

TRANSPORTATION RESEARCH CENTER

Indiana University  
Bloomington, Indiana 47403-1599

**REMOTE AIR BAG REPORT**

CASE NUMBER - IN97-007  
VEHICLE - 1991 FORD LTD CROWN VICTORIA LX  
LOCATION - MICHIGAN  
CRASH DATE - January, 1994

Submitted:

February 6, 1998

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

## **DISCLAIMERS**

This document is disseminated under the sponsorship of the Department of Transportation in the interest of information exchange. The United States Government assumes no responsibility for the contents or use thereof.

The opinions, findings, and conclusions expressed in this publication are those of the authors and not necessarily those of the National Highway Traffic Safety Administration.

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.

TRC/IU Case No. IN9707

February 6, 1998

Remote Air Bag Investigation  
Private Vehicle  
Location - Michigan

TRC/IU IN9707, Task 0081

Indiana University  
Transportation Research Center  
222 West Second Street  
Bloomington, Indiana 47403-1599

DTNH22-94-D-17058

U.S. Department of Transportation (NRD-32)  
National Highway Traffic Safety Administration  
National Center for Statistics and Analysis  
Washington, D.C. 20590-0003

January, 1994

Remote air bag deployment investigation involving a 1991 Ford Crown Victoria LX, four-door sedan, with manual safety belts and driver's air bag, and a longitudinal barrier (i.e., guardrail)

This report covers a remote investigation of an air bag deployment crash that involved a 1991 Ford Crown Victoria LX and a guardrail. This crash is of special interest because the Crown Victoria's driver sustained a lacerated aorta from his deploying driver side air bag. The Crown Victoria LX was traveling west in the westbound lane of a two-lane, undivided, frontage road--for an interstate highway, and was negotiating a right-hand curve. The case vehicle crossed the centerline into the eastbound lane while traveling essentially straight ahead in the right curve with a slight clockwise yaw prior to impact. The crash occurred when the case vehicle departed the south side of the roadway, striking a longitudinal barrier off the south roadside. The front left of the case vehicle impacted a "W"-beam guardrail, causing the driver side supplemental restraint system (air bag) to deploy. The case vehicle was redirected by the guardrail across the roadway where it came to rest heading westward near the mouth of an intersecting roadway. The posture of the case vehicle's driver (80-year-old male), just prior to the crash, is unknown; however, he habitually adjusted his seat back upright, sitting with his back against the seat back, the seat (i.e., track location) in its forward-most position, and the tilt steering wheel near its down-most position. The case vehicle's driver was not wearing his available, active, three-point, lap and shoulder belt and sustained, according to his medical records, fatal injuries which included: a 1.3 centimeter (0.5 inch) laceration to his ascending aorta, just above the aortic valve ring with hemorrhage (~ 200 cc) into his pericardial sac, and abrasions to his right cheek and anterior neck from the deploying air bag. In addition, he sustained a laceration above his right ear (right parietal area) from an unidentified source. There was no evidence of belt pattern bruising and/or abrasions to the driver's body.

Motor Vehicle Traffic Accident  
Air Bag  
Deployment  
Injury Severity

General Public

Unclassified

Unclassified

10

\$5,000

## TABLE OF CONTENTS

	<u>Page No.</u>
ACCIDENT DATA .....	1
AMBIENT CONDITIONS .....	1
ROADWAY .....	1
VEHICLES .....	2
VEHICLE DAMAGE .....	2
DEPLOYMENT IMPACT .....	2
COLLISION SEQUENCE .....	3
PRE-CRASH .....	3
CRASH .....	3
DRIVER/OCCUPANT DATA .....	3
CASE VEHICLE DRIVER INJURIES .....	4
DISCUSSION .....	5

# CASE SUMMARY

SCI Team #2, TRC/IU Case Number IN9707

Michigan

January, 1994

This remote report was brought to the NHTSA's attention in February, 1997 by the NHTSA's clipping service from a newspaper article in Michigan in September, 1996. The crash occurred in January, 1994 at 8:50 a.m. EST in Michigan and was investigated by the applicable township police department. The crash involved a 1991 Ford Crown Victoria, four-door sedan, and a longitudinal barrier. This contractor interviewed the next of kin (i.e., son and daughter-in-law, who lived in the same house as the driver) in February, 1997. This crash is of special interest because the Crown Victoria's driver (80-year-old male) sustained a lacerated aorta from his deploying driver side air bag. This summary is based on the Police Crash Report, interviews with his relatives, occupant kinematic principles, occupant medical records, and this contractor's evaluation of the evidence.

The Crown Victoria (case vehicle) was traveling westward, attempting to negotiate a right-hand curve, on a two-lane, undivided, frontage road (i.e., for an interstate highway) and intended to continue straight ahead in the curve. Although it is unknown exactly what avoidance maneuvers the driver of the case vehicle attempted, he at least braked--with full lock-up, depositing straight line skid marks prior to the crash. The case vehicle crossed the centerline into the eastbound lane while travelling essentially straight ahead in the right curve with a slight clockwise yaw prior to impact. The crash occurred when the case vehicle departed the south side of the roadway, striking a longitudinal barrier off the south roadside.

The front left corner of the case vehicle impacted a "W"-beam guardrail, causing the case vehicle's driver side supplemental restraint (air bag) to deploy. The crash severity to the case vehicle was low (9-14 m.p.h.).

The case vehicle's driver [183 centimeters and 60 kilograms (72 inches, 133 pounds)] was not wearing his available, active, three-point, lap and shoulder belt. There was no evidence of belt pattern bruising and/or abrasions to the driver's body.

As a result of the known attempted braking maneuver and the nonuse of his available safety belts, he most likely moved slightly forward just prior to impact. Based on the principles of occupant kinematics, the case vehicle's impact with the guardrail not only deployed the driver air bag, but thrust the driver forward, upward, and slightly to the left. The case vehicle's driver most likely rebounded backwards and to his left (toward the driver's door) as a result of impacting the guardrail and the subsequent redirection of the case vehicle back onto and across the roadway. The case vehicle was found in a parked position heading westward near the mouth of an intersecting roadway (i.e., on the north shoulder of the frontage road and on the east shoulder of the intersecting city street). The Police Crash Report is silent as to whether the case vehicle's ignition was on and whether the transmission selector was in gear. The case vehicle sustained very minor damage and was at rest on the level shoulder, parallel to the roadway, with no obstructions around it. The case vehicle's driver was in the driver's seat position and unconscious, with no evidence that any other person had intervened. Based on the available evidence, it appears that the case vehicle's driver may have maneuvered into a parked position before he lost consciousness.

The driver was transported by ambulance to the hospital. He sustained a fatal chest injury and, despite emergency resuscitation efforts, was pronounced dead 51 minutes post-crash. The injuries sustained by the case vehicle's driver included: a lacerated ascending aorta--with hemopericardium, abrasions to his right cheek and proximal neck, and a laceration above his right ear.

The case vehicle was a 1991 Ford Crown Victoria (VIN: 2FACP74F4MX-----). The case vehicle was not equipped with anti-lock brakes. The case vehicle was towed from the scene, most likely because the driver was incapacitated and the left front tire was flat. Based on the available photographs, the plastic or fiberglass front left corner area and headlight housing were cracked/shattered but the headlight lens was intact, the left bumper guard was missing, and the left front tire was deflated. In addition, the headlight/grille assembly was partially displaced. The CDC is estimated as: **11-FLEE-1** for the case vehicle (maximum crush was not estimable from the available photographs). The "W"-beam guardrail was slightly bent at the location of the impact. No reconstruction program (barrier option) was used on this crash because the NASS, CDS, SMASH protocol requires that actual vehicular crush measurements be obtained. In addition, this was a swiping-type impact with a yielding object, which is beyond the scope of the regular SMASH reconstruction damage only protocol; however, this contractor's visually estimated Delta V is between 13 km.p.h. (8 m.p.h.) and 16 km.p.h. (10 m.p.h.).

Immediately prior to the crash, according to the next of kin, the case vehicle's driver habitually adjusted his seat back upright, sitting with his back against the seat back, the seat (i.e., track location) in its forward-most position, and the tilt steering wheel near its down-most position. Based on the available scene photographs, the case vehicle's driver most likely had his left foot on the floor, his right foot on the brake, and both, hands on the steering wheel. There were no other occupants in the case vehicle.

# TRC/IU REMOTE AIR BAG REPORT

TRC/IU CASE NO. IN9707

FLEET - PRIVATE VEHICLE  
LOCATION - MICHIGAN

## ACCIDENT DATA

Location/Street:	City Street (i.e., service road for Interstate Highway)
State:	Michigan
Area/Type:	Rural, residential
Accident Date/Time:	January, 1994, @ 8:50 a.m.
Investigating Police Agency:	Township Police Department
Accident Type:	Car - ran-off-road (struck guardrail)
Occupant Injury Severity (air bag vehicle):	Laceration aorta (AIS-5)

## AMBIENT CONDITIONS

Light Conditions:	Daylight per Police Crash Report and available photographs
Weather Condition:	Precipitation per Police Crash Report
Precipitation:	Sleet/hail per Police Crash Report
Road Surface:	Icy per Police Crash Report and available photographs
Temperature:	17 degrees F (-8.3 degrees C) @ nearest weather station

## ROADWAY

### Case Vehicle

Location:	City Street (i.e., service road for Interstate Highway)
Number of Travel Lanes:	Two-lanes, undivided
Width:	Unknown
Surface Type:	Asphalt per available photographs
Vertical alignment:	Level per available photographs

## ROADWAY (CONTINUED)

### Case Vehicle

Horizontal alignment: Curve right  
Traffic Density: Light per relative (on scene shortly post-crash)  
Speed Limit: 80 km.p.h. (50 m.p.h.) per Police Crash Report  
Traffic Controls: Double solid yellow center ("*no passing*") lines and solid white edge lines on north and south edges of roadway

## VEHICLES

### Case Vehicle

Year: 1991  
Make: Ford  
Model: LTD Crown Victoria LX  
Body Type: Four-door sedan, six passengers  
V.I.N.: 2FACP74F4MX-----  
Mileage: Unknown, interviewee estimated 24,140 km (15,000 m)  
Windshield damage/source: Cracked (starred) by unknown contact (per medical records)  
Active Restraints: Three-point, lap and shoulder belts in front and rear out-board seating positions; lap belt only at front and rear center positions (per specifications)  
Passive Restraints: Factory installed driver side supplemental restraint system (air bag)  
Anti-lock brakes: No  
Fleet: Private vehicle  
Tow status: Towed due to damage (i.e., flat left front tire)  
Reported Defects: None per interviewee

## VEHICLE DAMAGE

### Case Vehicle

#### DEPLOYMENT IMPACT

Event number: First



### VEHICLE DAMAGE (CONTINUED)

#### Case Vehicle

#### DEPLOYMENT IMPACT (Continued)

Object struck:	Guardrail
Damage location:	Front
CDC:	11-FLEE-1 per available photographs
Estimated maximum crush:	Not estimable
Damaged components:	Front left fender and left front headlight assembly and tire (i.e., flat)
Repair estimate:	Unknown
Interior damage:	Unknown (at least driver side air bag module)

### COLLISION SEQUENCE

The following is based on the Police Crash Report, interviews with relatives (son and daughter-in-law, who lived in the same house) of the case vehicle's driver, occupant medical records, and this contractor's evaluation of the evidence.

**PRE-CRASH:** The case vehicle (Crown Victoria LX) was traveling west in the in the westbound lane of a two-lane, undivided, frontage road--for an interstate highway, and was attempting to continue in his westward travel path while negotiate a right-hand curve. Although it is unknown exactly what avoidance maneuvers the driver of the case vehicle attempted, he at least braked (see **SELECTED PHOTOGRAPH #01**)--with full lock-up, depositing straight line skid marks prior to the crash. The case vehicle crossed the centerline into the eastbound lane while travelling essentially straight ahead in the right curve with a slight clockwise yaw prior to impact. The crash occurred when the case vehicle departed the south side of the roadway, striking a longitudinal barrier off the south roadside.

**CRASH:** The front left of the case vehicle impacted a longitudinal barrier (i.e., "W"-beam guardrail) located off the south roadside causing the driver side supplemental restraint system (air bag) to deploy. The case vehicle was redirected by the guardrail and possibly steering back across the roadway where it came to rest heading westward near the mouth of an intersecting roadway (i.e., on the north shoulder of the frontage road and on the east shoulder of the intersecting city street).

### DRIVER/OCCUPANT DATA

#### Case Vehicle

Age:	80-year-old
------	-------------

## DRIVER/OCCUPANT DATA (CONTINUED)

Case Vehicle

Sex: Male

Height: 183 centimeters (72 inches) per autopsy

Weight: 60 kilograms (133 pounds) per autopsy

Occupation: Retired

Active Restraint System/Usage: Three-point lap and shoulder/Not used

Usage Source: Police Crash Report and medical records

Passive Restraint System/Usage: Driver side air bag/Air bag deployed

Usage Source: Interviewee, Police Crash Report, and medical records

Eye glasses/contacts: None (not required for driving)

Vehicle Familiarity: Unknown

Route Familiarity: Daily

Trip Plan: Home to restaurant

Manner of Leaving Scene: Ambulance

Type of Medical Treatment: Treated but subsequently expired at Hospital

CASE VEHICLE DRIVER INJURIES<sup>1,2</sup>

<u>Description of Injury</u>	<u>A.I.S.</u>	<u>Source of Data</u>	<u>Injury Mechanism</u>	<u>Certainty</u>
Laceration <sup>1</sup> ascending aorta, 1.3 centimeters (0.5 inches) above aortic valve ring with hemorrhage (~ 200 cc) into the pericardial sac	420216.5,4	1 <sup>2</sup>	Air bag, driver's side	{Certain}
Abrasions right cheek, small	290202.1,1	1 <sup>2</sup>	Air bag, driver's side	{Certain}

<sup>1</sup> The laceration was 3.2 centimeters (1.25 inches).

<sup>2</sup> These injuries were reported on the Medical Examiner's Report; however, the injury information in the report was based on an autopsy.

CASE VEHICLE DRIVER INJURIES<sup>3,4</sup> (CONTINUED)

<u>Description of Injury</u>	<u>A.I.S.</u>	<u>Source of Data</u>	<u>Injury Mechanism</u>	<u>Certainty</u>
Abrasions, deep, mandibular area <sup>3</sup> , and neck, scattered	390202.1,5	1 <sup>2</sup>	Air bag, driver's side	{Certain}
Laceration <sup>3</sup> above right ear (right parietal area)	190602.1,1	1 <sup>2</sup>	Unknown mechanism	{Unknown}

## DISCUSSION

This crash is of special interest because the case vehicle's driver sustained a lacerated aorta from his deploying driver side air bag. Because there were no other occupants in the vehicle, the posture of the case vehicle's driver immediately prior to the impact is unknown; however, according to the driver's next of kin, the driver habitually seated himself upright--with his back against the seat back, and positioned his seat track in its forward-most position and the tilt steering wheel in its down-most position. Based on the crash dynamics (i.e., locked wheel braking) the driver most likely had his left foot on the floor, his right foot on the brake, and both hands on the steering wheel. According to the Police Crash Report and the driver's medical records, he was not wearing his available, active, three-point, lap and shoulder belt.

According to the Police Crash Report and the available on-scene photographs (see **SELECTED PHOTOGRAPHS #01** and **#04**), the case vehicle's driver at least braked attempting to avoid the crash. As a result of this attempted avoidance maneuver and the nonuse of his available safety belts, he most likely moved slightly forward just prior to impact.

Based on the Police Crash Report and occupant kinematic principles, the case vehicle's impact with the guardrail, not only deployed the driver's side air bag, but thrust the driver forward, upward, and slightly leftward. As the driver moved forward he contacted his deploying driver side air bag. Because of his "*usual*" seating position (i.e., seat track in its forward-most position) and the position of the tilt steering wheel (i.e., near its down-most position), the thrust of the deploying air bag was focused on his thoracic area, and as a result, he was fatally injured. According to the Medical Examiner's report, which was based on an autopsy, he sustained: a 1.3 centimeter (0.5 inch) laceration to his ascending aorta, just above the aortic valve ring with hemorrhage (~ 200 cc) into his pericardial sac, and abrasions to his right cheek and anterior neck from the deploying air bag. In addition, he sustained a laceration above his right ear (right parietal area) from an unidentified<sup>5</sup> source.

After the impact the case vehicle's driver most likely rebounded backwards and to his left (toward the

<sup>3</sup> The medical examiner's report indicated that there was an 18 centimeter (7 inch) abrasion along and just below the left mandible. The interviewee indicated that there were abrasions from just below one ear to just below the other ear running just below the chin. Because of NASS CDS injury coding protocol, this injury is coded to the neck.

<sup>4</sup> This laceration was described as 4.4 centimeters (1.75 inches) in length and lenticular (curved like a lens) in nature.

<sup>5</sup> Without an interior inspection of the case vehicle or any interior photographs, this contractor cannot determine the injury mechanism. Because the driver was not belted and the vehicle was redirected by the guardrail, there are a lot of possible contact points.

## DISCUSSION (CONTINUED)

driver's door) as a result of impacting the guardrail and the subsequent redirection of the case vehicle back onto and across the roadway. The case vehicle was found in a parked position heading westward near the mouth of an intersecting roadway (i.e., on the north shoulder of the frontage road and on the east shoulder of the intersecting city street). The Police Crash Report is silent as to whether the case vehicle's ignition was on and whether the transmission selector was in gear. The case vehicle sustained very minor damage and was at rest on the level shoulder, parallel to the roadway, with no obstructions around it. The case vehicle's driver was in the driver's seat position and unconscious, with no evidence that any other person had intervened. Based on the available evidence, it appears that the case vehicle's driver may have maneuvered into a parked position before he lost consciousness.