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Special Crash Investigations
On-Site Office of Defects Investigation
Air Bag Non-Deployment Investigation
Vehicle: 2009 Saturn Outlook
Location: Michigan
Crash Date: June 2015

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15. Supplementary Notes

On-site ODI air bag non-deployment investigation of a 2009 Saturn Outlook, which ran off road and rolled over.

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

16. Abstract

This report documents the non-deployment of the rollover/side impact inflatable curtain (IC) air bags in a 2009 Saturn Outlook, which was involved in a single-vehicle, off-road, rollover crash. The investigation was requested by the Office of Defects Investigation (ODI) and included subsequent inspection of the vehicle, as well as imaging of the air bag control and rollover sensing modules by General Motors. This crash occurred in an interchange of a seven-lane, divided, interstate highway. The Saturn was a 4-door sport utility vehicle (SUV) equipped with multi-stage frontal air bags, front seat-mounted side impact air bags, and side impact IC air bags with roll sensing. A restrained 46-year-old male driver and a restrained 56-year-old male front right occupant occupied the vehicle. The Saturn was traveling northeast during a rainstorm when the driver lost control and the vehicle departed the left side of the roadway. The front plane struck a ditch (event 1) and the vehicle rolled over (event 2), right side leading, six quarter turns. Neither of the frontal air bags, seat-mounted side impact air bags, nor the IC air bags deployed during the crash sequence. The front plane damage and the WinSMASH results suggested that the frontal impact was probably not of sufficient severity to require deployment of the frontal air bags. The vehicle was also equipped with a rollover sensor and rolled over six quarter turns, suggesting deployment of the IC air bags should have occurred. The driver sustained police-reported "C" (possible) injuries and was transported by ambulance to a trauma center, where he was hospitalized for one day for treatment of minor injuries and observation. The front right occupant sustained police-reported "B" (non- incapacitating) injuries and was transported by ambulance to a trauma center, where he was hospitalized for two days for treatment of minor injuries and observation. The Saturn was towed from the crash scene due to damage.

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Indiana University Transportation Research Center
On-Site Office Of Defects Investigation
Air Bag Non-Deployment Investigation
Case Number: IN15020
Vehicle: 2009 Saturn Outlook
Location: Michigan
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BACKGROUND

This report documents the non-deployment of the rollover/side impact inflatable curtain (IC) air bags in a 2009 Saturn Outlook (**Figure 1**), which was involved in a single-vehicle, off-road, rollover crash. This crash investigation was initiated by the National Highway Traffic Safety Administration in June 2015 at the request of the Office of Defects Investigation (ODI) in Washington, DC, and was assigned on the same date. The investigation included subsequent inspection of the vehicle, and imaging of the air bag control and rollover sensing modules by the vehicle's manufacturer, General Motors. This crash occurred in June 2015 at 1315 hours, in Michigan, and was investigated by a local police agency. The vehicle inspection and scene inspections were completed in July 2015. Interviews with the driver and front right occupant were completed in July 2015.

Figure 1: 2009 Saturn Outlook

This crash occurred in an interchange of a seven-lane, divided, interstate highway. The Saturn was a 4-door sport utility vehicle (SUV) equipped with multi-stage frontal air bags, front-seat-mounted side impact air bags, and side impact IC air bags with roll sensing. A restrained 46-year-old male driver and a restrained 56-year-old male front right occupant occupied the vehicle. The Saturn was traveling northeast during a rainstorm when the driver lost control and the vehicle departed the left side of the roadway. The front plane struck a ditch (event 1) and the vehicle rolled over (event 2), right side leading, six quarter turns. Neither of the frontal air bags, seat-mounted side impact air bags, nor the IC air bags deployed during the crash sequence. The front plane damage and the WinSMASH results suggested that the frontal impact was probably not of sufficient severity to require deployment of the frontal air bags. The vehicle was also equipped with a rollover sensor and rolled over six quarter turns, suggesting deployment of the IC air bags should have occurred. The driver sustained police-reported "C" (possible) injuries and was transported by ambulance to a trauma center, where he was hospitalized for one day for treatment of minor injuries and observation. The front right occupant sustained police-reported "B" (non-incapacitating) injuries and was transported by ambulance to a trauma center, where

he was hospitalized for two days for treatment of minor injuries and observation. The Saturn was towed from the crash scene due to damage.

CRASH SUMMARY

Crash Site

This crash occurred during daylight hours on the north roadside and in the interchange area of a seven-lane, divided, interstate highway. The weather conditions were rain with 16 kilometers (10 miles) visibility, northwest winds at 19 km/h (12 mph), a temperature of 22.2 °C (72 °F), and a dew point of 16.7 °C (62 °F), according to local weather reports. The northeastbound roadway had three bituminous through lanes and an on-ramp acceleration lane which were separated from the three southwestbound lanes by a grass median. Each lane was approximately 3.5 m (11.6 ft) wide and the roadway was bordered by a 2.8 m (9.2 ft) bituminous median shoulder. Pavement markings consisted of broken white lane lines, a solid yellow median line, and a solid white edge line. The roadway grade was level and the speed limit was 113 km/h (70 mph).

Figure 2: Northeast roadway departure

Pre-Crash

The Saturn was traveling northeast in the center right through lane. The driver stated during the SCI interview that the cruise control was set at 113 km/h (70 mph) and that it was raining heavily. The driver stated he noticed another car in the ditch on the left side of the roadway. He tapped the brake to disengage the cruise control and the vehicle began to rotate counterclockwise. He stated he tried to turn the steering wheel to the right to regain control, but was unsuccessful. The Saturn departed the left side of the roadway (**Figure 2**) and the vehicle continued to rotate counterclockwise, down a 16-percent grade into a ditch.

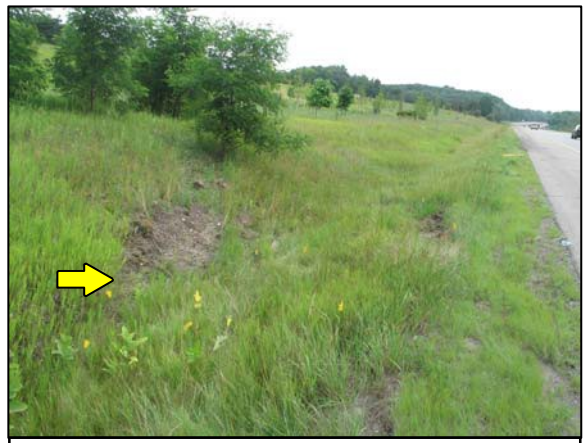


Figure 3: Front/undercarriage impact with back slope of ditch. Looking northeast.

Crash

The front plane struck the back slope of the ditch (**Figure 3**, event 1). The force direction was in the 2 o'clock sector and the impact resulted in no frontal air bag deployments. The WinSMASH barrier algorithm calculated the total delta-V as 8 km/h (5 mph). The longitudinal and lateral velocity changes were -5 km/h (-3 mph) and -6 km/h (-4 mph), respectively. The results

appeared reasonable based on the damage to the vehicle. The vehicle then rolled over (event 2), right side leading, six quarter turns through the ditch and up the 21 percent grade of the back slope of the ditch. The WinSMASH program could not be used to calculate delta-V on this event since rollovers are out of scope for the program. The severity of the damage was severe based on the extent of the roof crush. The Saturn traveled approximately 12 m (39 ft) from the point of rollover initiation, coming to final rest on its top plane, heading southwest. None of the air bags deployed during the rollover.

Post-Crash

The police responded to the crash, as did rescue and medical personnel. The front right occupant stated during the interview that he released his seat belt and tried to open the right front door. It would not open, so he kicked it open and exited under his own power. The driver stated during the interview that he was suspended upside down from his seat belt. He further stated that rescue personnel released the seat belt and his head hit the roof. He was placed on a rescue board and removed through the right front door. The driver and front right occupant sustained police reported "C" (possible) and "B" (non-incapacitating) injuries, respectively. Both were transported by ambulance to a trauma center. The driver and front right occupant were hospitalized for one and two days, respectively, for treatment of minor severity injuries. The vehicle was towed due to damage.

2009 SATURN OUTLOOK

Description

The Saturn was a front-wheel drive, 7-occupant, 4-door SUV with the VIN 5GZER13DX9Jxxxxxx manufactured in October 2008. The vehicle was equipped with a 3.6-liter, V-6 engine, 6-speed automatic transmission with sport shift feature, 4-wheel antilock brakes with electronic brake force distribution, brake assist, traction control, and electronic stability control (ESC). The vehicle was also equipped with multi-stage frontal air bags, front-seat-mounted side impact air bags, and side impact IC air bags with roll sensing. The vehicle had a tilt and telescoping steering column, which was adjusted between the center and full up positions and full forward position, respectively. The windshield glazing was AS1 laminated. The front row glazing was AS2 tempered and the remaining glazing was AS3 tempered, tinted original. The driver stated that the vehicle mileage was 129,800 miles (208,893 kilometers). The specified wheelbase was 302 cm (118.9 in).

The vehicle manufacturer's recommended tire size was P255/65R18 and the vehicle was equipped with Goodyear Assurance CS tires of the recommended size. The manufacturer's recommended cold tire pressure for the front and rear tires was 241 kPa (35 psi). The front tires were in good condition. The tread on the rear tires was in poor condition. The tire data for the Saturn is presented in the table below.

Position	Measured Pressure	Measured Tread Depth	Restricted	Damage
LF	221 kPa (32 psi)	5 mm (6 /32 in)	No	None
LR	200 kPa (29 psi)	2 mm (3 /32 in)	No	None
RR	Flat	2 mm (3 /32 in)	No	None
RF	193 kPa (28 psi)	6 mm (7 /32 in)	No	None

The front row was equipped with driver and front right occupant cloth-covered bucket seats with adjustable head restraints. The second row was equipped with cloth-covered bucket seats with folding backs and adjustable head restraints. The third row was equipped with a cloth-covered split bench seat with folding backs and adjustable head restraints at the outboard seating positions. The driver's seat track was adjusted between the middle and rear-most positions and the seat back was slightly reclined. The front right occupant's seat track was adjusted to the rear-most position and the seat back was slightly reclined. The top of the driver's and front right occupant's head restraints were located 26 cm (10.2 in) above the top of the seat back. The third row had fixed seat tracks.

Exterior Damage

Exterior Damage Event 1: The Saturn sustained damage to the front plane during the impact with the back slope of the ditch. The direct damage extended across the entire front plane and included the bumper fascia and the front undercarriage (**Figure 4**). The direct damage and Field L were 174 cm (68.5 in). There was dirt and grass embedded in the structures under the bumper and there were scratches to the bumper fascia. There was no crush to the bumper bar.

Figure 4: Front bumper fascia/undercarriage damage

Damage Classification Event 1: The Collision Deformation Classification (CDC) was 02FDLW1 (50 degrees).

Exterior Damage Event 2: Both side planes sustained minor damage and the roof sustained severe damage during the rollover. The direct damage on the left side began at the front bumper corner and extended 415 cm (163.4 in) rearward on the fender, A-pillar, front door, roof side rail, C-pillar, D-pillar, and quarter panel. The direct damage on the right plane began on the fender and extended 400 cm (157.8 in) intermittently on both doors, B-pillar, C-pillar, roof side rail, and D-pillar. Direct damage to the top plane began at the middle of the left A-pillar and extended the full length and width of the roof. The maximum lateral crush was 14 cm (5.5 in), occurring to the left D-pillar (**Figure 5**). The maximum vertical crush (**Figure 6**) was 32 cm (12.6 in), occurring at the left backlight header.

Figure 5: Maximum vertical crush at left D-pillar

Damage Classification Event 2: The CDC was 00TZDO4.

Figure 6: Maximum vertical crush

Event Data Recorder

Attempts to image the Saturn's EDR with version 16.1.1 of the Bosch Crash Data Retrieval (CDR) software via the Data Link Connector (DLC) were unsuccessful. The air bag control module (ACM) and rollover sensor (ROS) were accessed and were found to be partially submerged in water **(Figure 7**), since the vehicle had been stored outdoors, uncovered. The vehicle was moved inside a garage for inspection. The ACM and ROS were then removed from the vehicle and allowed to dry for several hours. Attempts to image both modules were again unsuccessful. The ACM and ROS modules were removed from the inspection site with the authorization of the insurance company and allowed to dry for several days. Both modules were then successfully imaged and reported with version 17.7.1 of the CDR software. The EDR report for each module stated that no events were recovered. The EDR reports for both modules are attached to the end of this report as **Appendices A and B**. GM subsequently imaged both modules.

Figure 7: ACM, partially submerged in water

Interior Damage

The interior of the Saturn sustained severe damage from intrusion of the occupant compartment. The most severe intrusions in the driver's and front right occupant positions involved the roof (**Figure 8**), which intruded vertically 21 cm (8.3 in) and 13 cm (5.1 in), respectively). The most severe intrusion occurred at the cargo area where the roof intruded vertically 33 cm (13 in). The glove box door was scratched from possible contact by the front right occupant's left knee. There was no other discernable evidence of occupant contact and no deformation to the steering wheel.

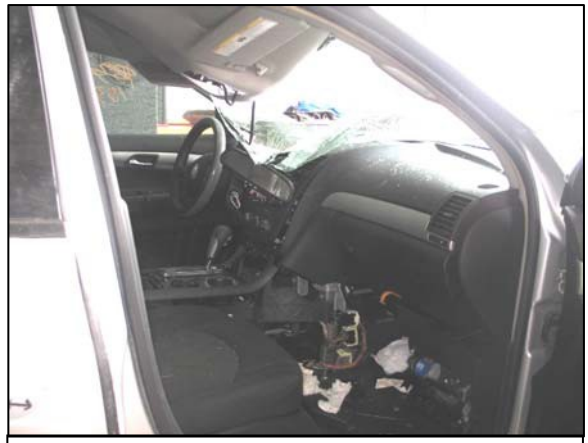


Figure 8: Intruded roof at first seating row

All of the non-fixed glazing was closed at the time of the crash. The windshield was cracked from impact forces, but remained in place. The third row left, third row right, and the backlight glazings were disintegrated from impact forces. The remaining glazing was undamaged. The left and right side doors remained closed and operational. The rear hatch opened slightly due to separation of the latch and striker.

Manual Restraint Systems

The front row seating positions were equipped with three-point lap and shoulder seat belts with sliding latch plates and adjustable upper anchors. The driver's and front right occupant's upper anchors were adjusted to the full-up position. The front row seat belts were also equipped with retractor-mounted pretensioners. Each retractor functioned normally and there was no evidence of pretensioner actuation. The second and third row seating positions were equipped with three-point lap and shoulder seat belts with sliding latch plates and fixed upper anchors.

The driver and front right occupant stated during the interview that they were each restrained by their lap and shoulder seat belt. The usage of the driver's seat belt was evidenced by load marks from the belt webbing on the latch plate belt guide. There was no discernable evidence of loading on the front right occupant's seat belt; however, injuries reported to right shoulder during the SCI interview suggested he was probably restrained by the lap and shoulder.

Supplemental Restraint Systems

The Saturn was equipped with multi-stage frontal air bags, front seat-mounted side impact air bags, and rollover/side impact IC air bags. No air bags deployed during the crash.

Air Bag Non-Deployment Discussion

NHTSA Recalls/Investigations/Technical Service Bulletins: The Safercar.gov website was searched on May 21, 2018, for air-bag-related issues with the 2009 Saturn Outlook. The website

listed 7 recalls, 1 investigation, 61 service bulletins, and 170 complaints. Six of the 170 complaints were related to the air bag system and of the 6, two were complaints of air bag non-deployment. Both complaints were from the same source and are subject of this investigation. Three of the service bulletins were related to the air bag system and dealt with the air bag indicator light. The single investigation was not related to the air bag system. One of the 7 recalls (GM 14V118) was related to the air bag system and dealt with a wiring harness issue with the driver and front right seat-mounted side impact air bag that could result in non-deployment of the seat-mounted air bag. The Saturn's driver stated during the interview that he was unaware that there were any recalls on the vehicle and to his knowledge no recall work had ever been done on the vehicle. GM stated that recall 14V118 was completed on March 18, 2014, approximately 9 months prior to purchase by the most recent owner.

A "Carfax" report on the Saturn, the subject of this investigation, reported that the vehicle had two owners, no reported issues, and no reported manufacturer recalls at the time of the crash. There were no reported crashes for the first owner, and no crashes reported for the second owner other than the subject of this investigation. No air-bag-related maintenance was reported in the detailed history section of the Carfax.

The SCI investigation determined that the frontal impact to the back slope of the ditch was probably not of sufficient severity to require deployment of the frontal air bags since there was no crush to the front bumper bar and only minor damage to the structural components below the bumper bar. The vehicle was equipped with IC air bags that were designed to deploy in a rollover and they did not deploy during the rollover sequence of this crash. The vehicle was equipped with a roll sensor and rolled over six quarter turns, suggesting deployment of the IC air bags should have occurred. The cause of the non-deployment of the IC air bags is unknown. GM provided the following commentary on the non-deployment of the Saturn's air bag system.

To further identify reasons for the nondeployment of the rollover protection air bags in the subject vehicle, GM was asked to examine the vehicle, image both modules, and to provide its assessment. Information collected from the rollover module identified DTC's UO151 (loss of communication with the SDM) and U0155 (loss of communication with the instrument control panel). Further signs of communication problems were found with the discrepancies among the ignition and synchronization cycle counters of both modules (Table 1 below).

SDM Ign Cycles at download	11,755
SDM Synchronization Counter	11,755
ROS Ignitions cycles at download	12,120
ROS Synchronization Counter	11,748

The exact causes of connectivity problems in the air bag system are unknown. However, these findings align with the vehicle owner complaint citing the presence of a yellow air bag warning light during the 6 months of ownership of the vehicle.

2009 SATURN OUTLOOK OCCUPANTS

Driver Demographics

Age/Sex:	46 years/male
Height:	180 cm (71 in)
Weight:	127 kg (280 lbs)
Eyewear:	None
Seat Type:	Bucket
Seat Track Position:	Between middle and rear-most
Manual Restraint Usage:	Lap and shoulder seat belt
Usage Source:	Vehicle inspection
Air Bags:	Frontal, seat-mounted side impact, and IC air bags, not deployed
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Removed due to injury through right front door
Transport From Scene:	Ambulance to trauma center
Medical Treatment:	Hospitalized one day

Driver Injuries

Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Sprain, acute cervical, with upper back tenderness, not further specified	640278.1	Roof	Probable
2	Contusion (bump) on top of head, not further specified	110402.1	Roof	Probable
3 4	Abrasions, 2.5 cm (1 in) at right lower abdomen and upper left shoulder	510202.1 710202.1	Torso portion of seat belt system	Certain
5 6	Contusions (bruising), sporadic, across abdomen, hip-to-hip	510402.1 510402.1	Lap portion of seat belt system	Certain
7	Laceration, 2.5 cm (1 in) right hip requiring surgical repair	510602.1	Buckle mechanism of seat belt system	Probable

Sources: Emergency room records, hospitalization Records, and Interviewee Data– Same Person. Injury Numbers 2 through 7 came only from Interviewee Data. Injury Number 1 came from a combination of Interviewee Data and Emergency Room Records.

Driver Kinematics

The driver was restrained by the lap and shoulder seat belt. The seat track was adjusted between the middle and rear-most positions and the seat back was reclined to a slightly reclined position. The top of the head restraint was located 26 cm (10.2 in) above the top of the seat back. The impact with the back slope of the ditch displaced the driver forward and to the right and he loaded the seat belt. The driver was redirected in multiple directions during the rollover and sustained an acute cervical sprain and a contusion (bump) on top of his head from contact to the roof. He loaded his seat belt and sustained a 2.5 cm (1 in) long abrasion at the upper left shoulder and lower right hip from the shoulder portion of the seat belt webbing and buckle, respectively. There was a 2.5 cm (1 in) long laceration at the right hip from loading the seat belt buckle that required surgical repair. He also sustained sporadic bruising across the abdomen from the lap portion of his seat belt. The driver stated that he was suspended by his seat belt and when the seat belt was released by rescue personnel, he fell and hit his head on the roof of the overturned vehicle. The driver was transported by ambulance to a trauma center where he was hospitalized for one day for treatment of minor severity injuries and observation.

Front Row Right Occupant Demographics

Age/Sex:	56 years/male
Height:	188 cm (74 in)
Weight:	83 kg (183 lbs)
Eyewear:	None
Seat Type:	Bucket
Seat Track Position:	Rear-most
Manual Restraint Usage:	Lap and shoulder seat belt
Usage Source:	Interview and official injury data
Air Bags:	Frontal, Seat-mounted side impact, and IC air bags, not deployed
Alcohol/Drug Involvement:	None
Egress From Vehicle:	Exited without assistance through right front door
Transport From Scene:	Ambulance to trauma center
Medical Treatment:	Hospitalized for two days

Front Row Right Occupant Injuries

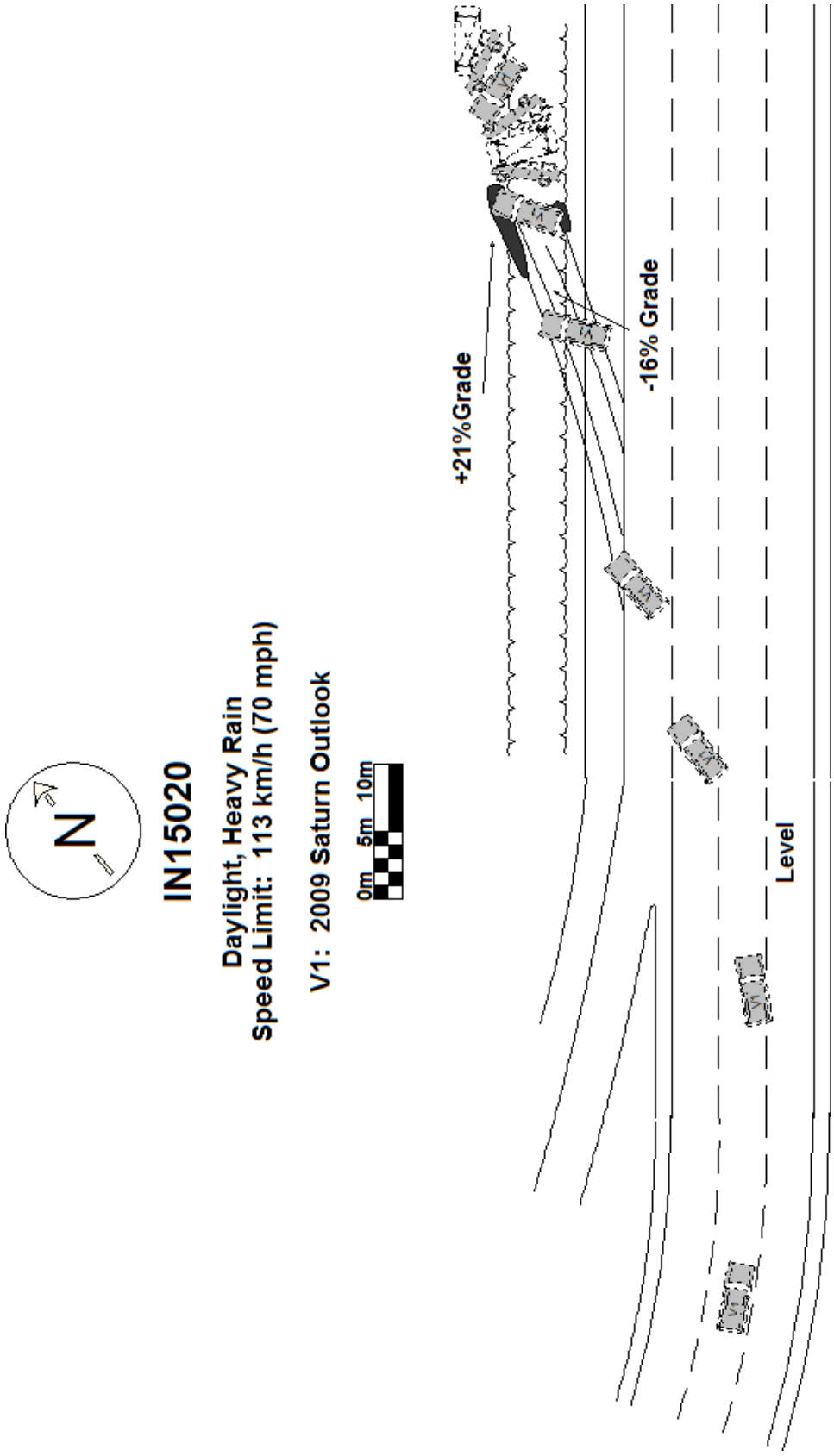
Injury No.	Injury	AIS 2015	Involved Physical Components (IPC)	IPC Confidence Level
1	Headache with amnesia for events post-crash, not further specified	110009.1	Roof	Probable
2	Contusion (bruise), 7.6 cm (3 in) left hip with tenderness, not further specified	510402.1	Interior, center console first row	Probable
	Tenderness and paraspinal muscle spasm in T- and L-spine, specifically T_9 to L_5, not further specified	Not coded		
3	Contusion, soft tissue injury with deep trauma to left shoulder, not further specified	710402.1	Roof	Probable
4	Contusion, soft tissue injury with deep trauma to right shoulder and from posterior right shoulder to posterior neck, not further specified	710402.1	Torso portion of seat belt system	Probable
5 6	Injury left wrist and hand, with tenderness, not further specified	710402.1 710402.1	Center instrument panel	Probable
7	Injury left knee, with tenderness, not further specified	810402.1	Right lower instrument panel (includes knee bolster)	Probable
8	Injury to right ankle, not further specified	810402.1	Right lower instrument panel (includes knee bolster)	Probable

Sources: Emergency room records, hospitalization records, and interviewee data– same person. Injury Number 1 came only from hospitalization records. Injury Numbers 2 to 7 came only from interviewee data.

Front Row Right Occupant Kinematics

The front right occupant was restrained by the lap and shoulder seat belt. The seat track was adjusted to the rear-most position and the seat back was slightly reclined. The top of the head restraint was located 26 cm (10.2 in) above the top of the seat back. The impact with the ditch displaced the driver forward and to the right and he loaded his seat belt. The occupant was redirected in multiple directions during the rollover. His head contacted the roof and he sustained a headache with amnesia for events post-crash as well as a contusion to his left shoulder. He loaded his seat belt and sustained a contusion to the right posterior neck and shoulder area. He contacted the center console and sustained a 7.6 cm (3 in) contusion to the left hip and a non-specified injury to his left wrist and hand from contact to the center instrument panel. He also sustained non-specified injuries to the left knee and right ankle from contact with the right lower instrument panel. The front right occupant was transported by ambulance to a trauma center where he was hospitalized for two days for treatment of minor severity injuries and observation.

CRASH DIAGRAM



APPENDIX A: 2009 SATURN OUTLOOK: EVENT DATA RECORDER REPORT, AIR BAG CONTROL MODULE[1]

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

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

CDR File Information

User Entered VIN	5GZER13DX9J******
User	
Case Number	
EDR Data Imaging Date	07/14/2015
Crash Date	
Filename	IN15020_V1_ACM.CDRX
Saved on	Tuesday, July 14 2015 at 14:15:56
Imaged with CDR version	Crash Data Retrieval Tool 16.1.1
Reported with CDR version	Crash Data Retrieval Tool 17.7.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Airbag Control Module
Event(s) recovered	None

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event may contain Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as Deployment Event #2, if the Non-Deployment Event is not locked. If a Non-Deployment occurs within 5 seconds of a deployment event, the ND will be locked to the deployment and cannot be overwritten. A locked Non Deployment Event cannot be overwritten by the SDM. A Non-Deployment can also be locked if two or more Non-Deployment Events occur within five seconds of one another. The recorded pre-crash data will be from the first Non-Deployment Events. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.
The second type of SDM recorded crash event is the Deployment Event. It also may contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events. If a second Deployment Event occurs any time after the Deployment Event, the Deployment Event #2 will overwrite any non-locked Non-Deployment Event. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

Data:

-SDM Recorded Vehicle Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. For Deployment Events, the SDM can record 220 milliseconds of data after Deployment criteria is met and up to 70 milliseconds before Deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 300 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.
-The CDR tool displays time from Algorithm Enable (AE) to time of Deployment command in a Deployment event and AE to time of maximum SDM recorded vehicle velocity change in a Non-Deployment event. Time from AE begins when the first air bag system enable threshold is met and ends when Deployment command criteria is met or at maximum SDM recorded vehicle velocity change. Air bag systems such as frontal, side, or rollover, may be a source of an enable. The time represented in a CDR report can be that of the enable of one air bag system to the Deployment time of another air bag system.
-Maximum Recorded Vehicle Velocity Change is the maximum square root value of the sum of the squares for the vehicle's combined "X" and "Y" axis change in velocity.
-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.
-SDM Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:
- -Significant changes in the tire's rolling radius
- -Final drive axle ratio changes
- -Wheel lockup and wheel slip

-Brake Switch Circuit Status indicates the status of the brake switch circuit.
-Pre-Crash data is recorded asynchronously. The 0.5 second Pre-crash data value (most recent recorded data point) is the data point last sampled before AE. That is to say, the last data point may have been captured just before AE but no more than 0.5 second before AE. All subsequent Pre-crash data values are referenced from this data point.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:

-The SDM receives a message with an “invalid” flag from the module sending the pre-crash data
-No data is received from the module sending the pre-crash data
-No module present to send the pre-crash data

-Pre-crash data associated with this event will always be for the first event even if it is not recorded.
-Driver’s and Passenger’s Belt Switch Circuit Status indicates the status of the seat belt switch circuit.
-The Time Between Non-Deployment to Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, “N/A” is displayed in place of the time. If the value is negative, then the Deployment Event occurred first. If the value is positive, then the Non-Deployment Event occurred first.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-The ignition cycle counter relies upon the transitions through OFF->RUN->CRANK power-moding messages, on the GMLAN communication bus, to increment the counter. Applying and removing of battery power to the module will not increment the ignition cycle counter.
-Once a firing loop has been commanded to be deployed, it will not be commanded to be deployed again during the same ignition cycle. Firing loop times for subsequent deployment type events, during the same ignition cycle, will record the deployment times as N/A.
-If more than one event is recorded, use the follow to determine which event the Multiple Event Data is associated with:
-If a Deployment event and not locked Non-Deployment event are recorded, the Multiple Event Data is associated with the Deployment event.
-If a Deployment event and a locked Non-Deployment event are recorded, then the Multiple Event Data is associated with both events.
-If a Deployment event and Deployment event #2 are recorded, then the Multiple Event Data is associated with both events.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

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

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

01004_SDMC-autoliv_r007

Hexadecimal Data

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$02	00	00	00	00	00	00	00
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$05	00	00	00	00	00	00	00
$06	40	00	00	00	00	00	00
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$0B	00	00	00	00	00	00	00
$0C	00	00	00	00	00	00	00
$0D	00	00	00	00	00	00	00
$0E	00	00	00	00	00	00	00
$0F	00	00	00	00	00	00	00
$10	00	00	00	00	00	00	00
$11	29	15	15	00	00	00	00
$12	FF	F0	FC	F0	C0	00	00
$13	FF	F0	FC	30	C0	00	00
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$16	06	16	17	0B	0C	00	00
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$1B	00	00	00	00	00	00	00
$1C	00	00	00	00	00	00	00
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$1E	01	00	00	00	00	00	00
$1F	00	00	00	00	00	00	00
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$25	00	00	00	00	00	00	00
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$28	00	39	41	08	1E	45	04
$29	03	24	00	00	00	00	00
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$39	00	00	00	00	00	00	00
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$3D	B4	C0	00	00	00	00	00
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$41	00	00	00	00	00	00	00
$42	00	00	00	00	00	00	00
$43	00	00	00	00	00	00	00
$44	00	00	00	00	00	00	00

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$5B   00 00 00 00 00 00 00
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$5D   00 00 00 00 00 00 00
$5E   00 00 00 00 00 00 00
$5F   00 00 00 00 00 00 00
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$9F   00 00 00 00 00 00 00
$A0   00 00 00 00 00 00 00
$A1   00 00 00 00 00 00 00
$A2   00 00 00 00 00 00 00
$A3   00 00 00 00 00 00 00
$A4   00 00 00 00 00 00 00
$A5   00 00 00 00 00 00 00

$01   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$02   00 00 00 00
$03   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$04   00 00 00 00
$05   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$06   00 00 00 00
$07   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$08   00 00 00 00
$09   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$0A   00 00 00 00
$0B   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$0C   00 00 00 00
$0D   00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00
$0E   00 00 00 00
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$22   91 78
$23   FA FA FA FA FA FA FA FA
$24   FA FA FA FA FA FA FA FA
$25   FA FA FA FA FA FA FA FA
$26   FA FA FA FA FA FA FA FA
```

```
$40   00 00
$42   D4 10 14
$43   00 F0 FC 9F
$44   F6 00 00 FC C0 C0
$45   01 01 0A 0A 64 64 64 64 02 64
$46   00 00 00 00 00 00 00 00 00 00 04 64
$47   18 08 08
$B4   41 53 34 36 37 39 45 35 33 30 54 54 44 57 31 30
$C1   01 8B 94 48
$C2   01 3D 10 AA
$CB   01 8B 94 47
$CC   01 8B 94 47
$DB   41 41
$DC   41 41
```

Disclaimer of Liability

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APPENDIX B: 2009 SATURN OUTLOOK EVENT DATA RECORDER REPORT,[2] ROLL OVER SENSOR (ROS)

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

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

CDR File Information

User Entered VIN	5GZER13DX9J******
User	
Case Number	
EDR Data Imaging Date	07/14/2015
Crash Date	
Filename	IN15020_V1_ROS.CDRX
Saved on	Tuesday, July 14 2015 at 15:40:53
Imaged with CDR version	Crash Data Retrieval Tool 16.1.1
Reported with CDR version	Crash Data Retrieval Tool 17.7.1
Reported with Software Licensed to (Company Name)	NHTSA
EDR Device Type	Roll-over Sensor
Event(s) recovered	None

Comments

No comments entered.

Data Limitations

Recorded Crash Events:

There are two types of recorded crash events. The first is the Non-Rollover Event. A Non-Deployment Event records data but does not deploy the air bag(s). The ROS can store one Non-Rollover Event. This event will be overwritten by the next Non-Rollover Event or by a second Rollover Event.

The second type of ROS recorded crash event is the Rollover Event. The ROS can store up to two different Rollover Events. Rollover Events cannot be overwritten or cleared from the ROS. Once the ROS records two Rollover Events, the ROS must be replaced.

Data:

-The ROS Records Lateral Acceleration, Vertical Acceleration, and Roll Rate data. This data reflects what the sensing system experienced during the recorded portion of the event. For Rollover Events, the ROS will record 490 milliseconds of data before the Deployment criteria is met and 250 milliseconds after Deployment criteria is met. For Non-Rollover Events, the ROS will record 490 milliseconds of data before event conclusion and 250 milliseconds after event conclusion. Acceleration and Roll Rate data are displayed in SAE sign convention.

-Event Recording Complete will indicate if data from the recorded event has been fully written to the ROS memory or if it has been interrupted and not fully written.

-ROS Recorded Vehicle Speed accuracy can be affected by various factors, including but not limited to the following:

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

-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:

- -The ROS receives a message with an "invalid" flag from the module sending the pre-crash data
- -No data is received from the module sending the pre-crash data
- -No module present to send the pre-crash data

-If power to the ROS is lost during a crash event, all or part of the crash record may not be recorded.

-Ignition Cycles Since DTCs Were Last Cleared can record a maximum value of 255 cycles and can only be reset by a scan tool.

-Event Recorded Last in the Ignition Cycle is used to determine event order if more than one event is recorded in the same ignition

-Rollover Occupant Containment Enable Status

- Enabled: Indicates that the ROS system enabled after the ROS internal system check
- Disabled: Indicates that the ROS system disabled after the ROS internal system check

-Rollover Occupant Containment Enable Override Status

- Normal: Indicates that the ROS system enabled after receipt of expected messages from the SDM
- Override: Indicates that the ROS system enabled without receipt of expected messages from the SDM (This does not inhibit ROS performance)

-Event Enable SDM Confirmation will confirm the SDM's recite of the ROS event enable message

-Post-Event/Event Concluded Confirmation Messages From the SDM will Confirm the SDM's recite of the ROS event conclusion message

-Order of Event Record Information Counter is used if two events are recorded on the same ignition cycle. The event with the smaller recorded counter value came before the event with the grater recorded counter value

-Data Recording Complete indicates that the data record for that portion of the event was completely written

-When reviewing ROS crash data, associated SDM crash data should also be reviewed.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

Data Source:
All ROS recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Status Data (Pre-Crash) is transmitted to the ROS, by various vehicle control modules, via the vehicle's communication network.

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

01037_ROSC_r005

Hexadecimal Data

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$04	00	00	00	00	00	00	00
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$07	00	8F	00	00	7F	80	7F
$08	81	81	61	77	78	58	00
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$11	FF	90	00	FF	90	01	FF
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$13	C1	51	FF	C1	51	FF	00
$14	C1	51	FF	C1	55	FF	00
$15	FF	FF	00	00	00	FF	00
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$19	FF	FF	FF	FF	00	00	00
$1A	FF	FF	7F	FF	FF	7F	00
$1B	FF	FF	7F	FF	FF	7F	00
$1C	FF	FF	7F	FF	FF	7F	00
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$C3   00 F1 19 D9
$CB   01 8B 08 1E
$CC   01 8B 08 1E
$D1   41 49
$D2   41 4A
$D3   48 42
$DB   42 41
$DC   42 41
```

Disclaimer of Liability

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DOT HS 812 571
October 2019

U.S. Department
of Transportation

**National Highway
Traffic Safety
Administration**

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