

**TRANSPORTATION SCIENCES  
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**VERIDIAN REMOTE AIR BAG RELATED ADULT PASSENGER  
FATALITY INVESTIGATION  
VERIDIAN CASE NO. CA99-011  
VEHICLE: 1997 PONTIAC TRANS SPORT  
LOCATION: PENNSYLVANIA  
CRASH DATE: OCTOBER 1998**

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.

## TECHNICAL REPORT STANDARD TITLE PAGE

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| <p>16. <i>Abstract</i><br/>This remote investigation focused on the severity of injury and the injury mechanisms for a 90 year old female front right passenger of a 1997 Pontiac Trans Sport minivan. The Pontiac was equipped with frontal air bags for the driver and front right passenger positions that deployed as a result of a minor severity front-to-side impact sequence with a 1988 Toyota pickup truck. The 51 year old female driver of the Pontiac was police reported as restrained by the manual belt system. She was not injured in the crash. The 90 year old female front right passenger of the Pontiac was belted, however, her seat was adjusted to a forward track position, which placed her within the deployment path of the passenger air bag. Based on the limited information sources of this remote investigation, the expanding air bag membrane contacted the face of the passenger resulting in fractures of the mandible, and soft tissue contusions, lacerations, and abrasions of the face. Her head was accelerated rearward by the expanding bag membrane which resulted in a large right subdural hematoma, right cerebral contusion, subarachnoid hemorrhage, and pneumocephalus. The passenger was transported by ambulance to a local hospital where her condition deteriorated. A craniotomy was performed to drain the hematoma, however, the passenger expired six days following the crash.</p> |   |   |                         |
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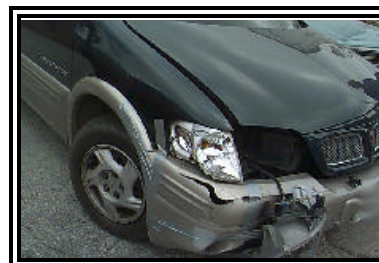
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**VERIDIAN REMOTE AIR BAG RELATED  
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LOCATION: PENNSYLVANIA  
DATE OF CRASH: OCTOBER 1998**

***BACKGROUND***

This remote investigation focused on the severity of injury and the injury mechanisms for a 90 year old female front right passenger of a 1997 Pontiac Trans Sport minivan. The Pontiac was equipped with frontal air bags for the driver and front right passenger positions that deployed as a result of a minor severity (**Figure 1**) front-to-side impact sequence with a 1988 Toyota pickup truck. The 51 year old female driver of the Pontiac was police reported as restrained by the manual belt system. She was not injured in the crash. The 90 year old female front right passenger of the Pontiac was belted, however, her seat was adjusted to a forward track position, which placed her within



**Figure 1. Frontal damage to the Pontiac Trans Sport.**

the deployment path of the passenger air bag. Based on the limited information sources of this remote investigation, the expanding air bag membrane contacted the face of the passenger resulting in fractures of the mandible, and soft tissue contusions, lacerations, and abrasions of the face. Her head was accelerated rearward by the expanding bag membrane which resulted in a large right subdural hematoma, right cerebral contusion, subarachnoid hemorrhage, and pneumocephalus. The passenger was transported by ambulance to a local hospital where her condition deteriorated. A craniotomy was performed to drain the hematoma, however, the passenger expired six days following the crash.

The crash occurred in October 1998 in the State of Pennsylvania. Notification of the crash was provided to NHTSA by the Pennsylvania State Police in May 1999 following a presentation at a traffic safety conference. The case was assigned to the Veridian SCI team on May 24, 1999 as a remote investigative effort. There was minimal photographic documentation available for this investigation. Aerial scene photographs were obtained from the State Police and five (5) vehicle images were obtained from the insurance company. The hospital medical records and autopsy report were obtained through the NASS cooperative agreements with the regional institutions.

***SUMMARY***

***Crash Site***

The crash occurred at a 3-leg Y-intersection of two, two-lane state routes in a rural area. Both roadways consisted of two asphalt travel lanes delineated by double yellow center lines. The posted speed limit was 56 km/h (35 mph). The crash occurred during dusk hours with no adverse weather conditions. The environmental surfaces were dry. Traffic flow in the north/southbound directions was controlled by a flashing yellow beacon while traffic on the intersecting roadway was regulated by a flashing red beacon.

The alignment of the southbound approach leg to the intersection was straight while the northbound leg was curved left with respect to vehicle travel.

### ***Vehicle Data***

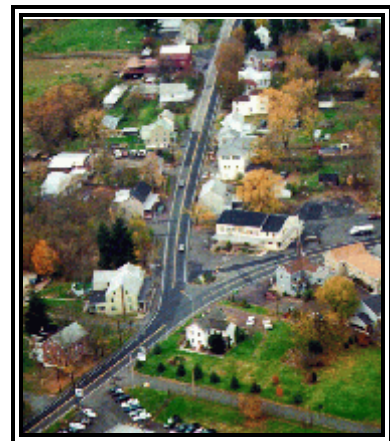
#### ***1997 Pontiac Transport***

The 1997 Pontiac Trans Sport was a 4-door minivan, inclusive of the rear liftgate. The vehicle was a front-wheel drive platform with a 4-speed automatic transmission and a column mounted selector lever. The front seated positions consisted of box mounted captain's chairs with folding inboard armrests and adjustable head restraints. Based on the available photographs, the Transport was equipped with power windows and a power locking system. The safety systems consisted of manual 3-point lap and shoulder belt systems for the front seated positions with frontal air bags. The frontal air bag system deployed as a result of the intersection crash with the Toyota pickup truck. The vehicle identification number and mileage were not reported.

### ***Crash Sequence***

#### ***Pre-Crash***

The driver of the Pontiac Trans Sport was proceeding in a southerly direction on the two lane state roadway at a police reported speed of 56 km/h (35 mph). The driver approached the intersection on the flashing yellow beacon and intended to continue through the intersection to proceed southbound. The 31 year old male driver of the Toyota pickup truck was traveling in a northerly direction at a police reported speed of 48 km/h (30 mph). A witness who was following the pickup truck, stated that the driver of the Toyota slowed on his approach to the intersection and activated the left turn signal to turn onto the intersecting roadway. The driver of the pickup truck detected the Pontiac on its approach to the intersection, however, the Toyota driver attempted to beat the Trans Sport across the intersection and initiated a left turn across the path of the Pontiac. The driver of the Pontiac braked and steered right in an attempt to avoid the impending impact. **Figure 2** is an aerial view of the crash site. A copy of the police crash schematic is attached as **Figure 7**, Page 8.



**Figure 2. Aerial view of the crash site**

#### ***Crash***

The front right area of the Pontiac struck the right rear side area of the Toyota resulting in minor damage to both vehicles. Resultant directions of force were within the 11 o'clock sector for the striking Pontiac and probably within the 2 o'clock sector for the Toyota pickup. Based on a single image of the exterior damage to the Pontiac, the velocity change was estimated in the 16-19 km/h (10-12 mph) range. This speed change resulted in deployment of the Pontiac's frontal air bag system.

The police schematic indicated the Pontiac was deflected in a slight clockwise (CW) direction prior to coming to rest near the point of impact. The Toyota was impacted on the right rear axle area which rotated

the vehicle CW. The Toyota continued along the intersecting roadway and departed the right side of the roadway where it came to the final rest adjacent to the road edge.

### ***Post-Crash Activities***

As the Toyota came to rest, the driver of the pickup truck noted motion from the occupants of the Pontiac. He then fled the scene by driving his vehicle to his residence located approximately 5 km (3 miles) from the crash site. He attempted to hide the vehicle behind his residence, however, police tracked the vehicle by following evidence created by the Toyota's damaged right rear tire and rim. The Toyota was subsequently towed from the driver's residence. The driver of the Pontiac was not injured. The front right passenger of the Trans Sport sustained a police report major injury, however, she was interviewed at the scene of the crash prior to ambulance transport to a local hospital where she was admitted for treatment of her injuries. The passenger's condition deteriorated and she expired six days following the crash. The Pontiac was driven from the scene and repaired prior to SCI assignment.

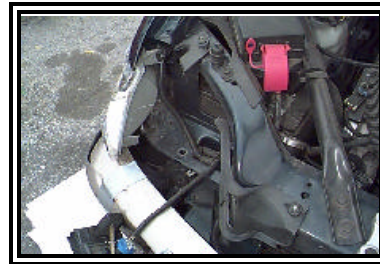
### ***Vehicle Damage***

#### ***Exterior -1997 Pontiac Trans Sport***

The Pontiac Trans Sport sustained minor damage to the front right area of the vehicle. The direct contact damage began right of center and extended to the right front corner (**Figure 3**). The bumper fascia was fractured at the impact location and the right headlamp assembly was fractured and separated from the radiator support mounting system (**Figure 4**). The lens for the right turn signal was fractured. The Collision Deformation Classification (CDC) for this event was 11-FZEW-1.



**Figure 3. Front right damage to the Trans Sport.**



**Figure 4. Right corner area of the upper radiator support and fractured headlamp.**

#### ***Exterior - 1988 Toyota Pickup Truck***

There were no photographs of the Toyota pickup truck available to this SCI investigation. The PAR noted damage to the right rear quarter panel with damage to the right rear tire and/or wheel. An estimated CDC for this damage was 02-RBEW-1.

#### ***Interior -1997 Pontiac Trans Sport***

Interior damage data for the 1997 Pontiac Trans Sport was not available for this report. It was noted from the available images that the windshield glazing was fractured with a focused fracture pattern located in the upper third of the glazing and aligned with the right front passenger air bag module. The fracture pattern appeared to be the result of contact by the cover flap for the front right air bag.

### ***Frontal Air Bag System - 1997 Pontiac Trans Sport***

The 1997 Pontiac Trans Sport was equipped with frontal air bags for the driver and front right passenger positions (**Figure 5**). The system utilized a single point Sensing and Diagnostic Module (SDM) that was located under the front right seat. This SDM had event data recording (EDR) capabilities, however, due to the remote nature of this investigation, the EDR was not downloaded.



**Figure 5. Overall view of the deployed frontal air bag system.**



**Figure 6. Top mounted front right passenger air bag module.**

The driver air bag module was mounted within the four-spoke steering wheel rim. The module cover flap opened at the designated I-configuration tear points. It was unknown if the driver air bag was tethered. There was no damage or contact evidence noted to the driver air bag.

The front right passenger air bag module was mounted in the right instrument panel in a top mount configuration (**Figure 6**) and concealed by a single cover flap. The flap opened in an upward direction toward the windshield. A fracture point to the windshield was located above the passenger module location and was attributed to cover flap contact. Again, due to the remote nature of this investigation, it was unknown if the passenger air bag was tethered. The front right air bag module appeared to have been removed from the top instrument panel prior to photographic documentation by the insurance company. In addition, the right sun visor is visible on the top of the right instrument panel (**Figure 6**). It was unknown if the visor had separated as a result of the crash (air bag deployment) or was removed prior to inspection by the insurance company.

### ***Driver Demographics***

#### ***1997 Pontiac Trans Sport***

|                   |                                      |
|-------------------|--------------------------------------|
| Age/Sex:          | 51 year old female                   |
| Height:           | Not reported                         |
| Weight:           | Not reported                         |
| Manual Restraint  |                                      |
| Usage:            | 3-point lap and shoulder belt system |
| Usage Source:     | Police report                        |
| Mode of Transport |                                      |
| From Scene:       | Drove Pontiac Trans Sport from scene |
| Type of Medical   |                                      |
| Treatment:        | Not injured                          |



***Driver Injuries***

| <b>Injury</b> | <b>Injury Severity (AIS 90/Update 98)</b> | <b>Injury Mechanism</b> |
|---------------|---|-------------------------|
| Not injured   | N/A                                       | N/A                     |

***Driver Kinematics***

The driver of the Pontiac Trans Sport was police reported as restrained by the manual 3-point lap and shoulder belt system. At impact she probably initiated a forward and left trajectory in response to the 11 o'clock impact force. The combination of belt usage and air bag deployment prevented contact to the steering assembly and possible injury. Following the crash, the driver drove the vehicle from the scene of the crash.

***Front Right Passenger Demographics***

Age/Sex: 90 year old female  
 Height: 157.5 cm (62.0")  
 Weight: 77.1 kg (170.0 lb)  
 Manual Restraint  
 Usage: 3-point lap and shoulder belt system  
 Usage Source: PAR, medical reports, and documented injuries  
 Seat Track Position: Unknown  
 Mode of Transport  
 From Scene: Ambulance  
 Medical Treatment: Transported to a local hospital and admitted for treatment where she expired six days following the crash.

***Front Right Passenger Injuries***

| <b>Injury</b>   | <b>Injury Severity (AIS 90/Update 98)</b> | <b>Injury Mechanisms</b>  |
|---|---|---|
| *Large right parietal subdural hematoma, greater than 2 cm in thickness with 1.2-2 cm of left shift and compression of the right lateral ventricle (craniotomy performed) | Critical (140656.5,1)                     | Acceleration of head from expansion of front right passenger air bag membrane |
| +Cerebral edema   | Serious (140660.3,9)                      | Acceleration of head from expansion of front right passenger air bag membrane |
| *Right cerebral contusion   | Serious (140604.3,1)                      | Contrecoup injury from expanding front right passenger air bag membrane       |
| *Right subarachnoid hemorrhage  | Serious (140684.3,1)                      | Contrecoup injury from expanding front right passenger air bag membrane       |

| <b>Injury</b>  | <b>Injury Severity (AIS 90/Update 98)</b>                                      | <b>Injury Mechanisms</b>                         |
|--|--|--|
| *Fracture of the left mandibular condylar neck with displacement of the left condylar head and a fracture of the angle of the right mandible | Moderate (250616.2,3)  | Expanding front right passenger air bag membrane |
| +Anterior/inferior dislocation of the right humeral head   | Moderate (751030.2,1)  | Shoulder belt webbing                            |
| +Contusion surrounding the top and anterior aspect of the right shoulder and lateral clavicle area   | Minor (790402.1,1)   | Shoulder belt webbing                            |
| +Small punctate lacerations and abrasions scattered over both anterior cheeks, lips, and chin  | Minor (290602.1,1; 290602.1,2; 290602.1,8; 290202.1,1; 290202.1,2; 290202.1,8) | Expanding front right passenger air bag membrane |
| +Contusion over the left earlobe   | Minor (290402.1,2)   | Expanding front right passenger air bag membrane |
| +Contusion over the left mastoid area of the scalp   | Minor (190402.1,2)   | Expanding front right passenger air bag membrane |
| +Contusion over the left side of the jaw   | Minor (290402.1,8)   | Expanding front right passenger air bag membrane |
| +Contusion across the anterior neck  | Minor (390402.1,5)   | Expanding front right passenger air bag membrane |
| +Scattered contusions of the upper medial aspect of the right breast   | Minor (490402.1,1)   | Expanding front right passenger air bag membrane |
| +Contusion of the mid anterior chest   | Minor (490402.1,4)   | Shoulder belt webbing                            |
| +15x8 cm (6x3") area of contusion over the mis aspect of the left lower leg  | Minor (890402.1,2)   | Glove box door, lower right instrument panel     |

*Source of Injury Data*

*\* Hospital medical records*

*+ Autopsy Report*

### ***Front Right Passenger Kinematics***

The front right female passenger of the Pontiac Trans Sport was seated in a presumed forward track position based on an interior image from the insurance company. She was restrained by the manual 3-point lap and shoulder belt system as evidenced by injuries and statements to the police and medical personnel. The passenger was probably displaced forward and slightly to her left by the pre-crash braking actions of

the driver. In addition, her head was turned slightly to the right as evidenced by the location of soft tissue injuries to the face.

At impact with the Toyota pickup truck, the frontal air bag system of the Pontiac deployed. The expanding front right passenger air bag impacted the face of the female passenger as she initiated a forward trajectory in response to the frontal impact force. Her loading force against the shoulder belt webbing resulted in a contusion surrounding the top and anterior aspect of the right shoulder and lateral clavicle area, a dislocation of the right shoulder, and a mid chest contusion.

The expanding air bag membrane produced small punctate lacerations and abrasions of the face, lips, and chin, and contusions over the left side of the jaw, anterior neck, extending onto the left mastoid area of the scalp, and left earlobe. Air bag expansion against her face resulted in a fracture of the left mandibular condylar neck with displacement of the head and a fracture of the right angle of the mandible.

The continued expansion of the front right air bag accelerated her head in a rearward direction. The head acceleration resulted in a large right parietal subdural hematoma with lateral shift and compression of the ventricle and cerebral edema. The motion of the brain within the skull that resulted from the acceleration induced by the air bag produced a contrecoup right cerebral contusion, right subarachnoid hemorrhage, and right pneumocephalus.

The passenger sustained scattered contusions of the upper medial aspect of the right breast that was attributed to air bag expansion. The air bag probably displaced the passenger rearward into the front right seat back. She came to rest in the front right seat position. The passenger was removed from the vehicle by emergency personnel and placed in an ambulance for transport to a local hospital.

### ***Medical Treatment***

The front right female passenger arrived at the local hospital in a conscious state, with a mental status of oriented x 3. Her vital statistics were listed as follows:

|                  |        |
|------------------|--------|
| Blood pressure - | 152/82 |
| Respirations -   | 16     |
| Pulse rate -     | 88     |

The passenger was assessed for soft tissue injuries, however, her condition rapidly deteriorated. A CT scan of the head revealed the large subdural hematoma. The passenger was transferred to the operating room where an emergency craniotomy was performed. The passenger developed a small degree of pneumocephalus that was medically documented as consistent with surgical intervention. She was placed on a ventilator and expired six days following the crash.

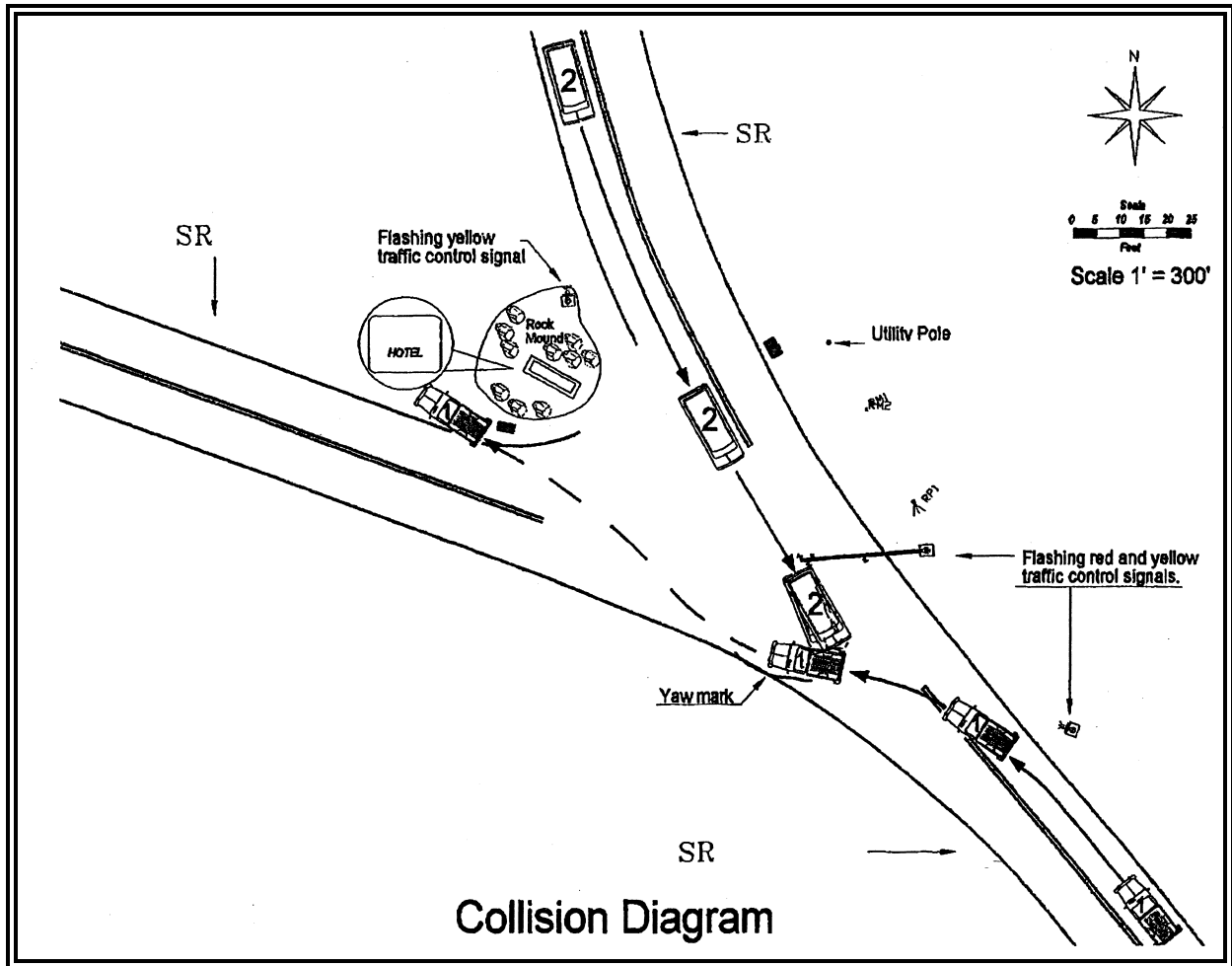


Figure 7. Police Crash Schematic