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Special Crash Investigations: On-Site Rollover Crash Investigation; Vehicle: 2019 Lexus NX300; Location: North Carolina; Date: May 2022

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15. Supplementary Notes

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

16. Abstract

This report documents the on-site investigation of the rollover crash of a 2019 Lexus NX300 crossover-type vehicle driven by a belted 48-year-old female and occupied by a belted 7-year-old male front-right passenger and a 7-year-old female second-row left passenger with a small dog. The crash occurred at the junction of a multi-lane roadway and driveway access to a service station when the front of the Lexus struck the right side of a 2013 Hyundai Sonata. The Lexus rotated clockwise and tripped into a left-side-leading three-quarter-turn rollover. The Hyundai also rolled over. All Lexus occupants sustained police-reported B-level non-incapacitating injuries and were transported to a level I trauma center for treatment. The driver was treated and released. The front passenger was hospitalized for an unknown number of days. The second-row passenger was treated and released. The belted 17-year-old female Hyundai driver sustained police reported B-level non-incapacitating injuries and was transported by ambulance to a level I trauma center.

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Special Crash Investigations
On-Site Rollover Crash Investigation
Case Number: CR22013
Vehicle: 2019 Lexus NX300
Location: North Carolina
Crash Date: May 2022

Background

This report documents the on-site investigation of the rollover crash of a 2019 Lexus NX300 crossover-type vehicle (Figure 1) and a 2013 Hyundai Sonata. The crash was identified by the Crash Report Sampling System and was selected and assigned to the Special Crash Investigations (SCI) team by the National Highway Traffic Safety Administration's Crash Investigation Division in September 2022. The SCI team at Crash Research & Analysis, Inc. obtained cooperation from the insurance company for the Lexus and conducted an on-site investigation in September 2022.

The crash occurred at the junction of a multi-lane roadway and driveway access to a service station. The Lexus was initially involved in a turn across-path crash with a 2013 Hyundai Sonata that resulted in frontal damage to the Lexus (Event 1). The vehicle subsequently rotated clockwise and tripped into a left-side-leading three-quarter-turn rollover (Event 3). During the rollover, the Lexus struck a curb that damaged its right plane (Event 4) and interrupted the rollover. The Hyundai also rolled over during the crash (Event 2) and came to rest on its roof. The Lexus driver's and passenger's frontal, outboard, seat-mounted side-impact, driver knee, and inflatable curtain (IC) air bags deployed in the Lexus during the crash. The front passenger seat had a seat cushion air bag, but its deployment could not be confirmed during the SCI inspection.

The Lexus was driven by a belted 48-year-old female with a belted 7-year-old male front-right passenger, and a belted 7-year-old female second-row left passenger. A small dog was also in the Lexus. All Lexus occupants sustained police-reported B-level non-incapacitating injuries and were transported to a level 1 trauma center for treatment. The driver was treated and released. The front passenger was hospitalized for an unknown number of days. The second-row passenger was treated and released. The belted 17-year-old female Hyundai driver sustained police reported B-level non-incapacitating injuries and was transported by ambulance to a level 1 trauma center. Details concerning her treatment were unknown at the time this report was submitted. Both vehicles were towed from the scene. The Lexus was taken to a salvage insurance yard where it was located for this SCI investigation.

Figure 1. Right front oblique view of the Lexus

The investigation had complete documentation of the Lexus including exterior damage, interior damage, occupant contact points, intrusion, and assessment of the manual and supplemental safety systems. The Lexus had an event data recorder (EDR) that was imaged and reported using the Bosch Crash Data Retrieval tool, version 21.5.1. The crash site was documented using the total station and digital images. The Hyundai was not insured for damage and could not be located for this investigation. The SCI investigator contacted the Lexus driver once for a brief partial interview and requested an authorization of release of medical records for herself and the two minor passengers. The medical records for the driver and the left rear passenger were received but the front passenger's records were not authorized for release.

Crash Summary

Crash Site

The crash occurred during morning hours at the junction of a multi-lane roadway and driveway access to a service station. The crash location was approximately 33 m (108 ft) south of a traffic controlled four-leg intersection. The Lexus was traveling south in the right lane of the five-lane roadway. The roadway had two lanes in both the north and southbound travel directions with a common center left turn lane. The travel lanes were 3.8 m (12.5 ft) in width and straight and level in the vicinity of the crash site. Roadway markings had broken white lane lines and painted solid yellow and broken center turn lane lines. The road edges were curbed. The road surface was bituminous and at the time of the crash was police-reported as dry. The National Weather Service listed the conditions as cloudy with a temperature of 23.8 °C (75 °F), winds out of the southwest at 16 km/h (10 mph), and 79 percent humidity. The posted speed limit was 72 km/h (45 mph).

The driveway to the service station was located west of the south travel lanes. A curbed gore area divided the driveway for traffic entering and exiting the station. This curbed concrete gore was in poor condition with cracked and displaced concrete from traffic overriding it. The curb varied in height to a maximum of 13 cm (5.1 in). Grass and concrete sidewalks bordered both road edges. Figures 2 and 3 show the respective views of the crash site for the approach of the Lexus and the Hyundai. A crash diagram is attached at the end of this report.

Figure 2. Facing south, path of travel for the Lexus. Arrow indicates left turn of the Hyundai.

Figure 3. Facing north, path of travel for the Hyundai. Arrow indicates left turn of the Hyundai.

Pre-Crash

The Lexus was traveling south in the right lane at an EDR-recorded speed of 94 km/h (58.4 mph) and accelerated through the four-leg intersection at 1.75 seconds prior to algorithm enable for TRG 1 (Event 1). As the Lexus driver approached the driveway for the service station, she observed the Hyundai initiating a left turn across her path of travel. The Lexus driver applied the service brakes and steered right at 0.75 seconds prior to algorithm enable to avoid the crash.

The Hyundai driver was traveling north in the center left turn lane to prepare and then initiate a left turn into the service station driveway. According to the Lexus driver, as the Hyundai was turning left, it appeared that it stopped in the roadway, exposing the right plane of her vehicle to approaching traffic.

Crash

The front of the Lexus struck the right passenger compartment area of the Hyundai broadside (Event 1). The damage to the Lexus was distributed across the front plane with a resultant direction of force of 12 o'clock. The impact deployed the driver's and passenger's frontal air bags, driver knee air bags, front passenger seat cushion, front row outboard seat-mounted side-impact and the IC air bags. The lateral component of the impact force coupled with the momentum of the Hyundai induced a clockwise rotation to the Lexus. The Lexus rotated approximately 30° clockwise as the left rear tire scuffed on the asphalt. The tire debeaded and the alloy wheel contacted the asphalt causing the vehicle to trip into a left-side-leading rollover (Event 3). At the initiation of rollover, the Lexus rotated approximately 60° clockwise. It rolled three quarter turns traversing the right lane and the south aspect of the service station driveway (Figure 4). The right side of the Lexus contacted the curb (Event 4) that bordered the south aspect of the driveway causing non-horizontal damage to the right A-pillar and front door. This contact interrupted the rollover as its momentum ceased and it rolled back onto its roof where it came to rest approximately 10 m (32 ft) from the initial impact.

The Hyundai was displaced laterally to its left by the Event 1 impact. Its left side tires contacted the curbed gore area of the service station driveway (Figure 5) and tripped the vehicle into a left-side-leading rollover (Event 2). The Hyundai rolled across the gore and into the south aspect of the driveway where it came to rest on its roof approximately 10 m (33 ft) southwest of the initial impact.

Figure 4. Facing southeast toward the south curb in Event 4

Figure 5. Facing southwest towards the tripping point of the Hyundai Event 2

Post-Crash

The Lexus driver exited the vehicle through her corresponding door. The right-front passenger was removed by EMS personnel through the right-front door and the left-rear passenger was assisted by a bystander through the left-rear door. They were transported by ambulances to a level 1 center for treatment of police-reported B-level non-incapacitating injuries. The driver and second row passenger were treated and released. According to the driver's interview, the front row passenger was hospitalized for an unknown number of days. The Hyundai driver was also assisted from her vehicle by EMS personnel and transported by ambulance to a level 1 trauma center for treatment of police-reported B-level non-incapacitating injuries. Details regarding her treatment are unknown at the time of this report.

The vehicles were up-righted and towed from the scene. The Lexus was transferred to a regional insurance vehicle salvage facility where it was held for this investigation. The Hyundai was not insured for damage and was removed from the original tow facility to an unknown location. It was not inspected for this investigation.

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2019 Lexus NX300

Description

The 2019 Lexus NX300 (Figure 6) was a 4-door crossover-type vehicle manufactured in September 2018 and was identified by VIN: JTJYARBZ9K2xxxxx. It was powered by a 2.0-liter turbocharged gasoline engine linked to a shiftable 6-speed automatic transmission with a console-mounted shifter and front-wheel drive. The service brakes were power-assisted 4-wheel disc with ABS. Additional features included adaptive cruise control, lane departure warning, lane keeping support, forward crash warning, crash imminent braking, pre- and post-collision safety systems, electronic stability control, traction control, and an indirect tire pressure monitoring system. During her interview, the driver said the car was always beeping at her and that she could not recall if it reacted to the crash or not. There were no recorded indications that the crash imminent braking activated during the crash events. The EDR's pre-crash data reported the driver as applying the brakes and steering right as an avoidance maneuver. The ignition system was keyless. Adjustments of the steering wheel/column included tilt and telescopic positions. The power steering system was electric. The manufacturers recommended tire size was 225/60R18 at a cold tire pressure of 220 kPa (32 psi) front and rear. The Lexus had 225/60R18 tires mounted on original equipment manufacturer alloy wheels. All four tires were Yokohama Geolander G91 with minimal tread ranging from 2–3 mm (2–4/32 in). The Lexus had a gross vehicle weight rating of 2,309 kg (5,090 lb). This was distributed as gross axle weight ratings of 1,266 kg and (2,790 lb) in the front and rear. The curb weight of the vehicle was 1,755 kg (3,869 lb).

Figure 6. Left front oblique view of the Lexus

The interior of the Lexus had seating for five occupants with eight-way power adjustable driver and front passenger seats. The three-passenger second row seat was a split-bench with folding backs and adjustable tracks. All five seat positions had adjustable head restraints. Safety systems had manual three-point lap and shoulder seat belts for all five positions. The front seat belts had retractor pretensioners. Supplemental protection had driver's and passenger's dual-stage frontal air bags, driver knee air bag, front row outboard seat-mounted side-impact air bags, front passenger's seat cushion, and dual sensing side impact and rollover IC air bags. All air bags deployed during the crash although the status of the front passenger seat cushion air bag could not be determined.

Vehicle History

A Carfax vehicle history for this specific 2019 Lexus NX300 showed that it was purchased new and registered in the State of North Carolina in November 2021. It was serviced regularly until May 2022 when it was reported to be in a total loss crash that is the subject crash of this report. There were no previous reported crashes or reported modifications made to the vehicle prior to the crash date.

NHTSA Recalls and Investigations

An August 2022 and January 2025 search of the NHTSA recall database using the Lexus's VIN revealed no open or unrepaired recalls.

Exterior Damage

The Lexus sustained damage to the front (Event 1), left, right, and top planes from the interrupted subsequent rollover (Events 3 and 4). The frontal damage was distributed across the front plane with a direct contact length of 127 cm (50.0 in) that extended from corner-to-corner. The bumper fascia was fractured and partially separated. The outer aspects were removed to access the bumper reinforcement bar for accurate documentation of the residual crush (Figure 7). The Field L, measured along the bumper reinforcement bar, was 126 cm (49.6 in). The residual crush was measured with a total station and the resultant profile was: C1 = 6 cm (2.4 in), C2 = 18 cm (7.1 in), C3 = 29 cm (11.4 in), C4 = 27 cm (10.6 in), C5 = 22 cm (8.7 in), C6 = 19 cm (7.5 in). The maximum crush of 29 cm (11.4 in) was at the C3 position.

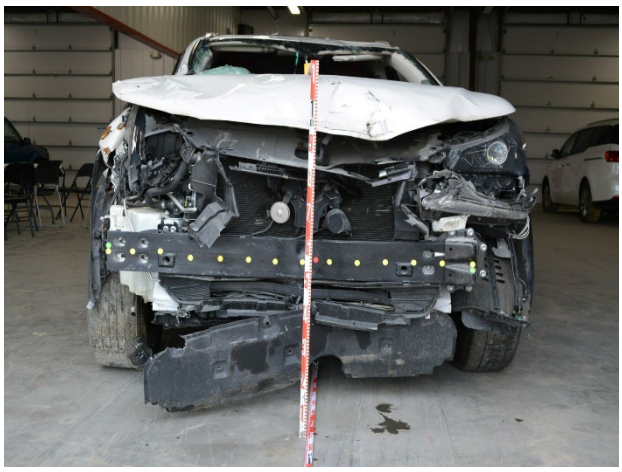


Figure 7. Damage to the front of the Lexus from SCI Event 1

For comparative purposes, the severity of the impact was calculated by the missing vehicle algorithm of the WinSMASH program. The total change in velocity (delta V) was 42 km/h (26.1 mph). The longitudinal and lateral components were -41 km/h (-25.5 mph) and 7 km/h (4.3 mph). The calculated result was considered borderline reconstruction due to missing damage information for the Hyundai. The collision deformation classification[1] (CDC) assigned to this damage pattern for Event 1 was 12FDEW2.

[1] SAE J224_202205 – SAE Recommended Practice describing vehicle collision damage in an alphanumeric format.

The rollover events (Events 3 and 4) produced damage to the left, top, and right planes. The left plane damage had abrasions and isolated dents and deformation along the full-length of the vehicle that extended onto the left roof side rail (Figure 8). The top plane damage was limited to the leading edge of the hood and the roof between the header and the sunroof. Minimal intrusion occurred at the level of the windshield header. This Event 3 was assigned a CDC of 00TDDO2.

The right plane had damage to the right upper A-pillar and right door from contact with the curb (Figure 9). This Event 4 curb contact interrupted the rollover event and was assigned a CDC of 00RYAW2.

Figure 8. Damage to the left and top plane during Event 3

Figure 9. Damage to the right A-pillar and right front door from Event 4

Event Data Recorder

The 2019 Lexus NX300 had an air bag electronic control unit (ECU) that was mounted to the floor on the center tunnel, beneath the center console. The ECU monitored the diagnostic functions of the restraint systems (air bags and seat belt pretensioners) and controlled the deployment/actuation of those devices dependent on crash event trigger severity. The ECU also had EDR capabilities to record crash event data for longitudinal (front/rear), lateral (side), and non-horizontal (rollover) crash events. At the time of the SCI inspection, the SCI investigator imaged the EDR data using the Bosch CDR software and tool, version 21.5.1, via a data link connector method. The data was later read using software version 23.0.2 and is included at the end of this technical report as an appendix.

The Lexus's EDR could store up to two recording pages (records) for each of the three crash event types, in chronological order based on event recognition (termed trigger or TRG). The reported data were referenced based on the TRG counter, and the recording of each event was based on a judgement threshold (specific value unknown) dependent on the type. In crash impacts where forces were recognized in several directions, data correlating to that event may be recorded in additional pages (i.e., an angular horizontal impact may be recorded in both front/rear and side event type pages). For a recorded event, if the "freeze signal" was indicated ON, data was locked, and subsequent events would not be recorded in that recording page. The freeze signal typically was associated with air bag deployment commands. If power supply to the

ECU was lost during or following a crash event, all or part of the data may not have been recorded to the EDR's memory.

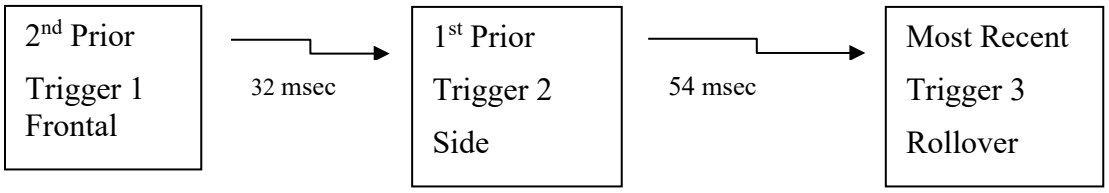
The imaged data had three triggers that were attributed to the events of the investigation. The triggers (TRG 1, TRG 2, and TGR 3) all occurred on ignition cycle 4,036. There was no diagnostic trouble codes present at the time of data imagery. The data reported that the driver's and front passenger's seat belts were buckled and that the front passenger classified as an AM50 (not child). The three triggers shared the same pre-crash data.

A portion of the 4.7 seconds pre-crash data of the first record is included in Table 1.

Table 1. Pre-Crash data for Trigger 1

Time (sec) Ev.1	Vehicle Speed km/h (mph)	Engine rpm	Accelerator Pedal % Full	Percent of Engine Throttle	Service Brake (on/off)	Brake Oil Pressure (Mpa)	Yaw Rate (deg/sec)	Steering Wheel Angle (deg.) (+L)
-4.75	95 (70)	2,100	19	10.5	OFF	0	-1.46	0
-4.25	94 (70)	2,000	7	0.5	OFF	0	-1.95	-1.5
-3.75	93 (71)	1,800	4.5	0	OFF	0	-1.46	0
-3.25	93 (71)	2,000	20.5	17.5	OFF	0	-0.98	0
-2.75	93 (71)	1,900	35.5	32.5	OFF	0	-0.98	0
-2.25	93 (71)	2,000	49	35	OFF	0	-0.98	1.5
-1.75	94 (70)	2,600	50.5	42	OFF	0	-0.98	1.5
-1.25	94 (66)	2,300	0	1	OFF	0	-2.44	-9
-0.75	83(14)	1,800	0	0	OFF	8.83	-7.81	-13.5
-0.25	68 (57)	1,400	0	0	ON	12.14	-4.39	-21
0	60 (57)	1,400	0	0	ON	11.9	-4.88	-19.5

Chronologically the sequence of the triggers is represented by the following graphic. Occurring first, TRG 1 was recognized as a frontal event followed 32 msec later by TRG 2, a side event. Combined, these two triggers were attributed to Event 1. TRG 3 was recognized as a rollover event 86 msec after TRG 1 Event 3.



The maximum recorded longitudinal delta V was -30.3 km/h (-18.9 mph) for Trigger 1. The lateral delta V was calculated by integrating the floor sensor lateral acceleration that was reported in m/s^2 and converting to km/h. The calculated result was equal to 3.3 km/h (2.1 mph) at 46 msec into Trigger 2. All supplemental restraint device actuations and deployments were related to TRG 1. The driver's and front passenger's pretensioners actuated at 11 msec. The driver's and passenger's frontal air bags, both front row outboard seat-mounted side-impact air bags, and the left and right IC air bags deployed at 13 msec. The passenger's frontal air bag second stage deployed at 23 msec and was followed by the driver's frontal air bag second stage deployed at 24 msec. There was no reported deployment time for the driver knee air bag or the front passengers seat cushion air bag.

The rollover data of Trigger 3 had approximately 2 seconds of roll rate data. Numerical integration of the data calculated approximately 146° of roll at 1.89 seconds after Trigger 3's initiation and was consistent with Event 3. Columns -1 and -2 in Table 2 represent the recorded time history of the vehicle's roll rate in 0.2 second intervals. The SCI-calculated roll angle of the Lexus is presented in column-3. The calculated angle was consistent with the rollover event.

Table 2. Roll data for Trigger 3

Time (sec)	Roll Rate (degrees/sec)	Calculated Roll Angle (degrees)
-0.22	0	0
-0.09	1.6	0.1
0.03	32.6	1.0
0.16	16.3	5.2
0.29	-48.9	3.2
0.42	-65.2	-4.4
0.54	-34.2	-10.7
0.67	-39.1	-14.5
0.80	-48.9	-20.5
0.93	-73.3	-28.0
1.06	-115.6	-40.1
1.18	-110.8	-54.8
1.31	-91.2	-67.8
1.44	-135.2	-81.1
1.57	-143.3	-99.4
1.70	-145.0	-118.0
1.82	-143.3	-136.2
1.89	-146.6	-145.4

Interior Damage

The interior of the Lexus sustained minor severity damage associated with deployment of several air bag systems, occupant contact, seat belt loading, passenger compartment intrusion, and post-crash windshield collapse (Figures 10 and 11). The maximum intrusion was located at the front passenger's A-pillar with 4 cm (1.5 in) vertically and 3 cm (1.1 in) laterally (Figure 12). The windshield header was also intruded 1 cm (0.3 in) vertically at a location 23 cm (9.1 in) right of the left A-pillar/header junction. There was a contact to the windshield located left of the rearview mirror. The driver reported that the small dog that was riding in the rear of the vehicle struck the windshield during the crash events.

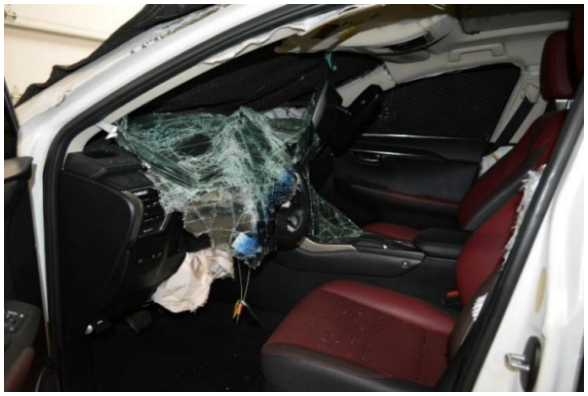


Figure 10. Viewing the first interior row damage

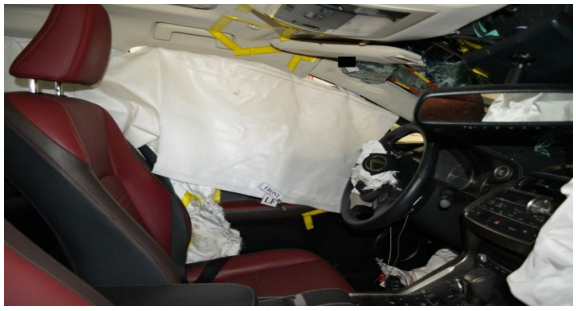


Figure 11. Contacts/damage to driver seat area

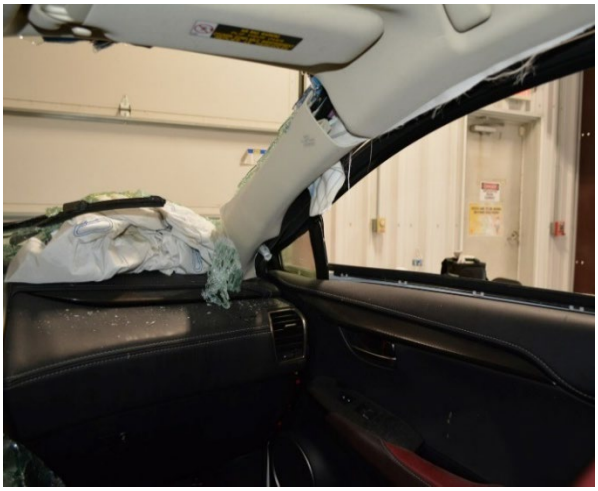


Figure 12. The intruded right A pillar

Manual Restraint Systems

The Lexus had manual three-point continuous loop lap and shoulder seat belt systems for the five seating positions. All systems had sliding latch plates. The front-row seat belt systems had adjustable D-rings and retractor pretensioners. The driver's upper anchorage adjustment was in the full-down position while the front right was adjusted to the full-up position. Both retractor pretensioners actuated during the frontal (Event 1) crash event.

At inspection, the driver's seat belt was locked in the extended/worn position. The driver was wearing the seat belt system evidenced by frictional abrasions on the polymer surface of the latch plate (Figure 13). There was no significant loading evidence of the belt webbing.

The front passenger was also belted, evidenced by the locked and extended position of the belt webbing due to actuation of the pretensioner (Figure 14). The loading evidence had frictional abrasions on the polymer surface of the latch plate and waffling of the belt webbing.

Figure 13. Driver's latch plate with friction burns evidence

Figure 14. Front passenger's latch plate with friction burn evidence

The second-row-left passenger was presumed to have been belted by the three-point seat belt. At inspection, there was no evidence of loading to the belt system (Figure 15). No occupant contacts in her occupant space were present to support an unbelted occupant; however, hair fibers were present along the ceiling and showed that the child possibly contacted the headliner when freed from her restraints. Her mass may have been insufficient to cause residual evidence of seat belt use.

Figure 15. Left rear passenger's latch plate void of friction evidence

Supplemental Restraint Systems

The Lexus had a certified advanced 208-compliant frontal air bag system that had dual stage driver's and passenger's frontal air bags, front seat belt retractor pretensioners, front seat track positioning sensors, seat belt buckle indicator switches, and an occupant classification sensor in the front right seat cushion. The driver's position had a knee air bag. IC air bags with dual sensing, side-impact and rollover, provided protection to both seat rows. Front seat-mounted side-impact air bags were in the outboard aspects of the front seatbacks. The front passenger seat position also had a seat cushion airbag. It was not apparent at the SCI inspection if the seat cushion air bag deployed or not. All air bags deployed during the Event 1 frontal crash.

Post-crash, the driver's frontal air bag and both IC air bags were cut from the vehicle. The air bags remained with the vehicle at the time of the SCI inspection. Both seat-mounted, driver knee, and passenger's frontal air bag remained intact and in place. Occupant contact was present to the driver's frontal, driver's outboard seat-mounted, and IC air bags and had scuffs and abrasions. There were stains to the passenger's frontal and outboard seat-mounted air bag but were attributed to post-crash events.

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2019 Lexus NX300 Occupants

Driver

Age/Sex:	48 years/female
Height:	163 cm (64 in)
Weight:	109 kg (240 lb)
Eyewear:	Unknown
Seat type:	Bucket seat with adjustable head restraint
Seat track position:	Middle
Manual restraint usage:	Three-point lap and shoulder belt
Usage source:	Vehicle inspection, EDR, police crash report (PCR)
Air bags:	Frontal, knee, seat-mounted, and IC air bags equipped; all deployed
Alcohol/drug involvement:	None
Egress from vehicle:	Exited under own power
Transport from scene:	Ambulance to a level 1 trauma center
Type of medical treatment:	Treated and released

Driver Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Bruising to face, NFS*	210402.1	Isolated Left Air Bag – Steering wheel hub	Probable
2	Left upper chest wall contusion; right chest wall contusion**	410402.1	Isolated Interior – Shoulder portion of belt restraint	Probable

Source – *Driver partial interview
Source - **Emergency room record

Driver Kinematics

The 48-year-old female Lexus driver was seated in a middle-track position with the seatback reclined 15° vertical. The head restraint was adjusted 5 cm (2 in) above the seatback. At the time of the SCI inspection, the adjustable steering wheel/column was in the full-up and forward positions. She was wearing the manual three-point lap and shoulder seat belt system, evidenced by frictional abrasions on the polymer surface of the latch plate and EDR data that recorded the driver's seat belt status as "ON."

At the frontal impact with the Hyundai (Event 1), the driver initiated a forward trajectory in response to the frontal crash forces. She loaded the seat belt webbing and the deployed driver's frontal and the knee air bags. During the rollover (Event 3), her head/shoulder probably contacted the IC air bag as well as her left arm to the outboard seat-mounted side-impact air

bags. When the inverted Lexus struck the curb with its right A-pillar (Event 4), the driver was probably displaced to her respective right and downwards. The driver exited through the driver's door and was transported by ambulance to a level 1 trauma center where she was treated and released.

Front-Right Passenger

Age/Sex:	7 years/male
Height:	Unknown
Weight:	Unknown
Eyewear:	Unknown
Seat type:	Bucket seat with adjustable head restraint
Seat track position:	Middle
Manual restraint usage:	Three-point lap and shoulder belt
Usage source:	Vehicle inspection, EDR, PCR
Air bags:	Frontal, seat-mounted, seat cushion and IC air bags equipped; Frontal, seat-mounted and IC air bags deployed. Seat cushion air bag deployment status unknown
Egress from vehicle:	Assisted from the vehicle by EMS personnel through right front door
Transport from scene:	Ambulance to a local trauma center
Type of medical treatment:	Hospitalized, unknown number of days

Front-Right Passenger Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Hip injury, NFS	N/A	Unknown	Unknown

Source – Driver partial interview

Front-Right Passenger Kinematics

The 7-year-old front-right passenger was seated in a middle-track position with the seatback reclined 15° and the head restraint adjusted 5 cm (2 in) above the seatback. He was wearing the manual seat belt system evidenced by waffling of the belt webbing, abrasions on the latch plate, EDR data that recorded his belt status as "ON," and that he registered as an AM50 (not child).

At impact with the Hyundai (Event 1), the front passenger initiated a forward trajectory and loaded the seat belt system and the deployed frontal air bag (Figure 16). During the rollover event (Event 3), he probably contacted the center console, the deployed right IC air bag, and the outboard seat-mounted side-impact air bag. He was transported by ambulance to a level 1 trauma center where he was treated for a driver-reported hip injury and hospitalized for an unknown number of days.

Figure 16. Passenger's frontal air bag

Second-Row Left Passenger

Age/Sex:	7 years/female
Height:	Unknown
Weight:	27 kg (60 lb)
Eyewear:	Unknown
Seat type:	Split bench seat with folding back(s)
Seat track position:	Non-adjustable seat track
Manual restraint usage:	Three-point lap and shoulder belt
Usage source:	Vehicle inspection, PCR
Air bags:	IC air bag equipped; deployed
Egress from vehicle:	Assisted from vehicle by bystander
Transport from scene:	Ambulance to a local trauma center
Type of medical treatment:	Treated and released

Second-Row Left Passenger Injuries

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
1	Minor contusion to forehead	210402.1	Isolated Left Air Bag – Left roof side rail	Probable
2	Minor contusion to upper lip	210402.1	Isolated Left Air Bag – Left roof side rail	Possible
3	Bruising to right side of face, NFS	210402.1	Injured, unknown source	Unknown

Inj. No.	Injury	Injury Severity AIS 2015	Involved Physical Component (IPC)	IPC Confidence Level
4	Minor superficial abrasion to right side of face, NFS	210202.1	Injured, unknown source	Unknown
5	Minor superficial abrasion over forehead	210202.1	Isolated Left Air Bag – Left roof side rail	Probable
6	Upper lip abrasion	210202.1	Isolated Left Air Bag – Left roof side rail	Possible
7	Left upper arm abrasion, 3 x 3 cm	710202.1	Isolated Left Air Bag – Left roof side rail	Certain
8	Left shoulder abrasion	710202.1	Isolated Left Air Bag – Left roof side rail	Certain

Source – Emergency room and EMS records

Second-Row Left Passenger Kinematics

The second-row left passenger was a 7-year-old female. She was belted by the manual three-point lap and shoulder belt system. She responded to the frontal impact (Event 1) crash by moving forward and loading the seat belt system. This would have held the passenger in place, thus preventing contact with the front left seatback. She contacted the deployed left IC air bag during the rollover event (Event 3). The driver reported that the rear passenger had "…got her arm tangled up in the air bag…." Figure 17 is a view of the second-row seat area.

Following the crash, the child passenger was helped from the vehicle by a bystander and transported by ambulance to a level 1 trauma center where she was treated and released.

Figure 17. Viewing the second-row seating

2013 Hyundai Sonata

Description

The 2013 Hyundai Sonata was a 4-door sedan identified by the police report with VIN 5NPEB4AC4DHxxxxxx. The Hyundai was not insured for collision; therefore, it was not transferred to an insurance auction facility. Attempted SCI contact with the owner and driver was unsuccessful and the vehicle was not inspected for this investigation. All vehicle-related data was retrieved by the NHTSA Product Information Catalog and Vehicle Listings[2] and the Canadian Vehicle Specifications[3] web programs.

Vehicle History

A commercially obtainable vehicle history for this specific 2013 Hyundai Sonata showed that the vehicle was purchased new and titled in the State of Ohio in January 2013. During its first ownership it was not involved in any crashes or had any modification/work done.

In September 2015 it was purchased and titled in the State of Ohio. It was reported stolen in December 2016 and was recovered in the same month. In March 2020 it was titled in the State of North Carolina. During its second ownership it was not involved in any reported crashes and no reported modifications/work were made.

In November 2020 it was purchased by its third owner and titled in the State of Ohio. During its third ownership it was not involved in any reported crashes and no reported modifications/work were made.

In April 2021 it was purchased by its fourth and current owner. The Hyundai was titled in the State of North Carolina. In May 2022 it was reported to be in a moderate crash located on its right side that is the subject crash of this investigation. There were no reported modifications/work done to the Hyundai during its fourth ownership.

Exterior damage

Based on the crash configuration and police-reported damage, the Hyundai sustained damage from the Event 1 crash with the Lexus to the passenger compartment area of the right plane. The PCR said that the right-side damage was linked to Event 1 as well as left-top damage for the Event 2 rollover.

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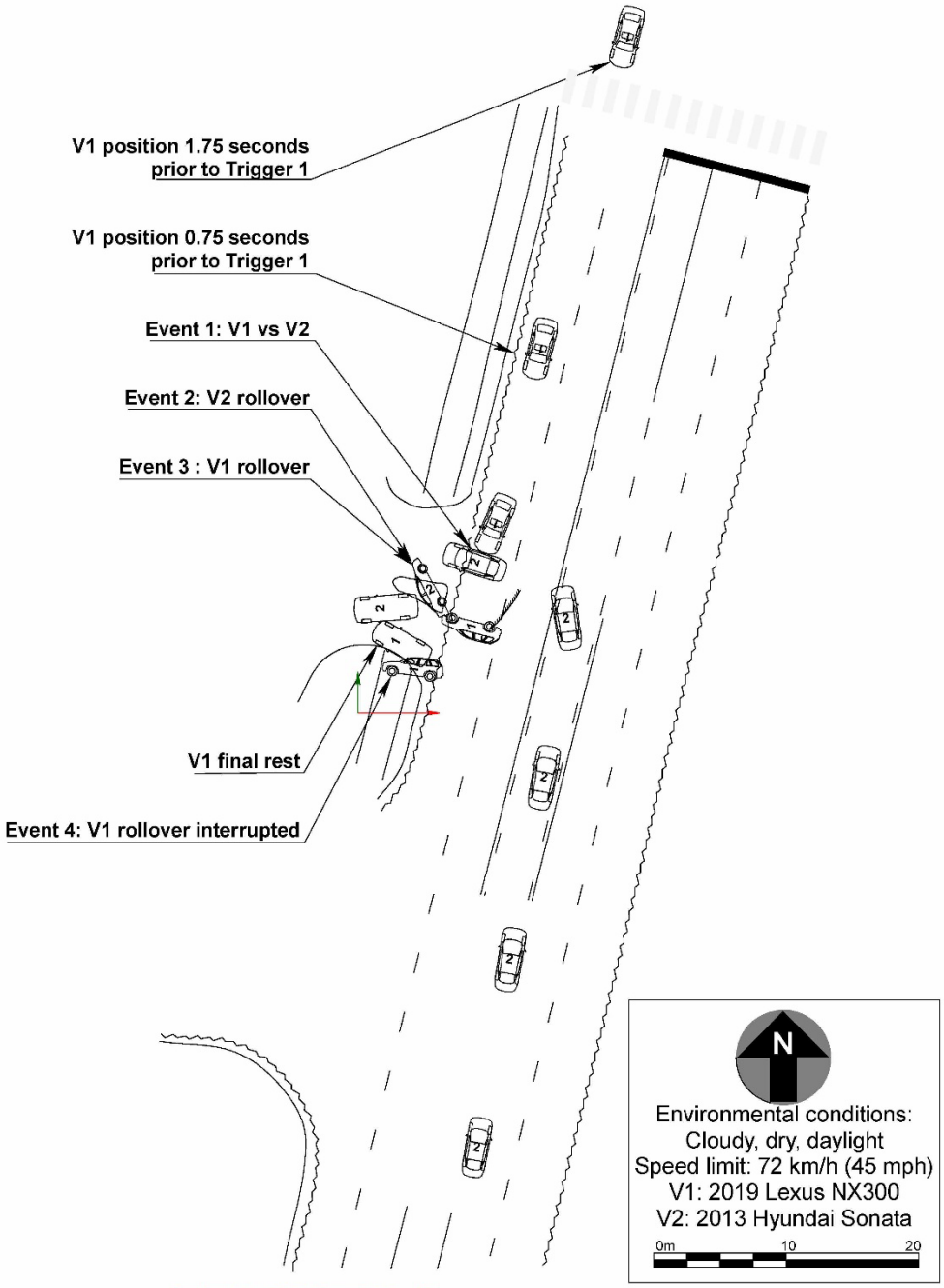
[2] National Highway Traffic Safety Administration. (21, September 2024). *Using NHTSA's VIN decoder to identify a vehicle's plant of manufacture*. [Web page and database portal]. https://vpic.nhtsa.dot.gov/decoder/

[3] National Highway Traffic Safety Administration. (21, September 2024). *Canadian vehicle specifications. [Web page and database portal]*. https://vpic.nhtsa.dot.gov/decoder/CaVehSpec?year=2022

Occupant Data

The Hyundai driver was a 17-year-old female. She was police-reported as belted by the three-point lap and shoulder belt system. According to its VIN, the Hyundai had driver's and passenger's frontal air bags and IC dual-sensing side-impact/rollover air bags. The PCR said that both frontal and IC airbags deployed because of the crash. The driver sustained B-level non-incapacitating injuries and was reportedly transported to a level 1 trauma center. Details regarding her treatment are unknown at the time of this report.

Crash Diagram



NHTSA	
Case Number:	CR22013

Appendix A: 2019 Lexus NX300 Event Data Recorder Report

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

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

CDR File Information

User Entered VIN/Frame Number	JTJYARBZ9K2******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	CR22013 ACM.CDRX
Saved on	
Imaged with CDR version	Crash Data Retrieval Tool 21.5.1
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 23.0.2
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	Front/Rear (1), Side (1), Rollover (1)

Comments

No comments entered.

Data Limitations

CDR Record Information:

- Due to limitations of the data recorded by the airbag ECU, such as the resolution, data range, sampling interval, time period of the recording, and the items recorded, the information provided by this data may not be sufficient to capture the entire crash.
- Pre-Crash data is recorded in discrete intervals. Due to different refresh rates within the vehicle's electronics, the data recorded may not be synchronous to each other.
- Airbag ECU data should be used in conjunction with other physical evidence obtained from the vehicle and the surrounding circumstances.
- If any of the front passenger seat airbags, side airbags, or Curtain Shield Airbags have deployed, data will not be overwritten or deleted by the airbag ECU following that event. If none of the airbags have deployed, the data of that event may be overwritten by a following event even if other airbags (pretensioner, rear seat airbag, etc.) have deployed.
- If power supply to the airbag ECU is lost during an event, all or part of the data may not be recorded.
- "Diagnostic Trouble Codes" are information about faults when a recording trigger is established. Various diagnostic trouble codes could be set and recorded due to component or system damage during an accident.
- The airbag ECU records only diagnostic information related to the airbag system. It does not record diagnostic information related to other vehicle systems.
- The TaSCAN, Global Tech Stream, or Intelligent Tester II devices (or any other Toyota genuine diagnostic tool) can be used to obtain detailed information on the diagnostic trouble codes from the airbag system, as well as diagnostic information from other systems. However, in some cases, the diagnostic trouble codes of the airbag system recorded by the airbag ECU when the event occurred may not match the diagnostic trouble codes read out when the diagnostic tool is used.

General Information:

- The data recording specifications of Toyota’s airbag ECUs are divided into the following categories. The specifications for 12EDR or later are designed to be compatible with NHTSA’s 49CFR Part 563 rule.
  - 00EDR / 02EDR / 04EDR / 06EDR / 10EDR / 12EDR / 13EDR / 15EDR / 17EDR / 19EDR / 21EDR / 22EDR
- The airbag ECU records data for all or some of the following accident types: frontal crash, rear crash , side crash, and rollover events. Depending on the installed airbag ECU, data for side crash and/or rollover events may not be recorded.
- This airbag ECU records record pre-crash data and post-crash data.
  - If a single event occurs independently, the data for that event is recorded on a one-to-one basis.
  - If multiple events occur successively (within a period of approximately 500ms), the establishment of the recording trigger for the first event is defined as the "pre-crash recording trigger". Pre-crash data for the first event and post-crash data for each successive event is then recorded.
- The airbag ECU has two recording pages (memory maps) to store pre-crash data. Additionally, to store post-crash data, the airbag ECU has two recording pages for each accident type: two pages for frontal and rear crash, two pages for a side crash, and two pages for rollover event.
- The data recorded by the airbag ECU includes correlating information between each previously occurring event (i.e., information that clarifies the collision event sequence. This correlation information consists of the following items.
  - Time from Previous Pre-Crash TRG
  - Linked Pre-Crash Page
  - Time from Pre-Crash TRG
  - TRG Count
  - Previous Crash Type

- In frontal and rear collision events, the first point where a longitudinal cumulative delta-V of over 0.8 km/h (0.5 mph) is reached is regarded as time zero for the recorded data. In side impact collision and rollover events, the point in time at which the recording trigger is established is regarded as time zero for the recorded data.
- The recording trigger judgment threshold value differs depending on the collision type (i.e., frontal crash, rear crash, side crash, or rollover event).
- Some of the data recorded by the airbag ECU is transmitted to the airbag ECU from various vehicle control modules by the vehicle's Controller Area Network (CAN).
- In some cases, the airbag ECU part number printed on the ECU label may not match the airbag ECU part number that the CDR tool reports. The part number retrieved by the CDR tool should be considered as the official ECU part number.
- In frontal and rear collision events, the record time varies depending on the period during which a longitudinal cumulative delta-V of over 0.8 km/h (0.5 mph) is reached, and time series data is recorded for up to 250 ms. The record time described above is indicated as "Length of Delta-V". "Delta-V, Longitudinal" outside the record time is indicated by area shaded in the table, and not indicated in the graph.

Data Element Sign Convention:
The following table provides an explanation of the sign notation for data elements that may be included in this CDR report.

Data Element Name	Positive Sign Notation Indicates
Maximum Delta-V, Longitudinal	Forward
Delta-V, Longitudinal	Forward
Lateral Acceleration for Frontal/Rear Crash, Floor Sensor	Left to Right
Lateral Acceleration, Side Satellite Sensor 1	Left to Right
Lateral Acceleration, Side Satellite Sensor 2	Left to Right
Lateral Acceleration, Side Satellite Sensor 3	Left to Right
Lateral Acceleration, Side Satellite Sensor 4	Left to Right
Lateral Acceleration for Side Crash, Floor Sensor	Left to Right
Roll Angle Peak	Clockwise Rotation
Roll Angle at the Time of TRG	Clockwise Rotation
Roll Rate	Clockwise Rotation
Lateral Acceleration for Rollover, Floor Sensor	Left to Right
Longitudinal Acceleration , VSC Sensor	Forward
Yaw Rate	Left Turn
Steering Input	Left Turn

Data Definitions:

- The "ON" setting for the "Freeze Signal" indicates a state in which the non-volatile memory can not be overwritten or deleted by the airbag ECU. After "Freeze Signal" has been turned ON, subsequent events will not be recorded.
- "Recording Status" indicates a state in which all recorded event data has been written into the non-volatile memory, or a state in which this process was interrupted and not fully written into the non-volatile memory. If "Recording Status" is "Incomplete", recorded event data may not be valid.
- If the "Occupant Size Classification, Front Passenger" displays "Child" or "Not Occupied", "Side Air Bag Deployment, Time to Deploy" and "Pretensioner Deployment, Time to Fire" may indicate a time even if deployment did not occur on the for following part no's:
  - 89170-07280, 35400, 35410, 35470, 42660, 0R120, 0R080, 0R081, 0R150
- "Engine RPM" indicates the number of engine revolutions, not the number of motor revolutions. The recorded value has an upper limit of 12,800 rpm. Resolution is 100 rpm and the value is rounded down and recorded. For example, if the actual engine speed is 799 rpm, the recorded value will be 700 rpm.
- If the electric vehicle is using a calculated/virtual engine RPM for drivetrain control, "Engine RPM" may be recorded, but should not be used during data analysis.
- The upper limit for the recorded "Vehicle Speed" value is 200 km/h (125mph). Resolution is 1km/h (0.6mph) and the value is rounded down and recorded. The accuracy of the "Vehicle Speed" value can be affected by various factors. These include, but not limited, to the following.
  - Significant changes in the tire's rolling radius
  - Wheel lock and wheel slip
- "Accelerator Pedal" has two recording specifications. Both the recorded value increases as the driver depresses the accelerator.
  - Percentage of accelerator pedal depressed (recorded as 0-100(%)).
  - Output voltage of accelerator pedal module (recorded as 0-5(V)).
- If M/T transmission vehicle of some limited model, "Shift Position" may display "Drive" regardless of the actual shift position.
- Depending on the type of occupant sensor installed in the vehicle, one of the following three recording formats for "Occupant Size Classification, Front Passenger" will be utilized.
  - Occupied / Not Occupied
  - AM50 / AF05 / Child / Not Occupied
  - AM50 / AF05 / Child or Not Occupied
- "Cruise Control Status" indicates whether the cruise control system is actuated or not. OFF indicates that the cruise control system is not actuated, but can also indicates that the vehicle is not equipped with the system.
- "Air Bag Warning Lamp, On/Off", "Ignition Cycle, Crash", "Seat Track Position Switch, Foremost, Status, Driver", "Occupant Size Classification, Front Passenger", "Safety Belt Status, Driver", "Safety Belt Status, Front Passenger", "Frontal Air Bag Suppression Switch Status, Front Passenger", and "RSCA Disable Switch" indicate the state approximately 1 second before time zero. They may not always indicate the state at the moment of collision.
- The upper and lower limits for the recorded value of "Motor RPM" is 17,500 rpm and -7,500 rpm respectively. Resolution is 100 rpm and the value is rounded down and recorded.
- "Brake Oil Pressure" has an upper limit of 12.14 Mpa. In the case of the vehicle that has not VSC system, "0 Mpa" or "Invalid" may be displayed.
- "Longitudinal Acceleration , VSC Sensor" has upper and lower limits for the recorded value of 8.973 m/s^2 and -8.973 m/s^2 respectively. This acceleration sensor does not sense collisions.

- "Sequential Shift Range" displaying "Undetermined" indicates the shift range is undetermined or was not being used.
- Some vehicles will not be equipped with all "Drive Mode" types indicated in the "Drive Mode" table. If some or all drive modes are not applicable to vehicle, "OFF" or "Invalid" may be displayed. The item in the "Drive Mode" table may not match the name of switch or indicator that equipped the vehicle.
- The upper and lower limits for the recorded value of "Steering Input" is 375 deg and -375 deg respectively. Resolution is 1.5 deg and the value is rounded down and recorded.
- Resolution of the "Air Bag Warning Lamp ON Time Since DTC was Set" is 15 minutes, and the value is rounded down and recorded.
- "Delta-V, Longitudinal" indicates the change in forward speed after time zero. This does not refer to vehicle speed, and it does not include the change in speed during the period from the start of the actual collision to establishment of the time zero.
- "Location of Side Satellite Sensor" shows the outline of a typical sensor position. Sensory location can be confirmed using the repair manual.
- "Time from Previous Pre-Crash TRG" indicates the time between the establishment of an event's pre-crash recording trigger to the establishment of a more recent event's pre-crash recording trigger. The upper limit for the recorded value is 16,381 milliseconds. In the event of establishment of the first pre-crash recording trigger after the ignition is switched ON, the upper limit value(max value) is recorded.
- "TRG Count" indicates a calculated value of the number of times recording triggers have been established for all crash types. The sequence in which each event occurred can be verified from the "TRG Count". The smaller the "TRG Count" value, the older the data. The upper limit for the recorded value is 65,533 times. When more than one event reaches the upper limit, the actual "TRG Count" may be greater than what is displayed for that event.
- "Linked Pre-Crash Page" is used to link 'paged" pre-crash data with 'paged" post-crash data. When old pre-crash data is overwritten by new pre-crash data, the "Linked Pre-Crash Page" value may record a page number that is not actually linked.
- Resolution of the "Time from Pre-Crash to TRG" is 50 [ms], and the value is rounded up and recorded.
- "Roll Angle at the Time of TRG" and "Roll Angle Peak" do not represent the actual roll angle of the vehicle. These values are used internally by the airbag ECU for sensing a rollover.

05013_ToyotaS00std_r033

System Status at Time of Retrieval

ECU Part Number	89170-78010
EDR Generation	13EDR
Complete File Recorded	Yes
Freeze Signal	ON
Freeze Signal Factor	Front Airbag Deployment
Diagnostic Trouble Codes Exist	No
Ignition Cycle ,Download (times)	4040
Multi-event, number of events (times)	2 or greater
Time from event 1 to 2 (s)	0.054
Time from Previous Pre Crash TRG (msec)	16381 or greater
Latest Pre-Crash Page	0
Contains Unlinked Pre-Crash Data	No

Event Record Summary at Retrieval

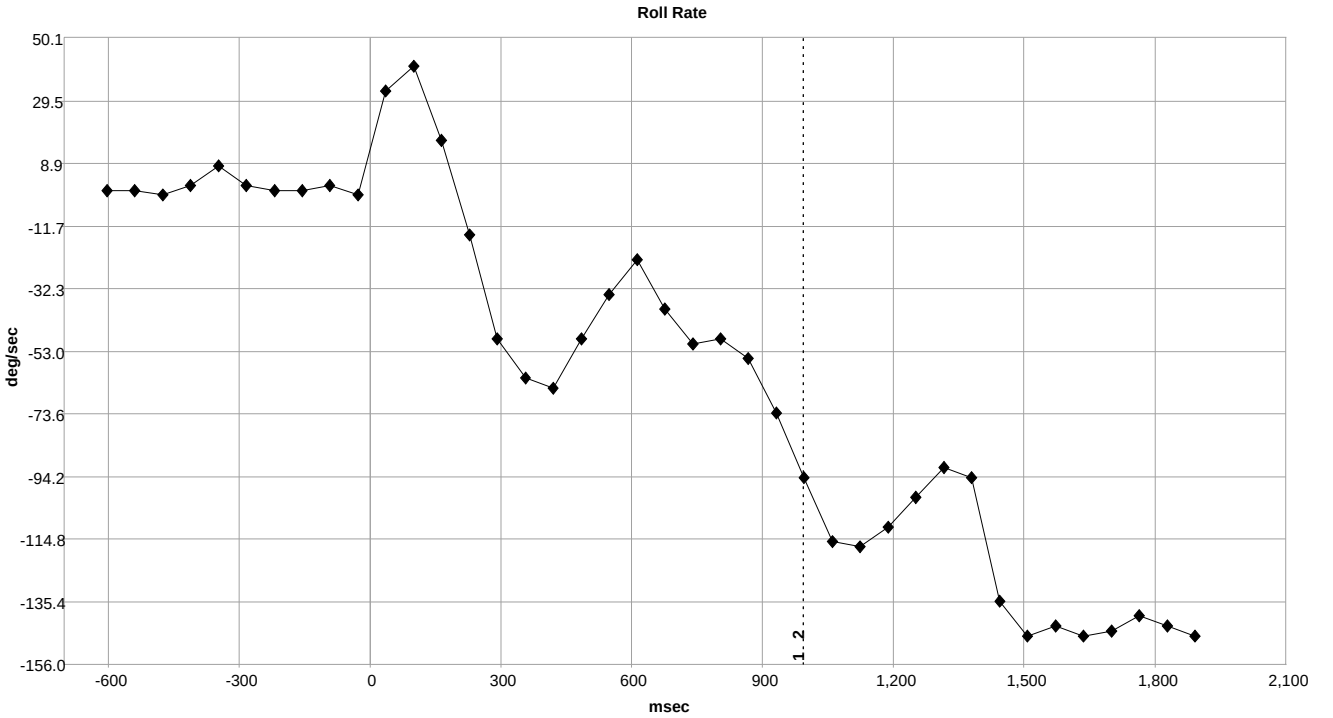
Events Recorded	TRG Count	Crash Type	Time (msec)	Pre-Crash & DTC Data Recording Status	Event & Crash Pulse Data Recording Status
Most Recent Event	3	Rollover	0	Complete (Page 0)	Complete (Rollover Page 0)
1st Prior Event	2	Side Crash	-54	Complete (Page 0)	Complete (Side Page 0)
2nd Prior Event	1	Front/Rear Crash	-86	Complete (Page 0)	Complete (Front/Rear Page 0)

System Status at Event (Most Recent Event, TRG 3)

Recording Status, Rollover Crash Info.	Complete
Crash Type	Rollover
TRG Count (times)	3
Previous Crash Type	Side Crash
Time from Pre-Crash TRG (msec)	75
Linked Pre-Crash Page	0
Side Curtain Airbag Deployment, Time to Deploy (msec)	994
Pretensioner Deployment, Time to Fire, Driver (msec)	994
Pretensioner Deployment, Time to Fire, Front Passenger (msec)	994

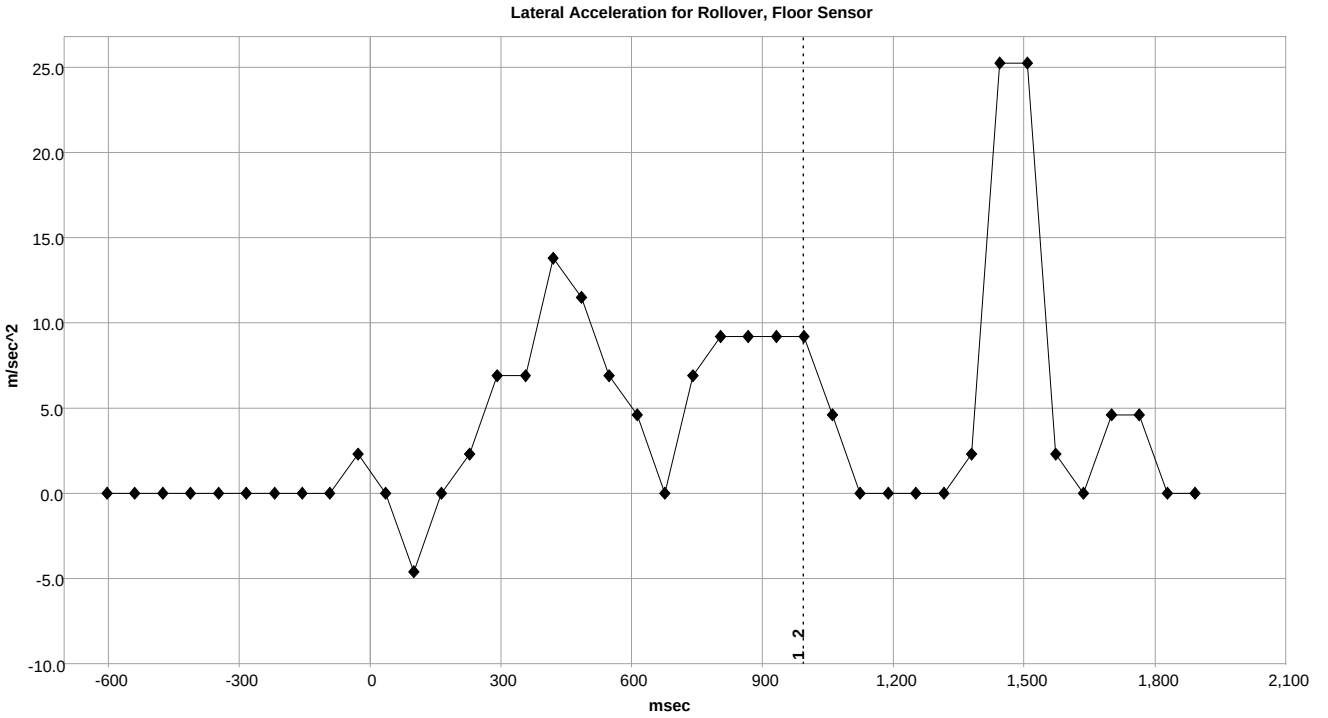
Rollover Crash Pulse (Most Recent Event, TRG 3 - table 1 of 2)

Recording Status, Time Series Data	Complete
Time from TRG to Next Sample (msec)	36
Roll Angle Peak (degrees)	-163.1
Roll Angle at the Time of TRG (degrees)	2.2



Deployment Time Marker Key

1	Driver/Passenger CSA
2	Driver/Passenger Pretensioner



Deployment Time Marker Key

1	Driver/Passenger CSA
2	Driver/Passenger Pretensioner

Rollover Crash Pulse (Most Recent Event, TRG 3 - table 2 of 2)

Time (msec)	Roll Rate (deg/sec)	Lateral Acceleration for Rollover, Floor Sensor (m/sec^2)
-604	0.0	0.0
-540	0.0	0.0
-476	-1.6	0.0
-412	1.6	0.0
-348	8.1	0.0
-284	1.6	0.0
-220	0.0	0.0
-156	0.0	0.0
-92	1.6	0.0
-28	-1.6	2.3
36	32.6	0.0
100	40.7	-4.6
164	16.3	0.0
228	-14.7	2.3
292	-48.9	6.9
356	-61.9	6.9
420	-65.2	13.8
484	-48.9	11.5
548	-34.2	6.9
612	-22.8	4.6
676	-39.1	0.0
740	-50.5	6.9
804	-48.9	9.2
868	-55.4	9.2
932	-73.3	9.2
996	-94.5	9.2
1060	-115.6	4.6
1124	-117.3	0.0
1188	-110.8	0.0
1252	-101.0	0.0
1316	-91.2	0.0
1380	-94.5	2.3
1444	-135.2	25.3
1508	-146.6	25.3
1572	-143.3	2.3
1636	-146.6	0.0
1700	-145.0	4.6
1764	-140.1	4.6
1828	-143.3	0.0
1892	-146.6	0.0

DTCs Present at Time of Event (Most Recent Event, TRG 3)

Recording Status, Diagnostic	Complete
Ignition Cycle Since DTC was Set (times)	0
Airbag Warning Lamp ON Time Since DTC was Set (min)	0
Diagnostic Trouble Codes	None

Pre-Crash Data, 1 Sample (Most Recent Event, TRG 3)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	250
TRG Count when Pre-crash TRG was Established (times)	1
Safety Belt Status, Driver	ON
Safety Belt Status, Front Passenger	ON
Occupant Size Classification, Front Passenger	AM50 (Not Child)
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	4036

Pre-Crash Data, -5 to 0 seconds (Most Recent Event, TRG 3)

Time (sec)	-4.75	-4.25	-3.75	-3.25	-2.75	-2.25	-1.75	-1.25	-0.75	-0.25	0 (TRG)
Vehicle Speed (MPH [km/h])	59 [95]	58.4 [94]	57.8 [93]	57.8 [93]	57.8 [93]	57.8 [93]	58.4 [94]	58.4 [94]	51.6 [83]	42.3 [68]	37.3 [60]
Accelerator Pedal, % Full (%)	19.0	7.0	4.5	20.5	35.5	49.0	50.5	0.0	0.0	0.0	0.0
Percentage of Engine Throttle (%)	10.5	0.5	0.0	17.5	32.5	35.0	42.0	1.0	0.0	0.0	0.0
Engine RPM (RPM)	2,100	2,000	1,800	2,000	1,900	2,000	2,600	2,300	1,800	1,400	1,400
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
Brake Oil Pressure (Mpa)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.83	12.14	11.90
Longitudinal Acceleration , VSC Sensor (m/sec^2)	-0.072	-0.287	-0.359	-0.072	0.072	0.502	0.359	0.287	-7.824	-7.680	-8.973
Yaw Rate (deg/sec)	-1.46	-1.95	-1.46	-0.98	-0.98	-0.98	-0.98	-2.44	-7.81	-4.39	-4.88
Steering Input (degrees)	0.0	-1.5	0.0	0.0	0.0	1.5	1.5	-9.0	-13.5	-21.0	-19.5
Shift Position	D	D	D	D	D	D	D	D	D	D	D
Sequential Shift Range	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	6	6	6
Cruise Control Status	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, PWR	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, ECO	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, Sport	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Drive Mode, Snow	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, EV	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

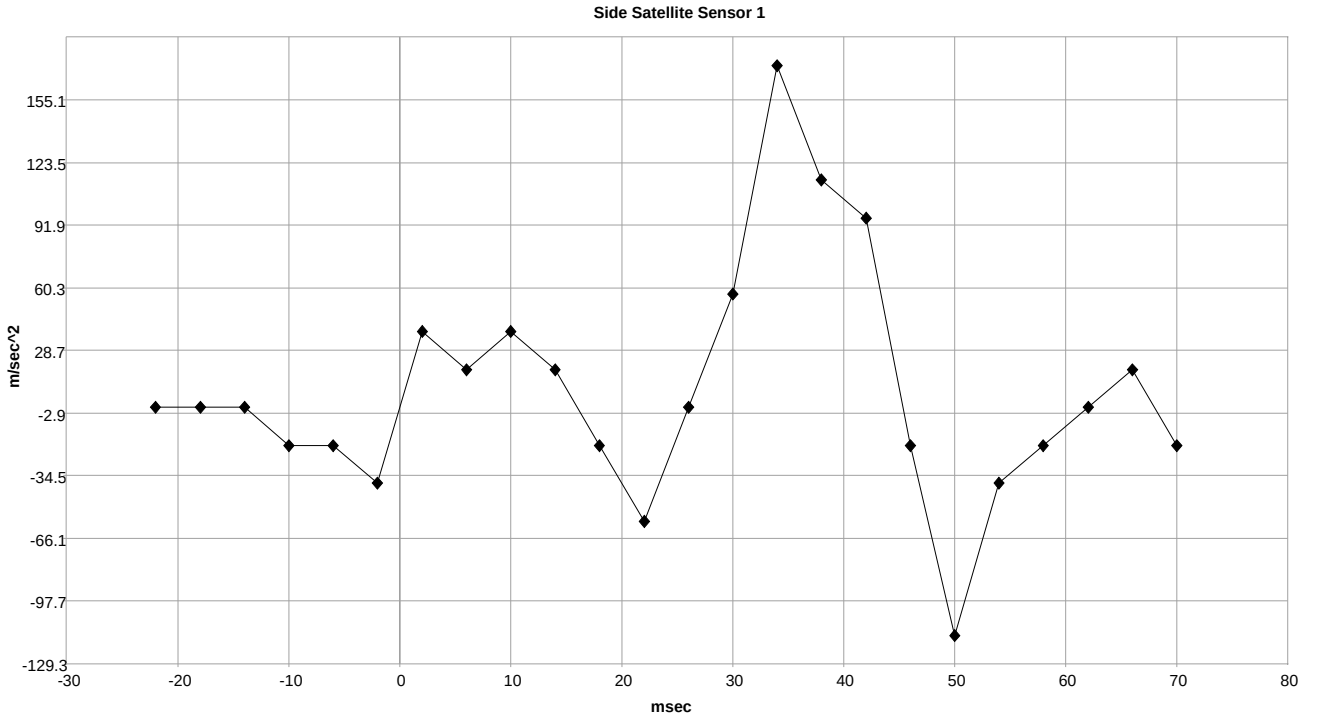
Fuel Injection Quantity (mm3/st)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

System Status at Event (1st Prior Event, TRG 2)

Recording Status, Side Crash Info.	Complete
Crash Type	Side Crash
TRG Count (times)	2
Previous Crash Type	Front/Rear Crash
Time from Pre-Crash TRG (msec)	21
Linked Pre-Crash Page	0
Side Airbag Deployment, Time to Deploy (If Equipped) (msec)	No
Side Curtain Airbag Deployment, Time to Deploy (If Equipped) (msec)	No
Pretensioner Deployment, Time to Fire (msec)	No
Rear Window Airbag Deployment, Time to Deploy (msec)	SNA

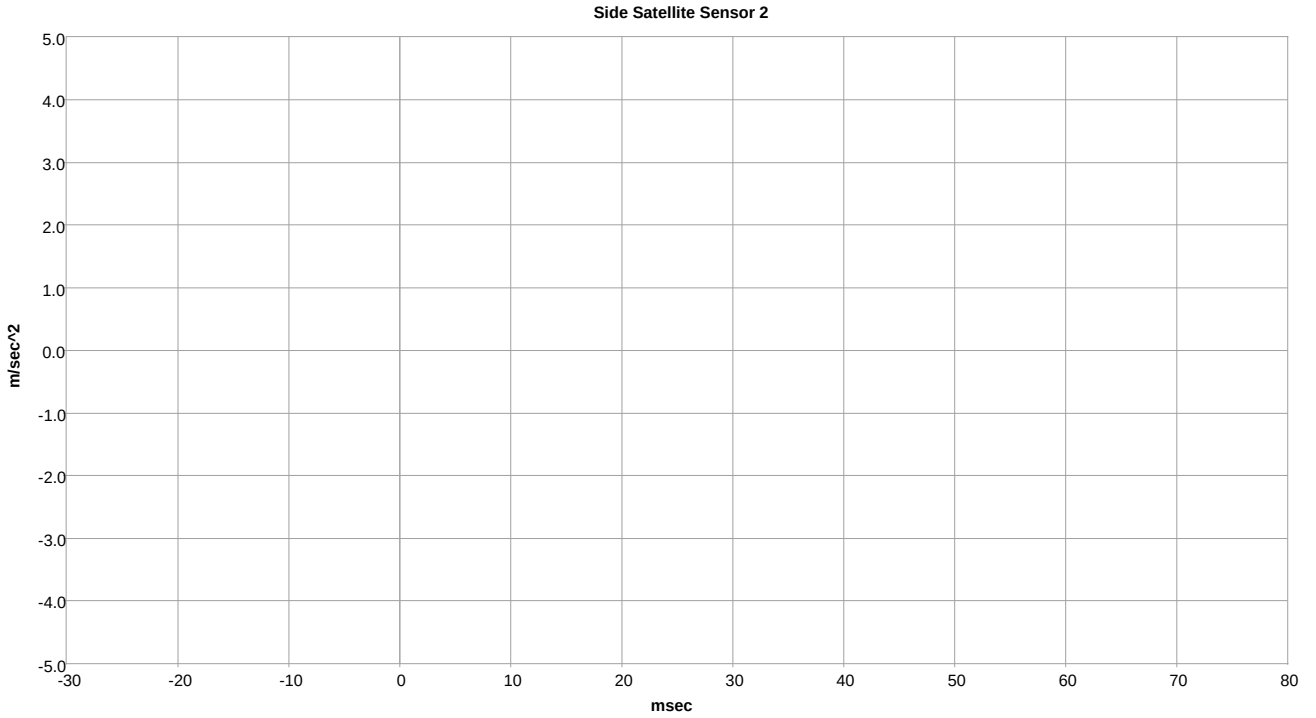
Lateral Crash Pulse (1st Prior Event, TRG 2 - table 1 of 2)

Recording Status, Time Series Data	Complete
Recorded Side	Left Side
Time from TRG to Next Sample (msec)	2
Location of Side Satellite Sensor 1	Front Door
Location of Side Satellite Sensor 2	Not Equipped
Location of Side Satellite Sensor 3	Not Equipped
Location of Side Satellite Sensor 4	C-Pillar
Location of Floor Sensor	Airbag ECU
Clipping Time of Lateral Acceleration, Side Satellite Sensor 1 (msec)	No
Clipping Time of Lateral Acceleration, Side Satellite Sensor 2 (msec)	SNA
Clipping Time of Lateral Acceleration, Side Satellite Sensor 3 (msec)	SNA
Clipping Time of Lateral Acceleration, Side Satellite Sensor 4 (msec)	No
Clipping Time of Lateral Acceleration, Floor Sensor (msec)	No



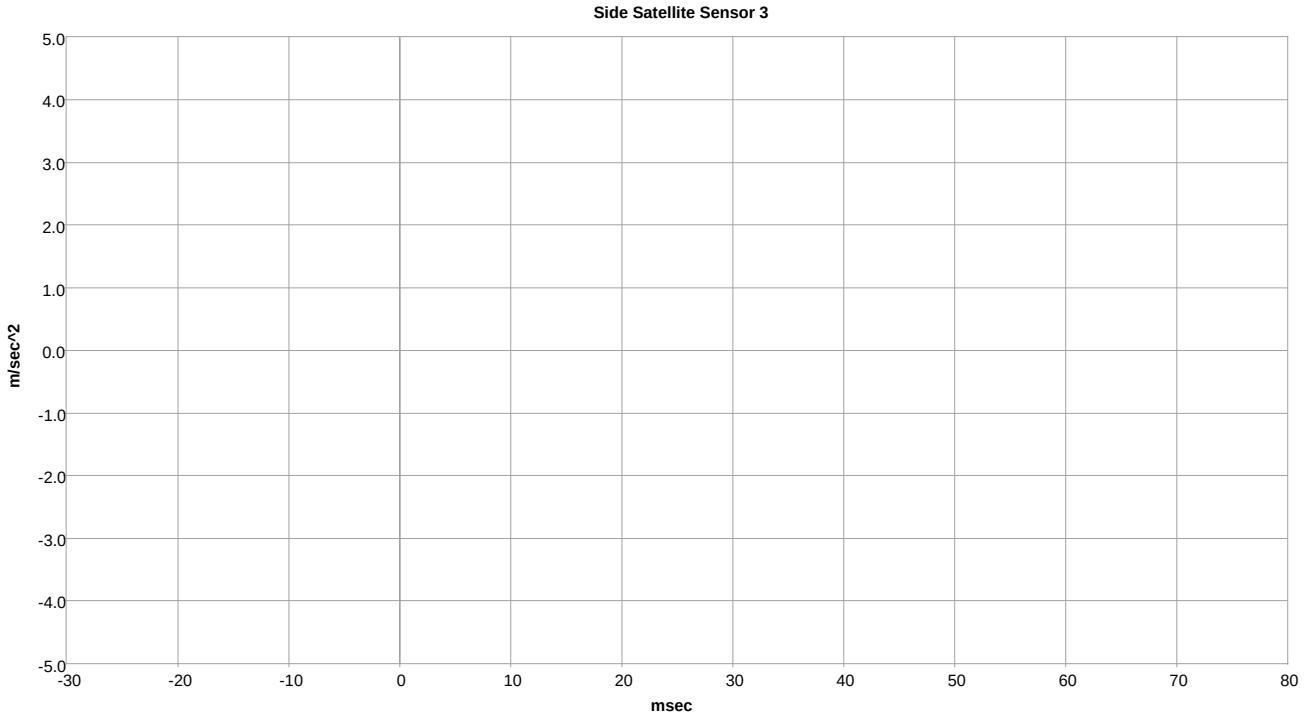
Deployment Time Marker Key

1	Driver/Passenger Pretensioner
2	Side Airbag
3	Rear Window Airbag Deployment Time



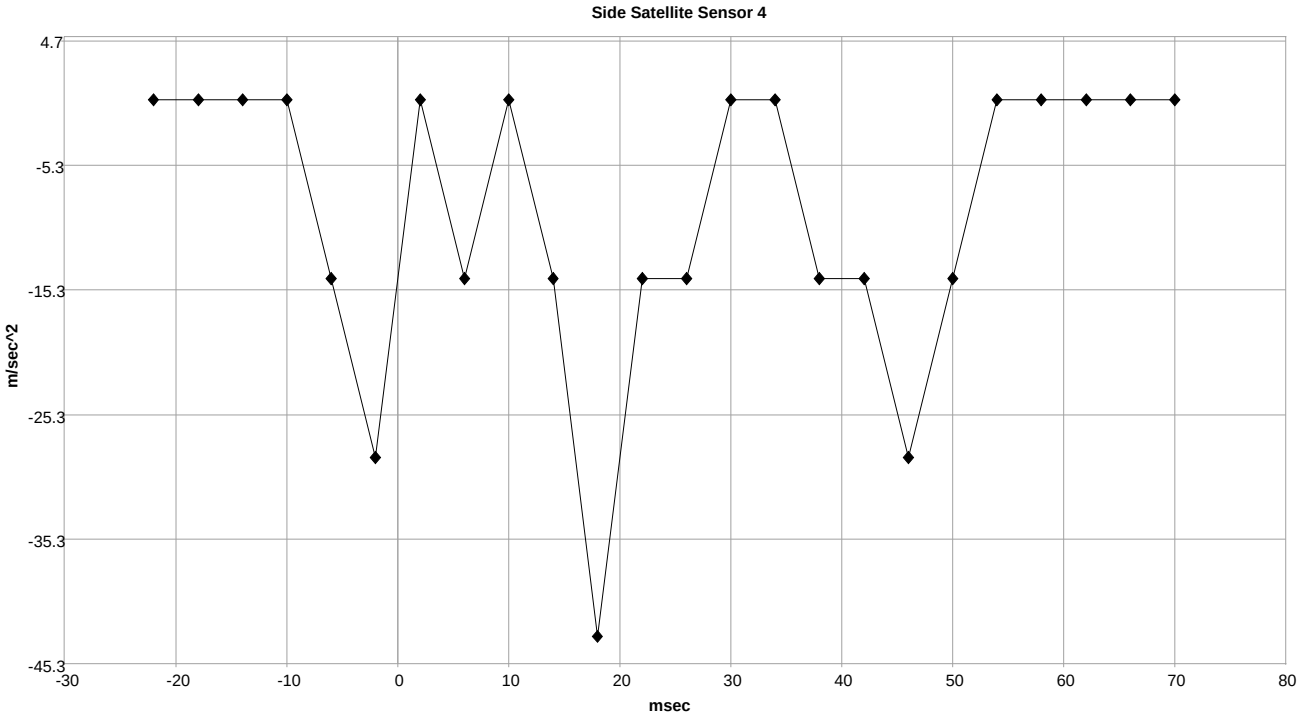
Deployment Time Marker Key

1	Driver/Passenger Pretensioner
2	Side Airbag
3	Rear Window Airbag Deployment Time



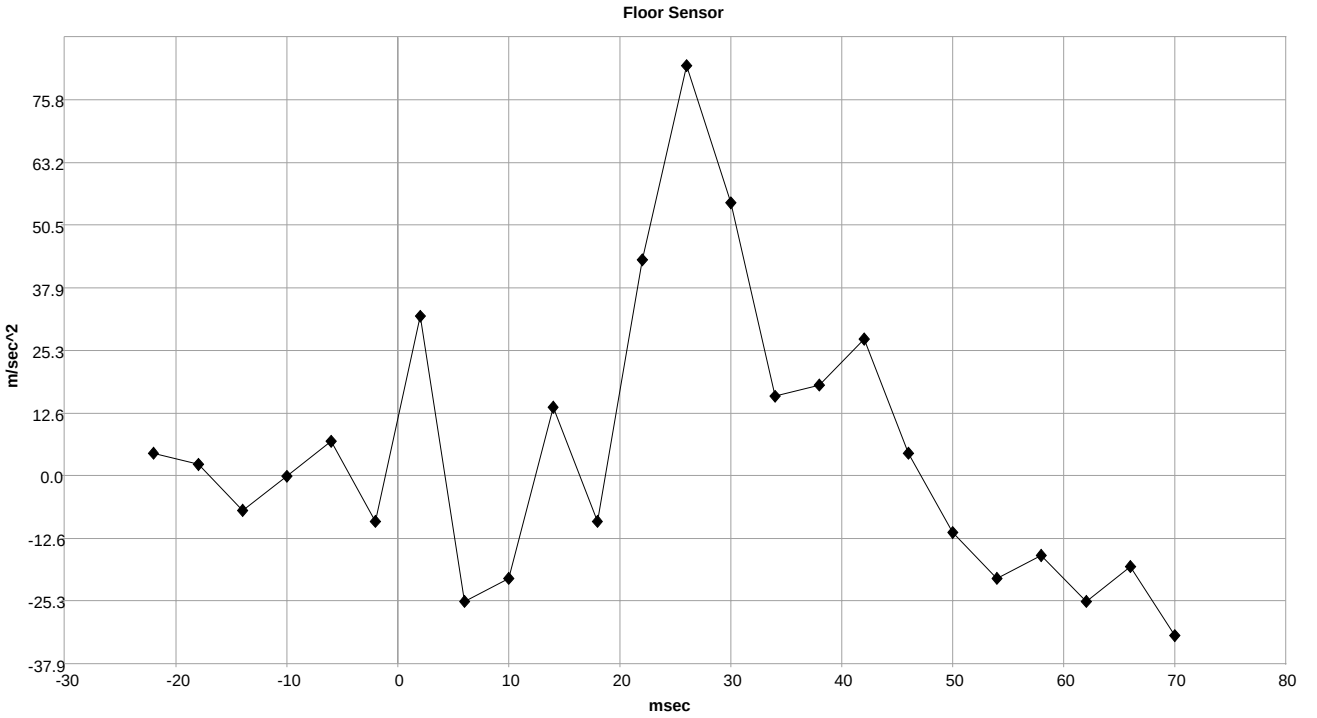
Deployment Time Marker Key

1	Side Curtain Airbag



Deployment Time Marker Key

1	Side Curtain Airbag



Deployment Time Marker Key

1	Driver/Passenger Pretensioner
2	Side Airbag
3	Rear Window Airbag Deployment Time
4	Side Curtain Airbag

Lateral Crash Pulse (1st Prior Event, TRG 2 - table 2 of 2)

Time (msec)	Lateral Acceleration, Side Satellite Sensor 1 (m/sec^2)	Lateral Acceleration, Side Satellite Sensor 2 (m/sec^2)	Lateral Acceleration, Side Satellite Sensor 3 (m/sec^2)	Lateral Acceleration, Side Satellite Sensor 4 (m/sec^2)	Lateral Acceleration for Side Crash, Floor Sensor (m/sec^2)
-22	0.0	SNA	SNA	0.0	4.6
-18	0.0	SNA	SNA	0.0	2.3
-14	0.0	SNA	SNA	0.0	-6.9
-10	-19.2	SNA	SNA	0.0	0.0
-6	-19.2	SNA	SNA	-14.4	6.9
-2	-38.3	SNA	SNA	-28.7	-9.2
2	38.3	SNA	SNA	0.0	32.2
6	19.2	SNA	SNA	-14.4	-25.3
10	38.3	SNA	SNA	0.0	-20.7
14	19.2	SNA	SNA	-14.4	13.8
18	-19.2	SNA	SNA	-43.1	-9.2
22	-57.5	SNA	SNA	-14.4	43.6
26	0.0	SNA	SNA	-14.4	82.7
30	57.5	SNA	SNA	0.0	55.1
34	172.4	SNA	SNA	0.0	16.1
38	114.9	SNA	SNA	-14.4	18.4
42	95.8	SNA	SNA	-14.4	27.6
46	-19.2	SNA	SNA	-28.7	4.6
50	-114.9	SNA	SNA	-14.4	-11.5
54	-38.3	SNA	SNA	0.0	-20.7
58	-19.2	SNA	SNA	0.0	-16.1
62	0.0	SNA	SNA	0.0	-25.3
66	19.2	SNA	SNA	0.0	-18.4
70	-19.2	SNA	SNA	0.0	-32.2

DTCs Present at Time of Event (1st Prior Event, TRG 2)

Recording Status, Diagnostic	Complete
Ignition Cycle Since DTC was Set (times)	0
Airbag Warning Lamp ON Time Since DTC was Set (min)	0
Diagnostic Trouble Codes	None

Pre-Crash Data, 1 Sample (1st Prior Event, TRG 2)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	250
TRG Count when Pre-crash TRG was Established (times)	1
Safety Belt Status, Driver	ON
Safety Belt Status, Front Passenger	ON
Occupant Size Classification, Front Passenger	AM50 (Not Child)
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	4036

Pre-Crash Data, -5 to 0 seconds (1st Prior Event, TRG 2)

Time (sec)	-4.75	-4.25	-3.75	-3.25	-2.75	-2.25	-1.75	-1.25	-0.75	-0.25	0 (TRG)
Vehicle Speed (MPH [km/h])	59 [95]	58.4 [94]	57.8 [93]	57.8 [93]	57.8 [93]	57.8 [93]	58.4 [94]	58.4 [94]	51.6 [83]	42.3 [68]	37.3 [60]
Accelerator Pedal, % Full (%)	19.0	7.0	4.5	20.5	35.5	49.0	50.5	0.0	0.0	0.0	0.0
Percentage of Engine Throttle (%)	10.5	0.5	0.0	17.5	32.5	35.0	42.0	1.0	0.0	0.0	0.0
Engine RPM (RPM)	2,100	2,000	1,800	2,000	1,900	2,000	2,600	2,300	1,800	1,400	1,400
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
Brake Oil Pressure (Mpa)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.83	12.14	11.90
Longitudinal Acceleration , VSC Sensor (m/sec^2)	-0.072	-0.287	-0.359	-0.072	0.072	0.502	0.359	0.287	-7.824	-7.680	-8.973
Yaw Rate (deg/sec)	-1.46	-1.95	-1.46	-0.98	-0.98	-0.98	-0.98	-2.44	-7.81	-4.39	-4.88
Steering Input (degrees)	0.0	-1.5	0.0	0.0	0.0	1.5	1.5	-9.0	-13.5	-21.0	-19.5
Shift Position	D	D	D	D	D	D	D	D	D	D	D
Sequential Shift Range	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	6	6	6
Cruise Control Status	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, PWR	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, ECO	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, Sport	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Drive Mode, Snow	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, EV	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

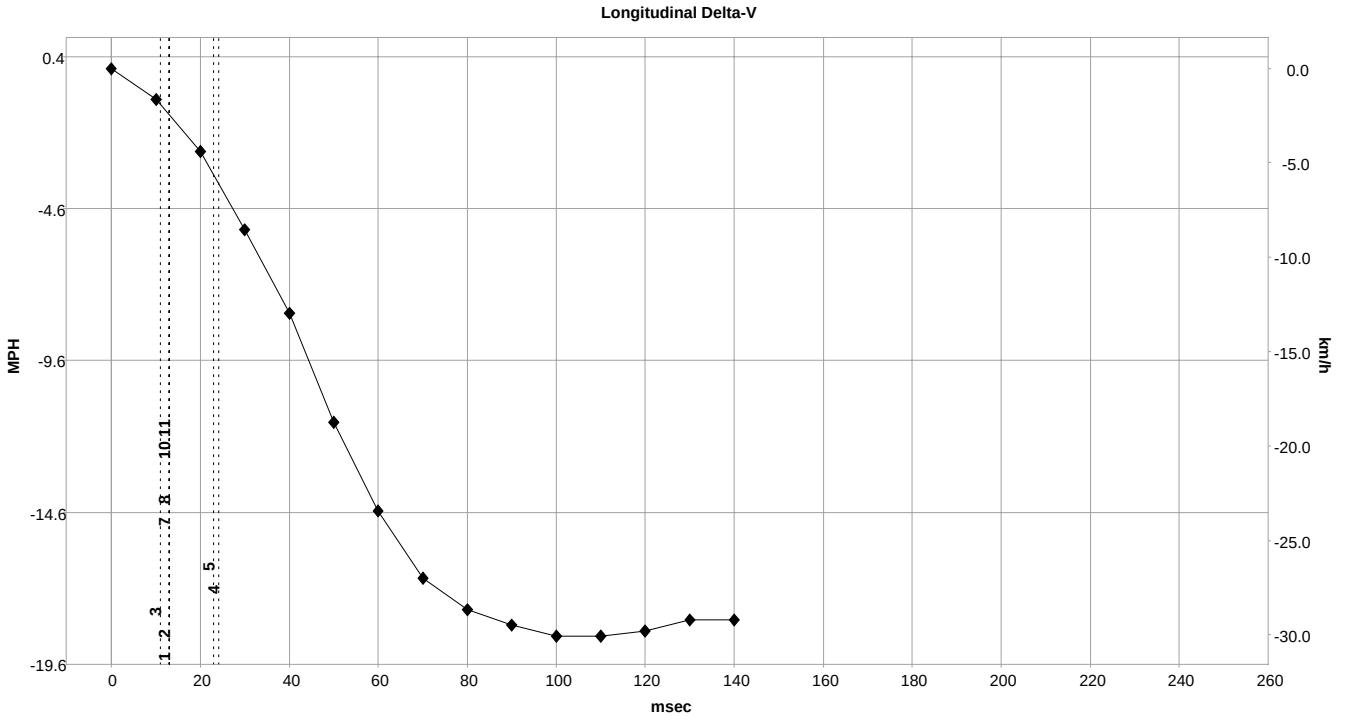
Fuel Injection Quantity (mm3/st)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

System Status at Event (2nd Prior Event, TRG 1)

Recording Status, Front/Rear Crash Info.	Complete
Crash Type	Front/Rear Crash
TRG Count (times)	1
Previous Crash Type	No Event
Time from Pre-Crash TRG (msec)	0
Linked Pre-Crash Page	0
Frontal Airbag Deployment, Time to 1st Stage Deployment, Driver (msec)	13
Frontal Airbag Deployment, Time to 1st Stage Deployment, Front Passenger (msec)	13
Pretensioner Deployment, Time to Fire, Driver (msec)	11
Pretensioner Deployment, Time to Fire, Front Passenger (msec)	11
Frontal Airbag Deployment, Time to 2nd Stage, Driver (msec)	24
Frontal Airbag Deployment, Time to 2nd Stage, Front Passenger (msec)	23
Active Head Restraint, Time to Deploy, Driver (msec)	SNA
Active Head Restraint, Time to Deploy, Front Passenger (msec)	SNA
Side Curtain Airbag Deployment, Time to Deploy, Driver (msec)	13
Side Curtain Airbag Deployment, Time to Deploy, Passenger (msec)	13
Side Airbag Deployment, Time to Deploy, Driver (msec)	13
Side Airbag Deployment, Time to Deploy, Passenger (msec)	13
Rear Window Airbag Deployment, Time to Deploy (msec)	SNA

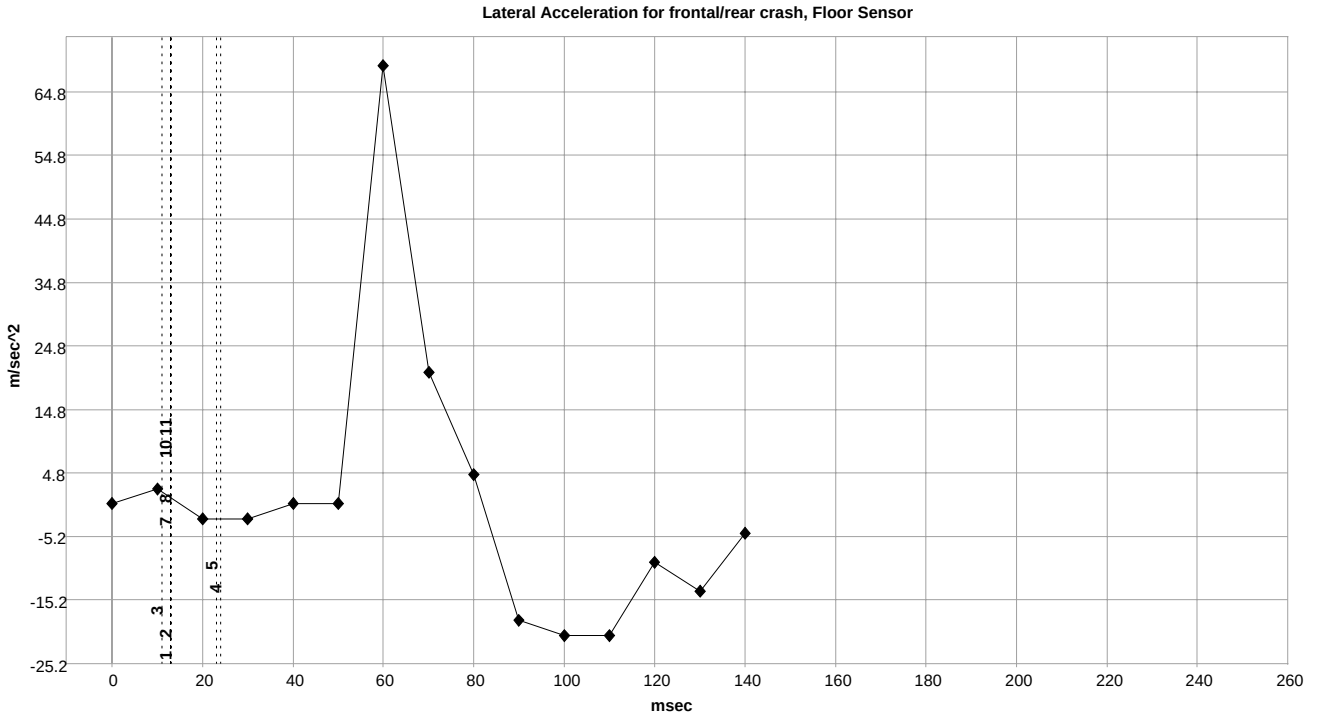
Longitudinal/Lateral Crash Pulse (2nd Prior Event, TRG 1 - table 1 of 2)

Recording Status, Time Series Data	Complete
Time from Time Zero to TRG (msec)	11.0
Length of Delta-V (msec)	140
Max. Longitudinal Delta-V (MPH [km/h])	-18.9 [-30.3]
Time, Maximum Delta-V, Longitudinal (msec)	104.5
Power Supply Status at Max. Delta-V	ON
Clipping Time of Longitudinal Delta-V (msec)	No
Clipping Time of Lateral Acceleration, Floor Sensor (msec)	No



Deployment Time Marker Key

1	Driver Airbag Deployment Time
2	Passenger Airbag Deployment Time
3	Driver/Passenger Pretensioner
4	Driver 2nd Stage Airbag Deployment Time
5	Passenger 2nd Stage Airbag Deployment
6	Driver/Passenger AHR
7	Driver CSA
8	Passenger CSA
9	Rear Window Airbag Deployment Time
10	Driver SAB
11	Passenger SAB



Deployment Time Marker Key

1	Driver Airbag Deployment Time
2	Passenger Airbag Deployment Time
3	Driver/Passenger Pretensioner
4	Driver 2nd Stage Airbag Deployment Time
5	Passenger 2nd Stage Airbag Deployment
6	Driver/Passenger AHR
7	Driver CSA
8	Passenger CSA
9	Rear Window Airbag Deployment Time
10	Driver SAB
11	Passenger SAB

Longitudinal/Lateral Crash Pulse (2nd Prior Event, TRG 1 - table 2 of 2)

Time (msec)	Longitudinal Delta-V (MPH [km/h])	Lateral Acceleration for Frontal/Rear Crash, Floor Sensor (m/sec^2)	Power Supply Status
0	0.0 [0.0]	0.0	ON
10	-1.0 [-1.7]	2.3	ON
20	-2.7 [-4.4]	-2.3	ON
30	-5.3 [-8.6]	-2.3	ON
40	-8.1 [-13.0]	0.0	ON
50	-11.7 [-18.8]	0.0	ON
60	-14.6 [-23.4]	68.9	ON
70	-16.8 [-27.0]	20.7	ON
80	-17.8 [-28.7]	4.6	ON
90	-18.3 [-29.5]	-18.4	ON
100	-18.7 [-30.1]	-20.7	ON
110	-18.7 [-30.1]	-20.7	ON
120	-18.5 [-29.8]	-9.2	ON
130	-18.2 [-29.2]	-13.8	ON
140	-18.2 [-29.2]	-4.6	ON
150	0.0 [0.0]	0.0	ON
160	0.0 [0.0]	0.0	ON
170	0.0 [0.0]	0.0	ON
180	0.0 [0.0]	0.0	ON
190	0.0 [0.0]	0.0	ON
200	0.0 [0.0]	0.0	ON
210	0.0 [0.0]	0.0	ON
220	0.0 [0.0]	0.0	ON
230	0.0 [0.0]	0.0	ON
240	0.0 [0.0]	0.0	ON
250	0.0 [0.0]	0.0	ON

DTCs Present at Time of Event (2nd Prior Event, TRG 1)

Recording Status, Diagnostic	Complete
Ignition Cycle Since DTC was Set (times)	0
Airbag Warning Lamp ON Time Since DTC was Set (min)	0
Diagnostic Trouble Codes	None

Pre-Crash Data, 1 Sample (2nd Prior Event, TRG 1)

Recording Status, Pre-Crash/Occupant	Complete
Time from Pre-Crash to TRG (msec)	250
TRG Count when Pre-crash TRG was Established (times)	1
Safety Belt Status, Driver	ON
Safety Belt Status, Front Passenger	ON
Occupant Size Classification, Front Passenger	AM50 (Not Child)
Frontal Airbag Suppression Switch Status, Front Passenger	SNA
RSCA Disable Switch	SNA
Seat Track Position Switch, Foremost, Status, Driver	No
Airbag Warning Lamp, On/Off	OFF
Ignition Cycle ,Crash (times)	4036

Pre-Crash Data, -5 to 0 seconds (2nd Prior Event, TRG 1)

Time (sec)	-4.75	-4.25	-3.75	-3.25	-2.75	-2.25	-1.75	-1.25	-0.75	-0.25	0 (TRG)
Vehicle Speed (MPH [km/h])	59 [95]	58.4 [94]	57.8 [93]	57.8 [93]	57.8 [93]	57.8 [93]	58.4 [94]	58.4 [94]	51.6 [83]	42.3 [68]	37.3 [60]
Accelerator Pedal, % Full (%)	19.0	7.0	4.5	20.5	35.5	49.0	50.5	0.0	0.0	0.0	0.0
Percentage of Engine Throttle (%)	10.5	0.5	0.0	17.5	32.5	35.0	42.0	1.0	0.0	0.0	0.0
Engine RPM (RPM)	2,100	2,000	1,800	2,000	1,900	2,000	2,600	2,300	1,800	1,400	1,400
Motor RPM (RPM)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid
Service Brake, ON/OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON	ON
Brake Oil Pressure (Mpa)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.83	12.14	11.90
Longitudinal Acceleration , VSC Sensor (m/sec^2)	-0.072	-0.287	-0.359	-0.072	0.072	0.502	0.359	0.287	-7.824	-7.680	-8.973
Yaw Rate (deg/sec)	-1.46	-1.95	-1.46	-0.98	-0.98	-0.98	-0.98	-2.44	-7.81	-4.39	-4.88
Steering Input (degrees)	0.0	-1.5	0.0	0.0	0.0	1.5	1.5	-9.0	-13.5	-21.0	-19.5
Shift Position	D	D	D	D	D	D	D	D	D	D	D
Sequential Shift Range	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	Undetermined	6	6	6
Cruise Control Status	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, PWR	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, ECO	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, Sport	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON	ON
Drive Mode, Snow	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF
Drive Mode, EV	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

Fuel Injection Quantity (mm3/st)	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid	Invalid

Hexadecimal Data

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

PIDs	PID	Data
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	03	37 38 30 31 30 30 30 30 36 38 30 30 30 36 38 30 30 30 36 45 30 30 30 36 45 30 30 30 36 44 30 30 30 36 44
	04	02 FF 01 01
	05	01
	06	17
	0A	03
	0B	00
	20	80 00 00 01
	21	02 A0
	40	00 00 00 01
	60	FF FF F0 01
	61	02 05 E8 00 C0 E0 05 00 02 80 02 80 00 00 00 00 00 00 00 00 03 55 03 55 14 D8 29 B1 85 5F C8 00
	62	A5 01 3F FD 0F C8 00 00 00 00
	63	55 10 0F C4 13 11 00 00 11 11 11 11 11 10 5F 5E 5D 5D 5D 5D 5E 5E 53 44 3C 26 0E 09 29 47 62 65 00 00 00 00 00 00 54 15 14 12 14 13 14 1A 17 12 0E 0E 00 00 00 00 66 60 00 01
	64	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
	65	55 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
	66	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
	67	55 E0 00 00 01 0D 0D 0B 0B 0A 55 FD FD 00 0D 00 0D 00 0D 00 0D 03 FE
	68	00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
	69	00 16 0F 00 00 00 06 00 10 00 1F 00 2F 00 44 00 55 00 62 00 68 00 6B 00 6D 00 6D 00 6C 00 6A 00 6A 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 6E 00 D1
	6A	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
	6B	55 00 15 00 02 FE FE FE FE 55 02 00 00 00 FF FF FE 02 01 02 01 FF FD 00 03 09 06 05 FF FA FE FF 00 01 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
	6C	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
	6D	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 FF FE 00 FF 00 FF FD FF FF 00 00 FF FF FE FF 00 00 00 00 00 00 FE 01 FE 01 FE 01 FE 01 FE
	6E	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
	6F	55 03 E2 10 4B 00 03 55 E4 00 00 FF 01 05 01 00 00 01 FF 14 19 0A F7 E2 DA D8 E2 EB F2 E8 E1 E2 DE D3 C6 B9 B8 BC C2 C8 C6 AD A6 A8 A6 A7 AA A8 A6 00 2B F3 C5
	70	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
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B9    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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March 2025

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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