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Special Crash Investigations On-Site Rollover Investigation Vehicle: 2015 Chevrolet Cruze Location: California Crash Date: December 2015

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants. Because each crash is a unique sequence of events, 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.

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16. Abstract The interest in this on-site investigation was the dynamics of a 2015 Chevrolet Cruze involved in rollover crash. The Chevrolet is compliant with Federal Motor Vehicle Safety Standard (FMVSS) No. 226, Ejection Mitigation, a rule established to reduce the partial and complete ejection of vehicle occupants through side windows in crashes, particularly rollover crashes. The crash occurred during evening hours in December 2015 on a four-lane, northbound interstate highway in California. The Chevrolet was being driven northbound in the first lane from the right by a belted 46-year-old male. The other vehicle involved in the crash was a 2001 Mack CV500 medium-heavy truck cement mixer being driven by a 28-year-old male in the second lane from the right. The police report indicated the Chevrolet was traveling approximately 40 km/h (25 mph) faster than the Mack. For unknown reasons, the Chevrolet changed lanes to the left and the front plane of the vehicle struck the back plane of the Mack. The Chevrolet was displaced to the right and subsequently overturned before coming to rest on the right shoulder. Following the crash, the Mack was brought to a controlled stop. The Chevrolet was equipped with frontal and knee air bags for the front row, seat-mounted side impact air bags for both rows and combination roll-sensing/side impact inflatable curtain (IC) air bags for both rows. During the crash, the driver's frontal, knee, and both IC air bags deployed. The driver of the Chevrolet sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a local hospital. The driver of the Mack was not injured and the Mack was driven from the scene. The Chevrolet was towed due to damage and declared to be a total loss.					
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**On-Site Rollover Investigation
Case Number DS16005
Vehicle: 2015 Chevrolet Cruze
Location: California
Crash Date: December 2015**

BACKGROUND

The interest in this on-site investigation was the dynamics of a 2015 Chevrolet Cruze involved in a rollover crash (**Figure 1**). The Chevrolet is compliant with Federal Motor Vehicle Safety Standard (FMVSS) No. 226, Ejection Mitigation, a rule established to reduce the partial and complete ejection of vehicle occupants through side windows in crashes, particularly rollover crashes. This crash was identified by a Dynamic Science, Inc., investigator during a review of online vehicle auctions. Images of the Chevrolet were forwarded to the Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration on February 29, 2016, and the case was assigned on March 1, 2016. The SCI team obtained a copy of the police report and completed the vehicle inspection on March 3, 2016. The Chevrolet was supported by the Bosch Crash Data Retrieval (CDR) system and the vehicle's event data recorder (EDR) was imaged during the inspection.



Figure 1. 2015 Chevrolet Cruze

The crash occurred during evening hours in December 2015 on a four-lane, northbound interstate highway in California. The Chevrolet was being driven northbound in the first lane from the right by a belted 46-year-old male. The other vehicle involved in the crash was a 2001 Mack CV500 medium-heavy tractor cement mixer being driven by a 28-year-old male in the second lane from the right. The police report indicated the Chevrolet was traveling approximately 40 km/h (25 mph) faster than the Mack. For unknown reasons, the Chevrolet changed lanes to the left and the front plane of the vehicle impacted the back plane of the Mack. The Chevrolet was displaced to the right and subsequently overturned before coming to rest on the right shoulder. Following the crash, the Mack was brought to a controlled stop.

The Chevrolet was equipped with frontal and knee air bags for the front row, seat-mounted side impact air bags for both rows and combination roll-sensing/side impact inflatable curtain (IC) air bags for both rows. During the crash, the driver's frontal, knee, and both IC air bags deployed. Both side windows in the front row of the Chevrolet disintegrated during the crash. The belted driver remained held in his seated position and no ejection occurred. He sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a local hospital. The driver of the Mack was not injured and the Mack was driven from the scene. The Chevrolet was towed due to damage. It was later declared to be a total loss and sold.

SUMMARY

Crash Site

The crash occurred on a four-lane, northbound interstate highway in California (**Figure 2**). The roadway was concrete-surfaced and was configured with paved shoulders measuring 1.2 m (4.0 ft) on the left edge and 3.0 m (10.0 ft) in width on the right edge. The lanes were separated by dashed white painted stripes and the roadway was bordered by a solid yellow painted stripe on the left edge and a solid white painted fog line on the right edge. This roadway was straight and level, and the posted speed limit was 105 km/h (65 mph) for two-axle vehicles and 89 km/h (55 mph) for heavy trucks. The investigating police officer noted no unusual conditions present at the time of the crash. The vehicles were moved prior to police investigation and final rest positions of the vehicles was unknown.



Figure 2. Crash site, northbound approach view

Conditions at the time of the crash as reported by the nearest weather station were as follows: temperature 12.2 °C (54.0 °F), winds south at 5.6 km/h (3.5 mph), visibility 16.0 km (10.0 mi) and clear skies. The crash occurred approximately five minutes prior to sunset suggesting light conditions were dusk and not completely dark. No overhead illumination was present in the immediate area of the crash. A crash diagram is included on page 12 of this report.

Pre-Crash

The Chevrolet was traveling northbound in the first lane from the right at an EDR-reported pre-crash vehicle speed of 76 km/h (47 mph) at Time -5.0 seconds. Cruise control was “Off” and the service brake was “Off.” At Time -0.5 seconds the vehicle speed had increased to 83 km/h (52 mph) and the service brake was still “Off.” A witness statement to police indicated the Chevrolet changed lanes to the left and traveled in a trajectory toward the back plane of the slower-traveling Mack. Given his statements to fire personnel and police, the driver of the Chevrolet was likely sleepy or fell asleep. He stated to fire personnel that he was tired and possibly fell asleep, and stated to police all he remembered was his vehicle overturning. The Chevrolet’s pre-crash speed and distances traveled during the EDR-reported time stamps beginning at Time -5.0 seconds and ending at Time -0.5 seconds are stated in the table below:

Time Stamp (seconds)	Vehicle Speed mph (km/h)	Incremental Distance Traveled m (ft)	Cumulative Distance Traveled m (ft)
-5.0	47 (76)	NA	NA
-4.5	48 (77)	10.7 (35.1)	10.7 (35.1)
-4.0	48 (78)	10.8 (35.5)	21.5 (70.6)
-3.5	49 (79)	11.0 (36.1)	32.5 (106.6)

-3.0	50 (81)	11.2 (36.9)	43.7 (143.4)
-2.5	50 (81)	11.2 (36.9)	54.9 (180.1)
-2.0	51 (82)	11.4 (37.4)	66.3 (217.5)
-1.5	51 (82)	11.4 (37.4)	77.7 (254.9)
-1.0	51 (82)	11.4 (37.4)	89.1 (292.3)
-0.5	52 (83)	11.5 (37.8)	100.6 (330.1)

The Mack was traveling northbound in the second from the left at a police-estimated speed of 48 km/h (30 mph).

Crash

The crash included two events. For Event 1, the front plane of the Chevrolet struck the back plane of the Mack. This was an impact to the left front corner of the Chevrolet extending down the left side and snagging the left front tire/wheel assembly. This event triggered the deployment of the driver’s steering-wheel-mounted frontal air bag and lower-instrument-panel-mounted knee air bag. The Chevrolet was displaced to the right while initiating a counterclockwise rotation. For Event 2, the vehicle initiated a right side leading trip rollover. The Chevrolet rotated counterclockwise approximately 90 degrees and when the vehicle’s direction of travel was lateral to its heading angle, its right side tires engaged the roadway with sufficient opposing lateral force to cause the vehicle to trip. This event triggered the deployment of the vehicle’s left and right IC air bags and actuation of both front row seat belt pretensioners. The vehicle rolled along its longitudinal axis for two quarter-turns and came to rest on its roof in an upside down orientation and facing north on the right shoulder.

The driver of the Mack indicated to police he felt a tug on his vehicle and then observed in his rear view mirror the Chevrolet overturned on the right shoulder. He brought the Mack to a controlled stop on the shoulder. Both vehicles were soon removed and police did not take on-scene measurements.

For the Chevrolet in Event 1, the WinSMASH Barrier algorithm calculated a total delta-V of 13 km/h (8 mph) with longitudinal and lateral components of -13 km/h (-8 mph) and 2 km/h (1 mph), respectively, and a barrier equivalent speed (BES) of 13 km/h (8 mph). The reconstruction for this impact was considered borderline. The EDR-reported velocity changes for this event were maximum longitudinal delta-V of -11 km/h (-7 mph) and maximum lateral delta-V of 8 km/h (5 mph).

The rollover event was out of scope for WinSMASH. The EDR stored the rollover event but did not record velocity changes for that event. The rollover is discussed in greater detail in the Rollover Mitigation section of this report.

Post-Crash

The Chevrolet’s OnStar notification was sent during the crash. Police and fire services were dispatched within two minutes of the crash with fire responders arriving first and police on-scene within 13 minutes.

The driver of the Chevrolet was attended to by fire personnel and then transported by ambulance to a local hospital. He was treated for minor injuries and released. The driver of the Mack was not injured or transported. The Chevrolet was towed due to damage and the Mack was driven from the scene. The Chevrolet was declared a total loss and was sold.

2015 CHEVROLET CRUZE

Description

The 2015 Chevrolet Cruze was identified by the Vehicle Identification Number 1G1PC5SB0F7xxxxxx. It was manufactured in April 2014. The vehicle was configured with an electronic odometer that was inoperable and the mileage was unknown. The Chevrolet was a four-door sedan configured with a 4-cylinder 1.4 liter gasoline engine, automatic transmission, front-wheel drive, ABS, tilt steering and daytime running lights. Additionally, the vehicle was equipped with standard electronic stability control and a rearview video system.

The vehicle manufacturer's recommended tire size was P215/60R16 with a recommended cold tire pressure of 241 kPa (35 psi) for the front and rear. The vehicle was equipped with Firestone FR710 tires of the recommended size. Specific tire data was as follows:

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	234 kPa (34 psi)	6 mm (8/32 in)	Yes	None
LR	228 kPa (33 psi)	4 mm (5/32 in)	No	None
RR	221 kPa (32 psi)	5 mm (6/32 in)	No	None
RF	221 kPa (32 psi)	6 mm (8/32 in)	No	None

The Chevrolet's interior was equipped with two rows of seating for five occupants. The front row was configured with two bucket seats with adjustable head restraints. The driver's head restraint was adjusted to 3.0 cm (1.2 in) above the seat back, the seat cushion was adjusted between middle to full rear track position and the seat back was slightly reclined.

The second row was configured with 60/40 split bench seat with folding backs and adjustable head restraints.

Exterior Damage

The Chevrolet sustained moderate severity crush damage to the front plane caused during the impact with the Mack and moderate severity crush damage to the roof caused during the rollover. For the frontal impact, the damage was located on the front bumper fascia, front left headlamp, left front fender and left front tire/wheel assembly. The left front tire was restricted. Direct damage to the bumper fascia began at the front left bumper corner and extended 17.0 cm (6.7 in) to the right. Direct damage down the left side extended from the front left bumper corner to the left front fender and measured 50.0 cm (19.7 in). The Field L extended from bumper corner to bumper corner and measured 160.0 cm (63.0 in) (**Figure 3**). Six crush measurements were calculated at bumper level as follows: $C_1 = 3.0$ cm (1.2 in), $C_2 = 0$ cm, $C_3 = 0$ cm, $C_4 = 0$ cm, $C_5 = 0$ cm, $C_6 = 0$ cm. Maximum

crush was located at C₁ and the Collision Deformation Classification (CDC) for the Chevrolet in Event 1 was 12FLEE3.

For the rollover, direct damage was present on the top plane beginning at the leading edge of the hood and extending rearward 251.0 cm (98.8 in) ending at the roof lateral to the B-pillar (**Figure 4**). Laterally, the damage was distributed from roof side rail to roof side rail measuring 118.0 cm (47.2 in). Maximum vertical and lateral crush were both located at the front left corner of the roof where it met the A-pillar. Maximum vertical crush measured 12.0 cm (4.7 in) and maximum lateral crush measured 4.0 cm (1.6 in). The CDC for Event 2 was 00TYDO2.

Event Data Recorder

The Chevrolet's EDR was imaged by SCI during the vehicle inspection using the data link connector method with power supplied by a portable power pack/jump box. The EDR was imaged using the Bosch CDR Tool version 16.4 and reported using version 17.4.2. The complete EDR report is included in this report as Attachment A.

The EDR stored three events for this crash, which maximized its storage capacity. The first event was a non-locked, non-deployment event and the two subsequent events were locked deployment events. Pre-crash data was reported for all three events. The EDR-reported second event was most representative of the frontal impact and the EDR-reported third event was most representative of the rollover. The EDR-reported first event appears to be related to the third event in the sense that both events share identical pre-crash data for the seconds prior to algorithm enable (AE), and appear to be followed chronologically by the second (frontal) event. This ordering sequence differs from the actual sequence of the crash events in which the frontal vehicle to vehicle impact came first and the rollover event came last. Additionally, the first (non-deployment) EDR event has higher longitudinal and lateral velocity changes than the second (deployment) event, even though the delta-T was longer. The EDR reported data suggests both events appear to be related to horizontal impacts. The third event is specifically identified as a rollover event.

The EDR-reported Event Record 1 and Event Record 3 at Time Stamp -0.5 seconds was as follows.

- Accelerator Pedal, % Full: 19
- Service Brake: Off
- Engine RPM: 1920



Figure 3. Front plane crush measurements, 2015 Chevrolet Cruze

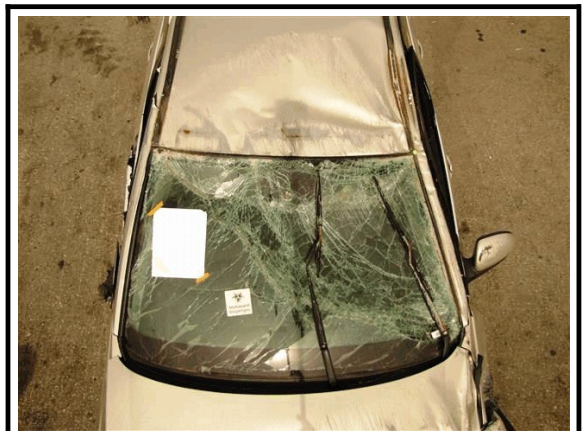


Figure 4. Top plane damage, 2015 Chevrolet Cruze

- Engine Throttle, % Full: 99
- Vehicle Speed (mph [km/h]): 52 [83]
- Cruise Control Active: No
- Cruise Control Resume Switch Active: No
- Cruise Control Set Switch Active: No
- Engine Torque (lb-ft [N-m]): 104 [140]
- Reduced Engine Power Mode Indicator: Off

System status at Event Record 1 indicated the driver's seat belt was buckled, the front passenger seat was empty, the low tire pressure warning lamp was Off, and this event was a non-deployment. The maximum EDR-reported longitudinal delta-V was -15 mph (-24 km/h) at 320 ms and the maximum lateral delta-V was 4 mph (7 km/h) at 136 ms. Event Data indicated no deployments were triggered for this event.

The EDR-reported Event Record 2 at Time Stamp -0.5 seconds was as follows.

- Accelerator Pedal, % Full: 0
- Service Brake: Off
- Engine RPM: 1344
- Engine Throttle, % Full: 99
- Vehicle Speed (mph [km/h]): 28 [45]
- Cruise Control Active: No
- Cruise Control Resume Switch Active: No
- Cruise Control Set Switch Active: No
- Engine Torque (lb-ft [N-m]): 55 [74]
- Reduced Engine Power Mode Indicator: Off

System Status at Event Record 2 indicated this event was a deployment. Time between Event 1 and Event 2 was 1.12 seconds. The maximum EDR-reported longitudinal delta-V was -7 mph (-11 km/h) at 120 ms and the maximum lateral delta-V was 5 mph (8 km/h) at 104 ms. Event data indicated the Frontal Air Bag Deployment Time to First Stage Deployment, Driver (msec) was 23. The data also indicated deployment of the following SRS but did not indicate times: Driver and Passenger Pretensioner First and Second Stage loops commanded, Left and Right Row Roof Rail/Head Curtains Loop Commanded, and Driver Knee Deployment Loop Commanded.

System status at Event Record 3 indicated this event was a deployment. Time between events was 0.02 seconds. The record reported Rollover Crash Pulse, and Lateral and Vertical Acceleration. Roll rates were recorded for 990 ms. The record reported most roll rates (and with higher values) had a negative sign notation indicative of a counterclockwise (left to right) roll direction. Event data indicated the Frontal Air Bag Deployment Time to First Stage Deployment, Driver (msec) was 23. Whereas Event Record 2 indicated deployment loops were commanded, Event Record 3 gave the times at which the deployment command criteria was met. The deployment times for the IC air bags and pretensioners was 212 ms.

Interior Damage

The Chevrolet's interior revealed damage from impact forces, deployed air bags, actuated seat belt pretensioners, occupant contacts, and post-crash activities. The windshield glazing was fractured and in place, and the left and right side glass in the front row was disintegrated. Four air bags deployed during the crash and both front row pretensioners actuated. Occupant contacts

were documented on the driver's pretensioned seat belt. Vertical intrusion reduced the front row of the occupant compartment as follows: left windshield header (10.0 cm [3.9 in]), middle windshield header (8.0 cm [3.1 in]), middle roof (9.0 cm [3.5 in]), left roof (6.0 cm [2.4 in]) and left A-pillar (6.0 cm [2.4 in]).

Manual Restraint Systems

The Chevrolet's interior was equipped with forward seating for five occupants and all seats were configured with three-point lap and shoulder seat belts. The front row belts were equipped with retractor pretensioners, sliding latch plates and adjustable D-rings. The driver's belt was configured with an emergency locking retractor (ELR) and the driver's D-ring was adjusted to the middle position. The driver's lap and shoulder belt exhibited evidence of historical usage and was used during the crash. The pretensioner was actuated with the belt locked in the extended position. The webbing revealed evidence of driver loading with scuff marks located near the latch plate beginning 30.0 cm (11.8 in) above the stop button and near the D-ring beginning 112.0 cm (44.1 in) above the stop button (**Figure 5**). The front right passenger lap and shoulder belt pretensioner was actuated with the belt locked in the stowed position.

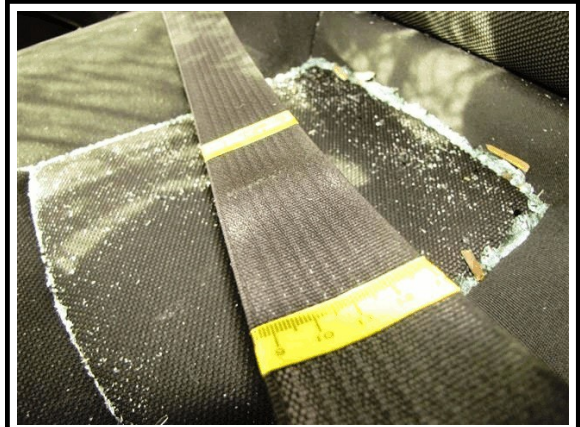


Figure 5. Driver loading evidence on seat belt, 2015 Chevrolet Cruze

Supplemental Restraint Systems

The Chevrolet's supplemental restraint systems (SRS) included 10 air bags in the following configuration: frontal dual-stage air bags for the driver and front passenger, knee air bags for the driver and front passenger, seat-mounted side impact air bags for the front and second row outboard seat positions, and IC air bags for the front and second row outboard seat positions. The vehicle manufacturer has reported that the side air bags meet out-of-position occupant requirements to minimize risk of side air bag-related injuries. During the crash, four air bags deployed in the following configuration: the driver's frontal air bag, the driver's knee air bag, and both IC air bags.

The driver's frontal air bag deployed during the vehicle-to-vehicle frontal impact from a module located in the steering wheel hub. The air bag was circular in shape and measured 49.0 cm (19.3 in) in diameter, and was configured with two vent ports and two internal tethers. This air bag was unremarkable and was likely loaded by the driver's face, neck and chest at impact.

The driver's knee air bag deployed during the frontal impact from the lower left instrument panel below the steering column. This air bag measured 43.0 cm (16.9 in) in width and 24.0 cm (9.5 in) in length. It was unremarkable and likely loaded by the driver's knees at impact. The left IC air bag deployed during the rollover from the left roof side rail over the front and second rows (**Figure 6**). It was generally oval in shape measuring 170.0 cm (66.9 in) in width and 54.0 cm (21.3 in) in length. The air bag was configured with a tether measuring 20.0 cm (7.9 in) at its forward aspect connecting the air bag to the A-pillar. The air bag hung in its

post-impact deflated state 18.0 cm (7.1 in) below the side glass. The air bag covered the area of second row side glass entirely and covered the area of front row side glass with the exception of gap measuring 20.0 cm (7.8 in) x 15.0 cm (5.9 in) below the tether and aft of the A-pillar at the forward-most aspect.

The right IC air bag was configured identically to the left. Both IC air bags appeared to have deployed normally. The left and right side glass in the front row disintegrated during the crash. It is noteworthy that the deployed IC air bags were not damaged by the disintegrated glass or by contact with the roadway during the rollover. The seat-mounted side impact air bags did not deploy.

FMVSS No.226, Ejection Mitigation

The 2015 Chevrolet Cruze is compliant with FMVSS No. 226, Ejection Mitigation. The rule established for FMVSS No. 226 was intended to reduce partial and complete ejection of vehicle occupants through side windows, particularly in rollover crashes. The standard applies to the side windows in the first three rows of seats, and a portion of the cargo area behind the first or second rows, in motor vehicles with gross vehicle weight rating (GVWR) of 4,536 kg (10,000 lb) or less. The FMVSS No. 226 standard evaluates if IC air bags are made sufficiently strong to mitigate occupant ejection regardless of whether the occupant has the window up or down, and even when the glazing is destroyed during the crash.

The vehicle's IC air bags revealed design features including combination deployment capability in both side impact and rollover crashes, large areas of coverage over the side glass both longitudinally and vertically, and tethering near the base of the A-pillars (**Figure 7**) to assist in keeping the deployed IC air bags in place and occupants within the occupant compartment. Additionally, the vehicle manufacturer states in the owner's manual that both IC air bags will deploy in any of the following three conditions: when either side of the vehicle is struck, if the sensing system predicts that the vehicle is about to rollover on its side, or in a severe frontal impact.

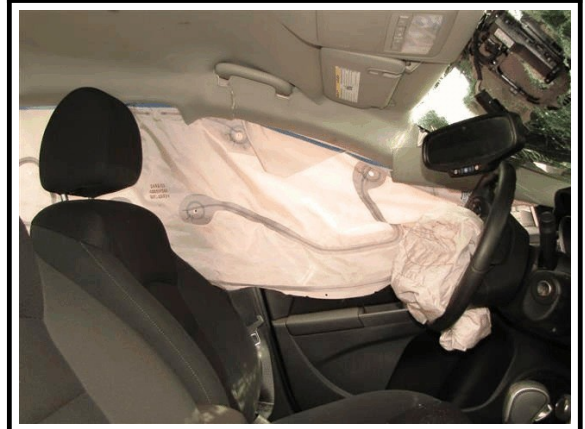


Figure 6. Deployed left IC air bag, 2015 Chevrolet Cruze



Figure 7. Deployed left IC air bag, area of coverage and tether location on A-pillar, 2015 Chevrolet Cruze

Rollover Mitigation

Based on dynamic (moving) test results, the Chevrolet had a rollover rating of four stars (out of a possible five) and a 10.9 percent chance of rollover in a single-vehicle crash. The vehicle was equipped with standard ESC and ABS. The driver of the Chevrolet fell asleep while traveling at highway speed and struck the slower moving medium-heavy Mack, causing restriction of the Chevrolet's left front wheel. Following the initial impact, the driver had little control over the steering and the EDR indicated there was no braking subsequent to that impact. Consequently, the vehicle's ESC and ABS were not engaged and did not mitigate the rollover potential. The off-set configuration of the impact displaced the Chevrolet to the right while it initiated a counterclockwise rotation. The EDR report indicated the Chevrolet did slow considerably between events, probably due to the longitudinal component of the first impact, the subsequent tire friction on the roadway caused by the lateral movement, and rotation following the frontal impact.

After rotating in a counterclockwise orientation approximately 90 degrees to a point where the vehicle's direction of travel was lateral to its heading angle, the right side tires engaged the ground with sufficient opposing lateral force to cause a right side leading trip rollover. The Chevrolet rolled a total of two quarter-turns and came to rest on its roof on the right shoulder of the roadway. The exact roll distance was not documented but the police reported an approximate distance traveled by the Chevrolet beginning at the point of impact with the other vehicle and ending at final rest as 23 m (75 ft).

The vehicle was equipped with tires of the recommended size, each tire having a minimum tread of 4 mm (5/32 in). Tire pressure measured during the SCI investigation was near the recommended level and, given the time between the crash and investigation, the tire pressure was determined to be non-contributory to the rollover. The primary cause of the crash was inattention by the driver of the Chevrolet and the subsequent rollover was caused primarily by the vehicle-to-vehicle impact.

2015 CHEVROLET CRUZE OCCUPANT

Driver Demographics

Age/Sex:	46 years/Male
Height:	185 cm (73 in)
Weight:	100 kg (220 lb)
Eyewear:	Unknown
Seat type:	Bucket seat with adjustable head restraint
Seat track position:	Middle to full rear
Manual restraint usage:	Lap and shoulder seat belt used Usage source: Vehicle inspection
Air bags:	Frontal air bag, knee air bag and IC air bag deployed; seat-mounted side impact air bag did not deploy
Alcohol/Drug data:	None
Egress from vehicle:	Unknown
Transport from scene:	Ambulance to hospital
Type of medical treatment:	Treated and released

Driver Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Abrasion, forehead	210202.1	Steering wheel hub	Possible
2	Abrasion, left neck	310202.1	Safety belt webbing	Certain
3	Abrasion, chest	410202.1	Safety belt webbing	Certain
4	Abrasion, left abdomen	510202.1	Safety belt webbing	Certain

Source: Medical records

Driver Kinematics

The belted 46-year-old male driver of the Chevrolet was seated in an unknown posture and was likely sleepy or asleep prior to the crash. He allowed his vehicle to change lanes to the left and travel directly into the back plane of the other vehicle. At impact, the driver's frontal and knee air bags deployed. The driver was displaced forward in response to the direction of force and "loaded" the seat belt webbing. He probably struck the deployed frontal air bag with his face and torso, and struck the deployed knee air bag with his legs. The vehicle initiated a counterclockwise rotation and the driver was held in his seat by the seat belt. The Chevrolet initiated a left side leading rollover and the driver was displaced to the left. His seat belt pretensioners actuated and the left IC air bag deployed. He again loaded the seat belt and possibly struck the deployed IC air bag with his head and left shoulder. The vehicle rolled two quarter-turns and came to rest on its roof. The driver was held in his seat by the pretensioned seat belt. According to EMS records, the driver self-extricated and sat near his vehicle until responders arrived. During his egress, probably through a front row window opening, his left hand contacted fractured glass causing a minor laceration. He complained of pain and was transported by ambulance to a local hospital where he was treated and released without admittance.



Figure 9. 2001 Mack CV500 left side view (owner image)

2001 MACK CV500

Description

The 2001 Mack CV500 (**Figures 8 and 9**) was identified by the Vehicle Identification No. 1M2AG03C81Mxxxxxx. The Mack was a medium-heavy single-unit straight truck cement mixer in a four-axle configuration and a GVWR greater than 4,536 kg (10,000 lb). It was equipped with a Mack E7-350 diesel engine and air brakes.



Figure 8. 2001 Mack CV500 back view (owner image)

Exterior Damage

According to the police report, the Mack sustained minor damage to the back plane including, but not limited to, a bent rear fender near the third axle. The vehicle was not available for inspection and no further data on exterior damage was obtained.

Occupant Data

The driver of the Mack was a belted 28-year-old male. He was not injured. Following the police investigation, he drove the vehicle from the scene.

CRASH DIAGRAM



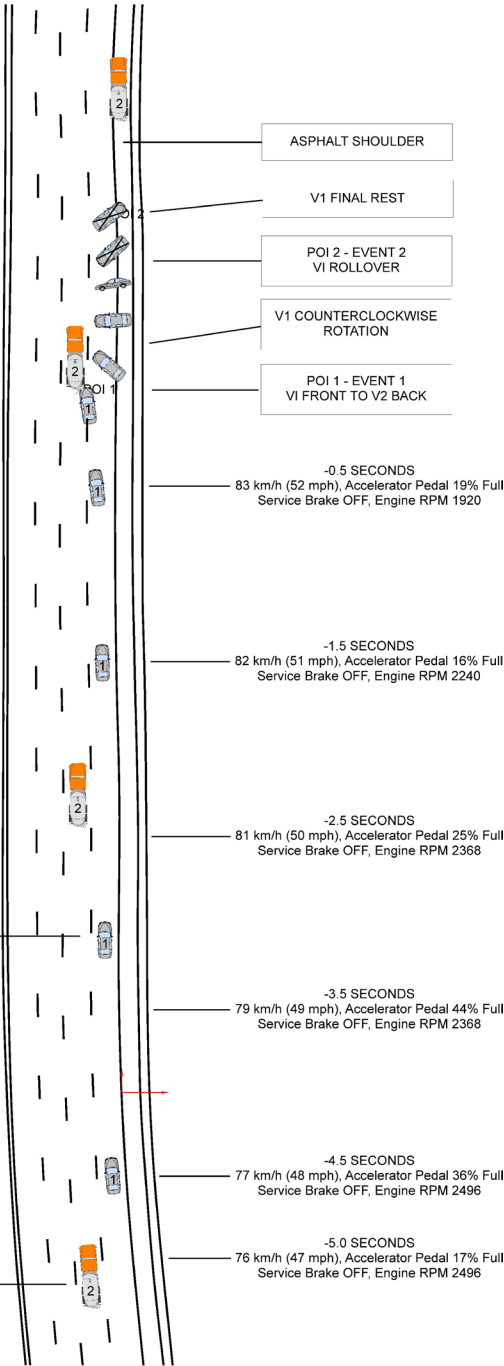
ROLLOVER INVESTIGATION
CALIFORNIA
DECEMBER 2015
N/B INTERSTATE HIGHWAY
V1: 2015 CHEVROLET CRUZE
V2: 2001 MACK CV500 WITH TRAILER
CONDITIONS: DUSK, CLEAR & DRY
SPEED LIMIT: 106 km/h (65 mph)



METERS

V1: 2015 CHEVROLET CRUZE

V2: 2001 MACK CV500



Case Number:

DS16005

Appendix A
Event Data Recorder Report 2015 Chevrolet Cruze

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	1G1PC5SB0F7*****
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	201750S3DS16005_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 16.4
Reported with CDR version	Crash Data Retrieval Tool 17.4.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Non-Deployment, Deployment, Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events for Front, Side, and Rear (FSR) Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH [8 km/h]. A Non-Deployment Event contains Pre-Crash and Crash data. The oldest Non-Deployment event can be overwritten by a Deployment Event, if all three records are full and the Non-Deployment Event is not locked. A Non-Deployment Event can be overwritten by a more recent Non-Deployment Event if all three records are full and the Non-Deployment is older than approximately 250 ignition cycles. Also, a Non-Deployment event can be recorded if one of the following occurs without the Deployment of any of the frontal air bags, side air bags, or roll bars:

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

The second type of SDM recorded crash event for FSR Events is the Deployment Event. It also contains Pre-Crash and Crash data. Deployment Events cannot be overwritten or cleared by the SDM.

Rollover Events contains Pre-Crash and Crash data. Rollover event follow the same rules as FSR Deployment events. The SDM can store up to three Events.

Data:

For FSR Events, SDM Recorded Vehicle Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment and Non-Deployment Events, the SDM will record up to 300 milliseconds of data after time zero. The SDM will also record up to 300 milliseconds of Vehicle Acceleration data after time zero.

For Rollover Events, the SDM may record Lateral Acceleration, Vertical Acceleration, and Roll Rate data, if the SDM is rollover capable. This data reflects what the sensing system experienced during the recorded portion of the event. For Rollover Deployment Events, the SDM will record up to 700 milliseconds of data before the Deployment criteria is met and 290 milliseconds after the Deployment criteria is met.

-Deployment loops may be displayed as being deployed in a Non-Deployment event record, if a Deployment event is qualified during the Non-Deployment event. That is, if two or more events are occurring at the same time and one is a Non-Deployment event and one of the others is a Deployment event, and the Deployment event is qualified while the Non-Deployment is still active, the deployed loops may be recorded in the Non-Deployment event record.

-Time between events is recorded in 10 msec intervals and is displayed in seconds for a maximum time of 655.33 seconds. The 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.
- 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 Counter tracks the number of Deployment events that have occurred during the SDM's lifetime.
- Dynamic Event Counter tracks the number of qualified events (either Deployments, Non-deploy, or Rollover events) that have occurred during the SDM's lifetime.
- For Deployment Events, DTC B0052 (Deployment commanded) shall be recorded with the remainder of the data for this event even though it occurred after Event Enable.
- Once a firing loop has been commanded to be deployed, it will not be commanded to be deployed again during the same ignition cycle. Firing loop deployment times for subsequent deployment type events, during the same ignition cycle, will not be recorded. Also, forced timer loops, will not be shown as being commanded to deploy. Loops without their own independent deployment calibration are called "forced timer loops." Examples of a forced timer loops are Pretensioner Deployment Loop #2 and Knee Deployment Loop.
- The GM parameter name is displayed in parentheses after the NHTSA Part 563 parameter name.
- The reported range of the longitudinal and lateral acceleration values is approximately ± 50 g.
- All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

Data Source:

- All SDM recorded data is measured, calculated, and stored internally, except for the following:
- Vehicle Status Data (Pre-Crash) is transmitted by the Body Control Module, via the vehicle's communication network.
 - The Belt Switch Circuit is wired directly to the SDM.

Data Element Sign Convention:

The following table provides an explanation of the sign notation for data elements that may be included in this CDR report. Directional references to sign notation are all from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

Data Element Name	Positive Sign Notation Indicates
Longitudinal Acceleration	Forward
Longitudinal Velocity Change	Forward
Lateral Acceleration	Left to Right
Lateral Velocity Change	Left to Right
Vertical Acceleration	Downward
Roll Rate	Clockwise Rotation

Hexadecimal Data:

Data that the vehicle manufacturer has specified for data retrieval is shown in the hexadecimal data section of the CDR report. The hexadecimal data section of the CDR report may contain data that is not translated by the CDR program. The control module contains additional data that is not retrievable by the CDR tool.

01042_SDM10P-autoliv_r017

System Status at Time of Retrieval

Dynamic Deployment Event Counter	2
Multi-Event, Number of Events (Dynamic Event Counter)	3
Dynamic OnStar Notification Event Counter	3
Vehicle Identification Number (VIN)	1G1PC5SB0F7*****
Ignition Cycle, Download (Ignition Cycles at Investigation)	1664
End Model Part Number	00CF5BA4
System Type	Autoliv
Software Module Identifier 1	00CF5B82
Software Module Identifier 2	05A2336B
Software Module Identifier 3	00CF2D7D
Manufacturing Traceability Data, Component Identifier	AS
Manufacturing Traceability Data, Part Number/Broadcast Code	9412
Manufacturing Traceability Data, Supplier Code	E
Manufacturing Traceability Data, Traceability Number	051584322
ESS # 1 Traceability Data, Component Identifier	AU
ESS # 1 Traceability Data, Part Number/Broadcast Code	2577
ESS # 1 Traceability Data, Supplier Code	E
ESS # 1 Traceability Data, Traceability Number	01B55FC7B
ESS # 2 Traceability Data, Component Identifier	AT
ESS # 2 Traceability Data, Part Number/Broadcast Code	2577
ESS # 2 Traceability Data, Supplier Code	E
ESS # 2 Traceability Data, Traceability Number	01B57F8E2
ESS # 3 Traceability Data, Component Identifier	AH
ESS # 3 Traceability Data, Part Number/Broadcast Code	2577
ESS # 3 Traceability Data, Supplier Code	E
ESS # 3 Traceability Data, Traceability Number	01B562653
ESS # 4 Traceability Data, Component Identifier	AJ
ESS # 4 Traceability Data, Part Number/Broadcast Code	2577
ESS # 4 Traceability Data, Supplier Code	E
ESS # 4 Traceability Data, Traceability Number	01B5E6B22
ESS # 5 Traceability Data, Component Identifier	DA
ESS # 5 Traceability Data, Part Number/Broadcast Code	4936
ESS # 5 Traceability Data, Supplier Code	E
ESS # 5 Traceability Data, Traceability Number	01B57DC79
ESS # 6 Traceability Data, Component Identifier	DB
ESS # 6 Traceability Data, Part Number/Broadcast Code	4936
ESS # 6 Traceability Data, Supplier Code	E
ESS # 6 Traceability Data, Traceability Number	01B5684F8
ESS # 7 Traceability Data, Component Identifier	00
ESS # 7 Traceability Data, Part Number/Broadcast Code	0000
ESS # 7 Traceability Data, Supplier Code	E
ESS # 7 Traceability Data, Traceability Number	000000000
ESS # 8 Traceability Data, Component Identifier	00
ESS # 8 Traceability Data, Part Number/Broadcast Code	0000
ESS # 8 Traceability Data, Supplier Code	E
ESS # 8 Traceability Data, Traceability Number	000000000

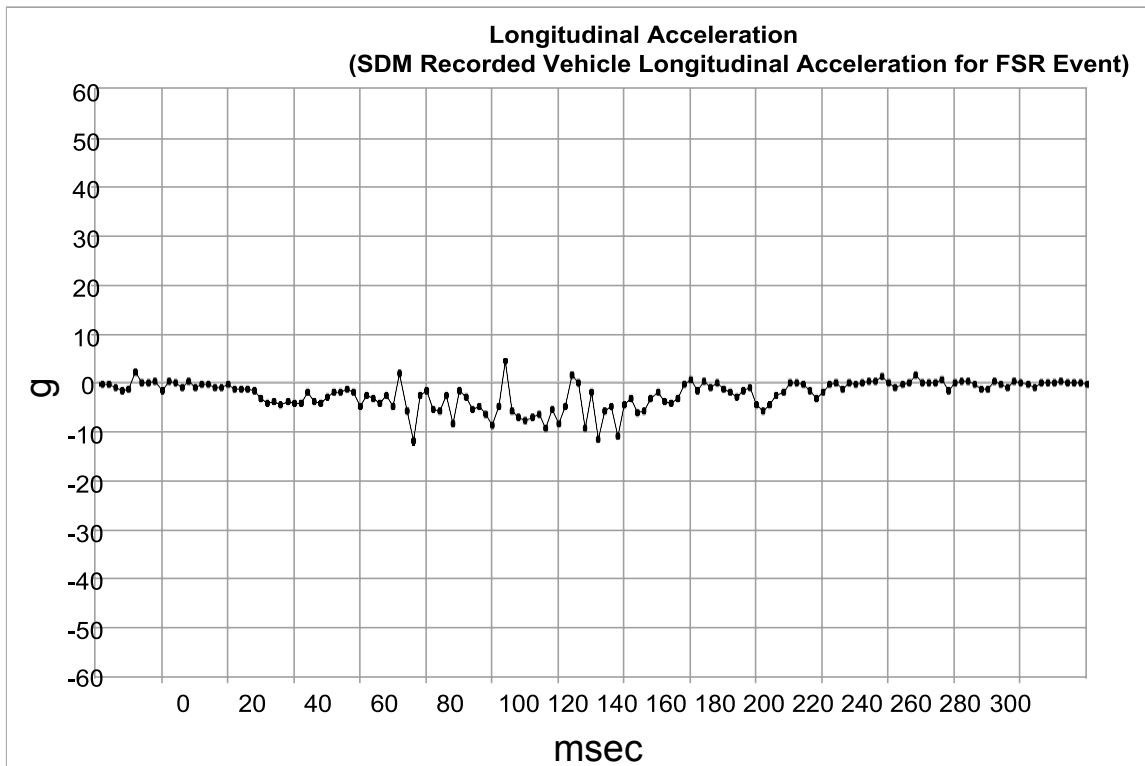
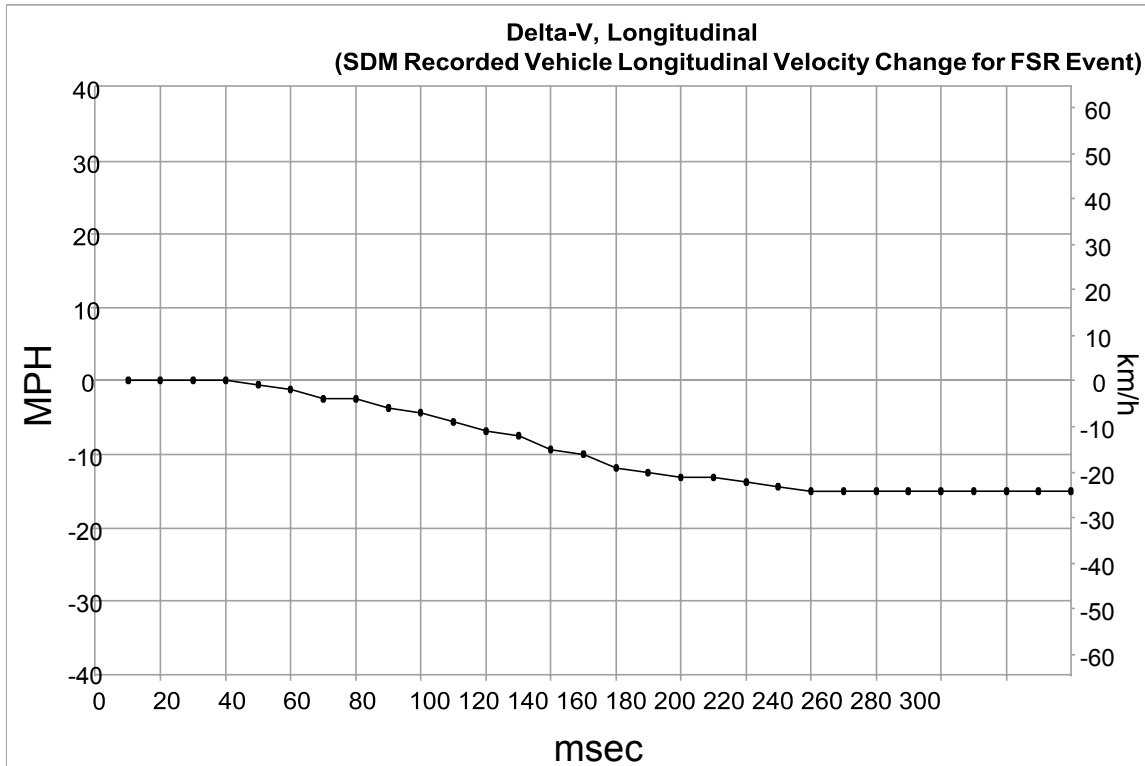
System Status at Event (Event Record 1)

Event Record Type	Non-Deployment
OnStar Deployment Status Data Sent	Yes
Complete file recorded (Event Recording Complete)	Yes
Crash Record Locked	No
OnStar SDM Recorded Vehicle Velocity Change Data Sent	Yes
Deployment Event Counter	0
Multi-Event, Number of Events (Event Counter)	1
OnStar Notification Event Counter	2
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	1659
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Rear	No
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	No
Event Severity Status: Frontal Stage 1	No
Event Severity Status: Frontal Stage 2	No
Event Severity Status: Left Side	No
Event Severity Status: Right Side	No
Event Severity Status: Rear	No
Event Severity Status: Rollover	No
Safety Belt Status, Driver (Driver Belt Switch Circuit Status)	Buckled
Safety Belt Status, Right Front Passenger (Passenger Belt Switch Circuit Status)	Not Buckled
Center Front Row Belt Switch Circuit Status (If Equipped)	Data Not Available
Left Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Center Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Right Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status	Empty
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Not Applicable)
Passenger Air Bag ON Indicator Status	Off
Passenger Air Bag OFF Indicator Status	On
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655330
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	1626
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]	-15 [-24]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	320
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	4 [7]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	136

DTCs Present at Time of Event (Event Record 1)
No Diagnostic Trouble Codes

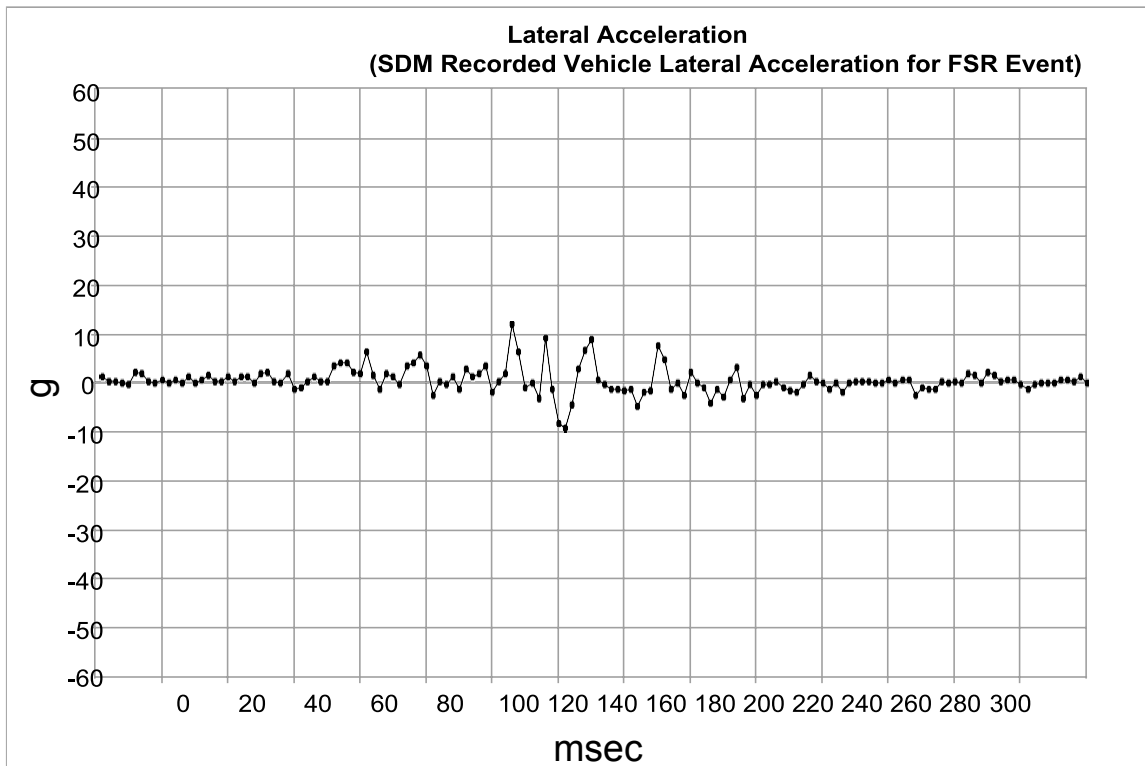
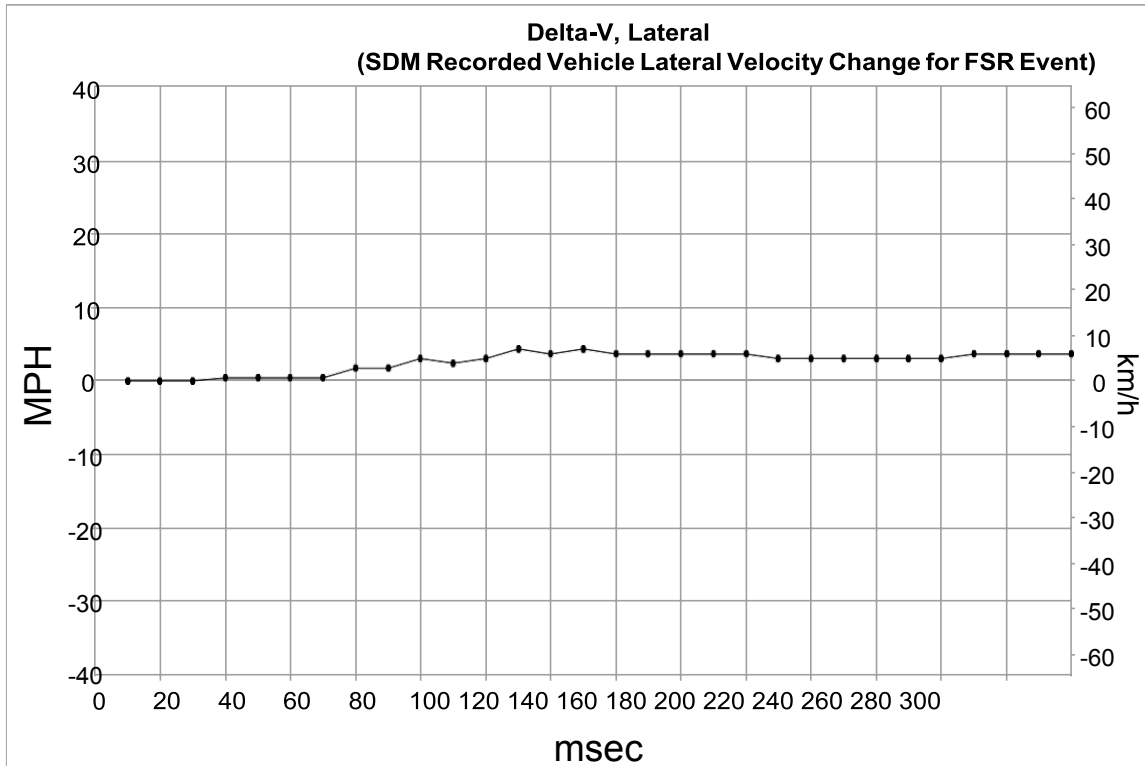
Event Data (Event Record 1)

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



Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	0.0	0.0
20	0.0	0.0
30	0.0	0.0
40	0.0	0.0
50	-0.6	-1.0
60	-1.2	-2.0
70	-2.5	-4.0
80	-2.5	-4.0
90	-3.7	-6.0
100	-4.3	-7.0
110	-5.6	-9.0
120	-6.8	-11.0
130	-7.5	-12.0
140	-9.3	-15.0
150	-9.9	-16.0
160	-11.8	-19.0
170	-12.4	-20.0
180	-13.0	-21.0
190	-13.0	-21.0
200	-13.7	-22.0
210	-14.3	-23.0
220	-14.9	-24.0
230	-14.9	-24.0
240	-14.9	-24.0
250	-14.9	-24.0
260	-14.9	-24.0
270	-14.9	-24.0
280	-14.9	-24.0
290	-14.9	-24.0
300	-14.9	-24.0

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	-5.4	202	-5.8
4	-0.6	104	-5.8	204	-4.6
6	-1.0	106	-2.6	206	-2.6
8	-1.8	108	-8.2	208	-2.2
10	-1.4	110	-1.8	210	-0.2
12	2.2	112	-3.0	212	-0.2
14	-0.2	114	-5.4	214	-0.6
16	-0.2	116	-5.0	216	-1.8
18	0.2	118	-6.6	218	-3.4
20	-1.8	120	-8.6	220	-2.2
22	0.2	122	-5.0	222	-0.6
24	-0.2	124	4.2	224	-0.2
26	-1.0	126	-5.8	226	-1.4
28	0.2	128	-7.0	228	-0.2
30	-1.0	130	-7.8	230	-0.6
32	-0.6	132	-7.0	232	-0.2
34	-0.6	134	-6.6	234	0.2
36	-1.0	136	-9.4	236	0.2
38	-1.0	138	-5.4	238	1.0
40	-0.6	140	-8.2	240	-0.2
42	-1.4	142	-5.0	242	-1.0
44	-1.4	144	1.4	244	-0.6
46	-1.4	146	-0.2	246	-0.2
48	-1.8	148	-9.4	248	1.4
50	-3.4	150	-2.2	250	-0.2
52	-4.2	152	-11.4	252	-0.2
54	-3.8	154	-5.8	254	-0.2
56	-4.6	156	-5.0	256	0.6
58	-3.8	158	-11.0	258	-1.8
60	-4.2	160	-4.6	260	-0.2
62	-4.2	162	-3.4	262	0.2
64	-2.2	164	-6.2	264	0.2
66	-3.8	166	-5.8	266	-0.6
68	-4.2	168	-3.4	268	-1.4
70	-3.0	170	-2.2	270	-1.4
72	-2.2	172	-3.8	272	0.2
74	-2.2	174	-4.2	274	-0.6
76	-1.4	176	-3.4	276	-1.0
78	-2.2	178	-0.6	278	0.2
80	-5.0	180	0.6	280	-0.2
82	-2.6	182	-1.8	282	-0.6
84	-3.4	184	0.2	284	-1.0
86	-4.2	186	-1.0	286	-0.2
88	-2.6	188	-0.2	288	-0.2
90	-5.0	190	-1.4	290	-0.2
92	1.8	192	-2.2	292	0.2
94	-5.8	194	-3.0	294	-0.2
96	-11.8	196	-1.8	296	-0.2
98	-2.6	198	-1.0	298	-0.2
100	-1.8	200	-4.6	300	-0.6



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	0.0	0.0
30	0.0	0.0
40	0.6	1.0
50	0.6	1.0
60	0.6	1.0
70	0.6	1.0
80	1.9	3.0
90	1.9	3.0
100	3.1	5.0
110	2.5	4.0
120	3.1	5.0
130	4.3	7.0
140	3.7	6.0
150	4.3	7.0
160	3.7	6.0
170	3.7	6.0
180	3.7	6.0
190	3.7	6.0
200	3.7	6.0
210	3.1	5.0
220	3.1	5.0
230	3.1	5.0
240	3.1	5.0
250	3.1	5.0
260	3.1	5.0
270	3.7	6.0
280	3.7	6.0
290	3.7	6.0
300	3.7	6.0

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	1.0
4	0.2
6	0.2
8	-0.2
10	-0.6
12	2.2
14	1.8
16	0.2
18	-0.2
20	0.6
22	-0.2
24	0.6
26	-0.2
28	1.0
30	-0.2
32	0.6
34	1.4
36	0.2
38	0.2
40	1.0
42	0.2
44	1.0
46	1.0
48	-0.2
50	1.8
52	2.2
54	0.2
56	-0.2
58	1.8
60	-1.4
62	-1.0
64	0.2
66	1.0
68	0.2
70	0.2
72	3.4
74	3.8
76	3.8
78	2.2
80	1.8
82	6.2
84	1.4
86	-1.4
88	1.8
90	1.0
92	-0.6
94	3.4
96	3.8
98	5.4
100	3.4

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
102	-2.6
104	0.2
106	-0.6
108	1.0
110	-1.4
112	2.6
114	1.0
116	1.8
118	3.4
120	-2.2
122	0.2
124	1.8
126	11.8
128	6.2
130	-1.0
132	-0.2
134	-3.4
136	9.0
138	-1.4
140	-8.2
142	-9.4
144	-4.6
146	2.6
148	6.6
150	8.6
152	0.6
154	-0.6
156	-1.4
158	-1.4
160	-1.8
162	-1.4
164	-5.0
166	-2.2
168	-1.8
170	7.4
172	4.6
174	-1.4
176	-0.2
178	-2.6
180	2.2
182	-0.2
184	-1.0
186	-4.2
188	-1.4
190	-3.0
192	0.6
194	3.0
196	-3.4
198	-0.6
200	-2.6

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
202	-0.6
204	-0.6
206	0.2
208	-1.0
210	-1.8
212	-2.2
214	-0.6
216	1.4
218	0.2
220	-0.2
222	-1.4
224	-0.2
226	-2.2
228	-0.2
230	0.2
232	0.2
234	0.2
236	-0.2
238	-0.2
240	0.6
242	-0.2
244	0.6
246	0.6
248	-2.6
250	-1.0
252	-1.4
254	-1.4
256	0.2
258	-0.2
260	0.2
262	-0.2
264	1.8
266	1.4
268	-0.2
270	2.2
272	1.4
274	0.2
276	0.6
278	0.6
280	-0.6
282	-1.4
284	-0.6
286	-0.2
288	-0.2
290	-0.2
292	0.6
294	0.6
296	0.2
298	1.0
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	17	Off	2496	23	47 [76]
-4.5	36	Off	2496	96	48 [77]
-4.0	40	Off	2432	99	48 [78]
-3.5	44	Off	2368	99	49 [79]
-3.0	46	Off	2432	99	50 [81]
-2.5	25	Off	2368	39	50 [81]
-2.0	16	Off	2368	36	51 [82]
-1.5	16	Off	2240	35	51 [82]
-1.0	34	Off	1984	99	51 [82]
-0.5	19	Off	1920	99	52 [83]

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	46 [62]	Off
-1.5	No	No	No	16 [22]	Off
-1.0	No	No	No	58 [78]	Off
-0.5	No	No	No	104 [140]	Off

System Status at Event (Event Record 2)

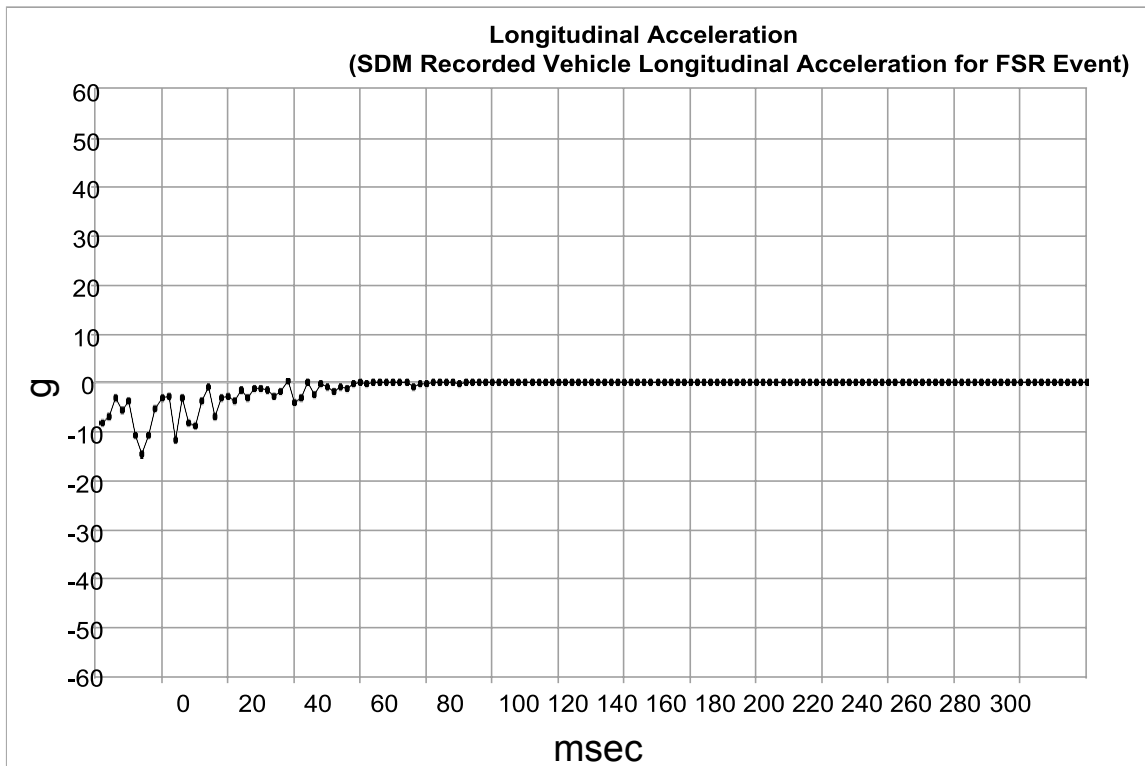
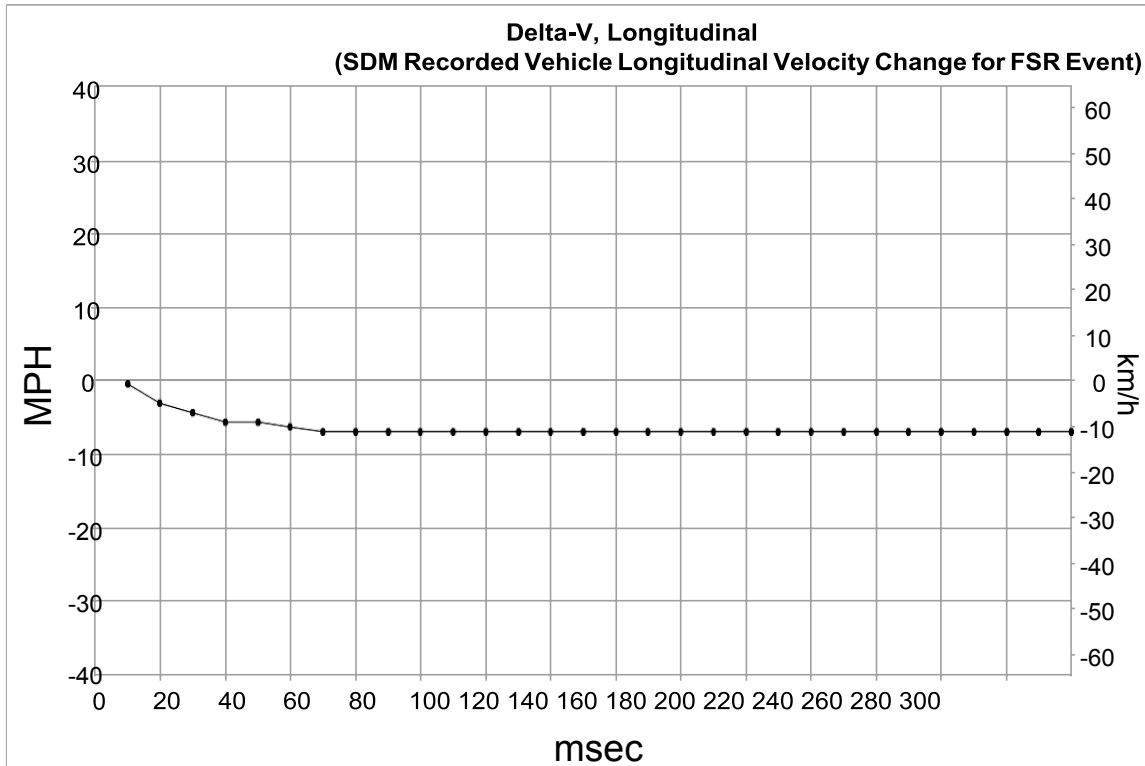
Event Record Type	Deployment
OnStar Deployment Status Data Sent	Yes
Complete file recorded (Event Recording Complete)	Yes
Crash Record Locked	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	Yes
Deployment Event Counter	1
Multi-Event, Number of Events (Event Counter)	2
OnStar Notification Event Counter	3
Time From Event 1 to 2 (Time Between Events) (seconds)	1.12
Ignition Cycle, Crash (Ignition Cycles at Event)	1659
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Rear	No
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	Yes
Event Severity Status: Frontal Stage 1	Yes
Event Severity Status: Frontal Stage 2	Yes
Event Severity Status: Left Side	No
Event Severity Status: Right Side	No
Event Severity Status: Rear	No
Event Severity Status: Rollover	No
Safety Belt Status, Driver (Driver Belt Switch Circuit Status)	Buckled
Safety Belt Status, Right Front Passenger (Passenger Belt Switch Circuit Status)	Not Buckled
Center Front Row Belt Switch Circuit Status (If Equipped)	Data Not Available
Left Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Center Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Right Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status	Empty
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Not Applicable)
Passenger Air Bag ON Indicator Status	Off
Passenger Air Bag OFF Indicator Status	On
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655330
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	1626
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]	-7 [-11]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	120
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	5 [8]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	104

DTCs Present at Time of Event (Event Record 2)

B0052-00

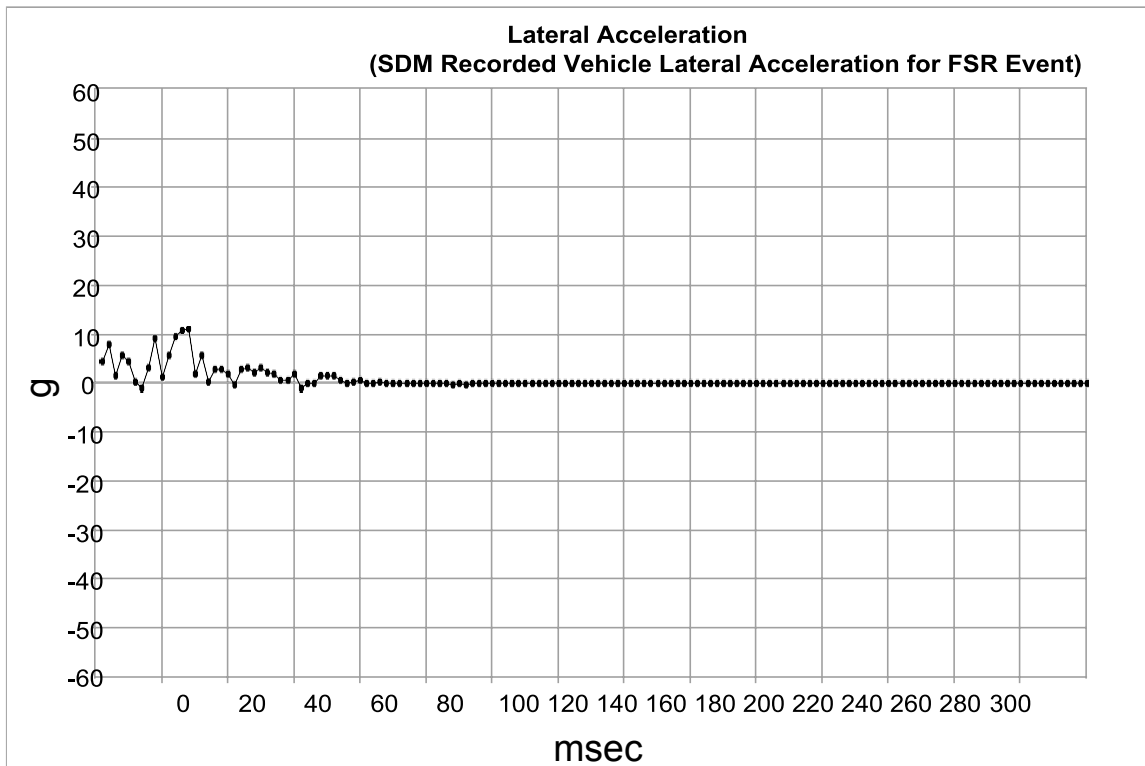
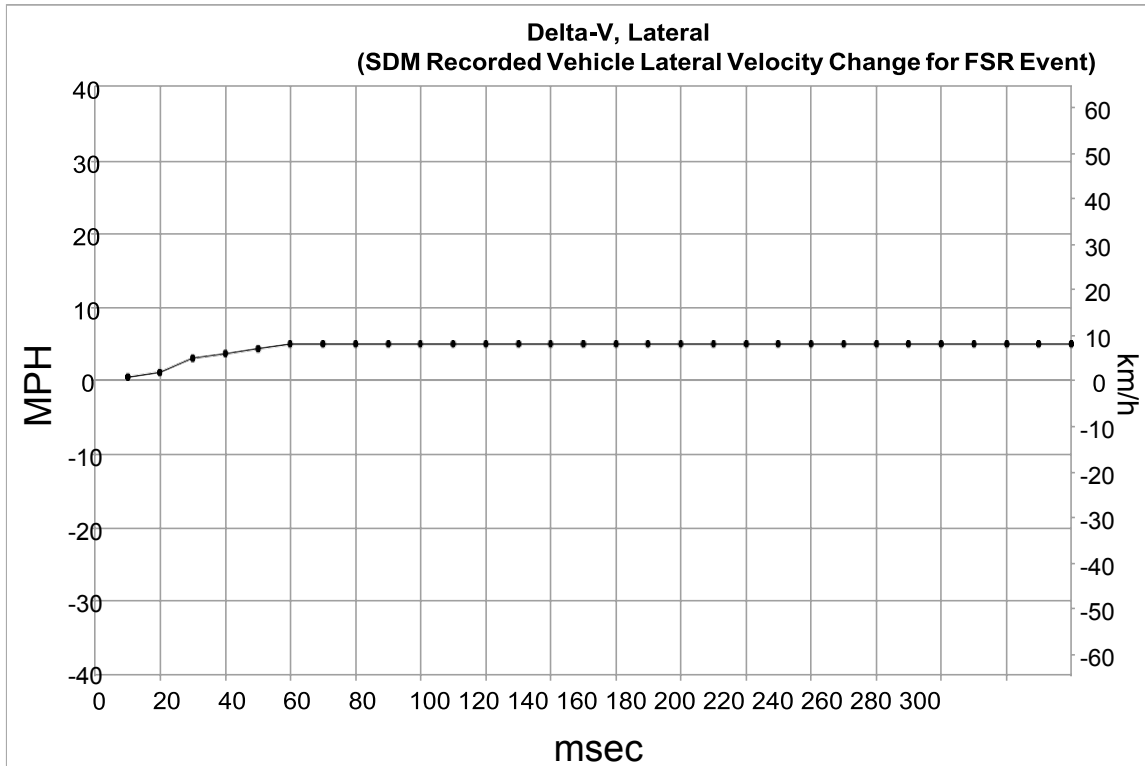
Event Data (Event Record 2)

Driver 1st Stage Deployment Loop Commanded	Yes
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	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	No
Passenger Thorax Loop Commanded	No
Left Row 2 Thorax Loop Commanded	No
Right Row 2 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
Passenger Knee Deployment Loop Commanded	No
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	23
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Right Front Passenger (Passenger 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (Passenger 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, driver (Driver Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available



Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	-0.6	-1.0
20	-3.1	-5.0
30	-4.3	-7.0
40	-5.6	-9.0
50	-5.6	-9.0
60	-6.2	-10.0
70	-6.8	-11.0
80	-6.8	-11.0
90	-6.8	-11.0
100	-6.8	-11.0
110	-6.8	-11.0
120	-6.8	-11.0
130	-6.8	-11.0
140	-6.8	-11.0
150	-6.8	-11.0
160	-6.8	-11.0
170	-6.8	-11.0
180	-6.8	-11.0
190	-6.8	-11.0
200	-6.8	-11.0
210	-6.8	-11.0
220	-6.8	-11.0
230	-6.8	-11.0
240	-6.8	-11.0
250	-6.8	-11.0
260	-6.8	-11.0
270	-6.8	-11.0
280	-6.8	-11.0
290	-6.8	-11.0
300	-6.8	-11.0

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	-8.2	102	-0.2	202	-0.2
4	-7.0	104	-0.2	204	-0.2
6	-3.4	106	-0.2	206	-0.2
8	-5.8	108	-0.2	208	-0.2
10	-3.8	110	-0.6	210	-0.2
12	-11.0	112	-0.2	212	-0.2
14	-14.6	114	-0.2	214	-0.2
16	-11.0	116	-0.2	216	-0.2
18	-5.4	118	-0.2	218	-0.2
20	-3.4	120	-0.2	220	-0.2
22	-3.0	122	-0.2	222	-0.2
24	-11.8	124	-0.2	224	-0.2
26	-3.4	126	-0.2	226	-0.2
28	-8.2	128	-0.2	228	-0.2
30	-9.0	130	-0.2	230	-0.2
32	-3.8	132	-0.2	232	-0.2
34	-1.0	134	-0.2	234	-0.2
36	-7.0	136	-0.2	236	-0.2
38	-3.4	138	-0.2	238	-0.2
40	-3.0	140	-0.2	240	-0.2
42	-3.8	142	-0.2	242	-0.2
44	-1.8	144	-0.2	244	-0.2
46	-3.4	146	-0.2	246	-0.2
48	-1.4	148	-0.2	248	-0.2
50	-1.4	150	-0.2	250	-0.2
52	-1.8	152	-0.2	252	-0.2
54	-3.0	154	-0.2	254	-0.2
56	-2.2	156	-0.2	256	-0.2
58	0.2	158	-0.2	258	-0.2
60	-4.2	160	-0.2	260	-0.2
62	-3.4	162	-0.2	262	-0.2
64	-0.2	164	-0.2	264	-0.2
66	-2.6	166	-0.2	266	-0.2
68	-0.6	168	-0.2	268	-0.2
70	-1.0	170	-0.2	270	-0.2
72	-2.2	172	-0.2	272	-0.2
74	-1.0	174	-0.2	274	-0.2
76	-1.4	176	-0.2	276	-0.2
78	-0.6	178	-0.2	278	-0.2
80	-0.2	180	-0.2	280	-0.2
82	-0.6	182	-0.2	282	-0.2
84	-0.2	184	-0.2	284	-0.2
86	-0.2	186	-0.2	286	-0.2
88	-0.2	188	-0.2	288	-0.2
90	-0.2	190	-0.2	290	-0.2
92	-0.2	192	-0.2	292	-0.2
94	-0.2	194	-0.2	294	-0.2
96	-1.0	196	-0.2	296	-0.2
98	-0.6	198	-0.2	298	-0.2
100	-0.6	200	-0.2	300	-0.2



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

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	4.2
4	7.8
6	1.4
8	5.4
10	4.2
12	0.2
14	-1.0
16	3.0
18	9.0
20	1.0
22	5.4
24	9.4
26	10.6
28	11.0
30	1.8
32	5.4
34	0.2
36	2.6
38	2.6
40	1.8
42	-0.6
44	2.6
46	3.0
48	2.2
50	3.0
52	2.2
54	1.8
56	0.6
58	0.6
60	1.8
62	-1.0
64	-0.2
66	-0.2
68	1.4
70	1.4
72	1.4
74	0.6
76	-0.2
78	0.2
80	0.6
82	-0.2
84	-0.2
86	0.2
88	-0.2
90	-0.2
92	-0.2
94	-0.2
96	-0.2
98	-0.2
100	-0.2

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
102	-0.2
104	-0.2
106	-0.2
108	-0.6
110	-0.2
112	-0.6
114	-0.2
116	-0.2
118	-0.2
120	-0.2
122	-0.2
124	-0.2
126	-0.2
128	-0.2
130	-0.2
132	-0.2
134	-0.2
136	-0.2
138	-0.2
140	-0.2
142	-0.2
144	-0.2
146	-0.2
148	-0.2
150	-0.2
152	-0.2
154	-0.2
156	-0.2
158	-0.2
160	-0.2
162	-0.2
164	-0.2
166	-0.2
168	-0.2
170	-0.2
172	-0.2
174	-0.2
176	-0.2
178	-0.2
180	-0.2
182	-0.2
184	-0.2
186	-0.2
188	-0.2
190	-0.2
192	-0.2
194	-0.2
196	-0.2
198	-0.2
200	-0.2

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
202	-0.2
204	-0.2
206	-0.2
208	-0.2
210	-0.2
212	-0.2
214	-0.2
216	-0.2
218	-0.2
220	-0.2
222	-0.2
224	-0.2
226	-0.2
228	-0.2
230	-0.2
232	-0.2
234	-0.2
236	-0.2
238	-0.2
240	-0.2
242	-0.2
244	-0.2
246	-0.2
248	-0.2
250	-0.2
252	-0.2
254	-0.2
256	-0.2
258	-0.2
260	-0.2
262	-0.2
264	-0.2
266	-0.2
268	-0.2
270	-0.2
272	-0.2
274	-0.2
276	-0.2
278	-0.2
280	-0.2
282	-0.2
284	-0.2
286	-0.2
288	-0.2
290	-0.2
292	-0.2
294	-0.2
296	-0.2
298	-0.2
300	-0.2

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

Contains No Recorded Data

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

Contains No Recorded Data

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

Contains No Recorded Data

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

Times (sec)	Accelerator Pedal, % Full (Accelerator Pedal Position)	Service Brake (Brake Switch Circuit State)	Engine RPM (Engine Speed)	Engine Throttle, % Full (Throttle Position)	Speed, Vehicle Indicated (Vehicle Speed) (MPH [km/h])
-5.0	40	Off	2432	99	48 [78]
-4.5	44	Off	2368	99	49 [79]
-4.0	46	Off	2432	99	50 [81]
-3.5	25	Off	2368	39	50 [81]
-3.0	16	Off	2368	36	51 [82]
-2.5	16	Off	2240	35	51 [82]
-2.0	34	Off	1984	99	51 [82]
-1.5	19	Off	1920	99	52 [83]
-1.0	0	On	1728	7	51 [82]
-0.5	0	Off	1344	49	28 [45]

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

Times (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Engine Torque (lb-ft [N-m])	Reduced Engine Power Mode Indicator
-2.0	No	No	No	58 [78]	Off
-1.5	No	No	No	104 [140]	Off
-1.0	No	No	No	34 [46]	Off
-0.5	No	No	No	55 [74]	Off

System Status at Event (Event Record 3)

Event Record Type	Deployment
OnStar Deployment Status Data Sent	Yes
Complete file recorded (Event Recording Complete)	Yes
Crash Record Locked	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	Yes
Deployment Event Counter	2
Multi-Event, Number of Events (Event Counter)	3
OnStar Notification Event Counter	1
Time From Event 1 to 2 (Time Between Events) (seconds)	0.02
Ignition Cycle, Crash (Ignition Cycles at Event)	1659
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Rear	No
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	No
Event Severity Status: Frontal Stage 1	No
Event Severity Status: Frontal Stage 2	No
Event Severity Status: Left Side	No
Event Severity Status: Right Side	No
Event Severity Status: Rear	No
Event Severity Status: Rollover	Yes
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
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	1626
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]	Data Not Available
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	Data Not Available
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	Data Not Available
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	Data Not Available

DTCs Present at Time of Event (Event Record 3)

B0052-00

Event Data (Event Record 3)

Driver 1st Stage Deployment Loop Commanded	No
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	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	No
Passenger Thorax Loop Commanded	No
Left Row 2 Thorax Loop Commanded	No
Right Row 2 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	No
Passenger Knee Deployment Loop Commanded	No
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Right Front Passenger (Passenger 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (Passenger 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, driver (Driver Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	212
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	212
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	212
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)	212

**Longitudinal Crash Pulse (Event Record 3)
Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for
FSR Event)**

Contains No Recorded Data

**Longitudinal Crash Pulse (Event Record 3)
Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for
FSR Event)**

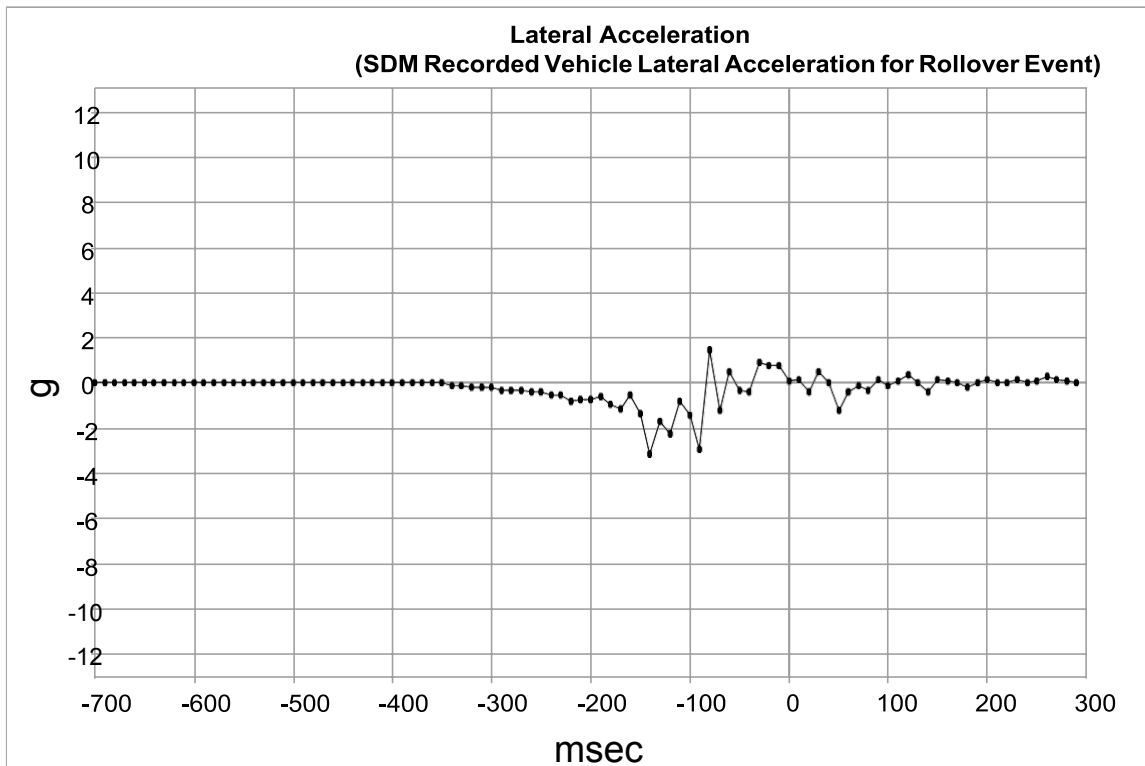
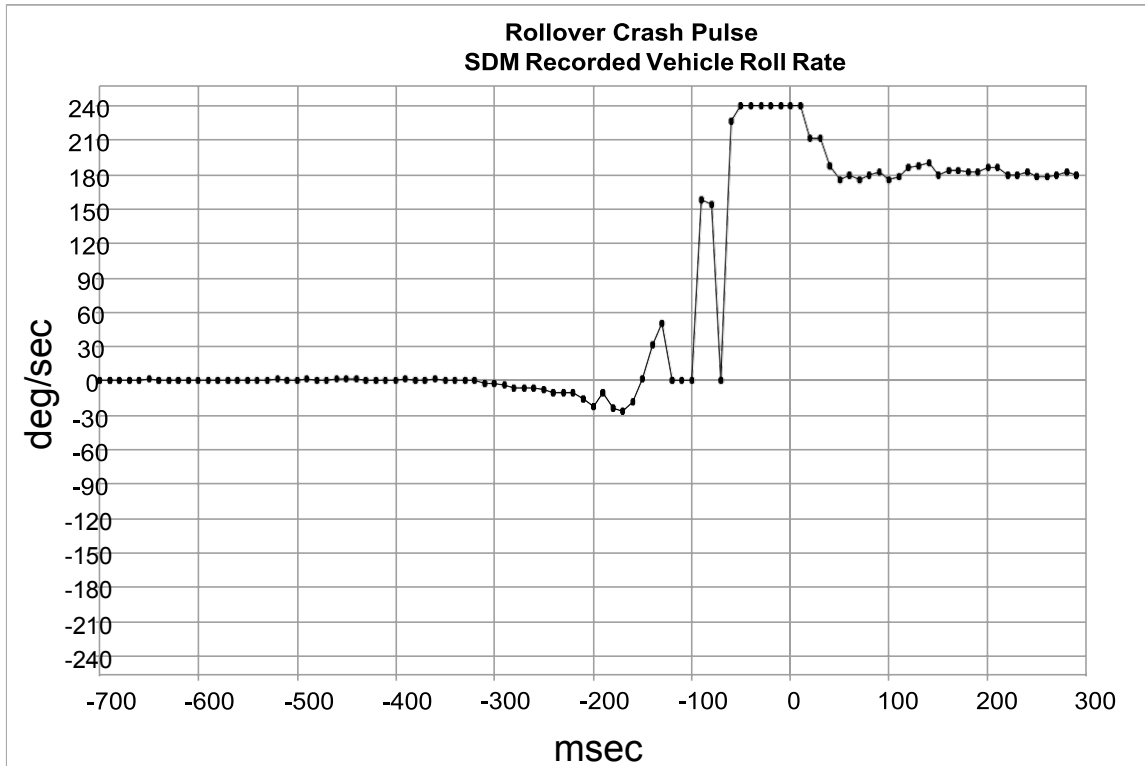
Contains No Recorded Data

**Lateral Crash Pulse (Event Record 3)
Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event)**

Contains No Recorded Data

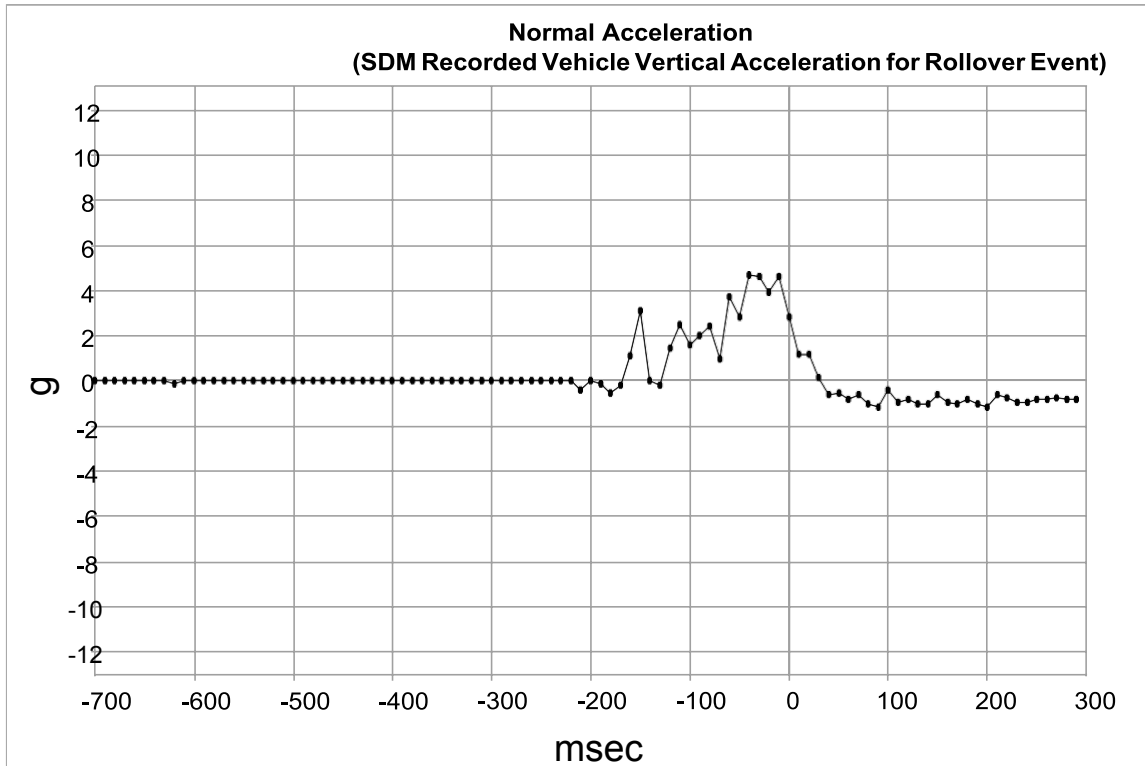
**Lateral Crash Pulse (Event Record 3)
Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event)**

Contains No Recorded Data



Time (msec)	SDM Recorded Vehicle Roll Rate (deg/sec)	Time (msec)	SDM Recorded Vehicle Roll Rate (deg/sec)
-700	0	-200	-22
-690	0	-190	-10
-680	0	-180	-24
-670	0	-170	-26
-660	0	-160	-18
-650	2	-150	2
-640	0	-140	32
-630	0	-130	50
-620	0	-120	0
-610	0	-110	0
-600	0	-100	0
-590	0	-90	158
-580	0	-80	154
-570	0	-70	0
-560	0	-60	226
-550	0	-50	240
-540	0	-40	240
-530	0	-30	240
-520	2	-20	240
-510	0	-10	240
-500	0	0	240
-490	2	10	240
-480	0	20	212
-470	0	30	212
-460	2	40	188
-450	2	50	176
-440	2	60	180
-430	0	70	176
-420	0	80	180
-410	0	90	182
-400	0	100	176
-390	2	110	178
-380	0	120	186
-370	0	130	188
-360	2	140	190
-350	0	150	180
-340	0	160	184
-330	0	170	184
-320	0	180	182
-310	-2	190	182
-300	-2	200	186
-290	-4	210	186
-280	-6	220	180
-270	-6	230	180
-260	-6	240	182
-250	-8	250	178
-240	-10	260	178
-230	-10	270	180
-220	-10	280	182
-210	-16	290	180

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for Rollover Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for Rollover Event) (g)
-700	0.0	-200	-0.7
-690	0.0	-190	-0.6
-680	0.0	-180	-0.9
-670	0.0	-170	-1.1
-660	0.0	-160	-0.5
-650	0.0	-150	-1.3
-640	0.0	-140	-3.1
-630	0.0	-130	-1.7
-620	0.0	-120	-2.2
-610	0.0	-110	-0.8
-600	0.0	-100	-1.4
-590	0.0	-90	-2.9
-580	0.0	-80	1.5
-570	0.0	-70	-1.2
-560	0.0	-60	0.5
-550	0.0	-50	-0.3
-540	0.0	-40	-0.4
-530	0.0	-30	0.9
-520	0.0	-20	0.8
-510	0.0	-10	0.8
-500	0.0	0	0.1
-490	0.0	10	0.2
-480	0.0	20	-0.4
-470	0.0	30	0.5
-460	0.0	40	0.0
-450	0.0	50	-1.2
-440	0.0	60	-0.4
-430	0.0	70	-0.1
-420	0.0	80	-0.3
-410	0.0	90	0.2
-400	0.0	100	-0.1
-390	0.0	110	0.1
-380	0.0	120	0.4
-370	0.0	130	0.0
-360	0.0	140	-0.4
-350	0.0	150	0.2
-340	-0.1	160	0.1
-330	-0.1	170	0.0
-320	-0.2	180	-0.2
-310	-0.2	190	0.0
-300	-0.2	200	0.2
-290	-0.3	210	0.0
-280	-0.3	220	0.0
-270	-0.3	230	0.2
-260	-0.4	240	0.0
-250	-0.4	250	0.1
-240	-0.5	260	0.3
-230	-0.5	270	0.2
-220	-0.8	280	0.1
-210	-0.7	290	0.0



Time (msec)	Normal Acceleration (SDM Recorded Vehicle Vertical Acceleration for Rollover Event) (g)
-700	0.0
-690	0.0
-680	0.0
-670	0.0
-660	0.0
-650	0.0
-640	0.0
-630	0.0
-620	-0.1
-610	0.0
-600	0.0
-590	0.0
-580	0.0
-570	0.0
-560	0.0
-550	0.0
-540	0.0
-530	0.0
-520	0.0
-510	0.0
-500	0.0
-490	0.0
-480	0.0
-470	0.0
-460	0.0
-450	0.0
-440	0.0
-430	0.0
-420	0.0
-410	0.0
-400	0.0
-390	0.0
-380	0.0
-370	0.0
-360	0.0
-350	0.0
-340	0.0
-330	0.0
-320	0.0
-310	0.0
-300	0.0
-290	0.0
-280	0.0
-270	0.0
-260	0.0
-250	0.0
-240	0.0
-230	0.0
-220	0.0
-210	-0.4

Time (msec)	Normal Acceleration (SDM Recorded Vehicle Vertical Acceleration for Rollover Event) (g)
-200	0.0
-190	-0.1
-180	-0.5
-170	-0.2
-160	1.1
-150	3.1
-140	0.0
-130	-0.2
-120	1.5
-110	2.5
-100	1.6
-90	2.0
-80	2.4
-70	1.0
-60	3.7
-50	2.8
-40	4.7
-30	4.6
-20	3.9
-10	4.6
0	2.8
10	1.2
20	1.2
30	0.2
40	-0.6
50	-0.5
60	-0.8
70	-0.6
80	-1.0
90	-1.1
100	-0.4
110	-0.9
120	-0.8
130	-1.0
140	-1.0
150	-0.6
160	-0.9
170	-1.0
180	-0.8
190	-1.0
200	-1.1
210	-0.6
220	-0.7
230	-0.9
240	-0.9
250	-0.8
260	-0.8
270	-0.7
280	-0.8
290	-0.8

Pre-Crash Data -5.0 to -0.5 sec (Event Record 3)

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	17	Off	2496	23	47 [76]
-4.5	36	Off	2496	96	48 [77]
-4.0	40	Off	2432	99	48 [78]
-3.5	44	Off	2368	99	49 [79]
-3.0	46	Off	2432	99	50 [81]
-2.5	25	Off	2368	39	50 [81]
-2.0	16	Off	2368	36	51 [82]
-1.5	16	Off	2240	35	51 [82]
-1.0	34	Off	1984	99	51 [82]
-0.5	19	Off	1920	99	52 [83]

Pre-Crash Data -2.0 to -0.5 sec (Event Record 3)

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	46 [62]	Off
-1.5	No	No	No	16 [22]	Off
-1.0	No	No	No	58 [78]	Off
-0.5	No	No	No	104 [140]	Off

Hexadecimal Data

DPID \$11
DF F3 C0 FC C0 7C 00

DPID \$15
01 02 00 04 05 06 07

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

DPID \$17
13 14 0C 0B 00 00 00

DPID \$32
00 FD 06 80 00 00 00

DPID \$35
78 00 00 00 00 00 00

DID \$01
41 55 32 35 37 37 45 30 31 42 35 35 46 43 37 42

DID \$03
41 54 32 35 37 37 45 30 31 42 35 37 46 38 45 32

DID \$05
41 48 32 35 37 37 45 30 31 42 35 36 32 36 35 33

DID \$07
41 4A 32 35 37 37 45 30 31 42 35 45 36 42 32 32

DID \$09
44 41 34 39 33 36 45 30 31 42 35 37 44 43 37 39

DID \$0B
44 42 34 39 33 36 45 30 31 42 35 36 38 34 46 38

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

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

DID \$30
02 00 03 03

DID \$90
31 47 31 50 43 35 53 42 30 46 37 2A 2A 2A 2A 2A 2A

DID \$9A
04 01

DID \$B4
41 53 39 34 31 32 45 30 35 31 35 38 34 33 32 32

DID \$C1
00 CF 5B 82

DID \$C2
05 A2 33 6B

DID \$C3
00 CF 2D 7D

DID \$CB
00 CF 5B A4

DID \$31

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0050 26 25 26 27 27 07 B9 07 3C 06
0060 CC 07 1C 63 63 23 24 27 63 63
0070 63 60 17 53 52 52 52 51 51 4F
0080 4E 4D 4C 00 FF FD 06 5A FD 00
0090 00 00 00 00 00 00 00 00 00 00
0100 00 00 00 00 00 00 00 00 00 00
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0140 7B 80 7B 82 79 82 78 84 76 83
0150 74 84 73 86 70 85 6F 86 6C 85
0160 6B 85 6A 85 6A 85 69 85 68 84
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0180 67 85 67 85 67 85 67 85 7E 82
0190 7E 80 7D 80 7B 7F 7C 7E 85 85
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0220 7E 83 7D 80 7D 80 7E 82 7C 80
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0240 76 80 74 7F 76 84 75 7C 75 7D
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0260 7A 89 7C 89 7A 85 73 84 79 8F
0270 77 83 75 7C 79 84 73 82 84 7E
0280 71 88 62 89 79 8D 7B 88 72 79
0290 71 80 79 7E 6B 82 7B 7C 78 86
0300 72 82 73 84 6F 88 6A 7A 73 80
0310 8A 84 71 9D 6E 8F 6C 7D 6E 7F
0320 6F 77 68 96 72 7C 6B 6B 73 68
0330 83 74 7F 86 68 90 7A 95 63 81
0340 71 7E 73 7C 64 7C 74 7B 77 7C
0350 70 73 71 7A 77 7B 7A 92 76 8B
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0380 78 87 7B 77 7D 7E 74 79 71 7E
0390 74 7E 79 80 7A 7D 7F 7B 7F 7A
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0030 13 22 10 10 19 2E 2C 28 10 00
0040 00 00 00 00 00 15 1B 1E 1F 23

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0070	63	63	63	2D	52	53	52	52	52	51
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DID \$33

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0060 CC 07 1C 63 63 23 24 27 63 63
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0090 00 00 00 00 00 00 00 00 00 00
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0520	7D	7F	7D	7D	7F	7D	7D	7F	7D	7D
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0630	78	7D	84	75	7D	87	76	79	8A	76
0640	7D	84	77	7C	8B	74	78	8C	72	7B
0650	88	78	88	7E	70	9C	6F	5E	7D	66
0660	6C	7B	7F	67	8C	7F	75	96	7F	6F
0670	8D	30	60	91	32	8C	95	7F	71	87
0680	0E	82	A2	07	7A	99	07	79	AC	07
0690	86	AB	07	85	A4	07	85	AB	07	7E
0700	99	07	7F	89	15	79	89	15	82	7F
0710	21	7D	77	27	71	78	25	79	75	27
0720	7C	77	25	7A	73	24	7F	72	27	7C
0730	79	26	7E	74	22	81	75	21	7D	73
0740	20	79	73	25	7F	77	23	7E	74	23
0750	7D	73	24	7B	75	24	7D	73	22	7F
0760	72	22	7D	77	25	7D	76	25	7F	74
0770	24	7D	74	26	7E	75	26	80	75	25
0780	7F	76	24	7E	75	25	7D	75	00	00
0790	00	00	00	00	00	00	00	00	00	00
0800	00	00	00	00	00	00	00	00	00	00
0810	00	00	00	00	00	00	00	00	00	00

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0830 00 00 00 00 00 00 00 00 00 00
0840 00 00 00 00 00 00 61 00 D4 00
0850 30 01 DE 04 B5 14 EB 00 00 00
0860 00 00 00 00 00 00 0C 01 FF FF
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1010 FF FF FF FF FF FF FF FF FF FF
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1200 FF
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U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

