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Special Crash Investigations: On-Site Driver Air Bag Inflator Rupture Investigation; Vehicle: 2010 Ford Fusion; Location: Florida; Crash Date: June 2021

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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 crash involving a 2010 Ford Fusion and a 2001 Dodge Ram in which the Ford driver's frontal air bag inflator ruptured, resulting in a severe laceration to the abdomen of the unbelted 52-year-old male driver. The crash occurred in the right lane of a 10-lane, divided State highway at a 3-leg intersection that included a driveway to a shopping plaza. The Dodge was driven by a belted 56-year-old male and occupied by a belted 56-year-old female in the right front seat. According to the police crash report, the Ford driver stated he was traveling west and changing lanes from the right-through-lane to the right-turn-lane, adjacent to the curb. Meanwhile, the Dodge was initially traveling south on the shopping plaza driveway that connected to the State highway and turning right onto the westbound roadway. The front plane of the Ford struck the left plane of the Dodge. This impact resulted in deployment of the Ford's driver's frontal air bag. During the deployment, the backside of the inflator ruptured. A fragment of the inflator was projected down and rearward, lacerating the driver in the abdomen. He was transported to a level II trauma center where he was hospitalized for two days. The Dodge driver did not sustain any police-reported injury.

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Special Crash Investigations
On-Site Driver Air Bag Inflator Rupture Crash Investigation
Office of Defects Investigation
Case No.: CR21018
Vehicle: 2010 Ford Fusion
Location: Florida
Crash Date: June 2021

Background

This report documents the on-site investigation of a crash involving a 2010 Ford Fusion (Figure 1) and a 2001 Dodge Ram in which the Ford driver's frontal air bag inflator ruptured, resulting in a severe laceration to the abdomen of the 23-year-old male driver. In July 2021 the National Highway Traffic Safety Administration initiated this crash investigation through notification from the Ford driver's legal counsel. The crash occurred in June 2021 and the investigation was assigned to the Special Crash Investigation (SCI) team at Crash Research & Analysis in July 2021. The Ford and crash scene were inspected in August 2021.

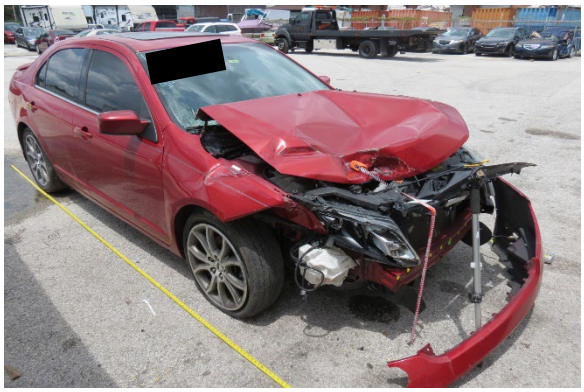

Figure 1. 2010 Ford Fusion

The crash occurred in the right lane of a 10-lane, divided State highway at a 3-leg intersection that included a driveway to a shopping plaza. The Ford was driven by an unbelted 52-year-old male. The Dodge was driven by a belted 56-year-old male and occupied by a belted 56-year-old female in the right front seat. According to the police crash report, the Ford driver said he was traveling west and was changing lanes from the right-through-lane to the right-turn lane, adjacent to the curb. Meanwhile, the Dodge was initially traveling south on the shopping plaza driveway that connected to the State highway and the driver was turning the vehicle right onto the westbound roadway. The front plane of the Ford struck the left plane of the Dodge. This impact resulted in deployment of the Ford's driver's frontal air bag. During the deployment the backside of the inflator ruptured. A fragment of the inflator was projected down and rearward, lacerating the driver in the abdomen. He was transported to a level II trauma center where he was hospitalized for two days. The Dodge driver and the front passenger did not sustain any police-reported injury.

Representatives from the inflator manufacturer (Takata) as well as the driver's attorney and consultants were present at the inspection of the vehicle. The SCI team inspected the Ford's driver's frontal air bag and its ruptured inflator. Also involved were measurement and documentation of Ford's exterior damage, inspection of the interior for occupant compartment intrusion and occupant contacts, and imaging of the Ford's event data recorder (EDR) with the Bosch Crash Data Retrieval tool. The crash scene was surveyed and photographed.

Crash Summary

Crash Site

This crash occurred during the afternoon at the 3-leg intersection of a suburban 10-lane, State highway (Figure 2). The weather conditions were cloudy with 19 km/h (12 mph) winds from the southwest and a temperature of 30 ºC (86 ºF). The police crash report (PCR listed the conditions as clear and dry. The Ford's trafficway traversed in an east/west compass direction with three westbound through lanes, two left turn lanes, and a right turn lane that were separated from the four eastbound lanes by a raised concrete median strip. The roadway traveled by the Dodge was a 12 m (39.3 ft) wide driveway that connected the State highway to a shopping plaza parking area. Both roadways were level and bituminous. Roadway markings for the Ford consisted of a solid white edge line, solid white right and left turn lane lines, dashed lane lines, and a solid yellow median line. The speed limit for the Ford was 72 km/h (45 mph). A crash diagram is included at the end of this report.

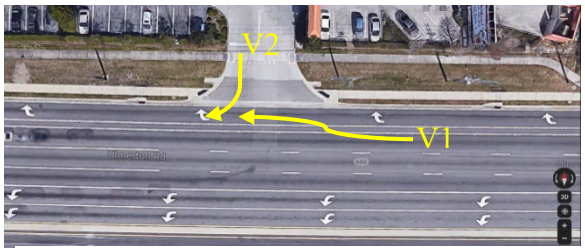

Figure 2. Overhead view of crash site. Image obtained from online mapping service

Pre-Crash

The Ford was traveling west in the right lane (Figure 3) at an EDR-reported speed of 64 km/h (39.8 mph) 5.0-seconds prior to algorithm enable (AE). At 3.5 seconds prior to AE, the driver applied the service brake and the vehicle's speed reduced to 54 km/h (33.6 mph) at AE. He stated to the police that he was changing lanes prior to the crash, from left to right. The EDR data showed that the driver gradually steered to the right to change lanes then braked quickly and steered left in an attempt to avoid the collision.

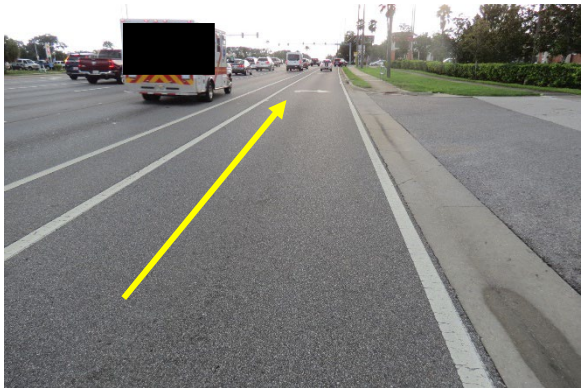

Figure 3. West view of the Ford's approach to impact area

The Ford's EDR-reported vehicle speed, percent accelerator pedal, service brake status, engine rpm, and steering wheel angle are presented in Table 1.

Table 1. Ford's EDR Data

Time (seconds)	Vehicle speed km/h (mph)	Accelerator pedal % full	Service brake on/off	Engine rpm	Steering wheel angle (degrees positive left)
-5.0	64.0 (39.8)	13	Off	1,600	2.4
-4.5	64.0 (39.8)	9	Off	1,600	2.0
-4.0	64.0 (39.8)	0	Off	1,600	2.1
-3.5	63.0 (39.1)	0	On	1,600	1.2
-3.0	63.0 (39.1)	0	On	1,600	0.3
-2.5	61.0 (37.9)	0	On	1,500	-0.2
-2.0	60.0 (37.3)	0	On	1,500	-1.9
-1.5	59.0 (36.7)	0	On	1,500	-2.3
-1.0	57.0 (35.4)	0	On	1,400	-1.9
-0.5	56.0 (34.8)	0	On	1,300	-1.6
0.0	54.0 (33.6)	0	On	1,300	11.2

The Dodge initially headed south on the driveway (Figure 4) from the shopping plaza and its driver intended to turn right onto the westbound roadway.

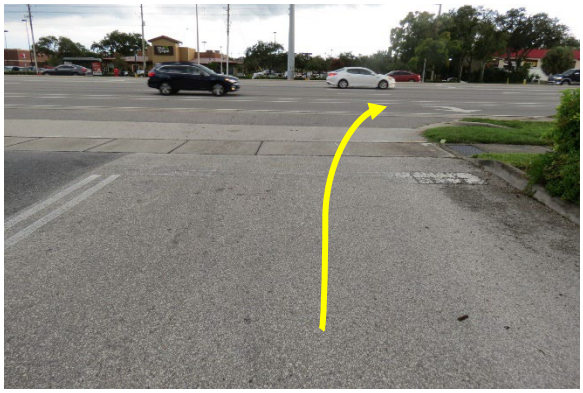

Figure 4. South view of Dodge's travel path

Crash

The front of the Ford struck the left side of the Dodge (Event 1). The principal direction of force on the Ford was in its 1 o'clock sector and resulted in deployment of the driver's frontal air bag. After the initial impact, the Dodge rotated clockwise, and its left side struck the right side of the Ford (Event 2) in a secondary side slap. Based on the PCR scene sketch, the Ford came to final rest in the right lane facing west. The Dodge rotated clockwise approximately 90° and was redirected off the roadway. It came to final rest on the roadside facing northwest.

Post-Crash

The police were notified of the crash and arrived 3 minutes afterward. Emergency medical personnel also responded. The Ford driver exited the left front door under his own power and according to the police crash report, was observed to have a severe laceration to his stomach due to the air bag deployment. He was transported by ambulance to a level II trauma center where he was hospitalized for two days for treatment of his injuries. The Ford was towed from the crash site and placed into a storage facility of an attorney where it was inspected for this investigation.

The Dodge driver and passenger did not sustain any police-reported injury and were not transported. The Dodge was also towed from the crash scene.

2010 Ford Fusion

Description

The Ford was a front-wheel-drive, 4-door sedan with Vehicle Identification Number 3FAHP0HA3ARxxxxxx, and was manufactured in October 2009. It was equipped with a 2.5-liter, 4-cylinder engine linked to a 6-speed automatic transmission and configured on a 273 cm (107.5 in) wheelbase. The Ford also had a 4-wheel anti-lock brake system (ABS), brake assist and electronic brakeforce distribution, traction control, and stability control. The gross vehicle weight rating was 1,991 kg (4,389 lb) with gross axle weight ratings of 1,063 kg (2,304 lb) front and 928 kg (2,045 lb) rear. Its curb weight was 1,490 kg (3,285 lb).

The vehicle manufacturer recommended tire size was P225/45R18. The rear wheels were equipped with a Continental Contact RX tire on the left and a LEAO Lion Sport tire on the right. Both tires were of the recommended size. The front wheels were equipped with Firestone Champion tires, size P255/45R16.[1] There was a 2.5 cm (1 in) difference in the width between the Ford's actual front tire size vs. the recommended size. This did not result in a significant speed difference than was reported in the EDR report. There was no damage to any of the tires and none were restricted from rotation. The front tires had a minimum of 2 mm (2/32 in) of tread. The rear tires had a minimum of 6 mm (7/32 in) of tread.

The interior of the Ford seated five occupants with cloth-covered front row bucket seats. The driver's head restraint was adjusted 7 cm (2.8 in) above the seatback. The second row was equipped with a cloth-covered bench seat with folding backs. All seat positions were equipped with adjustable head restraints.

Safety systems consisted of manual 3-point lap and shoulder seat belts for the five positions. All seat belt systems had sliding latch plates. The front seat belts had retractor pretensioners. Supplemental restraint was provided by dual-stage frontal air bags, outboard front seat-mounted side impact, and inflatable curtain (IC) air bags. The driver's frontal air bag deployed in this crash.

Vehicle History

A Carfax report documented vehicle history that included three owners. The report showed no major service performed, no previous crashes, and one open recall at the time of this crash.

According to the report, the first owner purchased the Ford new in November 2009 and it was titled as a commercial vehicle in Florida. The second owner purchased the vehicle in January 2012 in Florida with an estimated odometer reading of 69,200 km (43,000 miles). It entered dealer inventory in January 2013 with 89,878 km (55,849 miles). The third owner purchased the Ford in August 2013, and it was maintained by this owner with routine service with the last reported odometer reading reported 195,010 km (121,177 miles) in October 2020. The Carfax

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[1] Due to differences in the recommended versus actual tire sizes of the Ford, the reported vehicle speed values within the EDR data likely were not the actual speed of the vehicle. The estimated actual speed of a vehicle can be computed by dividing the actual tire diameter by the recommended tire diameter, then multiplying by the reported vehicle speed *(whereas, Estimated Actual Speed* $= \left[\frac{Actual\ tire\ diameter}{Recommended\ tire\ diameter}\right] \times Reported\ Vehicle\ Speed$).

reported the March 25, 2021 manufacturer safety recall concerning the driver's air bag inflator and the June 2021 crash under SCI investigation.

NHTSA Recalls and Investigations

The NHTSA website was checked in February 2022 and again in November 2023 for recalls regarding this vehicle. NHTSA issued a recall for the replacement of the driver air bag inflator on March 25, 2021. The recall was not addressed and remained open at the time of the crash. The details of this recall are as follows:

> NHTSA Recall # 21V158
> Manufacturer's Recall # 21S12
> Driver Air Bag Inflator Replacement
> Date: March 25, 2021
> Status: Recall incomplete, remedy not yet available
>
> *Safety Risk*
> The driver air bag inflator in your vehicle may explode in the event of a crash that causes deployment of the driver air bag. If an air bag inflator explodes, sharp metal fragments could strike the driver or other occupants causing serious injury or death.
>
> *Remedy*
> Ford Motor Company is working closely with its suppliers to produce parts for this repair. When parts become available in sufficient quantities, owners will be notified by mail and instructed to take their vehicle to a Ford or Lincoln dealer to have the driver air bag inflator replaced. There will be no charge for this service.

Further information was gathered from NHTSA Part 573 Safety Recall Reports 17E-034 concerning Takata, the manufacturer of the air bag, as well as the Ford Motor Company. The report pertaining to Ford included a description of the defect which stated, "TK Holdings, Inc. (Takata) has determined that a defect which relates to the motor vehicle safety in the driver frontal inflators installed as original equipment in certain [2006-2012 Ford Fusions] – Takata PSDI-5 Driver Air Bag Inflators desiccated with calcium sulfate. The determination was made that the desiccated propellant in these inflators may degrade after long-term exposure to high humidity and temperature cycling which could cause an inflator to rupture during air bag deployment." The vehicle information stated that the number of potentially affected vehicles was reported as 2,602,668 with production dates March 15, 2005, through July 29, 2012. The descriptive information added "Affected vehicles are equipped with Takata PSDI-5 driver frontal inflators that use calcium sulfate as a desiccant. The population of Fusion vehicles for the program is 1,323,642 units in the United States and federalized territories."

The report pertaining to the description of the Takata air bag inflator defect stated "Takata is submitting this defect information report (DIR) to address concerns shown in PSDI-5 PSAN air bag inflators that use calcium sulfate as a desiccant." A description of the cause of the defect stated "The propellant tablets in some of the subject inflators may experience an alteration over time, which could potentially lead to over-aggressive combustion in the event of an air bag deployment. Depending on the circumstances, this potential condition could create excessive

internal pressure when the air bag is deployed, which could result in the body of the inflator rupturing on deployment. Based upon Takata's investigation to date, the potential for such ruptures may occur in some of the subject inflators after several years of exposure to persistent conditions of high absolute humidity. The potential for rupture may also be influenced by other factors, including manufacturing variability or vehicle type."

Exterior Damage

The Ford sustained damage to the front end (Figure 5), with direct damage to the bumper fascia, bumper beam, hood, and right fender. The direct damage started 5 cm (2.0 in) to the right of the vehicle's centerline and extended right 77 cm (30.3 in). The Field L was 114 cm (44.9 in). Crush measurements were documented along the bumper beam with the maximum crush measuring 2 cm (0.8 in) occurring 17 cm (6.7 in) left of the center point. The residual crush profile was: C1 = 2 cm (0.8 in), C2 = 2 cm (0.8in), C3 = 2 cm (0.8 in), C4 = 1 cm (0.4 in), C5 = 1 cm (0.4 in), C6 = 0. The collision deformation classification (CDC)[2] for this impact was 01FZEW1. The missing vehicle algorithm of the WinSMASH was used to calculate the Ford's total delta V as 19 km/h (11.8 mph). The longitudinal and lateral velocity changes were -18 km/h (-11.2 mph) and -6 km/h (-3.7 mph). The results were borderline but considered reasonable.

The Ford also sustained direct damage to the right rear door and quarter panel (Figure 6) as the vehicles side-slapped after the initial impact. The direct damage began 32 cm (12.6 in) forward of the right rear axle and extended rearward 89 cm (35.0 in). The Field L was 89 cm (35.0 in). Crush measurements were documented on the right quarter panel and the maximum residual crush was 2 cm (0.8 in) which occurred 23 cm (9.1 in) rear of the right rear axle. The CDC for this impact was 03RZMW1.

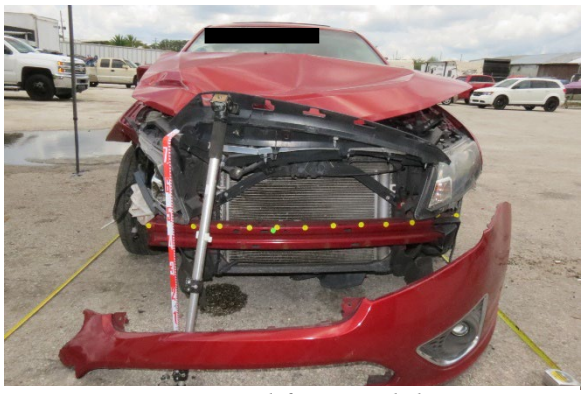


Figure 5. Ford front end damage

Event Data Recorder

The Ford's EDR was imaged with version 21.2 of the Bosch Crash Data Retrieval software and was reported with version 23.3. Electrical power was supplied by an external battery and the data was imaged via connection to the data link connector. The EDR was capable of recording deployment and non-deployments. Deployment events cannot be overwritten or cleared from the

[2] SAE J224_202205 SAE recommended practice describing vehicle collision damage in an alphanumeric format.

restraints control module (RCM). Non-deployment events can be overwritten by subsequent events. The RCM can store up to two deployment events. The EDR reported a locked frontal event, and the recording was complete and there were no fault codes reported. The EDR report is attached at the end of this report as an appendix.

Pre-Crash Data (First Record): The frontal air bag warning lamp was "Off," the driver's seat belt status was "Driver Not Buckled," and the driver seat track position was reported as "Not Forward."

Deployment Data (First Record): The maximum longitudinal and lateral delta Vs were reported as -21.52 km/h (-13.37 mph) and -7.13 km/h (-4.43 mph). These occurred 150 msec and 60 msec after AE.

Figure 6. Ford right side damage from side-slap

Interior Damage

The interior of the Ford did not sustain any intrusion damage during the crash, nor were there any contacts. All four doors remained closed and operational. The windshield was broken from the rearward displacement of the hood but all other glazing remained closed and undamaged. No occupant contacts were noted on the interior of the vehicle.

Manual Restraint Systems

The Ford had 3-point, continuous loop lap and shoulder seat belts for the five seat positions. All the seat belts were configured with sliding latch plates with adjustable D-rings in the front row. The driver's belt retracted onto an emergency locking retractor (ELR) while the others were switchable ELR/automatic locking retractors. The front row had retractor pretensioners. There was no evidence to support usage during this crash. The EDR confirmed the seat belt was not in use.

Supplemental Restraint Systems

The Ford had certified advanced 208-compliant driver's and passenger's frontal air bags, side impact outboard front seat-mounted and IC air bags. The frontal crash with the Dodge resulted in the deployment of the driver's frontal air bag. The driver's frontal air bag was located in the steering wheel hub. The deflated air bag was 55 cm (21.7 in) in diameter and there was no damage and no discernable evidence of occupant contact. The module cover was a two-flap

Figure 7. Cut on bottom flap of air bag module

configuration constructed of pliable vinyl, with a horizontal tear seam in the middle. The top flap was 19 cm (7.5 in) wide at the top and 17 cm (6.7 in) wide at the bottom, and 7 cm (2.8 in) high. The bottom flap was 15 cm (5.9 in) at the top and 9 cm (3.5 in) at the bottom and 14 cm (5.5 in) high. There was no damage to the top flap but the bottom flap sustained a 6 cm (2.4 in) vertical cut that started at the bottom of the flap (Figure 7).

Driver Frontal Air Bag Inflator Discussion

The driver frontal air bag inflator was manufactured by Takata and according to a Takata representative present at the vehicle inspection, was original equipment (Figure 8). The inflator was housed in the hub of the steering wheel and was divided into two sections for Stage 1 and Stage 2 deployment (Figure 9). Both sections contained a majority of ammonium nitrate pellets (propellant) mixed with small darker colored balls of a calcium sulfate desiccant (drying agent). The two sections were encased in a metal mesh filter and each section was separated by two horizontal metal dividers that fit against the perimeter of the inflator and around the vertical squibs. The inflator was mounted in the steering wheel hub, in line with the steering column, with the stage 2 side facing the instrument panel. The stage 1 side faced the driver. The inflator was 7.5 cm (3.0 in) in diameter and 4.5 cm (1.8 in) in height. The original height of the inflator was 3.4 cm (1.3 in) but the detonation of the propellant caused both the top and bottom to bulge (Figure 10).

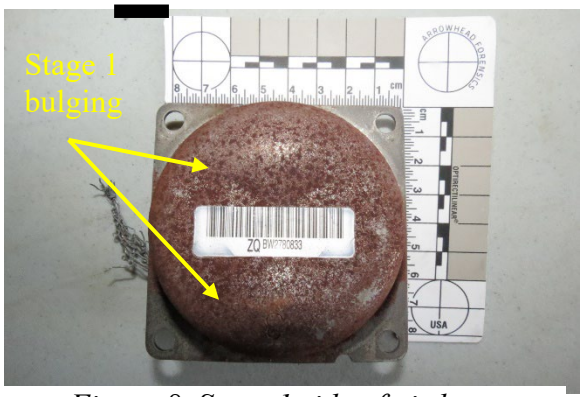


Figure 8. Stage 1 side of air bag inflator...note bulging of top side metal

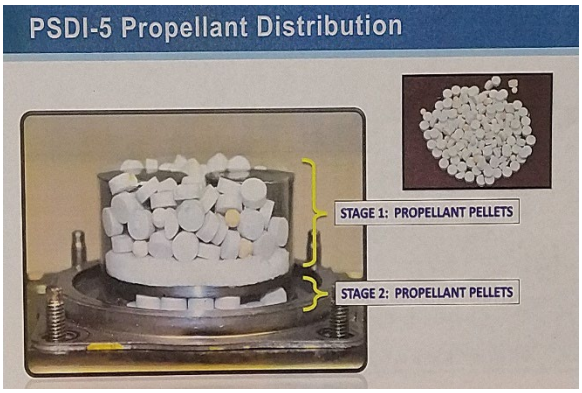


Figure 9. Cross section of PSDI-5 air bag inflator (image used with permission)

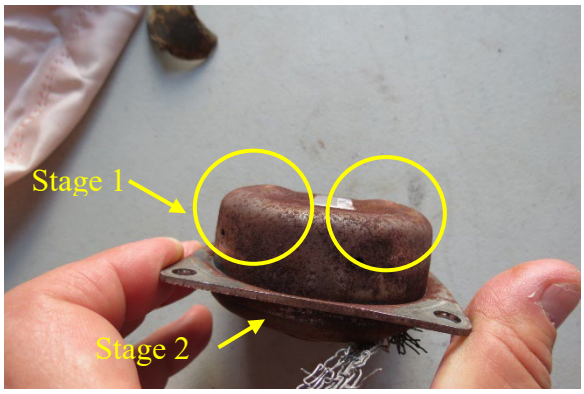


Figure 10. Side view of inflator...note the bulging on the stage 1 (bigger) side

Figure 11. Ruptured air bag inflator and fragment, stage 2 side

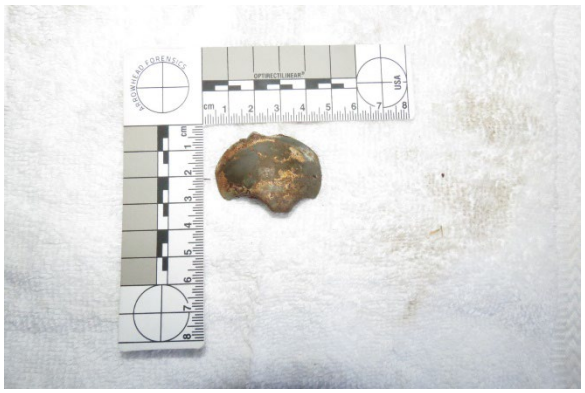


Figure 12. Ruptured fragment from stage 2 side of air bag inflator

During the deployment sequence of the air bag, the stage 2 side of the inflator ruptured (Figure 11). The stage 2 side was oriented toward the instrument panel and the fragment was projected toward the driver's abdomen. This fragment (Figure 12) was approximately 4 cm (1.6 in) long and 3 cm (1.2 in) wide and struck the driver and became embedded in his abdomen. Normally flat, the fragment bowed due to the rupture. The inflator rupture also involved sections of the mesh filter and horizontal divider and projected them into the driver's floor mat (Figures 13 and 14).

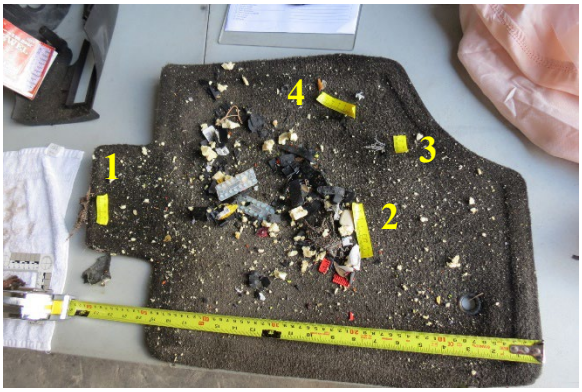


Figure 13. Inflator mesh filter (1, 2 and 3) and horizontal divider (4) embedded in the floor mat

Figure 14. Closeup of mesh filter embedded into floor mat

The inflator's horizontal divider (Figure 15) was projected out of the inflator downward. One half of it went through the floor mat and became embedded into the floor carpeting (Figure 16).

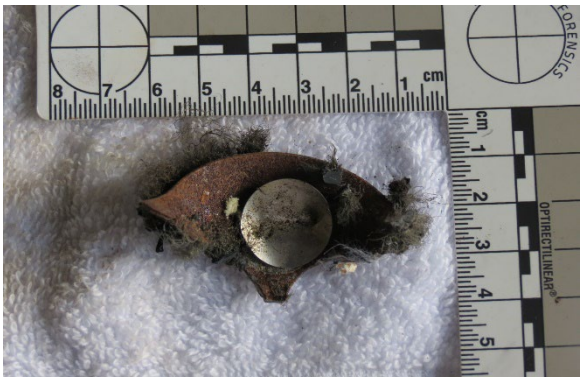


Figure 15. Inflator's horizontal divider

Figure 16. Inflator's horizontal divider embedded in floor carpeting

It is the investigator's opinion that the force/pressure of the stage 1 detonation could not be contained within the inflator and the horizontal divider was projected through, rupturing on the stage 2 side of the inflator.

2010 Ford Fusion Occupant

Driver Demographics

Age/sex:	56 years/male
Height:	165 cm (65 in)
Weight:	112 kg (247 lb)
Eyewear:	None
Seat type:	Bucket seat with adjustable head restraint
Seat track position:	Seat at rear most track position
Manual restraint usage:	Lap and shoulder seat belt available, not used
Usage source:	Vehicle inspection, EDR
Air bags:	Frontal, seat-mounted, and IC available; frontal deployed
Alcohol/drug involvement:	Alcohol=0; no drug test performed
Egress from vehicle:	Exited vehicle under own power
Transport from scene:	Transported by ambulance to level II trauma center
Medical treatment:	Hospitalized 2 days

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Penetrating wound with foreign body, curvilinear, measuring just over 5 x 2 cm, extending through left rectus into underlying rectus musculature	516002.1	Isolated Left Air Bag – Steering wheel hub (Inflator rupture)	Certain
2	Left abdomen contusion	510402.1	Isolated Left Air Bag – Steering wheel hub (Inflator rupture)	Certain
3	Laceration to left eyebrow, 2 cm	210602.1	Isolated Front – Steering wheel rim	Probable
4	Superficial laceration to bridge of nose	210602.1	Isolated Front – Steering wheel rim	Probable
5	Contusion to left eyebrow	210402.1	Isolated Front – Steering wheel rim	Probable
6	Laceration to right knee with linear metallic density foreign body measuring 1.2 cm in length	810602.1	Isolated Left Air Bag – Steering wheel hub (Inflator rupture)	Certain

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
7	Abrasion to right knee	810202.1	Isolated Front – Left lower instrument panel (includes knee bolster)	Certain
8	Abrasion to left knee	810202.1	Isolated Front – Left lower instrument panel (includes knee bolster)	Certain
9	Right lower thigh abrasion	810202.1	Isolated Left Air Bag – Steering wheel hub (Inflator rupture)	Certain

Source: Hospital record

Driver Kinematics

The driver was seated in an upright driving posture with his back against the seat. The seat was adjusted to the rear most track position with the seatback slightly reclined and the head restraint adjusted 7 cm (2.8 in) above the seatback. The driver's lap and shoulder seat belt was not in use. As a result of the frontal collision with the left side of the Dodge, the unbelted driver responded to the 1 o'clock direction of force and translated forward and slightly right from his pre-crash seat position. Based on pictures provided by legal counsel, his mid-section probably loaded against and under the steering wheel as he translated forward. According to the driver's medical records, the fragment from the air bag's inflator casing was projected downward and struck the driver's abdomen, piercing the skin and becoming embedded inside. The driver also sustained a 6 cm (2.4 in) abrasion on the inside of the right lower thigh. This was probably caused when the inflator's horizontal divider and metal mesh filter material was projected out of the inflator and struck the driver. A 1.2 cm (0.5 in) metallic foreign body was removed from his right knee, also likely a fragment from the inflator. The driver also sustained an approximately 2 cm (0.8 in) horizontal cut to his left eyebrow and a smaller laceration to the bridge of his nose, probably from contact to the steering wheel rim. Bilateral knee abrasions most likely occurred due to contact with the left lower knee bolster.

The driver was transported by ambulance to a level II trauma center where he was hospitalized for two days.

2001 Dodge Ram

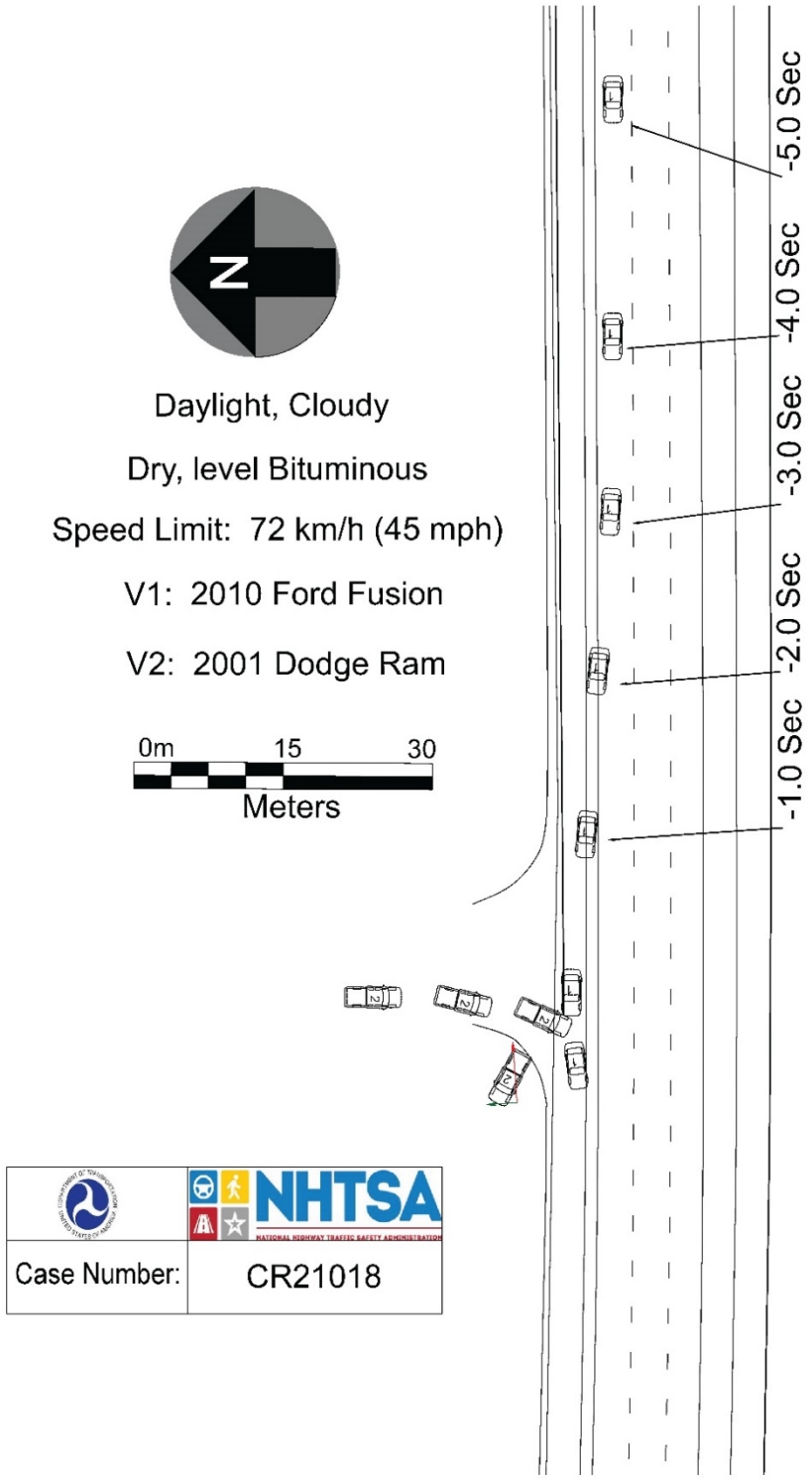
Description

The Dodge was a rear-wheel drive, 3-passenger, 2-door pickup truck with the VIN 1B7HC16YX1Sxxxxxx equipped with a 5.2-liter, V-8 engine, rear-wheel ABS, electronic brakeforce distribution, and dual frontal air bags. It had a 302 cm (118.9 in) wheelbase. The Dodge was towed from the crash scene. It was not available for inspection.

Occupant Data

The driver and front passenger were not injured nor transported for medical treatment.

Crash Diagram



Appendix. A Appendix: 2010 Ford Fusion Event Data Recorder Report

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

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

CDR File Information

User Entered VIN	3FAHP0HA3AR******
User	
Case Number	
EDR Data Imaging Date	08/09/2021
Crash Date	
Filename	21018 FORD EDR.CDRX
Saved on	Monday, August 9 2021 at 12:00:51
Imaged with CDR version	Crash Data Retrieval Tool 21.2
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 23.3
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
ACM Adapter Detected During Download	No
Event(s) recovered	locked frontal 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 Monday, August 9 2021 at 12:00:51.

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	3FAHP0HA3AR******
Current VIN from PCM	3FAHP0HA3AR******
Ignition cycle, download (first record)	19,682
Ignition cycle, download (second record)	N/A
Restraints Control Module Part Number	9E53-14B321-BK
Restraints Control Module Serial Number	3114957100000000
Restraints Control Module Software Part Number (Version)	9E53-14C028-AB
Left/Center Frontal Restraints Sensor Serial Number	1212EAB0
Left Side Restraint Sensor 1 Serial Number	0C5EC2E1
Left Side Restraint Sensor 2 Serial Number	1217BF63
Right Frontal Restraints Sensor Serial Number	1212EEA3
Right Side Restraint Sensor 1 Serial Number	1216B669
Right Side Restraints Sensor 2 Serial Number	1216BFD0

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)	20,078,290
Key-on Timer at event time zero (seconds)	965
Vehicle voltage at time zero (Volts)	13.689
Energy Reserve Mode entered during event (Y/N)	No

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)	33.5
Frontal airbag deployment, time to 2nd stage, driver (msec)	183.5
Maximum delta-V, longitudinal (MPH [km/h])	-13.37 [-21.52]
Time, maximum delta-V longitudinal (msec)	150
Maximum delta-V, lateral (MPH [km/h])	-4.43 [-7.13]
Time, maximum delta-V lateral (msec)	60
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

Pre-Crash Data -1 sec (First Record)

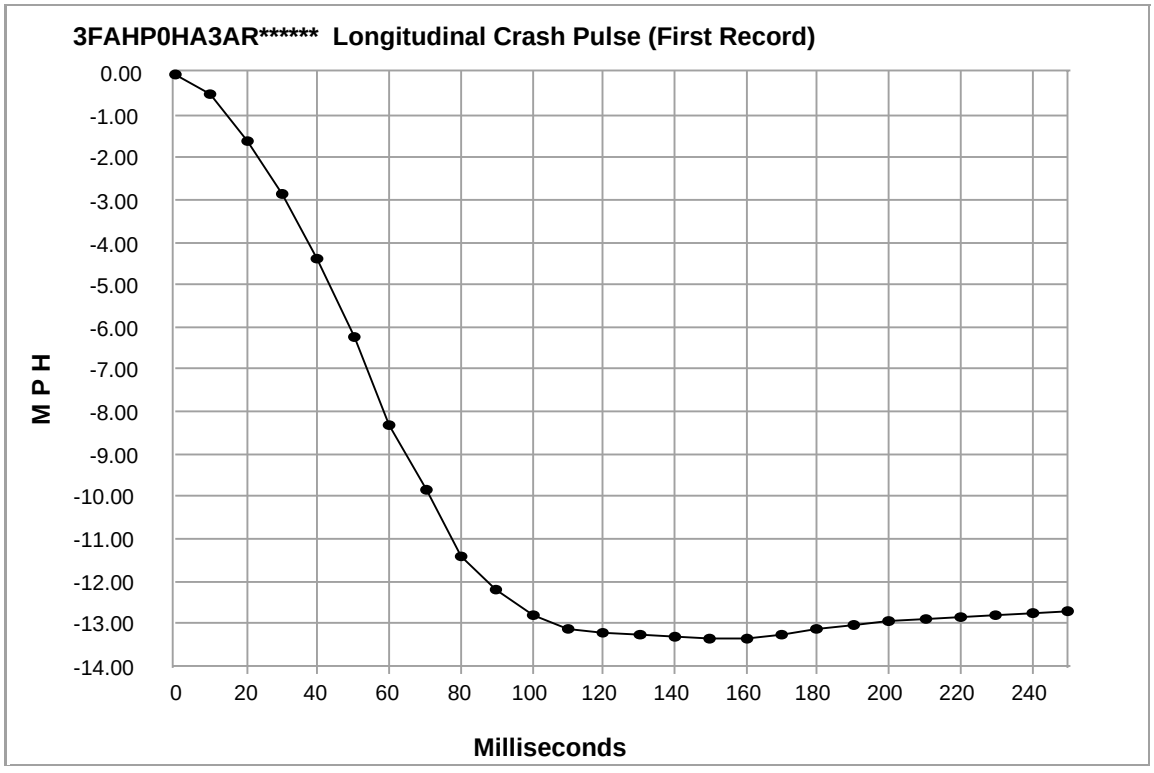
Ignition cycle, crash	19,677
Frontal air bag warning lamp, on/off	Off
Occupant size classification, front passenger (Child size Yes/No [Hex value])	No [$01]
Safety belt status, driver	Driver Not Buckled
Seat track position switch, foremost, status, driver	Not Forward
Safety belt status, front passenger	Passenger Not Buckled
Brake Telltale	Off
ABS Telltale	Off
Stability Control Telltale	Off
Speed Control Telltale	Off
Powertrain Wrench Telltale	Off
Powertrain Malfunction Indicator Lamp (MIL)Telltale	On

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)	Stability control (engaged, non-engaged)	Traction Control via Brakes (engaged, non-engaged)	Traction Control via Engine (engaged, non-engaged)
- 5.0	39.8 [64.0]	13	Off	1,600	non-engaged	non-engaged	non-engaged	non-engaged
- 4.5	39.8 [64.0]	9	Off	1,600	non-engaged	non-engaged	non-engaged	non-engaged
- 4.0	39.8 [64.0]	0	Off	1,600	non-engaged	non-engaged	non-engaged	non-engaged
- 3.5	39.1 [63.0]	0	On	1,600	non-engaged	non-engaged	non-engaged	non-engaged
- 3.0	39.1 [63.0]	0	On	1,600	non-engaged	non-engaged	non-engaged	non-engaged
- 2.5	37.9 [61.0]	0	On	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 2.0	37.3 [60.0]	0	On	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 1.5	36.7 [59.0]	0	On	1,500	non-engaged	non-engaged	non-engaged	non-engaged
- 1.0	35.4 [57.0]	0	On	1,400	non-engaged	non-engaged	non-engaged	non-engaged
- 0.5	34.8 [56.0]	0	On	1,400	non-engaged	non-engaged	non-engaged	non-engaged
0.0	33.6 [54.0]	0	On	1,300	non-engaged	non-engaged	non-engaged	non-engaged

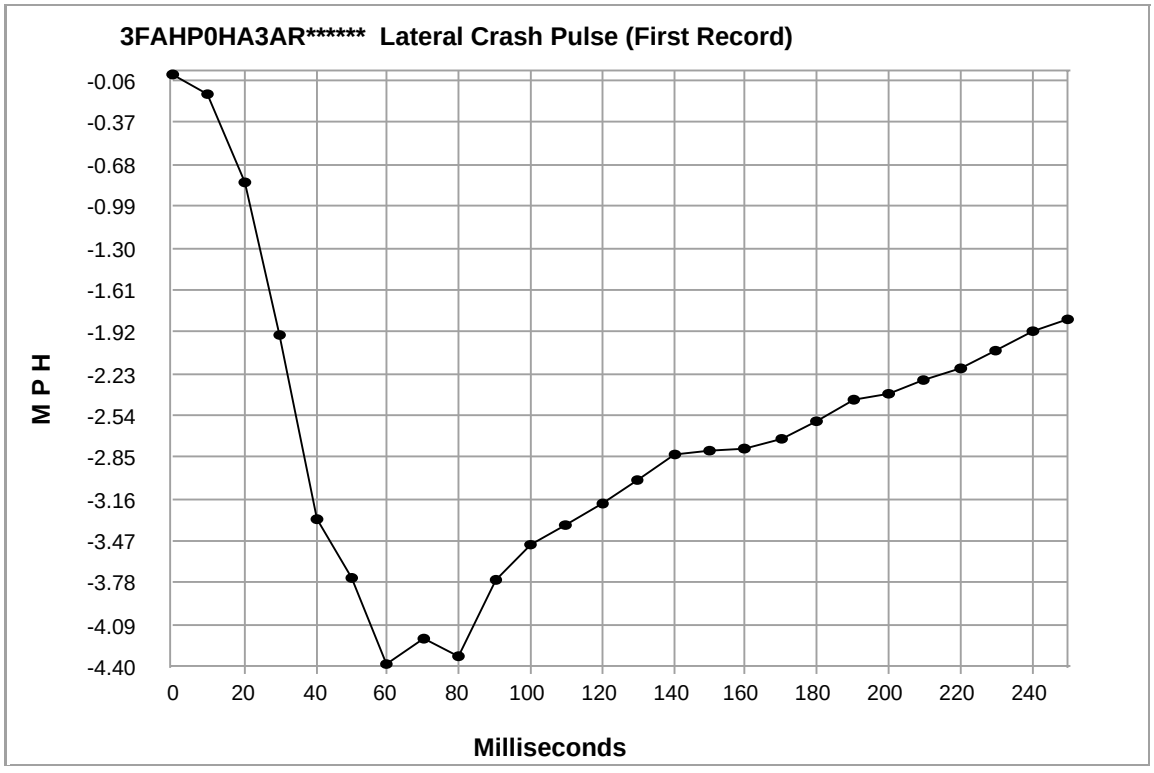
Pre-Crash Data -5 to 0 sec [10 samples/sec] (First Record)

Times (sec)	Steering Wheel Angle (degrees)	Stability Control Lateral Acceleration (g)	Stability Control Longitudinal Acceleration (g)	Stability Control Yaw Rate (deg/sec)
- 5.0	2.4	0.014	-0.003	-0.37
- 4.9	1.9	-0.001	-0.012	-0.75
- 4.8	1.6	0.008	-0.051	-0.75
- 4.7	1.3	0.006	-0.025	-0.5
- 4.6	1.8	0.008	-0.042	-1.0
- 4.5	2.0	0.026	-0.038	-1.0
- 4.4	2.4	0.025	-0.049	-0.37
- 4.3	1.8	0.012	-0.031	-0.37
- 4.2	2.0	0.023	-0.028	-0.87
- 4.1	2.1	0.011	-0.05	-0.5
- 4.0	2.1	0.027	-0.038	-0.37
- 3.9	2.1	-0.006	-0.066	-0.75
- 3.8	1.8	0.012	-0.05	-0.87
- 3.7	1.7	0.008	-0.054	-0.75
- 3.6	1.2	0.016	-0.065	-1.0
- 3.5	1.2	0.003	-0.065	-1.0
- 3.4	0.3	0.005	-0.069	-1.0
- 3.3	-0.6	-0.014	-0.085	-1.25
- 3.2	-0.7	-0.014	-0.092	-1.87
- 3.1	-0.6	-0.037	-0.078	-1.5
- 3.0	0.3	-0.006	-0.059	-1.87
- 2.9	2.5	-0.013	-0.07	-0.87
- 2.8	2.8	0.099	-0.14	-0.62
- 2.7	1.1	0.002	-0.087	-1.0
- 2.6	0.1	0.013	-0.099	-1.62
- 2.5	-0.2	0.008	-0.098	-1.12
- 2.4	-0.5	-0.013	-0.093	-1.37
- 2.3	-0.9	-0.002	-0.104	-1.25
- 2.2	-1.6	-0.023	-0.08	-1.5
- 2.1	-1.7	-0.019	-0.106	-1.25
- 2.0	-1.9	-0.023	-0.102	-1.62
- 1.9	-2.1	-0.024	-0.129	-1.75
- 1.8	-2.1	-0.008	-0.113	-1.87
- 1.7	-2.1	-0.024	-0.107	-1.37
- 1.6	-2.4	-0.027	-0.098	-1.62
- 1.5	-2.3	-0.005	-0.111	-1.0
- 1.4	-2.2	-0.047	-0.124	-1.25
- 1.3	-2.2	-0.008	-0.123	-1.75
- 1.2	-2.2	-0.027	-0.103	-1.75
- 1.1	-1.9	0.009	-0.15	-1.12
- 1.0	-1.9	-0.039	-0.138	-1.75
- 0.9	-1.9	-0.022	-0.112	-1.25
- 0.8	-2.2	-0.014	-0.113	-1.62
- 0.7	-2.3	-0.027	-0.101	-1.75
- 0.6	-2.0	-0.019	-0.12	-1.87
- 0.5	-1.6	-0.022	-0.138	-1.87
- 0.4	-1.1	-0.024	-0.133	-2.12
- 0.3	0.9	-0.015	-0.114	-1.87
- 0.2	5.3	0.038	-0.129	-1.0
- 0.1	16.5	0.102	-0.383	-0.25
0.0	11.2	0.062	-0.651	2.62



Longitudinal Crash Pulse (First Record)

Time (msec)	Delta-V, longitudinal (MPH)	Delta-V, longitudinal (km/h)
0	-0.03	-0.04
10	-0.52	-0.83
20	-1.61	-2.59
30	-2.88	-4.64
40	-4.39	-7.06
50	-6.25	-10.06
60	-8.29	-13.35
70	-9.84	-15.83
80	-11.41	-18.36
90	-12.22	-19.66
100	-12.82	-20.63
110	-13.10	-21.09
120	-13.23	-21.29
130	-13.27	-21.36
140	-13.32	-21.43
150	-13.37	-21.52
160	-13.33	-21.46
170	-13.25	-21.32
180	-13.12	-21.12
190	-13.05	-21.00
200	-12.95	-20.85
210	-12.88	-20.72
220	-12.84	-20.66
230	-12.81	-20.62
240	-12.75	-20.53
250	-12.69	-20.42



Lateral Crash Pulse (First Record)

Time (msec)	Delta-V, lateral (MPH)	Delta-V, lateral (km/h)
0	-0.01	-0.02
10	-0.15	-0.25
20	-0.81	-1.31
30	-1.95	-3.14
40	-3.31	-5.32
50	-3.75	-6.04
60	-4.38	-7.06
70	-4.20	-6.75
80	-4.33	-6.97
90	-3.76	-6.04
100	-3.50	-5.63
110	-3.36	-5.40
120	-3.20	-5.14
130	-3.02	-4.86
140	-2.84	-4.57
150	-2.80	-4.50
160	-2.78	-4.48
170	-2.72	-4.37
180	-2.58	-4.15
190	-2.43	-3.91
200	-2.38	-3.82
210	-2.28	-3.67
220	-2.19	-3.53
230	-2.06	-3.32
240	-1.92	-3.09
250	-1.83	-2.95

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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39 45 35 33 2D 31 34 42 33 32 31 2D 42 4B 00 00 00 00 00 00 00 00 00 00

33 31 31 34 39 35 37 31 30 30 30 30 30 30 30 30

39 45 35 33 2D 31 34 43 30 32 38 2D 41 42 00 00 00 00 00 00 00 00 00 00

12 12 EA B0 00 00 00 00 00 00 00 00 00 00 00 00

0C 5E C2 E1 00 00 00 00 00 00 00 00 00 00 00 00

12 17 BF 63 00 00 00 00 00 00 00 00 00 00 00 00

12 12 EE A3 00 00 00 00 00 00 00 00 00 00 00 00

12 16 B6 69 00 00 00 00 00 00 00 00 00 00 00 00

12 16 BF D0 00 00 00 00 00 00 00 00 00 00 00 00

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Event Record 1

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27 28 27 22 27 24 27 25 27 25 27 25 27 22 27 21 27 1C 27 1C 27 13 27 0A 27 09 27
0A 27 13 27 29 27 2C 27 1B 07 6D 07 6E 07 73 07 68 07 80 07 66 07 6A 07 4F 07 5F
07 65 07 6E 07 61 07 54 07 55 07 69 07 3A 07 46 07 60 07 5F 07 6B 07 58 07 46 07
4B 07 5E 07 4F 06 51 05 45 07 CD 07 C4 07 9D 07 B7 07 A6 07 AA 07 9F 07 B1 07 B4
07 9E 07 AA 07 8E 07 9E 07 9A 07 8F 07 8F 07 8B 07 7B 07 74 07 82 07 95 07 8A 07
44 07 79 07 DD 07 D8 07 C3 07 CE 07 B9 07 BD 07 B9 07 B8 07 C8 07 B8 07 B5 07 CB
07 A1 07 C8 07 B5 07 D9 07 A9 07 BA 07 C2 07 B5 07 BD 07 BA 07 B8 07 C1 07 F6 08
36 08 0E 07 DE 07 CF 07 D8 07 D6 07 D8 07 EA 07 E9 07 DC 07 E7 07 DB 07 EB 07 CA
07 DC 07 D8 07 E0 07 D3 07 D5 07 C2 07 C2 07 AB 07 CA 07 C3 08 33 07 D2 45 AE 45
E0 45 C7 45 D3 45 BA 45 D3 45 AE 45 A1 45 95 45 C7 45 AE 45 EC 45 D3 45 A1 45 A1
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DOT HS 813 541
February 2024

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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