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Special Crash Investigations
Air Bag Non-Deployment Crash Investigation
Vehicle: 2017 BMW X5
Location: Oregon
Crash Date: December 2016

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15. Supplementary Notes

This report documents the on-site investigation of the non-deployment of side air bags in a 2017 BMW X5 that was involved in a crash and the injuries sustained by the driver.

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.

16. Abstract

The crash involved three vehicles and occurred during the evening on a north/south State highway in Oregon in December 2016. The 2017 BMW X5 was being driven northbound by a belted 37-year-old female. The two other vehicles involved in the crash were a 2006 Saturn Ion being driven southbound by a belted 24-year-old female and a 2005 Pontiac Grand Prix being driven northbound by a belted 46-year-old male. The Saturn crossed the centerline for unknown reasons and entered the northbound lanes. The first event occurred between the Saturn and Pontiac and a second event occurred between the Saturn and the BMW. Following the second event, the BMW departed the roadway, struck a fence, and came to rest on the roadside. None of the BMW's air bags deployed during the crash. The driver of the Saturn sustained fatal injuries and was declared deceased on-scene. The other two drivers sustained non-life-threatening injuries and were transported by ambulance to local hospitals. Based on all available data there was no evidence suggesting the vehicle was involved in any impact of sufficient severity to warrant a side air bag deployment. The relatively low lateral delta-V caused by the vehicle-to-vehicle impact was likely below the threshold for triggering a side air bag deployment.

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Case Number: DS17002
Office of Defects Investigation
On-Site Air Bag Non-Deployment Crash Investigation
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BACKGROUND

This report documents the on-site investigation of the non-deployment of side air bags in a 2017 BMW X5 (**Figure 1**) that was involved in a crash and the injuries sustained by the driver. The investigation was initiated in response to a driver notification sent to the National Highway Traffic Safety Administration's Office of Defects Investigation (ODI). The Special Crash Investigations (SCI) group assigned the case to Dynamic Science, Inc., in February 2017. The owner of the BMW indicated in the notification that the vehicle's side air bag did not deploy in the crash, causing a head injury to the driver. The investigation was intended to determine occupant restraint usage, kinematics, injury sources, and air bag deployment parameters for this vehicle. Based on all available data there was no evidence suggesting the vehicle was involved in any impact of sufficient severity to warrant a side air bag deployment.

Figure 1. 2017 BMW X5

The BMW was being held at an auto body shop for a time and some tear-down was performed, but efforts to repair the vehicle were later ceased and it was declared to be a total loss. SCI obtained permission to conduct an on-site inspection following the vehicle's removal to an auto auction facility. The inspection was completed in April 2017. The BMW was supported by the Bosch Crash Data Retrieval (CDR) system and the vehicle's event data recorder (EDR) was imaged during the inspection. Air bag data found in the EDR report is discussed later in this report and the complete EDR report is included at the end of this report as an Attachment. The EDR report did not reveal any diagnostic trouble codes (DTCs) or other evidence indicating the supplemental restraint system performed in a way other than typically intended. The relatively low lateral delta-V caused by the vehicle-to-vehicle impact was likely below the threshold for triggering a side air bag deployment.

The three-vehicle crash occurred during the evening on a north/south State highway in Oregon in December 2016. The BMW was being driven northbound by a belted 37-year-old female.

The two other vehicles involved in the crash included a 2006 Saturn Ion being driven southbound by a belted 24-year-old female and a 2005 Pontiac Grand Prix being driven northbound by a belted 46-year-old male. The Saturn crossed the centerline for unknown reasons and entered the northbound lanes. The first event occurred between the Saturn and Pontiac and the second event occurred between the Saturn and the BMW. Following the second event, the BMW departed the roadway, struck a fence, and came to rest on the roadside. The two other vehicles came to rest on the shoulder. The driver of the Saturn sustained fatal injuries and was declared deceased on- scene. The other two drivers sustained non-life-threatening injuries and were transported by ambulance to local hospitals. All three vehicles were towed due to damage and the BMW was taken to a repair facility. It was later transferred to an auction facility and sold.

Crash Site

The crash occurred in the northbound lanes on a straight and level section of a divided north/south State highway (**Figure 2**). The roadway was asphalt surfaced and configured with two lanes each direction of travel separated by a painted divider. All lanes and the center divider measured 3.7 m (12.1 ft) wide. The lanes were delineated by a solid white painted fog line on the right, a dashed white painted stripe in the center, and a double solid yellow painted strip with a rumble strip on the right. The northbound lanes were bordered on the right edge by a paved shoulder measuring 3.0 m (9.8 ft) wide, a strip of ground measuring 10.8 m (35.4 ft), and a barbed wire fence. The posted speed limit for this roadway was 105 km/h (65 mph).

Figure 2. Crash site looking north

Police indicated the roadway was dry at the time of the crash with snow present on the roadside. Conditions at the time of the crash as reported by the nearest weather station were temperature 3.3 degrees C (26.1 degrees F), 66 percent humidity, calm winds, 16.0 km (10.0 mi) visibility, and cloudy skies. Light conditions were dark without illumination. A crash diagram is included at the end of this report.

Pre-Crash

The BMW was traveling northbound in the first lane from the right at an EDR-reported speed of 109 km/h (68 mph) with accelerator pedal position 0 percent full, engine RPM 1,600, steering input 0 degrees, service brake "Off," ABS activity "No ABS Activity" and stability control "Non-engaged" at Time Stamp -5.0 seconds. The driver of the BMW was watching the roadway and was not distracted. She heard or saw the first impact involving the other two vehicles then observed the Saturn approaching her vehicle in a trajectory from the left. At Time Stamp -0.5 seconds the data indicated vehicle speed 108 km/h (67 mph) and steering input 5 degrees (to right). At Time Stamp 0.0 seconds the data indicated vehicle speed 97 km/h (60 mph), steering input 50 degrees (to right),

service brake "On," ABS activity "ABS Activity" and stability control "On, Engaged." The air bag warning lamp was "Off." The table below summarizes the BMW's EDR-reported pre-crash data for time, vehicle speed, incremental and cumulative distance traveled for Record 1 in 0.5 second intervals.

Time Stamp (seconds)	Vehicle Speed km/h (mph)	Incremental Distance Traveled m (ft)	Cumulative Distance Traveled m (ft)
-5.0	109 (68)	NA	NA
-4.5	108 (67)	15.1 (49.7)	15.1 (49.7)
-4.0	108 (67)	15.0 (49.2)	30.1 (98.8)
-3.5	108 (67)	15.0 (49.2)	45.1 (148.0)
-3.0	108 (67)	15.0 (49.2)	60.1 (197.2)
-2.5	108 (67)	15.0 (49.2)	75.1 (246.4)
-2.0	108 (67)	15.0 (49.2)	90.1 (295.6)
-1.5	108 (67)	15.0 (49.2)	105.1 (344.8)
-1.0	108 (67)	15.0 (49.2)	120.1 (394.0)
-0.5	108 (67)	15.0 (49.2)	135.1 (443.2)
0	97 (60)	13.5 (44.3)	150.1 (492.5)

The table below summarizes the BMW's systems data at 0.0 seconds.

Time (sec) 0.0 at Event	Speed, Vehicle Indicated km/h (mph)	Accelerator Pedal (%)	Service Brake Activation
Record 1 (Most Recent)	97 (60)	0	On

The Pontiac was traveling northbound in the second lane from the right and slightly ahead of the BMW at a driver-reported speed of 96 km/h (60 mph). The Saturn was traveling southbound at an unknown speed in the second lane from the right. The police report indicated that the driver of the Saturn was overtaking another southbound vehicle and, for unknown reasons, departed the lane on the left edge, crossed over the center divider and entered the northbound lanes in a right side leading clockwise yaw. Police indicated the vehicle's tires deposited four yaw marks on the roadway beginning in the southbound lanes and ending in the northbound lanes.

Crash

The crash included three events. Initially, the front plane of the Pontiac struck the right plane of the Saturn (Event 1). The Saturn was displaced in an east trajectory at an unknown heading angle and an unknown plane of the vehicle struck the left plane of the BMW (Event 2). The driver of the BMW had already begun braking and steering to the right to avoid contact and, following the impact with the Saturn, the BMW traveled off the right edge of the roadway. It traveled diagonally in a northeast trajectory across a snow-covered area of ground measuring 10.8 m (35.4 ft) wide for approximately 43.0 m (140.0 ft) until the front plane of the BMW struck a barbed wire fence (Event 3). The vehicle came to rest in the area of the fence impact facing north (**Figure 3**). The Saturn and Pontiac both traveled short distances in an east trajectory before the Saturn came to rest facing south on the right shoulder and the Pontiac came to rest facing north in the right shoulder.

Figure 3. 2017 BMW X5 at final rest on roadside looking east (online news photo)

For the BMW in Event 2, the barrier algorithm of the WinSMASH program calculated a barrier equivalent speed (BES) of 11 km/h (7 mph). The plane of impact for the Saturn was unknown and the confidence level for the reconstruction was considered to be borderline. The EDR captured the vehicle-to-vehicle impact with the Saturn as a non-deployment event (Record 1, Most Recent). For this event, the EDR reported a maximum longitudinal delta-V of -10.0 km/h (-6.2 mph) and a maximum lateral delta-V of 7.0 km/h (4.3 mph). Those values were used to calculate a total delta-V of 10.1 km/h (6.3 mph) and a 320 degree principal direction of force (PDOF). The EDR reported this impact as a frontal event. However, damage to the vehicle's left plane as documented during the inspection indicated it was an impact to the vehicle's left plane. Direct damage to the front plane was caused during the subsequent fence impact.

For the Saturn in Event 2, WinSMASH calculated a BES of 7 km/h (4 mph).

For the BMW in Event 3, the barrier algorithm of the WinSMASH program calculated a BES of 12 km/h (7 mph). The EDR did not capture an event for the fence impact, probably because the delta-V was below the parameters required to trigger an event. Damage to the front plane consisted of scuff marks and minor crush (maximum 4 cm [1.6 in]) to the bumper fascia.

No air bags deployed in the BMW during the crash. According to the vehicle owner's manual, the air bags are not triggered in every impact situation, e.g., in less severe accidents or rear-end collisions. The manual did not include more specific deployment parameters. Given the relatively low delta-V of the two impacts sustained by the BMW, it is likely neither event met the deployment criteria for the vehicle's supplemental restraint system (SRS).

Post-Crash
Following the crash, the driver of the BMW waited for responders to arrive and was assisted from the vehicle through the left front door and transported by ambulance to a local hospital, where she was treated and released. The driver of the Saturn was declared deceased on-scene. The driver of the Pontiac complained of pain and was transported by ambulance to a local hospital. All three vehicles were towed due to damage and were later declared to be total losses.

2017 BMW X5

Description
The 2017 BMW X5 was identified by the Vehicle Identification Number (VIN): 5UXKR0C34H0xxxxxx. The vehicle's mileage at the time of the inspection was 1,091 km (678 mi). The BMW was a 4-door crossover type wagon configured with a rear hatch, 6-cylinder, 3.0-liter, gasoline engine with auto stop/start feature, automatic transmission, full-time all-wheel drive, antilock braking system (ABS), stability control, traction control, brake assist, daytime running lights, power tilt/telescoping steering column and tire specific low tire pressure warning. It was configured with automatic crash notification (ACN). The vehicle manufacturer recommended size P255/50R19 tires for the front and rear with a cold pressure of 250 kPa (36 psi) for the front and 300 kPa (44 psi) for the rear. The BMW was equipped with Michelin Latitude Tour HP tires of the recommended size manufactured in July 2016.

The BMW's interior was equipped with two rows of seating to accommodate a total of five occupants. The front row was configured with two bucket seats with power head restraints. The seat track for the driver was set in the middle position and her head restraint was adjusted to 5 cm (2.0 in) above the seat back. The front row seats were configured with active head restraints. According to the owner manual, in the event of a rear-end collision of sufficient severity, the active head restraint reduces the distance between the restraint and the head. Following actuation in a crash, the head restraint must be reset by a service center technician or the active safety feature will not be operational. The active head restraint for the driver did not actuate in this crash.

Exterior Damage
The BMW sustained direct contact damage to the left plane (Event 2) and front plane (Event 3) during the crash. Direct damage caused during the initial vehicle-to-vehicle impact (Event 2) began at the front right bumper corner and extended 263 cm (103.5 in) rearward, ending 30 cm (12.0 in) aft of the right B-pillar. Twenty-six measurements were taken at mid-door level using the Nikon Total Station and the Faro Blitz program computed crush measurement in six increments as follows: C_1 = 0 cm, C_2 = 3 cm (1.2 in), C_3 = 3 cm (1.2 in), C_4 = 12 cm (5.5 in), C_5 = 1 cm (0.4 in), C_6 = 0 cm. Maximum crush was located at 40 cm (16 in) aft of the left front axle and the collision deformation classification (CDC) for the BMW in Event 1 was 11LYEW2 (**Figure 4**).

Direct damage caused during the fence impact (Event 3) was located on the right aspect of the front bumper beginning 30 cm (11.8 in) left of front right bumper corner and extending 20 cm (7.9 in) to the left. The Field L extended from bumper corner to bumper corner and measured 180 cm (70.9 in). Twenty-one measurements were taken at bumper level using the Nikon Total Station and the Faro Blitz program computed crush measurement in six increments as follows: $C_1 = 4$ cm (1.6 in), $C_2 = 0$ cm, $C_3 = 1$ cm (0.4 in), $C_4 = 0$ cm, $C_5 = 0$ cm, $C_6 = 0$ cm. Maximum crush was located at the front left bumper corner and the CDC for the BMW in Event 1 was 12FREN1 (**Figure 5**).

Figure 4. Left side view, 2017 BMW X5

Figure 5. Front view, 2017 BMW X5

Event Data Recorder

The BMW's event data recorder was imaged via the data link connector (DLC). The report was imaged using Bosch CDR Tool version 17.3 and was reported using version 18.0.2. The complete EDR report is included in this report as **Appendix A**.

According to the air bag control module (ACM) data limitations, data for front, side, rear, and rollover events can be recorded either as non-deployment or deployment events.

Deployment events are locked into memory and cannot be overwritten. For this crash, the BMW was involved in two events, one a vehicle-to-vehicle which was captured by the EDR and one a fence impact that was not captured. Record 1, a vehicle-to-vehicle impact, was a frontal non-deployment event which was captured. Record 1 data included system status at event, deployment command data, pre-crash data -1 sec, pre-crash data -5 to 0 sec, and longitudinal and lateral crash pulse.

For Record 1, the event type was frontal, maximum longitudinal delta-V was -10.0 km/h (-6.2 km/h) and maximum lateral delta-V was -7.0 km/h (4.3 mph) at 65 ms. The pre-crash data at -1 second for this event was summarized as at Time Stamp -0.1 seconds as follows.

- Ignition Cycle, Crash: 151
- Safety Belt Status, Driver: Belted
- Safety Belt Status, Right Front Passenger: Unbelted
- Air Bag Warning Lamp: Off
- Seat Track Position Switch Status, Driver: Not Foremost

The EDR report did not reveal any diagnostic trouble codes (DTCs) or other evidence indicating the Supplemental Restraint System performed in a way other than intended. The relatively low lateral delta-V caused by the vehicle-to-vehicle impact was likely below the threshold for triggering a side air bag deployment.

NHTSA Recalls and Investigations

A search using the vehicle's year/make/model revealed one recall involving a potential inflator rupture of the driver's frontal air bag. A total number of 36 units were affected and a search using the vehicle's VIN revealed the vehicle involved in this crash was not affected. The recall search revealed one consumer complaint involving air bags which was submitted by the driver of the BMW involved in this crash investigation. No other recalls, complaints or investigations were listed among the recalls and safety issues at the time of this report.

Interior Damage

The BMW sustained minor interior damage caused by impact forces, integrity loss, driver contacts and post-crash activities. The left front and rear doors were jammed shut and the remaining doors and hatch remained closed and operational. The windshield was fractured at the top left aspect by an unknown source. The windshield was removed during tear down and was not inspected. The left side glass from the front and second row doors was missing. The front left side glass was contacted by the driver's head and disintegrated during the crash. The second row left side glass was removed during post-crash activities. The interior panels from the left side doors had also been removed during post-crash activities. The interior did not sustain any intrusion. The driver's seat belt was used during the crash but no evidence of driver loading was present.

Manual Restraint Systems

The BMW was equipped with seating for five occupants and all seats were configured with three-point lap and shoulder seat belts. The front row belts were equipped with retractor pretensioners, sliding latch plates and non-adjustable D-rings. The driver's belt was configured with an emergency locking retractor (ELR). The vehicle's EDR report indicated the driver's seat belt was buckled at the time of the crash. The pretensioner did not actuate. The driver probably loaded the belt during the two impacts but these were low delta-V events and the belt webbing did not reveal clearly defined loading evidence. An area of water stains and discoloration began 45.0 cm (17.7 in) above the stop button and extended 111.0 cm (43.7 in) upward toward the D-ring. The manual restraint for the driver of the BMW appeared to have functioned as intended.

Supplemental Restraint Systems

The BMW's occupant compartment was configured with eight air bags. The front row was configured with frontal air bags, knee air bag, and seat-mounted side air bags. The front and second rows were configured with combination roll-sensing/side impact IC air bags located above the side glass of both rows. No air bags deployed during the crash. The vehicle had been purchased new by the driver. It had no history of crashes, prior air bag deployments, or service.

Air Bag Non-Deployment Discussion

According to the vehicle owner's manual, the frontal air bag helps protect the driver and front passenger by responding to frontal impacts in which seat belts alone would not provide adequate restraint. The knee air bag supports the legs in a frontal impact. In a lateral impact, the seat-mounted side air bag supports the side of the body in the chest and lap area. In a lateral impact, the head (IC) air bag supports the head. The head (IC) air bag system is designed as an ejection mitigation countermeasure to reduce the likelihood of ejections of vehicle occupants through side windows during rollovers or side impact events. Regarding their protective action, the owner's manual states that air bags are not triggered in every impact situation, e.g., in less severe accidents or rear-end collisions. Both impacts in this crash involving the BMW were considered to be low severity impacts characterized by relatively low EDR-reported delta-V (none greater than 10.0 km/h (6.2 mph), limited crush (Extent Zone 1, swiping type damage) and no occupant compartment intrusion. The investigation revealed no evidence suggesting the left seat-mounted side air bag or left IC air bag should have deployed during the vehicle-to-vehicle impact.

2017 BMW X5 OCCUPANT

Driver Demographics

Age/Sex:	37 years/Female
Height:	163 cm (64 in)
Weight:	64 kg (140 lb)
Eyewear:	Prescription eyeglasses
Seat type:	Bucket seat with adjustable head restraint
Seat track position:	Middle
Manual restraint usage:	Lap and shoulder seat belt used
Usage source:	Vehicle inspection, EDR report and PAR
Air Bags:	Frontal air bag, knee air bag, seat-mounted side impact air bag, IC air bag not deployed
Alcohol/drug data:	None
Egress from vehicle:	Assisted through left door
Transport from scene:	Ambulance to local hospital
Type of medical treatment:	Treated and released

Driver Injuries

Inj. No.	Injury	AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1 2	Contusion, left face (temple), middle face and nose	210402.1	Side glass	Probable
3	Injuries to the head NFS (closed head injury)	100099.9	Side glass	Probable

Source: EMS Report, Interview

Driver Kinematics

The belted 37-year-old female driver of the BMW was seated in an upright posture and was operating the vehicle at a speed of 97 km/h (60 mph). She was watching the roadway and was not distracted. Just prior to impact with the other vehicle, she applied the brakes and steered right attempting to avoid contact by traveling off the roadway. At impact with the Saturn, the driver was displaced to the left and forward in response to the 320 degree direction of force. Her torso was held in place in her seat by the seat belt but her head and neck were displaced further to the left likely contacting and disintegrating the side glass and causing a contusion to the left temple and nose. She was wearing eyeglasses with plastic frames which likely contacted the side glass and face, causing a nose bleed. She had a piece of glass removed from her left eye which did not cause an injury. The driver also sustained an unspecified closed head injury without any loss of consciousness. During her transport to the hospital her Glasgow Coma Score (GCS) was 15. The driver missed three days from work while recovering from her injuries. She stated during the interview that she returned to full functionality in 2 to 3 weeks.

The BMW departed the roadway on the right edge and traveled across snow-covered ground during which time the driver was displaced slightly in response to the changing surface and uneven ground. At impact with the barbed wire fence, the driver was displaced forward toward the 0 degree direction of force. This was a low delta-V impact causing minor damage to the vehicle's front bumper. The BMW came to rest on the roadside in the area of the fence impact. Throughout the crash the driver was held in her seated position by the seat belt. Upon examination, neither the belt webbing, latch plate, or D-ring revealed evidence of driver loading and the seat belt pretensioner did not actuate. The driver did not sustain seat belt related contusions or abrasions. At some point, an unknown source caused a fracture to the windshield in a spider web pattern. During the interview, the driver stated she did not recall any part of her body contacting the windshield and no loose objects were present in the vehicle. Following the crash, her door was jammed shut. Responders pried it open and assisted the driver from the vehicle. She was transported by ambulance to a local hospital where she was treated and released.

2006 SATURN ION

Description

The 2006 Saturn Ion was identified in the police report using the VIN 1G8AZ5F06Zxxxxxx. The vehicle was a 4-door sedan configured with seating for 5 occupants. It was equipped with a 2.2 liter, 4-cylinder, gas engine, manual transmission, and front-wheel drive.

Exterior Damage

According to the police report and on-scene images, the Saturn sustained direct damage to the right plane and induced damage to the front, back, left, and top planes (**Figure 6**).

Figure 6. 2006 Saturn Ion at final rest looking east (online news photo)

Occupant Data

The belted 23-year-old female driver of the Saturn sustained fatal injuries of an unknown nature. She was declared deceased on-scene and her body was taken by the coroner to his office for examination.

2005 PONTIAC GRAND PRIX

Description

The 2005 Pontiac Grand Prix was identified in the police report using the VIN 2G2WP522351xxxxxx. The vehicle was a 4- door sedan equipped with a 3.8-liter, 6-cylinder, gasoline engine, front-wheel drive, and automatic transmission. It was configured with seating for 5 occupants and equipped with standard daytime running lights, tilt steering, ABS, and power steering, brakes, and windows.

Figure 7. 2005 Pontiac Grand Prix at final rest looking east (online news photo)

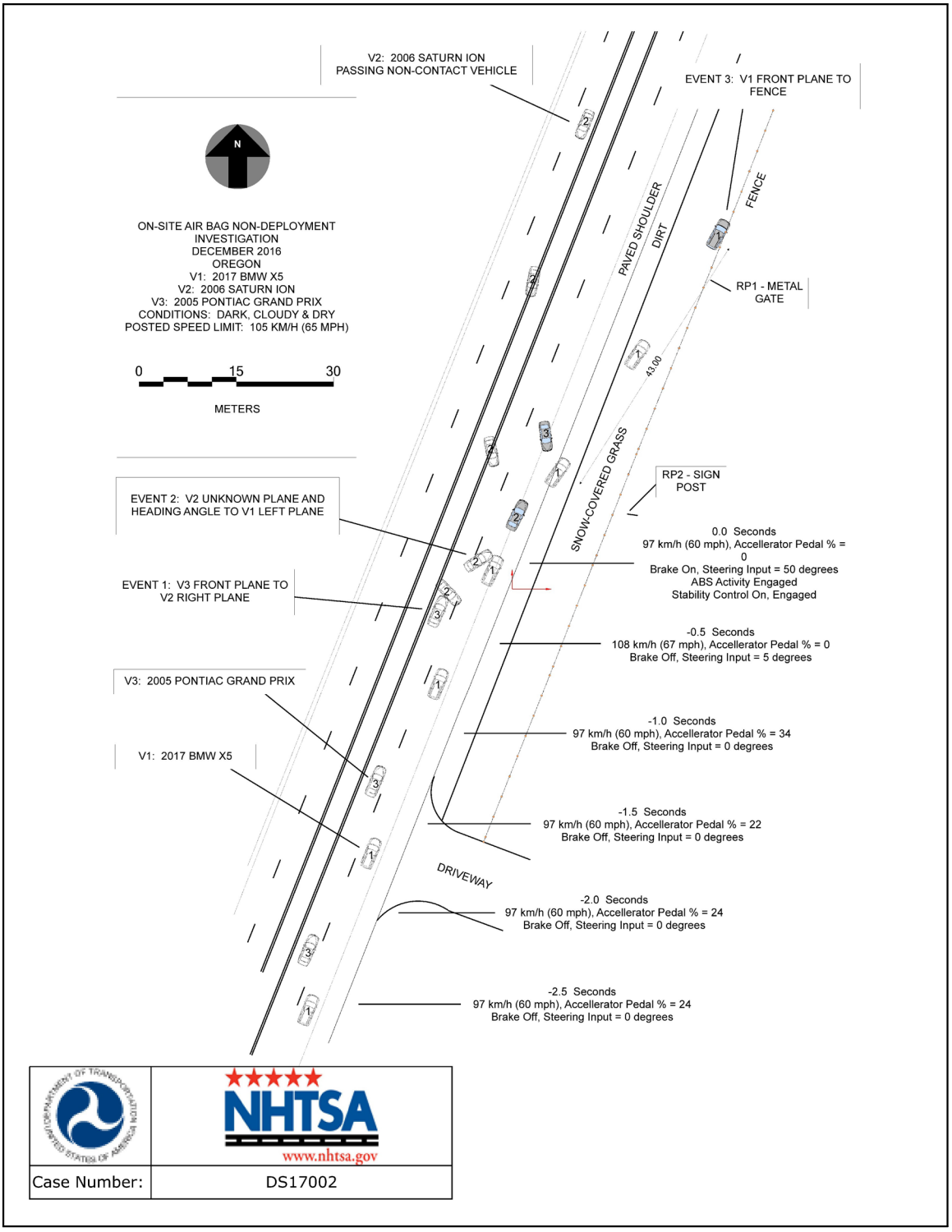
Exterior Damage

According to the police report and on-scene images (**Figure 7**), the Pontiac sustained direct damage to the front plane and induced damage to the left plane.

Occupant Data

Following the crash, the belted 22-year-old male driver of the Dodge complained of pain. He exited the vehicle unassisted and when responders arrived he was then transported to a local hospital where he was treated and released.

CRASH DIAGRAM



APPENDIX A: EVENT DATA RECORDER REPORT 2017 BMW X5[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	5UXKR0C34H0******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	201750S3DS17002_V1.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 17.3
Imaged with Software Licensed to (Company Name)	Company Name information was removed when this file was saved without VIN sequence number
Reported with CDR version	Crash Data Retrieval Tool 18.0.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Record 1

Comments

No comments entered.

Data Limitations

BMW AIRBAG CONTROL MODULE (ACSM) DATA LIMITATIONS:

General Information:
These limitations are intended to assist you in reading the event data that has been imaged from the vehicle's ACSM. They are not intended to provide specific information regarding the interpretation of this data. Event data should be considered in conjunction with other available physical evidence from the vehicle and scene.

BMW and Rolls Royce passenger vehicles designated as 2013 or later model year are designed to fulfill the "NHTSA 49 CFR 563 - Event Data Recorders" and to be compatible with the Bosch CDR tool.

The Recorded Crash Events can be read by the CDR over the vehicle's OBD connector which is the preferred procedure. Imaging data by connecting directly to the ACSM should only be attempted if the vehicle's electrical system is damaged. In this case proceed with CAUTION. When imaging by directly connecting to the ACSM, make sure the ACSM is not moved, tilted or turned over while connected to and powered by the CDR Interface Module. Also, after a CDR imaging process, wait at least one minute after power is removed from the ACSM before attempting to move the module. Not following these general ACSM guidelines for bench top imaging could cause new events to be recorded in the ACSM.

The ACSM current fault status will be altered if the ACSM is powered-up without having all of the other vehicle inputs connected. This situation will occur when imaging data while connected directly to the ACSM. This will not affect the stored fault data information in any of the Event Records.

To ensure the integrity of the data during imaging, the transmitted data will be first signed by the ACSM before being read by the CDR tool. This can take up to 60 seconds for each recorded event.
In case the signature build takes longer, a gateway timeout can occur. In this case the retrieving procedure should be retried under the same ignition cycle and could be successful, if not then a download directly from ECU is necessary.

Recorded Crash Events:
Data for front, side, rear and rollover events can be recorded as either non-deployment or deployment events. Both types of events can contain pre-crash and crash data. The ACSM can store up to five events such as Non-Deployment Events (NDE) and Deployment Events (DE):
- a Non-Deployment Event is recorded if the change in longitudinal or lateral velocity equals or exceeds 8km/h over a 150ms timeframe.
- a Deployment Event is recorded if any type of non-reversible deployable restraint device (e.g. front airbag(s), side airbag(s), side curtain airbag(s), ...) are commanded to deploy.
- Deployment Events are locked into memory and cannot be over-written.
- Non-Deployment Events are not locked into memory and (the oldest) can be over-written by subsequent Non-Deployment or Deployment Events.
- Recorded events will be imaged by the CDR tool in chronological order (the first event is the most recent one).

- If power to the ACSM is lost during an event, all the data of this event will be stored (see information "Complete file recorded"). For following events all or part of the event data record may not be recorded. Such events cannot be retrieved by the CDR tool.

The “event begin” t0 is:
- the change in longitudinal velocity equals or exceeds 0.8km/h over a 20ms timeframe (front threshold)
- the change in lateral velocity equals or exceeds 0.8km/h over a 5ms timeframe (side threshold)
- wake-up of the front, side or rear algorithm
- deployment of a restraint by the rollover algorithm.

The event recording will always be 300ms even if:
- the change in longitudinal and lateral velocity equals or falls below 0.8km/h over a 20ms timeframe OR,
- each algorithm is inactive.

Multiple Events:
Data recorded by the ACSM and imaged by the CDR tool is displayed relative to t0, not the time at which the vehicle made contact with another vehicle or object.

In case of multiple algorithm activities during an event (e.g. angular impact where algorithm start to algorithm reset for each individual algorithm) overlap in time (< 300ms) this is considered a “parallel event”. The first algorithm started (front, side or rear) or the first threshold reached or the deployment command of the rollover algorithm classifies the event type as “initial event”. The triggering times of the subsequent event(s) are in reference to t0 of the initial event and are reported.

If an accident consists of multiple events, during which the algorithm activities (algorithm start to algorithm reset for each individual algorithm) do not overlap in time and whose start times t0 are set apart less than 5 s, this is considered a multiple event.
A multiple event can consist of more than two events, provided their start times t0 are all within the 5 s following the initial event.
The chronological sequence within a multiple event is marked by the data element "multi-event, number of events." The time period between this event and the preceding event is marked in the data element "time from event n to n+1."

Data Element Sign Convention:
The sign convention is according to "NHTSA 49 CFR 563 - Event Data Recorders".

Data Element Name	Positive Sign Notation Indicates
Longitudinal Acceleration	Forward
Delta-V, Longitudinal	Forward
Maximum Delta-V, Longitudinal	Forward
Lateral Acceleration	Left to Right
Delta-V, Lateral	Left to Right
Maximum Delta-V, Lateral	Left to Right
Normal Acceleration	Downward
Vehicle Roll Angle	Clockwise Rotation around vehicles longitudinal axis
Steering Input	Right Turn

Data Elements:
Pre-Crash Data:
- Pre-Crash Data is recorded at 2 samples per second starting 5 seconds before t0.
- Pre-Crash Data is recorded asynchronously.
- Recorded Pre-Crash Data have a time resolution of 500ms. This can cause a possible delay of the collected data up to 500ms.
- Pre-Crash Data indicates “Data Invalid” if a message with an “invalid” flag from the module sending the pre-crash data is sent.
- Pre-Crash Data indicates “Data Not Available” if data is not received from the module sending the pre-crash data.
- Speed, vehicle indicated data is reported as an average of all wheels.
- Speed, vehicle indicated data accuracy can be affected by various factors, such as significant changes in tire size from the factory setting, wheel lockup or slip.
- Accelerator Pedal Position, percent full is the ratio of accelerator pedal position compared to the fully depressed position.
- Steering Input Angle is recorded in 5 degree increments and limited to -250 and 250 degrees.
- Service Brake Status only indicates driver initiated braking. An automatic braking (e.g. brake intervention by Adaptive Cruise Control) will not be recorded.
- ABS Activity Status indicates an ABS Control Intervention during driver initiated braking.
- Stability Control Status indicates a Stability Control Intervention. If the Stability Control is switched off by the driver, the recorded value is "Data Not Available".
- The EDR of all vehicles manufactured from July 2012 up to March 2013 cannot record an engagement of Stability Control (DSC) and is therefore not affected by the Table II requirements for data element “Stability control”. The recorded value will be “Non-engaged” even if Stability Control (DSC) actually engaged prior to the event.

Crash data:
- Acceleration data is recorded at 100Hz from t0 to 300ms.
- Delta-V data is recorded at 100Hz from t0 to 300ms.
- Delta-V, longitudinal reflects the change in velocity that the ACSM experienced in the longitudinal direction during the recorded portion of the event and is not the speed the vehicle was traveling before the event.
- Depending on the severity of the event and the accelerometer characteristics, saturation of the ACSM longitudinal or lateral accelerometers may occur. If the saturation exceeds duration of 10ms, the integration of Delta-V is stopped. The reported Delta-V values

are displayed as "Data Not Available".
- Restraint Deployment Time (e.g. airbag(s)) is reported as deployment request of this device.
- Restraint Disposal (e.g. 2nd stage of the frontal airbag(s)) is reported if a disposal request of this device occurs.
- Seat Track Position Switch Status is only reported as "foremost" or "not foremost".
- Occupant size classification, right front passenger airbag suppressed data is recorded as “yes” (suppressed) if the front passenger seat sensor system determined the passenger seat was empty or occupied by a child-seat.

Data Source:
All recorded data is measured and calculated within the ACSM except for the following parameters (if applicable) which are transmitted via the vehicle’s communication network to the ACSM:
- Speed, vehicle indicated
- Accelerator pedal position, percent full
- Service brake
- ABS activity
- Stability control
- Steering input angle
- Engine RPM

The Belt Switch Circuit is wired directly to the ACSM.

Hexadecimal Data:
All data that has been specified for imaging is shown in the hexadecimal data section of this report. However, not all of this data is translated by the CDR tool. The imaged ACSM may contain additional data that is not retrievable by the CDR tool.

0801_BMW_ACSM4C_r006

System Status at Retrieval

Ignition Cycle, Download (cycle)	172

System Status at Event (Record 1, Most Recent)

Event Type	Frontal
Ignition ON Timer, at Event (msec)	129,413,071
Time From Time Zero to Frontal Threshold (Beginning of Impact) (msec)	Not Recorded
Time From Time Zero to Side Threshold (Beginning of Impact) (msec)	Not Recorded
Time From Time Zero to Algorithm Wake-Up Start (Front) (msec)	0
Time From Time Zero to Algorithm Wake-Up Start (Side) (msec)	10
Time From Time Zero to Algorithm Wake-Up Start (Rear) (msec)	Not Recorded
Time From Time Zero to Deployment (Rollover) (msec)	Not Recorded
Time From Time Zero to Deployment (Pitchover) (msec)	Not Recorded
Time From Time Zero to Algorithm Wake-Up Start (Pedestrian Protection) (msec)	Not Recorded
Event Counter (counts)	1
Complete File Recorded (Yes, No)	Yes
Multi-Event, Number of Events	1
Time From Previous Event to Current Event (msec)	0
Maximum Delta-V, Longitudinal (MPH [km/h])	-6.2 [-10.0]
Maximum Delta-V, Lateral (MPH [km/h])	4.3 [7.0]
Time, Maximum Delta-V, Longitudinal (msec)	300
Time, Maximum Delta-V, Lateral (msec)	162
Time, Maximum Delta-V, Resultant (msec)	300

Deployment Command Data (Record 1, Most Recent)

Frontal Air Bag, Time to First Stage Deployment, Driver (msec)	Unknown
Frontal Air Bag, Time to Second Stage Deployment, Driver (msec)	Unknown
Frontal Air Bag, Time to Third Stage Deployment (Vent), Driver (msec)	Unknown
Frontal Air Bag, Second Stage Disposal, Driver	No Disposal
Frontal Air Bag, Third Stage Disposal (Vent), Driver	No Disposal
Frontal Air Bag, Time to First Stage Deployment, Front Passenger (msec)	Unknown
Frontal Air Bag, Time to Second Stage Deployment, Front Passenger (msec)	Unknown
Frontal Air Bag, Time to Third Stage Deployment (Vent), Front Passenger (msec)	Unknown
Frontal Air Bag, Second Stage Disposal, Front Passenger	No Disposal
Frontal Air Bag, Third Stage Disposal (Vent), Front Passenger	No Disposal
Side Air Bag, Time to Deployment First Stage, Driver (msec)	Unknown
Side Curtain/Tube Air Bag,Time to Deployment, Driver Side (msec)	Unknown
Pretensioner, Time to Deploy, Driver (msec)	Unknown
Knee Bag, Time to Deploy, Driver (msec)	Unknown
Side Air Bag, Time to Deployment First Stage, Front Passenger (msec)	Unknown
Side Curtain/Tube Air Bag, Time to Deployment, Passenger Side (msec)	Unknown
Pretensioner, Time to Deploy, Front Passenger (msec)	Unknown
Knee Bag, Time to Deploy, Front Passenger (msec)	Unknown

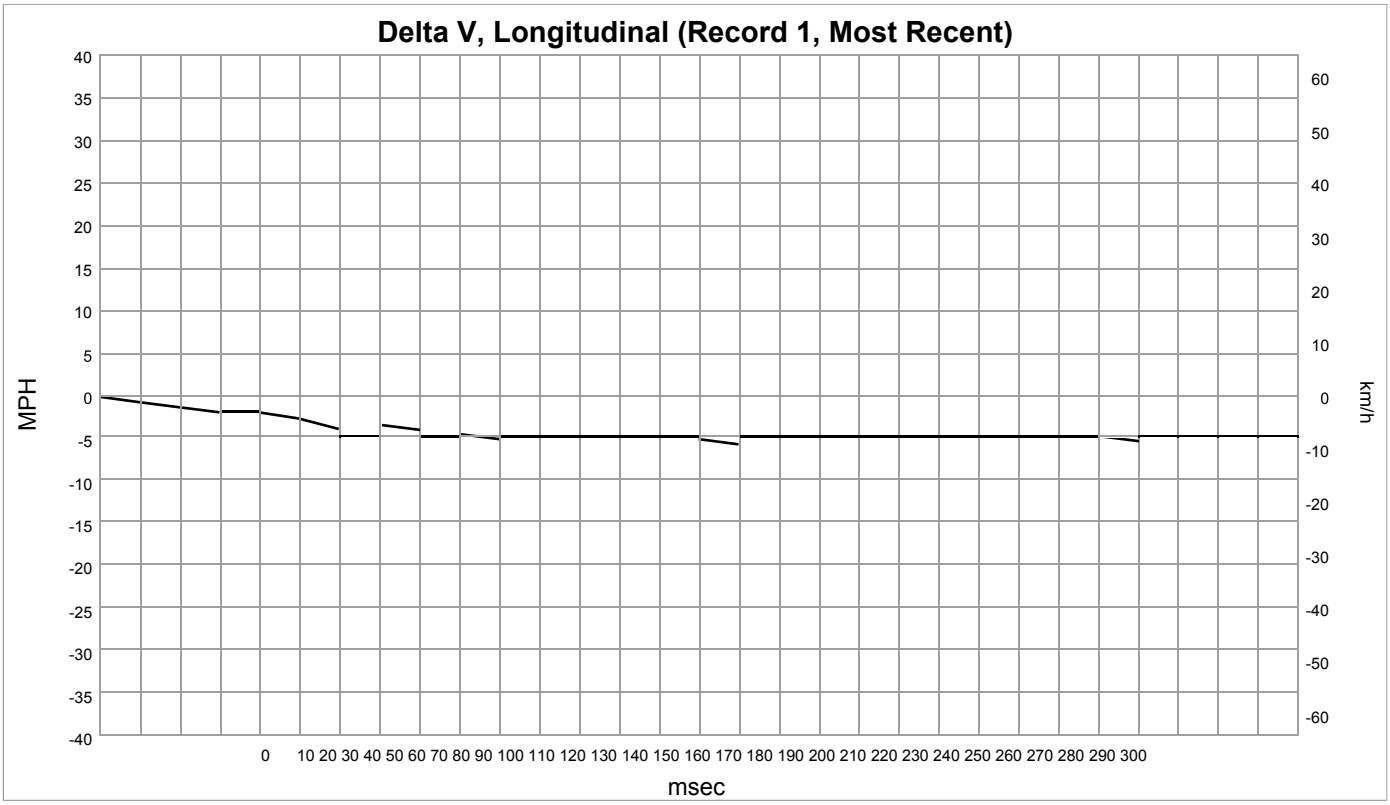
Pre-Crash Data -1 Sec (Record 1, Most Recent)

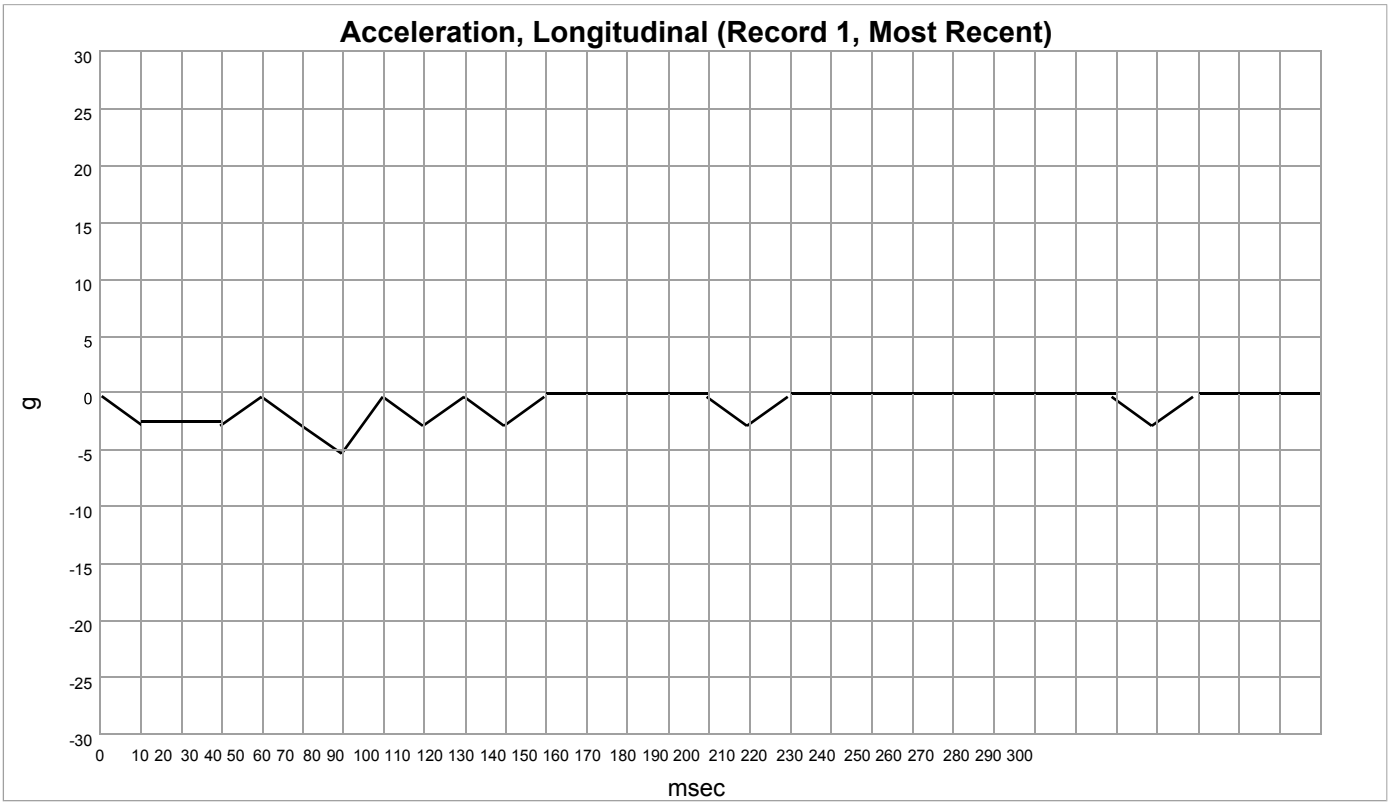
Ignition Cycle, Crash (cycle)	151
Safety Belt Status, Driver	Belted
Safety Belt Status, Front Passenger	Unbelted
Air Bag Warning Lamp (On,Off)	Off
Air Bag Suppression Switch Status, Front Passenger	Unknown
Seat Track Position Switch Status, Driver	Not Foremost
Seat Track Position Switch Status, Foremost, Front Passenger	Not Foremost
Occupant Size Classification, Front Passenger (Child)	Unknown

Pre-Crash Data -5 to 0 sec (Record 1, Most Recent)

Time (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % Full (%)	Engine RPM	Steering Input (deg)	Service Brake, On/Off	ABS Activity (Engaged, Non-engaged)	Stability Control (On Engaged, Non-engaged)
-5.0	68 [109]	0	1600	0	Off	No ABS Activity	Non-engaged
-4.5	67 [108]	15	1600	0	Off	No ABS Activity	Non-engaged
-4.0	67 [108]	22	1600	0	Off	No ABS Activity	Non-engaged
-3.5	67 [108]	22	1600	0	Off	No ABS Activity	Non-engaged
-3.0	67 [108]	25	1600	0	Off	No ABS Activity	Non-engaged
-2.5	67 [108]	24	1600	0	Off	No ABS Activity	Non-engaged
-2.0	67 [108]	24	1600	0	Off	No ABS Activity	Non-engaged
-1.5	67 [108]	22	1600	0	Off	No ABS Activity	Non-engaged
-1.0	67 [108]	34	1600	0	Off	No ABS Activity	Non-engaged
-0.5	67 [108]	0	1600	5	Off	No ABS Activity	Non-engaged
0.0	60 [97]	0	1500	50	On	ABS Activity	On, Engaged

Longitudinal Crash Pulse (Record 1, Most Recent)

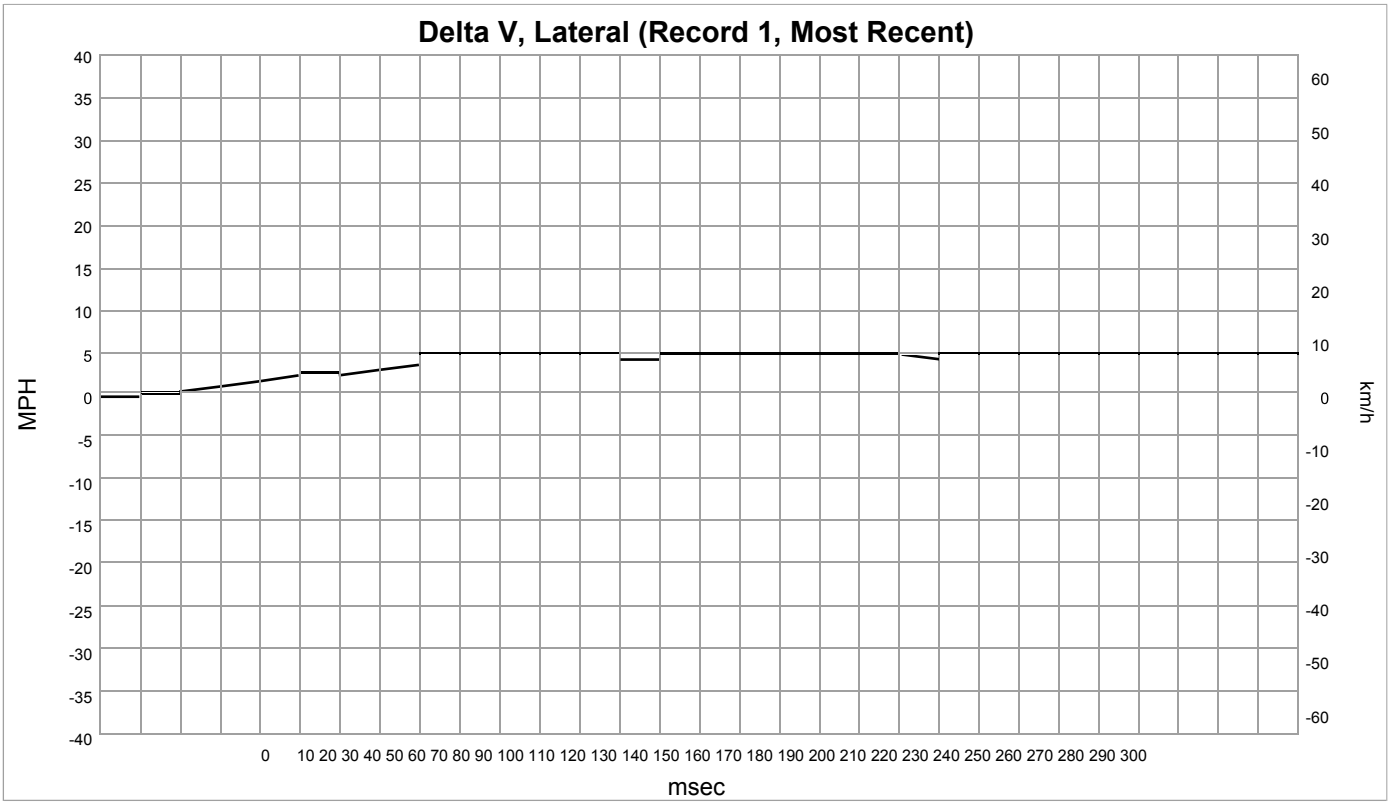


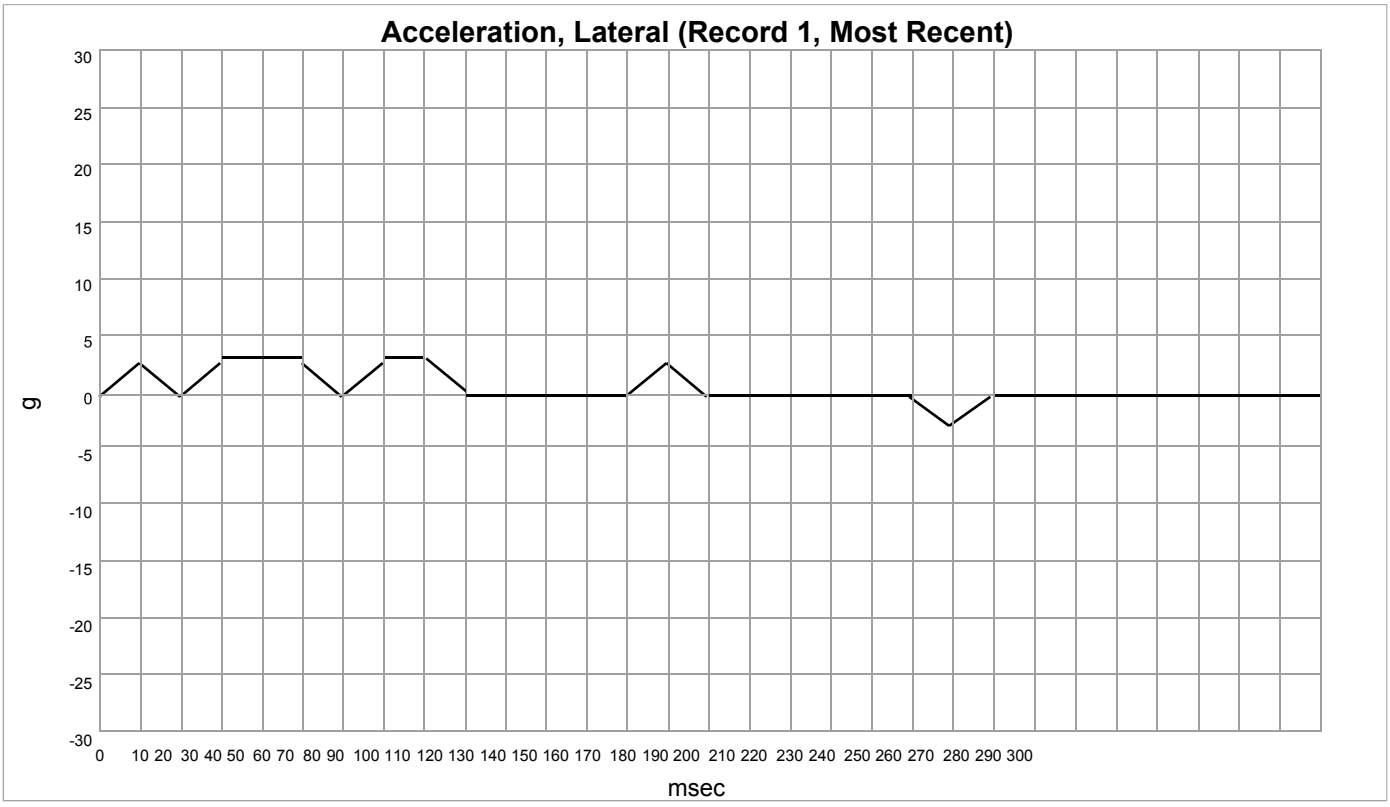


Longitudinal Crash Pulse (Record 1, Most Recent)

Time (msec)	Delta-V, Longitudinal (MPH [km/h])	Longitudinal Acceleration (g)
0	0.0 [0.0]	0
10	-0.6 [-1.0]	-3
20	-1.2 [-2.0]	-3
30	-1.9 [-3.0]	-3
40	-1.9 [-3.0]	0
50	-2.5 [-4.0]	-3
60	-3.7 [-6.0]	-5
70	-3.7 [-6.0]	0
80	-4.3 [-7.0]	-3
90	-4.3 [-7.0]	0
100	-5.0 [-8.0]	-3
110	-5.0 [-8.0]	0
120	-5.0 [-8.0]	0
130	-5.0 [-8.0]	0
140	-5.0 [-8.0]	0
150	-5.0 [-8.0]	0
160	-5.6 [-9.0]	-3
170	-5.6 [-9.0]	0
180	-5.6 [-9.0]	0
190	-5.6 [-9.0]	0
200	-5.6 [-9.0]	0
210	-5.6 [-9.0]	0
220	-5.6 [-9.0]	0
230	-5.6 [-9.0]	0
240	-5.6 [-9.0]	0
250	-5.6 [-9.0]	0
260	-6.2 [-10.0]	-3
270	-6.2 [-10.0]	0
280	-6.2 [-10.0]	0
290	-6.2 [-10.0]	0
300	-6.2 [-10.0]	0

Lateral Crash Pulse (Record 1, Most Recent)





Lateral Crash Pulse (Record 1, Most Recent)

Time (msec)	Delta-V, Lateral (MPH [km/h])	Lateral Acceleration (Lateral G High Range) (g)
0	0.0 [0.0]	0
10	0.6 [1.0]	3
20	0.6 [1.0]	0
30	1.2 [2.0]	3
40	1.9 [3.0]	3
50	2.5 [4.0]	3
60	2.5 [4.0]	0
70	3.1 [5.0]	3
80	3.7 [6.0]	3
90	3.7 [6.0]	0
100	3.7 [6.0]	0
110	3.7 [6.0]	0
120	3.7 [6.0]	0
130	3.7 [6.0]	0
140	4.3 [7.0]	3
150	4.3 [7.0]	0
160	4.3 [7.0]	0
170	4.3 [7.0]	0
180	4.3 [7.0]	0
190	4.3 [7.0]	0
200	4.3 [7.0]	0
210	3.7 [6.0]	-3
220	3.7 [6.0]	0
230	3.7 [6.0]	0
240	3.7 [6.0]	0
250	3.7 [6.0]	0
260	3.7 [6.0]	0
270	3.7 [6.0]	0
280	3.7 [6.0]	0
290	3.7 [6.0]	0
300	3.7 [6.0]	0

Hexadecimal Data

FA10 02

FA12 02 00 00 06 F1 00 00 06 01

FA11 04 00 01

FA13 01 00 01 00 00 02 FF FF 00 03 FF FF 00 04 00 00
00 05 00 0A 00 06 FF FF 00 07 FF FF 00 08 FF FF
00 09 FF FF 00 0A 00 01 00 15 64 00 1E 80 86 80
86 86 86 80 86 86 80 80 80 80 80 86 80 80 80 80
80 80 7B 80 80 80 80 80 80 80 80 80 00 17 64 00
1E 80 7B 7B 7B 80 7B 76 80 7B 80 7B 80 80 80 80
80 7B 80 80 80 80 80 80 80 80 80 7B 80 80 80 80
00 1F 64 1F 80 7F 7E 7D 7D 7C 7A 7A 79 79 78 78
78 78 78 78 77 77 77 77 77 77 77 77 77 77 76 76
76 76 76 00 20 64 1F 80 81 81 82 83 84 84 85 86
86 86 86 86 86 87 87 87 87 87 87 87 86 86 86 86
86 86 86 86 86 86 00 21 76 00 22 87 00 23 96 00
24 51 00 25 96 00 29 00 00 97 00 2A 00 00 AC 00
2B 00 00 2D 01 00 2E 00 00 33 FE 00 34 FE 00 35
FE 00 36 00 00 37 00 00 38 FE 00 39 FE 00 3A FE
00 3B 00 00 3C 00 00 3D FE 00 3E FE 00 3F FE 00
40 FE 00 41 FE 00 42 FE 00 43 FE 00 44 FE 00 47
01 00 48 00 00 4B 00 00 4C FE 00 4D 00 00 4E 00
00 4F FE 00 5B 6D 6C 6C 6C 6C 6C 6C 6C 6C 6C 61
00 5C 00 0F 16 16 19 18 18 16 22 00 00 00 5D 10
10 10 10 10 10 10 10 10 0F 00 5E 32 32 32 32
32 32 32 32 32 31 28 00 5F 00 00 00 00 00 00 00
00 00 00 01 00 60 00 00 00 00 00 00 00 00 00 00
01 00 61 00 00 00 00 00 00 00 00 00 00 00 01 02 3B
00 00 00 00 00 00 00 02 3C 00 00 00 00 00 00 00
00 00 00 00 00 00 00 03 E8 00 03 FB 00 00 07 B6
AF CF 03 FF 42 4E 62 07 A9 01 A6 FB 75 6E 4D C7
04 41 BF A8 F4 4D A4 88 82 95 2E 47 45 62 FE 83
9F 0B 6E 0D B2 53 99 00 1E 8B 1E 89 EF CB AC 1D
30 59 60 DC 65 5D A6 DD 06 AB A5 52 06 6E A6 A3
A4 FD DB 0E

FA14 00

FA15 00

FA16 00

FA17 00

FA18 No data received.

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**National Highway
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Administration**

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