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Special Crash Investigations: Remote Child Restraint System Crash Investigation; Vehicle: 2016 Nissan Rogue; Location: Maryland; Crash Date: November 2019

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15. Supplementary Notes

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

16. Abstract

This remote level investigation documented the road-departure, fixed-object crash of a 2016 Nissan Rogue and the fatal injuries sustained by a 4-year-old male restrained in a forward-facing child restraint system (CRS) secured in the second-row left position. The Nissan departed the road after avoiding a non-contact vehicle striking a utility pole with the front plane. The shell of the Britax Frontier Clicktight XE CRS reportedly fractured during the impact, allowing forward excursion of the child against the internal harness system. An advocate with knowledge of the crash circumstances provided this notification to the National Highway Traffic Safety Administration in March 2020. The SCI team contacted the investigating law enforcement agency, interviewed the investigator, and obtained copies of the police investigation, vehicle and crash site images, and images of the CRS and the event data recorder output. Additionally, SCI obtained copies of the hospital medical records for the driver and the 4-year-old child, as well as his autopsy report. The police interview, documents, and images provided the basis for this report. COVID-19 restrictions prevented physical inspection of the CRS by SCI.

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Special Crash Investigations
Remote Child Restraint System Crash Investigation
Office of Defects Investigation
Case Number: CR20015
Vehicle: 2016 Nissan Rogue
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Crash Date: November 2019

Background

This remote crash investigation documented the road-departure, fixed-object crash of a 2016 Nissan Rogue (Figure 1) and the fatal injuries sustained by a 4-year-old male restrained in a forward-facing child restraint system (CRS) secured in the second-row left position. The shell of the child's Britax Frontier Clicktight XE CRS reportedly fractured during the impact, allowing forward excursion of the child against the internal harness system. An advocate with knowledge of the crash circumstances notified the National Highway Traffic Safety Administration in March 2020. Further research was requested and the notification was forwarded to the Crash Investigation Division and assigned to the Special Crash Investigations (SCI) team at Crash Research & Analysis the same month. The SCI team contacted the investigating law enforcement agency, interviewed the investigator, and obtained copies of the police investigation, vehicle and crash site images, images of the CRS and the event data recorder (EDR) output. Additionally, SCI obtained copies of the hospital medical records for the driver and the 4-year-old child , as well as his autopsy report. The police interview, the obtained documents, and images provided the basis for this report. COVID-19 restrictions prevented physical inspection of the CRS by SCI.

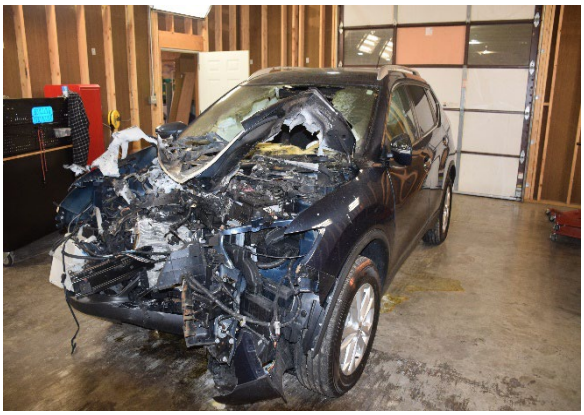


Figure 1. Left front oblique view of the Nissan.
Image obtained from the police investigation.

The crash occurred during the morning on a three-lane east/west roadway in an urban area. The posted speed limit was 40 km/h (25 mph). The Nissan was driven eastbound by a 37-year-old belted female with two children secured in CRSs in the second row. The 4-year-old male was restrained forward-facing by the internal 5-point harness in the Britax Frontier Clicktight XE

CRS, secured in the second-row left by the lower anchors of the LATCH system. A 2-year-old male was restrained forward-facing in an Alpha Omega Elite CRS, secured in the second-row right by the lower anchors. The Nissan driver steered right to avoid a non-contact vehicle that encroached into her lane of travel. The Nissan departed the right side of the road and struck a large-diameter utility pole with the center aspect of its front plane. Several air bags deployed in the vehicle. The Nissan rebounded and came to rest facing southeast in the right lane (Figures 2 and 3).

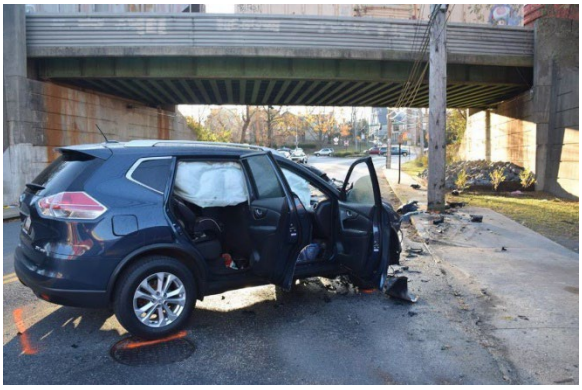


Figure 2. East-facing police image of the Nissan at final rest

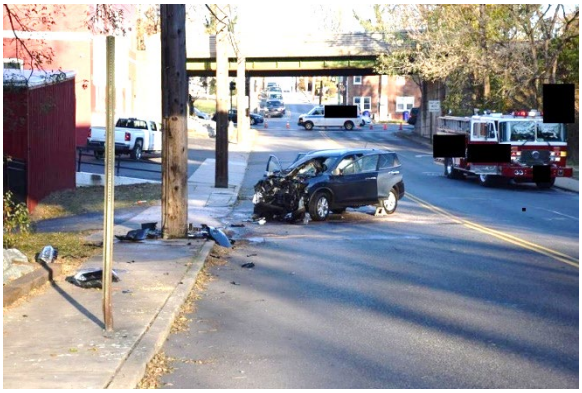


Figure 3. West-facing police image of the Nissan at final rest

The driver and the 2-year-old male were transferred by helicopter to a trauma center, where they were evaluated, treated, and released with police-reported minor severity injuries. The 4-year-old was initially unresponsive and transported to a local hospital where he was stabilized. He was then transferred to a trauma center by helicopter and hospitalized. He died 2 days after the crash. The cause of death was reported as blunt force injuries of the head.

Due to the delay between the dates of the crash and NHTSA notification, the Nissan (which had been deemed a total loss by its insurance company) was sold for salvage. Several parties involved in the crash have filed legal action. The Britax CRS was in the possession of an attorney representing the family of the deceased. Contact with the attorney occurred through other offices in NHTSA. There was no direct SCI involvement at this level; therefore, this case was processed as a remote investigation based on police-provided data.

Summary

Crash Site

The crash occurred on a three-lane city street (Figure 4) during the morning. It was dark with artificial lighting. The National Weather Service reported the following at the time of the crash: sunrise at 0653 hours, temperature of 6 ºC (22 ºF), 63 percent humidity, WSW winds at 14 km/h (9 mph) and fair conditions. The police reported the surface condition as dry. The crash occurred on the three-lane road with one lane for eastbound traffic and two lanes for opposing westbound traffic. The westbound lanes consisted of a designated right-turn lane and the left lane marked as a combination through- and left-turn lane. In the immediate vicinity of the crash site, the travel lanes were straight with a negative grade to the east that transitioned to a sag at the impact location. The road surface was asphalt and both edges of the roadway were bordered by concrete curbs. The east and westbound travel lanes were separated by a double yellow centerline. Concrete sidewalks extended from the curb lines. Located in the south sidewalk adjacent to the eastbound travel lanes were several large diameter wood utility poles. The struck pole, estimated at 46 cm (18 in) in diameter, was centered approximately 0.6 m (2 ft) south of the curb line. A driveway curb cutout and was located immediately prior to the location of the pole. A railroad overpass was located immediately east of the struck utility pole. A 4-leg intersection was located west of the crash site and traffic flow was regulated by a traffic signal system. The posted speed limit was 40 km/h (25 mph). A crash diagram is included at the end of this technical report.

Figure 4. Police image of the Nissan's eastbound approach to the crash site

Pre-Crash

The driver was transporting the second-row children to daycare prior to her continuation to work. The Nissan was traveling east on the city street. A witness traveling behind the Nissan stated that the Nissan passed through the intersection west of the crash site on a green light. The EDR-recorded speed for the Nissan was 37 to 41 km/h (23 to 25 mph) from -5.0 to -3.0 seconds of algorithm enable (AE). During this interval there was minimal accelerator pedal application as

the Nissan increased speed due to the downgrade of the roadway. The EDR also recorded minimal right steering and no brake application.

Both the Nissan driver and the witness told the investigating police officer that a small white car traveling in the opposing lane drifted across the centerline into the eastbound lane. During the -2.5 to -1.5 second pre-crash intervals, the EDR recorded right steering inputs of -17.5, -60, and -25 degrees. These steering inputs represent a right steering maneuver by the Nissan driver to avoid the encroaching vehicle. At -1.0 to 0.0 seconds of AE, the driver counter-steered left with recorded values of 37.5, 47.5 and 30 degrees. She also applied increasing acceleration in attempted avoidance at -1.0 to 0.0 seconds of AE, as the EDR recorded 100 percent accelerator pedal application. The latter avoidance maneuvers were in an attempt to correct the road departure and avoid impact with the pole.

Crash

The Nissan departed the right (south) edge of the travel lane at a driveway cutout. The front plane, center aspect of the Nissan struck the large-diameter utility pole (Event 1) that was centered approximately 0.6 m (2 ft) south of the road edge **(**Figure 5). The EDR-recorded speed at impact was 49 km/h (30 mph). The resultant direction of force was 12 o'clock. The Nissan crushed to maximum engagement then rebounded back onto the travel lane, where it came to final rest. The EDR recorded a maximum longitudinal delta V of -56 km/h (-35 mph) at 132.5 msec of AE. The maximum lateral delta V was recorded at -2 km/h (-1 mph) at 77.5 msec of AE. The crash actuated the front-row pretensioners at 29 msec of AE and deployed stage 1 of the driver's frontal air bag at 29 msec of AE and stage 2 at 32 msec of AE. The seat-mounted side impact air bags and the inflatable curtain (IC) air bags deployed at 41 msec of AE.

As the vehicle rebounded, it rotated approximately 30 degrees clockwise, coming to rest in the eastbound lane facing south (Figure 6). A fire began in the engine compartment (Event 2) and spread to the interior.

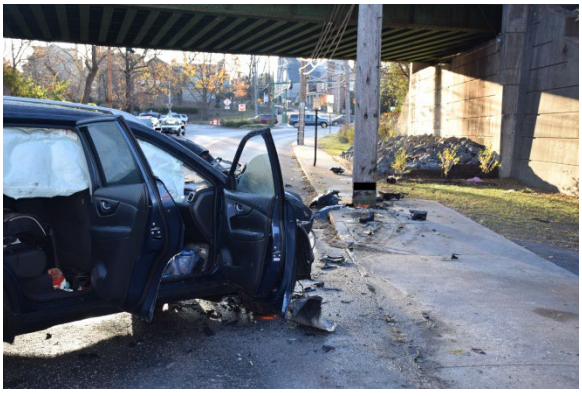


Figure 5. Impact with the utility pole and rebound to final rest. Image obtained from the investigating police agency.

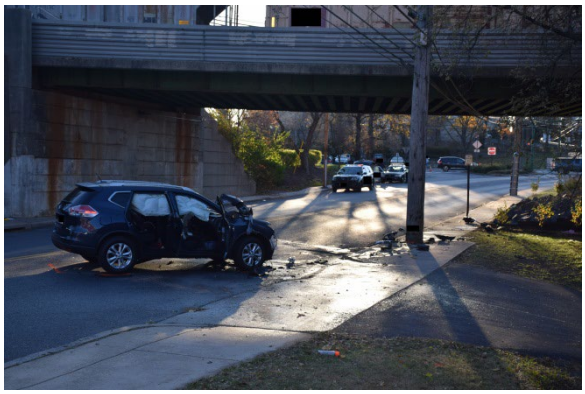


Figure 6. Rebound and final rest position of the Nissan. Image obtained from the investigating police agency.

Post-Crash

Immediately following the crash the Nissan driver unbuckled her seat belt system, opened the driver's door, and exited. A witness called the emergency response system. The Nissan driver went to the right side of the Nissan, opened the right rear door, and removed the 2-year-old from the CRS. She carried him to the south sidewalk, returned to the left side of the Nissan, and opened the left rear door in an attempt to remove the 4-year-old from the CRS. She reportedly unbuckled the 5-point harness system. The first arriving officer went to the Nissan and asked the driver to go to the sidewalk to attend to the 2-year-old and to stay a safe distance from the burning Nissan. Firefighters and ambulance personnel arrived. The police officer saw the 4-year-old's left arm caught in the 5-point harness system of the CRS and his right arm under the right armrest of the CRS. He was initially crying but became unresponsive and limp as the officer removed him from the Nissan. The officer further reported the engine compartment fire was becoming more intense as it spread to the interior of the Nissan. Firefighters suppressed the fire with water.

The driver and the 2-year-old second-row right passenger were transported by ambulance to the emergency room of a local hospital. They were evaluated and transferred by helicopter to a regional level 1 trauma center, where they were treated for their injuries and released. The 4-year-old second-row left passenger was placed in an ambulance and went into cardiac arrest. He was transported to the emergency room of a local hospital where he was revived and prepared for helicopter transfer to the pediatric wing of the level 1 trauma center. He was admitted in critical condition and was determined to be clinically brain dead 2 days following the crash. He was removed from life support the following day and expired.

Police investigated the crash, interviewing witnesses, imaged the Nissan's EDR, and digitally photographed the Nissan and crash site. This data provided the basis for this report.

2016 Nissan Rogue

Description

The vehicle was a 2016 Nissan Rouge 4-door crossover vehicle with the SV trim level and all-wheel drive. The Nissan was manufactured in July 2016 and identified by VIN KNMAT2MV0GPxxxxxx. Built on a 270 cm (106.5 in) wheelbase, the Nissan was powered by a 2.5-liter gasoline engine linked to a continuously variable-speed automatic transmission with a console-mounted shift lever. The gross vehicle weight rating was 2,122 kg (4,679 lb) with gross axle weight ratings of 1,072 kg (2,363 lb) front and 1,089 kg (2,401 lb) rear. The fuel system consisted of a 14.5-gallon tank with a right-side filler tube mounted aft of the rear axle. The vehicle manufacturer recommended tire size was P225/65R17 with specified cold tire pressures of 228 kPa (33 psi) for both axles. The Nissan had Sumitomo GeoTour tires of the recommended size mounted on OEM multi-spoke alloy wheels. Standard features included power-assisted 4-wheel disc brakes with ABS and emergency braking assist, electronic stability control, traction control, and a tire pressure monitoring system.

The Nissan had seating for five occupants with front-row bucket seats and a split-back, forward-folding three-passenger second-row bench seat. The driver seat was power-adjustable. All five seat positions had adjustable head restraints. The seating surfaces were cloth. Safety systems consisted of manual 3-point lap and shoulder seat belts for all five positions, certified advanced 208-compliant driver's and passenger's frontal air bags, front outboard seat-mounted side impact air bags and roof side-rail-mounted IC air bags. The driver's frontal, and both outboard seat-mounted and IC air bags deployed in the crash. Additionally, the Nissan was equipped with LATCH in the second-row left and right positions. The lower anchors secured the CRS.

Exterior Damage

The Nissan's front plane center and right aspects struck the utility pole (Event 1). The direct contact damage was estimated to be approximately 45 cm (18 in) wide and was centered approximately 10 cm (4 in) right of the vehicle's centerline. Based on police images, the depth of crush was estimated at approximately 60 cm (24 in) occurring on the bumper beam approximately 10 cm (4 in) right of the centerline (Figure 7). Damaged components included the bumper fascia, bumper beam, upper and lower radiator supports, hood, right front fender, both headlight assemblies, and grille with rearward displacement of the transverse-mounted engine and transmission. The EDR recorded a longitudinal delta V of -56 km/h (-35 mph) that occurred at 132.5 msec of AE and a lateral delta V of -2 km/h (-1 mph) that was recorded at 77.5 msec of AE. The direction of force was 12 o'clock. The collision deformation classification (CDC) was 12FZEW3.

The post-crash fire (Event 2) originated in the Nissan's engine compartment, appeared to have melted the aluminum hood, and spread rearward through the windshield and into the occupant compartment (Figure 8). The mother and police officer removed the children prior to passenger compartment involvement.

Figure 7. Frontal damage to the Nissan. Image provided by the investigating police agency.

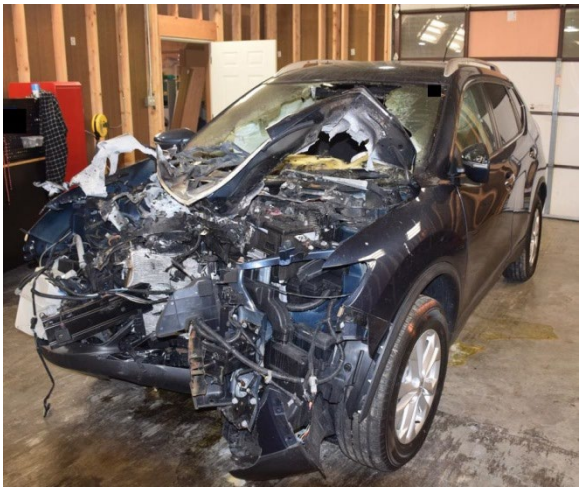


Figure 8. Front left oblique view of the frontal damage. Image provided by the investigating police agency.

Event Data Recorder

The Nissan Rogue had an air bag control module (ACM) that performed the diagnostic, sensing, and deployment command functions for the supplemental restraint systems. The EDR was imaged during the police investigation with the Bosch Crash Data Retrieval tool and software version 18.0.2 and a PDF copy of the data was shared with the SCI team. A sanitized copy of the data is attached at the end of this report as Appendix A.

The data limitations reported that the EDR could record non-deployment events and deployment events and could store two event records. A non-deployment event could be overwritten. A deployment event has a higher priority than a non-deployment event and cannot be interrupted or overwritten by another event. Deployment events, by definition, result in air bags deploying due to deployment thresholds being reached and/or exceeded. The EDR was capable of recording 5

seconds of pre-crash vehicle operational data as well. This data was recorded asynchronously relative to AE in 0.5-second intervals.

The imaged data indicated that the Nissan's EDR had completely recorded one deployment event. It occurred on ignition cycle 3,895 and the data was imaged on ignition cycle 3,897. The recorded deployment event (Event Record 1) was attributed to striking the utility pole. The driver's seat belt was recorded as buckled. The maximum recorded longitudinal and lateral velocity changes were -56 km/h (-35 mph) and -2 km/h (-1 mph). The maximum values occurred at 132.5 and 77.5 milliseconds (msec). The driver seat belt pretensioner was commanded to actuate at 29 msec and the driver's frontal air bag was commanded to deploy, with the first stage deploying at 29 msec and the second stage deploying at 32 msec.

The recorded pre-crash data are listed in the following table in 0.5 second intervals.

Time Seconds	Vehicle Speed km/h (mph)	Throttle Percentage	Engine rpm	Brake Switch Circuit Status	Steering Input
-5.0	37 (23)	8	1,700	Off	0°
-4.5	38 (24)	8	1,700	Off	0°
-4.0	39 (24)	8	1,800	Off	2.5°
-3.5	40 (25)	8	1,700	Off	5°
-3.0	41 (25)	10	1,800	Off	0°
-2.5	43 (27)	0	1,600	Off	-17.5°
-2.0	43 (27)	0	1,200	Off	-60°
-1.5	43 (27)	0	1,100	Off	-25°
-1.0	43 (27)	91	2,200	Off	37.5°
-0.5	46 (29)	100 (clip)	3,000	Off	47.5°
-0.0	49 (30)	100 (clip)	3,400	Off	30°

The data limitations stated that positive steering values indicated a left turn. Examination of the data trends indicated a relatively steady speed with right steering input at the -2.5 second interval, which was consistent with the witness-reported presence of an opposite direction vehicle encroaching into the Nissan's lane. The driver then steered left and accelerated at -1.0-second interval in an attempted maneuver to avoid the utility pole impact. The vehicle speed at AE was 49 km/h (30 mph), consistent with the recorded delta V.

Interior Damage

The Nissan (Figure 9) sustained damage attributed to air bag deployment and the post-crash fire. The occupant compartment did not appear to have been reduced in size by intrusion. The A-pillars were not displaced, and the center console appeared to be intact and not displaced by floor or cowl deformation. The driver's frontal air bag deployed from the steering wheel-mounted module as designed. Both IC air bags deployed through the separation of the headliner from the roof side rails and both outboard seat-mounted air bags deployed through the vertical seams of the seatbacks. Suspected driver contact to the lower instrument panel/knee bolster did not appear to have caused any deformation to the component.

The post-crash fire spread through the windshield into the occupant compartment after the occupants were out of the Nissan. Fire damage occurred to the windshield, upper instrument

panel, headliner, driver's head restraint, center console, and the driver's seat cushion. Firefighters extinguished the fire with water.

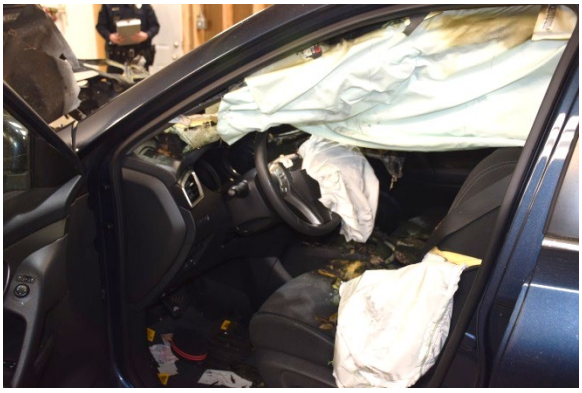


Figure 9. Fire damage to the front interior of the Nissan. Image provided by the investigating police agency.

Manual Restraint Systems

The Nissan had continuous-loop, 3-point lap and shoulder seat belts for the five seat positions, all using sliding latch plates. The driver's seat belt retracted onto an emergency locking retractor (ELR) while the others used switchable ELR/automatic locking retractors. Both front systems had adjustable D-rings and lower anchor and retractor pretensioners. The pretensioners actuated at 29 msec of AE. The driver used the seat belt system as determined by the police investigation and EDR data that recorded the system as buckled. Due to the remote nature of this investigation, loading specific to driver use could not be determined. The police did report that post-crash, the driver's shoulder belt webbing was extended, typical of pretensioner actuation. The second-row CRSs were secured to the vehicle by the lower anchors of the LATCH system. It was unknown if the top tether was used for either CRS. The second-row manual seat belt systems were not used during this crash.

Supplemental Restraint Systems

The Nissan had the certified advanced frontal air bag system that consisted of dual-stage driver and passenger frontal air bags, seat track positioning sensors, seat belt buckle switches, a right-front-seat occupant presence sensor and pretensioners in the front retractors and lower anchors. Side impact protection was provided by front outboard seat-mounted air bags and roof side-rail-mounted IC air bags. The driver's frontal, both outboard seat-mounted, and both IC air bags deployed during the crash. Additionally, the pretensioners actuated.

All air bags appeared to have deployed as designed from their respective modules. There was no apparent damage to the air bags outside of some post-crash heat evidence from the vehicle fire on the left IC air bag.

Child Restraint Systems

The child occupants of the Nissan were restrained in forward-facing CRSs in the second row of the vehicle. The Nissan driver stated to the investigating police officer that she obtained the

CRSs in used condition but no further information was provided. She further stated that the CRSs were installed in her vehicle by her brother, who was the father of the second-row left 4-year-old occupant. Both CRSs were secured to the vehicle by the lower anchor strap of the LATCH system. It is unknown if the top tethers were connected to the tether attachment points.

The 4-year-old second-row left child was restrained in a Britax Frontier Clicktight XE CRS, designed as a forward-facing CRS converting to a high-back booster seat using the 3-point lap and shoulder seat belt system. In this crash the Britax was used forward-facing. The police identified the CRS with a manufacture date of March 2015 and noted that it was rated for a 10-year life span. Britax specifications listed the CRS for use in the forward-facing mode with the internal 5-point harness for children 2 years and older, ranging in weight from 11.3 to 40.8 kg (25 to 90 lb), and height of 76.2 to 147.3 cm (30 to 58 in) when using the vehicle's seat belt system to install the CRS. However, when using the LATCH system, the recommendation for forward-facing using the lower anchors was limited to 18.1 kg (40 lb). The child was well within the height and weight parameters of the CRS in a forward-facing position using the vehicle's seat belt system for installation; however, the child was 1.8 kg (4 lb) over the recommended weight for forward-facing use with the lower anchors. The autopsy-reported height and weight of this child was 107 cm (42 in) and 20 kg (44 lb). In the booster seat mode, the weight limits were 18.1 to 54.4 kg (40 to 120 lb) and heights of 114.3 to 157.5 cm (45 to 62 in).

The CRS manufacturer's installation manual recommended the use of the top tether for all installations but required top tether use for children over 29.5 kg (65 lb) when using the 5-point harness system. The 4-year-old was seated forward-facing in the Britax Frontier Clicktight XE and restrained by the internal 5-point harness system. The CRS was secured to the vehicle by the lower anchor straps that were routed through the proper belt path (Figure 10). During the frontal crash, the child loaded the harness system. His loading of the harness appeared to have fractured the shell of the CRS. The police images supported a separation of the two halves of the backrest. The CRS was designed with a vertical adjustment mechanism for shoulder belt height. This mechanism remained with the forward half of the CRS shell while the locking cogs for the height adjustment remained with the aft half. The shoulder belts dropped to the lowest position and produced a horizontal fracture of the polymer shell (Figure 11). This fracture and separation apparently induced additional length to the shoulder harness resulting in forward excursion of the child occupant. Due to the remote nature of this investigation, the placement of the harness system is unknown as well as the use and position of the chest retainer clip. Also, there was no documentation of the top tether, therefore its use is unknown. Based on the fracture of the CRS shell, it seems possible that the tether was used because the aft half of the CRS shell appeared to have remained against the seatback.

The left aspect of the outer shell of the Britax CRS was abraded in a vertical pattern over a label. This abrasion was attributed to the deployment of the left IC air bag (Figure 12) as it deployed between the CRS and the closed window.

Figure 10. Installed Britax CRS in the second-row left position of the Nissan. Image obtained from the investigating police agency.

Figure 11. Separation of the Britax CRS shell and the horizontal fracture at the bottom of the harness adjustment mechanism. Image provided by the investigating police agency.

Figure 12. IC abrasions to the shell of the Britax CRS. Image provided by the investigating police agency.

The second-row right 2-year-old child was restrained forward-facing in a Dorel Alpha-Omega CRS (Figure 13). Police noted this CRS was manufactured in May 2011 and was labeled as having an 8-year life span. Based on the crash date, this CRS had expired 6 months earlier. The CRS appeared to have been used in a reclined position and secured to the vehicle by the lower anchor attachments. They were routed through the correct belt path. Use of the upper tether is unknown. The child was restrained by the 5-point internal harness system. The adjustment of the harness and use of the chest retainer clip is unknown. Based on the police images, there was no apparent damage to this CRS.

Figure 13. Doral Alpha-Omega CRS in the second-row right position. Image provided by the investigating police agency.

Post-crash, the investigating officer requested the services of two State Police officers who were certified child passenger safety technicians to inspect the installation of the CRSs. These officers reported the lower anchor strap attachments were used to install both CRSs. They were routed through the correct belt paths. On inspection of the Britax, they reported the CRS was installed loose with approximately 10 cm (4 in) of forward movement of the CRS and 5 to 8 cm (2 to 3 in) of lateral side-to-side movement. The police inspection of the Dorel Alpha-Omega determined there was approximately 5 cm (2 in) of forward movement of the CRS and 5 to 8 cm (2 to 3 in) of lateral movement.

2016 Nissan Rogue Occupant Data

Driver Demographics

Age/sex:	37 years/female
Height:	163 cm (64 in)
Weight:	55 kg (121 lb)
Eyewear:	Unknown
Seat type:	Bucket seat
Seat track position:	Mid-track
Manual restraint usage:	3-point lap and shoulder seat belt
Usage source:	Police images, EDR
Air bags:	Frontal, outboard seat-mounted, IC air bags available; all deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Exited under own power
Transport from scene:	Ambulance to a local hospital with helicopter transfer to a regional level 1 trauma center
Type of medical treatment:	Treated and released

Driver Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Abrasions across anterior chest	410402.1	Isolated IPC Interior – Shoulder portion of belt restraint	Probable
2	Right leg abrasion	810202.1	Isolated IPC Front – Left lower instrument panel (includes knee bolster)	Certain
3	Left leg abrasion	810202.1	Isolated IPC Front – Left lower instrument panel (includes knee bolster)	Certain

Source: emergency room records

Driver Kinematics

The driver was seated in an estimated mid-track position with the seatback in a normal recline. She was wearing the manual 3-point lap and shoulder seat belt system. Seat belt usage was determined from the extended position of the shoulder belt webbing due to pretensioner actuation, EDR data, and the minor severity injury across her chest.

At impact with the utility pole, the front-row pretensioners actuated that would have tightened the shoulder belt webbing across the driver's torso and pelvic region. The driver's frontal air bag deployed both stages at 29 and 32 msec of AE with the seat-mounted and IC air bags deploying at 41 msec of AE. The driver initiated a forward trajectory in response to the frontal crash forces.

She loaded the seat belt system that resulted in abrasions of the anterior chest. Although not confirmed by contact evidence, the driver's face and torso probably engaged the deployed frontal air bag that prevented her from direct contact with the steering assembly, thus preventing her from potential injury. Her lower extremities contacted the lower instrument panel/knee bolster resulting in abrasions to both legs.

Immediately following the crash, the driver unbuckled her seat belt system, opened the driver's door, and exited the vehicle. She removed the second-row right child occupant from the CRS and was attempting to remove the second-row left child occupant as police arrived on-scene. The driver was transported by ambulance to the emergency room of a local hospital then transferred by helicopter to a regional trauma center where she was treated for her injuries and released.

Second-Row Left Child Occupant

Age/sex:	4 years/male
Height:	107 cm (42 in)
Weight:	20 kg (44 lb)
Eyewear:	None
Seat type:	Split-bench with folding backs
Seat track position:	Not adjustable
Manual restraint usage:	Forward-facing CRS
Usage source:	Police images/investigation
Air bags:	IC air bag available; deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Removed by police officer due to perceived serious injuries and vehicle fire
Transport from scene:	Ambulance to local hospital, then helicopter transfer to a level 1 trauma center
Type of medical treatment:	Hospitalized; died 2 days later

Second-Row Left Child Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Brain stem: tonsillar herniation	140202.5	Isolated IPC Interior – Other seating position seatback	Possible
2	Small amount of acute subarachnoid hemorrhage adjacent to pons	140210.5	Isolated IPC Interior – Other seating position seatback	Possible
3	Acute subdural hemorrhage (20 mL) overlaying left cerebral convexity	140652.4	Isolated IPC Interior – Other seating position seatback	Possible
4	Marked swelling of brain as characterized by expansion of the gyri and compression of the sulci	140660.3	Isolated IPC Interior – Other seating position seatback	Possible

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
5	Diastatic fractures of coronal and sagittal sutures	150402.2	Isolated IPC Interior – Other seating position seatback	Possible
6	Right hemopneumothorax	442205.3	Isolated IPC Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
7	Left hemopneumothorax	442205.3	Isolated IPC Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
8	Bilateral pulmonary contusions	441410.3	Isolated IPC Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
9	1 ¼ x ½ inch purple contusion to chest	410402.1	Isolated Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
10	Contusions up to ¾ inch on right thigh	810402.1	Isolated Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
11	Contusions right lower leg	810402.1	Isolated Interior – Other seating position seatback	Probable
12	Contusions right foot	810402.1	Isolated Interior – Other seating position seatback	Probable
13	Contusions up to 1 inch on left hip	810402.1	Isolated Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
14	Contusions left thigh	810402.1	Isolated Interior – Child safety seat harness system (i.e., straps, retainer clip, latch plate, buckle)	Probable
15	Contusions left knee	810402.1	Isolated Interior – Other seating position seatback	Probable

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
16	¼ inch abrasion on top of right foot	810202.1	Isolated Interior – Other seating position seatback	Probable

Source: autopsy report (internal), emergency room records, hospitalization records

Second-Row Left Child Kinematics

The 4-year-old child was seated in the forward-facing Britax CRS and restrained by the integral 5-point harness system. The CRS was secured to the vehicle by the lower anchors of the LATCH system. Due to the damage to the CRS and the remote nature of this investigation, the specific adjustments of the LATCH belt could not be determined. It was unknown if the top tether was used to further secure the CRS. Also, the vertical adjustment of the harness straps, and use and position of the chest retainer clip at the time of the crash could not be determined. It should be noted that the Britax user's manual specifically stated to not use the lower anchor of the LATCH system for children weighing over 18.1 kg (40 lb). The autopsy-reported weight of this child occupant was 20 kg (44 lb). The child was within the stated maximum weight limit of 11.3 to 40.8 kg (25 to 90 lb) for the internal 5-point harness for children 2 years and older.

At impact with the utility pole, the vehicle experienced a 12 o'clock direction of impact force and underwent a longitudinal velocity change of -56 km/h (-35 mph). The IC air bags deployed as a result of the frontal crash event at 41 msec of AE. The IC air bag deployed between the left aspect of the CRS shell and the door glazing. A vertically oriented abrasion was noted to the shell of the CRS over a label that resulted from IC deployment.

Figure 14. Fractured seat back of the Britax CRS and the altered position of the integral harness. Image provided by the investigating police department.

The child would have initiated a forward trajectory in response to the crash forces and loaded the integral harness straps of the CRS. His loading of the harness system fractured the polymer structure of the CRS, thus separating the adjustment cogs from the vertical adjustment system of the CRS. This caused the harness straps to move to the lowest position which increased the length of the straps, allowing the occupant to translate forward beyond the confines of the CRS (Figure 14). The lower shell of the CRS also fractured horizontally at the lowest adjustment point

from occupant loading, thus resulting in additional length to the harness straps. As previously noted, the use and position of the chest clip is unknown. On inspection of the Britax, police reported the CRS was installed loose with approximately 10 cm (4 in) of forward movement of the CRS and 5 to 8 cm (2 to 3 in) of lateral side-to-side movement.

The occupant's head likely struck the back surface of the driver's seatback (possible confidence) resulting in fractures of the coronal and sagittal sutures of the skull with underlying injuries of the brain to include tonsillar herniation, subarachnoid and subdural hemorrhage, and marked swelling of the brain. His loading of the harness straps resulted in a chest wall contusion and bilateral pulmonary contusions and hemothoraces. He sustained contusions over the left hip and bilateral thighs from loading the harness and possibly extending over the harness in a partial ejection from the shell of the CRS. The occupant's right foot contacted the seatback, causing an abrasion and contusion.

Following the crash the driver attempted to remove the child occupant from the vehicle. He was initially crying. The first arriving officer asked the driver to walk away from the vehicle due to the fire. The officer found the 4-year-old child occupant unresponsive and limp with his left arm caught in the integral harness of the CRS and his right arm under the armrest of the CRS. The officer unbuckled the 5-point harness system and removed the child from the CRS. He was transferred to an awaiting ambulance in cardiac arrest and transported to the emergency room of a local hospital. He was revived and prepared for helicopter transfer to a level 1 trauma center where he was admitted. The 4-year-old was determined to be brain dead with life support terminated 2 days following the crash.

Second-Row Right Child Occupant

Age/sex:	2 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	None
Seat type:	Split-bench with folding backs
Seat track position:	Not adjustable
Manual restraint usage:	Forward-facing CRS
Usage source:	Police images/investigation
Air bags:	IC; deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Removed by driver due to perceived serious injury and vehicle fire
Transport from scene:	Ambulance to a local emergency room with helicopter transfer to level 1 trauma center
Type of medical treatment	Treated and released

Second-Row Right Child Injuries

Injury No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Tongue laceration	243400.1	Isolated Interior – Same occupant contact (specify): teeth to tongue	Probable
2	Forehead abrasion, NFS	210202.1	Injured, unknown source	Unknown

Source: police report

Second-Row Right Child Kinematics

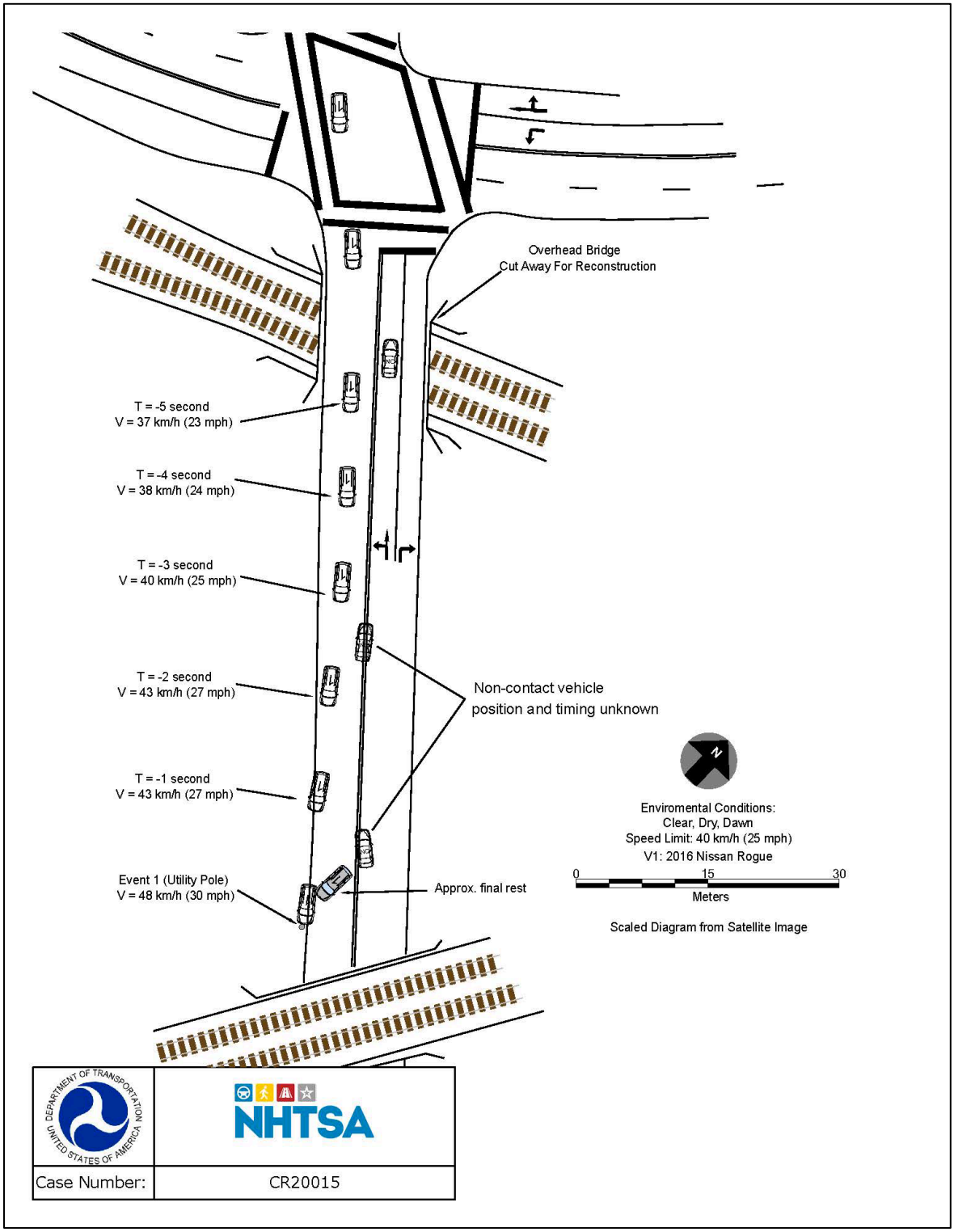
The 2-year-old child was seated in a forward-facing CRS and restrained by the integral 5-point harness system in the second-row right position of the Nissan. The CRS was secured to the vehicle by the LATCH belt. Use of the top tether is unknown. Due to the remote level of this investigation, the adjustment of the harness straps and the use and position of the chest retainer clip is unknown. The police inspection of the Dorel Alpha-Omega determined there was approximately 5 cm (2 in) of forward movement of the CRS and 5 to 8 cm (2 to 3 in) of lateral movement.

At impact with the utility pole, the child occupant responded to the frontal crash forces by initiating a forward trajectory and loading the integral harness straps. Due to his lack of significant injury, he apparently did not extend beyond the confines of the CRS and contact interior components. He sustained a police-reported self-inflicted tongue laceration and an abrasion of the forehead. The source of the abrasion is unknown.

During the crash, the right IC air bag deployed between the shell of the CRS and the door glazing. The CRS and the integral harness system did provide the child with a sufficient ride-down of the severe frontal crash forces.

Following the crash, he was removed from the CRS by the driver and carried to the south sidewalk. He was subsequently transported by ambulance to the emergency room of a local hospital and transferred by helicopter to a regional trauma center where he was evaluated, treated, and released.

Crash Diagram



Appendix A: 2016 Nissan Rogue Event Data Recorder Report[1]

[1] The Bosch CDR report in this technical report was imaged by the investigating law enforcement agency using the current version of the Bosch CDR software at the time of imaging the EDR. Only an electronic PDF file of the Bosch CDR report was provided by the law enforcement agency, and the EDR hexadecimal data has been deleted from the report due to potential personal identifiable information (VIN, etc.).

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	KNMAT2MV0GPxxxxxx
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 18.0.2
Imaged with Software Licensed to (Company Name)	
Reported with CDR version	Crash Data Retrieval Tool 18.0.2
Reported with Software Licensed to (Company Name)	
EDR Device Type	Airbag Control Module
Event(s) recovered	Event Record 1

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.

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
U1000	Current	(CAN COMMUNICATION FAILER)
B0094	Current	CRASH ZONE SENSOR [DISCONNECT]
B0092	Current	C-PILLAR SATELLITE SENSOR LH [DISCONNECT]
B0097	Current	C-PILLAR SATELLITE SENSOR RH [DISCONNECT]
B0001	Current	DRIVER AIRBAG MODULE CIRCUIT [OPEN]
B0010	Current	ASSIST AIRBAG MODULE CIRCUIT [OPEN]
B1431	Current	FRONT PRE-TEN RH CIRCUIT [OPEN]
B1430	Current	FRONT PRE-TEN LH CIRCUIT [OPEN]
B1433	Current	FRONT PRE-TEN2 RH CIRCUIT [OPEN]
B1432	Current	FRONT PRE-TEN2 LH CIRCUIT [OPEN]
B00D5	Current	PASSENGER AIRBAG INDICATOR CIRCUIT [OPEN]
B0002	Current	DRIVER AIRBAG MODULE 2ND CIRCUIT [OPEN]
B0011	Current	ASSIST 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 UNIT [UNDEFINED]
B00A0	Past	OCCUPANT DETECTION SENSOR [POWER FAIL]
B142A	Past	IGN VOLTAGE [LOW]
B1421	Past	FRONTAL COLLISION DETECTION

System Status at Event (Event Record 1)

Life Time Counter (sec)	3586230
Complete File Recorded (Yes/No)	Yes (Complete)
Ignition Cycle, Crash	3895
Ignition Cycle, Download	3897
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])	-35 [-56]
Time, Maximum Delta-V, Longitudinal (msec)	132.5
Maximum Delta-V, Lateral (MPH [km/h])	-1 [-2]
Time, Maximum Delta-V, Lateral (msec)	77.5
Maximum Acceleration, Longitudinal (g)	-49
Time, Maximum Acceleration, Longitudinal (msec)	52.5
Maximum Acceleration, Lateral (g)	29.5
Time, Maximum Acceleration, Lateral (msec)	57.5
Occupant Size Classification, Right Front Passenger, Child (Yes/No)	No

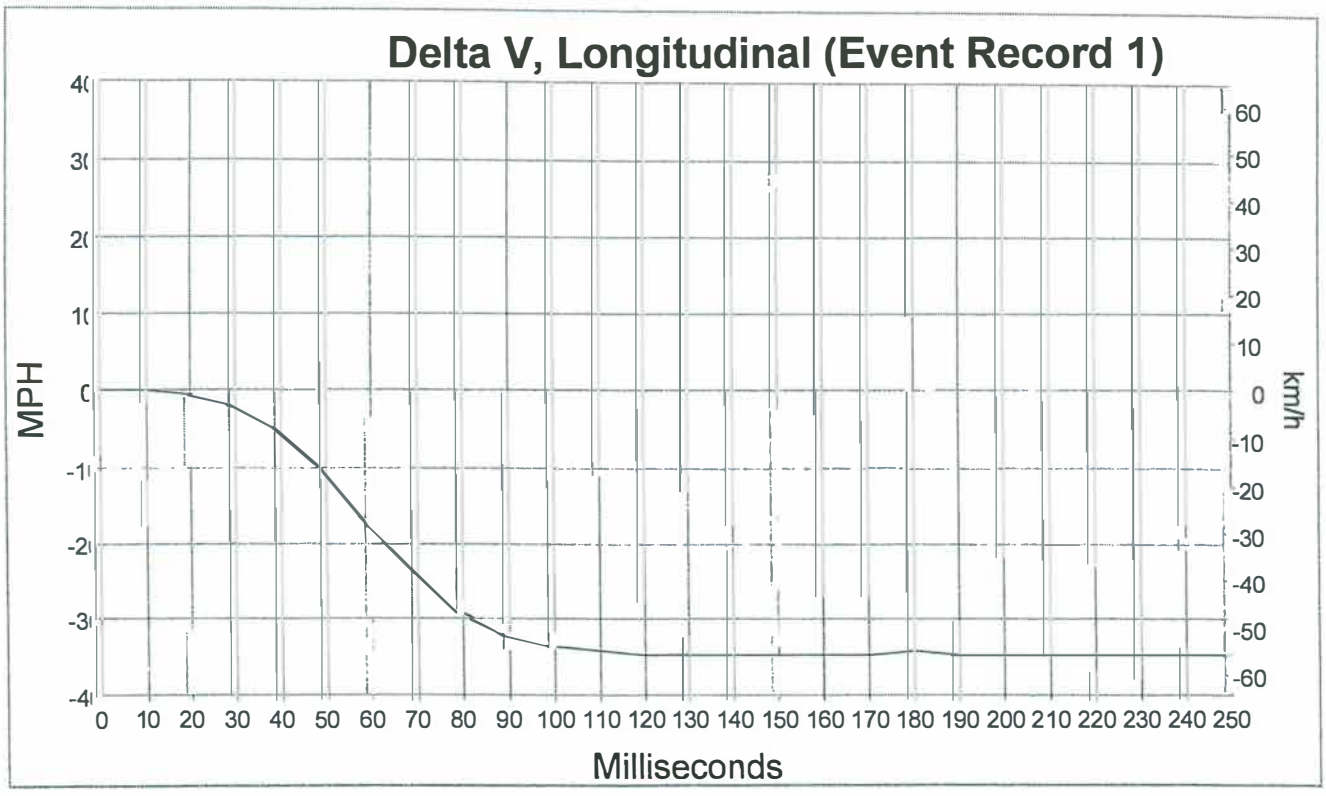
Deployment Command Data (Event Record 1)

Frontal Air Bag Deployment, Time to Deploy/First Stage, Driver (msec)	29
Frontal Air Bag Deployment, Time to Deploy/First Stage, Passenger (msec)	N/A
Frontal Air Bag Deployment, Time to 2nd Stage, Driver (msec)	32
Frontal Air Bag Deployment, Time to 2nd Stage, Right Front Passenger (msec)	N/A
Side Air Bag Deployment, Time to Deploy, Driver (msec)	41
Side Air Bag Deployment, Time to Deploy, Right Front Passenger (msec)	41
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Driver Side (msec)	41
Side Curtain/Tube Air Bag Deployment, Time to Deploy, Right Side (msec)	41
Pretensioner Deployment, Time to Fire, Driver (msec)	29
Pretensioner Deployment, Time to Fire, Right Front Passenger (msec)	29

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

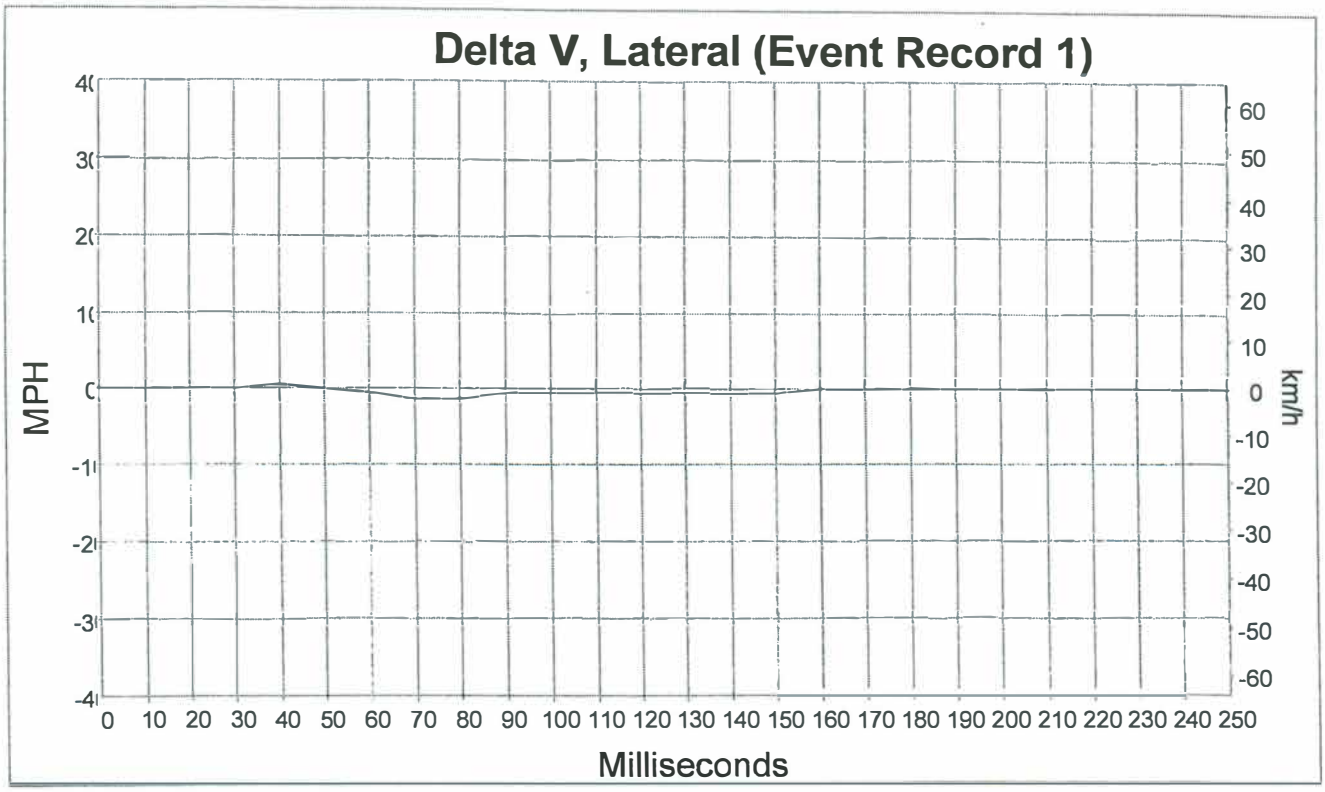
(the most recent sampled values are recorded prior to the event)

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	23 [37]	8	1700	1300	Off (Brake Not Activated)	0
-4.5	24 [38]	8	1700	1200	Off (Brake Not Activated)	0
-4.0	24 [39]	8	1800	1200	Off (Brake Not Activated)	2.5
-3.5	25 [40]	8	1700	1200	Off (Brake Not Activated)	5
-3.0	25 [41]	10	1800	1300	Off (Brake Not Activated)	0
-2.5	27 [43]	0	1600	1200	Off (Brake Not Activated)	-17.5
-2.0	27 [43]	0	1200	1100	Off (Brake Not Activated)	-60
-1.5	27 [43]	0	1100	1100	Off (Brake Not Activated)	-25
-1.0	27 [43]	91	2200	1300	Off (Brake Not Activated)	37.5
-0.5	29 [46]	100 (clp)	3000	2400	Off (Brake Not Activated)	47.5
0.0	30 [49]	100 (clp)	3400	3000	Off (Brake Not Activated)	30



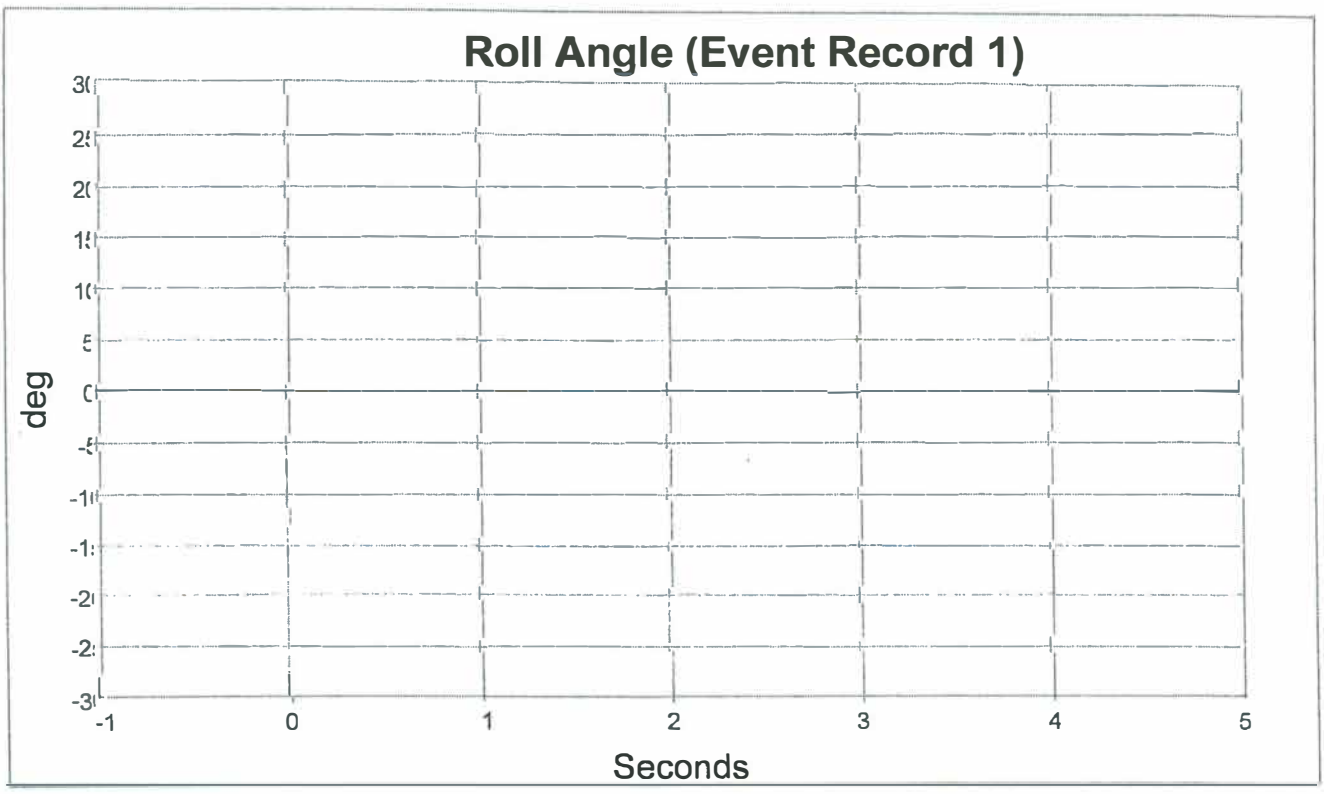
Longitudinal Delta V (Event Record 1)

Time (msec)	MPH [km/h]
0	0 [0]
10	0 [0]
20	-1 [-1]
30	-2 [-3]
40	-5 [-8]
50	-10 [-16]
60	-17 [-28]
70	-24 [-38]
80	-29 [-47]
90	-32 [-52]
100	-34 [-54]
110	-34 [-55]
120	-35 [-56]
130	-35 [-56]
140	-35 [-56]
150	-35 [-56]
160	-35 [-56]
170	-35 [-56]
180	-34 [-55]
190	-35 [-56]
200	-35 [-56]
210	-35 [-56]
220	-35 [-56]
230	-35 [-56]
240	-35 [-56]
250	-35 [-56]



Lateral Delta V (Event Record 1)

Time (msec)	MPH [km/h]
0	0 [0]
10	0 [0]
20	0 [0]
30	0 [0]
40	1 [1]
50	0 [0]
60	-1 [-1]
70	-1 [-2]
80	-1 [-2]
90	-1 [-1]
100	-1 [-1]
110	-1 [-1]
120	-1 [-1]
130	-1 [-1]
140	-1 [-1]
150	-1 [-1]
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]



Roll Angle (Event Record 1)

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	0
2.2	0
2.3	0
2.4	0
2.5	0
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

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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October 2022

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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