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REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-007
LOCATION - New York
VEHICLE - 1998 FORD CONTOUR
CRASH DATE - May 1998

Submitted:

June 10, 1999

Contract Number: DTNH22-94-D-17058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
National Center for Statistics and Analysis
Washington, D.C. 20590-0003

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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 crashworthiness performance of the involved vehicle(s) or their safety systems.

Technical Report Documentation Page

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Remote redesigned air bag report involving a 1998 Ford Contour, equipped with manual safety belts and dual, redesigned, front air bags, and a fixed object (i.e., large tree)

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Ford Contour (case vehicle) and a large tree. This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of crash events, and the unrestrained driver (18-year-old male) sustained a fatal aortic injury at impact. The case vehicle was traveling north in the northbound lane of a two-lane, undivided, city roadway when, for some unknown reason, the driver lost control of the vehicle, and the case vehicle began to rotate counterclockwise. Investigating officers estimated the case vehicle's pre-crash speed at 113 km.p.h. (70 m.p.h.). The case vehicle traveled off the left (west) road edge, across a grassy tree plat and a concrete sidewalk, just prior to impact. The front of the case vehicle impacted a large tree, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. While staying in contact with the tree, the case vehicle continued to rotate counterclockwise a few degrees. The case vehicle's driver was seated and was not wearing his available, active, three-point, lap and shoulder belt. His seat track location, steering wheel location, and posture are not known. According to his autopsy, he sustained: a transected aorta; bilaterally contused lungs; a displaced fracture of his right femur; right rib fractures (1-9); lacerations to his right lung, spleen, bladder, and liver; compound and comminuted fractures of the left tibia and fibula; a gaping left knee laceration; and other integumentary injuries. The case vehicle's driver was pronounced dead at the scene. The front right passenger (16-year-old female) was seated but her seat track's location is unknown. She was restrained by her available, active, three-point, lap and shoulder belt. She sustained, according to the police, possible ("C") injuries. The other two occupants (i.e., unspecified rear seating positions) were transported and hospitalized for unknown injuries.

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BACKGROUND

IN99-007

This case was brought to the NHTSA's attention by a review of the 1998 Fatality Analysis Reporting System (FARS) in February 1999. The crash involved a 1998 Ford Contour (case vehicle) and a fixed object (a large tree). The crash occurred in May, 1998, at 11:51 p.m., in New York, and was investigated by the applicable city police department. This case is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of crash events, and the unrestrained driver (18-year-old male) sustained a fatal aortic injury at impact. The Police Crash Report was received in March, 1999, while the autopsy and police photographs were received in May. This report is based on the Police Crash Report, police photographs, the autopsy report, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling north in the northbound lane of a two-lane, undivided, residential city street. Ambient conditions were dark, but lighted, and weather was cloudy. The roadway was bituminous, dry, straight, and level, with no defects; there were irregular pavement edges and no curbing of any kind (**Figure 1**). The posted speed limit was 48 km.p.h. (30 m.p.h.). Investigating officers estimated the case vehicle's pre-crash speed at 113 km.p.h. (70 m.p.h.).

Figure 1: Case vehicle's northbound approach; Note: right rear rotational tire scuff in right fore-ground (case photo #01)

Surviving case vehicle occupants indicated that the driver began speeding down the street and they all told him to slow down. For some unknown reason, the driver lost control of the case vehicle, and the vehicle began to rotate counterclockwise. Once the vehicle began its pre-crash, counterclockwise yaw, no avoidance maneuvers are detectable in the available police photographs nor were any cited by investigating officers. Police photographs show a gradually increasing degree of yaw into the impact (**Figure 2**).

Figure 2: Case vehicle's counterclockwise yaw marks across grass; Note: from left-to-right, marks are left front (beyond sidewalk), right front, left rear, and right rear (case photo #03)

The crash occurred off the left (west) side of the trafficway, in the lawn of a private residence. The case vehicle, yawing counterclockwise, traveled off the left road edge, across a tree plat and concrete sidewalk, and impacted a large tree head-on (**Figure 3** below), causing the driver and front right passenger supplemental restraints (air bags) to deploy. While staying in contact with the tree, the case vehicle continued its counterclockwise rotation a few more degrees and came to final rest facing west-northwest. The crash

severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)].

Figure 3: Case vehicle at final rest showing frontal damage from tree impact; Note: tree penetration depth (case photo #05)

CASE VEHICLE

The case vehicle was a front wheel drive, 1998 Ford Contour, five-passenger, four-door sedan (VIN: 3FAFP65L3WM------) equipped with a 2.5 liter, V-6, gasoline engine and a four-speed automatic transmission with the selector lever mounted in the center console. Four-wheel anti-lock brakes are an option for this vehicle, but it is not known if the case vehicle was so equipped. Its wheelbase was 271 centimeters (106.5 inches). No odometer reading was reported. The case vehicle was towed from the scene due to disabling damage.

Figure 4: Case vehicle's front seat area showing intrusion and buckling; Note: upward shift of floor and deformed front bucket seats and intrusion of toe pan and brake pedal (case photo #09)

The case vehicle sustained direct contact damage to the right-center of the front (**Figure 3**). Damaged components included the hood; front fascia, bumper, grille, and engine compartment brackets; and left and right headlamp assemblies and fenders. The windshield was fractured across its entire width. The left front wheel was pulled forward and the right front wheel was pushed rearward, causing rearward displacement of the right lower "A"-pillar. The rear edge of the hood probably contacted the lower portion of the windshield and the upper right "A"-pillar. The left and right roof rails and the roof itself were buckled near the "B"-pillars. The left and right front doors were subsequently removed to enable extrication of the victims (**Figure 4**). Based on the available police photographs, the CDC for the case vehicle is estimated as: **01-FZEW-3 (+40)**. The WinSMASH reconstruction program, barrier algorithm with CDC-only estimated crush profile, provides a borderline reconstruction, but the results appear reasonable. The estimated Total, Longitudinal, and Lateral Delta Vs are, respectively: 41.1 km.p.h. (25.5 m.p.h.), -35.6 km.p.h. (-22.1 m.p.h.), and -20.6 km.p.h. (-12.8 m.p.h.).

Intruding components into the front seating area included the instrument panel, toe pan, and foot well for both front occupants. The instrument panel appears to be displaced, with the bottom rotated slightly forward. The toe pan was pushed rearward, with the brake pedal visibly displaced (**Figure 4**). Based on the available police photographs, it cannot be determined whether the steering column also intruded. No steering wheel rim deformation is visible, but there are blood transfers to the rim covering (**Figure 5**). Upward movement of the driver's foot well and floor caused a similar upward movement to the forward edge of the driver's bucket seat.

Roof rail buckling was relatively modest and not thought to be of sufficient magnitude to reduce available occupant space.

Figure 5: Case vehicle's driver seating area; Note: deployed air bag and blood on steering wheel rim (case photo #10)

CASE VEHICLE OCCUPANTS

There were a total of four occupants in the case vehicle: the driver, a front right passenger, and two rear seat passengers whose specific rear seat positions are not known.

CASE VEHICLE DRIVER KINEMATICS

The case vehicle's driver [18-year-old, White (unknown if Hispanic) male] was not restrained by the available, manual, three-point, lap and shoulder safety belt system. The driver's [175 centimeters, 137 kilograms (69 inches, 301 pounds)] pre-crash seat adjustments, steering wheel position, and seated posture are not known. He was declared dead at the scene. The driver's injuries and kinematics are based on his autopsy and the principles of occupant kinematics.

As the case vehicle rotated counterclockwise, the case vehicle's unrestrained driver shifted slightly forward and to the right. The rotation had nearly reached the 45-degree mark when impact with the tree occurred. At impact the driver moved further forward and to the right, toward the +40 direction of principal force (PDOF). As a result his left knee contacted the instrument panel, resulting in a gaping laceration. His right knee loaded the center instrument panel causing a displaced fracture of the right femur, and the intrusion through the toe pan area caused compound, comminuted fractures of his left tibia and fibula. The air bag deployed against his torso, causing an abrasion to the medial surface of his left arm, but based on the driver's weight (above) and the high Delta V, the driver most likely deflated the air bag and loaded the steering column. Based on the driver's movement toward the PDOF, the deploying air bag most likely caused his torso to rotate counterclockwise such that he struck the steering wheel rim primarily with his right side. In this contractor's opinion, the impact with the steering wheel rim and hub caused the fracturing to his right ribs 1-through-9 (some twice), a transection to his aorta--distal to the ductus fibrosis, bilateral lung contusions, and lacerations to his right lung, superior abdomen, spleen, dome of his bladder, and liver. He also sustained a contusion just below his umbilicus from the steering wheel rim. As the case vehicle continued to rotate counterclockwise about the tree to final rest [a center of gravity distance of no more than 0.9 meters (3 feet)], the driver's body jackknifed over the lower steering wheel rim, allowing his head to sustain a mid-hairline laceration from contact with the center windshield. At final rest, he was slumped to the right, against the left side of a twisted front right passenger seat.

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1	Laceration of the thoracic aorta, "just distal to the ductus fibrosis" with bilateral hemothorax	420218.6 untreatable	Steering wheel hub and spokes	Probable	Autopsy
2	Contusions lungs, bilaterally	441410.4 severe	Steering wheel hub and spokes	Probable	Autopsy
3	Laceration right lung, posteriorly	441413.3 serious	Steering wheel rim	Probable	Autopsy
4	Fractured right ribs 1 - 9, five ribs with two fractures	450230.3 serious	Steering wheel rim	Probable	Autopsy
5	Fracture, displaced, right femur, not further specified	851800.3 serious	Center instrument panel	Probable	Autopsy
6	Fracture, compound, comminuted, left tibia, lower third	853422.3 serious	Toe pan	Certain	Autopsy
7	Fracture, compound, comminuted, left fibula, lower third	851610.2 moderate	Toe pan	Certain	Autopsy
8	Lacerations (2) liver, radiating from the attachment to the diaphragm, not further specified	541820.2 moderate	Steering wheel rim	Probable	Autopsy
9	Lacerations, multiple, spleen, not further specified	544220.2 moderate	Steering wheel rim	Probable	Autopsy
10	Laceration {tear} dome of bladder, not further specified	540622.3 serious	Steering wheel rim	Probable	Autopsy
11	Laceration, gaping, left knee	890602.1 minor	Left instrument panel	Probable	Autopsy
12	Laceration forehead at the center of the hairline	290602.1 minor	Windshield	Possible	Autopsy
13	Laceration anterior, superior abdomen	590602.1 minor	Steering wheel rim	Possible	Autopsy
14	Contusion just below the umbilicus	590402.1 minor	Steering wheel rim	Probable	Autopsy
15	Abrasion {"brush burn"} inner left arm	790202.1 minor	Driver's air bag	Probable	Autopsy

OTHER CASE VEHICLE OCCUPANTS

The front right passenger [16-year-old, White (unknown if Hispanic) female] was restrained by her available, manual, three-point, lap and shoulder safety belt system. Her (height and weight unknown) pre-crash

seat adjustments and posture are not known. At-impact, however, one or both of the rear seat occupants contacted the back of the front right passenger's seat and torqued the entire seat so that the left side was forward of the right, with the seat back deformed more than the seat (**Figure 6**). She was transported to a medical facility, but her treatment status is unknown. She was interviewed at home by an investigating officer two days post-crash. Her injuries were reported as "complaint of pain" to her knee/lower leg/foot.

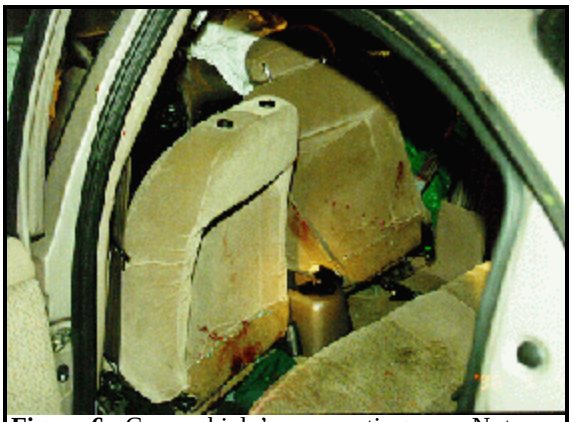

Figure 6: Case vehicle's rear seating area; Note: seat back deformation to front bucket seats from contact by rear seat occupants (case photo #11)

The two rear seat occupants (16-year-old male and a 17-year-old male, race and ethic origin unknown, height and weight unknown, specific seat positions unknown) both struck the backs of the front bucket seats such that the seat backs were deformed. According to the Police Crash Report, neither rear seat occupant was restrained by their available, manual, safety belts. Both occupants were transported to a medical facility and hospitalized.

OBJECT CONTACTED

The case vehicle impacted a large tree with a diameter, at the point of impact, of approximately 76 centimeters (30 inches--**Figure 4** above). There was surface scraping and peeling of the tree's bark in the area of the impact, but there is no evidence that the tree fractured or that it moved.