## TRANSPORTATION SCIENCES CRASH RESEARCH SECTION

Veridian Calspan Operations Buffalo, New York 14225

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

# NASS RABSS CASE NO. 1998-43-802G

# **RABSS VEHICLE - 1998 FORD ESCORT SE**

# LOCATION - STATE OF NORTH CAROLINA

# **CRASH DATE - JULY, 1998**

Contract No. DTNH22-94-D-07058

Prepared for:

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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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# REDESIGNED AIR BAG SPECIAL STUDY (RABSS) SCI TECHNICAL SUMMARY REPORT NASS RABSS CASE NO. 1998-43-802G RABSS VEHICLE - 1998 FORD ESCORT SE CRASH DATE - JULY, 1998

#### BACKGROUND

This investigation focused on a single vehicle crash involving a 1998 Ford Escort SE 4-door sedan. The Ford Escort was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a utility pole. The driver was operating the vehicle northbound on an urban two lane roadway when she allowed the vehicle to depart the right (east) pavement edge. As the vehicle exited the east pavement edge, the front right area struck a wooden utility pole resulting in moderate damage. The Ford rotated clockwise and came to rest in close proximity to the utility pole facing northeast. The 17 year old female driver of the Ford Escort was seated in an upright posture and restrained by the available 3-point manual lap and shoulder belt system. At impact, she initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of the right wrist resulting in a contusion. Although no injury was reported as a result of loading to the manual restraint, she sustained a contusion to the chin from contact with the deployed redesigned driver air bag. The 15 year old male front right passenger was also seated in an upright posture and restrained by the 3-point manual lap and shoulder belt system. At impact, he initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint and deployed redesigned passenger air bag. Loading of the manual restraint resulted in a contusion to the right shoulder. He also sustained a contusion to the posterior aspect of the left forearm from contact with the deployed passenger air bag. Neither occupant was transported for treatment.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 98-43-802G for 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/Calspan the task of case review and final report preparation.

#### **SUMMARY**

#### Crash Site

This single vehicle crash occurred during the late evening hours of July, 1998. At the time of the crash, it was dark (street lighted) with rainy conditions as the roads were wet. The crash occurred off the east pavement edge of a straight and level two lane north/south asphalt roadway (see Figure 6 - page 6). No traffic control was present at the scene which had a posted speed limit of 56 km/h (35 mph). The roadside environment featured barrier curbs and pedestrian sidewalks.

#### **Pre-Crash**

The 17 year old female driver of the 1998 Ford Escort exited a parking lot some distance south of the

crash site and began to travel north on the urban roadway (**Figure 1**). The intermittent rain conditions caused the windshield to fog over decreasing visibility as she proceeded at a (driver reported) speed of 32 km/h (20 mph). The driver adjusted the climate controls in an attempt to defog the windshield and failed to notice the vehicle as it traveled towards the right (east) curbline.



Figure 1. Northbound approach for the 1998 Ford Escort SE (struck pole in background).



Figure 2. Struck pole.

#### Crash

As the Ford Escort exited the east pavement edge of the urban two lane roadway, the front right area struck a 30.5 cm (12.0 in) wooden utility pole (**Figure 2**) resulting in moderate damage. Initial contact involved the extreme front right corner area which displaced the bumper and leading edge of the right fender. The continued forward motion of the vehicle resulted in engagement of the right front wheel/tire against the pole. This was the first significant structural contact. Therefore, the air bag system probably deployed at this time, late in the crash sequence. The impact induced deceleration was sufficient to deploy the Ford's redesigned frontal air bag system. The damage algorithm of the WinSMASH program computed a (barrier equivalent) velocity change of 12.5 km/h (7.8 mph). The specific longitudinal component was -12.5 km/h (-7.8 mph). The Collision Deformation Classification (CDC) for this impact to the Ford Escort was 12-FREE-4. At this point, the Ford rotated clockwise approximately 15 degrees and came to rest in close proximity to the utility pole facing northeast.

#### **Post-Crash**

Both occupants exited the vehicle under their own power. No ambulance was summoned to the crash site. The vehicle was towed from the scene.

#### **RABSS VEHICLE**

The 1998 Ford Escort SE was identified by the Vehicle Identification Number (VIN): 1FAFP13P1WW (production sequence deleted). The vehicle was a 4-door sedan equipped with front wheel drive and a 2.0 liter, 4 cylinder engine. The vehicle's odometer reading was 11,706 km (7,274 miles) at the time of the crash. The police report listed the driver's father as the owner of the vehicle. The seating was configured with front bucket and rear (folding back) bench seats. The driver reported no previous crashes or maintenance on the air bag system (original equipment). A portable cell phone was present but not in-use at the time of the collision.

# VEHICLE DAMAGE

## **Exterior Damage**

The 1998 Ford Escort SE sustained moderate frontal damage as a result of the impact with the utility pole (**Figure 3**). The direct contact damage began at the front right bumper corner and extended 22.0 cm (8.7 in) inboard. The impact deformed the full frontal width resulting in a combined direct and induced damage length (Field L) of 133.0 cm (52.4 in). Six crush measurements were documented at the level of the reinforcement bar (bumper cover separation): C1= 0 cm, C2= 0 cm, C3= 1.0 cm (0.4 in), C4= 0 cm, C5= 1.0 cm (0.4 in), C6= 3.0



Figure 3. Frontal damage to the 1998 Ford Escort SE.

cm (1.2 in). The contact damage extended rearward down the right side surface which deformed the fender and deflated/restricted the right front wheel/tire. Minor displacement of the hood was noted from engagement against the pole. Reduction in the right side wheelbase measured 19.0 cm (7.5 in). The windshield fractured at the right lower A-pillar area from exterior impact forces and the right mid-windshield area from the (interior) passenger air bag module cover flap. Unexplained damage which cannot be tied to another event was identified at the front left area and included in the NASS case file as overlapping damage (CDC = 12-FZEW-1), however, this minor damage had no effect on the WinSMASH output.

### **Interior Damage**

Interior damage to the Ford Escort identified through the NASS vehicle inspection was minimal and was attributed to the front right air bag module cover flap (fractured windshield). No intrusions were found in the vehicle. No deformation was documented to the knee bolsters (rigid plastic type) or steering wheel rim/column (tilt column set to the center position).

## **REDESIGNED AIR BAG SYSTEM**

The 1998 Ford Escort SE was equipped with redesigned frontal air bags for the driver and front right passenger positions. The air bags had 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). No contact evidence was identified on the air bag or exterior surface of the module cover flaps. The flaps were asymmetrical in shape as the upper flap measured 22.0 cm (8.7 in) in width and 8.0 cm (3.1 in) in height while the lower flap measured 22.0 cm (8.7 in) in width and 11.0 cm (4.3 in) in height. The NASS researcher measured the diameter of the driver air bag at 57.0 cm (22.4 in) in its deflated state (**Figure 4**). 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. There was no contact evidence identified on the air bag or exterior surface of the module cover flap. The cover flap was rectangular in shape and measured 31.5 cm (12.4 in) in width and 22.0 cm (8.7 in) in height. The NASS researcher measured the passenger air bag at 44.0 cm (17.3 in) in width and 63.0 cm (24.8 in) in height in its deflated state (**Figure 5**). No internal tether straps were present. 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 cutoff switch was reported for the front right redesigned passenger air bag.



Figure 4. 1998 Ford Escort SE redesigned driver air bag.



Figure 5. 1998 Ford Escort SE redesigned passenger air bag.

## DRIVER DEMOGRAPHICS

Age/Sex:	17 year old female
Height:	170 cm (67 in)
Weight:	68 kg (150 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview
Eyeware:	None
Type of Medical	
Treatment:	None

## **Driver Injuries**

Injury	Severity (AIS 90)	Injury Mechanism
Contusion anterior right wrist (2.5 in)	Minor (790402.1,1)	Front left air bag
Contusion chin (1.0 in)	Minor (290402.1,8)	Front left air bag

## **Driver Kinematics**

The 17 year old female driver of the 1998 Ford Escort SE was properly restrained by the available 3point lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the middle position. The NASS interview reported that she was belted, further evidenced by the lack of significant injury and contact points within the vehicle. At impact, she initiated a forward trajectory in response to the 12 o'clock impact force as the expanding air bag contacted the anterior aspect of her right wrist resulting in a 6.4 cm (2.5 in) contusion. This mechanism was evidenced by the pre-crash placement of the hands relative to the inflated diameter of the air bag. Although no injury was reported as a result of loading to the manual restraint, the driver's seated position and belt use allowed her face to move forward into the deployed air bag. As a result of bag contact, she sustained a 2.5 cm (1.0 in) chin contusion, evidenced by the kinematic response pattern relative to the rearward extent of the fully deployed air bag. The combination of restraint options provided protection against further contact to the steering wheel hub/rim. The driver was not transported for treatment.

#### FRONT RIGHT PASSENGER DEMOGRAPHICS

Age/Sex:	15 year old male
Height:	178 cm (70 in)
Weight:	68 kg (150 lb)
Seat Track Position:	Mid-to-rear position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview
Eyeware:	Prescription glasses
Type of Medical	
Treatment:	None

<i>Injury</i> Contusion right shoulder (2.0 in)	<i>Severity (AIS 90)</i> Minor (790402.1,1)	<i>Injury Mechanism</i> Shoulder belt webbing
Contusion posterior left forearm (3.0 in)	Minor (790402.1,2)	Front right air bag

## **Front Right Passenger Kinematics**

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The 15 year old male front right passenger of the 1998 Ford Escort SE was properly restrained by the available 3-point lap and shoulder belt system, seated in an upright posture (hands on lap) with the seat track adjusted to the mid-to-rear position. The NASS interview reported that he was belted, further evidenced by the lack of significant injury and contact points within the vehicle. At impact, he initiated a forward trajectory in response to the 12 o'clock impact force and loaded the manual restraint and deployed redesigned passenger air bag. Loading of the manual restraint resulted in a 5.1 cm (2.0 in) contusion to the right shoulder as evidenced by the size and location of the injury. He attempted to brace and sustained a contusion to the posterior aspect of the left forearm from contact with the deployed air bag. The right instrument panel was identified as the source of this injury in the NASS case file, however, the seat track position and rearward extent of the fully deployed air bag suggests the redesigned air bag a more viable source. The redesigned passenger air bag provided additional restraint against possible contact to the instrument panel. The passenger was not transported for treatment.



Figure 6. NASS Scene Diagram.