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Special Crash Investigations On-Site Side Inflatable Curtain Occupant Protection Investigation Vehicle: 2013 Chevrolet Impala Location: Missouri Crash Date: September 2016

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

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

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16. Abstract

This report documents on-site investigation is the side inflatable curtain (IC) occupant protection system of a 2013 Chevrolet Impala and the fatal injuries sustained by the driver. This crash occurred within the three- leg intersection of two, two-lane, undivided State highways. The Chevrolet was a four-door sedan equipped with side impact IC, front seat-mounted side impact, and multi-stage frontal air bags. A belted 21-year-old female driver occupied the vehicle. The Chevrolet was traveling east and the driver was making a left turn to proceed north at the intersection. The left plane was struck by the front plane of a southbound 2006 Ford F-350 (Event 1). The impact caused both vehicles to rotate counterclockwise and the Chevrolet's left fender struck the left plane of the Ford (Event 2). The Chevrolet was redirected southeast off the roadway, into a ditch. The Chevrolet continued southeast and the back plane struck and penetrated a barbed wire fence (Event 3). The Ford also departed the roadway and came to final rest on the east roadside heading slightly northeast. The driver of the Chevrolet sustained police-reported "K" (fatal) injuries and was transported by ambulance to a hospital. She was pronounced dead by a medical examiner 78 minutes post-crash. A belted 44-year-old male driver and a belted 32-year-old female front passenger occupied the Ford. Neither sustained police-reported injuries, nor were they transported for medical treatment. Both vehicles were towed from the crash scene due to damage.

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THE INDIANA UNIVERSITY

Transportation Research Center
On-Site Side Inflatable Curtain Occupant Protection Investigation
Case Number: IN17001
Location: Missouri
Vehicle: 2013 Chevrolet Impala
Crash Date: September 2016

BACKGROUND

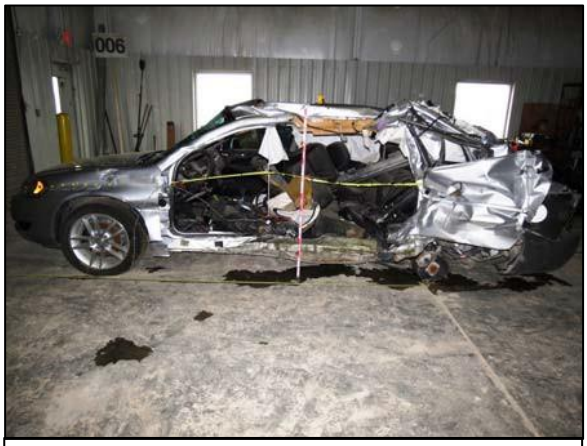


Figure 1. 2013 Chevrolet Impala

This report documents the on-site investigation in the side inflatable curtain (IC) occupant protection system of a 2013 Chevrolet Impala (**Figure 1**) and the fatal injuries sustained by the driver. This crash investigation was initiated by the National Highway Traffic Safety Administration on November 2016 after being discovered by the Special Crash Investigation team at the Indiana University Transportation Research Center through an internet search of Missouri police crash reports abstracts. The investigation was assigned on January 2017. The crash occurred in September 2016, at 1645 hours, in Missouri and was investigated by a local police agency. The crashinvolved the Chevrolet and a 2006 Ford F-350 crew cab, 4x4 pickup truck. The Chevrolet and Ford were inspected on January 2017 and the crash scene was inspected on January 2017.

This crash occurred in the three-leg intersection of two, two-lane, undivided State highways. The Chevrolet was a four-door sedan equipped with side impact IC, front seat-mounted side impact, and multi-stage frontal air bags. A belted 21-year-old female driver occupied the vehicle. The Chevrolet was traveling east and the driver was making a left turn to proceed north at the intersection. The left plane was struck by the front plane of a southbound 2006 Ford F-350 (Event 1). The impact caused both vehicles to rotate counterclockwise and the Chevrolet's left fender struck the left plane of the Ford (Event 2). The Chevrolet was redirected southeast off the roadway, into a ditch. The Chevrolet continued southeast and the back plane struck and penetrated a barbed wire fence (Event 3). The Ford also departed the roadway and came to final rest on the east roadside heading slightly northeast. The driver of the Chevrolet sustained police-reported "K" (fatal) injuries and was transported by ambulance to a hospital. She was pronounced dead by a medical examiner 78 minutes post-crash. A belted 44-year-old male driver and a belted 32-year-old female front passenger occupied the Ford. Neither sustained police-reported injuries, nor were they transported for medical treatment. Both vehicles were towed from the crash scene due to damage.

CRASH SUMMARY

Crash Site

This crash occurred during daylight hours in the three-leg intersection of two, two-lane undivided, State highways. The weather conditions were clear with 16 kilometers (10 miles) visibility, southerly winds at 12.8 km/h (8 mph), a temperature of 27.2° C (81° F), and a dew point of 16.7° C (62° F), according to local weather reports. The Chevrolet's roadway traversed in an east/west direction with one through lane in each direction and each lane was 2.8 m (9.2 ft) wide. A double yellow center line was the only roadway marking for the Chevrolet's roadway. The Ford's roadway traversed in a north/south direction with one through lane in each direction and each lane was approximately 3.1 m (10.2 ft) wide. A yellow "no-pass" center line for southbound traffic was the only roadway marking for the Ford. That marking changed to a double yellow center line at the north leg of the intersection. The roadway surfaces were dry, level bituminous with grass shoulders. The west leg of the intersection was controlled by a stop sign. The north/south legs of the intersection were uncontrolled. The speed limit for each roadway was 89 km/h (55 mph). The crash diagram is included at the end of this report.

Pre-Crash

The Chevrolet was traveling east in the eastbound through lane (**Figure 2**) and according to the event data recorder (EDR) report, the driver slowed down at the intersection stop sign but did not come to a complete stop. The driver turned left to proceed north. The Ford was traveling south in the southbound through lane, approaching the intersection (**Figure 3**) and the driver intended to continue straight through the intersection. The Chevrolet's EDR-reported percent accelerator pedal, service brake status, engine RPM, percent engine throttle, and pre-crash speed are presented in the table below.

Figure 2. Chevrolet's travel path, east to north

Chevrolet's Pre-Crash Data

Times (sec)	Accelerator Pedal, % Full	Service Brake Status	Engine RPM	Engine Throttle, % Full	Speed mph (km/h)
-5.0	0	On	768	10	4 [7]
-4.5	0	On	768	10	2 [4]
-4.0	0	Off	768	10	2 [3]
-3.5	0	Off	768	10	2 [3]
-3.0	12	Off	1024	21	2 [4]
-2.5	17	Off	1216	24	4 [6]

Times (sec)	Accelerator Pedal, % Full	Service Brake Status	Engine RPM	Engine Throttle, % Full	Speed mph (km/h)
-2.0	18	Off	1472	26	6 [9]
-1.5	62	Off	1984	47	7 12]
-1.0	99	Off	2560	17	12 [19]
-0.5	37	Off	2816	39	19 [30]

Crash

Figure 3. Ford southbound travel path

The left plane of the Chevrolet was struck the front plane of the Ford (Event 1). The force direction on the Chevrolet was in the 10 o'clock sector and the impact resulted in actuation of the driver's seat belt pretensioner and deployment of the driver's frontal, seat-mounted side impact, and both IC air bags. The Chevrolet's EDR reported the maximum longitudinal and lateral velocity changes as -30 km/h (-19 mph) and 37 km/h (23 mph), respectively. The WinSMASH program could not be used to calculate delta-V for this impact since the Ford had a large steel brush guard installed on the front end, which invalidated the vehicle's stiffness coefficients. The Barrier algorithm of the WinSMASH program calculated the Chevrolet's barrier equivalent speed as 35 km/h (21.7 mph). The initial impact redirected the Chevrolet southeast and caused the vehicle to rotate counterclockwise resulting in the left fender impacting the left front door of the Ford (Event 2). The damage algorithm of the WinSMASH program calculated the Chevrolet's total delta-V as 8 km/h (5 mph) for this impact. The longitudinal and lateral velocity changes were 0 km/h and 8 km/h (5 mph), respectively. The Ford's total delta-V was 1 km/h (0.6 mph). The longitudinal and lateral velocity changes were 0 km/h and 1 km/h (0.6 mph), respectively. The results for both vehicles were considered reasonable, based on the damage each sustained.

Figure 4. Southeast view, Chevrolet's fence impact (Event 3) and final rest areas

The impacts redirected the Chevrolet southeast and off the east road edge. The Chevrolet slid into a ditch, negatively graded 20 percent and up the back slope graded 13 percent. The vehicle traveled 12.5 m (41 ft from the east edge of the roadway to final rest and the back plane struck a barbed wire fence (Event 3, **Figure 4**) which was 5.9 m (19.3 ft) east of the road edge. The WinSMASH program could not calculate delta-V

for this impact since impacts with yielding objects are out of scope for the program. The Ford also continued in a southeast direction while rotating counterclockwise and departed the east road edge. The Ford came to rest on the east roadside, heading slightly northeast.

Post-Crash

The police were notified of the crash at 1718 hours and arrived at 1735 hours. Rescue and medical personnel also responded. The driver of the Chevrolet sustained police-reported "K" (fatal) injuries and was transported by ambulance to a hospital where she expired 78 minutes post-crash. The driver and front passenger of the Ford did not sustain any police-reported injuries nor were transported for medical treatment. Both vehicles were towed from the crash scene due to damage.

2013 CHEVROLET IMPALA

Description

The Chevrolet was a front-wheel drive, 5-occupant, 4-door sedan with VIN 2G1WC5E36D1xxxxxx, and was equipped with a 3.6-liter, V-6 engine, a 6-speed automatic transmission, 4-wheel antilock brakes with electronic brake force distribution and brake assist, traction control, and electronic stability control. The vehicle was also equipped with front seat-mounted side impact, side impact IC, and multi-stage frontal air bags, and driver as well as front passenger seat belt buckle switch sensors and pretensioners. The vehicle was equipped with a tilt steering column and the specified wheelbase was 281 cm (110.6 in).

The vehicle manufacturer's recommended tire size was P235/50R18, according to the 2013 "Tire Guide." The vehicle was equipped with Dunlop Signature tires of the recommended size on the left front, right front, and right rear wheels. The left rear wheel was displaced from the vehicle and was not present at the SCI vehicle inspection. The vehicle manufacturer's recommended cold tire pressure for the front and rear tires was 207 kPa (30 psi). The tires present at SCI inspection were all in good condition prior to the crash.

The front row was equipped with driver and front passenger leather-covered bucket seats with adjustable head restraints. The second row was equipped with a leather-covered bench seat with integral head restraints at the outboard seating positions. The driver's seat track and seat back angle could not be determined due to intrusion damage and the head restraint was detached from the seat back. The second row seat track and seat back were fixed.

Exterior Damage

Exterior Damage Event 1: The Chevrolet sustained direct and induced damage to both left side doors, the B- and C-pillars, rear window frame, quarter panel, and roof side rail during the initial impact with the Ford. The direct damage began 53 cm (20.9 in) rear of the left front axle and extended 203 cm (79.9 in) rearward. Both left doors were displaced and the crush profile at the mid-door level was estimated (**Figures 5** and **6**). Crush measurements were taken at the mid-door and sill levels and averaged where necessary, according to NHTSA field measurement protocol. The Field L was 203 cm (79.9 in). The crush values were C_1 = 10 cm (3.9 in), C_2 = 24 cm (9.4 in), C_3 = 34 cm (13.4 in), C_4 = 37 in (14.6 in), C_5 = 26 cm (10.2 in), C_6 = 16 cm (6.3 in). Themaximum residual crush was 55 cm (21.7 in) occurring 91 cm (35.8 in) rear of the left front axle at the mid-door level. The sill height was 30 cm (11.8 in) and the height of the maximum crush was 68 cm (26.8 in). The Door Sill Differential (DSD) was 26 cm (10.2 in).

Figure 5. Overhead of damage from impact with Ford

Figure 6. Overhead view of impact with Ford

Damage Classification Event 1: The Collision Deformation Classification (CDC) was 10LZAW4 (290 degrees).

Exterior Damage Event 2: The Chevrolet sustained direct damage to the left fender (**Figure 7**) during the side-slap impact with the left front door of the Ford. The direct damage began 40 cm (15.7 in) forward of the left front axle and extended 93 cm (36.6 in) rearward. The crush measurements were taken at the mid-door level. The Field L was 93 cm (36.6 in). The crush measurements were C_1 = 1 (0.4 in), C_2 = 1 cm (0.4 in), C_3 = 2 cm (0.8 in), C_4 = 2 cm (0.8 in), C_5 = 2 cm (0.8 in), C_6 = 0 cm and the maximum residual crush was 2 cm (0.8 in) occurring 5 cm (2 in) rear of the left front axle.

Damage Classification Event 2: The CDC was 09LFMW2 (270 degrees).

Exterior Damage, Event: The Chevrolet sustained direct damage to the back, right, and top planes when it struck a barbed wire fence.

Figure 7. Chevrolet left fender damage

Damage Classification, Event 3: The vehicle penetrated through the fence damaging three planes of the vehicle. Therefore, the following three CDCs were assigned to capture the totality of the damage: 06BZMW1 (180 degrees), 06RBAS2 (90 degrees), and 06TPDS1.

Event Data Recorder

Attempts to image the Chevrolet's EDR during the SCI vehicle inspection using version 17.2 of the Bosch Crash Data Retrieval Software were unsuccessful and the following error message appeared: "This vehicle module is not supported. Software ID was not recognized." However, the EDR had been previously imaged by the investigating police officer via direct connection to the air bag control module using version 16.6 of the CDR software. The officer provided a copy of the EDR file and the pdf version of the EDR report to this contractor. The EDR was successfully read by version 17.7 and the report is attached at the end of this report as **Appendix A**.

The EDR reported a deployment event. The "System Status at Event" record reported that a complete file was recorded, the Frontal Air Bag Warning Lamp was "Off," and the driver's seat belt status was "Buckled." The ignition cycles at the crash and when the data was imaged were 7,399 and 7,400, respectively. This event reported the trouble code B0052-00, which is an indicator that an air bag deployment was commanded. The pre-crash data were presented in the pre-crash section of this report on page 2.

Event Record 1: This deployment event was recorded during the Chevrolet's left plane impact from the front plane of the Ford. The first and second deployment loops were commanded for the driver's frontal air bag as well as for both front row seat belt pretensioners. Deployment loops for the driver's thorax air bag and both IC air bags were also commanded. The first and second stage deployments of the driver's frontal air bag occurred 23 msec and 123 msec, respectively after algorithm enable (AE). The driver's thorax air bag, both IC air bags, and both pretensioners were commanded to deploy at 5 msec after AE. The maximum longitudinal and lateral velocity changes were -30 km/h (-19 mph) and 37 km/h (23 mph), respectively. These occurred 228 msec and 78 msec after AE, respectively.

Interior Damage

The interior of the Chevrolet sustained severe intrusions damage (**Figure 8**). The most severe intrusions involved the left front door as well as the front plane of the Ford, which both intruded approximately 80 cm (31.5 in), based on damage to the left front seat. The left front door was missing at the time of SCI inspection. The seat back and seat cushion intruded laterally 25 cm (9.8 in) and19 cm (7.5 in), respectively. No discernable evidence of occupant contacts was observed. The left front door was displaced and detached from the vehicle while the left rear door was displaced rearward, but still attached to the vehicle. The right doors remained closed and operational.

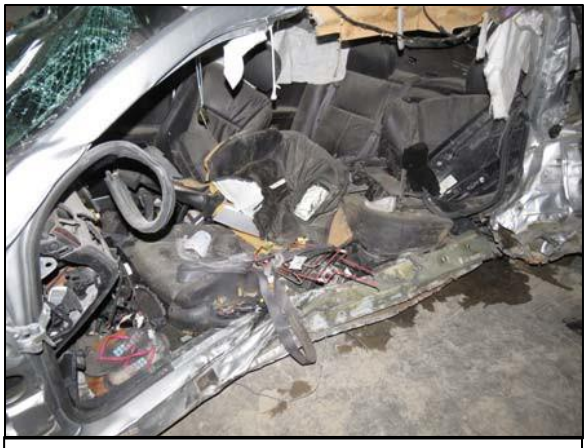


Figure 8. Chevrolet left plane intrusion damage

Manual Restraint Systems

The front and second rows were equipped with three-point lap and shoulder seat belts. The front row was equipped with lightweight locking latch plates and the second row was equipped with sliding latch plates. The front row seat belts were also equipped with retractor-mounted pretensioners that actuated during the crash.

The driver was restrained by the lap and shoulder seat belt and the belt webbing "horsetailed" (shredded) as it stretched and broke from the displacement of the B-pillar caused by the intruding front plane of the Ford. The latch plate remained in the buckle (**Figure 9**).

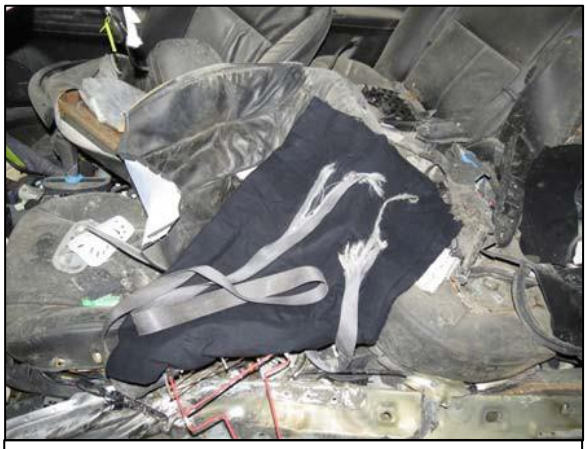


Figure 9. Chevrolet driver's "horsetailed" seat belt

Supplemental Restraint Systems

The Chevrolet was equipped with multi-stage frontal, front seat-mounted side impact, and side impact IC air bags. The driver's frontal, side impact, and both IC air bags deployed during the crash.

The driver's frontal air bag was located in the steering wheel hub and the deflated air bag was 52 cm (20.5 in) in diameter. The air bag deployed through I-shaped cover flaps. Each flap was 6 cm (2.4 in) wide and 13 cm (5.4 in) high. Inspection of the air bag and flaps revealed no discernable evidence of occupant contact and no damage.

The driver's seat-mounted side impact air bag was located in the outboard side of the seat back and deployed through a 21 cm x 8 cm (8.3 in x 3.1 in) flap. The deflated air bag was 33 cm (13 in) high and 32 cm (12.6in) wide and had a single vent port on the outboard side. There was no discernable evidence of occupant contact but there was a 6 cm (2.4 in) long cut on the inboard side and two cuts, measuring 3 cm (1.2 in) and 4 cm (1.6 in), respectively to the outboard side (**Figure 10**). These cuts occurred during the interaction with the left front door and the front plane of the Ford.

Figure 10. Cuts in driver's side impact air bag

The IC air bags were located along the roof side rails inside the headliner and extended from the A- pillar to the C-pillar. The left IC was torn by the impact and intrusion from Ford. The front 37 cm (14.6 in) of the IC remained (**Figure 11**), hanging from the roof side rail and the back 86 cm (14.6 in) also remained. The fabric in between that was torn from the vehicle and could not be located. Inspection of the remaining IC revealed no discernable evidence of occupant contact.

Figure 11. Remnant of left IC air bag

The forward third of deflated right IC was cut and removed from the front passenger position, but could still be measured. The IC was 190 cm (74.8 in) long, 43 cm (16.9 in) high, and extended 10 cm (8.7 in) below the beltline. The gap between the front of the IC and right A-pillar was approximately 66 cm (26 in) long and 40 cm (15.7 in) high. There was no discernable evidence of occupant contact or damage.

2013 CHEVROLET IMPALA OCCUPANT

Driver Demographics

Age/Sex:	21 years/female
Height:	160 cm (63 in)
Weight:	65 kg (143 lb)
Eyewear:	Unknown
Seat Type:	Bucket
Seat Track Position:	Unknown
Manual Restraint Usage:	Lap and shoulder belt
Usage Source:	Vehicle inspection
Air Bags:	Frontal, seat-mounted side impact, and IC deployed
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Unknown
Transport From Scene:	Ambulance
Medical Treatment:	Expired 78 minutes post-crash

Driver Injuries

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Injuries to head, suspected intracranial injury but no head/brain imaging occurred	100999.9	Tandem IPC configuration Air bag, driver's side inflatable curtain (IC) Exterior of other motor vehicle: brush guard	 Possible Probable
2	Fracture, basilar skull, with blood and fluid from nose, ears, and mouth, including a left hemotympanum	150200.3	Tandem IPC configuration Air bag, driver's side IC Exterior of other motor vehicle: brush guard	 Possible Probable
3	Fractured left ribs 2nd through 9th with some fracture in two places[1], not further specified	450203.3	Tandem IPC configuration Air bag, driver's side impact Air bag, driver's side IC Left front door panel, rear upper quadrant	 Possible Possible Certain

[1] The emergency room x-ray indicated that there was likely flail chest but there was symmetric chest wall rise noted during ventilation.

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
4	Pneumothorax, left, not further specified	442202.2	Tandem IPC configuration Air bag, driver's side impact Air bag, driver's side IC Left front door panel, rear upper quadrant	 Possible Possible Certain
5	Fractured pelvis[2] with obvious deformity and palpable bony laxity of pelvis and left hip; pelvis considered unstable, not further specified	856171.4	Tandem IPC configuration Left front door panel, rear lower quadrant Side impact air bag	Certain
6	Laceration, large, 10 cm (3.9 in) on left temporal scalp involving subcutaneous tissue, not further specified	110602.1	Exterior of other motor vehicle: brush guard	Probable
7	Contusion (bruising), minimal, face, not further specified	210402.1	Air bag, driver's side IC	Probable
8	Contusion, hematoma, superior central chest area, not further specified	410402.1	Exterior of other motor vehicle: brush guard	Probable
9	Contusion (bruising), large, left chest involving upper and lower chest	410402.1	Left front door panel, rear upper quadrant	Probable
10	Contusion, hematoma over left central back, not further specified	410402.1	Seat back, driver's	Probable
11	Laceration, 5.1 cm (2 in) on left lower back, not further specified	410602.1	Seat back, driver's	Possible

[2] The medical examiner indicated the pelvis was crushed but provided no confirmation.

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
12	Contusion (ecchymosis) left flank, not further specified	510402.1	Left front door panel, rear upper quadrant	Probable
13	Abrasions, extensive, on inferior (lower) abdomen including (a) 5.1 by 3.8 cm (2 x 1.5 in) on right lat- eral hip, (b) 5.1 cm (2 in) centrally located, and (c) four, horizontally oriented, left of center with largest measuring 15.2 cm (6 in)	510202.1	Lap portion of seat belt system	Probable
14	Contusions (bruising), extensive, across inferior (lower) abdomen, not further specified	510402.1	Lap portion of seat belt system	Probable
15	Contusion (ecchymosis), bilateral groin area[3], not further specified	510402.1	Steering wheel rim	Possible
16	Contusion (bruising), large, over left upper shoulder, not further specified	710402.1	Exterior of other motor vehicle: brush guard	Probable
17 18	Abrasion and contusion (bruising) to lateral left arm from shoulder to elbow, not further specified	710202.1 710402.1	Left front door panel, rear upper quadrant	Certain
19	Contusion (bruising), 15.2 by 5.1 cm (6 x 2 in) to left medial upper arm, not further specified	710402.1	Occupant's left lateral chest	Probable

[3] This lesion was also described as lower bilateral pelvic area.

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
20	Abrasions, 5.1 by 5.1 cm (2 x 2 in) on posterolateral distal right arm, not further specified	710202.1	Steering wheel rim	Possible
21	Abrasion, 1,3 cm (0.5 in) over right lateral elbow, not further specified	710202.1	Interior, center console first row	Probable
22	Contusion (ecchymosis, bruising) dorsum right wrist, not further specified	710402.1	Steering wheel rim	Possible
23	Contusion (bruising) to left index finger/hand and dorsum wrist, not further specified	710402.1	Left front door panel, forward upper quadrant	Probable
24 25	Abrasion, very large, from left flank to left lateral knee, not further specified	510202.1	Left front door panel, rear upper quadrant	Probable
		810202.1	Left front door panel, forward lower quadrant	Probable
26	Contusion (bruising), extensive, left thigh, not further specified	810402.1	Left front door panel, forward lower quadrant	Certain
27 28	Contusion (bruising) bilateral legs, not further specified	810402.1 810402.1	Unknown physical component	Unknown
29	Abrasions, 10.2 cm (4 in), obliquely oriented proximal lateral right thigh, not further specified	810202.1	Interior, center console first row	Probable
30	Abrasion, 2.5 x 2.5 cm (1 x 1 in), anterior distal right thigh, not further specified	810202.1	Steering wheel rim	Probable

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
31	Abrasion, 2.5 cm (1 in), anterior proximal right lower leg, not further specified	810202.1	Left lower instrument panel (includes knee bolster)	Certain
32 33	Abrasion, 2.5 cm (1 in), dorsum right foot and contusion (bruising) medial right ankle, not further specified	810202.1 810402.1	Floor, foot controls	Certain

Sources: Medical examiner records, emergency room records, and EMS treatment record.
Injury Numbers 1 to 4, 7, 8, 10, 12, 14 to 16, and 26 to 28 came only from emergency room records.
Injury Numbers 11, 13, 17, 18, 20, 21, 24, 25, and 29 to 33 came only from medical examiner records.
Injury Numbers 5, 6, 9, 19, 22, and 23 came from a combination of emergency room and medical examiner records.

Driver Kinematics

The driver was restrained by a lap and shoulder seat belt. The left plane impact to the Chevrolet by the front plane of the Ford resulted in actuation of the driver's seat belt pretensioner and deployment of the driver's frontal, seat-mounted side impact, and both IC air bags. The driver was initially displaced forward and to the left but then redirected rearward and to the right as the front plane of the Ford and the left front door intruded into the driver's area. The driver's head loaded the left IC air bag and then contacted the brush guard of the Ford, resulting in an intercranial injury and basilar skull fracture as well as a 10 cm (3.9 cm) laceration of the left temporal scalp. She also loaded left seat back air bag and the IC air bag, and also contacted the rear upper quadrant of the left front door panel, sustaining fractures to the left ribs, 2nd through 9th, and a left pneumothorax. The driver also sustained multiple abrasions, contusions, and lacerations.

The left plane side-slap impact with the left plane of the Ford was minor and probably had little effect on redirecting the driver. The driver likely remained in her seat as the Chevrolet was redirected into the ditch and the back plane struck and penetrated through the barbed wire fence. The driver sustained police-reported "K" (fatal) injuries and was transported by ambulance to a hospital, where she expired 78 minutes post-crash.

2006 FORD F-350 DESCRIPTION

Description

The Ford was a 4-wheel drive, 5-occupant, 4-door crew cab pickup truck with VIN 1FDWW37P16Exxxxxx, with a heavy after-market storage unit mounted to the back and a

heavy-duty steel brush guard mounted to the front plane. The Ford was equipped with a 6.6-liter, V- 8 diesel engine, and 4-wheel antilock brakes with electronic brake force distribution. The vehicle was also equipped with multi-stage frontal air bags, front row seat belt pretensioners, and an EDR.

Exterior Damage

Exterior Damage Crash Event 1: The brush guard was directly damaged as well as the hood and left fender during the initial impact with the Chevrolet. Direct damage began at the left front corner of the brush guard and extended across the entire front plane.

Damage Classification Event 1: The CDC was 11FDEW1 (340 degrees).

Exterior Damage Crash Event 2: The Ford sustained direct damage to the left front door during the impact with Chevrolet's left fender. The direct damage started 267 cm (105.1 in) forward of the left rear axle and extended rearward 112 cm (44.1 in). The crush measurements were taken on the lower door. The Field L was 151 cm (59.4 in). The crush measurements were C_1 = 0 cm, C_2 = 1 cm (0.4 in), C_3 = 2 cm (0.8 in), C_4 = 4 cm (1.6 in), C_5 = 0 cm, C_6 = 0 cm and the maximum residual crush was measured as 4 cm (1.6 in) 290 cm (114 in) forward of the left rear axle.

Damage Classification Event 2: The CDC for the side slap event was 09LPEW1 (270 degrees)

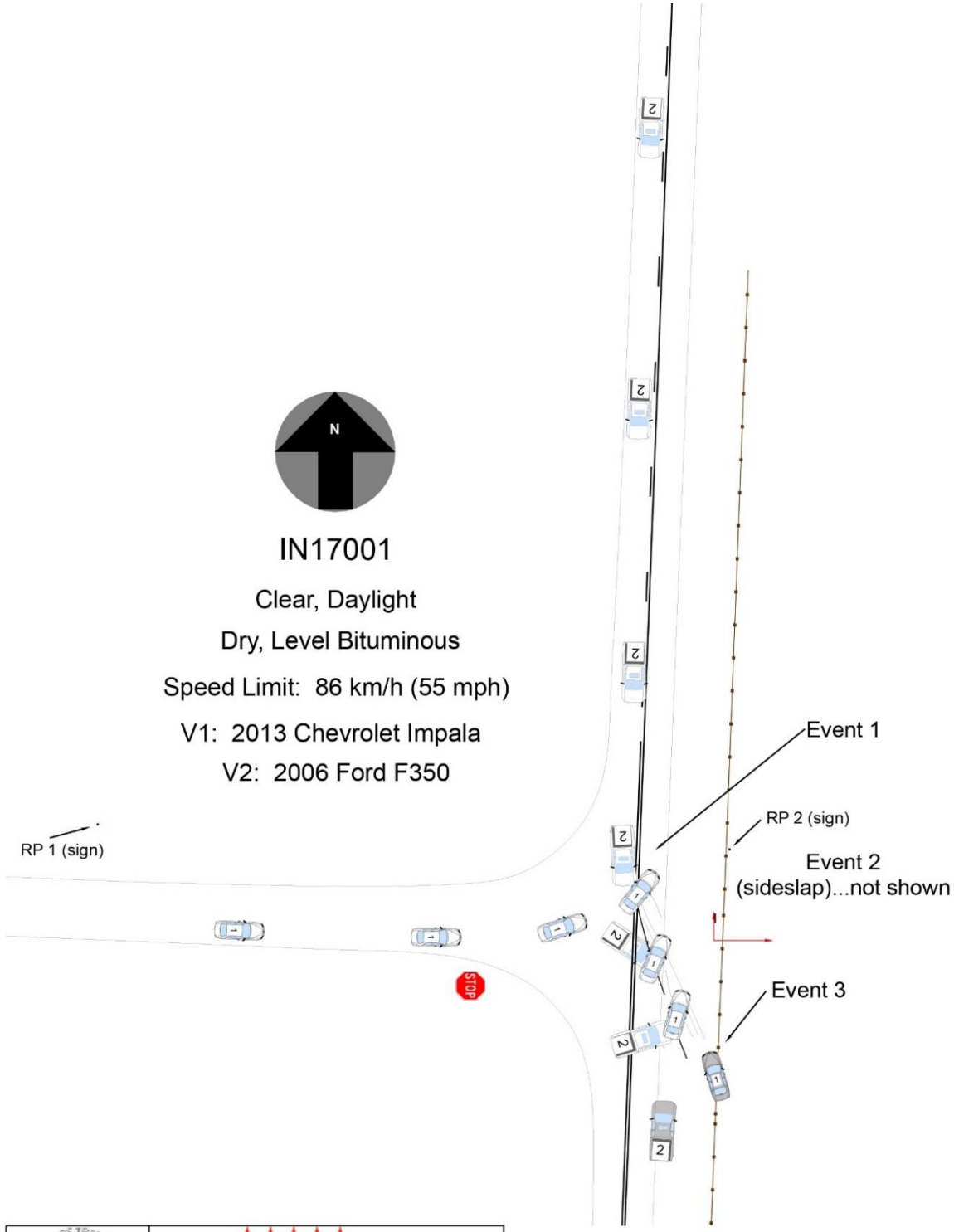
Event Data Recorder

The Ford's EDR was imaged via direct connection to the interface under the right cowl, using version 17.2 of the Bosch Crash Data Retrieval software and was reported using version 17.7. Power to the vehicle was supplied by an external battery. The EDR reported a deployment event. The "System Status at Deployment" record reported that no diagnostic codes were active when the event occurred, the passenger air bag switch position during the event was "Activated," and the frontal air bags and pretensioners were deployed 45 msec after AE. The longitudinal cumulative delta-V was reported as –19.9 km/h (-12.35 mph), occurring 116 msec after AE and the report is attached at the end of this report as **Appendix B**.

Occupant Data

The driver (43-year-old male) and front passenger (32-year-old female) were each restrained by a lap and shoulder seat belt according to the police crash report. Neither sustained any police reported injuries and were not transported for medical treatment.

CRASH DIAGRAM



APPENDIX A: 2013 CHEVROLET IMPALA
Event Data Recorder (EDR) Report[1]

[1] The EDR Report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the 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	2G1WC5E36D1******
User	
Case Number	
EDR Data Imaging Date	04/28/2017
Crash Date	
Filename	IN17001_V1_ACM.CDRX
Saved on	Friday, April 28 2017 at 11:38:49
Imaged with CDR version	Crash Data Retrieval Tool 17.3
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 17.7
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events for Front, Side, and Rear (FSR) Events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH [8 km/h]. A Non-Deployment Event contains Pre-Crash and Crash data. The oldest Non-Deployment event can be overwritten by a Deployment Event, if all three records are full and the Non-Deployment Event is not locked. A Non-Deployment Event can be overwritten by a more recent Non-Deployment Event if all three records are full and the Non-Deployment is older than approximately 250 ignition cycles. Also, a Non-Deployment event can be recorded if one of the following occurs without the Deployment of any of the frontal air bags, side air bags, or roll bars:

-Pretensioner(s) only Deployment
-Head Rest Deployment
-Battery Cut-Off Deployment

The second type of SDM recorded crash event for FSR Events is the Deployment Event. It also contains Pre-Crash and Crash data. Deployment Events cannot be overwritten or cleared by the SDM.
Rollover Events contains Pre-Crash and Crash data. Rollover event follow the same rules as FSR Deployment events.
The SDM can store up to three Events.

Data:

For FSR Events, SDM Recorded Vehicle Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment and Non-Deployment Events, the SDM will record up to 300 milliseconds of data after time zero. The SDM will also record up to 300 milliseconds of Vehicle Acceleration data after time zero.
For Rollover Events, the SDM may record Lateral Acceleration, Vertical Acceleration, and Roll Rate data, if the SDM is rollover capable. This data reflects what the sensing system experienced during the recorded portion of the event. For Rollover Deployment Events, the SDM will record up to 700 milliseconds of data before the Deployment criteria is met and 290 milliseconds after the Deployment criteria is met.
-Deployment loops may be displayed as being deployed in a Non-Deployment event record, if a Deployment event is qualified during the Non-Deployment event. That is, if two or more events are occurring at the same time and one is a Non-Deployment event and one of the others is a Deployment event, and the Deployment event is qualified while the Non-Deployment is still active, the deployed loops may be recorded in the Non-Deployment event record.
-Time between events is recorded in 10 msec intervals and is displayed in seconds for a maximum time of 655.33 seconds. The counter measures the time from the start of one event to the start of the next event if both events occur within the same ignition cycle.
-The Maximum SDM Recorded Vehicle Velocity Change may occur between the recorded 10 millisecond sample points of the SDM Recorded Vehicle Velocity Change.
-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.
-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

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

-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.
-Pre-Crash data is recorded asynchronously. The 0.5 second Pre-crash data value (most recent recorded data point) is the data point last sampled before AE. That is to say, the last data point may have been captured just before AE but no more than 0.5 second before AE. All subsequent Pre-crash data values are referenced from this data point.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:
-The SDM receives a message with an "invalid" flag from the module sending the pre-crash data
-Pre-Crash Electronic Data Validity Check Status indicates "Data Not Available" if:
-No data is received from the module sending the pre-crash data
-For diesel powered vehicles, the data displayed as Throttle Position (%) is actually the data for the Air Inlet Flap Position. This is not the same as the throttle position for a gasoline powered engines.
-Belt Switch Circuit Status indicates the status of the seat belt switch circuit.
-The ignition cycle counter will increment when the power mode cycles from OFF/Accessory to RUN. Applying and removing of battery power to the module will not increment the ignition cycle counter.
-Ignition Cycles Since DTCs Were Last Cleared can record a maximum value of 253 cycles and can only be reset by a scan tool.
-Dynamic Deployment Event Counter tracks the number of Deployment events that have occurred during the SDM's lifetime.
-Dynamic Event Counter tracks the number of qualified events (either Deployments, Non-deploy, or Rollover events) that have occurred during the SDM's lifetime.
-For Deployment Events, DTC B0052 (Deployment commanded) shall be recorded with the remainder of the data for this event even though it occurred after Event Enable.
-Once a firing loop has been commanded to be deployed, it will not be commanded to be deployed again during the same ignition cycle. Firing loop deployment times for subsequent deployment type events, during the same ignition cycle, will not be recorded. Also, forced timer loops, will not be shown as being commanded to deploy. Loops without their own independent deployment calibration are called "forced timer loops." Examples of a forced timer loops are Pretensioner Deployment Loop #2 and Knee Deployment Loop.
-Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously may be reported higher than Ignition Cycles At Event because the Ignition Cycles SIR Warning Lamp was ON/OFF counter is not cleared during the vehicle build process.
-Ignition Cycles At Event may be reported higher than Ignition Cycles At Investigation by one ignition cycle. This is due to the way Ignition Cycles At Investigation is written during a vehicle power loss situation.
-The GM parameter name is displayed in parentheses after the NHTSA Part 563 parameter name.
-The reported range of the longitudinal and lateral acceleration values is approximately ± 50 g.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

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

Data Element Sign Convention:
The following table provides an explanation of the sign notation for data elements that may be included in this CDR report. Directional references to sign notation are all from the perspective of the driver when seated in the vehicle facing the direction of forward vehicle travel.

Data Element Name	Positive Sign Notation Indicates
Longitudinal Acceleration	Forward
Longitudinal Velocity Change	Forward
Lateral Acceleration	Left to Right
Lateral Velocity Change	Left to Right
Vertical Acceleration	Downward
Roll Rate	Clockwise Rotation

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

01053_SDM11e-autoliv_r010

System Status at Time of Retrieval

Dynamic Deployment Event Counter	1
Multi-Event, Number of Events (Dynamic Event Counter)	1
Dynamic OnStar Notification Event Counter	1
Vehicle Identification Number (VIN)	??????????******
Ignition Cycle, Download (Ignition Cycles at Investigation)	7400
End Model Part Number	A5F00100
System Type	Autoliv
Software Module Identifier 1	015C281B
Software Module Identifier 2	015C281A
Software Module Identifier 3	015C281C
Manufacturing Traceability Data, Component Identifier	AS
Manufacturing Traceability Data, Part Number/Broadcast Code	6796
Manufacturing Traceability Data, Supplier Code	E
Manufacturing Traceability Data, Traceability Number	050027482
ESS # 1 Traceability Data, Component Identifier	AU
ESS # 1 Traceability Data, Part Number/Broadcast Code	0000
ESS # 1 Traceability Data, Supplier Code	E
ESS # 1 Traceability Data, Traceability Number	000000000
ESS # 2 Traceability Data, Component Identifier	AT
ESS # 2 Traceability Data, Part Number/Broadcast Code	0000
ESS # 2 Traceability Data, Supplier Code	E
ESS # 2 Traceability Data, Traceability Number	000000000
ESS # 3 Traceability Data, Component Identifier	AH
ESS # 3 Traceability Data, Part Number/Broadcast Code	0000
ESS # 3 Traceability Data, Supplier Code	E
ESS # 3 Traceability Data, Traceability Number	000000000
ESS # 4 Traceability Data, Component Identifier	AJ
ESS # 4 Traceability Data, Part Number/Broadcast Code	0000
ESS # 4 Traceability Data, Supplier Code	E
ESS # 4 Traceability Data, Traceability Number	000000000
ESS # 5 Traceability Data, Component Identifier	00
ESS # 5 Traceability Data, Part Number/Broadcast Code	0000
ESS # 5 Traceability Data, Supplier Code	E
ESS # 5 Traceability Data, Traceability Number	000000000
ESS # 6 Traceability Data, Component Identifier	00
ESS # 6 Traceability Data, Part Number/Broadcast Code	0000
ESS # 6 Traceability Data, Supplier Code	E
ESS # 6 Traceability Data, Traceability Number	000000000
ESS # 7 Traceability Data, Component Identifier	00
ESS # 7 Traceability Data, Part Number/Broadcast Code	0000
ESS # 7 Traceability Data, Supplier Code	E
ESS # 7 Traceability Data, Traceability Number	000000000
ESS # 8 Traceability Data, Component Identifier	00
ESS # 8 Traceability Data, Part Number/Broadcast Code	0000
ESS # 8 Traceability Data, Supplier Code	E
ESS # 8 Traceability Data, Traceability Number	000000000

System Status at Event (Event Record 1)

Event Record Type	Deployment
OnStar Deployment Status Data Sent	Yes
Complete file recorded (Event Recording Complete)	Yes
Crash Record Locked	Yes
OnStar SDM Recorded Vehicle Velocity Change Data Sent	Yes
Deployment Event Counter	1
Multi-Event, Number of Events (Event Counter)	1
OnStar Notification Event Counter	1
Time From Event 1 to 2 (Time Between Events) (seconds)	Data Not Available
Ignition Cycle, Crash (Ignition Cycles at Event)	7399
Algorithm Active: Frontal	Yes
Algorithm Active: Side	Yes
Algorithm Active: Rollover	No
Algorithm Active: Rear	Yes
Concurrent Event Flag Set	No
Event Severity Status: Frontal Pretensioner	Yes
Event Severity Status: Frontal Stage 1	Yes
Event Severity Status: Frontal Stage 2	No
Event Severity Status: Left Side	Yes
Event Severity Status: Right Side	No
Event Severity Status: Rear	No
Event Severity Status: Rollover	No
Safety Belt Status, Driver (Driver Belt Switch Circuit Status)	Buckled
Safety Belt Status, Right Front Passenger (Passenger Belt Switch Circuit Status)	Not Buckled
Center Front Row Belt Switch Circuit Status (If Equipped)	Data Not Available
Left Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Center Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Right Row 3 Belt Switch Circuit Status (If Equipped)	Data Not Available
Passenger Seat Occupancy Status	Empty
Occupant Size Right Front Passenger Child (Passenger Classification Status)	No (Not Applicable)
Passenger Air Bag ON Indicator Status	Off
Passenger Air Bag OFF Indicator Status	On
Low Tire Pressure Warning Lamp Status 0.5 Seconds Prior to Time Zero	Off
Frontal Air Bag Warning Lamp (SIR Warning Lamp Status 0.5 Seconds Prior to Time Zero)	Off
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655330
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	1699
Ignition Cycles Since DTCs Were Last Cleared 0.5 Seconds Prior to Time Zero	253
Maximum Delta-V, Longitudinal (Maximum Longitudinal SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	-19 [-30]
Time, Maximum Delta-V (Time From FSR Time Zero to Maximum Longitudinal SDM Recorded Vehicle Velocity Change)(msec)	228
Maximum Delta-V, Lateral (Maximum Lateral SDM Recorded Vehicle Velocity Change for FSR Event) MPH [km/h]	23 [37]
Time Maximum Delta-V, Lateral (Time From FSR Time Zero to Maximum Lateral SDM Recorded Vehicle Velocity Change)(msec)	78

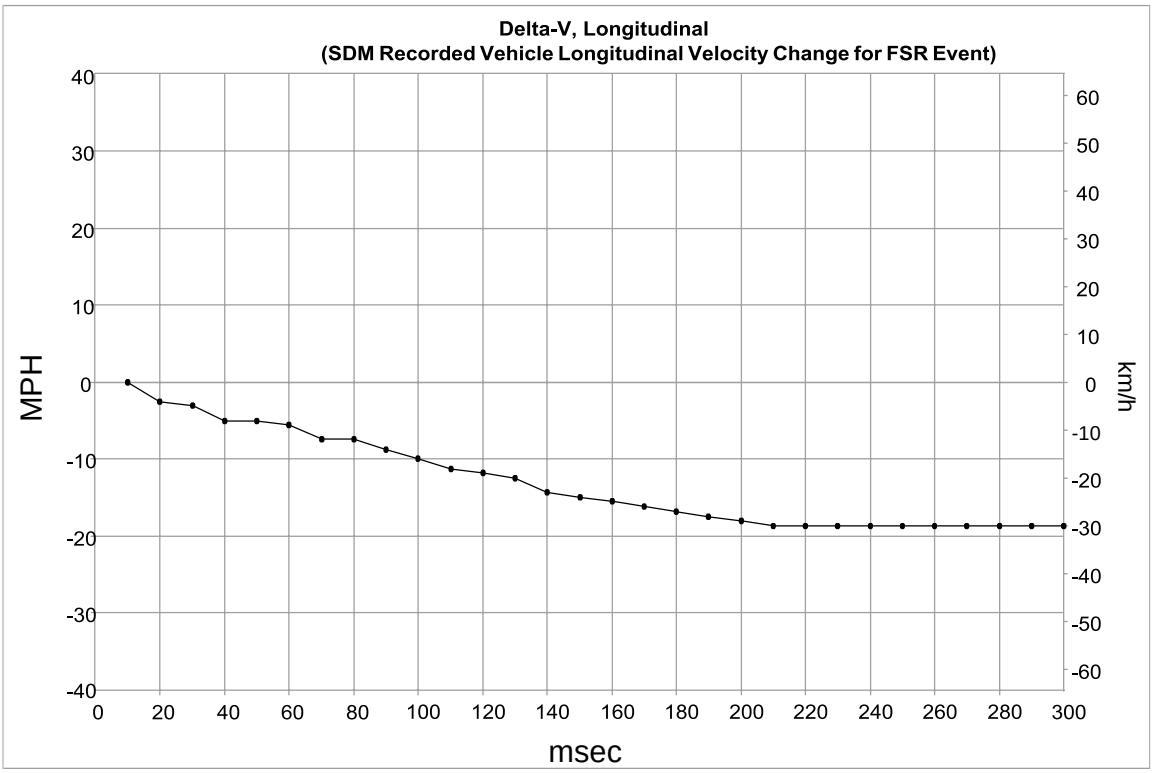
DTCs Present at Time of Event (Event Record 1)

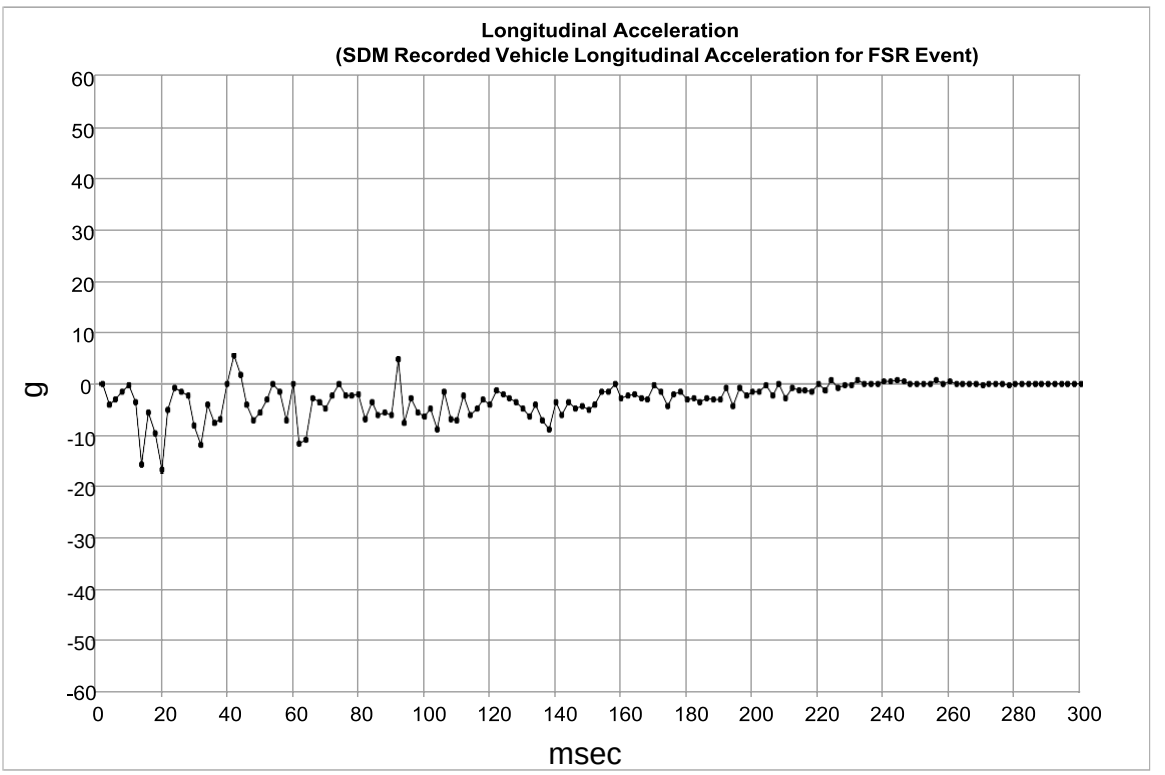
B0052-00

Event Data (Event Record 1)

Driver 1st Stage Deployment Loop Commanded	Yes
Passenger 1st Stage Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded	Yes
Passenger 2nd Stage Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop #1 Commanded	Yes
Passenger Pretensioner Deployment Loop #1 Commanded	Yes
Driver Pretensioner Deployment Loop #2 Commanded	Yes
Passenger Pretensioner Deployment Loop #2 Commanded	Yes
Driver Thorax Loop Commanded	Yes
Passenger Thorax Loop Commanded	No
Left Row 1 Roof Rail/Head Curtain Loop Commanded	Yes
Right Row 1 Roof Rail/Head Curtain Loop Commanded	Yes
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Driver (Driver 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	23
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (Driver 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	123
Frontal Air Bag Deployment, Time to 1st Stage Deployment, Right Front Passenger (Passenger 1st Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (Passenger 2nd Stage Time From Time Zero to Deployment Command Criteria Met) (msec)	Data Not Available
Side air bag deployment, time to deploy, driver (Driver Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	5
Side air bag deployment, time to deploy, right front passenger (Passenger Thorax/Curtain Time From Time Zero to Deployment Command Criteria Met) (msec)	5
Pretensioner Deployment, Time to Fire, Driver (Driver Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	5
Pretensioner Deployment, Time to Fire, Right Front Passenger (Passenger Pretensioner Time From Time Zero to Deployment Loop #1 or Loop #2 Command Criteria Met) (msec)	5

Longitudinal Crash Pulse (Event Record 1)





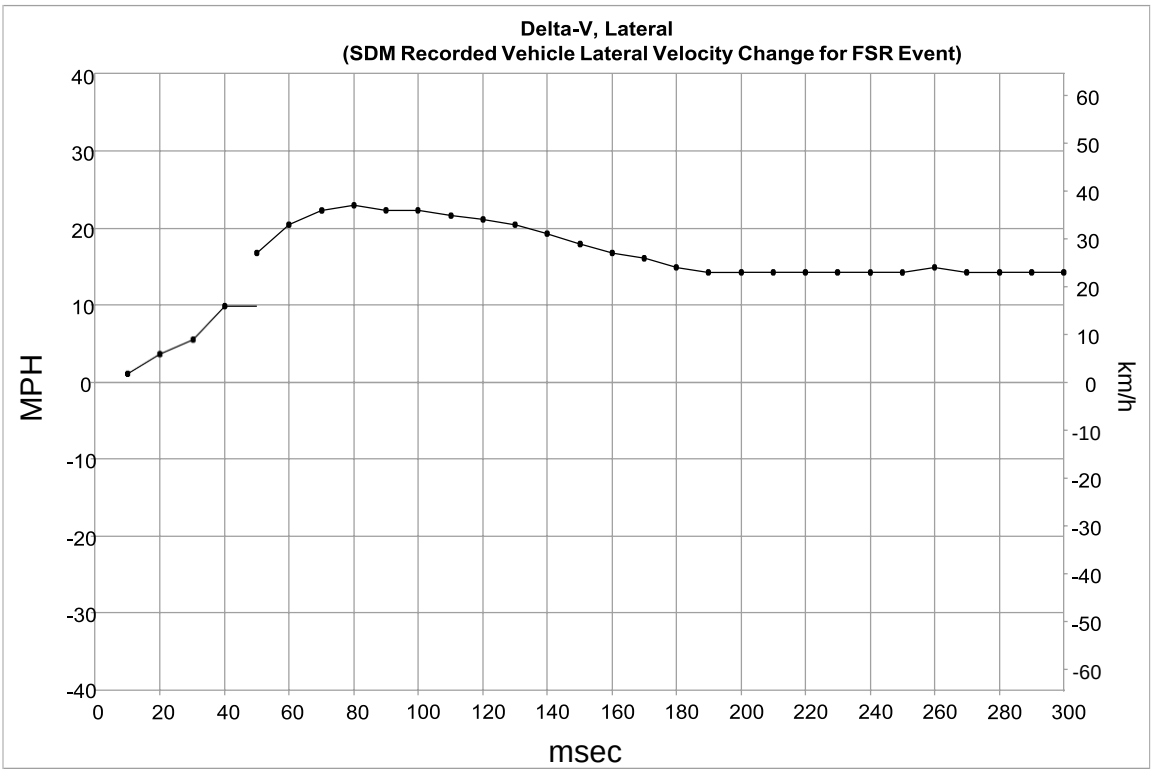
Longitudinal Crash Pulse (Event Record 1)

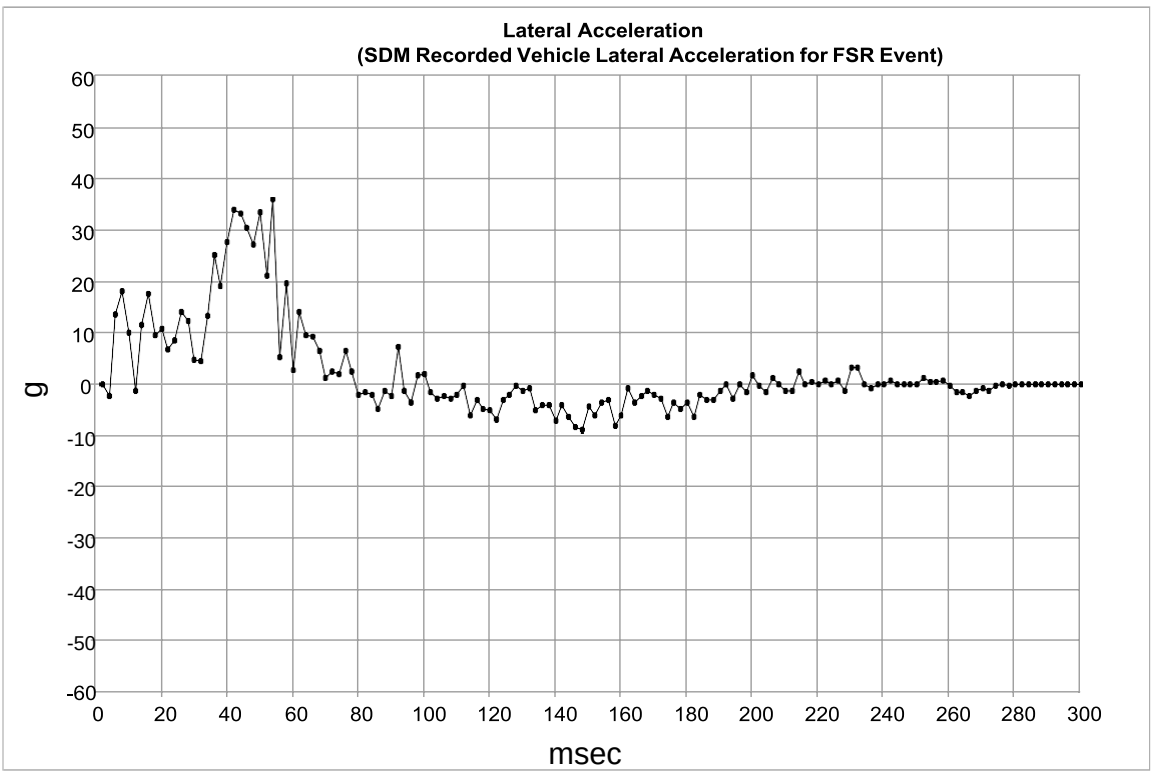
Time (msec)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (MPH)	Delta-V, Longitudinal (SDM Recorded Vehicle Longitudinal Velocity Change for FSR Event) (km/h)
10	0.0	0.0
20	-2.5	-4.0
30	-3.1	-5.0
40	-5.0	-8.0
50	-5.0	-8.0
60	-5.6	-9.0
70	-7.5	-12.0
80	-7.5	-12.0
90	-8.7	-14.0
100	-9.9	-16.0
110	-11.2	-18.0
120	-11.8	-19.0
130	-12.4	-20.0
140	-14.3	-23.0
150	-14.9	-24.0
160	-15.5	-25.0
170	-16.2	-26.0
180	-16.8	-27.0
190	-17.4	-28.0
200	-18.0	-29.0
210	-18.6	-30.0
220	-18.6	-30.0
230	-18.6	-30.0
240	-18.6	-30.0
250	-18.6	-30.0
260	-18.6	-30.0
270	-18.6	-30.0
280	-18.6	-30.0
290	-18.6	-30.0
300	-18.6	-30.0

Longitudinal Crash Pulse (Event Record 1)

Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)	Time (msec)	Longitudinal Acceleration (SDM Recorded Vehicle Longitudinal Acceleration for FSR Event) (g)
2	-0.2	102	-5.0	202	-1.8
4	-4.2	104	-9.0	204	-0.6
6	-3.4	106	-1.8	206	-2.6
8	-1.8	108	-7.0	208	-0.2
10	-0.6	110	-7.4	210	-3.0
12	-3.8	112	-2.6	212	-1.0
14	-15.8	114	-6.2	214	-1.4
16	-5.8	116	-5.0	216	-1.4
18	-9.8	118	-3.4	218	-1.8
20	-17.0	120	-4.2	220	-0.2
22	-5.4	122	-1.4	222	-1.4
24	-1.0	124	-2.2	224	0.6
26	-1.8	126	-3.0	226	-1.0
28	-2.6	128	-3.8	228	-0.6
30	-8.2	130	-5.0	230	-0.6
32	-12.2	132	-6.6	232	0.6
34	-4.2	134	-4.2	234	-0.2
36	-7.8	136	-7.4	236	-0.2
38	-7.0	138	-9.0	238	-0.2
40	-0.2	140	-3.8	240	0.2
42	5.4	142	-6.2	242	0.2
44	1.4	144	-3.8	244	0.6
46	-4.2	146	-5.0	246	0.2
48	-7.4	148	-4.6	248	-0.2
50	-5.8	150	-5.4	250	-0.2
52	-3.4	152	-4.2	252	-0.2
54	-0.2	154	-1.8	254	-0.2
56	-1.8	156	-1.8	256	0.6
58	-7.4	158	-0.2	258	-0.2
60	-0.2	160	-3.0	260	0.2
62	-11.8	162	-2.6	262	-0.2
64	-11.0	164	-2.2	264	-0.2
66	-3.0	166	-3.0	266	-0.2
68	-3.8	168	-3.4	268	-0.2
70	-5.0	170	-0.6	270	-0.6
72	-2.6	172	-1.8	272	-0.2
74	-0.2	174	-4.6	274	-0.2
76	-2.6	176	-2.2	276	-0.2
78	-2.6	178	-1.8	278	-0.6
80	-2.2	180	-3.4	280	-0.2
82	-7.0	182	-3.0	282	-0.2
84	-3.8	184	-3.8	284	-0.2
86	-6.2	186	-3.0	286	-0.2
88	-5.8	188	-3.4	288	-0.2
90	-6.2	190	-3.4	290	-0.2
92	4.6	192	-1.0	292	-0.2
94	-7.8	194	-4.6	294	-0.2
96	-3.0	196	-1.0	296	-0.2
98	-5.8	198	-2.6	298	-0.2
100	-6.6	200	-1.8	300	-0.2

Lateral Crash Pulse (Event Record 1)





Lateral Crash Pulse (Event Record 1)

Time (msec)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (MPH)	Delta-V, Lateral (SDM Recorded Vehicle Lateral Velocity Change for FSR Event) (km/h)
10	1.2	2.0
20	3.7	6.0
30	5.6	9.0
40	9.9	16.0
50	16.8	27.0
60	20.5	33.0
70	22.4	36.0
80	23.0	37.0
90	22.4	36.0
100	22.4	36.0
110	21.7	35.0
120	21.1	34.0
130	20.5	33.0
140	19.3	31.0
150	18.0	29.0
160	16.8	27.0
170	16.2	26.0
180	14.9	24.0
190	14.3	23.0
200	14.3	23.0
210	14.3	23.0
220	14.3	23.0
230	14.3	23.0
240	14.3	23.0
250	14.3	23.0
260	14.9	24.0
270	14.3	23.0
280	14.3	23.0
290	14.3	23.0
300	14.3	23.0

Lateral Crash Pulse (Event Record 1)

Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)	Time (msec)	Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for FSR Event) (g)
2	-0.2	102	-1.8	202	-0.6
4	-2.6	104	-3.0	204	-1.8
6	13.4	106	-2.6	206	1.0
8	17.8	108	-3.0	208	-0.2
10	9.8	110	-2.2	210	-1.4
12	-1.4	112	-0.6	212	-1.4
14	11.4	114	-6.2	214	2.2
16	17.4	116	-3.4	216	-0.2
18	9.4	118	-5.0	218	0.2
20	10.6	120	-5.4	220	-0.2
22	6.6	122	-7.0	222	0.6
24	8.2	124	-3.4	224	-0.2
26	13.8	126	-2.2	226	0.6
28	12.2	128	-0.6	228	-1.4
30	4.6	130	-1.4	230	3.0
32	4.2	132	-1.0	232	3.0
34	13.0	134	-5.4	234	-0.2
36	25.0	136	-4.2	236	-1.0
38	19.0	138	-4.2	238	-0.2
40	27.4	140	-7.4	240	-0.2
42	33.8	142	-4.2	242	0.6
44	33.0	144	-6.6	244	-0.2
46	30.2	146	-8.6	246	-0.2
48	27.0	148	-9.0	248	-0.2
50	33.4	150	-4.6	250	-0.2
52	21.0	152	-6.2	252	1.0
54	35.8	154	-3.8	254	0.2
56	5.0	156	-3.4	256	0.2
58	19.4	158	-8.2	258	0.6
60	2.6	160	-6.2	260	-0.6
62	13.8	162	-1.0	262	-1.8
64	9.4	164	-3.8	264	-1.8
66	9.0	166	-2.6	266	-2.6
68	6.2	168	-1.4	268	-1.4
70	1.0	170	-2.2	270	-1.0
72	2.2	172	-3.0	272	-1.4
74	1.8	174	-6.6	274	-0.6
76	6.2	176	-3.8	276	-0.2
78	2.2	178	-5.0	278	-0.6
80	-2.2	180	-3.8	280	-0.2
82	-1.8	182	-6.6	282	-0.2
84	-2.2	184	-2.2	284	-0.2
86	-5.0	186	-3.4	286	-0.2
88	-1.4	188	-3.4	288	-0.2
90	-2.6	190	-1.4	290	-0.2
92	7.0	192	-0.2	292	-0.2
94	-1.4	194	-3.0	294	-0.2
96	-3.8	196	-0.2	296	-0.2
98	1.4	198	-1.8	298	-0.2
100	1.8	200	1.4	300	-0.2

Rollover Crash Pulse (Event Record 1)
SDM Recorded Vehicle Roll Rate

Contains No Recorded Data

Rollover Crash Pulse (Event Record 1)
Lateral Acceleration (SDM Recorded Vehicle Lateral Acceleration for Rollover Event)

Contains No Recorded Data

Vertical Crash Pulse (Event Record 1)
Normal Acceleration (SDM Recorded Vehicle Vertical Acceleration for Rollover Event)

Contains No Recorded Data

Pre-Crash Data -5.0 to -0.5 sec (Event Record 1)

Times (sec)	Accelerator Pedal, % Full (Accelerator Pedal Position)	Service Brake (Brake Switch Circuit State)	Engine RPM (Engine Speed)	Engine Throttle, % Full (Throttle Position)	Speed, Vehicle Indicated (Vehicle Speed) (MPH [km/h])
-5.0	0	On	768	10	4 [7]
-4.5	0	On	768	10	2 [4]
-4.0	0	Off	768	10	2 [3]
-3.5	0	Off	768	10	2 [3]
-3.0	12	Off	1024	21	2 [4]
-2.5	17	Off	1216	24	4 [6]
-2.0	18	Off	1472	26	6 [9]
-1.5	62	Off	1984	47	7 [12]
-1.0	99	Off	2560	71	12 [19]
-0.5	37	Off	2816	39	19 [30]

Pre-Crash Data -2.0 to -0.5 sec (Event Record 1)

Times (sec)	Cruise Control Active	Cruise Control Resume Switch Active	Cruise Control Set Switch Active	Engine Torque (lb-ft [N-m])	Reduced Engine Power Mode Indicator
-2.0	No	No	No	61 [83]	Off
-1.5	No	No	No	141 [191]	Off
-1.0	No	No	No	198 [269]	Off
-0.5	No	No	No	150 [204]	Off

Hexadecimal Data

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DPID $11
FF F0 00 F0 C0 78 00

DPID $15
01 02 03 04 05 06 07

DPID $16
08 09 0A 0D 0E 00 00

DPID $17
00 00 00 00 00 00 00

DPID $32
00 FD 1C E8 00 00 00

DPID $35
78 00 00 00 00 00 00

DID $01
41 55 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $03
41 54 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $05
41 48 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $07
41 4A 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $09
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $0B
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $0D
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $0F
30 30 30 30 30 30 45 30 30 30 30 30 30 30 30

DID $30
01 00 01 01

DID $90
FF FF FF FF FF FF FF FF FF FF FF 2A 2A 2A 2A 2A 2A

DID $9A
04 01

DID $B4
41 53 36 37 39 36 45 30 35 30 30 32 37 34 38 32

DID $C1
01 5C 28 1B

DID $C2
01 5C 28 1A

DID $CB
01 5C 28 1C

DID $31
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0000    A5 F0 01 00 01 01 0B 1C E7 FF
0010    FF 00 00 00 16 A3 E3 00 00 00
0020    4C FC FC F0 00 00 C0 10 25 63
0030    3E 12 11 0C 00 00 00 00 00 00
0040    50 00 00 00 00 2C 28 1F 17 13
0050    10 0C 0C 0C 0C 08 38 08 BA 08
0060    1E 07 46 27 47 2F 1A 18 15 0A
0070    0A 0A 0A 1E 13 0C 09 06 04 03
0080    03 04 07 00 FF FD 06 A3 FD 00
0090    00 00 00 00 00 00 00 00 00 00
0100    00 00 00 00 00 00 00 00 00 00
0110    00 00 00 80 52 00 61 72 A4 27
0120    17 7B FF FF 05 05 05 05 7F 81
0130    7B 85 7A 88 77 8F 77 9A 76 A0
0140    73 A3 73 A4 71 A3 6F A3 6D A2
0150    6C A1 6B A0 68 9E 67 9C 66 9A
0160    65 99 64 97 63 96 62 96 61 96
0170    61 96 61 96 61 96 61 96 61 97
0180    61 96 61 96 61 96 61 96 7F 7F
0190    75 79 77 A1 7B AC 7E 98 76 7C
0200    58 9C 71 AB 67 97 55 9A 72 90
0210    7D 94 7B A2 79 9E 6B 8B 61 8A
0220    75 A0 6C BE 6E AF 7F C4 8D D4
0230    83 D2 75 CB 6D C3 71 D3 77 B4
0240    7F D9 7B 8C 6D B0 7F 86 62 A2
0250    64 97 78 96 76 8F 73 82 79 85
0260    7F 84 79 8F 79 85 7A 7A 6E 7B
0270    76 7A 70 73 71 7C 70 79 8B 91
0280    6C 7C 78 76 71 83 6F 84 73 7B
0290    69 78 7B 79 6E 78 6D 7A 79 7E
0300    70 70 73 77 77 73 75 72 7C 6E
0310    7A 77 78 7A 76 7E 73 7C 6F 7D
0320    75 72 6D 75 69 75 76 6D 70 75
0330    76 6F 73 6A 74 69 72 74 75 70
0340    7B 76 7B 77 7F 6B 78 70 79 7D
0350    7A 76 78 79 77 7C 7E 7A 7B 78
0360    74 6F 7A 76 7B 73 77 76 78 6F
0370    76 7A 78 77 77 77 77 7C 7D 7F
0380    74 78 7D 7F 79 7B 7B 83 7B 7E
0390    7E 7B 79 82 7F 7F 78 7C 7D 7C
0400    7C 85 7C 7F 7B 80 7F 7F 7C 81
0410    81 7F 7D 81 7E 7C 7E 87 81 87
0420    7F 7F 7F 7D 7F 7F 80 7F 80 81
0430    81 7F 80 7F 7F 7F 7F 7F 7F 82
0440    7F 80 81 80 7F 81 80 7E 7F 7B
0450    7F 7B 7F 79 7F 7C 7E 7D 7F 7C
0460    7F 7E 7F 7F 7E 7E 7F 7F 7F 7F
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 0820   26 00 00 00 00 00 00 00 00 00
 0830   00 00 00 00 00 00 00 00 00 00
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Disclaimer of Liability

The users of the CDR product and reviewers of the CDR reports and exported data shall ensure that data and information supplied is applicable to the vehicle, vehicle's system(s) and the vehicle ECU. Robert Bosch LLC and all its directors, officers, employees and members shall not be liable for damages arising out of or related to incorrect, incomplete or misinterpreted software and/or data. Robert Bosch LLC expressly excludes all liability for incidental, consequential, special or punitive damages arising from or related to the CDR data, CDR software or use thereof.

APPENDIX B: 2006 FORD F350
Event Data Recorder (EDR) Report[1]

[1] The EDR Report contained in this technical report was imaged using the current version of the Bosch CDR software at the time of the 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	1FDWW37P16E******
User	
Case Number	
EDR Data Imaging Date	01/26/2017
Crash Date	
Filename	IN17001_V2_ACM.CDRX
Saved on	Thursday, January 26 2017 at 17:08:57
Imaged with CDR version	Crash Data Retrieval Tool 17.2
Imaged with Software Licensed to (Company Name)	NHTSA
Reported with CDR version	Crash Data Retrieval Tool 17.7
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Deployment

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 Thursday, January 26 2017 at 17:08:57.

Data Limitations

Important Limitations on Bosch Crash Data Retrieval (CDR) Tool Capabilities.

Disclaimer: This Restraint Control Module (RCM) records longitudinal deceleration data for the purpose of understanding the input data the Restraint Control Module used to determine whether or not to deploy restraint devices. This module does not record vehicle speed, throttle position, brake on-off, and other data, which may be recorded in some 1999 model year and later General Motors modules. The deceleration data recorded by Ford's module during a crash can subsequently be mathematically integrated into a longitudinal Delta-V. Delta-V is the change in velocity during the recording time and is NOT the speed the vehicle was traveling before the accident, and is also not the Barrier Equivalent Velocity. The Bosch CDR Tool will read and interpret both acceleration in G's and Delta-V in mph. RCM's in Ford vehicles that can be read by the Bosch CDR tool are listed in the Bosch Help Files.

Important

If there is any question that the restraint system did not perform as it was designed to perform, please read the system only through the diagnostic link connector. The Bosch CDR kit provides an RCM interface cable to plug directly into the restraint control module. The Bosch CDR RCM Interface Cable connects only power, ground, and memory read pins to the relevant vehicle restraint control module. The other RCM pins normally connect to inputs, such as sensors, and outputs, such as airbags, are not connected when you use the RCM Interface Cable to plug directly into the module. Since the vehicle restraint control module is constantly monitoring airbag system readiness (when powered), it will detect that the sensors and airbags are not connected. The restraint control module may record a new diagnostic trouble code into memory for each device that is not connected. These new diagnostic trouble codes may record over previously written diagnostic trouble codes present prior to the accident and spoil evidence necessary to determine if the restraint system performed in the accident as it was designed to perform. Not only could this prevent Ford from being able to determine if the system performed as it was designed to perform, but, regardless of innocent inadvertence, you could raise issues of evidence spoliation in any litigation that may arise out of the accident. If you cannot read the module via the diagnostic link connector, and if you suspect improper system performance, contact Ford Motor Company and request their assistance to read the module with a proper vehicle simulator attached.

While data stored in RCM's is accurate, accident reconstructionists must be aware of the limitations of the data recorded in Ford's control modules and should compare the recorded data with the physical evidence at the accident scene using professional accident reconstruction techniques (i.e. vehicle crush characteristics, skid marks, etc) before making any assumptions about the import and validity of the data recorded in the module with respect to the crash event being analyzed. The following describes specific limitations that must be considered when analyzing recorded data. Investigators should obtain permission of the vehicle owner or have sufficient legal authority prior to reading any data.

1. There may be no deceleration data recorded in the module.

Loss of power (cut wires, damaged battery, crushed fuse box) to the module during or immediately after the crash may prevent the crash data from being recorded. A backup power supply within the module has sufficient power to continue to analyze the deceleration data and deploy restraint devices if needed, but there is no backup power for recording.

If the deceleration input does not create a vehicle longitudinal Delta-V above 4 mph within 100 milliseconds, there may not be any data recorded.

2. In unusual circumstances, deceleration data stored in the module may be from a crash other than the one you are currently analyzing.
The module will record data from some non-deploy events. If, after the module has recorded data from a non-deploy event, and there is a subsequent event in which there is a loss of power and no new recording is made for that subsequent event, the deceleration data in the module's memory may be from the prior event. If the new, subsequent event is a deploy event and recording has occurred, the deployment times should be recorded. If there are no deployment times recorded, but airbags or other restraint devices are observed to have deployed, the recorded data that you read are most likely from a prior event.

Once an airbag or other restraint device has been commanded to deploy, the data recorded in connection with that deployment are "locked", and subsequent crashes cannot be recorded.

If a vehicle is being repaired, the RCM should be replaced after any crash in which restraint devices deploy. Early printed shop manuals refer to re-using modules by clearing the "crash data memory full" code, but this is no longer true and the latest on-line electronic shop manual directs that modules be replaced.

Crashes that involve multiple impacts will record only one of the impacts. If there is a deployment, the deployment event will be recorded and locked. If no restraint device is commanded to deploy, the recorded data are not "locked", and subsequent impacts may record over any previous recorded data. Further analysis will be required to determine which of the events was actually recorded.

3. The computed longitudinal Delta-V may understate the total Delta-V

Many real-world crashes can last longer than the memory has the capacity to record. Therefore, the actual Delta-V of the event may be higher than the Delta-V calculated and displayed by the Bosch CDR System output. Review the end of the longitudinal acceleration/deceleration pulse - if it has not settled to zero G's by the end of the recording, the vehicle longitudinal Delta-V is most likely understated. If there is a clear decaying trend line you may choose, at your own risk, to estimate the total Delta-V by extrapolating the decay trend to zero and to calculate the additional Delta-V not captured.

Under some circumstances where power is interrupted, during the recording of data, or the module re-sets during the recording of data, a partial recording may occur. This will be shown as "no data" in the data table and will not be plotted on the graph of acceleration. When some portion of the acceleration data is not recorded, the Delta-V during that time cannot be calculated. A Delta-V will be calculated for the points that are valid, but the user must be aware that the partial Delta-V calculated will further underestimate the actual event total Delta-V.

4. This module records only longitudinal acceleration/deceleration of the vehicle. You must compute lateral or resultant total acceleration based on your estimated Principal Direction of Force (PDOF).

5. Vertical acceleration/decelerations are not recorded. Vehicle spin about a point not centered on the Restraints Control Module sensor may add or subtract from bulk vehicle motion.

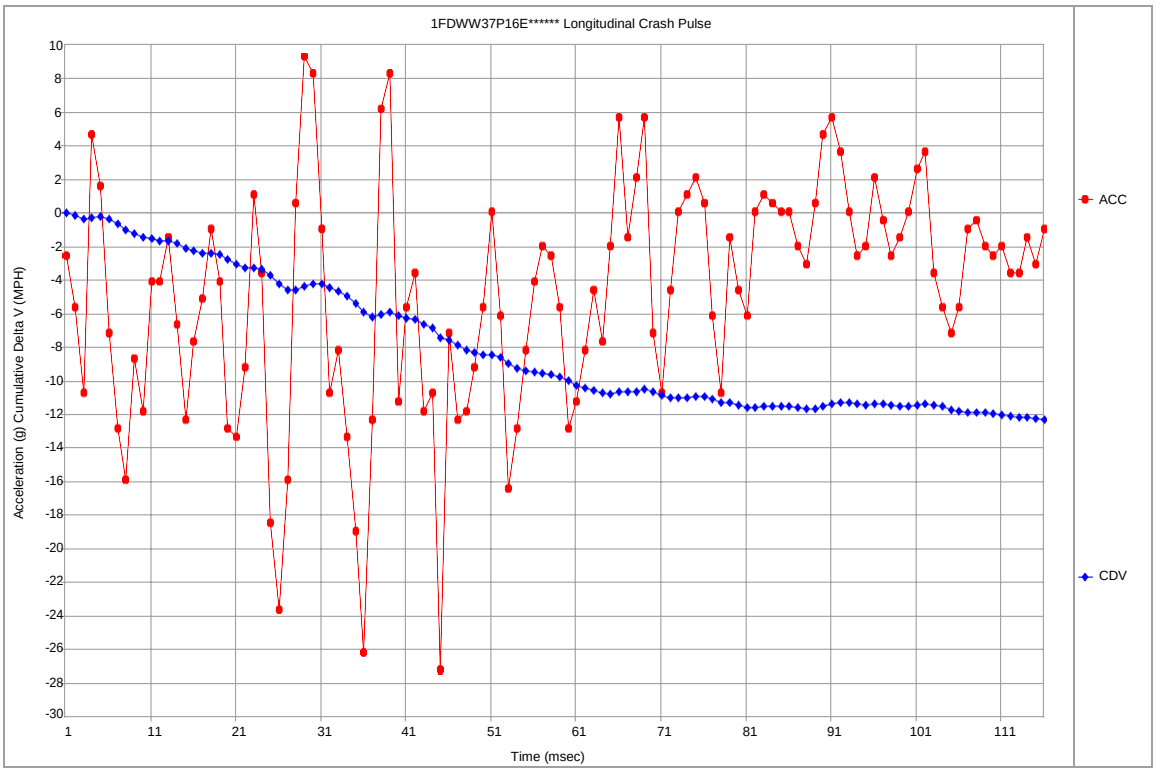
6. This module is not intended to record acceleration/deceleration in a side-impact event. If the side impact generates a longitudinal deceleration component sufficient to wake up the frontal deployment algorithm, there may be a recording of longitudinal deceleration in a side impact event.

Any Longitudinal Delta-V determined by using data read from the air bag module should be verified with physical evidence from the crash (such as vehicle crush, skid marks) and assumed accident sequence. Multiple impacts, angular collisions, side impacts, vehicle spin, etc should be considered in addition to the data read from the air bag module.

02001_RCM-1_r002

System Status At Deployment

Diagnostic codes active when event occurred	0
Passenger Airbag Switch Position During Event	Activated
Time From Side Safing Decision to Left (Driver) Side Bag Deployment (msec)	Not Deployed
Frontal and Pretensioner Fire time (ms)	45


1FDWW37P16E****** Longitudinal Crash Pulse
Acceleration (g) Cumulative Delta V (MPH)
Time (msec)
ACC
CDV

Crash Pulse Data

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
1	-2.57	-0.06
2	-5.65	-0.18
3	-10.79	-0.42
4	4.63	-0.32
5	1.54	-0.28
6	-7.20	-0.44
7	-12.85	-0.72
8	-15.93	-1.07
9	-8.74	-1.26
10	-11.82	-1.52
11	-4.11	-1.61
12	-4.11	-1.70
13	-1.54	-1.74
14	-6.68	-1.88
15	-12.34	-2.16
16	-7.71	-2.32
17	-5.14	-2.44
18	-1.03	-2.46
19	-4.11	-2.55
20	-12.85	-2.83
21	-13.36	-3.13
22	-9.25	-3.33
23	1.03	-3.31
24	-3.60	-3.39
25	-18.50	-3.79
26	-23.64	-4.31
27	-15.93	-4.66
28	0.51	-4.65
29	9.25	-4.45
30	8.22	-4.27
31	-1.03	-4.29
32	-10.79	-4.53
33	-8.22	-4.71
34	-13.36	-5.00
35	-19.02	-5.42
36	-26.21	-5.99
37	-12.34	-6.26
38	6.17	-6.13
39	8.22	-5.95
40	-11.31	-6.20
41	-5.65	-6.32
42	-3.60	-6.40
43	-11.82	-6.66
44	-10.79	-6.90
45	-27.24	-7.49
46	-7.20	-7.65
47	-12.34	-7.92
48	-11.82	-8.18
49	-9.25	-8.38
50	-5.65	-8.51
51	0.00	-8.51
52	-6.17	-8.64
53	-16.45	-9.01

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
54	-12.85	-9.29
55	-8.22	-9.47
56	-4.11	-9.56
57	-2.06	-9.60
58	-2.57	-9.66
59	-5.65	-9.78
60	-12.85	-10.07
61	-11.31	-10.31
62	-8.22	-10.49
63	-4.63	-10.60
64	-7.71	-10.77
65	-2.06	-10.81
66	5.65	-10.69
67	-1.54	-10.72
68	2.06	-10.68
69	5.65	-10.55
70	-7.20	-10.71
71	-10.79	-10.95
72	-4.63	-11.05
73	0.00	-11.05
74	1.03	-11.03
75	2.06	-10.98
76	0.51	-10.97
77	-6.17	-11.10
78	-10.79	-11.34
79	-1.54	-11.38
80	-4.63	-11.48
81	-6.17	-11.61
82	0.00	-11.61
83	1.03	-11.59
84	0.51	-11.58
85	0.00	-11.58
86	0.00	-11.58
87	-2.06	-11.62
88	-3.08	-11.69
89	0.51	-11.68
90	4.63	-11.58
91	5.65	-11.45
92	3.60	-11.38
93	0.00	-11.38
94	-2.57	-11.43
95	-2.06	-11.48
96	2.06	-11.43
97	-0.51	-11.44
98	-2.57	-11.50
99	-1.54	-11.53
100	0.00	-11.53
101	2.57	-11.48
102	3.60	-11.40
103	-3.60	-11.48
104	-5.65	-11.60
105	-7.20	-11.76
106	-5.65	-11.88
107	-1.03	-11.91
108	-0.51	-11.92
109	-2.06	-11.96

Milliseconds	Long. Acceleration (Gs)	Long. Cumulative Delta V (MPH)
110	-2.57	-12.02
111	-2.06	-12.06
112	-3.60	-12.14
113	-3.60	-12.22
114	-1.54	-12.26
115	-3.08	-12.32
116	-1.03	-12.35

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.

```
0800:  A6 42 40 5F 14 A2 58 2D 0D 23 0F 2D 38 4C C8 FF
0810:  10 FF F0 13 3C 78 F1 9E 08 A2 F9 EF 19 99 52 49
0820:  2D 03 B3 43 1E 0A F5 0A A1 5E 03 0E 1D 1E 00 25
0830:  3C 3C 80 28 05 28 B7 07 28 18 08 08 03 84 B7 06
0840:  04 05 0B 05 AD 42 41 06 5E 00 64 00 B4 0B B8 03
0850:  E8 09 60 11 30 05 78 09 60 17 70 00 78 00 CA 0E
0860:  74 11 30 03 20 00 08 00 0F 00 12 03 20 05 78 75
0870:  30 00 FA 00 17 03 20 07 D0 03 20 00 C8 04 45 01
0880:  DC 00 12 00 DC 00 78 01 EF D0 1E 40 14 08 FA 3C
0890:  32 1C 32 EE 3C 28 5A B4 FA 6B 02 18 10 05 FF 20
08A0:  14 FF 50 01 60 CC 4F FF FF FF FF FF FF FF FF D7
08B0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
08C0:  04 FF FF FF FF FF 57 09 63 35 43 33 41 02 02 1C
08D0:  00 FE 00 00 FF 00 02 FC 80 09 FC 80 0A FC 80 FF
08E0:  03 FD 80 04 FD 80 32 FD 80 2F FD 80 00 FB 00 FF
08F0:  1F 06 00 00 00 80 04 FF FF FF FF FF FF FF 00 40
0900:  06 31 76 57 09 98 FF FF FF 00 73 AA AA FF FF AA
0910:  AA 90 08 76 28 FF FF 26 20 45 83 26 02 95 FF 02
0920:  98 92 88 A6 A0 8F 84 7E 8C 86 95 95 9A 90 85 8E
0930:  93 9B 95 84 83 8B 9F 96 79 6F 7E 9E AF AD 9B 88
0940:  8D 83 78 6A 85 A9 AD 87 92 96 86 88 68 8F 85 86
0950:  8B 92 9D 91 7D 84 8D 95 99 98 92 84 87 8D 94 8E
0960:  99 A8 9A A1 A8 8F 88 94 9D 9F A1 9E 91 88 9A 94
0970:  91 9D 9F 9E 9D 9D 99 97 9E A6 A8 A4 9D 98 99 A1
0980:  9C 98 9A 9D A2 A4 96 92 8F 92 9B 9C 99 98 99 96
0990:  96 9A 97 9B 9D 04 00 00 20 97 00 00 00 00 00 00
09A0:  00 B2 00 B4 00 00 00 2D 00 6B 00 70 00 00 00 06
09B0:  00 00 00 DA 00 B4 00 C8 02 10 00 00 00 00 00 00
09C0:  00 00 B4 FF 01 FF FF 07 F9 00 FF FF FF FF FF FF
09D0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
09E0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
09F0:  FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
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Disclaimer of Liability

The users of the CDR product and reviewers of the CDR reports and exported data shall ensure that data and information supplied is applicable to the vehicle, vehicle's system(s) and the vehicle ECU. Robert Bosch LLC and all its directors, officers, employees and members shall not be liable for damages arising out of or related to incorrect, incomplete or misinterpreted software and/or data. Robert Bosch LLC expressly excludes all liability for incidental, consequential, special or punitive damages arising from or related to the CDR data, CDR software or use thereof.

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**National Highway
Traffic Safety
Administration**

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