Advanced Air Bag Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS03004
2003 Chevrolet Venture LS Minivan
California
November, 2002

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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator's expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract

This on-scene, in-depth investigation focused on the advanced occupant protection systems in the case vehicle. This two vehicle crash took place during a weekday morning in November, 2002 at 0720 hours. The weather was clear and the level bituminous roadway surface was dry and free of defects. The crash occurred within the confines of a four-leg intersection located in a residential neighborhood. Traffic for the eastbound travel lane is controlled by a posted stop sign and the speed limit for the east/west roadway is 40 km/h (25 mph). There are no traffic controls present for the north/south roadway and the posted speed limit for this roadway is 64 km/h (40 mph). The case vehicle is a 2003 Chevrolet Venture minivan that was being driven by a restrained 34-year-old female. The third row of seats, right side seated position was occupied by a restrained 9-year-old female. The Venture was traveling southbound on a five-lane roadway approaching the intersection. A 2000 Toyota Echo driven by a 20 year old female was traveling eastbound approaching the same intersection. As the vehicles entered the intersection, the front of the Chevrolet Venture struck the left side of the Toyota Echo. There was a side slap type impact between the right ride of Venture and the left rear of the Echo. The initial impact with the Echo resulted in the deployment of both front air bags in the Venture. Both the driver and the 9 year old female passenger had complained of pain and were transported to a local hospital via ground ambulance. The driver of the Venture sustained a left patella fracture. The 9-year-old child sustained a cervical strain. The driver of the other vehicle reportedly sustained a pelvic fracture, a laceration under her left eye, and abrasions to her forehead and left shoulder.

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**Dynamic Science, Inc.**
**Crash Investigation**
**Case Number: DS03004**

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## BACKGROUND:

**Figure 1**. 2003 Chevrolet Venture van

This on-site investigation focused on the Advanced Occupant Protection safety system installed in a 2003 Chevrolet Venture minivan. The system included redesigned (reduced force) driver and front right passenger air bags. In addition, the Venture was also equipped with seatback mounted side-impact air bag units for the front left and front right positions and a Sensing Diagnostic Module (SDM). The 34-year-old female driver of the Venture was traveling southbound on a five-lane roadway approaching a four-leg intersection. The third row of seats, right side seated position was occupied by a restrained by a tall 9-year-old female. A 2000 Toyota Echo driven by a 20 year old female was traveling eastbound approaching the same intersection. As the vehicles entered the intersection, the front of the Chevrolet Venture struck the left side of the Toyota Echo. The impact caused the Venture to rotate in a counterclockwise direction. The Echo rotated in a clockwise direction. There was a side slap type impact between the right ride of Venture and the left rear of the Echo. The initial impact with the Echo resulted in the deployment of both front air bags in the Venture. Both the driver and the 9 year old female passenger had complained of pain and were transported to a local hospital via ground ambulance. The driver of the other vehicle reportedly sustained a pelvic fracture (AIS-2), a laceration under her left eye (AIS-1) and abrasions (AIS-1) to her forehead and left shoulder.

This case was identified by the local National Automobile Sampling Primary Sampling Unit. The case was reported to DSI on January 24, 2003 by the National Highway Traffic Safety Administration with instructions to locate the case vehicle for an on-scene inspection. DSI located the case vehicle and conducted the investigation. The SDM data from the Venture was successfully downloaded from the vehicle during this on-site investigation and is included in this report as Attachment 2. All field work was completed on February 10th, 2003.

## SUMMARY

### Crash Site

This two vehicle crash took place during a weekday morning in November, 2002 at 0720 hours. The weather was clear and the level (-0.8%) bituminous roadway surface was dry and free of defects. The crash occurred within the confines of a four-leg intersection located in a southern California residential neighborhood. The southbound leg of the intersection consists of a five

lane undivided roadway with two through southbound travel lanes, two northbound travel lanes and a common, middle left turn lane which delineates the north and southbound travel lanes. The eastbound leg of the intersection is a two lane undivided roadway composed of an east and westbound travel lane. Traffic for the eastbound travel lane is controlled by a posted stop sign and the speed limit for the east/west roadway is 40 km/h (25 mph). There are no traffic controls present for the north/south roadway and the posted speed limit for this roadway is 64 km/h (40 mph).

**Figure 2**. Approach to area of impact (south)

**Pre-Crash**

The case vehicle is a fleet rental 2003 Chevrolet Venture LS extended wheelbase minivan that was being driven by a fully restrained 34-year-old female (178 cm, 70 in/ 64 kg, 140 lbs). The third row of seats, right side seated position was occupied by a restrained by a tall 9-year-old female (168 cm, 66 in). The driver of the case vehicle was proceeding southbound in lane 1 or the curb lane, approaching the intersection at a SDM recorded travel speed of 82 km/h (51 mph) three seconds prior to AE.

**Figure 3**. Approach to area of impact (east)

The other vehicle is a 2000 Toyota Echo which was being driven by a 20 year old female who police reported to be wearing the lap and shoulder restraint. The driver of the other vehicle indicated to the investigating police that she had stopped at the intersection adhering to the posted stop sign and then proceeded into the intersection, initiating a right turn with the intention of proceeding southbound on the adjoining roadway.

At a time frame designation of five seconds before algorithm enable (AE), the case vehicle was traveling 80 km/h (50 mph) according to downloaded SDM data. At approximately 3-4 seconds prior to AE the SDM downloaded data reflected that the case vehicle actually accelerated to 82 km/h (51 mph). Two seconds prior to AE the case vehicle initiated a deceleration (engine braking) to 69 km/h (43 mph). The SDM data recorded that the brake switch circuit status was "ON" one second before algorithm enable, indicating that the driver initiated a braking application in an attempt to avoid the impending crash.

**Crash**

The front of the case vehicle (01FDEW2) impacted the left front tire/wheel area of the other vehicle in an "L"-type impact configuration. Upon impact, the driver's and front, right passenger frontal air bags deployed in the case vehicle. The total velocity change for the case vehicle was calculated utilizing the Missing Vehicle Algorithm of the WinSmash collision model and was

29.0 km/h (18.0 mph) while the SDM recorded a change in velocity of -26.45 km/h (-16.44 mph). The WinSmash generated longitudinal delta V was calculated at -18.8 km/h (-11.7 mph).

Direct contact damage involved the entire frontal plane of the case vehicle and was 149.0 cm (67.0 in.) in length. Damaged components involved the front bumper fascia and bumper bar, upper and lower radiator supports, grille, hood, both fenders and the laminated windshield was cracked due contact by the passenger air bag module door. Maximum crush was 25.0 cm (10.0 in) and was located at the vehicle centerline. The improved principal direction of force was estimated at 20 degrees (12 o'clock side of the 1 o'clock sector). The right side wheelbase was reduced by 4.0 cm (2.0 in) while the left side wheelbase was elongated by 4.0 cm (2.0 in).

**Figure 4**. Frontal damage, Chevrolet Venture

The other vehicle 2000 Toyota Echo initiated a rapid clockwise rotation due to the initial left front tire/wheel impact. The left quarter panel/bumper corner of the other vehicle impacted the front, right door panel of the case vehicle in a secondary sideslap type impact. Direct contact from the sideslap impact initiated 179.5 cm (70.7 in.) forward of the rear axle and extended forward 60.5 cm (23.8 cm). The combined direct and induced damage length was 113.0 cm (44.5 in) in length and initiated 153.0 cm (60.2 in) forward of the rear axle. In addition, the right rear tempered side glazing disintegrated due to the secondary impact forces. A Collision Deformation Classification (CDC) of 03RPEW2 was assigned to the case vehicle for the secondary impact damage.

**Figure 5**. Sideslap damage, Chevrolet Venture

**Post-Crash**

After the vehicles came together in the secondary sideslap impact, the case vehicle initiated a counterclockwise rotation while being deflected in a southeasterly direction. The case vehicle traversed the southbound travel lanes and entered the common center turn lane where it came to rest facing in a northerly direction.

The Toyota Echo was deflected in a southerly direction and either rolled or was driven approximately 50.3 m (165.0 ft) before it came to rest in the southbound curb lane and facing southwest.

Two separate ambulance units were summoned to the crash location along with fire rescue, police units and two separate tow agencies. The first ambulance was notified of the crash at 0725 hours (5 minutes post-crash) and arrived on-scene at 0732 hours (12 minutes post-crash). Both the 34 year-old female driver and the 9 year-old female occupant were removed from the case vehicle and placed in the first responding ambulance unit. This ambulance departed the crash location at 0744 hours (24 minutes post-crash) and arrived at the hospital at 0755 hours (35 minutes post-crash).

The 34 year-old female driver sustained a fractured left patella (AIS-2) and was treated and released the same day of the crash. The 9 year-old female who occupied the third row, right side seated position, sustained a cervical strain (AIS-1) and was also treated and released the same day of the crash.

The second responding ambulance arrived on-scene, and the 20 year-old female driver of the other vehicle was removed and subsequently transported to a hospital;. The investigating police reported that she sustained a pelvis fracture (AIS-2), a laceration beneath her left eye (AIS-1), an abrasion to her forehead (AIS-1) and an abrasion to her left shoulder (AIS-1).

After the investigating police collected all of the pertinent information, the involved vehicles were removed by two separate tow agencies.

**VEHICLE DATA - 2003 Chevrolet Venture LS Minivan**

The 2003 Chevrolet Venture was identified by the Vehicle Identification Number (VIN): 1GNDX03E03DXXXXXX. The odometer reading was unknown at the time of the inspection due to the vehicle having no power. The vehicle was an extended wheelbase minivan that was equipped with a 3.4 liter, six-cylinder engine, an automatic transmission, front wheel drive, and a tilt steering wheel.

The left front, right front and right rear tires of the 2003 Chevrolet Venture LS Minivan were equipped with Firestone FR680 radial tires while the left rear had a replacement Uniroyal Tiger Paw GTS radial installed. The specific tire data is as follows:

| Tire | Tread | Pressure | Recommended pressure |
|---|---|---|---|
| LF | 7 mm (9/32 in) | 214 kPa (31 psi) | 241 kPa (35 psi) |
| LR | 9 mm (11/32 in) | 228 kPa (33 psi) | 241 kPa (35 psi) |
| RR | 9 mm (11/32 in) | 241 kPa (35 psi) | 241 kPa (35 psi) |
| RF | 7 mm (9/32 in | 214 kPa (31 psi | 241 kPa (35 psi) |

The front seating positions in the 2003 Chevrolet Venture LS Minivan consist of fabric covered forward facing bucket seats. Both front bucket seats are equipped with adjustable head restraints that were undamaged and both front seats were adjusted at their rearmost seat track position. The front, right bucket seat was unoccupied.

## VEHICLE DAMAGE

### Exterior Damage - 2003 Chevrolet Venture LS Minivan

| | | |
|---|---|---|
| Damage Description: | Moderate/ Primary Frontal Impact (Highest Delta V): Longitudinal displacement to the front bumper and fascia cover, hood, grille, upper / lower radiator supports, both fenders and the windshield was cracked due to contact from the module cover door of the deployed front, right passenger air bag unit. Maximum crush was 26.0 cm (10.2 in) located at the vehicle centerline. The right side wheelbase was reduced by 4.0 cm (2.0 in) while the left side wheelbase was elongated by 4 cm (2.0 in).<br><br>Minor/ Secondary Right Side Sideslap Impact : Lateral deformation noted to the front, right door panel along with surface scratches and abrasions. The right rear tempered side glazing disintegrated due to the secondary impact forces. | |
| CDC: | Crash Event 1: 01FDEW2<br>Crash Event 2: 03RPEW2 | |
| Delta V (Primary Impact): | Total | 29.0 km/h (18.0 mph) |
| | Longitudinal | -27.3 km/h (-16.9 mph) |
| | Latitudinal | -9.9 km/h (-6.2 mph) |
| | Energy | 131,200 joules<br>(30,686 ft lbs) |

**C measurements:** Six equidistant crush measurements were documented at the bumper level and the crush profile is as follows; $C_1$=0 cm, $C_2$= 4.0 cm (1.6 in), $C_3$= 16.0 cm (6.3 in.), $C_4$= 26.0 cm (10.2 in.), $C_5$= 11.0 cm (4.3 in.), $C_6$ = 0 cm. Maximum crush was documented at $C_4$ or at the vehicle centerline

### Interior Damage - 2003 Chevrolet Venture LS Minivan

The interior greenhouse area of the case vehicle was void of any intruding components and the case vehicle's integrity was not compromised. The laminated windshield glazing was cracked directly in front of the front, right passenger air bag module. The deploying passenger air bag module cover contacted and broke the windshield glazing. The interior was void of any detectable areas of occupant contact.

The interior of the case vehicle consisted of seven passenger seated positions with fabric covered, front box mounted bucket seats. The second row was comprised of a 60/40 fabric covered split bench seat with folding seatbacks at left and right side seated position. The third row was comprised of a three-passenger 50/50 bench fabric covered bench seat with folding seatbacks. There was no damage to the interior seats or head restraints.

**MANUAL RESTRAINT SYSTEMS - 2003 Chevrolet Venture LS Minivan**

The driver's manual restraint system consisted of a continuous loop 3-point lap and shoulder safety belt with a sliding latch plate and an adjustable shoulder belt upper anchorage in the mid position. The emergency locking retractor was located in the B-pillar. The front right seat and the two rear split bench seat outboard positions were equipped with 3-point manual lap and shoulder safety belts which consisted of a continuous loop belt webbing with a sliding latch plate and switchable emergency/automatic locking retractors. The third row split bench middle position was equipped with a manual 2-point lap safety belt which consisted of a continuous loop belt webbing with a locking latch plate. The second row right seat was equipped with an integrated child restraint and is designed for use by children at least one year of age, between 10-18 kg (22-40 lb) in weight, between 85-102 cm (34-40 in) in height, and capable of sitting upright alone.


**Figure 6**. Loading evidence to driver's seat belt

**Figure 7**. Latch mechanism misalignment

The driver's restraint exhibited evidence of historical use in the form of scratching to the latch plate. There was also evidence of loading in the form of frictional streaking/scoring diagonally across the seat belt webbing. The Deployment Event recorded by SDM reports that the driver's belt switch circuit status was "BUCKLED". The third row right restraint exhibited evidence of historical use in the form of scratching to the latch plate and faint frictional abrasions to the D-ring. The restraints in all the other seating position also exhibited evidence of historical use in the form of scratching striations to the latch plates.

The police report indicates that the third row, right side seat that the 9-year-old female occupant occupied had come forward off the floor and that she flew forward to the right slipping out of the safety seat belt. The insurance adjuster indicated that a General Motors representative in the presence of the driver had inspected the third row split bench seat latching mechanism and had conclude that it was operating properly. Inspection of the third row split bench seat by the SCI investigator found that the latching mechanism of the left half of the split bench operated

properly. The right half, however, did not properly line up with the striker post. The latch would contact the post and not allow the latch to lock. The latching mechanism had to be manually pushed forward away from the striker post and then it would align properly and lock around the striker post. The second and third row split bench seats are designed to be removed to load vehicle with cargo. The third row split bench seat can also be folded forward and stowed for cargo loading.

**FRONTAL AIR BAG SYSTEM - 2003 Chevrolet Venture LS Minivan**

The Chevrolet Venture was equipped with redesigned (reduced force) driver and front right passenger front air bags and front seat mounted side air bags. The driver's air bag was mounted in the steering wheel hub. The driver air bag module was located in the center hub of the steering wheel rim with a vertically oriented flap tear seam (I-configuration). The diameter of the deflated circular air bag was 65 cm (26 in). It was equipped with two internal tether straps and had two vent ports (11 and 01 o'clock positions). The maximum deflated air bag excursion measured approximately 20 cm (8 in). There were no indications of any damage to driver's air bag or the module cover flaps. On the face of the lower right quadrant of the air bag, there were vinyl transfers to the membrane from expansion within the module. There was no occupant contact evidence on the air bag.

**Figure 8**. Driver's air bag

**Figure 9**. Front right passenger air bag

The front right passenger air bag was a mid instrument panel mount with dual symmetrical module cover flaps. The deflated air bag was rectangular in shape with a height of approximately 50 cm (20 in) and a width of approximately 54 cm (21 in). The maximum deflated air bag excursion measured approximately 58 cm (23 in). The air bag had a single tethered sewn across the entire face of the air bag and had two vent ports (02 and 10 o'clock positions). There were no indications of any damage to front right passenger air bag. There was faint evidence of vinyl transfer to the membrane from expansion within the module to the upper middle face of the air bag. The single hinged module cover flap was rectangular in shape and measured 40 cm (16 in) wide by 30 cm (12 in) high. The right corner of the module cover flap was scuffed and bent from contact with the windshield. The windshield glazing was cracked and had vinyl transfer from the front right module cover flap.

The air bag system is controlled by the SDM. The system records the vehicle's forward velocity change. The SDM will record 100 milliseconds of data after the deployment criteria is met and

up to 50 milliseconds of data before deployment criteria is met. The SDM will also record 150 milliseconds of data after non-deployment criteria is met.

The SDM data was downloaded using the Vetronix Crash Data Retrieval System. Two events were recorded by the SDM; a deployment and non-deployment event.

**System Status at deployment indicates that:**

1. The SIR warning lamp status was OFF.
2. The driver's belt switch circuit status was BUCKLED.
3. Ignition cycles at deployment were 1168.
4. Ignition cycles at investigation were 1169.
5. A Maximum SDM recorded velocity change was not reported. The SDM adjusted algorithm velocity change graph indicated a -26.45 km/h (-16.44 mph) velocity change.
6. Algorithm enable (AE) to maximum SDM recorded velocity change was not reported.
7. Time between non-deployment and deployment events (sec): N/A
8. Event recording complete was YES.
9. The vehicle speed was 80 km/h (50 mph) five seconds before AE. The vehicle accelerated to 82 km/h (51 mph) four and three seconds before AE, and decelerated to 80 km/h (50 mph) two seconds before AE, and 69 km/h (43 mph) one second before AE.
10. The brake switch circuit status was OFF from five seconds through 2 seconds before AE. At one second before AE the brake switch circuit status was ON.

**System Status at non-deployment[1] indicates that:**

1. The SIR warning lamp status was OFF.
2. The driver's belt switch circuit status was UNBUCKLED.
3. Ignition cycles at non-deployment were 952.
4. Ignition cycles at investigation were 1169.
5. Maximum SDM recorded velocity change was -1.86 km/h (-1.16 mph).

[1] The recorded non-deployment event is not associated to the recorded deployment event. There is a difference of 216 between ignition cycles at deployment and non-deployment events.

**VEHICLE DATA - 2000 Toyota Echo**

| | | |
|---|---|---|
| Description: | 2000 Toyota Echo | |
| VIN: | Unknown | |
| Odometer: | Unknown | |
| Engine: | 1.5 Liter/ 4 cyl. | |
| Reported Defects: | None Reported | |
| Cargo: | Unknown | |
| Damage Description: | Primary (Highest Delta V): Damage reportedly isolated to the left fender, front, left wheel and door area (specifics are unknown).<br><br>Secondary (Second Highest Delta V): Left quarter-panel and reportedly left bumper corner area (specifics are unknown). | |
| CDC: | Crash Event 1: Unknown<br>Crash Event 2: Unknown | |
| Delta V (Missing Vehicle Algorithm): | Total | 38.0 km/h (23.6 mph) |
| | Longitudinal | -6.6 km/h (-4.1 mph) |
| | Latitudinal | 37.4 km/h (23.3 mph) |
| | Energy | 77,316 Joules (57,025 ft/lbs) |

**OCCUPANT DEMOGRAPHICS - 2003 Chevrolet Venture LS Minivan**

| | Occupant 1 | Occupant 2 |
|---|---|---|
| Age/Sex: | 34/Female | 9/Female |
| Seated Position: | Front, left | Third row, right side position |
| Seat Type: | Bucket, fabric covered | 50/50 split bench seat with folding back(s) |
| Height: | 178 cm (70 in) | 168 cm (66 in) |
| Weight: | 64 kg (140 lbs) | Unknown |
| Occupation: | Unknown | NA |
| Pre-existing Medical Condition: | Unknown | Unknown |
| Alcohol/Drug Involvement: | None | N/A |
| Driving Experience: | Unknown | N/A |
| Body Posture: | Upright, specifics are unknown | Upright, specifics are unknown |
| Hand Position: | Unknown | Unknown |
| Foot Position: | Right foot depressed the brake pedal (one second prior to AE). Left foot was on the floor | Unknown, but suspected that both feet were on the floor |
| Restraint Usage: | Three-point, manual lap and shoulder restraint used in a presumed normal and correct fashion with the shoulder belt webbing extending across her front and the lap belt webbing placed across her hip region. | Three-point, manual lap and shoulder restraint likely used (based upon vehicle inspection results, and police report data). Unknown if restraint used in a correct fashion. |

| | | |
|---|---|---|
| Air bag: | Steering wheel mounted air bag available. Air bag equipped with two vent ports at 11 and 1 o'clock sectors) and two internal tether straps. Driver's air bag deployed with a longitudinal delta V calculated at -18.8 km/h (-11.7 mph) | None |

**OCCUPANT DEMOGRAPHICS - Toyota Echo**

| | |
|---|---|
| Age/Sex: | 20/Female |
| Seated Position: | Front, left |
| Seat Type: | Bucket |
| Height: | 160 cm (63 in) |
| Weight: | 52 kg (115 lbs) |
| Occupation: | Unknown |
| Pre-existing Medical Condition: | Unknown |
| Alcohol/Drug Involvement: | None |
| Driving Experience: | Unknown, but > 10 years |
| Body Posture: | Unknown |
| Hand Position: | Unknown |
| Foot Position: | Unknown |
| Restraint Usage: | Police reported that she was wearing the available three-point lap and shoulder harness. |

**OCCUPANT INJURIES - 2003 Chevrolet Venture LS Minivan**

Injury data for both occupants in the case vehicle were obtained from emergency room records.

| | Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|---|
| Driver: | Fracture, inferior pole of the left patella | 852400.2,2 | Knee bolster | Probable |
| Third Row, Right Side Seated Occupant: | Cervical Strain | 640278.1,6 | Impact force | Certain |

**OCCUPANT INJURIES - Toyota Echo**

Injury data for the driver of the other vehicle was obtained from the police report.

| | Injury | OIC Code | Injury Mechanism | Confidence Level |
|---|---|---|---|---|
| Driver: | Pelvis fracture | 852600.2,9 | Left door panel | Possible |
| | Laceration under left eye | 290602.1,2 | Flying glass | Possible |
| | Abrasion to forehead | 290202.1,7 | Unknown source | Unknown |
| | Left shoulder abrasion | 790202.1,2 | Shoulder belt webbing | Probable |

**OCCUPANT KINEMATICS - 2003 Chevrolet Venture LS Minivan**

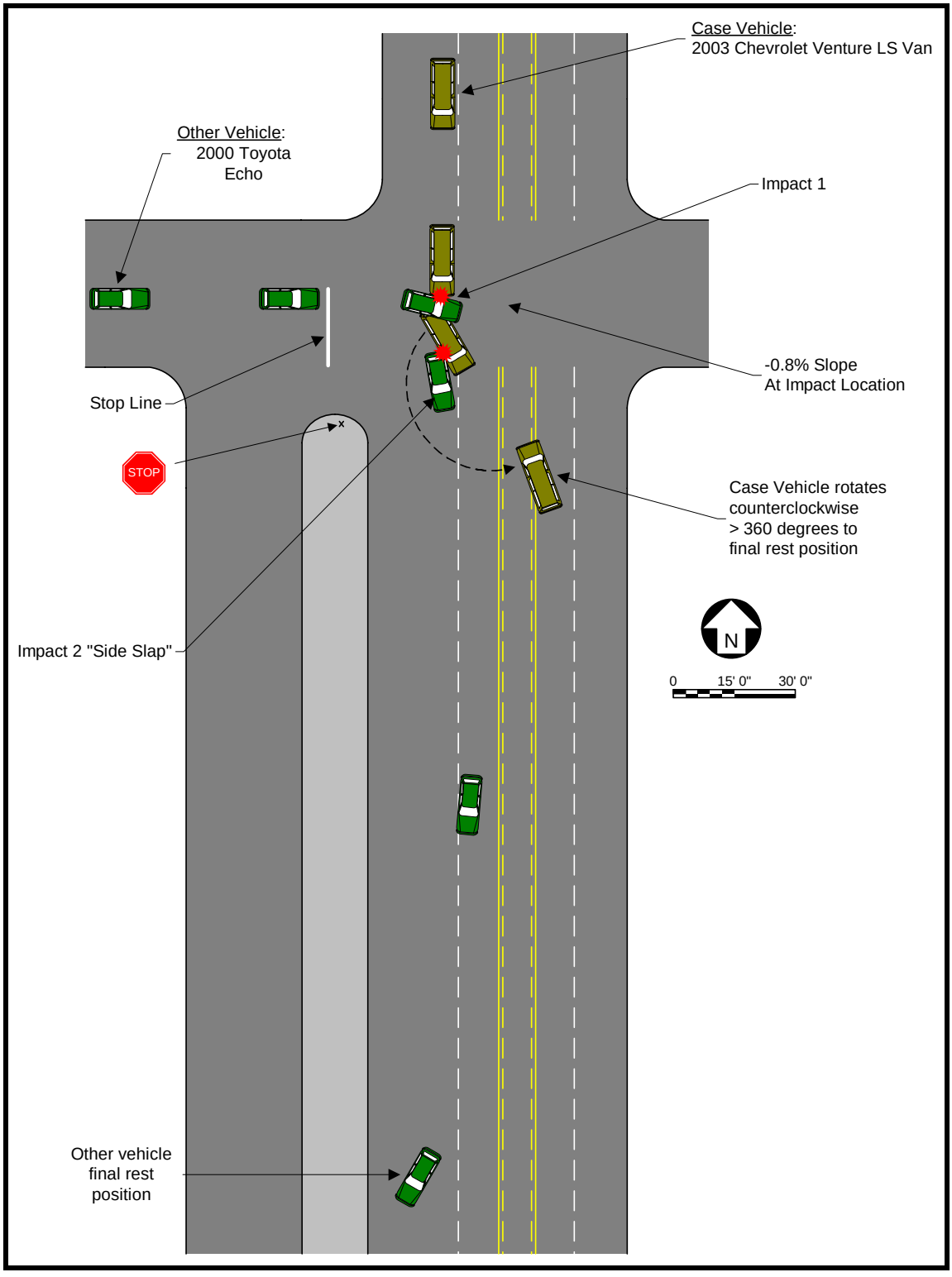
The 34 year-old female driver was wearing the available three-point manual lap and shoulder restraint in a normal fashion. It is suspected that there was some slack with the applied lap belt webbing and that it may have been worn in a loose fashion. The front left seat was adjusted to its most rearward seat track position. According to downloaded SDM deployment data, the brake switch was activated ON 1 second prior to AE. Her right foot was depressing the brake pedal and her left foot was likely on the floor as the front of the case vehicle impacted the left fender area of the other vehicle. She responded to the 20 degree principal direction of force by moving primarily forward and slightly to the right. The applied shoulder belt webbing restricted her upper torso from extended forward movement. Her lower torso slid forward, loading the applied lap belt webbing. Her left knee likely impacted the knee bolster which resulted in a fractured patella (AIS-2).

The driver probably moved to her right in response to the secondary sideslap impact. She was maintained in her respective seated position and was subsequently transported to a local hospital where she was treated and released.

The third row, right side position was occupied by a 9 year-old female who was wearing the available three-point manual lap and shoulder restraint in a normal and suspected correct fashion. She responded to the 1 o'clock impact force by moving forward and slightly to her right. As she loaded the applied lap and shoulder belt, the floor mounted locking mechanism for the third row seat apparently failed allowing the seat to pitch forward. One of the floor mounted seat anchor points was out of alignment. The striker post was out of alignment with the latching mechanism which allowed the removable seat to move forward in response to the initial 20 degree principal direction of force. As the seat moved forward, thee child's upper torso slipped through the applied shoulder belt webbing. She probably made contact with the second row seatback support, but this likely did not result in injury.

She responded to the secondary right side sideslap impact by moving to her right. She was subsequently transported to a local hospital where she was diagnosed and treated for a cervical strain (AIS-1) and released the same day of the crash.

## Attachment 1. Scene Diagram



**Attachment 2. Vetronix Output Report**

## CDR File Information

| | |
|---|---|
| Vehicle Identification Number | 1GNDX03E03D****** |
| Investigator | |
| Case Number | |
| Investigation Date | |
| Crash Date | |
| Filename | DS03004.CDR |
| Saved on | 2/10/03 11:10:45 AM |
| Collected with CDR version | Crash Data Retrieval Tool 1.680 |
| Reported with CDR version | Crash Data Retrieval Tool 2.900 |
| Event(s) recovered | Deployment<br>Non-Deployment |

## SDM Data Limitations

SDM Recorded Crash Events:
There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.
The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within 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, and then the Deployment Level Event will overwrite the Non-Deployment Event file.

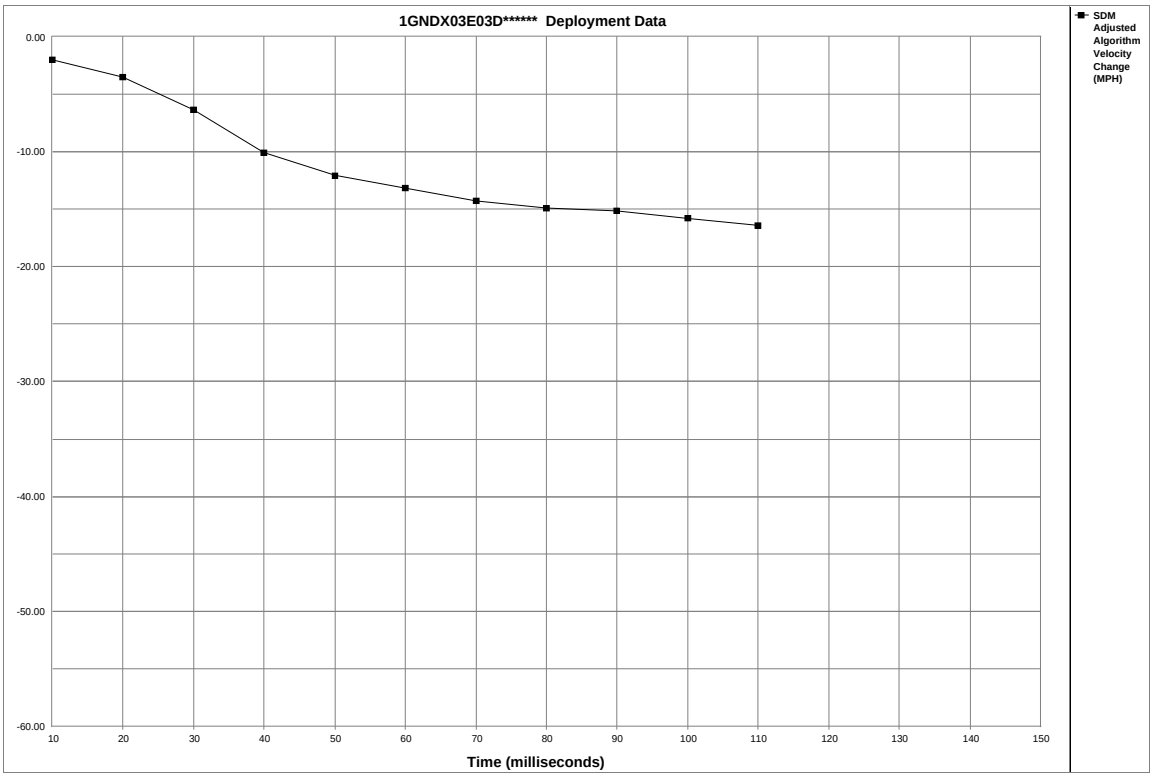
SDM Data Limitations:
-SDM Adjusted Algorithm Forward Velocity Change:
Once the crash data is downloaded, the CDR tool mathematically adjusts the recorded algorithm forward velocity data to generate an adjusted algorithm forward velocity change that may more closely approximate the forward velocity change the sensing system experienced during the recorded portion of the event. The adjustment takes place within the downloading tool and does not affect the crash data, which remains stored in the SDM. The SDM Adjusted Algorithm Forward Velocity Change may not closely approximate what the sensing system experienced in all types of events. For example, if a crash is preceded by other common events, such as rough road, struck objects, or off-road travel, the SDM Adjusted Algorithm Forward Velocity Change may be less than and some times significantly less than the actual forward velocity change the sensing system experienced. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For Deployment Events and Deployment Level Events, the SDM will record 100 milliseconds of data after deployment criteria is met and up to 50 milliseconds before deployment criteria is met. The maximum value that can be recorded for SDM Adjusted Algorithm Forward Velocity Change is about 112 MPH.
-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.
-Some of the Pre-Crash data may be recorded after Algorithm Enable (AE). This may happen in situations involving relatively "soft" crash pulses or those that take place over a relatively longer period of time. If this occurs, it may affect the reported pre-crash data values, but does not affect other data such as SDM Adjusted Algorithm Forward Velocity Change.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM receive an invalid message from the module sending the pre-crash data.
-Driver's Belt Switch Circuit Status indicates the status of the driver's seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Driver's Belt Switch Circuit may be reported other than the actual state.
-The Time Between 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 power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
SDM Data Source:
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted once a second by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.
-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the vehicle's communication network, to the SDM. Depending on vehicle option content, the Brake Switch Circuit Status data may not be available.
-The SDM may obtain Belt Switch Circuit Status data a number of different ways, depending on the vehicle architecture. Some switches are wired directly to the SDM, while others may obtain the data from various vehicle control modules, via the vehicle's communication network.

## System Status At Deployment

| | |
|---|---|
| SIR Warning Lamp Status | OFF |
| Driver's Belt Switch Circuit Status | BUCKLED |
| Passenger Belt Switch Circuit Status (If Equipped) | UNBUCKLED |
| Ignition Cycles At Deployment | 1168 |
| Ignition Cycles At Investigation | 1169 |
| Time Between Non-Deployment And Deployment Events (sec) | N/A |
| Event Recording Complete | Yes |

| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle |
|---|---|---|---|
| -5 | 50 | 1536 | 7 |
| -4 | 51 | 1536 | 7 |
| -3 | 51 | 1600 | 0 |
| -2 | 50 | 1472 | 0 |
| -1 | 43 | 1152 | 0 |

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




| Time (milliseconds) | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Adjusted Algorithm Velocity Change | -1.95 | -3.49 | -6.34 | -10.07 | -12.05 | -13.15 | -14.24 | -14.90 | -15.12 | -15.78 | -16.44 | N/A | N/A | N/A | N/A |

## System Status At Non-Deployment

| | |
|---|---|
| SIR Warning Lamp Status | OFF |
| Driver's Belt Switch Circuit Status | UNBUCKLED |
| Passenger Belt Switch Circuit Status (If Equipped) | UNBUCKLED |
| Ignition Cycles At Non-Deployment | 952 |
| Ignition Cycles At Investigation | 1169 |
| Maximum SDM Algorithm Forward Velocity Change (MPH) | -1.16 |

| Seconds Before AE | Vehicle Speed (MPH) | Engine Speed (RPM) | Percent Throttle |
|---|---|---|---|
| -5 | 4 | 1472 | 7 |
| -4 | 6 | 1024 | 0 |
| -3 | 6 | 832 | 0 |
| -2 | 2 | 640 | 0 |
| -1 | 1 | 576 | 0 |

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

## Hexadecimal Data

| | | | | | | |
|---|---|---|---|---|---|---|
| $01 | 0C | 04 | 2A | 15 | 00 | 00 |
| $02 | BC | DC | 00 | 00 | 00 | 00 |
| $03 | 41 | 53 | 32 | 31 | 37 | 31 |
| $04 | 4B | 36 | 52 | 4D | 33 | 31 |
| $05 | 02 | 41 | 01 | 01 | 00 | 00 |
| $06 | 09 | 38 | 46 | 20 | 00 | 00 |
| $10 | FF | 6D | FE | 00 | 00 | 00 |
| $11 | 96 | 00 | 00 | 00 | 00 | 80 |
| $12 | 00 | 00 | 00 | 00 | 00 | 00 |
| $13 | 00 | 00 | 00 | 00 | 00 | 00 |
| $14 | FF | 44 | ED | 80 | 55 | 00 |
| $18 | 80 | 80 | 80 | 7B | 7B | 7C |
| $1C | FA | FA | FA | FA | FA | FA |
| $1D | FA | FA | FA | FA | FA | FA |
| $1E | FA | FA | 00 | 00 | 00 | 00 |
| $1F | FF | 5A | 00 | 00 | 00 | 00 |
| $20 | 00 | 00 | 00 | 76 | FF | 00 |
| $21 | FF | FF | FF | FF | FF | FF |
| $22 | FF | FF | FF | FF | 00 | 00 |
| $23 | 00 | 01 | 01 | 02 | 02 | 02 |
| $24 | 02 | FF | FF | FF | FF | FF |
| $25 | FF | FF | FF | 07 | 00 | 00 |
| $26 | 02 | 03 | 09 | 0A | 07 | E1 |
| $27 | 00 | 00 | 00 | 00 | 11 | 00 |
| $28 | 09 | 0A | 0D | 10 | 17 | 00 |
| $29 | FF | 88 | FF | 00 | 00 | 00 |
| $2A | 00 | 00 | 00 | 00 | 00 | 00 |
| $2B | 00 | 00 | 00 | 00 | 00 | 00 |
| $2C | 00 | 00 | FF | 00 | 00 | 55 |
| $2D | 00 | 00 | 00 | 00 | 00 | 00 |
| $2E | 00 | 00 | 00 | 00 | 00 | 00 |
| $30 | 40 | 00 | 00 | 7D | 80 | 00 |
| $31 | FF | FF | 9F | FF | FF | FF |
| $32 | FF | FF | FF | FF | 00 | 00 |
| $33 | 09 | 09 | 00 | 00 | 03 | 03 |
| $34 | 00 | 00 | 04 | 07 | 0D | 15 |
| $35 | 19 | 1B | 1D | 1E | 1E | 1F |
| $36 | 20 | FF | FF | FF | FF | 0B |
| $37 | 45 | 51 | 52 | 52 | 51 | 80 |
| $38 | 00 | 00 | 00 | 11 | 11 | 00 |
| $39 | 12 | 17 | 19 | 18 | 18 | 00 |
| $3A | FF | 6D | FF | 00 | 00 | 00 |
| $3B | 11 | 11 | 00 | 00 | 00 | 00 |
| $3C | 2D | 04 | 0B | 00 | 00 | AA |
| $3D | 00 | 00 | 00 | 00 | 00 | 00 |
| $3E | 00 | 00 | 00 | 00 | 00 | 00 |
| $40 | FF | FF | FF | FF | FF | 00 |
| $41 | FF | FF | FF | FF | FF | FF |
| $42 | FF | FF | FF | FF | 00 | 00 |
| $43 | FF | FF | FF | 00 | 00 | 00 |