**CRASH DATA RESEARCH CENTER**
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Buffalo, NY 14225

# CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH INVESTIGATION
**SCI CASE NO.: CA09066**

**VEHICLE: 2009 ACURA TSX SEDAN**

**LOCATION: NORTH CAROLINA**

**CRASH DATE: AUGUST 2009**

Contract No. DTNH22-07-C-00043

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

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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 are 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.

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## BACKGROUND

This on-site investigation focused on the Certified Advanced 208-Compliant frontal air bag system and the Advanced Compatibility Engineering (ACE) frame structure of a 2009 Acura TSX sedan **(Figure 1)** that was involved in an offset frontal crash with a 2003 Chevrolet Trailblazer. The Acura was equipped with four-wheel anti-lock brakes, a Certified Advanced 208-Compliant (CAC) frontal air bag system, front seat-mounted side impact air bags, and side impact Inflatable Curtain (IC) air bags. The manufacturer of the Acura has certified that the vehicle is compliant to the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) 208. The CAC system includes dual-stage frontal air bags for the driver and front right passenger positions, seat track positioning sensors, retractor pretensioners, safety belt buckle switches, and a front right occupant presence sensor. The front left corner area of the Acura was impacted by the front of the Chevrolet resulting in deployment of the driver's frontal air bag, the left side IC air bag and the left side impact air bag. The 53-year-old female driver of the Acura was transported to a local hospital and admitted for 5 days for the treatment of moderate-severity injuries.

**Figure 1: Left front oblique view of the 2009 Acura TSX.**

The vehicle was identified through a visit to a regional vehicle salvage facility on September 28, 2009. An image of the Acura was forwarded to the Crash Investigations Division for review on the same day. Based on the impact configuration and the severity of the damage to the Acura, this case was assigned to the Calspan Special Crash Investigations (SCI) team for an on-site investigation on September 29, 2009. The on-site investigation was initiated on September 30, 2009. The investigation involved the inspection and documentation of the Acura and the Chevrolet, imaging of the Chevrolet's Event Data Recorder (EDR), a detailed interview with the driver of the Acura, and the documentation of the crash site.

## *SUMMARY*

### *Crash Site*

This crash occurred during the daylight hours of August 2009 on a two-lane north/south rural roadway. The environmental conditions were rain with a wet roadway at the time of the crash. The roadway consisted of two asphalt surfaced travel lanes. Each traffic lane measured 3.3 m (10.8 ft) in width and was bordered by narrow asphalt shoulders. The west shoulder measured 0.6 m (2 ft) in width and the east shoulder measured 0.5 m (1.6 ft) in width. Grass roadsides, with embankments sloping away from the roadway, extended outboard of the shoulders. The embankment on the east roadside began 1.9 m (6.2 ft) east of the road edge and had a negative 25 percent grade. On the west roadside, the embankment began 1 m (3.2 ft) west of the road edge and had a negative 4.9 percent grade. In the pre-crash area for the Acura, the roadway was straight and had a level grade. The pre-crash area for the Chevrolet included a curve to the left with a radius of curvature of 110 m (361 ft) and a negative grade of -1.6 percent. The curved section of roadway also included a superelevation of -1.6 percent from east to west. The posted speed limit in the area of the crash was 72 km/h (45 mph). The Scene Schematic is included as **Figure 10** of this report.

### *Vehicle Data*

#### *2009 Acura TSX*

The 2009 Acura TSX Sedan was manufactured in October 2008 and was identified by the Vehicle Identification Number (VIN): JH4CU26609C (production number deleted). The vehicle was purchased new in the summer of 2009 by the driver and had been driven approximately 2,200 km (1,000 mi) at the time of the crash.

The front-wheel drive Acura was powered by an inline, 2.4-liter, 4-cylinder transverse-mounted engine linked to a 5-speed automatic transmission. The braking system consisted of power-assisted front and rear disc brakes with four-wheel anti-lock, emergency brake assist and electronic brake force distribution. The Acura was also equipped with a direct Tire Pressure Monitoring System (TPMS). All windows were closed at the time of the crash. The Acura was equipped with Michelin Pilot HX MXM4 tires mounted on 17-inch OEM alloy wheels. The tire size matched the vehicle manufacturer recommendation. The vehicle manufacturer recommended cold tire pressure was 228 kPa (33 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

| Position | Measured Tire Pressure | Measured Tread Depth | Damage |
|---|---|---|---|
| Left Front | Tire flat | 8 mm (10/32 in) | 14 cm (5.5 in) fracture to the outboard bead edge of the rim, 6 cm (2.4 in) cut on tire sidewall |
| Left Rear | 200 kPa (29 PSI) | 8 mm (10/32 in) | None |

| Position | Measured Tire Pressure | Measured Tread Depth | Damage |
|---|---|---|---|
| Right Front | 207 kPa (30 PSI) | 8 mm (10/32 in) | None |
| Right Rear | 214 kPa (31 PSI) | 8 mm (10/32 in) | None |

The interior of the Acura was configured with leather-surfaced five-passenger seating. The front bucket seats were separated by a center console and equipped with adjustable head restraints. Both restraints were in the full-down position. The driver seat track was adjusted 3 cm (1.2 in) forward of the full-rear position. The front right seat track was in the full-rear position. The driver seat back was at an angle 22 degrees aft of vertical. The front right seat back angle was 27 degrees aft of vertical. The second row consisted of a bench seat with a split-folding back. The three rear seat positions were equipped with adjustable head restraints all in the full-down position.

The interior occupant safety systems consisted of 3-point lap and shoulder belt systems for the five designated seating positions, front seat safety belt retractor pretensioners, dual stage CAC frontal air bags, side impact air bags in the outboard aspects of the front seat backs, and IC air bags that provide protection for the four outboard seating positions.

***2003 Chevrolet Trailblazer***

The 2003 Chevrolet Trailblazer LTZ 4x2 was identified by the VIN: 1GNDS13S632 (production sequence deleted). The rear-wheel drive Chevrolet was powered by a 4.2-liter, inline 6-cylinder engine linked to a 4-speed automatic transmission. The braking system consisted of power-assisted front and rear disc brakes with four-wheel anti-lock and electronic brake force distribution. All windows were closed prior to the crash. The Chevrolet was equipped with dual-stage frontal air bags for the driver and front right passenger. All tires on the Chevrolet were size P245/65R17. Bridgestone Dueler H/T tires were mounted on the left front and right rear. A BF Goodrich Rugged Trail T/A was mounted on the left rear and a Michelin Cross Terrain was mounted on the right front. The manufacturer recommended tire size was P245/65R17 with a recommended cold tire pressure of 221 kPa (32 PSI) for the front and rear. The specific tire data at the time of the SCI inspection was as follows:

| Position | Measured Tire Pressure | Measured Tread Depth | Damage |
|---|---|---|---|
| Left Front | Tire flat | 2 mm (2/32 in) | Wheel cracked |
| Left Rear | 165 kPa (24 PSI) | 3 mm (4/32 in) | None |
| Right Front | 179 kPa (26 PSI) | 6 mm (8/32 in) | None |
| Right Rear | 159 kPa (23 PSI) | 2 mm (3/32 in) | None |

***Crash Sequence***

***Pre-crash***

The restrained 53-year-old female driver of the Acura was operating the vehicle southbound on the rural roadway at a driver estimated speed of 72 km/h (45 mph). **Figure 2** depicts the Acura's pre-crash trajectory. The restrained 20-year-old male driver of the Chevrolet was operating the vehicle northbound in a left curve on the same roadway. The Chevrolet crossed the center line and entered the southbound travel lane directly into the path of the Acura. The driver of the Acura detected the Chevrolet entering her lane, and initiated an avoidance maneuver by steering to the right and braking.

**Figure 2: Pre-crash trajectory of the Acura.**

***Crash***

The front plane of the Chevrolet impacted the left aspect of the Acura's front plane (Event 1). The direction of force for the initial impact was within the 12 o'clock sector for both vehicles. The force of the impact actuated the Acura driver's safety belt pretensioner and deployed the vehicle's driver air bag, the left IC, and the left side impact air bag. The frontal air bags in the Chevrolet also deployed. The Damage Algorithm of the WinSMASH program was used to calculate the severity of the crash (delta-V). The total delta-V of the Acura was 54 km/h (33.6) mph. The longitudinal and lateral delta-V components were -53.2 km/h (-33.1 mph) and 9.4 km/h (5.8 mph). The total delta-V of the Chevrolet was 40 km/h (24.9 mph) with a longitudinal and lateral delta-V of -40 km/h (-24.9 mph) and 0 km/h, respectively. The Chevrolet's EDR recorded a maximum longitudinal velocity change of -50.5 km/h (-31.4 mph).

The momentum of the vehicles combined with the offset impact location induced a counterclockwise (CCW) rotation to both vehicles during separation. The Acura rotated 100 degrees CCW and traveled approximately 11 m (36 ft) off the west side of the roadway. The Acura came to rest on the grass shoulder of the roadway facing east. A 3 m (9.8 ft) section of disturbed soil marked the final rest position of the vehicle. The Chevrolet rotated 160 degrees CCW and came to final rest in the northbound travel lane approximately 12 m (39.4 ft) from the impact facing south.

***Post-Crash***

Police, emergency medical and tow personnel responded to the crash site. The driver of the Acura stated that she lost consciousness for a short period of time after the crash, but regained consciousness as police and emergency medical personnel arrived at the scene. The driver of the

Acura was unable to exit the vehicle due to her right leg injury and a jammed left front door. The door was pried open by EMS and the Acura driver was removed from the vehicle by the first responders. She had sustained moderate-severity injuries and was transported from the scene by ground ambulance to a regional hospital where she was admitted for 5 days. Both vehicles were towed from the scene due to disabling damage. The Acura was transferred from the local tow yard to a regional vehicle salvage facility for auction, where it was inspected for this investigation. The Chevrolet was inspected at a local tow yard.

***2009 Acura TSX`***

***Exterior Damage***

The front left corner of the Acura sustained moderate damage in this offset frontal crash **(Figure 3)**. On the frontal plane, the direct contact damage to the bumper beam began 45 cm (17.7 in) left of the vehicle's centerline and extended left 14 cm (5.5 in) to the front bumper corner. The maximum crush was located at C2, 36 cm (14.2 in) right of the front left bumper corner and measured 46 cm (18.1 in). The combined direct and induced damage (Field L) extended along the full length of the front bumper beam. A residual crush profile was documented along this full width and was as follows: C1 = 45 cm (17.7 in), C2 = 46 cm (18.1 in), C3 = 37 cm (14.6 in), C4 = 21 cm (8.3 in), C5 = 8 cm (3.1 in), C6 = 0 cm.

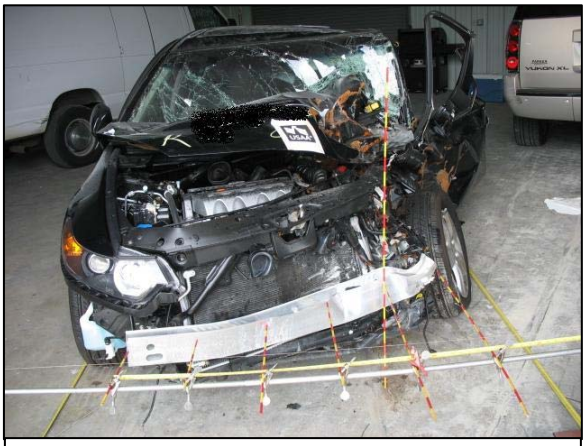

**Figure 3: Frontal damage sustained by the Acura.**

Due to the offset impact configuration, the direct contact damage wrapped around the left front corner onto the left plane (**Figure 4**). The direct contact extended rearward 214 cm (84.3 in) to the mid aspect of the front door. The left front door was jammed shut post-crash and pried open by the first responders. The left rear and both right side doors remained closed during the crash and were operational post-crash. The windshield was completely fractured by the impact forces. There was a triangular laminate tear resulting from contact with the hood in the area forward of the front left seating position. This triangular tear measured 30 cm (11.8 in) along the upper aspect, 22 cm (8.7 in) along the lower aspect and 13 cm (5.1 in) in height along the left aspect and was located 29 cm (11.4 in) below the windshield header and 27 cm (10.6 in)

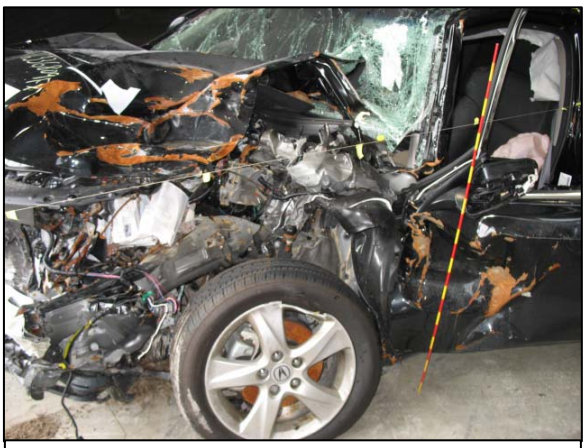

**Figure 4: Left side damage to the Acura.**

inboard of the left A-pillar. The left rear corner of the hood penetrated the windshield 10 cm (3.9 in) and caused the laminate tear. The front side windows were both disintegrated by the impact forces. The rear side windows, backlight glazing and sunroof glazing were not damaged in this crash. The Collision Deformation Classification (CDC) assigned for this impact was 12FLEE7.

***Interior Damage***

The Acura sustained moderate-severity damage that was attributed to passenger compartment intrusion, occupant contact and air bag deployment. The driver had loaded the steering wheel rim through the air bag resulting in 3 cm (1.2 in) of deformation to the upper half of the steering wheel rim and a 5 cm (2 in) scuff mark located 4 cm (1.6 in) to the left of the 12 o'clock position on the steering wheel rim. There was body fluid evidence on the driver's frontal air bag. The rearview mirror was displaced and had a skin oil transfer on the left side, attributed to the driver's right hand. The brake pedal was deformed 4 cm (1.6 in) as a result of contact with the driver's right foot. The steel backer panel under the left knee bolster was deformed as a result of contact with the driver's right knee. This deformation measured 8 cm (3.1 in) in width and 7 cm (2.8 in) in length and was located 16 cm (6.3 in) left of the center console and 10 cm (3.9) above the edge of the knee bolster.

The intrusion to the Acura is listed on the following table:

| Position | Component | Direction | Magnitude |
|---|---|---|---|
| Row 1 Left | A-pillar (upper) | Longitudinal | 43 cm (16.9 in) |
| Row 1 Left | Instrument panel left | Longitudinal | 23 cm (9.1 in) |
| Row 1 Left | Toe pan | Longitudinal | 10 cm (3.9 in) |
| Row 1 Center | Instrument panel center | Longitudinal | 5 cm (2 in) |

As a result of the floor pan deformation, the driver's seat had displaced laterally to the left and was contacting, but not compressed against the left B-pillar. The front left seat back retained its pre-crash position.

***Manual Restraint Systems***

The Acura was equipped with 3-point manual lap and shoulder belts for the five designated seating positions. All belt systems utilized continuous loop webbing. The driver belt system utilized a sliding latch plate and a retractor mounted pretensioner, which actuated during the crash. The left D-ring was height adjustable and was located in the full-up position. The driver's belt retracted onto an Emergency Locking Retractor (ELR). The driver used the safety belt at the time of the crash, which was supported by loading evidence on the belt webbing. This evidence consisted of a frictional abrasion on the belt webbing near the latch plate. The abrasion was located 71 to 74 cm (28 to 29.1 in) above the lower seat anchor. Additionally, the actuated retractor pretensioner locked the safety belt in the used position. The total length of spooled-out and locked webbing measured 155 cm (61 in).

The front right and second row safety belt systems utilized a switchable ELR/Automatic Locking Retractor (ALR) with sliding latch plates. In addition, the front right belt system utilized a retractor pretensioner which did not actuate during the crash and a height adjustable D-ring in the full-down position.

***Frontal Air Bag System***

The Acura was equipped with a CAC frontal air bag system. The CAC system consisted of dual-stage frontal air bags for the driver and right front passenger positions, seat track positioning sensors, safety belt buckle switches, retractor pretensioners, and a front right occupant presence sensor. The driver's air bag was concealed within the center hub of the 3-spoke steering wheel by a tri-flap design. The upper flap measured 13 cm (5.1 in) in width at the horizontal tear seam and 5 cm (2 in) in height. The lower flaps were triangular in shape and were 7 cm (2.8 in) in width and 8 cm (3.1 in) in height at the vertical tear seam. The driver's air bag (**Figure 5)** was 50 cm (19.7 in) in diameter in its deflated state. The air bag was vented by two circular vent ports located on the upper rear aspect of the air bag at the 11 and 1 o'clock positions. The air bag was tethered by two tethers attached to the face of the bag at the 12 and 6 o'clock positions with a 9 cm (3.5 in) tether seam on the face of the air bag. The face of the air bag was covered by post-crash body fluid, more heavily on the left aspect of the face of the bag. No crash-related damage was present on the driver's air bag.

**Figure 5: Driver's frontal air bag.**

The front right air bag was mounted within the upper aspect of the right instrument panel. The front right seat was not occupied during the crash suppressing the deployment of the air bag.

***Side Impact Air Bag System***

The Acura was equipped with front seat-mounted side impact air bags and roof side rail-mounted side impact IC air bags. The left IC and left side impact air bag deployed during this crash sequence. The right IC and right side impact air bag did not deploy.

The left IC deployed from the roof side rail. The IC measured 155 cm (61 in) in length and provided complete longitudinal coverage across the entire left side glazing. At the front and rear seating positions, the IC was 40 cm (15.7 in) in height and extended below the beltline at each outboard position. The IC was cut by emergency medical personnel 11 cm (4.3 in) forward of the B-pillar. The cut extended from the lower edge to the top of the IC, and forward to the front edge of the air bag. The IC was tethered to the A-pillar by a webbing strap. This strap was also

cut by EMS during the extrication of the driver. The left IC was free from occupant contacts and crash-related damage. The section of the IC that had been cut out was found on the floor of the vehicle and contained stains of an unknown origin at the time of the SCI inspection. **Figures 6 and 7** depict the left IC. The air bag was labeled with the following nomenclature: *>VMQ, PA66< 6096902 S107 M11B*.

**Figure 6: Forward section of left IC cut from the vehicle.**

**Figure 7: Left IC in second row of the Acura.**

The left side impact air bag deployed from a 42 cm (16.5 in) panel in the outboard aspect of the driver seat back. The air bag measured 20 cm (7.9 in) in width and 57 cm (22.4 in) in height (**Figure 8).** The air bag contained one vent port at the 12 o'clock position on the outboard aspect and no tethers. There was no damage or contact evidence on the side air bag.

**Figure 8: Left side impact air bag.**

***2003 Chevrolet Trailblazer***

***Exterior Damage***

The front plane of the Chevrolet Trailblazer sustained moderate-severity damage as a result of the impact with the Acura. The direct contact damage began 2 cm (0.8 in) left of the vehicle centerline and extended left 74 cm (29.1 in) to the corner. The maximum crush was located at the front left bumper corner and measured 59 cm (23.2 in). **Figure 9** depicts the frontal damage to the Chevrolet. A crush profile was documented along the full width of the front bumper reinforcement. This crush profile was as follows: C1 = 59 cm (23.2 in), C2 =

**Figure 9: Frontal damage to the Chevrolet.**

47 cm (18.5 in), C3 = 46 cm (18.1 in), C4 = 30 cm (11.8 in), C5 = 10 cm (3.9 in), C6 = 0 cm. The CDC assigned for this impact was 12FYEW3.

***Event Data Recorder***

The frontal air bag system in the Chevrolet was controlled by a Sensing Diagnostic control Module (SDM) located under the driver seat. The SDM had EDR capabilities. The Chevrolet's EDR was imaged at the time of the SCI inspection utilizing the Bosch Crash Data Retrieval tool via a connection with the Diagnostic Link Connector located under the left instrument panel and applying external 12-volt electrical power. The data was imaged using software version 3.2. The imaged data has been reported with version 3.5.1 and is included at the end of this report as **Attachment A**.

The imaged data indicated the EDR had recorded a Deployment and a Non-deployment event. The Deployment event occurred first and was related to the offset frontal crash. The event was completely recorded. At the time of the crash, the air bag indicator lamp in the instrument panel was "Off" and the number of ignition cycles was 14,403 (14,410 at investigation). The driver's safety belt was recorded as buckled. A Stage 2 frontal air bag deployment was commanded 17.5 milliseconds from Algorithm Enable (AE). The maximum recorded longitudinal delta-V was -50.5 km/h (-31.4 mph). The EDR recorded 5 seconds of pre-crash vehicle speed and engine parameters and 8 seconds of brake switch data. The EDR-reported speed of the Chevrolet was 82 km/h (51 mph) 1 second prior to AE. The vehicle's brakes were recorded as "Off" throughout the recorded time period.

The Non-deployment event occurred on ignition cycle 14,403 at an unknown time after the Deployment event. At the time of the event, the air bag indicator lamp was "On".

***2009 Acura TSX Driver Demographics***

| | |
|---|---|
| Age/Sex: | 53-year-old/Female |
| Height: | 175 cm (69 in) |
| Weight: | 73 kg (161 lb) |
| Eyewear: | None |
| Seat Track Position: | Mid track, 3 cm (1.2 in) forward of full-rear |
| Manual Safety Belt Use: | 3-point lap and shoulder belt |
| Usage Source: | Vehicle Inspection |
| Egress from Vehicle: | Extricated from vehicle due to jammed driver's door and removed by rescue personnel |
| Mode of Transport from Scene: | Ground ambulance |
| Type of Medical Treatment: | Admitted to a local hospital for 5 days. |

***Driver Injuries***

| Injury | | Injury Severity (AIS 90/Update 98) | Injury Source |
|---|---|---|---|
| Right bimalleolar fracture (medial and lateral malleolus) | 1 | Moderate (851612.2,1) | Foot controls (Brake pedal) |
| Sternum fracture (mildly displaced, fracture line appears transversely oriented) | 1 | Moderate (450804.2,4) | Safety belt |
| Right 4th metacarpal fracture (base of metacarpal, fracture fragment is displaced laterally) (Boxer's fracture) | 1 | Moderate (752002.2,1) | Center mirror (air bag related) |
| Closed head injury (awake, GCS=15 on initial observation) | 1 | Minor (160499.1,0) | Steering wheel rim |
| 5 cm shallow laceration on forehead over left eye (no sutures) | 1 | Minor (290600.1,7) | Steering wheel rim |
| Left forehead hematoma (large) | 1 | Minor (290402.1,7) | Steering wheel rim |
| Left forehead abrasion | 1 | Minor (290202.1,7) | Steering wheel rim |
| Left frontal scalp hematoma | 1 | Minor (190402.1,7) | Steering wheel rim |
| Right hip abrasion | 1 | Minor (890202.1,1) | Safety belt |
| Right knee avulsion (7 cm stellate, with glass foreign body removal) | 1 | Minor (890802.1,1) | Knee bolster |
| 5 cm contusion on top of left shoulder | 2 | Minor (790402.1,2) | Safety belt webbing |
| 20 cm contusion on underside of left arm (Bicep/triceps) | 2 | Minor (790402.1,2) | Left door panel –rear upper quadrant |
| 9 cm contusion across front of lower abdomen | 2 | Minor (590402.1,4) | Safety belt |
| Right leg contusion from mid-thigh to ankle | 2 | Minor (890402.1,1) | Knee bolster |
| 20 cm left hip contusion | 2 | Minor (890402.1,2) | Left door panel –rear lower quadrant |

*Injury Data = Hospital records (1) and driver interview (2)*

***Driver Kinematics***

The 53-year-old female driver was seated in a mid-track position 3 cm (1.2 in) forward of full-rear. She was restrained by the manual 3-point lap and shoulder belt system. The driver of the

Acura detected the Chevrolet prior to the impact and applied the brakes with her right foot. Her hands were on the steering wheel at approximately the 10 and 2 o'clock positions and she steered right in an attempt to avoid the crash.

The offset frontal impact actuated the driver's retractor pretensioner and deployed the driver's frontal air bag, left IC and left side impact air bag. The expanding driver's air bag contacted her forearms and displaced her hands from the steering wheel rim. Her displaced right hand impacted the rear view mirror, resulting in the fracture to the base of the fourth metacarpal (fling injury). In response to the frontal impact force, the driver initiated a forward and left trajectory within the front left seating position. She loaded the belt system resulting in the contusions to her left shoulder, abdomen, and right hip, and a fracture of the sternum. The driver loaded through the deployed frontal air bag with her torso and engaged the steering wheel rim with her chest and face, resulting in the hematoma to the left forehead, a 5 cm (2 in) vertical laceration to the left forehead, and a concussion (with driver reported loss of consciousness).

The driver's right foot loaded the brake pedal as a result of her forward motion in combination with the rearward displacement of the toe pan. Her loading force deformed the pedal and fractured her right ankle. Her right leg contacted the left lower instrument panel resulting in the right knee avulsion and contusions on the top of her leg that extended from her mid-right thigh to her right ankle. The driver's left flank loaded the door panel through side impact air bag resulting in the left hip contusion and the left upper arm contusion.

The driver stated in the SCI interview that she lost consciousness after the crash but regained consciousness as emergency personnel arrived at the crash scene. She was unable to exit the vehicle due to her injuries and the jammed driver's door. Emergency personnel pried the left front door open and removed the driver from the vehicle. The driver was transported by ground ambulance to a local hospital where she was admitted for a 5 days. The driver was then transferred to a rehabilitation facility for 14 days of therapy.

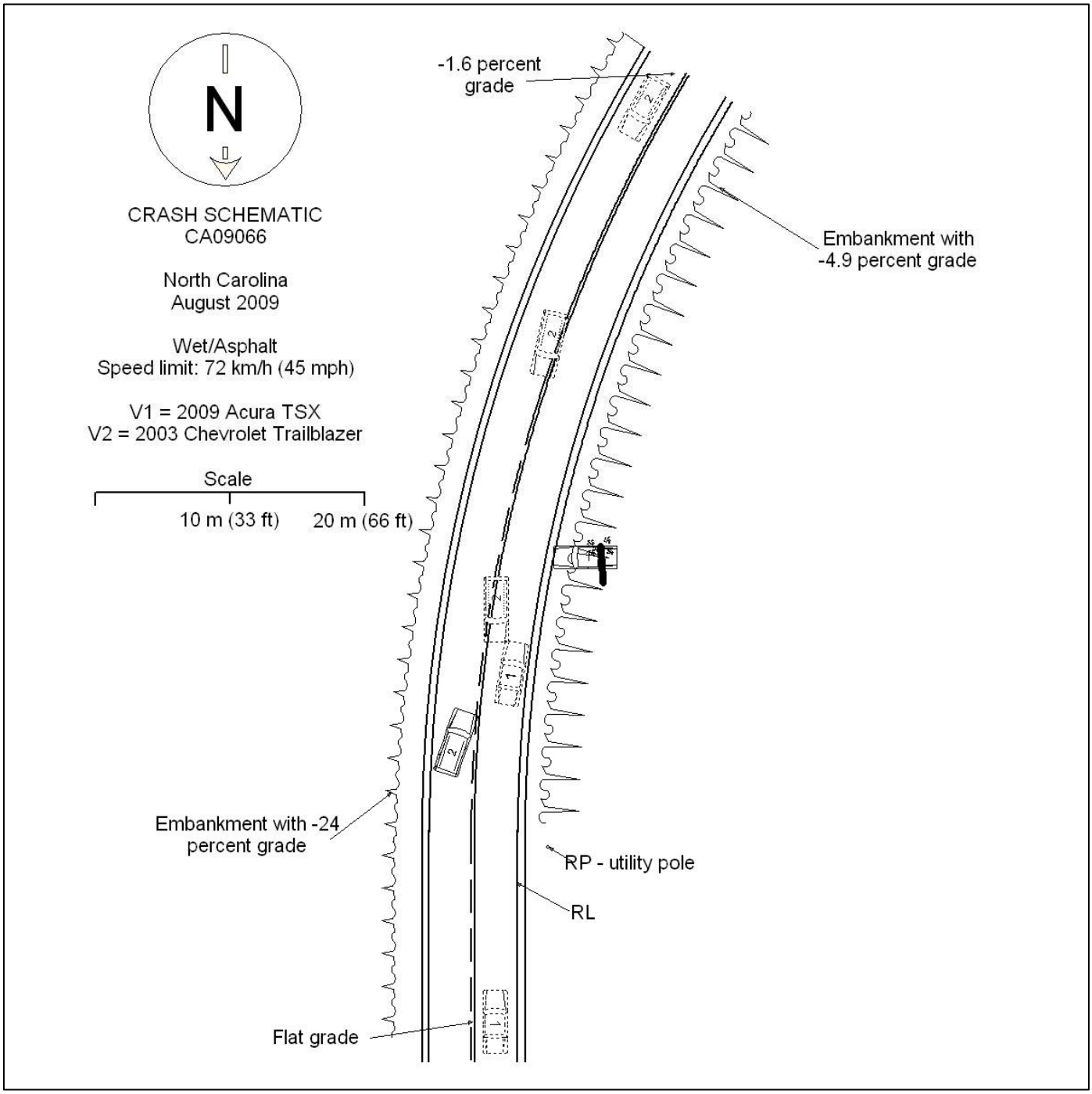


**Figure 10: Crash Schematic**

**ATTACHMENT A:**

2003 Chevrolet Trailblazer EDR Data

IMPORTANT NOTICE: Robert Bosch LLC and the manufacturers whose vehicles are accessible using the CDR System urge end users to use the latest production release of the Crash Data Retrieval system software when viewing, printing or exporting any retrieved data from within the CDR program. Using the latest version of the CDR software is the best way to ensure that retrieved data has been translated using the most current information provided by the manufacturers of the vehicles supported by this product.

## CDR File Information

| | |
|---|---|
| User Entered VIN | 1GNDS13S632****** |
| User | |
| Case Number | |
| EDR Data Imaging Date | |
| Crash Date | |
| Filename | |
| Saved on | Wednesday, September 30 2009 at 10:34:52 AM |
| Collected with CDR version | Crash Data Retrieval Tool 3.2 |
| Reported with CDR version | Crash Data Retrieval Tool 3.5.1 |
| EDR Device Type | airbag control module |
| Event(s) recovered | Deployment<br>Non-Deployment |

## Comments

No comments entered.

## 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). 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 longitudinal 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 a Deployment Level Event, 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 before 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 they occur within five seconds of one another. If multiple Non-Deployment Events occur within five 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 occur within five seconds of each other (but not necessarily all within five seconds of the Deployment Event), then the most severe of the Non-Deployment Events (which may have occurred more than five seconds prior to the Deployment Event) will be recorded and locked. If a Deployment Level Event occurs within five seconds after the Deployment Event, the Deployment Level Event will overwrite any non-locked Non-Deployment Event. If multiple Non-Deployment Events occur within five seconds prior to a Deployment Event, and one or more of those events was a Pretensioner Deployment Event, then the most recent Pretensioner Deployment Event will be recorded and locked. 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 Longitudinal Velocity Change reflects the change in longitudinal velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Longitudinal Velocity Changeis 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 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 can record up to the first 150 milliseconds of data after algorithm enable. Velocity Change data is displayed in SAE sign convention.

-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 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 to 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 will indicate whether one or more associated events preceded the recorded event.

-Multiple Events Not Recorded can be used in the following senieos:

-If a single event is recorded, this parameter will indicate whether one or more associated events prior to the recorded event was not recorded due to insufficient record space (because there were more events than there were available event records).

-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 due to insufficient record space.

-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 due to insufficient record space.

-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 Speed, Engine Speed, and Percent Throttle data are transmitted by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.

-Brake Switch Circuit Status data is transmitted 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.

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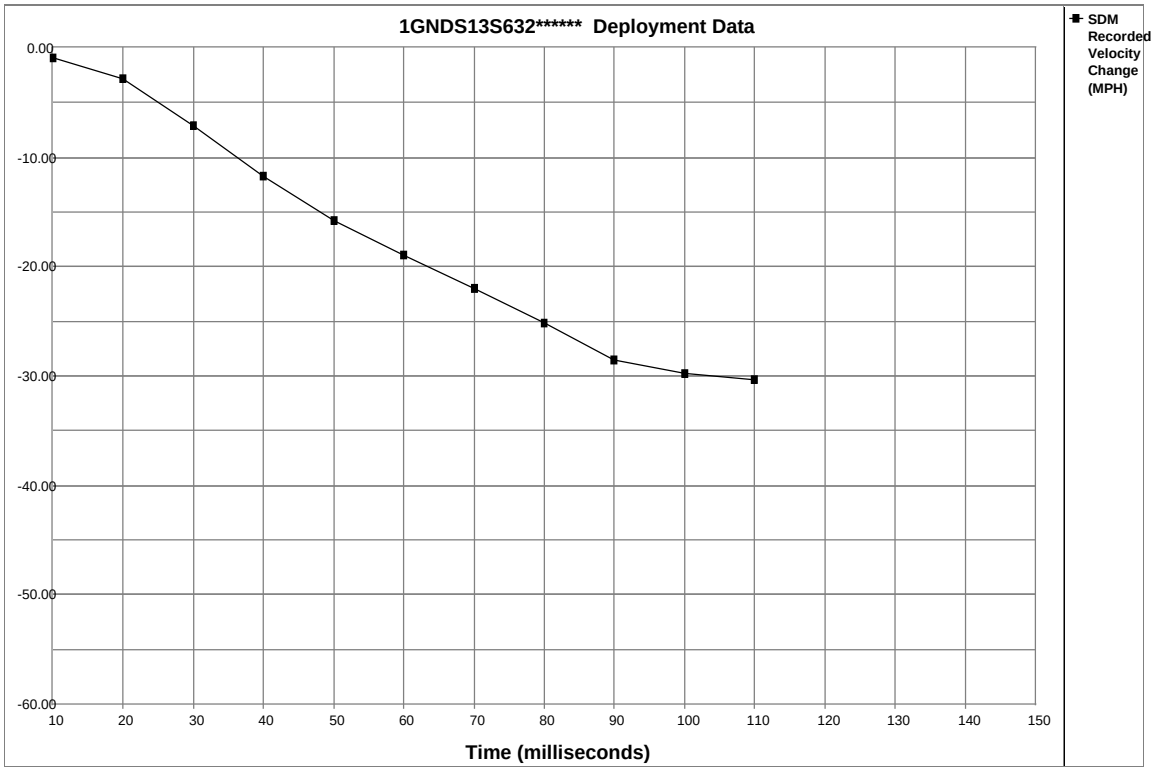
## System Status At Deployment

| | |
|---|---|
| SIR Warning Lamp Status | OFF |
| Driver's Belt Switch Circuit Status | BUCKLED |
| Ignition Cycles At Deployment | 14403 |
| Ignition Cycles At Investigation | 14410 |
| Maximum SDM Recorded Velocity Change (MPH) | -31.39 |
| Algorithm Enable to Maximum SDM Recorded Velocity Change (msec) | 120 |
| Driver 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec) | 15 |
| Driver 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec) | 17.5 |
| Passenger 1st Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec) | 15 |
| Passenger 2nd Stage Time From Algorithm Enable to Deployment Command Criteria Met (msec) | 17.5 |
| Time Between Non-Deployment And Deployment Events (sec) | N/A |
| Frontal Deployment Level Event Counter | 1 |
| Event Recording Complete | Yes |
| Multiple Events Associated With This Record | No |
| One Or More Associated Events Not Recorded | No |

| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle |
|---|---|---|---|
| -5 | 53 | 1536 | 10 |
| -4 | 52 | 1472 | 10 |
| -3 | 52 | 1408 | 10 |
| -2 | 52 | 1408 | 10 |
| -1 | 51 | 1408 | 10 |

| Seconds Before AE | Brake Switch Circuit State |
|---|---|
| -8 | OFF |
| -7 | OFF |
| -6 | OFF |
| -5 | OFF |
| -4 | OFF |
| -3 | OFF |
| -2 | OFF |
| -1 | OFF |



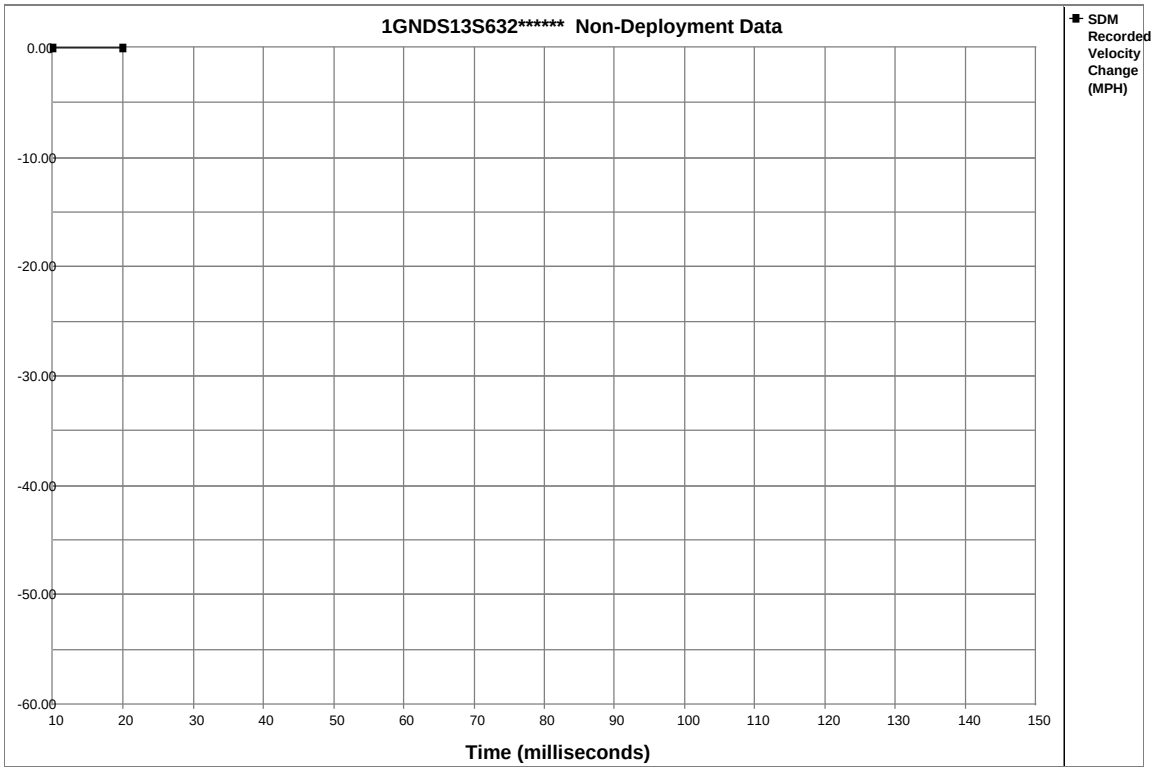

| Time (milliseconds) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recorded Velocity Change (MPH) | -0.93 | -2.79 | -7.13 | -11.78 | -15.81 | -18.91 | -22.01 | -25.11 | -28.52 | -29.76 | -30.38 | N/A | N/A | N/A | N/A |

## System Status At Non-Deployment

| | |
|---|---|
| SIR Warning Lamp Status | ON |
| Driver's Belt Switch Circuit Status | BUCKLED |
| Ignition Cycles At Non-Deployment | 14403 |
| Ignition Cycles At Investigation | 14410 |
| Maximum SDM Recorded Velocity Change (MPH) | 0.00 |
| Algorithm Enable to Maximum SDM Recorded Velocity Change (msec) | 120 |
| Crash Record Locked | No |
| Event Recording Complete | Yes |
| Multiple Events Associated With This Record | No |
| One Or More Associated Events Not Recorded | No |

| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle |
|---|---|---|---|
| -5 | 53 | 1536 | 10 |
| -4 | 52 | 1472 | 10 |
| -3 | 52 | 1408 | 10 |
| -2 | 52 | 1408 | 10 |
| -1 | 51 | 1408 | 10 |

| Seconds Before AE | Brake Switch Circuit State |
|---|---|
| -8 | OFF |
| -7 | OFF |
| -6 | OFF |
| -5 | OFF |
| -4 | OFF |
| -3 | OFF |
| -2 | OFF |
| -1 | OFF |




| Time (milliseconds) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Recorded Velocity Change (MPH) | 0.00 | 0.00 | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A | N/A |