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ON-SITE AIR BAG INVESTIGATION

CASE NUMBER - IN97-024
LOCATION - ALABAMA
VEHICLE - 1995 FORD CONTOUR GL
CRASH DATE - August 1997

Submitted:

October 19, 2000



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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.

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16. Abstract This report covers an on-site investigation of an air bag deployment crash that involved a 1995 Ford Contour GL (case vehicle), a 1987 Chevrolet S-10 pickup truck, and a 1989 Jeep Cherokee Limited sport utility vehicle. This crash is of special interest because the case vehicle's unrestrained, out-of-position front right passenger (21-month-old female), who was being held on the lap of the front right passenger (20-year-old female), sustained a critical head injury from the deploying front right air bag, resulting in her death. The case vehicle was following the Jeep Cherokee and both vehicles were traveling east in the eastbound lane up (i.e., a 3.2% grade, positive to the east) a two-lane, undivided, state highway. The Chevrolet S-10 was traveling west in the westbound lane down the same two-lane roadway. The Chevrolet S-10 entered the eastbound lane. The front left of the Chevrolet S-10 sideswiped the left side of the Jeep Cherokee. The Chevrolet S-10 continued in an west-southwesterly direction and the front right half of the case vehicle was impacted by the front right half of the Chevrolet S-10, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle's "on-lap" front right passenger was seated in the lap of her aunt. She was neither using an available child safety seat nor restrained by an available, active, three-point, lap-and-shoulder, safety belt system and sustained, according to her medical records, a critical nonanatomic brain injury and multiple soft tissue injuries to her face, neck, right shoulder and upper arm, left axillary area, and bilateral thighs. The case vehicle's driver (22-year-old female) was seated with her seat track positioned between its middle and forward-most positions, and the vehicle was not equipped with a tilt steering wheel. The front right passenger was seated with her seat track located between its middle and rearmost positions. The back left passenger (daughter; 8-year-old female) and the back right passenger (son; 3-year-old male) were both sitting but their seat track was not adjustable. None of the other four occupants were restrained by their available, active, three-point, lap-and-shoulder, safety belt systems. According to their medical records, the case vehicle's driver sustained minor abrasions and contusions to her face, arms, and knees. The adult front right passenger sustained multiple fractures including: her right tibial plafond, right medial malleolus, right distal fibula, and left finger. In addition she sustained a sprain and contusion to her left ankle and unspecified abrasions and multiple contusions to her upper and lower extremities. The back left passenger sustained minor contusions and abrasions. The back right passenger sustained minor abrasions and contusions to his right forehead, cheek, and chin.					
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This on-site investigation was brought to NHTSA's attention on August 8, 1997, by an Alabama state law enforcement officer. This crash involved a 1995 Ford Contour GL (case vehicle), a 1987 Chevrolet S-10 pickup truck (1st other vehicle), and a 1989 Jeep Cherokee Limited (2nd other vehicle). The crash occurred in August 1997, at 3:50 p.m., in Alabama and was investigated by the applicable state police district. This crash is of special interest because the case vehicle's unrestrained, "out-of-position" front right passenger [21-month-old, White (non-Hispanic) female], who was being held on the lap of the front right passenger [20 year-old, White (non-Hispanic) female], sustained a critical head injury from the deploying front right air bag, resulting in her death. This contractor inspected the scene and vehicles on 18-19 August, 1997. **Based on this contractor's initial determination (through WinSMASH) that the estimated total velocity change sustained by the case vehicle was 58.9 km.p.h. (36.6 m.p.h.), a speed loss judged to be a conservative estimate for this crash, the decision was made to drop this case on 21 October, 1997. Subsequently, in response to another NHTSA directive, this investigation was reopened and the investigation completed.** This report is based on the Police Crash Report, interviews with the case vehicle's driver and the investigating police officer, scene and vehicle inspections, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

SUMMARY

The case vehicle was following the Jeep Cherokee and both vehicles were traveling east in the eastbound lane up (i.e., a 3.2% grade, positive to the east) a two-lane, undivided, state highway and intended to continue in their eastward direction of travel. The Chevrolet S-10 was traveling west in the westbound lane down (i.e., a 3.2% grade, negative to the west) the same, two-lane roadway and intended to continue its westward travel direction. The Chevrolet S-10 entered the eastbound lane. The investigating police officer indicated that the driver of the Jeep Cherokee steered towards the right edge line, attempting to avoid the crash. The officer indicated further that he observed no scene evidence indicating that the drivers of the case vehicle or the Chevrolet S-10 attempted any avoidance maneuvers; however, the case vehicle's driver indicated that she steered to the left, attempting to avoid the impending crash. Both impacts occurred in the eastbound lane of the roadway (see **CRASH DIAGRAM** below).

The front left of the Chevrolet S-10 sideswiped the left side of the Jeep Cherokee. The Chevrolet S-10 continued in a west-southwesterly direction and the front right half of the case vehicle was impacted by the front right half of the Chevrolet S-10, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle rotated approximately 100 degrees clockwise, while continuing a short distance [1.8 meters (6 feet)] eastward, and came to rest crosswise in the middle of the roadway, heading south. The Chevrolet S-10 rotated clockwise, while continuing in a southwesterly direction, and traveled onto the south roadside before it descended down a steep grass embankment, coming to rest in a concrete drainage ditch, 21.9 meters (71.8 feet) southwest of impact, heading southeast. The Chevrolet S-10 rotated approximately 245 degrees clockwise before it came to rest. The Jeep Cherokee rotated approximately 180 degrees counterclockwise and traveled 44.4 meters (145.6

feet) eastward before coming to rest on the south shoulder, heading in a west-northwesterly direction.

The case vehicle's "on-lap" front right passenger [daughter of driver; 76 centimeters and 13 kilograms (30 inches, 28 pounds)] was neither using an available child safety seat nor restrained by an available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the "on-lap" front right passenger's body.

The case vehicle's driver reportedly steered to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of her available restraints, the "on-lap" front right passenger most likely moved slightly forward and to her right just prior to impact. The case vehicle's impact with the Chevrolet S-10 enabled the case vehicle's "on-lap" front right passenger to continue forward and upwards towards the 360 degree Direction of Principal Force as the case vehicle decelerated. As the child moved forward, her face and head impacted the deploying front right passenger air bag and pieces of the holed, intruding windshield. The expanding air bag lifted this occupant upwards where she impacted the front right sun visor and/or header before rebounding backwards toward the right side roof rail as the case vehicle rotated clockwise toward final rest. This occupant's position at final rest is unknown because bystanders quickly removed her after observing fire and smoke from the front right seating area.

The "on-lap" front right passenger was transported by ambulance to the hospital. She sustained a critical brain injury and was pronounced dead one hour and 12 minutes post-crash. The injuries sustained by the "on-lap" front right passenger included: a critical nonanatomic brain injury and multiple soft tissue injuries to her face, neck, right shoulder and upper arm, left axillary area, and bilateral thighs. The majority of the face, neck, right shoulder, and bilateral upper arm lesions were caused by her impact with the deploying air bag. Two facial lacerations were most likely caused when she contacted the intruding windshield glazing. Abrasions to her left upper forehead resulted from a contact to the right sun visor.

The injury mechanism associated with this occupant's nonanatomic brain injury cannot be determined because of this occupant's multiple contact points and the lack of specific medical information detailing the precise nature of her head injuries. This occupant's face and head impacted the deploying air bag. As a result of the high Delta V [greater than 40 km.p.h. (greater than 25 m.p.h.)], she was almost certainly moving upwards toward the front of the vehicle when she impacted the deploying air bag and, as a result, she was lifted upwards into the front right sun visor/header area. This occupant was essentially "*dead on arrival*" and was kept viable for transplant purposes. No autopsy was performed and it is unknown if any images (CT Scan, MRI, or X-rays) were taken since no imaging records were available. This occupant may have had a left frontoparietal skull fracture, but "caved in" or "indented" are not encodable descriptions. In addition, the medical records do not indicate whether or not cervical injury was suspected or ruled out. Without more specific knowledge regarding the exact nature of her injuries, an injury mechanism cannot be definitively assigned. However, this contractor does believe that the front right air bag played a significant role in the death of the case vehicle's "*on-lap*" front right passenger, either directly or indirectly. A direct role would be if the air bag caused this occupant's fatal lesion(s). An indirect role would be if the fatal lesion(s) resulted from her contact

with the front right sun visor/header area after being redirected upwards by the deploying air bag. What cannot be determined is the answer to the "*but for*" question (i.e., If the air bag had not been present, would this occupant have survived?). This contractor cannot answer that question because of the lack of medical records for this occupant. Given the severe nature of this crash and the amount of intrusion into the front right occupant space, there is a strong chance that this occupant might have been fatally injured anyway. In addition to the lack of detail pertaining to her head injuries and the total lack of medical determination regarding the presence or absence of thoracic and abdominal cavity injuries, the adult front right passenger's kinematics would have caused her to compress the "*on-lap*" occupant between herself and the intruding front right dash and windshield.

The case vehicle was a front wheel drive, 1995 Ford Contour GL, four-door sedan (VIN: 3FALP6533SM-----). The case vehicle was not equipped with anti-lock brakes. The 1st other vehicle was a rear wheel drive, 1987 Chevrolet S-10, extended bed pickup truck with a camper cap (VIN: 1GCBS14E4H2-----). The 2nd other vehicle was a four wheel drive, 1989 Jeep Cherokee Limited, four-door sport utility vehicle (VIN: 1J4FJ78L9KL-----). All three vehicles were towed due to damage. Based on the vehicle inspections, the CDCs for the primary impact in the crash were determined to be: **12-FZAW-6 (360)** for the case vehicle [maximum crush was 134 centimeters (52.8 inches) at C6], and **12-FZAW-6 (360)** for the Chevrolet S-10 [maximum crush was 140 centimeters (55.1 inches) at C6]. The CDCs for the initial impact between the Chevrolet S-10 and the Jeep Cherokee were: **12-LYES-2 (350)** for the S-10 and not determinable for the Jeep Cherokee because of its repair status. 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: 58.9 km.p.h. (36.6 m.p.h.), -58.9 km.p.h. (-36.6 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.).

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 air bag 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 6 centimeters (2.4 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 of 51 centimeters (20.1 inches). There was contact evidence (i.e., skin transfer) readily apparent on the driver's air bag and scratches on the lower right quadrant.

The front right passenger's air bag was located in the top of the instrument panel. An inspection of the front right air bag module's cover flap and air bag revealed that the cover flap opened at the designated tear points and there were scratches and gouging (i.e., evidence of contact with the windshield) on the front right air bag module's cover flap. The windshield had a spider web type impact, was split, and dangled inside the passenger compartment. The deploying front right air bag had contacted the windshield, and the glazing had cut a small hole in the top right hand side of the air bag's fabric. In addition, a small fire, of unknown origin, occurred within the vehicle, and the fire burned a hole in the top right side of the air bag and blackened the lower right half of the windshield. The front right passenger's air bag was designed with one tether, 7.5 centimeters (3.0 inches) in width. The front right air bag had one vent port,

approximately 7 centimeters (2.8 inches) in diameter. The deployed front right air bag was rectangular with a height of approximately 48 centimeters (18.9 inches) and a width of approximately 69 centimeters (27.2 inches). There were some blood splashes on the top right portion of the air bag and some unidentified fluid spots on the front right side.

The inspection of the case vehicle's interior surfaces revealed a multiplicity of other evidence of occupant contacts. There were: striations/scratches on the lower right steering wheel rim, an indentation and cloth transfer to the center instrument panel, striations below the right instrument panel, scrapes and cosmetic smears on the roof liner above the driver's seat, striations on the right roof side rail, striations and scrapes on the front right sun visor, a body oil smear on the right windshield, a left sneaker entrapped in the right foot well, scrapes and striations on the right front window sill, scrapes on the back of the center console, scrapes on the driver's seat back and posterior seat top and headrest, scrapes on the front right passenger seat back and posterior seat top and headrest, a scrape on the lower front portion of the interior surface of the right rear door, and scrapes on the left rear window sill.

Based on the driver's interview, immediately prior to the crash the case vehicle's "out of position" front right passenger was seated in an upright posture on the lap of the adult front right passenger (i.e., her aunt). She had her back against the seated adult, her feet on the seat, and both hands in her lap. The front right seat was positioned between its middle and rearmost positions, and the seat back was upright. Based on the vehicle inspection, the front right seat track position was unmeasurable because of the passenger compartment intrusion.

Prior to the crash the case vehicle's **driver** [22-year-old, White (non-Hispanic) female] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, and both hands on the steering wheel. Her seat track was positioned between its middle and forward-most positions, the seat back was upright, and the vehicle was not equipped with a tilt steering wheel. Based on the vehicle inspection, the driver's seat track position was unmeasurable because of the passenger compartment intrusion; although, the forward edge of the driver's seat was under the steering wheel rim.

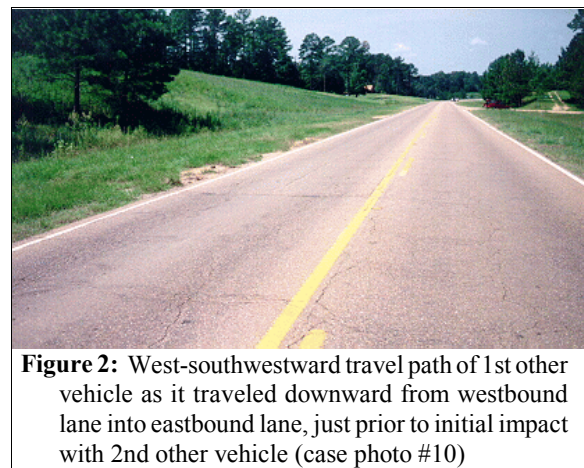
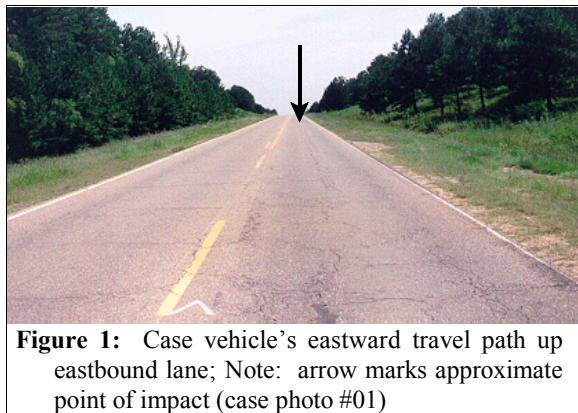
The adult **front right passenger** was seated in an upright posture with her back against the seat back, both feet on the floor, and both hands holding the child (i.e., niece) on her lap. Her seat track was located between its middle and rearmost positions and the seat back was upright. The **back left passenger** [daughter; 8-year-old, White (non-Hispanic) female] and the **back right passenger** [son; 3-year-old, White (non-Hispanic) male] were both sitting in an upright posture with their feet on the seat; however, the position of their hands is unknown. The seat back and seat track for the two back-seated passengers were not adjustable.

According to the investigating police officer and verified during the on-site inspection, the short statured **driver** [155 centimeters and 49 kilograms (61 inches, 107 pounds)], the adult **front right passenger** [180 centimeters and 93 kilograms (71 inches, 205 pounds)], the **back left passenger** (122 centimeters and 20 kilograms (48 inches, 45 pounds)], and the **back right passenger** (91 centimeters and 16 kilograms (36 inches, 35 pounds)] were not restrained by the case vehicle's available, active, three-point, lap-and-shoulder, safety belt systems. No evidence

of occupant loading was discovered on the seat belt webbings, "D"-rings, or latch plates of any of the case vehicle's front or rear outboard safety belts.

All four of the remaining occupants in the case vehicle were transported by ambulance to area hospitals. The driver and the two back seated passengers (i.e., driver's children) sustained minor injuries and were treated and released. The adult front right passenger sustained a serious injury and was stabilized before being transferred and hospitalized. According to their medical records, the case vehicle's driver sustained minor abrasions and contusions to her face and arms from contacting her deploying air bag. In addition, she sustained abrasions and contusions to her knees from contacting the left knee bolster and center instrument panel. The adult front right passenger sustained multiple fractures including: a comminuted right tibial plafond fracture, a right medial malleolus fracture, and transverse fracture of the distal fibula. All of these fractures resulted from the intrusion into the right toe pan area. She fractured a left finger on the instrument panel and sustained a sprain and contusion to her left ankle, also from toe pan intrusion. Her left sneaker was entrapped in the damaged front right floor pan area, near the center console (surrounded by a generous amount of blood on the carpet). It is not known which of the case vehicle's three front occupants deposited that blood; although the "on-lap" front right passenger is the most likely candidate. The adult front right passenger also sustained unspecified abrasions and multiple, unspecified contusions to her upper and lower extremities. The back left passenger sustained minor contusions and abrasions, including: a contusion to her left posterior shoulder--from impacting the interior surface of the left rear door during the case vehicle's clockwise rotation, and abrasions and contusions to her bilateral lower legs (and specifically left ankle) from impacting the driver's seat back. The driver's seat back was torqued with the right side leading because of contact by the back left passenger. In comparison, the front right seat back was perpendicular to the right "B"-pillar. The back right passenger sustained minor abrasions and contusions to his right forehead, cheek, and chin from impacting the back of the front right seat.

CRASH CIRCUMSTANCES



The case vehicle was following the Jeep Cherokee and both vehicles were traveling east in the eastbound lane up (i.e., a 3.2% grade, positive to the east) a two-lane, undivided, state highway (**Figure 1**) and intended to continue in their eastward direction of travel. The Chevrolet S-10 was traveling west in the westbound lane down (i.e., a 3.2% grade, negative to the west) the

same, two-lane roadway (**Figure 2**) and intended to continue its westward travel direction. The Chevrolet S-10 entered the eastbound lane. The investigating police officer indicated that the driver of the Jeep Cherokee steered towards the right edge line, attempting to avoid the crash. The officer indicated further that after the first impact he observed no scene evidence indicating that the drivers of the case vehicle or the Chevrolet S-10 attempted any avoidance maneuvers; however, the case vehicle's driver indicated that she steered to the left, attempting to avoid the impending crash. Pre-impact travel speed estimates of 80 km.p.h. (50 m.p.h.) were reported by the drivers of the case vehicle and the Jeep Cherokee. The driver of the Chevrolet S-10 reportedly could recall nothing of the crash sequence; in addition, his speedometer was not operable. Both impacts occurred in the eastbound lane of the roadway (see **CRASH DIAGRAM** below).

The state highway was straight and had a 3.2% grade positive to the east (i.e., an upgrade in the case vehicle's direction of travel) at the area of impact. The pavement was bituminous, but traveled, cracked, and worn, and the width of the travel lanes for both the east and westbound directions was 3.7 meters (12.1 feet). The shoulders were not improved (i.e., grass), and there was a 6.1 meter (20 foot) wide shoulder on the south side of the roadway. Pavement markings consisted of a single broken yellow centerline for both east and westbound traffic, augmented by a single solid yellow "no passing" line for eastbound traffic. In addition, solid white edge lines were present on both the north and south sides of the roadway. The estimated coefficient of friction was 0.50, excluding grade considerations. There were no visible traffic controls. The posted speed limit was 89 km.p.h. (55 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 cloudy with rain on and off, and the road pavement was wet. Traffic density was light, and the site of the crash was rural undeveloped, interspersed with some residential presence.



Figure 3 Case vehicle's front right damage with contour gauge present (case photo #12)



Figure 4: Case vehicle's front right damage viewed from right of front showing offset nature of impact and severe front right damage; Note: maximum crush at C6 (case photo #20)

The front left of the Chevrolet S-10 sideswiped the left side of the Jeep Cherokee. The Chevrolet S-10 rotated slightly counterclockwise after its initial impact and continued in a west-southwesterly direction, and the front right half of the case vehicle (**Figures 3 and 4** and **Figure 5** below) was impacted by the front right half of the Chevrolet S-10 (**Figures 6 through 8** below), causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle rotated approximately 100 degrees clockwise, while continuing a short

distance [1.8 meters (6 feet)] eastward, and came to rest crosswise in the middle of the roadway, heading south. The impact with the case vehicle caused the Chevrolet S-10's counterclockwise rotation to change to a clockwise rotation. The Chevrolet S-10 continued in a southwesterly direction, while rotating clockwise, and traveled onto the south roadside before it descended down a steep grass embankment, coming to rest in a concrete drainage ditch, 21.9 meters (71.8 feet) southwest of impact, heading southeast. The Chevrolet S-10 rotated approximately 245 degrees clockwise before it came to rest. The Jeep Cherokee rotated approximately 180 degrees counterclockwise and traveled 44.4 meters (145.6 feet) eastward before coming to rest on the south shoulder, heading in a west-northwesterly direction.



Figure 5: Case vehicle's front right damage viewed from left of front with contour gauge present showing offset nature of impact (case photo #13)



Figure 6: 1st other vehicle's front right damage showing severe rightward shift of front end; Note: position of C1 (case photo #51)



Figure 7: 1st other vehicle's front right damage, viewed from right of front, with contour gauge present showing offset nature of impact (case photo #64)

CASE VEHICLE

The case vehicle was a front wheel drive, 1995 Ford Contour GL, five-passenger, four-door sedan (VIN: 3FALP6533SM-----) equipped with power-assisted steering, a 2.0L, DOHC, SEFI, I-4 engine, and a four-speed automatic transmission. Braking was achieved by a power-assisted, front disc and rear drum system. Although four wheel, anti-lock brakes are an option for this model, there was no positive indication the case vehicle was so equipped. The case vehicle's wheelbase was 271 centimeters (106.5 inches), and the odometer



Figure 8: 1st other vehicle's right side showing right front tire which was shoved backwards under-neath damaged right "A"-pillar; Note: roof buck-ling (case photo #62)

Case Vehicle (Continued)

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reading at inspection was 71,271 kilometers (44,286 miles).

Inspection of the vehicle's interior revealed electronic windows and door locks; adjustable front bucket seats with adjustable head restraints; a non-adjustable back bench seat without head restraints for the back 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 height adjusters for the "D"-rings, and they were both located in the full-up position. The vehicle was equipped with knee bolsters for both the driver and front right passenger. No deformation to the driver's knee bolster was detected, while slight deformation was noted to the left side of the front right passenger's knee bolster. The automatic transmission selection lever was located in the center console. 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 front seat air bags deployed as a result of the case vehicle's frontal impact with the Chevrolet S-10.

CASE VEHICLE DAMAGE

The case vehicle's contact with the Chevrolet S-10 involved the front right half. Direct contact damage to the case vehicle began at the front right bumper corner and extended leftwards a measured distance of 90 centimeters (35.4 inches) of the 148 centimeters (58.3 inches) of undeformed end width (**Figure 9**). Front bumper-level maximum crush extended rearwards a measured distance of 134 centimeters (52.8 inches) at C6, while direct contact to the right "A"-pillar was measured 250 centimeters (98.4 inches) rearward of the original bumper corner. The wheelbase on the case vehicle's left side was extended 9 centimeters (3.5 inches) while the right side was shortened 48 centimeters (18.9 inches).

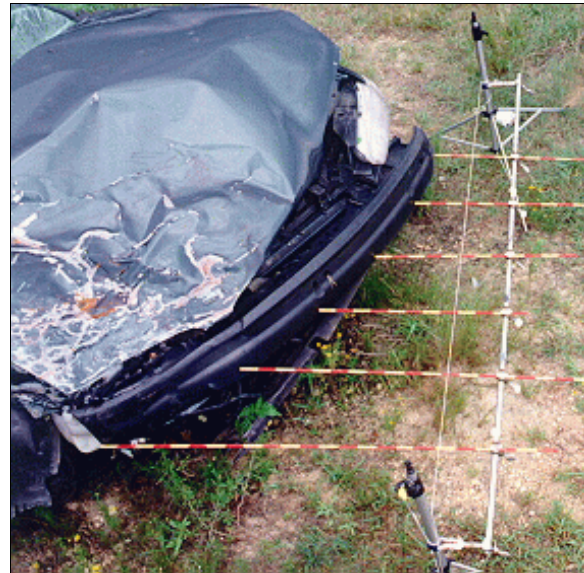


Figure 9: Reference line view from right of case vehicle's front right damage with contour gauge present showing crush profile (case photo #23)

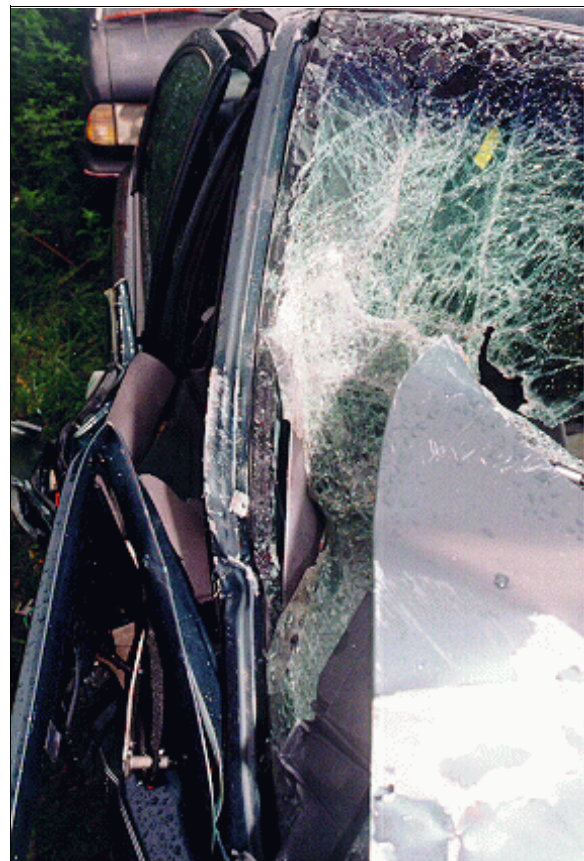


Figure 10: Close-up of direct damage to case vehicle's right "A"-pillar and holed windshield (case photo #22)

The case vehicle's front bumper, bumper fascia, grille, radiator, hood, right headlight and turn signal assemblies, right fender, right front wheel assembly, right front door, and right "A"-pillar (Figure 10 above) were directly damaged and crushed rearward and/or inward. The case vehicle's right front rear tire was physically restricted, and the right front and right rear tires were deflated from the crash. The windshield was holed through contact with the back edge of the case vehicle's hood and the right front door's glazing disintegrated during the impact. The left headlight and turn signal assemblies and left fender sustained induced damage. Remote buckling was also found on the right portion of the case vehicle's roof over the right front door.

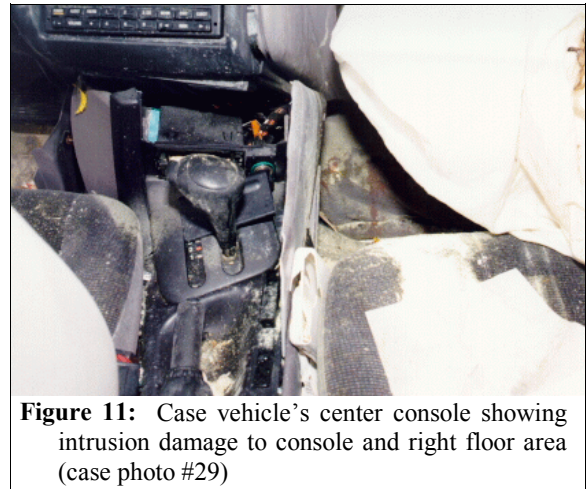


Figure 11: Case vehicle's center console showing intrusion damage to console and right floor area (case photo #29)

There was extensive intrusion to the case vehicle's interior. At the front right seat position, the roof was lowered 21 centimeters (8.3 inches), the right front door panel shoved in 17 centimeters (6.7 inches), the right instrument panel moved rearwards 9 centimeters (3.5 inches), the toe pan pushed rearward 6 centimeters (2.4 inches), and the A-pillar pushed inward 5 centimeters (2.0 inches). At the front center area (Figure 11), the center instrument panel was pushed rearward 40 centimeters (15.7 inches). At the driver's seat position, the toe pan was moved rearward 7.5 centimeters (3.0 inches), the floor pan pushed up 6 centimeters (2.4 inches), and the steering wheel pushed back 3 centimeters (1.2 inches).



Figure 12: Case vehicle's driver seating area showing deployed driver's air bag, toe pan intrusion, and occupant contacts below center instrument panel (case photo #26)

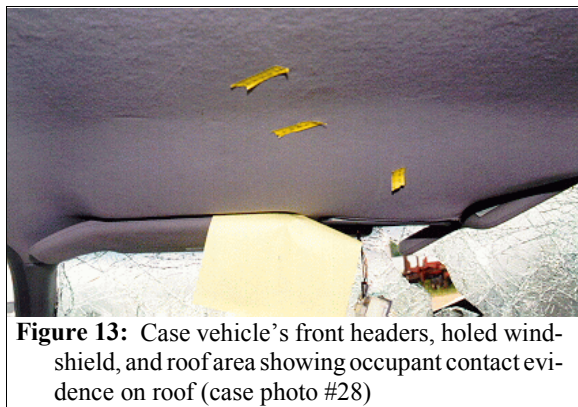


Figure 13: Case vehicle's front headers, holed windshield, and roof area showing occupant contact evidence on roof (case photo #28)

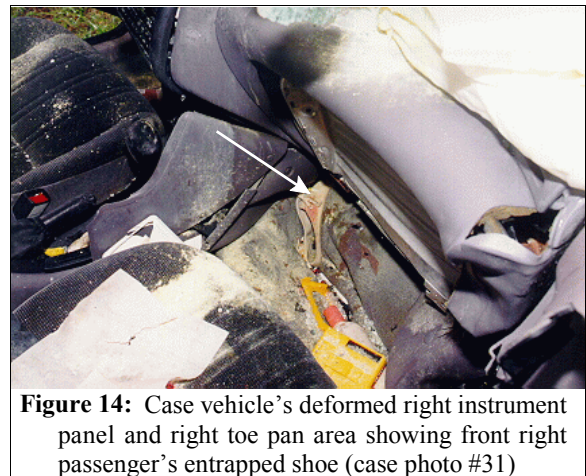


Figure 14: Case vehicle's deformed right instrument panel and right toe pan area showing front right passenger's entrapped shoe (case photo #31)

Inspection of the case vehicle's interior surfaces revealed a multiplicity of other evidence

of occupant contacts. There were: striations/scratches on the lower right steering wheel rim; an indentation and cloth transfer to the left side of the center instrument panel (**Figure 12**); scrapes and cosmetic smears on the roof liner above the driver's seat (**Figure 13** above); striations below the right instrument panel; striations on the right roof side rail; striations and scrapes on the front right sun visor; a body oil smear on the right windshield; blood around a left sneaker entrapped in a floor fold on the left side of the right foot well (**Figure 14** above); scrapes and striations on the right front window sill; scrapes on the back of the driver's bucket seat and posterior seat top and headrest (**Figure 15**); scrapes on the back left side of the center console; scrapes on the back side of the front right passenger's bucket seat and posterior seat top and headrest; a scrape on the lower front portion of the interior surface of the right rear door panel (**Figure 16**); and scrapes on the left rear window sill.

Based on the vehicle inspection, the CDC for the case vehicle's primary impact in the crash was determined to be: **12-FZAW-6 (360)**. The WinSMASH reconstruction program, damage only algorithm, was used on the case vehicle's highest severity impact (impact #2 in the crash sequence). The Total, Longitudinal, and Lateral Delta Vs are, respectively: 58.9 km.p.h. (36.6 m.p.h.), -58.9 km.p.h. (-36.6 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.).

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 air bags deployed as a result of the "offset" frontal impact with the Chevrolet S-10. The case vehicle's driver air bag was located in the steering wheel hub. The module cover consisted of symmetrical "H"-configuration cover flaps made of thick vinyl with overall dimensions of 18 centimeters (7.1 inches) at the horizontal seam and 8 centimeters (3.1 inches) vertically for both the upper and lower flaps. An inspection of the air bag module's cover flaps and air bag 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 6 centimeters (2.4 inches) in width. The driver's air bag had two vent ports, approximately



Figure 15: Back of case vehicle's driver seat showing occupant contact evidence on top of head restraint and back of center console (case photo #44)

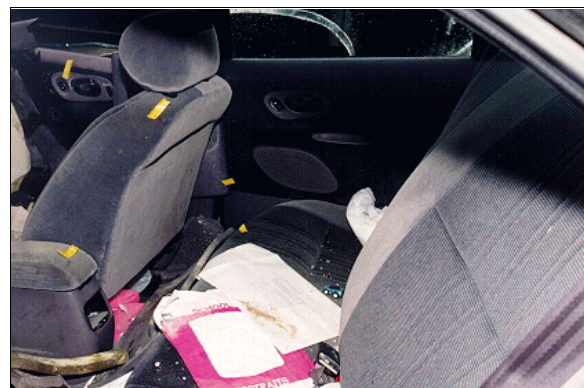


Figure 16: Case vehicle's back seating area showing occupant contact evidence on back of center console, front right seat back, lower "B"-pillar, and right front window sill (case photo #49)

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 of 51 centimeters (20.1 inches). Inspection of the driver's air bag revealed scratches on the lower right quadrant of the fabric (**Figure 17** below). The scratches extended from 3 centimeters (1.2 inches) to 28 centimeters (11.0 inches) left of the right circumference seam and 5.5 centimeters (2.2 inches) up from the bottom of the bag. There were, however, cosmetic smears on the roof liner above the driver's seat and a small indentation and cloth transfer to the extreme left side of the lower center instrument panel.



Figure 17: Case vehicle's deployed driver air bag showing contact evidence on bag's fabric near 12 o'clock position (case photo #37)

The front right passenger's air bag was located in the top of the instrument panel. There was a single, essentially rectangular, modular cover flap (i.e., hinged at the back and designed to flip upwards) . The cover flap was most likely made of a thick vinyl over a thick cardboard type frame. The flap's dimensions were not obtainable because the holed windshield glazing was dangling directly over the flap. The profile of the case vehicle's instrument panel resulted in an 11.5 centimeter (4.5 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 flap and air bag revealed that the cover flap opened at the designated tear points, and there were deformation, scratches, and gouging (i.e., evidence of contact with the windshield) on the front right air bag module's cover flap. The windshield had a spider web type impact, was split, and dangled inside the passenger compartment. The deploying front right air bag had contacted the windshield, and the glazing had cut a small hole in the top right hand side of the air bag's fabric. In addition, a small fire, of unknown origin, occurred within the vehicle, and the fire burned a hole in the top right side of the air bag (**Figure 18**) and blackened the lower right half of the windshield. The front right passenger's air bag was designed with one tether, 7.5 centimeters (3.0 inches) in width. The front right air bag had one vent port, approximately 7 centimeters (2.8 inches) in diameter. The deployed front right air bag was rectangular with a height of approximately 48 centimeters (18.9 inches) and a width of approximately 69 centimeters (27.2 inches). Inspection of the front right passenger air bag revealed blood splashes on the top right portion of the air bag and unidentified fluid stains to the front panel of the fabric. On the air bag's top panel, there was a blood stain at the front left corner; a blood stain just to the right of center, on the forward seam; a blood stain just to the left of the burn hole; a blood stain 5 centimeters (2.0 inches) back from the forward seam and 14 centimeters (5.5 inches) left of the right seam; and a burn hole [3 centimeters wide and 6 centimeters long (1.2



Figure 18: Case vehicle's deployed front right passenger air bag showing holed and burned area of fabric in center of air bag (case photo #40)

inches, 2.4 inches)], located 21 centimeters (8.3 inches) back from the forward seam and 8 centimeters (3.1 inches) left of the right seam. The clear fluid stains, of unknown substance, were located on the front, lower right quadrant. One stain was 2 centimeters (0.8 inches) up from the bottom seam and 20 centimeters (7.9 inches) left of the right seam, while the other fluid stain was 19 centimeters (7.5 inches) up from the bottom seam and 17 centimeters (6.7 inches) left of the right seam. In addition to the air bag contacts, the front right sun visor, the intruding windshield, the left side of the front right instrument panel, the right side of the center console, the right front door panel, and the roof liner over the front right passenger seat position were areas of other contact points.

CASE VEHICLE “ON-LAP” FRONT RIGHT PASSENGER KINEMATICS

Based on the driver’s interview, immediately prior to the crash the case vehicle’s “out of position” front right passenger [21-month-old, White (non-Hispanic) female] was seated in an upright posture on the lap of the adult front right passenger (i.e., her aunt). She had her back against the seated adult, her feet on the seat, and both hands in her lap. The front right seat was positioned between its middle and rearmost positions, and the seat back was upright. Based on the vehicle inspection, the front right seat track position was found to be significantly rearward of the driver’s seat, but the track measurement was unmeasurable because of the passenger compartment intrusion.

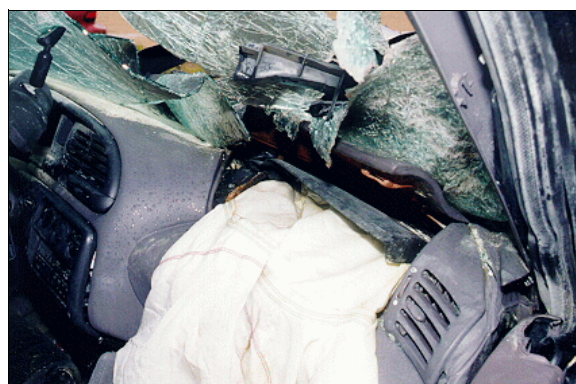


Figure 19 Case vehicle’s deployed front right passenger air bag, holed windshield, and damaged right instrument panel; Note: direct damage to right “A”-pillar (case photo #30)

The case vehicle’s “on-lap” front right passenger [daughter of driver; 76 centimeters and 13 kilograms (30 inches, 28 pounds)] was neither using an available child safety seat nor restrained by an available, active, three-point, lap-and-shoulder, safety belt system. Inspection of the available safety belt webbing, “D”-ring, and latch plate showed no evidence of loading. In addition, there was no evidence of belt pattern bruising and/or abrasions to the “on-lap” front right passenger’s body.



Figure 20: Close-up of case vehicle’s holed windshield showing blood on edge of broken glazing (case photo #32)

The case vehicle’s driver steered to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of her available restraints, the “on-lap” front right passenger most likely moved slightly forward and to her right just prior to impact. The case vehicle’s impact with the Chevrolet S-10 enabled the case vehicle’s “on-lap” front right passenger

to continue forward and upwards towards the 360 degree Direction of Principal Force as the case vehicle decelerated. As the child moved forward, her face and head impacted the deploying front right passenger air bag and pieces of the holed, intruding windshield (Figures 19 and 20). The expanding air bag lifted this occupant upwards where she impacted the front right sun visor and/or header before rebounding backwards toward the right side roof rail as the case vehicle rotated clockwise toward final rest. This occupant’s position at final rest is unknown because bystanders quickly removed her after observing fire and smoke from the front right seating area.

CASE VEHICLE “ON-LAP” FRONT RIGHT PASSENGER INJURIES

The “on-lap” front right passenger was transported by ambulance to the hospital. She sustained a critical brain injury and was pronounced dead one hour and 12 minutes post-crash. The injuries sustained by the “on-lap” front right passenger included: a critical nonanatomic brain injury and multiple soft tissue injuries to her face, neck, right shoulder and upper arm, left axillary area, and bilateral thighs. The majority of the face, neck, right shoulder, and bilateral upper arm lesions were caused by her impact with the deploying air bag. Two facial lacerations were most likely caused when she contacted the intruding windshield glazing (Figure 20 above). Abrasions to her left upper forehead resulted from a contact to the right sun visor (Figure 21).

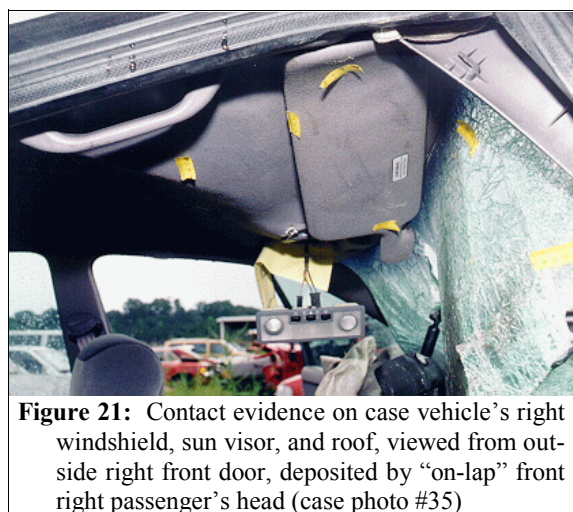


Figure 21: Contact evidence on case vehicle’s right windshield, sun visor, and roof, viewed from outside right front door, deposited by “on-lap” front right passenger’s head (case photo #35)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury ¹	160824.5 critical	Air bag, front right passenger’s ²	Possible	Emergency room records
2	Abrasions left upper forehead	290202.1 minor	Sun visor front right	Certain	Other: photographs from coroner ³
3	Contusion left eye, eye swollen shut	297402.1 minor	Air bag, front right passenger’s	Probable	Emergency room records
4	Abrasions right ear and right face	290202.1 minor	Air bag, front right passenger’s	Probable	Emergency room records

¹ This patient was unconscious and had no pulse, blood pressure, or spontaneous respirations on arrival at the emergency room. In addition, her pupils were equal, fixed, and dilated, and she was unresponsive with obvious head contact (i.e., the emergency room nurse indicated an “indented” area to the upper left forehead; the emergency room physician indicated that her left frontoparietal skull was “caved in”). The Emergency Room Diagnosis was “massive closed head injury”; she never regained consciousness prior to being pronounced dead.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
5	Contusion {bruising} right ear and right face	290402.1 minor	Air bag, front right passenger's	Probable	Emergency room records
6	Abrasion underneath chin	290202.1 minor	Air bag, front right passenger's	Probable	Other: photographs from coroner ³
7	Laceration left face	290600.1 minor	Right windshield glazing	Probable	Emergency room records
8	Lacerations left chin	290600.1 minor	Right windshield glazing	Probable	Emergency room records
9	Abrasions right neck	390202.1 minor	Air bag, front right passenger's ²	Certain	Emergency room records
10	Contusions {bruising} right neck	390402.1 minor	Air bag, front right passenger's	Certain	Emergency room records
11	Abrasions right clavicular area	790202.1 minor	Air bag, front right passenger's	Certain	Other: photographs from coroner ³
12	Contusion right clavicular area	790402.1 minor	Air bag, front right passenger's	Certain	Other: photographs from coroner ³
13	Abrasions right upper arm	790202.1 minor	Air bag, front right passenger's	Probable	Emergency room records
14	Contusions right upper arm	790402.1 minor	Air bag, front right passenger's	Probable	Emergency room records

² The injury mechanism associated for this occupant's nonanatomic brain injury cannot be precisely determined because of this occupant's multiple contact points and the lack of specific medical information detailing the precise nature of her head injuries. This occupant's face and head impacted the deploying front right air bag. As a result of the high Delta V [greater than 40 km.p.h. (greater than 25 m.p.h.)], she was almost certainly moving upwards toward the front of the vehicle when she impacted the deploying air bag and, as a result, she was lifted upwards into the front right sun visor/header area before rebounding backwards toward the right side roof rail. This occupant was essentially "dead-on-arrival" and was kept viable for transplant purposes. No autopsy was performed and it is unknown if any images (CT scan, MRI, or X-rays) were taken since no imaging records were available. This occupant may have had a left frontoparietal skull fracture, but "caved in" or "indented" are not encodable descriptions. In addition, the medical records do not indicate whether or not cervical injury was suspected or ruled out. Without more specific knowledge regarding the exact nature of her injuries, an injury mechanism cannot be definitively assigned. However, this contractor does believe that the front right air bag played a significant role in the death of the case vehicle's "on-lap" front right passenger, either directly or indirectly. A direct role would be if the air bag caused this occupant's fatal lesion(s). An indirect role would be if the fatal lesion(s) resulted from her contact with the front right sun visor/header area after being redirected upwards by the deploying air bag. What cannot be determined is the answer to the "but for" question (i.e., If the air bag had not been present, would this occupant have survived?). This contractor cannot answer that question because of the lack of medical records for this occupant. Given the severe nature of this crash and the amount of intrusion into the front right occupant space, there is a strong chance that this occupant might have been fatally injured anyway. In addition to the lack of detail pertaining to her head injuries and the total lack of medical determination regarding the presence or absence of thoracic and abdominal cavity injuries, the adult front right passenger's kinematics would have caused her to compress the "on-lap" occupant between herself and the intruding front right instrument panel and windshield.

³ These injuries were visible in the photographs obtain from the applicable county coroner.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
15	Abrasions right proximal forearm	790202.1 minor	Air bag, front right passenger's	Probable	Other: photographs from coroner ³
16	Abrasions left posterior axillary area	790202.1 minor	Air bag, front right passenger's	Possible	Emergency room records
17	Contusions {bruising} left posterior axillary area	790402.1 minor	Air bag, front right passenger's	Possible	Emergency room records
18	Abrasions left inner thigh area	890202.1 minor	Right instrument panel and below	Probable	Emergency room records
19	Contusion {bruising} left inner thigh area	890402.1 minor	Right instrument panel and below	Probable	Emergency room records
20	Laceration right anterolateral thigh	890602.1 minor	Right windshield glazing	Probable	Other: photographs from coroner ³

CASE VEHICLE DRIVER KINEMATICS

Prior to the crash the case vehicle's driver [22-year-old, White (non-Hispanic) female] was seated in an upright posture with her back against the seat back, her left foot on the floor, her right foot on the accelerator, and both hands on the steering wheel. Her seat track was positioned between its middle and forward-most positions, the seat back was upright, and the vehicle was not equipped with a tilt steering wheel. Based on the vehicle inspection, the driver's seat track position was unmeasurable because of the passenger compartment intrusion; although, the forward edge of the driver's seat was under the steering wheel rim.

According to the investigating police officer and verified during the on-site inspection, the short statured driver [155 centimeters and 49 kilograms (61 inches, 107 pounds)], was not restrained by her available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the driver's body, and the inspection of the driver's seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver steered to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of her available restraints, the driver most likely moved slightly forward and to her right just prior to impact. The case vehicle's impact with the Chevrolet S-10 enabled the case vehicle's driver to continue forward and upwards towards the 360 degree Direction of Principal Force as the case vehicle decelerated. As she moved forward, her face and head impacted the deploying driver's air bag. The air bag's fabric contained scratches on the lower right quadrant. As well, scratches were discovered at the bottom right of the steering wheel rim. The expanding air bag lifted this occupant upwards where she impacted

the roof and/or header above the driver’s seat before rebounding backwards toward the right front seat and center console areas as the case vehicle rotated clockwise toward final rest. This occupant’s position at final rest is unknown. According to her interview, she was able to exit the case vehicle without any assistance.

CASE VEHICLE DRIVER INJURIES

The case vehicle’s driver was transported by ambulance to the hospital. The driver sustained minor injuries and was treated and released. According to her medical records, she sustained minor abrasions and contusions to her face and arms from contacting her deploying air bag. In addition, she sustained abrasions and contusions to her knees from contacting the left knee bolster and center instrument panel.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion forehead, not further specified	290202.1 minor	Air bag, driver’s	Probable	Emergency room records
2	Contusions whole face	290402.1 minor	Air bag, driver’s	Probable	Interviewee (same person)
3	Abrasion right forearm, not further specified	790202.1 minor	Air bag, driver’s	Probable	Emergency room records
4	Contusion right arm, not further specified	790402.1 minor	Air bag, driver’s	Probable	Interviewee (same person)
5	Contusion {bruise} left wrist	790402.1 minor	Unknown contact mechanism	Unknown	Emergency room records
6	Contusions left arm, not further specified	790402.1 minor	Air bag, driver’s	Probable	Interviewee (same person)
7	Abrasions left knee	890202.1 minor	Knee bolster, driver’s	Probable	Emergency room records
8	Abrasions, deep, right knee	890202.1 minor	Center instrument panel and below	Probable	Emergency room records
9	Contusions {ecchymoses}, deep, left knee	890402.1 minor	Knee bolster, driver’s	Probable	Interviewee (same person)
10	Contusions {ecchymoses}, deep, right knee	890402.1 minor	Center instrument panel and below	Probable	Emergency room records

CASE VEHICLE FRONT RIGHT PASSENGER KINEMATICS

The adult front right passenger was seated in an upright posture with her back against the seat back, both feet on the floor, and both hands holding the child (i.e., niece) in her lap. Her seat track was located between its middle and rearmost positions and the seat back was upright.

According to the investigating police officer and verified during the on-site inspection, the adult front right passenger [180 centimeters and 93 kilograms (71 inches, 205 pounds)], was not restrained by her available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the front right passenger's body, and the inspection of the front right seat belt webbing, "D"-ring, and latch plate showed no evidence of loading.

The case vehicle's driver steered to the left, attempting to avoid the crash. As a result of this avoidance maneuver and the nonuse of her available restraints, the front right passenger most likely moved slightly forward and to her right just prior to impact. The case vehicle's impact with the Chevrolet S-10 enabled the case vehicle's front right passenger to continue forward and upwards towards the 360 degree Direction of Principal Force as the case vehicle decelerated. The front right passenger's torso and head were shielded and most likely protected from the deploying front right air bag and the intruding right instrument panel and right "A"-pillar by the body of the "on-lap" front right passenger. However, the adult front right passenger's bilateral arms were struck by the deploying air bag, most likely causing abrasions and contusions. On the other hand, the front right passenger's lower extremities absorbed the blunt of the intruding toe pan (i.e., ankles) and the right instrument panel (i.e., legs). Her left foot became entrapped in a fold of the intruding front right toe pan area (**Figure 14** above). After maximum engagement, the case vehicle rotated clockwise to its final rest position. As a result, the front right passenger most likely rebounded backwards and toward the right interior side surface and front right seat back. Her position at final rest is unknown because of the attention directed by bystanders toward quickly removing the young "on-lap" child and herself after fire and smoke were observed near the firewall, lower right windshield, and dash. Based on the interview with the case vehicle's driver, the front right passenger was unable to exit the case vehicle under her own power and required assistance because of her injuries.

CASE VEHICLE FRONT RIGHT PASSENGER INJURIES

The case vehicle's adult front right passenger was transported by ambulance to the hospital. The adult front right passenger sustained a serious injury and was stabilized before being transferred and hospitalized. According to her medical records, she sustained multiple fractures, including: a comminuted right tibial plafond fracture, a right medial malleolus fracture, and transverse fracture of the distal fibula. All of these fractures resulted from the intrusion into the right toe pan area. She fractured her second left metacarpal on the instrument panel and sustained a sprain and contusion to her left ankle, also from toe pan intrusion. Her left sneaker was entrapped in the damaged front right floor pan area, near the center console (surrounded by a generous amount of blood on the carpet). It is not known which of the case vehicle's three front occupants deposited that blood; although the "on-lap" front right passenger is the most likely candidate. The adult front right passenger also sustained unspecified abrasions and multiple, unspecified contusions to her upper and lower extremities.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Fracture, comminuted, closed, right tibial plafond ⁴	853422.3 serious	Toe pan, front right	Certain	Hospitalization records
2	Fracture, vertical, right medial malleolus	853412.2 moderate	Toe pan, front right	Certain	Hospitalization records
3	Fracture, transverse, right distal fibula	851606.2 moderate	Toe pan, front right	Certain	Hospitalization records
4	Fracture head left second metacarpal	752002.2 moderate	Right instrument panel and below	Probable	Hospitalization records
5	Sprain left ankle	850206.1 minor	Toe pan, front right	Certain	Hospitalization records
6	Contusion left ankle with edema laterally	890402.1 minor	Toe pan, front right	Certain	Hospitalization records
7	Abrasions, multiple, small, locations not further specified	990200.1 minor	Unknown contact mechanism	Unknown	Emergency room records
8	Contusions, multiple, small, bilateral arms	790402.1 minor	Unknown contact mechanism	Unknown	Hospitalization records
9	Contusions, multiple, small, bilateral upper and lower legs	890402.1 minor	Unknown contact mechanism	Unknown	Hospitalization records

CASE VEHICLE BACK LEFT PASSENGER KINEMATICS

The back left passenger [daughter; 8-year-old, White (non-Hispanic) female] was sitting in an upright posture with her feet on the seat; however, the position of her hands is unknown. The seat back and seat track for the back left passenger were not adjustable.

According to the investigating police officer and verified during the on-site inspection, the back left passenger (122 centimeters and 20 kilograms (48 inches, 45 pounds)) was not restrained by her available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the back left passenger's body, and the inspection of the back left passenger's seat belt webbing and latch plate showed no evidence of loading.

The case vehicle's driver steered to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of her available restraints, the back left passenger most likely moved slightly forward and to her right just prior to impact. The case

⁴ According to the ORTHOPAEDIC DICTIONARY, authored by Hoppenfeld, Stanley and Michael S. Zeide, published by J. B. Lippincott Company, this key term is defined as follows:

plafond fracture (plah-fon frakchur): a fracture of the distal end of the tibia that extends into the articular surface of the tibiotalar joint. Also know as a *tibial plafond fracture*.

vehicle's impact with the Chevrolet S-10 enabled the case vehicle's back left passenger to continue forward and upwards towards the 360 degree Direction of Principal Force as the case vehicle decelerated. As the child moved forward, her body impacted the back surface of the driver's bucket seat and adjustable head restraint (**Figure 15** above). The case vehicle's back left passenger rebounded backwards and toward the right side of the vehicle as it rotated counterclockwise toward final rest. This occupant's position at final rest is unknown. According to the interview with the case vehicle's driver (i.e., mother), she was able to exit the vehicle under her own power.

CASE VEHICLE BACK LEFT PASSENGER INJURIES

The case vehicle's back left child passenger was transported by ambulance to the hospital. The back left passenger (i.e., driver's child) sustained minor injuries and was treated and released. According to her medical records, she sustained minor contusions and abrasions, including: a contusion to her left posterior shoulder--from impacting the interior surface of the left rear door during the case vehicle's clockwise rotation, and abrasions and contusions to her bilateral lower legs (and specifically left ankle) from impacting the driver's seat back. The driver's seat back was torqued with the right side leading because of contact by the back left passenger (**Figure 22**). In comparison, the front right seat back was perpendicular to the right "B"-pillar.



Figure 22: Case vehicle's driver seating area showing deployed driver air bag and distorted driver's seat back; Note: seat back was rotated counterclockwise from contact by back left passenger (case photo #39)

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Contusion left posterior shoulder	790402.1 minor	Window sill, left rear door	Certain	Emergency room records
2	Abrasions bilateral lower legs, not further specified	890202.1 minor	Seat back, driver's	Probable	Emergency room records
3	Contusions bilateral lower legs, not further specified	890402.1 minor	Seat back, driver's	Probable	Emergency room records
4	Abrasions left ankle, not further specified	890202.1 minor	Seat back, driver's	Probable	Emergency room records
5	Contusion left ankle, not further specified	890402.1 minor	Seat back, driver's	Probable	Emergency room records

The back right passenger [son; 3-year-old, White (non-Hispanic) male] was sitting in an upright posture with his feet on the seat; however, the position of his hands is unknown. The seat back and seat track for the back right passenger were not adjustable.

According to the investigating police officer and verified during the on-site inspection, the back right passenger (91 centimeters and 16 kilograms (36 inches, 35 pounds)] was not restrained by his available, active, three-point, lap-and-shoulder, safety belt system. In addition, there was no evidence of belt pattern bruising and/or abrasions to the back right passenger's body, and the inspection of the back right passenger's seat belt webbing and latch plate showed no evidence of loading.

The case vehicle’s driver steered to the left, attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of his available restraints, the back right passenger most likely moved slightly forward and to his right just prior to impact. The case vehicle’s impact with the Chevrolet S-10 enabled the case vehicle’s back right passenger to continue forward and upwards towards the 360 degree Direction of Principal Force as the case vehicle decelerated. As the child moved forward, his face impacted the back surface of the front right bucket seat (**Figure 16** above). The case vehicle’s back right passenger rebounded backwards and toward the right side of the vehicle as it rotated counterclockwise toward final rest. This occupant’s position at final rest is unknown. According to the interview with the case vehicle’s driver (i.e., mother) he was able to exit the vehicle under his own power.

CASE VEHICLE BACK RIGHT PASSENGER INJURIES

The case vehicle’s back left child passenger was transported by ambulance to the hospital. The back right passenger (i.e., driver’s child) sustained minor injuries and was treated and released. According to his medical records, he sustained minor abrasions and contusions to his right forehead, cheek, and chin from impacting the back of the front right seat.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Abrasion right forehead	290202.1 minor	Seat back, front right passenger’s	Certain	Emergency room records
2	Abrasion right cheek	290202.1 minor	Seat back, front right passenger’s	Certain	Emergency room records
3	Abrasion chin	290202.1 minor	Seat back, front right passenger’s	Certain	Emergency room records
4	Contusion right forehead	290402.1 minor	Seat back, front right passenger’s	Certain	Emergency room records
5	Contusion right cheek	290402.1 minor	Seat back, front right passenger’s	Certain	Emergency room records

1ST OTHER VEHICLE

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The 1st other vehicle was a rear wheel drive, 1987 Chevrolet S-10, 4x2, three-passenger, two-door, extended bed, pickup truck (VIN: 1GCBS14E4H2-----) equipped with a camper cap; power-assisted, recirculating ball gear steering; a 2.5L, TBI, L-4 engine; and a four-speed manual transmission. Braking was achieved by a front disc and rear drum system; this vehicle was not equipped with anti-lock brakes. The case vehicle's wheelbase was 299 centimeters (117.9 inches), and the odometer reading at inspection was 134,211 kilometers (83,395 miles). The Chevrolet S-10 was equipped with active, three-point, lap-and-shoulder, safety belt systems at its outboard seat positions.

Based on the vehicle inspection, the CDCs for the Chevrolet S-10 were determined to be: **12-LYES-2 (350)** for the initial sideswiping impact (**Figure 23**) and **12-FZAW-6 (360)** for the primary impact [maximum crush was 140 centimeters (55.1 inches) at C6]. Direct damage was to the front bumper, grille, hood, right front headlamp assembly, right front fender, right front tire and wheel assembly, lower right "A" pillar, and right front door. The WinSMASH reconstruction program, damage only algorithm, was used on the Chevrolet S-10's highest severity impact. The Total, Longitudinal, and Lateral Delta Vs are, respectively: 60.8 km.p.h. (37.8 m.p.h.), -60.8 km.p.h. (-37.8 m.p.h.), and 0.0 km.p.h. (0.0 m.p.h.). The Chevrolet S-10 was towed from the scene due to damage.



Figure 23: Sideswipe damage along 1st other vehicle's left side from impact with 2nd other vehicle's left side (case photo #53)

2ND OTHER VEHICLE

The 2nd other vehicle was a four wheel drive, 1989 Jeep Cherokee Limited, 4x4, six-passenger, four-door, sport utility vehicle (VIN: 1J4FJ78L9KL-----) equipped with a 4.0L, MPI, I-6 engine and a five-speed manual transmission with overdrive. Four wheel anti-lock brakes are an option for this model, but it is unknown if it was so equipped. The 2nd other vehicle's wheelbase was 258 centimeters (101.4 inches), and the odometer reading at inspection is unknown. The Jeep Cherokee was equipped with active, three-point, lap-and-shoulder, safety belt systems at the front seat outboard positions.

The Jeep Cherokee sustained a sideswiping type impact and was in a partial state of repair when inspected (**Figure 24**). Based on the vehicle inspection, the CDC is not estimable. Sideswipe damage to the Jeep Cherokee continued rearward along its left front door until the lower portion of



Figure 24: Left side of 2nd other vehicle, viewed from left of back; showing repairs in progress resulting from sideswiping impact by front left of 1st other vehicle (case photo #69)

2nd Other Vehicle (Continued)

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the left rear door's forward seam was slightly snagged. The left front tire and wheel of the Chevrolet S-10 contacted the left rear tire and wheel of the Jeep Cherokee, slashing both tires and damaging both rims. Damaged exterior components included: the rear of the left fender, the left front door, the left rear door, the left rear quarter panel, the left rear wheel well, and the left rear tire and wheel. The Jeep Cherokee was towed due to damage.

CRASH DIAGRAM

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