TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER

Advanced Information Engineering Services
A General Dynamics Company
Buffalo, NY 14225

SCI 1 ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH INVESTIGATION

SCI 1 CASE NO. – CA03-042

SUBJECT VEHICLE – 2003 CHEVROLET AVALANCHE

LOCATION - STATE OF FLORIDA

CRASH DATE – JUNE 2003

Contract No. DTNH22-01-C-17002

Prepared for:

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

DISCLAIMER

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points 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.

TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No. CA03-042	*2. Government Accession No.*	*3. Recipient's Catalog No.*	
4. Title and Subtitle Certified Advanced 208-Compliant Vehicle Crash Investigation Vehicle: 2003 Chevrolet Avalanche Location: State of Florida		*5. Report Date*: October 2003 *6. Performing Organization Code*	
7. Author(s) Crash Data Research Center		*8. Performing Organization Report No.*	
9. Performing Organization Name and Address Transportation Sciences Crash Data Research Center Advanced Information Engineering Services A General Dynamics Company P.O. Box 400 Buffalo, New York 14225		*10. Work Unit No.* C00410.0000.0141 *11. Contract or Grant No.* DTNH22-01-C-17002	
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		*13. Type of Report and Period Covered* Technical Report Crash Date: June 2003 *14. Sponsoring Agency Code*	
15. Supplementary Note On-site investigation focused on the performance of the Certified Advanced-208 Compliant safety system in a 2003 Chevrolet Avalanche.			
16. Abstract This on-site investigation focused on the performance of the Certified Advanced 208-Compliant safety system in a 2003 Chevrolet Avalanche. The system included dual stage frontal air bags, seat track position sensors, and a front right occupant presence sensor. The Avalanche was also equipped with an Event Data Recorder (EDR) and seat back mounted side impact air bags for the driver and front right passenger positions. The Avalanche was occupied by a restrained 38-year-old male driver. The Avalanche was involved in a run-off-road type crash with a concrete overpass support pillar. The driver of the Avalanche was traveling in a southerly direction on a three-lane interstate. The driver reported to the police the he experienced chest pains and lost control of the vehicle and departed the right side of the road. The vehicle continued off-road until the front right area of the Avalanche impacted a concrete overpass support pillar with its front. The driver's frontal air bag deployed as result of the impact. The impact resulted in moderate frontal damage that required the Avalanche to be towed from the scene. The driver sustained police a reported possible injury and was not transported for treatment			
17. Key Words Frontal air bag deployment Advanced 208-Compliant		*18. Distribution Statement* General Public	
19. Security Classif. (of this report) Unclassified	*20. Security Classif. (of this page)* Unclassified	*21. No. of Pages* 12	*22. Price*

TABLE OF CONTENTS

SCI 1 ON-SITE CERTIFIED ADVANCED 208-COMPLIANT VEHICLE CRASH INVESTIGATION
SCI 1 CASE NO. – CA03-042
SUBJECT VEHICLE – 2003 CHEVROLET AVALANCHE
LOCATION - STATE OF FLORIDA
CRASH DATE – JUNE 2003

BACKGROUND

This on-site investigation focused on the performance of the Certified Advanced 208-Compliant (CAC) safety system in a 2003 Chevrolet Avalanche. The manufacturer of this vehicle certified that the vehicle meets the requirements of the Advanced 208 Federal Motor Vehicle Safety Standard (FMVSS). The system included dual stage frontal air bags, seat track position sensors, and a front right occupant presence sensor. The Avalanche was also equipped with an Event Data Recorder (EDR) and seat back mounted side impact air bags for the driver and front right passenger positions. The driver air bag deployed as a result of a front right impact with a concrete overpass support pillar. The Avalanche was occupied by a restrained 38-year-old male driver. The driver of the Avalanche was traveling in a southerly direction on the inboard (left) lane of a divided three-lane interstate. He stated that he was following a non-contact vehicle that swerved to avoid another vehicle. The driver of the Avalanche stated that he swerved right to avoid the other vehicle, crossing the center and right travel lanes. As the Avalanche departed the right shoulder, the driver stated that he attempted to brake and steer left. He was unable to regain control of the vehicle as the Avalanche traversed the roadside and struck the concrete pillar. The police report stated that the driver experienced chest pains which resulted in the loss of control of the vehicle. The driver stated to the SCI investigator that he did not experience chest pain until after the crash. The impact resulted in moderate frontal damage **(Figure 1)** that required the Avalanche to be towed from the scene. The driver was not injured as a result of the crash. He refused medical transport at the scene and did not seek follow-up medical treatment.

Figure 1. Frontal damage to the 2003 Chevrolet Avalanche.

This June 2003 crash was identified by the National Automotive Sampling System through the weekly review of police crash reports. The crash information was forwarded to the Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) due to the presence of the Certified Advanced 208-Compliant vehicle. The case was assigned to the Veridian Special Crash Investigations (SCI) team on July 25 and an on-site investigation was initiated on August 7.

SUMMARY

Crash Site

This single vehicle crash occurred during the nighttime hours of June 2003. At the time of the crash, the weather was clear with no adverse conditions. The interstate roadway was configured with three concrete travel lanes in each direction and was separated by a depressed grass median with a median barrier guardrail system. The roadway was curved to the left and level for southbound travel. Concrete shoulders bordered the southbound roadway and a grass embankment with a negative slope extended beyond the right shoulder. The posted speed limit for southbound traffic was 97 km/h (60 mph). The scene schematic is included as **Figure 9** of this report.

Crash Sequence

Pre-Crash

The 38-year-old restrained male driver of the Avalanche was operating the vehicle southbound in the left lane of the three-lane interstate **(Figure 2)**. The driver stated to the SCI investigator that he attempted to avoid a non-contact vehicle that was traveling ahead of his position. The driver initiated a right steering input that redirected the Avalanche across the travel lanes and departed the right side of the road in a tracking mode. The Avalanche traveled onto the shoulder and traversed the grass embankment. The driver began to brake and steer left; however, he could not regain control of the vehicle. The police report stated that the driver experienced chest pains which resulted in the loss of control of the vehicle. The driver stated to the SCI investigator that he did not experience chest pain until after the crash. The EDR download data showed that the vehicle was traveling at 62.7 km/h (39.0 mph) five seconds prior to the crash and had slowed to 40.2 km/h (25.0 mph) one second prior to impact. The EDR data also indicated that the driver applied the brakes three seconds prior to the crash.

Figure 2. Southbound approach to the crash site.

Crash

The front right area of the Avalanche impacted the concrete overpass support pillar **(Figure 3)** in a 12 o'clock impact configuration. The impact resulted in moderate damage to the front of the Avalanche. The damage algorithm of the WinSMASH program computed a total delta-V of 21.0 km/h (13.0 mph) for the Avalanche. The longitudinal and lateral components were -21.0 km/h (-13.0 mph) and 0.0, respectively. The EDR recorded a maximum velocity change of -27.9 km/h (-

Figure 3. Impact to concrete overpass support.

17.34 mph) at 187.5 milliseconds. The driver's frontal air bag deployed as a result of the impact.

Post-Crash

As a result of the offset right impact, the Avalanche rotated approximately 15 degrees clockwise and came to rest against the concrete pillar facing southwest. The driver was not injured and refused medical attention. The Avalanche sustained disabling damage and was towed from the crash site.

VEHICLE DATA – 2003 Chevrolet Avalanche

The 2003 Chevrolet Avalanche was identified by the Vehicle Identification Number (VIN): 3GNEK13T93 (production sequence omitted). At the time of the vehicle inspection, the odometer reading was unknown due to vehicle having no power. The driver stated to the SCI investigator that he purchased the vehicle new in January of 2003 and estimated the odometer reading at 6-8,000 km (4-5,000 miles). The vehicle was a four-door pick-up truck that was equipped with a 5.3-liter V8 engine, four-wheel drive, four-speed automatic transmission, power-assisted four wheel disc brakes with anti-lock, OEM alloy wheels, power-steering, tilt steering wheel and adjustable pedals. The Avalanche was equipped with Goodyear Wrangler HP 265/70R17 tires with a maximum pressure of 303 kpa (44 psi) listed on the sidewall. The manufacturer recommended tire pressures were 205 kpa (30 psi), front and rear. The specific tire data was as follows:

Tire	Measured Pressure	Tread Depth	Restricted	Damage
LF	231 kpa (33.5 psi)	7.1 mm (9/32)	No	None
LR	231 kpa (33.5 psi)	7.1 mm (9/32)	No	None
RF	0 kpa (0.0 psi)	7.1 mm (9/32)	Yes	De-beaded
RR	228 kpa (33 psi)	7.9 mm (10/32)	No	None

The seating positions in the Avalanche were configured with front bucket seats with adjustable head restraints. The front seat head restraints were adjusted to the full-down positions at the time of the vehicle inspection. The rear seat was configured with a bench seat with a 60/40 spilt folding rear seat back and adjustable head restraints for the outboard seating position and a fixed head restraint for the center. The rear seat head restraints were both adjusted to the full-down positions at the time of the vehicle inspection.

VEHICLE DAMAGE

Exterior Damage – *2003 Chevrolet Avalanche*

The 2003 Chevrolet Avalanche sustained moderate frontal damage as a result of the impact with the concrete overpass support pillar **(Figure 4)**. The maximum crush was 62.0 cm (24.4") and the direct contact damage began

Figure 4. Front of Chevrolet Avalanche.

47.0 cm (18.5”) right of the centerline and extended 42.0 cm (16.5”) to the front right bumper corner. The combined direct and induced damage was 153.0 cm (60.2”) that extended the full with of the bumper. The damaged components included the bumper cover, bumper beam and right support frame, hood, and right fender **(Figure 5)**. The right front wheel and suspension components were fractured and the right wheelbase was reduced by 6.0 cm (2.4”). The right front tire was restricted against the rear of the right front fender **(Figure 6)**. The base of the windshield at the right A-pillar was fractured from contact with the hood edge. The side and rear glazing were not damaged. The left front door exhibited a round dent approximately 30.5 cm (12.0”) in diameter from tow yard damage. Six crush measurements were documented at the bumper beam and are as follows: C1 = 0.0 cm, C2 = 1.0 cm (0.4”), C3 = 7.0 cm (2.8”), C4 = 12.0 cm (4.7”), C5 = 14.0 cm (5.5”), C6 = 62.0 cm (24.4”). The Collision Deformation Classification for the impact was 12-FREW-3.

Figure 5. Right view of the frontal damage.

Figure 6. Lateral view of the crush profile.

Interior – *2003 Chevrolet Avalanche*

The interior damage to the 2003 Chevrolet Avalanche was minor and attributed to passenger compartment intrusion, air bag deployment and occupant contact. The front right toe pan was intruded longitudinally approximately 2.0 cm (0.8”). A scuffmark was found on the driver’s safety belt and was located at 113.0 cm (44.5”) from the top of the safety belt in the fully extended position.

MANUAL RESTRAINT SYSTEMS – 2003 Chevrolet Avalanche

The 2003 Chevrolet Avalanche was equipped with integrated manual 3-point lap and shoulder belts for both front and center rear seating positions. The driver’s safety belt was configured with a sliding latch plate and a belt-sensitive Emergency Locking Retractor (ELR). The front right safety belt and the three rear safety belts were configured with sliding latch plates and switchable ELR/Automatic Locking Retractor (ALR). A scuff mark was found of the driver’s safety belt and inspection of the latch plate indicated historical use. The EDR data indicated that the driver’s safety belt was buckled during the crash and the driver stated to the SCI investigator that he did utilize the safety belt during the crash.

Certified Advanced 208-Compliant Safety System – *2003 Chevrolet Avalanche*

The 2003 Chevrolet Avalanche was equipped with a Certified Advanced 208-Compliant safety system. The system included dual-stage frontal air bags, a passenger presence sensor for the front right seat and seat track positioning sensors for the front left and front right. The system was monitored and controlled by a Sensing and Diagnostic control Module (SDM) that was located on the floor under the driver's seat. The SDM deployed the appropriate safety component(s) dependant on occupant presence, belt usage, seat track position and crash severity. In this crash, the SDM commanded a stage one deployment of the driver's air bag at 45 ms **(Figure 7)**. The driver's air bag module was located in the center of the steering wheel hub. The air bag was 67.0 cm (26.3") in diameter and contained two tethers and was vented by two vent ports at the 11 and 1 o'clock positions on the rear aspect of the air bag. The front right seat was not occupied during the crash therefore, the system did not deploy the front right air bag **(Figure 8)**.

Figure 7. Driver's area.

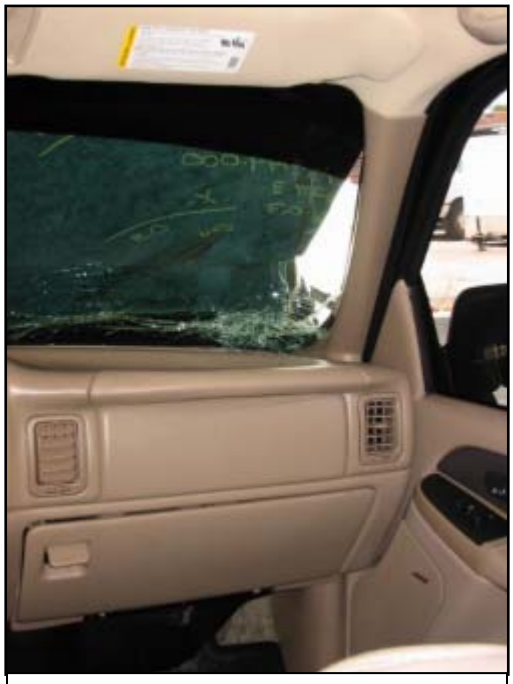


Figure 8. Non-deployed front right air bag.

Electronic Data Recorder- *2003 Chevrolet Avalanche*

The 2003 Chevrolet Avalanche was equipped with an Electronic Data Recorder (EDR). The EDR recorded data indicated that the Avalanche was traveling at 62.7 km/h (39.0 mph) five seconds pre-crash and had slowed to 40.2 km/h (25.0 mph) one second prior to the crash. The EDR data also indicates the driver's safety belt was buckled at the time of the crash and the driver applied the brakes three seconds prior to the crash. A maximum delta V of -27.9 km/h (-17.34 mph) at 187.5 milliseconds and a stage one deployment were also recorded by the EDR. The EDR printout is included with this report as **Attachment A**.

OCCUPANT DEMOGRAPHICS – 2003 Chevrolet Avalanche

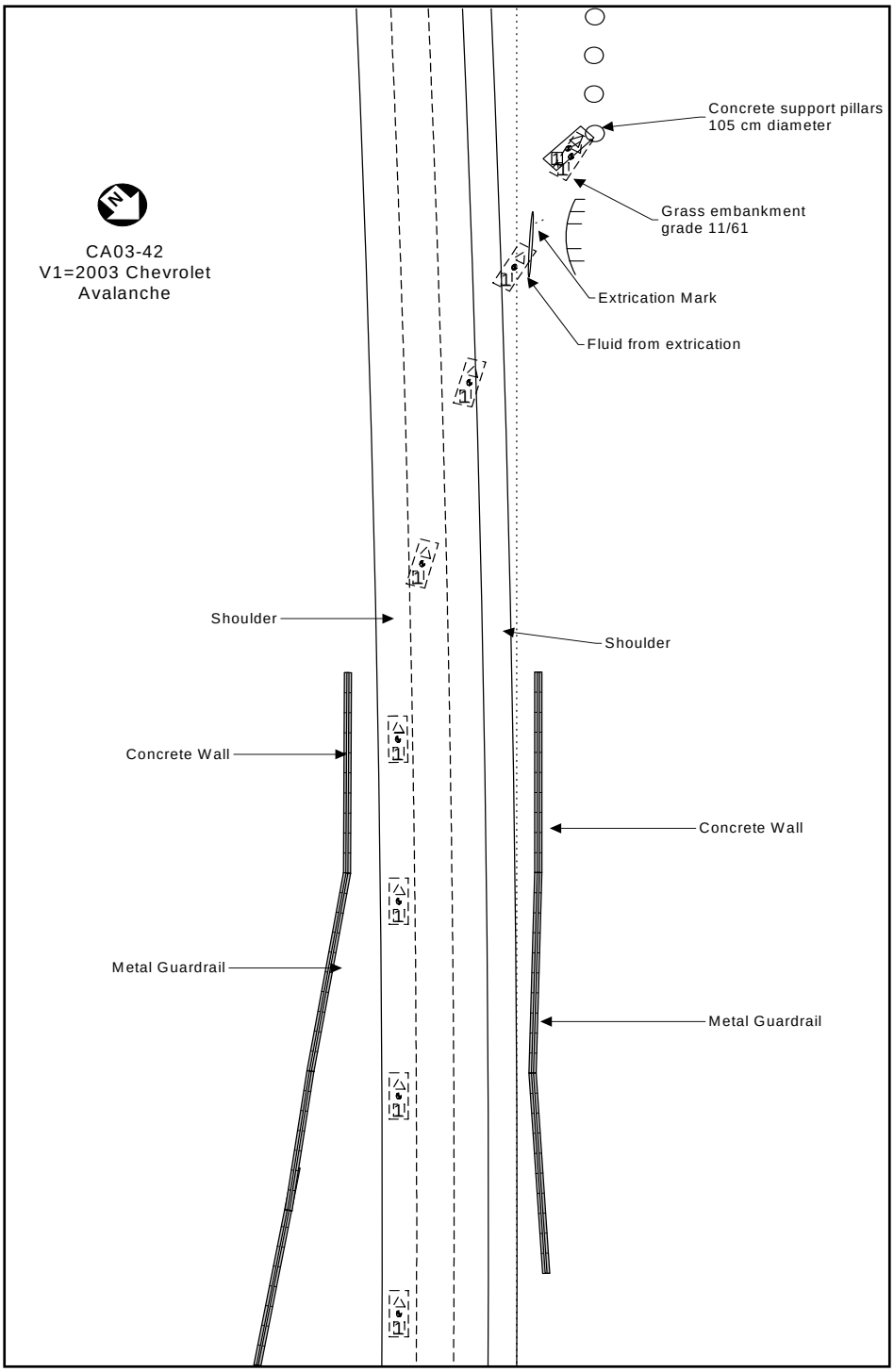
Driver

Age/Sex:	38-year-old/Male
Height:	Unknown
Weight:	Unknown
Seat Track Position:	Rear track position
Manual Restraint Use:	Manual 3-point lap and shoulder belt
Usage Source:	Vehicle inspection
Eyewear:	Unknown
Type of Medical Treatment:	None, not injured

Driver Kinematics

The 38-year-old male driver of the 2003 Chevrolet Avalanche was seated in an upright posture. He was restrained by the integrated manual 3-point lap and shoulder belt. At impact, he initiated a forward trajectory and loaded the safety belt. The driver was not injured by the crash and was not transported to a hospital.

Figure 6. Scene Schematic



Attachment A: EDR Printout

3GNEK13T[redacted] System Status At Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Ignition Cycles At Deployment	1133
Ignition Cycles At Investigation	1138
Maximum SDM Recorded Velocity Change (MPH)	-17.34
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	187.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	45
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Time Between Non-Deployment And Deployment Events (sec)	N/A

Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	-0.31	-0.93	-1.55	-2.17	-3.10	-4.34	-5.58	-7.13	-8.68	-9.92	-11.16	-12.09	-13.02	-14.26	N/A

PRE-CRASH DATA				
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	39	1152	0	ON
-4	32	1024	0	ON
-3	30	896	0	OFF
-2	27	832	0	ON
-1	25	768	0	ON