On Site Certified Advanced 208 Complaint Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS03011
2003 Chevrolet Avalanche K1500
Colorado
March, 2003

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 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.

Technical Report Documentation Page

1. Report No.	2. Government Accession No.	3. Recipient Catalog No.
DS03011		

4. Title and Subtitle	5. Report Date
Certified Advanced 208 Complaint Investigation	6. Performing Organization Report No.

7. Author(s)	8. Performing Organization Report No.
Dynamic Science, Inc.	

9. Performing Organization name and Address	10. Work Unit No. (TRAIS)
Dynamic Science, Inc. 530 College Parkway, Ste. K Annapolis, MD 21401	11. Contract or Grant no. DTNH22-01-C-27002

12. Sponsoring Agency Name and Address	13. Type of report and period Covered [Report Month, Year]
U.S. Dept. of Transportation (NRD-32) National Highway Traffic Safety Administration 400 7th Street, SW Washington, DC 20590	14. Sponsoring Agency Code

15. Supplemental Notes

16. Abstract

This two vehicle, front to front narrow end engagement type impact crash occurred in February 2003 at 0020 hours in the state of Colorado. The crash occurred on an undivided, two-lane state highway. The highway and crash area is in a mountainous location and the bituminous roadway consists of a series of curves for east and westbound traffic. The case involved a Certified Advanced 208 Compliant vehicle.

The case vehicle was a 2003 Chevrolet Avalanche K1500 4WD four door pickup truck was driven by a restrained 37 year-old-male (180 cm, 71 in/ 82 kg, 180 lbs). The front right seat was occupied by a restrained (driver reported) 37 year-old female (183 cm, 72 in/ 54 kg, 120 lbs). The case vehicle is equipped with dual stage frontal air bags. The other vehicle was a 1980 AMC Eagle AWD four door sedan that was being driven by a 32 year old male. The case vehicle (2003 Chevrolet Avalanche) was traveling eastbound at a police estimated speed of 56 km/h (35 mph). The other vehicle (AMC Eagle) was traveling in a westerly direction also at a police estimated speed of 56 km/h (35 mph). The driver of the other vehicle was traveling uphill and the driver failed to negotiate the right curve in the roadway, allowing the AMC Eagle to traverse the centerlines and enter the eastbound travel lane. The driver of the case vehicle had just negotiated a right curve in the roadway and had entered a straight transition section when she detected the other vehicle encroaching into her travel lane. The driver of the case vehicle steered as far to the right as possible while braking. The front left corner of the other vehicle impacted (12FLES6) the left front corner of the case vehicle in a front to front narrow end engagement type impact configuration. The case vehicle was in the process of being repaired so a CDC or crush profile could not be derived. The narrow end engagement impact deflected the case vehicle to the right as the right fender area impacted a W-Beam guardrail in a secondary impact. The driver of the other vehicle (AMC Eagle continued in a westerly direction in an attempt to flee the crash scene The driver of the case vehicle followed the other vehicle until it stopped and police were subsequently summoned to the location.

Neither the driver or the front right occupant in the case vehicle sustained any injuries as a result of the crash. The police report indicated that the driver of the other vehicle did not report any injuries.

17. Key Words	18. Distribution Statement
Certified Advanced 208 Complaint, Air bag, deployment	

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No of pages	22. Price

Form DOT F 1700.7 (8_72) Reproduction of this form and completed page is authorized

Dynamic Science, Inc.
Crash Investigation
Case Number: DS03011

TABLE OF CONTENTS

BACKGROUND:

Description: This Certified Advanced 208 Compliant (CAC) case was reported to DSI on April 4, 2003. A CAC vehicle is certified by the manufacturer to be compliant to Advanced Air Bag portion of Federal Motor Vehicle Safety Standards (FMVSS) No. 208. DSI located the case vehicle and initiated the investigation. The case vehicle was in the process of being repaired and NHTSA advised that if photographs of damage could be obtained then DSI should commence with the on-site inspection. The data from the Sensing Diagnostic Module (SDM) was downloaded and all field work was completed on April 9, 2003. Photographs obtained by the body shop were secured only after damaged components were removed. The insurance company indicated that they had images, but later reported that they could not be located.

Investigation Type:	On-Scene
Crash Location:	Colorado
Crash Date:	March, 2003
Notification Date:	April, 4, 2003
Field Work Completed:	April 09, 2003

SUMMARY

Crash Site

This two vehicle, front to front, sideswipe type impact occurred in the state of Colorado in March, 2003 at 0020 hours. The crash occurred on an undivided, two-lane state highway. The highway and crash area is in a mountainous location and the bituminous roadway consists of a series of curves for east and westbound traffic. The east travel lane of the roadway had a negative 4.1% grade at the location of the crash. The south edge of the roadway is bordered by an unimproved gravel shoulder with an adjacent wood strong-post W-beam guardrail. The north edge of the roadway is bordered by an ascending mountain side. It was dark at the time of the crash and the roadway is not lighted. There are no traffic controls and the posted speed limit for the eastbound case vehicle is 64 km/h (40 mph); the speed limit for the other westbound vehicle is 56 km/h (35 mph).

Figure 1.View showing case vehicle's eastbound travel lane at impact location

Figure 2. View showing other vehicle's westbound trajectory at impact location

Pre-Crash

The case vehicle was a 2003 Chevrolet Avalanche K1500 4WD four door pickup truck was driven by a restrained (driver reported)[1]37 year-old-male (180 cm., 71 in/ 82 kg, 180 lbs). The front right seat was occupied by a restrained (driver reported) 37 year-old female (183 cm., 72 in/ 54 kg, 120 lbs). The case vehicle is equipped with dual stage frontal air bags.

Figure 3. Front left three-quarter view of case vehicle showing vehicle under repair with damaged components removed

The other vehicle was a 1980 AMC Eagle AWD four door sedan that was being driven by a 32 year old male. The case vehicle (2003 Chevrolet Avalanche) was traveling eastbound at a police estimated speed of 56 km/h (35 mph). The other vehicle (AMC Eagle) was traveling in a westerly direction also at a police estimated speed of 56 km/h (35 mph). The driver of the other vehicle was traveling uphill and the driver failed to negotiate a right curve in the roadway, allowing the AMC Eagle to traverse the centerlines and enter the eastbound travel lane. The driver of the case vehicle had just negotiated a right curve in the roadway and had entered a straight transition section when he detected the other vehicle encroaching into his travel lane. The driver of the case vehicle braked and steered as far to the right as possible without impacting the W-beam guardrail located on the south road side.

Figure 4. Front left three-quarter view showing left fender damage to other vehicle

The SDM data indicates that the case vehicle was traveling 37 km/h (23 mph) with the brake switch circuit status on, three seconds prior to algorithm enabled (AE).

Crash

The front left corner of the other vehicle impacted (12FLES6)[2] the left front corner of the case vehicle in a front to front narrow end engagement type impact configuration. The narrow end engagement impact deflected the case vehicle to the right as the right fender/wheel well area impacted a W-Beam guardrail in a secondary impact.

---

[1] SDM data indicates driver's belt switch circuit status UNBUCKLED. Vehicle inspection indicates historical usage, but no loading evidence for either front outboard integrated safety seat belts.

[2] The narrow corner engagement type impact violates an acceptable application of the WinSmash 2.41 program due to a common velocity was not achieved. In addition, damage deformation documentation could not be determined due to removed damage components.

Post-Crash
The case vehicle was in the process of being repaired so a CDC or crush profile could not be ascertained.

The driver of the other vehicle (AMC Eagle) continued in a westerly direction in an attempt to flee the crash scene The driver of the case vehicle promptly pursued the other vehicle until it stopped and police were subsequently summoned to the location.

Both of the involved vehicles did not necessitate towing and were driven from the crash area. Neither the driver or the front right occupant in the case vehicle sustained any injuries as a result of the crash. The police report indicated that the driver of the other vehicle did not report any injuries.

Figure 5. View showing the case vehicle's non-deployed driver's air bag

Figure 6. View showing the case vehicle's non-deployed passenger air bag

VEHICLE DATA - 2003 Chevrolet Avalanche K1500

VIN:	3GNEK13T83GXXXXXX
Odometer:	20,011 kilometers (12,434 miles)
Engine:	5.7L, V8
Reported Defects:	None Reported
Cargo:	Motorcycle parts in cargo area less that 45 kg (100 lb)

The 2003 Chevrolet Avalanche K1500 was equipped with Firestone Wilderness brand tires. The specific tire data is as follows:

Tire	Tread	Measured Pressure	Tire Manufacturer Maximum Recommended Pressure
LF	8 mm (10/32 in)	296 kPa (43 psi)	303 kPa (44 psi)
LR	6 mm (8/32 in)	290 kPa (42 psi)	303 kPa (44 psi)
RR	6 mm (8/32 in)	296 kPa (43 psi)	303 kPa (44 psi)
RF	8 mm (10/32 in)	303 kPa (44 psi)	303 kPa (44 psi)

VEHICLE DAMAGE

Exterior Damage - 2003 Chevrolet Avalanche K1500

Damage Description:	Minor/ Primary Front Left Corner Impact (Highest Delta V): Damage noted to front fascia, grille area and the left fender. Front, left side (driver's) window glazing was removed for repairs and found in rear seat area. Glazing did not disintegrate. The left side, rear view mirror was missing. It is probable that this was a result of the initial sideswipe impact. Minor/Secondary Right Fender Impact: Probable surface abrasions and damage to wheel well area. Damaged components have been removed prior to inspection.	
CDC:	Crash Event 1: Unknown Crash Event 2: Unknown	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

C measurements: None obtained , case vehicle under repair

Interior Damage - 2003 Chevrolet Avalanche K1500

The case vehicle (2003 Chevrolet Avalanche) was void of any intruding components. There were scuff marks noted to the plastic knee bolster cover at the driver's position.

MANUAL RESTRAINT SYSTEMS - 2003 Chevrolet Avalanche K1500

There are manual seat integrated three-point lap and shoulder belts present for the front seated position. The front left and front right seated positions are equipped with switchable retractors (Emergency Locking Retractor-Automatic Locking Retractor) and sliding latch plates. The front middle (fold away jump seat) seat position is equipped with a manual lap safety belt equipped with a locking latch plate.

FRONTAL AIR BAG SYSTEM - 2003 Chevrolet Avalanche K1500

Occupant Protection System Discussion

This vehicle was equipped with an advanced occupant protection system certified to comply with the Advanced Air Bag portion of FMVSS No. 208. The system consists of the SDM, dual-level (dual stage) driver and front right passenger air bags, a front right passenger sensing system, and a driver's seat belt latch usage detector. The system is controlled by the SDM. The primary function of the SDM is to control the deployment of the occupant protection systems. 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 initial impact was sufficient to generate a non-deployment event. The Vetronix system status at non-deployment report indicates that:

1. SIR warning lamp status was OFF.
2. The driver's belt switch status was UNBUCKLED.
3. Ignition cycles at non-deployment 842.
4. Ignition cycles at investigation 886. The difference of 44 ignition cycles is due to the vehicle being driveable post crash.
5. Maximum SDM recorded velocity change -1.37 km/h (-0.85 mph).
6. Algorithm enable (AE) to maximum SDM recorded velocity change was 107.5 milliseconds.
7. Event recording complete YES.
8. Multiple events associated with this record NO.
9. One or more associated events not recorded NO.
10. The vehicle speed was 47 km/h (29 mph) five through 3 seconds before AE, accelerated to 48 km/h (30 mph) at 2 seconds before AE, and decelerated to 37 km/h (23 mph) at 1 second before AE.
11. The brake switch status was OFF from 5 through 2 seconds before AE, and was ON 1 second before AE.

The case vehicle was equipped with frontal air bags mounted in the steering wheel and mid-mounted in the instrument panel of the front right seat position. The front air bags in the case vehicle did not deploy on impact. The front right passenger air bag includes a "Passenger Sensing System". The system is designed to automatically switch the air bag on or off based on a passenger's weight. The system also uses a sensor in the passenger-side seat belt to measure how much tension is exerted by the seat belt when it is being cinched down, another means of determining what may be on the seat.

Figure 7. Front right Passenger Sensing System

There is an indicator on the rear-view mirror that alerts vehicle occupants to the status of the system at all times. If the light reads "Passenger Air Bag ON," the air bag is programmed to deploy in a frontal crash of sufficient severity. If it reads "Passenger Air Bag OFF," the system has turned off the air bag because it determined either that there is no occupant on the front passenger seat, or that a rear-facing infant seat, a forward-facing child restraint, a booster seat or a smaller person, such as a child who has outgrown child restraints, is present. The driver of the case vehicle indicated that the front right passenger air bag light was "ON".

Figure 8. Passenger sensing system indicator

The interior of the case vehicle consisted of a six passenger seating configuration. The front row was comprised of a 40/20/40 cloth covered reclining split bench seat (seats three), a second row comprised of a 60/40 cloth covered split-folding bench seat (seats three). The driver was seated in a cloth covered bench seat that was adjusted to between the forward most and middle seat track position with the seat back slightly reclined aft of vertical. The driver's manual restraint system consisted of a seat integrated manual continuous loop 3-point lap and shoulder safety belt with a sliding latch plate. The emergency locking retractor was located in the seat back. The front right seat and the two rear split bench outboard seat positions were equipped with manual continuous loop 3-point lap and shoulder safety belts with sliding latch plates and switchable emergency/automatic locking retractors. The middle front seat consisted of a manual lap belt with locking latch belt. The second row middle seat position was equipped with Lower Anchors and Tethers for Children (LATCH).

The driver's restraint exhibited evidence of historical use in the form of scratching to the latch plate. There was no evidence of loading. The non-deployment event recorded by SDM reports that the driver's belt switch circuit status was "UNBUCKLED". The front right restraint exhibited evidence of historical use in the form of scratching to the latch plate. There was no evidence of loading to the belt webbing.

The second row split bench seat folds forward and away to convert to a full size rear cargo box.

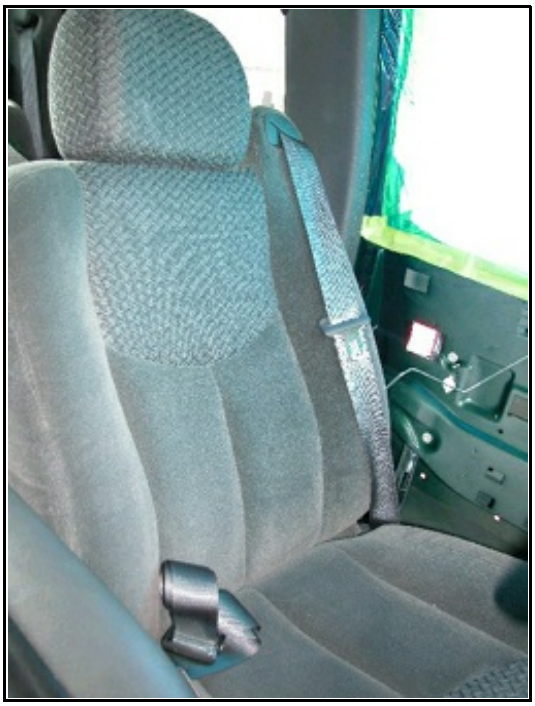


Figure 9. Case vehicle driver's seat

VEHICLE DATA - Other Vehicle 1980 AMC Eagle

Description:	1980 AMC Eagle AWD Four-Door Sedan	
VIN:	A0C355C163404	
Odometer:	Unknown	
Engine:	6 cylinder (258 CID) 4.2 Liter	
Reported Defects:	None Reported	
Cargo:	Unknown	
Damage Description:	Minor/ Left Fender Impact: Minor deformation noted to the left fender and wheel well area.	
CDC:	12FLES6	
Delta V:	Total	Unknown
	Longitudinal	Unknown
	Latitudinal	Unknown
	Energy	Unknown

OCCUPANT DEMOGRAPHICS - 2003 Chevrolet Avalanche K1500

	Occupant 1	Occupant 2
Age/Sex:	37/Male	37/Female
Seated Position:	Front left	Front right
Seat Type:	40/20/40 cloth covered split bench[3] seat. Seatback reclined at 25.7 degrees from vertical and seat adjusted between middle and forward most seat track position.	40/20/40 cloth covered split bench seat. Seatback reclined at 25.7 degrees from vertical and seat adjusted between middle and forward most seat track position.
Height:	180 cm (71 in)	183 cm (72 in)
Weight:	82 kg (180 lbs)	54 kg (120 lbs)
Occupation:	Unknown	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	None	None
Driving Experience:	Presumed to be > 10 years	Not applicable
Body Posture:	Upright, facing forward	Upright, facing forward (specifics are unknown).
Hand Position:	Both hands on the steering wheel rim at unknown o'clock positions.	Unknown
Foot Position:	His right foot was depressing the brake pedal while his left foot was on the floor.	Both feet on floor
Restraint Usage:	None used	None used
Air bag:	Steering wheel hub mounted drivers air bag (non-deployed)	Mid-mounted passenger frontal air bag (non-deployed)

[3] Per Chevrolet specifications

OCCUPANT DEMOGRAPHICS - other vehicle

Age/Sex:	32/Male
Seated Position:	Front left
Seat Type:	Bucket
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	Unknown
Alcohol/Drug Involvement:	None
Driving Experience:	Unknown
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Presumed that his right foot was depressing the accelerator pedal and his left foot was on the floor.
Restraint Usage:	Police reported that the driver was restrained

OCCUPANT INJURIES -2003 Chevrolet Avalanche K1500

	Injury	OIC Code	Injury Mechanism	Confidence Level
Driver:	Reported to be uninjured	N/A	N/A	N/A
RF Occupant:	Reported to be uninjured	N/A	N/A	N/A

OCCUPANT INJURIES - other vehicle

	Injury	OIC Code	Injury Mechanism	Confidence Level
Driver:	Reported to be uninjured	N/A	N/A	N/A

OCCUPANT KINEMATICS - 2003 Chevrolet Avalanche K1500

The 37-year-old male (180 cm, 71 in/ 82 kg, 180 lbs) driver was unrestrained and was seated upright, facing forward with both hands on the steering wheel rim. The split bench seat was adjusted to between forward most and middle track position. The seatback was slightly reclined. The driver of the case vehicle had just negotiated a right curve in the roadway when he detected the other vehicle (AMC Eagle) encroaching his lane from the opposing westbound travel lane. He steered the case vehicle as far to the right as possible and depressed the brake pedal, but was unable to avoid the impending impact. The front left fender region of the other vehicle impacted the front left corner of the case vehicle in a narrow end engagement type impact. In response to the likely[4] 12 o'clock impact force, the unrestrained driver of the case vehicle moved straight forward. His right knee/leg impacted the plastic knee bolster shroud as evidenced by documented scuff marks (Figure 10). His upper torso was restricted from extended forward movement due to his bracing effort with the steering wheel rim.

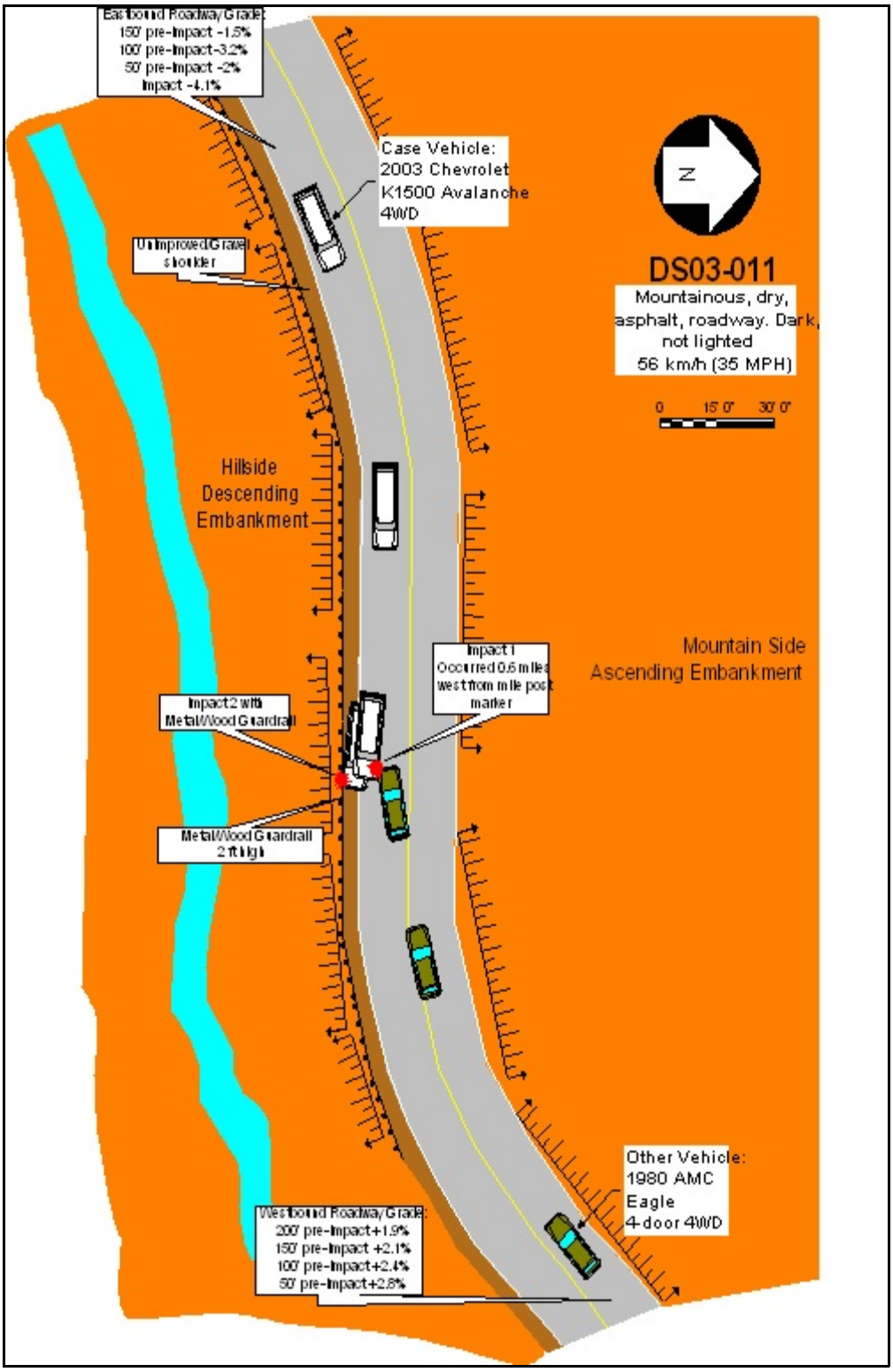
Figure 10. Close-up view showing scuff marks to plastic knee bolster shroud

The case vehicle was deflected into the W-beam guardrail located on the south roadside which resulted in minor impact damage to the right wheel well area. The driver's upper torso probably moved laterally to the right in response to the right side impact, but he was maintained in his respective seat. He was fully conscious and reportedly uninjured during the two crash events.

The 37-year-old female front right passenger (183 cm, 72 in/ 54 kg, 120 lbs) was unrestrained and was seated upright, and facing forward. The split bench seat was adjusted to between forward most and middle track position. The seatback was slightly reclined. The front right passenger responded to the initial narrow front end engagement impact force by moving directly forward. The sliding latch plate revealed surface scratches and striations which suggest regular usage of the lap and shoulder belt. The belt webbing however, showed no evidence of belt loading. She probably moved slightly to her right in response to the secondary right side impact with the guardrail. She was fully conscious and reportedly uninjured.

[4] Based upon damage distribution observed on other vehicle and impact configuration

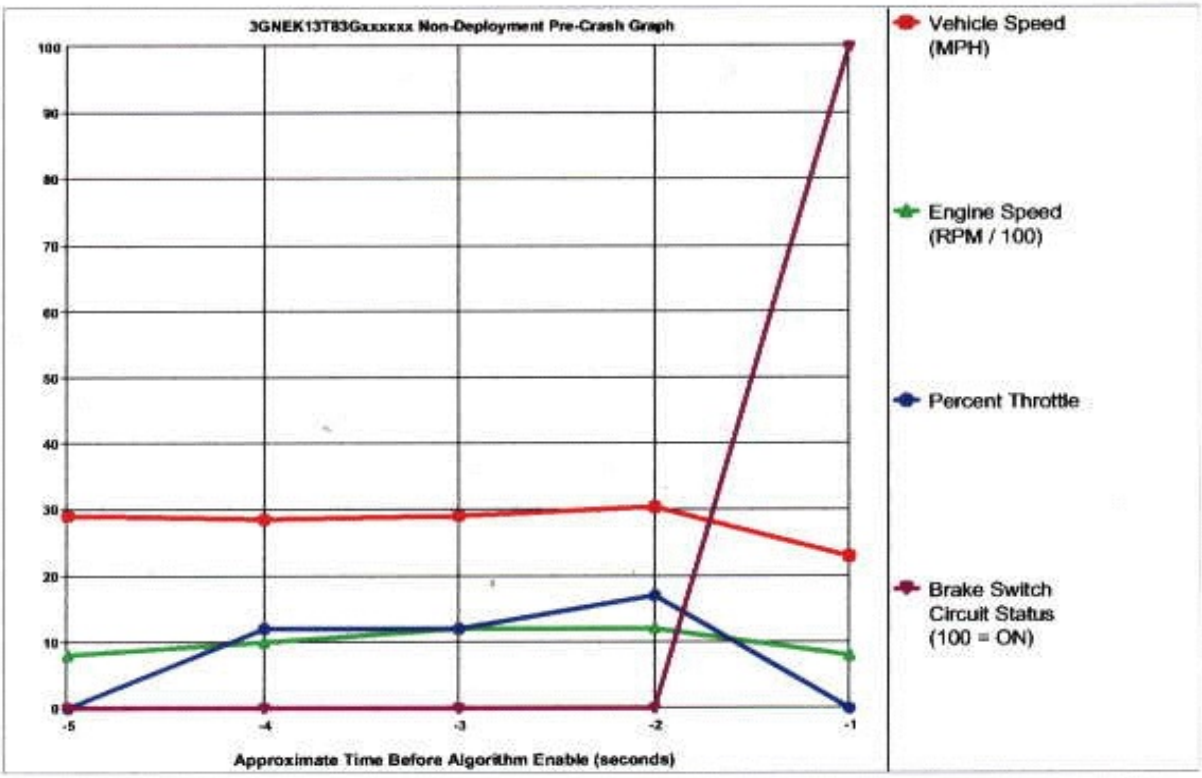
Attachment 1. SCENE DIAGRAM



Attachment 2. Vetronix Report

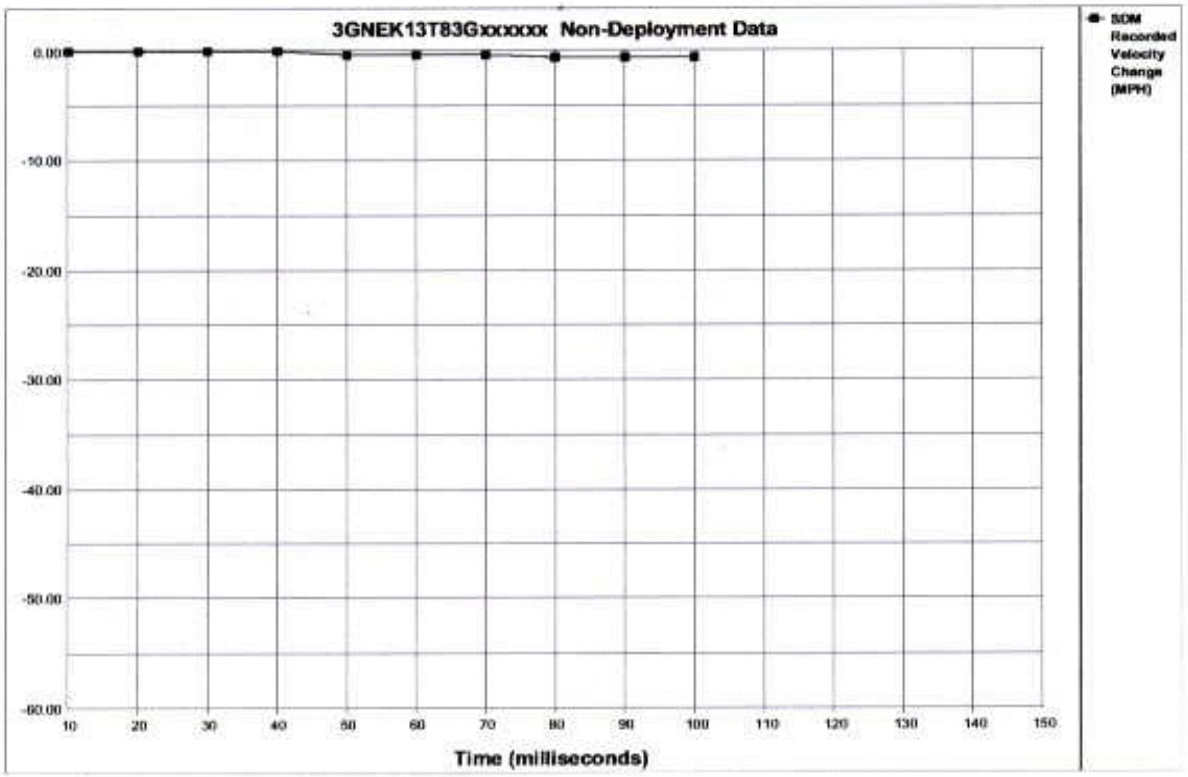
System Status At Non-Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Non-Deployment	842
Ignition Cycles At Investigation	886
Maximum SDM Recorded Velocity Change (MPH)	-0.85
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	107.5
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No



Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Circuit Status
-5	29	832	0	OFF
-4	29	960	12	OFF
-3	29	1152	12	OFF
-2	30	1216	17	OFF
-1	23	832	0	ON

Attachment 1. Vetronix Report (Continued)



Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	14
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	-0.31	-0.31	-0.31	-0.62	-0.62	-0.62	N/A	N/A	N/A	N