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SCI/NASS COMBINATION CASE REPORT

CASE NUMBER - NASS-2000-48-088C
LOCATION - Alabama
VEHICLE - 2000 OLDSMOBILE ALERO
CRASH DATE - May 2000

Submitted:

March 1, 2001

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National Highway Traffic Safety Administration
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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.

Technical Report Documentation Page

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15. *Supplementary Notes* Combination SCI/NASS air bag deployment investigation involving a 2000 Oldsmobile Alero with redesigned front air bags and with the EDR successfully downloaded, and a 1999 Oldsmobile Alero.			
16. *Abstract* This report covers a SCI/NASS combination investigation of a front air bag deployment crash that involved a 2000 Oldsmobile Alero four-door sedan (case vehicle) and a 1999 Oldsmobile Alero (other vehicle). This crash is of special interest because the case vehicle was equipped with an Event Data Recorder (EDR) that was successfully downloaded. The case vehicle's restrained driver (32-year-old male) and restrained front right passenger (40-year-old male) both sustained only minor soft tissue injuries and did not seek medical treatment. The case vehicle was traveling south in the inside southbound through lane of a divided urban trafficway (two lanes each direction with a wide grass median), approaching an intersection and intending to continue south. The intersection area included a median cut for the crossing street and the road surface in each direction was widened to four lanes to accommodate left- and right-turn-only lanes. The other vehicle had been traveling north in the northbound left turn lane on the same trafficway and had entered the median cut, intending to turn left to travel west. The other vehicle began its left turn across the path of the case vehicle. The case vehicle driver braked and steered right but the front of the case vehicle impacted the right side of the other vehicle, causing the case vehicle's driver and front right passenger air bags to deploy. The other vehicle's air bags also deployed. The case vehicle rotated clockwise, the other vehicle rotated counterclockwise and the left side of the case vehicle impacted the right side of the other vehicle. The case vehicle came to rest slightly south and west of the point of impact, heading north, having rotated approximately 180 degrees clockwise. The other vehicle departed the roadway in the southwest quadrant and came to rest on the roadside, heading southwest, having rotated approximately 90 degrees counterclockwise. Both vehicles were towed due to damage.			
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This case was brought to the NHTSA's attention by a review of the 2000 NASS/CDS data. The crash involves a 2000 Oldsmobile Alero (case vehicle) and a 1999 Oldsmobile Alero (other vehicle). The crash occurred in Alabama, in May 2000 at 1:05 p.m., and was investigated by the applicable municipal police agency. This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of the collision events and was also equipped with an Event Data Recorder (EDR) that was successfully downloaded. The case vehicle's restrained driver (32-year-old male) and restrained front right passenger (40-year-old male) both sustained minor injuries and did not seek medical treatment. The NASS researcher inspected the scene and both vehicles, and interviewed both drivers, in May 2000. This report is based on the Police Crash Report, the coded NASS case, scene and vehicle photographs, interview information, the data from the case vehicle's EDR, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

Figure 1: Case vehicle's southbound approach toward impact within the intersection

The case vehicle was traveling south in the inside southbound through lane of a four-lane, one-way roadway that was part of a divided urban trafficway, approaching a four-leg intersection intending to pass through the intersection and continue south. The other vehicle had been traveling north in the left-turn-only lane of a four-lane, one-way roadway that was part of the same urban trafficway, approaching the same intersection and intending to turn left to travel west. The trafficway was divided by a grass median with no barrier, with a median cut for the crossing street. For both northbound and southbound traffic, the respective roadways consisted of two through lanes, with the surface widened to four lanes to accommodate turn lanes in the area of the intersection. For both directions, the right-turn- and left-turn-only lanes were separated from the through lanes by solid white lines and were marked with painted ONLY and arrows. The through lanes were separated by dashed lane lines. There were no traffic controls for the north-south trafficway. East-west traffic was controlled by STOP signs at the outside corners and a NO U TURN sign in the median cut (**Figure 1**). It was daylight, with no adverse weather conditions, and the bituminous road surface was without defects. The roadway curved slightly to the right with a negative grade for southbound traffic. The other vehicle entered the median cut and then began the intended left turn, across the path of the case vehicle. The case vehicle driver braked without lock-up and steered right. It is not known if the driver of the other vehicle attempted any avoidance actions.

The crash occurred within the intersection. The front of the case vehicle impacted the right side of the other vehicle, causing the case vehicle's driver and front right passenger air bags to deploy. The other vehicle's driver and front right passenger air bags also deployed. The case vehicle rotated clockwise, the other vehicle rotated counterclockwise and the left side of the case vehicle struck the right side of the other vehicle in a second "sideslap" impact. The case vehicle rotated approximately 180 degrees and came to

rest heading north in the outside southbound lane. The other vehicle rotated approximately 90 degrees counterclockwise, slid off the roadway in the southwest quadrant and came to rest on the roadside heading southwest. Both vehicles were towed due to disabling damage.

CASE VEHICLE

The case vehicle was a front wheel drive 2000 Oldsmobile Alero GLS four-door, five-passenger sedan (VIN: 1G3NF52EXYC------), equipped with a V-6, 3.4 liter engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes were standard for this model. The case vehicle's wheelbase was 272 centimeters [107.0 inches], and the odometer reading was 19,022 kilometers [11,820 miles].

Figure 2: Case vehicle's front damage.

The case vehicle sustained direct contact damage across almost the entire front from the initial impact. The bumper cover was dislodged and shifted rightward, but not separated (the elastic rebound of the vinyl bumper cover conceals the actual crush to the bumper); the hood was bent upward and rearward, more so on the right; and the leading edge of the right fender was bent downward and rearward; the leading edge of the left fender was bent inward and rightward. The right headlight assembly was broken apart, but the lenses were not shattered (**Figures 2 and 3**). The right and left fenders sustained indirect damage and were bent and misshapen. The second (sideslap) impact caused very minor damage on the left front door. All the doors remained closed and operational and there was no glazing damage. The NASS researcher found no evidence of any intrusion.

Figure 3: Case vehicle's damage at front right

The CDC for the case vehicle's most severe impact was determined to be **11-FDEW-2 (340)**. The WinSMASH reconstruction program, damage-only algorithm based on the measured crush profile from the other vehicle and a CDC-only estimated crash profile for the case vehicle, was used on the case vehicle's most severe impact. The calculated estimates for Total, Longitudinal and Lateral Delta V are, respectively: 35 km.p.h. [22 m.p.h.], -33 km.p.h. [-21 m.p.h.] and 12 km.p.h. [8 m.p.h.]. These results closely match the EDR information. This was a crash of moderate severity for the case vehicle. The case vehicle was towed from the scene due to disabling damage.

The case vehicle was equipped with redesigned air bags that deployed at the driver and front right passenger seat positions, and an Event Data Recorder (EDR) that was successfully downloaded. There were no other automatic restraint devices in the case vehicle.

Figure 4: Driver's air bag

The driver's air bag was mounted in the steering wheel hub (**Figure 4**). The air bag was round with diameter 53 centimeters [20.9 inches]. The module cover flaps were arranged in a symmetrical "I" configuration, with each half 13 centimeters [5.1 inches] horizontally and 7 centimeters [2.8 inches] vertically. The air bag had two vent ports at the 11 and 1 o'clock positions, and two tethers. The driver's air bag showed black scuffing from the module cover flaps on the front and back, and no other evidence of contact.

The front right passenger's air bag was mounted in the top of the instrument panel (**Figure 5**). The air bag was rectangular, measuring 67 centimeters [26.4 inches] vertically and 53 centimeters [20.9 inches] horizontally. The single module cover flap was a rectangle with rounded corners measuring 33 centimeters [13.0 inches] horizontally and 16 centimeters [6.3 inches] vertically. The air bag had no vent ports and no tethers. It showed black scuffing from the cover flap on the left edge, and there was a small spot of blood above and to the right of the center.

Figure 5: Front right passenger's air bag

EVENT DATA RECORDER

The case vehicle's EDR was downloaded (see **Figures 8, 9 and 10**, at end). The deployment occurred on ignition cycle 1,391. The Supplemental Inflatable Restraint (SIR) warning lamp was off, indicating no problems with the air bag system, and the driver's safety belt was recorded as buckled. The EDR pre-crash data (**Figures 8 and 10**) indicate that the case vehicle was traveling 85 km.p.h. [53 m.p.h.] five seconds before the device detected the impact ("algorithm enable"). Recall that the case vehicle was traversing a gentle curve to the right with a negative slope. The pre-crash data show that the throttle was at 4 per cent, that is, the driver's foot was probably off of the accelerator. The driver apparently braked lightly as the vehicle was rounding the curve, with the EDR pre-crash data showing the brake light switch circuit "on" at four seconds prior to algorithm enable. The case vehicle's travel speed slowed slightly to 79 km.p.h. [49 m.p.h.] over the next two seconds (from -4 to -2 seconds, see **Figures 8 and 10**). At approximately two seconds prior to algorithm enable, the driver apparently braked hard because the travel speed dropped steeply to 51 km.p.h. [32 m.p.h.] in the interval between -2 and -1 seconds.

The EDR deployment data (**Figures 9 and 10**) indicate longitudinal Delta V of -34.41 km.p.h. [-21.38 m.p.h.] during the 120 milliseconds [0.12 seconds] after algorithm enable (the EDR did not record deployment data beyond 120 milliseconds). The WinSMASH calculated estimate for longitudinal Delta V was -33 km.p.h. [-21 m.p.h.], indicating close agreement between the recorded data and the calculated estimate.

CASE VEHICLE DRIVER

The case vehicle driver (32-year-old male, white, non-Hispanic, 198 centimeters, 82 kilograms [78 inches, 181 pounds]) was restrained by the available, manual, three-point, lap-and-shoulder safety belt system. The driver was reported by the police as sustaining no injuries. In the interview, the driver reported that he sustained very minor injuries and did not seek any treatment.

The driver was seated slightly reclined with the seat track at the rear most position, the tilt steering wheel in the middle position and the upper anchorage adjustment of the safety belt at the full-up position. Both hands were on the steering wheel, his right foot was on the brake and his left foot was on the floor. He braked and steered right immediately prior to the impact and probably moved slightly forward and leftward in response to these avoidance actions. Upon impact, he moved further forward and leftward, toward the 11 o'clock direction of principal force. The deploying air bag contacted the inner surface of his left wrist, causing an abrasion. Because he was using his safety belt system, his motion was restricted and his face and chest encountered the fully deployed air bag. Because he was cushioned by the air bag, he did not load the safety belt webbing with strong force. The case vehicle rotated clockwise and sustained a very minor sideslap impact on the left front door. The driver's legs flailed and he sustained abrasions on both knees due to contacting the knee bolster. His seat retained its pre-crash adjustment at final rest. He exited the vehicle under his own power.

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Abrasion, left inner wrist	790202.1 minor	Driver's air bag	Probable	Interview
2.	Abrasion, bilateral knees	890202.1 minor	Knee bolster	Probable	Interview

The case vehicle's front right passenger (40-year-old male, white, non-Hispanic, 183 centimeters, 77 kilograms [72 inches, 170 pounds]) was restrained by his available, manual, three-point, lap-and-shoulder safety belt system. The front right passenger was reported by the police as sustaining no injuries. In the interview, the driver reported that the front right passenger sustained very minor injuries and did not seek any treatment.

The front right passenger was seated slightly reclined with his back against the seat back, the seat track between the middle and rear most positions, his hands in his lap, his feet on the floor and the upper anchorage adjustment of the safety belt in the middle position. The driver braked and steered right immediately prior to the impact and the front right passenger probably moved slightly forward and leftward in response to these avoidance actions. Upon impact, he moved further forward and leftward, toward the 11 o'clock direction of principal force. Because he was using his safety belt system, his forward motion was restricted. He encountered the fully deployed air bag with his head and chest, sustaining an abrasion on his right temporal scalp. Because he was cushioned by the air bag, he did not load the safety belt webbing with strong force. The case vehicle rotated clockwise and sustained a very minor sideslap impact on the left front door. At final rest, his seat retained its pre-crash adjustment. He exited the vehicle under his own power.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	Abrasion, right temporal scalp	190202.1 minor	Passenger's air bag	Probable	Interview

OTHER VEHICLE

The other vehicle was a front wheel drive 1999 Oldsmobile Alero GL, four-door, five-passenger sedan (VIN: 1G3NL52T4XC------) equipped with an I-4, 2.4 liter engine and an automatic transmission with a console-mounted selector lever. Four-wheel anti-lock brakes were standard for this model. The other vehicle's wheelbase was 272 centimeters [107.0 inches], and the odometer reading was 49,767 kilometers [30,925 miles].

The other vehicle sustained direct contact damage along the right side, from the front wheel rearward to the middle of the front door (**Figure 6**). The wheel was tilted and suspension components were probably broken; the lower A-pillar showed moderate crush; the middle of the front door panel was crushed into a moderately deep "V" (**Figure 7**); the front door window glazing was shattered; the front door window frame was bent outward; both the front and back doors were jammed shut; and the outside

rearview mirror was broken loose. The front door was forced open by rescue personnel, leaving pry marks.

The CDC for the other vehicle's impact with the case vehicle was determined to be **01-RYEW-3 (40)**. The WinSMASH reconstruction program, damage only algorithm with the measured crush profile from the other vehicle and a CDC-only estimated crush profile for the case vehicle, was used on this vehicle's impact with the case vehicle. The calculated estimates for Total, Longitudinal and Lateral Delta V are, respectively: 35 km.p.h. [22 m.p.h.], -27 km.p.h. [-17 m.p.h.] and -23 km.p.h.[-14 m.p.h.]. The other vehicle was towed from the scene due to disabling damage.

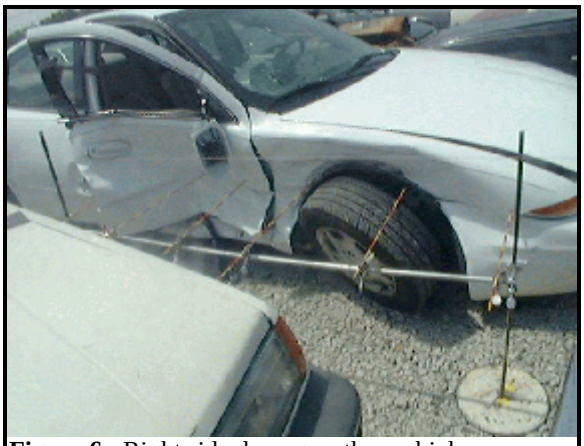
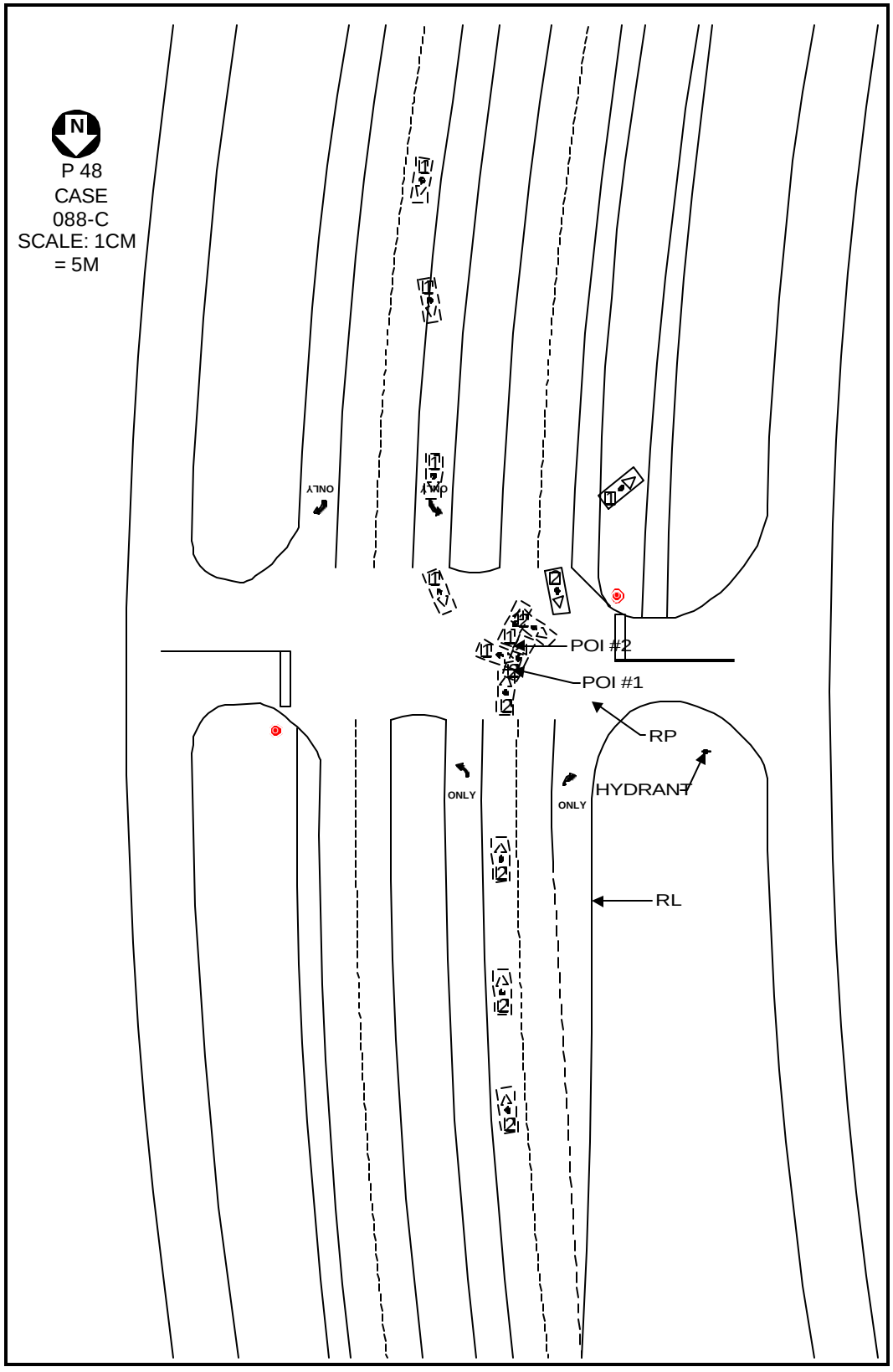


Figure 6: Right side damage, other vehicle

There were three occupants in the other vehicle. The driver and front right passenger air bags deployed as a result of the impact with the case vehicle. The restrained driver (23-year-old male) was transported via ambulance, treated for minor contusions and released. The restrained front right passenger (22-year-old female) was transported via ambulance, treated for minor contusions and strains, and released. The restrained back right passenger (6-year-old male) was not injured and did not receive any treatment.

Figure 7: Looking down at right side damage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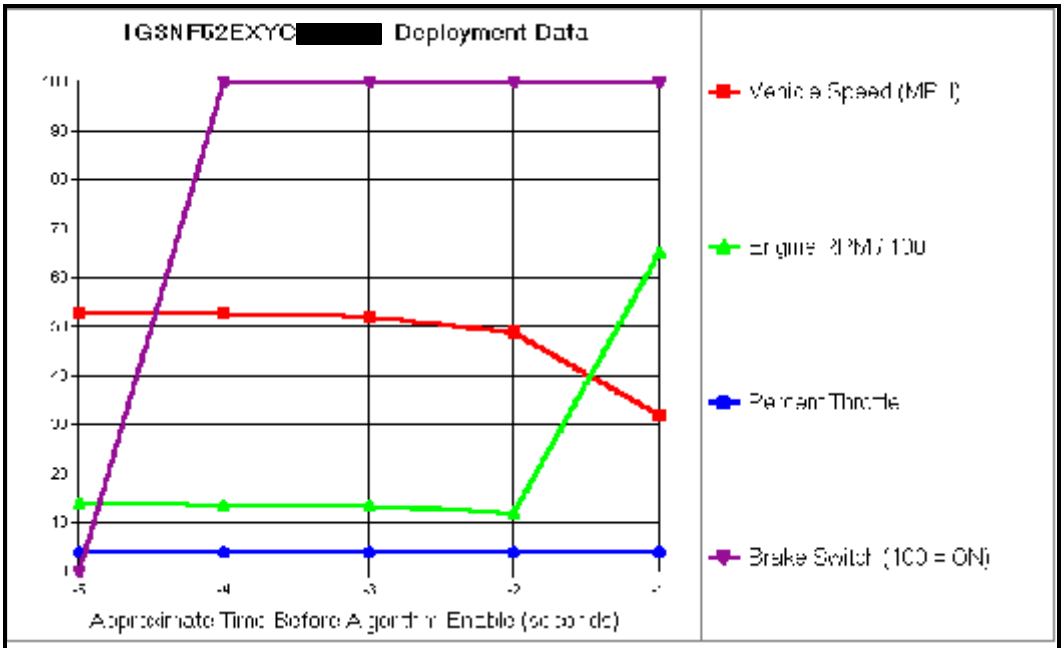


Figure 8: Graph of case vehicle's pre-crash conditions (data presented in Figure 10). Note that engine rpm's jump to 6500 between -2 and -1 seconds; this is thought to be an error in the EDR or the download.

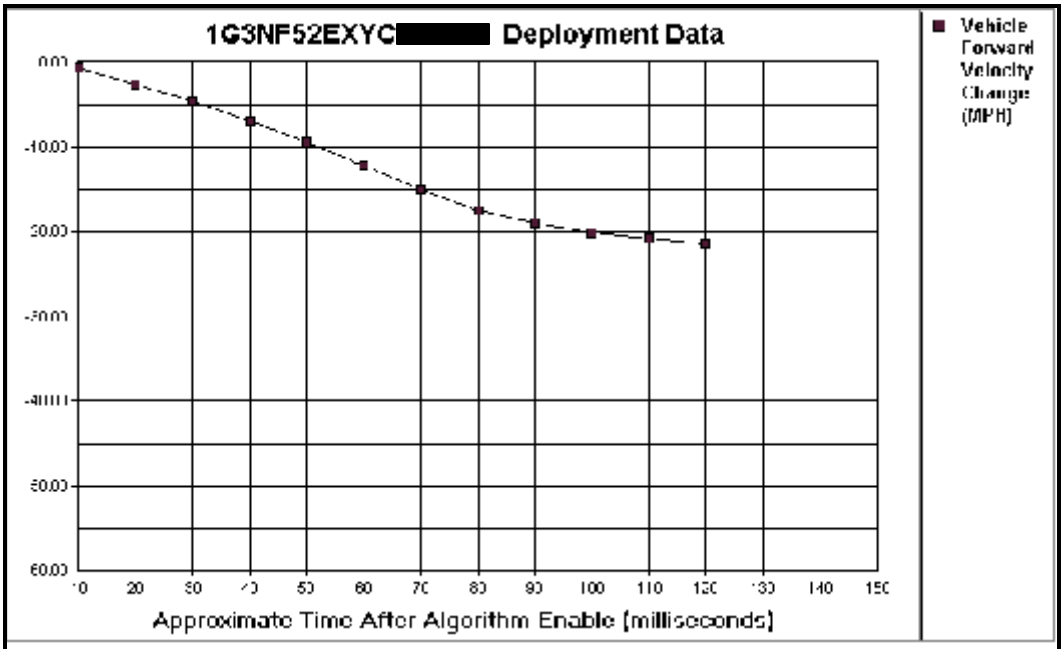
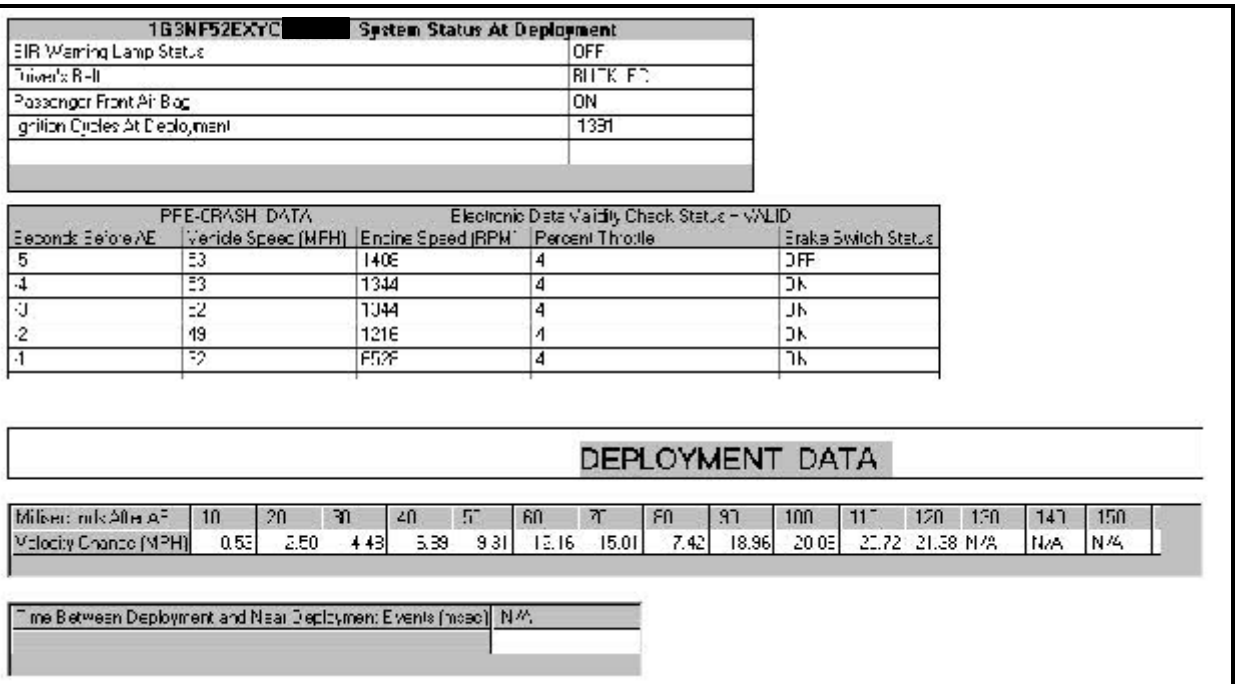


Figure 9: Graph of case vehicle's longitudinal Delta V following air bag deployment (data presented in Figure 10)



1G3NF52EXYC [redacted] System Status At Deployment	
SIR Warning Lamp Status	OFF
Driver's Belt	BUCKLED
Passenger Front Air Bag	ON
Ignition Cycles At Deployment	1331

PRE-CRASH DATA		Electronic Data Validity Check Status = VALID		
Seconds Before AE	Vehicle Speed (MPH)	Engine Speed (RPM)	Percent Throttle	Brake Switch Status
-5	53	1408	4	OFF
-4	53	1344	4	ON
-3	52	1344	4	ON
-2	49	1216	4	ON
-1	52	1536	4	ON

DEPLOYMENT DATA

Milliseconds After AE	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Velocity Change (MPH)	0.63	2.50	4.43	6.39	9.31	13.16	15.01	7.42	18.96	20.05	22.72	21.38	N/A	N/A	N/A

Time Between Deployment and Near Deployment Events (msec)	N/A

Figure 10: Case vehicle's data for graphs in Figure 8 and Figure 9