

Certified Advanced 208 Compliant Air Bag Investigation/ Vehicle v. Tree  
Dynamic Science, Inc. / Case Number: DS06030  
2007 Chevrolet Suburban  
Colorado  
November 2006

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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-site investigation focused on the Certified Advanced 208-Compliant (CAC) air bag system in a 2007 Chevrolet Suburban. The multi-stage air bags were certified by the manufacturer to be compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This single vehicle crash occurred as the Chevrolet Suburban lost control on a curve and struck a tree with its front end. The impact resulted in sufficient longitudinal deceleration of the Suburban to command the deployment of the driver's air bag. The driver sustained a rib fracture and multiple contusions. She was hospitalized for four days.				
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**Dynamic Science, Inc.**  
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## BACKGROUND

This on-site investigation focused on the Certified Advanced 208-Compliant (CAC) air bag system in a 2007 Chevrolet Suburban. The multi-stage air bags were certified by the manufacturer to be compliant with the advanced air bag portion of Federal Motor Vehicle Safety Standard (FMVSS) No. 208. This single vehicle crash occurred as the Chevrolet Suburban lost control on a curve and struck a tree with its front end. The impact resulted in sufficient longitudinal deceleration of the Suburban to command the deployment of the driver's air bag. After striking the tree, the Suburban rolled backwards approximately 3.7 m (12 ft). The driver sustained a right rib fracture, contusions across abdomen, a contusion on the left shoulder, and contusions to both breasts. She was hospitalized for four days.

This CAC case was identified by NHTSA during a review of police reports. DSI was faxed the report on December 12, 2006. DSI located the case vehicle and obtained permission to inspect the vehicle on December, 14, 2006. DSI was assigned the case on December 15, 2006. The case vehicle was inspected during the week of December 25<sup>th</sup>. Efforts were made to download data from the EDR, however the current software did not support this vehicle. Beta software was later obtained but the vehicle had since been sold to an unknown party. The case vehicle was inspected on December 28, 2006. The scene was not inspected during this trip due to blizzard conditions and road closures.

## SUMMARY

### Crash Site

This single vehicle crash occurred on a curved residential roadway in November 2006 at 1225 hours. At the time of the crash, there were no adverse weather conditions and asphalt roadway dry. This is a two lane roadway that initially travels east/west and curves to travel north/south. The two lanes of the roadway were separated by solid double yellow lines. There are dirt shoulders on both sides of the roadway. There is an uphill grade as the roadway transitions to the north. There is a tree off the right side of the roadway that was 7.3 m (24 ft) from the road



**Figure 1.** 2007 Chevrolet Suburban



**Figure 2.** Exemplar view, 2007 Chevrolet Suburban

edge and was just north of the northbound transition. The speed limit at this location is 56 km/h (35 mph).

### **Pre-Crash**

The driver of the case vehicle was traveling first westbound and then northbound at a police reported speed of 80 k/h (50 mph). The driver fell asleep and the vehicle drifted off the right side of roadway. The vehicle traveled 11.9 m (39.0 ft) before coming into contact with the tree.

### **Crash**

The Suburban struck the tree with its front end. The impact severity was moderate, and resulted in the deployment of the driver's frontal air bag. The barrier routine of the WinSmash program computed a total delta V of 46.0 km/h (28.6 mph)<sup>1</sup>. The longitudinal and lateral components were -46.0 km/h (-28.6 mph) and 0 km/h (0 mph), respectively. After striking the tree, the Suburban rolled backwards approximately 3.7 m (12.0 ft).

### **Post-Crash**

The driver sustained a right rib fracture, contusions across abdomen, a contusion on the left shoulder, and contusions to both breasts. She was assisted from the vehicle by emergency medical personnel. She was transported by ground ambulance to a local hospital where she was hospitalized for four days. She indicated that she did not sustain any internal or head injuries.

The Suburban was towed from the scene due to damage and later declared a total loss by the insurance company.

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<sup>1</sup>Calculated using stiffness values derived from NCAP test 5676

**VEHICLE DATA - 2007 Chevrolet Suburban**

The 2007 Chevrolet K1500 Suburban was identified by the Vehicle Identification Number (VIN): 1GNFK16387Jxxxxxx. The Suburban was a four-door sport utility vehicle that was equipped with a 5.8 liter V8 engine, automatic transmission, four wheel drive, the StabiliTrak Vehicle Stability Control System, electronic brake force distribution, front/rear disc brakes with ABS, four-speed automatic transmission, power steering, and a tilt steering column. The Suburban was configured with Goodyear Wrangler P265/70R17 tires with the manufacturer's recommended maximum pressure of 303 kPa (44 psi). The specific tire information is as follows:

<b>Position</b>	<b>Measured Pressure</b>	<b>Measured Tread Depth</b>	<b>Restricted</b>	<b>Damage</b>
LF	262 kPa (38 psi)	6 mm (8/32 in)	Slight	No
RF	221 kPa (32 psi)	6 mm (8/32 in)	No	No
LR	241 kPa (35 psi)	6 mm (8/32 in)	No	No
RR	255 kPa (37 psi)	6 mm (8/32 in)	No	No

The seating in the Chevrolet Suburban was configured with leather covered front bucket seats with adjustable head restraints, a second row three seat position 60/40 folding bench seat with a second row easy entry seat, and a third row two seat position split-bench seat. The driver's seat was adjusted to between the mid and forward most track position. The seat back was slightly reclined.

## Vehicle Damage

### Exterior Damage - 2007 Chevrolet Suburban

The 2007 Chevrolet Suburban sustained moderate front end damage as a result of the impact with the tree. The direct damage began 23.0 cm (9.0 in) from the left bumper corner and measured 50.0 cm (19.7 in) laterally. The maximum longitudinal crush was located at C3 and measured 68.0 cm (26.8 in). The bumper fascia was knocked off during the crash. The left wheelbase was shortened by 4.0 cm (1.6 in). The left front tire was slightly restricted. The right front door was jammed shut. The remaining doors remained closed and operational.

Six crush measurements were documented at the backing bar level as follows: C1 = 0 cm (0 in), C2 = 29.0 cm (11.4 in), C3 = 68.0 cm (26.8 in), C4 = 67.0 cm (26.3 in), C5 = 35.0 cm (13.8 in), C6 = 0 cm (0 in).

The Collision Deformation Classification (CDC) for the impact with the tree was 12FYEW3.



**Figure 3.** Front left, Chevrolet Suburban



**Figure 4.** Close up of backing bar



### Interior Damage - 2007 Chevrolet Suburban

The Chevrolet Suburban sustained minor interior damage as a result of occupant contacts the driver's air bag deployment. There was a faint scuff on the left side of the knee bolster. The shifter stalk was broken away. Blood was found on the seat bottom on the second row left seat.

### Manual Restraints - 2007 Chevrolet Suburban

The 2007 Chevrolet Suburban was configured with manual 3-point lap and shoulder belts for each of the seven seating positions. Both front seat safety belts were equipped with retractor pretensioners and adjustable D rings that were in the up full down position for the driver and in the full up position for the front right seat position. The driver's safety belt was configured with a sliding latch plate and an Emergency Locking Retractor (ELR). At the time of the vehicle inspection, the driver's retractor was restricted in the used position as a result of pretensioner actuation; the front right passenger's retractor was restricted in the stowed position as a result of pretensioner actuation. The second row seat belts were configured with sliding latch plates and switchable retractors. The third row seat belts were configured with sliding latch plates and switchable retractors.



**Figure 5.** Driver's seat belt tang



**Figure 6.** Scuff to knee bolster



**Figure 7.** Shifter stalk broken away

### Supplemental Restraint Systems - 2007 Chevrolet Suburban

The 2007 Chevrolet Suburban was equipped with dual-stage frontal air bag and safety belt retractor pretensioners for the driver and front right passenger positions. The driver's air bag and both front safety belt pretensioners deployed as result of the longitudinal deceleration of the Suburban during the impact with the tree. The front right passenger air bag did not deploy. The Suburban was also equipped with side air curtains that cover all six outboard seat positions. The side air curtains did not deploy.

The driver's air bag deployed from the center of the steering wheel hub through symmetrical H-configuration module cover flaps. Each flap measured 18.0 cm (7.0 in) high, 10.0 cm (3.9 in) wide at the top, and 5.0 cm (1.9 in) wide at the bottom. The deployed driver's air bag measured 50.0 cm (19.7 in) in diameter in its deflated state. There were 10 vertical folds across the air bag face. The air bag was tethered by a single internal strap that was attached to a 15.0 cm (5.9 in) circular stitch in the center of the air bag face. Two circular vent ports were located at the 11 and 1 o'clock aspects on the rear of the air bag. There were no indications of any damage or contact to the driver's air bag.



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



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

**OCCUPANT DEMOGRAPHICS - 2007 Chevrolet Suburban**

	Driver
Age/Sex:	45/Female
Seated Position:	Front left
Seat Type:	Leather covered bucket seat
Height:	170 cm (67 in)
Weight:	84 kg (185 lbs)
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	None
Driving Experience:	>20 years
Body Posture:	Normal, upright
Hand Position:	Unknown
Foot Position:	Right foot on accelerator, left on floor (prior to falling asleep)
Restraint Usage:	Lap and shoulder belt available, used
Air bag:	Driver's air bag available, deployed

**OCCUPANT INJURIES - 2007 Chevrolet Suburban**

Driver: Injuries obtained from interviewee.

<u>Injury</u>	<u>OIC Code</u>	<u>Injury Mechanism</u>	<u>Confidence Level</u>
Rib fracture, right (one of the higher ribs according to interviewee)	450212.1,1	Air bag	Probable
Contusion, left shoulder	790402.1,2	Seat belt webbing	Certain
Contusion, abdomen	590402.1,0	Seat belt webbing	Certain
Contusion, both breasts	490402.1,0	Seat belt webbing	Certain

**OCCUPANT KINEMATICS - 2007 Chevrolet Suburban****Driver kinematics**

The 45-year-old female driver was seated in an upright posture and restrained by the 3-point manual lap and shoulder belt. The seat track was adjusted to between the mid and forward most track position. The seat back was slightly reclined. At impact, the driver's air bag deployed and the safety belt pretensioners actuated. She loaded the safety belt, causing the shoulder, abdomen, and chest contusions. She likely engaged the deployed air bag with her face and chest. This appears to have caused the upper right side rib fracture. Her left knee contacted the knee bolster on the left side. Her right hand may have come off the steering wheel and struck the shifter stalk, separating it from the steering column. She was transported by ground ambulance to a local hospital where she was hospitalized for four days. She indicated that she did not sustain any internal or head injuries.

Attachment 1. Scene Diagram

