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Special Crash Investigations On-Site Crash Avoidance – Forward Collision Warning Investigation Vehicle: 2015 Chevrolet Tahoe Location: Texas Crash Date: December 2016

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16. Abstract This report documents a single vehicle crash investigation with the lane departure warning (LDW) system of a 2015 Chevrolet Tahoe. This crash occurred on the north side of a seven-lane, divided interstate highway in an interchange area. The Chevrolet was a 4-door sport utility vehicle (SUV) equipped with LDW and forward collision warning (FCW) systems, multistage frontal air bags, front seat-mounted side impact air bags, driver's front center air bag, and rollover/side impact inflatable curtain (IC) air bags. A belted 59-year-old female drove the vehicle. The Chevrolet was travelling northwest when it departed the right side of the roadway. The vehicle traveled across a ditch and up an embankment where it became airborne and began to roll over, right side leading (Event 1). The vehicle rolled over less than a full quarter turn when the front plane struck a 94 cm (37.0 in) diameter concrete bridge support pillar (Event 2). The vehicle rotated counterclockwise around the bridge pillar coming to final rest on its top plane heading southwest after rolling over a total of two quarter turns. The driver sustained fatal injuries and was transported by a funeral home vehicle to a local medical examiner's facility. The vehicle was towed from the crash scene due to damage.			
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BACKGROUND

This report documents a single-vehicle crash investigation with the lane departure warning (LDW) system of a 2015 Chevrolet Tahoe (**Figure 1**). This crash investigation was initiated by the National Highway Traffic Safety Administration in January 2017 through a review of reports in the Fatality Analysis Reporting System (FARS). It was assigned to the Special Crash Investigation Team at the Indiana University Transportation Research Center. Permission for an inspection of the vehicle was obtained from the insurance company in February 2017. This crash occurred in Texas in December 2016 in the morning hours and was investigated by a local police agency. The crash scene and Chevrolet were inspected in February 2017.

Figure 1: The damaged 2015 Chevrolet Tahoe

This crash occurred on the north side of a seven-lane, divided interstate highway in an interchange area. The Chevrolet was a 4-door sport utility vehicle (SUV) equipped with LDW and forward collision warning (FCW) systems, multistage frontal air bags, front seat-mounted side impact air bags, driver's front center air bag, and rollover/side impact inflatable curtain (IC) air bags. A belted 59-year-old female drove the vehicle. The Chevrolet was travelling northwest when it departed the right side of the roadway. The vehicle traveled across a ditch and up an embankment, where it became airborne and began to roll over, right side leading (Event 1). The vehicle rolled over less than a full quarter turn when the front plane struck a 94 cm (37.0 in) diameter concrete bridge support pillar (Event 2). The vehicle rotated counterclockwise around the bridge pillar, coming to final rest on its top plane heading southwest after rolling over two quarter turns. The driver sustained fatal injuries and was transported by a funeral home vehicle to a local medical examiner's facility. The vehicle was towed from the crash scene due to damage.

CRASH SUMMARY

Crash Site

This crash occurred during the morning on the north side of a straight, seven-lane, divided interstate highway in an interchange area. The weather conditions were overcast with 11 kilometers (7 miles) visibility, easterly winds at 10 km/h (6 mph), a temperature of 8.9 ℃ (48 ℉), and a dew point of 6.1 ℃ (43 ℉), according to local weather reports. The roadway had three

concrete northwest-bound through lanes and a concrete entrance ramp acceleration lane that were separated from three concrete southeast-bound through lanes by a grass median. The roadway pavement marking consisted of solid yellow median edge line, broken white lane lines, and a solid white right edge line. There were no rumble strips on either side of the roadway. The roadway was bordered by concrete shoulders. A blocked-out W-beam guardrail was located on both sides of the northwest-bound roadway that protected errant vehicles from the concrete support pillars of an overpass bridge. The speed limit was 113 km/h (70 mph). Crash diagrams are included at the end of this report. Please refer to the crash diagrams when reading the following pre-crash discussion.

Pre-Crash

The Chevrolet was travelling northwest (**Figure 2**) in the second through lane from the right prior to departing the right side of the roadway and sustaining two crash events. It was determined based on analysis of the vehicle's event data recorder (EDR) report and the crash scene evidence that the initial algorithm enable (AE)[1] most likely occurred on an embankment following the vehicle's departure from the right side of the roadway and travel across a ditch (**Figure 3**). The location of AE was located approximately 63 m (207 ft) northeast of the vehicle's departure point from the right side of the roadway. Using the 5 seconds of EDR-reported pre-crash data it was determined that the vehicle traveled a total distance of approximately 156 m (512 ft) to the area of AE. A timeline and likely on-roadway path of the vehicle was established by working backward from the area of AE along the off-roadway approach path, which was based on the physical evidence documented at the SCI crash scene inspection. At -5.0 to -4.0 sec prior to AE the vehicle was traveling northwest in the second through lane from the right at an EDR-reported speed of 110 km/h (68 mph) with the brake switch reported as "Off." At -3.0 sec the vehicle was traveling 112 km/h (70 mph) with the brake switch reported as "Off." The vehicle departed the right side of its travel lane approximately midway between -4.0 and -3.0 sec prior to AE. The lane line was a broken white line in good condition and the vehicle was equipped with an LDW system; however, there was insufficient information to determine if the system

Figure 2: View southeast from the area of roadway departure back to Chevrolet's approach environment

Figure 3: View northwest to Chevrolet's off-road travel path

[1] There were three EDR-reported events in this crash and AE for the vehicle's roll sensor was the first EDR-reported event. Please see specific discussion on this issue in the Event Data Recorder section of this report on page 6.

issued a warning since the EDR did not report LDW system data. In addition, it was not possible to investigate the status of the system via an SCI interview with the driver since she was killed in the crash. At -2.0 sec the vehicle was traveling 112 km/h (70 mph) with the brake switch reported as "Off" and departed the right side of the roadway after traveling a total distance of approximately 93 m (305 ft) from the -5.0 sec point. The edge line of the roadway was a solid white line in good condition, and again it is not known if the vehicle's LDW system issued a warning. The vehicle traveled an additional 31.5 m (103.3 ft) across the shoulder to the -1.0 sec point at which point the vehicle was traveling 114 km/h (71 mph) with the brake switch reported as "Off". The vehicle departed the edge of the shoulder in this area and traveled down a 13 percent grade into and across a ditch, then up an 11 percent grade as it traveled across the embankment. AE for the vehicle's roll sensor probably occurred on the embankment in this area (**Figure 4**) and the system commanded deployment of the both IC air bags, the driver's front center air ag, and both frontal seat belt pretensioners. The vehicle then became airborne as it continued across the embankment.

Figure 4: View northwest to area of AE on the embankment

Figure 5: Damage to the front plane from the impact with the bridge support pillar

Crash

The vehicle began to rollover, right side leading (Event 1), as it was airborne for a distance of approximately 15 m (49 ft). The front plane (**Figure 5**) then struck a 94 cm (37.0 in) diameter concrete bridge support pillar (**Figure 6**, Event 2) as the vehicle landed. The vehicle was rolled to the right less than a full quarter turn at the time of this impact as indicated by the crush pattern on the vehicle. The front plane crush was severe below the hood level, but the hood was not similarly crushed (**Figure 7**), indicating that the vehicle was rolled to the right approximately a half quarter turn when this impact occurred. As a result, the force direction was non-horizontal and WinSMASH calculated the delta V as 43 kmph and the barrier equivalent speed (BES) as 42 kmph. The vehicle's EDR reported the maximum longitudinal and lateral velocity changes as -87 km/h (-54 mph) and 20 km/h (12 mph),

Figure 6: Impact with concrete bridge support pillar looking west

respectively, and the impact resulted in deployment of both stages of the driver's frontal air bag. The vehicle rotated counterclockwise around the bridge pillar as it rolled over a second quarter turn landing on its roof on the concrete embankment slab and coming to final rest heading southwest for a total of two quarter turns. The total distance traversed during the rollover, which included the airborne phase of the rollover, was estimated to be 10 m (32 ft).

Figure 7: Crush to Chevrolet's bumper bar and hood

Post-Crash

The police were notified of the crash at 0822 hours and arrived on scene at 0825 hours. The left front door was jammed shut and emergency responders used a hydraulic rescue tool to pry the door open. Emergency responders then cut the driver's seat belt and removed her from the vehicle. The driver sustained fatal injuries and was transported by a funeral home vehicle to the local medical examiner's facility. Vehicle towing operations included dragging the vehicle down the concrete slab and through the dirt at the bottom of the slab. This action produced overlapping damage scratches to the front of the top plane and jammed dirt into the right windshield header and A-pillar. A hole was also created in the windshield in this area and dirt was jammed into the front of the interior headliner. The vehicle was then righted and towed from the crash scene.

2015 CHEVROLET TAHOE

Description

The Chevrolet was a rear-wheel-drive, 7-passenger, 4-door SUV with the VIN 1GNSCBKC6FRxxxxxx manufactured in September 2014. The vehicle was equipped with a 5.3-liter, V-8 engine, 6-speed automatic transmission with sport shift feature, 4-wheel, antilock brakes with electronic brake force distribution, brake assist, traction control, Tire pressure monitoring system (TPMS), and electronic stability control (ESC). The vehicle was also equipped with forward collision warning (FCW) without auto braking, LDW without lane keeping, vibrating safety alert driver's seat, blind spot detection, rear vision camera, back-up sensors, rear cross-traffic alert, multistage frontal air bags, driver's front center air bag, front seat-mounted side impact air bags, and rollover/side impact IC air bags that were compliant with Federal Motor Vehicle Safety Standard (FMVSS) No. 226, Ejection Mitigation. The vehicle was also equipped with a tilt/telescoping steering column. The column adjustments could not be determined since the steering assembly was damaged and displaced by driver contact. The specified wheelbase was 295 cm (116.1 in).

The vehicle manufacturer's recommended tire size was P275/55R20. The vehicle was equipped with Continental Cross Contact Ecoplus tires of the recommended size on the right front, right rear, and left rear wheels. The information for the left front tire could not be determined since the left front wheel was displaced from the vehicle during the crash and was not present at the SCI vehicle inspection. The vehicle manufacturer's recommended cold tire pressure for the front and rear tires

was 241 kPa (35 psi). The vehicle's tire data (collected approximately three months following the crash) are presented in the table below.

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	Unknown	Unknown	Unknown	Unknown
LR	248 kPa (36 psi)	5 mm (6/32 in)	No	None
RR	248 kPa (36 psi)	6 mm (7/32 in)	No	None
RF	Flat	5 mm (6/32 in)	Yes	Sidewall cut

The front row was equipped with driver and front passenger leather-covered bucket seats with adjustable head restraints. The second row was equipped with leather-covered bucket seats with adjustable head restraints in the outboard seating positions. The third row was equipped with a leather-covered bench seat with folding back and adjustable head restraints in the outboard seating positions. The driver's seat track adjustment could not be determined since the seat was displaced forward on its track during the crash. The top of the head restraint was located 19 cm (7.5 in) above the top of the seat back. The remaining seats were unoccupied at the time of the crash.

Lane Departure - Forward Collision Warning Discussion

The LDW system is camera-based with the camera located behind the rearview mirror and is designed to provide a visual and audible warning if the vehicle is getting too close to a right or left lane marker and the turn signal is not activated. The system is not designed with a lane keeping feature. The LDW system can detect lane markings at speeds of 56 km/h (35 mph) or greater. If the vehicle crosses a detected lane marking without the turn signal activated, an LDW icon on the instrument cluster will change from green to amber and flash. The driver's seat will then pulse three times on the side where the lane departure occurred and the "LDW" indicator on the instrument cluster directly in front of the driver will blink. The ability of the system to detect a lane marker can be affected by speed, lane marker condition, and weather. The system can be turned on or off via the "LDW" button that is located to the left of the steering wheel.

The LDW system applied to this crash since the Chevrolet crossed a white broken lane line and a solid white edge line prior to departing the right side of the roadway and crashing. However, it was not possible to determine if the system functioned as designed since the EDR reported no LDW system data. In addition, it was not possible to conduct an SCI interview with the driver to investigate the status of the system since she was killed in the crash.

The Chevrolet was also equipped with a FCW system without auto braking. The system was designed to detect a vehicle in front of it and issue a visual and audible warning and vibrate the driver's seat if a crash is possible. The system does not automatically apply the brakes. The FCW system did not apply to this crash since it was not designed to warn of impending impacts with objects such as guardrails, bridges, or construction barrels.

Exterior Damage

Exterior Damage Events 1: The Chevrolet sustained direct and induced damage to the right and top planes during the rollover. The direct damage on the right plane began on the A-pillar and

extended along the roof side rail to the D-pillar. The upper portions of the B- and C-pillars were also directly damaged and both door handles were abraded. There was no direct damage to the doors, fender, or quarter panel below the door handles. The direct damage to the top plane extended the full length and width of the top. There were also overlapping longitudinal scratches to the front of the top plane and on the right A-pillar that occurred during towing operations when the vehicle was dragged down the concrete slab. The maximum vertical crush was 5 cm (2.0 in) occurring to the roof just rear of the left windshield header. There was no lateral crush to the top plane.

Damage Classification Event 1: The Collision Deformation Classification (CDC) was 00TZDO2. The severity of the damage was minor.

Exterior Damage Event 2: The front plane sustained direct and induced damage when it struck the 94 cm (37.0 in) diameter concrete bridge support pillar during the rollover. There was also direct damage to the undercarriage, left fender, left sill, and left front door (**Figure 8**) since the vehicle was rolled to the right approximately a half quarter turn when this impact occurred. The direct damage to the front plane began at the left corner of the front bumper and extended 64 cm (25.2 in) to the right. The Field L was 82 cm (32.3 in). The crush measurements were taken on the bumper bar and the maximum residual crash was 80 cm (31.5 in) occurring at the left front bumper corner. The crush values were: C_1 = 80 cm (31.5 in), C_2 = 47 cm (18.5 in), C_3 = 32 cm (12.6 in), C_4 = 19 cm (7.5 in), C_5 = 10 cm (3.9 in), C_6 = 0 cm.

Figure 8: Damage to the undercarriage, fender, sill and left front door of the Chevrolet

Damage Classification Event 2: The CDC was 00FYEW3. The severity of the damage was severe.

Event Data Recorder

The Chevrolet's EDR was imaged with version 17.2 of the Bosch Crash Data Retrieval software and read with version 19.1.1 The EDR was imaged via direct connection to the air bag control module since it had been removed by police. The EDR report is attached at the end of this report as **Appendix A**.

The EDR was capable of storing three events. A non-deployment event could be overwritten by a more recent non-deployment event or by a deployment event. A deployment event could not be overwritten. The EDR recorded three deployment events and the recording was complete for each event. On-Star deployment and vehicle velocity change data was sent for each event. The driver's seat belt switch circuit status was reported as "Buckled" and her seat track position was reported as not in the foremost position. The ignition cycles at the crash and when the data were imaged were reported as 3,079, and 3,081, respectively.

Event Record 1: The "Event Severity Status" was reported as "Rollover" and 1 sec of "Rollover Crash Pulse" data were reported. Deployment of the driver's and front passenger's safety belt pretensioners, both IC air bags, and the driver's front center air bag were commanded at 253 msec following AE. The data limitations stated that for rollover deployment events, the EDR will report 700 msec of roll rate data prior and 290 msec after the deployment criteria is met (DCM). The data showed that from -180 msec to DCM (0 msec) the vehicle's counterclockwise roll rate increased rapidly from 0 deg/sec to -252 deg/sec.[2] Analysis of the crash scene evidence and the vehicle's off road trajectory indicated that this most likely occurred as the vehicle traveled across the approximate 30% cross slope of the embankment. The right side of the vehicle was on the high side of the slope, which would result in a counterclockwise roll rate as the vehicle traversed across the bottom of the ditch and then onto the embankment. This was the primary factor for determining the likely area of AE used for the time line discussion presented in the Pre-Crash section of this report on page 2.

Event Record 2: This event was recorded when the front plane struck the concrete bridge support pillar. Stage 1 and 2 deployment of the driver's frontal air bag was reported and the time to DCM for stages 1 and 2 was 73 and 76 msec, respectively. The maximum longitudinal and lateral velocity changes were reported as -87 km/h (-54 mph) and 20 km/h (12 mph), respectively, occurring at 298 and 186 msec, respectively after AE. Data trouble code B0052-00 (deployment commanded) was reported.

Event Record 3: The event severity status was reported as a rollover and was likely recorded as the vehicle was being righted for removal from the crash scene. It was reported as a deployment event, but there was no data reported on deployments of air bags, which had previously deployed during Events 1 and 2.

Interior Damage

The interior of the Chevrolet sustained severe damage from seven intrusions. The most severe intrusions in the driver's seating area involved the toe pan, side panel forward of the left A-pillar, and the left instrument panel. The toe pan and left instrument panel intruded longitudinally 52 cm (20.4 in) and 22 cm (8.7 in), respectively. The side panel forward of the A-pillar intruded laterally 20 cm (7.9 in). The upper half of the steering wheel was displaced forward 7 cm (2.8 in) from contact by the driver's chest when she loaded through the deployed frontal air bag during the impact with the bridge pillar. The lower left instrument panel was deformed from contact by the driver's left knee. The windshield glazing was cracked. It was holed at the upper right corner during towing operations. The windshield had also partially collapsed due to weathering. The left front, right front, third right rear, and backlight glazing was disintegrated during the crash. The remaining glazing was undamaged. The left front door was jammed shut and had been forced open by emergency responders with a hydraulic rescue tool. The left rear door was jammed shut. The remaining doors were closed and operational.

Manual Restraint Systems

The front row was equipped with three-point lap and shoulder seat belts with locking latch plates, adjustable upper anchors, and retractor-mounted pretensioners. The second and third rows were

[2] The EDR data limitations stated that clockwise roll rate is expressed in positive value.

equipped with lap-and-shoulder seat belts with sliding latch plates and fixed upper anchors. The driver's upper anchor was adjusted to the full-up position. Both the driver's and front passenger's pretensioner's actuated during the crash.

The driver's seat belt had been cut by emergency responders indicating she was belted at the time of the crash. The EDR also reported the status of the driver's seat belt switch circuit as "Buckled."

Supplemental Restraint Systems

The Chevrolet was equipped with multi-stage frontal air bags, driver's front center air bag, front seat-mounted side impact air bags, and rollover/side impact IC air bags. The driver's front center air bag and both IC air bags deployed during the rollover. Both stages of the driver's frontal air bag deployed during the impact with the bridge pillar.

The driver's frontal air bag module was located in the steering wheel hub and the module cover was a two-flap configuration constructed of pliable vinyl. Each flap was 7 cm (2.8 in) wide and 11 cm (4.3 in) high. The flaps opened at the designated tear seams and were undamaged. The deflated air bag was 48 cm (18.9 in) in diameter. The air bag sustained no damage during the crash. There was no discernable evidence of occupant contact on the air bag. There were a few blood spots/transfers on the air bag that likely occurred following the crash.

The driver's front center air bag was located in the inboard side of the driver's seat back and deployed through a tear seam. The deflated air bag was 33 cm (10.1 in) high and 46 cm (18.1 in) wide. There was no discernable evidence of occupant contact to the air bag and no damage.

The IC air bags were located along the roof side rail inside the headliner and extended from the A-pillar to the D-pillar. The front portion of the left IC had been cut and removed by emergency responders. The right IC was 266 cm (104.7) wide, 50 cm (19.7 in) high, and extended 20 cm (7.9 in) below the belt line.

2015 CHEVROLET TAHOE OCCUPANT

Driver Demographics

Age/sex:	59 years/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Unknown
Manual restraint usage:	Lap and shoulder belt
Usage source:	Vehicle inspection and EDR Frontal, front center, and both left ICs, deployed; seat-mounted side impact, not deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Removed by emergency responders
Transport from scene:	Funeral home vehicle to the local medical examiner's facility.
Medical treatment:	None

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Aorta, thoracic laceration; perforation; puncture-> major; rupture; transection; segmental loss; blood loss >20% by volume-> with aortic root or valve involvement	420212.5	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain
2	Anterior right ventricular laceration at base of heart NFS	441008.3	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain
3	Pericardial sac laceration	441602.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain
4	Rib Cage fracture(s) without flail, any location unilateral or bilateral-> >=3 ribs [OIS II] Anterior right ribs 4-10, anterior left ribs 5-10	450203.3	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain
5	Cerebrum subarachnoid hemorrhage over right parietal lobe, NFS	140693.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Probable
6	Cerebrum subarachnoid hemorrhage over left parietal and temporal lobes, NFS	140693.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
7	Left hemidiaphragm laceration NFS	440604.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain
8	Omentum laceration NFS	542220.2	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain
9	Extensive capsular and parenchymal lacerations involving the visceral and diaphragmatic surfaces of right lobes of liver, NFS	541820.2	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain
10	Extensive capsular and parenchymal lacerations involving the visceral and diaphragmatic surfaces of left lobes of liver, NFS	541820.2	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain
11	Spleen lacerations, NFS	544220.2	Isolated Front - Steering wheel (combination of rim and hub/spoke)	Certain
12	Thoracic vertebra(e) injury fracture without neurologic deficit-> vertebral body NFS	650430.2	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Probable
13	Right radius fracture NFS	752800.2	Isolated Front – Center instrument panel	Probable
14	Right ulna fracture NFS	753200.2	Isolated Front – Center instrument panel	Probable
15	Right femur fracture NFS	853000.3	Isolated Front – Left lower instrument panel (includes knee bolster)	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
16	Left distal tibia fracture, NFS [includes isolated medial or posterior malleolus; pilon fracture]	854331.2	Isolated Floor – Floor (including toe pan)	Probable
17	Left proximal tibia fracture, NFS	854111.2	Isolated Front - Left lower instrument panel (includes knee bolster)	Certain
18	Fractures of bones of left foot, NFS	852004.2	Isolated Floor – Floor (including toe pan)	Probable
19	Lateral left leg has gaping full-thickness laceration with disruption of underlying musculature	810604.2	Isolated Floor - Foot controls including parking brake	Probable
20	Lateral left ankle has gaping full-thickness laceration with disruption of underlying musculature	810604.2	Isolated Floor - Foot controls including parking brake	Probable
21	Stellate laceration to medial left ankle, NFS	810600.1	Isolated Floor - Foot controls including parking brake	Probable
22	Contusion to center of forehead	210402.1	Isolated Left Air Bag – Steering wheel hub	Probable
23	Abrasion to center of forehead	210202.1	Isolated Left Air Bag – Steering wheel hub	Probable
24	Right eyelid ecchymosis	210402.1	Isolated Left Air Bag – Steering wheel hub	Probable
25	Contusion to nose	210402.1	Isolated Left Air Bag – Steering wheel hub	Probable
26	Abrasion to nose	210202.1	Isolated Left Air Bag – Steering wheel hub	Probable
27	Abrasion to right cheek	210202.1	Isolated Left Air Bag – Steering wheel hub	Probable
28	Frontal subscapular hemorrhage	110402.1	Isolated Left Air Bag – Steering wheel hub	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
29	Contusion to underside of chin	210402.1	Isolated Front - Steering wheel rim	Probable
30	Left anterior neck has diagonal abrasion extending from sternal notch to superior left shoulder	310202.1	Isolated Interior - Shoulder portion of belt restraint	Certain
31	Left shoulder abrasion	710202.1	Isolated Interior - Shoulder portion of belt restraint	Certain
32	Scattered contusions to right breast	410402.1	Isolated Interior - Shoulder portion of belt restraint	Probable
33	Scattered contusions to upper right and lower right quadrant of abdomen	510402.1	Isolated Interior - Lap portion of belt restraint	Probable
34	Left back contusion	410402.1	Isolated Interior - This occupant's seatback	Probable
35	Scattered abrasions to left breast	410202.1	Isolated Interior - Shoulder portion of belt restraint	Probable
36	Scattered abrasions to right upper quadrant of abdomen	510202.1	Isolated Interior - Shoulder portion of belt restraint	Probable
37	Contusion to right arm	710402.1	Injured, unknown source	Unknown
38	Numerous abrasions to right forearm	710202.1	Isolated Front – Center instrument panel	Probable
39	Numerous abrasions to posterior right hand	710202.1	Isolated Front – Center instrument panel	Probable
40	Superficial lacerations scattered over fingers of left hand	710602.1	Isolated Front – Left instrument panel	Probable
41	Superficial contusions scattered over fingers of left hand	710402.1	Isolated Front – Left instrument panel	Probable
42	Superficial abrasions scattered over fingers of left hand	710202.1	Isolated Front – Left instrument panel	Probable

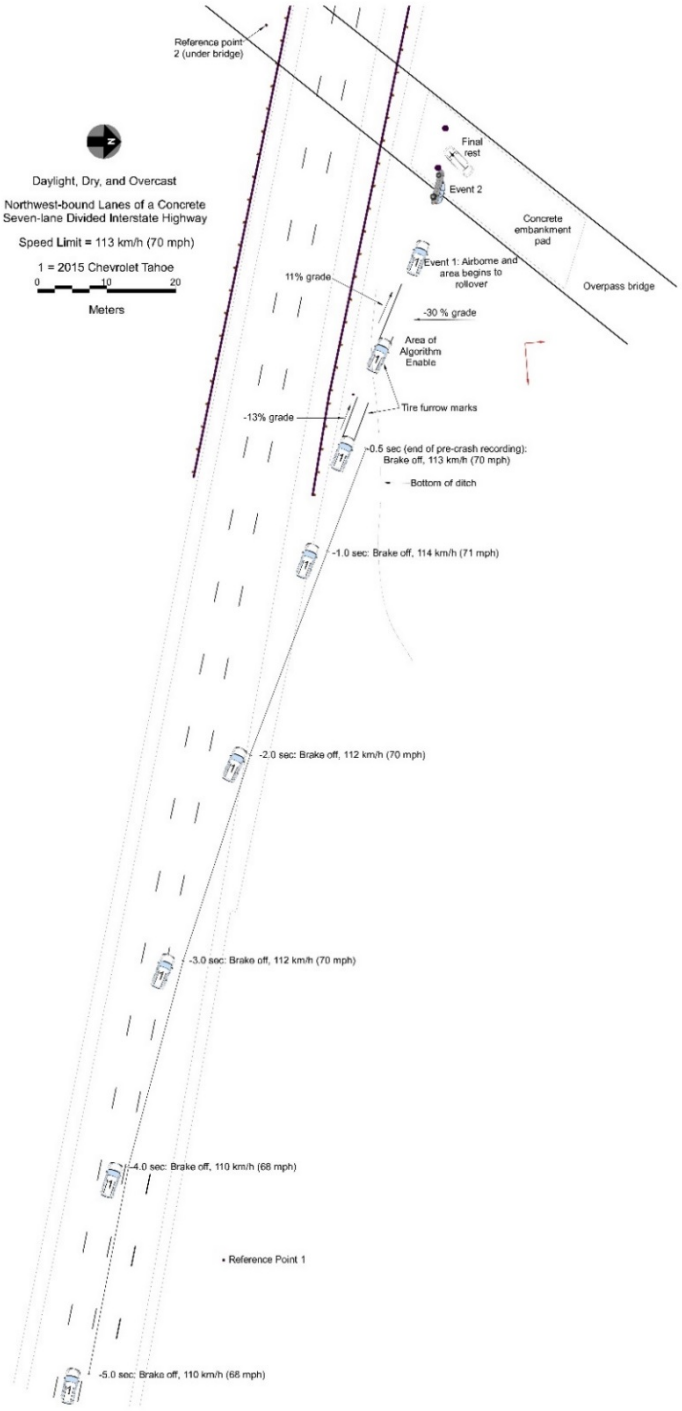
Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
43	Contusions on anterior and medial right thigh	810402.1	Isolated Front – Left lower instrument panel (includes knee bolster)	Probable
44	Scattered contusions over anterior left leg	810402.1	Isolated Front – Left lower instrument panel (includes knee bolster)	Certain
45	Contusions to anterior left thigh	810402.1	Isolated Front – Left lower instrument panel (includes knee bolster)	Probable
46	Numerous contusions to anterior left knee	810402.1	Isolated Front – Left lower instrument panel (includes knee bolster)	Certain
47	Contusions to medial and lateral left ankle	810402.1	Isolated Floor - Foot controls including parking brake	Probable
48	Contusions to posterior left foot	810402.1	Isolated Floor - Foot controls including parking brake	Probable
49	Right hemothorax	442200.3	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain
50	Left hemothorax	442200.3	Tandem IPC Initial: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel hub/spoke	 Certain Certain Certain

Source: Autopsy (internal)

Driver Kinematics

The driver was restrained by the lap and shoulder seat belt. The seat track position could not be determined since the seat was displaced forward on the track during the impact with the bridge support pillar. The driver was displaced up and down in her seat position as the vehicle traveled off road down the front slope of a ditch and then up an embankment on the back side of the ditch. The vehicle's roll sensor commanded deployment of both IC air and front center air bags and the driver's pretensioner in this area. She was redirected to the right in her seat belt as the vehicle began to rollover, right side leading. The frontal plane impact with the bridge support pillar resulted in deployment of both stages of the driver's frontal air bag and redirected her forward and her chest and face loaded the air bag. Her chest loaded through the air bag and contacted the steering wheel displacing the upper half of the steering wheel forward 7 cm (2.8 in). The driver was redirected toward the roof as the vehicle continued to rollover onto its top plane, where it came to final rest. Emergency responders used a hydraulic rescue tool to force open the left front door. They then cut her seat belt and removed her from the vehicle. The driver sustained fatal injuries and was transported by a funeral home vehicle to the local medical examiner's facility according to the police crash report.

CRASH DIAGRAM



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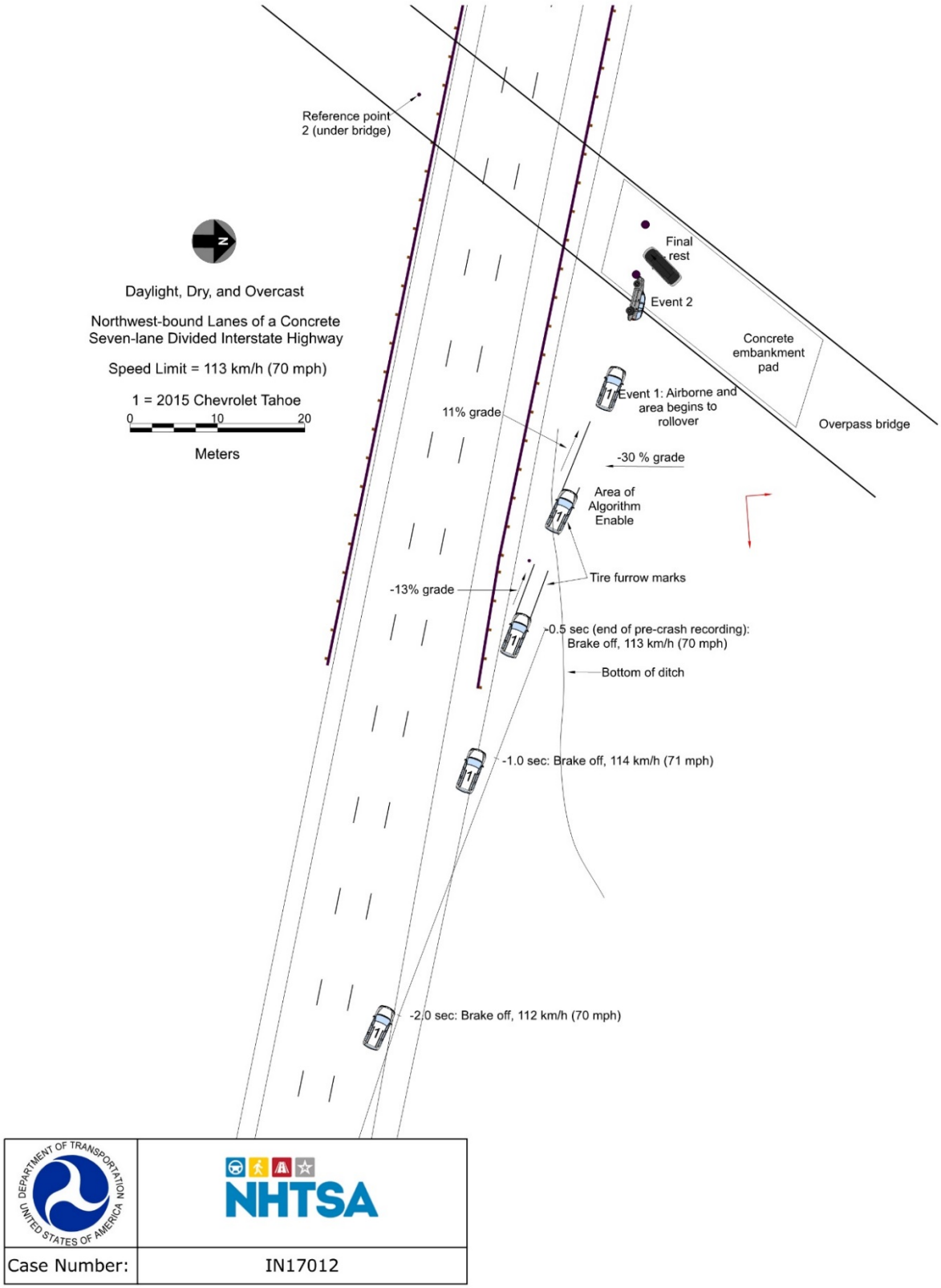
CRASH DIAGRAM, DETAILED VIEW



DEPARTMENT OF TRANSPORTATION UNITED STATES OF AMERICA	NHTSA
Case Number:	IN17012

APPENDIX A: 2015 CHEVROLET TAHOE EVENT DATA RECORDER (EDR) REPORT[3]

[3] The EDR report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the vehicle inspection. The CDR report contained in the associated Crash Viewer application may differ relative to this report.

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

CDR File Information

User Entered VIN	1GNSCBKC6FR******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	201750S2IN17012_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.2
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 19.1.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	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:

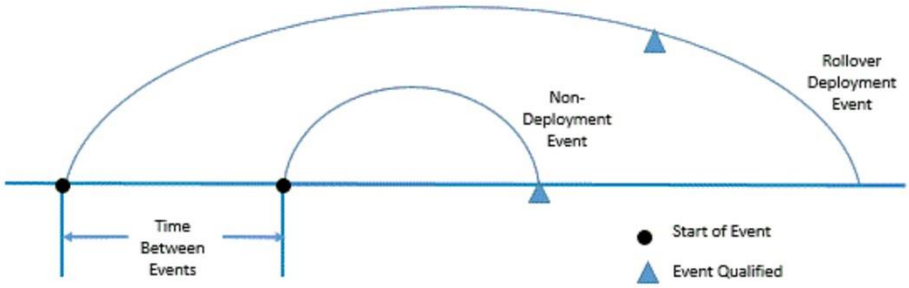
-Pretensioner(s) only Deployment
-Head Rest Deployment
-Battery Cut-Off Deployment

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. The SDM will only record Maximum SDM Recorded Vehicle Velocity Change for the first 300 milliseconds of the event.
-If the SDM Recorded Vehicle Velocity Change data exceeds the max output range of -127 km/h then the exceeded values will be displayed with an offset of a +256 km/h. If the SDM Recorded Vehicle Velocity Change data exceeds the max output range of +126

km/h then the exceeded values will be displayed with an offset of a -256 km/h.
-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.
-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:
-Significant changes in the tire's rolling radius
-Final drive axle ratio changes
-Wheel lockup and wheel slip
-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.
-Pre-Crash data is recorded asynchronously. The 0.5 second Pre-crash data value (most recent recorded data point) is the data point last sampled before Time Zero. That is to say, the last data point may have been captured just before Time Zero but no more than 0.5 second before Time Zero. All subsequent Pre-crash data values are referenced from this data point.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:
-The SDM receives a message with an "invalid" flag from the module sending the pre-crash data
-Pre-Crash Electronic Data Validity Check Status indicates "Data Not Available" if:
-No data is received from the module sending the pre-crash data
-For diesel powered vehicles, the data displayed as Throttle Position (%) is actually the data for the Air Inlet Flap Position. This is not the same as the throttle position for a gasoline powered engine.
-Belt Switch Circuit Status indicates the status of the seat belt switch circuit.
-The ignition cycle counter will increment when the power mode cycles from OFF/Accessory to RUN. Applying and removing of battery power to the module will not increment the ignition cycle counter.
-Ignition Cycles Since DTCs Were Last Cleared can record a maximum value of 253 cycles and can only be reset by a scan tool.
-Dynamic Deployment Event Counter tracks the number of Deployment events that have occurred during the SDM's lifetime.
-Dynamic Event Counter tracks the number of qualified events (either Deployments, Non-deploy, or Rollover events) that have occurred during the SDM's lifetime.
-For Deployment Events, DTC B0052 (Deployment commanded) shall be recorded with the remainder of the data for this event even though it occurred after Event Enable.
-Once a firing loop has been commanded to be deployed, it will not be commanded to be deployed again during the same ignition cycle. Firing loop times for subsequent deployment type events, during the same ignition cycle, will record the deployment times as N/A.
-In an event where the module is operating on energy reserve, the Dynamic counters may report a value that is less than the actual value. If the stored values in the Dynamic counters are less than the counter values in the event records or if more than one event record has the same counter value as another, the module may have been operating on its energy reserve.
-A Concurrent Event is when two events are happening nearly simultaneously. The "Concurrent Event Flag Set" parameter will indicate "Yes" if one event begins, but before that event is qualified, another event begins and is qualified.
A Non-Deployment event typically becomes qualified if that event exceeds the 5 MPH (8 km/h) delta V recording threshold and the event has concluded. A deployment event (FSR or Rollover) becomes qualified when a deployment has been commanded for that event.
Example of a Concurrent Event:
A Rollover event begins. Before the Rollover event is qualified, a Non-Deployment event begins and is qualified. Sometime after the Non-Deployment event is qualified, the Rollover event is qualified. The Non-Deployment event will be recorded in the first open record even though the Rollover event enabled before the Non-Deployment event. The Rollover event will be recorded in the next open record. The "Concurrent Event Flag Set" parameter will indicate "Yes" for the Rollover event. The "Time Between Events" parameter will indicate the time from the start of the Rollover event to the start of the Non-Deployment event.



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

-The GM parameter name is displayed in parentheses after the NHTSA Part 563 parameter name.
-The reported range of the longitudinal and lateral acceleration values is approximately ± 50 g.
-Due to a CDR Tool data imaging issue, all CDR files imaged from SDM-30 Delphi airbag control modules (ACM) using version 17.6

software are invalid and the ACM must be re-imaged using CDR version 17.6.1 and later software.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

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

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

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

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

01050_SDM30-delphi_r019

System Status at Time of Retrieval

Dynamic Deployment Event Counter	3
Multi-Event, Number of Events (Dynamic Event Counter)	3
Dynamic OnStar Notification Event Counter	3
Vehicle Identification Number (VIN)	1GNSCBKC6FR******
Ignition Cycle, Download (Ignition Cycles at Investigation)	3081
End Model Part Number	00CF6F2D
System Type	N/A
Software Module Identifier 1	00CF6F21
Software Module Identifier 2	016576DF
Software Module Identifier 3	01621D42
Manufacturing Traceability Data, LineID	K
Manufacturing Traceability Data, ShiftID	2
Manufacturing Traceability Data, Year	14
Manufacturing Traceability Data, DayOfTheYear	260
Manufacturing Traceability Data, Serial/Lot/BatchNumber	390A01Y00
ESS # 1 Traceability Data, Component Identifier	AU
ESS # 1 Traceability Data, Part Number/Broadcast Code	8677
ESS # 1 Traceability Data, Supplier Code	D
ESS # 1 Traceability Data, Traceability Number	P00000000
ESS # 2 Traceability Data, Component Identifier	AT
ESS # 2 Traceability Data, Part Number/Broadcast Code	8677
ESS # 2 Traceability Data, Supplier Code	D
ESS # 2 Traceability Data, Traceability Number	P00000000
ESS # 3 Traceability Data, Component Identifier	AH
ESS # 3 Traceability Data, Part Number/Broadcast Code	8676
ESS # 3 Traceability Data, Supplier Code	D
ESS # 3 Traceability Data, Traceability Number	A00000000
ESS # 4 Traceability Data, Component Identifier	AJ
ESS # 4 Traceability Data, Part Number/Broadcast Code	8676
ESS # 4 Traceability Data, Supplier Code	D
ESS # 4 Traceability Data, Traceability Number	A00000000
ESS # 5 Traceability Data, Component Identifier	DA
ESS # 5 Traceability Data, Part Number/Broadcast Code	8678
ESS # 5 Traceability Data, Supplier Code	D
ESS # 5 Traceability Data, Traceability Number	A00000000
ESS # 6 Traceability Data, Component Identifier	DB
ESS # 6 Traceability Data, Part Number/Broadcast Code	8678
ESS # 6 Traceability Data, Supplier Code	D
ESS # 6 Traceability Data, Traceability Number	A00000000
ESS # 7 Traceability Data, Component Identifier	??
ESS # 7 Traceability Data, Part Number/Broadcast Code	0000
ESS # 7 Traceability Data, Supplier Code	D
ESS # 7 Traceability Data, Traceability Number	A00000000
ESS # 8 Traceability Data, Component Identifier	??
ESS # 8 Traceability Data, Part Number/Broadcast Code	0000
ESS # 8 Traceability Data, Supplier Code	D
ESS # 8 Traceability Data, Traceability Number	A00000000

System Status at Event (Event Record 1)

Event Record Type	Deployment
OnStar Deployment Status Data Sent	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)	1
OnStar Notification Event Counter	1
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	3079
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Rear	Yes
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	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
Seat Track Position Switch, Foremost, Status, Driver (Driver Seat Position Status)	No (Rearward)
Seat Track Position Switch, Foremost, Status, Right Front Passenger (Passenger Seat Position Status)	No (Rearward)
Passenger Seat Occupancy Status	Empty
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Not Applicable)
Passenger Air Bag ON Indicator Status	Off
Passenger Air Bag OFF Indicator Status	On
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655330
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	2978
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
High Voltage Disable Notification Sent	Yes
Deployment Commanded in Energy Reserve Mode	No

DTCs Present at Time of Event (Event Record 1)

B0052-00

Event Data (Event Record 1)

Driver 1st Stage Deployment Loop Commanded	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 1 Roof Rail/Head Curtain Loop Commanded	Yes
Right Row 1 Roof Rail/Head Curtain Loop Commanded	Yes
Driver Center Inboard Loop Commanded	Yes
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	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)	253
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	253
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	253
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)	253

Longitudinal Crash Pulse (Event Record 1)
Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event)

Contains No Recorded Data

Longitudinal Crash Pulse (Event Record 1)
Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event)

Contains No Recorded Data

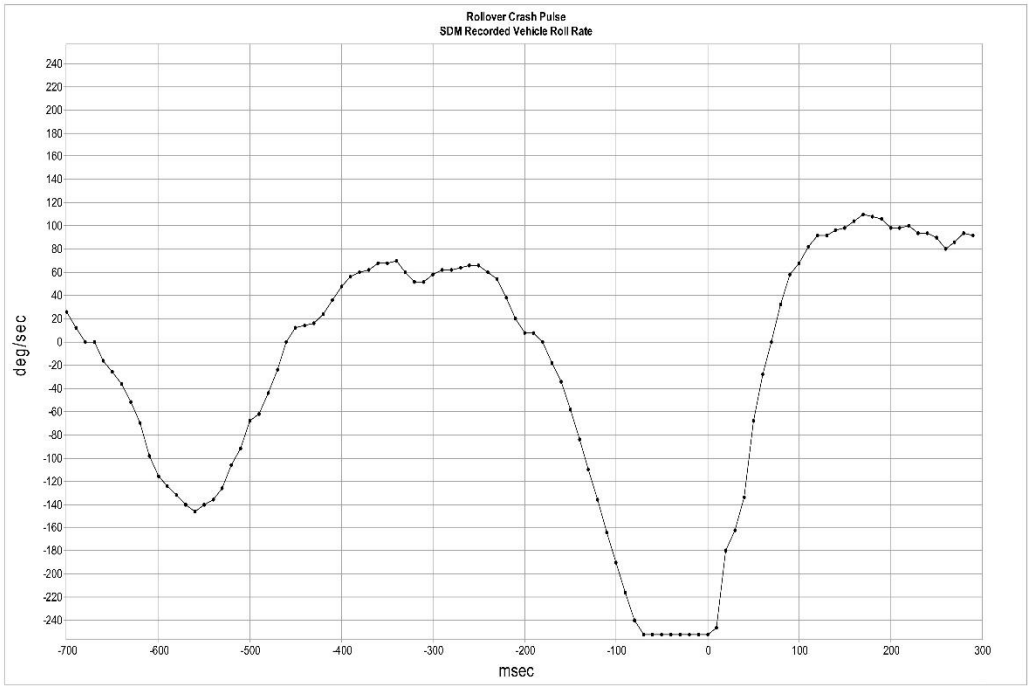
Lateral Crash Pulse (Event Record 1)
Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event)

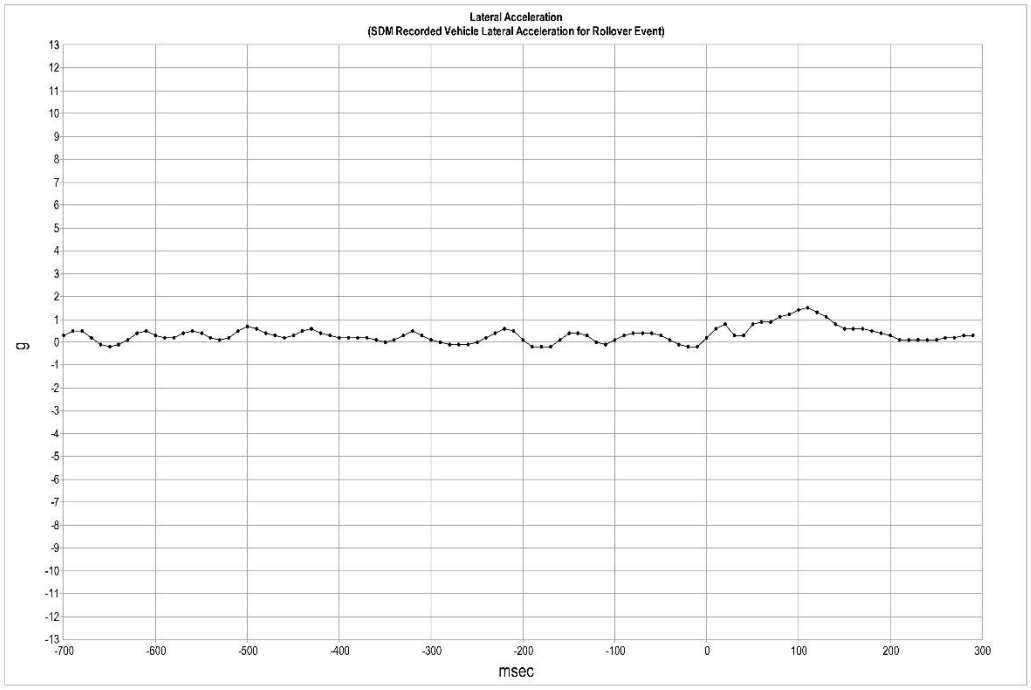
Contains No Recorded Data

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

Contains No Recorded Data

Rollover Crash Pulse (Event Record 1)





Rollover Crash Pulse (Event Record 1)

Time (msec)	SDM Recorded Vehicle Roll Rate (deg/sec)	Time (msec)	SDM Recorded Vehicle Roll Rate (deg/sec)
-700	26	-200	8
-690	12	-190	8
-680	0	-180	0
-670	0	-170	-18
-660	-16	-160	-34
-650	-26	-150	-58
-640	-36	-140	-84
-630	-52	-130	-110
-620	-70	-120	-136
-610	-98	-110	-164
-600	-116	-100	-190
-590	-124	-90	-216
-580	-132	-80	-240
-570	-140	-70	-252
-560	-146	-60	-252
-550	-140	-50	-252
-540	-136	-40	-252
-530	-126	-30	-252
-520	-106	-20	-252
-510	-92	-10	-252
-500	-68	0	-252
-490	-62	10	-246
-480	-44	20	-180
-470	-24	30	-162
-460	0	40	-134
-450	12	50	-68
-440	14	60	-28
-430	16	70	0
-420	24	80	32
-410	36	90	58
-400	48	100	68
-390	56	110	82
-380	60	120	92
-370	62	130	92
-360	68	140	96
-350	68	150	98
-340	70	160	104
-330	60	170	110
-320	52	180	108
-310	52	190	106
-300	58	200	98
-290	62	210	98
-280	62	220	100
-270	64	230	94
-260	66	240	94
-250	66	250	90
-240	60	260	80
-230	54	270	86
-220	38	280	94
-210	20	290	92

Rollover Crash Pulse (Event Record 1)

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

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	23	Off	1728	32	68 [110]
-4.5	25	Off	1728	31	68 [110]
-4.0	25	Off	1664	31	68 [110]
-3.5	25	Off	1728	33	69 [111]
-3.0	25	Off	1728	33	70 [112]
-2.5	25	Off	1728	34	70 [112]
-2.0	25	Off	1728	34	70 [112]
-1.5	25	Off	1728	34	70 [113]
-1.0	25	Off	1728	34	71 [114]
-0.5	25	Off	1728	35	70 [113]

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	179 [242]	Off
-1.5	No	No	No	177 [240]	Off
-1.0	No	No	No	179 [242]	Off
-0.5	No	No	No	190 [257]	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	2
Multi-Event, Number of Events (Event Counter)	2
OnStar Notification Event Counter	2
Time From Event 1 to 2 (Time Between Events) (seconds)	1.98
Ignition Cycle, Crash (Ignition Cycles at Event)	3079
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	Yes
Algorithm Active: Rear	Yes
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	Yes
Event Severity Status: Frontal Stage 1	Yes
Event Severity Status: Frontal Stage 2	Yes
Event Severity Status: Left Side	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
Seat Track Position Switch, Foremost, Status, Driver (Driver Seat Position Status)	No (Rearward)
Seat Track Position Switch, Foremost, Status, Right Front Passenger (Passenger Seat Position Status)	No (Rearward)
Passenger Seat Occupancy Status	Empty
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Not Applicable)
Passenger Air Bag ON Indicator Status	Off
Passenger Air Bag OFF Indicator Status	On
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	On
SIR Warning Lamp ON/OFF Time Continuously (seconds)	0
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	0
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]	-54 [-87]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	298
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	12 [20]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	186
High Voltage Disable Notification Sent	Yes
Deployment Commanded in Energy Reserve Mode	No

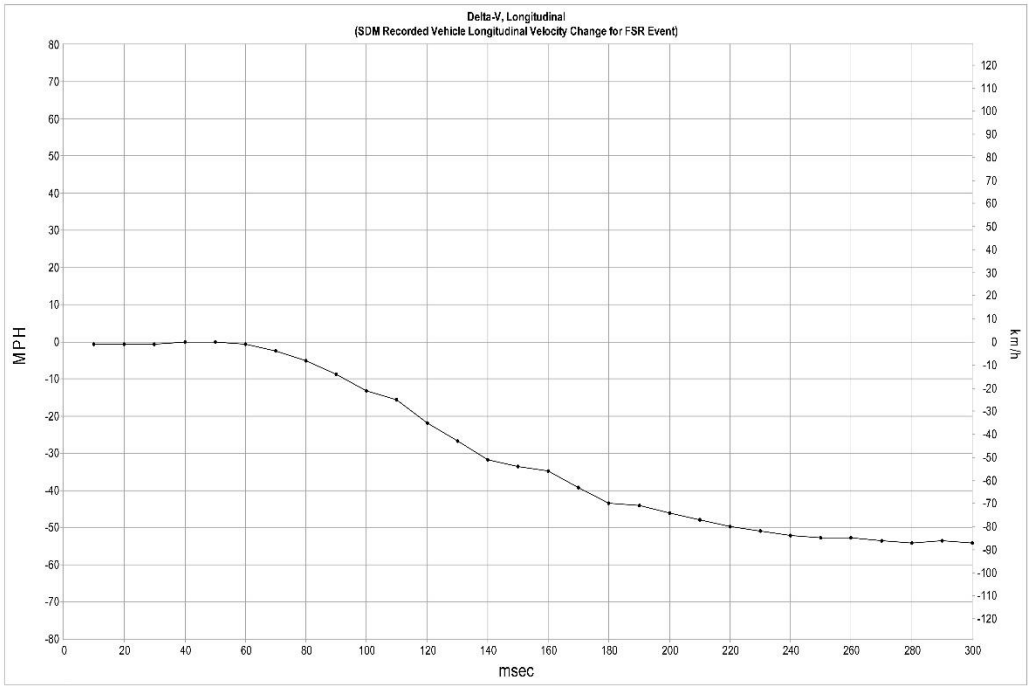
DTCs Present at Time of Event (Event Record 2)

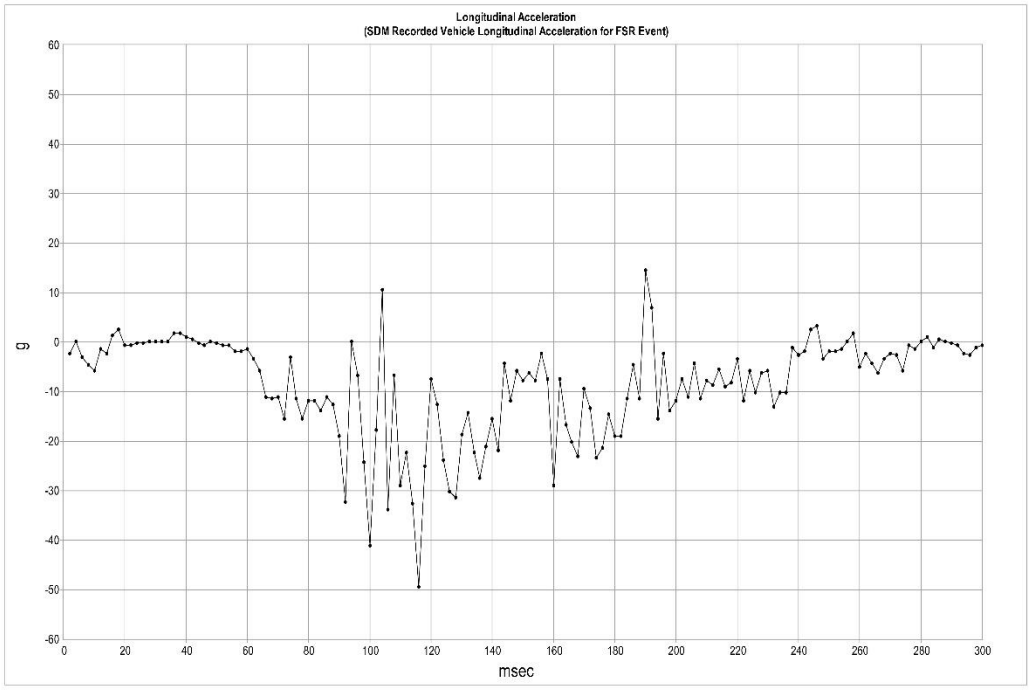
B0052-00

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	Yes
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	No
Passenger Pretensioner Deployment Loop #1 Commanded	No
Driver Pretensioner Deployment Loop #2 Commanded	No
Passenger Pretensioner Deployment Loop #2 Commanded	No
Driver Thorax Loop Commanded	No
Passenger Thorax Loop Commanded	No
Left Row 1 Roof Rail/Head Curtain Loop Commanded	No
Right Row 1 Roof Rail/Head Curtain Loop Commanded	No
Driver Center Inboard 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)	73
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	76
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Right Front Passenger (Passenger 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (Passenger 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, driver (Driver Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	Data Not Available

Longitudinal Crash Pulse (Event Record 2)





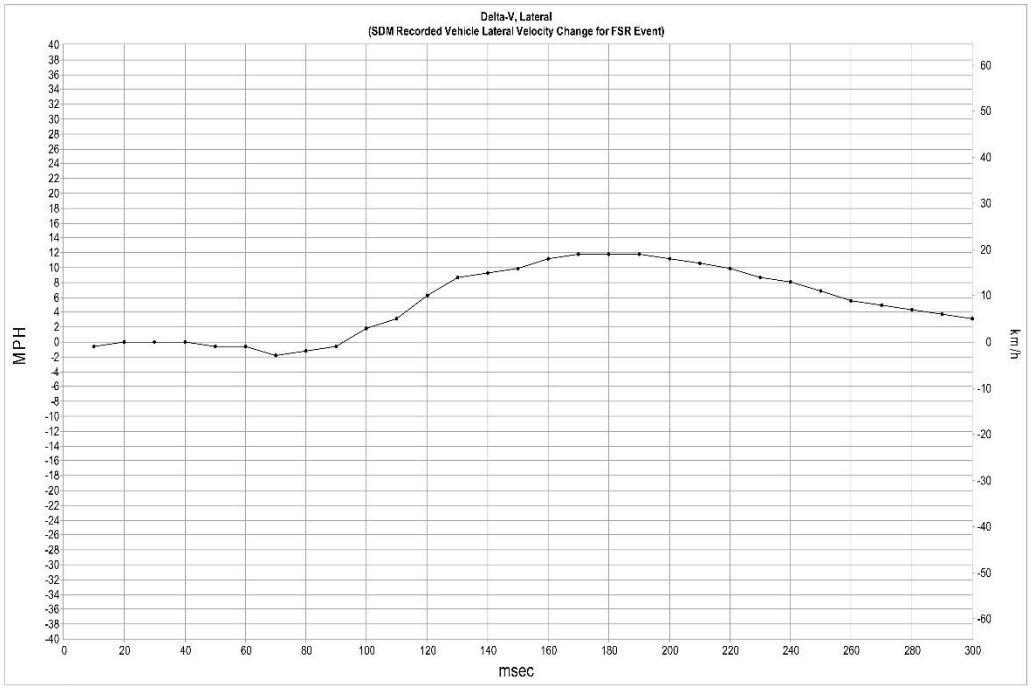
Longitudinal Crash Pulse (Event Record 2)

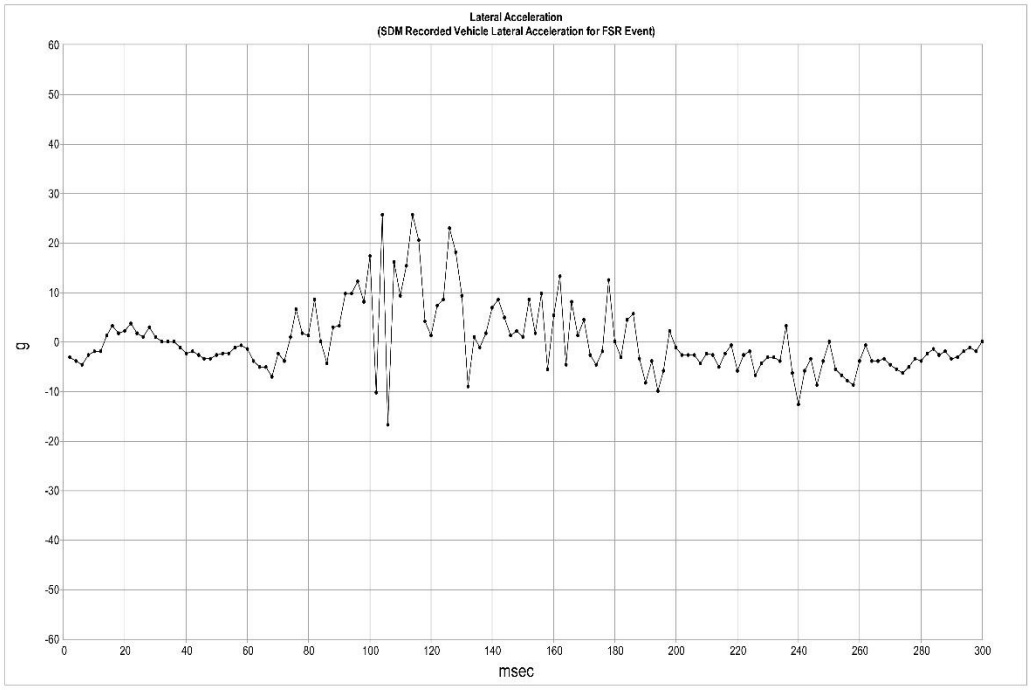
Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	-0.6	-1.0
20	-0.6	-1.0
30	-0.6	-1.0
40	0.0	0.0
50	0.0	0.0
60	-0.6	-1.0
70	-2.5	-4.0
80	-5.0	-8.0
90	-8.7	-14.0
100	-13.0	-21.0
110	-15.5	-25.0
120	-21.7	-35.0
130	-26.7	-43.0
140	-31.7	-51.0
150	-33.6	-54.0
160	-34.8	-56.0
170	-39.1	-63.0
180	-43.5	-70.0
190	-44.1	-71.0
200	-46.0	-74.0
210	-47.8	-77.0
220	-49.7	-80.0
230	-51.0	-82.0
240	-52.2	-84.0
250	-52.8	-85.0
260	-52.8	-85.0
270	-53.4	-86.0
280	-54.1	-87.0
290	-53.4	-86.0
300	-54.1	-87.0

Longitudinal Crash Pulse (Event Record 2)

Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
2	-2.2	102	-17.8	202	-7.4
4	0.2	104	10.6	204	-11.0
6	-3.0	106	-33.8	206	-4.2
8	-4.6	108	-6.6	208	-11.4
10	-5.8	110	-29.0	210	-7.8
12	-1.4	112	-22.2	212	-8.6
14	-2.2	114	-32.6	214	-5.4
16	1.4	116	-49.4	216	-9.0
18	2.6	118	-25.0	218	-8.2
20	-0.6	120	-7.4	220	-3.4
22	-0.6	122	-12.6	222	-11.8
24	-0.2	124	-23.8	224	-5.8
26	-0.2	126	-30.2	226	-10.2
28	0.2	128	-31.4	228	-6.2
30	0.2	130	-18.6	230	-5.8
32	0.2	132	-14.2	232	-13.0
34	0.2	134	-22.2	234	-10.2
36	1.8	136	-27.4	236	-10.2
38	1.8	138	-21.0	238	-1.0
40	1.0	140	-15.4	240	-2.6
42	0.6	142	-21.8	242	-1.8
44	-0.2	144	-4.2	244	2.6
46	-0.6	146	-11.8	246	3.4
48	0.2	148	-5.8	248	-3.4
50	-0.2	150	-7.8	250	-1.8
52	-0.6	152	-6.2	252	-1.8
54	-0.6	154	-7.8	254	-1.4
56	-1.8	156	-2.2	256	0.2
58	-1.8	158	-7.4	258	1.8
60	-1.4	160	-29.0	260	-5.0
62	-3.4	162	-7.4	262	-2.2
64	-5.8	164	-16.6	264	-4.2
66	-11.0	166	-20.2	266	-6.2
68	-11.4	168	-23.0	268	-3.4
70	-11.0	170	-9.4	270	-2.2
72	-15.4	172	-13.4	272	-2.6
74	-3.0	174	-23.4	274	-5.8
76	-11.4	176	-21.4	276	-0.6
78	-15.4	178	-14.6	278	-1.4
80	-11.8	180	-19.0	280	0.2
82	-11.8	182	-19.0	282	1.0
84	-13.8	184	-11.4	284	-1.0
86	-11.0	186	-4.6	286	0.6
88	-12.6	188	-11.4	288	0.2
90	-19.0	190	14.6	290	-0.2
92	-32.2	192	7.0	292	-0.6
94	0.2	194	-15.4	294	-2.2
96	-6.6	196	-2.2	296	-2.6
98	-24.2	198	-13.8	298	-1.0
100	-41.0	200	-11.8	300	-0.6

Lateral Crash Pulse (Event Record 2)





Lateral Crash Pulse (Event Record 2)

Time (msec)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (MPH)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (km/h)
10	-0.6	-1.0
20	0.0	0.0
30	0.0	0.0
40	0.0	0.0
50	-0.6	-1.0
60	-0.6	-1.0
70	-1.9	-3.0
80	-1.2	-2.0
90	-0.6	-1.0
100	1.9	3.0
110	3.1	5.0
120	6.2	10.0
130	8.7	14.0
140	9.3	15.0
150	9.9	16.0
160	11.2	18.0
170	11.8	19.0
180	11.8	19.0
190	11.8	19.0
200	11.2	18.0
210	10.6	17.0
220	9.9	16.0
230	8.7	14.0
240	8.1	13.0
250	6.8	11.0
260	5.6	9.0
270	5.0	8.0
280	4.3	7.0
290	3.7	6.0
300	3.1	5.0

Lateral Crash Pulse (Event Record 2)

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	-3.0	102	-10.2	202	-2.6
4	-3.8	104	25.8	204	-2.6
6	-4.6	106	-16.6	206	-2.6
8	-2.6	108	16.2	208	-4.2
10	-1.8	110	9.4	210	-2.2
12	-1.8	112	15.4	212	-2.6
14	1.4	114	25.8	214	-5.0
16	3.4	116	20.6	216	-2.2
18	1.8	118	4.2	218	-0.6
20	2.2	120	1.4	220	-5.8
22	3.8	122	7.4	222	-2.6
24	1.8	124	8.6	224	-1.8
26	1.0	126	23.0	226	-6.6
28	3.0	128	18.2	228	-4.2
30	1.0	130	9.4	230	-3.0
32	0.2	132	-9.0	232	-3.0
34	0.2	134	1.0	234	-3.8
36	0.2	136	-1.0	236	3.4
38	-1.0	138	1.8	238	-6.2
40	-2.2	140	7.0	240	-12.6
42	-1.8	142	8.6	242	-5.8
44	-2.6	144	5.0	244	-3.4
46	-3.4	146	1.4	246	-8.6
48	-3.4	148	2.2	248	-3.8
50	-2.6	150	1.0	250	0.2
52	-2.2	152	8.6	252	-5.4
54	-2.2	154	1.8	254	-6.6
56	-1.0	156	9.8	256	-7.8
58	-0.6	158	-5.4	258	-8.6
60	-1.4	160	5.4	260	-3.8
62	-3.8	162	13.4	262	-0.6
64	-5.0	164	-4.6	264	-3.8
66	-5.0	166	8.2	266	-3.8
68	-7.0	168	1.4	268	-3.4
70	-2.2	170	4.6	270	-4.6
72	-3.8	172	-2.6	272	-5.4
74	1.0	174	-4.6	274	-6.2
76	6.6	176	-1.8	276	-5.0
78	1.8	178	12.6	278	-3.4
80	1.4	180	0.2	280	-3.8
82	8.6	182	-3.0	282	-2.2
84	0.2	184	4.6	284	-1.4
86	-4.2	186	5.8	286	-2.6
88	3.0	188	-3.4	288	-1.8
90	3.4	190	-8.2	290	-3.4
92	9.8	192	-3.8	292	-3.0
94	9.8	194	-9.8	294	-1.8
96	12.2	196	-5.8	296	-1.0
98	8.2	198	2.2	298	-1.8
100	17.4	200	-1.0	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	25	Off	1728	33	70 [112]
-4.5	25	Off	1728	34	70 [112]
-4.0	25	Off	1728	34	70 [112]
-3.5	25	Off	1728	34	70 [113]
-3.0	25	Off	1728	34	71 [114]
-2.5	25	Off	1728	35	70 [113]
-2.0	0	Off	1664	21	70 [113]
-1.5	29	Off	1664	24	65 [105]
-1.0	87	Off	1664	21	62 [99]
-0.5	0	Off	3072	34	55 [89]

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	83 [112]	Off
-1.5	No	No	No	69 [94]	Off
-1.0	No	No	No	79 [106]	Off
-0.5	No	No	No	31 [42]	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	3
Multi-Event, Number of Events (Event Counter)	3
OnStar Notification Event Counter	3
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	3079
Algorithm Active: Frontal	No
Algorithm Active: Side	No
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
Seat Track Position Switch, Foremost, Status, Driver (Driver Seat Position Status)	Data Invalid
Seat Track Position Switch, Foremost, Status, Right Front Passenger (Passenger Seat Position Status)	No (Rearward)
Passenger Seat Occupancy Status	Data Invalid
Occupant Size Right Front Passenger Child (Passenger Classification Status)	Data Invalid
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	On
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	On
SIR Warning Lamp ON/OFF Time Continuously (seconds)	7010
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	0
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
High Voltage Disable Notification Sent	Yes
Deployment Commanded in Energy Reserve Mode	No

DTCs Present at Time of Event (Event Record 3)

B0012-04
B0013-04
B0015-0E
B0016-02
B001A-04
B001B-04
B001E-04
B0022-04
B0023-02

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

Longitudinal Crash Pulse (Event Record 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

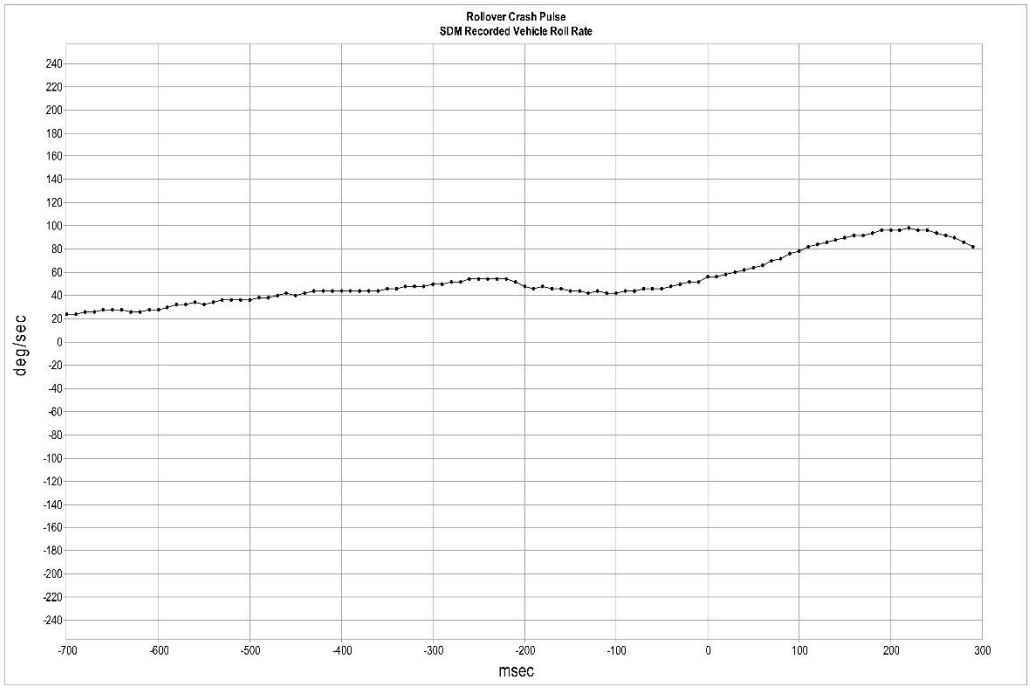
Lateral Crash Pulse (Event Record 3)
Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event)

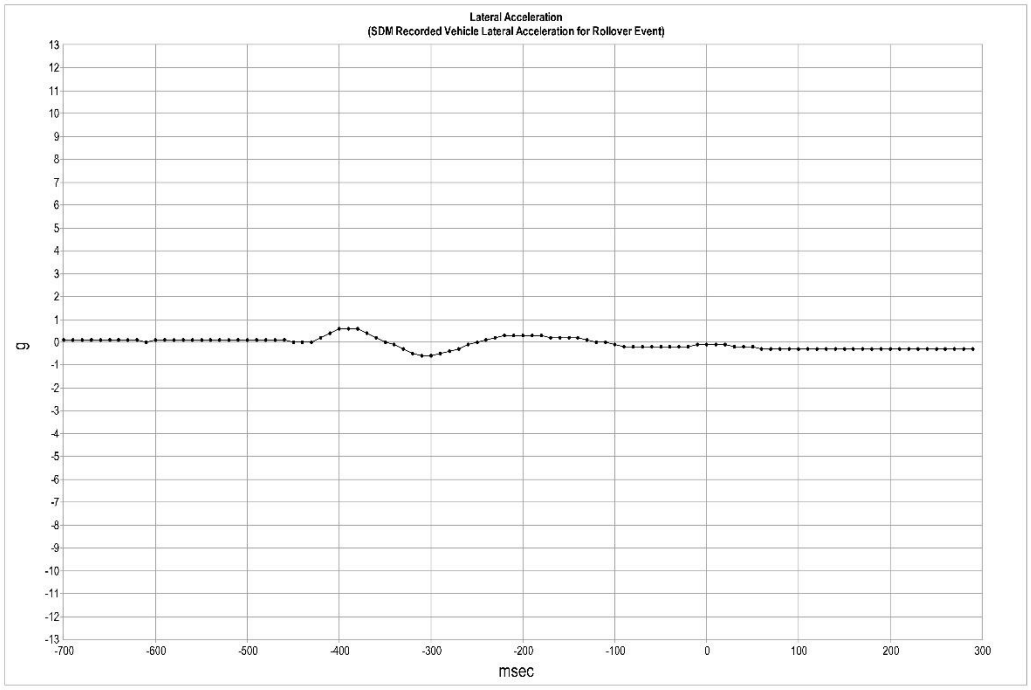
Contains No Recorded Data

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

Contains No Recorded Data

Rollover Crash Pulse (Event Record 3)





Rollover Crash Pulse (Event Record 3)

Time (msec)	SDM Recorded Vehicle Roll Rate (deg/sec)	Time (msec)	SDM Recorded Vehicle Roll Rate (deg/sec)
-700	24	-200	48
-690	24	-190	46
-680	26	-180	48
-670	26	-170	46
-660	28	-160	46
-650	28	-150	44
-640	28	-140	44
-630	26	-130	42
-620	26	-120	44
-610	28	-110	42
-600	28	-100	42
-590	30	-90	44
-580	32	-80	44
-570	32	-70	46
-560	34	-60	46
-550	32	-50	46
-540	34	-40	48
-530	36	-30	50
-520	36	-20	52
-510	36	-10	52
-500	36	0	56
-490	38	10	56
-480	38	20	58
-470	40	30	60
-460	42	40	62
-450	40	50	64
-440	42	60	66
-430	44	70	70
-420	44	80	72
-410	44	90	76
-400	44	100	78
-390	44	110	82
-380	44	120	84
-370	44	130	86
-360	44	140	88
-350	46	150	90
-340	46	160	92
-330	48	170	92
-320	48	180	94
-310	48	190	96
-300	50	200	96
-290	50	210	96
-280	52	220	98
-270	52	230	96
-260	54	240	96
-250	54	250	94
-240	54	260	92
-230	54	270	90
-220	54	280	86
-210	52	290	82

Rollover Crash Pulse (Event Record 3)

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	0.1	-200	0.3
-690	0.1	-190	0.3
-680	0.1	-180	0.3
-670	0.1	-170	0.2
-660	0.1	-160	0.2
-650	0.1	-150	0.2
-640	0.1	-140	0.2
-630	0.1	-130	0.1
-620	0.1	-120	0.0
-610	0.0	-110	0.0
-600	0.1	-100	-0.1
-590	0.1	-90	-0.2
-580	0.1	-80	-0.2
-570	0.1	-70	-0.2
-560	0.1	-60	-0.2
-550	0.1	-50	-0.2
-540	0.1	-40	-0.2
-530	0.1	-30	-0.2
-520	0.1	-20	-0.2
-510	0.1	-10	-0.1
-500	0.1	0	-0.1
-490	0.1	10	-0.1
-480	0.1	20	-0.1
-470	0.1	30	-0.2
-460	0.1	40	-0.2
-450	0.0	50	-0.2
-440	0.0	60	-0.3
-430	0.0	70	-0.3
-420	0.2	80	-0.3
-410	0.4	90	-0.3
-400	0.6	100	-0.3
-390	0.6	110	-0.3
-380	0.6	120	-0.3
-370	0.4	130	-0.3
-360	0.2	140	-0.3
-350	0.0	150	-0.3
-340	-0.1	160	-0.3
-330	-0.3	170	-0.3
-320	-0.5	180	-0.3
-310	-0.6	190	-0.3
-300	-0.6	200	-0.3
-290	-0.5	210	-0.3
-280	-0.4	220	-0.3
-270	-0.3	230	-0.3
-260	-0.1	240	-0.3
-250	0.0	250	-0.3
-240	0.1	260	-0.3
-230	0.2	270	-0.3
-220	0.3	280	-0.3
-210	0.3	290	-0.3

Vertical Crash Pulse (Event Record 3)
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 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	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-4.5	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-4.0	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-3.5	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-3.0	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-2.5	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-2.0	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-1.5	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-1.0	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available
-0.5	Data Not Available	On	Data Not Available	Data Not Available	Data Not Available

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	Data Not Available	Off
-1.5	No	No	No	Data Not Available	Off
-1.0	No	No	No	Data Not Available	Off
-0.5	No	No	No	Data Not Available	Off

Hexadecimal Data

```
DPID $11
FF F2 00 FC C6 7C 04

DPID $15
01 02 03 04 05 06 07

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

DPID $17
22 27 27 27 27 27 00

DPID $32
00 FF 0C 09 00 00 00

DPID $35
78 00 00 00 00 00 00

DID $01
41 55 38 36 37 37 44 50 30 30 30 30 30 30 30 30

DID $03
41 54 38 36 37 37 44 50 30 30 30 30 30 30 30 30

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

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

DID $09
44 41 38 36 37 38 44 41 30 30 30 30 30 30 30 30

DID $0B
44 42 38 36 37 38 44 41 30 30 30 30 30 30 30 30

DID $0D
01 00 30 30 30 30 44 41 30 30 30 30 30 30 30 30

DID $0F
01 00 30 30 30 30 44 41 30 30 30 30 30 30 30 30

DID $30
03 00 03 03

DID $90
31 47 4E 53 43 42 4B 43 36 46 52 2A 2A 2A 2A 2A 2A

DID $9A
0B 11

DID $B4
4B 32 31 34 32 36 30 33 39 30 41 30 31 59 30 30

DID $C1
00 CF 6F 21

DID $C2
01 65 76 DF

DID $C3
01 62 1D 42

DID $CB
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00 CF 6F 2D

DID $31

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 0030   19 19 19 19 19 19 19 17 00 00
 0040   00 00 00 00 00 1B 1B 1B 1B 1B
 0050   1B 1B 1A 1B 1B 08 A2 08 85 08
 0060   81 08 85 23 22 22 22 22 21 21
 0070   1F 1F 20 71 72 71 70 70 70 6F
 0080   6E 6E 6E 00 FF FD 0B A2 FD 80
 0090   52 00 FF FF FF FF FF FF FF FF
 0100   FF FF FF FF FF FF FF FF FF FF
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 0520   FF 41 7F FF 3D 7F FF 39 81 FF
 0530   36 82 FF 39 81 FF 3B 7F FF 40
 0540   7E FF 4A 7F FF 51 82 FF 5D 84
 0550   FF 60 83 FF 69 81 FF 73 80 FF
 0560   7F 7F FF 85 80 FF 86 82 FF 87
 0570   83 FF 8B 81 FF 91 80 FF 97 7F
 0580   FF 9B 7F FF 9D 7F FF 9E 7F FF
 0590   A1 7E FF A1 7D FF A2 7E FF 9D
 0600   80 FF 99 82 FF 99 80 FF 9C 7E
 0610   FF 9E 7D FF 9E 7C FF 9F 7C FF
 0620   A0 7C FF A0 7D FF 9D 7F FF 9A
 0630   81 FF 92 83 FF 89 82 FF 83 7E
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 0650   6E 7E FF 62 81 FF 55 81 FF 48
 0660   80 FF 3B 7D FF 2D 7C FF 20 7E
 0670   FF 13 80 FF 07 81 FF 01 81 FF
 0680   01 81 FF 01 80 FF 01 7E FF 01
 0690   7C FF 01 7B FF 01 7B FF 01 7F
 0700   FF 04 83 FF 25 85 FF 2E 80 FF
 0710   3C 80 FF 5D 85 FF 71 86 FF 7F
 0720   86 FF 8F 88 FF 9C 89 FF A1 8B
 0730   FF A8 8C FF AD 8A FF AD 88 FF
 0740   AF 85 FF B0 83 FF B3 83 FF B6
 0750   83 FF B5 82 FF B4 81 FF B0 80
 0760   FF B0 7E FF B1 7E FF AE 7E FF
 0770   AE 7E FF AC 7E FF A7 7F FF AA
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 0790   00 00 00 FF FF FF FF FF FF FF
 0800   FF FF FF FF FF FF FF FF FF FF
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 0820   FF FF FF FF FF FF FF FF FF FF
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 1070   FF FF FF FF FF FF FF FF FF FF
 1080   FF FF FF FF FF FF FF FF FF FF
 1090   FF FF FF FF FF FF FF FF FF FF
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 1110   FF 01 04 DD F7 BF 1B BD 01 00
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 1130   FF FF FF FF FF FF FF FF FF FF
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 1150   FF 00 00 0C 05 7F FF FF FF 00
 1160   00 21 3A 0F 01 00 00 13 0F 13
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 1180   FF FF FF FF FF FF FF FF FF FF
 1190   FF FF FF FF FF FF FF FF FF FF
 1200   FF

DID $32

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 0020   4C FC FC 00 00 00 FC 10 00 57
 0030   1D 00 19 19 19 19 19 19 00 00
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 0050   1B 1B 1B 1B 1B 06 F5 07 75 07
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0090   52 00 FF FF FF FF FF FF FF FF
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0140   7B 7C 77 7D 71 7E 6A 82 66 84
0150   5C 89 54 8D 4C 8E 49 8F 47 91
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0170   2F 8F 2D 8D 2B 8C 2A 8A 2A 88
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0290   9A C0 2B 56 6F A8 37 97 48 A6
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0380   59 67 7A 71 5D 85 62 7D 6D 79
0390   64 79 75 79 63 75 6C 7A 6A 79
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0420   66 76 66 88 7D 70 79 60 7B 71
0430   86 77 88 6A 77 76 7B 80 7B 72
0440   7C 6F 80 6C 84 6A 73 76 7A 7E
0450   75 76 70 76 77 77 7A 74 79 72
0460   71 70 7E 73 7C 77 80 76 82 7A
0470   7D 7C 81 79 80 7B 7F 77 7E 78
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0740   FF FF FF FF FF FF FF FF FF FF
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 1030   FF FF FF FF FF FF FF FF FF FF
 1040   FF FE CB 05 FE C0 05 00 00 00
 1050   00 00 00 00 00 00 00 0F 8E 00
 1060   00 00 10 11 00 00 00 00 00 00
 1070   00 00 00 00 00 00 00 10 2E 02
 1080   10 5E 10 64 00 00 00 00 00 00
 1090   00 00 00 00 00 00 00 FF FF FF
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 1160   00 21 41 CB 00 00 00 03 DF 02
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 1200   FF

DID $33

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 0080   FF FF FF 50 02 BD 00 00 FD 80
 0090   12 04 80 13 04 80 15 0E 80 16
 0100   02 80 1A 04 80 1B 04 80 1E 04
 0110   80 22 04 80 23 02 FF FF FF FF
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0510   7E FF 8C 7E FF 8D 7D FF 8D 7E
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0690   7B FF 99 7B FF 99 7C FF 9B 7C
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0740   AB 7A FF AC 7A FF AD 7A FF AD
0750   7A FF AE 7A FF AF 7A FF AF 7A
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0770   AF 7A FF AE 7A FF AD 7A FF AC
0780   7A FF AA 7A FF A8 7A FF 00 00
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1140   FF FF FF FF FF FF FF FF FF FF
1150   FF 00 00 0C 05 7F FF FF FF 00
1160   00 8C 38 14 01 00 00 13 0F 0F
1170   A5 FF FF 00 00 00 00 01 FF FF
1180   FF FF FF FF FF FF FF FF FF FF
1190   FF FF FF FF FF FF FF FF FF FF
1200   FF
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DOT HS 812 878
March 2020

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

14625-03020-v2b