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**Special Crash Investigations:
On-Site Alleged Brake Failure
Crash Investigation;
Vehicle: 2015 Nissan Rogue;
Location: Arizona;
Crash Date: October 2020**

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16. Abstract This report documents the on-site investigation of the alleged unintended failure of the brake assembly in a 2015 Nissan Rogue. This single-vehicle crash occurred in the approach to a four-leg intersection in Arizona in October 2020. The Nissan was traveling eastbound on a city street and was being driven by a belted 68-year-old female. The traffic signal at the intersection was red, and there was stopped traffic. According to the driver, as she approached the intersection, she applied the brakes, and the brake pedal traveled to the floor. She was unable to stop. She steered to the right to avoid the stopped traffic, struck a curb, and departed the roadway. The vehicle traveled into a landscaped area and struck a male landscaper working in this area. He sustained serious injuries. The vehicle continued through the landscaped area and then struck a tree where the vehicle came to rest. The position of the brake pedal assembly was initially thought to be a defect but was determined to be a design feature. Based on available evidence, it is likely that the cause of the crash was pedal misapplication.			
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Special Crash Investigations
On-Site Alleged Brake Failure Crash Investigation
Office of Defects Investigation
Case Number: DS20016
Vehicle: 2015 Nissan Rogue
Location: Arizona
Crash Date: October 2020

Background

This report documents the on-site investigation of the alleged unintended failure of the brake assembly in a 2015 Nissan Rogue (Figure 1). The vehicle inspection documented the vehicle damage, the restraint system, and the brake pedal assembly. This investigation was initiated by the Office of Defects Investigation in response to a driver notification. The Special Crash Investigations (SCI) group of the National Highway Traffic Safety Administration assigned the case to Dynamic Science, Inc., in October 2020. The vehicle inspection was conducted in November 2020. Representatives from Nissan participated in the inspection. A representative from the involved insurance company and a relative of the driver were present as observers. The vehicle was supported by the Bosch Crash Data Retrieval system, and the Event Data Recorder (EDR) was imaged during the inspection. The brake assembly was removed with the permission of the owner and taken into SCI's possession. It was then shipped to the ODI group for further inspection/analysis. After ODI's part inspection and analysis, there was no defect determination made for the brake pedal assembly. Based on the on-scene, vehicle, and EDR evidence, it is probable that the cause of the crash was pedal misapplication.



Figure 1. The 2015 Nissan Rogue

This single-vehicle crash occurred in the approach to a four-leg intersection in Arizona in October 2020. The Nissan was traveling eastbound on a city street and was being driven by a belted 68-year-old female. The traffic signal at the intersection was red, and there was stopped traffic. According to the driver, as she approached the intersection, she applied the brakes, and the brake pedal depressed fully to the floor. She was unable to stop. She steered to the right to avoid the stopped traffic, struck a curb, and departed the roadway. The vehicle traveled into a landscaped area and struck a male landscaper working in this area. According to the police report and medical records obtained by SCI, he sustained serious injuries. The vehicle continued

through the landscaped area and then struck a tree where the vehicle came to rest. The Nissan was towed from the scene due to damage and was placed on hold at a salvage facility.

Summary

Crash Site

The crash site was in the eastbound lanes of a median-divided 5-lane urban roadway approaching a four-leg intersection (Figure 2). The asphalt roadway was straight and level. The roadway was configured with two left turn lanes, two through lanes, and one right turn lane. The posted speed limit was 64 km/h (40 mph). The roadway was intersected on the right by a two-lane driveway leading into a shopping center. The east curb of the driveway measured 10 cm (3.9 in) in height and was composed of concrete. South of the roadway there was an area of landscaping that included sidewalks, multiple trees and plants, and a gravel surface. The landscaped area was between the main road and a parking lot. Along the path to the tree impact, the landscaped area changed elevations in undulating fashion (Figure 3). The slope measured -14 percent as the path approached the north/south sidewalk and 26 percent as it departed the sidewalk. The height difference between the tops of the slopes and the sidewalk was 49 cm (19.2 in). At 2.5 m (8.2 ft) east of the sidewalk, the slope changed to -17 percent and continued downward to the struck tree. The struck tree measured 20 x 60 cm (7.8 x 23.6 in). The weather at the nearest reporting station was 27 °C (82 °F), 16 percent humidity, winds out of south southeast at 11 km/h (7 mph), and clear. A crash diagram is included at the end of this report.



Figure 2. Eastbound approach, driveway on right



Figure 3. Landscape elevation changes, looking east

Pre-Crash

The Nissan was traveling eastbound in the first lane from the right approaching a four-leg intersection. The vehicle was being driven by a belted 68-year-old female and was traveling at an EDR-reported speed of 74 km/h (46 mph) five seconds prior to the crash. The Nissan's pre-crash speeds and distances are shown in the table on the next page.

Time	Vehicle Speed		Distance Traveled			
			Incremental		Cumulative	
-sec	km/h	mph	m	ft	m	ft
5	74	46	NA	NA	NA	NA
4.5	74	46	10.3	33.7	10.3	33.7
4	74	46	10.3	33.7	20.5	67.4
3.5	74	46	10.3	33.7	30.8	101.1
3	74	46	10.3	33.7	41.1	134.8
2.5	76	47	10.4	34.1	51.5	168.9
2	76	47	10.5	34.5	62	203.4
1.5	76	47	10.5	34.5	72.5	237.9
1	80	50	10.9	35.6	83.4	273.5
0.5	80	50	11.2	36.7	94.5	310.2
0	82	51	11.3	37	105.8	347.2

A 29-year-old male pedestrian was in the landscaped area cutting a tree. He was part of a three- or four-person landscaping crew. As the driver approached the intersection, there was stopped traffic ahead. The driver indicated that she braked, the brake pedal went to the floor, and she steered to the right to avoid the stopped traffic. The EDR report indicated that there was no brake application and that the accelerator pedal sensor was engaged to its maximum limit, indicated by the 100% (clp) recording beginning at time -1.5s through AE. The driver did steer to the right and crossed into the driveway entrance.

Crash

The Nissan traveled southeast across the driveway entrance and struck the concrete curb, causing damage to the left front tire rim (Event 1) and the left rear tire rim (Event 2). The vehicle continued northeast across the gravel-covered landscape surface. The vehicle sustained damage to the right rear tire rim probably from a curb impact (Event 3). The damage pattern did not appear to match the damage to the other rims. The vehicle traveled over the undulating terrain, crossed a sidewalk, and struck the pedestrian (Event 4). The Nissan traveled between two trees and then struck a third tree with its front plane (Event 5). The barrier algorithm of the WinSMASH program calculated a barrier equivalent speed (BES) for this yielding object impact (Event 5) at 34 km/h (21 mph). The tree was knocked down, and a portion of the tree fell on the Nissan (Event 6). The Nissan rotated counterclockwise and came to rest in the landscaped area.

Post-Crash

The driver of the Nissan exited with some assistance from EMS. According to the police report, she sustained “B” (suspected minor) injuries. She was transported by ambulance to a local trauma center, where she was treated and released. The pedestrian sustained “A” (suspected serious) injuries. He was initially cared for by a surgical nurse who was also a witness to the crash. He was then treated by the police and EMS before being transported to a local trauma center, where he was hospitalized for 16 days. The vehicle was towed from the scene due to damage.

2015 Nissan Rogue

Description

The 2015 Nissan Rogue Select was a 5-passenger, 5-door station wagon. The vehicle was identified by the Vehicle Identification Number JN8AS5MT8FWxxxxxx and was manufactured in January 2015. The vehicle mileage was 82,964 km (51,552). The vehicle was equipped with a 2.5-liter, 4-cylinder, gasoline engine; an automatic transmission; a front-wheel drive; and ABS. The steering ratio for a 2013 Rogue was 17.1:1. The vehicle manufacturer recommended tire size was P215/70R16 for the front and rear. The vehicle was equipped with Phantom AP tires of the recommended size. The specific tire information was as follows:

Position	Measured Tread Depth	Restricted	Damage
LF	3 mm (4/32 in)	No	De-beaded/rim damage
LR	4 mm (5/32 in)	No	De-beaded/rim damage
RR	4 mm (5/32 in)	No	De-beaded/rim damage
RF	3 mm (4/32 in)	No	None

Vehicle History

A CARFAX report was obtained. The report indicated that the vehicle had five owners. The current owner purchased the vehicle in 2016. There were no indications that the vehicle had been involved in any previous crashes.

Exterior Damage

The Nissan sustained moderate damage from impacts with several fixed objects.

The vehicle sustained left front rim damage from the first curb impact (Event 1). The Collision Deformation Classification (CDC) was 12FLWN3. The vehicle sustained left rear rim damage from the second curb impact (Event 2). The CDC was 12FLWN9. The vehicle also sustained damage to the right rear rim (Event 3). This damage appeared different from the rim damage found on the other two rims but likely also from the curb. The CDC was 12FRWN9.

The Nissan contacted the pedestrian with the front plane (Event 4). The impact with the tree masked the evidence deposited from the pedestrian impact. The CDC was 12F9E91.

The vehicle sustained front plane damage from the impact with a 20 x 60 cm (7.8 x 23.6 in) tree (Event 5). The direct damage began at the left front bumper corner and extended 36 cm (14.1 in) to the right (Figure 4). The direct contact extended under the reinforcement bar and onto the left engine cradle. Thirteen measurements were taken at the bumper reinforcement bar by the Nikon Total Station, and the Faro Blitz program computed crush measurement in six increments as follows: C₁ = 31 cm (12.2 in), C₂ = 38 cm (14.9 in), C₃ = 32 cm (12.5 in), C₄ = 21 cm (8.2 in), C₅

= 8 cm (3.1 in), and $C_6 = 0$ cm. The maximum crush was located 12 cm (4.7 in) right of the left front bumper corner and measured 38 cm (14.9 in). The CDC was 12FLEE2.



Figure 4. The 2015 Nissan Rogue, front plane damage

After the tree impact, the tree broke, and portions of the tree contacted the top plane of the Nissan (Event 6). There was damage to the hood, roof, and left door. The direct damage on the roof measured 87 x 63 cm (34.2 x 24.8 in), and the maximum crush was 10 cm (3.9 in). The CDC was 00TDDW2.

Event Data Recorder

The Nissan was equipped with an air bag control unit (ACU) that was configured with EDR capabilities. The EDR can store deployment and non-deployment events. It records five seconds of pre-crash data and 250 milliseconds (ms) of post-crash data. The pre-crash data include vehicle speed, accelerator pedal percentage, engine rpm, motor rpm, service brake switch status, and steering input. The data from the Nissan's EDR were imaged using the Bosch Crash Data Retrieval Tool version 19.5.3 through the DLC and was reported using version 21.2. Two events were recovered. The first event occurred at ignition cycle 5,050 and was not related to this crash. The second EDR event was related to this crash; in particular, case Event 1, the curb strike. The ignition cycle at download was 10,683. The difference between the cycles in the second event was mostly due to power losses during multiple download attempts by Nissan and SCI.

It appears that the supplemental restraint system (SRS) was awakened during the impacts to the curb and deployed the air bags and actuated the pretensioner at impact with the tree. It appeared that the system stayed awake for several seconds as it detected accelerations in this extended crash event. The distance from the curb impact to the tree impact was 30 m (99 ft). The time to traverse that distance at the last known speed of 82 km/h (51 mph) was 1.32 seconds. The maximum longitudinal delta V was -1 km/h (-1 mph) at 250 ms. The maximum lateral delta V was 8 km/h (5 mph) at 297.5 ms. After wake-up, any deployment events that occurred after 250 ms will show deployment command times of 250 ms in the EDR report. Delta Vs that occur after 250 ms exceed the recording limitation of the EDR, and therefore are not captured by the EDR. The reported -1 km/h (-1 mph) longitudinal delta V did not deploy the air bags and is not consistent with the vehicle damage. The driver's frontal air bag, pretensioners, and both side

impact and inflatable curtain (IC) air bags deployed at a reported time of 250 ms, which is the maximum time recording capability of the EDR. The deployments likely occurred later in the crash timing sequence, probably during the tree impact. The passenger's frontal air bag did not deploy.

The EDR report is included as Appendix A at the end of this report. The following table summarizes the EDR-reported pre-crash data for Event Record 2. These data appear to be the pre-crash data leading up to impact with the curb, defined by this report as Crash Events 1, 2, or 3.

Time Stamp	Speed	Accelerator Pedal	Engine rpm	Motor RPM	Service Brake	Steering Input
(sec)	km/h (mph)	%			(On, Off)	(degrees)
-5	74 (46)	3	1,300	NA	Off	0
-4.5	74 (46)	0	1,300	NA	Off	0
-4	74 (46)	15	1,300	NA	Off	-2.5
-3.5	74 (46)	86	1,500	NA	Off	0
-3	74 (46)	0	2,100	NA	Off	-42.5
-2.5	75 (47)	7	1,900	NA	Off	-27.5
-2	75 (47)	99	2,100	NA	Off	12.5
-1.5	76 (47)	100 (clp)	3,100	NA	Off	0
-1	80 (50)	100 (clp)	3,900	NA	Off	-75
-0.5	81 (50)	100 (clp)	4,500	NA	Off	-172.5
0	82 (51)	100 (clp)	4,500	NA	Off	-150

A negative steering input indicates a right turn. The notation "clp" indicates that the measurement captured by a sensor exceeded the design range of the sensor.

Brake Control and Unintended Acceleration Discussion

This investigation was initiated in response to a driver notification of an alleged brake failure. The driver reported that she pressed the brake pedal to the floor and that the vehicle did not stop. A relative later provided a video showing that the pedal was moving freely. The brake assembly was removed with the permission of the owner and taken into SCI's possession. It was then shipped to the ODI group. At the time of the SCI inspection, the pedal position was 10 cm (3.9 in) above the floor when pressed forward and 15 cm (5.9 in) above the floor when pulled rearward. The pedal did not return to the fully upward position when released and also was clearly not actuating the brake master cylinder. The brake pedal assembly was attached to the vehicle by four bolts and connected to the pushrod by a cotter pin. The component parts of the assembly include the stop lamp and brake pedal position switches, pedal, slide plate, slide plate horn, sub bracket and sub bracket claws, and main bracket (Figures 5-6).

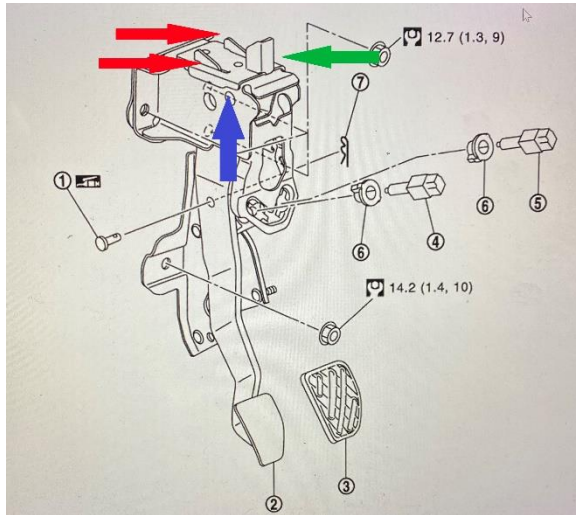


Figure 5. The 2015 Nissan Rogue, service manual image. Red arrow: sub bracket claws; Blue arrow: slide plate; Green arrow: slide plate horn.



Figure 6. The 2015 Nissan Rogue, brake assembly

The sub bracket is enclosed in the main bracket and has an internal pivot point. The sub bracket claws extend through the top of the bracket (Figure 7) and then through the slide plate (Figure 8). There is an impact bracket located aft of the assembly at the instrument panel. When a frontal collision causes sufficient damage or intrusion to move the brake pedal assembly rearward, by manufacturer design the slide plate horn comes into contact with the impact bracket thereby pushing the slide plate forward and releasing the sub-bracket claws. Once the sub-bracket claws are released, the pedal can no longer exert a force on the driver's lower leg (or the master cylinder actuation rod) thereby enhancing occupant safety by reducing the risk of lower leg injury (Figure 9). Nissan has indicated that the assembly was equipped with an injury mitigation feature designed to allow the brake pedal arm to rotate and move during a collision and that the feature performed as designed in this crash. Based on this safety design assessment, there was no attempt to manually manipulate the braking system using the pushrod. There was no evidence of fracture to the assembly. The slide plate horn appears to have been deformed during this crash sequence.

The evidence supporting unintended acceleration/pedal misapplication included EDR data (100% accelerator input starting at -1.5 seconds and service brake “Off” for entire pre-crash) and witness information.



Figure 7. The 2015 Nissan Rogue, sub bracket claws

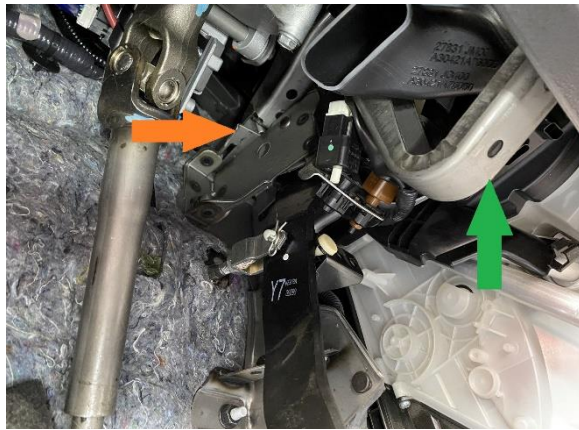


Figure 9. The 2015 Nissan Rogue. Green arrow: impact bracket; Orange arrow: slide plate.



Figure 8. The 2015 Nissan Rogue, slide plate

Interior Damage

The Nissan sustained minor interior damage from impact forces, occupant contacts, intrusion, and air bag deployments. There was vertical intrusion to the center roof in both rows that was likely from the tree branch impact. The brake assembly, by design, broke loose during the collision as discussed earlier. The left instrument panel exhibited a knee contact. The left rear door was jammed shut; the remaining doors remained closed and operational. The windshield was holed by a tree branch. There was no other glazing damage.

NHTSA Recalls and Investigations

A search last queried in August 2021 using the Nissan's VIN revealed that there were no open recalls or investigations.

Manual Restraint Systems

The front row was equipped with driver and front right passenger lap and shoulder seat belts. The driver's belt was equipped with continuous loop belt webbing, a sliding latch plate, an emergency locking retractor (ELR), and an adjustable upper anchor that was in the full-down position. The passenger's belt was equipped with continuous loop belt webbing, a sliding latch plate, a locking retractor, and an adjustable upper anchor. Both front row seat belts were equipped with retractor pretensioners. Both pretensioners actuated. The driver's seat belt was found in the spooled-out position and was used in the crash. The passenger seat belt was found in the fully retracted position. The belt was not used in this crash, and this seating position was not occupied at the time of the crash.

Supplemental Restraint Systems

The Nissan was equipped with an SRS consisting of an ACU, dual stage driver's and passenger's frontal air bags, retractor pretensioners for the front seat positions, IC side air bags for the front and second row outboard positions, and seat-mounted side air bags for the front row. It appears likely that the driver's frontal air bag, both seat-mounted side air bags, and both IC air bag deployed as a result of the impact with the tree. The driver's frontal air bag deployed from an H-configuration module cover located in the hub of the steering wheel rim. The air bag was circular and measured 52 cm (20.4 in) in diameter in its deflated state. The IC air bags measured 163 cm (64.1 in) in length and 42 cm (16.5 in) in height. Both IC air bags were cut by EMS during the driver extrication. The side air bags were 59 cm (23.3 in) in height and 20 cm (7.8 in) in width.

2015 Nissan Rogue Occupant

Driver Demographics

Age/sex:	68 years/female
Height:	155 cm (61 in)
Weight:	69 kg (152 lbs)
Eyewear:	Unknown
Seat type:	Bucket
Seat track position:	Unknown
Manual restraint usage:	Lap and shoulder belt available, used
Usage source:	Vehicle inspection, EDR data
Air bags:	Driver's frontal air bag, IC air bag, seat-mounted side air bag deployed
Alcohol/drug data:	None present
Egress from vehicle:	Assisted by EMS
Transport from scene:	Transported by ambulance to a hospital
Type of medical treatment:	Treated and released

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Closed sternal fracture	450804.2	Shoulder belt	Probable
2	Right anterior dislocation of the glenohumeral joint/shoulder	771030.2	Steering wheel	Probable
3	Tailbone contusion	810402.1	Seat cushion	Probable

Source: discharge summary, radiology, history, and physical.

Driver Kinematics

The 68-year-old female driver was seated in an unknown posture. She was belted with the D-ring adjusted to the full-down position. As the vehicle approach stopped traffic, the driver depressed the accelerator, believing that she was braking. The driver then began steering to the right while continually pressing on the accelerator. After striking the curb, the driver may have released the accelerator and attempted to brake, possibly deforming the brake assembly slide plate at impact with the tree. The impacts to the curb generated little deceleration, and the driver remained in place. As the vehicle passed over the undulating landscaping, there would have been a vertical component and contact with the seat cushion that probably caused the tailbone contusion. At impact with the tree, the driver was displaced forward and loaded the shoulder belt, causing the sternal injury. The driver's hands were on the steering wheel rim, and her forward movement probably caused the shoulder dislocation. She remained in the vehicle until assisted by EMS personnel.

Pedestrian

Pedestrian Demographics

Age/sex: 29 years/male
 Height: 170 cm (66 in)
 Weight: 80 kg (176 lbs)
 Eyewear: Unknown
 Alcohol/drug data: None
 Transport from scene: Ambulance
 Type of medical treatment: Transported to trauma center, hospitalized for 16 days.

Pedestrian Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Grade 4 splenic laceration	544226.4	Hood	Certain
2	Left pulmonary contusion (extensive)	441408.3	Hood	Certain
3	Left posterior medial rib fractures 1-9, left anterior rib fracture 2, left lateral rib fracture 3-8 with displacement, 9 no displacement	450203.3	Hood	Certain
4	Left clavicle fracture, distal 3 rd (comminuted)	750671.2	Hood	Probable
5	Fracture, left T7 transverse process	650420.1	Hood	Probable
6	Small mesenteric tear	542020.2	Hood	Certain
7	Left pneumothorax	442202.2	Hood	Certain
8	Fracture, left C7 transverse process	650220.1	Hood	Probable
9	Fracture, left T6 transverse process	650420.1	Hood	Probable
10	Left elbow dislocation	772030.1	Hood	Probable
11	Nasal bridge laceration	210600.1	Unknown	Unknown
12	Contusion, tip of tongue	243401.1	Unknown	Unknown
13	Abrasion, left hand	710202.1	Hood	Possible

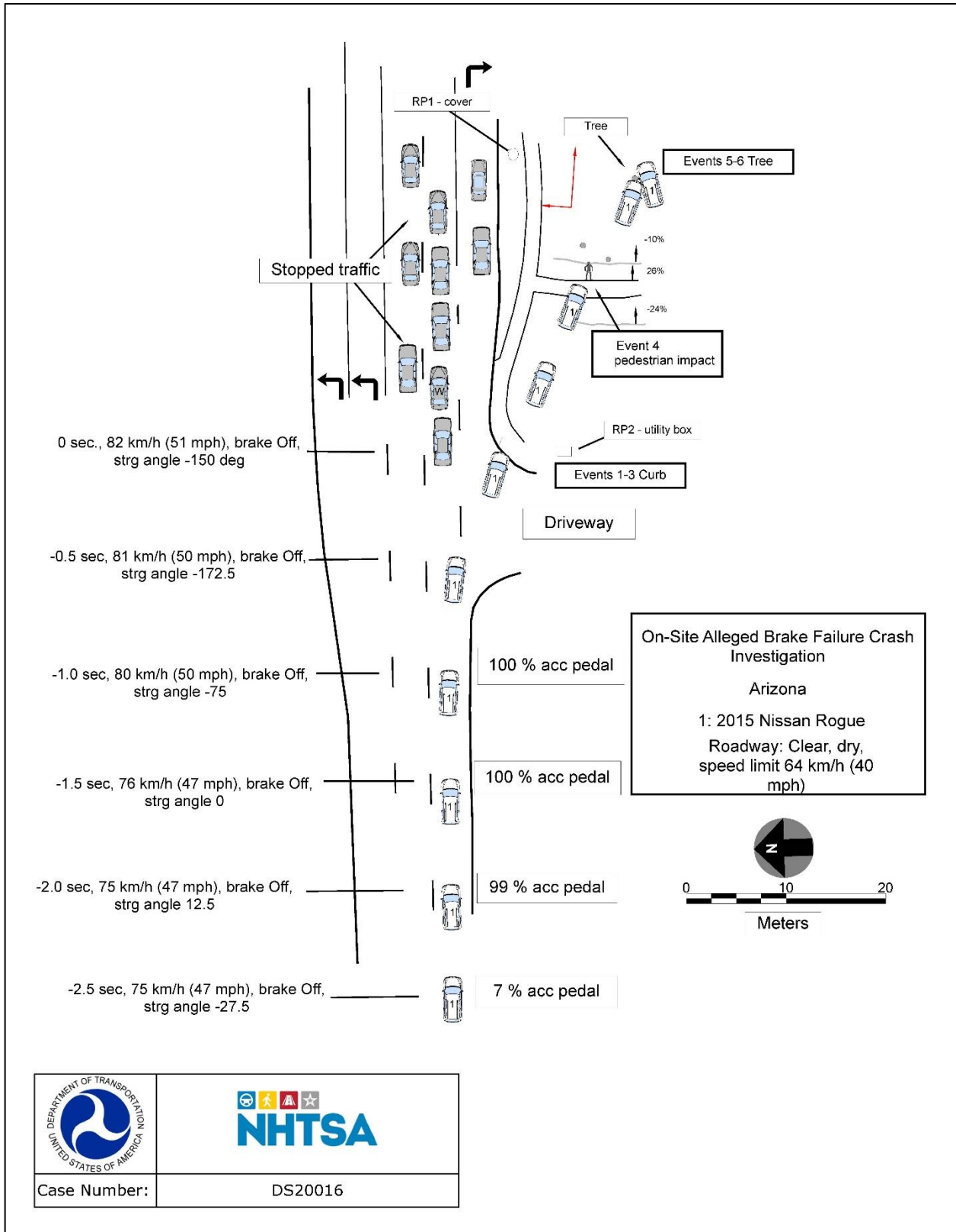
Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
14 15	Abrasions, bilateral legs	810202.1 810202.1	Bumper	Possible
16	Left chest abrasion	410202.1	Hood	Probable
17	Frontoparietal scalp hematoma	110402.1	Ground	Probable

Source: discharge summary, ER records, radiographic records.

Pedestrian Kinematics

The 29-year-old male pedestrian was standing in the landscaped area between the main road and a parking lot. He was part of a three- or four-person landscaping crew and was actively trimming or cutting a tree. He was positioned east of the north/south sidewalk. The Nissan departed the roadway, traveled over the undulated terrain, crossed the sidewalk, and struck the pedestrian. The witness reported that he was struck directly in the abdominal area. He was displaced to the east and came to rest under the branches near the struck tree. He was initially cared for by a surgical nurse who was also a witness to the crash. He was then treated by the police and EMS before being transported to a local trauma center, where he was hospitalized for 16 days.

Crash Diagram



Appendix A: Event Data Recorder Report for 2015 Nissan Rogue¹

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 Crash View 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	JN8AS5MT8FW*****
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	DS2016_V1_ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 19.5.3
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 21.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Event Record 1, Event Record 2

Comments

No comments entered.

Data Limitations

General Information:

Data limitations are intended to assist in reading event data that has been imaged from the vehicle's Air bag Control Unit (ACU). Event data should be considered in conjunction with other available physical evidence from the vehicle and scene.

Airbag Control Unit (ACU)

- The Air bag Control Unit (ACU) can store two types of events: Non-Deployment Events and Deployment.
 - A Non-Deployment Event is a crash or other physical occurrence which causes the ACU algorithm to be activated, but in which deployment thresholds are not reached.
 - A Deployment Event is a crash or other physical occurrence which causes ACU deployment thresholds to be reached or exceeded. Depending on the vehicle model, one or more of the following may be activated during a Deployment Event: front air bags, seat-mounted side airbags, roof-mounted or door-mounted curtain air bags, pretensioners, or pop-up roll bars.
- The ACU can record up to two events. If additional events occur subsequently, the older of the two events already recorded (i.e. the one which occurred first) is overwritten.
 - A Non-Deployment Event can be overwritten by another Non-Deployment event, or by a Deployment Event.
 - A Deployment Event has higher priority than a Non-Deployment Event, and cannot be interrupted or overwritten by another event.
 - The data pertaining to a Deployment Event is locked after being recorded. However, a second event can still be recorded subsequently in the portion of the event memory which is not locked.
- Event data includes both pre-crash data and crash data.
 - If the power supply to the ACU is lost during an event, all or part of the event data may not be recorded.
 - In addition to the recording of event data, the ACU has the ability to perform diagnostics and record Diagnostic Trouble Codes (DTCs).

Data Element Sign Convention:

The following table provides an explanation of the sign convention for data elements in the CDR report.

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
Vehicle Roll Angle	Left to Right Rotation
Steering Input	Left Turn

- "Life Time Counter (sec)" indicates the elapsed time, in seconds, from the vehicle's first ignition activation until the start of the first recorded event. The counter is incremented whenever the vehicle's ignition is on. The counter is reset to 0 if the ACU is replaced.
- "Complete File Recorded" indicates whether a complete EDR data set has been stored after the event. "Yes" indicates that a complete data set

- has been recorded. "No" indicates that only a portion of the data set has been recorded, for example due to the power to the ACU being lost during the event.
- "Multi-Event, Number of Events (1, 2)" indicates the number of events which are stored during a given ignition cycle. A Multi-Event occurs whenever the time between Event 2 trigger threshold and Event 1 trigger threshold is less than or equal to 5 seconds during the same ignition cycle, and "2" will be recorded in this case. Otherwise, "1" will be recorded.
 - "Air Bag Warning Lamp (On, Off)" indicates whether the ACU was in trouble mode or in normal operation mode at the time of the event. "On" indicates that the air bag warning lamp was illuminated at the time of the event, and the ACU was in trouble mode. "Off" indicates that the air bag warning lamp was not illuminated at the time of the event, and the ACU was in normal operation mode.
 - "Frontal Air Bag Suppression Switch Status" indicates whether front passenger air bag deployment was suppressed at the time of the event. "On" indicates that the front passenger air bag was suppressed at the time of the event (deployment inhibited). "Off" indicates that the front passenger air bag was not suppressed at the time of the event (deployment enabled). This data will not be available for all vehicles.
 - "Delta-V, Longitudinal" indicates the cumulative change in velocity along the longitudinal direction.
 - "Acceleration, Longitudinal" indicates the rate of change of velocity with time along the longitudinal direction.
 - "Delta-V, Lateral" indicates the cumulative change in velocity along the lateral direction.
 - "Acceleration, Lateral" indicates the rate of change of velocity with time along the lateral direction.
 - "Engine Throttle, % full" indicates the position of the accelerator pedal as a percentage of the fully depressed position.
 - "Service Brake (On, Off)" indicates whether the service brake is activated ("On") or not activated ("Off").
 - "Steering Input (deg)" indicates the angular displacement of the steering wheel measured in degrees. -250 deg indicates a 250 degree turn to the right of the steering wheel, 0 deg indicates the straight-ahead steering wheel position, and 250 deg indicates a 250 degree turn to the left of the steering wheel.
 - The notation "CLP" indicates that the measurement captured by a sensor exceeded the design range of the sensor.
 - "Seat Track Position Switch, Foremost, Status, Driver (Yes/No)" indicates whether the driver's seat is positioned within a designated threshold value of the most forward adjustment position. "Yes" indicates that the driver's seat is positioned within a designated threshold value of the most forward adjustment position. For all other adjustment positions, "No" is displayed. This data will not be available if the seat track position switch is not installed in the vehicle.
 - "Occupant Size Classification, Right Front Passenger, Child (Yes/No)" indicates whether or not the right front passenger is classified as a child (as defined in 49 CFR part 572, subpart N or smaller). This data will not be available for all vehicles.
 - "e-pedal ON/OFF Status" indicates whether "e-pedal" is activated (ON), or not activated (OFF). This data will not be available for all vehicles.
 - "ABS Warning lamp, on/off" indicates whether "Anti-lock Brake System" was in trouble mode or in normal operation mode at the time of the event. This data will not be available for all vehicles.
 - "AEB/FCW switch status ON/OFF (from ADAS)" indicates whether the switch of "Automatic Emergency Braking or Forward Collision Warning controlled by ADAS unit" was ON, or OFF at the time of the event. This data will not be available for all vehicles.
 - "AEB Warning lamp (from ADAS)" indicates whether "Automatic Emergency Braking controlled by ADAS unit" was in trouble mode or in normal operation mode at the time of the event. This data will not be available for all vehicles.
 - "ABS regulation status" indicates whether "Anti-lock Brake System" was activated (ABS in regulation), or not activated (no ABS regulation). This data will not be available for all vehicles.
 - "VDC switch status ON/OFF" indicates whether the switch of "Vehicle Dynamic Control" in ON, or OFF. This data will not be available for all vehicles.
 - "VDC status/warning" indicates whether "Vehicle Dynamic Control" was in normal operation mode and not activated (No failure and no control), in trouble mode and not activated (Failure), or in normal mode and activated (In active control). This data will not be available for all vehicles.
 - "Adaptive Cruise Control status" indicates whether "Intelligent Cruise Control status" was activated (ACC activated), waiting (ACC waiting), suspended (ACC suspended), or not activated (No display request). This data will not be available for all vehicles.
 - "AEB operating capability" indicates whether "Automatic Emergency Braking" was in trouble mode (Impossible to execute request) or in normal operation mode (Braking fully operational). This data will not be available for all vehicles.
 - "AEB Brake request (from ADAS)" indicates whether "Automatic Emergency Braking controlled by ADAS unit" was activated (Brake Torque AEB Maximum), or not activated (No Brake Request). This data will not be available for all vehicles.

Hexadecimal Data:

All data that has been specified for retrieval is shown in the Hexadecimal Data section of this report. However, the Hexadecimal Data section may contain data that is not translated by the CDR tool.

Data Sources:

- Crash data is measured internally in the ACU.
- Pre-crash data is not measured internally in the ACU, but is transmitted from other control units through the Controller Area Network (CAN).
- Pre-crash data and crash data are asynchronous.

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DTCs at Time of Retrieval

DTC	Status	Description
B1421	Current	FRONTAL COLLISION DETECTION
B1422	Current	SIDE COLLISION DETECTION
B0001	Current	DRIVER AIRBAG MODULE CIRCUIT [OPEN]
B1431	Current	FRONT PRE-TEN RH CIRCUIT [OPEN]
B1430	Current	FRONT PRE-TEN LH CIRCUIT [SHORT]
B1433	Current	FRONT PRE-TEN2 RH CIRCUIT [OPEN]
B1432	Current	FRONT PRE-TEN2 LH CIRCUIT [OPEN]
B0002	Current	DRIVER AIRBAG MODULE 2ND CIRCUIT [OPEN]
B0028	Current	SIDE AIRBAG MODULE RH CIRCUIT [OPEN]
B0020	Current	SIDE AIRBAG MODULE LH CIRCUIT [OPEN]
B00A0	Past	OCCUPANT DETECTION SENSOR [POWER FAIL]
B1422	Past	SIDE COLLISION DETECTION
B1421	Past	FRONTAL COLLISION DETECTION
B0093	Trouble Diag. Record	DOOR SATELLITE SENSOR LH [DISCONNECT]



System Status at Event (Event Record 1)

Life Time Counter (sec)	3166142
Complete File Recorded (Yes/No)	Yes (Complete)
Ignition Cycle, Crash	5050
Ignition Cycle, Download	10683
Multi-Event, Number of Events (1, 2)	1
Time from Event 1 to 2 (sec)	N/A
Safety Belt Status, Driver	On (Fastened)
Safety Belt Status, Right Front Passenger	On (Fastened)
Frontal Air Bag Warning Lamp (On, Off)	Off
Frontal Air Bag Suppression Switch Status	Off (AS airbag deploy)
Maximum Delta-V, Longitudinal (MPH [km/h])	-7 [-11]
Time, Maximum Delta-V, Longitudinal (msec)	300
Maximum Delta-V, Lateral (MPH [km/h])	0 [0]
Time, Maximum Delta-V, Lateral (msec)	100
Maximum Acceleration, Longitudinal (g)	-4.5
Time, Maximum Acceleration, Longitudinal (msec)	2.5
Maximum Acceleration, Lateral (g)	.5
Time, Maximum Acceleration, Lateral (msec)	10

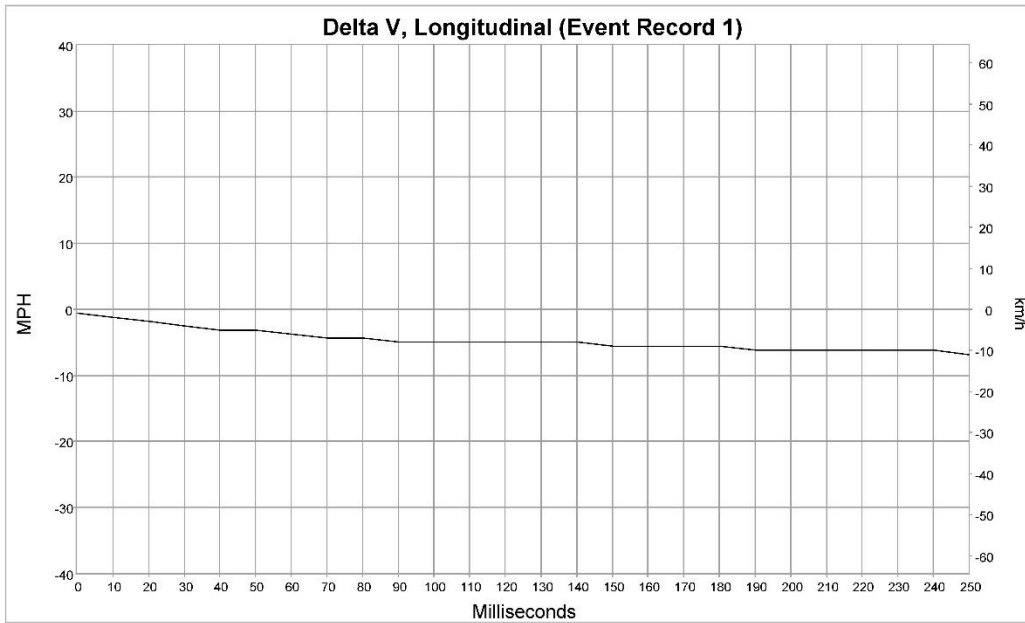
Deployment Command Data (Event Record 1)

Frontal Air Bag Deployment, Time to Deploy/First Stage, Driver (msec)	N/A
Frontal Air Bag Deployment, Time to Deploy/First Stage, Passenger (msec)	N/A
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (msec)	N/A
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (msec)	N/A
Side Air Bag Deployment, Time to Deploy, Driver (msec)	N/A
Side Air Bag Deployment, Time to Deploy, Right Front Passenger (msec)	N/A
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Driver Side (msec)	N/A
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Right Side (msec)	N/A
Pretensioner Deployment, Time to Fire, Driver (msec)	N/A
Pretensioner Deployment, Time to Fire, Right Front Passenger (msec)	N/A

Pre-Crash Data -5 to 0 sec [2 samples/sec] (Event Record 1)

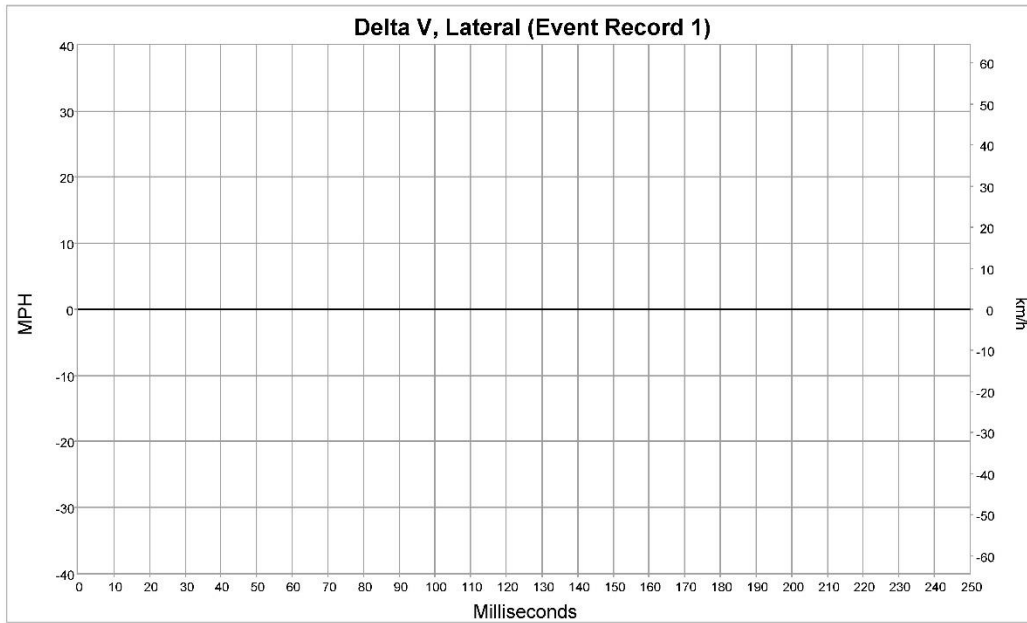
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % full	Engine RPM	Motor RPM	Service Brake (On, Off)	Steering Input (deg)
-5.0	10 [16]	0	1000	N/A	On (Brake Activated)	10
-4.5	10 [16]	0	1000	N/A	Off (Brake Not Activated)	2.5
-4.0	9 [15]	0	1000	N/A	Off (Brake Not Activated)	2.5
-3.5	9 [15]	0	1000	N/A	Off (Brake Not Activated)	2.5
-3.0	9 [15]	0	1000	N/A	Off (Brake Not Activated)	0
-2.5	9 [14]	9	1000	N/A	Off (Brake Not Activated)	-2.5
-2.0	9 [15]	14	1700	N/A	Off (Brake Not Activated)	-2.5
-1.5	11 [17]	18	2100	N/A	Off (Brake Not Activated)	-2.5
-1.0	12 [20]	19	2300	N/A	Off (Brake Not Activated)	-2.5
-0.5	14 [22]	0	2000	N/A	Off (Brake Not Activated)	5
0.0	6 [10]	0	900	N/A	On (Brake Activated)	10



Longitudinal Delta V (Event Record 1)

Time (msec)	MPH [km/h]
0	-1 [-1]
10	-1 [-2]
20	-2 [-3]
30	-2 [-4]
40	-3 [-5]
50	-3 [-5]
60	-4 [-6]
70	-4 [-7]
80	-4 [-7]
90	-5 [-8]
100	-5 [-8]
110	-5 [-8]
120	-5 [-8]
130	-5 [-8]
140	-5 [-8]
150	-6 [-9]
160	-6 [-9]
170	-6 [-9]
180	-6 [-9]
190	-6 [-10]
200	-6 [-10]
210	-6 [-10]
220	-6 [-10]
230	-6 [-10]
240	-6 [-10]
250	-7 [-11]



Lateral Delta V (Event Record 1)

Time (msec)	MPH [km/h]
0	0 [0]
10	0 [0]
20	0 [0]
30	0 [0]
40	0 [0]
50	0 [0]
60	0 [0]
70	0 [0]
80	0 [0]
90	0 [0]
100	0 [0]
110	0 [0]
120	0 [0]
130	0 [0]
140	0 [0]
150	0 [0]
160	0 [0]
170	0 [0]
180	0 [0]
190	0 [0]
200	0 [0]
210	0 [0]
220	0 [0]
230	0 [0]
240	0 [0]
250	0 [0]



System Status at Event (Event Record 2)

Life Time Counter (sec)	7410320
Complete File Recorded (Yes/No)	Yes (Complete)
Ignition Cycle, Crash	10669
Ignition Cycle, Download	10683
Multi-Event, Number of Events (1, 2)	1
Time from Event 1 to 2 (sec)	N/A
Safety Belt Status, Driver	On (Fastened)
Safety Belt Status, Right Front Passenger	Off (Unfastened)
Frontal Air Bag Warning Lamp (On, Off)	Off
Frontal Air Bag Suppression Switch Status	On (AS airbag inhibit)
Maximum Delta-V, Longitudinal (MPH [km/h])	-1 [-1]
Time, Maximum Delta-V, Longitudinal (msec)	250
Maximum Delta-V, Lateral (MPH [km/h])	5 [8]
Time, Maximum Delta-V, Lateral (msec)	297.5
Maximum Acceleration, Longitudinal (g)	-10.5
Time, Maximum Acceleration, Longitudinal (msec)	242.5
Maximum Acceleration, Lateral (g)	-17.5
Time, Maximum Acceleration, Lateral (msec)	250

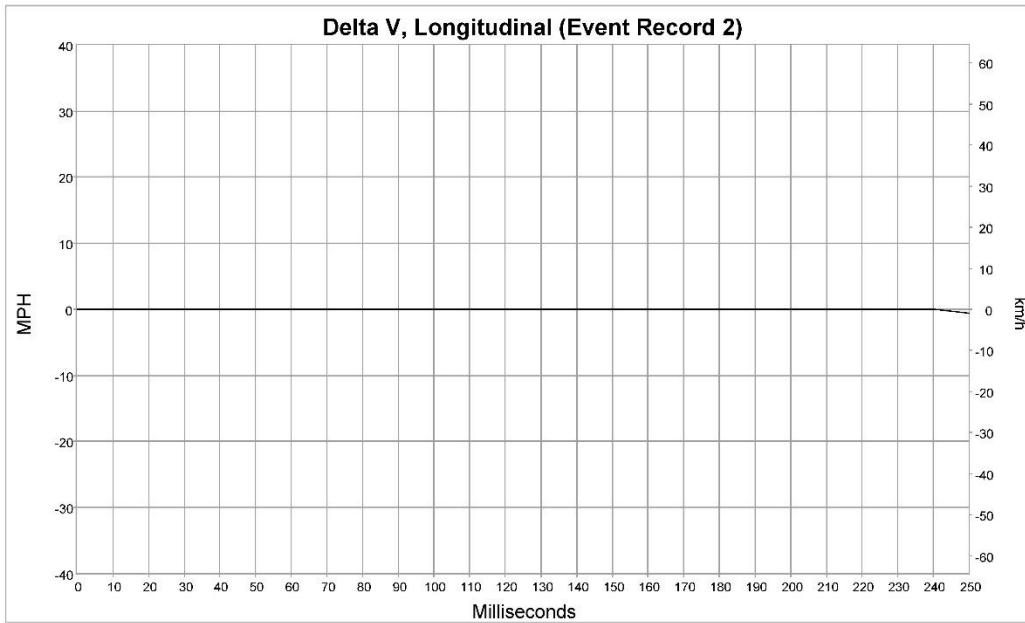
Deployment Command Data (Event Record 2)

Frontal Air Bag Deployment, Time to Deploy/First Stage, Driver (msec)	250
Frontal Air Bag Deployment, Time to Deploy/First Stage, Passenger (msec)	N/A
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (msec)	250
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (msec)	N/A
Side Air Bag Deployment, Time to Deploy, Driver (msec)	250
Side Air Bag Deployment, Time to Deploy, Right Front Passenger (msec)	250
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Driver Side (msec)	250
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Right Side (msec)	250
Pretensioner Deployment, Time to Fire, Driver (msec)	250
Pretensioner Deployment, Time to Fire, Right Front Passenger (msec)	250

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

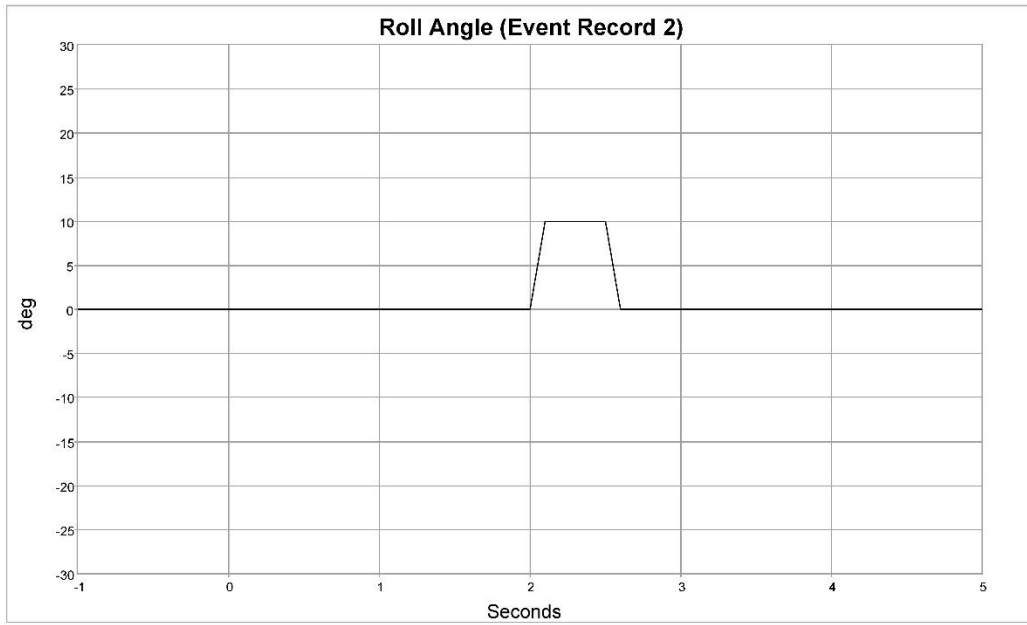
(the most recent sampled values are recorded prior to the event)

Time Stamp (sec)	Speed, Vehicle Indicated (MPH [km/h])	Accelerator Pedal, % full	Engine RPM	Motor RPM	Service Brake (On, Off)	Steering Input (deg)
-5.0	46 [74]	3	1300	N/A	Off (Brake Not Activated)	0
-4.5	46 [74]	3	1300	N/A	Off (Brake Not Activated)	0
-4.0	46 [74]	15	1300	N/A	Off (Brake Not Activated)	-2.5
-3.5	46 [74]	86	1500	N/A	Off (Brake Not Activated)	0
-3.0	46 [74]	0	2100	N/A	Off (Brake Not Activated)	-42.5
-2.5	47 [75]	7	1900	N/A	Off (Brake Not Activated)	-27.5
-2.0	47 [75]	99	2100	N/A	Off (Brake Not Activated)	12.5
-1.5	47 [76]	100 (clp)	3100	N/A	Off (Brake Not Activated)	0
-1.0	50 [80]	100 (clp)	3900	N/A	Off (Brake Not Activated)	-75
-0.5	50 [81]	100 (clp)	4500	N/A	Off (Brake Not Activated)	-172.5
0.0	51 [82]	100 (clp)	4500	N/A	Off (Brake Not Activated)	-150



Longitudinal Delta V (Event Record 2)

Time (msec)	MPH [km/h]
0	0 [0]
10	0 [0]
20	0 [0]
30	0 [0]
40	0 [0]
50	0 [0]
60	0 [0]
70	0 [0]
80	0 [0]
90	0 [0]
100	0 [0]
110	0 [0]
120	0 [0]
130	0 [0]
140	0 [0]
150	0 [0]
160	0 [0]
170	0 [0]
180	0 [0]
190	0 [0]
200	0 [0]
210	0 [0]
220	0 [0]
230	0 [0]
240	0 [0]
250	-1 [-1]



Roll Angle (Event Record 2)

Time (sec)	deg
-1.0	0
-0.9	0
-0.8	0
-0.7	0
-0.6	0
-0.5	0
-0.4	0
-0.3	0
-0.2	0
-0.1	0
0.0	0
0.1	0
0.2	0
0.3	0
0.4	0
0.5	0
0.6	0
0.7	0
0.8	0
0.9	0
1.0	0
1.1	0
1.2	0
1.3	0
1.4	0
1.5	0
1.6	0
1.7	0
1.8	0
1.9	0



2.0	0
2.1	10
2.2	10
2.3	10
2.4	10
2.5	10
2.6	0
2.7	0
2.8	0
2.9	0
3.0	0
3.1	0
3.2	0
3.3	0
3.4	0
3.5	0
3.6	0
3.7	0
3.8	0
3.9	0
4.0	0
4.1	0
4.2	0
4.3	0
4.4	0
4.5	0
4.6	0
4.7	0
4.8	0
4.9	0
5.0	0



Hexadecimal Data

```
61 01 00 00 00 94 21 00 94 22 00 80 01 13 94 31 13 94 30 1A 94 33 13 94 32 13 80 02 13 80 28 13
80 20 13 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 14 FF FF CF FF 00 00 00 00

61 02 80 93 88 00 00 01 03 FF FF FF 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

61 03 80 A0 00 FF FF 01 03 FF FF FF 00 94 22 00 00 00 01 15 FF FF FF 01 94 21 00 00 00 01 15 FF
FF FF 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

61 04 00 00 01 81 00 00 00 FF FF CC 0A 00 00 00 00

61 06 FA F4 F4 FA FA FA FA FF FF FA FA FA FA FF FF FA FA FA FA FA FA FF FF FF FF FF FA FA FA FA
FA FA FA FF FF FF FA FA FA FA FA FA FA FF FF FF FA FA FA FA 00 FA FA FF FF FF FF 7F 7F 7F 7F 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00

61 19 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00
00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01 00 00 00 01

61 1A 01 02 03 04 05 05 06 07 07 08 08 08 08 08 08 09 09 09 09 0A 0A 0A 0A 0A 0A 0B 0B 78 00 10
00 10 00 0F 00 0F 00 0F 00 0E 00 0F 00 11 00 14 00 16 00 0A 00 00 00 00 00 00 00 00 00 00 00 09
00 0E 00 12 00 13 00 00 00 00 00 01 01 01 01 01 01 01 01 01 01 13 BA 29 BB 00 01 FF FF 01 FF 00
00 01 FF FF FF FF FF FF FF FF FF 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80
80 80 80 80

61 1B 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80
00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
00 0A 00 0A 00 11 00 15 00 17 00 14 00 09

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7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F 7F
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FF FF FF FF FF FF 00 30 4F BE

61 1D 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
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00 63 00 64 00 64 00 64 00 64 00 64 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01 01
01 00 FA FF FA FA FA FA FA FA FA 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80
80 80 80 80

61 1E 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80 80
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61 83 31 56 58 30 41 07 34 41 4A 07 09 01 00 01 00 21 00 06 00 01 36 20 20 83

59 02 09 94 21 00 09 94 22 00 09 80 01 13 09 94 31 13 09 94 30 1A 09 94 33 13 09 94 32 13 09 80
02 13 09 80 28 13 09 80 20 13 09
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59 02 09 80 A0 00 08 94 22 00 09 94 21 00 09
59 0F 08 80 93 88 08



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U.S. Department
of Transportation
**National Highway
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