CRASH DATA RESEARCH CENTER

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CALSPAN ON-SITE ADULT AIR BAG RELATED FATALITY CRASH INVESTIGATION

CASE NO: CA07-001

VEHICLE: 1995 FORD ESCORT

LOCATION: PENNSYLVANIA

CRASH DATE: DECEMBER 2006

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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. Abstract This crash investigation focused on the severity of the crash and the source of injury that contributed to the death of a 54-year old female driver of a 1995 Ford Escort. The Escort was equipped with first generation air bags for the driver and front right positions. The front safety belt systems consisted of automatic motorized shoulder belts with manual lap belts. The driver was not restrained by the safety belt system. The Escort struck the back of a stopped 2003 Jeep Grand Cherokee at a three-leg intersection which resulted in minor severity frontal damage to the Escort and the deployment of the Escort's frontal air bag system. The female driver was seated in a mid to forward track position and was in the path of the expanding air bag. The driver's air bag expanded against her chest which resulted in a complete laceration of the aortic arch. She was found unconscious at the scene, but breathing and was transported by helicopter to a regional trauma center where she expired following arrival. The Escort was towed from the scene while the Jeep was driven to its destination.			
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BACKGROUND

This crash investigation focused on the severity of the crash and the source of injury that contributed to the death of a 54-year old female driver of a 1995 Ford Escort **(Figure 1)**. The Escort was equipped with first generation air bags for the driver and front right positions. The front safety belt systems consisted of automatic motorized shoulder belts with manual lap belts. The driver was not restrained by the safety belt system. The Escort struck the back of a stopped 2003 Jeep Grand Cherokee at a three-leg intersection which resulted in minor severity frontal damage to the Escort and the deployment of the Escort's frontal air bag system. The female driver was seated in a mid to forward track position and was in the path of the expanding air bag. The driver's air bag expanded against her chest which resulted in a complete laceration of the aortic arch. She was found unconscious at the scene, but breathing and was transported by helicopter to a regional trauma center where she expired following arrival. The Escort was towed from the scene while the Jeep was driven to its destination.


Figure 1. 1995 Ford Escort.

This December 29, 2006 crash was identified by NHTSA's Crash Investigation Division on Wednesday, January 3 and assigned to the Calspan Special Crash Investigations team for follow-up. Due to the deployment of the first generation air bag system in the 1995 Ford Escort, a remote level investigation was assigned and initiated by telephone follow-up with the investigating police agency. The Police Chief noted that there were limited photographs of the Escort; therefore the investigation was upgraded to on-site.

SUMMARY

Crash Site

The crash occurred at the east leg of a three-leg intersection on Friday, December 26, 2006, at 2000 hours. A two-lane roadway was intersected by another two-lane road form which formed the intersection. All three legs of the intersection were controlled by stop signs. The involved vehicles approached the intersection traveling in a westerly direction. On approach to the intersection, the vehicles traveled on a straight


Figure 2. Overall view of the crash site.

segment of road with a positive grade that increased to two percent at the intersection. Immediately prior to the intersection, the roadway curved to the left for westbound travel with a measured radius of curvature of 68.2 m (223.8'). The posted speed limits were 64 km/h (40 mph) for the east/west roadway and 56 km/h (35 mph) for the intersecting road. **Figure 2** is a westbound approach view of the intersection. The Crash Schematic is attached as **Figure 10** of this report.

Vehicle Data

The subject vehicle in this crash was a 1995 Ford Escort GT, two-door sedan with a rear hatchback **(Figure 3)**. The vehicle was manufactured in 12/94 and was identified by Vehicle Identification Number (VIN) 1FASP1285SW (production number deleted). The odometer reading at the time of the SCI inspection was 220,733 km (137, 161 miles). The Escort was powered by a transverse-mounted 1.8 liter inline four-cylinder engine linked to a five-speed manual transmission with a console mounted shifter. The service brakes were power-assisted four-wheel disc without anti-lock. The Escort was equipped with OEM steel wheels and P195/60R15 all-season radial tires. The front tires were Futura GLS Super Sport and the rears were Dunlop SP Sport 4000. The manufacturer recommended tire pressure was unknown. The specific tire data at the time of the SCI inspection was as follows:

Figure 3. Left side view of the Ford Escort.

Position	Measured Tire Pressure	Measured Tread Depth	Damage
Left Front	0 kPa	4 mm (5/32")	Cut in center tread
Left Rear	134 kPa (19.5 PSI)	2 mm (3/32")	None
Right Front	159 kPa (23 PSI)	5 mm (6/32")	None
Right Rear	128 kPa (18.5 PSI)	3 mm (4/32")	None

The interior of the Ford Escort was configured as a five-passenger vehicle with front bucket seats and a forward folding split bench rear seat. The front seats were covered with slip-on aftermarket seat covers. The front head restraints were adjustable and set to the full-down positions. The front safety belt systems consisted of automatic motorized shoulder belts with manual lap belts.

2003 Jeep Grand Cherokee

The 2003 Jeep Grand Cherokee was a four-wheel drive, four-door sport utility vehicle. It was identified by the VIN: 1J4GW48S73C (production number deleted). The Jeep was not inspected.

Crash Sequence

Pre-Crash

The driver of the Ford Escort was traveling in a westerly direction on approach to the three-leg intersection. A Jeep Grand Cherokee was stopped in the westbound lane at the mouth of the intersection for a stop sign which regulated traffic flow into the intersection. The 54-year old female driver of the Escort was intoxicated with a Police reported BAC of .289. The driver was traveling at a slow rate of speed on approach to the intersection. Due to her subsequent death and the lack of physical evidence at the crash site, it was unknown if she initiated avoidance action (i.e., braking). The driver of the Jeep Cherokee revealed during an SCI interview that she heard no braking sounds nor did she see the Escort prior to impact.

Crash

The front left area of the Ford Escort impacted the back right corner area of the Jeep Grand Cherokee. The initial contact involved the bumper of the Escort against the bumper of the Jeep. As the Escort continued to engage the Cherokee, the bumper underrode the back of the Cherokee which resulted in the left hood face and the left front fender to contact the Cherokee. The impact resulted in a force direction of 12 o'clock to the Escort and a presumed 6 o'clock impact force to the Cherokee. The crash resulted in minor damage to both vehicles and deployed the frontal air bag system in the Escort. The missing vehicle algorithm of the WinSMASH program computed a total velocity change of 15 km/h (9.3 mph) for the Ford with longitudinal and lateral components of -15 km/h (-9.3 mph) and 0 km/h respectively. The vehicles came to rest engaged at the mouth of the intersection near the point of impact.

Post-Crash

The driver of the Escort was found slumped forward and to her left within the vehicle with her head resting in the area of the left mid-A-pillar. The first responding officer reported that she was unconscious with a faint pulse. She was removed from the vehicle by rescue personnel who requested helicopter transport to a regional trauma center. The driver expired on-arrival due to a suspected aortic injury.

The Ford Escort was towed from the crash site. The driver and the rear seated child passengers of the Jeep were not injured. The Cherokee did not sustain disabling damage and was driven from the scene.

Vehicle Damage

Exterior – 1995 Ford Escort

The Ford Escort sustained minor severity damage as a result of the front-to-rear crash sequence with the back of the stopped Jeep Cherokee. Maximum crush was 10 cm (4") located at the left corner of the upper radiator support. The direct contact damage on the bumper fascia began 15 cm (6") left of the vehicle's centerline and extended 55 cm (21.5") to the left corner **(Figure 4)**. Although the bumper engaged the back of the Jeep, there was no residual crush at bumper level. The left aspect of the bumper was pulled forward as a result of separation from the Jeep.

The Escort partially underrode the back right corner area of the Jeep resulting in crush and contact damage to the hood face and the left front fender. A residual crush profile was documented at the face of the upper radiator support **(Figure 5)**. The six equidistant crush profiles were as follows: C1 = 10 cm (4”), C2 = 4 cm (1.75”), C3 = 1 cm (0.25”), C4 = 0 cm, C5 = 0 cm, C6 = 0 cm. The contact damage of the left front fender extended 70 cm (27.5”) rearward. The rearward crush was limited to the 10 cm (4”) at the leading edge. The Collision Deformation Classification (CDC) for this impact was 12-FYEW-1.

Figure 4. Direct contact damage on the frontal plane.

Figure 5. Extent of crush at the radiator support level.

Interior

The interior of the Ford Escort sustained minor severity damage as a result of air bag deployment and driver contact. The cover flap for the front right air bag opened forward and fractured the windshield. The glazing damage was limited to the right half of the glass.

The driver was positioned forward within the deployment path of the driver’s air bag. The expanding air bag engaged the chest of the driver as she responded to the frontal crash forces. Her loading force was transmitted into the steering wheel and the energy absorbing steering column. The steering wheel flange was deformed which resulted in a closure of the gap between the forward aspect of the wheel hub and the steering column **(Figure 6)**. The bottom gap was widened to 1 cm (0.25”).

Figure 6. Steering wheel flange deformation.

Figure 7. Wiper stalk deformed and fractured from column compression.

The driver compressed the energy absorbing steering column approximately 5 cm (2”). This column did not utilize a conventional shear bracket system. The column was an extrusion-type column that compressed through a sleeve. The plastic steering column cover fractured from column compression. The column compression resulted in bending and fracturing of the turn signal stalk and the wiper stalk **(Figure 7)** as they engaged the mid instrument panel.

Exterior – 2003 Jeep Grand Cherokee

The back right corner area of the Jeep Cherokee sustained minor damage. The vehicle was not inspected during the on-site investigation.

Safety Belt Systems

1995 Ford Escort

The Ford Escort was equipped with automatic motorized shoulder belt systems for the front outboard seated positions with manual lap belts. The front shoulder belts were unbuckled from the track buckles and retracted into the center mounted Emergency Locking Retractors (ELRs). The lap belts retracted to the outboard positions of the front seats and buckled into a center mounted buckle. The lap belt retractors were ELR.

The driver did not use the safety belt system. The first arriving officer at the scene of the crash observed the driver in the vehicle unconscious without belts. The automatic shoulder belt was unbuckled and stowed into the retractor. The lap belt was also fully stowed into the retractor. There was no loading evidence to support usage at the time of the crash.

The rear outboard positions were equipped with continuous loop lap and shoulder belts with sliding latch plates and ELRs. The center rear position was equipped with a fixed length lap belt with a cinching latch plate.

Frontal Air Bag System

1995 Ford Escort

The Ford Escort was equipped with first generation frontal air bags for the driver and front right passenger positions. **Figure 8** is a view of the deployed air bags The system utilized two ball-in-tube external crash sensors that were located on the forward aspect of the upper radiator support panel. Both sensors remained intact and were free of damage from the crash. The sensors were bar coded with the following:

	Left Sensor	**Right Sensor**
Part Number	F5CB148005 AA	F5CB146004AA
Serial Number	7A33947785	6Z33543291

The driver’s air bag deployed from a steering wheel mounted module and concealed by H-configuration module cover flaps. The air bag membrane was vented by two 4 cm (1.5”) diameter vent ports at the 12 o’clock positions. The ports were positioned on 18 cm (7”) centers and located 6 cm (2.5”) forward of the peripheral seam. The air bag was tethered by two straps at the 3 and 9 o’clock positions. The bag diameter in its deflated

state was 62 cm (24.5”). The maximum excursion of the driver’s air bag was 25 cm (10”) at the tether location. There was no damage or occupant contact evidence on the deployed driver’s air bag **(Figure 9)**.

The front right air bag deployed from a mid-mount module incorporated into the right instrument panel. The module utilized a single cover flap that measured 15 cm (5.75”) in depth and 32 cm (12.5”) in width. The flap was hinged at the forward edge and fully opened against the windshield, fracturing the laminated glass. The front right air bag was not tethered. The bag was vented by two 6 cm (2.25”) diameter ports located laterally at the 3 and 9 o’clock positions. There was no damage or contact evidence to the passenger air bag.

Figure 8. Deployed frontal air bag system.

Figure 9. Deployed driver’s air bag.

Driver Demographics

1995 Ford Escort

Age/Sex:	54-year old/Female
Height:	160 cm (63”) Police reported
Weight:	54 kg (120 lb) Police estimate
Eyewear:	Prescription eyeglasses
Seat Track Position:	Mid-to-forward
Safety Belt Usage:	None
Usage Source:	Vehicle inspection, observations of first responders
Egress from Vehicle:	Removed by rescue personnel
Mode of Transport From Scene:	Transported by ambulance to a regional trauma center
Type of Medical Treatment:	Expired on arrival

Driver Injuries

Injury	Injury Severity	Injury Source
*Complete laceration of the aortic arch	Critical (420210.5,4)	Expanding driver’s frontal air bag
+Lacerated lip	Minor (290602.1,8)	Expanding driver’s frontal air bag

Sources – **Coroner’s report/hospital radiology*
+Investigating police officer

Driver Kinematics

The 54-year old female driver of the 1995 Ford Escort was dressed in denim jeans, a T-shirt, and an open leather jacket. She was wearing prescription eyeglasses. Although the driver's seat had been moved to the full-rear position prior to the SCI investigation, the investigating officer had measured a distance of 38 cm (15") between the seat back and the steering wheel. During the investigation, the SCI investigator repositioned the driver's seat to the full forward position. In this position, the horizontal distance between the air bag module cover and seat back was 42 cm (16.5"). Based on the driver's demographics, it was estimated that the seat track was adjusted in the forward third position at the time of the crash. The head restraint was in the full down position. The driver was not restrained by the automatic and manual safety belt systems. Her non-belted status was observed by the first responders to the crash site, the lack of loading evidence on the belt system, and compression of the energy absorbing steering column.

The driver was heavily intoxicated with a police reported BAC of .289. She was seated in a forward track position and unrestrained. It was possible that the driver was slumped forward immediately prior to impact. At impact, the first generation frontal air bag system deployed. The driver was within the path of the deploying driver's air bag as she responded to the frontal crash forces. The expanding air bag contacted the chest of the driver which resulted in a complete laceration of the aortic arch. She also sustained a police reported lacerated lip from contact with the air bag. The combination of air bag expansion against the driver and her forward motion resulted in deflection of the steering wheel flange and compression of the energy absorbing steering column.

The aortic injury rendered the driver unconscious. She came to rest slumped forward against the steering wheel with her head resting against the left A-pillar at the beltline. The investigating officer opened the right front door and checked the pulse of the driver. A pulse was detected and rescue personnel were summoned to the scene. The driver was removed from the vehicle by ambulance personnel and transported by ground ambulance to a regional trauma center where she expired on arrival. A chest x-ray at the hospital revealed the aortic injury. The body was released to a funeral home without an autopsy.

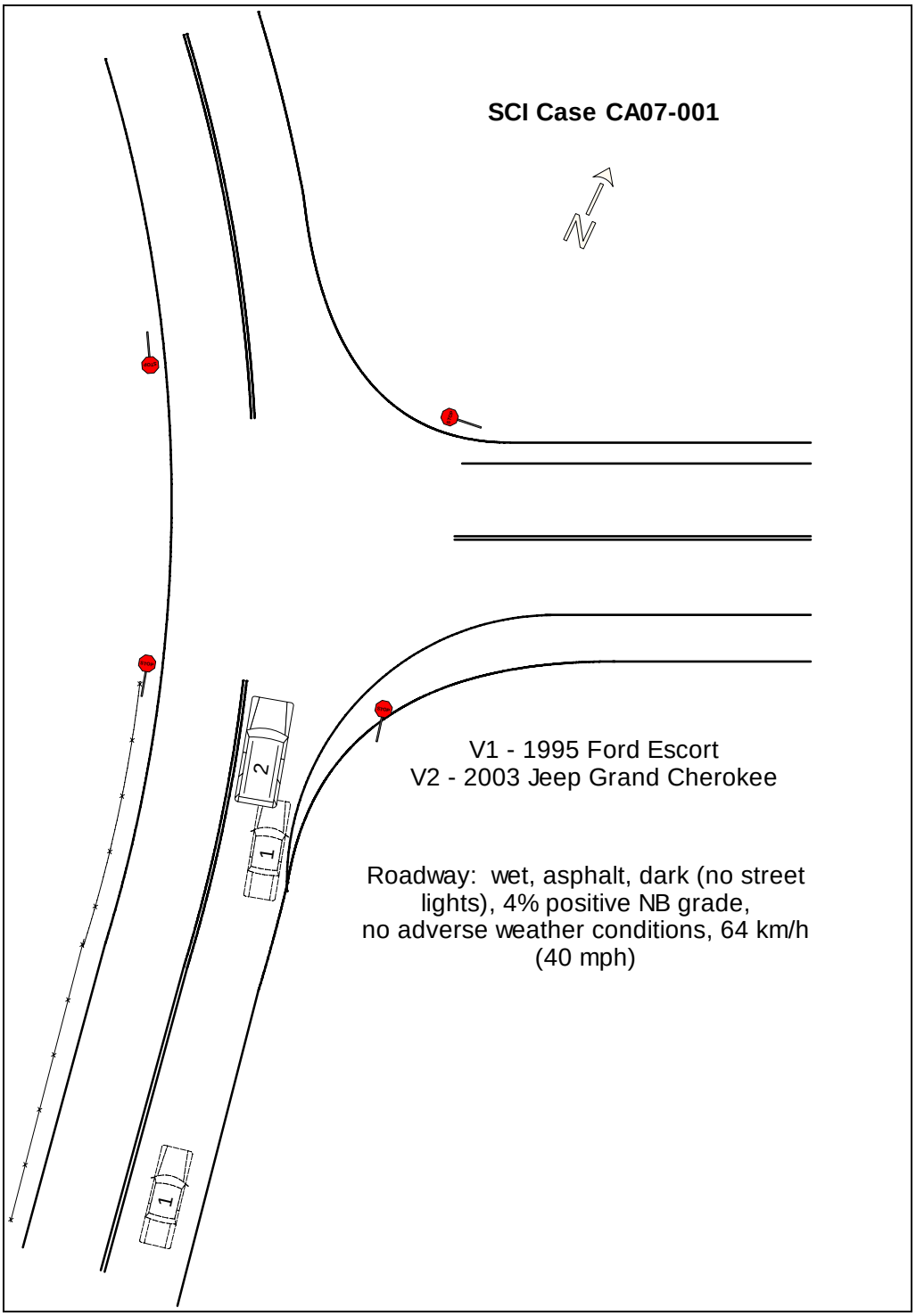

Figure 10 – Scene Schematic