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. 1999-45-807E

RABSS VEHICLE - 1998 FORD F-150 PICKUP TRUCK

LOCATION - STATE OF TENNESSEE

CRASH DATE - JULY, 1999

Contract No. DTNH22-94-D-07058

Prepared for:

U.S. Department of Transportation
National Highway Traffic Safety Administration
Washington, D.C. 20590

DISCLAIMER

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 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.

TECHNICAL REPORT STANDARD TITLE PAGE

1. *Report No.* 99-45-807E	2. *Government Accession No.*	3. *Recipient's Catalog No.*	
4. *Title and Subtitle* Redesigned Air Bag Special Study (RABSS) RABSS Vehicle - 1998 Ford F-150 Pickup Truck Location - State of Tennessee		5. *Report Date*: August, 1999 6. *Performing Organization Code*	
7. *Author(s)* Crash Research Section		8. *Performing Organization Report No.*	
9. *Performing Organization Name and Address* Transportation Sciences Crash Research Section Veridian Engineering (Calspan Operations) P.O. Box 400 Buffalo, New York 14225		10. *Work Unit No.* C01115.0225.(0000-0009) 11. *Contract or Grant No.* DTNH22-94-D-07058	
12. *Sponsoring Agency Name and Address* U.S. Department of Transportation National Highway Traffic Safety Administration Washington, D.C. 20590		13. *Type of Report and Period Covered* Technical Summary Report Crash Date: July, 1999 14. *Sponsoring Agency Code*	
15. *Supplementary Notes* NASS investigation of a frontal collision (into a fixed object) that involved a 1998 Ford F-150 pickup truck with redesigned frontal air bags.			
16. *Abstract* This investigation focused on a single vehicle crash involving a 1998 Ford F-150 pickup truck. The Ford pickup was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a bridge. The driver was operating the vehicle northbound on a 2 lane rural roadway when he observed a southbound non-contact vehicle encroaching into his path of travel. Upon recognition of the impending harmful event, he steered right and exited the right (east) pavement edge. As the Ford exited the east pavement edge, the front right area struck a concrete bridge rail resulting in moderate damage. The Ford came to rest against the bridge facing north. The 41 year old male driver of the Ford pickup truck was restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the middle position. At impact, he initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and redesigned driver air bag. He sustained a contusion to the left chest from the manual restraint. He continued the kinematic response pattern into the sunvisor and rear-view mirror which resulted in a 7.6 cm laceration to the left scalp. The driver was transported to a local hospital for treatment and released.			
17. *Key Words* Redesigned frontal air bag system Collision Deformation Classification (CDC): 01-FREE-4 Proper use of the manual belt system Scalp laceration		18. *Distribution Statement* General Public	
19. *Security Classif. (of this report)* Unclassified	20. *Security Classif. (of this page)* Unclassified	21. *No. of Pages* 5	22. *Price*

TABLE OF CONTENTS

BACKGROUND 1

SUMMARY
- Crash Site 1
- Pre-Crash 1
- Crash 2
- Post-Crash 2

RABSS VEHICLE 2

VEHICLE DAMAGE
- Exterior Damage 2
- Interior Damage 2

REDESIGNED AIR BAG SYSTEM 3

DRIVER DEMOGRAPHICS 4
- Driver Injuries 4
- Driver Kinematics 4

NASS SCENE DIAGRAM 5

REDESIGNED AIR BAG SPECIAL STUDY (RABSS)
SCI TECHNICAL SUMMARY REPORT
NASS RABSS CASE NO. 1999-45-807E
RABSS VEHICLE - 1998 FORD F-150 PICKUP TRUCK
CRASH DATE - JULY, 1999

BACKGROUND

This investigation focused on a single vehicle crash involving a 1998 Ford F-150 pickup truck. The Ford pickup was equipped with redesigned frontal air bags that deployed as a result of a frontal collision with a bridge. The driver was operating the vehicle northbound on a 2 lane rural roadway when he observed a southbound non-contact vehicle encroaching into his path of travel. Upon recognition of the impending harmful event, he steered right and exited the right (east) pavement edge. As the Ford exited the east pavement edge, the front right area struck a concrete bridge rail resulting in moderate damage. The Ford came to rest against the bridge facing north. The 41 year old male driver of the Ford pickup truck was restrained by the available 3-point manual lap and shoulder belt system, seated in an upright posture with the seat track adjusted to the middle position. At impact, he initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual restraint and redesigned driver air bag. He sustained a contusion to the left chest from the manual restraint. He continued the kinematic response pattern into the sunvisor and rear-view mirror which resulted in a 7.6 cm laceration to the left scalp. The driver was transported to a local hospital for treatment and released.

This crash was initially selected for investigation by the National Automotive Sampling System (NASS) as case number 99-45-807E for the Redesigned Air Bag Special Study. The Field Operations Branch 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 early evening hours of July, 1999. At the time of the crash, it was daylight with no adverse conditions as the roads were dry. The crash occurred off the east pavement edge of a 2 lane north/south asphalt roadway **(see Figure 8 - page 5)**. No traffic controls were present at the scene which had a posted speed limit of 64 km/h (40 mph).

Figure 1. Northbound approach for the 1998 Ford F-150 pickup truck.

Pre-Crash

The 41 year old male driver of the 1998 Ford F-150 pickup truck was operating the vehicle northbound on approach to a bridge overpass when he observed a southbound non-contact vehicle

encroaching into his path of travel. Upon recognition of the impending harmful event, he steered right and exited the east pavement edge **(Figure 1)**. There were no brake marks within the vehicle's trajectory indicative of pre-impact braking.

Crash

As the Ford exited the east pavement edge of the 2 lane roadway, the front right area impacted a concrete bridge rail resulting in moderate damage. The Collision Deformation Classification (CDC) for this impact to the Ford F-150 pickup truck was 01-FREE-4. The impact induced deceleration was sufficient to deploy the Ford's redesigned frontal air bag system. Although the impact was classified as a yielding object (bridge rail yielded-out of scope), the damage algorithm of the WinSMASH program computed a (barrier equivalent) velocity change of 18.5 km/h (11.5 mph). The respective longitudinal component was -17.4 km/h (-10.8 mph). The Ford came to rest against the bridge facing north.

Post-Crash

The driver of the Ford pickup truck exited the vehicle under his own power. Treatment was rendered at the scene by emergency medical technicians (EMT). The driver was transported to a local hospital for treatment and released. The vehicle was towed from the scene.

RABSS VEHICLE

The 1998 Ford F-150 pickup truck was identified by the Vehicle Identification Number (VIN): 1FTZF1727WN (production sequence deleted). The police report listed the vehicle as company owned. The vehicle was a regular cab pickup truck equipped with rear wheel drive, ABS (rear only) and a 4.2 liter, V-6 engine. The vehicle's odometer reading was 53,876 km (33,477 miles) at the time of the crash. The seating was configured with a split bench (with folding backs). The driver reported no previous crashes or maintenance on the air bag system (original equipment). No cell phone was present or in use at the time of the collision.

VEHICLE DAMAGE

Exterior Damage

The Ford pickup sustained moderate frontal damage as a result of the impact with the bridge **(Figure 2)**. The direct contact damage began at the front right bumper corner and extended 26.0 cm (10.2 in) inboard. The impact resulted in a combined direct and induced damage length (Field L) of 146.0 cm (57.5 in). Six crush measurements were documented at the level of the bumper: C1= 0 cm, C2= 0 cm, C3= 3.0 cm (1.2 in), C4= 8.0 cm (3.1 in), C5= 13.0 cm (5.1 in), C6= 44.0 cm (17.3 in). The direct contact damage extended 86.0 cm (33.9 in) rearward to the right front wheel which restricted and deflated the tire. The right wheelbase was displaced 27.0 cm (10.6 in). The windshield was fractured from interior occupant contact (only).

Figure 2. Frontal damage to the 1998 Ford F-150 pickup truck.

Interior Damage

Interior damage to the Ford pickup identified through the NASS vehicle inspection was minimal and was attributed to occupant contact. An indentation and scuff mark were documented on the exterior surface of the driver air bag (upper) module cover flap. Smudge marks and blood spattering were noted to the (left) upper and lower sections of the driver air bag. No deformation was noted to the steering wheel rim (fixed column). A strand of hair was noted to the left sunvisor. The rear-view mirror was displaced into the windshield which fractured the glazing. A scuff mark was documented on the left knee bolster (rigid plastic type). A longitudinal toepan intrusion of 5.0 cm (2.0 in) was documented to the front right seating area.

REDESIGNED AIR BAG SYSTEM

The 1998 Ford F-150 pickup truck 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). The flaps were asymmetrical in shape as the upper flap measured 19.0 cm (7.5 in) in width and 16.0 cm (6.3 in) in height while the lower flap measured 19.0 cm (7.5 in) in width and 8.0 cm (3.1 in) in height. An indentation and scuff mark were documented on the upper flap **(Figure 3)**. The NASS researcher measured the diameter of the driver air bag at 48.0 cm (18.9 in) in its deflated state **(Figure 4)**. The bag was tethered by four 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. Smudge marks and blood spattering were identified on the (left) upper and lower sections of the air bag. The blood spattering was attributed to the driver's scalp laceration. A thermal burn which measured 2.0 cm (0.8 in) was noted on the rear left aspect of the air bag **(Figure 5)** from deflation against the inflator.

Figure 3. Contact damage to the driver air bag upper module cover flap.

Figure 4. 1998 Ford F-150 redesigned driver air bag.

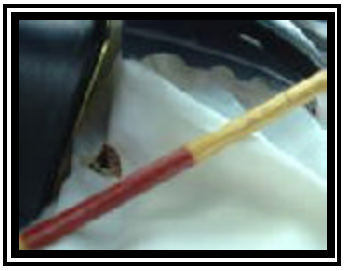

Figure 5. Thermal burn to the rear aspect of the driver air bag.

Figure 6. 1998 Ford F-150 redesigned passenger air bag.

The front right passenger air bag deployed from a mid-mount module in the right instrument panel with a single cover flap design hinged at the top aspect. The cover flap was rectangular in shape which opened in an upward direction toward the windshield and measured 40.0 cm (15.7 in) in width and 17.0 cm (6.7 in) in height. No contact evidence was identified on the air bag or exterior surface of the module cover flap. The NASS researcher measured the passenger air bag at 65.0 cm (25.6 in) in width and 60.0 cm (23.6 in) in height in its deflated state **(Figure 6)**. No vent ports or internal tether straps were present. A cutoff switch was found on the center instrument panel and was set to the on position.

DRIVER DEMOGRAPHICS

Age/Sex:	41 year old male
Height:	188 cm (74 in)
Weight:	104 kg (230 lb)
Seat Track Position:	Middle position
Manual Restraint Use:	3-point lap and shoulder belt system
Usage Source:	NASS vehicle inspection, driver interview, police report
Eyeware:	None
Type of Medical Treatment:	Transported to a local hospital and released

Driver Injuries

Injury	***Severity (AIS 90)***	***Injury Mechanism***
Laceration left scalp (7.6 cm)	Minor (190600.1,5)	Sunvisor/rear-view mirror
Contusion left chest	Minor (490402.1,2)	Shoulder belt webbing
Sprain right 1st toe	Minor (851002.1,1)	Indirect contact injury (toepan)

Driver Kinematics

The 41 year old male driver of the 1998 Ford F-150 pickup truck was restrained by the available 3-point lap and shoulder belt system, seated in an upright posture with his hands at the 10 o'clock and 2 o'clock positions on the steering wheel rim. Belt usage was confirmed by the lack of significant contact points within the vehicle relative to the injuries sustained. Although the driver's height and weight would have the seat track adjusted to the full rearward position, he stated during the NASS interview that the seat track was placed to the middle position for comfort.

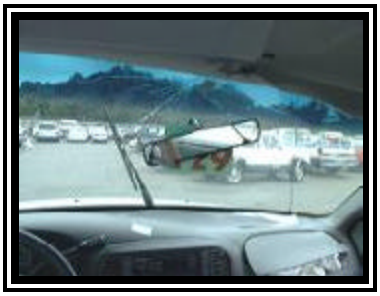

Figure 7. Occupant contact damage to the sunvisor/rear-view mirror.

At impact, the driver initiated a forward trajectory in response to the 1 o'clock impact force and loaded the manual belt and redesigned driver air bag. Although no injuries were reported as a result of loading to the redesigned driver air bag, he sustained a contusion to the left chest from the shoulder belt webbing. He rotated out of the shoulder belt which allowed him to get further forward. The driver continued the kinematic response pattern into the sunvisor and rear-view mirror which resulted in a 7.6 cm (3.0 in) laceration to the left scalp. This trajectory was evidenced by the hair strand documented to the sunvisor and displacement of the rear-view mirror into the windshield **(Figure 7)**. He also sustained a sprained toe from contact to the toepan. The driver was transported to a local hospital for treatment and released.

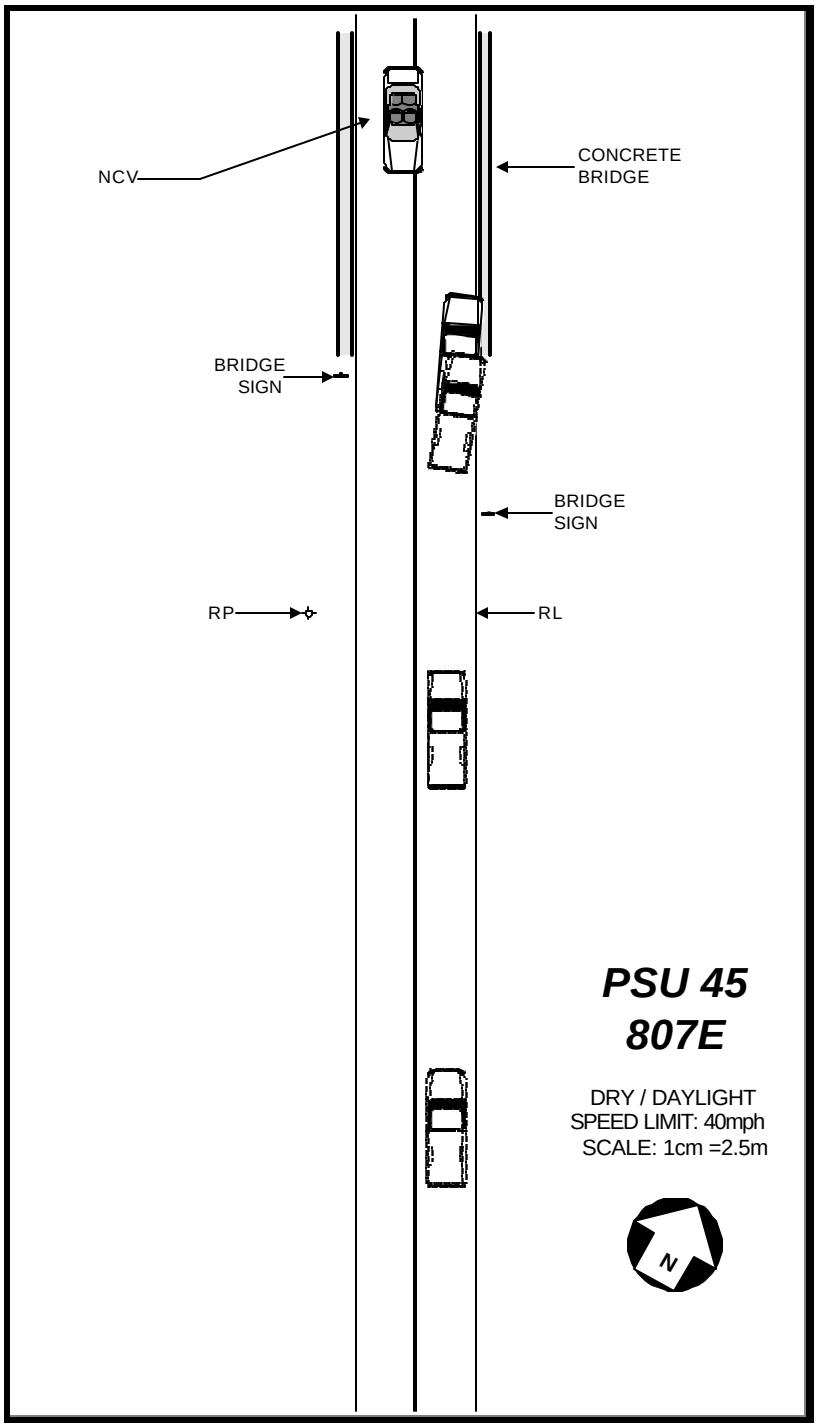

Figure 8. NASS Scene Diagram