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ON-SITE SIDE IMPACT INFLATABLE OCCUPANT PROTECTION INVESTIGATION

CASE NUMBER - IN-03-046
LOCATION - MINNESOTA
VEHICLE - 1998 NISSAN MAXIMA SE
CRASH DATE - October 2003

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. *Abstract*

This report covers an on-site investigation of an air bag deployment crash that involved a 1998 Nissan Maxima SE (case vehicle) and a 1993 GMC pickup-based truck (other vehicle). This crash is of special interest because the case vehicle was equipped with side impact air bags and the case vehicle's front right passenger (17-year-old, male) sustained only a minor injury in a right-angle configuration crash in which his front right passenger and right front seat back-mounted side impact air bags deployed. The trafficway on which the case vehicle was traveling was a divided, state highway, traversing in a west-northwesterly and east-southeasterly direction before approaching a four-leg intersection. On the eastern leg of the intersection, the highway had five-lanes with both the eastern and western roadways having two through lanes while the western roadway had one left-hand turn lane; in addition, there was one channelized right-hand turn lane. The trafficway on which the other vehicle was traveling was a divided, city street, traversing in a south-southwesterly and north-northeasterly directions before approaching the same four-leg intersection. On the northern leg of the intersection, the northern roadway had two through lanes while the southern roadway had one through and one left-hand turn lane; in addition, there was one channelized right-hand turn lane. The case vehicle was traveling west-northwest in the outside western through lane. The GMC had been stopped at a traffic control signal and began traveling south-southwestward in the southern through lane. The crash occurred in the four-leg intersection of the two trafficways. The right side of the case vehicle was impacted by the front of the GMC, causing the case vehicle's right front, seat back-mounted side impact air bag, driver, and front right passenger supplemental restraints (air bags) to deploy. During the vehicle's post-impact trajectory, sufficient deceleration occurred to deploy the left front, seat back-mounted side impact air bag. The case vehicle's front right passenger was seated with his seat track located in its rearmost position, and he was not using his available, active, three-point, lap-and-shoulder, safety belt system. He sustained, according to the interview with the mother of the case vehicle's driver, a minor contusion to his right arm. The driver (16-year-old, male) was seated with his seat track located between its middle and rearmost positions, and the tilt steering wheel was located in its down-most position. He was restrained by his available, active, three-point, lap-and-shoulder, safety belt system and, according to the driver's mother, he did not sustain any injuries as a result of this crash.

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This on-site investigation was brought to NHTSA's attention on or before November 4, 2003 by an emergency medical technician who was assisting on-scene at the crash in question. This crash involved a 1998 Nissan Maxima SE (case vehicle) and a 1993 GMC pickup-based truck (other vehicle). The crash occurred in October 2003, at 4:40 p.m., in Minnesota and was investigated by the applicable city police department. This crash is of special interest because the case vehicle was equipped with side impact air bags and the case vehicle's front right passenger [17-year-old, Black (non-Hispanic) male] sustained only a minor injury in a right-angle configuration crash in which his front right passenger and right front seat back-mounted side impact air bags deployed. This contractor inspected the scene and vehicles and interviewed the mother of the driver for the case vehicle on November 13, 2003. This summary is based on the Police Crash Report, an interview with the mother of the case vehicle's driver, scene and vehicle inspections, occupant kinematic principles, interviewee-reported medical information, and this contractor's evaluation of the evidence.

SUMMARY

Crash Environment:

The trafficway on which the case vehicle was traveling was a divided, state highway, traversing in a west-northwesterly and east-southeasterly direction before approaching a four-leg intersection. On the eastern leg of the intersection, the highway had five-lanes with both the eastern and western roadways having two through lanes while the western roadway had one left-hand turn lane; in addition, there was one channelized right-hand turn lane. The trafficway on which the other vehicle was traveling was a divided, city street, traversing in a south-southwesterly and north-northeasterly directions before approaching the same four-leg intersection. On the northern leg of the intersection, the northern roadway had two through lanes while the southern roadway had one through and one left-hand turn lane; in addition, there was one channelized right-hand turn lane. At the time of the crash the light condition was daylight, the atmospheric condition was cloudy, and the road pavement was dry; see **CRASH DIAGRAM** at end.

Pre-Crash:

The case vehicle was traveling west-northwest in the outside western through lane. The GMC had been stopped at a traffic control signal and began traveling south-southwestward in the southern through lane. The crash occurred in the four-leg intersection of the two trafficways.

Crash:

The right side of the case vehicle was impacted by the front of the GMC, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Furthermore, the right front, seat back-mounted side impact air bag also deployed.

Post-Crash:

As a result of the impact, the case vehicle was redirected westward–while most likely rotating clockwise, crossed the inside through lane of the western roadway, and departed the roadway onto the southern (left-hand) shoulder prior to entering the median that separated the two roadways. The case vehicle's left rear tire most likely dug into the negatively sloped earthen

median causing the left rear tire's bead to separate from its rim, deflating the tire. As a result, sufficient lateral deceleration occurred to deploy the driver's side (left front), seat back-mounted side impact air bag. The case vehicle most likely continued to rotate clockwise in the median and came to rest heading east-southeast in the median separating the eastern and western roadways.

Case Vehicle:

The 1998 Nissan Maxima SE was a front wheel drive, four-door sedan (VIN: JN1CA21A7WM------) and was equipped with **ADVANCED OCCUPANT PROTECTION SYSTEM** features. The case vehicle was equipped with redesigned front air bags and front seat back-mounted side impact air bags, all of which deployed as a result of the crash.

Vehicle Exterior:

Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **01-RZAW-2** (**20** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 13.7 km.p.h. (8.5 m.p.h.), -12.9 km.p.h. (-8.0 m.p.h.), and -4.7 km.p.h. (-2.9 m.p.h.). Based on the vehicle inspection, this collision reconstruction should be considered borderline, and the results appear to be low. The case vehicle was towed due to damage.

Other Vehicle:

The 1993 GMC C1500 Sierra was a rear wheel drive (4x2), two-door, incomplete pickup-based vehicle (VIN: 1GDDC14K0PZ------). This vehicle could not be located for inspection and, therefore, the CDC for the its impact with the case vehicle cannot be determined. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the GMC's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.4 km.p.h. (7.7 m.p.h.), -3.2 km.p.h. (-2.0 m.p.h.), and +12.0 km.p.h. (+7.5 m.p.h.). The GMC was towed due to damage.

Case Vehicle's Front Right Passenger:

The case vehicle's front right passenger (17-year-old, male) was most likely seated with his seat track located in its rearmost position, and he was not using his available, active, three-point, lap-and-shoulder, safety belt system. According to the driver's mother, he sustained only a minor contusion to his right arm, but the exact location of the lesion was unknown.

Case Vehicle's Driver:

The driver of the case vehicle's driver (16-year-old, male) was most likely seated with his seat track located between its middle and rearmost positions, and the tilt steering wheel was located in its down-most position. He was restrained by his available, active, three-point, lap-and-shoulder, safety belt system and, according to the driver's mother, he did not sustain any injuries as a result of this crash.

CRASH CIRCUMSTANCES

Crash Environment: The trafficway on which the case vehicle was traveling was a divided, state highway, traversing in a west-northwesterly and east-southeasterly direction before approaching

a four-leg intersection (**Figure 1** and **Figure 2**). On the eastern leg of the intersection, the highway had five-lanes with both the eastern and western roadways having two through lanes (**Figure 1** above) while the western roadway had one left-hand turn lane (**Figures 2** and **3**); in addition, there was one channelized right-hand turn lane (**Figures 2** and **3**). The trafficway on which the other vehicle was traveling was a divided, city street, traversing in a south-southwesterly and north-northeasterly directions before approaching the same four-leg intersection (**Figure 4** below). On the northern leg of the intersection, the northern roadway had two through lanes while the southern roadway had one through and one left-hand turn lane; in addition, there was one channelized right-hand turn lane (**Figure 5** below).

The case vehicle's state highway was curved slightly to the left for west-northwestbound traffic (**Figure 2**) and had a 2.5% grade negative to the west-northwest (i.e., a downgrade in the case vehicle's direction of travel), near the area of impact. The pavement was bituminous, but traffic polished, and the width of the outside western lane, on the eastern leg of the four-leg intersection, was 3.8 meters (12.5 feet). Near the mouth of the intersection, the shoulders were not improved (i.e., dirt, grass–**Figure 3**). The left-hand (i.e., southern) shoulder was associated with a unprotected grassy median. The grassy median was approximately 9.2 meters (30.2 feet) wide and separated the eastern and western roadways. The median was quite deep near its middle (**Figure 1**). The roadway was not bordered by curbs. Pavement markings for the roadway consisted of a solid yellow edge line on the left-hand (southern) side and a solid white edge line on right-hand (northern) side. In addition, the through lanes were divided by a dashed white line and the left-hand and right-hand turn lanes were separated from the through lanes by solid white lane lines. Each turn lane had the appropriate turn arrows painted on the pavement. The estimated coefficient of friction was 0.65. Traffic controls

Figure 1: Case vehicle's west-northwesterly travel path in inside through lane approaching four-leg intersection prior to emergence of turn lanes (case photo #02)

Figure 2: Case vehicle's west-northwesterly travel path in inside through lane approaching four-leg intersection viewed from right-hand turn lane (case photo #04)

Figure 3: Case vehicle's west-northwesterly travel path in inside through lane into four-leg intersection (case photo #05)

consisted of four on-colors, pre-timed, vertical mounted traffic control signals that were located on the northwestern quadrant of the four-leg intersection. In addition, a **KEEP RIGHT** sign (Manual on Uniform Traffic Control Devices, R4-7) was mounted on the western leg of the intersection in the median (**Figure 3** above). The statutory speed limit was 80 km.p.h. (50 m.p.h.). No regulatory speed limit sign was posted near the crash site.

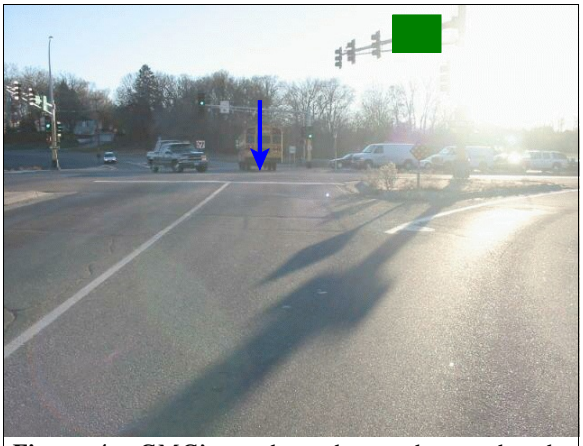


Figure 4: GMC's south-southwesterly travel path toward impact area (arrow) in intersection (case photo #10)

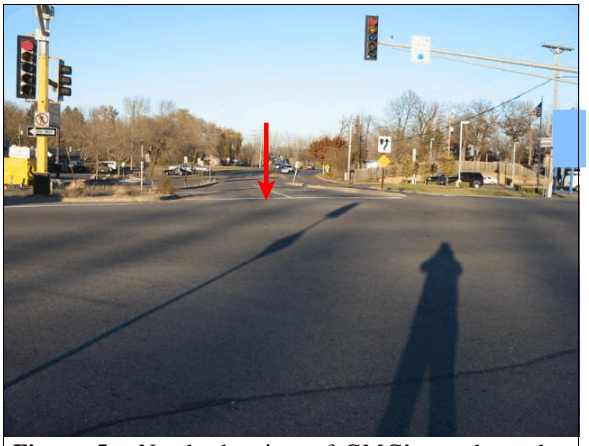


Figure 5: Northerly view of GMC's south-south-western travel path; arrow indicates approximate point of impact (case photo #15)

The other vehicle's city roadway was straight (**Figure 4**) at the mouth of the intersection (i.e., the southern roadway had just exited a left-hand curve prior to intersection– **Figure 5**). The trafficway had a 2.5% grade positive to the south-southeast (i.e., an upgrade in the GMC's direction of travel), near the area of impact. The pavement was bituminous but traveled, and the width of the southern through lane was 4.4 meters (14.4 feet). At the mouth of the intersection, the southern roadway was bordered by mountable curbs with the curb on the eastern side associated with a 1.7 meter (5.6 foot) raised paved median and the curb on the western side associated with a raised concrete traffic island (**Figure 4**). Pavement markings consisted of a single solid white lane line that separated the through lane from the left-hand turn lane. No centerline (on the left) or edge line (on the right) was used near the mouth of the intersection and no lane line separated the right-hand channelized lane from the through lane. The estimated coefficient of friction was 0.70. Traffic controls consisted of two on-colors, pre-timed, vertical mounted traffic control signals that were located on the southwestern quadrant of the four-leg intersection. Furthermore, there was a **LEFT TURN YIELD ON GREEN** sign (Manual on Uniform Traffic Control Devices, R10-12) which was mounted on the same traffic signal support arm. In addition, a **KEEP RIGHT** sign (MUTCD, R4-7) was mounted on the southern leg of the intersection in the median (**Figure 5**). The speed limit was undetermined. 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 cloudy, and the road pavement was dry. Traffic density is unknown, and the site of the crash was primarily urban commercial; see **CRASH DIAGRAM** at end.

Pre-Crash: The case vehicle was traveling west-northwest in the outside western through lane and intended to continue in its westerly travel path (**Figure 3** above). The GMC had been stopped at a traffic control signal and began traveling south-southwestward in the southern through lane, intending to continue in its southerly travel path (**Figure 4** above). The case vehicle's driver steered to the left, attempting to avoid the crash. The crash occurred in the four-leg intersection of the two trafficways (**Figures 4** and **5** above and **Figures 6** and **7**).

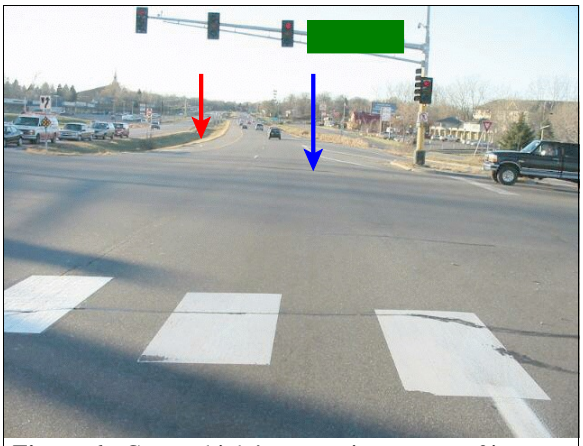


Figure 6: Case vehicle's approximate area of impact (blue arrow) within intersection and approximate final rest position (red arrow) in median (case photo #06)

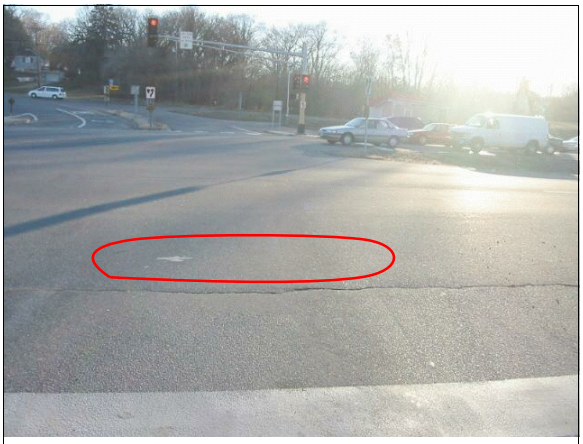


Figure 7: Approximate area of impact between GMC's front and right side of case vehicle (case photo #11)

Figure 8: Case vehicle's right side damage viewed from right of front; Note: damage rearward of right "A"-pillar (case photo #27)

Crash: The right side (**Figure 8**) of the case vehicle was impacted by the front of the GMC, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. Furthermore, the right front, seat back-mounted side impact air bag also deployed.

Post-Crash: As a result of the impact, the case vehicle was redirected westward–while most likely rotating clockwise, crossed the inside through lane of the western roadway, and departed the roadway onto the southern (left-hand) shoulder prior to entering the median that separated the two roadways. Based on the available evidence, the case vehicle's left rear tire most likely dug into the negatively sloped earthen median causing the left rear tire's bead to separate from its rim, deflating the tire (**Figure 9** and **Figure 10** below). As a result, sufficient lateral deceleration occurred to

Figure 9: Left side view of case vehicle's undamaged left side except for bead separation to and deflation of left rear wheel (case photo #19)

deploy the driver's side (left front), seat back-mounted side impact air bag. The case vehicle most likely continued to rotate clockwise in the median and, according to the Police Crash Report, came to rest heading east-southeast in the median separating the eastern and western roadways (**Figure 6** above).

Figure 10: Left rear view of case vehicle's undamaged left side except for bead separation to and deflation of left rear wheel (case photo #20)

CASE VEHICLE

The 1998 Nissan Maxima SE was a front wheel drive, five-passenger, four-door sedan (VIN: JN1CA21A7WM------) equipped with a 3.0L, V-6 engine and a four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum system. The case vehicle's wheelbase was 270 centimeters (106.3 inches), and the odometer reading at inspection is unknown because the case vehicle was equipped with an electronic odometer. The case vehicle was equipped with **ADVANCED OCCUPANT PROTECTION SYSTEM** features including redesigned air bags and front seat back-mounted side impact air bags.

Inspection of the vehicle's interior revealed adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat with integral 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 equipped with manually operated, upper anchorage adjusters for the "D"-rings. Both the driver and front right passenger had their upper anchorage adjusters located in the down-most positions. The vehicle was equipped with knee bolsters for both the driver and front right passenger, neither of which showed evidence of occupant contact or deformation. Automatic restraint was provided by a Supplemental Restraint System (SRS) that consisted of a redesigned frontal air bag for the driver and front right passenger seating positions. In addition, the vehicle was equipped with front, seat back-mounted, side impact air bags. Both frontal air bags deployed as a result of the case vehicle's right side impact with the GMC pickup-based vehicle. The front right passenger's seat back-mounted side air bag also deployed as a result of the case vehicle's right side impact with the GMC. On the other hand, the driver's seat back-mounted side air bag deployed as a result of the deceleration that resulted during the case vehicle's clockwise rotation when left rear tire deflated as the tire dug into the soft earthen median causing a bead separation.

CASE VEHICLE DAMAGE

Exterior Damage: The case vehicle's contact with the GMC truck involved its right side, from the forward edge of the right front door rearward (**Figures 11** and **12** below). Direct damage began 50 centimeters (19.7 inches) rearward of the right front axle and extended 231 centimeters (90.9 inches) rearward, along the right side. The Field L was measured from the same starting point, but extended 265 centimeters (104.3 inches) rearward along the right side. Maximum crush

was measured as 21 centimeters (8.3 inches) at C_4 (**Figure 13** and **14**). The table below shows the case vehicle's crush profile.

Figure 11: Case vehicle's right side damage with contour gauge positioned above sill showing crush at 2nd through 6th positions (case photo #25)

Figure 12: Case vehicle's right side damage with contour gauge positioned above sill showing crush at 1st through 4th positions (case photo #24)

Units	Event	Direct Damage		Field L	C_1	C_2	C_3	C_4	C_5	C_6	Direct	Field L
		Width CDC	Max Crush								±D	±D
cm	1	231	21	265	0	10	19	21	15	0	-28	-45
in		90.9	8.3	104.3	0.0	3.9	7.5	8.3	5.9	0.0	-11.0	-17.7

Figure 13: Overhead view of case vehicle's right side damage showing crush positions 2 through 6 (case photo #29)

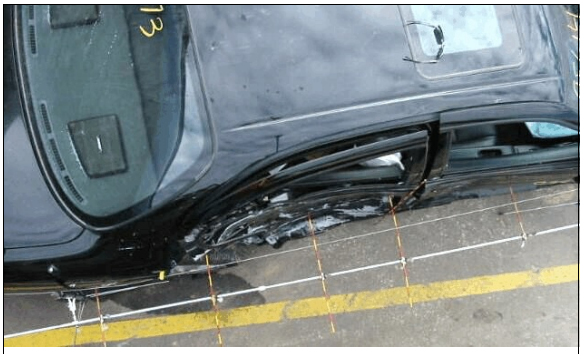


Figure 14: Overhead view of case vehicle's right side damage showing crush positions 1 through 5 (case photo #30)

The wheelbase on the case vehicle's right side was extended 5 centimeters (2.0 inches) while the left side was unaltered from the crash. The case vehicle's right doors and right "B"-pillar were directly damaged and crushed inward. The top portion of the right rear door and its window frame were displaced outward. The right front and both of the right rear glazings were disintegrated from the impact. In addition, the windshield's glazing sustained stress cracks as a result of the right side impact. No obvious induced damage or remote buckling was noted to the remainder of the case vehicle's exterior.

The case vehicle manufacturer's recommended tire size for this sub-model was: P205/55R16, and the case vehicle tires were the recommended size. The case vehicle's tire data are shown in the table below. In addition, both of the case vehicle's rear tires were deflated. Furthermore, the right rear tire was also restricted and sustained a sidewall puncture/cut.

Tire	*Measured Pressure*		*Recommend Pressure*		*Tread Depth*		*Damage*	*Restricted*	*Deflated*
	kpa	psi	kpa	psi	milli-meters	32nd of an inch			
LF	172	25	200	29	7	9	None	No	No
RF	48	7	200	29	8	10	None	No	No
LR	0	0	200	29	6	8	Rim separation	No	Yes
RR	0	0	200	29	6	8	Sidewall puncture/cut	Yes	Yes

Figure 15: Case vehicle's driver seating area showing deployed driver air bag, stress cracks to windshield's glazing, and no obvious occupant contact evidence (case photo #34)

Figure 16: Case vehicle's front right passenger seating area showing deployed front right passenger air bag, stress cracks to windshield's glazing, and no apparent evidence of occupant contact to interior surface of right front door, right instrument panel, or greenhouse areas (case photo #36)

Interior Damage: Inspection of the case vehicle's interior revealed no apparent evidence of occupant contact on either the front interior surfaces (**Figures 15** and **16**) or the right side interior surface of the case vehicle (**Figures 17** and **18** below). However, it is almost certain that, based on intrusions, the front right passenger was contacted by the inside of the right front door and arm rest, causing the interviewee-reported contusion to his right arm. Intrusions were noted to the interior surface of the right front door, the right "B"pillar, the right rear door, and the right rear sill area. The largest intrusion occurred to the right rear door's surface [i.e., 16 centimeters (6.3 inches)]. Finally, there was no evidence of compression of the energy absorbing shear capsules in the base of the steering column and no deformation to the steering wheel rim.

Figure 17: Interior surface of case vehicle's right front door showing no obvious occupant contact evidence on intruding surface (case photo #31)

Figure 18: Interior surface of case vehicle's right rear door showing 16 cm (6.3 in) of intrusion to back right seating area (case photo #64)

Damage Classification: Based on the vehicle inspection, the CDC for the case vehicle was determined to be: **01-RZAW-2** (**20** degrees). The WinSMASH reconstruction program, missing vehicle algorithm, was used on the case vehicle's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 13.7 km.p.h. (8.5 m.p.h.), -12.9 km.p.h. (-8.0 m.p.h.), and -4.7 km.p.h. (-2.9 m.p.h.). Based on the vehicle inspection, this collision reconstruction should be considered borderline, and the results appear to be low. The case vehicle was towed due to damage.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with a Supplemental Restraint System (SRS) that contained redesigned frontal air bags at the driver and front right passenger positions. In addition, the vehicle was equipped with front, seat back-mounted, side impact air bags. Both frontal air bags deployed as a result of the right side impact with the GMC pickup-based vehicle. The front right passenger's seat back-mounted side air bag also deployed as a result of the case vehicle's right side impact with the GMC. On the other hand, the driver's seat back-mounted side air bag deployed as a result of the deceleration that resulted during the case vehicle's clockwise rotation when left rear tire deflated as the tire dug into the soft earthen median causing a bead separation.

The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of asymmetrical, essentially "H"-configuration cover flaps made of thick vinyl with overall dimensions of 15 centimeters (5.9 inches) at the top horizontal seam, 14.5 centimeters (5.7 inches) at the bottom horizontal seam, 8 centimeters (3.1 inches) vertically for the upper flap, and 7 centimeters (2.8 inches) vertically for the lower flap. An inspection of the air bag module's cover flaps and the air bag's 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 four tethers, each approximately 7 centimeters (2.8 inches) in width. The driver's air bag had two vent ports, approximately 5 centimeters (2.0 inches) in diameter, located toward the center of the back surface at the 2:30 and 9:30 clock positions. The deployed driver's air bag was round with a diameter of 67 centimeters (26.4

inches). An inspection of the driver's air bag fabric revealed no contact evidence readily apparent on the air bag's fabric other than routine deployment dirt/grease scuffs (**Figure 19**).

Figure 19: Case vehicle's deployed driver air bag showing no apparent evidence of occupant contact (case photo #40)

The front right passenger's air bag was located in the top of the instrument panel. There were two asymmetrical, "H"-configuration, modular cover flaps made of a thick semi-pliable vinyl. The top cover flap was shaped like a parallelogram and the bottom flap was trapezoidal. The top flap had an overall width 24.5 centimeters (9.6 inches) from side to side and was 3 centimeters (1.2 inches) along both vertical seams. The bottom cover flap measured 24.5 centimeters (9.6 inches) at the bottom horizontal seam, 7.5 centimeters (3.0 inches) vertically along its left side, and 6.5 centimeters (2.6 inches) vertically along its right side. The profile of the case vehicle's instrument panel resulted in a 11 centimeter (4.3 inch) setback of the leading edge of the cover flap relative to the protruding right instrument panel. An inspection of the front right air bag module's cover flaps and the air bag's 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 front right passenger's air bag was designed without any tethers. The front right air bag had two vent ports, approximately 3 centimeters (1.2 inches) in diameter, located at the 2:30 and 9:30 clock positions. The deployed front right air bag was rectangular with a height of approximately 52 centimeters (20.5 inches) and a width of approximately 38 centimeters (15.0 inches). An inspection of the front right passenger's air bag fabric revealed an obvious contact on the front right air bag's fabric (i.e., a smudge/scuff) near the top center portion, most likely from contact by the front right passenger (**Figures 20** and **21**).

Figure 20: Front surface of case vehicle's deployed front right passenger air bag showing only a small area (i.e.,scuff) of occupant contact near the 12 o'clock position (case photo #44)

Figure 21: Close-up of scuff (highlighted) on case vehicle's deployed front right passenger air bag (case photo #45)

The case vehicle's driver and right front side impact inflatable occupant protection systems (air bags) were located near the top of the driver's and front right passenger's seat backs, respectively.

The bags were attached on the posterior surface of the seat back, curling around the side of the seat back. An inspection of the driver and right front side 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. Both the driver's and right front passenger's side impact air bags were designed without any tethers. Both of the side air bags had one vent port, approximately 4 centimeters (1.6 inches) in diameter, located on the outboard surface at the 5 and 7 o'clock positions, respectively (i.e., 5 o'clock for the right front side air bag when viewed from the right side of the vehicle and 7 o'clock for the driver's side air bag when viewed from the left side of the vehicle). The deployed side impact air bags were essentially rectangular with a height of approximately 29 centimeters (11.4 inches) and a width (i.e., forward excursion) of approximately 40 centimeters (15.7 inches). An inspection of the driver's air bag fabric revealed no contact evidence readily apparent on either the outboard or inboard surfaces of the driver side air bag's fabric. An inspection of the right front passenger's air bag fabric revealed only a possible contact area (e.g., scuff) on the outboard surface of the right front side air bag's fabric (i.e., most likely from the intrusion of the interior surface of the right front door). There was no evidence of occupant contact on the inboard surface.

The case vehicle's driver and right front side impact inflatable occupant protection systems (air bags) were located near the top of the driver's and front right passenger's seat backs, respectively. The bags were attached on the posterior surface of the seat back, curling around the edge of the seat back (**Figure 22** and **Figure 23**). An inspection of the driver and right front 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 (**Figure 23**). Both the driver's and right front passenger's air bags were designed without any tethers. Both of the air bags had one vent port, approximately 4 centimeters (1.6 inches) in diameter, located on the outboard surface at the 5 and 7 o'clock positions, respectively (i.e., 5 o'clock for the right front air bag when viewed from the right side of the vehicle and 7 o'clock for the driver's air bag when viewed from the left side of the vehicle). The deployed side impact air bags were essentially rectangular with a height of approximately 29 centimeters (11.4 inches) and a width (i.e., forward excursion) of approximately 40 centimeters (15.7 inches). An inspection of the driver's air bag fabric revealed no contact evidence readily apparent on either the outboard

Figure 22: Overhead view of case vehicle's deployed right front side impact air bag; Note: arrow shows bag's cover flap (case photo #50)

Figure 23: Case vehicle's front right seat back showing cover flap for right front side impact air bag (case photo #54)

(**Figure 24**) or inboard (**Figure 25**) surfaces of the driver side air bag's fabric. An inspection of the right front passenger's air bag fabric revealed only a possible contact area (e.g., scuff) on the outboard (**Figure 26**) surface of the right front side air bag's fabric (i.e., most likely from the intrusion of the interior surface of the right front door). There was no evidence of occupant contact on the inboard surface (**Figure 27**).

Figure 24: Outboard side of case vehicle's deployed driver side impact air bag (case photo #55)

Figure 25: Inboard side of case vehicle's deployed driver side impact air bag (case photo #56)

Figure 26: Outboard side of case vehicle's deployed right front side impact air bag (case photo #51)

Figure 27: Inboard side of case vehicle's deployed right front side impact air bag (case photo #52)

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The exact posture of the case vehicle's front right passenger [17-year-old, Black (non-Hispanic) male; 173 centimeters and 95 kilograms (68 inches, 210 pounds)] immediately prior to the crash is unknown. Based on the vehicle inspection he was most likely seated in a reclined posture but the exact position of his back is unknown. His feet were on the floor, but the exact position of his hands is unknown. His seat track was located in its rearmost position, and the seat back was significantly reclined (**Figure 18** above).

The case vehicle's front right passenger was not using his available, active, three-point, lap-and-shoulder, safety belt system. Furthermore, there was no mention by the interviewee of belt

pattern bruising and/or abrasions to the front right passenger's body, and the inspection of the front right passenger's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

Based on the Police Crash Report, the case vehicle's driver steered slightly to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of his available safety belts, the front right passenger most likely moved slightly to his right just prior to impact. The case vehicle's impact with the GMC enabled the case vehicle's front right passenger to continue forward and rightward along a path opposite the case vehicle's **20** degree Direction of Principal Force as the case vehicle decelerated. As a result, the front right passenger most likely loaded the interior intruding surface of his right front door and contacted both his deploying right seat back-mounted side impact air bag and his front right passenger air bag. As the case vehicle was redirected leftward after reaching maximum engagement with the GMC truck, the front right passenger most likely rebounded backward and to his left toward the center console and/or the driver's position. His exact posture at final rest was unknown to the interviewee, but he was a able to exit the case vehicle without assistance.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The front right occupant was treated at the crash scene by medical personnel but was not transported by ambulance to the hospital. According to the driver's mother, he sustained only a minor contusion to his right arm, but the exact location of the lesion was unknown.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion {bruise} right arm, unknown location	minor 790402.1,1	Right side interior surface, excluding hardware and/or armrest	Certain	Interviewee (friend)

CASE VEHICLE DRIVER KINEMATICS

The exact posture of the case vehicle's driver [16-year-old, White (non-Hispanic) male; 175 centimeters and 63 kilograms (69 inches, 138 pounds)] just prior to the crash is unknown but, based on the vehicle inspection, he was most likely seated with his back against the seat back, his left foot on the floor, his right foot on or near the accelerator, and at least one of his hands on the steering wheel. His seat track was located between its middle and rearmost positions, the seat

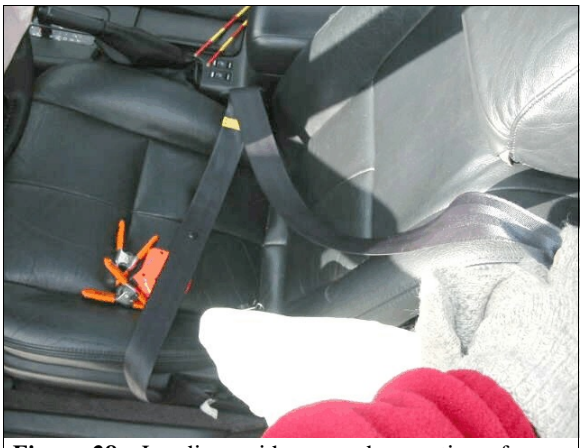


Figure 28: Loading evidence on lap portion of case vehicle's driver safety belt (case photo #59)

back was slightly reclined, and the tilt steering wheel was located in its down-most position.

The case vehicle's driver was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. There was no mention by the interviewee (i.e., driver's mother) of belt pattern bruising and/or abrasions to the driver's body, but the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed evidence of loading (i.e., stress mark from the driver's latch plate–**Figure 28** above and **Figure 29**).

Figure 29: Lap belt portion of case vehicle's driver safety belt showing loading mark from latch plate (case photo #60)

Based on the Police Crash Report, the case vehicle's driver steered slightly to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the use of his available safety belts, the driver most likely moved slightly to his right just prior to impact. The case vehicle's impact with the GMC enabled the case vehicle's driver to continue forward and rightward along a path opposite the case vehicle's **20** degree Direction of Principal Force as the case vehicle decelerated. As a result, the driver most likely loaded his safety belts and contacted both his deploying driver air bag. As the case vehicle was redirected leftward after reaching maximum engagement with the GMC truck, the driver most likely rebounded backward and to his left toward the left side of his seat back and the interior surface of the driver's door. When the case vehicle's left rear wheel assembly loaded into the earthen median, the vehicle's right seat back-mounted side impact air bag deployed. The driver most likely loaded this deploying air bag but the loading was probably minimal because the driver was positioned near the left side of his seat back at this time. His exact posture at final rest was unknown to the interviewee (i.e., mother), and he was a able to exit the case vehicle without assistance.

CASE VEHICLE DRIVER INJURIES

The driver was treated at the crash scene by medical personnel but was not transported by ambulance to the hospital. According to the driver's mother, he did not sustain any injuries as a result of this crash.

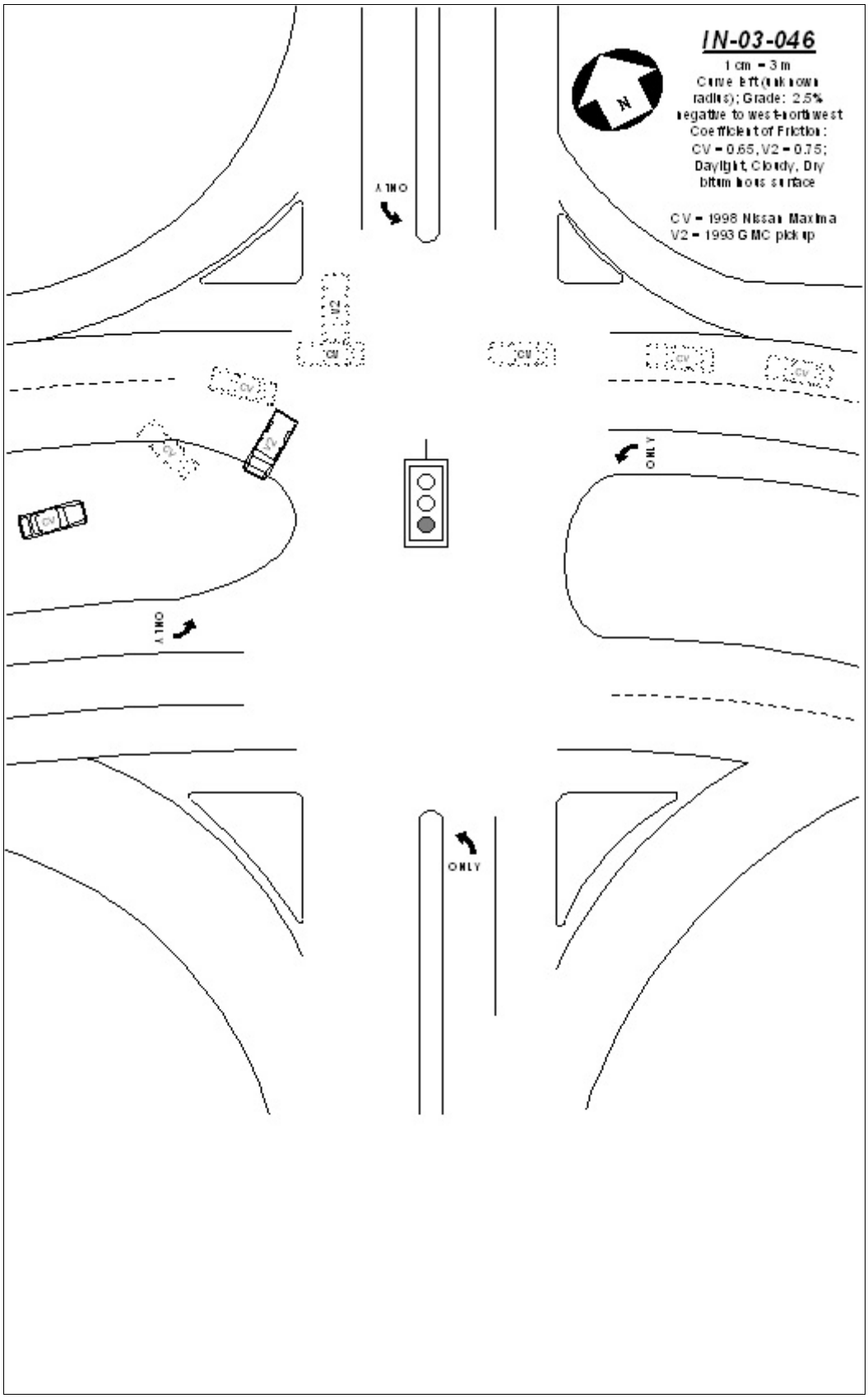
OTHER VEHICLE

Based on the VIN and manufacturer's specifications, the 1993 GMC C1500 Sierra was a rear wheel drive (4x2), two or three passenger, two-door, conventional cab, incomplete pickup-based vehicle (VIN: 1GDDC14K0PZ------) equipped with a 5.7L, V-8 engine and either the standard five-speed manual or the optional four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum, two-wheel, anti-lock system. The GMC's wheelbase was 298 centimeters (117.5 inches), and the odometer reading is unknown because the GMC's interior was not inspected. Furthermore, the vehicle was equipped with an air bag for the driver's

seat position only and manual, three-point, lap-and-shoulder, safety belt systems for the front outboard seating positions. A manual, two-point, lap belt was available for the front center seating position, assuming the vehicle was configured with a front bench seat. The interior was equipped with either bucket seats for the driver and front right passenger, or a three-passenger bench seat.

Damage Classification: This vehicle could not be located for inspection and, therefore, the CDC for the its impact with the case vehicle cannot be determined. The WinSMASH reconstruction program, missing vehicle algorithm, was used on the GMC's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 12.4 km.p.h. (7.7 m.p.h.), -3.2 km.p.h. (-2.0 m.p.h.), and +12.0 km.p.h. (+7.5 m.p.h.). For crash reconstruction purposes, the GMC was assumed to be a C1500 (one-half ton), 4x2, regular cab, standard bed pickup with the standard 4.3L, V-6 engine. Because the actual pickup-based vehicle was heavier, its weight is greater than that used for reconstruction purposes (i.e., larger engine and unknown type of attachment–most likely heavier than a standard pickup bed). As a result, the Delta Vs sustained by case vehicle will increase slightly while those of the pickup will decrease slightly. The GMC was towed due to damage.

GMC's Occupants: According to the Police Crash Report, the GMC's driver [54-year-old, (unknown race and/or ethnic origin) male] was restrained by his available, active, three-point, lap-and-shoulder, safety belt system. The driver was not transported by ambulance to the hospital, and he did not sustain any injuries as a result of this crash.


IN-03-046
1 cm = 3 m
Curve left (unknown radius); Grade: 2.5% negative to west-northwest
Coefficient of Friction:
CV = 0.65, V2 = 0.75;
Daylight, Cloudy, Dry bituminous surface
CV = 1998 Nissan Maxima
V2 = 1993 GMC pickup
N
ONLY
ONLY
ONLY
ONLY
CV
V2