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

16. Abstract

This report documents the move-over law crash investigation involving a 2014 Ford Explorer Police Interceptor. The police vehicle was struck on its rear plane by a 2019 Subaru Outback while engaged in the closure of a travel lane to provide blocking protection and visibility for a disabled vehicle that was in the process of being retrieved by a towing/recovery vehicle. The Ford was parked and unoccupied, in the right travel lane of a two-lane, limited-access roadway. Its emergency warning lights were activated (flashing). Inclement weather conditions at the time of the crash included heavy snow with reduced visibility. Speed on the limited-access roadway had been reduced from 105 km/h (65 mph) to 64 km/h (40 mph) using large highway signs and message boards due to the inclement weather. After impact by the Subaru, the Ford was displaced forward with clockwise rotation and struck a law enforcement officer (non-motorist) and a second parked and unoccupied 2017 Ford Explorer Police Interceptor. The non-motorist sustained serious injuries and was hospitalized.

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Special Crash Investigations
On-Site Move-Over Crash Law Crash Investigation
Case Number: CR20005
Vehicle: 2014 Ford Explorer Police Interceptor
Location: Massachusetts
Crash Date: December 2019

Background

This report documents the move-over law crash investigation involving a 2014 Ford Explorer Police Interceptor (Figure 1) that was struck on its rear plane by a 2019 Subaru Outback. The police vehicle was engaged in the closure of a travel lane to provide blocking protection and visibility for a disabled vehicle that was in the process of being retrieved by a towing/recovery vehicle. It was parked and unoccupied in the right travel lane of a two-lane, limited-access roadway. Its emergency warning lights were flashing. Inclement weather at the time of the crash included heavy snow with reduced visibility. Speed on the limited-access roadway had been reduced from 105 km/h (65 mph) to 64 km/h (40 mph) using large highway signs and message boards. After impact by the Subaru, the Ford was displaced forward with clockwise rotation and struck a law enforcement officer (non-motorist) and a second parked, unoccupied 2017 Ford Explorer Police Interceptor. The non-motorist sustained serious injuries and was hospitalized.

Figure 1. Right rear oblique view of the struck 2014 Ford at the time of the SCI vehicle inspection

The National Highway Traffic Safety Administration's Enforcement and Justice Services Division identified the crash through a search of the internet news media for crashes of interest regarding move-over laws. The notification was forwarded to the Special Crash Investigations (SCI) group in February 2020 and assigned for on-site investigation. Due to the COVID-19 pandemic and legal involvement, the on-site portion of this investigation was delayed until July 2020. On-site activities included the exterior inspections of both Ford Explorer Police Interceptors (MY 2014 and MY 2017). Data were imaged from the event data recorder (EDR) component of the 2014 vehicle using the current version of the Bosch Crash Data Retrieval (CDR) tool and software. A drive-by of the crash site was also conducted. Additionally, on-scene

digital photographs were obtained from the investigating law enforcement agency. The Subaru was a rental vehicle that was towed from the crash scene and retained by the rental company. It could not be located for inspection.

Legal Statutes Governing Vehicle Movements Around Emergency Vehicles and Driver Responsibility

In Massachusetts the Move-Over Law aims to make law enforcement, firefighters, paramedics, tow truck operators, and all roadside emergency and maintenance professionals safer on the job. The law took effect on March 22, 2009, and requires a driver approaching a stationary emergency or maintenance vehicle with flashing lights to move to the next adjacent lane and slow down, if it is safe to do so. Failure to comply could result in a fine of up to $100.
Every year first responders across the country are injured or killed on the job while providing emergency help. Massachusetts residents are asked to make a personal pledge to always move over to make their roadways safer for everyone.

Crash Summary

Crash Site

This crash occurred on a two-lane, limited-access roadway in an unlighted rural area at night. In the hours before the crash the weather consisted of accumulating and blowing snow, with occasional mixed precipitation/freezing rain. Reported conditions in the locale at the time included overcast skies with a snow/freezing rain mix, a temperature 20 ºC (30 ºF), 93-percent relative humidity, and a northeast breeze at 14 km/h (9 mph). The roadway was straight and level for a continuous distance in the eastbound travel direction for approximately 1 km (0.6 mi) leading into the crash site. Although speed on the limited-access roadway was regulated by a posted limit of 105 km/h (65 mph), the ongoing inclement weather and accumulating snow had caused authorities to post a reduced speed limit of 64 km/h (40 mph). This reduced speed was widely displayed using electronic signage and overhead message boards.

The limited-access roadway had two travel lanes in the eastbound and westbound directions, physically divided by a grass median with a double-faced W-beam guardrail barrier (Figure 2). The eastbound lanes were approximately 3.7 m (12 ft) wide, delineated by a single solid white fog line, broken white center line, and single solid yellow median line. The travel lanes were supported by a 4.0 m (13 ft) wide south (right) shoulder and a 1.5 m (5 ft) wide north (left) shoulder. All roadway surfaces were asphalt. A crash diagram is included at the end of this report.

Figure 2. Aerial view of the trafficway from Google Maps © 2023 Maxar Technologies, MassGIS

Pre-Crash

Prior to the crash, an uninvolved truck tractor with semi-trailer of unknown year, make, or model became disabled while straddling the single solid white lane line (right) and partially blocking the right lane of the eastbound portion of the limited-access roadway. There were wintery conditions, with an accumulation of snow on the roadway surface. Two law enforcement units and a tow truck had responded to assist the disabled vehicle. The 2017 and 2014 Ford Explorer Police Interceptors were parked and unoccupied in the right travel lane to provide visibility and warning for oncoming traffic and close/block the right lane to moving traffic. Both vehicles had their LED overhead emergency warning lights and taillight strobe flashers activated. The 2014 Ford was the first exposed unit, with the 2017 Ford an unspecified distance in front of the 2014

Ford. The two law enforcement officers who drove them were out of their vehicles and assisting at the scene. They wore fluorescent yellow safety jackets with white reflective striping, in accordance with their agency's policies.

The Subaru was traveling eastbound in the right travel lane. It had Subaru's Eyesight Driver Assist Technologies consisting of adaptive cruise control, lane-keeping assist, pre-collision braking, and pre-collision throttle management; however, it could not be determined if the system was activated. It was driven by a belted 30-year-old male and occupied by a belted 23-year-old female front right passenger and a belted 36-year-old male second-row right passenger. They were all foreign nationals in the United States on temporary education status. The driver had a temporary driver license issued by Massachusetts. The Subaru was owned by a rental car company. Specifics concerning the Subaru's pre-crash activities and route of travel remain unknown. Based on the distance between the crash site and the closest prior eastbound entrance ramp, they had been traveling east on the limited-access roadway for at least 11 km (7 mi).

The Subaru approached the active emergency scene from the west. Under clear environmental conditions, the Subaru's driver would have had an unimpeded view of the emergency warning lights and stationary vehicles for at least 1 km (0.6 mi). However, wintery weather reduced the visibility and caused a posted reduction in the active speed limit on the roadway to 64 km/h (40 mph).

The Subaru approached the stationary 2014 Ford Explorer Police Interceptor at an unknown speed and the driver did not detect the emergency scene until the final seconds before impact. Based on police images of the tire tracks through the snow on the roadway, reconstruction of the crash determined that a right steer and braking action was initiated. Due to the accumulation of snow, the Subaru likely experienced reduced braking and steering effectiveness. It rotated clockwise but less than 30 degrees and the driver lost control.

The Subaru driver did not respond to several electronic message requests for interview, and therefore, his specific actions are unknown. The police crash report stated that the driver received three traffic citations, speed greater than reasonable/prudent, failure to use care in stopping or turning, and negligent operation of a motor vehicle.

Crash

The crash occurred as the front of the Subaru's left side struck the right rear corner of the stationary 2014 Ford (Event 1). Directions of force were within the 6 o'clock sector for the Ford and 11 o'clock sector for the Subaru. This induced a clockwise rotation to the Ford about its vertical axis as it was displaced forward from its parked position. Similarly, a counterclockwise rotation was induced in the Subaru about its vertical axis as it struck the Ford and was redirected to the southeast. The 2014 Ford became left-side-leading as it rotated clockwise and was displaced forward. The Ford then struck one of the law enforcement officers who was returning to it (Event 2). This male non motorist, age unknown, was projected into the left travel lane by the Ford as it continued on its displaced trajectory.

The 2014 Ford completed approximately 170 degrees of total clockwise rotation and then struck the rear of the 2017 Ford as it came to rest (Event 3). The Subaru departed the south (right) road edge and came to rest in the roadside, facing north. It completed approximately 110 degrees of total counterclockwise rotation. The final rest positions of the 2014 Ford and Subaru were captured in on-scene law enforcement images. Figure 3 shows the 2014 Ford (left) and Subaru

(right) at final rest. Figure 4 shows the post-crash tire marks of the Subaru from impact through the accumulated snow and off of the roadway.

Figure 3. East-facing view of the 2014 Ford and 2019 Subaru at final rest (on-scene law enforcement image)

Figure 4. East-facing view of the Subaru's post-impact tire marks through the snow (on-scene law enforcement image)

Post-Crash

The second law enforcement officer assisting at the scene heard the crash as it occurred and immediately used his two-way radio to notify the emergency response system of the secondary incident. Additional law enforcement units as well as fire department and emergency medical services personnel were dispatched to the scene. The limited-access roadway was then closed to all eastbound traffic.

The non-motorist who was struck by the 2014 Ford while it was rotating and being displaced by the Subaru's impact sustained incapacitating (A-level) injuries. He was transported by ambulance to a regional trauma center and hospitalized. The three occupants of the Subaru denied injury and were not medically transported from the crash scene. The 2014 Ford was removed from the crash site and transferred on to a private yard, while the 2017 Ford remained

in service and was driven from the scene. The Subaru was towed from the scene and transferred to the regional lot of its rental car company's owner.

2014 Ford Explorer Police Interceptor

Description

The 2014 Ford Explorer Police Interceptor (Figure 5) was manufactured in March 2014 and identified by the Vehicle Identification Number (VIN) 1FM5K8AR1EGxxxxxx. The electric odometer reading was 143,275.7 km (89,027.4 miles) at the time of the SCI inspection. The Ford was an all-wheel drive platform powered by a 3.7-liter, V-6 gasoline engine linked to a 6-speed automatic transmission. Its brakes were power-assisted, 4-wheel disc with antilock (ABS). The gross vehicle weight rating (GVWR) was 2,858 kg (6,300 lb), with gross axle weight ratings (GAWR) of 1,452 kg (3,200 lb) front and 1,520 kg (3,350 lb) rear. The vehicle manufacturer's recommended tire size was P245/55R18, with recommended cold tire pressures of 250 kPa (36 PSI) at both axle positions.

Figure 5. Left front oblique view of the 2014 Ford Explorer Police Interceptor at the time of the SCI vehicle inspection

At the time of the SCI inspection, the Ford had Goodyear Eagle RSA tires of the recommended size at all four axle positions. All four tires had at least 5 mm (5/32 in) of tread. The left front, left rear, and right rear tires all remained inflated at the time of the SCI inspection and were not damaged in the crash. The right rear was cut/torn from direct involvement in the crash.

The Ford's interior was configured for the seating of up to five (2/3), with front-row bucket seats and second-row bench seat. It was a law enforcement patrol and transport vehicle equipped with a secure divider to isolate the second row for prisoner transport. The front row had emergency vehicle specialty equipment including mobile two-way radio, scanner, emergency light controller, siren, laptop pedestal mount, and other equipment. Manual restraint systems consisted of 3-point lap and shoulder seat belts for all seat positions. Supplemental restraint systems included front belt pretensioners, certified advanced 208-compliant (CAC) frontal air bags, front-seat-mounted side impact, and dual-sensing (side impact and rollover) inflatable curtain (IC) air bags.

Conspicuity and Emergency Vehicle Lighting

In conjunction with its duty service and responsibilities, the 2014 Ford Explorer was outfitted with a complement of emergency vehicle warning lights, a high-decibel siren, and communications equipment. The exterior had reflective banding and striping specifically intended to make the vehicle more visible to oncoming traffic from any direction and make the vehicle clearly identifiable to the public as a law enforcement vehicle.

Specific equipment on the exterior of the Ford included a blue paint scheme on the doors and body panels. To identify the agency and its service as a law enforcement vehicle, the agency's name was marked in reflective letters on the rear aspect of the left front and right front fenders, as well as across the center aspect of the rear tailgate/hatch. In addition, a large agency logo was affixed to the panel of the left front and right front doors. The license plate identified the unit number of the vehicle and law enforcement agency on both the front and rear of the vehicle. Bright white reflective striping that measured 2 cm (0.8 in) in height was affixed to the vehicle in several locations: (1) across the full-width of the front and rear bumpers along their center contour, (2) across the center aspect of the tailgate/hatch below the backlight glazing at the beltline, and (3) across the top of the backlight header/spoiler. There was also an 8 cm (3.1 in) tall bright white reflective chevron pattern across the width of the bottom of the tailgate/hatch. Lastly, 4 cm (1.6 in) wide bright yellow reflective striping was affixed to the interior aspect of the door paneling/frames of the side doors and tailgate/hatch, which became visible to the exterior when the doors were opened.

Emergency lighting equipment installed on the vehicle provided 360-degree visibility. Primary warning lighting was achieved by an LED lightbar that was mounted to the roof of the vehicle immediately behind the B-pillars. The lightbar was identified as a Defender series LED bar manufactured by Code 3.[1] It was fully populated with six forward-facing, six rear-facing, four corner, and two alley light modules. For the forward-facing LEDs, the two center modules were bright white takedown lights, while the outer four were blue LEDs that flashed in an alternating pattern. The rear-facing LEDs included four blue (center and ends) and two red, which flashed in an alternating pattern.

All four corner LEDs were blue and flashed simultaneously. The alley lights (sides) were white, controlled by separate switches. Additional perimeter lighting included blue LED flashers mounted in each headlight, and red LED flashers mounted in each taillight. The vehicle was further equipped with headlight flasher and taillight flasher control modules. Switches controlled the front-facing, rear-facing, alley, and take-down flash patterns. Figures 6 and 7 depict the emergency lights for the front and back, respectively, partially illuminated. At the time of the crash, all of the rear-facing warning lights (lightbar and taillight flashers) were in use.

[1] Code 3, Truganina, Victoria, Australia

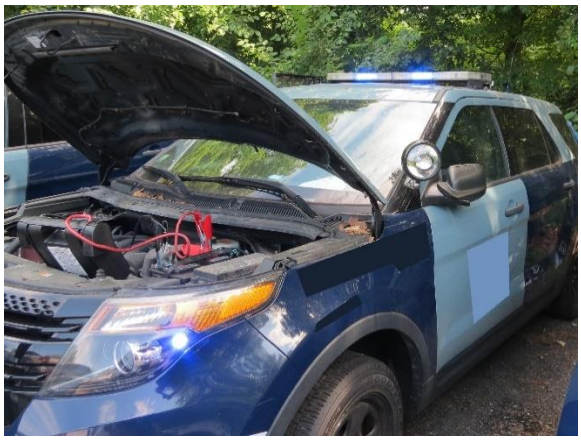


Figure 6. View of the Ford's partially illuminated emergency warning lights from the front

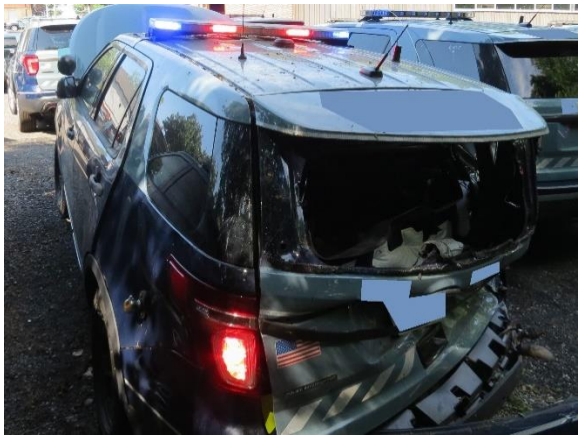


Figure 7. View of the Ford's partially illuminated emergency warning lights from the rear

Exterior Damage

This crash involved the back of the Ford, and the damage pattern was an off-set profile to the right aspect that overrode the bumper beam. The rear bumper fascia was fractured and partially separated from the vehicle, with longitudinal crush to the bumper beam, rear tailgate/hatch, and right rear quarter panel. The greatest depth of crush was located above the level of the rear bumper beam, at the bottom aspect of the tailgate/hatch and above the sill of the hatch. The right rear tire and wheel were directly contacted and involved in the damage profile. They were displaced forward, reducing the right wheelbase dimension by 18 cm (7.1 in) and increasing the left wheelbase by 4 cm (1.6 in).

Direct contact on the back plane began 25 cm (9.8 in) right of center and extended 55 cm (21.7 in) to the right rear corner. A crush profile was documented to the structure with the greatest depth of crush – the lower aspect of the tailgate/hatch – using a Nikon total station mapping system. The crush at this level was the best representative of the energy exchange in the impact. The corresponding direct and induced damage width (Field-L) was 160 cm (63.0 in). Accounting for free-space and estimated crush at the bumper level, the resultant averaged crush profile used for analysis was: C1 = 0, C2 = 4 cm (1.6 in), C3 = 10 cm (3.9 in), C4 = 36 cm (14.2 in), C5 = 39 cm (15.4 in), and C6 = 50 cm (19.7 in). Maximum crush was observed at the right rear corner.

The Collision Deformation Classification[2] (CDC) of 06BREW3 was assigned to the Ford's rear plane damage profile. Figure 8 shows the damage pattern from a horizontal perspective, while Figure 9 shows the rear damage profile from the right plane perspective.

The severity of the crash was calculated by the CDC algorithm of the WinSMASH program. The total calculated vehicle velocity change (delta V) of the Ford was 26 km/h (16 mph), with longitudinal and lateral components of 26 km/h (16 mph) and -5 km/h (-3 mph). The results of the borderline reconstruction appeared low.

Figure 8. Back plane damage profile to the Ford from the impact by the Subaru

Figure 9. View of the back plane damage profile and depth of crush from the right plane perspective

[2] SAE J224_202205 – SAE Recommended Practice describing vehicle collision damage in an alphanumeric format.

The Ford sustained minor damage in relation to its impact with the law enforcement officer (non-motorist). This damage consisted of an area of minor deformation (estimated less than 2 cm [1 in]) to the left rear quarterpanel above the left rear axle position (Figure 10). The CDC associated with the non-motorist impact was 09LBAW2. This impact was beyond the scope of the WinSMASH program.

Figure 10. Left rear quarter panel damage from impact by the non-motorist

The final crash event involved the back plane, left corner of the Ford. The edge of the tailgate, which was deformed outward by the initial impact from the Subaru, protruded from the vehicle's left rear corner. As the Ford slid to final rest, this protruding, deformed portion of the vehicle lightly contacted the rear plane of the 2017 Ford. The overlapping damage could not be measured or further evaluated. The CDC assigned for this event was 06BLMN01. No WinSMASH calculations could be conducted due to the overlapping nature of the damage.

Event Data Recorder

The 2014 Ford Explorer Police Interceptor had a restraints control module (RCM) mounted to the floor on the center tunnel, beneath the aftermarket center console. The RCM monitored the diagnostic functions of the vehicle's restraint systems (air bags and safety belt pretensioners) and controlled the deployment/actuation of those devices dependent upon crash event severity. The RCM had EDR capabilities to record crash event data for longitudinal, lateral, and rollover crash events. The SCI investigator used the Bosch CDR tool and software during the SCI inspection, using external power supplied to the vehicle's electrical system. Data were imaged using CDR software version 19.4.1, via a connection through the vehicle's diagnostic link connector (DLC). The data were later read using software version 23.0.2 and are included at the end of this report as Appendix A.

The EDR could store up to two crash event records, termed either "non-deployment trigger event," "air bag deployment event," and/or "non-air bag deployment event." By definition, a non-deployment trigger event was any event that met the recording threshold, but did not result in the deployment/actuation of any safety device within 150 milliseconds. An air bag deployment event deployed inflatable restraints, and a non-air bag deployment event deployed devices other than standard inflatable restraints (including pretensioner actuation). Non-deployment trigger event and non-air bag deployment event types were subject to overwrite by subsequent events of

greater severity or typing, whereas air bag deployment event types could not be overwritten. If power supply to the RCM was lost following a crash event, all or part of the data may not have been recorded to the EDR's memory. The EDR had the capacity to record 250 milliseconds of data once the minimum threshold was achieved in longitudinal or lateral event types. Associated to the recording of each event was a 5-second pre-crash buffer that recorded pre-crash data points in 0.5-second intervals. Data recorded included vehicle speed (mph), accelerator pedal (% full), service brake (on/off) status, engine speed (rpm), and ABS activity data. Additional data samples, including transmission gear selection, stability control activity, and steering wheel input, were also recorded. System status data were recorded at the time of an event, inclusive of reported diagnostic trouble codes (DTCs), belt usage of front-row occupants, and vehicle ignition cycle.

The imaged data contained two events, both deployment-level events that occurred on ignition cycle 3,739. The two events were 100 milliseconds apart. Both were completely recorded, and both remained unlocked. There were no DTCs reported, and the air bag warning lamp was off. Pre-crash data for both records indicated that the vehicle's transmission was in park and the vehicle was stationary, consistent with the pre-crash circumstances. The maximum longitudinal delta V reported for the first record event was 34.79 km/h (21.62 mph) at 164 milliseconds after time zero. The corresponding maximum lateral delta V was -2.19 km/h (-1.36 mph) at 62 milliseconds after time zero. The maximum longitudinal delta V reported for the second record event was 22.89 km/h (14.22 mph) at 110 milliseconds after time zero. The corresponding maximum lateral delta V was 1.93 km/h (1.20 mph) at 74 milliseconds after time zero.

Both of the recorded events were related to the same impact of the Subaru with the rear plane of the Ford. The recorded events were consecutive. Based on the time between the events, the configuration of the vehicles at impact, and the probable speed of the Subaru at impact, the cause of the detection of two events most likely relates to the circumstances of the vehicle's engagement during the crash. The Ford's impact with the non-motorist (SCI crash event 2) and the contact with the 2017 Ford (SCI crash event 3) were not of sufficient magnitude to be recognized or recorded by the 2014 Ford's RCM as events.

NHTSA Recalls and Investigations

A VIN-based query of the NHTSA's recall database (www.nhtsa.gov/recalls) for the 2014 Ford Explorer Police Interceptor showed no open recalls pertaining to this specific vehicle as of the date of this report.

2017 Ford Explorer Police Interceptor

Description

The 2017 Ford Explorer Police Interceptor (Figure 11) was identified by the VIN 1FM5K8AR1HGxxxxxx. According to law enforcement documentation, the vehicle's odometer reading at the time of the crash was 151,936.1 km (94,408.7 mi). It was an all-wheel-drive platform powered by a 3.7-liter, V-6 gasoline engine linked to a 6-speed automatic transmission. Its brakes were power-assisted, 4-wheel disc with ABS. The GVWR was 2,858 kg (6,300 lb), with GAWRs of 1,452 kg (3,200 lb) front and 1,520 kg (3,350 lb) rear. The vehicle manufacturer's recommended tire size was P245/55R18, with recommended cold tire pressures of 250 kPa (36 psi) for all four axle positions. At the time of the SCI inspection, the Ford had Goodyear Eagle RSA tires of the recommended size at all four axle positions. All four tires had at least 5 mm (5/32 in) of tread. All tires remained inflated and were not damaged in relation to the crash.

Figure 11. Left front oblique view of the 2017 Ford Explorer Police Interceptor at the time of the SCI vehicle inspection

The Ford's interior had seating of up to five (2/3), with front-row bucket seats and second-row bench seat. The vehicle, like the 2014 Interceptor, was a law enforcement patrol and transport vehicle with a secure divider to isolate the second row for prisoner transport. The front row had emergency vehicle specialty equipment including mobile two-way radio, scanner, emergency light controller, siren, laptop pedestal mount, and other equipment. Manual restraint systems consisted of 3-point lap and shoulder seat belts for all seat positions. Supplemental restraint systems included front belt pretensioners, CAC frontal air bags, front-seat-mounted side impact, and dual-sensing IC air bags.

Conspicuity and Emergency Vehicle Lighting

Like the 2014 Ford previously described, the 2017 Ford Explorer was a patrol vehicle for the same law enforcement agency. It was outfitted with a similar complement of emergency vehicle warning lights, high-decibel siren, and communications equipment, and the exterior appearance (paint scheme and decals) was nearly identical to the 2014 Ford as previously described.

Similar to the 2014 Ford, the 2017 Ford had bright white reflective striping that measured 2 cm (0.8 in) in height in several locations: (1) across the full width of the rear bumper along the contour and wrapping around the rear corners, (2) on the front bumper fascia at both corners, and (3) across the top of the backlight header/spoiler. There was also an 8 cm (3.1 in) tall bright white reflective chevron pattern across the width of the bottom of the tailgate/hatch. Emergency lighting equipment adorned the vehicle to provide 360-degree visibility. Primary warning lighting was achieved by an LED lightbar that was mounted to the roof of the vehicle immediately behind the B-pillars. It was fully populated with six forward-facing, six rear-facing, four corner, and two alley light modules. A push bar attached to the front bumper was outfitted with four LED warning lights: two forward-facing and two side-facing. A pair of LED fog lights was mounted to the lower aspect of the push bar. An LED module was mounted on the forward aspect of each side mirror. In addition, an LED module was mounted on the interior of the vehicle on each B-pillar, facing outward. The vehicle was further equipped with headlight flasher and taillight flasher control modules. Switches controlled front-facing, rear-facing, alley, and take-down flash patterns. At the time of the crash, all of the rear-facing warning lights (lightbar and taillight flashers) were in use.

Exterior Damage

This crash involved the back plane of the 2017 Ford and consisted of minimal damage. The 2017 Ford was lightly contacted by the damage pattern of the 2014 Ford as it came to rest. The only damage to the 2017 Ford consisted of a small scrape in the painted surface of the tailgate/hatch, immediately to the left of the license plate (Figure 12, highlighted by yellow circle). There was no measurable deformation or crush related to this minimal body contact. The CDC assigned to the 2017 Ford for the minor damage from impact by the 2014 Ford was 06BCMN1. No WinSMASH calculations could be computed for this minor severity impact that lacked physical deformation.

Figure 12. Back plane view of the minimal contact damage to the 2017 Ford (highlighted by yellow circle)

Event Data Recorder

The 2017 Ford Explorer Police Interceptor also had an RCM mounted to the floor on the center tunnel, beneath the aftermarket center console. The RCM monitored the diagnostic functions of the vehicle's restraint systems and controlled the deployment/actuation of those devices dependent upon crash event severity. The RCM had EDR capabilities to record crash data for longitudinal, lateral, and rollover crash events. The minimal damage sustained by the 2017 Ford relative to the minor body contact by the 2014 Ford in this crash likely was of insufficient magnitude to be detected or recorded by the RCM. No data were imaged from the 2017 Ford relative to this SCI Investigation.

NHTSA Recalls and Investigations

A VIN-based query of the NHTSA's recall database (www.nhtsa.gov/recalls) for the 2017 Ford Explorer Police Interceptor showed no open recalls pertaining to this specific vehicle as of the date of this report.

2019 Subaru Outback

Description

The 2019 Subaru Outback was an all-wheel-drive station wagon. No VIN number or other identifying information for the Subaru was available. It was towed from the scene and transferred to and retained by its rental car company owner and was not available for SCI inspection. On-scene images provided by the law enforcement agency as part of this SCI investigation substantiated a photographic inspection of the Subaru. Based on its make and model year, the Subaru had a 275 cm (108.3 in) wheelbase. It was equipped with Subaru's Eyesight Driver Assist Technologies.[3] These crash avoidance technologies included adaptive cruise control, lane-keep assist, pre-collision braking and pre-collision throttle management. The driver did not respond to requests for an interview; therefore, it could not be determined if the system(s) were in use or activated.

Exterior Damage

The Subaru had damage from the impact with the 2014 Ford that was located on the forward aspect of its left plane. Based on the reconstructed angle of the Subaru at impact with the Ford and its control loss, the initial plane of contact was the left plane. In the damage pattern was lateral and longitudinal crush from the impact and engagement with the Ford. Figures 13 and 14 are law enforcement images depicting the damaged Subaru from a front perspective and a left perspective.

Based on the discernable damage to the Subaru apparent in the images, the estimated CDC assigned was 11LFEW3. The damage with missing vehicle CDC algorithm of the WinSMASH model was used to calculate the severity of the crash. The total calculated vehicle velocity change (delta V) of the crash for the Subaru was 38 km/h (24 mph), with specific longitudinal and lateral components of -33 km/h (-20 mph) and 19 km/h (12 mph). Based on SCI expertise and observed vehicle damage, these borderline results were reasonable.

[3] www.subaru.com/eyesight.html#:~:text=EyeSight%20monitors%20your%20position%20on,you%20are-%20likely%20to%20hit

Figure 13. South-facing frontal view of the Subaru (on-scene law enforcement image)

Figure 14. East-facing view of the left damage profile to the Subaru from the impact with the Ford (law enforcement image)

Occupant Data

The Subaru was driven by the belted 30-year-old male with a belted 23-year-old female front right passenger, and belted 36-year-old male second-row right passenger. The Subaru was owned by an international rental car company. The three occupants were all foreign nationals in the United States on temporary status. The driver had a temporary driver license issued by Massachusetts. Specifics concerning the Subaru's pre-crash activities and route of travel remain unknown. Electronic message attempts contacting the driver for interview remain unanswered as of the date of this report. On-scene images depicted that air bags in the Subaru deployed in the crash, including the driver and passenger frontal air bags and both IC air bags. None of the Subaru's occupants sustained injury or were medically transported relative to the crash. The driver received three traffic citations following completion of the law enforcement investigation of the crash.

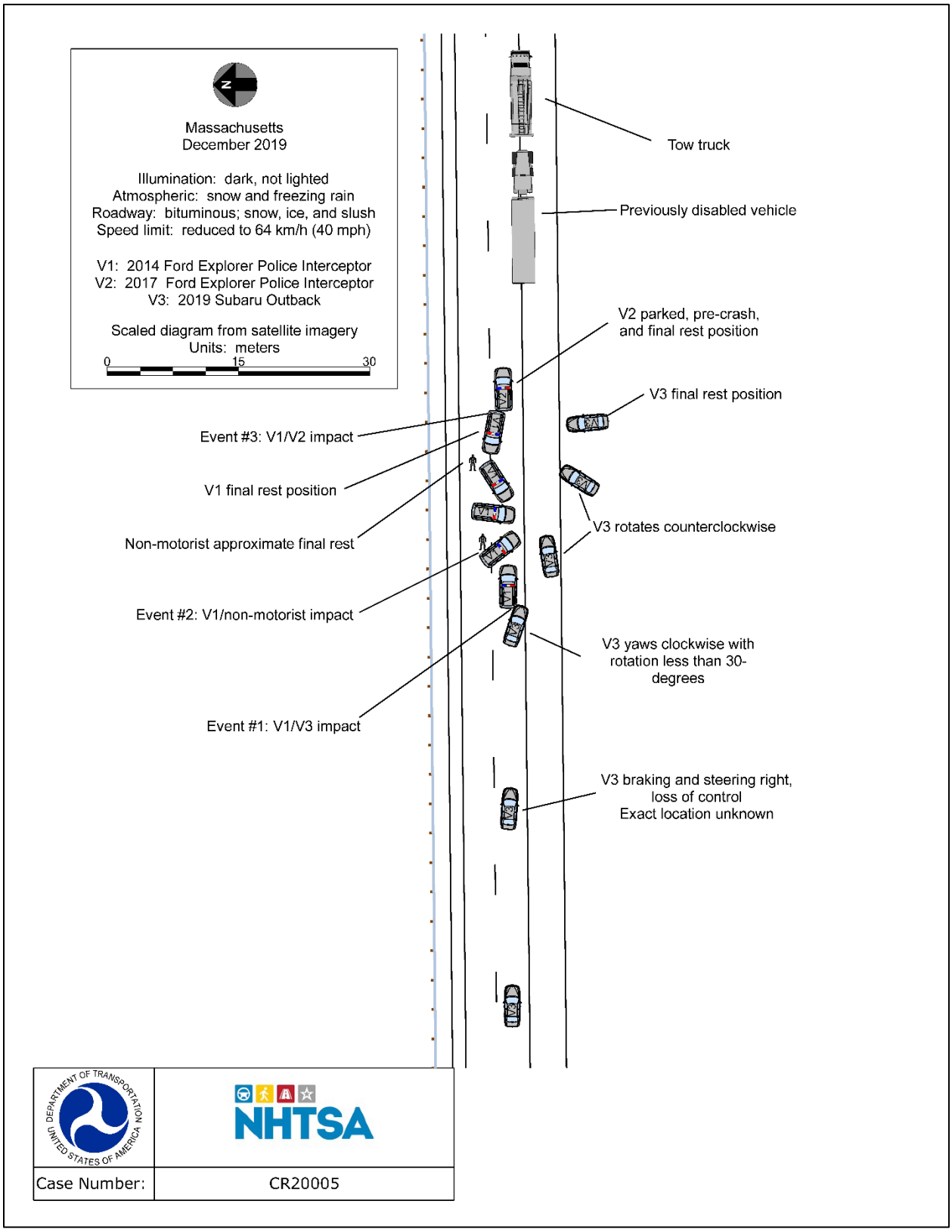
Law Enforcement Officer Non-Motorist

The non-motorist involved in this crash was a law enforcement officer who was the driver of the 2014 Ford. He had parked the 2014 Ford Explorer Police Interceptor marked law enforcement patrol vehicle in the right travel lane of the limited-access roadway. He activated the vehicle's rear-facing LED emergency warning lights to effectively close the right lane to moving traffic and provide conspicuity/protection for a tow truck that was assisting a disabled truck tractor with semi-trailer on the right roadway edge. The officer, age unknown, was outside the vehicle with the other officer who drove the 2017 Ford. Both were in a uniform of dark-colored shirts and pants with black boots. They put on bright yellow jackets with reflective striping, one of several variants of the agency's standard issue personal protective equipment. Figure 15 shows an on-scene image of one of the agency's law enforcement officers in a similar uniform. When the crash occurred, the law enforcement officer non-motorist was returning to the 2014 Ford. He was struck by the Ford's left rear aspect as it rotated clockwise and was displaced forward by the impact from the Subaru. The non-motorist was thrown a short distance into the left travel lane of the limited-access roadway.

Figure 15. Exemplar uniform of the non-motorist

The other officer heard the crash and immediately helped the injured officer up and out of the roadway. An ambulance transported him to a regional trauma center for police-reported incapacitating (A-level) injuries. He received treatment, and was released within 24 hours of the crash. The non-motorist's specific injuries remain unknown.

Crash Diagram



Appendix A: 2014 Ford Explorer Police Interceptor Event Data Recorder Report[4]

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

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

CDR File Information

User Entered VIN	1FM5K8AR1EG******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR20005_V1_ACM (2).CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 19.4.1
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 23.0.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	No
Event(s) recovered	Event Record 1, Event Record 2

Comments

No comments entered.

Data Limitations

Data Imaging:

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

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

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

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

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

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

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

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

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

EDR Data Elements Overview/Interpretation in CDR Report:

Under CDR File Information Section

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

Under System Status at Event Section

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

Under Deployment Data Section

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

Under Pre-Crash Data -5 to 0 sec

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

Under Longitudinal Crash Pulse

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

Under Lateral Crash Pulse

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

Under Rollover Sensor Data (if Applicable)

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

Data Sources:

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

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

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

3. External Modules to the RCM such as Powertrain Control Module, Brake Control Module, etc… Theses modules

communicate to the RCM via Vehicle Communication Network. The RCM stores the received data internally.

02010_RCM-RC7_r001

System Status at Time of Retrieval

VIN As Programmed into RCM at Factory	1FM5K8AR1EG******
Current VIN from PCM	1FM5K8AR1EG******
Ignition Cycle, Download (First Record)	3,748
Ignition Cycle, Download (Second Record)	3,748
Restraints Control Module Part Number	EB5T-14B321-AA
Restraints Control Module Serial Number	7113406400000000
Restraints Control Module Software Part Number (Version)	DG13-14C028-AG
Driver Side/Center Frontal Restraints Sensor Serial Number	00202837
Driver, Row 1, Side Restraint Sensor 1 Serial Number	00000042
Driver, Row 2, Side Restraint Sensor 2 Serial Number	00282838
Passenger Frontal Restraints Sensor Serial Number	00202837
Passenger, Row 1, Side Restraint Sensor 1 Serial Number	0000000B
Passenger, Row 2, Side Restraint Sensor 2 Serial Number	000C2837

System Status at Event (First Record)

Recording Status	Record Unlocked
Complete File Recorded (Yes, No)	Yes
Multi-Event, Number of Events	1
Time From Event 1 to 2 (msec)	N/A
Lifetime Operating Timer at Event Time Zero (sec)	18,740,295
Key-On Timer at Event Time Zero (sec)	5,875
Vehicle Voltage at Time Zero (V)	14.58
Energy Reserve Mode Entered During Event (Yes, No)	No

Faults Present at Start of Event (First Record)

No Faults Recorded

Deployment Data (First Record)

Maximum Delta-V, Longitudinal (MPH [km/h])	21.62 [34.79]
Time, Maximum Delta-V Longitudinal (msec)	164
Maximum Delta-V, Lateral (MPH [km/h])	-1.36 [-2.19]
Time, Maximum Delta-V Lateral (msec)	62
Longitudinal Delta-V Time Zero Offset (msec)	4.5 ms
Lateral Delta-V Time Zero Offset (msec)	4.5 ms
Roll Angle Time Zero Offset (msec)	24.5 ms

Pre-Crash Data -1 sec (First Record)

Ignition Cycle, Crash	3,739
Frontal Air Bag Warning Lamp, On/Off	Off
Safety Belt Status, Driver	Not Buckled
Seat Track Position Switch, Foremost, Status, Driver	Not Forward
Safety Belt Status, Front Passenger	Buckled
Seat Track Position Switch, Foremost, Status, Front Passenger	Not Forward
Brake Telltale	Off
ABS Telltale	Off
ESC/TC Telltale	Off
ESC/TC Off Telltale	Default
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Off

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

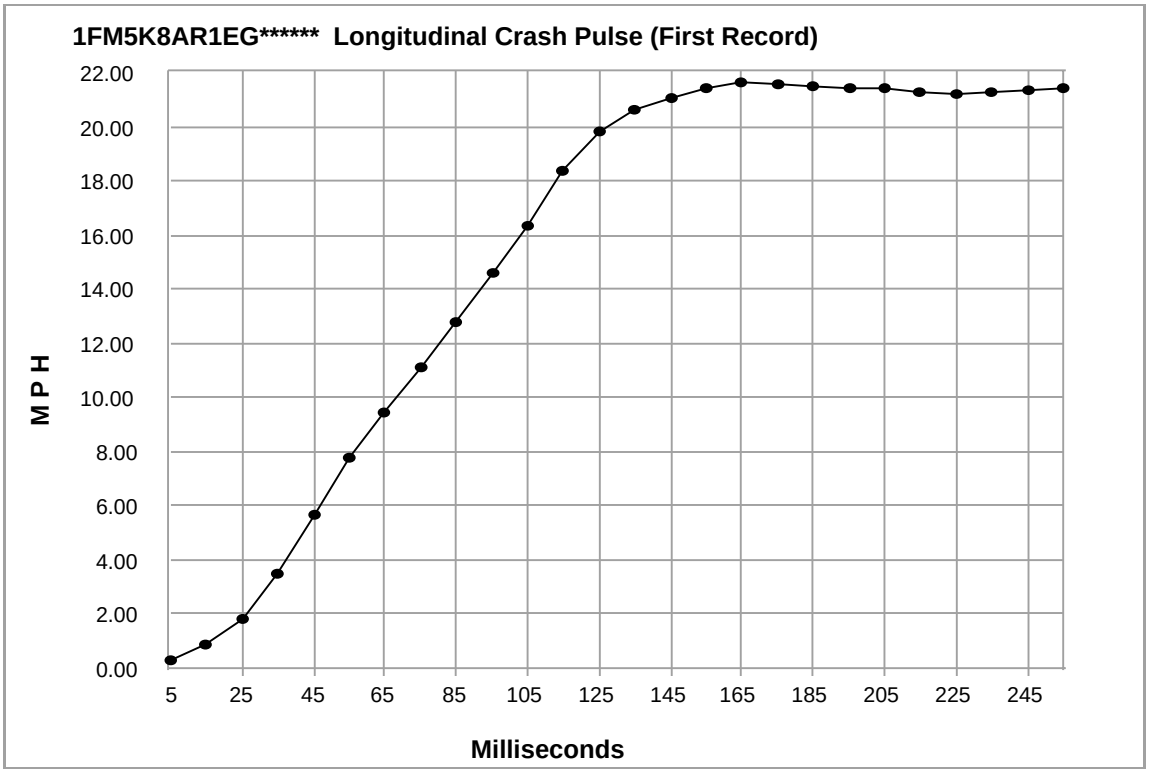
Times (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % Full	Service Brake, On/Off	Engine RPM	ABS Activity (Engaged, Non-Engaged)	Brake Powertrain Torque Request
- 5.0	0 [0]	0.0	Off	604	non-engaged	No
- 4.5	0 [0]	0.0	Off	604	non-engaged	No
- 4.0	0 [0]	0.0	Off	604	non-engaged	No
- 3.5	0 [0]	0.0	Off	600	non-engaged	No
- 3.0	0 [0]	0.0	Off	598	non-engaged	No
- 2.5	0 [0]	0.0	Off	612	non-engaged	No
- 2.0	0 [0]	0.0	Off	608	non-engaged	No
- 1.5	0 [0]	0.0	Off	600	non-engaged	No
- 1.0	0 [0]	0.0	Off	600	non-engaged	No
- 0.5	0 [0]	0.0	Off	598	non-engaged	No
0.0	0 [0]	0.0	Off	596	non-engaged	No

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

Times (sec)	Driver Gear Selection	Traction Control via Brakes	Wheel Torque (Nm)	Occupant Size Classification, Front Passenger (Child Size Yes/No [Hex value])	Speed Control Telltale
- 5.0	Park	non-engaged	-484	Yes [$02]	Off
- 4.5	Park	non-engaged	-508	Yes [$02]	Off
- 4.0	Park	non-engaged	-492	Yes [$02]	Off
- 3.5	Park	non-engaged	-476	Yes [$02]	Off
- 3.0	Park	non-engaged	-488	Yes [$02]	Off
- 2.5	Park	non-engaged	-496	Yes [$02]	Off
- 2.0	Park	non-engaged	-504	Yes [$02]	Off
- 1.5	Park	non-engaged	-492	Yes [$02]	Off
- 1.0	Park	non-engaged	-484	Yes [$02]	Off
- 0.5	Park	non-engaged	-496	Yes [$02]	Off
0.0	Park	non-engaged	-488	Yes [$02]	Off

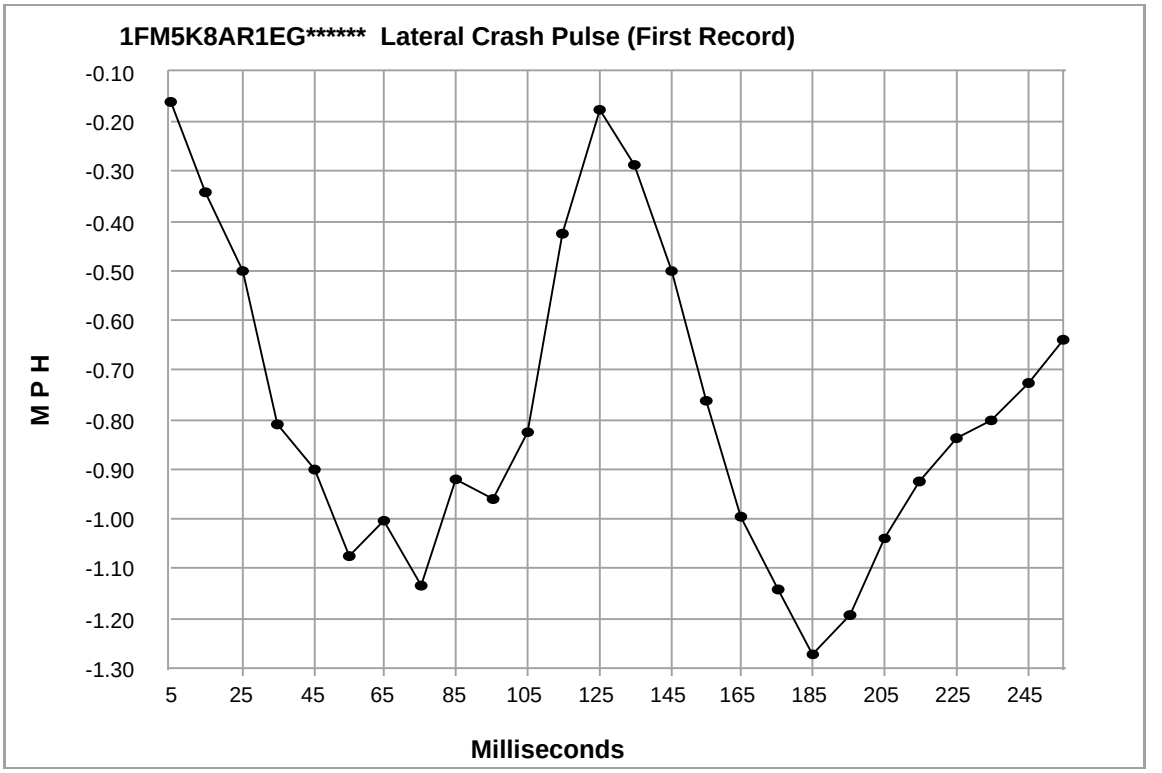
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)	Stability Control Roll Rate (deg/sec)
- 5.0	-16.3	0.0	0.01	0.5	-0.48
- 4.9	-16.3	0.0	0.006	0.45	-0.32
- 4.8	-16.3	0.0	0.009	0.45	-0.32
- 4.7	-16.3	0.003	0.011	0.4	-0.4
- 4.6	-16.3	0.0	0.009	0.4	-0.24
- 4.5	-16.3	0.0	0.007	0.5	-0.4
- 4.4	-16.3	0.0	0.01	0.43	-0.56
- 4.3	-16.3	0.0	0.01	0.52	-0.24
- 4.2	-16.3	0.0	0.012	0.43	-0.32
- 4.1	-16.3	0.002	0.009	0.47	-0.24
- 4.0	-16.3	-0.001	0.01	0.38	-0.16
- 3.9	-16.3	0.0	0.006	0.43	-0.28
- 3.8	-16.3	-0.002	0.01	0.43	-0.32
- 3.7	-16.3	-0.002	0.007	0.43	-0.52
- 3.6	-16.3	0.0	0.009	0.45	-0.32
- 3.5	-16.3	-0.003	0.006	0.5	-0.36
- 3.4	-16.3	0.0	0.01	0.4	-0.44
- 3.3	-16.3	0.003	0.007	0.47	-0.44
- 3.2	-16.3	0.0	0.01	0.4	-0.28
- 3.1	-16.3	0.0	0.007	0.5	-0.16
- 3.0	-16.3	0.0	0.012	0.43	-0.44
- 2.9	-16.3	0.001	0.007	0.43	-0.36
- 2.8	-16.3	0.0	0.012	0.36	-0.28
- 2.7	-16.3	0.002	0.007	0.52	-0.28
- 2.6	-16.3	0.0	0.012	0.34	-0.4
- 2.5	-16.3	-0.002	0.01	0.5	-0.36
- 2.4	-16.3	-0.001	0.009	0.43	-0.48
- 2.3	-16.3	-0.003	0.009	0.54	-0.48
- 2.2	-16.3	0.0	0.01	0.43	-0.28
- 2.1	-16.3	0.001	0.007	0.43	-0.52
- 2.0	-16.3	0.0	0.014	0.45	-0.32
- 1.9	-16.3	-0.002	0.007	0.45	-0.4
- 1.8	-16.3	-0.002	0.013	0.47	-0.36
- 1.7	-16.3	-0.001	0.009	0.4	-0.24
- 1.6	-16.3	-0.001	0.012	0.45	-0.28
- 1.5	-16.3	-0.003	0.008	0.43	-0.16
- 1.4	-16.3	0.001	0.013	0.47	-0.4
- 1.3	-16.3	-0.002	0.007	0.47	-0.24
- 1.2	-16.3	-0.001	0.012	0.38	-0.28
- 1.1	-16.3	0.0	0.007	0.4	-0.16
- 1.0	-16.3	-0.001	0.014	0.45	-0.28
- 0.9	-16.3	0.003	0.011	0.45	-0.32
- 0.8	-16.3	0.002	0.015	0.47	-0.32
- 0.7	-16.3	0.0	0.008	0.45	-0.28
- 0.6	-16.3	0.0	0.01	0.4	-0.4
- 0.5	-16.3	-0.005	0.008	0.5	-0.32
- 0.4	-16.3	0.0	0.014	0.45	-0.32
- 0.3	-16.3	-0.001	0.008	0.5	-0.48
- 0.2	-16.3	0.0	0.015	0.43	-0.44
- 0.1	-16.3	0.004	0.01	0.34	-0.12
0.0	-16.3	0.0	0.008	0.4	-0.48



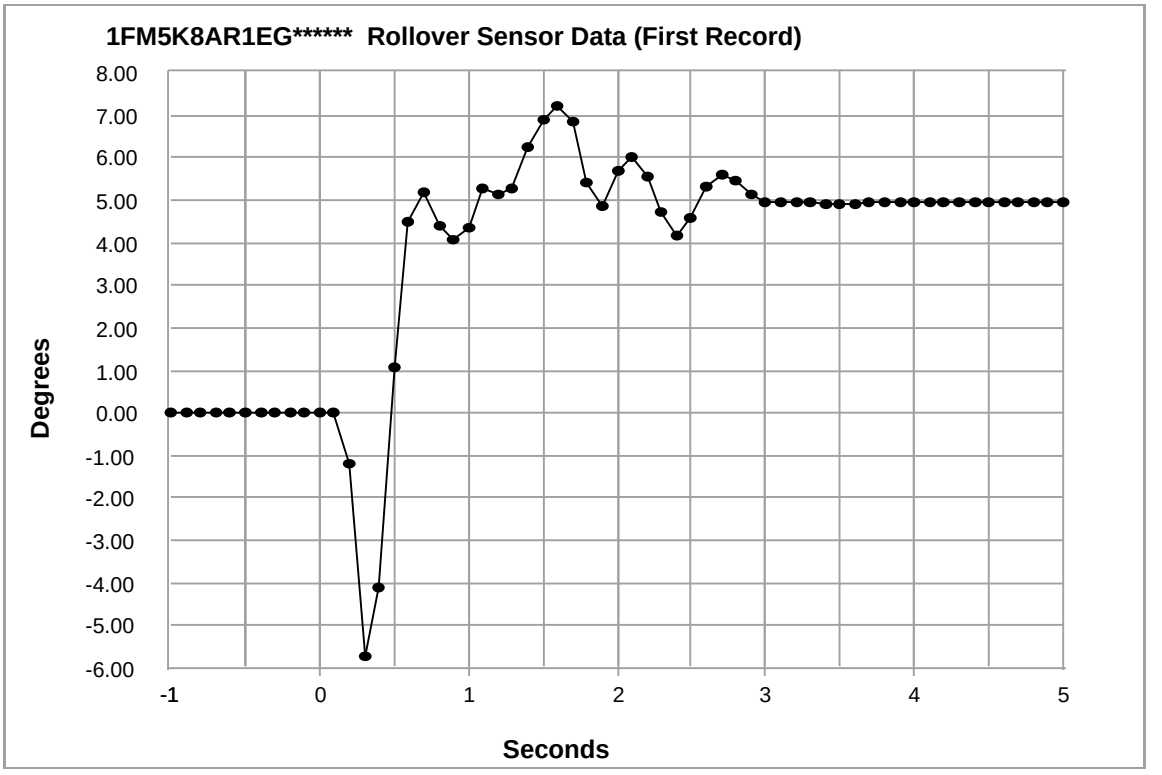
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
4.5	0.32	0.51
14.5	0.85	1.36
24.5	1.82	2.93
34.5	3.46	5.57
44.5	5.69	9.15
54.5	7.75	12.48
64.5	9.48	15.25
74.5	11.12	17.90
84.5	12.80	20.60
94.5	14.56	23.43
104.5	16.36	26.33
114.5	18.39	29.59
124.5	19.80	31.86
134.5	20.59	33.14
144.5	21.09	33.94
154.5	21.40	34.44
164.5	21.61	34.78
174.5	21.57	34.71
184.5	21.48	34.57
194.5	21.40	34.43
204.5	21.38	34.41
214.5	21.25	34.20
224.5	21.24	34.18
234.5	21.27	34.23
244.5	21.34	34.35
254.5	21.39	34.43



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
4.5	-0.16	-0.26
14.5	-0.34	-0.55
24.5	-0.50	-0.81
34.5	-0.81	-1.30
44.5	-0.90	-1.45
54.5	-1.07	-1.73
64.5	-1.00	-1.61
74.5	-1.13	-1.82
84.5	-0.92	-1.48
94.5	-0.96	-1.54
104.5	-0.82	-1.33
114.5	-0.42	-0.68
124.5	-0.18	-0.28
134.5	-0.29	-0.46
144.5	-0.50	-0.80
154.5	-0.76	-1.23
164.5	-1.00	-1.60
174.5	-1.14	-1.84
184.5	-1.27	-2.05
194.5	-1.19	-1.92
204.5	-1.04	-1.67
214.5	-0.92	-1.49
224.5	-0.84	-1.34
234.5	-0.80	-1.29
244.5	-0.73	-1.17
254.5	-0.64	-1.03



Rollover Sensor Data (First Record)

Time (sec)	Vehicle Roll Angle (deg)
-1.0	-0.01
-0.9	-0.01
-0.8	-0.01
-0.7	-0.01
-0.6	-0.01
-0.5	-0.01
-0.4	-0.01
-0.3	-0.01
-0.2	-0.01
-0.1	-0.01
0.0	-0.01
0.1	0.0
0.2	-1.21
0.3	-5.74
0.4	-4.1
0.5	1.08
0.6	4.49
0.7	5.19
0.8	4.41
0.9	4.07
1.0	4.36

Time (sec)	Vehicle Roll Angle (deg)
1.1	5.29
1.2	5.13
1.3	5.29
1.4	6.24
1.5	6.89
1.6	7.19
1.7	6.87
1.8	5.42
1.9	4.86
2.0	5.68
2.1	6.02
2.2	5.54
2.3	4.7
2.4	4.18
2.5	4.57
2.6	5.31
2.7	5.59
2.8	5.44
2.9	5.15
3.0	4.96
3.1	4.96

Time (sec)	Vehicle Roll Angle (deg)
3.2	4.96
3.3	4.95
3.4	4.91
3.5	4.9
3.6	4.93
3.7	4.95
3.8	4.95
3.9	4.95
4.0	4.95
4.1	4.95
4.2	4.95
4.3	4.95
4.4	4.95
4.5	4.95
4.6	4.95
4.7	4.95
4.8	4.95
4.9	4.95
5.0	4.95

System Status at Event (Second Record)

Recording Status	Record Unlocked
Complete File Recorded (Yes, No)	Yes
Multi-Event, Number of Events	2
Time From Event 1 to 2 (msec)	100
Lifetime Operating Timer at Event Time Zero (sec)	18,740,295
Key-On Timer at Event Time Zero (sec)	5,875
Vehicle Voltage at Time Zero (V)	14.58
Energy Reserve Mode Entered During Event (Yes, No)	No

Faults Present at Start of Event (Second Record)

No Faults Recorded

Deployment Data (Second Record)

Maximum Delta-V, Longitudinal (MPH [km/h])	14.22 [22.89]
Time, Maximum Delta-V Longitudinal (msec)	110
Maximum Delta-V, Lateral (MPH [km/h])	1.20 [1.93]
Time, Maximum Delta-V Lateral (msec)	74
Longitudinal Delta-V Time Zero Offset (msec)	1.0 ms
Lateral Delta-V Time Zero Offset (msec)	1.0 ms
Roll Angle Time Zero Offset (msec)	71.0 ms

Pre-Crash Data -1 sec (Second Record)

Ignition Cycle, Crash	3,739
Frontal Air Bag Warning Lamp, On/Off	Off
Safety Belt Status, Driver	Not Buckled
Seat Track Position Switch, Foremost, Status, Driver	Not Forward
Safety Belt Status, Front Passenger	Buckled
Seat Track Position Switch, Foremost, Status, Front Passenger	Not Forward
Brake Telltale	Off
ABS Telltale	Off
ESC/TC Telltale	Off
ESC/TC Off Telltale	Default
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL) Telltale	Off

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Second Record, table 1 of 2)

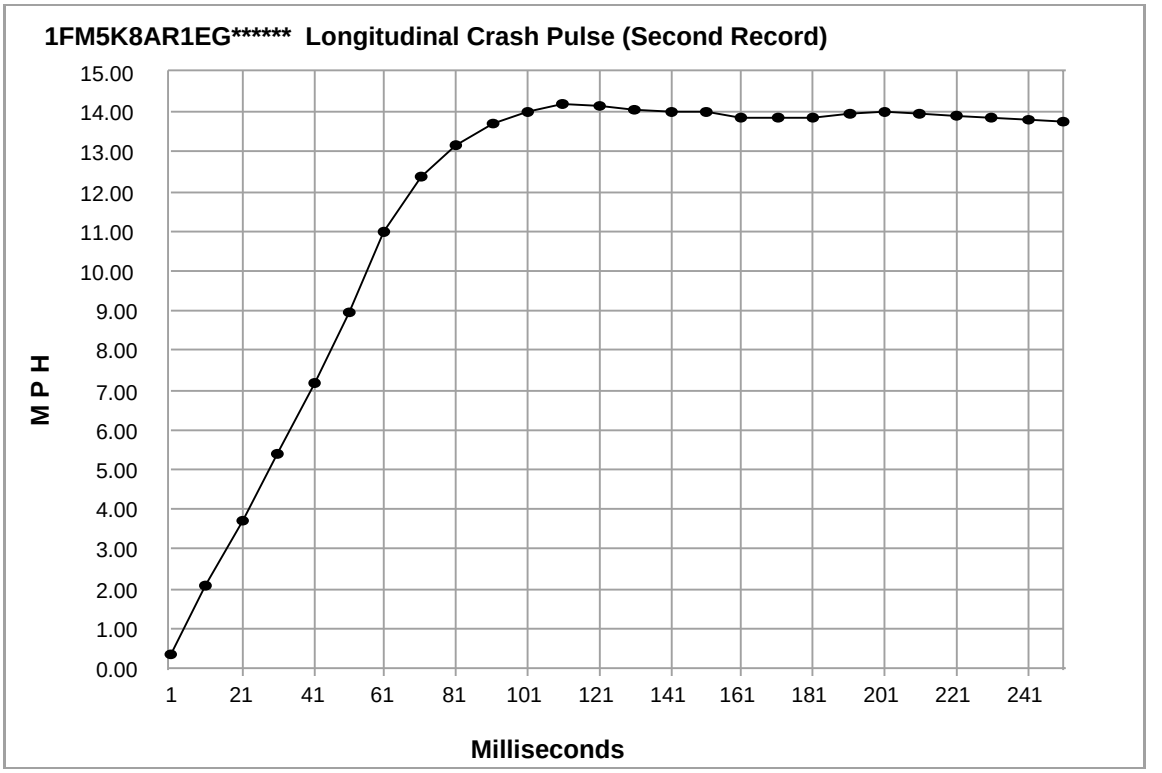
Times (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % Full	Service Brake, On/Off	Engine RPM	ABS Activity (Engaged, Non-Engaged)	Brake Powertrain Torque Request
- 5.0	0 [0]	0.0	Off	604	non-engaged	No
- 4.5	0 [0]	0.0	Off	604	non-engaged	No
- 4.0	0 [0]	0.0	Off	600	non-engaged	No
- 3.5	0 [0]	0.0	Off	598	non-engaged	No
- 3.0	0 [0]	0.0	Off	612	non-engaged	No
- 2.5	0 [0]	0.0	Off	608	non-engaged	No
- 2.0	0 [0]	0.0	Off	600	non-engaged	No
- 1.5	0 [0]	0.0	Off	600	non-engaged	No
- 1.0	0 [0]	0.0	Off	598	non-engaged	No
- 0.5	0 [0]	0.0	Off	596	non-engaged	No
0.0	0 [0]	0.0	Off	614	non-engaged	No

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

Times (sec)	Driver Gear Selection	Traction Control via Brakes	Wheel Torque (Nm)	Occupant Size Classification, Front Passenger (Child Size Yes/No [Hex value])	Speed Control Telltale
- 5.0	Park	non-engaged	-508	Yes [$02]	Off
- 4.5	Park	non-engaged	-492	Yes [$02]	Off
- 4.0	Park	non-engaged	-476	Yes [$02]	Off
- 3.5	Park	non-engaged	-488	Yes [$02]	Off
- 3.0	Park	non-engaged	-496	Yes [$02]	Off
- 2.5	Park	non-engaged	-504	Yes [$02]	Off
- 2.0	Park	non-engaged	-492	Yes [$02]	Off
- 1.5	Park	non-engaged	-484	Yes [$02]	Off
- 1.0	Park	non-engaged	-496	Yes [$02]	Off
- 0.5	Park	non-engaged	-488	Yes [$02]	Off
0.0	Park	non-engaged	-488	Yes [$02]	Off

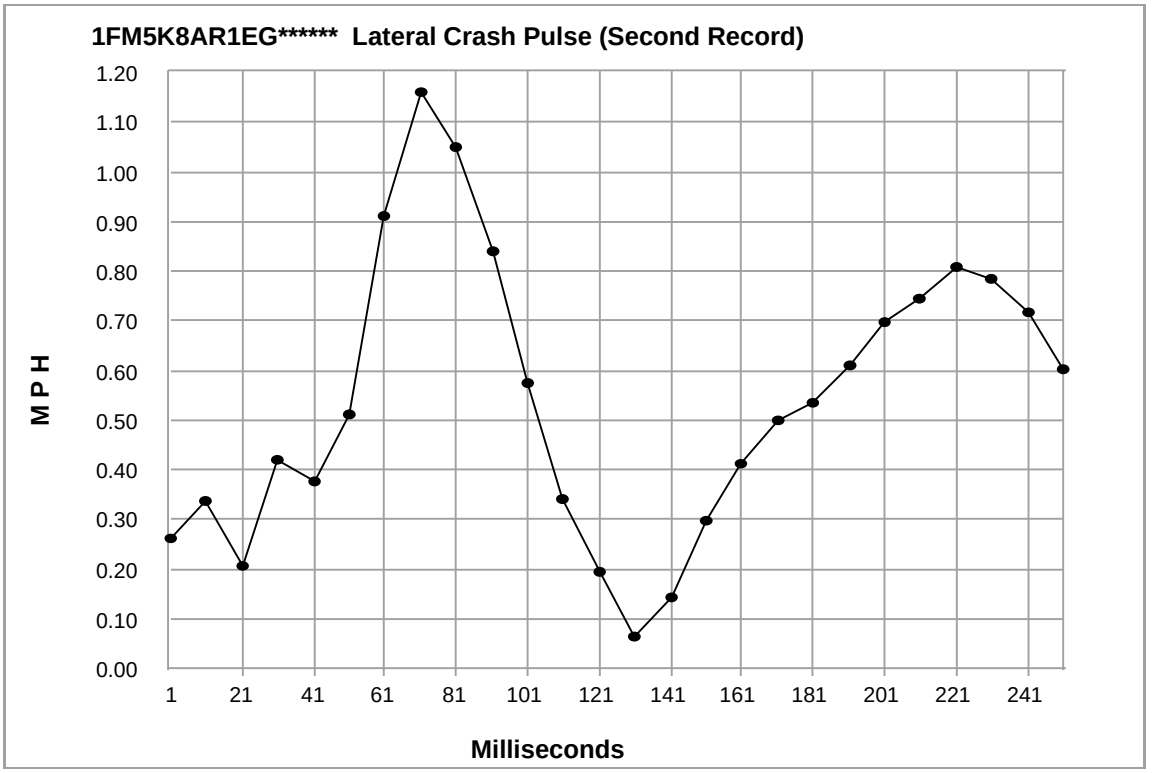
Pre-Crash Data -5 to 0 sec [10 samples/sec] (Second Record)

Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)	Stability Control Roll Rate (deg/sec)
- 5.0	-16.3	0.0	0.006	0.45	-0.32
- 4.9	-16.3	0.0	0.009	0.45	-0.32
- 4.8	-16.3	0.003	0.011	0.4	-0.4
- 4.7	-16.3	0.0	0.009	0.4	-0.24
- 4.6	-16.3	0.0	0.007	0.5	-0.4
- 4.5	-16.3	0.0	0.01	0.43	-0.56
- 4.4	-16.3	0.0	0.01	0.52	-0.24
- 4.3	-16.3	0.0	0.012	0.43	-0.32
- 4.2	-16.3	0.002	0.009	0.47	-0.24
- 4.1	-16.3	-0.001	0.01	0.38	-0.16
- 4.0	-16.3	0.0	0.006	0.43	-0.28
- 3.9	-16.3	-0.002	0.01	0.43	-0.32
- 3.8	-16.3	-0.002	0.007	0.43	-0.52
- 3.7	-16.3	0.0	0.009	0.45	-0.32
- 3.6	-16.3	-0.003	0.006	0.5	-0.36
- 3.5	-16.3	0.0	0.01	0.4	-0.44
- 3.4	-16.3	0.003	0.007	0.47	-0.44
- 3.3	-16.3	0.0	0.01	0.4	-0.28
- 3.2	-16.3	0.0	0.007	0.5	-0.16
- 3.1	-16.3	0.0	0.012	0.43	-0.44
- 3.0	-16.3	0.001	0.007	0.43	-0.36
- 2.9	-16.3	0.0	0.012	0.36	-0.28
- 2.8	-16.3	0.002	0.007	0.52	-0.28
- 2.7	-16.3	0.0	0.012	0.34	-0.4
- 2.6	-16.3	-0.002	0.01	0.5	-0.36
- 2.5	-16.3	-0.001	0.009	0.43	-0.48
- 2.4	-16.3	-0.003	0.009	0.54	-0.48
- 2.3	-16.3	0.0	0.01	0.43	-0.28
- 2.2	-16.3	0.001	0.007	0.43	-0.52
- 2.1	-16.3	0.0	0.014	0.45	-0.32
- 2.0	-16.3	-0.002	0.007	0.45	-0.4
- 1.9	-16.3	-0.002	0.013	0.47	-0.36
- 1.8	-16.3	-0.001	0.009	0.4	-0.24
- 1.7	-16.3	-0.001	0.012	0.45	-0.28
- 1.6	-16.3	-0.003	0.008	0.43	-0.16
- 1.5	-16.3	0.001	0.013	0.47	-0.4
- 1.4	-16.3	-0.002	0.007	0.47	-0.24
- 1.3	-16.3	-0.001	0.012	0.38	-0.28
- 1.2	-16.3	0.0	0.007	0.4	-0.16
- 1.1	-16.3	-0.001	0.014	0.45	-0.28
- 1.0	-16.3	0.003	0.011	0.45	-0.32
- 0.9	-16.3	0.002	0.015	0.47	-0.32
- 0.8	-16.3	0.0	0.008	0.45	-0.28
- 0.7	-16.3	0.0	0.01	0.4	-0.4
- 0.6	-16.3	-0.005	0.008	0.5	-0.32
- 0.5	-16.3	0.0	0.014	0.45	-0.32
- 0.4	-16.3	-0.001	0.008	0.5	-0.48
- 0.3	-16.3	0.0	0.015	0.43	-0.44
- 0.2	-16.3	0.004	0.01	0.34	-0.12
- 0.1	-16.3	0.0	0.008	0.4	-0.48
0.0	-16.3	1.202	2.0	-2.95	-2.4



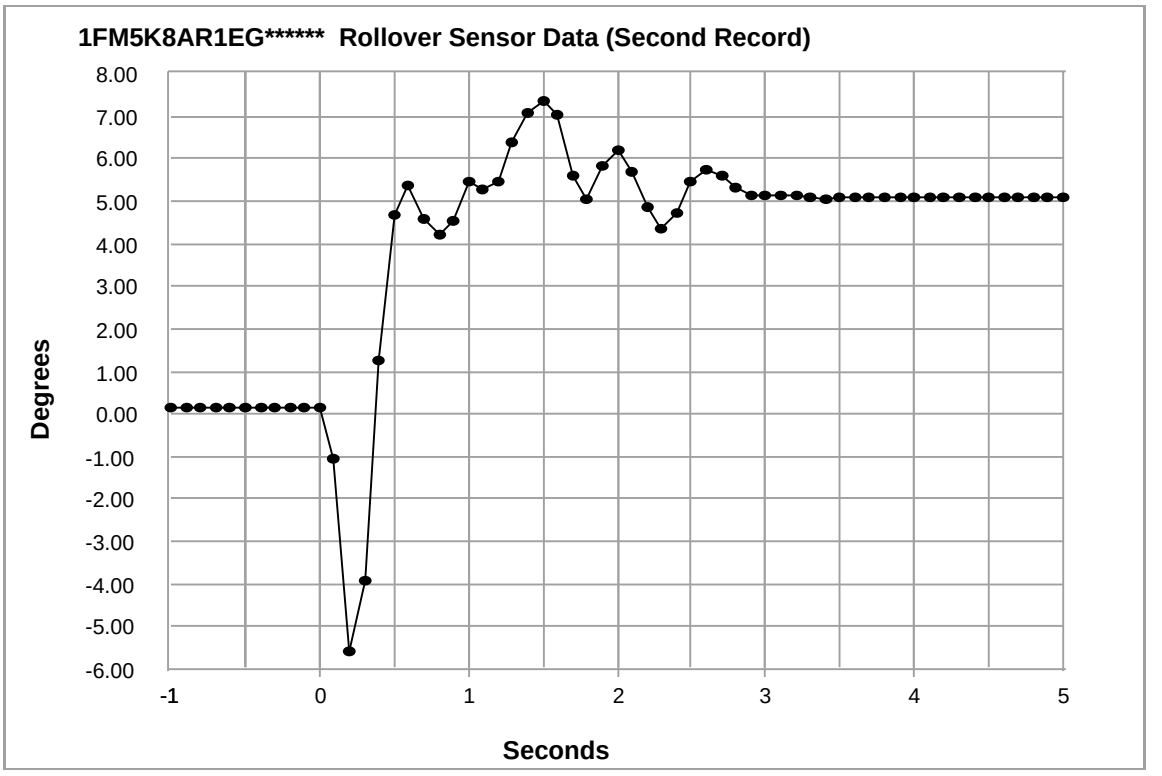
Longitudinal Crash Pulse (Second Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
1.0	0.36	0.57
11.0	2.08	3.34
21.0	3.72	5.99
31.0	5.40	8.69
41.0	7.16	11.53
51.0	8.96	14.42
61.0	10.99	17.69
71.0	12.40	19.95
81.0	13.19	21.23
91.0	13.69	22.04
101.0	14.00	22.53
111.0	14.22	22.88
121.0	14.17	22.80
131.0	14.08	22.66
141.0	14.00	22.53
151.0	13.99	22.51
161.0	13.86	22.30
171.0	13.84	22.27
181.0	13.87	22.33
191.0	13.95	22.44
201.0	14.00	22.53
211.0	13.97	22.49
221.0	13.92	22.40
231.0	13.84	22.27
241.0	13.80	22.20
251.0	13.79	22.19



Lateral Crash Pulse (Second Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
1.0	0.26	0.42
11.0	0.33	0.54
21.0	0.20	0.33
31.0	0.42	0.67
41.0	0.38	0.61
51.0	0.51	0.82
61.0	0.91	1.47
71.0	1.16	1.87
81.0	1.05	1.69
91.0	0.84	1.35
101.0	0.58	0.93
111.0	0.34	0.55
121.0	0.20	0.31
131.0	0.06	0.10
141.0	0.14	0.23
151.0	0.30	0.48
161.0	0.41	0.67
171.0	0.50	0.81
181.0	0.53	0.86
191.0	0.61	0.98
201.0	0.70	1.12
211.0	0.74	1.20
221.0	0.81	1.30
231.0	0.78	1.26
241.0	0.72	1.15
251.0	0.60	0.97



Rollover Sensor Data (Second Record)

Time (sec)	Vehicle Roll Angle (deg)
-1.0	0.15
-0.9	0.15
-0.8	0.15
-0.7	0.15
-0.6	0.15
-0.5	0.15
-0.4	0.15
-0.3	0.15
-0.2	0.15
-0.1	0.15
0.0	0.16
0.1	-1.04
0.2	-5.58
0.3	-3.94
0.4	1.24
0.5	4.65
0.6	5.35
0.7	4.57
0.8	4.23
0.9	4.52
1.0	5.45

Time (sec)	Vehicle Roll Angle (deg)
1.1	5.29
1.2	5.45
1.3	6.4
1.4	7.06
1.5	7.36
1.6	7.03
1.7	5.58
1.8	5.02
1.9	5.84
2.0	6.18
2.1	5.7
2.2	4.86
2.3	4.34
2.4	4.73
2.5	5.47
2.6	5.75
2.7	5.61
2.8	5.31
2.9	5.13
3.0	5.12
3.1	5.12

Time (sec)	Vehicle Roll Angle (deg)
3.2	5.11
3.3	5.07
3.4	5.07
3.5	5.09
3.6	5.11
3.7	5.11
3.8	5.11
3.9	5.11
4.0	5.11
4.1	5.11
4.2	5.11
4.3	5.11
4.4	5.11
4.5	5.11
4.6	5.11
4.7	5.11
4.8	5.11
4.9	5.11
5.0	5.11

Hexadecimal Data

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

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Event Record 1

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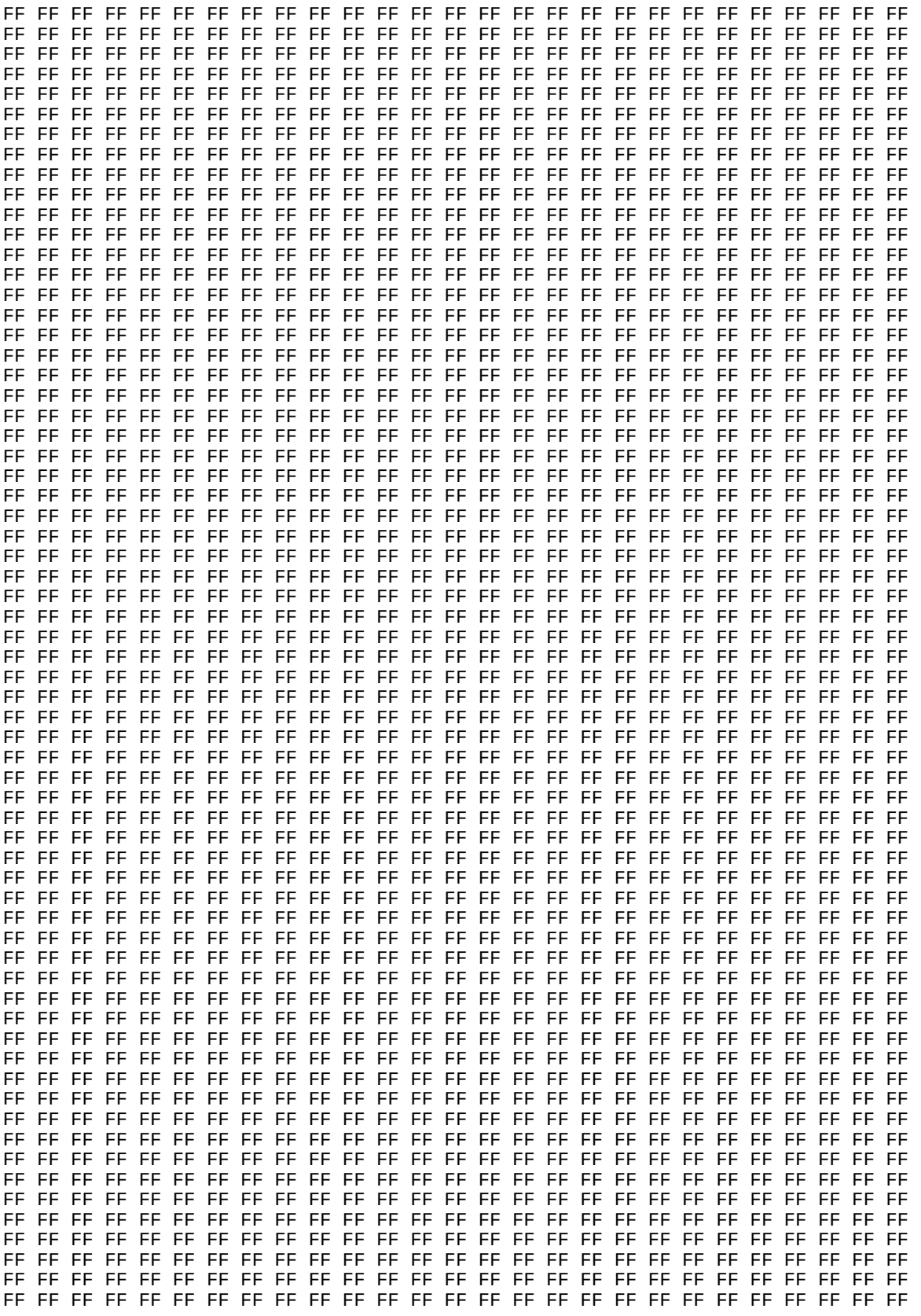

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DOT HS 813 445
June 2023

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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