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Special Crash Investigations: On-Site Reported Cruise Control Malfunction Crash Investigation; Vehicle: 2017 GMC Acadia; Location: Pennsylvania; Crash Date: July 2018

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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 reported cruise control malfunction in a 2017 GMC Acadia that precipitated this vehicle's crash with a concrete barrier. The GMC was traveling south in the right-most lane of a multi-lane, divided, limited-access highway. The belted 72-year-old male driver was the sole occupant of the vehicle and reported that he was traveling with the cruise control set at 97 km/h (60 mph). The right-most lane became a designated exit lane and curved to the right. The driver stated that as the GMC approached the exit, he turned the cruise control off, planning to coast to a safe speed. He claimed that the cruise control did not disengage and applied the brakes. The GMC entered the ramp, departed the left side of the roadway, and struck a roadside barrier. At impact, the driver's frontal air bag, knee air bag, seat-mounted side impact air bag, seat inboard air bag, and inflatable curtain air bags deployed. The GMC slid along the barrier and came to rest. The driver reported that he sustained unspecified injuries to his left shoulder and ribs as well as a fractured tooth, but he did not require medical attention or transport to a hospital.

Through the course of the SCI investigation and crash reconstruction, it was determined that the GMC departed the roadway while traveling at a speed that was most likely too great to maintain the curvature of the road. At inspection, crash damage prevented the ability to start or drive the vehicle. Operation of the cruise control could not be performed. Data imaged from the vehicle's EDR indicated that 2.0 seconds prior to the crash, the cruise control was off (not active) and remained off. An application of the brakes was not recorded in the pre-crash data. There was no evidence to suggest that the cruise control remained engaged or was otherwise contributory to the crash.

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Office of Defects Investigation
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Location: Pennsylvania
Crash Date: July 2018

Background

This report documents the reported cruise control malfunction in a 2017 GMC Acadia (Figure 1) that precipitated this vehicle's crash with a concrete barrier. The 72-year-old male driver provided notification of the crash to the National Highway Traffic Safety Administration in July 2018. The notification was identified for further research and was subsequently forwarded to NHTSA's Crash Investigation Division, and an on-site investigation was assigned to the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., in the same month. The SCI team contacted and established cooperation with the vehicle's insurer to facilitate an inspection of the vehicle and obtained a copy of the police crash report (PCR).

Figure 1. Left-front oblique view of the GMC Acadia

The GMC was traveling south in the right-most lane of a multi-lane, divided, limited-access highway. The belted driver was the sole occupant of the vehicle and reported that he was traveling with the cruise control set at 97 km/h (60 mph). The right-most lane became a designated exit lane and curved to the right. It was his intent to take the exit, travel around the cloverleaf-style interchange, and travel east on a crossing highway. The driver stated that as the GMC approached the exit, he turned the cruise control off, planning to coast to a safe speed. He stated that the cruise control did not disengage a short time later, and that he applied the brakes.

The GMC entered the exit ramp, departed the left side of the roadway, and struck a roadside barrier. At impact, the driver's frontal air bag, knee air bag, seat-mounted side impact air bag, center air bag, and the combination side impact/rollover sensing inflatable curtain (IC) air bags in the GMC deployed. The GMC slid along the barrier and came to rest. The driver reported in

his notification that he sustained unspecified injuries to his left shoulder and ribs as well as a fractured tooth, but he did not require medical attention or transport to a hospital.

The investigation included on-site inspections of the GMC's exterior and interior to measure the deformation and intrusion, document the evidence of interior occupant contact, examine the manual and supplemental restraint systems for use, and assess its cruise control, throttle, and brake systems. The GMC had an Event Data Recorder (EDR) that was supported by the Bosch Crash Data Retrieval (CDR) tool, which was imaged during the inspection. The SCI team also photographed and mapped the crash scene using a total station for causative factors.

Through the course of the SCI investigation and crash reconstruction, it was determined that the GMC departed the roadway at a speed most likely too great to maintain the curvature of the road. At the inspection, crash damage prevented the ability to start or drive the vehicle. Operation of the cruise control could not be performed. Data imaged from the vehicle's EDR indicated that 2.0 seconds prior to the crash the cruise control was off (not active) and remained off. An application of the service brakes was not recorded in the pre-crash data. There was no evidence to suggest that the cruise control remained engaged or was otherwise contributory to the crash.

Summary

Crash Site

The crash occurred during the afternoon hours on the southbound lanes of a multi-lane interstate located in a rural setting. The environmental conditions reported by the National Weather Service at the time of the crash included mostly cloudy skies with a temperature of 28 °C (83 °F), a northwest wind of 15 km/h (9 mph), and a relative humidity of 63 percent. Approaching the crash site, the southbound interstate was predominately level and consisted of three 3.7 m (12.1 ft) wide traffic lanes that traversed a shallow left curve (Figure 2). The posted speed limit was 89 km/h (55 mph). At the end of the left curve, the interstate lanes entered a straight section, and the right-most lane became a designated exit lane (Figure 3). At the exit, a gore formed as the exit roadway curved to the right. Posted at the entrance to the ramp was a yellow warning sign with a recommended speed of 40 km/h (25 mph). The ramp curved in a cloverleaf-style interchange and merged into an eastbound interstate roadway. It was noted during the SCI scene inspection that numerous sets of tire tracks were present on the roadside at the entry to the ramp, where other vehicles had previously departed the left side of the ramp in a manner similar to the crash under investigation.

Figure 2. Lookback view northward along the GMC's pre-crash travel trajectory

Figure 3. South-facing trajectory view of the GMC at the exit

Figure 4. South-facing trajectory view of the GMC on the exit ramp and its road departure

The exit ramp was 4.0 m (13.1 ft) wide (Figure 4). A solid yellow line on the left and a solid white line on the right delineated the ramp. At the point of the roadway departure, the radius of the curve measured 60.0 m (196.9 ft) with a level grade and the super-elevation measured 7.3 percent. There were a 1.6 m (5.2 ft) wide left shoulder and a 3.3 m (10.8 ft) wide right shoulder, both of which contained rumble strips cut into their surfaces. Jersey-style concrete barrier sections oriented parallel to the ramp were located on the roadside 6.1 m (20.0 ft) from the left pavement edge. Each barrier section measured 3.7 m (12.1 ft) long and 1.2 m (3.9 ft) tall. Three arcing tire marks on the left shoulder and roadside evidenced the GMC's road departure. The left rear tire mark began on the yellow line and led to the barrier impact, with a total length that measured 24.2 m (79.4 ft). The yellow and blue cones in the images denote the tire marks. The tire marks indicated that the GMC was in a clockwise yaw. A crash diagram is included at the end of this report.

Pre-Crash

The GMC was traveling south in the right-most lane of a three-lane, divided limited-access highway. The belted 72-year-old male driver was the sole occupant of the vehicle and reported that he was traveling with the cruise control set at 97 km/h (60 mph). The driver stated that it was his intent to take the exit, travel around the cloverleaf-style interchange, and proceed east on a crossing highway.

The driver stated that he turned the cruise control off approximately 275 m (902 ft) from the exit curve, planning to coast to a safe speed. A short time later, he realized that the cruise control did not disengage, and he applied the brakes. He further stated that the cruise control still did not disengage, although the "vehicle had slowed somewhat, but not slow enough to negotiate the curve."

The EDR-reported speed of the GMC was 97 km/h (60 mph) at the 5.0, 4.5, and 4.0-second intervals prior to algorithm enable (AE). At these respective times, a time/distance calculation determined that the GMC was located approximately 118 m (387 ft), 91 m (298 ft), and 64 m (210 ft) from the barrier impact. The pre-crash data set recorded that the speed then reduced to 86 km/h (53 mph) at the 2.0-second interval without a recorded application of the service brake.

The asynchronous recording of the pre-crash data may not have recorded an intermittent application of the brakes. Due to limitations of the EDR, the pre-crash status of the cruise control was only recorded for a 2.0-second time period prior to AE, and the data indicated that the cruise control was off (not active) at the -2.0-seond interval. At the -2.0 second interval, the GMC was located approximately 39 m (128 ft) from the impact.

The GMC departed the roadway approximately 1.0-second, 17 m (56 ft) prior to the barrier impact. The diverging tire marks observed at the SCI scene inspection indicated that the vehicle was in a clockwise yaw as it approached the barrier.

Crash

The left-front corner of the GMC struck the barrier (Event 1). Figure 5 is a southwest-facing trajectory view of the GMC at impact with the barrier. The yellow cones in the center of the image denote the ends of the left-front and right tire marks. The signpost in the image was not struck by the GMC. Abrasions and paint transfer to the concrete surface of the barrier evidenced the impact. Based on the reconstructed trajectory of the vehicle, the angle between the barrier face and the left plane of the GMC measured approximately 30 degrees. At impact, the air bags in the GMC deployed. The impact force of the GMC displaced two of the barrier sections approximately 15 cm (6 in) to the south. The barrier redirected the heading angle of the GMC to the west and the left plane/rear aspect of the vehicle struck the barrier in a side-slap. The length of the direct contact to the barrier measured 4.4 m (14.4 ft). The corresponding damage to the GMC was located at the forward third (Event 1) and the aft third of its left plane (Event 2). The GMC separated from the barrier, and with its momentum depleted, came to rest on the roadside at an unspecified location.

Figure 5. Southwest-facing image of the barrier showing its impact damage

Post-Crash

The police responded to the crash site. The driver exited the vehicle under his own power and stated to the officer that he had no significant injury. He refused medical attention or transport. The police officer completed his investigation and left the scene as the driver awaited the arrival of the tow truck, which then transported the GMC to a local dealership. The vehicle was

subsequently transferred to an insurance vehicle salvage facility, where it was located at the time of the SCI vehicle inspection.

2017 GMC Acadia

Description

The 2017 GMC Acadia Denali SUV (Figure 6) was manufactured in August 2016 and was identified by Vehicle Identification Number (VIN) 1GKKNXLS0HZxxxxxx. The odometer reading at the time of the inspection was 43,895 km (27,276 miles). The unibody-based platform was built on a 286 cm (112.6 in) wheelbase and powered by a 3.6-liter gasoline engine linked to 6-speed automatic transmission with all-wheel drive. The gross vehicle weight rating was 2,722 kg (6,001 lb), with gross axle weight ratings of 1,350 kg (2,976 lb) front and 1,545 kg (3,406 lb) rear. The curb weight was 1,998 kg (4,405 lb). The GMC had electronic stability control, traction control, emergency braking assist, power-assisted 4-wheel disc brakes with ABS, and electronic power steering. Crash avoidance features included lane departure warning with lane-keeping assist, forward collision warning, side blind zone alert, and rear-park assist. The vehicle manufacturer's recommended tire size was 235/55R20, with cold tire pressures of 250 kPa (36 PSI) front and rear. At the time of the crash, the GMC had Michelin Premier LTX all-season tires of the recommended size mounted on OEM 6-spoke alloy wheels. The tread depths all measured 7 mm (9/32 in).

Figure 6. Overhead view of the GMC showing its damage

The interior of the GMC was configured for the seating of seven occupants (2/2/3) with front-row bucket seats, second-row seats with folding seat backs, and a third row with flat-folding seat backs. The driver's seat was adjusted to a mid-track position 10 cm (3.9 in) forward of full-rear, with the seat back reclined 10 degrees aft of vertical and the head restraint adjusted 5 cm (2.0 in) above the seat back. Manual restraint was provided by 3-point lap and shoulder seat belt systems in all seven seat positions. Certified advanced 208-compliant (CAC) frontal air bags, front seat-mounted side impact air bags, driver knee air bag, front center air bag, and combination side impact/rollover-sensing IC air bags mounted in the roof side rails provided supplemental restraint.

Exterior Damage

The GMC sustained impact damage to its front and left planes during the barrier impact. The Event 1 damage, located on the front plane, began 59 cm (23.2 in) left of center and extended 30 cm (11.8) to the left corner (Figure 7). The extreme left end of the bumper reinforcement was involved in the impact (Figure 8). It was abraded, without residual crush. This damage pattern wrapped around the left corner, extended 148 cm (58.3 in) along the left fender, and ended at the leading edge of the left-front door. The fender was crushed laterally and abraded. The left-front wheel rim was fractured, and the tire was aired out. The collision deformation classification assigned to this damage pattern was 11FLEE5. Analysis of this corner impact was beyond the scope of the WinSMASH program due to the corner impact configuration.

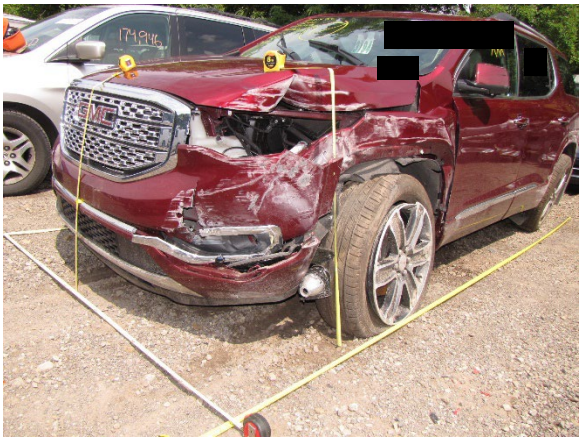


Figure 7. Left-front oblique view of the GMC's Event 1 damage

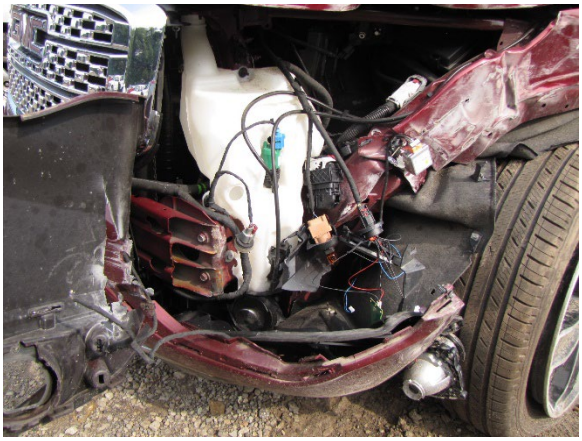


Figure 8. Close-up view of the minimal damage at the left end of the GMC's front bumper reinforcement

The left plane sustained damage located at its rear third (Figure 9). This region of damage began 75 cm (29.5 in) forward of the left rear axle and extended rearward 164 cm (64.6 in) spanning the quarterpanel. The damage consisted of longitudinal abrasions along the body panel with minimal lateral deformation. The left-rear wheel rim was fractured, and the wheel was canted.

The axle was bent. The wheelbase dimension was unchanged. The CDC assigned to this damage pattern was 10LZEW1. Analysis of this impact was beyond the scope of the WinSMASH program.

Figure 9. Left view of the GMC's Event 2 damage

Event Data Recorder

The GMC Acadia had a sensing and diagnostic control module that performed the diagnostic, sensing, and deployment command functions for the vehicle's supplemental restraint systems. This module had EDR capabilities and was imaged at the time of the SCI inspection using the Bosch CDR tool and software version 17.7.2. The vehicle's 12-volt battery was depleted at the inspection. External electrical power was supplied via the interior fuse block to complete the imaging process. The imaged file is reported with version 21.4.1 and is included as Appendix A.

The file's data limitations stated that the EDR was capable of recording two event types, namely non-deployment events and deployment events. A non-deployment 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. An unlocked non-deployment event could be overwritten. A non-deployment event that occurred within 5 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 had the capacity to store three events. A 5.0-second pre-crash buffer that described various vehicle performance parameters (including vehicle speed, accelerator pedal position, brake status, throttle position, and engine rpm) was recorded for each event record. These performance parameters were recorded asynchronously in 0.5-second intervals. Cruise control data were recorded in a separate buffer for a 2.0-second pre-crash time period.

The EDR recorded a singular event, termed Record 1, which was attributed to the crash under investigation. The imaged data indicated that the driver seat belt was buckled and the air bag warning lamp was off. The front passenger seat was not occupied. The ignition cycle count at the time of the crash was 4,147 and 4,153 at the time of the inspection. The 6-cycle disparity in the number of cycles was consistent with the towing and insurance processing of the vehicle.

The reported maximum recorded longitudinal delta V was -17 km/h (-10.6 mph) at 252 milliseconds. The maximum lateral delta V was 33 km/h (20.5 mph) at 220 milliseconds. The recorded actuation/deployment times for supplemental safety systems of the GMC are listed below:

- 34 milliseconds - Pretensioner loop #1 and driver's frontal stage 1, knee and IC air bags
- 38 milliseconds - Pretensioner loop #2 and driver's frontal stage 2
- 166 milliseconds - driver seat-mounted side impact air bag
- 201 milliseconds - center inboard air bag

The 5.0-second pre-crash data parameters associated to Record 1 are listed in the following table. Note that the data from the 2.0-second cruise control buffer have been combined into the table.

Time sec.	Speed km/h (mph)	Accelerator Pedal Percent	Throttle Percent	Engine rpm	Service Brake Status	Cruise Control Active
-5.0	97 (60.3)	0	28	1,600	Off	---
-4.5	97 (60.3)	0	28	1,600	Off	---
-4.0	97 (60.3)	0	28	1,600	Off	---
-3.5	96 (59.7)	0	24	1,600	Off	---
-3.0	95 (59.0)	0	11	1,536	Off	---
-2.5	92 (57.2)	0	12	1,472	Off	---
-2.0	86 (53.4)	0	17	1,408	Off	No
-1.5	77 (47.8)	0	10	1,152	Off	No
-1.0	73 (45.4)	0	11	1,088	Off	No
-0.5	60 (37.3)	0	0	832	Off	No

Although unrecorded due to the limitations of the cruise control buffer, the data trends at the -5.0-second time interval appeared to be consistent with the driver's statement that he was operating the vehicle with the cruise control set at 97 km/h (60 mph). The constant positions of the accelerator pedal and throttle percentage along with constant engine rpm were indicative of cruise control operation. The reduction in the vehicle speed and throttle percentage between the -4.0- and -3.5-second time intervals indicate that the cruise control was released (turned off) either through an unrecorded momentary application of the brake pedal due to asynchronous recording of the data or by manual operation of the controls at the steering wheel. The vehicle then began to slow down by rolling resistance. It was determined through a time/distance reconstruction of the vehicle's position that the GMC was entering the exit curve at this time. This is shown on the crash diagram.

The speed of the GMC continued to slow over the next 3.0 seconds without a recorded application of the service brakes. The lack of recording is possibly related to the asynchronous recording of the data and the driver's actions of pumping the brakes. The continued reduction in the speed of the GMC was attributed to the increasing road friction ("scrubbing") as the vehicle began to yaw and the probable activity of the GMC's electronic stability control feature. Activity of the electronic stability control was not recorded by the EDR.

The Cruise Control, the Cruise Control Set Switch, and the Cruise Control Resume Switch were all recorded as "No" for the four reported time steps beginning 2.0 seconds before AE (-2.0, -1.5, -1.0, -0.5).

NHTSA Recalls and Investigations

A query of NHTSA's recall database (www.nhtsa.gov/recalls) using the 2017 GMC Acadia's VIN determined that there were no open recalls and no investigations concerning this specific vehicle. These queries were run at the time of case assignment and again at the date of this final report submission.

Interior Damage

There was no observed interior damage or intrusion to the GMC attributable to the exterior force of the crash (Figure 10). All the glazing remained intact. There was no residual evidence of occupant contact to any components of the interior. The only interior damage was associated with the deployment of the vehicle's safety systems.

Manual Restraint Systems

The GMC was equipped with manual 3-point continuous-loop seat belts for the seven occupant positions. The front row seat belts were configured with lightweight locking latch plates, fixed D-rings and retractor, and lower anchor pretensioners. The driver's seat belt retracted onto an emergency locking retractor while the remainder used an ELR/automatic locking retractor. The pretensioners actuated at 34 milliseconds after AE. The stowed front row right seat belt was taut against the B-pillar at the time of the SCI vehicle inspection.

The physical evidence observed during the SCI vehicle inspection indicated that the driver used the seat belt system at the time of the crash. The retractor pretensioner actuated with 134 cm (52.8 in) of webbing extended from the D-ring to the lower anchor. Driver loading of the seat belt system was evidenced by a 13 cm (5.1 in) crease in the shoulder portion of the webbing (Figure 11), originating at the D-ring and extending toward the latch plate. There was an additional crease located at the buckled position of the latch plate. The observed evidence of use was consistent with the buckled status recorded by the EDR.

Figure 10. Left interior view of the GMC's front row

Figure 11. GMC interior image showing the crease in the driver's shoulder belt webbing at the left D-ring

Supplemental Restraint Systems

The driver's frontal air bag, knee air bag, seat-mounted side impact air bag, seat inboard air bag, and combination IC air bags deployed (Figures 12 and 13) as a result of the crash. All air bags deployed as designed and were devoid of occupant contact evidence. The driver, surrounded and cocooned by the deployed air bags, was protected from contacting the hard surfaces of the vehicle's interior, which likely mitigated injury.

Figure 12. Oblique interior view showing the deployed air bags at the driver's position

Figure 13. Right interior view of the GMC's front row and the deployed air bags

Cruise Control Operation and Crash Reconstruction

At the time of the SCI vehicle inspection, the GMC had a depleted battery. An external battery pack applied to the vehicle's battery allowed activation of the GMC's instrument panel. The driver information display in the instrument cluster indicated that the air bag system and parking brake required service. The vehicle's starter would not engage to turn the engine over. The engine would not attempt to start. It was not possible to scan the vehicle for potential diagnostic trouble codes. The use of scan tool/code reader used by the SCI team requires the operation of the vehicle's engine. The EDR reported only one diagnostic trouble code: B0052-00. This code was set when the crash occurred and signified that a supplemental restraint was commanded to deploy and that data were recorded to control module/EDR.

The crash was reconstructed using a speed/time/distance calculation based on the GMC's EDR data. The time history of the GMC's approximate position is shown in the attached crash diagram. It is apparent from the scaled drawing that the GMC entered the curve at an approximate speed of 97 km/h (60 mph). This speed was greater than the recommended 40 km/h (25 mph) speed for the exit ramp that was posted on a warning sign located prior to the exit on the right roadside.

The cruise control operated via a control pad integrated into left spoke of the steering wheel rim (Figure 14). The driver stated that he was operating the vehicle at a set speed of 97 km/h (60 mph) as he approached the exit. He stated in his crash notification that during the approach he turned the cruise control off, apparently planning to coast to a safe speed. A short time later, he realized that the cruise control did not disengage, and he attempted to disengage it by applying the brakes. He reported to the police investigator that it seemed like the car kept going.

The trends of the EDR-recorded RPM and throttle position data indicated that the cruise control was likely turned off by the driver, either manually at the steering wheel control or through an unrecorded brake application, approximately 3.5 to 4.0 seconds prior to the crash, as the GMC began to negotiate the curve. The EDR data reported that the cruise control was recorded off for all data samples (-2.0 seconds to -0.5 seconds) prior to AE. Additionally, the cruise control resume switch and the cruise control set switch were both recorded as "No" (not active) by the EDR. There was no recorded application of the brakes in the EDR pre-crash data. The GMC's

roadside departure was the result of the vehicle attempting to traverse the roadway at a speed that was most likely too great for its curvature. There was no evidence to suggest that the cruise control remained engaged or was otherwise contributory to the crash.

Figure 14. Interior view of the GMC's steering wheel and the operational pad for the cruise control

2017 GMC Acadia Occupant Data

Driver Demographics

Age/sex:	72 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Mid-track, 10 cm (3.9 in) forward of full-rear track
Manual restraint usage:	3-point lap and shoulder seat belt system
Usage source:	Vehicle inspection, EDR
Air bags:	Front, knee, inboard, seat-mounted side, and IC air bags available; all deployed
Alcohol/drug data:	None
Egress from vehicle:	Exited vehicle under own power
Transport from scene:	Private vehicle
Type of medical treatment:	None

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	None	N/A	N/A	N/A

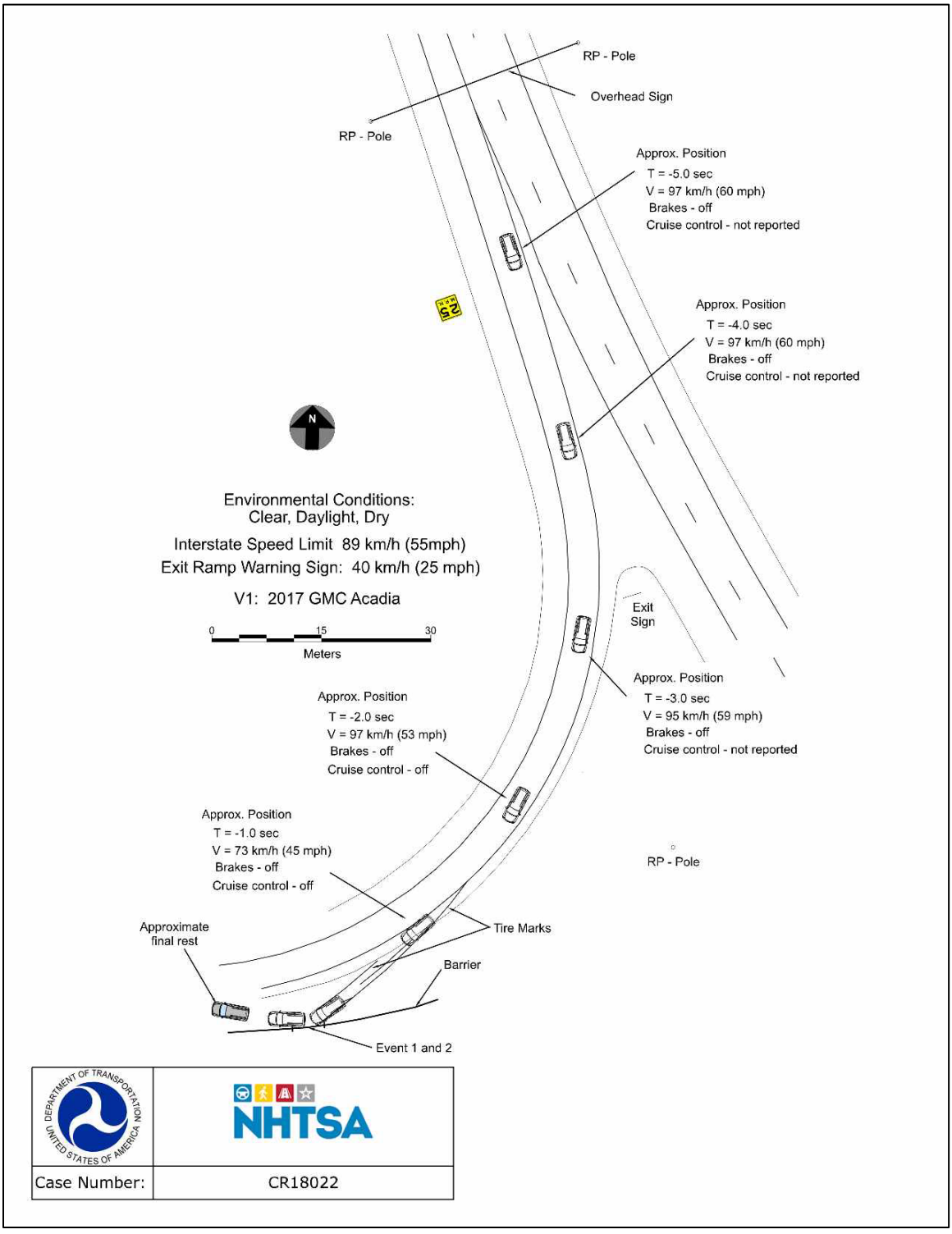
Source: PCR.

Driver Kinematics

The 72-year-old male driver of the GMC was seated with the power-seat track adjusted in a mid-track position 10 cm (3.9 in) forward of the full-rear and the seat back reclined 10 degrees aft of vertical. In this position, the horizontal distance between the seat back and the midpoint of the driver's frontal air bag module was 56 cm (22.0 in). The head restraint was adjusted 5 cm (2.0 in) above the seat back. He was restrained by the manual seat belt system, evidenced by a 13 cm (5.1 in) crease of the webbing at the D-ring location.

At impact with the concrete barrier, the seat belt pretensioner actuated, and the air bag systems around the driver's position deployed. The driver initiated a forward and slightly left trajectory in response to the 11 o'clock direction of force. He loaded the seat belt webbing, evidenced by the longitudinal creasing of the shoulder belt webbing. As the GMC was redirected to the west and contacted the barrier a second time, the driver remained in contact with and continued to load the seat belt, riding down the forces of the crash. It was probable that the driver contacted and loaded both the front, side, and IC air bags; however, there was no discernable contact evidence on the air bags to support such contact at the time of the SCI inspection. Post-crash, the driver remained in the driver seat and then exited the vehicle through the left door under his own power. He stated to the responding police officer that he was not injured and did not require medical attention.

Crash Diagram



Appendix A: Event Recorder Data Report for 2017 GMC Acadia[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	1GKKNXLS0HZ******
User	
Case Number	
EDR Data Imaging Date	07/31/2018
Crash Date	
Filename	CR18022_V1_ACM.CDRX
Saved on	Tuesday, July 31 2018 at 10:28:41
Imaged with CDR version	Crash Data Retrieval Tool 17.7.2
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 21.4.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Record 1 (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, pretensioners, or roll bars:

-Head Rest Deployment
-Battery Cut-Off Deployment

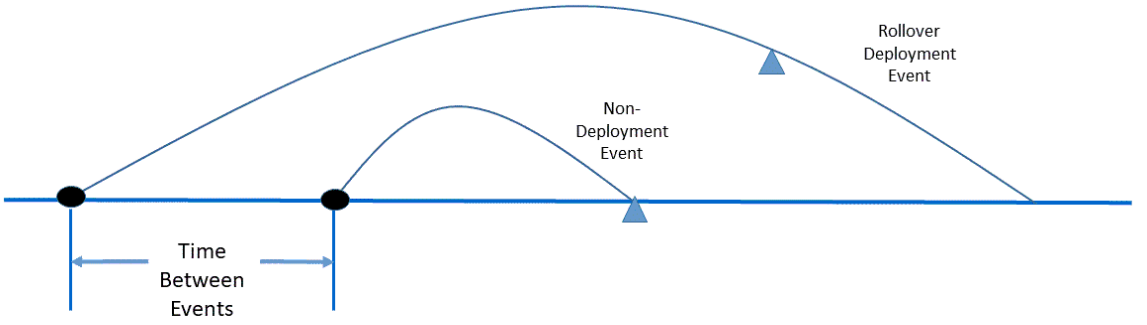
The second type of SDM recorded crash event for FSR Events is the Deployment Event. It also may contain Pre-Crash and Crash data. Deployment Events cannot be overwritten or cleared by the SDM.
Rollover Events contains Pre-Crash and Crash data. Rollover event follow the same rules as FSR Deployment events.
The SDM can store up to three Events.
There are two types of PedPro crash events. The first is the Non-Deployment PedPro Event. A Non-Deployment PedPro Event records data but does not deploy anything. A Non-Deployment PedPro Event may contain Pre-Crash and Crash data. The second type of PedPro recorded crash event is the Deployment PedPro Event. It also may contain Pre-Crash and Crash data. Deployment Events cannot be overwritten or cleared by the SDM.
The SDM can store up to two PedPro 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.
For FSR and Rollover deployment events, if the Deployment Loop Time from Time Zero to Deployment Loop Command Criteria Met is "Data Invalid", the deployment of the pretensioners and airbags occurred after 253 msec.
-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.
-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 or the commanded state of the brake lamps.
-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 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 Counters tracks the number of Deployment events that have occurred during the SDM's lifetime.
-Dynamic Event Counters 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.
-The airbag control module may continue to function after the vehicle has been turned off or to accessory, for a set period of time, this is called Prolongation. However, all other vehicle modules may have their functions shut down during Prolongation. For example, if the SIR warning lamp is commanded on by the airbag control module, during Prolongation, and is recorded in the EDR as being commanded on, the actual state of the warning lamp would be off to an observer since the vehicle display cluster would have been in the off state. Vehicle pre-event and system data may be recorded in the EDR as their commanded state, default state, or data invalid state.
-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.
-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.

01058_SDM40-conti_r010

System Status at Time of Retrieval

ESS # 1 Traceability Data, Component Identifier	AU
ESS # 1 Traceability Data, Part Number/Broadcast Code	3355
ESS # 1 Traceability Data, Supplier Code	T
ESS # 1 Traceability Data, Traceability Number	000069633
ESS # 1 Verification Data	67,567,619
ESS # 2 Traceability Data, Component Identifier	AT
ESS # 2 Traceability Data, Part Number/Broadcast Code	3355
ESS # 2 Traceability Data, Supplier Code	T
ESS # 2 Traceability Data, Traceability Number	0000G2623
ESS # 2 Verification Data	67,567,619
ESS # 3 Traceability Data, Component Identifier	AH
ESS # 3 Traceability Data, Part Number/Broadcast Code	3676
ESS # 3 Traceability Data, Supplier Code	T
ESS # 3 Traceability Data, Traceability Number	15WC44L2M
ESS # 3 Verification Data	235,209,217
ESS # 4 Traceability Data, Component Identifier	AJ
ESS # 4 Traceability Data, Part Number/Broadcast Code	3676
ESS # 4 Traceability Data, Supplier Code	T
ESS # 4 Traceability Data, Traceability Number	15GBSPF0A
ESS # 4 Verification Data	235,209,217
ESS # 5 Traceability Data, Traceability Number	15WKBUH1G
ESS # 5 Traceability Data, Component Identifier	DA
ESS # 5 Traceability Data, Part Number/Broadcast Code	3676
ESS # 5 Traceability Data, Supplier Code	T
ESS # 5 Verification Data	235,209,217
ESS # 6 Traceability Data, Component Identifier	DB
ESS # 6 Traceability Data, Part Number/Broadcast Code	3676
ESS # 6 Traceability Data, Supplier Code	T
ESS # 6 Traceability Data, Traceability Number	15WKBEM06
ESS # 6 Verification Data	235,209,217
ESS # 7 Traceability Data, Component Identifier	00
ESS # 7 Traceability Data, Part Number/Broadcast Code	0000
ESS # 7 Traceability Data, Supplier Code	T
ESS # 7 Traceability Data, Traceability Number	000000000
ESS # 7 Verification Data	0
ESS # 8 Traceability Data, Component Identifier	00
ESS # 8 Traceability Data, Part Number/Broadcast Code	0000
ESS # 8 Traceability Data, Supplier Code	T
ESS # 8 Traceability Data, Traceability Number	000000000
ESS # 8 Verification Data	0
AOS Data Key	0
SDM Primary Key Definition (Key 1-2)	20
SDM Primary Key Definition (Key 3-4)	14
Dynamic Deployment Event Counter	1
Multi-Event, Number of Events (Dynamic Event Counter)	1
Dynamic OnStar Notification Event Counter	1
Driver Frontal Stage 2 Commanded after Event End for Event Record #1	No
Passenger Frontal Stage 2 Commanded after Event End for Event Record #1	No
Driver Frontal Stage 2 Commanded after Event End for Event Record #2	No
Passenger Frontal Stage 2 Commanded after Event End for Event Record #2	No
Driver Frontal Stage 2 Commanded after Event End for Event Record #3	No
Passenger Frontal Stage 2 Commanded after Event End for Event Record #3	No
Longitudinal Accelerometer Range (g)	100
Lateral Accelerometer Range (g)	100
Dynamic PedPro Deploy Event Counter	0
Dynamic PedPro Event Counter	0
Vehicle Identification Number (VIN)	1GKKNXLS0HZ******
System Type	Continental SDM40 with integrated IMU
Ignition Cycle, Download (Ignition Cycles at Investigation)	4,153

System Status at Event (Record 1)

Complete File Recorded (Event Recording Complete)	Yes
Event Record Type	Deployment
Crash Record Locked	Yes
OnStar Deployment Status Data Sent	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	Yes
High Voltage Disable Notification Sent	Yes
Deployment Commanded in Energy Reserve Mode	No
Deployment Event Counter	1
Multi-Event, Number of Events (Event Counter)	1
OnStar Notification Event Counter	1
Algorithm Active - Frontal	Yes
Algorithm Active - Side	Yes
Algorithm Active - Rollover	No
Algorithm Active - Rear	Yes
Ignition Cycle, Crash (Ignition Cycles at Event)	4,147
Time From Event 1 to 2 (Time Between Events) (msec)	Data Not Available
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
Event Severity Status: Battery Disconnect Switch - Side Event	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
Center 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)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655,330
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	4,147
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])	-11 [-17]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change) (msec)	252
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) (MPH [km/h])	21 [33]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change) (msec)	220
Maximum Resultant Delta-V – Longitudinal Component for FSR Event (MPH [km/h])	-11 [-17]
Maximum Resultant Delta-V – Lateral Component for FSR Event (MPH [km/h])	21 [33]
Time from FSR Time Zero to time of the Maximum Resultant Delta-V (msec)	234
Blended Event FSR 1 Severity Type	Frontal (Pretensioner/Stage 1/Stage 2)
Blended Event FSR 2 Severity Type	Side (Left or Right Side)
Blended Event Time from FSR 1 Time Zero to FSR 2 Time Zero (msec)	8
Blended Event FSR 3 Severity Type	Data Not Available

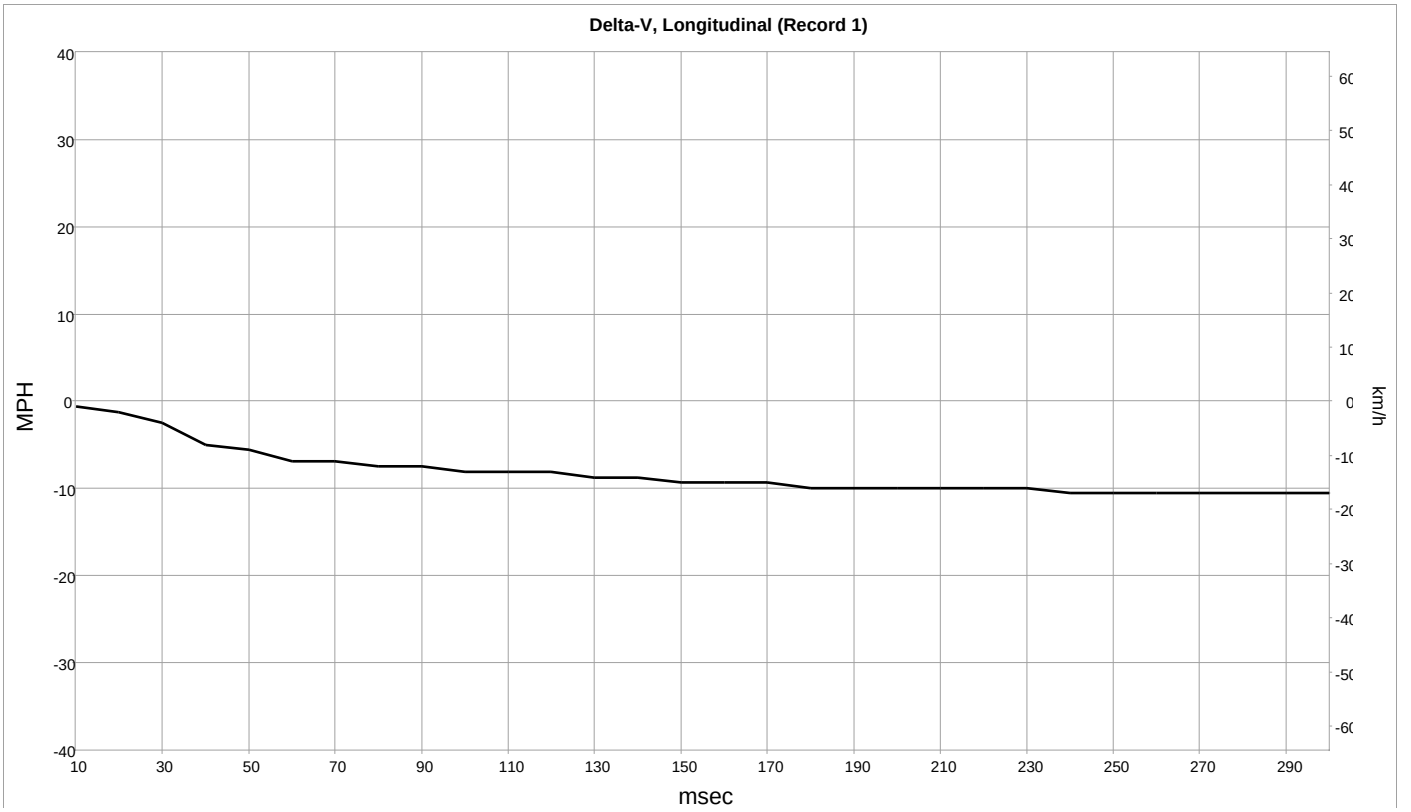
Blended Event Time from FSR 1 Time Zero to FSR 3 Time Zero (msec)	Data Not Available

Diagnostic Trouble Codes 0.5 Seconds Prior to Time Zero (Record 1)

DTC 1	B0052-00
DTC 2	N/A
DTC 3	N/A
DTC 4	N/A
DTC 5	N/A
DTC 6	N/A
DTC 7	N/A
DTC 8	N/A
DTC 9	N/A

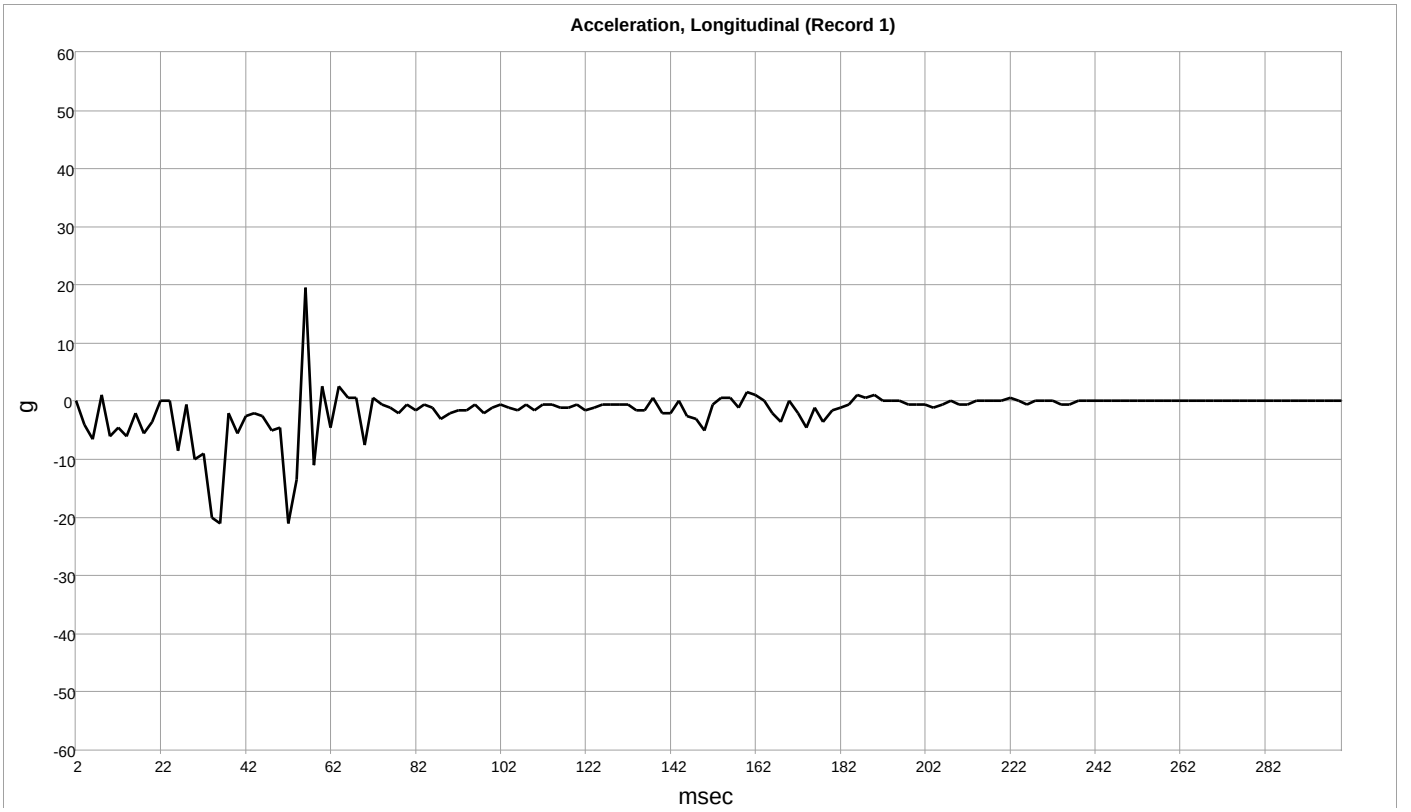
Deployment Command Data (Record 1)

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
Driver Knee Deployment Loop Commanded	Yes
Driver Center Inboard Loop Commanded (If Equipped)	Yes
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	34
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, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	38
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
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 Command Criteria Met) (msec)	34
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #1 Command Criteria Met) (msec)	34
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #2 Command Criteria Met) (msec)	38
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #2 Command Criteria Met) (msec)	38
Side Air Bag Deployment, Time to Deploy, Driver (Driver Thorax Time From Time Zero to Deployment Command Criteria Met) (msec)	166
Side Air Bag Deployment, Time to Deploy, Right Front Passenger (Passenger Thorax Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Left Row 1 Curtain Time From Time Zero to Deployment Command Criteria Met (msec)	34
Right Row 1 Curtain Time From Time Zero to Deployment Command Criteria Met (msec)	34
Driver Knee Time From Time Zero to Deployment Command Criteria Met (msec)	34
Driver Center Inboard Time From Time Zero to Deployment Loop Command Criteria Met (If Equipped) (msec)	201


Delta-V, Longitudinal (Record 1)
MPH
km/h
msec
40
30
20
10
0
-10
-20
-30
-40
10
30
50
70
90
110
130
150
170
190
210
230
250
270
290

Longitudinal Delta-V (Record 1)

Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH [km/h])
10	-1 [-1]
20	-1 [-2]
30	-2 [-4]
40	-5 [-8]
50	-6 [-9]
60	-7 [-11]
70	-7 [-11]
80	-7 [-12]
90	-7 [-12]
100	-8 [-13]
110	-8 [-13]
120	-8 [-13]
130	-9 [-14]
140	-9 [-14]
150	-9 [-15]
160	-9 [-15]
170	-9 [-15]
180	-10 [-16]
190	-10 [-16]
200	-10 [-16]
210	-10 [-16]
220	-10 [-16]
230	-10 [-16]
240	-11 [-17]
250	-11 [-17]
260	-11 [-17]
270	-11 [-17]
280	-11 [-17]
290	-11 [-17]
300	-11 [-17]

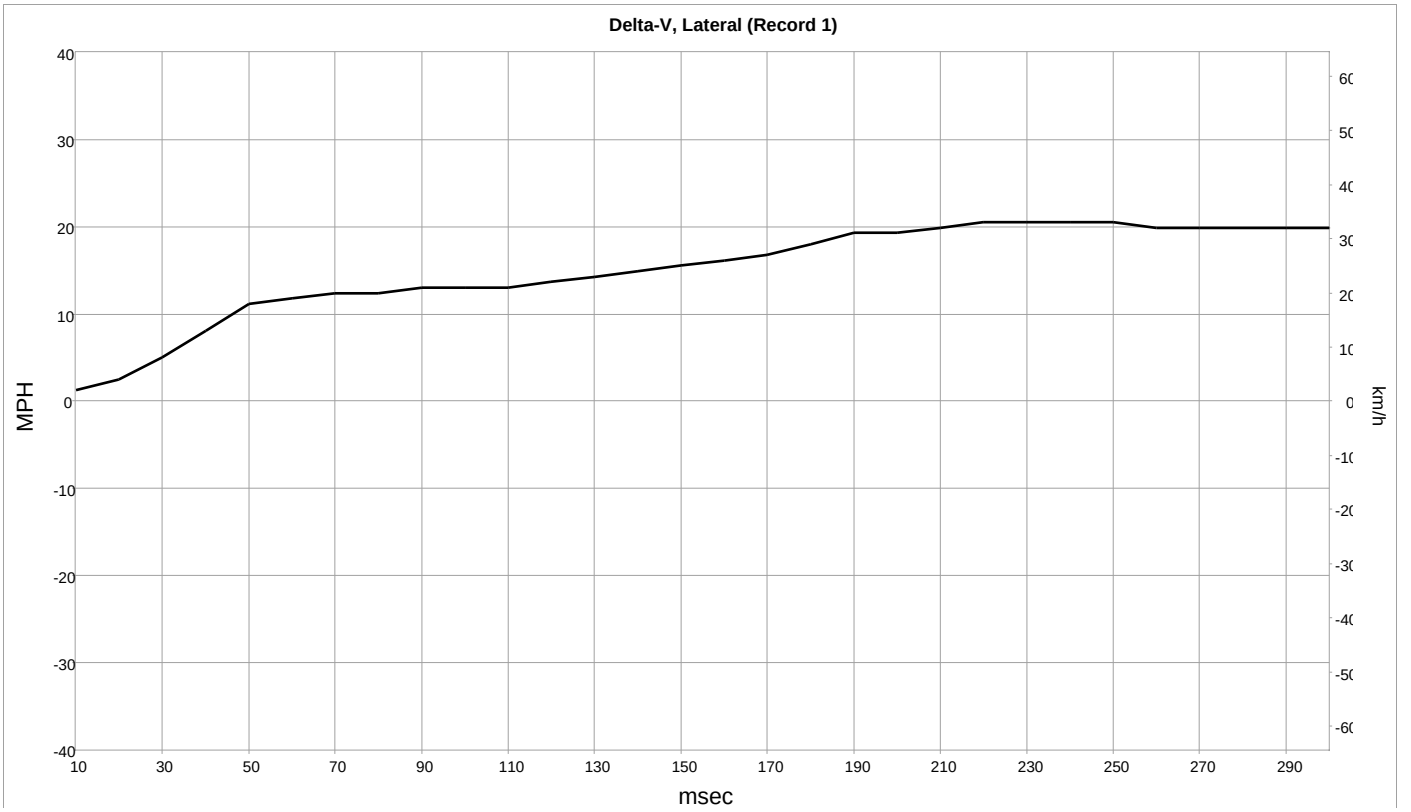

Acceleration, Longitudinal (Record 1)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
g
2
22
42
62
82
102
122
142
162
182
202
222
242
262
282
msec

Longitudinal Acceleration (Record 1)

Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
2	0.00
4	-4.00
6	-6.50
8	1.00
10	-6.00
12	-4.50
14	-6.00
16	-2.00
18	-5.50
20	-3.50
22	0.00
24	0.00
26	-8.50
28	-0.50
30	-10.00
32	-9.00
34	-20.00
36	-21.00
38	-2.00
40	-5.50
42	-2.50
44	-2.00
46	-2.50
48	-5.00
50	-4.50
52	-21.00
54	-13.50
56	19.50
58	-11.00
60	2.50
62	-4.50
64	2.50
66	0.50
68	0.50
70	-7.50
72	0.50
74	-0.50
76	-1.00
78	-2.00
80	-0.50
82	-1.50
84	-0.50
86	-1.00
88	-3.00
90	-2.00
92	-1.50
94	-1.50
96	-0.50
98	-2.00
100	-1.00
102	-0.50
104	-1.00
106	-1.50
108	-0.50
110	-1.50
112	-0.50

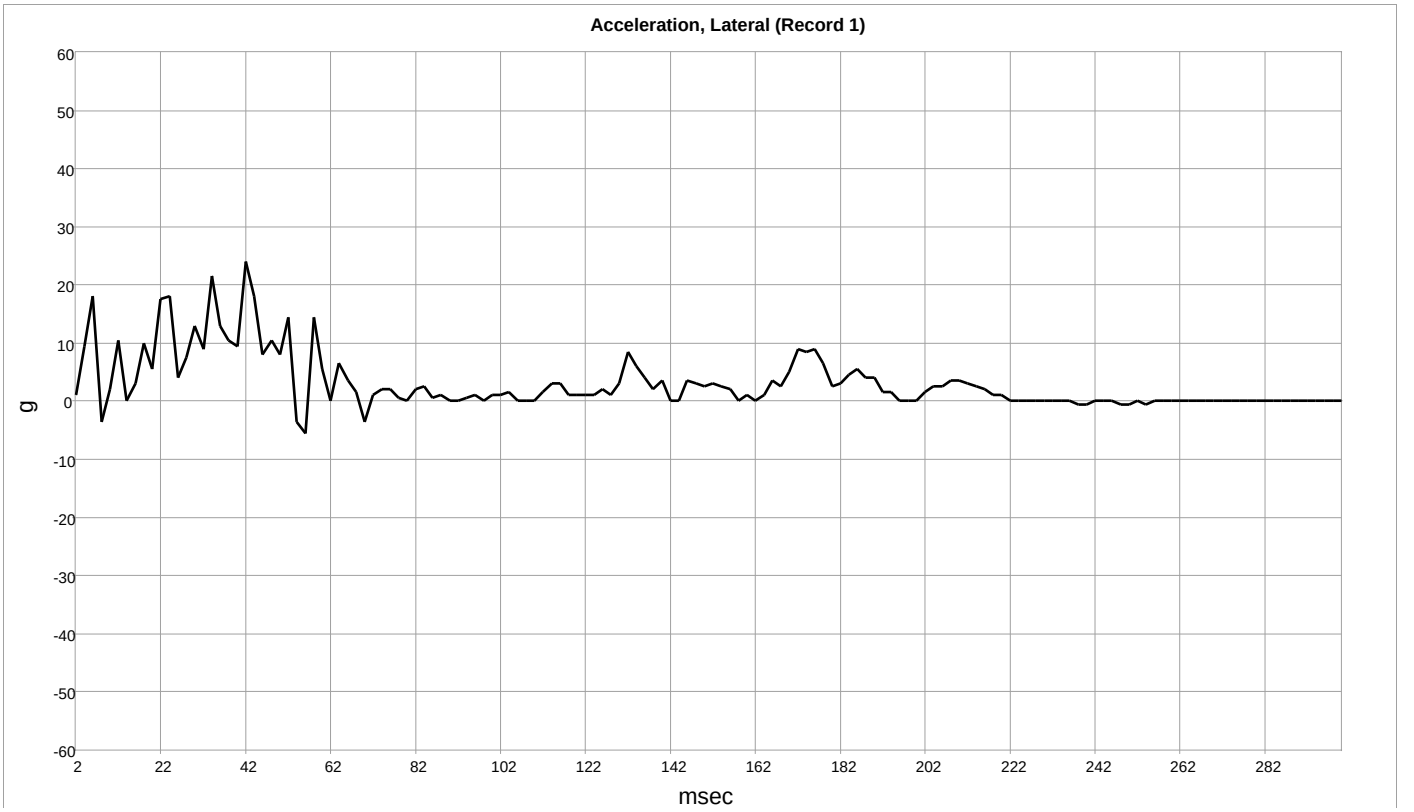
Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
114	-0.50
116	-1.00
118	-1.00
120	-0.50
122	-1.50
124	-1.00
126	-0.50
128	-0.50
130	-0.50
132	-0.50
134	-1.50
136	-1.50
138	0.50
140	-2.00
142	-2.00
144	0.00
146	-2.50
148	-3.00
150	-5.00
152	-0.50
154	0.50
156	0.50
158	-1.00
160	1.50
162	1.00
164	0.00
166	-2.00
168	-3.50
170	0.00
172	-2.00
174	-4.50
176	-1.00
178	-3.50
180	-1.50
182	-1.00
184	-0.50
186	1.00
188	0.50
190	1.00
192	0.00
194	0.00
196	0.00
198	-0.50
200	-0.50
202	-0.50
204	-1.00
206	-0.50
208	0.00
210	-0.50
212	-0.50
214	0.00
216	0.00
218	0.00
220	0.00
222	0.50
224	0.00
226	-0.50

Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
228	0.00
230	0.00
232	0.00
234	-0.50
236	-0.50
238	0.00
240	0.00
242	0.00
244	0.00
246	0.00
248	0.00
250	0.00
252	0.00
254	0.00
256	0.00
258	0.00
260	0.00
262	0.00
264	0.00
266	0.00
268	0.00
270	0.00
272	0.00
274	0.00
276	0.00
278	0.00
280	0.00
282	0.00
284	0.00
286	0.00
288	0.00
290	0.00
292	0.00
294	0.00
296	0.00
298	0.00
300	0.00


Delta-V, Lateral (Record 1)
MPH
km/h
msec
40
30
20
10
0
-10
-20
-30
-40
10
30
50
70
90
110
130
150
170
190
210
230
250
270
290

Lateral Delta-V (Record 1)

Time (msec)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (MPH [km/h])
10	1 [2]
20	2 [4]
30	5 [8]
40	8 [13]
50	11 [18]
60	12 [19]
70	12 [20]
80	12 [20]
90	13 [21]
100	13 [21]
110	13 [21]
120	14 [22]
130	14 [23]
140	15 [24]
150	16 [25]
160	16 [26]
170	17 [27]
180	18 [29]
190	19 [31]
200	19 [31]
210	20 [32]
220	21 [33]
230	21 [33]
240	21 [33]
250	21 [33]
260	20 [32]
270	20 [32]
280	20 [32]
290	20 [32]
300	20 [32]


Acceleration, Lateral (Record 1)
60
50
40
30
20
10
0
-10
-20
-30
-40
-50
-60
g
2
22
42
62
82
102
122
142
162
182
202
222
242
262
282
msec

Lateral Acceleration (Record 1)

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	1.00
4	9.50
6	18.00
8	-3.50
10	2.00
12	10.50
14	0.00
16	3.00
18	10.00
20	5.50
22	17.50
24	18.00
26	4.00
28	7.50
30	13.00
32	9.00
34	21.50
36	13.00
38	10.50
40	9.50
42	24.00
44	18.00
46	8.00
48	10.50
50	8.00
52	14.50
54	-3.50
56	-5.50
58	14.50
60	5.50
62	0.00
64	6.50
66	3.50
68	1.50
70	-3.50
72	1.00
74	2.00
76	2.00
78	0.50
80	0.00
82	2.00
84	2.50
86	0.50
88	1.00
90	0.00
92	0.00
94	0.50
96	1.00
98	0.00
100	1.00
102	1.00
104	1.50
106	0.00
108	0.00
110	0.00
112	1.50
114	3.00

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
116	3.00
118	1.00
120	1.00
122	1.00
124	1.00
126	2.00
128	1.00
130	3.00
132	8.50
134	6.00
136	4.00
138	2.00
140	3.50
142	0.00
144	0.00
146	3.50
148	3.00
150	2.50
152	3.00
154	2.50
156	2.00
158	0.00
160	1.00
162	0.00
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182	3.00
184	4.50
186	5.50
188	4.00
190	4.00
192	1.50
194	1.50
196	0.00
198	0.00
200	0.00
202	1.50
204	2.50
206	2.50
208	3.50
210	3.50
212	3.00
214	2.50
216	2.00
218	1.00
220	1.00
222	0.00
224	0.00
226	0.00
228	0.00
230	0.00

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
232	0.00
234	0.00
236	0.00
238	-0.50
240	-0.50
242	0.00
244	0.00
246	0.00
248	-0.50
250	-0.50
252	0.00
254	-0.50
256	0.00
258	0.00
260	0.00
262	0.00
264	0.00
266	0.00
268	0.00
270	0.00
272	0.00
274	0.00
276	0.00
278	0.00
280	0.00
282	0.00
284	0.00
286	0.00
288	0.00
290	0.00
292	0.00
294	0.00
296	0.00
298	0.00
300	0.00

Roll Rate (Record 1)

Contains No Recorded Data

Acceleration, Lateral, Rollover (Record 1)

Contains No Recorded Data

Acceleration, Normal, Rollover (Record 1)

Contains No Recorded Data

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

Time (sec)	Service Brake (Brake Switch Circuit State)	Accelerator Pedal Position, % Full (Accelerator Pedal Position) (%)	Engine RPM (Engine Speed) (RPM)	Engine Throttle, % Full (Throttle Position) (%)	Speed, Vehicle Indicated (Vehicle Speed) (MPH [km/h])
-5.0	Off	0	1,600	28	60 [97]
-4.5	Off	0	1,600	28	60 [97]
-4.0	Off	0	1,600	28	60 [97]
-3.5	Off	0	1,600	24	60 [96]
-3.0	Off	0	1,536	11	59 [95]
-2.5	Off	0	1,472	12	57 [92]
-2.0	Off	0	1,408	17	53 [86]
-1.5	Off	0	1,152	10	48 [77]
-1.0	Off	0	1,088	11	45 [73]
-0.5	Off	0	832	0	37 [60]

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

Time (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Reduced Engine Power Mode Indicator	Engine Torque (N-m)
-2.0	No	No	No	Off	-7
-1.5	No	No	No	Off	-5
-1.0	No	No	No	Off	-7
-0.5	No	No	No	Off	-22

Hexadecimal Data

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DPID $11
FF 1F 04 00 3F 0E 81

DPID $15
01 02 03 04 05 06 07

DPID $16
08 09 0A 0D 0E 13 00

DPID $17
00 00 00 00 00 00 00

DPID $1F
01 01 02 02 00 00 00

DPID $20
00 00 00 00 00 00 00

DPID $30
00 FF 00 00 00 00 00

DPID $32
00 FD 10 39 00 00 00

DPID $51
0B 00 00 00 00 00 00

DID $01
41 55 33 33 35 35 54 30 30 30 30 36 39 36 33 33

DID $02
04 07 00 03

DID $03
41 54 33 33 35 35 54 30 30 30 30 47 32 36 32 33

DID $04
04 07 00 03

DID $05
41 48 33 36 37 36 54 31 35 57 43 34 34 4C 32 4D

DID $06
0E 05 02 01

DID $07
41 4A 33 36 37 36 54 31 35 47 42 53 50 46 30 41

DID $08
0E 05 02 01

DID $09
44 41 33 36 37 36 54 31 35 57 4B 42 55 48 31 47

DID $0A
0E 05 02 01

DID $0B
44 42 33 36 37 36 54 31 35 57 4B 42 45 4D 30 36

DID $0C
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0E 05 02 01

DID $0D
30 30 30 30 30 30 54 30 30 30 30 30 30 30 30 30

DID $0E
00 00 00 00

DID $0F
30 30 30 30 30 30 54 30 30 30 30 30 30 30 30 30

DID $10
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DID $11
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DID $22
20 14

DID $30
01 00 01 01 00 64 64 00 00 00

DID $31
0000   A5 F8 01 00 01 01 0B 10 33 FF
0010   FF 00 00 00 0F AF 8C 20 00 40
0020   00 4C FC FC F0 00 00 F0 1C 00
0030   00 00 00 00 00 00 00 00 00 00
0040   00 00 00 00 00 00 0D 11 12 16
0050   17 18 19 19 19 19 06 74 06 93
0060   06 96 06 92 00 0B 0A 11 0C 0B
0070   18 1C 1C 1C 3C 49 4D 56 5C 5F
0080   60 61 61 61 00 FF FD 10 33 FD
0090   80 52 00 FF FF FF FF FF FF FF
0100   FF FF FF FF FF FF FF FF FF FF
0110   FF FF FF FF FF FF FF 6E 7E A0
0120   6E 6E A0 75 00 20 08 E0 FF 22
0130   FF 26 FF 22 22 26 26 A6 FF FF
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0150   FF FF FF FF FF FF FF 00 00 00
0160   00 00 C9 FF FF FF FF 00 00 00
0170   00 00 00 00 00 00 00 7E 81 7D
0180   83 7B 87 77 8C 76 91 74 92 74
0190   93 73 93 73 94 72 94 72 94 72
0200   95 71 96 71 97 70 98 70 99 70
0210   9A 6F 9C 6F 9E 6F 9E 6F 9F 6F
0220   A0 6F A0 6E A0 6E A0 6E 9F 6E
0230   9F 6E 9F 6E 9F 6E 9F 7F FF 80
0240   63 7E 6F 83 B5 7D 75 87 07 80
0250   63 7E A1 7D A7 80 C7 7E 3D 84
0260   19 7D A7 7F FF 7F 37 81 2B 7D
0270   D9 83 E7 7E A1 82 25 7F FF 86
0280   D5 7F FF 87 07 7C AD 81 8F 7F
0290   CD 82 ED 7C 17 85 13 7C 7B 83
0300   83 78 2F 88 65 77 CB 85 13 7F
0310   37 84 19 7D D9 83 B5 7F 05 89
0320   5F 7F 37 87 07 7F 05 83 1F 7E
0330   0B 84 19 7E 3D 83 1F 77 CB 85
0340   A9 7A B9 7E A1 87 9D 7D D9 7B
0350   B3 85 A9 80 F9 82 25 7E 3D 7F
0360   FF 80 F9 82 89 80 31 81 5D 80
0370   31 80 95 7D 11 7E A1 80 31 80
0380   63 7F CD 80 C7 7F 9B 80 C7 7F
0390   37 80 31 7F CD 7F FF 7F 69 80
0400   C7 7F CD 80 F9 7F 9B 80 31 7E
0410   D3 80 63 7F 37 7F FF 7F 69 7F
0420   FF 7F 69 80 31 7F CD 80 63 7F
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0440   63 7F 9B 80 95 7F 69 7F FF 7F
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0460   95 7F CD 81 2B 7F 9B 81 2B 7F
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0490   CD 80 63 7F CD 81 2B 7F CD 83
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0510   31 80 C7 7F 37 81 5D 7F 37 7F
0520   FF 7F FF 7F FF 7F 05 81 5D 7E
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0540   2B 80 31 80 F9 80 31 80 C7 7F
0550   9B 7F FF 80 95 80 63 80 63 7F
0560   FF 7F FF 80 63 7F 37 81 5D 7E
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0580   83 7E 3D 83 51 7F 9B 83 83 7E
0590   A1 82 89 7F 69 80 F9 7F 9B 81
0600   2B 7F CD 81 C1 80 63 82 25 80
0610   31 81 8F 80 63 81 8F 7F FF 80
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0640   95 7F 9B 80 F9 7F CD 80 F9 7F
0650   FF 81 5D 7F CD 81 5D 7F CD 81
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1190   37 C8 00 00 79 22 00 22 00 00
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May 2022

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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