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-06-027
LOCATION - MICHIGAN
VEHICLE - 2006 PONTIAC G6 SE1
CRASH DATE - June 2006

Submitted:

March 8, 2007
Revised: March 31, 2008

Contract Number: DTNH22-01-C-07002

Prepared for:

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

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-06-027	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Certified Advanced 208-Compliant Vehicle Investigation Vehicle - 2006 Pontiac G6 SE1 Location - Michigan		5. *Report Date:* March 8, 2007 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: June 2006 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site advanced air bag investigation involving a 2006 Pontiac G6 SE1 equipped with manual safety belts and manufacturer certified advanced 208-compliant driver and front right passenger air bag system.			
16. *Abstract* This report covers an on-site advanced air bag investigation that involved a 2006 Pontiac G6 SE1 (case vehicle) and a 1991 Chevrolet Corsica (other vehicle), which were involved in a front to right side intersection crash. This crash is of special interest because the supplemental restraint (air bag) system in the Pontiac G6 is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle was also equipped with an Event Data Recorder (EDR), and the case vehicle's driver [60-year-old, White (non-Hispanic) female] sustained a police reported “C” (possible) injury as a result of the crash. The case vehicle was southbound in the inside through lane of a five-lane, undivided city street approaching a signalized intersection. The Chevrolet was traveling west in the left turn lane and the driver executed the left turn and entered the intersection. The case vehicle’s front left corner impacted the Chevrolet’s right front corner causing a first stage deployment of the case vehicle driver’s air bag. As a result of the impact, the case vehicle rotated counterclockwise and came to final rest in the mouth of the southbound leg of the intersection heading southeast. The Chevrolet also rotated counterclockwise and came to rest in the intersection also heading southeast. The case vehicle’s driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. She sustained minor injury in the crash and was transported by ambulance to a hospital and treated and released.			
17. *Key Words* Advanced Air Bag 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*

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

TABLE OF CONTENTS IN-06-027

Page No.

BACKGROUND

IN-06-027

This investigation was brought to NHTSA's attention on or before August 10, 2006 by GES sampling activities. This crash involved a 2006 Pontiac G6 SE1 (case vehicle) and a 1991 Chevrolet Corsica LT (other vehicle), which were involved in a front to right side intersection crash. The crash occurred in June 2006, at 2:24 p.m., in Michigan and was investigated by the applicable city police department. This crash is of special interest because the supplemental restraint (air bag) system in the Pontiac G6 is certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Standard (FMVSS) No. 208. The case vehicle was also equipped with an Event Data Recorder (EDR), and the case vehicle's driver [60-year-old, White (non-Hispanic) female] sustained a police reported "C" (possible) injury as a result of the crash. This contractor inspected the case vehicle and scene, downloaded the EDR and interviewed the driver on August 29, 2006. This report is based on the police crash report, scene and case vehicle inspections, EDR data, case vehicle driver interview, case vehicle driver's medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was southbound in the inside through lane of a five-lane, undivided city street at approximately 72 km.p.h. (45 m.p.h) approaching a signalized intersection. The Chevrolet was traveling west in the left turn lane also approaching the intersection The Chevrolet's driver executed the left turn and entered the intersection. The case vehicle's driver steered right and applied the brakes in an attempt to avoid the crash. The case vehicle's front left corner impacted the Chevrolet's right front corner causing a first stage deployment of the case vehicle driver's air bag. As a result of the impact, the case vehicle rotated counterclockwise and came to final rest in the mouth of the southbound leg of the intersection heading southeast. The Chevrolet also rotated counterclockwise and came to rest in the intersection also heading southeast.

The CDC for the case vehicle was determined to be **11-FLEE-6** (**340** degrees). The WinSMASH reconstruction program could not be used to reconstruct the case vehicle's Delta V's because there was minimal involvement of the front bumper bar due to the narrow corner impact, and the crush measurements did not reflect the extent of damage to the vehicle. In addition, the majority of the crush energy was dissipated through the displacement of the left front wheel. The wheel displacement can not be accurately represented through the current WinSMASH vehicle stiffness coefficients. The case vehicle's EDR recorded the maximum longitudinal and lateral Delta Vs respectively as -24.0 km.p.h. (-14.91 m.p.h) and 8.7 km.p.h. (5.42 m.p.h.). The case vehicle was towed due to damage.

The case vehicle's driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The case vehicle's driver sustained minor injuries during the crash and was transported by ambulance to a hospital and treated and released. The driver's use of her safety belt system and the deployment of her safety belt pretensioner and advanced air bag mitigated her interaction with the case vehicle's interior components and reduced her injury potential.

Crash Environment: The trafficway on which the case vehicle was traveling was a five-lane, undivided, city street, traversing in a north-south direction, and the case vehicle was approaching a four-leg intersection. On both the northern and southern legs of the intersection, the north-south roadway had two through lanes in each direction and an opposing left turn lane. The outside through lanes were each approximately 4.4 meters (14.4 feet) in width. The inside through lanes the opposing left turn lane were each approximately 3.6 meters (11.8 feet) in width. The trafficway on which the Chevrolet was traveling was a five-lane, undivided, city street, traversing in an east-west direction, and the Chevrolet was approaching the same four-leg intersection. Both the east and west legs of the intersection had two through lanes and an opposing left turn lane. Each lane was approximately 3.8 meters in width (12.5 feet). Roadway pavement markings consisted of broken white lane lines and solid white stop bars at the intersection. Each opposing left turn lane had solid yellow outside edge lines adjacent to broken yellow inside edge lines in the opposing left turn lane area. The lane markings then transitioned to double solid yellow lane lines on the left with white left turn arrows and solid white lane line on the right near the intersection. The roadways were bordered by barrier curbs and the intersection was controlled by three-phase traffic signal lights. The speed limit for both vehicles 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 with an estimated coefficient of friction of 0.70. Traffic density was moderate and the site of the crash was urban commercial. See the Crash Diagram at the end of this report.

Pre-Crash: The case vehicle's driver stated she was southbound in the inside through lane (**Figure 1**) and was intending to continue southbound through the intersection. The driver estimated she was traveling approximately 64 km.p.h. (40 m.p.h.). The case vehicle's EDR data indicated that the case vehicle's pre-crash travel speed was 72 km.p.h. (45 m.p.h) slowing to 62 km.p.h. (42 m.p.h.) just prior to the crash. It also indicates she may have been changing lanes from the outside to the inside lane as she was approaching the intersection. The Chevrolet was traveling west in the left turn lane (**Figure 2**). The Chevrolet's driver was intending to turn left and travel southbound. The case vehicle's driver stated that she recalled taking no actions to avoid the crash. However, the case vehicle's EDR data indicated the driver steered right and applied the brakes just prior to the crash. The crash occurred within the intersection.

Figure 1: Approach of case vehicle to intersection, southbound in inside through lane

Figure 2: Approach of Chevrolet to intersection, westbound in left turn lane

Crash: The case vehicle's front left corner (**Figures 3** and **4**) impacted the Chevrolet's right front corner causing a first stage deployment of the case vehicle driver's air bag. The case vehicle's front right air bag did not deploy because there was no front right passenger in the case vehicle. The sensors in the front right seat properly determined the absence of an occupant and suppressed deployment of the front right air bag.

Figure 3: Overview of damage to front left corner of case vehicle from impact with right front corner of Chevrolet, increments on tape measure in 10ths of meter, each increment on rods is 5 cm (2 in)

Post-Crash: As a result of the impact, the case vehicle rotated counterclockwise approximately 45 degrees and came to final rest in the mouth of the southbound leg of the intersection heading southeast. The Chevrolet rotated counterclockwise approximately 125 degrees and came to rest in the intersection also heading southeast.

Figure 4: Damage to left fender and displacement of left front wheel from impact with right front corner of Chevrolet.

CASE VEHICLE

The 2006 Pontiac G6 SE1 was a front wheel drive, four-door sedan (VIN: 1G2ZG558064------). 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 was equipped with a 3.5L, V6 engine; four-speed automatic transmission and four wheel, disc brakes. The front seating row was equipped with bucket seats with adjustable head restraints, adjustable pedals, dual stage driver and front right passenger air bags; driver and front right passenger manual, three-point, lap-and-shoulder safety belts with adjustable upper anchors, usage sensors and pretensioners. In addition, the front right seat was equipped with an occupant presence sensor. The back seating row was equipped with a bench seat with folding backs; manual, three-point, lap-and-shoulder safety belts in all three seating positions and adjustable head restraints in the outboard seating positions. The case vehicle was also equipped with a LATCH system for securing child safety seats and an EDR. Front seat back-mounted side impact air bags, right and left side curtain air bags and anti-lock brakes were optional for this vehicle. The case vehicle's specification wheelbase was 285 centimeters (112.3 inches). The case vehicle's odometer reading at the time of the vehicle inspection was 10,866 kilometers (6,752 miles).

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 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 Chevrolet involved the left corner of the front bumper. The bumper fascia and a small portion of the bumper bar were directly damaged and the bumper fascia was torn off at the corner. In addition, the direct damage involved the left headlamp/turn signal assembly, left fender, left front wheel and front portion of the left front door. The left front wheel was significantly engaged and crushed rearward. The direct damage began at the left corner of the bumper fascia and extended approximately 38 centimeters (15 inches) across the bumper fascia. Since the impact occurred right at the corner, there was only minimal engagement of the bumper bar, which did not extend out to the corner of the bumper fascia. The maximum residual crush occurred at the left corner of the bumper bar (**Figure 5**) and was approximately 2 centimeter (0.8 inch). However the left front wheel (**Figure 6**) was heavily engaged and crushed rearward 16 centimeters (6.3 inches) shortening the left side wheelbase by this amount. The right side wheelbase was extended 2.0 centimeters (0.8 inch). Induced damage involved the left front door and hood. The table below shows the crush profile to the front bumper bar.

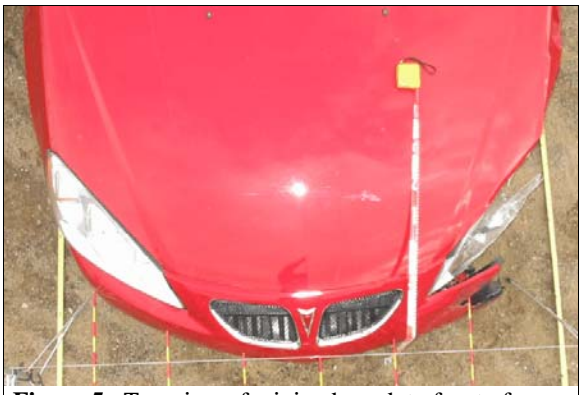


Figure 5: Top view of minimal crush to front of case vehicle, left corner of bumper fascia was torn off from impact with Chevrolet and minimal engagement of case vehicle's bumper bar, each increment on rods in 5 cm (2 in)

Figure 6: Rearward displacement of case vehicle's left front wheel due to engagement with the Chevrolet's right front corner during impact

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	38	25	125	0	0	0	0	0	2	-77	0
in		15.0	9.8	49.2	0.0	0.0	0.0	0.0	0.0	0.8	-30.3	0.0

The case vehicle's recommended tire size was: P225/50R17. The case vehicle was equipped with tires of this size on the right front, left rear and right rear. There was no left front

tire present on the vehicle at the time of the inspection. 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	Unk	Unk	207	30	Unk	Unk	Unknown	Unk	Unk
RF	207	30	207	30	7	9	None	No	No
LR	207	30	207	30	8	10	None	No	No
RR	207	30	207	30	8	10	None	No	No

Vehicle Interior: Inspection of the case vehicle's interior (**Figures 7** and **8**) revealed two small areas of discoloration on the top half of the driver's air bag that may have been driver contact marks. No other occupant contact marks were found. There was no evidence of compression of the energy absorbing steering column or deformation of the steering wheel (**Figure 9** below). In addition, no passenger compartment intrusions noted.

Figure 7: Overview of steering wheel, windshield and instrument panel

Figure 8: Overview of case vehicle driver's seat as found and left front door, seat is in rear-most position, subsequently determined that driver had seat adjusted to between middle and forward-most position at time of crash

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be **11-FLEE-6** (**340** degrees). The WinSMASH reconstruction program could not be used to reconstruct the case vehicle's Delta V's because there was minimal involvement of the front bumper bar due to the narrow corner impact and the crush measurements did not reflect the extent of damage to the vehicle. In addition, the majority of the crush energy was dissipated through the displacement of the left front wheel. The wheel displacement can not be accurately represented through the current WinSMASH vehicle stiffness coefficients. The case vehicle's EDR recorded the maximum longitudinal and lateral Delta Vs respectively as -24.0 km.p.h. (-14.91 m.p.h) and 8.7 km.p.h. (5.42 m.p.h.). The case vehicle was towed due to damage.

The case vehicle was equipped with a manufacturer certified advanced 208-compliant front air bag system. The driver's air bag deployed in this crash due to the impact with the Chevrolet. The front right air bag did not deploy because there was no front right passenger seated in the case vehicle at the time of the crash. The case vehicle's advanced air bag system properly suppressed the deployment of the front right passenger air bag.

The case vehicle's driver air bag was located in the steering wheel hub. The air bag module cover consisted of essentially "I"-configuration cover flaps made of medium thickness vinyl (**Figure 10**). Both the left and right cover flaps were convex at the top and square at the bottom. There was a circular manufacturer's logo located in the center of the left flap. A corresponding semi-circular cut-out was located in the center of the left cover flap to accommodate the logo. Each flap was approximately 14 centimeters (5.5 inches) in height along the vertical center tear seam, 6.5 centimeters (2.6 inches) in width along the top tear seam and 4.5 centimeters (1.8 inches) in width along the bottom tear seam. An inspection of the air bag module cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points. There was no evidence of damage during the deployment to the air bag module cover flaps or the air bag fabric. The deployed driver's air bag (**Figure 11**) was round with a diameter of about 60 centimeters (23.6 inches). The air bag was designed with four tethers, each approximately 5.5 centimeters (2.2 inches) in width and had two vent ports, each approximately 4 centimeters (1.6 inches) in diameter, located at the 11 and 1 o'clock positions. The distance between the mid-center of the driver's seat back, as positioned as the time of the vehicle inspection (i.e., seat at the rear-most track position, seat back slightly reclined), and the front surface of the air bag's fabric at approximate

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

Figure 10: Case vehicle's steering wheel and air bag module cover flaps

Figure 11: Case vehicle's driver air bag

full excursion was 37 centimeters (14.6 inches). Inspection of the air bag fabric revealed two small areas of discoloration on the top half of the air bag that may have been related to driver contact. No other occupant contact marks were noted on the air bag.

CRASH DATA RECORDING

The download of the case vehicle's EDR was done during the vehicle inspection via direct connection to the SDM. The EDR recorded a deployment event. The EDR reports are presented at the end of this report (**Figures 13-18**). The System Status at Deployment report (**Figure 16** below) shows the SIR warning lamp was off, the driver's seat belt switch circuit was recorded as buckled, the driver's pretensioner actuated and the front right passenger's air bag was suppressed. The system status report also shows that a first stage deployment was commanded at 52 milliseconds after algorithm enable (AE), and the air bag's second stage was disposed. Interpretation of the longitudinal velocity change data (**Figure 17** below) indicated that AE occurred at the approximate 30 millisecond sample point on the graph. The maximum recorded longitudinal velocity change was recorded as -24.0 km.p.h. (-14.91 m.p.h.) occurring at the 160 millisecond sample point on the graph.

The pre-crash data graph (**Figure 15**) indicates the case vehicle was traveling 72 km.p.h. (45 m.p.h.) five seconds prior to AE and slowed to 68 km.p.h. (42 m.p.h.) at one second prior to AE. The data also indicates the driver most likely applied the brakes and steered right just prior to the crash. It is this contractor's understanding that the precision of the steering wheel angle reported in the pre-crash data is in 16 degree increments.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash the case vehicle's driver [60-year-old, White (non-Hispanic) female; 163 centimeters and 76 kilograms (64 inches, 168 pounds)] was seated upright with her back against the seat back, her left foot on the floor, right foot on the accelerator and both hands on the steering wheel at the 10 o'clock and 4 o'clock positions. The driver's seat track was adjusted to between the middle and forward-most position, her seat back was upright, the tilt steering column was adjusted to the full down position and the foot controls were adjusted to the full rear position (i.e., closest to the driver). In addition, the driver was wearing glasses.

Based on the vehicle inspection and supported by the EDR data, the case vehicle's driver was restrained by her manual, three-point, lap-and-shoulder safety belt system. The adjustable upper anchor was found adjusted to its lowest position. Inspection of the safety belt assembly revealed load marks on the shoulder belt and "D" ring (**Figure 12**). In addition, the driver also reported belt pattern contusions to her left shoulder, chest and hips.

Figure 12: Load marks on case vehicle driver's shoulder belt and "D" ring (arrows)

The case vehicle's driver most likely steered right and applied the brakes just prior to impact. As a result, she may have moved forward and slightly left within her safety belt just prior to the impact. The impact with the Chevrolet caused the driver to continued forward and to the left along a path opposite the case vehicle's 340 degree direction of principal force as the case vehicle decelerated longitudinally and accelerated laterally to the right. The driver's pretensioner actuated and she loaded her safety belt causing a contusion from her left shoulder, across her chest and across both hips. Her face and chest also loaded her deployed air bag causing a contusion to her chest. The case vehicle driver's left foot also loaded the floor spraining her left ankle. In addition, the driver had sacks of groceries in the back seat, and a can was projected forward and impacted and contused the back of the driver's head. The driver remained in her seat restrained by her lap-and-shoulder safety belt and was removed from the case vehicle by emergency medical personnel. The driver's use of her safety belt system and the deployment of her safety belt pretensioner and advanced air bag mitigated her interaction with the case vehicle's interior components and reduced her injury potential.

CASE DRIVER INJURIES

The police crash report indicated the case vehicle's driver sustained a "C" (possible) injury and was transported from the scene by ambulance to a hospital. The driver was treated in the emergency room and released. The driver also received one follow-up doctor visit for pain treatment. The table below shows the case vehicle driver's injuries and injury mechanisms.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {bump} posterior scalp {head}, not further specified	minor 190402.1,6	Interior loose object (i.e., steel can from sack of groceries)	Probable	Interviewee (same person)
2	Abrasion left shoulder, not further specified	minor 790202.1,2	Torso portion of safety belt system	Probable	Emergency room records
3	Contusion {bruise and/or hematoma} left shoulder, not further specified	minor 790402.1,2	Torso portion of safety belt system	Probable	Emergency room records
4	Contusion {bruising} across chest, not further specified	minor 490402.1,0	Air bag, driver's	Probable	Interviewee (same person)
5	Contusion {bruising} across hips, not further specified	minor 590402.1,8	Lap portion of safety belt system	Certain	Interviewee (same person)
6	Sprain left ankle, not further specified	minor 850206.1,2	Floor, including toe pan	Probable	Emergency room records

The 1991 Chevrolet Corsica was a front wheel drive, four-door sedan (VIN: 1G1LT53G3MY------) equipped with a 2.2L, L4 engine and automatic transmission. The front seating row was equipped a driver air bag and manual, three-point, lap-and-shoulder safety belts.

Exterior Damage: The Chevrolet was not inspected. It could not be located. With no available vehicle photographs, a CDC could not be estimated. The Chevrolet was towed due to damage.

Chevrolet's Occupants: According to the police crash report, the Chevrolet's driver [26-year-old, (unknown race and ethnic origin) male] was not injured. It is not known if he was restrained. The police crash report indicated the driver fled the crash scene.

CDR File Information

Vehicle Identification Number	1G2ZG558064******
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	IN06027.CDR
Saved on	Tuesday, August 29 2006 at 08:55:27 AM
Collected with CDR version	Crash Data Retrieval Tool 2.800
Collecting program verification number	9238B95E
Reported with CDR version	Crash Data Retrieval Tool 2.800
Reporting program verification number	9238B95E
Interface used to collected data	Block number: 00 Interface version: 4A Date: 11-08-05 Checksum: 7500
Event(s) recovered	Deployment

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 can contain 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 can contain Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within five 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 unless a Deployment Level Event occurs within 5 seconds after the Deployment Event, then the Deployment Level Event will overwrite the Non-Deployment Event file.

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 220 milliseconds of data after deployment criteria is met and up to 70 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM will record up to the first 300 milliseconds of data after algorithm enable. The minimum SDM Recorded Vehicle Forward Velocity Change, that is needed to record a Non-Deployment Event, is 5 MPH.
-Maximum Recorded Vehicle Velocity Change is the maximum recorded velocity change in the vehicle's combined "X" and "Y" axis.
-Calculated Principal Direction of Force (PDOF) is the arctangent of the maximum observed lateral velocity change divided by the maximum observed longitudinal velocity change. PDOF is displayed where zero degrees is located at the front of the vehicle, with 90 degrees is displayed to the right side of the vehicle and so on, clockwise around the vehicle.
-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. The Passenger Belt Switch Circuit Status for 2006 Chevrolet Cobalt Sport Coupe (AP) model vehicles, with the option package that includes Recaro brand seats (RPO ALV), will always report a default value of "Buckled".
-The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than 5 seconds, "N/A" is displayed in place of the time. If the value is negative, then the Deployment

Figure 13: Case vehicle's CDR File Information and SDM Data Limitiations

Event occurred first. If the value is positive, then the Non-Deployment Event occurred first.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-The ignition cycle counter relies upon the transitions through OFF->RUN->CRANK power-moding messages, on the GMLAN communication bus, to increment the counter. Applying and removing of battery power to the module will not increment the ignition counter.
SDM Data Source:
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Status Data (Pre-Crash) is transmitted to the SDM, by various vehicle control modules, via the vehicle's communication network.
-The Belt Switch Circuit is wired directly to the SDM.

Figure 14: Case vehicle's SDM Data Limitations continued

System Status At AE

Vehicle Identification Number	**2ZG558*6*******
Low Tire Pressure Warning Lamp (If Equipped)	OFF
Vehicle Power Mode Status	Run
Remote Start Status (If Equipped)	Inactive
Run/Crank Ignition Switch Logic Level	Active
Brake System Warning Lamp (If Equipped)	OFF

System Status At 1 second

Transmission Range (If Equipped)	Fourth Gear
Transmission Selector Position (If Equipped)	Drive
Traction Control System Active (If Equipped)	No
Service Engine Soon (Non-Emission Related) Lamp	OFF
Service Vehicle Soon Lamp	OFF
Outside Air Temperature (degrees F) (If Equipped)	88.7
Left Front Door Status (If Equipped)	Closed
Right Front Door Status (If Equipped)	Closed
Left Rear Door Status (If Equipped)	Unused
Right Rear Door Status (If Equipped)	Unused
Rear Door(s) Status (If Equipped)	Closed

Pre-crash data

Parameter	-2 sec	-1 sec
Reduced Engine Power Mode	OFF	OFF
Cruise Control Active (If Equipped)	No	No
Cruise Control Resume Switch Active (If Equipped)	No	No
Cruise Control Set Switch Active (If Equipped)	No	No

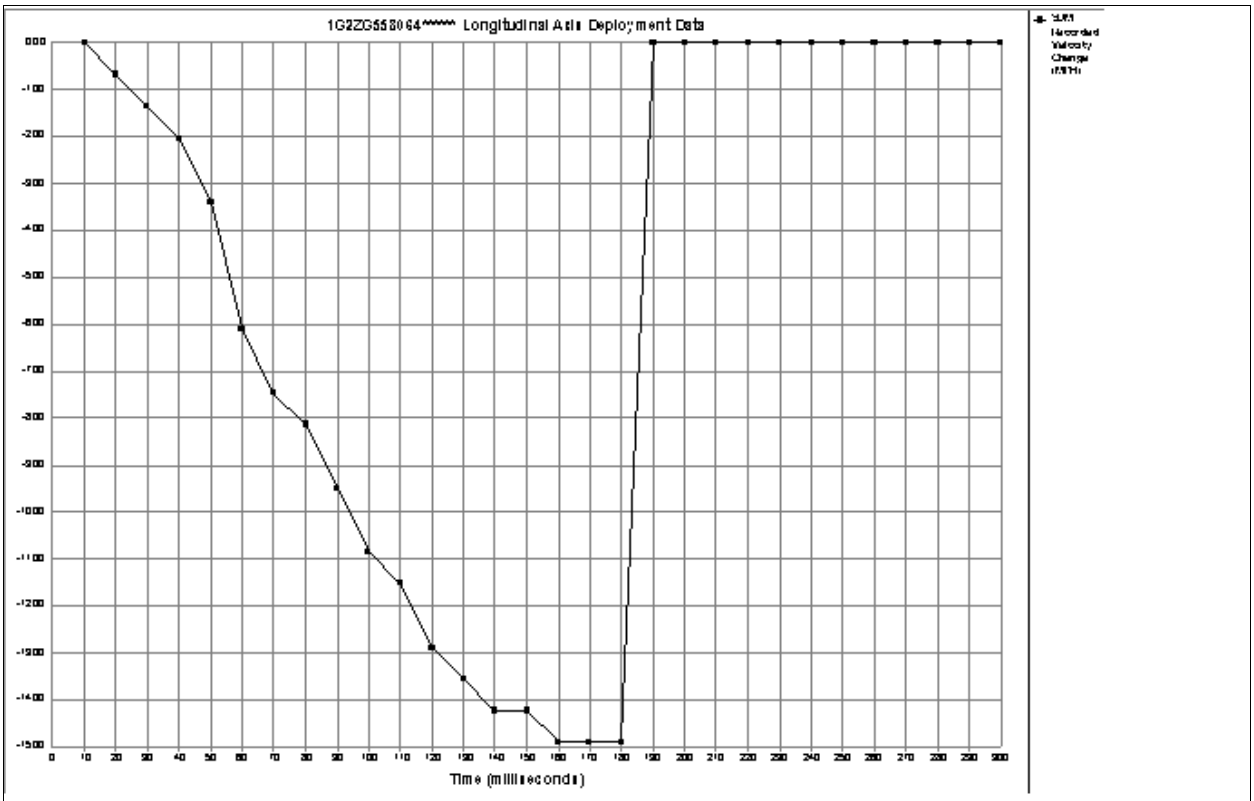
Pre-crash data

Parameter	-5 sec	-4 sec	-3 sec	-2 sec	-1 sec
Vehicle Speed (MPH)	45	45	45	45	42
Engine Speed (RPM)	1344	1216	1280	1216	1216
Percent Throttle	25	13	0	0	9
Brake Switch Circuit Status	OFF	OFF	OFF	OFF	ON
Accelerator Pedal Position (percent)	29	18	0	0	20
Antilock Brake System Active (If Equipped)	No	No	No	No	No
Lateral Acceleration (feet/s²)(If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Yaw Rate (degrees per second) (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid
Steering Wheel Angle (degrees) (If Equipped)	-16	-16	-16	-16	32
Vehicle Dynamics Control Active (If Equipped)	Invalid	Invalid	Invalid	Invalid	Invalid

Figure 15: Case vehicle's System Status at AE, System Status at 1 Second and Pre-Crash Data

System Status At Deployment	
Ignition Cycles At Investigation	1483
SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time (seconds)	655200
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	1467
Ignition Cycles At Event	1468
Ignition Cycles Since DTCs Were Last Cleared	254
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	UNBUCKLED
Diagnostic Trouble Codes at Event, fault number: 1	N/A
Diagnostic Trouble Codes at Event, fault number: 2	N/A
Diagnostic Trouble Codes at Event, fault number: 3	N/A
Diagnostic Trouble Codes at Event, fault number: 4	N/A
Diagnostic Trouble Codes at Event, fault number: 5	N/A
Diagnostic Trouble Codes at Event, fault number: 6	N/A
Automatic Passenger SIR Suppression System Validity Status at AE	Valid
Automatic Passenger SIR Suppression System Status at AE	Air Bag Suppressed
Automatic Passenger SIR Suppression System Validity Status at First Deployment Command	Valid
Automatic Passenger SIR Suppression System Status at First Deployment Command	Air Bag Suppressed
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	52
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	Disposal
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	Suppressed
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	Suppressed
Time Between Events (sec)	N/A
Driver First Stage Deployment Loop Commanded	Yes
Driver Second Stage Deployment Loop Commanded	Yes
Driver Side Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop Commanded	Yes
Driver (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Driver (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Driver Knee Deployment Loop Commanded	No
Passenger First Stage Deployment Loop Commanded	No
Passenger Second Stage Deployment Loop Commanded	No
Passenger Side Deployment Loop Commanded	No
Passenger Pretensioner Deployment Loop Commanded	Yes
Passenger (Initiator 1) Roof Rail/Head Curtain Loop Commanded	No
Passenger (Initiator 2) Roof Rail/Head Curtain Loop Commanded	No
Passenger Knee Deployment Loop Commanded	No
Second Row Left Side Deployment Loop Commanded	No
Second Row Left Pretensioner Deployment Loop Commanded	No
Third Row Left Roof Rail/Head Curtain Loop Commanded	No
Second Row Right Side Deployment Loop Commanded	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Third Row Right Roof Rail/Head Curtain Loop Commanded	No
Second Row Center Pretensioner Deployment Loop Commanded	No
Driver 2nd Stage Deployment Loop Commanded for Disposal	Yes
Passenger 2nd Stage Deployment Loop Commanded for Disposal	No
Multiple Event Counter	0
An Event(s) Preceded the Recorded Event(s)	No
An Event(s) was in Between the Recorded Event(s)	No
An Event(s) Followed the Recorded Event(s)	No
The Event(s) Not Recorded was a Deployment Event(s)	No
The Event(s) Not Recorded was a Non-Deployment Event(s)	No
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Deployment Event Recorded in the Non-Deployment Record	No
Event Recording Complete	Yes
Estimated Principal Direction of Force (PDOF) degrees	340

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

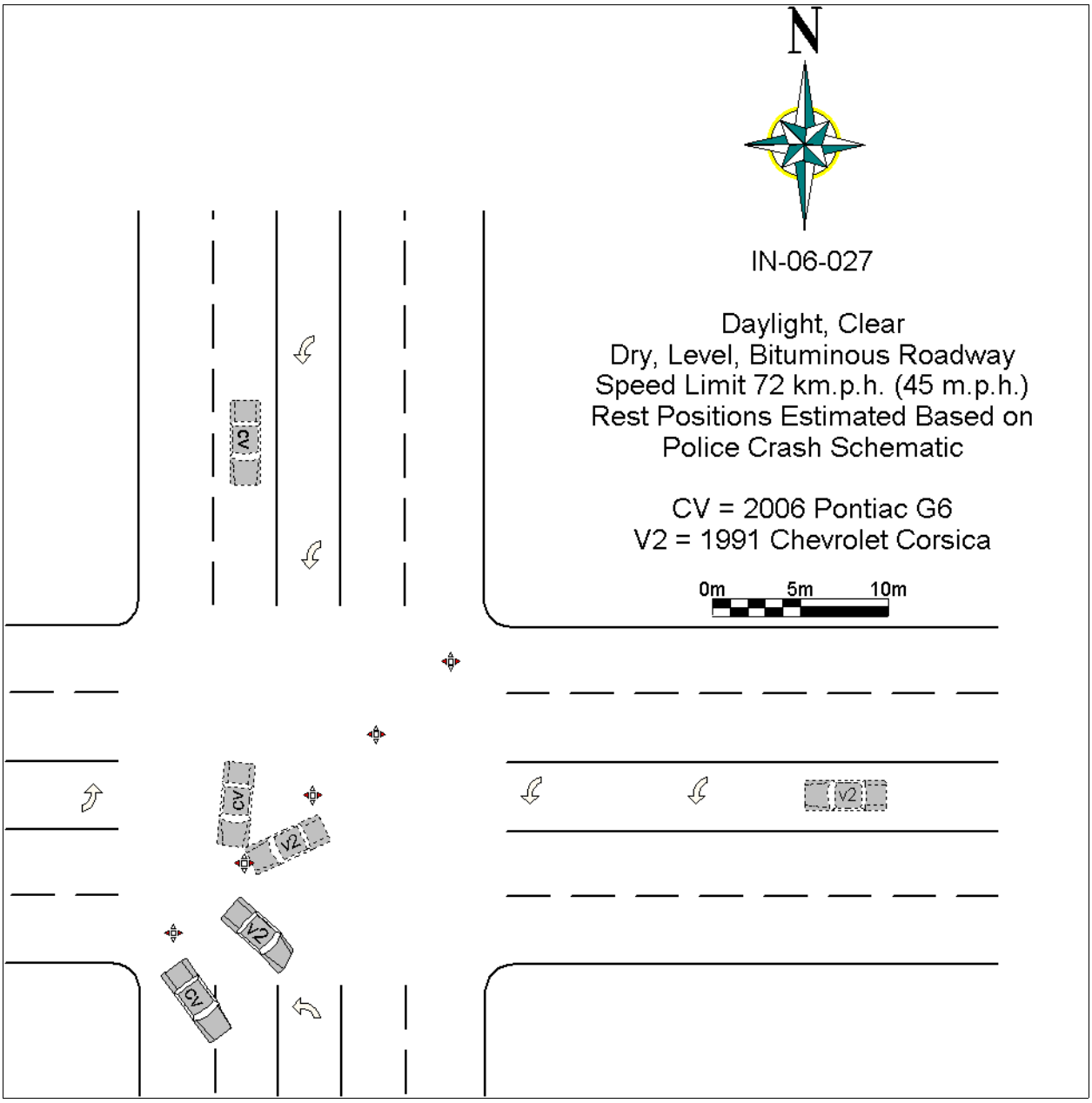


Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Longitudinal Axis Recorded Velocity	0.00	-0.68	-1.36	-2.03	-3.39	-6.10	-7.46	-8.13	-9.49	-10.85	-11.52	-12.88	-13.56	-14.23	-14.23
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Longitudinal Axis Recorded Velocity	-14.91	-14.91	-14.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 17: Case vehicle's deployment longitudinal velocity change graph

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.68	2.03	2.71	2.71	2.71	3.39	4.74	4.74	5.42	5.42	5.42	5.42	5.42
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Lateral Axis Recorded Velocity Change (MPH)	5.42	5.42	5.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 18: Case vehicle's deployment lateral velocity change graph


N
IN-06-027
Daylight, Clear
Dry, Level, Bituminous Roadway
Speed Limit 72 km.p.h. (45 m.p.h.)
Rest Positions Estimated Based on
Police Crash Schematic
CV = 2006 Pontiac G6
V2 = 1991 Chevrolet Corsica
0m 5m 10m
CV
V2
V2
V2
CV