

**TRANSPORTATION SCIENCES
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**VERIDIAN ON-SITE FRONTAL AIR BAG
ASYMMETRICAL DEPLOYMENT INVESTIGATION
VERIDIAN CASE NO. CA99-006
VEHICLE: 1997 BUICK SKYLARK
LOCATION: NEW JERSEY
CRASH DATE: MARCH 1999**

Contract No.
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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 are 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. <i>Abstract</i> This crash involved a 1997 Buick Skylark that was equipped with front air bags for the driver and right passenger positions. The crash occurred during daylight hours in the month of March 1999. The 76 year old male driver was traveling eastbound on an interstate route with his 76 year old wife who was seated in the front right passenger seat when the vehicle departed the left side of the roadway and struck the upstream end of a strong post W-beam guardrail system that located in the depressed grass median. The crash resulted in an asymmetrical deployment of the frontal air bag system where the front left driver air bag failed to deploy. The driver was pronounced deceased at the scene by the regional medical examiner.			
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VERIDIAN CASE NO. CA99-06
VEHICLE: 1997 BUICK SKYLARK
LOCATION: STATE OF NEW JERSEY
CRASH DATE: MARCH 1999**

BACKGROUND

This crash involved a 1997 Buick Skylark that was equipped with front air bags for the driver and right passenger positions. The crash occurred during daylight hours in the month of March 1999. The 76 year old male driver was traveling eastbound on an interstate route with his 76 year old wife who was seated in the front right passenger seat when the vehicle departed the left side of the roadway and struck the upstream end of a strong post W-beam guardrail system that located in the depressed grass median. The crash resulted in an asymmetrical deployment of the frontal air bag system where the front left driver air bag failed to deploy. The driver was pronounced deceased at the scene by the regional medical examiner.

The Crash Investigation Division (CID) of the National Highway Traffic Safety Administration (NHTSA) was notified by the Veridian Special Crash Investigation (SCI) Team after the Team had been made aware of the crash by a litigation consultant on April 21, 1999. The SCI Team was then directed by the CID at the request of the NHTSA's Office of Defects investigation (ODI) to conduct an on-scene investigation. The on-site investigation was scheduled for April 27, a mutual date agreed upon by the representing attorney and representatives from General Motors Corporation. All parties were present at the time of vehicle inspection.

SUMMARY

Crash Site

Prior to the crash, the 1997 Buick Skylark was traveling eastbound presumably in the left lane of a four lane divided (two lanes in each direction), negative 1.7 percent slope, straight, dry asphalt, interstate roadway with a posted speed limit of 105 km/h (65 mph). The weather was clear with good visibility reported by the investigating officer the tow truck operator. The solid yellow left roadway edge line and the broken white lane lines were in good condition (**refer to Figure 1**).



Figure 1- Approach trajectory of the Buick at 30 m from the point of impact (POI)

Crash Sequence

Pre-Crash

Scene evidence and damage to the front of vehicle indicated that the vehicle departed the roadway at a shallow angle, traveled parallel to the roadway and struck the guardrail end. The deformation pattern to the frontal plane of the vehicle was also indicative of a longitudinal impact configuration. The left front bumper corner was displaced rearward 42.5 cm (16.75") while the left axle was displaced 49.3 cm (19.4") rearward with no lateral displacement (**refer to Figure 2**). There were two 10.5 m (34') rolling tire prints leading to the guardrail end. The left tire print was directly in line with the barrier end and parallel to the roadway edge (**refer to Figure 3**). The driver possibly fell asleep or experienced a medical condition that resulted in loss of control of the vehicle prior to the roadway departure. In analyzing the scene evidence and vehicle damage, it appeared that the vehicle drifted off the roadway and struck the guardrail end without the driver initiating avoidance actions.



Figure 2- Damage resulting from the impact with the guardrail end



Figure 3- Trajectory of the Buick prior to the POI with the guardrail end

The damaged guardrail system had been replaced at the time of this on-site inspection. The attorney was present during this activity and indicated that the replacement guardrail system was very different from the system that was involved in the crash. The replacement system was a strong wooden post construction with a breakaway cable terminal (BCT) end treatment. The replacement BCT was located 3.75 m (12.3') north of the left roadway edge line. The attorney described the original system as consisting of metal posts mounted in concrete bases. He said the guardrail was deformed in a "V" shape pattern with the post and base adjacent to the "V" deformation displaced approximately 15 cm (6.0") from the impact.

Crash

The front left area of the Buick Skylark impact the barrier end resulting in a 12 o'clock direction of force impact. The assigned Collision Deformation Classification (CDC) code for the Buick was 12-FLEE-5. The extent zone of "5" was based on length of contact which extended 124.4 cm (49.0") along the left front fender area. Although this crash was beyond the scope of the WinSMASH algorithm due to energy management properties of guardrails, a barrier equivalent computation was performed to provide a range value for the delta V. The total delta V value computed by the damage routine was 29.6 km/h (18.4 mph) with a longitudinal component of -29.6 km/h (-18.4 mph) which was sufficient to deploy the Buick's frontal air bag system. The front left driver air bag failed to deploy while the front right passenger air bag functioned appropriately. Inspection of the air bag module indicated that the air bag and inflator unit were intact and the visible wiring was attached. There were no visible abnormalities noted.

As the Buick crushed to maximum engagement, the vehicle rotated approximately 70 degrees in a counterclockwise direction and traveled approximately 3.5 m (11.5') in a southeasterly direction before coming to rest straddling the inboard shoulder, facing in an easterly direction. **Figure 4** is a schematic of the crash scene.

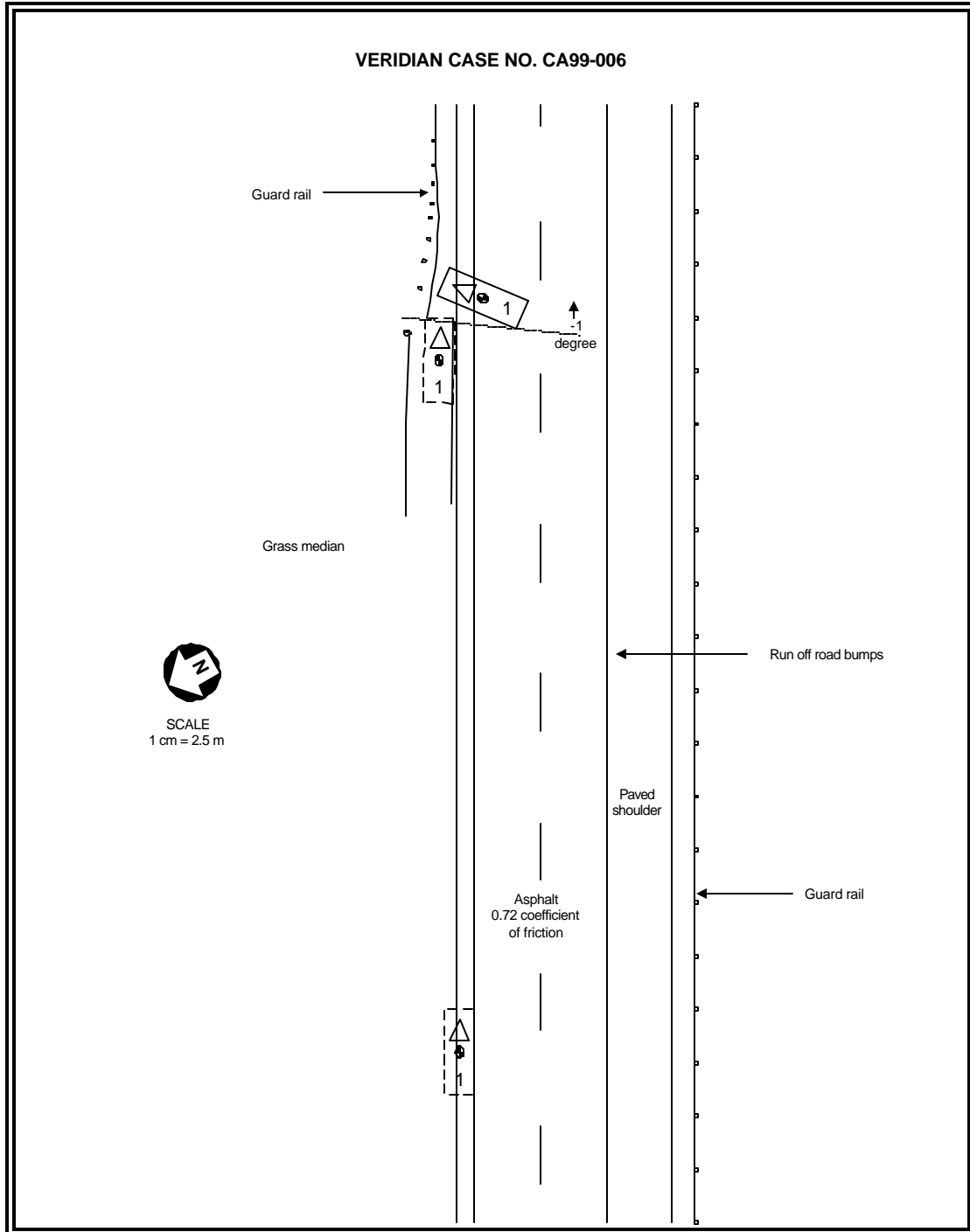


Figure 4- Scaled scene schematic

Post-Crash

Rescue personnel arrived on-scene and extricated the driver from the vehicle. The tow truck operator stated that the steering wheel rim was against the driver's chest at final rest, pinning him against the seat back. Rescue personnel removed the roof, cut the left front sill (rocker panel), and used a hydraulic spreader at the base of the A-pillar to push it toward its original position so ease the extrication process. The 76 year old female front right passenger was restrained by the manual 3- point lap and shoulder belt. She was removed from the vehicle by rescue personnel and transported to a trauma center where she was admitted for fracture of the ribs, facial swelling, and abrasions and laceration of the face. She was transferred to a senior citizens hospice center six days later. Rescue personnel were on-scene approximately two hours. The Buick was subsequently towed from the scene of the crash.

Vehicle Data

The vehicle was purchased by the driver as a used vehicle the previous year. The registration tag listed an odometer reading of 41,721 km (25,925 miles) which was presumed to have been the mileage at the time of purchase. The Buick was manufactured in January 1997 and was identified by vehicle identification number 1G4NJ52T8VC (production number deleted). At the time of the crash and subsequent SCI inspection, the Buick had an odometer reading of 74,105 km (46,048 miles). There was a recall campaign sticker on the upper radiator support which contained the following information:

GM Campaign
97018
Completed
35-572 Dealer Code

The specifics of the recall campaign were not known.

Vehicle Damage

Exterior - 1997 Buick Skylark

The 1997 Buick Skylark sustained severe exterior damage that involved the front bumper, the hood, the left front fender, radiator, left front wheel and axle, left A-pillar, left front door, left front door glazing and windshield (**refer to Figure 5**). Maximum crush was 42.5 cm (16.75") located at the left front bumper corner. The direct contact damage began at the front left bumper corner and extended 22.9 cm (9.0") inboard. The combined induced and direct contact damage (Field L) was 124.5 cm (49.0") which involved the full frontal width. The contact continued along the left front fender resulting in an overall contact extent of 124.5 cm (49.0"). The left side wheel base was displaced rearward 49.2 cm (19.4"). The crush profile is listed in the following table: $C_1 = 124.5$ cm (49.0"), $C_2 = 12.1$ cm (4.75"), $C_3 = 6.4$ cm (2.5"), $C_4 = 3.5$ cm (1.4"), $C_5 = 0$ cm, $C_6 = 0$ cm.



Figure 5 - Left front corner view of the Buick Skylark

The WinSMASH damage reconstruction algorithm was used to compute barrier equivalent delta V values. The output from the damage routine indicated that the vehicle experienced a total delta V of 29.6 km/h

(18.4 mph) as shown in the following table. This value appeared to be understated from the visually estimated delta V of 40-48 km/h (25-30 mph). The delta V experienced by the vehicle was sufficient to deploy the supplemental restraint system. The WinSMASH output is summarized in the following table:

Total delta V	29.6 km/h (18.4 mph)
Longitudinal delta V	-29.6 km/h (-18.4 mph)
Lateral delta V	0
Energy dissipated	49,991 joules (36,878 ft-lb)
Barrier equivalent speed	29.6 km/h (18.4 mph)

Interior -1997 Buick Skylark

Interior vehicle damage to the 1997 Buick Skylark was attributed to occupant contact, the partial deployment of the frontal air bag system, and compartment intrusion. The steering column, left instrument panel, left A-pillar, and the left toe pan were the most significant intruding components. Due to the location of the exterior damage (i.e., crush outboard of the left frame rail), the energy developed during the crash sequence was concentrated at the left front axle resulting in a severe rearward displacement of the axle.

A direct consequence of the left front axle displacement was the resulting rearward movement of the steering column. The tow truck operator who was on-scene during extrication activities observed that the steering wheel was against the driver's chest pinning him against the seat back. The steering wheel rim was deformed forward a measured distance of 15.2 cm (6.0") along the top portion and 6.4 cm (2.5") along the bottom edge that was attributed to contact with the driver's chest area. Both shear capsules were separated from the shear module with displacement values of 3.8 cm (1.5") at the left and 4.4 cm (1.75") at the right capsule.

The degree of steering column intrusion could not be determined due to the relocated position of the column by rescue. The left lower A-pillar, however, had a longitudinal intruded value of 40.6 cm (16.0"). The left instrument panel intrusion measured 21.6 cm (8.5"), however, this value was considered to be an altered minimum value due to the 20 cm (8"0) forward spreading by rescue personnel (**refer to Figure 6**).



Figure 6- View of the left lower A-pillar and left sill showing the area cut and spread by rescue

Both the turn signal stalk and the tilt wheel adjustment lever were bent and fractured. This was attributed to contact by the driver's left hand. There was a 15.2 cm (6.0") wide deformation contact pattern on the right side of the driver's knee bolster which was attributed to contact by the driver's right knee during the crash sequence. This contact was located 7.6 cm (3.0") left of the vehicle centerline.

The left sunvisor exhibited a 8.9 cm x 5.1 cm (3.5" x 2.0") beige smudge mark which was located 29.2 cm (11.5") left of the vehicle centerline. This was attributed to a possible driver head contact.

The driver's 3-point lap and shoulder belt exhibited witness marks (**refer to Figure 7**) that could support usage during the crash. There was a small disruption of the lap belt weave which measured 6.4 mm (0.25"). This small area was located over the seat cushion area and could have resulted from contact by some artifact in the driver's clothing (e.g., zipper, belt buckle, etc). There was a subtle striated abrasion pattern noted along the surface of the shoulder belt where it entered the vinyl cutout along the upper B-pillar. The determination of belt usage was confounded by the degree of steering wheel rim deformation and the total separation of the shear capsules. The degree of deformation and column movement generally represents a loading pattern by an unrestrained driver. Given the extreme rearward movement of the instrument panel and steering column from the impact, it appeared likely that the driver may have started to move forward and began to load the shoulder belt when the steering wheel contacted his chest. The belt restraint were not cut by rescue personnel during extrication activities.



Figure 7- View of the small disruption of the lap belt webbing

The front left seat appeared to be in a mid to rear adjusted position. The seat back was reclined 19 degrees aft of vertical. The steering column was rotated upward and pulled forward by rescue personnel. The residual dimension between the seat back and the steering wheel hub measured 45.7 cm (18.0") at a height of 53.3 cm (21.0") above the junction with the seat cushion.

The center instrument panel exhibited a scuff mark that measured 3.8 cm (1.5") vertically. It was located 10.2 cm (4.0") right of the vehicle centerline and was attributed to contact by the expanding front right passenger air bag.

The windshield was removed from the vehicle by rescue personnel. Although it exhibited obvious stress fractures, it was devoid of any occupant contact evidence.

The right front occupant was reportedly wearing the lap and shoulder belt at the time of the crash. There was no evidence of occupant loading noted on the restraint system.

Frontal Air Bag System

The Supplemental Restraint System (SRS) in the 1997 Buick Skylark Custom was designed with frontal air bags for the driver and right passenger positions which deployed in an asymmetrical deployment pattern. The front right passenger air bag deployed as designed while the front left driver air bag failed to deploy and remained encapsulated in the air bag module compartment (**refer to Figures 8 and 9**). The impact with the guardrail end was sufficient to deploy the SRS.



Figure 8- View showing the undeployed front left driver air bag module.

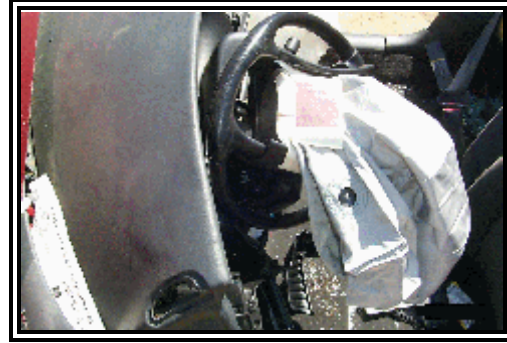


Figure 9- View of the front left driver air bag after it was mechanically removed from the air bag module

The General Motors representatives removed the SDM from under the right front passenger seat and downloaded the EEPROM data using an external power supply. Although the SDM was surrounded by water on the floor prior to its removal, it did not appear to have been damaged and readily uploaded the stored data.

The Tech 1 printout of the data stream was secured for this investigation. Although the encrypted binary code data was to be interpreted by the manufacturer, the data was never forwarded to the Veridian SCI team. The information shown under the Tech 1 Data List indicated that the driver seatbelt was buckled.

Front Left Air Bag

The front left air bag module was removed from the steering wheel mounting assembly and inspected for wiring continuity. While attempting to remove the air bag module, it was discovered that there were two anti-theft air bag locking bolts holding the unit in place. The head of the locking bolt was designed with a depressed irregular key lock type pattern. The outer edge (perimeter) of the bolt head was tapered which prevented the use of clamping tools for bolt removal.

The tow yard operator was not familiar with this bolt type and invited the owner of a nearby collision shop to lend his expertise and possibly some tools in assisting in the removal of these bolts. This met with little success as the collision shop owner was also not familiar with this bolt head design. Representatives from the General Motors did not recognize this type of air bag locking bolt and consequently did not have any tools in their tool kit to assist in the removal process. It was unknown whether this bolt type represented an OEM installation, a recall campaign, or a previous replacement unit as the result of a previous deployment.

After 30 minutes of effort, a mechanic was able to remove one of the mounting bolts from the front left air bag module which was then tilted on end to inspect the wiring. The typical yellow electrical connector and yellow wire appeared to be properly attached to the back of the inflator unit. Additionally, the yellow wire appeared to be properly routed through the steering wheel hub and connected to the steering wheel mounted clock spring. The wire was tensioned to check for wire connectivity with no abnormality noted. Visually, there did not appear to be any obvious problem with the unit.

The front left air bag module cover was mechanically (cut) opened along the “T” configured module cover flaps. The overall air bag module surface measured 10.2 cm (4.0") vertically and 12.7 cm (5.0") horizontally. The nontethered air bag was folded in a normal pattern and did not appear to have any imperfection of the fabric. It had two vent ports in the 2 o'clock/10 o'clock positions which measured 2.5 cm (1.0") in diameter. The following identification number was noted on the air bag:

P16756616
TXM963231686

An identification number attached to the rear surface of the inflator unit is listed below:

AB964015Q4ZZEA

Front Right Air Bag

The front right air bag module was a top mount design which incorporated a single flap that opened in an upward motion. The lateral edge closest to the windshield was designed with two tethers which measured 10.2 cm (4.0") wide and 6.4 cm (2.5") in length. There was one double tether on each side of the module cover. The outboard tether measured 7.6 cm(3.0") wide while the inboard tether measured 11.4 cm (4.5") wide. The vertical excursion of the cover was measured at 17.8 cm (7.0").

The air bag module cover measured 38.1 cm (15.0") laterally along the leading edge and 39.4 cm (15.25") along the windshield edge. The right side of the module cover measured 17.8 cm (7.0") longitudinally while the inboard side measured 27.3 cm (10.75"). The left side of the module was located 14.0 cm (5.5") right of the vehicle centerline. The vinyl flap did not reveal any evidence of occupant contact during the deployment sequence.

The front right air bag was designed with two top tethers which were attached approximately 17.8 cm (7.0") below the top face of the expanded air bag at the outside edges as noted by a lateral stitched seam line. The longitudinal excursion of the air bag measured 45.7 cm (18.0") while the vertical excursion measured 73.7 cm (29.0"). The lateral width of the frontal surface of the air bag measured 50.8 cm (20.0"). There were no visible vent ports in the air bag fabric. The seat back support was located 91.4 cm (36.0") rearward from the air bag module cover measured at a height of 53.3 cm (21.0") above the junction of the seat cushion.

The inboard lateral surface of the front right air bag exhibited two small linear red transfers that were associated with lipstick marks (**refer to Figures 10 and 11**). The marks measured 2.5 cm (1.0") in length and were 7.0 cm (2.75") apart. The marks were located 17.8 cm (7.0") from the frontal vertical seam line and 22.9 cm (9.0") below the tether stitched seam line.



Figure 10- Overall view of the inboard lateral surface of the front right passenger air bag showing the red lip stick transfer marks



Figure 11- Close-up view of the red lipstick transfers on the inboard lateral surface of the front right passenger air bag

Sensing and Diagnostic Module (SDM)

The SDM was located under the front right passenger’s seat. An external remote discriminating sensor which was located on the upper radiator support, 12.7 cm (5.0") right of the vehicle centerline. The identification number on the leading surface of the protective shield covering was 16203-119 AD3119ZE25893. The sensor housing was not damaged in the crash. The SDM was removed from the vehicle by the General Motors representative for download purposes. Although the hexadecimal data was successfully downloaded, the interpretation of the data was not forwarded to the Veridian SCI team for inclusion in this report.

Driver Demographics

Age/Sex: 76 year old male
 Height: 177.8 cm (70.0")
 Weight: 82.6 kg (182.0 lb)
 Manual Restraint
 Usage: 3-point lap and shoulder belt
 Usage Source: Vehicle inspection
 Seat Track Position: Mid-to-rear track position
 Medical Treatment: Expired at scene

Driver Injuries

Injury	Injury Severity (AIS90/Update)	Injury Source
0.6 cm laceration of the right side of the nose	290602.1,4	Unknown
Small irregular contusion on the right side of the forehead, measuring 1.6 cm in diameter	290402.1,7	Unknown

Injury	Injury Severity (AIS90/Update)	Injury Source
Large amount of hemorrhage into the soft tissue of the neck	Not codeable	Unknown
Multiple greenish purple contusions of the anterior chest wall and right upper arm, largest measuring 7 x 5 cm	490402.1,0	Steering wheel rim and hub
Numerous rib fractures on both the right and the left side (flail chest)	450266.5,3	Steering wheel rim and hub
<i>Supplemental discussion:</i> rib fractures included the second through the fourth ribs and the sixth through the 9 th ribs on the left side; the first through the eighth on the right side. There was 300 cc of bloody fluid in the right pleural cavity and 500 cc in the left pleural cavity.		
Tear of the pericardial sac with 100 cc of blood in the pericardial cavity	441602.2,4	Steering wheel rim and hub
1 cm laceration of the inferior vena cava	421802.3,4	Steering wheel rim and hub
Multiple linear abrasions and contusions of the ventral surface of the left arm, largest measuring 8 cm in length	790202.1,2 790402.1,2	Steering wheel rim
Fracture of the mid portion of the left femur	851814.3,2	Induced fracture from knee bolster loading/intrusion
Two lacerations of the left lower leg, larger measuring 1.4 cm in diameter	890600.1,2	Lower left instrument panel
<i>Supplemental discussion:</i> The coronary arteries and the aorta show moderate atherosclerosis. There were enlarged and partially matted retroperitoneal lymph nodes which were firm and gray, the largest lymph node measured 2.5 cm in diameter, the tumor tissue surrounded the distal aorta and the iliac arteries		
Extensive retroperitoneal hemorrhage	Not codeable	Steering wheel rim and hub

* Source of injury data - Autopsy Report

Driver Kinematics

The driver was seated in a mid-to-rear track position with the seat back adjusted approximately 19 degrees aft of vertical. He was restrained by the manual 3-point lap and shoulder belt system. At impact, he moved forward and began to load the shoulder belt webbing when the intruding steering wheel contacted his chest area. The forward displacement of the top and bottom portion of the steering wheel rim indicated that the driver's body wrapped over and under the rim. The steering column and wheel continued to move rearward as the result of impact forces and pinned the driver against the seat back support. This contact resulted in flail chest with hemothorax, a tear of the pericardial sac, and a laceration of the inferior vena cava.

The driver's knees contacted the knee bolster as noted by the 15.2 cm (6.0") wide deformation contact pattern on the right side of the driver's knee bolster. The loading force was transmitted through the knee resulting in the mid shaft fracture of the left femur.

Rescue personnel found the driver pinned against the seat back by the steering wheel. Rescue personnel removed the roof and used spreaders at the base of the A-pillar to free the driver. Rescue tools were utilized to pull the steering wheel away from the driver before he was removed from the vehicle. Refer to the Injury Table for a listing of the injuries identified in the autopsy report, the respective AIS-90/Update 98 injury code, and correlating injury source.

The driver was pronounced deceased at the scene by the medical examiner approximately two hours after the crash. His body was transported to the medical examiner's office where an autopsy was performed the following day.

Front Right Passenger Demographics

Age/Sex:	76 year old female
Height:	165.1 cm (65.0")
Weight:	57.6 kg (127.0 lb)
Seat Track Position:	Mid track
Manual Restraint	
Usage:	3-point lap and shoulder belt
Usage Source:	Vehicle inspection, injury data
Mode of Transport	
From Scene:	Ambulance to a regional trauma center
Type of Medical	
Treatment:	Admitted for seven days then transferred to a hospice/rehabilitation center

Front Right Passenger Injuries

Injury	Injury Severity (AIS90/Update 98)	Injury Source
* Cerebral concussion with closed head injury GCS = 15	Moderate (161000.2,0)	Front right air bag
* Complex avulsion laceration forehead (>15 cm, exposing bone)	Moderate (290604.2,7)	Fractured eyeglasses from the deploying front right air bag
* Subgaleal hematoma over anterior frontal bone	Minor (290402.1,7)	Front right air bag
* Hematoma left chest	Minor (490402.1,2)	Shoulder belt webbing
* Contusion left lung base	Serious (441406.3,2)	Shoulder belt webbing
* Fracture left lateral ribs 5-7	Moderate (450220.2,2)	Shoulder belt webbing
* Blunt trauma abdomen (possible fracture bilateral illiac crests)	Unknown (515099.7,0)	Lap belt loading
* Contusion right hand	Minor (790402.1,1)	Possible fling injury into the right upper A-pillar
* Abrasion right hand	Minor (790202.1,1)	Possible fling injury into the right upper A-pillar
* Contusion dorsal left hand	Minor (790402.1,2)	Possible fling injury into the mid instrument panel
* Abrasion dorsal left hand	Minor (790202.1,2)	Possible fling injury into the mid instrument panel
+ Contusions bilateral forearms	Minor (790402.1,3)	Front right air bag
~ Abrasions bilateral knees	Minor (890202.1,3)	Glove box door
~ Abrasion under left breast	Minor (490202.1,2)	Shoulder belt
~ 1.3 cm laceration left eyebrow	Minor (290602.1,2)	Displaced eye glasses from air bag contact
~ 1.3 cm laceration right cheek	Minor (290602.1,1)	Unknown
~ Contusion left neck	Minor (390402.1,2)	Unknown

Injury	Injury Severity (AIS90/Update 98)	Injury Source
~ Laceration left hand	Minor (790602.1,2)	Possible fling injury into the mid instrument panel
~ Ecchymosis left eyelid	Minor (297402.1,2)	Displaced eye glasses from air bag contact

*Source of injury data: *Discharge Summary
+EMS
~Emergency Room*

Front Right Passenger Kinematics

The front right passenger was seated in a presumed upright posture with the seat track adjusted to a mid track position. She was restrained by the manual 3-point lap and shoulder belt system, however, there were no crash related belt usage indicators detected on the belt webbing. At impact, the passenger initiated a forward trajectory in response to the 12 o'clock direction of force impact. She loaded the manual belt webbing which resulted in a hematoma of the left chest, an abrasion under the left breast, fractures of the left 5-7 ribs, and a left lung contusion. Her abdominal loading of the lap belt resulted in unspecified blunt abdominal trauma. Due to the mid track seated position, the passenger's knees contacted the glove box door which abraded both knees.

The passenger apparently attempted to brace against the upper instrument panel. Her out-stretched arms were contacted by the expanding air bag membrane which resulted bilateral forearm contusions and fling injuries to both hands from possible contact against the upper right A-pillar and the mid instrument panel.

The tethered air bag membrane expanded against the passenger's face and fractured her eyeglasses. The inboard side surface of the air bag contacted the occupants facial area as noted by the presence of two linear red lipstick transfers located 17.8 cm (7.0") from the frontal vertical seam line and 22.9 cm (9.0") below the tether stitched seam line. As a result of this contact and eyeglass damage, the passenger sustained a complex V-shaped avulsion laceration of the forehead, a laceration and ecchymosis of the left eyelid, a cerebral contusion, with a subgaleal hematoma over the frontal bone.

The passenger was removed from the vehicle by rescue personnel and transported via ambulance to a regional trauma center where she was admitted for seven days for treatment of her injuries. She was subsequently transferred to a senior citizens hospice facility for six days where she was monitored by medical staff.