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Special Crash Investigations: On-Site Rollover Crash Investigation; Vehicle: 2018 Jeep Grand Cherokee; Location: Illinois; Crash Date: March 2022

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15. Supplementary Notes

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

16. Abstract

This report documents the on-site investigation of a 2018 Jeep Cherokee that rolled over after a collision with a 2013 Ford F-450. The Jeep was traveling east in the right travel lane while a 2011 Volkswagen Jetta was in the left travel lane of a five-lane undivided roadway, as both vehicles approached a four-way intersection. The Ford was traveling west in the left lane of the roadway and entered the intersection. The Volkswagen entered the intersection preparing to make a left turn. The Ford sideswiped the left side of the Volkswagen and then struck the front plane of the Jeep. The Jeep departed the roadway and rolled over, right-side-leading, two quarter turns. Its belted 34-year-old female driver and a belted 15-year-old female front row passenger sustained incapacitating injuries (A-level). The Ford's 30-year-old male driver sustained non-incapacitating injuries (B-level). The occupants of the Volkswagen denied injury.

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Special Crash Investigations
On-Site Rollover Crash Investigation
Case Number: CR22009
Vehicle: 2018 Jeep Grand Cherokee
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Background

This report documents the on-site investigation of a 2018 Jeep Cherokee (Figure 1) that rolled over after other events involving a 2013 Ford F-450 (Figure 2). The Jeep had front seat belt pretensioners, certified advanced frontal air bags, a driver knee air bag, front outboard seat-mounted side-impact air bags, and inflatable curtain (IC) air bags.

Figure 1. Front view of the 2018 Jeep Grand Cherokee

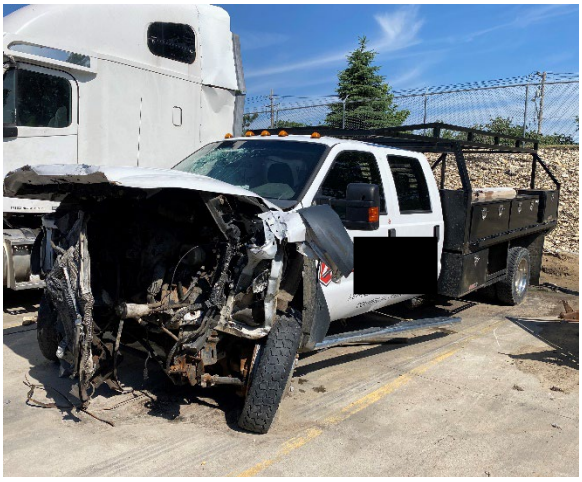

Figure 2. Left-front oblique view of the 2013 Ford F-450

This crash was identified by NHTSA's Crash Report Sampling System and forwarded to the Special Crash Investigations group in May 2022. The crash was then assigned for on-site investigation to Crash Research & Analysis, Inc. Cooperation with the local law enforcement agency was obtained, and an on-site investigation occurred in June 2022.

The Jeep was traveling east in the right travel lane while a 2011 Volkswagen Jetta was in the left travel lane of a five-lane undivided roadway, as both vehicles approached a four-way intersection. The Ford was traveling west in the left lane of the roadway and entered the intersection as the Volkswagen entered the intersection preparing to make a left turn. The crash occurred when the Ford sideswiped the left side of the Volkswagen and continued westbound, where it then struck the front plane of the Jeep. The impact redirected the Jeep to its right, where it departed the south side of the roadway and rolled over, right-side-leading, two quarter turns. The Jeep came to final rest on its top facing east. The Ford came to final rest adjacent to the Jeep facing south. The Volkswagens final rest is unknown. However, on-scene images show that the vehicle was driven to a side street.

The Jeep's belted 34-year-old female driver and a belted 15-year-old female front-row passenger sustained incapacitating (A-level) injuries. Both Jeep occupants were transported by ambulance to a trauma center. The driver was then transferred to a Level I center for specialized treatment

where her length of stay is unknown. The front passenger was transferred to a Level 1 trauma center, where she was hospitalized for 2 days. The Ford's 30-year-old male driver sustained non-incapacitating (B-level) injuries and was transported by ambulance to a local hospital. The extent of his treatment is unknown. The occupants of the Volkswagen denied injury.

Crash Summary

Crash Site

This crash occurred in the evening on a five-lane, undivided, eastbound/westbound roadway. The roadway was dark, but lighted by streetlamps. Reported weather conditions in the locale included cloudy conditions, a temperature of 4 ºC (40 ºF), 53-percent humidity, and winds from the east at 14 km/h (9 mph). In the eastbound travel direction (Figure 3), the roadway had an uphill grade and was straight. Travel lanes were approximately 3.7 m (12 ft) wide. The eastbound travel lanes were separated from the westbound travel lanes by a double-yellow centerline. The southern- and northern-most travel lanes were bordered by a raised curb. The traffic lanes in each direction were separated by white dashed lane lines. Figure 3 shows the east-facing view of the roadway on approach to the crash site. Speed was regulated by a posted limit of 56 km/h (35 mph) for the eastbound travel lanes and 64 km/h (40 mph) for the westbound travel lanes. A crash diagram is included at the end of this report.

Figure 3. Eastbound view of the Jeep's and Volkswagen's pre-crash approach to the crash site

Pre-Crash

The Jeep was traveling east in the right travel lane at unknown travel speed. The 34-year-old female driver and 15-year-old right-front passenger were restrained by the lap and shoulder belts. The Volkswagen was in the left turning lane facing eastbound preparing to turn onto the intersecting roadway. The Ford was traveling west in the left travel lane at an EDR-recorded speed of 73 km/h (45 mph) 5.0 seconds prior to algorithm enable (AE). The Ford's 30-year-old male driver was not belted. The Ford entered the intersection and began encroaching into the eastbound travel lane occupied by the Volkswagen.

Crash

The Ford sideswiped the Volkswagen (Event 1) resulting in damage to its left side. After separating from the Volkswagen, the Ford continued into the eastbound travel lanes, striking the Jeep (Event 2) in an offset frontal collision at an EDR-recorded speed of 68 km/h (42 mph). The Ford's momentum redirected the Jeep to its right and pushed it to the southern road edge. The Jeep's right-front wheel struck the curb (Event 3), tripping it into a right-side-leading two-quarter turn rollover (Event 4). The Jeep came to rest on its roof facing east in the grassy roadside (Figure 4). The Ford exited the southside of the roadway and came to final rest facing south just in front of the Jeep. The Volkswagen's final rest is unknown. However, on-scene images show that the vehicle was driven to a side street.

Figure 4. Southeast view of the Jeep and Ford at final rest. Image provided by local law enforcement

Post-Crash

Local emergency services were notified of the incident by a passerby. Emergency medical services removed the Jeep's driver and passenger due to perceived serious injury. Both were transported to a local hospital with A-level injuries. The driver was then transferred to a Level I center for specialized treatment where her length of stay is unknown. The front passenger was transferred to a Level 1 trauma center, where she was hospitalized for 2 days. It is unknown how the driver of the Ford exited the vehicle. He was transported to a local hospital with B-level injuries. The extent of his treatment is unknown. The driver and passenger of the Volkswagen exited the vehicle under their own power. They denied injury and were not transported.

2018 Jeep Grand Cherokee

Description

The 2018 Jeep Grand Cherokee Overland (Figure 5) was manufactured in October 2018 with the VIN 1C4RJFCG1JCxxxxxx. The Jeep was a 4-wheel drive platform, powered by a 3.6-liter, 6-cylinder gasoline engine linked to a variable transmission. Its service brakes were power-assisted 4-wheel disc with antilock (ABS). The gross vehicle weight rating was 2,949 kg (6,500 lb). At the time of the SCI inspection, the Jeep had Bridgestone Ecopia tires for all four tires of the manufacture recommended size. All four tires had 5 mm (6/32) of tread. The right-front wheel was displaced from the Jeep and the tire was de-beaded from the rim during the crash events. The left-front tire was cut during the crash sequence. The rear tires had no signs of damage.

Figure 5. Left-front oblique view of the 2018 Jeep Grand Cherokee

The Jeep's interior had seating for five occupants (2/3), with front row bucket seats and a second-row split bench with folding backs. All seating positions had adjustable head restraints. Manual restraint systems were 3-point lap and shoulder belts for all seating positions. Supplemental restraint systems included front safety belt retractors, seven air bags consisting of driver's and passenger's frontal, driver knee, front outboard seat-mounted side-impact, and left- and right-side IC air bags.

Exterior Damage

The front plane of the Ford struck the front of the Jeep in an offset configuration (Event 2). The direct contact damage was located 2 cm (0.8 in) left of the front center point extending 72 cm (28.3 in) left. The residual crush at the front bumper reinforcement bar was: C1 = 33 cm (13.0 in), C2 = 36 cm (14.2 in), C3 = 30 cm (11.8 in), C4 = 21 cm (8.3 in), C5 = 0 cm, C6 = 0 cm. Maximum crush was observed to be 56 cm (22.0 in) and was located 24 cm (9.4 in) left of the front-center point. The WinSMASH program provided a Barrier Equivalent Speed (BES) of 34 km/h (21 mph). The reconstruction was borderline, and the results were considered low. The collision deformation classification[1] (CDC) for this damage profile was 12FYEW3.

The curb impact (Event 3) resulted in fracture of the right-front suspension and separation of the right-front wheel assembly. The CDC for this damage profile was 03RFWN1.

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

Damage from the rollover (Event 4) was noted on the right and top planes, consistent with two-quarter turns. The damage consisted of abrasions on the right and top planes of the vehicle. Overlapping damage was noted to the roof and left A-pillar due to the frontal impact (Event 2). Vertical and lateral crush from the rollover is unknown. The CDC for this damage profile was 00TDDO2.

Event Data Recorder

The Jeep had an occupant restraint controller (ORC) that performed the diagnostic, sensing, and deployment command functions for the vehicle's supplemental restraint system. The module had EDR capabilities and was located under the center console rear of the gear shift. The EDR was not able to be imaged due to damage sustained by the module (Figure 6) and the connector during the crash sequence (Figure 7). The module was removed and taken into evidence by local law enforcement prior to the SCI inspection. The investigating officer advised the SCI investigator that they attempted to download the data from the module but were unsuccessful. The investigating officer also stated that they contacted the manufacturer to see if there were any other options to obtain the data from the module and were advised that the damage was too severe to obtain any data.

Figure 6. View of damage to the Jeep's EDR module. Image provided by local law enforcement

Figure 7. View of damage to the Jeep's EDR connecter cable

Interior Damage

Local law enforcement restricted access to the interior due to pending litigation; therefore, a complete interior inspection could not be obtained. The investigating officer requested the interior components not be manipulated or disturbed. However, images were obtained to assist with the investigation. The Jeep's interior sustained damage (Figures 8 and 9) and intrusion attributed to the frontal impact. The left A-pillar, steering wheel, and left instrument panel all intruded longitudinally an estimated 30 cm (12 in) due to the impact with the Ford. The lower instrument panel/knee bolster intruded to the forward edge of the driver seat cushion. The left A-pillar laterally intruded a visually estimated 25 cm (10 in). Two areas of dried blood were noted at the right sun visor and the right grab handle.

Figure 8. Lateral view of the Jeep's left A-pillar deformation

Figure 9. Overall view of the Jeep's instrument panel and front-row seating positions

The police on-scene documentation (Figures 10 and 11) showed broken glass where the Jeep came to rest attributed to the sunroof. A contact was noted to a fractured metal support bar from the sunroof. Blood and hair were seen on the sunroof support bar attributed to the driver's head.

Figure 10. Image of the fractured sunroof glass at the Jeep's final rest location. Image provided by local law enforcement.

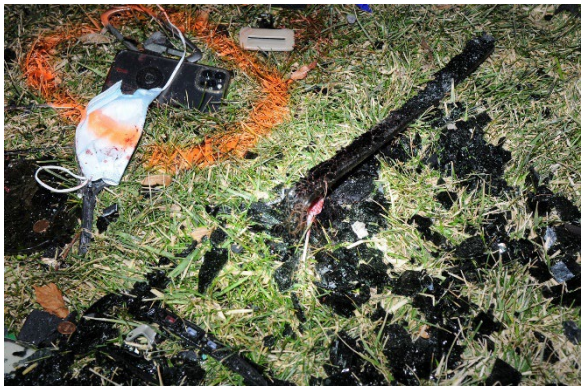

Figure 11. Close-up view of the Jeep's sunroof metal support bar indicting driver head contact. Image provided by local law enforcement.

Manual Restraint Systems

The Jeep had manual 3-point lap and shoulder seat belt systems for all five seating positions. All the 3-point lap and shoulder belt systems had continuous loop webbing with sliding latch plates. The front seat belts used retractor pretensioners that were observed to be actuated. The driver's seat belt system retracted onto an emergency locking retractor (ELR) while the other systems used switchable ELR/automatic locking retractor (ALR).

The driver's seat belt (Figures 12 and 13) was cut during extrication. The front passenger's seat belt was extended from the B-pillar but was looped under the seat. Due to the restrictions of not being able to move the seat, a detailed inspection of the front passenger's seat belt was not obtained. It should be noted that during the inspection the belt did not appear to have been cut.

Figure 12. Overall view of the Jeep driver's seat belt

Figure 13. Close-up view of the extrication cuts of the driver's seat belt in the Jeep

Supplemental Restraint Systems

The Jeep had supplemental occupant restraints including dual-stage driver's and passenger's frontal air bags, driver knee air bag, front outboard seat-mounted side-impact air bags, and IC air bags. Both frontal air bags and the driver knee air bag deployed during the crash.

Figure 14. View of the driver's frontal steering wheel hub-mounted air bag

Figure 15. View of the deployed passenger's frontal air bag

The driver's frontal air bag (Figure 14) deployed from the steering wheel hub-mounted module through the cover flaps without damage. It had no contact evidence. The driver knee air bag deployed and did not appear to be damaged. The passenger's frontal air bag (Figure 15) deployed through the cover flaps with no damage. A reddish stain in the center of the air bag was attributed to exposure to the environment.

The outboard seat-mounted side-impact air bags and the IC air bags did not deploy. The Jeep owner's manual[2] states, "The Occupant Restraint Controller (ORC) determines whether the deployment of the Side Air Bags in a particular rollover event is appropriate, based on the severity and type of collision…" and "…The Side Air Bags will not deploy in all rollover events. The rollover sensing system determines if a rollover event may be in progress and whether

[2] Jeep. (2018) 2018 Jeep Grand Cherokee: Owner's Manual.

deployment is appropriate. In the event the vehicle experiences a rollover or near rollover event, and deployment of the Side Air Bags is appropriate, the rollover sensing system will also deploy the seat belt pretensioners on both sides of the vehicle." Additionally, due to the EDR being damaged, it could not be determined if the ORC commanded the deployment of the IC air bags or the damage rendered the ORC unable to command the deployment.

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2018 Jeep Grand Cherokee Occupants

Driver Demographics

Age/Sex:	34 years/female
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat Type:	Forward-facing bucket seat with adjustable head restraint
Seat Track Position:	Middle-track position
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection and police crash report
Air Bags:	Driver's frontal, knee, seat-mounted, and IC air bags available; Driver's frontal and knee deployed
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Removed from vehicle due to perceived severe injuries
Transport from Scene:	Ambulance
Type of Medical Treatment:	Initially treated at Level II trauma center then transferred to Level I trauma center for specialized care, length of stay unknown

Driver Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Epidural hematoma along temporal lobe measures 1.2 cm	140636.5	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
2	Subdural hematoma along left frontal convexities measures 7 mm in thickness	140652.4	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
3	Punctate intraparenchymal hemorrhage or hemorrhagic contusions of right superior frontal gyrus and inferior right frontal lobe	140612.3	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
4	Moderate pneumocephalus centered in suprasellar cistern	140682.3	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
5	Fracture of roof of bilateral orbits through right sphenoid sinus; non-displaced fracture of right pterygoid process and hard palate	150200.3	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
6	Small subarachnoid hemorrhage along bilateral frontal convexities near vertex (right)	140693.2	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
7	Small subarachnoid hemorrhage along bilateral frontal convexities near vertex (left)	140693.2	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
8	Bilateral frontal calvarium fracture through left frontal sinus	150402.2	ICS #1: Isolated IPC Left Side – Left A (A1/A2)-pillar ICS #2: Isolated IPC Roof – Sunroof/components	Probable Possible
9	Displaced fracture of nasal bones	251002.2	Isolated IPC Left Side – Left A (A1/A2)-pillar	Probable
10	Nasal septum fracture	251006.2	Isolated IPC Left Side – Left A (A1/A2)-pillar	Probable

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
11	Bilateral maxillary sinus fracture, right more than left	250800.2	Isolated IPC Left Side – Left A (A1/A2)-pillar	Probable
12	Gaping 6 cm laceration to skull on forehead	210602.1	Isolated Roof – Sunroof components	Probable
13	Right-sided periorbital contusion	210402.1	Isolated Left Side – Left A (A1/A2)-pillar	Probable
14	Right pulmonary contusion to upper and middle lobe	441406.2	Tandem IPC Primary: Interior – Shoulder portion of belt restraint Secondary: Left Air Bag – Steering wheel hub Tertiary: Front – Steering wheel (combination of rim and hub/spoke)	 Possible Possible Probable

Source: Emergency room record; hospitalization record request denied

Driver Kinematics

The 34-year-old female drove the Jeep while using the 3-point lap and shoulder belt system. The driver's seat was in the middle-track position at the time of the SCI inspection. At the Jeep's initial frontal impact (Event 2) the seat belt system pretensioner actuated. The force of the crash resulted in intrusion of the left front door, A-pillar, and instrument panel. The driver responded forward and left, loading the seat belt with her torso. Her head probably struck the intruding A-pillar, resulting in head and brain injuries. The driver remained secured in her seat as the vehicle departed the roadway. When it struck the curb (Event 3) the vehicle initiated a right-leading roll (Event 4). It rolled two quarter turns, during which the driver's forehead struck the metal trim surrounding the sunroof. It is possible the brain injuries and skull fractures occurred during the rollover. Hair and blood were identified in on-scene photos taken during the police investigation. The Jeep came to final rest on its top plane with the driver suspended from her seating position.

Upon arriving, emergency medical services removed the Jeep driver due to her being semi-unconscious and transported her to a Level II trauma center by ambulance, where she was stabilized. She was then transferred to a Level I center for specialized treatment where her length of stay is unknown.

Front-Row-Right Occupant Demographics

Age/Sex:	15 years/female
Height:	152 cm (60 in)
Weight:	44 kg (96 lb)
Eyewear:	Unknown
Seat Type:	Forward-facing bucket seat with adjustable head restraint
Seat Track Position:	Middle-track position
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Air Bags:	Passenger's frontal, seat-mounted, and IC air bags available; Passenger's frontal deployed
Alcohol/Drug Involvement:	None
Egress from Vehicle:	Exited vehicle under own power
Transport from Scene:	Transported to Level II trauma center; transferred to Level I trauma center
Type of Medical Treatment:	Hospitalized for 2 days

Front-Row-Right Occupant Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Trace right pneumothorax	442202.2	ICS #1: Tandem IPC Primary: Interior – Shoulder portion of belt restraint Secondary: Right Air Bag – Right top instrument panel ICS #2: Isolated IPC Right Door Panel – Right door panel unknown/multiple quadrant	 Possible Possible Possible
2	Mildly displaced fracture of left olecranon, intra-articular	752163.2	Interior IPC Interior – Center console first row	Possible
3	Displaced nasal bone fractures	251002.2	Isolated IPC Front - Center instrument panel	Possible
4	Left eye commotio retinae, subretinal hemorrhage	241001.1	Isolated Front - Center instrument panel	Possible

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
5	Left corneal epithelial defect, hyphemia	240610.1	Isolated Front - Center instrument panel	Possible
6	Macular hole of left eye	240999.1	Isolated Front - Center instrument panel	Possible
7	Iritis of left eye	241499.1	Isolated Front - Center instrument panel	Possible
8	Superficial laceration to left upper eyelid (sutured)	210602.1	Isolated Front - Center instrument panel	Possible
9	Lacerations to left forehead (sutured)	210602.1	Isolated Front - Center instrument panel	Possible
10	Left forehead, left eye, left check, right eye, and right cheek hematomas	210402.1	Isolated Front - Center instrument panel	Possible
11	Abrasions to left forehead	210202.1	Isolated Front - Center instrument panel	Possible
12	Frontal scalp hematoma	110402.1	Isolated Front - Center instrument panel	Possible
13	Left elbow laceration, NFS	710600.1	Isolated Interior - Center console first row	Possible
14	Left 5th finger ecchymosis	710402.1	Injured, unknown source	Unknown
15	Left hip abrasion	810202.1	Isolated Interior – Lap portion of belt restraint	Possible

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
16	Left posterior thigh abrasion	810202.1	Isolated Interior – This occupant's seat cushion	Possible

Emergency room and hospital records

Front-Row-Right Occupant Kinematics

The 15-year-old female passenger was seated in the first-row right seat while utilizing the 3-point lap and shoulder belt. The seat was between the middle and rear-track positions at the time of the SCI inspection. At the initial frontal impact (Event 2), the passenger responded forward and left, loading the seat belt with her torso. Her head flexed forward and struck the intruding center instrument panel, resulting in the above identified injuries. Her left elbow struck the center console, resulting in a fracture and a laceration. She sustained a right pneumothorax that was either caused by her shoulder belt and air bag during the first event or to the right door panel during the rollover event. When the vehicle struck the curb (Event 3) and then initiated a right-leading roll (Event 4), the passenger was displaced to the right and vertically toward the roof. The vehicle rolled two-quarter turns and came to final rest on its top plane. The passenger was suspended from her seat with her head in contact with the headliner at the junction with the right A-pillar. Emergency medical services removed her from the Jeep due to perceived serious injuries and transported her by ambulance to a Level II trauma center for treatment. She was transferred to a Level I trauma center, where she was hospitalized for 2 days.

2013 Ford F-450

Description

The 2013 Ford F-450 (Figure 16) was manufactured in March 2013 with the VIN 1FD0W4HY5DExxxxxx. The Ford was 4-wheel drive powered by a 6.9-liter, 10-cylinder gasoline engine that was linked to a continuous variable transmission. Its service brakes were power-assisted 4-wheel disc with ABS. The gross vehicle weight rating was 7,484 kg (16,500 lb). The vehicle manufacturer's recommended tire size was 225/70R19.5. The left-front and right-front wheels had Hercules H-803 tires of the recommended size. The left-rear wheel had a Dayton D630D tire, and the right-rear wheel had a Wanli SDR02 tire; both tires were the recommended size. The left-front and right-rear tires had 7 mm (9/32) of tread. The left-rear tire had 8 mm (10/32) of tread and the right-front tire had 6 mm (7/32) of tread. None of the tires were restricted.

Figure 16. Front view of the 2013 Ford F-450

Exterior Damage

The sideswipe impact with the Volkswagen resulted in damage overlapped by the impact with the Jeep. This sideswipe damage resulted in the support step rail on the left side of the Ford to come loose. The damage resulted in an estimated TDC of 12FLEE1.

The frontal impact with the Jeep (Event 2) caused the aftermarket bumper guard to separate from the support frame mounts. The direct damage began 70 cm (27.6 in) right of the front center point and extended 60 cm (23.6 in) left. The residual crush at the front bumper reinforcement bar was: C1 = 8 cm (3.1 in), C2 = 4 cm (1.6 in), C3 = 1 cm (0.4 in), C4 = 0 cm, C5 = 0 cm, and C6 = 0 cm. Maximum crush was observed to be 8 cm (3.1 in) at the right-front bumper corner. The damage resulted in an estimated TDC of 01FZEW1.

Event Data Recorder (EDR)

The Ford had an air bag control module (ACM) that performed diagnostic, sensing, and deployment command functions for the vehicle's supplemental restraint systems. This module was removed by local law enforcement prior to the on-site inspection. Local law enforcement provided a copy of the EDR data. The imaged data was imaged with the Bosch Crash Data

Retrieval tool and software version 21.5 via direct connection to the module. The imaged data is reported with version 23.0. The EDR report is included at the end of this report as an Appendix.

The EDR recorded a single event record, and its data was consistent with the impact with the Jeep (Event 2). The maximum longitudinal delta V was -46.3 km/h (-28.7 mph). The maximum lateral delta V was -16.8 km/h (-10.4 mph).

Occupant Data

The Ford was driven by a 30-year-old male who was not secured by the available seat belt system. It is unknown how the driver exited the Ford. He was transported to a local hospital with B-level (non-incapacitating) injuries. The extent of his treatment is unknown.

2011 Volkswagen Jetta

Description

The 2011 Volkswagen Jetta (Figure 17) was a 4-door passenger vehicle with the VIN 3VWDZ7AJ3BMxxxxxx. It was powered by a 2.5 liter, 5-cylinder gasoline engine. The Volkswagen had a 265 cm (104.3 in) wheelbase and a reported curb weight of 1,381 kg (3,045 lb). It had seating for five passengers and had 3-point manual lap and shoulder belts for all seating positions. The Volkswagen was also equipped with six air bags including the driver's and passenger's frontal, front outboard seat-mounted side-impact, and IC air bags.

Figure 17. Front-left oblique view of the 2011 Volkswagen Jetta

Exterior Damage

No physical measurements were taken due to time constraints by the local law enforcement agency, but images were obtained. The sideswipe impact with the Ford resulted in damage extending from the left-front fender to the left-rear quarter panel. The damage resulted in an estimated CDC of 12LDES1.

Occupant Data

The Volkswagen was driven by a belted 41-year-old female with a belted 39-year-old male front-right passenger, a belted 11-year-old female second-row left-seat passenger, and a belted 9-year-old second-row right-seat passenger. They denied injury and were not treated at the scene or transported.

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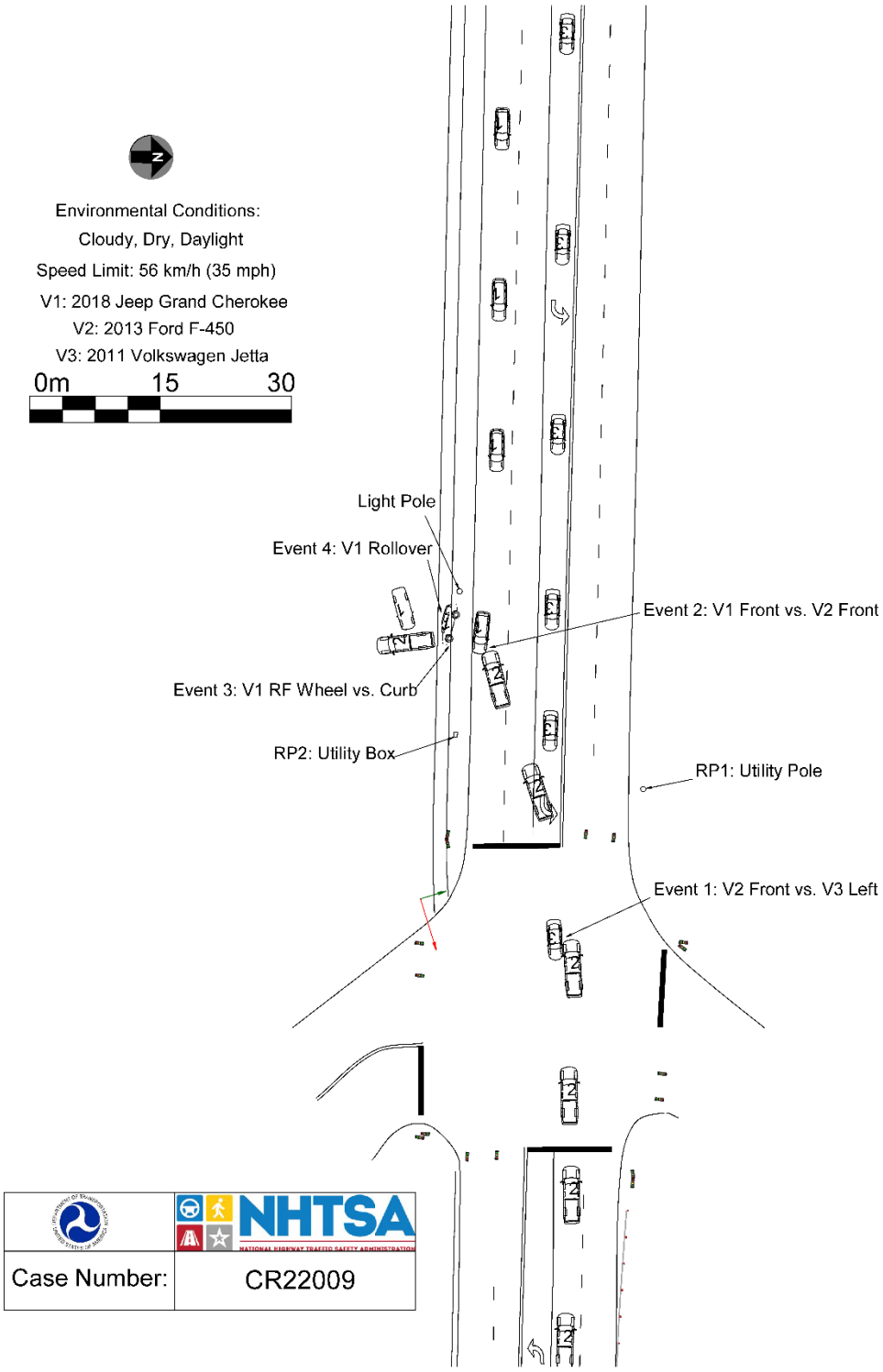
Crash Diagram



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Appendix: 2013 Ford F-450 Event Data Recorder Report[3]

[3] The EDR report contained in this technical report was imaged by the local law enforcement agency. It provided a CDRx file to the SCI investigator. 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	1FD0W4HY5DE******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR22009_V2_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 21.5
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 23.0
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	Yes
Event(s) recovered	locked frontal event Fuel cutoff level 1

Comments

No comments entered.

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

Data Limitations

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

Airbag Module Data Limitations:

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

Airbag Module Data Sources:

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

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

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

02007_RCM-RC6_r002

System Status at Time of Retrieval

VIN as programmed into RCM at factory	1FD0W4HY5DE******
Current VIN from PCM	1FD0W4HY5DE******
Ignition cycle, download (first record)	8,622
Ignition cycle, download (second record)	N/A
Restraints Control Module Part Number	DC3T-14B321-AB
Restraints Control Module Serial Number	7000629400000000
Restraints Control Module Software Part Number (Version)	CT43-14C028-AB
Left/Center Frontal Restraints Sensor Serial Number	175DB644
Left Side Restraint Sensor 1 Serial Number	2B3336B2
Left Side Restraint Sensor 2 Serial Number	1745643A
Right Frontal Restraints Sensor Serial Number	00000000
Right Side Restraint Sensor 1 Serial Number	4DB336B2
Right Side Restraints Sensor 2 Serial Number	17450F57

System Status at Event (First Record)

Recording Status	Locked Record
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	1
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	19,283,240
Key-on Timer at event time zero (seconds)	3,595
Vehicle voltage at time zero (Volts)	13.932
Energy Reserve Mode entered during event (Y/N)	Yes
Time Driver Front Satellite Sensor Lost Relative to Time Zero (msec)	20.0
Time Driver First Row Satellite Sensor Lost Relative to Time Zero (msec)	253.0
Time Passenger Second Row Satellite Sensor Lost Relative to Time Zero (msec)	253.0

Faults Present at Start of Event (First Record)

No Faults Recorded

Deployment Data (First Record)

Frontal airbag deployment, time to first stage deployment, driver (msec)	19.5
Pretensioner (retractor) deployment, time to fire, driver (msec)	19.5
Frontal airbag deployment, time to first stage deployment, front passenger (msec)	19.5
Side curtain airbag deployment, time to deploy, right side (msec)	83.5
Pretensioner (retractor) deployment, time to fire, right front passenger (msec)	19.5
Maximum delta-V, longitudinal (MPH [km/h])	-28.74 [-46.26]
Time, maximum delta-V longitudinal (msec)	290
Maximum delta-V, lateral (MPH [km/h])	-10.44 [-16.79]
Time, maximum delta-V lateral (msec)	134
Left or center front, satellite Sensor discriminating deployment	Yes
Left or center, front satellite Sensor safing	Yes
Right, front satellite sensor discriminating deployment	Yes
RCM, front sensor discriminating deployment	Yes
RCM, front sensor safing	Yes
Longitudinal Delta-V Time Zero Offset	3.5 ms
Lateral Delta-V Time Zero Offset	3.5 ms
Roll Angle Time Zero Offset	63.5 ms

Pre-Crash Data -1 sec (First Record)

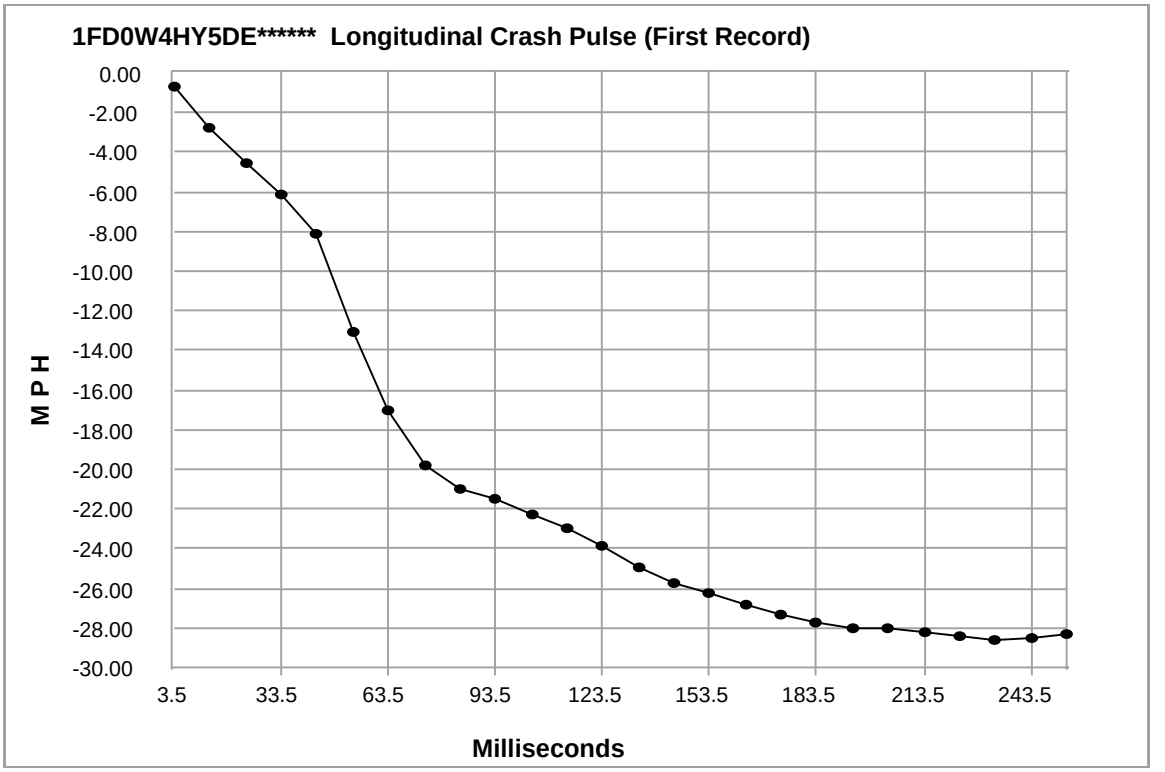
Ignition cycle, crash	8,621
Frontal air bag warning lamp, on/off	Off
Frontal air bag suppression switch status, front passenger	Not Active
Safety belt status, driver	Driver Not Buckled
Brake Telltale	Off
ABS Telltale	Off
Powertrain Wrench Telltale	Off
Speed Control Telltale	Off
MIL Telltale	Off

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

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	45 [73]	18.1	Off	1,716	non-engaged	No	Drive
- 4.5	45 [73]	16.4	Off	1,732	non-engaged	No	Drive
- 4.0	46 [74]	14.7	Off	1,738	non-engaged	No	Drive
- 3.5	46 [74]	8.8	Off	1,748	non-engaged	No	Drive
- 3.0	46 [74]	0.0	Off	1,762	non-engaged	No	Drive
- 2.5	46 [74]	0.0	Off	1,750	non-engaged	No	Drive
- 2.0	47 [75]	15.7	Off	1,728	non-engaged	No	Drive
- 1.5	47 [75]	34.9	Off	1,764	non-engaged	No	Drive
- 1.0	43 [70]	100.0	Off	1,974	engaged	No	Drive
- 0.5	43 [69]	100.0	Off	2,940	engaged	No	Drive
0.0	42 [68]	0.0	Off	3,432	engaged	No	Drive

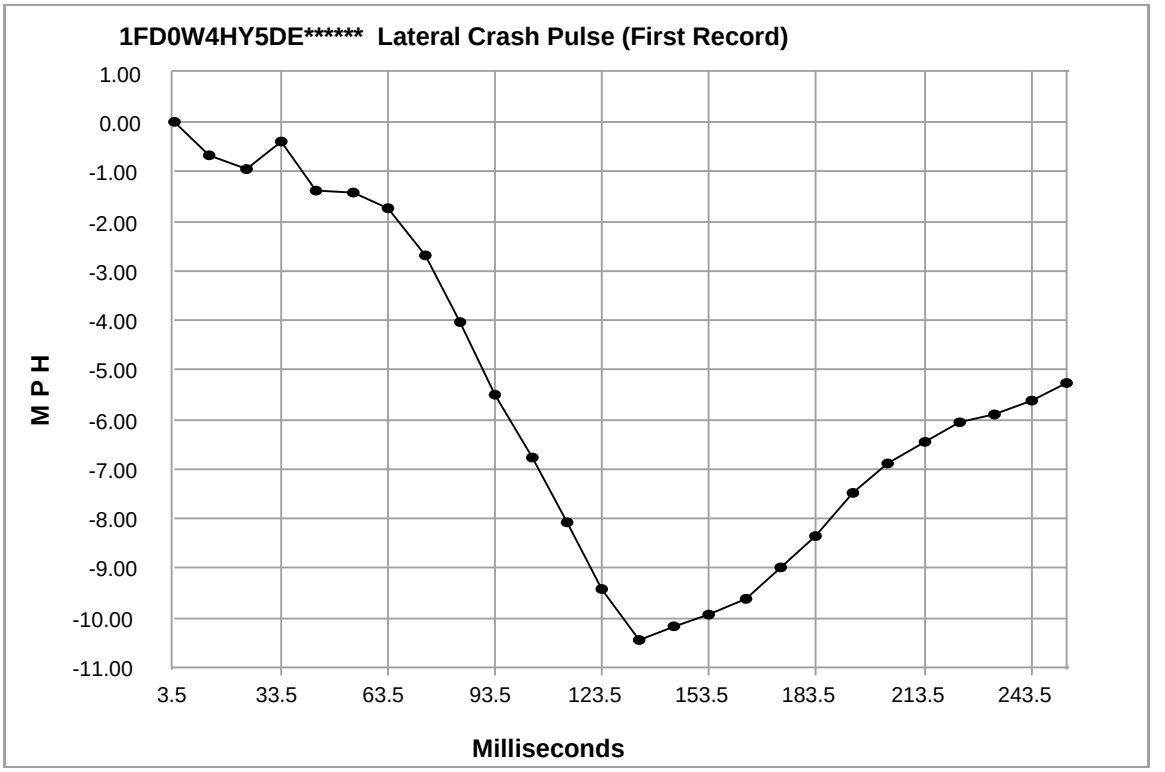
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

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



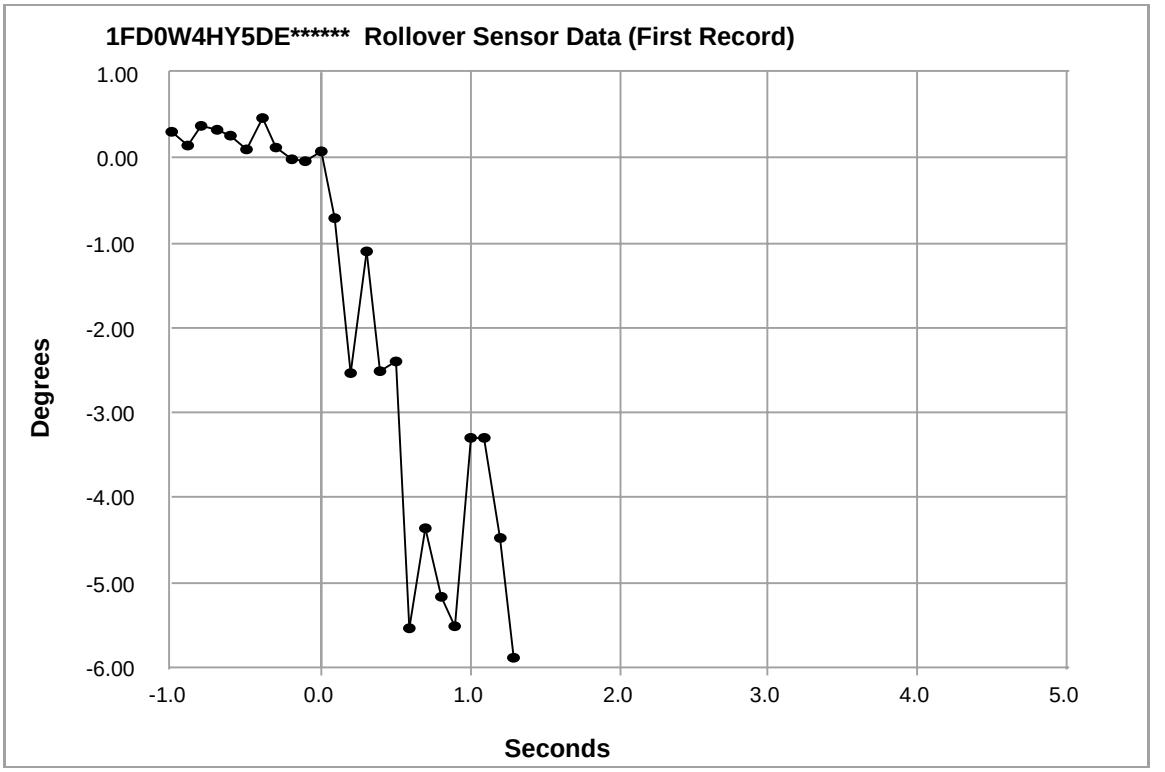
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
3.5	-0.73	-1.17
13.5	-2.80	-4.51
23.5	-4.60	-7.40
33.5	-6.10	-9.82
43.5	-8.13	-13.09
53.5	-13.09	-21.06
63.5	-17.06	-27.46
73.5	-19.75	-31.79
83.5	-21.00	-33.80
93.5	-21.49	-34.58
103.5	-22.25	-35.82
113.5	-22.93	-36.91
123.5	-23.82	-38.33
133.5	-24.92	-40.11
143.5	-25.78	-41.50
153.5	-26.22	-42.19
163.5	-26.87	-43.24
173.5	-27.35	-44.01
183.5	-27.72	-44.62
193.5	-28.00	-45.07
203.5	-27.98	-45.02
213.5	-28.17	-45.34
223.5	-28.42	-45.74
233.5	-28.60	-46.03
243.5	-28.49	-45.86
253.5	-28.36	-45.63



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
3.5	0.01	0.01
13.5	-0.67	-1.08
23.5	-0.92	-1.48
33.5	-0.40	-0.65
43.5	-1.37	-2.20
53.5	-1.42	-2.28
63.5	-1.74	-2.81
73.5	-2.67	-4.29
83.5	-4.03	-6.49
93.5	-5.50	-8.85
103.5	-6.74	-10.85
113.5	-8.06	-12.97
123.5	-9.43	-15.18
133.5	-10.44	-16.79
143.5	-10.19	-16.39
153.5	-9.91	-15.95
163.5	-9.61	-15.47
173.5	-8.99	-14.46
183.5	-8.35	-13.44
193.5	-7.49	-12.05
203.5	-6.88	-11.08
213.5	-6.43	-10.34
223.5	-6.06	-9.76
233.5	-5.89	-9.48
243.5	-5.61	-9.03
253.5	-5.27	-8.48



Rollover Sensor Data (First Record)

Time (sec)	Vehicle roll angle (degrees)
-1.0	0.31
-0.9	0.16
-0.8	0.38
-0.7	0.32
-0.6	0.27
-0.5	0.09
-0.4	0.48
-0.3	0.13
-0.2	-0.02
-0.1	-0.04
0.0	0.09
0.1	-0.7
0.2	-2.54
0.3	-1.11
0.4	-2.52
0.5	-2.39
0.6	-5.53
0.7	-4.36
0.8	-5.16
0.9	-5.52
1.0	-3.29

Time (sec)	Vehicle roll angle (degrees)
1.1	-3.3
1.2	-4.47
1.3	-5.89
1.4	N/A
1.5	N/A
1.6	N/A
1.7	N/A
1.8	N/A
1.9	N/A
2.0	N/A
2.1	N/A
2.2	N/A
2.3	N/A
2.4	N/A
2.5	N/A
2.6	N/A
2.7	N/A
2.8	N/A
2.9	N/A
3.0	N/A
3.1	N/A

Time (sec)	Vehicle roll angle (degrees)
3.2	N/A
3.3	N/A
3.4	N/A
3.5	N/A
3.6	N/A
3.7	N/A
3.8	N/A
3.9	N/A
4.0	N/A
4.1	N/A
4.2	N/A
4.3	N/A
4.4	N/A
4.5	N/A
4.6	N/A
4.7	N/A
4.8	N/A
4.9	N/A
5.0	N/A

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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43 54 34 33 2D 31 34 43 30 32 38 2D 41 42 00 00 00 00 00 00 00 00 00 00

17 5D B6 44 00 00 00 00 00 00 00 00 00 00 00 00

2B 33 36 B2 00 00 00 00 00 00 00 00 00 00 00 00

17 45 64 3A 00 00 00 00 00 00 00 00 00 00 00 00

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4D B3 36 B2 00 00 00 00 00 00 00 00 00 00 00 00

17 45 0F 57 00 00 00 00 00 00 00 00 00 00 00 00

31 46 44 30 57 34 48 59 35 44 45 2A 2A 2A 2A 2A 2A

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Event Record 1

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Event Record 2

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Disclaimer of Liability

DOT HS 813 685
March 2025

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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