



INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

School of Public and Environmental Affairs
222 West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

ON-SITE REDESIGNED AIR BAG INVESTIGATION

CASE NUMBER - IN01-013
LOCATION - MISSOURI
VEHICLE - 1998 CHEVROLET BLAZER
CRASH DATE - April, 2001

Submitted:

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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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16. <i>Abstract</i> This report covers an on-site investigation of an air bag deployment crash that involved a 1998 Chevrolet Blazer (case vehicle) and a 1980 Mazda RX7 (other vehicle). This crash is of special interest because the case vehicle was equipped with redesigned air bags and a <u>S</u> ensing <u>D</u> iagnostic <u>M</u> odule (SDM), which was successfully downloaded. The case vehicle was traveling north in the inside through lane of a five-lane, undivided, state roadway and was entering a controlled four-leg intersection (i.e., there were two through lanes in both the north and southbound directions and one opposing left-hand turn lane on both the north and south legs of the four-leg intersection). The Mazda was traveling east in the inside through lane of a five-lane, undivided, city street and was entering the same controlled four-leg intersection. The crash occurred in the four-leg intersection of the two roadways. The front of the case vehicle impacted the right side of the Mazda, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The Mazda was redirected northeastward where it struck a large, concrete-reinforced, metal traffic control signal pole with its front. The case vehicle rotated approximately 135 degrees clockwise from its pre-crash travel direction and also traveled northeastward. As the Mazda rotated clockwise off the pole its right front corner side slapped the case vehicle's left quarter panel as it was approaching. Next, the case vehicle impacted the same large traffic control signal pole with its left rear door, just behind the "B"-pillar. The Mazda rotated approximately 85 degrees clockwise after impacting the pole and came to rest, heading in an east-southeasterly direction. The case vehicle rotated approximately 15 degrees counterclockwise, while rebounding slightly backwards off the pole, before coming to rest, heading east-southeastward. The case vehicle's driver (21-year-old male) was seated with his seat track located in its rearmost position, and the tilt steering wheel was located in its middle position. He was not using his available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to his one available medical record (obtained from the police), an abrasion to his right "upper chest"/shoulder area.					
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This on-site investigation was brought to NHTSA's attention on April 23, 2001 by a Sergeant with the investigating Police Department. This crash involved a 1998 Chevrolet Blazer (case vehicle) and a 1980 Mazda RX7 (other vehicle). The crash occurred in April, 2001, at 4:29 p.m., in Missouri and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with redesigned air bags and a Sensing Diagnostic Module (SDM), which was successfully downloaded. This contractor inspected the scene and vehicles on April 26, 2001. This contractor interviewed the investigating police officer on April 26, 2001. This contractor was unable to interview the driver of the case vehicle because he has been incarcerated in a mental health facility. This report is based on the Police Crash Report, an interview with the investigating police officer, scene and vehicle inspections, occupant kinematic principles, an occupant medical record, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was traveling north in the inside through lane of a five-lane, undivided, state roadway and was entering a controlled four-leg intersection, intending to continue traveling northward (i.e., there were two through lanes in both the north and southbound directions and one opposing left-hand turn lane on both the north and south legs of the four-leg intersection). The Mazda was traveling east in the inside through lane of a five-lane, undivided, city street and was entering the same controlled four-leg intersection, intending to continue eastward. The case vehicle's driver made no avoidance maneuvers prior to the crash. The crash occurred in the four-leg intersection of the two roadways; see **CRASH DIAGRAM** below.

The front of the case vehicle impacted the right side of the Mazda, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle and the Mazda momentarily remained engaged with each other prior to separating. Upon separation, the Mazda was redirected northeastward towards the northeast corner of the intersection where it struck a large, concrete-reinforced, metal traffic control signal pole with its front. As a result of the pole impact, the Mazda rotated clockwise off the pole. The case vehicle rotated approximately 135 degrees clockwise from its pre-crash travel direction as it traveled northeastward toward the northeast corner of the intersection. As the Mazda rotated off the pole its right front corner side slapped the case vehicle's left quarter panel as it was approaching the northeast corner of the intersection. Next, the case vehicle impacted the same large traffic control signal pole with its left rear door, just behind the "B"-pillar. The Mazda rotated a total of approximately 85 degrees clockwise after impacting the pole and prior to coming to final rest, practically off the roadway, heading in an east-southeasterly direction, while straddling the outside northbound lane and the northeast corner of the intersection. The case vehicle rotated approximately 15 degrees counterclockwise, while rebounding slightly backwards off the pole, before coming to rest near the pole, on the northeast corner of the intersection, heading east-southeastward.

The 1998 Chevrolet Blazer was a four wheel drive, four-door sport utility vehicle (VIN: 1GN1T13WXW2-----). The case vehicle was equipped with four-wheel, anti-lock brakes. Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **12-FDEW-2**

(350), 09-LBEW-2 (280), and 08-LPAW-3 (230). The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 40.0 m.p.h. (24.9 m.p.h.), -39.4 km.p.h. (-24.5 m.p.h.), and + 6.9 km.p.h. (+ 4.3 m.p.h.). The case vehicle was towed due to damage.

The case vehicle's initial contact with the Mazda involved the entire front. Direct damage extended from bumper corner to bumper corner, a measured distance of 142 centimeters (55.9 inches). Residual maximum crush for frontal ("most severe") impact was measured as 53 centimeters (20.9 inches) at C₆. The wheelbase on the case vehicle's left side was shortened 3 centimeters (1.2 inches) while the right side was shortened 7 centimeters (2.8 inches). The case vehicle's front bumper, bumper fascia, grille, hood, radiator, right and left headlight and turn signal assemblies, and left fender were directly damaged and crushed rearward. The case vehicle's left and right front tires were physically restricted from the crash. The windshield was cracked and both the right and left fenders sustained induced damage as well.

The case vehicle's second impact with the Mazda (3rd event) involved the left quarter panel. The field "L" and direct damage began 31 centimeters (12.2 inches) forward of the left rear axle and extended rearwards, a measured distance of 123 centimeters (48.4 inches), to the left back bumper. Residual maximum crush for this impact was measured as 13 centimeters (5.1 inches). The pole impact (4th event) involved the case vehicle's left "B"-pillar and left rear door area. The direct damage started 117 centimeters (46.1 inches) forward of the left rear axle and extended further forward a measured distance of 62 centimeters (24.4 inches). The field "L" measurement could not be determined because of masked damage from the case vehicle's second impact with the Mazda. The residual maximum crush from the pole impact was measured as 15 centimeters (5.9 inches). The case vehicle's left front and rear doors, left roof, and left quarter panel were directly damaged and crushed inward. Furthermore, the glazing along the entire left side was disintegrated from the two side impacts.

The data downloaded from the case vehicle's **Sensing Diagnostic Module** (SDM) showed the case vehicle's Supplemental Inflatable Restraint (SIR) warning lamp status, driver's seat belt buckle status, and the case vehicle's ignition cycles at deployment. Downloaded data of interest indicated the following: the case vehicle's driver was unrestrained (which corroborates this investigators conclusion following the interior inspection), the command to deploy the air bags was given only 6.25 milliseconds after the algorithm was enabled, and the Delta V was 42.73 km.p.h. (26.55 m.p.h.). Although numerous witnesses and the case vehicle's driver reported high pre-crash travel speeds (i.e., beyond the speed limit), this investigator believes the recorded Delta V is reasonable, particularly given that the case vehicle essentially redirected the Mazda along the case vehicle's post-crash travel path as a result of the collision. According to the Police Crash Report, the case vehicle was traveling at a high rate of speed prior to the crash.

It should also be noted that the case vehicle's **SDM** recorded a near deployment event **after** the case vehicle's air bags deployed. The near deployment event recorded that the SIR warning lamp status was ON, the driver's seat belt was BUCKLED, and that a Delta V of 0.0 km.p.h. (0.0 m.p.h.) occurred over the entire 300 milliseconds recorded. It is unclear exactly what precipitated the near deployment recording.

The case vehicle's driver air bag was located in the steering wheel hub. An inspection of the air bag module's cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 12 centimeters (4.7 inches) in width. The driver's air bag had two vent ports, approximately 2.5 centimeters (1.0 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag was round with a diameter 62 centimeters (24.4 inches). An inspection of the driver's air bag fabric revealed a skin transfer to the center of the air bag and two small areas with blood and oily transfer. One was located in the upper left quadrant (11 o'clock position) and the other just to the right of center toward the 3:30 o'clock position.

The front right passenger's air bag was located in the middle of the instrument panel. An inspection of the front right air bag module's cover flap and the air bag's fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed without any tethers. The front right air bag had two vent ports, approximately 5 centimeters (2.0 inches) in diameter, located at the 10 and 2 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 41 centimeters (16.1 inches) and a width of approximately 57 centimeters (22.4 inches). An inspection of the front right passenger's air bag fabric revealed that there was no contact evidence readily apparent on the air bag's fabric.

Inspection of the case vehicle's interior revealed that the upper portion of the steering wheel rim was bent toward the left instrument panel, 3 centimeters (1.2 inches), as a result of the driver loading the air bag, momentarily blocking the air bag's forward expansion, and causing the air bag to expand against and bend the steering wheel rim. Furthermore, there was scuffing and deformation to the driver's knee bolster, just to the right of the steering column, and a crack and scuff to the driver's door armrest which most likely resulted from the minor intrusion that occurred to the case vehicle's left front door, left "B"-pillar, and left rear door panel from the case vehicle's left side impacts. Finally, the energy absorbing steering column showed no evidence of compression.

The 1980 Mazda RX7 was a rear wheel drive, two-door hatchback (VIN: SA22C-----). Based on the vehicle inspection, the CDCs for the Mazda were determined to be: **03-RYAW-5 (80)**, **12-FDEW-2 (350)** and **03-RFEW-2 (80)**. The WinSMASH reconstruction program, damage only algorithm, was used on the Mazda's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 70.0 km.p.h. (43.5 m.p.h.), -12.2 km.p.h. (-7.6 m.p.h.), and -68.9 km.p.h. (-42.8 m.p.h.). The Mazda was towed due to damage.

The Mazda's initial contact with the case vehicle involved its right side. Direct damage began 9 centimeters (3.5 inches) forward of the right rear axle and extended, a measured distance of 190 centimeters (74.8 inches), further forward along the right side and onto the right fender. Maximum crush for the Mazda's most severe impact was measured as 71 centimeters (28.0 inches) at C₄. The wheelbase on the Mazda's left side was extended approximately 20 centimeters (7.9 inches) while the right side was shortened approximately 72 centimeters (28.3 inches).

Immediately prior to the crash, the case vehicle's driver [21-year-old, White (unknown if Hispanic) male; of unknown height and 79 kilograms (175 pounds)] was presumably seated in an upright posture with his back against the seat back, his left foot on the floor, his right foot on the accelerator, his left hand on the steering wheel, and his right hand holding a cellular phone. His seat track was located in its rearmost position, the seat back was upright, and the tilt steering wheel was located in its middle position.

The case vehicle's driver was not using his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the nonuse of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's primary impact with the Mazda enabled the case vehicle's driver to continue forward and slightly leftward toward the 350 degree Direction of Principal Force as the case vehicle decelerated. As a result, the driver loaded his deploying air bag causing the air bag to expand somewhat towards the left instrument panel and deform the upper portion of the steering wheel rim. The case vehicle's driver rebounded back into his seat back as the case vehicle was redirected in a northeasterly direction. The case vehicle's left back side slap with the Mazda's right front corner and bumper (3rd event) sent the driver slightly forward but primarily to his left towards the interior surface of the driver's door. The case vehicle's impact with the pole (4th event) sent the driver further to his left where he contacted the door's handle. As the case vehicle rotated slightly counterclockwise off the pole, the driver was forced to his right and most likely backwards into his seat back. The exact posture of the case vehicle's driver at final rest is unknown.

The driver was transported by ambulance to the hospital. He sustained minor injuries and was most likely (disposition is not reported on the available medical record) treated and released (most likely into police custody). Based on the one available medical record (obtained from the police), the case vehicle's driver sustained an abrasion to his right "upper chest"/shoulder area.

CRASH CIRCUMSTANCES

The case vehicle was traveling north in the inside through lane of a five-lane, undivided, state roadway (**Figure 1**) and was entering a controlled four-leg intersection, intending to continue traveling northward (i.e., there were two through lanes in both the north and southbound directions and one opposing left-hand turn lane on both the north and south legs of the four-leg intersection). The Mazda was traveling east in the inside through lane of a five-lane, undivided, city street (**Figure 2** below) and was entering the same controlled four-leg intersection, intending to



Figure 1: Case vehicle's northward path of travel in inside northbound lane (case photo #01)

continue eastward. The case vehicle's driver made no avoidance maneuvers prior to the crash. The crash occurred in the four-leg intersection of the two roadways; see **CRASH DIAGRAM** below.

The case vehicle's State highway was straight and level at the area of impact. The pavement was bituminous, and the width of the inside eastbound lane was 3.3 meters (10.8 feet). The roadway was bordered by barrier curbs on both the east and west side of the roadway. Pavement markings consisted of a double solid yellow centerline for both the north and southbound traffic. The inside through lane was border on the left by a solid white lane line that separated it from the left-hand turn lane, and the through lanes were divided by a dashed white line. In addition, no edge lines were present. The estimated coefficient of friction was 0.90 because the existing bituminous surface had been scraped off in preparation for re-paving. Traffic controls consisted of three on-colors, pre-timed, vertical mounted traffic control signals on the northeast corner of the intersection. The statutory speed limit was 56 km.p.h. (35 m.p.h.). No regulatory speed limit sign was posted near the crash site.



Figure 2: Westward view of Mazda's eastbound path of travel in inside eastbound lane—where police officer is standing (case photo #11)

The other vehicle's city roadway was straight and level at the area of impact. The pavement was bituminous, and the width of the inside northbound lane was 3.3 meters (10.8 feet). The roadway was bordered by barrier curbs on both the north and south side of the roadway. Pavement markings consisted of a double solid yellow centerline for both the east and westbound traffic. The inside through lane was border on the left by a solid white lane line that separated it from the left-hand turn lane, and the through lanes were divided by a dashed white line. In addition, no edge lines were present. The estimated coefficient of friction was 0.95 because the existing bituminous surface had been scraped off in preparation for re-paving. Traffic controls consisted of three on-colors, pre-timed, vertical and horizontal mounted traffic control signals on the southeast corner of the intersection. The statutory speed limit was 56 km.p.h. (35 m.p.h.). No regulatory speed limit sign was posted near the crash site.

At the time of the crash the light condition was daylight, the atmospheric condition was clear, and the road pavement was dry. Traffic density was moderate. and the site of the crash was urban commercial.

The front (**Figure 3**) of the case vehicle impacted the right side of the Mazda (**Figure 4** below), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The impact and penetration to the



Figure 3: Case vehicle's frontal damaged from impact with Mazda's right side with contour gauge present (case photo #12)

Mazda right side caused the Mazda to roll towards the driver's side, causing the Mazda's left front tire to scuff, and its undercarriage to scrape, the bituminous pavement (**Figures 5 and 6**). In addition, the case vehicle and the Mazda momentarily remained engaged with each other prior to separating (**Figure 7**).

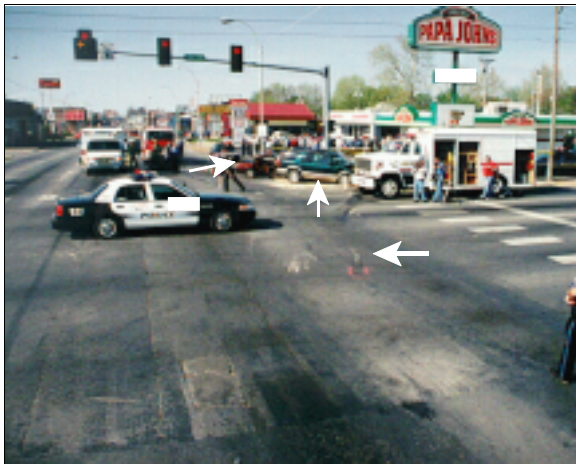


Figure 5: On-scene elevated view of crash scene looking north with vehicles at final rest positions off northeast corner of intersection; Note: impact evidence towards center of intersection (case photo #50)



Figure 4: Mazda's struck right side; Note: tape indicates width of direct damage (case photo #44)



Figure 6: Close-up on-scene view looking north at Mazda's left front tire (right) and undercarriage scraping (center) on asphalt surface at maximum engagement (case photo #50b)

Upon separation, the Mazda was redirected northeastward towards the northeast corner of the intersection where it struck a large, concrete-reinforced, metal traffic control signal pole with its front (**Figure 8** below). As a result of the pole impact, the Mazda rotated clockwise off the pole. The case vehicle rotated approximately 135 degrees clockwise from its pre-crash travel direction as it traveled northeastward toward the northeast corner of the intersection. As the Mazda rotated off the pole its right front corner side slapped the case vehicle's left quarter panel as it was approaching the northeast corner of the intersection (**Figure 9** below). Next, the case vehicle impacted the same large traffic control signal pole with its left rear door, just behind the "B"-pillar (**Figure 9** below). The Mazda rotated a total of approximately 85 degrees clockwise (**Figure 10** below) after impacting the pole and prior to coming to final rest, practically off the roadway, heading in an east-southeasterly direction, while straddling the outside northbound lane and the northeast corner of the intersection (**Figure 11** below). The case vehicle rotated



Figure 7: Overhead view of case vehicle's frontal deformation from impact with Mazda's right side; Note: damage atop hood from Mazda's right front door and quarter panel (case photo #13)

approximately 15 degrees counterclockwise, while rebounding slightly backwards off the pole, before coming to rest near the pole, on the northeast corner of the intersection, heading east-southeastward (**Figure 12**).



Figure 8: Mazda's frontal deformation from pole impact; Note: tape indicates width of direct damage (case photo #37)



Figure 9 Case vehicle's left side damage from pole (vertical tape and arrows) and side slap impact to left back from Mazda (case photo #20)



Figure 10: On-scene view looking northeast at case vehicle (foreground) and Mazda (background) at final rest positions (case photo #50c)

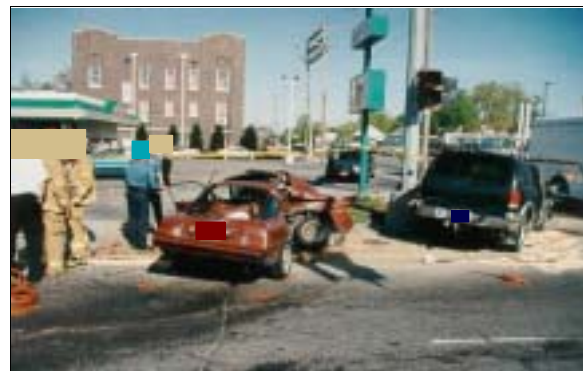


Figure 11: On-scene view looking east-southeast at final rest positions of case vehicle and Mazda (case photo #51)

CASE VEHICLE

The 1998 Chevrolet Blazer was a four wheel drive, five-passenger, four-door sport utility vehicle (VIN: 1GN1T13WXW2-----) equipped with a 4.3L, V-6 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, four-wheel, anti-lock system. The case vehicle's wheelbase was 272 centimeters (107.0 inches), and the odometer reading at inspection was 91,889 kilometers (57,097 miles).



Figure 12: On-scene view looking west showing case vehicle at final rest (case photo #52)

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable split back bench seat with folding cushions and adjustable head

restraints for the back outboard seating positions; continuous loop, three-point, lap-and-shoulder, safety belt systems at the front and back outboard positions; and a two-point, lap belt system at the back center position. The front seat belt systems were not equipped with manually operated, upper anchorage adjusters for the “D”-rings. The vehicle was equipped with knee bolsters for both the driver and front right passenger, and the driver’s knee bolster was scuffed and deformed. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a frontal air bag for the driver and front right passenger seating positions. Both frontal air bags deployed as a result of the case vehicle’s frontal impact with the Mazda.

CASE VEHICLE DAMAGE

The case vehicle’s initial contact with the Mazda involved the entire front (**Figure 3** above and **Figure 13**). Direct damage extended from bumper corner to bumper corner, a measured distance of 142 centimeters (55.9 inches). Residual maximum crush for frontal (“most severe”) impact was measured as 53 centimeters (20.9 inches) at C₆ (**Figure 7** above). The wheelbase on the case vehicle’s left side was shortened 3 centimeters (1.2 inches) while the right side was shortened 7 centimeters (2.8 inches). The case vehicle’s front bumper, bumper fascia, grille, hood, radiator, right and left headlight and turn signal assemblies, and left fender were directly damaged and crushed rearward (**Figures 3** and **7** above and **Figure 13**). The case vehicle’s left and right front tires were physically restricted from the crash. The windshield was cracked and both the right and left fenders sustained induced damage as well.

The case vehicle’s second impact with the Mazda (3rd event) involved the left quarter panel. The field “L” and direct damage began 31 centimeters (12.2 inches) forward of the left rear axle and extended rearwards, a measured distance of 123 centimeters (48.4 inches), to the left back bumper (**Figure 9** above). Residual maximum crush for this impact was measured as 13 centimeters (5.1 inches). The pole impact (4th event) involved the case vehicle’s left “B”-pillar and left rear door area (**Figure 14**). The direct damage started 117 centimeters (46.1 inches) forward of the left rear axle and extended further forward a measured distance of 62 centimeters (24.4 inches). The field “L” measurement could not be determined because of masked damage from the case vehicle’s second impact with the Mazda. The residual maximum crush from the pole impact was measured as 15 centimeters (5.9 inches). The case vehicle’s left front and rear



Figure 13: Case vehicle’s front and left side damage viewed from left of front; Note: pole impact to left rear door and side slap impact to left back (case photo #17a)

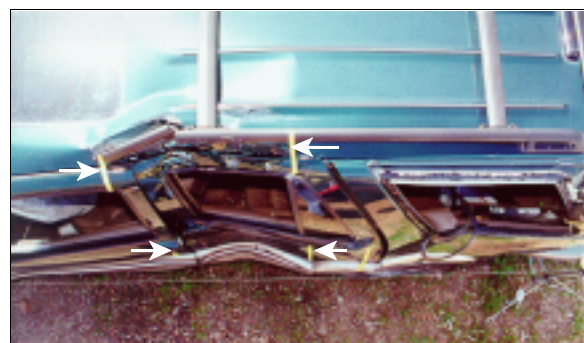


Figure 14: Overhead view of damage from case vehicle’s two left side impacts; Note: tape and arrows indicate width of contact from pole impact (case photo #21)

doors, left roof, and left quarter panel were directly damaged and crushed inward. Furthermore, the glazing along the entire left side was disintegrated from the two side impacts (**Figure 9** above).

Inspection of the case vehicle's interior revealed that the upper portion of the steering wheel rim was bent toward the left instrument panel, 3 centimeters (1.2 inches), as a result of the driver loading the air bag, momentarily blocking the air bag's forward expansion, and causing the air bag to expand against and bend the steering wheel rim (**Figure 15**). Furthermore, there was scuffing and deformation to the driver's knee bolster, just to the right of the steering column (**Figure 16**), and a crack and scuff to the driver's door armrest which most likely resulted from the minor intrusion that occurred to the case vehicle's left front door, left "B"-pillar, and left rear door panel from the case vehicle's left side impacts. Finally, the energy absorbing steering column showed no evidence of compression.

Based on the vehicle inspection, the CDCs for the case vehicle were determined to be: **12-FDEW-2 (350)**, **09-LBEW-2 (280)**, and **08-LPAW-3 (230)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 40.0 m.p.h. (24.9 m.p.h.), -39.4 km.p.h. (-24.5 m.p.h.), and + 6.9 km.p.h. (+ 4.3 m.p.h.). The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained frontal air bags at the driver and front right passenger positions. Both frontal air bags deployed as a result of the frontal impact with the Mazda. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of asymmetrical three flap design, made of thick vinyl, with overall dimensions of 18 centimeters (7.1 inches) at the horizontal seam and 2 centimeters (0.8 inches) vertically for the upper flap and "I"-configuration lower cover flaps with overall dimensions of 9 centimeters (3.5 inches) at the left and right horizontal seams and 9.5



Figure 15: Case vehicle's steering wheel showing bending to the top portion from occupant loading (case photo #31)



Figure 16: Case vehicle's driver knee bolster on right side of steering column showing scuff and deformation from driver's knee (case photo #33)

centimeters (3.7 inches) vertically. An inspection of the air bag module's cover flaps and the air bag fabric revealed that the cover flaps opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flaps. The driver's air bag was designed with two tethers, each approximately 12 centimeters (4.7 inches) in width. The driver's air bag had two vent ports, approximately 2.5 centimeters (1.0 inches) in diameter, located at the 11 and 1 o'clock positions. The deployed driver's air bag was round with a diameter 62 centimeters (24.4 inches). An inspection of the driver's air bag fabric revealed a skin transfer to the center of the air bag and two small areas with blood and oily transfer. One was located in the upper left quadrant (11 o'clock position) and the other just to the right of center toward the 3:30 o'clock position (**Figure 17**).

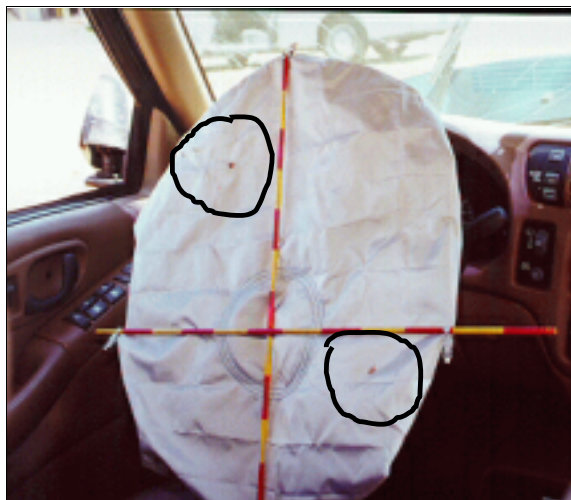


Figure 17: Case vehicle's deployed driver air bag highlighting two areas of blood (case photo #27)

The front right passenger's air bag was located in the middle of the instrument panel. There was a single, essentially rectangular, modular cover flap. The cover flap was made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were 32 centimeters (12.6 inches) at the lower horizontal seam and 13.5 centimeters (5.3 inches) along both vertical seams. The profile of the case vehicle's instrument panel was flush with the leading edge of the cover flap. An inspection of the front right air bag module's cover flap and the air bag's fabric revealed that the cover flap opened at the designated tear points, and there was no evidence of damage during the deployment to the air bag or the cover flap. The front right passenger's air bag was designed without any tethers. The front right air bag had two vent ports, approximately 5 centimeters (2.0 inches) in diameter, located at the 10 and 2 o'clock positions. The deployed front right air bag was rectangular with a height of approximately 41 centimeters (16.1 inches) and a width of approximately 57 centimeters (22.4 inches). An inspection of the front right passenger's air bag fabric revealed that there was no contact evidence readily apparent on the air bag's fabric (**Figure 18**).

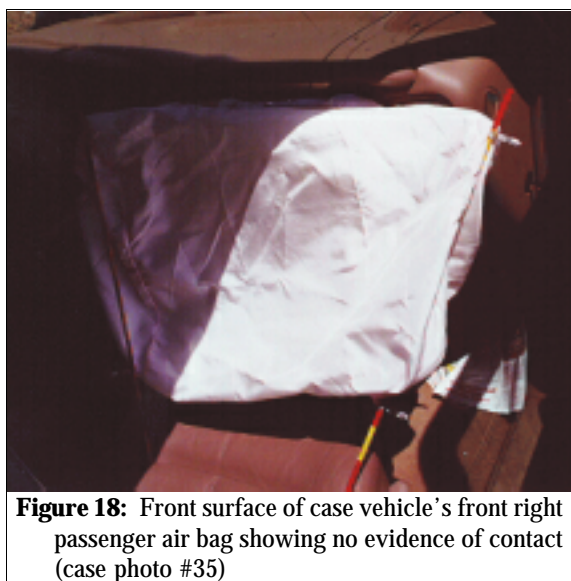


Figure 18: Front surface of case vehicle's front right passenger air bag showing no evidence of contact (case photo #35)

SENSING AND DIAGNOSTIC MODULE

As previously mentioned the case vehicle was equipped with a **Sensing Diagnostic Module (SDM)**. The data downloaded from the case vehicle's **Sensing Diagnostic Module (SDM)** showed

the case vehicle's Supplemental Inflatable Restraint (SIR) warning lamp status, driver's seat belt buckle status, and the case vehicle's ignition cycles at deployment. Downloaded data of interest indicated the following: the case vehicle's driver was unrestrained (which corroborates this investigator's conclusion following the interior inspection), the command to deploy the air bags was given only 6.25 milliseconds after the algorithm was enabled, and the Delta V was 42.73 km.p.h. (26.55 m.p.h.); see **SENSING AND DIAGNOSTIC MODULE DATA (Figures 20 and 21)** below. Although numerous witnesses and the case vehicle's driver reported high pre-crash travel speeds (i.e., beyond the speed limit), this investigator believes the recorded Delta V is reasonable, particularly given that the case vehicle essentially redirected the Mazda along the case vehicle's post-crash travel path as a result of the collision. According to the Police Crash Report, the case vehicle was traveling at a high rate of speed prior to the crash.

It should also be noted that the case vehicle's **SDM** recorded a near deployment event **after** the case vehicle's air bags deployed. The near deployment event recorded that the SIR warning lamp status was ON, the driver's seat belt was BUCKLED, and that a Delta V of 0.0 km.p.h. (0.0 m.p.h.) occurred over the entire 300 milliseconds recorded; see **SENSING AND DIAGNOSTIC MODULE DATA (Figures 22 and 23)** below. It is unclear exactly what precipitated the near deployment recording.

CASE VEHICLE DRIVER KINEMATICS

Immediately prior to the crash, the case vehicle's driver [21-year-old, White (unknown if Hispanic) male; of unknown height and 79 kilograms (175 pounds)] was presumably seated in an upright posture with his back against the seat back, his left foot on the floor, his right foot on the accelerator, his left hand on the steering wheel, and his right hand holding a cellular phone. His seat track was located in its rearmost position, the seat back was upright, and the tilt steering wheel was located in its middle position. According to the Police Crash Report, the driver's mother told an investigating officer (who interviewed her at the hospital) that a neurologist had interviewed her son early on the day of the crash and indicated to her that her son showed classic signs of schizophrenia and that her son (i.e., the driver) needed to see a psychologist. In addition, an investigating police officer learned from a doctor that a medical screening test had detected marijuana in the driver's blood system, but the level of the drug was unknown.

The case vehicle's driver was not using his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver made no known pre-crash avoidance maneuvers. As a result and independent of the nonuse of his available safety belts, his pre-impact body position did not change just prior to impact. The case vehicle's primary impact with the Mazda enabled the case vehicle's driver to continue forward and slightly leftward toward the **350** degree Direction of Principal Force as the case vehicle decelerated. As a result, the driver loaded his deploying air bag causing the air bag to expand somewhat towards the left instrument panel and deform the upper portion of the steering wheel rim. The case vehicle's driver rebounded back into his seat back as the case vehicle was redirected in a northeasterly direction. The case vehicle's left back side slap with the

Mazda’s right front corner and bumper (3rd event) sent the driver slightly forward but primarily to his left towards the interior surface of the driver’s door. The case vehicle’s impact with the pole (4th event) sent the driver further to his left where he contacted the door’s handle. As the case vehicle rotated slightly counterclockwise off the pole, the driver was forced to his right and most likely backwards into his seat back. The exact posture of the case vehicle’s driver at final rest is unknown.

CASE VEHICLE DRIVER INJURIES

The driver was transported by ambulance to the hospital. He sustained minor injuries and was most likely (disposition is not reported on the available medical record) treated and released (most likely into police custody). Based on the one available medical record (obtained from the police), the case vehicle's driver sustained an abrasion to his right “upper chest”/shoulder area.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion right shoulder, not further specified	790202.1 minor	Air bag, driver’s	Probable	Emergency room records

OTHER VEHICLE

The 1980 Mazda RX7 was a rear wheel drive, two-passenger, two-door hatchback (VIN: SA22C-----) equipped with a two rotor, inline, rotary engine and a five-speed manual transmission. Four-wheel, anti-lock brakes were not available for this vehicle and braking was achieved by a power-assisted, front disc and rear drum system. The case vehicle’s wheelbase was 242 centimeters (95.3 inches), and the odometer reading is unknown.

The Mazda’s initial contact with the case vehicle involved its right side. Direct damage began 9 centimeters (3.5 inches) forward of the right rear axle and extended, a measured distance of 190 centimeters (74.8 inches), further forward along the right side and onto the right fender (**Figure 4** above and **Figure 19**). Maximum crush for the Mazda’s most severe impact was measured as 71 centimeters (28.0 inches) at C₄. The wheelbase on the Mazda’s left side was extended approximately 20 centimeters (7.9 inches) while the right side was shortened approximately 72 centimeters (28.3 inches).



Figure 19: Overhead view of Mazda’s extensive right side damage and passenger compartment intrusion; Note: yellow tapes indicates width of direct damage (case photo #45)

Based on the vehicle inspection, the CDCs for the Mazda were determined to be: **03-RYAW-5 (80)**, **12-FDEW-2 (350)** and **03-RFEW-2 (80)**. The WinSMASH reconstruction

program, damage only algorithm, was used on the Mazda's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 70.0 km.p.h. (43.5 m.p.h.), -12.2 km.p.h. (-7.6 m.p.h.), and -68.9 km.p.h. (-42.8 m.p.h.). The Mazda was towed due to damage.

Based upon the Police Crash Report, the Mazda's driver [52-year-old, White (unknown if Hispanic) male was not using his available, active, three-point, lap-and-shoulder, safety belt system. The driver was transported by ambulance to the hospital. He sustained critical injuries and was pronounced dead later the same evening. The specific injuries sustained by the Mazda's driver are unknown but according to the Police Crash Report his injuries included at least the following: a lacerated liver with hemoperitoneum, fractures of his right 1st through 6th ribs, brain swelling and contusions, intraventricular hemorrhages, and contusions of his lungs.

The Mazda's front right passenger [83-year-old, White (unknown if Hispanic) female was not using her available, active, three-point, lap-and-shoulder, safety belt system. The front right passenger was not transported by ambulance to the hospital. She sustained fatal injuries and was pronounced dead at the scene. The specific injuries sustained by the Mazda's front right passenger are unknown but according to the Police Crash Report her injuries included at least the following: lacerations to her liver and diaphragm—in fact the liver was driven by the force of the impact up through the diaphragm into her thoracic cavity, a hinge fracture of base of her skull, a fractured pelvis and spine, and apparent severance of her right arm and right lower leg. The police report indicated that according to a doctor she died of massive blunt force trauma to her head and chest areas.

1GNDT13WXW2		System Status At Deployment	
SIR Warning Lamp Status		OFF	
Driver's Belt Switch Circuit Status		UNBUCKLED	
Passenger Front Air Bag Suppression Switch Circuit Status		Air Bag Not Suppressed	
Ignition Cycles At Deployment		6967	
Ignition Cycles At Investigation		6969	
Time From Algorithm Enable To Deployment Command (msec)		6.25	
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)	-2.19	-4.83	-7.46	-12.94	-16.89	-19.75	-21.72	-23.26	-24.13	-25.45	-26.33	-26.33	-26.11	-26.33	-26.33

Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	-26.33	-26.11	-26.33	-26.55	-26.55	-26.55	-26.55	-26.55	-26.33	-26.33	-26.55	-26.55	-26.55	-26.55	-26.55

Figure 20: Case vehicle's Supplemental Inflatable Restraint (SIR) warning lamp status and restraint system status at deployment, and the case vehicle's change in velocity (Delta V) over the first 300 milliseconds post deployment

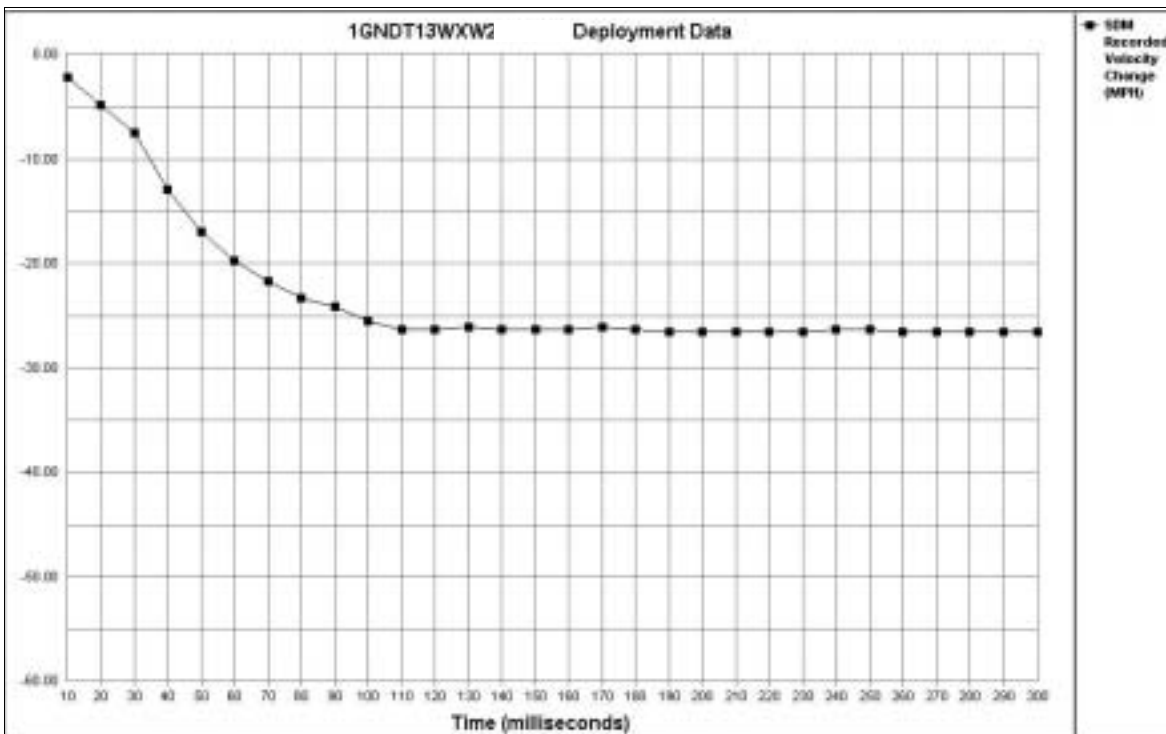


Figure 21: The case vehicle sustained a velocity change of approximately 42 km.p.h. (26 m.p.h.) during the first 110 milliseconds after the crash was detected

1GNDT13WXW2		System Status At Near Deployment													
SIR Warning Lamp Status	ON														
Driver's Belt Switch Circuit Status	BUCKLED														
Passenger Front Air Bag Suppression Switch Circuit Status	Air Bag Not Suppressed														
Ignition Cycles At Near Deployment	6967														
Ignition Cycles At Investigation	6969														
Algorithm Enable to Maximum SDM Recorded Velocity Change (insec)	0														
Maximum SDM Recorded Velocity Change (MPH)	0.00														
A Deployment was Commanded Prior to this Event	Yes														
Time (milliseconds)	10	20	30	40	50	60	70	80	90	100	110	120	130	140	150
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Time (milliseconds)	160	170	180	190	200	210	220	230	240	250	260	270	280	290	300
Recorded Velocity Change (MPH)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Figure 22: Case vehicle's Supplemental Inflatable Restraint (SIR) warning lamp status and restraint system status at near deployment, and the case vehicle's change in velocity (Delta V) over the first 300 milliseconds post near deployment activation; Note: this near deployment occurred after a command to deploy the air bags had been issued.



Figure 23: The case vehicle sustained a velocity change of approximately 0 km.p.h. (0 m.p.h.) during the entire 300 milliseconds recorded after the near deployment was detected

