INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER
School of Public and Environmental Affairs
501 S. Madison Street–Suite 105
Bloomington, Indiana 47403-2452
(812) 855-3908 Fax: (812) 855-3537

ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE INVESTIGATION

CASE NUMBER - IN08017
LOCATION - INDIANA
VEHICLE - 2007 CHEVROLET TRAILBLAZER LS
CRASH DATE - April 2008

Submitted:

March 21, 2009

Contract Number: DTNH22-07-C-00044

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.* IN08017	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* On-Site Certified Advanced 208-Compliant Vehicle Investigation Vehicle - 2007 Chevrolet Trailblazer LS Location - Indiana		5. *Report Date:* March 21, 2009 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 501 South Madison Street, Suite 105 Bloomington, Indiana 47403-2452		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-07-C-00044	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NVS-411) 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: April 2008 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* On-site Certified Advanced 208-Compliant Vehicle investigation involving a 2007 Chevrolet Trailblazer LS and a 2008 Pontiac G6.			
16. *Abstract* This report covers an on-site investigation of a crash that involved a 2007 Chevrolet Trailblazer LS and a 2008 Pontiac G6. The focus of this on-site investigation was the Chevrolet, which was certified by the manufacturer to be compliant to the Advanced Air Bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The Chevrolet was traveling south and the Pontiac was traveling north on a 2-lane highway. The Pontiac departed the right side of the roadway and impacted a guardrail, a bridge rail, and a concrete bridge rail anchor. The Pontiac rotated clockwise into the Chevrolet's travel lane where the front of the Chevrolet impacted the Pontiac's left side. The impact caused a stage 2 deployment of the Chevrolet's driver and front right passenger frontal air bags. The Chevrolet's restrained driver sustained fractures of the right foot and multiple contusions, abrasions, and lacerations. The restrained front right passenger sustained multiple contusions and abrasions. The unrestrained second row right passenger sustained fractures of both arms and multiple contusions and abrasions. All three occupants were transported from the crash scene by ambulance to a hospital. The driver and front right passenger were treated and released from the emergency room. The second row right passenger was transferred to a second hospital and admitted.			
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* 20	22. *Price*

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

TABLE OF CONTENTS IN08017

This crash was brought to the National Highway Traffic Safety Administration's attention on April 24, 2008 by Special Crash Investigation (SCI) team 2. This on-site investigation was assigned on April 29, 2008. The crash involved a 2007 Chevrolet Trailblazer LS and a 2008 Pontiac G6. The focus of this on-site investigation was the Chevrolet (**Figure 1**), which was equipped with an frontal air bag system that was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The crash occurred in April, 2008 at 1116 hours in Indiana and was investigated by the applicable county sheriff's department. This contractor inspected the Chevrolet and imaged the Event Data Recorder (EDR) on April 30, 2008. The Pontiac and crash scene were inspected and the driver and front right passenger were interviewed. This report is based on the police crash report, crash scene inspection, vehicle inspections, the Chevrolet occupant's medical records, occupant kinematic principles, and this contractor's evaluation of the evidence.

Figure 1: The damaged 2007 Chevrolet Trailblazer LS

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the Chevrolet and Pontiac were traveling was a two-lane, state highway, traversing in a north and south direction, and the crash occurred on a bridge. Each travel lane was 3.4 m (11.2 ft) in width. The south lane was bordered by a bituminous shoulder 2.7 m (8.9 ft) in width. The north lane was bordered by a bituminous shoulder 1.3 m (4.3 ft) in width. Both sides of the roadway were also bordered by a steel W-beam guardrail on the approach to the bridge. The roadway pavement markings consisted of white edge lines and double yellow center lines. The Chevrolet's roadway was curved to the right (west) and was a transition from a divided state highway off ramp. The speed limit was 56 km/h (35 mph). The Pontiac's roadway was curved to the right (east) and the speed limit was 88 km/h (55 mph). At the time of the crash, the light condition was daylight, the atmospheric condition was clear, and the roadway pavement was dry, level bituminous. Traffic density was light and the site of the crash was rural. See the Crash Diagram on page 14 of this report.

Pre-Crash: The Chevrolet was occupied by a restrained 53-year-old female driver, a restrained 24-year-old female front right passenger, and an unrestrained 34-year-old male second row right passenger. The Pontiac was being driven by a restrained 78-year-old male. The Chevrolet was southbound approaching a bridge (**Figure 2**) after exiting the highway off ramp and the driver intended to continue south. The Pontiac was traveling north approaching the bridge and the driver intended to continue north (**Figure 3**). The impact between the two vehicles occurred on the bridge in the south lane of the roadway. The Chevrolet's driver attempted to avoid the crash by

applying the brakes. The police investigator measured 25 meters (83 feet) of pre-impact, anti-lock braking tire marks.

Crash: As the Chevrolet was approaching the bridge, the Pontiac departed the east (right) side of the roadway and impacted a guardrail (event 1, **Figure 3**). The Pontiac traveled along the guardrail for 41 meters (134 feet) and its front right corner impacted the end of the bridge rail and concrete bridge rail anchor (event 2, **Figure 4**). The Pontiac's right front wheel snagged on the bridge rail anchor, which tore the wheel and suspension off the vehicle and caused the Pontiac to rotate clockwise. The impact redirected the vehicle to the northwest and it traversed 27 m (88.6 ft) across the roadway (**Figure 4**) while rotating clockwise 105 degrees. The back of the Pontiac impacted the west bridge rail (event 3, **Figure 5**) as the Chevrolet was skidding south toward the Pontiac's left side. The back remained engaged with the bridge rail as the Pontiac slid broadside an additional 6.4 m (21 ft) where the front of the Chevrolet (**Figure 6**) impacted its left side (event 4, **Figure 7**). The Chevrolet's direction of principal force was within the 12 o'clock sector and the impact force was sufficient to trigger a first stage deployment of the driver and front right passenger frontal air bags. As a result of this impact, the Pontiac rotated clockwise and its left quarter panel impacted the Chevrolet's right front door (event 5). The Chevrolet rotated clockwise 30 degrees and came to final rest on the southbound lane facing southwest (**Figure 8**). The Pontiac came to final rest next to the west bridge rail facing south.

Figure 2: South approach of Chevrolet; number on pavement designates meters to impact area

Figure 3: Northbound approach of Pontiac; arrow shows area of Pontiac's initial guardrail impact (guardrail had been replaced)

Figure 4: Arrow on right shows location of Pontiac's impact with end of east bridge rail and concrete bridge rail anchor, arrow on left shows area of impact with the Chevrolet

Post-Crash: The police, emergency medical and rescue services responded to the crash scene. The Chevrolet's driver and second row right passenger were removed from the vehicle by medical personnel. The front right passenger exited the vehicle without assistance. All of the occupants of the Chevrolet were transported by ambulance to a hospital. The driver of the Pontiac was pronounced deceased at the scene and both vehicles were towed due to damage.

Figure 5: The back of Pontiac impacted the west bridge rail; arrow shows area of impact between front of the Chevrolet and left side of the Pontiac

Figure 6: Damage to front of Chevrolet from impact with the Pontiac

Figure 7: Damage to left side of Pontiac from impact with the Chevrolet

Figure 8: View south from Chevrolet's approach to area of impact between the Chevrolet and Pontiac; arrow on left shows final rest location of the Chevrolet; arrow on right shows final rest location of the Pontiac

CASE VEHICLE

Case Vehicle: The 2007 Chevrolet Trailblazer LS was a 4-wheel drive, 4-door sport utility vehicle (VIN: 1GNDT13S072-------) equipped with a 4.2L, 6-cylinder engine, automatic transmission, 4-wheel anti-lock brakes with electronic brake force distribution, electronic stability control, a tire pressure monitoring system, and an EDR. The front row was equipped with bucket seats, adjustable head restraints, integral lap-and-shoulder belts, and dual stage driver and front right passenger frontal air bags. The second row was equipped with a split bench seat with folding backs, lap-and-shoulder belts, head restraints in the outboard seating positions, and Lower Anchors and Tethers for Children (LATCH) in the outboard seating positions.

CASE VEHICLE DAMAGE

Exterior Damage: The Chevrolet's front impact with the Pontiac involved the front of the vehicle. The bumper, bumper fascia, hood, right and left fenders, grille, and the right and left headlamp/turn light assemblies were directly damaged. The direct damage began at the front left bumper corner and extended 122 cm (48 in) across the full width of the bumper bar. The crush

measurements were taken on the bumper bar and the maximum residual crush was 18.0 cm (7.1 in) occurring 13 cm (5.1 in) right of C_3. The table below shows the vehicle's crush profile for the front 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	122	18	122	3	5	17	12	2	11	0	0
in		48.0	7.1	48.0	1.2	2.0	6.7	4.7	0.8	4.3	0.0	0.0

The Chevrolet's right side plane impact with the Pontiac involved the right front door. The damage was minor and limited to the door. The direct damage began 238 cm (93.7 in) forward of the right rear axle and extended 119 cm (46.9 in) rearward. The maximum residual crush was 2 cm (0.8 in) occurring at C_2. The table below shows the right front door crush profile.

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	2	119	2	119	0	2	1	1	1	0	32	32
in		46.9	0.8	46.9	0.0	0.8	0.4	0.4	0.4	0.0	12.6	12.6

The vehicle's right side wheelbase was shortened 14.0 cm (5.5 in) and the left side wheelbase was shortened 4.0 cm (2.4 in). Induced damage involved both fenders, the hood and the right front door.

Damage Classification: The Chevrolet's Collision Deformation Classifications (CDC) were **12-FDEW-1** (**0** degrees) for the front impact and **03-RPEW-1** (**90** degrees) for the right front door impact. The Missing Vehicle algorithm of the WinSMASH program calculated the Chevrolet's total Delta V for the front impact as 23 km/h (14.3 mph). The longitudinal and lateral velocity changes were -23 km/h (-14.3 mph) and 0 km/h. The Missing Vehicle algorithm of the WinSMASH program calculated the Chevrolet's total Delta V for the right front door impact as 5 km/h (3.1 mph). The longitudinal and lateral velocity changes were 0 km/h and -5 km/h (-3.1 mph). The results for both runs were borderline because they are based only on the Chevrolet's crush profiles. The EDR recorded a maximum longitudinal velocity change for the front impact of -45.09 km/h (-28.02 mph).

The Chevrolet's recommended tire size was P245/65R17. The Chevrolet was equipped with the recommended size tires. The Chevrolet's tire data are shown in the table below.

Tire	*Measured Pressure*		*Vehicle Manufacturer's Recommended Cold Tire Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kPa	psi	kPa	psi	milli-meters	32nd of an inch			
LF	Flat	Flat	207	30	8	10	None	No	Yes
LR	234	34	207	30	7	9	None	No	No
RR	228	33	241	35	7	9	None	No	No
RF	234	34	241	35	6	8	None	Yes	No

Vehicle Interior: The inspection of the Chevrolet's interior (**Figure 9**) revealed numerous areas of occupant contact evidence. Scuff marks from loading by the driver's knees were located on the knee bolster on each side of the steering column. The right half of the steering wheel rim was deformed 1 cm (0.4 in) as a result of the driver riding down the air bag and loading the steering wheel. The glove box door was cracked and scuffed due to loading by the front right passenger's knees. The front right seat back was displaced forward (**Figure 10**) due to loading by the unrestrained second row right passenger, and the second row right seat cushion was scuffed. All of the doors remained closed and operational and there was no damage or occupant contact to any of the window glazing. The passenger compartment sustained no intrusion.

Figure 9: View of the front row from the left front door

Figure 10: Deformation of the front right passenger seat back due to loading by the unrestrained second row right passenger

EVENT DATA RECORDER

The imaging of the Chevrolet's EDR was done via direct connection to the Sensing and Diagnostic Module (SDM). The EDR report is attached at the end of this report[1]. The EDR recorded a deployment event. The event recoding was complete and no associated events were recorded. The SIR warning lamp was recorded as off and the driver's and front right passenger's

[1] Please note that the attached EDR report does not include the hexadecimal data for confidentiality reasons.

seat belt switch circuits were recorded as buckled. The driver and front right passenger seat position switch circuits were recorded as rearward and both seat belt pretensioners were commanded to deploy. The report also indicated that a first stage deployment of the driver and front right passenger air bags was commanded. The time from Algorithm Enable (AE) to deployment command was 20 msec. The maximum longitudinal velocity change was recorded as -45.09 km/h (-28.02 mph) occurring at the 60 msec point of recorded data.

The pre-crash data recorded the vehicle's travel speed as 74 km/h (46 mph) at 2.5 sec prior to AE. The brake switch circuit was recorded as on at 1 sec prior to AE and remained on to the end of the pre-crash recording at 0.5 sec. The vehicle's speed was recorded as 72 km/h (45 mph) and 56 km/h (35 mph) at 1 sec and 0.5 sec prior to AE, respectively.

AUTOMATIC RESTRAINT SYSTEM

The Chevrolet was equipped with a Certified Advanced 208-Compliant (CAC) frontal air bag system that consisted of dual stage driver and front right passenger frontal air bags, seat belt usage sensors, driver and front right passenger seat position sensors, buckle-mounted pretensioners, and a front right passenger weight sensor. The frontal air bag sensors were located on the left and right lower front cross member. The manufacturer has certified that the vehicle is compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

The Chevrolet's driver air bag was located in the steering wheel hub. The air bag module cover flaps (**Figure 11**) were constructed of vinyl, and the tear seams were configured horizontally across the top, bottom, and vertically down the middle. Each module flap was 7.5 cm (3 in) in width at the top, 4.3 cm (1.7 in) in width at the bottom and 13 cm (5.1 in) in height at the vertical tear seam. The cover flaps separated at the designated tear points during the deployment and there was no evidence of damage or occupant contact on the cover flaps or the air bag fabric. The deployed driver's air bag (**Figure 12**) was round with a diameter of 68 cm (26.8 in). The air bag was designed with four tethers and two vent ports.

Figure 11: Driver's air bag module cover flaps; steering wheel rotated counterclockwise 90 degrees

Figure 12: Driver's air bag

The front right passenger air bag was located in the middle of the instrument panel. The air bag module cover flap (**Figure 13**) was constructed of vinyl and hinged at the top. The cover flap was 33 cm (13 in) in width and 13 cm (5.1 in) in height. There was no evidence of damage or occupant contact on the cover flap or the air bag fabric. The deployed front right passenger air bag (**Figure 14**) was square with a length and width of 50 cm (19.7 in). The air bag was designed with one tether and two vent ports.

Figure 13: The front right passenger air bag module cover flap (arrow)

Figure 14: Front right passenger air bag

MANUAL RESTRAINT SYSTEM

The Chevrolet was equipped with integral lap-and-shoulder belts in the driver and front right passenger seating positions. The driver's seat belt consisted of continuous loop belt webbing, buckle-mounted pretensioner, sliding latch plate, and an Emergency Locking Retractor (ELR). The front right seat belt was similarly equipped but had a switchable ELR/Automatic Locking Retractor (ALR). The three second row seat belts consisted of continuous loop belt webbing, sliding latch plates, switchable ELR/ALRs, and fixed upper anchors.

Inspection of the driver's seat belt assembly revealed load abrasions on the belt webbing (**Figure 15**), retractor housing (**Figure 16**), and the latch plate belt guide. While the EDR indicated that the pretensioner actuated, the retractor was not jammed and would retract the seat belt. The belt loading evidence indicated that the driver was restrained by the lap-and-shoulder belt.

Figure 15: Load mark on driver's seat belt

Inspection of the front right passenger's seat belt assembly revealed load abrasions on the belt webbing, latch plate belt guide (**Figure 17**), and retractor housing (**Figure 18**). The retractor was jammed indicating that the pretensioner actuated during the crash. The evidence indicated that the front right passenger was restrained by the lap-and-shoulder belt.

Inspection of the second row right passenger's seat belt assembly revealed no evidence of loading. The passenger also loaded the front right seat back during the crash and bent it forward. The evidence indicated that the second row right passenger was not restrained. The remaining seat positions were unoccupied.

Figure16: Load abrasions on driver's seat belt housing

Figure 17: Load abrasions on front right seat belt webbing (arrows) and latch plate

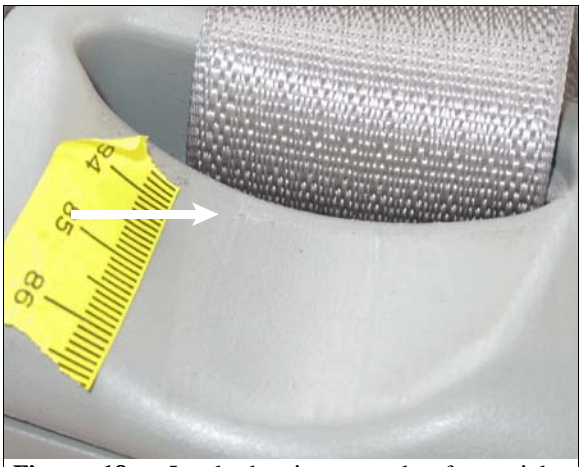


Figure 18: Load abrasions on the front right passenger's seat belt housing (arrow)

CASE VEHICLE DRIVER KINEMATICS

The Chevrolet's driver [53-year-old, female; 163 cm and 100 kg (64 in, 220 lbs)] was seated in an upright posture with her back against the seat back, both hands on the steering wheel and was bracing for impact. Her right foot was on the brake pedal and her left foot was on the floor. The seat track was adjusted to the middle position and the seat back was slightly reclined. The tilt steering wheel was located in the full up position and the driver was wearing glasses.

The Chevrolet's frontal impact with the Pontiac displaced the driver forward opposite the 12 o'clock direction of force and she loaded the seat belt, which caused contusions on the right breast and abdomen. Her face and chest loaded the deployed air bag, which caused an abrasion on the anterior neck. Her knees loaded the knee bolster and her right foot loaded the brake pedal. The interaction with the brake pedal resulted in a fracture of the right lateral malleolus and a fracture with impaction of the neck of the talus. The driver also sustained multiple abrasions, contusions, and lacerations. The driver remained restrained in her seat as the vehicle came to rest.

CASE VEHICLE DRIVER INJURIES

The driver was treated in a hospital emergency room and released. She had persistent swelling of the right foot and multiple follow-up doctor visits. The process of diagnosis and

treatment of the foot injury spanned four months. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Fracture, closed, incomplete, non-displaced right lateral malleolus	moderate 851608.2,1	Floor, foot controls {Indirect injury}	Certain	Interviewee (same person)
2	Fracture, impaction[2], involving dorsal[1]-medial aspect of neck of talus with adjacent fragments	moderate 853200.2,1	Floor, foot controls {Indirect injury}	Certain	Interviewee (same person)
3	Contusion of talus bone, result of inversion injury[3]	minor 850202.1,1	Floor, foot controls {Indirect injury}	Certain	Interviewee (same person)
4	Abrasion anterior neck with swelling	minor 390202.1,5	Air bag, driver's	Probable	Emergency room records
5	Contusion over right breast area	minor 490402.1,1	Torso portion of safety belt system	Certain	Emergency room records
6	Contusion {soft tissue injury} with edema transverse across lower anterior abdomen	minor 590402.1,8	Lap portion of safety belt system	Certain	Emergency room records
7	Abrasions right antecubital fossa, right elbow, and right proximal posterior forearm	minor 790202.1,1	Center instrument panel	Probable	Emergency room records
8	Contusion right elbow, not further specified	minor 790402.1,1	Center instrument panel	Probable	EMS treatment record
9	Laceration right antecubital fossa and right elbow	minor 790600.1,1	Center instrument panel	Probable	Emergency room records
10	Abrasions right distal lower leg/ankle	minor 890202.1,1	Floor, including toe pan	Probable	Emergency room records
11	Contusion, significant, right toes[2] and lateral ankle with swelling	minor 890402.1,1	Floor, foot controls {Indirect injury}	Certain	Emergency room records

[2] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
dorsum (dor′sem): 1. the back. 2. the aspect of an anatomical part or structure corresponding in position to the back; posterior, in the human.
d. of foot: d. pedis.
d. pe′dis: the upper surface of the foot; the surface opposite the sole.
fracture (frak′cher): 1. the breaking of a part, especially a bone. 2. a break or rupture in a bone.
impacted f.: fracture in which one fragment is firmly driven into the other.

[3] This refers to an inversion ankle sprain (i.e., the bottom of the foot is rotated inward) that resulted in a torn lateral collateral ligament complex and a high-grade tear of the anterior talofibular ligament and resulted in blood poling at the toes.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
12	Laceration right foot, not further specified	minor 890600.1,1	Floor, foot controls	Possible	Emergency room records
13	Contusion dorsum right mid and fore foot	minor 890402.1,1	Floor, foot controls	Certain	Emergency room records

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The front right passenger [24-year-old, female; 173 cm and 57 kg (68 in, 125 lbs)] was seated in a upright posture. Just prior to the crash sequence, the passenger was facing the driver and was carrying on a conversation, but she turned back facing forward when the driver applied the brakes. She had both feet on the floor and her hands in her lap. The seat track was adjusted to the middle position and the seat back was slightly reclined. The passenger was wearing glasses.

The front impact displaced the passenger forward opposite the 12 o'clock direction of force and she loaded the seat belt, which caused abrasions over the right hip, iliac crest, and right shoulder. While there was no discernable occupant contact evidence on the air bag, the passenger's face, chest and left forearm probably contacted the deployed air bag, and she sustained a contusion on the left forearm. Both of her knees loaded and fractured the glove box door (**Figure 19**), which caused an abrasion and contusion on each knee. The unrestrained second row right passenger loaded the front right seat back and displaced it forward into the front right passenger, which caused a contusion on the back of her left shoulder. The passenger remained restrained in her seat as the vehicle came to rest.

Figure 19: Scuff marks and crack in glove box door from contact by front right passenger's knees

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right passenger was treated and released from a hospital emergency room. The table below shows the passenger's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Abrasion over right hip and over right iliac crest	minor 590202.1,1	Lap portion of safety belt system	Certain	Emergency room records

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
2	Contusion {bruise}, 15.2 cm (6 in), on right hip, not further specified	minor 590402.1,1	Lap portion of safety belt system	Certain	Interviewee (same person)
3	Abrasion, superficial, over posterior right shoulder and scapula	minor 790202.1,1	Torso portion of safety belt system	Certain	Emergency room records
4	Contusion {bruise} on back of left shoulder	minor 790402.1,2	Seat back, front right passenger's	Certain	Interviewee (same person)
5	Contusion {bruise}, 7.6 cm (3 in) on inside of left forearm	minor 790402.1,2	Air bag, front right passenger's	Probable	Interviewee (same person)
6	Abrasion, superficial, over anterior left and right knees	minor 890202.1,3	Glove compartment door	Certain	Emergency room records
7	Contusions over anterior right knee and proximal tibia and over left anterior tibia, below knee	minor 890402.1,3	Glove compartment door	Certain	Interviewee (same person)

CASE VEHICLE SECOND ROW RIGHT KINEMATICS

The second row right passenger [34-year-old, male; 160 cm and 73 kg (63 in and 160 lbs)] was seated in an upright posture with his back against the seat back and both feet on the floor. The passenger was not wearing glasses.

When the Chevrolet's driver applied the brakes, the passenger braced with both hands on the front right seat back. The Chevrolet's front impact with the Pontiac displaced the passenger forward and he loaded both arms and his upper body against the front right seat back (**Figure 10**). He sustained a fracture of the left distal humerus and displaced fractures of the right radius and ulna from loading the seat back. He also sustained multiple contusions and abrasions involving the sternum, abdomen, both forearms, and the left wrist, also as a result of loading the front right seat back.

CASE VEHICLE SECOND ROW RIGHT INJURIES

The second row right passenger was treated in the emergency room of a local hospital and transferred to second hospital where he was hospitalized for four days. The table below shows the driver's injuries and injury sources.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source	Source Confidence	Source of Injury Data
1	Fracture, open, left distal humerus supracondylar region	serious 752604.3,2	Seat back, front right passenger's	Certain	Emergency room records
2	Fracture, transverse, mid-to-distal shaft right radius with displacement	serious 752804.3,1	Seat back, front right passenger's	Certain	Emergency room records
3	Fracture, transverse, mid-to-distal shaft right ulna with displacement	serious 753204.3,1	Seat back, front right passenger's	Certain	Emergency room records
4	Contusion over sternum, not further specified	minor 490402.1,4	Seat back, front right passenger's	Certain	Emergency room records
5	Contusion over upper abdominal wall, not further specified	minor 590402.1,7	Seat back, front right passenger's	Certain	Emergency room records
6	Abrasions, superficial, over right and left forearms, not further specified	minor 790202.1,3	Seat back, front right passenger's	Certain	Emergency room records
7	Contusion over volar[4] aspect right forearm, not further specified	minor 790402.1,1	Seat back, front right passenger's	Certain	Emergency room records
8	Contusion over volar aspect left wrist, not further specified	minor 790402.1,2	Seat back, front right passenger's	Probable	Emergency room records

OTHER VEHICLE

The 2008 Pontiac G6 was a front-wheel drive, four door sedan (VIN: 1G2ZF57BX84------), equipped with a 2.4L, 4-cylinder engine and automatic transmission. The vehicle was also equipped with four wheel anti-lock brakes with electronic brake force distribution, traction control, dual stage driver and front right passenger frontal air bags, and driver and front right passenger lap-and-shoulder belts. The frontal air bag system was certified by the manufacturer to be compliant to the Advanced Air Bag portion of the Federal Motor Vehicle Safety Standard (FMVSS) No. 208.

Figure 19: Damage to right side and back of the Pontiac from multiple impacts

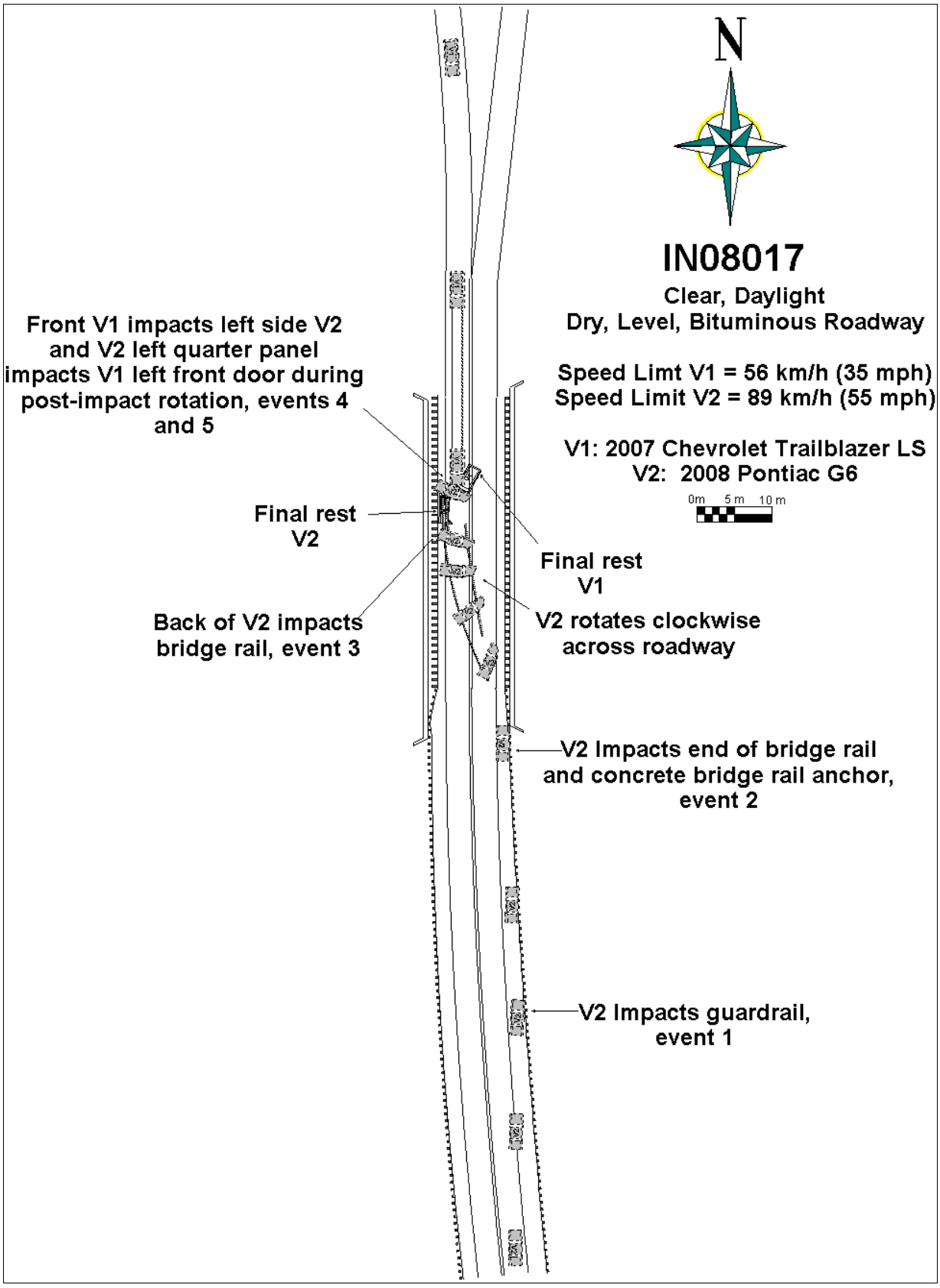
Exterior Damage: The Pontiac's impact with the Chevrolet involved the left side of the vehicle (**Figure 7**) . It sustained direct damage to the left

[4] The following term is defined in DORLAND'S ILLUSTRATED MEDICAL DICTIONARY as follows:
volar (vo'ler): pertaining to the palm or sole; plantar; indicating the flexor surface of the forearm, wrist, or hand.

fender and both left side doors. Crush measurements could not be taken on the left side due to extensive alteration of the vehicle from rescue operations. Both left side doors had been cut off the vehicle, the left A and B pillars had been cut, and the B pillar displaced. The left front door was not present at the inspection. The front, entire right side and the back were extensively damaged due to the impact with the guard rail and bridge rails (**Figure 19**).

The Missing Vehicle algorithm of the WinSMASH program calculated the Pontiacs's total Delta V for the left side impact with the Chevrolet as 34 km/h (21.1 mph). The longitudinal and lateral velocity changes were 17 km/h (10.6) and 29 km/h (18.0 mph). The results are borderline because they are based only on the Chevrolet's front crush profile.

Pontiac's Driver: According to the police crash report, the Pontiac's driver [78-year-old, male; unknown height and weight)] was restrained by the lap-and-shoulder belt.


N
IN08017
Clear, Daylight
Dry, Level, Bituminous Roadway
Speed Limt V1 = 56 km/h (35 mph)
Speed Limit V2 = 89 km/h (55 mph)
V1: 2007 Chevrolet Trailblazer LS
V2: 2008 Pontiac G6
0m 5 m 10 m
Front V1 impacts left side V2 and V2 left quarter panel impacts V1 left front door during post-impact rotation, events 4 and 5
Final rest V2
Back of V2 impacts bridge rail, event 3
Final rest V1
V2 rotates clockwise across roadway
V2 Impacts end of bridge rail and concrete bridge rail anchor, event 2
V2 Impacts guardrail, event 1

CDR File Information

User Entered VIN	1GNDT13S072******
User	
Case Number	
EDR Data Imaging Date	
Crash Date	
Filename	IN08017.CDR
Saved on	Thursday, May 1 2008 at 08:27:55 AM
Collected with CDR version	Crash Data Retrieval Tool 2.900
Reported with CDR version	Crash Data Retrieval Tool 3.1
EDR Device Type	airbag control module
Event(s) recovered	Deployment

IMPORTANT NOTICE: Robert Bosch LLC recommends that the latest production release of Crash Data Retrieval software be utilized when viewing, printing or exporting any retrieved data from within the CDR program. This ensures that the retrieved data has been translated using the most recent information including but not limited to that which was provided by the manufacturers of the vehicles supported in this product.

Data Limitations

Recorded Crash Events:
There are two types of recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event records data but does not deploy the air bag(s). The minimum SDM Recorded Vehicle Velocity Change, that is needed to record a Non-Deployment Event, is five MPH. A Non-Deployment Event 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 velocity change. This event will be cleared by the SDM, after approximately 250 ignition cycles. This event can be overwritten by a second Deployment Event, referred to as Deployment Event #2, if the Non-Deployment Event is not locked. The data in the Non-Deployment Event file will be locked, if the Non-Deployment Event occurred within five seconds of a Deployment Event. A locked Non Deployment Event cannot be overwritten or cleared by the SDM.
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 a second Deployment Event occurs any time after the Deployment Event, the Deployment Event #2 will overwrite any non-locked Non-Deployment Event. Deployment Events cannot be overwritten or cleared by the SDM. Once the SDM has deployed an air bag, the SDM must be replaced.

Data:
-SDM Recorded Vehicle Velocity Change reflects the change in velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle 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. For Deployment Events, the SDM will record 230 milliseconds of data after deployment criteria is met and up to 70 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM can record up to the first 300 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.
-Maximum Recorded Vehicle Velocity Change is the maximum square root value of the sum of the squares for the vehicle's combined "X" and "Y" axis change in velocity.
-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 by various factors, including but not limited to the following:
  -significant changes in the tire's rolling radius
  -final drive axle ratio changes
  -wheel lockup and wheel slip
-Brake Switch Circuit Status indicates the open/closed state of the brake switch circuit.
-Pre-Crash data is recorded asynchronously.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if:
  -the SDM receives a message with an "invalid" flag from the module sending the pre-crash data
  -no data is received from the module sending the pre-crash data
  -no module present to send the pre-crash data
-Driver's and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit.

-The Time Between Non-Deployment to Deployment Events is displayed in seconds. If the time between the two events is greater than five seconds, "N/A" is displayed in place of the time. If the value is negative, then the Deployment 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.
-All data should be examined in conjunction with other available physical evidence from the vehicle and scene.

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.

Multiple Event Data

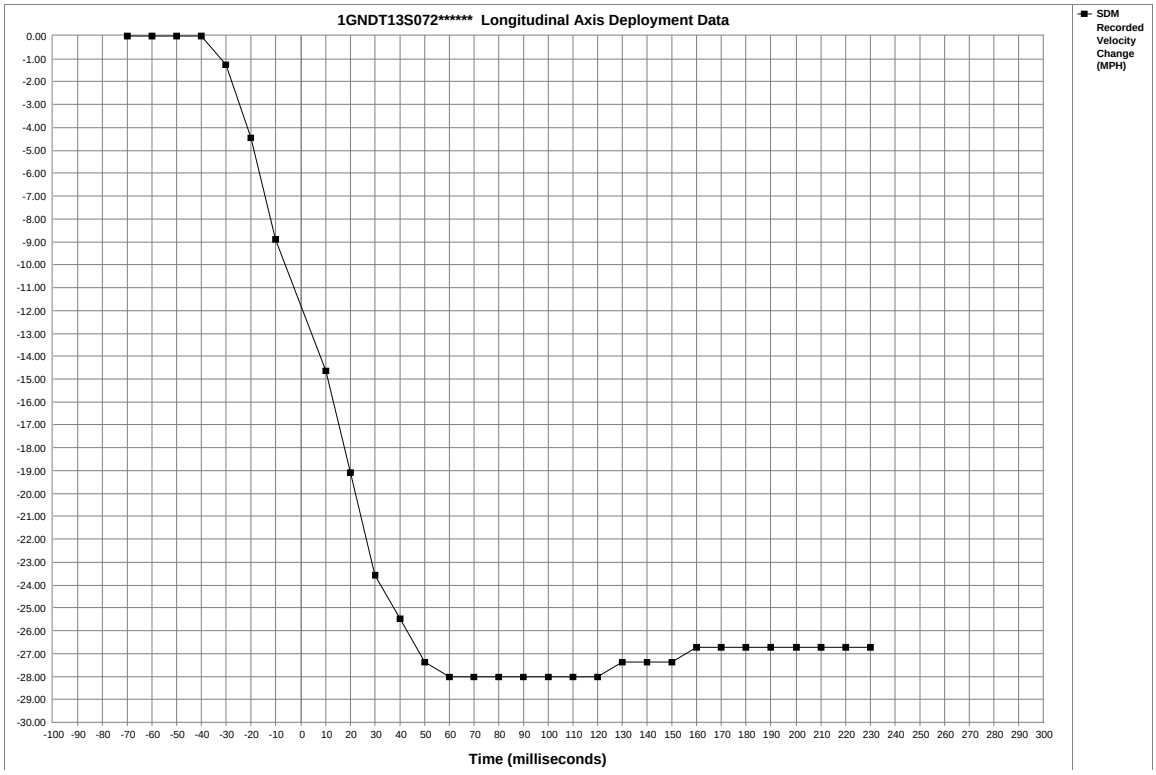
Associated Events Not Recorded	0
An Event(s) Preceded the Recorded Event(s)	No
An Event(s) was in Between the Recorded Event(s)	No
An Event(s) Followed the Recorded Event(s)	No
The Event(s) Not Recorded was a Deployment Event(s)	No
The Event(s) Not Recorded was a Non-Deployment Event(s)	No

Pre-Crash Data

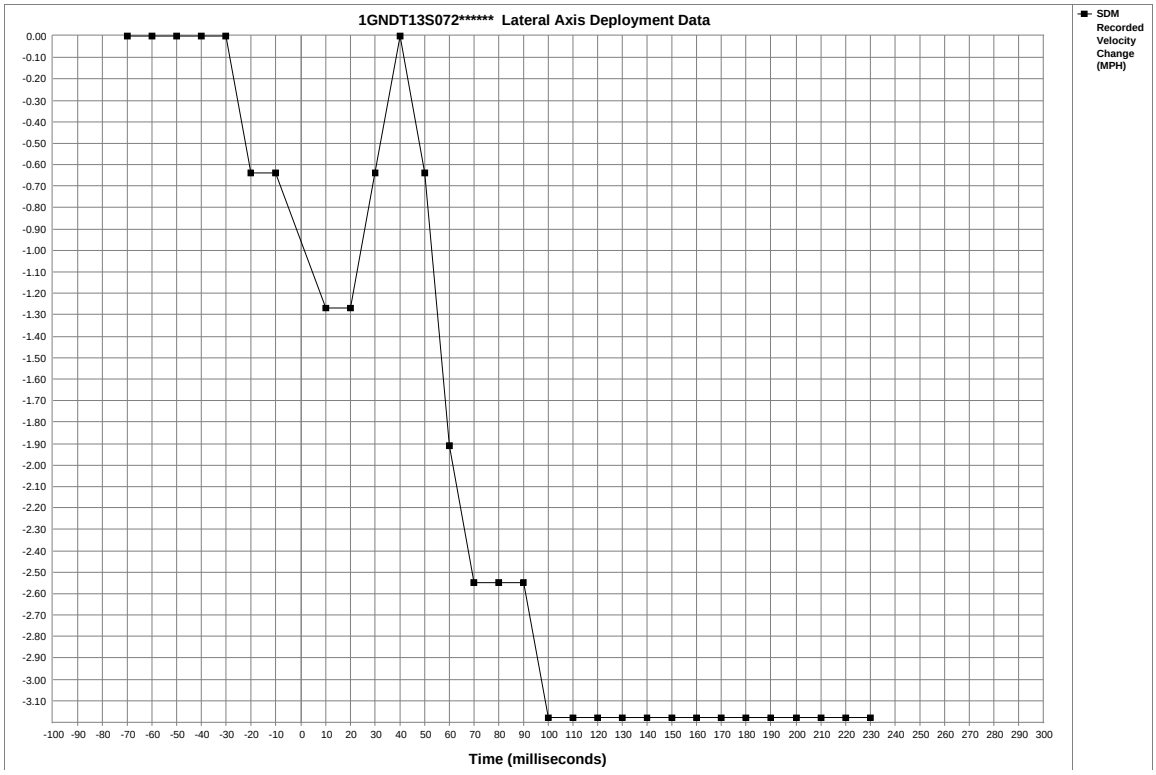
Parameter	-2.5 sec	-2.0 sec	-1.5 sec	-1.0 sec	-0.5 sec
Vehicle Speed (MPH)	46	47	47	45	35
Engine Speed (RPM)	1472	1728	1984	1344	1024
Percent Throttle	6	11	11	0	0
Brake Switch Circuit Status	OFF	OFF	OFF	ON	ON

System Status At Deployment

SIR Warning Lamp Status	OFF
SIR Warning Lamp ON/OFF Time Continuously (seconds)	655350
Number of Ignition Cycles SIR Warning Lamp was ON/OFF Continuously	2222
Ignition Cycles At Investigation	2268
Ignition Cycles At Event	2264
Ignition Cycles Since DTCs Were Last Cleared	255
Driver's Belt Switch Circuit Status	BUCKLED
Passenger's Belt Switch Circuit Status	BUCKLED
Driver Seat Position Switch Circuit Status	Rearward
Passenger Seat Position Switch Circuit Status	Rearward
Automatic Passenger SIR Suppression System Status	Air Bag Not Suppressed
Time Between Events (sec)	0
Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	20
Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Disposal
Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	20
Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec)	Disposal
Driver 1st Stage Time From Arming Signal to Deployment Command Signal	N/A
Driver 2nd Stage Time From Arming Signal to Deployment Command Signal	N/A
Passenger 1st Stage Time From Arming Signal to Deployment Command Signal	N/A
Passenger 2nd Stage Time From Arming Signal to Deployment Command Signal	N/A
Driver 1st Stage Field Effect Transistor (FET) on time	2.5
Driver 2nd Stage Field Effect Transistor (FET) on time	3.75
Passenger 1st Stage Field Effect Transistor (FET) on time	2.5
Passenger 2nd Stage Field Effect Transistor (FET) on time	3.75
Driver 1st Stage Deployment Loop Commanded	Yes
Driver 2nd Stage Deployment Loop Commanded	Yes
Driver Side Deployment Loop Commanded	No
Driver Pretensioner Deployment Loop Commanded	Yes
Driver Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Supplemental Deployment Loop #1 Commanded (If Equipped)	No
Passenger 1st Stage Deployment Loop Commanded	Yes
Passenger 2nd Stage Deployment Loop Commanded	Yes
Passenger Side Deployment Loop Commanded	No
Passenger Pretensioner Deployment Loop Commanded	Yes
Passenger Roof Rail/Head Curtain Loop Commanded (If Equipped)	No
Supplemental Deployment Loop #2 Commanded (If Equipped)	No
Second Row Left Side Deployment Loop Commanded	No
Second Row Left Pretensioner Deployment Loop Commanded (If Equipped)	No
Supplemental Deployment Loop #3 Commanded (If Equipped)	No
Second Row Right Side Deployment Loop Commanded (If Equipped)	No
Second Row Right Pretensioner Deployment Loop Commanded	No
Supplemental Deployment Loop #4 Commanded (If Equipped)	No
Supplemental Deployment Loop #4 Suppressed (If Equipped)	No
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
Diagnostic Trouble Codes at Event, fault number: 7	N/A
Diagnostic Trouble Codes at Event, fault number: 8	N/A
Diagnostic Trouble Codes at Event, fault number: 9	N/A
Crash Record Locked	Yes
Vehicle Event Data (Pre-Crash) Associated With This Event	Yes
Driver 1st Stage Deployment Algorithm Mode (Unbelted)	No Trigger Mode
Driver 1st Stage Deployment Algorithm Mode (Belted)	No Trigger Mode
Passenger 1st Stage Deployment Algorithm Mode (Unbelted)	No Trigger Mode
Passenger 1st Stage Deployment Algorithm Mode (Belted)	No Trigger Mode
Event Recording Complete	Yes



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	10	20	30	40	50	60	70	80
SDM Longitudinal Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	-1.27	-4.46	-8.91	-14.64	-19.10	-23.56	-25.47	-27.38	-28.02	-28.02	-28.02
Time (milliseconds)	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230
SDM Longitudinal Axis Recorded Velocity Change (MPH)	-28.02	-28.02	-28.02	-28.02	-27.38	-27.38	-27.38	-26.74	-26.74	-26.74	-26.74	-26.74	-26.74	-26.74	-26.74



Time (milliseconds)	-70	-60	-50	-40	-30	-20	-10	10	20	30	40	50	60	70	80
SDM Lateral Axis Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	-0.64	-0.64	-1.27	-1.27	-0.64	0.00	-0.64	-1.91	-2.55	-2.55
Time (milliseconds)	90	100	110	120	130	140	150	160	170	180	190	200	210	220	230
SDM Lateral Axis Recorded Velocity Change (MPH)	-2.55	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18	-3.18