CRASH DATA RESEARCH CENTER

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REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT

NASS CDS CASE NO. 1999-45-211J

RABSS VEHICLE - 1999 FORD ESCORT SE

LOCATION - STATE OF TENNESSEE

CRASH DATE - DECEMBER, 1999

Contract No. DTNH22-94-D-07058

Prepared for:

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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 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 investigation focused on a single vehicle crash involving a 1999 Ford Escort SE 4-door sedan equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of a frontal collision with a wooden utility pole. The driver of the Ford was operating the vehicle southbound on a rural 2-lane roadway when she allowed the vehicle to depart the right (west) pavement edge in a forward tracking mode. As the vehicle exited the west pavement edge, the front left area impacted a utility pole resulting in moderate damage. The restrained 67 year old female driver of the 1999 Ford Escort SE initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint, knee bolster and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the abdomen and left mid-chest with underlying fractures of the left 2-3 ribs. Contact to the knee bolster resulted in a contusion to the left knee. She also sustained a contusion of the right posterior hand and fracture of the right distal radius from contact to the left instrument panel. The driver was transported to a local trauma center for treatment and admitted for 17 days.			
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TABLE OF CONTENTS

REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT
NASS CDS CASE NO. 1999-45-211J
RABSS VEHICLE - 1999 FORD ESCORT SE
CRASH DATE - DECEMBER, 1999

BACKGROUND

This investigation focused on a single vehicle crash involving a 1999 Ford Escort SE 4-door sedan equipped with redesigned frontal air bags for the driver and front right passenger positions which deployed as a result of a frontal collision with a wooden utility pole. The driver of the Ford was operating the vehicle southbound on a rural 2-lane roadway when she allowed the vehicle to depart the right (west) pavement edge in a forward tracking mode. As the vehicle exited the west pavement edge, the front left area impacted a utility pole resulting in moderate damage. The restrained 67 year old female driver of the 1999 Ford Escort SE initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint, knee bolster and deployed redesigned driver air bag. Loading of the manual restraint resulted in contusions to the abdomen and left mid-chest with underlying fractures of the left 2-3 ribs. Contact to the knee bolster resulted in a contusion to the left knee. She also sustained a contusion of the right posterior hand and fracture of the right distal radius from contact to the left instrument panel. The driver was transported to a local trauma center for treatment and admitted for 17 days.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as CDS case number 1999-45-211J and also included in the Redesigned Air Bag Special Study. The Crash Investigation Division of the National Highway Traffic Safety Administration (NHTSA) assigned the Special Crash Investigation (SCI) team at Veridian the task of case review and final report preparation.

SUMMARY

Crash Site

This single vehicle crash occurred during the afternoon hours of December, 1999. At the time of the crash, it was daylight with no adverse conditions as the road was dry. The crash occurred off the west pavement edge of a (straight/level) 2-lane north/south rural roadway **(see Figure 8 - page 5)**. The asphalt roadway was bordered by grass shoulders with a utility pole located approximately 2.3 meters (7.5 feet) off the west pavement edge. No traffic control was present at the crash site which had a posted speed limit of 48 km/h (30 mph).

Pre-Crash

The 67 year old female driver of the 1999 Ford Escort SE was operating the vehicle southbound **(Figure 1)** at a (driver reported) speed of 56 km/h (35 mph) when she allowed the vehicle to depart the right (west) pavement edge in a forward tracking mode. The NASS interview stated that an unidentified northbound vehicle encroached into her lane of travel. As the right side wheels *"slipped off the apron"*, multiple steering maneuvers were unsuccessful in her attempts to regain control of the vehicle. However, scene evidence suggests she may have ben distracted and allowed the vehicle to simply drift off the road.

Figure 1. Southbound approach for the 1999 Ford Escort SE.

Figure 2. Struck utility pole.

Crash

As the Ford Escort departed the right (west) pavement edge of the rural 2-lane roadway, the front left area impacted a wooden utility pole **(Figure 2)** resulting in moderate damage. Although the impact was classified as out-of-scope (pole fractured/replaced), the WinSMASH reconstruction program computed a barrier equivalent velocity change of 34.4 km/h (21.4 mph) with a matching negative longitudinal component. The impact induced deceleration was sufficient to deploy the Ford's redesigned frontal air bag system. At this point, the vehicle rotated approximately 25 degrees counterclockwise and came to rest off the west road edge in close proximity to the point of impact facing southeast.

Post-Crash

The driver was removed from the vehicle by rescue personnel due to perceived serious injury and was subsequently transported by ambulance to a local trauma center for treatment and admitted for 17 days. The vehicle was towed from the crash site due to disabling damage.

RABSS VEHICLE

The 1999 Ford Escort SE was identified by the vehicle identification number (VIN): 1FAFP13P7XW (production number deleted). The vehicle was a 4-door sedan equipped with front-wheel drive a 2.0 liter, 4-cylinder engine. The police report listed the driver as the owner of the vehicle. At the time of the crash, the odometer had recorded 3,360 km (2,088 miles). The seating was configured with front bucket and rear bench seats (with folding backs). The driver reported no previous crashes or maintenance on the Ford's frontal air bag system. No cell phone was present or in-use at the time of the collision.

VEHICLE DAMAGE

Exterior

The 1999 Ford Escort sustained moderate frontal damage as a result of the impact with the utility pole **(Figure 3)**. The direct contact damage began 10.0 cm (3.9 in) to the left of the vehicle centerline and extended 45.0 cm (17.7 in) outboard. The impact deformed the entire front end width resulting in a combined direct and induced damage length (Field L) of 100.0 cm (39.4 in). Six crush measurements were documented at the level of the bumper: C1= 23.0 cm (9.1 in), C2= 59.0 cm (23.2 in), C3= 37.0 cm (14.6 in), C4= 18.0 cm (7.1 in), C5= 3.0 cm (1.2 in), C6= 0 cm. The Collision Deformation Classification (CDC) for this impact to the Ford was 12-FYEW-3 with a principal direction of force of

0 degrees. The hood was deformed up and rearward from engagement against the pole. The left fender was displaced slightly rearward which restricted the left front wheel/tire (not deflated). The windshield was fractured by (exterior) impact forces and the (interior) front right air bag module cover flap. Reduction in the left side wheelbase measured 10.0 cm (3.9 in).

Figure 3. Front left damage to the 1999 Ford Escort SE.

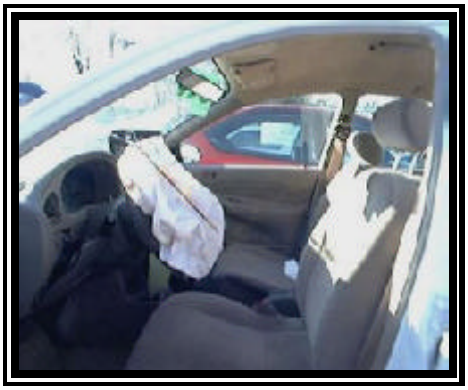

Figure 4. Interior view.

Interior

Interior damage to the Ford identified through the vehicle inspection was minimal and was attributed to occupant contact and component intrusion **(Figure 4)**. A scuff mark was documented on the left knee bolster and mid-instrument panel area. The side mirror and defroster adjustment knobs were deformed. The accelerator pedal was deformed to the right. Longitudinal intrusions into the driver space involved 12.0 cm (4.7 in) of toepan and 3.0 cm (1.2 in) of instrument panel intrusion. The NASS researcher reported a front left seat track anchor failure *(rear right seat anchor)*, however, this could not be confirmed during the SCI review due to inadequate field documentation.

REDESIGNED AIR BAG SYSTEM

The 1999 Ford Escort SE was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags deployed as a result of the crash. The driver air bag was housed in the center of the steering wheel with a horizontally oriented flap tear seam (H-configuration). The flaps were symmetrical in shape and measured 22.0 cm (8.7 in) in width along the tear seam and 10.0 cm (3.9 in) in height. Although no contact evidence was identified on the exterior surface of the module cover flaps, makeup transfers were documented at the upper right quadrant of the air bag face along with lipstick transfers to the lower right quadrant. The NASS researcher measured the diameter of the driver air bag at 61.0 cm (24.0 in) in its deflated state **(Figure 5)**. The bag was tethered by two internal straps and vented by two ports located at the 11 o'clock and 1 o'clock sectors on the rear aspect of the air bag.

The front right passenger air bag deployed from the right mid-instrument panel area with a single cover flap design hinged at the top aspect. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape and measured 31.0 cm (12.2 in) in width and 15.0 cm (5.9 in) in height. The NASS researcher measured the passenger air bag at 60.0 cm (23.6 in) in width and 78.0 cm (30.7 in) in height in its deflated state **(Figure 6)**. The bag was vented by two ports located at the 10 o'clock and 2 o'clock sectors on the side aspect of the air bag. No internal tether straps were present.

Figure 5. 1999 Ford Escort deployed redesigned driver air bag.

Figure 6. 1999 Ford Escort deployed redesigned passenger air bag.

DRIVER DEMOGRAPHICS

Age/Sex:	67 year old female
Height:	165 cm (65 in)
Weight:	88 kg (195 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system *(improper usage)*
Usage Source:	NASS vehicle inspection, driver interview, medical/police report
Eyeware:	Prescription glasses
Type of Medical Treatment:	Transported to a local trauma center and admitted (17 days)

Driver Injuries

Injury	*Severity (AIS 90)*	*Injury Mechanism*
*Fracture posterior/lateral left 2-3 ribs	Moderate (450220.2,2)	Shoulder belt webbing
+Fracture distal right radius	Moderate (752802.2,1)	Left instrument panel
+Contusion mesentery	Moderate (542010.2,8)	Lap belt webbing
+Contusion abdomen (“v” shaped)	Minor (590402.1,0)	Lap belt webbing
^Contusion left mid-chest	Minor (490402.1,2)	Shoulder belt webbing
+Contusion posterior right hand	Minor (790402.1,1)	Left instrument panel
+Contusion left knee	Minor (890402.1,2)	Left knee bolster

Sources - Discharge Summary/ER report+/History and Physical report^*

Driver Kinematics

The 67 year old female driver of the 1999 Ford Escort SE was seated in an upright posture with the seat track adjusted to the middle position. *Contrary to the NASS case file,* she was restrained by the

available 3-point manual lap and shoulder belt system, evidenced by the contusions sustained across the abdomen and left mid-chest. In addition, the medical reported a soft tissue injury that followed the size and orientation of the driver restraint ("v" shaped contusion). At impact, she initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint, knee bolster and deployed redesigned driver air bag. Loading of the manual restraint resulted in the above mentioned soft tissue injuries, mesentery contusion, and fractures of the left 2-3 ribs. The posterior/lateral aspect of the rib fractures indicates improper placement of the shoulder belt harness under the left arm. Contact to the knee bolster resulted in a contusion to the left knee as evidenced by the scuff mark documented to this component **(Figure 7)**. Contact to the deployed driver air bag was confirmed by the makeup transfers documented across the right portion of the air bag face. She also sustained a contusion to the right posterior hand and fracture of the right distal radius from contact to the left mid-instrument panel, evidenced by the deformed adjustment knobs and indentations documented to this component. The driver was removed from the vehicle by rescue personnel due to perceived serious injury and was transported by ambulance to a local trauma center for treatment and admitted for 17 days. The redesigned air bag provided protection against further contact to the steering wheel hub/rim, and potential serious injury.

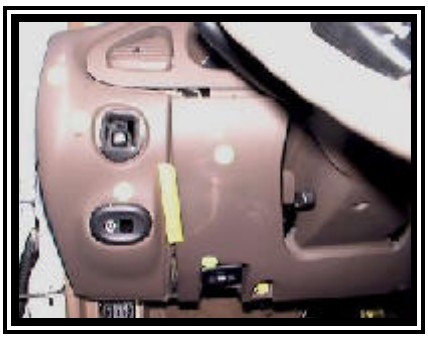

Figure 7. Scuff marks and indentations to the driver knee bolster and mid-instrument panel area.

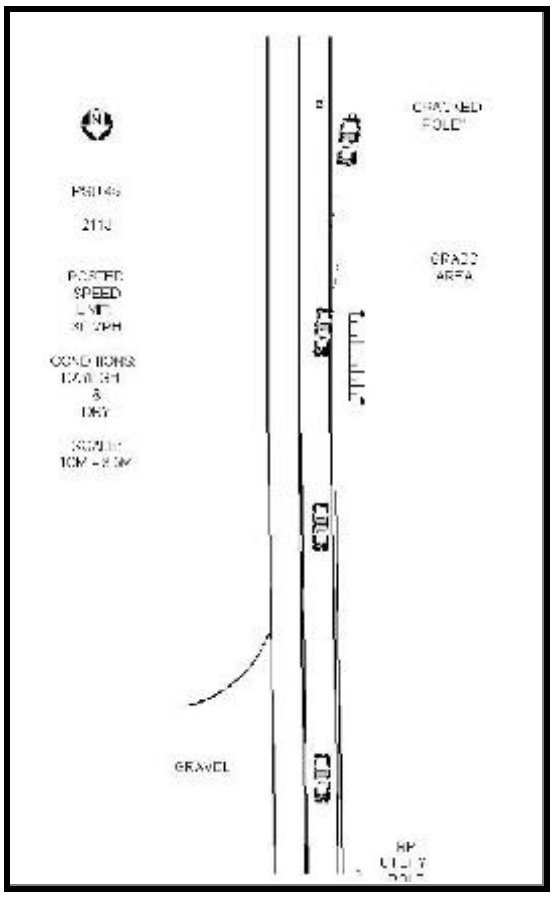

Figure 8. NASS Scene Diagram.