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ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-06-006
LOCATION - TEXAS
VEHICLE - 2005 CHEVROLET SILVERADO, EXTENDED CAB
CRASH DATE - March 2006

Submitted:

October 19, 2006
Revised: April 1, 2008

Contract Number: DTNH22-01-C-07002

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

1. *Report No.* IN-06-006	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Certified Advanced 208-Compliant Vehicle Investigation Vehicle - 2005 Chevrolet Silverado, Extended Cab Location - Texas		5. *Report Date:* October 19, 2006 6. *Performing Organization Code*	
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.*	
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1501		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-01-C-07002	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NPO-122) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. *Type of Report and Period Covered* Technical Report Crash Date: March 2006 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site air bag investigation involving a 2005 Chevrolet Silverado extended cab pickup truck with manual safety belts and dual front advanced air bag system.			
16. *Abstract* This report covers an on-site investigation of an air bag deployment crash that involved a 2005 Chevrolet Silverado extended cab pickup truck (case vehicle), which ran-off-road and impacted an impact attenuator. This crash is of special interest because the supplemental restraint (air bag) system in the Chevrolet Silverado is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle was also equipped with an Event Data Recorder (EDR), and the case vehicle's driver [30 year-old,(Asian) male] did not sustain any injury and the front right passenger [32-year-old, (Asian) male] sustained only a minor injury as a result of the crash. The case vehicle was traveling north in the outside lane of an eight-lane, divided Interstate highway and the driver was intending to merge into an exit lane. However, there was a vehicle in the exit lane. The case vehicle entered the gore as the driver was attempting to enter the exit lane. The driver steered left to reenter the expressway as he was reaching the end of the gore and approaching an impact attenuator. The driver then braked just prior to the impact. The front left of the case vehicle impacted the attenuator causing both stages of the driver and front right passenger air bags to deploy. The case vehicle rotated counterclockwise across the exit ramp and came to final rest on the east side of the exit ramp heading southwest. The driver, front right passenger and back left passenger were all restrained by their three-point, lap-and-shoulder safety belts. The driver was not injured. The front right passenger and back left passenger sustained minor injury.			
17. *Key Words* Advanced Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public	
19 *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 17	22. *Price*

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TABLE OF CONTENTS

Page No.

This on-site investigation was brought to NHTSA's attention on or before April 21, 2006 by NASS CDS/GES sampling activities. This crash involved a 2005 Chevrolet Silverado pickup truck (case vehicle) that ran-off-road and impacted an impact attenuator. The crash occurred in March, 2006, at 1:43 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the supplemental restraint (air bag) system in the Chevrolet Silverado is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle was also equipped with an Event Data Recorder (EDR), and the case vehicle's driver [30 year-old,(Asian) male] did not sustain any injury and the front right passenger [32-year-old, (Asian) male] sustained only a minor injury as a result of the crash. This contractor inspected the case vehicle and downloaded the data from the onboard EDR on May 2, 2006. This contractor inspected the scene on May 3, 2006 and interviewed the case vehicle's driver on May 8, 2006. This report is based on the police crash report, scene and vehicle inspections, EDR data, an interview with the case vehicle's driver, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling north in the outside lane of an eight-lane, divided Interstate highway and the driver was intending to merge into the exit lane; however, there was a vehicle to his right in the exit lane. The case vehicle entered the gore as the driver was attempting to enter the exit lane. The driver attempted to reenter the expressway as he was reaching the end of the gore and approaching an impact attenuator. The driver then braked just prior to the impact. The front left of the case vehicle impacted the attenuator causing both stages of the driver and front right passenger air bags to deploy. The case vehicle rotated counterclockwise across the exit ramp and came to final rest on the east side of the exit ramp heading southwest. At the time of the crash the light condition was daylight, the atmospheric condition was clear and the roadway pavement was dry.

The CDC for the case vehicle was determined to be: **12-FYEW-3** (**0** degrees). The case vehicle sustained 75 centimeters (29.5 inches) of residual maximum crush to it front occurring at C_1. The WinSMASH reconstruction program could not be used to calculate the case vehicle's Delta Vs because impacts with a yielding object, such as the impact attenuator, are out-of-scope for the program. However, the WinSMASH barrier algorithm was used to calculate a barrier equivalent speed of 38.1 km.p.h. (23.7 m.p.h.). In addition, the case vehicle's EDR recorded a maximum longitudinal Delta V of -25.7 km.p.h. (-15.99 m.p.h.) for this impact occurring at 150 milliseconds after algorithm enable. The case vehicle was towed due to damage.

The driver and front right passenger were both restrained by their manual, three-point, lap-and-shoulder safety belts. The driver was not injured. The front right passenger sustained abrasions on the top of both his hands from contact with his air bag. The driver's use of his safety belt system and the deployment of his air bag prevented him from being injured. The front right passenger's use of his safety belt system and the deployment of his air bag mitigated his interaction with the case vehicle's interior and reduced his injury potential.

The back left passenger was not restrained by his three-point, lap-and-shoulder safety belt system. He sustained a small laceration on the top of his head and a neck strain due to contact with the back of the driver's seat. The back left passenger's non-use of his safety belt system exposed him to impact with the back of the driver's seat.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was an eight-lane, divided, Interstate highway traversing in a north-south direction. The northbound roadway (i.e., case vehicle's roadway) had four through lanes and an exit lane. Each through lane was approximately 3.7 meters (12 feet) in width. The exit lane was approximately 4.5 meters in width and was bordered by a bituminous shoulder 1.3 meters (4.3 feet) in width. There was an impact attenuator in the gore between the through lanes and the exit lane. The gore was approximately 55.5 meters (182 feet) in length. The impact attenuator was protecting the end of a concrete barrier. At the time of the crash the light condition was daylight, the atmospheric condition was clear and the roadway pavement was dry, level, bituminous with an estimated coefficient of friction of 0.70. Traffic density was heavy and the site of the crash was commercial. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle's driver stated that he had been traveling north in the outside lane (**Figure 1**) and intended to merge into the exit lane; however, there was a vehicle to his right in the exit lane. The case vehicle entered the gore as the driver was attempting to enter the exit lane. The driver stated he realized he would not be able to move completely into the exit lane, so he attempted to reenter the expressway as he was reaching the end of the gore and approaching the impact attenuator. The case vehicle's driver stated he braked just prior to the impact. The crash occurred within the interchange area in the gore of the exit lane.

Figure 1: Overview of exit lane and impact attenuator at the end of the gore (green arrow), the impact attenuator has been repaired, red arrow shows police reported area of case vehicle's final rest

Crash: The front left of the case vehicle (**Figure 2** below) impacted the attenuator (**Figure 3** below) causing the case vehicle's driver and front right passenger air bags to deploy. Based on the downloaded EDR data, both stages of the dual stage air bags deployed.

Post-Crash: After the initial impact, the case vehicle continued forward and rotated counterclockwise as the impact attenuator collapsed. The case vehicle separated from the attenuator and rotated counterclockwise across the exit ramp to the northeast. The case vehicle came to final rest on the east side of the exit ramp facing southwest (**Figure 1**).

Figure 2: Front damage from impact with the impact attenuator, each increment of tape on hood is tenth of meter, each increment on rods is 5 cm (2 in)

Figure 3: Overview of exit ramp and repaired impact attenuator

CASE VEHICLE

The 2005 Chevrolet Silverado was a rear wheel drive, four-door pickup truck (VIN: 2GCEC19V351-------). The manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This vehicle was equipped with a 4.8L, V-8 engine; four speed automatic transmission with overdrive and four wheel anti-lock brakes. The front seating row was equipped with a split bench seat with adjustable head restraints, driver and front right passenger dual stage air bags, a front right passenger sensing system with seat position sensor; and driver and front right passenger manual, three-point, lap-and-shoulder safety belt systems with safety belt buckle sensors. The front center seat position was equipped with a two-point lap belt. The back seat was equipped with a bench seat with adjustable head restraints; integrated, three-point, lap-and-shoulder safety belt systems in the outboard positions and a two-point lap belt in the center seat position. In addition, the back seat was equipped with a LATCH system for securing child safety seats.

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity and driver and front right passenger safety belt usage to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat position, an occupant weight sensor in the seat cushion determines if an occupant is on the seat and enables or suppresses deployment of the air bag based on the amount of weight on the seat.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's impact with the impact attenuator involved the left portion of the front plane. The case vehicle's front bumper, lower bumper trim, grille, radiator, hood, left fender and left turn signal and headlamp assemblies were directly damaged and crushed rearward. Direct damage began at the left front bumper corner and extended 66 centimeters (26 inches) along the front bumper. Residual maximum crush was measured as 75 centimeters (29.5

inches) occurring at C_1 (**Figure 4**). The case vehicle also had sideswipe-type damage to the left sill below the driver's door (**Figure 5**). Based on the evidence and the reconstruction, this damage was determined not to be related to this crash. It did not appear associated with the crash attenuator impact because the damage was not continuous with the front damage, and the impact caused the case vehicle to rotate counterclockwise away from the attenuator. In addition, the height of the damage was not consistent with the height of the attenuator, and there were no objects in the case vehicle's area of final rest that could have caused the damage to the left sill. The table below shows the case vehicle's front crush profile.

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	66	75	146	75	54	36	18	1	0	-40	0
in		26.0	29.5	57.5	29.5	21.3	14.2	7.1	0.4	0.0	-15.7	0.0

Figure 4: Left side view of front crush due to impact with impact attenuator

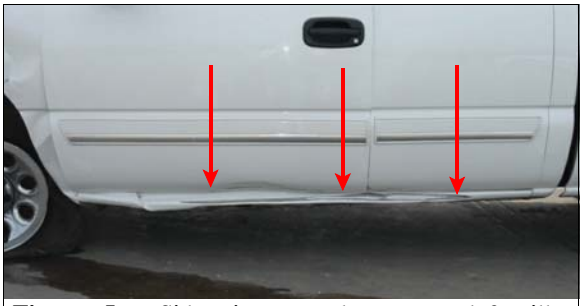


Figure 5: Sideswipe-type damage to left sill, determined not to be related to this crash

The case vehicle's left side wheelbase was shortened 25 centimeters (9.8 inches) while the right side wheelbase was extended 8 centimeters (3.1 inches). Induced damage involved the case vehicle's right headlamp and turn signal assemblies as well as the hood, windshield glazing and left fender. No other induced damage was noted to the remainder of the case vehicle's exterior.

The case vehicle's recommended tire size was P235/75R16. The case vehicle was equipped with tires size LT285/75R16. The tire data are shown in the table below.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	Flat	Flat	241	35	8	10	Sidewall cuts	Yes	Yes
RF	55	8	241	35	8	10	None	No	No
LR	248	36	241	35	7	9	None	No	No
RR	62	9	241	35	7	9	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior (**Figures 6**, **7** and **Figure 8** below) revealed some light occupant contact marks to the back of the driver's seat due to contact by the back left passenger. The driver also stated in the interview that the left rear passenger contacted the back of his seat back during the crash. One passenger compartment intrusion was documented. The driver's toe pan intruded longitudinally 10 centimeters (3.9 inches). Lastly, no evidence of deformation of the steering wheel or compression of the energy absorbing steering column was observed (**Figure 9** below).

Figure 6: Overview of steering wheel, instrument panel and windshield

Figure 7: Overview of center and right instrument panel and windshield

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FYEW-3** (**0** degrees). The WinSMASH reconstruction program could not be used to calculate the case vehicle's Delta Vs because impacts with a yielding object, such as the impact attenuator, are out-of-scope for the program. However, the WinSMASH barrier algorithm was used to calculate a barrier equivalent speed of 38.1 km.p.h. (23.7 m.p.h.). In addition, the case vehicle's EDR recorded a maximum longitudinal Delta V of -25.7 km.p.h. (-15.99 m.p.h.) for this impact. The case vehicle was towed due to damage.

Figure 8: Overview of back left passenger seat position

Figure 9: Left side view of steering wheel and column showing lack of deformation

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with dual stage air bags at the driver and front right passenger positions. Both the driver and front right passenger air bags deployed as a result of the case vehicle's impact with the impact attenuator.

The case vehicle's driver air bag was located in the steering wheel hub. The air bag module cover consisted of symmetrical "I"-configuration cover flaps made of pliable vinyl. Each cover flap was 7 centimeters (2.8 inches) in width at the top, 5 centimeters (2 inches) in width at the bottom and 12 centimeters (4.7 inches) in height as measured along the center tear seam. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points (**Figure 10**). There was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 11 centimeters (4.3 inches) in width. The driver's air bag had two vent ports (**Figure 11**), each approximately 3 centimeters (1.2 inches) in diameter, located at the 1 and 11 o'clock positions. The deployed driver's air bag (**Figure 12** below) was round with a diameter of approximately 65 centimeters (25.6 inches). An inspection of the driver's air bag fabric revealed no evidence of driver contact.

Figure 10: Case vehicle's driver air bag module cover flaps

Figure 11: Case vehicle's driver air bag vent ports

Figure 12: Overview of case vehicle's driver air bag

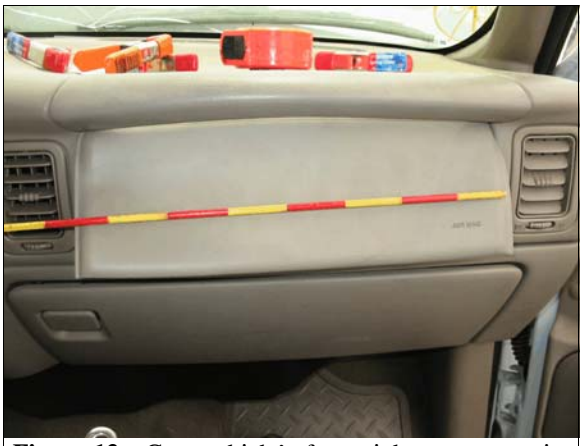


Figure 13: Case vehicle's front right passenger air bag module cover

Figure 14: Vent port on right side of case vehicle's front right passenger's air bag

Figure 15: Right front passenger air bag.

The front right passenger's air bag was located in the middle of the instrument panel (**Figure 13**). The air bag module cover consisted of a single rectangular-shaped cover flap 39 centimeters (15.4 inches) in width and 13 centimeters (5.1 inches) in height. An inspection of the air bag module cover flap (**Figure 13**) and the air bag fabric revealed that the cover flap opened at the designated tear points. There was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed with one wide tether, approximately 47 centimeters (18.5 inches) in width. The front right air bag had two vent ports, each approximately 3 centimeters (1.2 inches) in diameter (**Figure 14** below), located at the 9:30 and 2:30 clock positions. The deployed front right air bag (**Figure 15** below) was rectangular with a height of approximately 49 centimeters (19.3 inches) and a width of approximately 56 centimeters (22 inches). An inspection of the front right passenger's air bag fabric revealed no evidence of occupant contact.

CRASH DATA RECORDING

The case vehicle's EDR was downloaded via connection to the diagnostic link connector. The downloaded data indicated that a non-deployment

and a deployment event were recorded. The EDR reports for both events are presented in **Figures 17-22** at the end of this report. The EDR data indicated that the non-deployment event occurred greater than 25.4 seconds prior to the deployment event. The source of the non-deployment event may be associated with the narrow sideswipe-type damage on the sill below the driver's door. The evidence indicated that the sideswipe damage was most likely not associated with this crash.

The recorded pre-crash data for both the non-deployment and deployment records are identical. The recorded pre-crash data is most likely related to the deployment event because the EDR gives priority to writing the deployment data first. There may have been insufficient power to write the non-deployment pre-crash data resulting in a duplication of the deployment pre-crash data on the non-deployment record.

The EDR system status report for the deployment event shows that the SIR warning lamp was recorded as off, and the driver's and front right passenger's safety belt switch circuit were recorded as buckled. In addition, the front right passenger's seat position switch was recorded as rearward. The EDR recorded the maximum SDM forward velocity change as -25.73 km.p.h. (-15.99 m.p.h.) occurring 150 milliseconds after algorithm enable (AE). The system status report also showed that the first and second stage deployment criteria for the driver's and front right passenger's air bags were met, respectively at 7.5 milliseconds and 10 milliseconds after AE.

The pre-crash data indicates that five seconds prior to AE, the case vehicle was at 0% throttle traveling at 82 km.p.h. (51 m.p.h.), and the brake switch was recorded off. The brake switch is recorded on at three seconds prior to AE, and then off at two seconds as the percent throttle increases to 26%. Percent throttle is then recorded as 85% and speed at 82 km.p.h. (51 m.p.h) one second prior to AE, supporting the driver's statement that he tried to reenter the expressway just prior to the impact.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's driver [30-year-old, Asian male; 170 centimeters and 52.1 kilograms (67 inches, 115 pounds)] was most likely seated in an upright position with his back against the seat back, his left foot on the floor, his right foot on the accelerator and both of his hands on the steering wheel. The seat track was locked at the time of inspection, but it is estimated that it was positioned between the middle and forward-most locations. The seat back was slightly reclined.

Based on the interview data and supported by the EDR data, the case vehicle's driver was restrained by his integrated, three-point, lap-and-shoulder safety belt system. Inspection of the driver's safety belt webbing, shoulder belt guide and latch plate revealed no evidence of loading.

Just prior to the crash, the driver steered left in an attempt to return to the expressway. As a result, and independent of the use of his safety belts, he most likely moved slightly to the right just prior to impact. The case vehicle's impact with the impact attenuator caused the case vehicle driver to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The driver's safety belt retractor locked, he loaded his

safety belt assembly and his face and upper chest most likely contacted his deployed air bag. As the case vehicle rotated counterclockwise after impact, the driver most likely moved slightly to his right and continued to load his safety belt. The driver remained restrained in his seat as the case vehicle came to final rest. The driver's door was jammed closed due to damage, so the driver exited the vehicle under his own power through the driver's door window. The driver's use of his safety belt system and the deployment of his air bag prevented him from being injured.

CASE VEHICLE DRIVER INJURIES

The police crash report indicated the driver was not injured and was not transported to a medical facility. He did not sustain any injuries as a result of this crash and missed no work days.

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The case vehicle's front right passenger [32-year-old, (Asian) male; 165 centimeters and 52 kilograms (65 inches, 115 pounds)] was most likely seated in an upright posture with his back against the seat back and his feet on the floor. The position of his arms and hands is unknown. His seat track was located in its middle position, and the seat back was slightly reclined.

Based on the interview and supported by the EDR data, the case vehicle's front right passenger was restrained by his integrated, three-point, lap-and-shoulder safety belt system. Inspection of the passenger's safety belt webbing, shoulder belt guide and latch plate revealed no evidence of loading.

Just prior to the crash, the driver steered left in an attempt to return to the expressway. As a result and independent of the use of his safety belts, the front right passenger most likely moved slightly to his right just prior to impact. The case vehicle's impact with the impact attenuator caused the front right passenger to continue forward along a path opposite the case vehicle's 0 degree direction of principal force as the case vehicle decelerated. The passenger's safety belt retractor locked, he loaded the safety belt assembly and his face and chest most likely contacted his deployed air bag. In addition, both of his hands contacted the deployed air bag causing abrasions on the top of both hands. As the case vehicle rotated counterclockwise after impact, the passenger most likely moved slightly to the right and continued to load his safety belt. The front right passenger remained restrained in his seat as the case vehicle came to final rest. The interviewee indicated that the front right passenger exited the case vehicle under his own power through the right front window. The front right passenger's use of his safety belt system and the deployment of his air bag mitigated his interaction with the case vehicle's interior and reduced his injury potential.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The police crash report indicated the front right passenger was not injured and was not transported to a medical facility. It is unknown if the front right passenger missed any work days as a result of the crash. The table below shows the front right passenger's interviewee reported injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasions to top {dorsal} surface of both hands	minor 790202.1,3	Air bag, front right passenger's	Probable	Interviewee (driver)

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's back left passenger [83-year-old, (Asian) male; 168 centimeters and 72.6 kilograms (66 inches, 160 pounds)] was most likely seated in an upright posture with his back against the seat back and his feet on the floor. The position of his hands and arms is not known. There was no seat track and his seat back was not adjustable.

Based on interview data and the inspection of the safety belt assembly, the back left passenger was not restrained by his manual, three-point, lap-and-shoulder safety belt system.

As the driver attempted to steer the case vehicle left and back onto the expressway, the back left passenger most likely moved slightly to his right. The impact to the impact attenuator caused the back left passenger to move forward along a path opposite the case vehicle's 0 degree direction of principal force as the vehicle decelerated. He impacted the back of the driver's seat (**Figure 16**) causing a small laceration on top of his head near his forehead and a neck strain. As the case vehicle rotated counterclockwise, he most likely moved to the right and may have moved out of his seat position. His final rest position within the vehicle is not known. He was able to exit the case vehicle with some assistance. The back left passenger's non-use of his safety belt system exposed him to impact with the back of the driver's seat.

Figure 16: Overview of occupant contact marks on back of the driver's seats

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The police crash report indicated the back left passenger sustained a "C" (possible) injury and was transported by ambulance to a medical facility. He was and treated and released. The table below shows the back left passenger's injuries and injury mechanisms. It is not known if he received any follow-up treatment. The passenger was not working at the time of the cash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Strain {sprain}, cervical {neck}, not further specified	minor 640278.1,6	Seat back, driver's (indirect)	Certain	Emergency room records
2	Laceration {cut}, small, on vertex {top} of scalp {head}	minor 190602.1,9	Seat back, driver's	Certain	Interviewee (driver)

CDR File Information

Vehicle Identification Number	2GCEC19V351******
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	IN06006.CDR
Saved on	Tuesday, May 2 2006 at 11:11:22 AM
Collected with CDR version	Crash Data Retrieval Tool 2.800
Collecting program verification number	9238B95E
Reported with CDR version	Crash Data Retrieval Tool 2.800
Reporting program verification number	9238B95E
Interface used to collected data	Block number: 00 Interface version: 4A Date: 11-08-05 Checksum: 7500
Event(s) recovered	Deployment Non-Deployment

SDM Data Limitations

SDM Recorded Crash Events:
There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.
The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within 25.4 seconds of one another. Deployment Events cannot be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.
The data in the Non-Deployment Event file will be locked after a Deployment Event, if the Non-Deployment Event occurred within 5 seconds before the Deployment Event. If multiple Non-Deployment Events occur within 5 seconds prior to a Deployment Event, then the most severe Non-Deployment Event will be recorded and locked. If multiple Non-Deployment Events precede a Deployment Event, and multiple Non-Deployment Events occur within 5 seconds of each other (but not necessarily all within 5 seconds of the Deployment Event), and subsequent Non-Deployment Events are less severe than prior Non-Deployment Events, and the last of the multiple Non-Deployment Events occurs within 5 seconds of a Deployment Event, then the most severe of the Non-Deployment Events (which may have occurred more than 5 seconds prior to the Deployment Event) will be recorded and locked.

SDM Data Limitations:
-SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward 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. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For Deployment Events and Deployment Level Events, the SDM will record 100 milliseconds of data after deployment criteria is met and up to 50 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM will record the first 150 milliseconds of data after algorithm enable.
-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 if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.
-Brake Switch Circuit Status indicates the status of the brake switch circuit.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM receive an invalid message from the module sending the pre-crash data.
-Driver's and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Belt Switch Circuit may be reported other than the actual state.
-The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than 25.4 seconds, "N/A" is displayed in place of the time.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-Multiple Events Associated with this Record: This parameter will indicate whether one or more associated events

Figure 17: Case vehicle's CDR File Information and SDM Data Limitations

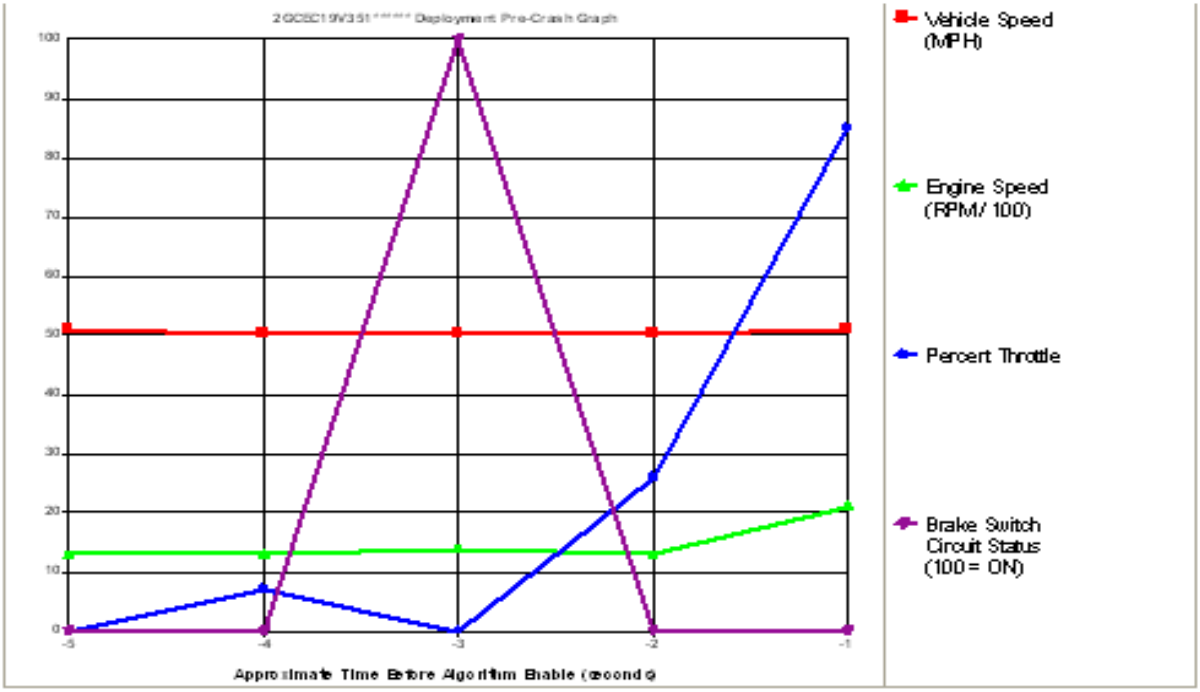
preceded the recorded event.
-One or More Associated Events Not Recorded: If a single event is recorded, this parameter will indicate whether one or more associated events, prior to the recorded event, was not recorded.
If two associated events are recorded, this parameter for the first event will indicate whether one or more associated events, prior to the first event, was not recorded.
If two associated events are recorded, this parameter, for the second event, will indicate whether one or more associated events, between the first and second events, was not recorded.

SDM Data Source:
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted once a second by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.
-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the vehicle's communication network, to the SDM.
-The SDM may obtain Belt Switch Circuit Status data a number of different ways, depending on the vehicle architecture. Some switches are wired directly to the SDM, while others may obtain the data from various vehicle control modules, via the vehicle's communication network.

Figure 18: Case vehicle's SDM Data Limitations continued

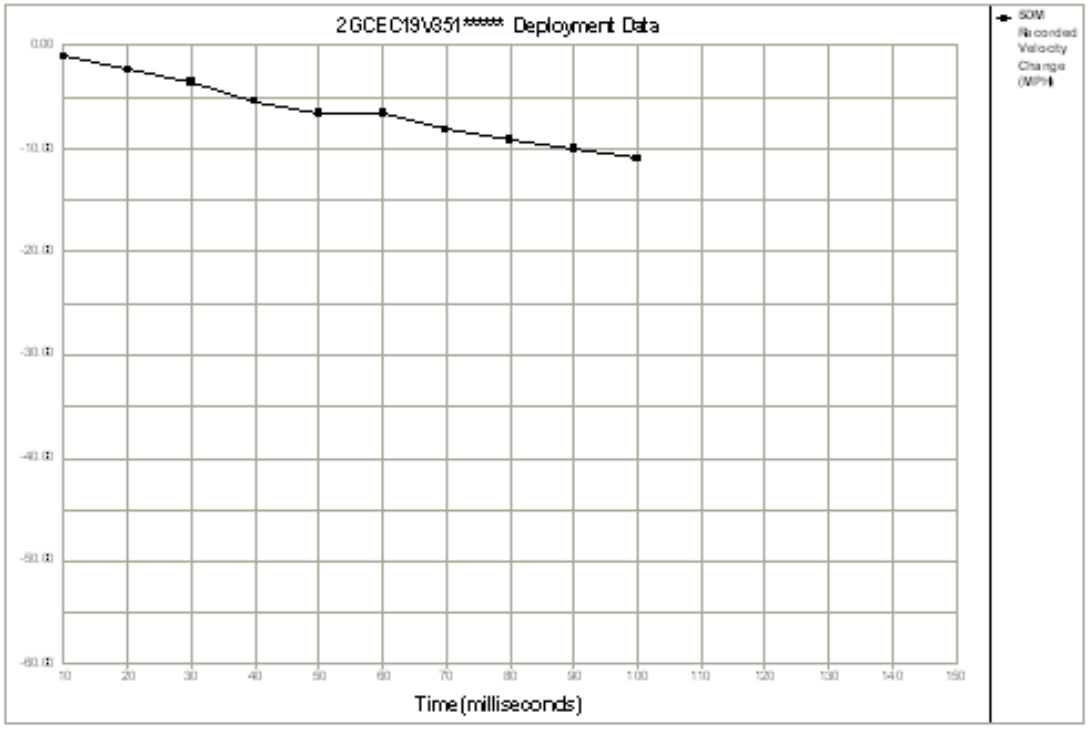
System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	BUCKLED
Passenger Seat Position Switch Circuit Status	Rearward
Ignition Cycles At Deployment	6265
Ignition Cycles At Investigation	6269
Maximum SDM Recorded Velocity Change (MPH)	-15.99
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	150
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	7.5
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	10
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	7.5
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	10
Time Between Non-Deployment And Deployment Events (sec)	N/A
Frontal Deployment Level Event Counter	1
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No



Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	51	1344	0	OFF
-4	50	1280	7	OFF
-3	50	1408	0	ON
-2	50	1344	26	OFF
-1	51	2112	85	OFF

Figure 19: Case vehicle's System Status at Deployment Report and Pre-Crash Data



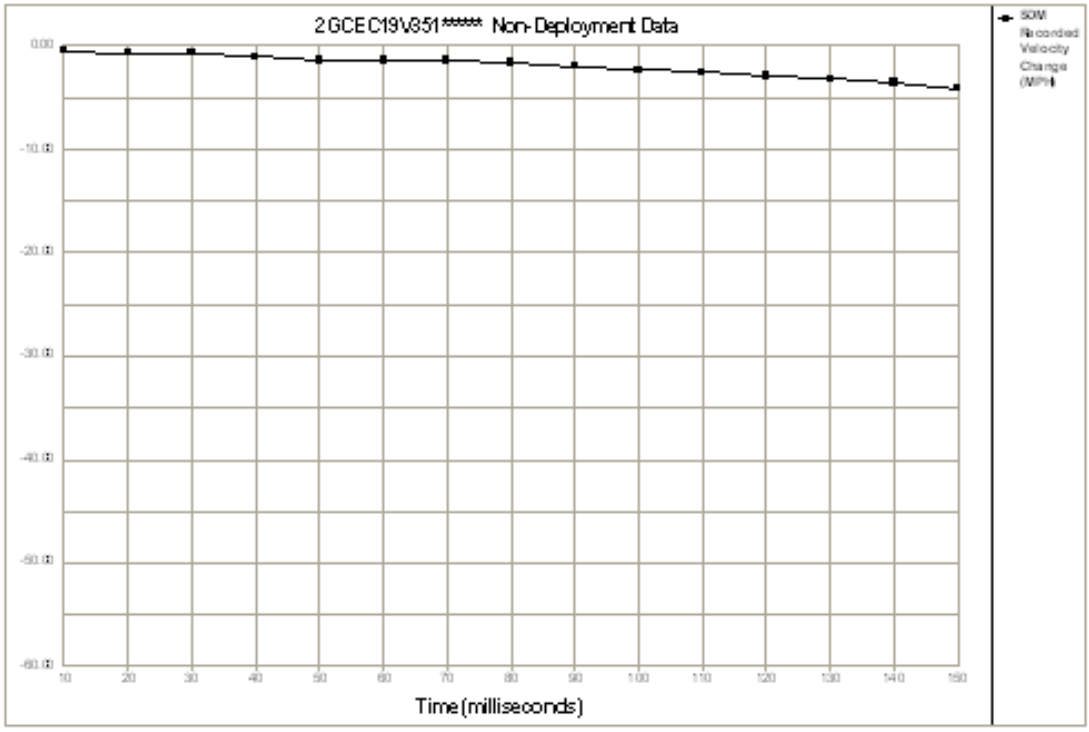
Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.93	-2.17	-3.41	-5.27	-6.51	-6.51	-8.06	-8.99	-9.92	-10.86	N/A	N/A	N/A	N/A	N/A

Figure 20: Case vehicle's Deployment SDM Recorded Velocity Change graph

System Status At Non-Deployment

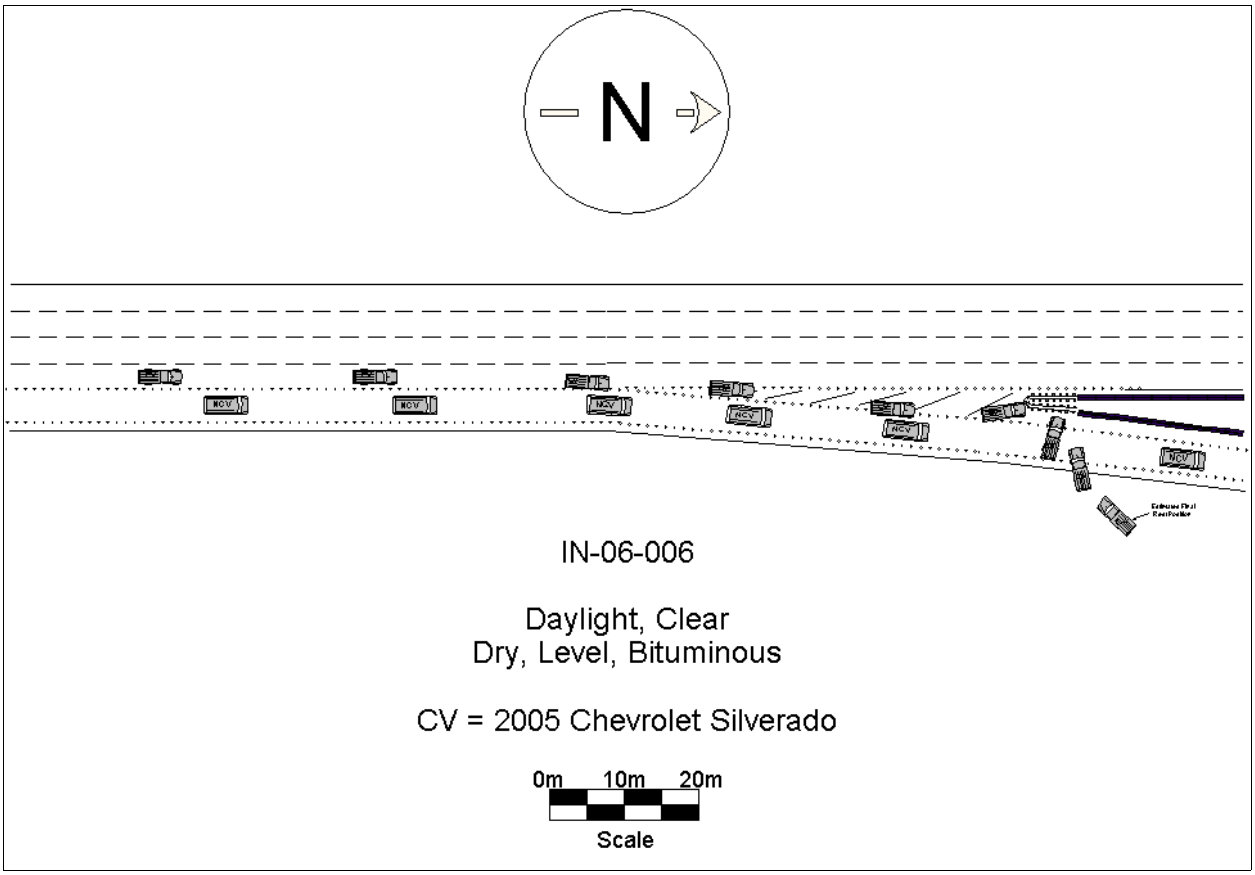
SIR Warning Lamp Status	ON
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	BUCKLED
Passenger Seat Position Switch Circuit Status	Rearward
Ignition Cycles At Non-Deployment	6265
Ignition Cycles At Investigation	6269
Maximum SDM Recorded Velocity Change (MPH)	-5.28
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	225
Crash Record Locked	No
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No

Figure 21: Case vehicle's System Status at Non-Deployment



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.31	-0.62	-0.62	-0.93	-1.24	-1.24	-1.24	-1.55	-1.86	-2.17	-2.48	-2.79	-3.10	-3.41	-4.03

Figure 22: Case vehicle's Non-Deployment SDM Recorded Velocity Change graph


N
IN-06-006
Daylight, Clear
Dry, Level, Bituminous
CV = 2005 Chevrolet Silverado
0m 10m 20m
Scale