CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH INVESTIGATION

CASE NO: CA04-029

VEHICLE: 2003 CHEVROLET TAHOE

LOCATION: VIRGINIA

CRASH DATE: MAY 2004

Contract No. DTNH22-01-C-17002

Prepared for:

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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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SCI CASE NO.: CA04-029
VEHICLE: 2003 CHEVROLET TAHOE
LOCATION: VIRGINIA
CRASH DATE: MAY, 2004

BACKGROUND

This on-site investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) occupant protection system in a 2003 Chevrolet Tahoe. This advanced occupant protection system was comprised of dual-stage frontal air bags, seat track position sensors for both front seats, front safety belt buckle switches, a front right occupant detection sensor, and a seat belt tension retractor sensor (for the front right manual restraint). The manufacturer certified that the CAC system met the advanced air bag requirements of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. The vehicle's Sensing and Diagnostic control Module (SDM) tailored the deployment of the frontal air bags based on the crash severity and inputs from these sensors. The SDM had Event Data Recorder (EDR) capabilities that captured pre-crash vehicle systems data and crash data related to an event. The EDR recorded a non-deployment event that was downloaded during the SCI inspection and was used as a supplement to the on-site investigation. The Chevrolet Tahoe, **Figure 1**, was involved in a minor sideswipe impact with a 1994 Isuzu Rodeo that resulted in a loss of control and right roadside departure. The Tahoe then impacted a fence and tree line that resulted in minor frontal damage and moderate left side damage. The frontal impact was a below-threshold impact that did not warrant the deployment of the vehicle's advanced frontal air bags. The vehicle was not equipped with side impact air bags. The Chevrolet Tahoe was occupied by a 42 year old restrained female driver, and a 17 year old restrained female front right passenger. The occupants of the Tahoe sustained police reported non-incapacitating injuries and were transported via ground ambulance to a local hospital. The 18 year old male driver of the Isuzu Rodeo suffered a police reported minor injury and denied medical attention.

Figure 1: Left front view of the 2003 Chevrolet Tahoe.

This crash was identified from a list of claims provided by an insurance company to the National Highway Traffic Safety Administration (NHTSA). The list identified Certified Advanced 208 Compliant vehicles that had been involved in total loss traffic crashes. The Crash Investigation Division of the NHTSA analyzed the list based on crash type and location and then forwarded a list of selected crashes to the Calspan Special Crash Investigations (SCI) team for follow-up investigation. The subject Chevrolet Tahoe was located in a salvage yard and cooperation was established with the local insurance adjuster. An on-site investigation was assigned to the

Calspan SCI team on July 7, 2004 and the Chevrolet Tahoe was inspected July 9, 2004. The Isuzu Rodeo had been salvaged and sold prior to SCI involvement and was not inspected. Photographs of this vehicle were not available.

SUMMARY

VEHICLE DATA

2003 Chevrolet Tahoe

The 2003 Chevrolet Tahoe was identified by the Vehicle Identification Number (VIN): 1GNEK13Z63R (production sequence deleted). The four-wheel drive, four door sport utility was configured with a 295 cm (116 in) wheelbase. The Gross Vehicle Weight Rating (GVWR) was 3,084 kg (6,900 lb). The power train consisted of a 5.3 liter/V8 engine linked to a four-speed automatic transmission with overdrive. The vehicle was equipped with LS model trim equipment to include power steering, power assist four-wheel disc brakes with ABS, power windows and door locks, and adjustable pedals. The interior was configured for eight passenger seating (2/3/3). The front row consisted of a cloth trimmed ten-way power adjustable driver seat and a manual front right seat. The second row was equipped a 60/40 spilt bench seat. The third row consisted of a 50/50 split bench seat. The manual restraint system consisted of seat-integrated 3-point lap and shoulder belts in the outboard positions of the first and third row and in the center position of the second row. The second row manual restraints consisted of continuous loop 3-point lap and shoulder belts with C-pillars mounted switchable retractors. The third row center position was lap belt equipped. The frontal air bag system consisted of driver and front right passenger air bags certified by the manufacturer to be compliant with the advanced FMVSS 208 occupant protection standard. The vehicle's date of manufacture was unknown; the front left door and manufacture's labels were missing at the time of the inspection. The Tahoe was equipped with Firestone Wilderness LE P265/70R16 tires on OEM alloy wheels. The manufacturer's recommended tire pressure was 241 kPa (35 PSI). The specific measured tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	0 kPa	9 mm (11/32 in)	Yes	Debeaded
LR	0 kPa	7 mm (9/32 in)	No	Debeaded
RF	214 kPa (31 PSI)	8 mm (10/32 in)	No	None
RR	12 kPa (2 PSI)	7 mm (9/32 in)	No	None

1994 Isuzu Rodeo

The 1994 Isuzu Rodeo was identified by the Vehicle Identification Number (VIN): 4S2CG58V0R4 (production sequence deleted). The 4x2, four-door sport utility vehicle had a Gross Vehicle Weight Rating of 2063 kg (4,550 lb). The power train consisted of a 3.2 liter/V6 engine and 4-speed automatic transmission. The service brakes consisted of power assisted front disc/rear drum brakes without ABS. The vehicle was not equipped with air bags. The vehicle was not available for inspection.

CRASH SITE

This two-vehicle crash occurred during the morning hours of May 2004 in a rural setting. At the time of the crash, it was daylight and the weather was not a factor. The asphalt road surface was dry. The crash occurred in the eastbound lanes of a divided four-lane east/west state route. **Figure 2** is an eastbound trajectory view leading into the crash site. The road was straight and level in the area of the crash. At the scene, the east and west lanes were separated by a 6.1 m (20 ft) wide depressed grass median. The two eastbound travel lanes measured 7.3 m (23.8 ft) in total width and were separated by broken white lines. The inboard and outboard edges of the travel lanes were delineated by solid yellow and white lines, respectively. There was no inboard shoulder to the road. The width of the pavement inboard of the yellow lane line measured 20 cm (8 in). The outboard travel lane was bordered by a 2.3 m (7.6 ft) wide paved shoulder. The grassy terrain outboard of the road shoulder sloped into a 30 cm (12 in) deep ditch. The center of the ditch was located 1.9 m (6.3 ft) south of the pavement edge. The top of the back slope leading out of the ditch was located 3.7 m (12.3 ft) south of the pavement edge and was approximately 0.8 m (2.7 ft) higher in elevation than the base of the ditch. An unimproved driveway leading to the open fields south of the road crossed the ditch in the area of Chevrolet's off-road trajectory.

Figure 2: Eastbound trajectory view.

The physical road evidence documented at the crash scene identified the trajectories of the Isuzu and Chevrolet, as the vehicles departed the right side of the roadway. **Figure 3** is a southeastward view of the road evidence. The vehicles departed the road at an angle of approximately 30 degrees relative to the eastbound travel direction. The road evidence consisted of a gouge attributed to the right front rim of the Isuzu, and a set of marks (a tire scuff and a pair of gouges) attributed to the left front tire, left rear rim and right rear rim of the Chevrolet, respectively. The Isuzu's rim gouge measured 11.5 m (37.6 ft) long, 3 cm (1 in) wide and 1 cm (0.5 in) deep and is depicted on the left side of Figure 3. The set of marks attributed to the Chevrolet are depicted on the center and right side of Figure 3. The left front tire mark measured 6.2 m (20.2 ft) long and 24 cm (9.5 in) wide. The gouge caused by the left rear rim measured 3.7 m (12.3 ft) long, 5 cm (2.0 in) wide and 3 cm (1 in) deep. The right rear rim gouge measured 4.9 m (16.2 ft) long, and was a surface abrasion. The orientation of the marks revealed the Chevrolet departed the road with a clockwise rotation and was off-tracking approximately 10 degrees.

Figure 3: Physical road evidence of the vehicles' trajectories.

A fence line located approximately 5.1 m (16.6 ft) south of the pavement edge was impacted and taken down by the Chevrolet Tahoe during its off-road trajectory. The fence was repaired prior to SCI inspection. An 81 cm (32 in) diameter tree and a 28 cm (11 in) diameter tree were located

2.8 m (9.3 ft) and 1.4 m (4.6 ft) south of the fence, respectively. The trees are depicted in **Figure 4** and were the Tahoe's point of impact.

Figure 4: Fence and trees impacted by the Tahoe.

CRASH SEQUENCE

Pre-Crash

The 2003 Chevrolet Tahoe was traveling east on the outboard lane driven by a 42 year old female. The driver was restrained at the time of the crash by the vehicle's 3-point lap and shoulder belt. The front right position of the Chevrolet was occupied by a 17 year old restrained female. The vehicle was traveling at an EDR reported speed of 101 km/h (63 mph). The 1994 Isuzu Rodeo was eastbound on the inboard lane driven by an 18 year old male. The Isuzu was overtaking the Chevrolet at the time of the crash. A schematic of the crash is included at the end of this report as **Figure 9.**

Crash

For unknown reasons, the driver of the Isuzu relinquished directional control of the vehicle and the vehicle drifted to the left onto the center median. The driver responded to the vehicle's errant trajectory by steering right to regain the road. In the process, the driver overcorrected and caused the Isuzu to cross through the inboard lane and enter the outboard lane along side the path of the Chevrolet. The right plane of the Isuzu contacted the left plane of the Chevrolet (Event 1) and both vehicles lost directional control. The driver of the Chevrolet reacted to the Isuzu by steering right and braking in an unsuccessful effort to avoid the crash. The Chevrolet and Isuzu departed the right side of the road in a non-tracking mode at a relative angle of 30 degrees to the eastbound travel direction.

The Chevrolet departed the pavement in the area of the unimproved driveway. The vehicle traversed the corner of the ditch and engaged the back slope. The vehicle's dynamics and undercarriage contact (Event 2) over this uneven terrain enabled the Sensing and Diagnostic Module's (SDM's) crash algorithm and a non-deployment event was recorded. The recorded speed of the Tahoe one second (T-1) prior to Algorithm Enable (AE) was 45 mph.

The front plane of the Chevrolet engaged and fractured the 10 cm (4 in) diameter fence post (depicted in **Figure 4**) and passed through the fence line (Event 3). At the time of the fence impact, the Tahoe had rotated approximately 65 degrees clockwise relative to its original travel direction. The Tahoe continued along this southeastward trajectory and the left corner of the vehicle's front bumper engaged the 81 cm (32 in) diameter tree (Event 4). This impact crushed the left corner of the bumper (outboard the frame) rearward deflating the left front tire. The direction of force for the frontal impacts was in the 11 o'clock sector at an estimated 320 degrees. The WINSMASH calculated total delta V of the Tahoe based on the combined frontal damage of Events 3 and 4 was 11 km/h (6.6 mph). The longitudinal and lateral delta V components were -8 km/h (-5 mph) and 7 km/h (4.2 mph), respectively.

The engagement of the front bumper with the tree initiated a clockwise vehicle rotation and the left front fender of the Tahoe impacted the 28 cm (11 in) diameter tree (Event 5). The sudden deceleration caused by this impact caused the vehicle to begin roll to the left. The Tahoe rolled approximately 45 degrees resulting in direct contact between the horizontal surface of the hood and tree that extended to the vehicle's centerline. The vertical damage to the tree measured 122 cm (48 in) consistent with these partial roll of the Tahoe. The dynamics of this impact were beyond the limits of the WINSMASH collision model. However, a baseline analysis was conducted using the profile along the left front fender of the Tahoe. The calculated total delta V of Event 5 was 13 km/h (8.1 mph). The longitudinal and lateral components were -4 km/h (-2.8 mph) and 12 km/h (7.8 mph). This baseline analysis underestimated the severity of the crash based on the crash dynamics and SCI field experience. Coincident with the described vehicle dynamics, the Tahoe rotated approximately 120 degrees clockwise about the tree to rest. The Chevrolet came to rest facing northwest in close proximity to the tree. Due to the passage of time between the crash date and the on-site inspection, the exact final rest position of the Tahoe could not be determined.

The Isuzu departed the road along the trajectory defined by the 11.5 m (37.6 ft) long rim gouge depicted on the left side of **Figure 3** above. It was probable that the gouge was related to one of the right tires that deflated during the vehicle to vehicle interaction. The Isuzu rotated clockwise and came to rest facing northwest on the road shoulder. A 1 m (3.2 ft) gouge mark defined the vehicle's probable final rest location.

Post-Crash

The police and ambulance personnel responded to the crash. The driver and front right passenger of the Chevrolet Tahoe were removed from the vehicle and transported to a local hospital via ground ambulance. The driver sustained a reported left lower extremity fracture. The front right passenger sustained a right shoulder contusion. The 18 year old male driver of the Isuzu was not injured. The Chevrolet and Isuzu sustained disabling damage and were towed. Both vehicles were subsequently deemed total losses by their respective insurance companies.

EXTERIOR DAMAGE

2003 Chevrolet Tahoe

The 2003 Chevrolet Tahoe sustained impact damage to the front and left side planes during the multiple impact crash sequence. **Figure 5** is an overall left side view of the Tahoe. At the time of the inspection the front left door was missing, therefore contact damage to exterior door panel could not be documented. However, it was probable that the front left door was also damaged during the vehicle to vehicle impact (Event 1). The left rear door was forced open during the extrication process and would not close. The rearward shift of the door measured 4 cm (1.5 in) at the striker. There was no measurable change in the wheelbase dimensions. The windshield was fractured in multiple locations from the exterior impact in the tree (Event 5). None of the side windows were damaged.

Figure 5: Left side view of the Tahoe.

The left side plane damage began 81 cm (32 in) rearward of the left rear axle and extended forward to the left B-pillar location 119 cm (47 in) forward of the left rear axle. The direct damage throughout the contact pattern consisted of abrasions and minor deformation of the body panels. The maximum measured deformation was 5 cm (2.0 in). The maximum deformation was located on the left rear quarterpanel 36 cm (14 in) aft of the left rear axle. The Collision Deformation Classification (CDC) of this impact was 09-LZEN1.

Figure 6 is a front view of the damaged Tahoe. The front plane of the Tahoe sustained 168 cm (66 in) of direct and induced damage that extended across the entire end width of the vehicle as a result of the impacts to the fence and 81 cm (32 in) diameter tree (Events 3 and 4). The direct contact began 51 cm (20.1 in) right of center and extended 134 cm (52.9 in) to the left front bumper corner. The residual crush profile measured along the front bumper was as follows: C1 = 14 cm (5.7 in), C2 = 4 cm (1.8 in), C3 = 9 cm (3.5 in), C4 = 10 cm (3.8 in), C5 = 2 cm (1.0 in), C6 = 0. The maximum crush was located at C1. The maximum crush occurred outboard the frame and was consistent with contact to the tree. The CDC of the overlapping damage was 11-FDEW1.

The Tahoe engaged the 28 cm (11 in) diameter tree (Event 5) with the left front fender, **Figure 7**. The direct contact began 4 cm (1.5 in) forward of the left front axle and ended 24 cm (9.5 in) rearward of the axle. The combined length of the direct and induced damage measured 89 cm (35 in). The direction of impact force was an estimated 290 degrees. The fender deformed laterally and shifted rearward. The direct contact with the tree wrapped onto the horizontal surface of the hood to the centerline. This deformation pattern indicated that the vehicle rolled to left approximately 45 degrees during the interaction. The residual crush profile measured along the top edge of the fender was as follows: C1 = 0, C2 = 47 cm (18.5 in), C3 = 46 cm (18.1 in), C4 = 28 cm (11.0 in), C5 = 13 cm (5.1 in), C6 = 6 cm (2.4 in). The CDC of the damage was 10-LFEN3.

Figure 6: Front view of the Tahoe.

Figure 7: Residual crush at the left front fender.

INTERIOR DAMAGE
2003 Chevrolet Tahoe

The interior damage to the Chevrolet Tahoe consisted of intrusion into the driver's interior space and interior driver contacts. **Figure 8** is an interior view of Row 1. The impact with the 28 cm (11 in) diameter tree (Event 5) resulted in intrusion of the upper instrument panel and knee bolster. The left upper instrument panel intrusion measured at the outboard corner was 16 cm (6.2 in). The bolster intrusion at the outboard aspect measured 15 cm (6 in). There was no intrusion into the front right occupant space.

Figure 8: Interior view across Row 1.

Contact to the driver's knee bolster consisted of a 27 cm x 15 cm (10.5 in x 6.0 in) area of blood and tissue. This evidence began at the outboard aspect of the bolster and extended to the right. The rigid bolster panel was not visibly deformed. However, the left mount of the bolster was fractured. The bolster mount was located 30 cm (12 in) left of the steering column centerline. No other contacts were identified. The lack of occupant contacts supported the fact that the driver and front right passenger were restrained by the integrated safety belts at the time of the crash.

At inspection, the four-spoke tilt steering wheel was adjusted to the center position. There was no deformation of the steering wheel rim and there was no evidence of loading to the steering column's shear capsules. The Tahoe was equipped with adjustable foot pedals. The pedals were adjusted to a forward position that measured 8 mm (0.3 in) aft of full forward. The adjustment range measured 43 mm (1.7 in).

The powered, ten-way adjustable driver seat was located in a mid-track position at the time of the inspection. The seat position measured 10.7 cm (4.2 in) rearward of full forward. The total seat track travel measured 21.6 cm (8.5 in). The seat back angle measured 14 degrees aft of vertical. The horizontal distance from the center of the air bag module to the seat back measured 43.9 cm (17.3 in). This distance was measured 41 cm (16 in) above the seat bight.

The manual front right seat was located in a mid-track position at the time of the inspection. The seat position measured 8.9 cm (3.8 in) rearward of full forward. The total seat track travel measured 21.6 cm (8.5 in). The seat back angle measured 15 degrees aft of vertical. The horizontal distance from the vertical face of the mid-mount air bag module to the seat back measured 70.6 cm (27.8 in). This distance was measured 48 cm (19 in) above the seat bight.

MANUAL RESTAINT SYSTEM
2003 Chevrolet Tahoe

The manual restraint system in the front row of the Tahoe consisted of integrated 3-point lap and shoulder belts with continuous loop webbing and sliding latch plates. The driver's restraint was stowed within the ELR retractor upon inspection. Examination of the latch plate revealed minor

indications of historical use consistent with the age of the vehicle. A webbing crease was identified at the belt guide with the webbing extended and buckled. The location of the crease measured 154 cm (60.8 in) from the outboard anchor. The SCI inspection determined the driver was restrained at the time of the crash. This determination was consistent with the downloaded EDR data; the EDR data indicated the driver restraint was buckled at the time of the crash.

The front right passenger's integrated restraint was stowed within the switchable retractor at the time of the inspection. The retractor was operational. Examination of the latch plate revealed historical usage marks consistent with the vehicle's age. Crash related evidence was identified on the extended webbing consistent with the restraint being used at the time of the crash. A crease in the webbing was located 144 cm (56.5 in) above the anchor at the belt guide. All evidence gathered at the SCI inspection indicated the front right passenger was restrained at the time of the crash.

CERTIFIED ADVANCED 208-COMPLIANT SYSTEM
2003 Chevrolet Tahoe

The Certified Advanced 208-Compliant (CAC) frontal air bag consisted of advanced dual stage air bags for the driver and front right passenger, seat track position sensors, front safety belt buckle switch sensors, and a front right occupant detection sensor. The front right occupant detection sensor was designed to detect the presence of a front right occupant and then to calibrate the weight and the seat track position of the occupant prior to issuing a deployment command. The frontal air bag system was certified by the manufacturer to have met the advanced air bag requirements of FMVSS No. 208. The frontal air bags were not commanded to deploy in this crash.

The CAC system was controlled and monitored by a Sensing and Diagnostic control Module (SDM) located under the driver's seat. Additionally, two crash sensors, symmetrically located on forward frame rails, were used to aid in crash detection and assess crash severity. The SDM was equipped with an Event Data Recorder (EDR) that recorded data related to the crash. This data was downloaded by the SCI investigator at the time of the vehicle inspection.

The EDR was downloaded utilizing the Vetronix Crash Data Retrieval (CDR) hardware and software version 2.321. The data was downloaded by connecting the CDR hardware directly to the SDM located under the driver's seat. Electrical power was supplied by an external 12 volt source.

The EDR recorded and stored a long duration Non-Deployment event that was related to the subject crash. The event was recorded on Ignition Cycle 1838 and the data was downloaded on Ignition cycle 1839. Data fields within the stored data indicated that the recording was complete, multiple events were associated to the recorded portion of the data and one or more of those associated events were not recorded. The maximum longitudinal delta V recorded by the EDR was -32 km/h (-19.9 mph). This value was recorded 517.5 milliseconds after Algorithm Enable (AE). It should be noted that the EDR recorded delta V at 150 milliseconds after AE was -5 km/h (-2.8 mph). The recorded delta V data was consistent with a slowly developing multiple event crash. The complete EDR report downloaded from the vehicle is attached to the end of this report as *Attachment A*.

OCCUPANT DEMOGRAPHICS
2003 Chevrolet Tahoe

	Driver	***Front Right Passenger***
Age/Sex:	42 year old / Female	17 year old / Female
Height:	Not reported	Not reported
Weight:	Not reported	Not reported
Seat Position:	Mid track	Mid track
Restraint Use:	3-point lap and shoulder belt	3-point lap and shoulder belt
Usage Source:	SCI inspection, EDR	SCI inspection
Medical Treatment:	Treated and released	Treated and released

DRIVER INJURY
2003 Chevrolet Tahoe

Injury	***Injury Severity (AIS 98 Update)***	***Injury Mechanism***
Left lower extremity fracture, NFS	Moderate (852002.2,2)	Knee bolster
Left lower extremity abrasion and contusion	Minor (890202.1,2) (890402.1,2)	Knee bolster
Left chest contusion	Minor (490402.1,2)	Safety belt

Note: the above injuries were based on the driver interview. No records of treatment were available from the reported hospital.

DRIVER KINEMATICS
2003 Chevrolet Tahoe

The 42 year old female driver of the Chevrolet was seated in an upright posture with the seat adjusted to a mid-track position. She was restrained by the vehicle's manual safety belt. Upon initial contact with the Isuzu, the ELR retractor of the safety belt system locked. As the vehicle left the road and drove through the roadside ditch, the driver reacted to the non-horizontal force of the undercarriage impact by initiating a downward and forward trajectory. The driver loaded the seat cushion and loaded the locked manual safety with her torso. The vehicle then experienced a series of closely spaced impacts to the front and left planes. The driver rode down the force of these impacts by a continued loading of the safety belt system to rest. During the impact the instrument panel and bolster intruded. The intrusion resulted in the driver's left lower extremity fracture and associated soft tissue injury. The driver's loading of the safety belt resulted in her left chest contusion.

FRONT RIGHT PASSENGER INJURY
2003 Chevrolet Tahoe

Injury	*Injury Severity (AIS 98 Update)*	*Injury Mechanism*
Right shoulder contusion, NFS	Minor (790402.1,1)	Safety belt

Note: the above injury was identified via driver interview.

FRONT RIGHT PASSENGER KINEMATICS
2003 Chevrolet Tahoe

The 17 year old female front right passenger was restrained at the time of the crash and seated in a mid-track position with an upright posture. The front right passenger responded to the multiple impact event by initiating a forward trajectory. She loaded the locked manual safety belt with her torso and rode down the force of the impacts. Her restraint loading resulted in a right shoulder contusion. She then rebounded back into the seat and came to rest.

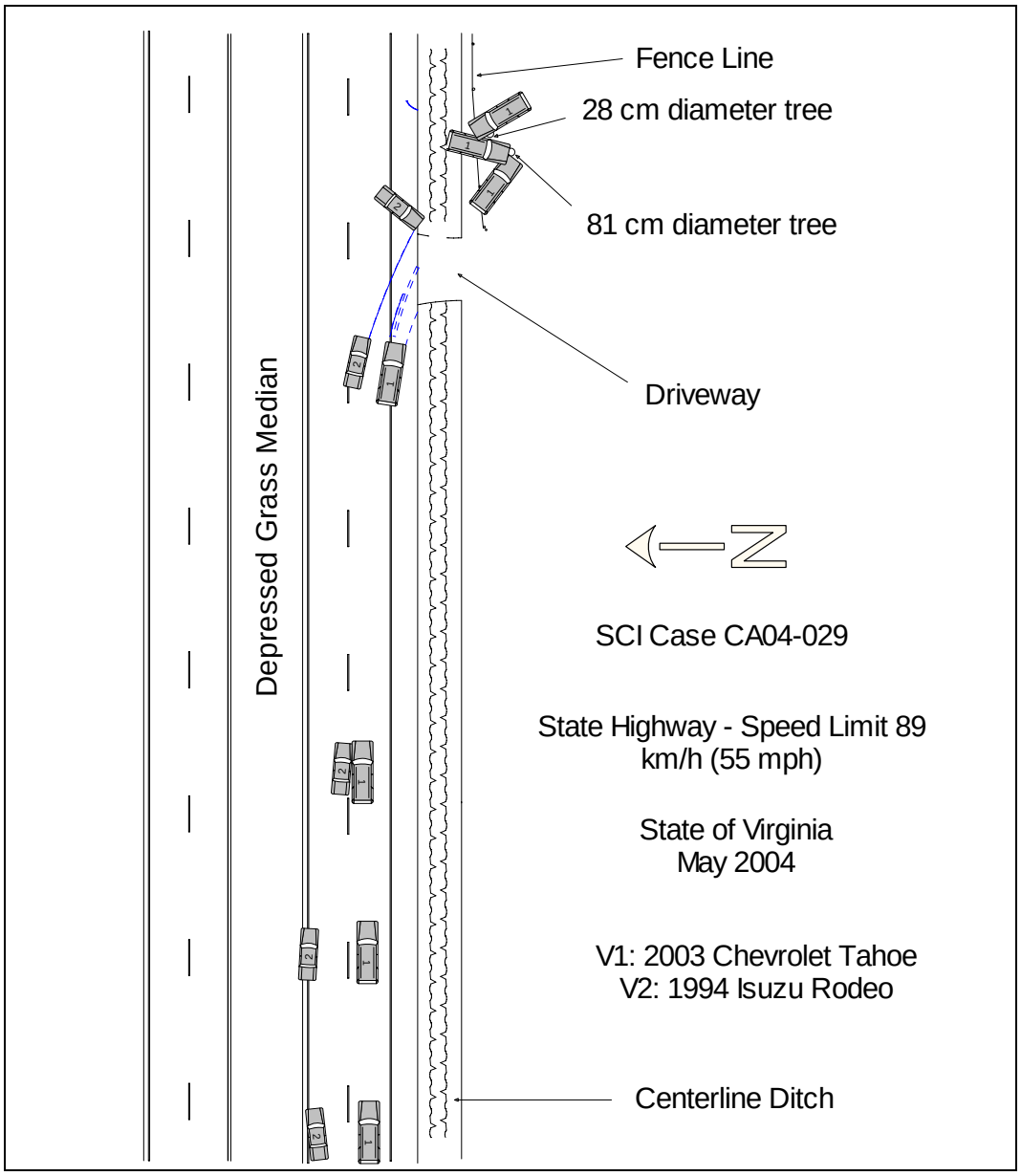


Figure 9 – Crash Schematic

ATTACHMENT A

CDR File Information

Vehicle Identification Number	1GNEK13Z63Rxxxxxx
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	CA04-029 NOSEQ.CDR
Saved on	Thursday, July 8 2004 at 08:39:10 AM
Collected with CDR version	Crash Data Retrieval Tool 2.321
Collecting program verification number	4CFCF183
Reported with CDR version	Crash Data Retrieval Tool 2.800
Reporting program verification number	9238B95E
Interface used to collected data	Block number: 00 Interface version: 3C Date: 05-20-04 Checksum: ED00
Event(s) recovered	Non-Deployment

SDM Data Limitations

SDM Recorded Crash Events:
There are two types of SDM recorded crash events. The first is the Non-Deployment Event. A Non-Deployment Event is an event severe enough to "wake up" the sensing algorithm but not severe enough to deploy the air bag(s). It contains Pre-Crash and Crash data. The SDM can store up to one Non-Deployment Event. This event can be overwritten by an event that has a greater SDM recorded vehicle forward velocity change. This event will be cleared by the SDM after the ignition has been cycled 250 times.
The second type of SDM recorded crash event is the Deployment Event. It also contains Pre-Crash and Crash data. The SDM can store up to two different Deployment Events, if they occur within 25.4 seconds of one another. Deployment Events cannot be overwritten or cleared from the SDM. Once the SDM has deployed the air bag, the SDM must be replaced.
The data in the Non-Deployment Event file will be locked after a Deployment Event, if the Non-Deployment Event occurred within 5 seconds before the Deployment Event. If multiple Non-Deployment Events occur within 5 seconds prior to a Deployment Event, then the most severe Non-Deployment Event will be recorded and locked. If multiple Non-Deployment Events precede a Deployment Event, and multiple Non-Deployment Events occur within 5 seconds of each other (but not necessarily all within 5 seconds of the Deployment Event), and subsequent Non-Deployment Events are less severe than prior Non-Deployment Events, and the last of the multiple Non-Deployment Events occurs within 5 seconds of a Deployment Event, then the most severe of the Non-Deployment Events (which may have occurred more than 5 seconds prior to the Deployment Event) will be recorded and locked.

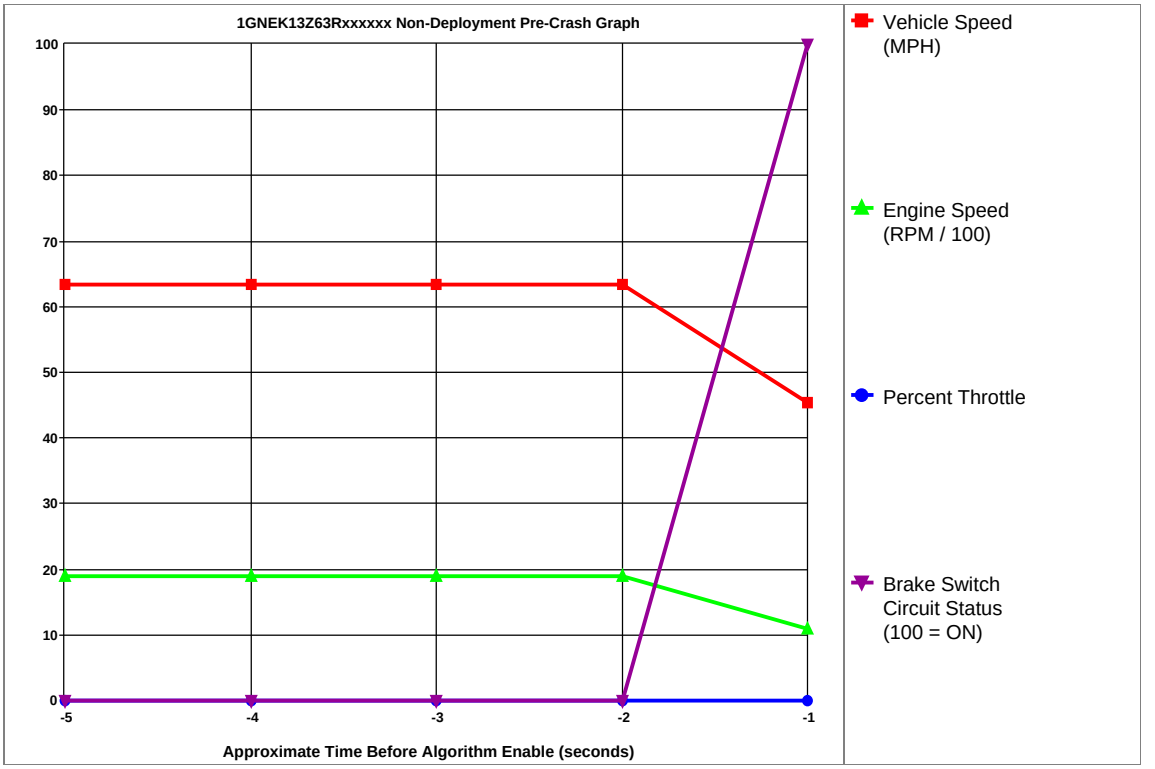
SDM Data Limitations:
-SDM Recorded Vehicle Forward Velocity Change reflects the change in forward velocity that the sensing system experienced during the recorded portion of the event. SDM Recorded Vehicle Forward Velocity Change is the change in velocity during the recording time and is not the speed the vehicle was traveling before the event, and is also not the Barrier Equivalent Velocity. This data should be examined in conjunction with other available physical evidence from the vehicle and scene when assessing occupant or vehicle forward velocity change. For Deployment Events and Deployment Level Events, the SDM will record 100 milliseconds of data after deployment criteria is met and up to 50 milliseconds before deployment criteria is met. For Non-Deployment Events, the SDM will record the first 150 milliseconds of data after algorithm enable.
-Event Recording Complete will indicate if data from the recorded event has been fully written to the SDM memory or if it has been interrupted and not fully written.
-SDM Recorded Vehicle Speed accuracy can be affected if the vehicle has had the tire size or the final drive axle ratio changed from the factory build specifications.
-Brake Switch Circuit Status indicates the status of the brake switch circuit.
-Pre-Crash Electronic Data Validity Check Status indicates "Data Invalid" if the SDM receive an invalid message from the module sending the pre-crash data.
-Driver's and Passenger's Belt Switch Circuit Status indicates the status of the seat belt switch circuit. If the vehicle's electrical system is compromised during a crash, the state of the Belt Switch Circuit may be reported other than the actual state.
-The Time Between Non-Deployment and Deployment Events is displayed in seconds. If the time between the two events is greater than 25.4 seconds, "N/A" is displayed in place of the time.
-If power to the SDM is lost during a crash event, all or part of the crash record may not be recorded.
-Multiple Events Associated with this Record: This parameter will indicate whether one or more associated events preceded the recorded event.
-One or More Associated Events Not Recorded: If a single event is recorded, this parameter will indicate whether one or more associated events, prior to the recorded event, was not recorded.
If two associated events are recorded, this parameter for the first event will indicate whether one or more associated events, prior to the first event, was not recorded.
If two associated events are recorded, this parameter, for the second event, will indicate whether one or more associated

events, between the first and second events, was not recorded.

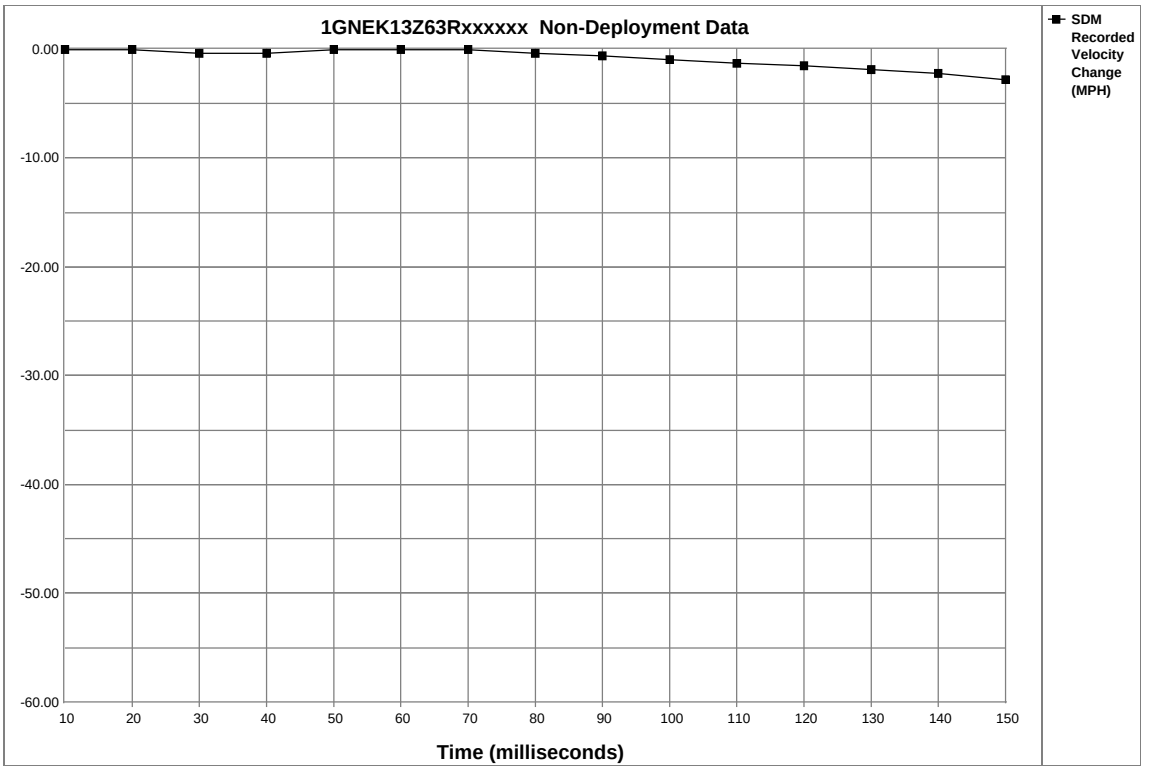
SDM Data Source:
All SDM recorded data is measured, calculated, and stored internally, except for the following:
-Vehicle Speed, Engine Speed, and Percent Throttle data are transmitted once a second by the Powertrain Control Module (PCM), via the vehicle's communication network, to the SDM.
-Brake Switch Circuit Status data is transmitted once a second by either the ABS module or the PCM, via the vehicle's communication network, to the SDM.
-The 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 Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Seat Position Switch Circuit Status	Rearward
Ignition Cycles At Non-Deployment	1838
Ignition Cycles At Investigation	1839
Maximum SDM Recorded Velocity Change (MPH)	-19.90
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	517.5
Crash Record Locked	No
Event Recording Complete	Yes
Multiple Events Associated With This Record	Yes
One Or More Associated Events Not Recorded	Yes



Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	63	1856	0	OFF
-4	63	1856	0	OFF
-3	63	1856	0	OFF
-2	63	1856	0	OFF
-1	45	1088	0	ON



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	-0.31	-0.31	0.00	0.00	0.00	-0.31	-0.62	-0.93	-1.24	-1.55	-1.86	-2.17	-2.79

Hexadecimal Data

This page displays all the data retrieved from the air bag module.
It contains data that is not converted by this program.

```
$01  F1 26 C4 F8 AE 4A
$02  F1 F1 00 00 A8 00
$03  41 53 33 31 30 37
$04  4B 37 4D 35 38 31
$05  00 00 00 00 00 00
$06  15 19 24 48 00 00
$07  00 00 00 00 00 00
$08  00 00 00 00 00 00
$09  00 00 00 00 00 00
$0A  00 00 00 00 00 00
$0B  00 00 00 00 00 00
$0C  00 00 00 00 00 00
$0D  00 00 00 00 00 00
$0E  00 00 00 00 00 00
$0F  00 00 00 00 00 00
$10  FF 1A 80 00 00 00
$11  81 81 81 80 7F 80
$12  A3 91 91 21 21 01
$13  FF 02 00 00 00 00
$14  03 03 00 00 6C 00
$15  FA FA FA FA FA FA
$16  FA FA FA FA FA FA
$17  FA FA 00 00 00 00
$18  00 0F 05 AC F1 00
$19  09 00 0A 00 00 64
$1A  00 00 00 00 00 00
$1B  00 00 00 00 00 00
$1C  00 0C 00 00 00 00
$1D  00 00 00 00 00 00
$1F  FF 00 00 00 00 00
$20  1E FD 00 00 FF FF
$21  FF FF FF FF FF FF
$22  FF FF FF FF FF FF
$23  FF FF FF FF FF FF
$24  00 04 02 1C CF 4A
$25  B6 00 00 03 FF FF
$26  00 00 01 01 00 00
$27  00 01 02 03 04 05
$28  06 07 09 00 FF 1A
$29  C0 A5 FF FF FF FF
$2A  FF FF FF FF FF FF
$2B  FF FF FF FF FF FF
$2C  FF FF FF FF FF FF
$2D  FF FF 00 00 00 00
$30  FF FF FF FF FF FF
$31  FF FF FF FF FF FF
$32  FF FF FF FF FF FF
$33  FF FF FF FF FF FF
$34  FF FF FF FF FF FF
$35  FF FF FF FF FF FF
$36  FF FF FF FF FF FF
$37  FF FF FF FF FF FF
$38  FF FF FF FF FF FF
$39  FF FF FF FF FF FF
$3A  FF FF FF FF FF FF
$3B  FF FF FF FF FF FF
$3C  FF FF FF FF FF FF
$3D  FF FF 00 00 00 00
$40  66 66 66 66 66 00
$41  00 00 00 00 00 00
$42  00 00 1D 1D 1D 1D
$43  1D 00 7D 80 00 00
```

$44	49	66	66	66	66	00
$45	80	00	00	00	00	00
$46	00	00	11	1D	1D	1D
$47	1D	00	7D	80	00	00
$48	FF	FF	FF	FF	FF	FF
$49	FF	FF	FF	FF	FF	FF
$4A	FF	FF	FF	FF	FF	FF
$4B	FF	FF	FF	FF	00	00
$4C	FF	FF	FF	FF	FF	FF
$4D	FF	FF	FF	FF	FF	FF
$4E	FF	FF	FF	FF	FF	FF
$4F	FF	FF	FF	FF	00	00
$50	FF	FF	FF	FF	FF	FF
$51	FF	FF	FF	FF	FF	FF
$52	FF	FF	FF	FF	FF	FF
$53	FF	FF	FF	FF	FF	FF
$54	FF	FF	FF	FF	FF	FF