U.S. Department of Transportation
National Highway Traffic Safety Administration

NHTSA

DOT HS 813 364

January 2023

Special Crash Investigations: On-Site Air Bag Non-Deployment Crash Investigation; Vehicle: 2016 Ford Explorer Police Interceptor; Location: Louisiana; Crash Date: April 2017

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Suggested APA Format Citation:

Crash Research & Analysis, Inc. (2023, January). *Special Crash Investigations: On-site air bag non-deployment crash investigation; Vehicle: 2016 Ford Explorer Police Interceptor; Location: Louisiana; Crash Date: December 2017* (Report No. DOT HS 813 364). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 813 364		

4. Title and Subtitle	5. Report Date
Special Crash Investigations: On-Site Air Bag Non-Deployment Crash Investigation; Vehicle: 2016 Ford Explorer Police Interceptor; Location: Louisiana; Crash Date: April 2017	January 2023
	6. Performing Organization Code

7. Author	8. Performing Organization Report No.
Crash Research & Analysis, Inc.	CR17007

9. Performing Organization Name and Address	10. Work Unit No. (TRAIS)
Crash Research & Analysis, Inc. PO Box 302 Elma, NY 14059	**11. Contract or Grant No.** 693JJ919C000004

12. Sponsoring Agency Name and Address	13. Type of Report and Period Covered
National Highway Traffic Safety Administration 1200 New Jersey Avenue SE Washington, DC 20590	Technical Report
	14. Sponsoring Agency Code

15. Supplementary Notes

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

16. Abstract

This report documents the on-site investigation of the non-deployment of the air bag systems in a 2016 Ford Explorer Police Interceptor during a multi-event, rollover crash. Further interest was the potential carbon monoxide (CO) exposure of the Ford's 36-year-old unbelted female driver. At the time of the case assignment, the Ford Explorer was not under recall; however, NHTSA had a Preliminary Evaluation #PE16-008 in response to consumer reports of exhaust fumes entering the interiors of model year (MY) 2011 to 2015 Ford Explorers. As the SCI investigation proceeded, the Preliminary Evaluation was elevated to an Engineering Analysis #EA17-002 and expanded to cover the model years 2011 to 2017.

In this crash, the police-officer driver lost control for undetermined reasons causing the Explorer to depart the roadway, strike the embankment of a driveway, and roll over into a drainage canal. Although the Ford was equipped with certified advanced 208-compliant (CAC) frontal air bags, front-seat-mounted side impact air bags, and dual-sensing (side impact and rollover) inflatable curtain (IC) air bags, none deployed in the crash. The driver sustained police-reported moderate (B-level) injuries and was transported by ambulance to a local hospital, where she was diagnosed with elevated levels of CO and crash-related injuries.

17. Key Words	18. Distribution Statement
non-deployment, rollover, carbon monoxide (CO)	This document is available to the public from the DOT, BTS, National Transportation Library, Repository & Open Science Access Portal, rosap.ntl.bts.gov.

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price
Unclassified	Unclassified	51	

Form DOT F 1700.7 (8-72) Reproduction of completed page authorized

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On-Site Air Bag Non-Deployment Crash Investigation
Office of Defects Investigation
Case Number: CR17007
Vehicle: 2016 Ford Explorer Police Interceptor
Location: Louisiana
Crash Date: April 2017

Background

This report documents the on-site investigation of the non-deployment of the air bag systems in a 2016 Ford Explorer Police Interceptor (Figure 1) during a multi-event, rollover crash. Further interest was the potential carbon monoxide (CO) exposure of the Ford's 36-year-old unbelted female driver. At the time of the case assignment, the Ford Explorer was not under recall; however, NHTSA had a Preliminary Evaluation #PE16-008 in response to consumer reports of exhaust fumes entering the interiors of model year (MY) 2011 to 2015 Ford Explorers. As the SCI investigation proceeded, the Preliminary Evaluation was elevated to an Engineering Analysis #EA17-002 and expanded to cover the model years 2011 to 2017.

In this crash, the police-officer driver lost control for undetermined reasons causing the Explorer to depart the roadway, strike the embankment of a driveway, and roll over into a drainage canal. Although the Ford was equipped with certified advanced 208-compliant (CAC) frontal air bags, front-seat-mounted side impact air bags, and dual-sensing (side impact and rollover) inflatable curtain (IC) air bags, none deployed in the crash. The driver sustained police-reported moderate (B-level) injuries and was transported by ambulance to a local hospital, where she was diagnosed with elevated levels of CO and crash-related injuries.

Figure 1. Oblique view of the 2016 Ford Explorer Police Interceptor at the time of the SCI inspection

The crash was reported to NHTSA's Office of Defects Investigation (ODI) by a person representing the Ford's owner, the municipality of the local police department. The notification was forwarded to the Special Crash Investigations (SCI) team at

Crash Research & Analysis, Inc., and assigned for on-site investigation in May 2017. The SCI team contacted the Ford's municipal owner and established cooperation to inspect the vehicle. The on-site portion of this investigation took place during May 2017 and included the documentation of the Ford's exterior and interior damage, identification of occupant contact, and assessment of the manual and supplemental restraint systems. The Bosch crash data retrieval (CDR) tool was used to image event data recorder (EDR) data from the Ford's restraints control module (RCM). The SCI investigator attempted to operate the vehicle in order to monitor CO levels using a multi-gas meter, but crash-induced damage prevented sustainable operation to do so. The physical environment of the crash site was documented, and interviews were conducted with several people representing the driver.

Summary

Crash Site

The crash occurred on an east/west two-lane roadway in the afternoon. According to the National Weather Service, conditions in the rural locale at the time of the crash included cloudy skies with a temperature of 28.9 °C (84 °F), 61 percent relative humidity, and 32.5 km/h (19.6 mph) southerly winds. A Nikon Nivo 5.M+ total station was used to document the physical environment of the roadway and crash site during the SCI inspection.

Both the eastbound and westbound travel lanes measured 3.4 m (11.2 ft) wide. They were delineated by a double-yellow centerline that was broken on the north side to permit passing for westbound traffic. Single-solid white fog lines and narrow 0.7 m (2.3 ft) wide shoulders supported the travel lanes. Speed on the straight and level roadway was regulated by a posted limit of 80 km/h (50 mph). In the vicinity of the crash a large drainage canal paralleled the roadway; it was approximately 7.6 m (25.0 ft) wide and 3.0 m (10.0 ft) deep. The normal water level in the canal was 2.5 m (8.2 ft) wide and 0.6 m (2.0 ft) deep. Several residences and businesses were located along the roadway, served by driveways that had large-diameter culverts or small bridges across the drainage canal. Figure 2 shows an eastbound view of the roadway for the Ford's pre-crash travel trajectory. A crash diagram is included at the end of this report.

Figure 2. Eastbound trajectory view of the Ford in the area of the crash

Pre-Crash

The Ford's 36-year-old female driver was a law enforcement officer for a municipal agency. The following details concerning her pre-crash activities were substantiated according to her law-enforcement co-workers and superiors during SCI in-person interviews. At the time of the crash, the driver was approaching the end of a 12-hour shift that had consisted primarily of a traffic enforcement detail on a nearby limited-access roadway. A fellow officer had accompanied her in the right front position of the Ford during this detail. That officer performed the in-person contacts and enforcement, while the driver managed communications, completed documentation, and directed the enforcement detail activities while remaining inside the Ford. This traffic detail focused on speed enforcement, specifically targeting excessive violations of the posted limit. The officers routinely pushed their patrol vehicles through aggressive acceleration and high-speed

operation in order to catch up to and pull over speeding vehicles. This was the manner in which the Ford was primarily operated on the day of the crash. During the remainder of the on-duty time, the Ford was left idling with the ignition on and the engine running.

With the outside temperature in the 80's, the driver kept the windows closed and the air conditioning turned on. At the time of the SCI inspection, the temperature control was adjusted to its coldest setting, the blower was adjusted to a 5/7 (approximately 70%) power setting, and the recirculate function was turned on. The driver's partner confirmed during interview that the air conditioning adjustments observed during the SCI inspection were unmodified since the time of the crash.

As the end of the shift neared, the officers concluded their traffic detail on the limited-access roadway. The driver dropped her partner off at his patrol vehicle, and then began to travel back to the agency's barrack to complete documentation and conclude her shift. As the Ford traveled east along the straight and level portion of the local two-lane roadway, it began to drift right from its travel lane. It maintained a straight-errant trajectory as its right tires departed the roadway and traversed along the grassy surface on the edge of the drainage canal. There was no evidence of any steering or braking attempt by the driver to regain the roadway or control the trajectory of the Ford.

Data imaged from the Ford's RCM showed that the vehicle was traveling at 53 km/h (33 mph) at 5 seconds prior to algorithm enable (AE). The speed decreased to approximately 48 km/h (30 mph) over the 5-second data interval. There was slight application of the vehicle's accelerator pedal recorded (2.1-3.8%), with no recorded application of the service brake. The combined pre-crash buffer data indicated that the Ford coasted, without driver input, for the entire recorded pre-crash interval. When the crash occurred, the driver had reportedly been in the vehicle continuously for approximately the previous hour to hour and a half. This was confirmed by the data imaged from the Ford, which indicated a key-on timer value of 4,720 seconds (equivalent to 78 minutes and 40 seconds) of continuous operation.

Crash

The first crash event occurred as the Ford gently ramped up the west edge of a driveway that intersected the roadway. This caused the undercarriage of the Ford to scrape the soil/gravel surface (Event 1), evidenced by displacement of the material as observed at the time of the SCI crash site inspection. Crash forces were of insufficient magnitude to affect or alter the Ford's errant trajectory.

The Ford continued eastbound and vaulted over the 4.5 m (14.8 ft) wide driveway, and then pitched forward and downward into the drainage canal. The second crash event occurred as the Ford's front plane struck the soil/mud surface in the bottom of the drainage canal at the edge of the water. Areas of engagement included the right half of the Ford's front bumper beam/fascia with the soft embankment at the water's edge. Dynamics of the vehicle's trajectory, including the forward pitch of the vehicle and the location of the vehicle's center of mass with respect to the location of the applied force of the second impact at the front of the vehicle, created an instability that induced a forward end-over-end movement. However, the right bias of the Event 2 impact engagement induced a slight clockwise rotation to the vehicle.

In this manner, the Ford stood nearly upright on its front plane in the drainage ditch before it flopped downward into the water onto its left plane (Event 3). This rollover event was not interrupted, but brought the Ford to final rest in the water of the drainage ditch. At rest, the Ford was positioned facing west and on its left plane, located approximately 16.0 m (52.5 ft) east of the initial undercarriage impact. Figure 3 shows the driveway and area of impact for the first event, while Figure 4 shows the drainage canal and the Ford's final rest position in an on-scene image obtained from the law enforcement agency.

Figure 3. East-facing view of the gouge mark in the soil/gravel surface of the roadside from the Ford's undercarriage impact (Event 1)

Figure 4. View of the Ford on its left plane at final rest in the drainage canal (on-scene image obtained from the law enforcement agency)

Post-Crash

The local emergency response system received communications reporting the crash and dispatched firefighting, EMS, and law enforcement personnel to the scene. The first arriving law enforcement officer (not the partner who had been with her for much of her shift) found the driver semi-responsive and disoriented, lying in muddy water on the inside of the left front glazing. He assisted her from the overturned Ford through the right front door. An ambulance arrived and personnel began treatment of the driver's injuries, and then transported her to a local

hospital for further medical evaluation and care. The driver was confused and experiencing short-term memory loss; however, emergency personnel identified that the driver had sustained a head injury during the crash.

After being in the emergency department of the local hospital for nearly 2 hours without significant improvement in her state of confusion and ill effects, CO exposure was identified via blood testing as the underlying cause. Despite having received oxygen since the crash, the driver still exhibited high levels of CO in her system. She received hyperbaric treatment for the CO exposure as well as treatment of her traumatic crash-related injuries, and was released from the hospital on the same day as the crash.

Having learned of the elevated CO levels in the driver's system, the suspected cause of the crash, the officer's superiors contacted her law enforcement partner who had accompanied her, so he could be tested for CO exposure and receive treatment if necessary. However, that officer had returned home after completing his on-duty time and exercised, running about 3 miles. During SCI interview, he did not recall if he had experienced any symptoms of CO exposure such as headache, dizziness, nausea, etc., on the date of the crash, but did state that he exercised and "felt fine." As such, he had elected not to seek evaluation, and it therefore remains unknown if the partner had any CO in his system. Following the on-scene investigation, the Ford was removed from the drainage canal and towed to a local tow yard. It was then transferred to the municipality that owned it, where it remained at the time of the SCI inspection.

2016 Ford Explorer Police Interceptor

Description

The 2016 Ford Explorer Police Interceptor (Figure 5) was manufactured in March 2016 and was identified by the VIN 1FM5K8AR4GGxxxxxx. Its electronic odometer reading obtained during the SCI vehicle inspection was 14,709.9 km (9,140.3 mi). The all-wheel-drive Ford was powered by a 3.7-liter, V-6 flex-fuel (unleaded gasoline/E-85) internal combustion engine. It had a steering column-mounted shift lever for its 6-speed automatic transmission. The Ford had a 287 cm (113.0 in) wheelbase with a gross vehicle weight rating of 2,877 kg (6,342 lb). The front and rear gross axle weight ratings were 1,452 kg (3,200 lb) and 1,520 kg (3,350 lb), respectively. Its curb weight as an incomplete vehicle (before installation of emergency warning lights, communications, and other law enforcement equipment), was 2,146 kg (4,731 lb). The manufacturer's recommended tire size was P245/55R18, with recommended cold tire pressures of 250 kPa (36 PSI) for all four axle positions. The Ford had Goodyear Eagle RS-A tires of the recommended size at all four axle positions. Specific tire data measured at the time of the SCI inspection were as follows.

Figure 5. Right plane view of the 2016 Ford Explorer Police Interceptor

Position	Tire Identification Number (TIN)	Measured Tread Depth	Restriction	Damage
LF	M6DX JA2R 2416	6 mm (8/32 in)	No	None
LR	M6DX JA2R 1116	4 mm (5/32 in)	No	None
RR	M6DX JA2R 1116	6 mm (7/32 in)	No	None
RF	M6DX JA2R 1116	5 mm (6/32 in)	Yes	Cut in sidewall

The vehicle had antilock disc brakes with electronic brakeforce distribution, electronic stability control (ESC), electronic traction control (ETC), a direct tire pressure monitoring system, dusk-sensing automatic headlights, and aftermarket emergency lighting. The ESC and ETC served to assist the driver in maintaining control despite adverse driving conditions or avoidance actions. Additional assistance technologies included cruise control, rear parking sensors, and a post-collision safety system.

The Ford had seating for up to five people. The driver and front-right seats were cloth-surfaced, forward-facing bucket seats with adjustable head restraints. The driver's seat featured electronic seat track adjustments, with a manual seatback recline adjustment. All right-front seat adjustments were manual. At the time of the SCI inspection, both front-row seats were adjusted

to their rearmost track positions, with the seatbacks slightly reclined and the adjustable head restraints fully down. Based on the damaged condition of the vehicle, the seats remained in the same positions as they were at the time of the crash.

An aftermarket center console contained an armrest, cup holders, emergency warning lights and siren controls, communications equipment, and a laptop computer mount. The second row of the Ford had a three-passenger bench seat. The seat track and seatback were fixed in position, and there were no head restraints. An aftermarket "cage" enclosed the second row, dividing it entirely from both the front row and rear cargo area. All seat positions had 3-point lap and shoulder seat belt systems for manual restraint. The Ford also had other supplemental restraint systems, which are described in detail in the Supplemental Restraint Systems section of this report.

Vehicle History

The Ford was an official, marked police vehicle owned and operated by a municipal law enforcement agency. It was a fleet-duty vehicle, not issued to any specific officer and not available as a "take-home" vehicle. According to a supervisor, the police department had been in possession of the vehicle for approximately 9 months. Until the crash it had received only routine scheduled maintenance (oil/fluid changes, etc.). The Ford did not have a prior crash history. The driver was familiar with its systems and their functionality, as she driven it frequently in her on-duty time. She did not routinely take the vehicle home.

Exterior Damage

Damage to the Ford was located primarily on the front and left planes. There did not appear to be any visible damage to the Ford due to the Event 1 impact, based on visualization beneath the vehicle. The SCI investigator had no way to lift the vehicle to perform a thorough inspection of the undercarriage and confirm a complete lack of damage from the first event. The direction of force from the crash into the driveway embankment was non-horizontal. The collision deformation classification (CDC) assigned to the Ford for Event 1 was 00UDDU1. No delta V calculations could be computed due to the non-horizontal nature of the impact forces and the lack of residual deformation/damage.

Damage from the Event 2 impact with the bottom of the drainage canal was located on the Ford's front plane, biased to the right side. Mud was packed into the various surfaces of the front plane, with significant visible damage and deformation to surrounding components. An aftermarket bumper guard was slightly deformed, with mud packed into its left aspects. The bumper beam and fascia were also deformed, the grille was fractured and displaced, and the hood was deformed in a vertical "tented" fashion (Figure 6). It was apparent to the SCI investigator that the aftermarket bumper guard provided additional rigidity to the Ford's front plane, and therefore decreased the significance of the deformation sustained to it.

Direct contact appeared to span the entire 180 cm (70.9 in) end width of the vehicle. Using a direct and induced damage length (Field-L) of 120 cm (47.2 in) across the bumper beam's entire width, a residual crush profile was documented with the following resultant measurements: C1 = 6 cm (2.4 in), C2 = 11 cm (4.3 in), C3 = 14 cm (5.5 in), C4 = 16 cm (6.3 in), C5 = 14 cm (5.5 in) and C6 = 6 cm (2.4 in). Maximum crush was located 12 cm (4.7 in) right of the vehicle's centerline. Figure 7 shows the Ford's front plane deformation from overhead . The CDC

assigned to the Ford for the Event 2 impact was 00FDEW1. The barrier algorithm of the WinSMASH model was used to calculate a borderline reconstruction of the Event 2 impact for analysis purposes. The total calculated delta V was 23 km/h (14 mph), with a longitudinal component of -23 km/h (-14 mph) and a lateral component of zero.

Figure 6. View of the Ford's front plane damage

Figure 7. Overhead view of the Ford's front plane damage profile

The Event 3 rollover was not interrupted, and consisted primarily of an end-over-end orientation. Bias of the Event 2 impact to the right aspect of the Ford's front plane induced a slight clockwise rotation to the vehicle, which led to the left side-leading orientation in the dynamic rollover. Due to the location of the roll in the drainage canal and the water surface contacted, damage to the vehicle was minimal and visible only to the left plane of the Ford.

Figure 8 shows the Ford's left plane damage. There was slight deformation to the left door panels, with the maximum lateral deformation that measured approximately 5 cm (2.0 in) in magnitude located on the upper aspect of the left front fender. The CDC assigned to the Ford for the Event 3 damage was 00LDAO2. No delta V calculations could be performed due to the non-horizontal nature of the impact forces, the lack of deformation to the vehicle, and the dynamics of the roll that were beyond the capabilities of the WinSMASH model.

Figure 8. Minimal damage to the Ford's left plane

Event Data Recorder

The 2016 Ford Explorer Police Interceptor had an RCM mounted to the floor on the center tunnel, beneath the aftermarket center console. The RCM monitored the diagnostic functions of the vehicle's restraint systems (air bags and seat belt pretensioners) and controlled the deployment/actuation of those devices dependent upon crash event severity. The RCM had EDR capabilities to record crash event data for longitudinal, lateral, and rollover crash events. The SCI investigator used the Bosch CDR tool and software during the SCI inspection, but was unable to communicate with the RCM. With permission from the municipal owner, the RCM was removed from the Ford for desktop imaging. Data were imaged using CDR software version 17.3, via a direct connection to the module. The data were later read using software version 21.5.1, and is included at the end of this report as Appendix A.

The EDR could store up to two crash event records, termed either "non-deployment trigger event," "air bag deployment event," and/or "non-air bag deployment event." By definition, a non-deployment trigger event was any event that met the recording threshold, but did not result in the deployment/actuation of any safety device within 150 milliseconds.

An air bag deployment event deploys inflatable restraints, and a non-air bag deployment event deploys devices other than inflatable restraints (including pretensioner actuation). Non-deployment trigger event and non-air bag deployment event types were subject to overwrite by subsequent events of greater severity or typing, whereas air bag deployment event types could not be overwritten. If power supply to the RCM was lost following a crash event, all or part of the data may not have been recorded to the EDR's memory. The EDR had the capacity to record 250 milliseconds of data once the minimum threshold was achieved in longitudinal or lateral event types. The recording of each respective event included a 5-second pre-crash buffer that recorded pre-crash data points in 0.5-second intervals. Data recorded included vehicle speed (mph), accelerator pedal (% full), service brake (on/off) status, engine speed (rpm), and ABS activity data.

Additional data samples, including transmission gear selection, stability control activity, and steering wheel input, were recorded. System status data were recorded at the time of an event, inclusive of reported diagnostic trouble codes (DTCs), seat belt usage of front-row occupants, and vehicle ignition cycle.

The imaged data contained one event, termed "First Record." It was a non-deployment trigger event type that occurred on ignition cycle 327. At the time of the event, the seat belt status of the driver and front-right positions were both reported "Unbuckled," with their respective seat track positions report designated "Not forward." There were no DTCs reported, and the air bag warning lamp was "Off." The brake telltale, ABS telltale, ESC telltale, powertrain wrench telltale, and powertrain malfunction indicator lamp telltale were all reported "Off." The maximum longitudinal delta V reported for the first record event was -9.25 km/h (-5.75 mph) at 300 milliseconds after time zero. There was no reported maximum lateral delta V. The first record had the following recorded pre-crash buffer data:

Time	Vehicle Speed	Accelerator Pedal (% Full)	Service Brake	Engine rpm	Steering Wheel Angle (degrees)
-5.0	53 km/h (33.0 mph)	3.8	OFF	1,120	0.0
-4.5	53 km/h (32.8 mph)	2.9	OFF	1,046	0.0
-4.0	52 km/h (32.6 mph)	0.0	OFF	1,142	0.0
-3.5	52 km/h (32.2 mph)	2.7	OFF	1,104	0.0
-3.0	51 km/h (31.9 mph)	2.1	OFF	1,222	0.0
-2.5	51 km/h (31.5 mph)	3.8	OFF	1,230	0.0
-2.0	50 km/h (31.0 mph)	0.0	OFF	1,272	-2.0
-1.5	49 km/h (30.6 mph)	0.0	OFF	1,324	-4.7
-1.0	49 km/h (30.2 mph)	0.0	OFF	1,272	-7.9
-0.5	48 km/h (29.7 mph)	0.0	OFF	1,252	-21.0
0.0	46 km/h (28.5 mph)	0.0	OFF	1,278	-16.2

After a review of the imaged data, the SCI investigator noted that the data were truncated at 250 milliseconds, and therefore the entire crash pulse was not captured by the recorded data. The recorded data corresponded only to Event 1 of the crash (undercarriage impact/engagement). As this was the only event recorded by the Ford's RCM, it was apparent that the RCM was unable to distinguish a separation in the crash event sequence, and therefore did not recognize, record, or respond to the Event 2 frontal impact or the Event 3 rollover. This explained the lack of supplemental restraint deployment, which was related to the low overall severity of the recorded longitudinal crash pulse.

Interior Damage

The Ford's interior was inspected for crash-related damage and occupant contact. There was no intrusion into the occupant space of the Ford's interior due to the multi-event crash. All the Ford's doors remained closed during the crash and were operational post-crash.

There were two particular areas of occupant contact identified in the Ford. The first was significant forward collapse/deformation of the upper half of the steering wheel rim. It was apparent the driver loaded the steering wheel rim with her chest and abdomen during the crash sequence. Despite significant deformation to the rim, the column and shear capsules remained intact. The second area of occupant contact was located on the left upper aspect of the windshield. This consisted of an approximate 30x30 cm (11.8x11.8 in) area that was fractured in a circular pattern, with numerous strands of the driver's hair captured on the sharp edges of the fractured glazing. It was apparent that this contact was from the driver's head and face. Figure 9 shows the identified contacts in the Ford. It is probable that the driver also struck the left upper

A-pillar, left roof side rail, and windshield header during the rollover sequence and as the vehicle came to final rest. She also likely struck the partially opened [<5 cm (<2.0 in)] left front glazing. However, these surfaces were covered in mud residue at the time of the SCI inspection as a result of water infiltrating into the overturned vehicle following the crash. This prevented identification and documentation of such contact. With exception to the windshield that was fractured by occupant contact, all the Ford's remaining glazing remained intact and was undamaged during the crash sequence.

Figure 9. Driver contact to the steering wheel rim and windshield with the Ford

Manual Restraint Systems

The Ford had 3-point lap and shoulder seat belt systems for all five seat positions. Both the driver and front-right occupant seat belts used continuous-loop webbing with cinching latch plates, and were height-adjustable at their B-pillar-mounted D-ring positions. They were both adjusted full down at the time of the SCI inspection. The driver's seat belt retracted onto an emergency locking retractor (ELR), while the front right seat belt used an ELR/automatic locking Retractor. Both had lower anchor and retractor pretensioners, none of which was actuated.

Figure 10. View of the driver's seat belt in the Ford at the time of the SCI inspection

At the time of SCI inspection the driver seat belt was extended from the retractor with the webbing wrapped around the armrest of the center console (Figure 10). There was no discernable loading evidence to the latch plate or webbing material.

It was initially theorized that the belt was routinely positioned in this fashion with the latch plate engaged in the buckle as a form of habitual non-use with intent to overcome the repetitive seat belt chime warning. However, the imaged EDR data indicated that the driver's seat belt system was unbuckled at the time of the crash. Therefore, although the specific positioning of the seat belt system remains unknown, it is certain that the system was not in use by the driver at the time of the crash. The front right occupant's seat belt system remained functional and was loosely stowed against the B-pillar. It was not in use at the time of the crash. The same was true of all three of the second row seat belt systems.

Supplemental Restraint Systems

The Ford had inflatable supplemental restraint systems, including frontal air bags, front-seat-mounted side impact air bags, and IC air bags. The frontal air bag system complied with Federal Motor Vehicle Safety Standard (FMVSS) No. 208 and included front seat belt lower anchor and retractor pretensioners, seat track position and seat belt buckle switch sensors, and a front-right occupant presence detection (weight) sensor. The IC air bag system had dual-sensing capabilities (side impact and rollover), and complied with FMVSS No. 226. None of the Ford's supplemental restraint systems deployed during the multi-event crash.

NHTSA Recalls and Investigations

A VIN-based query of NHTSA's recall database (www.nhtsa.gov/recalls) at the time of the SCI inspection showed no recalls or open investigations pertaining to this specific vehicle. A query as of the July 2022 date of this report identified one recall and one open investigation. The recall, identified by NHTSA Campaign #19V435 was issued on June 10, 2019, more than 2 years after this crash and its investigation, and pertained to the potential for fracture of the rear suspension toe link. The recall is unrelated to this crash investigation. The open investigation was EA17-002, the Ford Explorer exhaust odor investigation referenced earlier in this report.

Air Bag Non-Deployment Discussion

The lack of supplemental restraint deployment in the Ford as a result of the multi-event crash was explained through a review of the imaged EDR data. Although the vehicle recognized a crash event and recorded data, the recognized event was the minor severity undercarriage impact and engagement at the onset of the overall crash sequence.

The Ford continued to monitor axial acceleration and recorded crash data after recognizing the initial event, but the RCM was unable to distinguish the occurrence of the Event 2 frontal impact with the ground in the bottom of the drainage canal. This event and the corresponding engagement produced significant deformation to the front plane of the Ford and elicited a kinematic response from the driver that produced traumatic injuries. However, the event was not recognized or recorded by the Ford's RCM. Similarly, the third and final rollover event was also not recognized or recorded by the Ford's RCM. Because the RCM did not recognize these events, there was no deployment/actuation of any supplemental restraint devices commanded.

Carbon Monoxide Discussion

NHTSA initiated a Preliminary Evaluation (PE) of MY2011-2015 Ford Explorers on July 1, 2016. Identified as #PE16-008, the open investigation concerned complaints that reported the release of exhaust fumes into the occupant compartment of MY 2011-2015 Ford Explorers. NHTSA was concerned about the corresponding possibility of CO occupant exposure that could result if exhaust fumes infiltrated the occupant compartment. The PE was upgraded to an Engineering Analysis (EA) on July 27, 2017, identified as EA17-002 with an expanded scope to include the 2016 and 2017 model years. As of December 2022, the EA remained open.

On December 10, 2012 Ford issued Technical Service Bulletin (TSB) 12-12-4, which specified the sealing and undercoating of certain areas of the rear floor plan and body seams, replacement of the rear air extractors, and installation of rear lift gate drain valves on 2011 – 2013 Ford Explorers to prevent exhaust odor in the vehicle with the auxiliary climate control system on. A second TSB, identified as 14-0130 and issued July 22, 2014, expanded the scope of the 12-12-4 TSB to include the 2014 and 2015 model year Explorers and added software changes to the recirculation mode of the air conditioning system during full-throttle application events. In September 2017, after the subject vehicle crash date, Ford released Field Service Action FSA 17B25 that instructed operators of Explorers upfitted as Police vehicles how to remedy vehicles that exhibit an exhaust odor in the vehicle while the climate control system is in auto or recirculation mode. FSA 17B25 provides instruction on how to Identify and seal aftermarket upfitter induced leaks, install exhaust downturn tips, reprogram the HVAC system, and check for emissions fault codes related to leaking manifolds and repair if leaking.

During the vehicle inspection, the SCI investigator removed a portion of the vehicle's rear bumper cover in order to visualize the right rear air extractor.

Figure 11. View of the Ford's right rear air extractor

Figure 11 shows the Ford's air extractor at the right rear corner of the vehicle at the time of the SCI vehicle inspection. The extractor was a polymer vent that had six flexible flaps on the outer surface. It should be noted that at the time of the SCI on-site investigation, the SCI investigator was aware only of the right rear air extractor. Following the vehicle inspection, it was learned that there was an additional air extractor on the left side of the vehicle in the same general location. The left air extractor was not visually inspected as part of the on-site vehicle inspection.

The supervisor indicated that none of the adjustment settings in the Ford had been modified since the crash. The SCI investigator attempted to energize the vehicle's low-voltage electrical system to document the adjustment settings of the HVAC and climate control system. However, the vehicle's battery was depleted. An external power supply was used by the SCI investigator and applied directly to the Ford's battery in order to energize the vehicle during the vehicle inspection process.

The SCI investigator succeeded in turning on the Ford's ignition, and observed the climate control system as it became energized and began operation. Unaltered from the time of the crash, the HVAC was turned on and the temperature control was adjusted to its coldest setting, with the blower adjusted to a 5/7 (70%) power setting and the recirculate turned on. The HVAC discharge setting was adjusted to direct air toward the occupant torso/face. Figure 12 shows the HVAC and climate control knobs/and adjustments.

Figure 12. Energized and operating HVAC and climate system controls in the Ford during the SCI inspection

The SCI investigator had planned to operate the Ford's engine and measure levels of CO both inside and outside the vehicle to document the change in CO levels created by the operation and infiltration of exhaust, if any, to the interior. The CO levels were to be monitored and measured by the SCI investigator using a Pulsar Plus Single-Gas CO Detector manufactured by MSA Safety Incorporated.[1] Using external power supply to charge the vehicle's low-voltage electrical system, the SCI investigator was able to start the Ford's engine. All systems began to function, and appeared to operate normally. However, within less than 30-seconds of beginning operation, systems and components, including the HVAC and aftermarket communications equipment, began operating intermittently and spontaneously turning on and off. The instrument cluster flashed, and there were fluctuations in engine throttle and revolution speed. The SCI investigator immediately turned off the ignition.

It was suspected that a depleted battery was the root cause of the intermittent operation. A charger was applied to the vehicle's battery in an attempt to resolve the apparent electrical issues. After an extended time period of charging, however, the battery charge could not be restored. The SCI investigator attempted operation of the vehicle a second time, by applying a

[1] Cranberry Township, PA

supplemental external power source to the battery and starting the vehicle's engine. Once again, the vehicle appeared to operate normally for approximately 30 seconds before systems and components exhibited the same intermittent and spontaneous on/off cycles. The SCI investigator again terminated engine operation, with no change in CO levels detected after the brief operation attempts.

The SCI operation of the vehicle and measurement/documentation of CO levels was suspended due to fear of potentially causing further damage to the vehicle. Ultimately, the SCI investigator was unable to definitively determine if vehicle exhaust may have entered the passenger compartment and contributed to the elevated CO levels measured in the driver following the crash.

Blood Gas test results reported at the hospital 2 hours-36 minutes after the reported time of the crash indicated a CO level of 8.2 percent with an oxygen level of 88.4 percent. After receiving hyperbaric treatment, the CO level dropped to 4.7 percent 3 hours-50 minutes post-crash. The oxygen level at that time was 94.2 percent.

The medical record indicated the driver had smoked tobacco since 2013 with a self-reported habit of 20 cigarettes per day. The interpretive data included with the Blood Gas results indicated that the "normal" CO reference range for a Smoker could be 1.5-5.0 percent. The Nonsmoker "normal" CO reference range was <1.5 percent. The role smoking played in the driver's physiological condition relative to the crash was not determined.

2016 Ford Explorer Police Interceptor Occupant Data

Driver Demographics

Age/sex:	36 years/female
Height:	165 cm (65 in)
Weight:	68 kg (150 lb)
Eyewear:	None
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Rearmost
Manual restraint usage:	None used; 3-point lap and shoulder seat belt available
Usage source:	Vehicle inspection, EDR
Air bags:	Equipped with CAC frontal, front seat-mounted, and IC air bags; None deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Exited vehicle with assistance from emergency responders
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Evaluated, treated, and released within 24 hours of the crash

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Cervical strain	640278.1	Windshield	Probable
2	Avulsion to left upper forehead	210802.1	Windshield	Certain
3	Contusion left forehead	210402.1	Windshield	Certain
4	Abrasions to the left forehead	210202.1	Windshield	Certain
5	Contusions with ecchymosis to the posterior scalp	110402.1	Windshield header	Probable
6	Left facial contusions	210402.1	Windshield	Certain
7	Abrasion left cheek	210202.1	Steering wheel rim	Possible
8	Displacement of four front teeth, lower	251402.1	Steering wheel rim	Possible
9	Abrasions to the left knee	810202.1	Left lower instrument panel	Probable
10	Carbon monoxide poisoning	419200.2	Unknown	N/A

Source: surrogate interviews; medical records

Driver Kinematics

The 36-year-old female was in the Ford driver's seat, adjusted to its rearmost track position, with the seatback slightly reclined. Although the vehicle was equipped with a 3-point lap and shoulder seat belt system for manual restraint, the driver was unrestrained. This lack of restraint usage was determined through an inspection of the post-crash condition of the seat belt system and occupant contact evidence, in conjunction with a review of the EDR data imaged from the Ford. She was an on-duty law enforcement officer who, at the time of the crash, was approaching the end of a 12-hour shift. The majority of that shift, approximately 10 hours, was spent in the Ford.

According to key-on timer data reported by the Ford's imaged EDR, the vehicle had been in continuous operation for 78 minutes, 40 seconds at the time of the crash. While on-duty, the officer worked a traffic detail on a limited access roadway, monitoring traffic speed and operation. She pulled over an unknown number of vehicles during the detail, which required pushing the Ford through aggressive acceleration and high-speed operation in order to catch up to and pull over speeding vehicles. During the remainder of the on-duty time in the vehicle, the driver had the air conditioning turned on with the temperature control was adjusted to its coldest setting, the blower adjusted to a 5/7 (70%) power setting, and the recirculate turned on. It was reported that the driver smoked throughout her work shift.

The Ford departed the roadway and ramped up the west side of the driveway without avoidance braking or steering input by the driver. She remained in the driver's seat as the Ford's undercarriage scraped the ground on the west side of the driveway. Minimal longitudinal forces to the undercarriage engagement induced a slight forward trajectory to her body. Due to her unresponsive state and lack of seat belt, she likely became slumped forward, with her face close to the upper half of the steering wheel as the vehicle vaulted over the driveway and into the drainage canal.

When the Ford's front plane struck the muddy bottom of the drainage canal, the driver experienced an abrupt forward trajectory. Her lower face and jaw struck the upper half of the steering wheel rim, resulting in injuries to the driver's teeth. Her head and face then struck the upper left corner of the windshield, fractured the windshield and injuring the driver further, including concussion and soft tissue injuries. Simultaneously, her torso loaded and deformed the steering wheel rim while her knees struck the left lower instrument panel.

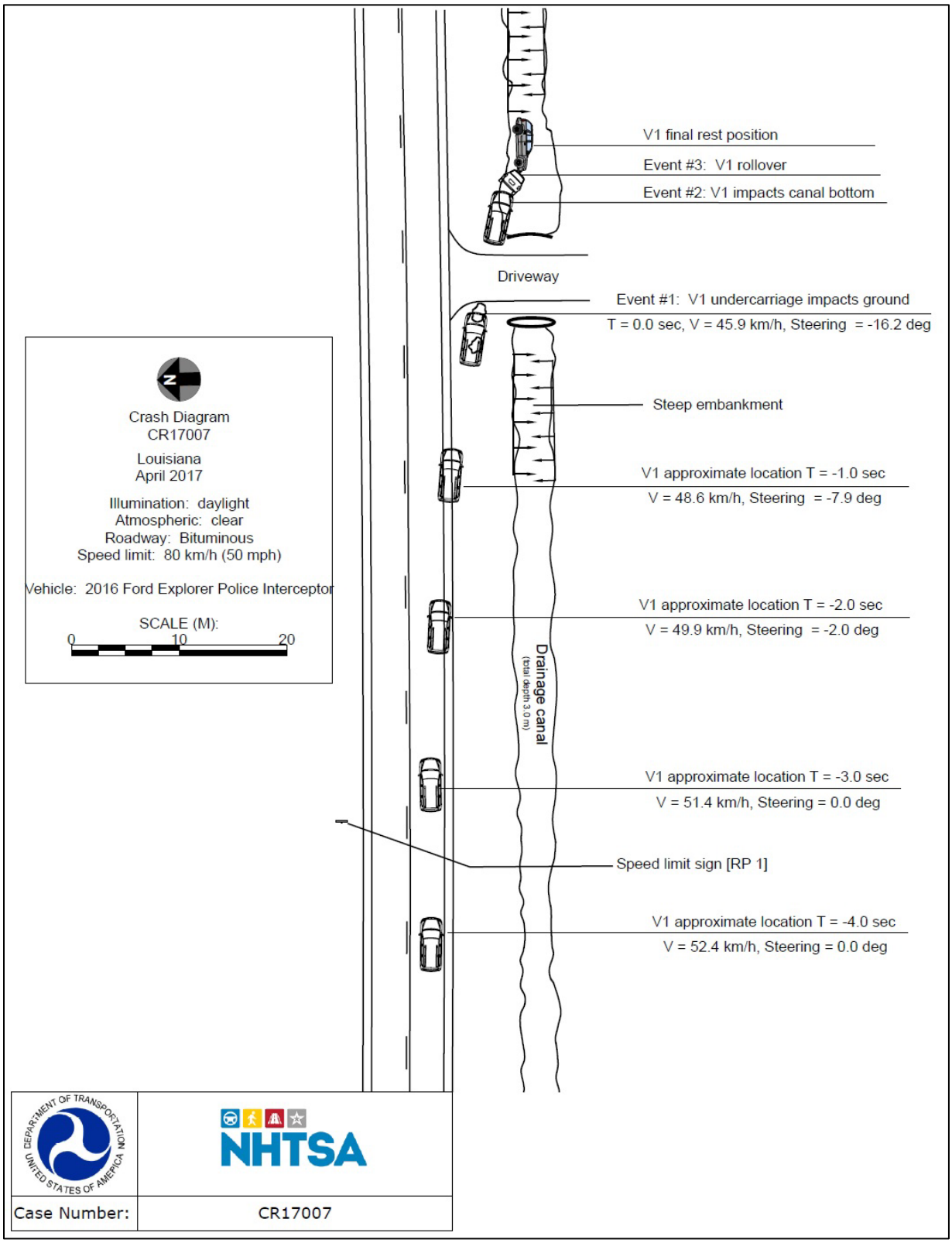
The windshield and steering wheel contacts were documented with corresponding damage to the vehicle's interior during the SCI vehicle inspection. The unbelted driver remained forward and in contact with frontal components as the Ford fell into the water of the canal on its left plane. Impact of the vehicle's left plane into the water induced a lateral kinematic response from the driver, and her left flank contacted the left front glazing. Her head struck the left upper A-pillar, and her left shoulder struck the left roof side rail. Although these contacts were determined to have occurred based on the dynamics of the crash and the corresponding kinematic response of the driver, there was no discernable contact evidence to support such contacts documented during the SCI vehicle inspection due to the masking of the surfaces of the involved vehicle components with a mud residue from the drainage canal's water.

The first arriving law enforcement officer found her semi-responsive and disoriented, lying inside the overturned Ford in the muddy water on the left front glazing. She was assisted from the vehicle upward and out through the right front door, evidenced by footprints on the front row seats, center console, and center armrest. An ambulance arrived and transported her to a local hospital for medical evaluation and care.

Upon her arrival, she remained confused and experiencing short-term memory loss with a Glasgow Coma Score of 14. Although she was identified as having sustained a head injury during the crash, she was cared for in the hospital's emergency department for nearly 2 hours without significant improvement in her state of confusion and ill effects. CO exposure was then identified as the underlying cause of her confusion. Despite having received oxygen since the crash, she still exhibited high levels of CO in her system. She received hyperbaric treatment for

the CO exposure as well as treatment of her traumatic crash-related injuries, and was released from the hospital 4 hours-8 minutes after the reported time of the crash.

Crash Diagram



Appendix A: 2016 Ford Explorer Police Interceptor Event Data Recorder Report[2]

[2] 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	1FM5K8AR4GG******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	201750S1CR17007_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.3
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 21.5.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	Yes
Event(s) recovered	Event Record 1

Comments

No comments entered.

The retrieval of this data has been authorized by the vehicle's owner, or other legal authority such as a court order or search warrant, as indicated by the CDR tool user on .

Data Limitations

Data Imaging:

CAUTION: When imaging data directly from the RCM on a bench top, make sure the RCM is placed on a flat surface without any movement (static) while connected to and powered by the CDR interface. Not following the above guideline for bench top imaging could risk inducing new events to be recorded in the RCM and possibly overwriting a Non airbag deployment.

Note that the RCM Adapter Detected during Download parameter equal to " Yes" indicates that the EDR data was collected directly from the RCM. When equal to "No", it indicates that the EDR data was collected through the OBD II from the vehicle.

Restraints Control Module (RCM) Recorded Crash Event(s):

The RCM can store up to two crash events. Event types are categorized as follow:

1. Non deployment trigger event is an event in which EDR recording trigger threshold is met or exceeded (minimum of 5 mph (8kph) Accumulated Delta Velocity within 150ms interval), but no device(s) have deployed. The data from such event can be overwritten by subsequent events.

2. Airbag deployment event is an event in which frontal, side or curtain airbags have deployed. Note that such event cannot be overwritten or cleared from the Restraints Control Module (RCM). Once the RCM has deployed any airbag device(s), the RCM must be replaced.

3. Some RCM may also categorize Non airbag deployment event. This type is an event in which non airbag devices such as pretentioners, knee bolster etc… have deployed. Note that such event can be overwritten given a subsequent "deployment" event.

"Time zero" or Event Beginning of any event (First Record or Second Record) is defined as the first Algorithm wake up during that event. So all the Pre-Crash, At Event, Delta V Data, deployment times etc… are relative to "Time zero".

It is possible that conditions in a crash may result in an incomplete event data record.

EDR Data Elements Overview/Interpretation in CDR Report:

Under CDR File Information Section

- Event(s) recovered indicates if an event was detected and recorded by RCM. If no event is detected, it will indicate "none". If a trigger or non airbag deployment event is detected, it will indicate "unlocked event". If an airbag deployment is detected, it will indicate "locked frontal event", or "locked side event", or "locked rollover event".

Under System Status at Event Section

- Complete file recorded indicates if data from the recorded event has been fully written to the RCM memory.
- If the RCM detected a peripheral crash sensor was lost during an event, the crash sensor would be identified as well as the time it was lost during that event relative to Time zero. If no loss of a peripheral crash sensor, nothing would be displayed. Note in some vehicles, loss of a peripheral crash sensor may lead to the loss of another peripheral crash sensor due to shared communication.

Under Deployment Data Section

- If the RCM commanded a deployment during an event, the deployment device(s) would be identified as well as the time the RCM commanded its deployment relative to Time zero. If no device was commanded to deploy by the RCM, nothing (no deployment device (s)) would be displayed.

Under Pre-Crash Data -5 to 0 sec

- Steering Wheel Angle if Applicable: positive value indicates left turn, and negative value would indicate right turn.
- Stability Control Lateral Acceleration if Applicable: Lateral Acceleration (Y-direction) is the acceleration along the lateral axis of the vehicle, reported as positive when accelerating to the left.
- Stability Control Longitudinal Acceleration if Applicable**:** Longitudinal Acceleration (X-direction) is the acceleration along the longitudinal axis of the vehicle, reported as positive when accelerating in a forward direction.
- Stability Control Yaw Rate if Applicable: The Yaw Axis is the vertical axis of the vehicle, generally perpendicular to the plane of the road. A positive Yaw Rate is counter-clockwise when observing the vehicle from above.
- Stability Control Roll Rate if Applicable: The Roll Axis is the longitudinal axis of the vehicle, generally aligned with the primary axis of motion of the vehicle. A positive Roll Rate is counter-clockwise when observing the vehicle from the front.

Under Longitudinal Crash Pulse

- Delta-V, longitudinal: SAE J211 sign convention, negative value generally indicates a front crash and positive value generally indicates a rear crash. Longitudinal delta-V reflects the change in forward velocity that the sensing system experienced from Time zero. It is not the speed the vehicle was traveling before the event. Note that the vehicle speed is recorded separately. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle longitudinal delta-V.

Under Lateral Crash Pulse

- Delta-V, lateral: SAE J211 sign convention, Positive value generally indicates a driver side crash and negative value generally indicates a passenger side crash.

Under Rollover Sensor Data (if Applicable)

- Vehicle roll angle if applicable: The Roll Axis is the longitudinal axis of the vehicle, generally aligned with the primary axis of motion of the vehicle. A positive Roll Angle is counter-clockwise when observing the vehicle from the front.

Data Sources:

The Restraints Control Module (RCM) contains all recorded data on any event. Data collected from the RCM comes from multiple sources:

1. Internal to the RCM such as internal sensors for delta Velocity data, rollover angle data if applicable, etc… which are measured, calculated and stored internally.

2. External to the RCM but with a direct connection such as buckle switches, peripheral crash sensors, seat track switch(s) etc… which are measured, calculated and stored internally.

3. External Modules to the RCM such as Powertrain Control Module, Brake Control Module, etc… Theses modules communicate to the RCM via Vehicle Communication Network. The RCM stores the received data internally.

02013_RCM-RC7P_r001

System Status at Time of Retrieval

VIN As Programmed into RCM at Factory	1FM5K8AR4GG******
Current VIN (From PCM)	1FM5K8AR4GG******
Ignition Cycle, Download (First Record)	332
Ignition Cycle, Download (Second Record)	N/A
Restraints Control Module Part Number	GB5T-14B321-AC
Restraints Control Module Serial Number	7054411237070000
Restraints Control Module Software Part Number (Version)	FL3T-14C028-AA
Driver Side/Center Frontal Restraints Sensor Serial Number	0026294E
Driver, Row 1, Side Restraint Sensor 1 Serial Number	00000052
Driver, Row 2, Side Restraint Sensor 2 Serial Number	00AB1E0A
Passenger Frontal Restraints Sensor Serial Number	000A294C
Passenger, Row 1, Side Restraint Sensor 1 Serial Number	00000097
Passenger, Row 2, Side Restraint Sensor 2 Serial Number	00AD1DBC
Steering Wheel Location	Left Hand Drive

System Status at Event (First Record)

Complete File Recorded (Yes,No)	Yes
Multi-Event, Number of Events	1
Time From Event 1 to 2 (msec)	0
Lifetime Operating Timer at Event Time Zero (sec)	2,390,290
Key-On Timer at Event Time Zero (sec)	4,720
Vehicle Voltage at Time Zero (V)	14.0
Energy Reserve Mode Entered During Event (Yes, No)	No

Faults Present at Start of Event (First Record)

No Faults Recorded

Deployment Data (First Record)

Maximum Delta-V, Longitudinal (MPH [km/h])	-5.75 [-9.25]
Time, Maximum Delta-V Longitudinal (msec)	300.0

Pre-Crash Data -1 sec (First Record)

Ignition cycle, Crash	327
Frontal Air Bag Warning Lamp, On/Off	Off
Safety Belt Status, Driver	Unbuckled
Seat Track Position Switch, Foremost, Status, Driver	Not Forward
Seat Track Position Switch, Foremost, Status, Front Passenger	Not Forward
Safety Belt Status, Front Passenger	Unbuckled
Brake Telltale	Off
ABS Telltale	Off
ESC/TC Telltale	Off
ESC/TC Off Telltale	Default Mode
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Fresh Off

Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record) - Table 1 of 2

Time (sec)	Speed, Vehicle Indicated (MPH [km/h])	Speed, Vehicle Indicated, Quality Factor	Accelerator Pedal, % Full	Accelerator Pedal, % Full, Quality Factor	Service Brake, On/Off	Service brake, Quality Factor	Engine RPM	ABS Activity (Engaged, Non-Engaged)
- 5.0	33.0 [53]	OK	3.8	OK	Off	OK	1,120	Non-engaged
- 4.5	32.8 [53]	OK	2.9	OK	Off	OK	1,046	Non-engaged
- 4.0	32.6 [52]	OK	0.0	OK	Off	OK	1,142	Non-engaged
- 3.5	32.2 [52]	OK	2.7	OK	Off	OK	1,104	Non-engaged
- 3.0	31.9 [51]	OK	2.1	OK	Off	OK	1,222	Non-engaged
- 2.5	31.5 [51]	OK	3.8	OK	Off	OK	1,230	Non-engaged
- 2.0	31.0 [50]	OK	0.0	OK	Off	OK	1,272	Non-engaged
- 1.5	30.6 [49]	OK	0.0	OK	Off	OK	1,324	Non-engaged
- 1.0	30.2 [49]	OK	0.0	OK	Off	OK	1,272	Non-engaged
- 0.5	29.7 [48]	OK	0.0	OK	Off	OK	1,252	Non-engaged
0.0	28.5 [46]	OK	0.0	OK	Off	OK	1,278	Non-engaged

Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record) - Table 2 of 2

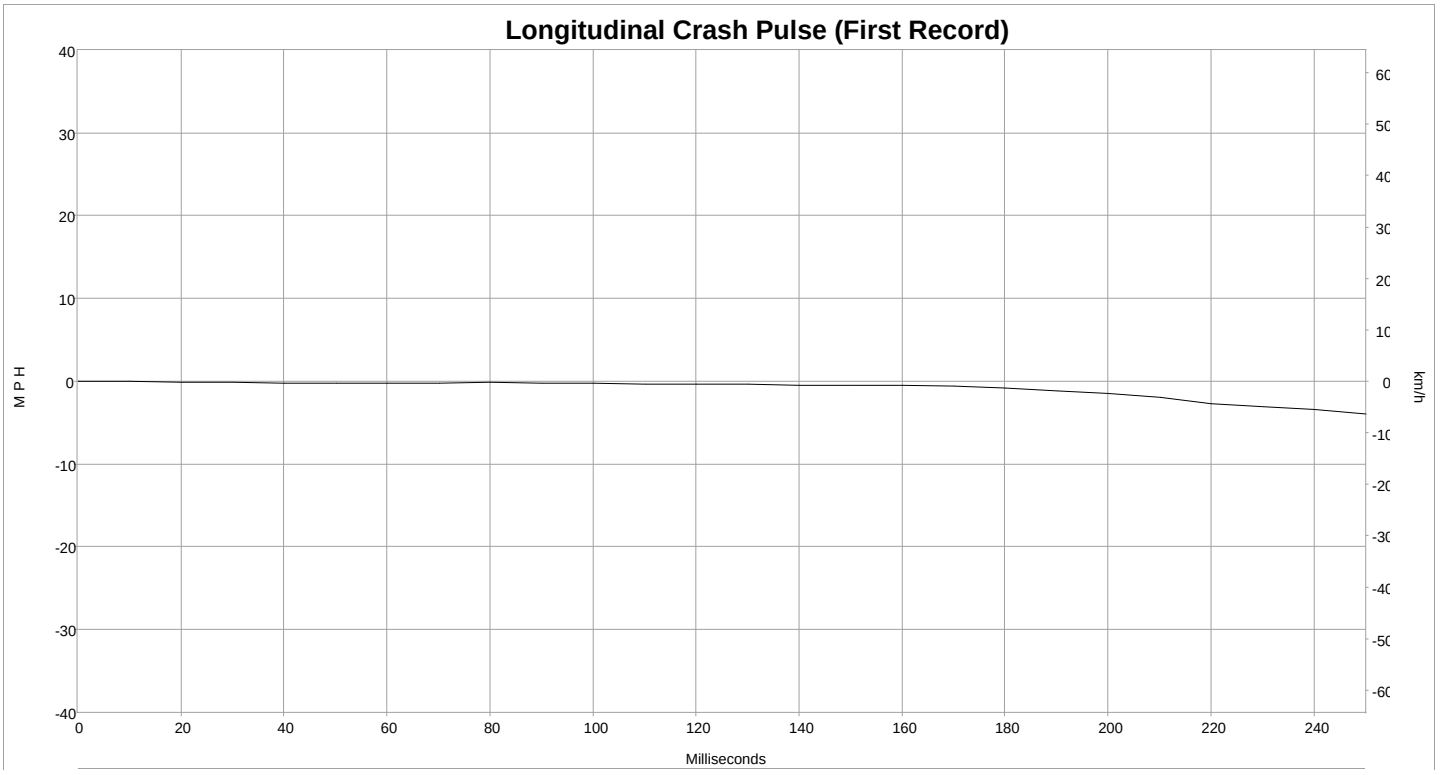
Time (sec)	Brake Powertrain Torque Request 1	Brake Powertrain Torque Request 2	Traction Control via Brakes	Wheel Torque (N-m)	Speed Control Status	Driver Gear Selection (Auto Trans)	Occupant Size Classification, Front Passenger (Child size Yes/No [Hex value])
- 5.0	No	No	No	-100	Off	Drive	No [$01]
- 4.5	No	No	No	-32	Off	Drive	No [$01]
- 4.0	No	No	No	-60	Off	Drive	No [$01]
- 3.5	No	No	No	-80	Off	Drive	No [$01]
- 3.0	No	No	No	-36	Off	Drive	No [$01]
- 2.5	No	No	No	-56	Off	Drive	No [$01]
- 2.0	No	No	No	-52	Off	Drive	No [$01]
- 1.5	No	No	No	-60	Off	Drive	No [$01]
- 1.0	No	No	No	-52	Off	Drive	No [$01]
- 0.5	No	No	No	-100	Off	Drive	No [$01]
0.0	No	No	No	-208	Off	Drive	No [$01]

Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

Time (sec)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)	Stability Control Roll Rate (deg/sec)	Steering Wheel Angle (deg)
- 5.0	0.02	-0.01	-0.01	0.36	0.0
- 4.9	0.00	-0.02	0.03	1.16	0.0
- 4.8	0.00	-0.02	0.15	0.87	0.0
- 4.7	0.02	-0.01	0.17	0.79	0.0
- 4.6	0.03	0.00	-0.01	0.31	0.0
- 4.5	0.02	-0.02	-0.03	-0.44	0.0
- 4.4	0.03	-0.03	0.13	-0.07	0.0
- 4.3	0.02	-0.03	0.15	-0.44	0.0
- 4.2	0.01	-0.04	0.15	-0.60	0.0
- 4.1	0.02	-0.03	0.00	-0.07	0.0
- 4.0	0.03	-0.03	0.08	-0.68	0.0
- 3.9	0.02	-0.03	0.22	-1.16	0.0
- 3.8	0.02	-0.03	0.19	-1.19	0.0
- 3.7	0.03	-0.03	0.10	-0.07	0.0
- 3.6	-0.01	-0.03	0.31	0.11	0.0
- 3.5	0.03	-0.04	0.36	0.28	0.0
- 3.4	0.03	-0.03	0.47	0.87	0.0
- 3.3	0.02	-0.04	0.17	1.00	0.0
- 3.2	0.01	-0.03	0.31	-0.79	0.0
- 3.1	0.02	-0.02	0.33	0.76	0.0
- 3.0	-0.01	-0.06	0.10	-0.47	0.0
- 2.9	0.03	-0.03	0.13	0.95	-0.2
- 2.8	0.10	-0.02	0.13	-0.31	-0.2
- 2.7	0.04	-0.02	0.15	-1.16	-0.2
- 2.6	0.03	-0.02	-0.08	-1.19	-0.2
- 2.5	0.03	-0.02	-0.29	-0.07	0.0
- 2.4	0.03	-0.03	-0.22	0.39	0.0
- 2.3	0.02	-0.05	0.00	2.75	-0.4
- 2.2	-0.04	-0.03	-0.01	3.15	-1.6
- 2.1	0.06	-0.07	-0.47	2.15	-1.6
- 2.0	-0.01	-0.05	-0.49	7.47	-2.0
- 1.9	0.00	-0.03	-0.08	-1.00	-1.9
- 1.8	0.02	-0.03	-0.40	3.12	-2.2
- 1.7	0.05	-0.03	-1.13	2.67	-3.1
- 1.6	-0.02	-0.05	-1.20	-0.31	-3.9
- 1.5	0.01	0.00	-1.40	1.48	-4.7
- 1.4	-0.02	0.00	-1.70	-3.39	-5.2
- 1.3	0.00	-0.04	-2.15	6.28	-5.7
- 1.2	-0.12	-0.10	-1.97	5.88	-7.2
- 1.1	-0.01	-0.04	-1.54	11.24	-7.0
- 1.0	-0.07	-0.04	-1.00	11.52	-7.9
- 0.9	0.03	-0.05	-1.27	4.11	-10.1
- 0.8	0.07	-0.04	-2.73	3.71	-12.5
- 0.7	0.05	-0.07	-3.88	4.19	-15.2
- 0.6	-0.10	-0.17	-4.19	8.64	-19.2
- 0.5	-0.20	-0.11	-3.91	3.95	-21.0
- 0.4	0.15	-0.07	-5.45	7.15	-19.4
- 0.3	0.01	-0.15	-5.18	6.39	-19.4
- 0.2	-0.04	-0.04	-5.34	12.16	-19.0
- 0.1	-0.07	-0.06	-5.70	5.43	-17.8
0.0	0.10	-0.09	-5.20	23.27	-16.2

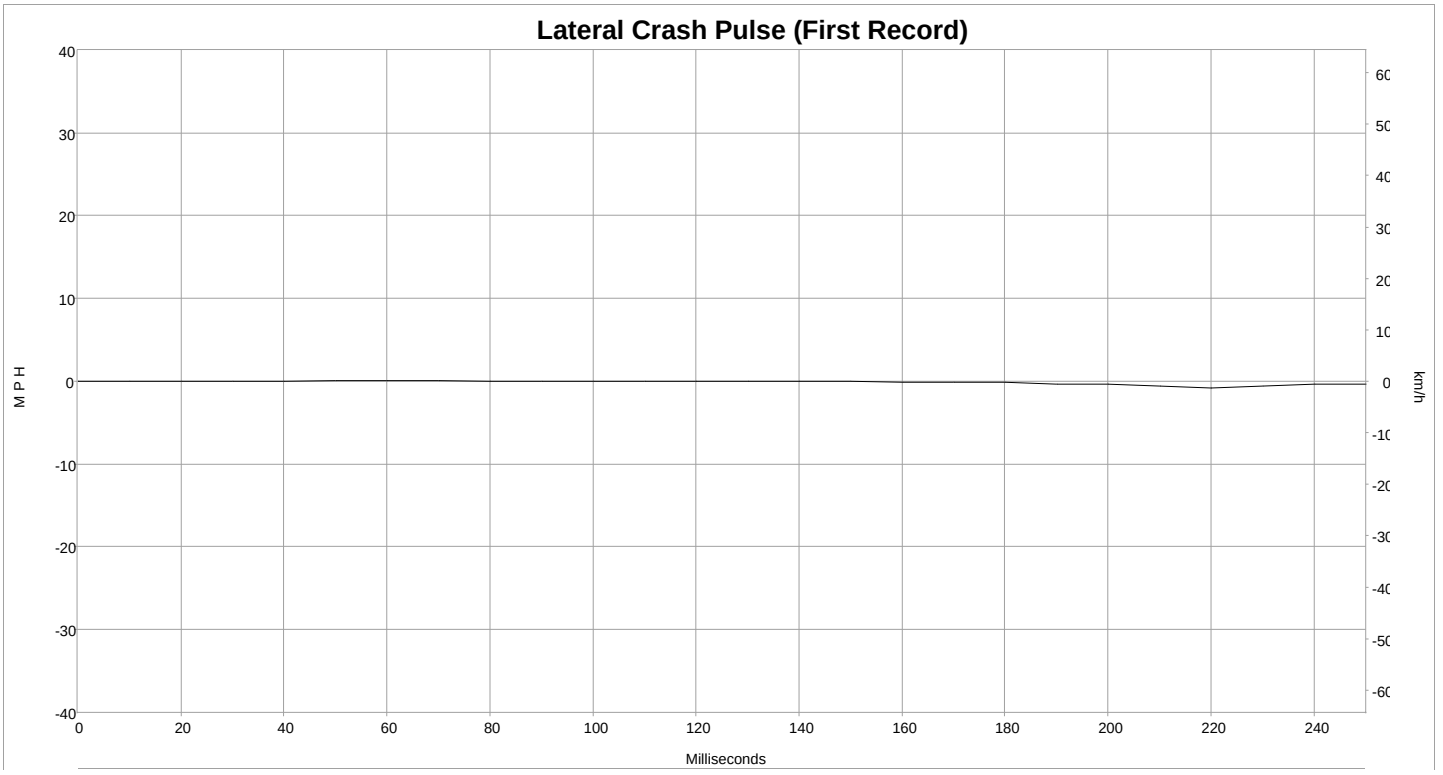
Post-Crash Data 0 to 5 sec [4 samples/sec] (First Record)

Time (sec)	Impact Event Feedback Status
0.00	Normal
0.25	Normal
0.50	Normal
0.75	Normal
1.00	Normal
1.25	Normal
1.50	EventInProgress
1.75	EventInProgress
2.00	EventInProgress
2.25	EventInProgress
2.50	EventInProgress
2.75	EventInProgress
3.00	EventInProgress
3.25	EventInProgress
3.50	EventInProgress
3.75	EventInProgress
4.00	EventInProgress
4.25	EventInProgress
4.50	EventInProgress
4.75	EventInProgress
5.00	EventInProgress



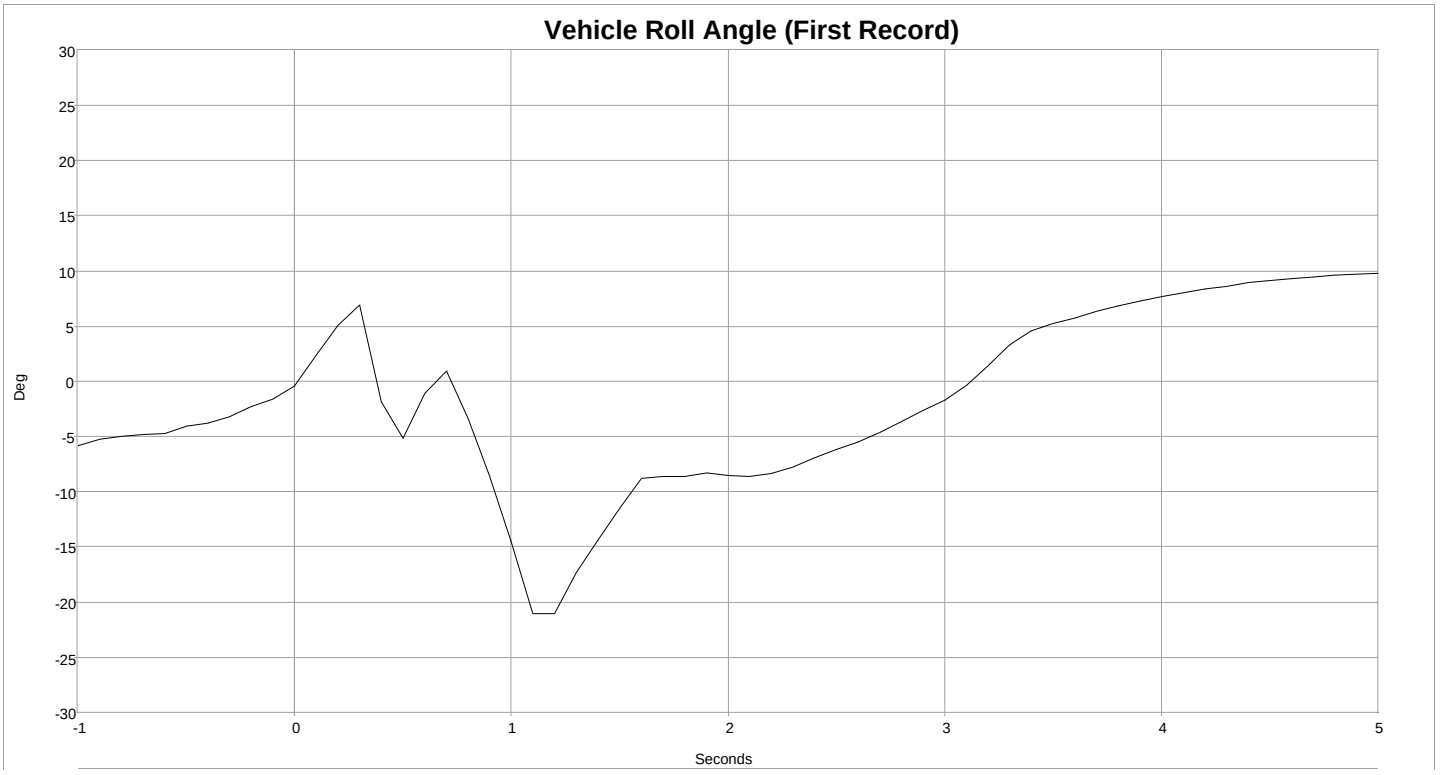
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
0	0.00	0.00
10	-0.04	-0.07
20	-0.09	-0.14
30	-0.16	-0.25
40	-0.21	-0.33
50	-0.21	-0.34
60	-0.21	-0.34
70	-0.21	-0.34
80	-0.17	-0.27
90	-0.21	-0.33
100	-0.24	-0.39
110	-0.29	-0.46
120	-0.34	-0.54
130	-0.39	-0.62
140	-0.40	-0.65
150	-0.42	-0.67
160	-0.46	-0.74
170	-0.52	-0.83
180	-0.75	-1.20
190	-1.12	-1.80
200	-1.47	-2.37
210	-1.95	-3.14
220	-2.74	-4.41
230	-3.01	-4.85
240	-3.41	-5.48
250	-3.94	-6.34



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, Lateral (MPH)	Delta-V, Lateral (km/h)
0	0.00	0.00
10	0.00	0.00
20	-0.01	-0.01
30	0.03	0.05
40	0.05	0.08
50	0.13	0.21
60	0.12	0.20
70	0.08	0.13
80	0.02	0.04
90	-0.03	-0.05
100	-0.02	-0.03
110	-0.01	-0.01
120	0.00	0.00
130	0.02	0.04
140	-0.01	-0.01
150	-0.04	-0.07
160	-0.09	-0.15
170	-0.10	-0.16
180	-0.17	-0.27
190	-0.31	-0.50
200	-0.38	-0.61
210	-0.54	-0.87
220	-0.83	-1.34
230	-0.52	-0.84
240	-0.37	-0.59
250	-0.34	-0.54



Vehicle Roll Angle (First Record)

Time (sec)	Vehicle Roll Angle (deg)
-1.0	-5.82
-0.9	-5.20
-0.8	-5.00
-0.7	-4.78
-0.6	-4.73
-0.5	-4.03
-0.4	-3.83
-0.3	-3.24
-0.2	-2.31
-0.1	-1.63
0.0	-0.44
0.1	2.38
0.2	5.04
0.3	6.94
0.4	-1.86
0.5	-5.19
0.6	-1.13
0.7	0.91
0.8	-3.36
0.9	-8.51
1.0	-14.47

Time (sec)	Vehicle Roll Angle (deg)
1.1	-21.02
1.2	-21.03
1.3	-17.35
1.4	-14.33
1.5	-11.52
1.6	-8.78
1.7	-8.65
1.8	-8.63
1.9	-8.32
2.0	-8.53
2.1	-8.63
2.2	-8.33
2.3	-7.75
2.4	-6.97
2.5	-6.20
2.6	-5.47
2.7	-4.65
2.8	-3.67
2.9	-2.64
3.0	-1.65
3.1	-0.35

Time (sec)	Vehicle Roll Angle (deg)
3.2	1.42
3.3	3.26
3.4	4.56
3.5	5.28
3.6	5.76
3.7	6.30
3.8	6.83
3.9	7.28
4.0	7.69
4.1	8.06
4.2	8.34
4.3	8.65
4.4	8.92
4.5	9.13
4.6	9.32
4.7	9.47
4.8	9.60
4.9	9.71
5.0	9.77

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 system.

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$5B17 - Event Type
00 00 00 00

$F113 - RCM Part Number
47 42 35 54 2D 31 34 42 33 32 31 2D 41 43 00 00 00 00 00 00 00 00 00 00

$F18C - RCM Serial Number
37 30 35 34 34 31 31 32 33 37 30 37 30 30 30 30

$F188 - RCM Software Part Number
46 4C 33 54 2D 31 34 43 30 32 38 2D 41 41 00 00 00 00 00 00 00 00 00 00

$5800 - Left/Center Frontal Restraints Sensor Serial Number
00 26 29 4E D8 A1 7E 00 00 00 00 00 00 00 00 00

$5801 - Left Side Restraints Sensor One Serial Number
00 00 00 52 AF 01 A1 00 00 00 00 00 00 00 00 00

$5802 - Left Side Restraints Sensor Two Serial Number
00 AB 1E 0A 5E 08 1B 00 00 00 00 00 00 00 00 00

$5804 - Right Frontal Restraints Sensor Serial Number
00 0A 29 4C 6C 95 80 00 00 00 00 00 00 00 00 00

$5805 - Right Side Restraints Sensor One Serial Number
00 00 00 97 55 5B 91 00 00 00 00 00 00 00 00 00

$5806 - Right Side Restraints Sensor Two Serial Number
00 AD 1D BC 7D 40 0E 00 00 00 00 00 00 00 00 00

$DE00 - Original VIN
31 46 4D 35 4B 38 41 52 34 47 47 2A 2A 2A 2A 2A 2A

$F190 - Current VIN
31 46 4D 35 4B 38 41 52 34 47 47 2A 2A 2A 2A 2A 2A 2A 00 00 00 00 00 00 00

$DE01 - RCM Option Content
67 68 CE 3B 10 0C 67 08
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$5817 - Event Record 1


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BC 00 00 00 BE 00 00 00 BC 00 00 00 96 00 00 00 B4 00 00 00 DA 00 00 00 FE 00 00 00 2A 01
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DC BF FF FF D1 BF FF FF 10 CB FF FF 43 D4 FF FF D7 DC FF FF 32 E5 FF FF 99 E5 FF FF A9 E5
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44 FF 54 FF 7A FF A9 FF 91 FF 12 FF AD FE 92 FE AB FE 24 FE 3C FE 2E FE 0F FE 3A FE 1F 00
65 00 4C 00 45 00 1B 00 DA FF FA FF DA FF CC FF FA FF C5 FF 9B FF 98 FF FA FF 0A 00 18 00
4C 00 57 00 BB FF 42 00 D7 FF 53 00 E5 FF 9B FF 98 FF FA FF 22 00 F0 00 13 01 BC 00 8C 02
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02 7C 00 00 FF F3 00 01 0D 00 03 00 0F 14 82 AB CB 12 A4 00 00 02 72 00 00 FF E7 00 01 0D
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$5818 - Event Record 2

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DOT HS 813 364
January 2023

U.S. Department
of Transportation

**National Highway
Traffic Safety
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15714-010923-v5