

**TRANSPORTATION SCIENCES
CRASH DATA RESEARCH CENTER**

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**VERIDIAN REMOTE
ADVANCED 208 COMPLAINT VEHICLE CRASH INVESTIGATION**

SCI TECHNICAL SUMMARY REPORT

NASS/SCI COMBO CASE NO. 03-08-063F

VEHICLE – 2003 CHEVROLET AVALANCHE

LOCATION - STATE OF PENNSYLVANIA

CRASH DATE – APRIL 2003

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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**VERIDIAN REMOTE ADVANCED 208 COMPLIANT VEHICLE CRASH
INVESTIGATION
SCI SUMMARY TECHNICAL REPORT
NASS/SCI COMBO CASE NO. 03-08-063F
SUBJECT VEHICLE – 2003 CHEVROLET AVALANCHE
LOCATION - STATE OF PENNSYLVANIA
CRASH DATE – APRIL 2003**

BACKGROUND

This investigation focused on the performance of the advanced 208-Compliant occupant protection system in a 2003 Chevrolet Avalanche. The system included dual stage frontal air bags, right front passenger presence detection and seat track position sensors for the front left and front right seats. The Chevrolet (**Figure1**) was involved in an intersection collision with a 1999 Oldsmobile Intrigue that resulted in the deployment of the Chevrolet's driver's air bag. The Oldsmobile was equipped with redesigned frontal air bags that deployed as a result of the impact. Both vehicles were equipped with an Electronic Data Recorder (EDR) that was downloaded as a supplement to the investigation. The Chevrolet was occupied by an unrestrained 78-year old male driver that was not injured. The Oldsmobile was occupied by a restrained 40-year old female driver that was not injured in the event and a restrained 64-year old female front right passenger. The Oldsmobile's front right passenger sustained minor injuries and was transported to a hospital for treatment and released.



Figure 1. 2003 Chevrolet Avalanche

The crash was initially selected for investigation by PSU 08 of the National Automotive Sampling System as Case No: 2003-08-063F. The Crash Investigation Division of the National Highway Traffic Safety Administration assigned a combined investigative effort of the crash to the Special Crash Investigations team at Veridian Engineering due to the agency's interest in the field performance of vehicles equipped with these advanced safety systems. This remote effort involved a review of the NASS EDS, a download of the EDR recovered from the Chevrolet and a narrative summary report.

SUMMARY

Crash Site

This two-vehicle crash occurred during the morning hours in April 2003. At the time of the crash, it was daylight and there were no adverse weather conditions. The road surface was dry. The crash occurred at the four-leg intersection



Figure 2. Crash site from westbound approach.

of a four-lane east/west county road and a two-lane north/south road (**Figure 2**). The east/west roadway was divided by yellow double-lines and was bordered with 15.0 cm (6.0”) concrete curbs. The intersection was controlled by a three-phase traffic light that was regulating the east/west traffic flow. The traffic was reported as operating properly. The speed limit in the area of the crash was 64 km/h (40 mph).

Crash Sequence

Pre-Crash

The 2003 Chevrolet Avalanche was traveling eastbound in the inboard lane driven by an unrestrained 78-year old male (**Figure 3**) approaching the four-leg intersection. It was the driver’s intension to turn left at the intersection. The EDR data indicated that the Chevrolet’s travel speed was 14.9 km/h (24.0 mph) five seconds prior to the crash and the vehicle decelerated to 7.5 km/h (12.0 mph) one second before the crash. The 1999 Oldsmobile Intrigue was traveling westbound in the outboard lane driven by a 40-year old restrained female (**Figure 4**) and occupied by a restrained 64-year old female front right passenger. It was the Oldsmobile driver’s intension to travel through the intersection. The Oldsmobile’s EDR did not have the capability to record pre-crash data. The driver reported during the NASS interview that her pre-impact travel speed was approximately 24.8 km/h (40.0 mph).

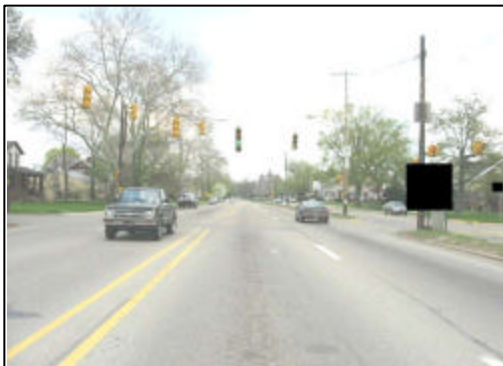


Figure 3. Chevrolet approach to the intersection.



Figure 4. Oldsmobile approach to intersection.

Crash

As the Chevrolet entered the intersection, the driver turned left across the path of the Oldsmobile (**Figure 5**). The front left aspect of the Oldsmobile struck the front right aspect of the Chevrolet in an 11 and 2 o’clock impact configuration. The force of the impact caused the deployments of the Chevrolet’s driver air bag and both frontal air bags in the Oldsmobile. The EDR recorded a maximum longitudinal

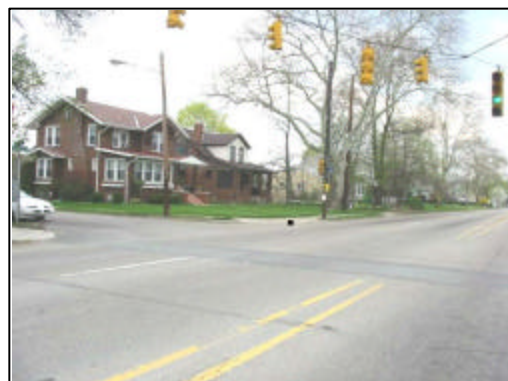


Figure 5. Area of impact.

velocity change in the crash of -17.46 km/h (-10.85 mph) for the Chevrolet and -35.31 km/h (-21.94 mph) for the Oldsmobile, respectively. The EDR data for the Chevrolet and Oldsmobile is included in this report as **Attachment A** and **B**.

The impact with the Oldsmobile forward of the Chevrolet's center of gravity caused the Chevrolet to rotate counterclockwise as it slid to rest. The angular collision redirected the Oldsmobile northward and both vehicles came to rest in the northwest quadrant of the intersection. Both vehicles sustained disabling damage and had to be towed. A schematic of the crash scene developed by the NASS researcher is attached to the end of this report, **Figure 11**.

Post-Crash

The police and ambulance personnel responded to the scene. The 78-year old driver of the Chevrolet and the 40-year old driver of the Oldsmobile were not injured. The Oldsmobile's 64-year old front right passenger sustained a police reported minor arm injury. This passenger was transported via ambulance to a local hospital, treated, and released the same day.

VEHICLE DATA – 2003 Chevrolet Avalanche

The 2003 Chevrolet Avalanche was identified by the Vehicle Identification Number (VIN): 3GNEC13T43 (production sequence omitted). The odometer reading was 8,047 km (5,000 miles) at the time of the inspection. The vehicle was a four-door pickup truck that was equipped with a 5.3-liter, eight-cylinder engine, four-wheel ABS, rear wheel drive and a four-speed automatic transmission. The Chevrolet tires were Firestone Wilderness LE radials size P265/70R16. The pickup's seating was configured with a three-passenger front bench seat with a flip and fold center seat console and a three passenger second row bench. The manual restraints system consisted of integrated 3-point lap and shoulder belts for the front outboard positions and center lap belt. The second row restraints system consisted of C-pillar mounted lap and shoulder belts for the outboard positions and an integrated lap shoulder belt for the center position. The supplement restraint system consisted of advanced dual stage frontal air bags.

VEHICLE DAMAGE

Exterior – 2003 Chevrolet Avalanche

The 2003 Chevrolet Avalanche sustained minor severity damage as a result of the intersection collision. The vehicle was in a state of repair at the time of the NASS inspection and the damaged parts had been removed (**Figure 6**). Based on the repair estimate, the following components were replaced: bumper fascia, bumper reinforcement bar, bumper supports, grille, right head light assembly, and right and



Figure 6. Under repair Chevrolet.

left front fenders with an approximate repair cost of \$8,220. The damage appeared to be limited to components forward of the radiator support plane. There was no reported suspension repair. All glazing remained intact. The Collision Deformation Classification for this impact was 99-F999-9. A WinSmash missing vehicle algorithm was used on this crash due to the lack of crush data for the Chevrolet. The total delta V for the Chevrolet was 24.0 km/h (14.9 mph) and the longitudinal and lateral components were -20.8 km/h (-12.9 mph) and -12.0 km/h (-7.5 mph) respectively. The WinSmash calculated delta V results were consistent with the downloaded EDR data.

Interior – 2003 Chevrolet Avalanche

There was no identified interior damage or intrusion related to the exterior crash forces (**Figure 7**).



Figure 7. Interior of Chevrolet.

VEHICLE DATA – 1999 Oldsmobile Intrigue

The 1999 Oldsmobile Intrigue was identified by the Vehicle Identification Number (VIN): 1G3WS52K0X (production sequence omitted). The odometer reading was 64,374 km/h (40,000 miles) at the time of the inspection. The vehicle was a four-door sedan that was equipped with 3.8 liter, six-cylinder engine, four-wheel

ABS, front wheel drive and a four speed automatic transmission. The front tires on the Oldsmobile were BFGoodrich Control T/A radials, size P225/60R16. The vehicle's rear tires were Goodyear Eagle GA radial, size P225/60R16. The Oldsmobile was configured with front bucket seats and a second row bench seat. The vehicle was configured with manual lap and shoulder belts for the outboard positions and a center rear lap belt. The Supplemental Restraint System consisted of redesigned driver and front right passenger air bags.

Exterior – 1999 Oldsmobile Intrigue

The 1999 Oldsmobile Intrigue sustained moderate severity frontal damage as result of the impact with the Chevrolet (**Figure 8**). The damage consisted of longitudinal displacement of the bumper fascia, reinforcement bar, bumper supports, left front fender, and hood. The direct contact damage began at the centerline and extended 70.0 cm (27.5") to the front left bumper corner. The combined direct and induced damage measured 125.0 cm (49.2"). Six crush measurements were documented along the bumper (**Figure 9**): C1=23.0 cm (9.0"), C2 =35.0 cm (13.8), C3= 28.0 cm (11.0"), C4= 22.0 cm (8.7"), C5= 0.0 cm, C6= 0.0 cm. The Collision Deformation Classification for this impact was 11-FYEW-2. The WinSmash calculated total delta V for the Oldsmobile was 37.0 km/h (23.0 mph). The longitudinal and lateral components were -34.8 km/h (-21.6 mph) and 12.7 km/h (7.9 mph), respectively. The WinSmash results were consistent with the EDR data.



Figure 8. Oldsmobile Intrigue



Figure 9. Crush profile

MANUAL RESTRAINT SYSTEMS – 2003 Chevrolet Avalanche

The 2003 Chevrolet Avalanche was equipped with integrated manual 3-point lap and shoulder belts for the front outboard positions and a front center lap belt. The driver's safety belt was configured with a sliding latch plate and a belt-sensitive Emergency Locking Retractor (ELR). The front center lap safety belt was configured with a locking latch plate. The front right safety belt and the three rear safety belts were configured with a sliding latch plate and switchable ELR/ALR retractor. Inspection of the driver's belt showed no evidence of usage in this crash and minimal historical use overall. It was determined the driver was unrestrained in the crash. The EDR data indicated that the driver's safety belt was unbuckled during the crash. It should be noted however, the driver claims to have utilized the safety belt during the NASS interview.

Advance208 Compliant Safety System – 2003 Chevrolet Avalanche

The 2003 Chevrolet Avalanche was equipped with an advanced 208-Compliant safety system. The system included dual-stage frontal air bags, a passenger presence detector for the front right seat and seat track position sensors for the front left and front right. The front right seat was not occupied during the crash therefore the system did not deploy the front right air bag. The system was monitored and controlled by a Sensing and Diagnostic Control Module (SDM) located 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 the subject crash, the SDM commanded a stage one deployment of the driver's air bag.



**Figure 10. Removed driver's air bag.
Occupant contact on center of air bag.**

The front left air bag (**Figure 10**) deployed from the center of the steering wheel hub. The air bag diameter measured 55.0 cm (21.6”). The front left air bag module was configured with two symmetrical I-configuration cover flaps. The cover flaps measured 6.0 cm (2.4”) in width and 12.0 cm (4.7”) in height. The front left air bag contained two tethers and was vented by two vent ports on the rear aspect of the air bag at the 11 and 1 o’clock positions. A possible skin transfer was noted on the center of the air bag. However, this contact did not result in an injury.

OCCUPANT DEMOGRAPHICS – 2003 Chevrolet Avalanche

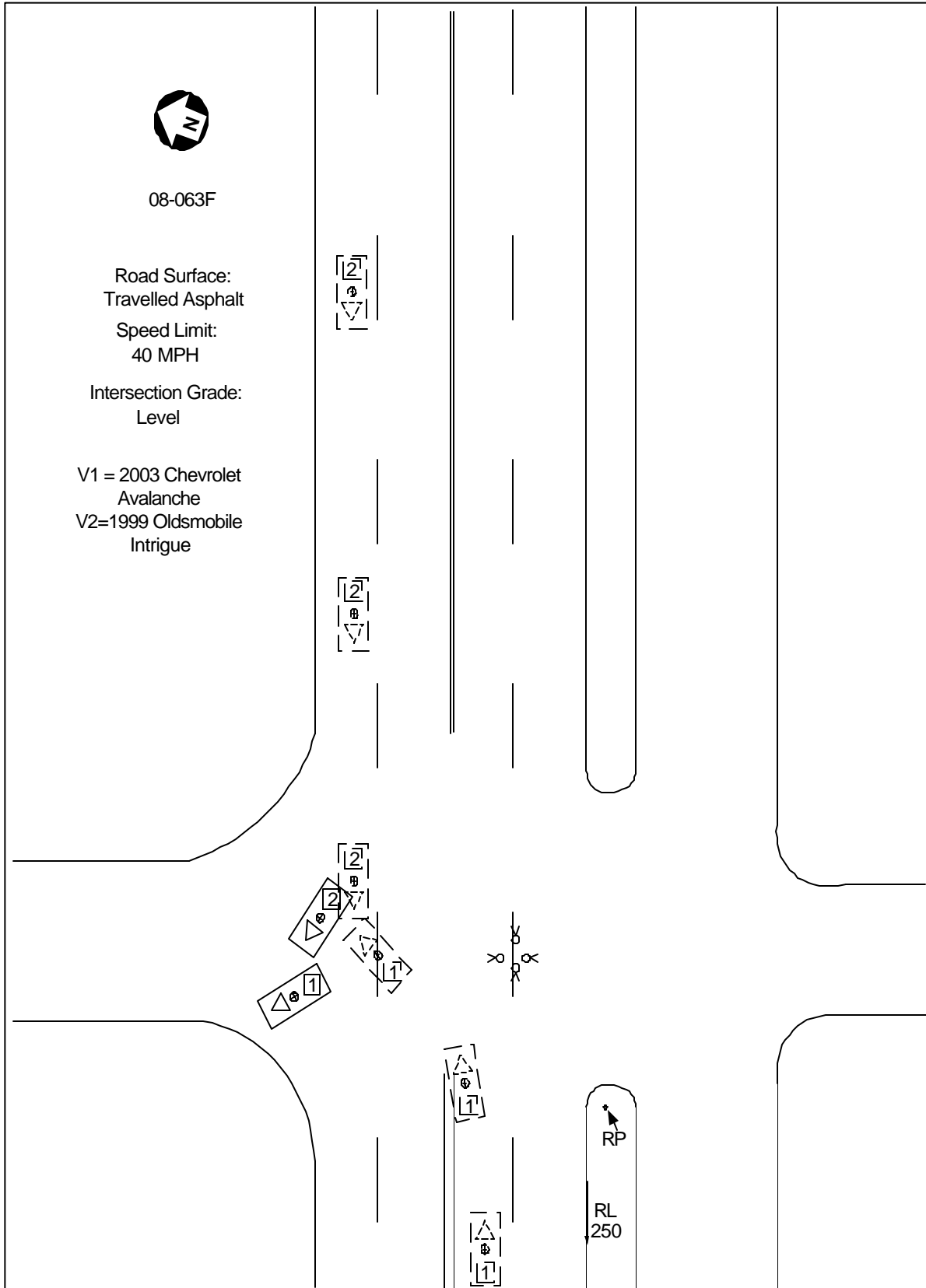
Driver Data

Age/Sex:	78-year-old male
Height:	180 cm (71.0”)
Weight:	68 kg (150lbs)
Seat Track Position:	Mid-track
Manual Restraint Use:	None Used
Usage Source:	Vehicle inspection, EDR
Eyewear:	Eyeglasses/sunglasses
Type of Medical Treatment:	Not Injured

Driver Kinematics

The 78-year-old male driver of the 2003 Chevrolet Avalanche was seated in an upright posture and was unrestrained. The seat was in the mid-track position. At impact, the front left air bag deployed. The unrestrained driver initiated a forward and rightward trajectory in response to the 2 o’clock direction of force and possibly contacted the frontal air bag with his face. A possible skin transfer was noted on the center of the air bag. The driver was not injured in the crash and exited the vehicle under his own power.

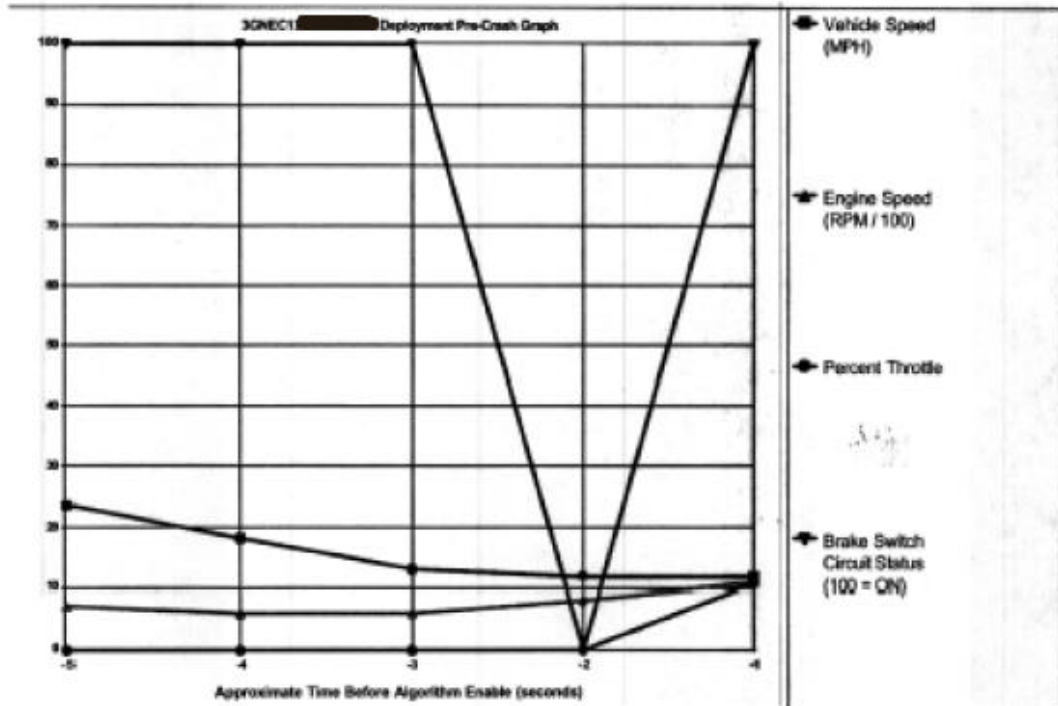
Figure 11. NASS Scene Schematic



Attachment A: EDR printout page 1 2003 Chevrolet Avalanche.

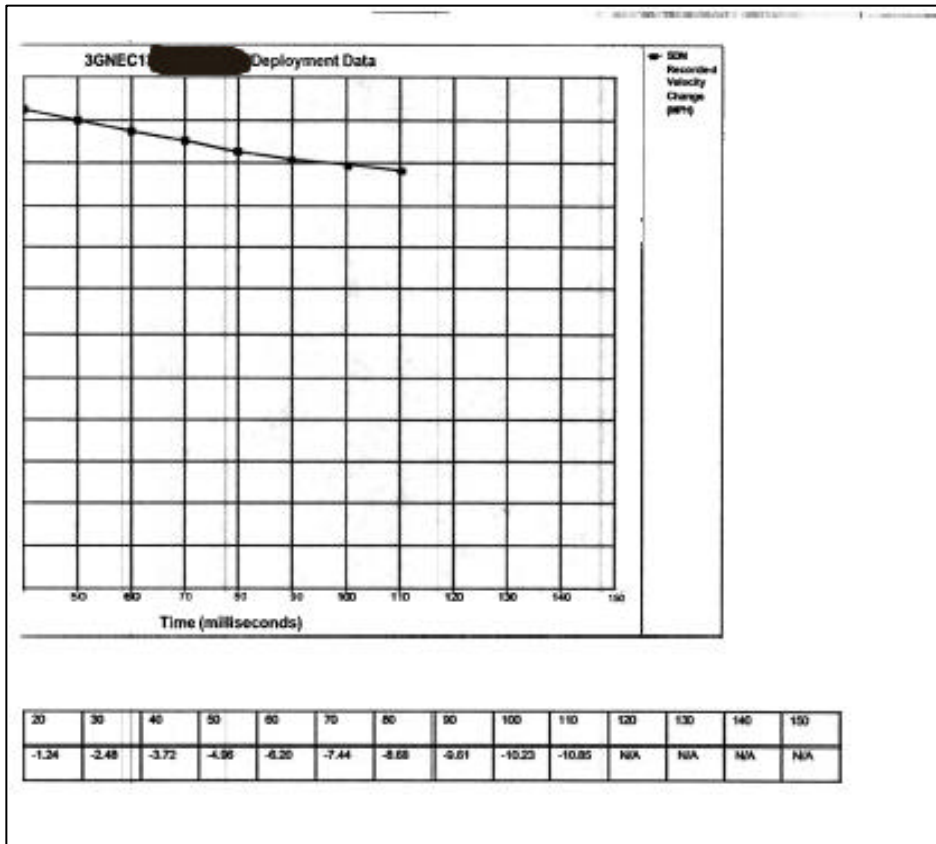
System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Deployment	1268
Ignition Cycles At Investigation	1284
Maximum SDM Recorded Velocity Change (MPH)	-11.50
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	127.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	17.5
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
Frontal Deployment Level Event Counter	1
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	24	704	0	ON
-4	18	576	0	ON
-3	13	640	0	ON
-2	12	832	0	OFF
-1	12	1088	11	ON

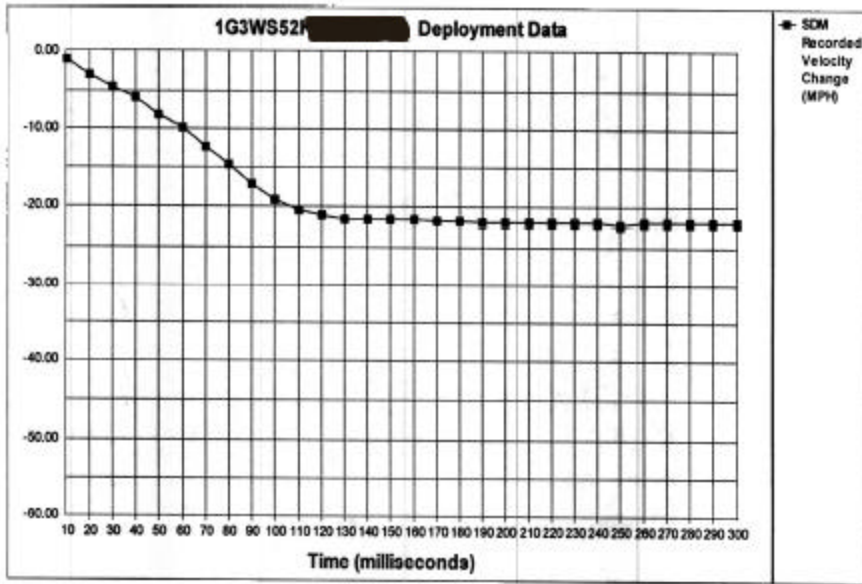
Attachment A: EDR printout page 2 2003 Chevrolet Avalanche.



Attachment B: EDR printout page 1 1999 Oldsmobile Intrigue.

System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	BUCKLED
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed
Ignition Cycles At Deployment	9384
Ignition Cycles At Investigation	9396
Time From Algorithm Enable To Deployment Command (msec)	18.75
Time Between Near 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)	-0.88	-2.86	-4.81	-6.82	-8.12	-8.87	-12.29	-14.70	-17.11	-19.09	-20.40	-21.06	-21.30	-21.50	-21.50
Time (milliseconds)	150	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	-21.50	-21.72	-21.72	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94	-21.94