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ON-SITE ROLLOVER INVESTIGATION

CASE NUMBER - IN-06-031

LOCATION - TEXAS

VEHICLE - 2005 CHEVROLET SILVERADO CREW CAB PICKUP TRUCK

CRASH DATE - July 2006

Submitted:

January 10, 2007

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Contract Number: DTNH22-01-C-07002

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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

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15. <i>Supplementary Notes</i> On-site rollover investigation involving a 2005 Chevrolet Silverado crew cab pickup truck equipped with manual safety belts and dual front advanced air bag system.					
16. <i>Abstract</i> This report covers an on-site rollover investigation that involved a 2005 Chevrolet Silverado crew cab pickup truck (case vehicle) and a 2001 Ford Expedition XLT (other vehicle), which were involved in an intersection collision. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features and rolled over following the initial impact, and one of the case vehicle's five occupants [a 16-year-old, male] sustained a police-reported "A" (incapacitating) injury as a result of the crash. The case vehicle was northbound in the northbound lane of a two-lane city street. The Ford was westbound in the left through lane of a seven-lane, divided city street also approaching the intersection. The intersection was uncontrolled for westbound/eastbound traffic. The two vehicles entered the intersection and the front of the Ford impacted the right side of case vehicle (event 1). The case vehicle rotated clockwise, the Ford rotated rapidly clockwise and the Ford's left rear corner impacted the back right corner of the case vehicle (event 2). The case vehicle continued to rotate clockwise and traveled toward the northwest corner of the intersection where it rolled over one quarter roll onto its left side (event 3) sustaining only minor damage. It came to final rest heading northeast. The Ford rotated clockwise and came to rest in the westbound lanes in the northwest leg of the intersection heading east. The 16-year-old male and a 17-year-old-male were both riding in the pickup bed and were ejected during the crash. They were both transported by ambulance to a hospital. The restrained driver and unrestrained back left passenger were not injured. The unrestrained front center passenger sustained a police reported "B" (non-incapacitating-evident) injury and was transported by ambulance to a hospital.					
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This on-site investigation was brought to NHTSA's attention on or before September 6, 2006 by NASS CDS/GES sampling activities. This crash involved a 2005 Chevrolet Silverado C1500 crew cab pickup truck (case vehicle) and a 2001 Ford Expedition XLT (other vehicle), which were involved in an intersection collision. The crash occurred in July 2006, at 8:30 p.m., in Texas and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features and rolled over following the initial impact, and one of the case vehicle's five occupants [a 16-year-old, (unknown race and ethnic origin) male] sustained a police-reported "A" (incapacitating) injury as a result of the crash. This contractor inspected the case vehicle on October 11, 2006 and inspected the scene on October 12, 2006. This contractor was unable to contact the case vehicle's driver or occupants for an interview and was unable to locate the Ford. This report is based on the police crash report, scene inspection, case vehicle inspection, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was northbound in the northbound lane of a two-lane city street. The case vehicle was approaching a stop sign at a four leg intersection at an EDR recorded speed of 84 km.p.h. (52 m.p.h). The Ford was westbound in the left through lane of a seven-lane divided city street also approaching the intersection. The intersection was uncontrolled for westbound traffic. The police crash report indicated that the case vehicle's driver disregarded the stop sign and entered the intersection. The case vehicle's EDR data indicated that the driver applied the brakes prior to the crash. The front of the Ford impacted the right side of case vehicle (event 1). The case vehicle rotated clockwise, the Ford rotated rapidly clockwise and the Ford's left rear corner impacted the back right corner of the case vehicle (event 2). The case vehicle continued to rotate clockwise and traveled toward the northwest corner of the intersection where it rolled over one quarter roll onto its left side (event 3). The case vehicle came to final rest on its left side heading northeast on the northwest corner of the intersection. The Ford rotated clockwise and came to rest in the westbound lanes in the northwest leg of the intersection heading east.

The CDCs for the case vehicle were determined to be **02-RZEW-3** (60 degrees) for the right side impact (event 1) with the front of the Ford, **06-BZEW-1** for the back impact with the back left of the Ford (event 2) and **00-LYAO-2** for the rollover (event 3). The maximum residual crush for the right side impact was measured as 40 centimeters (15.7 inches) occurring 17 centimeters (6.7 inches) rear of C₄. The WinSMASH reconstruction program, missing vehicle algorithm, calculated the case vehicle's Total, Longitudinal, and Lateral Delta Vs for the right side impact (i.e., highest severity impact) respectively as: 14.0 km.p.h. (8.7 m.p.h.), -7.0 km.p.h. (4.3 m.p.h.), and -12.1 km.p.h. (-7.5 m.p.h.). This was a borderline reconstruction and the results appeared low. In addition, based on the damage to the left side of the case vehicle, the severity of the rollover was determined to be minor. The case vehicle was towed due to damage.

The Ford was not inspected, so no CDC could be assigned or extent of damage determined. The WinSMASH reconstruction program, missing vehicle algorithm, calculated the Ford's Total, Longitudinal, and Lateral Delta Vs respectively as: 16.0 km.p.h. (9.9 m.p.h.), -13.9 km.p.h. (8.6

m.p.h.), and 8.0 km.p.h. (5.0 m.p.h.). This was a borderline reconstruction and the results appeared low. The Ford was towed due to damage.

Two of the case vehicle's passengers were riding in the pickup bed. Their position in the bed is not known, but it is likely they were sitting down at the front of the pickup bed. They were not restrained. There were no seats or restraints in the pickup bed. Both passengers were ejected from the pickup bed during the crash; however, it is not known if the ejection occurred prior to the rollover. Both passenger's were reported transported by ambulance to a hospital. One of the pickup bed passengers [16-year-old, (unknown race and ethnic origin) male] sustained a police reported "A" (incapacitating) injury. The other pickup bed passenger [17-year-old, (unknown race and ethnic origin) male] sustained a police reported "B" (non-incapacitating-evident) injury. The unrestrained front center passenger [15-year-old, (unknown race and ethnic origin) female] sustained a police reported "B" (non-incapacitating-evident) injury and was transported by ambulance to a hospital. The restrained driver [17-year-old, (unknown race, Hispanic) male], and unrestrained back left passenger [18-year-old, (unknown race and ethnic origin) male] were reported as not injured and not transported from the scene. The nature and extent of the injuries to the three injured passengers could not be determined. The police reported treating hospital had no record of treatment for these individuals.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a two-way city street, traversing in a north and south direction. The case vehicle was approaching a four-leg intersection. The case vehicle's roadway had one northbound travel lane 3.6 meters (11.8 feet) in width and one southbound travel lane 3.2 meters (10.5 meters). The case vehicle's roadway pavement markings consisted of a solid yellow center line and faded, solid white stop bar. The case vehicle's roadway was controlled by a stop sign. The trafficway on which the Ford was traveling was a seven-lane, divided, city street, traversing in an east and west direction. The Ford was approaching the same intersection. The Ford's approach roadway was curved left and had three westbound through lanes and a left turn lane. The average lane width was 3.3 meters (10.6 feet). The westbound lanes were divided from the three eastbound through lanes by a raised, curbed median. The average width of the eastbound through lanes was 3.4 meters (11.2 feet) and the median was 1.1 meter (3.6 feet) in width. The Ford's roadway was uncontrolled. The Ford's roadway pavement markings consisted of solid white edge line, broken white lane lines, solid white left turn lane line and solid yellow median line. The speed limit for the case vehicle was 48 km.p.h. (30 m.p.h.). The speed limit for the Ford was 72 km.p.h. (45 m.p.h.). At the time of the crash the light condition was daylight, the atmospheric condition was clear and the roadway pavement was dry, level bituminous for the case vehicle and dry concrete with a negative 4.4% grade for the Ford. Traffic density at the time of the crash is unknown and the site of the crash is rural. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was northbound in the northbound lane (**Figure 1** below) approaching the intersection at an EDR recorded speed of 84 km.p.h. (52 m.p.h). The case vehicle's driver was intending to continue northbound. The Ford was westbound in the left through lane also approaching the intersection (**Figure 2** below). The Ford's driver was intending

Crash Circumstances (Continued)

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to continue westbound. The police crash report indicated that the case vehicle's driver disregarded the stop sign and entered the intersection. The case vehicle's EDR data indicated that the driver applied the brakes prior to the crash. The crash occurred within the intersection.

Crash: The front of the Ford impacted the right side of case vehicle [Figure 3, (event 1)]. The case vehicle rotated clockwise, the Ford rotated rapidly clockwise and the Ford's left rear corner impacted the back right corner of the case vehicle [Figure 4 below, (event 2)]. The case vehicle continued to rotate clockwise and traveled toward the northwest corner of the intersection where it rolled over one quarter roll onto its left side [Figure 5 below, (event 3)].

Post-Crash: The case vehicle traveled off the roadway and came to final rest on its left side heading northeast on the northwest corner of the intersection (Figure 2). The Ford rotated clockwise and came to rest in the westbound lanes in the northwest leg of the intersection heading east (Figure 2).

CASE VEHICLE

The 2005 Chevrolet Silverado was a rear wheel drive, four-door, crew cab pickup truck (VIN: 2GCEC13T651-----). equipped with a 5.3L, 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 usage sensors. The front center seat position was equipped with a two-point lap belt. The back seat was equipped with a split bench seat with folding back and adjustable head restraints in the outboard positions; three-point, lap-and-



Figure 1: Approach of case vehicle northbound to intersection, red arrow shows area of initial impact, yellow arrow shows area of rollover



Figure 2: Approach of Ford westbound to area of impact, blue arrow shows area of Ford's final rest, red arrow shows area of case vehicle final rest



Figure 3: Damage to case vehicle's right side from impact with front of Ford

shoulder safety belt systems and was equipped with a LATCH system for securing child safety seats. In addition, the manufacturer of this vehicle has certified that it meets the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The case vehicle's wheelbase was 365 centimeters (143.7 inches). The case vehicle's odometer reading at the time of inspection was unknown because the vehicle was equipped with an electronic odometer.

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 front of the Ford (event 1) involved the right side of the vehicle. The right front door, right rear door and the front of the truck bed were crushed inward. The direct damage began 65 centimeters (25.6 inches) rear of the right front axle and extended 228 centimeters (89.8 inches) along the right side of the vehicle. Crush measurements were taken at the mid-door level. The maximum residual crush was measured as 40 centimeters (15.7 inches) occurring 17 centimeters (6.7 inches) rear of C₄ (**Figure 6** below). The table below shows the case vehicle's right side crush profile.



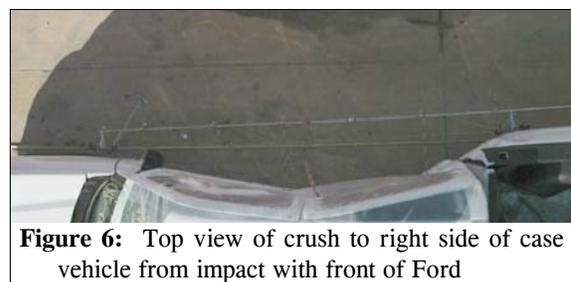
Figure 4: Damage to back bumper and tailgate from secondary impact with Ford



Figure 5: Overview of minor rollover damage to left side a case vehicle's cab

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	228	40	251	3	21	35	35	26	2	-7	-2
in		89.8	15.7	98.8	1.2	8.3	13.8	13.8	10.2	0.8	-2.8	-0.8

The case vehicle’s back impact with the left rear corner of the Ford (event 2) involved the back bumper and tailgate. The direct damage began at the back right bumper corner and involved the right portion of the tailgate. The rollover involved the left side of the vehicle. The direct damage involved the left fender, left side doors and pillars and the left roof side rail. There was grass jammed into the seam between the left front and left rear doors and into the front of the left rear door window frame. In addition, the left side view mirror was broken off.



The case vehicle’s right side wheelbase was shortened 3.0 centimeters (1.2 inches) and the left side wheelbase was extended 2.0 centimeters (0.8 inches). Induced damaged involved the front bumper, truck bed, tailgate, back bumper and left front door. In addition, the hood appeared to be sprung.

The recommended tire size was: P245/70R17, and the vehicle was equipped with tires of this size. The case vehicle’s tire data are shown in the table below.

Tire	Measured Pressure		Recommend Pressure		Tread Depth		Damage	Restricted	Deflated
	kpa	psi	kpa	psi	milli-meters	32 nd of an inch			
LF	186	27	241	35	7	9	None to tire, but rim scraped	No	No
RF	186	27	241	35	6	8	None	No	No
LR	200	29	241	35	6	7	Sidewall scraped, grass in bead, asphalt in rim	No	No
RR	179	26	241	35	6	7	None	No	No

Vehicle Interior: Inspection of the case vehicle’s interior (Figures 7, 8 and 9 below) revealed a hair in the top of the left front window frame and a few scuffs and dirt on the roof near the left front window and a few scuffs on the roof near the back left window. In addition, a few scuffs

were found on the left rear window. No other occupant contact evidence was found.

The case vehicle sustained several intrusions to the right side of the vehicle due to the impact with the Ford. There was 20 centimeters (7.9 inches) of right “B”-pillar intrusion and 15 centimeters (5.9 inches) of right rear door intrusion into the back right seat position, and 10 centimeters (3.9 inches) of right front door intrusion into the front right seat position. Finally, there was no evidence of compression of the energy absorbing steering column, and no deformation of the steering wheel rim was observed.

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be **02-RZEW-3 (60 degrees)** for the right side impact (event 1) with the front of the Ford, **06-BZEW-1** for the back impact with the back left of the Ford (event 2) and **00-LYAO-2** for the rollover (event 3). The WinSMASH reconstruction program, missing vehicle algorithm, was used to reconstruct the case vehicle's Delta Vs for the right side (i.e., highest severity) impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 14.0 km.p.h. (8.7 m.p.h.), -7.0 km.p.h. (4.3 m.p.h.), and -12.1 km.p.h. (-7.5 m.p.h.). The reconstruction is borderline and the results appear to be low. Based on the damage to the left side of the case vehicle, the severity of the rollover was determined to be minor. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle's driver air bag was located in the steering wheel hub and the front right passenger's air bag was located in the front of the instrument panel. Neither of these air bags deployed as a result of the crash. The case vehicle crash sensing algorithm most likely determined there was insufficient longitudinal deceleration to require their deployment.



Figure 7: Overview of case vehicle's steering wheel, windshield and instrument panel



Figure 8: Orange dots shows marks on left front roof area, arrow shows location of strand of hair embedded in left front window frame



Figure 9: Overview of left rear window and door

The download of the case vehicle's EDR was done during the vehicle inspection via direct connection to the SDM. The EDR recorded a non-deployment event. The EDR reports are presented at the end of this report (**Figures 10-13**). The System Status at Non-Deployment report shows the SIR warning lamp was recorded as off, the driver's seat belt switch circuit was recorded as buckled, the front right passenger's seat belt switch circuit was recorded as unbuckled and the passenger's seat was recorded as being in the rearward position. The maximum SDM recorded velocity change was recorded as -3.56 km.p.h. (-2.21 m.p.h.) occurring 210 milliseconds (0.140 seconds) after algorithm enable (AE). In addition, the system status report shows that the event recording was complete.

The pre-crash data graph indicates the case vehicle was traveling 84 km.p.h. (52 m.p.h.) at five seconds prior to AE. At three seconds prior to AE the brake switch is recorded as on, percent throttle is recorded as zero and vehicle speed is recorded as 79 km.p.h. (49 m.p.h.). The brake switch is recorded as on for the remaining two seconds of the pre-crash data.

CASE VEHICLE UNENCLOSED AREA PASSENGER 1 KINEMATICS

Immediately prior to the crash the case vehicle's unenclosed area passenger 1 [16-year-old, (unknown race and ethnic origin) male; unknown height and weight] was riding in the bed of the case vehicle. His location in the pickup bed is not known. However, he was likely sitting down at the front of the pickup bed. He was not restrained. There were no seats or restraints in the pickup bed.

The Ford's impact to the right side of the case vehicle caused the passenger to move to the right and he most likely impacted the right side of the pickup bed. The police crash report indicated he was ejected from the pickup bed during the crash. It is not known if the ejection occurred prior to the rollover.

CASE VEHICLE UNENCLOSED AREA PASSENGER 1 INJURIES

The police crash report indicated the passenger sustained an "A" (incapacitating) injury. The police crash report also indicated he was transported by ambulance from the scene to a hospital. The nature and extent of the passenger's injuries are not known. The police reported treating hospital had no record of treatment for this passenger.

CASE VEHICLE UNENCLOSED AREA PASSENGER 2 KINEMATICS

Immediately prior to the crash the case vehicle's unenclosed area passenger 2 [17-year-old, (unknown race and ethnic origin) male; unknown height and weight] was riding in the bed of the case vehicle. His location in the pickup bed is not known. However, he was likely sitting down at the front of the pickup bed. He was not restrained. There were no seats or restraints in the pickup bed.

The Ford's impact to the right side of the case vehicle caused the passenger to move to the right and he most likely impacted the right side of the pickup bed. The police crash report indicated he was ejected from the pickup bed during the crash. It is not known if the ejection occurred prior to the rollover.

CASE VEHICLE UNENCLOSED AREA PASSENGER 2 INJURIES

The police crash report indicated the passenger sustained an "B" (non-incapacitating-evident) injury. The police crash report also indicated he was transported by ambulance from the scene to a hospital. The nature and extent of the passenger's injuries are not known. The police reported treating hospital had no record of treatment for this passenger.

CASE VEHICLE FRONT CENTER PASSENGER KINEMATICS

Immediately prior to the crash the case vehicle's center front passenger [15-year-old, (unknown race and ethnic origin) female; unknown height and weight] was most likely seated in a upright position. Her feet were most likely on the floor. The position of her hands and arms is not known. Her seat track was adjusted to the middle position and the seat back was slightly reclined.

The front center passenger was most likely not restrained by her two-point lap belt. The police crash report indicated that the front center passenger was not restrained. Inspection of the safety belt showed signs of historic use but no evidence of loading from this crash was observed.

As a result of the case vehicle driver's pre-crash braking, the front center passenger most likely moved forward and braced against the instrument panel. The Ford's front impact to the case vehicle's right side caused the passenger to move right and forward along a path opposite the case vehicle 60 degree direction of principal force as the case vehicle decelerated longitudinally and accelerated laterally to the left. She most likely contacted the instrument panel and the right side of her body most likely impacted the intruded right front door. The case vehicle's back right impact with the Ford then most likely caused the passenger to move rearward against the front seat back. The passenger then moved to the left and toward the roof as the case vehicle rolled over onto its left side. The passenger most likely impacted the driver's right side and her head likely impacted the left roof side rail and upper window frame leaving a strand of hair deposited in the left front window frame. The front center passenger most likely came to rest on the driver. She most likely exited the case vehicle by climbing out of the broken-out, right front window. The right front door was jammed shut due to the impact.

CASE VEHICLE FRONT CENTER PASSENGER INJURIES

The police crash report indicated the front center passenger sustained an "B" (non-incapacitating-evident) injury. The police crash report also indicated she was transported by ambulance from the scene to a hospital. The nature and extent of the passenger's injuries are not known. The police reported treating hospital had no record of treatment for this passenger.

Immediately prior to the crash the case vehicle's driver [17-year-old, (unknown race, Hispanic) male; unknown height and weight] was most likely seated in a upright position with both hands on the steering wheel. He had one of his feet on the brake. His seat track was adjusted to the middle position and the seat back was slightly reclined.

The case vehicle's driver was most likely restrained by his manual, three-point, lap-and-shoulder safety belt. The EDR data recorded the driver's safety belt switch circuit as buckled.

The case vehicle driver's pre-crash braking most likely caused his safety belt retractor to lock and he moved forward into the safety belt. He was also most likely bracing against the steering wheel. The Ford's front impact to the case vehicle's right side caused the driver to move right and forward along a path opposite the case vehicle's 60 degree direction of principal force as the case vehicle decelerated longitudinally and accelerated laterally to the left and he loaded his safety belt. The case vehicle's back right impact with the Ford then most likely caused the driver to move rearward against his seat back. The driver then moved to the left and impacted the left front door with the left side of his body as the case vehicle rolled over onto its left side. In addition, the front center passenger most likely impacted the right side of the driver's body. The driver came to rest against the left front door. The front center passenger was most likely on top of him. The driver most likely exited the case vehicle by climbing out of the broken-out, right front window. The right front door was jammed shut due to the impact.

CASE VEHICLE DRIVER INJURIES

The police crash report indicated the driver was not injured and was not transported from the scene to a treatment facility.

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

Immediately prior to the crash, the back left passenger [18-year-old, (unknown race and ethnic origin) male; unknown height and weight] was most likely seated in an upright position. His feet were most likely on the floor. The position of his hands and arms is not known. The passenger's seat track was not adjustable.

The back left passenger was most likely not restrained by his three-point, lap-and-shoulder safety belt. The police crash report indicated that the back left passenger was not restrained. Inspection of the safety belt showed signs of historic use but no evidence of loading from this crash was observed.

As a result of the case vehicle driver's pre-crash braking, the back left passenger most likely moved forward and braced against the back of the driver's seat. The Ford's front impact to the case vehicle's right side caused the passenger to move right and forward along a path opposite the case vehicle's 60 direction of principal force as the case vehicle decelerated longitudinally and accelerated laterally to the left. He most likely impacted the back of the front seats and the right side of his body most likely impacted the intruded right rear door. The case vehicle's back right

impact with the Ford then most likely caused the passenger to move rearward against the seat back. The passenger then moved to the left and toward the roof as the case vehicle rolled over onto its left side and he most likely impacted the roof and the left rear door. The back left passenger most likely came to rest against the left rear door. He most likely exited the case vehicle by climbing out of the broken-out, right rear window. The right rear door was jammed shut due to the impact.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The police crash report indicated the back left passenger was not injured and was not transported from the scene to a treatment facility.

OTHER VEHICLE

The 2001 Ford Expedition was a four door, rear wheel drive, sport utility vehicle (VIN: 1FMRU15W31L-----). The Ford was equipped with driver and front right passenger redesigned air bags which deployed as a result of the impact with the case vehicle.

Exterior Damage: The Ford was not inspected. It could not be located. With no available vehicle photographs, a CDC could not be estimated and the extent of damage could not be determined. The WinSMASH reconstruction program, missing vehicle algorithm, calculated the Ford's Total, Longitudinal, and Lateral Delta Vs respectively as: 16.0 km.p.h. (9.9 m.p.h.), -13.9 km.p.h. (8.6 m.p.h.), and 8.0 km.p.h. (5.0 m.p.h.). This was a borderline reconstruction and the results appeared low. The Ford was towed due to damage.

Ford's Driver: According to the police crash report, the Ford's driver [49-year-old, White (non-Hispanic) male] was restrained by his manual, three-point, lap-and-shoulder, safety belt system. The police crash report indicated the driver sustained no injury and was not transported by ambulance to a treatment facility.

CDR File Information	
Vehicle Identification Number	2GCEC13T651*****
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	IN06031.CDR
Saved on	Wednesday, October 11 2006 at 09:55:32 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	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 preceded the recorded event.

Figure 10: Case vehicle's CDR File Information and SDM Data Limitations

-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.

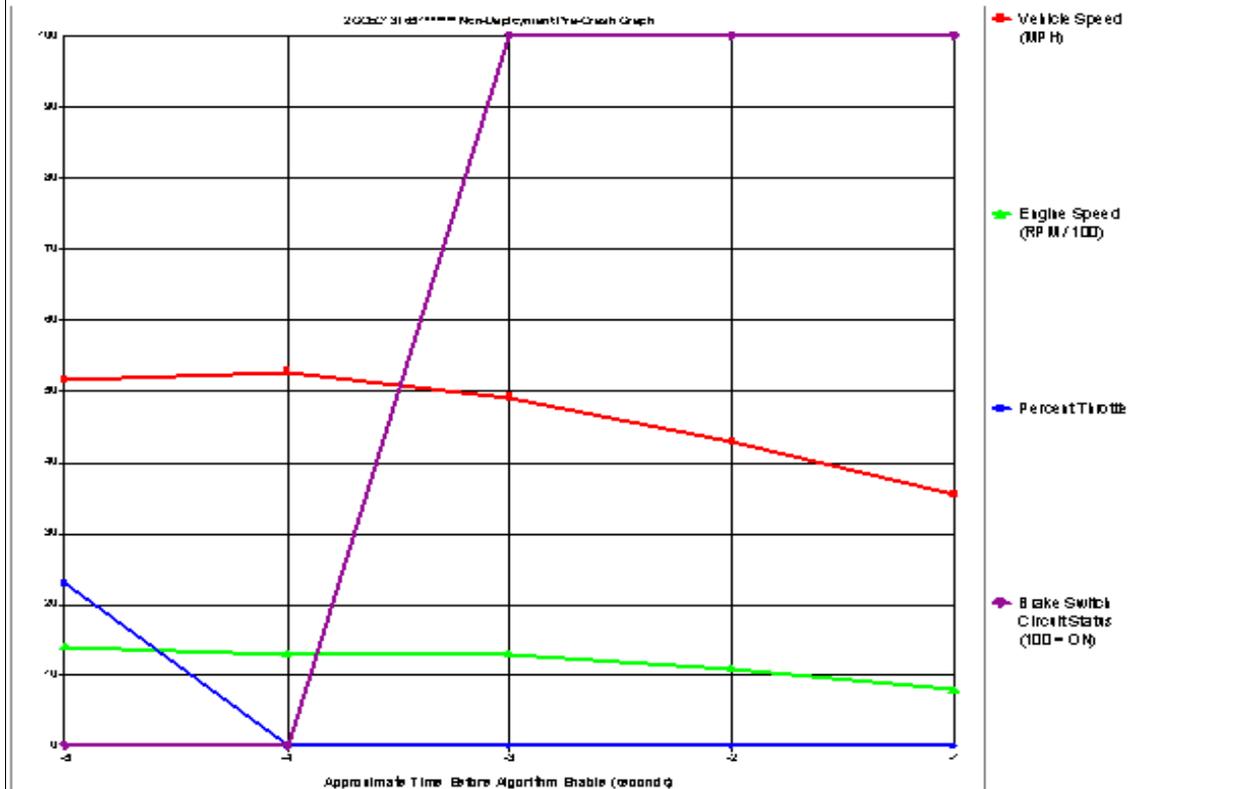
-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the vehicle's communication network, to the SDM.

-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 11: Case vehicle SDM Data Limitations continued

System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Passenger Seat Position Switch Circuit Status	Rearward
Ignition Cycles At Non-Deployment	4458
Ignition Cycles At Investigation	4459
Maximum SDM Recorded Velocity Change (MPH)	-2.21
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	210
Crash Record Locked	No
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	52	1408	23	OFF
-4	53	1344	0	OFF
-3	49	1280	0	ON
-2	43	1088	0	ON
-1	35	832	0	ON

Figure 12: Case vehicle's System Status at non-Deployment report

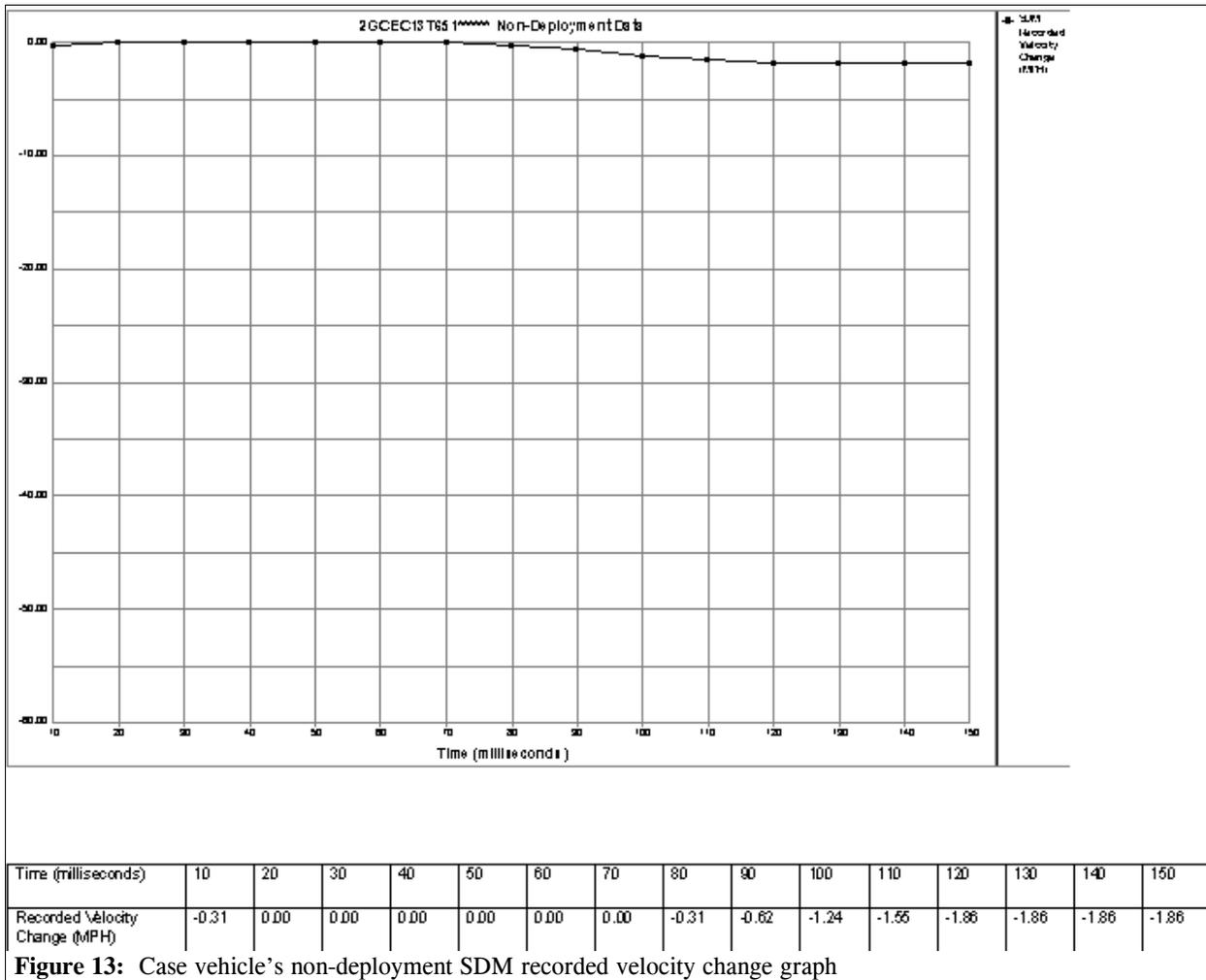


Figure 13: Case vehicle's non-deployment SDM recorded velocity change graph

