INDIANA UNIVERSITY
TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
222 West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN-04-019
LOCATION - Texas
VEHICLE - 2003 GMC SIERRA, EXTENDED CAB
CRASH DATE - May 2004

Submitted:

May 08, 2005

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

DISCLAIMERS

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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-04-019	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Certified Advanced 208-Compliant Vehicle Investigation Vehicle - 2003 GMC Sierra, Extended Cab Location - Texas		5. *Report Date:* May 08, 2005 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: May 2004 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site air bag investigation involving a 2003 GMC Sierra, 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 2003 GMC Sierra extended cab pickup truck (case vehicle),which ran-off-road and impacted a wooden utility pole. This crash is of special interest because the case vehicle was equipped with multiple Advanced Occupant Protection System (AOPS) features, including certified advanced 208-compliant air bags as well as an Event Data Recorder (EDR), and the case vehicle's driver (38 year-old, male) did not sustain any injuries as a result of the crash. The trafficway on which the case vehicle was traveling was a straight, two-way, four-lane, divided, city street, traversing in a northwest and southeast direction. The case vehicle was traveling northwest in the outside lane approaching the intersection of a median cut and a side street. A non-contact car turned left (north) across his path from the median cut into the side street. The case vehicle's driver steered right and applied the brakes. The case vehicle contacted the outside curb southeast and northwest of the intersection, departed the north side of the roadway, crossed a sidewalk, and the front right impacted an approximate 30 centimeter (12 inches) diameter wooden utility pole causing the driver's air bag to deploy. The driver's seat track was located between its middle and forward position, the seat back was slightly reclined, and the tilt steering column was located in its middle position. The driver was restrained by his integral, three-point, lap-and-shoulder safety belt. He did not sustain any injuries and lost no work days as a result of the crash.			
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* 15	22. *Price* $6,700

Form DOT 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS IN-04-019

Page No.

Page No.

BACKGROUND IN-04-019

This on-site investigation was brought to NHTSA's attention on or about June 18, 2004 by NASS CDS/GES sampling activities. This crash involved a 2003 GMC Sierra extended cab pickup truck (case vehicle) that impacted a wooden utility pole. The crash occurred in May, 2004, at 6:23 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, including certified advanced 208 compliant air bags as well as an Event Data Recorder (EDR), and the case vehicle's driver [38-year-old, White (Hispanic) male] did not sustain any injury as a result of the crash. This contractor inspected the case vehicle and downloaded the EDR on June 28, 2004, inspected the crash scene on June 29, 2004, and interviewed the case vehicle's driver on August 10, 2004. This summary is based on the police crash report, scene and vehicle inspections, an interview with the case vehicle's driver and the owner of the property where the crash occurred, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

Crash Environment: The trafficway on which the case vehicle was traveling was a straight, two-way, four-lane, divided, city street, traversing in a northwest and southeast direction. Each travel direction contained two travel lanes and was divided by a raised, curbed median containing grass and trees. There were also cuts in the median to allow access to adjacent residential streets. The case vehicle's approach to the crash location was uncontrolled and the speed limit was 56 km.p.h. (35 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, traffic polished concrete. Traffic density was moderate and the site of the crash was urban residential.

Pre-Crash: The case vehicle was traveling northwest in the outside lane approaching the intersection of a median cut and a side street, and the driver was intending to continue northwestbound. The case vehicle driver stated that he steered right and applied the brakes to avoid a car that turned left (north) across his path from the median cut into the side street. The case vehicle departed the north side of the roadway and crossed a sidewalk. The crash occurred on the north side of the roadway in the yard of a residential property.

Crash: The front right corner of the case vehicle impacted a wooden utility pole causing the case vehicle's driver air bag to deploy. The case vehicle's front right air bag did not deploy because there was no front right occupant in the case vehicle.

Post-Crash: As a result of the impact, the case vehicle fractured the utility pole, rotated clockwise a few degrees and came to final rest against the utility pole facing northwest.

Case Vehicle: The 2003 GMC Sierra was a two-door, rear wheel drive, extended cab pickup truck (VIN: 2GTEC19V531------) equipped with four wheel, anti-lock brakes; dual stage driver and front right passenger air bags, front right air bag suppression switch and front seat integrated lap and shoulder safety belt systems for the driver and front right passenger. The front right seat was also equipped with a weight sensor to detect the presence of an occupant. In addition, the case vehicle was equipped with an EDR housed within the air bag system's Sensing and Diagnostic Module (SDM).

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat position, an occupant weight pressure sensor and a seat belt tension sensor provide data to the electronic control module. The electronic control module compares the seat pressure and seat belt tension data to threshold values, determines if the front right air bag should be suppressed or enabled and communicates the decision to the air bag control module. The air bag will be suppressed when the seat pressure is at or below what a 6-year-old child in a booster seat produces or when the belt tension is above 6.8 kilograms (15 pounds). The air bag will be enabled if the seat pressure is at or above what a 46.7 kilogram (103 pound) occupant produces and the seat belt tension is below 6.8 kilograms (15 pounds).

Vehicle Exterior: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FREE-5 (0-**degrees). The WinSMASH reconstruction program could not be used to reconstruct the case vehicle's velocity change (Delta V) because the utility pole fractured. However, the data from the EDR download indicated a maximum SDM recorded velocity change of 20.66 km.p.h. (-12.84). The case vehicle was towed due to damage.

Exterior Damage: The case vehicle's impact with the utility pole involved the right corner of the front bumper, grille and the hood, as well as the right headlamp/turn lamp assembly. As the impact progressed, the utility pole engaged the right fender and the right front wheel. The right front wheel was displaced rearward 14 centimeters (5.5 inches), and the right fender was crushed back nearly to the base of the windshield. The direct damage began at the right corner of the front bumper and extended 13 centimeters (5.1 inches) along the bumper. Crush measurements were taken at the bumper and maximum crush was measured as 42 centimeters (16.5 inches) occurring at C_6. A second level of crush was measured above the bumper at C_6 due to the crush of the right fender. The measured crush at this level was 134 centimeters (52.8 inches). The average crush at C_6 was then calculated as 88 centimeters (34.6 inches). Induced damage involved the front bumper, grille, hood, windshield, right fender and right front door.

The recommended tire size was: P235/75R16 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	32nd of an inch			
LF	241	35	241	35	7	9	None	No	No
RF	0	0	241	35	7	9	None	Yes	Yes
LR	234	34	241	35	7	9	None	No	No
RR	234	34	241	35	6	8	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed no evidence of occupant contact to any interior surfaces or components. In addition, there was no evidence of compression of the

energy absorbing steering column, and no deformation of the steering wheel rim was observed.

Supplemental Restraints: The case vehicle's driver air bag was located in the steering wheel hub. 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. There was no evidence of damage during the deployment to the air bag module cover flaps or the air bag. The deployed driver's air bag was round with a diameter of about 64 centimeters (25.2 inches). The air bag was designed with two tethers, each approximately 12 centimeters (4.7 inches) in width and had two vent ports approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. In addition, there were two air bag module cover flaps.

The front right passenger air bag was located in the middle of the instrument panel. It was equipped with an air bag suppression switch that was set to the "Auto" position. The deployment of the front right air bag was properly suppressed by the case vehicle's advanced occupant protection system because there was no front right passenger in the case vehicle at the time of the crash.

Crash Data Recording: The download of the case vehicle's EDR was done during the vehicle inspection via connection to the case vehicle's diagnostic link connector. The downloaded data indicated that a non-deployment event and deployment event were recorded. In addition, the data indicated there were one or more associated events that were not recorded. The non-deployment and deployment events occurred during this crash because they occurred 0.6 seconds apart and were both recorded on the same ignition cycle. The EDR data indicated the SIR warning lamp was recorded as off and the driver's seat belt switch circuit was recorded as buckled. In addition, the maximum SDM recorded velocity change (Delta V) was recorded as -2.0 km.p.h. (-1.24 m.p.h.) for the non-deployment event occurring 157.5 milliseconds (0.1575 seconds) after algorithm enable, and 20.7 km.p.h. (-12.84 m.p.h.) for the deployment event occurring 217.5 milliseconds (0.2175 seconds) after algorithm enable. The first stage deployment criteria for the driver's air bag was met 65 milliseconds (0.065 seconds) after algorithm enable. The second stage deployment criteria for the driver's air bag was not met.

The pre-crash data indicate that the case vehicle was traveling 75.6 km.p.h. (47 mph) five seconds prior to algorithm enable, and the brake switch circuit was recorded as on for two seconds prior to algorithm enable.

Case Vehicle's Driver: Immediately prior to the crash, the case vehicle's driver [38-year-old, White (Hispanic) male; 170 centimeters and 91 kilograms (67 inches, 200 pounds)] was seated in an upright driving posture with both hands on the steering wheel and his right or left foot on the brake. The driver's seat track was located between its middle and forward position, the seat back was slightly reclined, and the tilt steering column was located in its middle position.

Based on this contractor's vehicle inspection and supported by the EDR data, the case vehicle's driver was restrained by his three-point, lap-and-shoulder safety belt system. Inspection of the safety belt assembly revealed some rippling of the shoulder belt webbing in an area of the belt consistent with usage of the safety belt in the crash.

The driver steered right and applied the brakes in a successful attempt to avoid a vehicle that turned in front of him. The case vehicle's impact with the utility pole caused the driver to move forward along a path opposite the case vehicle's 0 degree direction of principal force and locked his safety belt retractor. The driver loaded his safety belt and his face and chest most likely made contact with his deployed air bag. The driver rebounded back into his seat following the impact and remained in his seat as the vehicle came to final rest. The driver was able to exit the vehicle without assistance.

The police crash report indicated the driver sustained no injury as a result of the crash, and was not transported from the scene. The driver stated that he did not receive any treatment subsequent to the crash, and did not lose any work days as a result of the crash.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a straight, two-way, four-lane, divided, city street, traversing in a northwest and southeast direction (**Figure 1**). Each travel direction contained two travel lanes and was divided by a raised, curbed median containing grass, trees and street lamp poles. The outside of both roadways was bordered by barrier curbs and sidewalks adjacent to residential properties. There were also cuts in the median to allow access to adjacent residential streets. The outside and inside northwestbound travel lanes were 3.2 meters (10.5 feet) and 3.3 meters (10.8 feet) wide respectively while the outside and inside southeastbound travel lanes were 3.0 meters (9.8 feet) and 3.2 meters (10.5 feet) wide respectively. The roadway pavement markings consisted of single broken white lane lines. The case vehicle's approach to the crash location was uncontrolled and the speed limit was 56 km.p.h. (35 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, travel polished concrete with a coefficient of friction of approximately 0.65. Traffic density was moderate and the site of the crash was urban residential.

Figure 1: Approach of case vehicle in outside northwestbound lane; Note, arrows show first curb contact and struck utility pole (case photo #02)

Pre-Crash: The case vehicle was traveling northwest in the outside lane approaching the intersection of a median cut and a side street (**Figure 1**), and the driver was intending to continue northwestbound. The case vehicle driver steered right and braked to avoid a car that turned left (north) across his path from the median cut into a side street. The case vehicle contacted the outside curb of the roadway southeast of the side street intersection, then contacted the outside curb northwest of the intersection and departed the north side of the roadway. The case vehicle crossed a sidewalk and entered the yard of a residential property. The crash occurred on the north side of the roadway in the yard of the residential property.

Figure 2: Approach of the case vehicle to impact with the utility pole; Note, arrow shows tire scuff on curb; at white chalk mark, not the broad scuff (case photo #04)

Figure 3: Overview of the damage [each stripe on rods is 5 cm (2 in)] to the right corner of the front bumper, hood, right fender and right front wheel (case photo #21)

Crash: The case vehicle traveled over the curb and sidewalk (**Figure 2** above) on the north side of the roadway and the front right corner of the case vehicle (**Figure 3**) impacted a wooden utility pole (**Figure 4**) causing the case vehicle's driver air bag to deploy. The case vehicle's front right air bag did not deploy because there was no front right occupant in the case vehicle.

Figure 4: Close view of the damage to the struck utility pole, the pole to the left was installed post crash (case photo #10)

Post-Crash: As a result of the impact, the case vehicle fractured the utility pole, but did not break it off its base, rotated clockwise a few degrees, traveled several feet and came to final rest against the utility pole facing northwest. The final rest position of the case vehicle was not indicated on the police crash report, but this contractor's interview with the owner of the property where the crash occurred indicated that the case vehicle was still in contact with the utility pole at final rest.

CASE VEHICLE

The 2003 GMC Sierra was a two-door, rear wheel drive, extended cab pickup truck (VIN: 2GTEC19V531------) equipped with four wheel, anti-lock brakes; dual stage driver and front right passenger air bags, front right air bag suppression switch and front seat integrated lap and shoulder safety belt system for the driver and front right passenger. The front right seat was also equipped with a weight sensor to detect the presence of an occupant. In addition, the case vehicle was equipped with an EDR housed within the air bag system's SDM.

The various sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity to determine the front air bag inflation level appropriate for the severity of the crash. For the front right seat position, an occupant weight pressure sensor and a seat belt tension sensor provide data to the electronic control module. The electronic control module compares the seat pressure and seat belt tension data to threshold values, determines if the front right air bag should be suppressed or enabled and communicates the decision to the air bag control module. The air bag will be suppressed when the seat pressure is at or below what a 6-year-old child in a booster seat produces or when the belt tension is above 6.8 kilograms (15 pounds). The air bag will be enabled if the seat pressure is at or above what a 46.7 kilogram (103 pound) occupant produces and the seat belt tension is below 6.8 kilograms (15 pounds).

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's impact with the utility pole involved the right corner of the front bumper, grille and the hood, as well as the right headlamp/ turn lamp assembly (**Figure 5**). As the impact progressed, the utility pole engaged the right fender and the right front wheel. The right front wheel was crushed rearward into the back of the wheelhouse, which buckled the cowl, fractured the windshield and deformed the right front door. The right fender was crushed back nearly to the base of the windshield.

The direct damage began at the right corner of the front bumper and extended 13 centimeters (5.1 inches) along the bumper. Crush measurements were taken at the bumper and maximum crush was measured as 42 centimeters (16.5 inches) occurring at C_6 (**Figure 6**). A second level of crush was measured above the bumper at C_6 due to the crush of the right fender. The measured crush at this level was 134 centimeters (52.8 inches). The average crush at C_6 was then calculated as 88 centimeters (34.6 inches). The table below shows the case vehicle's final crush profile

Figure 5: Close view of damage to right corner of front bumper, the hood, right fender and right front wheel (case photo #23)

Figure 6: Right side view of crush profile to case vehicle's front bumper prior to adjustment of baseline placement (case photo #20)

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	13	134	162	0	0	1	17	16	88	75	0
in		5.1	52.8	63.8	0.0	0.0	0.4	6.7	6.3	34.6	29.5	0.0

The case vehicle's wheelbase was reduced 14 centimeters (16.5 inches) on the right side and extended 5 centimeters (2 inches) on the left side. Induced damage involved the front bumper, grille, hood, windshield, right fender and right front door..

The recommended tire size was: P235/75R16 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	32nd of an inch			
LF	241	35	241	35	7	9	None	No	No
RF	0	0	241	35	7	9	None	Yes	Yes
LR	234	34	241	35	7	9	None	No	No
RR	234	34	241	35	6	8	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed no evidence of occupant contact to any interior surfaces or components (**Figure 7**). There were a few dark smears on the driver's air bag, but these did not appear to be related to occupant contact. In addition, there was no evidence of compression of the energy absorbing steering column, and no deformation of the steering wheel rim was observed **(Figure 8).**

Figure 7: Overview of steering wheel, air bag module flaps and left instrument panel (case photo #28)

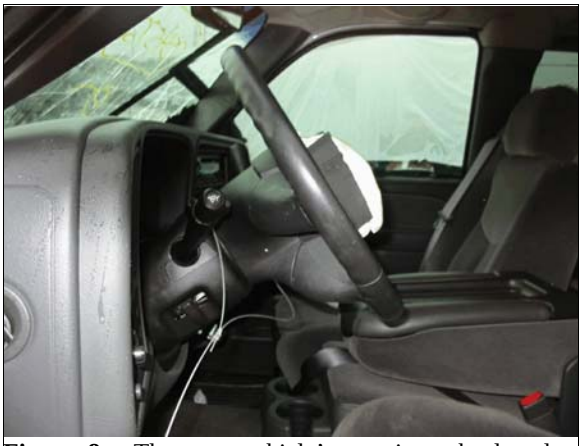


Figure 8: The case vehicle's steering wheel and steering column (case photo #27)

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **12-FREE-5** (**0**-degrees). The WinSMASH reconstruction program could not be used to reconstruct the case vehicle's velocity change (Delta V) because the utility pole fractured. Yielding object situations such as this are out-of-scope of the WinsSMASH program. However, the data from the EDR download indicated a maximum SDM recorded velocity change of 20.66 km.p.h. (-12.84). The case vehicle was towed due to damage.

Figure 9: Case vehicle's driver air bag (case photo #29)

Figure 10: Case vehicle's driver air bag vent ports (case photo #30)

Figure 11: Overview of the right instrument panel and location of front right air bag (case photo #40)

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with certified advanced 208-compliant air bags at the driver and front right passenger positions. The driver's air bag deployed as a result of the case vehicle's impact with the wooden utility pole.

The case vehicle's driver air bag was located in the steering wheel hub. 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. There was no evidence of damage during the deployment to the air bag module cover flaps or the air bag. The deployed driver's air bag (**Figure 9**) was round with a diameter of approximately 64 centimeters (25.2 inches). The air bag was designed with two tethers, each approximately 12 centimeters (4.7 inches) in width and had two vent ports (**Figure 10**), each approximately 3 centimeters (1.2 inches) in diameter, located at the 11 and 1 o'clock positions. The module cover (**Figure 7** above) consisted of asymmetrical "I"-configuration cover flaps constructed of medium weight, pliable vinyl. Each flap was 14.5 centimeters (5.7 inches) in width at the top, 10 centimeters (3.9 inches) in width at the bottom and 12 centimeters (4.7 inches) in height along the center tear seam. The distance between the mid-center of the driver's seat back, as positioned at the time of the vehicle inspection, and the front surface of the air bag fabric at full excursion was 45 centimeters (17.7 inches). Inspection of the air bag fabric revealed no evidence of occupant contact. There were a few dark smears on the air bag, but they appeared to be due to post-impact handling of the air bag.

The front right passenger air bag was located in the middle of the instrument panel (**Figure 11** above). It was equipped with an air bag suppression switch that was set to the "Auto" position (**Figure 12**). The deployment of the front right air bag was properly suppressed by the case vehicle's advanced occupant protection system because there was no front right passenger in the case vehicle at the time of the crash.

Figure 12: Case vehicle's front right air bag suppression switch (case photo #39)

CRASH DATA RECORDING

The download of the case vehicle's EDR was done during the vehicle inspection via connection to the case vehicle's diagnostic link connector. The EDR reports for the downloaded data are presented at the end of this report (**Figures 13-18**). The downloaded data indicated that a non-deployment event and deployment event were recorded. In addition, the data indicated there were one or more associated events that were not recorded. The system status reports for the non-deployment event (**Figure 13** below) and deployment event (**Figure 16** below) show that both events occurred during this crash because they occurred 0.6 seconds apart and were both recorded on the same ignition cycle. The system status reports also show that the SIR warning lamp was recorded as off and the driver's seat belt switch circuit was recorded as buckled. In addition, the maximum SDM recorded velocity change (Delta V) was recorded as -2.0 km.p.h. (-1.24 m.p.h.) for the non-deployment event occurring 157.5 milliseconds (0.1575 seconds) after algorithm enable, and 20.7 km.p.h. (-12.84 m.p.h.) for the deployment event occurring 217.5 milliseconds (0.2175 seconds) after algorithm enable. Lastly, the pre-crash data indicate that the case vehicle was traveling 75.6 km.p.h. (47 mph) five seconds prior to algorithm enable, and the brake switch circuit was recorded as on for two seconds prior to algorithm enable.

The System Status at Deployment report (**Figure 16** below) shows that the first stage deployment criteria for the driver's air bag was met 65 milliseconds (0.065 seconds) after algorithm enable, and the second stage deployment criteria for the driver's air bag was not met. In addition, the system status report indicates that multiple events are associated with the report, but one or more were not recorded. The evidence observed during this contractor's scene inspection indicated that the case vehicle sustained two curb contacts prior to the utility pole impact. It appears that the curb contacts were sufficient enough to activate the case vehicle's crash sensing algorithm. The time between the non-deployment and deployment events (i.e., 0.6 seconds) shown on the System Status at Deployment report (**Figure 16** below) indicates the second curb contact was recorded as the non-deployment event.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's driver [38-year-old, White (Hispanic) male; 170 centimeters and 91 kilograms (67 inches, 200 pounds)] was seated in an upright driving posture with both hands on the steering wheel and his right or left foot on the brake. The driver's seat track was located between its middle and forward position, the seat back was slightly reclined, and the tilt

steering column was located in its middle position.

Based on this contractor's vehicle inspection and supported by the EDR data, the case vehicle's driver was restrained by his three-point, lap-and-shoulder safety belt system. Inspection of the safety belt assembly revealed some rippling of the shoulder belt webbing in an area of the belt consistent with usage of the safety belt in the crash.

The driver steered right and applied the brakes in an attempt to avoid a vehicle that turned left in front of him. The case vehicle's contacts with the outside curbs of the roadway southeast and northwest of the side street intersection probably did not alter the driver's posture prior to the utility pole impact; however, one or both contacts may have locked his safety belt retractor. The case vehicle's front right impact with the utility pole caused the driver to move forward along a path opposite the case vehicle's 0 degree direction of principal force and locked his safety belt retractor. The driver loaded his safety belt and his face and chest most likely made contact with his deployed air bag. The driver rebounded back into his seat following the impact and remained in his seat as the vehicle came to final rest. The driver was able to exit the vehicle without assistance.

CASE VEHICLE DRIVER INJURIES

The police crash report indicated the driver sustained no injury as a result of the crash, and was not transported from the scene. The driver stated that he did not receive any treatment subsequent to the crash, and did not lose any work days as a result of the crash.

2GTEC19V531xxxxxx System Status At Non-Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Non-Deployment	1705
Ignition Cycles At Investigation	1715
Maximum SDM Recorded Velocity Change (MPH)	-1.24
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	157.5
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.31	-0.31	-0.31	-0.31	0.00	0.00	-0.31	-0.62	-0.62	-0.62	-0.62	-0.62	-0.62	-0.62	-0.93

PRE-CRASH DATA				
Seconds Before AE	**Vehicle Speed (MPH)**	**Engine Speed (RPM)**	**Percent Throttle**	**Brake Switch Circuit Status**
-5	47	1920	13	OFF
-4	47	1920	29	OFF
-3	48	1920	18	OFF
-2	45	1664	0	ON
-1	32	1152	0	ON

Figure 13: Case vehicle's System Status at Non-Deployment report

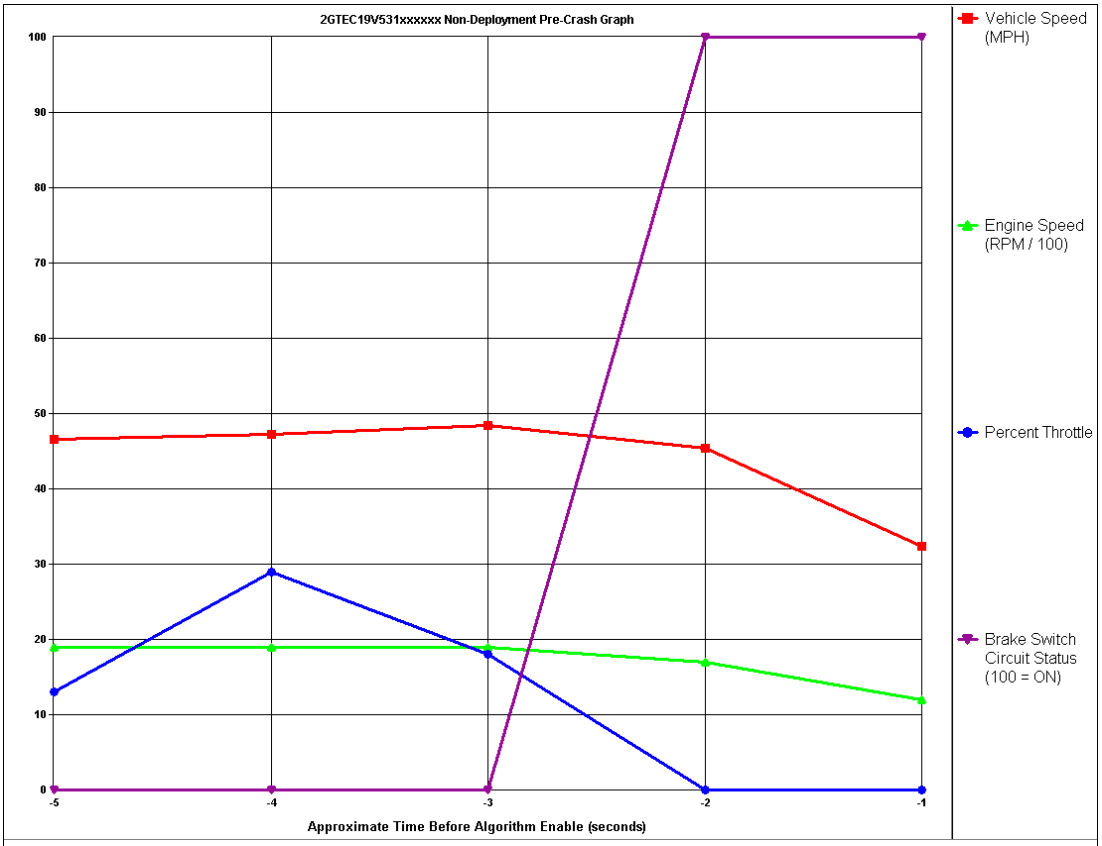


Figure 14: Case vehicle's Non-Deployment Pre-Crash Graph

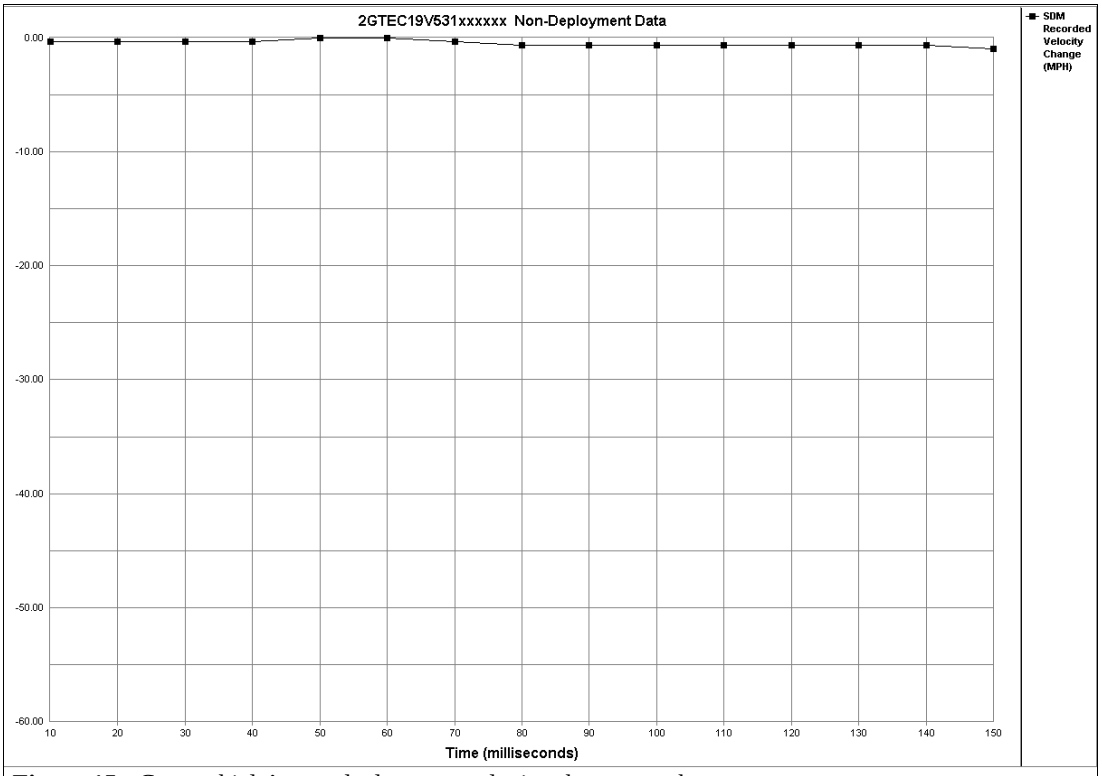


Figure 15: Case vehicle's non deployment velocity change graph

2GTEC19V531xxxxxx System Status At Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Deployment	1705
Ignition Cycles At Investigation	1715
Maximum SDM Recorded Velocity Change (MPH)	-12.84
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	217.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	65
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Time Between Non-Deployment And Deployment Events (sec)	.6
Frontal Deployment Level Event Counter	1
Event Recording Complete	Yes
Multiple Events Associated With This Record	Yes
One Or More Associated Events Not Recorded	Yes

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.93	-1.55	-1.86	-2.48	-3.41	-4.34	-4.96	-5.89	-6.82	-8.06	-8.37	-9.30	-10.54	-11.16	-11.47

PRE-CRASH DATA				
Seconds Before AE	**Vehicle Speed (MPH)**	**Engine Speed (RPM)**	**Percent Throttle**	**Brake Switch Circuit Status**
-5	47	1920	13	OFF
-4	47	1920	29	OFF
-3	48	1920	18	OFF
-2	45	1664	0	ON
-1	32	1152	0	ON

Figure 16: Case vehicle's System Status at Deployment report

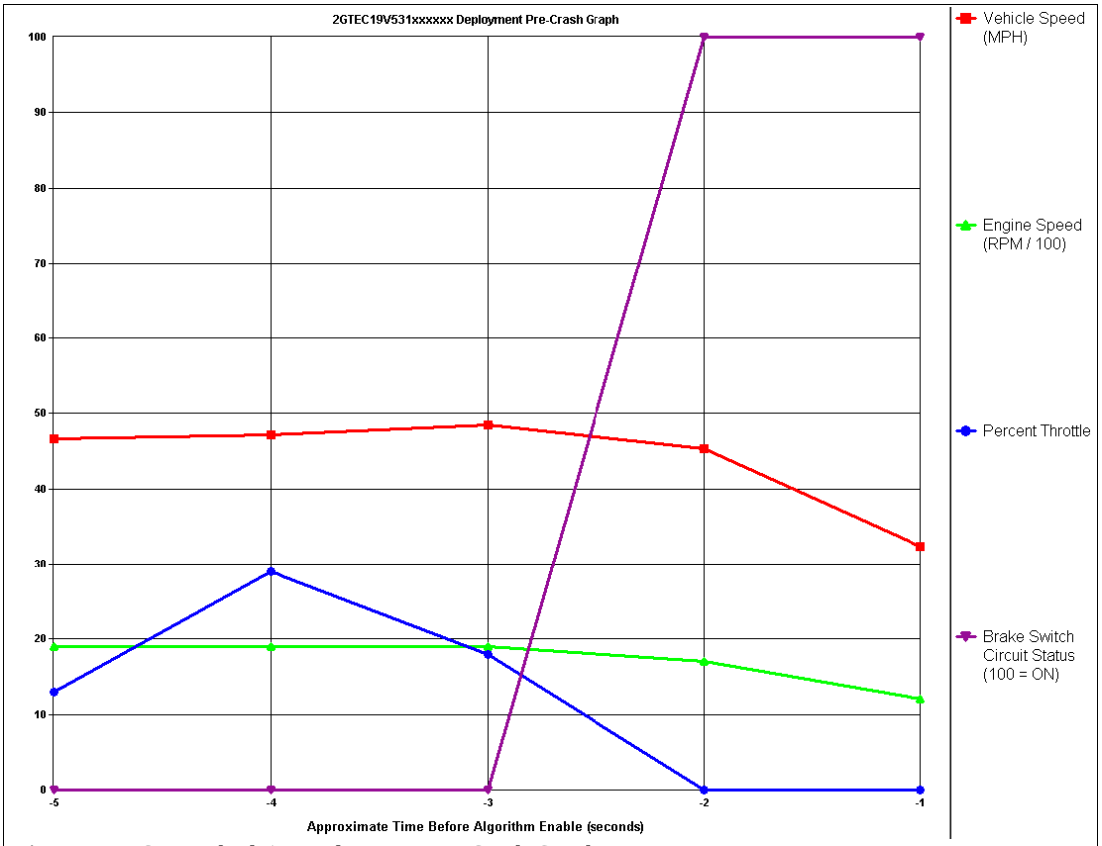


Figure 17: Case vehicle's Deployment Pre-Crash Graph

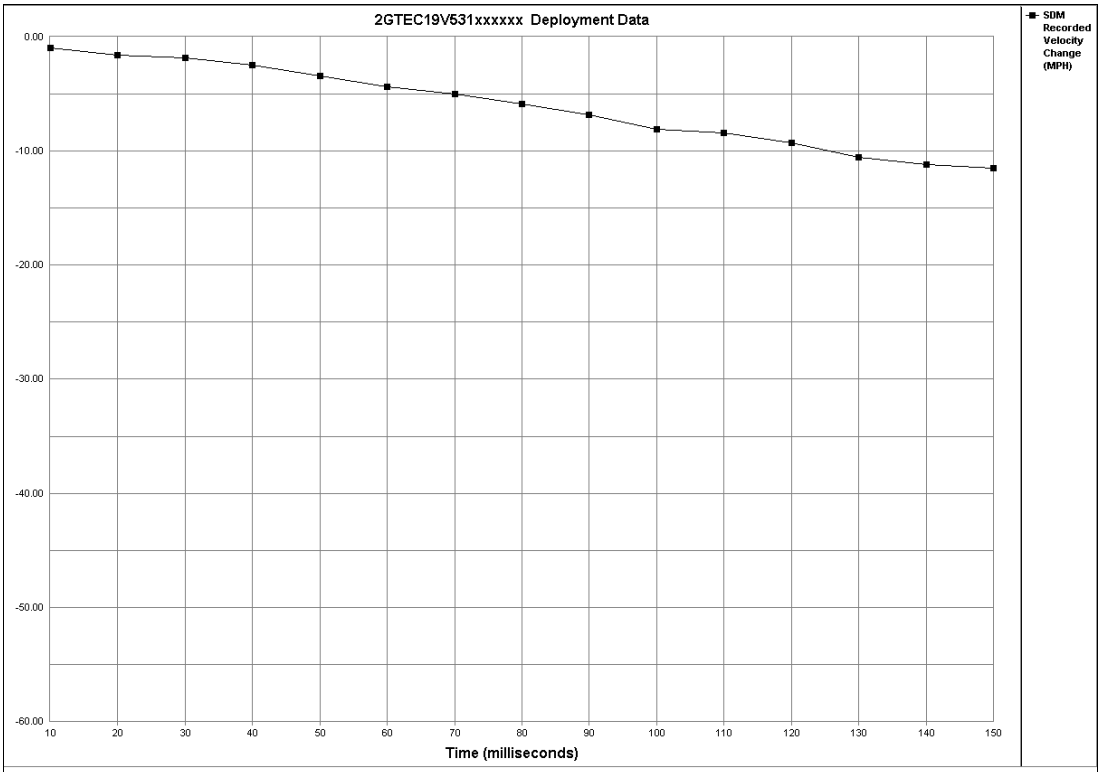
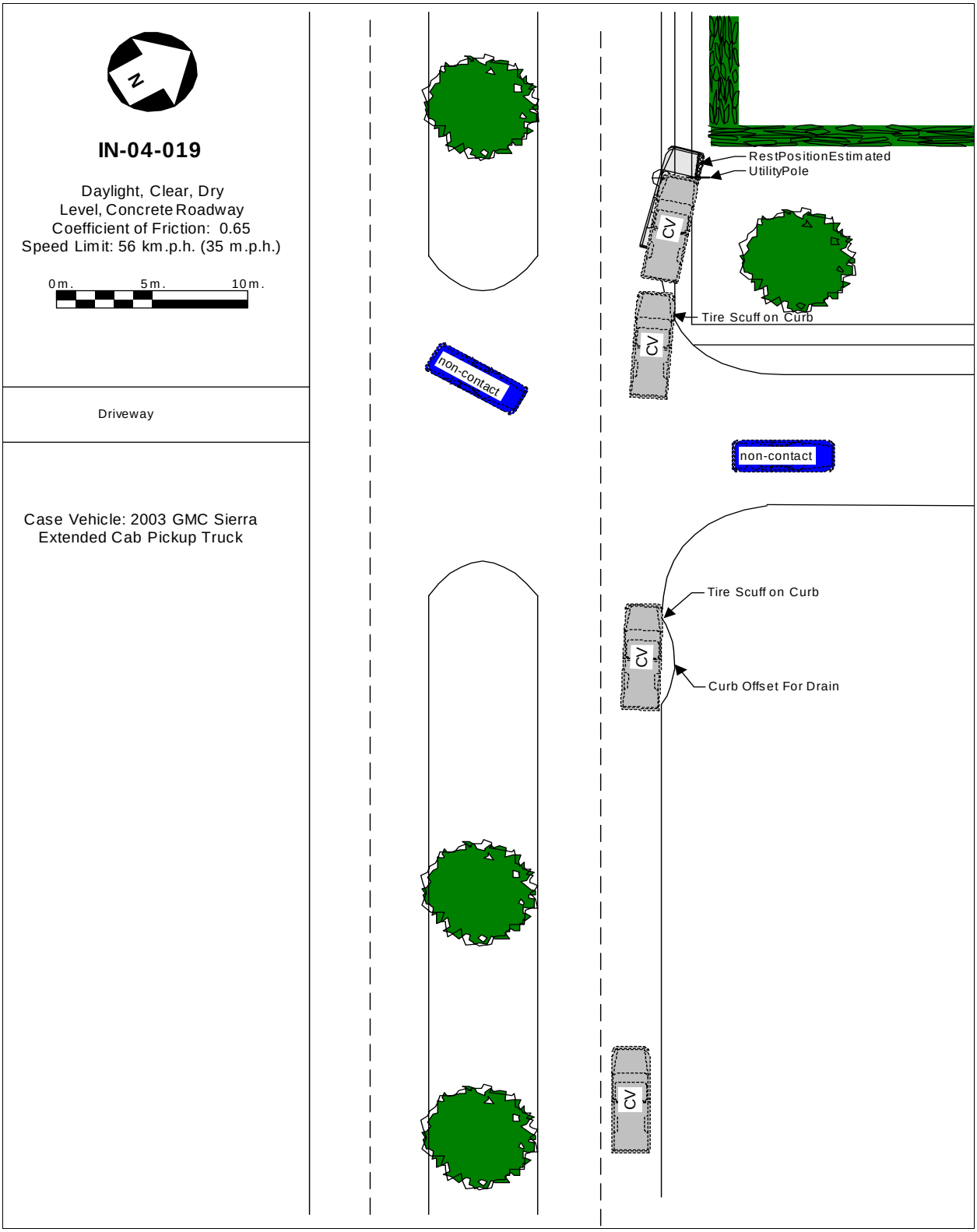


Figure 18: Case vehicle's deployment velocity change graph


N
IN-04-019
Daylight, Clear, Dry
Level, Concrete Roadway
Coefficient of Friction: 0.65
Speed Limit: 56 km.p.h. (35 m.p.h.)
0m. 5m. 10m.
Driveway
Case Vehicle: 2003 GMC Sierra
Extended Cab Pickup Truck
non-contact
RestPositionEstimated
UtilityPole
CV
Tire Scuff on Curb
CV
non-contact
Tire Scuff on Curb
CV
Curb Offset For Drain
CV