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

NHTSA

DOT HS 812 848

December 2019

Special Crash Investigations

On-Site Ambulance Crash Investigation

Vehicle: 2016 Ford F-450 Type I Ambulance

Location: Virginia

Crash Date: February 2018

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Crash Research & Analysis, Inc. (2019, December). *Special Crash Investigations: On-site Ambulance Crash Investigation; Vehicle 2016 Ford F-450 Type I Ambulance; Location: Virginia; Date: February 2018* (Report No. DOT HS 812 848). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
DOT HS 812 848		

4. Title and Subtitle	5. Report Date
Special Crash Investigations On-Site Ambulance Crash Investigation; Vehicle: 2016 Ford F-450 Type I Ambulance Location: Virginia Crash Date: February 2018	December 2019
	6. Performing Organization Code

7. Author	8. Performing Organization Report No.
Crash Research & Analysis, Inc.	CR18003

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. DTNH22-12-C-00269

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.

16. Abstract

This report documents the on-site investigation of a 2016 Ford F-450 Type I ambulance that crashed into the rear of a tanker semi-trailer that was stopped at a controlled intersection. The ambulance was staffed by a crew of three career emergency medical services (EMS) professionals who were in the process of transporting a patient in a non-emergency mode (without the use of emergency warning lights or siren) for mental health treatment. The 29-year-old belted male driver and 24-year-old belted female front right passenger sustained B-level (non-incapacitating) injuries, the belted 26-year-old male EMS crewmember sustained A-level (incapacitating) injuries, and the partially-belted 47-year-old female patient died from her injuries 8 days after the crash. A portion of the patient compartment completely separated from the Ford's chassis during the crash.

17. Key Words	18. Distribution Statement
Ambulance, patient, fatality, severe separation, wheeled ambulance cot, ambulance remount	Document is available to the public from the National Technical Information Service, www.ntis.gov.

19 Security Classif. (of this report)	20. Security Classif. (of this page)	21 No. of Pages	22. Price
Unclassified	Unclassified	55	

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

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BACKGROUND

This report documents the on-site investigation of a 2016 Ford F-450 Type I ambulance (**Figure 1**) that crashed into the rear of a tanker semi-trailer that was stopped at a controlled intersection. The ambulance was staffed by a crew of three career emergency medical services (EMS) professionals who were in the process of transporting a patient in a non-emergency mode (without the use of emergency warning lights or siren) for mental health treatment. The 29-year-old belted male driver and 24-year-old belted female front right passenger sustained B-level (non-incapacitating) injuries, the belted 26-year-old male EMS crewmember sustained A-level (incapacitating) injuries, and the partially-belted 47-year-old female patient died from her injuries 8 days after the crash. A portion of the patient compartment completely separated from the Ford's chassis during the crash.

Figure 1: Right front oblique view of the 2016 Ford F-450 Type I ambulance at the time of the SCI inspection.

The crash was identified by the Office of EMS of the National Highway Traffic Safety Administration, which notified the Crash Investigation Division. Notification was forwarded to the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., in February 2018. The SCI team contacted the investigating law enforcement agency to determine specifics of the crash, which was assigned for on-site investigation. Cooperation was established with that law enforcement agency and the on-site portion of this investigation took place in March 2018. The on-site activities included the documentation of the ambulance's exterior and interior damage, identification of occupant contact, and the assessment of its manual and supplemental restraint systems. The wheeled ambulance cot was inspected for damage and restraint use, and its fastening system in the patient compartment was also inspected. The Ford was equipped with a restraints control module (RCM) that had event data recorder (EDR) capabilities. However, the RCM had been removed from the vehicle by the law enforcement agency and was not available to the SCI investigator for imaging. The law enforcement agency provided an electronic PDF file of the imaged data and on-scene images to the SCI investigator.

The SCI investigator also conducted an inspection of the crash site and documented the physical environment using photographs and a total station mapping system. An additional component of the on-site investigation included a review of the law enforcement agency's documentation and information concerning the crash, as well as interviews of involved parties. Multiple attempts were made to contact the ambulance service and its involved crewmembers; however, those parties refused to cooperate with the SCI investigation.

CRASH SUMMARY

Crash Site

The crash occurred on a four-lane divided roadway in a rural setting during morning daylight hours. The National Weather Service reported conditions in the locale at the time of the crash as clear skies with a temperature of -2.8 ºC (27 ºF), 100 percent relative humidity, and calm winds. The police crash report listed the environmental conditions as clear and dry.

The east/west roadway consisted of two travel lanes in each direction that were divided by a 9.4 m (30.8 ft) wide depressed grass median. For the eastbound portion, the left (inboard) travel lane was 3.1 m (10.2 ft) wide and the right (outboard) travel lane was 3.5 m (11.5 ft) wide. They were delineated by a single broken white line, with a single solid yellow median line and a single solid white fog line. Although there was no substantial median shoulder, a 2.7 m (8.9 ft) wide shoulder supported the right travel lane. Both the roadway and shoulder surfaces were asphalt. Speed was regulated by a posted limit of 89 km/h (55 mph). **Figure 2** depicts a west-facing lookback view of the roadway. There were no tactile warning strips in the shoulder surfaces. However, for the approach to the intersection, highlighted perpendicular rumble strips alerted traffic to the presence of the signalized intersection (**Figure 3**). They were located 116- to 110 m (380.6- to 360.9 ft) west of the intersection, near the onset of the left turn lane. A crash diagram is included at the end of this report.

Figure 2: West-facing lookback view of the roadway for the ambulance's pre-crash travel trajectory.

Figure 3: East-facing view of the roadway and pre-crash approach of the ambulance to the intersection.

Ambulance Agency, Crew, and Transport Description

Multiple telephone messages and requests to the ambulance service for information concerning the company and its involved employees remained unanswered at the time of this report. Without cooperation of the ambulance service, the SCI investigator conducted a review of paperwork and other articles in the ambulance during the SCI vehicle inspection, researched the company online, and reviewed associated information/documentation. Based on these sources, the following specifics concerning the service and involved crew were determined.

First, the private ambulance service was a multi-tiered medical transport service not associated with any particular medical treatment center. It was capable of providing all levels of EMS care, from basic life support (BLS) to advanced (ALS) critical care. The service performed inter-facility transfers, private requests, and specialty transports, using a fleet of Type I and Type II ambulances. It employed career professionals consisting of administrative staff, support personnel, dispatchers, and emergency medical technicians (EMTs) of varying levels of care. The service maintained its equipment and were certified that they operated in compliance with all Virginia Department of Health regulations. There was no information available or disclosed to the SCI investigator concerning the EMS crew's work schedule, training, or credentials. The only known information is that the crew consisted of three people because one of them was in the process of completing field training time following the person's recent hiring for employment. At the time of the crash, the individual in training was seated in the cab of the ambulance at the front row right positon. No information concerning the crew's activities prior to the incident transport was available.

When the crash occurred, the ambulance was transporting a female patient from a local hospital to a regional facility for specialized psychiatric care. The transport was executed in a non-emergency mode (without the use of emergency warning lights or siren). The distance of the trip was 195 km (121 mi), and would have required approximately 125 minutes of travel time. The crash occurred when the ambulance had completed just 48 km (30 mi) of that distance, approximately 37 minutes into the trip.

Pre-Crash

The following pre-crash specifics were substantiated from the evidence gathered during the SCI investigation and from the statements made to the investigating law enforcement agency by the involved occupants. Prior to the crash, the ambulance was requested to transport the 47-year-old female patient from a local hospital to a regional facility for specialized psychiatric care. The ambulance responded and retrieved the patient, then secured her to the wheeled ambulance cot using the three lateral manual restraint straps (lower leg, thigh, and chest). Although the cot was equipped with the shoulder straps that created a multi-point harness system, they were not used during this specific transport.

Of note, the ambulance service's policies and standard operating guidelines dictated that, unless patient care required otherwise, the patient was to be completely and securely restrained by all harness straps at all times while on the cot. A lack of cooperation by the ambulance service and crew prevented the SCI investigator from determining the specific reasoning concerning the incomplete use of the cot's restraint straps.

The crew loaded the wheeled ambulance cot into the patient compartment and secured it into position using the cot fastening system. The 29-year-old male positioned himself in the driver's seat of the ambulance. The 24-year-old female, who was in the process of completing her field training, assumed the front row right position in the ambulance's cab. She was fatigued, and intended to rest during the lengthy travel time. Both front row occupants used the available 3-point lap and shoulder seat belt systems for their manual restraint. The 26-year-old male EMS crewmember entered the patient compartment and situated himself on the left-facing bench seat. It was his responsibility to oversee the patient and attend to any of her healthcare needs that arose during the long-distance transport. The patient was lying on the wheeled ambulance cot in a semi-Fowler's position, an anatomical position of comfort in which the backrest of the cot was reclined to a supine angle of approximately 30- to 45 degrees.

Based on statements made by the ambulance crew to the investigating law enforcement officer, as the ambulance traveled southeast toward its destination, the patient became drowsy and fell asleep. With no ongoing healthcare duties, the EMS crewmember moved from the bench seat and positioned himself in the rear-facing captain's chair forward of the wheeled ambulance cot. From that position, the crewmember could continue to maintain oversight of the patient. According to the law enforcement documentation of the crash, the EMS crewmember used the 3-point lap and shoulder seat belt for manual restraint.

The ambulance traveled eastbound along the multi-lane divided roadway. It entered an approximate 0.8 km (0.5 mi) straightaway, on approach to the intersection. Data imaged from the Ford's RCM and provided electronically to the SCI investigator by the law enforcement service indicated that the vehicle was traveling at a consistent speed of 103 km/h (64 mph) over nearly the entire 5-second pre-crash data interval. The speed control (cruise control system) was active, which indicated that the driver was allowing the vehicle to maintain its speed as the ambulance traveled along the roadway.

The electronic traffic signal at the intersection cycled to control east/west traffic on the divided roadway. The truck, a 2018 Volvo tractor with tanker semi-trailer, stopped in the right travel lane at the intersection. Also stopped at the intersection was a 2012 Dodge Ram in the left travel lane. The Ford ambulance approached the intersection and back plane of the tanker semi-trailer at speed. An arching 12.8 m (42.0 ft) long rotating tire mark from the ambulance's right front tire evidenced that the driver steered hard left immediately prior to impact in an attempt to avoid the crash. Corresponding braking input was reported by the imaged EDR data at time zero.

Crash

The ambulance's right front tire mark and area of initial impact (highlighted on the roadway by blue marking paint) is depicted in **Figure 4**. The ambulance's front plane, right aspect struck the tanker's back plane, left aspect. Due to the abrupt steering input by the ambulance's driver immediately prior to impact, the associated forces were in the 1 o'clock sector for the Ford ambulance and the 6 o'clock sector for the tanker trailer. The right corner of the Ford's cab engaged the outer left rear wheel/tire of the trailer, while the leading right corner aspect of the patient compartment module engaged the rear plane of the cylindrical tank. Associated forces produced significant deformation to the patient compartment module of the ambulance, and the engagement of the vehicles induced a clockwise rotation to the Ford ambulance.

Figure 4: East-facing view of the ambulance's right front tire mark across the right (outboard) travel lane.

The ambulance maintained forward momentum and separated from the tanker trailer as it rotated clockwise. When it had achieved approximately 35 degrees of total clockwise rotation and traveled a distance of approximately 7 m (23 ft) from the initial point of impact, the second crash event then occurred. The front plane, left aspect of the ambulance struck the rear plane, left aspect of the Dodge. Directions of force were in the 11 o'clock sector for the Ford ambulance and the 6 o'clock sector for the Dodge. Associated forces displaced the Dodge forward, while the clockwise rotation of the Ford was exacerbated.

As the ambulance maintained its clockwise rotation and achieved approximately 90 degrees of total clockwise rotation, its left rear axle entered the depressed grass median. As the vehicle slid to final rest, the momentum of the vehicle and severe damage to the patient compartment caused the entire upper structure of the patient compartment to separate from the forward, right, and rear aspects of the frame. The top and sides of the patient compartment module rolled left off of the vehicle's frame, exposing the entire interior of the patient compartment to the outside environment (**Figure 5**). The Dodge and the Volvo truck tractor with tanker semi-trailer

Figure 5: View of the ambulance at final rest (*on-scene image obtained from an online news source).*

were driven through the intersection after the crash and brought to controlled final rest positions adjacent to the right shoulder.

Post-Crash

There were multiple witnesses to the crash who contacted the local emergency response system. Local fire department, law enforcement, and EMS personnel responded to the crash site. According to law enforcement, first arriving personnel found the wheeled ambulance cot displaced from the fastener system and upside-down on the left wall cabinetry. The patient was still restrained to the wheeled ambulance cot by the three lateral restraints. Emergency personnel used a seat belt cutting tool to cut the three lateral straps of the wheeled ambulance cot's harness system, then removed the cot from on top of the patient. She was observed to have sustained massive head injuries with profuse bleeding, which EMS providers attempted to control using direct pressure dressings. The patient was secured to a long spine board and transported by an ambulance to a local hospital, where she was admitted for care and underwent emergency surgical procedures. Ultimately, the patient died from her injuries 8 days after the crash.

The driver and front row right occupant exited the crashed Ford ambulance under their own power. The male EMS crewmember was removed from the remnants of the patient compartment by emergency personnel, due to the perceived severity of his injuries. All three occupants were transported by other ambulances to local hospitals. Neither the driver of the Volvo truck tractor nor the driver of the Dodge sustained injury.

Local law enforcement conducted their documentation of the crash scene and completed their investigation. A local recovery service transferred the Ford ambulance to a local yard, where it was held pending completion of the law enforcement agency's investigation of the crash. The Volvo truck tractor and tanker semi-trailer were documented at the crash scene and released to their owner. The Dodge was driven from the crash site by its owner.

2016 FORD F-450 SUPER DUTY XLT

Description

The 2016 Ford F-450 (**Figure 6**) was identified by the Vehicle Identification Number (VIN) 1FDUF4GT5GExxxxxx. It was manufactured as an incomplete vehicle chassis in July 2015. The powertrain consisted of a 6.7 liter, V-8 diesel engine that was linked to a 6-speed automatic transmission with a column-mounted shifter and rear-wheel drive. The service brakes were power-assisted front and rear ventilated disc with anti-lock brakes. The vehicle manufacturer's

Figure 6: Left front oblique view of the 2016 Ford F-450 Super Duty at the time of the SCI inspection.

recommended tire size was LT225/70R19.5 with recommended cold tire pressures of 655 kPa (95 PSI) front and 620 kPa (90 PSI) rear.

At the time of the crash, the Ford was configured with Uniroyal tires of the recommended size at the left front and left rear positions. The right front and outer right rear tires were missing from the crash, and no make/model information was visible for the right rear inner tire. The cab of the ambulance was configured with cloth-surfaced bucket seats that had adjustable head restraints and folding inboard armrests. Customized emergency lighting switches and radio communication equipment were mounted to the center stack of the instrument panel. Safety equipment consisted of 3-point lap and shoulder seat belt systems with retractor pretensioners for both of the cab's seat positions. Supplemental restraint was provided by dual-stage frontal air bags and inflatable curtain (IC) air bags for the driver and front right passenger positions. A keyed air bag cut-off switch was mounted in the left aspect of the center instrument panel, to the right of the steering wheel. Both frontal air bags deployed during the crash.

Type I Ambulance Patient Compartment

The Ford's chassis was completed as a Type I ambulance during secondary manufacturing in May 2016. At that time a previously used Horton Emergency Vehicles (original date of manufacture unknown) patient compartment was affixed to the new Ford chassis. Emergency services operations equipment, such as warning lights, sirens, and radio communications, were also installed in the Ford's cab and about the exterior of the vehicle. This installation was classified as a "remount" project, where the patient compartment module from an ambulance whose chassis has exceeded its usable lifetime was recycled by being reconditioned and mounted onto a new vehicle chassis. Electronics and other systems in the patient compartment and about its exterior were updated or replaced in the process. It should be noted that the remount manufacturing practice has been the topic of debate for some time among EMS organizations and professionals, ambulance vehicle manufacturers, and ambulance accreditation committees. As of early 2018, the Commission on Accreditation of Ambulance Services (CAAS) was still working on discussing the issue of remount manufacturing, and had not yet published Standard Documentation.[1] NHTSA has collaborated with the CAAS in this effort.

The patient compartment was equipped as a mobile emergency medical care unit, configured for the seating of up to five total occupants. This included a rear-facing captain's chair at the forward aspect of the patient compartment, a two-occupant left-facing bench seat on the right side, a single-occupant right-facing bench seat on the left side, and a centralized rear-facing wheeled ambulance cot. A visual opening to the cab of the ambulance was located adjacent to the captain's chair positon. There were multiple cabinets and a counter area mounted to the left

[1] Aguirre, L. (2017, August). *Rethinking remounts – Developing a national standard for ambulance remounts*. . Tulsa, OK: JEMS/EMS Insider. Available at www.caas.org/wp-content/uploads/2017/07/Rethinking-Remounts-EMS-Insider-August-2017.pdf

wall of the interior. The layout included double rear-entry doors for cot loading and a single right entry door. Interior cabinets were constructed of plywood and aluminum components of varying thicknesses, bonded together using a variety of glue, wooden pegs, and metallic screws. Surfaces were covered with a laminate finish and/or vinyl-covered foam padding, and all cabinets were outfitted with clear polymer sliding doors. Aluminum corner bead and plastic were used for edge trim. Fiberglass and foam insulation provided thermal and acoustic protection from the environment.

Vehicle Weight/Payload

The Ford chassis was placarded by its manufacturer with a gross vehicle weight rating (GVWR) of 7,484 kg (16,500 lb). This was distributed as gross axle weight ratings (GAWR) of 3,175 kg (7,000 lb) front and 5,443 kg (12,000 lb) rear. Manufacturer literature indicated that the curb weight of the incomplete vehicle chassis (prior to the affixation of the patient compartment module) was 3,305 kg (7,286 lb). The patient compartment was a remounted unit, and there was no weight/payload placard for the total vehicle. Based on SCI expertise and comparative vehicles examined in historical crashes, the typical maximum weight of the patient compartment module did not exceed 2,268 kg (5,000 lb). Therefore, the SCI estimated maximum weight of the vehicle was 5,573 kg (12,286 lb), allowing for a minimum payload of approximately 1,911 kg (4,214 lb).

During the SCI vehicle inspection, the SCI investigator estimated the weight of the equipment and supplies to be approximately 249 kg (550 lb). The combined total weight of the vehicle's occupants was not more than 365 kg (805 lb), for a total payload of occupants plus equipment of no more than 614 kg (1,355 lb). Based on the vehicle's placarded GVWR and other available weight information, it was the SCI investigator's assessment that the ambulance was therefore operating well in its usable payload capacity and weight rating at the time of the crash.

Exterior Damage

The cab of the Ford ambulance sustained moderate front and right plane damage, while the patient compartment sustained significant damage associative to the events of the crash. Direct contact damage relative to the first crash event began on the Ford's front plane at 48 cm (18.9 in) right of center on the bumper beam and extended 40 cm (15.7 in) to the right front bumper corner. The leftmost aspect of the direct contact damage corresponded to the outer left rear tire/wheel of the tanker semi-trailer. At a higher level on the hood, damage began 65 cm (25.6 in) right of center and extended 23 cm (9.0 in) to the right front corner.

A residual crush profile of the front plane was obtained using a direct and induced damage length (Field-L) across the entire 176 cm (69.3 in) width of the damaged bumper beam. The center of the Field-L was the vehicle's centerline, while the direct damage center was located 68 cm (26.8 in) right of center. Accounting for free space due to the contour of the bumper beam, the profile produced the following resultant measurements for the Event 1 damage pattern: C1 – C4 = 0 cm

(0 in), C5 = 4 cm (1.6 in), and C6 = 33 cm (13.0 in). The direct damage extended down the right plane of the ambulance.

SCI reconstruction of the crash determined that the right front tire/wheel of the Ford ambulance engaged the left rear dual tires/wheels of the tanker semi-trailer, which sheared the right front tire/wheel from the Ford. The irregular shape of the damage pattern to the Ford's front plane (**Figure 7**) matched the profile of the semi-trailer's rear plane. The damage extended longitudinally down the right plane of the Ford (**Figure 8**).

Figure 7: Front plane view of the 2016 Ford F-450 and its front plane damage profile.

Figure 8: Right overhead perspective view of the ambulance cab and the magnitude of the damage extent.

The Truck Deformation Classification (TDC) assigned to the Ford for the impact with the rear plane of the tanker semi-trailer was 01FRAE9. No WinSMASH calculations could be performed because the corner impact type and vehicle model were beyond the scope of the model.

The front right aspect of the patient compartment also engaged the rear plane of the semi-trailer. This contact sheared the entire front half of the right wall off of the patient compartment, and produced extensive damage to the patient compartment module. The right rear dual tires/wheels of the ambulance also engaged the left rear dual tires/wheels of the semi-trailer, which contributed to the ambulance's clockwise rotation, sheared the outer right rear tire from the ambulance, and deformed the Ford's wheelbase dimensions. **Figure 9** depicts the right plane of the ambulance at the time of the SCI inspection.

Figure 9: Right plane view of the Ford ambulance and the damage to the patient compartment.

The first impact event with the tanker semi-trailer compromised the integrity of the patient compartment module by separating the walls from the floor structure on the right, front, and rear planes of the patient compartment. During the later stages of the crash, the entire top and sides of the patient compartment module rolled to the left off of the frame, exposing the entire interior to the outside environment. This damage was evident in the on-scene images provided by the investigating law enforcement agency (**Figure 10**).

Figure 10: Right plane view of the Ford and patient compartment remnants (*on-scene law enforcement image*).

The second impact event with the Dodge produced minor damage to the left aspect of the Ford's front plane. Direct contact began 43 cm (16.9 in) left of center on the bumper beam and extended 45 cm (17.7 in) to the left front bumper corner. On the hood, the damage began 50 cm (19.7 in) left of center and extended to the left corner. A small area of red paint transfer was observed on the left front corner of the hood. The left front headlight assembly was disintegrated, and there was minor deformation to the hood and bumper beam (**Figure 11**) which evidenced the Ford's engagement with the Dodge.

Figure 11: Left front damage to the Ford associative to the impact with the Dodge.

A residual crush profile of the front plane was obtained using a direct and induced damage length (Field-L) across the entire 176 cm (69.3 in) width of the damaged bumper beam. The center of the Field-L was the vehicle's centerline, while the direct damage center was located 66 cm (26.0 in) left of center. Accounting for free space due to the contour of the bumper beam, the profile produced the following resultant measurements for the Event 2 damage pattern: C1 = 12 cm (4.7 in), C2 = 8 cm (3.1 in), C3 = 1 cm (0.4 in), and C4-C6 = 0 cm (0 in). The TDC assigned to the Ford for the impact with the rear plane of the Dodge was 11FYEW1. No WinSMASH calculations could be performed because the impact was not in the scope of the model.

Event Data Recorder

The Ford chassis was equipped with an air bag RCM mounted to the center tunnel beneath the center instrument panel. The RCM monitored and measured vehicle acceleration in multiple axes, and had EDR capabilities to record data for longitudinal, lateral, and rollover crash pulses.

The SCI investigator was unable to image any data from the Ford during the vehicle inspection process because the investigating law enforcement agency had removed the RCM and retained it as evidence under direction of a search warrant. The RCM was therefore unavailable to the SCI investigator. However, the law enforcement agency provided an electronic copy (.PDF) of the data, which had been imaged and reported using software version 17.6.1 of the Bosch Crash Data Retrieval tool. The EDR report is included at the end of this technical report as **Appendix A**.

The EDR component of the RCM could record "Non-Deployment" or "Deployment" event types. Non-deployment events could be overwritten by subsequent events, whereas deployment events became locked and could not be overwritten. The RCM had the capacity to store up to two events. At algorithm enable (AE) and recognition of an event, the EDR had the capacity to record up to 250 milliseconds of longitudinal and lateral delta-V data in 10 millisecond intervals. Roll angle data was recorded in 0.1-second intervals for 1 second prior and 5 seconds after AE. Associated to each event was a 5-second pre-crash buffer that recorded vehicle speed (mph), accelerator pedal position (%), service brake (on/off), engine speed (rpm), ABS activity (engaged, non-engaged), and other various data.

The imaged data reported a total of three events, including one locked frontal event, one locked rollover event, and one unlocked event. Due to the limitations of the EDR, data was provided only for the one locked event (First Record) and one unlocked event (Second Record). Both recorded events occurred on ignition cycle 4,912, when the key-on time was 3,850 seconds. The key-on timer data indicated that the Ford had been running for just over 64 minutes of continuous operation when the crash occurred. This matched the pre-crash activities of the ambulance. Based on SCI expertise, the locked frontal event was related to the SCI reconstructed first crash event with the rear plane of the tanker semi-trailer. The locked rollover event occurred 1.9 seconds after the first event. This occurred when the Ford's rear tires/wheels dropped into the depressed median as the vehicle slid to final rest and the entire upper aspect of the patient compartment opened to the left and exposed the vehicle's interior.

Pre-crash data for the two recorded events was consistent. The data samples overlapped with a 2.0-second overlap, corresponding to the 1.9-second interval between the events. The pre-crash data reports included the following data, with time intervals referenced with respect to each individual event record (R):

Time R1	Time R2	Vehicle Speed km/h (mph)	Accelerator Pedal (%-full)	Service Brake	Engine rpm	ABS Activity	Gear Selection
-5.0	-	103 (64)	0	Off	1,928	Non-engaged	Drive
-4.5	-	103 (64)	0	Off	1,924	Non-engaged	Drive
-4.0	-	103 (64)	0	Off	1,928	Non-engaged	Drive
-3.5	-	103 (64)	0	Off	1,928	Non-engaged	Drive
-3.0	-5.0	103 (64)	0	Off	1,926	Non-engaged	Drive
-2.5	-4.5	103 (64)	0	Off	1,924	Non-engaged	Drive

Time R1	Time R2	Vehicle Speed km/h (mph)	Accelerator Pedal (%-full)	Service Brake	Engine rpm	ABS Activity	Gear Selection
-2.0	-4.0	103 (64)	0	Off	1,928	Non-engaged	Drive
-1.5	-3.5	103 (64)	0	Off	1,932	Non-engaged	Drive
-1.0	-3.0	103 (64)	0	Off	1,932	Non-engaged	Drive
-0.5	-2.5	103 (64)	0	Off	1,928	Non-engaged	Drive
0.0	-2.0	102 (63)	0	On	1,730	Engaged	Drive
-	-1.5	0 (0)	0	On	0	Non-engaged	Drive
-	-1.0	30 (19)	0	On	0	Non-engaged	Park
-	-0.5	14 (9)	0	On	0	Non-engaged	Park
-	0.0	1 (1)	0	On	0	Non-engaged	Park

The first record was a deployment event that produced the following commands:

Device	Time (milliseconds)
Pretensioner (retractor), driver	146.5
Pretensioner (retractor), right front	146.5
Frontal air bag, driver	190.5
Frontal air bag, right front	190.5
Inflatable curtain (IC), left	146.5
Inflatable curtain (IC), right	146.5

The maximum recorded longitudinal vehicle velocity change of the first record was -43.68 km/h (-27.14 mph), which was reported at 300 milliseconds after AE. The maximum recorded lateral vehicle velocity change was -15.27 km/h (-9.49 mph), reported 106 milliseconds after AE. Although the lateral delta-V data appeared to have plateaued from the event, the longitudinal delta-V was still increasing. This indicated that the crash pulse had not yet have achieved its maximum in the recording time interval.

For the second record, the maximum recorded longitudinal vehicle velocity change was 13.05 km/h (8.11 mph). This was reported at 300 milliseconds after AE. The maximum lateral vehicle velocity change was 1.12 km/h (0.70 mph), reported 295 milliseconds after AE. Roll angle data revealed a maximum total rotation of less than ten (10) degrees. No supplemental restraint devices were available to deploy for the second trigger. However, based on the recorded delta-V data, no deployment/actuation commands would have occurred due to the direction and magnitude of the forces.

Interior Damage

There was minor damage to the interior of the Ford's cab; however, there was extensive damage to the interior of the patient compartment. The focal damage in the cab was related to intrusion/integrity loss of the right front door, occupant contact, and supplemental restraint (air bag) deployment. There was also a small scuff to the left lower instrument panel associative to contact from the driver's right knee (**Figure 12**). The first impact event with the tanker semi-trailer included longitudinal forces that captured the forward aspect of the right front door and displaced it rearward. This separated the hinges from the right lower A-pillar. Subsequent rearward displacement of the door crushed its rear aspect, which collapsed the latch around the striker.

Figure 12: Crossing view of the ambulance cab interior, with the driver knee contact to the left lower instrument panel identified by yellow marking tape.

The SCI investigator observed that although the door's latch/striker and hinges were separated, the door remained captured in a rearward position due to damage. It is certain that the door was displaced inward (intruded) into the occupant space of the cab during the crash. However, such intrusion was likely less than 5 cm (2.0 in) at maximum engagement during the crash. Intrusion of the door could not be accurately determined during the SCI inspection.

Significant damage to the patient compartment module of the ambulance was related to the engagement with the tanker semi-trailer during the first impact event, and included the complete separation of the forward, right, and rear planes from the floor. The entire stack of cabinetry original located at the forward right corner of the interior was missing. Further integrity loss included the separation of the right entry door and its frame. It was apparent to the SCI investigator, based on the impact dynamics and the observed damage that the cot and patient were likely contacted and displaced by front cabinetry and patient compartment walls as the separation of the patient compartment module occurred during the crash. With the separated cabinetry missing, the SCI investigator was unable to document any contact evidence on the cabinets to support such dynamics. However, blood splatter observed on the ceiling of the interior support the SCI investigator's conclusion (**Figure 13)**.

Figure 13: Rear-facing view of directional blood splatter on the ceiling of the patient compartment.

The only other evidence related to the occupants and their kinematics was an area of pooled blood on the left wall, aft of the CPR seat position (**Figure 14**). This evidenced the final rest position of the patient. She was found post-crash lying face down, still buckled by the lateral restraint straps of the cot and with the cot on top of her.

Figure 14: View of the left wall and pooled blood that evidenced the patient occupant's final rest position.

Manual Restraint Systems

The cab of the Ford was configured with 3-point lap and shoulder seat belt systems for the driver and front right passenger positions. Both systems consisted of continuous loop webbing with a sliding latch plate, an adjustable D-ring, and retractor pretensioners. The front row D-rings were both adjusted to their respective full-down positions at the time of the SCI inspection. The retractor pretensioners were actuated as a result of the crash.

The driver's seat belt webbing was extended from the retractor, with the webbing hanging loosely against the seatback. Definitive abrasions in the polymer surface in the belt path of the latch plate evidenced driver loading during the crash, and corresponded to polymer transfer on the webbing (**Figure 15**). The front right seat belt system was also found hanging loosely and extended from the retractor, with similar loading abrasions on the latch plate. The webbing between the latch plate loading and the D-ring was waffled (**Figure 16**), and evidenced occupant loading from the crash. Based on the SCI investigator's observations, it was evident that the driver and front right passenger were both restrained by the manual seat belt systems at the time of the crash. This determination was supported by the data imaged from the Ford's EDR.

Figure 15: Latch plate loading transfer on the webbing of the Ford's driver safety belt system.

Figure 16: View of the front right passenger's safety belt system and loading evidence.

The patient compartment was configured with manual seat belt systems for each position. For the occupied rear-facing captain's chair, an integrated 3-point lap and shoulder seat belt system was available. It had a retractor mounted in the seat back, with continuous loop webbing and a sliding latch plate. The system was located on the right aspect of the seat, with respect to its orientation. The latch plate was slid upward with excess webbing hanging loosely at the time of the SCI inspection (**Figure 17**). Although there was little evidence of historical wear, there appeared to be slight waffling of the webbing below the latch plate that may have correlated to occupant loading in the crash. It was the opinion of the SCI investigator that the system was in use by the male EMT at the time of the crash.

Figure 17: Three-point lap and shoulder safety belt system for the captain's chair position at the time of the SCI inspection.

The right side bench seat was equipped with two multi-point harness systems, while the left side bench seat was equipped with a manual lap belt system only. These positions were not occupied, nor were any of these restraint systems in use, at the time of the crash.

Supplemental Restraint Systems

The Ford F-450 series was equipped with a dual-stage frontal, front seat-mounted side-impact, and IC air bags for both the driver and front right passenger positions. The driver's frontal air bag was mounted in the hub of the four-spoke steering wheel and concealed by an I-configuration cover flap. The passenger's frontal air bag was mounted in the mid-upper aspect of the right instrument panel and concealed by H-configuration cover flaps. An air bag cut-off switch for the passenger's frontal air bag was located in the left aspect of the center instrument panel, immediately to the right of the steering wheel/column. The switch was not activated at the time of the crash; therefore, there was no suppression of the passenger's frontal air bag. Of the six available air bags, both frontal and both IC air bags deployed as a result of the frontal crash event with the back of the tanker semi-trailer.

The driver's frontal air bag deployed from the module without damage. It was internally tethered, with a pair of 2 cm (0.8 in) diameter vents on the back side of the bag. A discolored scuff, attributed to driver face contact, was located at the 12 o'clock position immediately above the outer circumference of the center stitch pattern (**Figure 18**).

Figure 18: Deployed driver's frontal air bag in the Ford ambulance.

Figure 19: View of the deployed passenger's frontal air bag at the time of the SCI inspection.

The passenger's frontal air bag also deployed without damage during the crash. Although there was no discernable loading evidence on the air bag, an area of splattered red liquid was observed on the left half of the air bag's face (**Figure 19**). The SCI investigator was unable to determine either the specific type of substance splattered on the air bag or its source.

The left and right IC air bags deployed from the roof side rails of the Ford's cab without damage. They provided vertical coverage from the roof to below the beltline, extending down below the base of the side glazing. The left IC air bag appeared to be clean, with no evidence of driver contact (**Figure 20**). However, the right IC air bag had several longitudinal scuffs along its lower half (**Figure 21**), suggestive of make-up transfer and occupant contact by the front row right occupant during the Event 1 impact engagement.

Figure 20: Deployed left IC air bag in the Ford ambulance.

Figure 21: View of the deployed right IC air bag at the time of the SCI inspection.

Wheeled Ambulance Cot

The wheeled ambulance cot installed in the Ford ambulance was a Power Pro XT Model 6500, manufactured by Stryker. Its serial number was S/N 12064xxxx, indicative that it was manufactured in June 2012. The Stryker cot (**Figure 22**) was constructed of a tubular aluminum frame with circumferential weld joints and steel hardware fasteners. The X-frame supporting the mattress platform featured power lift capabilities with infinite height positions between a minimum of 36 cm (14 in) and a maximum of 105 cm (41.5 in). The mattress platform featured 0-73 degrees of positive backrest angular adjustment via a manually controlled gas-pressure cylinder. In a similar fashion, the leg portion featured 15 degrees of positive angular adjustment.

Figure 22: View of the Stryker Power Pro wheeled ambulance cot at the time of the SCI inspection.

Overall dimensions of the cot were 58 cm (23 in) wide and 206 cm (81 in) long. A placard declared that the load capacity limit of the cot was 318 kg (700 lb). Electrical power was supplied by a removable 24-V nickel-cadmium (NiCad) direct current battery manufactured by DeWalt.

The Stryker cot was equipped with a multi-point harness system for manual restraint of its occupant (patient). This system consisted of a lateral lower extremity strap, a lateral lap/thigh strap, and an upper torso harness which incorporated two shoulder straps that buckled into a lateral chest strap. All of the straps were constructed of fixed-length webbing that included either locking latch plates or sewn buckles.

At the time of the SCI inspection, the three lateral straps had all been cut adjacent to the right side of the cot, and their latch plates remained engaged in their respective buckles. The shoulder harness straps hung loosely, were not damaged, and were not buckled in the lateral chest strap. This indicated to the SCI investigator that the shoulder straps were not in use at the time of the crash. Only the lateral harness strap was used in the partial restraint of the cot occupant. **Figure 23** depicts the shoulder straps and lateral chest strap, with the cut location to the lateral strap visible on the right edge of the mattress platform.

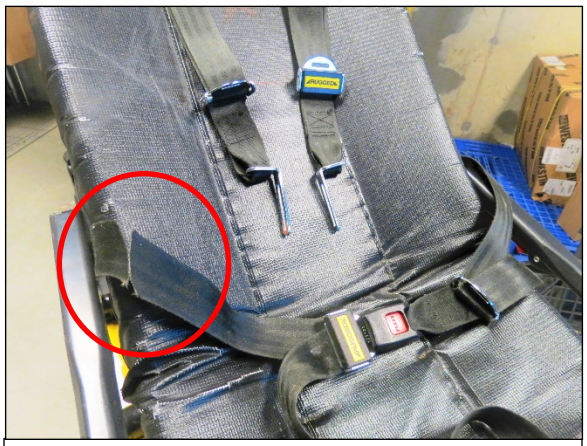


Figure 23: Lateral chest strap buckled without the shoulder straps (*cut location highlighted by the red circle*).

Cot Damage

The patient cot sustained minor damage attributable to occupant loading and contact with displaced cabinets in relation to the crash event. The locking pin was slightly rotated on the right lower frame rail, evidentiary of the loading force exerted on it by the combined mass of the cot and patient during the crash. The forward support of the left arm rail was fractured (**Figure 24**), likely associative to contact with cabinetry while being displaced during the crash. There was also a few small gouges/tears in the fabric of the mattress at the top of the backrest, with a small area of blood transfer from the patient occupant (**Figure 25**).

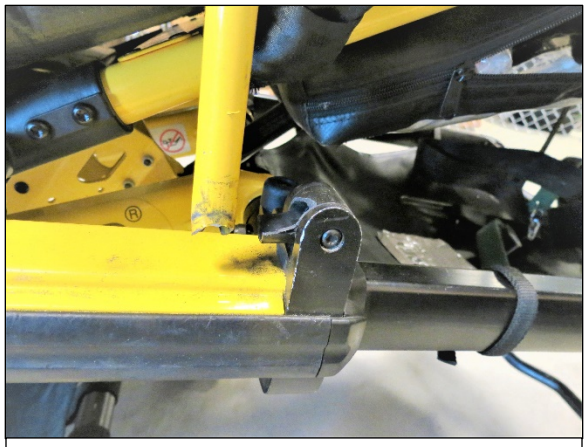


Figure 24: View of the fractured left arm rail support.

Figure 25: Blood transfer on top edge of cot mattress.

Cot Fastening System

The Stryker ambulance cot was secured in place and positioned in the floor of the patient compartment via a Stryker Model 6370 Cot Fastener System. It was identified by the S/N: 39612. The system consisted of a forward antler bracket and a rear locking rail-clamp mechanism, both of which were mounted to the floor of the patient compartment. The antler bracket cradled the forward portion of the cot's frame, while the vertically-oriented locking clamp mechanism secured the locking pin that was affixed to the lower frame rail of the cot.

The antler bracket was secured to the floor of the patient compartment by two hand-tightened bolts that were in-line at the forward and aft aspect of the steel tube bracket. Four bolts held the rectangular base of the clamp to a vertical support. Combined, these two components were intended to restrict the lateral and longitudinal movement of the cot in the ambulance during transport. **Figures 26 and 27** depict the antler bracket and locking clamp mechanism as observed by the SCI investigator during the vehicle inspection.

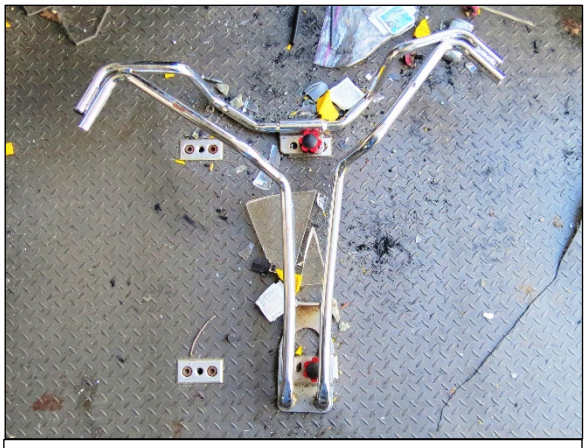


Figure 26: Antler bracket of the cot fastening system mounted in the Ford ambulance.

Figure 27: Disengaged locking clamp mechanism in the patient compartment.

The SCI investigator observed that the bolts of the antler bracket remained intact and the bracket was in place. However, it was crooked with respect to the alignment of the securement points, and the right aspect was deformed diagonally to the front and right (toward the direction of the primary impact forces). The rail clamp mounting bracket, bolts, and clamp mechanism also remained intact, with the clamp in the unlocked position. The SCI investigator concluded that the clamp had released during the crash. The occupant responded toward the frontal crash force and the back of her torso compressed against the mattress platform and inclined back support. This translated a loading force into the cot's frame. The moment of this force created a load at the locking clamp mechanism that forced the rail clamp open.

2016 FORD F-450 TYPE I AMBULANCE OCCUPANT DATA

Driver Demographics

Age/sex:	29 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Rearmost
Manual restraint usage:	3-point lap and shoulder seat belt
Usage source:	Vehicle inspection
Air bags:	Front and IC air bags available; both deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Exited under own power
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Treated and released

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Left index finger laceration 1.5 cm	710602.1	Left upper instrument panel	Certain
2	Right elbow abrasion	710202.1	Center instrument panel/center stack	Certain

Source: Emergency room records

Driver Kinematics

The 29-year-old male driver of the Ford ambulance was seated in the bucket seat with the track adjusted to its full-rear position and the seatback slightly reclined. He was restrained by the available 3-point lap and shoulder seat belt system. The driver's belt usage was determined from its post-crash condition observed by the SCI investigator during inspection, and confirmed by the imaged RCM data.

The driver used the cruise control feature of the vehicle to allow the Ford to maintain its travel speed. The vehicle entered a long straightway and approached the controlled intersection at a constant speed. The rapid left steering and abrupt braking avoidance attempt by the driver immediately prior to the crash suggested that the driver may have been distracted as he approached the stopped tanker semi-trailer. The exact source of his distraction, if any, could not be determined by this SCI investigation.

Regardless, the driver remained belted and in the bucket seat position as he steered hard left and depressed the brake pedal. At impact with the tanker semi-trailer, the driver initiated a forward and slightly right trajectory. His body loaded the seat belt system after the webbing's slack was reduced by the actuation of the seat belt pretensioner system.

The driver's right knee contacted and scuffed the left lower instrument panel, while his chest and face contacted the deployed driver's frontal air bag. His arms extended forward and his hands likely deflected off of the upper instrument panel, which possibly produced the laceration to his left finger and abrasion to his right elbow. There were no further injuries documented to substantiate or support the driver's kinematics.

The Ford began to rotate clockwise as it deflected off of the tanker semi-trailer's left rear corner aspect. The driver remained belted, and his overall displacement about the interior was prevented by his manual restraint usage. It is likely that the secondary impact with the back plane of the Dodge was of insufficient severity to affect the driver's kinematics or induce injury.

The driver remained buckled in the seat belt system as the ambulance slid to rest at the intersection. He was likely directed rearward and to the left in relation to the forces associated with the drop off into the median, and possibly contacted the deployed left IC air bag with his

left flank. However, there was no discernable contact evidence or injury to support such contact. The driver exited the Ford without assistance through the left front door. Following the arrival of emergency response personnel, he was transported by ambulance to a local hospital for evaluation. The driver was treated and released within hours of the crash. He was later criminally charged with reckless driving and involuntary manslaughter. The outcome of those charges had not yet been determined at the time of this report.

Front Row Right Occupant Demographics

Age/sex:	24 years/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Forward-facing bucket seat with adjustable head restraint
Seat track position:	Rearmost
Manual restraint usage:	3-point lap and shoulder seat belt
Usage source:	Vehicle inspection
Air bags:	Front and IC air bags available; both deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Exited under own power
Transport from scene:	Ambulance to a local hospital
Type of medical treatment:	Treated and released

Front Row Right Occupant Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Right breast contusion, NFS	410402.1	Seat belt system	Certain
2	Left breast contusion, NFS	410402.1	Seat belt system	Certain
3	Right wrist contusion	710402.1	Right door panel, forward upper quadrant	Certain
4	Multiple small abrasions to right hand	710202.1	Right door panel, forward upper quadrant	Certain
5	Multiple small abrasions to forehead	210202.1	Deployed frontal air bag	Probable
6	Multiple small abrasions to right cheek	210202.1	Deployed frontal air bag	Probable
7	Multiple small abrasions to left cheek	210202.1	Deployed frontal air bag	Probable
8	Multiple small abrasions to right lower leg	810202.1	Right lower instrument panel	Certain
9	Multiple small abrasions to lower left leg	810202.1	Right lower instrument panel	Certain

Source: Emergency room records

Front Row Right Occupant Kinematics

The 24-year-old female front row right occupant of the Ford ambulance was seated in the bucket seat with the track adjusted to its full-rear position and the seatback slightly reclined. She was restrained by the available 3-point lap and shoulder seat belt system, her usage of which was determined from the post-crash condition of the system as observed by the SCI investigator. Her belted status was also later confirmed by the imaged RCM data.

The front row right occupant was completing her field training time as part of the process to receiving full time employment with the company. She was fatigued, and elected to sit in the front row right position for the extended trip so that she could rest. It is believed that the front row right occupant was slouched in the right front seat position and asleep when the crash occurred.

At impact with the rear plane of the tanker semi-trailer, the front row right occupant initiated a forward trajectory. Her body loaded the seat belt system, which likely produced the contusions to her breasts. Her lower extremities extended forward and engaged the underside of the right lower instrument panel, resulting in abrasions to her lower legs. The front row right occupant also contacted the deployed passenger's frontal air bag, which probably produced the multiple small abrasions to her forehead and face. Last, her right arm contacted and engaged the forward upper quadrant of the right front door as it intruded during the vehicle to vehicle engagement. This contact produced the contusions and abrasions to her right wrist and hand. Although there was no discernable contact evidence support these contacts, the dynamics of the crash and documented injuries supported the SCI investigators assessment of the front row right occupant's kinematics.

The secondary impact with the back plane of the Dodge was of insufficient severity to affect the front row right occupant's kinematics or induce injury. She remained belted and in the front row right seat position as the vehicle slid to final rest at the intersection. The forces associated with the drop-off of the Ford's rear wheels into the median likely directed the front row right occupant against the seat back and slightly to the left. After the crash, she exited the ambulance's cab by crawling over the center console and out of the left front door. She was transported to a local hospital by ambulance, treated, and released within hours of the crash.

Captain's Chair Occupant Demographics

Age/sex:	26 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Captain's chair (box-mounted)
Seat track position:	Not adjustable
Manual restraint usage:	3-point lap and shoulder seat belt
Usage source:	Vehicle inspection

Air bags: None available
Alcohol/drug involvement: None
Egress from vehicle: Removed from vehicle due to perceived serious injuries
Transport from scene: Ambulance to Level II trauma center
Type of medical treatment: Admitted and hospitalized for 4 days

Captain's Chair Occupant Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Grade 3 liver laceration involving segments 2 and 3	541824.3	Displaced cabinetry	Probable
2	Concussion, NFS	161000.2	Displaced cabinetry	Probable
3	Left elbow avulsion fracture of the distal humerus	751351.2	Displaced cabinetry	Probable
4	Contusion to left anterior interosseous nerve or localized branch of radial nerve	730602.1	Displaced cabinetry	Probable
5	Contusion to left elbow	710402.1	Displaced cabinetry	Probable
6	Small frontal scalp laceration within hair	110602.1	Displaced cabinetry	Probable
7	Scalp laceration right apex	110600.1	Displaced cabinetry	Probable
8	Scalp laceration left apex	110600.1	Displaced cabinetry	Probable
9	Laceration left face near tragus of ear	210600.1	Displaced cabinetry	Probable
10	Laceration above left eyebrow 1 cm	210602.1	Displaced cabinetry	Probable
11	Small left frontotemporal scalp hematoma	110402.1	Displaced cabinetry	Probable
12	Contusion to left eye	210402.1	Displaced cabinetry	Probable
13	Left finger laceration 2 cm	710602.1	Displaced cabinetry	Probable
14	Abrasion on back near the lower thoracic spine, midline	410202.1	Displaced cabinetry	Probable
15	Abrasion above lower abdomen	510202.1	Displaced cabinetry	Probable
16	Abrasions to right scapula	710202.1	Displaced cabinetry	Probable
17	Abrasions to left scapula	710202.1	Displaced cabinetry	Probable
18	Abrasions to left forearm	710202.1	Displaced cabinetry	Probable
19	Abrasion to right shin	810202.1	Displaced wheeled ambulance cot	Probable
20	Abrasion to left shin	810202.1	Displaced wheeled ambulance cot	Probable

Source: Hospital records

Captain's Chair Occupant Kinematics

The 26-year-old male EMS provider was seated in the rear-facing captain's chair of the patient compartment when the crash occurred. He was originally seated on the left-facing bench seat, but had moved to the captain's chair after the patient fell asleep during the long distance transport. Slight waffling of the webbing and the overall post-crash condition of the seat belt system appeared to the SCI investigator to correspond to usage of the seat belt system by the captain's chair occupant at the time of the crash.

The EMS provider's responsibilities were limited during the trip due to the mental health nature of the transport, and with the patient sleeping, there was little for him to do. He likely was positioned leaning to his right against the left wall of the patient compartment.

At impact with the tanker semi-trailer, the captain's chair occupant initiated a rearward and left trajectory with respect to his rear-facing orientation. His body depressed against the seat back and cushion of the captain's chair, and his left flank was exposed from the left side of the seat. During the engagement of the ambulance and semi-trailer, the stack of cabinetry at the right front corner of the patient compartment became displaced toward the rear left of the patient compartment. This cabinetry contacted and engaged the captain's chair occupant during its displacement, producing numerous injuries to the occupant's left flank, left upper extremity, left head, and back. His usage of the manual seat belt system prevented his displacement from the captain's chair as the ambulance then rotated clockwise and was redirected.

The secondary impact with the back plane of the Dodge was of insufficient severity to affect the captain's chair occupant's kinematics or induce injury.

The captain's chair occupant remained belted, and was subsequently drawn rearward and to the left (forward and to his right with respect to his orientation) as the entire left wall of the patient compartment rolled to the left off of the ambulance's frame and the rear wheels of the Ford dropped off into the median. It is highly likely that the occupant was contacted by other loose objects during this time. However, the overall severity of this displacement was minimal, and likely did not produce significant injury or exacerbate the severity of injuries he had already sustained. The captain's chair occupant was removed from the wreckage by emergency response personnel due to the perceived level of severity of his injuries. He was transported to a Level II trauma center and hospitalized for 4 days for the treatment of his injuries.

Wheeled Ambulance Cot Occupant Demographics

Age/sex:	47 years/female
Height:	Unknown
Weight:	65 kg (143 lb)
Eyewear:	Unknown
Seat type:	Wheeled ambulance cot
Seat track position:	N/A

Manual restraint usage:	Multi-point harness system available; lateral restraint straps only used (shoulder harness straps not used)
Usage source:	Vehicle inspection
Air bags:	None available
Alcohol/drug involvement:	None
Egress from vehicle:	Removed from vehicle due to perceived serious injuries
Transport from scene:	Ambulance to Level II trauma center
Type of medical treatment:	Admitted; died 8 days after crash

Wheeled Ambulance Cot Occupant Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Diffuse axonal injury	161012.5	Displaced cabinetry	Probable
2	Diffuse cerebral edema with right-to-left shift of 7 mm	140672.4	Displaced cabinetry	Probable
3	Diffuse subarachnoid hemorrhage involving the bifrontal temporal regions, parietal regions, occipital region and sylvian fissure	140695.3	Displaced cabinetry	Probable
4	Subdural hemorrhage layering along tentorium adjacent to falx cerebri	140651.3	Displaced cabinetry	Probable
5	Contusion to inferior left frontal lobe	140602.3	Displaced cabinetry	Probable
6	Degloving-type injury to left scalp/24 cm full-thickness laceration with galea and temporalis muscle exposed and bleeding	110804.2	Displaced cabinetry	Probable
7	Subacute emphysema scalp hematoma	110402.1	Displaced cabinetry	Probable
8	Fractures to left 1st-4th, 8th-9th, 11th-12th ribs; fractures to right 1st, 8th-9th ribs	450203.3	Left wall cabinetry	Probable
9	Tiny left apical pneumothorax	442202.2	Left wall cabinetry	Probable
10	Minimal contusion to lung apex	441407.2	Left wall cabinetry	Probable
11	Fracture to right pedicle, C6	650226.2	Displaced cabinetry	Probable
12	Fracture to C6 bilateral lamina	650217.2	Displaced cabinetry	Probable
13	Fracture of right lateral vertebral body, C7	650230.2	Displaced cabinetry	Probable
14	Fracture of right pedicle, C7	650226.2	Displaced cabinetry	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
15	Transverse fracture, T8	650420.1	Displaced cabinetry	Probable
16	Fracture to left pedicle, T8	650426.2	Displaced cabinetry	Probable
17	Fracture to left lamina, T8	650424.2	Displaced cabinetry	Probable
18	Minimal compression fracture of central aspect of vertebral body, T11	650432.2	Displaced cabinetry	Probable
19	Minimal compression fracture of central aspect of vertebral body, T12	650432.2	Displaced cabinetry	Probable
20	Comminuted left scapular fracture	750900.2	Displaced cabinetry	Probable
21	Comminuted angulated fracture of midshaft of left humerus	751271.2	Displaced cabinetry	Probable

Source: Hospital records

Wheeled Ambulance Cot Occupant Kinematics

The 47-year-old female patient of the Ford ambulance was positioned semi-Fowler on the wheeled ambulance cot. She was partially restrained by the cot's multi-point harness system: all three lateral restraint straps were used (leg, thigh, and chest), but the shoulder harness straps were not in use. The specific reason for the lack of complete usage of the harness system by the crew remains unknown.

The patient's restraint status was determined by the SCI investigator through a post-crash examination of the wheeled ambulance cot. The patient was being transported long distance for a specialized mental health care. There was no emergent condition requiring active intervention by the EMS crew; it was a relaxed, "routine" trip. The patient ultimately fell asleep on the cot, and was believed to have been sleeping when the crash occurred. At impact with the tanker semi-trailer, the patient initiated a trajectory toward the impact forces. Her posterior compressed and loaded the mattress platform of the cot, and the force load translated through the cot's frame to the locking clamp mechanism. The patient began to slide vertically up the reclined backrest of the mattress platform as she maintained her loading force on the ambulance cot. The combination of the patient's loading force, the cot's mass, and the crash forces caused the cot to begin to pitch forward. The patient maintained her trajectory and slid beneath the lateral restraint straps of the multi-point harness system. The lack of shoulder restraint strap usage prevented restriction of her upper body as her shoulders passed beyond the mattress platform and separated from the cot.

The stack of cabinetry at the forward right aspect of the patient compartment became separated by the impact and was projected rearward and to the left. This stack of cabinetry contacted the

captain's chair occupant and patient as it was projected into the patient compartment. This produced extensive head, spine, and thoracic injuries to the patient, and redirected her back toward the cot in the direction of the left rear of the patient compartment. The separated cabinetry and right wall components contacted the cot and displaced it vertically and toward the left wall of the patient compartment. The patient remained partially belted to the cot, and was displaced with the cot as it separated from the cot fastening system.

The secondary impact with the back plane of the Dodge was of insufficient severity to affect the patient's kinematics or induce injury. The cot and patient occupant were directed rearward and to the left as the Ford's rear wheels dropped into the median and the entire patient compartment rolled to the left and off from the Ford's chassis. The patient contacted the left wall cabinetry face-down, with the cot still partially belted to her back. This increased her loading force on the left cabinetry, and may have exacerbated the severity of her injuries. When the ambulance came to final rest, the patient was face down on the left wall of the patient compartment facing rearward, still restrained to the cot by the lateral harness straps, and with the entire wheeled ambulance cot on top of her. Emergency response personnel cut the lateral straps of the harness system along the right side of the cot (with respect to the occupant's focal direction) and lifted the cot off of the patient. They immobilized her on a long spine board and transported her by ambulance to a Level II trauma center. The patient ultimately succumbed to her injuries 8 days after the crash.

2018 VOLVO TRUCK TRACTOR/TANKER SEMI-TRAILER

Description

The stopped tractor/semi-trailer unit was a 2018 Volvo conventional tractor with tanker semi-trailer. The tractor was identified by the VIN 4V4NC9EH2JNxxxxxx; no VIN was available for the tanker semi-trailer. The Volvo tractor did not sustain damage as a result of the crash. However, significant damage was sustained by the rear aspect of the tanker semi-trailer. The truck and semi-trailer were retained by their respective owners after the crash, and had returned to their out-of-State origin prior to SCI case assignment. Consequently, neither was available for SCI inspection. **Figure 28** depicts the combined unit at the crash site, while **Figure 29** depicts the damage pattern to the back of the tanker semi-trailer.

Figure 28: Left rear oblique view of the truck tractor and semi-trailer (*on-scene law enforcement image*).

Figure 29: Left lateral view of the damage tanker semi-trailer (*on-scene law enforcement image*).

Occupant Data

According to the PAR, the Volvo was operated by a belted male driver who did not sustain injury. His age remains unknown due to sanitization of the PAR by the law enforcement agency.

2012 DODGE RAM 2500

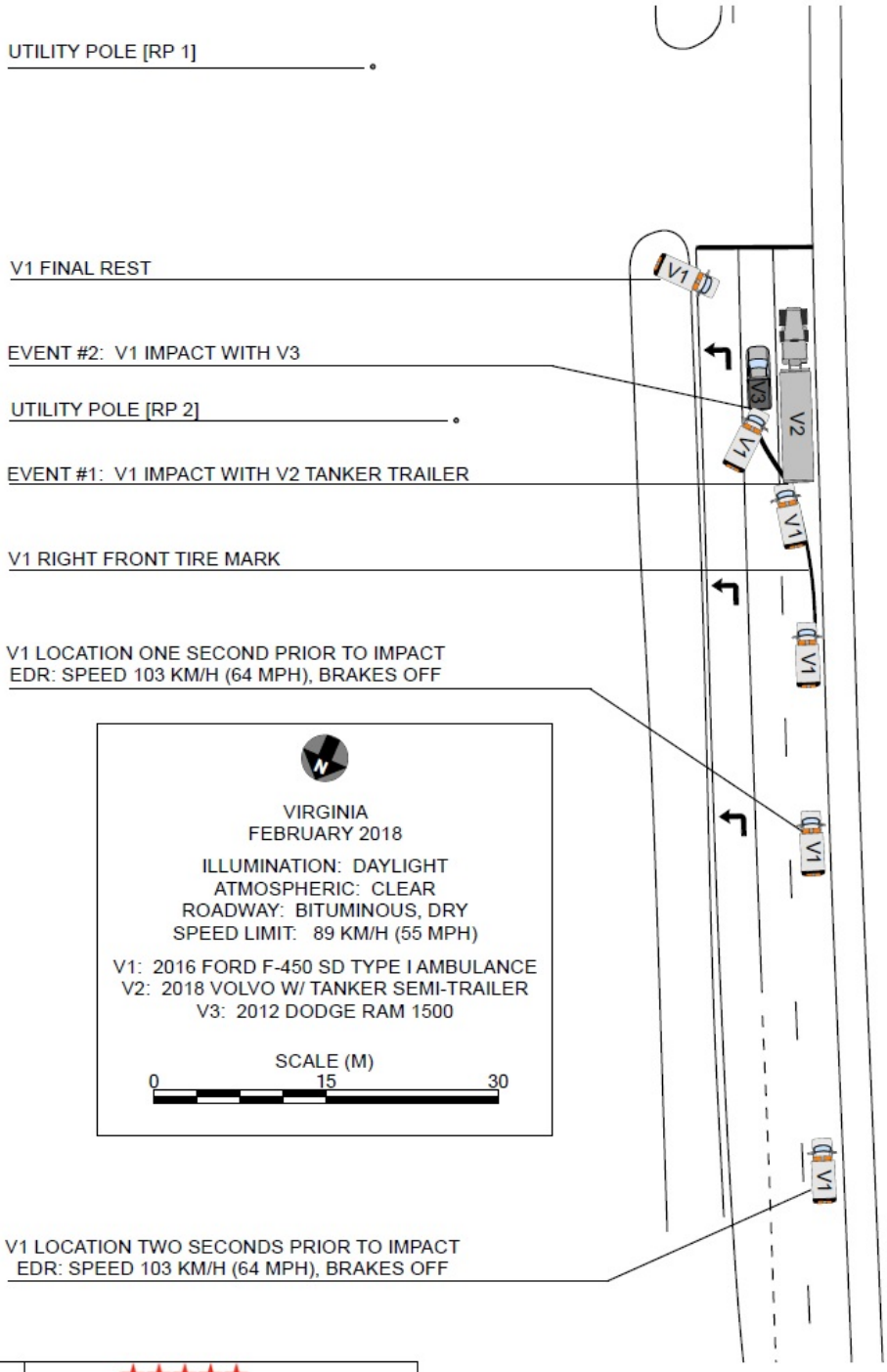
Description

The third vehicle in this crash was a 2012 Dodge Ram 2500 series pickup truck, identified by the VIN 3C6UD5DL6CGxxxxxx. It was powered by a 6.7 liter, V-8 diesel engine that was linked to a 4-wheel drive platform. The vehicle was stopped at the intersection when the crash occurred and sustained minor rear plane damage. It was driven from the scene post-crash and retained by its owner; it was not available for SCI inspection. There were no images of the Dodge in the law enforcement records.

Occupant Data

According to the PAR, the Dodge was operated by a belted male driver who did not sustain injury. His age remains unknown due to sanitization of the PAR by the law enforcement agency.

CRASH DIAGRAM



	NHTSA www.nhtsa.gov
Case Number:	CR18003

APPENDIX A: 2016 Ford F-450 Super Duty Event Data Recorder Report[2]

[2] The Bosch CDR report in this technical report was imaged by the investigating law enforcement agency using the current version of the Bosch CDR software at the time of imaging the EDR. Only an electronic PDF file of the Bosch CDR report was provided by the law enforcement agency, and the EDR hexadecimal data has been deleted from the report due to potential personal identifiable information (vehicle identification number, etc.).

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	1FDUF4GT5GExxxxxx
User	
Case Number	
EDR Data Imaging Date	02/27/2018
Crash Date	
Filename	1FDUF4GT5GExxxxxx_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.6.1
Imaged with Software Licensed to (Company Name)	
Reported with CDR version	Crash Data Retrieval Tool 17.6.1
Reported with Software Licensed to (Company Name)	
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	No
Event(s) recovered	locked frontal event locked rollover event unlocked event

Comments

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 Tuesday, February 27 2018 at 13:45:12.

Data Limitations

Restraints Control Module Recorded Crash Events:
Deployment Events cannot be overwritten or cleared from the Restraints Control Module (RCM). Once the RCM has deployed any airbag device, the RCM must be replaced. The data from events which did not qualify as deployable events can be overwritten by subsequent events. The RCM can store up to two deployment events.

Airbag Module Data Limitations:

- Restraints Control Module Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced from the point of algorithm wake up. It is not the speed the vehicle was traveling before the event. Note that the vehicle speed is recorded separately five seconds prior to algorithm wake up. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change.
- Event Recording Complete will indicate if data from the recorded event has been fully written to the RCM memory or if it has been interrupted and not fully written.
- If power to the Airbag Module is lost during a crash event, all or part of the crash record may not be recorded.
- For 2011 Ford Mustangs, the Steering Wheel Angle parameter indicates the change in steering wheel angle from the previously recorded sample value and does not represent the actual steering wheel position.

Airbag Module Data Sources:

- Event recorded data are collected either INTERNALLY or EXTERNALLY to the RCM.

  - INTERNAL DATA is measured, calculated, and stored internally, sensors external to the RCM include the following:
    > The Driver and Passenger Belt Switch Circuits are wired directly to the RCM.
    > The Driver's Seat Track Position Switch Circuit is wired directly to the RCM.
    > The Side Impact Sensors (if equipped) are located on the side of vehicle and are wired directly to the RCM.
    > The Occupant Classification Sensor is located in the front passenger seat and transmits data directly to the RCM on high-speed CAN bus.
    > Front Impact Sensors (right and left) are located at the front of vehicle and are wire directly to the RCM.

  - EXTERNAL DATA recorded by the RCM are data collected from the vehicle communication network from various sources such as Powertrain Control Module, Brake Module, etc.

02007_RCM-RC6_r002

System Status at Time of Retrieval

VIN as programmed into RCM at factory	1FDUF4GT5GExxxxxx
Current VIN from PCM	1FDUF4GT5GExxxxxx
Ignition cycle, download (first record)	4,913
Ignition cycle, download (second record)	4,913
Restraints Control Module Part Number	DC3T-14B321-BB
Restraints Control Module Serial Number	3133464100000000
Restraints Control Module Software Part Number (Version)	CT43-14C028-AB
Left/Center Frontal Restraints Sensor Serial Number	1BA1F1EC
Left Side Restraint Sensor 1 Serial Number	5FC065D3
Left Side Restraint Sensor 2 Serial Number	00000000
Right Frontal Restraints Sensor Serial Number	00000000
Right Side Restraint Sensor 1 Serial Number	790024000
Right Side Restraints Sensor 2 Serial Number	00000000

System Status at Event (First Record)

Recording Status	Locked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	1
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	21,191,700
Key-on Timer at event time zero (seconds)	3,850
Vehicle voltage at time zero (Volts)	13.689
Energy Reserve Mode entered during event (Y/N)	Yes
Time Passenger Second Row Satellite Sensor Lost Relative to Time Zero (msec)	150.0

Faults Present at Start of Event (First Record)

No Faults Recorded

Deployment Data (First Record)

Frontal airbag deployment, time to first stage deployment, driver (msec)	190.5
Side curtain airbag deployment, time to deploy, driver side (msec)	146.5
Pretensioner (retractor) deployment, time to fire, driver (msec)	146.5
Frontal airbag deployment, time to first stage deployment, front passenger (msec)	190.5
Side curtain airbag deployment, time to deploy, right side (msec)	146.5
Pretensioner (retractor) deployment, time to fire, right front passenger (msec)	146.5
Maximum delta-V, longitudinal (MPH [km/h])	-27.14 [-43.68]
Time, maximum delta-V longitudinal (msec)	300
Maximum delta-V, lateral (MPH [km/h])	-9.49 [-15.27]
Time, maximum delta-V lateral (msec)	106
Left or center front, satellite Sensor discriminating deployment	Yes
Left or center, front satellite Sensor safing	Yes
RCM, front sensor discriminating deployment	Yes
RCM, front sensor safing	Yes
RCM, rollover sensor discriminating deployment	Yes
RCM, vertical sensor safing	Yes
Longitudinal Delta-V Time Zero Offset	9.5 ms
Lateral Delta-V Time Zero Offset	9.5 ms
Roll Angle Time Zero Offset	19.5 ms

Pre-Crash Data -1 sec (First Record)

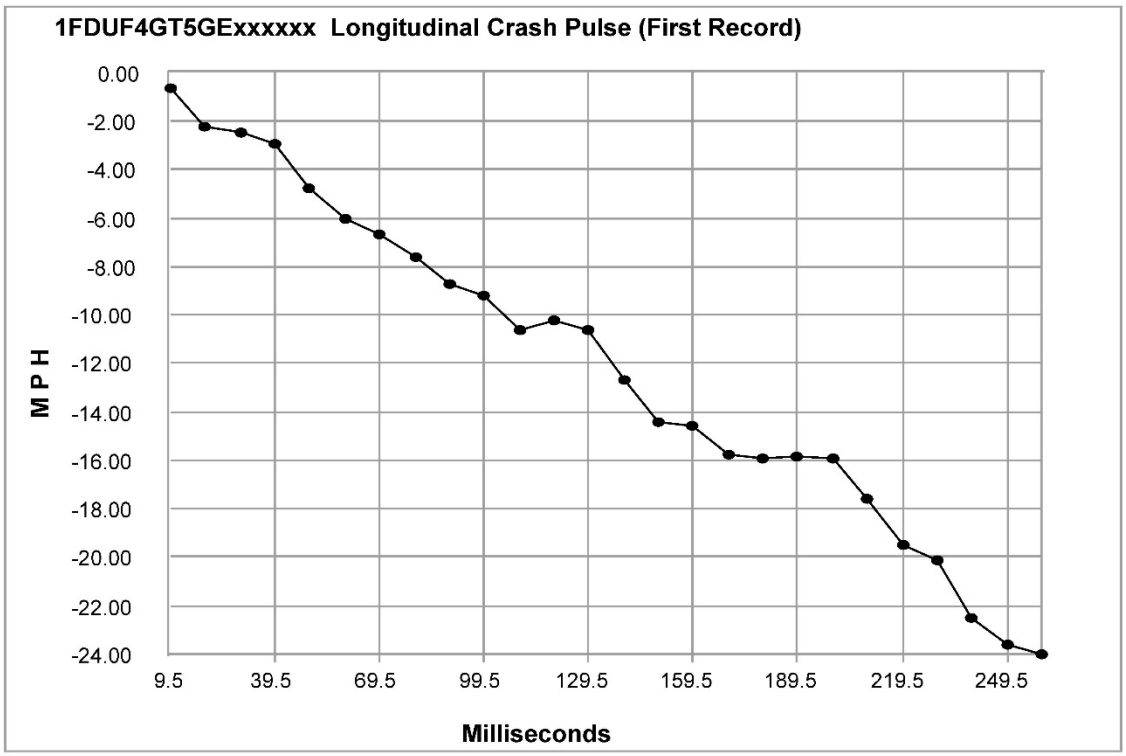
Ignition cycle, crash	4,912
Frontal air bag warning lamp, on/off	Off
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Buckled
Brake Telltale	Off
ABS Telltale	Off
Powertrain Wrench Telltale	Off
Speed Control Telltale	Active
MIL Telltale	Off

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

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
- 4.5	64 [103]	0.0	Off	1,924	non-engaged	No	Drive
- 4.0	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
- 3.5	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
- 3.0	64 [103]	0.0	Off	1,926	non-engaged	No	Drive
- 2.5	64 [103]	0.0	Off	1,924	non-engaged	No	Drive
- 2.0	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
- 1.5	64 [103]	0.0	Off	1,932	non-engaged	No	Drive
- 1.0	64 [103]	0.0	Off	1,932	non-engaged	No	Drive
- 0.5	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
0.0	63 [102]	0.0	On	1,730	engaged	No	Drive

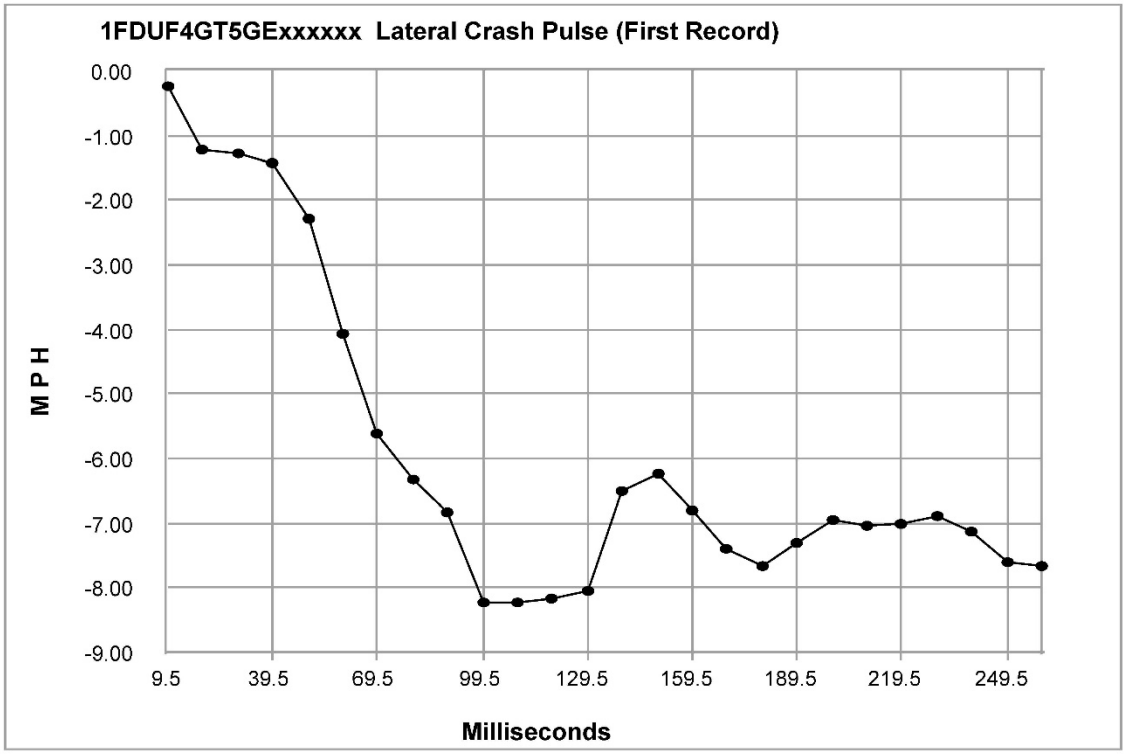
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

Times (sec)	Steering Wheel Angle (degrees)
- 5.0	0.0
- 4.9	0.0
- 4.8	0.0
- 4.7	0.0
- 4.6	0.0
- 4.5	0.0
- 4.4	0.0
- 4.3	0.0
- 4.2	0.0
- 4.1	0.0
- 4.0	0.0
- 3.9	0.0
- 3.8	0.0
- 3.7	0.0
- 3.6	0.0
- 3.5	0.0
- 3.4	0.0
- 3.3	0.0
- 3.2	0.0
- 3.1	0.0
- 3.0	0.0
- 2.9	0.0
- 2.8	0.0
- 2.7	0.0
- 2.6	0.0
- 2.5	0.0
- 2.4	0.0
- 2.3	0.0
- 2.2	0.0
- 2.1	0.0
- 2.0	0.0
- 1.9	0.0
- 1.8	0.0
- 1.7	0.0
- 1.6	0.0
- 1.5	0.0
- 1.4	0.0
- 1.3	0.0
- 1.2	0.0
- 1.1	0.0
- 1.0	0.0
- 0.9	0.0
- 0.8	0.0
- 0.7	0.0
- 0.6	0.0
- 0.5	0.0
- 0.4	0.0
- 0.3	0.0
- 0.2	0.0
- 0.1	0.0
0.0	0.0



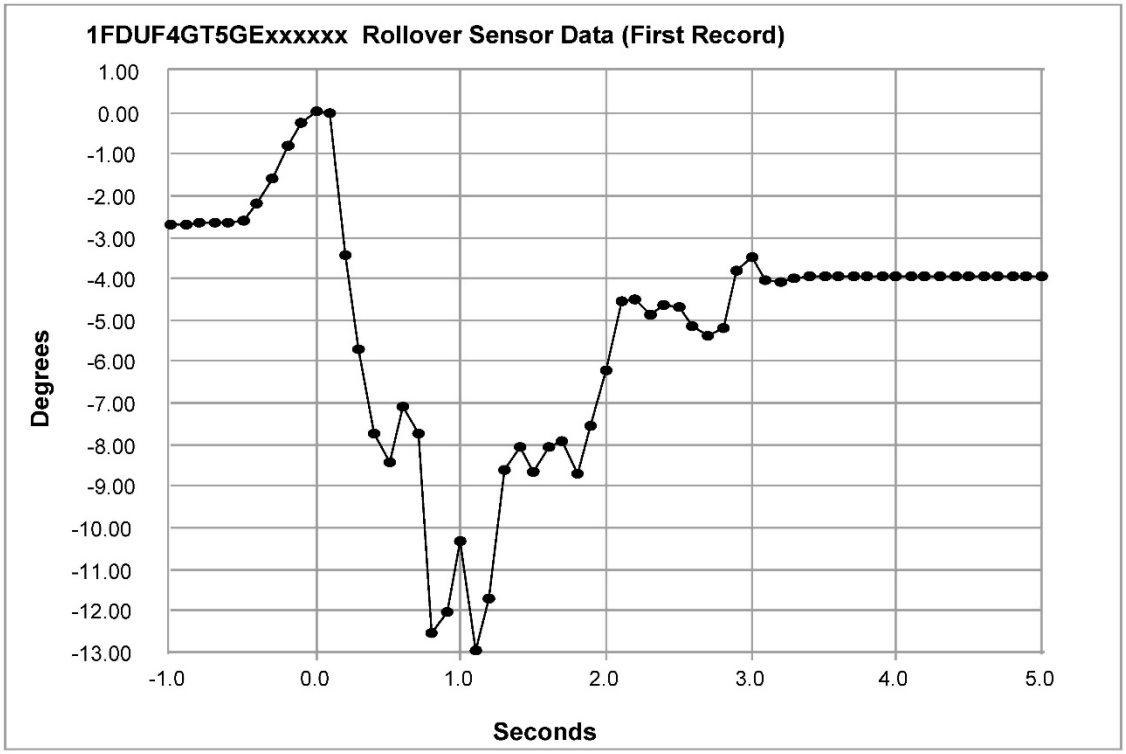
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
9.5	-0.61	-0.98
19.5	-2.24	-3.60
29.5	-2.46	-3.96
39.5	-2.93	-4.72
49.5	-4.74	-7.62
59.5	-6.05	-9.74
69.5	-6.62	-10.65
79.5	-7.57	-12.19
89.5	-8.68	-13.97
99.5	-9.16	-14.73
109.5	-10.65	-17.14
119.5	-10.25	-16.49
129.5	-10.61	-17.07
139.5	-12.66	-20.37
149.5	-14.45	-23.25
159.5	-14.61	-23.51
169.5	-15.78	-25.40
179.5	-15.96	-25.68
189.5	-15.81	-25.45
199.5	-15.91	-25.60
209.5	-17.62	-28.35
219.5	-19.48	-31.35
229.5	-20.12	-32.37
239.5	-22.53	-36.27
249.5	-23.62	-38.01
259.5	-23.97	-38.57



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
9.5	-0.23	-0.37
19.5	-1.23	-1.98
29.5	-1.27	-2.04
39.5	-1.41	-2.27
49.5	-2.29	-3.69
59.5	-4.08	-6.57
69.5	-5.60	-9.02
79.5	-6.33	-10.18
89.5	-6.82	-10.97
99.5	-8.22	-13.23
109.5	-8.23	-13.24
119.5	-8.18	-13.17
129.5	-8.04	-12.94
139.5	-6.51	-10.48
149.5	-6.24	-10.04
159.5	-6.79	-10.92
169.5	-7.40	-11.90
179.5	-7.66	-12.34
189.5	-7.29	-11.74
199.5	-6.96	-11.21
209.5	-7.03	-11.32
219.5	-7.00	-11.26
229.5	-6.91	-11.11
239.5	-7.12	-11.46
249.5	-7.62	-12.26
259.5	-7.67	-12.35



Rollover Sensor Data (First Record)

Time (sec)	Vehicle roll angle (degrees)	Time (sec)	Vehicle roll angle (degrees)	Time (sec)	Vehicle roll angle (degrees)
-1.0	-2.68	1.1	-12.94	3.2	-4.08
-0.9	-2.68	1.2	-11.73	3.3	-4.01
-0.8	-2.67	1.3	-8.59	3.4	-3.95
-0.7	-2.67	1.4	-8.05	3.5	-3.95
-0.6	-2.67	1.5	-8.67	3.6	-3.95
-0.5	-2.6	1.6	-8.07	3.7	-3.95
-0.4	-2.17	1.7	-7.92	3.8	-3.95
-0.3	-1.61	1.8	-8.72	3.9	-3.95
-0.2	-0.8	1.9	-7.53	4.0	-3.95
-0.1	-0.23	2.0	-6.21	4.1	-3.95
0.0	0.03	2.1	-4.56	4.2	-3.95
0.1	-0.03	2.2	-4.5	4.3	-3.95
0.2	-3.45	2.3	-4.88	4.4	-3.95
0.3	-5.72	2.4	-4.62	4.5	-3.95
0.4	-7.74	2.5	-4.7	4.6	-3.95
0.5	-8.45	2.6	-5.13	4.7	-3.95
0.6	-7.08	2.7	-5.38	4.8	-3.95
0.7	-7.74	2.8	-5.21	4.9	-3.95
0.8	-12.55	2.9	-3.81	5.0	-3.95
0.9	-12.01	3.0	-3.5		
1.0	-10.32	3.1	-4.02		

System Status at Event (Second Record)

Recording Status	Unlocked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	2
Time from event 1 to 2 (msec)	1,900
Lifetime Operating Timer at event time zero (seconds)	21,191,700
Key-on Timer at event time zero (seconds)	3,850
Vehicle voltage at time zero (Volts)	12.96
Energy Reserve Mode entered during event (Y/N)	No
Time Passenger Second Row Satellite Sensor Lost Relative to Time Zero (msec)	Data lost prior to event

Faults Present at Start of Event (Second Record)

U3FFF-93
U2100-00

Deployment Data (Second Record)

Maximum delta-V, longitudinal (MPH [km/h])	8.11 [13.05]
Time, maximum delta-V longitudinal (msec)	300
Maximum delta-V, lateral (MPH [km/h])	0.70 [1.12]
Time, maximum delta-V lateral (msec)	295
Longitudinal Delta-V Time Zero Offset	7.5 ms
Lateral Delta-V Time Zero Offset	7.5 ms
Roll Angle Time Zero Offset	77.5 ms

Pre-Crash Data -1 sec (Second Record)

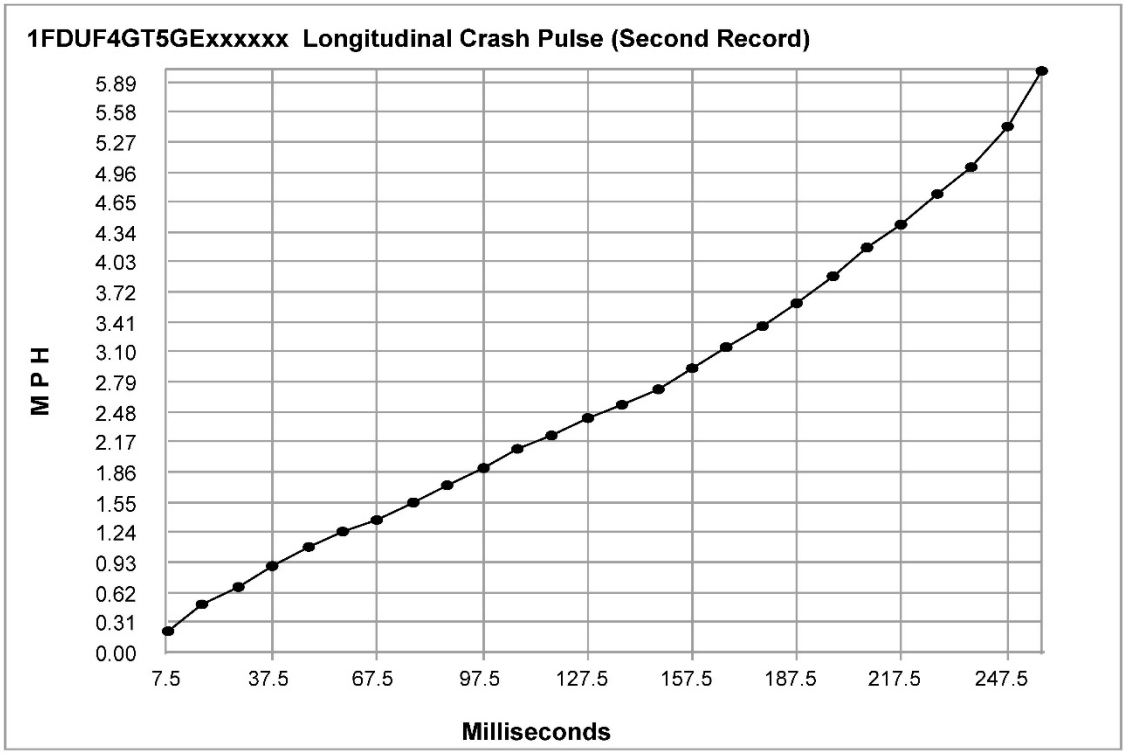
Ignition cycle, crash	4,912
Frontal air bag warning lamp, on/off	On
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Buckled
Brake Telltale	Off
ABS Telltale	On
Powertrain Wrench Telltale	Off
Speed Control Telltale	Off
MIL Telltale	On

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

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	64 [103]	0.0	Off	1,926	non-engaged	No	Drive
- 4.5	64 [103]	0.0	Off	1,924	non-engaged	No	Drive
- 4.0	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
- 3.5	64 [103]	0.0	Off	1,932	non-engaged	No	Drive
- 3.0	64 [103]	0.0	Off	1,932	non-engaged	No	Drive
- 2.5	64 [103]	0.0	Off	1,928	non-engaged	No	Drive
- 2.0	63 [102]	0.0	On	1,730	engaged	No	Drive
- 1.5	0 [0]	0.0	On	0	non-engaged	No	Drive
- 1.0	19 [30]	0.0	On	0	non-engaged	No	Park
- 0.5	9 [14]	0.0	On	0	non-engaged	No	Park
0.0	1 [1]	0.0	On	0	non-engaged	No	Park

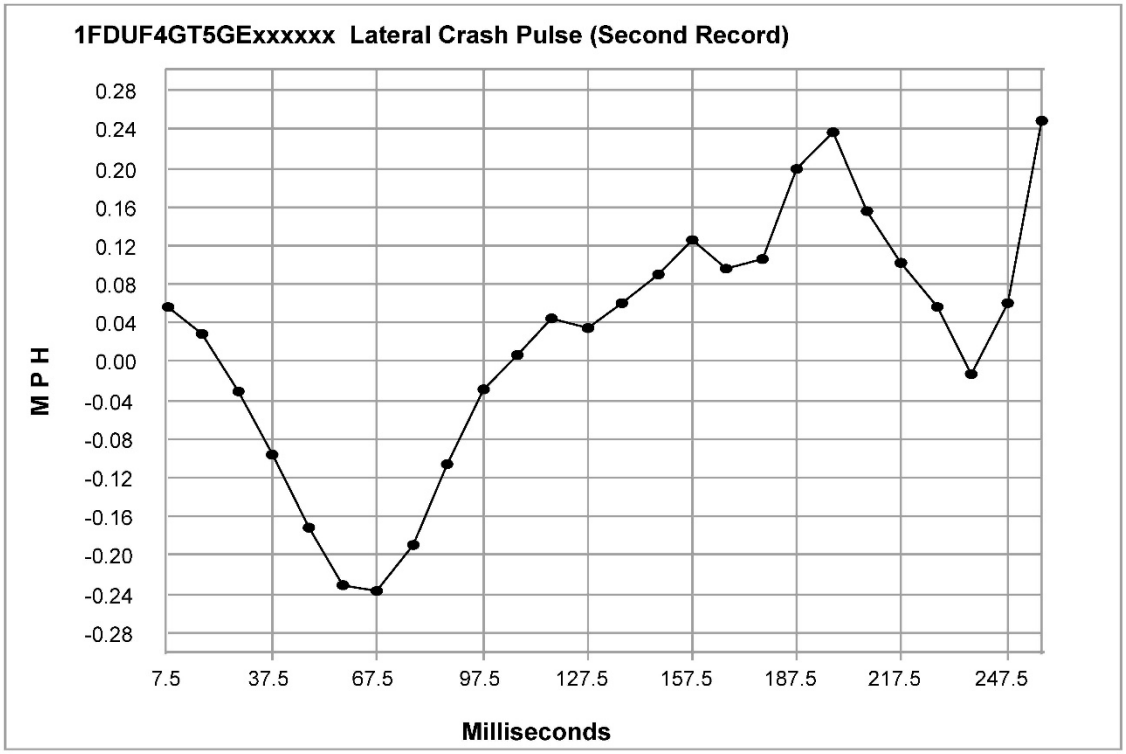
Pre-Crash Data -5 to 0 sec [10 samples/sec] (Second Record)

Times (sec)	Steering Wheel Angle (degrees)
- 5.0	0.0
- 4.9	0.0
- 4.8	0.0
- 4.7	0.0
- 4.6	0.0
- 4.5	0.0
- 4.4	0.0
- 4.3	0.0
- 4.2	0.0
- 4.1	0.0
- 4.0	0.0
- 3.9	0.0
- 3.8	0.0
- 3.7	0.0
- 3.6	0.0
- 3.5	0.0
- 3.4	0.0
- 3.3	0.0
- 3.2	0.0
- 3.1	0.0
- 3.0	0.0
- 2.9	0.0
- 2.8	0.0
- 2.7	0.0
- 2.6	0.0
- 2.5	0.0
- 2.4	0.0
- 2.3	0.0
- 2.2	0.0
- 2.1	0.0
- 2.0	0.0
- 1.9	0.0
- 1.8	0.0
- 1.7	0.0
- 1.6	0.0
- 1.5	0.0
- 1.4	0.0
- 1.3	0.0
- 1.2	0.0
- 1.1	0.0
- 1.0	0.0
- 0.9	0.0
- 0.8	0.0
- 0.7	0.0
- 0.6	0.0
- 0.5	0.0
- 0.4	0.0
- 0.3	0.0
- 0.2	0.0
- 0.1	0.0
0.0	0.0



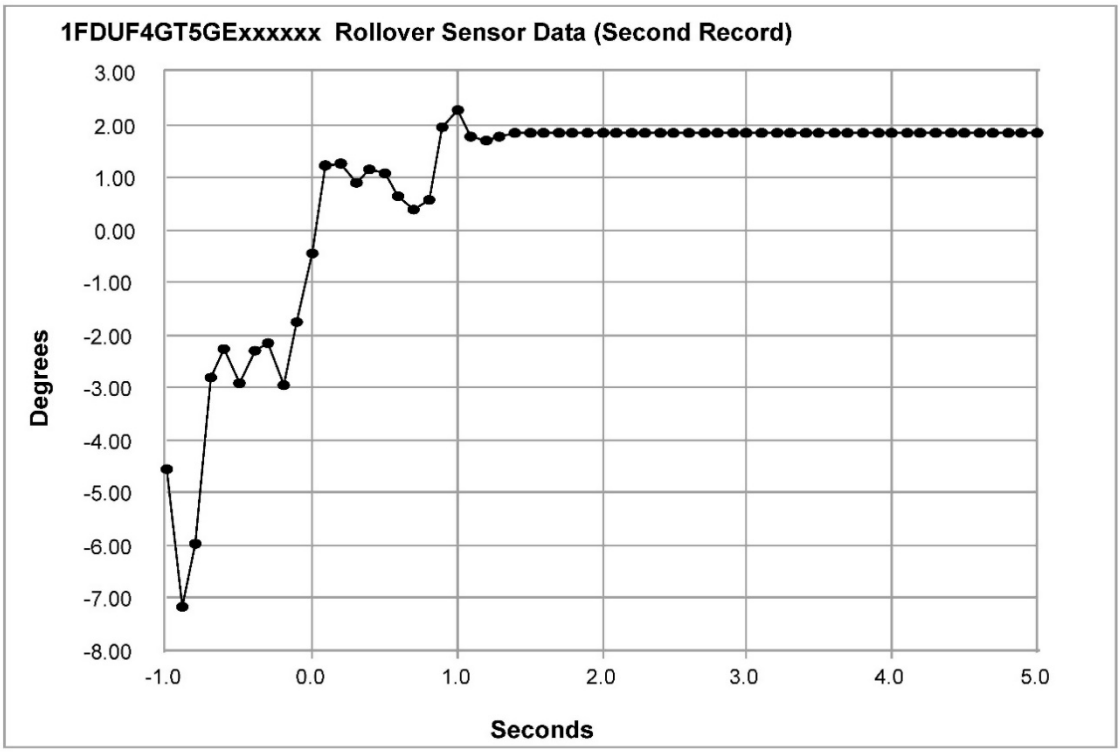
Longitudinal Crash Pulse (Second Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
7.5	0.22	0.35
17.5	0.49	0.79
27.5	0.68	1.09
37.5	0.89	1.43
47.5	1.10	1.76
57.5	1.25	2.01
67.5	1.37	2.21
77.5	1.54	2.48
87.5	1.73	2.79
97.5	1.90	3.06
107.5	2.09	3.37
117.5	2.23	3.59
127.5	2.41	3.88
137.5	2.55	4.10
147.5	2.71	4.35
157.5	2.93	4.72
167.5	3.15	5.06
177.5	3.37	5.42
187.5	3.61	5.81
197.5	3.89	6.26
207.5	4.17	6.71
217.5	4.42	7.11
227.5	4.72	7.60
237.5	5.02	8.07
247.5	5.43	8.74
257.5	5.99	9.64



Lateral Crash Pulse (Second Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
7.5	0.06	0.09
17.5	0.03	0.05
27.5	-0.03	-0.05
37.5	-0.10	-0.15
47.5	-0.17	-0.27
57.5	-0.23	-0.37
67.5	-0.24	-0.38
77.5	-0.19	-0.30
87.5	-0.11	-0.17
97.5	-0.03	-0.05
107.5	0.01	0.01
117.5	0.04	0.07
127.5	0.03	0.06
137.5	0.06	0.10
147.5	0.09	0.14
157.5	0.13	0.20
167.5	0.10	0.15
177.5	0.11	0.17
187.5	0.20	0.32
197.5	0.24	0.38
207.5	0.16	0.25
217.5	0.10	0.16
227.5	0.06	0.09
237.5	-0.01	-0.02
247.5	0.06	0.10
257.5	0.25	0.40



Rollover Sensor Data (Second Record)

Time (sec)	Vehicle roll angle (degrees)	Time (sec)	Vehicle roll angle (degrees)	Time (sec)	Vehicle roll angle (degrees)
-1.0	-4.55	1.1	1.75	3.2	1.83
-0.9	-7.16	1.2	1.69	3.3	1.83
-0.8	-5.96	1.3	1.77	3.4	1.83
-0.7	-2.82	1.4	1.83	3.5	1.83
-0.6	-2.28	1.5	1.83	3.6	1.83
-0.5	-2.9	1.6	1.83	3.7	1.83
-0.4	-2.29	1.7	1.83	3.8	1.83
-0.3	-2.15	1.8	1.83	3.9	1.83
-0.2	-2.94	1.9	1.83	4.0	1.83
-0.1	-1.76	2.0	1.83	4.1	1.83
0.0	-0.44	2.1	1.83	4.2	1.83
0.1	1.21	2.2	1.83	4.3	1.83
0.2	1.27	2.3	1.83	4.4	1.83
0.3	0.89	2.4	1.83	4.5	1.83
0.4	1.16	2.5	1.83	4.6	1.83
0.5	1.07	2.6	1.83	4.7	1.83
0.6	0.65	2.7	1.83	4.8	1.83
0.7	0.39	2.8	1.83	4.9	1.83
0.8	0.57	2.9	1.83	5.0	1.83
0.9	1.96	3.0	1.83		
1.0	2.27	3.1	1.83		

DOT HS 812 848
December 2019

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

14544-121319-v2