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July 2018

Special Crash Investigations
On-Site Ambulance Crash Investigation
Vehicle: 2013 Chevrolet Express 3500 Type II Ambulance
Location: New York
Crash Date: May 2017

DISCLAIMER

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

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems.

This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.

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16. Abstract
This report documents the on-site investigation of a single-vehicle run-off-road/fixed-object crash of a 2013 Chevrolet Express 3500 Type II ambulance that resulted in the fatality of a 64-year-old male patient being transported in non-emergency mode. The ambulance was driven by a 20-year-old male driver and occupied by the patient and a 20-year-old female State-certified emergency medical technician in the patient compartment of the ambulance. As indicated by law enforcement and confirmed by data in this report, it was determined that the driver was fatigued and fell asleep while operating the vehicle. This resulted in the ambulance's right roadside departure, where the vehicle struck a large-diameter tree at the roadside. The wheeled ambulance cot came free from its securement and was displaced in the interior during the crash. The patient, who had previous medical diagnosis including cancer and sepsis, also became displaced from the wheeled ambulance cot and suffered multiple traumatic injuries in the crash. He was pronounced deceased at the crash site. Both 20-year-old emergency medical services crewmembers were transported by other ambulances to local hospitals for treatment and released within hours of the crash.

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CRASH DATE: MAY 2017

BACKGROUND

This report documents the on-site investigation of a single-vehicle run-off-road/fixed object crash of a 2013 Chevrolet Express 3500 Type II ambulance that resulted in the fatality of a 64-year-old male patient being transported in non-emergency mode. The ambulance was driven by a 20-year-old male driver and occupied by the patient and a 20-year-old female State-certified emergency medical technician (EMT) in the patient compartment of the ambulance. As indicated by law enforcement and confirmed by data in this report, it was determined that the driver was fatigued and fell asleep while operating the vehicle. This resulted in the ambulance's right roadside departure, where the vehicle struck a large-diameter tree at the roadside (**Figure 1**). The wheeled ambulance cot came free from its securement and was displaced in the interior during the crash. The patient, who had previous medical diagnosis including cancer and sepsis, also became displaced from the wheeled ambulance cot and suffered multiple traumatic injuries in the crash. He was pronounced deceased at the crash site. Both 20-year-old emergency medical services (EMS) crewmembers were transported by other ambulances to local hospitals for treatment and released within hours of the crash.

Figure 1: View of the ambulance at final rest (*on-scene image obtained from an online news source).*

The crash was identified by a regional office of the National Highway Traffic Safety Administration, which notified its Office of Emergency Medical Services (EMS). The notification was forwarded to NHTSA's Crash Investigation Division (CID) and assigned for on-site investigation by the Special Crash Investigations (SCI) team at Crash Research & Analysis, Inc., in May 2017. The SCI team contacted the regional NHTSA office and investigating law enforcement agency, and established cooperation on the same day for on-site investigation. The on-site portion of this investigation took place during May 2017, and included the documentation and measurement of the ambulance's exterior and interior damage and intrusion, identification of the points of occupant contact, and assessment and documentation of the manual and supplemental restraint systems. Event data recorder (EDR) data was imaged from the Chevrolet during the vehicle inspection process using the Bosch Crash Data Retrieval (CDR) tool. A Nikon

Nivo 5+M total station and photographs were used to document the physical environment of the crash site.

SUMMARY

Crash Site

The crash occurred on a two-lane roadway in a rural area during daylight hours. At the time of the crash, the National Weather Service reported conditions as clear skies with a temperature of 22 ºC (72 ºF), 38 percent relative humidity, and westerly winds at 9.3 km/h (5.8 mph). The police crash report listed the environmental conditions as clear and dry.

The east/west asphalt-surfaced roadway consisted of two travel lanes that were delineated by a yellow centerline that permitted passing for westbound traffic. In the vicinity of the crash site, the travel lanes were straight and essentially level. The westbound lane was 3.6 m (11.8 ft) wide and had an adjacent 1.2 m (3.9 ft) wide shoulder (**Figure 2**). The eastbound lane was 3.5 m (11.5 ft) wide and was bordered by a 1.3 m (4.3 ft) wide shoulder. Solid white edge lines delineated the travel lanes from the shoulders. There were no tactile warning strips in the shoulder surfaces. The north roadside consisted of grass vegetation with a tree line located an average of 4.0 m (13.1 ft) from the north road edge. A particular hardwood tree with a trunk diameter of 50 cm (19.7 in) was located 3.4 m (11.2 ft) north of the road edge, leaning approximately 12 degrees to the south (toward the roadway). Speed was regulated by a posted limit of 89 km/h (55 mph). A crash diagram is included at the end of this report.

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

Ambulance Agency, Crew, and Transport Description

The ambulance agency was cooperative with the investigative efforts of the law enforcement agency and this SCI investigation. However, specifics concerning the employee's training and credentials were not available. The SCI investigator conducted a review of paperwork and other articles in the ambulance during the SCI vehicle inspection, researched the company, and reviewed the agency's information. Based on these multiple sources, the following specifics concerning the agency and the involved crew were determined.

First, the private ambulance agency was a multi-tiered medical transport service not associated with any particular medical treatment center. It was capable of providing EMS care at both the basic life support (BLS) and advanced (ALS) levels. The agency performed emergency response, mutual aid, interfacility transfers, private requests, and specialty transports using a fleet of more than 40 ambulances and emergency response vehicles. It employed an all-career staff of more than 250 people, including management, support personnel, drivers, dispatchers, and EMTs of varying levels of care. The agency maintained its equipment and operated in compliance with all State Department of Health regulations.

The ambulance agency primarily scheduled its employees on 12-hour shifts, and the involved crew was working a 12-hour shift on the date of the crash. The crash occurred approximately 8 hours into their shift. The driver had worked on the day preceding the crash, but had 14 hours of off-duty time overnight prior to his on-duty time on the day of the crash. No further information concerning the crew's work schedule or their credentials was available.

When the crash occurred, the ambulance was transporting a male cancer patient from a regional medical center to his residence. This transport was executed in a non-emergency mode (without the use of emergency warning lights or siren). The total distance of this trip was 53 km (33 mi), and would have required approximately 55 minutes of total travel time. The crash occurred when the ambulance had completed 29 km (18 mi) of that distance, approximately 34 minutes into the trip. The incident trip was the ambulance crew's fifth transport/response of their shift. No specifics concerning the four prior transports/responses were available.

Pre-Crash

At the time of the crash, the ambulance was traveling westbound on the rural two-lane roadway. It was occupied by the 20-year-old male driver, 20-year-old female EMT, and 64-year-old male patient. The driver was in the driver's seat and restrained by the vehicle's available 3-point lap and shoulder seat belt system. The female EMT was positioned unrestrained on the rear-facing captain's chair at the forward wall of the patient compartment, overseeing and attending to the patient. The patient was lying on the wheeled ambulance cot in a "standard" Fowler's position, an anatomical position of comfort in which the backrest of the cot was reclined to an upright angle of approximately 45 to 60 degrees. He was restrained by the multipoint harness straps. Ambulance agency policy required that the patient was completely and securely restrained by all harness straps at all times while on the cot.

The SCI reconstruction of the crash indicated that the driver likely fell asleep or was not fully alert to the driving task. This caused the ambulance to begin to drift to the right from its travel lane. According to the data imaged from the Chevrolet's EDR, the ambulance was traveling at a recorded speed of 87 km/h (54 mph) at 2.5 seconds prior to algorithm enable (AE). GPS data provided by the ambulance agency for the law enforcement investigation indicated that the last reported vehicle speed prior to the crash was 84 km/h (52 mph). It should be noted that the ambulance was equipped with a windshield-mounted video camera that recorded forward- and rearward-facing views of the roadway and the vehicle's interior. This data was stored to memory and was capable of retrieval. However, the unit was extensively damaged during the crash, and no recorded data could be recovered from the unit post-crash. As part of the law enforcement investigation, other sources of possible distraction were examined and the driver's cellular telephone device was examined as evidence. Records from the service provider revealed that no calls or texts were either sent or received in the minutes preceding the crash. Law enforcement determined that the cellular phone was not a source of distraction in this crash, and shared this information with the SCI investigator.

The right front tire of the ambulance departed the north road edge and entered the soft grass/soil surface of the roadside. The vehicle maintained its westbound trajectory. Data imaged from the Chevrolet's EDR indicated that the driver did not respond to the road departure.

Figure 3: West-facing view of the ambulance's right front tire mark (highlighted) through the roadside.

A 34 m (111.5 ft) long rotating tire mark from the ambulance's right front tire evidenced the vehicle's trajectory as it approached the large diameter tree at the roadside. This single tire mark (**Figure 3**) was documented during the SCI crash site inspection, and revealed a departure angle for the ambulance of 7 degrees. Undulation of the right front tire through the terrain of the roadside evidently alerted the driver to the errant trajectory of the vehicle. Pre-crash EDR data indicated that the driver applied the brakes at 0.5 seconds prior to AE. At that time, the vehicle's speed was 77 km/h (48 mph). Law enforcement reported to the SCI investigator that the driver stated during interview that he "dosed off for a few seconds and woke up when he felt the rumble strips." As referenced in the crash site description, there were no rumble strips.

Crash

The crash occurred as the right aspect of the Chevrolet's front plane struck the tree (**Figure 4**). Impact forces were in the 12 o'clock sector for the ambulance. As the frontal structure of the Chevrolet crushed, the leading edge of the right front fender and the right front tire/wheel engaged the tree. The front suspension separated and the tire/wheel and brake assembly struck the lower right A-pillar and sill. The Chevrolet continued forward as the right A-pillar, windshield header, and fiberglass roof extension struck the tree. Frontal components of the vehicle were crushed past the location of the Chevrolet's

Figure 4: West-facing view of the struck large diameter tree.

right B-pillar. The right front door was compressed and jammed closed against the B-pillar, which deformed the double doors on the right plane of the patient compartment. The latch of the forward right door released as the door was displaced rearward. The aft door was jammed closed. The ambulance came to rest against the tree, with penetration of the tree extending beyond the right B-pillar.

Post-Crash

There were several witnesses to the crash who contacted the local emergency response system and reported that the ambulance had crashed into a tree and was in the ditch, with a patient in the back of the ambulance and the driver still behind the wheel. Local law enforcement, fire department, and EMS personnel were dispatched to the crash site. **Figures 5 and 6** are on-scene police images depicting the final rest position of the ambulance and its degree of engagement with the large diameter tree.

Figure 5: East-facing view of the ambulance against the large diameter tree at final rest (*on-scene law enforcement image*).

Figure 6: South-facing view of the ambulance at final rest and crushed against the tree (*on-scene law enforcement image*).

According to the interview of the driver conducted by the law enforcement agency following the crash, the driver was unable to unbuckle his seat belt due to his positioning and the tension on the seat belt. He instead retrieved a pair of trauma shears in reach and used them to cut the seat belt webbing. The driver then opened the left front door of the vehicle and exited the ambulance without assistance. He went to the back of the ambulance and opened the rear loading doors of the patient compartment, where he observed that the wheeled ambulance cot was out of position and the patient was nearly entirely separated from the cot. The wheeled ambulance cot was angled upward and forward to the right, with the head portion of its frame sitting angled on the "antler bracket" and the foot portion of its frame resting on the bench seat. The patient's body was separated from the wheeled ambulance cot, though the lower aspect of his lower extremities remained in contact with the cot's mattress and partially tangled in the harness system. With assistance from a witness who stopped to help and the EMT crewmember, the driver unbuckled the harness straps of the wheeled ambulance cot and removed the cot from the patient compartment through the rear loading doors.

Emergency response personnel began arriving at the crash site and took over caring for the involved occupants. The patient was removed from the ambulance and cardiopulmonary resuscitation (CPR) was performed with advanced cardiac life support care administered on-scene by EMS personnel for a period of approximately 25 minutes. Resuscitative efforts were unsuccessful and the patient was pronounced deceased at the crash site. The patient's body was removed from the crash scene by the local medical examiner for postmortem examination.

The driver and the EMT crewmember received on-scene care and were transported by separate ambulances to local hospitals. Both were evaluated, treated, and released on the same day as the crash. The ambulance was recovered from the scene and impounded by the investigating law enforcement agency. It was held in secure storage pending inspection for this SCI investigation.

2013 CHEVROLET EXPRESS 3500 TYPE II AMBULANCE

Description

Figure 7: Left front oblique view of the 2013 Chevrolet Express 3500 at the time of the SCI inspection.

The 2013 Chevrolet Express 3500 (**Figure 7**) was identified by the Vehicle Identification Number 1GBZGUCLXD1xxxxxx. It was manufactured as an incomplete vehicle chassis in August 2012. The powertrain consisted of a 6.6 liter Duramax V-8 diesel engine 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 disc with anti-lock brakes. The vehicle manufacturer's recommended tire size was LT245/75R16E with recommended cold tire pressures of 414 kPa (60 psi) front and 552 kPa (80 psi) rear. At the time of the crash, the Chevrolet was configured with BF Goodrich Commercial T/A tires of the recommended size and mounted on OEM steel wheels. Due to its direct involvement in the impact damage pattern, the right front tire was flat with cuts of the sidewall and tread. There was no damage or restriction to the remaining three tires. All had ample tread and were inflated.

The cab of the ambulance was configured with two cloth-surfaced bucket seats that had integral head restraints and folding inboard armrests. Customized emergency lighting switches and radio communication equipment was mounted to the center stack of the instrument panel. Safety equipment consisted of manual 3-point lap and shoulder seat belt systems for both cab seat positions. Supplemental restraint was provided by dual-stage frontal air bags for the driver and front right passenger positions. A keyed air bag cut-off switch was mounted in the center of the instrument panel. Both frontal air bags deployed during the crash.

Type II Ambulance Patient Compartment

The Chevrolet's chassis was completed as a Mirage LT2 Type II ambulance during secondary manufacturing in May 2013 by Demers Ambulance Manufacturing, Inc. As part of the secondary manufacturing process, a raised fiberglass roof structure was affixed to the Chevrolet's cargo area and the interior space was completed as a patient compartment. Emergency services operations equipment, such as warning lights, sirens, and radio communications were installed in the cab and on the exterior of the vehicle.

The patient compartment was equipped as a mobile emergency medical care unit, configured for the seating of up to four occupants and with a centralized patient cot. There were multiple cabinets and a counter area mounted to the left wall and bulkhead area of the interior. The layout included double rear-entry doors for cot loading and double right entry doors.

Figure 8: View of an exemplar Type II interior.

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 all cabinets were outfitted with clear polymer sliding doors. Aluminum corner bead was used for edge trim. Fiberglass and foam insulation provided thermal and acoustic protection from the outside environment. Seating included a two-passenger, left-facing bench seat mounted on the right wall above the right rear axle position, as well as a rear-facing single position seat (often referred to in the ambulance industry as a "captain's chair") at the front of the patient compartment, directly forward of the patient cot. A pass-through to the cab of the ambulance was located adjacent to this positon. **Figure 8** shows an interior view of a similar Type II ambulance for exemplar comparison.

Vehicle Weight/Payload

The Chevrolet chassis was placarded by its manufacturer with a gross vehicle weight rating of 4,491 kg (9,900 lb). This was distributed as gross axle weight ratings of 2,087 kg (4,600 lb) front and 2,760 kg (6,084 lb) rear. The secondary manufacturer had affixed a label in the patient compartment of the ambulance that declared that the total useable payload of the vehicle, including the weight of equipment, cargo, and occupants, was 973 kg (2,146 lb).

During the SCI vehicle inspection, the SCI investigator estimated the combined weight of the EMS equipment and supplies on-board the involved ambulance to be approximately 204 kg (450 lb). The combined total weight of the vehicle's occupants was not more than 251 kg (553 lb), for a total payload of occupants plus equipment of no more than 455 kg (1,003 lb). Based on the vehicle's placarded gross vehicle weight rating and declared useable payload, it was the SCI investigator's assessment that the ambulance was operating in its specified payload capacity and weight rating at the time of the crash.

Exterior Damage

The Chevrolet sustained severe damage to its front plane, right aspect. This included extensive crush and deformation. Direct contact damage began 65 cm (25.6 in) right of centerline and extended to the right front bumper corner. Based on the undeformed end width of the bumper beam of 184 cm (72.4 in), the maximum width of the direct damage was 27 cm (10.6 in). In the damage pattern was longitudinal deformation to the bumper, grille/fascia, right headlight assembly, right front fender, hood, engine compartment components, windshield header, roof, and surrounding components (**Figure 9**).

Figure 9: Front plane view of the 2013 Chevrolet Express 3500 Type II ambulance at the time of the SCI inspection.

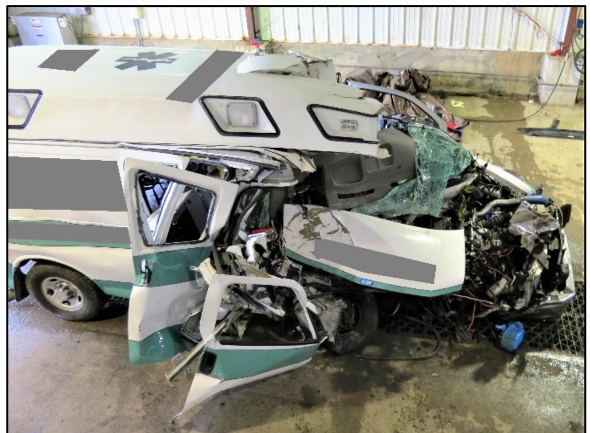


Figure 10: Right overhead perspective view of the ambulance and the magnitude of the damage extent.

A residual crush profile was obtained using a direct and induced damage length (Field-L) across the width of the damaged bumper beam. Accounting for free space due to the contour of the bumper beam, the profile produced the following resultant measurements: C1 – C3 = 0 cm, C4 = 2 cm (0.8 in), C5 = 4 cm (1.6 in), and C6 = 47 cm (18.5 in). This crush profile grossly underestimated the severity of the damage, due to the angle of the vehicle and struck tree (which largely missed the bumper beam). As is visible in **Figure 10**, the SCI investigator observed maximum direct contact and crush that extended rearward 298 cm (117.3 in) from the front plane.

The right wheelbase was reduced 132 cm (52.0 in), the right A-pillar was displaced rearward 150 cm (59.0 in), and the right B-pillar was displaced rearward 88 cm (34.6 in). All three of these measurements were determined in comparison to the left plane components of the Chevrolet during inspection. The entire space of the right front door was compressed, and the right loading doors were deformed and displaced.

The Collision Deformation Classification (CDC) assigned to the Chevrolet for the impact with the large-diameter tree was 12FRAE9. No WinSMASH calculations were performed due to the gross underrepresentation of the crush profile, which would have produced results not representative of the impact.

Event Data Recorder

The Chevrolet chassis was equipped with an air bag sensing and diagnostic module (SDM) mounted beneath the left front seat. The SDM had EDR capabilities to record crash data. The SCI investigator imaged the 2013 Chevrolet ambulance's EDR using the Bosch CDR tool with software version 17.3. A connection was made directly to the SDM using an external electrical power source. The imaged data was later read using software version 17.7.2, and is included at the end of this technical report as **Appendix A**.

The SDM monitored and measured vehicle acceleration in both the longitudinal and lateral directions. The threshold minimal crash pulse was a measured delta-V of 8 km/h (5 mph). The EDR could record two different event types and store a combination of up to three events. Recognized events were termed "Non-Deployment" or "Deployment," and up to two different deployment events and one locked non-deployment event could be stored. Non-deployment events could be overwritten after approximately 250 ignition cycles, whereas deployment events became locked and could not be overwritten. At AE and recognition of a longitudinal or lateral event, the EDR had the capacity to record longitudinal and lateral delta-V data in 10 millisecond intervals. Up to 300 milliseconds were recorded for a non-deployment event, while up to 70 milliseconds before criteria were met and up to 220 milliseconds after criteria were met was recorded for deployment event types. Associated to each event was a 2.5-second pre-crash buffer that recorded accelerator pedal position (%), vehicle speed (mph), engine speed (rpm), throttle (%), and brake switch circuit state data. For the 0.5 and 1-second pre-crash intervals, the EDR also recorded cruise control usage, engine torque, and reduced engine power mode data.

The imaged data contained two deployment events, both occurring on ignition cycle 32,437. Event recording was reported complete for both recovered events. The time reported between event triggers was 0 seconds, indicative that both were related to the elongated crash event with the large diameter tree. Pre-crash data was associated with the first recorded event, as outlined in the following table:

Time (seconds)	-2.5	-2.0	-1.5	-1.0	-0.5
Accelerator Pedal	0%	0%	0%	0%	0%
Vehicle Speed	84 km/h (54 mph)	84 km/h (54 mph)	82 km/h (53 mph)	80 km/h (50 mph)	80 km/h (48 mph)
Engine Speed	1408 rpm	1408 rpm	1408 rpm	1280 rpm	1216 rpm
Throttle	8%	9%	11%	11%	2%
Brake Switch	OFF	OFF	OFF	OFF	ON
Cruise Control Active	-	-	-	No	No
Red. Engine Power	-	-	-	OFF	OFF

The first trigger commanded deployment of the driver and passenger frontal air bag system at 25 milliseconds after AE. The maximum SDM recorded longitudinal vehicle velocity change of the first trigger was -60.77 km/h (-37.76 mph), which was reported at 220 milliseconds after AE. The maximum SDM recorded lateral vehicle velocity change was -11.49 km/h (-7.14 mph), reported 100 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 may not yet have achieved its maximum.

For the second trigger, the maximum SDM recorded longitudinal vehicle velocity change was -8.2 km/h (-4.08 mph). This was reported from 180-220 milliseconds after AE. The maximum lateral vehicle velocity change was (3.06 mph), reported from 170-220 milliseconds after AE. No supplemental restraint devices were available to deploy for the second trigger.

Interior Damage

Severe damage was sustained by the interior of the ambulance as a result of the crash. The focal damage was related to occupant compartment intrusion in the cab of the ambulance and patient compartment, associative to the extensive deformation resultant from the tree engagement. There was no discernable occupant contact. The left front door of the cab of the ambulance remained closed during the crash and was operational post-crash. However, the right front door was crushed longitudinally by the exterior deformation and jammed closed between the displaced A- and B-pillars. The right side loading doors came disengaged from their closure latches and were jammed shut during the crash due to compression deformation as the vehicle engaged the tree. Both rear loading doors at the back plane remained closed and were operational post-crash.

The extreme magnitude of the Chevrolet's deformation hindered a precise assessment of its intrusions. Longitudinal intrusions observed included greater than 100 cm (39.4 in) to the right instrument panel, more than 150 cm (59.1 in) to the right A-pillar and right windshield header, and more than 60 cm (23.6 in) to the center instrument panel. In its intruded state, the right aspect of the instrument panel protruded through the cab's pass-through and into the patient compartment, with complete collapse of the right front position (**Figure 11**). The severe deformation to the windshield header and roof had separated the header, roof, and left A-pillar at their junction, and deformed the entire roof to the right.

Figure 11: Crossing view of the ambulance cab and the severe interior damage/intrusion

Figure 12: Forward-facing view of the patient compartment interior and crash-related damage.

Significant damage of the interior occurred at the forward right aspect of the patient compartment. The entire stack of cabinetry adjacent to the right loading doors was displaced rearward and deformed such that it was engaged against the right C-pillar and forward aspect of the bench seat. This resulted from the rearward displacement of the right front position of the cab and corresponding intrusion of the large diameter tree during the impact engagement. Equipment in the cabinetry was entrapped and entangled in the deformed components. Overhead structure of the roof was fractured and separated, with the heating, ventilation, and air conditioning system displaced and partially destroyed. **Figure 12** provides a forward-facing view of the patient compartment interior at the time of the SCI inspection. There was no discernable occupant contact to any of the exposed surfaces in the patient compartment.

Manual Restraint Systems

The cab of the Chevrolet 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 buckle pretensioners. The driver's D-ring was adjusted to the full-up position at the time of the SCI inspection.

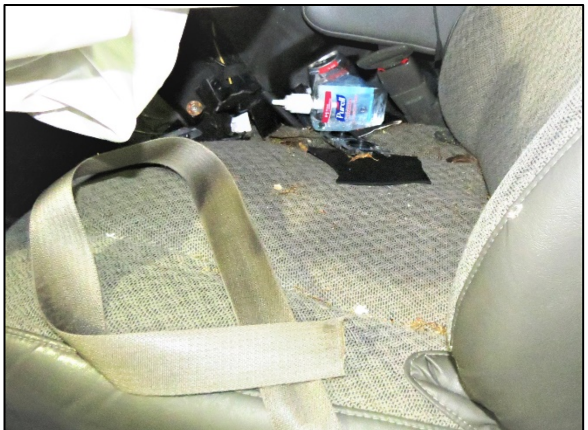


Figure 13: View of the cut portion of the driver's seat belt system and the latch plate engaged in the buckle.

The driver's seat belt webbing was cut, with the shoulder portion spooled onto the retractor and concealed in the left B-pillar of the vehicle. The exposed webbing contained a minor abrasion from loading in the belt path of the latch plate, and had heavy evidence of historical wear. The latch plate remained engaged in the buckle. Based on the condition of the driver's seat belt system (**Figure 13**), it was evident that the driver was restrained at the time of the crash. This determination was supported by the data imaged from the Chevrolet's EDR.

The patient compartment was configured with three manual seat belt systems. The rear-facing captain's chair was equipped with an integrated 3-point lap and shoulder seat belt system, with dual retractors for the lap and shoulder portions of the system and a sliding latch plate. This seat belt system had little evidence of historical wear, and was devoid of loading evidence. It was not in use by the female EMT at the time of the crash.

The right side bench seat was equipped with two manual lap belt systems. These belts systems served as combination systems to restrain people seated in either of the side-facing positions, or a patient positioned lengthwise on top of the bench seat. These positions were not occupied at the time of the crash, nor were any of these restraint systems in use at the time of the crash.

Supplemental Restraint Systems

The Chevrolet 3500 series was equipped with a dual-stage frontal air bag system for 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 upper aspect of the right instrument panel and concealed by H-configuration cover flaps. An air bag cut-off switch for the front right air bag was located in the center instrument panel. The switch was not activated at the time of the crash; therefore, there was no suppression of the front right passenger's air bag. Both air bags deployed as a result of the frontal crash event with the large diameter tree.

The deployed driver's frontal air bag measured 70 cm (27.6 in) in overall diameter in its deflated state. It was vented by a pair of 4 cm (1.6 in) diameter vent ports on the back side of the air bag. Tethering was internal, with two straps sewn to the interior aspect of the air bag's center circumference. There was no damage or discernable occupant contact evidence to the deployed driver's air bag (**Figure 14**).

Figure 14: Deployed driver's frontal air bag in the 2013 Chevrolet ambulance.

Figure 15: View of the deployed front right passenger's air bag at the time of the SCI inspection.

The passenger's frontal air bag also deployed in the crash. However, the severe intrusion displaced the instrument panel such that the passenger's frontal air bag was not accessible by the SCI investigator for detailed inspection (**Figure 15).**

Wheeled Ambulance Cot

The wheeled ambulance cot (**Figure 16**) installed in the Chevrolet ambulance was an MX-Pro Model 6082, manufactured by Stryker. Its serial number was serial number 03063xxxx, indicative that it was manufactured in June 2003. An additional label affixed by the ambulance agency owner indicated that the cot had been serviced on January 21, 2015. The Stryker cot was constructed of a tubular aluminum frame with circumferential weld joints and steel hardware fasteners. The X-frame supporting the mattress platform featured manual raise/lower capabilities with height positions between a minimum of 34 cm (13.5 in) and a maximum of 95 cm (37.5 in). The mattress platform itself featured positive backrest angular adjustment between 2- and 73-degrees via a manually controlled gas-pressure cylinder. The leg portion featured 14 degrees of positive angular adjustment. Overall dimensions of the cot were 58 cm (23.0 in) wide and 205 cm (80.7 in) long. A placard declared that the load capacity limit of the cot was 295 kg (650 lb).

Figure 16: View of the Stryker MX-Pro wheeled ambulance cot at the time of the SCI inspection.

Figure 17: Shoulder harness straps of the Stryker cot after being buckled together by the SCI investigator.

The Stryker cot was equipped with a multipoint 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 straps were constructed of fixed length webbing that included either locking latch plates or sewn buckles. At the time of the SCI inspection, all straps of the system were unbuckled and hanging loosely from the frame. Extensive historical wear on the exposed surfaces of the webbing evidenced habitual historical use, but there was no discernable evidence of crash-related loading on any of the systems' straps. Given the frontal nature of the crash forces and the kinematic response of the occupant that would have resulted, no significant loading to the lateral restraint straps would likely have occurred. The SCI investigator buckled the shoulder harness straps together (**Figure 17**) and noted that the design of the system placed extensive space between the shoulder straps, their anchorage, and the occupant. The shoulder straps were designed to be affixed to the top of the mattress platform frame at the head end of the cot. The length of the frame meant that, in order to be in contact with the shoulder straps in such a manner that they could have restricted the occupant's movement, the occupant would have had to be displaced forward/upward along the mattress platform a significant distance.

Despite the lack of loading evidence, there were multiple circumstances that led the SCI investigator to conclude that all of the cot's harness straps were in use at the time of the crash. This included the design of the harness system and its observed adjustments, historical wear, the accounts of the involved EMS crewmembers (driver and captain's chair occupant), as well as the ambulance agency's policy that directed its employees to utilize all straps at all times. It was apparent to the SCI investigator that the cot's occupant had slipped upward and slightly left (with respect to his orientation) during the crash, and the slack room in the system enabled the occupant to slide out of the shoulder harness without restricting the occupant's movement or producing loading evidence on the straps.

Cot Damage

The patient cot sustained minor damage attributable to occupant loading in relation to the crash event. The occupant responded toward the frontal crash force and his back/torso compressed against the mattress platform and inclined back support, which translated a loading force into the cot's frame. The moment (torque) of this force created a load at the locking clamp mechanism that exceeded the shear strength of the tubular aluminum frame. This caused the frame rail to shear at the securement location of the locking pin (**Figure 18**). Following the shear of the tubular aluminum frame rail, the cot became dislodged from the fastening system and was subjected to unrestricted movement in the patient compartment. The locking pin was found loose on the floor in the patient compartment at the time of the SCI inspection (**Figure 19**).

Figure 18: View of the sheared lower right frame rail of the wheeled ambulance cot.

Figure 19: Separated locking pin found loose in the patient compartment during the SCI vehicle inspection.

Cot Fastening System

The Stryker ambulance cot was secured in place and positioned in the floor of the patient compartment via a Stryker Model 6371 Cot Fastener System. It was manufactured in May 2013 and was identified by the serial number 13054xxxx. The system consisted of a forward antler bracket mounted to the floor and a rear locking rail-clamp mechanism mounted on the base of the left wall 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 specifically-designed 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 two vertical supports. Combined, these two components were intended to restrict the lateral and longitudinal movement of the cot in the ambulance during transport. **Figures 20 and 21** depict the antler bracket and locking clamp mechanism as observed by the SCI investigator during the vehicle inspection.

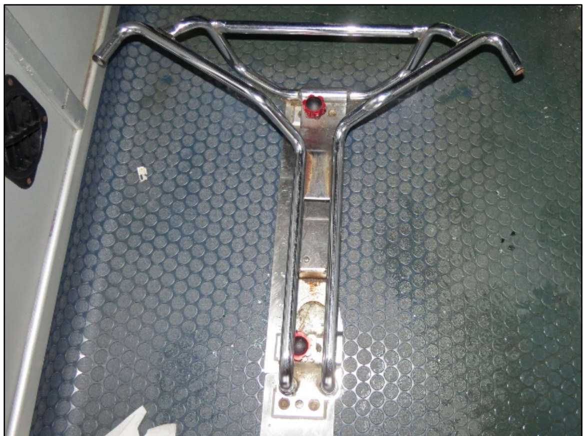


Figure 20: Antler bracket of the cot fastening system mounted in the Chevrolet ambulance.

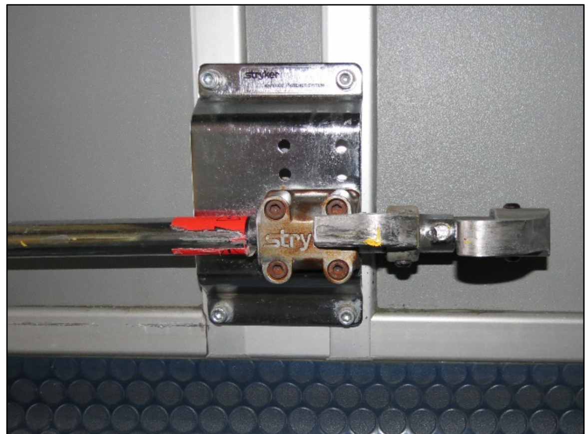


Figure 21: Disengaged locking clamp mechanism in the patient compartment.

The SCI investigator observed that the bolts of the antler bracket remained intact and the bracket was in place and not deformed. The rail clamp mounting bracket, bolts, and clamp mechanism also remained intact, with the clamp in the unlocked position. On-scene images depicted the clamp in the open position, with the fractured locking pin displaced and lying loosely on the floor at the right rear aspect of the patient compartment. The SCI investigator concluded that the clamp had possibly released during the crash as a result of loading by the combined forces of the mass of the cot, mass of the occupant, and crash.

2013 CHEVROLET EXPRESS 3500 TYPE II AMBULANCE OCCUPANT DATA

Driver Demographics

Age/Sex:	20 years/male
Height:	183 cm (72 in)
Weight:	100 kg (220 lb)
Eyewear:	Unknown
Seat Type:	Forward-facing bucket seat with integral head restraint
Seat Track Position:	Full rear-track
Manual Restraint Usage:	3-point lap and shoulder seat belt
Usage Source:	Vehicle inspection, imaged EDR data
Air Bags:	Dual-stage front air bag available, deployed
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Exited vehicle without assistance
Transport From Scene:	Ambulance to a local hospital
Type of Medical Treatment:	Treated and released within hours of the crash

Driver Injuries

Injury No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence
1	Multiple lacerations to right upper extremity	710600.1	Displaced windshield glazing	Probable
2	Multiple lacerations to left upper extremity	710600.1	Displaced windshield glazing	Probable
3	Multiple lacerations to right lower extremity	810600.1	Center cowl	Probable
4	Multiple lacerations to left lower extremity	810600.1	Intruded left lower instrument panel	Probable
5	Abrasions to right upper extremity	710202.1	Intruded center instrument panel	Probable
6	Abrasions to right lower extremity	810202.1	Lower left instrument panel and below	Probable
7	Abrasions to left lower extremity	810202.1	Lower left instrument panel and below	Probable
8	Abrasions on dorsum of left hand	710202.1	Displaced windshield glazing	Probable
9	Abrasions on dorsum of left forearm	710202.1	Displaced windshield glazing	Probable

Source – Hospital records

Driver Kinematics

The 20-year-old male driver of the Chevrolet 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 data imaged from the Chevrolet's EDR.

The driver became drowsy as he operated the vehicle westbound. He ultimately was overcome by that drowsiness and likely dozed off, allowing the Chevrolet to maintain its speed and drift to the right from its travel lane as it continued westbound along the roadway. The vehicle departed the roadway without avoidance input from the driver. However, the undulation of the vehicle as it began to traverse the roadside likely alerted the driver, as the data imaged from the EDR indicated that the brakes were applied immediately prior to the impact. The Chevrolet approached and struck the large diameter tree in the roadside.

At impact with the tree, the driver initiated a forward and right trajectory. He loaded the seat belt system, and his body flexed forward toward the deployed dual-stage air bag. It is highly likely that his head and face contacted the inflated driver's frontal air bag.

As the forces of the crash continued to increase and the ambulance engaged the tree, severe deformation was sustained by the vehicle. Frontal components were crushed and displaced rearward. The instrument panel was deflected rearward and to the left, as the entire front row right space collapsed. The driver's lower extremities contacted and engaged the lower instrument panel and center cowl, but there was no physical evidence of such contact. As the windshield header and roof were deformed rearward, the glazing became displaced from the windshield. It contacted the driver's head and upper extremities, producing soft tissue injuries.

Severe intrusion on the right half of the cab induced significant reduction in the available space surrounding the driver. He found himself engaged against the intruded cowl, instrument panel, and steering wheel as the vehicle came to final rest. Due to his positioning and the corresponding tension on the manual seat belt system, he was unable to unbuckle the latch plate from the buckle. He retrieved a pair of trauma shears that were in reach and used them to cut the shoulder portion of the seat belt webbing in the area of his lower right chest. He then opened the left front door of the Chevrolet and exited the vehicle without assistance. After assisting the EMS crewmember and patient, the driver received medical treatment on scene. He was transported by another ambulance to a local hospital where he was treated, submitted to blood work for a toxicology investigation, and released in hours of the crash.

Captain's Chair Occupant Demographics

Age/Sex:	20 years/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Box-mounted rear-facing captain's chair
Seat Track Position:	Full-rear (with respect to seat orientation)
Manual Restraint Usage:	None, integrated 3-point lap and shoulder belt was available
Usage Source:	Vehicle inspection
Air Bags:	None
Alcohol/Drug Involvement:	Unknown
Egress From Vehicle:	Exited vehicle under own power
Transport From Scene:	Ambulance to a local hospital
Type of Medical Treatment:	Treated and released within hours of the crash

Captain's Chair Occupant Injuries

Injury No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence
1	Unknown	N/A	N/A	N/A

Source – Records requested, not received

Captain's Chair Occupant Kinematics

The 20-year-old female EMT was seated in the rear-facing captain's chair positioned at the forward wall of the patient compartment. Although an integral 3-point lap and shoulder seat belt system was available to her for manual restraint, she was not belted.

The EMS crewmember was likely unaware of the ambulance's errant trajectory. At impact with the tree, she responded to the frontal crash forces by initiating a forward trajectory and loading the rear-facing seatback with her posterior. This provided a complete and even distribution of her mass to allow for a ride-down of the crash forces, and likely did not result in injury. However, as other objects, unsecured equipment, and the patient responded to the crash forces, the captain's chair occupant was subjected to contact from those items as they were displaced uncontrolled about the patient compartment's interior. The occupant was most-likely contacted by miscellaneous loose EMS equipment. She reported during the law enforcement interview that she was also contacted by the patient as he separated from the ambulance cot, as well as contacted by the ambulance cot after it also became displaced. It is likely that the portion of the wheeled ambulance cot that contacted the EMT was the top aspect of the displaced mattress platform.

The EMS occupant exited the ambulance under her own power following the crash. With the help of the driver, she began to administer care to the patient. Following the arrival of emergency response personnel, the female was transported by ambulance to a local hospital for evaluation and treatment. No documentation concerning the EMS crewmember's injuries was available and her course of treatment remains unknown. Requests for medical records concerning the EMS crewmember made to the reported treating facility and surrounding facilities were all returned with no records of treatment.

Wheeled Ambulance Cot Occupant Demographics

Age/Sex:	64 years/male
Height:	182 cm (71.5 in)
Weight:	75 kg (166 lb)
Eyewear:	None
Seat Type:	Wheeled ambulance cot
Seat Track Position:	Not applicable
Manual Restraint Usage:	Multipoint harness system
Usage Source:	Vehicle inspection
Air Bags:	None
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Removed from vehicle while unconscious/unresponsive
Transport From Scene:	None
Type of Medical Treatment:	None

Wheeled Ambulance Cot Occupant Injuries

Injury No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence
1	Right ventricle laceration, extending 1 cm along lateral aspect and extending into ventricular chamber	441012.5	Intruded forward wall/cabinetry of patient compartment	Possible
2	Left lung laceration, 2 cm to of upper lobe	441431.3	Intruded forward wall/cabinetry of patient compartment	Possible
3	Right hemothorax with small hemoperitoneum	442200.3	Intruded forward wall/cabinetry of patient compartment	Possible
4	Left hemothorax with small hemoperitoneum	442200.3	Intruded forward wall/cabinetry of patient compartment	Possible
5	Left kidney laceration, 3 cm into parenchyma	541624.3	Intruded forward wall/cabinetry of patient compartment	Possible
6	Small laceration into spleen capsule	544222.2	Intruded forward wall/cabinetry of patient compartment	Possible
7	Torn pericardial sac	441602.2	Intruded forward wall/cabinetry of patient compartment	Possible
8	Right temporal and parietal subarachnoid hemorrhage	140693.2	Intruded forward wall/cabinetry of patient compartment	Certain
9	Left temporal and parietal subarachnoid hemorrhage	140693.2	Intruded forward wall/cabinetry of patient compartment	Certain
10	Fracture of spine at T2 level	650416.2	Intruded forward wall/cabinetry of patient compartment	Certain
11	Fracture of spine at T10 level	650416.2	Intruded forward wall/cabinetry of patient compartment	Certain
12	Fracture of spine at L2 level	650616.2	Intruded forward wall/cabinetry of patient compartment	Certain
13	Fracture of right superior pubic ramus	856151.2	Intruded forward wall/cabinetry of patient compartment	Probable
14	Left parietal scalp laceration, 7 cm	110602.1	Intruded forward wall/cabinetry of patient compartment	Certain

15	Right posterior parietal scalp laceration, 5.5 cm	110602.1	Intruded forward wall/cabinetry of patient compartment	Certain
16	Contusions to left lower back, 8 x 4 cm zone	410402.1	Intruded forward wall/cabinetry of patient compartment	Certain
17	Left forearm contusions	710402.1	Intruded forward wall/cabinetry of patient compartment	Probable
18	Left dorsal hand contusions	710402.1	Intruded forward wall/cabinetry of patient compartment	Probable
19	Left elbow abrasion, 1x1 cm	710202.1	Intruded forward wall/cabinetry of patient compartment	Probable
20	Right forearm abrasions, upper dorsal, 4x1 cm and 7x4 cm	710202.1	Intruded forward wall/cabinetry of patient compartment	Probable

Source – Post-mortem examination report

Wheeled Ambulance Cot Occupant Kinematics

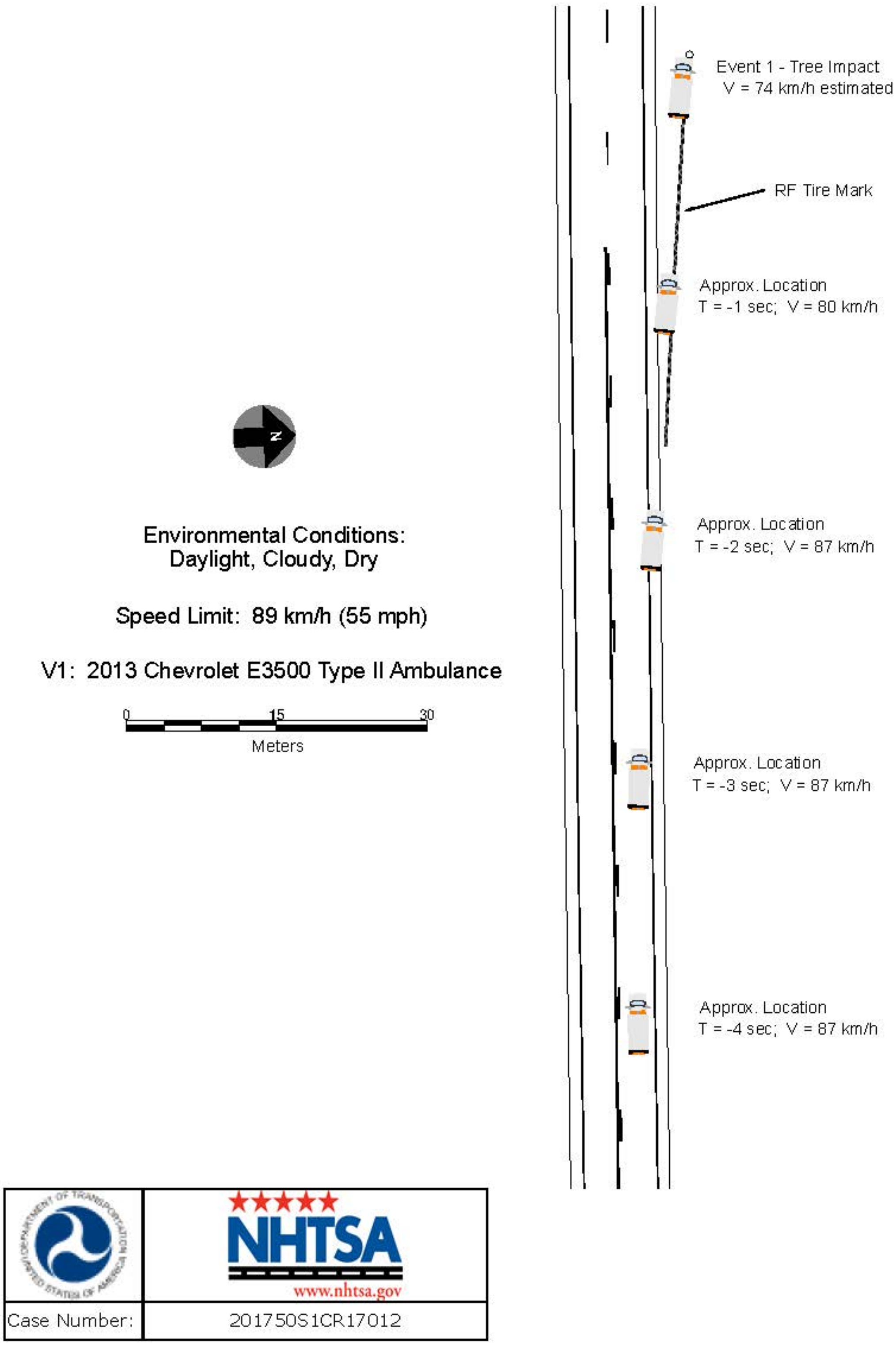
The 64-year-old male patient was in a “standard” Fowler position on the wheeled ambulance cot. Pertinent to the discussion of the patient was that he was a cancer patient who was being transported home following discharge from a regional medical center. The patient had been at the facility for approximately one week for treatment related to a sepsis infection. Due to poor circulation, he was wearing compression boots on his lower extremities. He also had a gastric feeding tube in place. The patient was dressed in a hospital gown and covered by several sheets. After positioning the patient on the cot prior to beginning the transport, the EMS crew had secured the patient using the multipoint harness system. The wheeled ambulance cot was then loaded into the Chevrolet ambulance and secured in the “antler bracket” and locking clamp mechanism.

At impact with the tree, the patient would have initiated a trajectory toward the impact forces. His posterior compressed and loaded the mattress platform of the cot, and the force load was translated through the cot’s frame and to the locking clamp mechanism. The patient began to slide vertically up the partially reclined backrest of the mattress platform as he maintained his 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 shear and moment (torque) forces at the locking pin exceeded the strength of the aluminum frame of the cot, which fractured the frame. This allowed the cot to pitch even farther forward during the prolonged impact engagement, and exacerbated the patient’s kinematic response.

As the cot pitched upward, the patient maintained his trajectory and slipped from multi-point harness system. His shoulders passed between their anchorage points at the top of the mattress platform frame, and he began to separate from the cot. The patient proceeded on a trajectory toward the bulkhead of the patient compartment (forward wall/cabinetry). It is possible that his right upper extremity and flank may have contacted the captain's chair occupant as he was displaced forward. The patient contacted the forward wall/cabinetry as these components were displaced rearward by the impact/intrusion, producing multiple head and posterior injuries to the patient. Although his upper extremities and torso were completely separated from the cot, his lower extremities remained in contact with the cot and were partially entangled in the multi-point harness system when the vehicle came to final rest.

The patient was unconscious following the crash, and his body was removed from the ambulance by the EMS crew with assistance from witnesses and responding emergency services personnel. Responders worked the patient using resuscitative measures for more than twenty minutes, but they were unable to revive the patient. It is possible that rib and sternum fractures, as well as other thoracic injuries, were sustained by the patient as a result of CPR efforts. The patient was pronounced deceased at the crash site. His body was removed by the local medical examiner, who conducted an internal autopsy and determined that the patient's cause of death was multiple traumatic blunt force injuries.

CRASH DIAGRAM



Appendix A:

2013 Chevrolet Express 3500 Event Data Recorder Report[1]

[1] The EDR report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the investigation. The CDR report contained in the associated Crash Viewer 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	1GBZGUCLXD1******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR17012_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.3
Imaged with Software Licensed to (Company Name)	Company Name information was removed when this file was saved without VIN sequence number
Reported with CDR version	Crash Data Retrieval Tool 17.7.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment Deployment #2

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event may contain Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle velocity change. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as Deployment Event #2, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds of a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.
The second type of SDM recorded crash event is the Deployment Event. It also may contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events. If a second Deployment Event occurs any time after the Deployment Event, the Deployment Event #2 will overwrite any non-locked Non-Deployment Event. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

Data:

-SDM Recorded Vehicle Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment Events, the SDM will record 220 milliseconds of data after Deployment criteria is met and up to 70 milliseconds before Deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 300 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.
-The CDR tool displays time from Algorithm Enable (AE) to time of Deployment command in a Deployment event and AE to time of maximum SDM recorded vehicle velocity change in a Non-Deployment event. Time from AE begins when the first air bag system enable threshold is met and ends when Deployment command criteria is met or at maximum SDM recorded vehicle velocity change. Air bag systems such as frontal, side, or rollover, may be a source of an enable. The time represented in a CDR report can be that of the enable of one air bag system to the Deployment time of another air bag system.
-Maximum Recorded Vehicle Velocity Change is the maximum square root value of the sum of the squares for the vehicle's combined "X" and "Y" axis change in velocity.
-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.
-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

- -Significant changes in the tire's rolling radius
- -Final drive axle ratio changes
- -Wheel lockup and wheel slip

-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.
-Pre-Crash data is recorded asynchronously. The 0.5 second Pre-crash data value (most recent recorded data point) is the data

point last sampled before AE. That is to say, the last data point may have been captured just before AE but no more than 0.5 second before AE. All subsequent Pre-crash data values are referenced from this data point.
-Pre-Crash Electronic Data Validity Check Status indicates “Data Invalid” if:
-The SDM receives a message with an “invalid” flag from the module sending the pre-crash data
-No data is received from the module sending the pre-crash data
-No module is present to send the pre-crash data
-Pre-crash data associated with this event will always be for the first event even if it is not recorded.
-Driver’s and Passenger’s Belt Switch Circuit Status indicates the status of the seat belt switch circuit.
-The Time Between Non-Deployment to Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, “N/A” is displayed in place of the time. If the value is negative, then the Deployment Event occurred first. If the value is positive, then the Non-Deployment Event occurred first.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-The ignition cycle counter relies upon the transitions through OFF->RUN->CRANK power-moding messages, on the GMLAN communication bus, to increment the counter. Applying and removing of battery power to the module will not increment the ignition cycle counter.
-If more than one event is recorded, use the follow to determine which event the Multiple Event Data is associated with:
-If a Deployment event and not locked Non-Deployment event are recorded, the Multiple Event Data is associated with the Deployment event.
-If a Deployment event and a locked Non-Deployment event are recorded, then the Multiple Event Data is associated with both events.
-If a Deployment event and Deployment event #2 are recorded, then the Multiple Event Data is associated with both events.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene

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

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

01006_SDMCG_r004

Multiple Event Data

Associated Events Not Recorded	0
Event(s) was an Extended Concatenated Event	No
An Event(s) was in Between the Recorded Event(s)	No
An Event(s) Followed the Recorded Event(s)	No
The Event(s) Not Recorded was a Deployment Event(s)	No
The Event(s) Not Recorded was a Non-Deployment Event(s)	No

System Status At AE

Low Tire Pressure Warning Lamp (If Equipped)	OFF
Vehicle Power Mode Status	Run
Remote Start Status (If Equipped)	Inactive
Run/Crank Ignition Switch Logic Level	Active

Pre-crash data

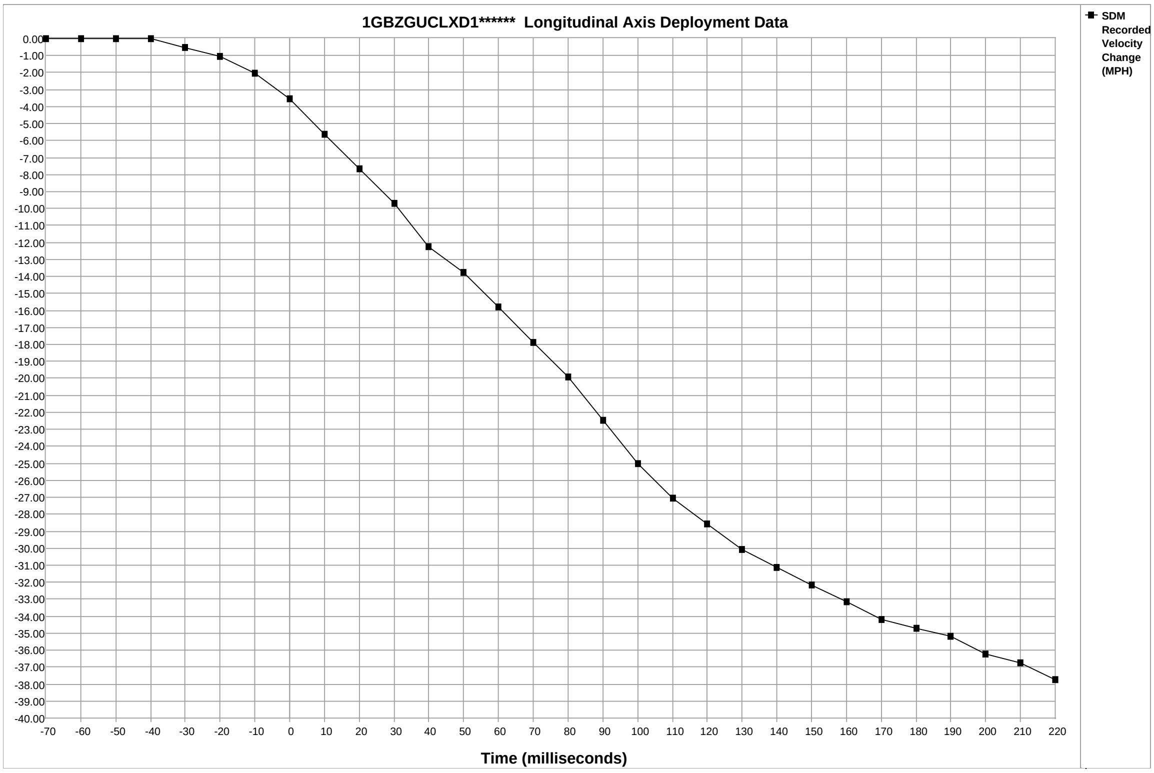
Parameter	-1.0 sec	-0.5 sec
Reduced Engine Power Mode	OFF	OFF
Cruise Control Active (If Equipped)	No	No
Cruise Control Resume Switch Active (If Equipped)	No	No
Cruise Control Set Switch Active (If Equipped)	No	No
Engine Torque (foot pounds)	5.16	-56.43

Pre-Crash Data

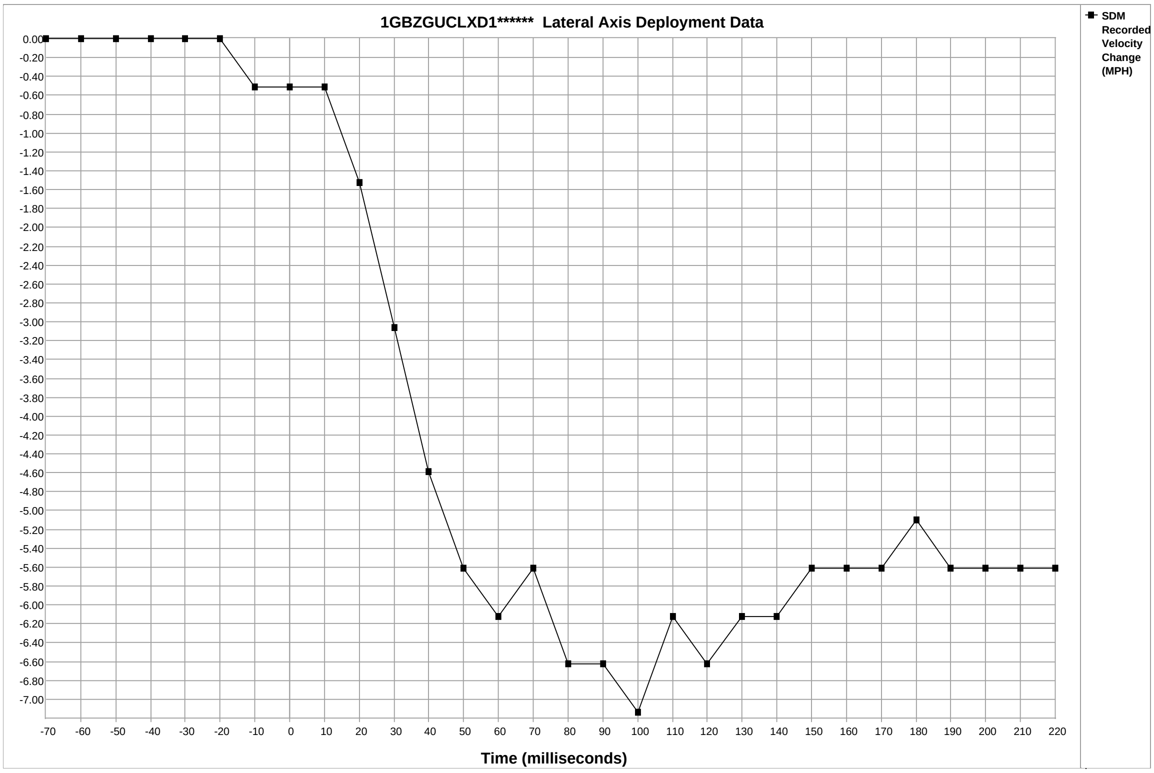
Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Accelerator Pedal Position (percent)	0	0	0	0	0
Vehicle Speed (MPH)	54	54	53	50	48
Engine Speed (RPM)	1408	1408	1408	1280	1216
Percent Throttle	8	9	11	11	2
Brake Switch Circuit State	OFF	OFF	OFF	OFF	ON

System Status At Deployment

Ignition Cycles At Investigation	32438
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655350
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	16613
Ignition Cycles At Event	32437
Ignition Cycles Since DTCs Were Last Cleared	255
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Air Bag Indicator Status at Event Enable	Undefined
Passenger SIR Suppression Switch Circuit Status	Air Bag Not Suppressed
Diagnostic Trouble Codes at Event, fault number: 1	B1199-00
Diagnostic Trouble Codes at Event, fault number: 2	N/A
Diagnostic Trouble Codes at Event, fault number: 3	N/A
Diagnostic Trouble Codes at Event, fault number: 4	N/A
Diagnostic Trouble Codes at Event, fault number: 5	N/A
Diagnostic Trouble Codes at Event, fault number: 6	N/A
Diagnostic Trouble Codes at Event, fault number: 7	N/A
Diagnostic Trouble Codes at Event, fault number: 8	N/A
Diagnostic Trouble Codes at Event, fault number: 9	N/A
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	25
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	25
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Driver Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Time Between Events (sec)	0
Event Recording Complete	Yes
Driver First Stage Deployment Loop Commanded	Yes
Passenger First Stage Deployment Loop Commanded	Yes
Driver Second Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded for Disposal	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded for Disposal	No
Driver Pretensioner Deployment Loop Commanded (If Equipped)	No
Passenger Pretensioner Deployment Loop Commanded (If Equipped)	No
Driver Side Deployment Loop Commanded (If Equipped)	No
Passenger Side Deployment Loop Commanded (If Equipped)	No
Second Row Left Side Deployment Loop Commanded (If Equipped)	No
Second Row Right Side Deployment Loop Commanded (If Equipped)	No
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver (Initiator 3) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger (Initiator 3) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver Knee Deployment Loop Commanded (If Equipped)	No
Passenger Knee Deployment Loop Commanded (If Equipped)	No
Second Row Left Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Right Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Center Pretensioner Deployment Loop Commanded (If Equipped)	No



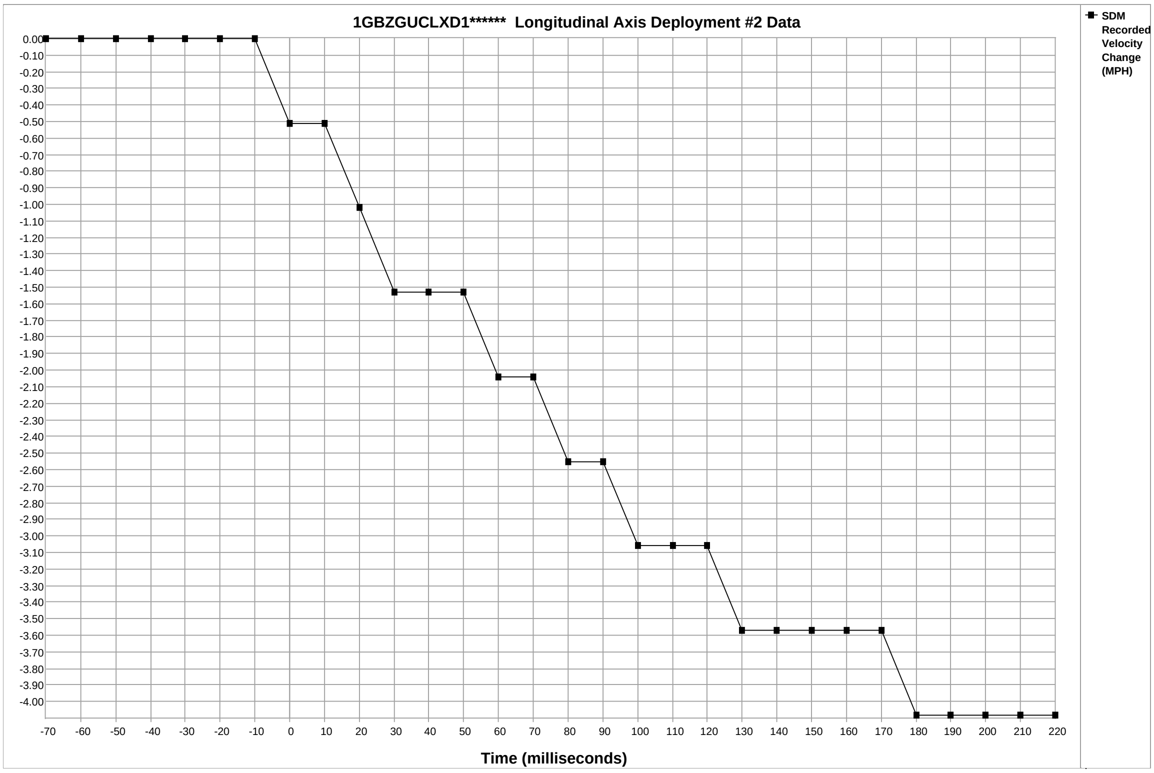
Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	-0.51	-1.02	-2.04	-3.57	-5.61	-7.65	-9.69	-12.25	-13.78	-15.82	-17.86
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-19.90	-22.45	-25.00	-27.04	-28.57	-30.10	-31.12	-32.15	-33.17	-34.19	-34.70	-35.21	-36.23	-36.74	-37.76



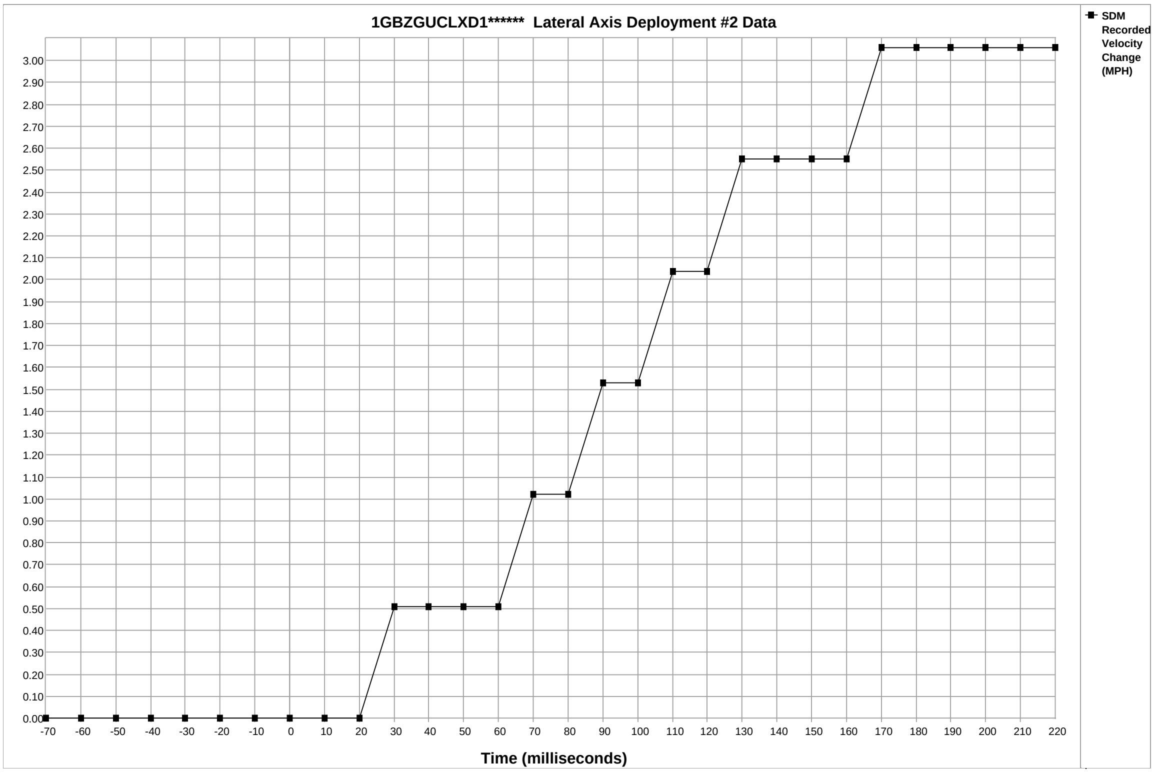
Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	-0.51	-0.51	-0.51	-1.53	-3.06	-4.59	-5.61	-6.12	-5.61
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Lateral Axis Recorded Velocity Change (MPH)	-6.63	-6.63	-7.14	-6.12	-6.63	-6.12	-6.12	-5.61	-5.61	-5.61	-5.10	-5.61	-5.61	-5.61	-5.61

System Status At Deployment #2

Ignition Cycles At Investigation	32438
SIR Warning Lamp Status	ON
SIR Warning Lamp ON/OFF Time Continuously (seconds)	0
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	0
Ignition Cycles At Event	32437
Ignition Cycles Since DTCs Were Last Cleared	255
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Air Bag Indicator Status at Event Enable	Undefined
Passenger SIR Suppression Switch Circuit Status	Air Bag Not Suppressed
Diagnostic Trouble Codes at Event, fault number: 1	B0052-00
Diagnostic Trouble Codes at Event, fault number: 2	B1000-00
Diagnostic Trouble Codes at Event, fault number: 3	B1199-00
Diagnostic Trouble Codes at Event, fault number: 4	N/A
Diagnostic Trouble Codes at Event, fault number: 5	N/A
Diagnostic Trouble Codes at Event, fault number: 6	N/A
Diagnostic Trouble Codes at Event, fault number: 7	N/A
Diagnostic Trouble Codes at Event, fault number: 8	N/A
Diagnostic Trouble Codes at Event, fault number: 9	N/A
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Driver Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Passenger Side or Roof Rail/Head Curtain Time From Algorithm Enable to Deployment Command Criteria Met (msec)	N/A
Crash Record Locked	Yes
Deployment Event Recorded in the Non-Deployment Record	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	No
Time Between Events (sec)	0
Event Recording Complete	Yes
Driver First Stage Deployment Loop Commanded	No
Passenger First Stage Deployment Loop Commanded	No
Driver Second Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded for Disposal	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger 2nd Stage Deployment Loop Commanded for Disposal	No
Driver Pretensioner Deployment Loop Commanded (If Equipped)	No
Passenger Pretensioner Deployment Loop Commanded (If Equipped)	No
Driver Side Deployment Loop Commanded (If Equipped)	No
Passenger Side Deployment Loop Commanded (If Equipped)	No
Second Row Left Side Deployment Loop Commanded (If Equipped)	No
Second Row Right Side Deployment Loop Commanded (If Equipped)	No
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver (Initiator 3) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Passenger (Initiator 3) Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Driver Knee Deployment Loop Commanded (If Equipped)	No
Passenger Knee Deployment Loop Commanded (If Equipped)	No
Second Row Left Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Right Pretensioner Deployment Loop Commanded (If Equipped)	No
Second Row Center Pretensioner Deployment Loop Commanded (If Equipped)	No



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.51	-0.51	-1.02	-1.53	-1.53	-1.53	-2.04	-2.04
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-2.55	-2.55	-3.06	-3.06	-3.06	-3.57	-3.57	-3.57	-3.57	-3.57	-4.08	-4.08	-4.08	-4.08	-4.08



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	0	10	20	30	40	50	60	70
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.51	0.51	0.51	0.51	1.02
Time (milliseconds)	80	90	100	110	120	130	140	150	160	170	180	190	200	210	220
SDM Lateral Axis Recorded Velocity Change (MPH)	1.02	1.53	1.53	2.04	2.04	2.55	2.55	2.55	2.55	3.06	3.06	3.06	3.06	3.06	3.06

Hexadecimal Data

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$46   00 2F C0 00 00 00 00
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$5B   00 00 01 00 01 00 00
$5C   02 00 03 01 03 01 00
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$42  56 08 14
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$44  56 3E E0 C0 FF FC
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$47  1D 09 08
$B4  41 53 38 38 33 31 4B 52 32 32 30 38 52 34 4B 5A
$C1  01 3C E2 0E
$C2  01 8B A1 82
$CB  01 3D 0F 4F
$CC  01 3D 0F 4F
$DB  41 41
$DC  41 41
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July 2018

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