INDIANA UNIVERSITY

TRANSPORTATION RESEARCH CENTER

School of Public and Environmental Affairs
222West Second Street
Bloomington, Indiana 47403-1501
(812) 855-3908 Fax: (812) 855-3537

REMOTE AIR BAG DEPLOYMENT REPORT

CASE NUMBER - IN99-010
LOCATION - Oregon
VEHICLE - 1998 TOYOTA COROLLA
CRASH DATE - March 1998

Submitted:

June 3, 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

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.

Technical Report Documentation Page

1. *Report No.* IN99-010	2. *Government Accession No.*	3. *Recipient's Catalog No.*
4. *Title and Subtitle* Remote Air Bag Deployment Investigation Vehicle - 1998 Toyota Corolla Location - Oregon		5. *Report Date:* June 3, 1999 6. *Performing Organization Code*
7. *Author(s)* Special Crash Investigations Team #2		8. *Performing Organization Report No.* Task # 0192
9. *Performing Organization Name and Address* Transportation Research Center Indiana University 222 West Second Street Bloomington, Indiana 47403-1599		10. *Work Unit No. (TRAIS)* 11. *Contract or Grant No.* DTNH22-94-D-17058
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation (NRD-32) National Highway Traffic Safety Administration National Center for Statistics and Analysis Washington, D.C. 20590-0003		13. *Type of Report and Period Covered* Technical Report Crash Date: March 1998 14. *Sponsoring Agency Code*

15. *Supplementary Notes*

Remote air bag deployment investigation involving a 1998 Toyota Corolla with manual safety belts and dual redesigned front air bags, and a disabled and unoccupied 1970 Dodge school bus

16. *Abstract*

This report covers a remote investigation of an air bag deployment crash that involved a 1998 Toyota Corolla (case vehicle) and a disabled and unoccupied 1970 Dodge school bus that had been converted for use as a recreational vehicle (vehicle #2). This crash is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of collision events and the unrestrained driver (43-year-old male) died from a crushed skull. The case vehicle was traveling south in the southbound lanes of a two-lane roadway that was part of a divided rural interstate highway. Vehicle #2 was disabled, unoccupied and stopped on the west asphalt shoulder of the same interstate. The case vehicle drifted off the right (west) road edge onto the west shoulder. There is no evidence that the case vehicle's driver attempted any avoidance maneuvers. The front of the case vehicle underrode the rear left third of vehicle #2, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. As the case vehicle went under vehicle #2's rear bumper, all components above the belt line were sheared off, except the left upper A-, B-, and C-pillars as well as the left roof rail. The case vehicle penetrated under vehicle #2 enough to dislodge the bus's rear axle and the drive train. The case vehicle then separated from vehicle #2, rotated clockwise approximately 260 degrees and came to rest heading northeast, straddling the centerline of the southbound lanes. A small fire erupted in the engine compartment of the case vehicle and was extinguished by a truck driver. Other bystanders pulled the driver from the case vehicle and laid him on the west shoulder. The crash severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)]. The case vehicle driver sustained a crushed skull and was pronounced dead at the scene.

17. *Key Words* Redesigned Air Bag Deployment Motor Vehicle Traffic Crash Injury Severity		18. *Distribution Statement* General Public	
19 *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 4	22. *Price* $2,500

Form DOT 1700.7 (8-72) Reproduction of completed page authorized

TABLE OF CONTENTS

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 Toyota Corolla (case vehicle) and a disabled and unoccupied 1970 Dodge school bus that had been converted for use as a recreational vehicle (vehicle #2). The crash occurred in March 1998, at 2:00 a.m., in Oregon, and was investigated by the applicable state police department. This case is of special interest because the case vehicle was equipped with redesigned air bags that deployed as a result of collision events and the unrestrained driver (43-year-old male) died from a crushed skull. The Police Crash Report was received in March 1999, while the police photographs and the coroner's report of a non-invasive death examination arrived in May. This report is based on the Police Crash Report, brief conversations with the investigating officers, the death examination report, police photographs, occupant kinematic principles, and this contractor's evaluation of the evidence.

CRASH CIRCUMSTANCES

The case vehicle was traveling south in an unknown lane of a two-lane, southbound roadway that was part of a four-lane, divided rural interstate highway (**Figure 1**). Vehicle #2 was disabled and unoccupied on the west asphalt shoulder of the same interstate, headed south. Ambient conditions were dark, overcast, and dry pavement with no roadway defects. The roadway was bituminous, straight, and level, with a single solid yellow edge line on the left (east), a single solid white edge line on the right (west), and a single broken white centerline separating the two southbound lanes. The posted speed limit was 105 km.p.h. (65 m.p.h.). The case vehicle drifted off the right (west) edge line onto the west shoulder. There is no evidence that the case vehicle's driver attempted to make any avoidance maneuvers.

Figure 1: Case vehicle's final rest position in southbound lanes (case photo #01)

Figure 2: Impact area is left-center foreground; Note: vehicle #2's spare tire and case vehicle driver covered by blue blanket (case photo #02)

The crash occurred on the right (west), asphalt shoulder (**Figure 2**). The front of the case vehicle impacted the back of vehicle #2, causing the case vehicle's driver and front right passenger supplemental restraints (air bags) to deploy. The case vehicle went under vehicle #2's back bumper, in a classic rear underride collision scenario, with the back surface of the bus shearing off almost all structures above the beltline on the case vehicle. The case vehicle penetrated under vehicle #2 enough to dislodge the bus's rear axle and the drive train. The case vehicle separated from vehicle #2, rotated clockwise

approximately 260 degrees and came to rest heading northeast, straddling the southbound lanes. A small fire erupted in the engine compartment of the case vehicle and was extinguished by a truck driver. Other bystanders pulled the driver from the case vehicle and laid him on the west shoulder. The force of the impact moved vehicle #2 forward (south) approximately one bus length [7.6 meters (25 feet)]. Vehicle #2 remained on the west shoulder, heading south at final rest.

CASE VEHICLE

The case vehicle was a front wheel drive, 1998 Toyota Corolla, 5-passenger, four-door sedan (VIN: 1NXBR12EXWZ------), equipped with a 1.8 liter, I-4, gasoline engine and an automatic transmission. Four-wheel anti-lock brakes were an option for this vehicle, but it is not known if the case vehicle was so equipped. The case vehicle's wheelbase was 246 centimeters (97.0 inches). An odometer reading was not reported. The case vehicle was towed from the scene due to disabling damage.

Figure 3: Case vehicle's front damage; Note: roof pushed back over trunk (case photo #04)

Figure 4: Case vehicle's top and right side damage; Note: damaged hood, windshield, and roof areas (case photo #08)

Figure 5: Case vehicle's driver seat area and missing roof; Note: visible blood stain locations (case photo #07)

The case vehicle sustained direct contact damage consisting of heavy crushing of the front bumper and grille into the engine compartment and rearward shearing of the sheet metal from behind the front bumper to the backlight, leaving only the left upper A-, B-, and C-pillars, as well as the left roof rail, standing above the beltline (**Figure 3**). This damage resulted from the case vehicle underriding the rear left third of vehicle #2, and with sufficient depth to dislodge both vehicle #2's rear axle and its drive train. Case vehicle damaged components include: the front bumper, left and right headlamp assemblies, the grille, the hood, the right front fender, the windshield, the right upper A-, B-, and C-pillars, the roof and right roof rail, the right front and right rear doors, and the backlight (**Figure 4**). The CDC for the case vehicle, estimated from police photographs, is **12-FZAA-9**. This crash is out-of-scope for the WinSMASH reconstruction program. The crash severity for the case vehicle was high [greater than 40 km.p.h. (25 m.p.h.)]. The crash damage and post-impact travel of the case vehicle and the post-impact travel of vehicle #2 indicate that the pre-impact travel speed of the case vehicle was at least the posted

speed limit of 105 km.p.h. (65 m.p.h.).

The catastrophic destruction of the case vehicle's passenger compartment above the beltline included all structures to the right of the left roof rail and those components were pushed rearward. Intrusion to the driver's seating area below the beltline is not well visualized in the available photographs, with the exception of the toe pan being pushed rearward and the post-impact position of the driver's seat back being rearward of the left upper B-pillar. The right side of the instrument panel was pushed rearward and the front right passenger's seat back was broken and laid backwards. Both the driver and front right passenger air bag fabrics showed several areas of blood stain, as did the left front door interior panel and the interior top of the left rocker panel (**Figure 5** above).

CASE VEHICLE DRIVER

The case vehicle driver [43-year-old male; white (unknown if Hispanic); 183 centimeters and 77 kilograms (72 inches, 170 pounds)] was not restrained by the available, manual, three-point, lap and shoulder safety belt system. There were no other case vehicle occupants. The driver's pre-crash seat adjustments, steering wheel position, and posture are not known. The following discussion of the driver's injuries is based on the coroner's report of a non-invasive death examination.

The case vehicle's driver was probably in a normal driving posture, with both hands on the steering wheel, his back against the seat back and his feet on the floor and foot controls. The collision scenario (drifting off the right road edge at 2:00 a.m.) suggests that the driver may have fallen asleep, and he may have been slumped in his seat. With no pre-impact braking reported and not being restrained by the available safety belts, the driver probably moved straight forward in response to the head-on impact, toward the 12 o'clock direction of principal force. He probably encountered the deploying driver's air bag with his face and chest. As the case vehicle penetrated under vehicle #2, the hood was crushed, folded and displaced rearward. As the case vehicle continued to penetrate further, the hood was forced through the windshield and the back surface of the bus began to shear off the case vehicle's greenhouse structures. The driver's head was impacted by the hood, causing "semi-decapitation with skull fractures and brain lacerations, due to blunt impact to head," as described in the coroner's report. There were no other injuries mentioned.

CASE VEHICLE DRIVER INJURIES

Injury Number	Injury Description (including Aspect)	NASS Injury Code & AIS 90	Injury Source (Mechanism)	Source Confidence	Source of Injury Data
1.	"Instantly lethal massive head injuries" -- face partially sheared off, exposing brain and nasopharynx; extensive skull fractures with brain lacerations	113000.6 untreatable	Hood	Probable	Coroner's Report

Vehicle #2 was a 1970 Dodge S600 conventional school bus (VIN: J67FG0S------), with a gasoline engine, converted for use as a recreational vehicle. An odometer reading was not reported. Vehicle #2 was towed from the scene due to disabling damage. Vehicle #2 was previously disabled, stopped on the southbound roadway's west shoulder outside of the travel lanes and unoccupied. The left third of vehicle #2's back bumper was sheared off (**Figure 6**), with direct contact the left rear wheel and tire, separation of the drive shaft and induced damage to the body panels on the back surface. The underslung spare tire was broken off (**Figure 2** above).

Figure 6: Vehicle #2's rear plane damage; Note: damage limited to left third of rear plane (case photo #10)