



U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**



DOT HS 813 101

March 2021

**Special Crash Investigations:
On-Site Child Restraint System
Crash Investigation;
Vehicle: 2012 Ford Explorer;
Location: Texas;
Crash Date: September 2019**

DISCLAIMER

This publication is distributed by the U.S. Department of Transportation, National Highway Traffic Safety Administration, in the interest of information exchange. The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the Department of Transportation or the National Highway Traffic Safety Administration. The United States Government assumes no liability for its contents or use thereof. If trade or manufacturers' names are mentioned, it is only because they are considered essential to the object of the publication and should not be construed as an endorsement. The United States Government does not endorse products or manufacturers.

Suggested APA Format Citation:

Crash Research & Analysis, Inc. (2021, March). *Special crash investigations: On-site child restraint system crash investigation; vehicle: 2012 Ford Explorer; location: Texas; crash date: September 2019* (Report No. DOT HS 813 101). National Highway Traffic Safety Administration.

Technical Report Documentation Page

1. Report No. DOT HS 813 101	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Special Crash Investigations: On-Site Child Restraint System Crash Investigation; Vehicle: 2012 Ford Explorer; Location: Texas; Crash Date: September 2019		5. Report Date March 2021	
		6. Performing Organization Code	
7. Author Crash Research & Analysis, Inc.		8. Performing Organization Report No. CR19002	
9. Performing Organization Name and Address Crash Research & Analysis, Inc. P.O. Box 302 Elma, NY 14059		10. Work Unit No. (TRAIS)	
		11. Contract or Grant No. 693JJ919RQ000616	
12. Sponsoring Agency Name and Address National Highway Traffic Safety Administration National Center for Statistics and Analysis (NSA-110) 1200 New Jersey Avenue SE Washington, DC 20590		13. Type of Report and Period Covered Technical Report	
		14. Sponsoring Agency Code	
15. Supplementary Notes Each crash represents a unique sequence of events, and generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicles or their safety systems. This report and associated case data are based on information available to the Special Crash Investigation team on the date this report was published.			
16. Abstract This report documents the on-site investigation of a forward-facing Dorel Juvenile Group, Safety First, "Grow and Go" child restraint system (CRS) used to secure a 17-month-old female in the second-row center of a 2012 Ford Explorer involved in a frontal crash with a 2017 Honda CR-V. The Ford was occupied by a belted 41-year-old male driver, a belted 35-year-old female right front passenger, and the child occupant who was harnessed in the forward-facing CRS secured to the second-row center seat by the LATCH (Lower Anchors and Tethers for Children) system. The force of the crash deployed air bags in both vehicles. The child sustained critical injuries and was pronounced deceased at the scene. The driver and front right passenger of the Ford sustained non-incapacitating (B-level) injuries and were transported to a hospital for medical treatment. The driver of the Honda also sustained fatal injuries. The investigation determined that the child was secured in the CRS by LATCH in the second-row center position of the Ford; however, the vehicle manufacturer did not approve of the second-row center position due to the spacing of the lower anchors. During the impact, the child responded to the 12 o'clock direction of the severe frontal impact with a forward trajectory. As her torso decelerated, the head/neck flexed forward beyond the anatomical limits of the cervical spine, resulting in her fatal injury.			
17. Key Words child restraint system, LATCH, fatality		18. Distribution Statement The document is available to the public from the National Technical Information Service, www.ntis.gov .	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 53	22. Price

Table of Contents

Background	1
Summary.....	3
Crash Site	3
Pre-Crash.....	3
Crash	3
Post-Crash.....	4
2012 Ford Explorer.....	5
Description.....	5
Exterior Damage	6
Event Data Recorder.....	7
Interior Damage	8
Manual Restraint Systems.....	8
Supplemental Restraint Systems.....	9
Child Restraint System	10
2012 Ford Explorer Occupant Data.....	13
Driver Demographics.....	13
Driver Injury	13
Driver Kinematics.....	13
Front Right Passenger Demographics.....	13
Front Right Passenger Injury	14
Front Right Passenger Kinematics.....	14
Second-Row Center Occupant Demographics.....	14
Second-Row Center Occupant Injury	15
Second-Row Center Occupant Kinematics.....	17
2017 Honda CR-V.....	18
Description.....	18
Exterior Damage	18
Occupant Data.....	19
Crash Diagram	20
Appendix A: Event Data Recorder Report for 2012 Ford Explorer	A-1

Special Crash Investigations
On-Site Child Restraint System Crash Investigation
Case Number: CR19002
Vehicle: 2012 Ford Explorer
Location: Texas
Crash Date: September 2019

Background

This report documents the on-site investigation of a forward-facing Dorel Juvenile Group, Safety First, “Grow and Go” child restraint system (CRS) used to secure a 17-month-old female in the second-row center position of a 2012 Ford Explorer (Figure 1) involved in a frontal crash with the right plane of a 2017 Honda CR-V. The child sustained fatal injuries. The crash was identified by the Crash Investigation Division (CID) of the National Highway Traffic Safety Administration through a review of online news reports and was forwarded to the Special Crash Investigations (SCI) team in September 2019. The SCI team contacted the investigating police agency and the attorney representing the Ford’s passengers and established cooperation in September 2019. The on-site portion of this investigation, which took place in October 2019, was attended by consultants for both drivers. Authorization from the attorney to interview the Ford’s occupants was not obtained.



Figure 1. The 2012 Ford Explorer

The crash occurred in the northbound lanes of a four-lane, undivided U.S. highway. At the time of the crash, the weather was heavy rain. The crash developed when the belted 76-year-old male driver of the Honda lost control of the vehicle while negotiating a left curve. The Honda yawed counterclockwise across the centerline and into the path of the northbound Ford. The front plane of the Ford struck the right plane of the Honda. The Ford was occupied by a belted 41-year-old male driver, a belted 35-year-old female right front passenger, and the child, who was harnessed in the forward-facing CRS secured to the second-row center seat by the LATCH (Lower Anchors and Tethers for Children) system’s lower anchors and top tether. The force of the crash deployed air bags in both vehicles. The child sustained critical injuries and was pronounced deceased at the scene 44 minutes post-crash. Her body was transported to a funeral home prior to transfer to the medical examiner’s office for autopsy. The driver and right front passenger of the Ford

sustained police-reported non-incapacitating (B-level) injuries and were transported to a hospital, where they were treated and released. The Honda driver sustained fatal injuries (K-level) and was pronounced deceased 97 minutes post-crash. His body was also transported to a funeral home prior to medical examiner transfer.

The SCI on-site investigation consisted of the inspection of the Ford to measure its exterior and interior damage, assess the manual and supplemental restraint systems, and identify points of occupant contact. The attorney representing the Ford's occupants held control of the CRS and permitted a partial inspection, which included examination for occupant loading and crash-related damage. The Ford was equipped with an Event Data Recorder (EDR), supported by the Bosch Crash Data Retrieval tool. This EDR was removed from the vehicle by consultants hired by the attorney representing the Ford's occupants, and the data file was obtained by the SCI team in November 2019. The exterior damage of the Honda was also measured and documented with digital images. Its EDR was removed by the police who determined that it was too severely damaged by crash forces to be imaged. The crash site and physical environment of the roadway were photographed and mapped by the total station during the SCI inspection.

The investigation determined that the child was secured in the CRS by LATCH in the second-row center position of the Ford; however, the vehicle manufacturer did not approve of the second-row center position due to the spacing of the lower anchors. During the impact, the child responded to the 12 o'clock direction of the severe frontal impact with a forward trajectory. As her torso decelerated, the head/neck flexed forward beyond the anatomical limits of the cervical spine, resulting in her fatal injury.

Summary

Crash Site

The crash occurred on an undivided, four-lane U.S. Highway in daylight. The environmental conditions reported by the National Weather Service were rain, a temperature of 34.4 °C (94.0 °F), 43 percent relative humidity, and west winds at 16 km/h (10 mph). The bituminous roadway was wet and oriented primarily in a north/south direction. There was a large radius right curve and positive 2% grade in the northbound direction. The respective travel lanes were separated by a double-yellow line. The lanes measured 3.1 m (10.2 ft) wide and were separated by broken white lines. The edges of the roadway were delineated by solid white fog lines. The bituminous shoulders were 3.5 m (11.5 ft). The posted speed limit was 113 km/h (70 mph).

Pre-Crash

The Ford was traveling north in the left lane of the northbound roadway (Figure 2) at an EDR-reported speed of 88 km/h (55 mph) at 5 seconds prior to algorithm enable (AE). The Honda was traveling south in the left lane of the southbound roadway (Figure 3) at an unknown speed. The Honda broke traction of the wet road surface and began to rotate counterclockwise, traversing the centerline and into the northbound lanes. A pre-impact tire mark attributed to the Honda began in the southbound left lane and continued for 65 m (213.2 ft) into the northbound right lane. Based on the EDR, the Ford driver started to steer significantly to the right at -2 sec prior to AE. He applied the service brakes at -1.5 second of AE. Crash scene evidence also indicated that the driver steered to the right to avoid the crash. The crash diagram is included at the end of this report.



Figure 2. North view, the Ford's approach



Figure 3. Southbound view of the Honda's approach

Crash

The crash occurred in the center of the northbound lanes (Figure 4) when the front plane of the Ford struck the right plane of the Honda (Event 1). The EDR recorded speed of the Ford at impact was 66 km/h (41 mph). The resultant directions of force were in the 12 o'clock sector for the Ford and 3 o'clock for the Honda. As a result of the impact, both frontal and IC air bags, as well as the driver's seat-mounted air bag, deployed. The Ford rotated slightly counterclockwise and came to final rest facing north, mostly in the right lane, with the right rear wheel on the

shoulder. The impact also rotated the Honda counterclockwise, and it came to final rest straddling the northbound lanes, facing northeast.



Figure 4. Impact/final rest area (northbound view)

Post-Crash

The police were notified of the crash and arrived 21 minutes later. Rescue and medical personnel also responded. The second-row center occupant of the Ford was fatally injured and pronounced deceased at the crash site. The driver and right front passenger of the Ford sustained police-reported non-incapacitating (B-level) injuries and were transported by ambulance to a local hospital, where they were treated and released. The Honda driver was fatally injured and pronounced deceased at the crash site. Both fatal occupants were transported to a funeral home prior to transfer to the medical examiner's office for autopsy.

2012 Ford Explorer

Description

The Ford Explorer was a 4-door, front-wheel-drive sport utility vehicle (SUV) manufactured in July 2011, with the VIN 1FMHK7F85CGxxxxxx, and powered by a 3.5 liter, V-6, gasoline engine and a 6-speed automatic transmission. The vehicle placard listed the gross vehicle weight rating (GVWR) at 2,794 kg (6,100 lb), with gross axle weight ratings of 1,397 kg (3,080 lb) front and 1,497 kg (3,300 lb) rear. The vehicle was equipped with 4-wheel disc brakes with ABS, brake assist, electronic brakeforce distribution, stability control, and traction control. The manufacturer recommended tire size was P255/50R20, with cold tire pressures of 241 kPa (35 PSI). The Ford was equipped with Nexen Roadian HR tires on the front wheels and Hankook Optimo H426 tires on the rear wheels. All tires were of the recommended size. The specific tire data at the time of the SCI inspection was as follows:

Position	Tire Identification Number	Measured Tread Depth	Restricted	Damage
LF	Unknown	2 mm (2/32 in)	N/A	Sidewall holed
LR	5MYP PDL H	5 mm (7/32 in)	N	None
RR	5MYP PDL H	4 mm (6/32 in)	No	None
RF	8EXM CE	3 mm (4/32/in)	No	Sidewall holed

The interior of the Ford was configured for seven occupants with front-row bucket seats with adjustable head restraints, a split-bench second-row seat with folding backs and adjustable head restraints, and a third-row split bench seat with folding backs and non-adjustable, folding head restraints. Manual safety systems included 3-point lap and shoulder seat belts for the seven seat positions. Supplemental restraints included frontal air bags for the driver and right front positions, front-row-seat-mounted side impact air bags, and dual sensing (side impact and rollover) inflatable curtain (IC) air bags. Both left and right frontal and IC air bags deployed during the crash, and so did the driver's seat-mounted side impact air bag. The second-row seat was configured with Lower Anchors and Tethers for Children (LATCH), with lower anchors present for the outboard seating positions and top tether anchors present for all three seat positions (Figures 5 and 6). The vehicle's owner's manual stated: "The standard spacing for LATCH lower anchors is 28 cm (11 in). Do not use LATCH lower anchors for the center seating positions unless the child seat manufacturer's instructions permit and specify using anchors spaced at least as far apart as those in this vehicle." The space between the outboard seat anchors was 28 cm (11 in), and the space between the two inboard anchors (at the center seat) was 52 cm (20.5 in). The second-row center position was not an approved LATCH position by the CRS manufacturer.



Figure 5. Second-row seat LATCH anchor points



Figure 6. Second-row top tether anchor points

Exterior Damage

Exterior damage was present on the front and left planes of the Ford, consistent with the dynamics of the crash sequence. The front bumper beam, bumper fascia, grille, hood, fenders, and both headlamp/turn signal assemblies were all directly damaged (Figure 7). The direct and induced damage extended the entire length of the front plane, 160 cm (63.0 in), based on exemplar measurements. The Field L was 143 cm (56.3 in). Crush measurements were taken on the bumper beam. The residual maximum crush was 48 cm (18.9 in), occurring at the front left bumper corner. The crush profile measurements were C1 = 46 cm (18.1 in), C2 = 42 cm (16.5 in), C3 = 48 cm (18.9 in), C4 = 42 cm (16.5 in), C5 = 33 cm (13.0 in), and C6 = 21 cm (8.3 in).



Figure 7. The Ford's front plane damage

The collision deformation classification (CDC) assigned to the damage pattern was 12FDEW3 (350 degrees). As the Ford and the Honda were engaged and moving toward final rest, the Honda rotated around the left front corner of the Ford and contacted the Ford's left plane. The direct

damage extended 349 cm (137.4 in) along the left plane during the prolonged engagement. The damage algorithm of the WinSMASH program calculated the Ford's total delta V as 49 km/h (30 mph). The longitudinal and lateral velocity changes were -49 km/h (-30 mph) and 9 km/h (6 mph). The results appeared low. The EDR reported the maximum longitudinal and lateral delta Vs as -68.59 km/h (-42.62 mph) and 10.79 km/h (6.71 mph), respectively.

Event Data Recorder

The Ford was equipped with an air bag control module (ACM) that performed the diagnostic, sensing, and deployment command functions for the vehicle's supplemental restraint systems. The module was removed for imaging by the representing attorney's crash consultant, and the CDRx file was provided to the SCI team in November 2019. The data was imaged with version 19.1 of the Bosch Crash Data Retrieval software. It was reported for this report with version 21.0. The EDR report is attached at the end of this report as Appendix A.

The data limitations reported that the restraints control module (RCM) could store up to two deployment events. Data from deployment events cannot be overwritten or cleared from the RCM. Data from non-deployments can be overwritten. The imaged data recovered a locked frontal event, a locked side event, and an unlocked event. There were two records included in the report.

First Record: This record was unrelated to this crash. It occurred at 2,936 ignition cycles, and the second record was recorded at 12,158 cycles.

Second Record: The EDR reported a locked event, and the recording was complete. There were no diagnostic faults present prior to the start of the second record, the frontal air bag warning lamp was "Off," and the seat belt status of both driver and front-row passenger was "Buckled."

The EDR recorded five seconds of pre-crash data. The vehicle speed, accelerator pedal percentage, service brake status, engine RPM, ABS activity, and wheel torque are presented in the table below:

Times (sec)	Speed km/h (mph)	Accel. pedal, % full	Service brake, on/off	Engine rpm	ABS activity	Wheel torque	Steering wheel angle
-5/0	88 (55)	24.9	Off	1,924	Non-engaged	428	0.3
-4.5	87 (54)	24.6	Off	1,930	Non-engaged	436	0.5
-4.0	87 (54)	24.6	Off	2,004	Non-engaged	508	0.0
-3.5	88 (55)	28.8	Off	2,018	Non-engaged	528	-2.1
-3.0	88 (55)	28.7	Off	2,038	Non-engaged	528	-2.2
-2.5	89 (55)	24.0	Off	2,000	Non-engaged	492	-1.7

Times (sec)	Speed km/h (mph)	Accel. pedal, % full	Service brake, on/off	Engine rpm	ABS activity	Wheel torque	Steering wheel angle
-2.0	88 (55)	0.0	Off	1,934	Non-engaged	424	-7.7
-1.5	85 (53)	0.0	On	1,556	Non-engaged	52	-29.4
-1.0	81 (50)	0.0	On	1,450	engaged	-8	-12.1
-0.5	75 (47)	0.0	On	1,330	engaged	-32	-6.6
0.0	66 (41)	0.0	On	1,110	engaged	-80	-10.4

Examination of the data indicates a reduction in speed from the -2.0 to 0.0-second interval prior to AE and a corresponding release of the service brakes. Further examination of the steering wheel angle indicated that the driver steered right prior to the crash. The maximum longitudinal and lateral acceleration was recorded as -68.59 km/h (-42.62 mph) and 10.79 km/h (6.71 mph), respectively, and occurred at 142 and 100 msec, respectively, after AE. Air bag deployments and pretensioner actuations occurred at the following times after AE:

- Driver and right front passenger frontal (1st and 2nd stages) 11.5/21.5 msec
- Driver thorax and IC 38.5 msec
- Driver retractor and buckle pretensioner 1.5/6.5 msec
- RF Passenger IC 38.5 msec
- RF Passenger retractor and buckle pretensioner 1.5/6.5 msec

Interior Damage

The occupant compartment of the Ford did not sustain intrusion damage from the frontal engagement with the Honda. The driver loaded through the deployed air bag and engaged and deformed the upper half of the steering wheel rim forward approximately 3 cm (1.2 in). His loading force also compressed the energy absorbing steering column (Figure 8). His knees contacted and deformed the knee bolster. There were no identified contacts attributed to the front right passenger.

Manual Restraint Systems

The front row of the Ford was equipped with 3-point lap and shoulder seat belts, retractor-mounted pretensioners, sliding latch plates, and adjustable upper anchors. The driver's and right front passenger's upper anchors were adjusted to the full-down positions. The second and frontfronts were equipped with lap and shoulder seat belts with sliding latch plates, fixed upper anchors, and emergency/automatic locking retractors (ELR/ALR). None of the second and third-row seat belts were used during the crash.

The driver was restrained by his seat belt. Both retractor and buckle pretensioners actuated during the crash. As the pretensioners actuated, the seat belt webbing was pulled taut across the driver as he was displaced forward as a result of frontal crash forces and loaded the seat belt system. Loading evidence consisted of frictional abrasions on the latch plate belt guide (Figure 9). There were also 7 cm (2.8 in) and 22 cm (8.7 in) long frictional abrasions on the webbing

from engagement against the buckle and D-ring, respectively, and an unretractable length of webbing was extended from the retractor, consistent with usage.



Figure 8. The Ford's steering wheel/column deformation



Figure 9. Frictional abrasions on the driver's latch plate

The right front passenger was also restrained by her seat belt. Both retractor and buckle pretensioners actuated during the crash. Loading evidence consisted of frictional abrasions on the latch plate belt guide. There were also 8 cm (3.1 in) and 48 cm (18.9 in) long frictional abrasions on the webbing from engagement against the buckle and D-ring, respectively.

The three second-row seat belt systems were not in use at the time of the crash. The CRS was secured in the center position of the second row by the LATCH system. Refer to the Child Restraint System section below for more information.

Supplemental Restraint Systems

The Ford was configured with six air bags consisting of dual-stage Certified Advanced 208-Compliant (CAC) frontal air bags for the driver and third right positions, front-seat-mounted side impact air bags, and dual sensing (side impact and rollover) inflatable curtain (IC) air bags. Both the frontal (Figure 10) and IC air bags deployed during the crash, and so did the driver's seat-mounted side impact air bag.

The driver's frontal air bag was mounted in the center hub of the steering wheel and was concealed by I-configuration cover flaps. The deflated air bag measured 53 cm (20.9 in) in diameter. The driver loaded through the air bag as evidenced by the deformation of the upper half of the steering wheel rim. The lower half of the back side of the air bag was stained with blood, though there was no discernable driver contact (i.e., tissue transfer) evidence to the air bag.



Figure 10. The Ford's deployed frontal air bags

The driver's seat-mounted side impact air bag deployed through a tear seam in the left side surface of the seat back. The deployed air bag was 52 cm (20.5 in) in height and 22 cm (8.7 in) in width. There was no discernable evidence of driver contact or damage to the air bag.

The right front passenger's frontal air bag was mounted to the top of the instrumental panel and concealed by a single rectangular cover flap. The deflated air bag was 60 cm (23.6 in) in height and 43 cm (16.9 in) in width. There were small blood stains on the center left of the front side of the air bag but no discernable contacts or damage were noted.

Both IC air bags were located along the roof side rail inside the headliner and extended from the A-pillar to the D-pillar. Both deployed IC air bags were 230 cm (90.5 in) in overall length, including a sail panel attached to the forward edge of the air bag. There was a 32 cm (12.6 in) gap between the forward edge of the sail panel and the base of the A-pillar. The IC air bags were 49 cm (19.3 in) in height and extended 11 cm (4.3 in) below the beltline. No discernable contacts or damage was noted on either IC air bag. The top aspect of both IC air bags was cut horizontally by rescue personnel to facilitate occupant removal.

Child Restraint System

The second-row center passenger was positioned in a Dorel Juvenile Group, Safety First "Grow and Go" convertible CRS (Figure 11). The CRS was manufactured on February 17, 2017, and was identified by Model No. CC138EFL. The CRS was constructed of a molded plastic shell with a multi-piece padded cover, dual armrests with integrated cup holders, and a 5-position adjustable headrest with corresponding positions for the shoulder portion of the 5-point harness system. The CRS was designed for use as a rear-facing infant seat for children of up to 18.1 kg (40 lb), a forward-facing 5-point harness restraint for children of 10.1 to 29.4 kg (22 to 65 lb), and a high-back belt-positioning booster seat for children of 18.1 to 45.4 kg (40 to 100 lb). At the time of the crash, the shoulder straps and headrest were adjusted to one setting up from the bottom, and the adjustable crotch strap buckle was set in the position closest to the child. The base was adjustable to three positions and was color coded for use in forward-facing (position 1,

red) or rear-facing (positions 2 and 3, blue), and at the time of inspection, the base was tilted to position 1 (Figure 12). The CRS was equipped with Lower Anchors and Tethers for Children (LATCH) with color-coded belt paths for use as forward-facing (red) and rear-facing (blue).



Figure 11. Dorel Safety First, "Grow and Go" CRS



Figure 12. Left side of CRS with incline adjustment at the "1" (most upright) position

Based on information from the investigating officer, representing attorney, and evidence in the vehicle, the CRS was installed forward-facing in the second-row center position at the time of the crash with LATCH lower anchor connectors and top tether in use. A load mark on the top of the center seat back indicated the top tether was used during the crash (Figure 13). Further indentations from the center seat belt buckle could be seen on the seatback, indicating the vehicle's seat belt was not used to secure the CRS to the seat.

The CRS LATCH lower anchor connectors and top tether were examined during SCI inspection and were found to be unremarkable. The LATCH anchors at the second-row seat bight were available only at the outboard seating positions, and were spaced 28 cm (11 in) apart (see Figure 5 on p. 6). The CRS LATCH straps were connected to the inboard anchors which were 52 cm (20.5 in) apart. The Ford Owner's Manual identified and illustrated: "A child seat with rigid LATCH attachments cannot be installed at the center seating position. LATCH compatible child seats can only be used at this seating position provided the child seat manufacturer's instructions permit use with the anchor spacing stated."¹ The CRS manufacturer was queried by the SCI Investigator in October 2019 regarding use in second-row center seats. The representative stated that the LATCH features of this CRS should not be used in the center position.

At the scene of the crash, the child was removed from the CRS and the vehicle by rescue personnel. She was pronounced deceased at the crash scene and was transported to a funeral home prior to transfer to the medical examiner's office. The CRS was left in the vehicle. The investigating officer removed it from the vehicle and transferred custody to the representing attorney who authorized the SCI inspection.

Based on the inspection and research, the CRS was secured to the second-row seat in an unapproved manner at the time of the crash. Inspection of the CRS revealed one small stress mark on the front of the seat, 14 cm (5.5 in) left of the center, but otherwise there was no observed structural damage or discernable stress marks to the shell. The levers for the headrest/shoulder strap adjustment did not function properly (Figure 14), and the left harness

¹ 2012 Ford Explorer Owner's Manual, p. 217.

strap holder (used when moving child in and out of the CRS) was broken off, though it is unknown whether it was a result of this crash. Frictional abrasions at the belt routing area from the LATCH straps were minimal; all buckles, hardware, and the shoulder strap retainer clip were undamaged and in good working condition.



Figure 13. Top tether load mark at top second-row, center seat back



Figure 14. CRS headrest and shoulder strap adjustment levers

2012 Ford Explorer Occupant Data

Driver Demographics

Age/sex: 41 years/male
 Height: Unknown
 Weight: Unknown
 Eyewear: Unknown
 Seat type: Bucket seat with adjustable head restraint
 Seat track position: Between middle and rear-most
 Manual restraint usage: 3-point lap and shoulder seat belt
 Usage source: Vehicle inspection
 Air bags: Front, seat-mounted, and IC air bags available and deployed
 Alcohol/drug data: None
 Egress from vehicle: Unknown
 Transport from scene: Ambulance
 Type of medical treatment: Hospital, treated and released

Driver Injury

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Unknown	Unknown	Unknown	Unknown

Medical request rejected due to lack of medical release. Interview refused.

Driver Kinematics

The driver was restrained by the lap and shoulder seat belt. The seatback was reclined approximately 20 degrees aft of vertical and the seat track was adjusted between the middle and rear-most positions. The front plane impact to the Ford resulted in the deployment of the driver's frontal, seat back-mounted, and IC air bags and the actuation of the pretensioners. The driver was displaced forward and slightly left, loading the seat belt webbing and the deployed frontal air bag. He continued to load through the air bag and engaged the steering wheel rim, center hub, and the steering column. His loading force deformed the steering wheel rim and compressed the energy absorbing steering column against the intruding instrument panel. He also contacted and deformed the knee bolster with his knees. The driver rebounded rearward back into his seat and remained in his seat belt as the vehicle rotated slightly counterclockwise and came to final rest. Blood was noted on the back of the frontal air bag, indicating a cut and subsequent contact with the air bag at some point in the crash sequence. The driver sustained non-incapacitating injuries (B-level) and was transported to a hospital, where he was treated and released. The driver's medical records were requested, but the request was refused due to lack of medical release by the patient.

Front Right Passenger Demographics

Age/sex: 35 years/female
 Height: Unknown
 Weight: Unknown

Eyewear: Unknown
 Seat type: Bucket with adjustable head restraint
 Seat track position: Between middle and rear-most
 Manual restraint usage: 3-point lap and shoulder seat belt
 Usage source: SCI inspection
 Air bags: Frontal and IC, deployed; seat-mounted side impact, not deployed
 Alcohol/drug data: None
 Egress from vehicle: Unknown
 Transport from scene: Ambulance
 Medical treatment: Hospital, treated and released

Front Right Passenger Injury

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Unknown	Unknown	Unknown	Unknown

Medical request rejected due to lack of medical release. Interview refused.

Front Right Passenger Kinematics

The front right passenger was restrained by the lap and shoulder seat belt. Her seat track was between the middle and rear-most positions and the seatback was reclined approximately 40 degrees aft of vertical at the time of SCI inspection. This could have been adjusted by rescue personnel after the crash. The front plane impact to the Ford displaced the occupant forward and slightly left, loading the seat belt webbing and frontal air bag. She rebounded back into her seat and remained in her seat belt as the vehicle rotated slightly counterclockwise and came to final rest. A small blood stain was noted on the front left of her frontal air bag. The occupant sustained non-incapacitating injuries (B-level) and was transported by ambulance to a hospital, where she was treated and released. The front right passenger's medical records were requested, but the request was refused due to lack of medical release by the patient.

Second-Row Center Occupant Demographics

Age/sex: 17 months/female
 Height: 75 cm (31.5 in)
 Weight: 14 kg (29.5 lb)
 Eyewear: None
 Seat type: Split bench with folding backs
 Seat track position: Non-adjustable
 Manual restraint usage: CRS with LATCH used
 Usage source: Vehicle inspection, information from investigating officer
 Air bags: None
 Alcohol/drug data: None
 Egress from vehicle: Removed by rescue personnel
 Transport from scene: Transported to a funeral home
 Type of medical treatment: None

Second-Row Center Occupant Injury

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Brain stem crush-type injury; partially crushed but not transected. Subdural hemorrhage surrounds the brainstem, having dissected upward from the spinal canal, no further specificity	140214.6	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Certain
2	Open fracture of C6-C7 with crushed spinal cord	610224.5	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Certain
3	Severe atlanto-occipital fracture/separation, no further specificity	650208.3	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Certain
4	Cerebellum subarachnoid hemorrhage, no further specificity	140466.2	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Certain
5	Acute subarachnoid hemorrhage to left cerebral hemisphere, no further specificity	140693.2	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Certain
6	Left femur shaft fracture, no further specificity	853221.3	Injured, unknown source	Unknown
7	Abrasion to right temple to cheek, 8 x 3 cm	210202.1	Same occupant contact (specify) right knee	Probable
8	Contusion to lower right cheek, 2 x 1 cm	210402.1	Same occupant contact (specify) right knee	Probable
9	Contusion below right eyebrow 1.5 x 0.5 cm	210402.1	Same occupant contact (specify) right knee	Probable
10	Contusion to right forehead 1 cm; contusion above left eyebrow 2.5 x 1 cm	210402.1	Same occupant contact (specify) right knee	Probable
11	Abrasion to lower inner right forehead 1.5 x 0.5 cm; abrasion above left eyebrow 2.5 x 1 cm	210202.1	Same occupant contact (specify) right knee	Probable
12	Abrasion to upper left eyelid, 1 x 0.5 cm	210202.1	Same occupant contact (specify) left knee	Probable
13	Abrasion to left temple, 2.5 x 1 cm	210202.1	Same occupant contact (specify) left knee	Probable
14	Scalp hemorrhage; subgaleal; right frontal 4 x 3 cm	110402.1	Injured, unknown source	Unknown

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
15	Scalp hemorrhage; subgaleal; right temporal 3 cm	110402.1	Injured, unknown source	Unknown
16	Scalp hemorrhage; subgaleal; left temporal 2 cm	110402.1	Injured, unknown source	Unknown
17	Abrasions to right abdomen 5 x 4 cm; abrasion to right lower abdomen, 7 x 1 mm	510202.1	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Probable
18	Abrasions to left abdomen 6 x 9 cm cluster	510202.1	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Probable
19	Abrasion along left inguinal fold 3 x 1.5 cm	510202.1	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Probable
20	Contusion to mon pubis 4 cm	510402.1	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Probable
21	Abrasion to proximal anterior right upper leg 8 x 1 cm	810202.1	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Probable
22	Contusion to medial right lower leg 7 mm	810402.1	Other seating position seatback - RF seatback	Probable
23	Contusion to medial left upper leg 7 x 1.2 cm	810402.1	Child safety seat harness system, (i.e., straps, retainer clip, latch plate, buckle)	Probable

Source: autopsy report (internal).

Second-Row Center Occupant Kinematics

The child was seated in the Dorel Safety First “Grow and Go” convertible CRS. The CRS was installed in a forward-facing position in the second-row center position of the Ford and secured to the vehicle with the LATCH system. The inboard anchor points of the left and right seats were used with the lower anchor connectors. The child was restrained in the CRS by the integral 5-point harness system. Since the child was removed from the CRS immediately after the crash, the positioning of the chest clip could not be determined. Interviews of the driver and front passenger were refused.

The front plane impact of the Ford displaced the child forward and slightly left, and she loaded the 5-point harness. As her torso decelerated, the head/neck flexed forward beyond the anatomical limits of the cervical spine, resulting in her fatal injury. She rebounded back into the CRS as the vehicle rotated slightly counterclockwise and came to final rest. Autopsy results indicated that the child sustained a brain stem crush-type injury, subarachnoid hemorrhages to both the cerebellum and cerebrum parts of the brain, an open fracture of the C6-C7 cervical vertebrae with crushed spinal cord, and a severe atlanto-occipital fracture/separation. These injuries were caused when crash forces moved the child forward while the torso was restrained by the CRS harness. The child also sustained multiple facial soft tissue injuries, caused by probable contact to her own lower extremities. She sustained abdomen, groin, and upper leg soft tissue injuries due to contact with the CRS harness (lower). The child was pronounced deceased 44 minutes post-crash and was transported to a funeral home prior to transfer to the medical examiner.

2017 Honda CR-V

Description

The Honda, an all-wheel drive, 5-occupant, 4-door SUV with the VIN 2HKRW2H99HHxxxxxx, was equipped with “Touring” level features. The vehicle was configured on a 266 cm (104.7 in) wheelbase. The manufacturer’s listed curb weight was 1,580 kg (3,512 lb). The GVWR was 2,130 kg (4,695 lb), with front and rear gross axle ratings of 1,100 kg (2,425 lb) and 1,075 (2,369 lb), respectively. The Honda was equipped with a 1.5-liter, I-4 engine linked to a continuously variable-speed automatic transmission; 4-wheel antilock brakes; stability control; electronic brakeforce distribution; emergency brake assist; traction control; and a tire pressure monitoring system. The vehicle was also equipped with dual-stage frontal air bags, front-seat-mounted side impact air bags, and left and right IC air bags. The manufacturer’s recommended tire size was P235/60R18. The Honda was equipped with Hankook Kinergy GT tires of the recommended size. Both rear tires had 1 mm (2/32”) of remaining tread. According to the investigating officer, the EDR could not be imaged due to damage.

Exterior Damage

The Honda sustained damage to its entire right plane as a result of the impact with the Ford. The right fender, both doors, quarter panel, rear wheel, and B-pillar were directly damaged (Figure 15). The direct damage began 256 cm (100.8 in) forward of the right rear axle and extended rearward 298 cm (117.3 in). The Field L was 350 cm (137.8 in). Crush measurements were taken at the lower door level with maximum residual crush of 44 cm (17.3 in) occurring 128 cm (50.4 in) forward of the right front axle. The crush values were C1 = 22 cm (8.7 in), C2 = 40 cm (15.7 in), C3 = 52 cm (20.5 in), C4 = 47 cm (18.5 in), C5 = 42 cm (16.5 in), and C6 = 7 cm (2.8 in).



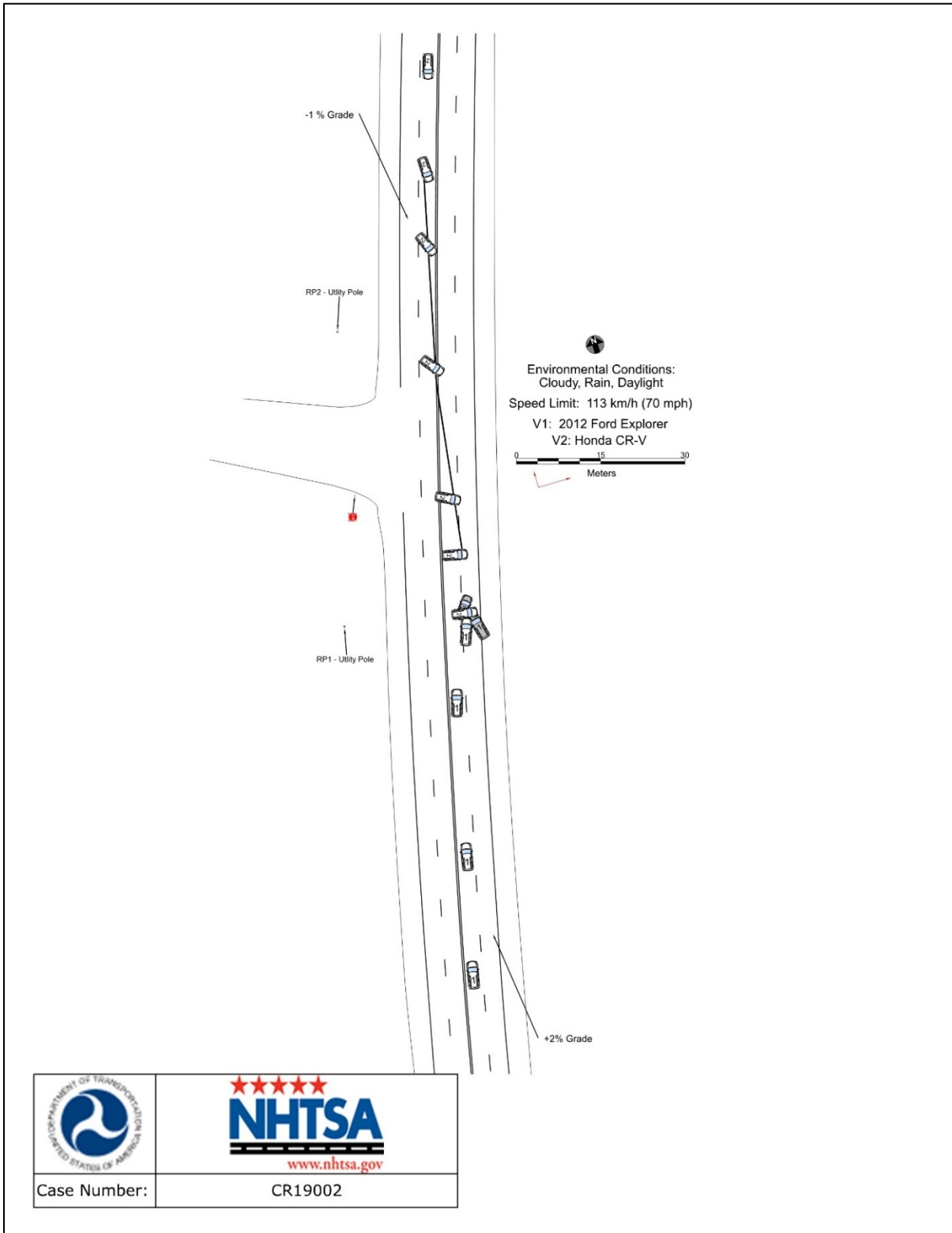
Figure 15. Right side damage to the Honda

The CDC was 03RDAW4. The damage algorithm of the WinSMASH program calculated the total delta V as 70 km/h (44 mph). The longitudinal and lateral velocity changes were 12 km/h (7 mph) and -69 km/h (-43 mph). The results appeared reasonable.

Occupant Data

The 76-year-old male driver was restrained by his lap and shoulder seat belt. He sustained fatal injuries and was pronounced deceased 97 minutes post-crash. He was transported to a funeral home prior to transfer to the medical examiner's office for autopsy.

Crash Diagram



Appendix A: Event Data Recorder Report for 2012 Ford Explorer ²

² The EDR report contained in this technical report was imaged by a third-party consultant using version 19.1 of the Bosch CDR software. The CDRx file was supplied to SCI and is reported below with Bosch CDR version 21.0. 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	1FMHK7F85CG*****
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR19002_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 19.1
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 21.0
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 locked side event unlocked event

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	1FMHK7F85CG*****
Current VIN from PCM	1FMHK7F85CG*****
Ignition cycle, download (first record)	12,160
Ignition cycle, download (second record)	12,160
Restraints Control Module Part Number	BB5T-14B321-AH
Restraints Control Module Serial Number	711785120000000
Restraints Control Module Software Part Number (Version)	BB5T-14C028-AD
Left/Center Frontal Restraints Sensor Serial Number	1499C42F
Left Side Restraint Sensor 1 Serial Number	3A025B22
Left Side Restraint Sensor 2 Serial Number	14943FA2
Right Frontal Restraints Sensor Serial Number	1499FC83
Right Side Restraint Sensor 1 Serial Number	47C16822
Right Side Restraints Sensor 2 Serial Number	144EE1E5

System Status at Event (First Record)

Recording Status	Unlocked 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)	3,103,150
Key-on Timer at event time zero (seconds)	1,065
Vehicle voltage at time zero (Volts)	13.851
Energy Reserve Mode entered during event (Y/N)	No



Faults Present at Start of Event (First Record)

No Faults Recorded



Deployment Data (First Record)

Maximum delta-V, longitudinal (MPH [km/h])	-8.32 [-13.39]
Time, maximum delta-V longitudinal (msec)	266
Maximum delta-V, lateral (MPH [km/h])	-0.49 [-0.78]
Time, maximum delta-V lateral (msec)	300
Longitudinal Delta-V Time Zero Offset	1.5 ms
Lateral Delta-V Time Zero Offset	1.5 ms
Roll Angle Time Zero Offset	61.5 ms

Pre-Crash Data -1 sec (First Record)

Ignition cycle, crash	2,936
Frontal air bag warning lamp, on/off	Off
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [\$01]
Safety belt status, driver	Driver Buckled
Seat track position switch, foremost, status, driver	Not Forward
Safety belt status, front passenger	Passenger Not 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
Speed Control Telltale	Off
MIL Telltale	Off



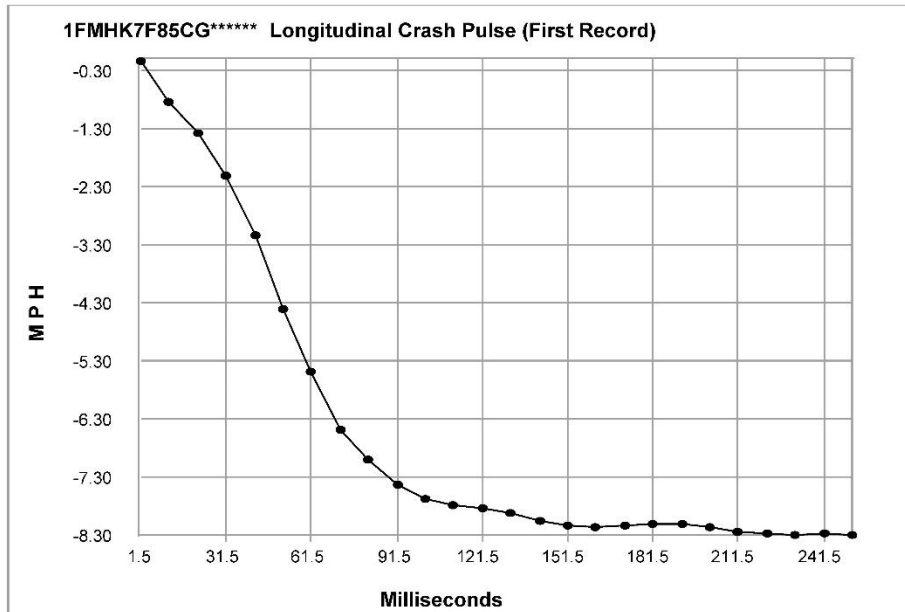
Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)

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	Traction Control via Brakes	Wheel Torque
- 5.0	14 [22]	11.5	Off	1,428	non-engaged	No	Drive	non-engaged	736
- 4.5	14 [23]	10.4	Off	1,400	non-engaged	No	Drive	non-engaged	644
- 4.0	15 [24]	17.6	Off	1,440	non-engaged	No	Drive	non-engaged	624
- 3.5	16 [26]	20.3	Off	1,734	non-engaged	No	Drive	non-engaged	1,204
- 3.0	17 [28]	21.0	Off	1,780	non-engaged	No	Drive	non-engaged	1,172
- 2.5	19 [30]	21.1	Off	1,800	non-engaged	No	Drive	non-engaged	1,136
- 2.0	20 [32]	22.8	Off	1,876	non-engaged	No	Drive	non-engaged	1,160
- 1.5	21 [34]	23.6	Off	1,926	non-engaged	No	Drive	non-engaged	1,136
- 1.0	22 [36]	24.4	Off	1,984	non-engaged	No	Drive	non-engaged	1,140
- 0.5	21 [34]	0.0	On	1,736	non-engaged	No	Drive	non-engaged	472
0.0	9 [15]	0.0	On	1,112	engaged	No	Drive	non-engaged	-256



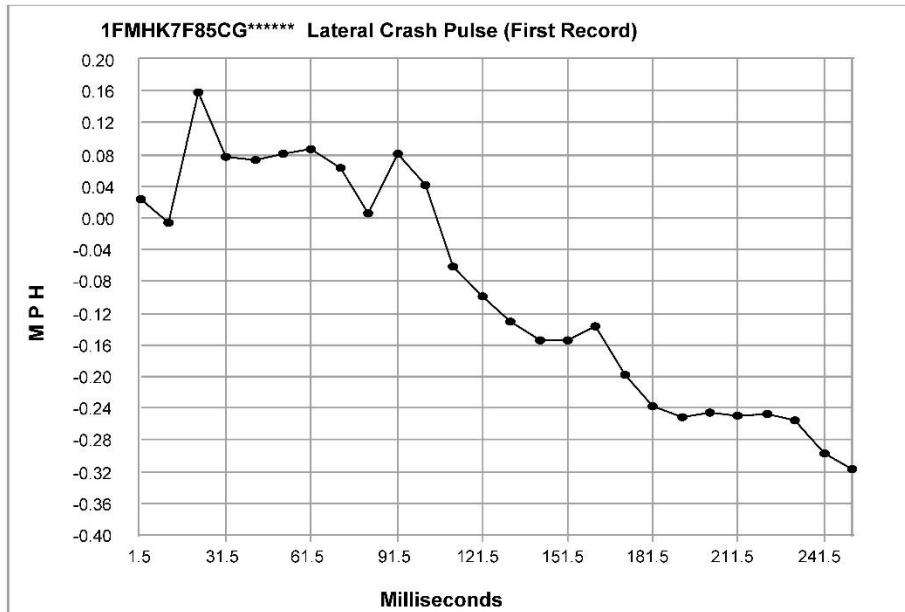
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

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	-0.3	0.037	0.088	-0.12	-0.25
-4.9	-0.3	0.044	0.083	0.0	-1.25
-4.8	-0.3	0.027	0.083	-0.12	-1.0
-4.7	-0.3	0.031	0.083	0.25	-0.5
-4.6	-0.1	0.021	0.082	-0.75	0.0
-4.5	0.0	0.043	0.083	-0.12	0.12
-4.4	0.0	0.047	0.083	-0.37	-0.87
-4.3	0.0	0.049	0.083	0.62	0.0
-4.2	0.0	0.059	0.083	-0.12	-0.62
-4.1	0.2	0.047	0.083	-0.25	0.0
-4.0	0.3	0.048	0.083	0.12	-0.5
-3.9	0.5	0.016	0.101	-0.37	-0.87
-3.8	0.5	0.041	0.14	0.0	-0.25
-3.7	0.5	0.035	0.143	-0.25	-0.5
-3.6	1.0	0.017	0.143	-0.25	-0.25
-3.5	1.3	0.047	0.143	0.25	-0.62
-3.4	1.7	0.044	0.145	0.12	-0.87
-3.3	2.2	0.068	0.143	0.12	0.0
-3.2	2.6	0.068	0.143	0.37	-0.62
-3.1	2.8	0.047	0.138	0.5	0.0
-3.0	3.1	0.058	0.143	0.5	-0.5
-2.9	3.4	0.067	0.143	0.5	-0.75
-2.8	3.4	0.045	0.145	-0.12	-0.37
-2.7	3.4	0.033	0.143	0.12	-0.87
-2.6	3.5	0.037	0.143	0.0	-0.37
-2.5	3.5	0.03	0.13	0.5	-0.62
-2.4	3.5	0.028	0.148	0.0	-0.87
-2.3	3.5	0.044	0.143	0.87	0.0
-2.2	3.2	0.027	0.143	0.62	-0.5
-2.1	1.5	0.047	0.132	0.25	-0.75
-2.0	0.0	0.027	0.143	0.0	-0.87
-1.9	0.0	0.036	0.14	0.0	-0.87
-1.8	0.0	0.027	0.143	-0.37	-0.37
-1.7	0.0	0.028	0.143	-0.37	-0.62
-1.6	0.0	0.026	0.13	-0.25	-0.37
-1.5	0.0	0.026	0.143	-0.12	-0.37
-1.4	-0.1	0.033	0.145	0.25	-0.12
-1.3	-0.1	0.019	0.143	-0.37	-1.12
-1.2	-0.5	0.037	0.143	-0.37	-0.87
-1.1	-0.8	0.048	0.143	0.0	-1.75
-1.0	-0.6	0.035	0.143	-0.12	-0.62
-0.9	-0.8	0.027	0.153	0.0	-0.87
-0.8	-1.8	0.033	0.143	-0.37	-1.12
-0.7	-4.6	0.027	0.103	-0.62	-1.0
-0.6	-5.1	0.038	-0.385	-1.25	-1.25
-0.5	-3.8	0.027	-0.664	-1.37	-0.12
-0.4	-3.2	0.019	-0.805	-0.5	-0.75
-0.3	-5.1	0.017	-0.899	0.0	-1.0
-0.2	-5.1	0.037	-0.881	-0.25	-0.62
-0.1	-4.8	0.048	-0.956	-0.5	0.0
0.0	-3.6	0.076	-0.958	0.5	-0.37



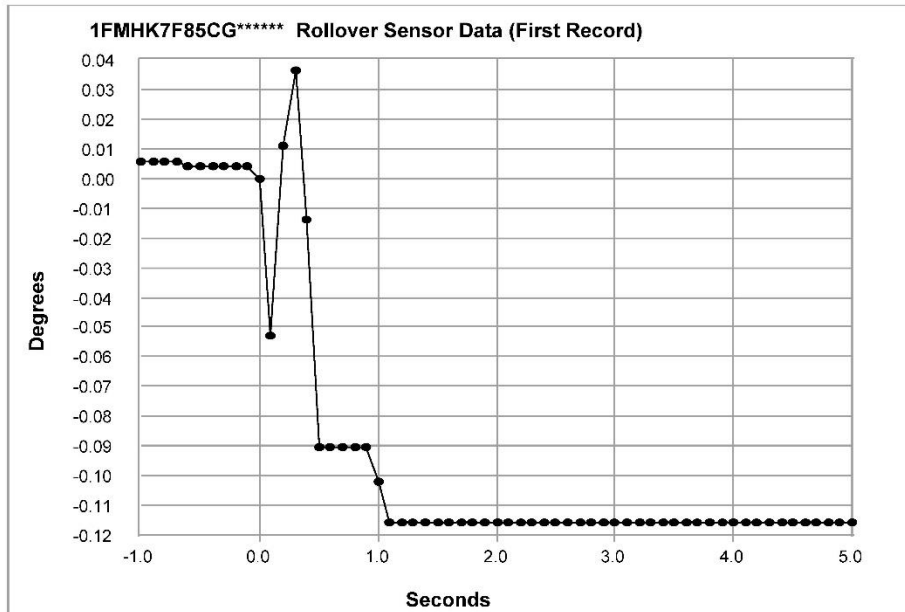
Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
1.5	-0.14	-0.22
11.5	-0.84	-1.36
21.5	-1.38	-2.21
31.5	-2.11	-3.39
41.5	-3.14	-5.06
51.5	-4.41	-7.09
61.5	-5.48	-8.81
71.5	-6.49	-10.44
81.5	-7.01	-11.29
91.5	-7.43	-11.96
101.5	-7.68	-12.37
111.5	-7.79	-12.54
121.5	-7.83	-12.60
131.5	-7.93	-12.76
141.5	-8.07	-12.98
151.5	-8.13	-13.09
161.5	-8.16	-13.13
171.5	-8.13	-13.08
181.5	-8.12	-13.07
191.5	-8.12	-13.06
201.5	-8.17	-13.15
211.5	-8.24	-13.27
221.5	-8.27	-13.32
231.5	-8.29	-13.35
241.5	-8.28	-13.33
251.5	-8.29	-13.34



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
1.5	0.02	0.04
11.5	-0.01	-0.01
21.5	0.16	0.25
31.5	0.08	0.12
41.5	0.07	0.12
51.5	0.08	0.13
61.5	0.09	0.14
71.5	0.06	0.10
81.5	0.01	0.01
91.5	0.08	0.13
101.5	0.04	0.07
111.5	-0.06	-0.10
121.5	-0.10	-0.16
131.5	-0.13	-0.21
141.5	-0.15	-0.25
151.5	-0.15	-0.25
161.5	-0.14	-0.22
171.5	-0.20	-0.32
181.5	-0.24	-0.38
191.5	-0.25	-0.40
201.5	-0.24	-0.39
211.5	-0.25	-0.40
221.5	-0.25	-0.40
231.5	-0.25	-0.41
241.5	-0.30	-0.48
251.5	-0.32	-0.51



Rollover Sensor Data (First Record)

Time (sec)	Vehicle roll angle (degrees)
-1.0	0.01
-0.9	0.01
-0.8	0.01
-0.7	0.01
-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
0.1	-0.05
0.2	0.01
0.3	0.04
0.4	-0.01
0.5	-0.09
0.6	-0.09
0.7	-0.09
0.8	-0.09
0.9	-0.09
1.0	-0.1

Time (sec)	Vehicle roll angle (degrees)
1.1	-0.12
1.2	-0.12
1.3	-0.12
1.4	-0.12
1.5	-0.12
1.6	-0.12
1.7	-0.12
1.8	-0.12
1.9	-0.12
2.0	-0.12
2.1	-0.12
2.2	-0.12
2.3	-0.12
2.4	-0.12
2.5	-0.12
2.6	-0.12
2.7	-0.12
2.8	-0.12
2.9	-0.12
3.0	-0.12
3.1	-0.12

Time (sec)	Vehicle roll angle (degrees)
3.2	-0.12
3.3	-0.12
3.4	-0.12
3.5	-0.12
3.6	-0.12
3.7	-0.12
3.8	-0.12
3.9	-0.12
4.0	-0.12
4.1	-0.12
4.2	-0.12
4.3	-0.12
4.4	-0.12
4.5	-0.12
4.6	-0.12
4.7	-0.12
4.8	-0.12
4.9	-0.12
5.0	-0.12



System Status at Event (Second Record)

	Locked Record
Recording Status	
Complete file recorded (yes,no)	Yes
Multi-event, number of events (1,2)	2
Time from event 1 to 2 (msec)	N/A
Lifetime Operating Timer at event time zero (seconds)	15,850,930
Key-on Timer at event time zero (seconds)	2,570
Vehicle voltage at time zero (Volts)	13.77
Energy Reserve Mode entered during event (Y/N)	Yes
Time Driver Front Satellite Sensor Lost Relative to Time Zero (msec)	24.0
Time Passenger Front Satellite Sensor Lost Relative to Time Zero (msec)	28.0
Time Driver First Row Satellite Sensor Lost Relative to Time Zero (msec)	177.0
Time Passenger Second Row Satellite Sensor Lost Relative to Time Zero (msec)	177.0



Faults Present at Start of Event (Second Record)

No Faults Recorded

Deployment Data (Second Record)

Frontal airbag deployment, time to first stage deployment, driver (msec)	11.5
Frontal airbag deployment, time to 2nd stage, driver (msec)	21.5
Side curtain airbag deployment, time to deploy, driver side (msec)	38.5
Side (thorax) air bag deployment, time to deploy, driver (msec)	38.5
Pretensioner (retractor) deployment, time to fire, driver (msec)	1.5
Frontal airbag deployment, time to first stage deployment, front passenger (msec)	11.5
Frontal airbag deployment, time to 2nd stage, front passenger (msec)	21.5
Side curtain airbag deployment, time to deploy, right side (msec)	38.5
Pretensioner (retractor) deployment, time to fire, right front passenger (msec)	1.5
Pretensioner (buckle) deployment, time to fire, driver (msec)	6.5
Pretensioner (buckle) deployment, time to fire, right front passenger (msec)	6.5
Maximum delta-V, longitudinal (MPH [km/h])	-42.62 [-68.59]
Time, maximum delta-V longitudinal (msec)	142
Maximum delta-V, lateral (MPH [km/h])	6.71 [10.79]
Time, maximum delta-V lateral (msec)	100
Left, forward, side satellite sensor discriminating deployment	Yes
Left, forward, side satellite sensor safing	Yes
Left, rear, side satellite sensor safing	Yes
Right, forward, side satellite sensor safing	Yes
Right, rear, side satellite sensor safing	Yes
RCM, side left sensor safing	Yes
RCM, side right sensor safing	Yes
Left or center front, satellite Sensor discriminating deployment	Yes
Left or center, front satellite Sensor safing	Yes
Right, front satellite sensor safing	Yes
RCM, front sensor discriminating deployment	Yes
RCM, front sensor safing	Yes
Longitudinal Delta-V Time Zero Offset	5.0 ms
Lateral Delta-V Time Zero Offset	5.0 ms
Roll Angle Time Zero Offset	45.0 ms



Pre-Crash Data -1 sec (Second Record)

Ignition cycle, crash	12,158
Frontal air bag warning lamp, on/off	Off
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [\$08]
Safety belt status, driver	Driver Buckled
Seat track position switch, foremost, status, driver	Not Forward
Safety belt status, front passenger	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
Speed Control Telltale	Off
MIL Telltale	Off



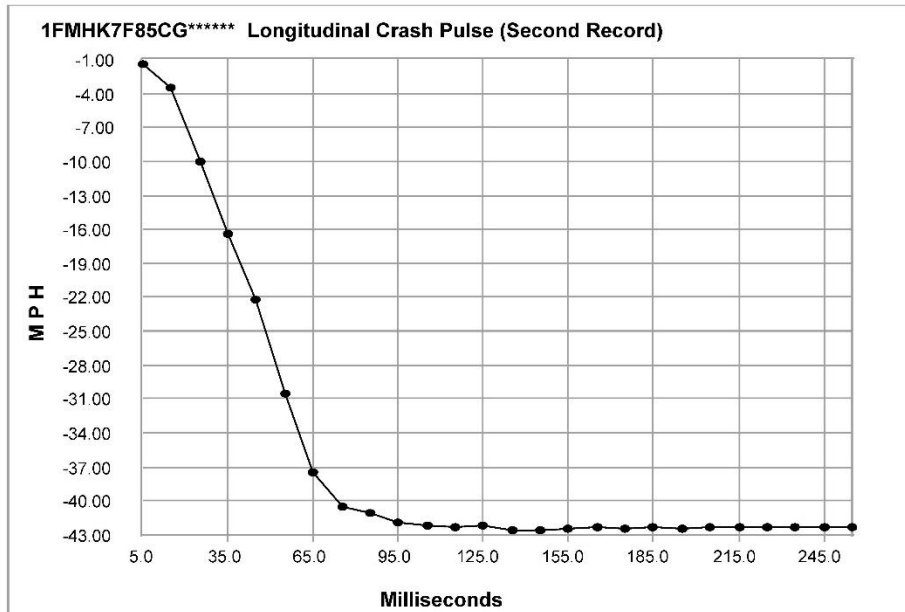
Pre-Crash Data -5 to 0 sec [2 samples/sec] (Second Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection	Traction Control via Brakes	Wheel Torque
- 5.0	55 [88]	24.9	Off	1,924	non-engaged	No	Drive	non-engaged	428
- 4.5	54 [87]	24.6	Off	1,930	non-engaged	No	Drive	non-engaged	436
- 4.0	54 [87]	28.8	Off	2,004	non-engaged	No	Drive	non-engaged	508
- 3.5	55 [88]	28.8	Off	2,018	non-engaged	No	Drive	non-engaged	528
- 3.0	55 [88]	28.7	Off	2,038	non-engaged	No	Drive	non-engaged	528
- 2.5	55 [89]	24.0	Off	2,000	non-engaged	No	Drive	non-engaged	492
- 2.0	55 [88]	0.0	Off	1,934	non-engaged	No	Drive	non-engaged	424
- 1.5	53 [85]	0.0	On	1,556	non-engaged	No	Drive	non-engaged	52
- 1.0	50 [81]	0.0	On	1,450	engaged	No	Drive	non-engaged	-8
- 0.5	47 [75]	0.0	On	1,330	engaged	No	Drive	non-engaged	-32
0.0	41 [66]	0.0	On	1,110	engaged	No	Drive	non-engaged	-80



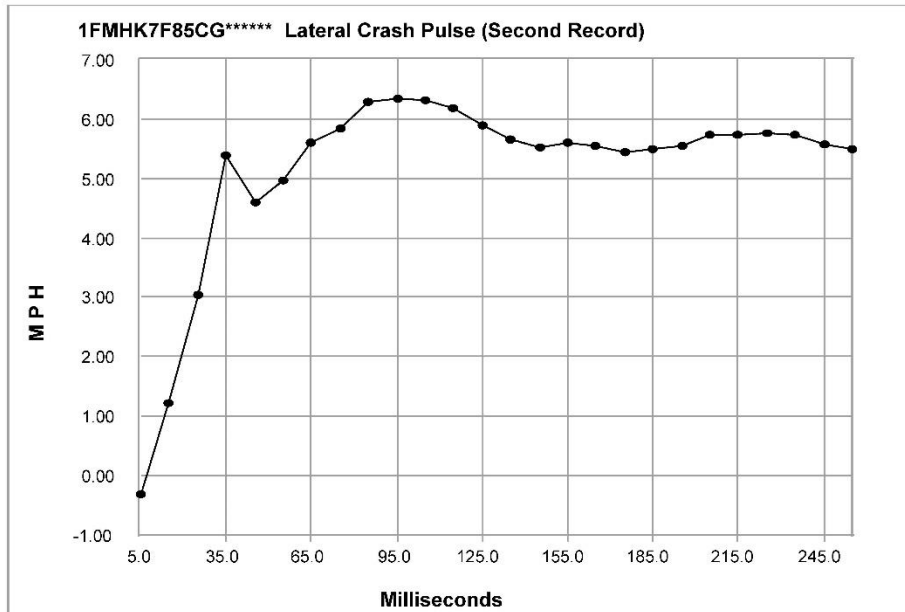
Pre-Crash Data -5 to 0 sec [10 samples/sec] (Second Record)

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	0.3	0.009	0.005	0.0	-0.25
-4.9	0.6	0.006	0.028	-0.25	-0.75
-4.8	0.6	0.029	0.01	-0.12	-0.25
-4.7	0.6	0.025	0.028	0.0	-0.62
-4.6	0.6	0.018	0.02	0.12	-1.0
-4.5	0.5	0.019	0.028	0.25	-1.0
-4.4	0.5	0.022	0.015	-0.62	-0.87
-4.3	0.5	0.029	0.028	-0.5	-0.87
-4.2	0.3	0.004	0.028	-0.5	0.25
-4.1	0.2	0.022	0.04	-0.5	-0.37
-4.0	0.0	0.027	0.007	0.25	-1.12
-3.9	-0.2	0.024	0.028	-0.62	-1.5
-3.8	-0.4	0.047	0.028	-0.5	-1.75
-3.7	-0.8	0.009	0.028	-0.25	-1.62
-3.6	-1.5	0.013	0.047	-0.62	-1.12
-3.5	-2.1	-0.006	0.047	-1.12	-0.87
-3.4	-2.4	-0.002	0.028	-0.62	-0.87
-3.3	-2.4	0.0	0.03	-0.5	-0.62
-3.2	-2.5	0.003	0.022	-0.5	0.0
-3.1	-2.3	-0.002	0.028	-0.62	0.0
-3.0	-2.2	0.025	0.007	-1.5	-2.0
-2.9	-2.2	-0.016	0.012	-0.87	-1.12
-2.8	-2.2	-0.008	0.028	-0.87	0.0
-2.7	-2.0	-0.002	0.007	-1.0	-0.87
-2.6	-1.9	-0.013	0.028	-0.37	-0.25
-2.5	-1.7	-0.004	0.007	-0.37	-0.37
-2.4	-1.8	-0.009	0.03	-0.5	-1.0
-2.3	-2.1	-0.028	0.015	-0.75	-0.25
-2.2	-2.4	-0.021	0.028	-0.75	-0.5
-2.1	-4.5	-0.021	0.007	-0.87	-1.62
-2.0	-7.7	-0.037	0.022	-1.62	-1.87
-1.9	-14.4	-0.108	0.007	-3.0	-1.75
-1.8	-25.0	-0.142	-0.017	-5.37	-2.87
-1.7	-30.3	-0.207	-0.106	-6.75	-3.87
-1.6	-30.6	-0.296	-0.165	-7.12	-1.62
-1.5	-29.4	-0.266	-0.121	-6.75	-0.5
-1.4	-24.1	-0.197	-0.182	-4.37	1.75
-1.3	-24.6	-0.196	-0.318	-3.5	0.75
-1.2	-25.5	-0.174	-0.263	-4.87	-0.87
-1.1	-18.4	-0.041	-0.364	-4.5	2.0
-1.0	-12.1	-0.081	-0.342	-1.25	0.5
-0.9	-15.6	-0.009	-0.297	0.75	-0.87
-0.8	-22.9	-0.073	-0.376	-2.37	-2.62
-0.7	-7.6	0.071	-0.328	-2.5	0.37
-0.6	-5.1	-0.033	-0.482	-0.62	1.12
-0.5	-6.6	0.057	-0.423	0.0	-1.75
-0.4	-5.1	0.075	-0.458	0.12	-1.12
-0.3	-14.0	-0.045	-0.448	-0.75	-0.62
-0.2	-12.8	0.034	-0.548	-1.0	-1.87
-0.1	-10.2	-0.124	-0.418	-2.25	1.12
0.0	-10.4	-0.125	-0.579	-3.12	-2.62



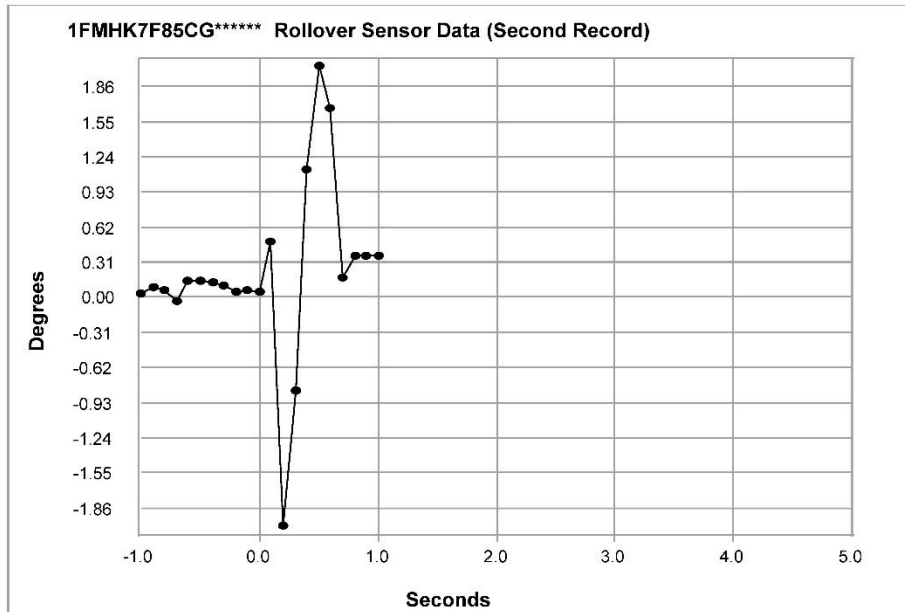
Longitudinal Crash Pulse (Second Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
5.0	-1.36	-2.19
15.0	-3.45	-5.55
25.0	-10.02	-16.12
35.0	-16.45	-26.47
45.0	-22.27	-35.84
55.0	-30.54	-49.15
65.0	-37.49	-60.34
75.0	-40.48	-65.14
85.0	-41.09	-66.13
95.0	-41.94	-67.49
105.0	-42.13	-67.80
115.0	-42.34	-68.14
125.0	-42.22	-67.94
135.0	-42.53	-68.44
145.0	-42.54	-68.45
155.0	-42.46	-68.33
165.0	-42.34	-68.13
175.0	-42.40	-68.23
185.0	-42.35	-68.16
195.0	-42.40	-68.23
205.0	-42.31	-68.09
215.0	-42.29	-68.06
225.0	-42.26	-68.01
235.0	-42.30	-68.07
245.0	-42.24	-67.99
255.0	-42.30	-68.07



Lateral Crash Pulse (Second Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
5.0	-0.31	-0.50
15.0	1.21	1.94
25.0	3.05	4.90
35.0	5.39	8.68
45.0	4.60	7.41
55.0	4.97	8.00
65.0	5.60	9.01
75.0	5.84	9.40
85.0	6.29	10.13
95.0	6.33	10.19
105.0	6.32	10.17
115.0	6.17	9.93
125.0	5.89	9.48
135.0	5.66	9.11
145.0	5.53	8.91
155.0	5.61	9.03
165.0	5.55	8.93
175.0	5.45	8.77
185.0	5.49	8.83
195.0	5.55	8.92
205.0	5.74	9.23
215.0	5.73	9.22
225.0	5.77	9.29
235.0	5.72	9.21
245.0	5.58	8.98
255.0	5.49	8.84



Rollover Sensor Data (Second Record)

Time (sec)	Vehicle roll angle (degrees)
-1.0	0.04
-0.9	0.08
-0.8	0.06
-0.7	-0.03
-0.6	0.15
-0.5	0.14
-0.4	0.14
-0.3	0.1
-0.2	0.04
-0.1	0.06
0.0	0.05
0.1	0.49
0.2	-2.01
0.3	-0.83
0.4	1.12
0.5	2.04
0.6	1.67
0.7	0.18
0.8	0.37
0.9	0.37
1.0	0.37

Time (sec)	Vehicle roll angle (degrees)
1.1	N/A
1.2	N/A
1.3	N/A
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.

06 00 00 00

42 42 35 54 2D 31 34 42 33 32 31 2D 41 48 00 00 00 00 00 00 00 00 00 00

37 31 31 37 38 35 31 32 30 30 30 30 30 30 30

42 42 35 54 2D 31 34 43 30 32 38 2D 41 44 00 00 00 00 00 00 00 00 00 00

14 99 C4 2F 00 00 00 00 00 00 00 00 00 00 00

3A 02 5B 22 00 00 00 00 00 00 00 00 00 00 00

14 94 3F A2 00 00 00 00 00 00 00 00 00 00 00

14 99 FC 83 00 00 00 00 00 00 00 00 00 00 00

47 C1 68 22 00 00 00 00 00 00 00 00 00 00 00

14 4E E1 E5 00 00 00 00 00 00 00 00 00 00 00

31 46 4D 48 4B 37 46 38 35 43 47 2A 2A 2A 2A 2A

31 46 4D 48 4B 37 46 38 35 43 47 2A 2A 2A 2A 2A 2A 00 00 00 00 00 00 00

DOT HS 813 101
March 2021



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

