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SCI/NASS COMBINATION ADULT AIR BAG-RELATED FATALITY INVESTIGATION

CASE NUMBER - NASS-2004-49-168A
LOCATION - Texas
VEHICLE - 2004 Mercedes Benz S430
CRASH DATE - June 2004

Submitted:
April 22, 2005
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Contract Number: DTNH22-01-C-07002

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National Highway Traffic Safety Administration
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The crash investigation process is an inexact science which requires that physical evidence such as skid marks, vehicular damage measurements, and occupant contact points be coupled with the investigator' s expert knowledge and experience of vehicle dynamics and occupant kinematics in order to determine the pre-crash, crash, and post-crash movements of involved vehicles and occupants.

Because each crash is a unique sequence of events, generalized conclusions cannot be made concerning the crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

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On-site investigation of an air bag deployment crash involving a 2004 Mercedes Benz S430, equipped with multiple advanced occupant protection systems, and a 1999 Toyota Camry

16. *Abstract*
This report covers a combination SCI/NASS on-site investigation of an adult air bag-related fatality crash involving a 2004 Mercedes Benz S430 (case vehicle) and a 1999 Toyota Camry (other vehicle). This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection systems and the front right passenger (56-year-old female), who was restrained by the manual lap-and-shoulder safety belt system with buckle pretensioner, sustained critical head and chest injuries, resulting in her death. The case vehicle was executing a left turn across the other vehicle' s path. There is no evidence that either driver attempted any avoidance actions. The other vehicle was traveling at high speed and the case vehicle' s front right corner was impacted by the other vehicle' s front. The case vehicle rotated counterclockwise, the other vehicle rotated clockwise and the case vehicle' s right side was impacted by the other vehicle' s left side. Both vehicles were towed due to disabling damage. The case vehicle' s driver and front right passenger frontal air bags, the right front and right back door-mounted side impact air bags and the right roof rail-mounted inflatable curtain air bag all deployed. The case vehicle' s front right passenger probably recognized the impending crash and reflexively leaned forward and leftward in an effort to protect herself. In this posture she was very close to the frontal air bag module in the instrument panel and the deploying air bag struck her head and chest causing critical brain and lung injuries. She was hospitalized and declared dead approximately 50 hours post-crash. The case vehicle' s driver (17-year-old male) was also restrained by the available lap-and-shoulder safety belt system and the driver' s frontal air bag deployed. He was transported via ambulance to a hospital where he was treated and released.

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Page No.

BACKGROUND

NASS-2004-49-168A

This combination SCI/NASS investigation was brought to the NHTSA's attention in early July 2004 by NASS-CDS sampling activities. This crash involved a 2004 Mercedes-Benz S430 (case vehicle, NASS vehicle #2) and a 1999 Toyota Camry (other vehicle, NASS vehicle #1). The crash occurred in June 2004, at 10:15 p.m., in Texas, and was investigated by the applicable municipal police department. This crash is of special interest because the case vehicle was equipped with multiple advanced occupant protection system (AOPS) features, and the case vehicle's front right passenger (56-year-old female, white, unknown if Hispanic) sustained critical head and chest injuries from her deploying front right instrument panel-mounted air bag, resulting in her death. The case vehicle driver (17-year-old male, white, unknown if Hispanic) sustained minor and moderate injuries and was treated and released at a hospital emergency department. This report is based on the coded NASS case and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle had been traveling northward in the northbound left turn lane of a four-lane roadway that was part of a divided trafficway (three through lanes and a left turn lane in each direction, separated by a curbed grass median), approaching a four-leg intersection, and was beginning to make a left turn (**Figure 1**). The other vehicle was traveling southward in the center southbound through lane of the same divided trafficway, approaching the same intersection and intending to continue southward (**Figure 2**). It was dark but lighted, the weather was clear, the speed limit for both vehicles was 56 km.p.h. [35 m.p.h.], and the concrete road surfaces were dry and without defects. The other vehicle was traveling at high speed (a witness, quoted on the police crash report, estimated 113 km.p.h. [70 m.p.h.]). There is no evidence that either driver attempted any avoidance maneuvers prior to the impact. The crash occurred in the southbound roadway, within the four-leg intersection of the two trafficways.

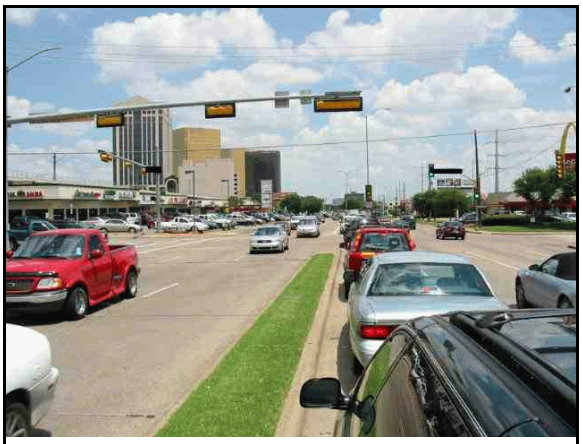


Figure 1: Case vehicle's northbound approach toward left turn at intersection

Figure 2: Other vehicle's southbound approach toward intersection

The case vehicle's front right corner was impacted by the Toyota's front right area. The case vehicle rotated counterclockwise and the Toyota rotated clockwise while maintaining contact

such that the left half of the Toyota' s front engaged the case vehicle' s right side. This impact caused the case vehicle's driver and front right passenger frontal air bags to deploy. The two vehicles continued rotating as they separated and the case vehicle' s right rear corner sustained a side slap impact with the Toyota' s left rear door and wheel well area. The case vehicle was redirected southward in the southbound roadway while rotating counterclockwise and came to rest straddling the center and outside southbound lanes, heading northeast. The case vehicle' s front right and back right door-mounted side impact air bags and the right roof rail-mounted inflatable curtain air bag also deployed, but it is not known when during the collision sequence these air bags deployed. The Toyota was redirected to the southwest and rotated slightly clockwise before it jumped the curb and came to rest heading west on the southwest corner of the intersection. The Toyota was equipped with dual frontal air bags that deployed.

CASE VEHICLE

The case vehicle was a 2004 Mercedes-Benz S430V rear wheel drive, four-door, five-passenger sedan (VIN: WDBNG70J34A------), equipped with a 4.3 liter V8 gasoline engine, an automatic transmission with a console-mounted selector lever, and four wheel anti-lock disc brakes with electronic brake force distribution. The case vehicle was equipped with: advanced (dual stage) driver and passenger frontal air bags; a front right seat occupancy weight sensor in the seat cushion; driver and front right seat belt buckle sensors; front and rear door-mounted side impact air bags; left and right roof rail-mounted inflatable curtains that provide protection for front and back outboard seating positions; seat belt pretensioners with load limiters for all seat positions; head restraints that were fore-and-aft adjustable as well as height adjustable at all seat positions; and LATCH system components for the outboard rear seating positions. Its wheelbase was 309 centimeters [121.5 inches]. The odometer reading is not known due to the non-functional electronic instrument panel. The case vehicle was towed due to disabling damage.

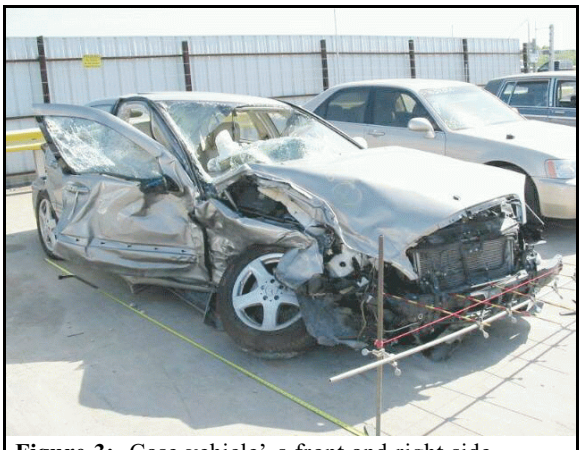


Figure 3: Case vehicle' s front and right side

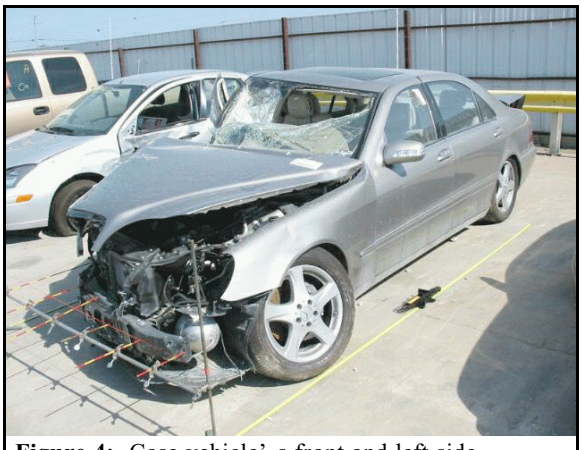


Figure 4: Case vehicle' s front and left side

The case vehicle sustained heavy direct contact damage from the first impact at the front right corner. As the two vehicles rotated into each other, the right front wheel/axle/suspension, fender, hood, A-pillar and the right front door also sustained heavy direct contact damage (**Figure**

3). The bumper cover was torn away, the grill was shattered, both headlamp/turn signal assemblies were broken away and the left front wheel and fender sustained substantial induced damage (**Figure 4**). Maximum longitudinal crush for the frontal impact was measured as 43 centimeters [16.9 inches] at the front right corner. The right front corner structures were crushed 27 centimeters [10.6 inches] laterally. The right wheelbase was reduced by 33 centimeters [13.0 inches] and left wheelbase was stretched by 6 centimeters [2.4 inches]. The right front axle/suspension was broken and the right front tire was restricted by deformed body panels.

The CDC for the case vehicle's first impact was determined to be **01-FREW-2 (40)**. The WinSMASH reconstruction program, damage algorithm based on the measured crush profile of both vehicles, was used. For the most severe (first) impact, the case vehicle's total, longitudinal and lateral delta-Vs are, respectively: 30 km.p.h. [19 m.p.h.], -23 km.p.h. [-14 m.p.h.] and -19 km.p.h. [-12 m.p.h.]. The NASS researcher judged that these results are reasonable but probably somewhat low due to the stiffness of the structures at the right front wheel and right A-pillar.

The case vehicle also sustained moderate direct contact damage from the second (side slap) impact at its right rear corner (**Figure 5**). As the two vehicles rotated and separated from the first impact, the case vehicle sustained direct contact beginning at the right rear corner and continuing forward to the C-pillar and the trailing edge of the right rear door. The right rear turn signal/tail lamp assembly was shattered, the quarter panel was crushed inward, the trunk lid was deformed and displaced, the area above the wheel well including the fuel port was dented and crushed slightly, and there was abrading on the lower C-pillar and on the right rear door near. The right rear tire was restricted by deformed body panels. Maximum crush was measured as 30 centimeters [11.8 inches] slightly forward of the apex of the right rear corner.

Figure 5: Case vehicle's back and right side

The CDC for the second impact was determined to be **03-RZEW-2 (90)**. The WinSMASH reconstruction program, damage algorithm based on the measured profile of both vehicles, was used. For the second (side slap) impact, the case vehicle's total, longitudinal and lateral delta-Vs are, respectively: 9 km.p.h. [6 m.p.h.], 0 km.p.h. [0 m.p.h.] and -9 km.p.h. [-6 m.p.h.]. These results seem reasonable. The second impact was of minor severity (1-13 km.p.h. [1-8 m.p.h.]) for the case vehicle.

The case vehicle's windshield was heavily cracked across its entire width, with complete separation along the left two-thirds of the windshield header, tearing of the laminate along an oblique crack and further separation along the right A-pillar (**Figures 3** and **4**). The case vehicle's side glazing was laminated and the right front door window glazing was entirely

shattered but did not break away. The right rear window sustained minor cracking and the back light sustained a localized area of heavy cracking at the lower right corner. There was no other glazing damage.

The case vehicle sustained several moderate intrusions primarily at the front right seat area (**Figure 6**), including: the lower right A-pillar (17 cm. [6.7 inches] longitudinal); the right side panel forward of the A-pillar (11 cm. [4.3 inches] lateral); the right front door sill (approximately 10 cm. [3.9 inches] lateral); the right front toe pan (approximately 10 cm. [3.9 inches] longitudinal; the right instrument panel (approximately 10 cm. [3.9 inches] longitudinal); the right roof rail in the right front seat area (4 cm. [1.6 inches] lateral); and other intrusions, of lesser magnitude, across the entire width of the front seat row. The right front door was jammed shut and there are pry marks where rescue personnel forced the door open.

Figure 6: Intrusions in front right seat area

Inspection of the case vehicle's interior revealed various points of occupant contact, mostly in the front right seating area. These included: scuffing on the lower instrument panel; blood and cracking of the right front door-mounted audio speaker grille; and deformation of the right front door arm rest. There was occupant contact evidence on the front right frontal air bag and the right roof rail-mounted curtain wall air bag in the right front seating area. In addition, there was evidence of loading on the front right seat belt buckle. The front right seat belt webbing was cut by rescue personnel.

AUTOMATIC RESTRAINT SYSTEM

The case vehicle was equipped with driver and front right passenger frontal air bags, door-mounted side impact air bags at the four outboard seating positions, and roof rail-mounted inflatable curtains that provide protection for the front and back seats, for a total of eight air bags in the vehicle. The two frontal air bags, the right front and back door-mounted side impact air bags and the right roof rail-mounted inflatable curtain all deployed, for a total of five deployed air bags.

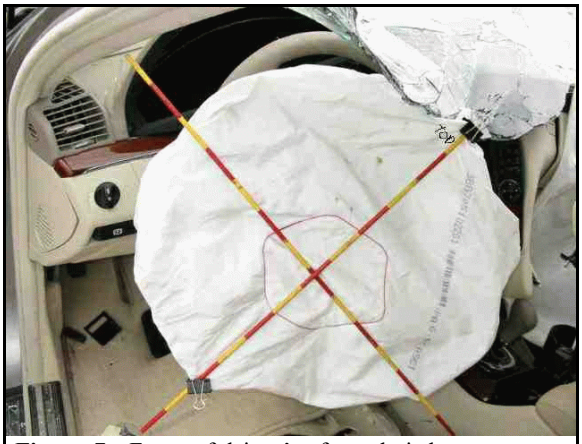


Figure 7: Front of driver's frontal air bag

The driver's frontal air bag (**Figure 7**) was mounted in the steering wheel hub with the module cover flaps in the H-configuration. The

cover flaps measured 16 centimeters [6.3 inches] horizontally, with the upper flap 6 centimeters [2.4 inches] vertically and the lower flap 9 centimeters [3.5 inches]. The cover flaps opened at the tear points and there was no evidence of damage to the cover flaps or the adjacent structures. The driver's frontal air bag was round with a diameter of 60 centimeters [23.6 inches]. There was one circular vent port of unknown diameter, located near the center on the back. There were areas of blood droplets and scuffing on the front of the air bag, with no evidence of contact on the back. There was no evidence of damage to the driver's frontal air bag.

The front right passenger's frontal air bag (**Figure 8**) was located in the top of the instrument panel on the right, with cover flaps in the H-configuration. The cover flaps measured 30 centimeters [11.8 inches] horizontally, with the upper flap 10 centimeters [3.9 inches] vertically and the lower flap 6 centimeters [2.4 inches]. The cover flaps opened at the tear points, except the pre-stressed seam on the right side of the lower flap did not tear open along its entire length, and there was no evidence of damage to the cover flaps or the adjacent structures. The front right passenger's frontal air bag was rectangular, measuring 60 centimeters [23.6 inches] horizontally and 50 centimeters [19.7 inches] vertically. There was one vent port, of unknown diameter, on the right side of the air bag. There were areas of blood staining, makeup transfers and scuffing on the front of the air bag, with no evidence of contact on the top, bottom or sides. There was no evidence of damage to the front right passenger's frontal air bag.

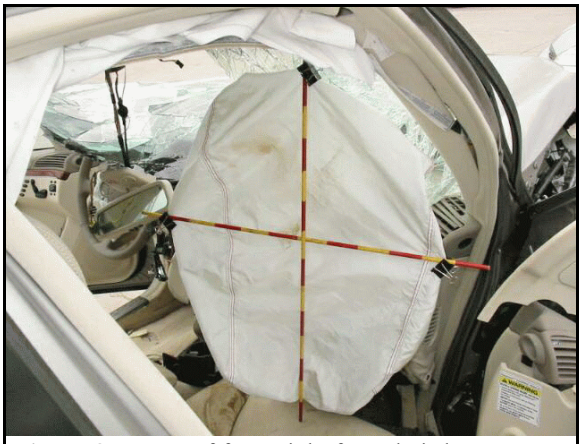


Figure 8: Front of front right frontal air bag

The front right door-mounted side impact air bag (**Figure 9**) was located above the arm rest, with a single cover flap behind a fabric panel. The fabric panel separated along a pre-stressed seam and the module cover flap opened downward through the opening in the fabric panel. There was tearing of the upper fabric panel on the rearward edge. The cover flap measured 20 centimeters [7.7 inches] horizontally and 6 centimeters [2.7 inches] vertically. There was no evidence of damage to the cover flap. The air bag was approximately trapezoidal in shape, measuring 52 centimeters [20.5 inches] horizontally and 30 centimeters [11.8 inches] vertically. There was no vent port. There was an area of unidentified staining on the inboard surface of the air bag, near the forward edge, and no other evidence of occupant contact. There was no evidence of damage to the front right door-mounted side impact air bag.

Figure 9: Inboard surface of front right door-mounted side impact air bag

The right side roof rail-mounted inflatable curtain (**Figures 10** and **11**) was installed behind a trim panel where the roof joins the side of the passenger compartment interior. There is no module cover flap as such for the inflatable curtain. Rather, the expanding inflatable curtain causes the trim panel to separate from the side structures and the inflatable curtain emerges through this opening. There was no evidence of damage along the length of the trim panel. The single inflatable curtain provides protection for both the front and back seat areas. The curtain wall was rectangular, measuring 162 centimeters [63.8 inches] horizontally and 31 centimeters [12.2 inches] vertically. There was no vent port. There was an area of scuffing from an undetermined source near the front edge and no other evidence of contact. There was no evidence of damage to the right roof rail-mounted inflatable curtain.

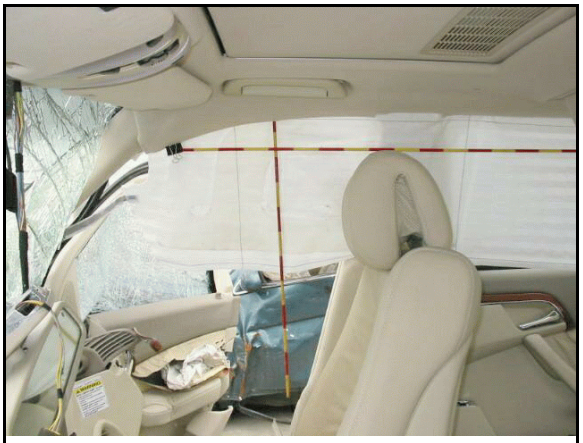


Figure 10: Front portion, inboard surface of right roof rail-mounted inflatable curtain

Figure 11: Rear portion, inboard surface of right roof rail-mounted inflatable curtain

The back right door-mounted side impact air bag (**Figure 12**) was located immediately above the arm rest, with a single cover flap behind a fabric panel. The fabric panel separated along a pre-stressed seam across the middle, with the module cover flap opening downward through the opening in the fabric panel. There was no evidence of damage to the fabric panels. The cover flap measured 20 centimeters [7.7 inches] horizontally and 6 centimeters [2.7 inches] vertically. There was no evidence of damage to the cover flap. The back right door-mounted side impact air bag was approximately oval in shape, measuring 52 centimeters [20.5 inches] horizontally and 30 centimeters [11.8 inches] vertically. There was no vent port. There was no evidence of occupant contact and no evidence of damage to the back right door-mounted side impact air bag.

Figure 12: Inboard surface of back right door-mounted side impact air bag

The case vehicle' s front right passenger (56-year-old female, white, unknown if Hispanic, 168 centimeters, 86 kilograms [66 inches, 190 pounds]) was restrained by her available, active, three-point, lap-and-shoulder safety belt system. The front right bucket seat track was adjusted at the middle position and the seat back was upright. Her pre-crash posture is not known, but she was probably in a normal seated posture, with her back against the seat back and her feet on the floor.

There is no evidence that the case vehicle driver attempted any avoidance maneuvers and the front right passenger was probably leaning slightly to the right in response to the left turn steering maneuver. Based on the front right passenger' s injuries, it seems likely that she noticed the other vehicle approaching at high speed and reflexively attempted to protect herself by leaning forward and to the left. In this posture, she was very close to the instrument panel air bag. The case vehicle' s front right corner was impacted by the other vehicle' s front, causing the case vehicle' s driver and front right passenger air bags to deploy and causing the driver and front right passenger pretensioners to actuate. The front right passenger moved forward, rightward and slightly upward, in a direction parallel and opposite to the 50 degree direction of the impact force. The deploying front right frontal air bag impacted the right side of her head, neck and chest causing numerous critical (AIS 5), severe (AIS 4) and serious (AIS 3) brain injuries, atlanto-occipital dislocation, multiple bilateral rib fractures, bilateral lung contusions, and contusions on her right scalp, right mandible, neck, right shoulder and chest. She loaded the safety belt webbing as the pretensioner actuated and she sustained fractures in the pelvis, contusions of the small intestines, and skin contusions across her lower abdomen. Her right knee loaded against the knee bolster and she sustained a mid-shaft fracture of the right femur with contusions and abrasions on her right knee. Her feet loaded against the intruding toe pan and she sustained bilateral tibia and fibula fractures. Her left leg loaded against the intruding center portion of the instrument panel and she sustained contusions, abrasions and lacerations on her left lower leg. As the case vehicle rotated counterclockwise and then sustained the second (side slap) impact, she moved further to the right. Her right leg loaded against the intruded right side panels and she sustained abrasions on her right thigh and lower leg. The driver also moved rightward and impacted the left side of the right front occupant' s head and shoulder, causing a subgaleal hematoma in the left parietal area and contusions on her left shoulder and left upper arm. As the case vehicle came to final rest, she was unconscious and held in place by the safety belt system.

FRONT RIGHT PASSENGER' S INJURIES

The front right passenger was transported by ground ambulance to a hospital. She was admitted for treatment and subsequently pronounced dead approximately 50 hours post-crash.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Hematoma/hemorrhage, subdural, small-to-moderate, over vertices of cerebral hemispheres and base of skull, especially in posterior cranial fossa and foramen magnum	critical 140654.5,3	Air bag, front right passenger' s	Certain	Autopsy
2	Diffuse axonal injury, not further specified	critical 140628.5,3	Air bag, front right passenger' s	Certain	Hospitalization records
3	Injury with hemorrhage in brain stem, not further specified	critical 140210.5,8	Air bag, front right passenger' s	Certain	Hospitalization records
4	Dislocation, atlanto-occipital, with palpated gaping anterior separation	moderate 650208.2,6	Air bag, front right passenger' s	Certain	Autopsy
5	Hemorrhage, intracerebral, subcortical, not further specified	serious 140644.4,1	Air bag, front right passenger' s	Certain	Autopsy
6	Contusion {hematoma}, 0.6 cm (0.2 in) posterior right rostral pons, adjacent to superior cerebellar peduncle (dorsal pons)	critical 140204.5,8	Air bag, front right passenger' s	Certain	Autopsy
7	Hemorrhage, subarachnoid, diffuse, not further specified	serious 140684.3,2	Air bag, front right passenger' s	Certain	Autopsy
8	Hemorrhage, subarachnoid, diffuse, not further specified	serious 140684.3,1	Air bag, front right passenger' s	Certain	Hospitalization records
9	Contusions cerebrum: 1 cm (0.4 in) curvilinear anterior right frontal lobe and 2 x 2 cm (0.8 x 0.8 in) adjacent right hippocampus at lateral geniculate body	serious 140614.3,1	Air bag, front right passenger' s	Certain	Autopsy
10	Hemorrhage/hematoma within right lateral ventricle, not further specified	severe 140678.4,1	Air bag, front right passenger' s	Certain	Autopsy

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
11	Fractured ribs: 1-12 left anterolaterally, 1-12 right anterolaterally, 1-12 right posteriorly, with bilateral flail chest and bilateral lung {pulmonary} contusions {soft bloody parenchyma} and bilateral hemothoraces (i.e., 50 cc serosanguineous fluid in each pleural cavity); Note: many ribs are displaced	critical 450266.5,3	Air bag, front right passenger' s	Certain	Hospitalization records
12	Fracture left superior and inferior pubic ramii, with displacement {floating segment}	serious 852604.3,5	Lap portion of safety belt system	Certain	Hospitalization records
13	Fracture, closed, displaced, mid-to-distal right femur	serious 851814.3,1	Knee bolster, front right passenger' s	Certain	Autopsy
14	Fracture right fibula, not further specified as to site	moderate 851605.2,1	Floor, including toe pan	Certain	Hospitalization records
15	Fracture, displaced, right tibia, not further specified as to site	serious 853405.3,1	Floor, including toe pan	Certain	Hospitalization records
16	Fracture left fibula, not further specified as to site	moderate 851605.2,2	Floor, including toe pan	Certain	Hospitalization records
17	Fracture, open[1], displaced, left anteromedial ankle (i.e., tibia)	serious 853405.3,2	Floor, including toe pan	Certain	Hospitalization records
18	Hemorrhage, subarachnoid, diffuse, small-to-moderate, most prominent over cerebellum, including posterior cranial fossa and foramen magnum	serious 140466.3,6	Air bag, front right passenger' s	Certain	Autopsy
19	Contusion, 10.2 x 10.2 cm (4 x 4 in) right mandibular face area	minor 290402.1,8	Air bag, front right passenger' s	Certain	Autopsy
20	Contusion, subscalpular, right ear region	minor 190402.1,1	Air bag, front right passenger' s	Certain	Autopsy
21	Contusion, subscalpular, left ear region	minor 190402.1,2	Other occupant: driver	Certain	Hospitalization records
22	Contusions, extensive, large, left shoulder, left upper arm, antecubital fossa, and volar surface left wrist	minor 790402.1,2	Other occupant: driver	Possible	Autopsy

[1] The following lacerations were described: two, one gaping, 5.1 x 3.8 cm (2 x 1.5 in) anteromedial lower leg near left ankle; in addition, one 7.6 cm (3 in) over exposed displaced fracture anteromedial left ankle.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
23	Contusions, extensive, large, right shoulder, right antecubital fossa, posterior right upper arm, elbow, forearm, and dorsum right hand	minor 790402.1,1	Air bag, front right passenger' s	Certain	Autopsy
24	Contusions, extensive, chest, not further specified, with extravasation in subcutaneous muscle of upper and lateral chest and breasts	minor 490402.1,3	Air bag, front right passenger' s	Certain	Autopsy
25	Contusion, extensive, neck, NFS, with extravasation in subcutaneous muscle of neck	minor 390402.1,9	Air bag, front right passenger' s	Certain	Autopsy
26	Contusions scattered right anterior thigh	minor 890402.1,1	Right side interior surface, excluding hardware and/or armrest	Certain	Autopsy
27	Contusions, large, right lateral knee, not further specified	minor 890402.1,2	Knee bolster, front right passenger' s	Certain	Autopsy
28	Contusions, large, right lower leg and dorsum foot	minor 890402.1,2	Right side interior surface, excluding hardware and/or armrest	Certain	Autopsy
29	Abrasions, scattered, right lower leg, not further specified	minor 890202.1,1	Knee bolster, front right passenger' s	Certain	Autopsy
30	Abrasions, scattered, left lower leg anteriorly	minor 890202.1,2	Center instrument panel and below	Certain	Autopsy
31	Contusions, majority anterior left leg–large	minor 890402.1,2	Center instrument panel and below	Certain	Autopsy
32	Laceration, minor, left lower leg, not further specified	minor 890602.1,2	Center instrument panel and below	Certain	Autopsy
33	Contusion, abundant, right groin and hip and contusion, small than right, left groin	minor 590402.1,8	Lap portion of safety belt system	Certain	Autopsy

The case vehicle' s driver (17-year-old male, white, unknown if Hispanic, height and weight not known) was restrained by his available, active, three-point, lap-and-shoulder safety belt system. His bucket seat track was adjusted at the rearmost position and the seat back was slightly reclined. His pre-crash posture is not known, but he was probably in a normal driving posture with his back against the seat back, at least one hand on the steering wheel and his feet on the floor or operating the foot controls.

The driver was executing a left turn and he was probably leaning slightly to the right. He did not attempt any avoidance maneuvers and his posture did not change. The case vehicle' s front right corner area was impacted by the other vehicle' s front, causing the case vehicle' s driver and front right passenger frontal air bags to deploy and causing the driver and front right passenger pretensioners to actuate. The driver probably moved slightly forward and rightward in response to the 1:00 o' clock direction of force, but he was held in place by the safety belt system. He probably encountered the driver' s air bag with his face and chest and he sustained a moderate non-anatomic brain injury (unconsciousness known to be less than one hour). The air bag contacted his right wrist, causing an abrasion and a contusion, and his right hand was jammed against the steering wheel rim resulting in a fracture in his third right finger. He loaded the safety belt webbing and sustained an abrasion on the left side of his neck, plus abrasions and contusions across his abdomen. As the case vehicle sustained the second (side slap) impact and then slid to final rest, his upper left arm impacted the left side interior and he sustained a contusion. His position at final rest is not known, but he was probably slumped (unconscious) in the driver' s seat, held in place by the safety belt system.

DRIVER' S INJURIES

The driver was transported by ground ambulance to a hospital. He was treated and released at the emergency department.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Nonanatomic brain injury, unconsciousness known to be less than one hour	160414.2,0 moderate	Driver' s frontal air bag	Probable	Emergency Room
2	Fracture, proximal phalanx, third right finger	752404.1,1 minor	Steering wheel rim	Certain	Emergency Room
3	Abrasion, left neck/throat	390202.1,2 minor	Belt restraint webbing/buckle	Certain	Emergency Room
4	Abrasion, right wrist	790202.1,1 minor	Driver' s frontal air bag	Certain	Emergency Room
5	Contusion, right wrist	790402.1,1 minor	Driver' s frontal air bag	Certain	Emergency Room

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
6	Contusion, left upper arm	790402.1,2 minor	Left side interior surface	Probable	Emergency Room
7	Abrasion, abdomen, unknown area	590202.1,9 minor	Belt restraint webbing/buckle	Certain	Emergency Room
8	Contusion, abdomen, unknown area	590402.1,9 minor	Belt restraint webbing/buckle	Certain	Emergency Room

OTHER VEHICLE

The other vehicle was a 1999 Toyota Camry front wheel drive, four-door, five-passenger sedan (VIN: 4T1BG22K8XU------). The Toyota was equipped with driver and front right passenger air bags which deployed as a result of the crash. The odometer reading is not known due to the non-functional electronic odometer. Its wheelbase was 267 centimeters [105.2 inches]. The Toyota was towed due to damage.

Figure 13: Toyota' s front and right side

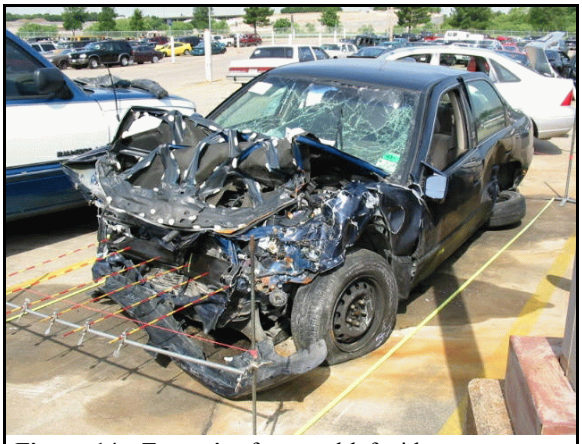


Figure 14: Toyota' s front and left side

The Toyota sustained direct contact damage across its entire front from the first impact (**Figures 13** and **14**). The grille and both headlamp/turn signal assemblies were shattered and broken away, the bumper cover was torn off, and all the structures in the front overhang were shifted to the right. The steel bumper was crushed rearward, more so on the right, and the radiator was crushed against the engine block. The surface panel of the hood was torn off of its frame and the frame was crushed rearward and folded. The right fender was crushed rearward and folded outward. The left fender had extensive direct crush resulting from the sustained contact as the Toyota rotated clockwise into the right side of the case vehicle. Maximum longitudinal crush from the first impact was measured as 71 centimeters [27.9 inches] near the center of the front plane. Both front tires were deflated and their rotation was restricted by deformed body panels. The wheelbase was shortened by 20 centimeters [7.9 inches] on the right and 8

centimeters [3.1 inches] on the left. The windshield was heavily cracked, the left front and right rear window glazing was shattered and there was no other glazing damage.

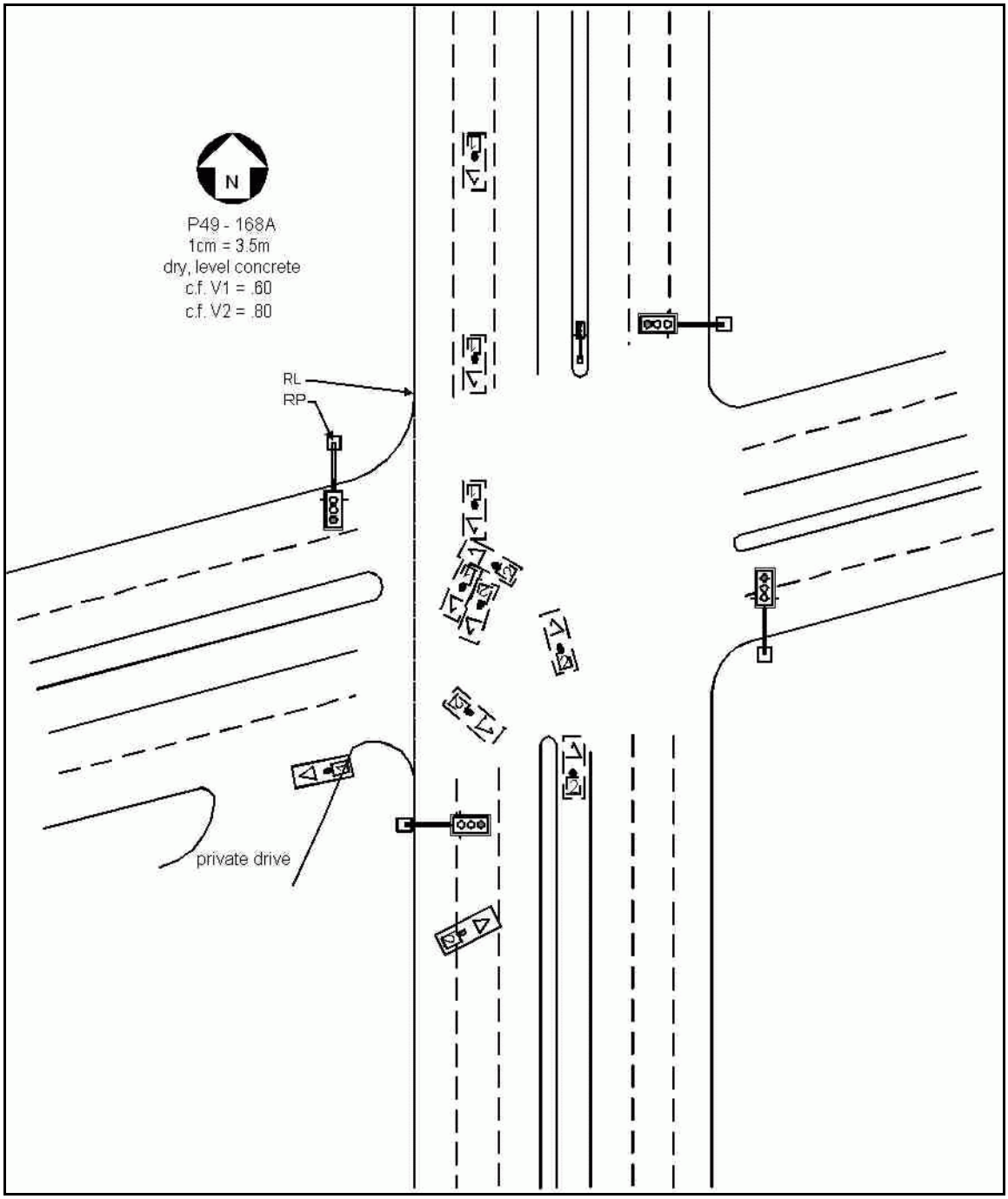
The CDC for the Toyota' s first impact was determined to be **71-FDEW-3 (340)** (i.e., the force was in the 11:00 o' clock sector with the + 60 right end shift increment). The WinSMASH reconstruction program, damage algorithm based on the measured crush profile of both vehicles, was used. For the most severe (first) impact, the Toyota' s total, longitudinal and lateral delta-Vs are, respectively: 44 km.p.h. [27 m.p.h.], -41 km.p.h. [-26 m.p.h.] and + 15 km.p.h. [+ 9 m.p.h.]. The NASS researcher judged that these results are reasonable but probably somewhat low.

The Toyota also sustained direct contact damage in the area of the left rear door, wheel well and wheel from the second (side slap) impact (**Figure 15**). As the Toyota rotated clockwise in response to the 11:00 o' clock force of the first impact, its front pitched downward and its rear wheels were probably off the ground. The left rear door panel and the leading edge of the left rear wheel well contacted the case vehicle' s right rear corner and quarter panel (see **Figure 5**). The Toyota sustained moderate crush and the left rear wheel was broken off the axle. Maximum crush was measured as 13 centimeters [5.1 inches], at the trailing edge of the left rear door.

Figure 15: Toyota' s left side, showing side slap impact area

The CDC for the Toyota' s second impact was determined to be **09-LZEW-2 (270)**. The WinSMASH reconstruction program, damage algorithm based on the measured profile of both vehicles, was used. For the second (side slap) impact, the Toyota' s total, longitudinal and lateral delta-Vs are, respectively: 13 km.p.h. [8 m.p.h.], 0 km.p.h. [0 m.p.h.] and + 13 km.p.h. [+ 8 m.p.h.]. These results seem reasonable. The second impact was of minor severity (1-13 km.p.h. [1-8 m.p.h.]) for the Toyota.

According to the police crash report, the Toyota's driver (32-year-old male, white, unknown if Hispanic, height and weight unknown) was not using his available, active, three-point, lap-and-shoulder safety belt system and the driver' s frontal air bag deployed. The driver was transported by ground ambulance to a hospital where he was admitted for five days.


N
P49 - 168A
1cm = 3.5m
dry, level concrete
c.f. V1 = .60
c.f. V2 = .80
RL
RP
private drive