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ON-SITE ADVANCED OCCUPANT PROTECTION SYSTEM INVESTIGATION

CASE NUMBER - IN-04-020
LOCATION - TEXAS
VEHICLE - 2004 GMC ENVOY
CRASH DATE - May 2004

Submitted:

August 17, 2005
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Contract Number: DTNH22-01-C-07002

Prepared for:

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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

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15. *Supplementary Notes*
On-site air bag investigation involving a 2004 GMC Envoy with integral, three-point manual safety belts and dual front advanced air bag system.

16. *Abstract*
This report covers an on-site investigation of an air bag non-deployment crash that involved a 2004 GMC Envoy (case vehicle),which was struck by a hit-and-run vehicle and ran-off-road and impacted a metal luminaire pole and rolled over. This crash is of special interest because the case vehicle was equipped with an Advanced Occupant Protection System (AOPS), an Event Data Recorder (EDR) and the case vehicle's driver (35-year-old, female) sustained a police reported "B" (non-incapacitating-evident) injury as a result of the crash. The case vehicle was traveling east in the center lane of a six lane, divided interstate highway. A car pulled out from behind the case vehicle and began to pass it on the left. The car then entered the case vehicle's travel lane and impacted the case vehicle on the left rear door. The case vehicle's driver steered right and the case vehicle began to rotate clockwise and traveled across the outside travel lane and departed the south side of the roadway. The case vehicle's left fender impacted a metal luminaire pole and broke it off its base. The case vehicle then rolled over, driver side leading, one-and-one-half times (six quarter turns) and came to rest on its top facing south. The case vehicle was equipped with dual stage, driver and front right passenger air bags. Neither of these air bags deployed as a result of the crash. The EDR data indicated that the case vehicle's longitudinal deceleration during the crash was not sufficient to require air bag deployment. The case vehicle driver was restrained by her integral, three-point, lap-and-shoulder safety belt system. As the case vehicle rolled over, the driver contacted her head on the intruding roof and sustained a cervical strain. In addition, she sustained a laceration on her right elbow due to flying glass particles. The driver was able to exit the case vehicle under her own power. The driver was transported by ambulance to a local hospital and was treated and released.

17. *Key Words* Advanced Air Bag Deployment	Motor Vehicle Traffic Crash Injury Severity	18. *Distribution Statement* General Public	
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BACKGROUND

This on-site investigation was brought to NHTSA's attention on or about June 8, 2004 by NASS GES sampling activities. This crash involved a 2004 GMC Envoy sport utility vehicle (case vehicle) that was struck by a hit-and-run vehicle, departed the roadway, struck a metal luminaire pole and rolled over. The crash occurred in May, 2004, at 9:13 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 an Advanced Occupant Protection System (AOPS), an Event Data Recorder (EDR), and the case vehicle's driver [35-year-old, Black (non-Hispanic) female] sustained a police reported "B" (non-incapacitating-evident) injury as a result of the crash and her air bag did not deploy. 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 July 7, 2004. This report is based on the police crash report, scene and vehicle inspections, an interview with the case vehicle driver, occupant kinematic principles and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling east in the center lane of a six lane, divided interstate highway. A car pulled out from behind the case vehicle and began to pass it on the left. The car then entered the case vehicle's travel lane and impacted the case vehicle on the left rear door. The case vehicle's driver steered right and the case vehicle began to rotate clockwise and traveled across the outside travel lane and departed the south side of the roadway. The case vehicle's left fender impacted a metal luminaire pole and broke it off its base, and the vehicle began to rollover, driver side leading. The case vehicle rolled over one-and-one-half times (six quarter turns) across an entrance ramp and adjacent service roadway and came to rest on its top across both lanes of the service roadway facing south. The case vehicle was equipped with dual stage, driver and front right passenger air bags. Neither of these air bags deployed as a result of the crash. The EDR data indicated that the case vehicle's longitudinal deceleration during the crash was not sufficient to require air bag deployment. At the time of the crash the light condition was dark with street lights, the weather was clear, the roadway pavement was dry and traffic density was light.

Based on the damage to the case vehicle, the CDCs were determined to be: **06-LZES-1** (**190** degrees) for the impact with the hit-and-run car, **10-LFEW-2** (**290** degrees) for the impact with the metal luminaire pole and, **00-TDDO-3** for the rollover. The WinSMASH reconstruction program was used to reconstruct a barrier equivalent speed (BES) for the luminaire pole impact. The WinSMASH program calculated a BES of 7.7 km.p.h. (4.9 m.p.h.) based on the damage to the left fender. The EDR recorded a longitudinal Delta V of -10.3 km.p.h. (-6.4m.p.h.) for the luminaire pole impact. The rollover crash severity was judged to be moderate based on the amount of crush to the roof.

Immediately prior to the crash, the case vehicle's driver was seated in an upright driving posture with both hands on the steering wheel, her right foot on the accelerator and left foot on the floor. She was restrained by her integral, lap-and shoulder safety belt system. The driver stated she was unaware of the impending crash with the hit-and-run car and was unsure what, if any, actions she took following the impact. The EDR data indicated that the driver did not apply

the brakes. However, it is likely that the driver steered to the right following the impact with the hit-and-run car and the case vehicle began to rotate clockwise. As a result, the driver most likely moved to the left and against her door as the rotation increased. The driver most likely continued to the left and slightly forward due to the impact with the luminare pole. The driver then most likely stayed against her door and moved upward as the case vehicle began its driver side leading rollover, and she impacted her head on the intruding roof during the rollover. The driver sustained a cervical strain due to this contact. As the case vehicle rolled over, the side windows were broken out and the driver lacerated her right elbow on flying glass particles. The driver's integral safety belt system kept her restrained in her seat throughout the rollover. She was able to release herself from the seat belt and exited the vehicle without assistance. The driver's use of the integral, lap-and-shoulder safety belt mitigated her injuries and prevented possible ejection from the vehicle during the rollover.

The police crash report indicated the driver sustained a "B" (non-incapacitating-evident) injury as a result of the crash and was transported from the crash scene by ambulance to a local hospital. The driver was treated in the emergency room for her injuries and released. The driver stated she lost 10 work days as a result of the crash and sought no follow-up treatment.

CRASH CIRCUMSTANCES

Crash Environment: This crash occurred within an interchange area. The trafficway on which the case vehicle was traveling was a six-lane, divided, interstate highway traversing in an east and west direction. Each travel direction contained three travel lanes, paved shoulders and was divided by a concrete median barrier. Each travel lane was approximately 3.7 meters (12 feet) wide and each shoulder was approximately 3.1 meters (10 feet) wide. Pavement markings consisted of a yellow median line, broken white lane lines and a solid white edge line. The case vehicle's approach to the crash location was uncontrolled and the speed limit was 97 km.p.h. (60 m.p.h.). At the time of the crash the light condition was dark with street lights, the atmospheric condition was clear, and the roadway pavement was dry, level concrete. The roadway coefficient of friction was estimated to be 0.72. Traffic density was light and the site of the crash was urban commercial. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle was traveling east in the center lane approaching an entrance ramp from a service roadway that ran parallel to the case vehicle's roadway (**Figure 1**). The case vehicle was traveling at an EDR recorded speed of 97 km.p.h. (60 m.p.h.) 5 seconds prior to algorithm enable, and the driver was intending to continue eastbound. According to the driver of the case vehicle, a car was also traveling east and was behind the case vehicle. The car changed lanes to the left inside lane and began to pass the case vehicle and then moved to the right into the case vehicle's lane. The impact between the car and

Figure 1: Overview of eastbound travel lanes from the outside lane; arrow shows area of crash

case vehicle occurred in the case vehicle's travel lane. The case vehicle's subsequent impact with the luminaire pole occurred off the south side of the roadway in the gore (**Figure 2** below) followed by a driver side leading rollover across the adjacent entrance ramp and service roadway (**Figure** 3 below). The driver indicated she took no actions to avoid the impact with the car and was unsure what, if any, actions she may have taken following that impact.

Figure 2: Orange cone shows base of luminaire pole impacted by case vehicle, photo view to southeast, arrow shows area of rollover

Figure 3: Overview of area of rollover across service roadway, plastic and/or rubber transfer from case vehicle's luggage rack and/or right door gasket highlighted in white in foreground, arrow shows area of final rest

Crash: The right front corner of the car impacted the left rear door of the case vehicle just in front of the left rear wheel (**Figure 4**). The case vehicle driver probably steered right and the vehicle began to rotate clockwise and traveled across the outside, eastbound lane and shoulder, departed the south edge of the roadway and entered the gore of the entrance ramp. The case vehicle's left fender and left front wheel (**Figure 5**) then impacted and broke off a luminaire pole. The case vehicle then began a driver side leading rollover as it departed the gore and entered the entrance ramp. The case vehicle rolled over one-and-one-half times (six quarter turns) across the entrance ramp and service roadway (**Figure 3** and **Figures 6** and **7** below). Neither the driver or front right air bags deployed during the crash. The EDR data indicated that the case vehicle's longitudinal deceleration due to the luminaire pole impact was not sufficient to require air bag deployment.

Figure 4: Damage to case vehicle's left rear door from impact by hit-and-run car

Figure 5: Damage to case vehicle's left fender and left front wheel from impact with luminaire pole

Post-Crash: The car that initially impacted the case vehicle did not stop and left the scene of the crash. Following the rollover, the case vehicle came to rest on its top across both lanes of the service roadway facing south (**Figure 3**).

CASE VEHICLE

The 2004 GMC Envoy was a four-door, rear wheel drive, sport utility vehicle (VIN: 1GKDS13S042------) equipped with a 4.2 liter, L6 engine; four speed automatic transmission and electronic traction assist. Braking was achieved by power assisted, four wheel, anti-lock disc brakes. The case vehicle was also equipped with driver and front right passenger dual stage air bags, front seat back-mounted side impact air bags, and driver and front right passenger bucket seats with adjustable head restraints and integral lap-and-shoulder safety belt systems. The back seat was equipped with a split bench seat with manual, three-point, lap-and-shoulder safety belts and adjustable head restraints in the outboard seat positions. In addition, the case vehicle was equipped with an EDR housed within the air bag's Sensing and Diagnostic Module (SDM), and a LATCH system for securing child safety seats. The case vehicle's wheelbase was 287 centimeters (113 inches). The odometer reading at the time of inspection was 9696 kilometers (6025 miles).

Figure 6: Crush to the case vehicle's roof from rollover; view from back of vehicle

Figure 7: Roof crush, hood scratches and pavement grinding to A-pillars and roof rails from rollover

The sensors in the case vehicle's advanced occupant restraint system analyze a combination of factors including the predicted crash severity and safety belt usage to determine the front air bag inflation level appropriate for the severity of the crash.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's impact with the hit-and-run car produced a small area of direct and induced damage to the left rear door adjacent to left rear wheel house (**Figure 4** above). The direct damage began at the front of the left rear wheel housing and extended about 33 centimeters (13 inches) along the left rear door, and maximum crush was aapproximately 3 centimeters occurring just forward of the left rear wheel house. The impact with the luminaire pole produced direct damage to the left fender and hood, and displaced the left front wheel rearward 8 centimeters (3.2 inches). The direct damage began 281 centimeters (110.6 inches) forward of the left rear axle and extended 46 centimeters (18.1 inches) along the left fender. Crush measurements were taken at the left fender and the maximum crush was measured as 14 centimeters (5.5 inches) occurring at C_4. The rollover produced extensive direct damage and crush to the case vehicle's roof (**Figure 6** and **7**). There was extensive pavement grinding marks on the A-pillars and roof rails as well as pavement scratches on the hood (**Figure 7**). The table below shows the case vehicle's crush profile for the left fender impact with the luminaire pole.

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								$\pm$D	$\pm$D
cm	2	46	14	107	0	3	7	14	13	0	164	147
in		18.1	5.5	42.1	0.0	1.2	2.8	5.5	5.1	0.0	64.6	57.9

The case vehicle's wheelbase was reduced 8 centimeters (3.2 inches) on the left side and reduced 4 centimeters (1.6 inches) on the right side. Induced damage involved the front bumper, both fenders, hood, windshield, all the doors and the rear hatch.

The recommended tire size was: P245/65R17 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	0	0	207	30	10	12	Cuts in sidewall	No	Yes
RF	228	33	207	30	9	11	None	Yes	No
LR	228	33	241	35	9	11	None, Grass in bead	No	No
RR	228	33	241	35	7	9	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior revealed evidence of possible occupant contact to the steering wheel rim. However, there was no evidence of compression of the energy absorbing steering column, and no deformation of the steering wheel rim was observed (**Figure 8** below). In addition, there was evidence of occupant contact to the roof, above the driver's seat position at the forward edge of the sunroof. There appeared to be scuffs in the roof nap in this area. No other occupant contact marks were observed. There were numerous occupant compartment intrusions due to the rollover damage to the roof. Some of the most severe intrusions occurred to the driver's occupant space (**Figure 9** below). They were as follows: 34 centimeters (13.4 inches) of vertical roof and windshield header intrusion, 25 centimeters (9.8 inches) of vertical and 16 centimeters (6.3 inches) of lateral left A-pillar intrusion and, 25 centimeters (9.8 inches) of vertical and 16 centimeters of lateral left roof side rail intrusion.

Damage Classification: Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **06-LZES-1** (**190** degrees) for the impact with the hit-and-run car, **10-LFEW-2** (**290** degrees) for the impact with the luminaire pole and, **00-TDDO-3** for the rollover.

Figure 8: Right side view of steering wheel and steering column showing no deformation

The WinSMASH reconstruction program was used to reconstruct a barrier equivalent speed (BES) for the luminaire pole impact. The WinSMASH program calculated a BES of 7.7 km.p.h. (4.9 m.p.h.) based on the damage to the left fender. The EDR recorded a longitudinal component of Delta V of -10.3 km.p.h. (-6.4m.p.h.) for the luminaire pole impact. The rollover crash severity was judged to be moderate based on the amount of crush to the roof. The case vehicle was towed due to damage.

Figure 9: Intrusion into driver's occupant space and overview of steering wheel (rotated 180 degrees) and instrument panel

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with dual stage driver and front right passenger air bags as well as front seat back-mounted side impact air bags. The case vehicle's driver air bag was located in the steering wheel hub (**Figure 9**) and the front right passenger air bag was located in the middle of the right instrument panel (**Figure 10**). Neither air bag deployed in this crash. In addition, neither side impact air bag deployed. The EDR data indicated that the front air bag deployment criteria was not achieved during the crash sequence.

Figure 10: Center and right instrument panel; front right air bag module cover just above glove box door

CRASH DATA RECORDING

The download of the case vehicle's EDR was done during the vehicle inspection via direct connection to the SDM. The downloaded data indicated that the case vehicle sustained a non-deployment event. The data also indicated that multiple events were detected, and one or more were not recorded. The additional events were not recorded because the EDR can only store one non-deployment event. This contractor believes the recorded non-deployment event was associated with the case vehicle's impact with the luminaire pole, and the event or events that were not recorded were related to the rollover and possibly the impact by the hit-and-run car. The EDR reports are presented at the end of this report (**Figures 12 - 16**).

The system status report for the non-deployment event show that the SIR warning lamp was recorded as off and the driver's seat belt switch circuit was recorded as buckled. The system status report also shows the maximum SDM recorded velocity change (i.e., Delta-V) was -10.30 km.p.h. (-6.40 m.p.h.) occurring 122.5 milliseconds after algorithm enable (AE), and the event recording was complete.

The pre-crash data graph show that the case vehicle was traveling 96.5 km.p.h. (60 mph) five seconds prior to AE. The case vehicle's speed then decreased to 80.5 km.p.h. (50 m.p.h.) from three seconds to one second prior to AE, and the percent throttle fell to 0% indicating the driver had removed her foot from the accelerator, probably in response to the impact by the hit-and-run vehicle.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's driver [35-year-old, black (non-Hispanic) female; 177.8 centimeters (70 inches) and 58 kilograms (128 pounds)] was seated in an upright driving posture with both hands on the steering wheel, her right foot on the accelerator and left foot on the floor. Her seat track was located between the middle and rear positions, the seat back was slightly reclined, her back was against the seat and the tilt steering wheel was adjusted to its center position.

Figure 11: Overview of case vehicle driver's safety belt, yellow tape shows area of slight rippling in shoulder belt

Based on the evidence observed during the vehicle inspection and supported by the EDR data, the case vehicle's driver was restrained by her integral, three-point, lap-and-shoulder safety belt system. Inspection of the seat belt assembly revealed some rippling of the shoulder belt webbing in an area of the belt consistent with usage in the crash (**Figure 11**). In addition, the driver stated she was restrained by her lap-and-shoulder belt during the crash.

The driver stated she was unaware of the impending crash with the hit-and-run car and was unsure what, if any, actions she took following the impact with the hit-and-run car. The EDR data indicate that the driver did not apply the brakes. It is likely that the impact by the hit-and-run car to the case vehicle's left rear door caused the back of the case vehicle to move to the right to some degree. In response the driver likely steered to the right, and the case vehicle began it's clockwise rotation. The deceleration due to the clockwise rotation most likely locked the driver's safety belt retractor, and the driver most likely moved to the left and against her door during the rotation. The luminaire pole impact caused the driver to continue to the left and slightly forward along a path opposite the 290 degree direction of principal force as the case vehicle decelerated. The driver most likely stayed against her door and moved upward against her safety belt as the case vehicle began its driver side leading rollover. The driver continued to load her safety belt as the case vehicle rolled over. Some light scuff marks were found in the roof nap at the front of the sunroof, above the driver's seat, indicating the driver probably impacted her head on the roof during the rollover. The driver sustained a cervical strain due to this contact. As the case vehicle rolled over, the side windows broke out and the driver lacerated her right elbow on flying glass particles. The driver's integral safety belt system kept her restrained in her seat throughout the rollover. She was able to release herself from her safety belt and exited the vehicle without assistance. The driver's use of the integral, lap-and-shoulder safety belt mitigated her injuries and prevented possible ejection from the vehicle during the rollover.

CASE VEHICLE DRIVER INJURIES

The police crash report indicated the driver sustained a "B" (non-incapacitating-evident) injury as a result of the crash and was transported from the crash scene by ambulance to a local hospital. The driver was treated in the emergency room for her injuries and released. The driver's injuries and injury mechanisms are presented in the table below. The driver stated she lost 10 work days as a result of the crash and sought no follow-up treatment.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Strain, acute cervical, not further specified	minor 640278.1,6	Roof	Probable	Emergency room records
2	Laceration {cut} on right elbow, not further specified	minor 790600.1,1	Noncontact injury: flying glass, unknown source	Probable	Interviewee (same person)

CDR File Information

Vehicle Identification Number	1GKDS13S042xxxxxx
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	IN04020 CDR WO NUMBER.CDR
Saved on	Monday, June 28 2004 at 11:32:10 AM
Collected with CDR version	Crash Data Retrieval Tool 2.24
Collecting program verification number	70CD83DD
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: 39 Date: 10-09-03 Checksum: 0300
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 Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Driver's 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 12: Case vehicle's 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 Belt Switch Circuit is wired directly to the SDM.

Figure 13: Case vehicle's SDM Data Limitations continued

1GKDS13S042xxxxxx System Status At Non-Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Non-Deployment	649
Ignition Cycles At Investigation	653
Maximum SDM Recorded Velocity Change (MPH)	-6.40
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	122.5
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)	-0.62	-0.62	-0.93	-0.93	-1.55	-2.48	-3.41	-4.03	-4.96	-5.58	-5.89	-6.20	-6.20	-6.20	-6.20

PRE-CRASH DATA

Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	60	1920	18	OFF
-4	60	1920	18	OFF
-3	60	1856	12	OFF
-2	59	1792	0	OFF
-1	50	1472	0	OFF

Figure 14: The case vehicle's System Status at Non-Deployment report.

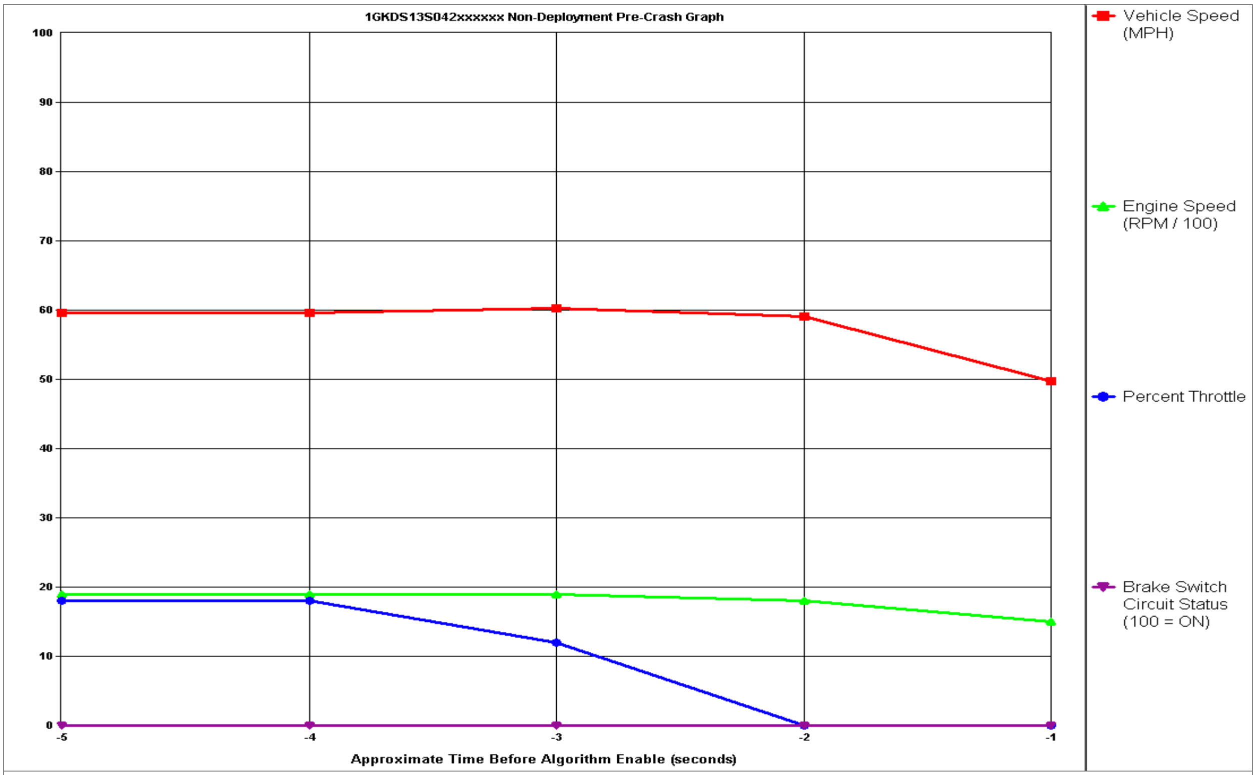


Figure 15: The case vehicle's Non-Deployment Pre-Crash Graph

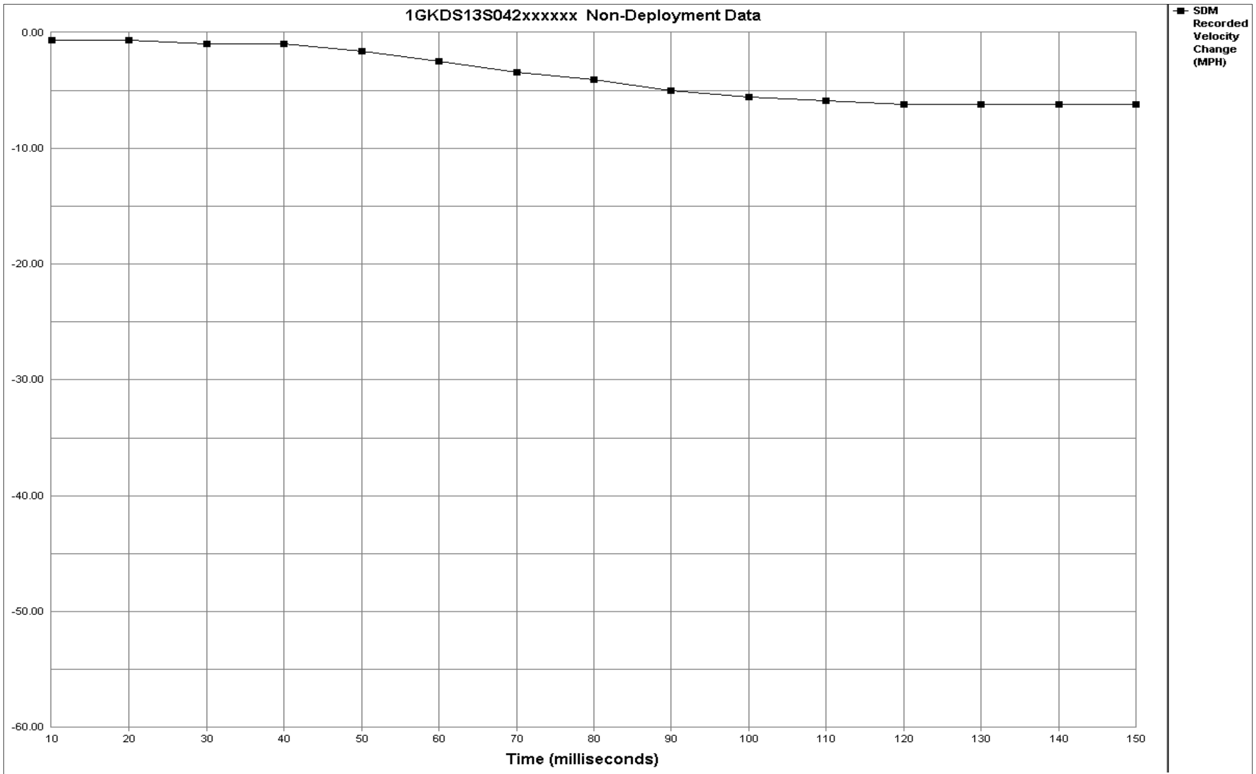
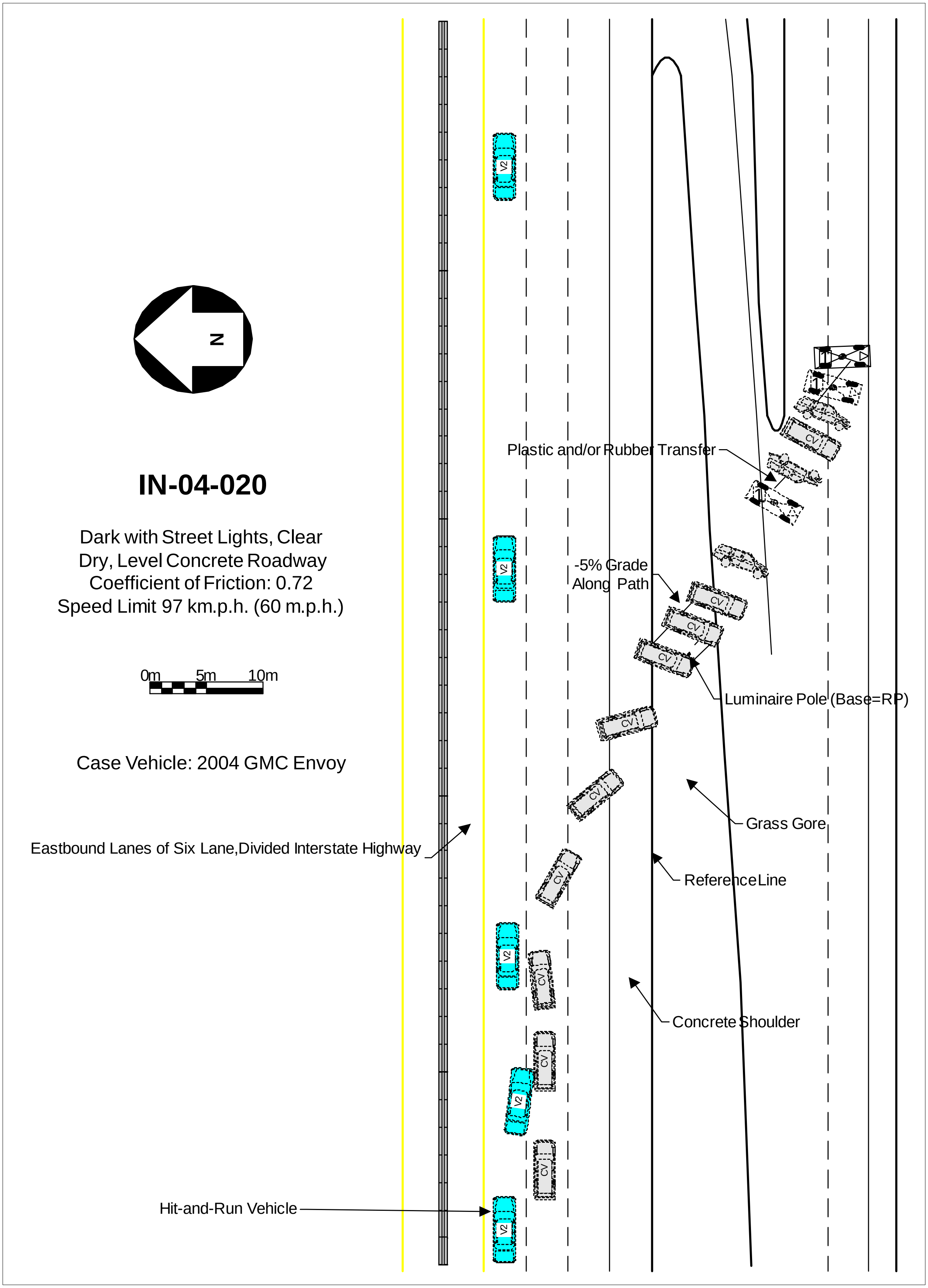


Figure 16: The case vehicle's SDM Recorded Velocity Change graph


N
IN-04-020
Dark with Street Lights, Clear
Dry, Level Concrete Roadway
Coefficient of Friction: 0.72
Speed Limit 97 km.p.h. (60 m.p.h.)
0m 5m 10m
Case Vehicle: 2004 GMC Envoy
Eastbound Lanes of Six Lane,Divided Interstate Highway
Hit-and-Run Vehicle
Plastic and/or Rubber Transfer
-5% Grade
Along Path
Luminaire Pole (Base=RP)
Grass Gore
Reference Line
Concrete Shoulder
V2
CV