiple small bowel mesenteric hematomas (OIS I), no further specificity	541410.2	Isolated: Interior - Lap portion of belt restraint	Probable
9	Cecal serosal tear, no further specificity	540822.2	Isolated: Interior - Lap portion of belt restraint	Probable
10	Right distal tibia fracture medial malleolus; pilon fracture - partial articular	854362.3	Isolated: Floor – Floor (including toe pan)	Certain
11	Right fibula (malleoli) fracture at distal fibular diaphysis, open	854472.2	Isolated: Floor – Floor (including toe pan)	Certain
12	Right ankle joint dislocation, open	877131.2	Isolated: Floor – Floor (including toe pan)	Certain
13	Left distal tibia fracture medial malleolus; pilon fracture - partial articular	854361.2	Isolated: Floor – Floor (including toe pan)	Certain
14	Left fibula (malleoli) fracture at distal fibular diaphysis	854471.2	Isolated: Floor – Floor (including toe pan)	Certain
15	Left ankle joint dislocation	877130.2	Isolated: Floor – Floor (including toe pan)	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
16	Pelvic ring fracture posterior arch intact; isolated fracture not destroying the integrity of the pelvic ring; right sacral ala, left iliac wing, left superior pubic rami, left inferior pubic rami	856151.2	Critical IPC 2-point Critical #1: Interior – This occupant's seat cushion Critical #2: Interior – Lap portion of belt restraint	Certain Probable
17	Right patella transverse fracture	854500.2	Isolated: Front – Left lower instrument panel (includes knee bolster)	Certain
18	Right calcaneus fracture, open, no further specificity	857301.2	Isolated: Floor – Floor (including toe pan)	Certain
19	Right subtalar joint dislocation, open, no further specificity	877231.1	Isolated: Floor – Floor (including toe pan)	Certain
20	Right posterior tibial artery injury with segmental injury to medial branch going underneath midfoot	821099.1	Isolated: Floor – Floor (including toe pan)	Certain
21	Right ankle lacerations, 11 cm and 9 cm	810602.1	Isolated: Floor – Floor (including toe pan)	Probable
22	Laceration over mid anterior shaft of left tibia, 5 cm	810602.1	Isolated: Front – Left lower instrument panel (includes knee bolster)	Certain
23	Lumbar vertebra(e) injury fracture without neurologic deficit-> bilateral transverse process, L1	650620.1	Isolated: Interior - Lap portion of belt restraint	Probable
24	Lumbar vertebra(e) injury fracture without neurologic deficit-> bilateral transverse process, L2	650620.1	Isolated: Interior - Lap portion of belt restraint	Probable
25	Lumbar vertebra(e) injury fracture without neurologic deficit-> bilateral transverse process, L3	650620.1	Isolated: Interior - Lap portion of belt restraint	Probable
26	Lumbar vertebra(e) injury fracture without neurologic deficit-> right transverse process, L4	650620.1	Isolated: Interior - Lap portion of belt restraint	Probable
27	Chest contusion (seat belt sign)	410402.1	Isolated: Interior - Shoulder portion of belt restraint	Certain
28	Lower abdomen contusion, no further specificity	510402.1	Isolated: Interior - Lap portion of belt restraint	Certain
29	Left hip abrasion	810202.1	Isolated: Left Door Panel – Left rear lower quadrant	Probable

Source: hospital records

Driver Kinematics

The 63-year-old female was seated in the Chevrolet's driver seat. She had adjusted the seat to a track position between middle and rearmost, with the seatback slightly reclined. Her adjustment level of the head restraint remains unknown, as it was removed from the seat post-crash by emergency responders. She used the available 3-point lap and shoulder seat belt system for manual restraint. Her use of the seat belt system was determined by the post-crash SCI inspection of the Chevrolet's manual restraints and corroborated by the data imaged from the vehicle SDM.

On the day of the crash, she was driving east on the rural, two-lane roadway. Specifics of her pre-crash activities remain unknown. She had both front windows fully opened and drove at a near constant speed within the posted limit. The data further showed that the driver recognized the errant trajectory of the Mitsubishi and its encroachment into her travel path, as she released the accelerator pedal and depressed the brake pedal in an attempt to avoid the crash.

At impact with the front plane of the Mitsubishi, the driver initiated a rapid forward trajectory. The lower anchor and retractor pretensioners actuated, then the driver frontal air bag, left front seat-mounted air bag, and both IC air bags deployed. The driver loaded the seat belt with her abdomen and chest, while her legs extended forward. This loading spooled webbing from the retractor, evidenced by the transfer on the webbing observed during the SCI inspection. Her loading also gathered the webbing in the forward aspect of the D-ring, and produced a small frictional abrasion in the belt path of the latch plate. The driver's loading of the seat belt resulted in several internal and soft tissue injuries, including rib fractures, left lung contusion, left diaphragmatic laceration, left hemopneumothorax, anterior pneuomomediastinum (emphysema in the space between the lungs), chest contusion, and abdominal contusion.

The driver contacted the deployed driver frontal air bag with her head and chest, while her knees loaded the intruding instrument panel. In conjunction with the intrusion of the floor/toe pan, the driver sustained several lower extremity injuries that included bilateral tibia and fibula fractures, bilateral ankle joint dislocations, a right patella fracture, right calcaneus fracture, right subtalar joint dislocation, right ankle lacerations, left leg laceration, and a right tibial artery injury. The intrusion of the floor/toe pan and induced damage buckling also thrust the driver's seat cushion upward, which, combined with the driver's forward trajectory, induced loading of the seat cushion and floor/toe pan that translated forces through the driver's lower extremities and posterior. This resulted in several injuries including a cecal serosal tear, pelvic ring fracture, laceration of the left gluteal arteries, and lumbar vertebrael fractures.

The driver remained restrained by the seat belt as the Chevrolet rotated and slid to final rest. Emergency response personnel extricated her from the vehicle, immobilized her on a long spine board, and transported her via ambulance to a local hospital. She was admitted for the treatment of incapacitating injuries, but ultimately expired 3 days after the crash.

2003 Mitsubishi Galant

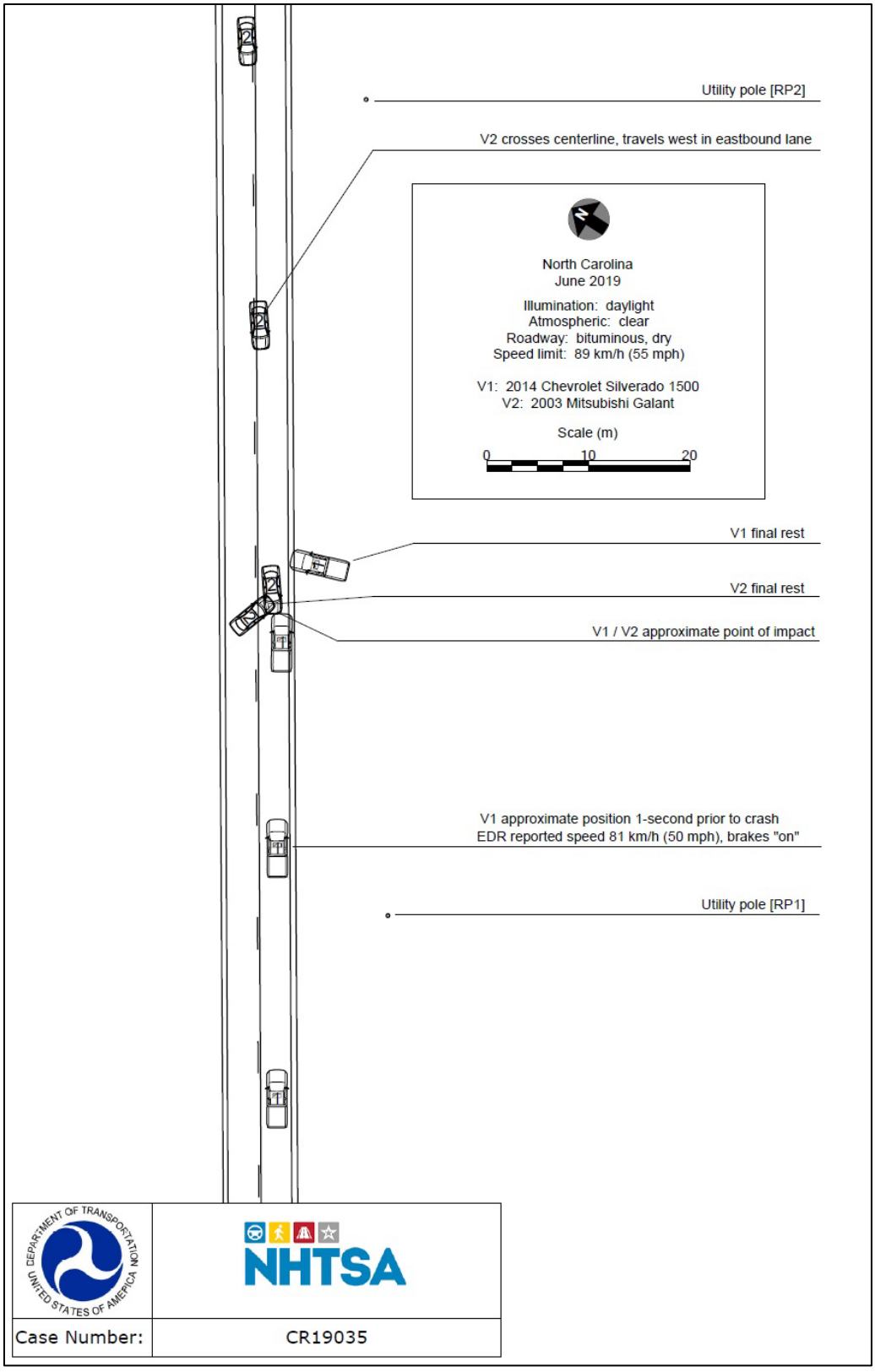
Description

The 2003 Mitsubishi Galant was identified by the VIN 4A3AA46G83Exxxxxx. It was a 4-door sedan with a 263 cm (103.7 in) wheelbase and powered by a 2.4-liter, inline, 4-cylinder gasoline engine. No further specifics concerning the Mitsubishi were available. It could not be located for inspection as part of this SCI investigation.

Occupant Data

The Mitsubishi was driven by the 18-year-old female with a 19-year-old male front-row right passenger. According to law enforcement documentation of the crash, both occupants were belted and air bags deployed (unspecified). Emergency responders declared the Mitsubishi driver deceased at the crash site. The 19-year-old passenger was transported by ambulance to a local hospital and admitted for the treatment of incapacitating (A-level) injuries.

Crash Diagram



Appendix A: Event Data Recorder Report for 2014 Chevrolet Silverado 1500[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	1GCRCPEH0EZ******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR19035_V1_ACM.CDRX
Saved on	Wednesday, December 4 2019 at 13:35:16
Imaged with CDR version	Crash Data Retrieval Tool 19.1.1
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 21.5
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events 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:

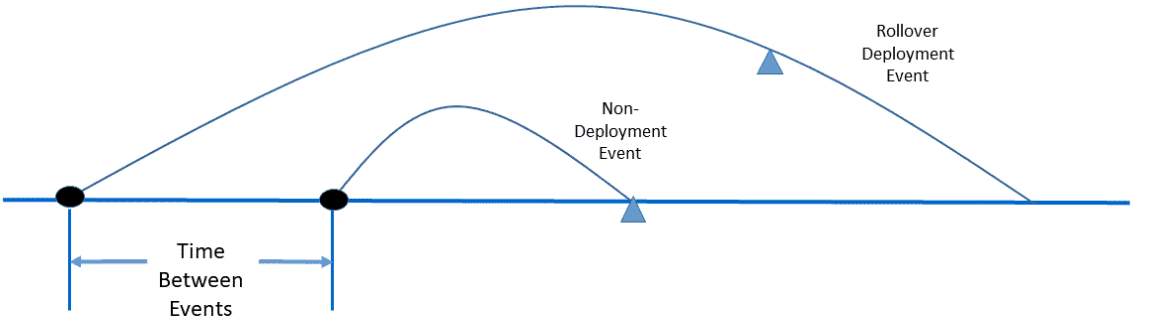
-Pretensioner(s) only Deployment
-Head Rest Deployment
-Battery Cut-Off Deployment

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 counter measures the time from the start of one event to the start of the next event if both events occur within the same ignition cycle.
-The Maximum SDM Recorded Vehicle Velocity Change may occur between the recorded 10 millisecond sample points of

the SDM Recorded Vehicle Velocity Change. The SDM will only record Maximum SDM Recorded Vehicle Velocity Change for the first 300 milliseconds of the event.
-If the SDM Recorded Vehicle Velocity Change data exceeds the max output range of -127 km/h then the exceeded values will be displayed with an offset of a +256 km/h. If the SDM Recorded Vehicle Velocity Change data exceeds the max output range of +126 km/h then the exceeded values will be displayed with an offset of a -256 km/h.
-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 Time Zero. That is to say, the last data point may have been captured just before Time Zero but no more than 0.5 second before Time Zero. 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 engine.
-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 times for subsequent deployment type events, during the same ignition cycle, will record the deployment times as N/A.
-In an event where the module is operating on energy reserve, the Dynamic counters may report a value that is less than the actual value. If the stored values in the Dynamic counters are less than the counter values in the event records or if more than one event record has the same counter value as another, the module may have been operating on its energy reserve.
-A Concurrent Event is when two events are happening nearly simultaneously. The "Concurrent Event Flag Set" parameter will indicate "Yes" if one event begins, but before that event is qualified, another event begins and is qualified.
A Non-Deployment event typically becomes qualified if that event exceeds the 5 MPH (8 km/h) delta V recording threshold and the event has concluded. A deployment event (FSR or Rollover) becomes qualified when a deployment has been commanded for that event.
Example of a Concurrent Event:
A Rollover event begins. Before the Rollover event is qualified, a Non-Deployment event begins and is qualified. Sometime after the Non-Deployment event is qualified, the Rollover event is qualified. The Non-Deployment event will be recorded in the first open record even though the Rollover event enabled before the Non-Deployment event. The Rollover event will be recorded in the next open record. The "Concurrent Event Flag Set" parameter will indicate "Yes" for the Rollover event. The "Time Between Events" parameter will indicate the time from the start of the Rollover event to the start of the Non-Deployment event.



Event Recor #1	Event Record #2
Event Record Type = Non – Deployment	Event Record Type = Rollover
Concurrent Event Flag = No	Concurrent Event Flag = Yes
Time Between Events = NA	Time Between Events = XX seconds

-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.
-Due to a CDR Tool data imaging issue, all CDR files imaged from SDM-30 Delphi airbag control modules (ACM) using version 17.6 software are invalid and the ACM must be re-imaged using CDR version 17.6.1 and later software.
-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.

01050_SDM30-delphi_r020

System Status at Time of Retrieval

Dynamic Deployment Event Counter	0
Multi-Event, Number of Events (Dynamic Event Counter)	0
Dynamic OnStar Notification Event Counter	0
Vehicle Identification Number (VIN)	1GCRCPEH0EZ******
Ignition Cycle, Download (Ignition Cycles at Investigation)	13550
End Model Part Number	00CF6930
System Type	N/A
Software Module Identifier 1	00CE44D6
Software Module Identifier 2	016214F4
Software Module Identifier 3	01621D42
Manufacturing Traceability Data, LineID	K
Manufacturing Traceability Data, ShiftID	2
Manufacturing Traceability Data, Year	14
Manufacturing Traceability Data, DayOfTheYear	181
Manufacturing Traceability Data, Serial/Lot/BatchNumber	3M0TYZH00
ESS # 1 Traceability Data, Component Identifier	AU
ESS # 1 Traceability Data, Part Number/Broadcast Code	8677
ESS # 1 Traceability Data, Supplier Code	D
ESS # 1 Traceability Data, Traceability Number	P00000000
ESS # 2 Traceability Data, Component Identifier	AT
ESS # 2 Traceability Data, Part Number/Broadcast Code	8677
ESS # 2 Traceability Data, Supplier Code	D
ESS # 2 Traceability Data, Traceability Number	P00000000
ESS # 3 Traceability Data, Component Identifier	AH
ESS # 3 Traceability Data, Part Number/Broadcast Code	8676
ESS # 3 Traceability Data, Supplier Code	D
ESS # 3 Traceability Data, Traceability Number	A00000000
ESS # 4 Traceability Data, Component Identifier	AJ
ESS # 4 Traceability Data, Part Number/Broadcast Code	8676
ESS # 4 Traceability Data, Supplier Code	D
ESS # 4 Traceability Data, Traceability Number	A00000000
ESS # 5 Traceability Data, Component Identifier	DA
ESS # 5 Traceability Data, Part Number/Broadcast Code	8678
ESS # 5 Traceability Data, Supplier Code	D
ESS # 5 Traceability Data, Traceability Number	A00000000
ESS # 6 Traceability Data, Component Identifier	DB
ESS # 6 Traceability Data, Part Number/Broadcast Code	8678
ESS # 6 Traceability Data, Supplier Code	D
ESS # 6 Traceability Data, Traceability Number	A00000000
ESS # 7 Traceability Data, Component Identifier	??
ESS # 7 Traceability Data, Part Number/Broadcast Code	0000
ESS # 7 Traceability Data, Supplier Code	D
ESS # 7 Traceability Data, Traceability Number	A00000000
ESS # 8 Traceability Data, Component Identifier	??
ESS # 8 Traceability Data, Part Number/Broadcast Code	0000
ESS # 8 Traceability Data, Supplier Code	D
ESS # 8 Traceability Data, Traceability Number	A00000000

System Status at Event (Event Record 1)

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)	1
OnStar Notification Event Counter	1
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	13550
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	Yes
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	Yes
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)	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
Seat Track Position Switch, Foremost, Status, Driver (Driver Seat Position Status)	No (Rearward)
Seat Track Position Switch, Foremost, Status, Right Front Passenger (Passenger Seat Position Status)	No (Rearward)
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)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655330
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	8152
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]	-40 [-65]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	158
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	9 [14]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	56
High Voltage Disable Notification Sent	Yes
Deployment Commanded in Energy Reserve Mode	No

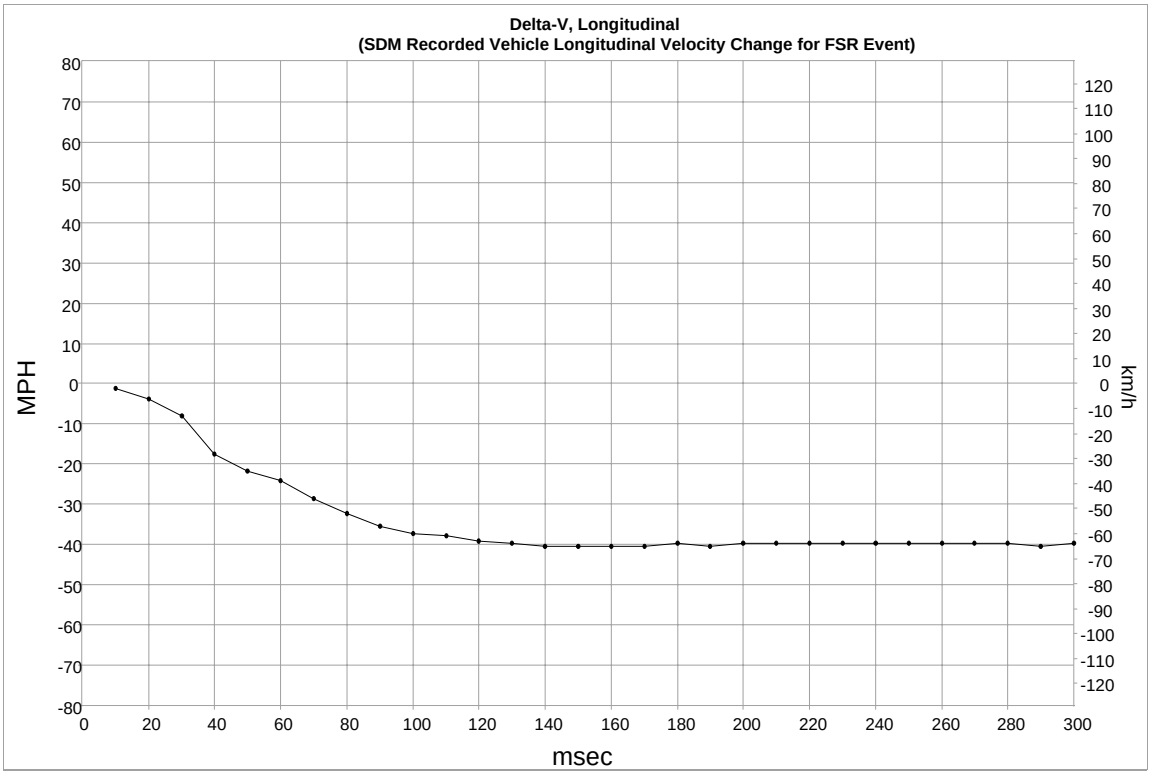
DTCs Present at Time of Event (Event Record 1)

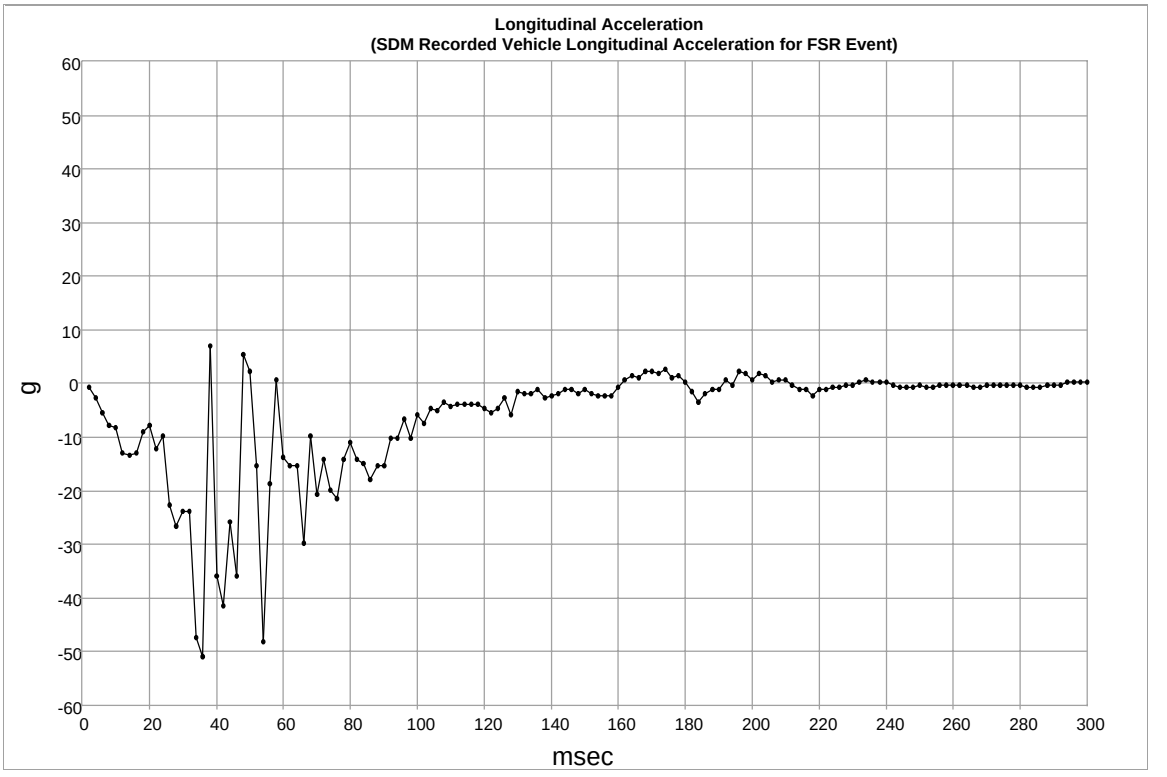
B0052-00

Event Data (Event Record 1)

Driver 1st Stage Deployment Loop Commanded	Yes
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	Yes
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	Yes
Passenger Pretensioner Deployment Loop #1 Commanded	Yes
Driver Pretensioner Deployment Loop #2 Commanded	Yes
Passenger Pretensioner Deployment Loop #2 Commanded	Yes
Driver Thorax Loop Commanded	Yes
Passenger Thorax Loop Commanded	No
Left Row 1 Roof Rail/Head Curtain Loop Commanded	Yes
Right Row 1 Roof Rail/Head Curtain Loop Commanded	Yes
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	9
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	12
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)	15
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	15
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	8
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)	8

Longitudinal Crash Pulse (Event Record 1)





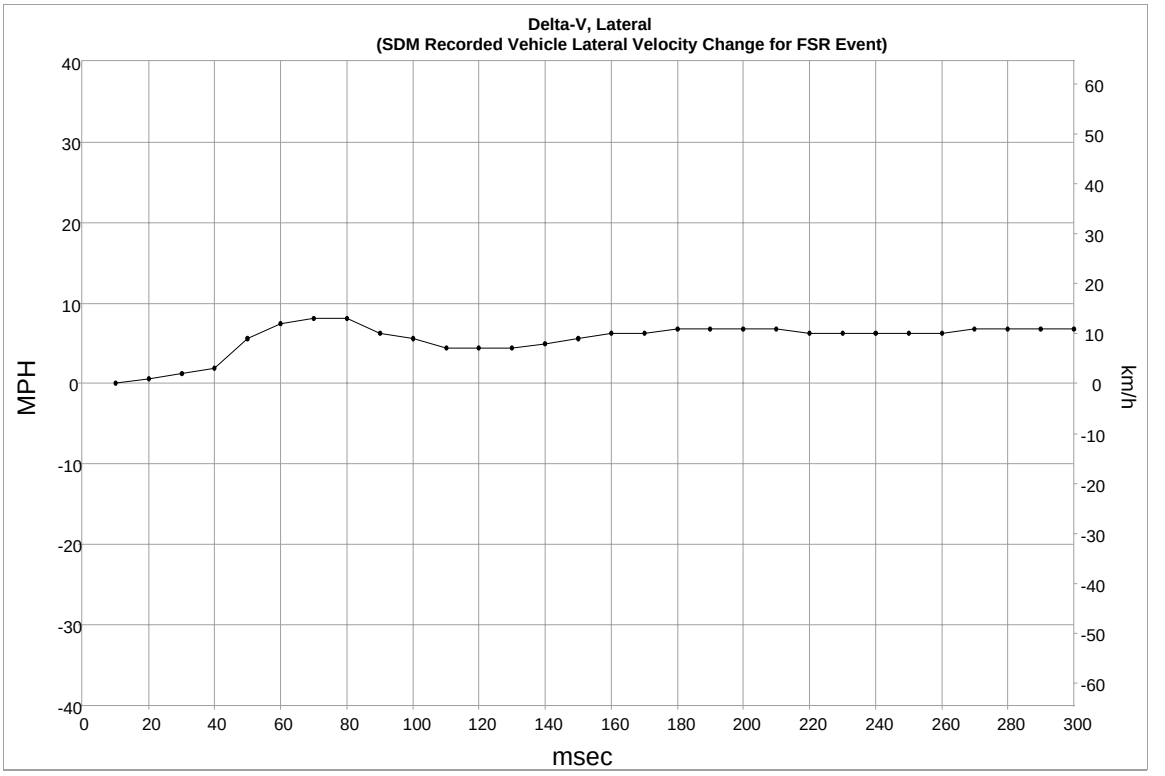
Longitudinal Crash Pulse (Event Record 1)

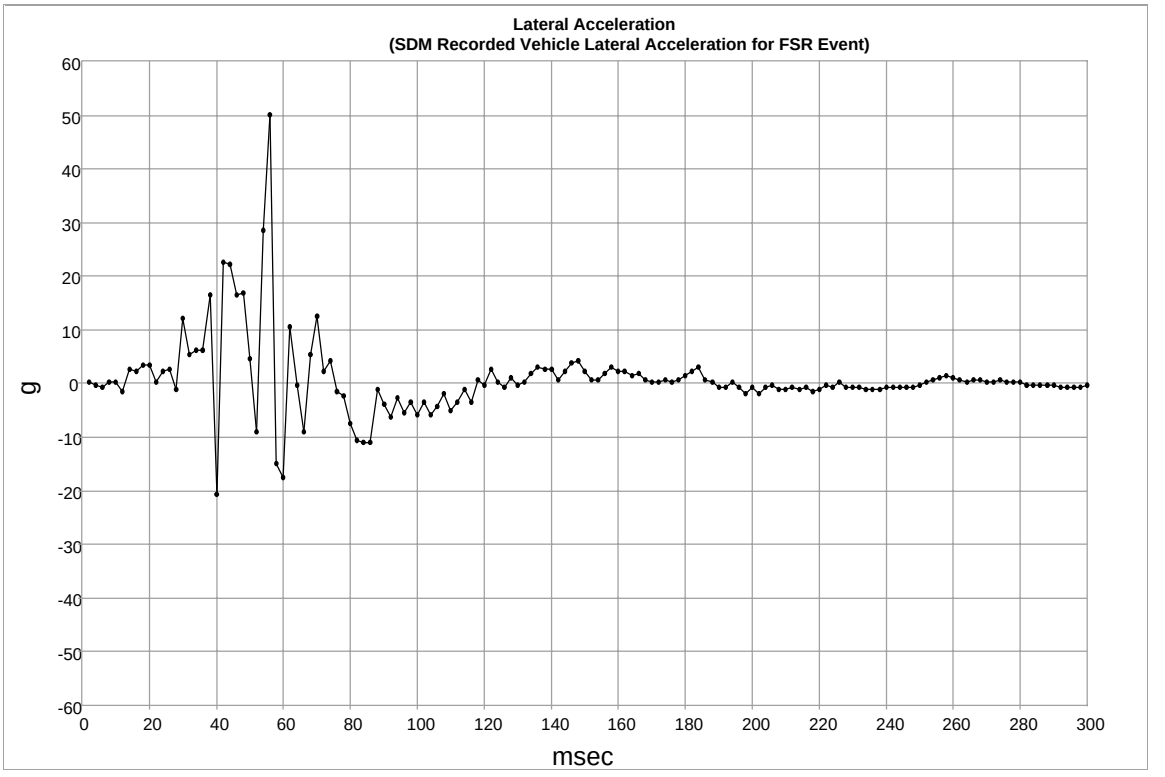
Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	-1.2	-2.0
20	-3.7	-6.0
30	-8.1	-13.0
40	-17.4	-28.0
50	-21.7	-35.0
60	-24.2	-39.0
70	-28.6	-46.0
80	-32.3	-52.0
90	-35.4	-57.0
100	-37.3	-60.0
110	-37.9	-61.0
120	-39.1	-63.0
130	-39.8	-64.0
140	-40.4	-65.0
150	-40.4	-65.0
160	-40.4	-65.0
170	-40.4	-65.0
180	-39.8	-64.0
190	-40.4	-65.0
200	-39.8	-64.0
210	-39.8	-64.0
220	-39.8	-64.0
230	-39.8	-64.0
240	-39.8	-64.0
250	-39.8	-64.0
260	-39.8	-64.0
270	-39.8	-64.0
280	-39.8	-64.0
290	-40.4	-65.0
300	-39.8	-64.0

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	-0.6	102	-7.4	202	1.8
4	-2.6	104	-4.6	204	1.4
6	-5.4	106	-5.0	206	0.2
8	-7.8	108	-3.4	208	0.6
10	-8.2	110	-4.2	210	0.6
12	-13.0	112	-3.8	212	-0.2
14	-13.4	114	-3.8	214	-1.0
16	-13.0	116	-3.8	216	-1.0
18	-9.0	118	-3.8	218	-2.2
20	-7.8	120	-4.6	220	-1.0
22	-12.2	122	-5.4	222	-1.0
24	-9.8	124	-4.6	224	-0.6
26	-22.6	126	-2.6	226	-0.6
28	-26.6	128	-5.8	228	-0.2
30	-23.8	130	-1.4	230	-0.2
32	-23.8	132	-1.8	232	0.2
34	-47.4	134	-1.8	234	0.6
36	-51.0	136	-1.0	236	0.2
38	7.0	138	-2.6	238	0.2
40	-35.8	140	-2.2	240	0.2
42	-41.4	142	-1.8	242	-0.2
44	-25.8	144	-1.0	244	-0.6
46	-35.8	146	-1.0	246	-0.6
48	5.4	148	-1.8	248	-0.6
50	2.2	150	-1.0	250	-0.2
52	-15.4	152	-1.8	252	-0.6
54	-48.2	154	-2.2	254	-0.6
56	-18.6	156	-2.2	256	-0.2
58	0.6	158	-2.2	258	-0.2
60	-13.8	160	-0.6	260	-0.2
62	-15.4	162	0.6	262	-0.2
64	-15.4	164	1.4	264	-0.2
66	-29.8	166	1.0	266	-0.6
68	-9.8	168	2.2	268	-0.6
70	-20.6	170	2.2	270	-0.2
72	-14.2	172	1.8	272	-0.2
74	-19.8	174	2.6	274	-0.2
76	-21.4	176	1.0	276	-0.2
78	-14.2	178	1.4	278	-0.2
80	-11.0	180	0.2	280	-0.2
82	-14.2	182	-1.4	282	-0.6
84	-15.0	184	-3.4	284	-0.6
86	-17.8	186	-1.8	286	-0.6
88	-15.4	188	-1.0	288	-0.2
90	-15.4	190	-1.0	290	-0.2
92	-10.2	192	0.6	292	-0.2
94	-10.2	194	-0.2	294	0.2
96	-6.6	196	2.2	296	0.2
98	-10.2	198	1.8	298	0.2
100	-5.8	200	0.6	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	1.2	2.0
40	1.9	3.0
50	5.6	9.0
60	7.5	12.0
70	8.1	13.0
80	8.1	13.0
90	6.2	10.0
100	5.6	9.0
110	4.3	7.0
120	4.3	7.0
130	4.3	7.0
140	5.0	8.0
150	5.6	9.0
160	6.2	10.0
170	6.2	10.0
180	6.8	11.0
190	6.8	11.0
200	6.8	11.0
210	6.8	11.0
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	6.8	11.0
280	6.8	11.0
290	6.8	11.0
300	6.8	11.0

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	0.2	102	-3.4	202	-1.8
4	-0.2	104	-5.8	204	-0.6
6	-0.6	106	-4.2	206	-0.2
8	0.2	108	-1.8	208	-1.0
10	0.2	110	-5.0	210	-1.0
12	-1.4	112	-3.4	212	-0.6
14	2.6	114	-1.0	214	-1.0
16	2.2	116	-3.4	216	-0.6
18	3.4	118	0.6	218	-1.4
20	3.4	120	-0.2	220	-1.0
22	0.2	122	2.6	222	-0.2
24	2.2	124	0.2	224	-0.6
26	2.6	126	-0.6	226	0.2
28	-1.0	128	1.0	228	-0.6
30	12.2	130	-0.2	230	-0.6
32	5.4	132	0.2	232	-0.6
34	6.2	134	1.8	234	-1.0
36	6.2	136	3.0	236	-1.0
38	16.6	138	2.6	238	-1.0
40	-20.6	140	2.6	240	-0.6
42	22.6	142	0.6	242	-0.6
44	22.2	144	2.2	244	-0.6
46	16.6	146	3.8	246	-0.6
48	17.0	148	4.2	248	-0.6
50	4.6	150	2.2	250	-0.2
52	-9.0	152	0.6	252	0.2
54	28.6	154	0.6	254	0.6
56	50.2	156	1.8	256	1.0
58	-15.0	158	3.0	258	1.4
60	-17.4	160	2.2	260	1.0
62	10.6	162	2.2	262	0.6
64	-0.2	164	1.4	264	0.2
66	-9.0	166	1.8	266	0.6
68	5.4	168	0.6	268	0.6
70	12.6	170	0.2	270	0.2
72	2.2	172	0.2	272	0.2
74	4.2	174	0.6	274	0.6
76	-1.4	176	0.2	276	0.2
78	-2.2	178	0.6	278	0.2
80	-7.4	180	1.4	280	0.2
82	-10.6	182	2.2	282	-0.2
84	-11.0	184	3.0	284	-0.2
86	-11.0	186	0.6	286	-0.2
88	-1.0	188	0.2	288	-0.2
90	-3.8	190	-0.6	290	-0.2
92	-6.2	192	-0.6	292	-0.6
94	-2.6	194	0.2	294	-0.6
96	-5.4	196	-0.6	296	-0.6
98	-3.4	198	-1.8	298	-0.6
100	-5.8	200	-0.6	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	20	Off	1344	32	55 [89]
-4.5	20	Off	1344	32	55 [89]
-4.0	20	Off	1344	32	55 [89]
-3.5	20	Off	1344	32	55 [89]
-3.0	20	Off	1344	32	55 [89]
-2.5	20	Off	1344	32	55 [89]
-2.0	19	Off	1344	32	55 [89]
-1.5	0	Off	1344	14	55 [89]
-1.0	0	On	1216	14	50 [81]
-0.5	0	On	1152	16	48 [78]

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	107 [145]	Off
-1.5	No	No	No	66 [90]	Off
-1.0	No	No	No	3 [4]	Off
-0.5	No	No	No	-11 [-14]	Off

Hexadecimal Data

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FF F0 00 FC C6 7C 04

DPID $15
01 02 03 04 05 06 07

DPID $16
08 09 0A 0D 0E 27 27

DPID $17
27 27 27 27 27 27 00

DPID $32
00 FF 34 EE 00 00 00

DPID $35
78 00 00 00 00 00 00

DID $01
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DID $03
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DID $05
41 48 38 36 37 36 44 41 30 30 30 30 30 30 30 30

DID $07
41 4A 38 36 37 36 44 41 30 30 30 30 30 30 30 30

DID $09
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DID $0B
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DID $0D
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DID $0F
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DID $30
00 00 00 00

DID $90
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DID $9A
0B 11

DID $B4
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DID $C2
01 62 14 F4

DID $C3
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DID $CB
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 0050   15 15 15 15 15 06 83 06 A7 07
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 0190   79 7F 72 7E 6C 80 6B 80 5F 7C
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 0210   67 85 47 86 3D 7D 44 9E 44 8D
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 0260   4E 8A 4A 7C 5C 7A 64 6D 5C 65
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0190   FE FF 20 00 01 00 22 00 01 00
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0220   33 00 01 00 29 00 0A 00 5F 00
0230   0C 00 70 00 FD FF 64 00 35 00
0240   64 00 18 00 C8 00 1C 00 7F 01
0250   1B 00 E2 FF 48 00 97 00 AA FF
0260   AE 00 60 00 6C 00 5F 00 97 00
0270   48 00 E9 FF 49 00 F5 FF 15 00
0280   40 00 DB FF CB 00 7A 00 4E 00
0290   D5 00 FC FF C2 FF 3A 00 B7 FF
0300   41 00 2D 00 40 00 00 00 7D 00
0310   DA FF 29 00 18 00 56 00 36 00
0320   3C 00 0B 00 53 00 12 00 5A 00
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DOT HS 813 361
August 2022

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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