

On-scene Investigation / Vehicle to Vehicle
Dynamic Science, Inc. / Case Number: DS00-009
2000 Ford Taurus SE 4-door
Wisconsin
June, 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 crash-worthiness performance of the involved vehicle(s) or their safety systems.

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16. Abstract <p>This case was initiated because the case vehicle was equipped with an Event Data Recorder and Advanced Occupant Protection System. This crash occurred in Wisconsin in June, 2000 at 1940 hours. The case vehicle, a 2000 Ford Taurus SE 4-door sedan driven by a 63-year-old male (178 cm-70 in./91 kg-200 lbs), was traveling westbound at a police estimated speed of 72 km/h (45 mph). The front right seat was occupied by a 62-year-old female (165 cm-65 in./68 kg-150 lbs). The other vehicle, a 1998 Ford Ranger Pickup driven by an unrestrained 19-year-old male, was traveling eastbound at a police estimated speed of 89 km/h (55 mph). For an unknown reason the other vehicle crossed the center line and into the westbound travel lane. The driver of the case vehicle attempted to avoid the crash by steering to the right and driving onto the westbound asphalt and dirt shoulders. The collision occurred on the westbound travel lane and shoulder areas. The front of the case (12FLEE8) vehicle struck the front other vehicle (12FLEE6) in a frontal off-set configuration. The direct damage on the case vehicle extended down the left side of the vehicle's driver door. On impact, both front air bags in the case deployed. The driver's air bag in the other vehicle also deployed. The impact caused the case vehicle and the other vehicle to rotate in a counterclockwise direction. The case vehicle continued in a counterclockwise rotation, ran off the roadway and came to final rest in a ditch facing in a easterly direction--having rotated approximately 180-degrees. The other vehicle rolled over onto its roof and then back onto its wheels. The other vehicle came to final rest east of the case vehicle facing in an easterly direction and on the shoulder of the westbound travel lane.</p> <p>The Delta V for the case vehicle was computed using WinSmash version 2.12. A CDC of 12FDEW4 was used for the case vehicle and CDC of 12FLEE6 for the other vehicle estimated from the police photographs. WinSmash calculated a total delta v of 66.0 km/h (41.0 mph), a longitudinal delta v of -65.0 km/h (-40.4 mph) and a latitudinal delta v of 11.5 km/h (7.1 mph) for the case vehicle. The other vehicle sustained a total delta v of 63.0 km/h (39.1 mph), a longitudinal delta v of -62.0 km/h (-38.6 mph) and a latitudinal delta v of 10.9 km/h (6.8 mph). The results fit the collision model for the case vehicle and appear reasonable. This is a borderline reconstruction for the other vehicle.</p> <p>The driver of the case vehicle sustained fatal injuries. The coroner was paged at 1945 hours and arrived at the scene and pronounced the driver of the case vehicle dead at 2003 hours. An invasive autopsy was not performed. The coroner palpated the body at the scene and found that all ribs were felt to be fractured, a fractured left shoulder, a fractured left clavicle, an open fracture of the left arm at the elbow, a fractured left hip, a fractured tibia and fibula, puncture wounds of the right and left ankles, and a laceration to the forehead above the left eye.</p> <p>The front right occupant of the case vehicle was entrapped and extricated from the vehicle. She was transported to the hospital with "A" type injuries. She sustained fractures to all her ribs on the left side, a fracture to her left humerus, and contusions to both of her knees. She was transported to a hospital and hospitalized for three days.</p>					
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Accident Investigation
Case Number: DS00-009

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BACKGROUND:

Description: This Event Data Recorder and Advanced Occupant Protection System case was reported to the NHTSA by Dynamic Science, Inc. on August 4, 2000. DSI was assigned the case on the same day. An on-site investigation was conducted and all field work was completed on August 12, 2000.

Investigation Type: On-scene

Crash Location: Wisconsin

Crash Date: June, 2000

Notification Date: August 4, 2000

Field Work Completed: August 12, 2000

SUMMARY:

This crash occurred in Wisconsin in June, 2000 at 1940 hours. The crash occurred on an undivided two lane, two way traffic, straight and level, dry, asphalt rural state highway. There are asphalt and dirt shoulders on the north and south roadway edges. There were no traffic controls present, and the posted speed limit is 89 km/h (55 mph). The weather was clear and the asphalt roadway was dry and free of defects.

The case vehicle, a 2000 Ford Taurus SE 4-door sedan driven by a restrained 63-year-old male (178 cm-70 in./91 kg-200 lbs), was traveling westbound at a police estimated speed of 72 km/h (45 mph). The front right seat was occupied by a restrained 62-year-old female (165 cm-65 in./68 kg-150 lbs). The other vehicle, a 1998 Ford Ranger Pickup driven by an unrestrained 19-year-old male, was traveling eastbound at a police estimated speed of 89 km/h (55 mph).

For an unknown reason the other vehicle crossed the center line and into the westbound travel lane. The driver of the case vehicle attempted to avoid the crash by steering to the right and driving onto the westbound asphalt and dirt shoulders. The collision occurred on the westbound travel lane and shoulder areas. The front of the case (12FDEW4) vehicle struck the front other vehicle (12FLEE6) in a frontal off-set configuration. The direct damage on the case vehicle extended down the left side of the vehicle's driver door. On impact, both front air bags in the case deployed. The driver's air bag in the other vehicle also deployed.



Figure 1. Final rest positions at scene—looking east.

The impact caused the case vehicle and the

other vehicle to rotate in a counterclockwise direction. The case vehicle continued in a counterclockwise rotation, ran off the roadway and came to final rest in a ditch facing in a easterly direction--having rotated approximately 180-degrees. The other vehicle rolled over onto its roof and then back onto its wheels. The other vehicle came to final rest east of the case vehicle facing in an easterly direction and on the shoulder of the westbound travel lane.

The case vehicle sustained severe damage to the front bumper, hood, grille area, front left fender, left side door, the windshield, left side windows disintegrated, and the roof buckled. The battery and the fuse box in the engine compartment were also damaged. There was intrusion to the driver's compartment area from the driver's door, A and B pillars, toe pan, instrument panel and the roof side rail. The case vehicle was subsequently declared a total loss by the insurance company and sold as salvage. The other vehicle sustained severe damage to the front bumper, hood, grille, front left fender, windshield, and the roof buckled. Both vehicles were towed from the scene due to damage.

The case vehicle was assigned a Collision Deformation Classification (CDC) of 12FDEW4 and a Principle Direction of Force (PDOF) of 350 degrees. The combined direct and induced damage width was 108.0 cm (42.5 in.) [CRASH L = 148 cm (58.3 in.)], and the maximum crush depth was 78.0 cm (30.7 in.) located at C₁. The Delta V for the case vehicle was computed using WinSmash version 2.12. A CDC of 12FDEW4 was used for the case vehicle and CDC of 12FLEE6 for the other vehicle estimated from the police photographs. WinSmash calculated a total delta v of 66.0 km/h (41.0 mph), a longitudinal delta v of -65.0 km/h (-40.4 mph) and a latitudinal delta v of 11.5 km/h (7.1 mph) for the case vehicle. The other vehicle sustained a total delta v of 63.0 km/h (39.1 mph), a longitudinal delta v of -62.0 km/h (-38.6 mph) and a latitudinal delta v of 10.9 km/h (6.8 mph). The results fit the collision model for the case vehicle and appear reasonable. This is a borderline reconstruction for the other vehicle.

The driver of the case vehicle sustained fatal injuries. The coroner was paged at 1945 hours and arrived at the scene and pronounced the driver of the case vehicle dead at 2003 hours. An invasive autopsy was not performed. The coroner palpated the body at the scene and found that all ribs were felt to be fractured, a fractured left shoulder, a fractured left clavicle, an open fracture of the left arm at the elbow, a fractured left hip, a fractured tibia and fibula, puncture wounds of the right and left ankles, and a laceration to the forehead above the left eye.

The front right occupant of the case vehicle was entrapped and extricated from the vehicle. She was transported to the hospital with "A" type injuries. She sustained fractures to all her ribs on the left side, a fracture to her left humerus, and contusions to both of her knees. She was transported to a hospital and hospitalized for three days.

The driver of the other vehicle was transported to the hospital with "C" type injuries. A newspaper article indicates that he sustained minor injuries, was transported to a local hospital, treated and released that evening.

The police report indicates that an ambulance was notified at 1941 hours and it arrived at the scene at 1953 hours.

Scene Diagram

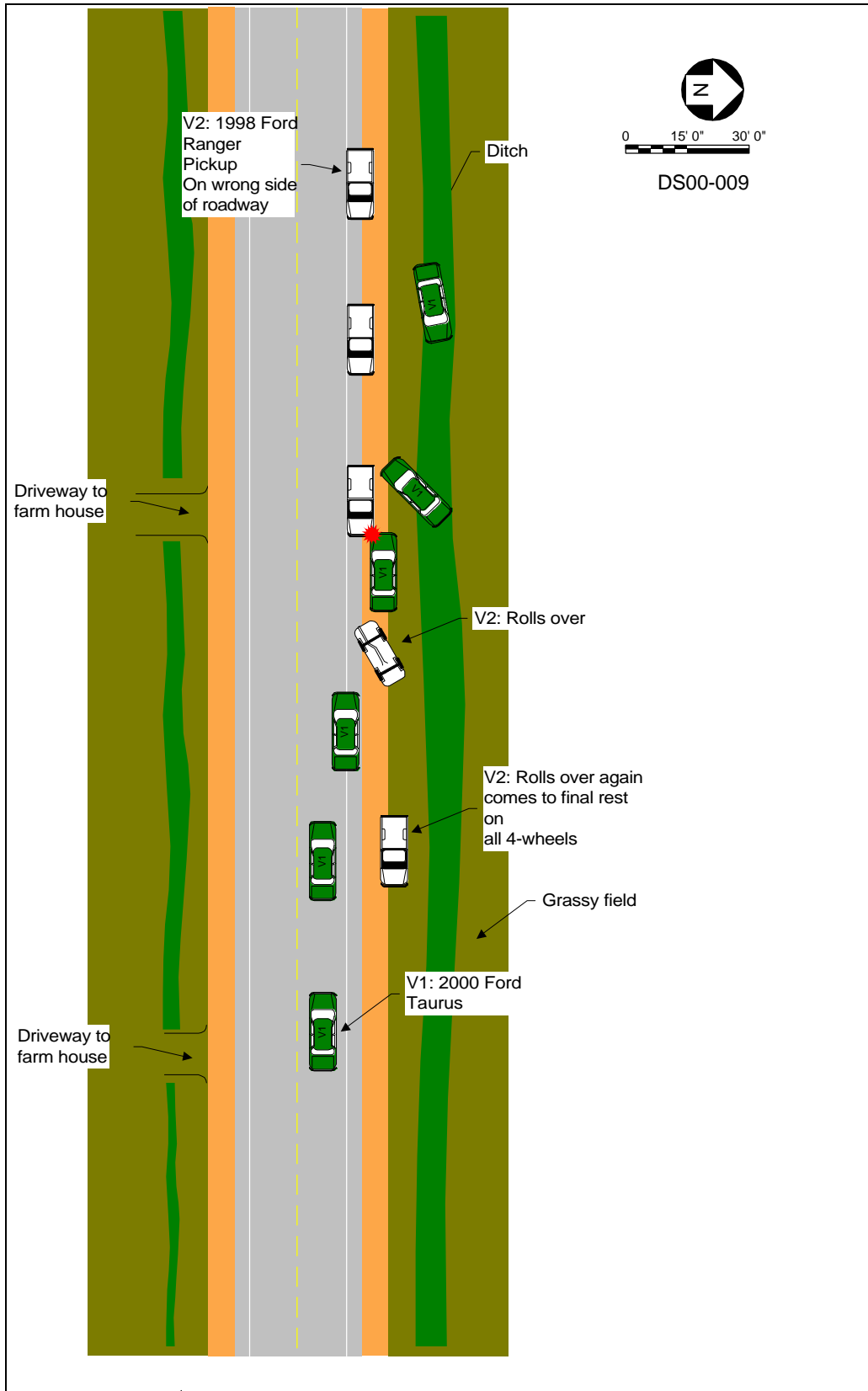


Figure 2. Scene diagram.

DETAILED INFORMATION

Vehicles

Case vehicle

Description:	2000 Ford Taurus SE 4-door	
VIN:	1FAFP53U1YGXXXXXX	
Odometer:	4,871 km (3,027 miles)	
Engine:	3.0 L V6	
Reported Defects:	None	
Cargo:	None	
Damage Description:	Severe off-set frontal damage that covered the front bumper, grille, radiator, hood, and front left fender. The roof buckled. Direct damage extended from the front left bumper down the left side to the driver's door area. The left side of the vehicle intruded into the driver's passenger compartment area. The front fuse box and the battery in the engine compartment had been damaged and probably knocked out electrical power to the vehicle. Vehicle towed from scene.	
CDC:	12FLEE8	
Delta V:	Total	66.0 km/h (41.0 mph)
	Longitudinal	-65.0 km/h (-40.4 mph)
	Latitudinal	11.5 km/h (7.1 mph)
	Energy	187,890 joules (138,581 ft-lbs)



Figure 3. Exterior damage to driver's side of case vehicle.

AOPS Discussion

This vehicle was equipped with an advanced occupant protection system. The system consists of a Restraint Control Module (RCM) dual stage front air bags, seat belt pretensioners, seat track sensors, and seat belt latch usage detectors. The system is controlled by the RCM. The primary function of the RCM is to control the deployment of the occupant protection systems. The system records longitudinal and lateral acceleration. Data related to the driver and passenger air bag deployment include: 78 milliseconds of crash pulse, deployment strategy of the dual-stage air bag system, seat belt latch use, pretensioner operation, and driver seat track location.

The data from the Restraint Control Module (RCM) could not be downloaded in the field. The RCM was removed from the vehicle on August 12, 2000 and was sent to Ford Motor Company. Ford later indicated that no data was recorded by the RCM. This was attributed by Ford as possibly the lack of power available when the battery and fuse box were damaged early in the collision. They indicated that the primary function of the RCM was to deploy the air bag.

The case vehicle steering wheel mounted driver's air bag was circular and measured 46 cm (18.1 in.) in diameter. It was equipped with two tethers and two vent holes at 11 and 01 o'clock positions. There was blood all about the front and rear top right quadrant of the air bag. The dual module covers opened in an "H" configuration. There were no indications of any damage to driver's air bag or the covers. The case vehicle front right passenger's air bag was rectangular and measured 38 cm (14.9 in.) high by 57 cm (22.4 in.) wide. It was equipped with two vent ports at 10 and 02 o'clock positions and did not have any tethers. There were blood drops on the face of the lower quadrant. There were also black smudges on the face of the air bag that were caused by the module cover. The single flap module cover opened properly and was not damaged.

Both front seat positions of the case vehicle were equipped with seat belt buckle pretensioners. The front left pretensioner barrel was checked and measured 10.8 cm (4.3 in.)—indicating that it had not fired. The front right pretensioner barrel was checked and measured 11.0 cm (4.3 in.)—indicating that it had not fired. Ford has indicated that "The 2000MY Taurus pretensioner threshold is an independent calculation from the air bag threshold. While the pretensioner threshold is generally similar to the belted/driver seat forward air bag threshold, and while in general the pretensioners will deploy at the same time as the air bags or prior to the air bags, it is possible for the air bags to deploy before the pretensioners or for the air bags to deploy and not the pretensioners." Since as indicated earlier that there was no data recorded from the RCM it is not clear that the system did not perform as designed. It is also not clear whether the damage to the battery or the fuse box in the engine compartment contributed to the pretensioners not firing.

The steering column breakaway coupling was intact, but the shaft was completely separated.

Other vehicle (Ford Ranger)

Description: 1998 Ford Ranger XL 4x4 Pickup-Super Cab
 VIN: 1FTZR15X6WPXXXXXX
 Odometer: 56,842 km (35,321 miles)
 Engine: 4.0L, 6 cylinder
 Reported Defects: None
 Cargo: Unknown
 Damage Description: Severe off-set frontal damage. Front bumper, grille, hood, and front left fender. The roof buckled and the rear backlight glazing disintegrate. The roof appears to have intruded vertically into the driver's passenger compartment area. Vehicle towed from scene due to damage.

CDC :
 Impact 1 v. Case Vehicle 12FLEE6 (Estimated from police photographs)
 Impact 2--Rollover 00TPD02 (Estimated from police photographs)

Delta V (Impact 1 v. case vehicle):

Total	63.0 km/h (39.1 mph)
Longitudinal	-62.0 km/h (-38.6 mph)
Latitudinal	10.9 km/h (6.8 mph)
Energy	369,156 joules (272,275 ft-lbs)



Figure 4. Other vehicle.

Occupants

<u>Case vehicle (Ford Taurus)</u>	Occupant 1	Occupant 2
Age/Sex:	63/Male	62/Female
Seated Position:	Front left	Front right
Seat Type:	Gray colored, fabric covered bucket seat. Seat track position is unknown due to the damage and intrusion from the impact forces. The intrusion deformed both the seat cushion and the seat back.	Gray colored, fabric covered bucket seat. Seat track position was between middle and rear most position. The set back was cut off presumably by emergency rescue personnel to render aid at the collision scene. The vehicle inspection revealed extrication marks on the front right door area.
Height:	178 cm (70 in.)	165 cm (65 in.)
Weight:	91 kg (200 lbs)	68 kg (150 lbs)
Occupation:	Truck driver	Unknown
Pre-existing Medical Condition:	None noted	None noted
Alcohol/Drug Involvement:	Blood test indicated an ethanol of 0.017 g/100 mL	NA
Driving Experience:	Unknown but presumed to be greater than 44 years.	NA
Body Posture:	Assumed normal, upright.	Assumed normal, upright.
Hand Position:	Unknown	Unknown
Foot Position:	Unknown, presumed to have right foot on accelerator pedal.	Unknown
Restraint Usage:	Lap and shoulder belt available, used	Lap and shoulder belt available, used
Air bag:	Steering wheel mounted air bag, deployed	Top mounted air bag, deployed

Other vehicle (Ford Ranger)

Age/Sex:	19/Male
Seated Position:	Front left
Seat Type:	Unknown
Height:	Unknown
Weight:	Unknown
Occupation:	Unknown
Pre-existing Medical Condition:	None noted
Alcohol/Drug Involvement:	Blood test performed, no alcohol found
Driving Experience:	Unknown, probably <= one year
Body Posture:	Unknown
Hand Position:	Unknown
Foot Position:	Unknown
Restraint Usage:	Lap and shoulder belt not used—per police
Air bag:	Air bag deployed—per police photographs

Injuries and Injury MechanismsCase vehicle (Ford Taurus)

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	All ribs felt to be fractured	450240.4, 3	807.09	Steering wheel/air bag
	Fractured left shoulder (coded as acromion)	751600.2, 2	811.01	Seat belt
:	Fractured left clavicle	752200.2, 2	767.2	Steering wheel rim/indirect
	Open fracture of left arm at the elbow	751900.2, 2	813.10	Steering wheel rim/indirect
	Fractured left hip	852600.2, 2	808.8	Indirect-left knee bolster
	Fractured left tibia/fibula	853404.2, 2 851605.2, 2	823.82 823.82	Knee bolster\left instrument panel
	Puncture wounds of right and left ankles	890600.1, 1 890600.1, 2	891.0 891.0	Pedals, steering column coupling
	Laceration to forehead above left eye	290600.1, 7	873.42	Flying glass
Front right occupant:	All left side ribs fractured	450210.2, 2	807.09	Center console
	Fractured left humerus	752602.2, 2	812.20	Center console
	Contusions to left and right knees	890402.1, 2 890402.1, 1	924.11 924.11	Right instrument panel

Other vehicle (Ford Ranger)

	<u>INJURY</u>	<u>OIC CODE</u>	<u>ICD-9</u>	<u>SOURCE</u>
Driver:	Injured, details unknown			

Occupant Kinematics

The 63-year-old male driver (178 cm-70 in./91 kg-200 lbs) of the case vehicle was presumed to have been seated in a normal, upright fashion. He was wearing the available lap and shoulder belt; the seat belt was cut by emergency rescue personnel and the seat belt latch was found still latched and locked into the seat belt buckle. The shoulder belt upper anchorage adjustment was in the full down position. The seat track of the grey colored, fabric-covered bucket seat could not be determined due to the damaged caused to the seat by the entire left side intruding into the driver's compartment. The seat back angle was adjusted at 68 degrees from horizontal. At impact, the driver responded to the 350 degrees direction of force by moving straight forward. At the same time the A and B pillars, left side door, left side roof side rail, toe pan, and left instrument panel were all intruding into the driver's compartment area from the collision with the other vehicle. The lap and shoulder belts restricted this forward motion and caused fractures to his left shoulder. His upper body came into contact with the deployed air bag. He loaded the steering column—there was movement of the steering column shear capsules measured as 1.9 cm (0.7 in.) on the right side and 3.5 cm (1.4 in.) on the left side. All ribs on were felt to be fractured from contact with the steering wheel and air bag. The driver holding the steering wheel rim with his left hand indirectly caused an open fracture of left arm at the elbow, and a fracture of his left clavicle. The intruding left instrument panel-knee bolster caused the fractures to his left tibia and fibula. As the left instrument panel-knee bolster pushed his left leg rearward it indirectly caused the fractured left hip. The puncture wounds to his right and left ankles were caused by the brake and gas pedals, and the shaft separation of the steering column. As the case vehicle rotated clockwise 180 degrees, the driver reacted with his upper body moving to the left. He sustained a laceration to his forehead above the left eye possibly from flying glass. He came to final rest on the driver's air bag. He was declared dead at the scene by the coroner at 2003 hours—23 minutes after the collision occurred.

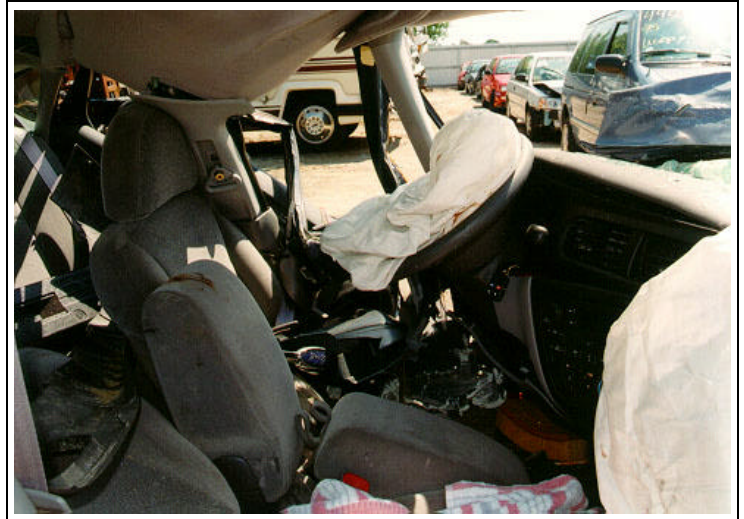


Figure 5. Intrusion into driver's compartment.



Figure 6. Blood on Vehicle 1 driver's air bag.

The 62-year-old female front right occupant (165 cm-65 in./68 kg-150 lbs) of the case vehicle was presumed to be seated in a normal, upright fashion. She was wearing the available manual lap and shoulder belt. The shoulder belt upper anchorage adjustment was in the full up. The seat track of the grey colored, fabric-covered bucket seat was adjusted to between the middle and rear most track position. The seat back had been cut by emergency rescue personnel, presumably for treatment. At impact, the front right occupant responded to the 350 degrees direction of force by moving straight forward. The lap and shoulder belts restricted her forward motion. She struck the right instrument panel with her knees—there was a scuff mark on the cover of the glove box. She sustained contusions to both knees as a result of contact with the right instrument panel. As the case vehicle rotated clockwise 180 degrees her upper body reacted by moving to left. She struck the center console area causing fractures to all the ribs on her left side and a fractured left humerus. She came to final rest leaning up against the center console. There were blood drops on the lower face of the front right passenger's air bag. The police report indicates that she was entrapped and extricated from the vehicle. She was transported to the hospital and was hospitalized for three days.



Figure 7. Scuff mark to glove box from contact with front right occupant's legs.



Figure 8. Front right passenger air bag.